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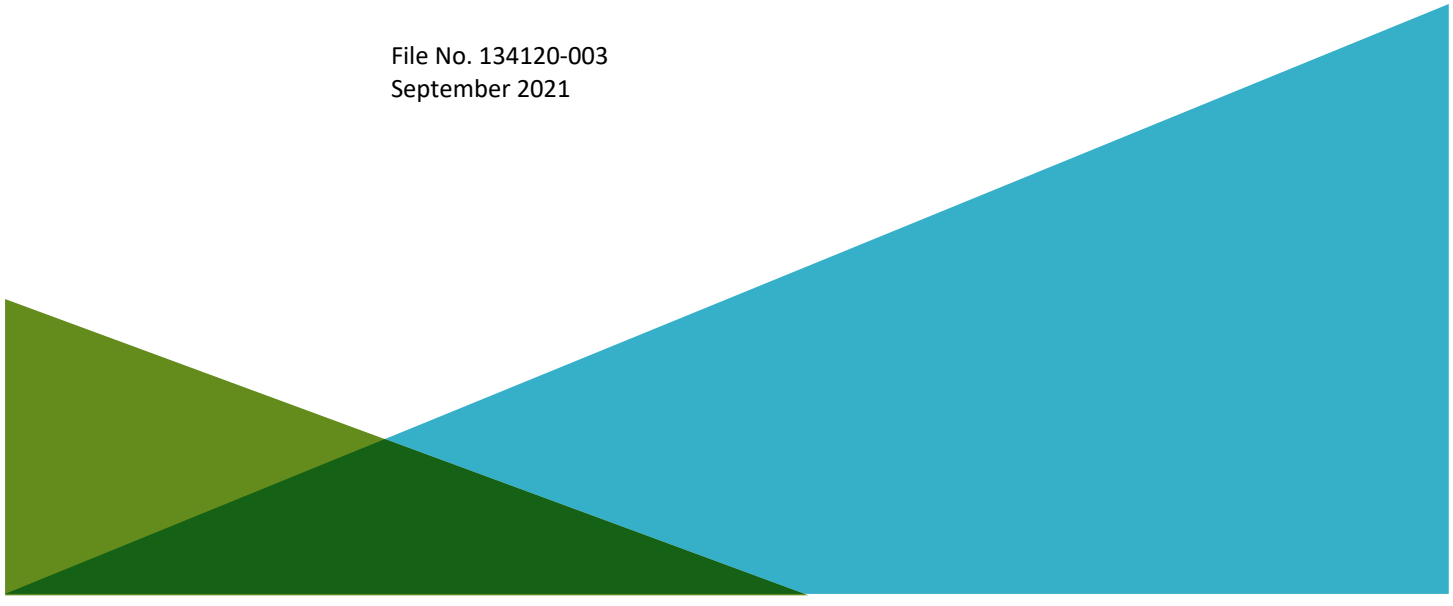
GEOTECHNICAL DESIGN REPORT

INTERSTATE 295 BRIDGE NOS. 5833 AND 1509 OVER U.S. ROUTE 1 MAINEDOT WINS 023106.00 AND 023110.00 YARMOUTH, MAINE

by
Haley & Aldrich, Inc.
Portland, Maine

for
Maine Department of Transportation
Augusta, Maine

File No. 134120-003
September 2021



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13 September 2021
File No. 134120-002

Maine Department of Transportation
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Attention: Laura Krusinski, P.E.
Senior Geotechnical Engineer

Subject: Geotechnical Design Report
Interstate 295 Bridge Nos. 5833 and 1509 over U.S. Route 1
MaineDOT WINs 023106.00 and 023110.00
Yarmouth, Maine

Ladies and Gentlemen:

We are pleased to submit herewith our report entitled, "Geotechnical Design Report, Interstate 295 Bridge Nos. 5833 and 1509 over U.S. Route 1, MaineDOT WINs 023106.00 and 023110.00, Yarmouth, Maine." This Geotechnical Design Report (GDR) has been prepared in accordance with our proposal, dated 9 April 2021 and executed by your Wayne Frankhauser, Jr. on 30 April 2021, and the provisions of our General Consultant Agreement (GCA) with the Maine Department of Transportation (MaineDOT), No. CT20150706000000000010.

Introduction

This GDR presents the results of preliminary design phase (Phase I) and final design phase (Phase II) subsurface exploration and laboratory testing programs and technical evaluations, and provides geotechnical design recommendations completed by Haley & Aldrich, Inc. (Haley & Aldrich) on behalf of the Maine Department of Transportation (MaineDOT) for the proposed replacement of the Interstate 295 (I-295) Bridge Nos. 5833 (northbound; NB) and 1509 (southbound; SB) over U.S. Route 1 in Yarmouth, Maine (see Figure 1, Project Locus). Our technical evaluations were coordinated with HNTB Corporation (HNTB), the bridge designer, throughout the design phase of the project and during development and submission of a 100 percent plans, specification and estimate (PSE) package to MaineDOT.

HORIZONTAL COORDINATE SYSTEM, ELEVATION DATUM AND PROJECT STATIONING

Plan locations of test borings are reported as northing and easting coordinates relative to the Maine State Plane Coordinate System, North American Datum of 1983 (NAD 83), Maine 2000 West Zone. The project elevation datum and elevations referenced herein are in feet and reference the North American

Vertical Datum of 1988 (NAVD 88). Several baselines were developed by HNTB for the multiple existing and proposed alignments as summarized below:

- Proposed SB On-Ramp: Sta. 100+00
- Proposed SB Off-Ramp: Sta. 200+00
- Proposed SB Mainline: Sta. 700+00
- Proposed NB Mainline: Sta. 800+00

PROJECT LOCATION AND EXISTING BRIDGE STRUCTURES

The existing Interstate 295 Exit 17 Bridges (bridges) carry Interstate 295 traffic northbound (NB) and southbound (SB) over U.S. Route 1 in Yarmouth, Maine.

Based on our review of historic bridge drawings provided by MaineDOT, it is our understanding that the existing NB and SB bridges were originally constructed in 1959 and each consists of an approximate 260-ft long, 35-ft wide, three-span structure supported on two stub abutments and two piers. The historic drawings also indicate that the existing abutments and piers are supported on HP10x42 steel H-piles with a "design capacity" equal to 35 tons. Based on the subsurface conditions that are present at the site, it is our opinion that the piles likely penetrate the full thickness of the marine clay and generate most of their load carrying resistance through end bearing in/on the marine sand deposit, glacial till and/or bedrock.

Based on the information shown on the historic bridge drawings piles supporting the abutments and piers include both plumb piles and piles battered at 1H:4V.

Historic bridge drawings that were provided by MaineDOT are included in Appendix C.

PROPOSED BRIDGE STRUCTURES

During design, HNTB developed and evaluated multiple bridge replacement alternatives considering several factors including but not limited to overall project cost, maintenance of traffic, and future bridge maintenance. The bridge replacement alternative recommended by HNTB in the PDR consists of an "on-alignment" replacement of the NB bridge and replacement of the SB bridge to the west of the existing SB bridge.

The bridge superstructures will be constructed using metalized steel plate girders (five beam lines) running parallel to the long dimension of the bridge, with an 8-in. thick composite concrete deck and a 3-in. thick bituminous concrete wearing surface separated by a ¼-in. thick high performance waterproofing membrane. The bridge superstructure will be supported on two stub abutments and one pier at the stations summarized below.

Substructure	Station at Centerline of Alignment (ft)	
	Northbound Structure	Southbound Structure
Abutment No. 1	Sta. 826+16.5	Sta. 726+21
Pier No. 1	Sta. 829+83.5	Sta. 727+41.5
Abutment No. 2	Sta. 831+45.5	Sta. 729+02

The proposed bridge structures will be approximately 41-ft wide (shoulder-to-shoulder) and will consist of two, 12-ft wide travel lanes, a 4-ft wide inside shoulder and a 10-ft wide outside shoulder. Based on our review of profile and cross section drawings developed by HNTB for the recommended bridge replacement alternatives, we anticipate the following maximum raises in site grade will be required to construct the bridge approach embankments and meet proposed finish grades:

- SB mainline: up to approximately 23 ft
- NB mainline: up to approximately 2 ft
- SB on ramp: up to approximately 2 ft
- SB off ramp: up to approximately 5 ft

Please note that the amount of fill placement required to construct the NB mainline and SB on and off ramps is limited because the proposed alignments generally fall within the limits of the existing alignments. A larger amount of fill will be needed to construct the SB mainline because the proposed roadway alignment generally falls outside the limits of the existing embankment.

Existing and proposed site conditions are shown on Figures 2 and 3, Site and Subsurface Exploration Location Plans.

Subsurface Exploration Programs

HISTORIC EXPLORATIONS

A subsurface investigation, consisting of test borings was completed in December 1956 and January 1957 to provide information for the design and construction of the existing bridges. A total of seven test borings, designated RI-1 through RI-7, were completed along the alignment of the existing bridges. Test borings were drilled to depths ranging from approximately 23 to 45 ft below ground surface (BGS) at the time of the explorations. The drilling and sampling methods that were used to advance the test borings are shown on the historic test boring logs included in Appendix D. The approximate plan locations of the historic test borings are shown on Figure 2.

PRELIMINARY PHASE (PHASE I) SUBSURFACE EXPLORATIONS

Haley & Aldrich completed a preliminary design phase (Phase I) subsurface exploration program at the site in October 2019. A total of six test borings, designated BB-YRO-101 through BB-YRO-106, were drilled adjacent to and along the existing NB and SB bridge structures and approach embankments.

The Phase I test boring locations were laid out in the field by Haley & Aldrich by taping distances from existing site features prior to the start of drilling. "As-drilled" test boring locations and ground surface elevations at test boring locations were determined in the field by MaineDOT using GPS survey equipment upon the completion of drilling and were provided to Haley & Aldrich. The as-drilled plan locations and ground surface elevations of the Phase I explorations are summarized in Table I and are shown on Figures 2 and 3.

The Phase I test borings were drilled by Northern Test Borings, Inc. (NTB) of Gorham, Maine using a Diedrich D-50 track-mounted drill rig. Test borings were advanced to depths ranging from approximately 28 to 53 ft BGS using cased-washed drilling methods and a combination of 3 in. (NW-size) and 4 in. (HW-size) outside diameter (OD) steel casing.

Soil samples were generally collected continuously and/or at standard, 5-ft intervals, by driving a 1-3/8-in. ID split-spoon sampler with a 140-lb hammer dropped from a height of 30 in., as indicated on the test boring logs. The number of hammer blows required to advance the sampler through each 6 in. interval was recorded and is provided on the logs. The uncorrected SPT N-value (N-uncorrected) is defined as the total number of blows required to advance the sampler through the middle 12 in. of the 24-in. sampling interval. The drill rig was equipped with a calibrated automatic hammer per MaineDOT requirements. The energy-corrected SPT N-value (N_{60}) is equal to the uncorrected N-value multiplied by the hammer efficiency factor (0.901; 90.1 percent theoretical hammer efficiency) divided by 0.6.

In-situ vane shear tests were conducted within the marine clay deposit in some test borings. In-situ vane shear tests were conducted with either a 55 mm by 110 mm or 65 mm by 130 mm Geonor rectangular vane (per MaineDOT requirements) attached to a 2-ft long, 12-mm diameter rod extension, attached to a string of 5/8-in. outside diameter (OD) hollow chrome-moly rods. At each in-situ vane shear test location, the vane was pushed (by hand) until the bottom of the vane was approximately 1 to 2 ft below the bottom of the borehole. The vane was then rotated at a rate of about 90 degrees per minute using a calibrated torque wrench. Results of the vane shear testing, including raw torque values and calculated shear strengths, are provided on the test boring logs in Appendix A.

A total of two, relatively undisturbed samples of marine clay were obtained from test borings BB-YRO-103 and BB-YRO-105 (one from each test boring). The samples were obtained by advancing a 3-in. OD thin-wall Shelby tube into the clay using a piston sampler.

Test borings BB-YRO-101, -102, -105, and -106 were advanced approximately 10 ft into bedrock using a 2.0-in. (NQ-size) ID diamond-tipped core barrel.

All soil and bedrock samples from the Phase I test borings were collected and preserved in glass jars and wooden boxes, respectively. The samples that were not submitted for laboratory testing are available for review upon request and are currently being stored at the Haley & Aldrich storage facility in Portland, Maine.

All Phase I drilling and sampling activities were performed in accordance with MaineDOT requirements.

DESIGN PHASE (PHASE II) SUBSURFACE INVESTIGATION

Haley & Aldrich completed a design phase (Phase II) subsurface exploration program at the site in June 2021. A total of eleven test borings, designated BB-YRO-201 through BB-YRO-211, were drilled adjacent to and along the existing NB and SB bridge structures and approach embankments, and at proposed stormwater basin locations.

The Phase II test borings were laid out in the field by Haley & Aldrich using GPS survey equipment prior to the start of drilling. "As-drilled" test boring locations and ground surface elevations were determined in the field by MaineDOT using GPS survey equipment upon the completion of drilling and were provided to Haley & Aldrich. The as-drilled plan locations and ground surface elevations of the Phase II explorations are summarized in Table I and are shown on Figures 2 and 3.

The Phase II test borings were drilled by NTB to depths ranging from approximately 16 to 37 ft BGS using similar means and methods that were used to drill, sample, and conduct in-situ testing in the Phase I test borings. The drill rig was equipped with a calibrated automatic hammer per MaineDOT requirements. The energy-corrected SPT N-value (N_{60}) is equal to the uncorrected N-value multiplied by the hammer efficiency factor (0.976; 97.6 percent theoretical hammer efficiency) divided by 0.6.

A total of two, relatively undisturbed samples of marine clay, were obtained from test borings BB-YRO-204 and BB-YRO-206 using similar means and methods to those described in the previous section of this report.

Test borings BB-YRO-204, BB-YRO-205, and BB-YRO-207 were advanced up to approximately 10 ft into bedrock using a 2.0-in. (NQ-size) ID diamond-tipped core barrel or a roller bit.

Four observation wells were installed in the completed boreholes BB-YRO-203, BB-YRO-206, BB-YRO-210, and BB-YRO-211 to provide information on the static groundwater levels at the site. The observation wells consisted of 2-in. ID, machine-slotted PVC pipe and solid PVC riser pipe extending approximately 3 ft above existing ground surface. The observation wells were outfitted with a steel guardpipe and lock/cap assembly. The observation well installation and groundwater monitoring reports are provided in Appendix B.

All soil and bedrock samples from the Phase II test borings were collected and preserved in glass jars and wooden boxes, respectively. The samples that were not submitted for laboratory testing are available for review upon request and are currently being stored at the Haley & Aldrich storage facility in Portland, Maine.

All Phase II drilling and sampling activities were performed in accordance with MaineDOT requirements.

Generalized Subsurface Conditions

The subsurface conditions present at the site generally consist of a thin layer of topsoil and/or fill overlying naturally-deposited marine silt/clay, marine sand, glacial till and bedrock. Refer to Table II for

a detailed summary of the soil units and encountered thicknesses at each test boring location. A general description of each soil/bedrock unit is provided separately, below. Detailed soil and bedrock descriptions are provided on the test boring logs included in Appendix A. Refer to Figures 3 and 4, Interpretive Subsurface Profiles, for a graphical representation of the subsurface conditions present along the proposed NB and SB highway/bridge alignments.

Soil Unit		Approximate Encountered Thickness (ft)	Generalized Description
Topsoil		0.2 to 1.6	Very soft to stiff SILT (ML) with variable amounts of clay, sand, gravel, and organic matter *(encountered in each test boring except BB-YRO-106 and -205)*
Fill		1 to 14	Loose to medium dense, fine to coarse SAND (SP, SM) with variable amounts of fine to coarse gravel and silt; sandy GRAVEL trace silt (GP); very soft to very stiff, SILT (ML) with variable amounts of clay, sand and gravel, some asphalt; silty CLAY (CL) *(encountered in each test boring except BB-YRO-202 and -209)*
Marine Deposit	Silt / Clay	11 to 30	Medium stiff to hard SILT (ML) with variable amounts of fine sand; very soft to hard CLAY (CL) with variable amounts of silt and sand with trace organics *(encountered in each test boring except BB-YRO-201)*
	Sand	1 to 19	Loose to dense, fine to medium SAND (SP, SM, SW) with variable amounts of clay, silt and gravel (*encountered in each test boring except BB-YRO-202 and -211)*
Glacial Till		0.1 to >2	Medium dense to very dense fine to medium SAND (SM, SP) with variable amounts of fine to coarse gravel and silt; fine GRAVEL (GP) with variable amounts of fine to coarse sand and silt (*encountered in test borings BB-YRO-102 through -106, -203, and -209)*
Bedrock		Top of bedrock surface encountered at depths ranging from 15 to 43 ft BGS (El. 19 to El. 45) and generally slopes down from west to east. *(encountered in each test boring except BB-YRO-209 through -211)*	

Please note that soil descriptions provided on the test boring logs and summarized above do not represent actual field conditions other than at the specific test boring locations. The actual conditions will likely vary from those described herein.

BEDROCK CONDITIONS

Approximately 10 ft of bedrock was sampled in test borings BB-YRO-101, BB-YRO-102, BB-YRO-105, BB-YRO-106, BB-YRO-204. BB-YRO-205, and BB-YRO-207. Where encountered and as shown in Table II, the top of bedrock surface varies between approximately 15 and 43 ft BGS (El. 19 and El. 45) and generally slopes down from west to east. The top of bedrock surface is generally flat along the proposed SB alignment, and slopes down from north to south along the proposed NB alignment. The

interpolated the top of bedrock surface along the proposed NB and SB alignments is shown graphically in the interpretive subsurface profiles shown in Figures 3 and 4, respectively.

The sampled and recovered bedrock generally consisted of the following:

- Moderately hard to very hard, fresh to moderately weathered GRANOFELS and GRANITE. Primary joints dip at low to moderate angles and are moderately close to closely spaced. Secondary joints dipping steeply and widely spaced. Joints are tight to open and some joint surfaces have silt infillings and/or are weathered. Occasional coarse grained pegmatitic intrusions are present.

Rock quality designation (RQD) is a common parameter that is used to help assess the competency of sampled bedrock. RQD is defined as the sum of pieces of recovered bedrock greater than 4 in. in length divided by the total length of the bedrock core run. RQD values for bedrock encountered at the site ranged from 35 to 100 percent (average = 79 percent) indicating poor to excellent rock quality (average = good rock quality) as determined using the MaineDOT Geotechnical Section "Key to Soil and Rock Descriptions and Terms Field Identification Information," dated January 2020.

More detailed information on the sampled and recovered bedrock is provided on the test boring logs in Appendix A. Photographs of the bedrock sampled and recovered during the Phase I and Phase II subsurface exploration programs are also provided for reference in Appendix A.

GROUNDWATER CONDITIONS

As discussed previously, four observation wells were installed in the completed boreholes BB-YRO-203, BB-YRO-206, BB-YRO-210, and BB-YRO-211 to provide information on the static groundwater levels at the site. The measured water levels during the period 4 June 2021 to 26 July 2021 in each of the observation wells is summarized below.

Observation Well No.	Ground Surface Elevation	Approximate Range in Measured Water Level	
		Depth BGS	Elevation
BB-YRO-203(OW)	60.7	11 to 12	El. 49 to El. 50
BB-YRO-206(OW)	65.5	12 to 13	El. 52 to El. 54
BB-YRO-210(OW)	61.7	24	El 37
BB-YRO-211(OW)	59.4	0 to 3	El. 57 to El. 60

In general, water levels fluctuate with season, precipitation, local soil/bedrock conditions, and excavation means and methods. Therefore, water levels encountered during construction may vary from those summarized above, provided on the testing boring logs included in Appendix A and shown on the groundwater monitoring reports included in Appendix B.

Laboratory Test Results

Phase I and Phase II laboratory testing programs were conducted by Haley & Aldrich on representative soil and rock samples collected during the subsurface exploration programs to aid in soil classification and determination of engineering soil and rock properties. Laboratory testing was selected based on conditions encountered and was performed in accordance with applicable American Society for Testing Materials (ASTM) testing procedures by GeoTesting Express, Inc. of Acton, Massachusetts. A summary of the lab testing results completed for the project is provided below.

Laboratory Test	ASTM Test Designation	Soil/ Bedrock Unit	No. of Tests Completed	Range in Test Results[1]
Grain Size	ASTM D422	Marine Deposit (silt/clay)	1	AASHTO Classification: A-4 USCS Classification: CL
		Marine Deposit (sand)	10	AASHTO Classification: A-2-4, A-2, A-3, A-4 USCS Classification: ML, SC, SM, SP
		Glacial Till	1	AASHTO Classification: A-1-b USCS Classification: SM
Atterberg Limits	ASTM D4318	Fill	1	LL = 18% PL = 13% PI = 5% WC = 21%
		Marine Deposit (silt/clay)	15	27% < LL < 49% 17% < PL < 27% 10% < PI < 28% 26% < WC < 42%
One Dimensional Consolidation	ASTM D2435 (Method B)		4	3.8 ksf < Pp < 9.2 ksf 0.021 < RR < 0.025 0.18 < CR < 0.22 114.7 pcf < γ_T < 116.9 pcf
Compressive Strength and Elastic Moduli of Rock	ASTM D7012 (Method D)	Bedrock	4	Peak Compressive Stress: 12,709 to 23,541 psi Young's Modulus: 5,760,000 to 68,100,000 psi Bulk Density: 161 to 169 pcf

Notes:
[1] – ksf = kips per square foot; pcf = pounds per cubic foot; psi = pounds per square inch; LL = liquid limit; PL = plastic limit; PI = plasticity index; WC = water content; Pp = pre-consolidation pressure; RR = recompression ratio; CR = compression ratio; γ_T = total unit weight

Laboratory test results are shown on the individual test boring logs in Appendix A with complete results provided in Appendix C.

Geotechnical Evaluations and Design Recommendations

Geotechnical design recommendations, as discussed and provided herein, were developed in accordance with the following documents:

- AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, Ninth Edition, 2020, referred to herein as AASHTO LRFD,
- MaineDOT Bridge Design Guide (BDG), August 2003, with Interim Revisions through June 2018, referred to herein as Bridge Design Guide.

Engineering calculations that support the design recommendations outlined in this report are provided for reference in Appendix E.

SEISMIC SITE CLASS AND DESIGN PARAMETERS

Site class was determined in accordance with AASHTO LRFD Section 3.10.3.1 using Method B. In instances where SPT N60-values were equal to 0 or were greater than 100 blows per foot (bpf), default values of 1 and 100 bpf were used, respectively.

Based on the nature and thickness of the overburden soils and depth to bedrock encountered in the test borings, we recommend that the site be considered "Site Class D." Spectral accelerations were determined based on the geographic site location and the recommended "Site Class D" designation using the United States Geological Survey (USGS) Seismic Design Web Service, which is based on the AASHTO recommended response spectra for a 7 percent probability of exceedance in 75 years (approx. 1,000-year return period). The recommended seismic design parameters are summarized below.

Design Parameter	Design Value
Site factor for short-period range of accel. response spectrum, F_a =	1.6
Site factor for long-period range of accel. response spectrum, F_v =	2.4
Site factor at zero-period on accel. response spectrum, F_{pga} =	1.6
Horizontal response spectral accel. coeff. at 0.2-s period on rock, S_S (g) =	0.17
Horizontal response spectral accel. coeff. at 1.0-s period on rock, S_1 (g) =	0.045
Peak seismic ground accel. coeff. on rock, PGA (g) =	0.084
Horizontal response spectral accel. coeff. at 0.2-s period modified by F_a, S_{DS} (g) =	0.27
Horizontal response spectral accel. coeff. at 1.0-s period modified by F_v, S_{D1} (g) =	0.11
Peak seismic ground accel. coeff. modified by F_{pga}, As (g) =	0.14

In accordance with AASHTO LRFD Section 3.10.6, the site falls within Seismic Zone 1 based on the calculated value of S_{D1} (i.e., 0.11 < 0.15 = Seismic Zone 1 from AASHTO LRFD Table 3.10.6.1).

Based on our review of the available subsurface data it is our opinion that the naturally-deposited soils present at the site have sufficient fines content and/or are sufficiently "dense" such that the potential for liquefaction to occur during the design earthquake event is low.

APPROACH EMBANKMENT DESIGN CONSIDERATIONS

Subsurface soil conditions along the proposed bridge and approach roadway alignments can affect the planning and design of the proposed embankments (approach roadways). Maximum raises in grade required to construct the proposed SB mainline vary from approximately 14 ft (south approach) to 23 ft (north approach). Global embankment stability and settlement analyses were conducted to assess the feasibility of constructing the embankments using normal weight earthfill over the marine deposit soils (silt/clay) present at the site. Please note that because of the limited amount of fill required to construct the NB mainline and SB on and off ramps, global stability and settlement evaluations were not completed for those embankments.

Global Embankment Stability

Embankment construction using normal weight earthfill can cause excessive vertical and lateral strains that could potentially result in a shear failure of the foundation soil and subsequent failure of the embankments. A series of computer-assisted, two-dimensional global stability evaluations were performed using the computer program Slide2 developed by Rocscience, Inc. to evaluate the likelihood of global stability failures for the proposed SB bridge approach embankments.

Static and pseudo-static seismic (pseudo-static) global stability evaluations were conducted transverse to the proposed SB bridge/highway baseline at the approximate locations where maximum raises in grade are anticipated (i.e., Sta. 725+50 and Sta. 729+50), which were judged by Haley & Aldrich to be the "critical" sections. Longitudinal global stability evaluations were also completed for the SB bridge/highway embankment in both the north-south (Abutment 1) and south-north (Abutment 2) directions.

The soil profiles used in our global stability models were developed based on the subsurface conditions encountered in the test borings. The physical and strength properties used to complete the global stability evaluations are summarized below.

Material	Total Unit Weight (pcf)	Friction Angle (degrees)	Undrained Shear Strength (psf)
New Embankment Fill	125	32	0
Existing Fill	115	28	0
Abutment/Pier Concrete	Infinite strength		
Marine Silt/Clay (above El. 55)	115	0	1,250
Marine Silt/Clay (below El. 55)	115	0	600
Marine Sand	118	30	0
Glacial Till	125	32	0
Bedrock	infinite strength		

In addition, a 250 pound per square foot (psf) live load surcharge was assumed to act over the embankment width in both the static and pseudo-static load cases.

Please note that the factor of safety for the pseudo-static load case was calculated using a horizontal acceleration coefficient, k_h, of 0.068 g (i.e., one-half of the acceleration coefficient, As). A value of As/2 was selected in accordance with AASHTO LRFD guidance in Section 11.6.5.2.2. The reduction from As is due to soil slope flexibility and the fact that the peak ground acceleration during an earthquake lasts only for a very short period of time.

The static and pseudo-static global stability factors of safety calculated from our evaluations are summarized below.

Location	Orientation	Calculated Factor of Safety[1]	
		Static	Pseudo-Static
Sta. 725+50	Transverse	1.3	1.1
Sta. 729+50		1.9	1.5
Abutment No. 1	Longitudinal	1.5	1.2
Abutment No. 2		1.4	1.1

Notes:
[1] – Calculated factors of safety shown for Bishop method of analysis.

The minimum required factor of safety as specified by both AASHTO LRFD and the Bridge Design Guide for embankments under static conditions that do and do not support structures are 1.5 and 1.3, respectively. In addition, the minimum required factor of safety for embankments subjected to pseudo-static seismic loading are 1.1 and 1.0, respectively. The results indicate that the proposed embankments meet the required minimum acceptable factors of safety using standard embankment construction and normal weight earthfill.

The slope stability software used for these analyses models the approach embankments as an infinitely wide embankment. Since the embankments have finite width, it is our opinion that the calculated factors of safety summarized above may be slightly conservative. Therefore, actual factors of safety for a three-dimensional model would be somewhat higher than those presented above. In addition, the presence of existing and proposed abutment and pier piles were neglected in the longitudinal slope stability evaluations. Because of this, it is our opinion that the calculated factors of safety presented above may be slightly conservative and that the actual static and pseudo-static factors of safety would likely be slightly greater than the values shown.

Settlement

The marine deposits (silt/clay) that underlie the proposed SB approach embankments will undergo elastic compression and consolidation settlement when embankment loads are applied (i.e., normal weight earthfill is placed). Settlement due to the placement of normal weight earthfill for the north and south approach embankments to the SB bridge structure was evaluated using the computer software program Settle3 v. 5.002 by Rocscience, Inc. The following compressibility parameters and assumptions were used in the settlement analyses:

Property	Design Value
Reference Test Boring(s)	BB-YRO-103, BB-YRO-105, BB-YRO-204 and BB-YRO-206
Preconsolidation Pressure (Pp)	8,700 psf; constant with depth
Virgin Compression Ratio (CR)	0.20
Recompression Ratio (RR)	0.023
Coefficient of Consolidation (c_v)	1x10-5 ft^2/sec to 1x10-6 ft^2/sec

The results of the settlement analyses are summarized below.

Location	Elastic Settlement (in.)	Consolidation Settlement (in.)	Total Settlement[1] (in.)	Anticipated Post-Construction Settlement (in.)
North Approach to SB Bridge	¼ to 1¾	1¾ to 3¾	2 to 5½	< ½
South Approach to SB Bridge	¼ to 1¼	1¾ to 3	2 to 4¼	

Notes:
[1] – total settlement does not include secondary compression.

The criteria for post-construction total settlement of highway embankments within 200 ft of span bridges as provided by MaineDOT is as follows:

- 2 in. from 0 to 5 years
- 2 in. from 5 to 20 years
- 2 in. from 20 to 75 years

Elastic settlements due to construction of the embankments are anticipated to occur relatively quickly, as embankment construction proceeds. Therefore, we do not consider that elastic settlement will contribute to post-construction settlement. We anticipate that approximately 10 to 15 percent of the calculated consolidation settlement of the marine deposit (silt/clay) will occur during the approximate 1 to 2-year construction duration, before final paving begins. This is because the marine deposit (silt/clay) is relatively thin, is over-consolidated (i.e., consolidation settlement is anticipated to be recompression, which generally corresponds to a greater coefficient of consolidation as compared to normally-consolidated soils undergoing virgin compression), and because double-drainage of the marine deposit is likely since a granular material (marine sand) is present beneath the marine deposit. Post-construction settlement is anticipated to be negligible (i.e., less than approximately ½ in.). Based on the magnitude of the calculated settlement summarized above and the time over which it is anticipated to occur, it is our opinion that post-construction settlement will be less than the criteria noted above. Because of this, it is our opinion that special embankment construction techniques (e.g., installation of prefabricated vertical drains, use of lightweight fill materials, staged embankment construction, temporary earthfill preload/surcharge, etc.) are not necessary.

BRIDGE ABUTMENT AND PIER FOUNDATION SUPPORT

As discussed above and shown on the interpretive subsurface profiles (Figures 3 and 4), the subsurface conditions along the proposed NB and SB bridge alignments consist primarily of marine silt/clay soils overlying marine sand, glacial till and bedrock. Based on our experience working on similar projects with similar subsurface conditions, it is our opinion that the marine silt/clay and marine sand soils are not suitable to support the bridge superstructure loads. We do, however, consider the glacial till soils and bedrock suitable to support the replacement bridges. Based on the depth to the suitable foundation bearing strata and the anticipated magnitude of the design loads, it is our opinion that driven pile foundations are the most practicable and cost-effective foundation alternative.

Based on the information summarized above, we recommend the following pile types and sizes be used to support the bridge abutments and piers.

- HP14x89 steel H-piles to support the NB bridge abutments and the NB and SB bridge piers.
- HP14x117 steel H-piles to support the SB bridge abutments.

Corrosion and Deterioration

The geotechnical engineering design of the proposed piles included consideration of corrosion in accordance with AASHTO LRFD Section 10.7.5. Based on our visual observation of the soil samples and our experience on similar projects with similar soil conditions, it is our opinion that the in-situ soils have low corrosive potential. Therefore, the net factored pile resistances recommended in the following sections do not include a reduction in pile cross sectional area for steel degradation.

Downdrag

Downdrag occurs due to relative vertical displacement between a pile and the surrounding soil. In accordance with AASHTO LRFD Section 3.11.8, where the relative displacement exceeds 0.4 in., downdrag is likely to be fully developed. Assuming that the SB bridge abutment piles are driven after roughly one-third to one-half of the approach embankment fills are placed (i.e., from existing ground surface up to the proposed bottom of substructure elevation; abutments are stub and not full height), it is our opinion that a sufficient amount of settlement (i.e., > 0.4 in.) will occur during placement of the remaining approach embankment fill (i.e., from the bottom of the abutment substructures up to proposed finish grade) to fully mobilize downdrag forces on the piles.

For the downdrag evaluations, the pile displacement was assumed to be zero (i.e., end bearing piles with no elastic pile compression). The estimated pile-soil relative displacements exceeded 0.4 in. along the upper approximately 26 to 28 ft of the pile located below the bottom of the abutments and above the bottom of the marine silt/clay layer. Therefore, downdrag was assumed to be fully mobilized in that zone. Downdrag load was calculated using static analysis methods and the load factors shown below. In cohesive soils, the α method was used, and in cohesionless soils, the Nordlund/Thurman method was used, in accordance with AASHTO LRFD recommendations. The calculated downdrag loads are summarized in below.

Substructure Location	Load Factor	HP14x117 Factored Downdrag Load (kips)[1]
SB Abutment No. 1	1.05 (granular) 1.40 (cohesive)	104
SB Abutment No. 2		

Notes:
[1] – The perimeter or "box" area of the H-pile was used to compute the surface area of the pile side.

We therefore recommend that the SB bridge abutment piles be designed to account for a factored downdrag load of 104 kips per pile.

Please note that because the raise in grade along the NB approach embankments is limited (i.e., < 1 to 2 ft; maximum) it is our opinion that sufficient settlement (i.e., > 0.4 in.) will not occur after the abutment piles are installed to mobilize downdrag forces. Therefore, the NB bridge abutment piles do not need to be designed to account for downdrag loads.

Pile Group Evaluations

Haley & Aldrich completed pile group evaluations for each proposed bridge substructure. Substructure loading information was developed by HNTB for the Service, Strength and Extreme Event limit states. In addition, HNTB completed the structural design of all substructure pile caps. The substructure loads developed by HNTB are provided in Appendix E.

Pile group analyses were performed using the computer program FB-MultiPier, which is a nonlinear finite-element analysis soil-structure interaction program. The program couple's nonlinear structural finite-element analysis with nonlinear static soil models for axial, lateral and torsional soil behavior to provide a system of analysis for coupled bridge pier structures and foundation systems. FB-MultiPier models were developed by Haley & Aldrich, including substructure loading data and pile group geometry (pile cap dimensions, pile layout and spacing, etc.) based on information provided by HNTB. The models included subsurface soil, rock and groundwater conditions based on the conditions encountered in the Phase I and Phase II test borings as well as the static axial compressive pile resistances presented herein. Multiple iterations were completed at each substructure location to determine the most efficient pile type and pile size required to adequately resist the applied loads and moments. The program output was evaluated, summarized, and discussed with HNTB prior to finalizing. The results of pile group evaluations are presented below.

Steel H-pile Section	Bridge Structure	Substructure Location	Max. Factored Compressive Load (kips)			Max. Factored Uplift Load (kips)			Max. Lateral Pile Head Displacement (in.)	
			SER	STR	EE	SER	STR	EE	Long.	Trans.
HP14x89	NB	Abut. 1 and 2	233	330	135	0	0	0	0.03 to 0.20	0
		Pier 1	252	317	351	17	8	28	0.12 to 0.34	0.02 to 0.06
	SB	Pier 1								
HP14x117	SB	Abut. 1 and 2	234	331	134	0	0	0	0.02 to 0.17	0

Our evaluations show that the design of the abutment and pier pile groups is controlled by lateral loading and the need to limit the maximum lateral pile head displacements in both the longitudinal and transverse directions to less than ¼ to ½ in., respectively, which are the maximum permissible deflections specified by HNTB.

Axial Uplift Pile Resistance

Uplift loads on NB and SB pier piles at the service, strength, and extreme event limit states, which range from 8 to 28 kips (see above), will be resisted by friction between the piles and the surrounding soil along the embedded pile length. As shown above, piles supporting the NB and SB bridge abutments are not subjected to uplift forces. The nominal uplift resistance of an HP14x89 steel H-pile at the NB and SB piers was evaluated in accordance with the static analysis method presented in AASHTO LRFD Section 10.7.3.8.6b (α-method) with the resistance factors specified in Section 10.5.5.1 (Service Limit State resistance factor equal to 1.0), Table 10.5.5.2.3-1 (Strength Limit State resistance factor equal to 0.25 or 0.35) and Section 10.5.5.3 (extreme event limit state resistance factor equal to 0.80). The factored uplift resistances of an HP14x89 steel H-pile at the NB and SB pier locations are summarized below.

Bridge Structure	Substructure Location	Factored Uplift Resistance *(Max. Factored Uplift Load)* (kips)		
		SER	STR	EE
NB	Pier 1	126 *(17)*	34 *(8)*	100 *(28)*
SB		54 *(17)*	13 *(8)*	43 *(28)*

As shown above, the factored uplift resistances exceed the maximum factored uplift loads (demands) at the service, strength, and extreme event limit states at both substructure locations.

Axial Compression Pile Resistance

As discussed previously, it is our opinion that steel H-piles will need to be driven to/into bedrock to provide the minimum required axial compressive resistance, primarily through end bearing resistance, considering the nature, consistency, and limited thickness of overburden soils.

Structural Resistance

In accordance with AASHTO LRFD Section 10.7.3, a distinction is made between piles driven to "soft" rock and those that are driven to "hard" rock. Based on our experience on similar projects with similar bedrock conditions, the sampling, recovery and RQD measurements summarized herein, observation of the recovered rock core samples, and the results of laboratory testing, it is our opinion that the bedrock at the site should be classified as "hard". The geotechnical resistance of piles driven to end bearing in "hard" rock is controlled by the structural resistance as discussed in AASHTO LRFD Section 10.7.3.2.3. The structural resistance factor (Section 6.5.4.2) for axial resistance of piles in compression and subject to damage due to severe driving ("hard" rock bearing stratum) is 0.5. In addition, resistance factors for Service and Extreme Limit State loading are 1.0. Therefore, the nominal and factored structural resistances of HP14x89 and HP14x117 steel H-piles at the Service, Strength and Extreme Event Limit States are summarized below.

Steel H-pile Section	Nominal Structural Resistance (kips)	Factored Structural/Geotechnical Resistance (kips)		
		Service Limit State (ϕ=1.0)	Strength Limit State (ϕ=0.5)	Extreme Limit State (ϕ=1.0)
HP14x89	1,305	1,305	653	1,305
HP14x117	1,720	1,720	861	1,720

Drivability Resistance

The engineering design of the proposed abutment and pier piles also includes consideration of drivability resistance in accordance with AASHTO LRFD Section 10.7.8. The drivability evaluations were conducted using the computer program GRL WEAP 2010 developed by GRL

Engineers, Inc. The drivability analyses were conducted to determine 1) if the piles could be impact driven through overburden soils to bedrock and 2) what nominal resistance could be achieved using hammer sizes typical of local pile driving contractors without damaging or overstressing the piles while keeping the penetration resistance below 15 blows per inch (bpi), which is the upper limit of penetration resistance typically allowed by the MaineDOT Standard Specifications.

The drivability evaluations were conducted assuming that a Delmag D36-32 single acting diesel hammer with a maximum rated energy equal to 90,560 ft-lbs. will be used to install the piles. The Delmag D36-32 hammer has a ratchet style fuel pump with four settings, which are designed to limit the ram stroke to 5.2 ft (fuel setting 1), 7.0 ft (fuel setting 2), 8.8 ft (fuel setting 3), and 11.4 ft (fuel setting 4; maximum). Drivability evaluations were completed at each proposed substructure location based on the subsurface conditions present at the site. The drivability resistance for the HP 14x89 and HP14x117 steel H-piles is at each substructure is summarized below.

Bridge Structure	Substructure Location	Steel H-pile Section	Drivability Resistance (kips)	
			Nominal	Factored (ϕ_{dyn}=0.65)
NB	Abutment No. 1	HP14x117	800	520
	Pier No. 1	HP14x89	600	390
	Abutment No. 2	HP14x117	800	520
SB	Abutment No. 1	HP14x89	600	390
	Pier No. 1			
	Abutment No. 2			

Our evaluations show that at the nominal drivability resistance at each substructure location, the maximum permissible compressive driving stresses are below the maximum permissible limit specified in AASHTO LRFD Section 10.7.8, which is 45 ksi (90% of F_y for 50 ksi steel piles). Predicted penetration resistances at each substructure location range from approximately 4 to 5 bpi (maximum permissible allowed by MaineDOT is 15 bpi).

Please note that the drivability resistances summarized above are based on an assumed pile hammer size, hammer energy setting and the assumption that the piles penetrate through the entire soil overburden and end bear in/on bedrock. If the actual, factored axial compressive pile loads vary or if the actual pile-hammer system used to install the piles is different than the assumed system, additional evaluations will be required to determine the nominal and factored drivability resistances that can be achieved at a reasonable penetration resistance without overstressing the piles.

Summary and Recommended Axial Compressive Resistance

The factored axial compressive pile resistance is controlled by the lesser of the Strength Limit State drivability and structural resistances since the piles will be installed using impact hammers

and the minimum nominal resistance will be confirmed using dynamic testing. The abutment and pier factored resistances (structural and drivability) are summarized below for each bridge structure and substructure.

Steel H-pile Section	Bridge Structure	Substructure Location	Factored Structural Resistance (kips)	Factored Drivability Resistance (kips)	Governing Factored Resistance (kips)	Factored Strength Limit State Pile Load (kips)
HP14x89	NB	Abutment Nos. 1 and 2	653	390	390	330
		Pier No. 1				317
	SB	Pier No. 1				
HP14x117	SB	Abutment Nos. 1 and 2	861	520	520	331

As summarized above, the factored Strength I Limit State axial compressive pile resistance is controlled by the drivability resistance. Therefore, we recommend that a net (after downdrag forces are accounted for) factored Strength I Limit State axial compressive resistances equal to 390 kips and 416 kips for HP14x89 and HP14x117 steel H-piles, respectively, be used as the upper, factored axial compressive pile resistance limits in designing the bridge substructures.

MaineDOT standard practice is to dynamically test (during construction) a minimum of one pile per substructure (i.e., 1 pile/substructure x 3 substructures/bridge x 2 bridges = 6 piles total) and not less than 2 percent of the total number of piles anticipated for both bridges to confirm that the minimum required nominal resistance has been achieved unless variable subsurface or sloping bedrock conditions are present. The top of bedrock surface varies between approximately 25 and 43 ft BGS (El. 19 and El. 40) and generally slopes down from west to east. The top of bedrock surface is generally flat along the proposed SB alignment, and slopes down from north to south along the proposed NB alignment. Based on this information, it is our opinion that variable subsurface conditions exist at the site, particularly in the east-west direction (transverse to the bridge alignments), which justifies the need for an increased number of "test piles" (i.e., those that are dynamically tested during construction). Therefore, we recommend a minimum of two piles at each substructure (i.e., 2 piles/substructure x 3 substructures/bridge x 2 bridges = 12 piles total) be dynamically tested during construction.

We also recommend that minimum pile spacing, clearance and embedment (into the pile cap) meet the requirements of AASHTO LRFD Section 10.7.1.2. The pile tips should also be protected using cast steel driving shoes to prevent damage when driving through the dense glacial till and to/into bedrock. Drive shoes will also help in seating the piles into sloping bedrock, if present.

Estimated Pile Tip Elevations and Pile Lengths

As discussed previously, the piles are expected to develop most of their axial compressive resistance through end bearing in/on bedrock. For estimating pile length bid quantities, we recommend the following:

Bridge Structure	Substructure Location	Bottom of Pile Cap Elev.	Top of Pile Elev.	Approx. Top of Bedrock Elev.[1]	Est. Pile Tip Elev.[2]	Approx. In-Place Pile Length (ft)	Recommended Min. Delivered Pile Length[3] (ft)
NB	Abut. No. 1	71.0	72.5	21	20	52.5	55
	Pier No. 1	59.0	60.5	25	24	36.5	40
	Abut. No. 2	69.0	70.5	30	29	41.5	45
SB	Abut. No. 1	69.0	70.5	38	37	33.5	35
	Pier No. 1	59.0	60.5	40	39	21.5	25
	Abut. No. 2	70.0	71.5	37	36	35.5	40

Notes:

[1] Values shown based on elevation of top of bedrock encountered in test borings drilled at the site and rounded down to the nearest 1-ft increment.

[2] Values shown based on the assumption that piles tips are located 1 ft below the estimated top of bedrock surface.

[3] Represents the approximate recommended minimum delivered pile length rounded up to the nearest 5-ft increment.

Please note that the estimated pile lengths summarized above do not account for an additional 5 ft of pile required for dynamic testing instrumentation or any additional pile length needed to accommodate the Contractor's leads and pile driving equipment. We recommend that the Contractor evaluate the subsurface conditions present at the site and estimate actual delivered pile lengths at each substructure location, which will be submitted to the Resident for review prior to ordering in accordance with the requirements of the Standard Specifications.

Based on the anticipate pile lengths summarized above, we anticipate that only minimal pile splicing will be required, specifically for the NB bridge abutment piles. The actual amount of pile splicing may vary and is dependent on the actual order lengths proposed by the Contractor.

Limitations

This report is prepared for the exclusive use of MaineDOT relative to the subject project. There are no intended beneficiaries other than MaineDOT. Haley & Aldrich shall owe no duty whatsoever to any other person or entity on account of the Agreement or the report. Use of this report by any person or entity other than MaineDOT for any purpose whatsoever is expressly forbidden unless such other person or entity obtains written authorization from MaineDOT and Haley & Aldrich. Use of this report by such other person or entity without the written authorization of MaineDOT and Haley & Aldrich shall be at such other person's or entities sole risk and shall be without legal exposure or liability to Haley & Aldrich.

Use of this report by any person or entity, including by MaineDOT, for a purpose other than relative to the subject project is expressly prohibited unless such person or entity obtains written authorization from Haley & Aldrich indicating that the report is adequate for such other use. Use of this report by any other person or entity for such other purpose without written authorization by Haley & Aldrich shall be at such person's or entities sole risk and shall be without legal exposure or liability to Haley & Aldrich.

The information provided herein is based, in part, upon the data obtained from the referenced subsurface explorations. The nature and extent of variations between explorations may not become evident until construction. If variations then appear, it may be necessary to re-evaluate the recommendations of this report.

It is our understanding that this report may be included as a reference document in the documents that will be provided to the prospective Contractors for bidding. Please note that the recommendations included herein are superseded by the information contained in the contract documents (drawings, specifications and special provisions) and that the information contained in the contract documents takes precedence over the information provided in this report.

Closure

We appreciate the opportunity to continue to provide MaineDOT services on this project. Please do not hesitate to contact us if you have any questions or comments.

Sincerely yours,
HALEY & ALDRICH, INC.

Bryan C. Steinert for

Tucker Jones, E.I.T.
Geotechnical Engineer

Bryan C. Steinert

Bryan C. Steinert, P.E.
Senior Project Manager

W. A. Chadbourne

Wayne A. Chadbourne, P.E.
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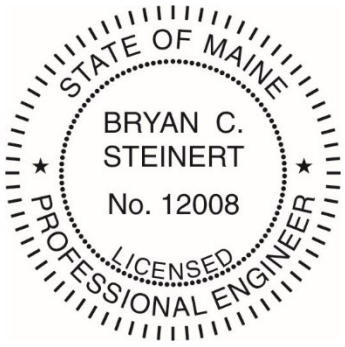


Enclosures:

Table I -	Subsurface Exploration Location Data
Table II -	Subsurface Exploration Subsurface Data
Figure 1 -	Project Locus
Figures 2-3 -	Boring Location Plans
Figure 3 -	Interpretive Subsurface Profile – I-295 Northbound
Figure 4 -	Interpretive Subsurface Profile – I-295 Southbound
Appendix A -	Test Boring Logs and Rock Core Photographs
Appendix B -	Observation Well Installation and Groundwater Monitoring Reports
Appendix C -	Laboratory Test Results
Appendix D -	Historic Bridge Plans
Appendix E -	Calculations

TABLE I
Subsurface Exploration Location Data
Interstate 295 Bridge Nos. 5833 and 1509 over U.S. Route 1
MaineDOT WINs 023106.00 and 023110.00
Yarmouth, Maine

Haley & Aldrich, Inc. File No.: 134120-003

Phase	Test Boring No.[1]	Ground Surface Elevation (ft)[3]	Station[4]	Offset Distance (ft) & Direction[4,5]	Horizontal Coordinates[2]	
					Northing (Y)	Easting (X)
Phase I	BB-YRO-101	65.1	727 + 33	26 RT	355,184	1,039,148
	BB-YRO-102	64.8	728 + 70	25 RT	355,295	1,039,226
	BB-YRO-103	67.5	729 + 86	7 LT	355,407	1,039,271
	BB-YRO-104	62.3	828 + 35	84 RT	355,163	1,039,343
	BB-YRO-105	65.7	829 + 68	33 RT	355,300	1,039,384
	BB-YRO-106	63.7	831 + 89	67 RT	355,455	1,039,545
Phase II	BB-YRO-201	60.1	723 + 21	39 LT	354,878	1,038,866
	BB-YRO-202	61.9	724 + 46	55 LT	354,990	1,038,922
	BB-YRO-203	60.7	724 + 27	98 LT	354,999	1,038,877
	BB-YRO-204	60.2	725 + 79	34 LT	355,089	1,039,013
	BB-YRO-205	64.5	726 + 96	27 LT	355,184	1,039,083
	BB-YRO-206	65.5	727 + 81	75 LT	355,281	1,039,093
	BB-YRO-207	64.6	728 + 59	23 LT	355,316	1,039,181
	BB-YRO-208	68.2	729 + 88	66 LT	355,446	1,039,226
	BB-YRO-209	69.7	731 + 47	45 LT	355,557	1,039,345
	BB-YRO-210	61.7	826 + 29	86 RT	354,999	1,039,219
	BB-YRO-211	59.4	831 + 09	157 RT	355,336	1,039,567

Notes:
[1] Test boring locations are shown on Figures 2 and 3, Site and Subsurface Exploration Location Plans.
[2] As-drilled coordinates of test borings were determined by MaineDOT using GPS survey equipment, are measured in feet and reference NAD83, Maine 2000 West Zone coordinate system.
[3] Ground surface elevations at test boring locations were determined in the field by MaineDOT using GPS survey equipment, are measured in feet and reference the North American Vertical Datum of 1988 (NAVD 88).
[4] Station and offset information shown are approximate and are relative to I-295 NB and SB baselines and were determined by Haley & Aldrich based on information provided by HNTB Corporation and rounded to the nearest foot.
[5] LT = offset distance toward left direction; RT = offset distance toward right direction; ft = feet.

	Individual	Date
Prepared By:	T. Jones	6/14/2021
Checked By:	B. Steinert	7/9/2021
Reviewed By:	W. Chadbourne	9/9/2021

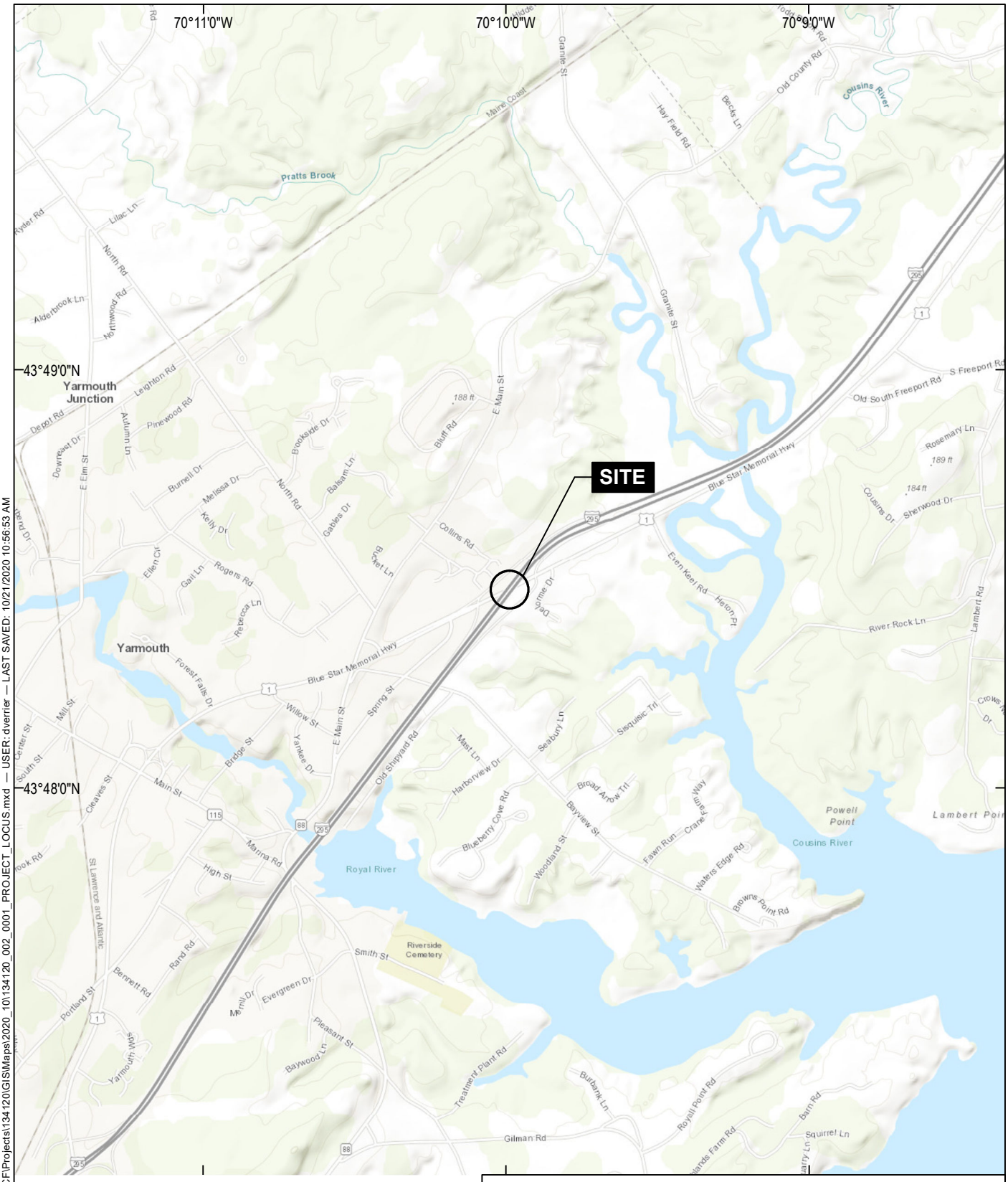
TABLE II
Subsurface Exploration Subsurface Data
Interstate 295 Bridge Nos. 5833 and 1509 over U.S. Route 1
MaineDOT WINs 023106.00 and 023110.00
Yarmouth, Maine

Haley & Aldrich, Inc. File No.: 134120-003

Phase	Test Boring No.[1]	Ground Surface Elevation[2,3] (ft)	Approximate Strata Thickness[3,4] (ft)												Approximate Top of Bedrock Depth (ft)	Approximate Elevation of Top of Bedrock[3]	Approximate Bottom of Exploration Depth (ft)	Approximate Elevation of Bottom of Exploration[3]
			Topsoil/Fill			Marine Deposit (Silt/Clay)			Marine Deposit (Sand)			Glacial Till						
			Depth to Top (ft)	Elev. of Top (ft)	Thickness (ft)	Depth to Top (ft)	Elev. of Top (ft)	Thickness (ft)	Depth to Top (ft)	Elev. of Top (ft)	Thickness (ft)	Depth to Top (ft)	Elev. of Top (ft)	Thickness (ft)				
Phase I	BB-YRO-101	65.1	0.0	65.1	3.6	3.6	61.5	18.0	21.6	43.5	3.2	NE	NE	NE	24.8	40.3	35.0	30.1
	BB-YRO-102	64.8	0.0	64.8	3.7	3.7	61.1	16.8	20.5	44.3	4.3	24.8	40.0	0.4	25.2	39.6	35.2	29.6
	BB-YRO-103	67.5	0.0	67.5	1.1	1.1	66.4	17.9	19.0	48.5	7.4	26.4	41.1	1.5	27.9	39.6	27.9	39.6
	BB-YRO-104	62.3	0.0	62.3	3.3	3.3	59.0	21.7	25.0	37.3	14.3	39.3	23.0	3.6	42.9	19.4	42.9	19.4
	BB-YRO-105	65.7	0.0	65.7	2.7	2.7	63.0	28.5	31.2	34.5	8.0	39.2	26.5	0.9	40.1	25.6	50.1	15.6
	BB-YRO-106	63.7	0.0	63.7	6.5	6.5	57.2	30.0	36.5	27.2	5.7	42.2	21.5	0.6	42.8	20.9	53.0	10.7
Phase II	BB-YRO-201	60.1	0.0	60.1	14.0	NE	NE	NE	14.0	46.1	1.3	NE	NE	NE	15.3	44.8	15.7	44.4
	BB-YRO-202	61.9	0.0	61.9	0.4	0.4	61.5	19.1	NE	NE	NE	NE	NE	NE	19.5	42.4	19.7	42.2
	BB-YRO-203	60.7	0.0	60.7	3.3	3.3	57.4	12.8	16.1	44.6	3.9	20.0	40.7	>0.1	NE	NE	20.1	40.6
	BB-YRO-204	60.2	0.0	60.2	7.0	7.0	53.2	11.0	18.0	42.2	3.8	NE	NE	NE	21.8	38.4	32.0	28.2
	BB-YRO-205	64.5	0.0	64.5	3.2	3.2	61.3	18.3	21.5	43.0	2.4	NE	NE	NE	23.9	40.6	33.9	30.6
	BB-YRO-206	65.5	0.0	65.5	3.5	3.5	62.0	13.0	16.5	49.0	>9.1	NE	NE	NE	NE	NE	25.6	39.9
	BB-YRO-207	64.6	0.0	64.6	3.5	3.5	61.1	19.5	23.0	41.6	3.8	NE	NE	NE	26.8	37.8	37.0	27.6
	BB-YRO-208	68.2	0.0	68.2	2.0	2.0	66.2	16.0	18.0	50.2	6.5	NE	NE	NE	24.5	43.7	24.5	43.7
	BB-YRO-209	69.7	0.0	69.7	0.7	0.7	69.0	20.3	21.0	48.7	4.0	25.0	44.7	>2.0	NE	NE	27.0	42.7
	BB-YRO-210	61.7	0.0	61.7	0.7	0.7	61.0	14.4	15.1	46.6	>11.9	NE	NE	NE	NE	NE	27.0	34.7
	BB-YRO-211	59.4	0.0	59.4	0.5	0.5	58.9	>26.5	NE	NE	NE	NE	NE	NE	NE	NE	27.0	32.4

Notes:
[1] Test boring locations are shown on Figures 2 and 3, Site and Subsurface Exploration Location Plans.
[2] Ground surface elevations at test boring locations were determined in the field by MaineDOT using GPS survey equipment.
[3] Elevations are measured in feet and reference the North American Vertical Datum of 1988 (NAVD 88).
[4] "NE" indicates stratum was not encountered in test boring.

	Individual	Date
Prepared By:	T. Jones	6/14/2021
Checked By:	B. Steinert	7/9/2021
Reviewed By:	W. Chadbourne	9/9/2021



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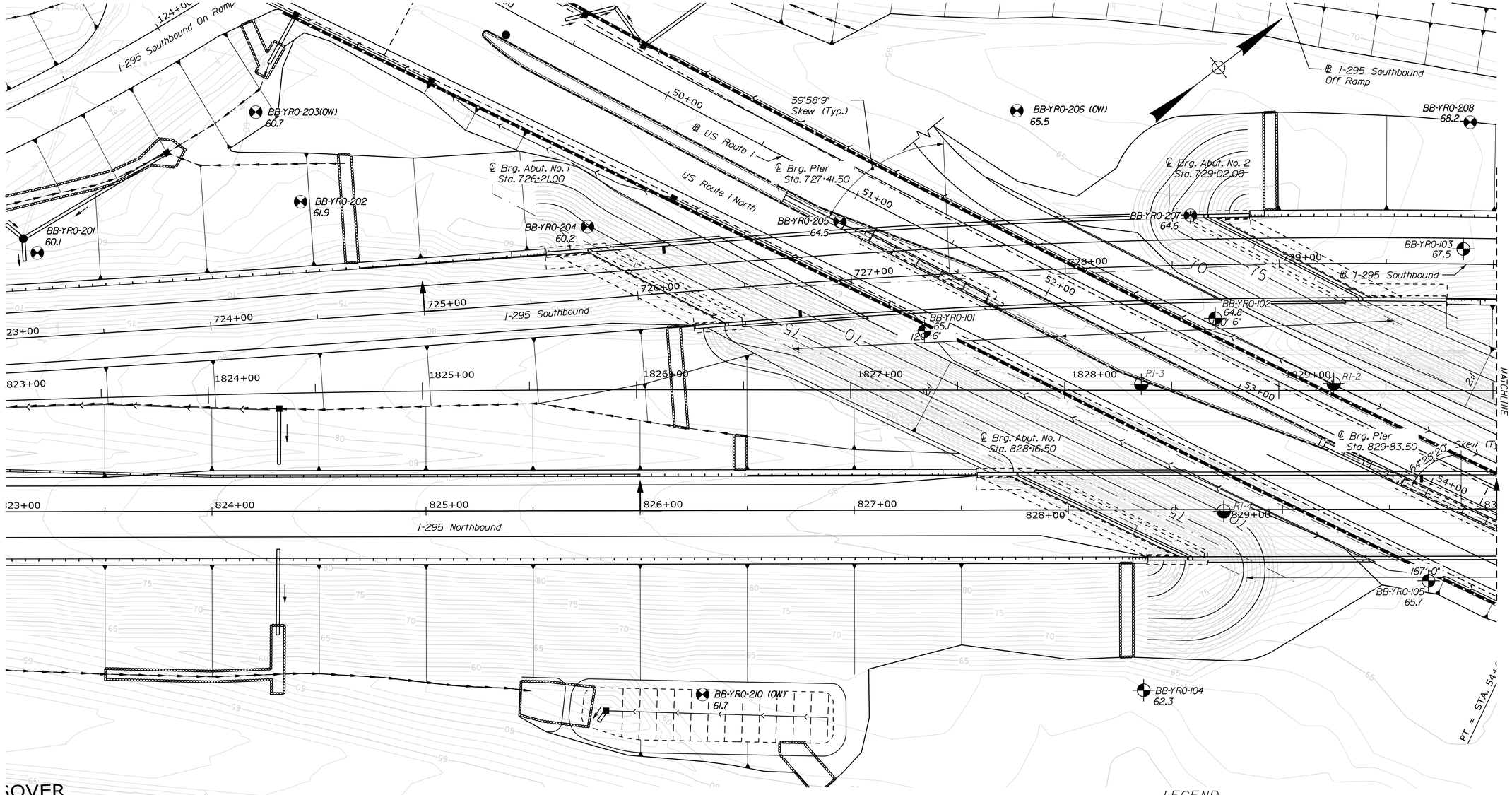
HALEY ALDRICH

INTERSTATE 295 BRIDGE NOS. 5833 AND
1509 OVER U.S. ROUTE 1
MAINEDOT WINS 023106.00 AND 023110.00
YARMOUTH, MAINE

PROJECT LOCUS

SCALE: AS SHOWN
AUGUST 2021

FIGURE 1



SOVER

NOTES:

1. EXISTING AND PROPOSED SITE CONDITIONS INCLUDING TOPOGRAPHIC AND SITE GRADING INFORMATION, AND THE LOCATION AND ORIENTATION OF EXISTING SITE FEATURES AND THE PROPOSED BRIDGE STRUCTURES ARE TAKEN FROM ELECTRONIC MICROSTATION FILES PROVIDED BY HNTB CORPORATION.
2. THE PLAN LOCATIONS OF AND GROUND SURFACE ELEVATIONS AT PRELIMINARY AND FINAL DESIGN PHASE (PHASE I AND PHASE II) TEST BORINGS SHOWN WERE DETERMINED UPON THE COMPLETION OF DRILLING BY THE MAINE DEPARTMENT OF TRANSPORTATION USING GPS SURVEY EQUIPMENT.
3. THE PLAN LOCATION OF HISTORIC TEST BORINGS WERE DETERMINED BY HALEY & ALDRICH BY ELECTRONICALLY OVERLAYING, SCALING AND ROTATING HISTORIC DRAWINGS AND ARE APPROXIMATE.
4. ELEVATIONS ARE IN FEET AND REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
5. TEST BORINGS WERE MONITORED IN THE FIELD BY A HALEY & ALDRICH GEOLOGIST OR GEOTECHNICAL ENGINEER.
6. REFER TO APPENDIX A FOR TEST BORING LOGS AND PHOTOGRAPHS OF ROCK CORE SAMPLES RECOVERED FROM TEST BORINGS. REFER TO APPENDIX B FOR OBSERVATION WELL INSTALLATION AND GROUNDWATER MONITORING REPORTS.

LEGEND:

BB-YR0-204 60.2	DESIGNATION, AS-DRILLED LOCATION AND GROUND SURFACE ELEVATION OF FINAL DESIGN PHASE (PHASE II) TEST BORING DRILLED BY NORTHERN TEST BORINGS, INC. OF GORHAM, MAINE UNDER THE DIRECTION OF HALEY & ALDRICH IN JUNE 2021
BB-YR0-101 65.1	DESIGNATION, AS-DRILLED LOCATION AND GROUND SURFACE ELEVATION OF PRELIMINARY DESIGN PHASE (PHASE I) TEST BORING DRILLED BY NORTHERN TEST BORINGS, INC. OF GORHAM, MAINE UNDER THE DIRECTION OF HALEY & ALDRICH IN OCTOBER 2019
RI-1	DESIGNATION AND APPROXIMATE LOCATION OF HISTORIC TEST BORING DRILLED BY THE MAINE STATE HIGHWAY COMMISSION
(OW)	DENOTES OBSERVATION WELL INSTALLED IN COMPLETED BOREHOLE
	DESIGNATION, LOCATION, AND ORIENTATION OF INTERPRETIVE SUBSURFACE PROFILE; (SEE FIGURES 4 AND 5)

PLAN

25 0 25 50

Scale of Feet

HALEY ALDRICH

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

WIN 023106.00 & 023110.00 BRIDGE PLANS

5833 & 1509

	BY	DATE
PROJ. MANAGER	----------	
DESIGN-DETAILED	B. STEINERT	K. POST	7-30-21
CHECKED-REVIEWED	B. STEINERT	W. CHABBORNE	9-9-21
DESIGN2-DETAILED2	----------	----------	------
DESIGN3-DETAILED3	----------	----------	------
REVISIONS 1	----------	----------	------
REVISIONS 2	----------	----------	------
REVISIONS 3	----------	----------	------
REVISIONS 4	----------	----------	------
FIELD CHANGES	----------	----------	------

SIGNATURE

P.E. NUMBER

DATE

I-295 OVER US ROUTE 1
EXIT 17 INTERCHANGE
YARMOUTH CUMBERLAND

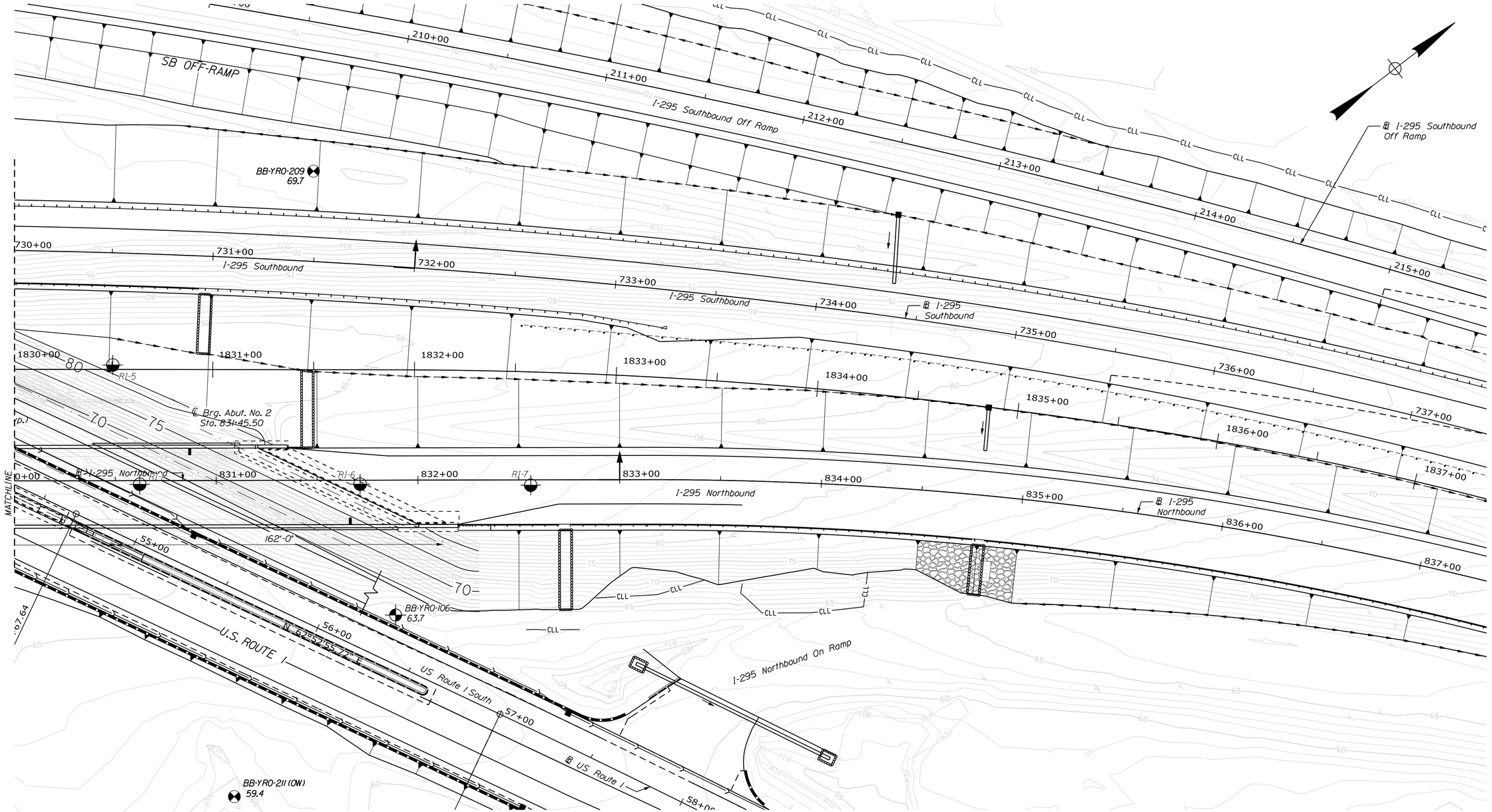
BORING LOCATION PLAN (1 OF 2)

SHEET NUMBER

2

OF 5

Filename: ...\134120_013_BR_Yarmouth Expo Plan A.dgn Division: Username: Date:9/12/2021



NOTES:

1. EXISTING AND PROPOSED SITE CONDITIONS INCLUDING TOPOGRAPHIC AND SITE GRADING INFORMATION, AND THE LOCATION AND ORIENTATION OF EXISTING SITE FEATURES AND THE PROPOSED BRIDGE STRUCTURES ARE TAKEN FROM ELECTRONIC MICROSTATION FILES PROVIDED BY HNTB CORPORATION.
2. THE PLAN LOCATIONS OF AND GROUND SURFACE ELEVATIONS AT PRELIMINARY AND FINAL DESIGN PHASE (PHASE I AND PHASE II) TEST BORINGS SHOWN WERE DETERMINED UPON THE COMPLETION OF DRILLING BY THE MAINE DEPARTMENT OF TRANSPORTATION USING GPS SURVEY EQUIPMENT.
3. THE PLAN LOCATION OF HISTORIC TEST BORINGS WERE DETERMINED BY HALEY & ALDRICH BY ELECTRONICALLY OVERLAYING, SCALING AND ROTATING HISTORIC DRAWINGS AND ARE APPROXIMATE.
4. ELEVATIONS ARE IN FEET AND REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
5. TEST BORINGS WERE MONITORED IN THE FIELD BY A HALEY & ALDRICH GEOLOGIST OR GEOTECHNICAL ENGINEER.
6. REFER TO APPENDIX A FOR TEST BORING LOGS AND PHOTOGRAPHS OF ROCK CORE SAMPLES RECOVERED FROM TEST BORINGS. REFER TO APPENDIX B FOR OBSERVATION WELL INSTALLATION AND GROUNDWATER MONITORING REPORTS.

LEGEND:

- BB-YR0-211 / 59.4 — DESIGNATION, AS-DRILLED LOCATION AND GROUND SURFACE ELEVATION OF FINAL DESIGN PHASE (PHASE II) TEST BORING DRILLED BY NORTHERN TEST BORINGS, INC. OF GORHAM, MAINE UNDER THE DIRECTION OF HALEY & ALDRICH IN JUNE 2021
- BB-YR0-101 / 65.1 — DESIGNATION, AS-DRILLED LOCATION AND GROUND SURFACE ELEVATION OF PRELIMINARY DESIGN PHASE (PHASE I) TEST BORING DRILLED BY NORTHERN TEST BORINGS, INC. OF GORHAM, MAINE UNDER THE DIRECTION OF HALEY & ALDRICH IN OCTOBER 2019
- RI-1 — DESIGNATION AND APPROXIMATE LOCATION OF HISTORIC TEST BORING DRILLED BY THE MAINE STATE HIGHWAY COMMISSION.
- (OW) — DENOTES OBSERVATION WELL INSTALLED IN COMPLETED BOREHOLE
- DESIGNATION, LOCATION, AND ORIENTATION OF INTERPRETIVE SUBSURFACE PROFILE; (SEE FIGURES 4 AND 5)

PLAN

25 0 25 50

Scale of Feet

HALEY ALDRICH

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

WIN 023106.00 & 023110.00 BRIDGE PLANS
5833 & 1509

	BY	DATE
PROJ. MANAGER		
DESIGN-DETAILED	B. STEINERT	7-30-21
CHECKED-REVIEWED	B. STEINERT	9-9-21
DESIGN2-DETAILED2		
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE

P.E. NUMBER

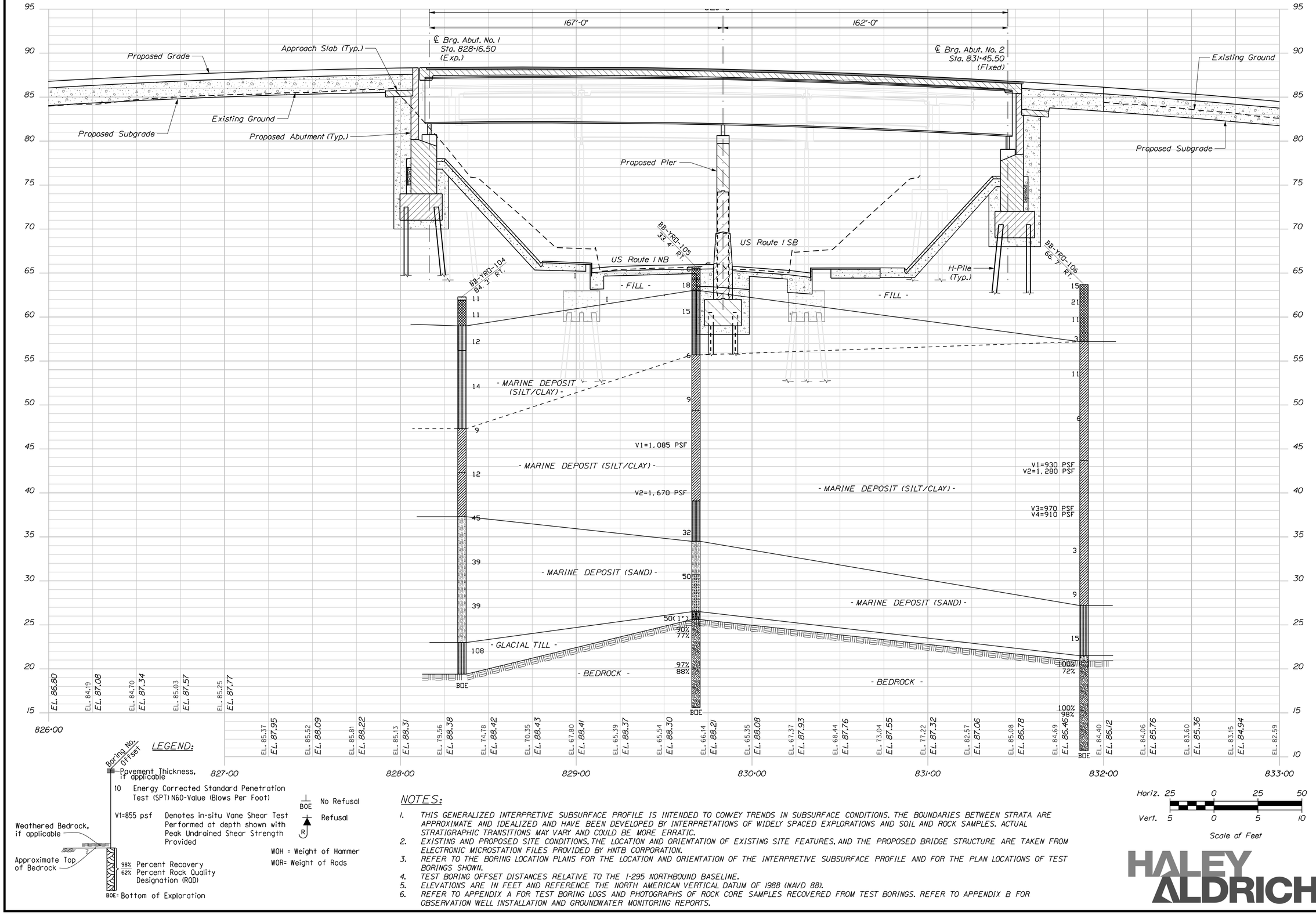
DATE

I-295 OVER US ROUTE 1
EXIT 17 INTERCHANGE
YARMOUTH CUMBERLAND

BORING LOCATION PLAN (2 OF 2)

SHEET NUMBER
3
OF 5

Filename: ...\134120_014_BR_Yarmouth Expo Plan B.dgn Division: Username: Date:9/12/2021



LEGEND:

10 Energy Corrected Standard Penetration Test (SPT) N60-Value (Blows Per Foot)

V1=855 psf Denotes in-situ Vane Shear Test Performed at depth shown with Peak Undrained Shear Strength Provided

98% Percent Recovery
62% Percent Rock Quality Designation (RQD)

BOE No Refusal

R Refusal

WOH = Weight of Hammer
WOR= Weight of Rods

NOTES:

1. THIS GENERALIZED INTERPRETIVE SUBSURFACE PROFILE IS INTENDED TO CONVEY TRENDS IN SUBSURFACE CONDITIONS. THE BOUNDARIES BETWEEN STRATA ARE APPROXIMATE AND IDEALIZED AND HAVE BEEN DEVELOPED BY INTERPRETATIONS OF WIDELY SPACED EXPLORATIONS AND SOIL AND ROCK SAMPLES. ACTUAL STRATIGRAPHIC TRANSITIONS MAY VARY AND COULD BE MORE ERRATIC.
2. EXISTING AND PROPOSED SITE CONDITIONS. THE LOCATION AND ORIENTATION OF EXISTING SITE FEATURES, AND THE PROPOSED BRIDGE STRUCTURE ARE TAKEN FROM ELECTRONIC MICROSTATION FILES PROVIDED BY HNTB CORPORATION.
3. REFER TO THE BORING LOCATION PLANS FOR THE LOCATION AND ORIENTATION OF THE INTERPRETIVE SUBSURFACE PROFILE AND FOR THE PLAN LOCATIONS OF TEST BORINGS SHOWN.
4. TEST BORING OFFSET DISTANCES RELATIVE TO THE I-295 NORTHBOUND BASELINE.
5. ELEVATIONS ARE IN FEET AND REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
6. REFER TO APPENDIX A FOR TEST BORING LOGS AND PHOTOGRAPHS OF ROCK CORE SAMPLES RECOVERED FROM TEST BORINGS. REFER TO APPENDIX B FOR OBSERVATION WELL INSTALLATION AND GROUNDWATER MONITORING REPORTS.

Horiz. 25 0 25 50
Vert. 5 0 5 10
Scale of Feet

HALEY ALDRICH

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

WIN 023106.00 & 023110.00 BRIDGE PLANS
5833 & 1509

	BY	DATE
PROJ. MANAGER	----------	------
DESIGN-DETAILED	B. STEINERT	K. POST 7-30-21
CHECKED-REVIEWED	B. STEINERT	W. CHABBURNE 9-9-21
DESIGN2-DETAILED2	----------	------
DESIGN3-DETAILED3	----------	------
REVISIONS 1	----------	------
REVISIONS 2	----------	------
REVISIONS 3	----------	------
REVISIONS 4	----------	------
FIELD CHANGES	----------	------

SIGNATURE

P.E. NUMBER

DATE

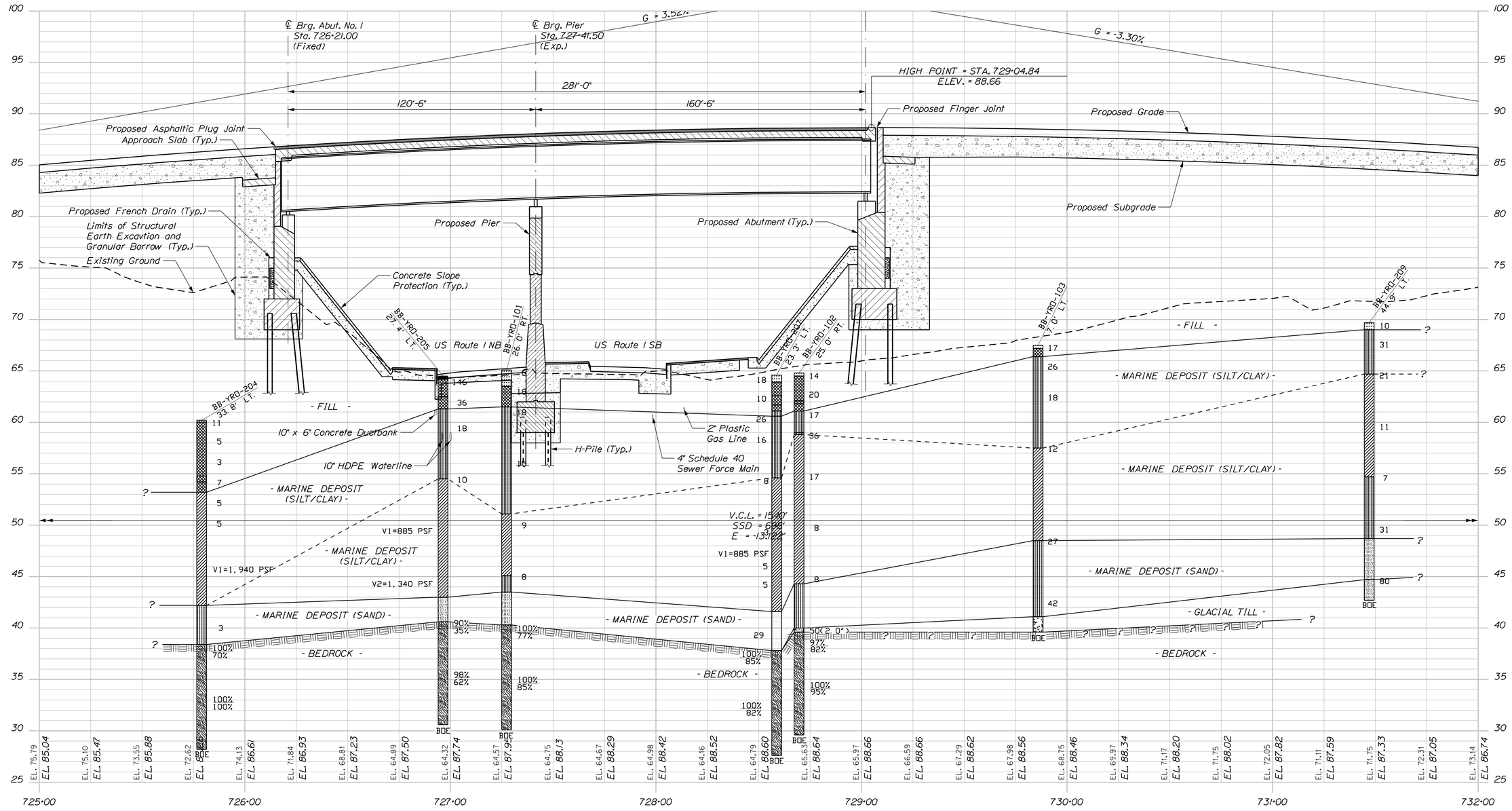
I-295 OVER US ROUTE 1
EXIT 17 INTERCHANGE
YARMOUTH CUMBERLAND

INTERPRETIVE SUBSURFACE PROFILE - I-295 NORTHBOUND

SHEET NUMBER
4
OF 5

Date:9/13/2021
Username:
Filename: ...\134120_012_BR_Yarmouth NB Profile.dgn
Division:

Filename: ...\134120_0015_BR_Yarmouth SB Profile.dgn Username: Date:9/13/2021



Boring No.
Offset

LEGEND:

- Pavement Thickness, if applicable
- 10 — Energy Corrected Standard Penetration Test (SPT) N60-Value (Blows Per Foot)
- V1=855 psf — Denotes in-situ Vane Shear Test Performed at depth shown with Peak Undrained Shear Strength Provided
- BOE — No Refusal
- R — Refusal
- WOH = Weight of Hammer
- WOR= Weight of Rods
- Weathered Bedrock, if applicable
- Approximate Top of Bedrock
- 98% Percent Recovery
- 62% Percent Rock Quality Designation (RQD)
- BOE= Bottom of Exploration

NOTES:

1. THIS GENERALIZED INTERPRETIVE SUBSURFACE PROFILE IS INTENDED TO CONVEY TRENDS IN SUBSURFACE CONDITIONS. THE BOUNDARIES BETWEEN STRATA ARE APPROXIMATE AND IDEALIZED AND HAVE BEEN DEVELOPED BY INTERPRETATIONS OF WIDELY SPACED EXPLORATIONS AND SOIL AND ROCK SAMPLES. ACTUAL STRATIGRAPHIC TRANSITIONS MAY VARY AND COULD BE MORE ERRATIC.
2. EXISTING AND PROPOSED SITE CONDITIONS, THE LOCATION AND ORIENTATION OF EXISTING SITE FEATURES, AND THE PROPOSED BRIDGE STRUCTURE ARE TAKEN FROM ELECTRONIC MICROSTATION FILES PROVIDED BY HNTB CORPORATION.
3. REFER TO THE BORING LOCATION PLANS FOR THE LOCATION AND ORIENTATION OF THE INTERPRETIVE SUBSURFACE PROFILE AND FOR THE PLAN LOCATIONS OF TEST BORINGS SHOWN.
4. TEST BORING OFFSET DISTANCES RELATIVE TO THE I-295 SOUTHBOUND BASELINE.
5. ELEVATIONS ARE IN FEET AND REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
6. REFER TO APPENDIX A FOR TEST BORING LOGS AND PHOTOGRAPHS OF ROCK CORE SAMPLES RECOVERED FROM TEST BORINGS. REFER TO APPENDIX B FOR OBSERVATION WELL INSTALLATION AND GROUNDWATER MONITORING REPORTS.

Horiz. 25 0 25 50
Vert. 5 0 5 10
Scale of Feet

HALEY ALDRICH

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

WIN 023106.00 & 023110.00 BRIDGE PLANS
5833 & 1509

	BY	DATE
PROJ. MANAGER	----------	------
DESIGN-DETAILED	B. STEINERT	K. POST 7-30-21
CHECKED-REVIEWED	B. STEINERT	W. CHABBOURNE 9-9-21
DESIGN2-DETAILED2	----------	------
DESIGN3-DETAILED3	----------	------
REVISIONS 1	----------	------
REVISIONS 2	----------	------
REVISIONS 3	----------	------
REVISIONS 4	----------	------
FIELD CHANGES	----------	------

SIGNATURE

P.E. NUMBER

DATE

I-295 OVER US ROUTE 1
EXIT 17 INTERCHANGE
YARMOUTH CUMBERLAND

INTERPRETIVE SUBSURFACE
PROFILE - I-295 SOUTHBOUND

SHEET NUMBER
5
OF 5

APPENDIX A

Test Boring Logs and
Rock Core Photographs

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS (more than half of material is larger than No. 200 sieve size)	GRAVELS (more than half of coarse fraction is larger than No. 4 sieve size)	CLEAN GRAVELS (little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel sand mixtures, little or no fines.
		GRAVEL WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (more than half of coarse fraction is smaller than No. 4 sieve size)	CLEAN SANDS (little or no fines)	SW	Well-graded sands, Gravelly sands, little or no fines
			SP	Poorly-graded sands, Gravelly sand, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (more than half of material is smaller than No. 200 sieve size)	SILTS AND CLAYS (liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, Silty or Clayey fine sands, or Clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, Gravelly clays, Sandy clays, Silty clays, lean clays.
			OL	Organic silts and organic Silty clays of low plasticity.
	SILTS AND CLAYS (liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine Sandy or Silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
	HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.

Desired Soil Observations (in this order, if applicable):

Color (Munsell color chart)
Moisture (dry, damp, moist, wet)
Density/Consistency (from above right hand side)
Texture (fine, medium, coarse, etc.)
Name (Sand, Silty Sand, Clay, etc., including portions - trace, little, etc.)
Gradation (well-graded, poorly-graded, uniform, etc.)
Plasticity (non-plastic, slightly plastic, moderately plastic, highly plastic)
Structure (layering, fractures, cracks, etc.)
Bonding (well, moderately, loosely, etc.,)
Cementation (weak, moderate, or strong)
Geologic Origin (till, marine clay, alluvium, etc.)
Groundwater level

MODIFIED BURMISTER SYSTEM

Descriptive Term	Portion of Total (%)
trace	0 - 10
little	11 - 20
some	21 - 35
adjective (e.g. Sandy, Clayey)	36 - 50

TERMS DESCRIBING DENSITY/CONSISTENCY

Coarse-grained soils (more than half of material is larger than No. 200 sieve): Includes (1) clean gravels; (2) Silty or Clayey gravels; and (3) Silty, Clayey or Gravelly sands. Density is rated according to standard penetration resistance (N-value).

Density of Cohesionless Soils	Standard Penetration Resistance N-Value (blows per foot)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

Fine-grained soils (more than half of material is smaller than No. 200 sieve): Includes (1) inorganic and organic silts and clays; (2) Gravelly, Sandy or Silty clays; and (3) Clayey silts. Consistency is rated according to undrained shear strength as indicated.

Consistency of Cohesive soils	SPT N-Value (blows per foot)	Approximate Undrained Shear Strength (psf)	Field Guidelines
Very Soft	WOH, WOR, WOP, <2	0 - 250	Fist easily penetrates
Soft	2 - 4	250 - 500	Thumb easily penetrates
Medium Stiff	5 - 8	500 - 1000	Thumb penetrates with moderate effort
Stiff	9 - 15	1000 - 2000	Indented by thumb with great effort
Very Stiff	16 - 30	2000 - 4000	Indented by thumbnail
Hard	>30	over 4000	Indented by thumbnail with difficulty

Rock Quality Designation (RQD):

RQD (%) = $\frac{\text{sum of the lengths of intact pieces of core* > 4 inches}}{\text{length of core advance}}$

*Minimum NQ rock core (1.88 in. OD of core)

Rock Quality Based on RQD

Rock Quality	RQD (%)
Very Poor	≤25
Poor	26 - 50
Fair	51 - 75
Good	76 - 90
Excellent	91 - 100

Desired Rock Observations (in this order, if applicable):

Color (Munsell color chart)
Texture (aphanitic, fine-grained, etc.)
Rock Type (granite, schist, sandstone, etc.)
Hardness (very hard, hard, mod. hard, etc.)
Weathering (fresh, very slight, slight, moderate, mod. severe, severe, etc.)
Geologic discontinuities/jointing:
-dip (horiz - 0-5 deg., low angle - 5-35 deg., mod. dipping - 35-55 deg., steep - 55-85 deg., vertical - 85-90 deg.)
-spacing (very close - <2 inch, close - 2-12 inch, mod. close - 1-3 feet, wide - 3-10 feet, very wide >10 feet)
-tightness (tight, open, or healed)
-infilling (grain size, color, etc.)
Formation (Waterville, Ellsworth, Cape Elizabeth, etc.)
RQD and correlation to rock quality (very poor, poor, etc.)
ref: ASTM D6032 and FHWA NHI-16-072 GEC 5 - Geotechnical Site Characterization, Table 4-12
Recovery (inch/inch and percentage)
Rock Core Rate (X.X ft - Y.Y ft (min:sec))

Maine Department of Transportation
Geotechnical Section
Key to Soil and Rock Descriptions and Terms
Field Identification Information

Sample Container Labeling Requirements:

WIN
Bridge Name / Town
Boring Number
Sample Number
Sample Depth
Blow Counts
Sample Recovery
Date
Personnel Initials

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacement
Location: Yarmouth, Maine

Boring No.: BB-YR0-101
WIN: 23106.00+23110.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	65.1	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	10/21/2019-10/21/2019	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 727+33.43 SB, 26.0'R	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	13.7 ft
Hammer Efficiency Factor: 0.901		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample Attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample Attempt; V = Field Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = Weight of 140lb. Hammer; WOR/C = Weight of Rods or Casing; WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf); $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw Field SPT N-value; Hammer Efficiency Factor = Rig Specific Annual Calibration Value; N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf); WC = Water Content, percent; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; G = Grain Size Analysis; C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/12	0.0 - 2.0	1/1/3/3	4	6	OPEN			Brown, moist, medium stiff, SILT, roots -TOPSOIL-(OL) PID Reading=0.0 ppm	
								63.5		1.6	
	2D	24/4	2.0 - 4.0	6/4/8/8	12	18				Brown, moist, medium dense, fine to medium SAND, trace coarse sand, trace fine gravel, trace silt -FILL-(SP) PID Reading=0.0 ppm	
								61.5		3.6	
	3D	24/20	4.0 - 6.0	3/5/7/12	12	18				Grey, moist, very stiff, SILT, interbedded fine sand layer -MARINE DEPOSIT-(ML) PID Reading=0.0 ppm	
5											
	4D	24/24	9.0 - 11.0	3/4/6/7	10	15				Brown to grey, moist, stiff, SILT (ML)	
10							WOH				
							56				
							71				
							86				
							HW DRIVE	51.1		14.0	
15	5D	24/24	15.0 - 17.0	2/2/4/2	6	9				Grey, wet, stiff, Silty CLAY (CL) -MARINE DEPOSIT-(CL)	
20	6D	24/20	20.0 - 22.0	1/2/3/7	5	8		45.1		20.0 Grey, wet, loose, fine Sandy SILT -MARINE DEPOSIT-(ML)	G#535450 A-4, ML
								43.5		21.6 Brown, wet, loose, fine SAND, trace medium sand, trace silt, poorly-graded -MARINE DEPOSIT-(SP)	
25								40.3		24.8	

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Boring No.: BB-YR0-101

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacement
Location: Yarmouth, Maine

Boring No.: BB-YR0-101
WIN: 23106.00+23110.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	65.1	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	10/21/2019-10/21/2019	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 727+33.43 SB, 26.0'R	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	13.7 ft
Hammer Efficiency Factor: 0.901		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	R1	60/60	25.0 - 30.0	RQD = 77%			NQ CORE			Top of Bedrock El. 40.3 Grey to dark grey, fine to medium-grained, GRANOFELS, hard, fresh to slightly weathered. Joints dipping at low angles, close to moderately close, tight to open (primarily open), slightly weathered, planar to undulating, rough, 1/16-in. thick silt infilled joint, occasional coarse-grained pegmatitic intrusion, one secondary steeply dipping joint. Rock Quality=Good Recovery=100% R1 Core Times (min:sec): 25.0-26.0' (1:32); 26.0-27.0' (1:54); 27.0-28.0' (1:14); 28.0-29.0' (1:12); 29.0-30.0' (1:26)	
30	R2	60/60	30.0 - 35.0	RQD = 85%						Similar to R1 above, except no secondary joint, occasional coarse-grained pegmatitic intrusion. Rock Quality=Good Recovery=100% R2 Core Times (min:sec): 30.0-31.0' (1:18); 31.0-32.0' (1:21); 32.0-33.0' (1:17); 33.0-34.0' (1:21); 34.0-35.0' (1:31)	
35								30.1		35.0 **Bottom of Exploration at 35.0 feet below ground surface.**	
40											
45											
50											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacement
Location: Yarmouth, Maine

Boring No.: BB-YR0-102
WIN: 23106.00+23110.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	64.8	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	10-11-19/10-11-19	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 728+69.6 SB, 25.0'R	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	17.9 ft
Hammer Efficiency Factor: 0.901		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample Attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample Attempt; V = Field Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = Weight of 140lb. Hammer; WOR/C = Weight of Rods or Casing; WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf); $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw Field SPT N-value; Hammer Efficiency Factor = Rig Specific Annual Calibration Value; N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf); WC = Water Content, percent; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; G = Grain Size Analysis; C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
				Sample Information							
0	1D	24/18	0.0 - 2.0	3/4/5/11	9	14	HSA	64.5		-TOPSOIL- 0.3 Brown, moist, stiff, SILT, few asphalt pieces, some fine to coarse sand, trace fine gravel -FILL-(ML) PID Reading=0.0 ppm	
	2D	24/20	2.0 - 4.0	5/8/5/5	13	20		62.1		2.7	
								61.8		Rust-brown, moist, medium dense, fine to medium SAND, trace coarse sand, trace fine gravel -FILL-(SP)	
	3D	24/15	4.0 - 6.0	4/5/6/6	11	17		61.1		3.0 Grey, dry, stiff, SILT -FILL-(ML)	
5								59.0		3.7	
	4D	24/18	6.0 - 8.0	10/12/12/11	24	36		58.8		Grey-brown, dry to moist, stiff, SILT, mottled, trace organics, root fibers -MARINE DEPOSIT-(ML)	
										5.8 Olive-brown, moist, stiff, SILT -MARINE DEPOSIT-(ML)	
										6.0 Olive-brown with brown-grey mottling, moist, hard, Silty CLAY -MARINE DEPOSIT-(CL)	
10	5D	24/24	10.0 - 12.0	4/5/6/7	11	17	HW PUSH			Similar to 4D, except very stiff, trace organics -MARINE DEPOSIT-(CL)	
							122				
							HW DRIVE				
15	6D	24/24	15.0 - 17.0	2/2/3/3	5	8				Grey-brown, moist, medium stiff, Silty CLAY -MARINE DEPOSIT-(CL)	
										Note: Encountered sand in wash water at 18.0 ft.	
20	7D	24/20	20.0 - 22.0	3/2/3/12	5	8		44.3		Grey-brown, wet, medium stiff, Silty CLAY, occasional silty fine sand layers -MARINE DEPOSIT-(CL)	
										20.5 Brown-grey with rust-brown layers, wet, loose, fine SAND, little silt -MARINE DEPOSIT-(SM)	
25								40.0		24.8	

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

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Boring No.: BB-YR0-102

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacement
Location: Yarmouth, Maine

Boring No.: BB-YR0-102
WIN: 23106.00+23110.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	64.8	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	10-11-19/10-11-19	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 728+69.6 SB, 25.0'R	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	17.9 ft
Hammer Efficiency Factor: 0.901		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_V = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	8D	2/0	25.0 - 25.2	50(2.0")			NQ	39.6		Note: Sand and gravel observed in wash water.	
	R1	60/58	25.2 - 30.2	RQD = 82%			CORE			-PROBABLE GLACIAL TILL- Note: Split-spoon refusal at 25.2 ft.	
										25.2	
										Top of Bedrdock El. 39.6 Grey to dark brown, fine-grained, GRANOFELS, hard, fresh to slightly weathered. Joints dipping at low angles, close to moderately close, tight to open, 1/16 to 1/4-in. thick silt infilling on one joint surface, slightly weathered, planar, smooth, rough, occasional granitic intrusions (approximately 1 to 4-in. thick). One secondary moderately dipping joint. Rock Quality=Good Recovery=97% R1 Core Times (min:sec): 25.2-26.2' (1:44); 26.2-27.2' (1:59); 27.2-28.2' (2:28); 28.2-29.2' (1:59); 29.2-30.2' (2:01)	qp=12,709 psi (27.6-28.0')
30	R2	60/60	30.2 - 35.2	RQD = 95%						Similar to R1, 1/16-in. thick silt infilling on one joint surface, planar to undulating, pegmatitic to granitic intrusions (approximately 4-in. to 1-ft thick). Rock Quality=Excellent Recovery=100% R2 Core Times (min:sec): 30.2-31.2' (3:44); 31.2-32.2' (2:02); 32.2-33.2' (2:48); 33.2-34.2' (1:52); 34.2-35.2' (2:20)	qp=22,436 psi (33.9-34.3')
35								29.6		35.2	
										Bottom of Exploration at 35.2 feet below ground surface.	
40											
45											
50											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacement
Location: Yarmouth, Maine

Boring No.: BB-YR0-103
WIN: 23106.00+23110.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	67.5	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	10-11-19/10-11-19	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 729+85.9 SB, 7.0'L	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	2.2 ft
Hammer Efficiency Factor: 0.901		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/24	0.0 - 2.0	3/5/6/8	11	17	HSA	67.2		Dark brown, ORGANIC SOIL, with roots -TOPSOIL-(OL)	
								66.4		0.3	
	2D	24/20	2.0 - 4.0	5/6/11/12	17	26				Brown, moist, stiff, SILT, trace fine gravel, little fine sand, little coarse to medium sand -FILL-(ML) PID Reading=0.0 ppm	
										1.1	
										Brown-grey to rust-brown, moist, stiff to very stiff, SILT, trace organics -MARINE DEPOSIT-(ML) PID Reading=0.0 ppm	
5	3D	24/24	5.0 - 7.0	4/5/7/6	12	18				Grey-brown with rust-brown mottling, moist, very stiff, SILT, trace organics, one fine-grained sand pocket -MARINE DEPOSIT-(ML)	WC=27% LL=45% PL=21% PI=24%
10	4D	24/24	10.0 - 12.0	3/4/4/3	8	12		57.5		10.0	
										Grey, wet, stiff, Silty CLAY, trace organics -MARINE DEPOSIT-(CL)	WC=37% LL=48% PL=24% PI=24%
15	5D MV	24/24	15.0 - 17.0 15.4 - 15.4	Push thru vane			HW DRIVE			Grey, wet, Silty CLAY -MARINE DEPOSIT-(CL) Note: Attempted vane shear test, vane refusal at 15.4 ft.	WC=41% LL=42% PL=21% PI=21%
	1U	24/24	17.0 - 19.0								C#IP-2 WC=33% LL=49% PL=21% PI=28%
								48.5		19.0	
20	6D	24/11	19.0 - 21.0	11/10/8/9	18	27				Rust-brown to brown, wet, medium dense, fine SAND, some silt at bottom of sample -MARINE DEPOSIT-(SM)	G#535451 A-2-4, SM
25											

Remarks:

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Boring No.: BB-YR0-103

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacement
Location: Yarmouth, Maine

Boring No.: BB-YR0-103
WIN: 23106.00+23110.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	67.5	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	10-11-19/10-11-19	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 729+85.9 SB, 7.0'L	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	2.2 ft
Hammer Efficiency Factor:	0.901	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_V = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	7D	24/17	25.0 - 27.0	3/9/19/17	28	42	HW DRIVE	41.1		Light brown to grey, wet, medium dense, fine SAND, little silt -MARINE DEPOSIT-(SM)	
										26.4	
								39.6		Grey-brown to rust-brown, wet, medium dense to dense, fine GRAVEL, some coarse to fine sand, trace silt -GLACIAL TILL-(GP) Note: Encountered probable top of bedrock at 27.9 ft, weathered rock pieces observed in wash.	
										27.9	
										Bottom of Exploration at 27.9 feet below ground surface.	
30											
35											
40											
45											
50											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacement
Location: Yarmouth, Maine

Boring No.: BB-YR0-104
WIN: 23106.00+23110.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	62.3	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	10-18-2019/10-18-2019	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 828+35.0 NB, 84.3'R	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	7.9 ft
Hammer Efficiency Factor: 0.901		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample Attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample Attempt; V = Field Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = Weight of 140lb. Hammer; WOR/C = Weight of Rods or Casing; WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf); $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw Field SPT N-value; Hammer Efficiency Factor = Rig Specific Annual Calibration Value; N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf); WC = Water Content, percent; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; G = Grain Size Analysis; C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/21	0.0 - 2.0	3/4/3/3	7	11	OPEN	61.9		Brown to dark brown, dry, medium stiff, ORGANIC SOIL, roots -TOPSOIL-(OL) PID Reading=0.0 ppm	
										0.4	
	2D	24/17	2.0 - 4.0	3/3/4/4	7	11				Brown to rust-brown, dry to moist, stiff, SILT, roots -FILL-(ML) PID Reading=0.0 ppm	
								59.0		3.3	
										Brown to rust-brown, dry to moist, stiff, SILT, trace roots, trace clay, trace fine sand -MARINE DEPOSIT-(ML) PID Reading=0.0 ppm Note: Probable perched water at 4.0 ft.	
5	3D	24/20	5.0 - 7.0	6/4/4/5	8	12					
								56.2		6.1	
										Brown, moist, medium stiff, SILT -MARINE DEPOSIT-(ML)	
10	4D	24/24	10.0 - 12.0	3/4/5/7	9	14	20			Olive-brown, moist, stiff, SILT, trace clay -MARINE DEPOSIT-(ML)	
							47				
							59				
							71				
							33/6"				
15	5D	24/24	15.0 - 17.0	3/3/3/5	6	9	OPEN	47.3		15.0	
										Olive-brown, wet, stiff, Silty CLAY -MARINE DEPOSIT-(CL)	
20	6D	24/21	20.0 - 22.0	6/4/4/6	8	12	105	42.3		20.0	G#535452 A-4, SC
							103			Brown to brown-grey, wet, medium dense, fine Sandy CLAY -MARINE DEPOSIT-(SC)	
							97				
							123				
25							127				

Remarks:

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Boring No.: BB-YR0-104

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacement
Location: Yarmouth, Maine

Boring No.: BB-YR0-104
WIN: 23106.00+23110.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	62.3	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	10-18-2019/10-18-2019	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 828+35.0 NB, 84.3'R	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	7.9 ft
Hammer Efficiency Factor: 0.901		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
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S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_V = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	7D	24/13	25.0 - 27.0	10/9/11/14	30	45	43/6"	37.3		25.0	G#535453 A-2-4, SP
							77			Brown, moist to wet, dense, fine SAND, trace medium sand and silt -MARINE DEPOSIT-(SP)	
							99				
							98				
							82				
							89/6"				
30	8D	24/13	30.0 - 32.0	8/11/15/13	26	39	HW DRIVE			Similar to 7D, except little medium sand -MARINE DEPOSIT-(SP)	G#535454 A-3, SP
35	9D	24/12	35.0 - 37.0	12/13/13/14	26	39				Brown, moist to wet, dense, fine SAND, trace medium sand and silt -MARINE DEPOSIT-(SP)	G#535455 A-3, SP
								23.0		39.3	G#535456 A-1-b, SM
40	10D	24/18	40.0 - 42.0	22/39/33/43	72	108				Brown to grey-brown, wet, very dense, fine to medium SAND, some fine to coarse gravel, little silt, trace coarse sand, well bonded -GLACIAL TILL-(SM)	
										Note: Encountered probable top of bedrock at 42.9 ft.	
								19.4		42.9	
										Bottom of Exploration at 42.9 feet below ground surface.	
45											
50											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacement
Location: Yarmouth, Maine

Boring No.: BB-YR0-105
WIN: 23106.00+23110.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	65.7	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	10-18-2019/10-21-2019	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 829+68.1 NB, 33.4'R	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	31.1 ft
Hammer Efficiency Factor: 0.901		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample Attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample Attempt; V = Field Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = Weight of 140lb. Hammer; WOR/C = Weight of Rods or Casing; WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf); $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw Field SPT N-value; Hammer Efficiency Factor = Rig Specific Annual Calibration Value; N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf); WC = Water Content, percent; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; G = Grain Size Analysis; C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/16	0.0 - 2.0	4/2/2/2	4	6	HSA	65.5		Brown, moist, soft, SILT -TOPSOIL-(OL) PID Reading=0.0 ppm 0.2	
								64.3		Brown, moist, loose, medium to fine SAND, little coarse gravel, little silt, 1-in. thick layer of dark grey, dry, fine gravel to coarse sand -FILL-(SM) 1.4	
	2D	24/19	2.0 - 4.0	5/6/6/8	12	18		63.0		Brown, moist, soft to very stiff, SILT (ML), trace medium to fine sand, trace coarse sand -FILL-(ML) PID Reading=0.0 ppm 2.7	
5	3D	24/24	5.0 - 7.0	5/4/6/7	10	15				Brown to grey mottled, moist, stiff, SILT, trace clay, trace plant matter -MARINE DEPOSIT-(ML)	WC=26% LL=39% PL=22% PI=17%
10	4D	24/24	10.0 - 12.0	2/2/2/4	4	6	HW PUSH	55.7		10.0 Grey, moist, medium stiff, Silty CLAY, trace plant matter -MARINE DEPOSIT-(CL)	WC=38% LL=49% PL=23% PI=26%
15	5D	24/24	15.0 - 17.0	3/2/4/3	6	9				Olive-brown, moist to wet, medium stiff to stiff, Silty CLAY -MARINE DEPOSIT-(CL)	
								49.4		16.3 Grey, wet, medium stiff to stiff, Silty CLAY -MARINE DEPOSIT-(CL)	
	U1	24/22	18.0 - 20.0								C#IP-1 WC=42% LL=43% PL=23% PI=20%
20	6D V1	24/24	20.0 - 22.0 20.6 - 21.0	Push thru vane Su=1,085/155 psf						Similar to 5D, one sand seam -MARINE DEPOSIT-(CL) 55x110 mm Vane Raw Torque Readings: V1: 280/40 in-lbs	WC=35% LL=38% PL=20% PI=18%
	MV		21.3 - 21.3							Note: Vane refusal at approximately 21.3 ft.	
25											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

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Boring No.: BB-YR0-105

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacement
Location: Yarmouth, Maine

Boring No.: BB-YR0-105
WIN: 23106.00+23110.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	65.7	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	10-18-2019/10-21-2019	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 829+68.1 NB, 33.4'R	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	31.1 ft
Hammer Efficiency Factor: 0.901		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_V = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	7D V2	24/24	25.0 - 27.0 ~~25.1 - 25.5~~	Push thru vane Su=1,670/235 psf	6	9	HW ~~DRIVE~~			Similar to 5D -MARINE DEPOSIT-(CL) 55x110 mm Vane Raw Torque Readings: V2: 430/60 in-lbs	
								39.1		26.6 Grey to brown, moist, medium stiff, Sandy SILT, one 1-in. thick weathered rock piece, occasional sand seam -MARINE DEPOSIT-(ML)	
30	8D	24/16	30.0 - 32.0	9/9/12/9	21	32				Similar to 7D -MARINE DEPOSIT-(ML)	
								34.5		31.2 Brown, moist, medium dense, fine SAND, trace silt, poorly-graded -MARINE DEPOSIT-(SP)	
35	9D	24/13	35.0 - 37.0	11/14/19/18	33	50		30.7		35.0 Brown, moist, dense, fine SAND, trace medium sand, little silt -MARINE DEPOSIT-(SP-SM)	G#535457 A-2-4, SP-SM
								26.5		39.2 Note: Drill action indicates sand and gravel from 39.2 to 40.1 ft. -PROBABLE GLACIAL TILL-	
40	10D R1	1/0 60/54	40.0 - 40.1 40.1 - 45.1	50/1" RQD = 77%			NQ CORE	25.6		Note: Split-spoon refusal at 40.1 ft. 40.1 Top of Bedrock at El. 25.6 Grey to light grey, fine-grained, quartz-rich GRANITE, hard, fresh to slightly weathered. Joint dipping at low angles, wide, tight, one 1/16-in. thick silt infilled joint, fresh to slightly weathered, planar, smooth to rough. Rock Quality=Good Recovery=90% R1 Core Times (min:sec): 40.1-41.1' (1:04); 41.1-42.1' (1:01); 42.1-43.1' (1:10); 43.1-44.1' (0:52); 44.1-45.1' (1:02)	qp=23,541 psi (40.6-41.0')
45	R2	60/58	45.1 - 50.1	RQD = 88%						Similar to R1, one secondary joint moderately dipping tight. Layer of silt 0.5-in. thick at approximately 48.1 ft. Rock Quality=Good Recovery=97% R2 Core Times (min:sec): 45.1-46.1' (1:04); 46.1-47.1' (1:25); 47.1-48.1' (1:03); 48.1-49.1' (1:10); 49.1-50.1' (1:12)	qp=21,055 psi (46.6-47.0')
50											

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacement
Location: Yarmouth, Maine

Boring No.: BB-YR0-105
WIN: 23106.00+23110.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	65.7	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	10-18-2019/10-21-2019	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 829+68.1 NB, 33.4'R	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	31.1 ft
Hammer Efficiency Factor:	0.901	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
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MU = Unsuccessful Thin Wall Tube Sample Attempt
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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_V = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
50								15.6		50.1 **Bottom of Exploration at 50.1 feet below ground surface.**	
55											
60											
65											
70											
75											

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacement
Location: Yarmouth, Maine

Boring No.: BB-YR0-106
WIN: 23106.00+23110.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	63.7	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	10-11-19/10-11-19	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 831.88.8 NB, 66.7'R	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	24.2 ft
Hammer Efficiency Factor:	0.901	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
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WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
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WC = Water Content, percent
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C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/16	0.0 - 2.0	3/5/5/4	10	15	HSA			Brown to dark brown, dry, stiff, SILT, little fine to coarse sand, trace gravel -FILL-(ML) PID Reading=0.0 ppm	
	2D	24/13	2.0 - 4.0	6/8/6/4	14	21				Similar to 1D, except very stiff -FILL-(ML) PID Reading=0.0 ppm	
	3D	24/15	4.0 - 6.0	4/4/3/3	7	11				Brown, dry, stiff, SILT, little fine to coarse sand, trace gravel -FILL-(ML) PID Reading=0.0 ppm	
5								58.2		5.5	
	4D	24/13	6.0 - 8.0	2/1/1/3	2	3		57.2		Light grey, dry, loose, Sandy GRAVEL, trace silt, poorly-graded -FILL-(GP) 6.5 Olive brown-grey mottled, moist, soft, Silty CLAY -MARINE DEPOSIT-(CL)	
10	5D	24/21	10.0 - 12.0	3/3/4/3	7	11				Olive-brown, moist, stiff, Silty CLAY, trace organics -MARINE DEPOSIT-(CL)	
15	6D MV	24/24	15.0 - 17.0 15.0 - 15.0	2/2/2/3	4	6	HW DRIVE			Note: Attempted vane shear test at 15.0 ft, too stiff to penetrate soil. Olive-brown, wet, medium stiff, Silty CLAY, trace organic -MARINE DEPOSIT-(CL)	
20	7D V1 V2	24/24	20.0 - 22.0 20.6 - 21.0 21.6 - 22.0	Push thru vane Su=930/155 psf Su=1,280/155 psf				43.7		20.0 Grey, wet, medium stiff to stiff, Silty CLAY -MARINE DEPOSIT-(CL) 55x110 mm raw torque vane: V1: 240/40 in-lbs V2: 330/40 in-lbs	
25											

Remarks:

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Boring No.: BB-YR0-106

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacement
Location: Yarmouth, Maine

Boring No.: BB-YR0-106
WIN: 23106.00+23110.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	63.7	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	10-11-19/10-11-19	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 831.88.8 NB, 66.7'R	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	24.2 ft
Hammer Efficiency Factor: 0.901		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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SSA = Solid Stem Auger
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WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
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WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	8D	24/24	25.0 - 27.0	Push thru vane			HW			Grey, wet, medium stiff, Silty CLAY -MARINE DEPOSIT-(CL) 55x110 mm raw torque vane: V3: 250/40 in-lbs V4: 235/40 in-lbs	
	~~V3~~		~~25.6 - 26.0~~	~~Su=970/155 psf~~							
	V4		26.6 - 27.0	Su=910/155 psf							
										Note: Attempt vane shear test, advanced vane to refusal at 30.2 ft.	
30	9D	24/24	30.0 - 32.0	2/1/1/3	2	3				Grey, wet, soft to medium stiff, Silty CLAY, with sand layers from 30.0 to 30.6 ft -MARINE DEPOSIT-(CL)	
	~~MV~~		~~30.2 - 30.2~~								
										Note: Vane attempted at 35.0 ft, refusal.	
35	10D	24/24	35.0 - 37.0	3/3/3/7	6	9				Similar to 9D, except stiff with interbedded sand -MARINE DEPOSIT-(CL)	
	~~MV~~		~~35.0 - 35.0~~								
								27.2		36.5 Brown, wet, loose to medium dense, Silty fine SAND -MARINE DEPOSIT-(SM)	
							170				
40	11D	24/18	40.0 - 42.0	7/6/4/4	10	15	149			Brown, wet, medium dense, fine SAND, some medium sand and silt, silt layer from 41.7 to 42.0 ft -MARINE DEPOSIT-(SM)	G#535458 A-2-4, SM
							158				
							77	21.5		42.2	
								20.9		Note: Encountered sand and gravel in wash water from 42.2 to 42.8 ft. -PROBABLE GLACIAL TILL-	
	R1	60/43	43.0 - 48.0	RQD = 72%			NQ CORE			42.8 Top of Bedrock El. 20.9 Light grey to dark grey, fine-grained, GRANOFELS, hard, fresh to slightly weathered. Joints dipping at low angles to horizontal, close to moderately close, tight to open, occasional moderately weathered joint surfaces, planar to undulating, occasional coarse-grained pegmatitic to granitic intrusions. Rock Quality=Fair Recovery=100%	
45										R1 Core Times (min:sec): 43.0-44.0' (3:57); 44.0-45.0' (4:07); 45.0-46.0' (3:36); 46.0-47.0' (4:33); 47.0-48.0' (5:03)	
	R2	60/59	48.0 - 53.0	RQD = 98%						Similar to above, except joints dipping at low to moderate angles, and wide spacing, rough joint surfaces, pegmatitic intrusion from	
50											

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacement
Location: Yarmouth, Maine

Boring No.: BB-YR0-106
WIN: 23106.00+23110.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	63.7	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	10-11-19/10-11-19	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 831.88.8 NB, 66.7'R	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	24.2 ft
Hammer Efficiency Factor: 0.901		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
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WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
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N-uncorrected = Raw Field SPT N-value
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N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
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T_V = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
50							NQ CORE			49.3 to 50.8 ft. Rock Quality=Excellent Recovery=100% R2 Core Times (min:sec): 48.0-49.0' (4:31); 49.0-50.0' (3:27); 50.0-51.0' (2:45); 51.0-52.0' (2:28); 52.0-53.0' (2:48)	
								10.7		53.0 **Bottom of Exploration at 53.0 feet below ground surface.**	
55											
60											
65											
70											
75											

Remarks:

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Top Row: BB-YRO-105, Run No. R1, 40.1 (left) to 45.1 (right)
Top Middle Row: BB-YRO-105, Run No. R2, 45.1 (left) to 50.1 (right)
Bottom Middle Row: BB-YRO-101, Run No. R1, 25.0 (left) to 30.0 (right)
Bottom Row: BB-YRO-101, Run No. R2, 30.0 (left) to 35.0 (right)

Top Row: BB-YRO-106, Run No. R1, 43.0 (left) to 48.0 (right)
Top Middle Row: BB-YRO-106, Run No. R2, 48.0 (left) to 53.0 (right)
Bottom Middle Row: BB-YRO-102, Run No. R1, 25.2 (left) to 30.2 (right)
Bottom Row: BB-YRO-102, Run No. R2, 30.2 (left) to 35.2 (right)

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-201
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	60.1	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	6-7-2021/6-7-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	--
Boring Location:	Sta. 723+21.0 SB, 38.9'LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	4.7 ft
Hammer Efficiency Factor: 0.976		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D/A	24/16	0.0 - 2.0	1/2/2/2	4	7	SSA	59.6		Brown, dry, soft, SILT, some fine sand, trace organics -TOPSOIL-(OL)	
										0.5	
	2D	24/16	2.0 - 4.0	3/4/5/4	9	15				Brown, damp, medium stiff, Clayey SILT, trace fine sand, trace organics -FILL-(ML)	
										Brown, damp, stiff, Clayey SILT, trace organics -FILL-(ML)	
	3D	24/9	4.0 - 6.0	3/3/2/2	5	8				Brown mottled, moist, medium stiff, Clayey SILT, trace coarse gravel in tip -FILL-(ML)	
5											
	4D/A	24/18	6.0 - 8.0	4/4/4/3	8	13		53.4		Brown-grey mottled, moist, stiff, Clayey SILT, trace fine sand, trace organics -FILL-(ML)	
										6.7	
	5D	24/24	8.0 - 10.0	3/4/3/3	7	11				Brown, damp, medium dense, fine SAND, trace coarse sand, trace silt -FILL-(SP)	
										Brown, moist, medium dense, fine SAND, some clayey silt layers, trace medium to coarse sand, trace fine gravel -FILL-(SP)	
10	6D	24/15	10.0 - 12.0	2/2/3/2	5	8	HW PUSH			Brown, moist, loose, fine to medium SAND, some clayey silt layers, trace coarse sand, 5-in. thick topsoil with roots at top -FILL-(SP)	
	7D	24/12	12.0 - 14.0	1/1/1/3	2	3				Brown, wet, very loose, fine to medium SAND, little silt, trace coarse sand -FILL-(SP)	
	8D/A	24/12	14.0 - 16.0	7/8/22/50(1")	30	49		46.1		14.0	
15								44.8		Brown, wet, dense, fine to medium SAND, trace coarse gravel, trace silt, heavily oxidized stain bottom 11 in. -MARINE DEPOSIT-(SP)	
								44.4		15.3	
										Weathered rock fragments -WEATHERED BEDROCK- Note: Casing refusal on probable bedrock at 15.7 ft.	
										15.7	
20										**Bottom of Exploration at 15.7 feet below ground surface.**	
25											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Boring No.: BB-YRO-201

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-202
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	61.9	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	6-7-2021/6-7-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 724+45.7 SB, 55.0' LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	4.0 ft
Hammer Efficiency Factor: 0.976		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample Attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample Attempt; V = Field Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = Weight of 140lb. Hammer; WOR/C = Weight of Rods or Casing; WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf); $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw Field SPT N-value; Hammer Efficiency Factor = Rig Specific Annual Calibration Value; N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf); WC = Water Content, percent; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; G = Grain Size Analysis; C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
				Sample Information							
0	1D/A	24/24	0.0 - 2.0	3/4/5/5	9	15	SSA	61.5		Brown, dry, medium stiff, SILT, trace fine sand, trace roots -TOPSOIL-(OL)	
										0.4	
	2D	24/24	2.0 - 4.0	4/6/8/8	14	23				Brown mottled, damp, stiff, Clayey SILT, trace organics -MARINE DEPOSIT-(ML)	
										Brown mottled, damp, very stiff, Clayey SILT, trace organics -MARINE DEPOSIT-(ML)	
5	3D	24/24	6.0 - 8.0	3/4/6/6	10	16				Brown mottled, damp, very stiff, Clayey SILT -MARINE DEPOSIT-(ML)	
10	4D V1	24/24	10.0 - 12.0 10.3 - 10.7	Su>2,135			HW PUSH	51.9		10.0 Brown-grey mottled, moist, very stiff, Silty CLAY, occasional brown fine sand seams -MARINE DEPOSIT-(CL) 55x110 mm vane raw torque readings: V1: >550 in-lbs	
	MV		14.0 - 14.2							Note: Attempted vane shear test, vane refusal at 14.2 ft, probable sand layer.	
15	5D	24/24	15.0 - 17.0	5/4/2/2	6	10				Brown-grey, wet, loose, Silty fine SAND and Silty CLAY interlayered	
								45.9		-MARINE DEPOSIT-(SM/CL)	
										16.0 Grey, wet, loose, Silty fine SAND and medium stiff, Silty CLAY interlayered -MARINE DEPOSIT-(SM/CL)	
								42.4		19.5	
20								42.2		Probable weathered rock at 19.5 ft based on drill action. -WEATHERED BEDROCK- Note: Casing refusal on probable bedrock at 19.7 ft.	
										19.7 **Bottom of Exploration at 19.7 feet below ground surface.**	
25											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Boring No.: BB-YRO-202

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-203
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	60.7	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	6-4-2021/6-4-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	--
Boring Location:	Sta. 724+27.4 SB, 98.2'LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	11.7 ft
Hammer Efficiency Factor: 0.976		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample Attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample Attempt; V = Field Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = Weight of 140lb. Hammer; WOR/C = Weight of Rods or Casing; WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf); $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw Field SPT N-value; Hammer Efficiency Factor = Rig Specific Annual Calibration Value; N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf); WC = Water Content, percent; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; G = Grain Size Analysis; C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
				Sample Information							
0	1D/A	24/12	0.0 - 2.0	1/3/12/25	15	24	SSA	60.2		Brown, dry, very soft, SILT, roots -TOPSOIL-(OL)	
										0.5	
	2D	24/8	2.0 - 4.0	4/6/5/6	11	18				Brown, moist, medium dense, fine to medium SAND, trace silt, trace gravel -FILL-(SP)	
								57.4		3.3	
										Grey-brown mottled, moist, very stiff, Silty CLAY -MARINE DEPOSIT-(CL)	
5	3D	24/24	5.0 - 7.0	4/5/6/4	11	18				Grey-brown mottled, moist, very stiff, Silty CLAY -MARINE DEPOSIT-(CL)	
10	4D	24/24	10.0 - 12.0	2/3/2/3	5	8	HW PUSH			Grey, wet, medium stiff, Silty CLAY -MARINE DEPOSIT-(CL)	
15	5D V1	24/9	15.0 - 17.0 15.4 - 15.8	Su=855/235 psf						Grey, wet, medium stiff, Silty CLAY -MARINE DEPOSIT-(CL)	
								44.6		55x110 mm vane raw torque readings: V1: 220/60 in-lbs	
										16.1	
										Brown, wet, medium dense, fine SAND, trace silt -MARINE DEPOSIT-(SP)	
20								40.7		20.0	
	6D	1/1	20.0 - 20.1	50(1")				40.6		Grey, wet, very dense, medium SAND, little coarse sand, trace gravel, trace silt -GLACIAL TILL-(SP)	
										20.1	
										Bottom of Exploration at 20.1 feet below ground surface.	
25											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Boring No.: BB-YRO-203

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-204
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	60.2	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	6-4-2021/6-4-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 725+79.0 SB, 33.8'LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	5.1 ft
Hammer Efficiency Factor: 0.976		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D/A	24/13	0.0 - 2.0	2/3/4/6	7	11	SSA	60.0		Brown, moist, medium stiff, SILT, roots -TOPSOIL-(OL)	
										0.2	
	2D	24/16	2.0 - 4.0	3/1/2/1	3	5				Brown, moist, medium dense, fine SAND, trace silt, asphalt with oil-like odor -FILL-(SP) Brown, moist, loose, fine to coarse SAND, little silt, trace gravel -FILL-(SP)	
	3D/A	24/16	4.0 - 6.0	2/1/1/1	2	3				Similar to 2D -FILL-(SP)	
5								54.8		5.4	
	4D/A	24/21	6.0 - 8.0	1/2/2/2	4	7		54.2		Grey-brown mottled, moist, very soft, Clayey SILT -FILL-(ML)	WC=21% LL=18% PL=13% PI=5%
										6.0	
	5D	24/10	8.0 - 10.0	1/1/2/1	3	5		53.2		Grey-brown, moist, loose, fine SAND, little clayey silt interbedded -FILL-(SP)	WC=32% LL=31% PL=19% PI=12%
										7.0	
10	6D	24/16	10.0 - 12.0	2/1/2/2	3	5	HW			Grey, moist, medium stiff, Silty CLAY -MARINE DEPOSIT-(CL) Grey-brown mottled, moist, medium stiff, Silty CLAY, roots -MARINE DEPOSIT-(CL) Similar to 5D -MARINE DEPOSIT-(CL)	
	1U	24/24	12.0 - 14.0								C#IP-1 WC=36% LL=39% PL=27% PI=12%
	7D V1	24/24	14.0 - 16.0 14.4 - 14.8	Su=1,940/465 psf						Grey, wet, stiff, Silty CLAY -MARINE DEPOSIT-(CL) 55x110 mm vane raw torque readings: V1: 500/120 in-lbs	WC=30% LL=38% PL=23% PI=15%
15										Note: Drill action indicates sand at 18.0 ft.	
								42.2		18.0	
20	8D	22/14	20.0 - 21.8	2/1/1/50(4")	2	3				Grey, wet, very loose, Silty fine SAND, trace medium sand and fine gravel, little coarse gravel -MARINE DEPOSIT-(SM) Note: Weathered rock in tip.	G#621449 A-4, SM
								38.4		21.8	
	R1	60/60	22.0 - 27.0	RQD = 70%			NQ CORE			Top of Bedrock El. 38.4 R1: Grey to dark grey, fine to medium-grained, GRANOFELS, hard, fresh. Joints dipping at low to moderate angles, close to moderate spacing, tight, slightly weathered, planar, rough, thin silt coatings on joints, occasional coarse-grained pegmatite intrusions.	
25											

Remarks:

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Boring No.: BB-YRO-204

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-204
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	60.2	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	6-4-2021/6-4-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 725+79.0 SB, 33.8'LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	5.1 ft
Hammer Efficiency Factor: 0.976		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_V = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25										Rock Quality=Fair Recovery=100% R1 Core Times (min:sec): 22.0-23.0' (2:58); 23.0-24.0' (2:45); 24.0-25.0' (3:08); 25.0-26.0' (3:21); 26.0-27.0' (3:28)	
	R2	60/60	27.0 - 32.0	RQD = 100%						R2: Grey to dark grey, fine to medium-grained, GRANOFELS, hard, fresh. Joints dipping at low to moderate angles, close to moderate spacing, tight, slightly weathered, planar, rough, thin silt coatings on joints, quartz intrusions. Rock Quality=Excellent Recovery=100% R2 Core Times (min:sec): 27.0-28.0' (2:10); 28.0-29.0' (2:03); 29.0-30.0' (2:27); 30.0-31.0' (2:18); 31.0-32.0' (2:36)	
30								28.2		32.0 **Bottom of Exploration at 32.0 feet below ground surface.**	
35											
40											
45											
50											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-205
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	64.5	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	6-9-2021/6-9-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 726+96.4 SB, 27.4'LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	18.1 ft
Hammer Efficiency Factor: 0.976		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample Attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample Attempt; V = Field Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = Weight of 140lb. Hammer; WOR/C = Weight of Rods or Casing; WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf); $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw Field SPT N-value; Hammer Efficiency Factor = Rig Specific Annual Calibration Value; N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf); WC = Water Content, percent; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; G = Grain Size Analysis; C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
				Sample Information							
0	1D/A	24/24	0.5 - 2.5	56/45/45/16	90	146	SSA	64.2		-BITUMINOUS CONCRETE- 0.3 Very dense, Reclaim BITUMINOUS CONCRETE, slight petroleum-like odor	
	2D/A	24/23	2.5 - 4.5	22/14/8/17	22	36		62.5		-FILL- 2.0 Tan, dry, dense, fine to medium SAND, trace coarse sand	
								61.3		-FILL-(SP) Tan, wet, dense, fine to medium SAND, trace coarse sand -FILL-(SP) 3.2	
5	3D	24/24	5.0 - 7.0	3/4/7/9	11	18				Olive-brown mottled, damp, hard, SILT, trace fine sand, trace clay -MARINE DEPOSIT-(ML) Olive-brown, damp, very stiff, Clayey SILT, trace organics -MARINE DEPOSIT-(ML)	
10	4D	24/24	10.0 - 12.0	2/3/3/2	6	10	HW PUSH	54.5		10.0 Olive-brown, moist, stiff, Silty CLAY, trace organics -MARINE DEPOSIT-(CL)	
15	5D V1	24/24	15.0 - 17.0 15.0 - 15.4	Su=885/115 psf						Grey, wet, medium stiff, Silty CLAY, occasional fine sand seams -MARINE DEPOSIT-(CL) 55x110 mm vane raw torque readings: V1: 220/80 in-lbs Note: Vane pushed 4 in., encountered granular soil.	
20	6D/A V2	24/22	20.0 - 22.0 20.5 - 20.9	Su=1,340/310 psf						Grey, wet, stiff, Silty CLAY, occasional fine sand layers -MARINE DEPOSIT-(CL) 55x110 mm raw torque vane readings:	
							80	43.0		V2: 340/80 in-lbs Note: Sand seams encountered during vane advancement.	
							72			21.5 Brown, wet, loose, fine SAND, trace silt -MARINE DEPOSIT-(SP)	
	R1	60/54	23.9 - 28.9	RQD = 35%			113 NQ CORE	40.6		23.9 Top of Bedrock El. 40.6 R1: Light to dark grey, fine-grained, GRANOFELS, hard, fresh to	
25											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Boring No.: BB-YRO-205

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-205
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	64.5	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	6-9-2021/6-9-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 726+96.4 SB, 27.4'LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	18.1 ft
Hammer Efficiency Factor: 0.976		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_V = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25							NQ CORE			slightly weathered. Joints dipping at low angles, close, tight to open, planar to undulating, smooth to rough, fractured zone from approximately 24.6 to 24.9 ft. Rock Quality=Poor Recovery=90% R1 Core Times (min:sec): 23.9-24.9' (1:32); 24.9-25.9' (1:15); 25.9-26.9' (0:59); 26.9-27.9' (1:01); 27.9-28.9' (1:17) Note: Water loss at 24.5 ft.	
	R2	60/59	28.9 - 33.9	RQD = 62%						R2: Light to dark grey, fine-grained, GRANOFELS, hard, fresh to slightly weathered. Joints horizontal to low angles, close, tight to open, planar to undulating, smooth to rough, quartz intrusion from 30.9 to 32.0 ft. Rock Quality=Fair Recovery=98% R2 Core Times (min:sec): 28.9-29.9' (1:27); 29.9-30.9' (1:20:); 30.9-31.9' (1:31); 31.9-32.9' (1:21); 32.9-33.9' (1:32)	
30								30.6		33.9 **Bottom of Exploration at 33.9 feet below ground surface.**	
35											
40											
45											
50											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-206
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	65.5	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	6-3-2021/6-4-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	--
Boring Location:	Sta. 727+80.5 SB, 74.7'LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	12.3 ft
Hammer Efficiency Factor: 0.976		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample Attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample Attempt; V = Field Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = Weight of 140lb. Hammer; WOR/C = Weight of Rods or Casing; WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf); $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw Field SPT N-value; Hammer Efficiency Factor = Rig Specific Annual Calibration Value; N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf); WC = Water Content, percent; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; G = Grain Size Analysis; C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D/A	24/16	0.0 - 2.0	2/4/7/7	11	18	SSA	64.9		Brown, moist, stiff, SILT, trace fine sand, roots -TOPSOIL-(OL)	
										0.6	
	2D	24/16	2.0 - 4.0	6/4/3/2	7	11				Brown, moist, medium dense, fine SAND, trace silt -FILL-(SP)	
								62.0		3.5	
	3D	24/24	4.0 - 6.0	3/5/7/8	12	20		61.5		Grey, moist, medium stiff, Clayey SILT -MARINE DEPOSIT-(ML)	WC=30% LL=44% PL=24% PI=20%
5										4.0	
										Grey, moist, very stiff, Silty CLAY -MARINE DEPOSIT-(CL)	
	4D	24/24	6.0 - 8.0	5/9/9/9	18	29		59.2		6.3	
								58.9		Grey, fine SAND layer	
										6.6	
	5D	24/24	8.0 - 10.0	4/3/5/6	8	13				Grey, moist, very stiff, Silty CLAY -MARINE DEPOSIT-(CL) Grey, moist, stiff, Silty CLAY -MARINE DEPOSIT-(CL)	WC=34% LL=41% PL=24% PI=17%
10											
	6D	24/24	10.0 - 12.0	2/3/2/4	5	8	HW PUSH			Grey, wet, medium stiff, Silty CLAY -MARINE DEPOSIT-(CL)	
	1U	24/24	12.0 - 14.0								C#IP-2 WC=33% LL=29% PL=17% PI=12%
	7D MV	24/24	14.0 - 16.0 14.6 - 15.0	2/2/1/3	3	5				Brown to grey, wet, medium stiff, Silty CLAY -MARINE DEPOSIT-(CL) Note: Attempted field vane shear test, no penetration.	WC=34% LL=27% PL=17% PI=10%
15								50.6		14.9	
	8D MV	24/18	16.0 - 18.0 16.5 - 16.9	4/3/4/3	7	11		49.0		Grey, wet, medium stiff, Silty CLAY, trace interbedded fine sand seams -MARINE DEPOSIT-(CL)	G#621450 A-4(8), CL
										16.5	G#621451 A-4, SM
										Grey-brown, wet, medium dense, Silty fine SAND -MARINE DEPOSIT-(SM) Note: Attempted field vane shear test, no penetration.	
20								45.5		20.0	
	9D	24/21	20.0 - 22.0	3/4/2/5	6	10				Grey-brown, wet, loose, fine Sandy SILT, two 1-in. thick silt layers -MARINE DEPOSIT-(ML)	G#621452 A-4, ML
25											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Boring No.: BB-YRO-206

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-206
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	65.5	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	6-3-2021/6-4-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	--
Boring Location:	Sta. 727+80.5 SB, 74.7'LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	12.3 ft
Hammer Efficiency Factor:	0.976	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_V = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	10D	7/7	25.0 - 25.6	2/50(1")			71	40.5 39.9		25.0 Brown, wet, very dense, fine to medium SAND, trace silt, one 1-in. thick clay layer -MARINE DEPOSIT-(SP) 25.6 **Bottom of Exploration at 25.6 feet below ground surface.**	
30											
35											
40											
45											
50											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-207
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	64.6	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	6-3-2021/6-3-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 728+58.9 SB, 23.3'LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	13.2 ft
Hammer Efficiency Factor: 0.976		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
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V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
				Sample Information							
0	1D/A	24/19	0.0 - 2.0	2/5/6/6	11	18	SSA	63.9		Brown, moist, stiff, SILT, trace fine sand, roots -TOPSOIL-(OL) 0.7	
								62.6		Brown, moist, medium dense, fine to coarse SAND, trace silt, trace gravel -FILL-(SP)	
	2D/A	24/14	2.0 - 4.0	6/3/3/5	6	10		61.7		2.0	
								61.1		Grey, moist, stiff, Silty CLAY -FILL-(OL)	
	3D	24/18	4.0 - 6.0	4/6/10/10	16	26		60.6		2.9 Reworked grey, mottled, rust-brown, medium stiff, SILT -FILL-(ML)	
5										3.5	
	4D	24/15	6.0 - 8.0	7/5/5/6	10	16				Grey mottled, moist, medium stiff, Clayey SILT, organics -MARINE DEPOSIT-(ML)	
										4.0 Grey-brown mottled, moist, very stiff, Clayey SILT, trace organics -MARINE DEPOSIT-(ML)	
										Grey, wet, very stiff, Clayey SILT, trace sand seams, trace organics -MARINE DEPOSIT-(ML)	
10	5D	24/24	10.0 - 12.0	2/2/3/4	5	8	HW PUSH	54.6		10.0 Grey, wet, medium stiff, Silty CLAY -MARINE DEPOSIT-(CL)	
15	6D MV	24/23	15.0 - 17.0 15.4 - 15.8	2/1/1/1	2	3				Grey, wet, soft, Silty CLAY -MARINE DEPOSIT-(CL) Note: Attempted field vane shear test, no penetration.	
	V1		17.6 - 18.0	Su=465/115 psf						55x110 mm vane raw torque readings: V1: 120/30 in-lbs	
	7D MV	24/24	18.0 - 20.0 18.4 - 18.8	WOH/WOH/3/1	3	5				Grey, wet, medium stiff, CLAY, occasional 1-in. thick sand layers -MARINE DEPOSIT-(CL) Note: Attempted field vane shear test, no penetration.	
20	8D	24/24	20.0 - 22.0	4/2/1/3	3	5				Grey, wet, medium stiff, Silty CLAY, intermittent grey-brown fine sand layers -MARINE DEPOSIT-(CL)	
							74	41.6		Note: Drill action indicates granular soil at 23.0 ft. 23.0	
25							46				

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

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Boring No.: BB-YRO-207

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-207
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	64.6	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	6-3-2021/6-3-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 728+58.9 SB, 23.3'LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	13.2 ft
Hammer Efficiency Factor: 0.976		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
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MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_V = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	9D	19/8	25.0 - 26.6	8/7/11/50(1")	18	29	71			Grey-brown, wet, medium dense, fine to medium SAND, trace coarse sand, trace gravel, trace silt, well graded, mica -MARINE DEPOSIT-(SW)	
							59	37.8		26.8	
	R1	60/60	27.0 - 32.0	RQD = 85%			NQ CORE			Top of Bedrock El. 37.6 R1: Grey to dark grey, fine to medium-grained, GRANOFELS, hard, fresh. Joints dipping at low angles, close to moderate spacing, tight, planar, rough, trace silt on joints, pegatite intrusions, foliated layer (3-in. thick) at 28.5 ft. Rock Quality=Good Recovery=100% R1 Core Times (min:sec): 27.0-28.0' (2:41); 28.0-29.0' (2:28); 29.0-30.0' (2:35); 30.0-31.0' (2:58); 31.0-32.0' (2:57)	
30											
	R2	60/60	32.0 - 37.0	RQD = 82%						R2: Similar to R1. Rock Quality=Good Recovery=100% R2 Core Times (min:sec): 32.0-33.0' (3:27); 33.0-34.0' (3:11); 34.0-35.0' (2:55); 35.0-36.0' (2:12); 36.0-37.0' (2:11)	
35											
								27.6		37.0	
										Bottom of Exploration at 37.0 feet below ground surface.	
40											
45											
50											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-208
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	68.2	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	6-3-2021/6-3-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	--
Boring Location:	Sta. 729+88.3 SB, 66.3'LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	8.4 ft
Hammer Efficiency Factor:	0.976	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
				Sample Information							
0	1D/A	24/17	0.0 - 2.0	3/3/9/11	12	20	SSA			Brown, moist, stiff, SILT, trace fine sand, roots -TOPSOIL-(OL)	
								67.1		1.1	
								66.2		Grey-brown, moist, very stiff, SILT, reworked -FILL-(ML)	
	2D	24/20	2.0 - 4.0	7/7/14/14	21	34				2.0	
										Grey, moist, hard, SILT, trace organics -MARINE DEPOSIT-(ML	
5	3D	24/23	5.0 - 7.0	2/5/7/10	12	20				Grey, moist, very stiff, SILT -MARINE DEPOSIT-(ML)	
							60				
							131				
10	4D	24/24	10.0 - 12.0	3/4/5/4	9	15	HW PUSH	58.2		10.0	
										Brown-grey, wet, stiff, Silty CLAY -MARINE DEPOSIT-(CL)	
15	5D MV	24/24	15.0 - 17.0 15.0 - 15.4	2/3/4/5	7	11				Note: Attempted field vane shear test, no penetration.	
								52.2		16.0	
										Grey, wet, stiff, Silty CLAY, intermittent sand layers -MARINE DEPOSIT-(CL)	
										Note: Drill action indicates change at 18.0 ft.	
								50.2		18.0	
20	6D	24/13	20.0 - 22.0	6/8/9/8	17	28				Brown, wet, medium dense, fine to medium SAND, trace silt -MARINE DEPOSIT-(SP)	
	7D	12/8	23.5 - 24.5	6/12/50(0")						Grey-brown, wet, medium dense, fine to medium SAND, trace fine gravel, trace silt -MARINE DEPOSIT-(SP)	
25								43.7			

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Boring No.: BB-YRO-208

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-208
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	68.2	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	6-3-2021/6-3-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	--
Boring Location:	Sta. 729+88.3 SB, 66.3'LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	8.4 ft
Hammer Efficiency Factor:	0.976	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_V = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25										Note: Split-spoon refusal at 24.5 ft.	
										24.5	
										Bottom of Exploration at 24.5 feet below ground surface.	
30											
35											
40											
45											
50											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-209
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	69.7	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	6-3-2021/6-3-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 731+47.3 SB, 44.9'LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	8.3 ft
Hammer Efficiency Factor: 0.976		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample Attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample Attempt; V = Field Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = Weight of 140lb. Hammer; WOR/C = Weight of Rods or Casing; WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf); $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw Field SPT N-value; Hammer Efficiency Factor = Rig Specific Annual Calibration Value; N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf); WC = Water Content, percent; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; G = Grain Size Analysis; C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
				Sample Information							
0	1D/A	24/24	0.0 - 2.0	1/2/4/6	6	10	SSA	69.0		Grey-brown, moist, medium stiff, SILT, trace fine sand -TOPSOIL-(OL)	
										0.7	
	2D	24/23	2.0 - 4.0	7/8/11/15	19	31				Grey-brown mottled, moist, very stiff, SILT, organics -MARINE DEPOSIT-(ML)	
										Grey-brown mottled, moist, hard, SILT, organics -MARINE DEPOSIT-(ML)	
5	3D	24/24	5.0 - 7.0	3/6/7/12	13	21		64.7		5.0	
										Grey-brown mottled, moist, very stiff, Silty CLAY, organics -MARINE DEPOSIT-(CL)	
10	4D	24/24	10.0 - 12.0	3/3/4/4	7	11	HW PUSH			Grey-brown mottled, wet, stiff, Silty CLAY, frequent fine sand seams -MARINE DEPOSIT-(CL)	
15	5D/A MV	24/22	15.0 - 17.0 15.6 - 16.0	2/2/2/3	4	7		54.7		15.0	
										Grey, wet, medium stiff, SILT, frequent fine sand seams -MARINE DEPOSIT-(ML) Note: Attempted field vane shear test, no penetration.	
20	6D MV	24/9	20.0 - 22.0 20.6 - 21.0	7/9/10/12	19	31				Note: Attempted field vane shear test, no penetration.	
								48.7		21.0	
										Grey to light-brown, wet, dense, fine SAND, trace silt, poorly graded -MARINE DEPOSIT-(SP)	
25											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Boring No.: BB-YRO-209

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-209
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	69.7	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	J. Fletcher	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	6-3-2021/6-3-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 731+47.3 SB, 44.9'LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	8.3 ft
Hammer Efficiency Factor: 0.976		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
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MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_V = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	7D	24/14	25.0 - 27.0	16/22/27/15	49	80	HW	44.7		25.0 Grey-brown, wet, very dense, fine to medium SAND, trace gravel, trace silt, poorly graded GLACIAL TILL-(SP)	
								42.7		27.0 **Bottom of Exploration at 27.0 feet below ground surface.**	
30											
35											
40											
45											
50											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-210
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	61.7	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	6-9-2021/6-9-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	--
Boring Location:	Sta. 826+28.9 NB, 85.9'RT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	17.8 ft
Hammer Efficiency Factor:	0.976	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample Attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample Attempt; V = Field Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = Weight of 140lb. Hammer; WOR/C = Weight of Rods or Casing; WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf); $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw Field SPT N-value; Hammer Efficiency Factor = Rig Specific Annual Calibration Value; N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf); WC = Water Content, percent; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; G = Grain Size Analysis; C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D/A	24/16	0.0 - 2.0	4/5/5/4	10	16	HW PUSH	61.0		Brown, dry, stiff, SILT, trace fine sand, trace roots -TOPSOIL-(OL)	
										0.7	
	2D	24/18	2.0 - 4.0	4/4/5/5	9	15				Brown mottled, dry, stiff, SILT, trace clay, trace organics -MARINE DEPOSIT-(ML)	
										Brown mottled, damp, stiff, SILT, little clay, trace organics -MARINE DEPOSIT-(ML)	
5	3D	24/24	5.0 - 7.0	7/8/11/12	19	31				Brown mottled, damp, hard, SILT, little clay, trace organics -MARINE DEPOSIT-(ML)	
10	4D	24/24	10.0 - 12.0	3/4/5/6	9	15	OPEN			Brown, damp, stiff, Clayey SILT, trace fine sand -MARINE DEPOSITS-(ML)	
15	5D/A	24/22	15.0 - 17.0	4/2/7/11	9	15		46.6		Brown, moist, stiff, fine Sandy SILT, fine sand layers -MARINE DEPOSIT-(ML)	
										15.1	
										Tan, damp, loose to medium dense, fine SAND, poorly graded -MARINE DEPOSIT-(SP)	
20	6D	24/9	20.0 - 22.0	7/9/9/10	18	29				Tan, wet, medium dense, fine SAND, poorly graded -MARINE DEPOSIT-(SP)	
25											

Remarks:

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Boring No.: BB-YRO-210

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-210
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	61.7	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	6-9-2021/6-9-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	--
Boring Location:	Sta. 826+28.9 NB, 85.9'RT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	17.8 ft
Hammer Efficiency Factor: 0.976		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
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MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_V = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	7D	24/7	25.0 - 27.0	7/7/11/10	18	29	OPEN	34.7		Tan, wet, medium dense, fine SAND, poorly graded -MARINE DEPOSIT-(SP)	
										27.0 **Bottom of Exploration at 27.0 feet below ground surface.**	
30											
35											
40											
45											
50											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-211
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	59.4	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/30#
Date Start/Finish:	6-7-2021/6-7-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	--
Boring Location:	Sta. 831+09.0 NB, 156.5'RT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	0.3 ft
Hammer Efficiency Factor: 0.976		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D/A	24/24	0.0 - 2.0	1/2/6/8	8	13	HW PUSH	58.9		Dark brown, dry, very soft, SILT, trace fine sand, trace roots -TOPSOIL-(OL)	
										0.5	
	2D	24/24	2.0 - 4.0	4/7/10/12	17	28				Brown mottled, dry, stiff, SILT, some clay, trace organics -MARINE DEPOSIT-(ML) Brown mottled, dry, very stiff, Clayey SILT -MARINE DEPOSIT-(ML)	
5	3D	24/24	5.0 - 7.0	4/5/6/7	11	18				Brown mottled, damp, very stiff, Clayey SILT -MARINE DEPOSIT-(ML)	
10	4D	24/24	10.0 - 12.0	2/3/3/3	6	10		49.4		10.0 Brown-grey, wet, stiff, Silty CLAY -MARINE DEPOSIT-(CL)	
15	5D	24/24	15.0 - 17.0	1/1/1/1	2	3				Grey, wet, soft, Silty CLAY -MARINE DEPOSIT-(CL)	
20	6D	24/24	20.0 - 22.0	WOH/WOH/WOH/ WOH						Grey, wet, very soft, Silty CLAY -MARINE DEPOSIT-(CL)	
25											

Remarks:

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Boring No.: BB-YRO-211

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 Exit 17 NB and SB Bridge Replacements
Location: Yarmouth, Maine

Boring No.: BB-YRO-211
WIN: 23106.00+23110.00

Driller:	Northern Test Borings, Inc.	**Elevation (ft.)**	59.4	**Auger ID/OD:**	--
Operator:	M. Nadeau	**Datum:**	NAVD 88	**Sampler:**	Split-Spoon 1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Diedrich D-50 Track-Mounted Rig	**Hammer Wt./Fall:**	SS-140/30#; HW-140/
Date Start/Finish:	6-7-2021/6-7-2021	**Drilling Method:**	SSA/HW Drive	**Core Barrel:**	--
Boring Location:	Sta. 831+09.0 NB, 156.5'RT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	0.3 ft
Hammer Efficiency Factor: 0.976		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_V = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	7D	24/24	25.0 - 27.0	Su=1,065/195 psf			OPEN			Grey, wet, stiff, Silty CLAY, trace coarse gravel -MARINE DEPOSIT-(CL) 55x110 mm vane raw torque readings: V1: 275/50-in-lbs V2: 270/20 in-lbs	
	V1		~~25.6 - 26.0~~								
	V2		26.6 - 27.0	Su=1,050/80 psf				32.4		27.0	
										Bottom of Exploration at 27.0 feet below ground surface.	
30											
35											
40											
45											
50											

Remarks:

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Top Row: BB-YRO-207, Run No. R1, 27.0 (left) to 32.0 (right)
Top Middle Row: BB-YRO-207, Run No. R2, 32.0 (left) to 37.0 (right)
Bottom Middle Row: BB-YRO-204, Run No. R1, 22.0 (left) to 27.0 (right)
Bottom Row: BB-YRO-204, Run No. R2, 27.0 (left) to 32.0 (right)

Top Row: BB-YRO-205, Run No. R1, 23.9 (left) to 28.9 (right)
Bottom Row: BB-YRO-205, Run No. R2, 28.9 (left) to 33.9 (right)

APPENDIX B

Observation Well Installation and Groundwater Monitoring Reports

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No. BB-YRO-203(OW)

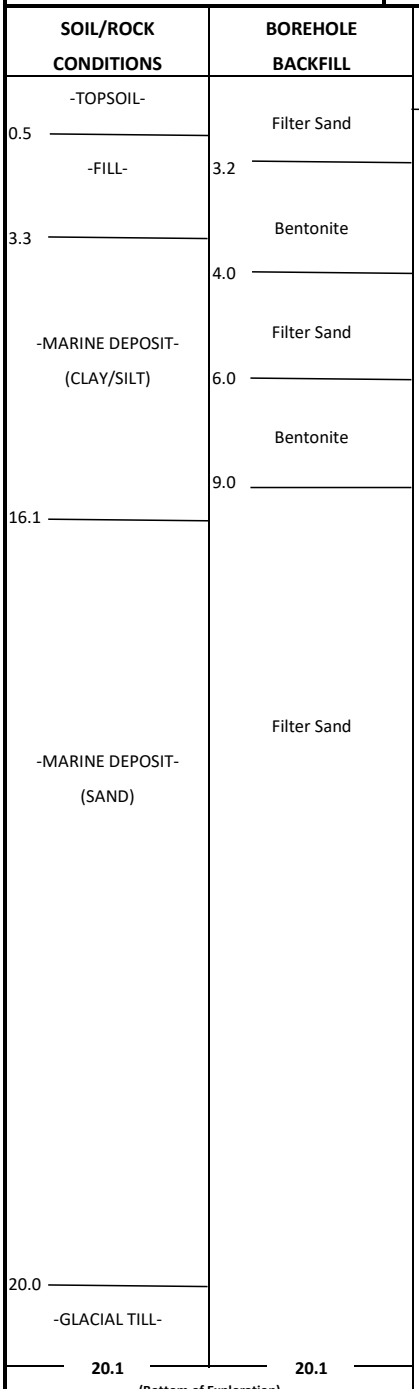
Boring No. BB-YRO-203

PROJECT	Interstate 295 Exit 17 NB and SB Bridge Replacements	**H&A FILE NO.**	0134120-003
LOCATION	Yarmouth, Maine	**PROJECT MGR.**	B. Steinert
CLIENT	Maine Department of Transportation	**FIELD REP.**	T. Jones
CONTRACTOR	Northern Test Borings, Inc.	**DATE INSTALLED**	6/7/2021
DRILLER	M. Nadeau	**WATER LEVEL**	11.7 ft

Ground El. 60.7 ft
El. Datum NAVD 88

Location See Plan

☑ **Guard Pipe**
☐ **Roadway Box**



Type of protective cover/lock Locking Cap

Height of top of guard pipe above ground surface 2.1 ft

Height of top of riser pipe above ground surface 1.8 ft

Type of protective casing: Steel Guard Pipe
Length 5.2 ft
Inside Diameter 4.5 in

Depth of bottom of guard pipe/roadway box 3.1 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite Seal	6.8	2.2

Type of riser pipe: Schedule 40 PVC
Inside diameter of riser pipe 2.0 in
Type of backfill around riser Filter Sand (No. 2)

Diameter of borehole 4.0 in

Depth to top of well screen 10.0 ft

Type of screen Schedule 40 PVC
Screen gauge or size of openings 0.010 in
Diameter of screen 2.0 in
Type of backfill around screen Filter Sand (No. 2)

Depth of bottom of well screen 19.5 ft

Bottom of Silt trap 20.0 ft

Depth of bottom of borehole 20.1 ft

11.8 ft	+	9.5 ft	+	0.5 ft	=	21.8 ft
Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length

COMMENTS:

\\haleyaldrich.com\share\CF\Projects\134120\003 - Final Design + CD Prep\Field\Well Logs

HALEY ALDRICH

GROUNDWATER MONITORING REPORT

OW/PZ NUMBER BB-YRO-203(OW)

PROJECT	Interstate 295 Exit 17 NB and SB Bridge Replacements	**H&A FILE NO.**	0134120-003
LOCATION	Yarmouth, Maine	**PROJECT MGR.**	B. Steinert
CLIENT	Maine Department of Transportation	**FIELD REP.**	T. Jones
CONTRACTOR	Northern Test Borings, Inc.	**DATE**	6/7/2021

ELEVATION OF REFERENCE POINT 62.5 (PVC 1.8' Stickup) **REFERENCE POINT:** **Ground Surface** **PVC** X **Other**

Date	Time	Elapsed Time (days)	Depth of Water from Reference Point	Elevation of Water	Remarks	Read By
6/7/2021	7:30	0	13.5	49.0	75 and Sunny	TPJ
6/9/2021	12:45	2	12.8	49.7	85 and Sunny	TPJ
6/17/2021	1:15	10	13.1	49.4	75 and Sunny	TPJ
7/6/2021	10:00	29	13.3	49.2	75 and cloudy, rain 2 days prior	TPJ
7/26/2021	9:00	49	12.9	49.6	75 and cloudy	TPJ

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No. BB-YRO-206(OW)

Boring No. BB-YRO-206

PROJECT	Interstate 295 Exit 17 NB and SB Bridge Replacements	**H&A FILE NO.**	0134120-003
LOCATION	Yarmouth, Maine	**PROJECT MGR.**	B. Steinert
CLIENT	Maine Department of Transportation	**FIELD REP.**	T. Jones
CONTRACTOR	Northern Test Borings, Inc.	**DATE INSTALLED**	6/4/2021
DRILLER	M. Nadeau	**WATER LEVEL**	12.3 ft

Ground El. 65.5 ft
El. Datum NAVD 88

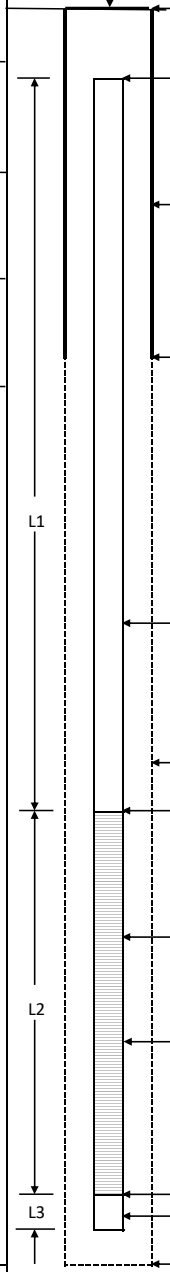
Location See Plan

☑ **Guard Pipe**
☐ **Roadway Box**

SOIL/ROCK CONDITIONS	BOREHOLE BACKFILL
-TOPSOIL-	
0.6	Filter Sand
-FILL-	4.0
3.5	Bentonite
	5.0
-MARINE DEPOSIT-	Filter Sand
(CLAY/SILT)	11.2
w/sand seams	Bentonite
	13.6
16.5	
	Filter Sand
-MARINE DEPOSIT-	
(SAND)	
25.6	25.6

(Bottom of Exploration)

(Numbers refer to depth from ground surface in feet)



(Not to Scale)

Type of protective cover/lock	Locking Cap	
Height of top of guard pipe above ground surface	2.2	ft
Height of top of riser pipe above ground surface	2.1	ft
Type of protective casing:	Steel Guard Pipe	
Length	5.2	ft
Inside Diameter	4.5	in
Depth of bottom of guard pipe/roadway box	3.0	ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite Seal	11.2	2.4

Type of riser pipe:	Schedule 40 PVC	
Inside diameter of riser pipe	2.0	in
Type of backfill around riser	Filter Sand (No. 2)	
Diameter of borehole	4.0	in
Depth to top of well screen	15.0	ft
Type of screen	Schedule 40 PVC	
Screen gauge or size of openings	0.010	in
Diameter of screen	2.0	in
Type of backfill around screen	Filter Sand (No. 2)	
Depth of bottom of well screen	24.5	ft
Bottom of Silt trap	25.0	ft
Depth of bottom of borehole	25.6	ft

17.1 ft	+	9.5 ft	+	0.5 ft	=	27.1 ft
Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length

COMMENTS:

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HALEY ALDRICH

GROUNDWATER MONITORING REPORT

OW/PZ NUMBER BB-YRO-206(OW)

PROJECT	Interstate 295 Exit 17 NB and SB Bridge Replacements	**H&A FILE NO.**	0134120-003
LOCATION	Yarmouth, Maine	**PROJECT MGR.**	B. Steinert
CLIENT	Maine Department of Transportation	**FIELD REP.**	T. Jones
CONTRACTOR	Northern Test Borings, Inc.	**DATE**	6/4/2021

ELEVATION OF REFERENCE POINT 67.6 (PVC 2.1' Stickup) **REFERENCE POINT:** **Ground Surface** **PVC** X **Other**

Date	Time	Elapsed Time (days)	Depth of Water from Reference Point	Elevation of Water	Remarks	Read By
6/4/2021	3:00	0	14.4	53.2		JF
6/7/2021	7:00	3	15.1	52.5	75 and sunny	TPJ
6/17/2021	1:15	13	15.3	52.3	75 and sunny	TPJ
7/6/2021	10:00	32	15.4	52.2	75 and cloudy, rain 2 days prior	TPJ
7/26/2021	9:00	52	13.8	53.8	75 and cloudy	TPJ

OBSERVATION WELL

HALEY ALDRICH

Well No. BB-YRO-210(OW)

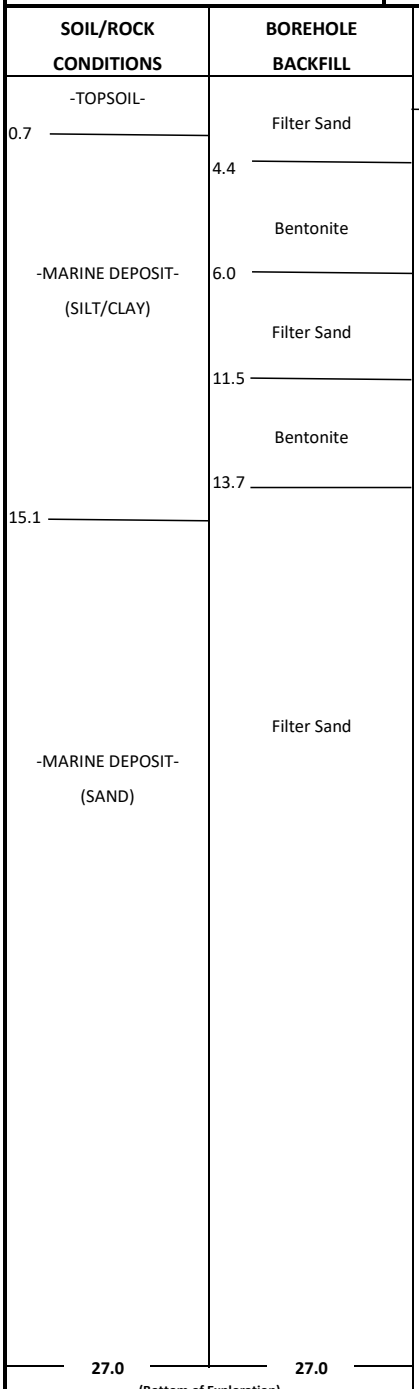
Boring No. BB-YRO-210

PROJECT	Interstate 295 Exit 17 NB and SB Bridge Replacements	**H&A FILE NO.**	0134120-003
LOCATION	Yarmouth, Maine	**PROJECT MGR.**	B. Steinert
CLIENT	Maine Department of Transportation	**FIELD REP.**	T. Jones
CONTRACTOR	Northern Test Borings, Inc.	**DATE INSTALLED**	6/10/2021
DRILLER	M. Nadeau	**WATER LEVEL**	17.8 ft

Ground El. 61.7 ft
El. Datum NAVD 88

Location See Plan

☑ **Guard Pipe**
☐ **Roadway Box**



Type of protective cover/lock Locking Cap

Height of top of guard pipe above ground surface 2.3 ft

Height of top of riser pipe above ground surface 2.0 ft

Type of protective casing: Steel Guard Pipe

Length 5.2 ft

Inside Diameter 4.5 in

Depth of bottom of guard pipe/roadway box 2.9 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite Seal	11.5	2.2

Type of riser pipe: Schedule 40 PVC

Inside diameter of riser pipe 2.0 in

Type of backfill around riser Filter Sand (No. 2)

Diameter of borehole 4.0 in

Depth to top of well screen 17.0 ft

Type of screen Schedule 40 PVC

Screen gauge or size of openings 0.010 in

Diameter of screen 2.0 in

Type of backfill around screen Filter Sand (No. 2)

Depth of bottom of well screen 26.5 ft

Bottom of Silt trap 27.0 ft

Depth of bottom of borehole 27.0 ft

(Not to Scale)

19.0 ft	+	9.5 ft	+	0.5 ft	=	29.0 ft
Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length

COMMENTS:

HALEY ALDRICH

GROUNDWATER MONITORING REPORT

OW/PZ NUMBER BB-YRO-210(OW)

PROJECT	Interstate 295 Exit 17 NB and SB Bridge Replacements	**H&A FILE NO.**	0134120-003
LOCATION	Yarmouth, Maine	**PROJECT MGR.**	B. Steinert
CLIENT	Maine Department of Transportation	**FIELD REP.**	T. Jones
CONTRACTOR	Northern Test Borings, Inc.	**DATE**	6/9/2021

ELEVATION OF REFERENCE POINT 63.7 (PVC 2.0' Stickup) **REFERENCE POINT:** **Ground Surface** **PVC** X **Other**

Date	Time	Elapsed Time (days)	Depth of Water from Reference Point	Elevation of Water	Remarks	Read By
6/9/2021	1:45	0	26.4	37.3	85 and sunny	TPJ
6/17/2021	1:15	8	26.4	37.3	75 and sunny	TPJ
7/6/2021	10:00	27	26.4	37.3	75 and cloudy, rain 2 days prior	TPJ
7/26/2021	9:00	47	26.4	37.3	75 and cloudy	TPJ

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No. BB-YRO-211(OW)

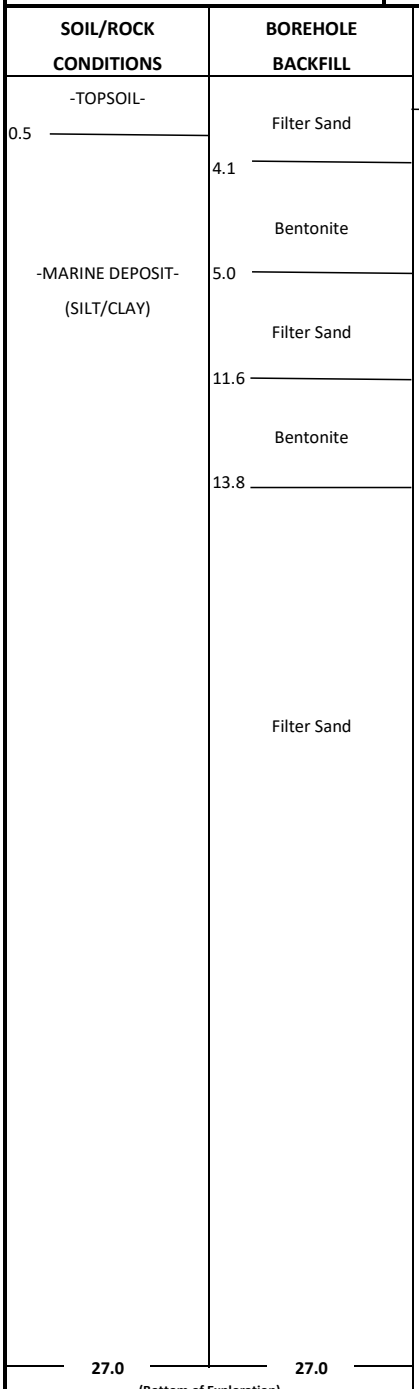
Boring No. BB-YRO-211

PROJECT	Interstate 295 Exit 17 NB and SB Bridge Replacements	**H&A FILE NO.**	0134120-003
LOCATION	Yarmouth, Maine	**PROJECT MGR.**	B. Steinert
CLIENT	Maine Department of Transportation	**FIELD REP.**	T. Jones
CONTRACTOR	Northern Test Borings, Inc.	**DATE INSTALLED**	6/10/2021
DRILLER	M. Nadeau	**WATER LEVEL**	+0.3 FT (above ground surface)

Ground El. 59.4 ft
El. Datum NAVD 88

Location See Plan

☑ **Guard Pipe**
☐ **Roadway Box**



Type of protective cover/lock Locking Cap

Height of top of guard pipe above ground surface 1.8 ft

Height of top of riser pipe above ground surface 1.4 ft

Type of protective casing: Steel Guard Pipe

Length 5.2 ft

Inside Diameter 4.5 in

Depth of bottom of guard pipe/roadway box 3.4 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite Seal	11.6	2.2

Type of riser pipe: Schedule 40 PVC

Inside diameter of riser pipe 2.0 in

Type of backfill around riser Filter Sand (No. 2)

Diameter of borehole 4.0 in

Depth to top of well screen 17.0 ft

Type of screen Schedule 40 PVC

Screen gauge or size of openings 0.010 in

Diameter of screen 2.0 in

Type of backfill around screen Filter Sand (No. 2)

Depth of bottom of well screen 26.5 ft

Bottom of Silt trap 27.0 ft

Depth of bottom of borehole 27.0 ft

(Not to Scale)

18.4 ft	+	9.5 ft	+	0.5 ft	=	28.4 ft
Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length

COMMENTS: Silt trap length included in screen length.

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HALEY ALDRICH

GROUNDWATER MONITORING REPORT

OW/PZ NUMBER BB-YRO-211(OW)

PROJECT	Interstate 295 Exit 17 NB and SB Bridge Replacements	**H&A FILE NO.**	0134120-003
LOCATION	Yarmouth, Maine	**PROJECT MGR.**	B. Steinert
CLIENT	Maine Department of Transportation	**FIELD REP.**	T. Jones
CONTRACTOR	Northern Test Borings, Inc.	**DATE**	6/9/2021

ELEVATION OF REFERENCE POINT 60.8 (PVC 1.4' Stickup) **REFERENCE POINT:** **Ground Surface** **PVC** X **Other**

Date	Time	Elapsed Time (days)	Depth of Water from Reference Point	Elevation of Water	Remarks	Read By
6/9/2021	7:00	0	1.1	59.7	80 and sunny	TPJ
6/9/2021	1:45	0	1.8	59.0	80 and sunny	TPJ
6/17/2021	1:15	8	4.2	56.6	75 and sunny	TPJ
7/6/2021	10:00	27	3.6	57.2	75 and cloudy, rain 2 days prior	TPJ
7/26/2021	9:00	47	2.2	58.6	75 and cloudy	TPJ

APPENDIX C

Laboratory Test Results

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

Boston
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Transmittal

TO:

Bryan Steinert

Haley & Aldrich, Inc.

75 Washington Avenue, Suite 203

Portland, ME 04101-2617

DATE: 1/9/2020	GTX NO: 311099
RE: I-295 Exit 17 Bridge	

COPIES	DATE	DESCRIPTION
	1/9/2020	**January 2020 Laboratory Test Report**

REMARKS:

SIGNED: _____

Jonathan Campbell, Laboratory Manager

CC:

APPROVED BY : _____

Joe Tomei, Director of Testing Services

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

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Atlanta
Chicago
Los Angeles
New York
www.geotesting.com

January 9, 2020

Bryan Steinert
Haley & Aldrich, Inc.
75 Washington Avenue, Suite 203
Portland, ME 04101-2617

RE: I-295 Exit 17 Bridge, Yarmouth, ME (GTX-311099)

Dear Bryan:

Enclosed are the test results you requested for the above referenced project. GeoTesting Express, Inc. (GTX) received 21 samples from you on 12/18/2019. These samples were labeled as follows:

Boring Number	Sample Number	Depth
BB-YRO-101	6D	20.0-22.0 ft
BB-YRO-102	R1	27.1-28.0 ft
BB-YRO-102	R2	33.9-34.5 ft
BB-YRO-103	1U	17.0-19.0 ft
BB-YRO-103	3D	5.0-7.0 ft
BB-YRO-103	4D	10.0-12.0 ft
BB-YRO-103	5D	15.0-17.0 ft
BB-YRO-103	6D	20.0-22.0 ft
BB-YRO-104	6D	20.0-22.0 ft
BB-YRO-104	7D	25.0-27.0 ft
BB-YRO-104	8D	30.0-32.0 ft
BB-YRO-104	9D	35.0-37.0 ft
BB-YRO-104	10D	40.0-42.0 ft
BB-YRO-105	3D	5.0-7.0 ft
BB-YRO-105	4D	10.0-12.0 ft
BB-YRO-105	1U	18.0-20.0 ft
BB-YRO-105	6D	20.0-22.0 ft
BB-YRO-105	9D	35.0-37.0 ft
BB-YRO-105	R1	40.6-41.2 ft
BB-YRO-105	R2	46.6-47.1 ft
BB-YRO-106	11D	40.0-42.0 ft

GTX performed the following tests on these samples:

2 ASTM D2435 - Incremental Consolidation
9 ASTM D422 - Grain Size Analysis - Sieve Only
9 ASTM D4318 - Atterberg Limits
4 ASTM D7012 Method D- Elastic Moduli of Rock in Uniaxial Compression

The results presented in this report apply only to the items tested. This report shall not be reproduced except in full, without written approval from GeoTesting Express. The remainder of these samples will be retained for a period of sixty (60) days and will then be discarded unless otherwise notified by you. Please call me if you have any questions or require additional information. Thank you for allowing GeoTesting Express the opportunity of providing you with testing services. We look forward to working with you again in the future.

Respectfully yours,

Jon Campbell
Laboratory Manager

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

Boston
Atlanta
Chicago
Los Angeles
New York

www.geotesting.com

Geotechnical Test Report **1/9/2020**

GTX-311099

I-295 Exit 17 Bridge

Yarmouth, ME

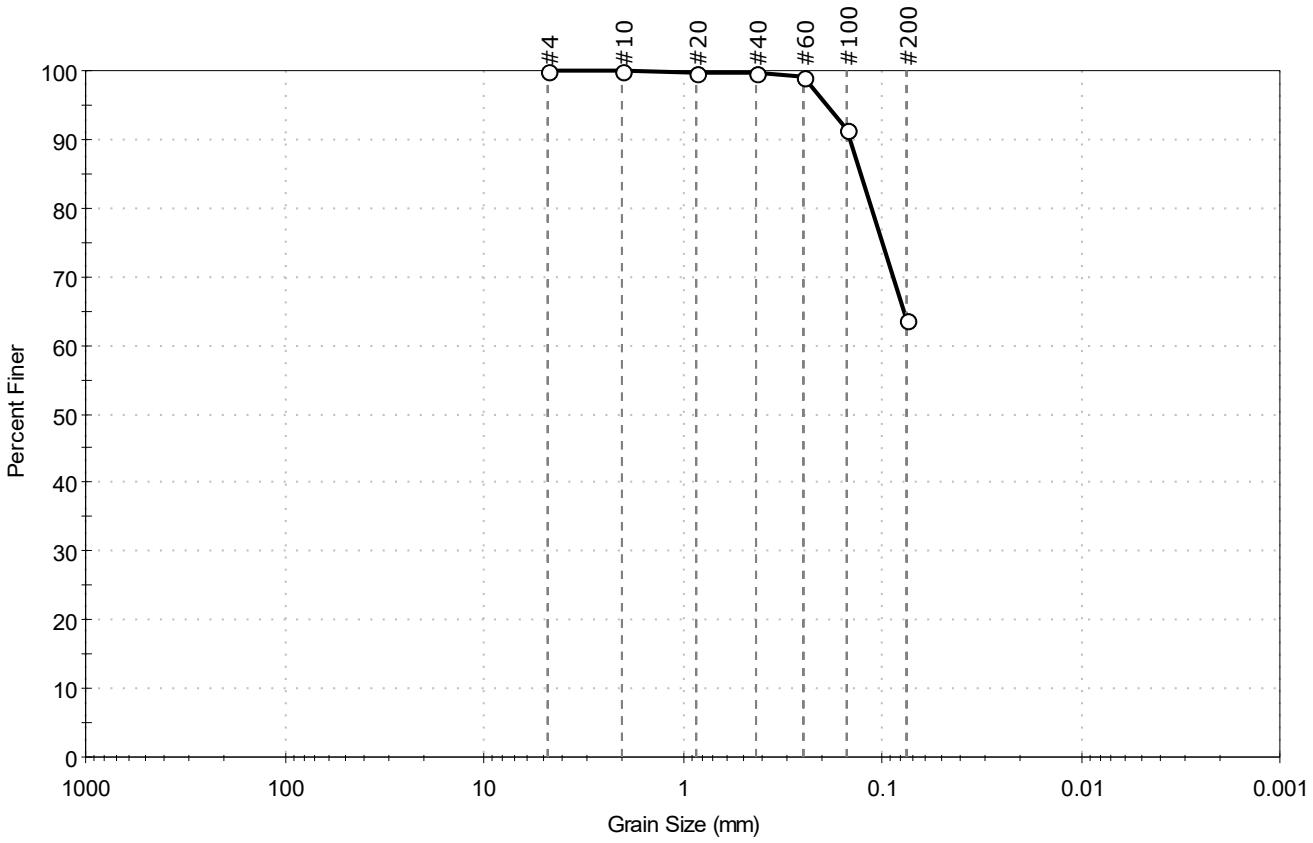
Client Project No.: 134120-002

Prepared for:

Haley & Aldrich, Inc.

Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-101	Sample Type:	jar	Tested By:	ckg
Sample ID:	6D	Test Date:	01/03/20	Checked By:	jsc
Depth :	20.0-22.0 ft	Test Id:	535450		
Test Comment:	---				
Visual Description:	Moist, dark gray sandy clay				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	36.4	63.6

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	99		
#100	0.15	91		
#200	0.075	64		

Coefficients

D_{85} = 0.1281 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 N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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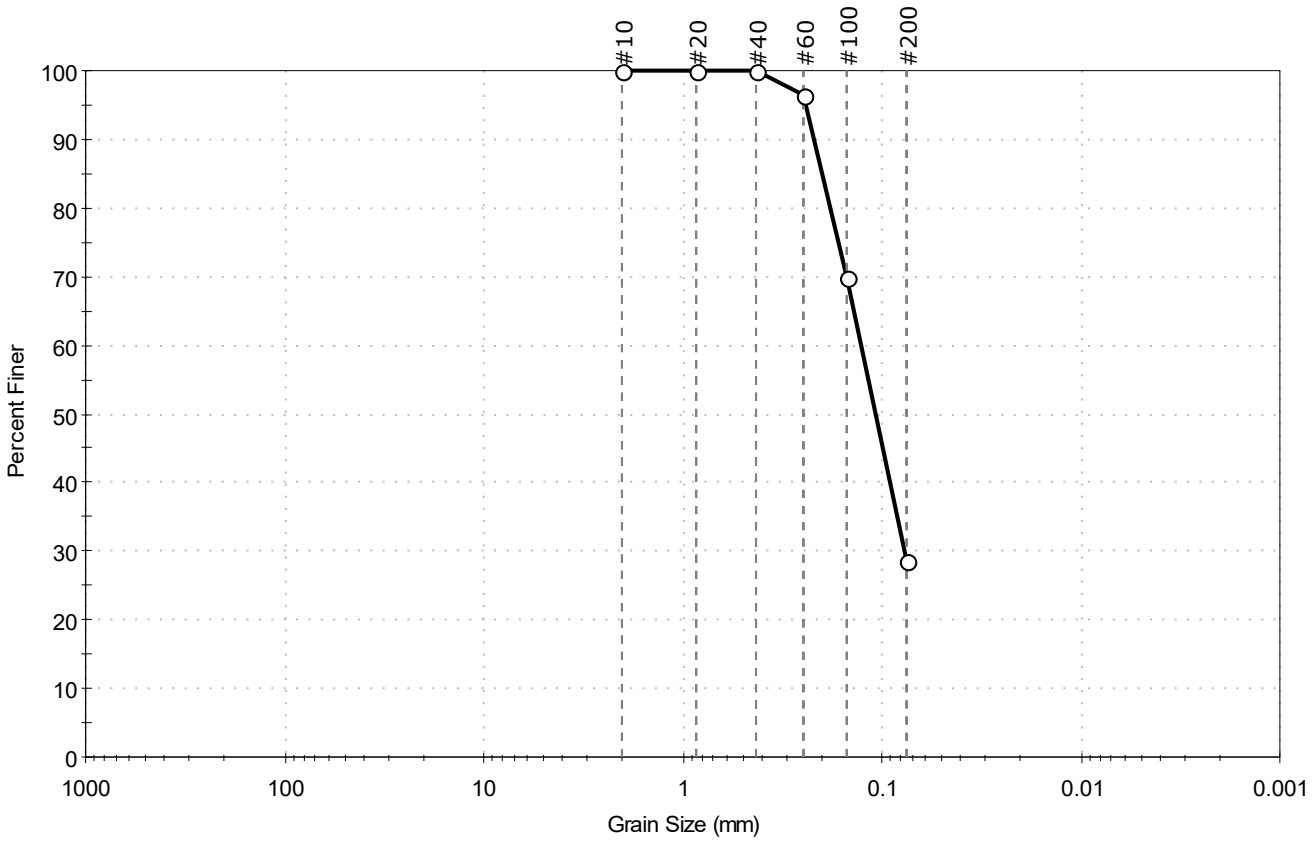
Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-103	Sample Type:	jar	Tested By:	ckg
Sample ID:	6D	Test Date:	01/03/20	Checked By:	jsc
Depth :	20.0-22.0 ft	Test Id:	535451		
Test Comment:	---				
Visual Description:	Moist, light yellowish brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	71.3	28.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	96		
#100	0.15	70		
#200	0.075	29		

Coefficients

D_{85} = 0.2005 mm	D_{30} = 0.0767 mm
D_{60} = 0.1267 mm	D_{15} = N/A
D_{50} = 0.1072 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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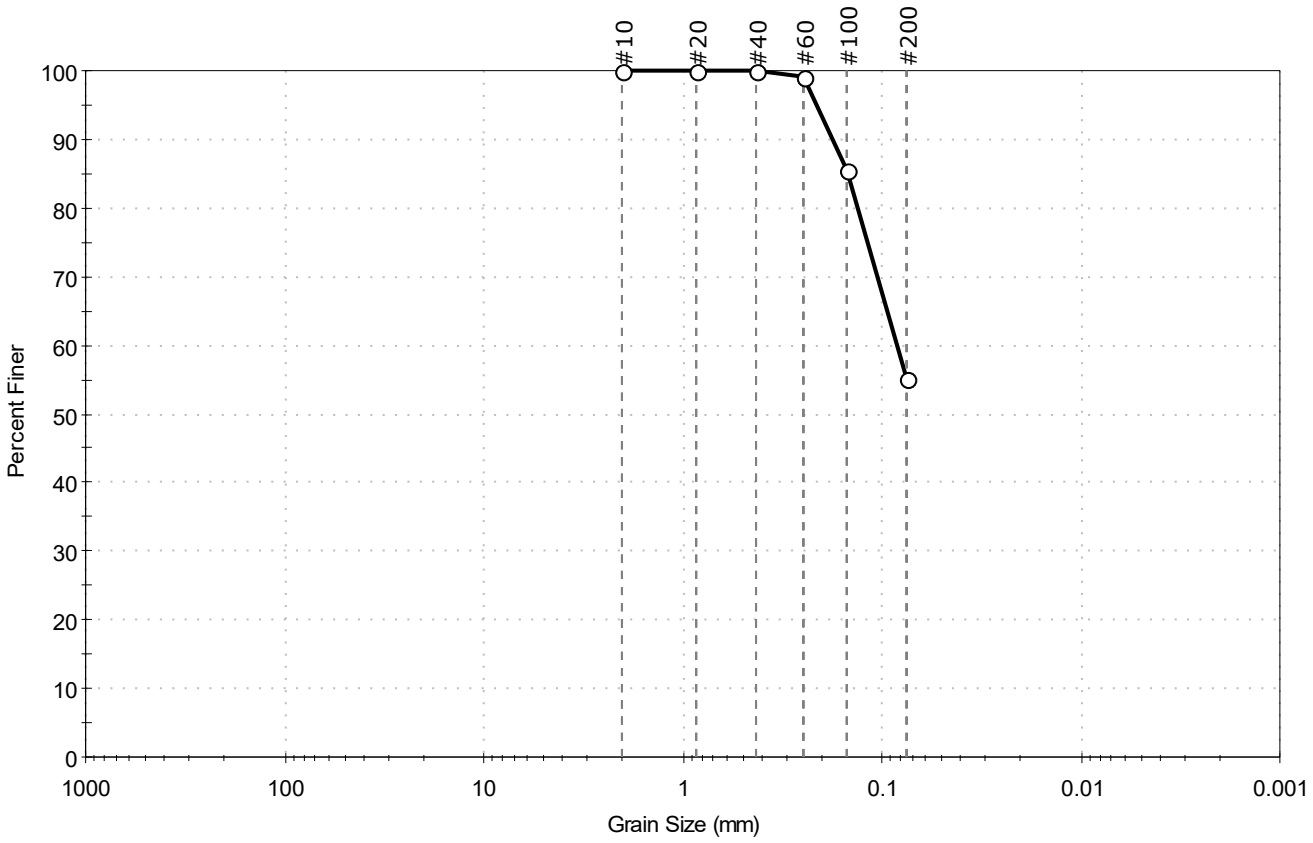
GeoTesting EXPRESS

Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-104	Sample Type:	jar	Tested By:	ckg
Sample ID:	6D	Test Date:	01/03/20	Checked By:	jsc
Depth :	20.0-22.0 ft	Test Id:	535452		

Test Comment: ---
Visual Description: Moist, light olive brown sandy clay
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	44.7	55.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	99		
#100	0.15	86		
#200	0.075	55		

Coefficients

D_{85} = 0.1481 mm	D_{30} = N/A
D_{60} = 0.0835 mm	D_{15} = N/A
D_{50} = N/A	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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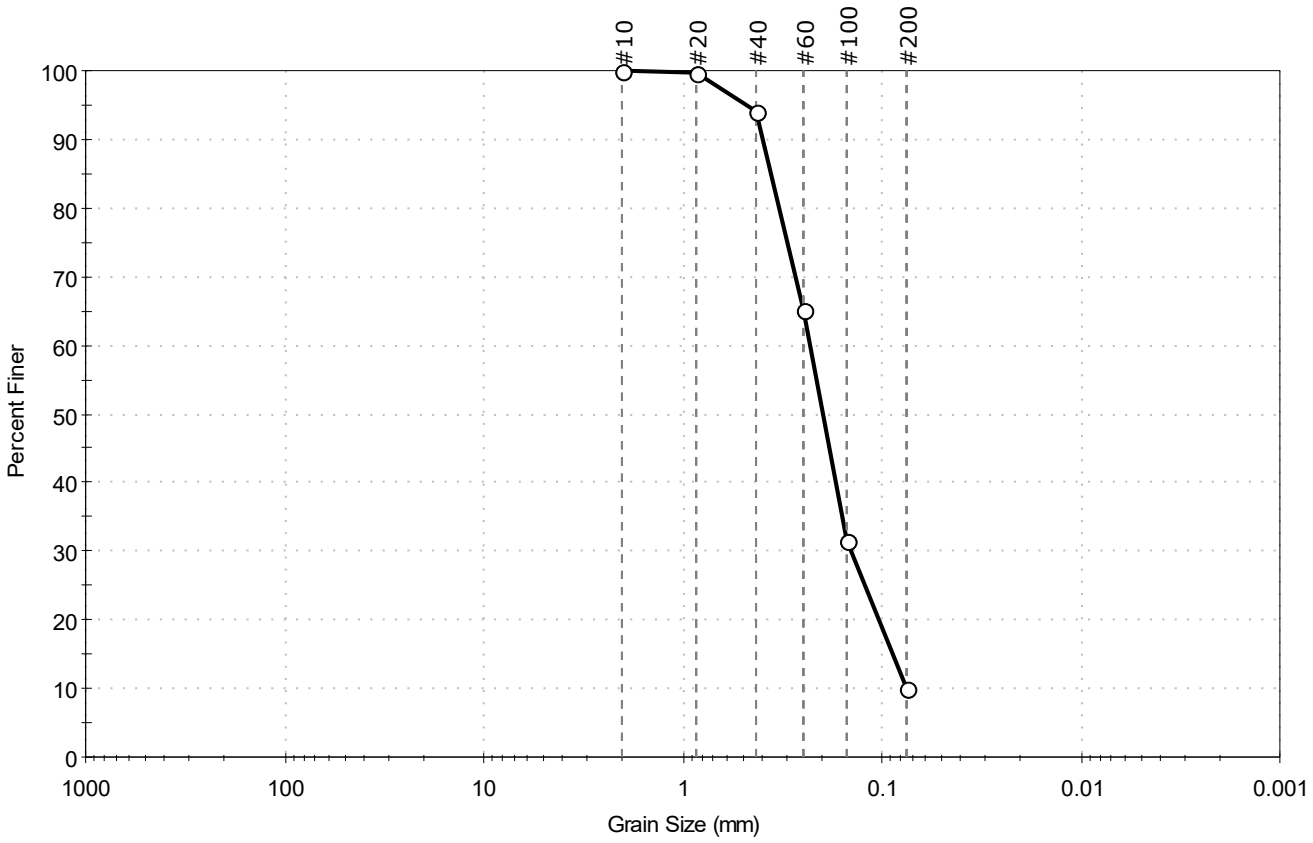
Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-104	Sample Type:	jar	Tested By:	ckg
Sample ID:	7D	Test Date:	01/03/20	Checked By:	jsc
Depth :	25.0-27.0 ft	Test Id:	535453		
Test Comment:	---				
Visual Description:	Moist, light olive brown sand with silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	89.9	10.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	100		
#40	0.42	94		
#60	0.25	65		
#100	0.15	32		
#200	0.075	10		

Coefficients

D_{85} = 0.3600 mm	D_{30} = 0.1422 mm
D_{60} = 0.2311 mm	D_{15} = 0.0878 mm
D_{50} = 0.1984 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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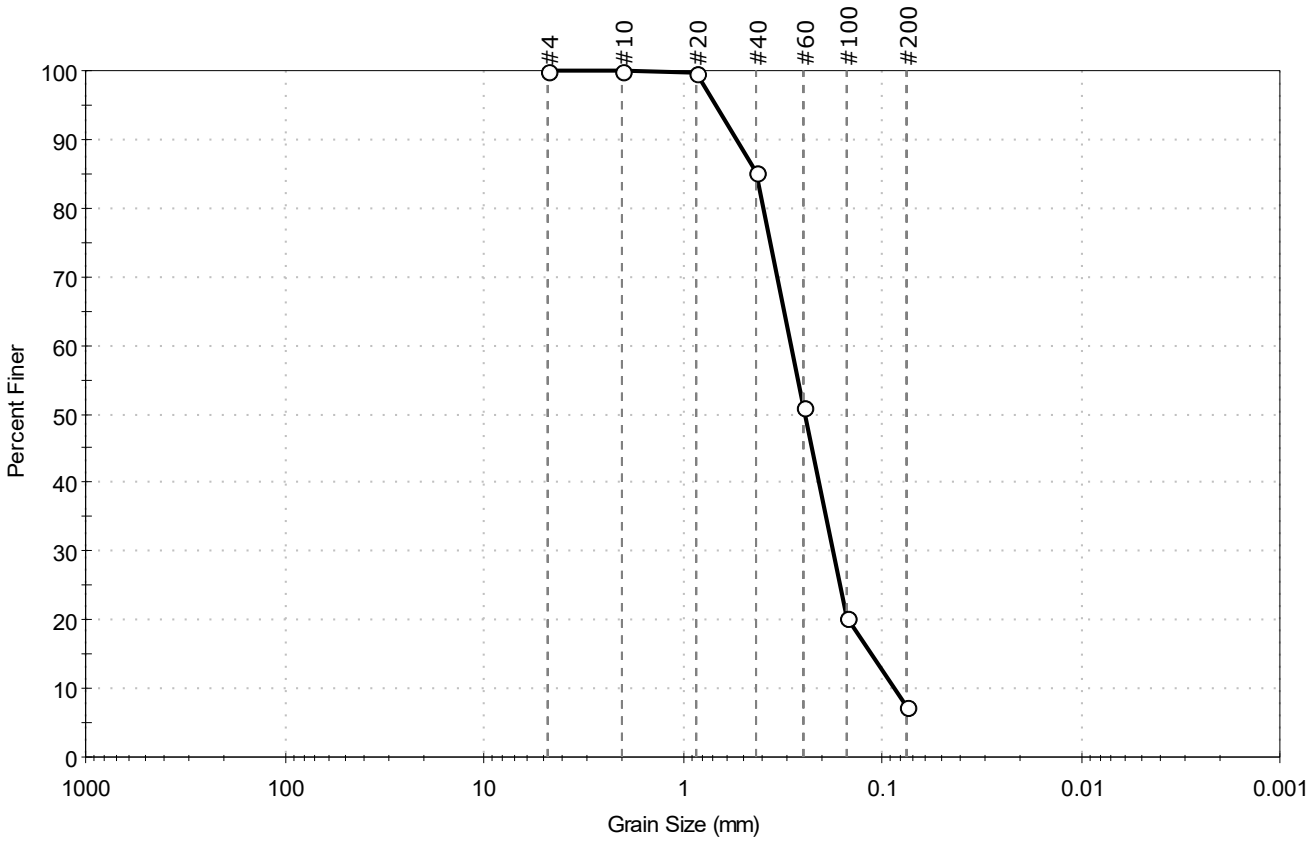
Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-104	Sample Type:	jar	Tested By:	ckg
Sample ID:	8D	Test Date:	01/05/20	Checked By:	jsc
Depth :	30.0-32.0 ft	Test Id:	535454		
Test Comment:	---				
Visual Description:	Moist, olive brown sand with silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	92.7	7.3

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	85		
#60	0.25	51		
#100	0.15	20		
#200	0.075	7.3		

Coefficients

D_{85} = 0.4227 mm	D_{30} = 0.1761 mm
D_{60} = 0.2875 mm	D_{15} = 0.1127 mm
D_{50} = 0.2461 mm	D_{10} = 0.0866 mm
C_u = 3.320	C_c = 1.246

Classification

ASTM N/A

AASHTO Fine Sand (A-3 (1))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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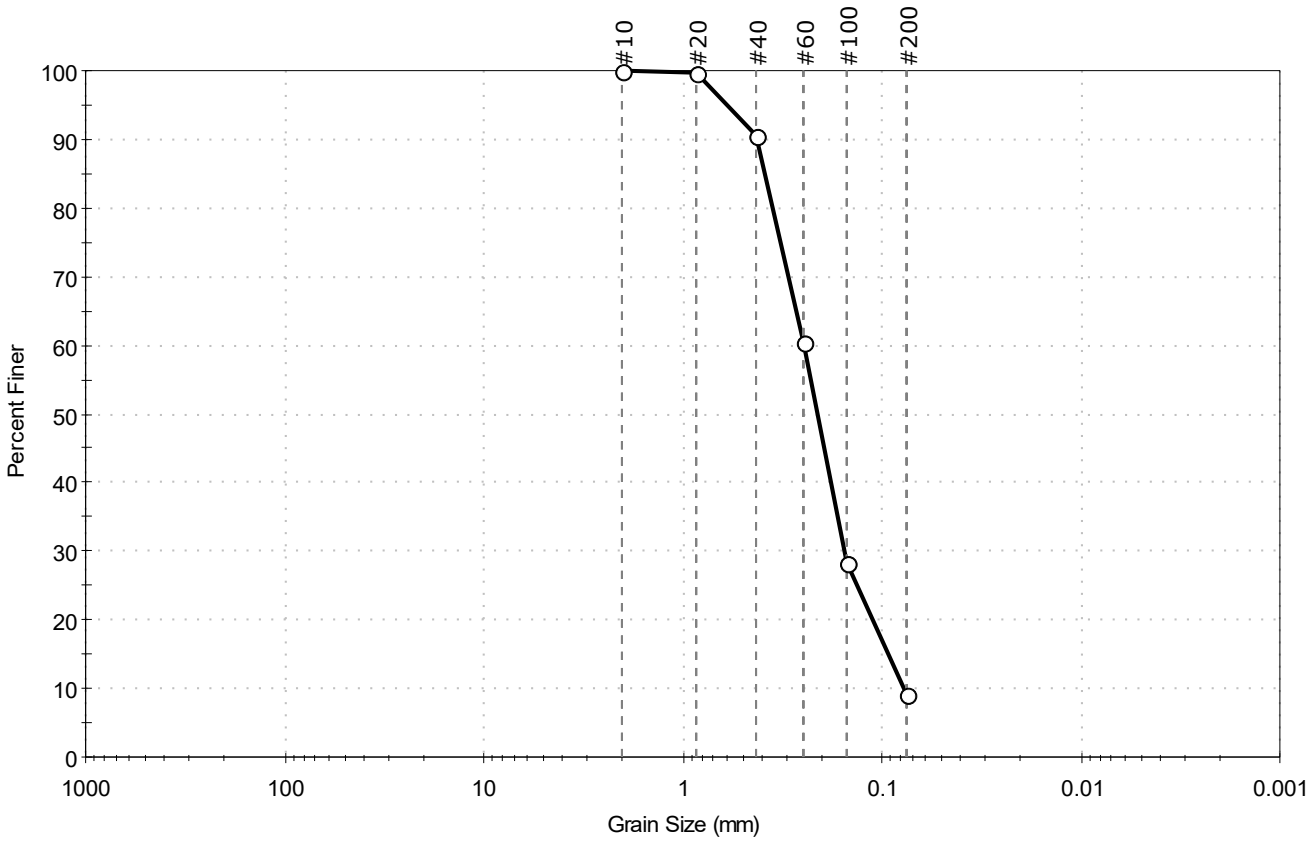
Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-104	Sample Type:	jar	Tested By:	ckg
Sample ID:	9D	Test Date:	01/05/20	Checked By:	jsc
Depth :	35.0-37.0 ft	Test Id:	535455		
Test Comment:	---				
Visual Description:	Moist, olive brown sand with silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	90.8	9.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	100		
#40	0.42	90		
#60	0.25	60		
#100	0.15	28		
#200	0.075	9.2		

Coefficients

D_{85} = 0.3857 mm	D_{30} = 0.1540 mm
D_{60} = 0.2481 mm	D_{15} = 0.0926 mm
D_{50} = 0.2117 mm	D_{10} = 0.0773 mm
C_u = 3.210	C_c = 1.237

Classification

ASTM N/A

AASHTO Fine Sand (A-3 (1))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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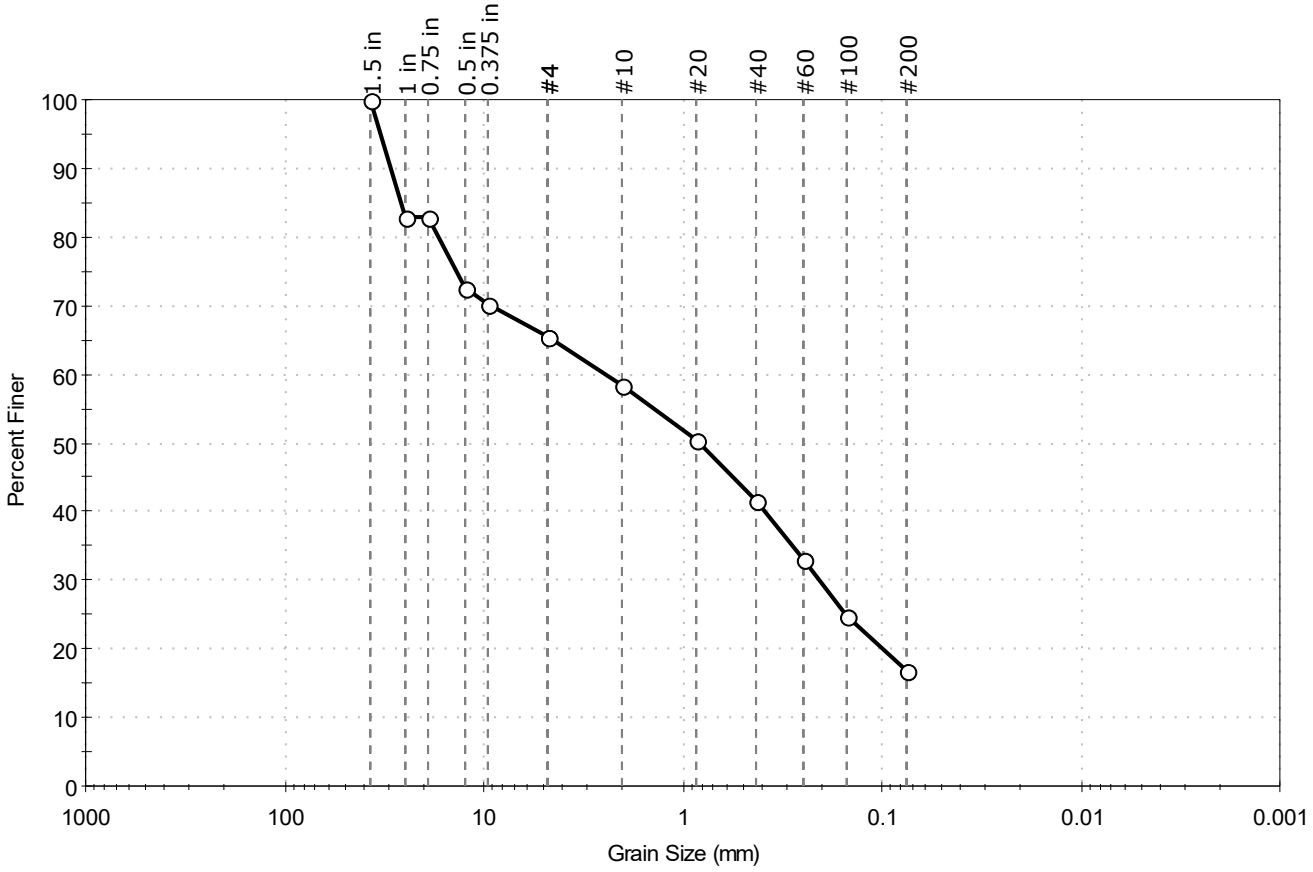
GeoTesting EXPRESS

Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-104	Sample Type:	jar	Tested By:	ckg
Sample ID:	10D	Test Date:	01/03/20	Checked By:	jsc
Depth :	40.0-42.0 ft	Test Id:	535456		
Test Comment:	---				
Visual Description:	Moist, pale brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	34.7	48.6	16.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	83		
0.75 in	19.00	83		
0.5 in	12.50	73		
0.375 in	9.50	70		
#4	4.75	65		
#4	4.75	65		
#10	2.00	59		
#20	0.85	50		
#40	0.42	42		
#60	0.25	33		
#100	0.15	25		
#200	0.075	17		

Coefficients

D_{85} = 26.2809 mm D_{30} = 0.2079 mm

D_{60} = 2.4122 mm D_{15} = N/A

D_{50} = 0.8188 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

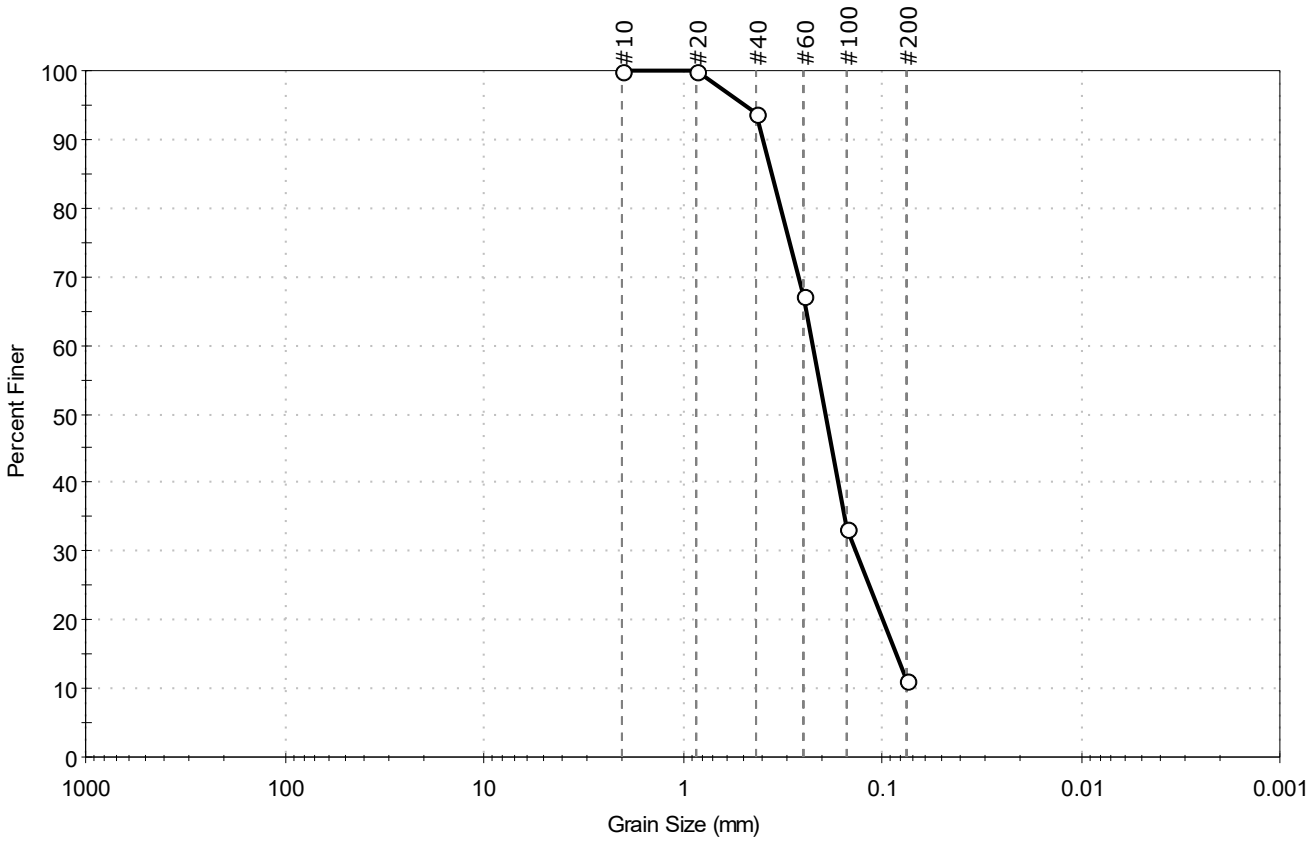
Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-105	Sample Type:	jar	Tested By:	ckg
Sample ID:	9D	Test Date:	01/05/20	Checked By:	jsc
Depth :	35.0-37.0 ft	Test Id:	535457		
Test Comment:	---				
Visual Description:	Moist, light olive brown sand with silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	88.7	11.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	100		
#40	0.42	94		
#60	0.25	67		
#100	0.15	33		
#200	0.075	11		

Coefficients

D_{85} = 0.3567 mm	D_{30} = 0.1354 mm
D_{60} = 0.2241 mm	D_{15} = 0.0843 mm
D_{50} = 0.1929 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

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

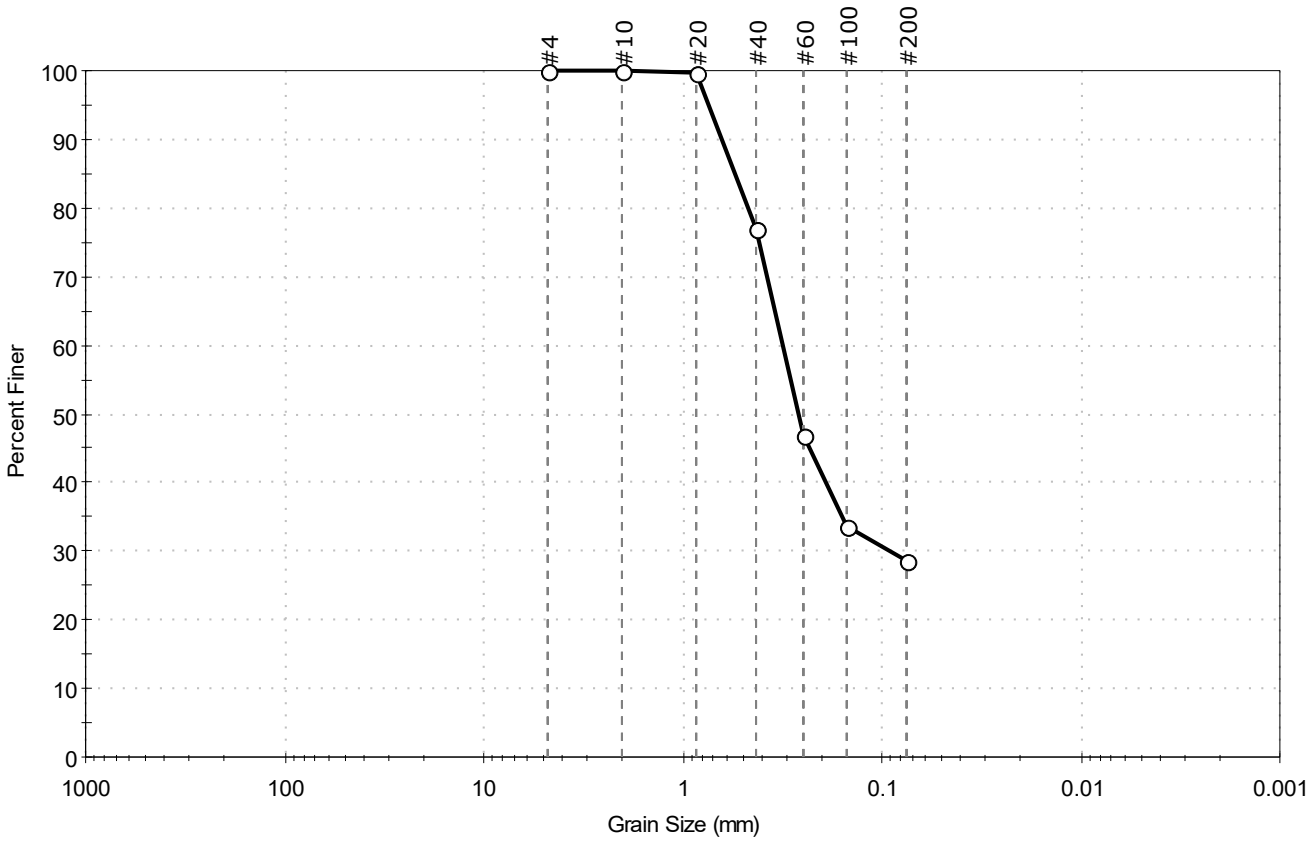
Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-106	Sample Type:	jar	Tested By:	ckg
Sample ID:	11D	Test Date:	01/05/20	Checked By:	jsc
Depth :	40.0-42.0 ft	Test Id:	535458		
Test Comment:	---				
Visual Description:	Moist, dark grayish brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	71.4	28.6

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	77		
#60	0.25	47		
#100	0.15	34		
#200	0.075	29		

Coefficients

D_{85} = 0.5415 mm	D_{30} = 0.0916 mm
D_{60} = 0.3149 mm	D_{15} = N/A
D_{50} = 0.2642 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

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

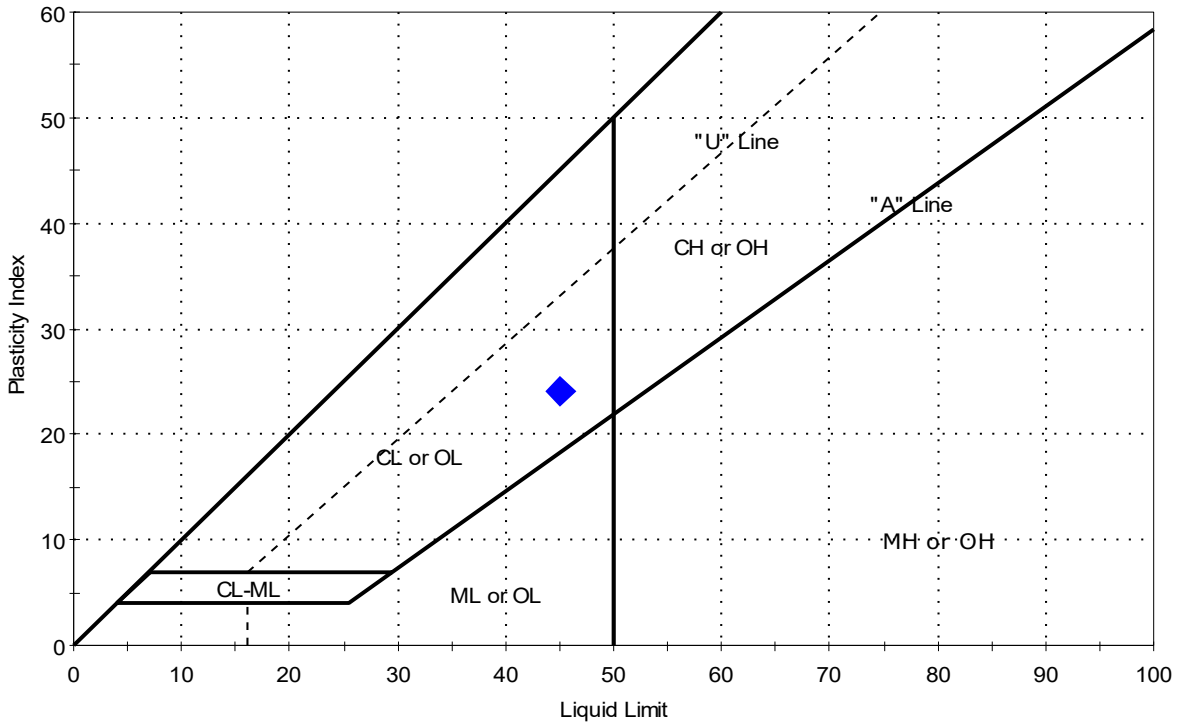
Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-103	Sample Type:	jar	Tested By:	cam
Sample ID:	3D	Test Date:	01/09/20	Checked By:	jsc
Depth :	5.0-7.0 ft	Test Id:	535441		
Test Comment:	---				
Visual 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
◆	3D	B-YRO-10	5.0-7.0 ft	27	45	21	24	0.2	

Sample Prepared using the WET method

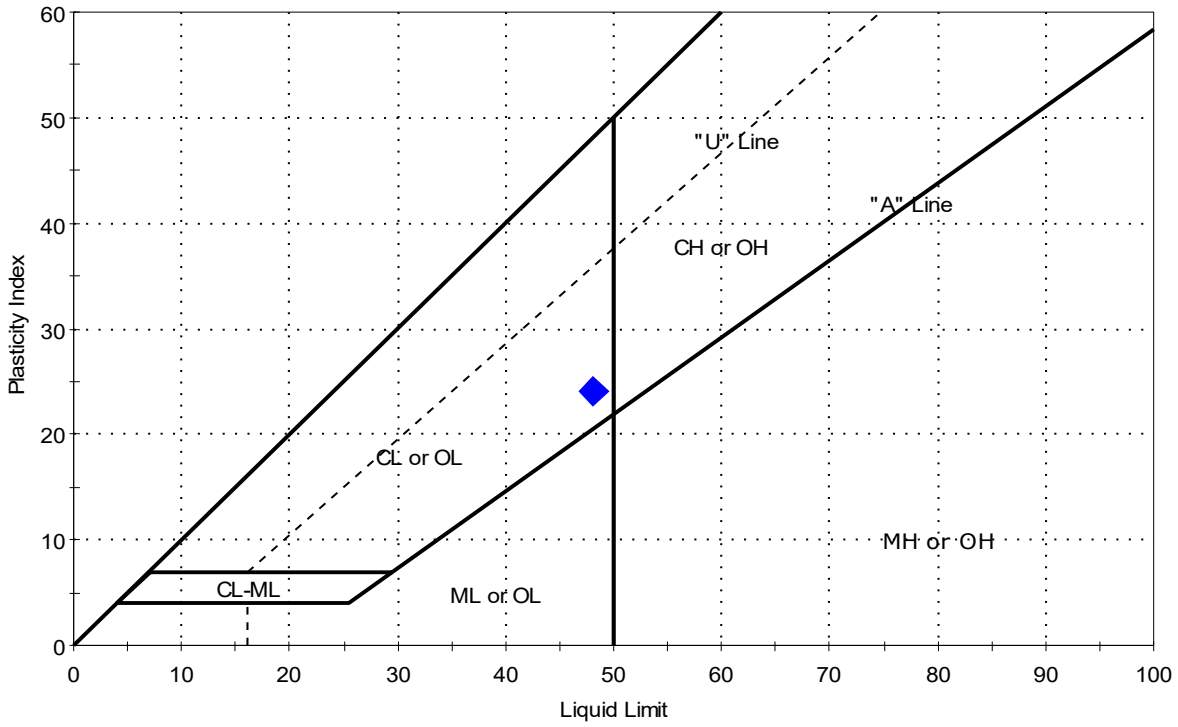
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-103	Sample Type:	jar	Tested By:	cam
Sample ID:	4D	Test Date:	01/09/20	Checked By:	jsc
Depth :	10.0-12.0 ft	Test Id:	535442		
Test Comment:	---				
Visual 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
◆	4D	B-YRO-10	10.0-12.0 ft	37	48	24	24	0.5	

Sample Prepared using the WET method

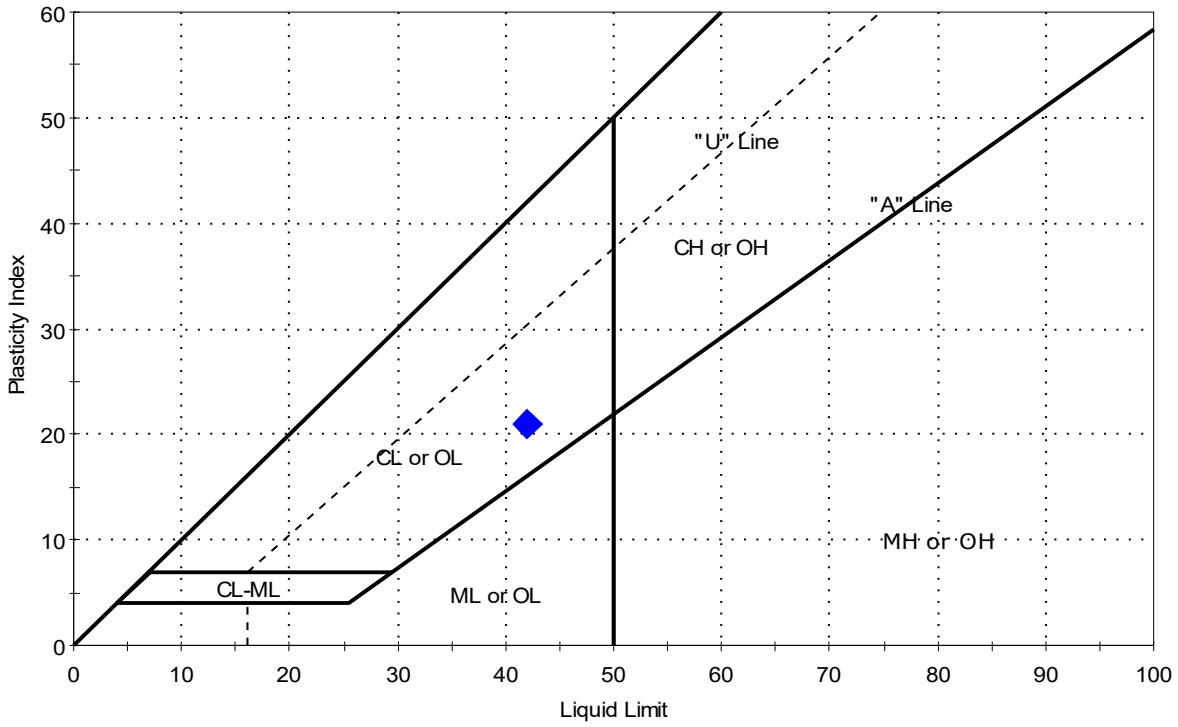
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-103	Sample Type:	jar	Tested By:	cam
Sample ID:	5D	Test Date:	01/09/20	Checked By:	jsc
Depth :	15.0-17.0 ft	Test Id:	535443		
Test Comment:	---				
Visual Description:	Moist, 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
◆	5D	B-YRO-10	15.0-17.0 ft	41	42	21	21	1	

Sample Prepared using the WET method

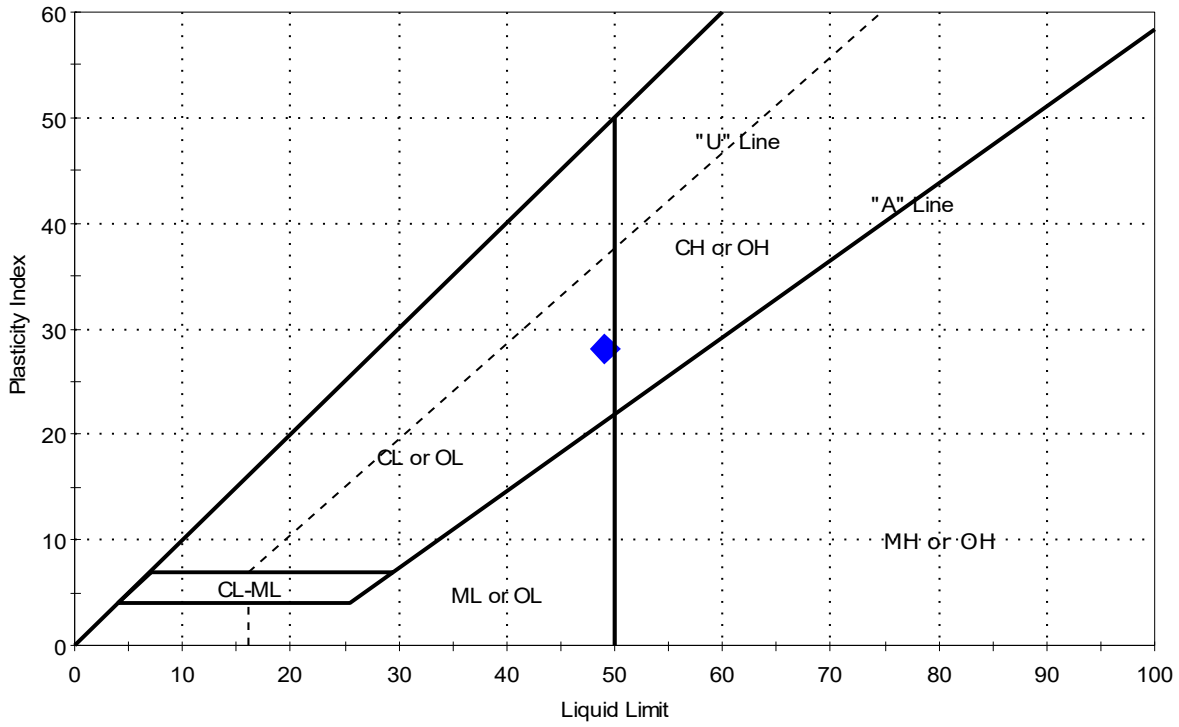
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-103	Sample Type:	tube	Tested By:	cam
Sample ID:	1U	Test Date:	01/09/20	Checked By:	jsc
Depth :	17.0-19.0 ft	Test Id:	535444		
Test Comment:	---				
Visual 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
◆	1U	B-YRO-10	17.0-19.0 ft	33	49	21	28	0.4	

Sample Prepared using the WET method

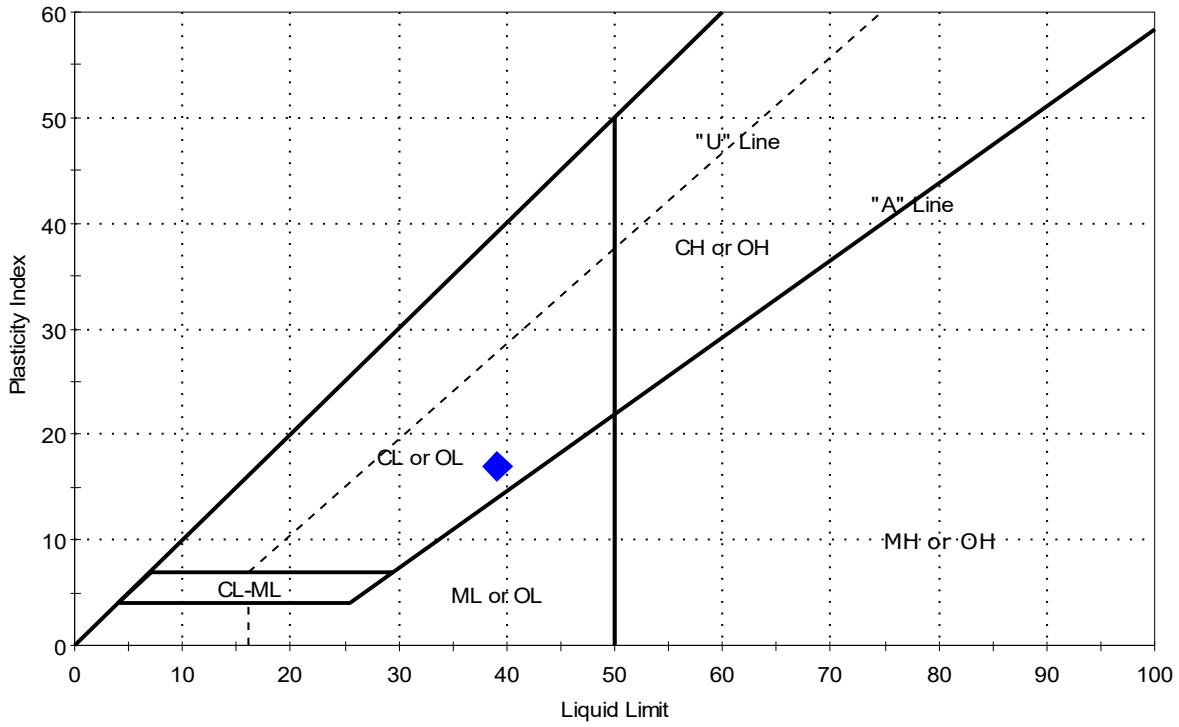
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-105	Sample Type:	jar	Tested By:	cam
Sample ID:	3D	Test Date:	01/09/20	Checked By:	jsc
Depth :	5.0-7.0 ft	Test Id:	535445		
Test Comment:	---				
Visual Description:	Moist, dark olive and dark reddish brown mottled 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
◆	3D	B-YRO-10	5.0-7.0 ft	26	39	22	17	0.3	

Sample Prepared using the WET method

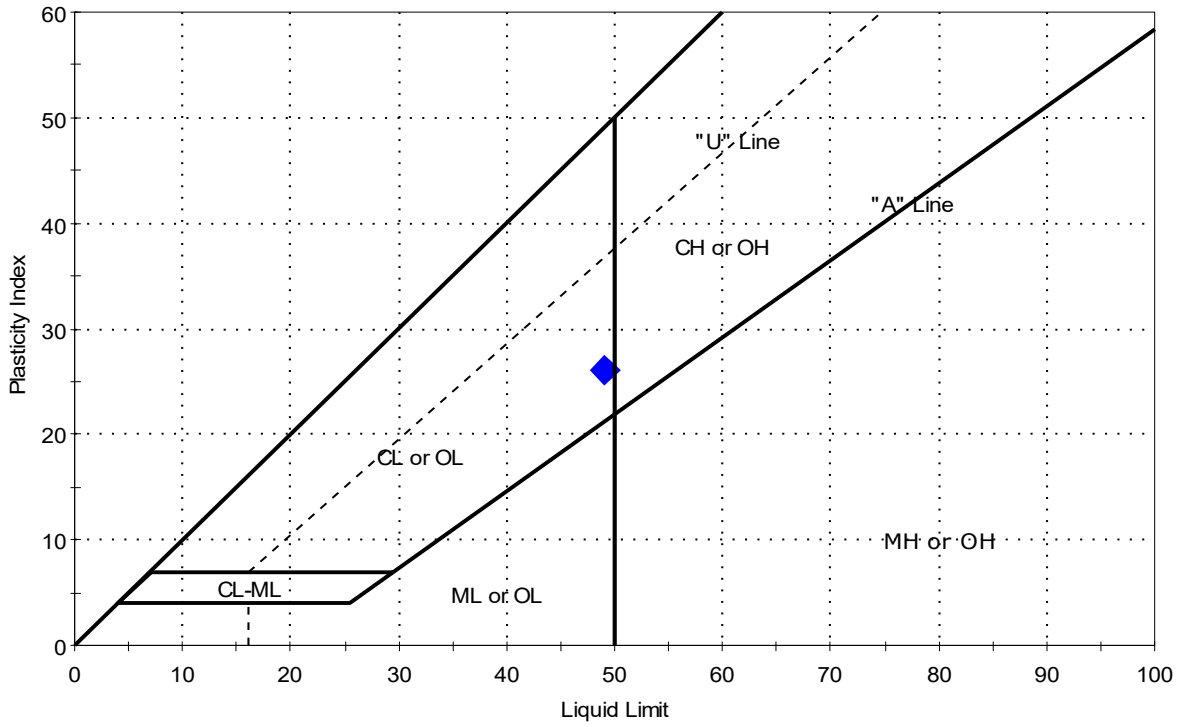
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-105	Sample Type:	jar	Tested By:	cam
Sample ID:	4D	Test Date:	01/09/20	Checked By:	jsc
Depth :	10.0-12.0 ft	Test Id:	535446		
Test Comment:	---				
Visual Description:	Moist, olive brown 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
◆	4D	B-YRO-10	10.0-12.0 ft	38	49	23	26	0.6	

Sample Prepared using the WET method

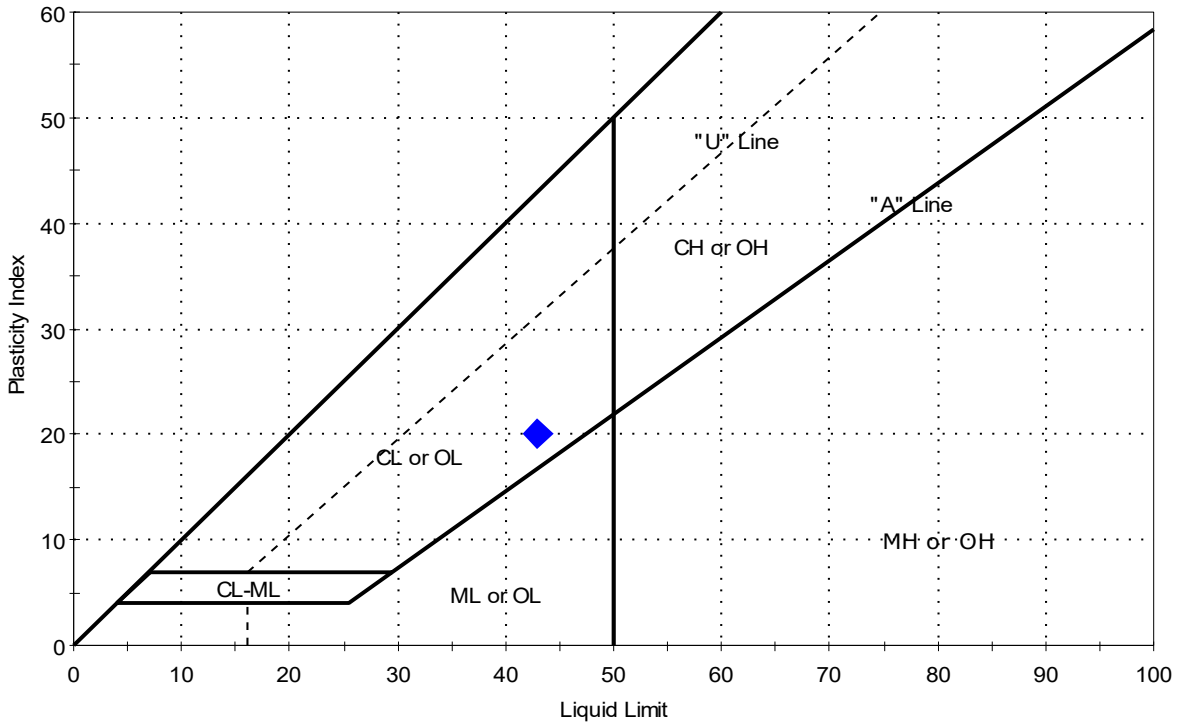
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-105	Sample Type:	tube	Tested By:	cam
Sample ID:	1U	Test Date:	01/09/20	Checked By:	jsc
Depth :	18.0-20.0 ft	Test Id:	535448		
Test Comment:	---				
Visual Description:	Moist, 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
◆	1U	B-YRO-10	18.0-20.0 ft	42	43	23	20	1	

Sample Prepared using the WET method

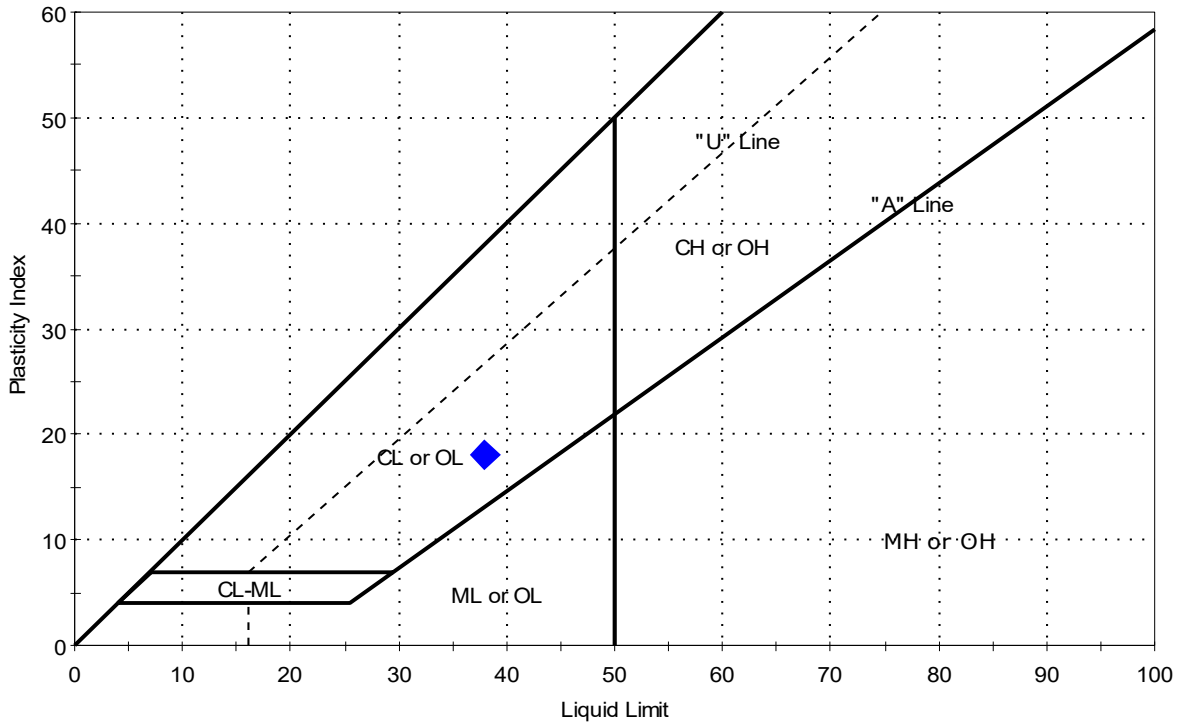
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Haley & Aldrich, Inc.				
Project:	I-295 Exit 17 Bridge				
Location:	Yarmouth, ME			Project No:	GTX-311099
Boring ID:	BB-YRO-105	Sample Type:	jar	Tested By:	cam
Sample ID:	6D	Test Date:	01/09/20	Checked By:	jsc
Depth :	20.0-22.0 ft	Test Id:	535449		
Test Comment:	---				
Visual Description:	Moist, dark 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
◆	6D	B-YRO-10	20.0-22.0 ft	35	38	20	18	0.8	

Sample Prepared using the WET method

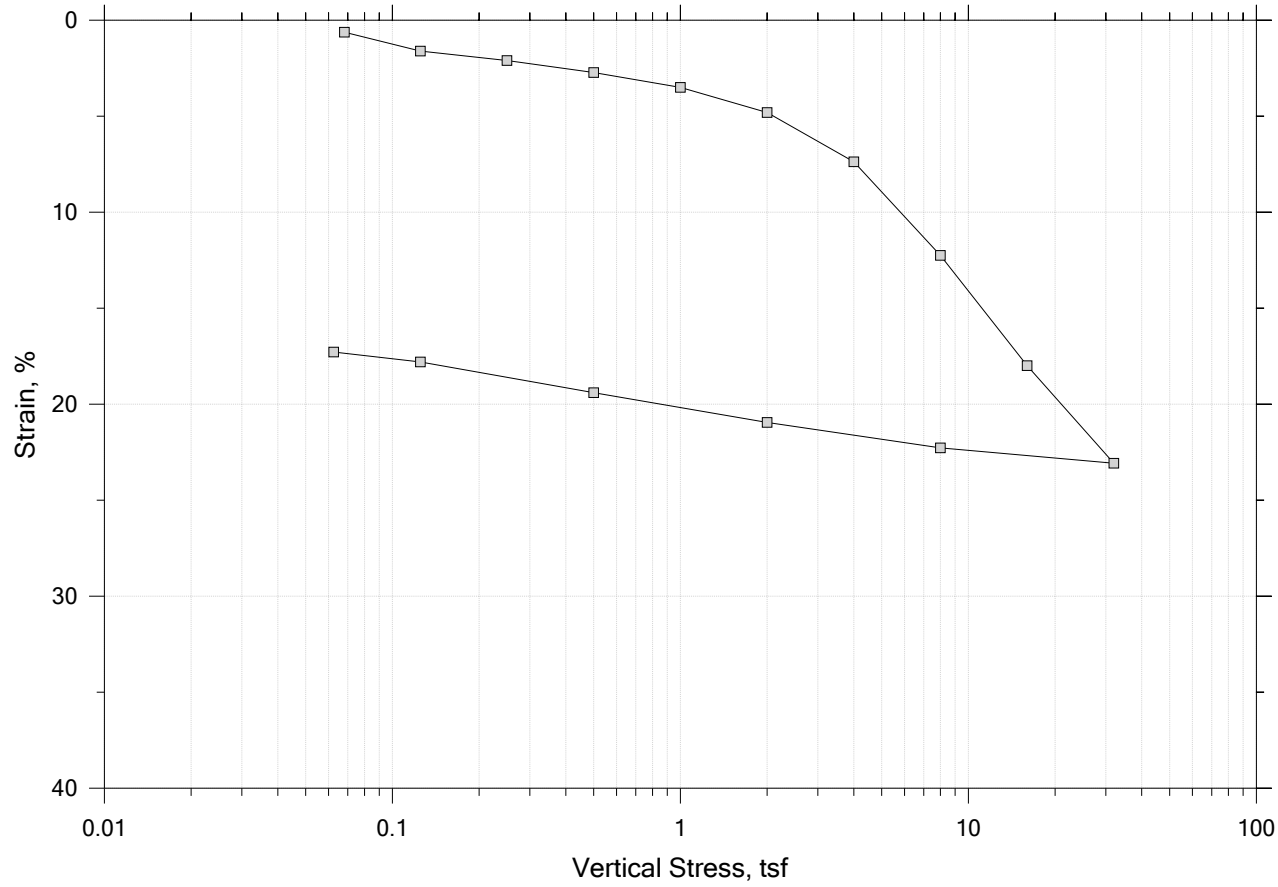
Dry Strength: VERY HIGH

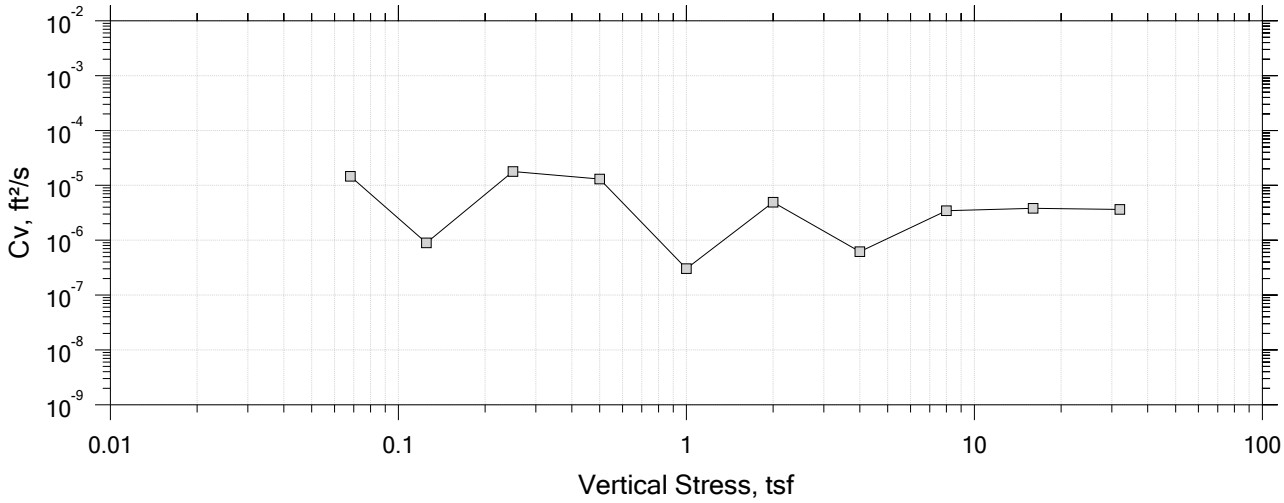
Dilatancy: SLOW

Toughness: LOW

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report





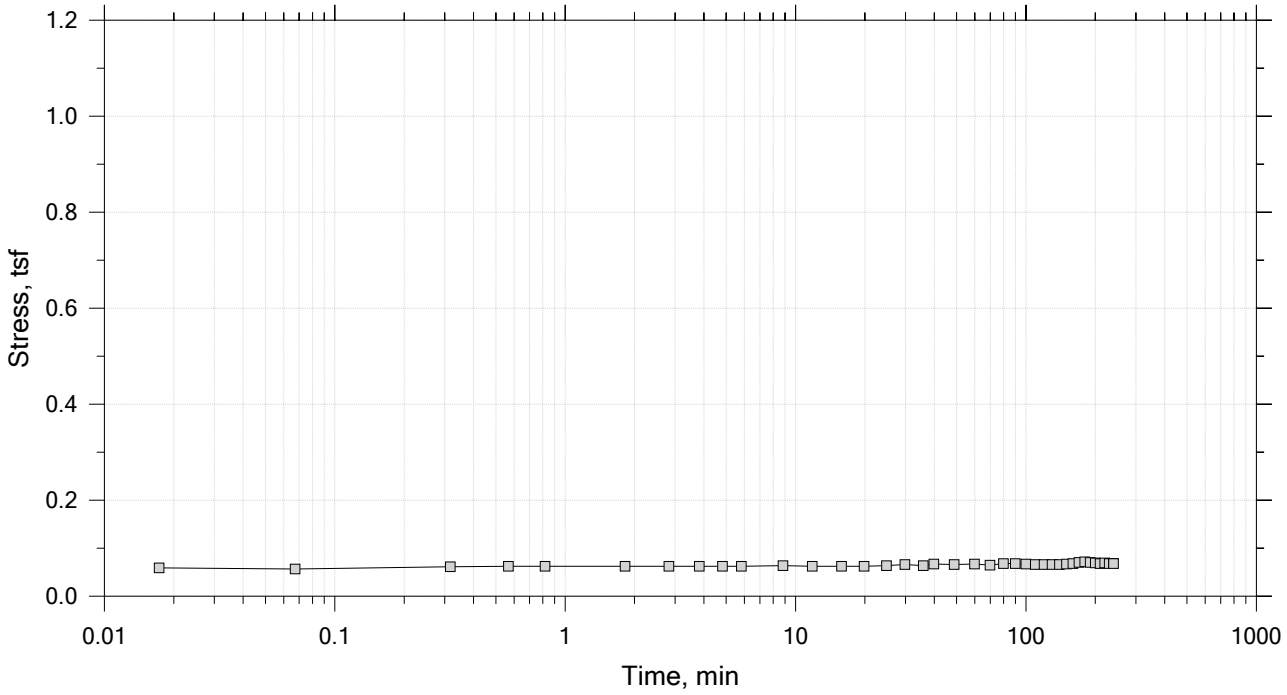
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		
	Displacement at End of Increment		

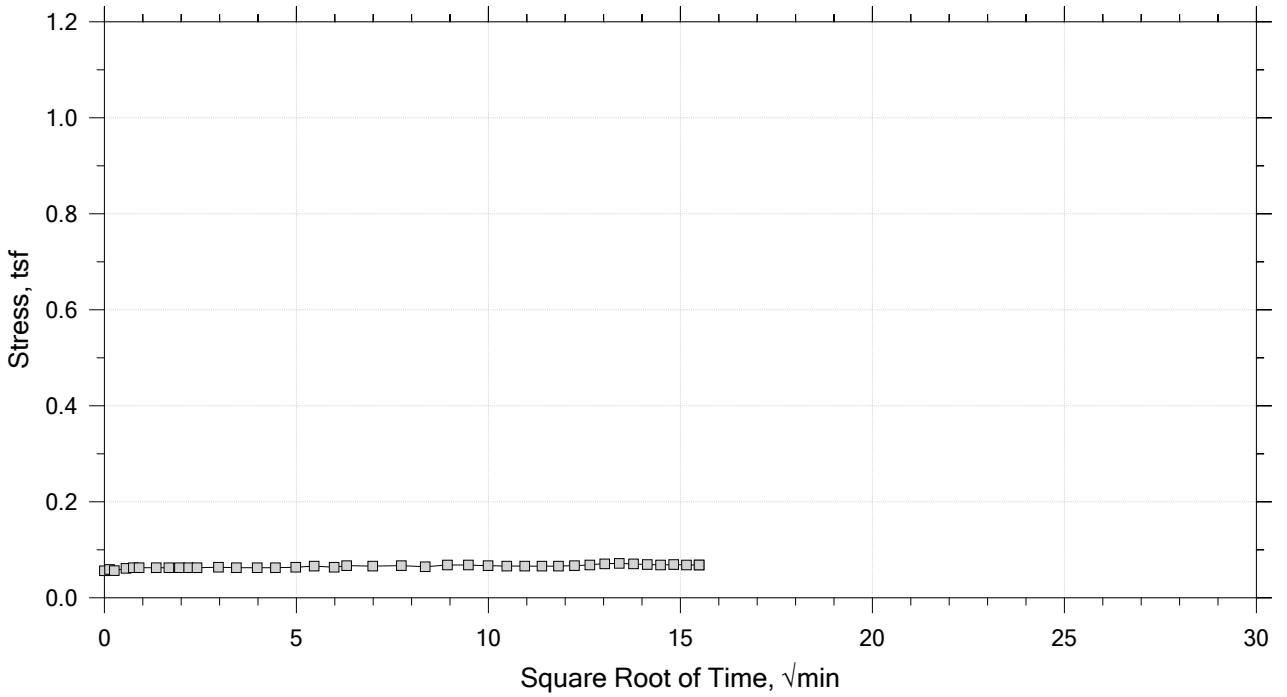
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 15

Constant Volume Step

Stress: 0.0681 tsf





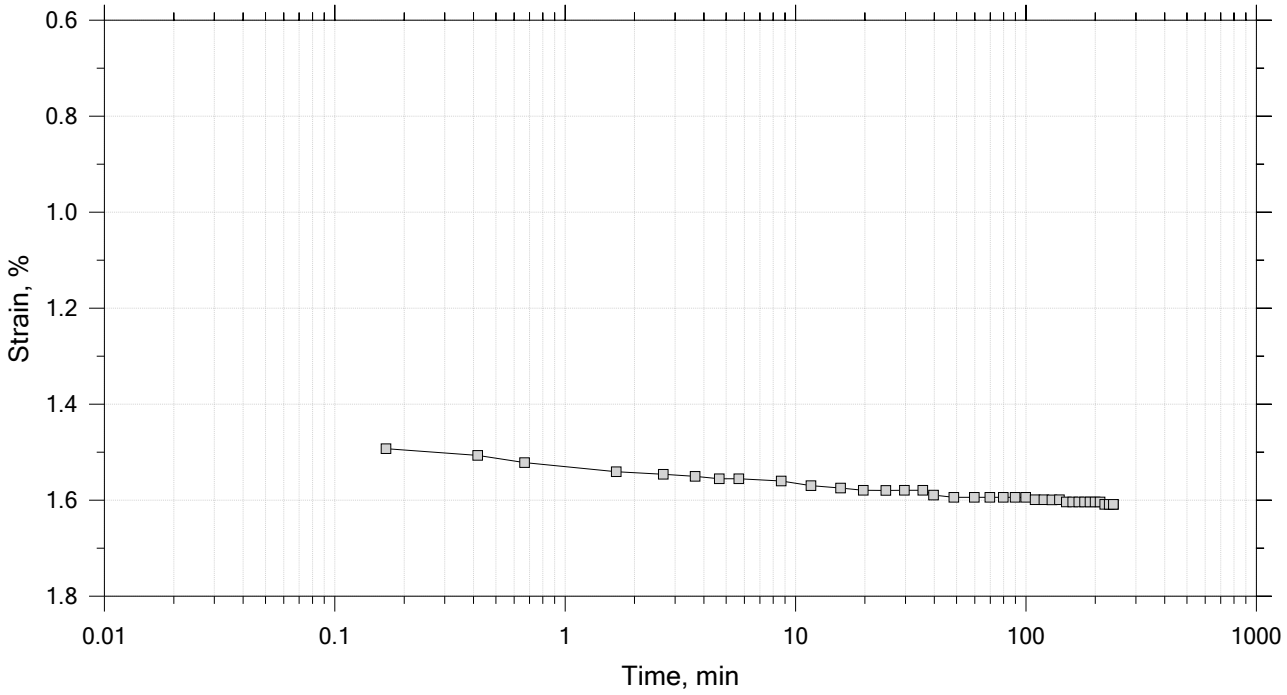
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		

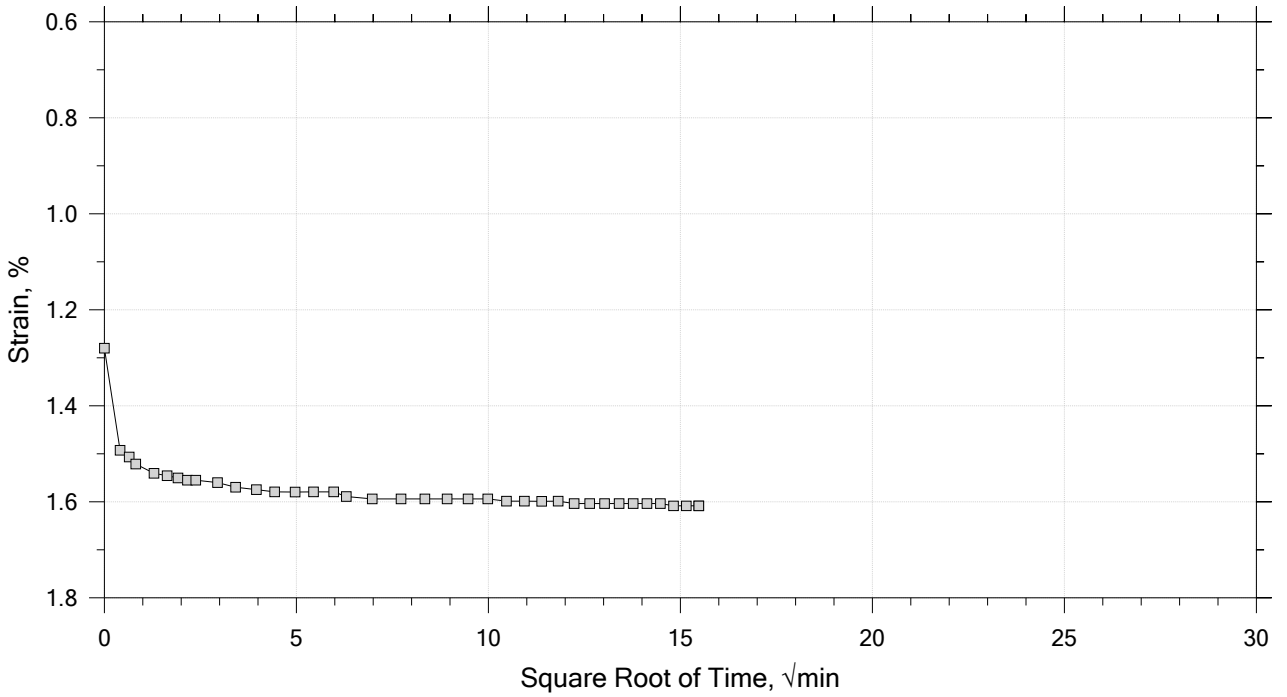
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 15

Constant Load Step

Stress: 0.125 tsf

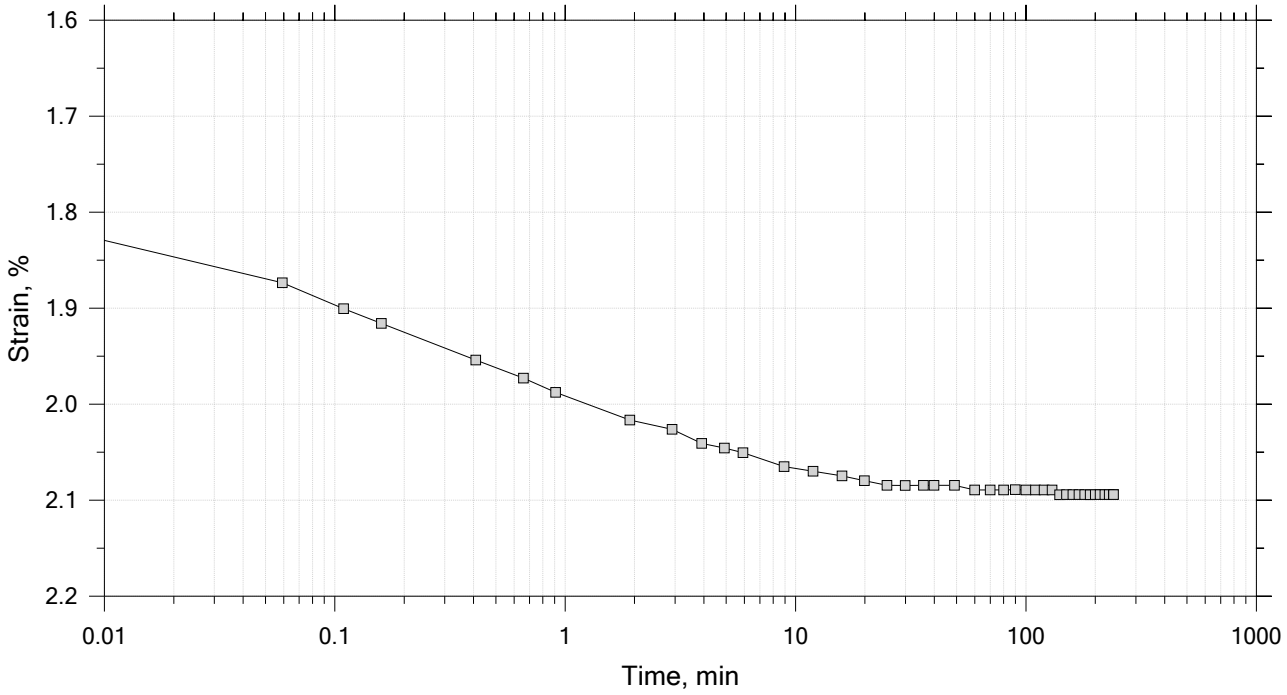


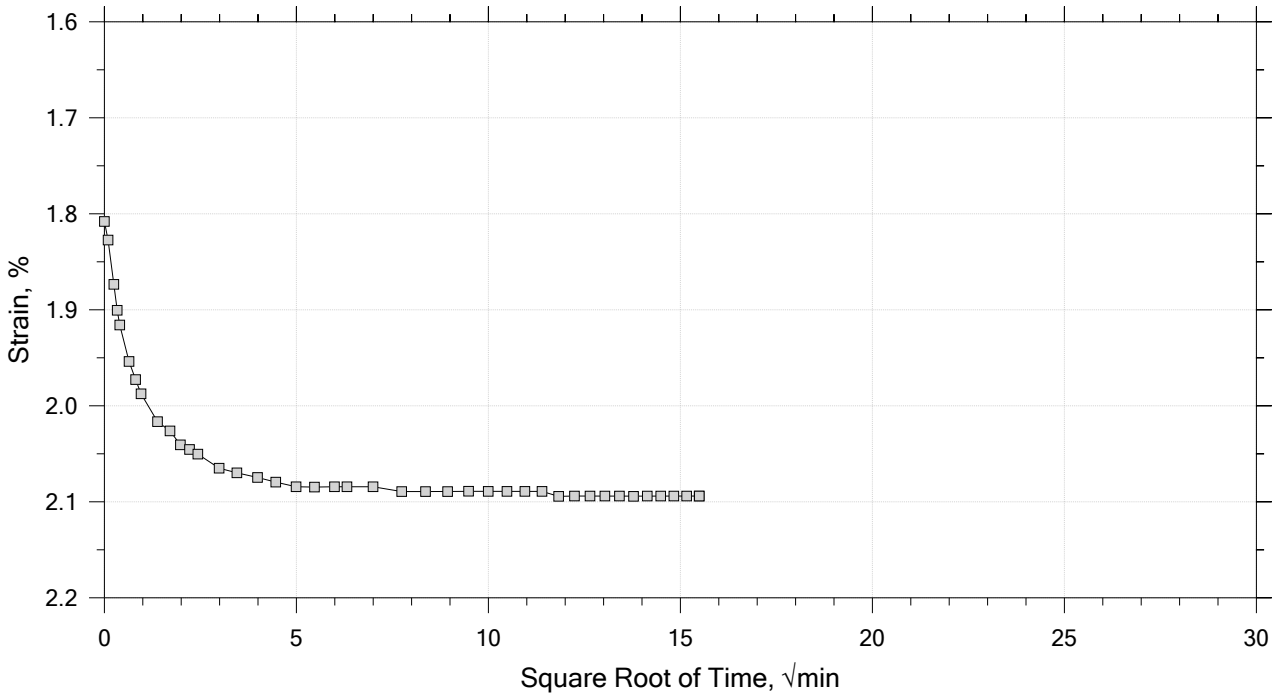


GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 15
Constant Load Step
Stress: 0.25 tsf





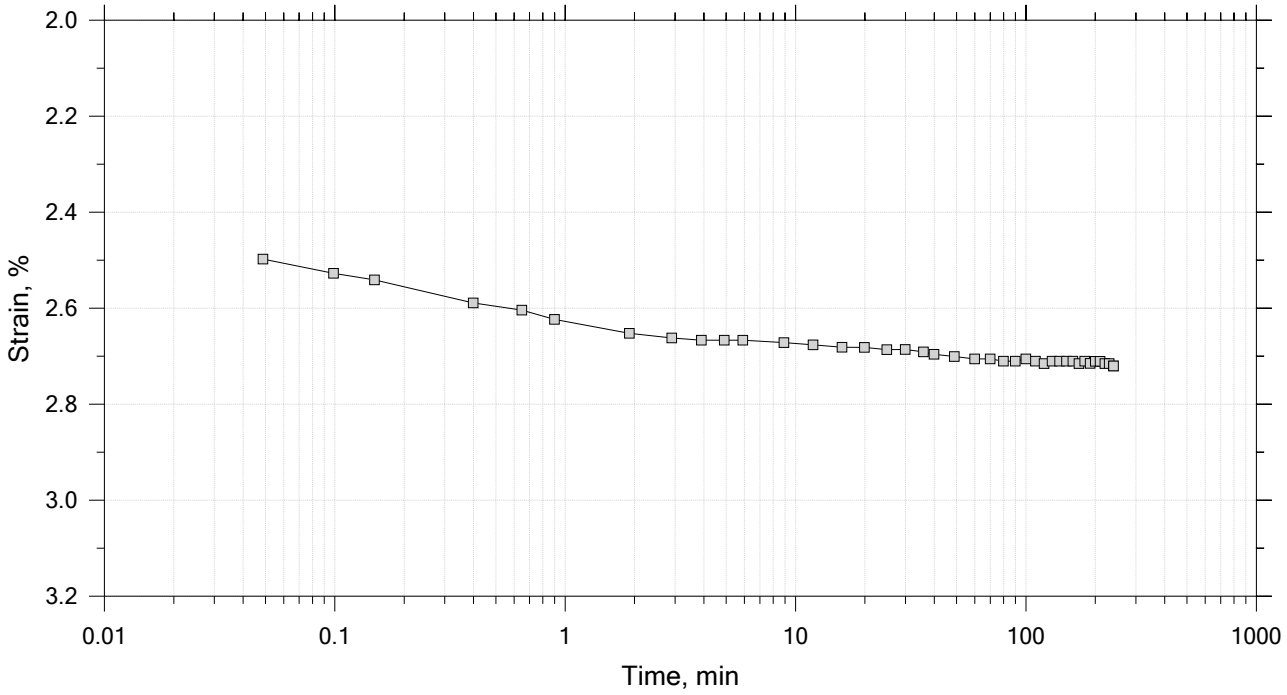
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		

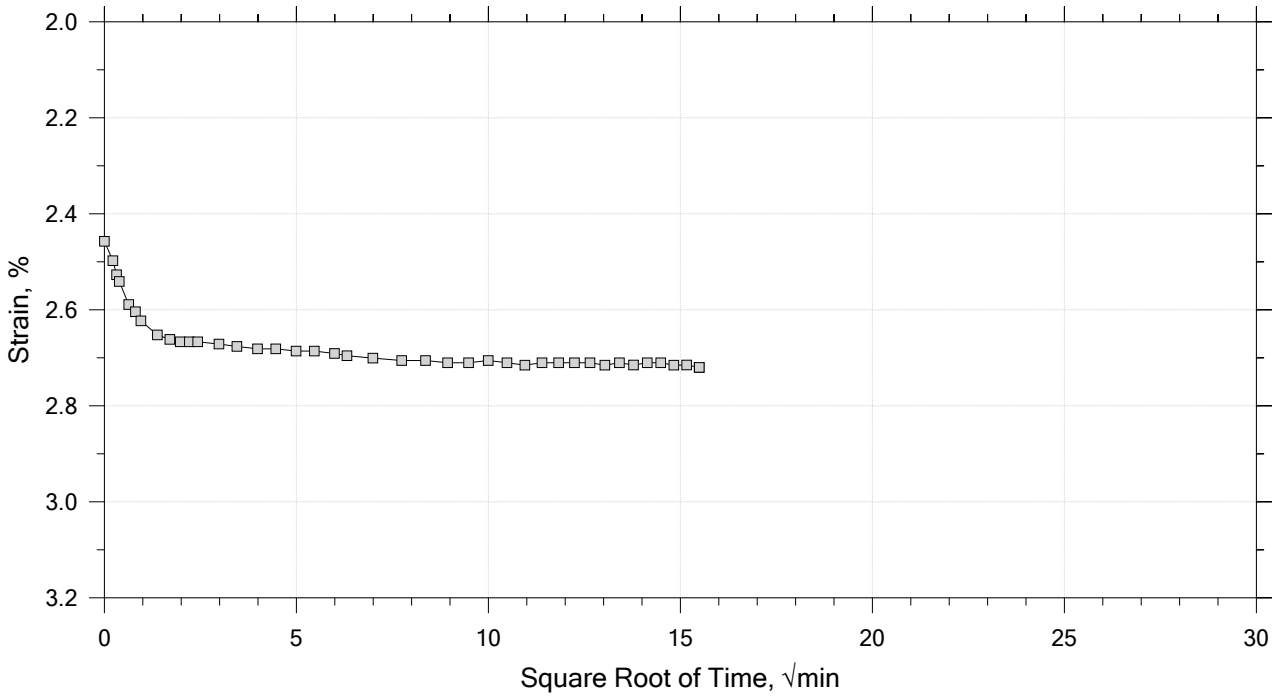
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 15

Constant Load Step

Stress: 0.5 tsf





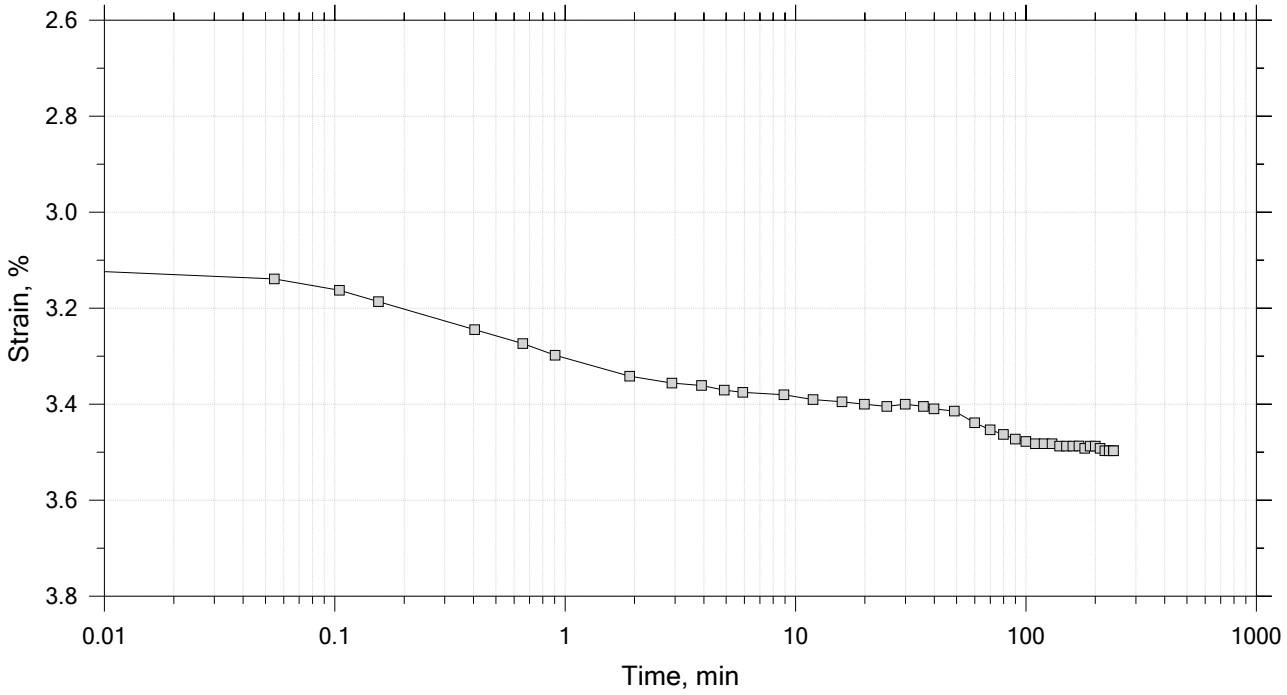
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		

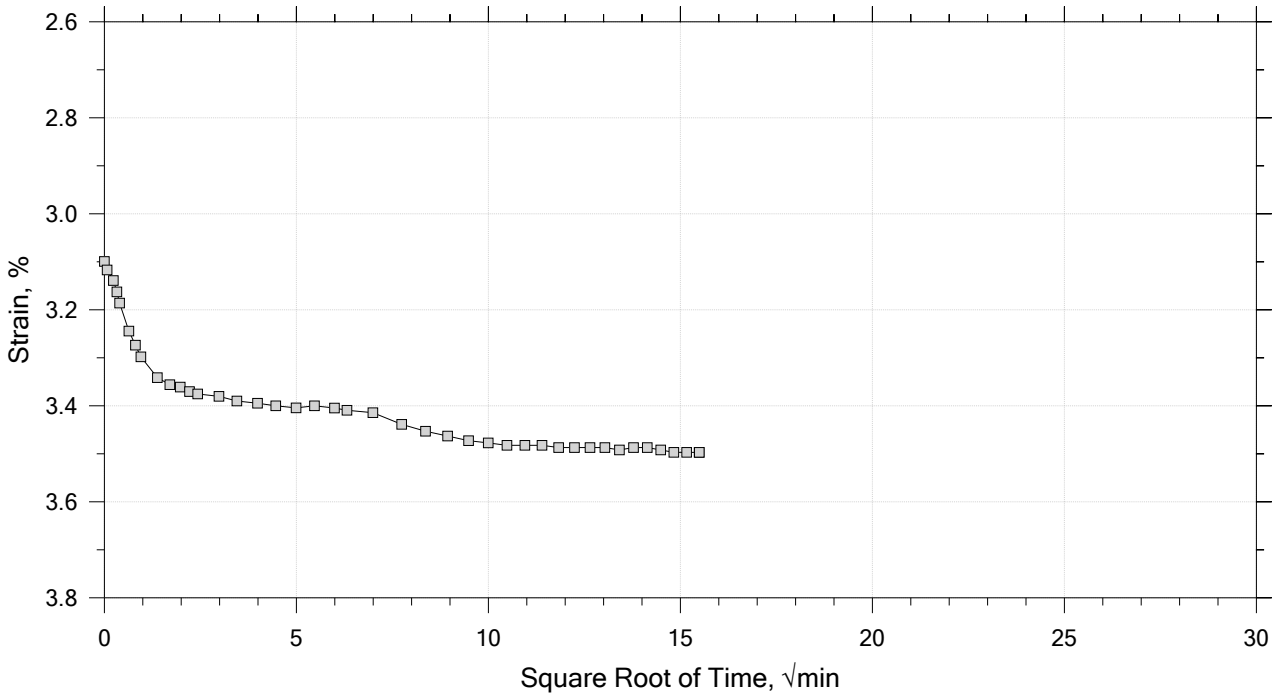
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 15

Constant Load Step

Stress: 1 tsf





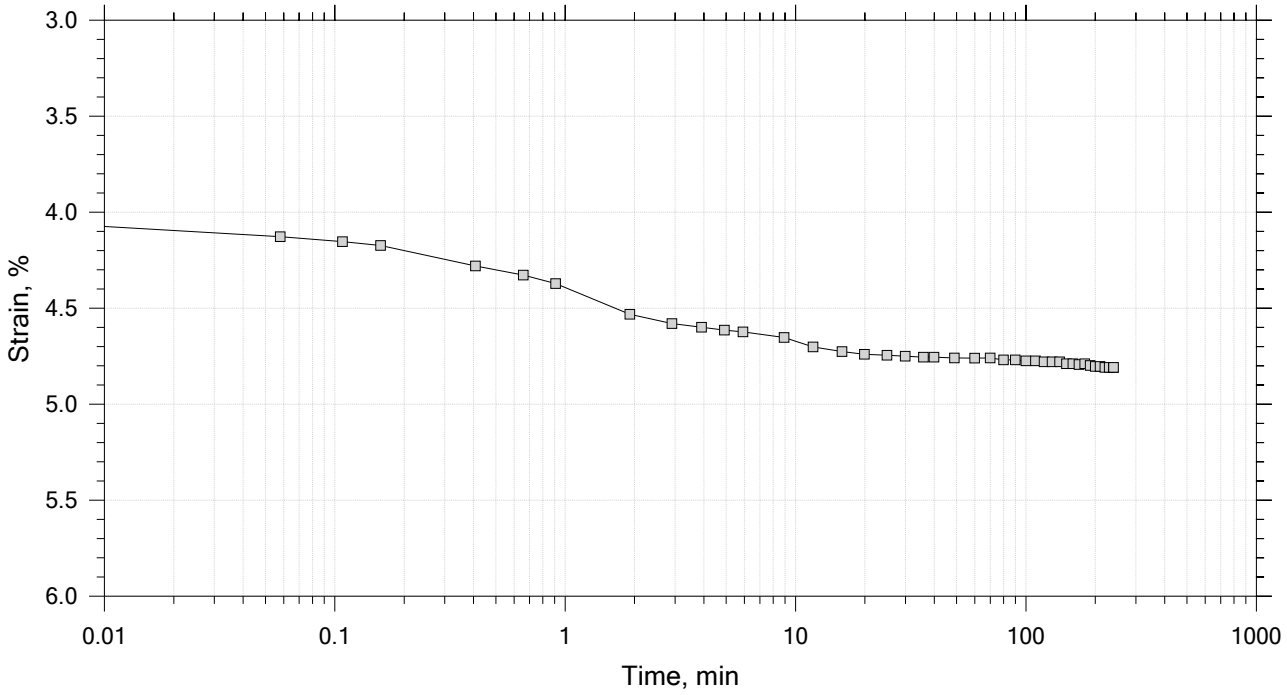
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		

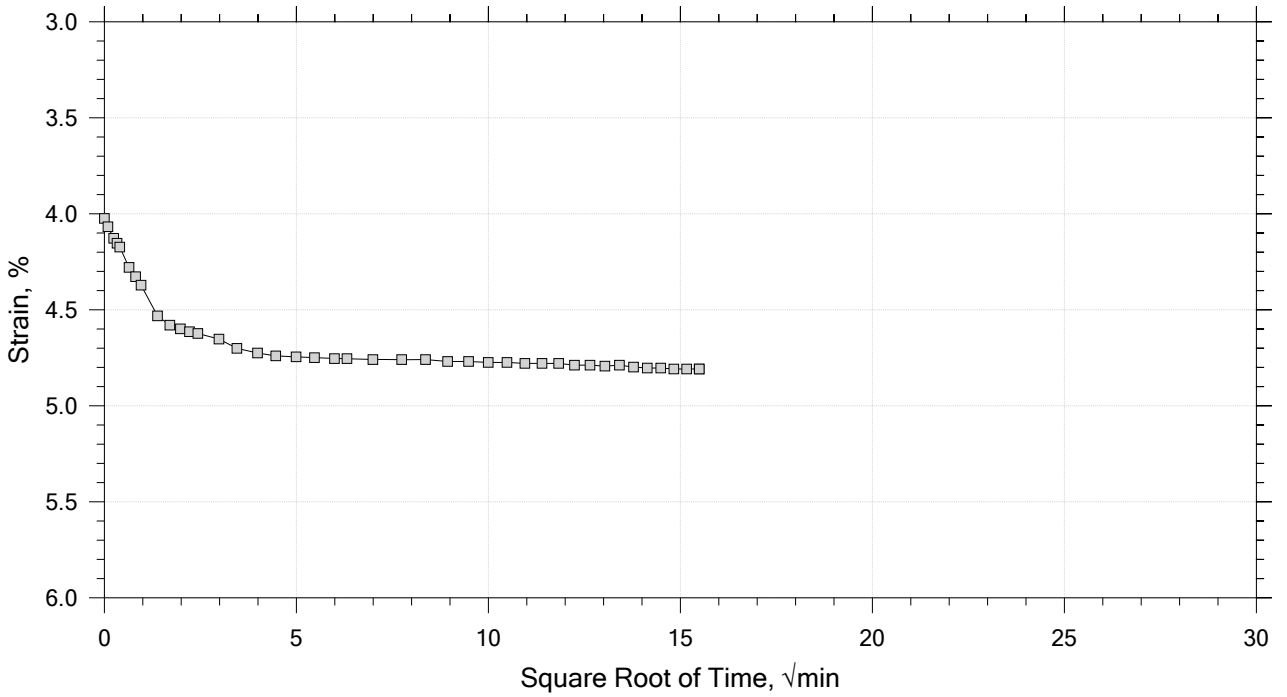
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 15

Constant Load Step

Stress: 2 tsf





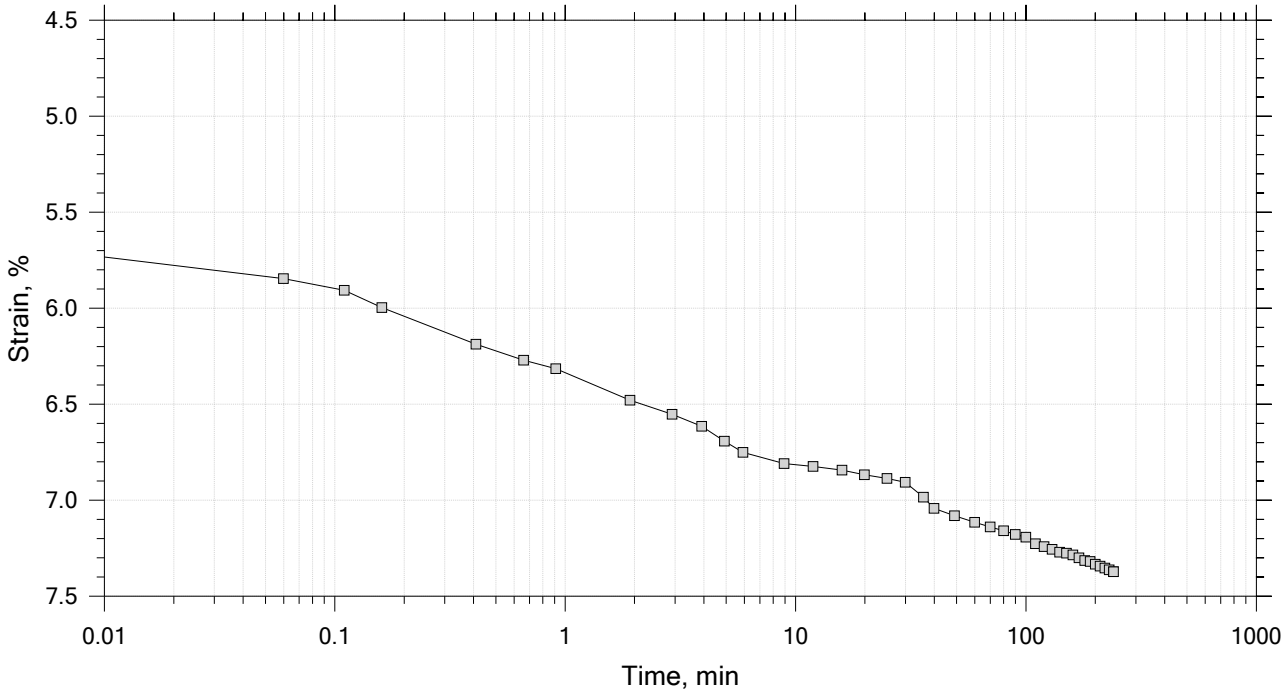
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		

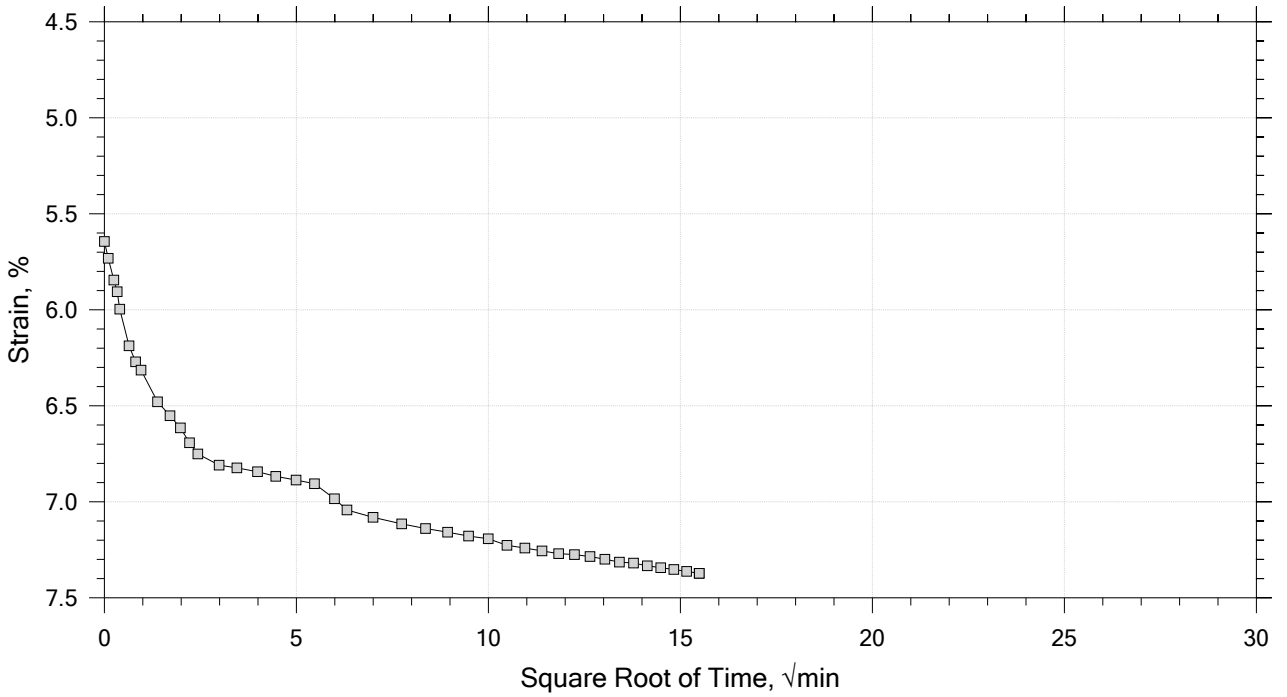
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 15

Constant Load Step

Stress: 4 tsf





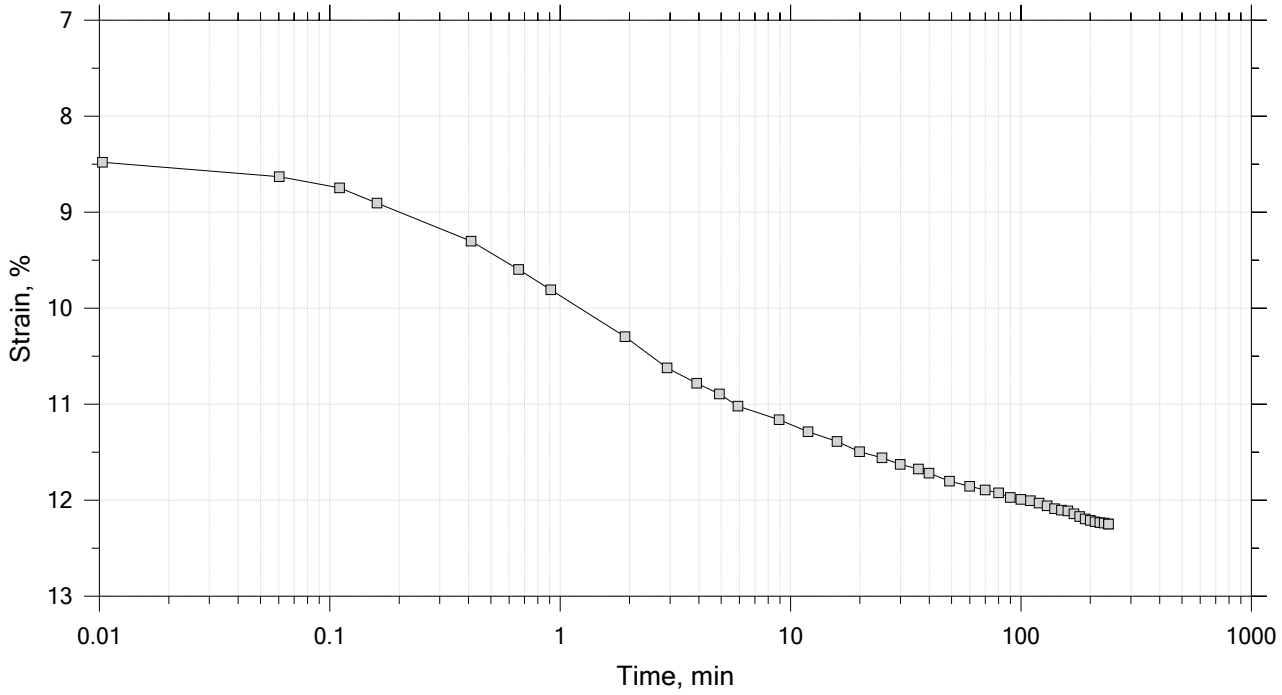
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		

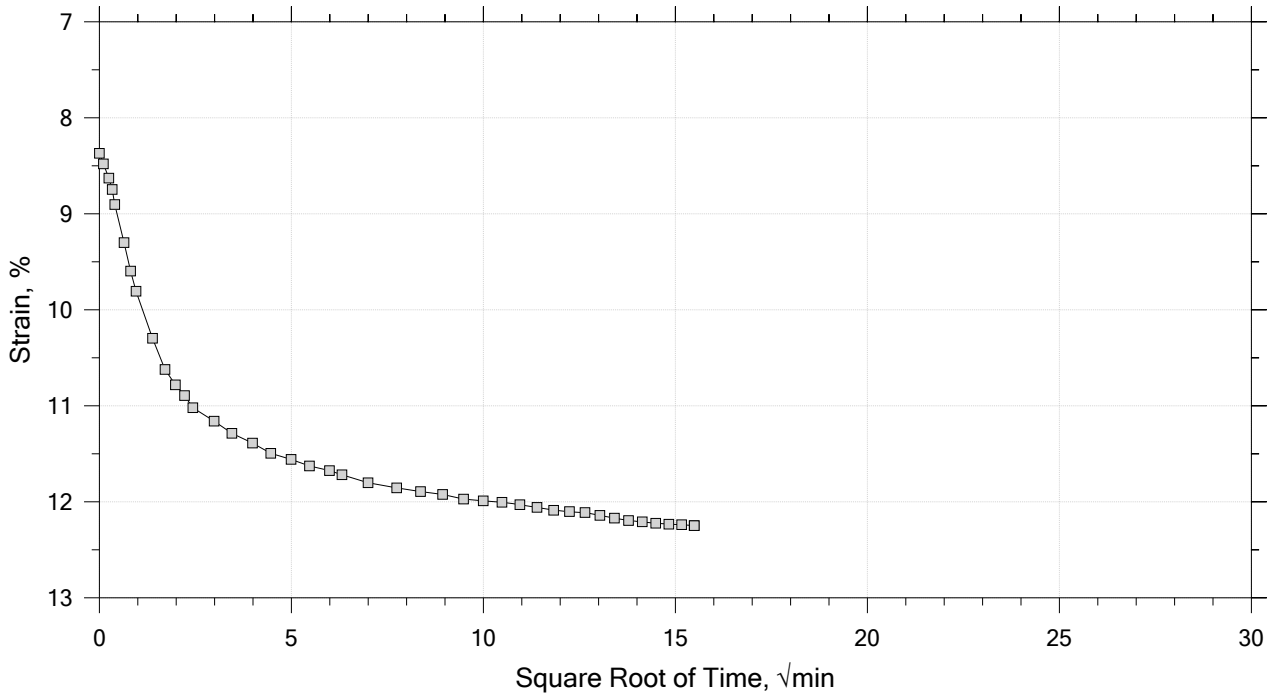
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 15

Constant Load Step

Stress: 8 tsf





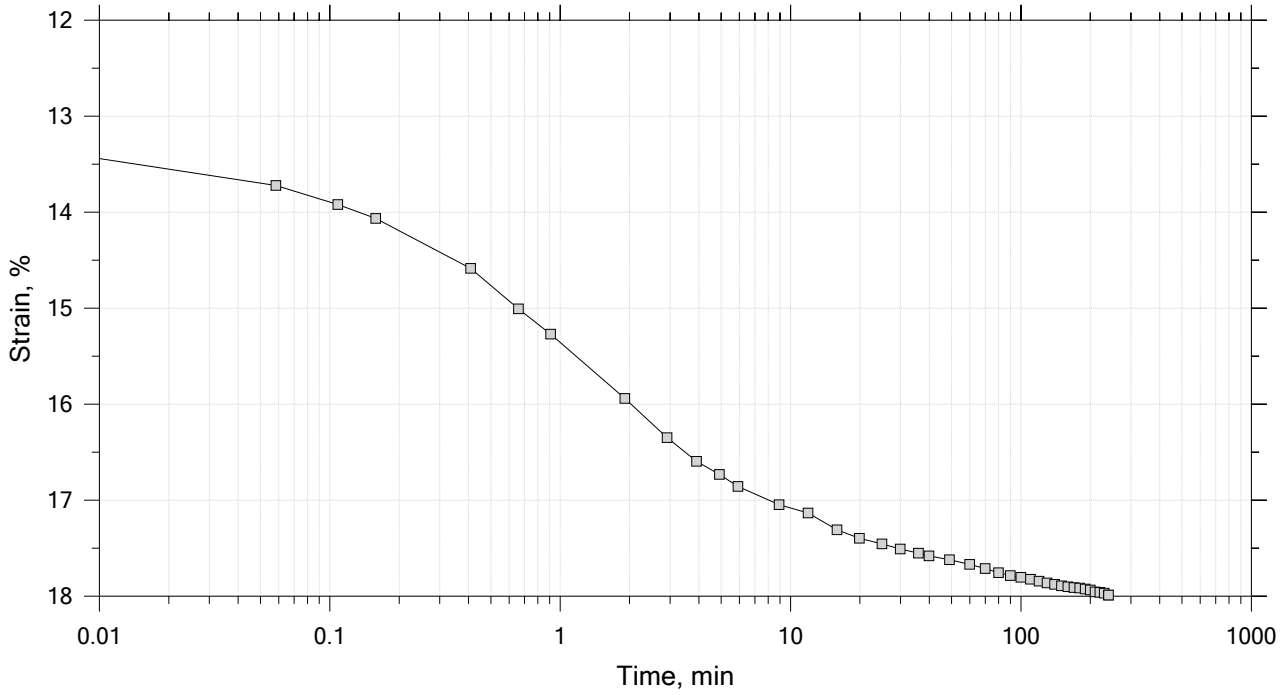
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		

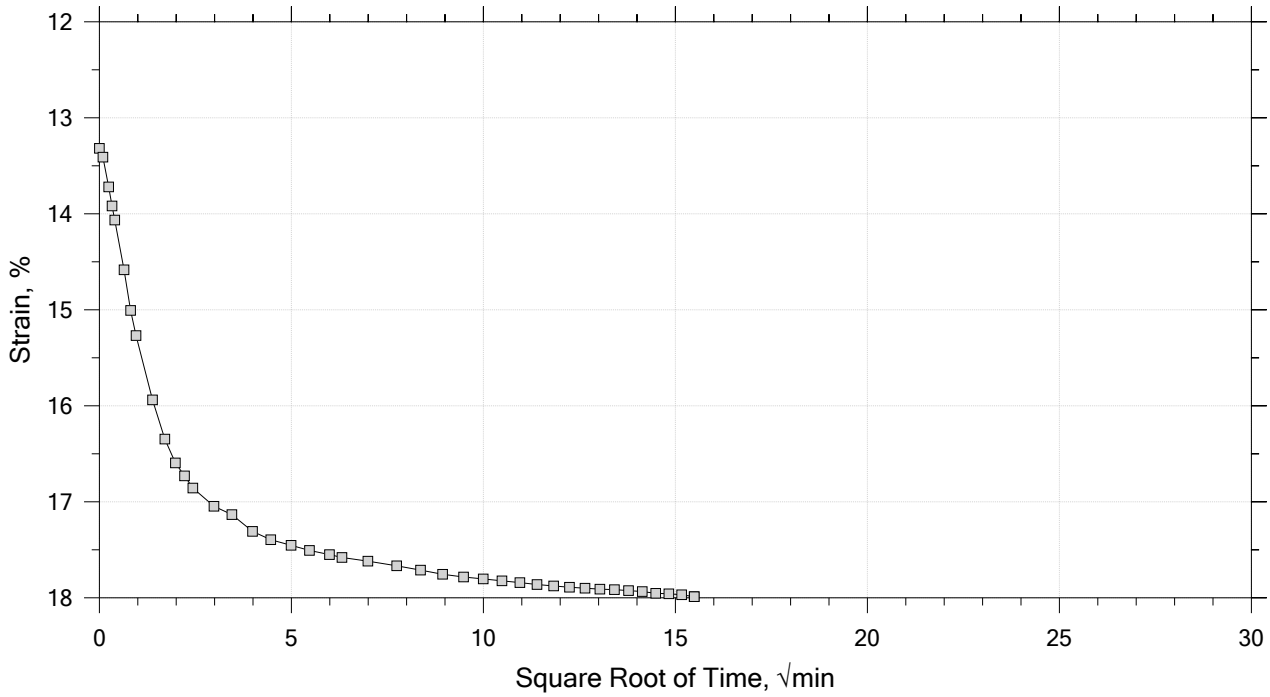
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 15

Constant Load Step

Stress: 16 tsf

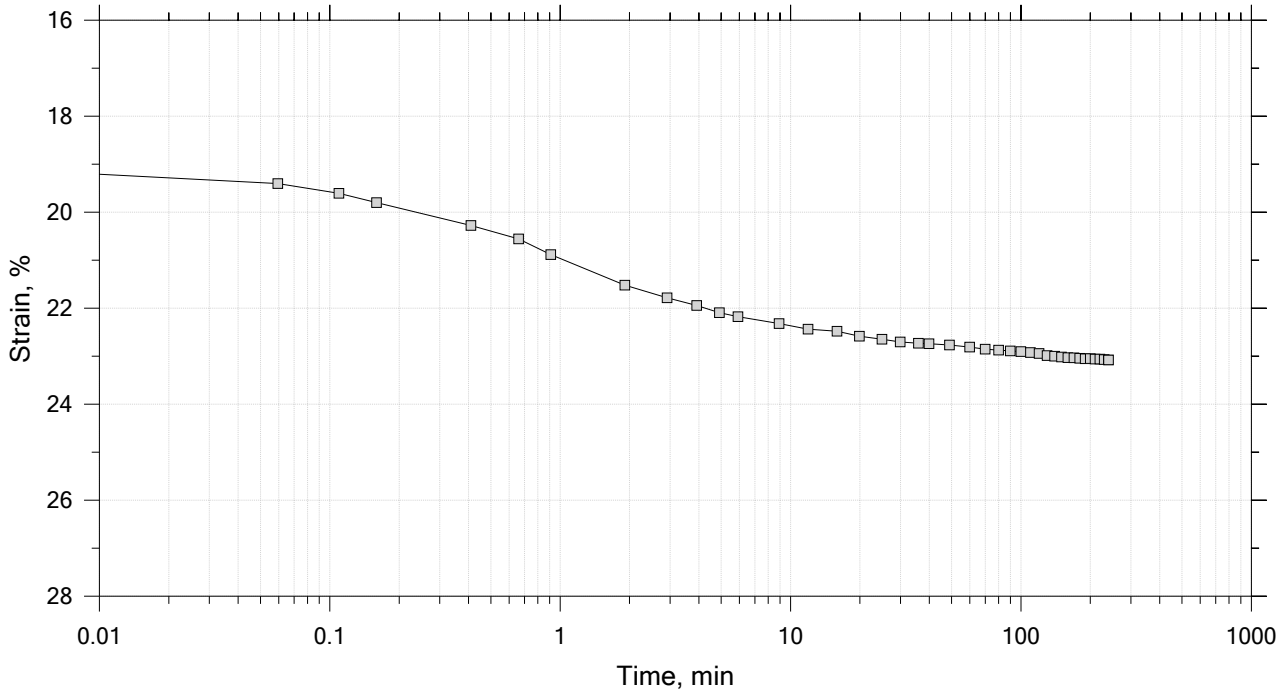


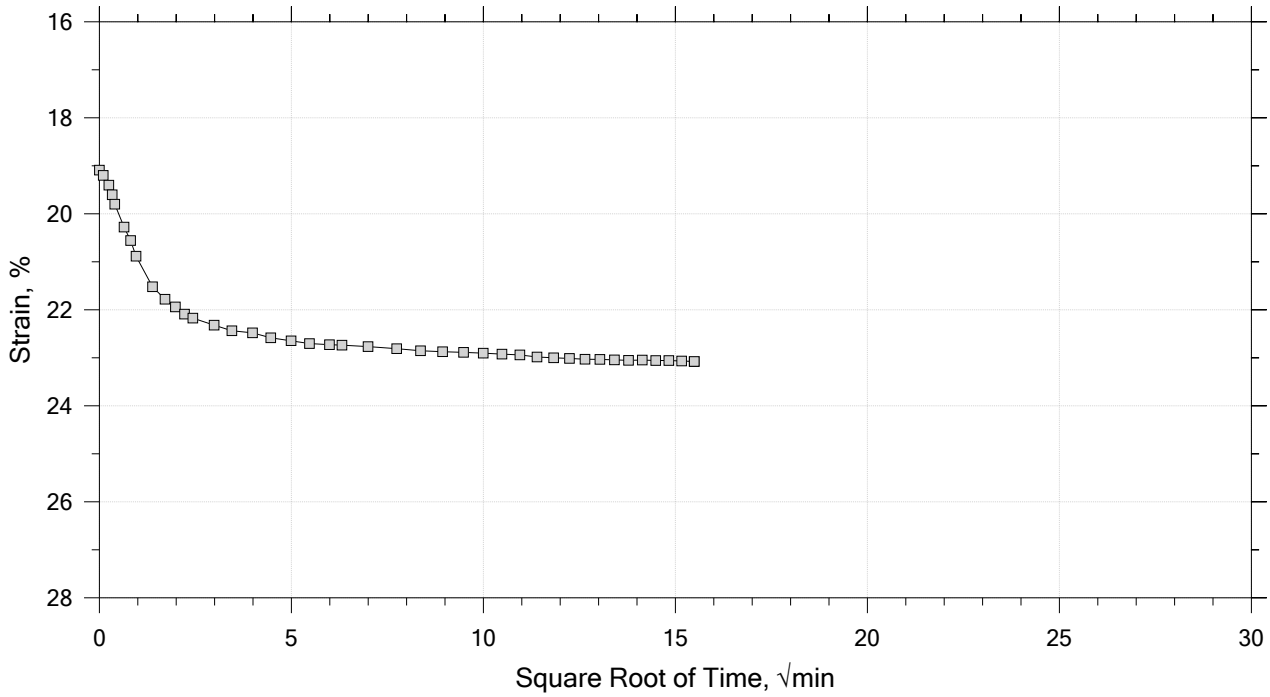


GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 15
Constant Load Step
Stress: 32 tsf

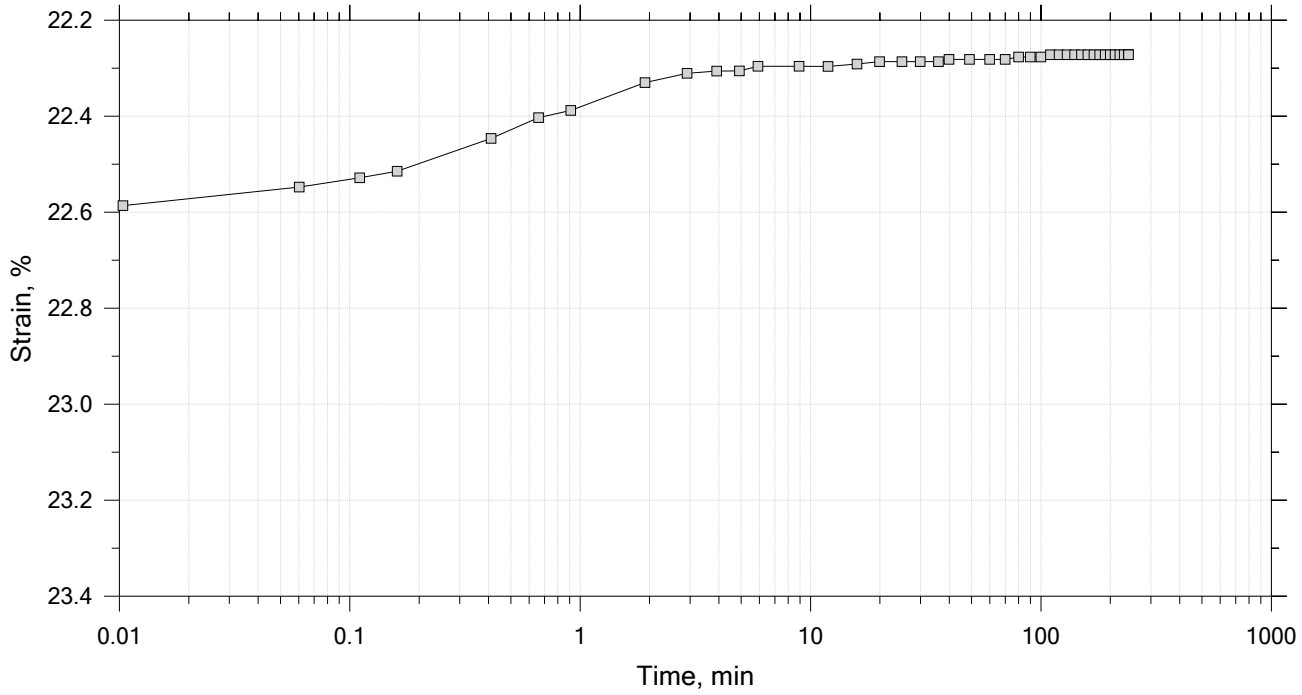


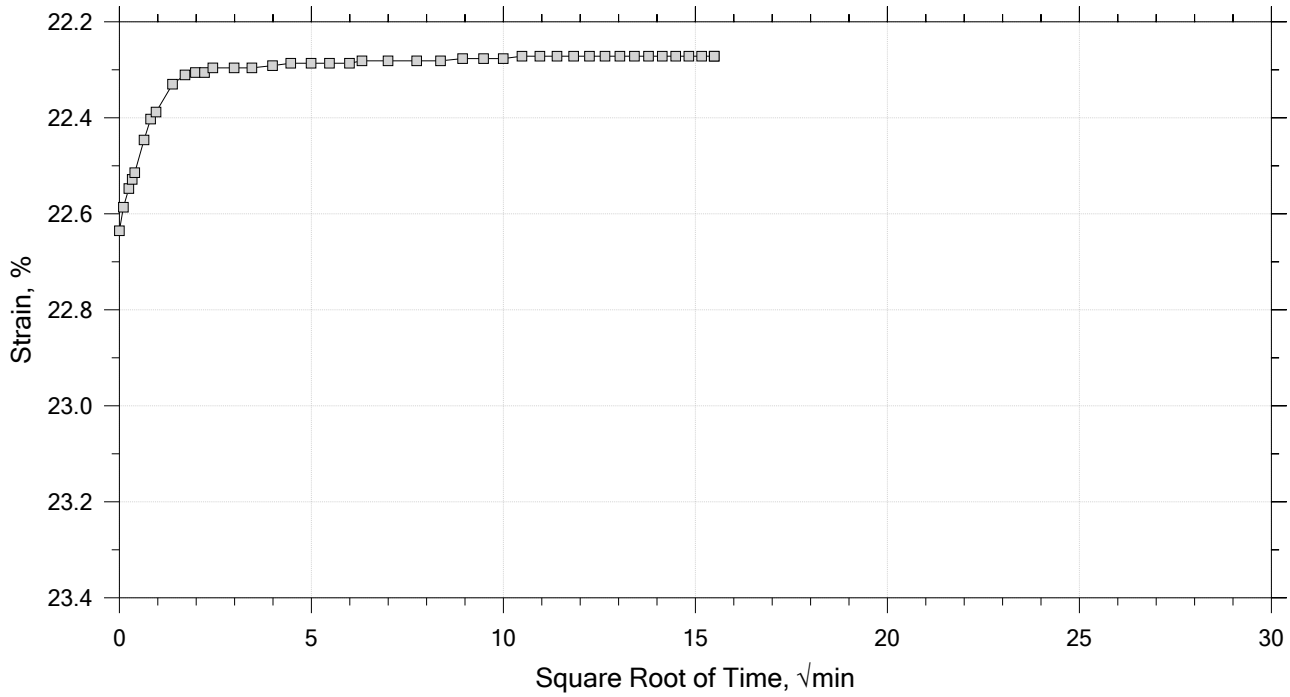


GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 15
Constant Load Step
Stress: 8 tsf





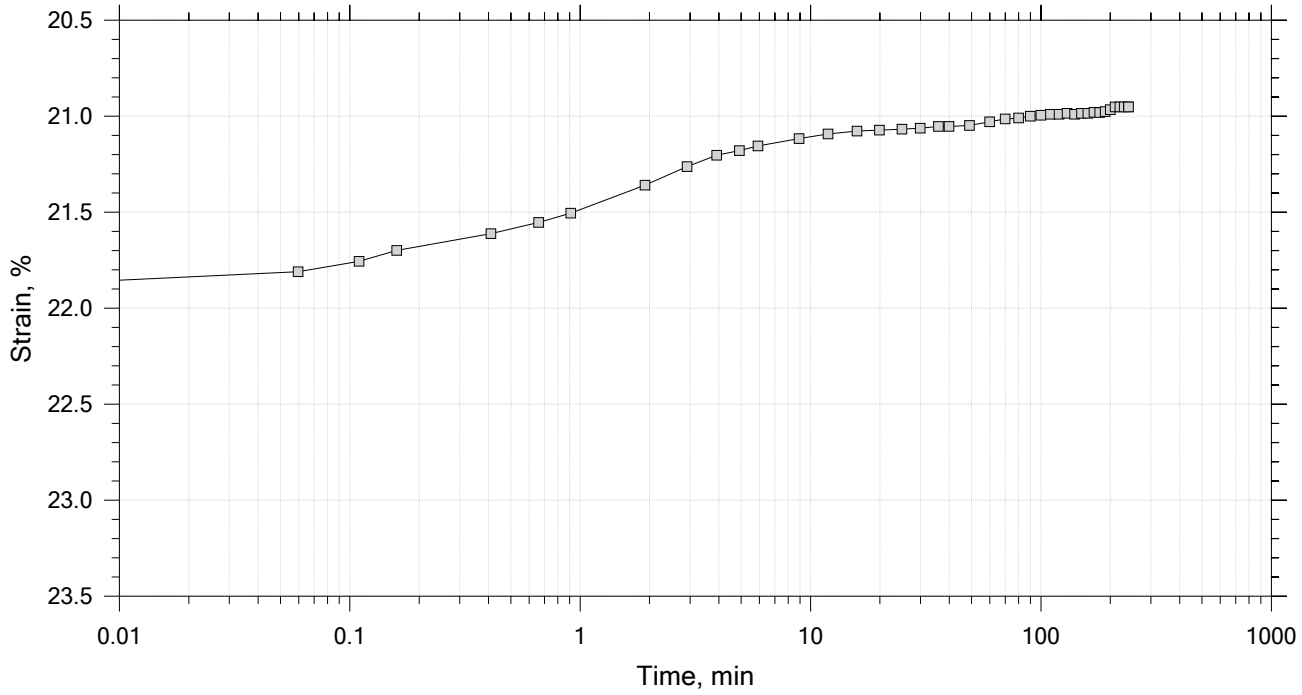
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		

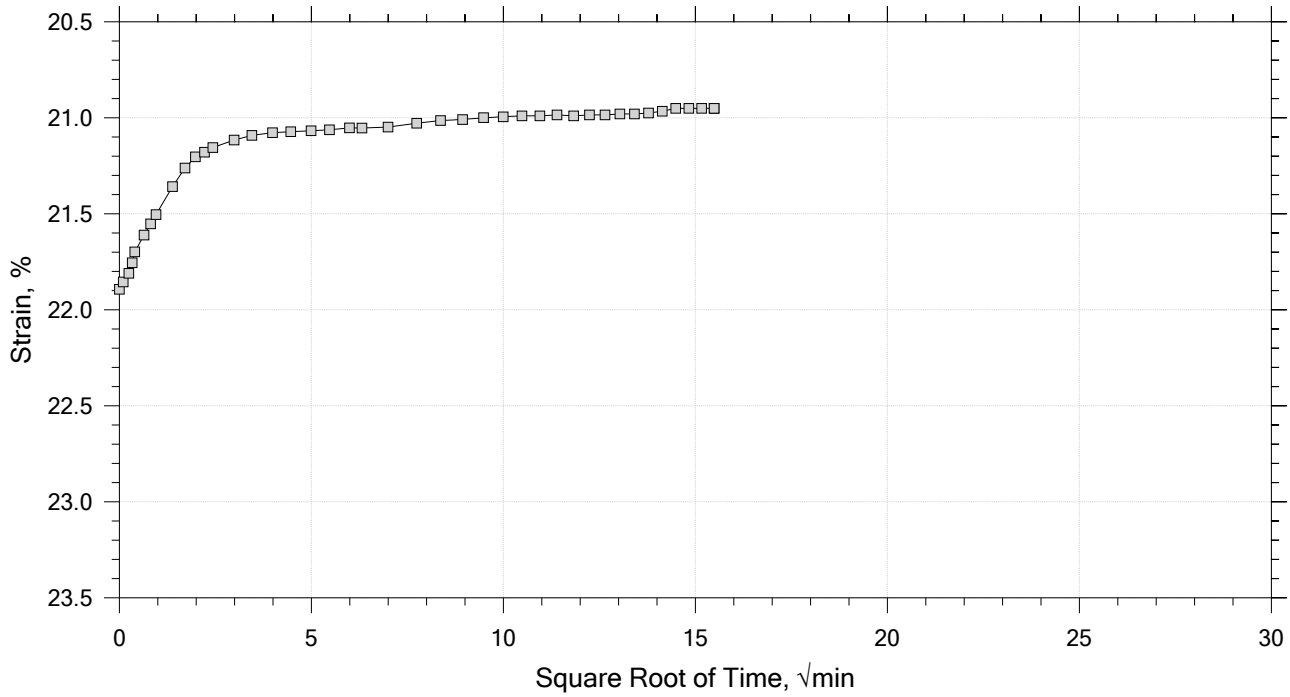
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 15

Constant Load Step

Stress: 2 tsf

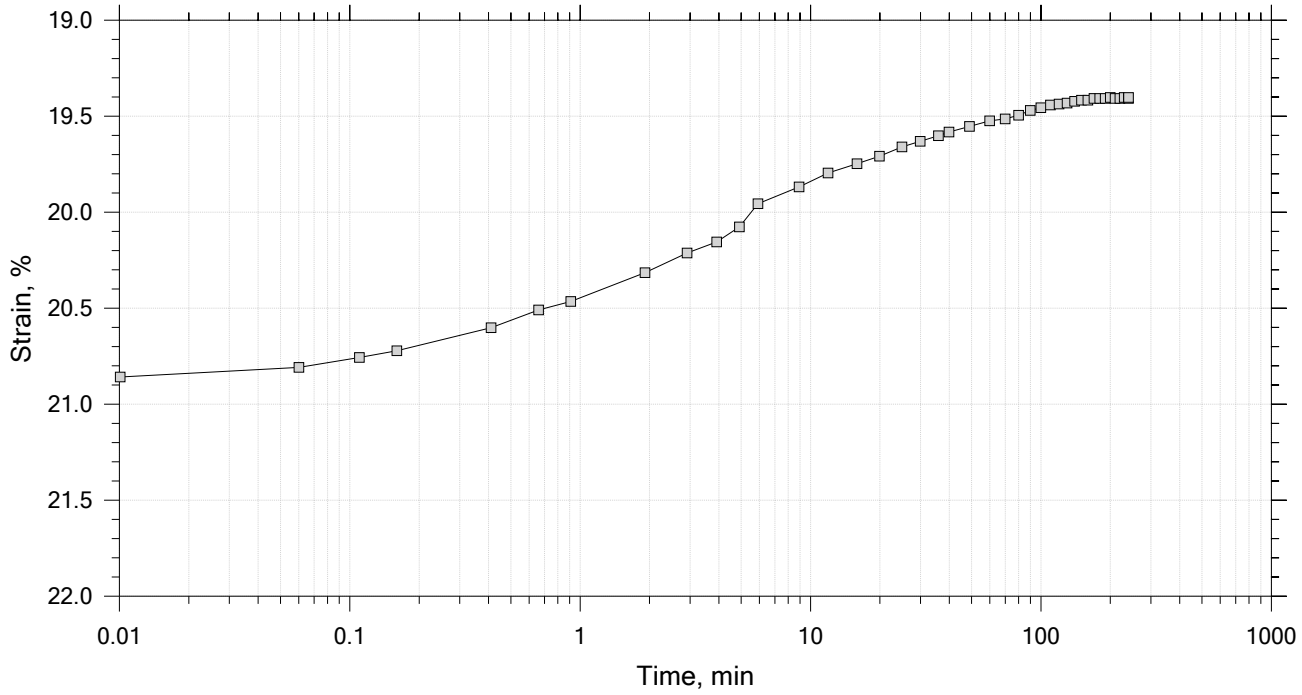


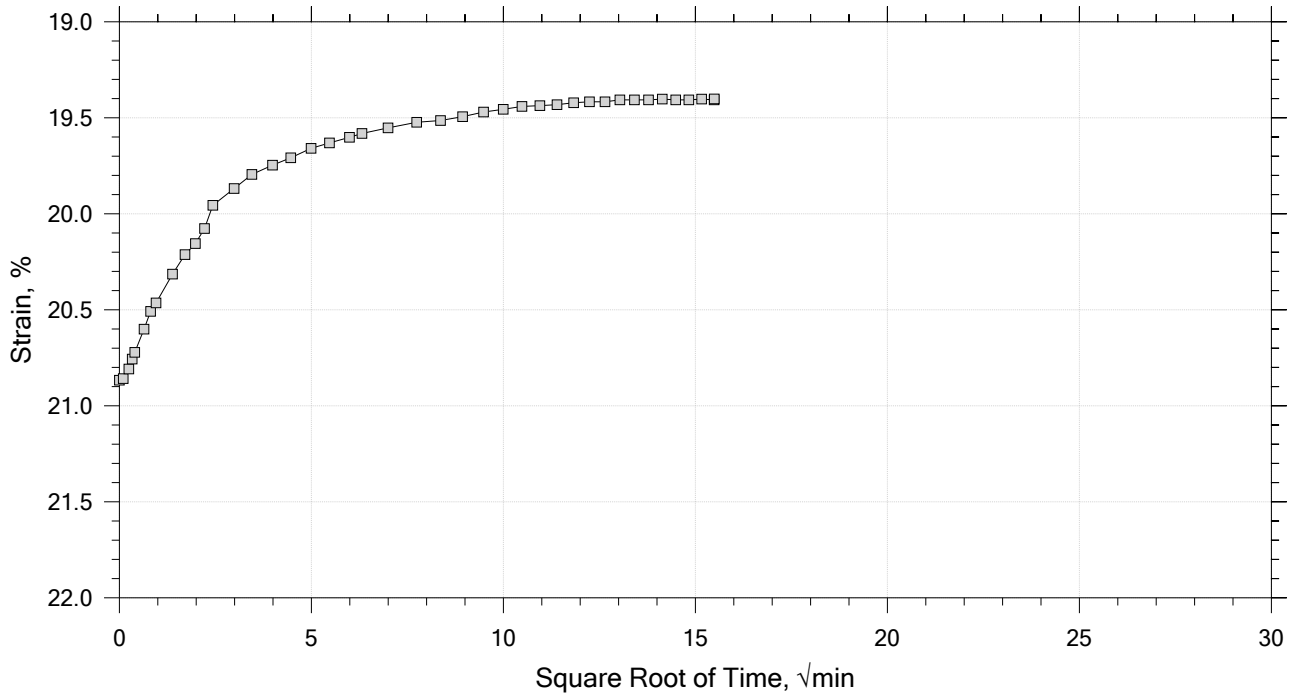


GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 15
Constant Load Step
Stress: 0.5 tsf

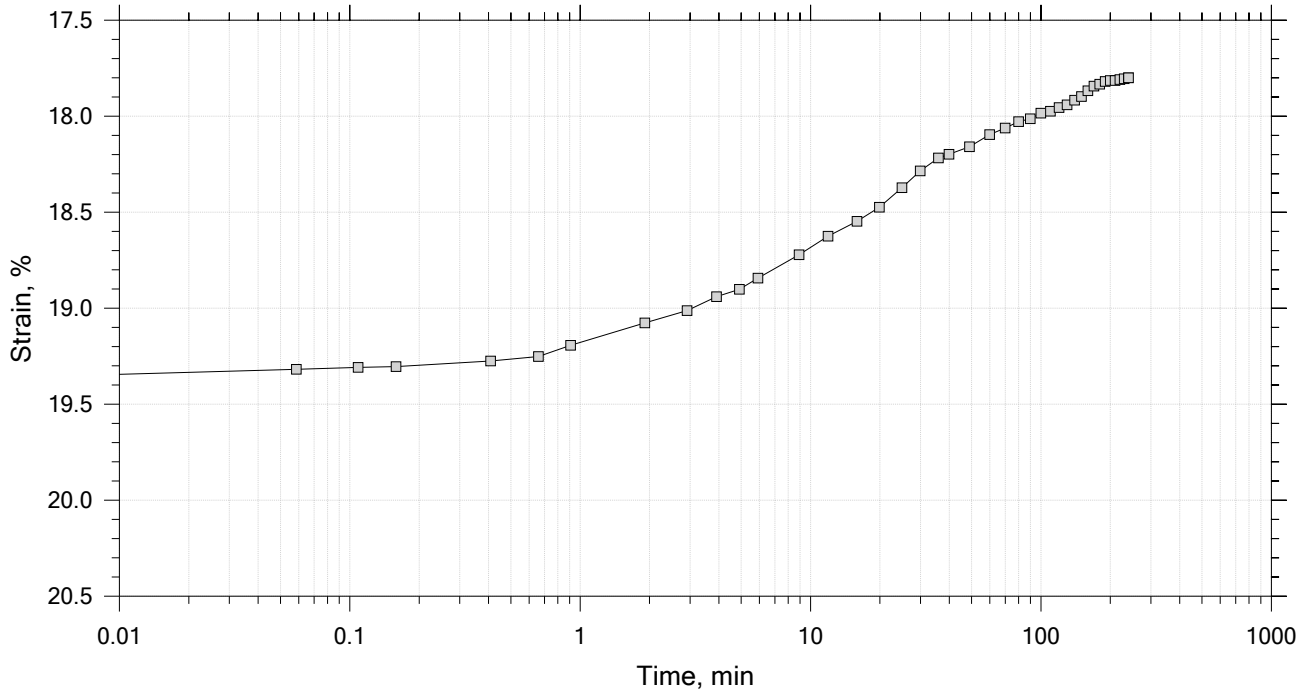


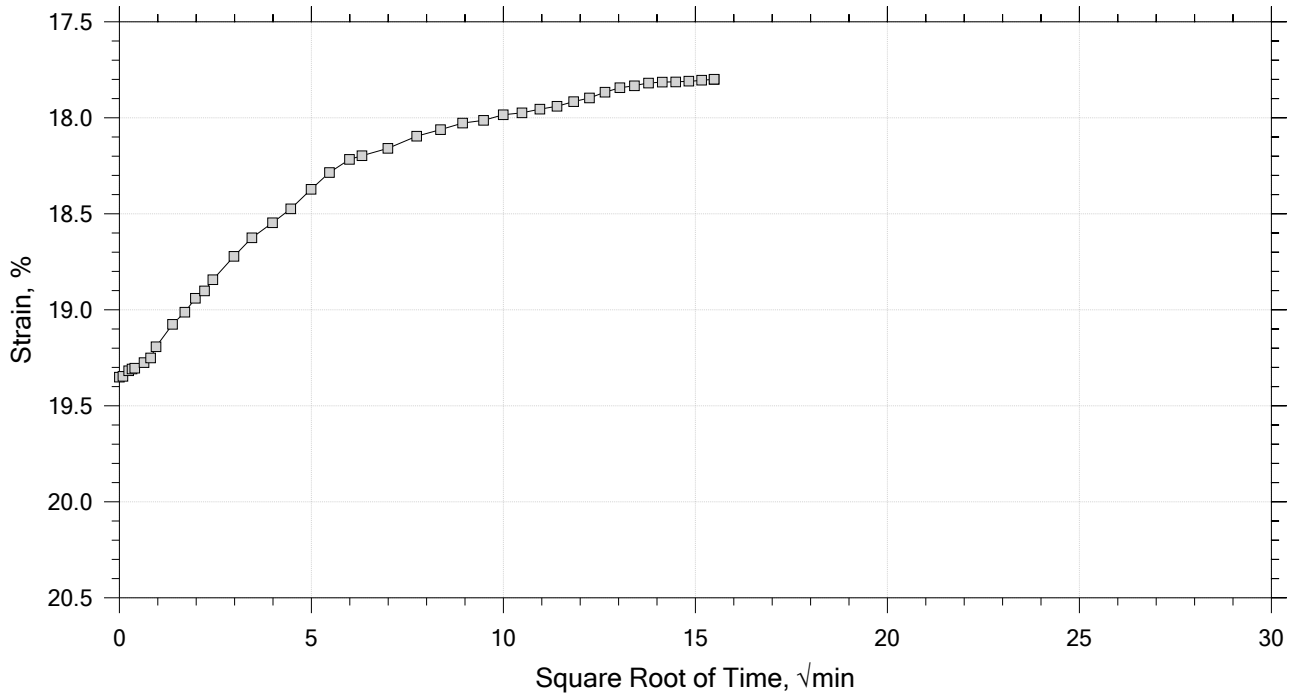


Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
Boring No.: BBYRO-103	Tested By: md	Checked By: anm
Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
Test No.: IP-2	Sample Type: intact	Elevation: ---
Description: Moist, olive gray clay		
Remarks: System JJ, Swell Pressure = 0.0681 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 15
Constant Load Step
Stress: 0.125 tsf

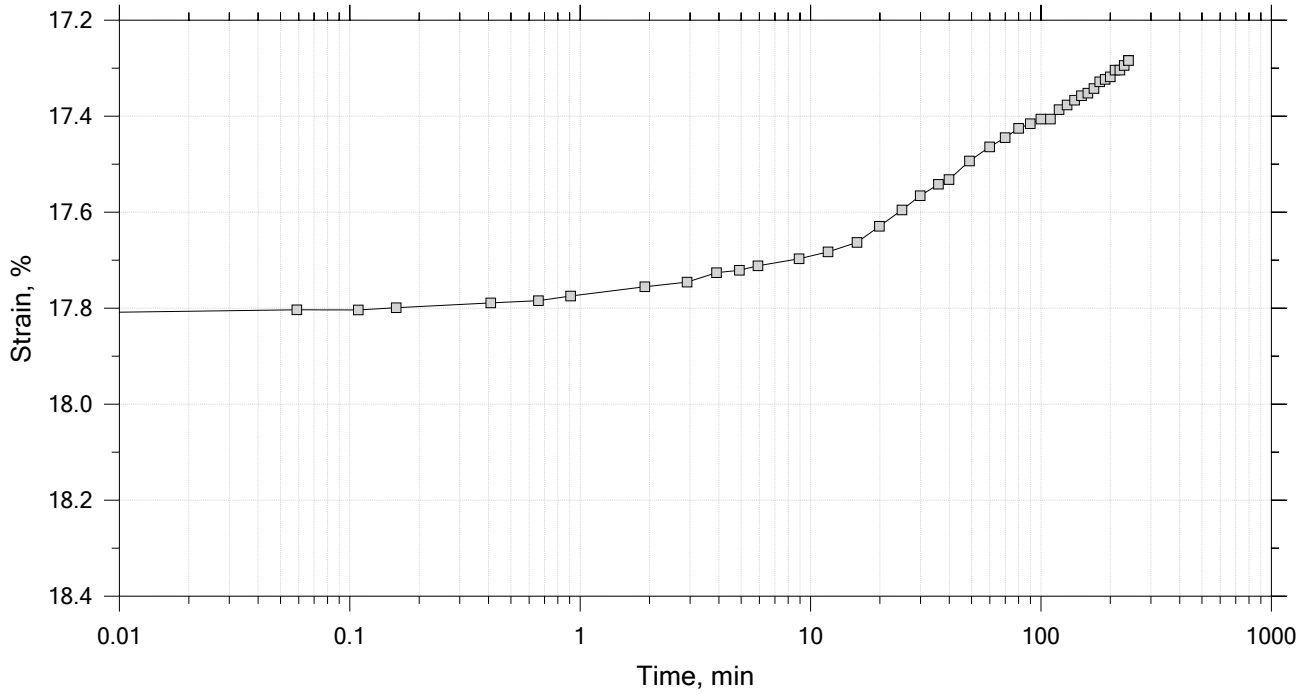


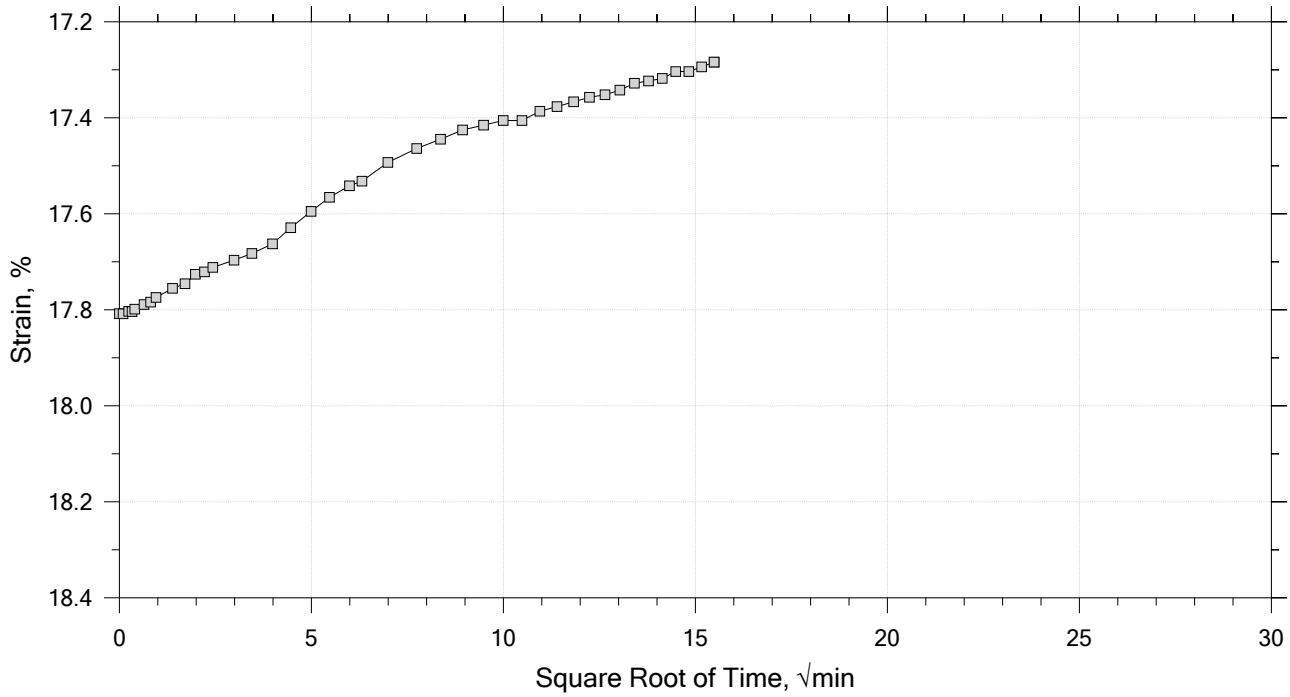


GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 15
Constant Load Step
Stress: 0.0625 tsf





Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
Boring No.: BBYRO-103	Tested By: md	Checked By: anm
Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
Test No.: IP-2	Sample Type: intact	Elevation: ---
Description: Moist, olive gray clay		
Remarks: System JJ, Swell Pressure = 0.0681 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 2.50 in	Estimated Specific Gravity: 2.74	Liquid Limit: 49
Initial Height: 1.00 in	Initial Void Ratio: 1.04	Plastic Limit: 21
Final Height: 0.83 in	Final Void Ratio: 0.697	Plasticity Index: 28

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	D-2459	RING		C-2312
Mass Container, gm	8.35	108.68	108.68	9.05
Mass Container + Wet Soil, gm	214.22	256.5	244	146.36
Mass Container + Dry Soil, gm	163.47	216.57	216.57	118.53
Mass Dry Soil, gm	155.12	107.89	107.89	109.48
Water Content, %	32.72	37.01	25.42	25.42
Void Ratio	---	1.04	0.70	---
Degree of Saturation, %	---	97.14	100.00	---
Dry Unit Weight, pcf	---	83.734	100.88	---

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.

GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Log of Time Coefficients

Step	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/s	Mv 1/tsf	k ft/day	Ca %
1	0.0681	0.006206	1.03	0.621	0.000	0.00e+00	9.11e-02	0.00e+00	0.00e+00
2	0.125	0.01609	1.01	1.61	0.000	0.00e+00	1.74e-01	0.00e+00	0.00e+00
3	0.250	0.02094	1.00	2.09	0.000	0.00e+00	3.88e-02	0.00e+00	0.00e+00
4	0.500	0.02720	0.989	2.72	0.000	0.00e+00	2.50e-02	0.00e+00	0.00e+00
5	1.00	0.03497	0.973	3.50	0.000	0.00e+00	1.55e-02	0.00e+00	0.00e+00
6	2.00	0.04808	0.947	4.81	1.211	4.32e-06	1.31e-02	1.53e-04	0.00e+00
7	4.00	0.07373	0.894	7.37	0.000	0.00e+00	1.28e-02	0.00e+00	0.00e+00
8	8.00	0.1225	0.794	12.2	1.238	3.75e-06	1.22e-02	1.23e-04	0.00e+00
9	16.0	0.1799	0.677	18.0	1.184	3.47e-06	7.18e-03	6.71e-05	0.00e+00
10	32.0	0.2308	0.573	23.1	1.096	3.28e-06	3.18e-03	2.82e-05	0.00e+00
11	8.00	0.2227	0.589	22.3	0.000	0.00e+00	3.36e-04	0.00e+00	0.00e+00
12	2.00	0.2095	0.616	21.0	1.319	2.65e-06	2.20e-03	1.58e-05	0.00e+00
13	0.500	0.1940	0.648	19.4	2.897	1.25e-06	1.03e-02	3.49e-05	0.00e+00
14	0.125	0.1780	0.681	17.8	11.021	3.43e-07	4.27e-02	3.95e-05	0.00e+00
15	0.0625	0.1728	0.691	17.3	0.000	0.00e+00	8.25e-02	0.00e+00	0.00e+00

GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

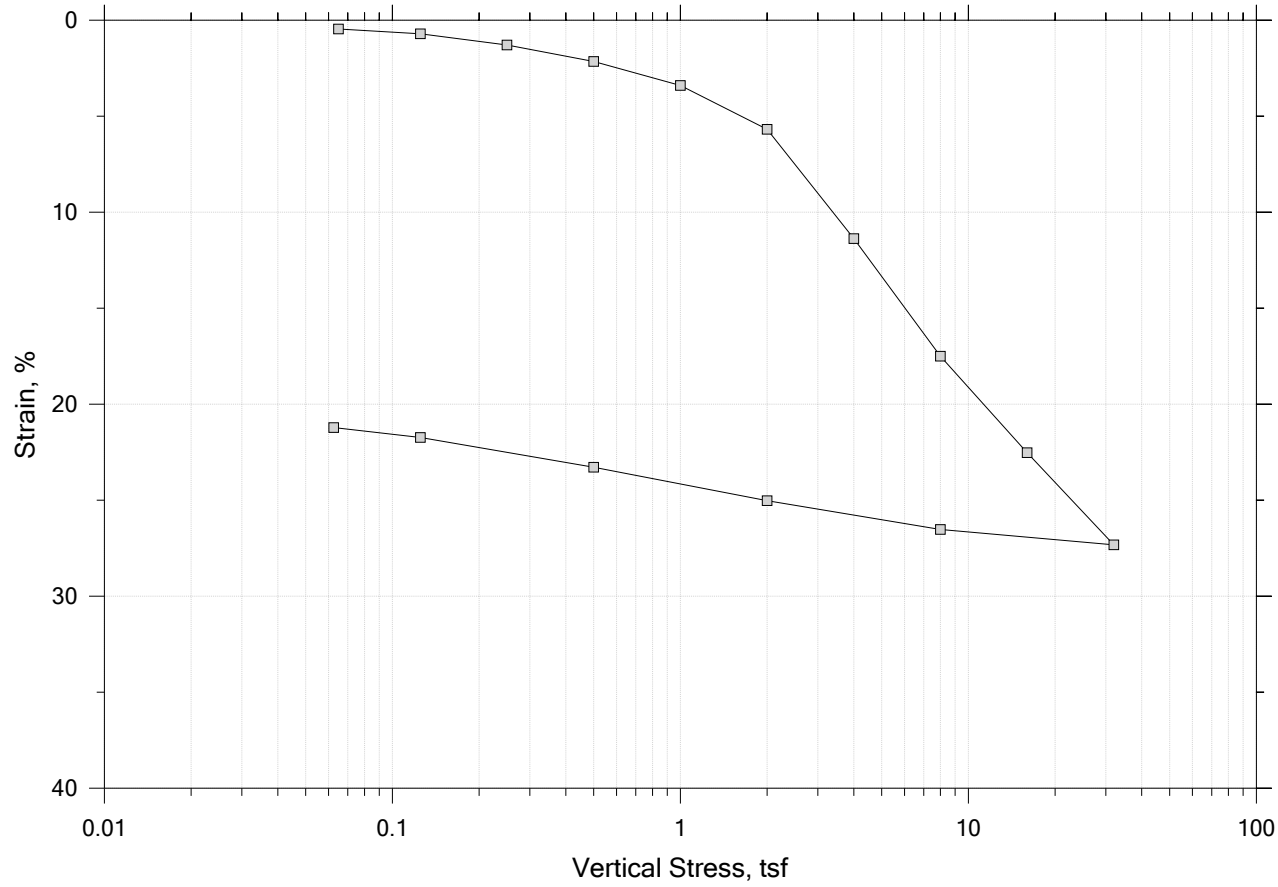
Square Root of Time Coefficients

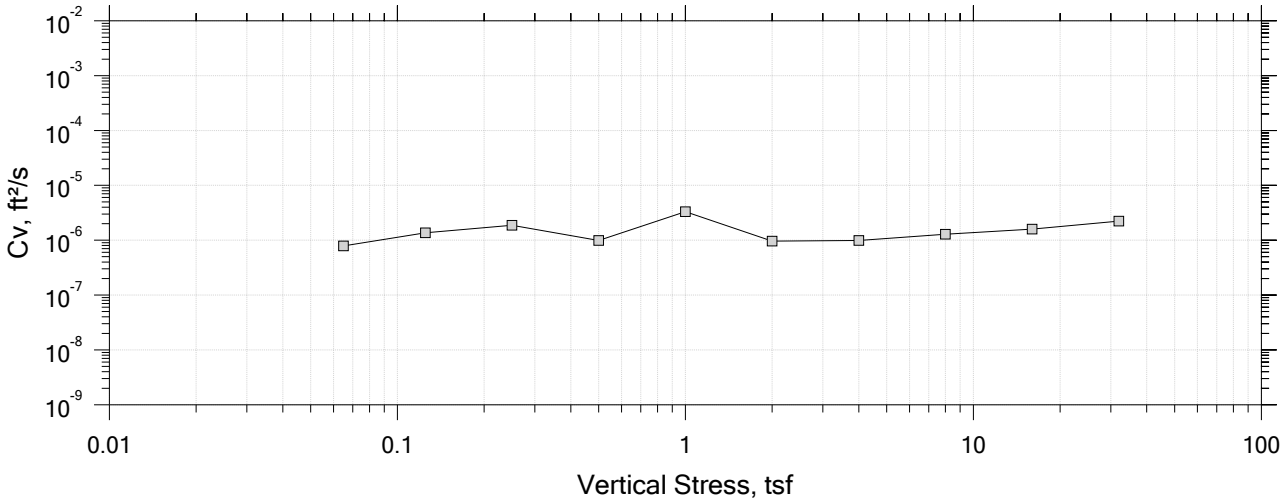
Step	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv ft²/s	Mv 1/tsf	k ft/day
1	0.0681	0.006206	1.03	0.621	3.000	8.13e-06	9.11e-02	2.00e-03
2	0.125	0.01609	1.01	1.61	24.215	9.91e-07	1.74e-01	4.64e-04
3	0.250	0.02094	1.00	2.09	1.950	1.21e-05	3.88e-02	1.27e-03
4	0.500	0.02720	0.989	2.72	2.941	7.95e-06	2.50e-02	5.37e-04
5	1.00	0.03497	0.973	3.50	139.903	1.65e-07	1.55e-02	6.90e-06
6	2.00	0.04808	0.947	4.81	4.416	5.10e-06	1.31e-02	1.80e-04
7	4.00	0.07373	0.894	7.37	49.024	4.41e-07	1.28e-02	1.53e-05
8	8.00	0.1225	0.794	12.2	7.379	2.70e-06	1.22e-02	8.89e-05
9	16.0	0.1799	0.677	18.0	5.043	3.51e-06	7.18e-03	6.78e-05
10	32.0	0.2308	0.573	23.1	4.859	3.19e-06	3.18e-03	2.74e-05
11	8.00	0.2227	0.589	22.3	3.143	4.67e-06	3.36e-04	4.23e-06
12	2.00	0.2095	0.616	21.0	5.307	2.84e-06	2.20e-03	1.69e-05
13	0.500	0.1940	0.648	19.4	9.666	1.62e-06	1.03e-02	4.50e-05
14	0.125	0.1780	0.681	17.8	45.624	3.56e-07	4.27e-02	4.11e-05
15	0.0625	0.1728	0.691	17.3	129.709	1.29e-07	8.25e-02	2.86e-05

GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BBYRO-103	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/24/19	Depth: 17.0-19.0 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System JJ, Swell Pressure = 0.0681 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report

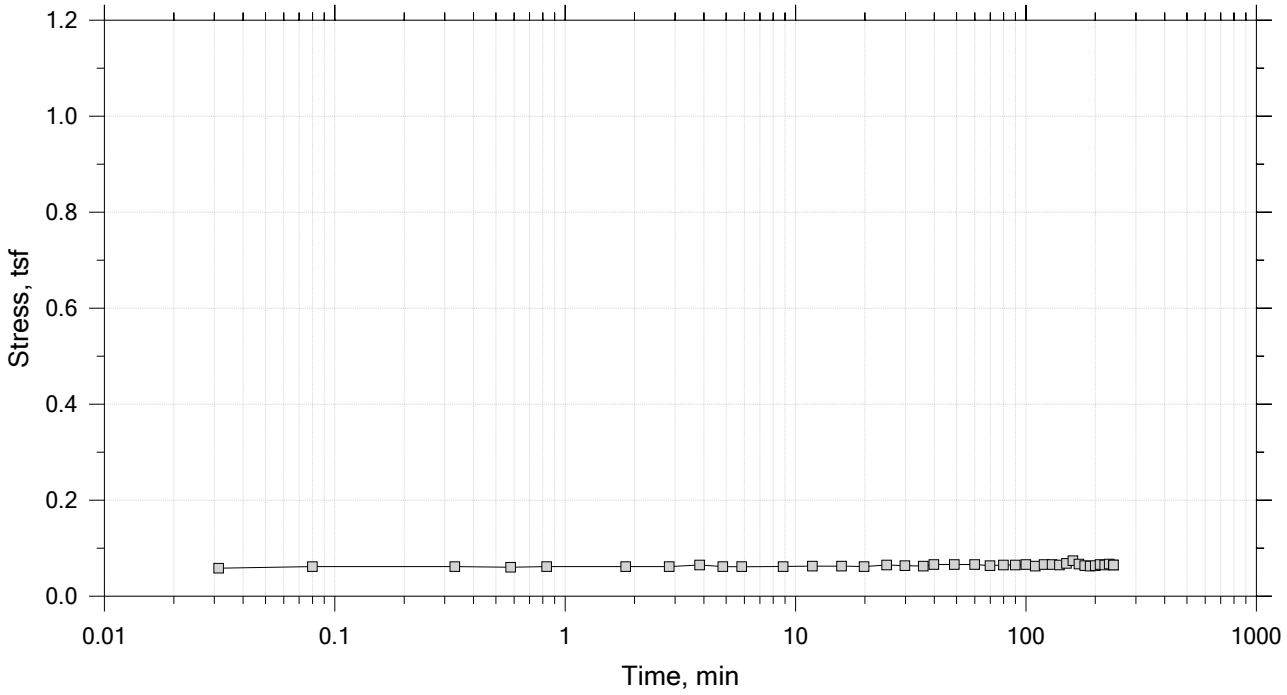


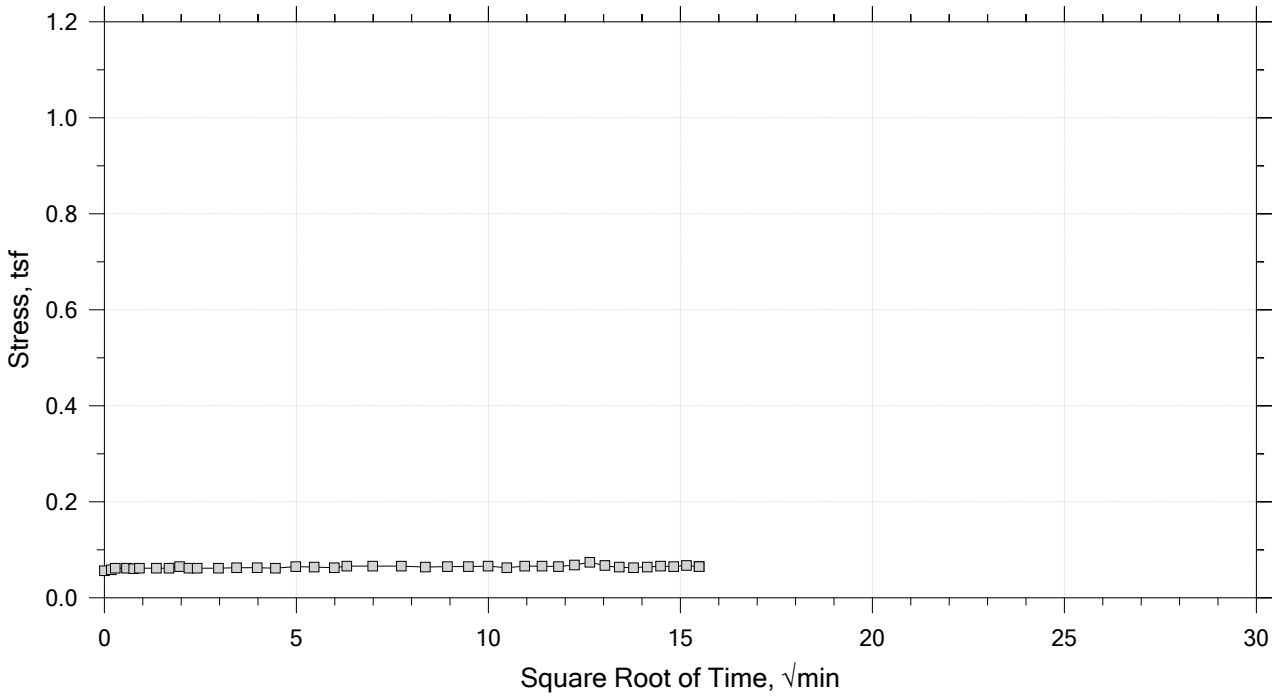


GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 15
Constant Volume Step
Stress: 0.0649 tsf





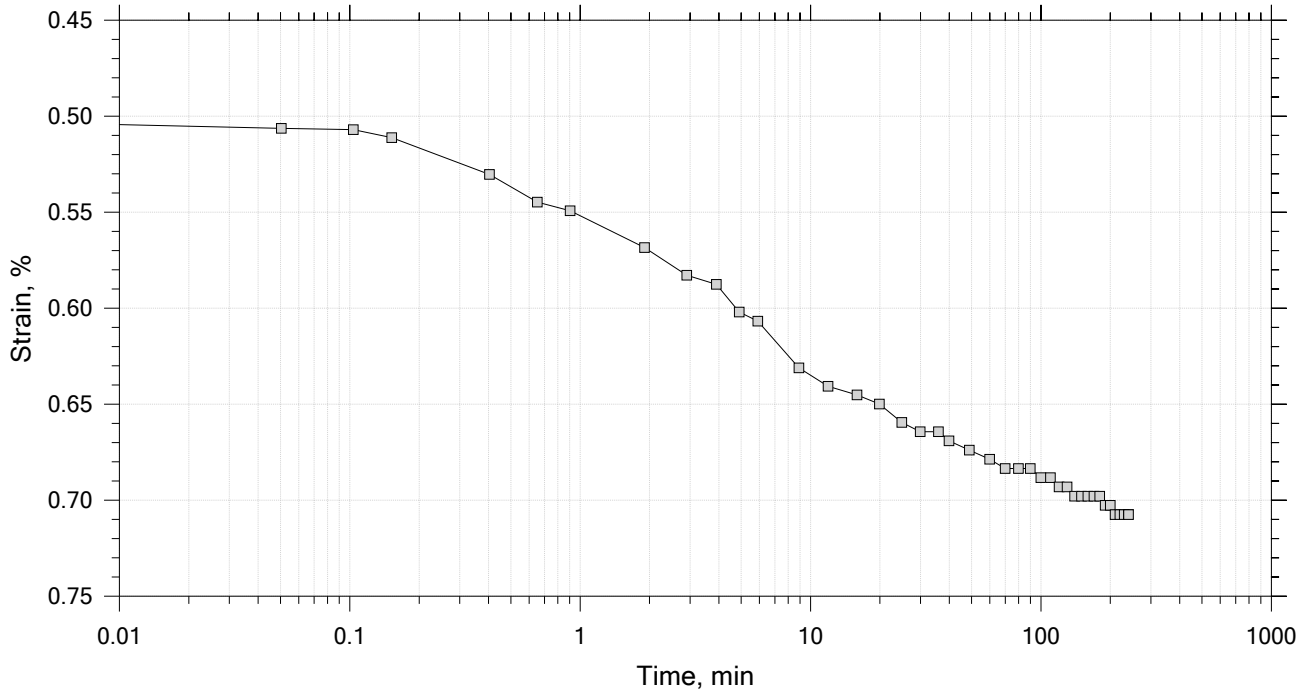
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		

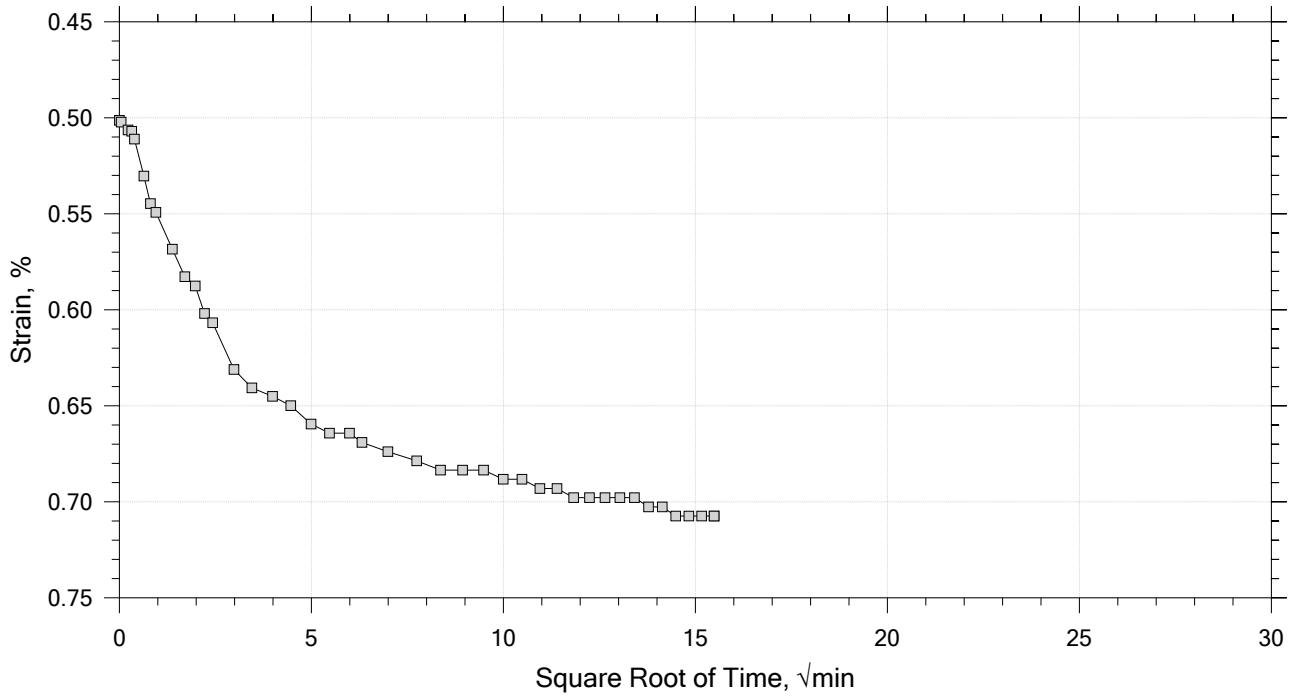
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 15

Constant Load Step

Stress: 0.125 tsf





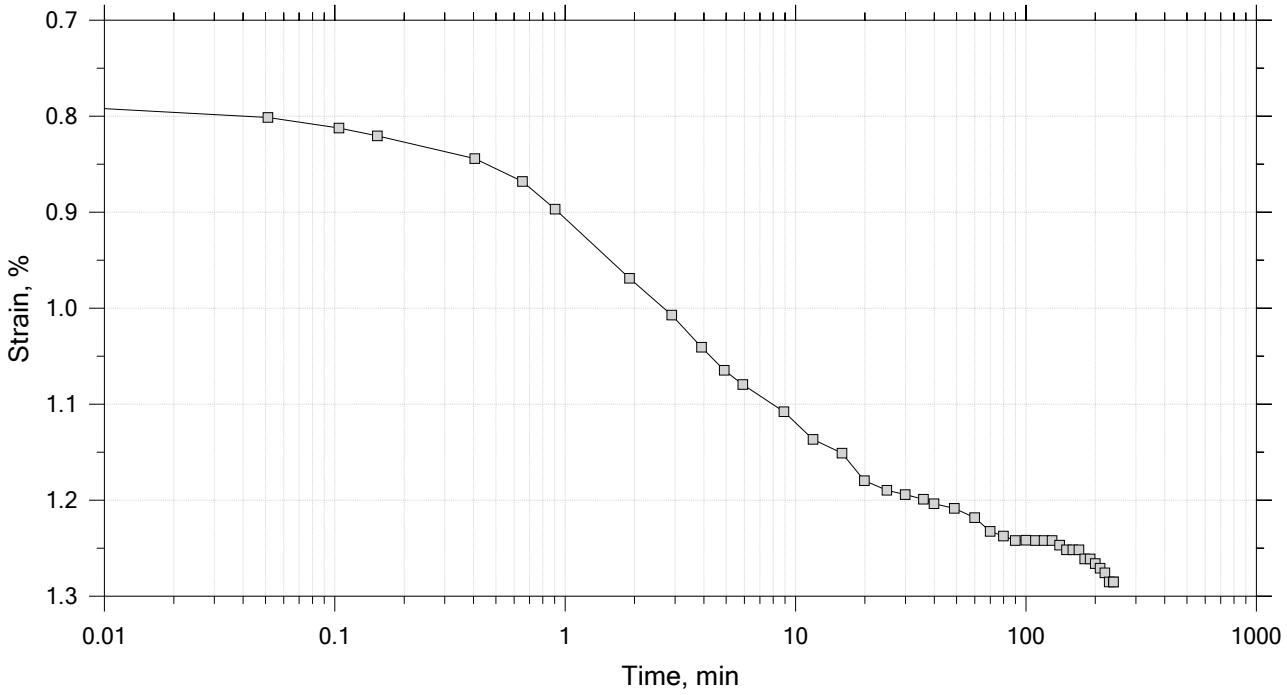
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		

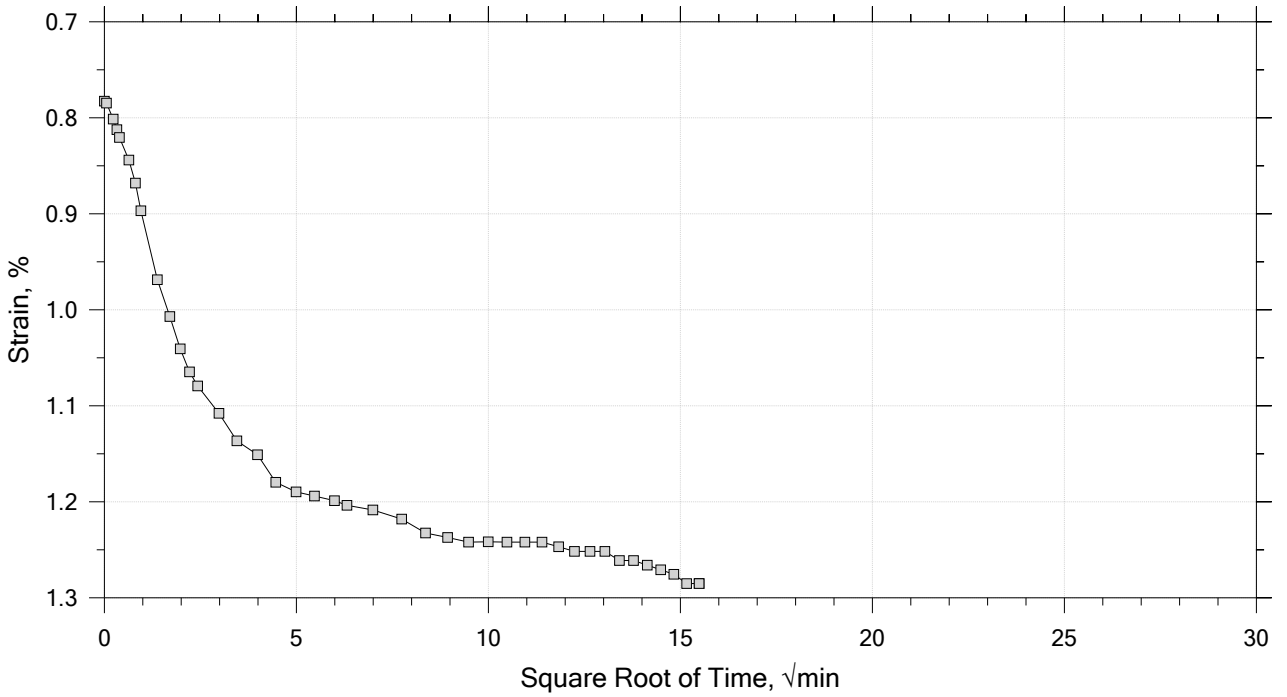
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 15

Constant Load Step

Stress: 0.25 tsf





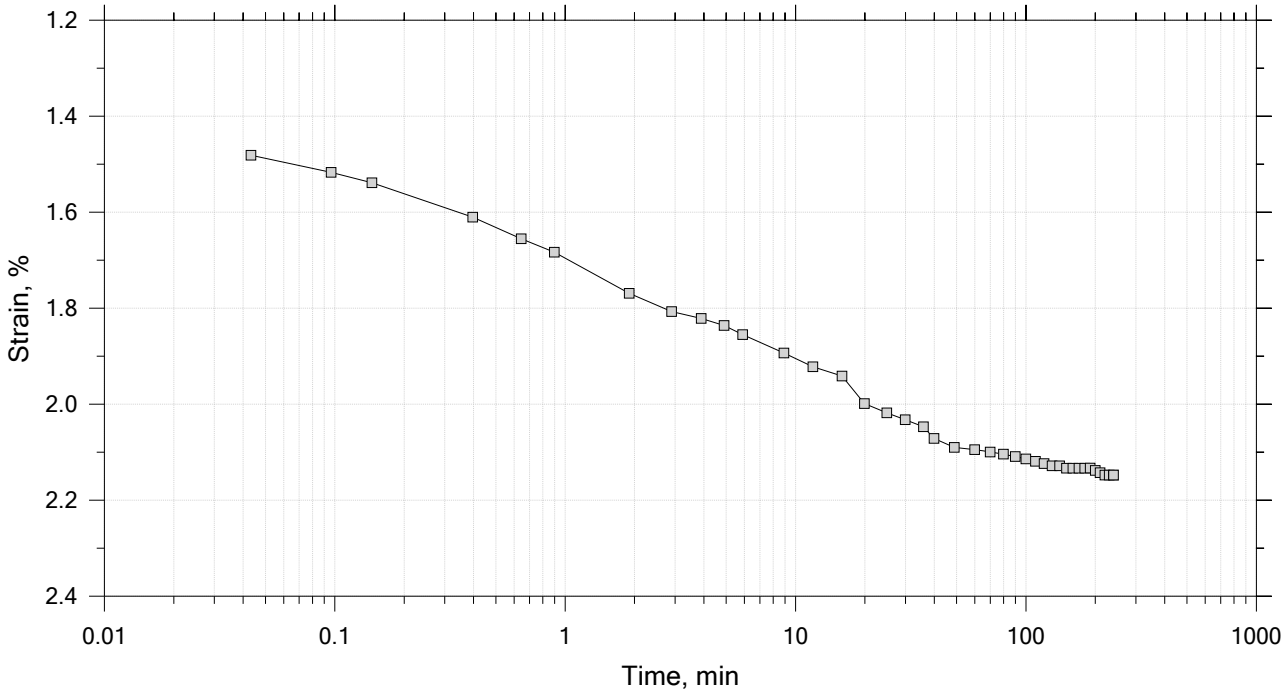
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		

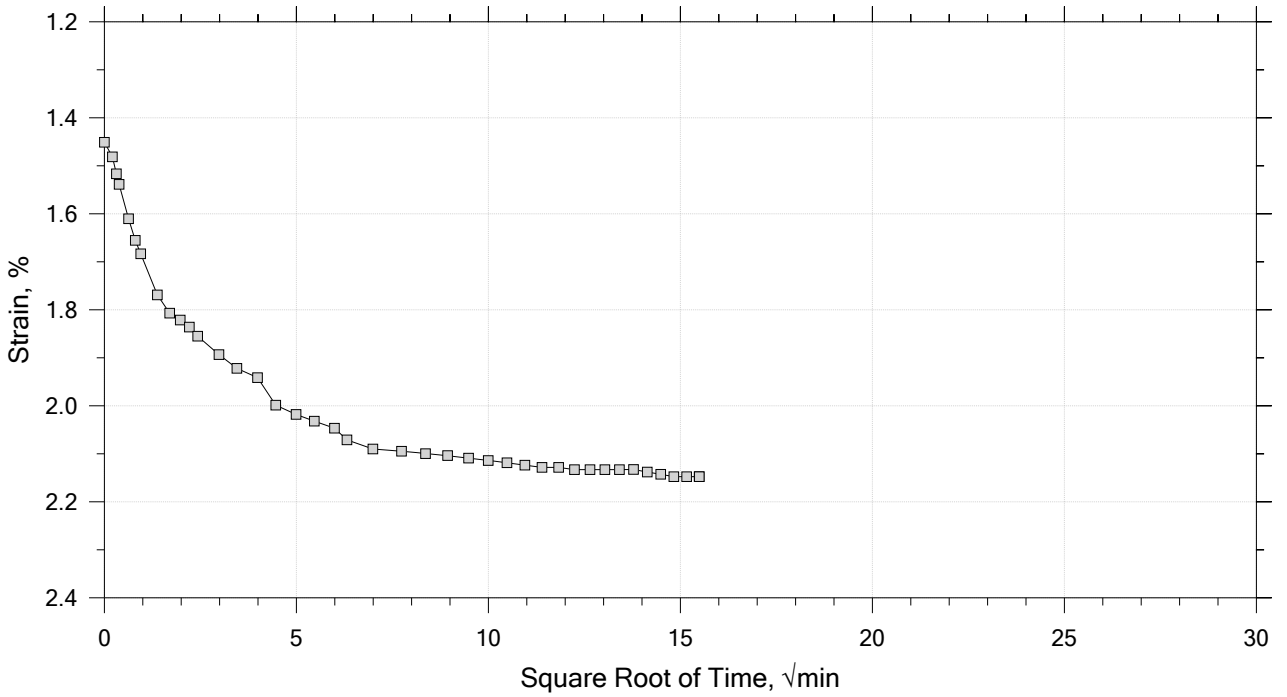
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 15

Constant Load Step

Stress: 0.5 tsf





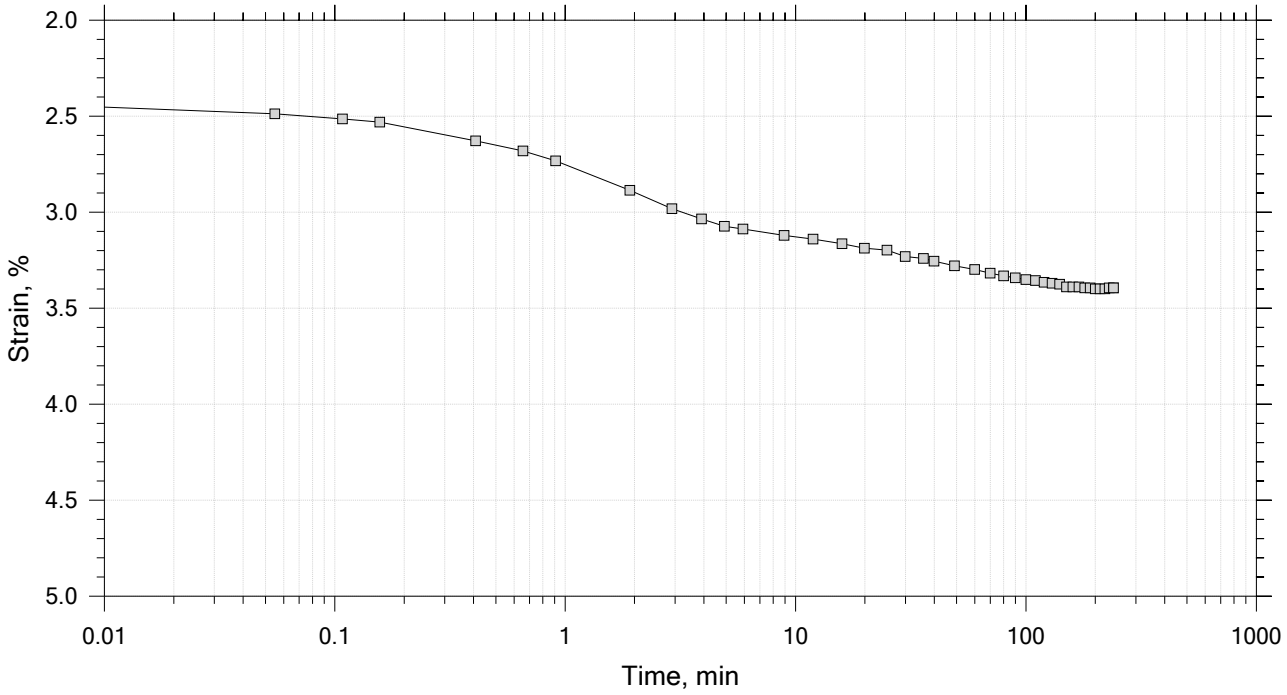
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		

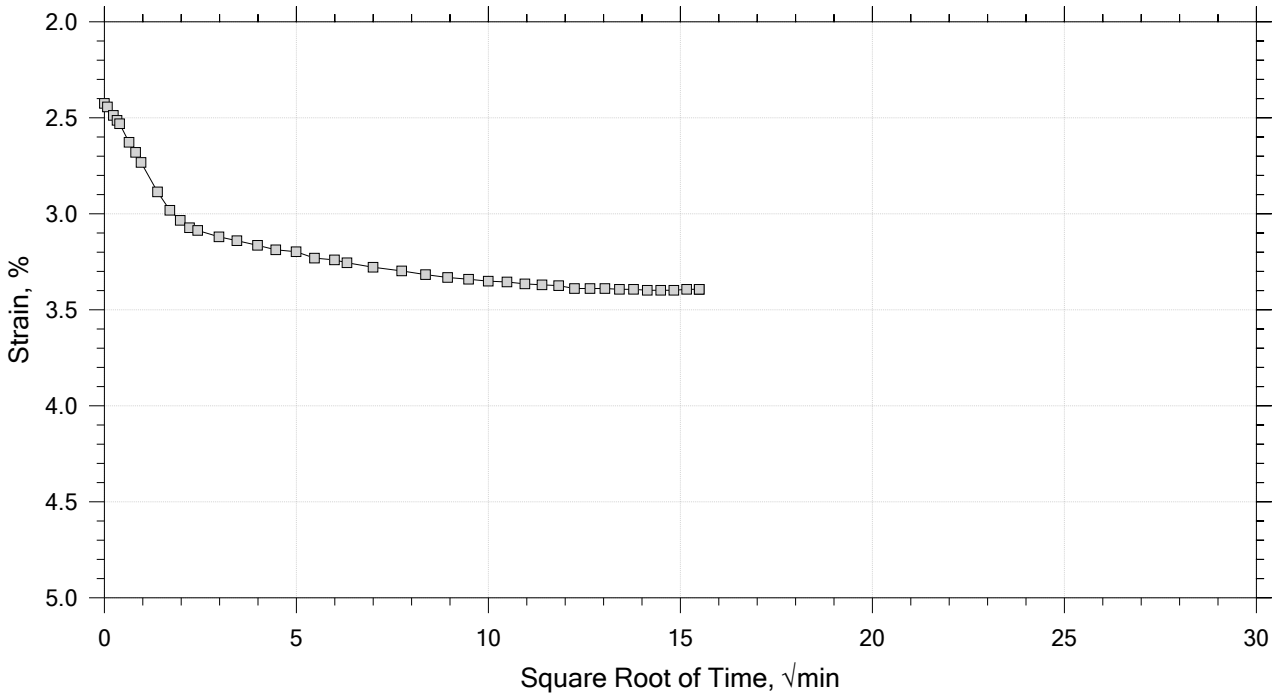
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 15

Constant Load Step

Stress: 1 tsf





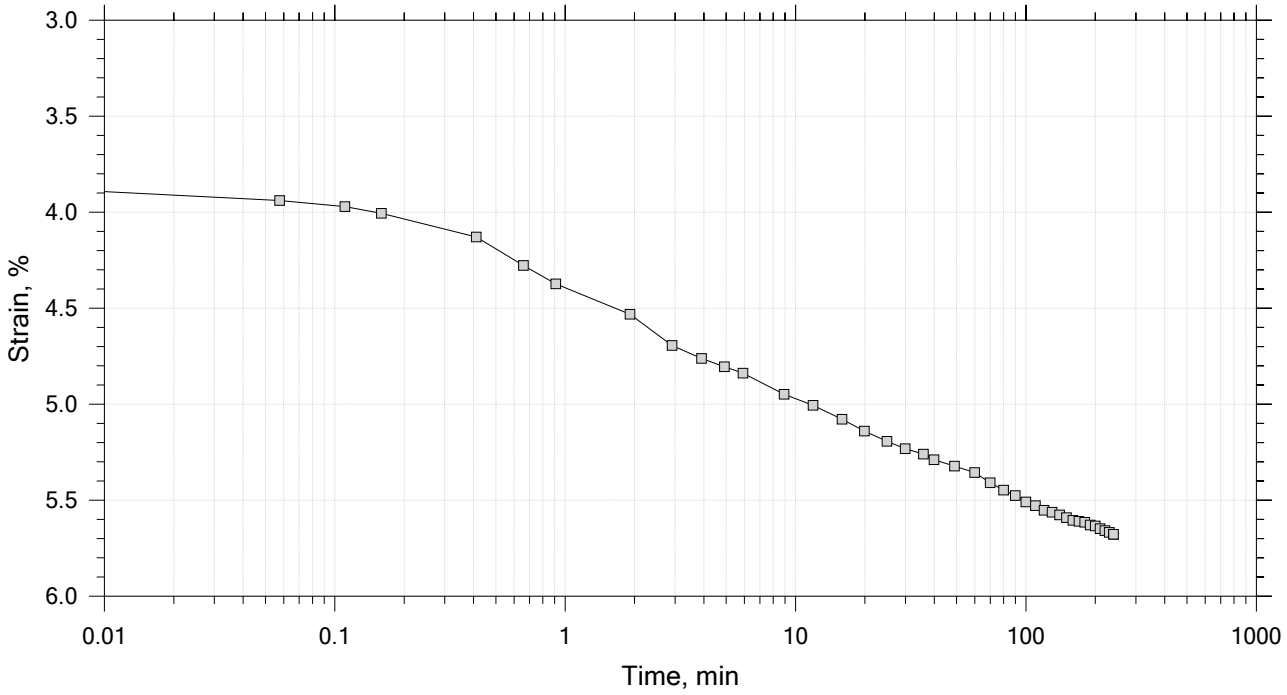
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		

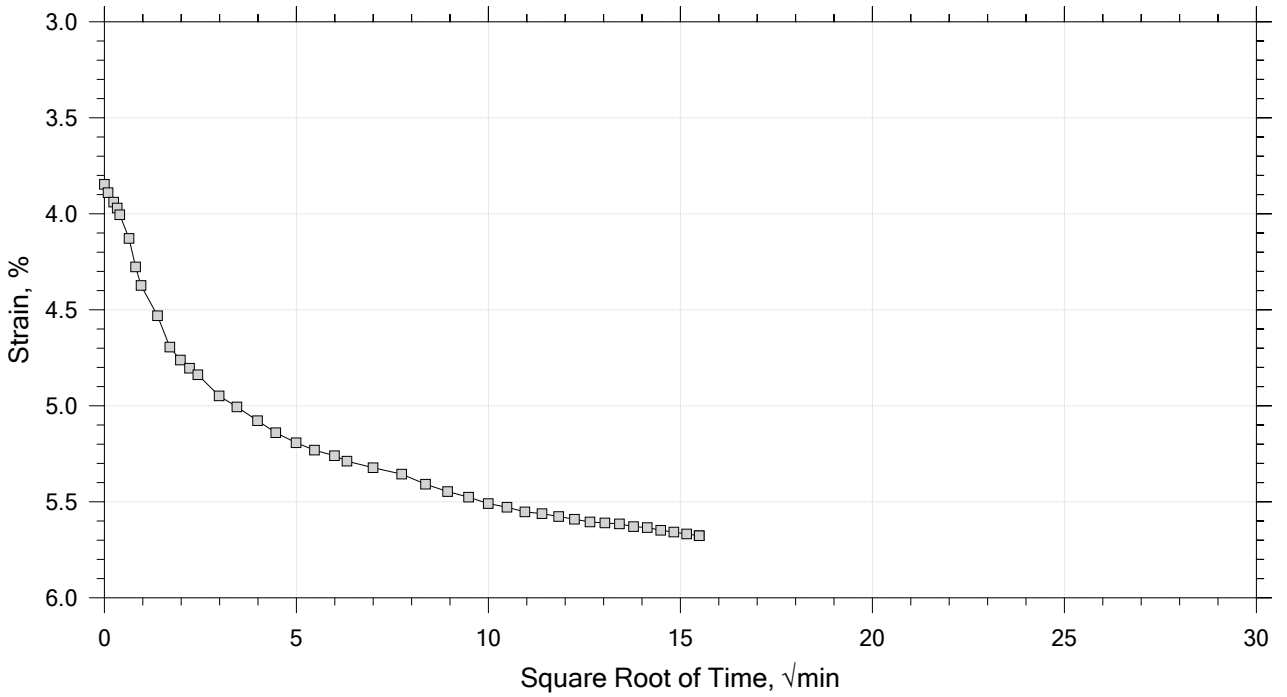
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 15

Constant Load Step

Stress: 2 tsf





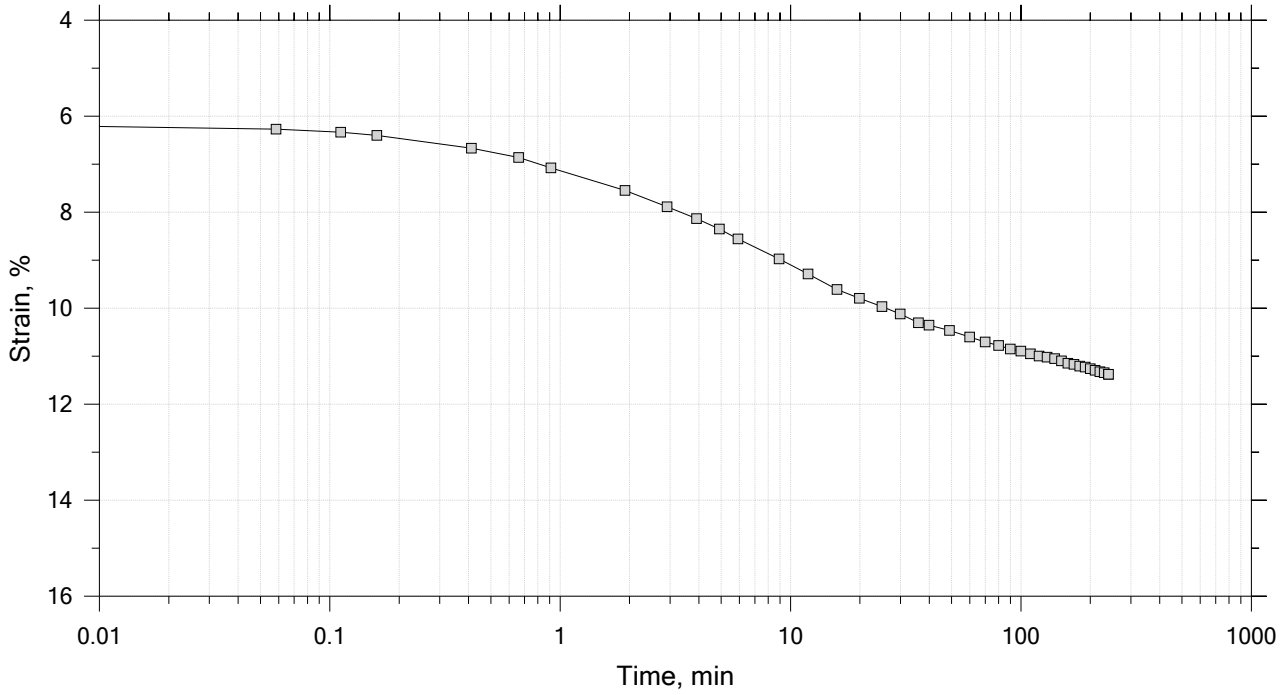
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		

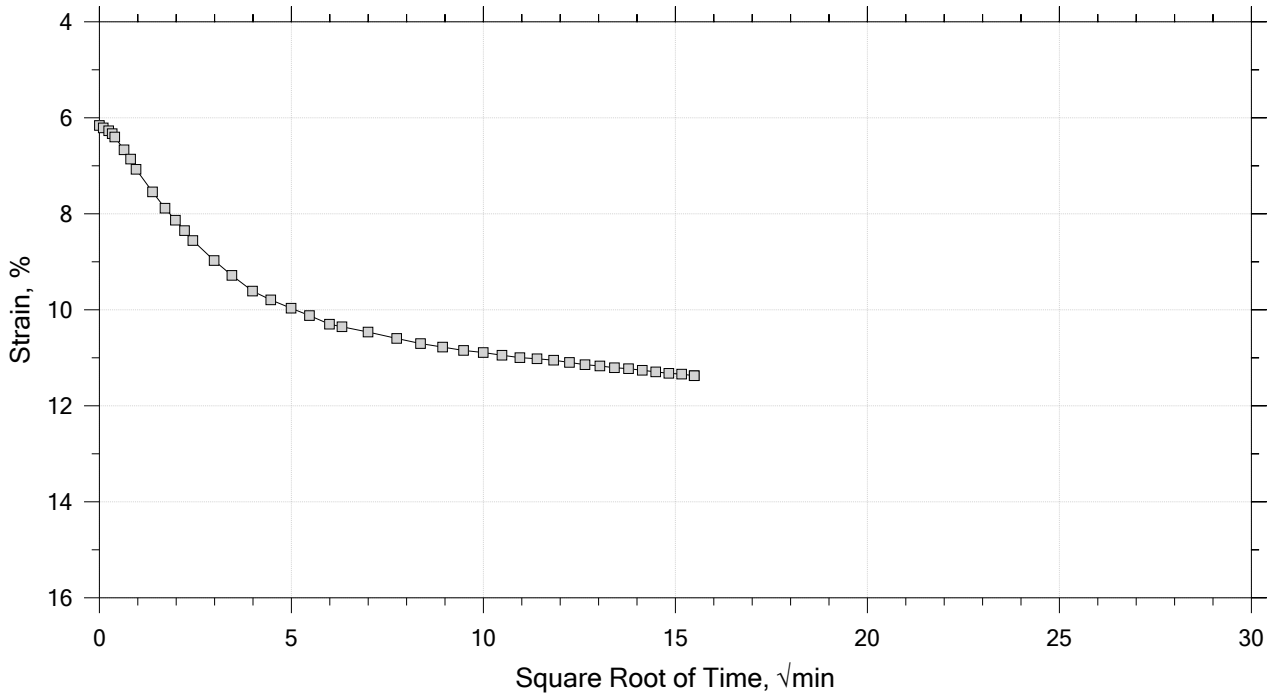
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 15

Constant Load Step

Stress: 4 tsf





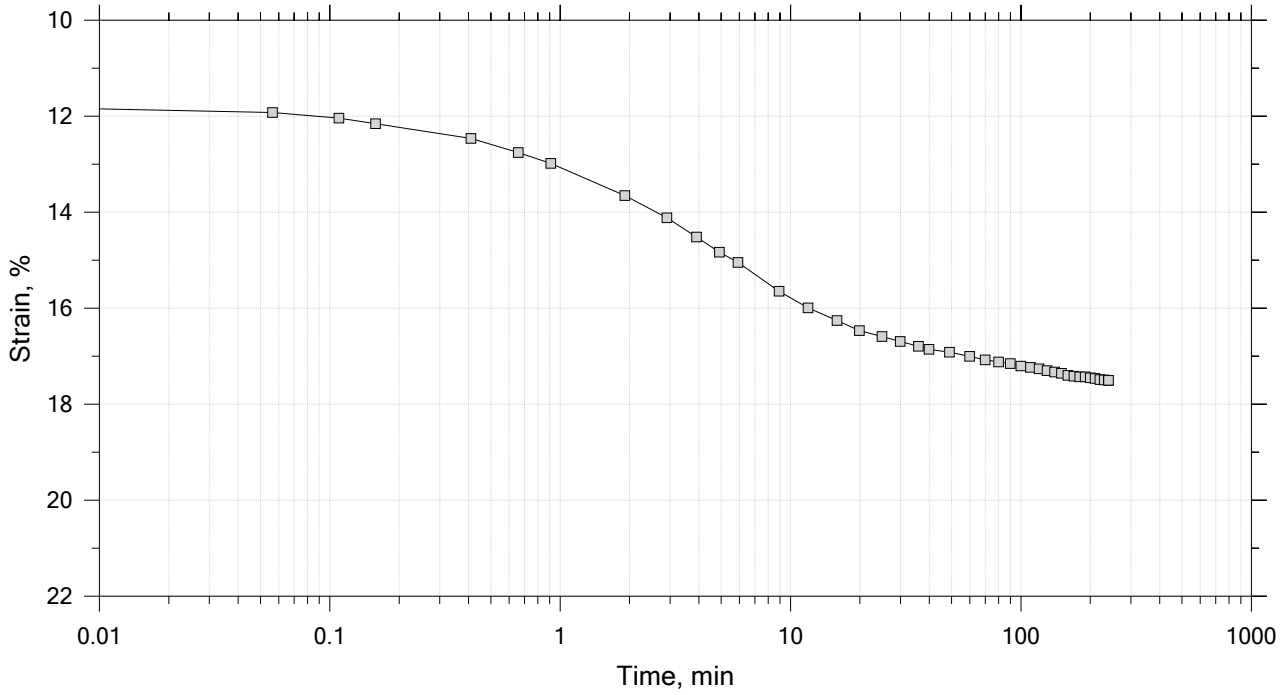
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		

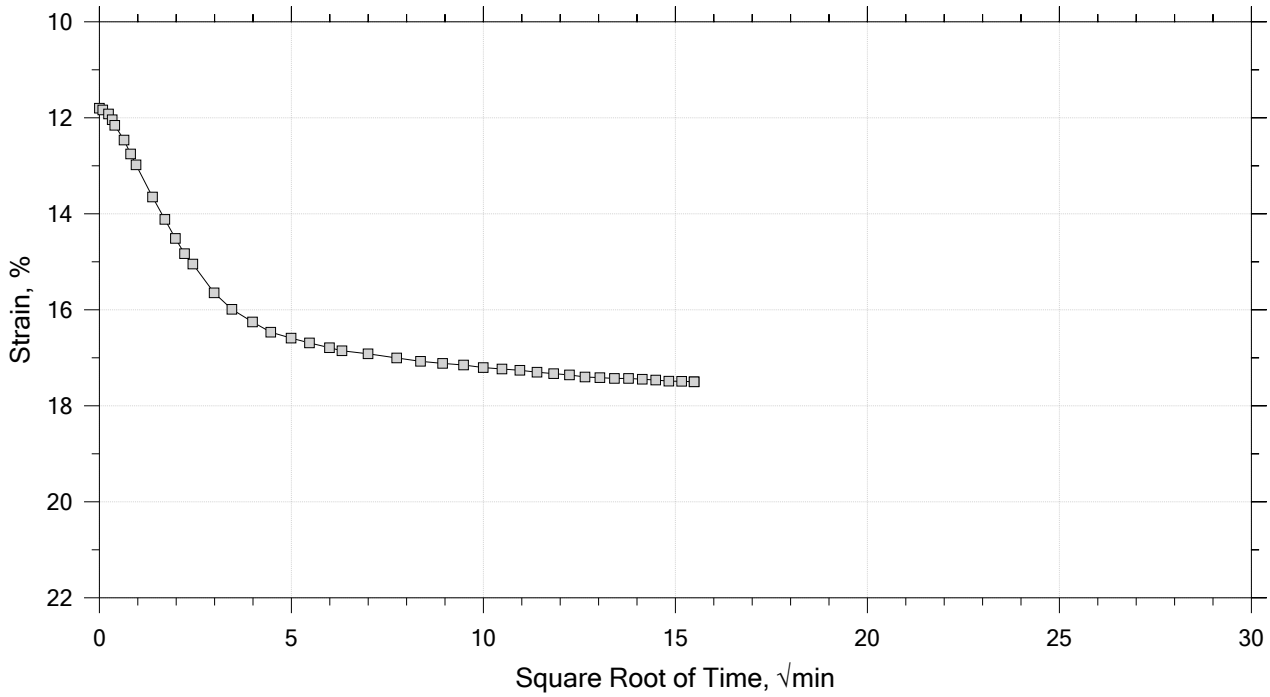
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 15

Constant Load Step

Stress: 8 tsf





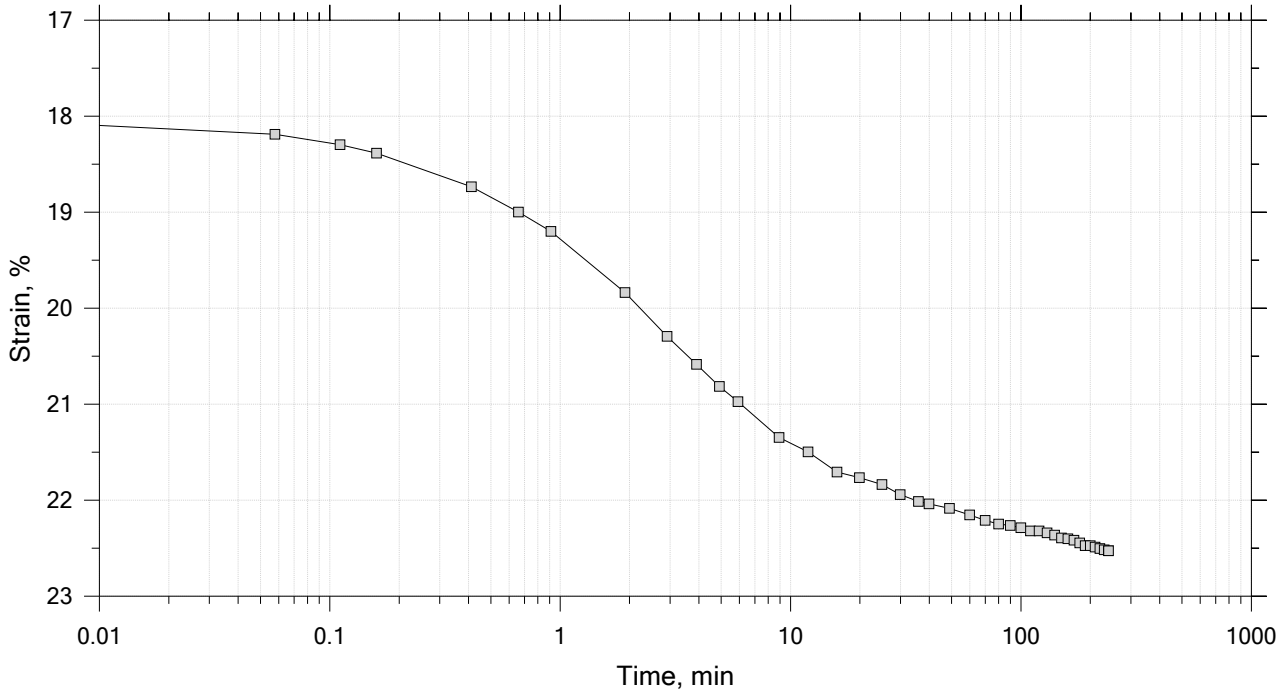
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		

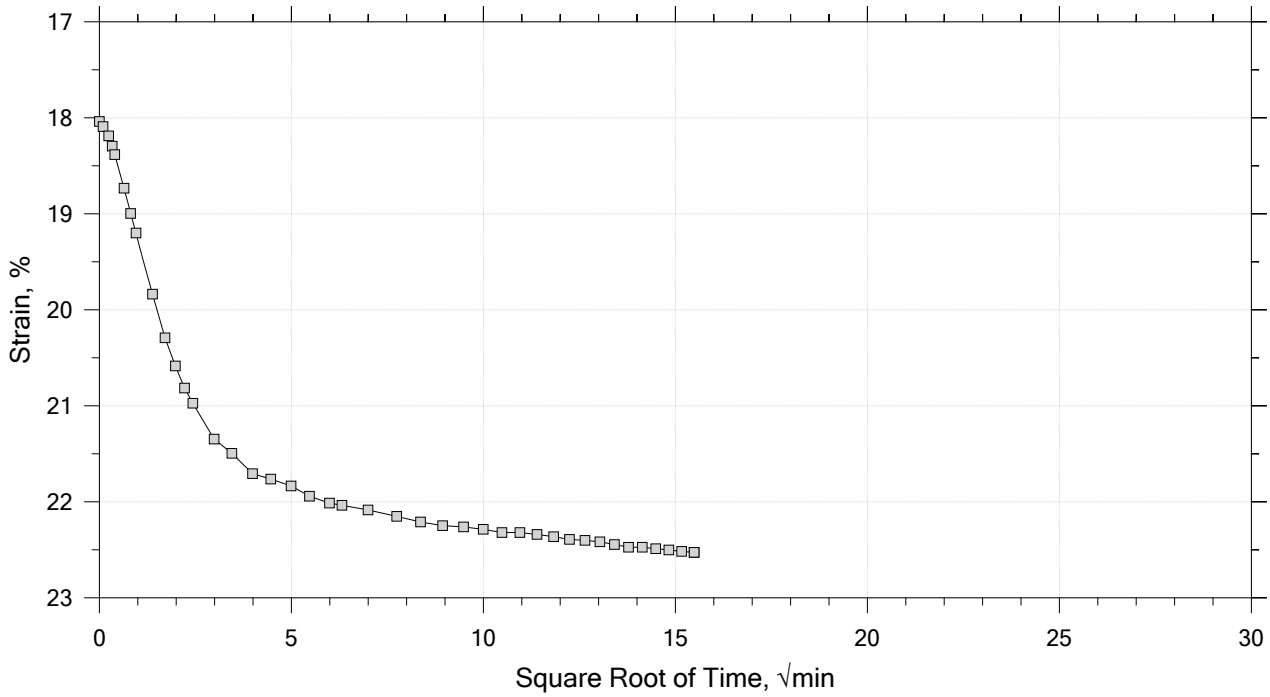
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 15

Constant Load Step

Stress: 16 tsf

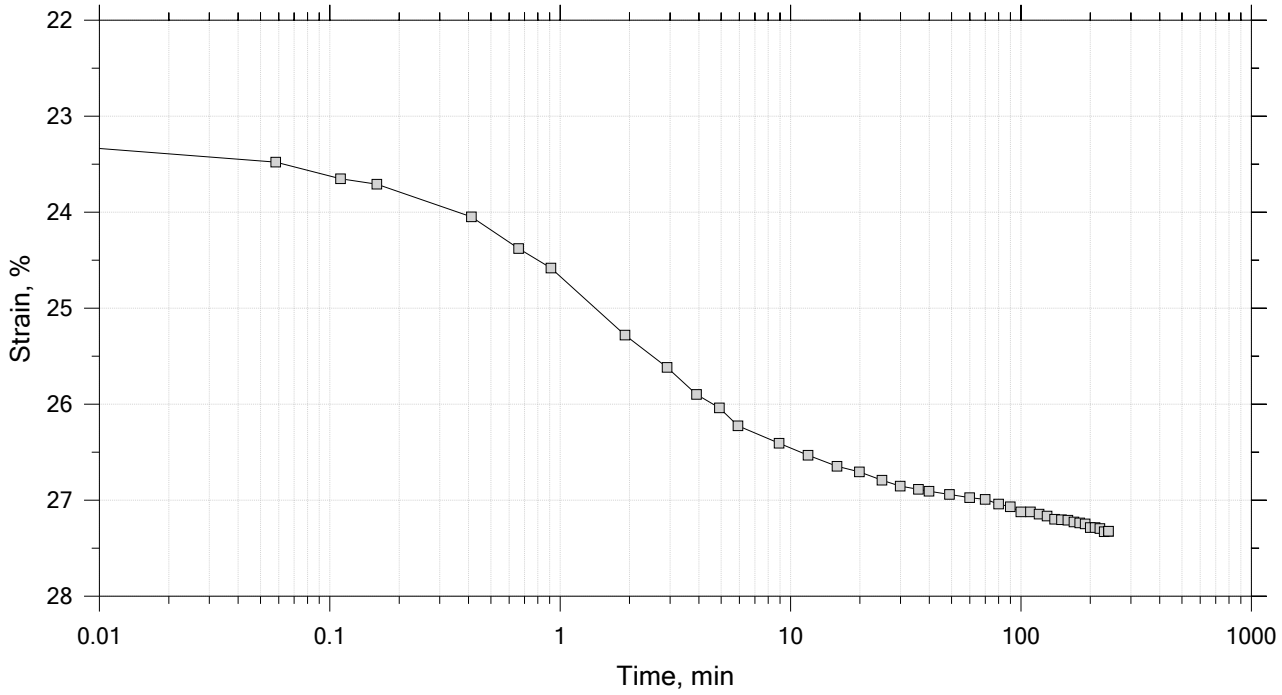


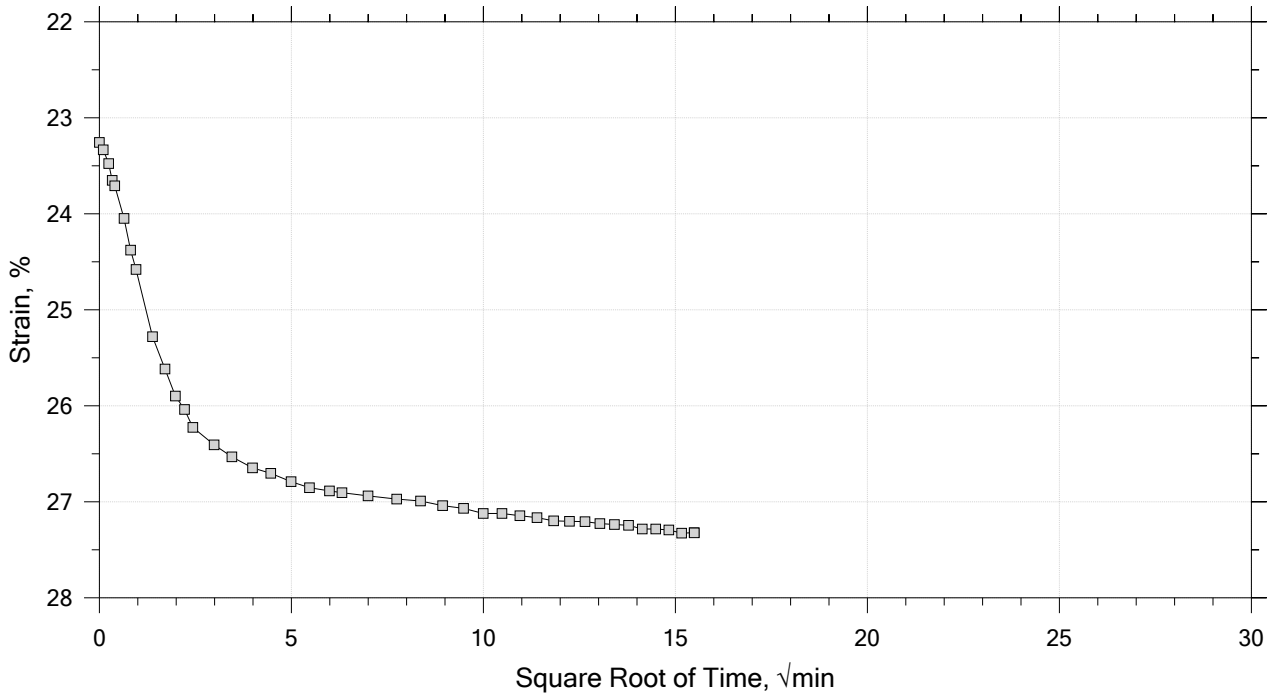


GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 15
Constant Load Step
Stress: 32 tsf

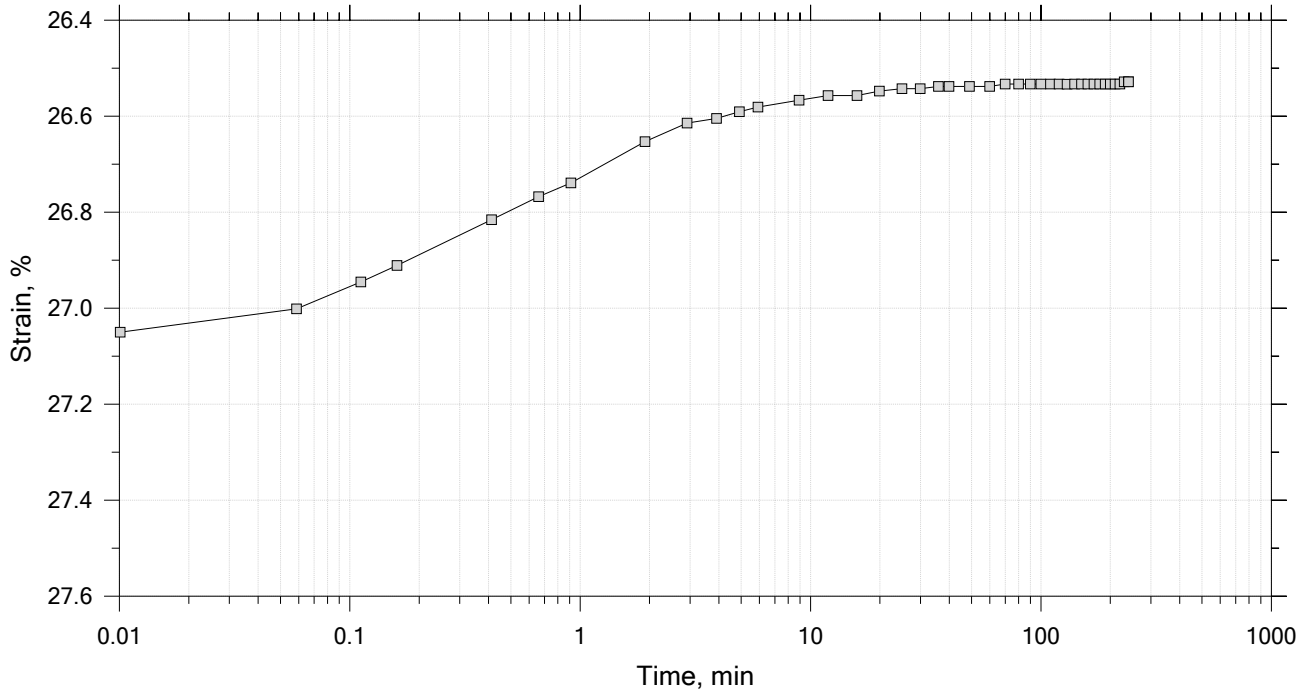


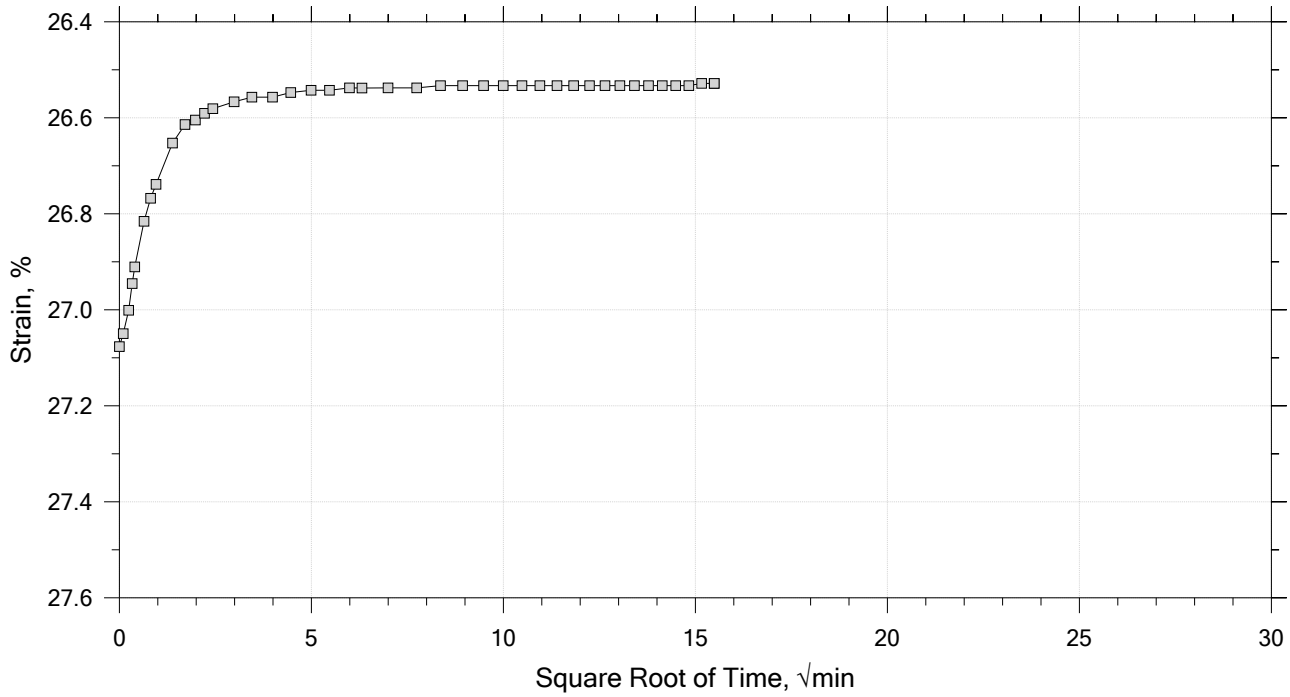


GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 15
Constant Load Step
Stress: 8 tsf





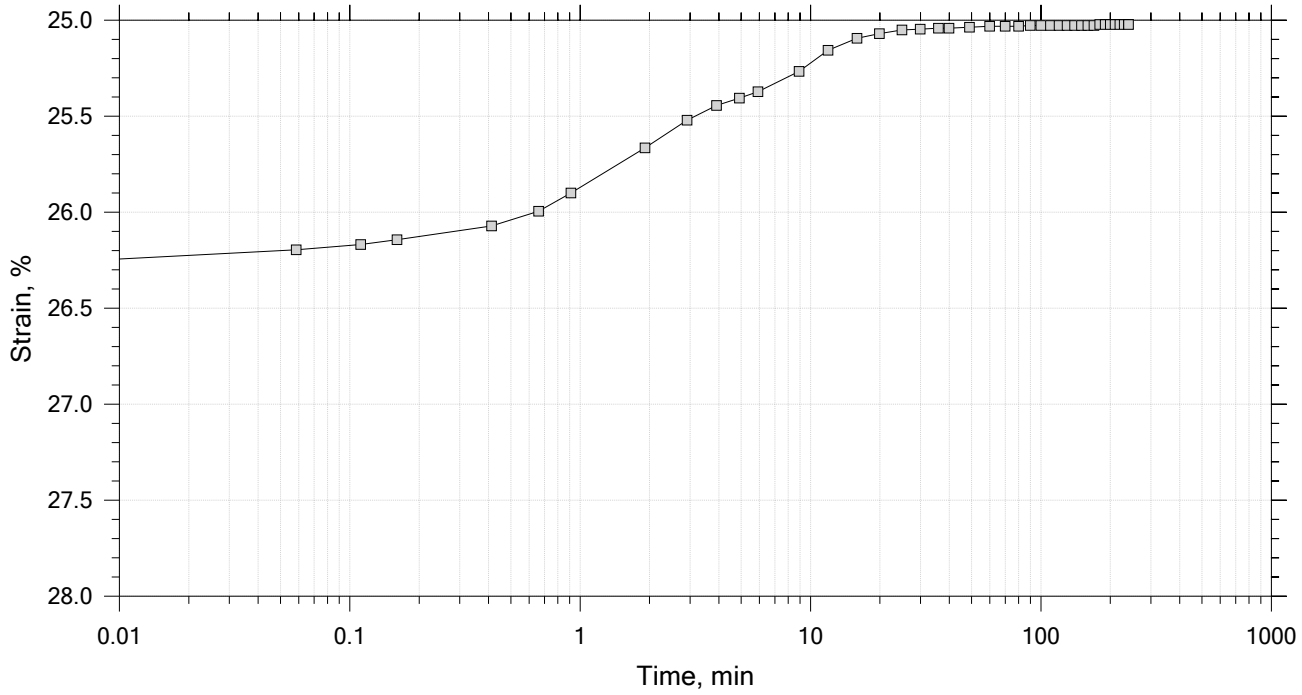
GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		

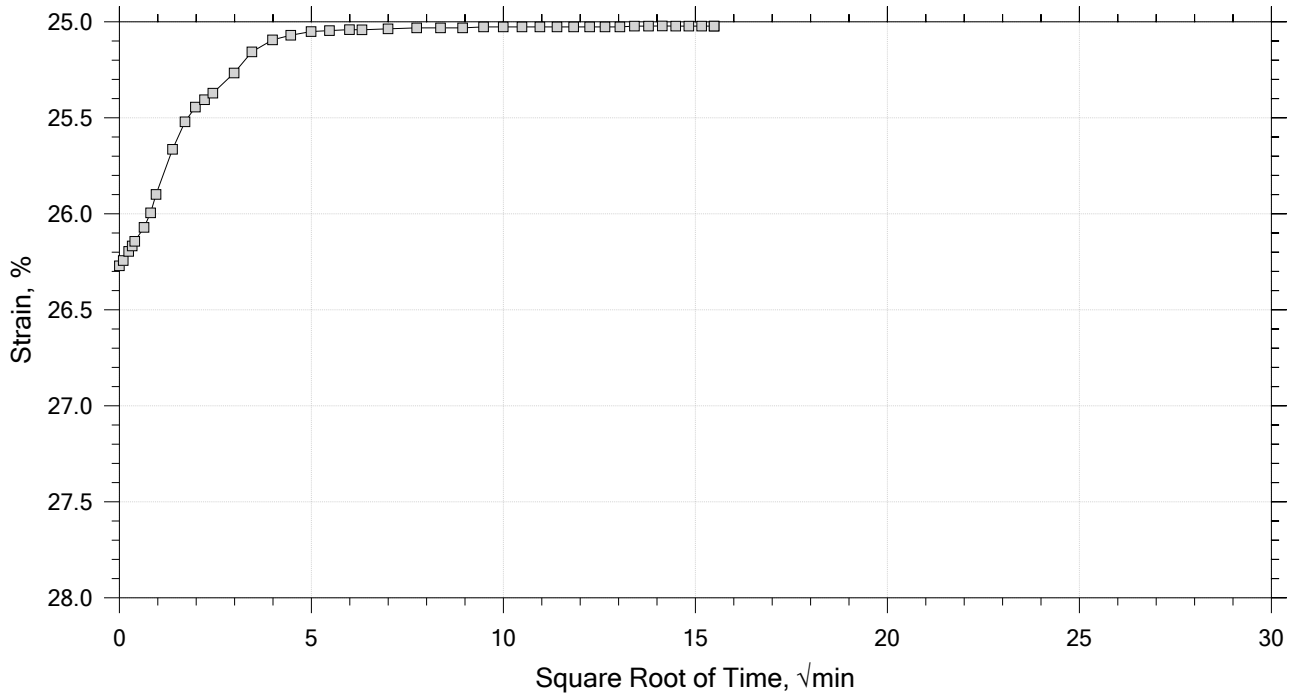
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 15

Constant Load Step

Stress: 2 tsf

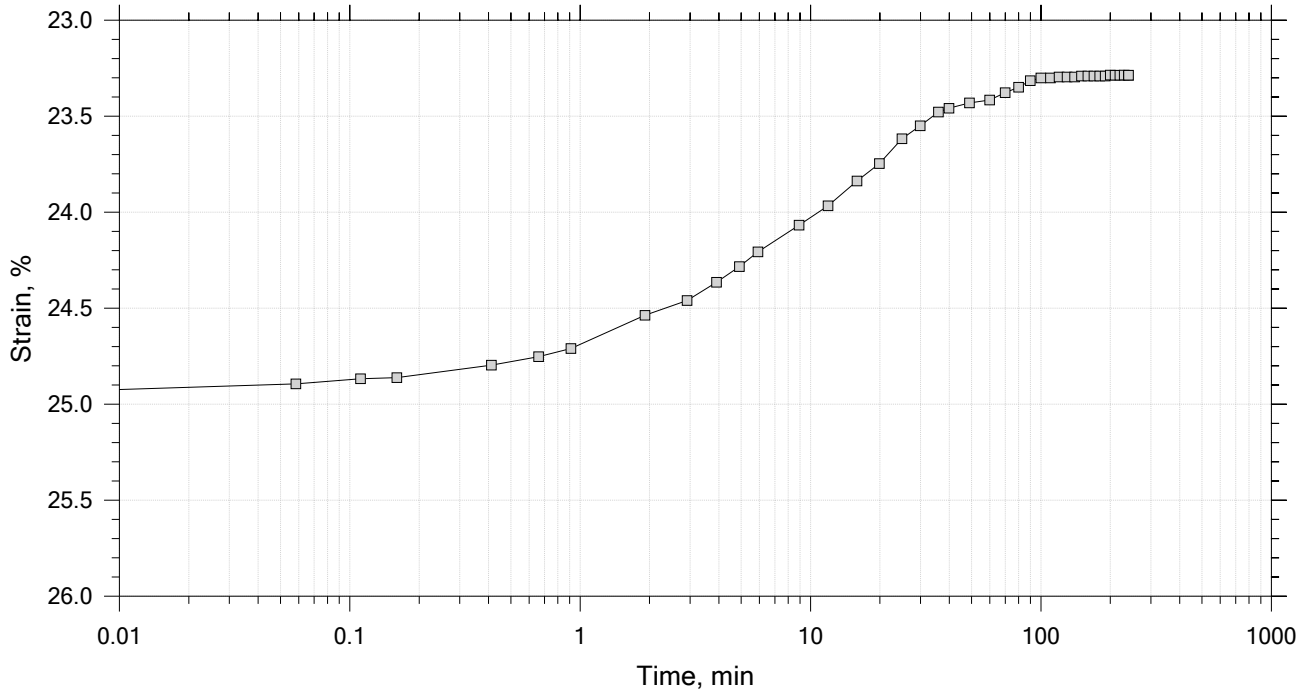


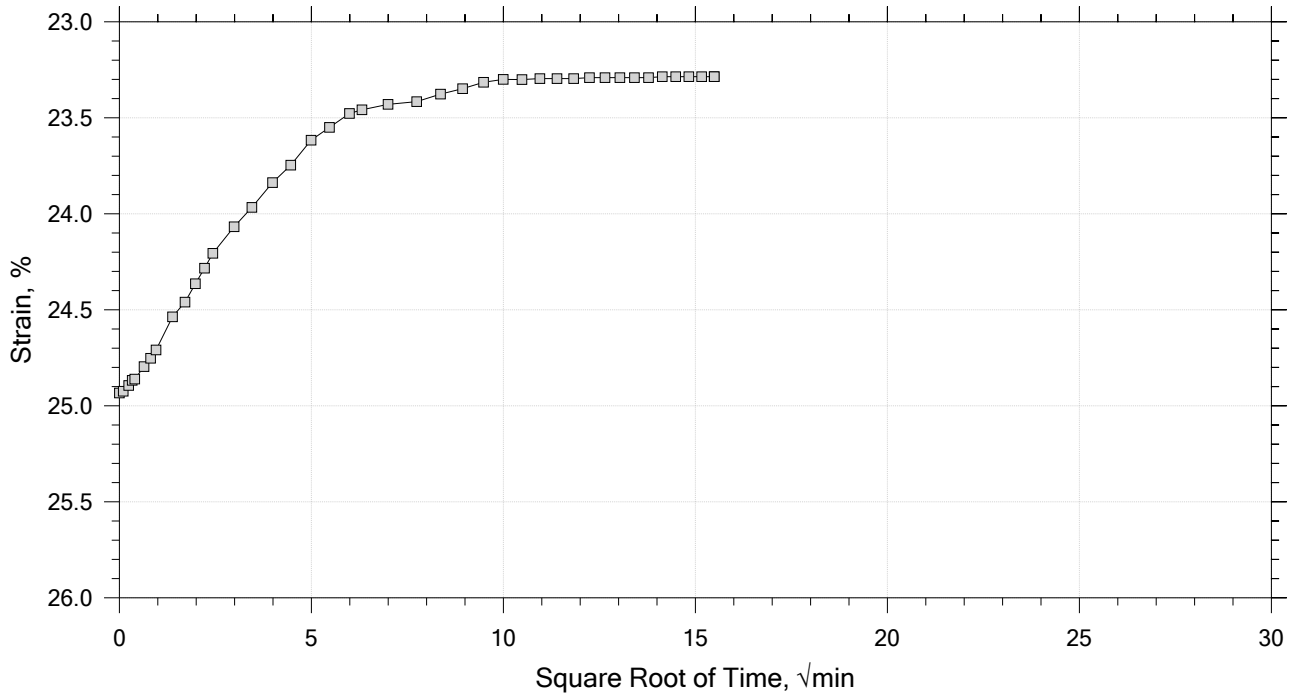


GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 15
Constant Load Step
Stress: 0.5 tsf

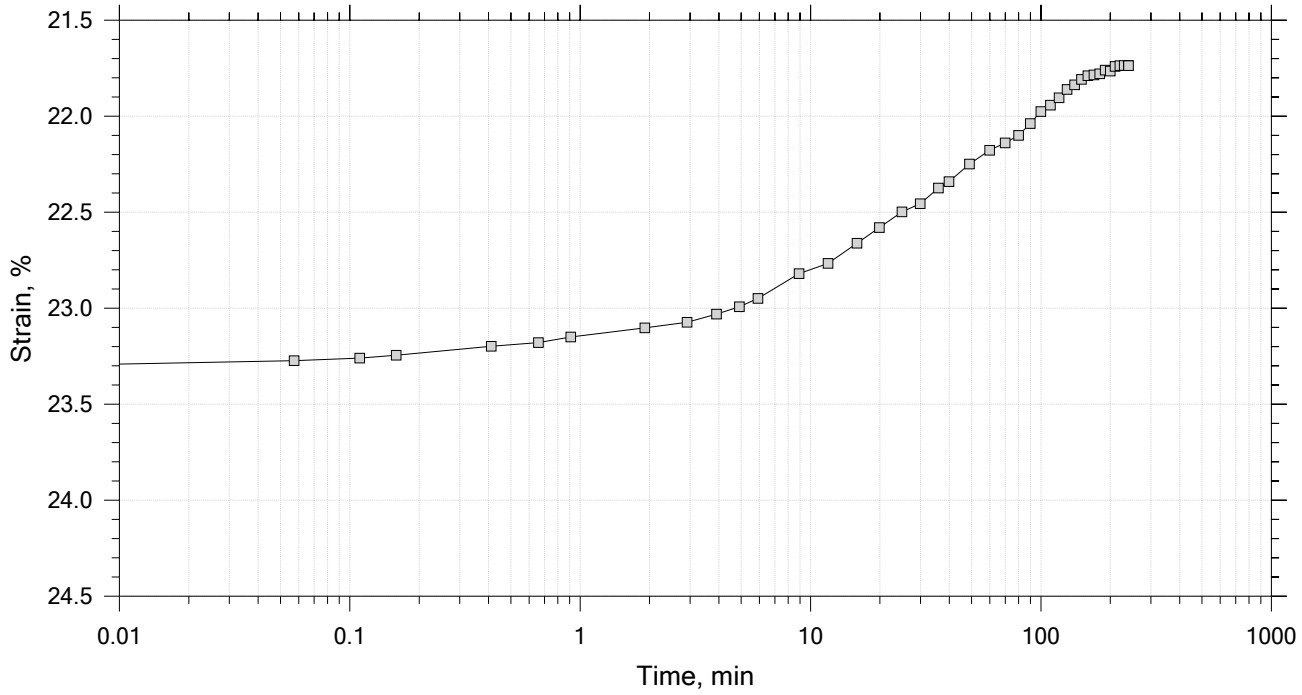


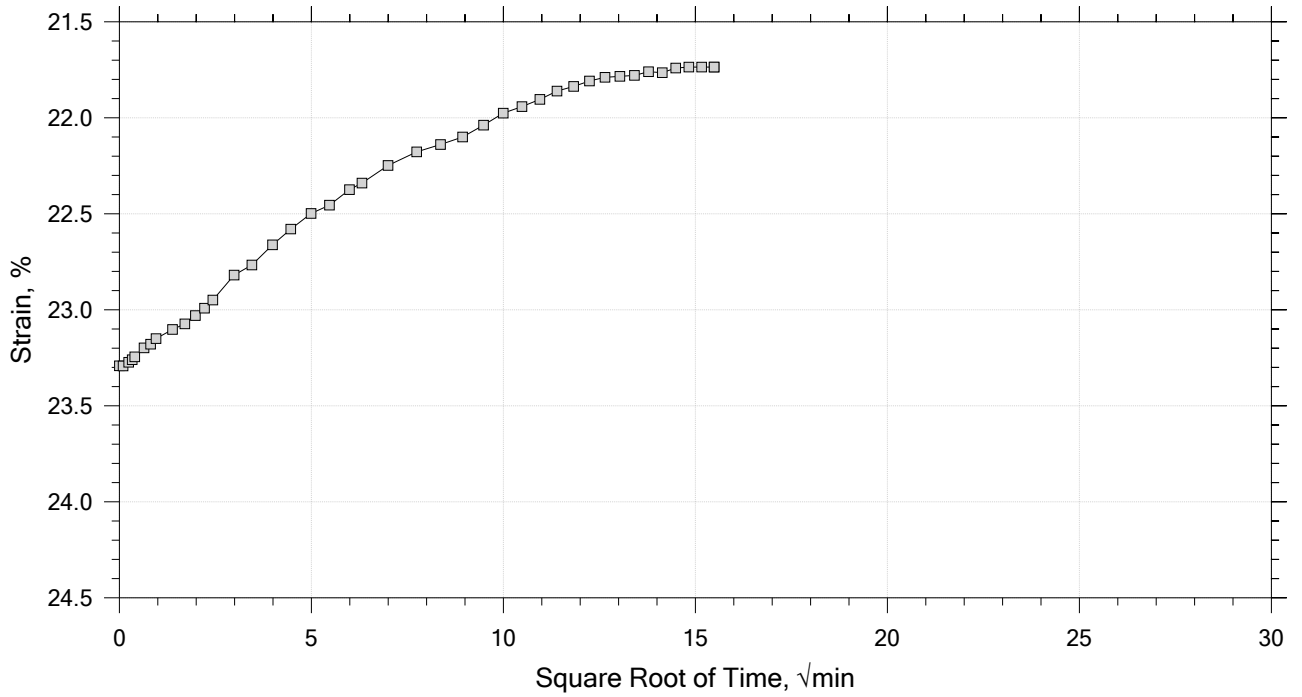


GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 15
Constant Load Step
Stress: 0.125 tsf

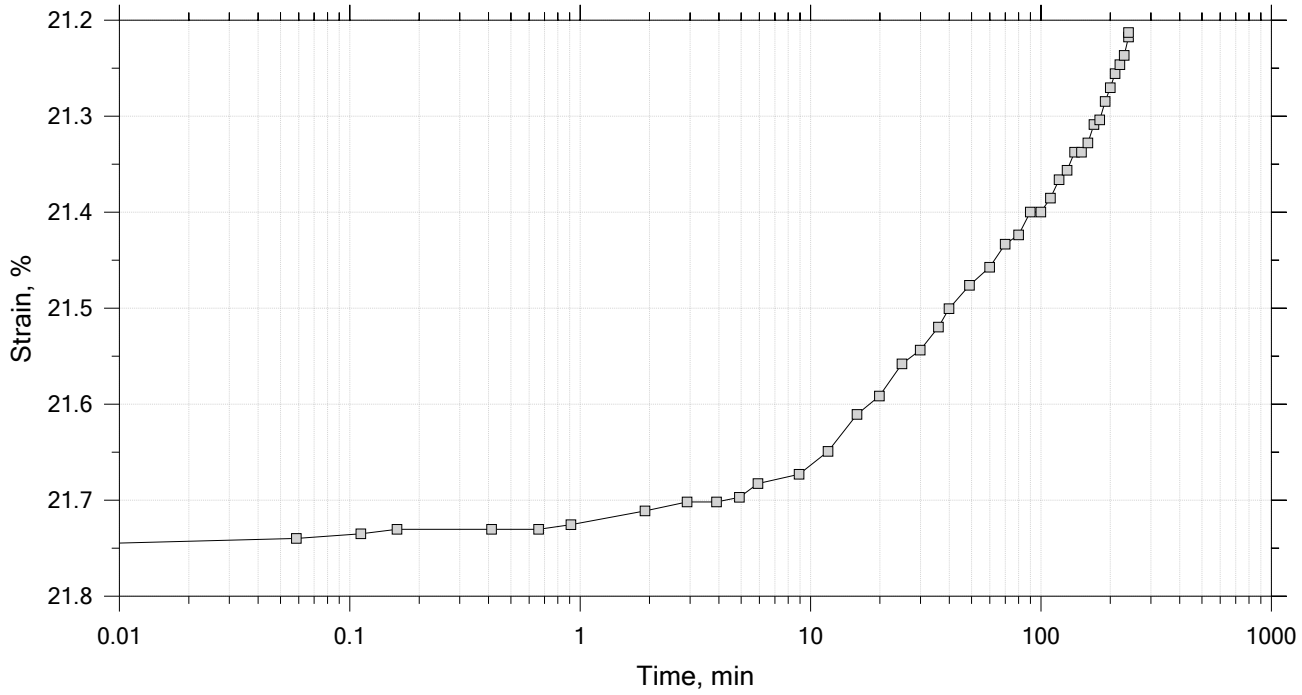


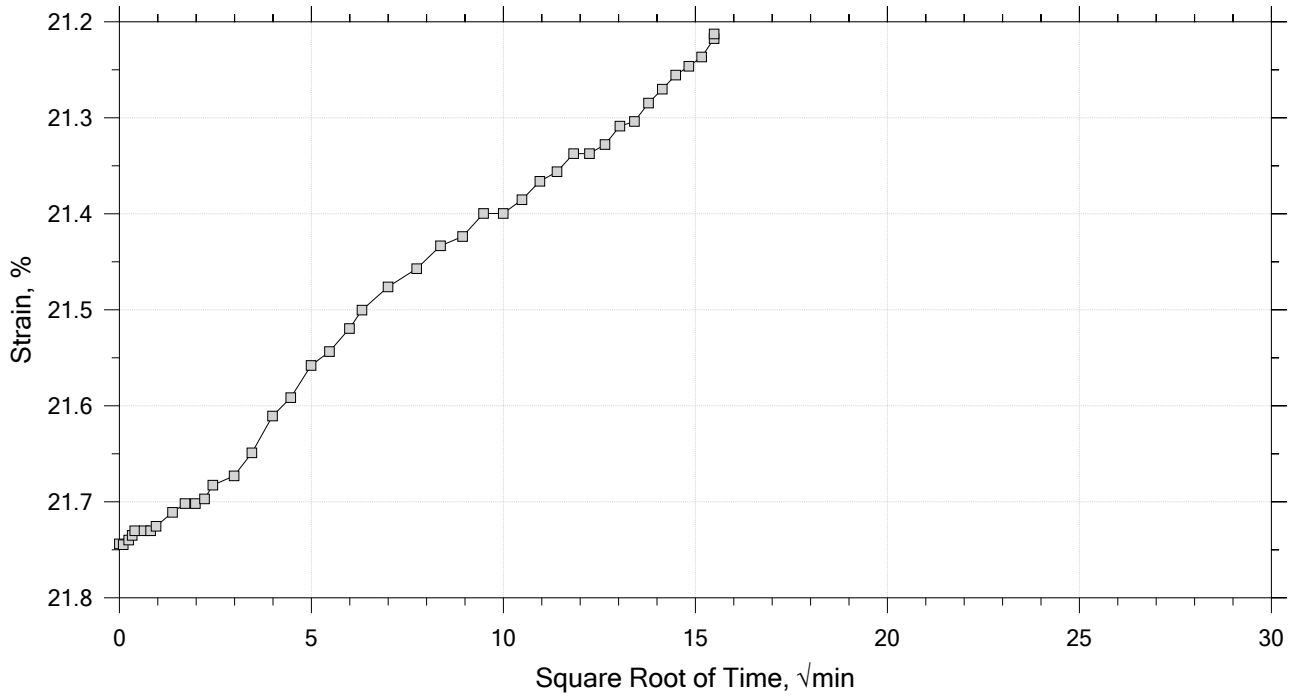


GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 15
Constant Load Step
Stress: 0.0625 tsf





Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: System II, Swell Pressure = 0.0649 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 2.50 in	Estimated Specific Gravity: 2.73	Liquid Limit: 43
Initial Height: 1.00 in	Initial Void Ratio: 1.04	Plastic Limit: 23
Final Height: 0.80 in	Final Void Ratio: 0.635	Plasticity Index: 20

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	B-2498	RING		B-2166
Mass Container, gm	9.42	109.72	109.72	8.36
Mass Container + Wet Soil, gm	299.14	257.53	242	141.09
Mass Container + Dry Soil, gm	213.37	217	217	116
Mass Dry Soil, gm	203.95	107.28	107.28	107.64
Water Content, %	42.05	37.79	23.31	23.31
Void Ratio	---	1.04	0.64	---
Degree of Saturation, %	---	98.64	100.00	---
Dry Unit Weight, pcf	---	83.254	104.07	---

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.

GeoTesting EXPRESS	Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
	Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
	Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System II, Swell Pressure = 0.0649 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Log of Time Coefficients

Step	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/s	Mv 1/tsf	k ft/day	Ca %
1	0.0649	0.004575	1.04	0.458	0.000	0.00e+00	7.05e-02	0.00e+00	0.00e+00
2	0.125	0.007075	1.03	0.707	4.339	1.30e-06	4.16e-02	1.46e-04	0.00e+00
3	0.250	0.01285	1.02	1.29	0.000	0.00e+00	4.62e-02	0.00e+00	0.00e+00
4	0.500	0.02148	1.00	2.15	0.000	0.00e+00	3.45e-02	0.00e+00	0.00e+00
5	1.00	0.03394	0.975	3.39	1.442	3.74e-06	2.49e-02	2.51e-04	0.00e+00
6	2.00	0.05677	0.928	5.68	0.000	0.00e+00	2.28e-02	0.00e+00	0.00e+00
7	4.00	0.1138	0.812	11.4	5.168	9.23e-07	2.85e-02	7.09e-05	0.00e+00
8	8.00	0.1750	0.687	17.5	2.935	1.42e-06	1.53e-02	5.87e-05	0.00e+00
9	16.0	0.2253	0.584	22.5	2.297	1.59e-06	6.28e-03	2.69e-05	0.00e+00
10	32.0	0.2732	0.486	27.3	1.366	2.35e-06	3.00e-03	1.90e-05	0.00e+00
11	8.00	0.2653	0.502	26.5	0.000	0.00e+00	3.31e-04	0.00e+00	0.00e+00
12	2.00	0.2502	0.533	25.0	0.000	0.00e+00	2.51e-03	0.00e+00	0.00e+00
13	0.500	0.2329	0.568	23.3	0.000	0.00e+00	1.16e-02	0.00e+00	0.00e+00
14	0.125	0.2174	0.600	21.7	0.000	0.00e+00	4.13e-02	0.00e+00	0.00e+00
15	0.0625	0.2121	0.611	21.2	0.000	0.00e+00	8.37e-02	0.00e+00	0.00e+00

GeoTesting EXPRESS

Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: System II, Swell Pressure = 0.0649 tsf		
Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Square Root of Time Coefficients

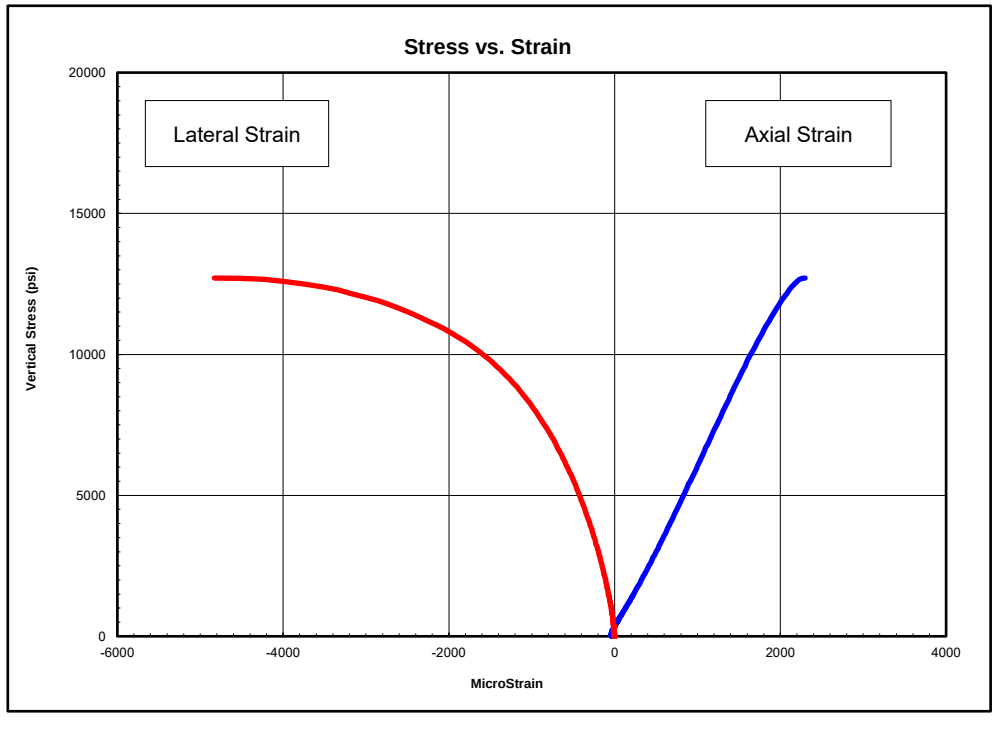
Step	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv ft²/s	Mv 1/tsf	k ft/day
1	0.0649	0.004575	1.04	0.458	29.636	8.24e-07	7.05e-02	1.57e-04
2	0.125	0.007075	1.03	0.707	15.783	1.54e-06	4.16e-02	1.72e-04
3	0.250	0.01285	1.02	1.29	14.520	1.66e-06	4.62e-02	2.06e-04
4	0.500	0.02148	1.00	2.15	25.282	9.38e-07	3.45e-02	8.72e-05
5	1.00	0.03394	0.975	3.39	9.027	2.57e-06	2.49e-02	1.73e-04
6	2.00	0.05677	0.928	5.68	25.935	8.62e-07	2.28e-02	5.31e-05
7	4.00	0.1138	0.812	11.4	20.482	1.00e-06	2.85e-02	7.70e-05
8	8.00	0.1750	0.687	17.5	16.506	1.09e-06	1.53e-02	4.49e-05
9	16.0	0.2253	0.584	22.5	10.922	1.44e-06	6.28e-03	2.43e-05
10	32.0	0.2732	0.486	27.3	7.617	1.82e-06	3.00e-03	1.47e-05
11	8.00	0.2653	0.502	26.5	3.224	4.06e-06	3.31e-04	3.63e-06
12	2.00	0.2502	0.533	25.0	12.404	1.09e-06	2.51e-03	7.38e-06
13	0.500	0.2329	0.568	23.3	36.253	3.89e-07	1.16e-02	1.22e-05
14	0.125	0.2174	0.600	21.7	99.870	1.48e-07	4.13e-02	1.64e-05
15	0.0625	0.2121	0.611	21.2	0.000	0.00e+00	8.37e-02	0.00e+00

GeoTesting EXPRESS

Project: I-295 Exit 17 Bridge	Location: Yarmouth, ME	Project No.: GTX-311099
Boring No.: BB-YRO-105	Tested By: md	Checked By: anm
Sample No.: 1U	Test Date: 12/21/19	Depth: 18.0-20.0 ft
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: System II, Swell Pressure = 0.0649 tsf		
Displacement at End of Increment		

Client:	Haley & Aldrich, Inc.
Project Name:	I-295 Exit 17 Bridge
Project Location:	Yarmouth, ME
GTX #:	311099
Test Date:	12/31/2019
Tested By:	jck
Checked By:	jsc
Boring ID:	BB-YRO-102
Sample ID:	R1
Depth, ft:	27.60-27.97
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: 12,709 psi

The strain values recorded for this test produce values of Poisson's Ratio that exceed maximum values found in rocks.

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
1300-4700	5,690,000	---
4700-8000	6,250,000	---
8000-11400	5,810,000	---

Notes:
Test specimen tested at the approximate as-received moisture content and at standard laboratory temperature.
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:	Haley & Aldrich, Inc.	Test Date:	12/20/2019
Project Name:	I-295 Exit 17 Bridge	Tested By:	jck
Project Location:	Yarmouth, ME	Checked By:	smd
GTX #:	311099		
Boring ID:	BB-YRO-102		
Sample ID:	R1		
Depth:	27.60-27.97 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:	4.56	4.56	4.56
Specimen Diameter, in:	2.00	1.99	2.00
Specimen Mass, g:	635.35		
Bulk Density, lb/ft^3	169	**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.? NO

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? **NO**

END FLATNESS AND PARALLELISM (Procedure FP1)

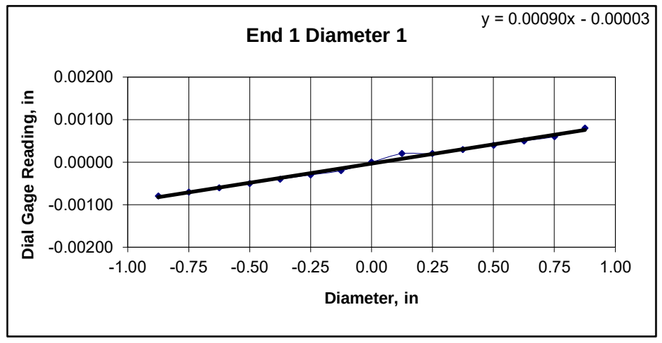
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00080	-0.00070	-0.00060	-0.00050	-0.00040	-0.00030	-0.00020	0.00000	0.00020	0.00020	0.00030	0.00040	0.00050	0.00060	0.00080
Diameter 2, in (rotated 90°)	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010

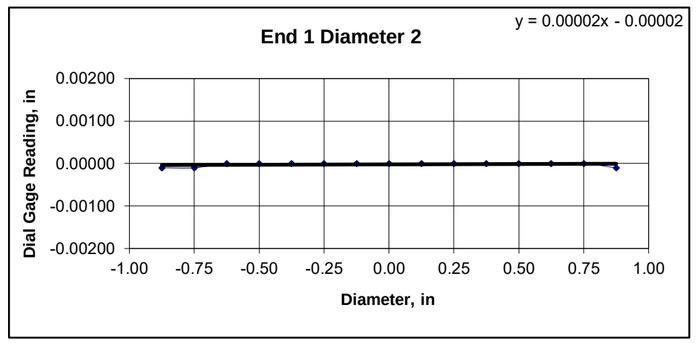
Difference between max and min readings, in:
0° = 0.00160 90° = 0.00010

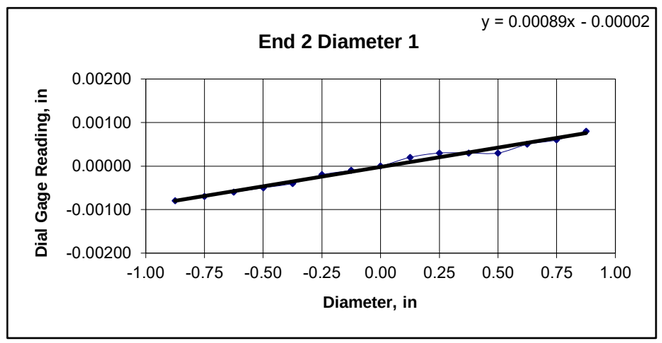
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00080	-0.00070	-0.00060	-0.00050	-0.00040	-0.00020	-0.00010	0.00000	0.00020	0.00030	0.00030	0.00030	0.00050	0.00060	0.00080
Diameter 2, in (rotated 90°)	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

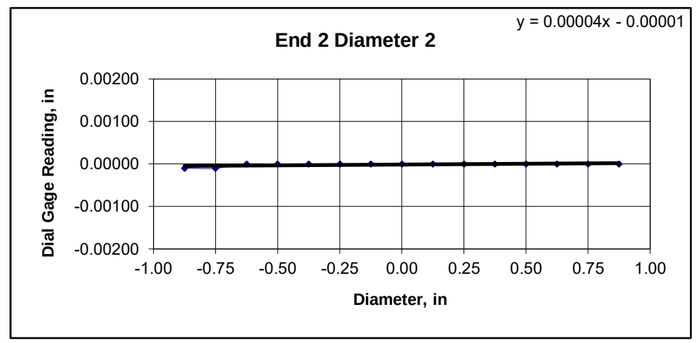
Difference between max and min readings, in:
0° = 0.0016 90° = 0.0001

Maximum difference must be < 0.0020 in. Difference = ± 0.00080
Flatness Tolerance Met? **YES**









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00090
Angle of Best Fit Line: 0.05173

End 2:
Slope of Best Fit Line 0.00089
Angle of Best Fit Line: 0.05091

Maximum Angular Difference: 0.00082

Parallelism Tolerance Met? **YES**
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00002
Angle of Best Fit Line: 0.00098

End 2:
Slope of Best Fit Line 0.00004
Angle of Best Fit Line: 0.00213

Maximum Angular Difference: 0.00115

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	0.00160	1.995	0.00080	0.046	YES
Diameter 2, in (rotated 90°)	0.00010	1.995	0.00005	0.003	YES
END 2					
Diameter 1, in	0.00160	1.995	0.00080	0.046	YES
Diameter 2, in (rotated 90°)	0.00010	1.995	0.00005	0.003	YES

Maximum angle of departure must be ≤ 0.25°

Perpendicularity Tolerance Met? **YES**

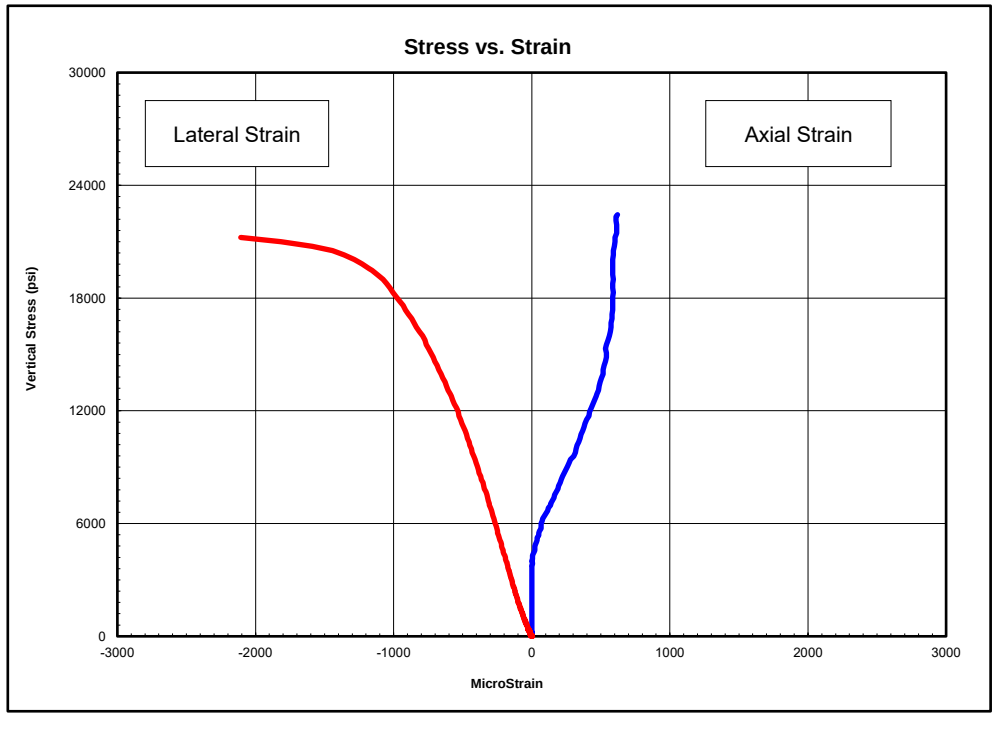
Client:	Haley & Aldrich, Inc.
Project Name:	I-295 Exit 17 Bridge
Project Location:	Yarmouth, ME
GTX #:	311099
Test Date:	12/30/2019
Tested By:	cmh
Checked By:	smd
Boring ID:	BB-YRO-102
Sample ID:	R1
Depth, ft:	27.60-27.97

After cutting and grinding

After break

Client:	Haley & Aldrich, Inc.
Project Name:	I-295 Exit 17 Bridge
Project Location:	Yarmouth, ME
GTX #:	311099
Test Date:	12/31/2019
Tested By:	jck
Checked By:	jsc
Boring ID:	BB-YRO-102
Sample ID:	R2
Depth, ft:	33.93-34.30
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: 22,436 psi

The strain values recorded for this test produce values of Poisson's Ratio that exceed maximum values found in rocks.

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
2200-8200	27,500,000	---
8200-14200	18,500,000	---
14200-20200	68,100,000	---

Notes:
Test specimen tested at the approximate as-received moisture content and at standard laboratory temperature.
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:	Haley & Aldrich, Inc.	Test Date:	12/20/2019
Project Name:	I-295 Exit 17 Bridge	Tested By:	jck
Project Location:	Yarmouth, ME	Checked By:	smd
GTX #:	311099		
Boring ID:	BB-YRO-102		
Sample ID:	R2		
Depth:	33.93-34.30 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:	4.40	4.40	4.40
Specimen Diameter, in:	2.00	2.00	2.00
Specimen Mass, g:	592		
Bulk Density, lb/ft^3	163	**Minimum Diameter Tolerence Met?**	**YES**
Length to Diameter Ratio:	2.2	**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.? NO

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? **NO**

END FLATNESS AND PARALLELISM (Procedure FP1)

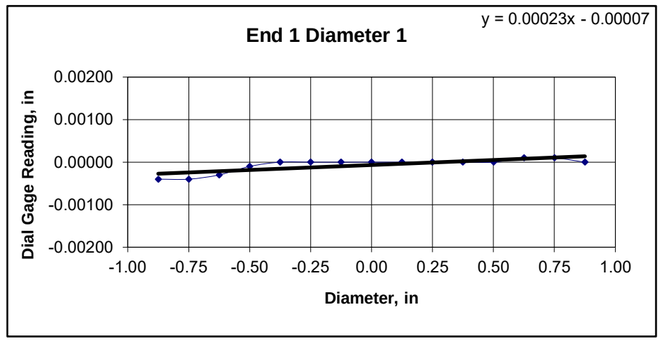
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00040	-0.00040	-0.00030	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010	0.00000
Diameter 2, in (rotated 90°)	0.00080	0.00060	0.00050	0.00040	0.00030	0.00020	0.00010	0.00000	-0.00010	-0.00020	-0.00040	-0.00050	-0.00060	-0.00070	-0.00080

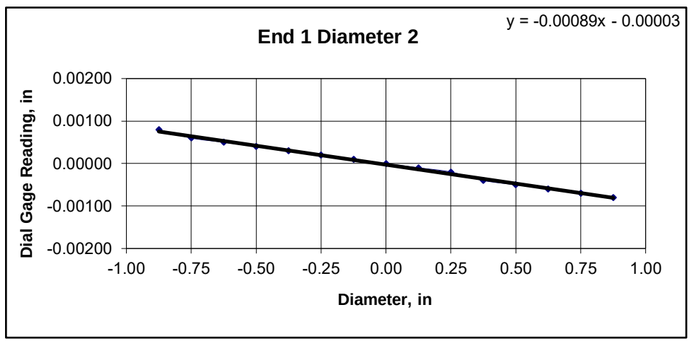
Difference between max and min readings, in:
0° = 0.00050 90° = 0.00160

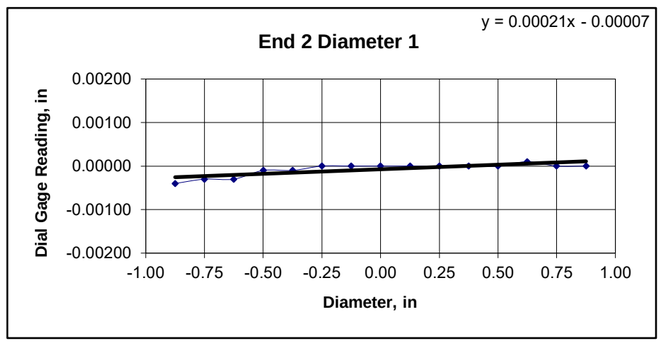
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00040	-0.00030	-0.00030	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00000	0.00000
Diameter 2, in (rotated 90°)	0.00080	0.00070	0.00060	0.00050	0.00040	0.00030	0.00010	0.00000	-0.00020	-0.00020	-0.00040	-0.00050	-0.00060	-0.00070	-0.00080

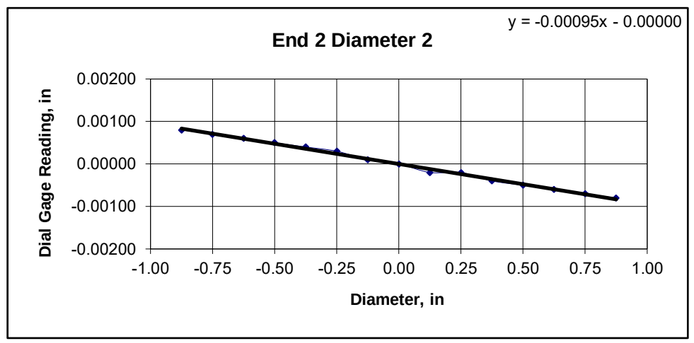
Difference between max and min readings, in:
0° = 0.0005 90° = 0.0016

Maximum difference must be < 0.0020 in. Difference = ± 0.00080
Flatness Tolerance Met? **YES**









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00023
Angle of Best Fit Line: 0.01342

End 2:
Slope of Best Fit Line 0.00021
Angle of Best Fit Line: 0.01195

Maximum Angular Difference: 0.00147

Parallelism Tolerance Met? **YES**
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00089
Angle of Best Fit Line: 0.05108

End 2:
Slope of Best Fit Line 0.00095
Angle of Best Fit Line: 0.05451

Maximum Angular Difference: 0.00344

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	0.00050	2.000	0.00025	0.014	YES
Diameter 2, in (rotated 90°)	0.00160	2.000	0.00080	0.046	YES
END 2					
Diameter 1, in	0.00050	2.000	0.00025	0.014	YES
Diameter 2, in (rotated 90°)	0.00160	2.000	0.00080	0.046	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? **YES**

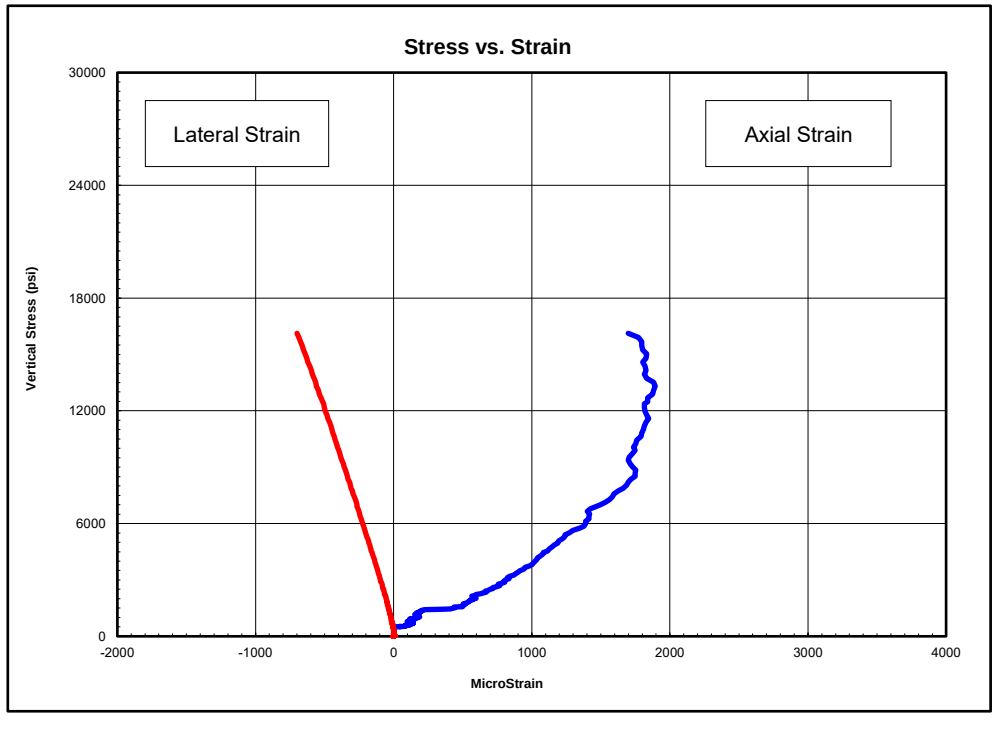
Client:	Haley & Aldrich, Inc.
Project Name:	I-295 Exit 17 Bridge
Project Location:	Yarmouth, ME
GTX #:	311099
Test Date:	12/31/2019
Tested By:	cmh
Checked By:	smd
Boring ID:	BB-YRO-102
Sample ID:	R2
Depth, ft:	33.93-34.30

After cutting and grinding

After break

Client:	Haley & Aldrich, Inc.
Project Name:	I-295 Exit 17 Bridge
Project Location:	Yarmouth, ME
GTX #:	311099
Test Date:	12/31/2019
Tested By:	jck
Checked By:	jsc
Boring ID:	BB-YRO-105
Sample ID:	R1
Depth, ft:	40.64-41.01
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: 23,541 psi

The graph above does not include values up to the peak stress value. The strain gauges failed before the peak value was attained.

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
2400-8600	5,760,000	0.25
8600-14900	---	---
14900-21200	---	---

Notes:
Test specimen tested at the approximate as-received moisture content and at standard laboratory temperature.
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:	Haley & Aldrich, Inc.	Test Date:	12/20/2019
Project Name:	I-295 Exit 17 Bridge	Tested By:	jck
Project Location:	Yarmouth, ME	Checked By:	smd
GTX #:	311099		
Boring ID:	BB-YRO-105		
Sample ID:	R1		
Depth:	40.64-41.01 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:	4.48	4.48	4.48
Specimen Diameter, in:	2.00	1.99	2.00
Specimen Mass, g:	591.77		
Bulk Density, lb/ft^3	161	**Minimum Diameter Tolerence Met?**	**YES**
Length to Diameter Ratio:	2.2	**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)

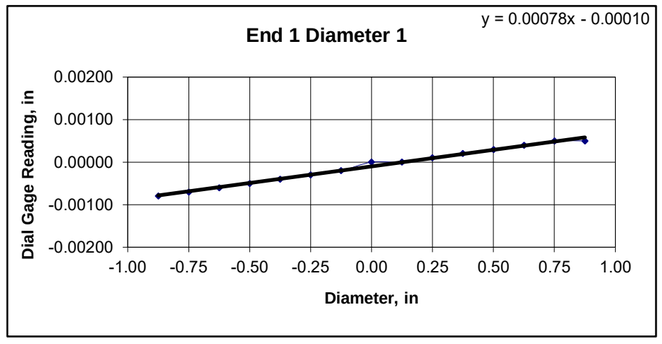
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00080	-0.00070	-0.00060	-0.00050	-0.00040	-0.00030	-0.00020	0.00000	0.00000	0.00010	0.00020	0.00030	0.00040	0.00050	0.00050
Diameter 2, in (rotated 90°)	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00020	-0.00020

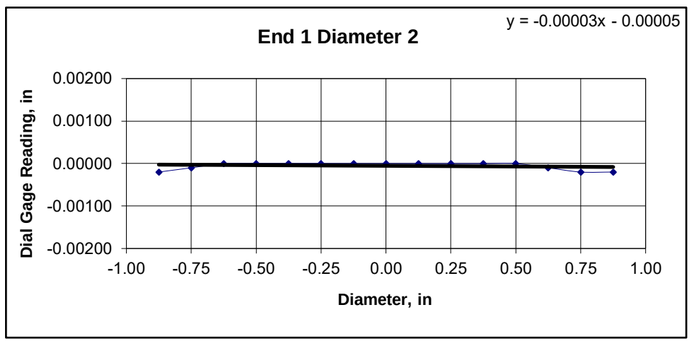
Difference between max and min readings, in:
0° = 0.00130 90° = 0.00020

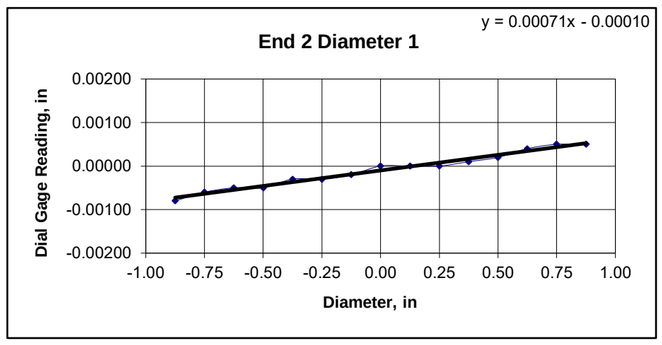
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00080	-0.00060	-0.00050	-0.00050	-0.00030	-0.00030	-0.00020	0.00000	0.00000	0.00000	0.00010	0.00020	0.00040	0.00050	0.00050
Diameter 2, in (rotated 90°)	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020

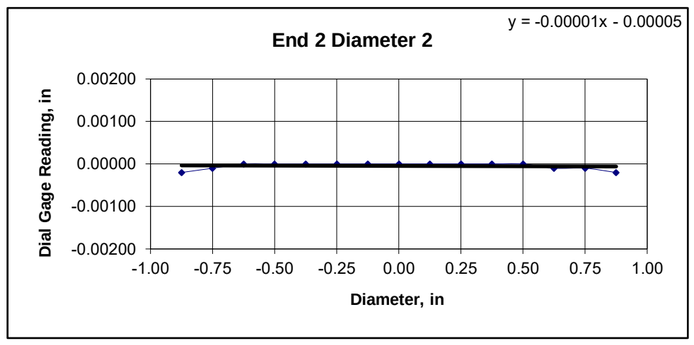
Difference between max and min readings, in:
0° = 0.0013 90° = 0.0002

Maximum difference must be < 0.0020 in. Difference = ± 0.00065
Flatness Tolerance Met? **YES**









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00078
Angle of Best Fit Line: 0.04469

End 2:
Slope of Best Fit Line 0.00071
Angle of Best Fit Line: 0.04093

Maximum Angular Difference: 0.00377

Parallelism Tolerance Met? **YES**
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00003
Angle of Best Fit Line: 0.00180

End 2:
Slope of Best Fit Line 0.00001
Angle of Best Fit Line: 0.00082

Maximum Angular Difference: 0.00098

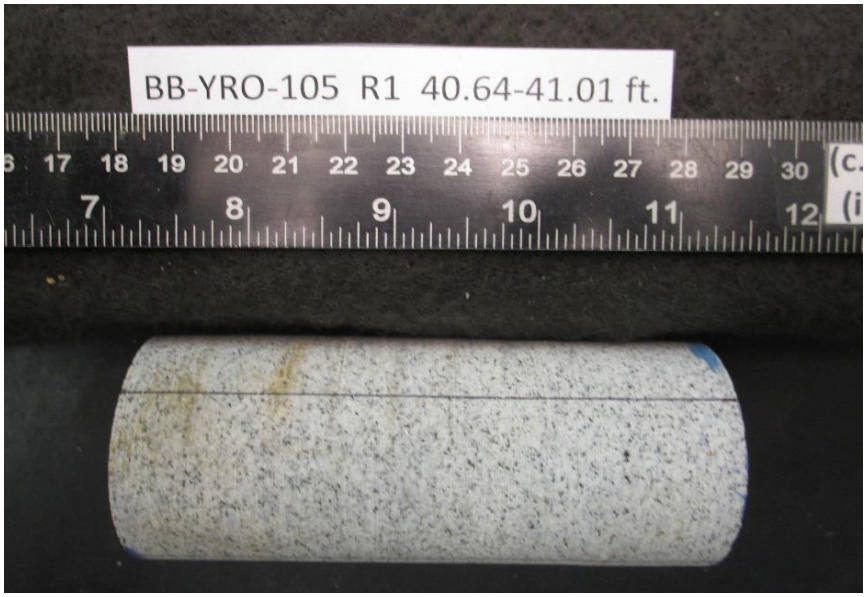
Parallelism Tolerance Met? **YES**
Spherically Seated

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	0.00130	1.995	0.00065	0.037	YES
Diameter 2, in (rotated 90°)	0.00020	1.995	0.00010	0.006	YES
END 2					
Diameter 1, in	0.00130	1.995	0.00065	0.037	YES
Diameter 2, in (rotated 90°)	0.00020	1.995	0.00010	0.006	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? **YES**

Client:	Haley & Aldrich, Inc.
Project Name:	I-295 Exit 17 Bridge
Project Location:	Yarmouth, ME
GTX #:	311099
Test Date:	12/31/2019
Tested By:	cmh
Checked By:	smd
Boring ID:	BB-YRO-105
Sample ID:	R1
Depth, ft:	40.64-41.01

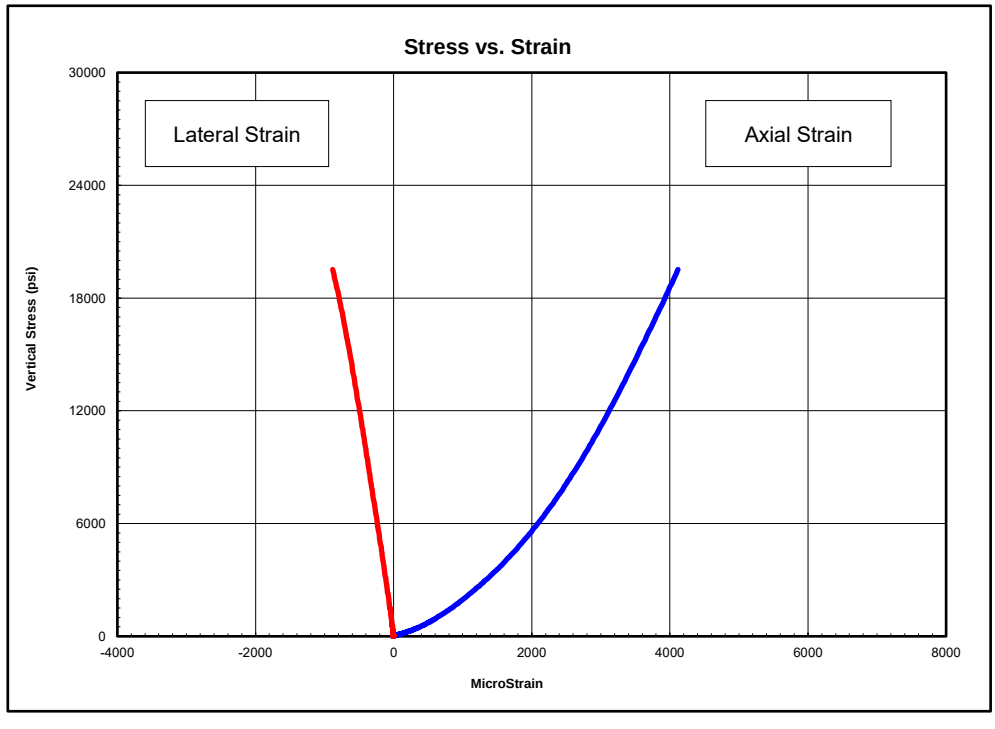


After cutting and grinding

After break

Client:	Haley & Aldrich, Inc.
Project Name:	I-295 Exit 17 Bridge
Project Location:	Yarmouth, ME
GTX #:	311099
Test Date:	12/31/2019
Tested By:	jck
Checked By:	jsc
Boring ID:	BB-YRO-105
Sample ID:	R2
Depth, ft:	46.63-47.0
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: 21,055 psi

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
2100-7700	3,980,000	0.16
7700-13300	6,330,000	0.27
13300-18900	7,600,000	0.39

Notes:
Test specimen tested at the approximate as-received moisture content and at standard laboratory temperature.
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:	Haley & Aldrich, Inc.	Test Date:	12/20/2019
Project Name:	I-295 Exit 17 Bridge	Tested By:	jck
Project Location:	Yarmouth, ME	Checked By:	smd
GTX #:	311099		
Boring ID:	BB-YRO-105		
Sample ID:	R2		
Depth:	46.63-47.0 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:	4.36	4.36	4.36
Specimen Diameter, in:	1.99	1.99	1.99
Specimen Mass, g:	577.62		
Bulk Density, lb/ft^3	162	**Minimum Diameter Tolerence Met?**	**YES**
Length to Diameter Ratio:	2.2	**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)

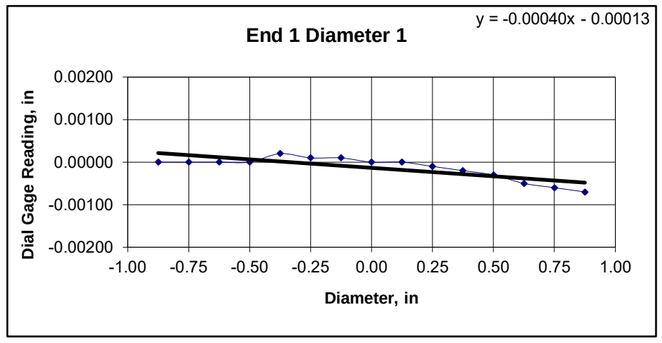
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00020	0.00010	0.00010	0.00000	0.00000	-0.00010	-0.00020	-0.00030	-0.00050	-0.00060	-0.00070
Diameter 2, in (rotated 90°)	-0.00060	-0.00050	-0.00030	-0.00030	-0.00020	-0.00010	-0.00010	0.00000	0.00000	0.00010	0.00020	0.00020	0.00020	0.00040	0.00040

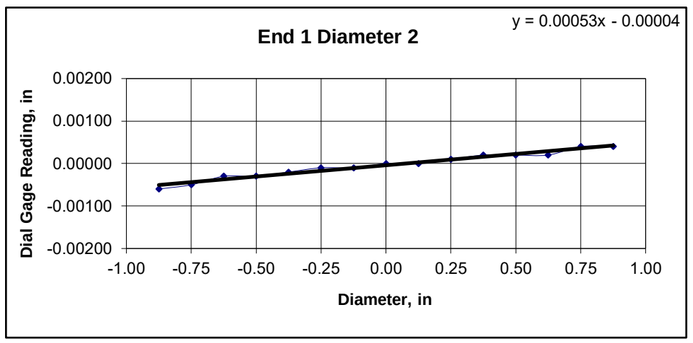
Difference between max and min readings, in:
0° = 0.00090 90° = 0.00100

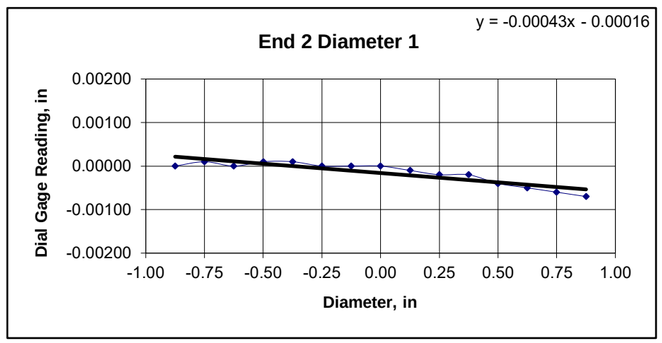
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00010	0.00000	0.00010	0.00010	0.00000	0.00000	0.00000	-0.00010	-0.00020	-0.00020	-0.00040	-0.00050	-0.00060	-0.00070
Diameter 2, in (rotated 90°)	-0.00070	-0.00060	-0.00040	-0.00040	-0.00030	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00020	0.00020	0.00020	0.00030	0.00040

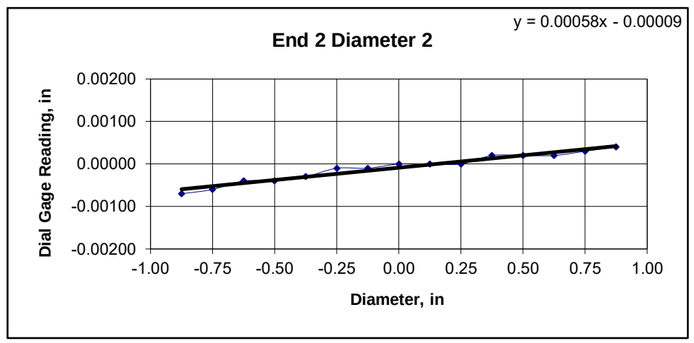
Difference between max and min readings, in:
0° = 0.0008 90° = 0.0011

Maximum difference must be < 0.0020 in. Difference = ± 0.00055
Flatness Tolerance Met? **YES**









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00040
Angle of Best Fit Line: 0.02275

End 2:
Slope of Best Fit Line 0.00043
Angle of Best Fit Line: 0.02456

Maximum Angular Difference: 0.00180

Parallelism Tolerance Met? **YES**
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00053
Angle of Best Fit Line: 0.03045

End 2:
Slope of Best Fit Line 0.00058
Angle of Best Fit Line: 0.03323

Maximum Angular Difference: 0.00278

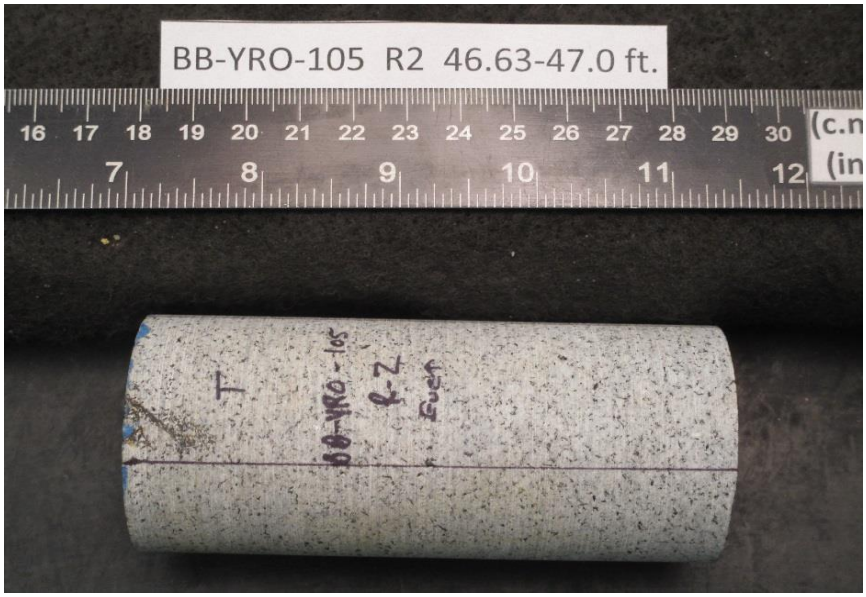
Parallelism Tolerance Met? **YES**
Spherically Seated

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	0.00090	1.990	0.00045	0.026	YES
Diameter 2, in (rotated 90°)	0.00100	1.990	0.00050	0.029	YES
END 2					
Diameter 1, in	0.00080	1.990	0.00040	0.023	YES
Diameter 2, in (rotated 90°)	0.00110	1.990	0.00055	0.032	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? **YES**

Client:	Haley & Aldrich, Inc.
Project Name:	I-295 Exit 17 Bridge
Project Location:	Yarmouth, ME
GTX #:	311099
Test Date:	12/31/2019
Tested By:	cmh
Checked By:	smd
Boring ID:	BB-YRO-105
Sample ID:	R2
Depth, ft:	46.63-47.0



After cutting and grinding

After break

GeoTesting EXPRESS

WARRANTY and LIABILITY

GeoTesting Express (GTX) warrants that all tests it performs are run in general accordance with the specified test procedures and accepted industry practice. GTX will correct or repeat any test that does not comply with this warranty. GTX has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

GTX may report engineering parameters that require us to interpret the test data. Such parameters are determined using accepted engineering procedures. However, GTX does not warrant that these parameters accurately reflect the true engineering properties of the *in situ* material. Responsibility for interpretation and use of the test data and these parameters for engineering and/or construction purposes rests solely with the user and not with GTX or any of its employees.

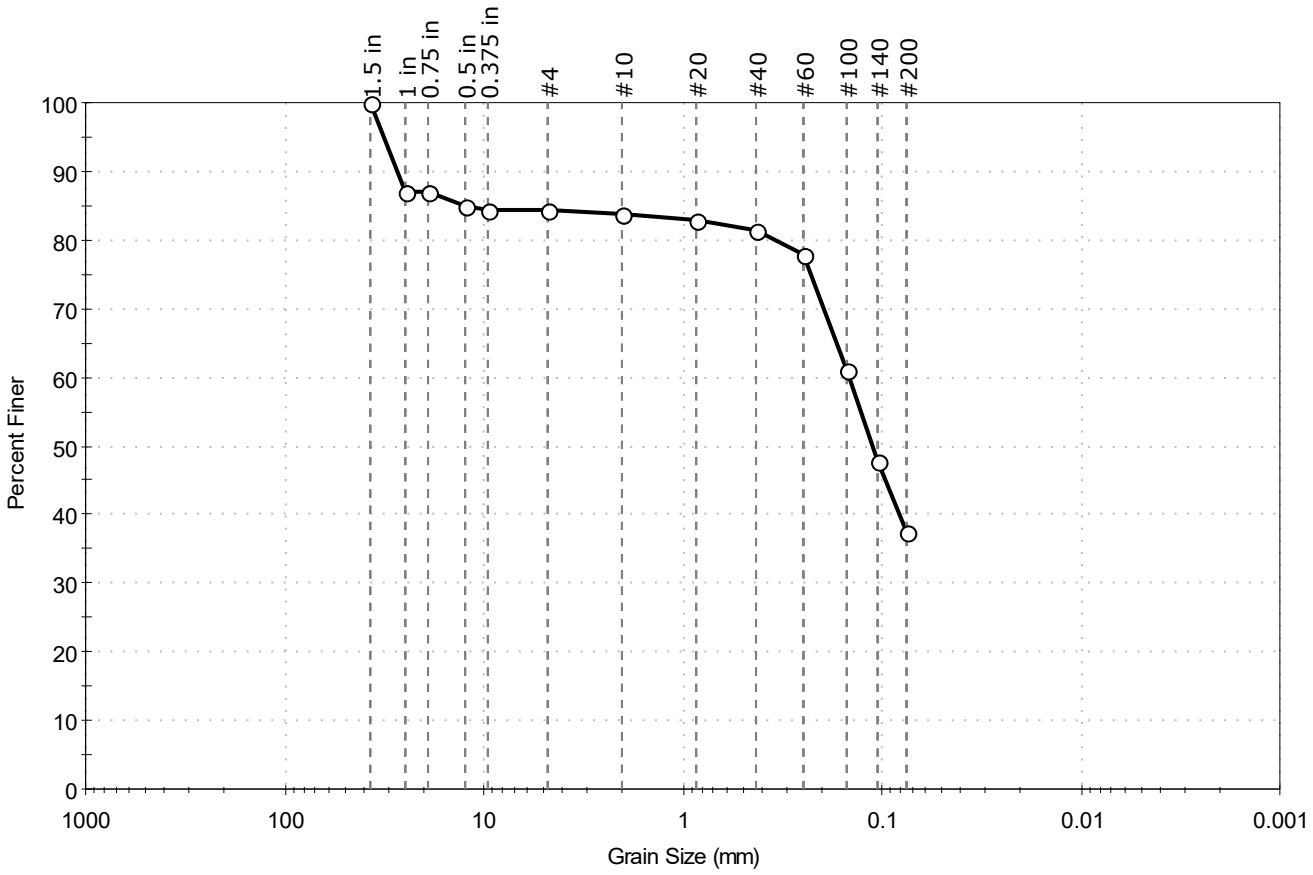
GTX's liability will be limited to correcting or repeating a test which fails our warranty. GTX's liability for damages to the Purchaser of testing services for any cause whatsoever shall be limited to the amount GTX received for the testing services. GTX will not be liable for any damages, or for any lost benefits or other consequential damages resulting from the use of these test results, even if GTX has been advised of the possibility of such damages. GTX will not be responsible for any liability of the Purchaser to any third party.

Commonly Used Symbols

A	pore pressure parameter for $\Delta\sigma_1 - \Delta\sigma_3$
B	pore pressure parameter for $\Delta\sigma_3$
CAI	CERCHAR Abrasiveness Index
CIU	isotropically consolidated undrained triaxial shear test
CR	compression ratio for one dimensional consolidation
CSR	cyclic stress ratio
C_c	coefficient of curvature, $(D_{30})^2 / (D_{10} \times D_{60})$
C_u	coefficient of uniformity, D_{60}/D_{10}
C_c	compression index for one dimensional consolidation
C_α	coefficient of secondary compression
c_v	coefficient of consolidation
c	cohesion intercept for total stresses
c'	cohesion intercept for effective stresses
D	diameter of specimen
D	damping ratio
D_{10}	diameter at which 10% of soil is finer
D_{15}	diameter at which 15% of soil is finer
D_{30}	diameter at which 30% of soil is finer
D_{50}	diameter at which 50% of soil is finer
D_{60}	diameter at which 60% of soil is finer
D_{85}	diameter at which 85% of soil is finer
d_{50}	displacement for 50% consolidation
d_{90}	displacement for 90% consolidation
d_{100}	displacement for 100% consolidation
E	Young's modulus
e	void ratio
e_c	void ratio after consolidation
e_o	initial void ratio
G	shear modulus
G_s	specific gravity of soil particles
H	height of specimen
H_R	Rebound Hardness number
i	gradient
I_S	Uncorrected point load strength
$I_{S(50)}$	Size corrected point load strength index
H_A	Modified Taber Abrasion
H_T	Total hardness
K_o	lateral stress ratio for one dimensional strain
k	permeability
LI	Liquidity Index
m_v	coefficient of volume change
n	porosity
PI	plasticity index
P_c	preconsolidation pressure
p	$(\sigma_1 + \sigma_3) / 2$, $(\sigma_v + \sigma_h) / 2$
p'	$(\sigma'_1 + \sigma'_3) / 2$, $(\sigma'_v + \sigma'_h) / 2$
p'_c	p' at consolidation
Q	quantity of flow
q	$(\sigma_1 - \sigma_3) / 2$
q_f	q at failure
q_o, q_i	initial q
q_c	q at consolidation
S_r	Post cyclic undrained shear strength
T	temperature
t	time
U, UC	unconfined compression test
UU, Q	unconsolidated undrained triaxial test
u_a	pore gas pressure
u_e	excess pore water pressure
u, u_w	pore water pressure
V	total volume
V_g	volume of gas
V_s	volume of solids
V_s	shear wave velocity
V_v	volume of voids
V_w	volume of water
V_o	initial volume
v	velocity
W	total weight
W_s	weight of solids
W_w	weight of water
w	water content
w_c	water content at consolidation
w_f	final water content
w_l	liquid limit
w_n	natural water content
w_p	plastic limit
w_s	shrinkage limit
w_o, w_i	initial water content
α	slope of q_f versus p_f
α'	slope of q_f versus p_f'
γ_t	total unit weight
γ_d	dry unit weight
γ_s	unit weight of solids
γ_w	unit weight of water
ε	strain
ε_{vol}	volume strain
ε_h, ε_v	horizontal strain, vertical strain
μ	Poisson's ratio, also viscosity
σ	normal stress
σ'	effective normal stress
σ_c, σ'_c	consolidation stress in isotropic stress system
σ_h, σ'_h	horizontal normal stress
σ_v, σ'_v	vertical normal stress
σ'_{vc}	Effective vertical consolidation stress
σ_1	major principal stress
σ_2	intermediate principal stress
σ_3	minor principal stress
τ	shear stress
φ	friction angle based on total stresses
φ'	friction angle based on effective stresses
φ'_r	residual friction angle
φ_{ult}	φ for ultimate strength

Client:	Haley & Aldrich, Inc.				
Project:	I-295 NB/SB Bridge Replacements				
Location:	Yarmouth, ME			Project No:	GTX-313814
Boring ID:	BB-YRO-204	Sample Type:	jar	Tested By:	ckg
Sample ID:	8D	Test Date:	06/22/21	Checked By:	emm
Depth :	20-21.8 ft	Test Id:	621449		
Test Comment:	---				
Visual Description:	Moist, gray clayey sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	15.6	46.9	37.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	87		
0.75 in	19.00	87		
0.5 in	12.50	85		
0.375 in	9.50	84		
#4	4.75	84		
#10	2.00	84		
#20	0.85	83		
#40	0.42	81		
#60	0.25	78		
#100	0.15	61		
#140	0.11	48		
#200	0.075	37		

Coefficients

D_{85} = 12.1554 mm D_{30} = N/A

D_{60} = 0.1460 mm D_{15} = N/A

D_{50} = 0.1122 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

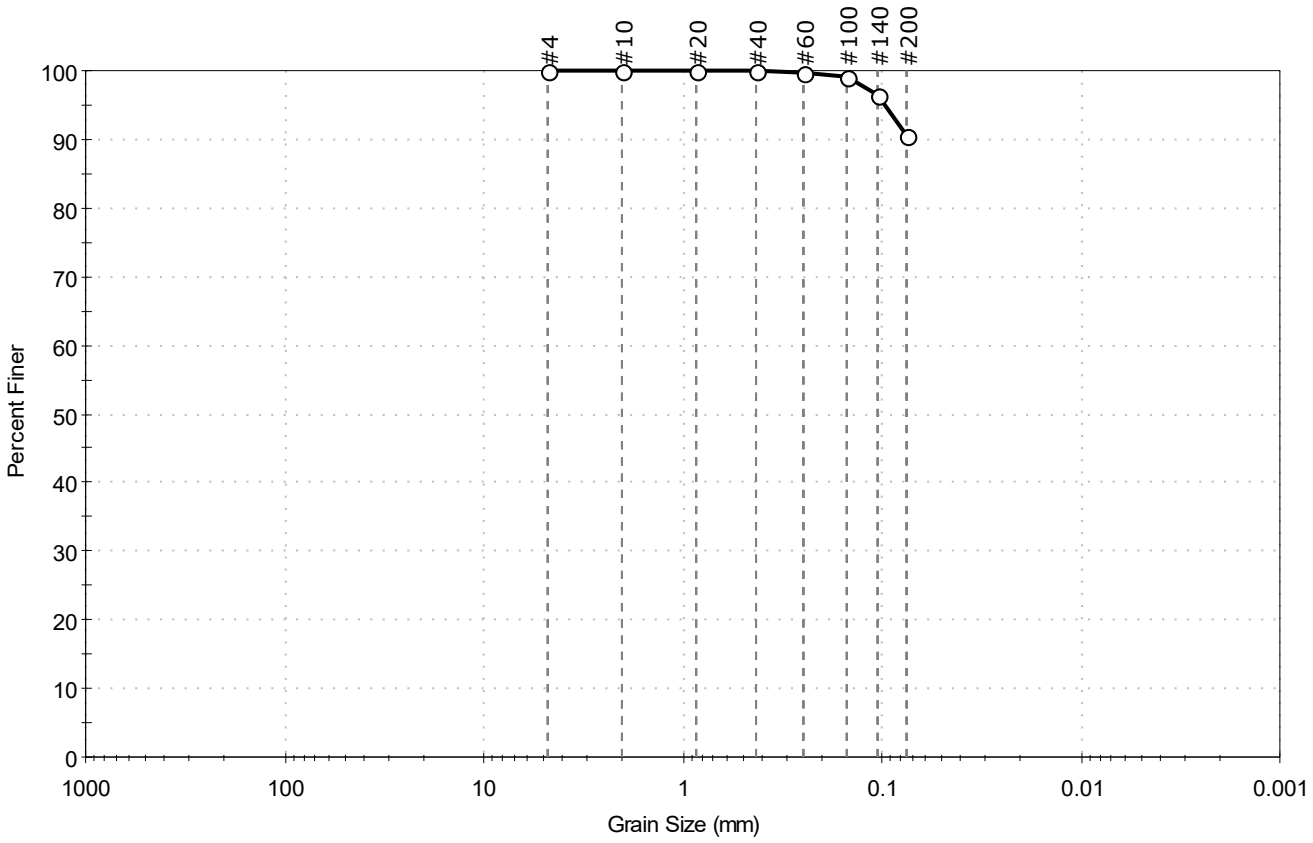
Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

GeoTesting EXPRESS

Client:	Haley & Aldrich, Inc.				
Project:	I-295 NB/SB Bridge Replacements				
Location:	Yarmouth, ME			Project No:	GTX-313814
Boring ID:	BB-YRO-206	Sample Type:	jar	Tested By:	ckg
Sample ID:	7D	Test Date:	06/22/21	Checked By:	emm
Depth :	14-16 ft	Test Id:	621450		
Test Comment:	---				
Visual Description:	Wet, gray clay				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	9.4	90.6

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	99		
#140	0.11	96		
#200	0.075	91		

Coefficients

D_{85} = N/A	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 Lean CLAY (CL)

AASHTO Silty Soils (A-4 (8))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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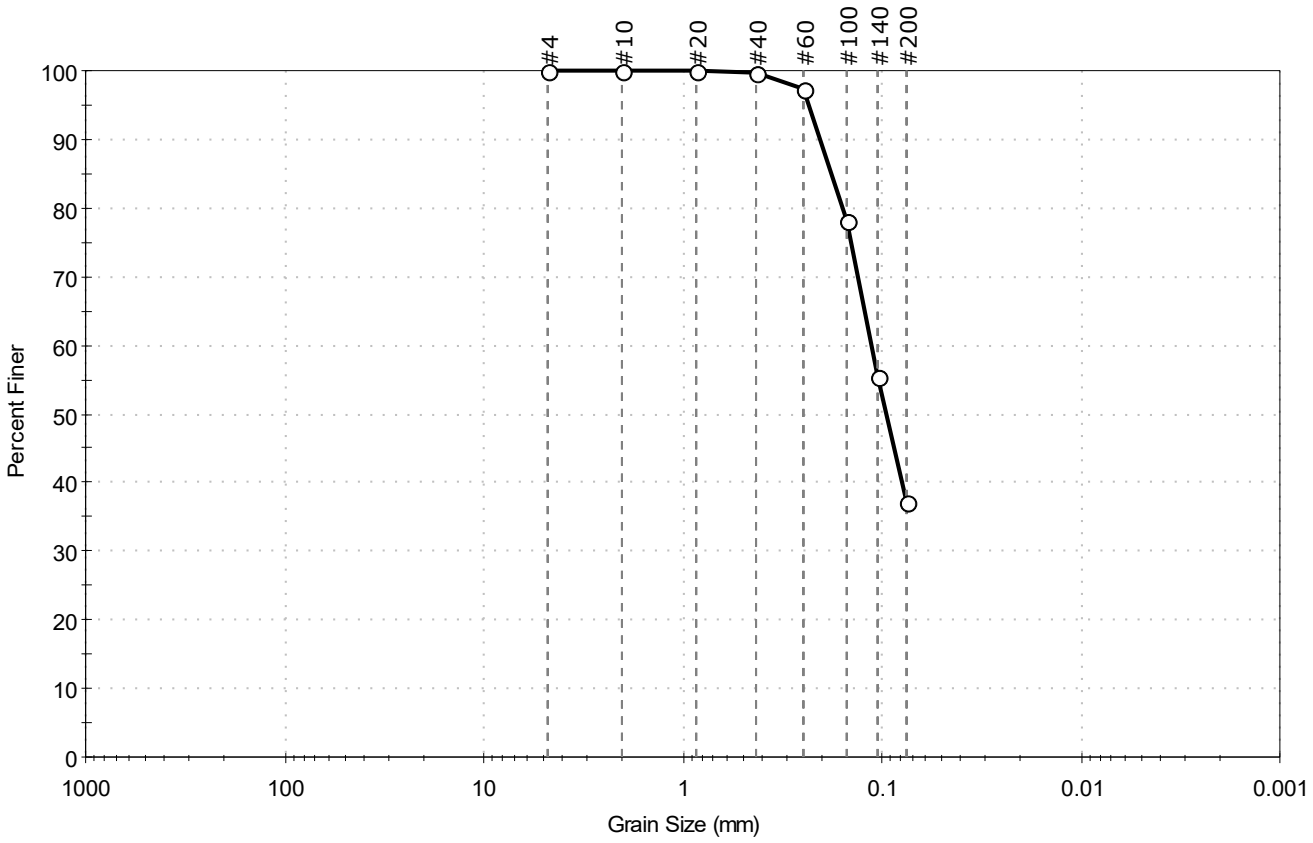
Client:	Haley & Aldrich, Inc.				
Project:	I-295 NB/SB Bridge Replacements				
Location:	Yarmouth, ME			Project No:	GTX-313814
Boring ID:	BB-YRO-206	Sample Type:	jar	Tested By:	ckg
Sample ID:	8D	Test Date:	06/22/21	Checked By:	emm
Depth :	16-18 ft	Test Id:	621451		
Test Comment:	---				
Visual Description:	Moist, light oilve brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	62.8	37.2

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	97		
#100	0.15	78		
#140	0.11	55		
#200	0.075	37		

Coefficients

D_{85} = 0.1797 mm	D_{30} = N/A
D_{60} = 0.1138 mm	D_{15} = N/A
D_{50} = 0.0958 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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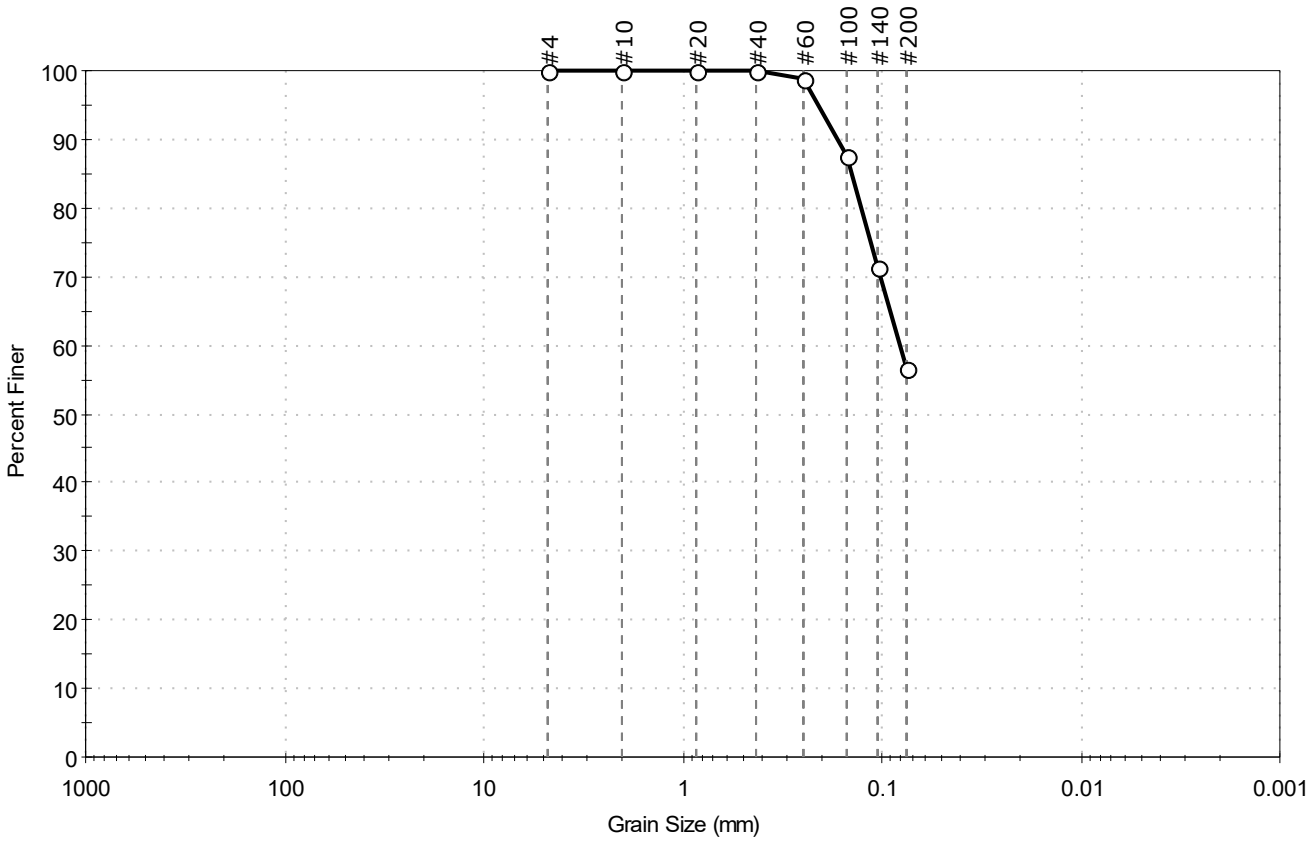
Client:	Haley & Aldrich, Inc.				
Project:	I-295 NB/SB Bridge Replacements				
Location:	Yarmouth, ME			Project No:	GTX-313814
Boring ID:	BB-YRO-206	Sample Type:	jar	Tested By:	ckg
Sample ID:	9D	Test Date:	06/22/21	Checked By:	emm
Depth :	20-22 ft	Test Id:	621452		
Test Comment:	---				
Visual Description:	Moist, light olive brown sandy silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	43.4	56.6

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	99		
#100	0.15	87		
#140	0.11	71		
#200	0.075	57		

Coefficients

D_{85} = 0.1422 mm	D_{30} = N/A
D_{60} = 0.0812 mm	D_{15} = N/A
D_{50} = N/A	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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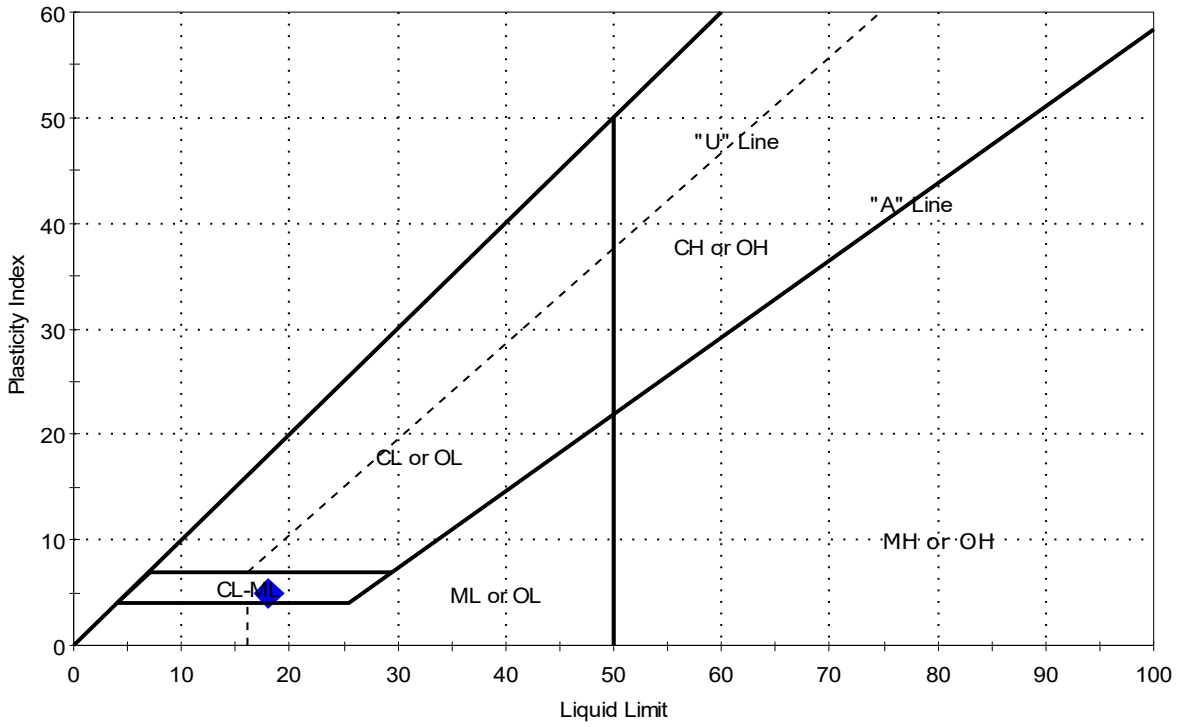
Client:	Haley & Aldrich, Inc.				
Project:	I-295 NB/SB Bridge Replacements				
Location:	Yarmouth, ME			Project No:	GTX-313814
Boring ID:	BB-YRO-204	Sample Type:	jar	Tested By:	cam
Sample ID:	4DA	Test Date:	06/25/21	Checked By:	emm
Depth :	6-8 ft	Test Id:	621443		
Test Comment:	---				
Visual Description:	Moist, olive brown silty, clay with sand				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	4DA	B-YRO-20	6-8 ft	21	18	13	5	1.6	

Sample Prepared using the WET method

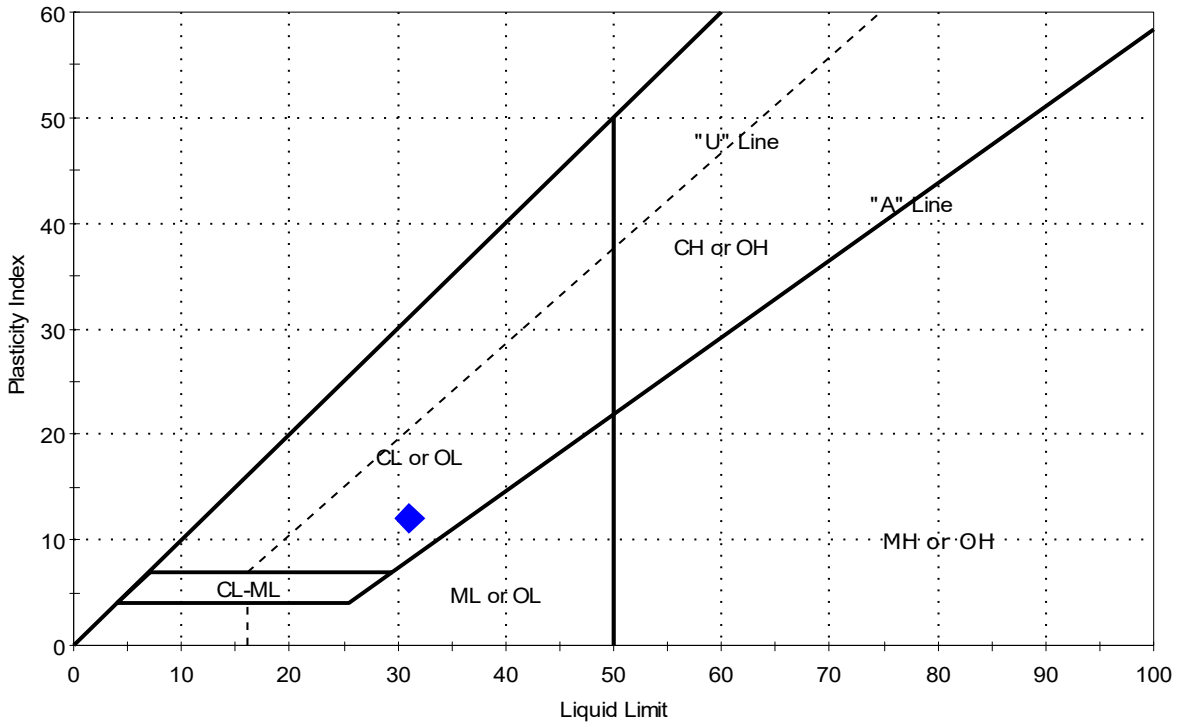
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Haley & Aldrich, Inc.				
Project:	I-295 NB/SB Bridge Replacements				
Location:	Yarmouth, ME			Project No:	GTX-313814
Boring ID:	BB-YRO-204	Sample Type:	jar	Tested By:	cam
Sample ID:	5D	Test Date:	06/28/21	Checked By:	emm
Depth :	8-10 ft	Test Id:	621444		
Test Comment:	---				
Visual Description:	Moist, dark grayish 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
◆	5D	B-YRO-20	8-10 ft	32	31	19	12	1.1	

Sample Prepared using the WET method

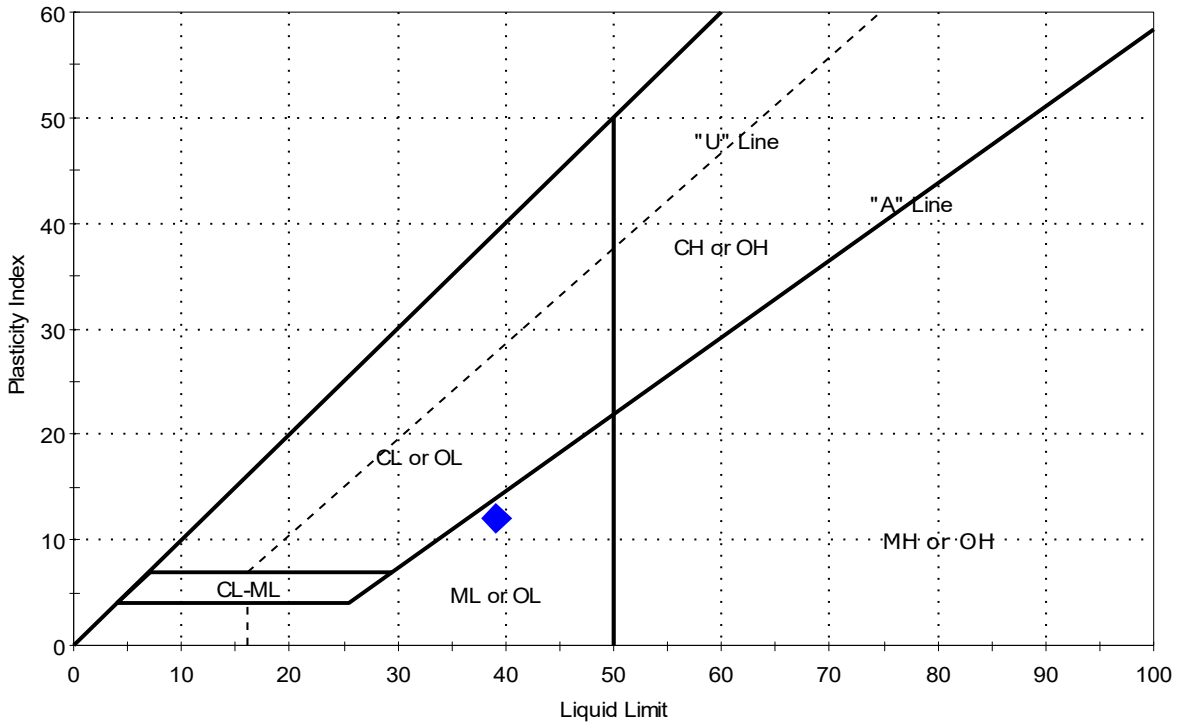
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: MEDIUM

Client:	Haley & Aldrich, Inc.				
Project:	I-295 NB/SB Bridge Replacements				
Location:	Yarmouth, ME			Project No:	GTX-313814
Boring ID:	BB-YRO-204	Sample Type:	tube	Tested By:	cam
Sample ID:	U1	Test Date:	06/29/21	Checked By:	emm
Depth :	12-14 ft	Test Id:	621441		
Test Comment:	---				
Visual Description:	Moist, greenish gray silt				
Sample Comment:	Sample contains organics				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	U1	B-YRO-20	12-14 ft	36	39	27	12	0.8	

Sample Prepared using the WET method

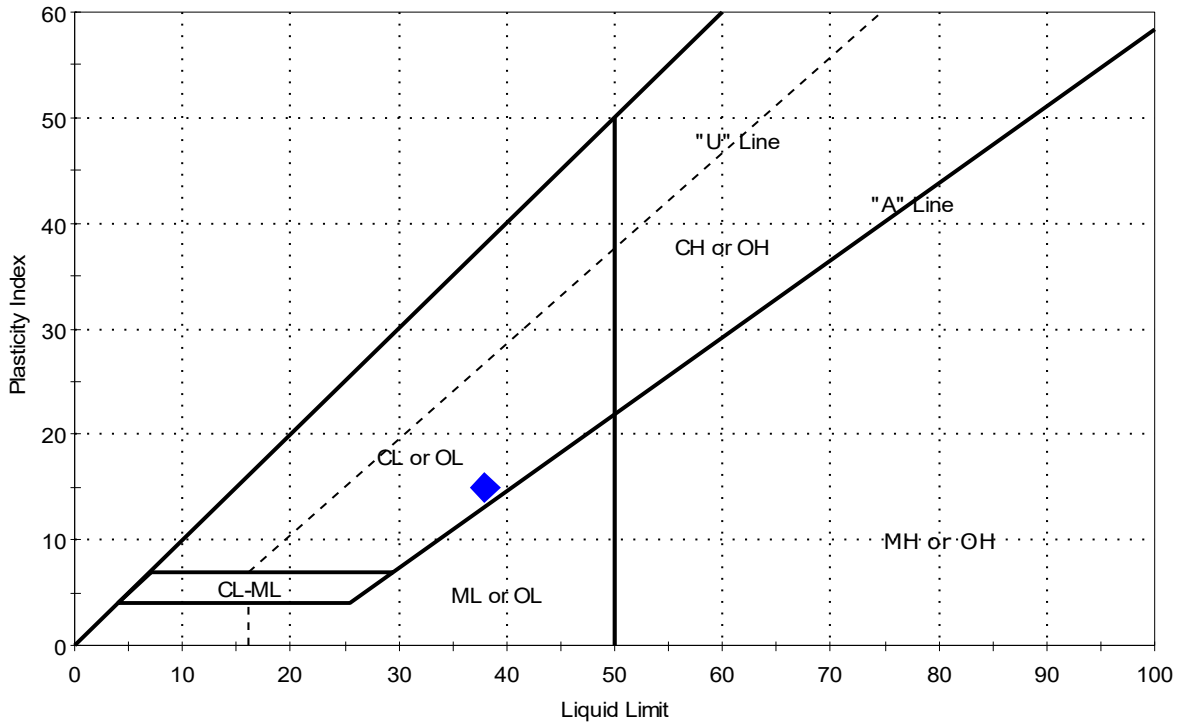
Dry Strength: MEDIUM

Dilatancy: SLOW

Toughness: LOW

Client:	Haley & Aldrich, Inc.				
Project:	I-295 NB/SB Bridge Replacements				
Location:	Yarmouth, ME			Project No:	GTX-313814
Boring ID:	BB-YRO-204	Sample Type:	jar	Tested By:	cam
Sample ID:	7D	Test Date:	06/25/21	Checked By:	emm
Depth :	14-16 ft	Test Id:	621445		
Test Comment:	---				
Visual Description:	Moist, dark 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
◆	7D	B-YRO-20	14-16 ft	30	38	23	15	0.4	

Sample Prepared using the WET method

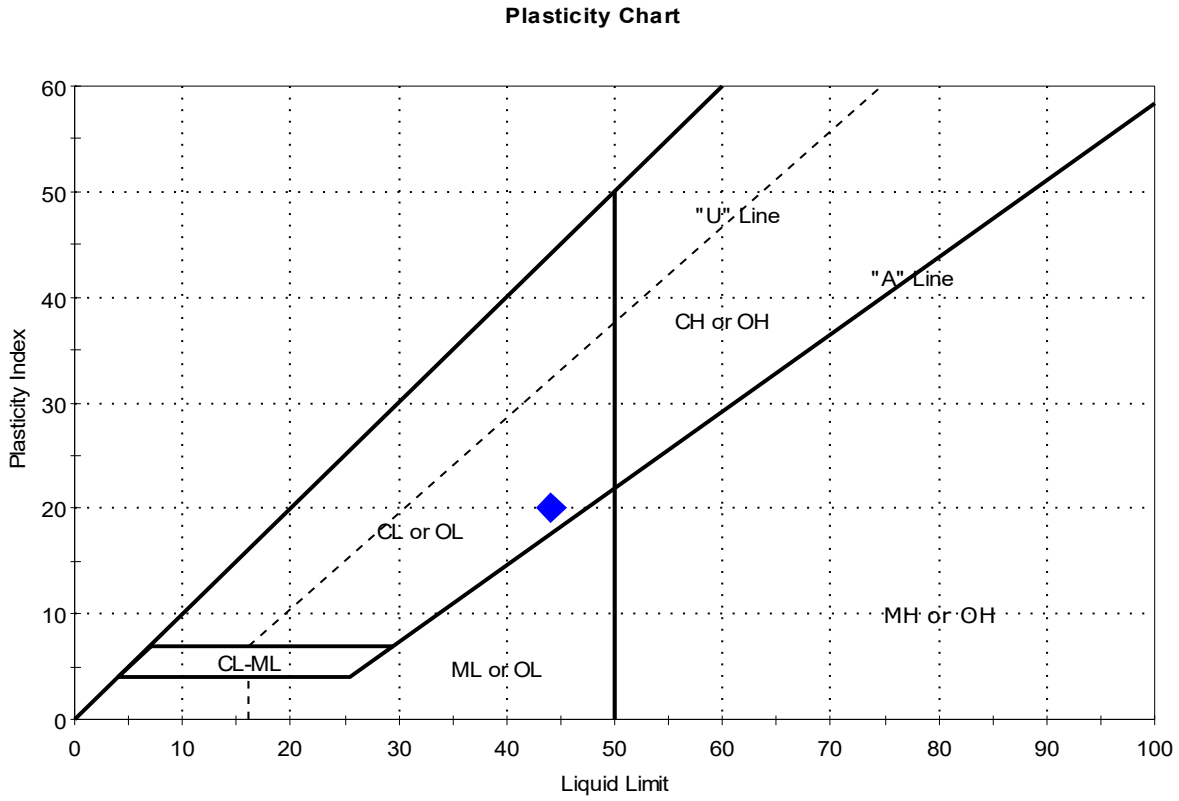
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Haley & Aldrich, Inc.				
Project:	I-295 NB/SB Bridge Replacements				
Location:	Yarmouth, ME			Project No:	GTX-313814
Boring ID:	BB-YRO-206	Sample Type:	jar	Tested By:	cam
Sample ID:	3D	Test Date:	06/29/21	Checked By:	emm
Depth :	4-6 ft	Test Id:	621446		
Test Comment:	---				
Visual 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
◆	3D	B-YRO-20	4-6 ft	30	44	24	20	0.3	

Sample Prepared using the WET method

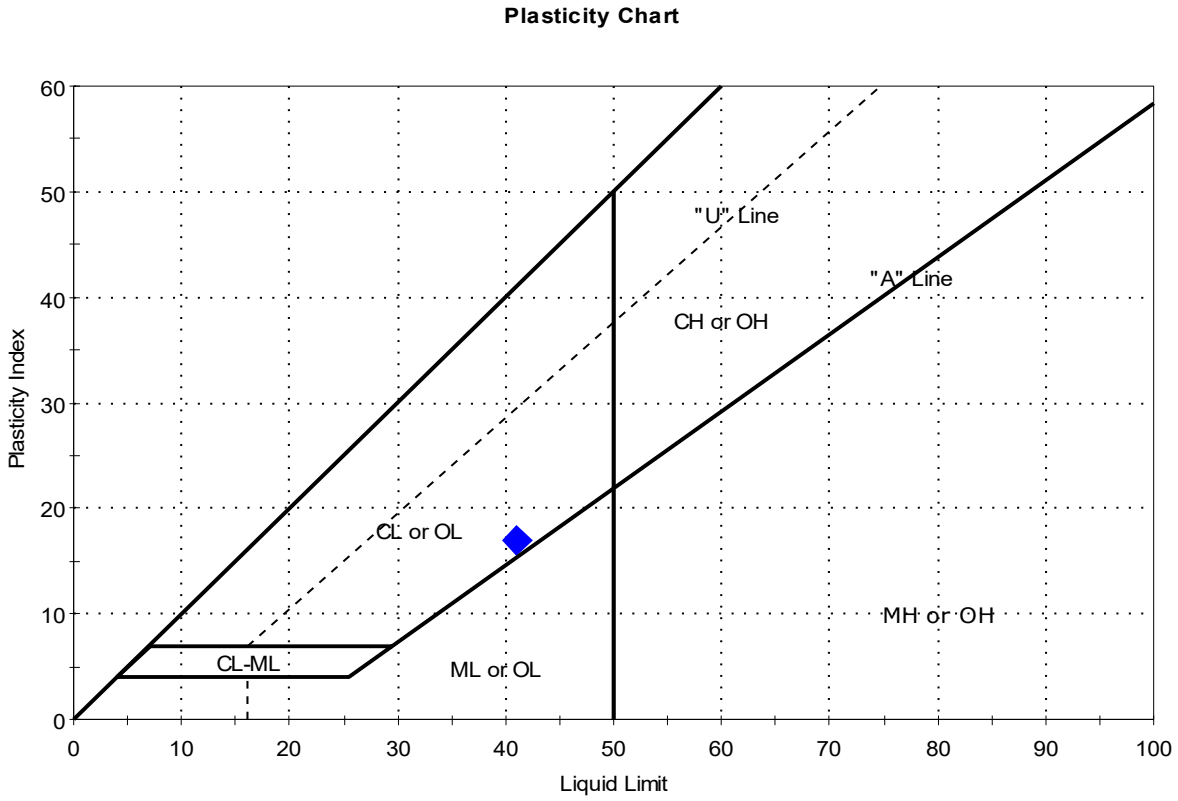
Dry Strength: n/a

Dilatancy: n/a

Toughness: n/a

Client:	Haley & Aldrich, Inc.				
Project:	I-295 NB/SB Bridge Replacements				
Location:	Yarmouth, ME			Project No:	GTX-313814
Boring ID:	BB-YRO-206	Sample Type:	jar	Tested By:	cam
Sample ID:	5D	Test Date:	06/24/21	Checked By:	emm
Depth :	8-10 ft	Test Id:	621447		
Test Comment:	---				
Visual 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
◆	5D	B-YRO-20	8-10 ft	34	41	24	17	0.6	

Sample Prepared using the WET method

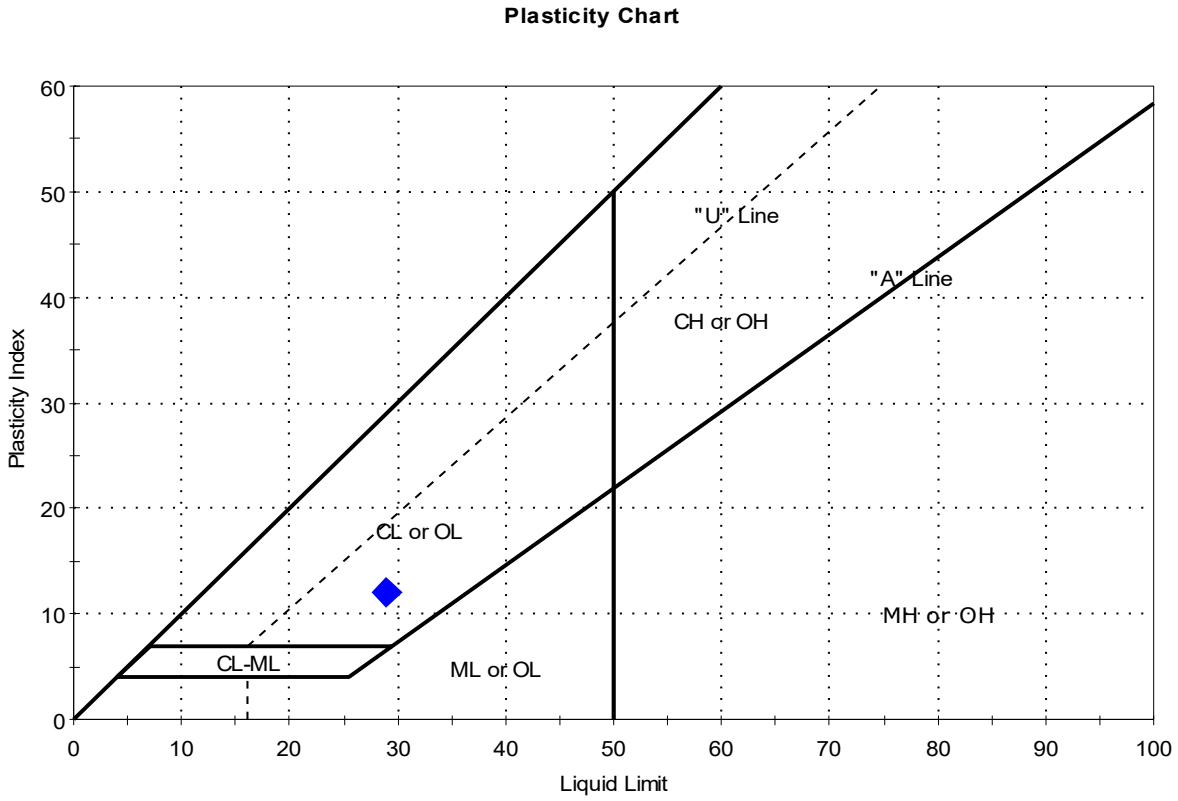
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Haley & Aldrich, Inc.				
Project:	I-295 NB/SB Bridge Replacements				
Location:	Yarmouth, ME			Project No:	GTX-313814
Boring ID:	BB-YRO-206	Sample Type:	tube	Tested By:	cam
Sample ID:	U1	Test Date:	06/28/21	Checked By:	emm
Depth :	12-14 ft	Test Id:	621442		
Test Comment:	---				
Visual Description:	Wet, 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
◆	U1	B-YRO-20	12-14 ft	33	29	17	12	1.3	

Sample Prepared using the WET method

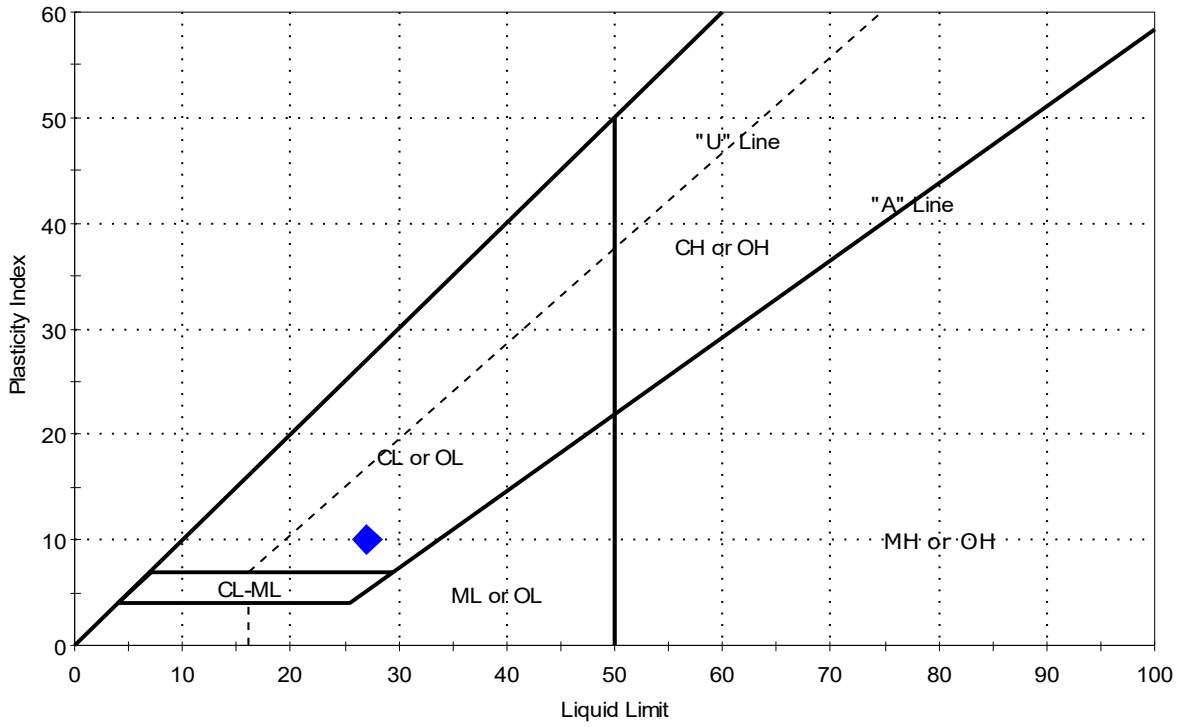
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Haley & Aldrich, Inc.				
Project:	I-295 NB/SB Bridge Replacements				
Location:	Yarmouth, ME			Project No:	GTX-313814
Boring ID:	BB-YRO-206	Sample Type:	jar	Tested By:	cam
Sample ID:	7D	Test Date:	06/25/21	Checked By:	emm
Depth :	14-16 ft	Test Id:	621448		
Test Comment:	---				
Visual Description:	Wet, gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318

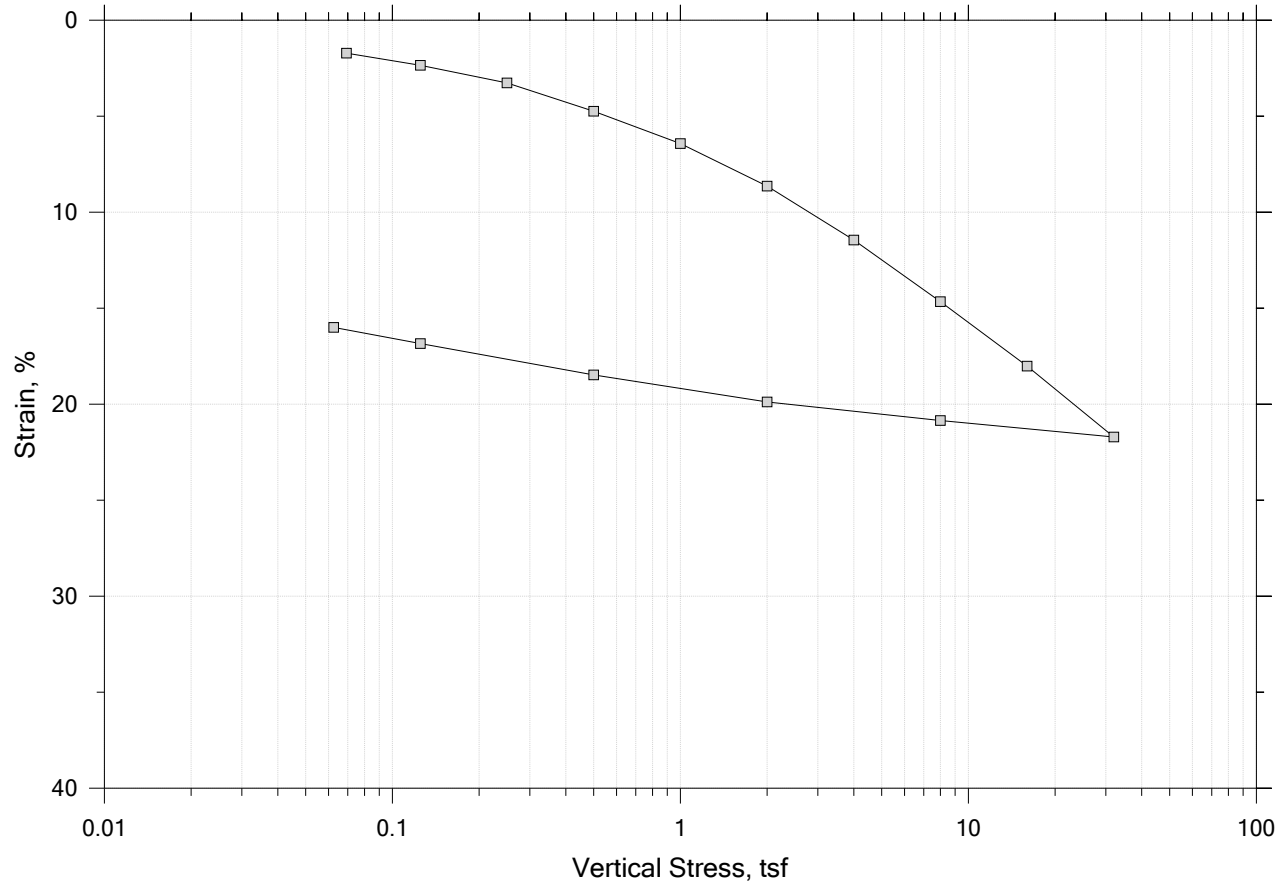


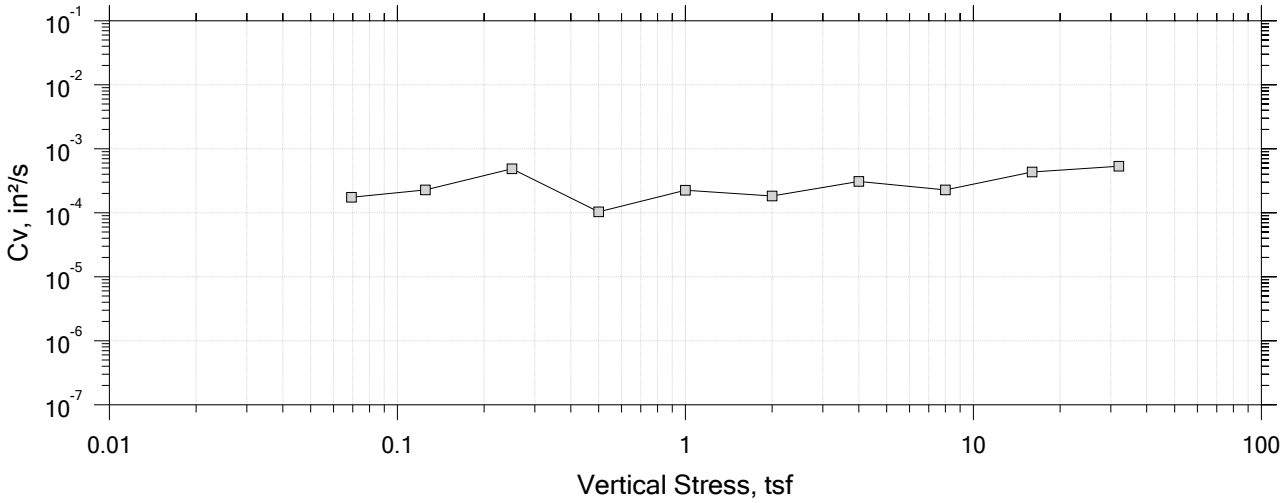
Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	7D	B-YRO-20	14-16 ft	34	27	17	10	1.7	Lean CLAY (CL)

Sample Prepared using the WET method
0% Retained on #40 Sieve
Dry Strength: VERY HIGH
Dilatancy: SLOW
Toughness: LOW

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report

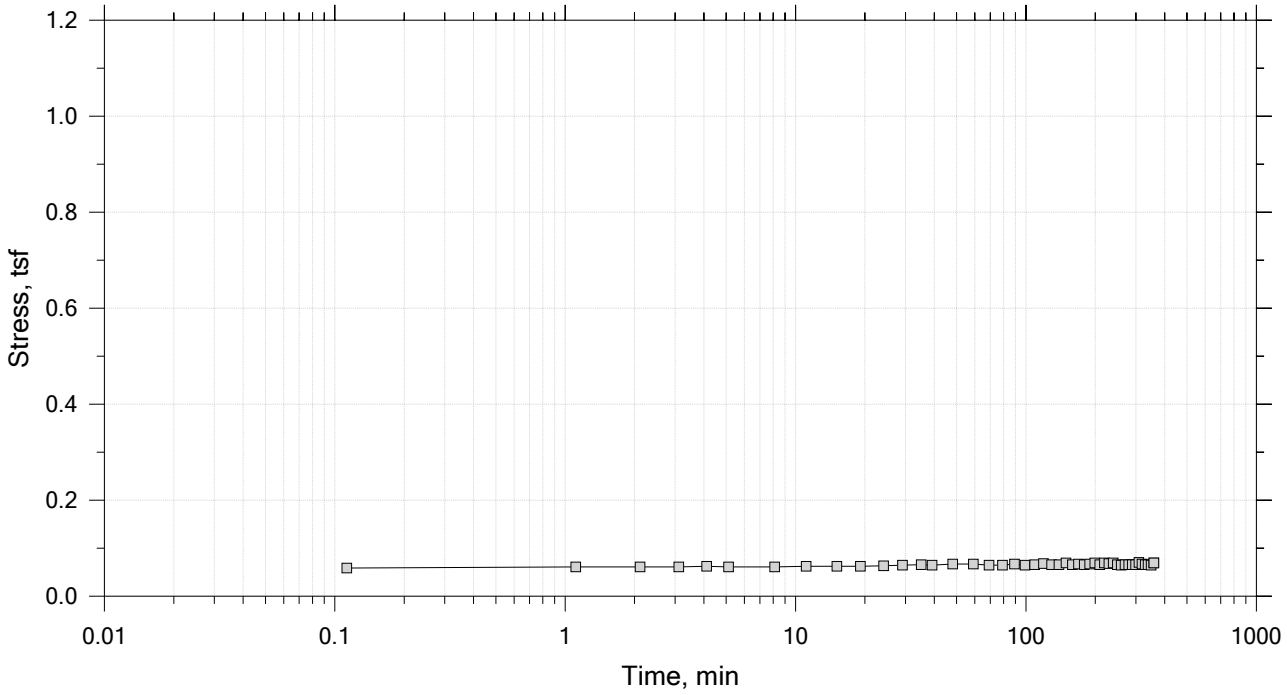


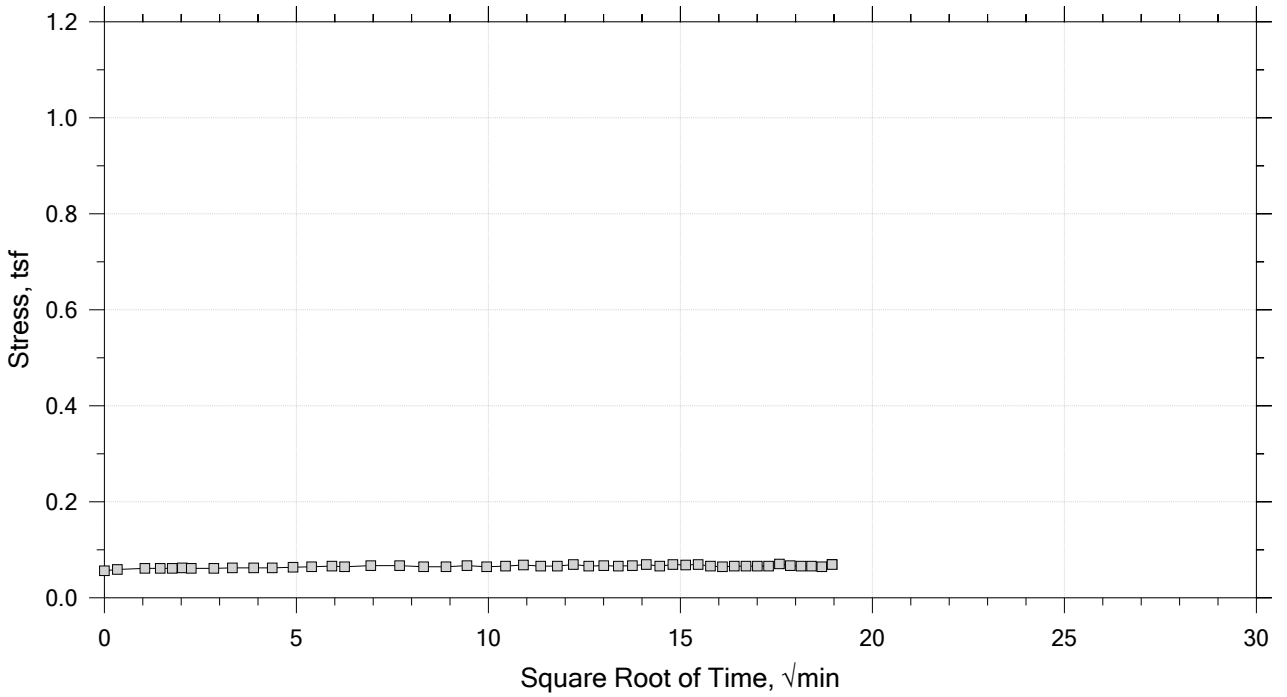


GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, greenish gray silt		
	Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 15
Constant Volume Step
Stress: 0.0693 tsf





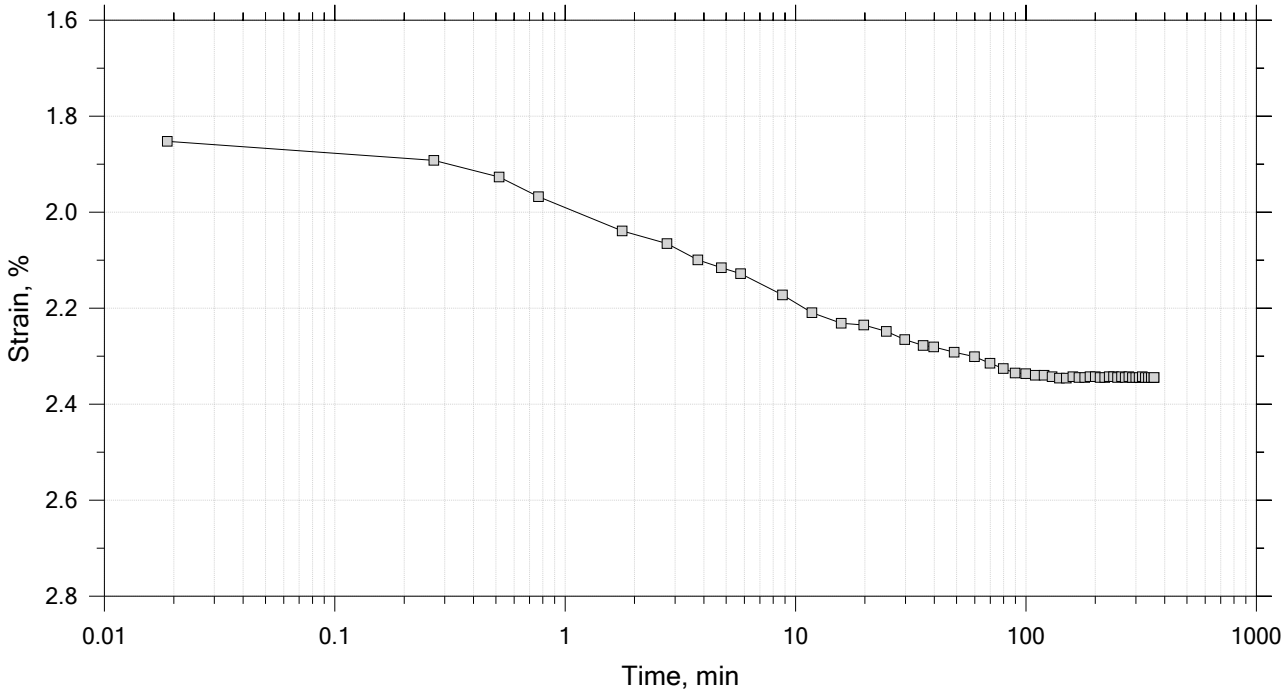
GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, greenish gray silt		
	Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

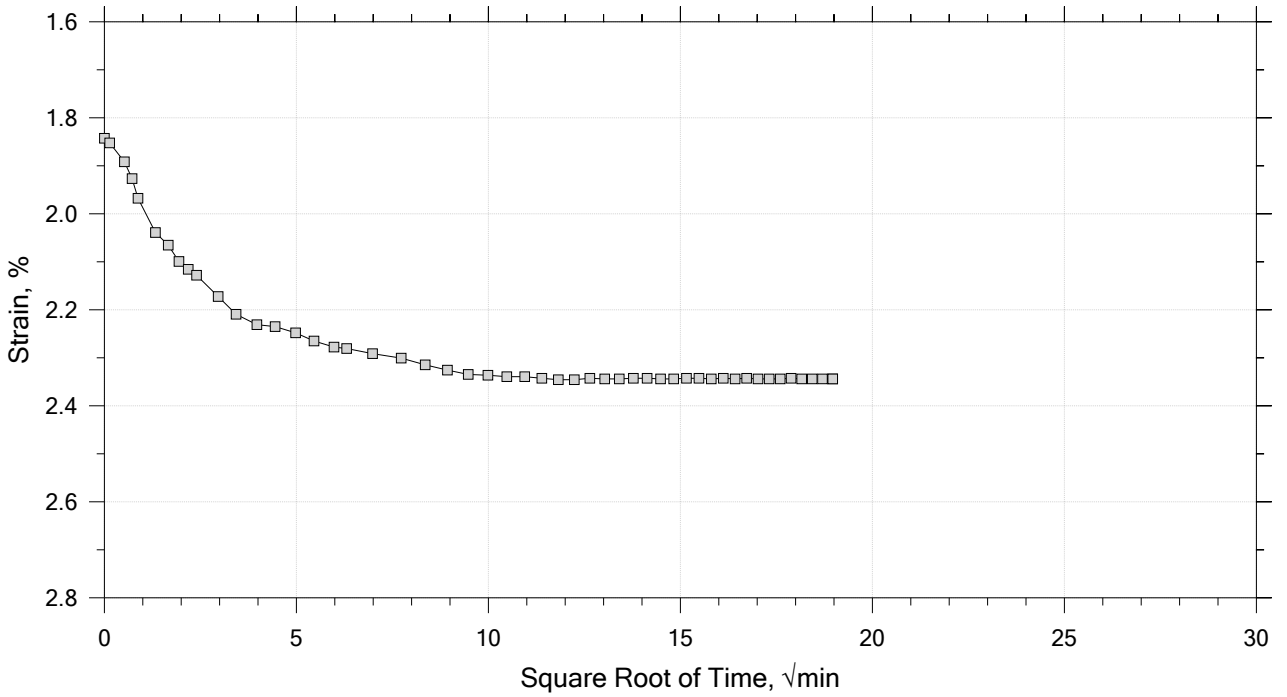
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 15

Constant Load Step

Stress: 0.125 tsf





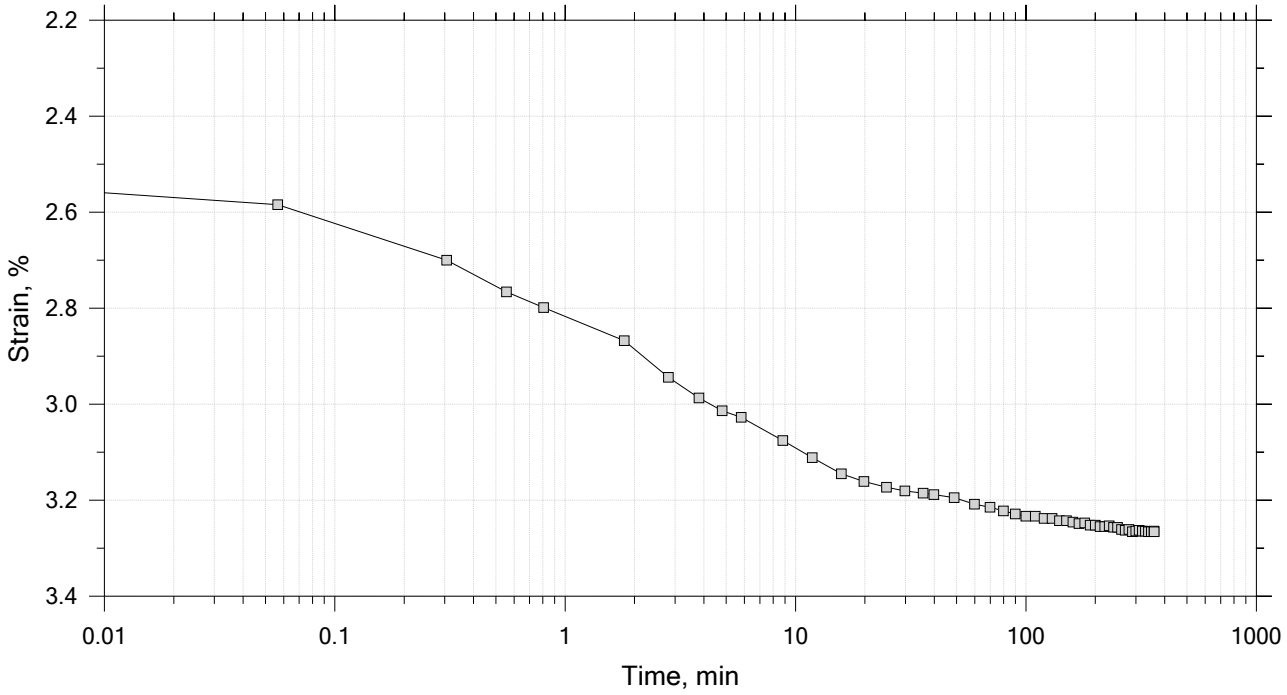
Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, greenish gray silt		
Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

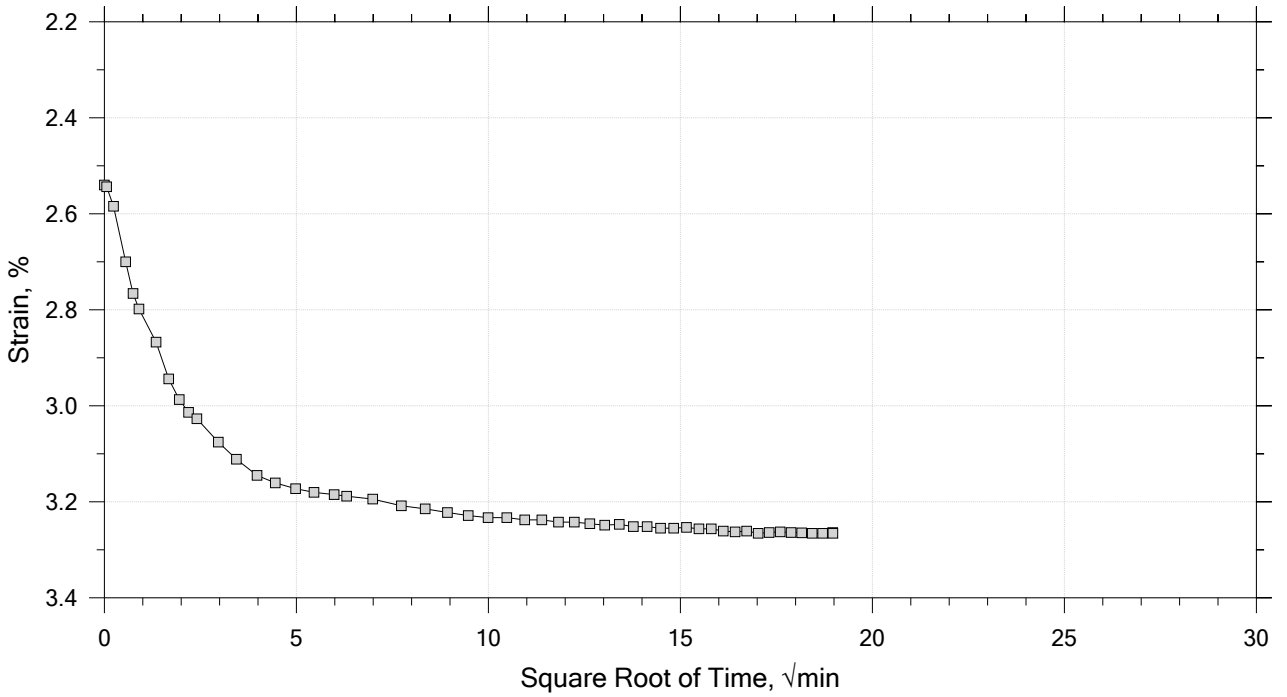
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 15

Constant Load Step

Stress: 0.25 tsf





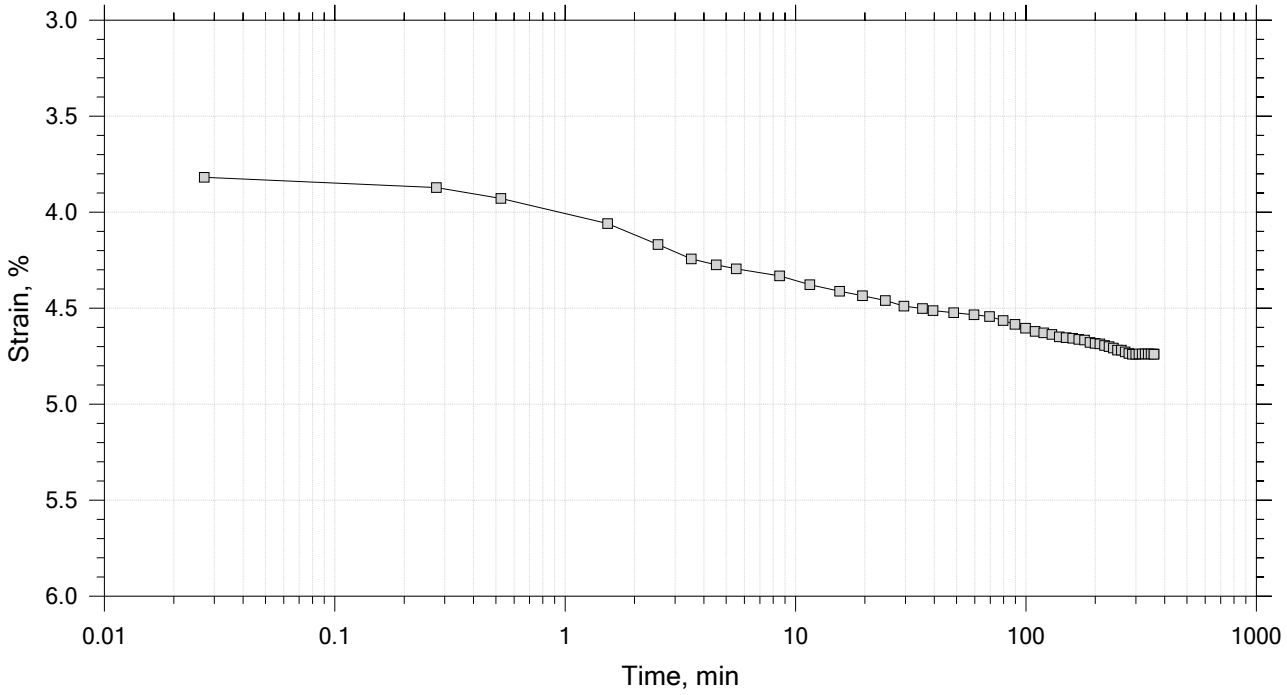
GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, greenish gray silt		
	Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

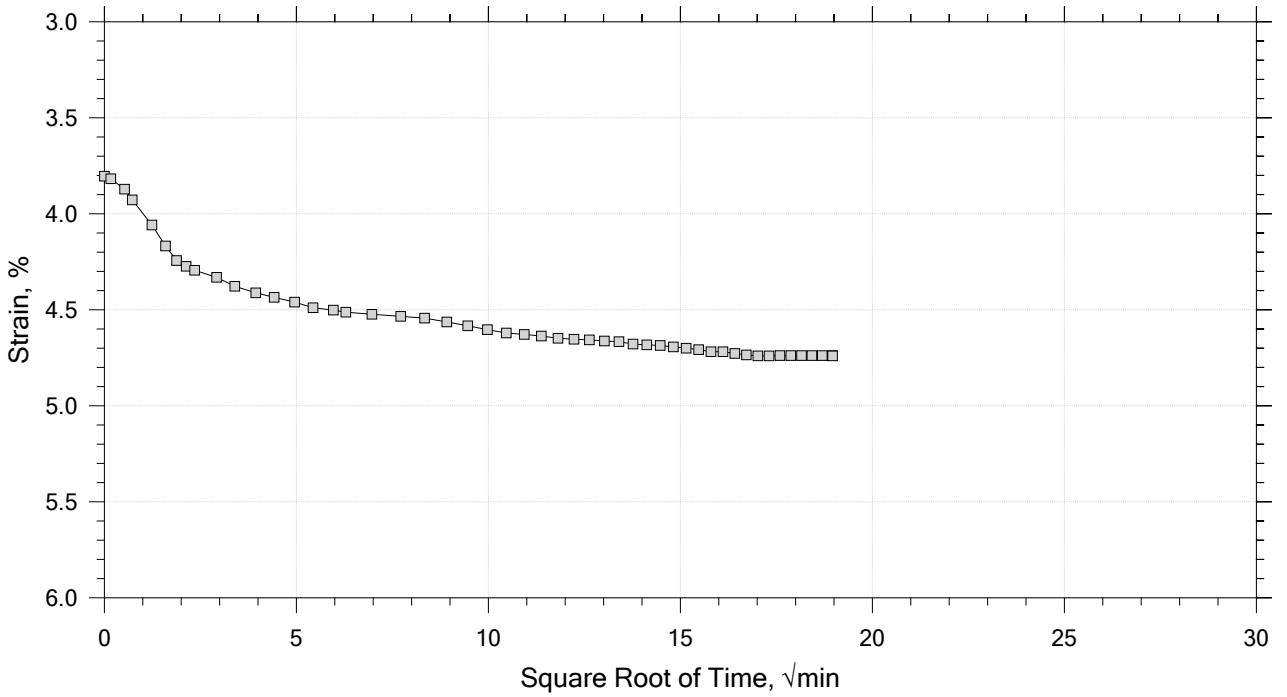
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 15

Constant Load Step

Stress: 0.5 tsf





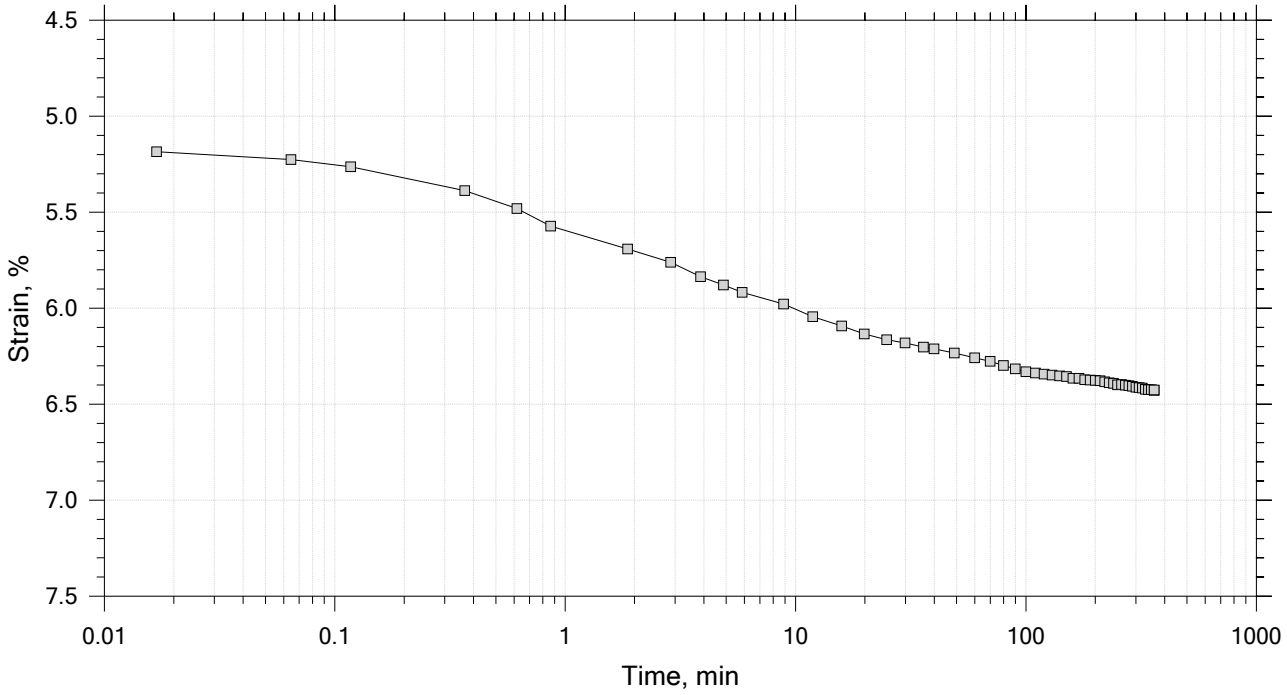
GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, greenish gray silt		
	Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

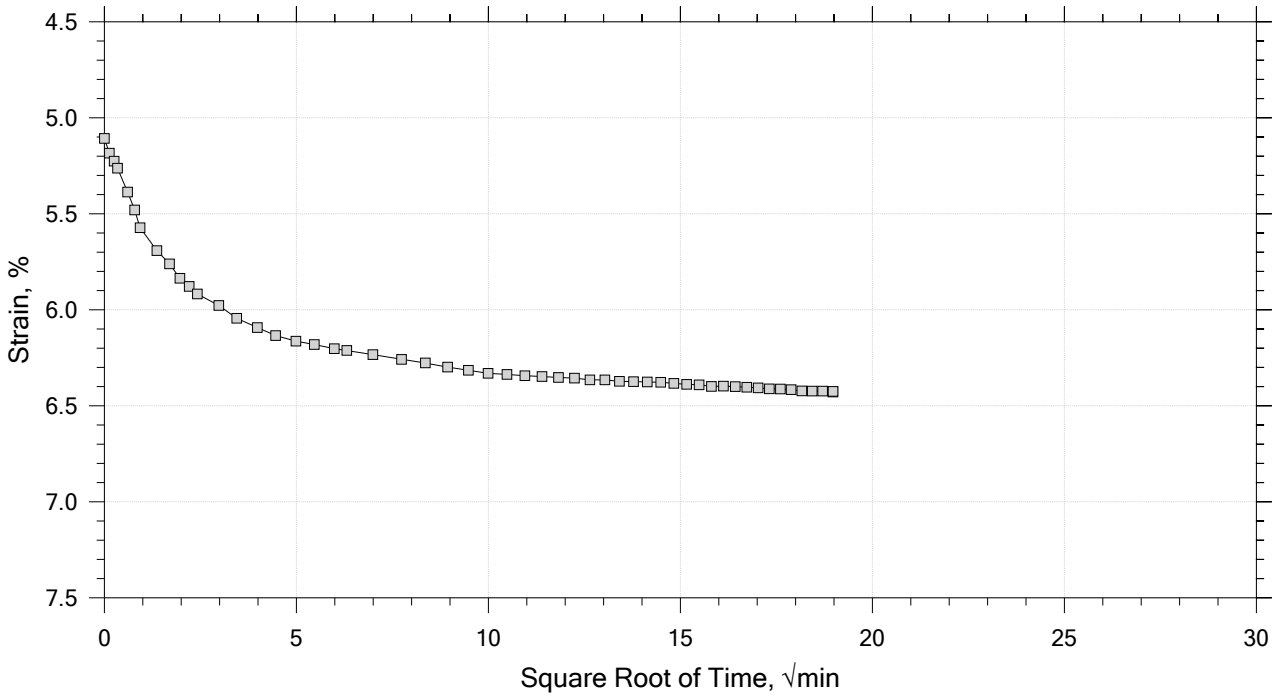
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 15

Constant Load Step

Stress: 1 tsf





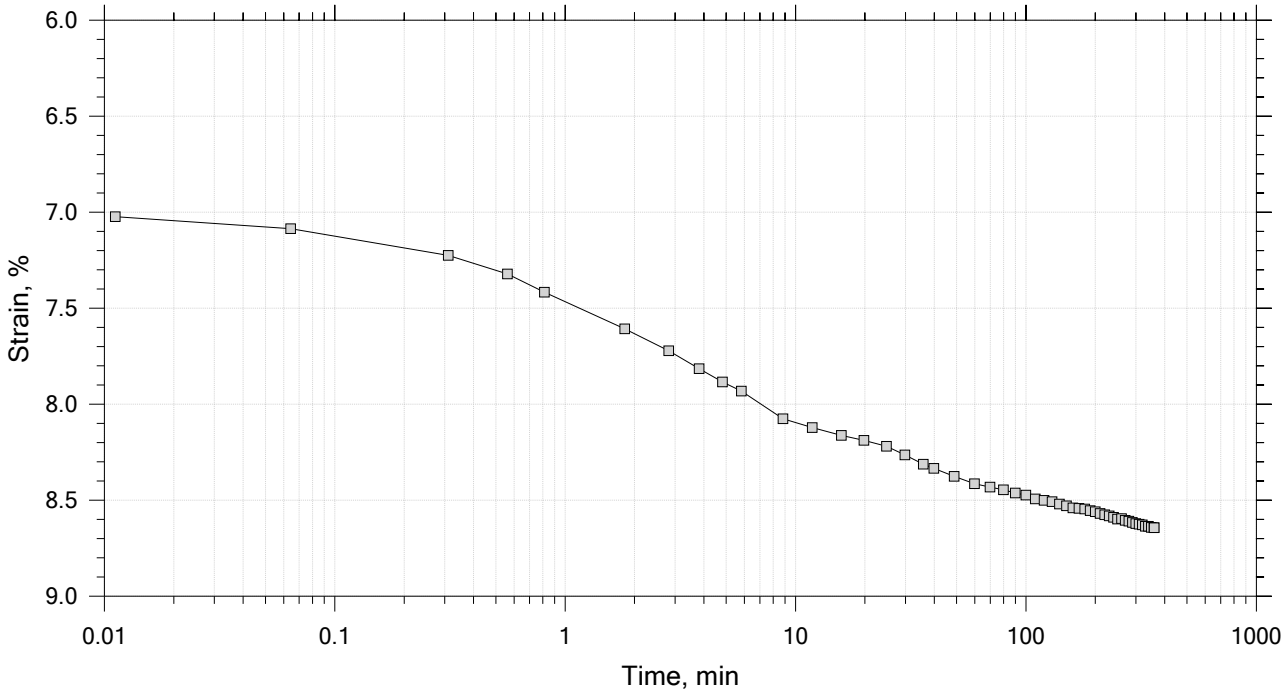
Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, greenish gray silt		
Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

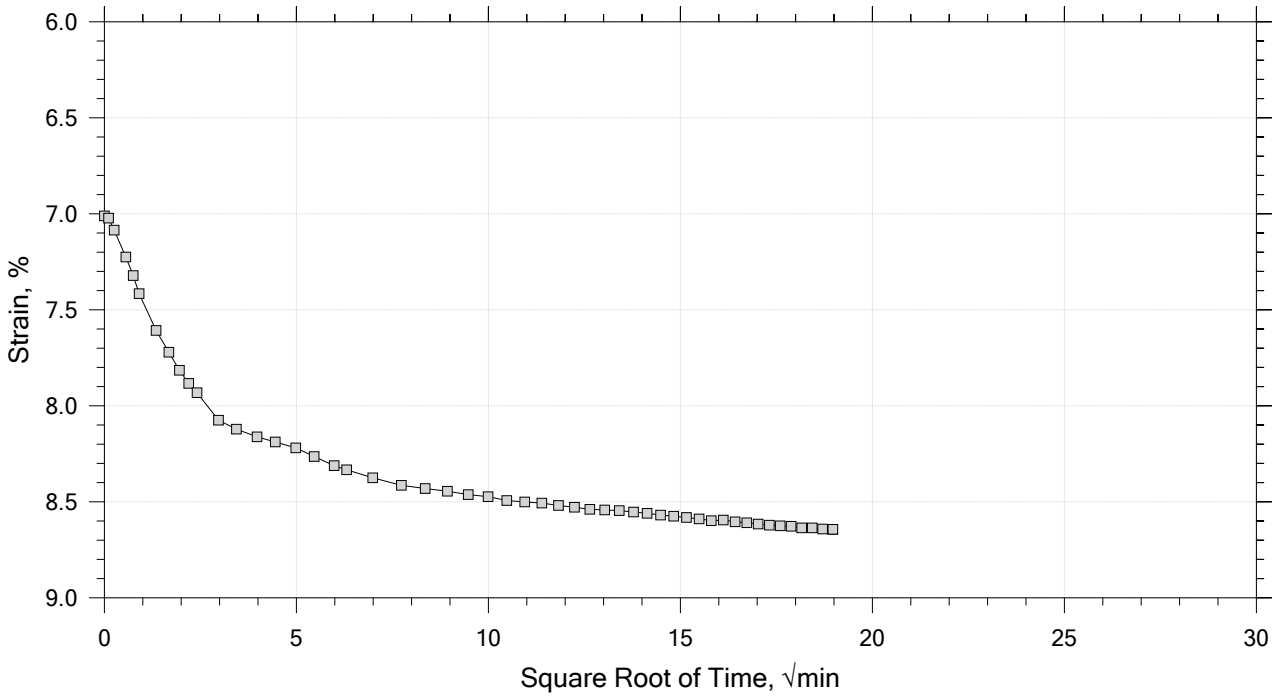
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 15

Constant Load Step

Stress: 2 tsf





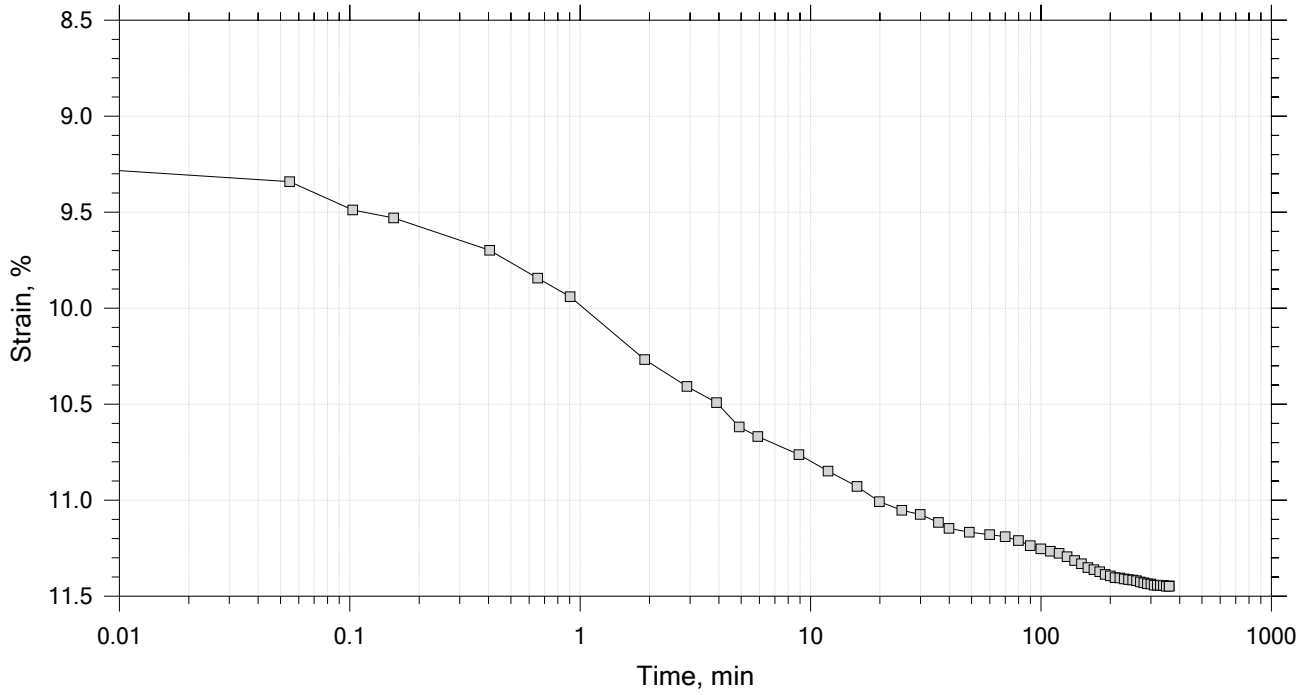
GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, greenish gray silt		
	Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

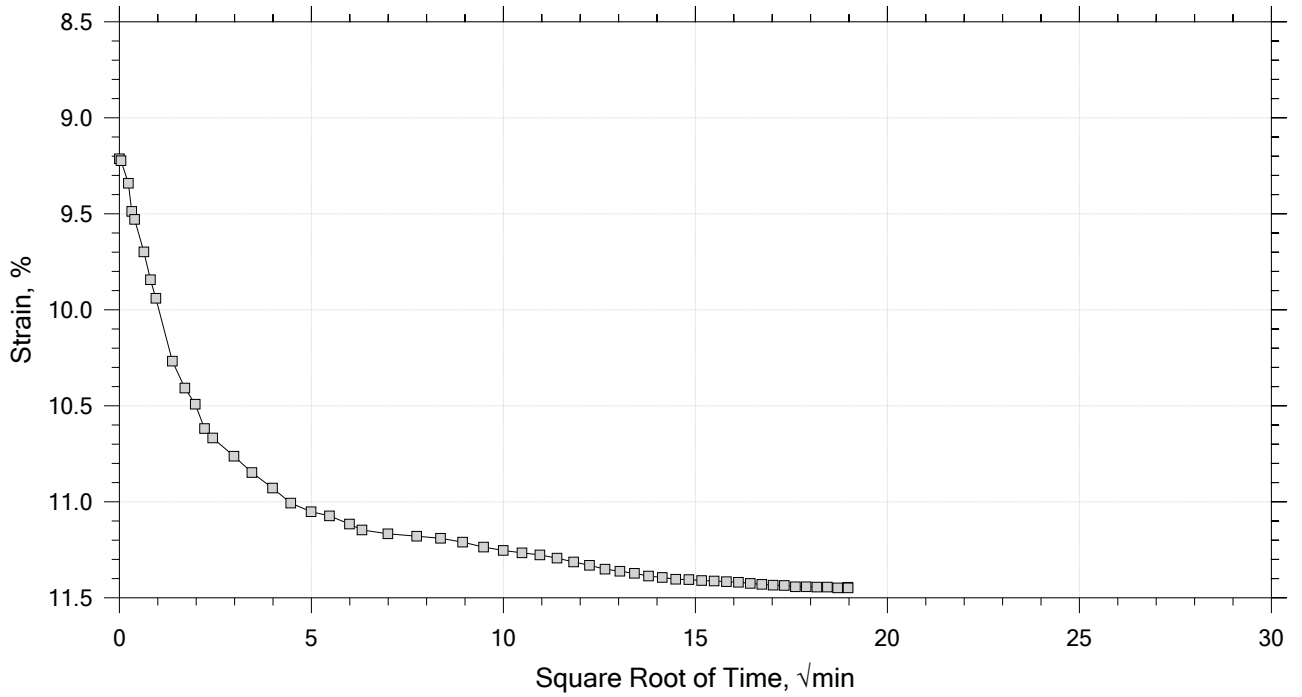
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 15

Constant Load Step

Stress: 4 tsf





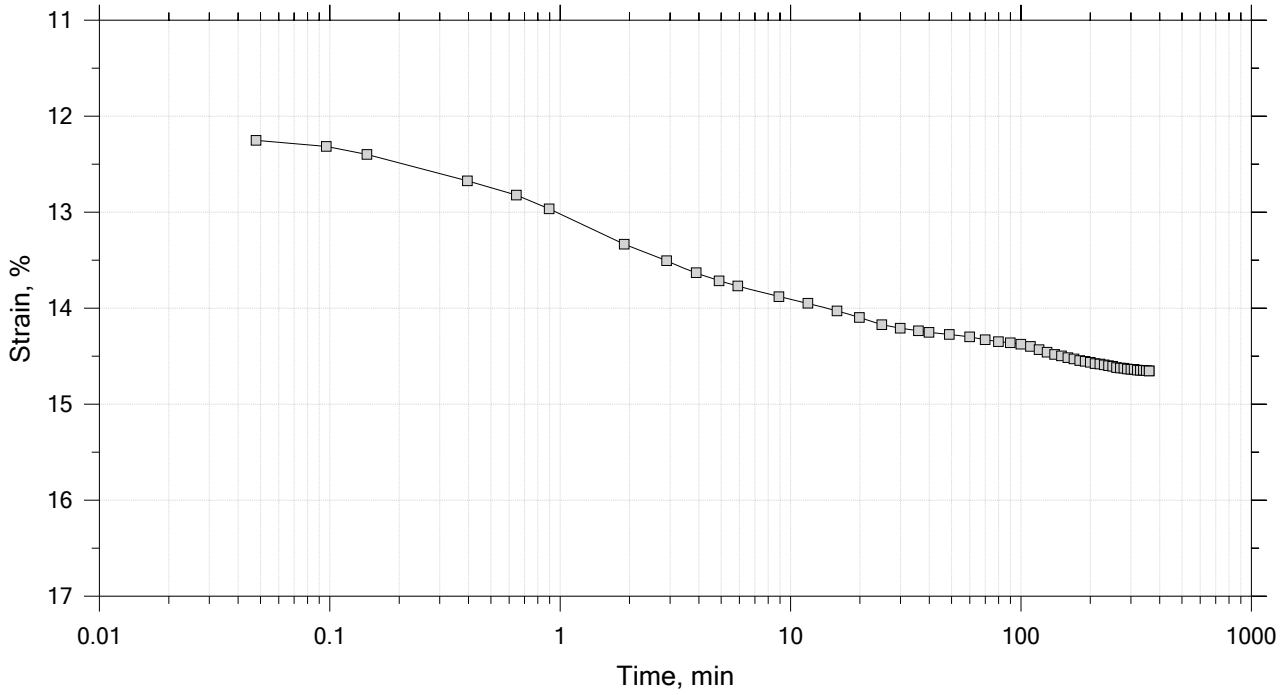
GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, greenish gray silt		
	Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

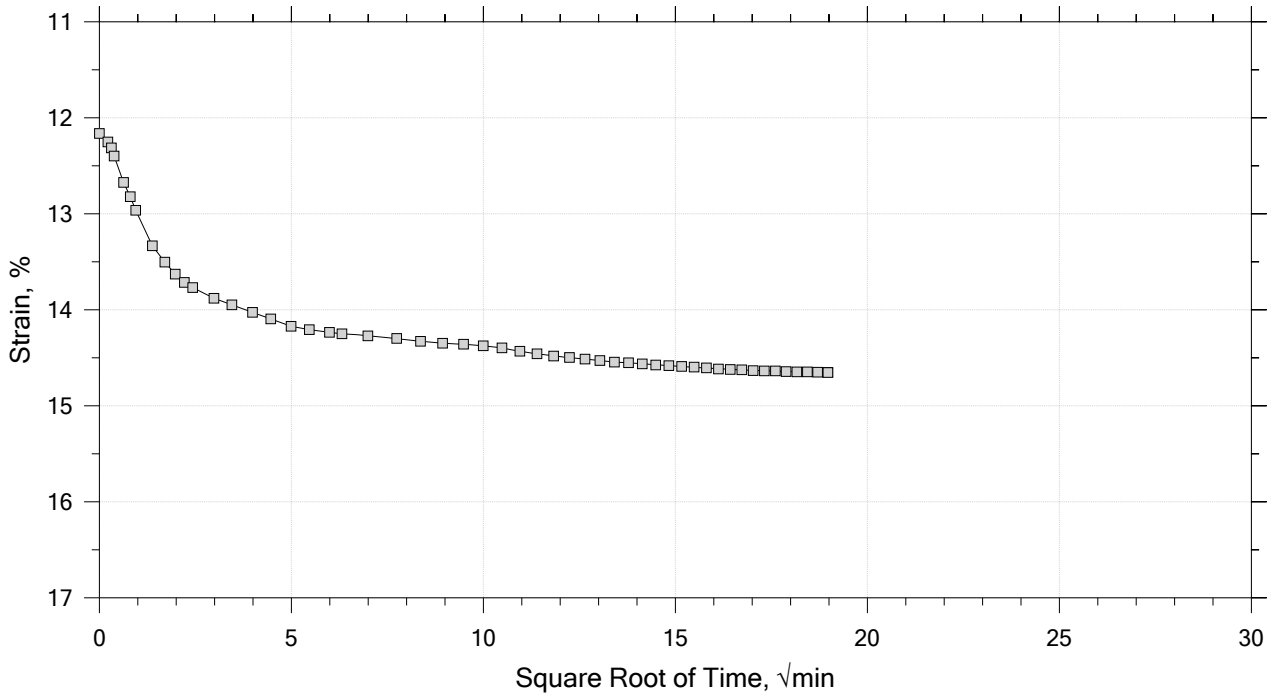
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 15

Constant Load Step

Stress: 8 tsf





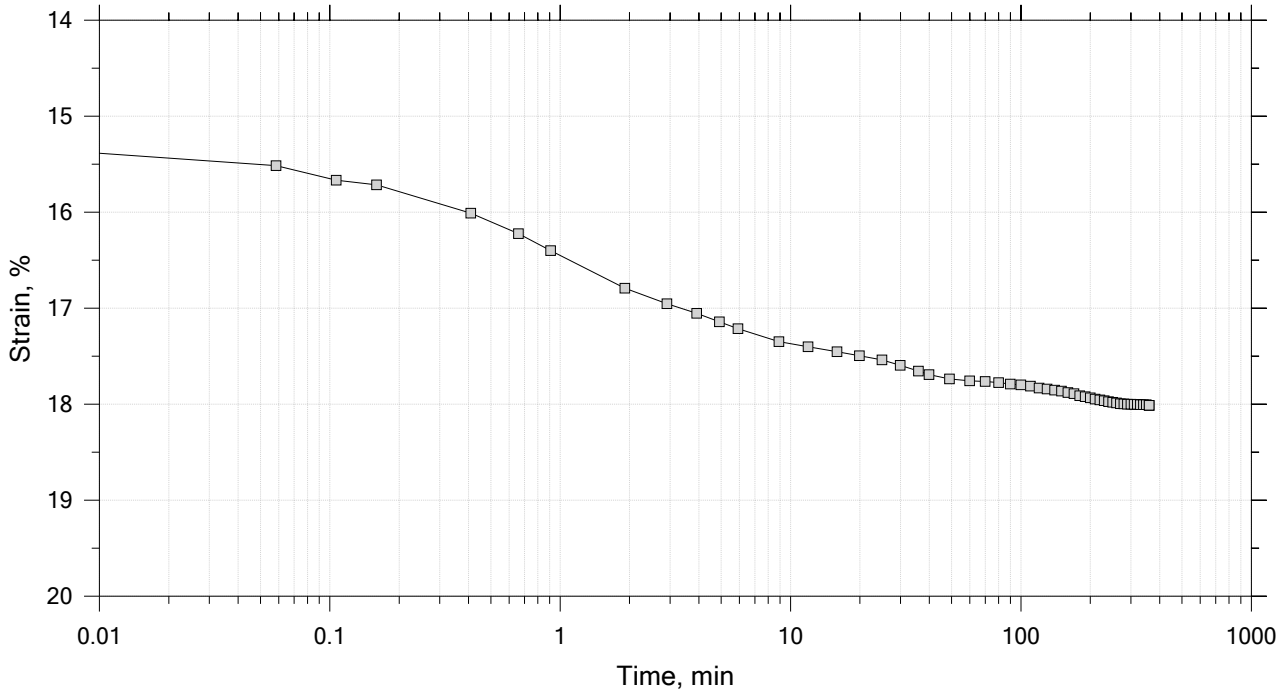
GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, greenish gray silt		
	Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

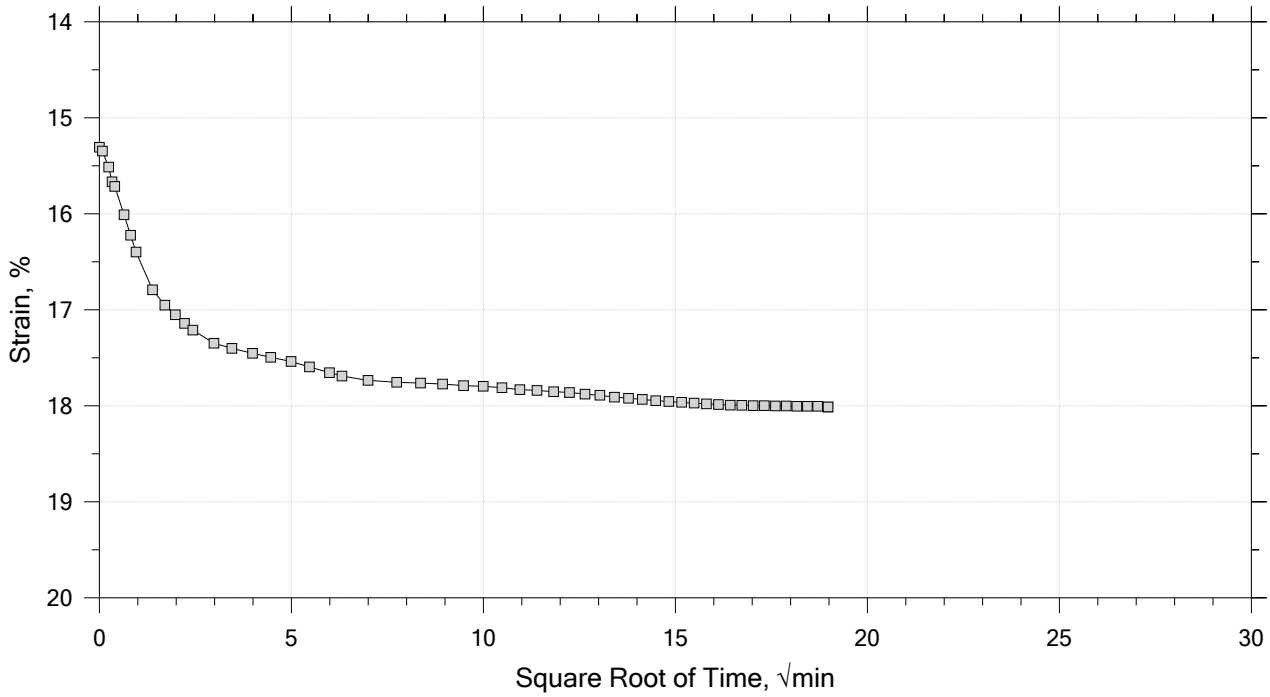
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 15

Constant Load Step

Stress: 16 tsf

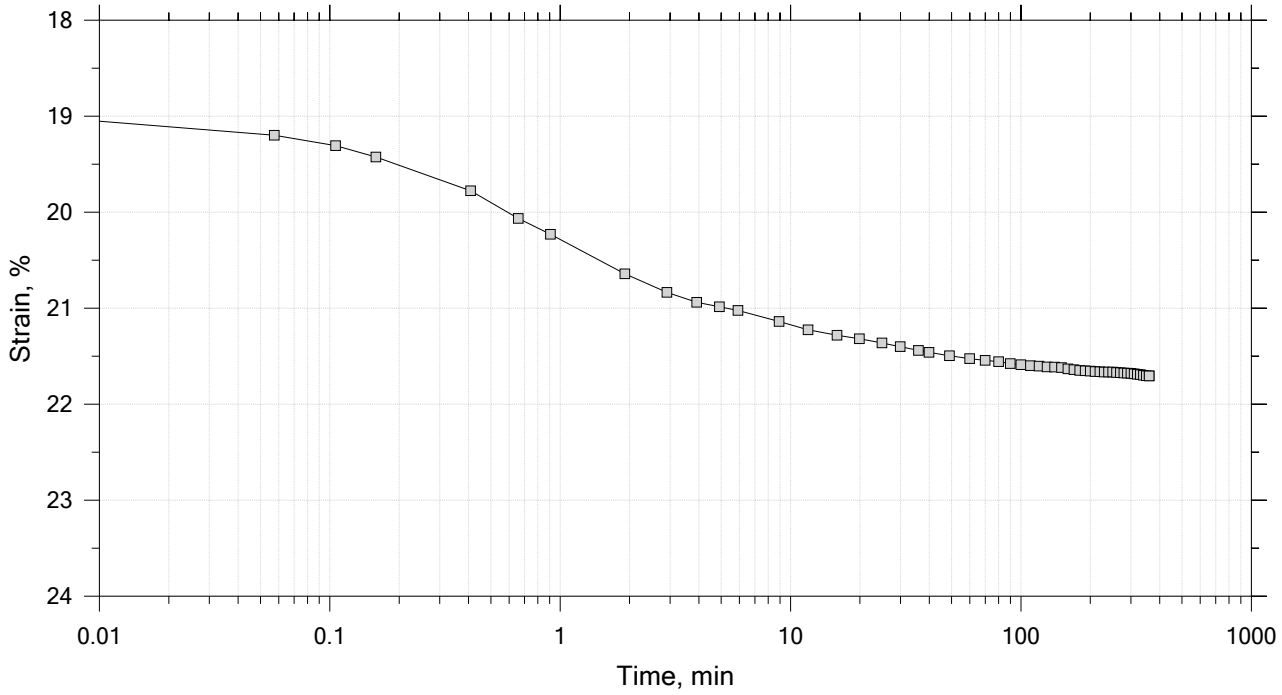


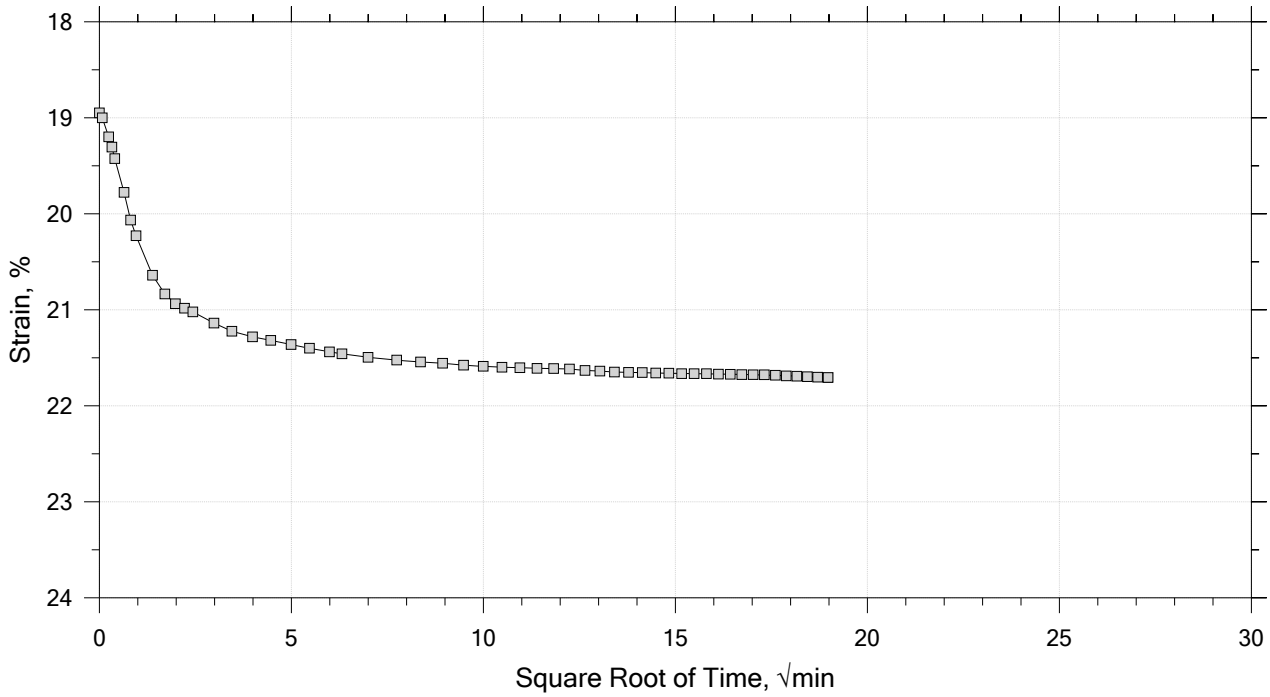


GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, greenish gray silt		
	Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 15
Constant Load Step
Stress: 32 tsf

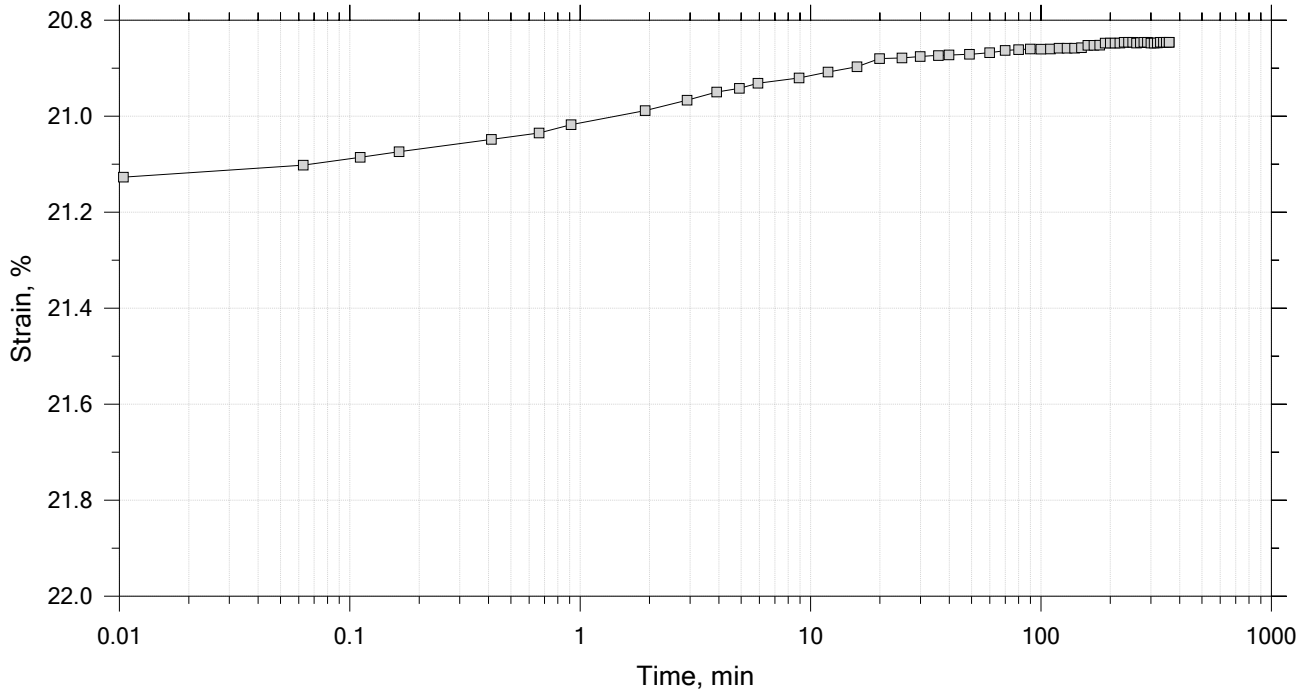


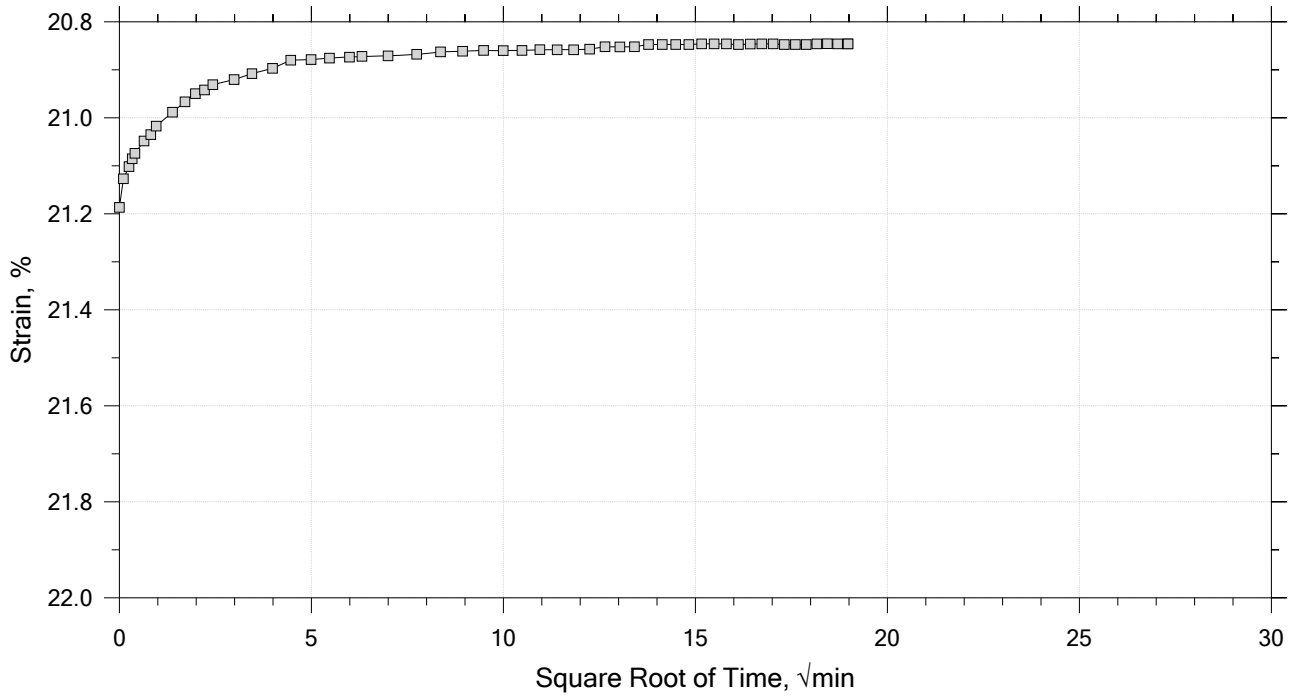


GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, greenish gray silt		
	Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 15
Constant Load Step
Stress: 8 tsf

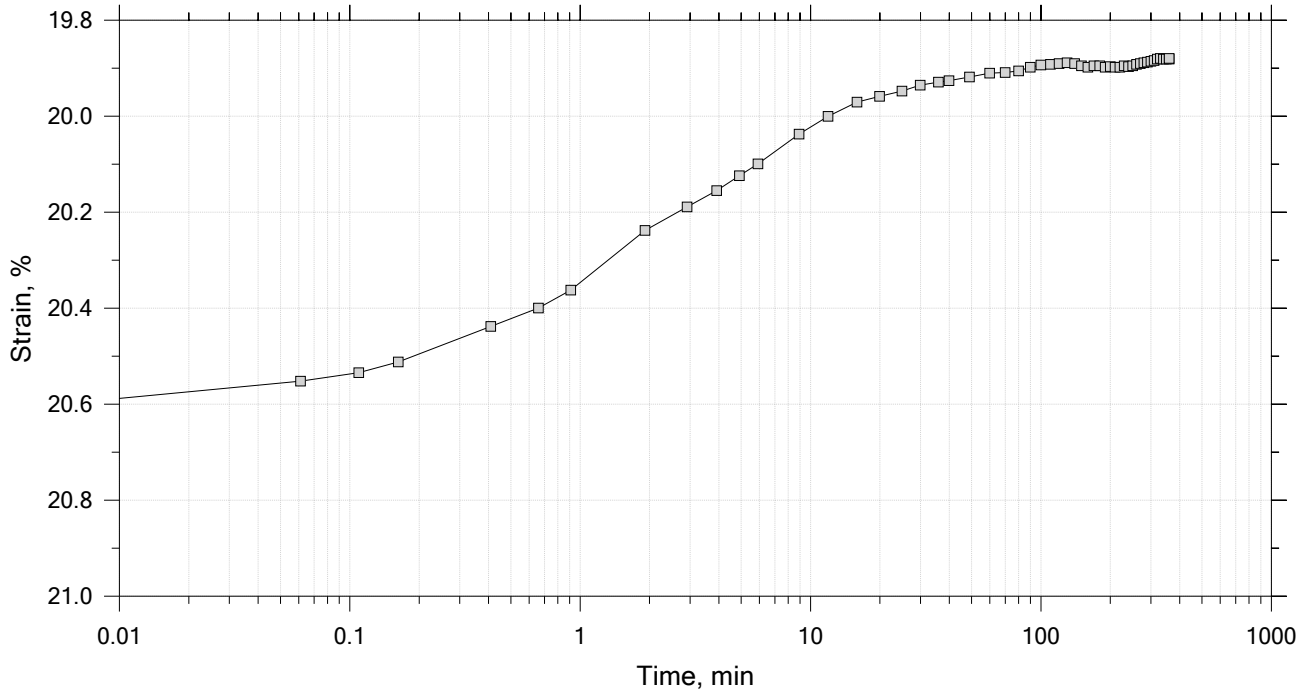


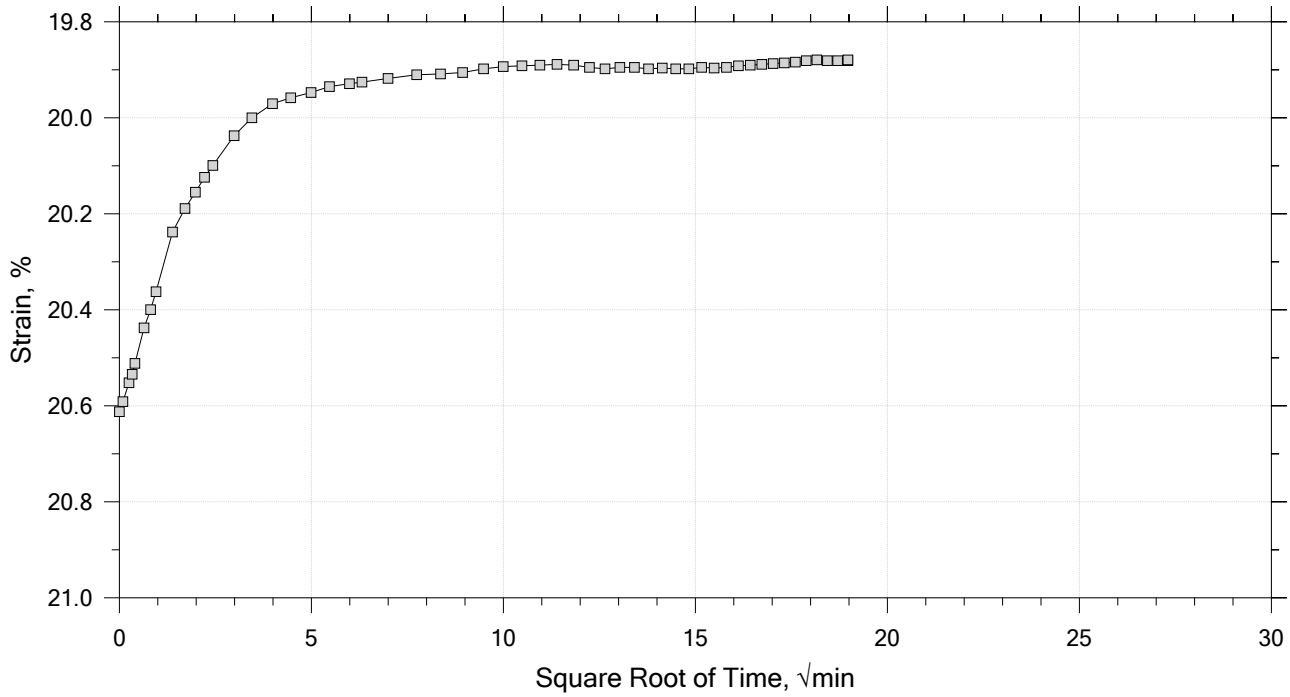


GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, greenish gray silt		
	Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 15
Constant Load Step
Stress: 2 tsf

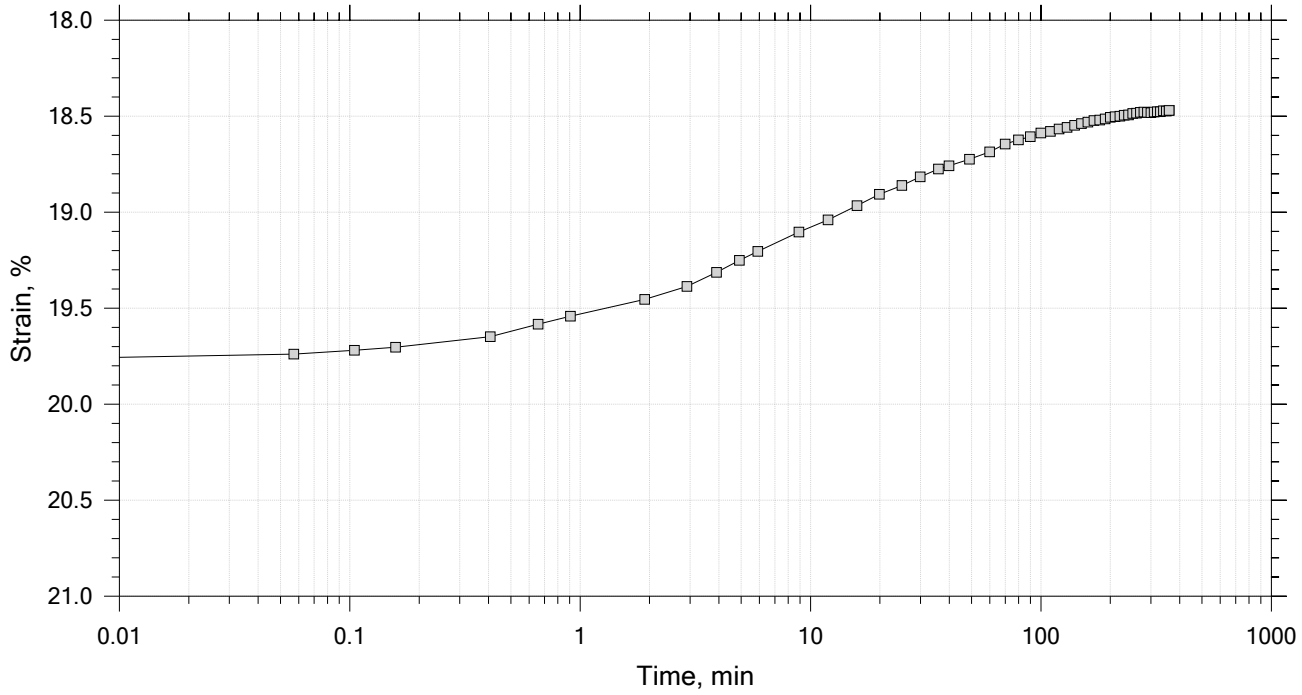


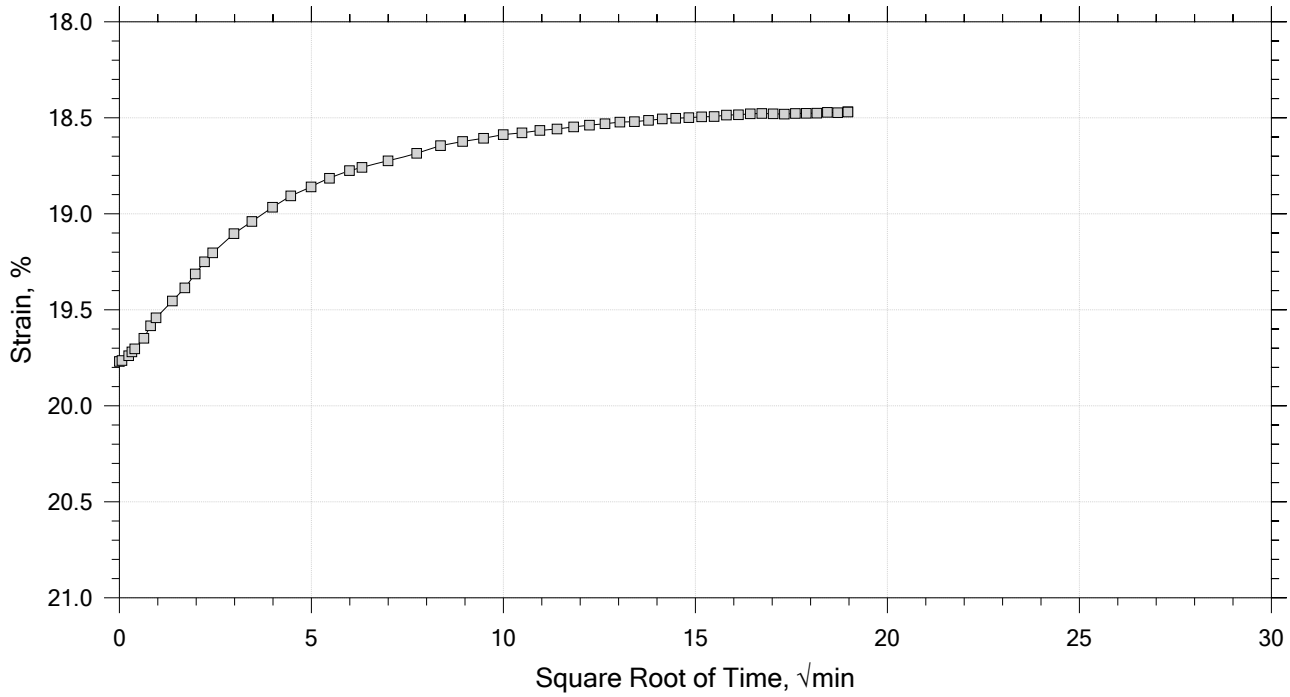


GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, greenish gray silt		
	Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 15
Constant Load Step
Stress: 0.5 tsf

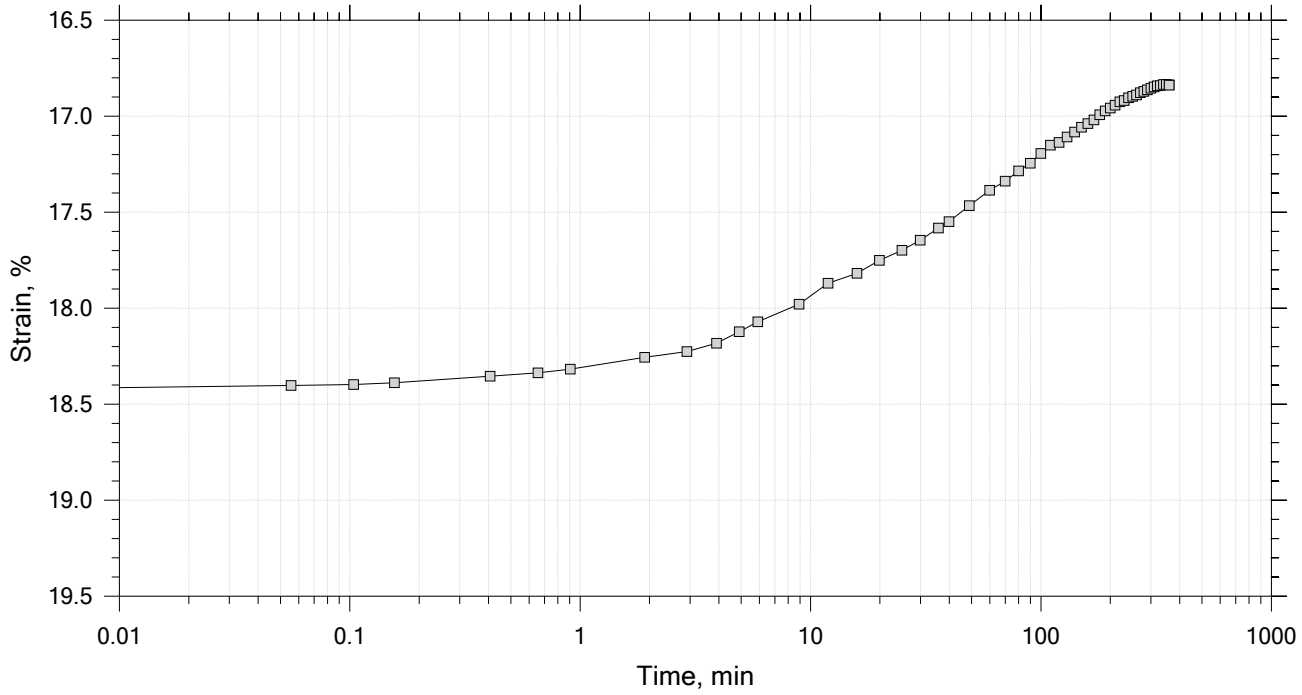


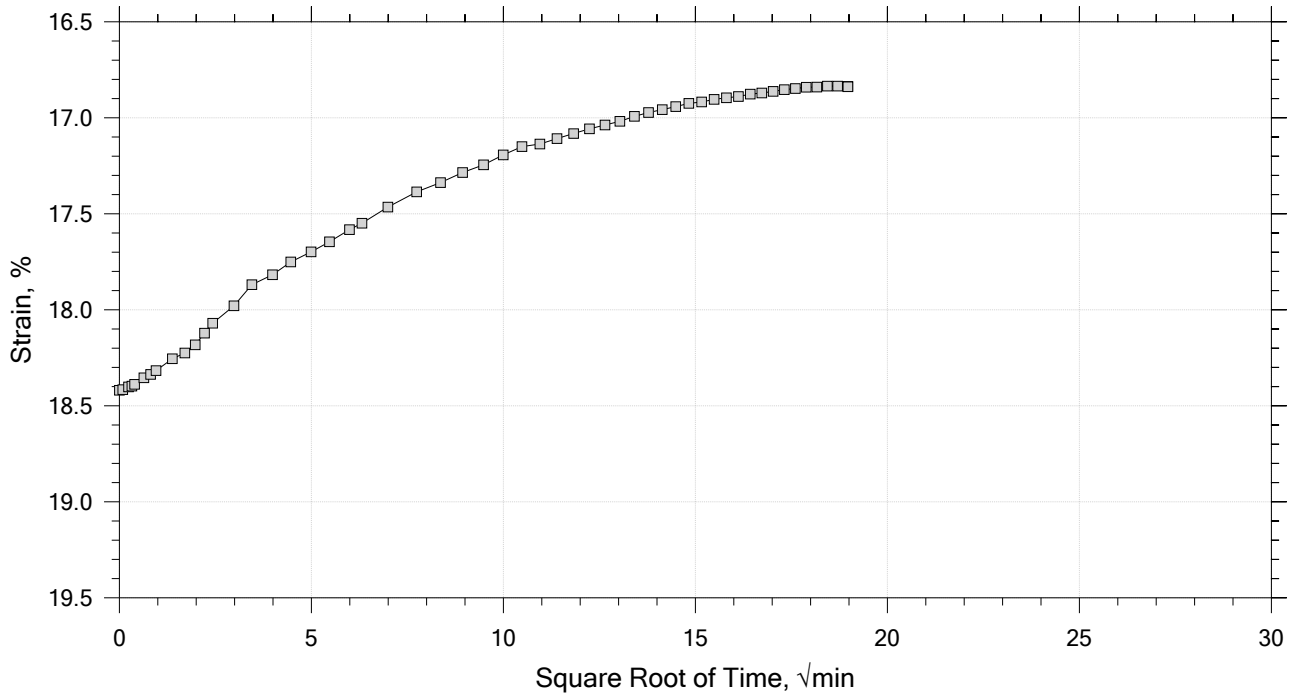


GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, greenish gray silt		
	Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 15
Constant Load Step
Stress: 0.125 tsf

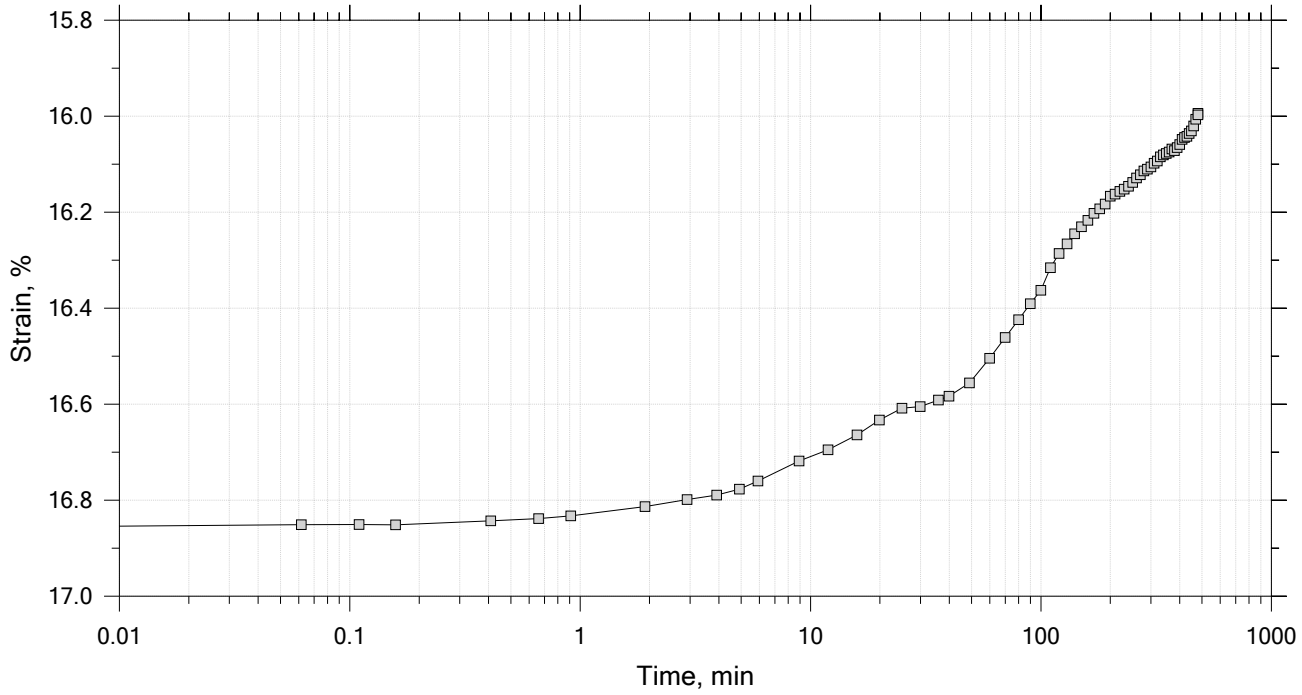


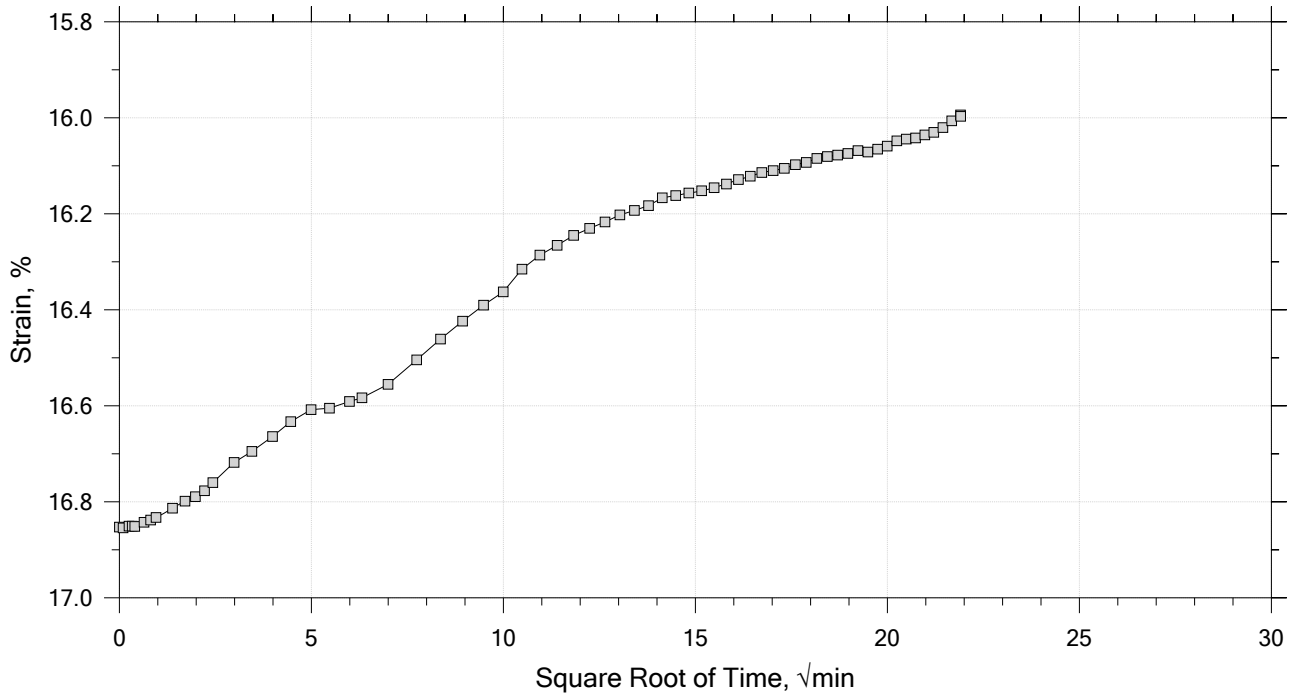


Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, greenish gray silt		
Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 15
Constant Load Step
Stress: 0.0625 tsf





GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, greenish gray silt		
	Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 2.50 in	Estimated Specific Gravity: 2.75	Liquid Limit: 39
Initial Height: 1.00 in	Initial Void Ratio: 0.981	Plastic Limit: 27
Final Height: 0.84 in	Final Void Ratio: 0.664	Plasticity Index: 12

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	E2875	RING		B-1369
Mass Container, gm	8.51	109.78	109.78	8.14
Mass Container + Wet Soil, gm	120.12	260.44	248.49	149.64
Mass Container + Dry Soil, gm	90.49	221.52	221.52	122.13
Mass Dry Soil, gm	81.98	111.74	111.74	113.99
Water Content, %	36.14	34.83	24.13	24.13
Void Ratio	---	0.98	0.66	---
Degree of Saturation, %	---	97.69	100.00	---
Dry Unit Weight, pcf	---	86.721	103.24	---

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.

GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, greenish gray silt		
	Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Square Root of Time Coefficients

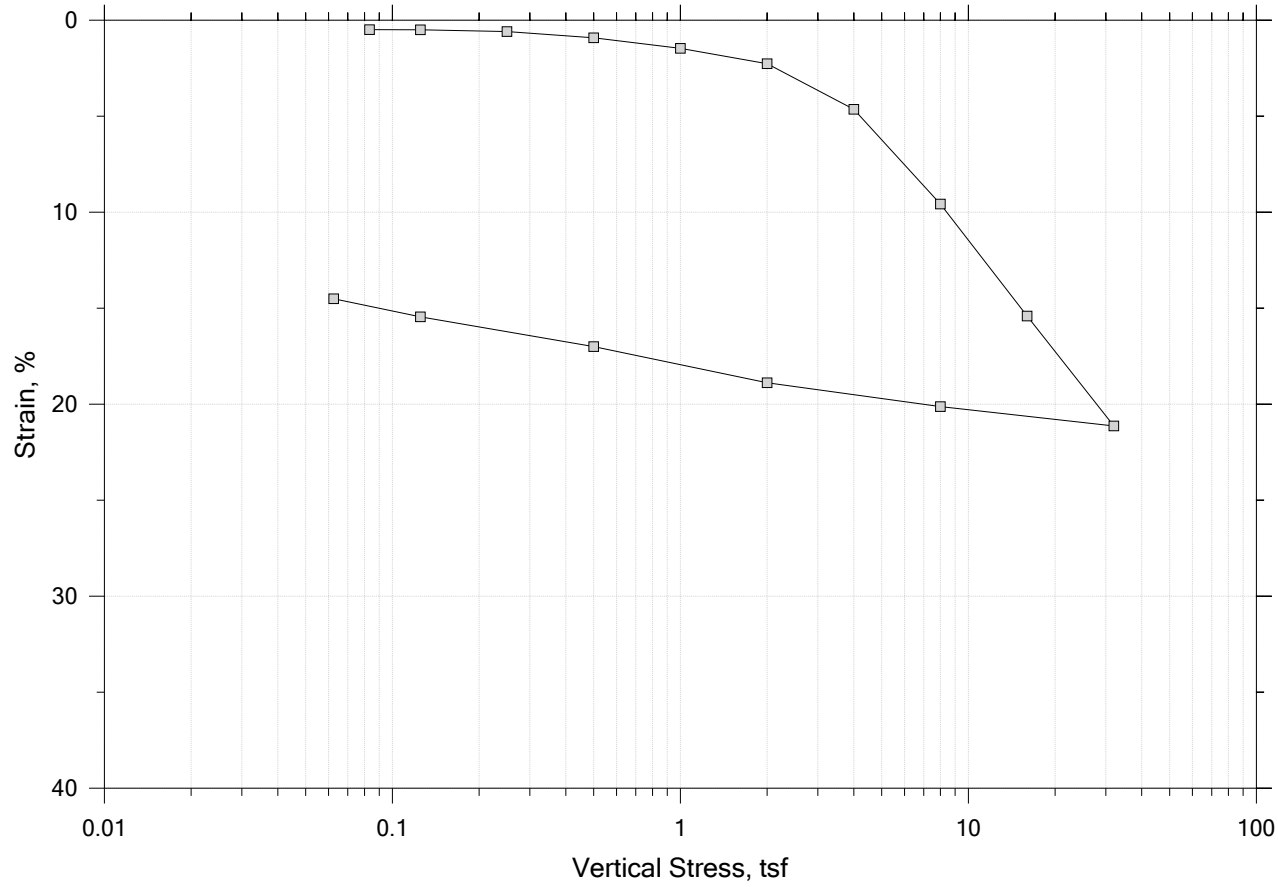
Step	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv in²/s	Mv 1/tsf	k ft/day
1	0.0693	0.01718	0.947	1.72	19.870	1.75e-04	2.48e-01	8.12e-04
2	0.125	0.02344	0.935	2.34	14.918	2.27e-04	1.12e-01	4.78e-04
3	0.250	0.03266	0.916	3.27	6.878	4.85e-04	7.37e-02	6.70e-04
4	0.500	0.04740	0.887	4.74	31.489	1.03e-04	5.90e-02	1.14e-04
5	1.00	0.06425	0.854	6.43	13.968	2.26e-04	3.37e-02	1.42e-04
6	2.00	0.08644	0.810	8.64	16.500	1.83e-04	2.22e-02	7.61e-05
7	4.00	0.1145	0.754	11.4	9.287	3.08e-04	1.40e-02	8.09e-05
8	8.00	0.1465	0.691	14.7	11.750	2.27e-04	8.01e-03	3.41e-05
9	16.0	0.1801	0.624	18.0	5.708	4.33e-04	4.20e-03	3.41e-05
10	32.0	0.2171	0.551	21.7	4.263	5.32e-04	2.31e-03	2.30e-05
11	8.00	0.2085	0.568	20.8	6.537	3.35e-04	3.58e-04	2.25e-06
12	2.00	0.1988	0.587	19.9	8.213	2.73e-04	1.61e-03	8.23e-06
13	0.500	0.1847	0.615	18.5	24.361	9.48e-05	9.39e-03	1.67e-05
14	0.125	0.1684	0.648	16.8	105.393	2.27e-05	4.35e-02	1.85e-05
15	0.0625	0.1600	0.664	16.0	312.393	7.90e-06	1.35e-01	1.99e-05

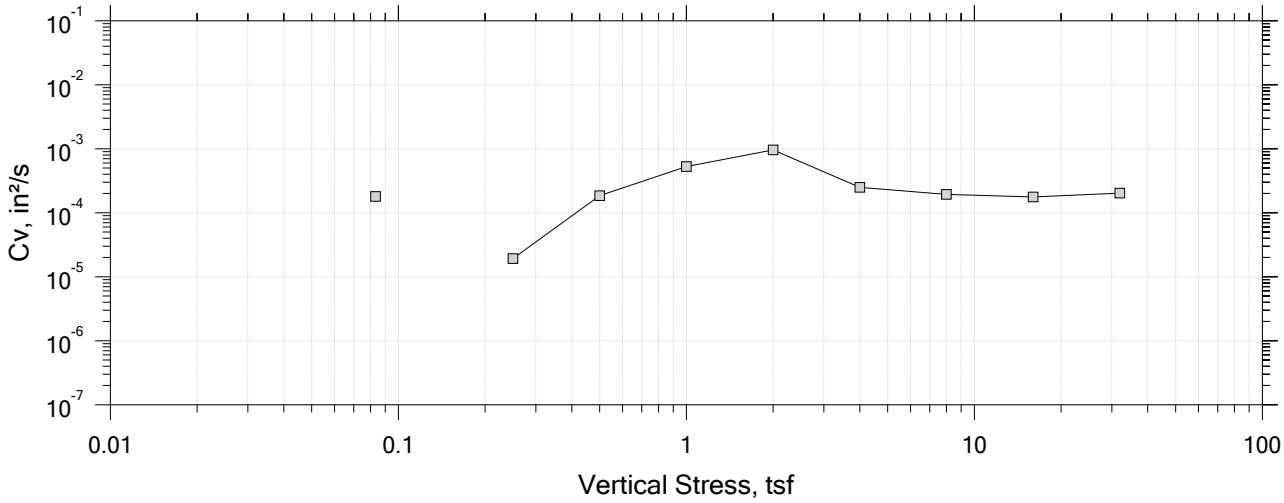
GeoTesting EXPRESS

Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
Boring No.: BB-YRO-204	Tested By: trm	Checked By: njh
Sample No.: U1	Test Date: 6/18/21	Depth: 12-14 ft
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, greenish gray silt		
Remarks: System LTIII-0837, Swell Pressure = 0.0693 tsf		
Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report

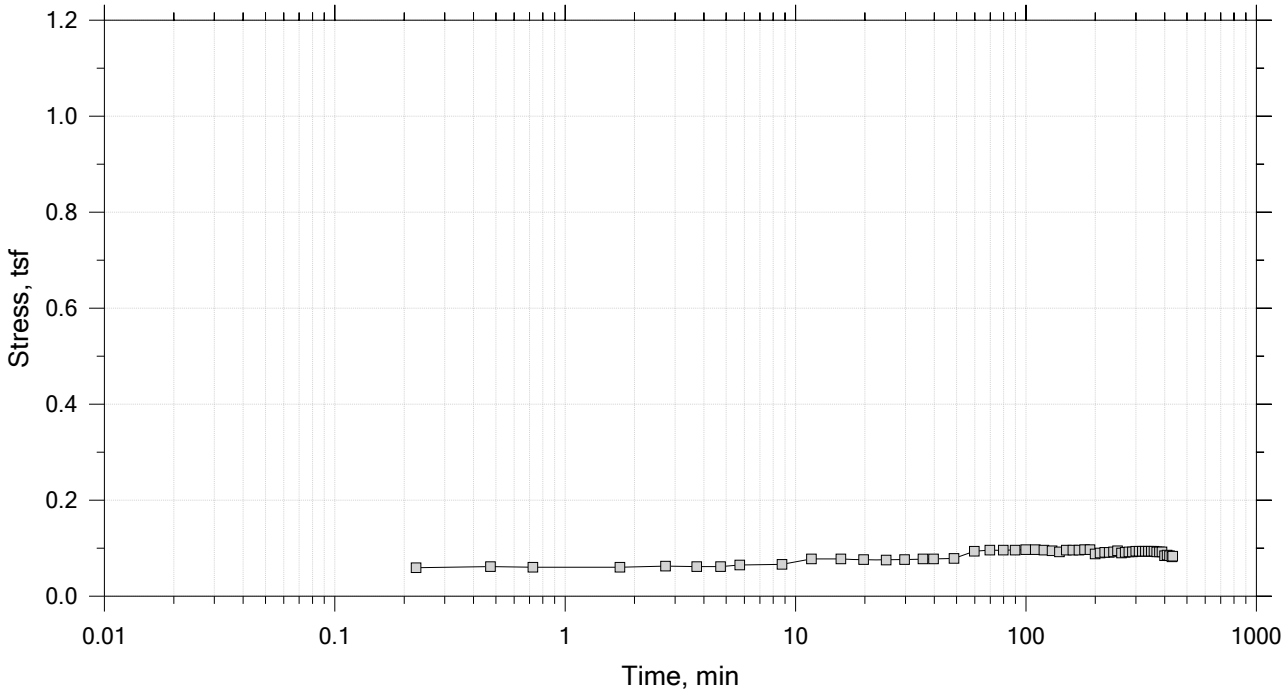


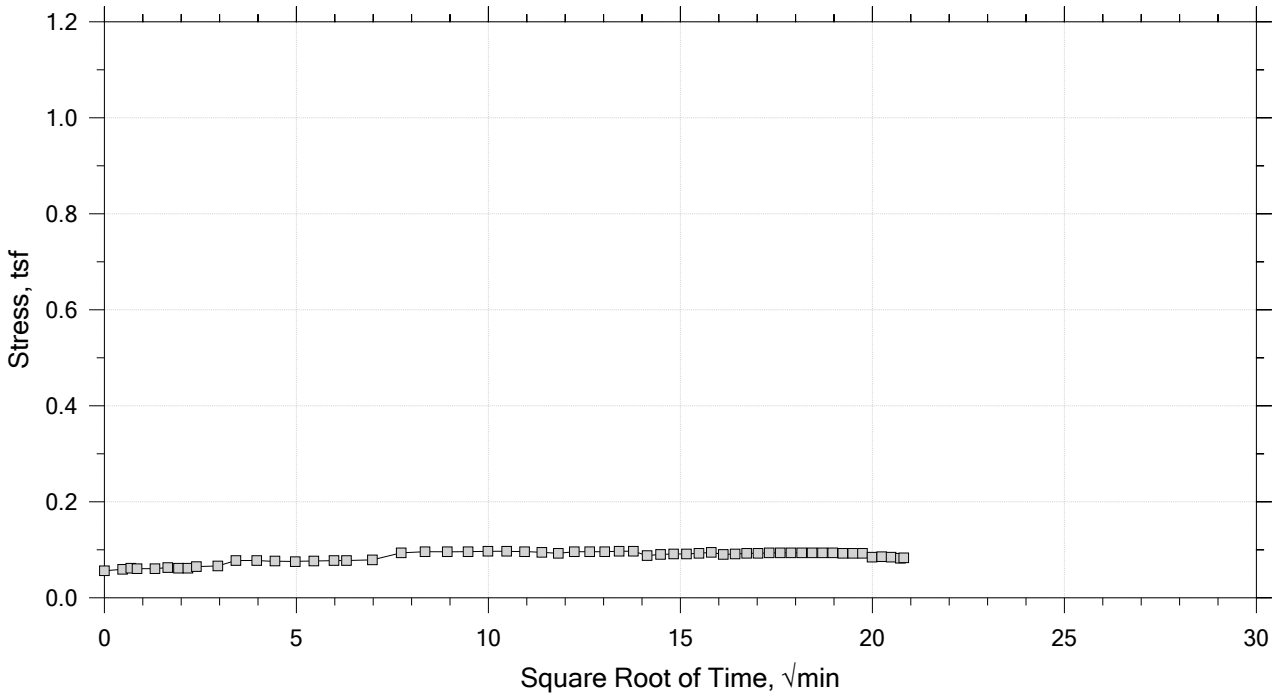


GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System LTIII-0837		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 15
Constant Volume Step
Stress: 0.0833 tsf





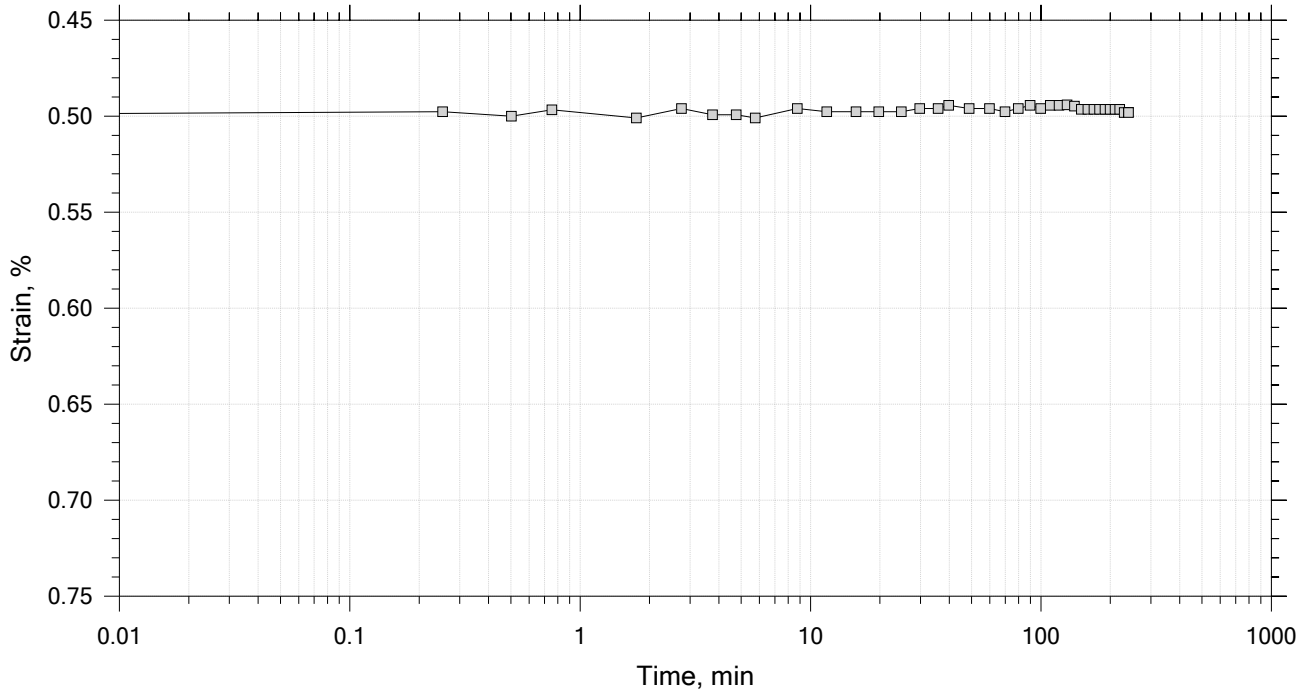
GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System LTIII-0837		

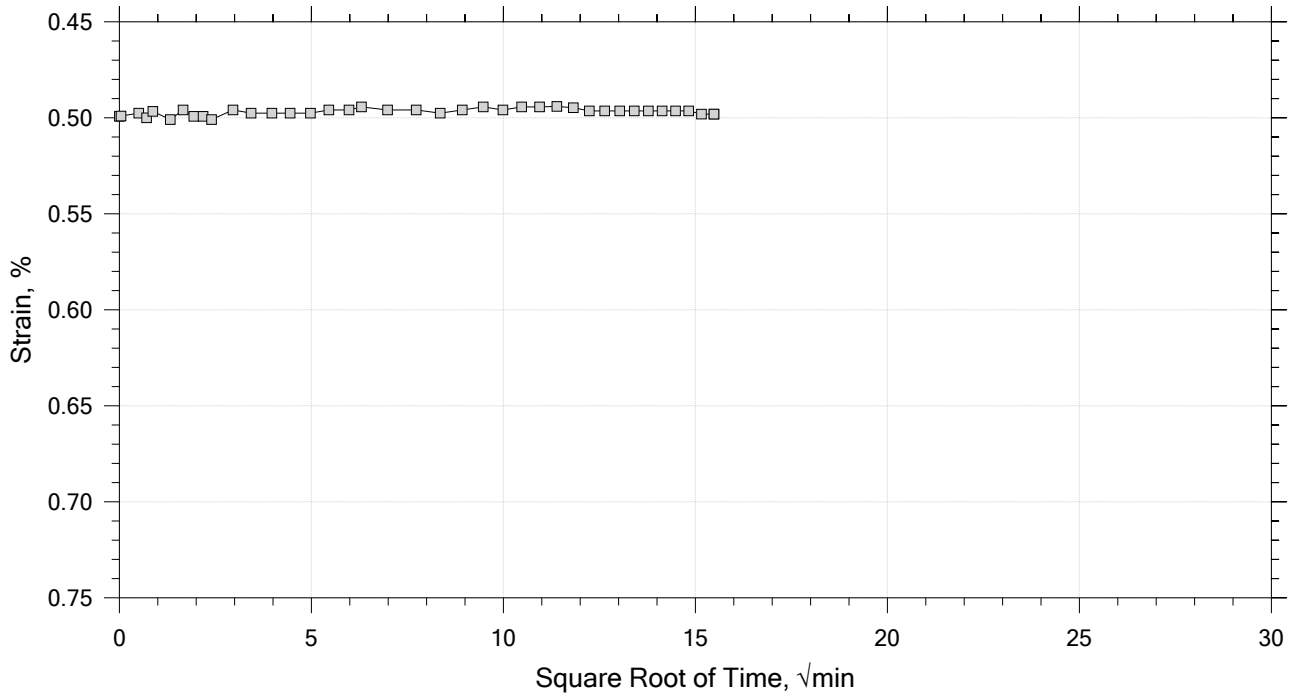
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 15

Constant Load Step

Stress: 0.125 tsf

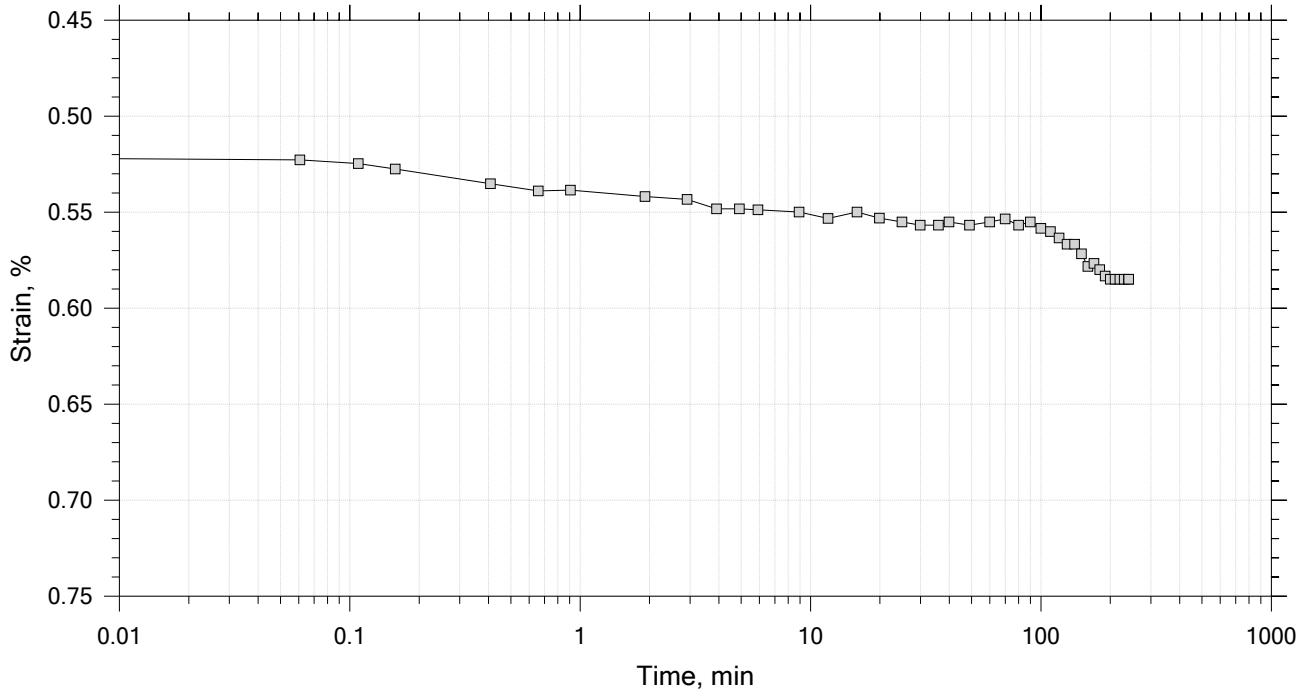


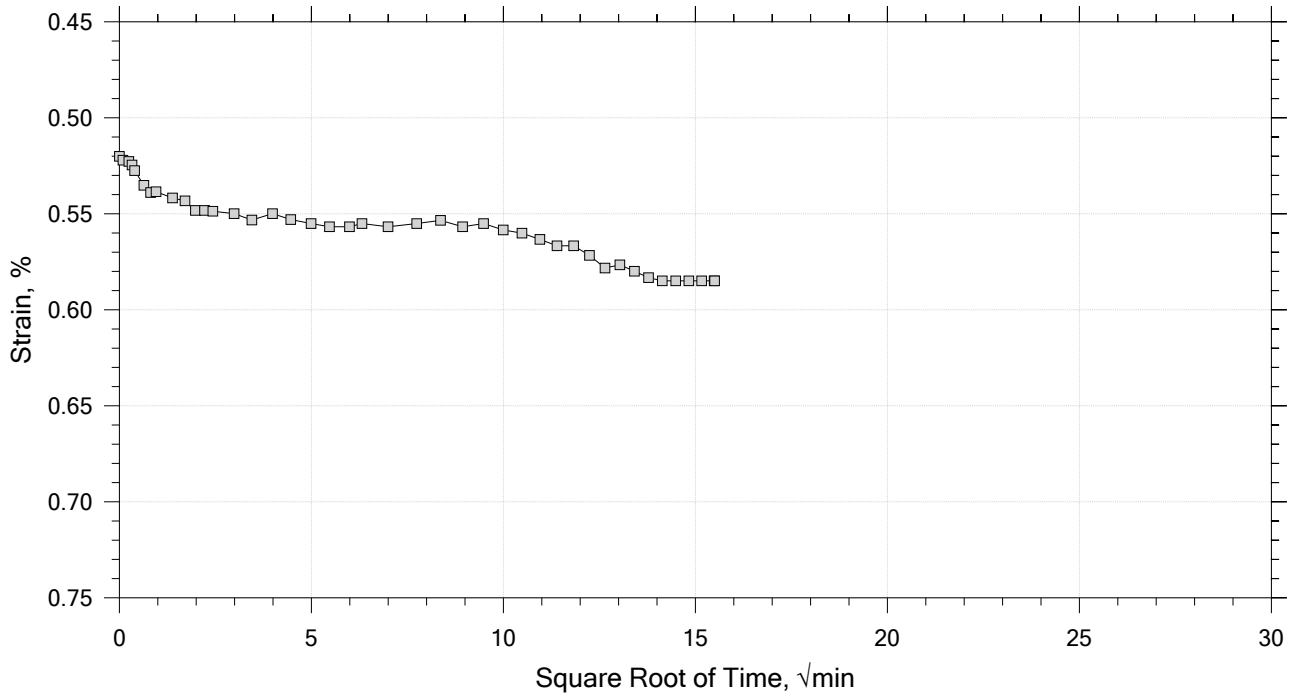


GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System LTIII-0837		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 15
Constant Load Step
Stress: 0.25 tsf





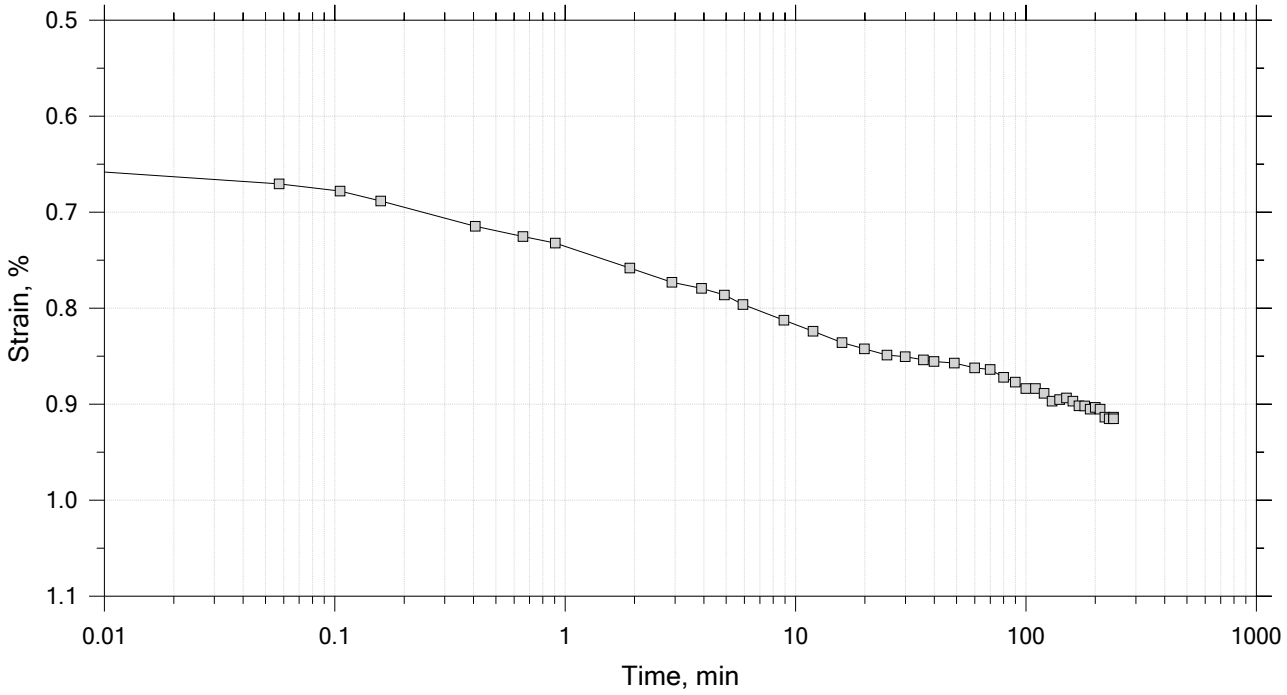
GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System LTIII-0837		

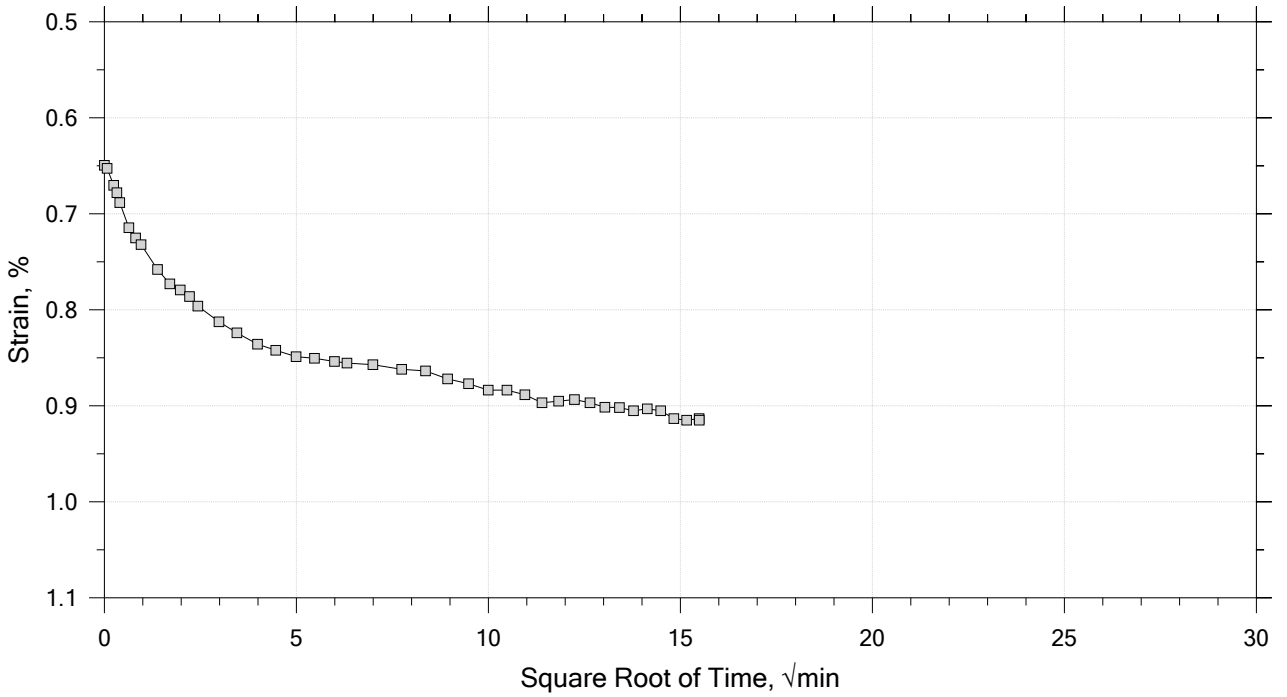
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 15

Constant Load Step

Stress: 0.5 tsf





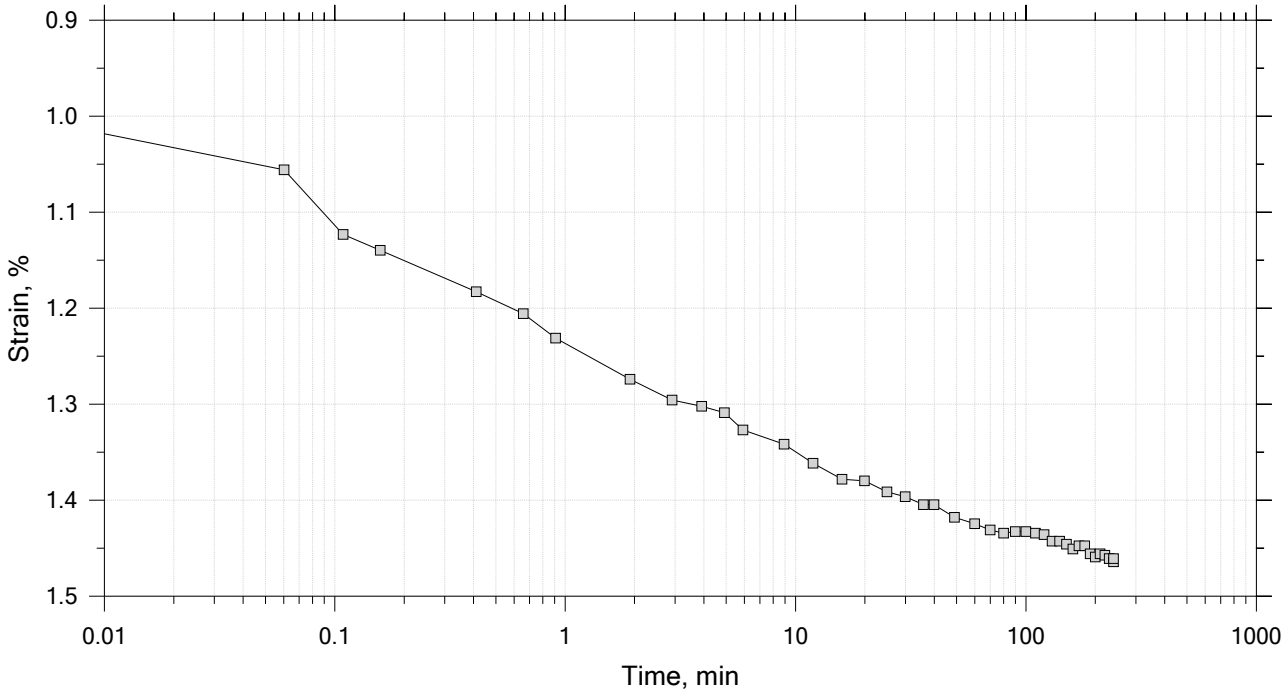
GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System LTIII-0837		

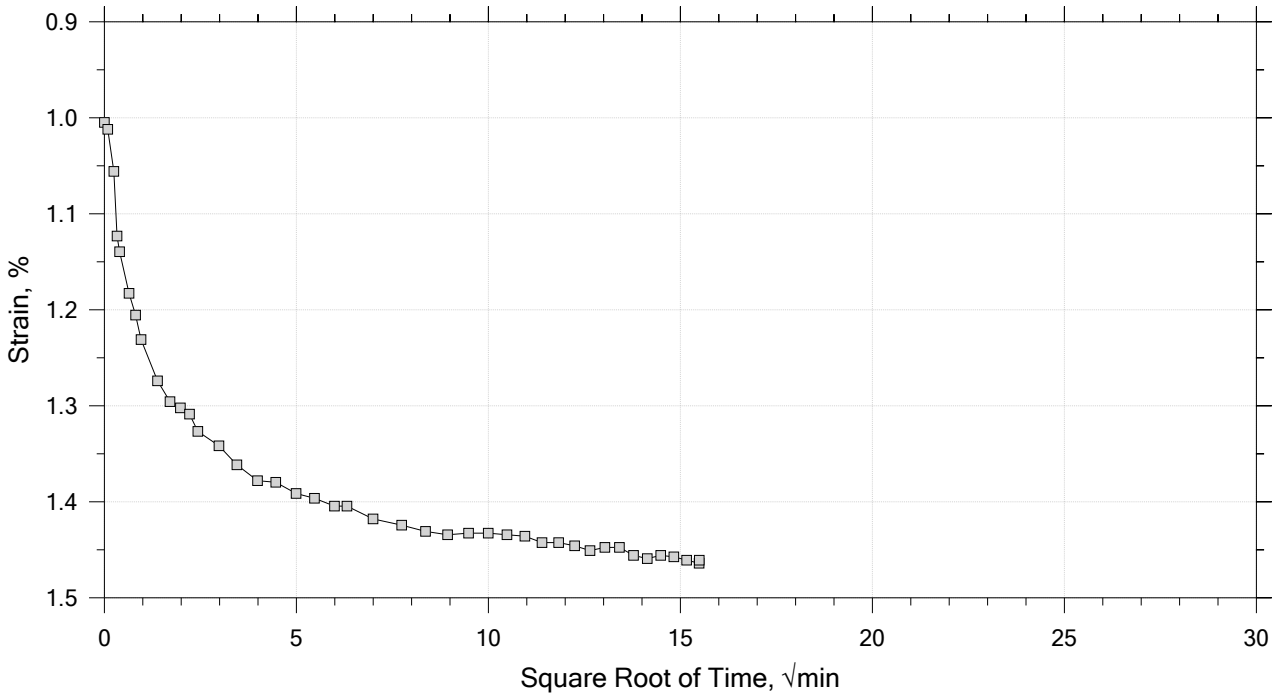
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 15

Constant Load Step

Stress: 1 tsf

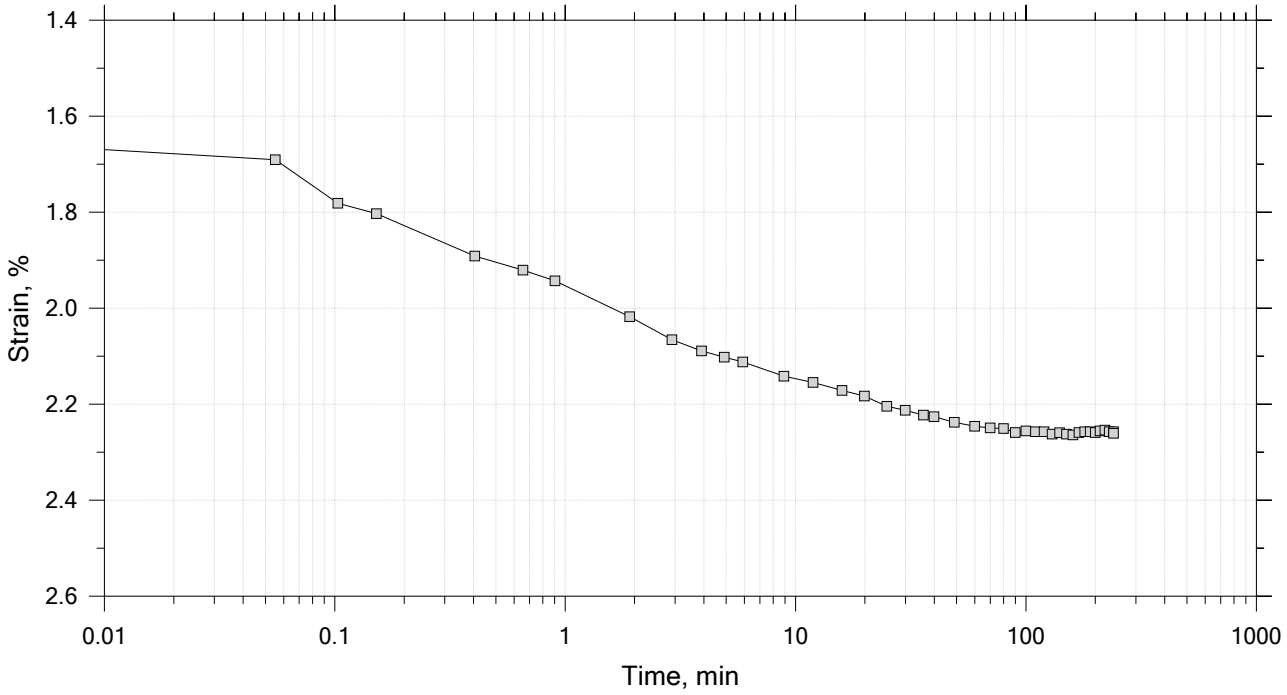


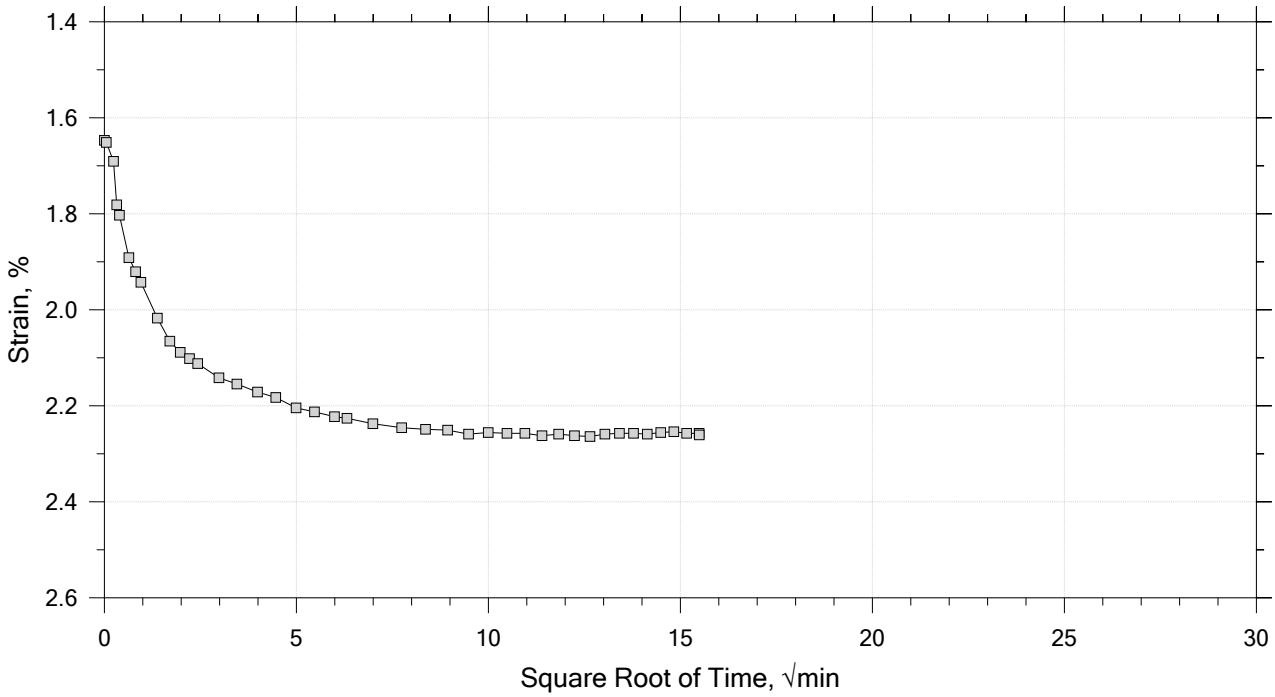


Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
Test No.: IP-2	Sample Type: intact	Elevation: ---
Description: Moist, olive gray clay		
Remarks: System LTIII-0837		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 15
Constant Load Step
Stress: 2 tsf





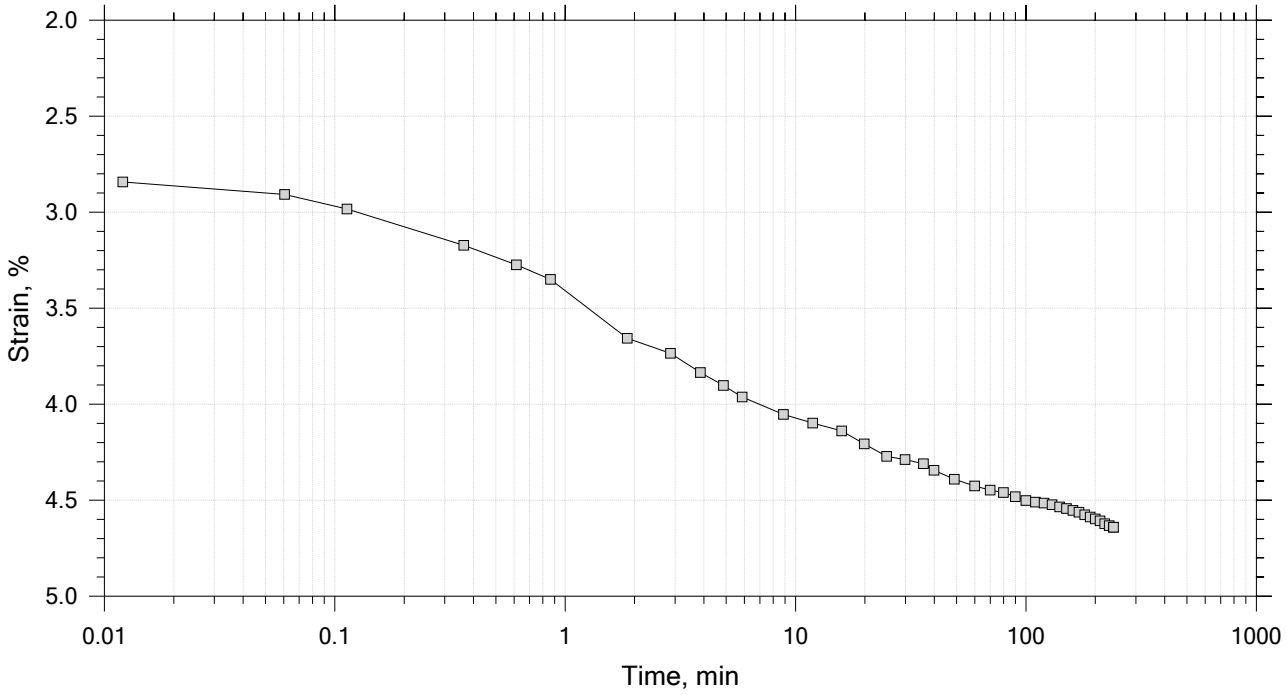
GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System LTIII-0837		

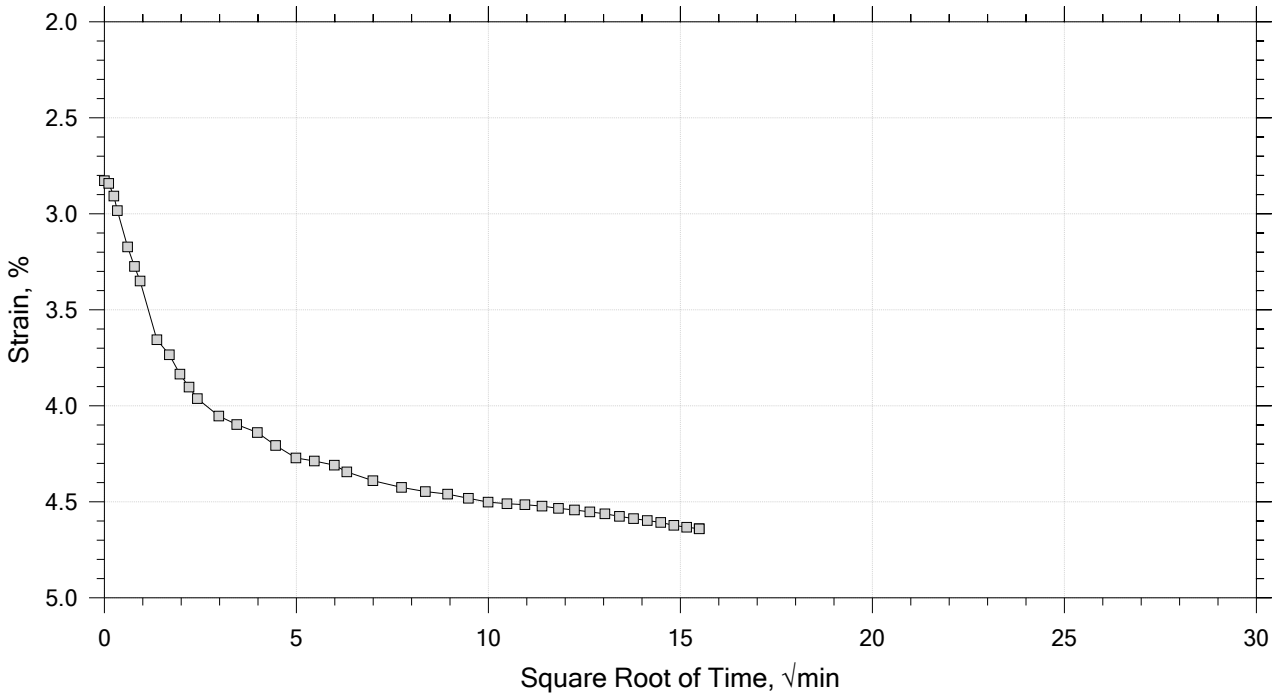
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 15

Constant Load Step

Stress: 4 tsf





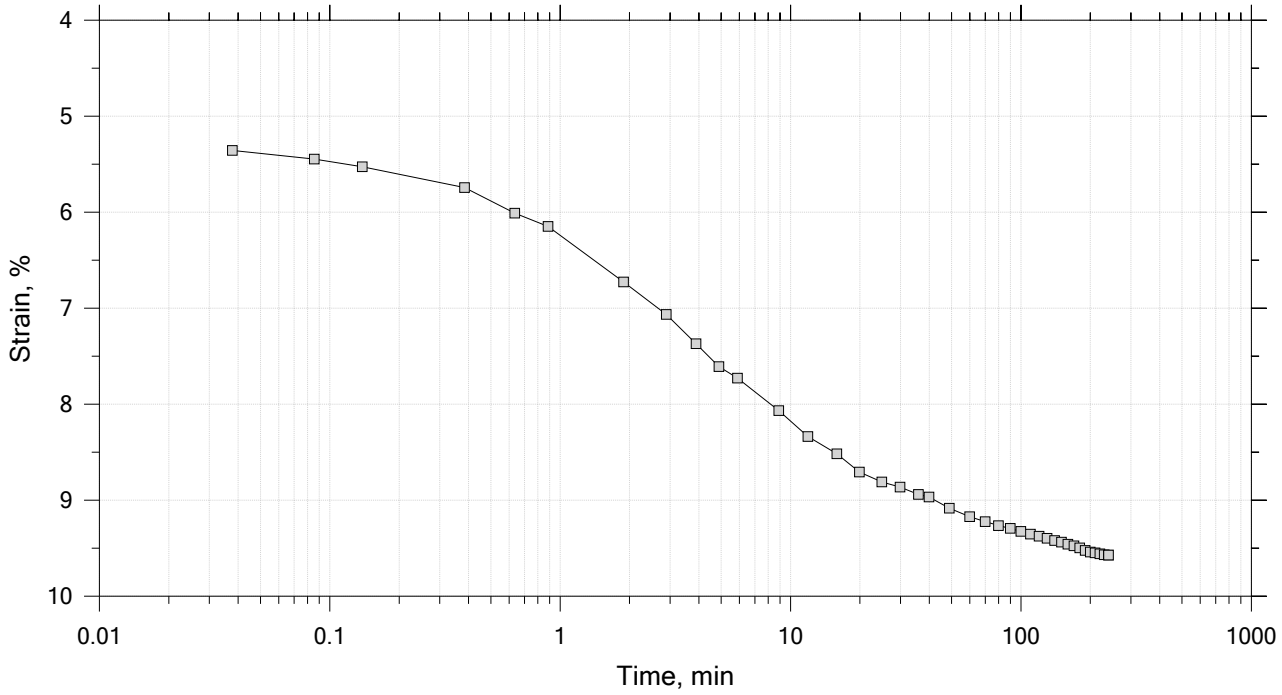
GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System LTIII-0837		

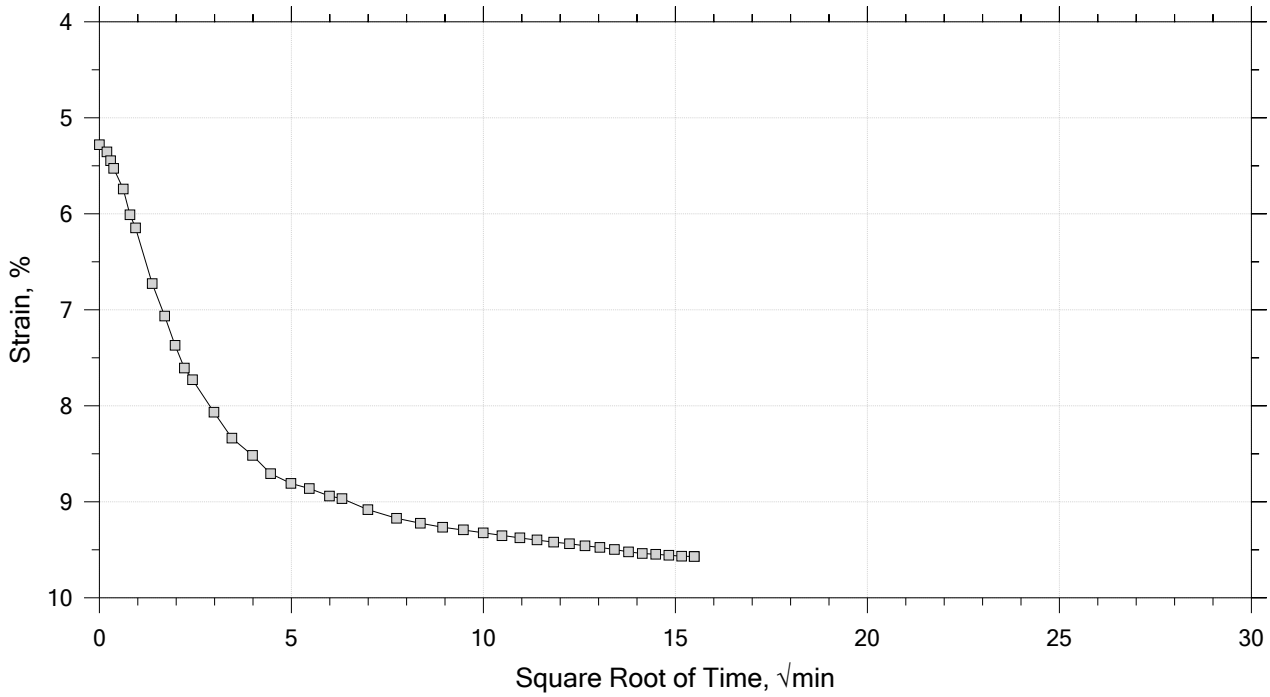
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 15

Constant Load Step

Stress: 8 tsf





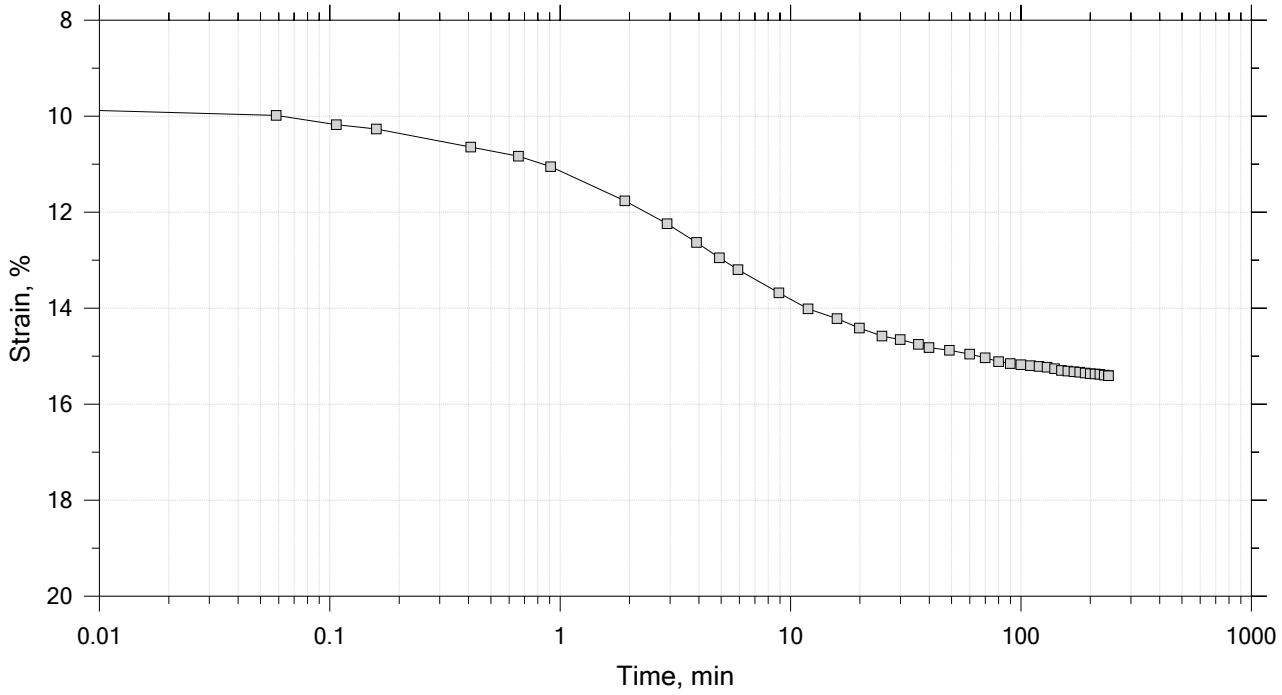
GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System LTIII-0837		

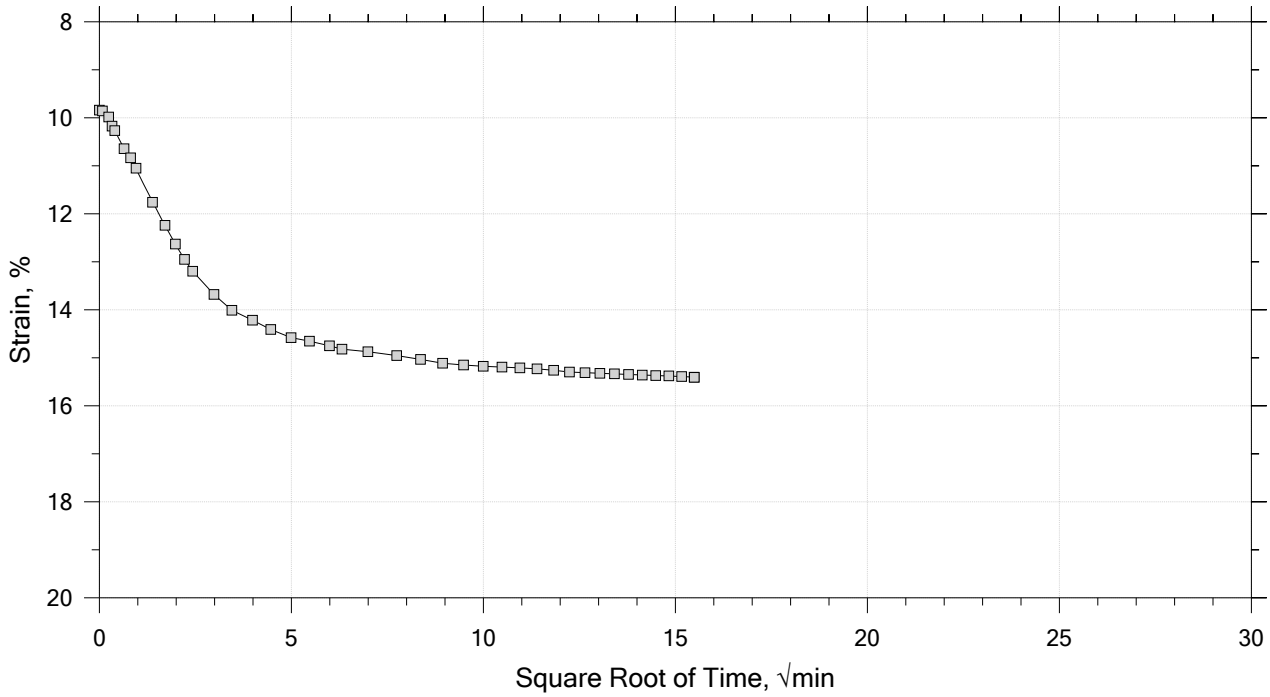
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 15

Constant Load Step

Stress: 16 tsf

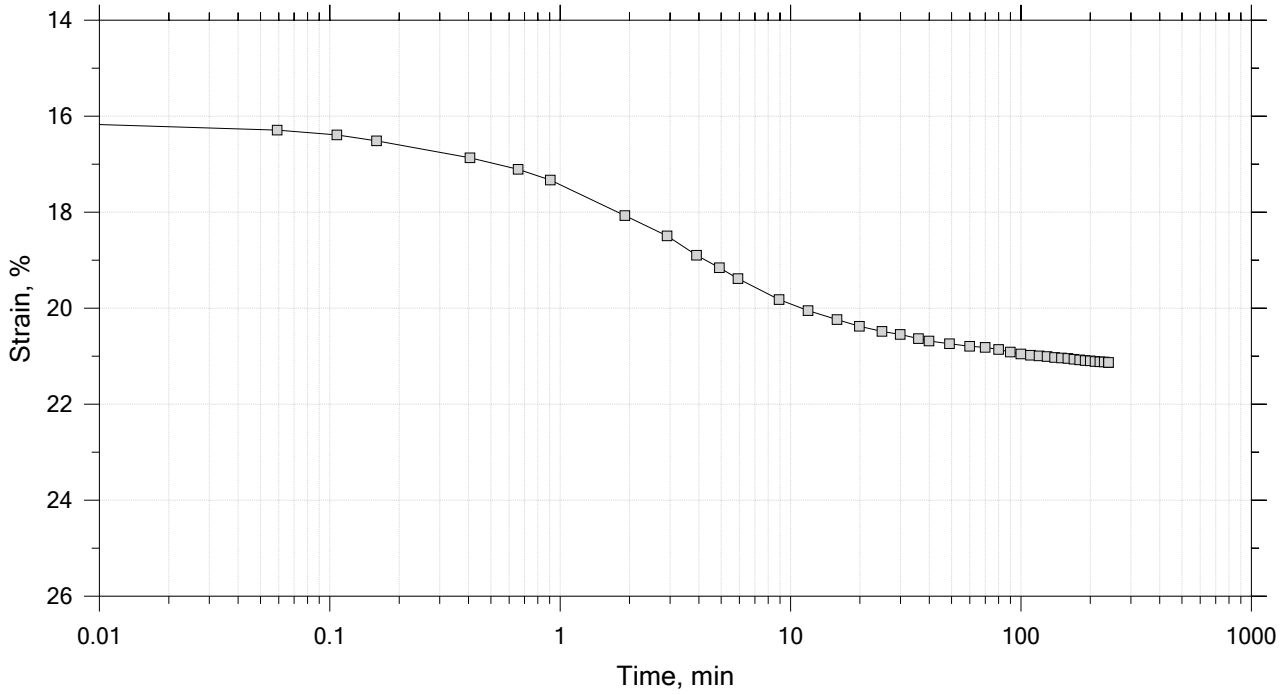


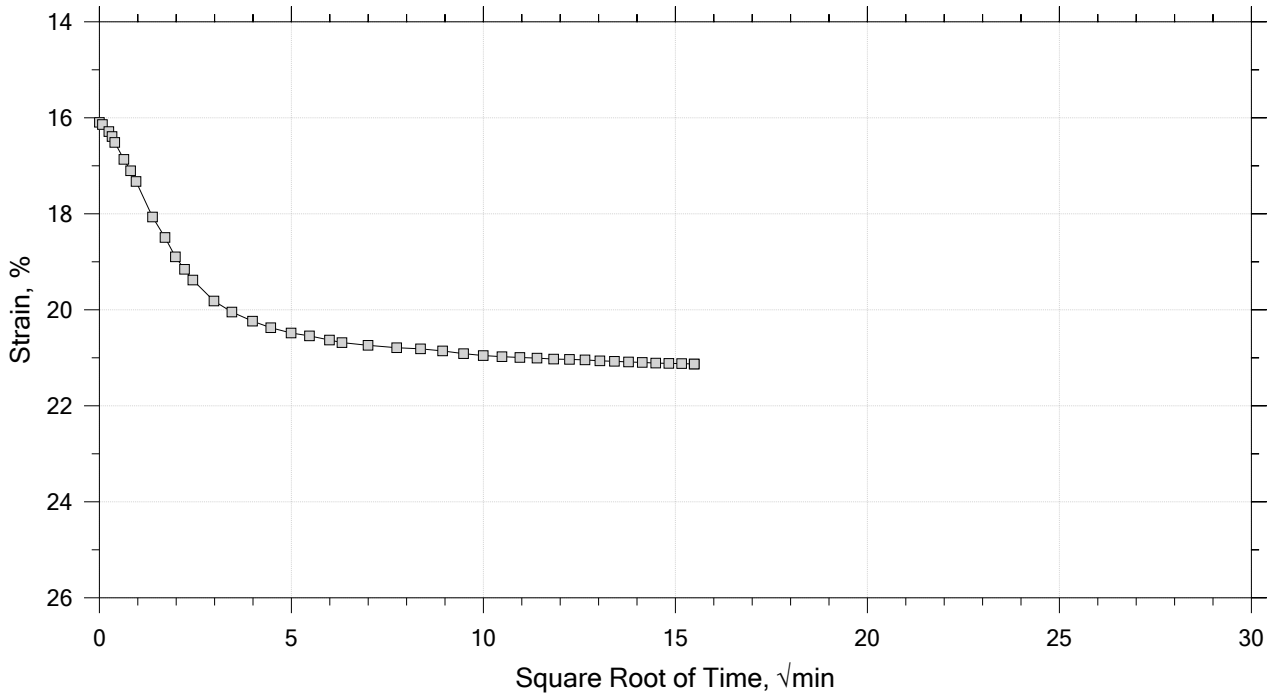


Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
Test No.: IP-2	Sample Type: intact	Elevation: ---
Description: Moist, olive gray clay		
Remarks: System LTIII-0837		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 15
Constant Load Step
Stress: 32 tsf

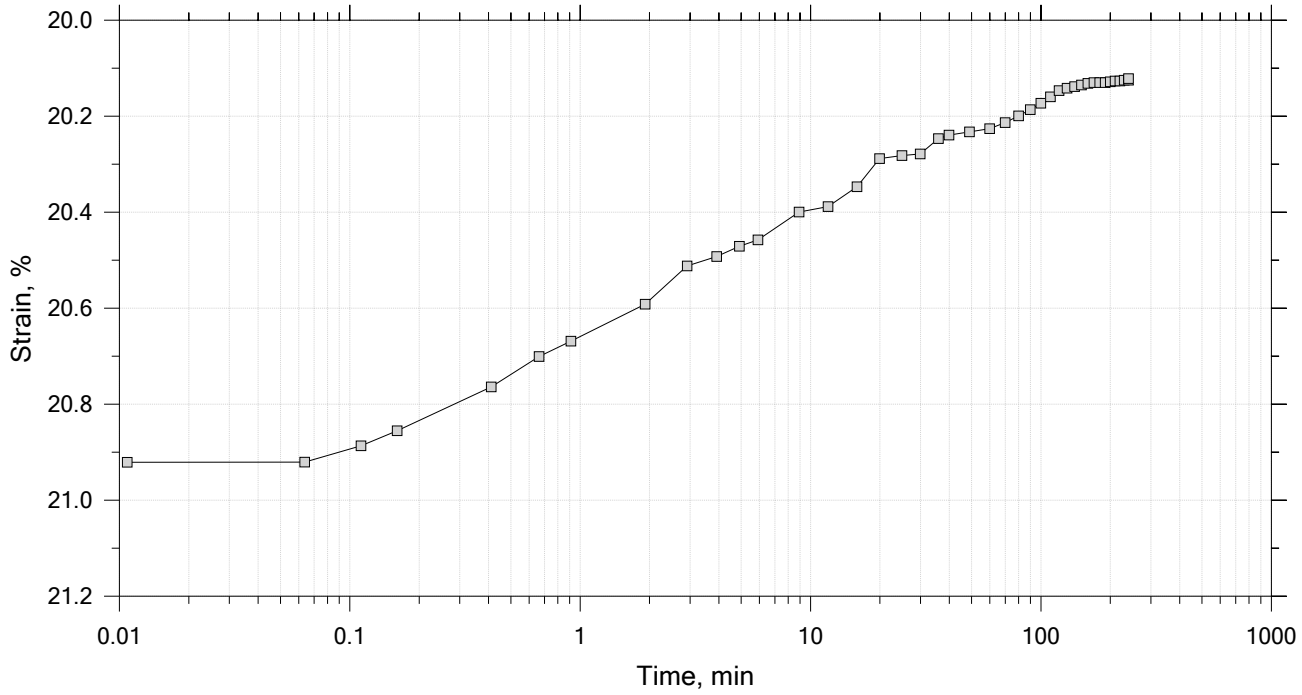


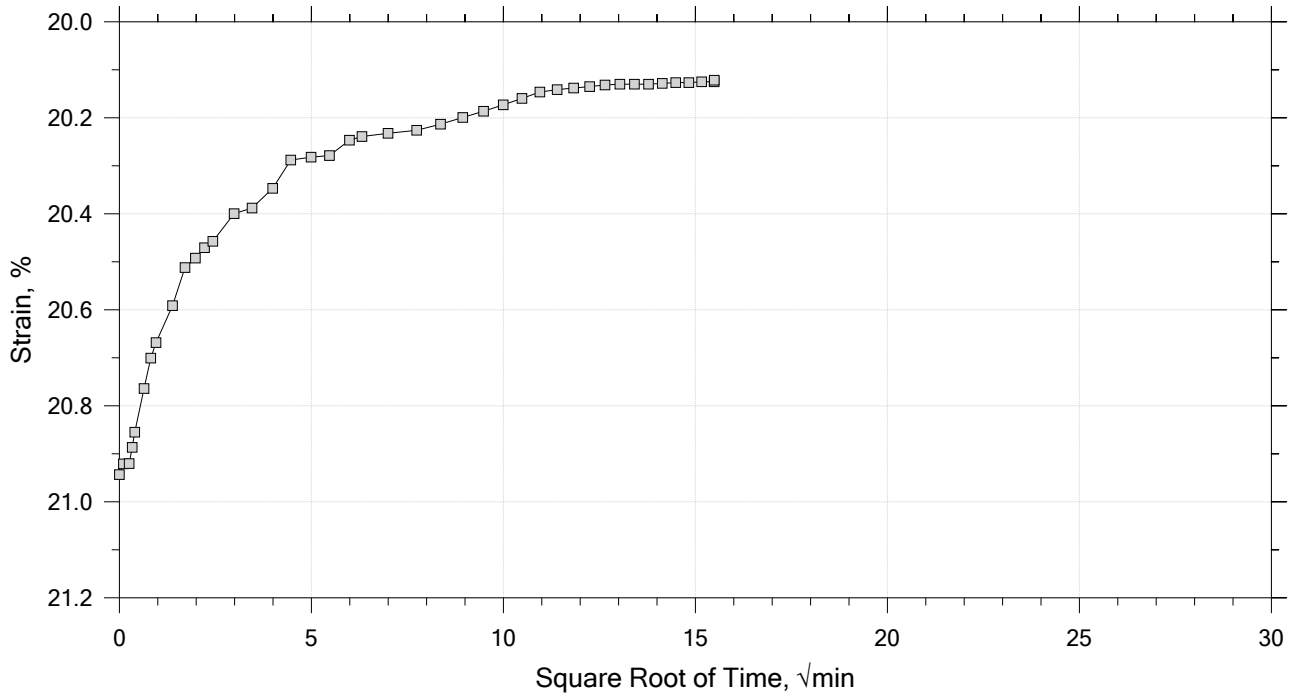


GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System LTIII-0837		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 15
Constant Load Step
Stress: 8 tsf

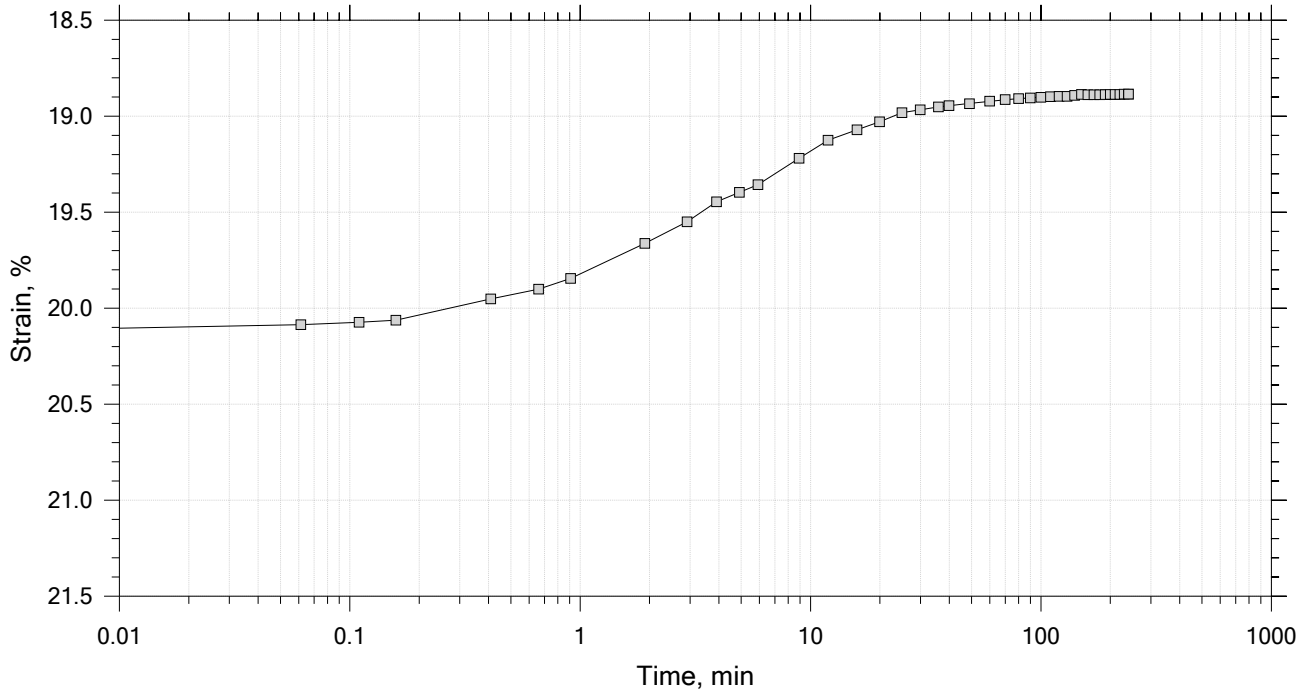


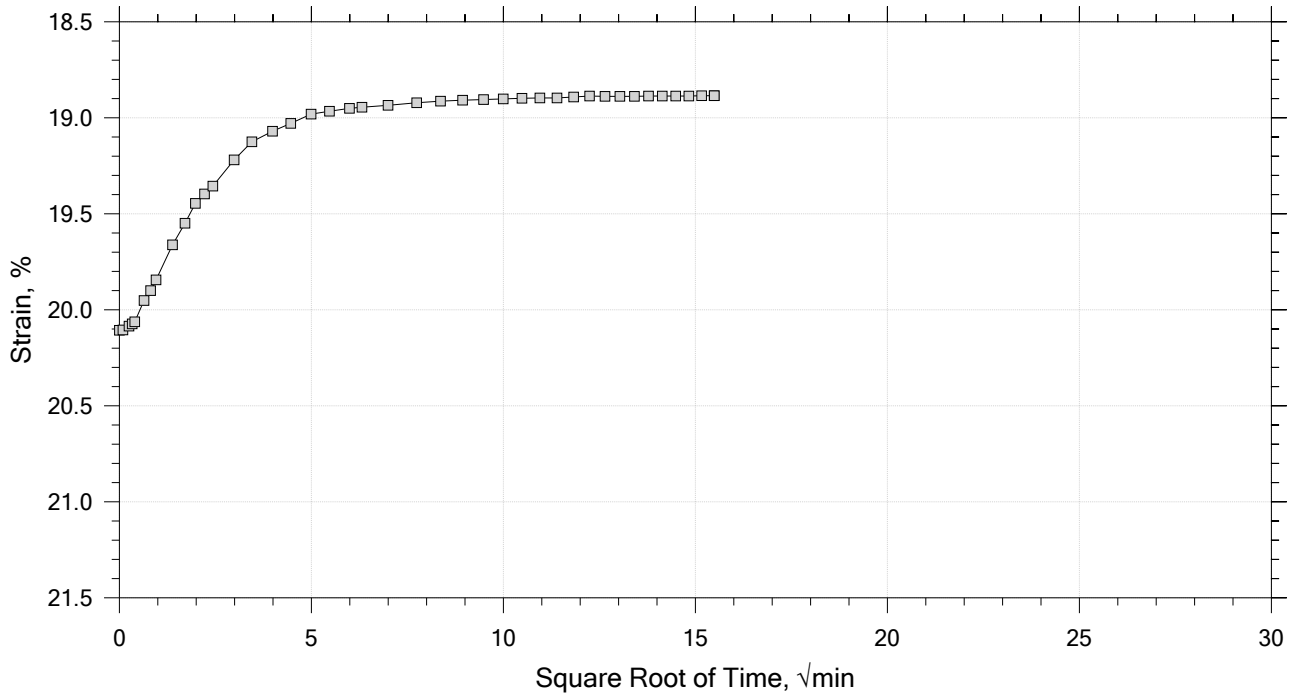


GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System LTIII-0837		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 15
Constant Load Step
Stress: 2 tsf

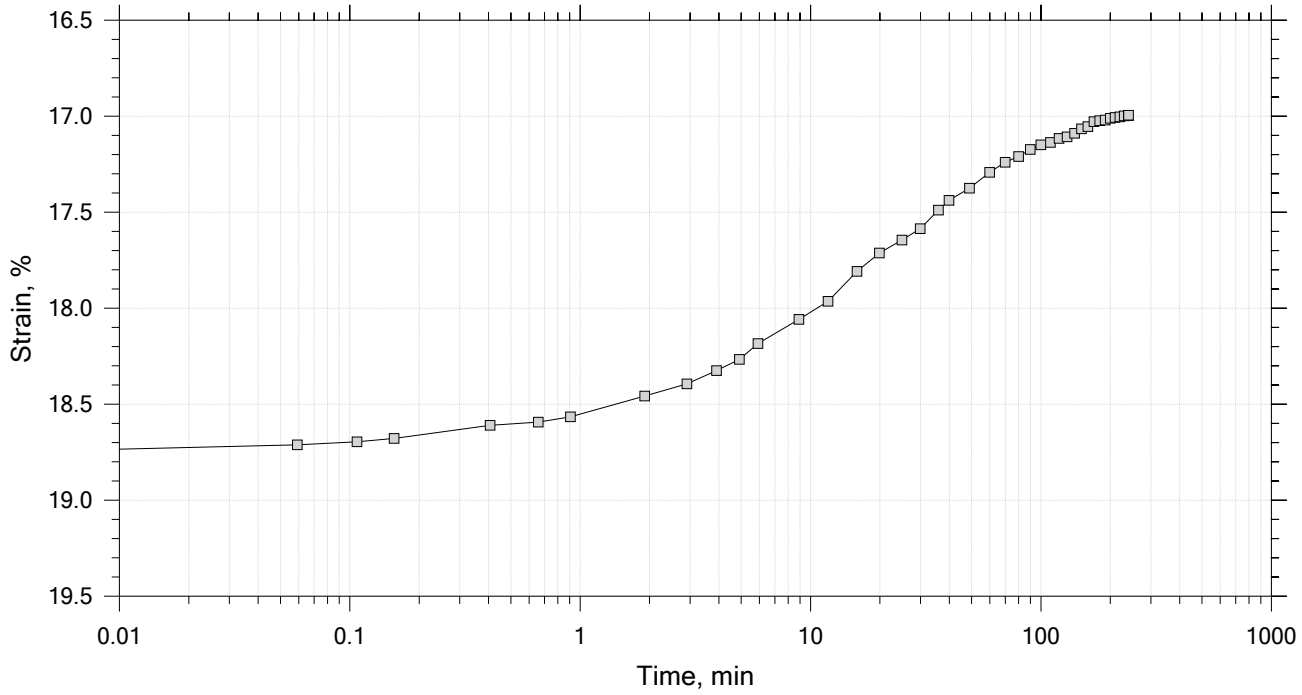


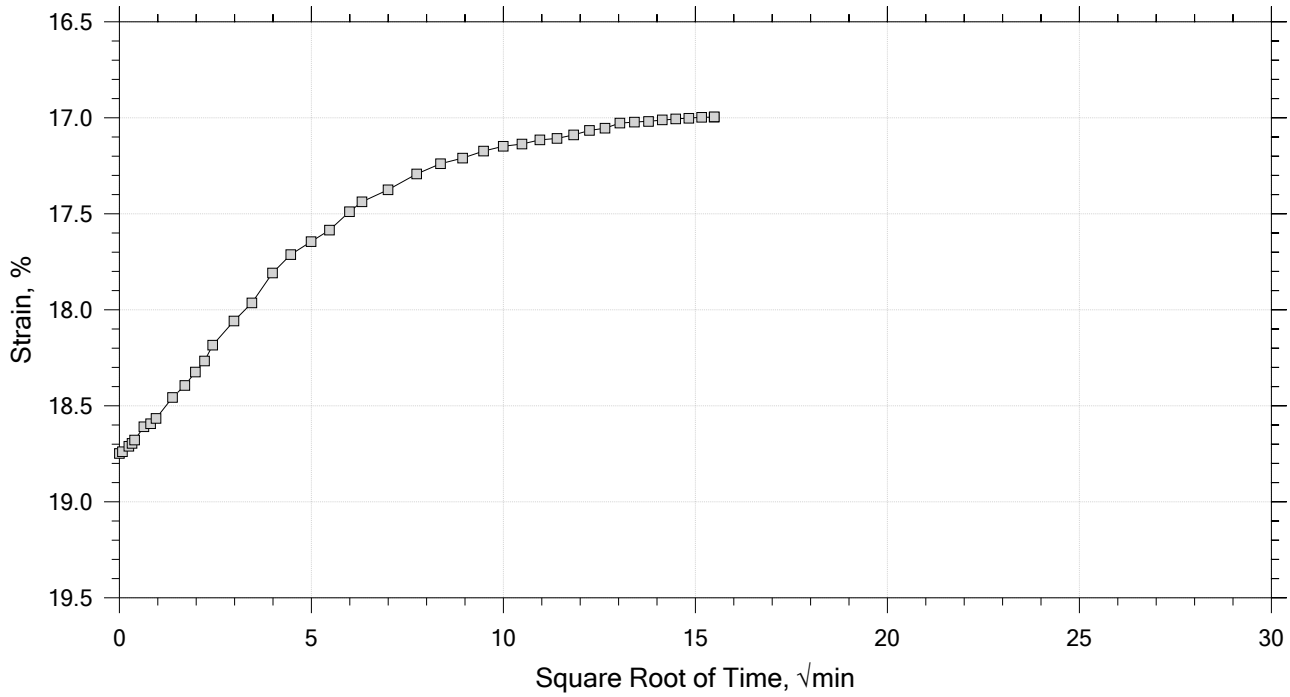


GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System LTIII-0837		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 15
Constant Load Step
Stress: 0.5 tsf

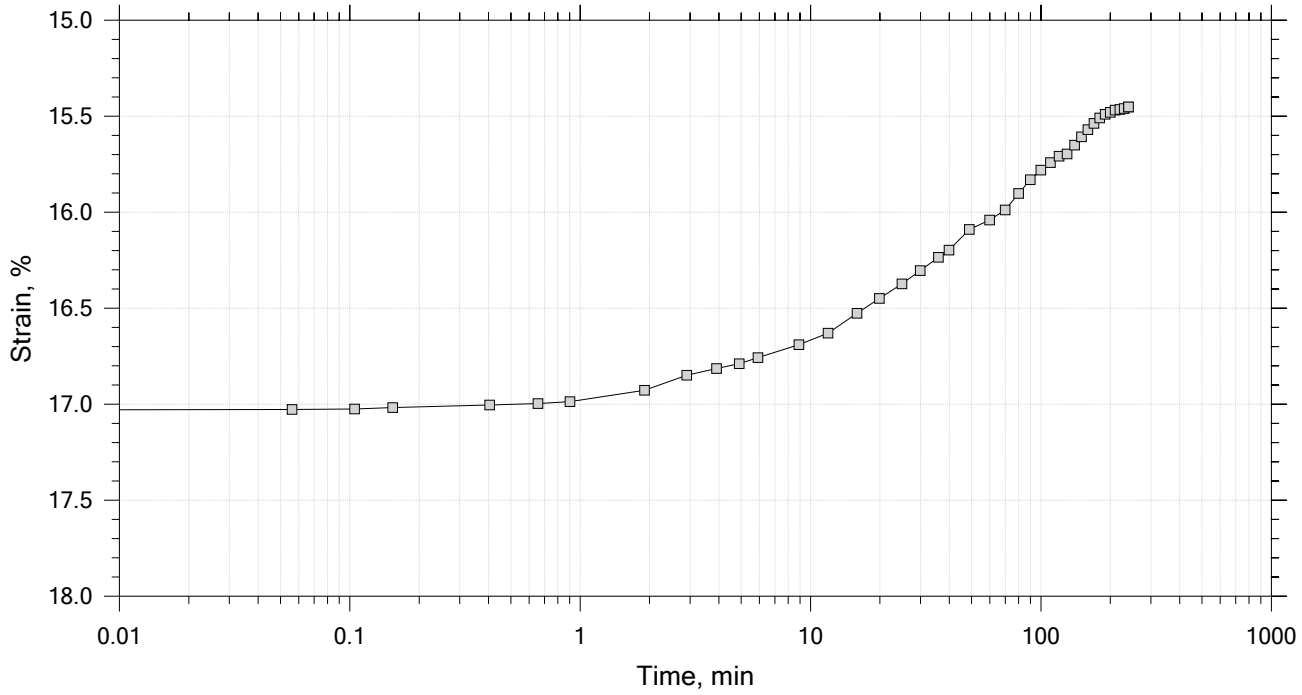


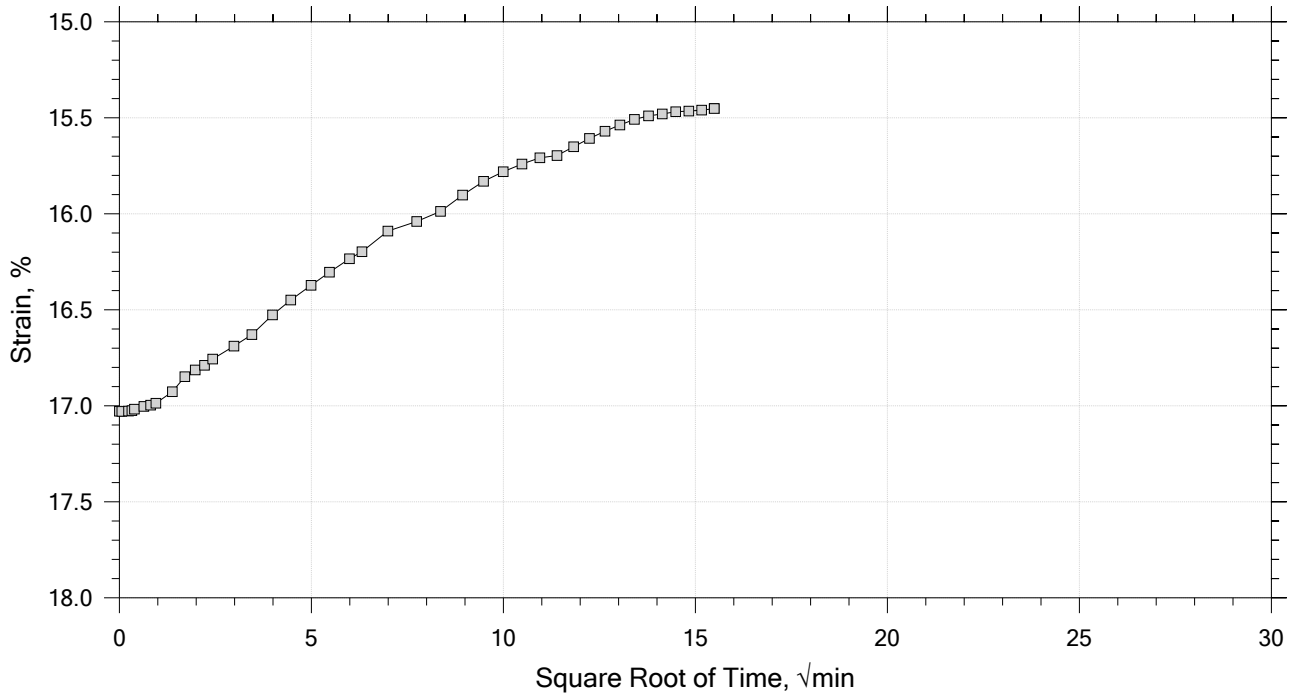


GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System LTIII-0837		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 15
Constant Load Step
Stress: 0.125 tsf

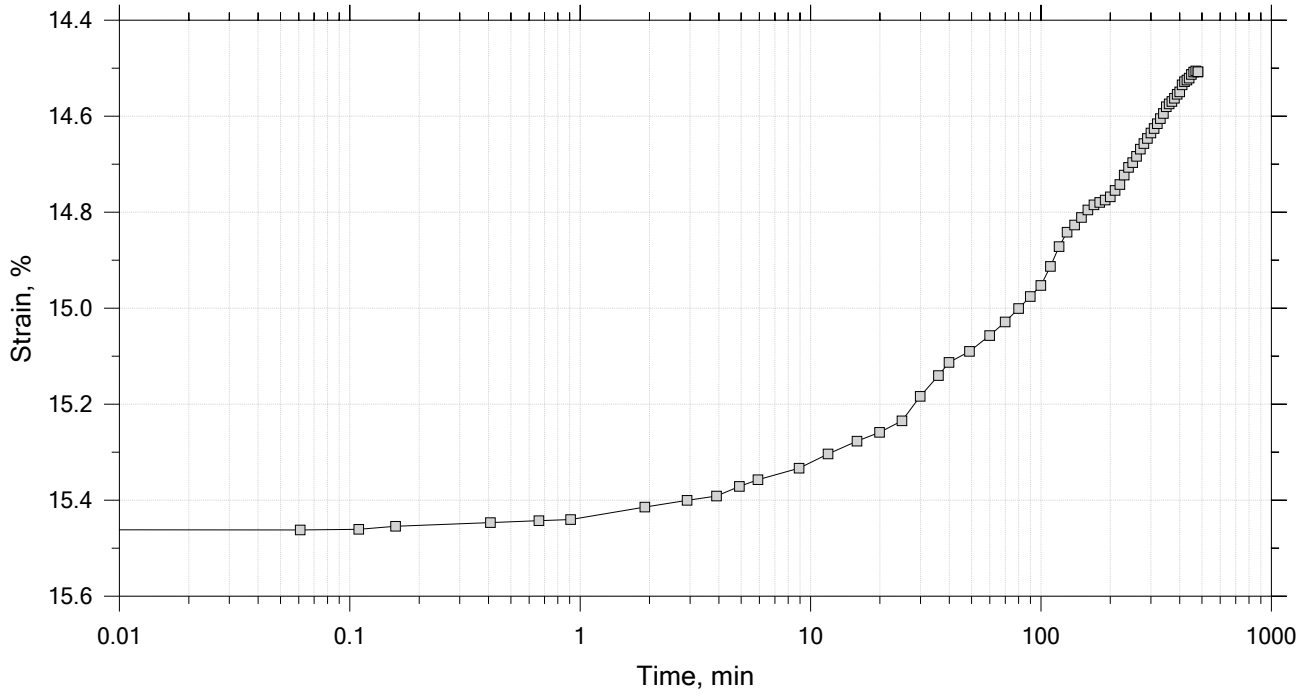


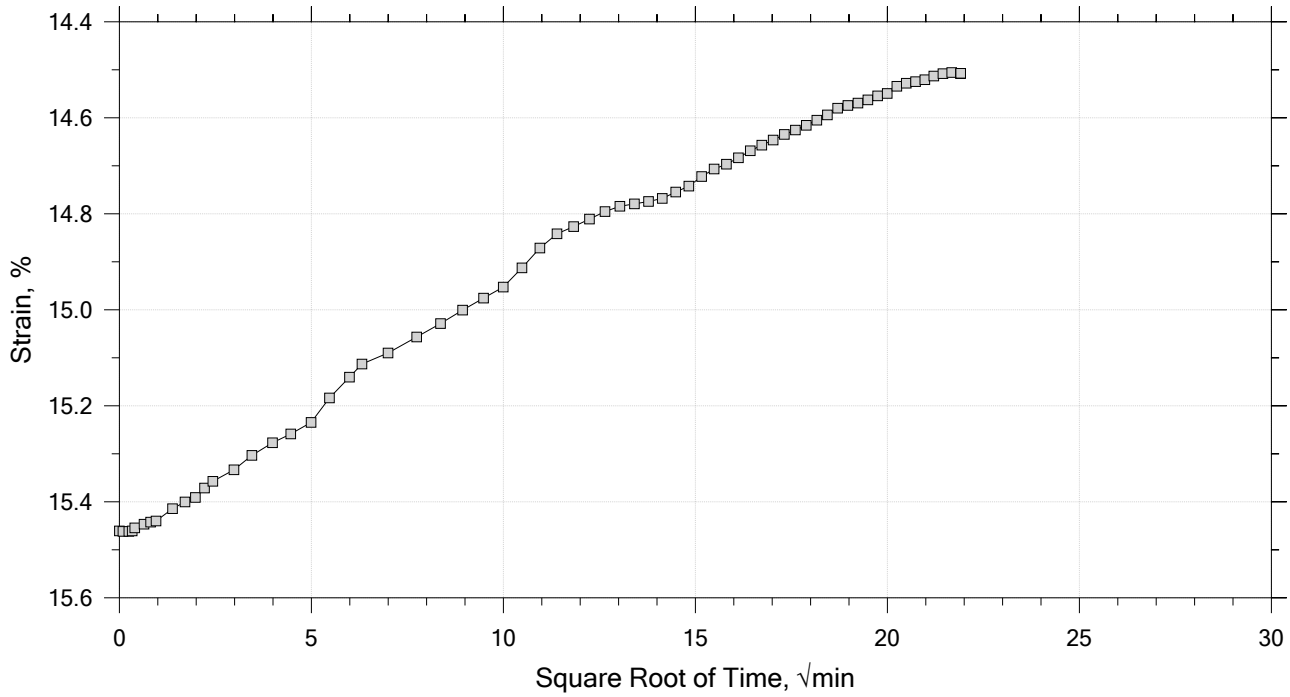


Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
Test No.: IP-2	Sample Type: intact	Elevation: ---
Description: Moist, olive gray clay		
Remarks: System LTIII-0837		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 15
Constant Load Step
Stress: 0.0625 tsf





GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System LTIII-0837		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 2.50 in	Estimated Specific Gravity: 2.76	Liquid Limit: 29
Initial Height: 1.00 in	Initial Void Ratio: 1.03	Plastic Limit: 17
Final Height: 0.85 in	Final Void Ratio: 0.738	Plasticity Index: 12

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	E0265	RING		E-1392
Mass Container, gm	8.54	109.83	109.83	8.18
Mass Container + Wet Soil, gm	110.35	259.51	248.38	147.15
Mass Container + Dry Soil, gm	85.06	219.19	219.19	117.87
Mass Dry Soil, gm	76.52	109.36	109.36	109.69
Water Content, %	33.05	36.87	26.69	26.69
Void Ratio	---	1.03	0.74	---
Degree of Saturation, %	---	98.68	100.00	---
Dry Unit Weight, pcf	---	84.871	99.273	---

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.

GeoTesting EXPRESS

Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
Test No.: IP-2	Sample Type: intact	Elevation: ---
Description: Moist, olive gray clay		
Remarks: System LTIII-0837		

One-Dimensional Consolidation by ASTM D2435 - Method B

Square Root of Time Coefficients

Step	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv in²/s	Mv 1/tsf	k ft/day
1	0.0833	0.004866	1.02	0.487	19.578	1.80e-04	5.84e-02	1.96e-04
2	0.125	0.004981	1.02	0.498	---	---	---	---
3	0.250	0.005849	1.02	0.585	181.932	1.92e-05	6.95e-03	2.50e-06
4	0.500	0.009151	1.01	0.915	18.863	1.85e-04	1.32e-02	4.56e-05
5	1.00	0.01461	1.00	1.46	6.527	5.29e-04	1.09e-02	1.08e-04
6	2.00	0.02261	0.986	2.26	3.552	9.58e-04	8.00e-03	1.44e-04
7	4.00	0.04641	0.938	4.64	13.175	2.50e-04	1.19e-02	5.57e-05
8	8.00	0.09571	0.838	9.57	15.779	1.93e-04	1.23e-02	4.46e-05
9	16.0	0.1541	0.719	15.4	15.307	1.77e-04	7.30e-03	2.42e-05
10	32.0	0.2113	0.603	21.1	11.662	2.02e-04	3.58e-03	1.36e-05
11	8.00	0.2012	0.623	20.1	21.849	1.02e-04	4.20e-04	8.01e-07
12	2.00	0.1889	0.649	18.9	16.233	1.41e-04	2.06e-03	5.44e-06
13	0.500	0.1699	0.687	17.0	55.075	4.32e-05	1.26e-02	1.02e-05
14	0.125	0.1545	0.718	15.5	203.117	1.22e-05	4.11e-02	9.41e-06
15	0.0625	0.1451	0.738	14.5	448.333	5.70e-06	1.51e-01	1.61e-05

GeoTesting EXPRESS	Project: I-295 NB/SB Bridge Replacement	Location: Yarmouth, ME	Project No.: GTX-313814
	Boring No.: BB-YRO-206	Tested By: trm	Checked By: njh
	Sample No.: U1	Test Date: 6/21/21	Depth: 12-14 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, olive gray clay		
	Remarks: System LTIII-0837		
	Displacement at End of Increment		

APPENDIX D

Historic Bridge Plans

B. P. R. REG. NO.	STATE	FEDERAL AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
1	MAINE	I-95-4(10)	17	121

FAY, SPOFFORD & THORNDIKE, INC.
ENGINEERS BOSTON-PORTLAND

YARMOUTH

Key Plan
For traffic data See Sh. 20

Sh. 17

Note: for Profile Ramps A & B, See Sh. # 23
For Utilities See Sh. 47

CURVE DATA RAMP "B"

①	②	③
P.I. Sta. 1+50.14	P.I. Sta. 5+50.84	Δ 3°04'25.68"
Δ 6°00'00"	Δ 6°00'00"	D 2°20'42.68"
D 2°00'00	D 1°30'00"	T 65.55'
T 150.14'	T 200.18'	L 131.07'
L 300.00'	L 400.00'	R 2443.12'
R 2864.79'	R 3819.72'	

④	⑤
Δ 6°00'00"	Δ 6°00'00"
D 5°30'45.58"	D 1°51'16.49"
T 54.47'	T 161.91'
L 108.84'	L 323.52'
R 1039.35'	R 3089.43'

RAMP "A" - CURVE DATA

①	②
P.I. Sta. 8+68.36	P.I. Sta. 15+46.70
Δ 23°-52'-45.45"	Δ 26°36'00"
D 6°00'00"	D 6°00'00"
T 201.93'	T 225.74'
L 397.98'	L 443.33'
R 954.93'	R 954.93'

CLEARING
Sta. 551+00 to Sta. 553+50 Lt.
" 554+50 " " 556+50 Rt. & Lt.
" 564+00 " " 565+00 Lt.

Sta. 562+80.73 Interstate 489+70.90 Rte. 1 N.B.
Sta. 563+96.17 Interstate 490+74.51 Rte. 1 S.B.

PLAN AND PROFILE
SCALE: HOR. 1"=50'
VERT. 1"=10'

STA 550+00 TO STA 565+00

P.V.I. Sta. 551+69.40
El. 65.01
V.C. 600'
M. 0.98
S.S.D. 1000'+

P.V.I. Sta. 563+25
El. 95.05
V.C. 1172
M. 8.204
S.S.D. 550'

▲ Revision April 13, 1961

M-1756

"PLAN-PLAN "PROFIL" ... B.P.R.E. STANDARD

0 1 2 3 4 5 INCHES

B. P. R. REG. NO.	STATE	FEDERAL AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
1	MAINE	I-95-4(10)	18	121

FAY, SPOFFORD & THORNDIKE, INC. ENGINEERS BOSTON-PORTLAND

YARMOUTH

SOUTHBOUND

NORTHBOUND

ROUTE #1 S.B.

ROUTE #1 N.B.

Ramp "A"

Ramp "E"

Gen'l Laura H. Cleaves

Dorothy Fels Groves

John I Clara Hilton

Gordon Mc Leod

Falsmoor Inn

Esso Station

Ralph Romano

Guy P.

Fr. Priv.

Mon.

F.P.

F.H.

Auger Boring

P.P. #31 P.P. #32 P.P. #33 P.P. #34 P.P. #35

Sta. 565+00 TO STA. 580+00

Note: Sta. 492+50 to Sta. 910+00 Exist. S.B. Rte #1 Remove Conc. Pavmt. Area to be Regraded Loamed & Seeded. See X Sect. Sheets No. 117 & 118

Note: Profile Grade Line shown from Sta. 565+34.47 to Sta. 578+88.41 is for L.E.P. N.B.L. Elevation shown for S.B.L. are N.B.L. grades carried radially to R.E.P. S.B.L.

Key Plan — For traffic data See Sht. 20

PLATE J — PLAN-PROFILE O. P. R. & R. E. STANDARD

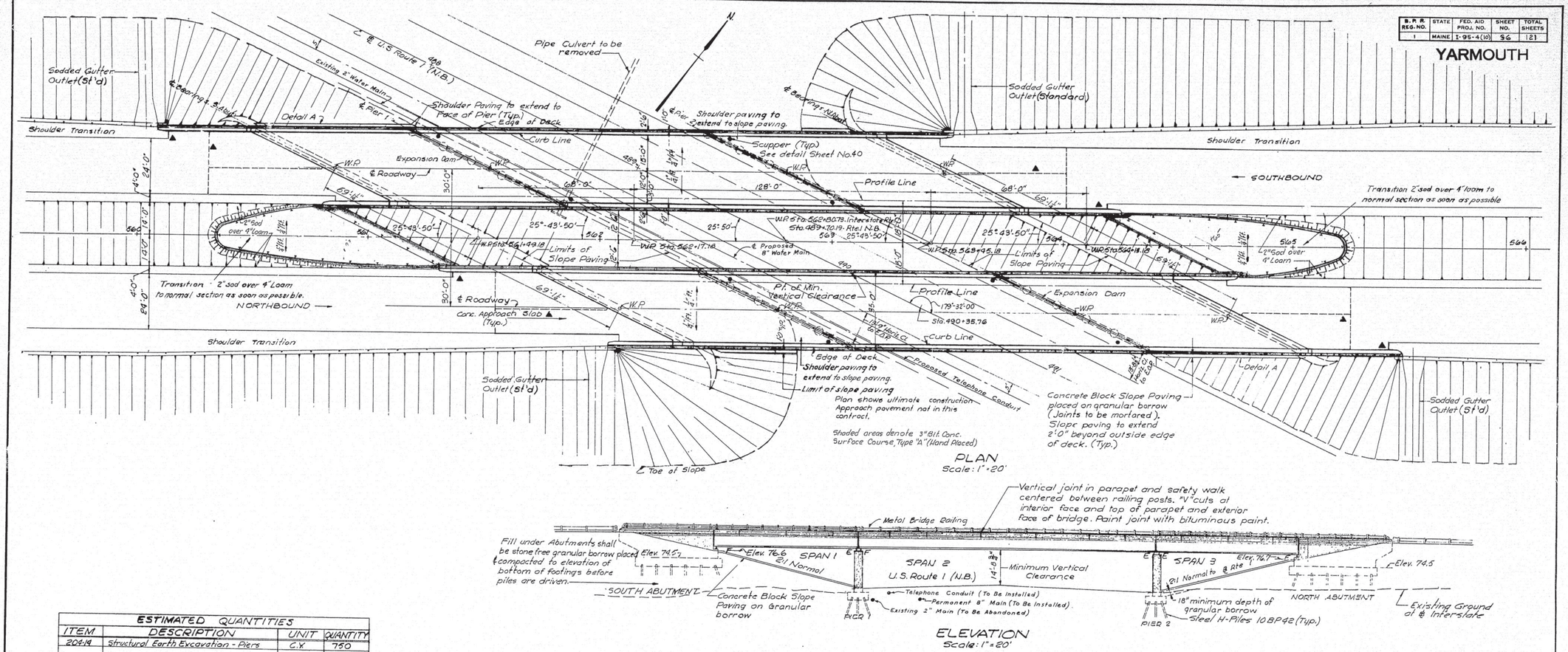
▲ Revision April 13, 1961

M-1757

Qm-14 786

B.P.R. REG. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
1	MAINE	I-95-4(10)	36	121

YARMOUTH



PLAN
Scale: 1" = 20'

ELEVATION
Scale: 1" = 20'

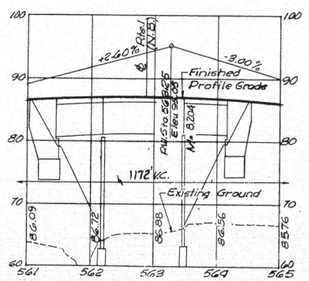
ESTIMATED QUANTITIES

ITEM	DESCRIPTION	UNIT	QUANTITY
204-14	Structural Earth Excavation - Piers	C.Y.	750
302-7	Gravel Base Course: In Place Measurement	C.Y.	263
307-8	Reinforced Portland Cement Concrete Approach Slabs	S.Y.	450
701-33	Portland Cement Concrete, Abutments & Retaining Walls	C.Y.	1,195
701-37	Portland Cement Concrete, Substructure Columns, Column Bases, Bents, Collision Walls, Girders, Struts, etc.	C.Y.	450
701-40	Portland Cement Concrete, Roadway & Sidewalk Slabs on Steel Bridges	C.Y.	670
701-44	Portland Cement Concrete, Wearing Surface on Bridges	C.Y.	200
701-47	Portland Cement	Bbl.	3,775
701-57	Metal Roadway Scuppers	Ea.	8
702-108	Structural Steel: Fabricated & Delivered	Lbs.	1,019,000
702-109	Structural Steel: Erection	Lbs.	1,019,000
702-105	Structural Steel, Field Painting	Lbs	1,019,000
705-13	Reinforcing Steel: Delivered	Lbs.	242,700
705-14	Reinforcing Steel: Placing	Lbs.	242,700
705-17	Shear Connectors	L.S.	1
708-16	Steel H Beam Piles 42 lbs/Ft.	L.F.	*13,700
710-6	Waterproofing Joints	L.F.	80
804-6	French Drains	C.Y.	400
806-7	Aluminum Rail Delivered & Erected	L.F.	1,380
808-6	Slope Paving For Bridges	S.Y.	1,550

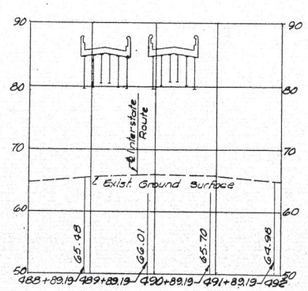
* Includes 924 L.F. Allowance for Pile Bearing Plates and 200 L.F. Allowance for Splices.

DES.	L.B. Cook
DR.	E.L.A.
TR.	—
CHK.	R.K.& P.W.
APP'D.	

Boston Blue Print-300-4-57



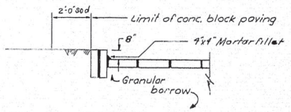
▲ PROFILE - INTERSTATE
Scale: Hor: 1" = 100'
Vert. 1" = 10'



PROFILE - ROUTE 1 (N.B.)
Scale: Hor: 1" = 100'
Vert. 1" = 10'

GENERAL NOTES

1. SPECIFICATIONS:
   A.A.S.H.O. 1953
   Maine State Highway Commission, Standard Specifications and Special Provisions.
2. LIVE LOAD
   H20-S16-44 Modified
3. FOUNDATIONS:
   Steel H-Piles 10 BP 42
   Design Capacity of piles - 85 Tons.
4. ALLOWABLE STRESSES
   Structural Steel - 18,000 p.s.i.
   Reinforcing Steel - 18,000 p.s.i.
   Concrete - 1,200 p.s.i.
5. CONCRETE
   Class 'A' - Footings, Piers, Abutments, Approach Slabs & Decks.
6. ELEVATIONS:
   Elevations are based on Elev. 0.00 of Mean Sea Level.



DETAIL A

▲ Revision April 13, 1961

STATE HIGHWAY COMMISSION
AUGUSTA, MAINE

PORTLAND-YARMOUTH INTERSTATE

INTERSTATE OVER ROUTE 1

GENERAL PLAN AND ELEVATION

SHEET NO. 36 OF 121 | SCALE: AS NOTED

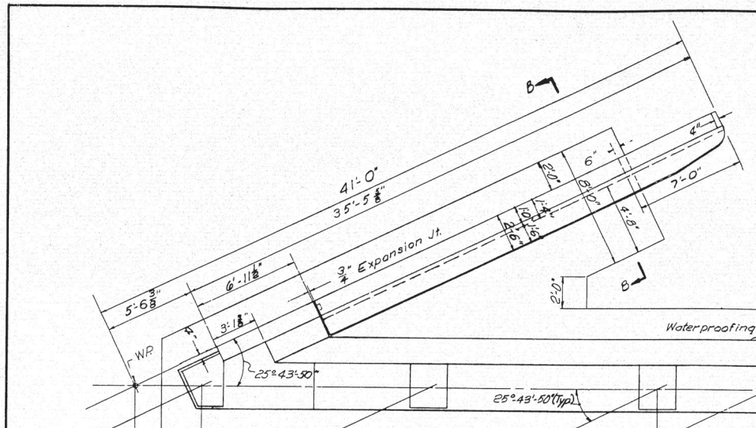
FAY, SPOFFORD & THORNDIKE, INC. ENGINEERS BOSTON, MASS.

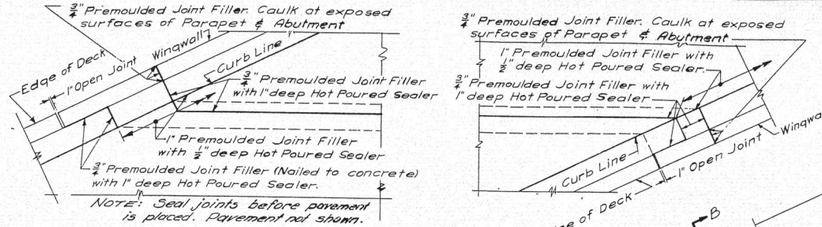
Qm-14
7.58

M-1758

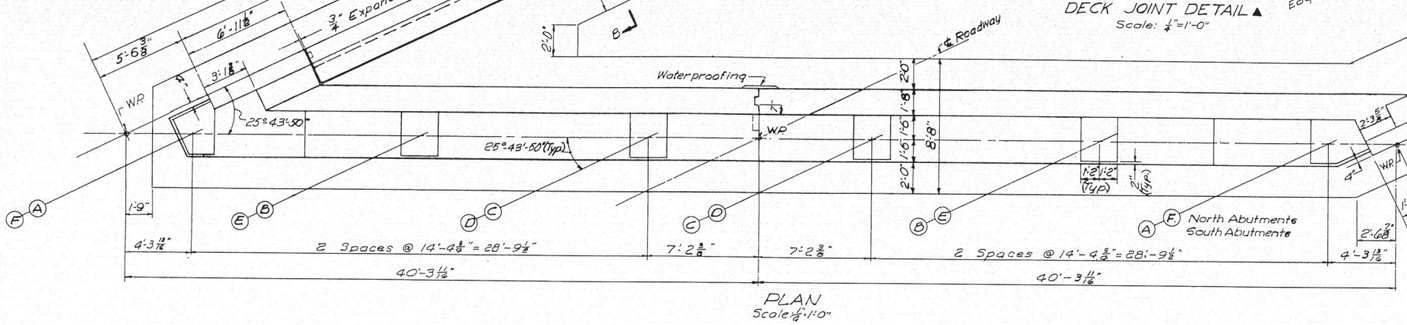
B.P.R. REG. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
1	MAINE	I-95-4(10)	37	121

YARMOUTH

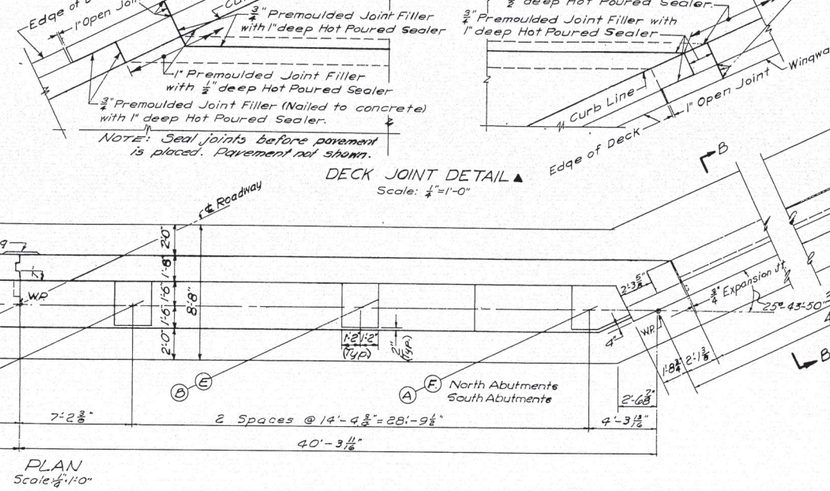


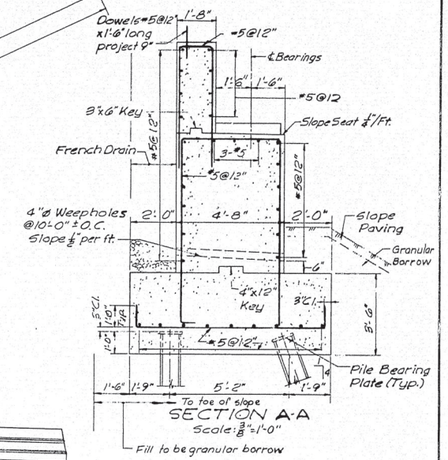


DECK JOINT DETAIL ▲
Scale: ¼"=1'-0"



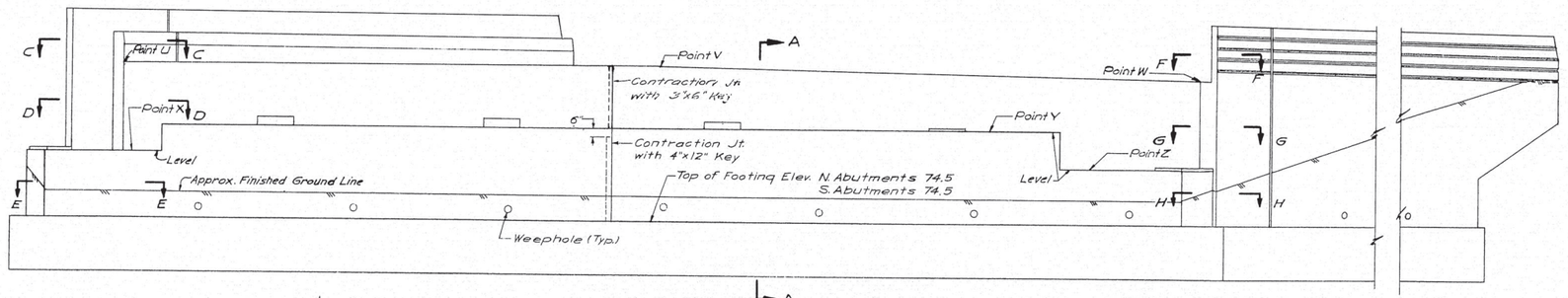
PLAN
Scale: 1/8"=1'-0"



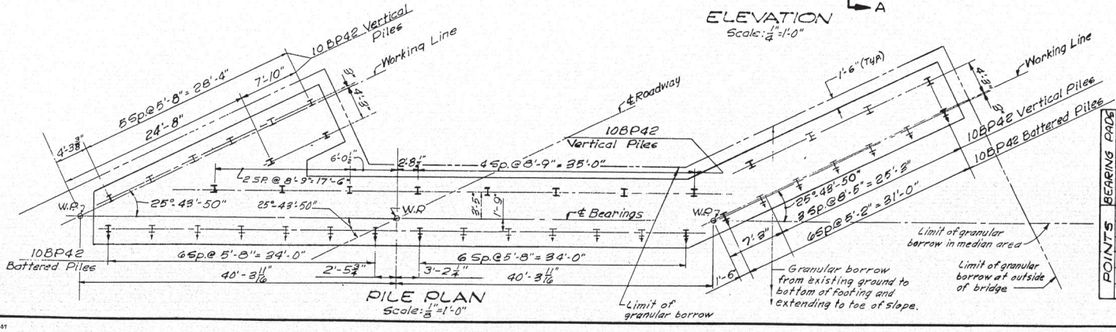


SECTION A-A
Scale: ⅜"=1'-0"

Fill to be granular borrow



ELEVATION
Scale: 1/4"=1'-0"



PILE PLAN
Scale: 1/8"=1'-0"

DES.	V.J.K.
DR.	RMM
TR.	
CHK.	R.K.
APP'D.	

Boston Blue Print-300-4-57

ELEVATION SCHEDULE		NORTHBOUND		SOUTHBOUND	
		N. ABUTMENT	S. ABUTMENT	N. ABUTMENT	S. ABUTMENT
BEARING PADS	A	79.37	79.70	79.96	78.70
	B	81.53	82.04	82.19	81.11
	C	81.54	82.22	82.28	81.37
	D	81.42	82.27	82.28	81.49
	E	81.16	82.20	82.06	81.48
	F	78.77	79.91	79.75	79.33
POINTS	U	84.99	85.60	85.61	84.95
	V	85.08	85.82	85.84	84.98
	W	84.40	85.36	85.89	84.34
	X	79.20	79.74	79.79	79.16
	Y	80.99	81.87	81.89	80.94
	Z	78.60	79.53	79.58	78.53

Notes:
1. For Construction Notes and Typical Details, see Sheet No. 39
2. For Wingwall Elevations, see Sheet No. 38
3. For Sections B-B thru H-H, see Sheet No. 38

▲ Revision April 13, 1961

STATE HIGHWAY COMMISSION
AUGUSTA, MAINE

PORTLAND-YARMOUTH INTERSTATE

INTERSTATE OVER ROUTE 1

ABUTMENT DETAILS

SHEET NO. 37 OF 121 | SCALE: AS NOTED

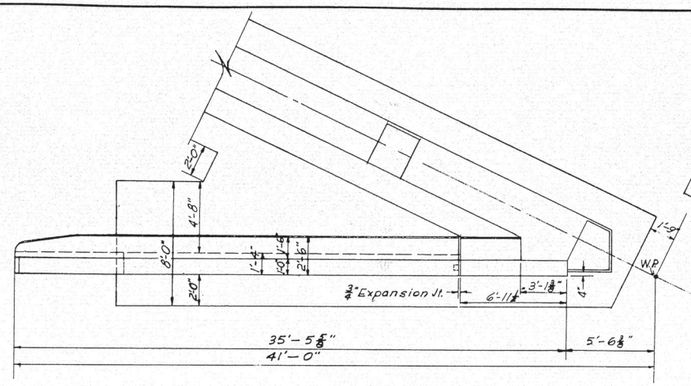
FAY, SPOFFORD & THORNDIKE, INC. ENGINEERS BOSTON, MASS.

Qm-14
759

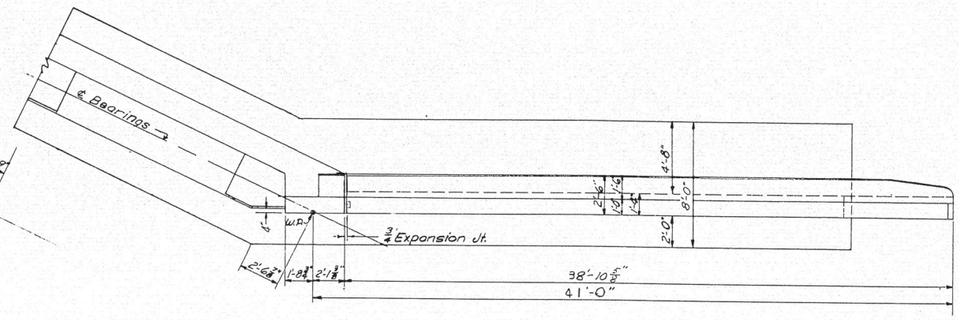
M-1759

B. P. R. REG. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
1	MAINE	I-95-4(10)	38	121

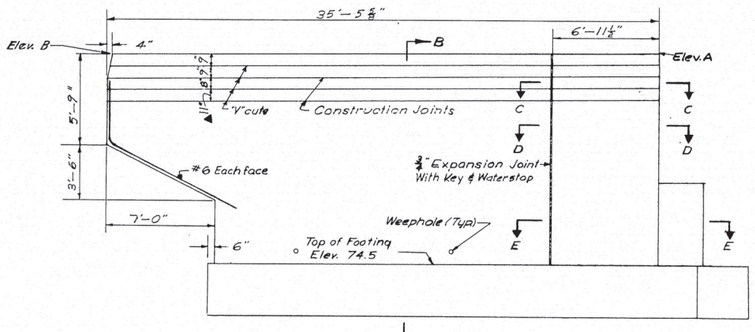
YARMOUTH



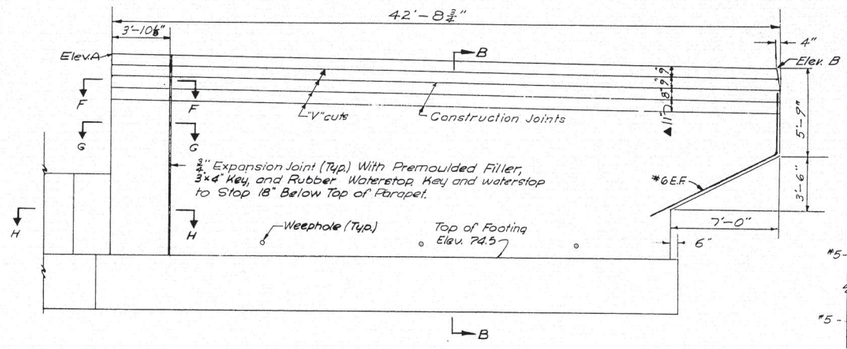
PLAN
Scale 1/4" = 1'-0"



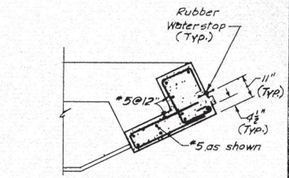
PLAN
Scale 1/4" = 1'-0"



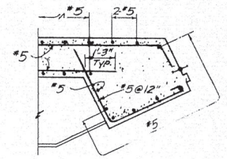
ELEVATION
Scale 1/4" = 1'-0"



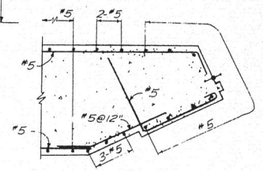
ELEVATION
Scale 1/4" = 1'-0"



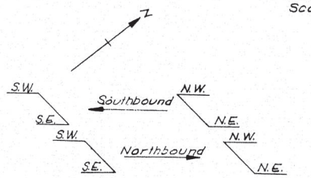
SECTION F-F
Scale: 3/8" = 1'-0"



SECTION G-G
Scale: 3/8" = 1'-0"

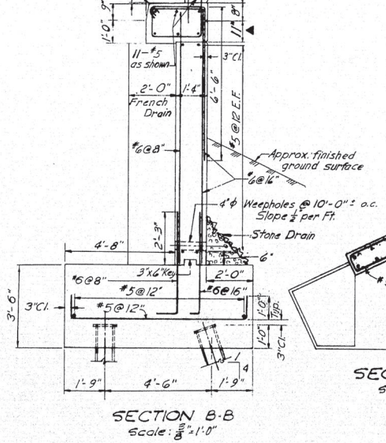


SECTION H-H
Scale: 3/8" = 1'-0"

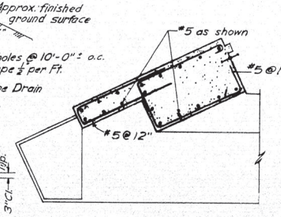


POINT	▲ WINGWALL ELEVATIONS							
	NORTHBOUND				SOUTHBOUND			
	N.W.	N.E.	S.W.	S.E.	N.W.	N.E.	S.W.	S.E.
A	88.48	87.86	88.83	87.06	89.06	88.85	87.82	88.44
B	88.17	87.34	88.56	88.96	88.97	88.98	87.29	88.14

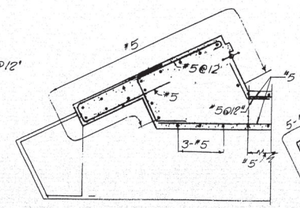
NOTE: For location of points see Elevations.



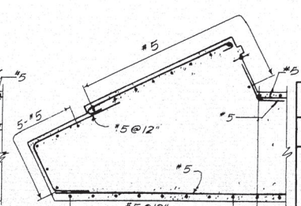
SECTION B-B
Scale: 3/8" = 1'-0"



SECTION C-C
Scale: 3/8" = 1'-0"



SECTION D-D
Scale: 3/8" = 1'-0"



SECTION E-E
Scale: 3/8" = 1'-0"

Notes: The stone drain in front of the Wingwall weepholes shall consist of 3 cubic feet of gravel per lineal foot of wall. It shall be considered part of the French Drain for payment purposes.
For Construction Notes and Typical Details, See Sheet No. 39

▲ Revision April 13, 1961

DES.	V.J.K.
DR.	R.M.M.
TR.	——
CHK.	R.K.
APP'D.	

Boston Blue Print-300-4-57

STATE HIGHWAY COMMISSION
AUGUSTA, MAINE

PORTLAND-YARMOUTH INTERSTATE

INTERSTATE OVER ROUTE 1

WINGWALLS

SHEET NO. 38 OF 121 | SCALE: AS NOTED

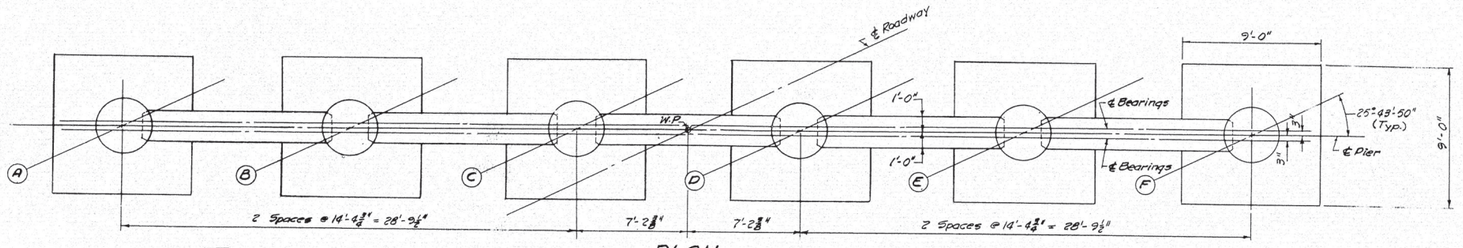
FAY, SPOFFORD & THORNDIKE, INC.
ENGINEERS BOSTON, MASS.

Qm-14
760

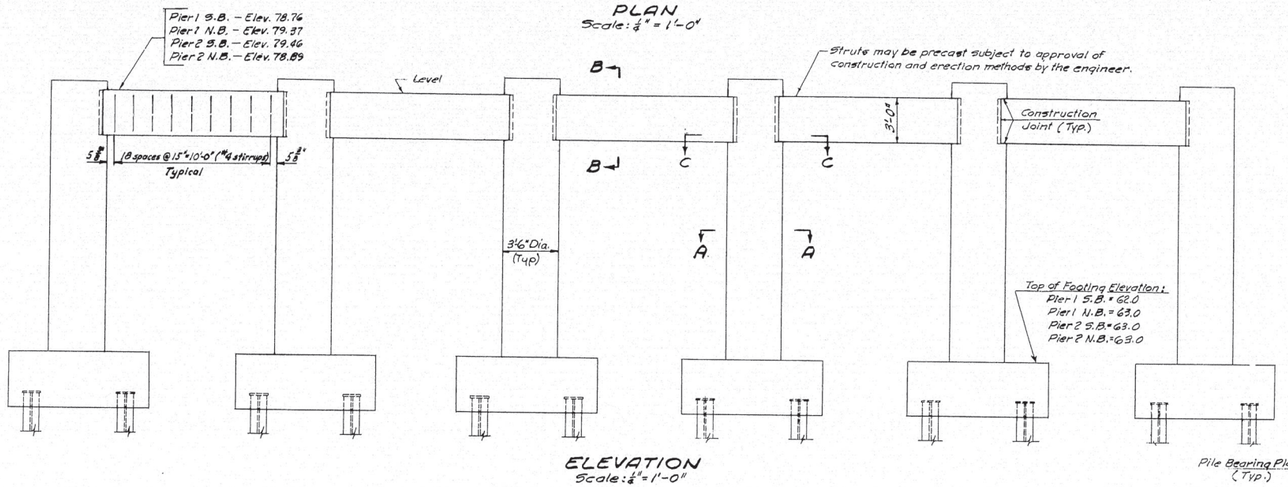
M-1760

B. P. R. REG. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
1	MAINE	I-95-4(10)	39	121

YARMOUTH

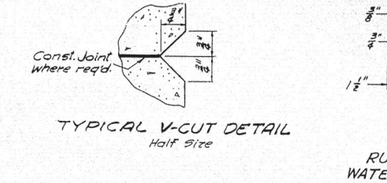


PLAN
Scale: 1/8" = 1'-0"

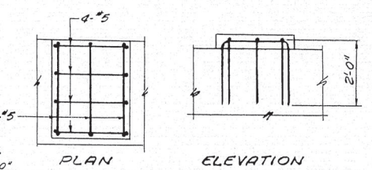


ELEVATION
Scale: 1/8" = 1'-0"

END ELEVATION
Scale: 1/2" = 1'-0"



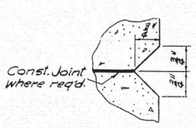
WATERPROOFING DETAIL



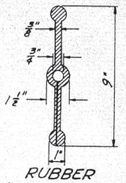
To be used where top of pad is 4" or more above Abutment Bridge Seat.

BEARING PAD DISTRIBUTION STEEL
Scale: 1/2" = 1'-0"

TYPICAL DETAILS



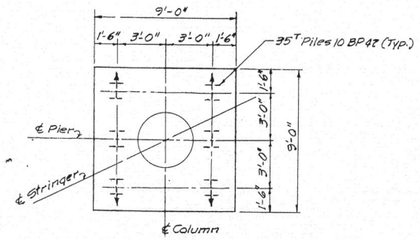
TYPICAL V-CUT DETAIL
Half Size



RUBBER WATERSTOP
Scale: 3"=1'-0"

Construction Notes

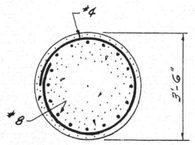
1. Reinforcing steel to have 2" minimum cover unless otherwise noted.
2. All bar splices to lap 20 diameters (12" min.) unless otherwise noted.
3. All bar embedments to be 35 diameters unless otherwise noted.
4. Bearing pads and tops of pier columns to be of sufficient height to permit bush hammering to the proper elevation.
5. All bearing pads to be placed integrally with the abutments.
6. All exposed corners except on bearing pads and tops of pier columns to have 3/4" chamfer. Bearing pads and tops of pier columns to have tooled edges.
7. Reinforcing steel in or beneath bearing pads and in tops of pier columns to be positioned to clear swedge anchor bolts. For swedge anchor bolts, see Bearing Details on Sheet No. 44.



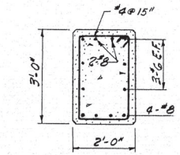
TYPICAL PILE PLAN
Scale: 1/4" = 1'-0"

TOP OF COLUMN ELEVATIONS

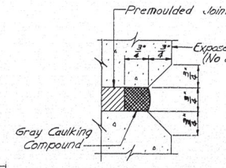
	COLUMN	PIERS 1	PIERS 2
SOUTHBOUND	A	79.26	79.96
	B	79.58	80.11
	C	79.80	80.24
	D	79.88	80.25
	E	79.83	80.11
	F	79.67	79.96
NORTHBOUND	A	79.87	79.78
	B	80.10	79.85
	C	80.24	79.92
	D	80.25	79.84
	E	80.11	79.62
	F	79.88	79.39



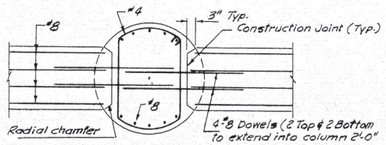
SECTION A-A
Scale: 1/4" = 1'-0"



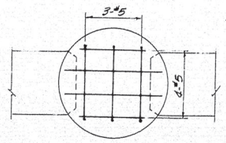
SECTION B-B
Scale: 1/4" = 1'-0"



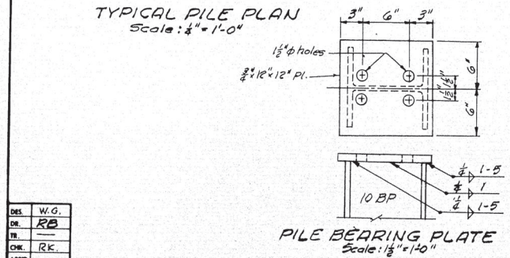
CAULKING DETAIL
Half Size



SECTION C-C
Scale: 1/2" = 1'-0"



BEARING DISTRIBUTION STEEL
TOP OF PIER COLUMN
Scale: 1/2" = 1'-0"



PILE BEARING PLATE
Scale: 1 1/2" = 1'-0"

DES	W.G.
DR.	RB
TR.	—
CHK.	RK.
APP'D.	

Boston Blue Print-300-4-67

STATE HIGHWAY COMMISSION
AUGUSTA, MAINE

PORTLAND-YARMOUTH INTERSTATE

INTERSTATE OVER ROUTE 1

PIER DETAILS

SHEET NO. 39 OF 121 | SCALE: AS NOTED

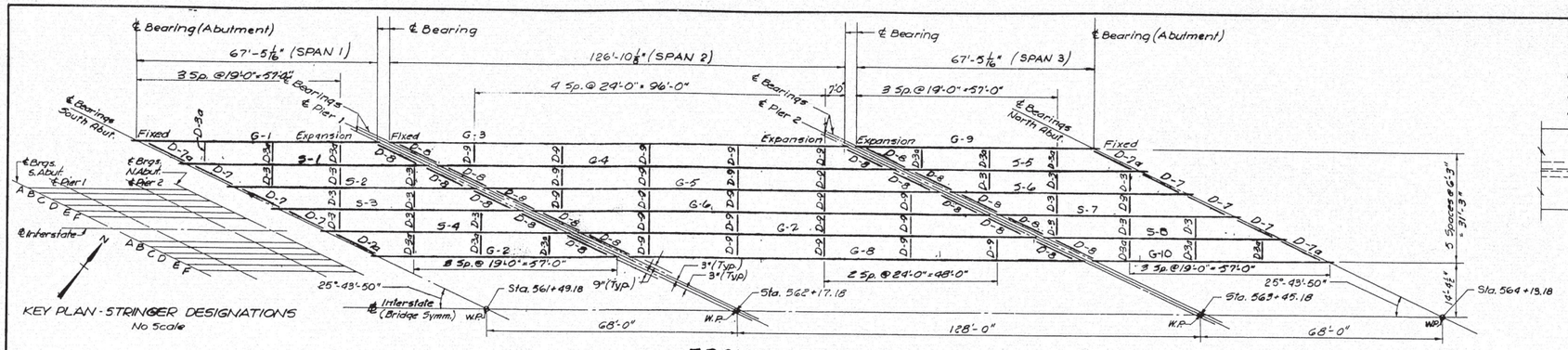
FAY, SPOFFORD & THORNDIKE, INC.
ENGINEERS BOSTON, MASS.

Qm-12
761

M-1761

YARMOUTH

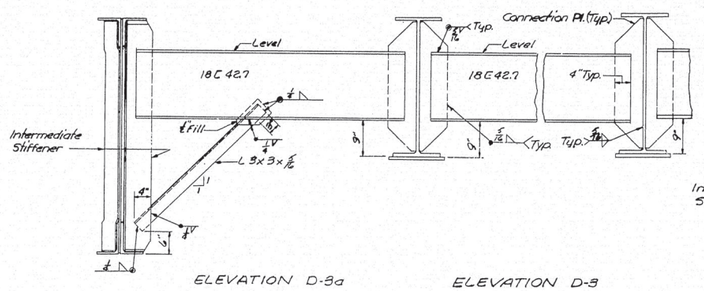
B. P. R. REG. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
1	MAINE	I-95-4(10)	40	121



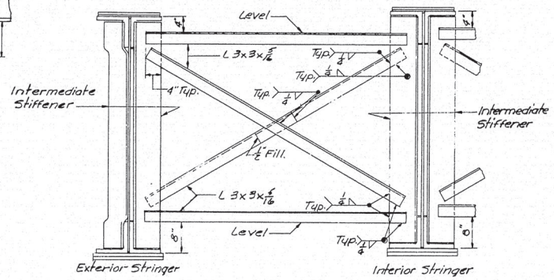
FRAMING PLAN

SOUTHBOUND SHOWN, NORTHBOUND SIMILAR

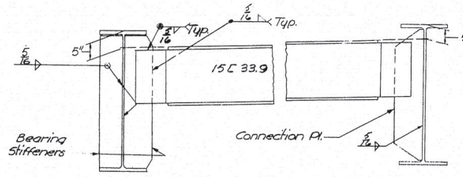
Scale: 1/16" = 1'-0"



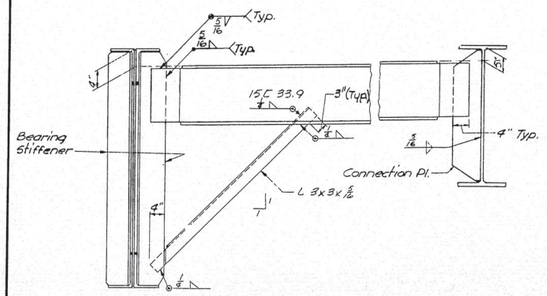
ELEVATION D-8a



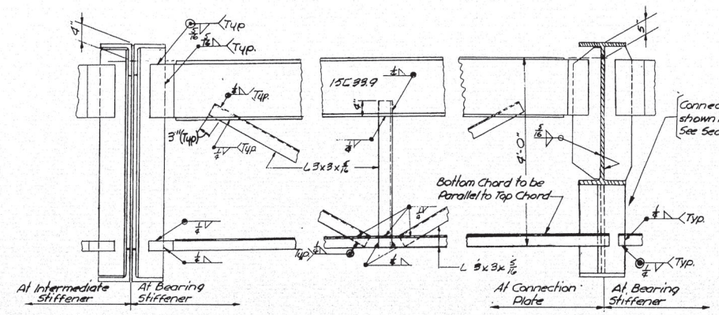
ELEVATION D-9



DEVELOPED ELEVATION D-7



DEVELOPED ELEVATION D-7a



CONNECTION AT PLATE GIRDER

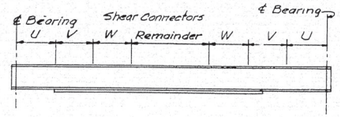
DEVELOPED ELEVATION D-8

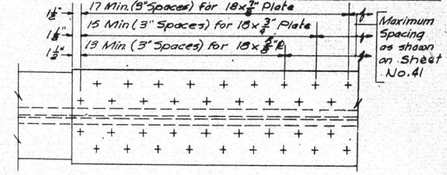
CONNECTION AT 36 WF

DIAPHRAGM DETAILS

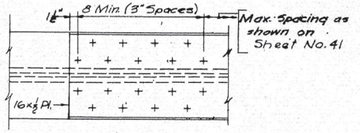
Scale: 3/8" = 1'-0"

Note: For Size of Stiffener and Connection Angles (or Plates) See Stiffener Schedule on Sheet No. 41





BOTTOM COVER PLATES



TOP COVER PLATES

RIVET SPACING AT END OF COVER PLATES

Scale 1" = 1'-0"

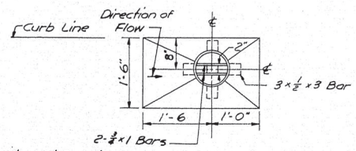
STRINGER	Δ	SPIRAL SHEAR CONNECTORS						STUD SHEAR CONNECTORS					
		SPIRAL "U"		SPIRAL "V"		SPIRAL "W"	REMAINDER	SPIRAL "U"		SPIRAL "V"		SPIRAL "W"	REMAINDER
		LENGTH	PITCH	LENGTH	PITCH	LENGTH	PITCH	LENGTH	PITCH	LENGTH	PITCH	LENGTH	PITCH
G1, G2, G9, G10	3/16	12'-0"	2@16"	12'-0"	2@18"	—	—	2@18"	12'-0"	2@7 1/2"	12'-0"	2@10"	—	—	2@17"
G3, G8	3/16	*	2@15"	14'-0"	1@8"	16'-0"	1@19"	1@18"	*	6@12"	14'-0"	2@12"	16'-0"	3@18"	5@18"
G4 thru G7	3	*	2@11"	14'-6"	1@6 1/2"	16'-0"	1@6"	1@10 1/2"	*	4@11"	14'-6"	3@9"	16'-0"	3@14"	3@18"
S1 thru S8	1/2	12'-0"	2@7"	12'-0"	2@9"	—	—	1@7"	12'-0"	3@5"	12'-0"	3@6 1/2"	—	—	3@10"

* Length = Distance ℄ Bearing to end of first cover plate.

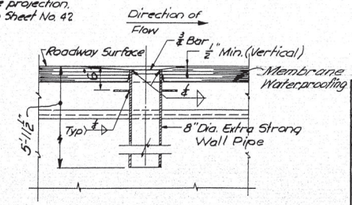
Spiral Pitch: 2@X" denotes a 3/8" ϕ double spiral at X" pitch.
All other designations refer to a 3/8" ϕ single spiral.

Stud Pitch: 2@X" denotes 2-3/4" ϕ studs per pitch @ X" pitch.
3@X" denotes 3 studs per pitch @ X" pitch.
4@X" denotes 4 studs per pitch @ X" pitch.

Δ = Dead load deflection @ mid-span



PLAN



SECTION THRU SCUPPER

SCUPPER DETAIL

Scale: 1/2" = 1'-0"

Note: For Location of Scuppers See Sheet No. 36

FRAMING NOTES

1. All ℄ bearings are parallel.
2. All stringers are parallel to ℄ Interstate.
3. All dimensions on Framing Plan are horizontal.
4. WF Stringers are not to be cambered but shall be erected with natural bow up.
5. Plate girders are to be cambered for dead load deflection plus vertical curve. Camber diagrams shall be submitted to the Engineer for approval.
6. For bearing, shear connector, and welded cover plate details see Sheet No. 44

Note:
For stringers S-1 thru S-8, the steel for the WF sections and cover plates shall conform to A.S.T.M. A-373. All other structural steel shall conform to A.S.T.M. A-7 or A-373 unless specified otherwise.

▲ Revision April 13, 1961

STATE HIGHWAY COMMISSION
AUGUSTA, MAINE

PORTLAND-YARMOUTH INTERSTATE

INTERSTATE OVER ROUTE 1

FRAMING PLAN AND DETAILS

SHEET NO. 40 OF 121	SCALE: AS NOTED	

FAY, SPOFFORD & THORNDIKE, INC. ENGINEERS BOSTON, MASS.

Qm-14
762

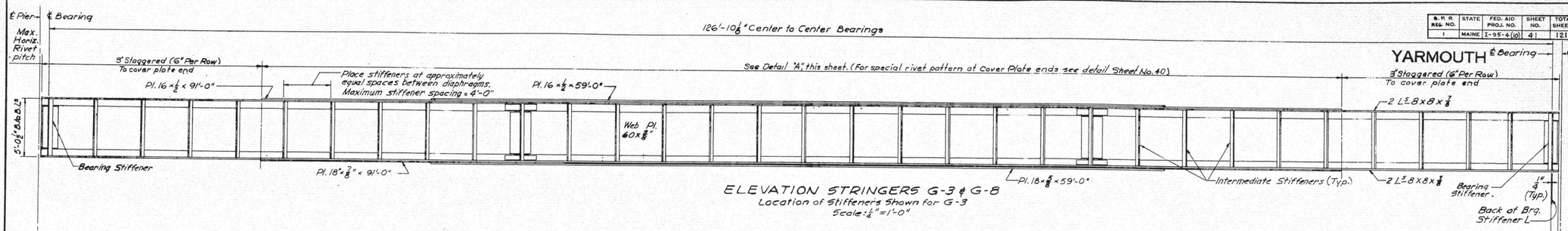
DES.	RW & RK
DR.	CEG
TR	CEG
CHK.	RK
APP'D.	

Boston Blue Print-300-4-57

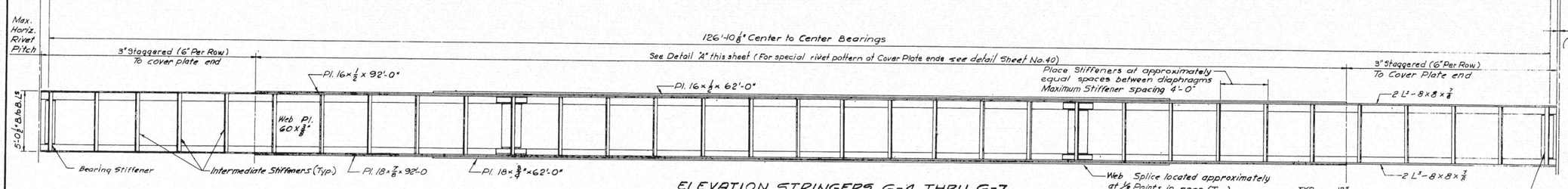
M-1762

B. P. R. REG. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
1	MAINE	I-95-4(10)	41	121

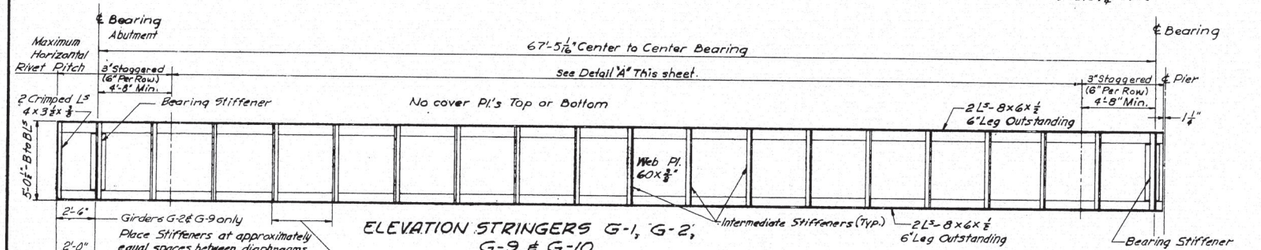
YARMOUTH



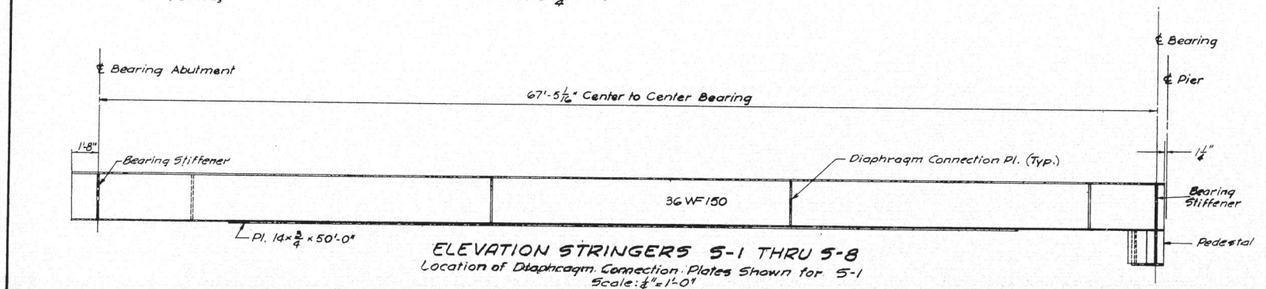
ELEVATION STRINGERS G-3 ℄ G-8
Location of Stiffeners Shown for G-3
Scale: ¼" = 1'-0"



ELEVATION STRINGERS G-4 THRU G-7
Location of Stiffeners Shown for G-4
Scale: ¼" = 1'-0"



ELEVATION STRINGERS G-1, G-2, G-9 ℄ G-10
Location of Stiffeners Shown for G-1
Scale: ¼" = 1'-0"



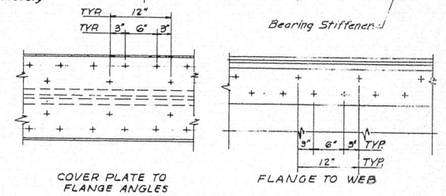
ELEVATION STRINGERS S-1 THRU S-8
Location of Diaphragm Connection Plates Shown for S-1
Scale: ¼" = 1'-0"

Notes: All cover plates are symmetrical about ℄ span.

Maximum Vertical Rivet pitch to be 6".

For diaphragm location and connection details see Framing Plan & Diaphragm Details on Sheet No. 40

All dimensions centerline to centerline of Bearings are horizontal dimensions.



COVER PLATE TO FLANGE ANGLES

FLANGE TO WEB

DETAIL "A"
Scale: 1" = 1'-0"
(Min. Rivet Pitch for Flanges)

STIFFENER SCHEDULE

STRINGER	BEARING STIFFENERS * Side with Diaphragm Connection	BEARING STIFFENERS * Side without Diaphragm Connection	INTERMEDIATE STIFFENERS Side with Diaphragm Connection	INTERMEDIATE STIFFENERS Side without Diaphragm Connection
G1, G2, G9, G10	L 7 × 4 × ⅞ With 12 - ½ Fill	L 6 × 4 × ½ With 12 × ½ Fill	L 7 × 4 × ½ With 4 - ½ Fill	L 4 × 3½ × ⅜ Crimped
G3 THRU G8	L 7 × 4 × ⅞ With 12 × ⅞ Fill	L 7 × 4 × ⅞ With 12 - ⅞ Fill	L 7 × 4 × ½ With 4 - ⅞ Fill	L 5 × 3½ × ⅜ Crimped
S-1 THRU S-8	Pl. 7 × ⅞	Pl. 5½ × ⅞	Pl. 7 × ⅞	None

* Note: All Stringers to have a Bearing Stiffener on each side of the Web at each Bearing.

STATE HIGHWAY COMMISSION
AUGUSTA, MAINE

PORTLAND-YARMOUTH INTERSTATE

INTERSTATE OVER ROUTE 1
FRAMING DETAILS PART 1

SHEET NO. 41 OF 121 | SCALE: AS NOTED

FAY, SPOFFORD & THORNDIKE, INC. ENGINEERS BOSTON, MASS.

Qm-14 763

DES.	RK & PA
DR.	C.A.K.
TR.	
CHK.	RK
APPD.	

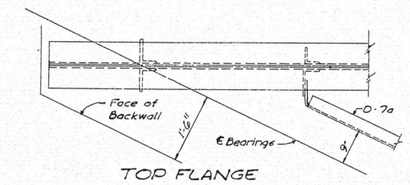
Dietzgen Blue Print-800-4-61

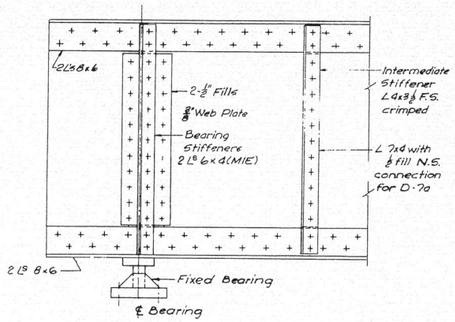
ML-1763

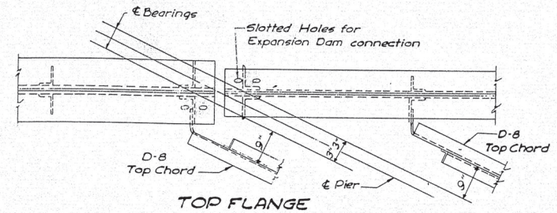
0 1 2 3 4 5 INCHES

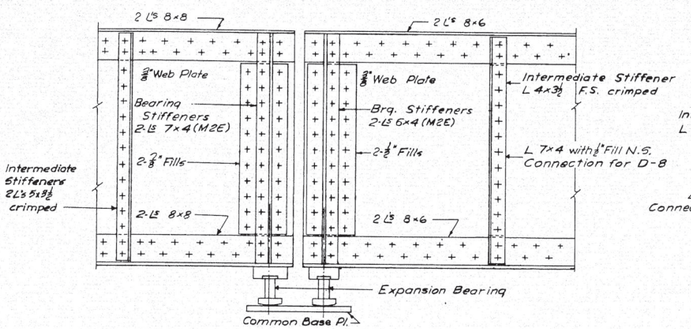
B.P.R. REG. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
1	MAINE	I-95-4(10)	42	121

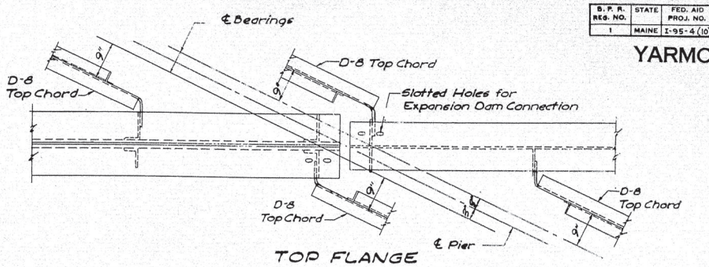
YARMOUTH

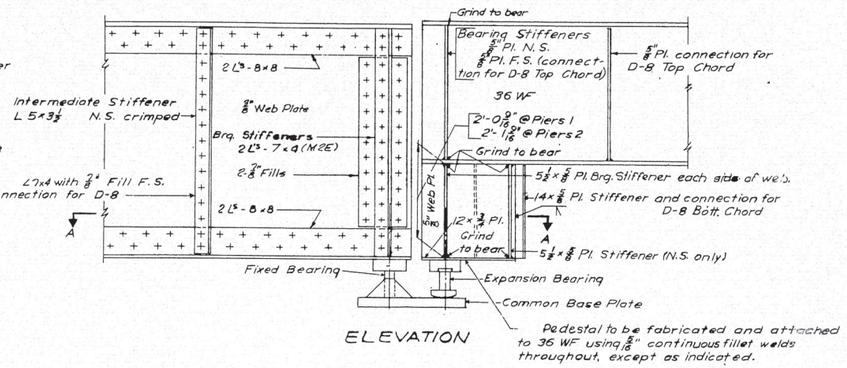


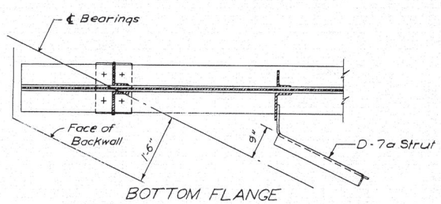


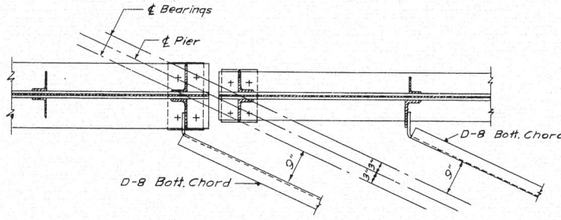


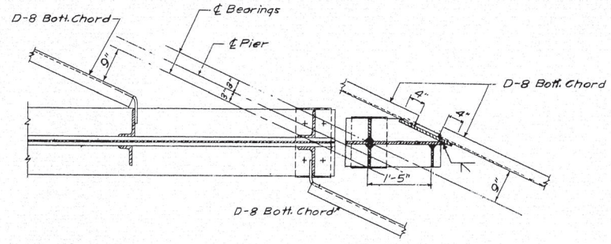


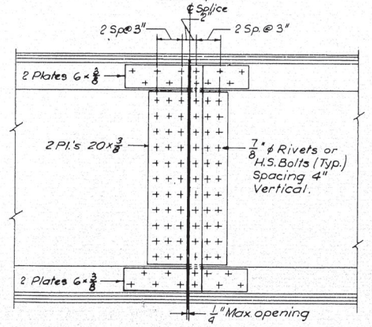


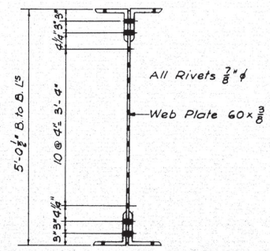












Note: For size of stiffener and connection angles (or plates), see Stiffener Schedule on Sheet No. 41

DES.	R.E.& P.W.
DR.	C.R.
TR.	——
CHK.	R.K.
APP'D.	

Brandon Blue Print-000-4-57

STATE HIGHWAY COMMISSION
AUGUSTA, MAINE

PORTLAND-YARMOUTH INTERSTATE

INTERSTATE OVER ROUTE 1
FRAMING DETAILS PART II

SHEET NO. 42 OF 121 | SCALE: AS NOTED

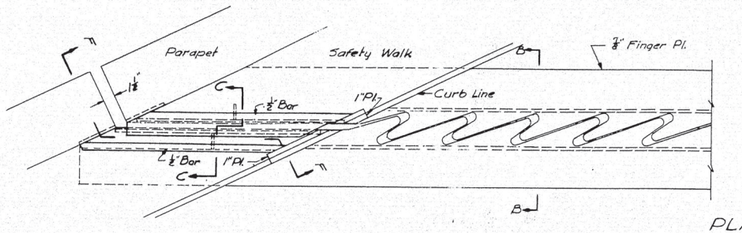
FAY, SPOFFORD & THORNDIKE, INC. ENGINEERS BOSTON, MASS.

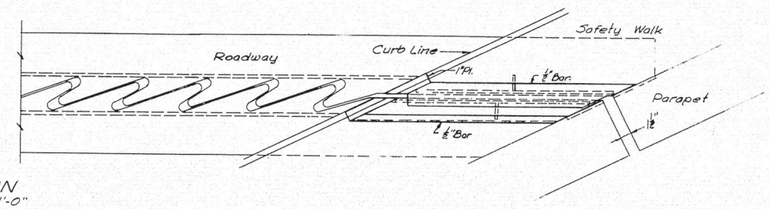
Qm-14 764

M-1764

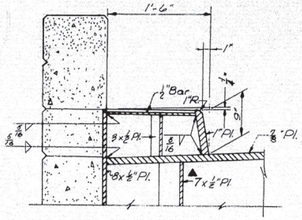
B. P. R. REG. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
1	MAINE	I-95-4(10)	43	121

YARMOUTH

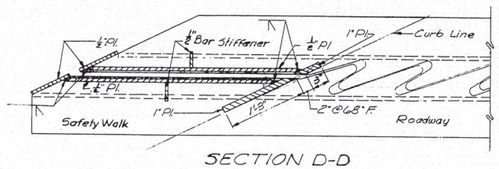




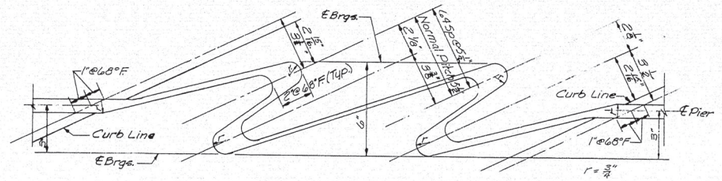
PLAN
Scale: 1"=1'-0"



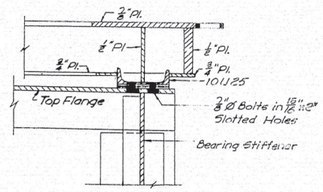
SECTION F-F
Scale: 1"=1'-0"



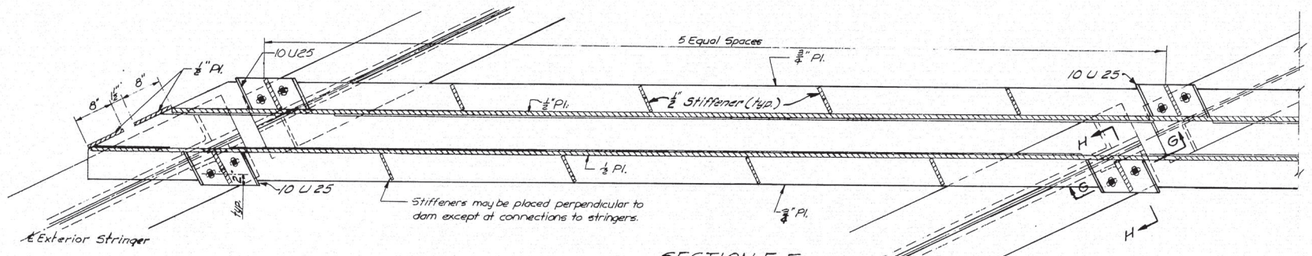
SECTION D-D
Scale: 1"=1'-0"
ANCHOR STRAPS NOT SHOWN



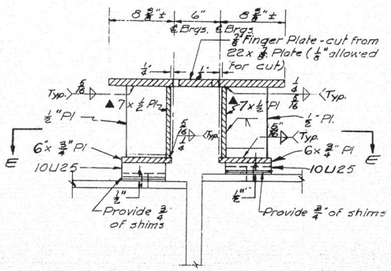
FINGER DETAIL
Scale: 3"=1'-0"



SECTION G-G

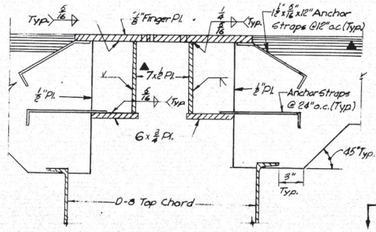


SECTION E-E
Scale: 1"=1'-0"
ANCHOR STRAPS NOT SHOWN

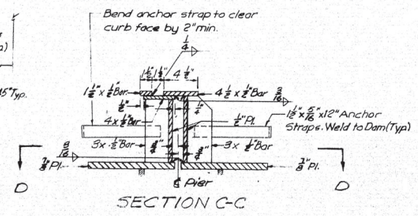


SECTION THRU EXPANSION DAM AT STRINGER SUPPORT

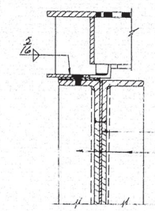
(Parts of sections have been rotated for clarity. For true sections see G-G & H-H.)



SECTION B-B



SECTION C-C



SECTION H-H

NOTES:
1. Finger plates are to follow roadway grade.
2. Anchor straps are to be perpendicular to dam.

▲ Revision April 13, 1961

DES.	R.N.W.
DR.	H.K.F.
TR.	C.E.G.
CK.	R.K.
APPR.	

Boston Blue Print-800-4-61

STATE HIGHWAY COMMISSION
AUGUSTA, MAINE

PORTLAND-YARMOUTH INTERSTATE

INTERSTATE OVER ROUTE 1
EXPANSION DAM DETAILS
AT PIER 2

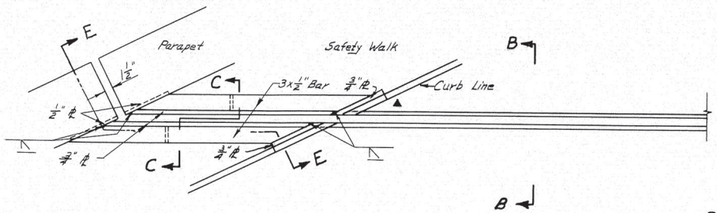
SHEET NO. 43 OF 121	SCALE: AS NOTED	

FAY, SPOFFORD & THORNDIKE, INC.
ENGINEERS BOSTON, MASS.

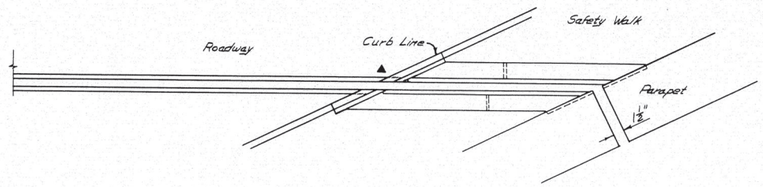
Qm-14
765

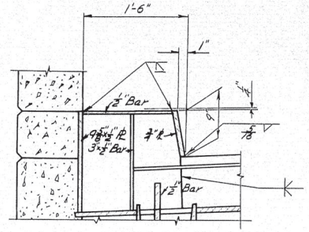
M-1765

B. P. R. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE	I-95-4(10)	43A	121

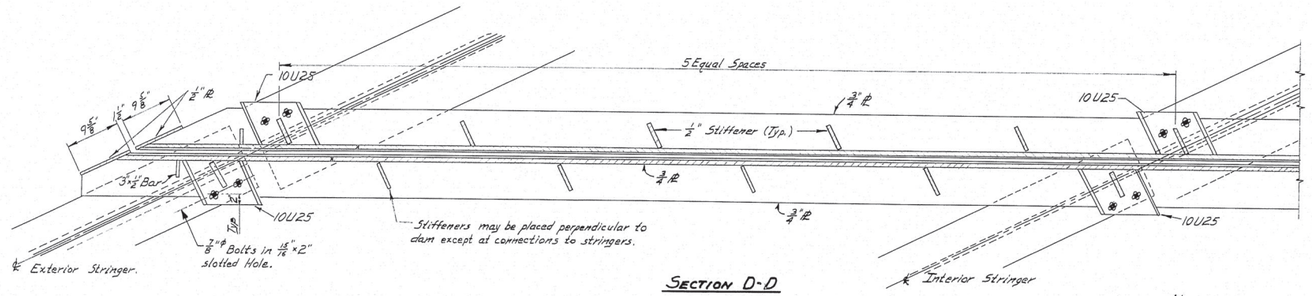


PLAN
Scale 1"=1'-0"



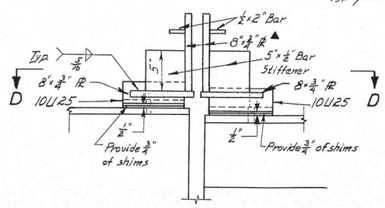


▲ SECTION E-E



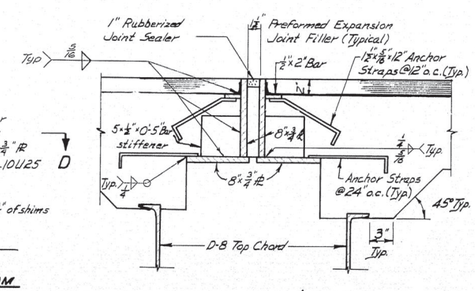
SECTION D-D
Scale 1"=1'-0"
Anchor Straps not Shown

Notes:
1. Expansion dam to follow roadway grade.
2. Anchor straps are to be perpendicular to dam.

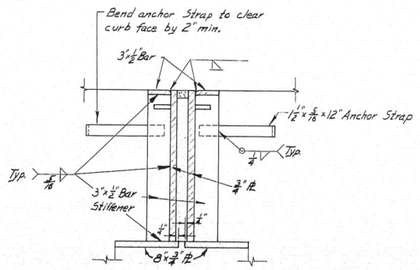


SECTION THRU EXPANSION DAM AT STRINGER SUPPORT

(Parts of section have been rotated for clarity.)



SECTION B-B ▲



SECTION C-C

▲ Revision April 13, 1961

DESIGN– RISSEL TRACE– JHW CHECK– Harris	BRIDGE NO. SURVEY– PLOT–

STATE HIGHWAY COMMISSION
BRIDGE DIVISION

INTERSTATE OVER ROUTE 1

IN THE TOWN OF

YARMOUTH

CUMBERLAND COUNTY

EXPANSION DAM DETAILS PIER 1

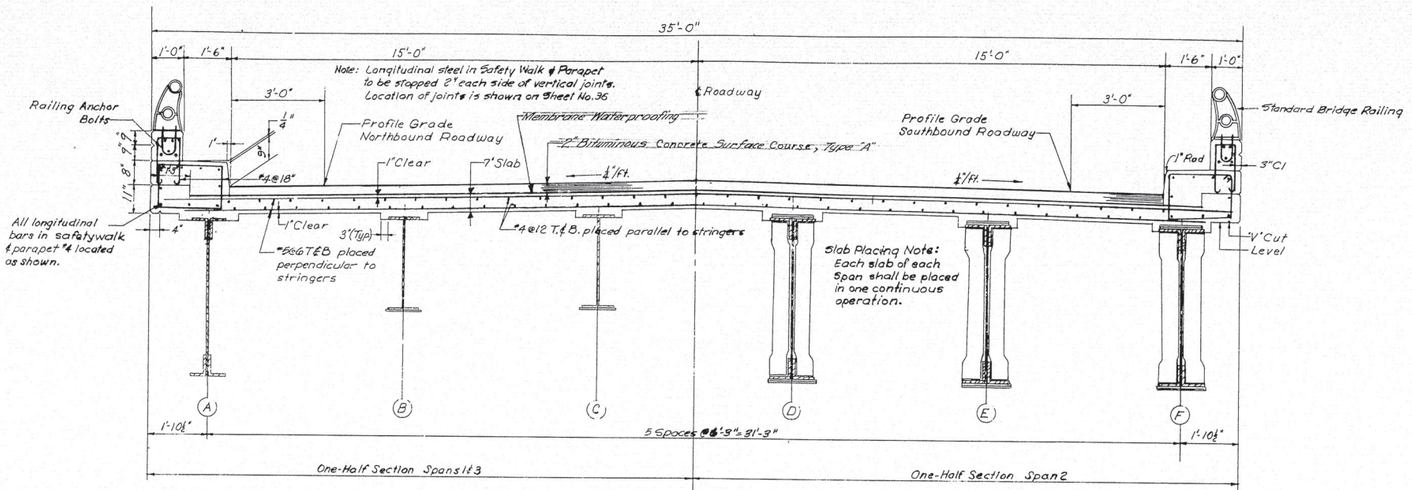
SHEET 43A OF 121 AUGUSTA, MAINE FEBRUARY 1961

M-1766

C. E. CO., NO. 270 64687

B.P.R. REG. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
1	MAINE	I-95-4(10)	44	121

YARMOUTH

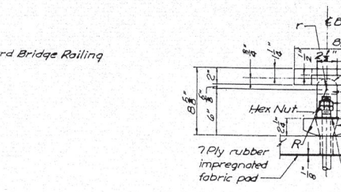


TYPICAL CROSS SECTION OF DECK ▲

Note: For Construction Notes See Sheet No. 39

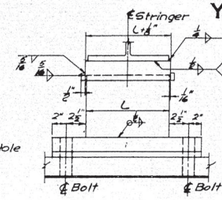
SCREED SETTING ▲

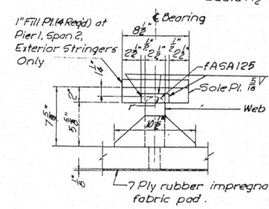
After structural steel has been erected levels are to be run on top flanges of stringers. Screeds for slab are to be set on the basis of these levels corrected for 70 percent of the dead load deflection shown on sheet No. 40, for Span 2, & 80 percent for Spans 1 & 3.

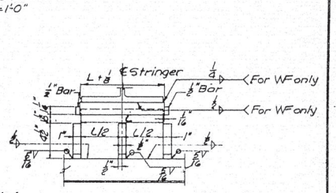


EXPANSION BEARING

Scale: 1½" = 1'-0"

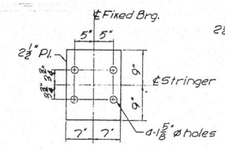




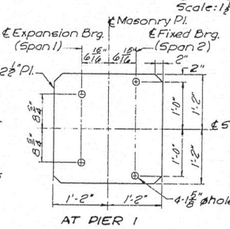


FIXED BEARING

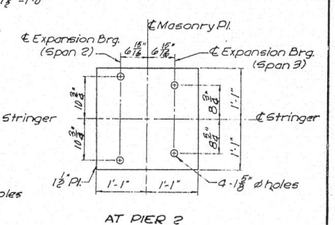
Scale: 1½" = 1'-0"



AT ABUTMENTS



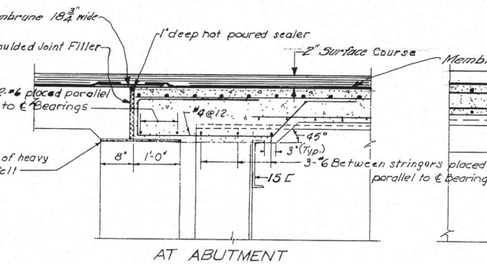
AT PIER 1



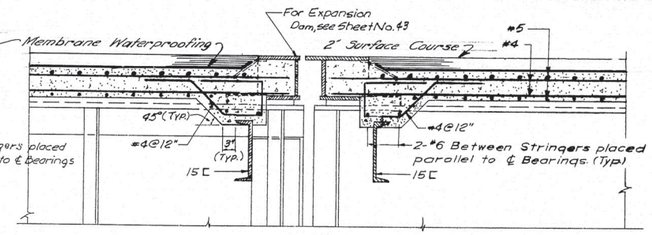
AT PIER 2

MASONRY PLATES

Scale: ¾" = 1'-0"



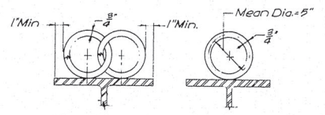
AT ABUTMENT



AT PIER 2

Pier 1 similar except expansion dam.

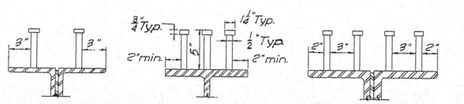
▲ LONGITUDINAL SECTIONS (See sh. #43A)



DOUBLE SPIRAL SINGLE SPIRAL

Spiral Notes

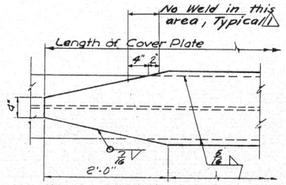
1. All spirals to be fabricated with ⅜" ø plain bars and to have a mean diameter of 5 inches.
2. Spirals to be welded to stringer flange with two ⅜" fillet welds, 2½" long at each point of contact.
3. Spiral lengths given on framing plan are net lengths and do not include any allowance for laps.
4. Where spiral sections are joined, they shall be lapped for a distance of one-half the smaller pitch.



2 STUDS PER PITCH 3 STUDS PER PITCH 4 STUDS PER PITCH

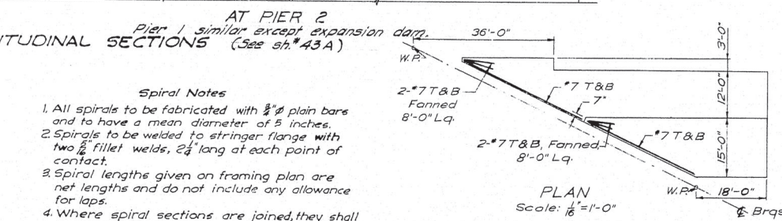
SHEAR CONNECTOR DETAILS

Scale: 1½" = 1'-0"



COVER PLATE DETAIL FOR WF STRINGERS ONLY

Scale: 1" = 1'-0"



PLAN

Scale: 1/16" = 1'-0"

For Fixed Brgs, r = 1 7/16" for sole plate and 1⅛" for web
At Abutments, Pier 1 (Span 1) and Pier 2 (Span 3), L = 1'-0½"
At Pier 1 (Span 2) and Pier 2 (Span 2), L = 1'-4½"
For Expansion Brgs:
Rocker radii (Concentric)
r = 1⅛"; R = 6"
Sole Plate: r = 1 7/16"

Notes:

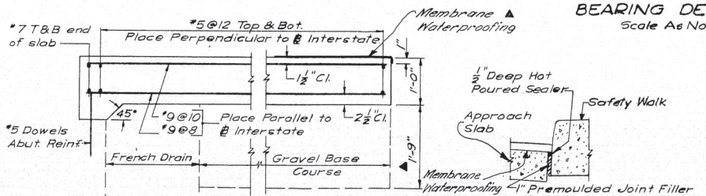
Bearings to be fastened to plate girders using four ⅞" ø rivets or high-strength bolts in 15/16" ø holes.

Anchor bolts to be 1¼" ø swedge bolts 2'-0" long with jam nut, hex nut, and plate washer as shown at expansion bearings; and with hex nut and lock washer at fixed bearings. Projection above masonry plate to be 6" at expansion bearings and 2½" at fixed bearings.

BEARING DETAILS

Scale As Noted

▲ Revision April 13, 1961



LONGITUDINAL SECTION

Scale: ¾" = 1'-0"

▲ SECTION AT CURB

Scale: ½" = 1'-0"

APPROACH SLAB DETAILS

△ Field change, March 31, 1961

STATE HIGHWAY COMMISSION
AUGUSTA, MAINE

PORTLAND-YARMOUTH INTERSTATE

INTERSTATE OVER ROUTE 1

CROSS SECTION AND DETAILS

SHEET NO. 44 OF 121 | SCALE: AS NOTED

FAY, SPOFFORD & THORNDIKE, INC. ENGINEERS BOSTON, MASS.

Qm-14 766

DES.	R.W.
DR.	R.M.M.
TR.	—
CHK.	R.K.
APPD.	

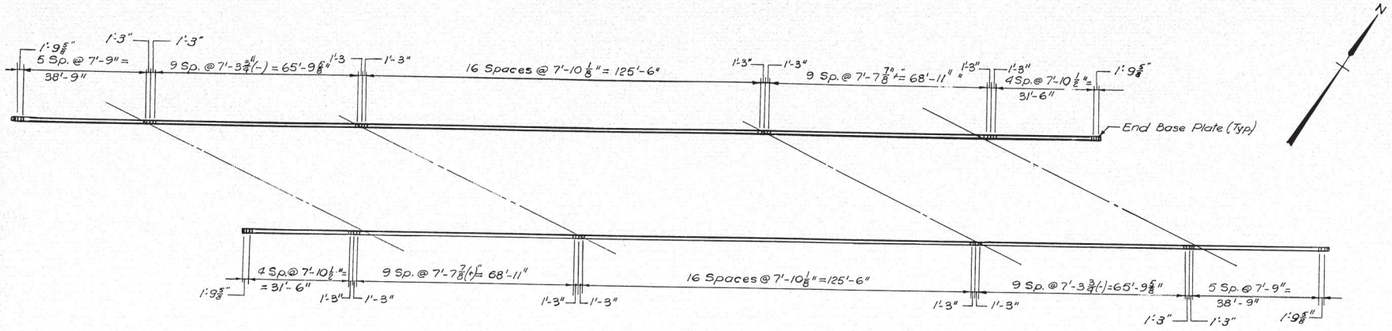
Boston Blue Print-300-4-57

M-1767

0 1 2 3 4 5 INCHES

B. P. R. REQ. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
1	MAINE	I-95-4(10)	45	121

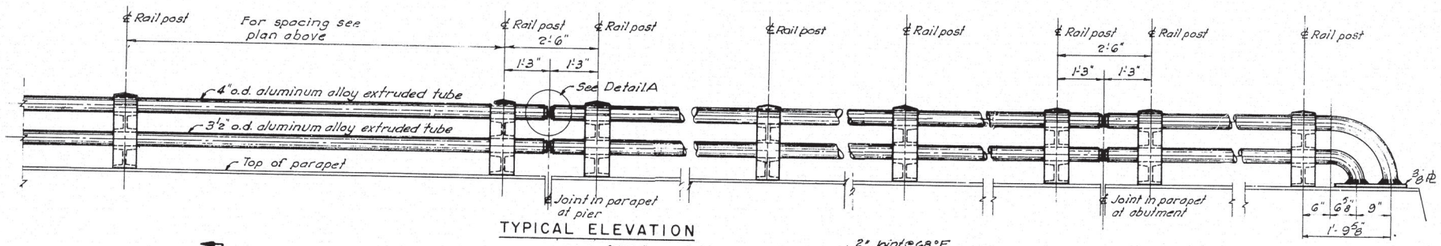
YARMOUTH



PLAN OF RAILING

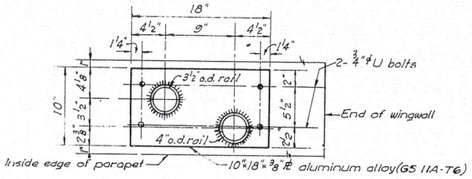
Southbound Shown
Northbound Similar
Scale: 1" = 20'

Note: All dimensions in plan are horizontal.



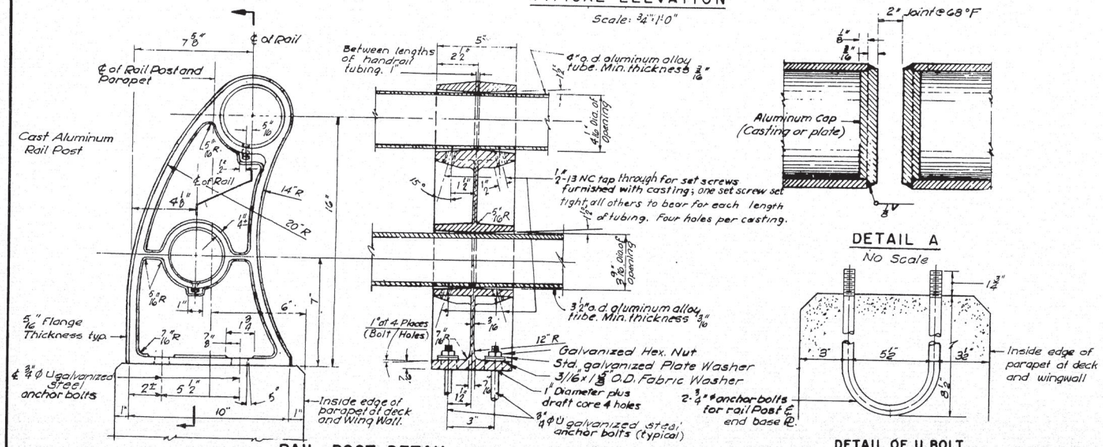
TYPICAL ELEVATION

Scale: ¾"=1'-0"



DETAIL OF END BASE PLATE

Scale: 1½"=1'-0"



RAIL POST DETAIL

Scale: 3"=1'-0"

DETAIL OF U BOLT FOR RAIL POST

Scale: 3"=1'-0"

NOTES:

1. The bottom of each railing post shall be thoroughly coated with an aluminum impregnated caulking compound before installation.
2. Railing post to be set normal to parapet.
3. As far as practicable, rail bars shall have a minimum length of two panels and be continuous thru at least one rail post. There shall be only one rail bar splice per post
4. Aluminum alloy shims in number equal to 50% of rail posts, shall be provided for erection of posts.

DES.	—
DR.	RB
TR.	—
CHK.	RHW
APP'D.	

Boston Blue Print-300-1-67

STATE HIGHWAY COMMISSION
AUGUSTA, MAINE

PORTLAND-YARMOUTH INTERSTATE

INTERSTATE OVER ROUTE 1

RAILING DETAILS

SHEET NO. 45 OF 121 | SCALE: AS NOTED

FAY, SPOFFORD & THORNDIKE, INC. ENGINEERS BOSTON, MASS.

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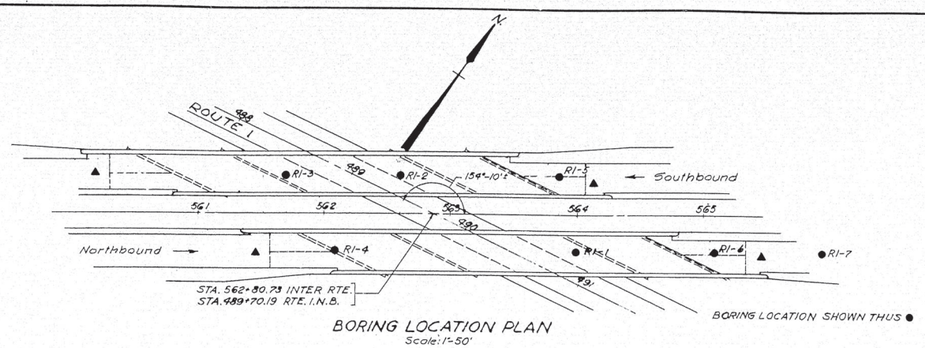
IM-1768

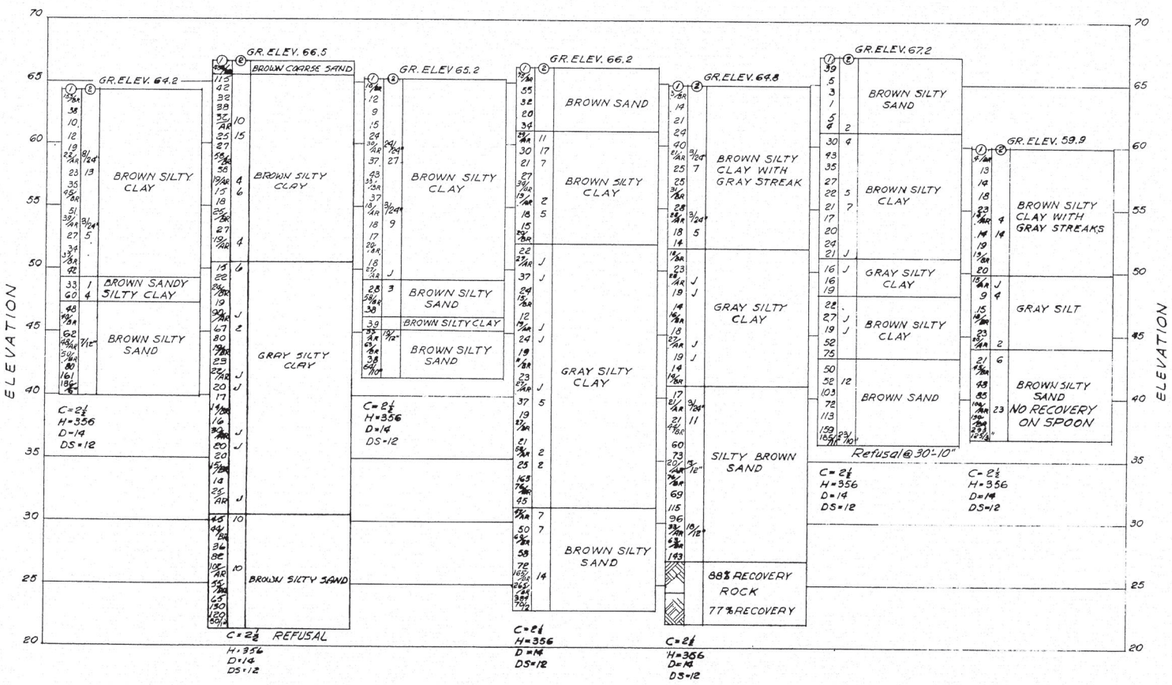
B. F. R. REG. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
1	MAINE	I-95-4(10)	46	121

YARMOUTH



BORING LOCATION PLAN
Scale: 1"=50'

BORING RI-3 STA. 561+70, 30'L
BORING RI-4 STA. 562+08', 30'R
BORING RI-2 STA. 562+62', 39'L
BORING RI-5 STA. 563+86, 33'L
BORING RI-1 STA. 563+99, 30'R
BORING RI-6 STA. 565+09', 30'R
BORING RI-7 STA. 565+95', 30'R



GENERAL NOTES
1. BORINGS WERE MADE BY THE MAINE STATE HIGHWAY COMMISION DEC. 1956 AND JAN. 1957
2. FIGURES IN COLUMN ① = BLOWS PER FOOT ON CASING
   FIGURES IN COLUMN ② = BLOWS PER FOOT ON SAMPLER ROD EXCEPT AS NOTED.
3. ELEVATIONS ARE REFERRED TO MEAN SEA LEVEL.
4. ADDITIONAL SOIL INFORMATION OBTAINED FROM LABORATORY TESTS IS AVAILABLE FROM THE MAINE STATE HIGHWAY COMMISSION.

SCALE: VERT: 1"=5'

LEGEND
C = DIAMETER OF CASING IN INCHES
H = WEIGHT OF HAMMER IN POUNDS
D = DROP ON CASING IN INCHES
DS = DROP ON SAMPLER ROD IN INCHES
J = SAMPLER DRIVEN BY STATIC LOAD NOT EXCEEDING ½ TON
AR = CASING WAS DRIVEN WASHING AHEAD OF CASING
BR =

DES.	—
DR.	W.C.
TR.	—
CHK.	RFC
APP'D.	

Boston Blue Print-300-4-57

▲ Revision April 13, 1961

STATE HIGHWAY COMMISSION
AUGUSTA, MAINE

PORTLAND-YARMOUTH INTERSTATE

INTERSTATE OVER ROUTE 1
BORING DATA

SHEET NO. 46 OF 121 | SCALE: AS NOTED

FAY, SPOFFORD & THORNDIKE, INC. ENGINEERS BOSTON, MASS.

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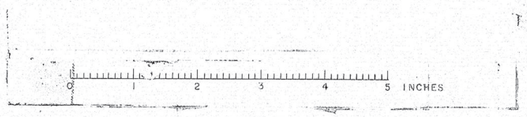
768

M-1769



APPENDIX E

Calculations

Seismic Site Class and
Seismic Design Parameters

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	1
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

PROBLEM STATEMENT & OBJECTIVE

Determine the Seismic Site Class using available subsurface, SPT N or shear wave velocity (Vs) information.

EXECUTIVE SUMMARY

Based on the subsurface conditions encountered at the 17 test borings near the proposed substructures (BB-YRO-101 through BB-YRO-106 and BB-YRO-201 through BB-YRO-211), recommend a **Seismic Site Class D**.

REFERENCES

1. AASHTO Guide Specifications for LRFD Seismic Bridge Design, 2nd Edition, 2011 (2012 Interim Revisions).
2. AASHTO LRFD Bridge Design Specifications, 7th Edition, 2014.
3. International Building Code 2009.
4. ASCE/SEI 7-05 Minimum Design Loads For Buildings and Other Structures
5. International Building Code 2012.
6. ASCE/SEI 7-10 Minimum Design Loads For Buildings and Other Structures

AVAILABLE INFORMATION

1. Phase I test boring logs; boring nos. BB-YRO-101 through BB-YRO-106.
2. Phase II test boring logs; boring nos. BB-YRO-201 through BB-YRO-211.
3. Design drawings prepared and provided by HNTB.

ASSUMPTIONS

1. Where SPT N, Vs or su data was available to depths less than 100 ft, the subsurface profile was extended to 100 ft. The SPT N, Vs or su for the extended profile was then assumed based on the available information.

PROCEDURE

1. Check the site against the three categories of Site Class F (see attached Table 3.4.2.1-1), requiring site-specific ground motion response evaluation. If the site corresponds to any of these categories, classify the site as Site Class F and conduct a site-specific ground motion response evaluation.
2. Categorize the site using one of the following three methods (Method A, B, or C).

Method A
Average shear wave velocity for the upper 100 ft of the soil profile:

$$\overline{V_s} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{V_{si}}}$$

where

V_{si} = shear wave velocity of *i* th soil (ft/s).
d_i = thickness of *i* th soil layer (ft).
n = total number of distinctive soil layers in the upper 100 ft of the site profile.
i = any one of the layers between 1 and n.

PROCEDURE

Method B
Average standard penetration test (SPT) for the upper 100 ft of the soil profile:

$$\bar{N} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{N_i}}$$

where

N_i = standard penetration resistance as measured directly in the field, uncorrected blow count, of *i* th soil layer not to exceed 100 ft (blows/ft).
d_i = thickness of *i* th soil layer (ft).
n = total number of distinctive soil layers in the upper 100 ft of the site profile.
i = any one of the layers between 1 and n.

Method C
Average standard penetration test (SPT) for the cohesionless layers in the upper 100 ft of the soil profile:

$$\bar{N}_{ch} = \frac{\sum_{i=1}^{m} d_i}{\sum_{i=1}^{m} \frac{d_i}{N_i}}$$

where

N_i = standard penetration resistance as measured directly in the field, uncorrected blow count, of *i* th cohesionless soil layer (blows/ft).
d_i = thickness of *i* th cohesionless soil layer (ft).
m = total number of distinctive cohesionless soil layers in the upper 100 ft of the site profile.
i = any one of the layers between 1 and m.

Average undrained shear strength for the cohesive layers in the upper 100 ft of the soil profile:

$$\bar{s}_u = \frac{\sum_{i=1}^{k} d_i}{\sum_{i=1}^{k} \frac{d_i}{s_{ui}}}$$

where

s_{ui} = undrained shear strength of *i* th cohesive soil layer (psf), not to exceed 5000 psf
d_i = thickness of *i* th cohesive soil layer (ft).
k = total number of distinctive cohesive soil layers in the upper 100 ft of the site profile.
i = any one of the layers between 1 and k.

Based on the available information, Method B will be used for the seismic Site Class evaluation.

SITE CLASS DEFINITIONS

(Table from AASHTO Guide Specifications for LRFD Seismic Bridge Design, 2nd Edition, 2011 (with 2012 Interim Revisions)).

Table 3.4.2.1-1—Site Class Definitions

Site Class	Soil Type and Profile
A	Hard rock with measured shear wave velocity, $\overline{v}_s > 5000$ ft/sec
B	Rock with 2500 ft/sec $< \overline{v}_s < 5000$ ft/sec
C	Very dense soil and soil rock with 1200 ft/sec $< \overline{v}_s < 2500$ ft/sec, or with either $\overline{N} > 50$ blows/ft or $\overline{s}_u > 2.0$ ksf
D	Stiff soil with 600 ft/sec $< \overline{v}_s < 1200$ ft/sec, or with either 15 blows/ft $< \overline{N} < 50$ blows/ft or 1.0 ksf $< \overline{s}_u < 2.0$ ksf
E	Soil profile with $\overline{v}_s < 600$ ft/sec, or with either $\overline{N} < 15$ blows/ft or $\overline{s}_u < 1.0$ ksf, or any profile with more than 10 ft of soft clay defined as soil with $PI > 20$, $w > 40\%$, and $\overline{s}_u < 0.5$ ksf
F	Soils requiring site-specific ground motion response evaluations, such as: • Peats or highly organic clays ($H > 10$ ft of peat or highly organic clay, where H = thickness of soil) • Very high plasticity clays ($H > 25$ ft with $PI > 75$) • Very thick soft/medium stiff clays ($H > 120$ ft)

Exceptions:

Where the soil properties are not known in sufficient detail to determine the site class, a site investigation shall be undertaken sufficient to determine the site class. Site Class E or F should not be assumed unless the authority having jurisdiction determines that Site Class E or F could be present at the site or in the event that Site Class E or F is established by geotechnical data.

where:

$\overline{v}_s$ = average shear wave velocity for the upper 100 ft of the soil profile as defined in Article 3.4.2.2

$\overline{N}$ = average standard penetration test (SPT) blow count (blows/ft) (ASTM D 1586) for the upper 100 ft of the soil profile as defined in Article 3.4.2.2

$\overline{s}_u$ = average undrained shear strength in ksf (ASTM D 2166 or D 2850) for the upper 100 ft of the soil profile as defined in Article 3.4.2.2

PI = plasticity index (ASTM D 4318)

w = moisture content (ASTM D 2216)

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	4
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

CALCULATIONS - METHOD B

Exploration ID: BB-YRO-101
Ground Surface El.: 65.1

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N	Su (psf)	d/Su
1D	1.0	64.1	Fill	2.0	4	0.500		
2D	3.0	62.1	Fill	2.0	12	0.167		
3D	5.8	59.3	Marine Clay	3.5	12	0.292		
4D	10.3	54.8	Marine Clay	5.5	10	0.550		
5D	15.8	49.3	Marine Clay	5.5	6	0.917		
6D	21.7	43.4	Clay/Sand	6.3	5	1.260		
	62.4	2.7	Bedrock	75.2	100	0.752		
		65.1						
		65.1						
		65.1			

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	5
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

CALCULATIONS - METHOD B

Exploration ID: BB-YRO-102
Ground Surface El.: 64.8

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N	Su (psf)	d/Su
1D	1.0	63.8	Fill	2.0	9	0.222		
2D	3.0	61.8	Fill	2.0	13	0.154		
3D	5.0	59.8	Fill	2.0	11	0.182		
4D	7.5	57.3	Marine Clay	3.0	24	0.125		
5D	11.3	53.5	Marine Clay	4.5	11	0.409		
6D	16.0	48.8	Marine Clay	5.0	5	1.000		
7D	21.7	43.1	Clay/Sand	6.3	5	1.260		
8D	25.0	39.8	Glacial Till	0.4	100	0.004		
	62.6	2.2	Bedrock	74.8	100	0.748		
		64.8						
		64.8						
		64.8			

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	6
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

CALCULATIONS - METHOD B

Exploration ID: BB-YRO-103
Ground Surface El.: 67.5

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N	Su (psf)	d/Su
1D	1.0	66.5	Fill	2.0	11	0.182		
2D	3.3	64.2	Marine Clay	2.5	17	0.147		
3D	6.4	61.1	Marine Clay	4.0	12	0.333		
4D+5D	13.8	53.7	Marine Clay	10.5	8	1.313		
6D	22.7	44.8	Marine Sand	7.4	18	0.411		
7D	27.2	40.3	Glacial Till	1.5	28	0.054		
	64.0	3.5	Bedrock	72.1	100	0.721		
		67.5						
		67.5						
		67.5			

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	7
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

CALCULATIONS - METHOD B

Exploration ID: BB-YRO-104
Ground Surface El.: 62.3

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N	Su (psf)	d/Su
1D	1.0	61.3	Fill	2.0	7	0.286		
2D	3.3	59	Fill/Clay	2.5	7	0.357		
3D	6.5	55.8	Marine Clay	4.0	8	0.500		
4D	11.0	51.3	Marine Clay	5.0	9	0.556		
5D	16.0	46.3	Marine Clay	5.0	6	0.833		
6D	21.0	41.3	Clay/Sand	5.0	8	0.625		
7D	26.0	36.3	Marine Sand	5.0	30	0.167		
8D	31.0	31.3	Marine Sand	5.0	26	0.192		
9D	36.4	25.9	Marine Sand	5.8	26	0.223		
10D	41.1	21.2	Glacial Till	3.6	72	0.050		
	71.5	-9.2	Bedrock	57.1	100	0.571		
		62.3						
		62.3						
		62.3			

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	8
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

CALCULATIONS - METHOD B

Exploration ID: BB-YRO-105
Ground Surface El.: 65.7

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N	Su (psf)	d/Su
1D	1.0	64.7	Fill	2.0	4	0.500		
2D	3.3	62.4	Fill/Clay	2.5	12	0.208		
3D	6.5	59.2	Marine Clay	4.0	10	0.400		
4D	11.0	54.7	Marine Clay	5.0	4	1.250		
5D	16.2	49.5	Marine Clay	5.3	6	0.883		
6D	30.0	35.7	Marine Clay	4.3	9	0.478		
7D	25.5	40.2	Marine Clay	4.7	13	0.362		
8D	30.7	35	Clay/Sand	5.7	21	0.271		
9D	36.4	29.3	Marine Sand	5.7	33	0.173		
10D	59.7	6	Glacial Till	0.9	100	0.009		
	70.1	-4.4	Bedrock	59.9	100	0.599		
		65.7						
		65.7						
		65.7			

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	9
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

CALCULATIONS - METHOD B

Exploration ID: BB-YRO-106
Ground Surface El.: 63.7

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N	Su (psf)	d/Su
1D	1.0	62.7	Fill	2.0	10	0.200		
2D	3.0	60.7	Fill	2.0	14	0.143		
3D	5.0	58.7	Fill	2.0	7	0.286		
4D	7.5	56.2	Marine Clay	3.0	2	1.500		
5D	16.2	47.5	Marine Clay	4.5	7	0.643		
6D	21.2	42.5	Marine Clay	5.3	4	1.325		
7D	26.0	37.7	Marine Clay	4.7	10	0.470		
8D	31.0	32.7	Marine Clay	5.0	8	0.625		
9D	35.0	28.7	Marine Clay	5.0	2	2.500		
10D	39.4	24.3	Marine Clay	3.0	6	0.500		
11D	71.1	-7.4	Marine Sand	5.7	10	0.570		
		63.7	Bedrock	57.8	100	0.578		
		63.7						
		63.7						
		63.7			

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	10
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

CALCULATIONS - METHOD B

Exploration ID: BB-YRO-201
Ground Surface El.: 60.1

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N	Su (psf)	d/Su
1D/A	1.0	59.1	Fill	2.0	4	0.500		
2D	3.0	57.1	Fill	2.0	9	0.222		
3D	5.0	55.1	Fill	2.0	5	0.400		
4DA	7.0	53.1	Fill	2.0	8	0.250		
5D	9.0	51.1	Fill	2.0	7	0.286		
6D	11.0	49.1	Fill	2.0	5	0.400		
7D	13.0	47.1	Fill	2.0	2	1.000		
8DA	15.0	45.1	Marine Sand	1.3	30	0.043		
	57.7	2.4	Bedrock	84.7	100	0.847		
		60.1						
		60.1						
		60.1			

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	11
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

CALCULATIONS - METHOD B

Exploration ID: BB-YRO-202
Ground Surface El.: 61.9

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N	Su (psf)	d/Su
1DA	1.0	60.9	Marine Clay	2.0	9	0.222		
2D	3.5	58.4	Marine Clay	3.0	14	0.214		
3D/4D	8.3	53.6	Marine Clay	6.5	10	0.650		
5D	15.5	46.4	Marine Clay	8.0	6	1.333		
	59.8	2.1	Bedrock	80.5	100	0.805		
		61.9						
		61.9						
		61.9			

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	12
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

CALCULATIONS - METHOD B

Exploration ID: BB-YRO-203
Ground Surface El.: 60.7

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N	Su (psf)	d/Su
1DA	1.0	59.7	Fill	2.0	15	0.133		
2D	3.8	56.9	Fill/Clay	2.5	11	0.227		
3D	4.0	56.7	Marine Clay	4.0	11	0.364		
4D/5D	11.5	49.2	Clay/Sand	11.5	5	2.300		
6D	60.0	0.7	Bedrock	80.0	100	0.800		
		60.7						
		60.7						
		60.7						
		60.7						
		60.7						
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		60.7						
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		60.7						
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		60.7						
		60.7						
		60.7						
		60.7						
		60.7						
		60.7						
					$\Sigma d/N$ =	3.824	$\Sigma d/Su$ =	0.000

Total Thickness of Cohesionless (ft) =	100.0	$N_{ch\text{-}bar}$ (blows/ft) =	26.1	$S_{u\text{-}bar}$ (psf) =	#DIV/0!
Total Thickness of Cohesive (ft) =	0.0	Site $Class_N$ =	D	Site $Class_{Su}$ =	#DIV/0!
Total Thickness (ft) =	100.0	Site Class =	#DIV/0!		

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	13
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

CALCULATIONS - METHOD B

Exploration ID: BB-YRO-204
Ground Surface El.: 60.2

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N	Su (psf)	d/Su
1DA	1	59.2	Fill	2.0	7	0.286		
2D	3	57.2	Fill	2.0	3	0.667		
3DA	5	55.2	Fill	2.0	2	1.000		
4DA	7	53.2	Fill	2.0	4	0.500		
5D	9	51.2	Marine Clay	2.0	3	0.667		
6D+7D	13	47.2	Marine Clay	6.0	3	2.000		
8D	18.9	41.3	Clay/Sand	5.8	2	2.900		
	60.9	-0.7	Bedrock	78.2	100	0.782		
		60.2						
		60.2						
		60.2			

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	14
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

CALCULATIONS - METHOD B

Exploration ID: BB-YRO-205
Ground Surface El.: 64.5

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N	Su (psf)	d/Su
1DA	1.0	63.5	Fill	2.0	90	0.022		
2DA	3.4	61.1	Fill	2.8	22	0.127		
3D	6.7	57.8	Marine Clay	3.7	11	0.336		
4D	16.1	48.4	Marine Clay	5.0	6	0.833		
5D	21.3	43.2	Marine Clay	5.2	7	0.743		
6DA	62.0	2.5	Marine Clay	5.2	11	0.473		
		64.5	Bedrock	76.1	100	0.761		
		64.5						
		64.5						
		64.5			

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	15
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

CALCULATIONS - METHOD B

Exploration ID: BB-YRO-206
Ground Surface El.: 65.5

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N	Su (psf)	d/Su
1DA	1.0	64.5	Fill	2.0	11	0.182		
2D	3.0	62.5	Fill	2.0	7	0.286		
3D	5.0	60.5	Marine Clay	2.0	12	0.167		
4D	7.0	58.5	Marine Clay	2.0	18	0.111		
5D	9.0	56.5	Marine Clay	2.0	8	0.250		
6D	11.5	54	Marine Clay	3.0	5	0.600		
7D	14.3	51.2	Marine Clay	2.5	3	0.833		
8D	16.3	49.2	Marine Clay	1.6	7	0.229		
9D	20.3	45.2	Marine Sand	6.4	6	1.067		
10D	24.6	40.9	Marine Sand	2.1	100	0.021		
	62.8	2.7	Bedrock	74.4	100	0.744		
		65.5						
		65.5						
		65.5			

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	16
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

CALCULATIONS - METHOD B

Exploration ID: BB-YRO-207
Ground Surface El.: 64.6

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N	Su (psf)	d/Su
1DA	1.0	63.6	Fil	2.0	11	0.182		
2DA	3.0	61.6	Fill	2.0	6	0.333		
3D	5.0	59.6	Marine Clay	2.0	16	0.125		
4D	7.0	57.6	Marine Clay	3.0	10	0.300		
5D	11.3	53.3	Marine Clay	4.5	5	0.900		
6D	15.5	49.1	Marine Clay	4.0	2	2.000		
7D	18.8	45.8	Marine Clay	2.5	3	0.833		
8D	21.5	43.1	Marine Clay	3.0	3	1.000		
9D	24.9	39.7	Marine Sand	3.8	18	0.211		
	63.4	1.2	Bedrock	73.2	100	0.732		
		64.6						
		64.6						
		64.6			

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	17
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

CALCULATIONS - METHOD B

Exploration ID: BB-YRO-208
Ground Surface El.: 68.2

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N	Su (psf)	d/Su
1DA	1.0	67.2	Fill	2.0	12	0.167		
2D	3.3	64.9	Marine Clay	2.5	21	0.119		
3D	6.5	61.7	Marine Clay	4.0	12	0.333		
4D	11.0	57.2	Marine Clay	5.0	9	0.556		
5D	16.0	52.2	Marine Clay	5.0	7	0.714		
6D	20.7	47.5	Marine Sand	4.3	17	0.253		
7D	23.7	44.5	Marine Sand	1.7	18	0.094		
	62.3	5.9	Bedrock	75.5	100	0.755		
		68.2						
		68.2						
		68.2			

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	18
Client	Maine Department of Transportation	Date	13-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Seismic Site Class	Checked by	BCS

CALCULATIONS - METHOD B

Exploration ID: BB-YRO-209
Ground Surface El.: 69.7

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N	Su (psf)	d/Su
1DA	1.0	68.7	Marine Clay	2.0	6	0.333		
2D	3.3	66.4	Marine Clay	2.5	19	0.132		
3D	6.5	63.2	Marine Clay	4.0	13	0.308		
4D	11.0	58.7	Marine Clay	5.0	7	0.714		
5DA	16.0	53.7	Marine Clay	5.0	4	1.250		
6D	20.7	49	Clay/Sand	5.0	19	0.263		
7D	23.7	46	Sand/Till	76.5	49	1.561		
		69.7						
		69.7						
		69.7			

RESULTS SUMMARY

Boring Number	Parameter	Average Value	Site Class
BB-YRO-101	N	23	D
BB-YRO-102	N	24	D
BB-YRO-103	N	32	D
BB-YRO-104	N	23	D
BB-YRO-105	N	19	D
BB-YRO-106	N	11	E
BB-YRO-201	N	25	D
BB-YRO-202	N	31	D
BB-YRO-203	N	26	D
BB-YRO-204	N	11	E
BB-YRO-205	N	30	D
BB-YRO-206	N	22	D
BB-YRO-207	N	15	D
BB-YRO-208	N	33	D
BB-YRO-209	N	22	D

CONCLUSIONS & RECOMMENDATIONS

Based on the subsurface conditions encountered at the 15 test borings near the proposed substructures (BB-YRO-101 through BB-YRO-106 and BB-YRO-201 through BB-YRO-209), recommend a **Seismic Site Class D**.

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Global Embankment Stability

PROBLEM STATEMENT AND OBJECTIVE

Calculate the global stability minimum factor of safety at critical sections along the proposed highway alignment.

REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 9th edition, 2020.
2. Slide version 7.0 by RocScience.
3. Maine DOT Bridge Design Guide, August 2003, with interim revisions through June 2018.

AVAILABLE INFORMATION

1. Design Drawings prepared by HNTB

ASSUMPTIONS

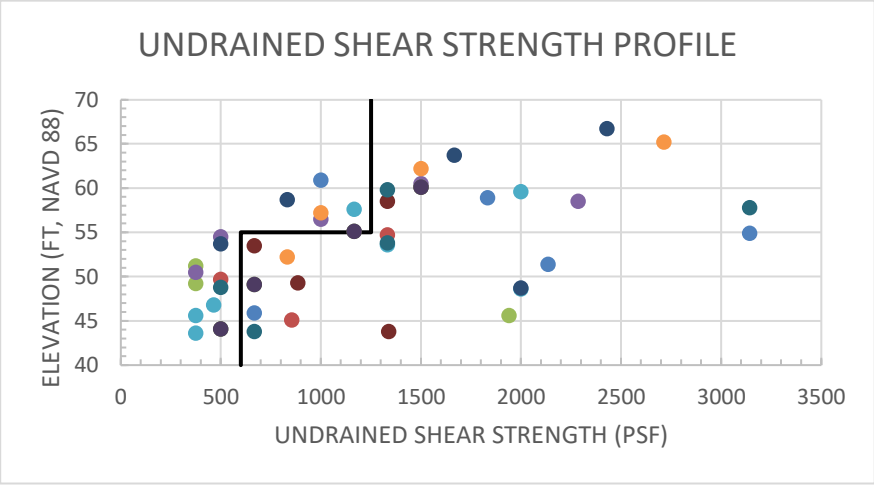
Soil profiles will be modeled to match settlement calculation models, as summarized below.

SOIL PROPERTIES

Material	Unit Weight (pcf)	Friction Angle (degrees)	Undrained Shear Strength (psf)
New Fill	125	32	0
Existing Fill	115	28	0
Marine Deposit	115		1250/600
Glacial Till	125	32	0
Bedrock	infinite strength		

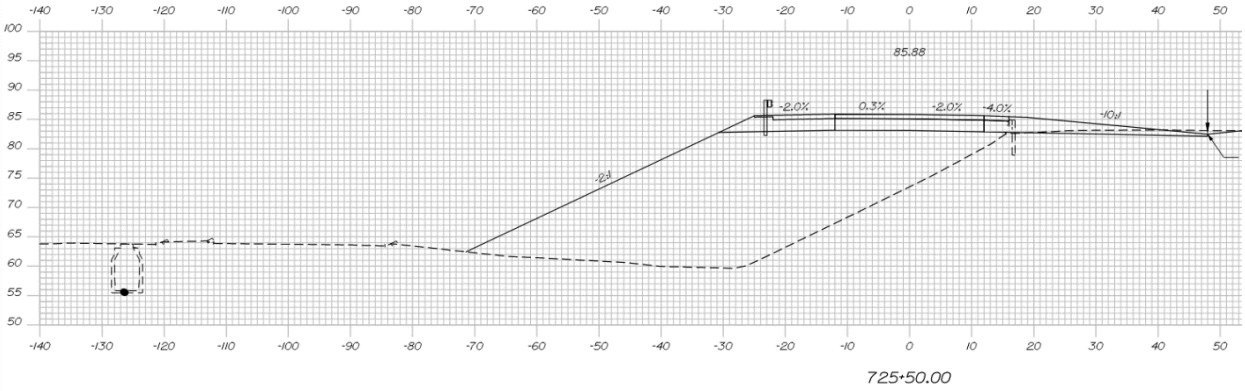
Notes:

1. Plot of undrained shear strength values presented below. Data taken from in-situ vane shear testing and correlating SPT N-values to undrained shear strength.



STA 725+50 GEOMETRY

Fill height = 25 ft *Ground surface at center = El. 73.5*



STA 725+50 SOIL PROFILE AND PROPERTIES (not to scale)

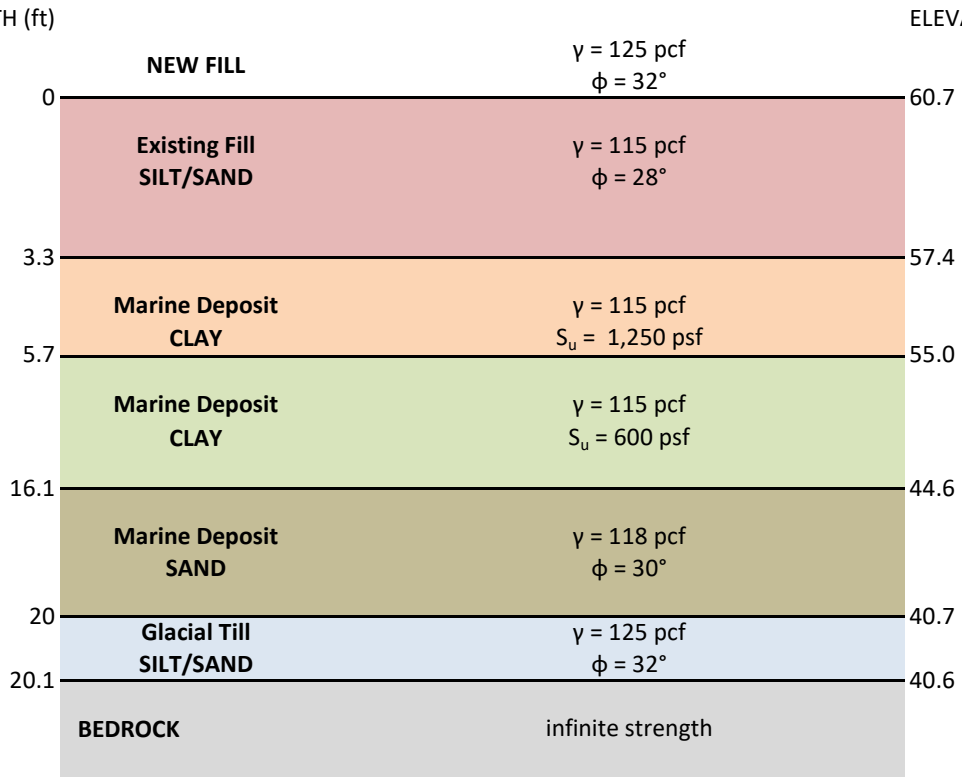
Based on boring BB-YRO-204, BB-YRO-203
Groundwater elevation = 49.6 (based on monitoring well BB-YRO-203(OW))

Boring BB-YRO-204 (distance from the center= 33.9 LT)

DEPTH (ft)			ELEVATION (ft)
	NEW FILL	γ = 125 pcf ϕ = 32°	
0			60.2
	Existing Fill **SILT/SAND**	γ = 115 pcf ϕ = 28°	
7			53.2
	Marine Deposit **CLAY**	γ = 115 pcf S_u = 600 psf	
18			42.2
	Glacial Till **SILT/SAND**	γ = 125 pcf ϕ = 32°	
21.8			38.4
	BEDROCK	infinite strength	

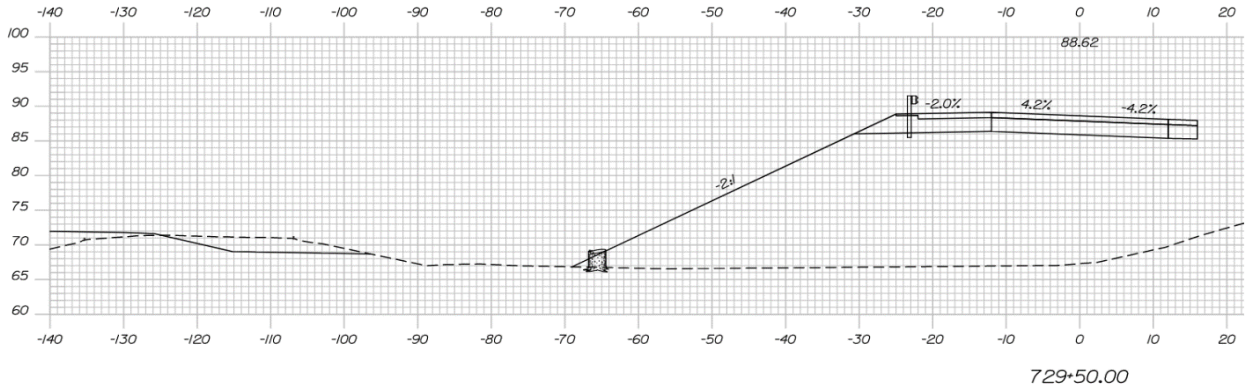
STA 725+50 Continued

Boring BB-YRO-203 (distance from the center= 98.2 LT)



STA 729+50 GEOMETRY

Fill height = 22 ft *Ground surface at center = El. 67.3*



STA 729+50 SOIL PROFILE AND PROPERTIES (not to scale)

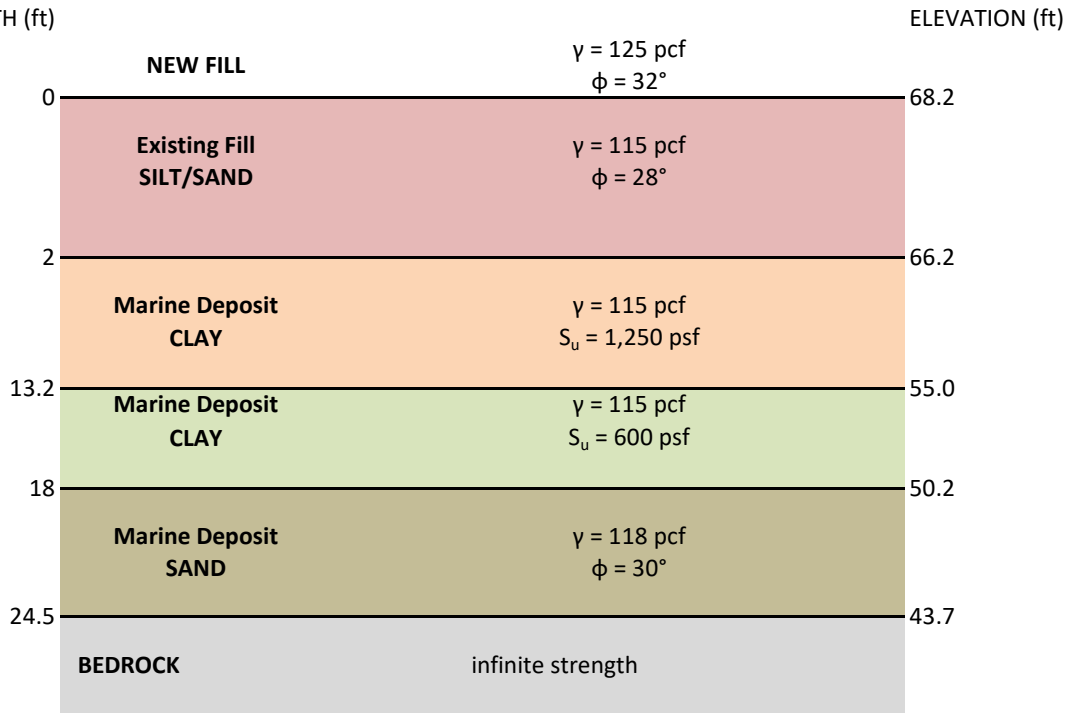
Based on boring BB-YRO-103, BB-YRO-208
Groundwater elevation = 53.8 (based on monitoring well BB-YRO-206(OW))

Boring BB-YRO-103 (distance from the center= 7.0 LT)

DEPTH (ft)			ELEVATION (ft)
	NEW FILL	γ = 125 pcf ϕ = 32°	
0			67.5
	Existing Fill **SILT/SAND**	γ = 115 pcf ϕ = 28°	
1.1			66.4
	Marine Deposit **CLAY**	γ = 115 pcf S_u = 1,250 psf	
12.5			55.0
	Marine Deposit **CLAY**	γ = 115 pcf S_u = 600 psf	
19			48.5
	Marine Deposit **SAND**	γ = 118 pcf ϕ = 30°	
26.4			41.1
	Glacial Till **SILT/SAND**	γ = 125 pcf ϕ = 32°	
27.9			39.6
	BEDROCK	infinite strength	

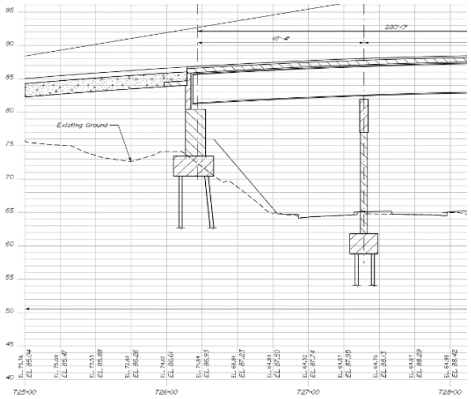
STA 729+50 Continued

Boring BB-YRO-208 (distance from the center= 66.3 LT)



ABUT 1 GEOMETRY

Fill height = 14 ft



ABUT 1 SOIL PROFILE AND PROPERTIES (not to scale)

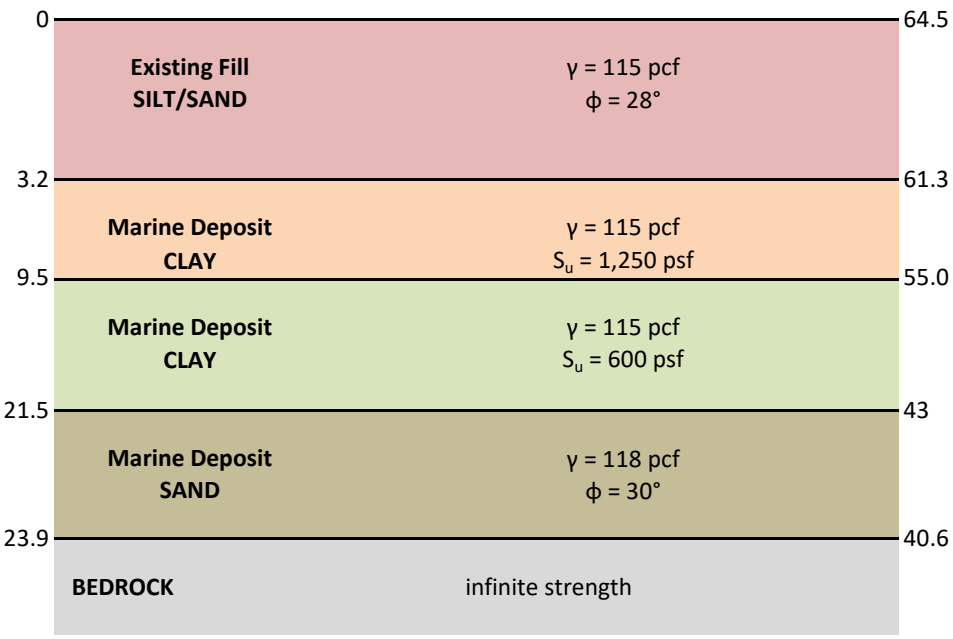
Based on boring BB-YRO-204, BB-YRO-205, BB-YRO-101
Groundwater elevation = 49.6 (based on monitoring well BB-YRO-203(OW))

Boring BB-YRO-204 (STA. 725+29.0)

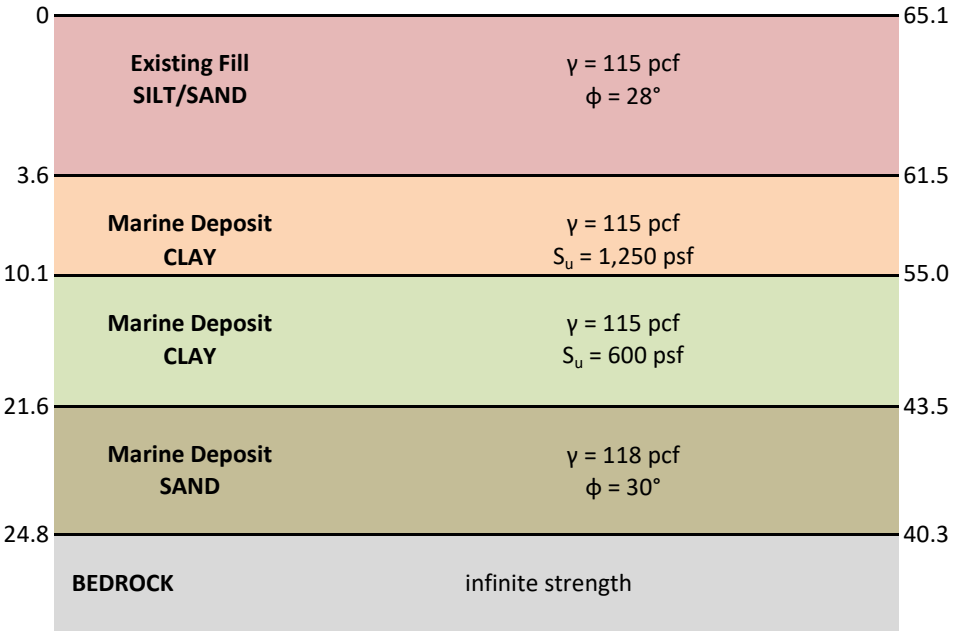
DEPTH (ft)			ELEVATION (ft)
	NEW FILL	γ = 125 pcf ϕ = 32°	
0			60.2
	Existing Fill **SILT/SAND**	γ = 115 pcf ϕ = 28°	
7			53.2
	Marine Deposit **CLAY**	γ = 115 pcf S_u = 600 psf	
18			42.2
	Marine Deposit **SAND**	γ = 118 pcf ϕ = 30°	
21.8			38.4
	BEDROCK	infinite strength	

ABUT 1 Continued

Boring BB-YRO-205 (STA. 726+96.4)

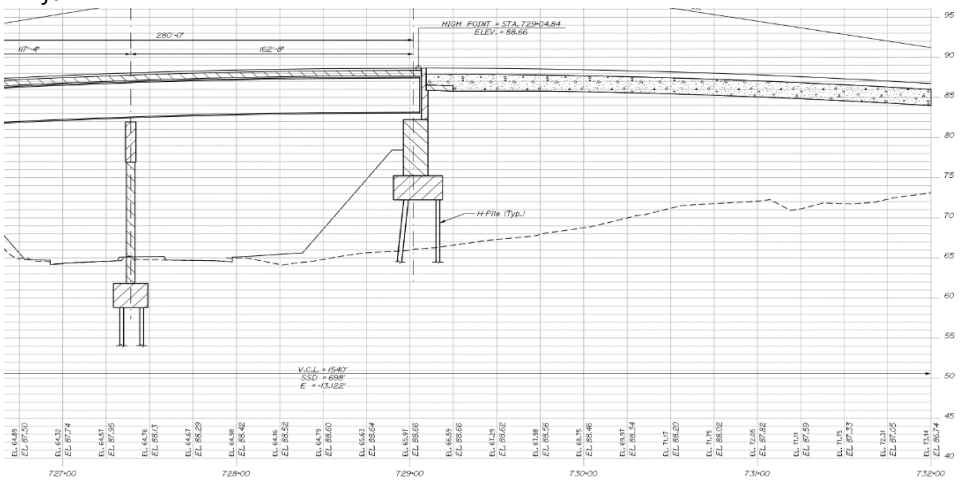


Boring BB-YRO-101 (STA. 727+33.4)



ABUT 2 GEOMETRY

Fill height = 22 ft



ABUT 1 SOIL PROFILE AND PROPERTIES (not to scale)

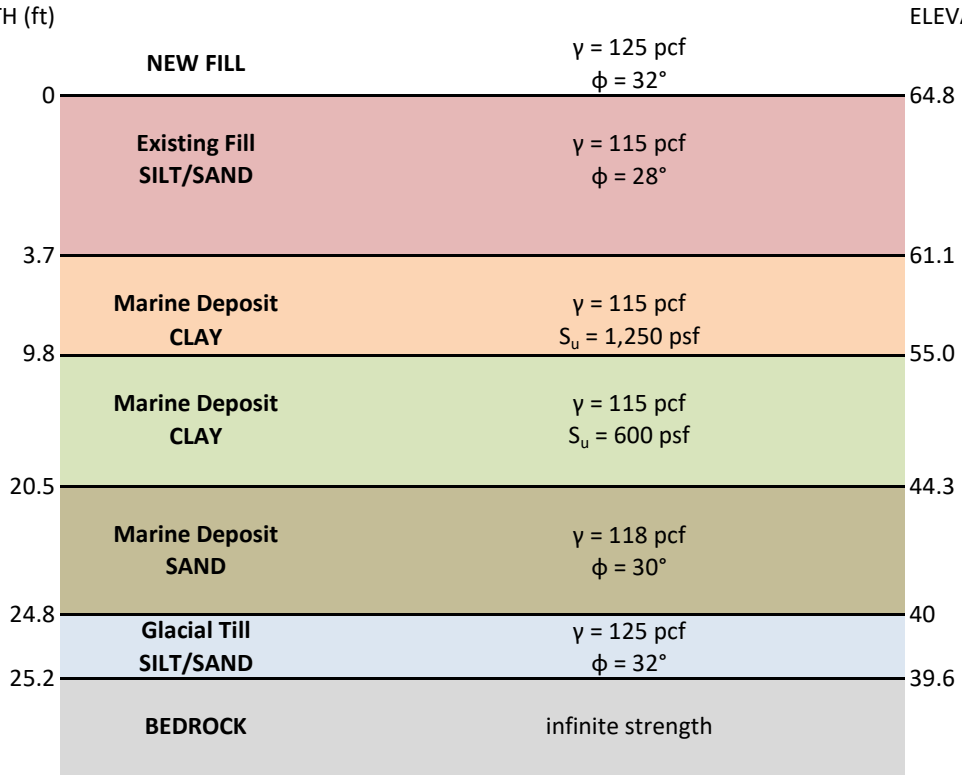
Based on boring BB-YRO-103, BB-YRO-102, BB-YRO-207, BB-YRO-101, BB-YRO-205
Groundwater elevation = 53.8 (based on monitoring well BB-YRO-206(OW))

Boring BB-YRO-103 (STA. 729+85.9)

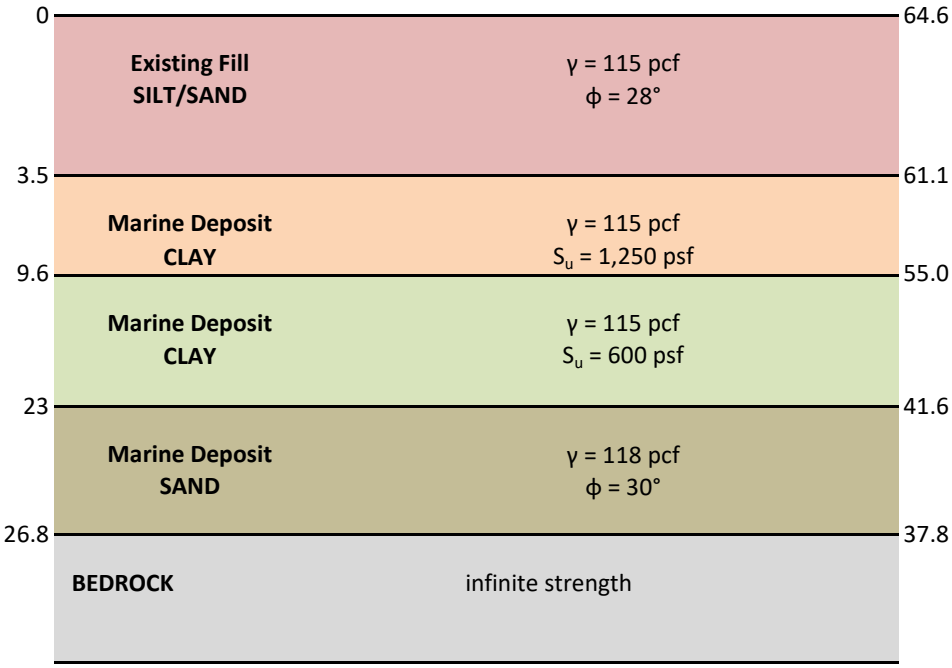
DEPTH (ft)			ELEVATION (ft)
	NEW FILL	γ = 125 pcf ϕ = 32°	
0			67.5
	Existing Fill **SILT/SAND**	γ = 115 pcf ϕ = 28°	
1.1			66.4
	Marine Deposit **CLAY**	γ = 115 pcf S_u = 1,250 psf	
12.5			55.0
	Marine Deposit **CLAY**	γ = 115 pcf S_u = 600 psf	
19			48.5
	Marine Deposit **SAND**	γ = 118 pcf ϕ = 30°	
26.4			41.1
	Glacial Till **SILT/SAND**	γ = 125 pcf ϕ = 32°	
27.9			39.6
	BEDROCK	infinite strength	

ABUT 2 Continued

Boring BB-YRO-102 (STA. 728+69.6)

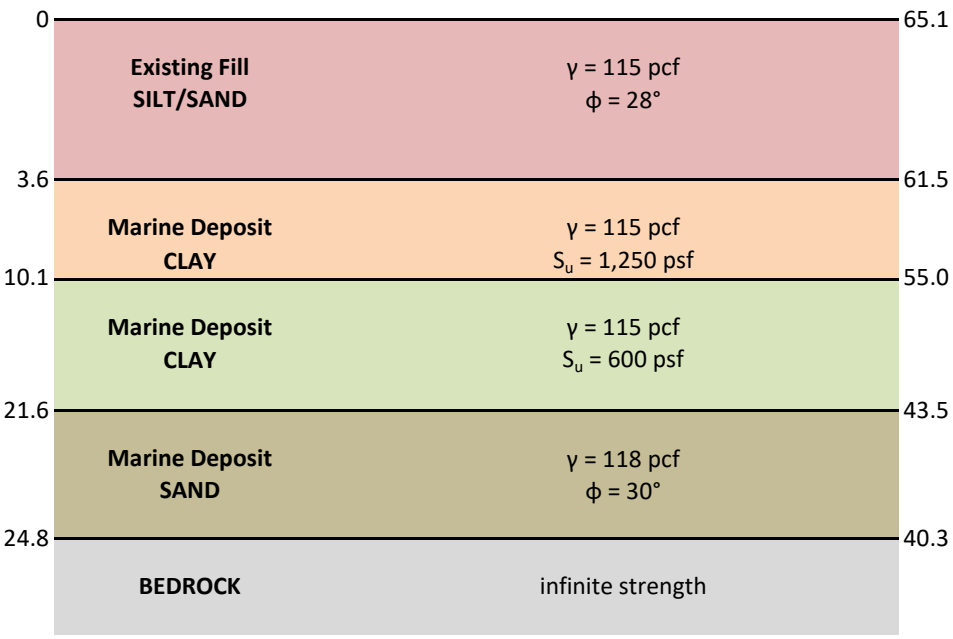


Boring BB-YRO-207 (STA. 728+58.9)



ABUT 2 Continued

Boring BB-YRO-101 (STA. 727+33.4)



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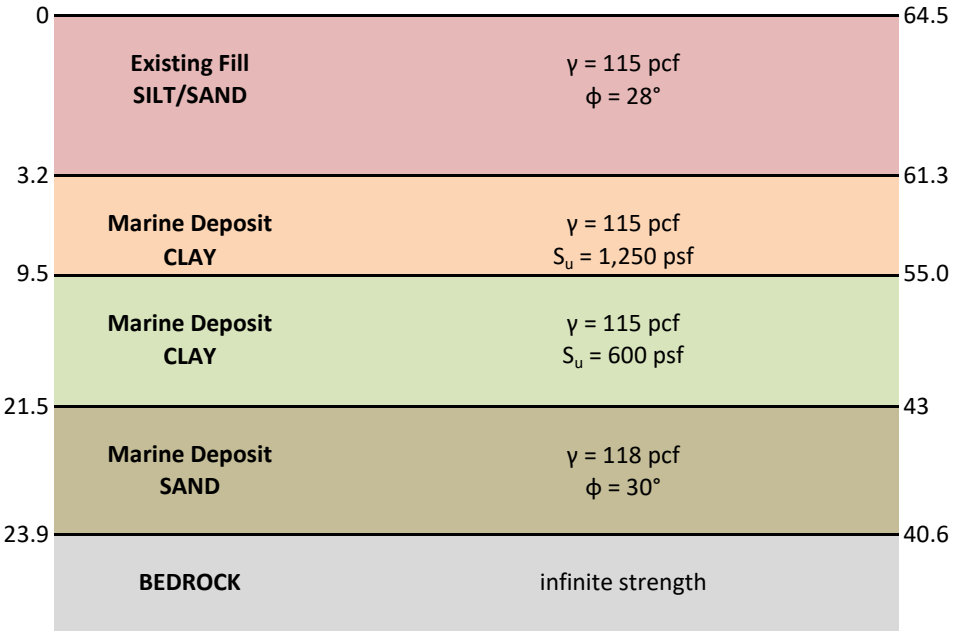
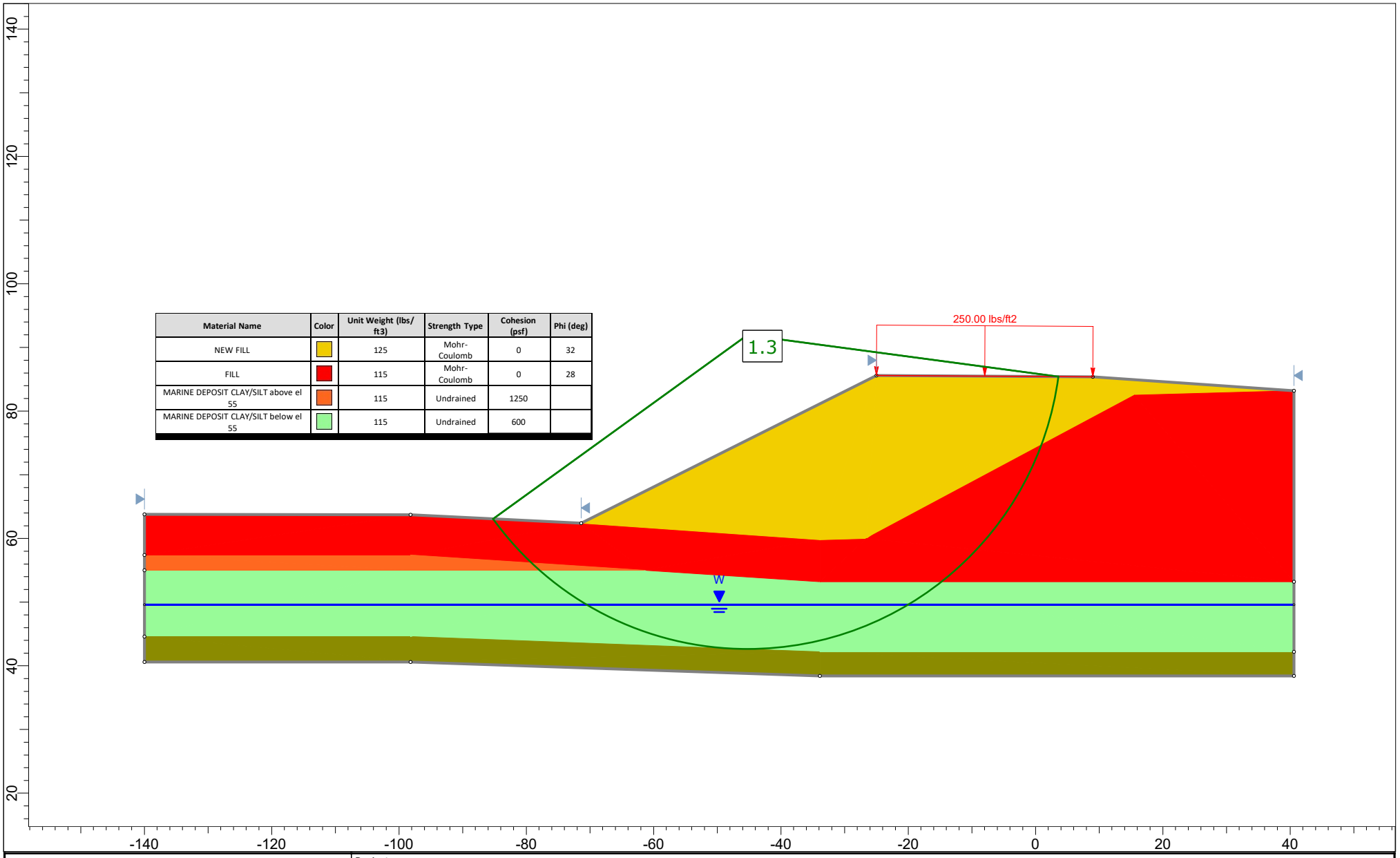


RESULTS AND CONCLUSIONS

Section	Height of Embank-ment	New Weight Fill Thickness (ft)	Stages	Factor of Safety (Bishop Method)
Sta. 725+50	25	25	Final Condition + Loading	1.3
			Site Class D Pseudo-Static, 0.068g	1.1
Sta. 729+50	22	22	Final Condition + Loading	1.9
			Site Class D Pseudo-Static, 0.068g	1.5
Abut 1	14	14	Final Condition + Loading	1.5
			Site Class D Pseudo-Static, 0.068g	1.2
Abut 2	22	22	Final Condition + Loading	1.4
			Site Class D Pseudo-Static, 0.068g	1.1

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
NEW FILL		125	Mohr-Coulomb	0	32
FILL		115	Mohr-Coulomb	0	28
MARINE DEPOSIT CLAY/SILT above el 55		115	Undrained	1250	
MARINE DEPOSIT CLAY/SILT below el 55		115	Undrained	600	



rocscience

SLIDEINTERPRET 9.004

Project	SLIDE - An Interactive Slope Stability Program		
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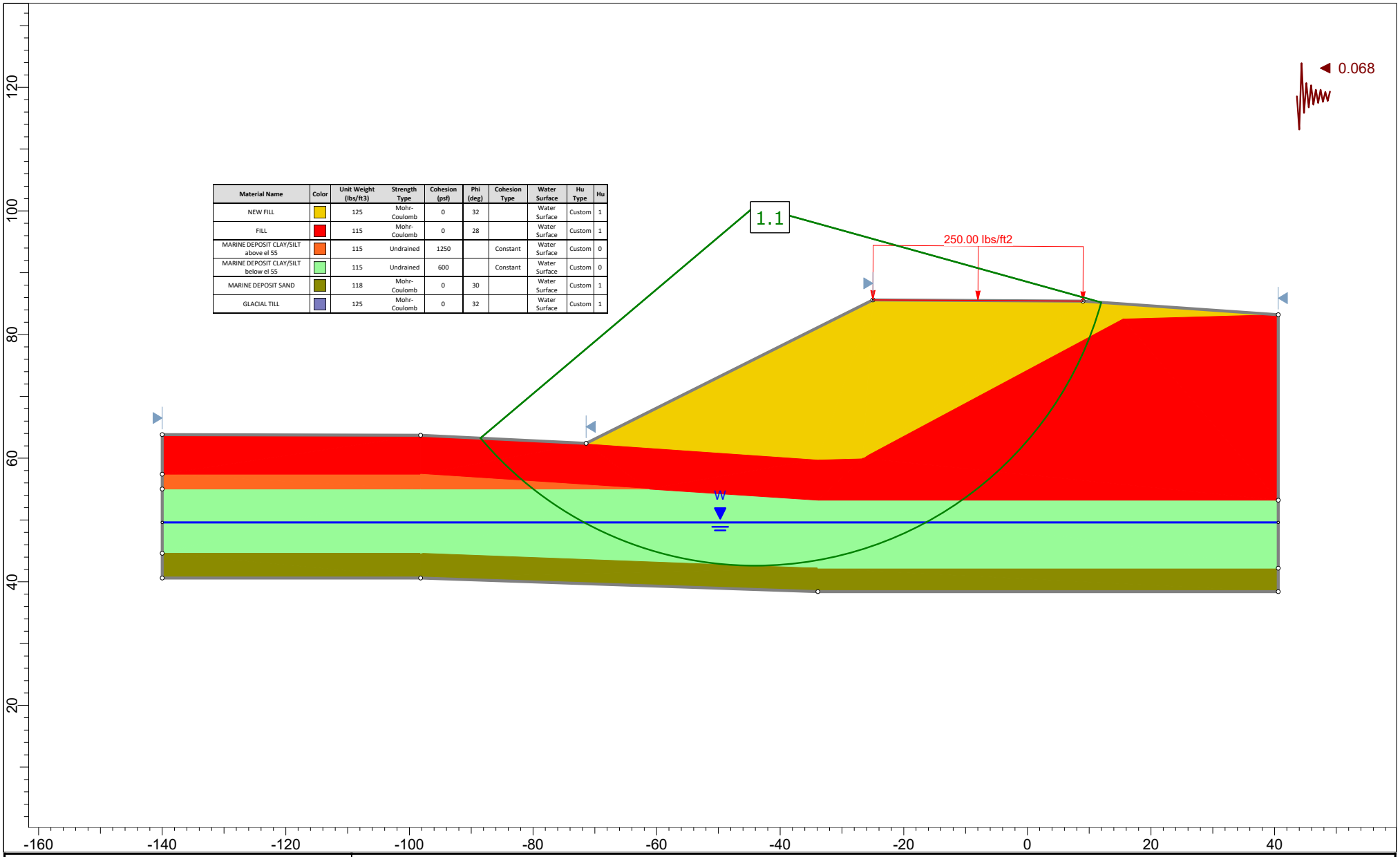


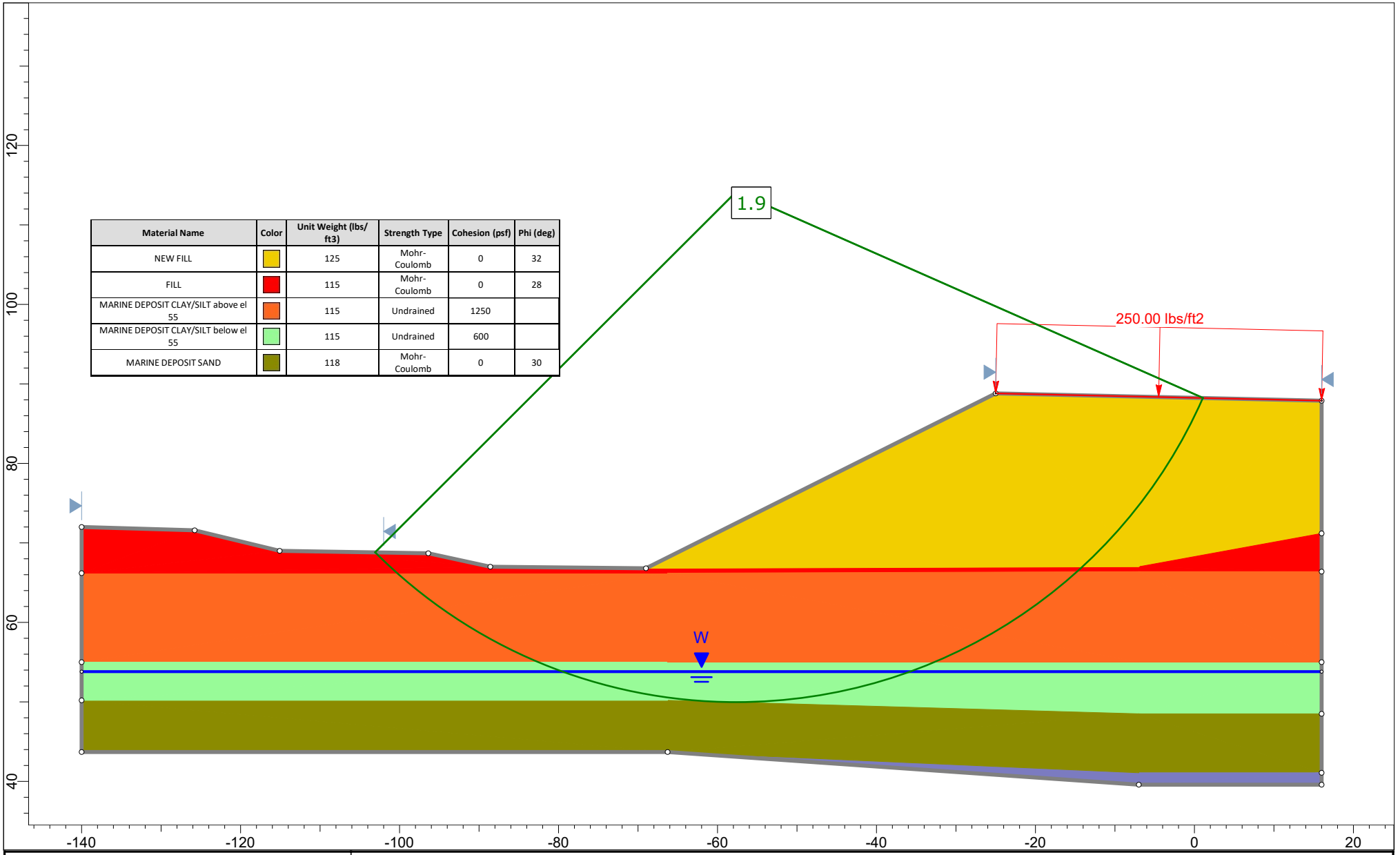
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Water Surface	Hu Type	Hu
NEW FILL		125	Mohr-Coulomb	0	32		Water Surface	Custom	1
FILL		115	Mohr-Coulomb	0	28		Water Surface	Custom	1
MARINE DEPOSIT CLAY/SILT above el 55		115	Undrained	1250		Constant	Water Surface	Custom	0
MARINE DEPOSIT CLAY/SILT below el 55		115	Undrained	600		Constant	Water Surface	Custom	0
MARINE DEPOSIT SAND		118	Mohr-Coulomb	0	30		Water Surface	Custom	1
GLACIAL TILL		125	Mohr-Coulomb	0	32		Water Surface	Custom	1

rocscience

SLIDEINTERPRET 9.004

Project	SLIDE - An Interactive Slope Stability Program		
Group	Psuedo-Static	*Scenario*	Master Scenario
Drawn By		*Company*	
Date	7/16/2021, 7:19:10 AM	*File Name*	725+50 Pseudo-Static.slmd

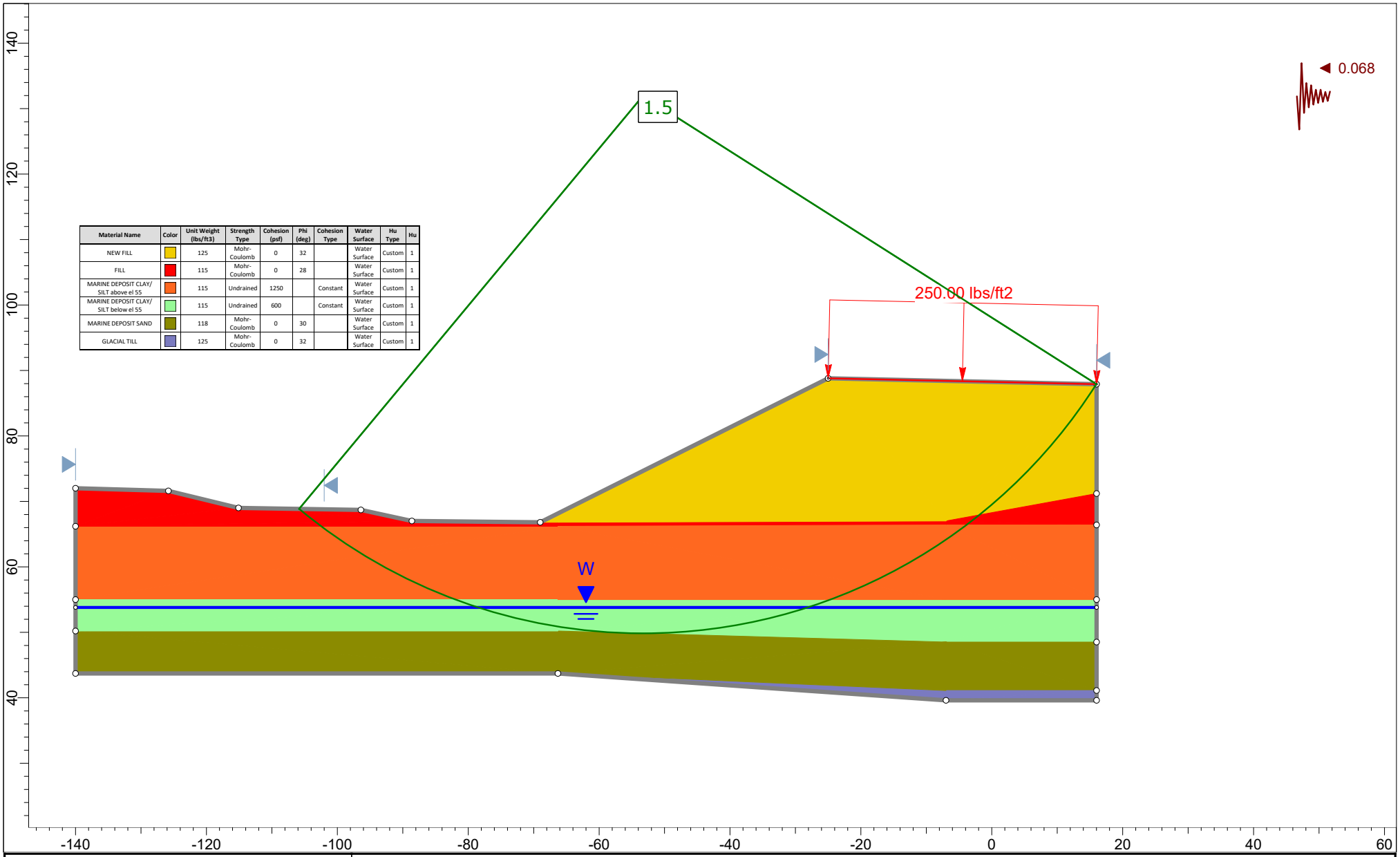
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
NEW FILL		125	Mohr-Coulomb	0	32
FILL		115	Mohr-Coulomb	0	28
MARINE DEPOSIT CLAY/SILT above el 55		115	Undrained	1250	
MARINE DEPOSIT CLAY/SILT below el 55		115	Undrained	600	
MARINE DEPOSIT SAND		118	Mohr-Coulomb	0	30



rocscience

SLIDEINTERPRET 9.004

Project	SLIDE - An Interactive Slope Stability Program		
Group	Static	*Scenario*	Master Scenario
Drawn By		*Company*	
Date	7/16/2021, 7:40:23 AM	*File Name*	729+50 Static.slmd

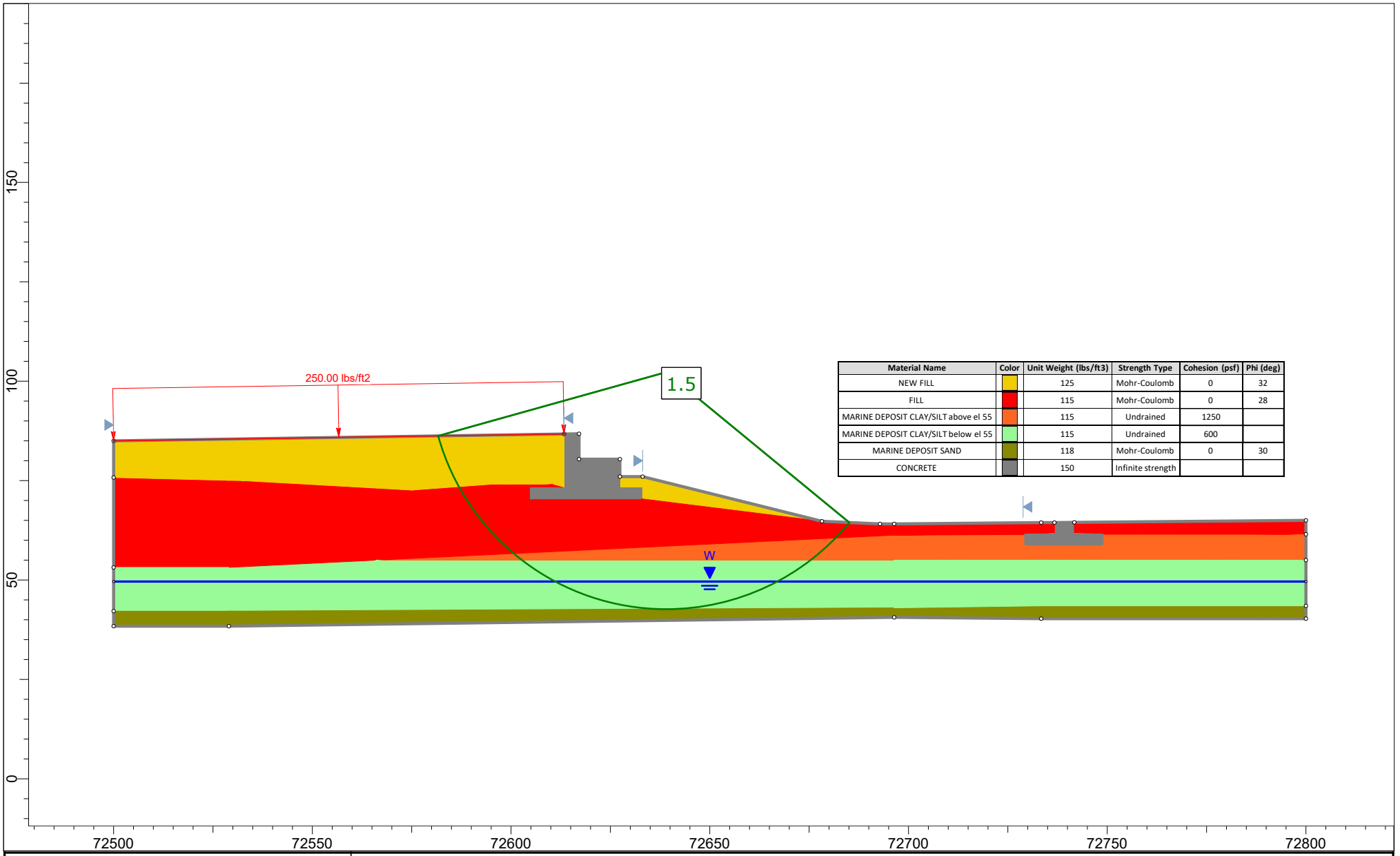


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Water Surface	Hu Type	Hu
NEW FILL		125	Mohr-Coulomb	0	32		Water Surface	Custom	1
FILL		115	Mohr-Coulomb	0	28		Water Surface	Custom	1
MARINE DEPOSIT CLAY/ SILT above el 55		115	Undrained	1250		Constant	Water Surface	Custom	1
MARINE DEPOSIT CLAY/ SILT below el 55		115	Undrained	600		Constant	Water Surface	Custom	1
MARINE DEPOSIT SAND		118	Mohr-Coulomb	0	30		Water Surface	Custom	1
GLACIAL TILL		125	Mohr-Coulomb	0	32		Water Surface	Custom	1

rocscience

SLIDEINTERPRET 9.004

Project	SLIDE - An Interactive Slope Stability Program		
Group	Pseudo-Static	*Scenario*	Master Scenario
Drawn By		*Company*	
Date	7/16/2021, 7:40:23 AM	*File Name*	729+50 Pseudo-Static.slmd

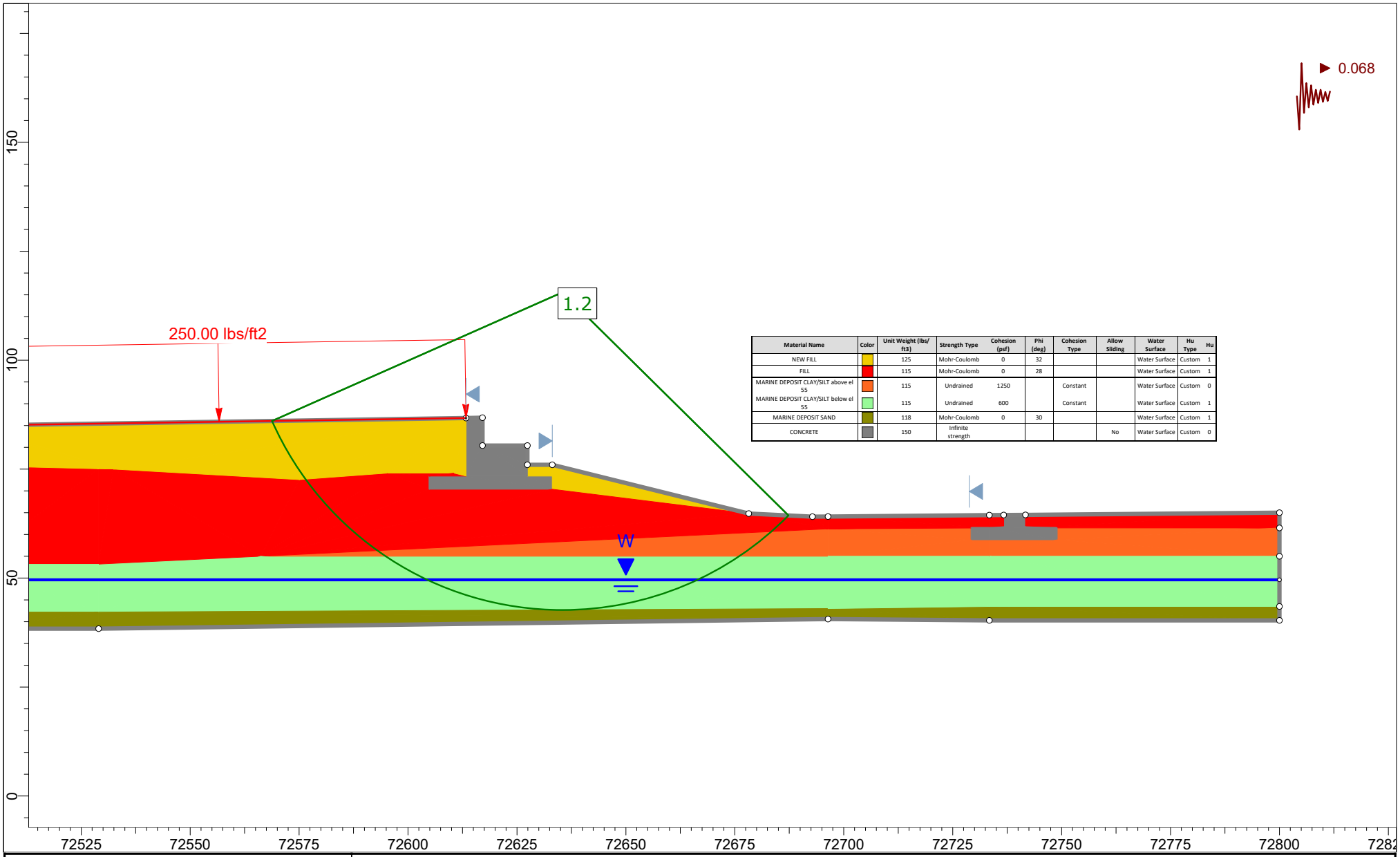


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
NEW FILL		125	Mohr-Coulomb	0	32
FILL		115	Mohr-Coulomb	0	28
MARINE DEPOSIT CLAY/SILT above el 55		115	Undrained	1250	
MARINE DEPOSIT CLAY/SILT below el 55		115	Undrained	600	
MARINE DEPOSIT SAND		118	Mohr-Coulomb	0	30
CONCRETE		150	Infinite strength		

rocscience

SLIDEINTERPRET 9.004

Project	SLIDE - An Interactive Slope Stability Program		
Group	Static	*Scenario*	Master Scenario
Drawn By		*Company*	
Date	7/16/2021, 8:01:31 AM	*File Name*	Abut1 Static.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Allow Sliding	Water Surface	Hu Type	Hu
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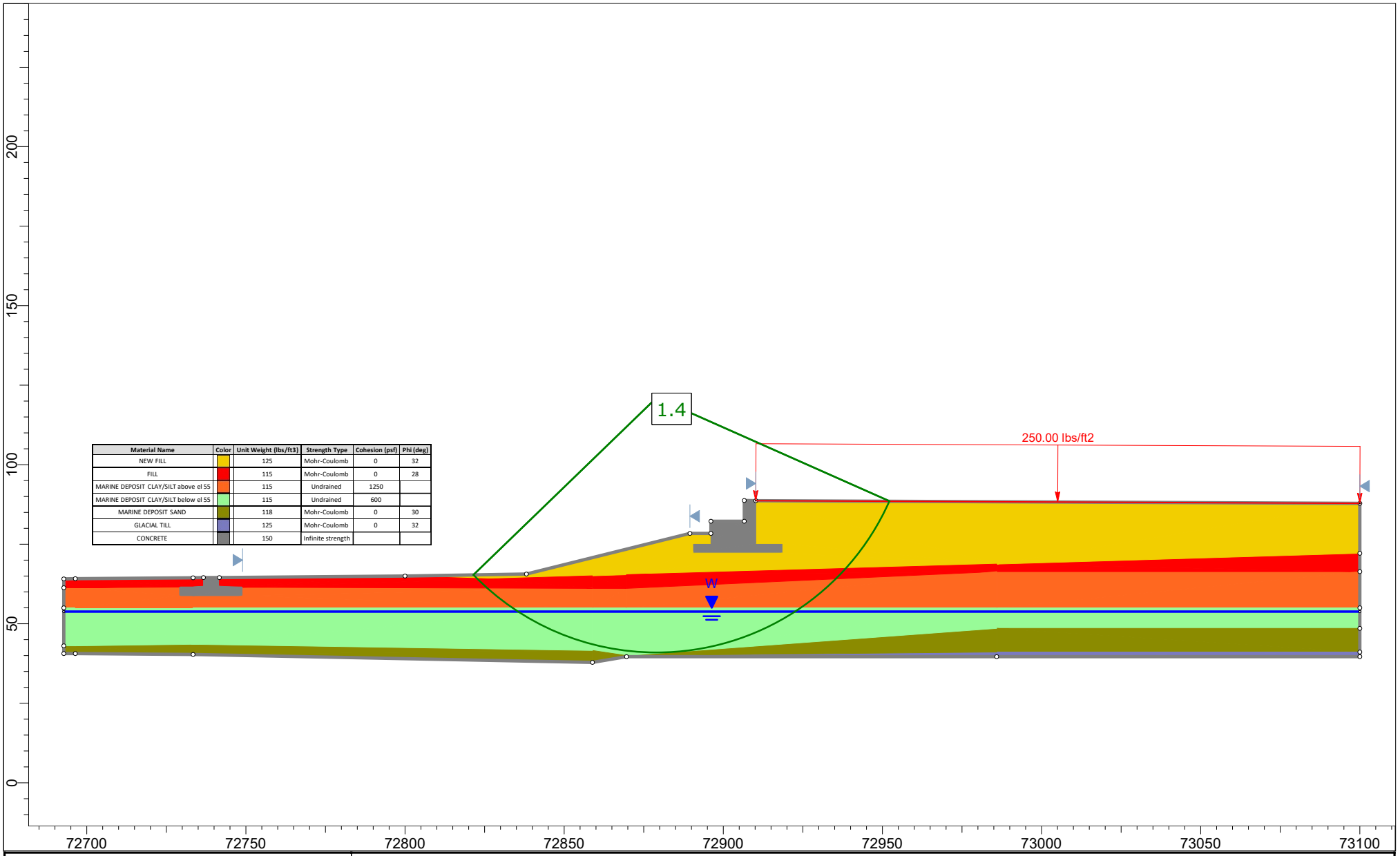
FILL		115	Mohr-Coulomb	0	28			Water Surface	Custom	1
MARINE DEPOSIT CLAY/SILT above el 55		115	Undrained	1250		Constant		Water Surface	Custom	0
MARINE DEPOSIT CLAY/SILT below el 55		115	Undrained	600		Constant		Water Surface	Custom	1
MARINE DEPOSIT SAND		118	Mohr-Coulomb	0	30			Water Surface	Custom	1
CONCRETE		150	Infinite strength				No	Water Surface	Custom	0

rocscience

SLIDEINTERPRET 9.004

Project	SLIDE - An Interactive Slope Stability Program		
Group	Pseudo-Static	*Scenario*	Master Scenario
Drawn By		*Company*	
Date	7/16/2021, 8:01:31 AM	*File Name*	Abut1 Pseudo-Static.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
NEW FILL		125	Mohr-Coulomb	0	32
FILL		115	Mohr-Coulomb	0	28
MARINE DEPOSIT CLAY/SILT above el 55		115	Undrained	1250	
MARINE DEPOSIT CLAY/SILT below el 55		115	Undrained	600	
MARINE DEPOSIT SAND		118	Mohr-Coulomb	0	30
GLACIAL TILL		125	Mohr-Coulomb	0	32
CONCRETE		150	Infinite strength		

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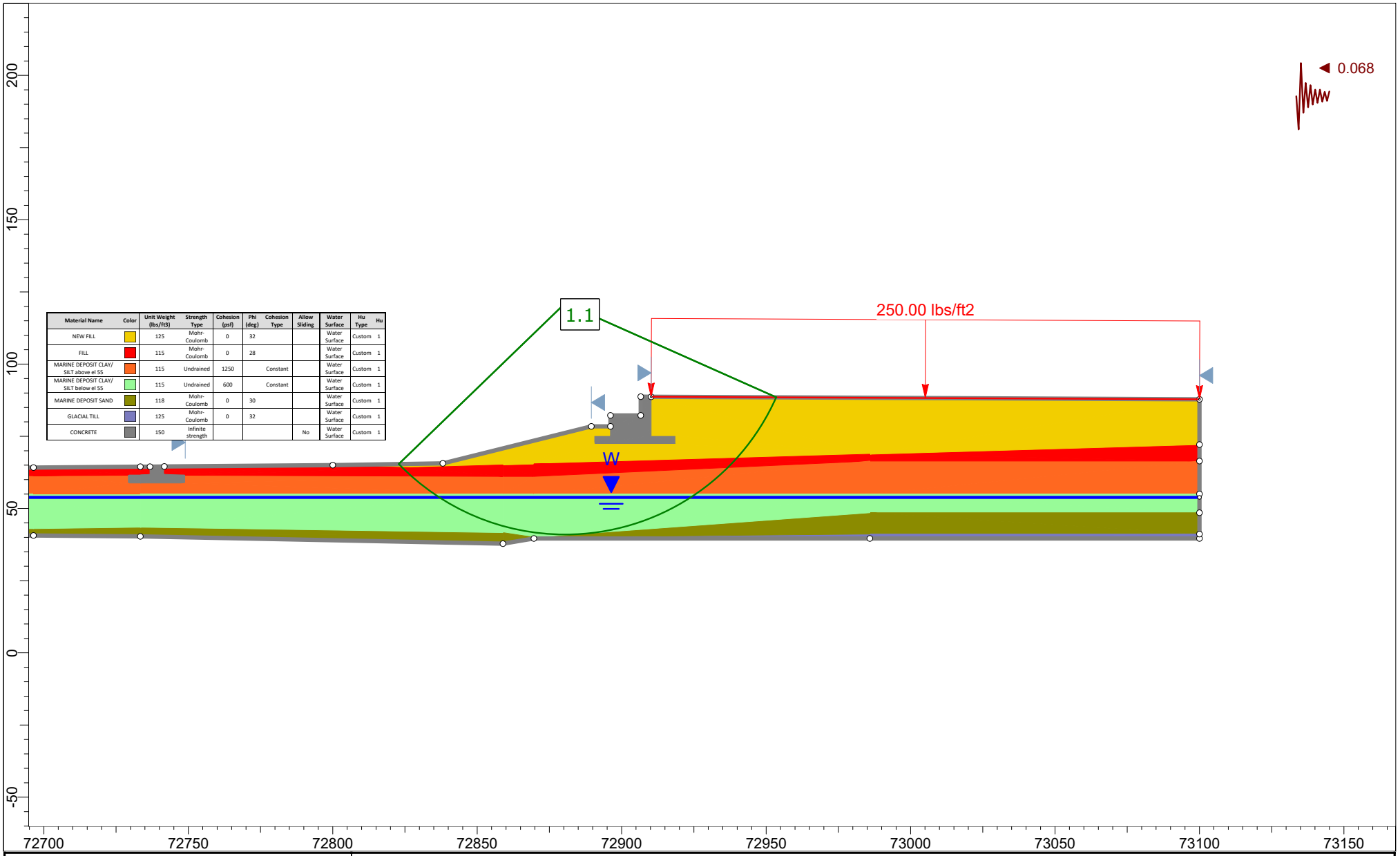
SLIDEINTERPRET 9.004

Project	SLIDE - An Interactive Slope Stability Program		
Group	Static	*Scenario*	Master Scenario
Drawn By		*Company*	
Date	7/16/2021, 9:07:19 AM	*File Name*	Abut2 Static.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Allow Sliding	Water Surface	Hu Type	Hu
NEW FILL		125	Mohr-Coulomb	0	32			Water Surface	Custom	1
FILL		115	Mohr-Coulomb	0	28			Water Surface	Custom	1
MARINE DEPOSIT CLAY/ SILT above el 55		115	Undrained	1250		Constant		Water Surface	Custom	1
MARINE DEPOSIT CLAY/ SILT below el 55		115	Undrained	600		Constant		Water Surface	Custom	1
MARINE DEPOSIT SAND		118	Mohr-Coulomb	0	30			Water Surface	Custom	1
GLACIAL TILL		125	Mohr-Coulomb	0	32			Water Surface	Custom	1
CONCRETE		150	Infinite strength				No	Water Surface	Custom	1

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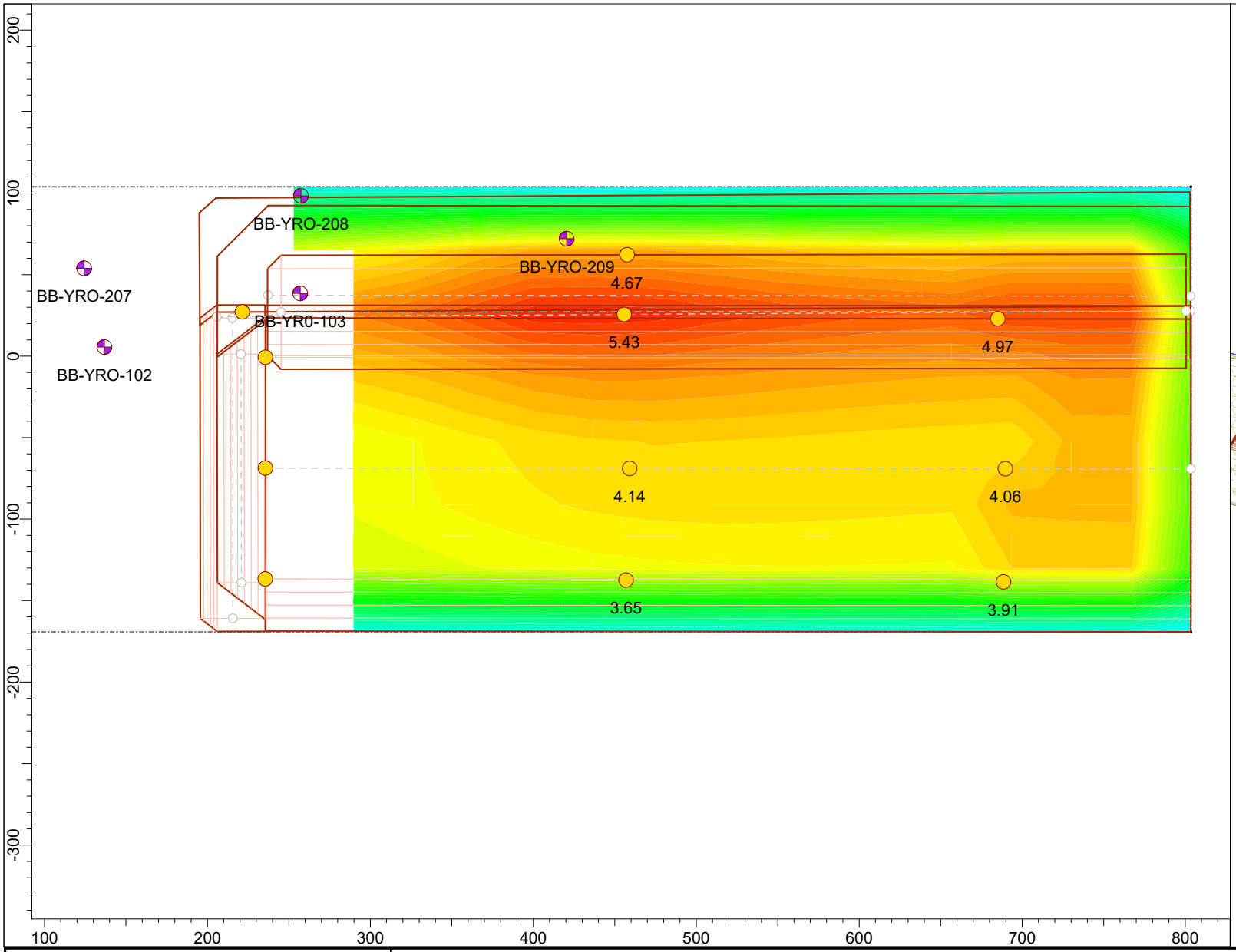
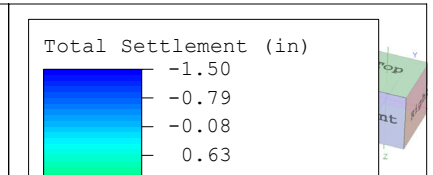
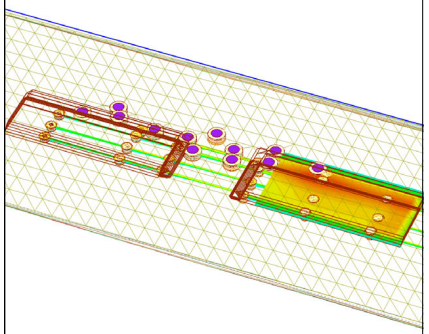
SLIDEINTERPRET 9.004

Project	SLIDE - An Interactive Slope Stability Program		
Group	Pseudo-Static	*Scenario*	Master Scenario
Drawn By		*Company*	
Date	7/16/2021, 9:07:19 AM	*File Name*	Abut2 Pseudo-Static.slmd

Settlement

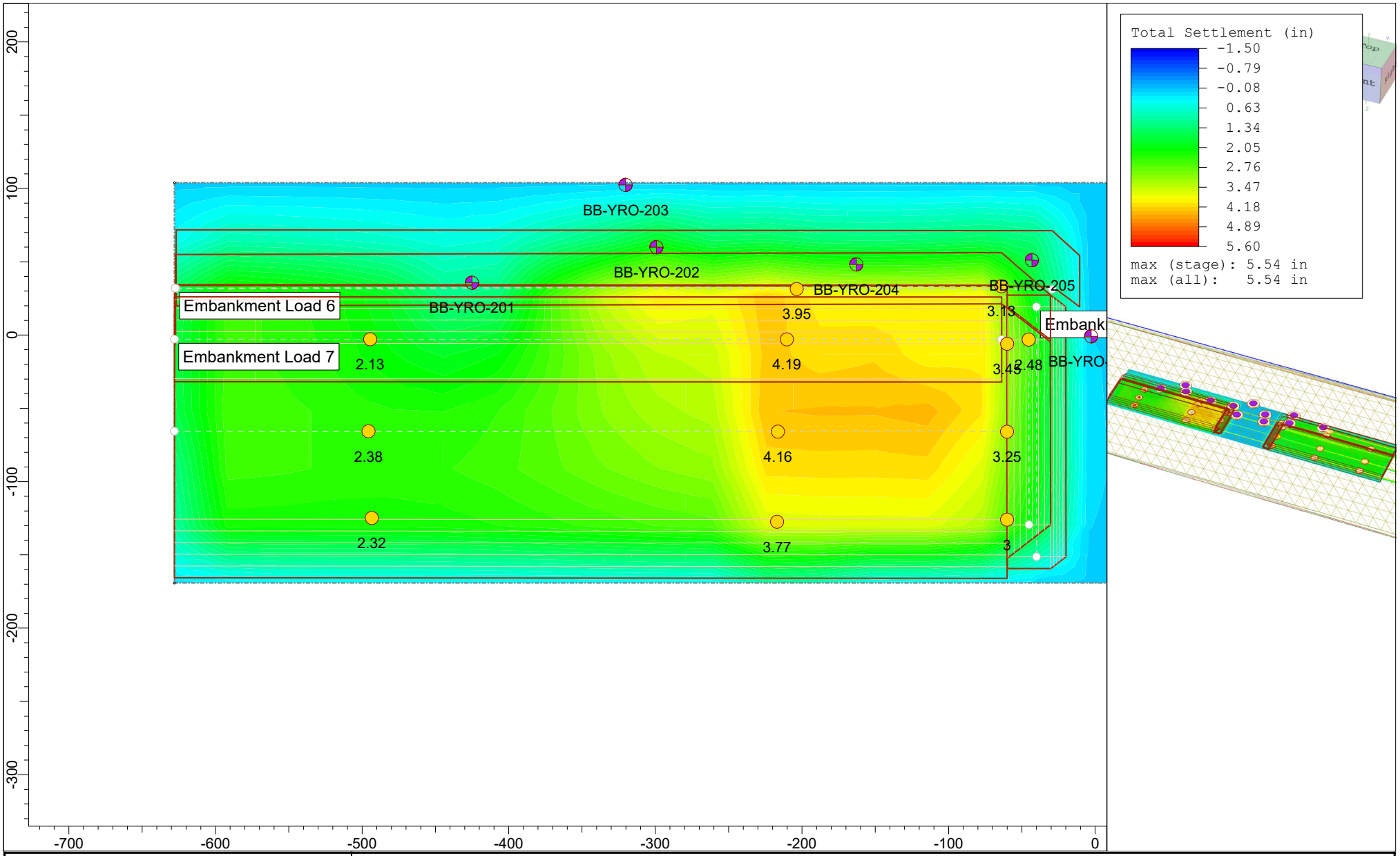






rocscience	*Project*	I-295 Exit 17 Yarmouth Bridges	
	Analysis Description	Settlement	
	Drawn By	J. DuBois	*Company* Haley & Aldrich, Inc.
	Date	6/24/2020, 4:19:02 PM	*File Name* 2021-0901-HAI-Yarmouth Bridges-Settlement-Simplified.s3z

SETTLE3 5.012



rocscience	*Project*	I-295 Exit 17 Yarmouth Bridges	
	Analysis Description	Settlement	
	Drawn By	J. DuBois	*Company* Haley & Aldrich, Inc.
	Date	6/24/2020, 4:19:02 PM	*File Name* 2021-0901-HAI-Yarmouth Bridges-Settlement-Simplified.s3z

SETTLE3 5.012

Structural Pile Resistance

HALEY ALDRICH	CALCULATIONS	File No.:	134120-002
		Sheet:	1 of 2
Client:	Maine Department of Transportation	Date:	7-Oct-2020
Project:	Yarmouth Exit-17 Bridge Replacement; WIN: 023106.00 & WIN: 023110.00	Computed by:	JAD
Subject:	Structural Resistance of H-Piles	Checked by:	BCS

STRUCTURAL RESISTANCE ASSUMPTIONS

1. H-Piles are driven to rock and the structural axial compression resistance of the pile is limited by the geotechnical axial resistance of the pile section (see Sheet 1).
2. H-Piles are subject to damage due to good driving conditions. Resistance factor for axial resistance of piles in compression is 0.5 (Section 6.5.4.2 AASHTO LRFD 2017).
3. No corrosion loss is assumed.
4. H-Piles are completely embedded in soil and there is no reduction in axial resistance due to buckling.
5. This calculation only addresses axial resistance, if the piles are subjected to lateral loads, the structural resistance under combined axial load and flexure should also be evaluated.
6. The pile section has Fy = 50 ksi.
7. Equations used herein are from AASHTO LRFD 2017.

CALCULATIONS

P_n shall be determined as follows:

- If $\frac{P_e}{P_o} \geq 0.44$, then:

$$P_n = \left[0.658^{\left(\frac{P_o}{P_e}\right)}\right] P_o \qquad (6.9.4.1.1\text{-}1)$$

- If $\frac{P_e}{P_o} < 0.44$, then:

$$P_n = 0.877 P_e \qquad (6.9.4.1.1\text{-}2)$$

where:

A_g = gross cross-sectional area of the member (in.^{2})

F_y = specified minimum yield strength (ksi)

P_e = elastic critical buckling resistance determined as specified in Article 6.9.4.1.2 for flexural buckling, and as specified in Article 6.9.4.1.3 for torsional bucking or flexural-torsional buckling, as applicable (kips)

P_o = equivalent nominal yield resistance = QF_yA_g (kips)

Q = slender element reduction factor determined as specified in Article 6.9.4.2. Q shall be taken equal to 1.0 for bearing stiffeners.

6.9.4.1.2—Elastic Flexural Buckling Resistance

The elastic critical buckling resistance, P_e, based on flexural buckling shall be taken as:

$$P_e = \frac{\pi^2 E}{\left(\frac{K\ell}{r_s}\right)^2} A_g \qquad (6.9.4.1.2\text{-}1)$$

where:

A_g = gross cross-sectional area of the member (in.^{2})

K = effective length factor in the plane of buckling determined as specified in Article 4.6.2.5

ℓ = unbraced length in the plane of buckling (in.)

r_s = radius of gyration about the axis normal to the plane of buckling (in.)

Section	Corrosion (in)	Effective A_s (in)	f_y (ksi)	Q	$P_0=Q\cdot f_y\cdot A_s$ (kip)	P_e (kip)	P_0/P_e	**P_n (kip)**	**ϕP_n (kip)**
HP14x117	0.000	34.4	50	1.0	1,722	∞	0	**1,722**	**861**
HP14x89	0.000	26.1	50	1.0	1,305	∞	0	**1,305**	**653**

Notes:

1. $Q\cdot fy\cdot As$ from Section 6.9.4.1.1 of AASHTO LRFD, Q=1 for nonslender elements. Pile is considered nonslender because the unbraced length is zero (i.e., completely embedded in soil).
2. P_e from Eq. 6.9.4.1.2-1 (Elastic Flexural Buckling Resistance). With the unbraced length=0, $P_e=\infty$.
3. P_n from Eq. 6.9.4.1.1-1.
4. Resistance factor for axial resistance of piles in compression is 0.5 (Section 6.5.4.2 AASHTO LRFD 2017).

Pile Group Evaluations

PROBLEM STATEMENT AND OBJECTIVE

Perform pile group evaluations for the proposed new pier for the I-295 northbound bridge.

AVAILABLE INFORMATION

1. PDF plan titled, "134120_007_Yarmouth Expo Plan May 2021 30 Scale."
2. Boring log BB-YRO-105 dated 18 to 21 October 2019 drilled by Northern Test Boring, Inc.
3. PDF plan titled, "Yarmouth Pier Pile Layouts" sheet number 259 for northbound bridge pier from HNTB received on 17 June 2021.
4. Email from HNTB dated 30 June 2021 with updated 32-pile layout and loads applied at the center of the pile cap. Loads include the weight of the soil above the pile cap and the self-weight of the pile cap.
5. Email from HNTB dated 6 July 2021 with additional responses regarding lateral loads for Strength and Service Limit States, location of loads applied, and confirmation that M_L is the moment about the bridge transverse and M_T is the moment about the bridge longitudinal.
6. Email from HNTB dated 17 June 2021 with response that piles will be embedded 1.5 ft into the cap and could be considered as a "fixed" head.
7. Rock laboratory test results by GeoTesting Express provided in a transmittal dated 9 January 2020.

REFERENCES

1. FB-MultiPier Manual v.5.7.0.
2. AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020.
3. LPile Manual by Ensoft.

ASSUMPTIONS

1. The proposed pier at the new northbound bridge will be considered based on discussions with HNTB that it is the contorlling pier location.
2. The closest boring to the new northbound bridge pier is BB-YRO-105.
3. Pile section is a HP14x89 with Fy=50 ksi. No corrosion loss to pile section.
4. Fixed pile-to-pile cap connection based on correspondance with HNTB in email dated 17 June 2021.
5. Loads were provided at the top center of the pier pile cap but include soil and cap weight.
6. Pile cap dimensions are 9 ft by 78 ft by 3 ft with three columns on the pile cap. Loads will be distributed through the entire pile cap, assume rigid pile cap with loads applied at the center of pile cap in model. The loads were modeled at the center of the pile cap with a rigid cap in the model. A second model with the loads applied at each of the three column location was also modeled for comparison yielding similar results.
7. Elevation datum: North American Vertical Datum of 1988, NAVD88.
8. Ground surface elevation: El. 65.7 (based on boring BB-YRO-105)
9. Design GW elevation: El. 52 (based on review of boring log BB-YRO-105)
10. Bottom of pile cap/top of pile elevation: El. 59 based on the "Yarmouth Pier Pile Layouts" PDF plan.
11. Pile tip elevation (driven to bedrock): El. 25.6 (based on boring BB-YRO-105)
12. Lateral group effects were considered using p-multipliers (see page 2).
13. Select piles are battered (see page 2).
14. An unconfined compressive strength of 12,709 psi (lowest of the laboratory test results from boring BB-YRO-102 depth 27.6-27.97 ft) will be considered to generate the bedrock lateral springs.

LOADS

	Loads from HNTB						Loads in FBMPier					
Case	F_T (kips)	F_L (kips)	P (axial) (kips)	M_T (kip-ft)	M_L (kip-ft)	Torque (kip-ft)	Fx (kips)	Fy (kips)	Fz (kips)	Mx (kip-ft)	My (kip-ft)	Mz (kip-ft)
Strength	268	479	5199	29670	6344	0	479	268	5199	30474	-7781	0
Service	251	465	3886	22099	5671	0	465	251	3886	22852	-7066	0
Extreme	372	1004	5254	23531	7143	0	1004	372	5254	24647	-10155	0

Notes:

1. Loads were provided by HNTB on 30 June 2021.
2. Loads provided by HNTB include the self-weight of the pile cap and the soil above the pile cap.
3. Loads provided by HNTB are applied at the top center of the pile cap.
4. Loads were translated to the FB-MultiPier coordinate system and were transferred to the bottom of the pile cap. A 3-ft pile cap thickness was assumed.

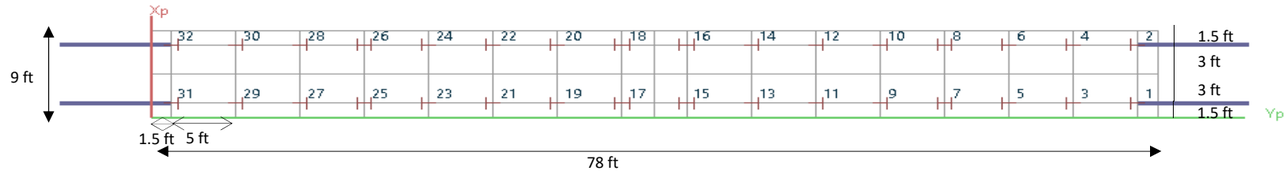
PILE LAYOUT AND PILE PROPERTIES

Pile cap dimensions: 9 ft by 78 ft by 3 ft

Pile Type	Corrosion Loss	Steel Yield Stress	Tip Elevation
HP14x89	N/A	50 ksi	25.6

Pile to pile cap connection: fixed
Bottom of cap modeled at El. 59
Pile cap thickness: 3 ft
Four corner piles are battered on 3H:12V (1H:4V), remaining piles are plumb
Pile cap is modeled as rigid

Pile Cap Model in FBMPier:



P-MULTIPLIERS

S/D	R1	R2	R3 and on	
3	0.8	0.4	0.3	
5	1	0.85	0.7	

P-multipliers above are from Table 10.7.2.4-1 of AASHTO LRFD 2010 (LRFDUS05-I1: June 2010 Errata)

4.3	0.9	0.7	0.6	based on spacing of 5 ft (bridge transverse direction)
5.1	1.0	0.9	0.7	based on spacing of 6 ft (bridge longitudinal direction)

Actual p-multipliers modeled are for S/D = 4.3

SOIL PROPERTIES

					Lateral Soil Springs							Axial Soil Springs			Tip Soil Springs	
Layer No.	Material Name	Top Elevation (ft)	Bottom Elevation (ft)	Unit Weight (pcf)	Friction Angle (degrees)	Undrained Shear Strength (psf)	Unconfined Compressive Strength (psi)	k (pci)	Poisson's Ratio	ε_{50}	ε_{100}	G (psf)	G (ksi)	Nominal Unit Side Resistance (psf)	Z (in.)	Q (lbs)
1	Existing Fill	65.7	63.0	120	30	--	--	50	0.35	--	--	43200	0.3	66	--	--
2	Marine Deposits (Cohesive)	63.0	34.5	120	--	1085	--	--	0.4	0.007	0.01	174375	1.2	600	--	--
3	Marine Deposits (Granular)	34.5	26.5	120	32	--	--	60	0.35	--	--	160000	1.1	1643	--	--
4	Glacial Till	26.5	25.6	130	36	--	--	100	0.35	--	--	533333	3.7	2405	--	--
5	Bedrock	25.6	--	--	--	--	12709	--	--	--	--	--	--	--	0, 1.4, 10	0, 1300000 1300000

NOTES:

1. Groundwater at El. 52 (based on review of boring BB-YRO-105)
2. Pile tip elevation at El. 25.6 (top of bedrock).
3. The undrained shear strength for the cohesive layer #2 was based on the field vane shear performed at depth 20.6-21 ft at boring location BB-YRO-105.
4. The lateral soil spring parameter for the modulus k was based on Figure 12.3.c of the Lpile manual (reference #3) for the cohesionless layers.
5. The lateral soil spring parameter for the ε_{50} and ε_{100} was based on guidance provided in the Lpile manual for the cohesive layer.
6. The axial soil spring parameter for the shear modulus G was based on the FBMPier manual (reference #1) Equation 12.5H for cohesive layers and Equation 12.5.G for cohesionless layers.
7. The nominal unit side resistance for each soil layer was estimated using the Beta method.
8. The tip soil springs for bedrock was based on HP14x189 section area of 26.1 in^2 and Fy=50 ksi. The rock tip spring, structural resistance controls.

RESULTS

Limit State	Maximum Factored Vertical Compression Load on Single Pile (kips)	Maximum Factored Vertical Uplift Load on Single Pile (kips)	Lateral Displacement dx at Top of Pile (inches)	Lateral Displacement dy at Top of Pile (inches)	Maximum Moment Mx on Single Pile (kip-ft)	Maximum Moment My on Single Pile (kip-ft)	Maximum Shear Vx on Single Pile (kips)	Maximum Shear Vy on Single Pile (kips)
Strength	317	8	0.14	0.03	24	30	13	9
Service	252	17	0.12	0.02	24	27	13	8
Extreme Event	351	28	0.34	0.06	46	48	30	13

NOTES:

1. The lateral displacement dx is the displacement along the bridge longitudinal.
2. The lateral displacement dy is the displacement along the bridge transverse.
3. The moment Mx is the moment about the pile strong axis.
4. The moment My is the moment about the pile weak axis.
5. The shear Vx is the shear force along the bridge longitudinal.
6. The shear Vy is the shear force along the bridge transverse.
7. A 3-ft thick rigid pile cap with fixed pile-to-pile cap connection was assumed.
8. Bottom of pile cap modeled at El. 59.
9. Pile section HP 14x89 with Fy=50 ksi and no corrosion loss.
10. Piles were modeled with tip elevation on top of bedrock at El. 25.6 based on boring BB-YRO-105.
11. Pile lateral group effects were modeled.

PROBLEM STATEMENT AND OBJECTIVE

Perform pile group evaluations for the proposed new abutments for the I-295 northbound and southbound bridges.

AVAILABLE INFORMATION

1. PDF plan titled, "134120_007_Yarmouth Expo Plan May 2021 30 Scale."
2. Boring logs BB-YRO-102, BB-YRO-104, and BB-YRO-106 dated 11 to 18 October 2019 drilled by Northern Test Boring, Inc. and boring logs BB-YRO-204 and BB-YRO-207 dated 3 to 4 June 2021 drilled by Northern Test Boring, Inc.
3. PDF plan titled, "Abutment and Wingwall Sections with defined load directions" and "Abutment Foundation Forces" provided by HNTB in an email dated 1 July 2021.
4. Email from HNTB dated 1 July 2021 with the bottom elevation of the pile cap at each abutment, sketch of abutment sections and loads applied at the center and mid-depth of the pile cap. Loads include the weight of the soil above the pile cap and the self-weight of the pile cap.
5. Email from HNTB dated 17 June 2021 with response that piles will be embedded 1.5 ft into the cap and could be considered as a "fixed" head.
6. Sheet no. 8 "I-295 Southbound Profile 2" and no. 11 "I-295 Northbound Profile 2" from the draft PDR dated 24 August 2020.
7. Rock laboratory test results by GeoTesting Express provided in a transmittal dated 9 January 2020.

REFERENCES

1. FB-MultiPier Manual v.5.7.0
2. AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020.
3. LPile manual by Ensoft.
4. "Effects of Soil Slope on Lateral Pile Capacity of Piles in Cohesive and Cohesionless Soils," report by Nontapat Nimityongskul, Paul Barker, and Scott A. Ashford dated March 2012.

ASSUMPTIONS

1. The closest borings in the area are BB-YRO-204 (Abutment No. 1 for SB bridge), BB-YRO-207 and BB-YRO-102 (Abutment No. 2 for SB bridge), BB-YRO-104 (Abutment No. 1 for NB bridge), BB-YRO-106 (Abutment No. 2 for NB bridge). Two conditions/locations were modeled: a shallow bedrock profile based on boring BB-YRO-204 at the SB Bridge Abutment No. 1 and a deep bedrock profile based on boring BB-YRO-106 at the NB Bridge Abutment No. 2.
2. The loads were provided by HNTB per unit width of pile cap i.e. in kip/ft or kip-ft/ft. A pile spacing of 8 ft (largest spacing observed based on the range between 6'5" and 8'0") was used to calculate the load per pair of piles.
3. Pile section is an HP14x89 with Fy=50 ksi. No corrosion loss to pile section.
4. Fixed pile-to-pile cap connection based on correspondance with HNTB in email dated 17 June 2021.
5. Loads are provided at the center and mid-depth of the pile cap and include the weight of the pile cap.
6. Pile cap is modeled as rigid.
7. Elevation datum: North American Vertical Datum of 1988, NAVD88.
8. For SB Bridge Abutment No. 1 (shallow bedrock profile from BB-YRO-204):
   Final ground surface elevation: El. 76
   Existing ground surface at pile cap: El. 72
   GW elevation: El. 55.4
   Bottom of pile cap/top of pile elevation: El. 69
   Pile tip elevation (driven to bedrock): El. 38.4
   Pile lateral group effects are negligible since the piles are widely spaced. However, the effect of the slope in front of the abutments was considered using p-multipliers.
   Front pile in pair is battered (see page 2).
9. For NB Bridge Abutment No. 2 (deep bedrock profile from boring BB-YRO-106):
   Final ground surface elevation: El. 77
   Existing ground surface at pile cap: El. 85 (embankment will be cut down, no new fill)
   GW elevation: El. 50
   Bottom of pile cap/top of pile elevation: El. 69
   Pile tip elevation (driven to bedrock): El. 20.9
   Pile lateral group effects are negligible since the piles are widely spaced. However, the effect of the slope in front of the abutments was considered using p-multipliers.
   Front pile in pair is battered (see page 2).
10. Based on the drawings, the least distance from the final grade to the bottom of the pile cap of the abutments is about 5.6 ft and the least horizontal distance from the crest of the slope to the front row face of the piles is about 4.3 ft.
11. An unconfined compressive strength of 12,709 psi (lowest of the laboratory test results from boring BB-YRO-102 depth 27.6-27.97 ft) will be considered to generate the bedrock lateral springs.

LOADS

Case	Loads from HNTB			Pile Spacing (ft)	Loads in FBMPier					
	P (vert) (kip/ft)	H_perp (kip/ft)	M_perp (kip-ft/ft)		Fx (kips)	Fy (kips)	Fz (kips)	Mx (kip-ft)	My (kip-ft)	Mz (kip-ft)
Strength I	53.7	15.9	72.7	8	127.2	0	429.6	0	-772.4	0
Strength I	51.7	6.3	18	8	50.4	0	413.6	0	-219.6	0
Strength I	32.8	14.3	45.2	8	114.4	0	262.4	0	-533.2	0
Strength I	30.8	6.3	5.3	8	50.4	0	246.4	0	-118.0	0
Strength V	39.3	15.5	71.1	8	124	0	314.4	0	-754.8	0
Strength V	51	15.5	65.2	8	124	0	408	0	-707.6	0
Service I	38.9	10.9	49.58	8	87.2	0	311.2	0	-527.4	0
Service I	33	10.9	41.6	8	87.2	0	264	0	-463.6	0
Extreme II	32.2	1.7	11.8	8	13.6	0	257.6	0	-114.8	0
Extreme II	29.2	1.7	7.8	8	13.6	0	233.6	0	-82.8	0

NOTES:

1. Loads were provided by HNTB on 1 July 2021.
2. Loads provided by HNTB include the self-weight of the pile cap and the soil above the pile cap.
3. Loads provided by HNTB are applied at the center and mid-depth of the pile cap.
4. Loads were translated to the FB-MultiPier coordinate system and were transferred to the bottom of the pile cap. A 3-ft pile cap thickness was assumed.
5. Loads were provided by HNTB per unit width of the pile cap. The load provided by HNTB was then multiplied by 8 ft (largest pile-to-pile spacing observed) for input into FBMPier. The range of center-to-center spacing of the piles based on review of the drawings for the abutments was between 6'5" and 8'0".

PILE LAYOUT AND PILE PROPERTIES

Shallow Bedrock Profile (based on boring BB-YRO-204 at SB Bridge Abutment No. 1)

Pile Type	Corrosion Loss	Steel Yield Stress	Tip Elevation
HP14x89	N/A	50 ksi	38.4

Pile to pile cap connection: fixed
Bottom of cap modeled at El. 69
Pile cap thickness: 3 ft
Front pile is battered on 3H:12V (1H:4V), back pile is plumb
Pile spacing from front to back is 7.7 ft

Deep Bedrock Profile (based on boring BB-YRO-106 at NB Bridge Abutment No. 2)

Pile Type	Corrosion Loss	Steel Yield Stress	Tip Elevation
HP14x89	N/A	50 ksi	20.9

Pile to pile cap connection: fixed
Bottom of cap modeled at El. 69
Pile cap thickness: 3 ft
Front pile is battered on 3H:12V (1H:4V), back pile is plumb
Pile spacing from front to back is 7.7 ft

P-MULTIPLIERS

Figure 14-2 from reference #4 was used to determine the influence of the slope in front of the abutments to the lateral capacity of the piles.

Based on the figure to the right and the depth and horizontal distances of the pile cap in regards to the slope (summarized in assumption #10), a p-multiplier of 0.6 for the front row and 1.0 for the back row was used in the model.

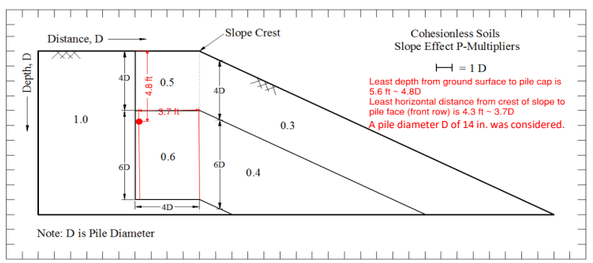


Figure 14-2 Recommended p-Multipliers for a Generalized Cohesionless Slope

SOIL PROPERTIES (SHALLOW BEDROCK BASED ON BORING BB-YRO-204)

					Lateral Soil Springs							Axial Soil Springs			Tip Soil Springs	
Layer No.	Material Name	Top Elevation (ft)	Bottom Elevation (ft)	Unit Weight (pcf)	Friction Angle (degrees)	Undrained Shear Strength (psf)	Unconfined Compressive Strength (psi)	k (pci)	Poisson's Ratio	ε_{50}	ε_{100}	G (psf)	G (ksi)	Nominal Unit Side Resistance (psf)	Z (in.)	Q (lbs)
1	New Fill	76.0	72.0	125	34	--	--	60	0.35	--	--	76800	0.5	175	--	--
2	Existing Fill	72.0	53.2	120	30	--	--	40	0.35	--	--	106667	0.7	635	--	--
3	Marine Deposits (Cohesive)	53.2	42.2	120	--	1940	--	--	0.4	0.007	0.01	311786	2.2	1184	--	--
4	Marine Deposits (Granular)	42.2	38.4	120	32	--	--	50	0.35	--	--	106667	0.7	1916	--	--
5	Bedrock	38.4	--	--	--	--	12709	--	--	--	--	--	--	--	0, 1.4, 10	0, 1300000 1300000

NOTES:

1. Groundwater at El. 55.4 (based on boring BB-YRO-204)
2. Pile tip elevation at El. 38.4 (top of bedrock).
3. The undrained shear strength for the cohesive layer #3 was based on the field vane shear performed at depth 14.4-14.8 ft at boring location BB-YRO-204.
4. The lateral soil spring parameter for the modulus k was based on Figure 12.3.c of the Lpile manual (reference #3) for the cohesionless layers.
5. The lateral soil spring parameter for the ε_{50} and ε_{100} was based on guidance provided in the Lpile manual for the cohesive layer.
6. The axial soil spring parameter for the shear modulus G was based on the FBMPier manual (reference #1) Equation 12.5H for cohesive layers and Equation 12.5.G for cohesionless layers.
7. The nominal unit side resistance for each soil layer was estimated using the Beta method.
8. The tip soil springs for bedrock was based on HP14x89 section area of 26.1 in^2 and Fy=50 ksi. Rock tip spring, structural resistance controls.

SOIL PROPERTIES (DEEP BEDROCK BASED ON BORING BB-YRO-106)

					Lateral Soil Springs							Axial Soil Springs			Tip Soil Springs	
Layer No.	Material Name	Top Elevation (ft)	Bottom Elevation (ft)	Unit Weight (pcf)	Friction Angle (degrees)	Undrained Shear Strength (psf)	Unconfined Compressive Strength (psi)	k (pci)	Poisson's Ratio	ε_{50}	ε_{100}	G (psf)	G (ksi)	Nominal Unit Side Resistance (psf)	Z (in.)	Q (lbs)
1	Existing Fill	77.0	57.2	120	30	--	--	40	0.35	--	--	106667	0.7	484	--	--
2	Marine Deposits (Cohesive)	57.2	27.2	120	--	910	--	--	0.4	0.01	0.05	146250	1.0	1398	--	--
3	Marine Deposits (Granular)	27.2	21.5	120	32	--	--	60	0.35	--	--	160000	1.1	2689	--	--
4	Glacial Till	21.5	20.9	130	36	--	--	100	0.35	--	--	533333	3.7	3750	--	--
5	Bedrock	20.9	--	--	--	--	12709	--	--	--	--	--	--	--	0, 1.4, 10	0, 1300000 1300000

NOTES:

1. Groundwater at El. 50 (based on boring BB-YRO-106)
2. Pile tip elevation at El. 20.9 (top of bedrock).
3. The undrained shear strength for the cohesive layer #2 was based on the field vane shear performed at depth 26.6-27.0 ft at boring location BB-YRO-106.
4. The lateral soil spring parameter for the modulus k was based on Figure 12.3.c of the Lpile manual (reference #3) for the cohesionless layers.
5. The lateral soil spring parameter for the ε_{50} and ε_{100} was based on guidance provided in the Lpile manual for the cohesive layer.
6. The axial soil spring parametr for the shear modulus G was based on the FBMPier manual (reference #1) Equation 12.5H for cohesive layers and Equation 12.5.G for cohesionless layers.
7. The nominal unit side resistance for each soil layer was estimated using the Beta method.
8. The tip soil springs for bedrock was based on HP14x89 section area of 26.1 in^2 and Fy=50 ksi. Rock tip spring, structural resistance controls.

RESULTS

	SHALLOW BEDROCK PROFILE								DEEP BEDROCK PROFILE							
Limit State	Maximum Factored Vertical Compression Load on Single Pile (kips)	Maximum Factored Vertical Uplift Load on Single Pile (kips)	Lateral Displacement dx at Top of Pile (inches)	Lateral Displacement dy at Top of Pile (inches)	Maximum Moment Mx on Single Pile (kip-ft)	Maximum Moment My on Single Pile (kip-ft)	Maximum Shear Vx on Single Pile (kips)	Maximum Shear Vy on Single Pile (kips)	Maximum Factored Vertical Compression Load on Single Pile (kips)	Maximum Factored Vertical Uplift Load on Single Pile (kips)	Lateral Displacement dx at Top of Pile (inches)	Lateral Displacement dy at Top of Pile (inches)	Maximum Moment Mx on Single Pile (kip-ft)	Maximum Moment My on Single Pile (kip-ft)	Maximum Shear Vx on Single Pile (kips)	Maximum Shear Vy on Single Pile (kips)
Strength	330	N/A	0.2	0	0	70	35	0	327	N/A	0.2	0	0	64	32	0
Service	233	N/A	0.12	0	0	34	22	0	231	N/A	0.12	0	0	35	20	0
Extreme Event	135	N/A	0.03	0	0	42	11	0	134	N/A	0.02	0	0	44	11	0

NOTES:

1. The lateral displacement dx is the displacement along the bridge longitudinal.
2. The lateral displacement dy is the displacement along the bridge transverse.
3. The moment Mx is the moment about the pile weak axis.
4. The moment My is the moment about the pile strong axis.
5. The shear Vx is the shear force along the bridge longitudinal.
6. The shear Vy is the shear force along the bridge transverse.
7. A 3-ft thick rigid pile cap with fixed pile-to-pile cap connection was assumed.
8. Bottom of pile cap modeled at El. 69.
9. Pile section HP 14x89 with Fy=50 ksi and no corrosion loss.
10. Piles were modeled with tip elevation on top of bedrock at El. 38.4 based on boring BB-YRO-204 for the shallow bedrock profile and El. 20.9 based on boring BB-YRO-106 for the deep bedrock profile.
11. Pile lateral group effects are negligible since the piles are widely space. However, the effect of the slope in front of the abutments was considered using p-multipliers.

PROBLEM STATEMENT AND OBJECTIVE

Perform pile group evaluations for the proposed new abutments for the I-295 northbound and southbound bridges.

AVAILABLE INFORMATION

1. PDF plan titled, "134120_007_Yarmouth Expo Plan May 2021 30 Scale."
2. Boring logs BB-YRO-102, BB-YRO-104, and BB-YRO-106 dated 11 to 18 October 2019 drilled by Northern Test Boring, Inc. and boring logs BB-YRO-204 and BB-YRO-207 dated 3 to 4 June 2021 drilled by Northern Test Boring, Inc.
3. PDF plan titled, "Abutment and Wingwall Sections with defined load directions" and "Abutment Foundation Forces" provided by HNTB in an email dated 1 July 2021.
4. Email from HNTB dated 1 July 2021 with the bottom elevation of the pile cap at each abutment, sketch of abutment sections and loads applied at the center and mid-depth of the pile cap. Loads include the weight of the soil above the pile cap and the self-weight of the pile cap.
5. Email from HNTB dated 17 June 2021 with response that piles will be embedded 1.5 ft into the cap and could be considered as a "fixed" head.
6. Sheet no. 8 "I-295 Southbound Profile 2" and no. 11 "I-295 Northbound Profile 2" from the draft PDR dated 24 August 2020.
7. Rock laboratory test results by GeoTesting Express provided in a transmittal dated 9 January 2020.

REFERENCES

1. FB-MultiPier Manual v.5.7.0
2. AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020.
3. LPile manual by Ensoft.
4. "Effects of Soil Slope on Lateral Pile Capacity of Piles in Cohesive and Cohesionless Soils," report by Nontapat Nimityongskul, Paul Barker, and Scott A. Ashford dated March 2012.

ASSUMPTIONS

1. The closest borings in the area are BB-YRO-204 (Abutment No. 1 for SB bridge), BB-YRO-207 and BB-YRO-102 (Abutment No. 2 for SB bridge), BB-YRO-104 (Abutment No. 1 for NB bridge), BB-YRO-106 (Abutment No. 2 for NB bridge). Two conditions/locations were modeled: a shallow bedrock profile based on boring BB-YRO-204 at the SB Bridge Abutment No. 1 and a deep bedrock profile based on boring BB-YRO-106 at the NB Bridge Abutment No. 2.
2. The loads were provided by HNTB per unit width of pile cap i.e. in kip/ft or kip-ft/ft. A pile spacing of 8 ft (largest spacing observed based on the range between 6'5" and 8'0") was used to calculate the load per pair of piles.
3. Pile section is an HP14x117 with Fy=50 ksi. No corrosion loss to pile section.
4. Fixed pile-to-pile cap connection based on correspondance with HNTB in email dated 17 June 2021.
5. Loads are provided at the center and mid-depth of the pile cap and include the weight of the pile cap.
6. Pile cap is modeled as rigid.
7. Elevation datum: North American Vertical Datum of 1988, NAVD88.
8. For SB Bridge Abutment No. 1 (shallow bedrock profile from BB-YRO-204):
   Final ground surface elevation: El. 76
   Existing ground surface at pile cap: El. 72
   GW elevation: El. 55.4
   Bottom of pile cap/top of pile elevation: El. 69
   Pile tip elevation (driven to bedrock): El. 38.4
   Pile lateral group effects are negligible since the piles are widely spaced. However, the effect of the slope in front of the abutments was considered using p-multipliers.
   Front pile in pair is battered (see page 2).
9. For NB Bridge Abutment No. 2 (deep bedrock profile from boring BB-YRO-106):
   Final ground surface elevation: El. 77
   Existing ground surface at pile cap: El. 85 (embankment will be cut down, no new fill)
   GW elevation: El. 50
   Bottom of pile cap/top of pile elevation: El. 69
   Pile tip elevation (driven to bedrock): El. 20.9
   Pile lateral group effects are negligible since the piles are widely spaced. However, the effect of the slope in front of the abutments was considered using p-multipliers.
   Front pile in pair is battered (see page 2).
10. Based on the drawings, the least distance from the final grade to the bottom of the pile cap of the abutments is about 5.6 ft and the least horizontal distance from the crest of the slope to the front row face of the piles is about 4.3 ft.
11. An unconfined compressive strength of 12,709 psi (lowest of the laboratory test results from boring BB-YRO-102 depth 27.6-27.97 ft) will be considered to generate the bedrock lateral springs.

LOADS

	Loads from HNTB			Pile	Loads in FBMPier					
Case	P (vert) (kip/ft)	H_perp (kip/ft)	M_perp (kip-ft/ft)	Spacing (ft)	Fx (kips)	Fy (kips)	Fz (kips)	Mx (kip-ft)	My (kip-ft)	Mz (kip-ft)
Strength I	53.7	15.9	72.7	8	127.2	0	429.6	0	-772.4	0
Strength I	51.7	6.3	18	8	50.4	0	413.6	0	-219.6	0
Strength I	32.8	14.3	45.2	8	114.4	0	262.4	0	-533.2	0
Strength I	30.8	6.3	5.3	8	50.4	0	246.4	0	-118.0	0
Strength V	39.3	15.5	71.1	8	124	0	314.4	0	-754.8	0
Strength V	51	15.5	65.2	8	124	0	408	0	-707.6	0
Service I	38.9	10.9	49.58	8	87.2	0	311.2	0	-527.4	0
Service I	33	10.9	41.6	8	87.2	0	264	0	-463.6	0
Extreme II	32.2	1.7	11.8	8	13.6	0	257.6	0	-114.8	0
Extreme II	29.2	1.7	7.8	8	13.6	0	233.6	0	-82.8	0

NOTES:

1. Loads were provided by HNTB on 1 July 2021.
2. Loads provided by HNTB include the self-weight of the pile cap and the soil above the pile cap.
3. Loads provided by HNTB are applied at the center and mid-depth of the pile cap.
4. Loads were translated to the FB-MultiPier coordinate system and were transferred to the bottom of the pile cap. A 3-ft pile cap thickness was assumed.
5. Loads were provided by HNTB per unit width of the pile cap. The load provided by HNTB was then multiplied by 8 ft (largest pile-to-pile spacing observed) for input into FBMPier. The range of center-to-center spacing of the piles based on review of the drawings for the abutments was between 6'5" and 8'0".

PILE LAYOUT AND PILE PROPERTIES

Shallow Bedrock Profile (based on boring BB-YRO-204 at SB Bridge Abutment No. 1)

Pile Type	Corrosion Loss	Steel Yield Stress	Tip Elevation
HP14x117	N/A	50 ksi	38.4

Pile to pile cap connection: fixed
Bottom of cap modeled at El. 69
Pile cap thickness: 3 ft
Front pile is battered on 3H:12V (1H:4V), back pile is plumb
Pile spacing from front to back is 7.7 ft

Deep Bedrock Profile (based on boring BB-YRO-106 at NB Bridge Abutment No. 2)

Pile Type	Corrosion Loss	Steel Yield Stress	Tip Elevation
HP14x117	N/A	50 ksi	20.9

Pile to pile cap connection: fixed
Bottom of cap modeled at El. 69
Pile cap thickness: 3 ft
Front pile is battered on 3H:12V (1H:4V), back pile is plumb
Pile spacing from front to back is 7.7 ft

P-MULTIPLIERS

Figure 14-2 from reference #4 was used to determine the influence of the slope in front of the abutments to the lateral capacity of the piles.

Based on the figure to the right and the depth and horizontal distances of the pile cap in regards to the slope (summarized in assumption #10), a p-multiplier of 0.6 for the front row and 1.0 for the back row was used in the model.

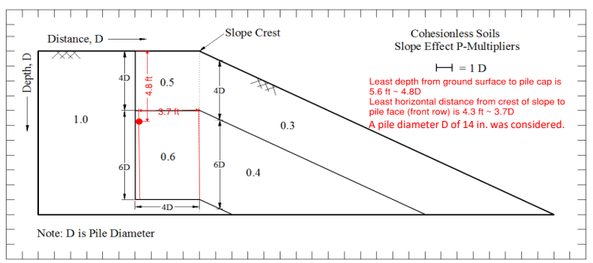


Figure 14-2 Recommended p-Multipliers for a Generalized Cohesionless Slope

SOIL PROPERTIES (SHALLOW BEDROCK BASED ON BORING BB-YRO-204)

					Lateral Soil Springs							Axial Soil Springs			Tip Soil Springs	
Layer No.	Material Name	Top Elevation (ft)	Bottom Elevation (ft)	Unit Weight (pcf)	Friction Angle (degrees)	Undrained Shear Strength (psf)	Unconfined Compressive Strength (psi)	k (pci)	Poisson's Ratio	ε_{50}	ε_{100}	G (psf)	G (ksi)	Nominal Unit Side Resistance (psf)	Z (in.)	Q (lbs)
1	New Fill	76.0	72.0	125	34	--	--	60	0.35	--	--	76800	0.5	175	--	--
2	Existing Fill	72.0	53.2	120	30	--	--	40	0.35	--	--	106667	0.7	635	--	--
3	Marine Deposits (Cohesive)	53.2	42.2	120	--	1940	--	--	0.4	0.007	0.01	311786	2.2	1184	--	--
4	Marine Deposits (Granular)	42.2	38.4	120	32	--	--	50	0.35	--	--	106667	0.7	1916	--	--
5	Bedrock	38.4	--	--	--	--	12709	--	--	--	--	--	--	--	0, 1.4, 10	0, 1700000 1700000

NOTES:

1. Groundwater at El. 55.4 (based on boring BB-YRO-204)
2. Pile tip elevation at El. 38.4 (top of bedrock).
3. The undrained shear strength for the cohesive layer #3 was based on the field vane shear performed at depth 14.4-14.8 ft at boring location BB-YRO-204.
4. The lateral soil spring parameter for the modulus k was based on Figure 12.3.c of the Lpile manual (reference #3) for the cohesionless layers.
5. The lateral soil spring parameter for the ε_{50} and ε_{100} was based on guidance provided in the Lpile manual for the cohesive layer.
6. The axial soil spring parameter for the shear modulus G was based on the FBMPier manual (reference #1) Equation 12.5H for cohesive layers and Equation 12.5.G for cohesionless layers.
7. The nominal unit side resistance for each soil layer was estimated using the Beta method.
8. The tip soil springs for bedrock was based on HP14x117 section area of 34.4 in^2 and Fy=50 ksi. Rock tip spring, structural resistance controls.

SOIL PROPERTIES (DEEP BEDROCK BASED ON BORING BB-YRO-106)

					Lateral Soil Springs							Axial Soil Springs			Tip Soil Springs	
Layer No.	Material Name	Top Elevation (ft)	Bottom Elevation (ft)	Unit Weight (pcf)	Friction Angle (degrees)	Undrained Shear Strength (psf)	Unconfined Compressive Strength (psi)	k (pci)	Poisson's Ratio	ε_{50}	ε_{100}	G (psf)	G (ksi)	Nominal Unit Side Resistance (psf)	Z (in.)	Q (lbs)
1	Existing Fill	77.0	57.2	120	30	--	--	40	0.35	--	--	106667	0.7	484	--	--
2	Marine Deposits (Cohesive)	57.2	27.2	120	--	910	--	--	0.4	0.01	0.05	146250	1.0	1398	--	--
3	Marine Deposits (Granular)	27.2	21.5	120	32	--	--	60	0.35	--	--	160000	1.1	2689	--	--
4	Glacial Till	21.5	20.9	130	36	--	--	100	0.35	--	--	533333	3.7	3750	--	--
5	Bedrock	20.9	--	--	--	--	12709	--	--	--	--	--	--	--	0, 1.4, 10	0, 1700000 1700000

NOTES:

1. Groundwater at El. 50 (based on boring BB-YRO-106)
2. Pile tip elevation at El. 20.9 (top of bedrock).
3. The undrained shear strength for the cohesive layer #2 was based on the field vane shear performed at depth 26.6-27.0 ft at boring location BB-YRO-106.
4. The lateral soil spring parameter for the modulus k was based on Figure 12.3.c of the Lpile manual (reference #3) for the cohesionless layers.
5. The lateral soil spring parameter for the ε_{50} and ε_{100} was based on guidance provided in the Lpile manual for the cohesive layer.
6. The axial soil spring parametr for the shear modulus G was based on the FBMPier manual (reference #1) Equation 12.5H for cohesive layers and Equation 12.5.G for cohesionless layers.
7. The nominal unit side resistance for each soil layer was estimated using the Beta method.
8. The tip soil springs for bedrock was based on HP14x117 section area of 34.4 in^2 and Fy=50 ksi. Rock tip spring, structural resistance controls.

RESULTS

	SHALLOW BEDROCK PROFILE								DEEP BEDROCK PROFILE							
Limit State	Maximum Factored Vertical Compression Load on Single Pile (kips)	Maximum Factored Vertical Uplift Load on Single Pile (kips)	Lateral Displacement dx at Top of Pile (inches)	Lateral Displacement dy at Top of Pile (inches)	Maximum Moment Mx on Single Pile (kip-ft)	Maximum Moment My on Single Pile (kip-ft)	Maximum Shear Vx on Single Pile (kips)	Maximum Shear Vy on Single Pile (kips)	Maximum Factored Vertical Compression Load on Single Pile (kips)	Maximum Factored Vertical Uplift Load on Single Pile (kips)	Lateral Displacement dx at Top of Pile (inches)	Lateral Displacement dy at Top of Pile (inches)	Maximum Moment Mx on Single Pile (kip-ft)	Maximum Moment My on Single Pile (kip-ft)	Maximum Shear Vx on Single Pile (kips)	Maximum Shear Vy on Single Pile (kips)
Strength	331	N/A	0.17	0	0	76	35	0	329	N/A	0.18	0	0	68	32	0
Service	234	N/A	0.11	0	0	38	22	0	232	N/A	0.11	0	0	37	20	0
Extreme Event	134	N/A	0.02	0	0	44	11	0	134	N/A	0.02	0	0	46	11	0

NOTES:

1. The lateral displacement dx is the displacement along the bridge longitudinal.
2. The lateral displacement dy is the displacement along the bridge transverse.
3. The moment Mx is the moment about the pile weak axis.
4. The moment My is the moment about the pile strong axis.
5. The shear Vx is the shear force along the bridge longitudinal.
6. The shear Vy is the shear force along the bridge transverse.
7. A 3-ft thick rigid pile cap with fixed pile-to-pile cap connection was assumed.
8. Bottom of pile cap modeled at El. 69.
9. Pile section HP 14x117 with Fy=50 ksi and no corrosion loss.
10. Piles were modeled with tip elevation on top of bedrock at El. 38.4 based on boring BB-YRO-204 for the shallow bedrock profile and El. 20.9 based on boring BB-YRO-106 for the deep bedrock profile.
11. Pile lateral group effects are negligible since the piles are widely space. However, the effect of the slope in front of the abutments was considered using p-multipliers.

Uplift Pile Resistance

HALEY ALDRICH

CALCULATIONS

Client	MAINEDOT
Project	I-295 BRIDGES OVER U.S. ROUTE 1
Subject	UPLIFT RESISTANCE

File No.	134120-003
Sheet	1 of 4
Date	8/3/21
Computed By	BCS
Checked By	TPJ

OBJECTIVE: CALCULATE FACTORED UPLIFT RESISTANCE OF A SINGLE HP14x89 STEEL H-PILE AT THE NB AND SB PIERS.

SUBSURFACE CONDITIONS:

NB PIER 1 (AVG. OF TEST BORINGS BB-YRO-105 AND -106)

AVG. GS = EL. 64.7
AVG FILL THICK = 4.5 FT

EL. 59 (BOT. OF PILE CAP)
-CLAY- EL. 55
-CLAY- EL. 49
EL. 31 (AVG. BOT. OF CLAY)
-SAND-
EL. 24 (AVG. BOT. OF SAND)
-TILL- EL. 23 (AVG. T.O.R.)

COMBINE INTO 1 LAYER AND CALC. VERT. EFF. STRESS @ MIDPOINT....

$\sigma'_v = (EL.64.7 - EL.60.2)(120\ pcf) + (EL.60.2 - EL.55)(115\ pcf) + (EL.55 - EL.49)(115\ pcf) + (EL.49 - EL.31)(115 - 62.4\ pcf) + (EL.31 - EL.27)(118\ pcf) = 2,997\ psf$

SB PIER 1 (TEST BORING BB-YRO-205)

EL. 59 (BOT. OF PILE CAP)
-CLAY- EL. 55
-CLAY- EL. 49
EL. 43 (BOT. OF CLAY)
-SAND- EL. 40.6 (T.O.R.)

8 Jan 2015

EVALUATION:

NB PIER 1:

PILE PERIMETER (HP14x89) = $(2)\left(\frac{13.8\,IN}{12\,IN/FT}\right) + (2)\left(\frac{14.7\,IN}{12\,IN/FT}\right) = 4.75\ ^{LF}/_{FT}$

PILE LENGTH = EL. 59 - EL. 23 = 36 FT

USE α METHOD TO CALCULATE NOMINAL AND FACTORED FRICTIONAL RESISTANCE FOR PORTION OF PILE EMBEDDED MARINE CLAY....

$q_s = \alpha S_u$ (10.7.3.8.6b-1)

FROM SLOPE STABILITY EVAL. S_u = 1,250 PSF ABOVE EL. 55 AND S_u = 600 PSF BELOW EL. 55.

FROM FIGURE 10.7.3.8.6b-1 α = 0.9375

$q_{s1} = (0.9375)(1{,}250\ psf) = 1{,}172\ psf$

$q_{s2} = (0.9375)(600\ psf) = 562\ psf$

CALCULATE NOMINAL FRICTIONAL RESISTANCE IN MARINE CLAY....

$= (EL.\ 59 - EL.\ 55)(4.75\ ^{LF}/_{FT})(1{,}172\ psf) + (EL.\ 55 - EL.\ 31)(4.75\ ^{LF}/_{FT})(600\ psf)$

$= 90.7$ KIPS $= 90$ KIPS

$= 1.0$ [SER] PER SECTION 10.5.5.1

RESISTANCE FACTOR = 0.25 PER AASHTO LRFD TABLE 10.7.3.8.6b [STR]
0.80 [EE] PER SECTION 10.5.5.3

CALCULATE FACTORED FRICTIONAL RESISTANCE IN MARINE CLAY....

$= (90.7\ KIPS)(0.25) = 22.7$ KIPS $= 22$ KIPS [STR]

USE NORDLUND/THURMAN METHOD TO CALCULATE NOMINAL AND FACTORED FRICTIONAL RESISTANCE FOR PORTION OF PILE EMBEDDED IN MARINE SAND/GLACIAL TILL....

$q_s = K_\delta C_F \sigma'_v \frac{\sin(\delta+\omega)}{\cos\omega}$ (10.7.3.8.6f-1)

DETERMINE K_δ FROM FIGURE 10.7.3.8.6f-2 ($\phi = 30°$; $\omega = 0$ DEG.)....

$A_{HP14x89} = 26.1\ IN^2/FT = 0.18\ ^{FT^3}/_{LF}$ .... $K_\delta = 0.85$

100% Post-consumer waste

EVALUATION: (CONT.)

NB PIER 1: (CONT.)

DETERMINE C_F FROM FIGURE 10.7.3.8.6f-5 ....

FOR STEEL H-PILES $w/V = 0.18\ FT^3/FT$ $\delta/\phi \cong 0.80$ (FIGURE 10.7.3.8.6f-6)

FOR $\delta/\phi = 0.80$ AND $\phi = 30°$ $C_F \cong 0.94$

DETERMINE δ... $\delta/\phi \cong 0.80 \Rightarrow \delta/30\ DEG = 0.80 \Rightarrow \delta = 24\ DEG.$

CALCULATE NOMINAL FRICTIONAL RESISTANCE IN MARINE SAND/GLACIAL TILL

$$q_s = (0.85)(0.94)(2{,}997\ LB/FT^2)\ \frac{\sin(24°)}{\cos(0)}$$

$$= 973\ PSF\ (4.75^{4F}/FT)(EL.31 - EL.23) = 36\ KIPS$$

RESISTANCE FACTOR = 0.35 PER AASHTO LRFD TABLE 10.7.3.8.6b

$= 36\ KIPS\ (0.35) = 12\ KIPS$

TOTAL FACTORED FRICTIONAL RESISTANCE AVAILABLE TO RESIST FACTORED DEMANDS ....

LIMIT STATE (RESIST. FACTOR)	FACTORED UPLIFT RESIST. (KIPS)
SEE (1.0)	126 KIPS
STR (0.25/0.35)	34 KIPS
EE (0.80)	100 KIPS

8 Jan 2015
MMP_HA5x5Calc
100% Post-consumer wa

HALEY ALDRICH

CALCULATIONS

Client: MAINEDOT
Project: I-295 BRIDGES OVER U.S. ROUTE 1
Subject: UPLIFT RESISTANCE

File No. 134120-003
Sheet 4 of 4
Date 8/3/21
Computed By BCS
Checked By TPJ

EVALUATION: (CONT.)

SB PIER 1:

USE α METHOD TO CALCULATE NOMINAL AND FACTORED FRICTIONAL RESISTANCE FOR PORTION OF PILE EMBEDDED IN MARINE CLAY....

$q_s = \alpha S_u$ (10.7.3.8.6b-1)

FROM SHEET 2 $\alpha = 0.9375$

$q_{s1} = (0.9375)(1{,}250\,psf) = 1{,}172\,psf$

$q_{s2} = (0.9375)(600\,psf) = 562\,psf$

CALCULATE NOMINAL FRICTIONAL RESISTANCE IN MARINE CLAY....

$= (El.59 - El.55)(4.75^{LF/FT})(1{,}172\,psf) + (El.55 - El.43)(4.75^{LF/FT})(562\,psf)$

$= 54\,kips$

IGNORE CONTRIBUTION OF MARINE SAND DUE TO LIMITED THICKNESS (CONSERVATIVE)....

CALCULATE FACTORED RESISTANCES...

SER = 54 kips (1.0) = 54 kips

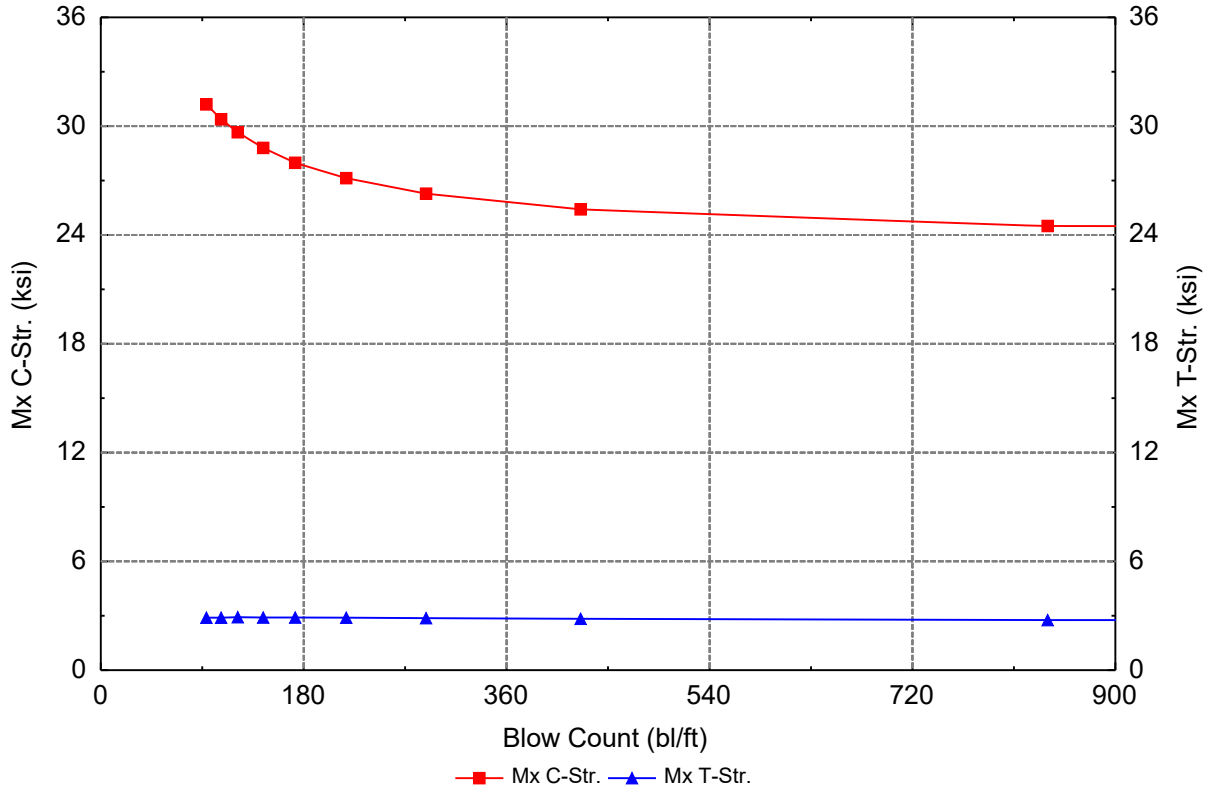
STR = 54 kips (0.25) = 13 kips

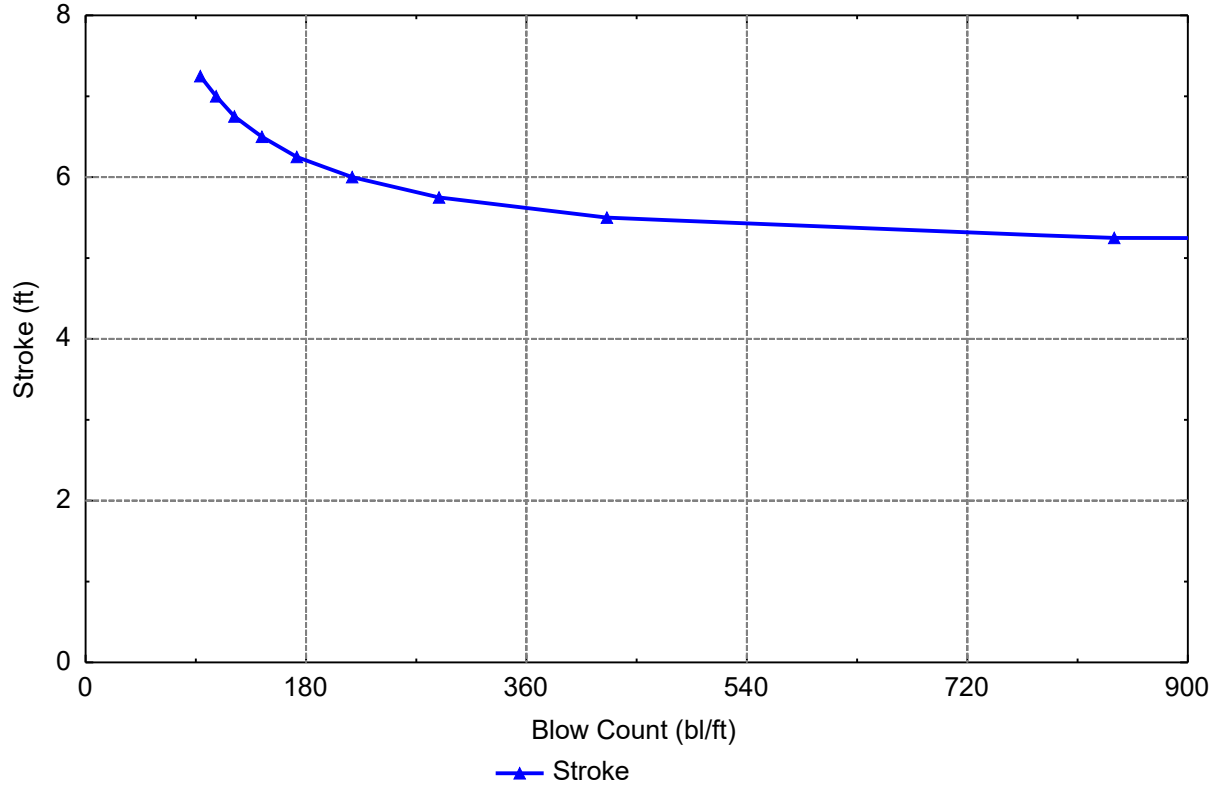
EE = 54 kips (0.80) = 43 kips

8 Jan 2015
100% Post-consumer waste

Pile Drivability Resistance

Bearing Graph Summary — DELMAG D 36-32

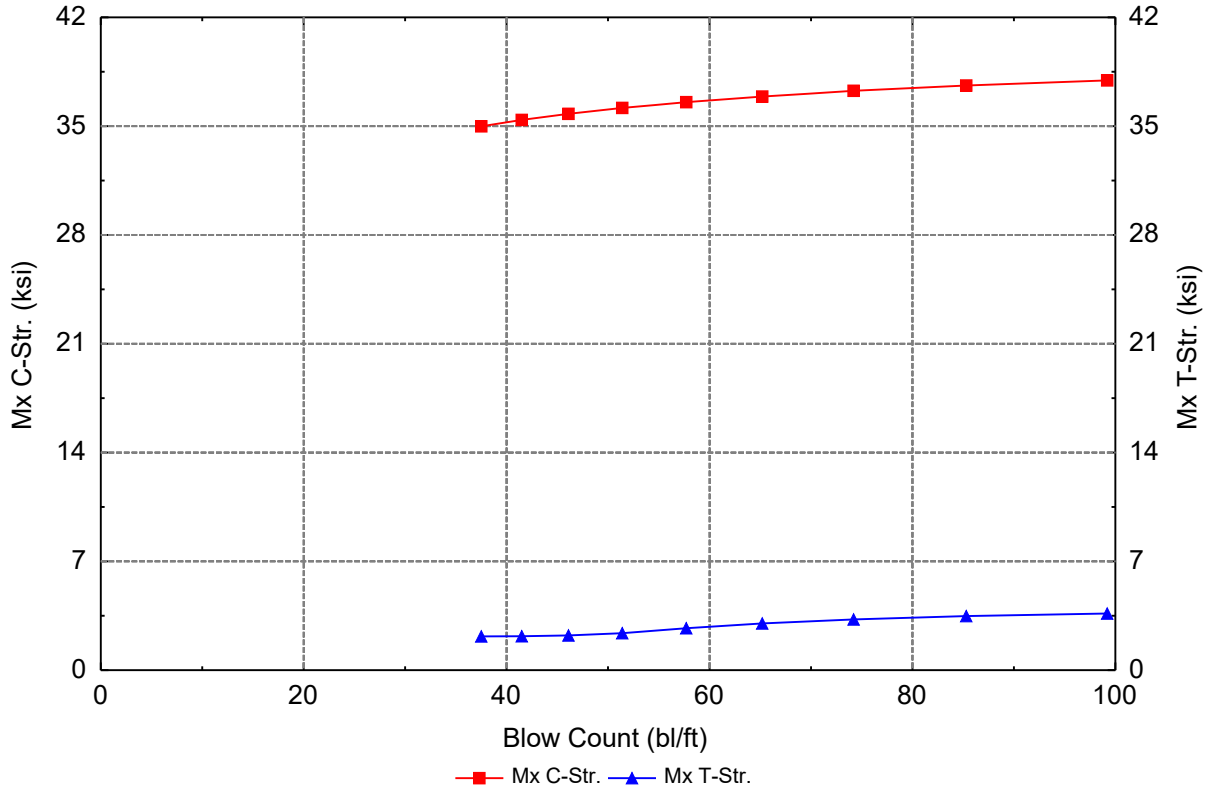


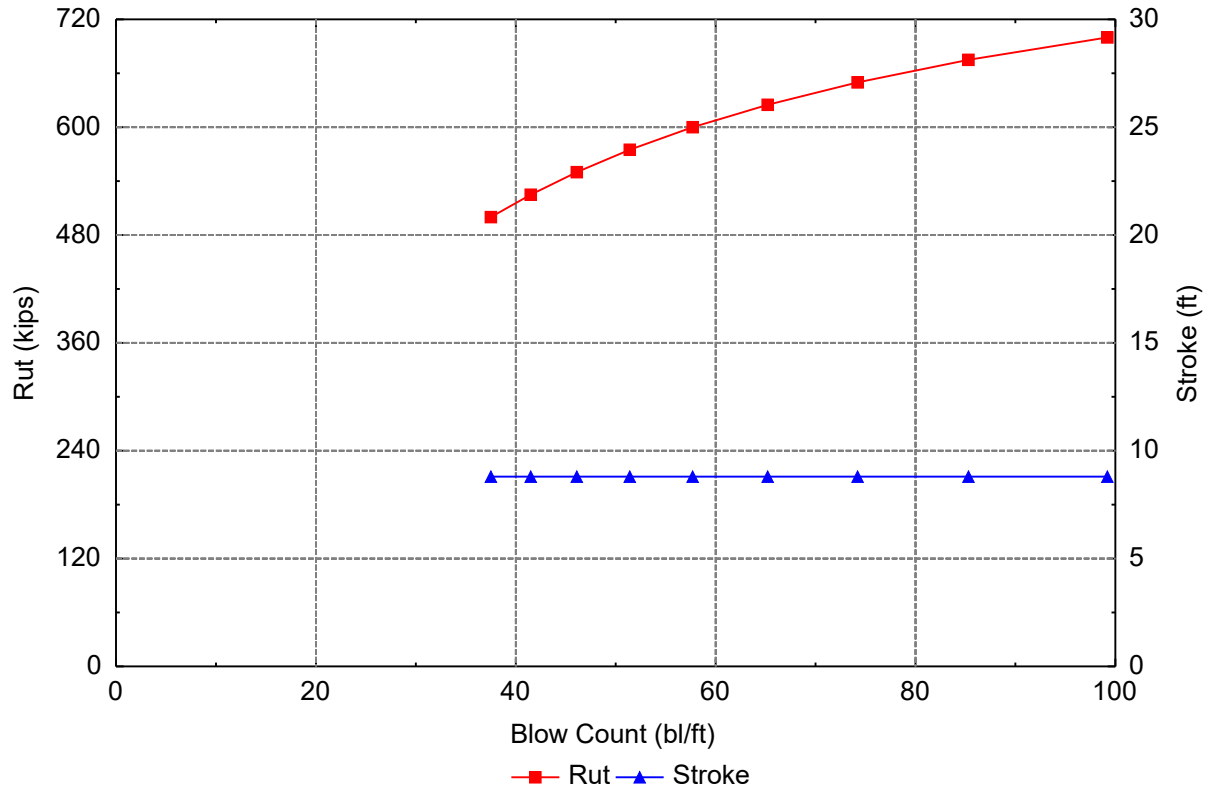


DELMAG D 36-32

Rut	Mx C-Str.	Mx T-Str.	Blow Ct	Stroke	ENTHRU	Hammer
kips	ksi	ksi	bl/ft	ft	kip-ft	-
600.0	23.54	2.67	9999.0	5.00	16.23	D 36-32
600.0	24.50	2.76	839.9	5.25	17.85	D 36-32
600.0	25.41	2.84	425.7	5.50	19.62	D 36-32
600.0	26.28	2.87	288.6	5.75	21.30	D 36-32
600.0	27.13	2.90	217.7	6.00	23.02	D 36-32
600.0	27.98	2.91	172.5	6.25	24.82	D 36-32
600.0	28.80	2.91	144.0	6.50	26.54	D 36-32
600.0	29.66	2.92	121.5	6.75	28.41	D 36-32
600.0	30.39	2.90	106.7	7.00	30.06	D 36-32
600.0	31.20	2.90	93.7	7.25	31.94	D 36-32

Bearing Graph Summary — DELMAG D 36-32

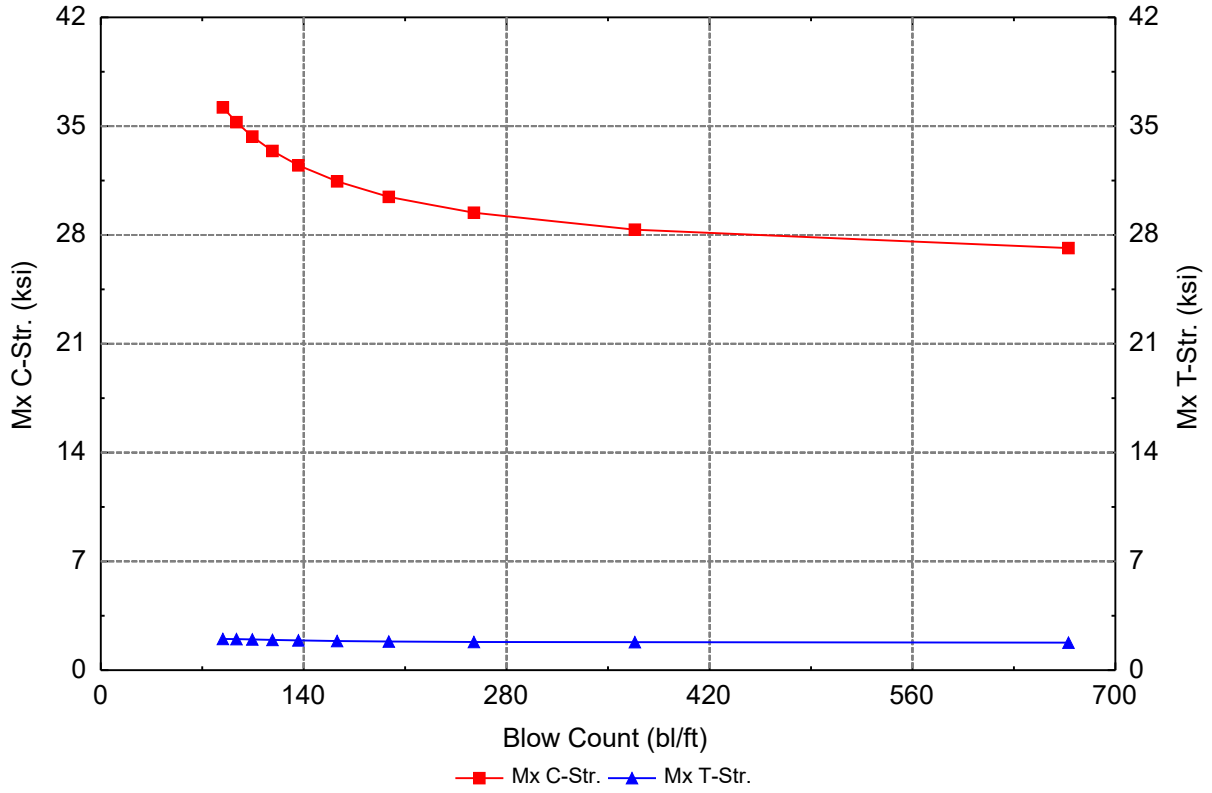


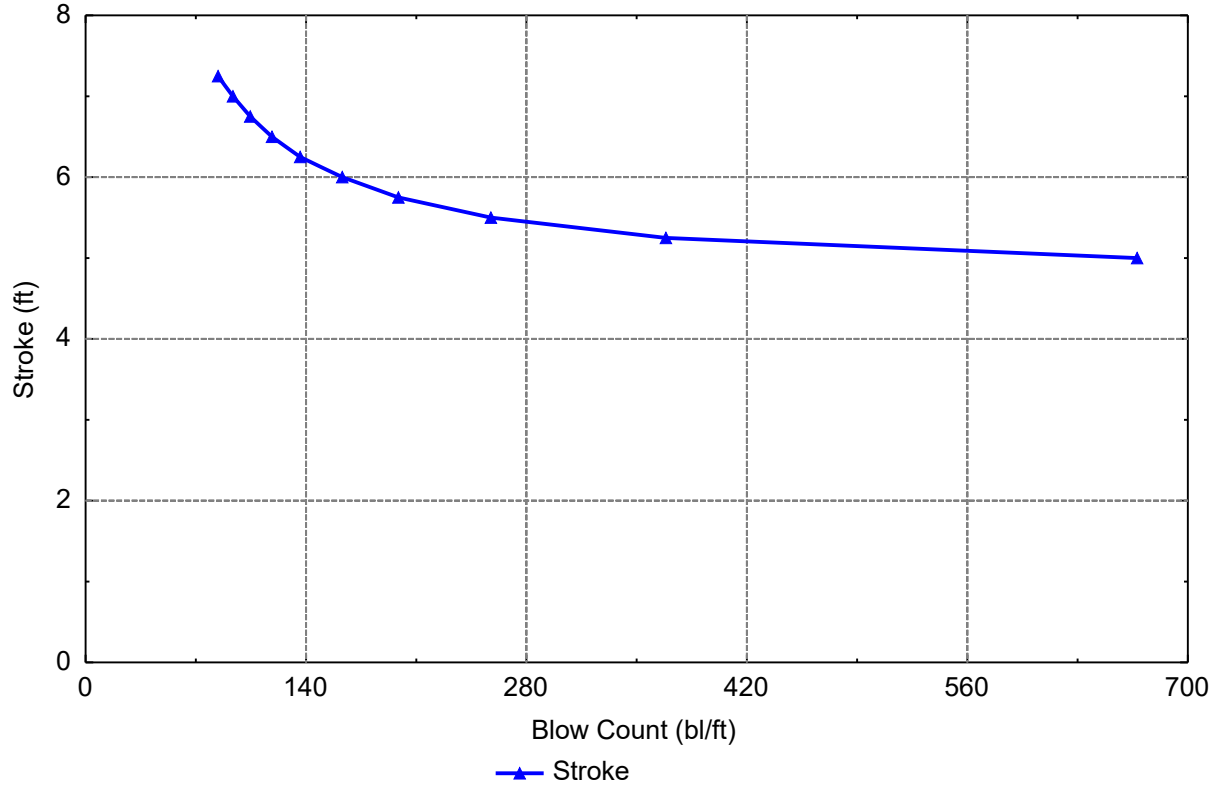


DELMAG D 36-32

Rut	Mx C-Str.	Mx T-Str.	Blow Ct	Stroke	ENTHRU	Hammer
kips	ksi	ksi	bl/ft	ft	kip-ft	-
500.0	34.99	2.17	37.5	8.80	44.12	D 36-32
525.0	35.40	2.19	41.5	8.80	43.85	D 36-32
550.0	35.80	2.24	46.1	8.80	43.59	D 36-32
575.0	36.18	2.39	51.4	8.80	43.35	D 36-32
600.0	36.54	2.71	57.7	8.80	43.13	D 36-32
625.0	36.91	3.01	65.2	8.80	42.92	D 36-32
650.0	37.27	3.27	74.2	8.80	42.72	D 36-32
675.0	37.62	3.48	85.3	8.80	42.54	D 36-32
700.0	37.95	3.65	99.2	8.80	42.38	D 36-32

Bearing Graph Summary — DELMAG D 36-32

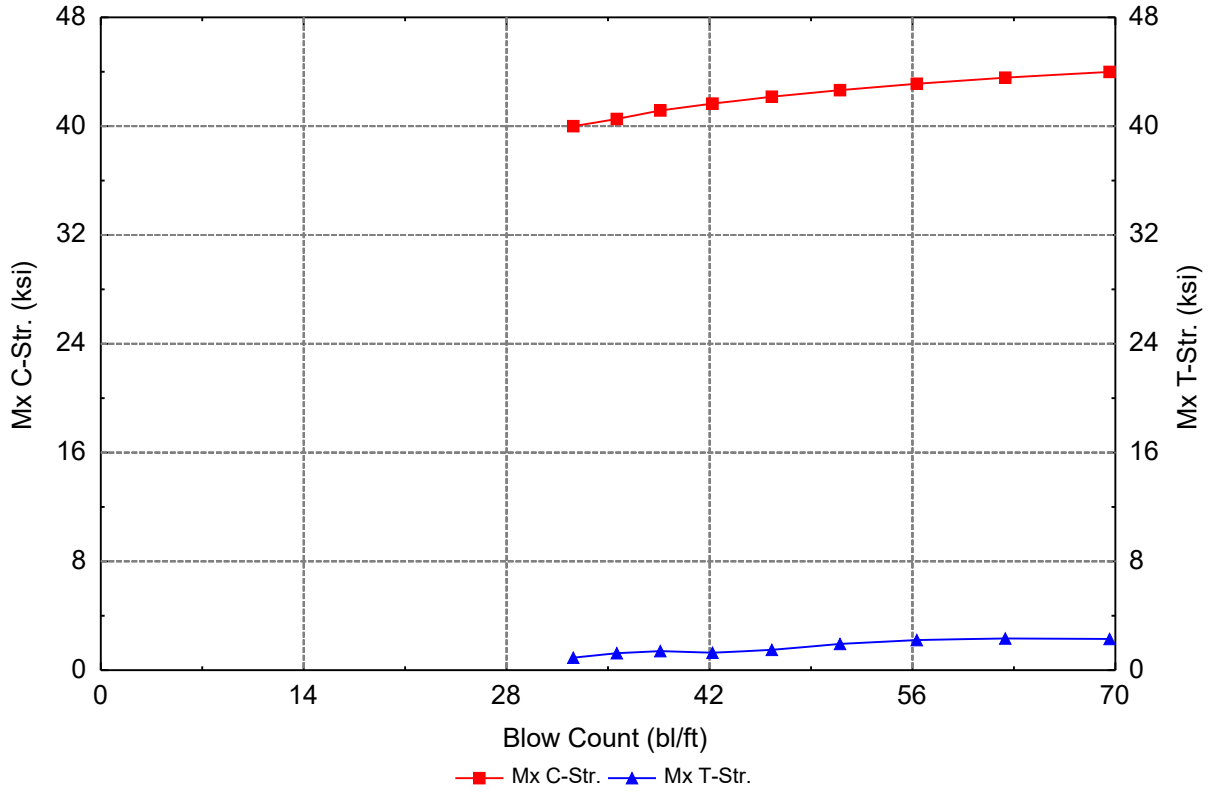


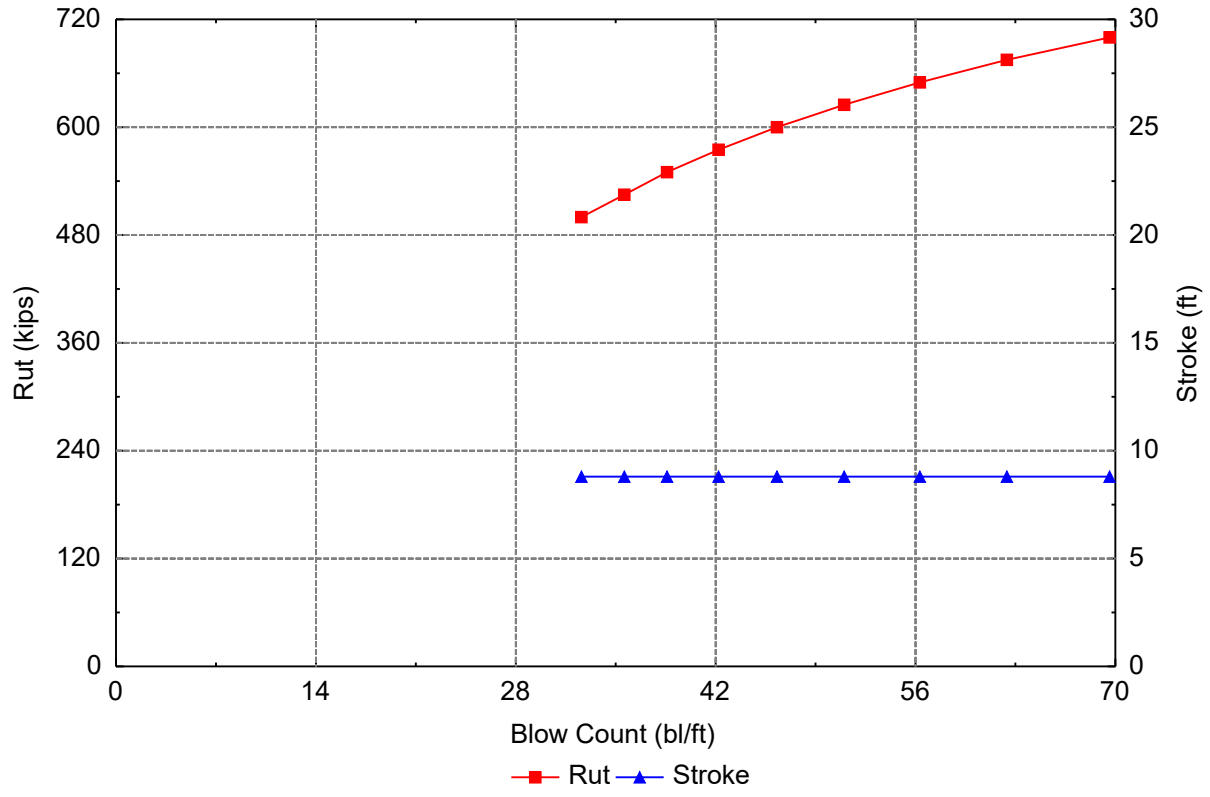


DELMAG D 36-32

Rut	Mx C-Str.	Mx T-Str.	Blow Ct	Stroke	ENTHRU	Hammer
kips	ksi	ksi	bl/ft	ft	kip-ft	-
600.0	27.16	1.78	667.7	5.00	14.90	D 36-32
600.0	28.34	1.80	368.5	5.25	16.59	D 36-32
600.0	29.43	1.82	257.4	5.50	18.23	D 36-32
600.0	30.45	1.85	198.7	5.75	19.84	D 36-32
600.0	31.46	1.88	163.0	6.00	21.44	D 36-32
600.0	32.48	1.92	136.3	6.25	23.19	D 36-32
600.0	33.40	1.95	118.4	6.50	24.84	D 36-32
600.0	34.33	1.98	104.6	6.75	26.54	D 36-32
600.0	35.26	2.00	93.6	7.00	28.28	D 36-32
600.0	36.20	2.01	84.2	7.25	30.12	D 36-32

Bearing Graph Summary — DELMAG D 36-32

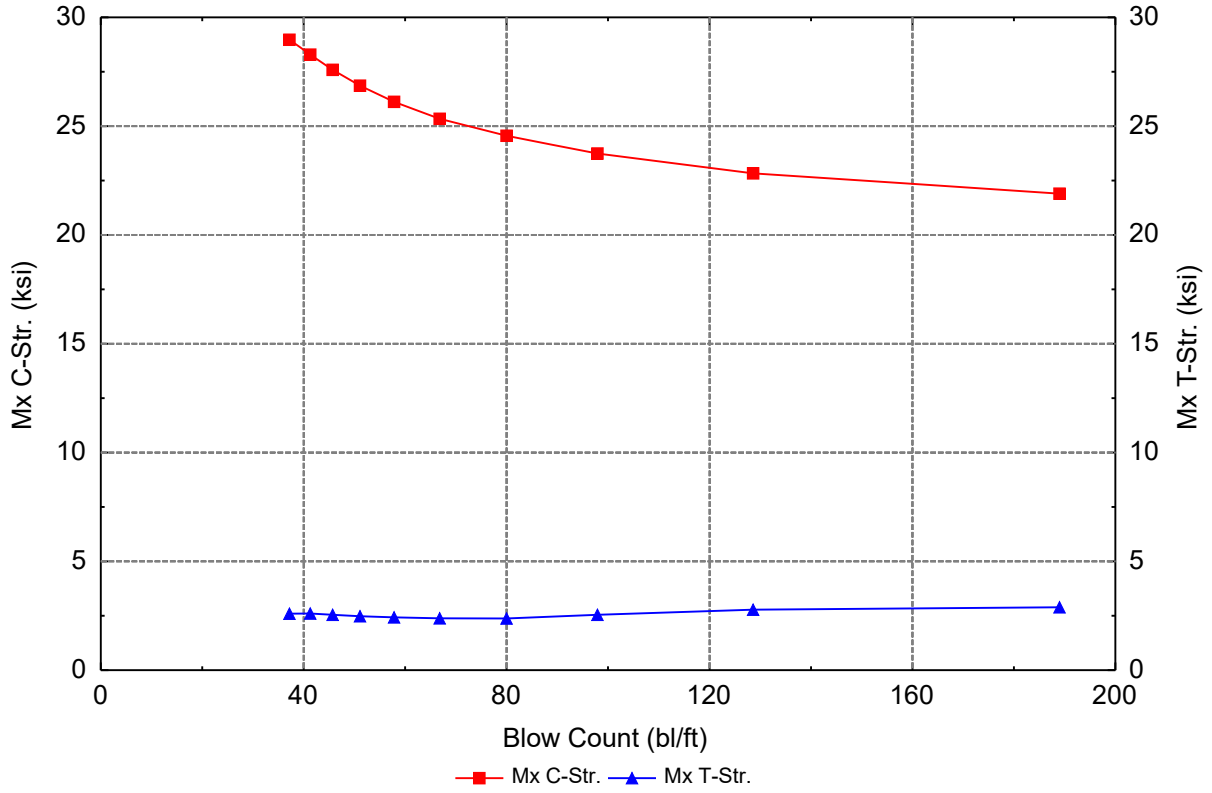


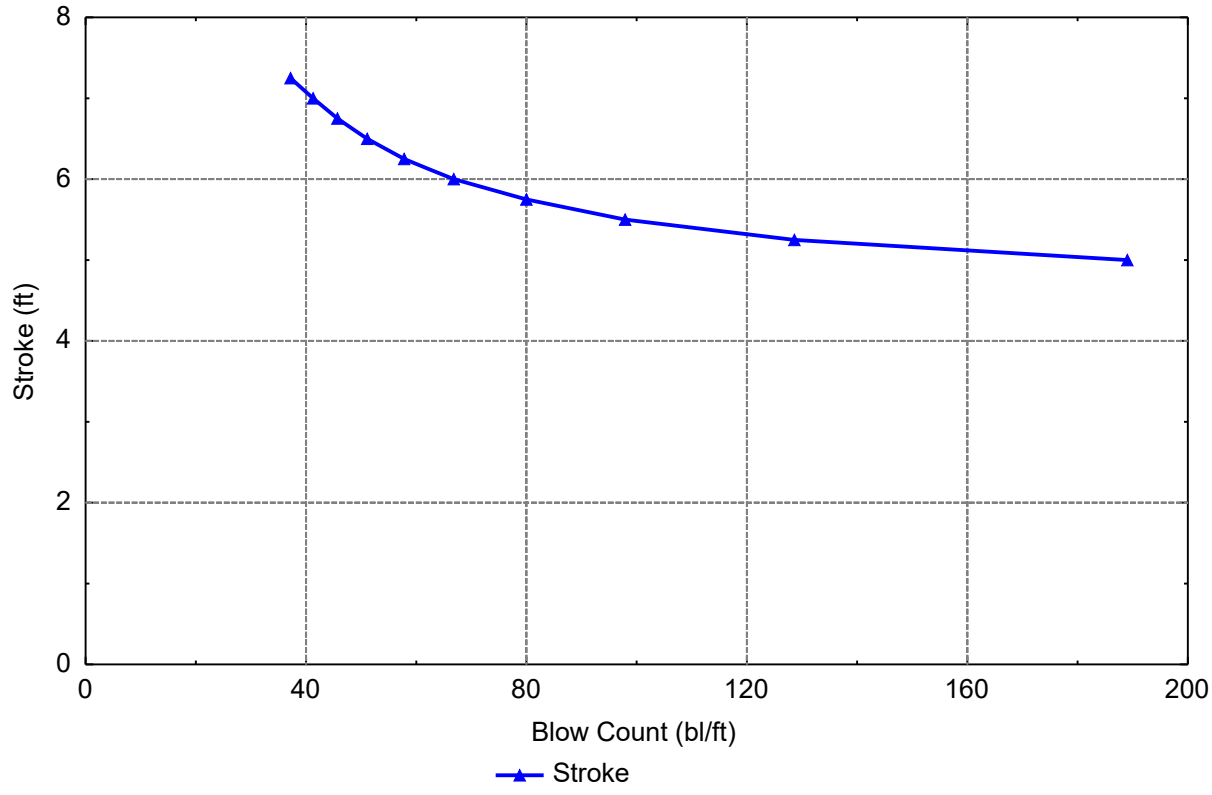


DELMAG D 36-32

Rut	Mx C-Str.	Mx T-Str.	Blow Ct	Stroke	ENTHRU	Hammer
kips	ksi	ksi	bl/ft	ft	kip-ft	-
500.0	40.00	0.92	32.6	8.80	41.37	D 36-32
525.0	40.53	1.25	35.6	8.80	41.11	D 36-32
550.0	41.16	1.40	38.6	8.80	41.09	D 36-32
575.0	41.67	1.29	42.2	8.80	40.87	D 36-32
600.0	42.17	1.49	46.3	8.80	40.67	D 36-32
625.0	42.65	1.93	51.0	8.80	40.47	D 36-32
650.0	43.13	2.22	56.3	8.80	40.27	D 36-32
675.0	43.58	2.33	62.4	8.80	40.09	D 36-32
700.0	43.99	2.30	69.6	8.80	39.89	D 36-32

Bearing Graph Summary — DELMAG D 36-32

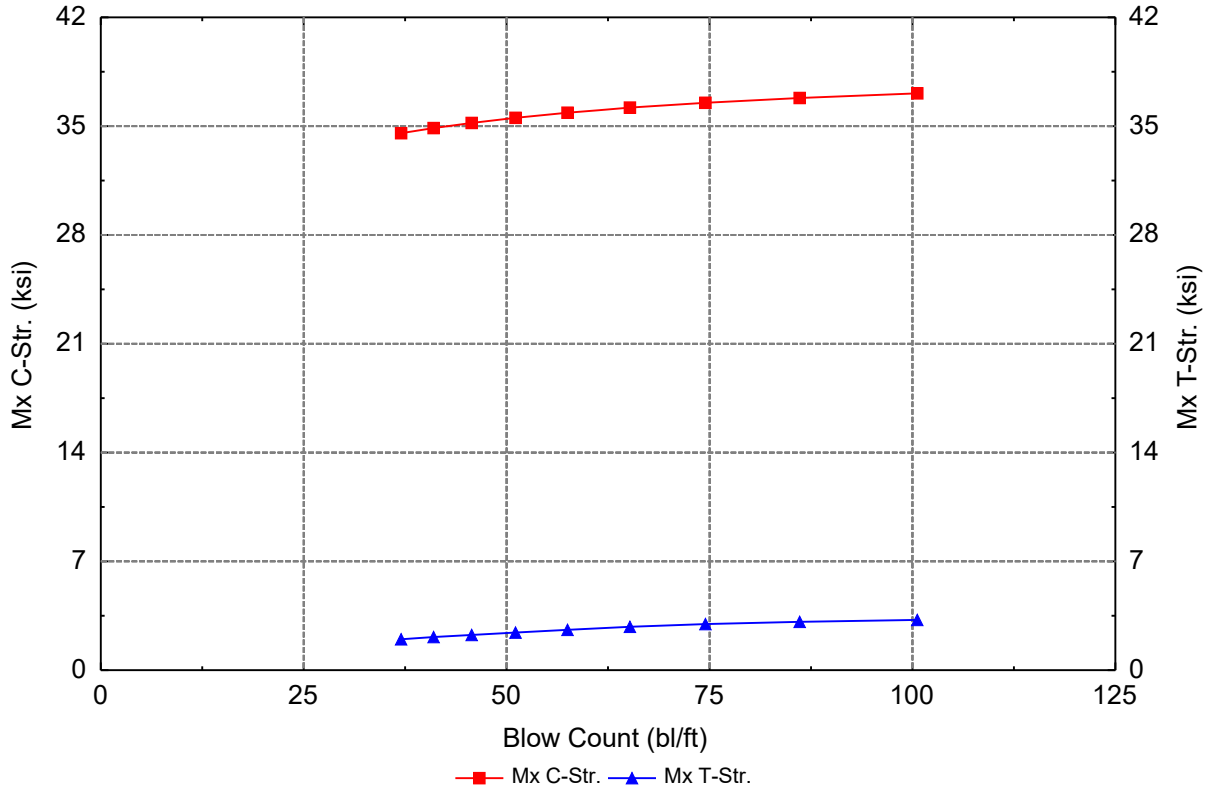


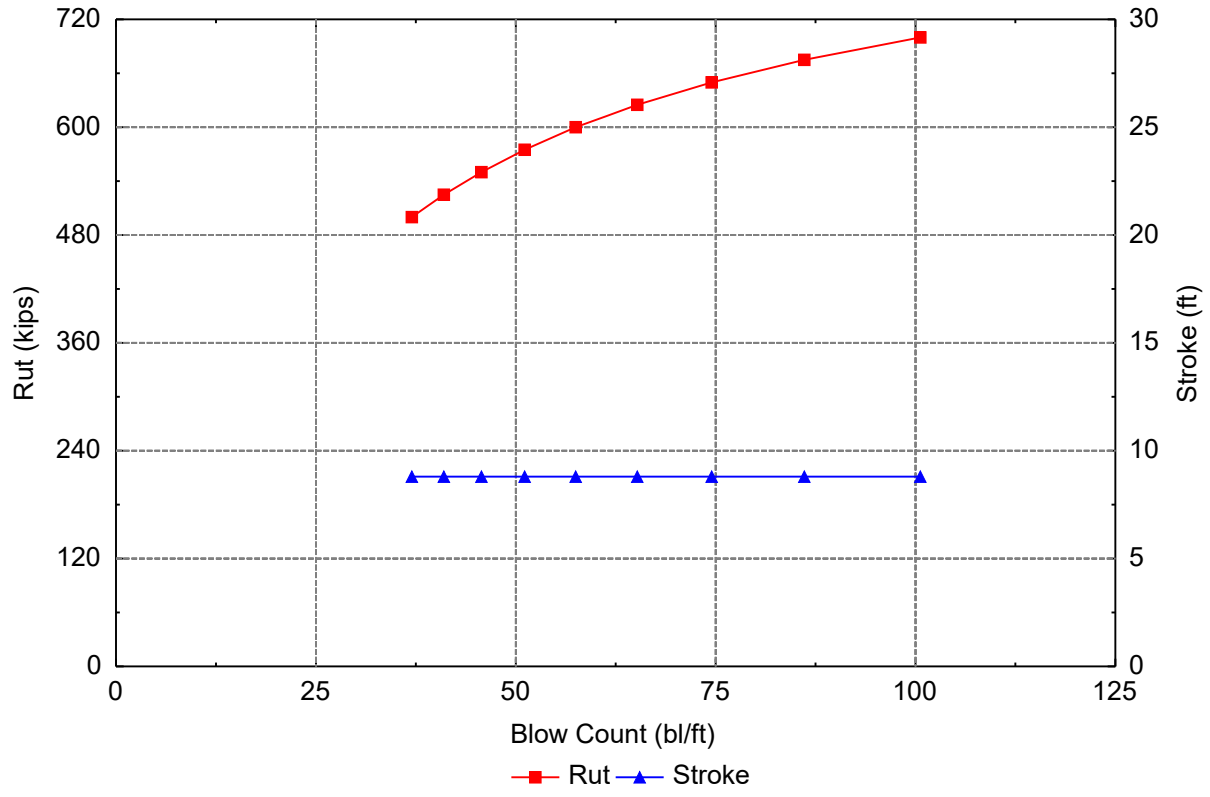


DELMAG D 36-32

Rut	Mx C-Str.	Mx T-Str.	Blow Ct	Stroke	ENTHRU	Hammer
kips	ksi	ksi	bl/ft	ft	kip-ft	-
600.0	21.90	2.89	189.0	5.00	17.23	D 36-32
600.0	22.84	2.78	128.6	5.25	19.13	D 36-32
600.0	23.74	2.55	97.9	5.50	21.05	D 36-32
600.0	24.56	2.38	80.0	5.75	22.89	D 36-32
600.0	25.34	2.38	66.8	6.00	24.97	D 36-32
600.0	26.12	2.43	57.8	6.25	27.00	D 36-32
600.0	26.87	2.48	51.1	6.50	29.17	D 36-32
600.0	27.59	2.55	45.7	6.75	31.41	D 36-32
600.0	28.29	2.60	41.3	7.00	33.69	D 36-32
600.0	28.97	2.60	37.2	7.25	36.08	D 36-32

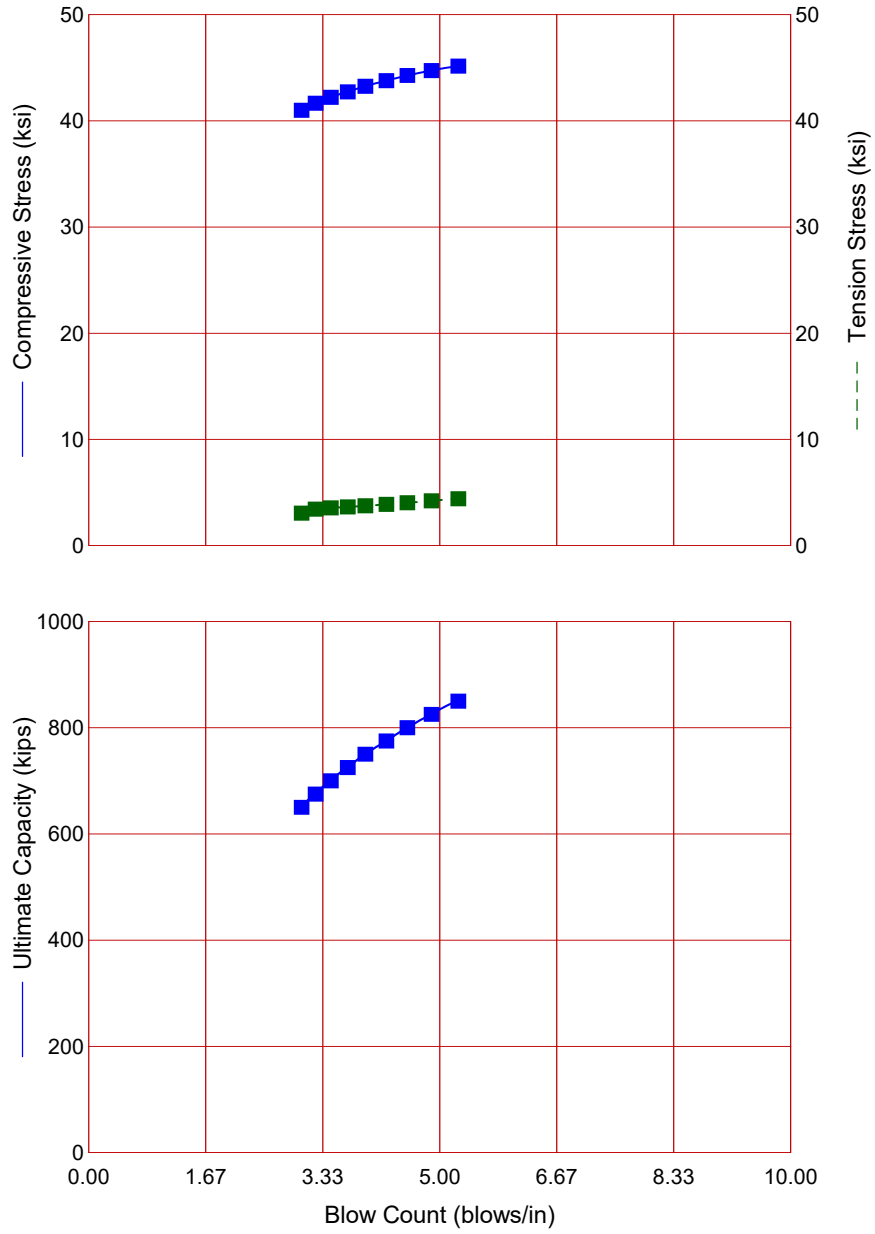
Bearing Graph Summary — DELMAG D 36-32





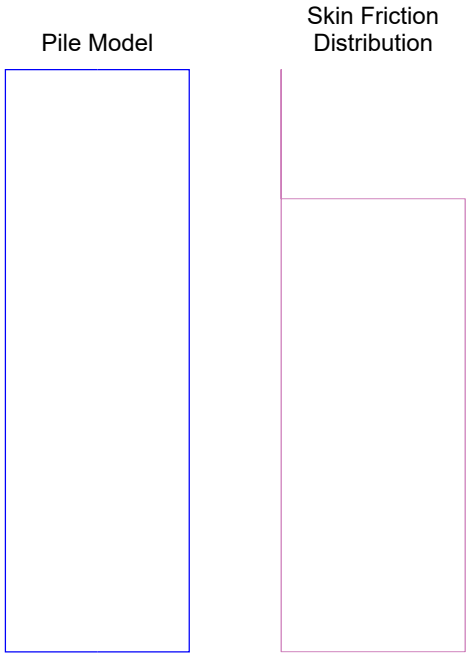
DELMAG D 36-32

Rut	Mx C-Str.	Mx T-Str.	Blow Ct	Stroke	ENTHRU	Hammer
kips	ksi	ksi	bl/ft	ft	kip-ft	-
500.0	34.55	1.99	37.0	8.80	43.96	D 36-32
525.0	34.88	2.13	41.0	8.80	43.67	D 36-32
550.0	35.21	2.27	45.7	8.80	43.41	D 36-32
575.0	35.54	2.42	51.1	8.80	43.16	D 36-32
600.0	35.87	2.60	57.5	8.80	42.94	D 36-32
625.0	36.19	2.79	65.2	8.80	42.76	D 36-32
650.0	36.51	2.97	74.5	8.80	42.61	D 36-32
675.0	36.82	3.12	86.1	8.80	42.47	D 36-32
700.0	37.12	3.24	100.6	8.80	42.34	D 36-32



DELMAG D 36-32

Stroke	8.80	ft
Ram Weight	7.93	kips
Efficiency	0.800	
Pressure	Variable	
Helmet Weight	4.40	kips
Hammer Cushion	91300	kips/in
COR of H.C.	0.800	
Skin Quake	0.100	in
Toe Quake	0.040	in
Skin Damping	Variable	
Toe Damping	0.150	sec/ft
Pile Length	45.00	ft
Pile Penetration	35.00	ft
Pile Top Area	34.40	in2

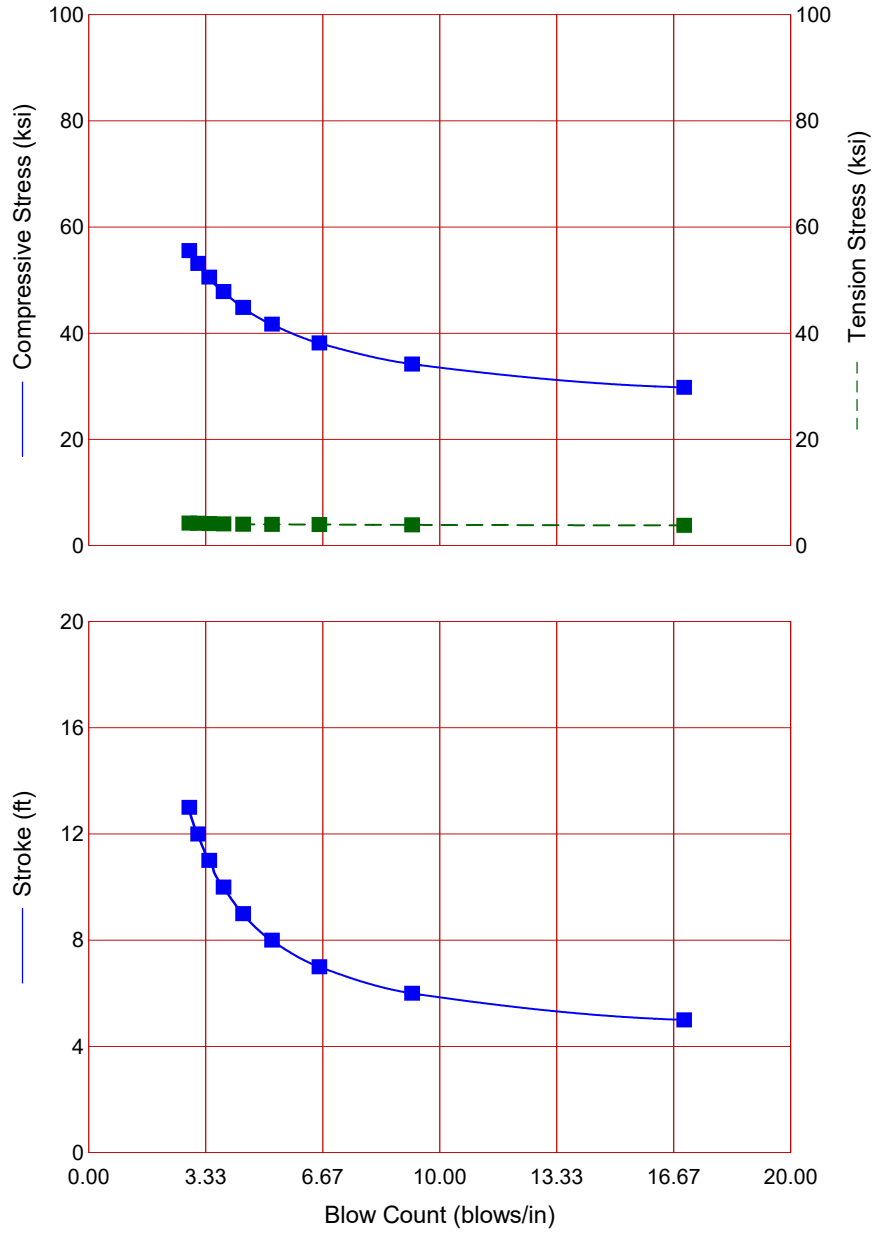


Res. Shaft = 10 %
(Proportional)

Haley & Aldrich Inc
Yarmouth SB Bridge - Abut 1+2 Variable

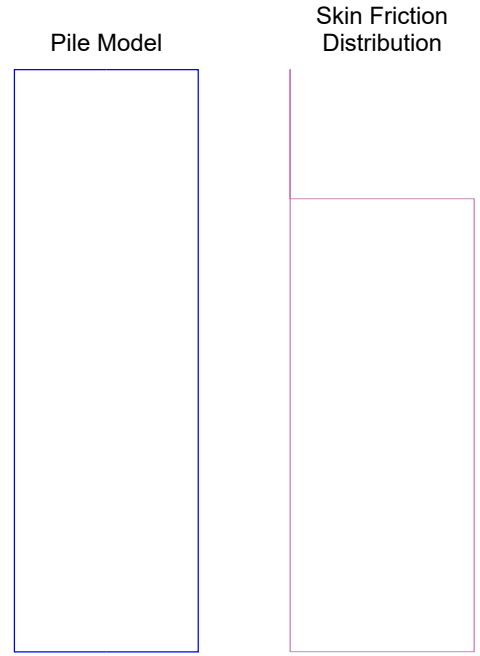
14-Jan-2021
GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count blows/in	Stroke ft	Energy kips-ft
650.0	40.98	3.05	3.0	8.80	41.84
675.0	41.64	3.44	3.2	8.80	41.68
700.0	42.20	3.56	3.4	8.80	41.40
725.0	42.72	3.65	3.7	8.80	41.15
750.0	43.25	3.75	3.9	8.80	40.95
775.0	43.77	3.89	4.2	8.80	40.63
800.0	44.26	4.04	4.5	8.80	40.47
825.0	44.72	4.22	4.9	8.80	40.35
850.0	45.14	4.41	5.3	8.80	40.18



DELMAG D 36-32

Capacity	800.0	kips
Ram Weight	7.93	kips
Efficiency	0.800	
Pressure	1450 (100%)	psi
Helmet Weight	4.40	kips
Hammer Cushion	91300	kips/in
COR of H.C.	0.800	
Skin Quake	0.100	in
Toe Quake	0.040	in
Skin Damping	Variable	
Toe Damping	0.150	sec/ft
Pile Length	45.00	ft
Pile Penetration	35.00	ft
Pile Top Area	34.40	in2



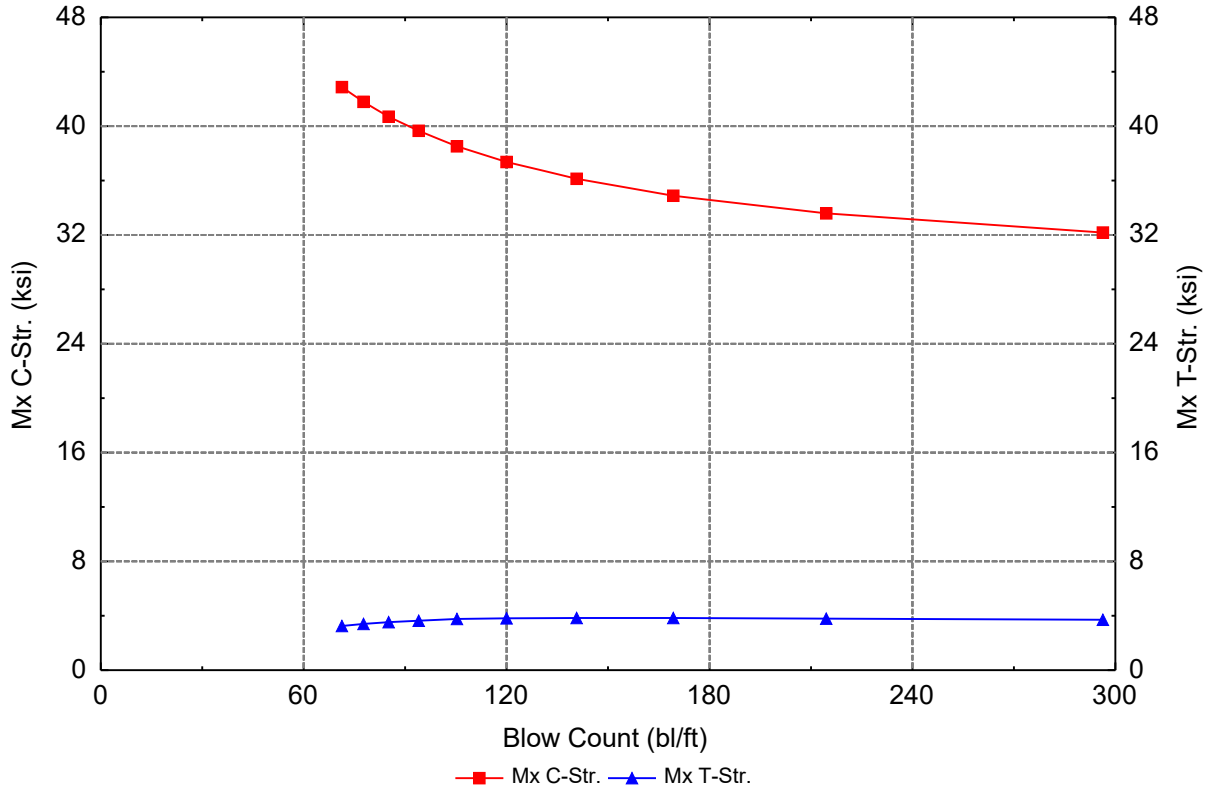
Res. Shaft = 10 %
(Proportional)

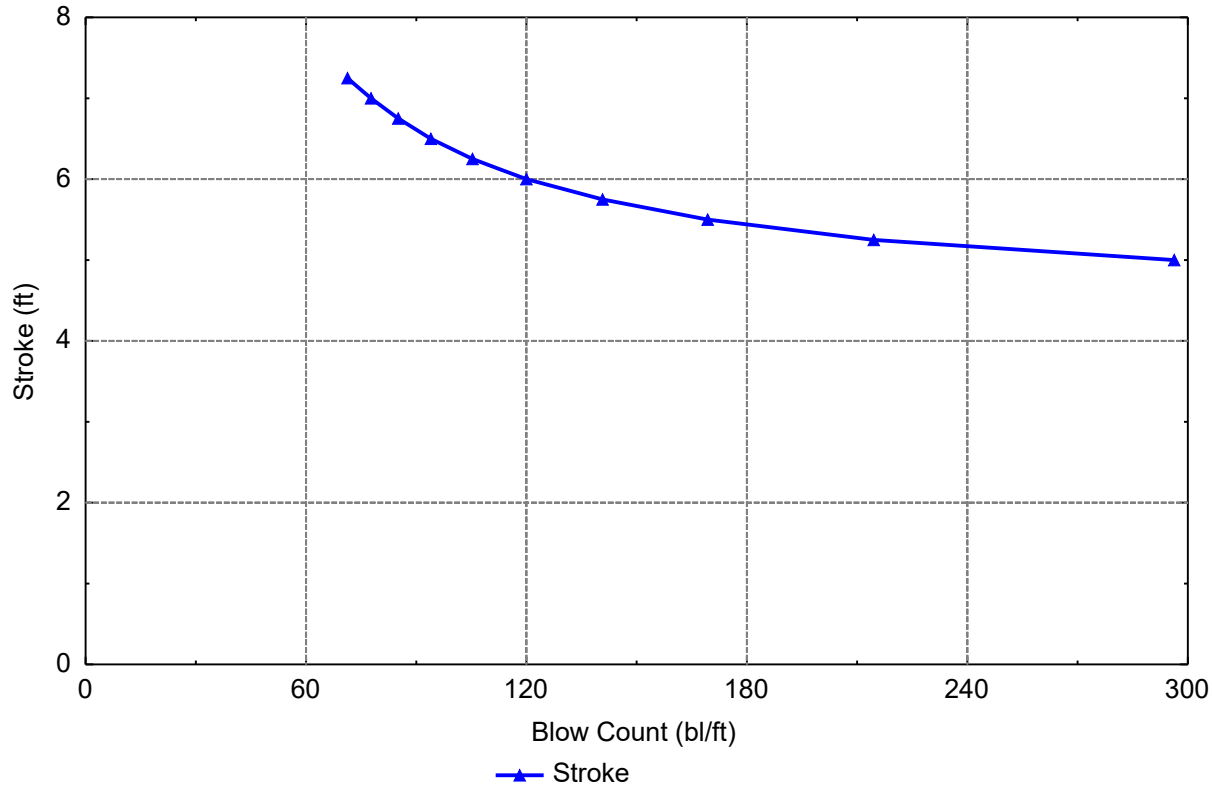
Haley & Aldrich Inc
Yarmouth SB Bridge - Abut 1+2 Constant

14-Jan-2021
GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count blows/in	Stroke ft	Energy kips-ft
800.0	29.80	3.85	17.0	5.00	20.14
800.0	34.20	3.92	9.2	6.00	25.81
800.0	38.15	3.98	6.6	7.00	31.15
800.0	41.70	4.02	5.2	8.00	36.37
800.0	44.85	4.05	4.4	9.00	41.52
800.0	47.84	4.11	3.8	10.00	46.59
800.0	50.56	4.16	3.4	11.00	51.55
800.0	53.15	4.21	3.1	12.00	56.55
800.0	55.55	4.25	2.9	13.00	61.48

Bearing Graph Summary — DELMAG D 36-32

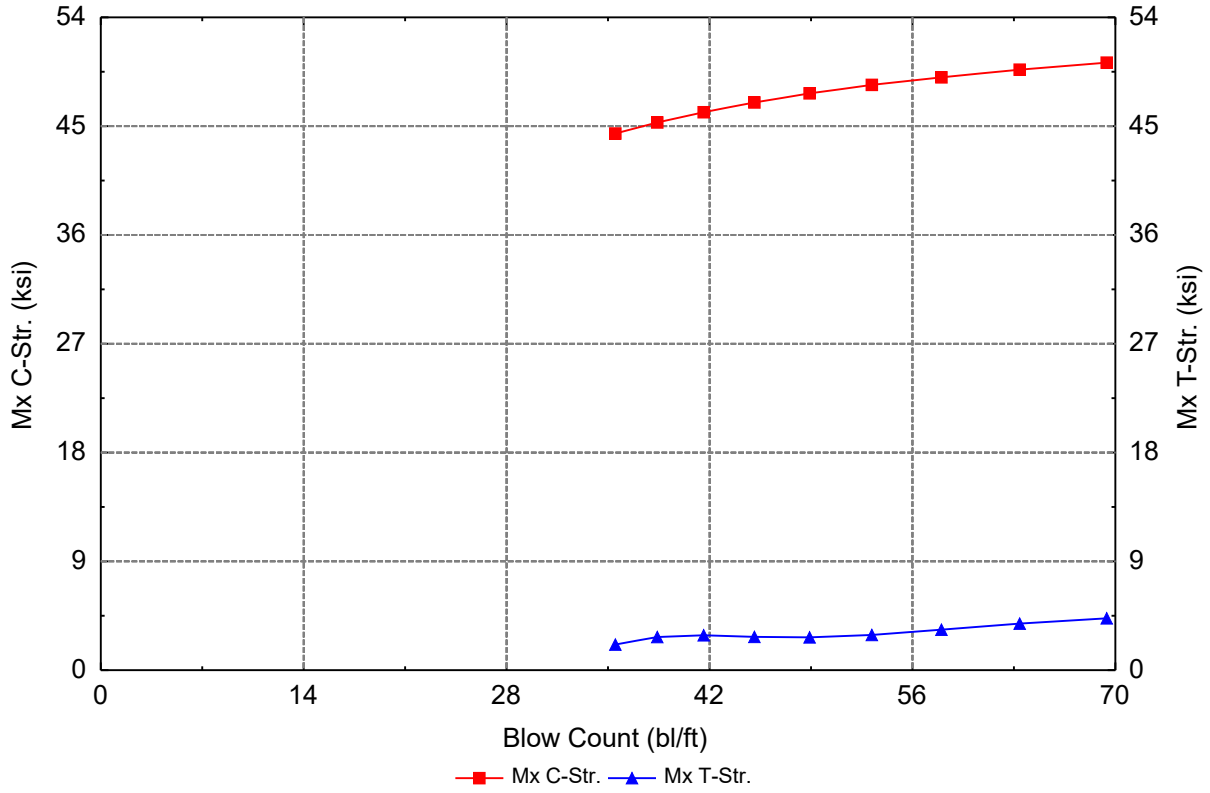


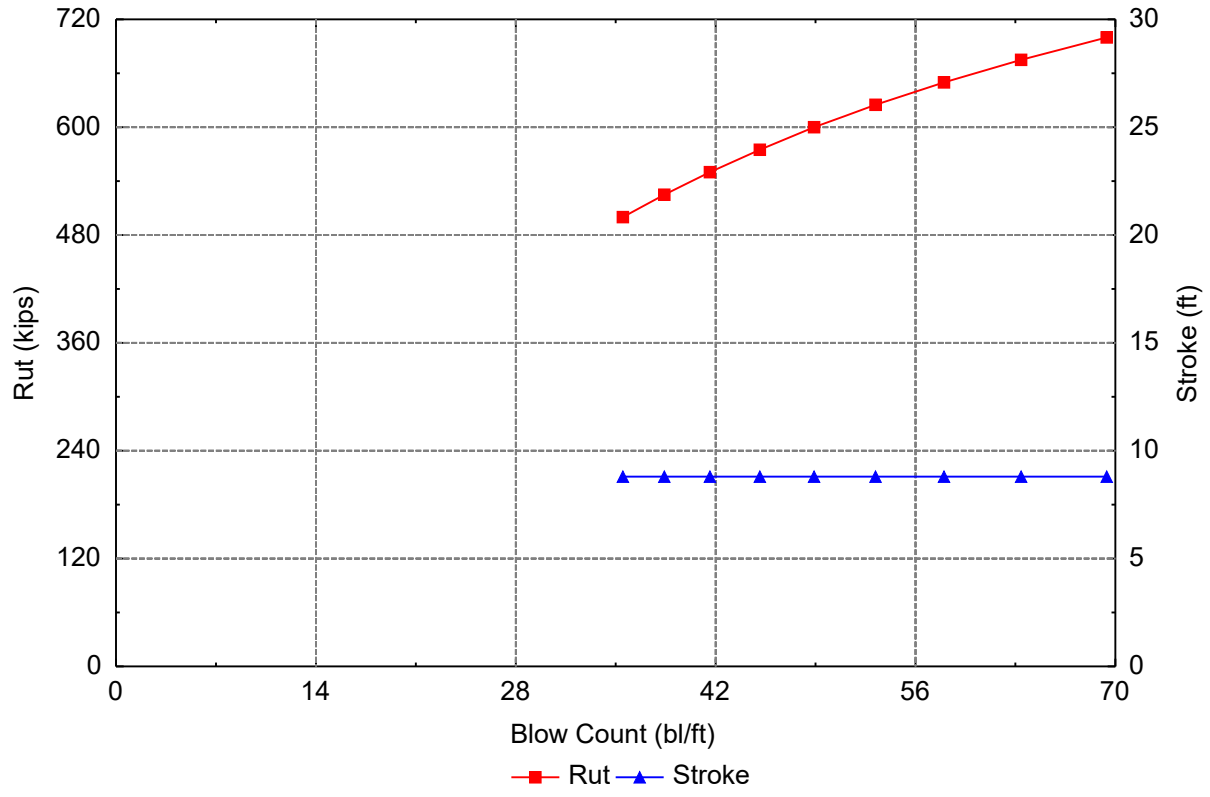


DELMAG D 36-32

Rut	Mx C-Str.	Mx T-Str.	Blow Ct	Stroke	ENTHRU	Hammer
kips	ksi	ksi	bl/ft	ft	kip-ft	-
600.0	32.18	3.71	296.3	5.00	14.27	D 36-32
600.0	33.60	3.79	214.5	5.25	15.82	D 36-32
600.0	34.88	3.84	169.3	5.50	17.37	D 36-32
600.0	36.14	3.84	140.7	5.75	18.92	D 36-32
600.0	37.37	3.81	120.0	6.00	20.56	D 36-32
600.0	38.52	3.77	105.3	6.25	22.16	D 36-32
600.0	39.66	3.64	94.0	6.50	23.77	D 36-32
600.0	40.70	3.53	85.1	6.75	25.41	D 36-32
600.0	41.79	3.40	77.7	7.00	27.09	D 36-32
600.0	42.87	3.25	71.3	7.25	28.88	D 36-32

Bearing Graph Summary — DELMAG D 36-32





DELMAG D 36-32

Rut	Mx C-Str.	Mx T-Str.	Blow Ct	Stroke	ENTHRU	Hammer
kips	ksi	ksi	bl/ft	ft	kip-ft	-
500.0	44.39	2.13	35.5	8.80	40.68	D 36-32
525.0	45.31	2.75	38.4	8.80	40.41	D 36-32
550.0	46.16	2.89	41.6	8.80	40.15	D 36-32
575.0	46.96	2.76	45.1	8.80	39.91	D 36-32
600.0	47.71	2.72	48.9	8.80	39.67	D 36-32
625.0	48.42	2.92	53.2	8.80	39.45	D 36-32
650.0	49.05	3.36	58.0	8.80	39.22	D 36-32
675.0	49.67	3.85	63.4	8.80	39.01	D 36-32
700.0	50.26	4.29	69.4	8.80	38.81	D 36-32

Lateral Earth Pressures

HALEY ALDRICH	CALCULATIONS	File No.	134120-003
		Sheet	1 of 3
Client	Maine Department of Transportation	Date	8-Jul-21
Project	Yarmouth I-295 Exit 17 NB and SB Bridge Replacement	Computed by	TPJ
Subject	Active Lateral Earth Pressure Coefficients for NB Abutment Breastwalls	Checked by	BCS

PROBLEM STATEMENT & OBJECTIVE

Calculate static active earth pressure coefficients for the bridge structure abutment breastwalls. Per MaineDOT BDG Section 3.6.4, for walls with a total height greater than 5 ft, the horizontal movement of the top of the wall due to structural deformation of the stem and rotation of the foundation is sufficient to develop active conditions. In addition, MaineDOT BDG Section 3.6.5 requires the use of Coulomb Theory when calculating the static active earth pressure coefficients for cantilever walls and abutments with short heels. Calculate static active earth pressure coefficients for abutment wingwalls using a range in backfill slope inclination using Rankine Theory, which will result in a slightly conservative design, since backfill slope geometry is unknown.

AVAILABLE INFORMATION & REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 9th edition, 2020.
2. MaineDOT Bridge Design Guide, August 2003, with interim revisions through June 2018.
3. Design drawings prepared by HNTB.

ASSUMPTIONS

1. Abutment breastwalls and wingwalls are backfilled with Granular Borrow.
2. Free draining material used to backfill walls and drains are provided (i.e., no hydrostatic pressures develop).

ACTIVE EARTH PRESSURE COEFFICIENT FOR PROPOSED NORTHBOUND BRIDGE STRUCTURE ABUTMENT NO. 1 BREASTWALL

SOIL PROPERTIES AND FILL/ABUTMENT BREASTWALL GEOMETRY

designates input cell

Total Unit Weight, Υ (pcf) =	125	pcf	Soil Type 4, MaineDOT BDG Table 3-3
Effective Friction Angle, ϕ' =	32	degrees	Soil Type 4, MaineDOT BDG Table 3-3
Backslope Angle, β =	-0.2	degrees	estimate from highway profile
Backface of Wall Angle to Horizontal, Θ =	90	degrees	per preliminary HNTB design drawings
Soil and Wall Friction Angle, δ =	24	degrees	Soil Type 4, MaineDOT BDG Table 3-3

Static Active Lateral Earth Pressure Coefficient, K_a

$K_a = \sin^2(\Theta+\phi')/r(\sin^2\Theta\sin(\Theta-\delta))$ AASHTO LRFD Eq. 3.11.5.3-1

where $r = [1 + \sqrt{(\sin(\phi+\delta)\sin(\phi-\beta)/(\sin(\Theta-\delta)\sin(\Theta+\beta))}]^2$ AASHTO LRFD Eq. 3.11.5.3-2

K_a = 0.27

ACTIVE EARTH PRESSURE COEFFICIENT FOR PROPOSED NORTHBOUND BRIDGE STRUCTURE ABUTMENT NO. 2 BREASTWALL

SOIL PROPERTIES AND FILL/ABUTMENT BREASTWALL GEOMETRY

designates input cell

Total Unit Weight, Υ (pcf) =	125	pcf	Soil Type 4, MaineDOT BDG Table 3-3
Effective Friction Angle, ϕ' =	32	degrees	Soil Type 4, MaineDOT BDG Table 3-3
Backslope Angle, β =	-0.8	degrees	estimate from highway profile
Backface of Wall Angle to Horizontal, Θ =	90	degrees	per preliminary HNTB design drawings
Soil and Wall Friction Angle, δ =	24	degrees	Soil Type 4, MaineDOT BDG Table 3-3

Static Active Lateral Earth Pressure Coefficient, K_a

$K_a = \sin^2(\Theta+\phi')/r(\sin^2\Theta\sin(\Theta-\delta))$ AASHTO LRFD Eq. 3.11.5.3-1

where $r = [1 + \sqrt{(\sin(\phi+\delta)\sin(\phi-\beta)/(\sin(\Theta-\delta)\sin(\Theta+\beta))}]^2$ AASHTO LRFD Eq. 3.11.5.3-2

K_a = 0.27

ACTIVE EARTH PRESSURE COEFFICIENT FOR PROPOSED SOUTHBOUND BRIDGE STRUCTURE ABUTMENT NO. 1 BREASTWALL

SOIL PROPERTIES AND FILL/ABUTMENT BREASTWALL GEOMETRY

designates input cell

Total Unit Weight, Υ (pcf) =	125	pcf	Soil Type 4, MaineDOT BDG Table 3-3
Effective Friction Angle, ϕ' =	32	degrees	Soil Type 4, MaineDOT BDG Table 3-3
Backslope Angle, β =	-0.8	degrees	estimate from highway profile
Backface of Wall Angle to Horizontal, Θ =	90	degrees	per preliminary HNTB design drawings
Soil and Wall Friction Angle, δ =	24	degrees	Soil Type 4, MaineDOT BDG Table 3-3

Static Active Lateral Earth Pressure Coefficient, K_a

$K_a = \sin^2(\Theta+\phi')/r(\sin^2\Theta\sin(\Theta-\delta))$ AASHTO LRFD Eq. 3.11.5.3-1

where $r = [1 + \sqrt{(\sin(\phi+\delta)\sin(\phi-\beta)/(\sin(\Theta-\delta)\sin(\Theta+\beta))}]^2$ AASHTO LRFD Eq. 3.11.5.3-2

K_a = 0.27

ACTIVE EARTH PRESSURE COEFFICIENT FOR PROPOSED SOUTHBOUND BRIDGE STRUCTURE ABUTMENT NO. 2 BREASTWALL

SOIL PROPERTIES AND FILL/ABUTMENT BREASTWALL GEOMETRY

designates input cell

Total Unit Weight, Υ (pcf) =	125	pcf	Soil Type 4, MaineDOT BDG Table 3-3
Effective Friction Angle, ϕ' =	32	degrees	Soil Type 4, MaineDOT BDG Table 3-3
Backslope Angle, β =	-0.1	degrees	estimate from highway profile
Backface of Wall Angle to Horizontal, Θ =	90	degrees	per preliminary HNTB design drawings
Soil and Wall Friction Angle, δ =	24	degrees	Soil Type 4, MaineDOT BDG Table 3-3

Static Active Lateral Earth Pressure Coefficient, K_a

$K_a = \sin^2(\Theta+\phi')/r(\sin^2\Theta\sin(\Theta-\delta))$ AASHTO LRFD Eq. 3.11.5.3-1

where $r = [1 + \sqrt{(\sin(\phi+\delta)\sin(\phi-\beta)/(\sin(\Theta-\delta)\sin(\Theta+\beta))}]^2$ AASHTO LRFD Eq. 3.11.5.3-2

K_a = 0.27

ACTIVE EARTH PRESSURE COEFFICIENTS FOR PROPOSED WINGWALLS

SOIL PROPERTIES AND FILL/ABUTMENT WINGWALL GEOMETRY

designates input cell

Total Unit Weight, Υ (pcf) =	125	pcf	Soil Type 4, MaineDOT BDG Table 3-3
Effective Friction Angle, ϕ' =	32	degrees	Soil Type 4, MaineDOT BDG Table 3-3

Slope Inclination (deg.)	K_a
0	0.307
1	0.307
2	0.308
3	0.308
4	0.309
5	0.311
6	0.312
7	0.314
8	0.316
9	0.318
10	0.321
11	0.324
12	0.328
13	0.331
14	0.336
15	0.341
16	0.346
17	0.352
18	0.358
19	0.366
20	0.374
21	0.383
22	0.393
23	0.405
24	0.418
25	0.434
26	0.451
27	0.473
28	0.498
29	0.531
30	0.574
31	0.639
32	0.848

TABLE 11-3
Rankine active earth pressure coefficients K_a using Eq. (11-7a)

β	ϕ = 26	28	30	32	34	36	38	40	42
0	0.3905	0.3610	0.3333	0.3073	0.2827	0.2596	0.2379	0.2174	0.1982
5	0.3959	0.3656	0.3372	0.3105	0.2855	0.2620	0.2399	0.2192	0.1997
10	0.4134	0.3802	0.3495	0.3210	0.2944	0.2696	0.2464	0.2247	0.2044
15	0.4480	0.4086	0.3729	0.3405	0.3108	0.2834	0.2581	0.2346	0.2129
20	0.5152	0.4605	0.4142	0.3739	0.3381	0.3060	0.2769	0.2504	0.2262
25	0.6999	0.5727	0.4936	0.4336	0.3847	0.3431	0.3070	0.2750	0.2465
30	—	—	0.8660	0.5741	0.4776	0.4105	0.3582	0.3151	0.2784
35	—	—	—	—	—	0.5971	0.4677	0.3906	0.3340
40	—	—	—	—	—	—	—	0.7660	0.4668

Since $\cos\beta$ is a permanent entry it is convenient to include it with K'_a of Eq. (11-7) or K'_p of Eq. (11-8), giving, e.g.,

$$K_a = \cos\beta \frac{\cos\beta - \sqrt{\cos^2\beta - \cos^2\phi}}{\cos\beta + \sqrt{\cos^2\beta - \cos^2\phi}} \qquad (11\text{-}7a)$$

Frost Penetration

HALEY ALDRICH	CALCULATIONS	File No.:	134120-003
		Sheet:	1 of 2
Client:	Maine Department of Transportation	Date:	8-Jul-2021
Project:	Interstate 295 Bridge Nos. 5833 and 1509 over U.S. Route 1	Computed by:	BCS
Subject:	Frost Penetration Depth Evaluation	Updated by:	

OBJECTIVE

Evaluate maximum depth of frost penetration based on soil and groundwater conditions, as well as geographic site location.

REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 9th edition, 2020.
2. MaineDOT Bridge Design Guide, August 2003, with interim revisions through June 2018.
3. Preliminary design drawings prepared by HNTB.

EVALUATION

1. Abutment breastwall and wingwalls will bear in new embankment fill (granular borrow).

2. From MaineDOT Bridge Design Guide Figure 5-1 (see next sheet), the design freezing index for the site is approximately 1,300°F - days

3. Estimate range in frost penetration depth using MaineDOT Bridge Design Guide Table 5-1 (see next sheet) and the design freezing index above (1,300°F - days).

4. For coarse grained soil with water contents ranging from 10 to 30 percent, from Table 5-1, maximum depth of frost penetration ranges from approximately 4.5 ft to 6.5 ft.

Recommend abutment breastwall and wingwall footings be founded at least 5 ft below the lowest adjacent ground surface exposed to freezing based on experience for southern Maine area.

HALEY ALDRICH	CALCULATIONS	File No.:	134120-003
		Sheet:	2 of 2
Client:	Maine Department of Transportation	Date:	8-Jul-2021
Project:	Interstate 295 Bridge Nos. 5833 and 1509 over U.S. Route 1	Computed by:	BCS
Subject:	Frost Penetration Depth Evaluation	Updated by:	

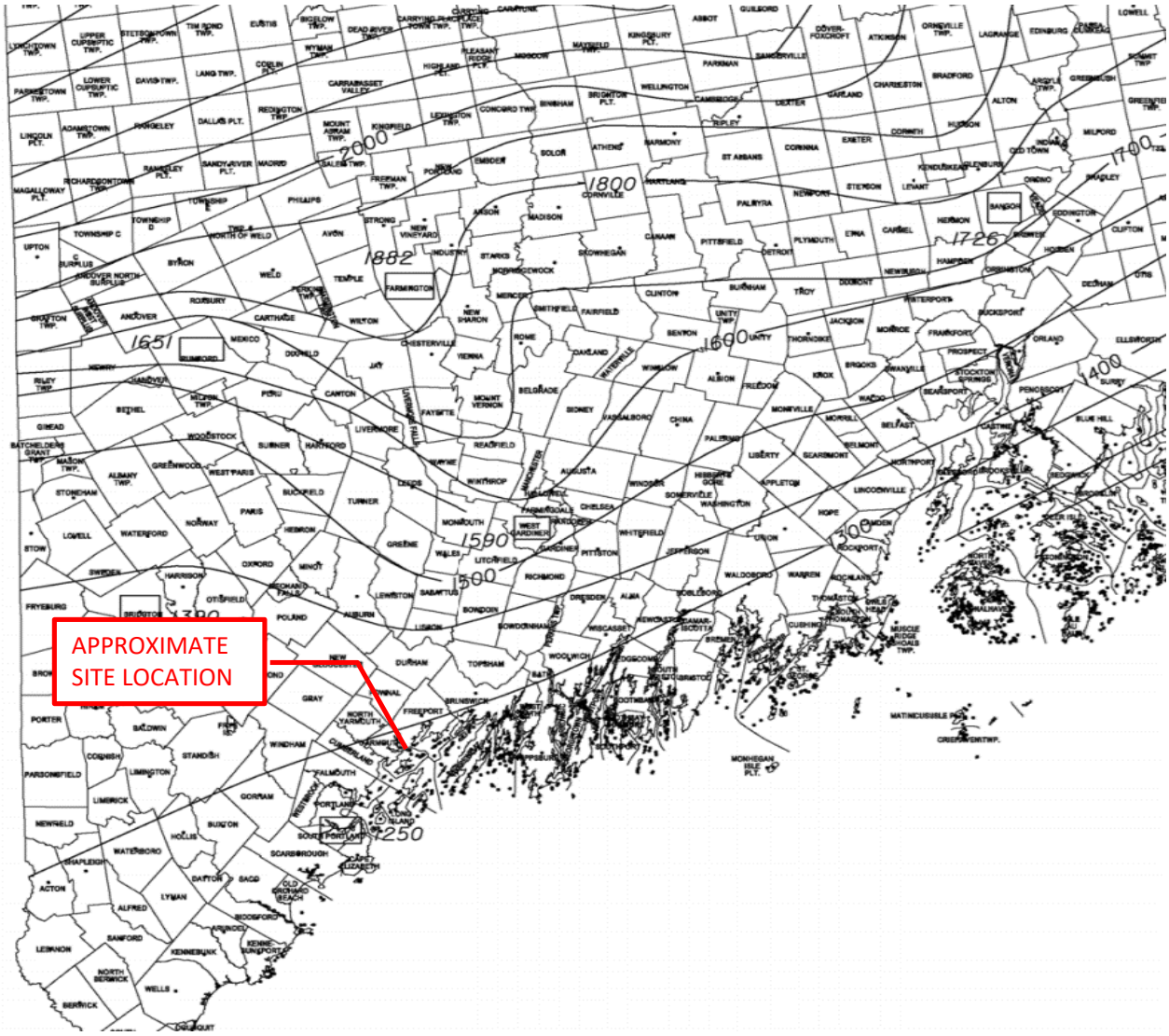


Table 5-1 Depth of Frost Penetration

Design Freezing Index	Frost Penetration (in)					
	Coarse Grained			Fine Grained		
	w=10%	w=20%	w=30%	w=10%	w=20%	w=30%
1000	66.3	55.0	47.5	47.1	40.7	36.9
1100	69.8	57.8	49.8	49.6	42.7	38.7
1200	73.1	60.4	52.0	51.9	44.7	40.5
1300	76.3	63.0	54.3	54.2	46.6	42.2
1400	79.2	65.5	56.4	56.3	48.5	43.9
1500	82.1	67.9	58.4	58.3	50.2	45.4
1600	84.8	70.2	60.3	60.2	51.9	46.9
1700	87.5	72.4	62.2	62.2	53.5	48.4
1800	90.1	74.5	64.0	64.0	55.1	49.8
1900	92.6	76.6	65.7	65.8	56.7	51.1
2000	95.1	78.7	67.5	67.6	58.2	52.5
2100	97.6	80.7	69.2	69.3	59.7	53.8
2200	100.0	82.6	70.8	71.0	61.1	55.1
2300	102.3	84.5	72.4	72.7	62.5	56.4
2400	104.6	86.4	74.0	74.3	63.9	57.6
2500	106.9	88.2	75.6	75.9	65.2	58.8
2600	109.1	89.9	77.1	77.5	66.5	60.0