Tier 3 Toll Plaza Redevelopments

Biddeford, Portland and Falmouth, Maine

Geotechnical Report

Prepared for:

Maine Turnpike Authority

March 2015

Prepared by

HNTB Corporation
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STATE OF MAINE
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LICENSED
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Roland A. Lavallee

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Executive Summary

This geotechnical report summarizes the recommendations for the redevelopment of the existing toll plazas Biddeford, Portland and Falmouth, ME, respectively. The proposed project includes new toll booths at all three plazas and the relocation of the adjacent support building at Exit 53. Included in this report is a presentation of the subsurface information collected, design recommendations for the new toll booths, overhead roofs and support building and a brief discussion of construction considerations.

1.0 INTRODUCTION

The geotechnical investigation was performed for the proposed expansion of three toll plazas at Exits 32, 46 and 53, located in Biddeford, Portland and Falmouth, respectively. This geotechnical report provides the results of our field and laboratory investigations and our recommendations for the proposed structures.

2.0 BACKGROUND

2.1 Existing Structures

The existing toll plaza at Exit 32 consists of three entering toll lanes, while the plazas at Exits 46 and 53 have two entering toll lanes. There are existing support buildings at each of the toll plazas.

2.2 Proposed Expansion

The proposed expansions at each toll plaza include an additional toll lane. In addition, at Exit 53 the existing support building will be relocated to allow for the additional toll lane.

3.0 SUBSURFACE CONDITIONS

3.1 Geology

Available surficial geologic mapping of indicates that the plaza sites are underlain by glacial deposits consisting of clays underlain by mixtures of sand, and gravel. Additionally, based on our borings, the majority of the toll plaza area has been modified by fill placement.

The bedrock geologic mapping of the area indicates that the underlying rock at Exit 32 consists of granite from the Biddeford Pluton, at Exit 46 bedrock consists of granofels of the Hutchins Formation, and at Exit 53 bedrock consists of gneiss and granofels of the Berwick Formation.

3.2 Subsurface Explorations

Eight (8) test borings were drilled by New England Boring Contractors of Hermon, ME between December 16 and 22nd, 2014. All test borings were observed on a full-time basis by an HNTB geotechnical engineer.

The test borings were drilled with a Mobile drill rig with a combination of 3-inch diameter flush jointed casing and drive and wash drilling techniques. Bedrock was cored using an NX sized core barrel. The test borings were drilled to final depths of between 19 and 37 feet below the existing ground surface. Each borehole was backfilled with the drill cuttings and/or clean sand upon completion. Borings drilled within pavement areas were patched with asphalt after backfilling was complete.

Split-spoon sampling was typically conducted at five-foot depth intervals generally in accordance with ASTM D1586. The number of blows of a 140 pound hammer falling 30 inches required to drive the split spoon sampler for each 6-inch increment was recorded. The Standard Penetration Test (SPT) N-value is determined as the sum of the blows over the second and third 6-inch increment of penetration. In addition, selected cohesive soils were sampled with 3 inch diameter Shelby tubes.

Boring Location Plans and Boring Logs are included in **Appendix A**.

3.3 Laboratory Testing

Laboratory testing was performed on select soil and rock samples, by Geotesting Express in Acton, Massachusetts. Laboratory testing included moisture content, Atterberg Limits testing, grain size distribution and consolidation testing of select soil samples. Select rock samples were tested for Hardness and unconfined compressive strength testing. The results of these tests are included in **Appendix B**.

3.4 Soil/Rock Descriptions

Based on the soil borings, the general soil profile can be described as fill soil from the ground surface or beneath pavements underlain by natural soils and bedrock. The site soil and bedrock are described below. Boring logs are included in **Appendix A**.

Surficial Materials

Surficial materials noted at in the borings consisted of asphalt paving and topsoil. Asphalt paving was noted in all of the plaza borings from 4 to 10 inches thick with the exception of PB- 3-03 and PB-53-04.

Boring PB-53-03 and PB-53-04 were performed outside the pavement area and encountered between 0 and 6 inches of topsoil.

Fill

Fill was encountered at all of the borings, with the exception of PB-53-03 and PB-53-04. Fill soils generally consisted of moist, medium dense fine to coarse SAND with various amounts of gravel and clay. Where encountered the fill layer ranged in thickness between 6 to 13 feet. In several locations the bottom of fill soils consisted of nested cobbles and boulders.

Glaciomarine Soils

Glaciomarine soils were encountered below the fill soils in all borings, with the exception of PB-53-03 and PB-53-04. These soils typically consisted of CLAY with varying amounts of silt. The clay soils typically exhibited an upper stiffer layer, which is consistent with areas of prior desiccation during periods of fluctuating shorelines.

Sand and Gravel Soils

Sand and gravel soils were noted below the Glaciomarine clay soils. These soils consisted of sands with varying amounts of gravel and gravels with varying amounts of sand.

Bedrock

Bedrock was encountered in all of the borings, at depths ranging from 15 to 37 feet below the existing surface. Rock encountered was cored at Exits 32 and 53 and consisted of granite and granofel, respectively.

3.5 Groundwater Conditions

Long term static groundwater readings were not taken in the borings. Groundwater observations were made during drilling and the groundwater level at the time of drilling was determined from these observations from 8 to 18.5 feet. The groundwater measurements noted may not represent static groundwater levels or indicate local seasonal variations.

4.0 DESIGN RECOMMENDATIONS

We recommended the use of shallow foundations for the new plaza gantry and booth foundations, due to the presence of granular fill soils and the over consolidated nature of the existing clay soils. See Appendix C for full calculations.

4.1 Plaza Gantry Shallow Foundation

The AASHTO 17th Edition was used to calculate allowable bearing capacity for shallow foundations. For the purposes of evaluation the allowable bearing capacity initial assumptions were made for gantry foundation. A foundation size of 5 ft by 5 ft square with a minimum embedment depth of 5 feet was assumed for gantry foundations. The final foundation shape will likely be based on the eccentricity requirements due to the wind loads on the foundations.

We recommend that following allowable bearing capacities for each plaza.

Exit 32	4,000 psf
Exit 46	6,500 psf
Exit 53 (Plaza)	5,000 psf
Exit 53 (Building)	6,000 psf

Due to the over consolidated nature of the clay soils at the existing plazas, the proposed gantry foundations are not expected to undergo long term settlement. Any noted settlements should be related to construction disturbance to the foundation subsoils and should be immediate in nature.

4.2 Toll Booth and Plaza Slab

The settlement for the toll booth island and the plaza slab on grade were performed to determine if any additional support was needed. Based on our calculations, the slabs on grade should not undergo any long term settlement and will not require additional support by the use of deep foundations.

4.3 Seismic Design Criteria

Based on our review of the requirements of the AASHTO specifications, Division IA, Section 3, and the results of the field investigations, the following seismic criteria should be used during design of the proposed structure.

Seismic Design Criteria

Peak Acceleration Coefficient (% g)	7.0
Seismic Performance Category	A
Soil Profile Type	I
Site Coefficient (S)	1.0
Liquefaction Potential	Not Applicable

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Construction Dewatering

No dewatering activities should be required beyond typical construction practices. These may include ensuring positive drainage from the site for rainwater and preventing run-off from the adjacent roadway from accessing the construction area.

5.2 Existing Structures

Care should be taken to protect existing structures from potential impact from new construction. In particular, new foundations should not be placed in such a manner to undermine existing foundations. Any new foundation should be placed at a similar bearing elevation as existing adjacent foundations, or the existing foundations will require underpinning.

New foundations placed immediately adjacent to existing foundations will induce settlement, of up to ¼ inch in portions of the existing foundations immediately adjacent to new construction.

REFERENCES

1. "Surficial Geology – Portland Quadrangle, Maine", Maine Geological Survey, Open-File No. 06-01, 2006

2. "Bedrock Geology of the Portland 1:100,000 Quadrangle", Maine Geological Survey, Open File 98-1-1998

3. "Bedrock Geology – Portland West Quadrangle, Maine", Maine Geological Survey, Newberg, Open-File No. 03-94-2003

4. "Bedrock Geology of the Kittery 1:100,000 Quadrangle", Maine Geological Survey, Geologic Map 08-78-2008

5. "AASHTO Standard Specifications for Highway Bridges" – 17th Edition, 2005.

LIMITATIONS

Explorations

- Water level readings have been made in the boreholes at times and under conditions stated in the boring logs. This information has been reviewed and interpretations have been made in this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors occurring since the time measurements were made.

Review

- In the event that any changes in the nature, design or location of the proposed structure are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing.

Use of Report

- This Geotechnical Report has been prepared for this project by HNTB. This report is for design purposes only. Contractors wishing a copy of the report may obtain it with the understanding that its scope is limited to design considerations only.

APPENDIX A

Boring Logs,
Boring Location Plan

APPENDIX B

Laboratory Testing

APPENDIX C

Calculations

REFERENCES

1. "Surficial Geology – Portland Quadrangle, Maine", Maine Geological Survey, Open-File No. 06-01, 2006

2. "Bedrock Geology of the Portland 1:100,000 Quadrangle", Maine Geological Survey, Open File 98-1-1998

3. "Bedrock Geology – Portland West Quadrangle, Maine", Maine Geological Survey, Newberg, Open-File No. 03-94-2003

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LIMITATIONS

Explorations

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Review

- In the event that any changes in the nature, design or location of the proposed structure are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing.

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APPENDIX A

Boring Logs,
Boring Location Plan

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SOIL BORING LOG

Boring Number: PB-32-01

Client: Maine Turnpike Authority
Project Name: Tier 3 - Exit 32 ORT
Project Number: 57576
Location: Biddeford, ME
Boring Location: N , E

Drilling Contractor: NEBC
Driller: Rich Leonard
Drill Rig: Mobile 35
Boring Diameter: 4 in
Ground Surface Elevation: ft

Advancement Method: Drive and Wash
Date Started: 12/19/2014 Completed: 12/19/2014
Abandonment Method: Backfill with spoils
Groundwater during Drilling: 18.5 ft
Field Representative: E. Strode

Sample Number	Depth (ft)	Recovery/ Penetration	Blowcounts / Qu	Graphic	Depth/ Elevation	Lithology	Comments
						0-4" Asphalt	Based on cuttings
						Brown, medium to fine SAND (FILL)	
						Very stiff, moist, gray with brown, CLAY and SILT (FILL)	Cobble noted at 3.5 ft
					5		
SS-1	5 - 7	24/ 24	12 18 21 29				
						very stiff, moist, gray, Silty CLAY	
					10		
SS-2	10 - 12	24/ 24	6 13 17 18				
						Stiff, moist, gray CLAY	
					15		
SS-3	15 - 17	24/ 24	4 5 6 6				
						Soft, wet, gray CLAY	

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SOIL BORING LOG

Boring Number: PB-32-01

Sample Number	Depth (ft)	Recovery/ Penetration	Blowcounts / Qu	Graphic	Depth/ Elevation	Lithology	Comments
SS-4	20 - 22	24/ 24	1 1 1 2			Soft, wet, gray CLAY	
						Gray, wet, SAND and CLAY	Based on cuttings
SS-5	25 - 25.3	4/ 4	100/4"		25		
						Very dense, brown, wet, SAND and GRAVEL	
						Bedrock	
						Bottom of Exploration - 27'	
					30		
					35		
					40		

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ROCK CORING LOG

Boring Number: PB-32-01

Client: Maine Turnpike Authority
Project Name: Tier 3 - Exit 32 ORT
Project Number: 57576
Location: Biddeford, ME
Boring Location: N , E

Drilling Contractor: NEBC
Driller:
Drill Rig:
Boring Size: 4 in
Coring Method:

Core Barrel:
Barrel Type:
Ground Surface Elevation: ft
Date Started: 12/19/2014 Completed: 12/19/2014
Field Representative: E. Strode

Sample Number	Bit Type	Recovery/ Penetration	RQD (%)	Graphic	Depth/ Elevation	Lithology	Comments
					5		
					10		

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ROCK CORING LOG

Boring Number: PB-32-01

Sample Number	Bit Type	Recovery/ Penetration	RQD (%)	Graphic	Depth/ Elevation	Lithology	Comments
					20		
					25		
					30		

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SOIL BORING LOG

Boring Number: PB-32-02

Client: Maine Turnpike Authority
Project Name: Tier 3 - Exit 32 ORT
Project Number: 57576
Location: Biddeford, ME
Boring Location: N , E

Drilling Contractor: NEBC
Driller: Rich Leonard
Drill Rig: Mobile 35
Boring Diameter: 4 in
Ground Surface Elevation: ft

Advancement Method: Drive and Wash
Date Started: 12/19/2014 Completed: 12/19/2014
Abandonment Method: Backfill with spoils
Groundwater during Drilling: 8.5 ft
Field Representative: E. Strode

Sample Number	Depth (ft)	Recovery/ Penetration	Blowcounts / Qu	Graphic	Depth/ Elevation	Lithology	Comments
						0-6" - Asphalt	
						Dark brown, moist, medium to fine SAND (FILL)	Based on cuttings
						Stiff, moist, gray with brown, CLAY & SILT (FILL)	
					5		
SS-1	5 - 7	24/ 24	11 15 18 23				
						Stiff, wet, CLAY	
					10		
SS-2	10 - 12	24/ 24	5 6 8 9				
					15		
ST-3	15 - 17	18/ 24	Push				
						Stiff, wet, CLAY, little sand, trace fine gravel	Cobbles noted 17.5-19 ft

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SOIL BORING LOG

Boring Number: PB-32-02

Sample Number	Depth (ft)	Recovery/ Penetration	Blowcounts / Qu	Graphic	Depth/ Elevation	Lithology	Comments
SS-4	20 - 22	24/ 24	12 11 12 16			Stiff, wet, CLAY, little sand, trace fine gravel	Cobbles noted 17.5-19 ft
						GRANITE	Rollerbit to 25 ft
					25	Top of Rock Core - 25 ft - See attached Rock Core log	
					30		
					35		
					40		

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ROCK CORING LOG

Boring Number: PB-32-02

Client: Maine Turnpike Authority
Project Name: Tier 3 - Exit 32 ORT
Project Number: 57576
Location: Biddeford, ME
Boring Location: N , E

Drilling Contractor: NEBC
Driller: Rich Leonard
Drill Rig: Mobile 35
Boring Size: 4 in
Coring Method: Core

Core Barrel: Split
Barrel Type: Wireline
Ground Surface Elevation: ft
Date Started: 12/19/2014 Completed: 12/19/2014
Field Representative: E. Strode

Sample Number	Bit Type	Recovery/ Penetration	RQD (%)	Graphic	Depth/ Elevation	Lithology	Comments
RC-1	Diamond	60/60	100		30	***25.0' - 30.0'***- GRANITE - sound, fresh, very hard, gray with black and white mottling, massive	
					35	***30.0'*** - Bottom of Exploration	

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SOIL BORING LOG

Boring Number: PB-46-01

Client: Maine Turnpike Authority
Project Name: Tier 3 - Exit 46 ORT
Project Number: 57576
Location: Portland, ME
Boring Location: N , E

Drilling Contractor: NEBC
Driller: Rich Leonard
Drill Rig: Mobile 35
Boring Diameter: 4 in
Ground Surface Elevation: ft

Advancement Method: Drive and Wash
Date Started: 12/16/2014 Completed: 12/16/2014
Abandonment Method:
Groundwater during Drilling: 8 ft
Field Representative: E. Strode

Sample Number	Depth (ft)	Recovery/ Penetration	Blowcounts / Qu	Graphic	Depth/ Elevation	Lithology	Comments
						0-8" - Asphalt	
						Brown, moist, SAND, little silt, little gravel (FILL)	Based on cuttings
						Dense, moist, black, medium to fine SAND, little silt, trace debris (FILL)	
					5		
SS-1	5 - 7	24/ 24	19 17 19 19				
						Dense, moist, gray, fine SAND and SILT	
						Dense, wet, black, coarse to fine SAND and silt, little gravel	Strong petroleum odor noted
					10		
SS-2	10 - 12	18/ 24	21 21 20 44				
						Dark gray, wet, SAND	Based on cuttings Cobbles noted 11-13'
						Stiff, wet, tan, CLAY	
					15		
SS-3	15 - 17	3/ 24	9 14 13 16				
						Medium stiff, wet, gray CLAY	
SS-4	17 - 19	24/ 24	3 6 10 13				
SS-5	19 - 21	21/ 24	6 8 10 12				

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SOIL BORING LOG

Boring Number: PB-46-01

Sample Number	Depth (ft)	Recovery/ Penetration	Blowcounts / Qu	Graphic	Depth/ Elevation	Lithology	Comments
SS-5	19 - 21	21/ 24				Medium stiff, wet, gray CLAY	
SS-6	21 - 23	24/ 24	5 7 7 9				
SS-7	23 - 25	24/ 24	3 3 4 5		25		
SS-8	25 - 27	24/ 24	2 3 1 3				
SS-9	27 - 29	24/ 24	2 2 3 3				
SS-10	29 - 31	24/ 24	WOR WOH WOH WOH		30	Very soft, wet, gray CLAY	
SS-11	31 - 33	24/ 24	10 14 22 20			Dense, wet, gray, medium to fine SAND, with clay lenses	
					35	Bedrock	Rollerbit to 25 ft
						Bottom of Exploration - 35 ft	
					40		

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SOIL BORING LOG

Boring Number: PB-46-02

Client: Maine Turnpike Authority
Project Name: Tier 3 - Exit 46 ORT
Project Number: 57576
Location: Portland, ME
Boring Location: N , E

Drilling Contractor: NEBC
Driller: Rich Leonard
Drill Rig: Mobile 35
Boring Diameter: 4 in
Ground Surface Elevation: ft

Advancement Method: Drive and Wash
Date Started: 12/18/2014 Completed: 12/18/2014
Abandonment Method:
Groundwater during Drilling: 9.5 ft
Field Representative: E. Strode

Sample Number	Depth (ft)	Recovery/ Penetration	Blowcounts / Qu	Graphic	Depth/ Elevation	Lithology	Comments
						0-10" - Asphalt	
						Brown, moist, medium to fine SAND (FILL)	Based on cuttings
					5	Gray, moist, SAND and CLAY (FILL)	
SS-1	5 - 7	20/ 24	4 14 19 14			Dense, moist, black, SAND, little silt (FILL)	Strong petroleum odor
						Gray, moist, SAND and CLAY (FILL)	Based on cuttings
					10	Very dense, gray, wet, fine SILT some sand, trace gravel	
SS-2	10 - 12	18/ 24	19 28 27 64				
					15	Stiff, wet, gray with brown CLAY	
SS-3	15 - 17	16/ 24	8 9 13 13				

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SOIL BORING LOG

Boring Number: PB-46-02

Sample Number	Depth (ft)	Recovery/ Penetration	Blowcounts / Qu	Graphic	Depth/ Elevation	Lithology	Comments
ST-4	20 - 22	18/ 24	Push			Very soft, wet, gray CLAY	
SS-5	24 - 26	24/ 24	WOR WOH WOH WOH		25		
ST-6	27 - 29	18/ 24	Push				
					30		
SS-7	30 - 32	24/ 24	WOR WOR WOR WOR				
					35		
SS-8	35 - 37	24/ 24	WOR 3 13 11			Medium dense, gray, wet, Clayey SAND	
					40	Bottom of Exploration 37 ft	

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SOIL BORING LOG

Boring Number: PB-53-01

Client: Maine Turnpike Authority
Project Name: Tier 3 - Exit 53 ORT
Project Number: 57576
Location: Falmouth, ME
Boring Location: N , E

Drilling Contractor: NEBC
Driller: Rich Leonard
Drill Rig: Mobile 35
Boring Diameter: 4 in
Ground Surface Elevation: ft

Advancement Method: Drive and Wash
Date Started: 12/17/2014 Completed: 12/17/2014
Abandonment Method: Backfill with Spoils
Groundwater during Drilling: 16 ft
Field Representative: E. Strode

Sample Number	Depth (ft)	Recovery/ Penetration	Blowcounts / Qu	Graphic	Depth/ Elevation	Lithology	Comments
						0-10" - Asphalt	
						Brown, medium to fine SAND (FILL)	Based on cuttings
						Stiff to medium stiff, moist, gray, CLAY, trace sand (FILL)	
					5		
SS-1	5 - 7	20/ 24	10 18 21 35				
					10		
SS-2	10 - 12	24/ 24	6 7 9 9				
						Medium stiff, moist, CLAY and SAND	
					15		
SS-3	15 - 17	24/ 24	4 4 8 9				
						Medium dense, wet, brown, medium to fine SAND	
						Medium dense, wet, light tan and gray, fine SAND	

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SOIL BORING LOG

Boring Number: PB-53-01

Sample Number	Depth (ft)	Recovery/ Penetration	Blowcounts / Qu	Graphic	Depth/ Elevation	Lithology	Comments
SS-4	20 - 22	8/ 24	8 10 12 14			Medium dense, wet, light tan and gray, fine SAND	
						Weathered Rock	
						Phyllite	
					25	Bottom of Exploration - 25 ft	
					30		
					35		
					40		

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SOIL BORING LOG

Boring Number: PB-53-02

Client: Maine Turnpike Authority
Project Name: Tier 3 - Exit 53 ORT
Project Number: 57576
Location: Falmouth, ME
Boring Location: N , E

Drilling Contractor: NEBC
Driller: Rich Leonard
Drill Rig: Mobile 35
Boring Diameter: 4 in
Ground Surface Elevation: ft

Advancement Method: Drive and Wash
Date Started: 12/17/2014 Completed: 12/17/2014
Abandonment Method: Backfill with Spoils
Groundwater during Drilling: 14 ft
Field Representative: E. Strode

Sample Number	Depth (ft)	Recovery/ Penetration	Blowcounts / Qu	Graphic	Depth/ Elevation	Lithology	Comments
						0-8" - Asphalt	
						Tan, moist, medium to fine SAND (FILL)	Based on cuttings
					5	Stiff, moist, gray CLAY (FILL)	
SS-1	5 - 7	24/ 24	6 8 13 16				
					10	Medium dense, moist, tan SAND and CLAY	
SS-2	10 - 12	24/ 24	3 5 6 7				
					15	Dense, wet, tan with gray, fine SAND, some silt	
SS-3	15 - 17	24/ 24	8 12 16 18				

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SOIL BORING LOG

Boring Number: PB-53-02

Sample Number	Depth (ft)	Recovery/ Penetration	Blowcounts / Qu	Graphic	Depth/ Elevation	Lithology	Comments
SS-4	20 - 22	16/ 24	9 18 18 22			Dense, wet, tan with gray, fine SAND, some silt	
					25	Weathered Rock	
						Phyllite	
						Bottom of Exploration - 27 ft	
					30		
					35		
					40		

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SOIL BORING LOG

Boring Number: PB-53-03

Client: Maine Turnpike Authority
Project Name: Tier 3 - Exit 53 ORT
Project Number: 57576
Location: Falmouth, ME
Boring Location: N , E

Drilling Contractor: NEBC
Driller: Rich Leonard
Drill Rig: Mobile 35
Boring Diameter: 4 in
Ground Surface Elevation: ft

Advancement Method: Drive and Wash
Date Started: 12/22/2014 Completed: 12/22/2014
Abandonment Method: Backfill with Spoils
Groundwater during Drilling: 10 ft
Field Representative: G. Kola

Sample Number	Depth (ft)	Recovery/ Penetration	Blowcounts / Qu	Graphic	Depth/ Elevation	Lithology	Comments
						Wet, brown, fine to coarse SAND	
					5		
SS-1	5 - 7	14/ 24	6 10 16 21			Medium dense, moist, brown, fine SAND, little silt	
					10		
SS-2	10 - 12	10/ 24	7 13 24 45			Dense, wet, light brown, fine SAND, little silt	
						Weathered Rock	Rollerbit to 15 ft
					15		
						Top of Core - 15 ft - See Rock Core Log for more info	

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ROCK CORING LOG

Boring Number: PB-53-03

Client: Maine Turnpike Authority
Project Name: Tier 3 - Exit 53 ORT
Project Number: 57576
Location: Falmouth, ME
Boring Location: N , E

Drilling Contractor: NEBC
Driller: Rich Leonard
Drill Rig: Mobile 35
Boring Size: 4 in
Coring Method: Core

Core Barrel: HQ
Barrel Type: Wireline
Ground Surface Elevation: ft
Date Started: 12/22/2014 Completed: 12/22/2014
Field Representative: G. Kola

Sample Number	Bit Type	Recovery/ Penetration	RQD (%)	Graphic	Depth/ Elevation	Lithology	Comments
RC-1	Diamond	42/48	40			***15.0' - 19.0'***- Phyllite - moderately weathered, moderately fractured, hard, gray, thin bedding	
						19.0' - Bottom of Exploration	
					20		
					25		

HNTB
31 St. James Avenue, Suite 300
Boston, MA 02116
Phone (617) 542-6900
Fax (617) 428-6905

SOIL BORING LOG

Boring Number: PB-53-04

Client: Maine Turnpike Authority
Project Name: Tier 3 - Exit 53 ORT
Project Number: 57576
Location: Falmouth, ME
Boring Location: N , E

Drilling Contractor: NEBC
Driller: Rich Leonard
Drill Rig: Mobile 35
Boring Diameter: 4 in
Ground Surface Elevation: ft

Advancement Method: Drive and Wash
Date Started: 12/16/2014 Completed: 12/17/2014
Abandonment Method: Backfill with Spoils
Groundwater during Drilling: 8 ft
Field Representative: E. Strode

Sample Number	Depth (ft)	Recovery/ Penetration	Blowcounts / Qu	Graphic	Depth/ Elevation	Lithology	Comments
						0-6" Topsoil	
						Medium dense, moist, brown, fine SAND, trace clay seams	
					5		
SS-1	5 - 7	24/ 24	9 11 16 15				
						Medium dense, wet, tan, fine SAND	
					10		
SS-2	10 - 12	12/ 24	11 11 11 12				
						Very dense, wet, tan, medium to fine SAND, little gravel	
					15		
SS-3	15 - 16.8	14/ 22	33 58 68 50/4"				
						Weathered Rock Top of Rock Core - 20 ft - See attached Rock Core Log	

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ROCK CORING LOG

Boring Number: PB-53-04

Client: Maine Turnpike Authority
Project Name: Tier 3 - Exit 53 ORT
Project Number: 57576
Location: Falmouth, ME
Boring Location: N , E

Drilling Contractor: NEBC
Driller: Rich Leonard
Drill Rig: Mobile 35
Boring Size: 4 in
Coring Method: Core

Core Barrel: HQ
Barrel Type: Wireline
Ground Surface Elevation: ft
Date Started: 12/16/2014 Completed: 12/17/2014
Field Representative: E. Strode

Sample Number	Bit Type	Recovery/ Penetration	RQD (%)	Graphic	Depth/ Elevation	Lithology	Comments
RC-1	Diamond	18/24	0			***20.0' - 22.0'***- Phyllite - Highly fractured, moderately weathered, hard, gray, fine grained *20.8' - 3 inch quartz seam*	
RC-2	Diamond	60/60	95		25	***22.0' - 27.0'***- Phyllite - sound, fresh, hard, gray fine grained, thin foliation *24.1' - Joint, 20 deg, planar, rough, and open, some discoloration on surface* *25.7' - Joint, 35 deg, planar, rough, and open, discoloration on surface*	
					30	***27.0'*** - Bottom of Exploration	

PB-32-01
PB-32-02
PLAN
25 0 25 50
Scale of Feet
EXIT 32 - BIDDEFORD

EXIT 46 NB - JETPORT NORTHBOUND

PB-53-01
PB-53-02
PB-53-03
PB-53-04
PLAN
25 0 25 50
Scale of Feet
EXIT 53 - WEST FALMOUTH

APPENDIX B

Laboratory Testing

Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	---	Sample Type:	---	Tested By:	jbr
Sample ID:	---	Test Date:	01/02/15	Checked By:	emm
Depth :	---	Test Id:	319293		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
PB-21-01	SS- 4	20-22 ft	Moist, greenish gray clay	31.0
PB-21-02	ST- 2	15-17 ft	Moist, olive gray clay	40.0
PB-46-02	SS- 2	10-12 ft	Moist, dark gray silt with sand	17.2
PB-46-02	ST- 4	20-22 ft	Moist, olive gray clay	36.5
PB-46-02	ST- 6	27-29 ft	Moist, dark olive gray clay	37.1
PB-53-01	SS- 2	10-12 ft	Moist, olive gray clay	29.9
PB-53-02	SS- 2	10-12 ft	Moist, olive clay	28.4
PB-53-02	SS- 3	15-17 ft	Moist, brown silty sand	11.3
PB-53-04	SS- 1	5-7 ft	Moist, olive sandy silt	20.3

Notes: Temperature of Drying : 110° Celsius

Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	---	Sample Type:	---	Tested By:	jbr
Sample ID:	---	Test Date:	01/05/15	Checked By:	emm
Depth :	---	Test Id:	319284		

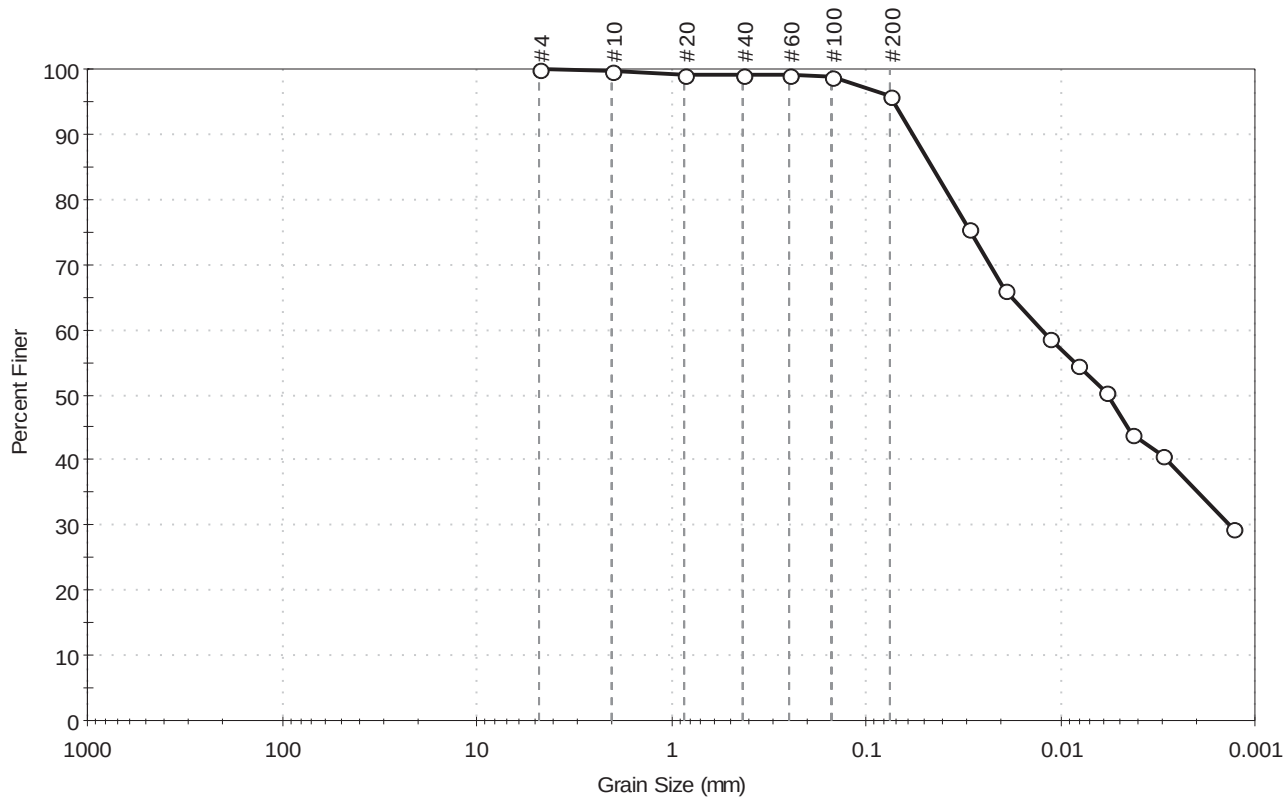
Amount of Material Passing #200 Sieve - ASTM D1140

Boring ID	Sample ID	Depth	Visual Description	Fines, %
PB-53-01	SS-2	10-12 ft	Moist, olive gray clay	98.2
PB-53-04	SS-1	5-7 ft	Moist, olive sandy silt	52.5

Notes: Tests performed using Method B - washing using a wetting agent
Dry mass of test specimen was determined directly

Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-21-01	Sample Type:	jar	Tested By:	jbr
Sample ID:	SS-4	Test Date:	01/07/15	Checked By:	emm
Depth :	20-22 ft	Test Id:	319277		
Test Comment:	---				
Sample Description:	Moist, greenish gray clay				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	4.0	96.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	99		
#60	0.25	99		
#100	0.15	99		
#200	0.075	96		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0293	76		
---	0.0191	66		
---	0.0114	59		
---	0.0082	55		
---	0.0059	50		
---	0.0042	44		
---	0.0030	41		
---	0.0013	30		

Coefficients

D_{85} = 0.0452 mm D_{30} = 0.0014 mm
D_{60} = 0.0125 mm D_{15} = N/A
D_{50} = 0.0058 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM Lean clay (CL)

AASHTO Clayey Soils (A-6 (15))

Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

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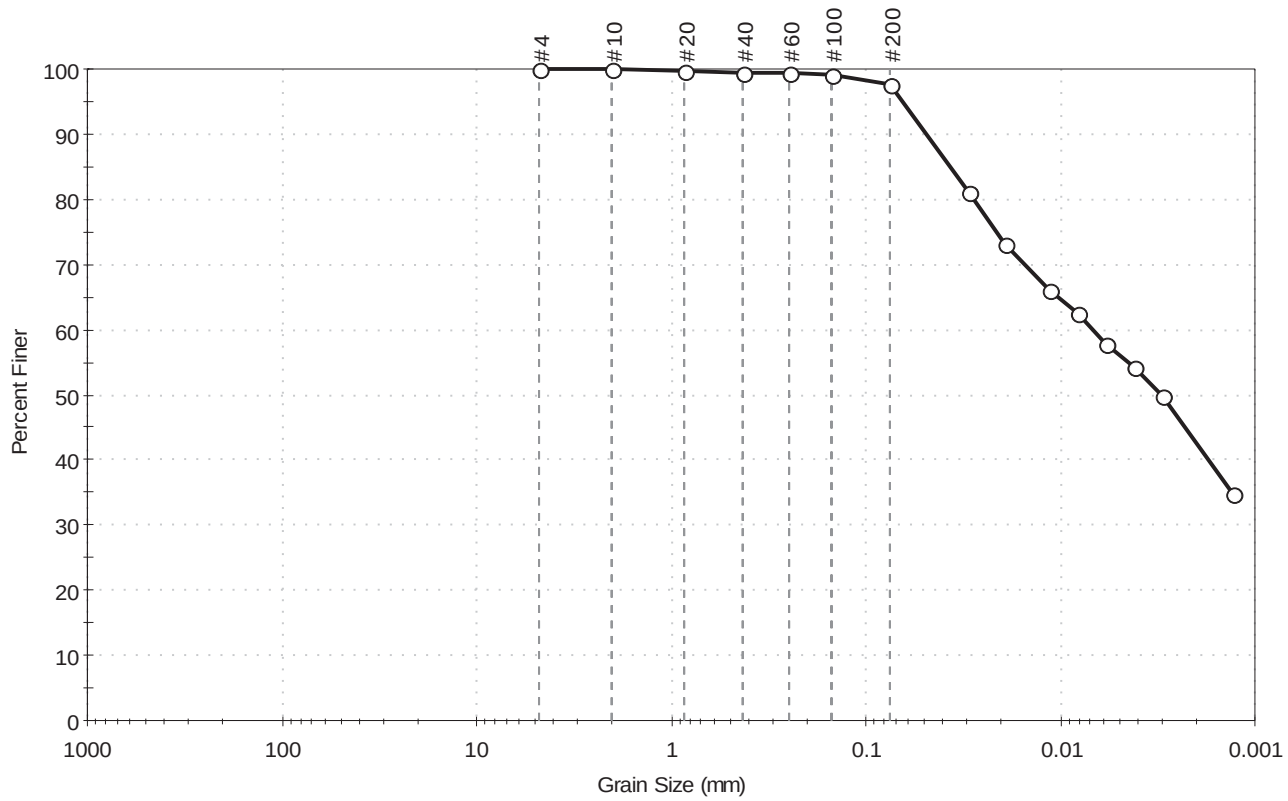
Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-21-02	Sample Type:	tube	Tested By:	jbr
Sample ID:	ST-2	Test Date:	01/07/15	Checked By:	emm
Depth :	15-17 ft	Test Id:	319278		
Test Comment:	---				
Sample Description:	Moist, olive gray clay				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	2.4	97.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	99		
#100	0.15	99		
#200	0.075	98		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0296	81		
---	0.0193	73		
---	0.0114	66		
---	0.0081	63		
---	0.0058	58		
---	0.0042	54		
---	0.0030	50		
---	0.0013	35		

Coefficients

D_{85} = 0.0367 mm D_{30} = N/A
D_{60} = 0.0068 mm D_{15} = N/A
D_{50} = 0.0031 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM Lean clay (CL)

AASHTO Clayey Soils (A-7-6 (24))

Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

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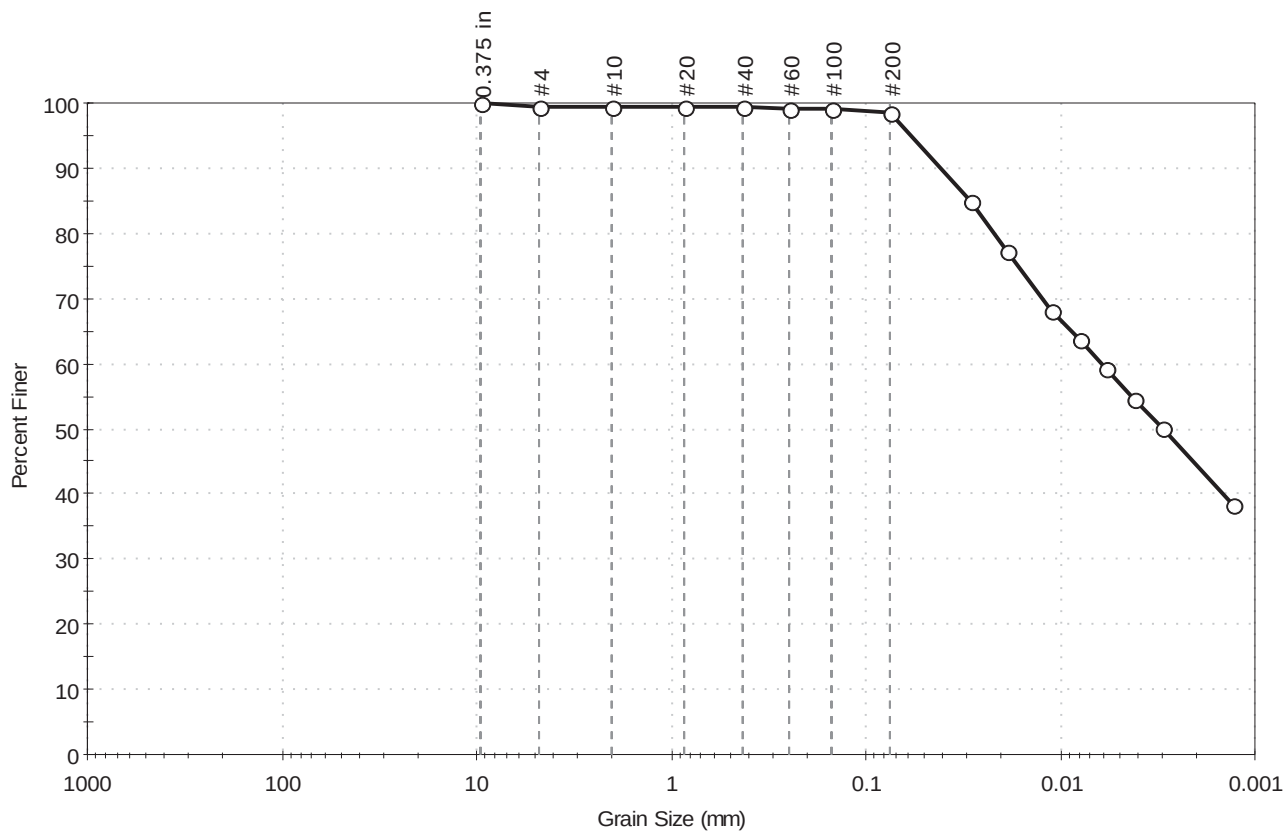
Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-46-01	Sample Type:	jar	Tested By:	jbr
Sample ID:	SS-8	Test Date:	01/07/15	Checked By:	emm
Depth :	25-27 ft	Test Id:	319279		
Test Comment:	---				
Sample Description:	Moist, greenish gray clay				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.6	0.8	98.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	99		
#10	2.00	99		
#20	0.85	99		
#40	0.42	99		
#60	0.25	99		
#100	0.15	99		
#200	0.075	99		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0288	85		
---	0.0187	77		
---	0.0112	68		
---	0.0081	64		
---	0.0058	59		
---	0.0041	55		
---	0.0030	50		
---	0.0013	38		

Coefficients

D_{85} = 0.0287 mm D_{30} = N/A
D_{60} = 0.0061 mm D_{15} = N/A
D_{50} = 0.0029 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM Lean clay (CL)

AASHTO Clayey Soils (A-7-6 (23))

Sample / Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve

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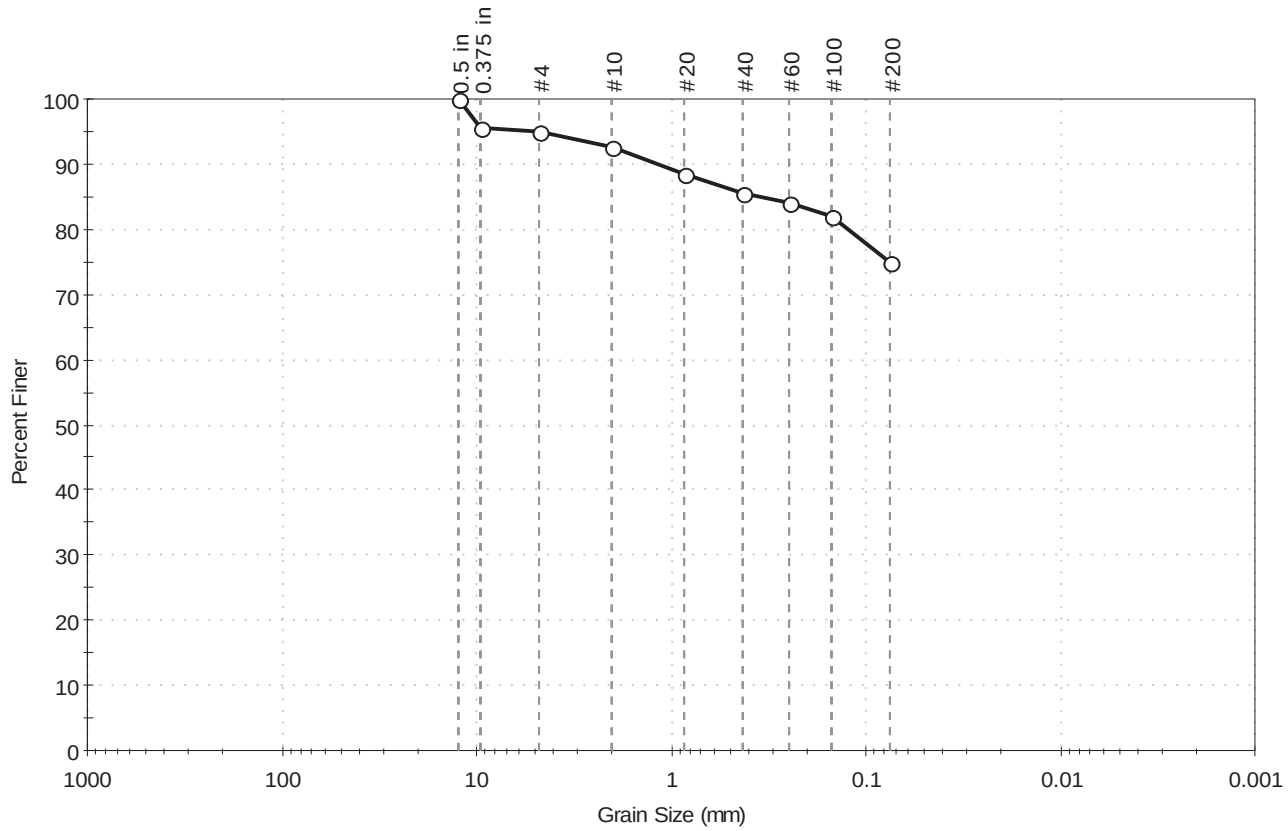
Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-46-02	Sample Type:	jar	Tested By:	jbr
Sample ID:	SS-2	Test Date:	01/05/15	Checked By:	emm
Depth :	10-12 ft	Test Id:	319282		
Test Comment:	---				
Sample Description:	Moist, dark gray silt with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	4.9	20.3	74.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	96		
#4	4.75	95		
#10	2.00	93		
#20	0.85	89		
#40	0.42	85		
#60	0.25	84		
#100	0.15	82		
#200	0.075	75		

Coefficients

D_{85} = 0.3588 mm	D_{30} = N/A
D_{60} = N/A	D_{15} = N/A
D_{50} = N/A	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM Silt with sand (ML)

AASHTO Silty Soils (A-4 (0))

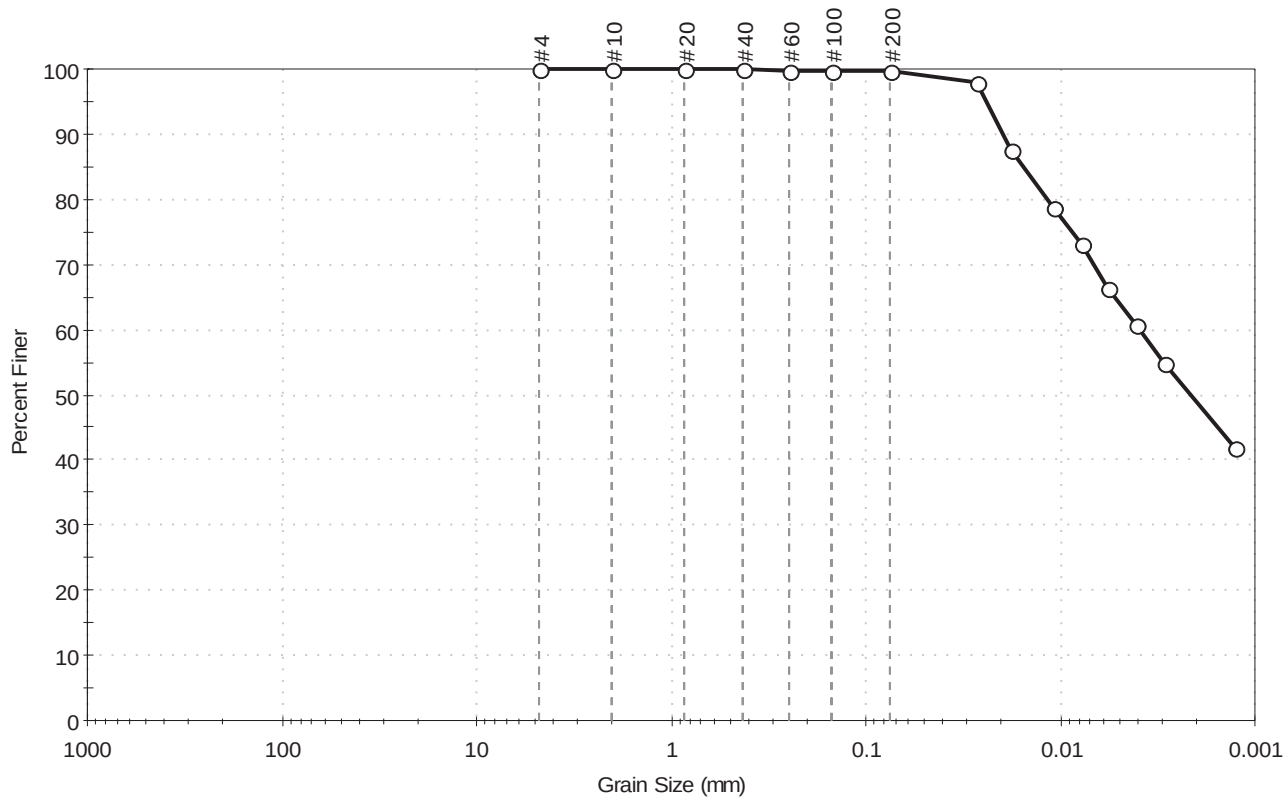
Sample / Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-46-02	Sample Type:	tube	Tested By:	jbr
Sample ID:	ST-4	Test Date:	01/07/15	Checked By:	emm
Depth :	20-22 ft	Test Id:	319280		
Test Comment:	---				
Sample Description:	Moist, olive gray clay				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	0.4	99.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	100		
#100	0.15	100		
#200	0.075	100		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0272	98		
---	0.0181	88		
---	0.0108	79		
---	0.0078	73		
---	0.0056	66		
---	0.0041	61		
---	0.0029	55		
---	0.0013	42		

Coefficients

D_{85} = 0.0154 mm D_{30} = N/A
D_{60} = 0.0039 mm D_{15} = N/A
D_{50} = 0.0021 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM Lean clay (CL)

AASHTO Clayey Soils (A-7-6 (24))

Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

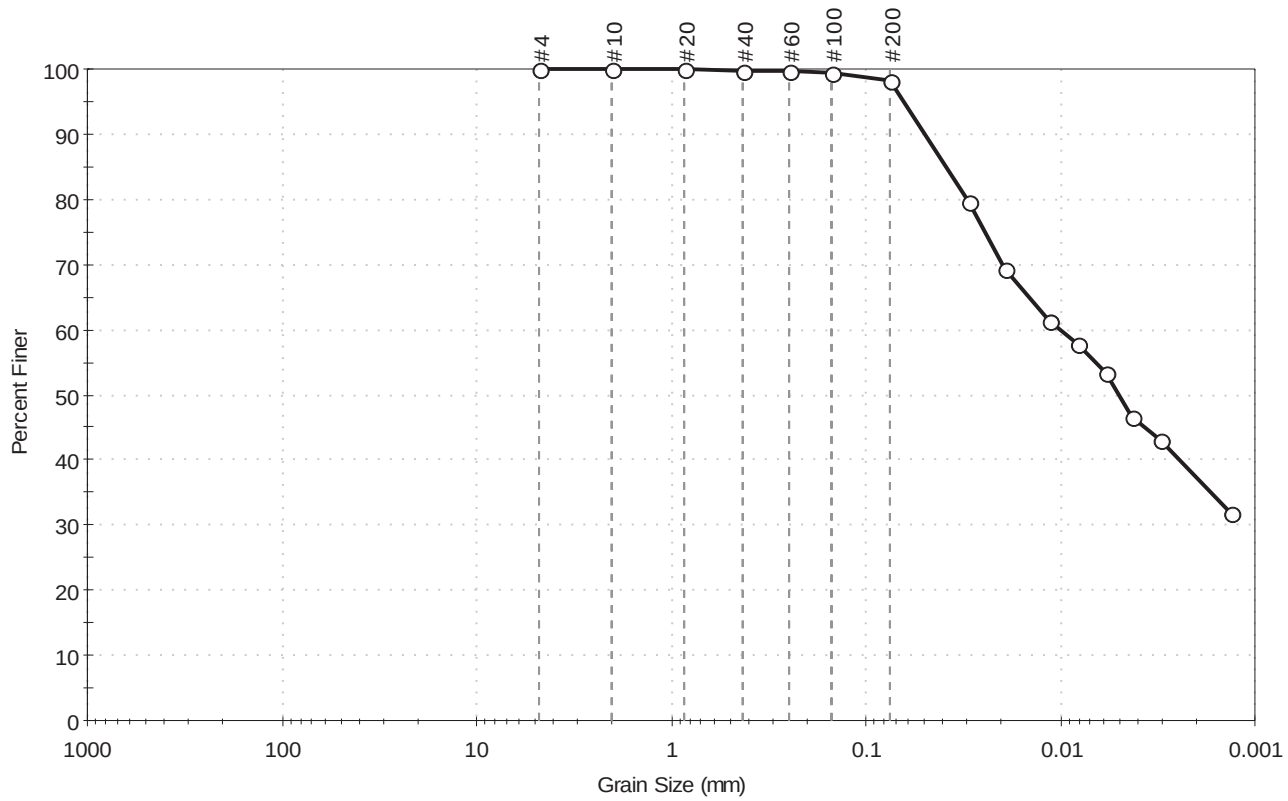
Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-46-02	Sample Type:	tube	Tested By:	jbr
Sample ID:	ST-6	Test Date:	01/07/15	Checked By:	emm
Depth :	27-29 ft	Test Id:	319281		
Test Comment:	---				
Sample Description:	Moist, dark olive gray clay				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	1.6	98.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	100		
#100	0.15	99		
#200	0.075	98		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0296	80		
---	0.0194	69		
---	0.0115	61		
---	0.0082	58		
---	0.0059	53		
---	0.0043	46		
---	0.0030	43		
---	0.0013	32		

Coefficients

D_{85} = 0.0387 mm D_{30} = N/A
D_{60} = 0.0101 mm D_{15} = N/A
D_{50} = 0.0050 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM Lean clay (CL)

AASHTO Clayey Soils (A-6 (21))

Sample / Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve

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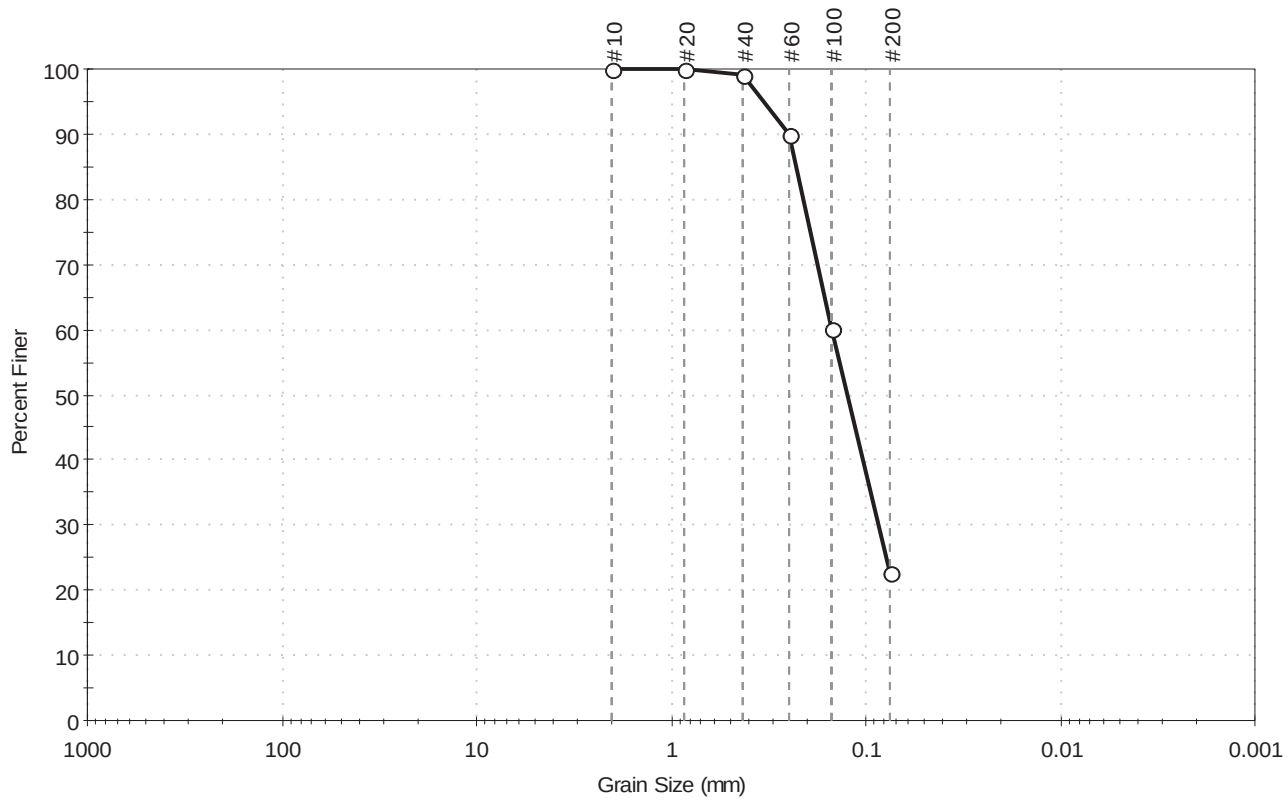
Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-53-02	Sample Type:	jar	Tested By:	jbr
Sample ID:	SS-3	Test Date:	01/02/15	Checked By:	emm
Depth :	15-17 ft	Test Id:	319283		
Test Comment:	---				
Sample Description:	Moist, brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	77.2	22.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	90		
#100	0.15	60		
#200	0.075	23		

Coefficients

D_{85} = 0.2301 mm D_{30} = 0.0857 mm
D_{60} = 0.1499 mm D_{15} = N/A
D_{50} = 0.1244 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM Silty sand (SM)

AASHTO Silty Gravel and Sand (A-2-4 (0))

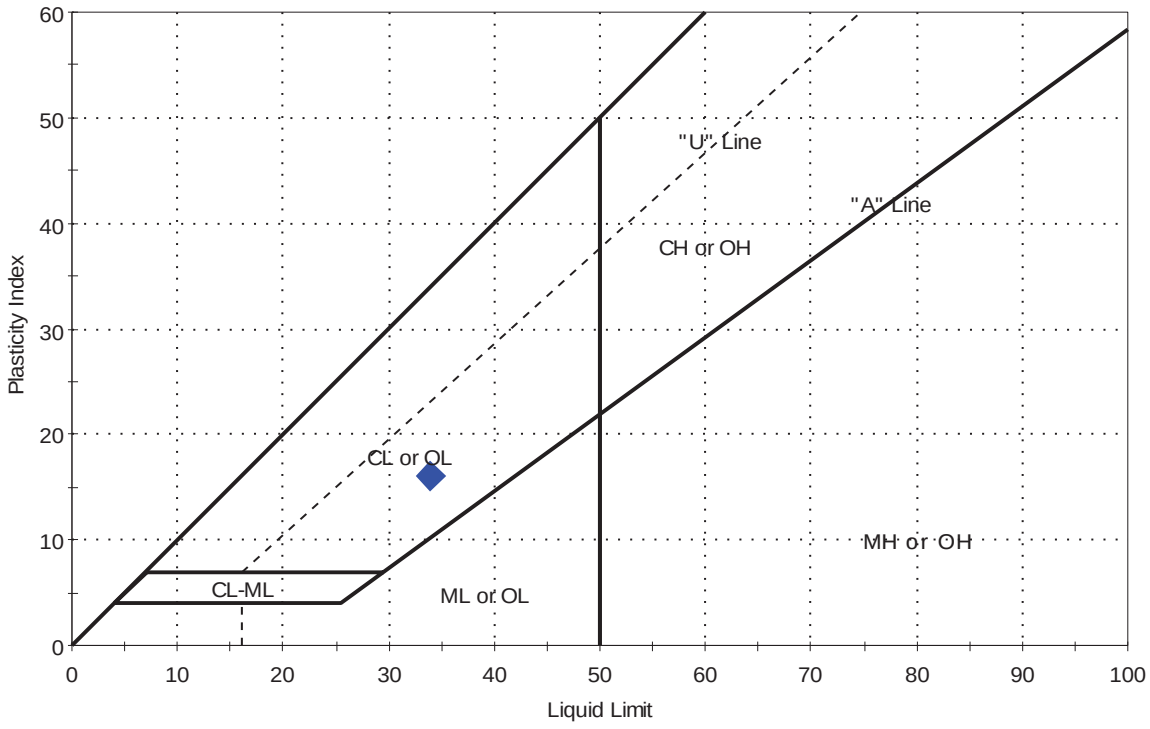
Sample / Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-21-01	Sample Type:	jar	Tested By:	cam
Sample ID:	SS-4	Test Date:	01/05/15	Checked By:	emm
Depth :	20-22 ft	Test Id:	319268		
Test Comment:	---				
Sample Description:	Moist, greenish gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS-4	PB-21-01	20-22 ft	31	34	18	16	0.8	Lean clay (CL)

Sample Prepared using the WET method

1% Retained on #40 Sieve

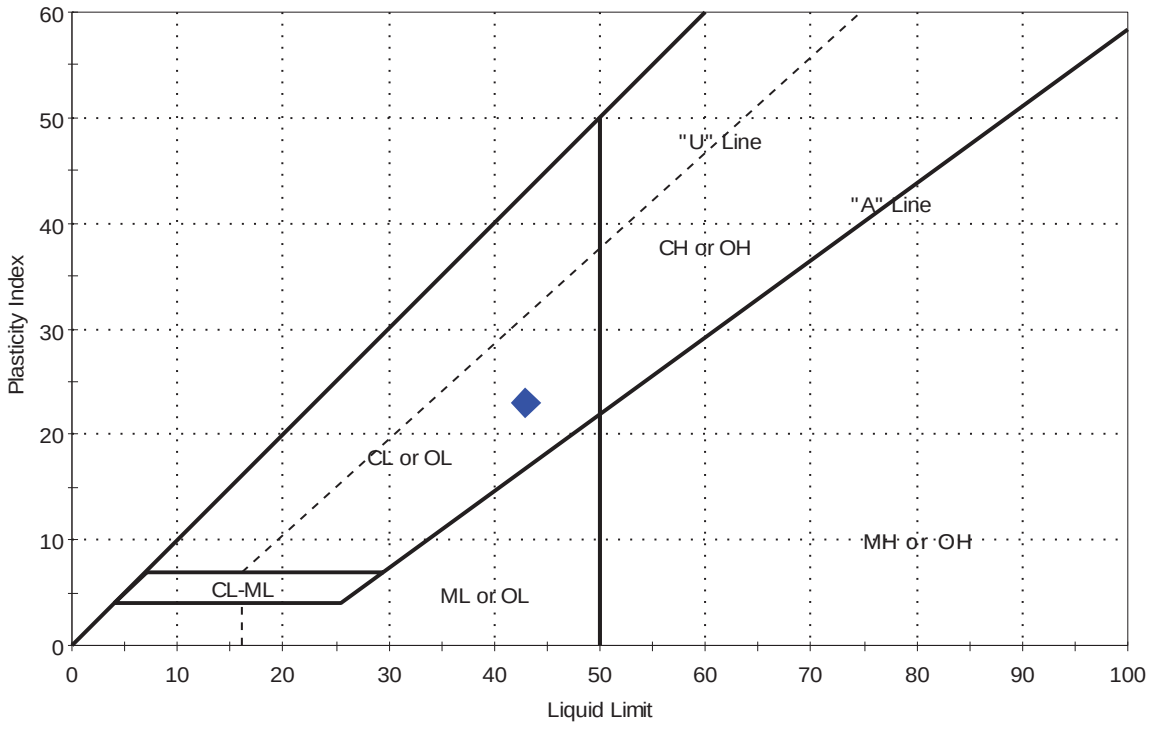
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-21-02	Sample Type:	tube	Tested By:	cam
Sample ID:	ST-2	Test Date:	01/05/15	Checked By:	emm
Depth :	15-17 ft	Test Id:	319269		
Test Comment:	---				
Sample Description:	Moist, olive gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	ST-2	PB-21-02	15-17 ft	40	43	20	23	0.9	Lean clay (CL)

Sample Prepared using the WET method

1% Retained on #40 Sieve

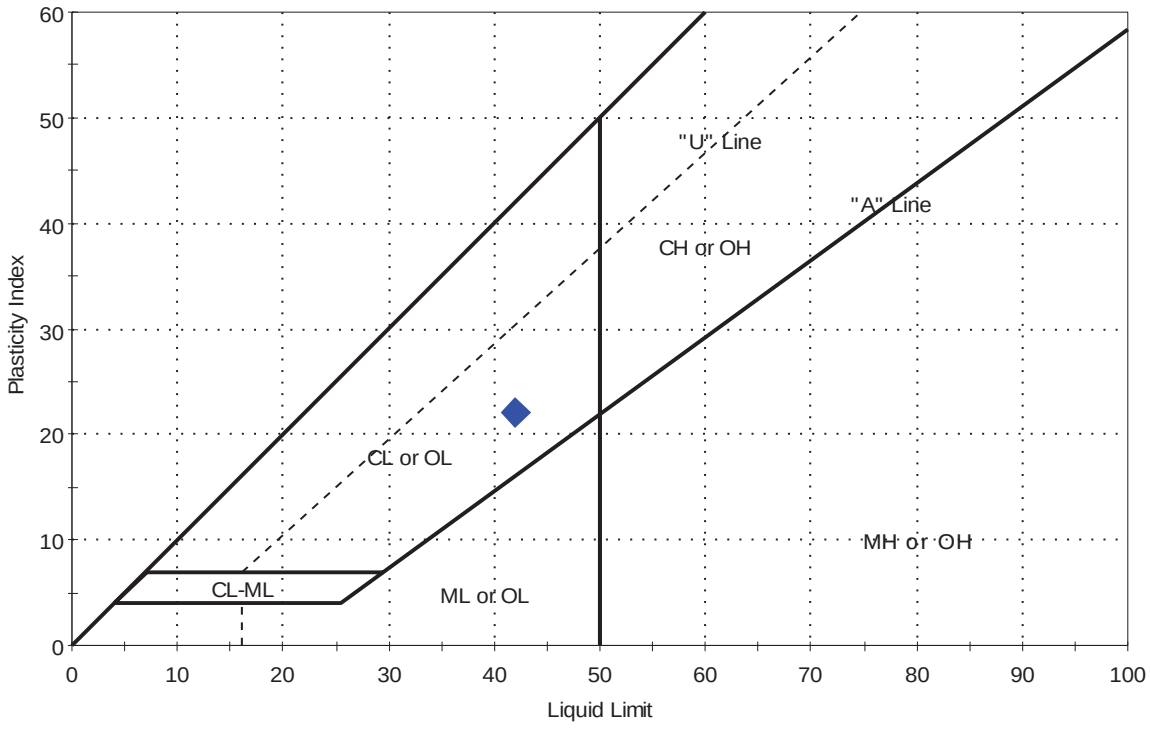
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-46-01	Sample Type:	jar	Tested By:	cam
Sample ID:	SS-8	Test Date:	01/05/15	Checked By:	emm
Depth :	25-27 ft	Test Id:	319270		
Test Comment:	---				
Sample Description:	Moist, greenish gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS-8	PB-46-01	25-27 ft	33	42	20	22	0.6	Lean clay (CL)

Sample Prepared using the WET method

1% Retained on #40 Sieve

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-46-02	Sample Type:	jar	Tested By:	cam
Sample ID:	SS-2	Test Date:	01/05/15	Checked By:	emm
Depth :	10-12 ft	Test Id:	319271		
Test Comment:	---				
Sample Description:	Moist, dark gray silt with sand				
Sample Comment:	---				

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS-2	PB-46-02	10-12 ft	17	n/a	n/a	n/a	n/a	Silt with sand (ML)

15% Retained on #40 Sieve

Dry Strength: MEDIUM

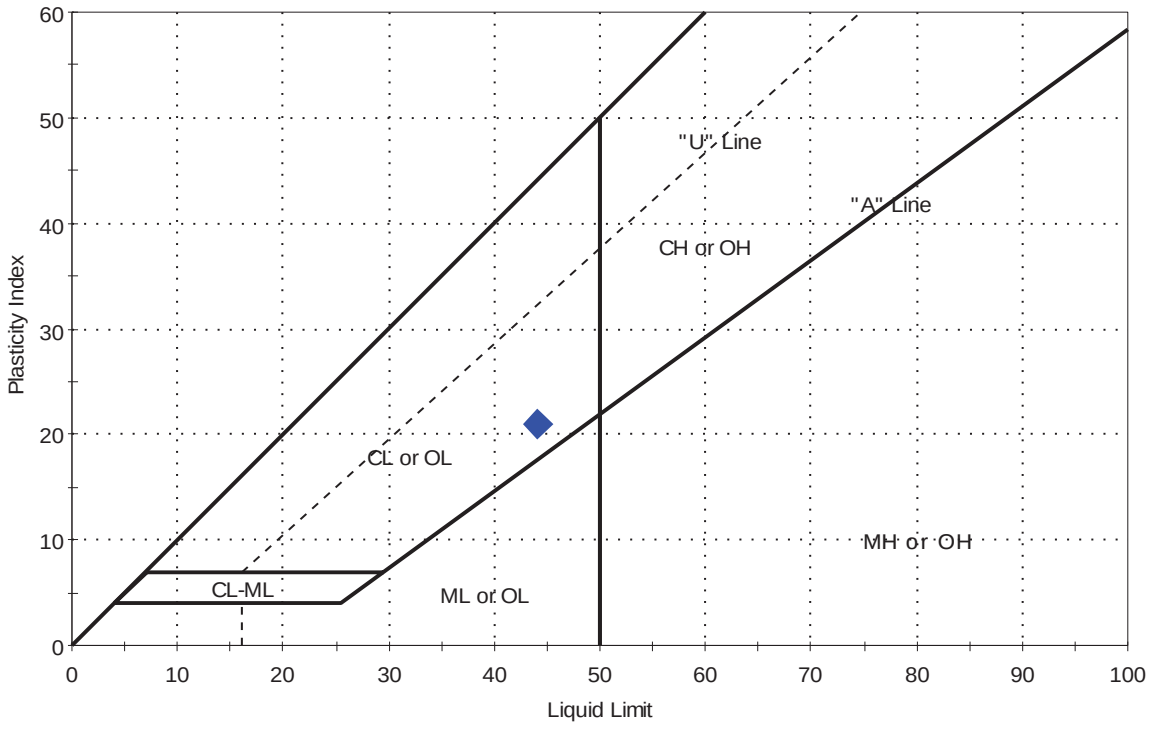
Dilatancy: RAPID

Toughness: n/a

The sample was determined to be Non-Plastic

Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-46-02	Sample Type:	tube	Tested By:	cam
Sample ID:	ST-4	Test Date:	01/02/15	Checked By:	emm
Depth :	20-22 ft	Test Id:	319272		
Test Comment:	---				
Sample Description:	Moist, olive gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	ST-4	PB-46-02	20-22 ft	36	44	23	21	0.6	Lean clay (CL)

Sample Prepared using the WET method

0% Retained on #40 Sieve

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

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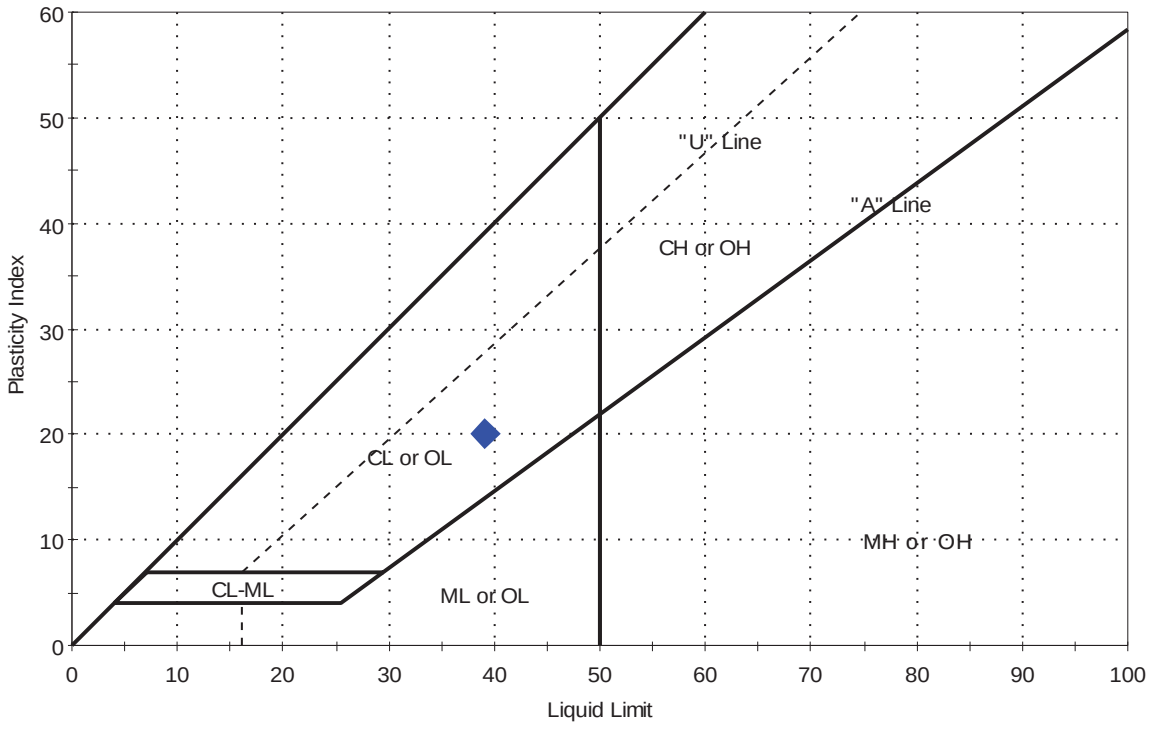
Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-46-02	Sample Type:	tube	Tested By:	cam
Sample ID:	ST-6	Test Date:	01/02/15	Checked By:	emm
Depth :	27-29 ft	Test Id:	319273		
Test Comment:	---				
Sample Description:	Moist, dark olive gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	ST-6	PB-46-02	27-29 ft	37	39	19	20	0.9	Lean clay (CL)

Sample Prepared using the WET method

0% Retained on #40 Sieve

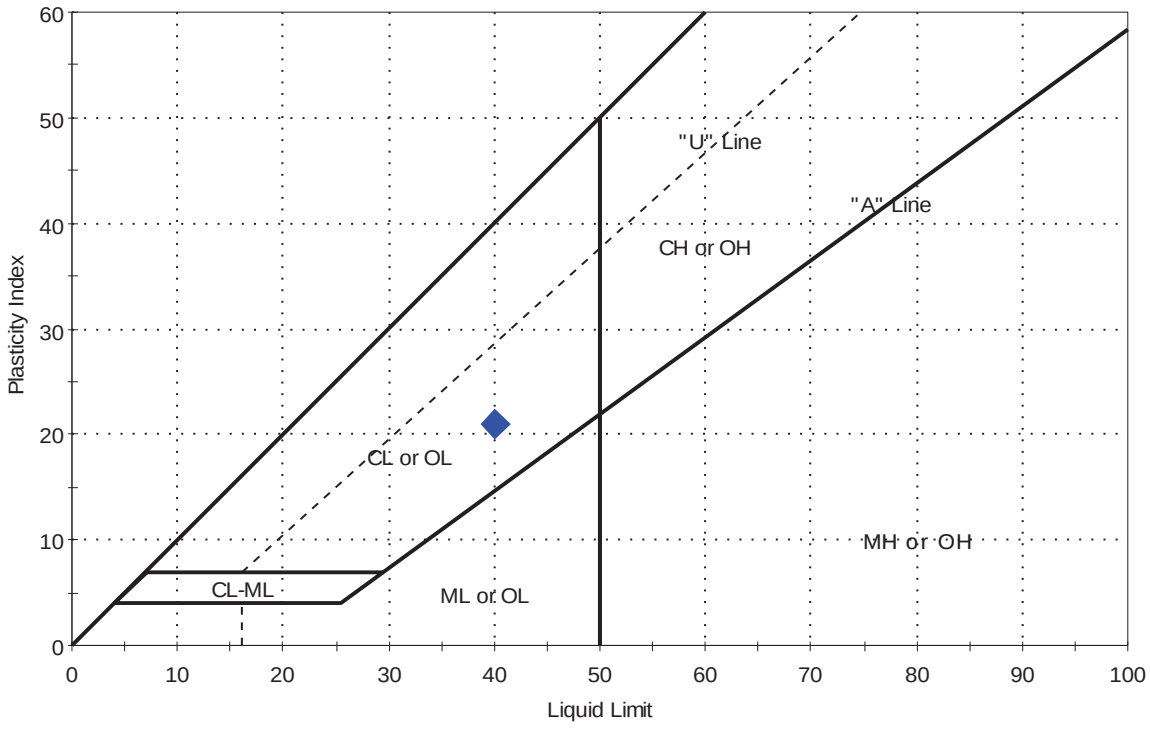
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-53-01	Sample Type:	jar	Tested By:	cam
Sample ID:	SS-2	Test Date:	01/06/15	Checked By:	emm
Depth :	10-12 ft	Test Id:	319276		
Test Comment:	---				
Sample Description:	Moist, olive gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS-2	PB-53-01	10-12 ft	30	40	19	21	0.5	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

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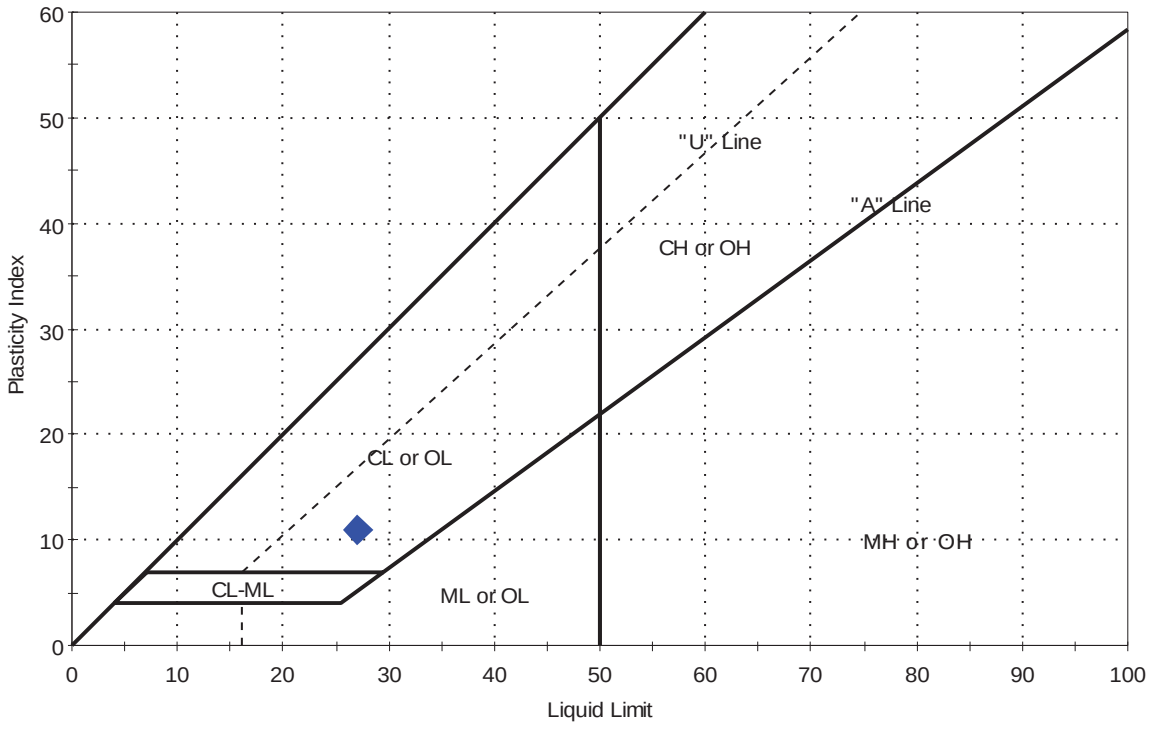
Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-53-02	Sample Type:	jar	Tested By:	cam
Sample ID:	SS-2	Test Date:	01/05/15	Checked By:	emm
Depth :	10-12 ft	Test Id:	319275		
Test Comment:	---				
Sample Description:	Moist, olive clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS-2	PB-53-02	10-12 ft	28	27	16	11	1.1	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	HNTB Corporation				
Project:	MTA Tier 3 ORT				
Location:	Falmouth, ME			Project No:	GTX-302707
Boring ID:	PB-53-02	Sample Type:	jar	Tested By:	cam
Sample ID:	SS-3	Test Date:	12/31/14	Checked By:	emm
Depth :	15-17 ft	Test Id:	319274		
Test Comment:	---				
Sample Description:	Moist, brown silty sand				
Sample Comment:	---				

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS-3	PB-53-02	15-17 ft	11	n/a	n/a	n/a	n/a	Silty sand (SM)

1% Retained on #40 Sieve

Dry Strength: LOW

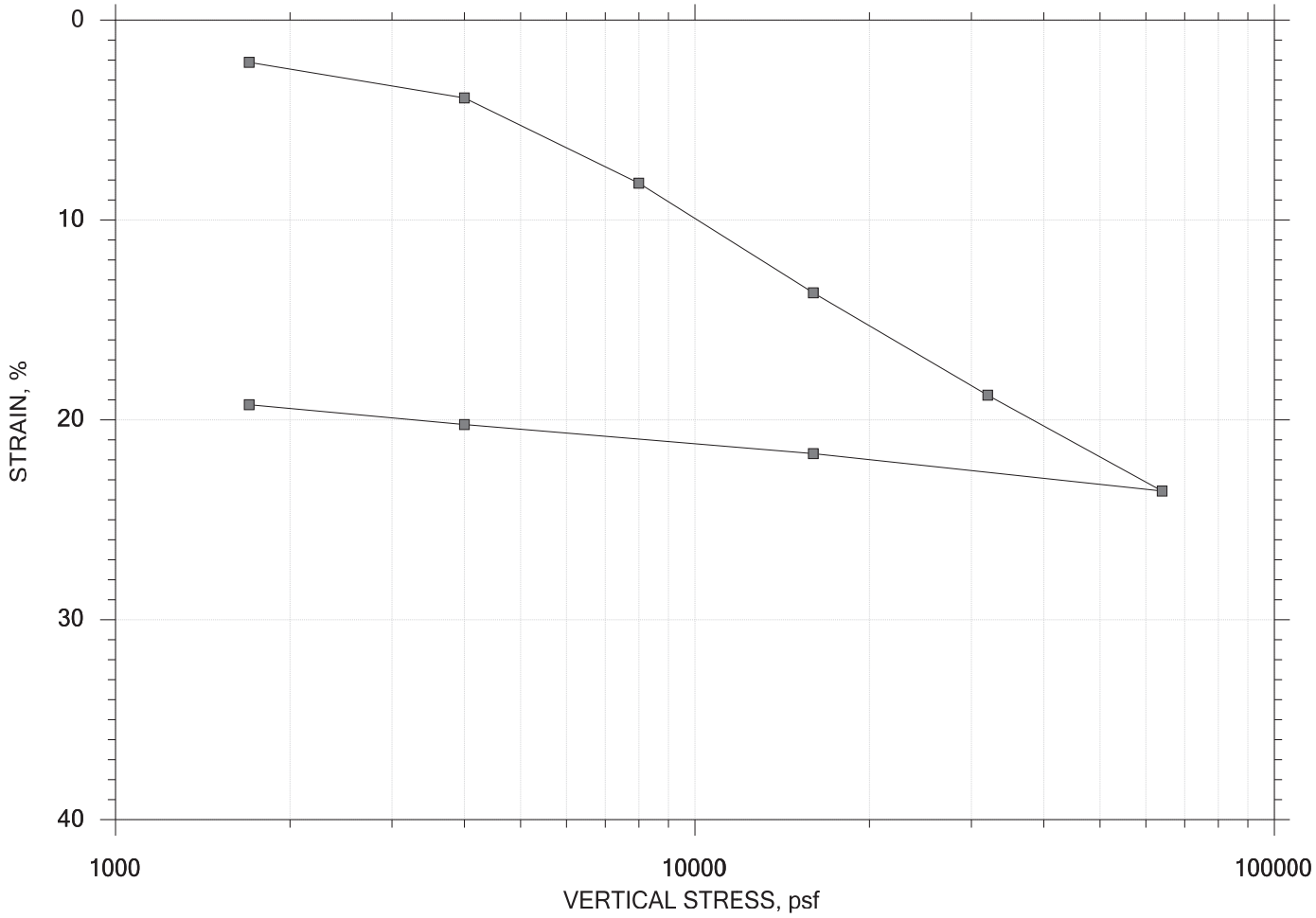
Dilatancy: RAPID

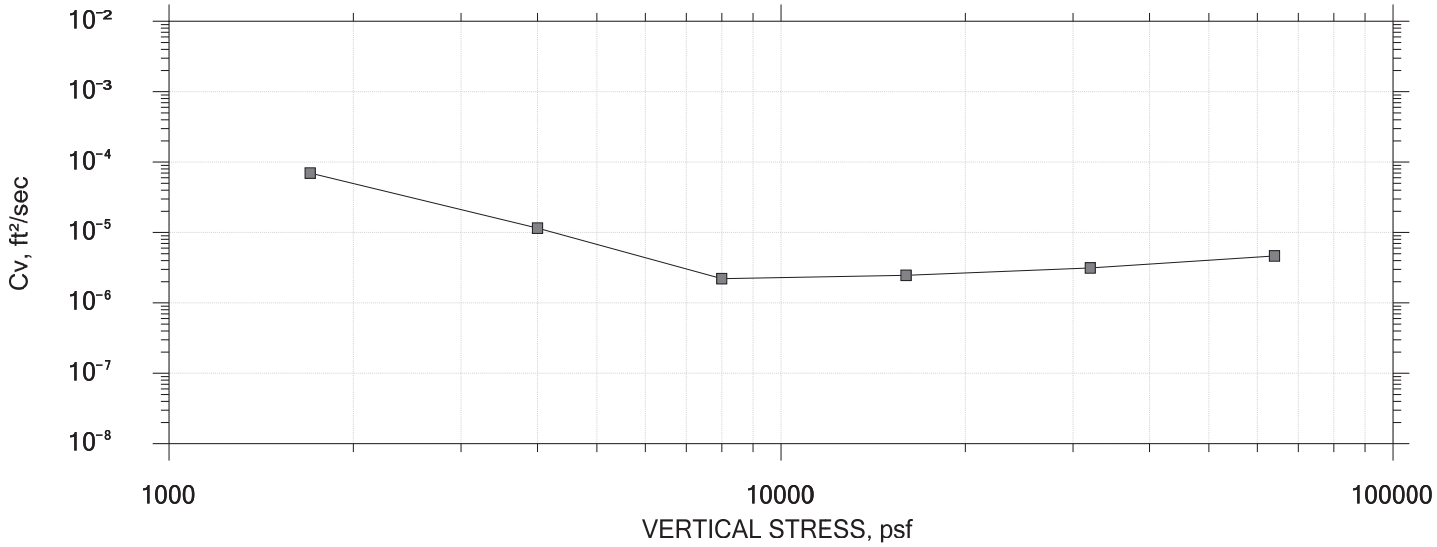
Toughness: n/a

The sample was determined to be Non-Plastic

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

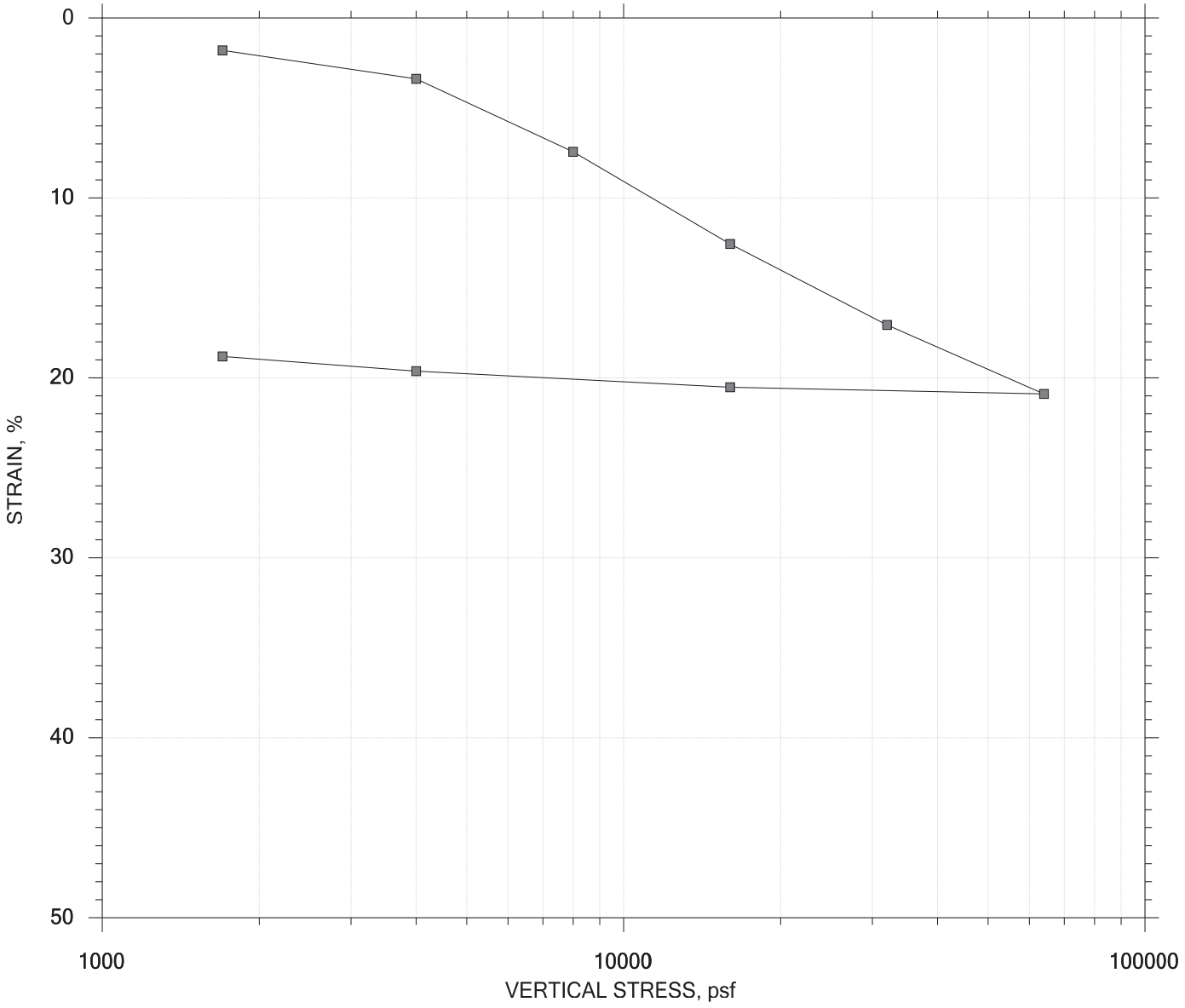




GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-21-02	Tested By: md	Checked By: jdt
	Sample No.: ST-2	Test Date: 12/27/14	Test No.: IP-1A
	Depth: 15-17 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System F		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



					Before Test	After Test
Current Vertical Effective Stress: ---				Water Content, %	33.47	21.74
Preconsolidation Stress: ---				Dry Unit Weight, pcf	87.076	108.84
Compression Ratio: ---				Saturation, %	92.77	100.00
Diameter: 2.5 in		Height: 1 in		Void Ratio	1.01	0.61
LL: 43	PL: 20	PI: 23	GS: 2.81			

GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-21-02	Tested By: md	Checked By: jdt
	Sample No.: ST-2	Test Date: 12/27/14	Test No.: IP-1A
	Depth: 15-17 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System F		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
Boring No.: PB-21-02	Tested By: md	Checked By: jdt
Sample No.: ST-2	Test Date: 12/27/14	Depth: 15-17 ft
Test No.: IP-1A	Sample Type: intact	Elevation: ---

Soil Description: Moist, olive gray clay
Remarks: System F

Estimated Specific Gravity: 2.81	Liquid Limit: 43	Specimen Diameter: 2.50 in
Initial Void Ratio: 1.01	Plastic Limit: 20	Initial Height: 1.00 in
Final Void Ratio: 0.610	Plasticity Index: 23	Final Height: 0.80 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	14777	RING		15395
Wt. Container + Wet Soil, gm	258.52	258.48	245.32	146.49
Wt. Container + Dry Soil, gm	196.01	220.93	220.93	121.79
Wt. Container, gm	8.1000	108.73	108.73	8.1700
Wt. Dry Soil, gm	187.91	112.20	112.20	113.62
Water Content, %	33.27	33.47	21.74	21.74
Void Ratio	---	1.01	0.610	---
Degree of Saturation, %	---	92.77	100.00	---
Dry Unit Weight, pcf	---	87.076	108.84	---

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefore, values may not represent actual values for the specimen.

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: MTA Tier 3 ORT
Boring No.: PB-21-02
Sample No.: ST-2
Test No.: IP-1A

Location: Falmouth, ME
Tested By: md
Test Date: 12/27/14
Sample Type: intact

Project No.: GTX-302707
Checked By: jdt
Depth: 15-17 ft
Elevation: ---

Soil Description: Moist, olive gray clay
Remarks: System F

Displacement at End of Increment

	Applied Stress psf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/sec	Mv 1/psf	k ft/day
1	1.70e+003	0.01797	0.977	1.80	0.812	2.97e-005	1.06e-005	1.69e-003
2	4.00e+003	0.03380	0.945	3.38	5.108	4.56e-006	6.88e-006	1.69e-004
3	8.00e+003	0.07433	0.863	7.43	13.382	1.64e-006	1.01e-005	8.97e-005
4	1.60e+004	0.1255	0.760	12.6	9.978	1.99e-006	6.40e-006	6.88e-005
5	3.20e+004	0.1705	0.670	17.1	7.268	2.45e-006	2.81e-006	3.72e-005
6	6.40e+004	0.2089	0.592	20.9	4.470	3.60e-006	1.20e-006	2.33e-005
7	1.60e+004	0.2052	0.600	20.5	2.393	6.45e-006	7.70e-008	2.68e-006
8	4.00e+003	0.1962	0.618	19.6	6.121	2.56e-006	7.49e-007	1.03e-005
9	1.70e+003	0.1880	0.634	18.8	15.591	1.03e-006	3.56e-006	1.97e-005

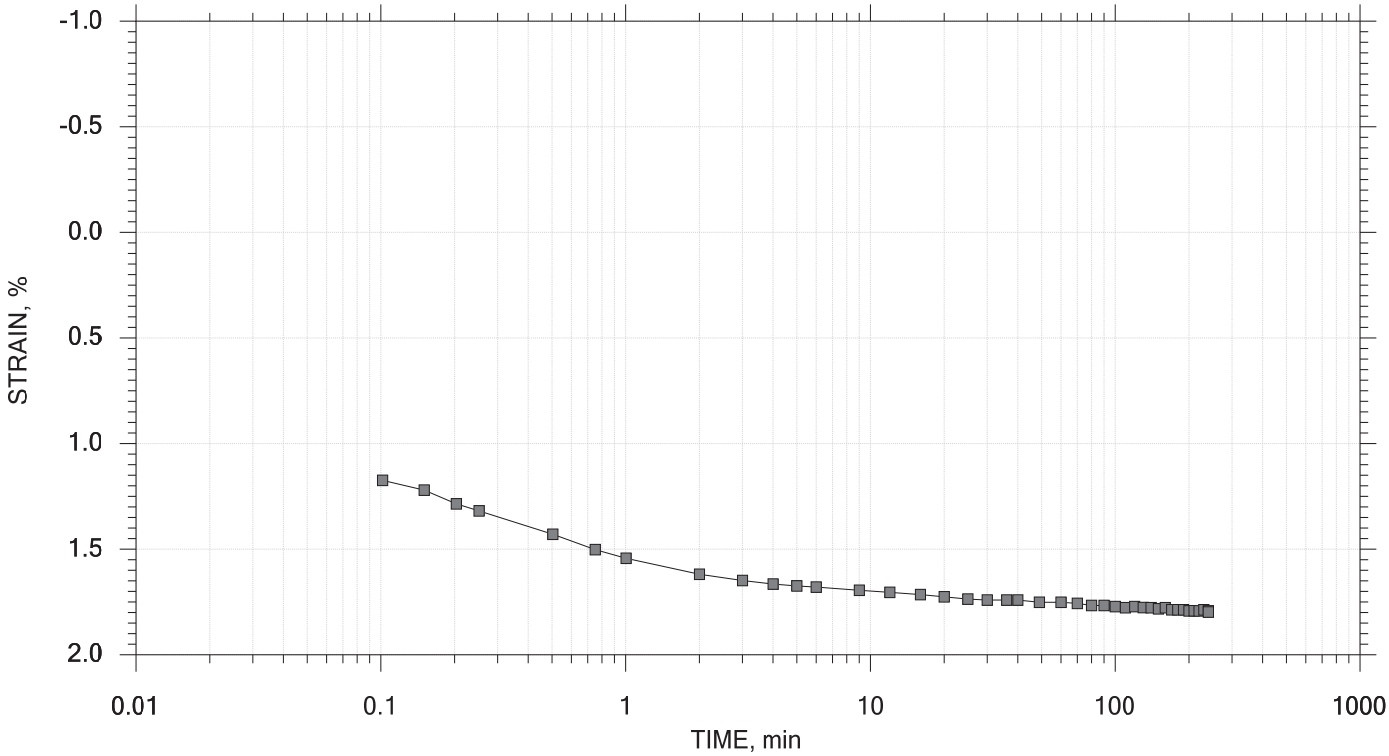
	Applied Stress psf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/sec	Mv 1/psf	k ft/day	Ca %
1	1.70e+003	0.01797	0.977	1.80	0.000	0.00e+000	1.06e-005	0.00e+000	0.00e+000
2	4.00e+003	0.03380	0.945	3.38	0.503	1.08e-005	6.88e-006	3.99e-004	0.00e+000
3	8.00e+003	0.07433	0.863	7.43	2.412	2.11e-006	1.01e-005	1.16e-004	0.00e+000
4	1.60e+004	0.1255	0.760	12.6	2.277	2.03e-006	6.40e-006	7.00e-005	0.00e+000
5	3.20e+004	0.1705	0.670	17.1	1.743	2.37e-006	2.81e-006	3.60e-005	0.00e+000
6	6.40e+004	0.2089	0.592	20.9	1.206	3.10e-006	1.20e-006	2.01e-005	0.00e+000
7	1.60e+004	0.2052	0.600	20.5	0.000	0.00e+000	7.70e-008	0.00e+000	0.00e+000
8	4.00e+003	0.1962	0.618	19.6	1.656	2.20e-006	7.49e-007	8.88e-006	0.00e+000
9	1.70e+003	0.1880	0.634	18.8	4.458	8.35e-007	3.56e-006	1.60e-005	0.00e+000

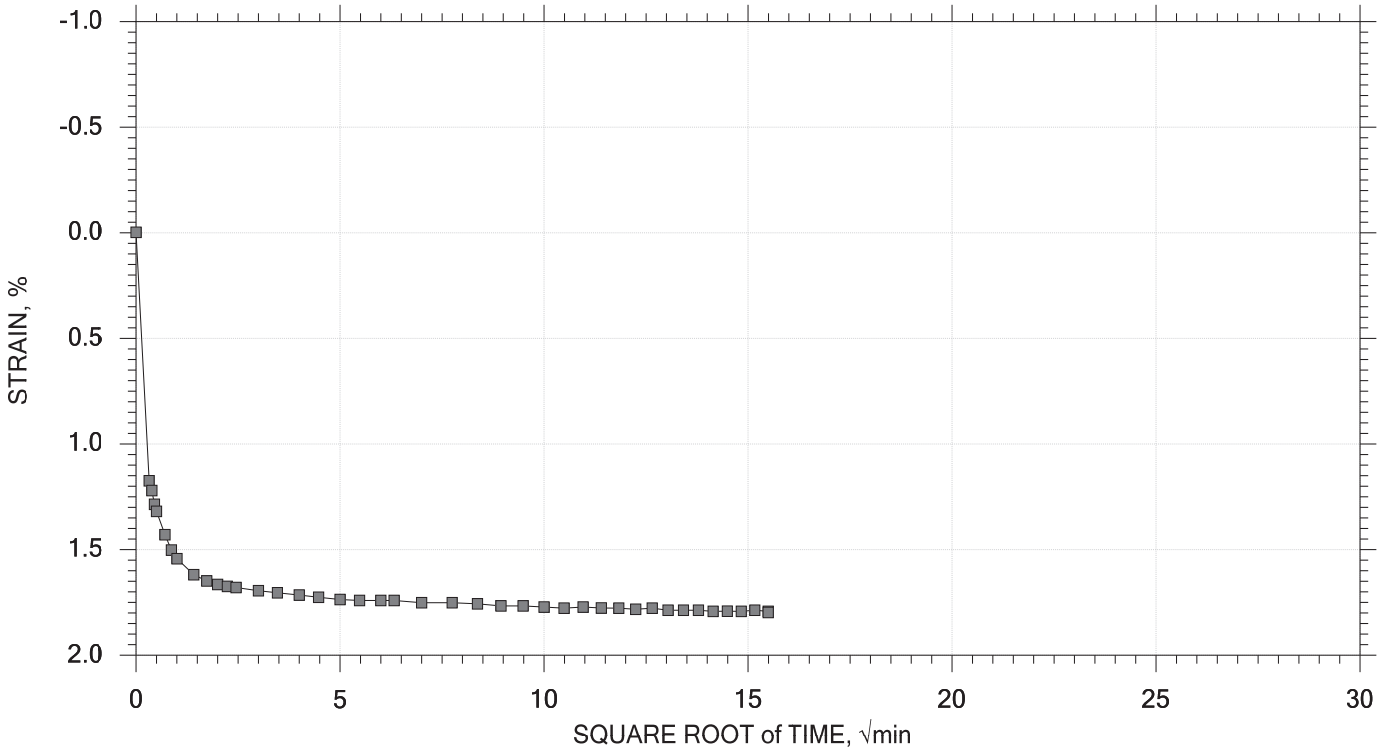
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 1 of 9

Stress: 1700 psf





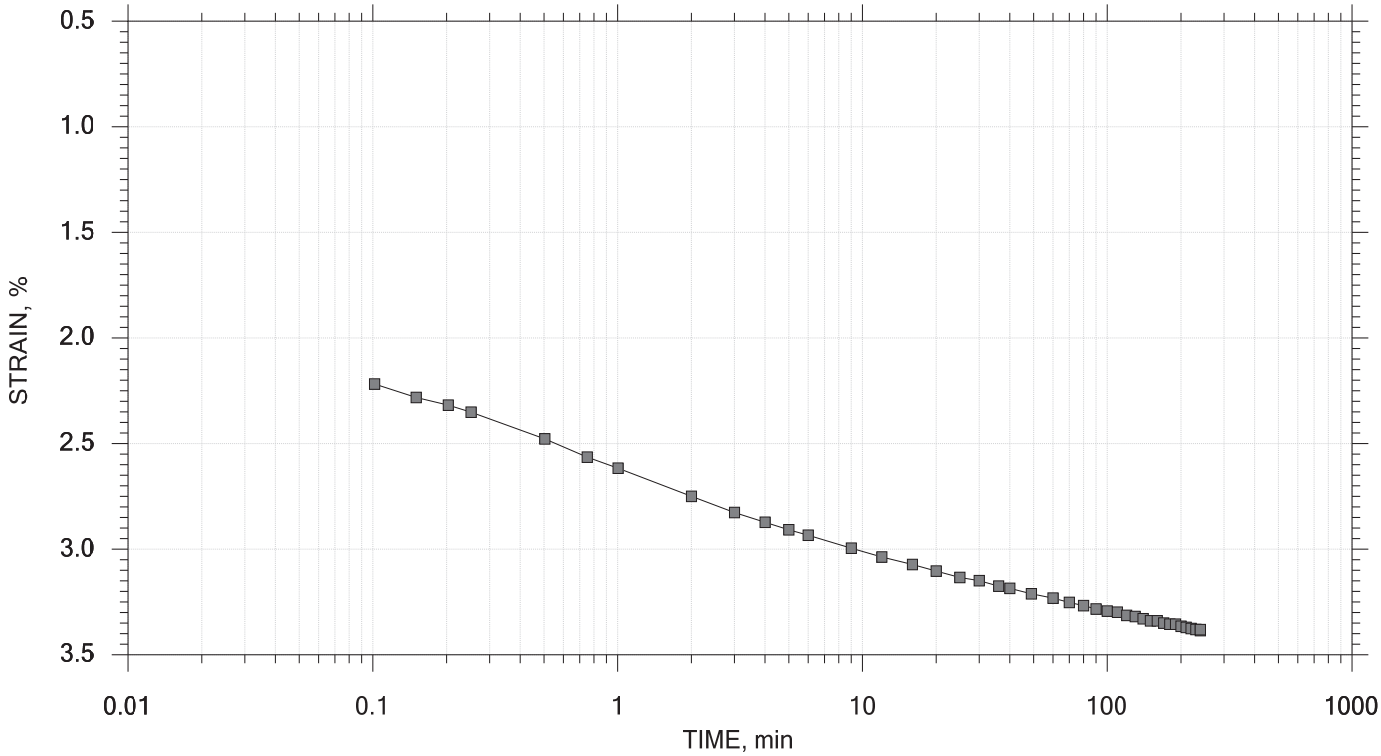
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-21-02	Tested By: md	Checked By: jdt
	Sample No.: ST-2	Test Date: 12/27/14	Test No.: IP-1A
	Depth: 15-17 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System F		

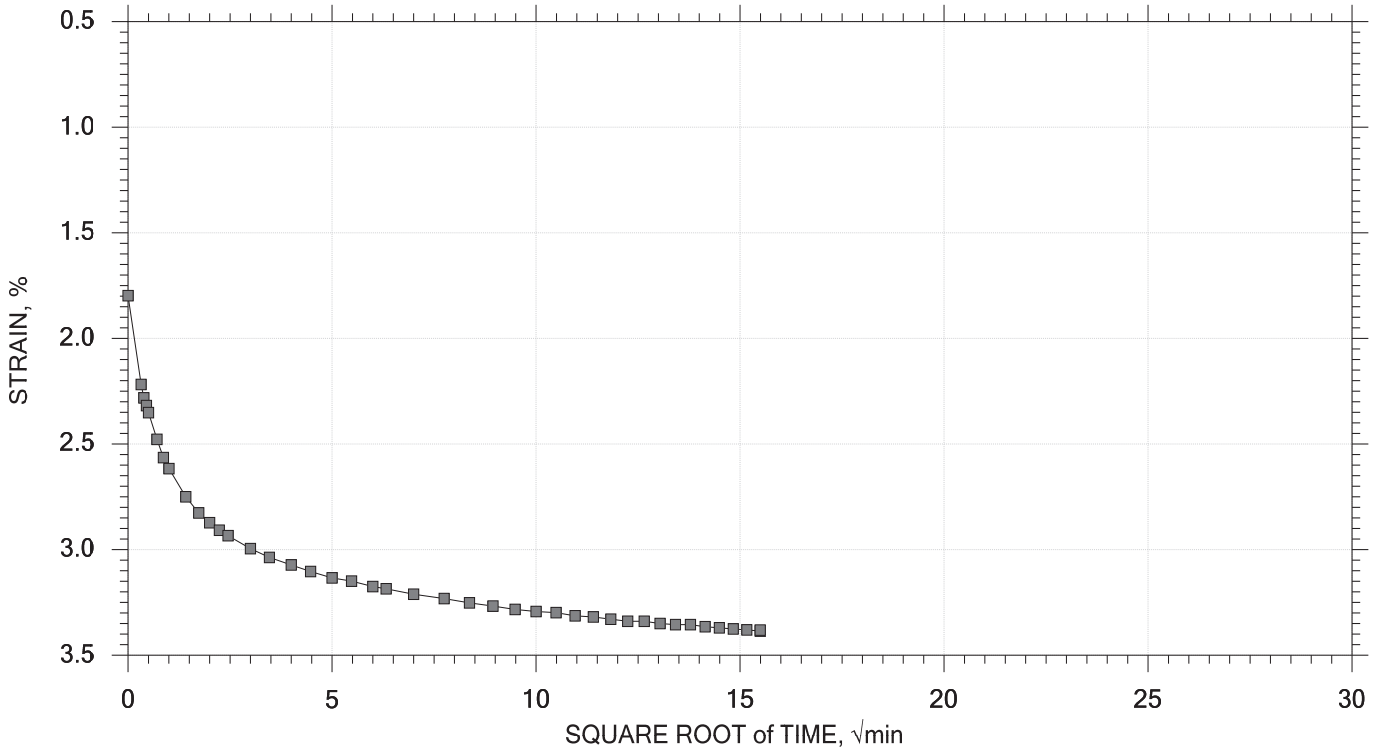
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 9

Stress: 4000 psf





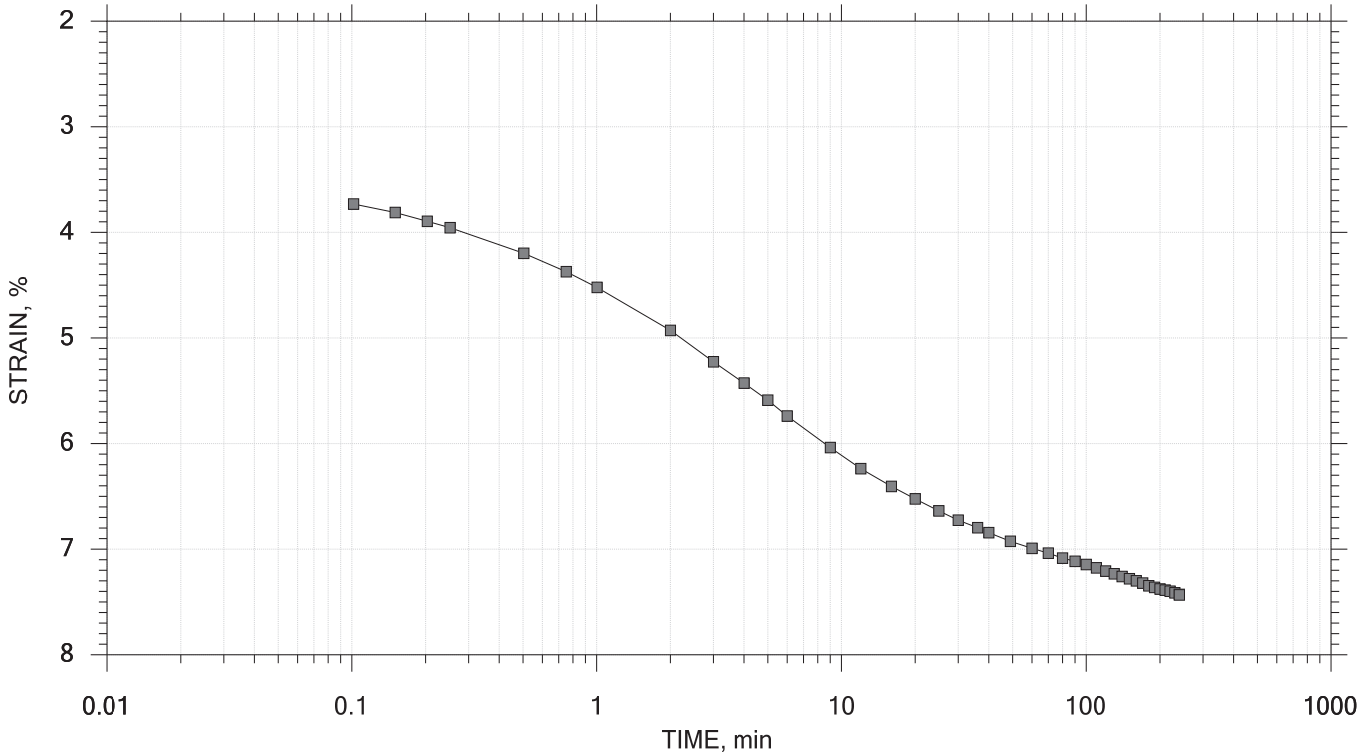
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-21-02	Tested By: md	Checked By: jdt
	Sample No.: ST-2	Test Date: 12/27/14	Test No.: IP-1A
	Depth: 15-17 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System F		

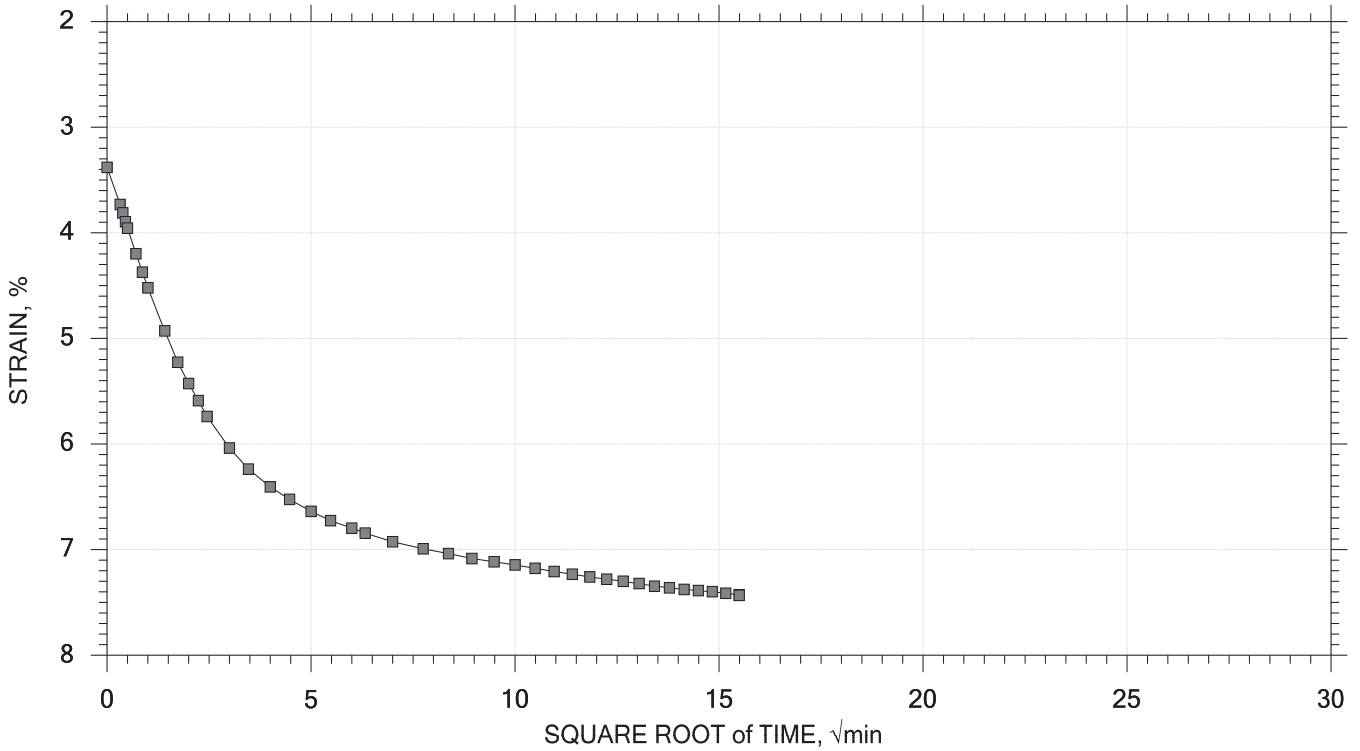
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 9

Stress: 8000 psf





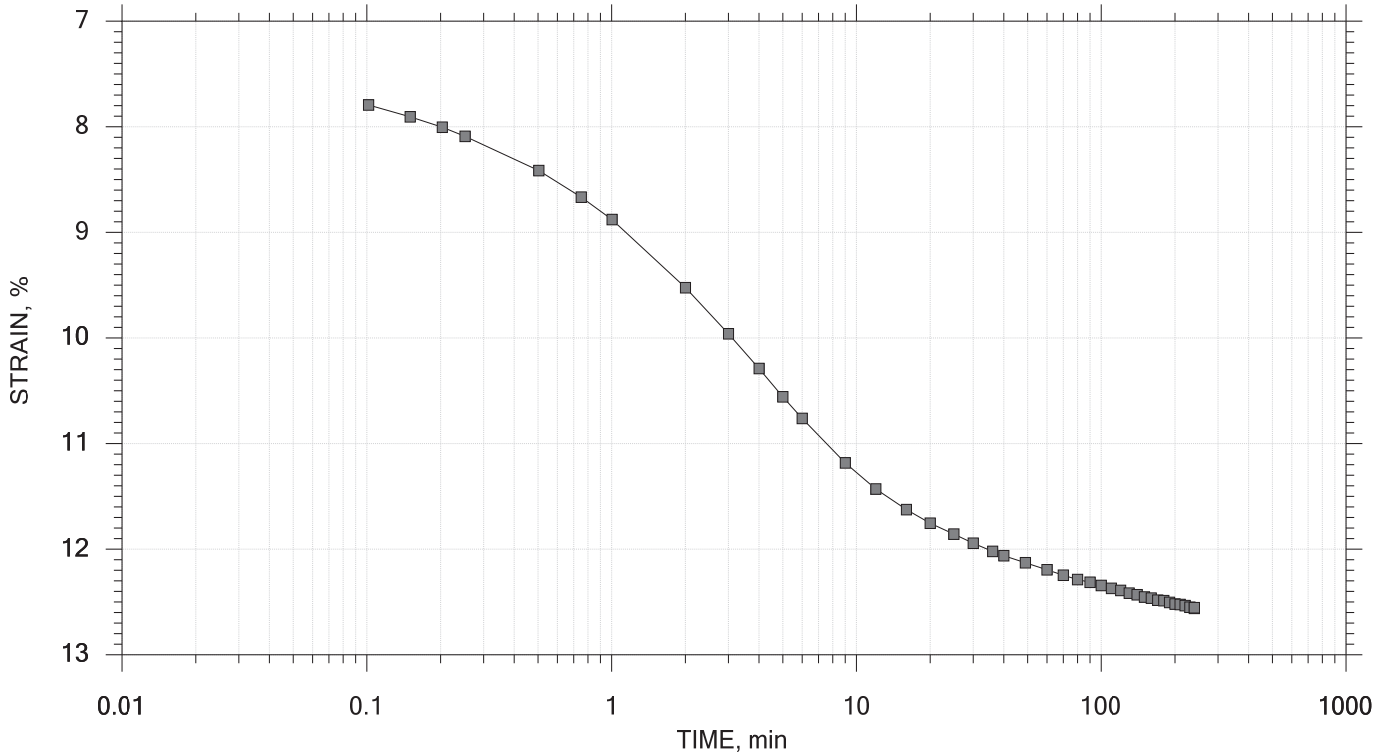
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-21-02	Tested By: md	Checked By: jdt
	Sample No.: ST-2	Test Date: 12/27/14	Test No.: IP-1A
	Depth: 15-17 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System F		

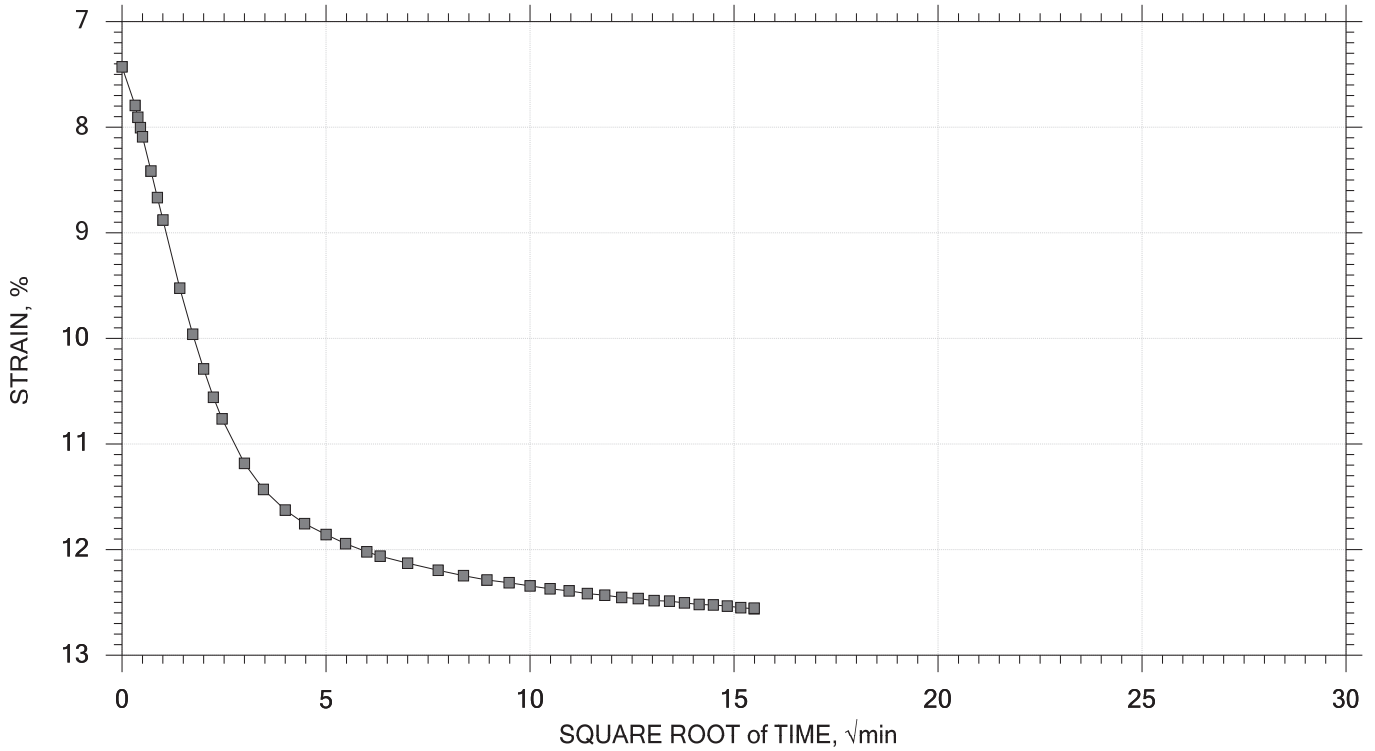
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 9

Stress: 16000 psf





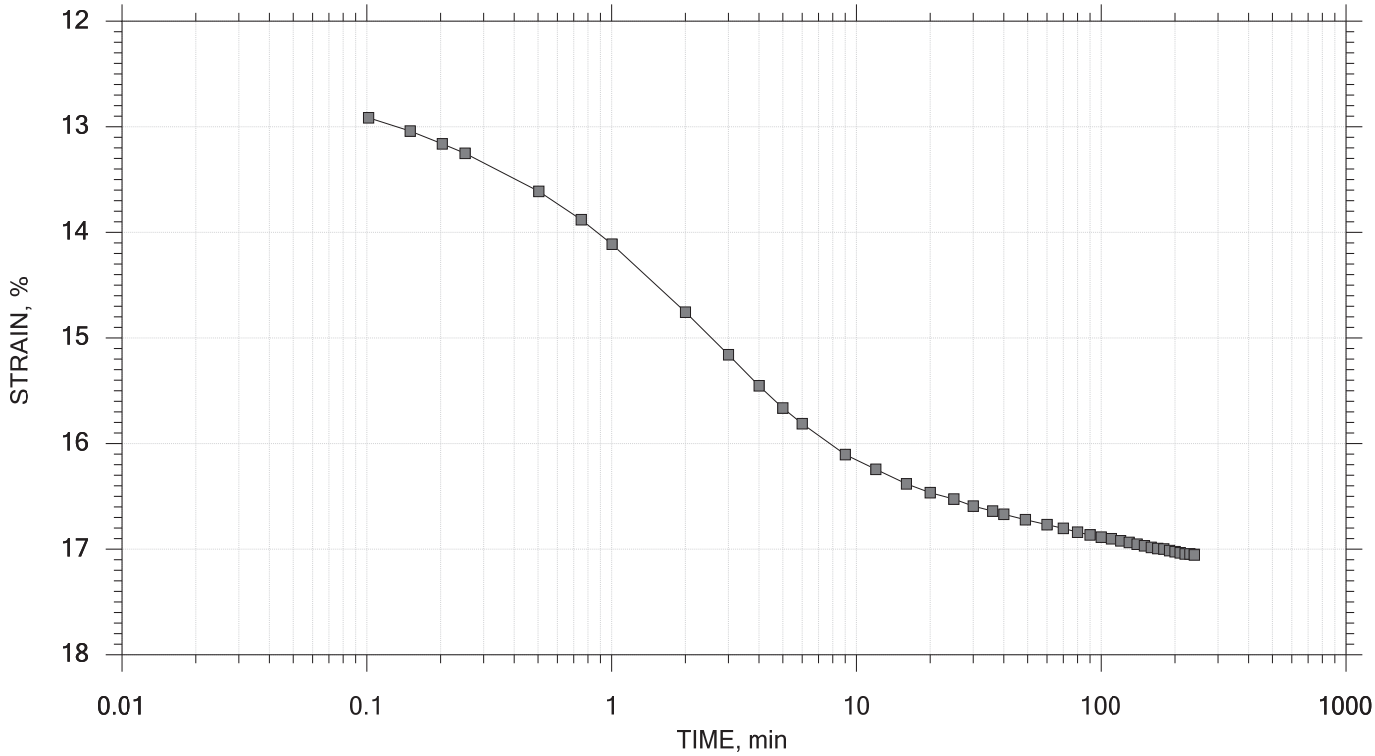
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-21-02	Tested By: md	Checked By: jdt
	Sample No.: ST-2	Test Date: 12/27/14	Test No.: IP-1A
	Depth: 15-17 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System F		

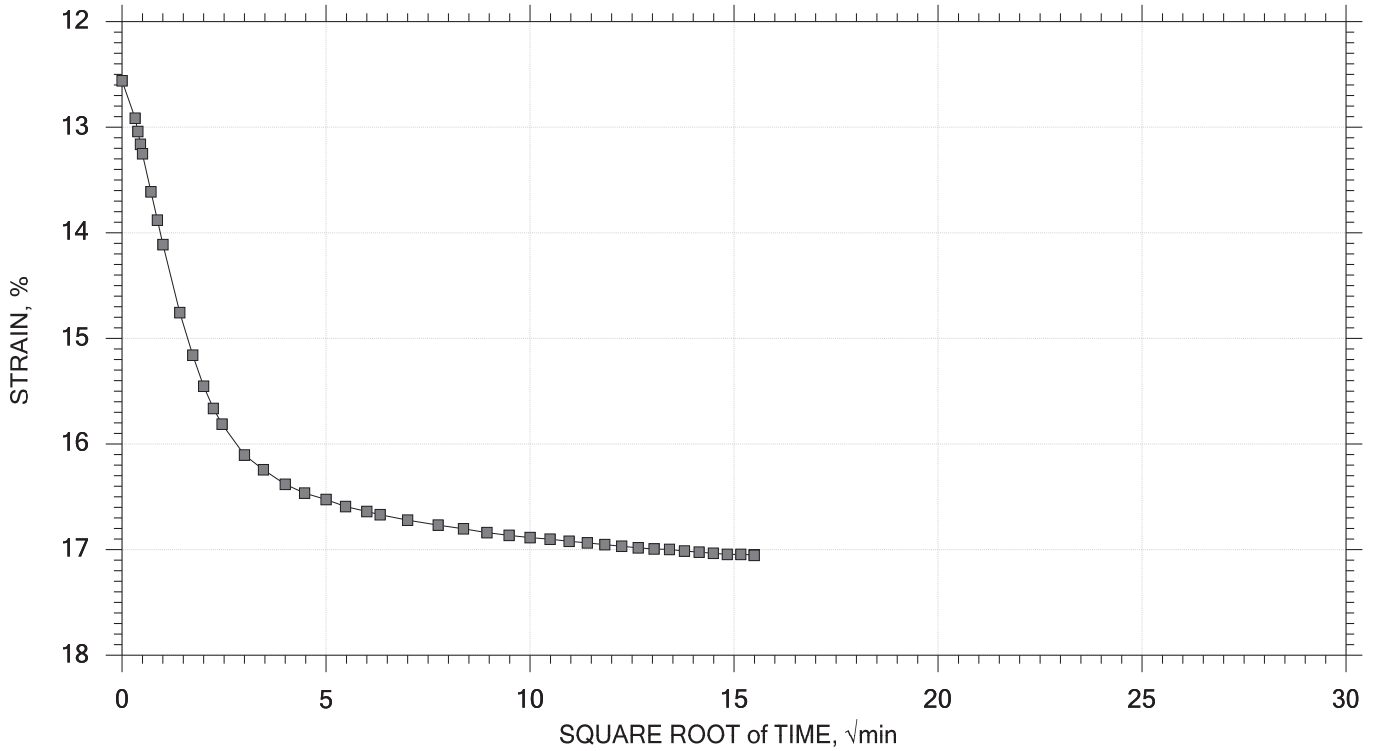
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 9

Stress: 32000 psf





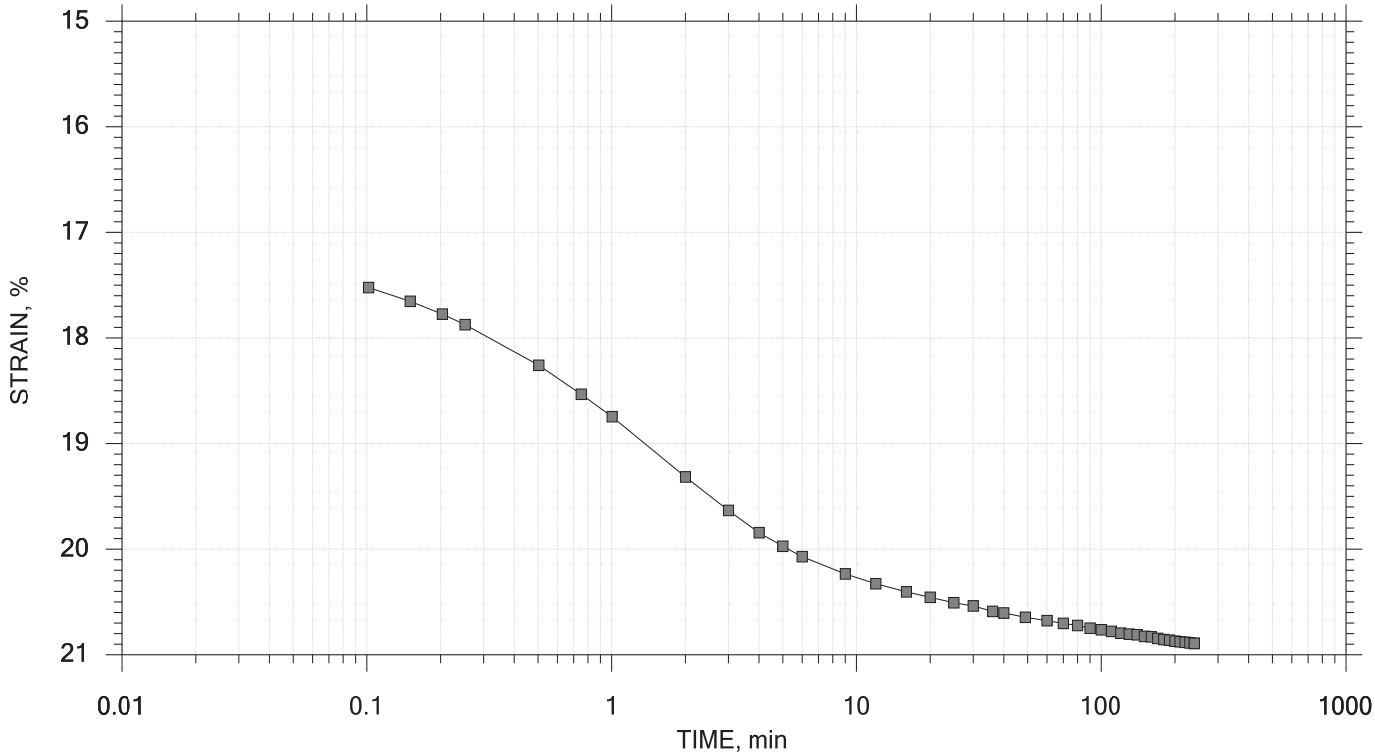
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-21-02	Tested By: md	Checked By: jdt
	Sample No.: ST-2	Test Date: 12/27/14	Test No.: IP-1A
	Depth: 15-17 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System F		

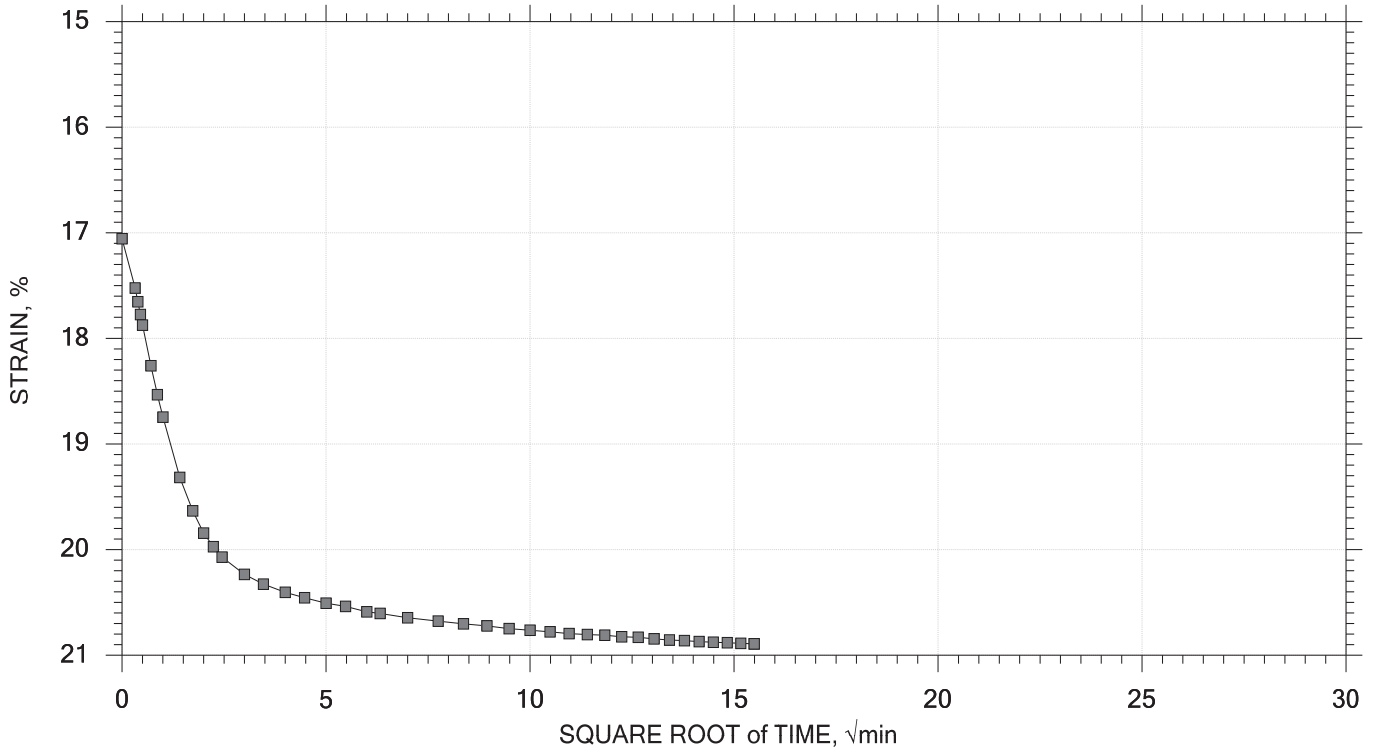
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 9

Stress: 64000 psf





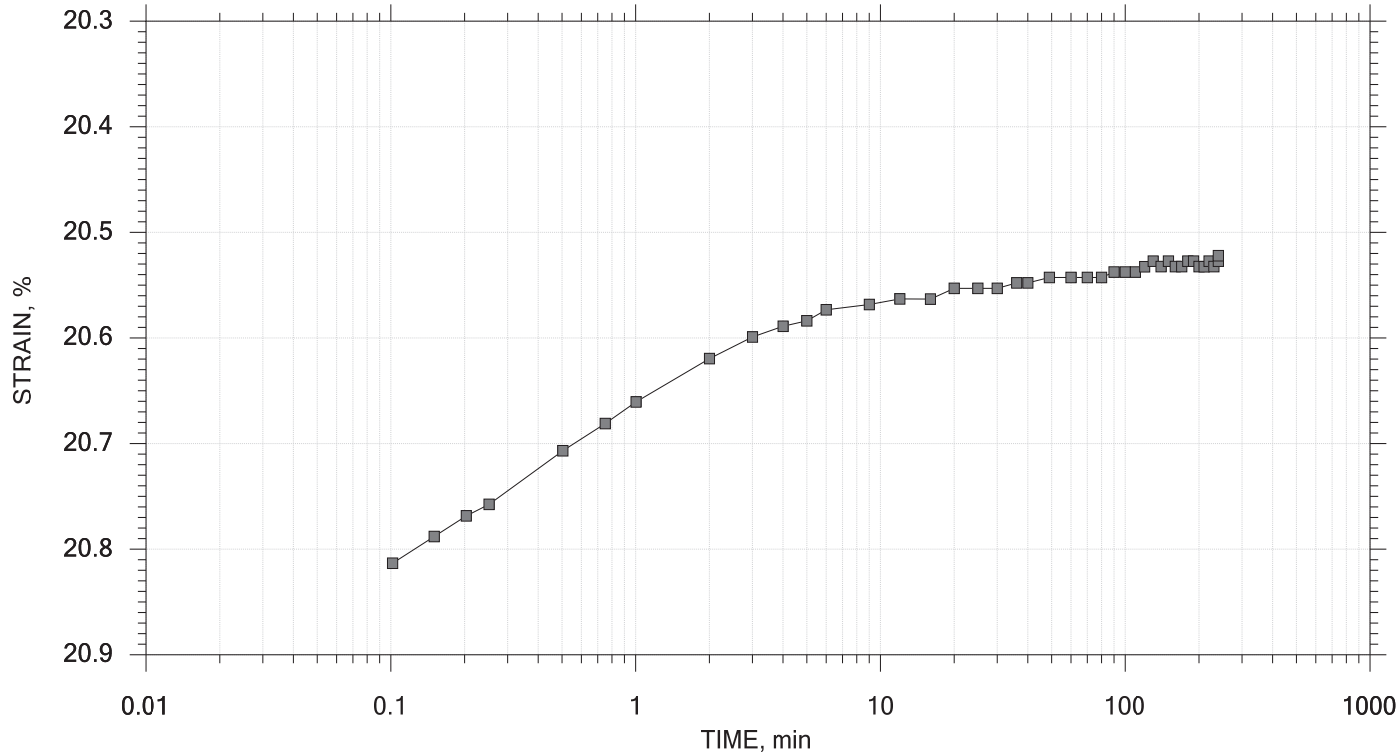
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-21-02	Tested By: md	Checked By: jdt
	Sample No.: ST-2	Test Date: 12/27/14	Test No.: IP-1A
	Depth: 15-17 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System F		

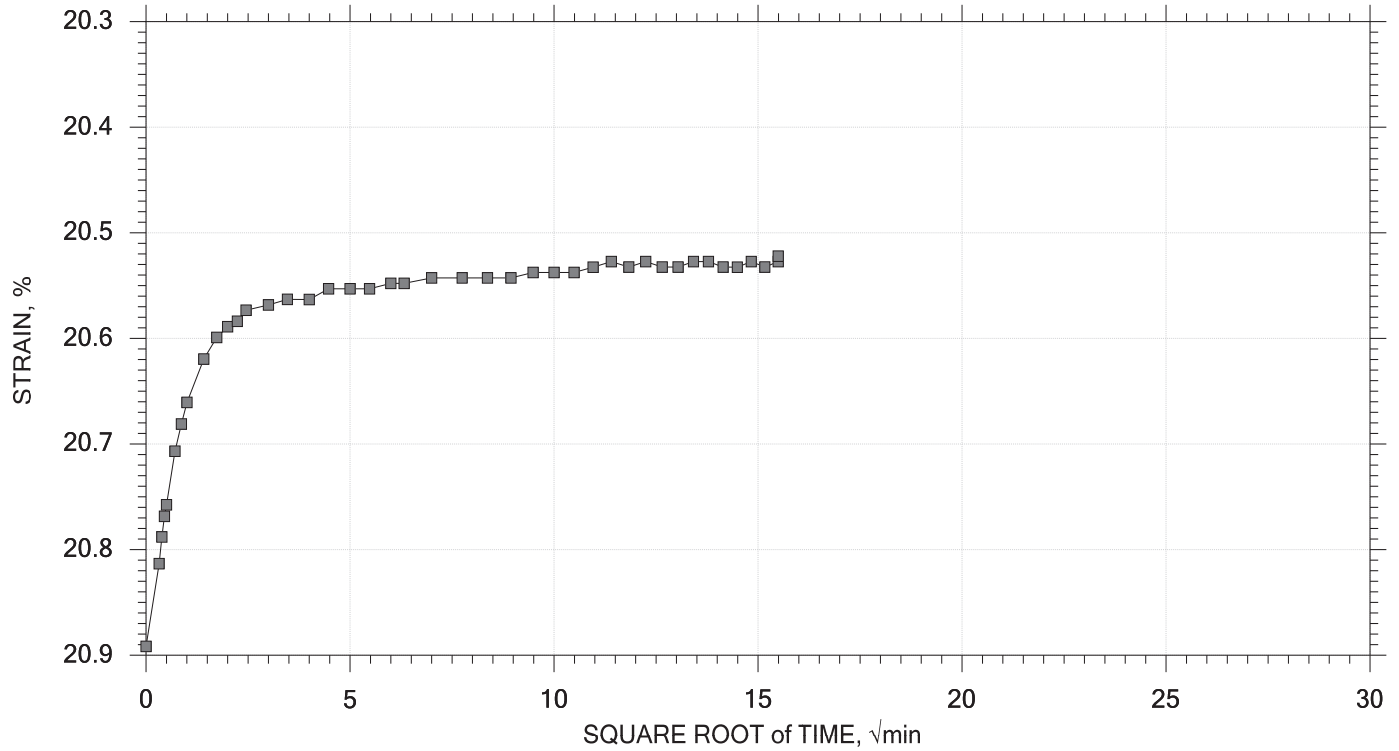
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 9

Stress: 16000 psf





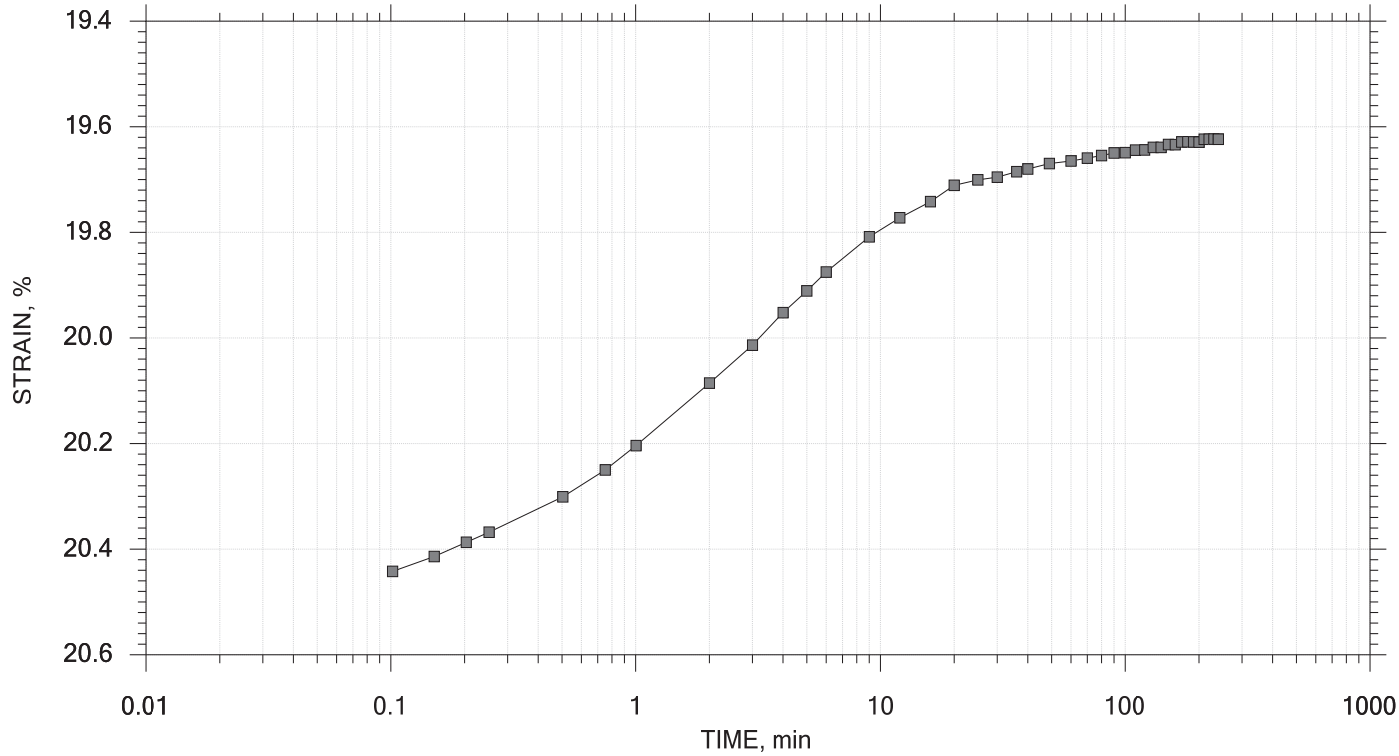
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-21-02	Tested By: md	Checked By: jdt
	Sample No.: ST-2	Test Date: 12/27/14	Test No.: IP-1A
	Depth: 15-17 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System F		

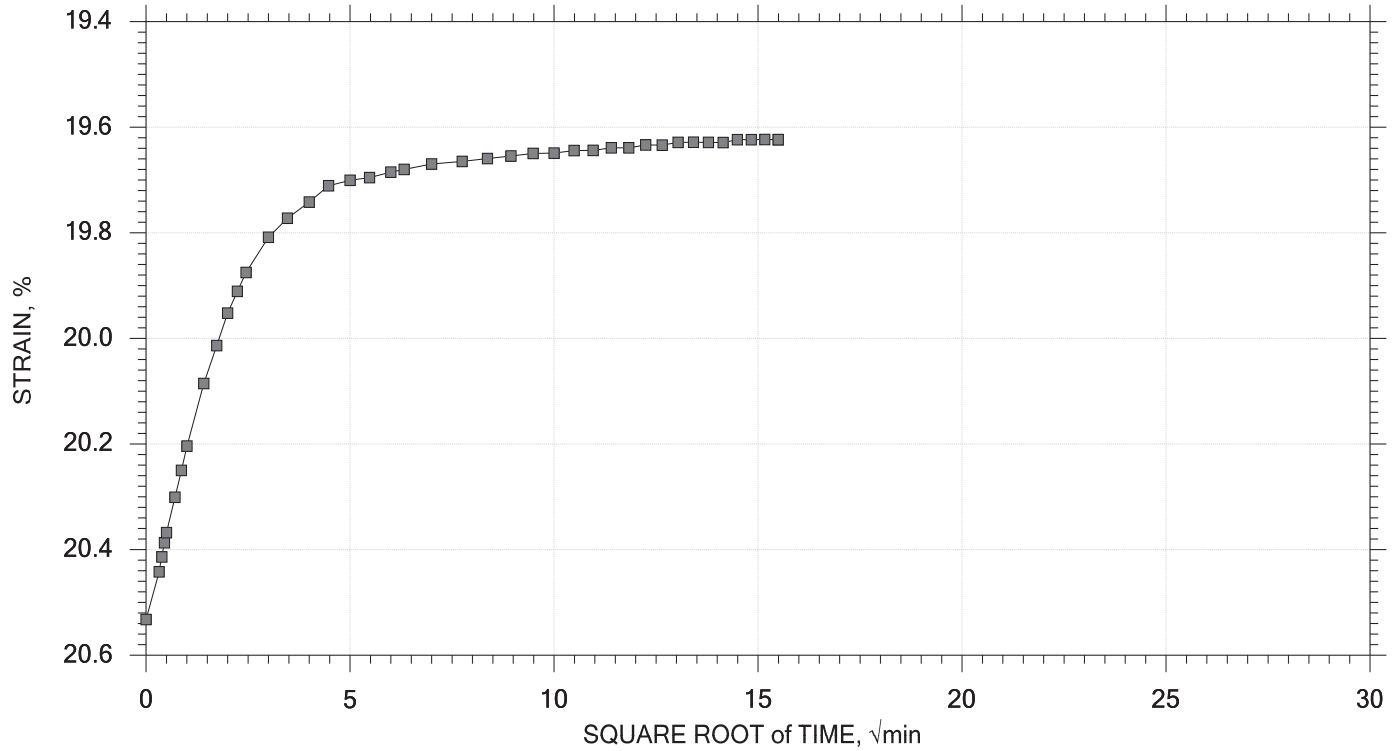
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 9

Stress: 4000 psf





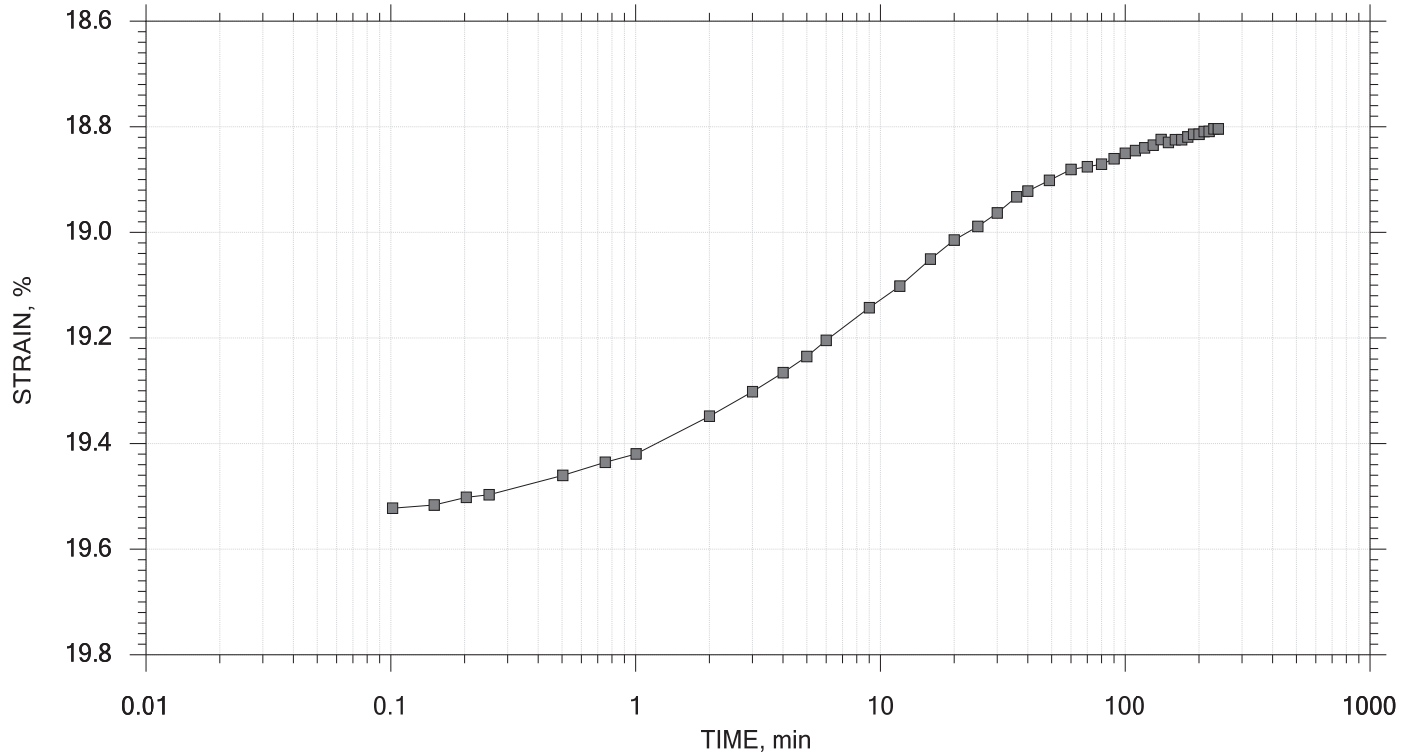
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-21-02	Tested By: md	Checked By: jdt
	Sample No.: ST-2	Test Date: 12/27/14	Test No.: IP-1A
	Depth: 15-17 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System F		

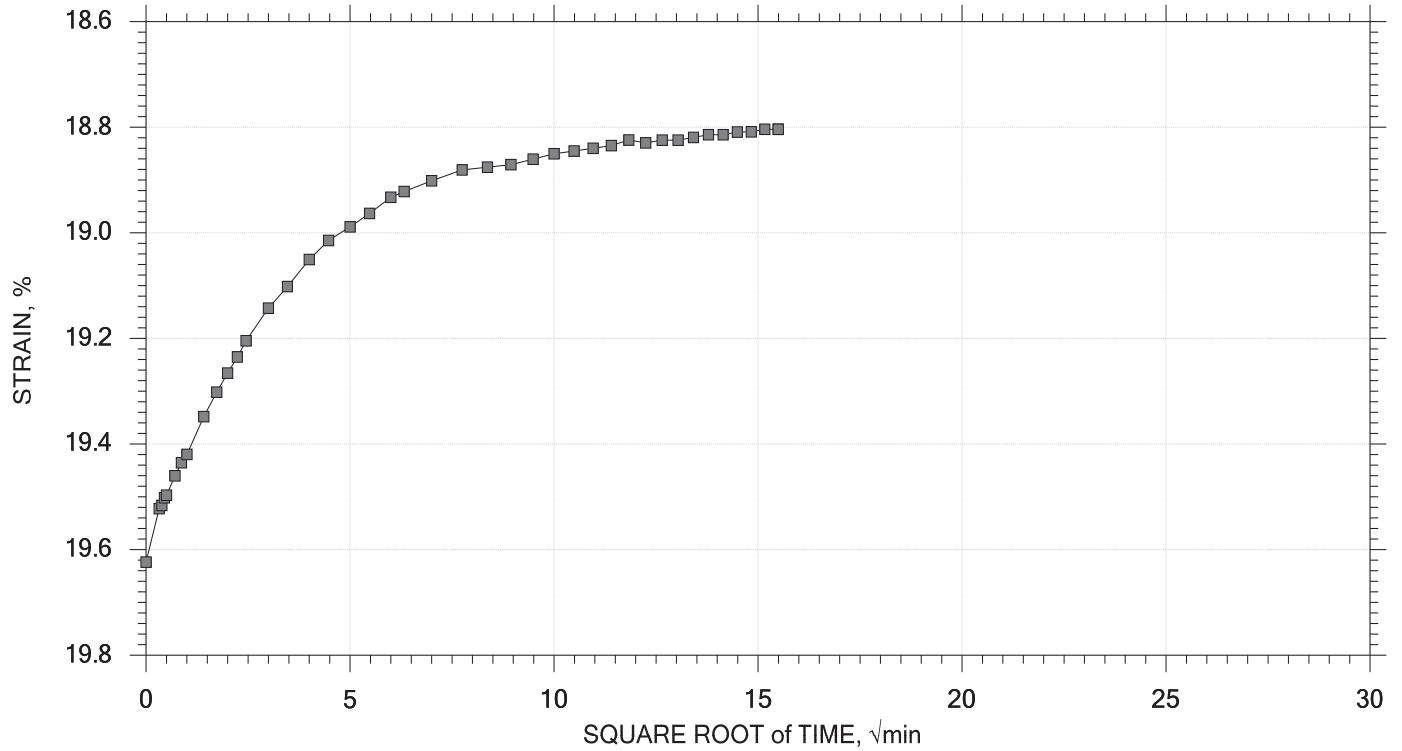
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 9

Stress: 1700 psf

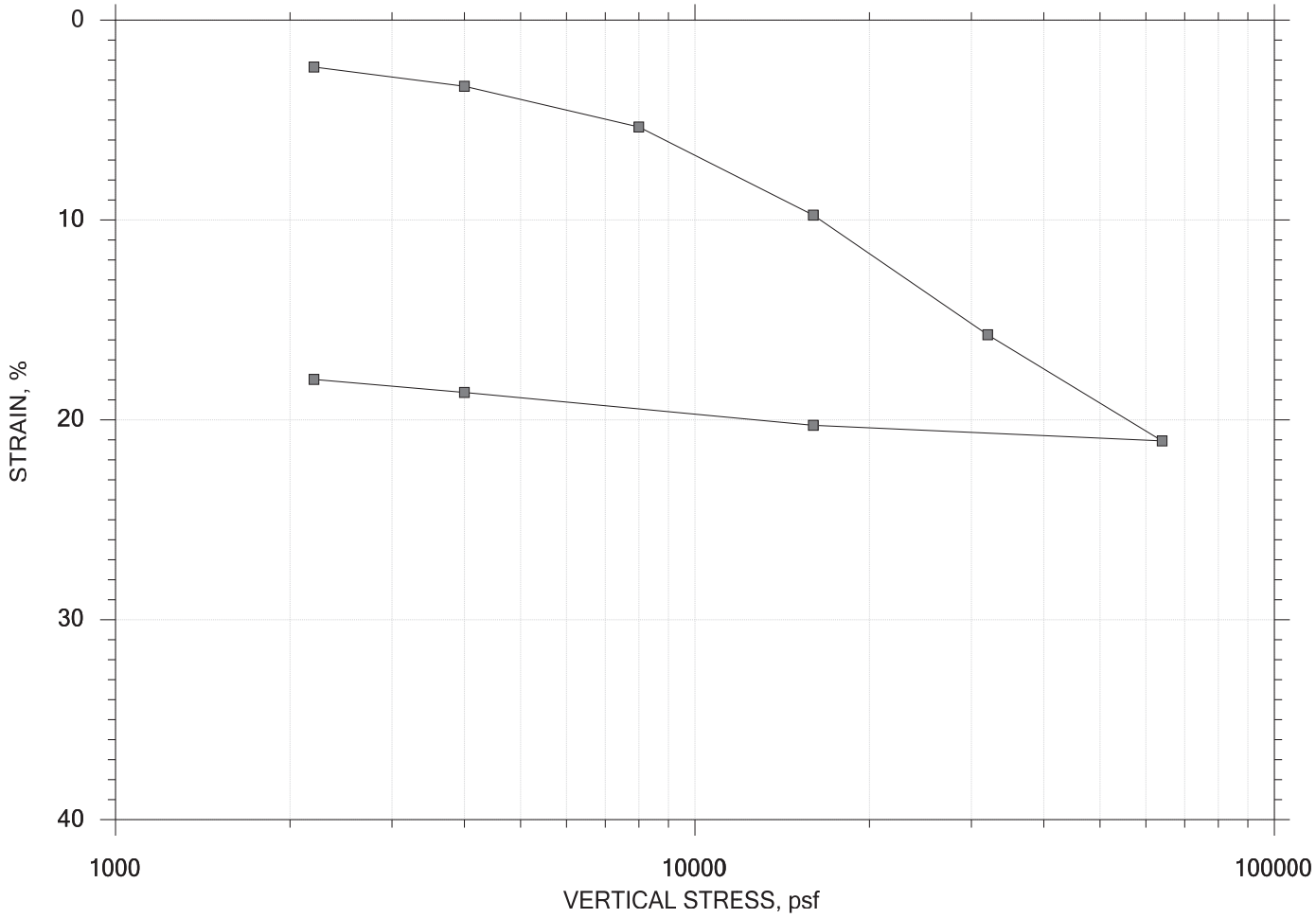


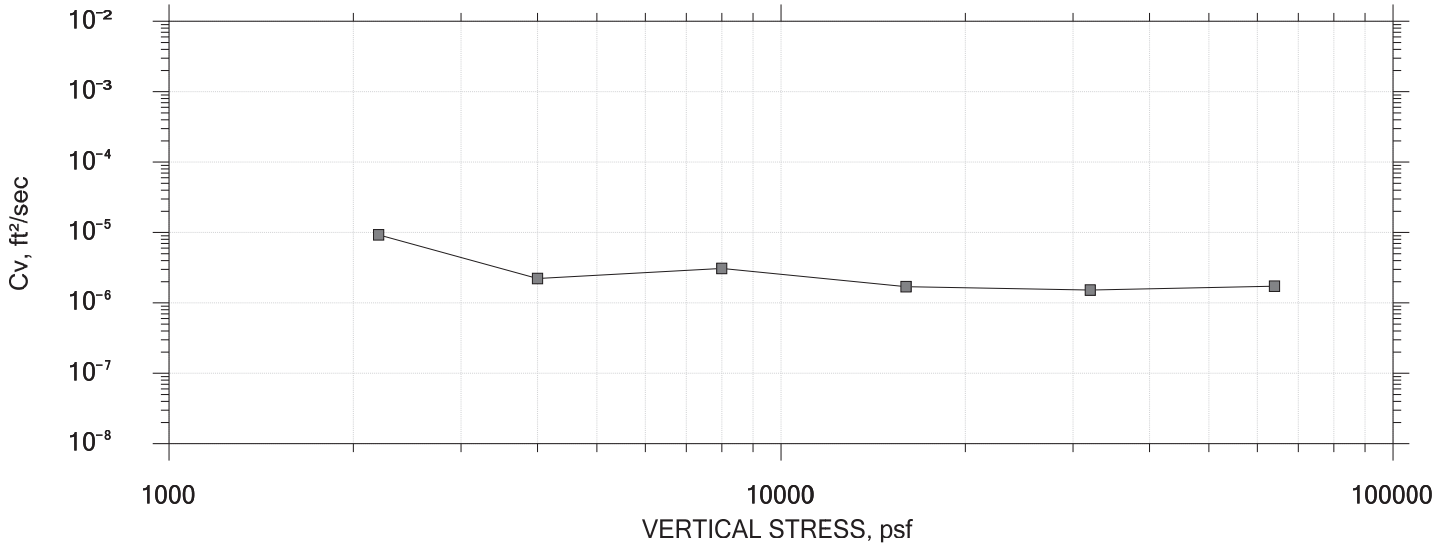


GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-21-02	Tested By: md	Checked By: jdt
	Sample No.: ST-2	Test Date: 12/27/14	Test No.: IP-1A
	Depth: 15-17 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System F		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

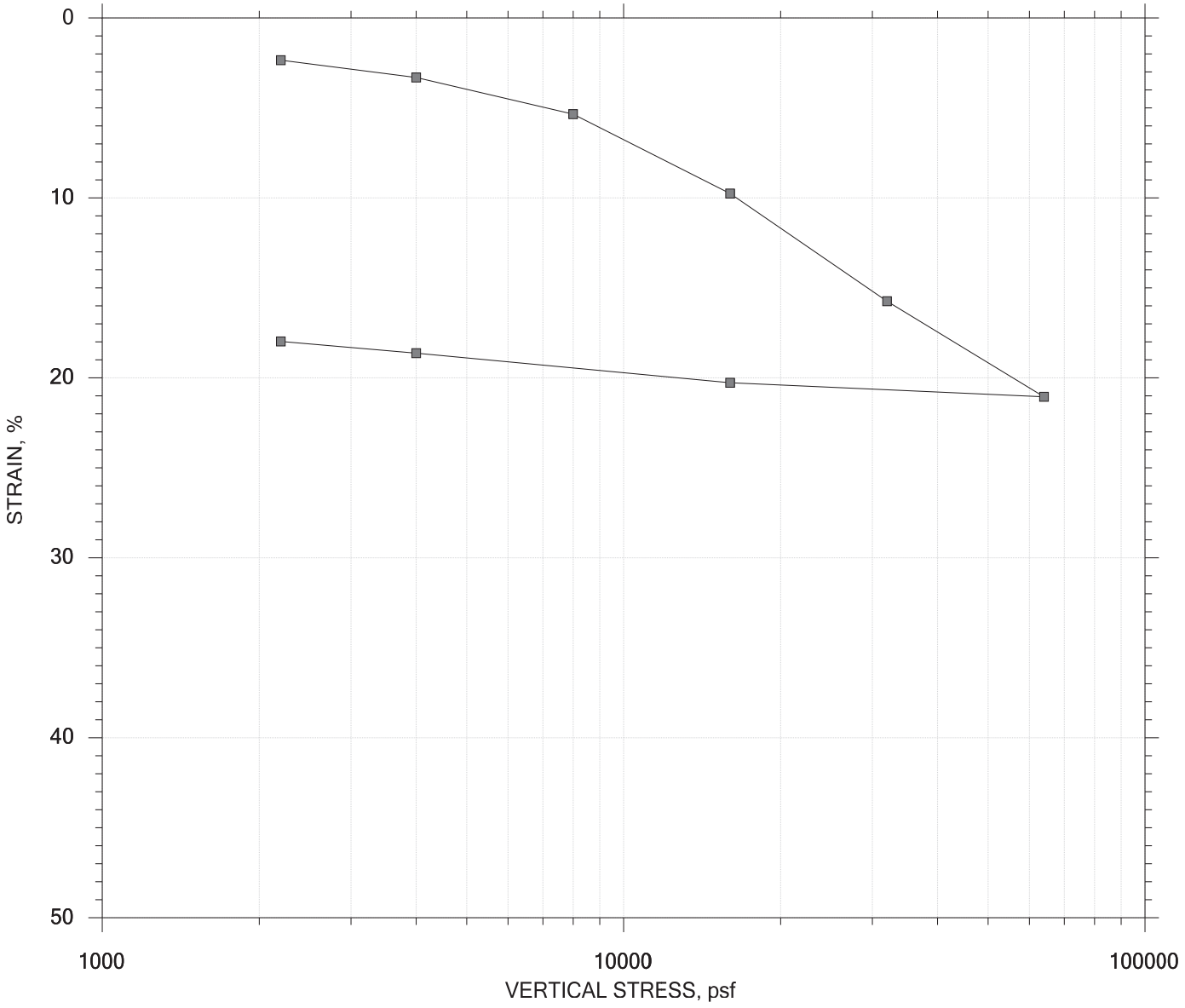




GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-4	Test Date: 12/27/14	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System Y		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



					Before Test	After Test
Current Vertical Effective Stress: ---				Water Content, %	42.61	29.43
Preconsolidation Stress: ---				Dry Unit Weight, pcf	80.258	96.696
Compression Ratio: ---				Saturation, %	99.90	100.00
Diameter: 2.5 in		Height: 1 in		Void Ratio	1.21	0.84
LL: 44	PL: 23	PI: 21	GS: 2.85			

GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-4	Test Date: 12/27/14	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System Y		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: MTA Tier 3 ORT
Boring No.: PB-46-02
Sample No.: ST-4
Test No.: IP-3

Location: Falmouth, ME
Tested By: md
Test Date: 12/27/14
Sample Type: intact

Project No.: GTX-302707
Checked By: jdt
Depth: 20-22 ft
Elevation: ---

Soil Description: Moist, olive gray clay
Remarks: System Y

Estimated Specific Gravity: 2.85
Initial Void Ratio: 1.21
Final Void Ratio: 0.838

Liquid Limit: 44
Plastic Limit: 23
Plasticity Index: 21

Specimen Diameter: 2.50 in
Initial Height: 1.00 in
Final Height: 0.83 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	14828	RING		16729
Wt. Container + Wet Soil, gm	177.09	258.74	245.11	142.74
Wt. Container + Dry Soil, gm	129.34	214.67	214.67	112.17
Wt. Container, gm	7.9200	111.26	111.26	8.3000
Wt. Dry Soil, gm	121.42	103.41	103.41	103.87
Water Content, %	39.33	42.61	29.43	29.43
Void Ratio	---	1.21	0.838	---
Degree of Saturation, %	---	99.90	100.00	---
Dry Unit Weight, pcf	---	80.258	96.696	---

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefore, values may not represent actual values for the specimen.

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: MTA Tier 3 ORT
Boring No.: PB-46-02
Sample No.: ST-4
Test No.: IP-3

Location: Falmouth, ME
Tested By: md
Test Date: 12/27/14
Sample Type: intact

Project No.: GTX-302707
Checked By: jdt
Depth: 20-22 ft
Elevation: ---

Soil Description: Moist, olive gray clay
Remarks: System Y

Displacement at End of Increment

	Applied Stress psf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/sec	Mv 1/psf	k ft/day
1	2.20e+003	0.02344	1.16	2.34	3.274	7.32e-006	1.07e-005	4.21e-004
2	4.00e+003	0.03307	1.14	3.31	7.189	3.22e-006	5.35e-006	9.30e-005
3	8.00e+003	0.05341	1.10	5.34	8.867	2.53e-006	5.09e-006	6.95e-005
4	1.60e+004	0.09755	0.998	9.76	13.738	1.53e-006	5.52e-006	4.54e-005
5	3.20e+004	0.1574	0.866	15.7	13.488	1.38e-006	3.74e-006	2.79e-005
6	6.40e+004	0.2105	0.748	21.0	9.863	1.66e-006	1.66e-006	1.48e-005
7	1.60e+004	0.2027	0.765	20.3	8.492	1.82e-006	1.61e-007	1.58e-006
8	4.00e+003	0.1863	0.802	18.6	41.774	3.81e-007	1.37e-006	2.82e-006
9	2.20e+003	0.1797	0.816	18.0	83.685	1.96e-007	3.64e-006	3.84e-006

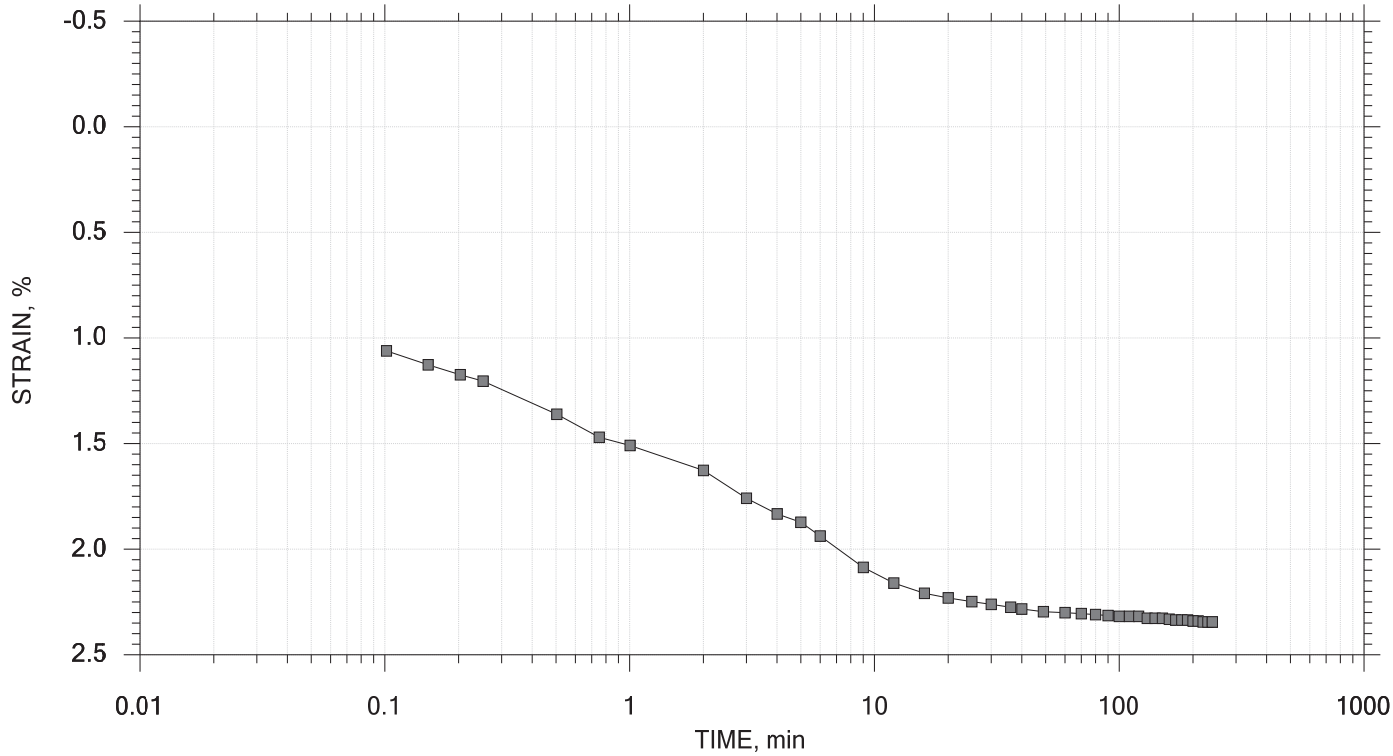
	Applied Stress psf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/sec	Mv 1/psf	k ft/day	Ca %
1	2.20e+003	0.02344	1.16	2.34	0.000	0.00e+000	1.07e-005	0.00e+000	0.00e+000
2	4.00e+003	0.03307	1.14	3.31	2.685	2.00e-006	5.35e-006	5.78e-005	0.00e+000
3	8.00e+003	0.05341	1.10	5.34	1.497	3.49e-006	5.09e-006	9.56e-005	0.00e+000
4	1.60e+004	0.09755	0.998	9.76	2.725	1.79e-006	5.52e-006	5.32e-005	0.00e+000
5	3.20e+004	0.1574	0.866	15.7	2.794	1.55e-006	3.74e-006	3.13e-005	0.00e+000
6	6.40e+004	0.2105	0.748	21.0	2.286	1.66e-006	1.66e-006	1.49e-005	0.00e+000
7	1.60e+004	0.2027	0.765	20.3	0.000	0.00e+000	1.61e-007	0.00e+000	0.00e+000
8	4.00e+003	0.1863	0.802	18.6	6.358	5.82e-007	1.37e-006	4.30e-006	0.00e+000
9	2.20e+003	0.1797	0.816	18.0	0.000	0.00e+000	3.64e-006	0.00e+000	0.00e+000

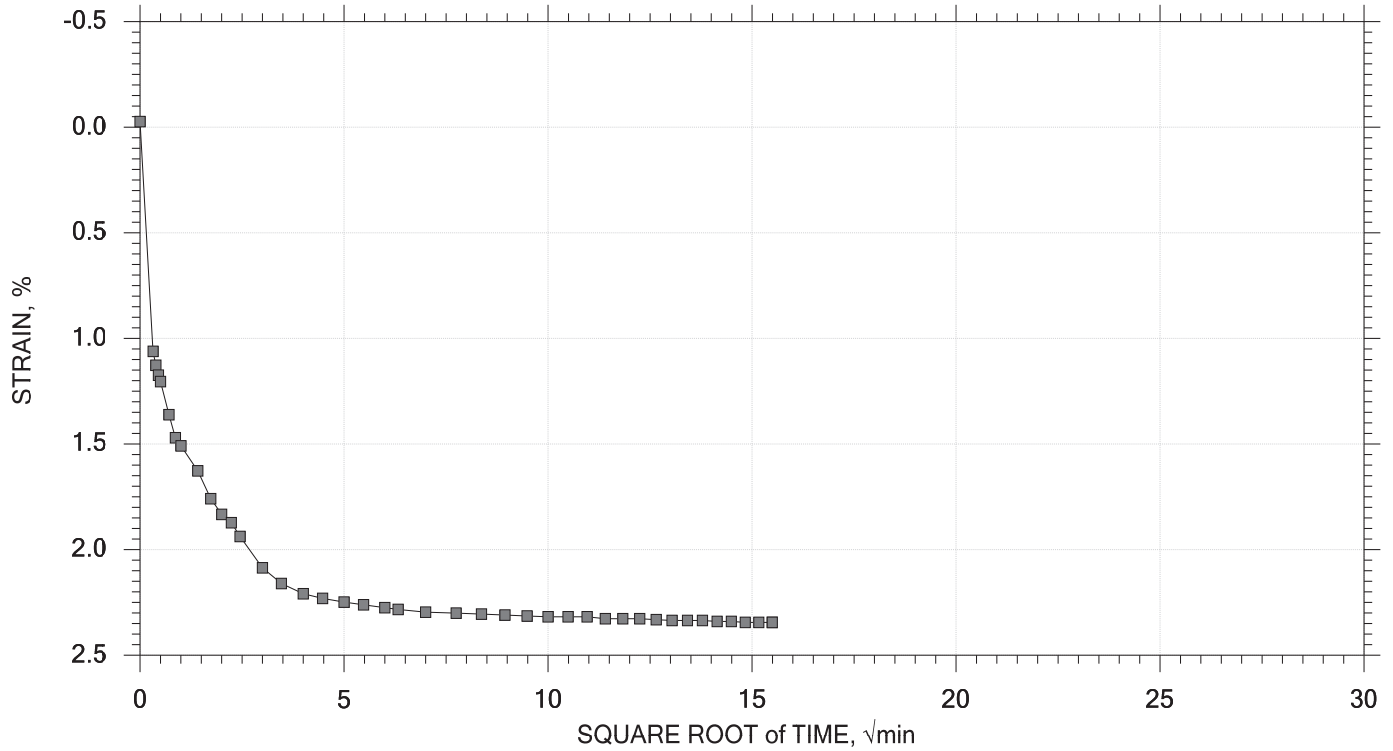
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 1 of 9

Stress: 2200 psf





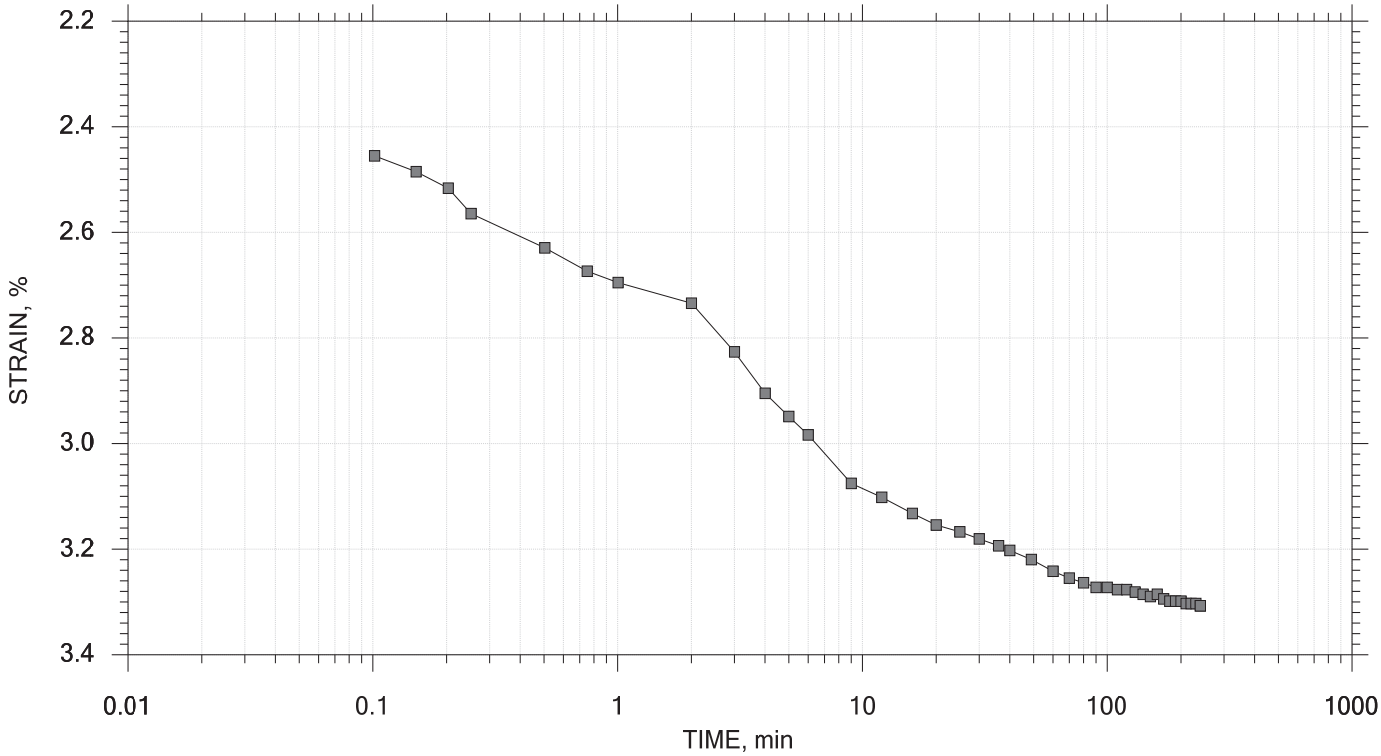
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-4	Test Date: 12/27/14	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System Y		

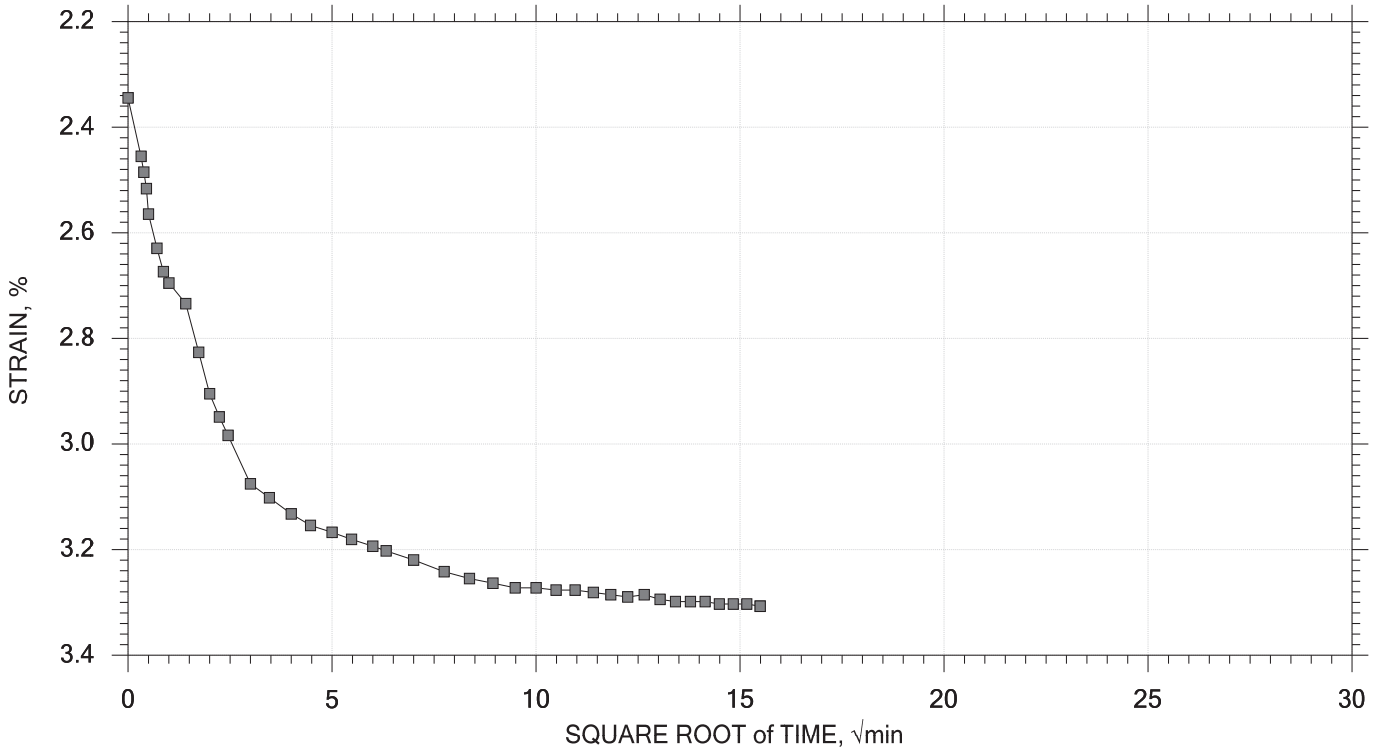
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 9

Stress: 4000 psf





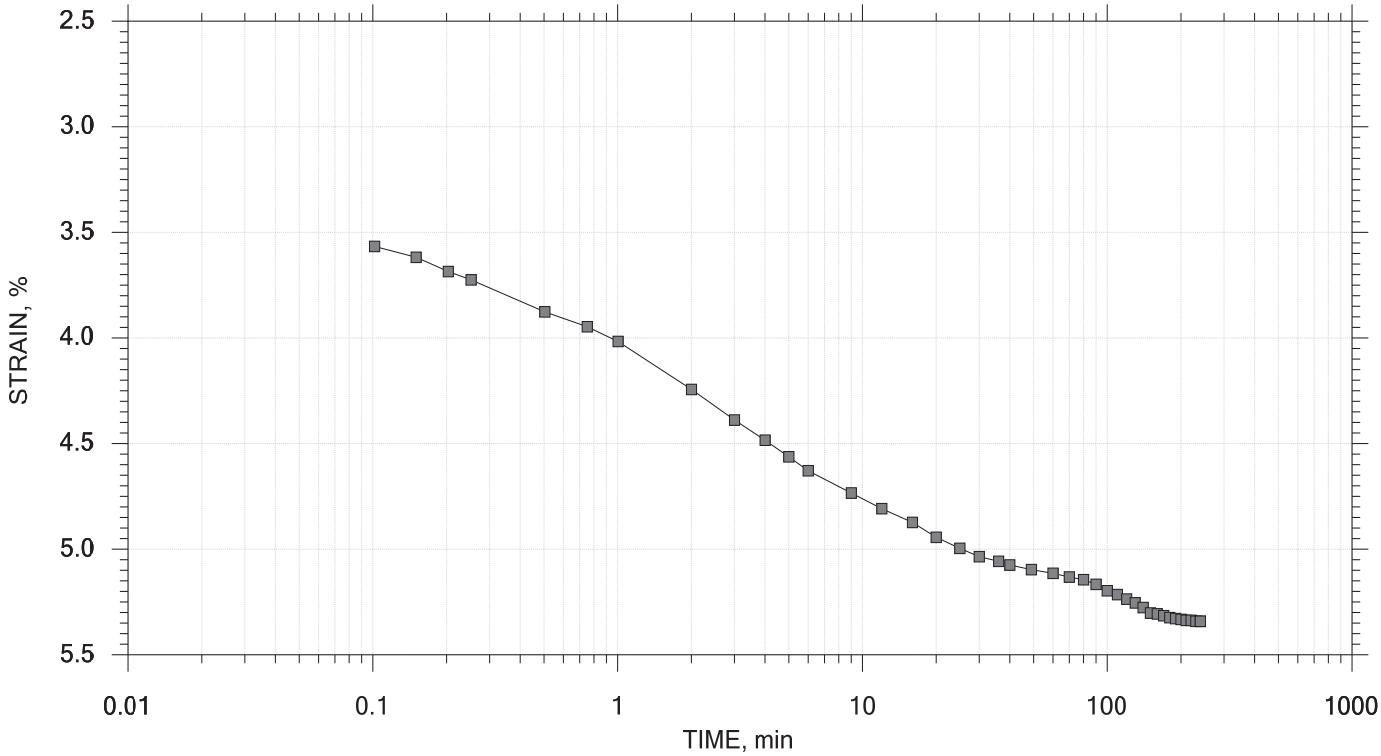
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-4	Test Date: 12/27/14	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System Y		

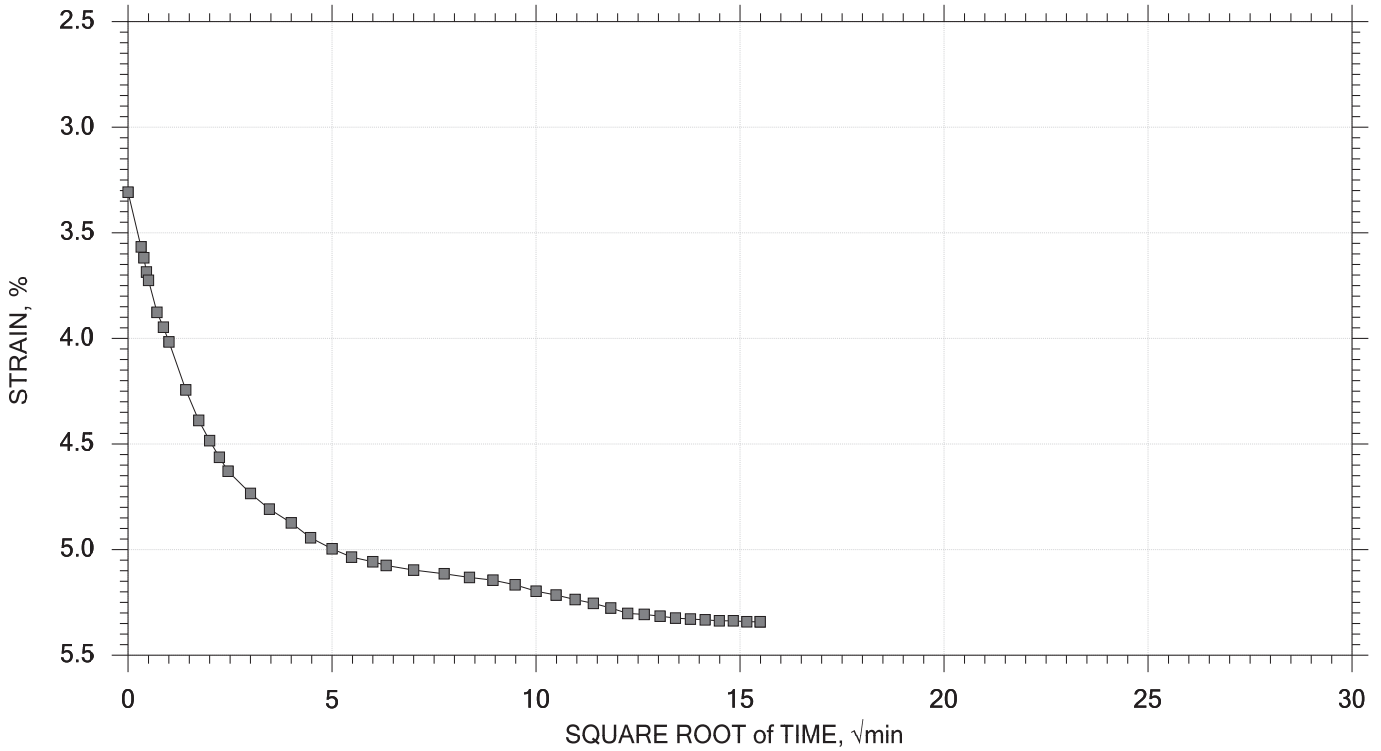
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 9

Stress: 8000 psf





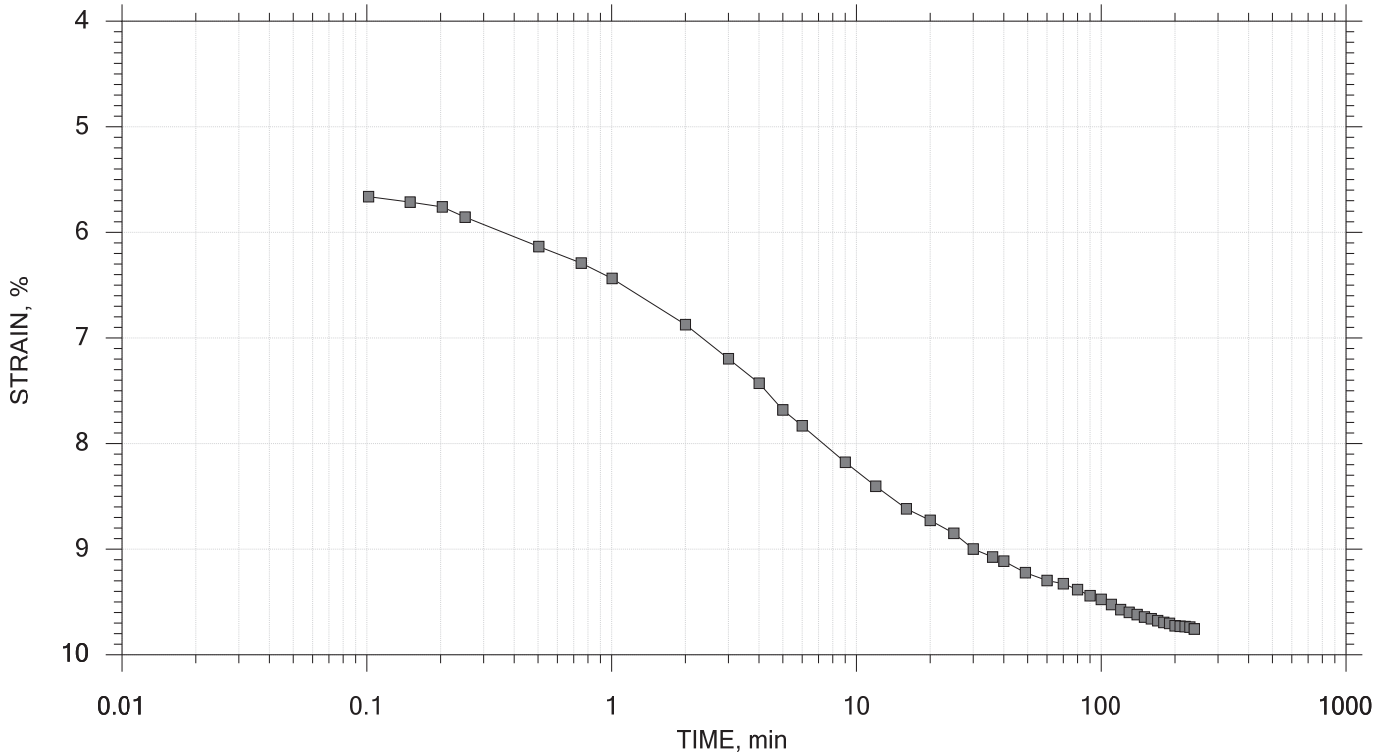
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-4	Test Date: 12/27/14	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System Y		

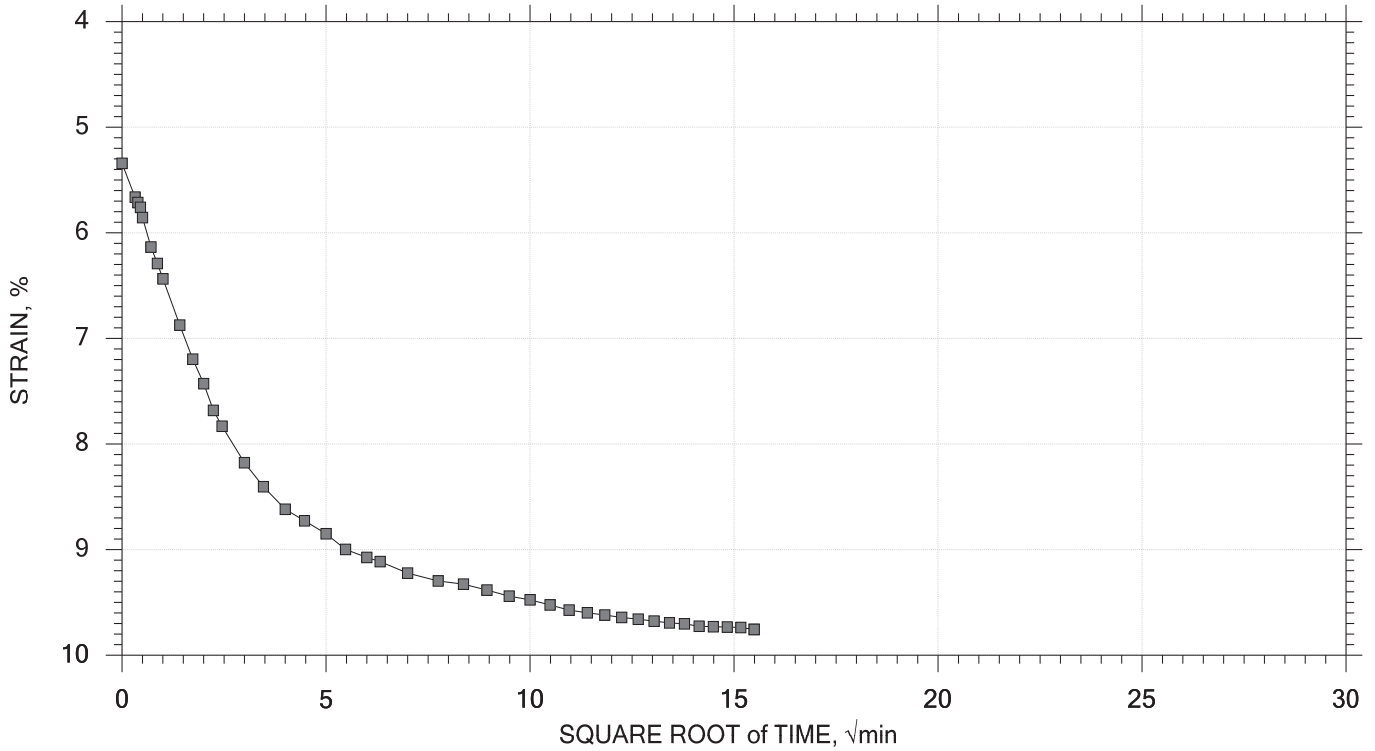
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 9

Stress: 16000 psf





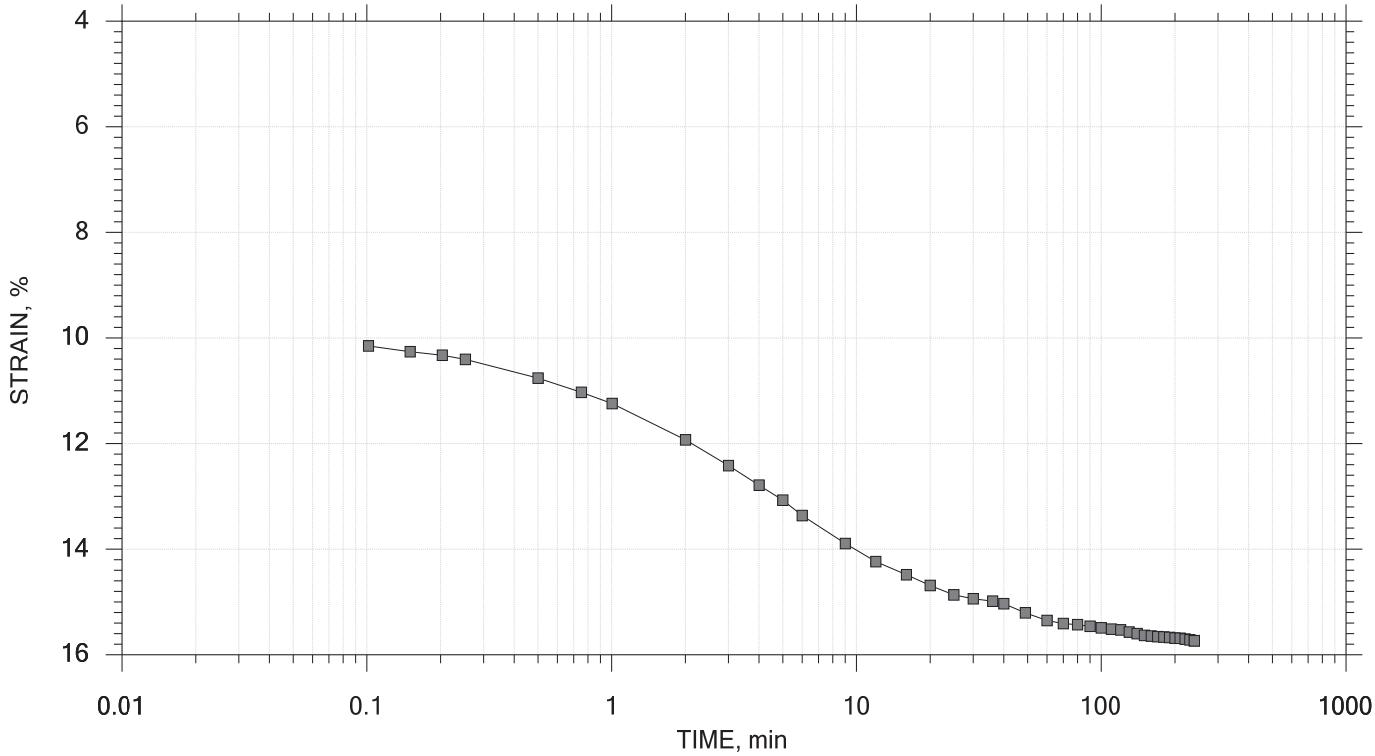
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-4	Test Date: 12/27/14	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System Y		

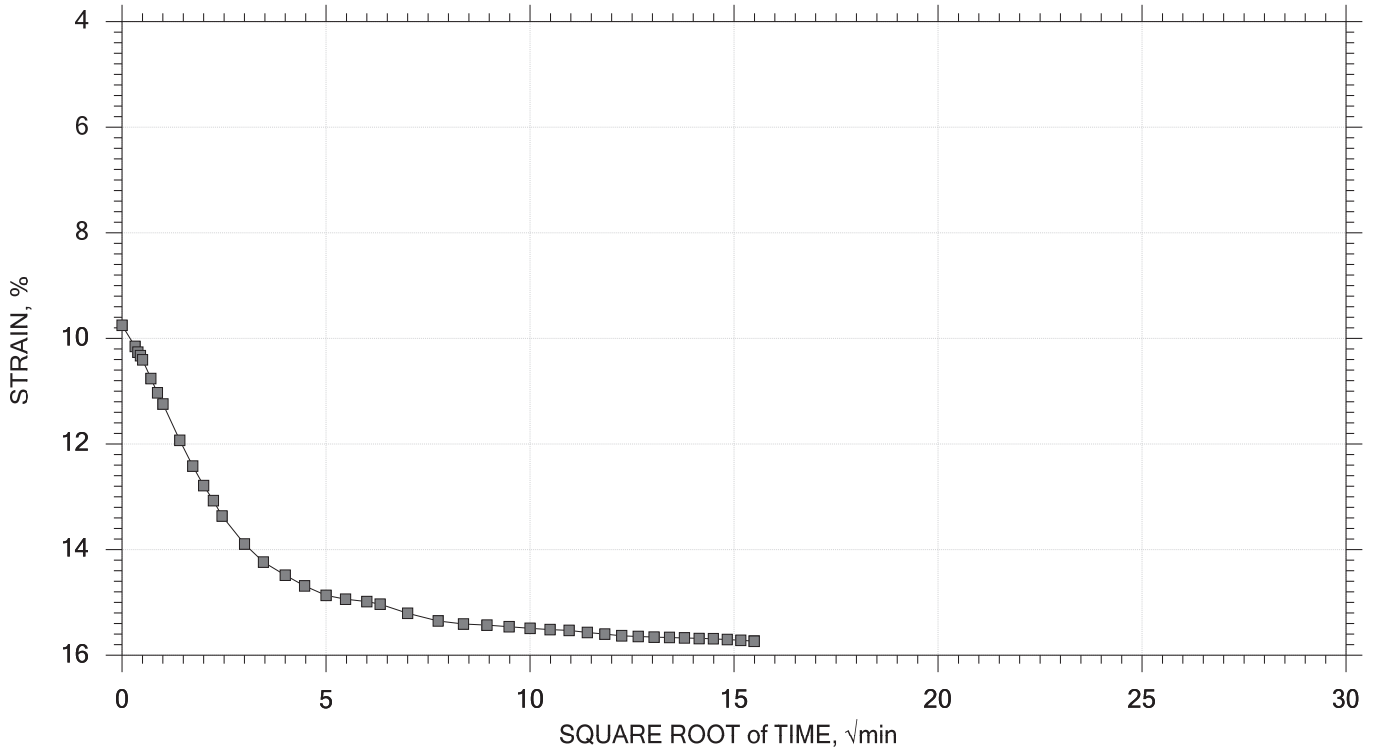
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 9

Stress: 32000 psf





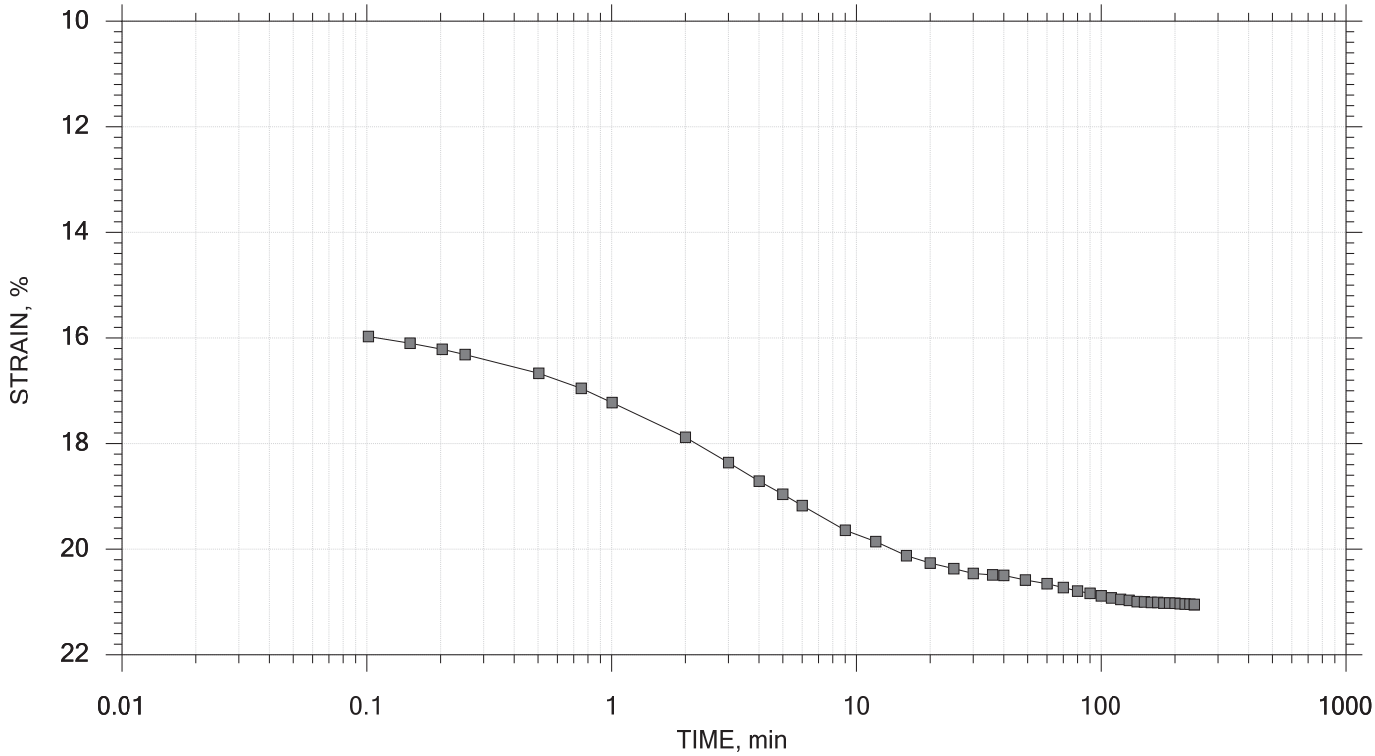
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-4	Test Date: 12/27/14	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System Y		

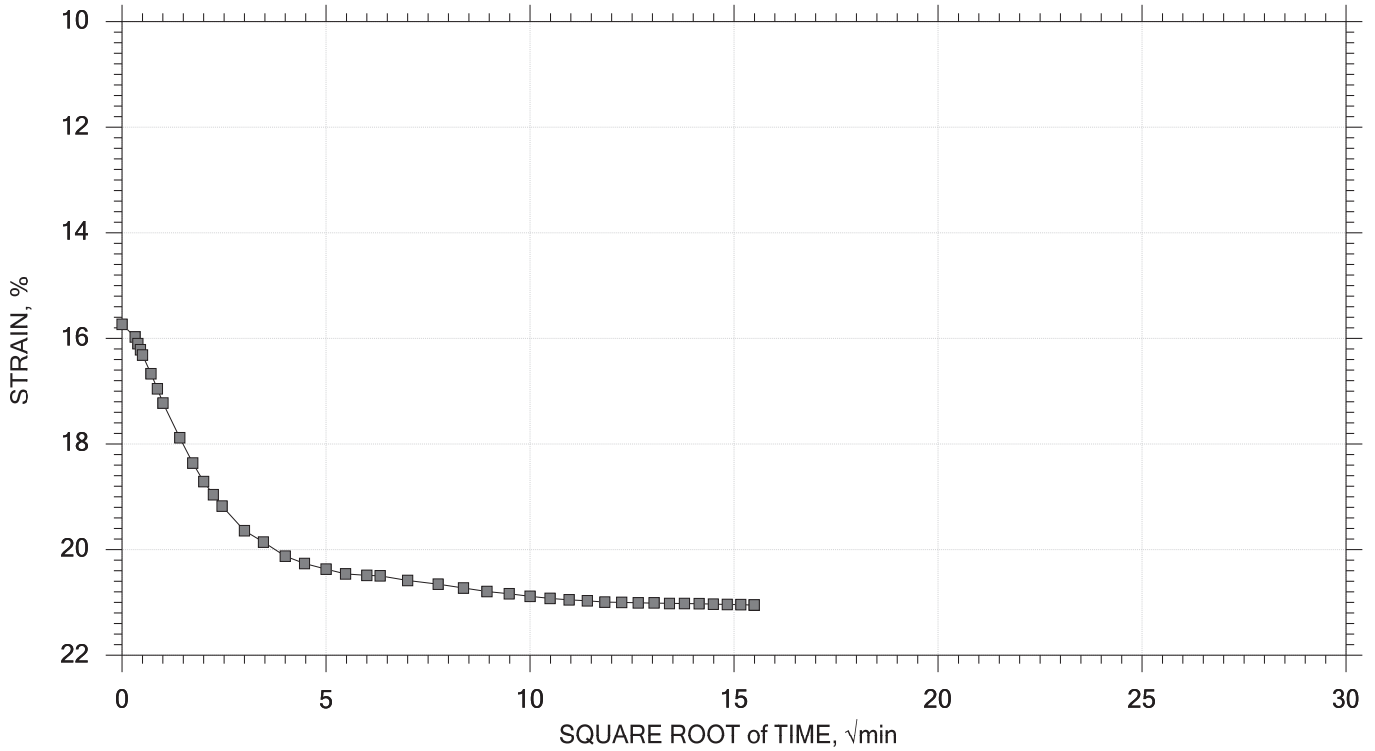
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 9

Stress: 64000 psf





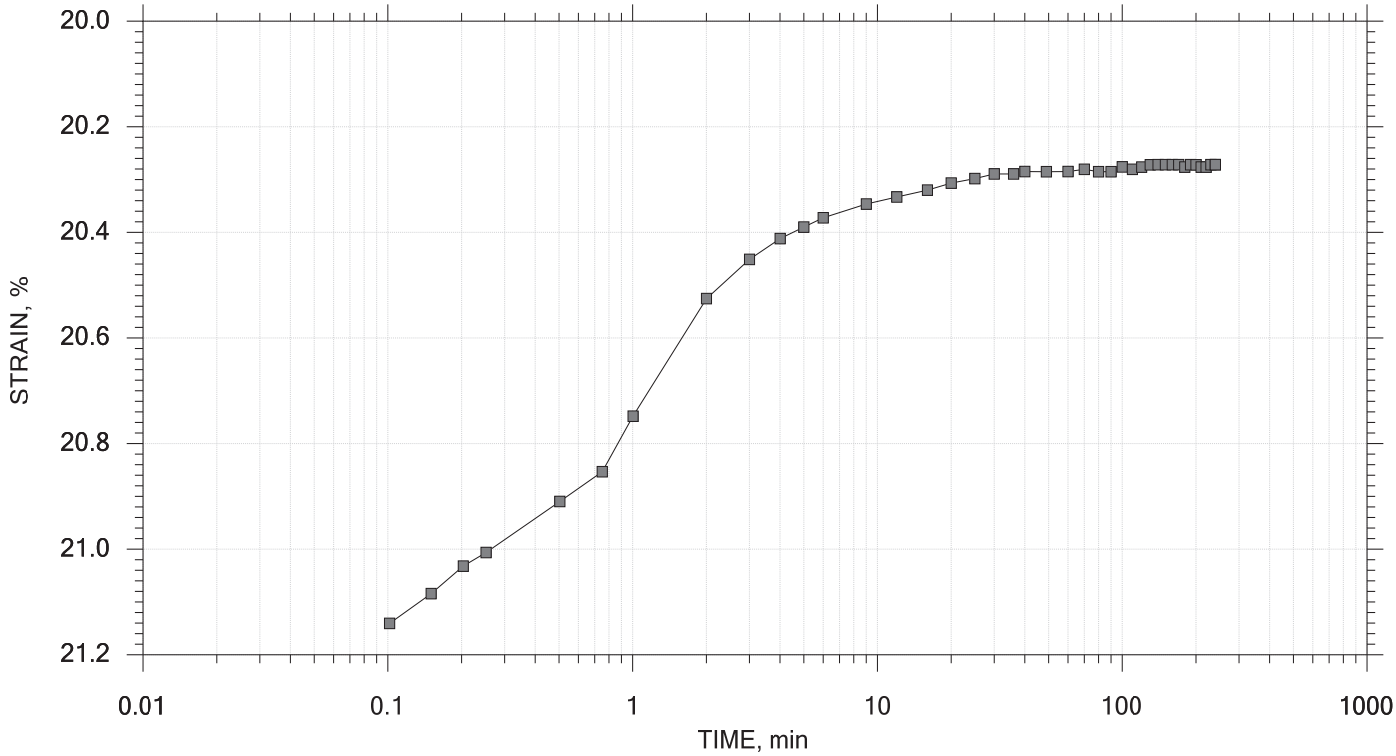
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-4	Test Date: 12/27/14	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System Y		

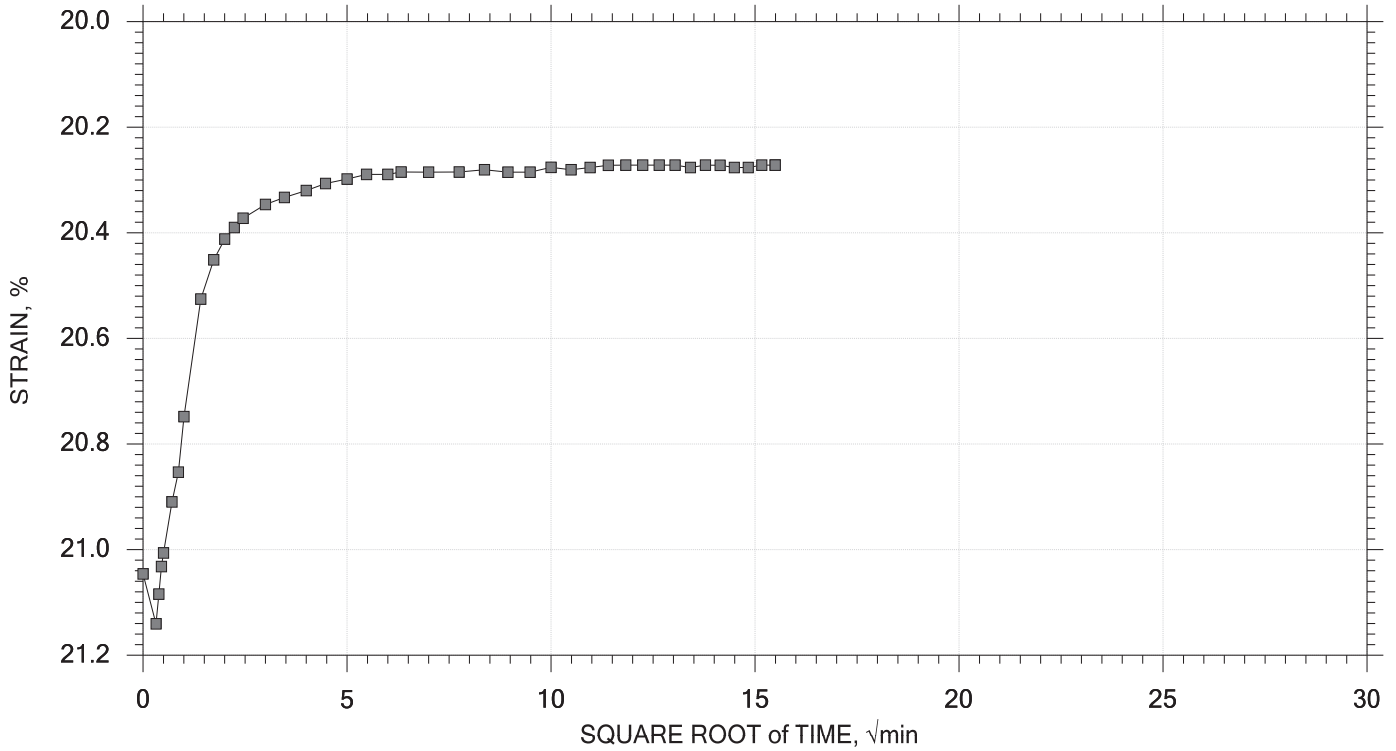
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 9

Stress: 16000 psf





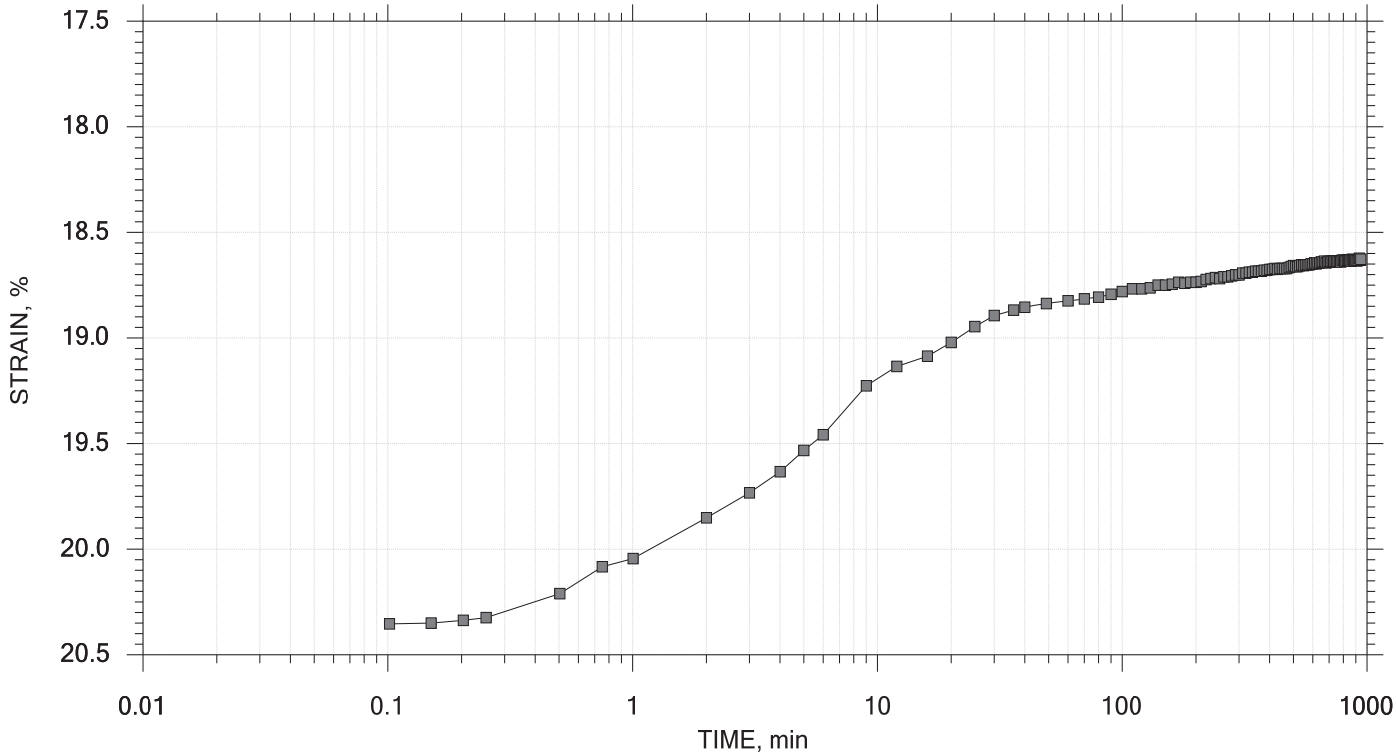
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-4	Test Date: 12/27/14	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System Y		

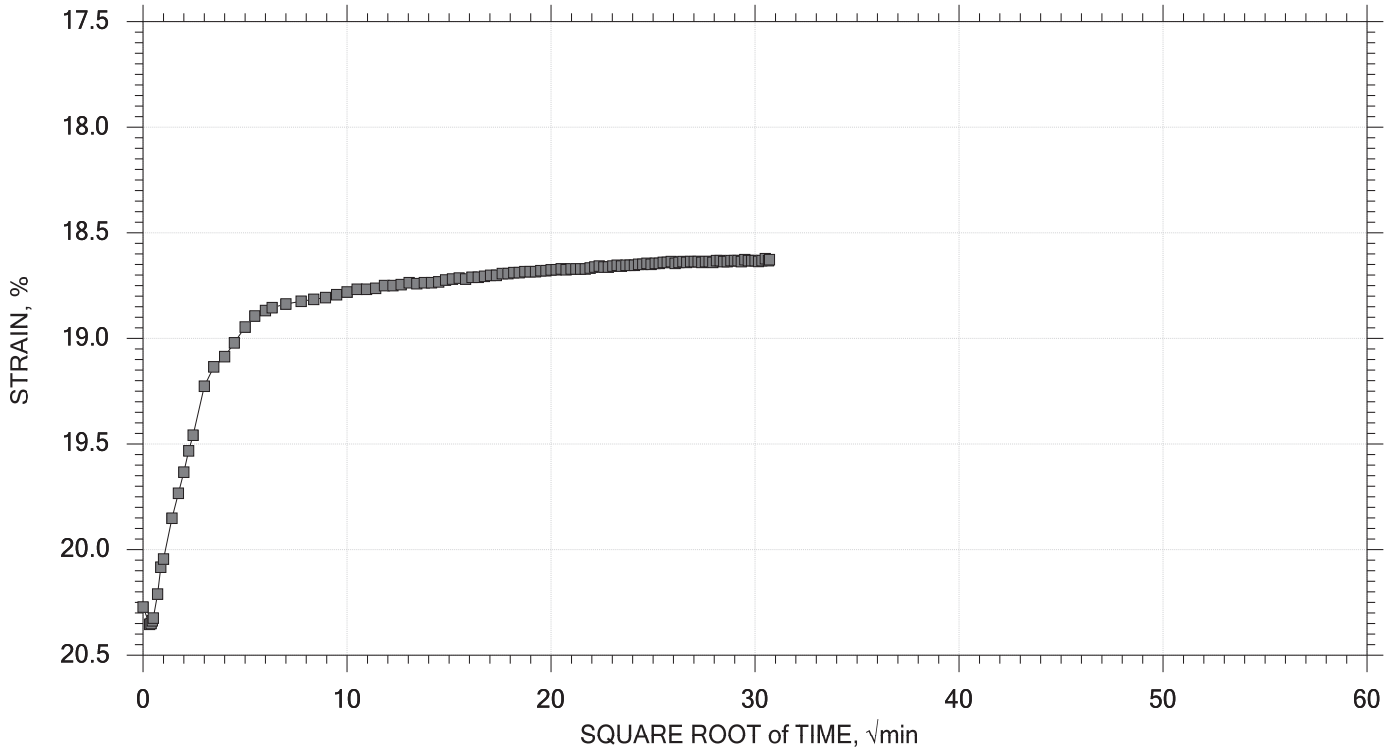
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 9

Stress: 4000 psf





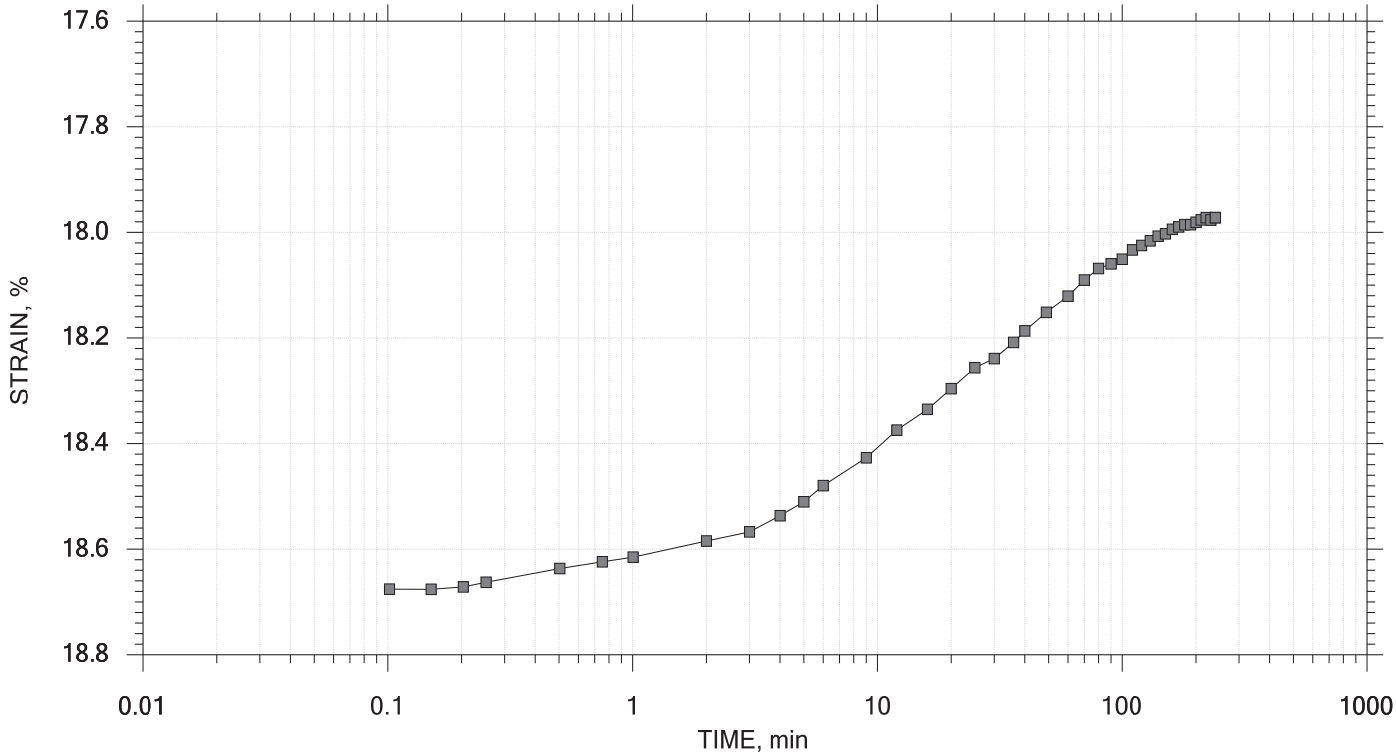
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-4	Test Date: 12/27/14	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System Y		

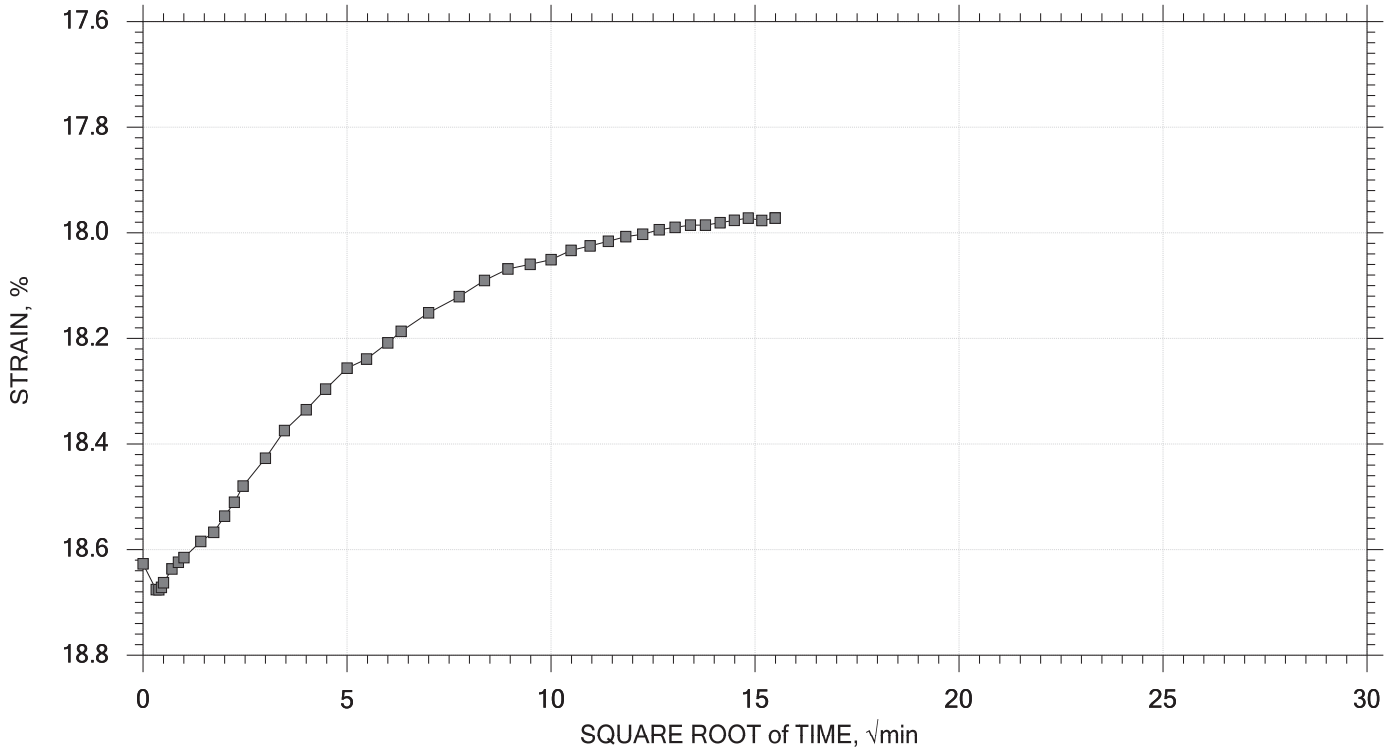
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 9

Stress: 2200 psf

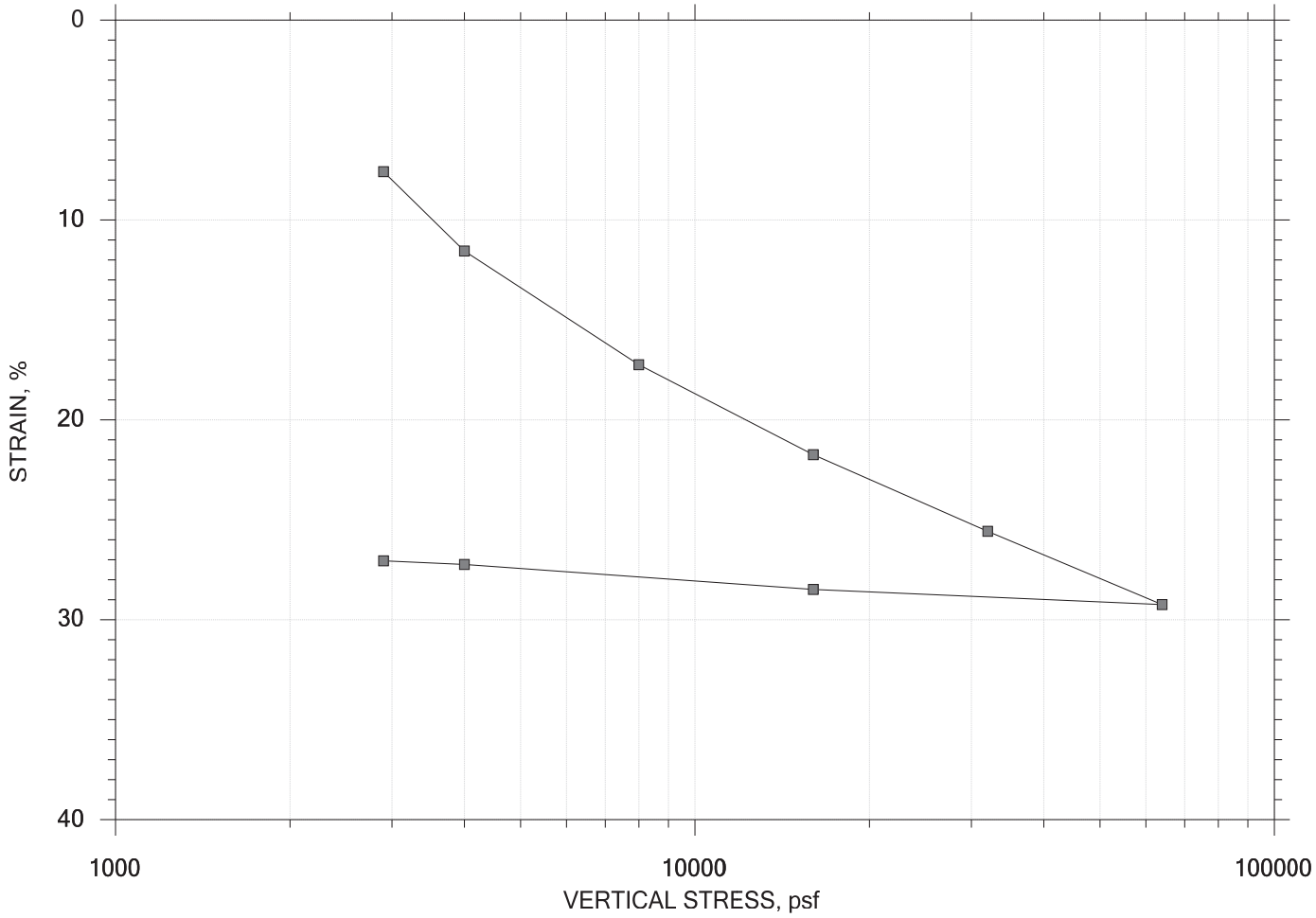


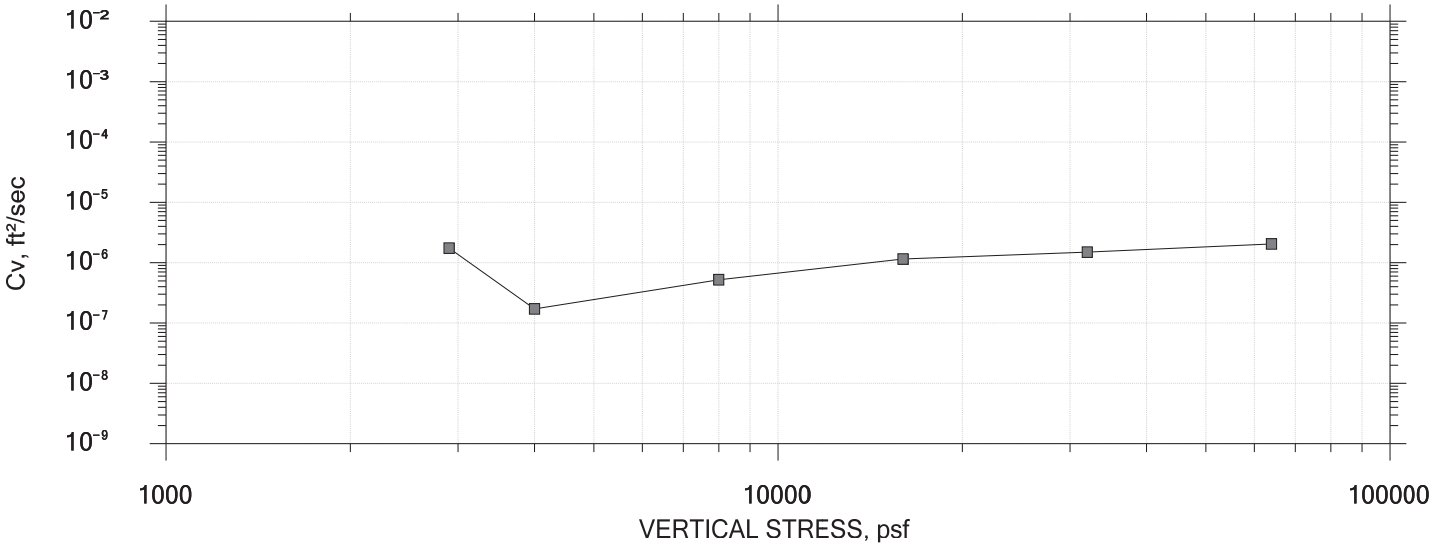


GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-4	Test Date: 12/27/14	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System Y		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

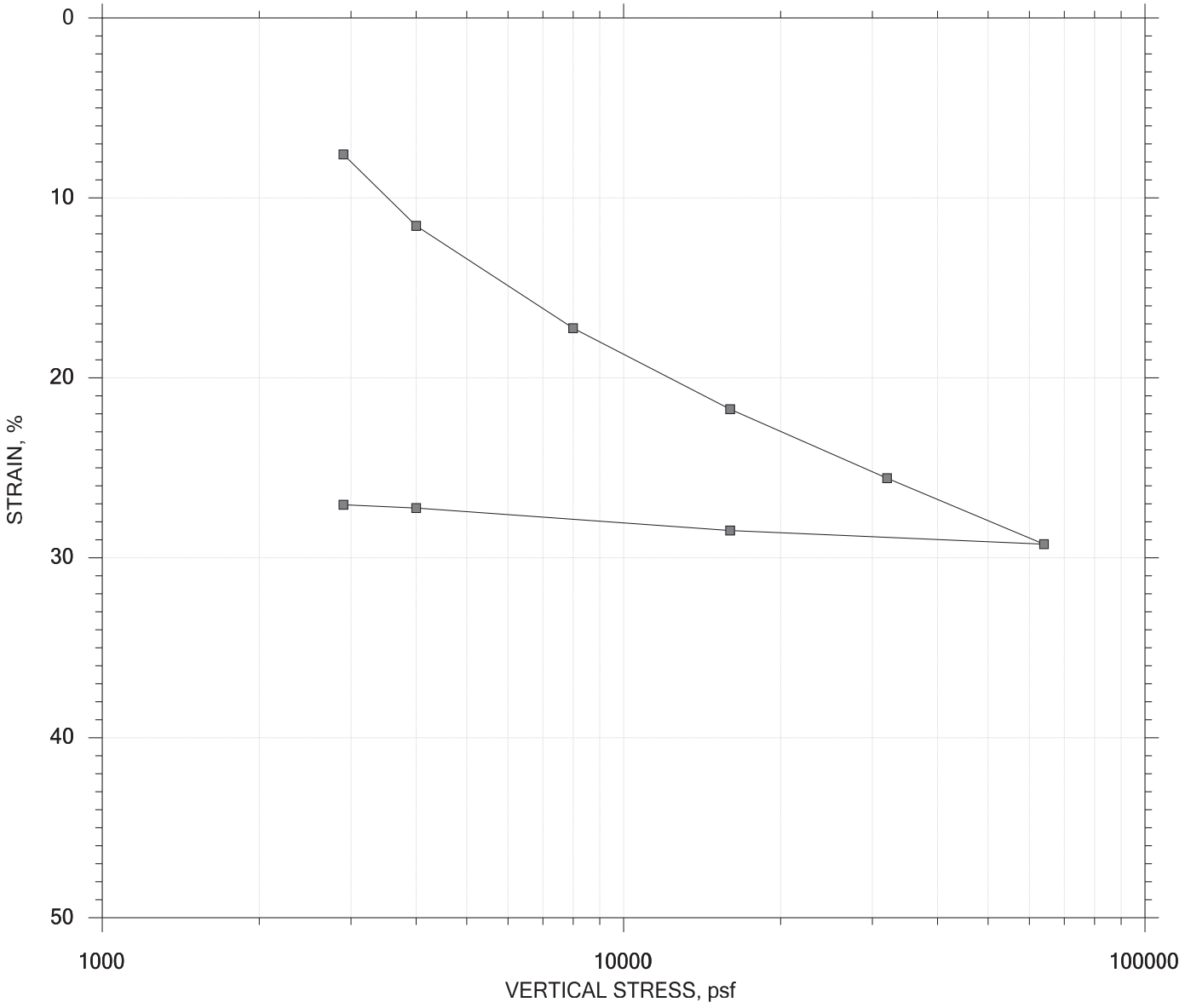




GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-6	Test Date: 12/27/14	Test No.: IP-2
	Depth: 27-29 ft	Sample Type: intact	Elevation: ---
	Description: Moist, dark olive gray clay		
	Remarks: System R		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



					Before Test	After Test
Current Vertical Effective Stress: ---				Water Content, %	47.18	24.36
Preconsolidation Stress: ---				Dry Unit Weight, pcf	75.422	104.75
Compression Ratio: ---				Saturation, %	99.24	100.00
Diameter: 2.5 in		Height: 1 in		Void Ratio	1.35	0.69
LL: 39	PL: 19	PI: 20	GS: 2.84			

GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-6	Test Date: 12/27/14	Test No.: IP-2
	Depth: 27-29 ft	Sample Type: intact	Elevation: ---
	Description: Moist, dark olive gray clay		
	Remarks: System R		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
Boring No.: PB-46-02	Tested By: md	Checked By: jdt
Sample No.: ST-6	Test Date: 12/27/14	Depth: 27-29 ft
Test No.: IP-2	Sample Type: intact	Elevation: ---

Soil Description: Moist, dark olive gray clay
Remarks: System R

Estimated Specific Gravity: 2.84	Liquid Limit: 39	Specimen Diameter: 2.50 in
Initial Void Ratio: 1.35	Plastic Limit: 19	Initial Height: 1.00 in
Final Void Ratio: 0.692	Plasticity Index: 20	Final Height: 0.72 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	14659	RING		16224
Wt. Container + Wet Soil, gm	138.99	252.06	229.89	129.94
Wt. Container + Dry Soil, gm	102.06	206.21	206.21	106.12
Wt. Container, gm	8.2600	109.03	109.03	8.3500
Wt. Dry Soil, gm	93.800	97.183	97.183	97.770
Water Content, %	39.37	47.18	24.36	24.36
Void Ratio	---	1.35	0.692	---
Degree of Saturation, %	---	99.24	100.00	---
Dry Unit Weight, pcf	---	75.422	104.75	---

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefore, values may not represent actual values for the specimen.

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: MTA Tier 3 ORT
Boring No.: PB-46-02
Sample No.: ST-6
Test No.: IP-2

Location: Falmouth, ME
Tested By: md
Test Date: 12/27/14
Sample Type: intact

Project No.: GTX-302707
Checked By: jdt
Depth: 27-29 ft
Elevation: ---

Soil Description: Moist, dark olive gray clay
Remarks: System R

Displacement at End of Increment

	Applied Stress psf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/sec	Mv 1/psf	k ft/day
1	2.90e+003	0.07580	1.17	7.58	18.673	1.22e-006	2.61e-005	1.71e-004
2	4.00e+003	0.1155	1.08	11.6	130.580	1.54e-007	3.61e-005	2.99e-005
3	8.00e+003	0.1724	0.944	17.2	36.127	4.98e-007	1.42e-005	3.81e-005
4	1.60e+004	0.2174	0.839	21.7	16.760	9.49e-007	5.63e-006	2.88e-005
5	3.20e+004	0.2557	0.748	25.6	9.618	1.49e-006	2.40e-006	1.92e-005
6	6.40e+004	0.2924	0.662	29.2	7.085	1.82e-006	1.15e-006	1.13e-005
7	1.60e+004	0.2848	0.680	28.5	3.407	3.64e-006	1.59e-007	3.12e-006
8	4.00e+003	0.2723	0.710	27.2	28.941	4.41e-007	1.04e-006	2.47e-006
9	2.90e+003	0.2705	0.714	27.0	39.964	3.26e-007	1.70e-006	2.99e-006

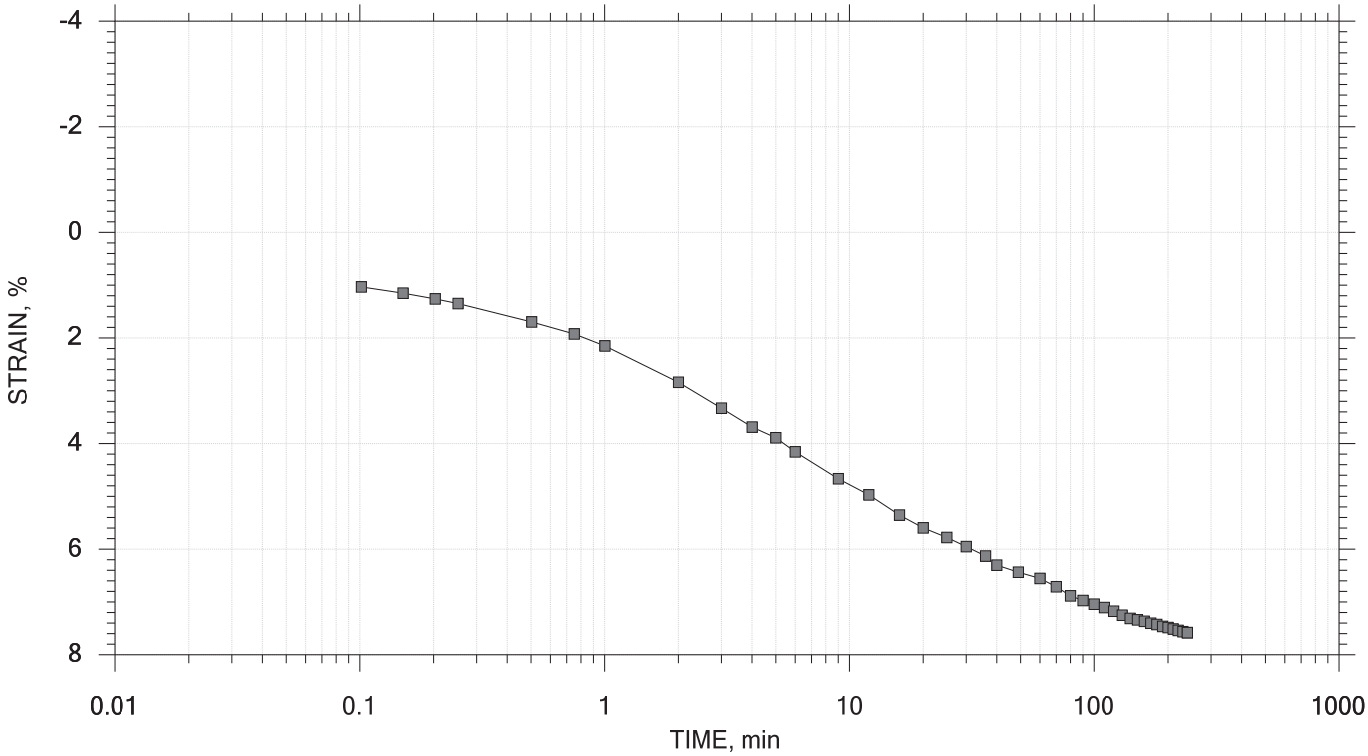
	Applied Stress psf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/sec	Mv 1/psf	k ft/day	Ca %
1	2.90e+003	0.07580	1.17	7.58	2.221	2.38e-006	2.61e-005	3.35e-004	0.00e+000
2	4.00e+003	0.1155	1.08	11.6	25.438	1.83e-007	3.61e-005	3.57e-005	0.00e+000
3	8.00e+003	0.1724	0.944	17.2	7.952	5.25e-007	1.42e-005	4.03e-005	0.00e+000
4	1.60e+004	0.2174	0.839	21.7	2.930	1.26e-006	5.63e-006	3.83e-005	0.00e+000
5	3.20e+004	0.2557	0.748	25.6	2.349	1.41e-006	2.40e-006	1.83e-005	0.00e+000
6	6.40e+004	0.2924	0.662	29.2	1.442	2.08e-006	1.15e-006	1.29e-005	0.00e+000
7	1.60e+004	0.2848	0.680	28.5	0.514	5.61e-006	1.59e-007	4.81e-006	0.00e+000
8	4.00e+003	0.2723	0.710	27.2	0.000	0.00e+000	1.04e-006	0.00e+000	0.00e+000
9	2.90e+003	0.2705	0.714	27.0	0.000	0.00e+000	1.70e-006	0.00e+000	0.00e+000

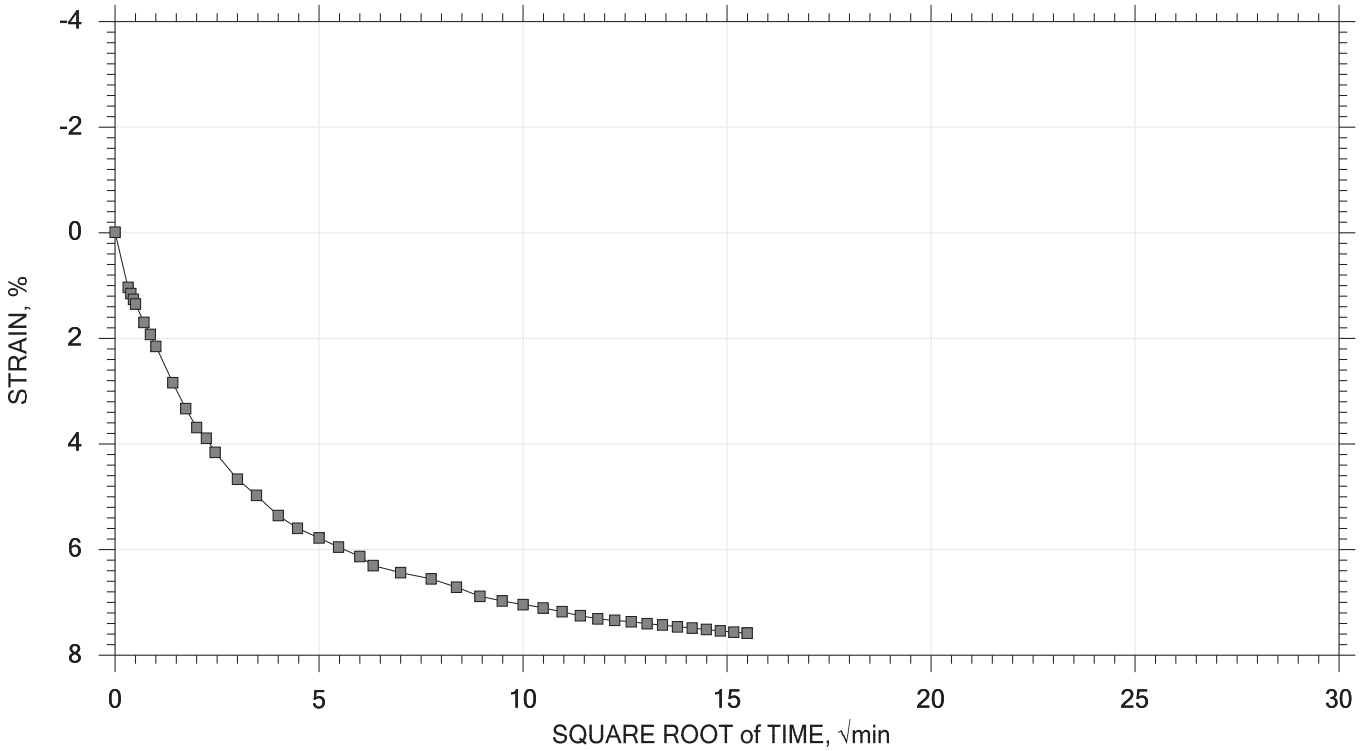
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 1 of 9

Stress: 2900 psf





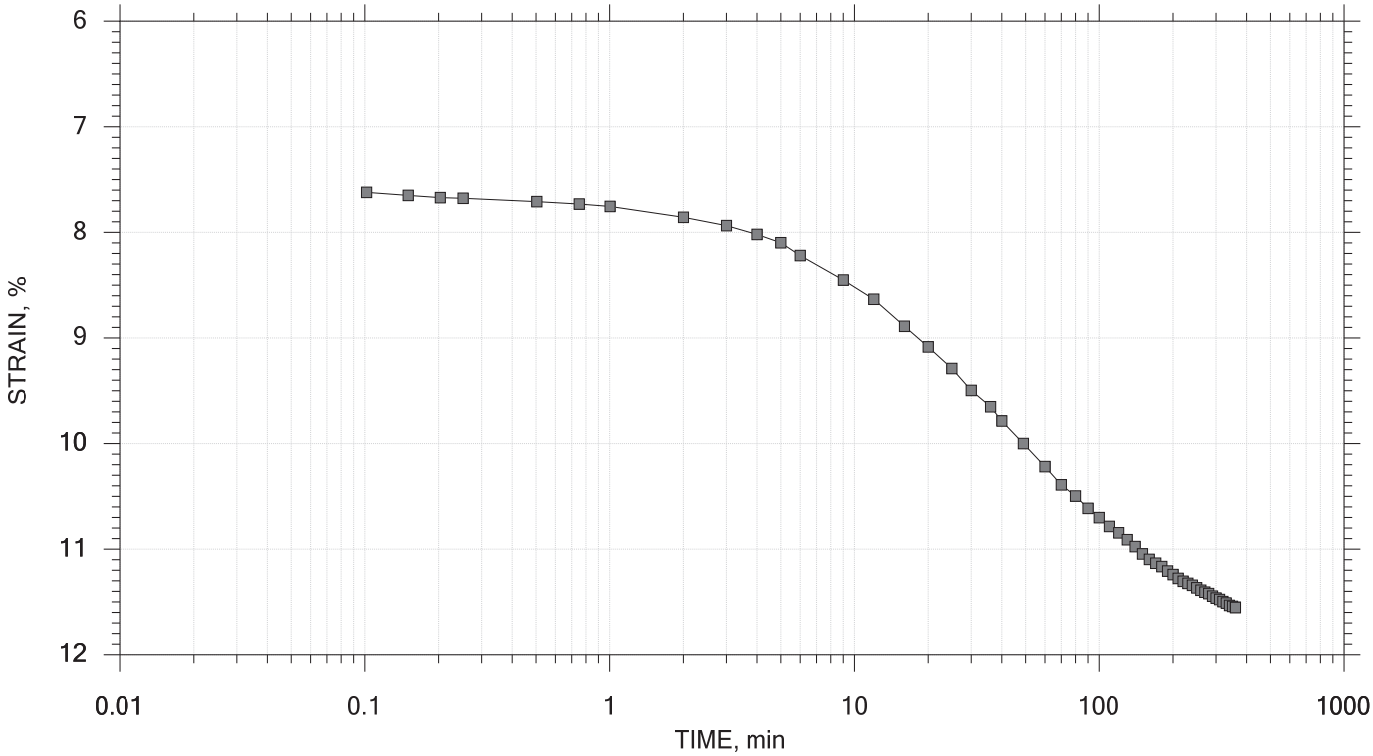
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-6	Test Date: 12/27/14	Test No.: IP-2
	Depth: 27-29 ft	Sample Type: intact	Elevation: ---
	Description: Moist, dark olive gray clay		
	Remarks: System R		

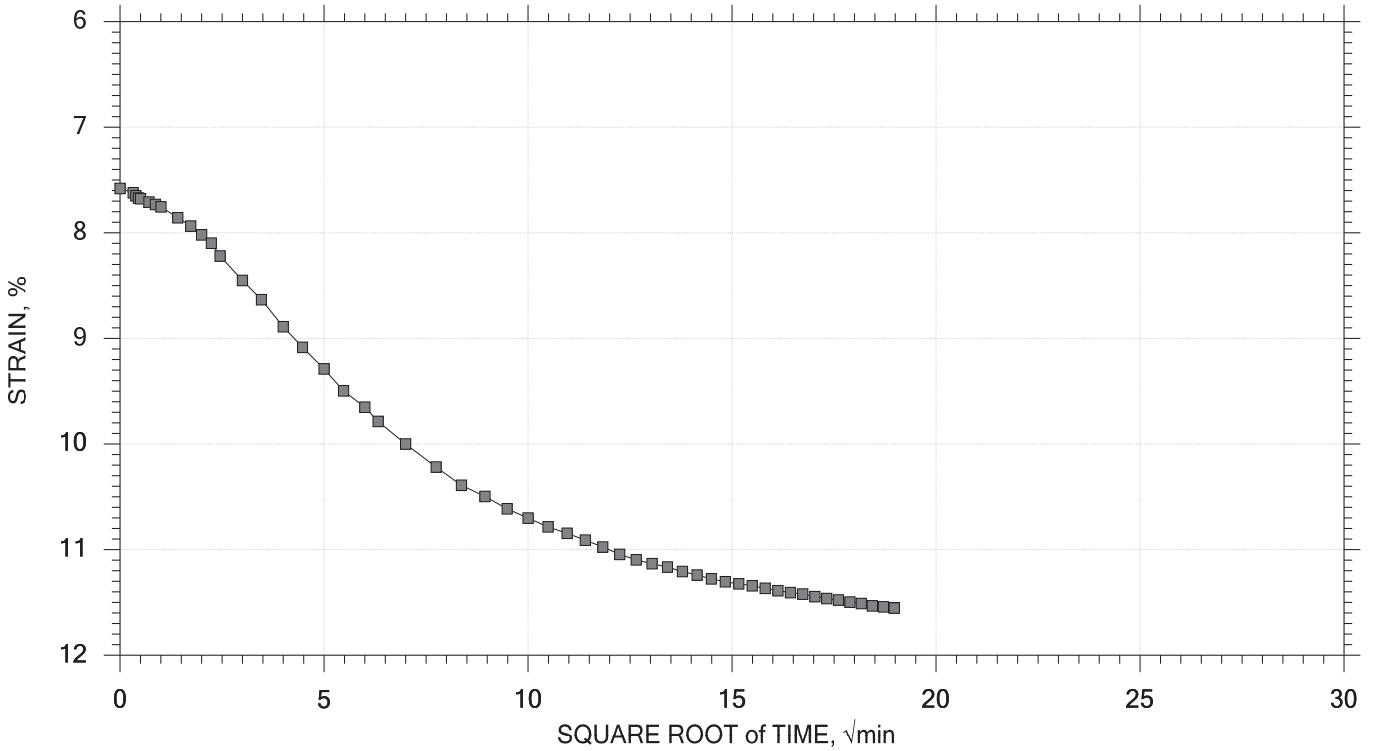
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 9

Stress: 4000 psf





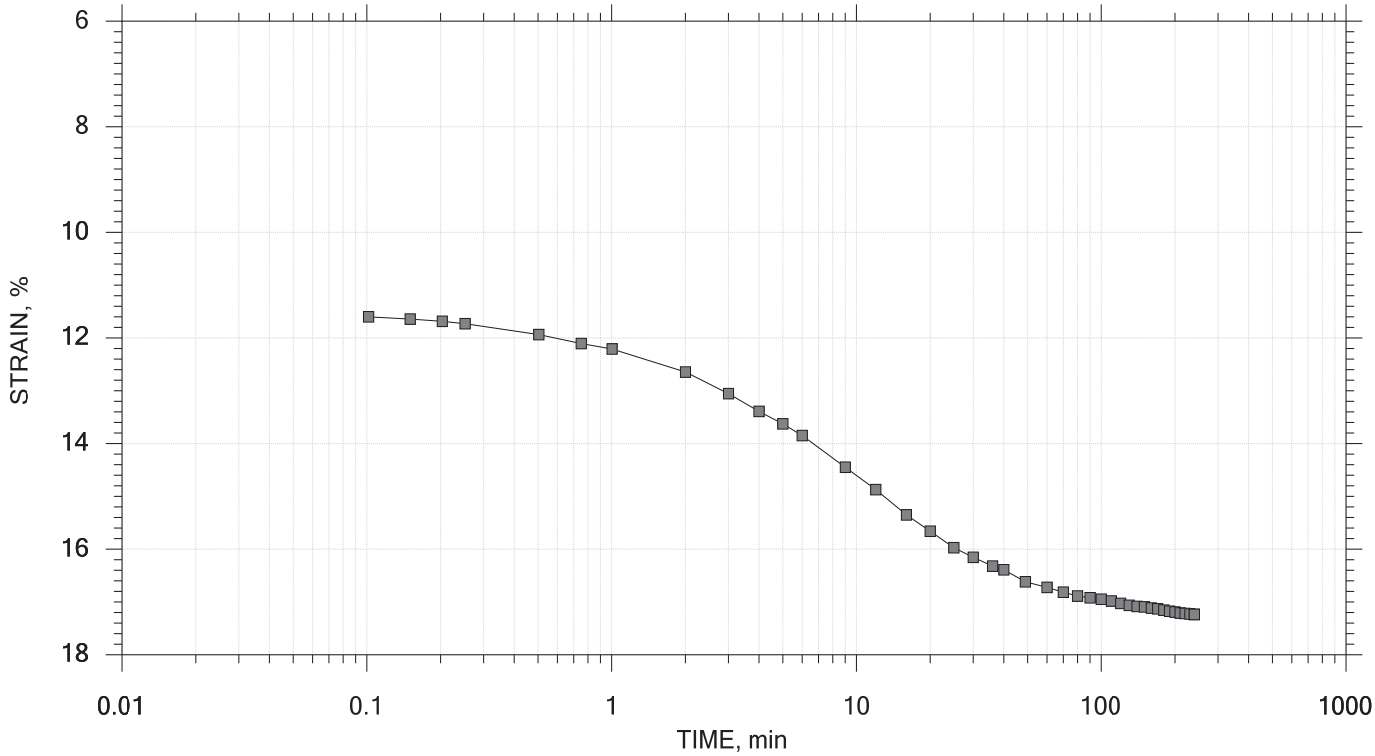
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-6	Test Date: 12/27/14	Test No.: IP-2
	Depth: 27-29 ft	Sample Type: intact	Elevation: ---
	Description: Moist, dark olive gray clay		
	Remarks: System R		

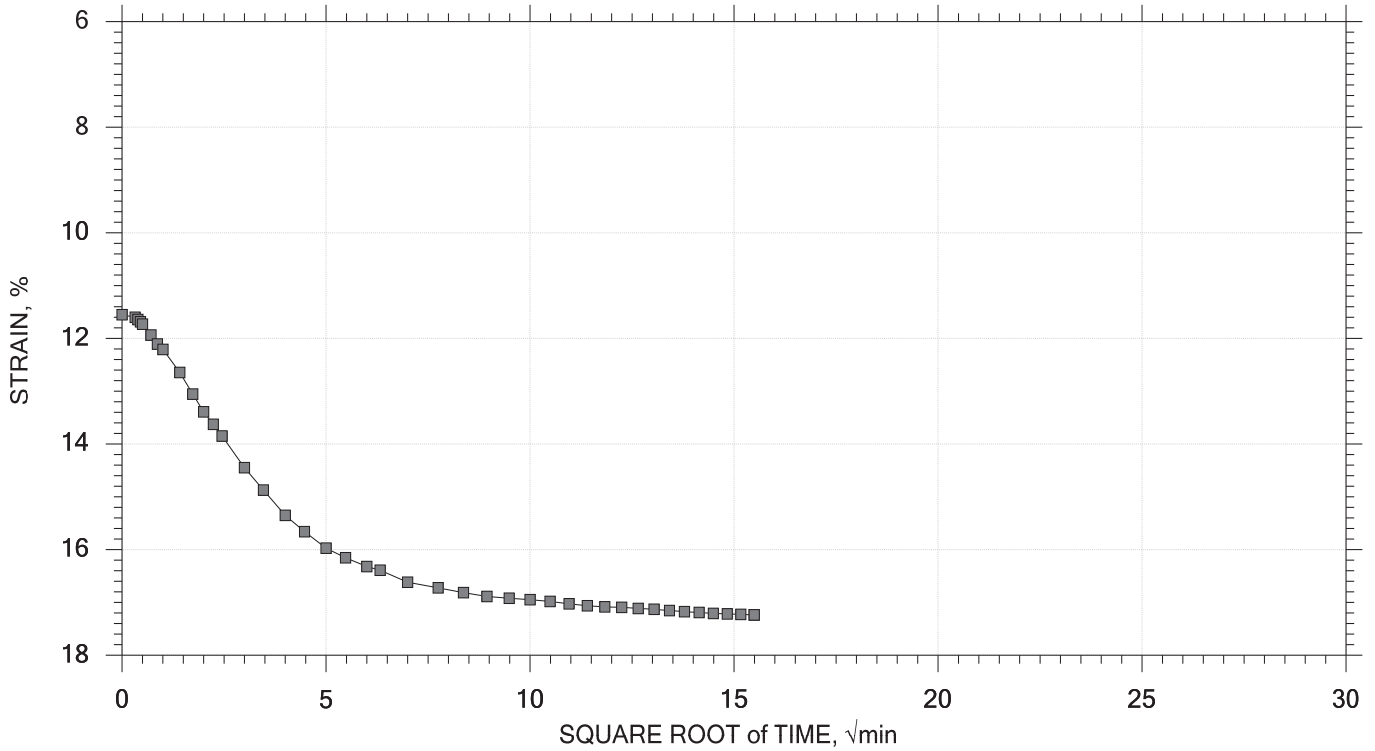
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 9

Stress: 8000 psf





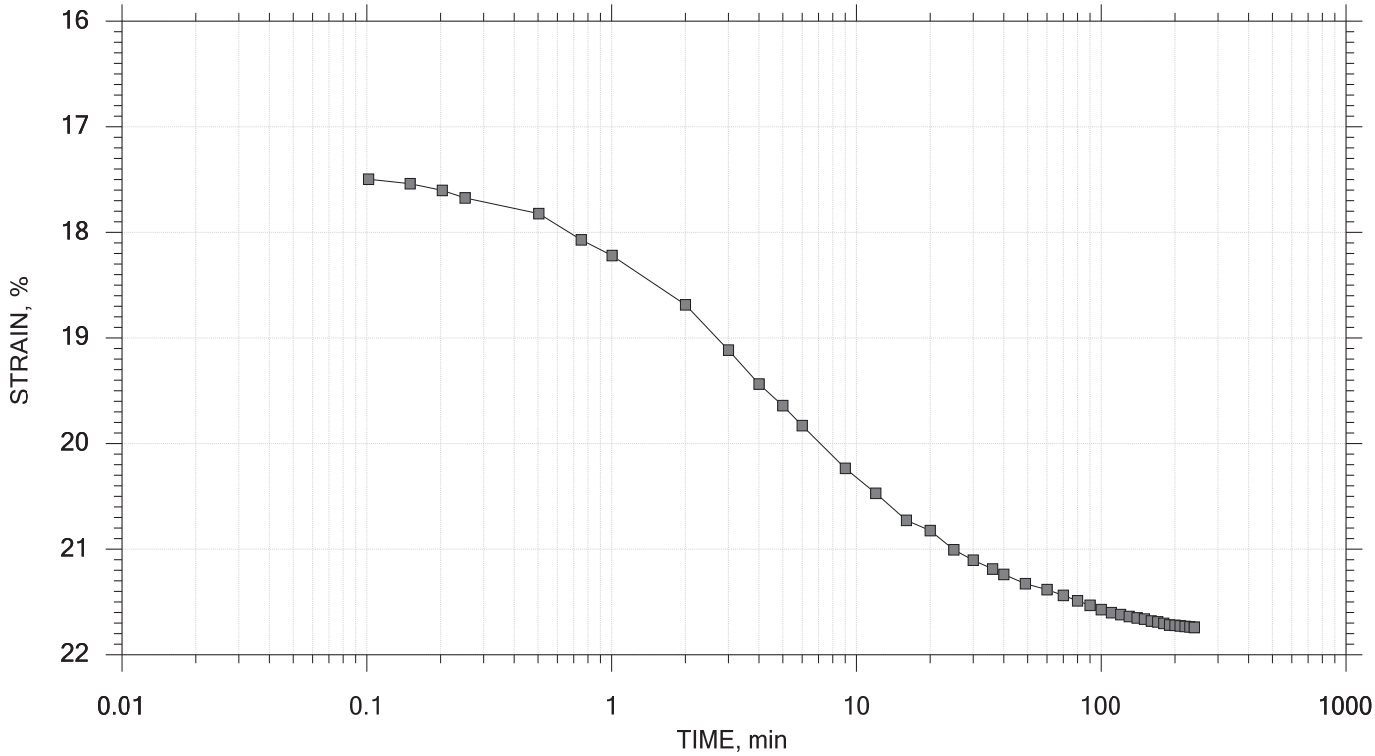
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-6	Test Date: 12/27/14	Test No.: IP-2
	Depth: 27-29 ft	Sample Type: intact	Elevation: ---
	Description: Moist, dark olive gray clay		
	Remarks: System R		

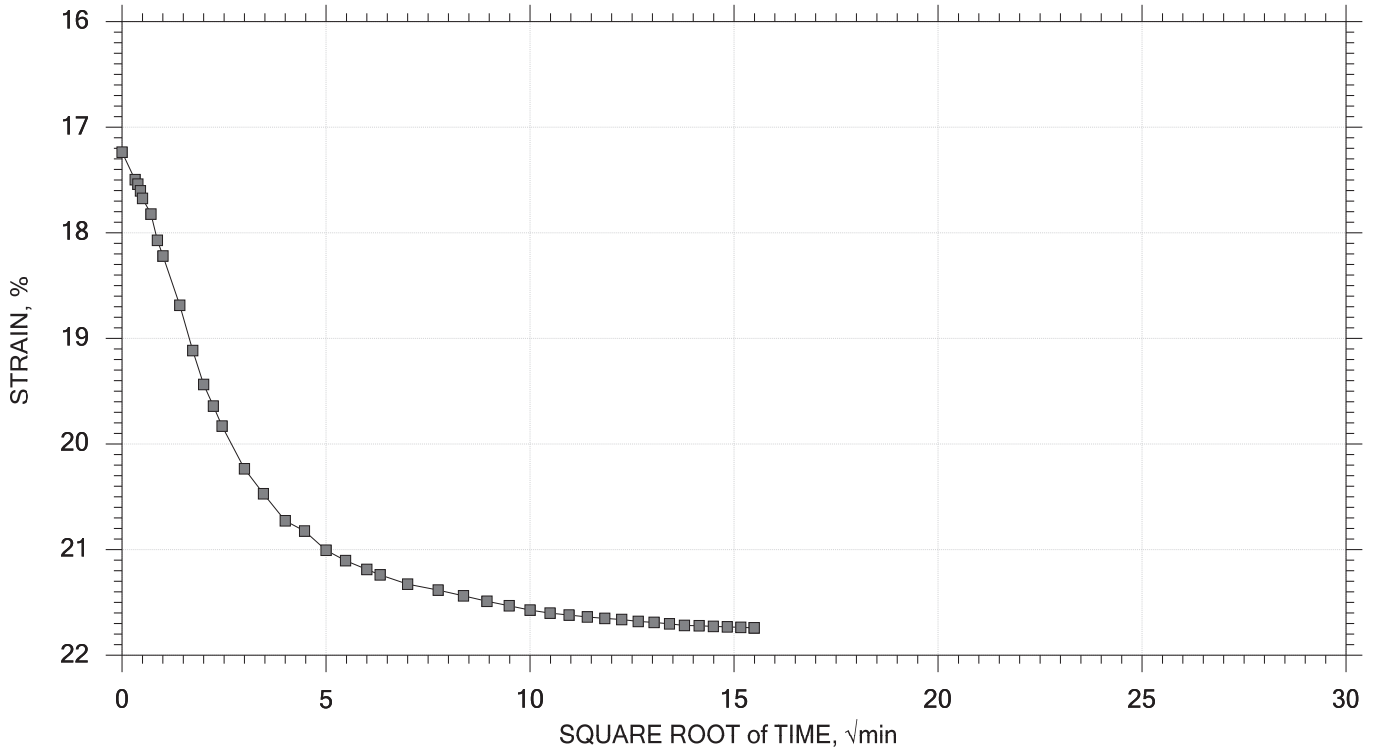
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 9

Stress: 16000 psf





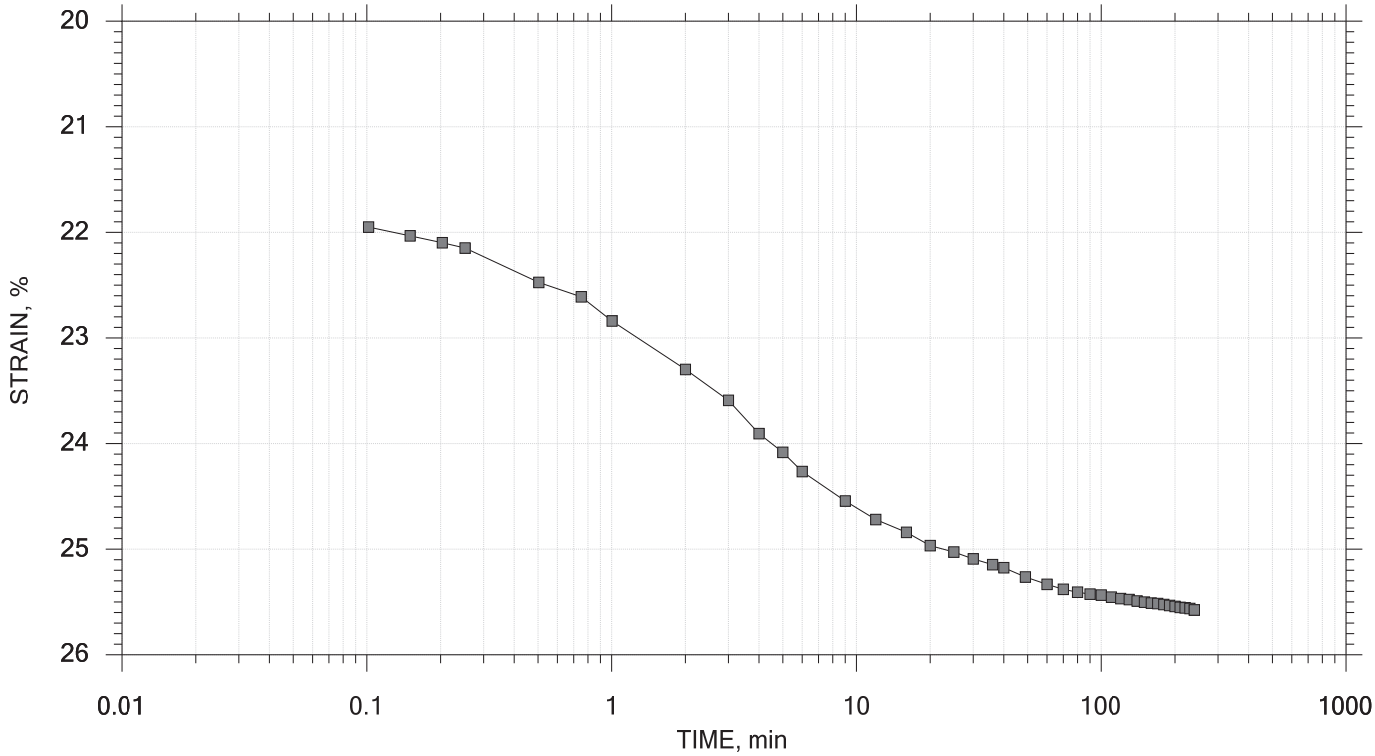
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-6	Test Date: 12/27/14	Test No.: IP-2
	Depth: 27-29 ft	Sample Type: intact	Elevation: ---
	Description: Moist, dark olive gray clay		
	Remarks: System R		

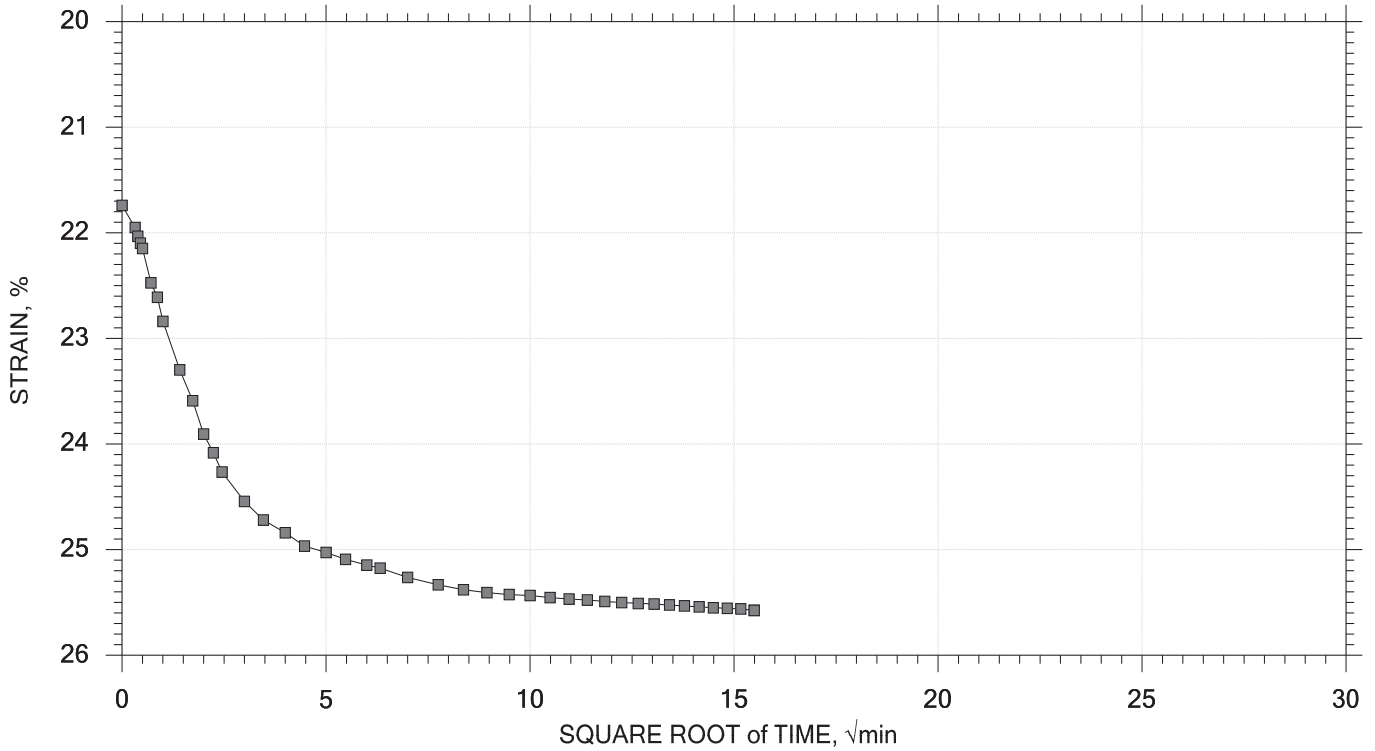
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 9

Stress: 32000 psf





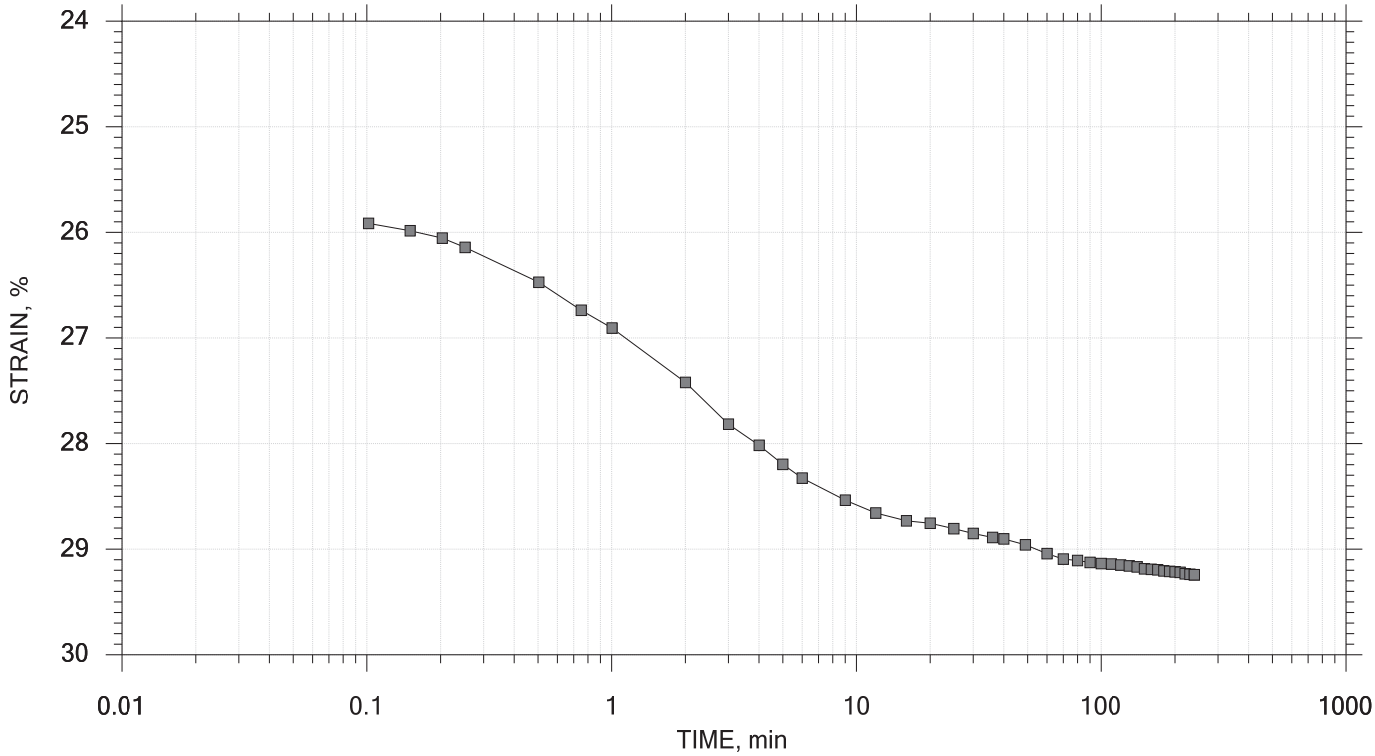
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-6	Test Date: 12/27/14	Test No.: IP-2
	Depth: 27-29 ft	Sample Type: intact	Elevation: ---
	Description: Moist, dark olive gray clay		
	Remarks: System R		

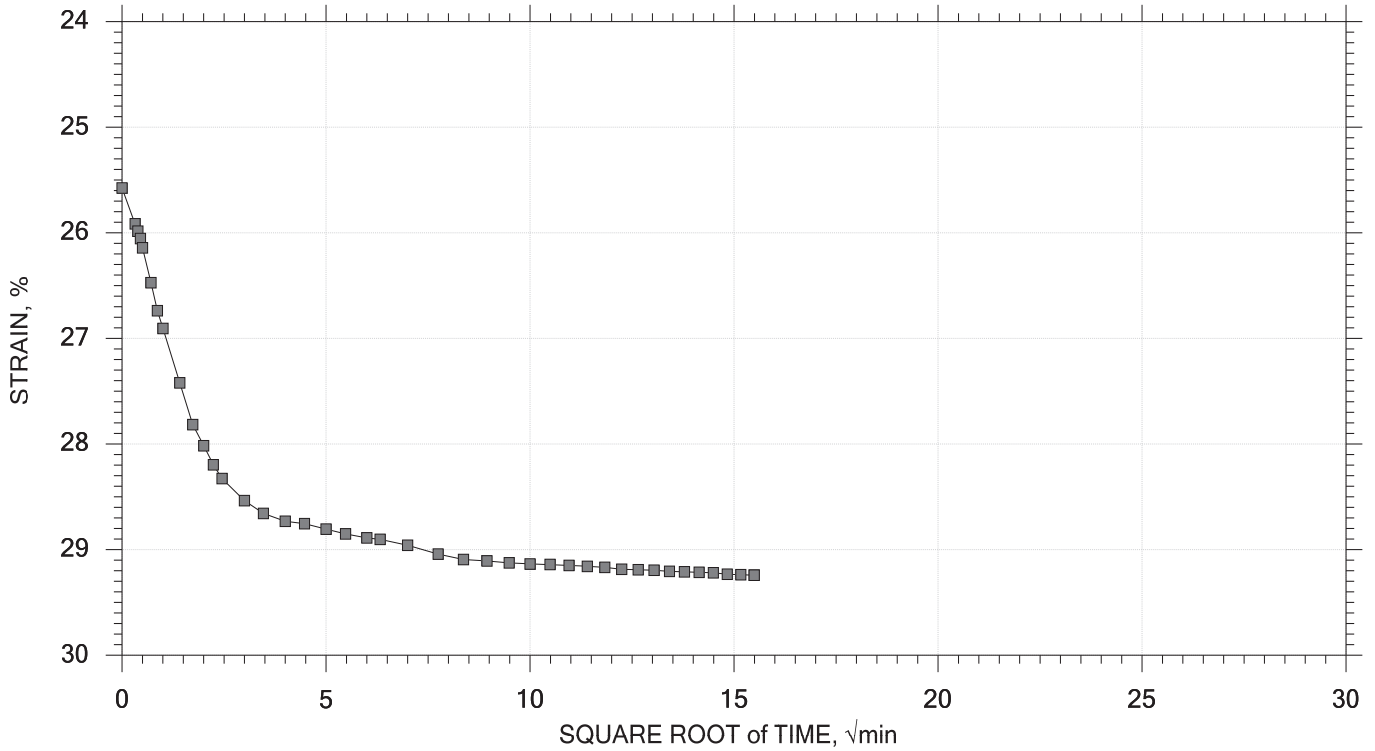
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 9

Stress: 64000 psf





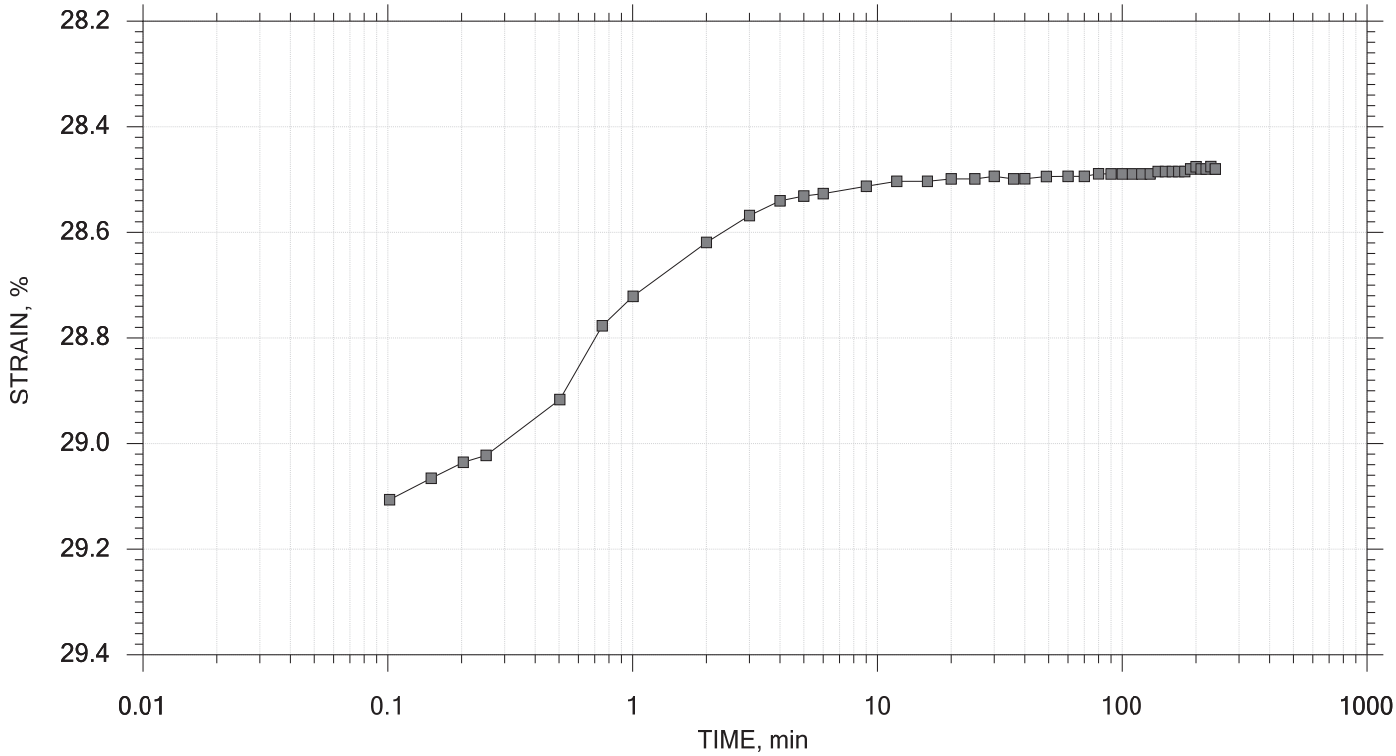
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-6	Test Date: 12/27/14	Test No.: IP-2
	Depth: 27-29 ft	Sample Type: intact	Elevation: ---
	Description: Moist, dark olive gray clay		
	Remarks: System R		

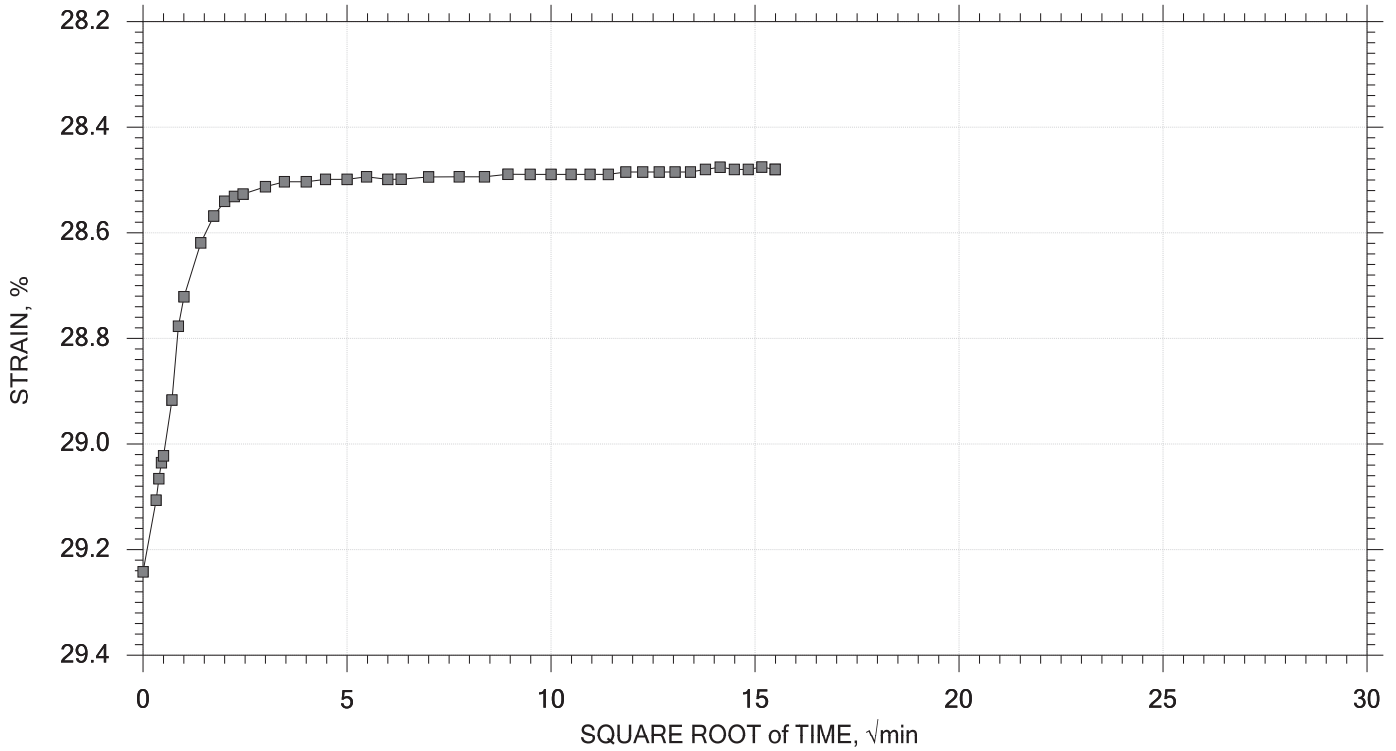
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 9

Stress: 16000 psf





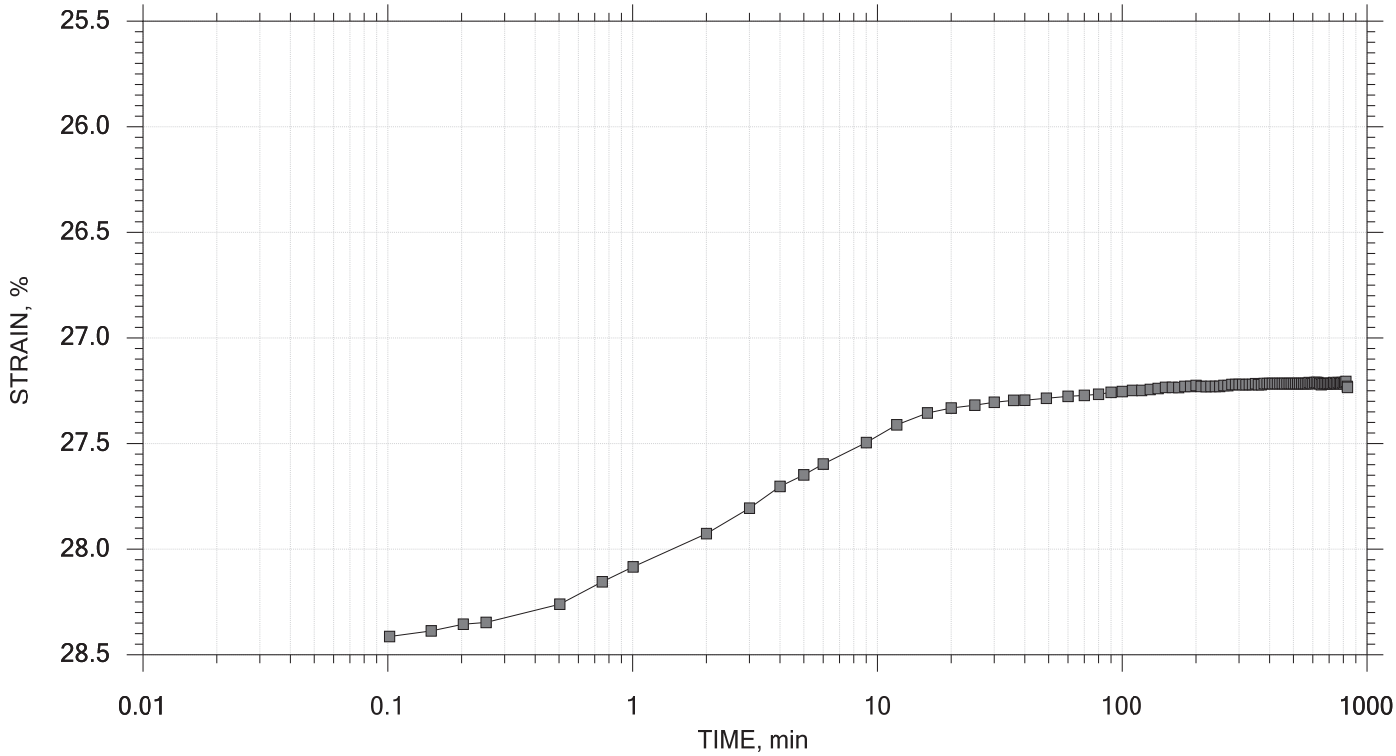
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-6	Test Date: 12/27/14	Test No.: IP-2
	Depth: 27-29 ft	Sample Type: intact	Elevation: ---
	Description: Moist, dark olive gray clay		
	Remarks: System R		

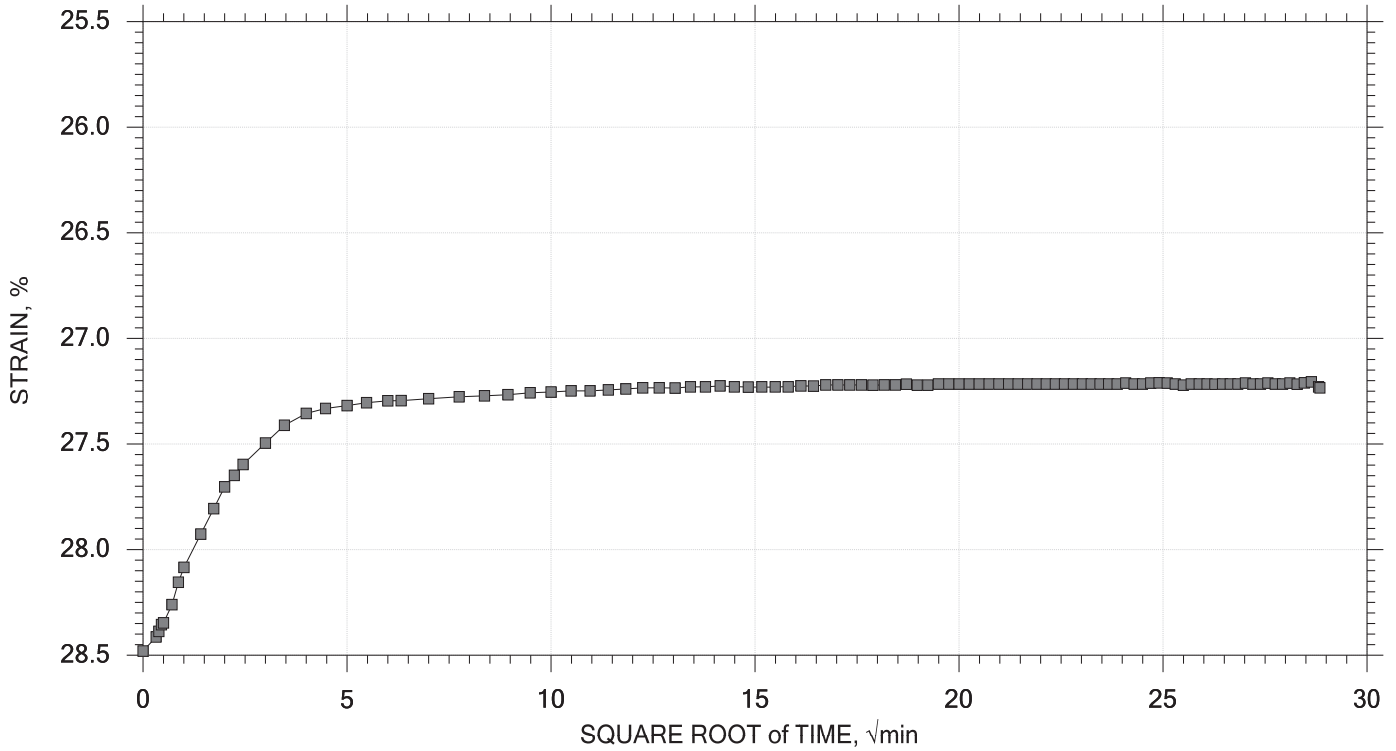
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 9

Stress: 4000 psf





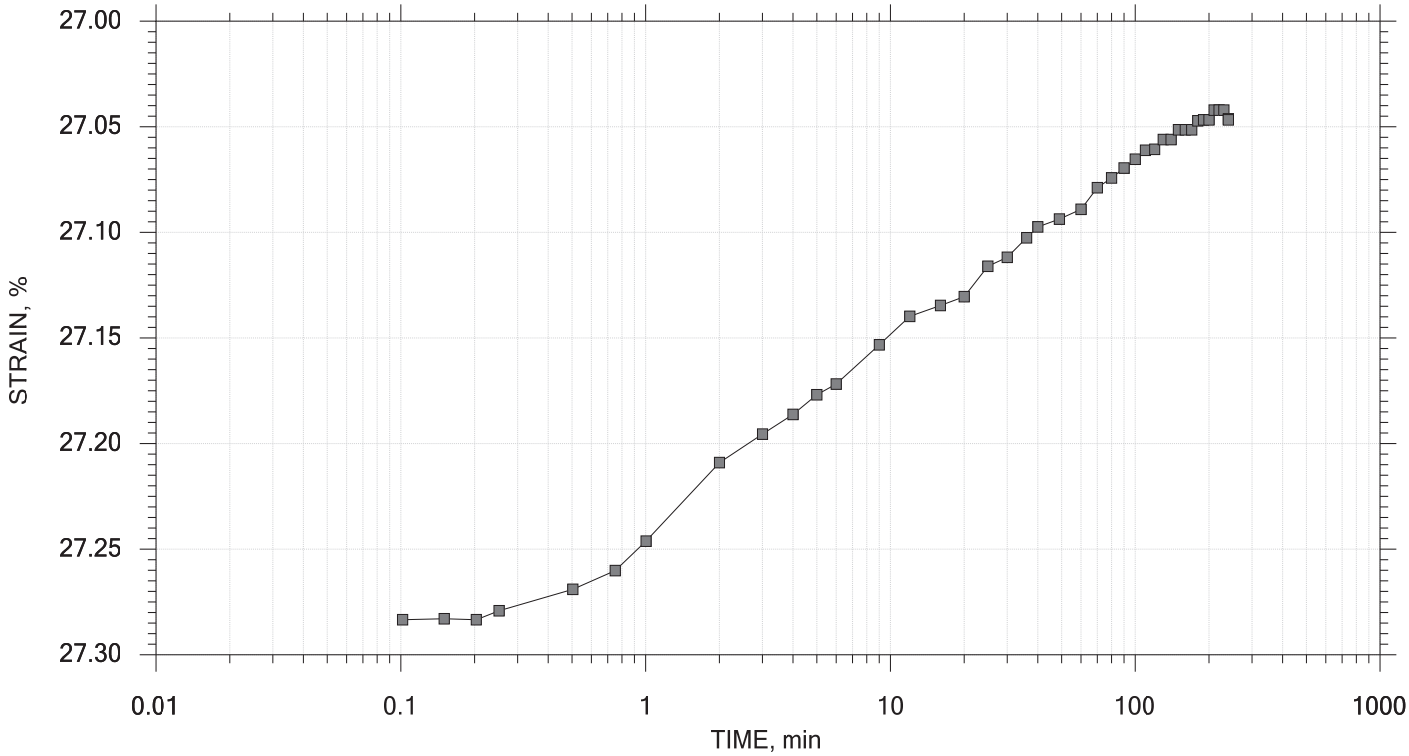
GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-6	Test Date: 12/27/14	Test No.: IP-2
	Depth: 27-29 ft	Sample Type: intact	Elevation: ---
	Description: Moist, dark olive gray clay		
	Remarks: System R		

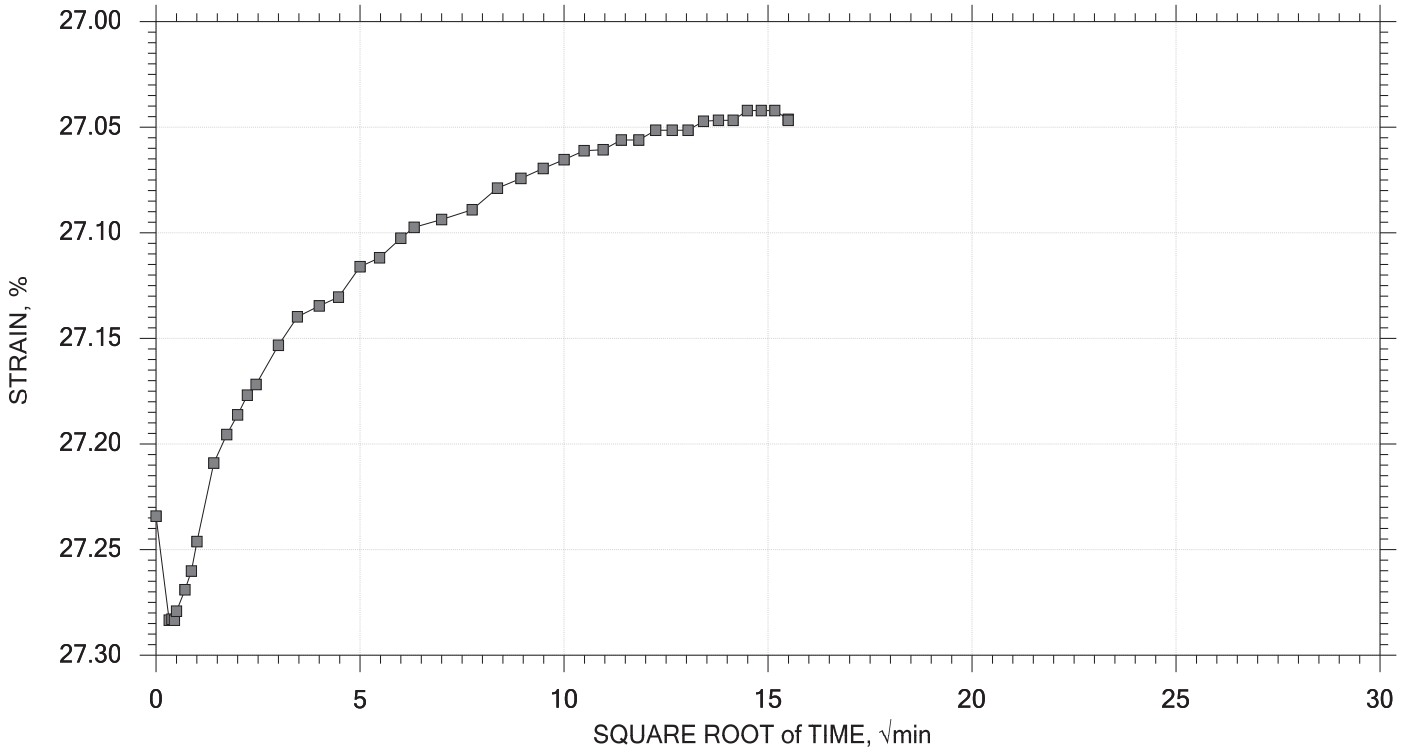
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 9

Stress: 2900 psf

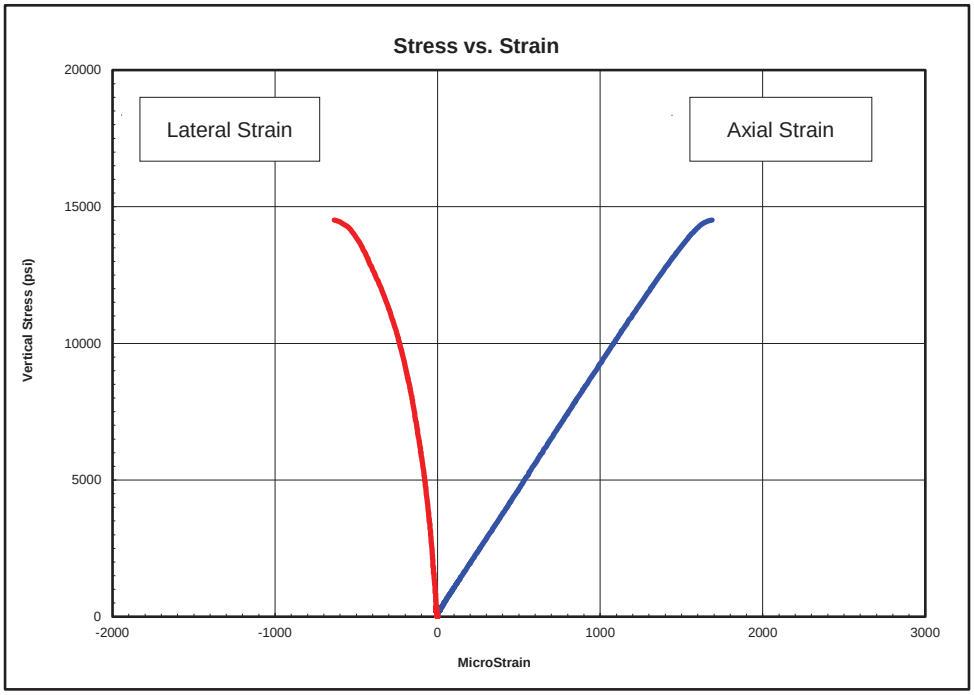




GeoTesting EXPRESS	Project: MTA Tier 3 ORT	Location: Falmouth, ME	Project No.: GTX-302707
	Boring No.: PB-46-02	Tested By: md	Checked By: jdt
	Sample No.: ST-6	Test Date: 12/27/14	Test No.: IP-2
	Depth: 27-29 ft	Sample Type: intact	Elevation: ---
	Description: Moist, dark olive gray clay		
	Remarks: System R		

Client:	HNTB Corporation
Project Name:	MTA Tier 3 ORT
Project Location:	Falmouth, ME
GTX #:	302707
Test Date:	1/7/2015
Tested By:	daa
Checked By:	mpd
Boring ID:	PB-32-02
Sample ID:	RC-1
Depth, ft:	25-30
Sample Type:	rock core
Sample Description:	See photographs Intact material failure

Compressive Strength and Elastic Moduli of Rock by ASTM D7012 - Method D



Peak Compressive Stress: 14,508 psi

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
1500-5300	9,070,000	0.15
5300-9200	9,120,000	0.27
9200-13100	8,730,000	---

Notes: The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.
Young's Modulus and Poisson's Ratio calculated using the tangent to the line in the stress range listed.
Calculations assume samples are isotropic, which is not necessarily the case.

Client:	HNTB Corporation	Test Date:	1/5/2015
Project Name:	MTA Tier 3 ORT	Tested By:	daa
Project Location:	Falmouth, ME	Checked By:	mpd
GTX #:	302707		
Boring ID:	PB-32-02		
Sample ID:	RC-1		
Depth:	25-30 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.50	4.50	4.50
Specimen Diameter, in:	1.99	1.99	1.99
Specimen Mass, g:	601.85		
Bulk Density, lb/ft^3	163	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.3	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:

Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.

Straightness Tolerance Met? YES

END FLATNESS AND PARALLELISM (Procedure FP1)

END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00020	0.00020	0.00020	0.00010	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010	-0.00020	-0.00030	-0.00030	-0.00040
Diameter 2, in (rotated 90°)	0.00030	0.00030	0.00030	0.00020	0.00020	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020	-0.00020

Difference between max and min readings, in:

0° = 0.00060 90° = 0.00050

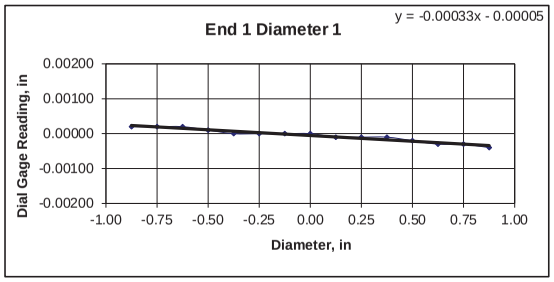
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00020	0.00020	0.00020	0.00020	0.00020	0.00010	0.00010	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010	-0.00020	-0.00020
Diameter 2, in (rotated 90°)	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00010	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00030	-0.00030	-0.00040

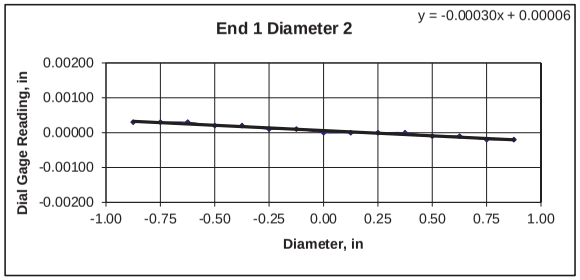
Difference between max and min readings, in:

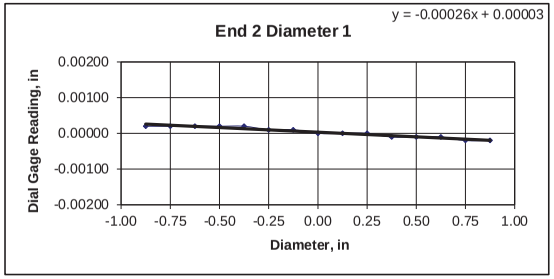
0° = 0.0004 90° = 0.0006

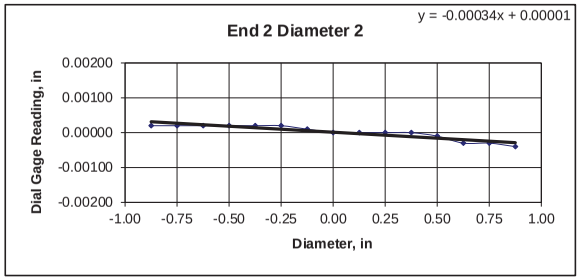
Maximum difference must be < 0.0020 in. Difference = ± 0.00030

Flatness Tolerance Met? YES









DIAMETER 1

End 1:

Slope of Best Fit Line	-0.00033
Angle of Best Fit Line:	-0.01891

End 2:

Slope of Best Fit Line	-0.00026
Angle of Best Fit Line:	-0.01490

Maximum Angular Difference: 0.00401

Parallelism Tolerance Met? YES

Spherically Seated

DIAMETER 2

End 1:

Slope of Best Fit Line	-0.00030
Angle of Best Fit Line:	-0.01719

End 2:

Slope of Best Fit Line	-0.00034
Angle of Best Fit Line:	-0.01948

Maximum Angular Difference: 0.00229

Parallelism Tolerance Met? YES

Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00060	1.990	0.00030	0.017	YES
Diameter 2, in (rotated 90°)	0.00050	1.990	0.00025	0.014	YES
END 2					
Diameter 1, in	0.00040	1.990	0.00020	0.012	YES
Diameter 2, in (rotated 90°)	0.00060	1.990	0.00030	0.017	YES

Maximum angle of departure must be ≤ 0.25°

Perpendicularity Tolerance Met? YES

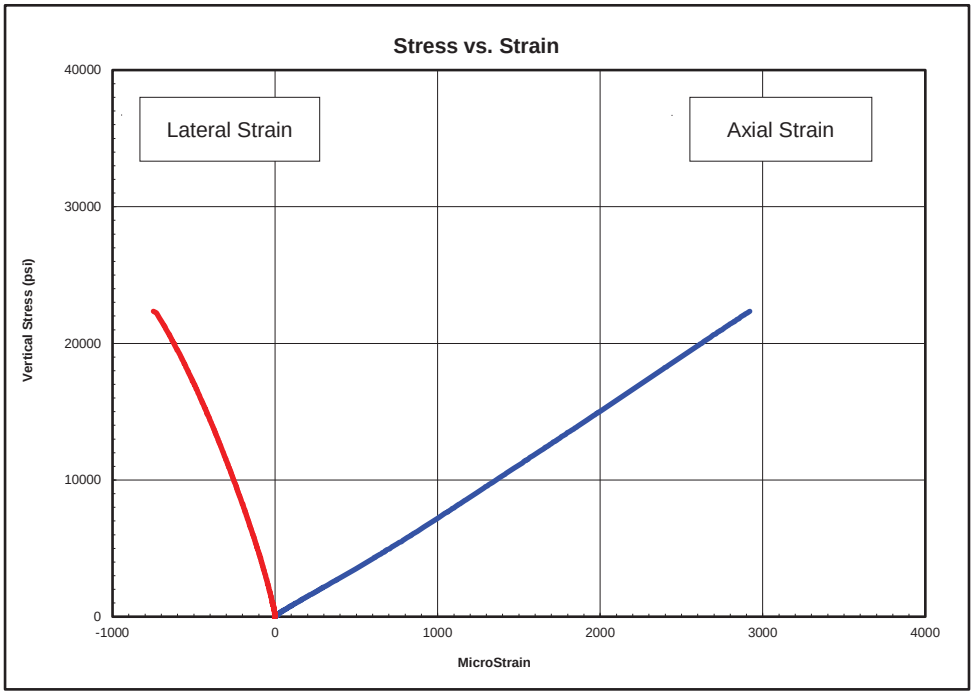
Client:	HNTB Corporation
Project Name:	MTA Tier 3 ORT
Project Location:	Falmouth, ME
GTX #:	302707
Test Date:	1/7/2015
Tested By:	daa
Checked By:	mpd
Boring ID:	PB-32-02
Sample ID:	RC-1
Depth, ft:	25-30

After cutting and grinding

After break

Client:	HNTB Corporation
Project Name:	MTA Tier 3 ORT
Project Location:	Falmouth, ME
GTX #:	302707
Test Date:	1/7/2015
Tested By:	daa
Checked By:	mpd
Boring ID:	PB-53-04
Sample ID:	RC-2
Depth, ft:	15-20
Sample Type:	rock core
Sample Description:	See photographs Intact material failure

Compressive Strength and Elastic Moduli of Rock by ASTM D7012 - Method D



Peak Compressive Stress: 22,360 psi

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
2200-8200	7,280,000	0.19
8200-14200	7,840,000	0.25
14200-20100	7,980,000	0.32

Notes: The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.
Young's Modulus and Poisson's Ratio calculated using the tangent to the line in the stress range listed.
Calculations assume samples are isotropic, which is not necessarily the case.

Client:	HNTB Corporation	Test Date:	1/5/2015
Project Name:	MTA Tier 3 ORT	Tested By:	daa
Project Location:	Falmouth, ME	Checked By:	mpd
GTX #:	302707		
Boring ID:	PB-53-04		
Sample ID:	RC-2		
Depth:	15-20 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.21	4.21	4.21
Specimen Diameter, in:	1.99	1.99	1.99
Specimen Mass, g:	571.9		
Bulk Density, lb/ft^3	166	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.1	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:

Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.

Straightness Tolerance Met? YES

END FLATNESS AND PARALLELISM (Procedure FP1)

END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00020
Diameter 2, in (rotated 90°)	0.00020	0.00020	0.00020	0.00020	0.00010	0.00010	0.00000	0.00000	-0.00010	-0.00020	-0.00020	-0.00030	-0.00040	-0.00040	-0.00060

Difference between max and min readings, in:

0° = 0.00030 90° = 0.00080

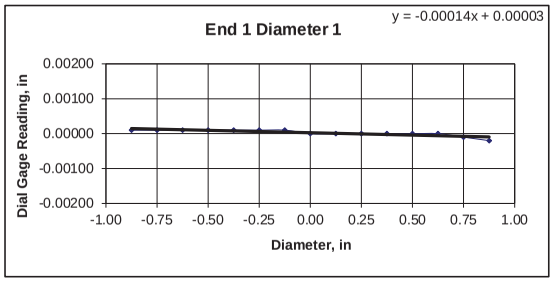
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010
Diameter 2, in (rotated 90°)	0.00020	0.00020	0.00020	0.00020	0.00010	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020	-0.00030	-0.00040	-0.00050

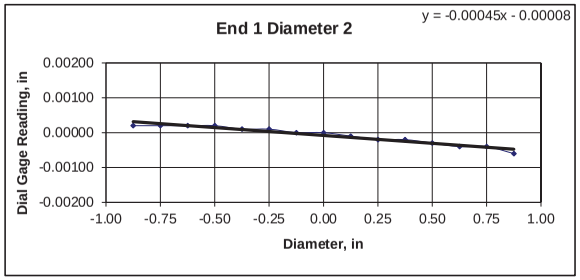
Difference between max and min readings, in:

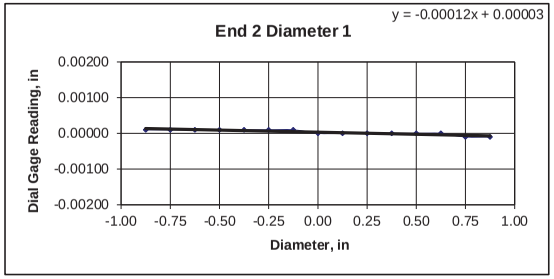
0° = 0.0002 90° = 0.0007

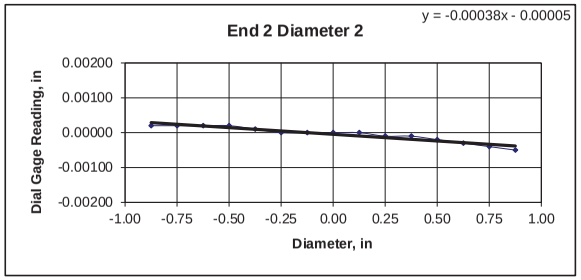
Maximum difference must be < 0.0020 in. Difference = ± 0.00040

Flatness Tolerance Met? YES









DIAMETER 1

End 1:

Slope of Best Fit Line -0.00014

Angle of Best Fit Line: -0.00802

End 2:

Slope of Best Fit Line -0.00012

Angle of Best Fit Line: -0.00688

Maximum Angular Difference: 0.00115

Parallelism Tolerance Met? YES

Spherically Seated

DIAMETER 2

End 1:

Slope of Best Fit Line -0.00045

Angle of Best Fit Line: -0.02578

End 2:

Slope of Best Fit Line -0.00038

Angle of Best Fit Line: -0.02177

Maximum Angular Difference: 0.00401

Parallelism Tolerance Met? YES

Spherically Seated

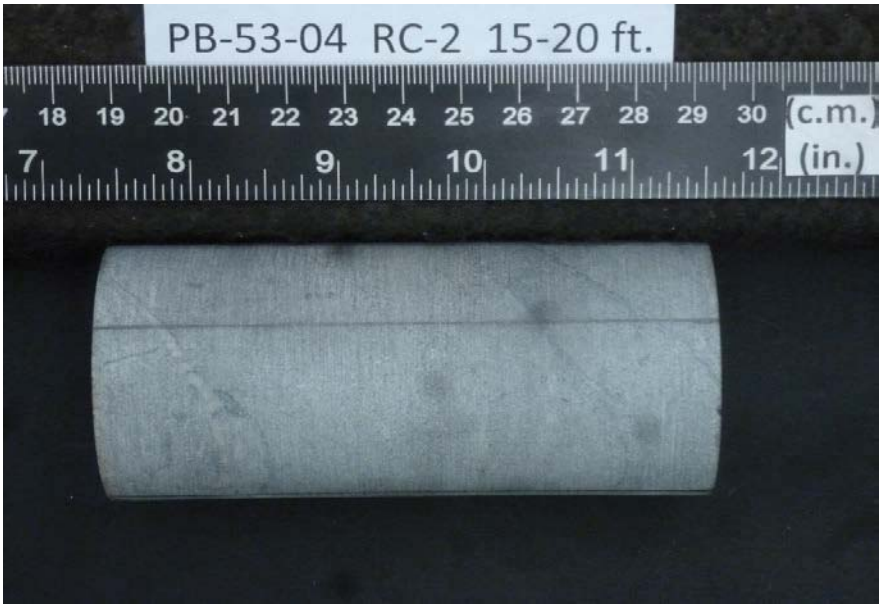
PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00030	1.990	0.00015	0.009	YES
Diameter 2, in (rotated 90°)	0.00080	1.990	0.00040	0.023	YES
END 2					
Diameter 1, in	0.00020	1.990	0.00010	0.006	YES
Diameter 2, in (rotated 90°)	0.00070	1.990	0.00035	0.020	YES

Maximum angle of departure must be ≤ 0.25°

Perpendicularity Tolerance Met? YES

Client:	HNTB Corporation
Project Name:	MTA Tier 3 ORT
Project Location:	Falmouth, ME
GTX #:	302707
Test Date:	1/7/2015
Tested By:	daa
Checked By:	mpd
Boring ID:	PB-53-04
Sample ID:	RC-2
Depth, ft:	15-20



After cutting and grinding

After break

Client:	HNTB Corporation
Project Name:	MTA Tier 3 ORT
Project Location:	Falmouth, ME
GTX #:	302707
Test Date:	1/7/2015
Tested By:	smd
Checked By:	mpd
Boring ID:	PB-53-04
Sample ID:	RC-2
Depth, ft:	15-20
Sample Type:	rock core
Sample Description:	core

Determination of Rock Hardness by Rebound Hammer Method (Schmidt Hammer) by ASTM D5873

Length, in	Diameter, in	Specimen Moisture Condition	Weathering and Alteration Condition of Sample	Remarks
6.0	1.9	As-Received	Fresh	---

Schmidt Hammer Readings

1.	42.0	6.	47.0
2.	44.0	7.	48.0
3.	42.0	8.	41.0
4.	48.0	9.	47.0
5.	48.0	10.	45.0

Average: 45.2

Correction Factor: 1.010

Schmidt Hardness Number, H_R: 45.6

Notes: Test performed using an Type L Schmidt Hammer
Test specimen was clamped into a steel cradle
Test was performed with the Schmidt hammer plunger axis near vertical
Specimen stored and tested at standard laboratory temperature.

APPENDIX C

Calculations

Calcs For	Tier 3 - Exit 32 Foundations	Job No.	57576	HNTB
Made by	E. Strode	Date	1/12/15	
Checked by	N. Hourani	Date	4/27/2015	Sheet No.

Biddeford - Canopy Foundations

The proposed additional toll booth and canopy, will be located to the North of the existing tolls booths and will be supported by a shallow foundation.

Soil Stratigraphy

Per AASHTO 17th Edition - Section

Use soil conditions - PB-32-01 Water 18 ft

Layers Top	Bottom	Thickness (ft)	Soil Type	N Value	γ_d (pcf)	ϕ (deg)	c (psf)
0	0.3	0.3	Asphalt	na	120		na
0.3	3	2.7	Sand (FILL)	39	115	32	0
3	9	6	Clay & Silt (FILL)	30	105	20	500
9	18.5	9.5	Silty Clay	11	100	0	500
18.5	22.5	4	Soft Clay	2	100	0	200
22.5	25.5	3	Sand and Clay	100/4	120	30	0
25.5	27	1.5	Bedrock		145		

Allowable Bearing Capacity

Assumptions:
- Canopy foundation is approximately 5 ft by 5 ft
- Founded at frost depth (5 ft)
- Wing load acts at a 90 deg angle of inclination

$q_{ult} = c\, s_c\, i_c\, N_c + 0.5\, \gamma\, B\, s_\gamma\, i_\gamma\, N_\gamma + q\, s_q\, i_q\, N_q$ Eq 4.4.7.1-1

B	5 ft		N_γ	5.39			
L	5 ft		N_q	6.4		Table 4.4.7.1A	
γ	105 pcf		N_c	14.83			
q	556.5 psf	s_γ	0.6	(4.4.7.1.1.2-3)	i_γ	0.8298	(4.4.7.1.1.2-4)
		s_q	1.36	(4.4.7.1.1.2-2)	i_q	0.8298	(4.4.7.1.1.2-3)
		s_c	1.43	(4.4.7.1.1.2-1)	i_c	0.7983	(4.4.7.1.1.3-1)
					n	1.5	(4.4.7.1.1.3-4)
q_{ult} =	13210 psf						
		Factor of Safety - 3					
q_{all} =	4403 psf				Use	4000 psf	

Calcs For	Tier 3 - Exit 32 Foundations	Job No.	57576	HNTB
Made by	E. Strode	Date	1/12/15	
Checked by	N. Hourani	Date	4/27/2015	Sheet No.

Estimated Settlement

Long term settlement will be related to the existing clay soils at the site and will be related to consolidation settlement. The sand layer immediately overlaying the rock has been discounted due to it's depth and the immediate nature of any settlements related to this layer. The settlement was estimated using Section 4.4.7.2.3 of the AASHTO 17th Edition, and results of laboratory testing.

Proposed Loading

The below loading was provide by the HNTB Maine office for the canopy foundations

Dead Load (k)	31	Snow Load (k)	33	Ice Load (k)	0.2

Assumptions:

The Clay Fill and the upper silty clay layer are overconsolidated

The lower soft clay is normally consolidated.

For over consolidated soils use: $S_c = H_c\left[C_{re}\log\frac{\sigma'_p}{\sigma'_0} + C_{ce}\log\frac{\sigma'_f}{\sigma'_p}\right]$ Eq 4.4.7.2.3-3

For normally consolidated soils use: $S_c = H_c C_{ce}\left[\log\frac{\sigma'_f}{\sigma'_p}\right]$ Eq 4.4.7.2.3-2

Assume worst case condition - Full allowable bearing capacity is used

Assume Stress distribution of foundation stress is based on the Figure 4.4.7.2.1A (b)

Assume 5,000 psf allowable Bearing Capacity

Layer	Depth to Center	H_c	C_{ce}	C_{re}	σ'_p	σ'_o	σ'_f	S_c
	ft	ft			psf	psf	psf	in
Clay & Silt (FILL)	6	4	0.16	0.0474	4600	556.5	1705.0	-1.22
Silty Clay	13.75	9.5	0.16	0.0474	4600	1451.5	1135.0	-8.38
Soft Clay	20.5	4	0.125			2001.7	1565.2	-0.64
						Estimated Total		-1.86

Note:

The estimated negative settlement in the clayey layers is due to the final pressure being below the prior highest pressure. This indicates that the soil layer should not undergo additional settlement due to the proposed load.

Recommendations:

We recommend that the proposed new canopy foundation use an allowable bearing capacity of 5,000 psf. Based on the setttlement calculations, the proposed foundations should undergo minimal settlement related to construction.

Calcs For	Tier 3 - Exit 32 Foundations	Job No.	57576	HNTB
Made by	E. Strode	Date	3/20/15	
Checked by	N. Hourani	Date	4/27/2015	Sheet No.

Biddeford - Toll Island

The proposed additional toll booth and canopy, will be located to the North of the existing tolls booths and will be supported by a shallow foundation.

Soil Stratigraphy

Per AASHTO 17th Edition - Section

Use soil conditions - PB-32-01 Water 18 ft

Layers Top	Bottom	Thickness (ft)	Soil Type	N Value	γ_d (pcf)	ϕ (deg)	c (psf)
0	0.3	0.3	Asphalt	na	120		na
0.3	3	2.7	Sand (FILL)	39	115	32	0
3	9	6	Clay & Silt (FILL)	30	105	20	500
9	18.5	9.5	Silty Clay	11	100	0	500
18.5	22.5	4	Soft Clay	2	100	0	200
22.5	25.5	3	Sand and Clay	100/4	120	30	0
25.5	27	1.5	Bedrock		145		

Assumptions:
- Toll island will act as a strip footing, eight feet wide by 65 ft long
- The island will be frost protected

Estimated Settlement

Long term settlement will be related to the existing clay soils at the site and will be related to consolidation settlement. The sand layer immediately overlaying the rock has been discounted due to it's depth and the immediate nature of any settlements related to this layer. The settlement was estimated using Section 4.4.7.2.3 of the AASHTO 17th Edition, and results of laboratory testing.

Proposed Loading

The below loading was provide by the HNTB Maine office for the canopy foundations

Island Load 0.472 ksf

Assumptions:

The Clay Fill and the upper silty clay layer are overconsolidated

The lower soft clay is normally consolidated.

For over consolidated soils use: $S_c = H_c\left[C_{re}\log\frac{\sigma'_p}{\sigma'_o} + C_{ce}\log\frac{\sigma'_f}{\sigma'_p}\right]$ Eq 4.4.7.2.3-3

For normally consolidated soils use: $S_c = H_c C_{ce}\left[\log\frac{\sigma'_f}{\sigma'_p}\right]$ Eq 4.4.7.2.3-2

Assume worst case condition - Full allowable bearing capacity is used

Assume Stress distribution of foundation stress is based on the Figure 4.4.7.2.1A (a)

Assume 5,000 psf allowable Bearing Capacity

Layer	Depth to Center ft	H_c ft	C_{ce}	C_{re}	σ'_p psf	σ'_o psf	σ'_f psf	S_c in
Clay & Silt (FILL)	6	4	0.16	0.0474	4600	556.5	105.3	-10.51
Silty Clay	13.75	9.5	0.16	0.0474	4600	1451.5	895.2	-10.26
Soft Clay	20.5	4	0.125			2001.7	1445.3	-0.85
						Estimated Total		-11.36

Note:

The estimated negative settlement in the clayey layers is due to the final pressure being below the prior highest pressure. This indicates that the soil layer should not undergo additional settlement due to the proposed load.

Recommendations:

We recommend that the proposed new canopy foundation use an allowable bearing capacity of 5,000 psf. Based on the setttlement calculations, the proposed foundations should undergo minimal settlement related to construction.

Calcs For	Tier 3 - Exit 46 Foundations	Job No.	57576	HNTB
Made by	E. Strode	Date	1/12/15	
Checked by	N. Hourani	Date	4/27/2015	Sheet No.

Portland - Canopy Shallow Foundations

The proposed additional toll booth and canopy, will be located to the North of the existing tolls booths and will be supported by a shallow foundation.

Soil Stratigraphy

Per AASHTO 17th Edition - Section

Use soil conditions - PB-46-02 Water 20 ft

Layer	Layers Top	Layers Bottom	Thickness (ft)	Soil Type	N Value	γ_d (pcf)	ϕ (deg)	c (psf)
1	0	0.8	0.8	Asphalt	NA	120		na
2	0.8	3.5	2.7	Sand (Fill)	NA	115	32	0
3	3.5	5.5	2	Sand & Clay (Fill)	NA	110	28	250
4	5.5	7	1.5	Sand (Fill)	33	115	32	0
5	7	9.5	2.5	Sand & Clay (Fill)	NA	110	28	250
6	9.5	14.5	5	Sand and Silt	55	115	34	0
7	14.5	20	5.5	Clay and Silt	22	110	0	500
8	20	27	7	Upper Soft Clay	WOR	100	0	250
9	27	36	9	Lower Soft Clay	WOR	100	0	250
10	36	37	1	Clayey Sand	16	115	30	0
11	37			Bedrock	NA	145		

Allowable Bearing Capacity

Assumptions:
- Canopy foundation is approximately 5 ft by 5 ft
- Founded at frost depth (5 ft)
- Assume foundations will bear on the Sand Fill layer

$q_{ult} = c\, s_c\, i_c\, N_c + 0.5\, \gamma\, B\, s_\gamma\, i_\gamma\, N_\gamma + q\, s_q\, i_\theta\, N_q$ Eq 4.4.7.1-1

B	5 ft	N_γ	30.22		
L	5 ft	N_q	23.18		Table 4.4.7.1A
γ	110 pcf	N_c	35.49		
q	571.5 psf	s_γ	0.6 (4.4.7.1.1.2-3)	i_γ	0.809503 (4.4.7.1.1.2-4)
		s_q	1.62 (4.4.7.1.1.2-2)	i_q	0.781165 (4.4.7.1.1.2-3)
		s_c	1.65 (4.4.7.1.1.2-1)	i_c	0.769568 (4.4.7.1.1.3-1)
				n	1.5 (4.4.7.1.1.3-4)

q_{ult} = 20851 psf

Factor of Safety - 3

q_{all} = 6950 psf Use 6500 psf

Calcs For	Tier 3 - Exit 46 Foundations	Job No.	57576	HNTB
Made by	E. Strode	Date	1/12/15	
Checked by	N. Hourani	Date	4/27/2015	Sheet No.

Estimated Settlement

Long term settlement will be related to the existing clay soils at the site and will be related to consolidation settlement. The sand layer immediately overlaying the rock has been discounted due to it's depth and the immediate nature of any settlements related to this layer. The settlement was estimated using Section 4.4.7.2.3 of the AASHTO 17th Edition, and results of laboratory testing.

Proposed Loading

The below loading was provide by the HNTB Maine office for the canopy foundations

Dead Load (k)	31	Snow Load (k)	33	Ice Load (k)	0.2

Assumptions:

- Layers 4, 6 and 10 are considered to undergo immediate settlements during the construction period and will not contribute to long term settlment
- Layers 5, 7 and 8 are considered to be overconsolidated and share similar properties
- Layer 9 is considered to be normally consolidated
- The full allowable bearing capacity was assumed for the proposed load
- Stress distribution below the foundation is based on Figure 4.4.7.2.1A (a)

For over consolidated soils use: $$S_c = H_c\left[C_{re}\log\frac{\sigma'_p}{\sigma'_0} + C_{ce}\log\frac{\sigma'_f}{\sigma'_p}\right]$$ Eq 4.4.7.2.3-3

For normally consolidated soils use: $$S_c = H_c C_{ce}\left[\log\frac{\sigma'_f}{\sigma'_p}\right]$$ Eq 4.4.7.2.3-2

Layer	Depth to Center	H_c	C_{ce}	C_{re}	σ'_p	σ'_o	σ'_f	S_c
	ft	ft			psf	psf	psf	in
5 - Sand & Clay (Fill)	8.25	2.5	0.188	0.0374	8000	936.5	1535.0	-3.00
7 - Clay and Silt	17.25	5.5	0.188	0.0374	8000	1779.9	1692.0	-6.76
8 - Upper Soft Clay	23.5	7	0.188	0.0374	8000	2042.4	1944.1	-7.84
9 - Lower Soft Clay	31.5	9	0.125			2343.2	2212.4	-0.34
						Estimated Total		-0.34

Note:

The estimated negative settlement in the clayey layers is due to the final pressure being below the prior highest pressure. This indicates that the soil layer should not undergo additional settlement due to the proposed load.

Recommendations:

We recommend that the proposed new booth foundation use an allowable bearing capacity of 7,500 psf. Based on the setttlement calculations, the proposed foundations should undergo minimal settlement related to construction.

Calcs For	Tier 3 - Exit 46 Foundations	Job No.	57576	HNTB
Made by	E. Strode	Date	1/12/15	
Checked by	N. Hourani	Date	4/27/2015	Sheet No.

Portland - Island Settlement

The proposed additional toll booth and canopy, will be located to the North of the existing tolls booths and will be supported by a shallow foundation

Soil Stratigraphy

Per AASHTO 17th Edition - Section

Use soil conditions - PB-46-02 Water 20 ft

Layer	Top	Layers Bottom	Thickness (ft)	Soil Type	N Value	γ_d (pcf)	ϕ (deg)	c (psf)
1	0	0.8	0.8	Asphalt	NA	120		na
2	0.8	3.5	2.7	Sand (Fill)	NA	115	32	0
3	3.5	5.5	2	Sand & Clay (Fill)	NA	110	28	250
4	5.5	7	1.5	Sand (Fill)	33	115	32	0
5	7	9.5	2.5	Sand & Clay (Fill)	NA	110	28	250
6	9.5	14.5	5	Sand and Silt	55	115	34	0
7	14.5	20	5.5	Clay and Silt	22	110	0	500
8	20	27	7	Upper Soft Clay	WOR	100	0	250
9	27	36	9	Lower Soft Clay	WOR	100	0	250
10	36	37	1	Clayey Sand	16	115	30	0
11	37			Bedrock	NA	145		

Assumptions:
- Toll island will act as a strip footing, eight feet wide by 65 ft long
- The island will be frost protected

Estimated Settlement

Long term settlement will be related to the existing clay soils at the site and will be related to consolidation settlement. The sand layer immediately overlaying the rock has been discounted due to it's depth and the immediate nature of any settlements related to this layer. The settlement was estimated using Section 4.4.7.2.3 of the AASHTO 17th Edition, and results of laboratory testing

Proposed Loading

The below loading was provide by the HNTB Maine office for the canopy foundations

Island Load 0.472 ksf

Assumptions:

- Layers 4, 6 and 10 are considered to undergo immediate settlements during the construction period and will not contribute to long term settlment
- Layers 5, 7 and 8 are considered to be overconsolidated and share similar properties
- Layer 9 is considered to be normally consolidated
- The full allowable bearing capacity was assumed for the proposed load
- Stress distribution below the foundation is based on Figure 4.4.7.2.1A (a)

For over consolidated soils use: $S_c = H_c\left[C_{re}\log\frac{\sigma'_p}{\sigma'_0} + C_{ce}\log\frac{\sigma'_f}{\sigma'_p}\right]$ Eq 4.4.7.2.3-3

For normally consolidated soils use: $S_c = H_c C_{ce}\left[\log\frac{\sigma'_f}{\sigma'_p}\right]$ Eq 4.4.7.2.3-2

Layer	Depth to Center ft	H_c ft	C_{re}	C_{ce}	σ'_p psf	σ'_o psf	σ'_f psf	S_c in
5 - Sand & Clay (Fill)	8.25	2.5	0.188	0.0374	8000	936.5	365.3	-6.52
7 - Clay and Silt	17.25	5.5	0.188	0.0374	8000	1779.9	1380.1	-7.86
8 - Upper Soft Clay	23.5	7	0.188	0.0374	8000	2042.4	1814.2	-8.31
9 - Lower Soft Clay	31.5	9	0.125			2343.2	2115.0	-0.60
						Estimated Total		-0.60

Note:

The estimated negative settlement in the clayey layers is due to the final pressure being below the prior highest pressure. This indicates that the soil layer should not undergo additional settlement due to the proposed load.

Recommendations:

We recommend that the proposed new booth foundation use an allowable bearing capacity of 7,500 psf. Based on the setttlement calculations, the proposed foundations should undergo minimal settlement related to construction.

Calcs For	Tier 3 - Exit 53 - Building	Job No.	57576	HNTB
Made by	E. Strode	Date	1/23/15	
Checked by	N. Hourani	Date	4/27/2015	Sheet No.

Falmouth - Building Foundations

The proposed new Building will be located to the west of the existing buildingand will be supported by a shallow foundation.

Soil Stratigraphy

Per AASHTO 17th Edition - Section

Use soil conditions - PB-53-04 Water 16 ft

Layers Top	Bottom	Thickness (ft)	Soil Type	N Value	γ_d (pcf)	ϕ (deg)	c (psf)
0	0.5	0.5	Topsoil	NA	100		na
0.5	8	7.5	Sand some clay	27	115	30	0
8	13.5	5.5	Sand	22	110	30	0
13.5	19	5.5	Sand, little gravel	126	120	34	0
19	20	1	Bedrock	NA	140		

Allowable Bearing Capacity

Assumptions:
- Booth foundation is approximately 5 ft by 10 ft
- Founded at frost depth (5 ft)

$q_{ult} = c\, s_c\, N_c + 0.5\, \gamma\, B\, s_\gamma\, N_\gamma + q\, s_q\, N_q$ Eq 4.4.7.1-1

B	5 ft	N_γ	22.4	
L	10 ft	N_q	18.4	Table 4.4.7.1A
γ	115 pcf	N_c	30.14	
q	567.5 psf	s_γ	0.8	
		s_q	1.29	
		s_c	1.31	

q_{ult} = 18608 psf

Factor of Safety - 3

q_{all} = 6203 psf Use 6000 psf

Calcs For	Tier 3 - Exit 53 - Building	Job No.	57576	HNTB
Made by	E. Strode	Date	1/23/15	
Checked by	N. Hourani	Date	4/27/2015	Sheet No.

Estimated Settlement

Due to the lack of cohesive soils noted in the area of the proposed building, the settlements are expected to be immediate in nature and to occur during or immediately following construction. Therefore the proposed building is expected to undergo minimal long term settlement and the estimated settlement noted below will occur coincidental with construction.

Proposed Loading

The proposed loading for the building foundations were not provided, we have assumed the full geotechnical capacity will be applied to the foundations for the purposes of settlement estimates.

Assumptions:

- The proposed building will be founded on strip footings located at the buildings perimeter
- The strip footings will be located at a frost depth of 5 feet below the final grade
- Strip footings are assumed to be a minimum of 24 inches wide

Elastic Settlement

$$S_e = \left[q_o(1-\upsilon^2)\sqrt{A}\right]/(E_s\beta_z)$$

ν	0.25		
E_s	709616.8 psf		Table 4.4.7.2.2A
β_z	1.41	Table 4.4.7.2.2B	
A	60 sf		Assume 24 in by 30 ft
q_o	6000 psf		

S_e = 0.52 in

Calcs For	Tier 3 - Exit 53 - Toll Booths	Job No.	57576	HNTB
Made by	E. Strode	Date	1/23/15	
Checked by	N. Hourani	Date	4/27/2015	Sheet No.

Falmouth - Canopy Shallow Foundations

The proposed additional toll booth and canopy, will be located to the North of the existing tolls booths and will be supported by a shallow foundation.

Soil Stratigraphy

Per AASHTO 17th Edition - Section

Use soil conditions - PB-53-01 Water 16 ft

Layers Top	Bottom	Thickness (ft)	Soil Type	N Value	γ_d (pcf)	ϕ (deg)	c (psf)
0	0.8	0.8	Asphalt	na	120		na
0.8	3	2.2	Sand (FILL)	na	115	32	0
3	13	10	Clay & Silt (FILL)	27	105	20	500
13	16	3	Clay and Sand	12	100	30	200
16	19.5	3.5	Fine Sand	12	100	30	0
19.5	23.5	4	Fine Sand	22	120	30	0
23.5	25	1.5	Bedrock		145		

Assumptions:
- Toll island will act as a strip footing, eight feet wide by 65 ft long
- The island will be frost protected

Estimated Settlement

Long term settlement will be related to the existing clay soils at the site and will be related to consolidation settlement. The sand layer immediately overlaying the rock has been discounted due to it's depth and the immediate nature of any settlements related to this layer. The settlement was estimated using Section 4.4.7.2.3 of the AASHTO 17th Edition, and results of laboratory testing.

Proposed Loading

The below loading was provide by the HNTB Maine office for the canopy foundations

Island Load 0.472 ksf

Assumptions:

The Clay and Silt Fill layer is similar to the soils tested in PB-46-02

The fill layer is overconsolidated.

For over consolidated soils use: $S_c = H_c\left[C_{re}\log\frac{\sigma'_p}{\sigma'_0} + C_{ce}\log\frac{\sigma'_f}{\sigma'_p}\right]$ Eq 4.4.7.2.3-3

Assume worst case condition - Full allowable bearing capacity is used

Assume Stress distribution of foundation stress is based on the Figure 4.4.7.2.1A (b)

Layer	Depth to Center	H_c	C_{ce}	C_{re}	σ'_p	σ'_o	σ'_f	S_c
	ft	ft			psf	psf	psf	in
Clay & Silt (FILL)	8	10	0.188	0.0374	4600	874	210.3	-26.99

Note:

The estimated negative settlement in the clayey layers is due to the final pressure being below the prior highest pressure. This indicates that the soil layer should not undergo additional settlement due to the proposed load.

Recommendations:

We recommend that the proposed new canopy foundation use an allowable bearing capacity of 5,000 psf. Based on the settlement calculations, the proposed foundations should undergo minimal settlement related to construction.

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Falmouth - Canopy Shallow Foundations

The proposed additional toll booth and canopy, will be located to the North of the existing tolls booths and will be supported by a shallow foundation.

Soil Stratigraphy

Per AASHTO 17th Edition - Section

Use soil conditions - PB-53-01 Water 16 ft

Layers Top	Bottom	Thickness (ft)	Soil Type	N Value	γ_d (pcf)	ϕ (deg)	c (psf)
0	0.8	0.8	Asphalt	na	120		na
0.8	3	2.2	Sand (FILL)	na	115	32	0
3	13	10	Clay & Silt (FILL)	27	105	20	500
13	16	3	Clay and Sand	12	100	30	200
16	19.5	3.5	Fine Sand	12	100	30	0
19.5	23.5	4	Fine Sand	22	120	30	0
23.5	25	1.5	Bedrock		145		

Allowable Bearing Capacity

Assumptions:
- Canopy foundation is approximately 5 ft by 5 ft
- Founded at frost depth (5 ft)
- Wing load acts at a 90 deg angle of inclination

$q_{ult} = c\, s_c\, i_c\, N_c + 0.5\, \gamma\, B\, s_\gamma\, i_\gamma\, N_\gamma + q\, s_q\, i_\theta\, N_q$ Eq 4.4.7.1-1

B	5 ft		N_γ	5.39			
L	5 ft		N_q	6.4		Table 4.4.7.1A	
γ	105 pcf		N_c	14.83			
q	559 psf	s_γ	0.6	(4.4.7.1.1.2-3)	i_γ	0.8298	(4.4.7.1.1.2-4)
		s_q	1.36	(4.4.7.1.1.2-2)	i_q	0.8298	(4.4.7.1.1.2-3)
		s_c	1.43	(4.4.7.1.1.2-1)	i_c	0.7983	(4.4.7.1.1.3-1)
					n	1.5	(4.4.7.1.1.3-4)

q_{ult} = 16344 psf

Factor of Safety - 3

q_{all} = 5448 psf Use 5000 psf

Calcs For	Tier 3 - Exit 53 - Toll Booths	Job No.	57576	HNTB
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Estimated Settlement

Long term settlement will be related to the existing clay soils at the site and will be related to consolidation settlement. The sand layer immediately overlaying the rock has been discounted due to it's depth and the immediate nature of any settlements related to this layer. The settlement was estimated using Section 4.4.7.2.3 of the AASHTO 17th Edition, and results of laboratory testing.

Proposed Loading

The below loading was provide by the HNTB Maine office for the canopy foundations

Dead Load (k)	31	Snow Load (k)	33	Ice Load (k)	0.2

Assumptions:

The Clay and Silt Fill layer is similar to the soils tested in PB-46-02

The fill layer is overconsolidated.

For over consolidated soils use: $S_c = H_c\left[C_{re}\log\frac{\sigma'_p}{\sigma'_0} + C_{ce}\log\frac{\sigma'_f}{\sigma'_p}\right]$ Eq 4.4.7.2.3-3

Assume worst case condition - Full allowable bearing capacity is used

Assume Stress distribution of foundation stress is based on the Figure 4.4.7.2.1A (b)

Layer	Depth to Center	H_c	C_{ce}	C_{re}	σ'_p	σ'_o	σ'_f	S_c
	ft	ft			psf	psf	psf	in
Clay & Silt (FILL)	8	10	0.188	0.0374	4600	874	1110.0	-10.69

Note:

The estimated negative settlement in the Clay and Silt layer is due to the final pressure being below the prior highest pressure. This indicates that the soil layer should not undergo additional settlement due to the proposed load, this layer will not rebound.

Recommendations:

We recommend that the proposed new canopy foundation use an allowable bearing capacity of 5,000 psf. Based on the settlement calculations, the proposed foundations should undergo minimal settlement related to construction.