REPORT

Geotechnical Evaluation Report
Culvert Replacement at Brandy Brook

State Route 25, Gorham, Maine
MaineDOT WIN 18821.00

Submitted to:

Kate Maguire, PE
Maine Department of Transportation
Highway Program
16 State House Station
Augusta, ME 04333-0016

Submitted by:

Golder Associates Inc.
670 North Commercial Street, Suite 103
Manchester, NH 03101
+1 603 668-0880

Project No. 1669139

April 20, 2020

April 20, 2020 Project No. 1669139

Kate Maguire, PE
Maine Department of Transportation
Highway Program
16 State House Station
Augusta, ME 0433-0016

RE: GEOTECHNICAL EVALUATION REPORT
STATE ROUTE 25, GORHAM, MAINE
MAINEDOT WIN 18821.00

Dear Kate:

Golder Associates Inc. (Golder) is pleased to submit this Geotechnical Evaluation Report to the Maine Department of Transportation (MaineDOT) summarizing our geotechnical investigation and evaluations for the proposed culvert replacement and Brandy Brook relocation on SR 25 in Gorham, Maine. This report presents the subsurface information and field-testing data obtained during the field investigations, the results of geotechnical laboratory tests, and geotechnical recommendations for the proposed culvert replacement and stream relocation. Our work was completed in accordance with the scope and budgets described in our Professional Services On-Call/Task Order Subcontract dated December 28, 2016 with modifications on December 8, 2017 and June 19, 2019. The Terms and Conditions governing the work are stated in our General Service Agreement with Maine DOT dated June 2015.

We appreciate the opportunity to assist MaineDOT on this interesting project and it has been a pleasure working with you and your colleagues and consultants. Please contact us if you have any questions concerning our report or require additional information.

Sincerely,
Golder Associates Inc.



Jeffrey D. Lloyd, PE
Senior Engineer

Peter C. Ingraham, PE
Senior Geological Engineer and Principal

MEL/JDL/drb

https://golderassociates.sharepoint.com/sites/123643/project files/1669139 mainedot gorham culvert & wall/700 reports/2020-apr and 2019-dec final report/1669139 final report cover letter.docx

Golder Associates Inc.
670 North Commercial Street, Suite 103, Manchester, NH 03101 T: +1 603 668-0880 F: +1 603 668-1199

Golder and the G logo are trademarks of Golder Associates Corporation

Table of Contents

1.0 INTRODUCTION 1

1.1 Background 1

2.0 GEOLOGIC SETTING 1

2.1 Regional Surficial Geology 1

2.2 Regional Bedrock Geology 2

3.0 SUBSURFACE INVESTIGATIONS 2

3.1 MaineDOT Investigation – 100 Series Boring 2

3.2 Golder Investigation – 200 Series Borings 2

3.2.1 Test Boring Explorations 3

3.2.2 Instrumentation 4

3.3 Golder Investigation – 300 Series Borings 4

3.3.1 Test Boring Explorations 4

3.4 Laboratory Testing 5

4.0 SUBSURFACE CONDITIONS 6

5.0 GEOTECHNICAL DESIGN AND CONSTRUCTION RECOMMENDATIONS 8

5.1 New Proposed Culvert Location 8

5.1.1 Bearing Capacity and Subgrade Modulus 8

5.1.2 Heave 8

5.1.3 Scour and Riprap 9

5.2 Settlement at the Existing Culvert Location 9

5.3 Stream Channel Relocation 9

5.3.1 Heave 10

5.3.2 Global Stability Analysis 10

5.3.3 Scour and Riprap 11

5.4 Settlement Existing Stream Channel 11

5.5 Frost Considerations 11

5.6 Construction Considerations 11

6.0 CLOSING 12

7.0 REFERENCES 12

TABLES

Table 1 Subsurface Exploration Locations
Table 2 Summary of In Situ Vane Shear Testing Results
Table 3 Summary of Rock Core Quality
Table 4 Summary of Laboratory Soil Index and Classification Testing Results
Table 5 Summary of Laboratory Engineering Property Testing and Results
Table 6 Summary of Slope Stability Analysis Scenarios and Resulting Factors of Safety

FIGURES

Figure 1 Site Location Map
Figure 2 Boring Location Plan
Figure 3 Interpreted Subsurface Profile A-A’
Figure 4 Interpreted Subsurface Profile B-B'
Figure 5 Depth Plots of Key Engineering Parameters

APPENDICES

APPENDIX A
Boring Logs

APPENDIX B
Rock Core Photos

APPENDIX C
Laboratory Test Results

APPENDIX D
Calculations

1.0 INTRODUCTION

This report summarizes the results of Golder Associates Inc.'s (Golder's) geotechnical investigation, evaluation, and design in support of the culvert replacement and proposed widening of State Route 25 (SR) at Brandy Brook in Gorham, Maine (see Figure 1). The purpose of this report is to present soil and bedrock information at the culvert replacement site obtained from subsurface investigations and laboratory tests; discuss geotechnical considerations for the new proposed culvert location and relocation an approximately 300-foot section of Brandy Brook to the northeast; and present recommended geotechnical parameters for design and construction. Our work was completed in accordance with our Professional Services On-Call/Task Order Subcontract dated December 28, 2016 with modifications on December 8, 2017 and June 19, 2019.

1.1 Background

MaineDOT is proposing to widen SR 25 in the vicinity of Brandy Brook to accommodate wider shoulders and replace an existing box culvert carrying Brandy Brook under SR 25 at approximately Station 12+65. To accommodate the widened shoulder on the east-bound lane, an approximately 300-foot long portion of Brandy Brook will be relocated to the northeast side of SR 25. In accordance with the plan set dated November 18, 2019 and updated grading plan dated June 2019, MaineDOT plans to replace the existing culvert with a 12-foot span, 8-foot rise precast concrete, four-sided, box culvert relocated southeast of the existing culvert to approximately Station 15+80. The proposed box culvert will be 176-feet long with the southern invert located at elevation 130.64 feet and the northern invert located at elevation 128.44 feet. The culvert will be skewed approximately 37 degrees counterclockwise from parallel to the roadway cross-section as it crosses SR 25. The upstream and downstream ends of the culverts will be protected with a 12-foot span, 2-foot rise, and 10-foot long precast concrete toe-wall sealed to the bottom of the box culvert. No headwalls or wingwalls for the culvert are planned.

The vertical profile and horizontal alignment for the existing roadway will remain the same. The new slope of the embankment along the northeast side of SR 25 down to the realigned Brandy Brook will be excavated to 2H:1V with a 2.5H:1V backslope between the stream and the existing grade. The old stream bed southwest of SR 25 will be backfilled with compacted materials and graded with a slope of 3H:1V down from the shoulder of the road.

2.0 GEOLOGIC SETTING

2.1 Regional Surficial Geology

The site is located in southern Maine within the Seaboard Lowlands Physiographic Province (Femmemen and Johnson, 1946). Mapped as lying within glaciomarine Pleistocene Presumpscot Formation, consisting of massive to laminated grey and blue-grey (weathering to brown) silt, silty clay, and fine sand; locally may contain boulders and layers of sand and gravel. Regionally the Presumpscot Formation occurs as a blanket deposit over bedrock and older glacial sediments. The mapped thickness varies from less than 3 feet to over 150 feet. The Presumpscot Formation was deposited during period of late glacial marine submergence. Locally, a Pleistocene-aged end moraine complex (essentially glacial outwash) is mapped as occurring below the Presumpscot Formation, and consists of coarse gravel, sand, till, and silt, commonly sitting on shallow bedrock. This unit was formed sub-aqueously at or near the ice front during retreat of the marine-based glacier (Prescott 1975; Smith 1999a; Smith 1999b).

Regional surficial geologic mapping also indicates bedrock was encountered at house wells about 330 feet northwest and about 660 feet southeast of the site, at 60 and 95 feet below ground surface (feet bgs), respectively. Bedrock is exposed on the northeast side of Route 25 about 900 feet and 1,300 feet southeast of the

site, about 1,700 feet northwest of the site, and in an active aggregate quarry about 500 feet east of the site. A MaineDOT test boring at a box culvert/bridge about 1,250 feet northwest of site encountered 3 feet of silt and sand, overlying at least 16 feet clay and silt (Neal and Smith 1998).

2.2 Regional Bedrock Geology

The site is mapped as lying at the contact between the Silurian-Ordovician Hutchins Corner and the Windham Formations. The Windham is slightly younger, consisting of non-migmatized brownish grey, fine-grained, non- to slightly rusty-weathering, massive-to-thin bedded biotite-muscovite-garnet schist, locally containing staurolite, kyanite, and/or fibrolitic sillimanite. Thin interbeds of quartz-biotite-muscovite-garnet granofels and granulose schist, and rarely calc-silicate granofels occur throughout the formation. A 90 feet to 300 feet thick ribbony-bedded brownish grey weathering metalimestone and calc-silicate marble exists within the middle of the formation and is mapped about 1,100 feet northwest of the site (Berry and Hussey, 1998; Hussey 1996; Hussey 1971). The Hutchins Corner Formation previously mapped as the Late Silurian-Early Devonian Berwick Formation (Hussey 1971), and consists of flaggy, bluish to purplish-grey to light tan weathering, medium grained, biotite-quartz-plagioclase granofels (Berry and Hussey, 1998). Beds of 4 inches to 6 inches, up to several feet thick. Graded bedding is common, with bed bases sharp and distinct. Small greenish grey, calc-silicate-rich lenses and thin beds occur infrequently in the granofels. Massive rusty weathering quartzose biotite schist comprises 10% of unit (Hussey 1996). The mapping cited above indicates the beds generally strike northeast-southwest, generally parallel with foliation, and dip steeply to the southeast at about 55° to 60°. The site lies within the southeastern overturned limb of a synform plunging gently to the northeast. The detailed geologic map (Hussey 1971) indicates the site likely lies within the Hutchins Corner Formation lithology.

3.0 SUBSURFACE INVESTIGATIONS

3.1 MaineDOT Investigation – 100 Series Boring

In April 2008, MaineDOT completed an exploratory boring (HB-GBB-101) located off the eastbound guardrail on the southwest corner of the site. The boring was drilled using a CME 45C drill rig using 5-inch solid stem auger and cased wash methods and was advanced to refusal at 51.8 feet below ground surface (bgs). Undisturbed Shelby tube and disturbed Standard Penetration Test (SPT) sampling was conducted along with in-situ vane shear testing to a depth of 36.37 feet bgs, after which the hole was advanced to refusal using the roller cone.

3.2 Golder Investigation – 200 Series Borings

In support of a possible retaining wall along Brandy Brook, Golder completed five (5) 200-series test borings (HB-GBB-201 through -205) between December 13, 2016 and January 17, 2017 along the roadway between the existing culvert and the entrance to the adjacent rock quarry. Two standpipe piezometers were installed in the HB-GBB-201 and HB-GBB-205 boreholes to measure groundwater and potential artesian groundwater pressures. The field program included in-situ vane shear testing in the clay strata to measure undrained shear strength. Golder geotechnical engineers were on site during the advancement of the test borings to monitor drilling activities, select sampling intervals, log the conditions encountered, and obtain soil and rock core samples for use in visual descriptions and classifications and subsequent laboratory testing. The as-drilled boring locations were surveyed by MaineDOT on January 14, 2017. Boring location coordinates and ground surface elevations are summarized in Table 1, and boring locations with respect to existing and planned site features are shown in Figure 2.

3.2.1 Test Boring Explorations

Borings HB-GBB-201, HB-GBB-203, and HB-GBB-204 were completed by MaineDOT using a CME 45C trailer-mounted rig. Borings HB-GBB-202/202A and HB-GBB-205 were completed by NEBC using a Mobile B53 truck-mounted rig. Borings were initially advanced using a solid stem auger to depths of between 5 feet and 11 feet to set HW (4-inch) size casing. Thereafter, borings were drilled using the cased and wash boring method where casing was advanced in 5-foot increments until refusal at the bedrock surface. Borings HB-GBB-201 and HB-GBB-202/HB-GBB-202A were drilled adjacent to the existing culvert alignment to depths of 56.5 feet bgs and 61.5 feet bgs, respectively. Borings HB-GBB-203, HB-GBB-204, and HB-GBB-205 were drilled along the existing roadway alignment to depths of between 45.5 feet and 60.5 feet. During drilling for boring HB-GBB-202, the auger bit was damaged and lost downhole. Thus, HB-GBB-202A was drilled offset 2.8 feet from HB-GBB-202.

Standard Penetration Testing (SPT) was performed using a calibrated automatic hammer system and standard 2-inch split spoon sampler in accordance with ASTM D1586 for all borings. Continuous sampling was performed through shallow fill soils, after which samples were collected at 5-foot intervals to refusal. At depths where in situ vane shear tests were conducted, the SPT sampler was deployed to collect the soil after the vane was removed to aid in classification of the soil associated with the vane strength. Soil samples were collected and stored in jars (MaineDOT provided plastic containers, NEBC provided glass jars). The number of hammer blows required to advance the split spoon sampler through each 6-inch interval was recorded. Raw, uncorrected N-values are calculated as the sum of the hammer blows to advance the sampler during the 6-inch to 18-inch interval are shown on the boring logs (Appendix A). SPT hammer efficiency factors were 0.943 and 0.569 for the MaineDOT and NEBC automatic hammers, respectively.

Undisturbed, 3-inch diameter Shelby tube samples were collected at selected intervals in the clayey soils using a hydraulic GUS sampler following ASTM D6519 methods. Samples were sealed with the field and transported back to Golder offices for subsequent selection for laboratory testing to obtain engineering soil parameters.

In-situ vane shear tests were conducted in deposits where cohesive soils were encountered. A MaineDOT-owned Geonor 55-mm by 110-mm rectangular vane was used for vane shear testing. The borehole was advanced to 12 inches above the desired test depth and then the vane was advanced by hand to the test depth using dedicated vanes rods. The vane was then rotated with a torque wrench at a rate consistent with ASTM D2573 to obtain the peak torque used to estimate the peak undrained shear strength. The vane was then rotated at least ten times by hand at the same depth to remold/disturb the soil and then rotated again for a residual torque used to estimate the residual undrained shear strength. Results from vane shear testing, including raw torque readings and calculated uncorrected undrained shear strengths, are summarized in Table 2, and on the boring logs in Appendix A.

Rock core was collected upon reaching refusal of either the HW casing or roller cone bit using NQ-size (2.0 inch ID) diamond-tipped core barrels. Bedrock was encountered at depths ranging from between 40.5 feet bgs to 59.0 feet bgs. Rock core samples measuring 5.0 feet to 10.5 feet in length were collected from each of the borings. Rock core samples were placed in wooden boxes for further analysis off site. Core recovery, calculated Rock Quality Designation (RQD), and coring rate times per core interval were recorded for each core interval and are provided on the boring logs (Appendix A). A detailed summary of rock quality for the recovered rock core is presented in Table 3 and photographs of the rock core are presented in Appendix B.

Details of the sampling methods used, field data obtained, and soil and rock conditions encountered during the investigations are presented on the 200-series boring logs provided in Appendix A. Soils were field classified in general accordance with ASTM D 2488 and the MaineDOT Key to Soil and Rock Descriptions and Terms. A

description of the boring log symbols and terms used for the soil and rock descriptions precedes the boring logs presented in Appendix A. Photographs of the rock core are shown in Appendix B.

3.2.2 Instrumentation

Piezometers were installed in borings HB-GBB-201 and HB-GBB-205. The piezometers were made of 1¼-inch PVC piping with a nominal 5-foot length of machine slotted screen at the bottom of the pipe. Depths of the piezometer screens were selected based on where artesian conditions were encountered in preliminary boring HB-GBB-101 and the changes in the stratigraphy from Phase 2 investigations.

Borehole HB-GBB-201 was backfilled with #25 Holliston sand to 10 inches above the top of bedrock and the well was installed with the bottom of the screen at 55.3 feet. Sand was then placed to a depth of 48 feet (8.5 feet in total), followed by an approximately 10-inch thick layer of bentonite chips and then backfilled with grey silt clay cuttings to a depth of 15 feet before filling the remainder of the borehole with native fill to the ground surface. A well protector was installed at the top of the piezometer.

Borehole HB-GBB-205 was backfilled with native soil to a depth of 18.5 feet, after which 2 feet of bentonite plug then 0.8 feet of #25 Holliston sand. The well was then placed so that the bottom of the 5-foot screen was at a depth of 15 feet within the native clay layer. The borehole was backfilled with the #25 Holliston sand to a depth of 9 feet, a 1-foot layer of bentonite plug to a depth of 8 feet, and then native soil to the ground surface. A well protector was installed at the top of the piezometer.

Road boxes were installed to cover the wells and allow Golder employees to return to take water level readings. Water levels in these piezometers were checked periodically by hand to assess groundwater conditions. During the field program the water level in the wells were manually read at least once per week using a Geokon GK-404 handheld vibrating wire readout box. After the conclusion of the field program, a Golder collected water level readings in the wells on January 26, 2017.

3.3 Golder Investigation – 300 Series Borings

To support the realignment of Brandy Brook, Golder completed five (5) 300-series test borings (HB-GBB-301 through -305) between January 3 and January 9, 2018, located north of SR 25 in the area between SR 25 and the rock quarry. Two (2) borings were completed along the proposed stream and culvert alignment (Borings HB-GBB-302 and HB-GBB-304) and three (3) borings were completed north of the proposed backslope of the proposed realigned stream channel (Borings HB-GBB-301, HB-GBB-303 and HB-GBB-305). The field program included in-situ vane shear testing in the clay strata to measure undrained shear strength. Golder geotechnical engineers were on site during the advancement of the test borings to monitor drilling activities, select sampling intervals, log the conditions encountered, and obtain soil and rock core samples for using in visual descriptions and classifications and subsequent laboratory testing. The as-drilled boring locations were surveyed by MaineDOT on January 9, 2018. Boring location coordinates and ground surface elevations are summarized in Table 1, and boring locations with respect to existing site features are shown in Figure 2.

3.3.1 Test Boring Explorations

The borings were completed by Northern Test Boring (NTB) of Gorham, Maine using a Diedrich D-50 Turbo track-mounted rig. Borings were initially advanced using a hollow stem auger to depths of between 10 feet and 12 feet to set HW (4-inch) size casing. Thereafter, borings were drilled using the cased and wash boring method where casing was advanced in 5-foot increments until the Presumpscot silty clay layer was reached and an open hole method was used to advance the boring and collect samples. Borings HB-GBB-301, HB-GBB-303 and HB-GBB-

305 were drilled to bedrock encountered at depths of 44.7 feet, 51.2 feet, and 44.9 feet bgs, respectively. Borings HB-GBB-302 and HB-GBB-304 were drilled to the top of till encountered at depths 46.2 feet and 31.9 feet bgs, respectively. During the drilling of boring HB-GBB-305 the core barrel was damaged and lost downhole. No further attempts were made to collect rock core samples at this location.

Standard Penetration Testing (SPT) was performed using a calibrated automatic hammer system and standard 2-inch split spoon sampler in accordance with ASTM D1586 for all borings. Sampling was conducted at 5-foot intervals for HB-GBB-301, HB-GBB-303, and HB-GBB-305 to refusal at the top of bedrock. Continuous sampling was conducted for HB-GBB-302 and HB-GBB-304 through the fill to the top of the Presumpscot silty clay. Thereafter, sampling was conducted at 5-foot increments for the remainder of the borings. At depths where in situ vane shear tests were conducted, the SPT sampler was deployed to collect the soil after the vane was removed to aid in classification of the soil associated with the vane strength. The number of hammer blows required to advance the split spoon sampler through each 6-inch interval was recorded. Raw, uncorrected N-values are calculated as the sum of the hammer blows to advance the sampler during the 6-inch to 18-inch interval are shown on the boring logs (Appendix A). The SPT hammer efficiency factor was 0.979 for the NTB Diedrich D-50 turbo drill rig. Soil samples were collected and stored in jars.

Undisturbed, 3-inch diameter Shelby tube samples were collected at selected intervals in the clayey soils using a hydraulic GUS sampler following ASTM D6519 methods. Samples were sealed with the field and transported back to Golder offices for subsequent selection for laboratory testing to obtain engineering soil parameters.

In-situ vane shear tests were conducted in deposits where cohesive soils were encountered. A Geonor 55-mm by 110-mm rectangular vane was used for vane shear testing. The borehole was advanced to 1-foot above the desired test depth and then the vane was advanced by hand to the test depth using dedicated vanes rods. The vane was then rotated with a torque wrench at a rate consistent with ASTM D2573 to obtain the peak torque used to estimate the peak undrained shear strength. The vane was then rotated at least ten times by hand at the same depth to remold/disturb the soil and then rotated again for a residual torque used to estimate the residual undrained shear strength. A second vane test sequence was then conducted after advancing the vane another 12 inches. Results from vane shear testing, including raw torque readings and calculated uncorrected undrained shear strengths, are summarized in Table 2, and shown on the boring logs in Appendix A.

Details of the sampling methods used, field data obtained, and soil and rock conditions encountered during the investigation are presented on the 300-series boring logs provided in Appendix A. Soils were field classified in general accordance with ASTM D 2488 and the MaineDOT Key to Soil and Rock Descriptions and Terms. A description of the boring log symbols and terms used for the soil and rock descriptions precedes the boring logs presented in Appendix A.

3.4 Laboratory Testing

Geotechnical laboratory tests were performed on representative soil samples collected during the subsurface investigation to assist in soil classification and for evaluations of engineering properties for strength and compressibility. SPT split spoon samples were collected in all borings, (HB-GBB-101, HB-GBB-201 through HB-GBB-205 and HB-GBB-301 through HB-GBB-305) and soil index and classification tests were performed on these samples by MaineDOT Soil Testing Laboratory and GeoTesting Express of Acton, Massachusetts. Shelby tube samples were collected from borings HB-GBB-101, -201, -202, -203, -301 and -305 and soil testing to obtain engineering properties of the clay from undisturbed tube samples was performed by both MaineDOT Soil Testing Laboratory and GeoTesting Express, Inc. of Acton, Massachusetts. Laboratory work was performed in

accordance with applicable American Society for Testing Materials (ASTM) and American Association of State Highway Transportation Officials (AASHTO) testing procedures. The types and numbers of each of the laboratory tests conducted on the 100-, 200-, and 300-seies samples are summarized below.

Soil Laboratory Test	Testing Standard	Number of Tests Completed
Grainsize - Coarse Fraction	ASTM D6913	10
Grainsize - Fine Fraction	ASTM D7928	23
Water Content	ASTM D2216	53
Atterberg Limits	ASTM D4318	26
Specific Gravity	ASTM D854	21
pH	ASTM G51	2
Electrical Resistivity	ASTM G57	2
Chlorides	ASTM D512	2
Sulfates	ASTM D516	2
X-Ray Shelby Tube	ASTM D5542	3
Shelby Tube Handling/ Tube Log	GTX-S1003/S1016	3
Incremental Consolidation	ASTM D2435	7
Consolidated Undrained Triaxial Shear	ASTM D4767	3

Measured results from the laboratory testing program are summarized in Table 4 for index and classification tests and Table 5 for engineering properties from advanced laboratory tests on the undisturbed tube samples of clay. Figure 5 plots select data from Table 4 and Table 5 with depth. Selected soil and rock testing results are included on the boring logs in Appendix A. Complete laboratory test results are provided in Appendix C.

4.0 SUBSURFACE CONDITIONS

Soils encountered at the borings were found to generally include fill materials placed during culvert installation and construction of the roadway, naturally occurring silty sands and gravels (glacial outwash) over bedrock, and Presumpscot silty clay. Detailed descriptions of the soil and bedrock conditions encountered at the borings are provided on the boring logs in Appendix A. The following descriptions summarize the major stratigraphic units.

- **Asphalt Pavement:** Asphalt pavement thicknesses observed in the 200-series borings along SR 25 ranged from 7.5 to 12 inches. Asphalt pavement thicknesses observed near the existing culvert alignment is 7.5 to 10 inches and near the new proposed culvert alignment is 12 inches.
- **Concrete Road Deck:** A layer of concrete with metal rebar, estimated to be 6-inch thick, was encountered beneath the asphalt pavement surface in HB-GBB-202A but not in nearby boring HB-GBB-201. This layer is interpreted as a former road surface that may have been partially removed.

- **Fill:** Fill was encountered in all borings. The layer was observed to be between 2.3 feet and 15.4 feet thick and start between elevation 138.3 feet and 150.8 feet. Generally, the thickness of the fill is greater in the 200-series borings along SR 25. The depth of fill ranges from 4.5 feet to 10.5 feet in the 300-series borings north of SR 25. The fill consisted of fine to coarse sand with gravel fractions ranging from "gravelly" to "trace" and silt fractions ranging from “silty” to "trace". Laboratory testing resulted in the soil being classified as SM, SW-SM, SP-SM, or SC-SM (USCS classification) and A-2-4 or A-1-b (AASHTO classification). For the 200-series boring along SR 25, there is a distinction between shallower and deeper fill. The shallower fill is roadway subbase consisting of brown, medium dense to dense, fine to coarse sand, some to trace gravel, and some to little silt. The deeper fill consists of golden brown, fine to medium sand with some gravel and some silt. N_{60}-values for the fill, corrected for hammer efficiency, ranged from 6 to 93, where N_{60}-values generally decreased with increasing depth within the fill. The fill layer transitions to Presumpscot silty clay between 3 feet and 16 feet bgs in the 200 and 300 series borings and to alluvial sand at 7.0 feet bgs for HB-GBB-101.

- **Alluvial Sand:** A 7.5-foot thick layer of grey sand was encountered in HB-GBB-101 between elevation 135.6 feet and 128.1 feet. The N_{60}-value for this layer, corrected for hammer efficiency, was 1. This sand layer transitions to the Presumpscot silty clay at 14.5 feet bgs.

- **Presumpscot Silty Clay:** Presumpscot silty clay was encountered in all borings. The layer was observed to be between 20 feet and 41 feet thick and start between elevation 128.1 feet and 144.8 feet. Generally, the thickness of the clay layer is greater in the western portion of the investigated area and the thickness of the clay layer decreases from about 37 feet in the west to 20 feet in the east along the proposed stream realignment. The thickness of the clay layer ranges from approximately 20 feet to 26 feet along the new proposed culvert alignment in the eastern portion of the site. The Presumpscot silty clay is a grey, moist to wet, very soft, soft, medium stiff, to stiff silty clay. The clay was found to be tan or tan-grey and have trace to little fine to coarse sand in the upper portion of the layer near the fill. The clay was additionally found to be brown in the lower portion of the layer adjacent to the underlying glacial outwash. Laboratory testing resulted in the soil being classified as CL low plasticity clay (USCS classification) or A-6, A-7-6, or A-4 (AASHTO classification) for the 200-series borings, while the layer was described as CL-ML low plasticity silty clay with some CL or ML samples (USCS classification) or A-4, A-6, or A-5 (AASHTO classification) for the 300-series borings. Field vane test (FVT) data yielded undrained shear strength (s_u) values between 223 psf and 1786 psf. In borings below SR 25, s_u generally decreased from a high value to a low value mid-depth of the layer before increasing again. In borings north of SR 25 outside of the roadway development area, s_u generally increased with depth. Where field vane tests were not conducted, SPT N_{60}-values ranged from WOR (weight of rod) to 13 (soft to stiff). N_{60}-values of 20 and 53 were measured where gravel was encountered at 5 feet to 9 feet in HB-BGG-203. The clay layer transitions to glacial outwash deposits between 30.5 feet and 57 feet bgs.

- **Glacial Outwash:** Glacial outwash was encountered in all 200 and 300 series borings. The layer was observed to be between 0.6 feet and 17 feet thick and start between elevation 86.8 feet and 102.7 feet. The glacial outwash consisted of grey to brown, wet, loose, medium dense, dense to hard, clayey to silty, fine to coarse sand with "trace" to "some” silt, clay, and gravel. Laboratory testing resulted in the soil being classified as SM silty sand (USCS classification) or A-1-b or A-2-4 (AASHTO classification). SPT N_{60}-values ranged from 18 to 95. The glacial outwash layer transitioned to bedrock between 30.5 feet and 57 feet bgs.

- **Bedrock:** The bedrock surface was encountered in all borings except in HB-GBB-101, HB-GBB-302, and HB-GBB-304 which were terminated above bedrock. Between 4 feet and 10 feet of rock core was collected

in each of the 200-series borings in 5-foot runs and no rock core was collected in the 300-series borings. Table 3 provided detailed information the recovery, rock quality designation (RQD), rock mass rating (RMR), and descriptions of lithology, rock mass and discontinuities.

- **Groundwater:** Groundwater level measurements were measured upon completion of the boreholes and removal of the casing, or in the open-standpipe wells installed in borings HB-GBB-201 and HB-GBB-205. Groundwater levels shown on the subsurface profile (Figure 3) were interpreted based on observed changes in saturation and water level meter measurements. Groundwater levels are interpreted to be between approximately 1.3 feet and 7 feet bgs for the borings along the roadway and between approximately 7 feet and 10 feet bgs north of the roadway along the slope. Groundwater was not recorded in HB-GBB-101.

5.0 GEOTECHNICAL DESIGN AND CONSTRUCTION RECOMMENDATIONS

5.1 New Proposed Culvert Location

We understand that MaineDOT plans to replace the existing culvert with a 12-foot span, 8-foot rise precast concrete, four-sided, box culvert located approximately 320 feet east of the existing culvert. The proposed box culvert will be 176-feet long with the southern invert located at elevation 130.64 feet and the northern invert located at elevation 128.44 feet. The design also includes two feet of simulated streambed material to be placed inside the floor of the box culvert. The culvert will be skewed approximately 37 degrees counterclockwise from parallel to the roadway cross-section as it crosses SR 25. The upstream and downstream ends of the culverts will be protected with a 12-foot span, 2-foot rise, and 10-foot long precast concrete toe-wall sealed to the bottom of the box culvert. No headwalls or wingwalls for the culvert are planned. The existing roadway vertical profile and horizontal alignment will remain the same. As this is an area of the site that is currently embankment fill, the construction of the box culvert in this location will result in a net unloading of the foundation soils.

Based on the subsurface conditions encountered during the subsurface exploration program, the bottom of the proposed culvert will be located within the native Presumpscot silty clay layer below the existing fill layer. The following discussion provides details of the geotechnical analyses conducted related to bearing resistance, subgrade modulus, and heave.

5.1.1 Bearing Capacity and Subgrade Modulus

The base of the proposed box culvert will be founded within the Presumpscot silty clay layer. Figure 2 shows the location in plan and Figure 4 shows the location with respect to the design soil profile. The proposed box culvert will be founded on a 2-foot thick, geotextile wrapped, geogrid-reinforced crushed stone mat. For this condition we recommend a strength limit state factored bearing resistance of 1.28 ksf be used for design. A modulus of subgrade reaction for a 1-foot x 1-foot steel plate (k_1) equal to 25 pci should be used for structural design of the proposed culvert. The estimated maximum reduction in effective stress after the new culvert and overlying fill are fully installed is expected to result in a net unloading by approximately 270 psf. Thus, the service limit state bearing resistance used to limit settlement of foundation soils to 1 inch does not apply in this case. Refer to the calculations included in Appendix D.

5.1.2 Heave

Installation of the new proposed box culvert will require excavation of site soils at-, and adjacent to SR 25 to elevations between 128.4 feet and 126.2 feet into the Presumpscot silty clay layer to accommodate the culvert and one foot of backfill below it. The approximate maximum depth for this excavation is 22 feet. The type and

methods of excavation are not known during the writing of this report; however, excavation will likely require dewatering and will result in unloading of the Presumpscot silty clay below the excavation depth.

A net reduction in effective stress in the Presumpscot silty clay layer below the culvert is estimated to following excavation of the soil to the culvert elevation. Thus, Golder evaluated consolidation-induced heave deformation of the Presumpscot silty clay below the culvert elevation for the excavated condition related to the changes in geometry and effective stress state. Approximately 3.5 inches of heave deformation was estimated for the 8.7-foot thick clay layer remaining below the excavated elevation. 95% of the estimated heave deformation is expected to occur within approximately 88 days or 3 months. We estimate a small net reduction in effective stress in the Presumpscot silty clay layer below the culvert will remain following installation of the culvert and placement of the overlying fill and roadway. Approximately 0.2 inches of heave deformation was estimated to remain following culvert installation. Refer to the calculations included in Appendix D.

5.1.3 Scour and Riprap

Both the inlet and outlet of the culvert will be armored with riprap in accordance with MaineDOT Standard Detail 610(04) for stone scour protection, Standard Detail 802(05) for Roadway Culvert End Slope Treatment and Standard Specification 610.08 Plain Riprap. Both the inlet and outlet should include a 2-foot thick by 10-foot long Plain Riprap apron and a 2-foot deep by 1-foot thick toe wall/cut off wall along the width of the culvert to prevent undermining. The riprap slope will be underlain by a non-woven stabilization geotextile meeting the requirements of Standard Specification 722.01. The design also includes two feet of simulated streambed material (in accordance with MaineDOT provision 203.33) and stream channel rock (in accordance with MaineDOT provision 610.210) to be placed on the floor of the box culvert. The special fill should extend over the riprap apron.

5.2 Settlement at the Existing Culvert Location

The existing culvert (see Figure 2) will need to be decommissioned and the existing grade of SR 25 maintained. The two options Golder evaluated are: 1) removal and fill replacement, consisting of excavation and removal of the existing culvert and reestablishing the grade of SR with fill, and 2) leave in place, consisting of filling the existing culvert with lightweight flowable fill. We estimated settlement of the approximately 40-foot thick Presumpscot silty clay layer and 1.5-foot thick glacial outwash layer below the culvert base elevation for both scenarios. For the removal and fill replacement option, where fill consists of Gravel Borrow (MaineDOT Specification 703.20), we estimated settlement to be approximately 0.7 inches. For the leave in place option with lightweight flowable fill, we estimated settlement to be approximately 0.5 inches. Refer to the calculations included in Appendix D. Based on the minimal difference in estimated settlement, and that filling in the existing culvert is less invasive to the existing embankment, Golder recommends that the existing culvert be left in place and backfilled with flowable fill.

5.3 Stream Channel Relocation

An approximately 300-foot long portion of Brandy Brook will be relocated to the northeast side of SR 25. The bottom of the stream will be located in the Presumpscot silty clay layer between elevations of approximately 130.5 feet and 127.5 feet (see Figure 4), approximately 17 to 20 feet below the elevation of SR 25. Excavation for the stream bed and bank will create new slopes between the stream and SR 25 and stream and topography to the northeast. The new stream bed will be approximately 14 feet wide with 2.5H:1V backslope to the northeast and a 2H:1V slope adjacent to SR 25. The design includes 18 inches of special fill (i.e., simulated streambed material) at the base of the stream bed. The following sections discuss the global stability analyses for three representative stream cross sections along the stream location alignment, the streambed bottom heave analysis, and scour.

5.3.1 Heave

Relocation of Brandy Brook will require excavation of site soils adjacent to SR 25 for the new stream bed. Excavation for the stream bed and side slopes will require about 15 feet to 20 feet of excavation into the Presumpscot silty clay layer. The type and methods of excavation are not known during the writing of this report; however, excavation will likely require dewatering and will result in unloading of the Presumpscot silty clay below the excavation on the side slopes and below the steam bed. A net reduction in effective stress in the Presumpscot silty clay layer below the culvert will occur following excavation to the stream bed elevation. Thus, Golder evaluated heave of the Presumpscot silty clay below the stream bed elevation based on changes in geometry and effective stress state using both strength and deformation analyses. Heave deformation is estimated to be 5.0 inches based on consolidation settlement properties of the approximately 24-foot thick clay below the excavated elevation. 95% of the estimated heave deformation is expected to occur within roughly 670 days or 22 months. Refer to the calculations included in Appendix D.

5.3.2 Global Stability Analysis

Slope stability was evaluated using a total stress analysis for the post-excavation condition where the stream bed and side slopes consisted of the native soil surface and when the slopes were lined with a 2-foot layer of riprap. Three stability sections were chosen where the native slope at the stream bed excavation changed geometry to check stability: station 13+75 located halfway along the proposed stream bed realignment, station 14+25 near the existing level lip spreader, and station 14+75 near the proposed drainage swale into the new stream bed conveying water from the culvert passing under the rock quarry driveway. At each station and for each riprap scenario two stability analyses were performed: stability of the 2H:1V slope between SR 25 to the west and the stream bed, and stability of the 2.5H:1V backslope between the uphill slope to the east and the streambed.

Total stress analyses were performed for all stations and the cases with and without riprap, and were the primary method used to examine the stability of the excavated stream and side slope geometry. Subsurface conditions used in the models were interpreted based on the soil stratigraphy and groundwater conditions encountered during our 2017 and 2018 exploration program and soil properties corresponding to SPT blow counts, field vane shear test undrained shear strengths, and laboratory testing performed on soil samples. The analyses were conducted using undrained strength parameters within the Presumpscot silty clay layer (see Figure 5 for the design soil profiles) and drained strength parameters in the coarse-grained fills and glacial outwash above and below the Presumpscot layer, respectively. The groundwater table used in the slide models was determined based on the groundwater elevations measured in the monitoring wells and nearby borings during the site investigation program.

The stability analyses were performed using the two-dimensional, limit equilibrium software model *Slide* by Rocscience using Spencer's method for both circular and non-circular failure surfaces and Bishops Simplified Method for circular surfaces. The auto-refine search method, Cuckoo search method, and simulated annealing search method were analyzed and compared to help verify the model results for the existing conditions model. Concave failure surfaces were eliminated from the analyses.

A minimum factor of safety (FS) acceptable for these analyses is 1.30. Table 6 summarizes the resulting minimum FS for each scenario analyzed. Assumed geometries, configurations, subsurface conditions, and stability analyses results are presented in Appendix D.

Golder did not conduct an analysis the new embankment slope of 3H:1V to be created between SR 25 and the existing Brandy Brook stream bed. This is because the subsurface soil conditions are similar to those analyzed for

the 2H:1V slope between SR 25 and the new stream bed, the new embankment slope will be shallower than those analyzed for the new stream bed, and the fill extends all the way to the existing far bank of the stream. Golder believes that factors of safety against slope failure will be similar or possibly greater than for the slopes analyzed.

5.3.3 Scour and Riprap

Scour countermeasures and slope erosion control issues will be addressed within the stream channel and slopes. Construction of erosion protection measures should be based on Special Details – Stream Plan & Profile in the plan set, which includes a 1.5-foot thick layer of special fill simulated streambed with areas of cobble bar and rock band features. The slopes will be covered with void-filled Plain Riprap 3 feet beyond the edge of the special fill to mitigate erosion. The special fill and or riprap should be underlain by a non-woven erosion control geotextile meeting the requirements of Standard Specification 722.03. Heave of the soils below the streambed, estimated to be to be 5 inches, may lead to erosion of the special fill or a change in the slope of the stream traverse.

5.4 Settlement Existing Stream Channel

Approximately 300 feet of the existing Brandy Brook stream channel will be decommissioned and the slope between SR 25 and the existing stream bed backfilled on a 3H:1V slope down from SR 25 to stabilize the roadway. We recommend that the excavation be backfilled using material excavated from the proposed realigned stream channel. The embankment backfill will result in a net loading of soils from the shoulder of SR 25 to the infilled existing stream channel. We estimate that loading from the embankment fill will result in up to ½ inch inches of settlement on the shoulder of SR 25 and up to 1.6 inches of settlement within the middle of the infilled stream bed. Refer to the calculations included in Appendix D.

5.5 Frost Considerations

Golder estimated an average frost depth for the subsurface profile below the culvert bottom elevations using the MaineDOT Bridge Design Guide (MaineDOT, 2018) as a reference. The site has an air design freezing index of approximately 1300 F-degree days. We estimate average and maximum frost penetration depths of approximately 3.2 feet and 3.6 feet, respectively for the soils at the site. Refer to the frost penetration depth calculations in Appendix D.

5.6 Construction Considerations

At the writing of this report, the sequence of the work and considerations for water diversion are unknown. However, construction activities will require soil excavation and will likely include construction of cofferdams and earth support systems to support culvert and stream bed excavations during construction and to control water flow during construction. Design of all temporary earth support systems should comply with OSHA requirements. The contractor should control groundwater and surface water infiltration so that construction can be completed under dry conditions.

The native soils at the site, specifically the Presumpscot silty clay, are susceptible to disturbance as a result of exposure to water, construction traffic and overburden removal. Furthermore, the contractor should be made aware that it is estimated that limiting open time for the structure excavation to 10 to 20 days will reduce estimated heave at the base of the excavation from 3.5 inches to between 1.5 and 2 inches. All subgrade surfaces should be protected from unnecessary construction traffic.

6.0 CLOSING

This Geotechnical Evaluation Report was prepared for the exclusive use of MaineDOT for specific application to the proposed box culvert replacement crossing Brandy Brook on SR 25 in Gorham, Maine. The evaluations and recommendations contained within were made in accordance with generally accepted soil and foundation engineering practices in this geographical area and under similar time and financial constraints. Golder makes no other warranty, either express or implied. If changes in the nature, design, or location of the proposed project are planned, Golder should be notified to review the appropriateness of our conclusions and recommendations, and to modify the recommendations as appropriate to reflect the changes in design. In addition, Golder should review the final plans and specifications to evaluate compliance with these recommendations.

Our analyses, and recommendations are based, in part, on information obtained from the referenced subsurface explorations completed at the discrete locations described in the report. Readers of this report should make their own interpretation of the results of the subsurface investigations and laboratory testing. Variations in the nature and extent of subsurface conditions between explorations should be expected. Golder should be notified if conditions encountered during construction vary from those described in this report so that we may re-evaluate, and if necessary, revise the recommendations made in this report.

The professional services provided by Golder for this project include only the geotechnical aspects of the subsurface conditions at this site. The presence or implications of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this report and have not been investigated or addressed.

7.0 REFERENCES

AASHTO, 2017. LRFD Bridge Design Specifications, 8th Ed.

American Society of Testing and Materials (ASTM), 2019. Volumes 4.08 and 4.09.

Berry, H.N., IV, and Hussey, A.M., II, 1998. Bedrock Geology of the Portland 1:100,000 Quadrangle, Maine and New Hampshire. Maine Geological Survey, Open-File No. 98-1, map scale 1:100,000.

Bowles, Joseph E., 1982. Foundation Analysis and Design, 3rd Ed. McGraw-Hill.

Das, Braja M., 2011. Principles of Foundation Engineering, 7th Ed. Thomson Brooks/Cole.

Fennemen, N.M. and Johnson, D.W., 1946. Physical Divisions of the United States, U.S. Geological Survey, 1 sheet, map scale 1:7,000,000.

FHWA, 2002. GEOTECHNICAL ENGINEERING CIRCULAR NO. 6: Shallow Foundations, Report No. FHWA-SA-02-054.

GeoTesting Express, 2017. Laboratory Test Report transmitted to Golder Associates. Dated March 2, 2017.

Holtz, R.D., Kovacs, W.D., and Sheahan, T.C. 2011. An Introduction to Geotechnical Engineering, 2nd Ed., Pearson, Upper Saddle, NJ.

Hussey, A.M., II, 1996. Geology of the Standish 7 ½' Quadrangle, Southwestern Maine. Maine Geological Survey Open-File No. 96-1, 4 p., map scale 1:24,000.

Hussey, A.M., II, 1971. Geologic Map of the Portland Quadrangle, Maine. Maine Geological Survey Geologic Map Series GM-1, 19 p., map scale 1:62,500.

MaineDOT, 2018. Bridge Design Guide. August 2003 with updates to June 2018.

MaineDOT, 2017. Gorham Brandy Brook Route 25 Cross Sections. Dated January 26, 2017.

MaineDOT, 2017, 2018. Laboratory testing results for Work Number 18821.00. 2017 and 2018.

MaineDOT, 2019. WIN 18821.00 Gorham Draft PDR-PIC Plan Set. Dated April 16, 2019; received April 22, 2019.

MaineDOT, 2019. Gorham - Brandy Brook Route 25: Cross Sections. Dated June 13, 2019 and August 2019.

MaineDOT Geotechnical Section, 2016. Key to Soil and Rock Descriptions and Terms: Field Identification Information. Dated October 2016.

Neal, C.D. and Smith, G.W., 1998. Significant Sand and Gravel Aquifers, Gorham Quadrangle, Maine. Maine Geological Survey Open-File Report 98-143, map scale 1:24,000.

Osberg, P. H., Hussey, A.M., and Boone, G. M., 1985. Bedrock geologic map of Maine. Maine Geological Survey, scale 1:500,000.

Prescott, G.C., Jr. 1975. Ground Water Favorability and Surficial Geology of the Portland Area, Maine. United States Geological Survey Hydrologic Investigations Atlas HA-561, map scale 1:62,500.

Puller, Malcolm. 2003. Deep Excavations: A Practical Manual, 2nd Ed. Thomas Telford Publishing.

Rocscience, 2019. “SLIDE – 2D Limit Equilibrium Slope Stability Analysis”, Version 2018 8.018, Rocscience, Inc., Toronto, Ontario, Canada, build date November 21, 2019.

Smith, G.W., 1999a. Surficial Geology of the Gorham 7.5-Minute Quadrangle, Cumberland County, Maine. Maine Geological Survey Open-File Report 99-84, 8 p.

Smith, G.W., 1999b. Surficial Geology of the Gorham Quadrangle, Maine. Maine Geological Survey Open-File Report 99-111, map scale 1:24,000.

Winterkorn & Fang, 1975. Foundation Engineering Handbook. Litton Educational Publishing, Inc.

Golder and the G logo are trademarks of Golder Associates Corporation

TABLES

Table 1: Subsurface Exploration Locations
Geotechnical Design Recommendation Report
Brandy Brook Culvert & Stream Relocation
Gorham, Maine
MaineDOT WIN 18821.00

Test Boring Designation[2,3,4]	As-Drilled Locations[1,5,6]		Existing Ground Surface Elevation[5,6] (feet)	Boring Depth[7] (feet)	Comments
	Northing	Easting			
HB-GBB-101	309486.96	958303.78	142.6	51.8	Bedrock at 90.8 ft. elevation
HB-GBB-201	309481.57	958370.06	143.8	61.6	Bedrock at 87.2 ft. elevation
HB-GBB-202	309456.94	958368.74	143.7	4.0	Boring terminated because of equipment failure
HB-GBB-202A	309455.25	958370.95	143.8	69.0	Adjacent to HB-GBB-202, Bedrock at 84.8 ft. elevation
HB-GBB-203	309374.14	958477.76	145.1	56.2	Bedrock at 93.9 ft. elevation
HB-GBB-204	309384.14	958516.09	145.3	45.5	Bedrock at 104.8 ft. elevation
HB-GBB-205	309251.11	958638.45	151.8	60.5	Bedrock at 101.8 ft. elevation
HB-GBB-301	309546.23	958431.63	138.3	44.7	Bedrock at 93.6 ft. elevation
HB-GBB-302	309542.74	958531.93	149.2	46.2	Boring terminated in glacial outwash
HB-GBB-303	309469.06	958508.08	147.7	51.2	Bedrock at 96.5 ft. elevation
HB-GBB-304	309461.14	958604.33	152.1	31.9	Boring terminated in glacial outwash
HB-GBB-305	309381.88	958598.48	149.4	44.9	Bedrock at 104.5 ft. elevation

Notes:
1. Test boring locations are shown in Figure 2 entitled "Boring Location Plan".
2. Borings HB-GBB-201, HB-GBB-203, and HB-GBB-204 were performed by MaineDOT in December, 2016.
3. Borings HB-GBB-202, HB-GBB-202A, and HB-GBB-205 were perfomed by the New England Boring Contractors in January, 2017.
4. Borings HB-GBB-301, HB-GBB-302, HB-GBB-303, HB-GBB-304, and HB-GBB-305 were performed by Northern Test Boring in January, 2018.
5. As-drilled locations and elevations for 200-series borings are derived from MaineDOT "BOR1-4-17MDOTedit.csv" received on January 18, 2017.
6. As-drilled locations and elevations for 300-series borings are derived from MaineDOT "18821 Gorham Clearance Report.xlsx" received on January 26, 2018.
7. Depth below ground surface (bgs).
8. Boring logs presented in Appendix A.

Prepared By: MEL/HTV
Checked By: KAR/MEL
Reviewed By: CCB

Table 2: Summary of In-Situ Vane Shear Testing Results
Geotechnical Design Recommendation Report
Brandy Brook Culvert
Gorham, Maine
MaineDOT WIN: 18821.00

Test Boring Designation[1]	Existing Ground Surface Elevation[2] (ft)	Test Number	Depth Below Ground Surface (ft)	Approximate Test Elevation (ft)	Vane Size[3] (mm x mm)	V_{max}[4] (ft-lbs)	$V_{remolded}$[4] (ft-lbs)	s_u[5] (psf)	$s_{u(remolded)}$[5] (psf)	S_t[6] (-)	Comments
HB-GBB-101	142.6	MV	22 - 24	120.6 - 118.6	65 x 130	-	-	-	-	-	Could not push
		V1	25 - 25.4	117.6 - 117.3	55 x 110	5.5	2.0	246	89	2.8	
		V2	26 - 26.4	116.6 - 116.2	55 x 110	15.0	1.5	670	67	10.0	
		MV	32 - 32.4	110.6 - 110.2	55 x 110	-	-	-	-	-	Could only push 0.4'
		V3	35 - 35.4	107.6 - 107.2	55 x 110	5.0	1.0	223	45	5.0	
		V4	36 - 36.4	106.6 - 106.2	55 x 110	14.0	1.0	625	45	13.9	
HB-GBB-201	143.8	MV	17 – 19	126.8 – 124.8	55 x 110	-	-	-	-	-	Could not push
		V1	20.6 – 21	123.2 – 122.8	55 x 110	14.0	4.0	625	179	3.5	
		V2	21.6 – 22	122.2 – 121.8	55 x 110	11.5	2.0	513	89	5.8	
		V3	28.6 – 29	115.2 – 114.8	55 x 110	12.0	2.0	536	89	6.0	
		V4	29.6 – 30	114.2 – 113.8	55 x 110	11.0	2.0	491	89	5.5	
		V5	30.6 – 31	113.2 – 112.8	55 x 110	12.0	1.5	536	67	8.0	
		V6	31.6 – 32	112.2 – 111.8	55 x 110	11.5	1.0	513	45	11.5	
		V7	37.6 – 38	106.2 – 105.8	55 x 110	26.5	1.5	1183	67	17.7	
		V8	38.6 – 39	105.2 – 104.8	55 x 110	21.0	0.5	938	22	42.0	
		V9	40.6 – 41	103.2 – 102.8	55 x 110	15.0	1.0	670	45	15.0	
		V10	41.6 – 42	102.2 – 101.8	55 x 110	18.5	1.0	826	45	18.5	
		V11	45.6 – 46	98.2 – 97.8	55 x 110	18.5	2.0	826	89	9.3	
		V12	46.6 – 47	97.2 – 96.8	55 x 110	22.0	2.5	982	112	8.8	
		V13	50.6 – 51	93.2 – 92.8	55 x 110	29.0	5.5	1295	246	5.3	
		MV2	51.6 – 52	92.2 – 91.8	55 x 110	-	-	-	-	-	Could not push
HB-GBB-202A	143.8	V1	18.6 – 19	125.2 – 124.8	55 x 110	6.0	2.0	268	89	3.0	
		V2	19.6 – 20	124.2 – 123.8	55 x 110	7.5	1.5	335	67	5.0	
		V3	22.6 – 23	121.2 – 120.8	55 x 110	10.0	1.0	447	45	10.0	
		V4	23.6 – 24	120.2 – 119.8	55 x 110	8.0	1.0	357	45	8.0	
		V5	25.6 – 26	118.2 – 117.8	55 x 110	9.5	2.5	424	112	3.8	
		V6	26.6 – 27	117.2 – 116.8	55 x 110	11.0	1.0	491	45	11.0	
		V7	31.1 – 31.5	112.7 – 112.3	55 x 110	10.0	2.0	447	89	5.0	
		V8	32.1 – 32.5	111.7 – 111.3	55 x 110	10.0	2.0	447	89	5.0	
		V9	35.6 – 36	108.2 – 107.8	55 x 110	13.0	2.5	580	112	5.2	
		V10	36.6 – 37	107.2 – 106.8	55 x 110	15.0	1.0	670	45	15.0	
		V11	42.6 – 43	101.2 – 100.8	55 x 110	15.5	0.5	692	22	31.0	
		V12	43.6 – 44	100.2 – 99.8	55 x 110	16.5	0.5	737	22	33.0	
		V13	45.6 – 46	98.2 – 97.8	55 x 110	18.0	1.5	804	67	12.0	
		V14	46.6 – 47	97.2 – 96.8	55 x 110	18.0	1.0	804	45	18.0	
		V15	50.6 – 51	93.2 – 92.8	55 x 110	23.5	3.5	1049	156	6.7	
		MV1	51.6 – 52	92.2 – 91.8	55 x 110	-	-	-	-	-	Could not push
HB-GBB-203	145.1	V1	18.1 – 18.5	127 – 126.6	55 x 110	12.0	2.0	536	89	6.0	
		V2	19.1 – 19.5	126 – 125.6	55 x 110	21.5	7.5	960	335	2.9	
		V3	28.1 – 28.5	117 – 116.6	55 x 110	8.0	1.5	357	67	5.3	
		V4	29.1 – 29.5	116 – 115.6	55 x 110	10.0	0.5	447	22	20.0	
		V5	30.6 – 31	114.5 – 114.1	55 x 110	19.0	3.0	848	134	6.3	
		V6	31.6 – 32	113.5 – 113.1	55 x 110	13.0	1.5	580	67	8.7	
		V7	35.6 – 36	109.5 – 109.1	55 x 110	14.5	1.0	647	45	14.5	
		V8	36.6 – 37	108.5 – 108.1	55 x 110	18.0	1.5	804	67	12.0	
		V9	40.6 – 41	104.5 – 104.1	55 x 110	18.0	4.0	804	179	4.5	
		MV1	41.6 – 42	103.5 – 103.1	55 x 110	-	-	-	-	-	Could not push
HB-GBB-204	145.3	MV1	13 – 15	132.3 – 130.3	55 x 110	-	-	-	-	-	Could not push
		MV2	15 – 17	130.3 – 128.3	55 x 110	-	-	-	-	-	Could not push
		V1	18.6 – 19	126.7 – 126.3	55 x 110	13.0	1.5	580	67	8.7	
		V2	19.6 – 20	125.7 – 125.3	55 x 110	13.0	2.0	580	89	6.5	
		V3	22.6 – 23	122.7 – 122.3	55 x 110	15.5	2.0	692	89	7.8	
		V4	23.6 – 24	121.7 – 121.3	55 x 110	16.0	2.0	714	89	8.0	
		V5	25.6 – 26	119.7 – 119.3	55 x 110	15.5	2.0	692	89	7.8	
		V6	26.6 – 27	118.7 – 118.3	55 x 110	18.0	3.0	804	134	6.0	
		MV3	35 – 37	110.3 – 108.3	55 x 110	-	-	-	-	-	Could not push
HB-GBB-205	151.8	MV1	15 – 17	136.8 – 134.8	55 x 110	-	-	-	-	-	Could not push
		MV2	20 – 22	131.8 – 129.8	55 x 110	-	-	-	-	-	Could not push
		V1	27.6 – 28	124.2 – 123.8	55 x 110	22.0	4.0	982	179	5.5	
		V2	28.6 – 29	123.2 – 122.8	55 x 110	20.0	5.0	893	223	4.0	
		MV3	30 – 32	121.8 – 119.8	55 x 110	-	-	-	-	-	Could not push
HB-GBB-301	138.3	V1	22.6 – 23	115.7 – 115.3	65 x 130	21.5	0.5	591	14	43.0	
		V2	23.6 – 24	114.7 – 114.3	65 x 130	26.5	1.0	728	27	26.5	
		V3	25.6 – 26	112.7 – 112.3	65 x 130	13.5	2.0	371	55	6.8	
		MV1	26.6 – 27	111.7 – 111.3	65 x 130	-	-	-	-	-	Could not push
		MV2	32.6 – 33	105.7 – 105.3	65 x 130	-	-	-	-	-	Could not push
		MV3	33.6 – 34	104.7 – 104.3	65 x 130	-	-	-	-	-	Could not push
HB-GBB-302	149.2	V1	15.6 – 16	133.6 – 133.2	55 x 110	15.0	2.0	670	89	7.5	
		V2	16.6 – 17	132.6 – 132.2	55 x 110	10.0	1.0	447	45	10.0	
		V3	20.6 – 21	128.6 – 128.2	65 x 130	15.0	1.5	412	41	10.0	
		V4	21.6 – 22	127.6 – 127.2	65 x 130	15.5	1.5	426	41	10.3	
		V5	25.6 – 26	123.6 – 123.2	65 x 130	23.5	1.5	646	41	15.7	
		V6	26.6 – 27	122.6 – 122.2	65 x 130	22.5	1.0	618	27	22.5	
		V7	30.6 – 31	118.6 – 118.2	65 x 130	30.0	2.0	824	55	15.0	
		V8	31.6 – 32	117.6 – 117.2	65 x 130	27.0	1.5	742	41	18.0	
		V9	35.6 – 36	113.6 – 113.2	65 x 130	28.0	3.0	769	82	9.3	
		V10	36.6 – 37	112.6 – 112.2	65 x 130	27.0	2.0	742	55	13.5	
		V11	40.6 – 41	108.6 – 108.2	65 x 130	36.0	4.0	989	110	9.0	
		MV1	41.6 – 42	107.6 – 107.2	65 x 130	-	-	-	-	-	Could not push

Table 2: Summary of In-Situ Vane Shear Testing Results
Geotechnical Design Recommendation Report
Brandy Brook Culvert
Gorham, Maine
MaineDOT WIN: 18821.00

Test Boring Designation[1]	Existing Ground Surface Elevation[2] (ft)	Test Number	Depth Below Ground Surface (ft)	Approximate Test Elevation (ft)	Vane Size[3] (mm x mm)	V_{max}[4] (ft-lbs)	$V_{remolded}$[4] (ft-lbs)	s_u[5] (psf)	$s_{u(remolded)}$[5] (psf)	S_t[6] (-)	Comments
HB-GBB-303	147.7	V1	20.6 – 21	127.1 – 126.7	65 x 130	23.0	2.5	632	69	9.2	
		V2	21.6 – 22	126.1 – 125.7	65 x 130	21.0	2.0	577	55	10.5	
		V3	25.6 – 26	122.1 – 121.7	65 x 130	22.0	1.5	604	41	14.7	
		V4	26.6 – 27	121.1 – 120.7	65 x 130	26.0	2.0	714	55	13.0	
		V5	30.6 – 31	117.1 – 116.7	65 x 130	26.0	2.0	714	55	13.0	
		V6	31.3 – 31.7	116.4 – 116	65 x 130	31.0	2.0	852	55	15.5	
		V7	35.6 – 36	112.1 – 111.7	65 x 130	31.0	2.5	852	69	12.4	
		V8	36.6 – 37	111.1 – 110.7	65 x 130	30.0	2.0	824	55	15.0	
		V9	40.6 – 41	107.1 – 106.7	65 x 130	44.3	> 1217	-	-	-	Maximum torque achieved
		MV1	41.6 – 42	106.1 – 105.7	65 x 130	-	-	-	-	-	Could not push
HB-GBB-304	152.1	V1	15.6 – 16	136.5 – 136.1	65 x 130	22.0	5.0	604	137	4.4	
		V2	16.6 – 17	135.5 – 135.1	65 x 130	18.5	4.0	508	110	4.6	
		V3	20.6 – 21	131.5 – 131.1	65 x 130	26.0	3.0	714	82	8.7	
		V4	21.6 – 22	130.5 – 130.1	65 x 130	28.5	3.0	783	82	9.5	
		V5	25.6 – 26	126.5 – 126.1	65 x 130	35.0	4.0	962	110	8.8	
		V6	26.6 – 27	125.5 – 125.1	65 x 130	37.0	5.0	1016	137	7.4	
		MV1	30.6 – 31	121.5 – 121.1	65 x 130	-	-	-	-	-	Could not push
HB-GBB-305	149.4	V1	15.6 – 16	133.8 – 133.4	65 x 130	24.0	3.0	659	82	8.0	
		V2	16.6 – 17	132.8 – 132.4	65 x 130	27.0	3.0	742	82	9.0	
		V3	22.6 – 23	126.8 – 126.4	65 x 130	30.0	3.0	824	82	10.0	
		V4	23.6 – 24	125.8 – 125.4	65 x 130	23.0	3.0	632	82	7.7	
		V5	25.6 – 26	123.8 – 123.4	65 x 130	35.0	4.0	962	110	8.8	
		MV1	26.6 – 27	122.8 – 122.4	65 x 130	-	-	-	-	-	Could not push
		V6	30.6 – 31	118.8 – 118.4	55 x 110	40.0	5.0	1786	223	8.0	
		MV2	31.6 – 32	117.8 – 117.4	55 x 110	-	-	-	-	-	Could not push

Notes:

1. Test boring locations are shown on Figure 2, Boring Location Plans.
2. As-drilled locations and elevations surveyed by MaineDOT using GPS survey equipment. Elevations reference the North American Vertical Datum of 1988 (NAVD88).
3. Geonor Rectangular Vane.
4. V_{max} and $V_{remolded}$ are the direct peak and remolded vane torque readings in ft-lbs.
5. s_u and $s_{u(remolded)}$ are the calculated (per ASTM D2573) peak and remolded undrained shear strengths, rounded to the nearest 5 psf. Conversion from torque readings to shear strength based on data from Geonor. For the 55 x 110 mm vane, 1 ft-lb = 44.65 psf. For the 65 x 130 mm vane, 1 ft-lb = 27.47 psf.
6. Sensitivity, S_t, is calculated as $s_u/s_{u(remolded)}$
7. Vane shear test results are shown on the boring logs in Appendix A.
8. ft-lbs = foot-pounds of torque, psf = pounds per square foot.

Prepared By: MEL/HTV
Checked By: KAR/MEL
Reviewed By: CCB

Table 3: Summary of Rock Core Quality
Geotechnical Design Report
Brandy Brook Culvert & Stream Relocation
Gorham, Maine
MaineDOT WIN: 18821.00

Test Boring Designation	Core Size	Existing Ground Surface Elevation[1]	Run						TCR [2]		RQD [3]			Physical Rock Parameters			Lithologic, Rock Mass and Discontinuity Description
			No.	Midpoint Depth Below Bedrock Surface	Depth Below Ground Surface (ft)			Length	Length	%	Length	%	Designation	Weathering[4]	Estimated Field Strength[4]	Rock Mass Rating [RMR][5]	
	(in)	(ft)		(ft)	Start	End	Midpoint	(ft)	(ft)		(ft)						
HB-GBB-201	NQ [1.875"]	143.8	R1	2.5	56.6	61.6	59.1	5.0	4.83	97%	4.58	92%	Excellent	Slightly Weathered (W2)	Strong (R4)	58	56.5-61.5 ft: Light to dark grey, fine grained, slightly weathered (W2), strong (R4), slightly-metamorphosed SANDSTONE (GRANOFELS); with thin white quartz veins and thin bands of biotite throughout.; planar discontinuities, mostly subvertical and along biotite foliations, smooth, moderately spaced (14" - 20"), 57.5 ft. - 57.7 ft. minor (<1mm) mineral infilling on fracture surface, 60.8 ft. - 61.5 silt infilling in fractures and minor rust staining on fracture surfaces, core more broken up [Hutchins Corner Formation].
HB-GBB-202A	NQ [1.875"]	143.8	R1	2.5	59.0	64.0	61.5	5.0	3.63	73%	3.44	69%	Fair	Slightly Weathered (W2)	Strong (R4) to Very Strong (R5)	51	59 ft. - 69 ft. Light to dark slightly weathered (W2), strong to very strong (R4 to R5), slightly-metamorphosed SANDSTONE (GRANOFELS); with thin white quartz veins, thin bands of biotite, and small pyrite crystals throughout. Discontinuities very close to moderately spaced (1" to 23.5"); 59 ft. to 61.5 ft. vertical planar discontinuity, smooth, traces of silt and fine sand along fracture, minor iron staining; At 66.5 ft. smooth planar fracture 30 deg. from vertical, 1 - 2 mm thick mineral infilling on fracture surface [Hutchins Corner Formation].
			R2	7.5	64.0	69.0	66.5	5.0	5.00	100%	4.92	98%	Excellent	Slightly Weathered (W2)	Strong (R4) to Very Strong (R5)	60	
HB-GBB-203	NQ [1.875"]	145.1	R1	2.5	51.2	56.2	53.7	5.0	3.65	73%	2.25	45%	Poor	Slightly Weathered (W2)	Strong (R4)	45	51.2-56.2 ft: Light to dark grey, fine grained, slightly weathered (W2), strong (R4), slightly-metamorphosed SANDSTONE (GRANOFELS); with thin white quartz veins and thin bands of biotite throughout.; planar discontinuities, ~45 deg., smooth to rough, discontinuities closely spaced (2.75" to 7"), minor (<1 mm) silt infilling on fracture surfaces, 51.6 ft. to 51.9 ft. possible granitic intrusion, fine to medium grained pink granite [Hutchins Corner Formation].
HB-GBB-204	NQ [1.875"]	145.3	R1	2.5	40.5	45.5	43.0	5.0	4.58	92%	4.33	87%	Good	Slightly Weathered (W2)	Strong (R4)	57	40.5-45.5 ft: Light to medium grey, fine grained, slightly weathered (W2), strong (R4), slightly-metamorphosed SANDSTONE (GRANOFELS); with thin white quartz veins, thin bands of biotite and small pyrite crystals throughout.; planar discontinuities, ~30 deg. from vertical, smooth,moderately spaced (16.5 in. apart), minor (<1mm) mineral infilling on fracture surface [Hutchins Corner Formation].
HB-GBB-205	NQ [1.875"]	151.8	R1	2.5	50.0	55.0	52.5	5.0	4.17	83%	3.71	74%	Good	Slightly Weathered (W2)	Strong (R4)	54	56.5-61.5 ft: Light to dark grey, fine grained, slightly weathered (W2), strong (R4), slightly-metamorphosed SANDSTONE (GRANOFELS); with white quartz veins (up to 1" thick), thin bands of biotite, and small pyrite crystals throughout.; planar to wavy discontinuities, smooth to rough, discontinuities extremely closely to moderately spaced (0.5" to 21.5"); 56.5 ft. - 58.5 ft. silt/clay infilling of dizcontinuities (<1mm to 2mm thick); Broken core from 59 ft. to 60.5 ft. [Hutchins Corner Formation].
			R2	7.8	55.0	60.5	57.8	5.5	5.46	99%	3.48	63%	Good	Slightly Weathered (W2)	Strong (R4)	50	

Notes:

1. As-drilled locations and elevations for 200-series borings are derived from MaineDOT "BOR1-4-17MDOTedit.csv" received on January 18, 2017.
2. TCR = total core recovery. Total core recovery is the length of core recovered divided by the length of the run.
3. RQD = rock quality designation. RQD is the total length of intact, full diameter core pieces recovered with a length greater than or equal to twice the core diameter (i.e., length of 4 inches) measured along the core axis. The percent RQD is the total length of RQD measured versus the run length. Note that vertical discontinuities are not included in determination of RQD.
4. Weathering and Estimated Field Strength based on Tables II.4 and II.3 (respectively) in Willey, 2004 (based on ISRM, 1981).
5. Rock Mass Rating System (Bieniawski, 1989) assigns numerical ratings to six parameters, including the strength of the intact rock, the RQD, the discontinuity spacing, groundwater conditions, and orientation of discontinuities. These ratings are summed to give the RMR value. As proposed foundation of box culvert will be a slab on grade, the rating adjustment for joint orientation was assigned a value of 0. Correlation of geologic field mapping data of exposed rock outcrops with the rock core samples and proposed foundation type may allow for a different rating adjustment for joint orientation, and thus a modification to the RMR value shown on this table.

Prepared by: LLM
Checked by: MEL / JRS
Reviewed by: CCB

Table 4: Summary of Laboratory Soil Index and Classification Testing Results
Geotechnical Design Recommendation Report
Brandy Brook Culvert
Gorham, Maine
MaineDOT WIN 18821.00

Test Boring Designation[1]	Existing Ground Surface Elevation [2] (ft)	Sample Number	Sample Depth Below Ground Surface (ft)	Approximate Sample Elevation (ft)	Sieve Minus No. 200 (%):	Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Liquidity Index	Specific Gravity	AASHTO Soil Classification[3,4]	USCS Soil Classification[3,4]	Frost Classification[5]
HB-GBB-101	142.6	1U	20.0 - 22.0	122.6 - 120.6	98.4	35.5	33	21	12	1.2	-	A-6	CL	III
HB-GBB-201	143.8	2D	3.5 - 5.5	140.3 - 138.3	13.4	4.8	-	-	-	-	-	A-1-b	SM	II
		7D	15.0 - 17.0	128.8 126.8	-	26.4	39	22	17	-	-	A-6	CL	III
		8D	17.0 - 19.0	126.8 124.8	93.9	32.9	-	-	-	-	2.7	A-6	CL	III
		9D	20.0 - 22.0	123.8 - 121.8	-	37.2	43	24	19	-	-	A-7-6	CL	III
		U2	35.0 - 37.0	108.8 106.8	-	31.0	32	19	13	0.9	-	A-6	CL	-
		12D	45.0 - 47.0	98.8 - 96.8	99.1	39.3	-	-	-	-	2.72	A-7-6	CL	III
HB-GBB-202A	143.8	7D	12.0 - 14.0	131.8 - 129.8	45.6	24.6	-	-	-	-	2.63	A-4	SC-SM	II
		9D	16.0 18.0	127.8 - 125.8	89.0	32.5	-	-	-	-	2.69	A-4	CL	IV
		1U	20.0 - 22.0	123.8 - 121.8	-	40.0	38	20	18	1.1	-	A-6	CL	-
		12D	35.0 - 37.0	108.8 - 106.8	-	32.0	28	20	8	-	-	A-4	CL	IV
		14D	50.0 - 52.0	93.8 - 91.8	99.0	37.0	-	-	-	-	2.75	A-4	CL	IV
HB-GBB-203	145.1	1D	1.5 - 3.5	143.6 - 141.6	12.0	5.6	-	-	-	-	-	A-1-b	SM	II
		5D	15.5 - 17.5	129.6 - 127.6	98.4	35.0	-	-	-	-	2.74	A-7-6	CL	III
		6D	17.5 - 19.5	127.6 - 125.6	-	33.1	43	24	19	-	-	A-7-6	CL	III
		U1	25.0 - 27.0	120.1 - 118.1	-	38.0	32	19	13	1.5	-	A-6	CL	-
		7D	30.0 - 32.0	115.1 - 113.1	98.8	36.3	-	-	-	-	2.75	A-7-6	CL	III
		9D	40.0 - 42.0	105.1 - 103.1	-	37.9	41	22	19	-	-	A-7-6	CL	III
HB-GBB-204	145.3	1D	1.0 3.0	144.1 142.1	12.1	4.6	-	-	-	-	-	A-1-b	SM	II
		2D	3.0 - 5.0	142.3 - 140.3	89.4	25.6	-	-	-	-	2.63	A-7-6	CL	III
		5D	10.0 - 12.0	135.3 - 133.3	91.2	25.2	-	-	-	-	2.68	A-7-6	CL	III
		7D	25.0 - 27.0	120.3 118.3	-	42.5	41	23	18	-	-	A-7-6	CL	III
		8DA	35.0 - 37.0	110.3 - 108.3	-	37.3	33	19	14	-	-	A-6	CL	III
HB-GBB-205	151.8	4D	7.0 - 9.0	144.8 - 142.8	58.6	17.4	24	18	6	-	2.75	A-4	CL-ML	IV
		6D	15.0 17.0	136.8 - 134.8	68.9	34.9	-	-	-	-	2.68	A-4	CL	IV
		8D	30.0 32.0	121.8 - 119.8	-	38.9	37	23	14	-	-	A-6	CL	III
		10D	40.0 - 42.0	111.8 - 109.8	12.4	10.2	-	-	-	-	-	A-1-b	SM	II
HB-GBB-301	138.3	2D	5.0 - 7.0	133.3 - 131.3	30.5	17.9	-	-	-	-	-	A-2-4	SM	II
		3D	10.0 - 12.0	128.3 - 126.3	66.8	26.8	26	19	7	1.1	2.62	A-4	CL-ML	IV
		1U	20.0 - 22.5	118.3 - 115.8	98.2	44.2	37	25	12	1.6	2.77	A-6	CL-ML	III
		5D	25.0 - 27.0	113.3 - 111.3	98.9	33.9	29	21	8	1.6	2.62	A-4	CL	IV
		2U	30.0 - 32.5	108.3 - 105.8	98.3	40.3	35	24	11	1.5	2.69	A-6	CL-ML	IV
		6D	35.0 - 37.0	103.3 - 101.3	-	34.9	-	-	-	-	-	-	-	-
HB-GBB-302	149.2	2D	2.0 - 4.0	147.2 - 145.2	22.9	21.3	-	-	-	-	-	A-2-4	SM	II
		3D	4.0 - 6.0	145.2 - 143.2	70.2	21.0	26	18	8	0.4	2.59	A-4	CL	IV
		6D	10.0 - 12.0	139.2 - 137.2	-	32.7	-	-	-	-	-	-	-	-
		8D	15.0 - 17.0	134.2 - 132.2	99.0	42.4	-	-	-	-	2.69	A-4	CL-ML	IV
		9D	20.0 - 22.0	129.2 - 127.2	-	37.4	31	22	9	1.7	-	A-4	CL	IV

Table 4: Summary of Laboratory Soil Index and Classification Testing Results
Geotechnical Design Recommendation Report
Brandy Brook Culvert
Gorham, Maine
MaineDOT WIN 18821.00

Test Boring Designation[1]	Existing Ground Surface Elevation [2] (ft)	Sample Number	Sample Depth Below Ground Surface (ft)	Approximate Sample Elevation (ft)	Sieve Minus No. 200 (%):	Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Liquidity Index	Specific Gravity	AASHTO Soil Classification[3,4]	USCS Soil Classification[3,4]	Frost Classification[5]
HB-GBB-303	147.7	1D	0.0 - 2.0	147.7 - 145.7	19.9	7.3	-	-	-	-	-	A-1-b	SM	II
		2D	5.0 - 7.0	142.7 - 140.7	20.2	17.8	-	-	-	-	-	A-2-4	SM	II
		3D	10.0 - 12.0	137.7 - 135.7	81.0	14.3	-	-	-	-	2.73	A-4	CL-ML	IV
		4D	15.0 - 17.0	132.7 - 130.7	-	45.1	-	24	-	-	-	-	-	-
		7D	30.0 - 32.0	117.7 - 115.7	-	37.5	-	-	-	-	-	-	-	-
HB-GBB-304	152.1	2D	2.0 - 4.0	150.1 - 148.1	17.6	5.9	-	-	-	-	-	A-1-b	SM	II
		4D	6.0 - 8.0	146.1 - 144.1	11.4	17.6	-	-	-	-	-	A-2-4	SP-SM	0
		6D	10.0 - 12.0	142.1 - 140.1	92.1	35.7	32	21	11	1.3	2.68	A-6	CL	IV
		7D	15.0 - 17.0	137.1 - 135.1	-	39.9	34	23	11	1.5	-	A-6	CL	IV
HB-GBB-305	149.4	2D	5.0 - 7.0	144.4 - 142.4	21.1	66.7	-	NP	-	-	2.62	A-2-4	SC-SM	II
		3D	10.0 - 12.0	139.4 - 137.4	-	33.6	-	-	-	-	-	-	-	-
		4D	15.0 - 17.0	134.4 - 132.4	-	29.0	35	22	13	0.5	-	A-6	CL	III
		1U	20.0 - 22.0	129.4 - 127.4	99.4	46.4	41	37	4	2.4	2.70	A-5	ML	IV
		5D	25.0 - 27.0	124.4 - 122.4	-	41.9	33	25	8	2.1	-	A-4	ML	IV
		7D	35.0 - 37.0	114.4 - 112.4	24.4	11.0	-	-	-	-	-	A-2-4	SM	II

Notes:

1. Test boring locations are shown in Figure 2 entitled "Boring Location Plan"
2. As-drilled elevations are derived from MaineDOT "BOR1-4-17MEDOTedit.csv" received by Golder on January 18, 2017 via email for 200-series borings and "18821GorhamClearanceReport.xlsx" via email for 300-series borings on January 28, 2018.
3. AASHTO and USCS symbols assigned based on interpretation of laboratory test results.
4. Laboratory testing for all split spoon samples and 300-series undisturbed tube samples was performed by MaineDOT. Laboratory testing for 200-series undisturbed tube samples was performed by GeoTesting Express, Inc. Complete laboratory soil test results are provided in Appendix B.
5. Frost classification provided by MaineDOT in reported laboratory data.

Prepared By: MEL/HTV
Checked By: KAR/MEL
Reviewed By: CCB

Table 5: Summary of Laboratory Engineering Property Testing and Results
Geotechnical Design Recommendation Report
Brandy Brook Culvert & Stream Relocation
Gorham, Maine
MaineDOT WIN 18821.00

Test Boring Designation[1]	Existing Ground Surface[2]	Sample Number	Sample Depth Below Ground Surface	Approximate Sample Elevation	Tube X-Ray	Tube Log	Engineering Property Test Type[3]	Test Number	Bulk Unit Weight[4]	In situ vertical effective stress, σ'_v[5]	Undrained Shear Strength[6]	Preconsolidation Stress, σ'_p[7]	Recompression Index, C_r[8]	Compression Index, C_c[8]	Coefficient of Consolidation, c_v[9]	Comments
(-)	(ft)	(-)	(ft)	(ft)	(-)	(-)	(-)	(-)	(pcf)	(psf)	(psf)	(psf)	(-)	(-)	(ft^2/day)	(-)
HB-GBB-101	142.6	1U	20.0 - 22.0	122.6 - 120.6	no	no	ILC	210291	111	1629	-	N/A	0.01	0.17	0.03	Consolidation curve flat through recompression into normal compression. C_r likely low, σ'_p not able to be determined
HB-GBB-201	143.8	2U	35.0 - 37.0	108.8 - 106.8	yes	yes	CIUC, ILC	CU-2-1, IP-2	118	2236	928	4000	0.03	0.54	0.52	CIUC Consolidation stress = 2400 psf (init. est. in situ σ'_v)
HB-GBB-202A	143.8	1U	20.0 - 22.0	123.8 - 121.8	yes	yes	CIUC, ILC	CU-3-1, IP-3	114	1340	624	1360	0.10	0.31	0.07	CIUC Consolidation stress = 1700 psf (init. est. in situ σ'_v)
HB-GBB-203	145.1	1U	25.0 - 27.5	120.1 - 117.6	yes	yes	CIUC, ILC	CU-1-1, IP-1	107	2013	809	2400	0.06	0.40	0.13	CIUC Consolidation stress = 1800 psf (init. est. in situ σ'_v)
HB-GBB-301	138.3	1U	20.0 - 22.5	118.3 - 115.8	no	no	ILC	303043	111	1608	-	4000	0.07	0.57	0.26	-
		2U	30.0 - 32.5	108.3 - 105.8	no	no	ILC	303046A	111	2104	-	500	0.11	0.27	0.03	-
HB-GBB-305	149.4	1U	20.0 - 22.5	129.4 - 126.9	no	no	ILC	303077	109	1802	-	4000	0.03	0.61	0.52	-

Notes:

1. Test boring locations are shown on Figure 2 entitled "Boring Location Plan".
2. As-drilled locations and elevations surveyed by MaineDOT using GPS survey equipment. Elevations reference the North American Vertical Datum of 1988 (NAVD88).
3. ILC= Incremental Load Consolidation, CIUC= Consolidated Isotropic Undrained Compression Triaxial Shear
4. Bulk unit weight values were measured during engineering property testing. Refer to Appendix C for more detailed laboratory results.
5. In situ vertical effective stress for each sample was estimated using the interpreted soil profiles (Figures 3 and 4), engineering properties profile (Figure 5), average water table, and estimates or measurements of unit weight for each soil type in the profile.
6. Undrained shear strength determined as the peak of the stress vs. strain plot resulting from isotropically consolidated undrained compression triaxial (CIUC) tests.
7. Preconsolidation stress determind using the Casagrande Construction method on stress vs. void ratio plots from incremental load consolidation (ILC) tests.
8. Recompression and compression indices were determined by interpretation of stress vs. void ratio plots from incremental load consolidation (ILC) tests.
9. Coefficient of consolidation values reported are from the incremental load consolidation test load increment closest to the estimated in situ vertical effective stress state.
10. Complete laboratory test results for soil testing are provided in Appendix C.
11. Laboratory testing was performed by GeoTesting Express, Inc. for the 200-series boring samples and MaineDOT for the 300-series boring samples

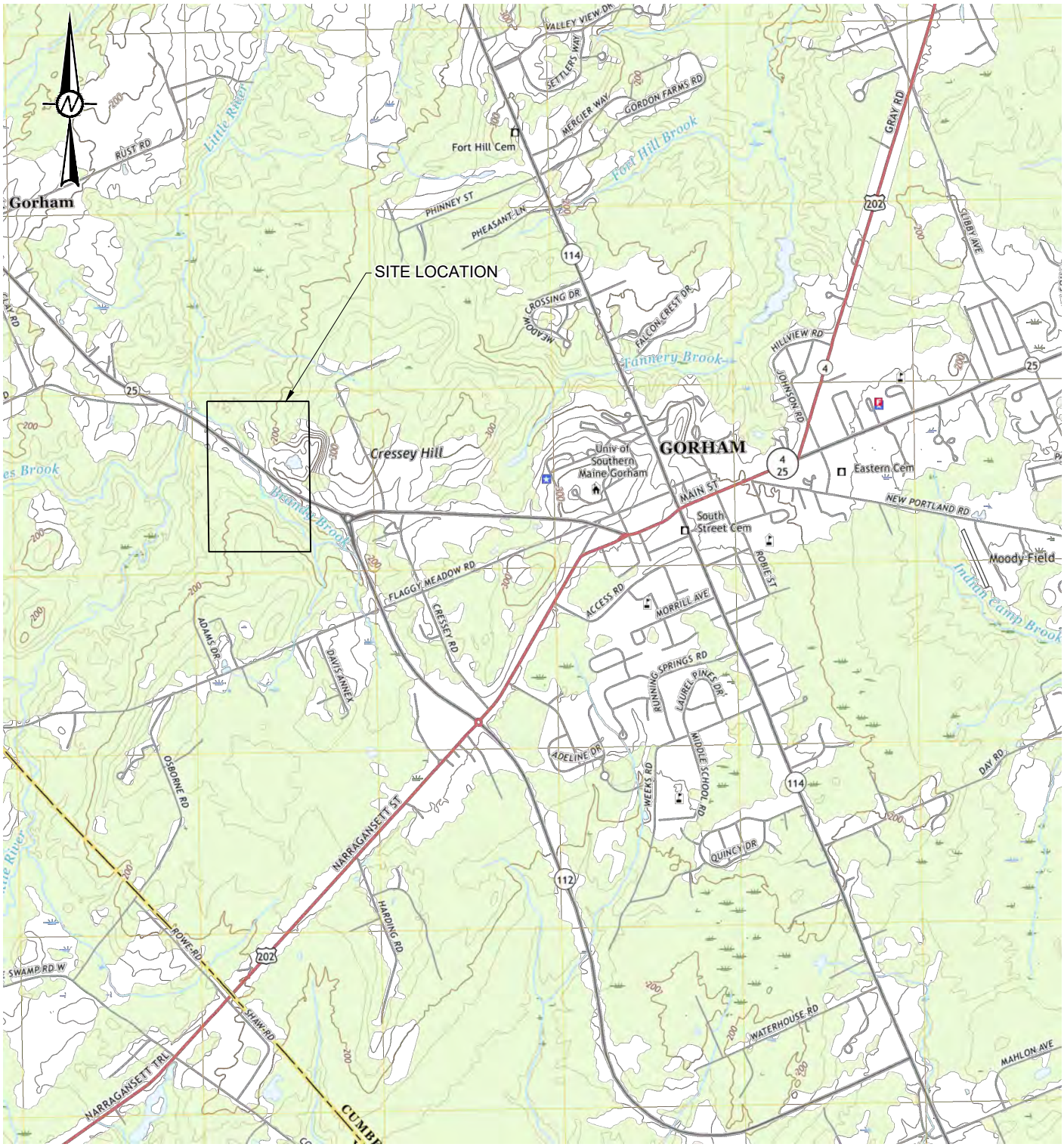
Prepared By: MEL
Checked By: KAR
Reviewed By: JDL

Table 6: Summary of Slope Stability Analysis Scenarios and Resulting Factors of Safety
Geotechnical Design Recommendation Report
Brandy Brook Culvert & Stream Relocation
Gorham, Maine
MaineDOT WIN 18821.00

Station	Rip Rap	Slope	Analysis Method	Minimum Factor of Safety
13+75	None	2H:1V SR 25 to stream bed	Non Circular - Spencer	1.36
13+75	None	2.5H:1V NE slope to stream bed	Non Circular - Spencer	1.60
13+75	2 feet	2H:1V SR 25 to stream bed	Non Circular - Spencer	1.36
13+75	2 feet	2.5H:1V NE slope to stream bed	Non Circular - Spencer	1.50
14+25	None	2H:1V SR 25 to stream bed	Non Circular - Spencer	1.36
14+25	None	2.5H:1V NE slope to stream bed	Non Circular - Spencer	1.53
14+25	2 feet	2H:1V SR 25 to stream bed	Non Circular - Spencer	1.36
14+25	2 feet	2.5H:1V NE slope to stream bed	Non Circular - Spencer	1.51
14+75	None	2H:1V SR 25 to stream bed	Non Circular - Spencer	1.30
14+75	None	2.5H:1V NE slope to stream bed	Non Circular - Spencer	1.35
14+75	2 feet	2H:1V SR 25 to stream bed	Non Circular - Spencer	1.30
14+75	2 feet	2.5H:1V NE slope to stream bed	Non Circular - Spencer	1.31

Prepared by: MEL
Checked by: KAR
Reviewed by: JDL

FIGURES



REFERENCE(S)

BASE MAP TAKEN FROM U.S.G.S. MAP TITLE, "GORHAM, ME" DATED 2018. PROVIDED BY USGS STORE.

0 1/4 1/2
1" = 1/2 mi MILES

CLIENT
MAINE DEPARTMENT OF TRANSPORTATION
16 STATE HOUSE STATION
AUGUSTA, MAINE 04333

CONSULTANT
GOLDER

YYYY-MM-DD	2020-04-15
DESIGNED	MEL
PREPARED	MPB
REVIEWED	CJS
APPROVED	JDL

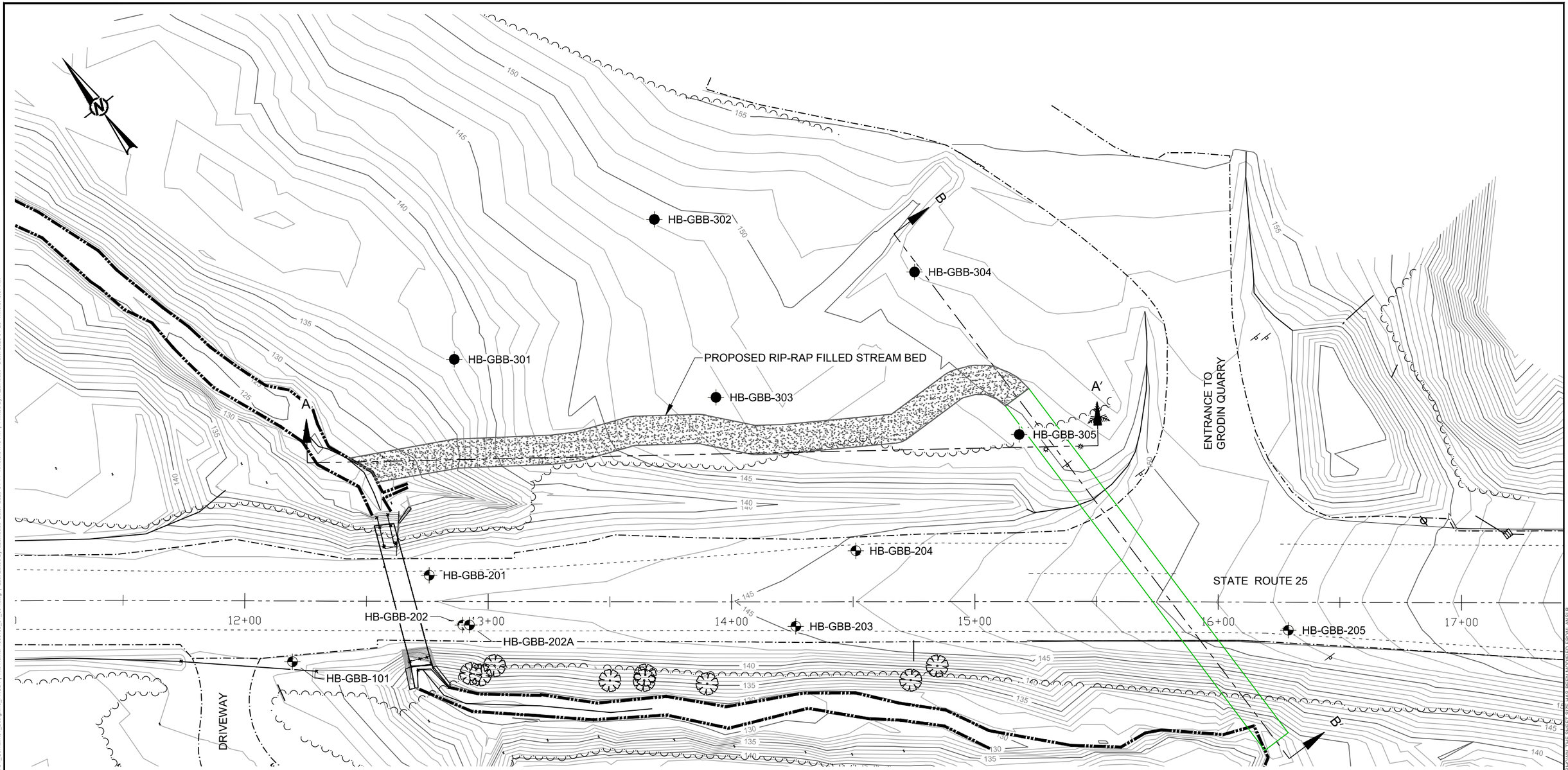
PROJECT
CULVERT REPLACEMENT AND STREAM RELOCATION
STATE ROUTE 25, GORHAM, ME WIN 18821.00

TITLE
SITE LOCATION MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1669139	04	0	01

Last Edited By: azumbado Date: 2020-04-14 Time:5:04:31 PM | Printed By: AZumbado Date: 2020-04-20 Time:9:15:11 AM
Path: \\golder.gds\complexdata\Office\Manchester\SIM\MEDOT\Gorham, ME\99_PROJ\1669139_MEDOT_Gorham\04_Design\40_PROD\ | File Name: 1669139_04_005.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A
0 1 in



LEGEND

HB-GBB-301	2018 TEST BORING LOCATION
HB-GBB-201	2016/2017 TEST BORING LOCATION
A	SUBSURFACE SECTION LOCATION
15+00	PROJECT STATIONING
	EXISTING TREES
	EXISTING CULVERT LOCATION
	PROPOSED APPROXIMATE CULVERT LOCATION

REFERENCES:

1. AS DRILLED BORING LOCATION PLAN DERIVED FROM ELECTRONIC BASE PLAN FILE NAME: "3D CONTOURS.DGN" PROVIDED TO GOLDER BY MaineDOT ON 12/19/2016.
2. AS-DRILLED LOCATIONS AND ELEVATIONS FOR THE 200 SERIES BORINGS ARE DERIVED FROM MAINEDOT "BOR1-4-17MDOTEDIT.CSV" RECEIVED BY GOLDER ON JANUARY 18, 2017.
3. AS-DRILLED LOCATIONS AND ELEVATIONS FOR THE 300 SERIES BORINGS ARE DERIVED FROM MAINEDOT "18821 GORHAM CLEARANCE REPORT.XLSX" RECEIVED BY GOLDER ON JANUARY 26, 2018.

0 20 40
1" = 40' FEET

CLIENT
MAINE DEPARTMENT OF TRANSPORTATION
16 STATE HOUSE STATION
AUGUSTA, MAINE 04333

CONSULTANT
GOLDER

YYYY-MM-DD	2020-04-15
DESIGNED	MEL
PREPARED	AAZ
REVIEWED	CJS
APPROVED	JDL

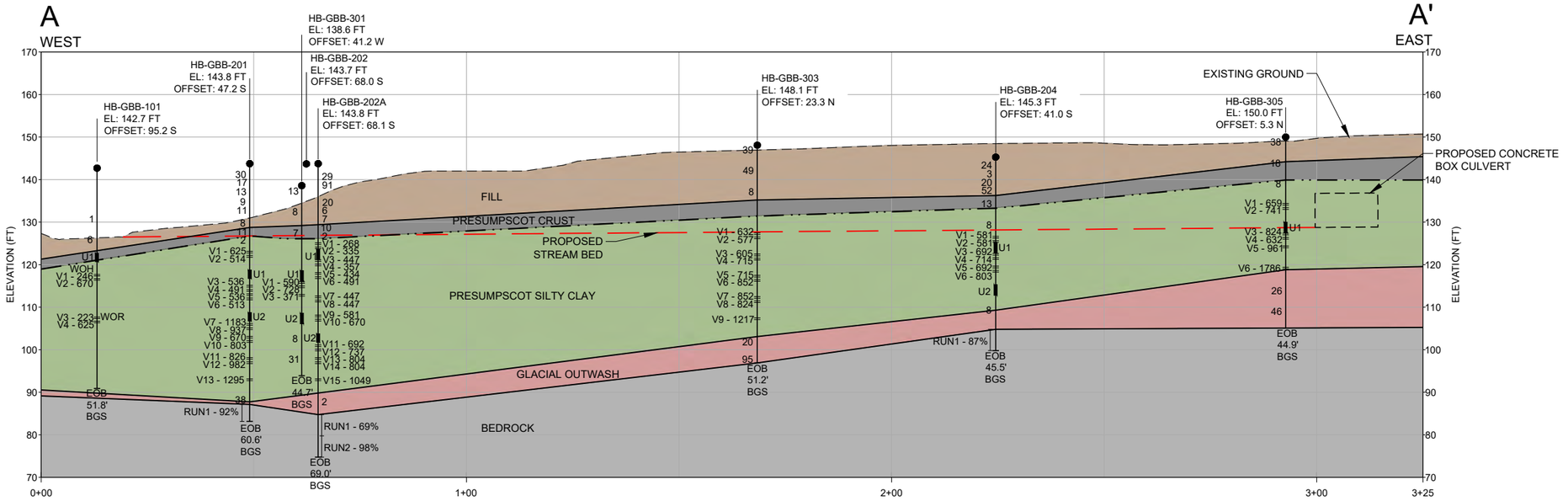
PROJECT
CULVERT REPLACEMENT AND STREAM RELOCATION
STATE ROUTE 25, GORHAM, ME WIN 18821.00

TITLE
BORING LOCATION PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
1669139	04	0	02

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Path: \\golder.gds\corp\excdata\Office\Manchester\SM\MEDOT\Gorham, ME\99_PROJ\1669139_MEDOT_Gorham\04_Design\40_PROD\ | File Name: 1669139_04_004.dwg | Last Edited By: azumbado Date: 2020-04-14 Time:5:04:43 PM | Printed By: AZumbado Date: 2020-04-20 Time:9:16:07 AM



LEGEND

BB-GBB-201
EL: 143.8'
OFFSET: 47.2' S
BORING LOCATION I.D.
ELEVATION
OFFSET FROM SECTION LINE

30 — SPT: N_{60} - VALUE

U1 — SHELBY TUBE SAMPLE LOCATION

V1 - 625 — FIELD VANE SHEAR TEST LOCATION

RUN1 - 92% — ROCK CORE RUN NUMBER AND RQD

EOB 60.6' BGS — END OF BORING DEPTH BELOW GROUND SURFACE (BGS)

- BROWN TO GREY, LOOSE TO VERY DENSE, SILTY FINE TO COARSE SAND AND GRAVEL (FILL)
- GREY, MEDIUM STIFF TO STIFF, SILTY CLAY, SILTY/CLAYEY FINE SAND, SANDY SILT (PRESUMPSCOT CRUST)
- GREY, VERY SOFT TO STIFF, SILTY CLAY (PRESUMPSCOT SILTY CLAY)
- BROWN TO GREY, MEDIUM DENSE TO VERY DENSE, FINE TO COARSE SAND, SOME SILT/CLAY, LITTLE GRAVEL (GLACIAL OUTWASH)
- LIGHT TO DARK GREY, FINE-GRAINED SCHIST, STRONG TO VERY STRONG, SLIGHTLY WEATHERED (WINDHAM FORMATION)
- PROPOSED 12' SPAN x 8' RISE 176' LENGTH PRECAST CONCRETE BOX CULVERT

REFERENCES:

1. AS DRILLED BORING LOCATION PLAN DERIVED FROM ELECTRONIC BASE PLAN FILE NAME: "3D Contours.dgn" PROVIDED TO GOLDER BY MaineDOT ON 12/19/2016.
2. AS-DRILLED LOCATIONS AND ELEVATIONS FOR THE 200 SERIES BORINGS ARE DERIVED FROM MAINEDOT "BOR1-4-17MDOTEDIT.CSV" RECEIVED BY GOLDER ON JANUARY 18, 2017.
3. AS-DRILLED LOCATIONS AND ELEVATIONS FOR THE 300 SERIES BORINGS ARE DERIVED FROM MAINEDOT "18821 GORHAM CLEARANCE REPORT.XLSX" RECEIVED BY GOLDER ON JANUARY 26, 2018.

0 15 30
1" = 30'
FEET

CLIENT
MAINE DEPARTMENT OF TRANSPORTATION
16 STATE HOUSE STATION
AUGUSTA, MAINE 04333

CONSULTANT
GOLDER

YYYY-MM-DD	2020-04-15
DESIGNED	MEL
PREPARED	AAZ
REVIEWED	CJS
APPROVED	JDL

PROJECT
CULVERT REPLACEMENT AND STREAM RELOCATION
STATE ROUTE 25, GORHAM, ME WIN 18821.00

TITLE
INTERPRETED SUBSURFACE PROFILE A-A'

PROJECT NO.	CONTROL	REV.	FIGURE
1669139	04	0	03

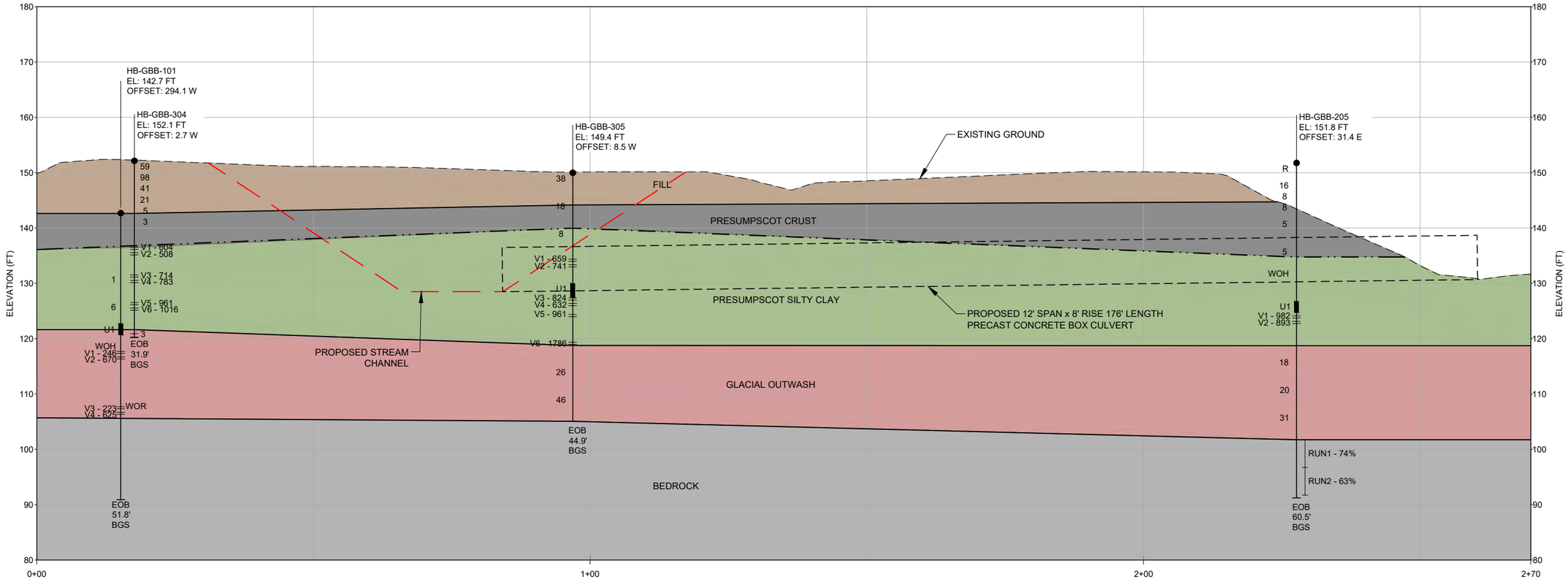
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1 in
0

Path: \\golder.gds\corp\kecdata\Office\Manchester\SM\MMEDOT\Gorham, ME\99_PROJ\1669139_MEDOT_Gorham\04_Design\40_PROD\ | File Name: 1669139_04_002.dwg | Last Edited By: azumbado Date: 2020-04-15 Time:1:52:36 PM | Printed By: AZumbado Date: 2020-04-20 Time:9:16:45 AM

B
NORTH

B'
SOUTH



LEGEND

HB-GBB-304 EL: 152.2' OFFSET: 2.7' W	BORING LOCATION I.D. ELEVATION OFFSET FROM SECTION LINE
59	SPT: N_{60} - VALUE
U1	SHELBY TUBE SAMPLE LOCATION
V1 - 604	FIELD VANE SHEAR TEST LOCATION
RUN1 - 92%	ROCK CORE RUN NUMBER AND RQD
EOB 31.9' BGS	END OF BORING DEPTH BELOW GROUND SURFACE (BGS)

- BROWN TO GREY, LOOSE TO VERY DENSE, SILTY FINE TO COARSE SAND AND GRAVEL (FILL)
- GREY, MEDIUM STIFF TO STIFF, SILTY CLAY, SILTY/CLAYEY FINE SAND, SANDY SILT (PRESUMPSCOT CRUST)
- GREY, VERY SOFT TO STIFF, SILTY CLAY (PRESUMPSCOT SILTY CLAY)
- BROWN TO GREY, MEDIUM DENSE TO VERY DENSE, FINE TO COARSE SAND, SOME SILT/CLAY, LITTLE GRAVEL (GLACIAL OUTWASH)
- LIGHT TO DARK GREY, FINE-GRAINED SCHIST, STRONG TO VERY STRONG, SLIGHTLY WEATHERED (WINDHAM FORMATION)

REFERENCES:

1. AS DRILLED BORING LOCATION PLAN DERIVED FROM ELECTRONIC BASE PLAN FILE NAME: "3D Contours.dgn" PROVIDED TO GOLDER BY MaineDOT ON 12/19/2016.
2. AS-DRILLED LOCATIONS AND ELEVATIONS FOR THE 200 SERIES BORINGS ARE DERIVED FROM MAINEDOT "BOR1-4-17MDOTEDIT.CSV" RECEIVED BY GOLDER ON JANUARY 18, 2017.
3. AS-DRILLED LOCATIONS AND ELEVATIONS FOR THE 300 SERIES BORINGS ARE DERIVED FROM MAINEDOT "18821 GORHAM CLEARANCE REPORT.XLSX" RECEIVED BY GOLDER ON JANUARY 26, 2018.

0 10 20
1" = 20' FEET

CLIENT
MAINE DEPARTMENT OF TRANSPORTATION
16 STATE HOUSE STATION
AUGUSTA, MAINE 04333

CONSULTANT
GOLDER

YYYY-MM-DD	2020-04-15
DESIGNED	MEL
PREPARED	AAZ
REVIEWED	CJS
APPROVED	JDL

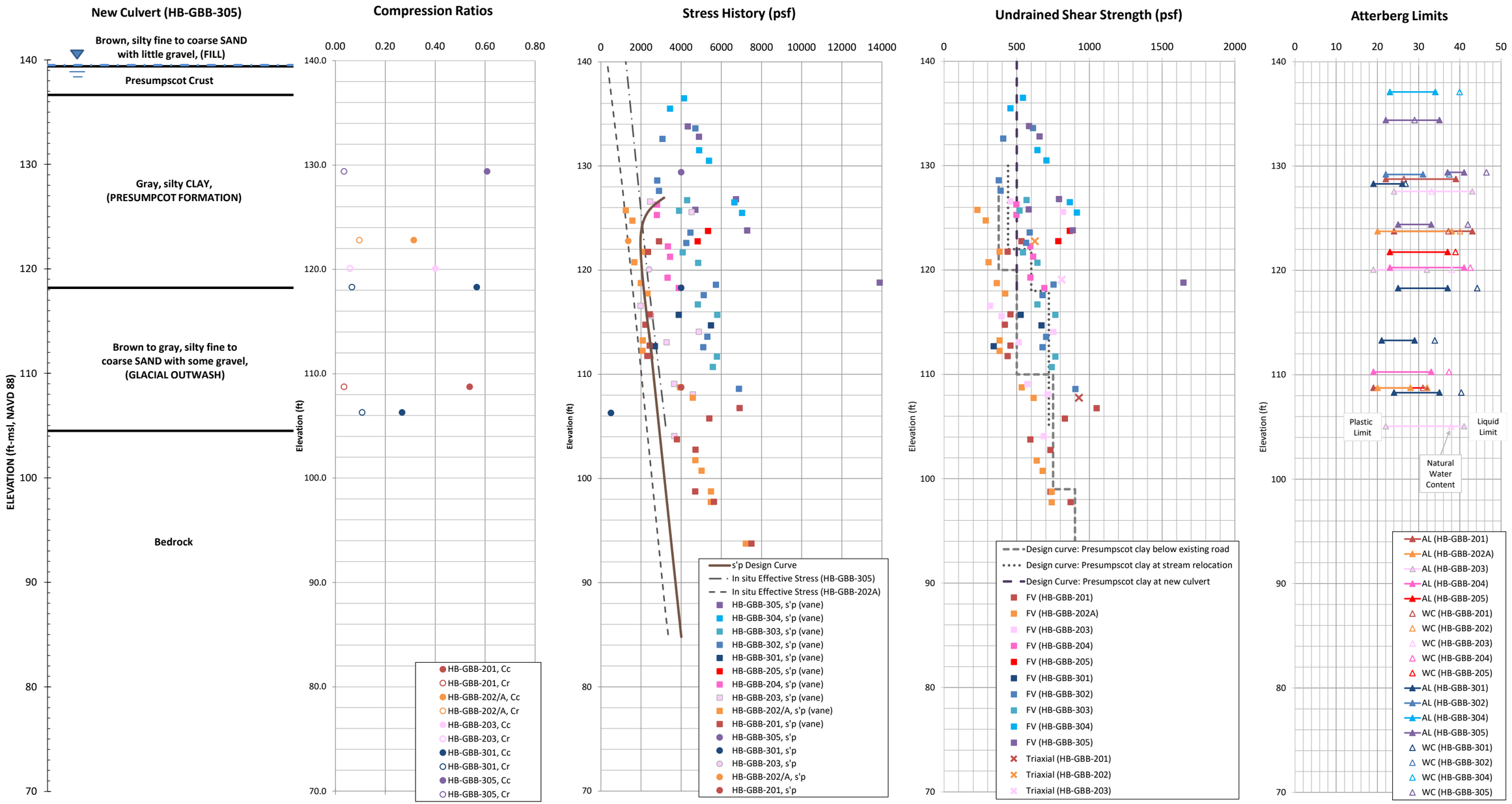
PROJECT
CULVERT REPLACEMENT AND STREAM RELOCATION
STATE ROUTE 25, GORHAM, ME WIN 18821.00

TITLE
INTERPRETED SUBSURFACE PROFILE B-B'

PROJECT NO.	CONTROL	REV.	FIGURE
1669139	04	0	04

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Path: \\golder.gds\complexdata\Office\Manchester\SNM\MEDOT\Gorham, ME\99_PROJ\1669139_MEDOT_Gorham\04_Design\40_PROD\ | File Name: 1669139_04_003.dwg | Last Edited By: azumbado Date: 2020-04-15 Time:1:32:59 PM | Printed By: AZumbado Date: 2020-04-20 Time:9:17:16 AM



Notes:
1) Subsurface profile displayed on this chart is generalized. Actual subsurface conditions will vary across the site. For more detailed soil descriptions, refer to the boring logs in Appendix A.
2) Peak vane shear test (VST) data presented in this chart is corrected for plasticity index.
3) Boring locations are shown on Figure 2.
4) σ'_p from Casagrande constructions are intended to indicate the "most probable" value for past maximum vertical effective stress at the location of the existing culvert.

Job No. 1669139	SCALE: N/A	**Depth Plots of Key Engineering Parameters**	
DR. BY: KAR	DATE: 11/11/2019		
CHK BY: MEL	DATE: 11/21/2019		
REV BY: JDL	DATE: 11/21/2019	MaineDOT WIN 18821.00 Gorham Brandy Brook Culvert Replacement Gorham, ME	**Figure: 5**
Golder Associates			

APPENDIX A

Boring Logs

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: MaineDOT Gorham Culvert & Wall
Location: Gorham, Maine

Boring No.: HB-GBB-101
WIN: 10801.00

Driller:	MaineDOT	**Elevation (ft.)**	142.6	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	E. Giguere/C. Giles	**Datum:**	NAVD 88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	4/3/08; 08:30-13:00	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	N/A
Boring Location:	12+19.7, 25.0 Rt.	**Casing ID/OD:**	HW	**Water Level*:**	None Observed
Hammer Efficiency Factor: 0.77		**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

Sample Information

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							SSA	142.2		TOPSOIL, sod and grass	
								142.0		0.4	
										Brown, wet, silty, fine to medium SAND. (Fill)	
5							18				
							14				
							11	135.6		7.0	
							10				
							9				
10	1D	24/13	10.00 - 12.00	1/1/WOH/1	1	1	4			Grey, saturated, very loose, silty fine to medium SAND, trace clay	
							8				
							9				
							10				
							15	128.1			
15	2D	24/18	15.00 - 17.00	2/3/2/WOH	5	6	WOH			Grey, wet, medium stiff, clayey-SILT, trace fine sand	
							8				
							9				
							9				
							8				
20	IU	24/24	20.00 - 22.00	Hydraulic Push			WOH	122.6		20.0	G,C#210291 A-6, CL WC=35.5% LL=33.0 PL=21.0 PI=12
							3			Grey, wet, very soft, clayey-SILT, trace fine sand	
	3D/MV	24/24	22.00 - 24.00	WOH/WOH/WOH/ WOH	-		WOH			Similar to above. 65x130mm failed vane attempt, would not push	
							WOH				
25							WOH				

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: MaineDOT Gorham Culvert & Wall
Location: Gorham, Maine

Boring No.: HB-GBB-101
WIN: 10801.00

Driller:	MaineDOT	**Elevation (ft.)**	142.6	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	E. Giguere/C. Giles	**Datum:**	NAVD 88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	4/3/08; 08:30-13:00	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	N/A
Boring Location:	12+19.7, 25.0 Rt.	**Casing ID/OD:**	HW	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.77	**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	V1		25.00 - 25.37	Su=246/89 psf			WOH			55x110 mm vane raw torque readings: V1:5.5/2.0 ft-lbs	
	V2		26.00 - 26.37	Su=670/67 psf			WOH			55x110 mm vane raw torque readings V2:15.0/1.5 ft-lbs	
							WOH				
							2				
							WOC				
30	MU	24/0	30.00 - 32.00							Failed Tube attempt. Open Hole, roller coned ahead to 35.0' bgs	
	MV		32.00 - 32.37							Failed 55x110 mm vane attempt, would only push 0.4'	
	4D	24/20	33.00 - 35.00	WOR/WOR/WOR/ WOR	-					Grey, saturated, very soft, clayey-SILT, trace fine sand	
35	V3		35.00 - 35.37	Su=223/45 psf						55x110 mm vane raw torque readings: V3:5.0/1.0 ft-lbs	
	V4		36.00 - 36.37	Su=625/45 psf						55x110 mm vane raw torque readings: V4:14.0/1.0 ft-lbs	
										Roller Coned ahead to 51.5' bgs. Similar to above to 51.5' bgs., few more sand layers.	
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: MaineDOT Gorham Culvert & Wall
Location: Gorham, Maine

Boring No.: HB-GBB-101
WIN: 10801.00

Driller:	MaineDOT	**Elevation (ft.)**	142.6	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	E. Giguere/C. Giles	**Datum:**	NAVD 88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	4/3/08; 08:30-13:00	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	N/A
Boring Location:	12+19.7, 25.0 Rt.	**Casing ID/OD:**	HW	**Water Level*:**	None Observed
Hammer Efficiency Factor: 0.77		**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.
50											
	5D	3.6/3.6	51.00 - 51.30	50(3.6")	-			90.8		51.8	
										Bottom of Exploration at 51.8 feet below ground surface. SPOON REFUSAL, good bounce.	
55											
60											
65											
70											
75											

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-201
WIN: 18821.00

Driller:	T. Dagget	**Elevation (ft.)**	143.8	**Auger ID/OD:**	SSA
Operator:	B. Wilder	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	12/13/16(9:40) to 12/19/16(13:15)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	12+78.8, 10.3 ft Lt.	**Casing ID/OD:**	HW	**Water Level*:**	8" b.g.s 12/21/16(10:50)
Hammer Efficiency Factor:	0.943	**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							SSA	143.0		10" Asphalt Pavement. 0.8	
	1D	24/12	1.50 - 3.50	6/9/10/2	19	30				Dark brown, damp, medium dense, fine to coarse SAND, some gravel, little silt (Fill).	
	2D	24/6	3.50 - 5.50	8/9/2/17	11	17				Grey-brown, damp, medium dense, Gravelly fine to coarse SAND, little silt (Fill).	WC = 4.8% Fines: 13.4% A-1-b, SM
5	3D	24/4	5.50 - 7.50	6/3/5/9	8	13				Grey-brown moist, loose, sub-angular GRAVEL, little sand, little silt (Fill).	
							29				
							44	135.8		8.0	
	4D	24/8	8.00 - 10.00	4/3/3/5	6	9	29			Top 4": Brown, moist, loose, medium to coarse SAND, little gravel, trace silt. Bottom 4": Brown, moist, loose, fine SAND, some silt (Fill).	
							25				
10	5D	24/0	10.00 - 12.00	4/4/3/2	7	11	8			Brown, moist, loose, medium to coarse SAND, some gravel, trace silt (Fill). 8" recovery in second spoon attempt. 10': Casing sunk 0.6' while adding a new segment.	
							20				
							20				
	6D	24/4	13.00 - 15.00	3/2/3/4	5	8	13			Brown, moist, loose, coarse SAND, little gravel, trace silt (Fill).	
							25				
15	7D	24/14	15.00 - 17.00	3/4/3/4	7	11	15	128.8		15.0 Grey, moist, medium stiff, Silty CLAY, trace sand; contains oxidized spotting throughout (Presumpscot Formation). PP = 2.0, 1.5, 2.25 TSF; T_V = 0.54 TSF	WC = 26.4% LL = 39 PL = 22 PI = 17 LI = 0.3 A-6, CL
							20				
	8D	24/24	17.00 - 19.00	1/1/WOH/WOR	1	2	27			Grey-tan, moist, very soft, Silty CLAY, with darker grey streaks (Presumpscot Formation). PP = 0.75, 0.5, 0.75 TSF; T_V = 0.15 TSF	WC = 32.9% Fines: 93.9% A-6, CL
	MV			Could Not Push			20			MV: Failed 55x110 mm vane attempt. Vane only pushed 1/10 ft.	
							25				
20	9D	24/24	20.00 - 22.00	WOR/WOR/WOR/ WOR	-		14			Tan-grey, moist, medium stiff, Silty CLAY; 21'1" to 21'3" darker in color (dark grey) (Presumpscot Formation). 55x110 mm vane raw torque readings: V1: 14.0/4.0 ft-lbs V2: 11.5/2.0 ft-lbs	WC = 37.2% LL = 43 PL = 24 PI = 19 LI = 0.7 A-7-6, CL
	V1		20.60 - 21.00	Su = 625/179 psf							
	V2		21.60 - 22.00	Su = 514/89 psf			20				
							23				
							19				
25							20				

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-201
WIN: 18821.00

Driller:	T. Dagget	**Elevation (ft.)**	143.8	**Auger ID/OD:**	SSA
Operator:	B. Wilder	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	12/13/16(9:40) to 12/19/16(13:15)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	12+78.8, 10.3 ft Lt.	**Casing ID/OD:**	HW	**Water Level*:**	8" b.g.s 12/21/16(10:50)
Hammer Efficiency Factor:	0.943	**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	1U	24/24	25.00 - 27.00	Hydraulic Push			21			Grey, moist, soft to medium stiff, Silty CLAY (Presumpscot Formation).	
							27				
							27				
	V3		28.60 - 29.00	Su = 536/89 psf			20			55x110 mm vane raw torque readings:	
	V4		29.60 - 30.00	Su = 491/89 psf			25			V3: 12.0/2.0 ft-lbs V4: 11.0/2.0 ft-lbs	
30	10D	24/13	30.00 - 32.00	WOR/WOR/WOR/ WOR	-		13			Vane had a bit of sand on it.	
	~~V5~~		~~30.60 - 31.00~~							Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation).	
	V6		31.60 - 32.00	Su = 536/67 psf Su = 513/45 psf			22			55x110 mm vane raw torque readings: V5: 12.0/1.5 ft-lbs V6: 11.5/1.0 ft-lbs	
							22				
							20				
							21				
35	2U	24/24	35.00 - 37.00	Hydraulic Push			25			Grey, wet, medium stiff to stiff, Silty CLAY (Presumpscot Formation).	
							28				
	V7		37.60 - 38.00	Su = 1183/67			26			55x110 mm vane raw torque readings:	
	V8		38.60 - 39.00	Su = 937/22			27			V7: 26.5/1.5 ft-lbs Driller reports possible sand seam at 37.5'.	
							27			V8: 21.0/0.5 ft-lbs	
40	11D	24/22	40.00 - 42.00	WOR/WOR/WOR/ WOR	-		17			Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation).	
	~~V9~~		~~40.60 - 41.00~~							T_V = 0.05 TSF	
	V10		41.60 - 42.00	Su = 670/45 psf Su = 826/45 psf			30			55x110 mm vane raw torque readings: V9: 15.0/1.0 ft-lbs V10: 18.5/1.0 ft-lbs	
							29				
							34				
							33				
45	12D	24/24	45.00 - 47.00	WOP/WOP/WOP/ WOP	-		38			Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation).	WC = 39.3% Fines: 99.1% A-7-6, CL
	~~V11~~		~~45.60 - 46.00~~							55x110 mm vane raw torque readings:	
	V12		46.60 - 47.00	Su = 826/89 psf Su = 982/112 psf			28			V11: 18.5/2.0 ft-lbs V12: 22.0/2.5 ft-lbs	
							36				
							28				
50							39				

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-201
WIN: 18821.00

Driller:	T. Dagget	**Elevation (ft.)**	143.8	**Auger ID/OD:**	SSA
Operator:	B. Wilder	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	12/13/16(9:40) to 12/19/16(13:15)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	12+78.8, 10.3 ft Lt.	**Casing ID/OD:**	HW	**Water Level*:**	8" b.g.s 12/21/16(10:50)
Hammer Efficiency Factor:	0.943	**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.
50	13D	24/24	50.00 - 52.00	WOH/WOH/WOH/WOH	-		37			Grey, wet, stiff, Silty CLAY (Presumpscot Formation). 55x110 mm vane raw torque readings: V13: 29.0/5.5 ft-lbs MV: Failed vane attempt.	
	V13		50.60 - 51.00	Su = 1295/246psf			28				
	MV			Could not push			28				
							27				
							25				
55	14D	24/11	55.00 - 57.00	WOR/10/14/29(2")	24	38	70			Top 5.5": Grey, wet, very stiff, Silty CLAY (Presumpscot Formation).	
								87.8		56.0	
	R1			RQD = 92%			NQ-2	87.2		Bottom 5.5": Grey, wet, medium dense, Clayey fine to coarse SAND, some silt, little gravel (Glacial Outwash).	
										56.6	
										Top of bedrock at Elev. 87.2 ft based on split spoon and roller cone refusal.	
60										Light to dark grey, fine grained, slightly weathered (W2), strong (R4), SCHIST; with thin white quartz veins and thin bands of biotite throughout.; planar discontinuities, mostly subvertical and parallel with folliation, smooth, moderately spaced (14" - 20"), 57.5 ft. - 57.7 ft. minor (<1mm) calcite infilling on fracture surface, 60.8 ft. - 61.5 silt infilling in fractures and minor rust staining on fracture surfaces, core more broken up [Windham Formation]. Rock Mass Quality: Excellent Core Times (min:sec): 56.6' - 57.6': (5:44) 57.6' - 58.6': (4:48) 58.6' - 59.6': (3:52) 59.6' - 60.6': (3:56) 60.6' - 61.6': (4:29) 97% Recovery	
								82.2		61.6	
65										**Bottom of Exploration at 61.6 feet below ground surface.**	
70											
75											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-202A
WIN: 18821.00

Driller:	C. Dupuis	**Elevation (ft.)**	143.8	**Auger ID/OD:**	SSA
Operator:	NEBC	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown	**Rig Type:**	Mobile B53	**Hammer Wt./Fall:**	140/30 SS; 300/15 casing
Date Start/Finish:	1/5/17(9:45) to 1/12/17(13:00)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	12+92.3, 10.2 ft Rt.	**Casing ID/OD:**	HW	**Water Level*:**	1.33' b.g.s. 1/12/2017 (9:50)
Hammer Efficiency Factor:	0.569	**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							SSA	143.2		7.5" Asphalt Pavement.	
										0.6	
	1D	24/1	1.00 - 3.00	50(1.1")	---					Brown, dry, very dense, fine to coarse SAND, some angular light grey gravel, possibly crushed rock, little silt (Subbase Fill).	
	2D	24/3	2.00 - 4.00	14/7/24/29	31	29				Auger grinding sound, hard, grey material below pavement, possibly concrete.	
										Brown, moist, dense, fine to coarse SAND, little gravel, trace silt, trace organic wood fibers (Subbase Fill).	
	3D	24/3	4.00 - 6.00	22/50/46/12	96	91				Light grey powder and coming up around auger at about 2 ft. depth.	
5										Small bits of metal, possibly rebar coming up on auger.	
										Less auger grinding, brown soil coming up around auger.	
	4D	24/1	6.00 - 8.00	50(3")	---					Brown, damp, very desnse, fine to coarse SAND, some clay, little gravel (Subbase Fill).	
										Brown, damp, very dense, Clayey fine to coarse SAND, little gravel (Fill).	
	5D	24/5	8.00 - 10.00	22/10/11/4	21	20	13			Dark grey/tan, wet, medium dense, coarse SAND, some clay (Fill).	
							15				
10	6D	24/4	10.00 - 12.00	8/4/2/2	6	6	11			Dark grey, wet, loose, angular GRAVEL, little sand, little clay (Fill).	
							8				
	7D	24/14	12.00 - 14.00	2/1/6/6	7	7	12	131.8		12.0	WC = 24.6% Fines: 45.6% A-4, SC-SM
							29			Grey, wet, loose, Silty fine to medium SAND, trace gravel, trace clay, trace red organic woody fibers, small (0.5" - 1") sand seams at top and bottom of sample (Fill).	
	8D	24/8	14.00 - 16.00	10/8/3/2	11	10	13	129.8		14.0	
15							10			Grey, wet, medium dense, fine to coarse SAND, little clay, little organics; top 1.5" of sample dark red wood chips, lighter coloured woody fibers thoughout sample; (Fill).	
	9D	24/8.5	16.00 - 18.00	1/1/1/2	2	2	10	127.8		Tip of spoon contains blue/grey clay (Presumpscot Formation).	WC = 32.5% Fines: 89.0% A-4, CL
							9			14 ft to 16 ft, light colored wood chips in wash.	
	V1		18.60 - 19.00	Su = 268/89 psf			HP_a			16.0	
	V2		19.60 - 20.00	Su = 335/67 psf						Grey, wet, soft, Silty CLAY, little sand (Presumpscot Formation).	
20	1U	24/20.5	20.00 - 22.00	Hydraulic Push						HP_a = Casing pushed with drill rig hydraulics.	
										55x110 mm vane raw torque readings:	
										V1: 6.0/2.0 ft-lbs	
										V2: 7.5/1.5 ft-lbs	
										Grey, wet, soft, Silty CLAY (Presumpscot Formation).	
	V3		22.60 - 23.00	Su = 447/45 psf						55x110 mm vane raw torque readings:	
	V4		23.60 - 24.00	Su = 357/45 psf						V3: 10.0/1.0 ft-lbs	
25										V4: 8.0/1.0 ft-lbs	

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.
3. Boring HB-GBB-202 was abandoned at 4 ft. when auger bit was lost downhole. HB-GBB-202A was drilled 3 ft SE of HB-GBB-202 and sampled from 4 ft. to bottom of exploration.

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-202A
WIN: 18821.00

Driller:	C. Dupuis	**Elevation (ft.)**	143.8	**Auger ID/OD:**	SSA
Operator:	NEBC	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown	**Rig Type:**	Mobile B53	**Hammer Wt./Fall:**	140/30 SS; 300/15 casing
Date Start/Finish:	1/5/17(9:45) to 1/12/17(13:00)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	12+92.3, 10.2 ft Rt.	**Casing ID/OD:**	HW	**Water Level*:**	1.33' b.g.s. 1/12/2017 (9:50)
Hammer Efficiency Factor: 0.569		**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	10D	24/22	25.00 - 27.00	WOR/WOR/WOR/WOR	-					Grey, wet, soft, Silty CLAY, trace organics (Presumpscot Formation).	
	V5		25.60 - 26.00	Su = 424/112 psf						55x110 mm vane raw torque readings:	
	V6		26.60 - 27.00	Su = 491/45 psf						V5: 9.5/2.5 ft-lbs	
										V6: 11.0/1.0 ft-lbs	
30	11D	24/12	30.50 - 32.50	WOR/WOR/WOR/WOR	-					Grey, wet, soft, Silty CLAY (Presumpscot Formation).	
	V7		31.10 - 31.50	Su = 447/89 psf						Driller reported possible sand or gravel layer at 30.5 ft.	
	V8		32.10 - 32.50	Su = 447/89 psf						55x110 mm vane raw torque readings:	
										V7: 10.0/2.0 ft-lbs	
										V8: 10.0/2.0 ft-lbs	
35	12D	24/13	35.00 - 37.00	WOR/WOR/WOR/WOR	-					Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation).	WC = 32.0%
	V9		35.60 - 36.00	Su = 581/112 psf						At 35', driller reported possible sand seam when pushing vane; gritty sound when casing pushed.	LL = 28
	V10		36.60 - 37.00	Su = 670/45 psf						55x110 mm vane raw torque readings:	PL = 20
										V9: 13.0/2.5 ft-lbs	PI = 8
										V10: 15.0/1.0 ft-lbs	LI = 1.5
											A-4, CL
40	2U	24/21.8	40.00 - 42.00	Hydraulic Push						Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation).	
	V11		42.60 - 43.00	Su = 692/22 psf						55x110 mm vane raw torque readings:	
	V12		43.60 - 44.00	Su = 737/22 psf						V11: 15.5/0.5 ft-lbs	
										V12: 16.5/0.5 ft-lbs	
45	13D	24/24	45.00 - 47.00	WOR/WOR/WOR/WOR	-					Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation).	
	V13		45.60 - 46.00	Su = 804/67 psf						55x110 mm vane raw torque readings:	
	V14		46.60 - 47.00	Su = 804/45 psf						V13: 18.0/1.5 ft-lbs	
										V14: 18.0/1.0 ft-lbs	
50											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.
3. Boring HB-GBB-202 was abandoned at 4 ft. when auger bit was lost downhole. HB-GBB-202A was drilled 3 ft SE of HB-GBB-202 and sampled from 4 ft. to bottom of exploration.

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-202A
WIN: 18821.00

Driller:	C. Dupuis	**Elevation (ft.)**	143.8	**Auger ID/OD:**	SSA
Operator:	NEBC	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown	**Rig Type:**	Mobile B53	**Hammer Wt./Fall:**	140/30 SS; 300/15 casing
Date Start/Finish:	1/5/17(9:45) to 1/12/17(13:00)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	12+92.3, 10.2 ft Rt.	**Casing ID/OD:**	HW	**Water Level*:**	1.33' b.g.s. 1/12/2017 (9:50)
Hammer Efficiency Factor:	0.569	**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.
50	14D ~~V15~~ MV	24/24	50.00 - 52.00 ~~50.60 - 51.00~~ 51.60 - 52.00	WOR/WOR/WOR/ WOH Su = 1049/156psf Could Not Push	-					Grey, wet, stiff, Silty CLAY (Presumpscot Formation). 55x110 mm vane raw torque readings: V15: 23.5/3.5 ft-lbs MV: Failed 55x110 mm vane attempt. Some sand on vane.	WC = 37.0% Fines: 99.0% A-4, CL
55	15D	24/24	55.00 - 57.00	WOH/WOR/2/4	2	2				Grey, wet, soft, Silty CLAY, little sand (Presumpscot Formation).	
								86.8		57.0 Sand and gravel noted in wash.	
								84.8		59.0	
	R1			RQD = 69%			NQ-2			Top of bedrock at Elev. 84.8 ft based on casing driving refusal. R1: Light to dark slightly weathered (W2), strong to very strong (R4 to R5) SCHIST; with thin white quartz veins thin bands of biotite, and small pyrite crystals throughout. Discontinuities very close to moderately spaced (1" to 23.5"); 59 ft. to 61.5 ft. vertical planar discontinuity, smooth with traces of silt and fine sand, minor iron staining. [Windham Formation]. Rock Mass Quality: Fair R1 Core Times (min:sec): 59' - 60': (3:10) 60' - 61': (2:02) 61' - 61.5': (1:56) - Lock Up 62' - 63': No time recorded. 63' - 64': No time recorded. 73% Recovery	
60	R2			RQD = 98%				74.8		R2: Light to dark slightly weathered (W2), strong to very strong (R4 to R5), SCHIST; with thin white quartz veins, thin bands of biotite, and small pyrite crystals throughout. Discontinuities moderately spaced (5" to 23.5") At 66.5 ft. smooth planar fracture 30 deg. from vertical, 1 - 2 mm thick calcite infilling on fracture surface [Windham Formation]. Rock Mass Quality: Excellent R2 Core Times (min:sec): 64' - 65': No time recorded. 65' - 66': (3:29) 66' - 67': (2:47) 67' - 68': (2:57) 68' - 69': (2:56) 100% Recovery	
65											
70											
75											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.
3. Boring HB-GBB-202 was abandoned at 4 ft. when auger bit was lost downhole. HB-GBB-202A was drilled 3 ft SE of HB-GBB-202 and sampled from 4 ft. to bottom of exploration.

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-202A
WIN: 18821.00

Driller:	C. Dupuis	**Elevation (ft.)**	143.8	**Auger ID/OD:**	SSA
Operator:	NEBC	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown	**Rig Type:**	Mobile B53	**Hammer Wt./Fall:**	140/30 SS; 300/15 casing
Date Start/Finish:	1/5/17(9:45) to 1/12/17(13:00)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	12+92.3, 10.2 ft Rt.	**Casing ID/OD:**	HW	**Water Level*:**	1.33' b.g.s. 1/12/2017 (9:50)
Hammer Efficiency Factor: 0.569		**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.
75										69.0 **Bottom of Exploration at 69.0 feet below ground surface.**	
80											
85											
90											
95											
100											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.
3. Boring HB-GBB-202 was abandoned at 4 ft. when auger bit was lost downhole. HB-GBB-202A was drilled 3 ft SE of HB-GBB-202 and sampled from 4 ft. to bottom of exploration.

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-203
WIN: 18821.00

Driller:	T. Dagget	**Elevation (ft.)**	145.1	**Auger ID/OD:**	SSA
Operator:	B. Wilder	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown/ C. Stuart	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	12/21/16(1115) to 12/28/16(13:35)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	14+26.4, 10.7 ft Rt.	**Casing ID/OD:**	HW	**Water Level*:**	5.85' b.g.s. 12/27/2016
Hammer Efficiency Factor:	0.943	**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							SSA	144.4		8.5" Asphalt pavment.	
										0.7	
	1D	24/12	1.50 - 3.50	18/40/19/14	59	93				Upper 4" Dark brown transitioning to light tan/brown, damp, very dense, fine to coarse SAND, some gravel, little silt, large piece of gravel in tip of spoon (Fill).	WC = 5.6% Fines: 12.0% A-1-b, SW-SM
	2D	24/8	3.50 - 5.50	5/4/4/13	8	13				Brown to tan, damp, loose, fine to coarse SAND, little gravel, little clay, gravel content increasing towards bottom of the sample, (Fill).	
5	3D	24/0	5.50 - 7.50	6/12/10/9	22	35	155			No Recovery.	
							168				
							108				
								137.1		8.0	
	4D	24/3	8.00 - 10.00	4/9/23/15	32	50	22			Brown and dark grey, damp, dense, GRAVEL, little sand, little clay, (Fill).	
							41				
10							10				
							15				
							8			Light grey wash.	
							4				
							5			Brown wash with organics and wood chips.	
15	5D	24/22	15.50 - 17.50	4/1/1/3	2	3	15	129.6		15.5	
							18			Light grey, wet to saturated, soft, Silty CLAY, trace fine sand, highly plastic (Presumpscot Formation).	WC = 35.0% Fines: 98.4% A-7-6, CL
	6D	24/24	17.50 - 19.50	WOR/1/1/1	-		13			Too soft for PP	
	V1		18.10 - 18.50	Su = 536/89 psf			15			T_V = 0.14, 0.13, 0.15 TSF	WC = 33.1% LL = 43 PL = 24 PI = 19 LI = 0.5 A-7-6, CL
	V2		19.10 - 19.50	Su = 960/335 psf			18			Grey, wet, medium stiff, Silty CLAY, trace fine sand, highly plastic, material becomes stiffer towards end of sample.	
20							24			T_V = 0.14, 0.15 (Presumpscot Formation).	
							25			55x110 mm vane raw torque readings: V1: 12.0/2.0 ft-lbs V2: 21.5/7.5 ft-lbs	
							23				
							18				
25							14				

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-203
WIN: 18821.00

Driller:	T. Dagget	**Elevation (ft.)**	145.1	**Auger ID/OD:**	SSA
Operator:	B. Wilder	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown/ C. Stuart	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	12/21/16(1115) to 12/28/16(13:35)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	14+26.4, 10.7 ft Rt.	**Casing ID/OD:**	HW	**Water Level*:**	5.85' b.g.s. 12/27/2016
Hammer Efficiency Factor:	0.943	**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	1U	30/25	25.00 - 27.50	Hydraulic Push			9			Grey, wet, soft, Silty CLAY, trace fine sand (Presumpscot Formation).	
							13				
							13				
	V3		28.10 - 28.50	Su = 357/67 psf			11			55x110 mm vane raw torque readings: V3: 8.0/1.5 ft-lbs	
	V4		29.10 - 29.50	Su = 447/22 psf			10			V4: 10.0/0.5 ft-lbs	
30	7D	24/12	30.00 - 32.00	WOR/WOR/WOR/ WOR	-		6			Possible sand seam noted when pushing vane. Grey, wet to saturated, medium stiff, Silty CLAY, trace fine sand in black bands (Presumpscot Formation).	WC = 36.3% Fines: 98.8% A-7-6, CL
	~~V5~~ V6		~~30.60 - 31.00~~ 31.60 - 32.00	Su = 848/134 psf Su = 581/67 psf			18			55x110 mm vane raw torque readings: V5: 19.0/3.0 ft-lbs V6: 13.0/1.5 ft-lbs	
							17				
							10				
							17				
35	8D	24/12	35.00 - 37.00	WOR/WOR/WOR/ WOR	-		10			Grey, wet to saturated, medium stiff, Silty CLAY, trace fine sand (Presumpscot Formation).	
	~~V7~~ V8		~~35.60 - 36.00~~ 36.60 - 37.00	Su = 647/45 psf Su = 804/67 psf			15			55x110 mm vane raw torque readings: V7: 14.5/1.0 ft-lbs V8: 18.0/1.5 ft-lbs	
							17				
							15				
							10				
40	9D	24/12	40.00 - 42.00	Su = 804/179 psf			13			Grey, wet to moist, medium stiff, Silty CLAY, trace fine sand, highly plastic (Presumpscot Formation).	WC = 37.9% LL = 41 PL = 22 PI = 19 LI = 0.8 A-7-6, CL
	~~V9~~ MV		~~40.60 - 41.00~~ 41.60 - 42.00	Could Not Push			15			55x110 mm vane raw torque readings: V9: 18.0/4.0 ft-lbs MV: Failed 55x110 mm vane attempt.	
							14				
							10				
							8				
45								100.1		45.0	
	10D	24/4	45.00 - 47.00	4/8/5/9	13	20	13			Grey, wet, medium dense, Clayey fine to coarse SAND, little silt, trace gravel (Glacial Outwash). Fine sand in wash at 45 ft.	
							15				
							15				
							138				
50							230				

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-203
WIN: 18821.00

Driller:	T. Dagget	**Elevation (ft.)**	145.1	**Auger ID/OD:**	SSA
Operator:	B. Wilder	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown/ C. Stuart	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	12/21/16(1115) to 12/28/16(13:35)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	14+26.4, 10.7 ft Rt.	**Casing ID/OD:**	HW	**Water Level*:**	5.85' b.g.s. 12/27/2016
Hammer Efficiency Factor:	0.943	**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.
50	11D	36/12	50.00 - 53.00	24/20/28/95	48	75	370			Blow counts not valid, hole not cleaned out properly. Grey, wet, dense, Gravelly fine to coarse SAND, some silt (Glacial Outwash). Grinding sound while drilling at 49-50 ft.	
	R1	60/43.7	51.20 - 56.20	RQD = 45%			191 NQ-2	93.9		51.2 Top of bedrock at Elev. 93.9 ft based on split spoon refusal. Light to dark grey, fine grained, slightly weathered (W2), strong (R4), SCHIST; with thin white quartz veins and thin bands of biotite throughout.; planar discontinuities 45 degrees from vertical, smooth to rough, discontinuity closely spaced (2.75" to 7"), minor (<1 mm) silt infilling on fracture surfaces, 51.6 ft. to 51.9 ft. fine to medium grained pink granodorite [Windham Formation]. Rock Mass Quality: Good Core Times (min:sec): 51.2' -52.2': (6:19) 52.2' -53.2': (1:09) 53.2' -54.2': (3:03) 54.2' -55.2': (3:57) 55.2' -56.2': (5:08) 73% Recovery	
55								88.9		56.2 **Bottom of Exploration at 56.2 feet below ground surface.**	
60											
65											
70											
75											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-204
WIN: 18821.00

Driller:	T. Dagget	**Elevation (ft.)**	145.3	**Auger ID/OD:**	SSA
Operator:	B. Wilder	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	12/15/16(11:35) to 12/21/16(10:40)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	14+51.1, 20.4 ft Lt.	**Casing ID/OD:**	HW	**Water Level*:**	5.5'b.g.s. 12/21/2016 (10:35)
Hammer Efficiency Factor:	0.943	**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							SSA	144.6		8" Pavement thickness.	
										0.7	
	1D	24/12.5	1.00 - 3.00	8/9/6/3	15	24				Brown, damp, medium dense, Gravelly fine to coarse SAND, little silt (Subbase Fill).	WC = 4.6% Fines: 12.1% A-1-b, SM
								142.3		3.0	
	2D	24/8	3.00 - 5.00	2/1/1/3	2	3				Grey, damp, soft, Silty CLAY, little sand (Fill). PP = 1.75, 2.0 TSF	WC = 25.6% Fines: 89.4% A-7-6, CL
5	3D	24/7.5	5.00 - 7.00	5/9/4/4	13	20				Dark grey-brown, damp, stiff, medium to coarse Sandy CLAY, little gravel, trace silt (Fill).	
	4D	24/5.5	7.00 - 9.00	5/5/28/45	33	52				Grey, damp, dense, GRAVEL, some fine to coarse sand, trace silt, possibly crushed cobble (Fill). Auger making grinding sound 8 - 8.8 ft.	
	1A									Dark grey, soft, damp, Silty CLAY, trace fine sand, trace organic wood fibres (Presumpscot Formation).	
10	5D	24/24	10.00 - 12.00	2/4/4/6	8	13	14			Tan and grey with mottling, damp, medium stiff, Silty CLAY, with very fine sand seams in grey clay, some pockets of saturated clay, and trace red fibrous material (organic); siltier at top of sample than bottom (Presumpscot Formation). PP = 0.5, 2.25, 2.5, 2.25 TSF; T_V > 9.5 TSF MV: Failed 55x110 mm vane attempt.	WC = 25.2% Fines: 91.2% A-7-6, CL
							15				
							19				
	MV			Could Not Push			21				
							12				
15	6D MV	24/6	15.00 - 17.00	3/2/3/2 Could Not Push	5	8	4			Tan-grey, wet, medium stiff, Silty CLAY, trace organic fibres (Presumpscot Formation). MV: Failed 55x110 mm vane attempt.	
							11				
							12				
	V1		18.60 - 19.00	Su = 581/67 psf			19			55x110 mm vane raw torque readings: V1: 13/1.5 ft-lbs V2: 13/2 ft-lbs	
	V2		19.60 - 20.00	Su = 581/89 psf			20				
20	1U	30/24	20.00 - 22.50	Hydraulic Push			27			Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation).	
							27				
	V3		22.60 - 23.00	Su = 692/89 psf			29			55x110 mm vane raw torque readings: V3: 15.5/2 ft-lbs V4: 16/2 ft-lbs	
	V4		23.60 - 24.00	Su = 714/89			23				
25							19				

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-204
WIN: 18821.00

Driller:	T. Dagget	**Elevation (ft.)**	145.3	**Auger ID/OD:**	SSA
Operator:	B. Wilder	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	12/15/16(11:35) to 12/21/16(10:40)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	14+51.1, 20.4 ft Lt.	**Casing ID/OD:**	HW	**Water Level*:**	5.5'b.g.s. 12/21/2016 (10:35)
Hammer Efficiency Factor:	0.943	**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	7D	24/24	25.00 - 27.00	WOP/WOP/WOP/ WOP	-		19			Grey, damp, medium stiff, Silty CLAY (Presumpscot Formation). 55x110 mm vane raw torque readings: V5: 15.5/2 ft-lbs V6: 18/3 ft-lbs	WC = 42.5% LL = 41 PL = 23 PI = 18 LI = 1.1 A-7-6, CL
	V5		25.60 - 26.00	Su = 692/89							
	V6		26.60 - 27.00	Su = 803/134			27				
							29				
							30				
							31				
30	2U	30/24.5	30.00 - 32.50	Hydraulic Push			57			Grey, wet, very soft, Silty CLAY (Presumpscot Formation).	
							40				
							40				
							31				
							41				
35	8D	24/24	35.00 - 37.00	WOR/2/3/5	5	8	40			Top 12": Grey, wet, medium stiff, Silty CLAY.	WC = 37.3%
	MV			Could Not Push				109.3		Bottom 12": Grey, wet, loose, Clayey fine to coarse SAND, trace gravel (Presumpscot Formation). MV: Failed 55x110 mm vane attepmt. Vane only pushed 0.8 ft.	LL = 33 PL = 19 PI = 14 LI = 1.3 A-6, CL
							34				
							45			36.0	
							72			Artesinal pressure, water coming up and flowing out casing 2 - 3 ft above ground surface. Brown sand coming up in water.	
							80				
40	9D	24/9	40.00 - 42.00	50	---		NQ-2	104.8		Dark grey-brown, wet, very dense, Gravelly coarse SAND, trace silt, top of sample more gravelly than bottom (Glacial Outwash). Less artesinal pressure, water no longer flowing over the casing. Brown sand and small gravel in the wash.	
	R1			RQD = 87%						40.5	
										Top of bedrock at Elev. 104.8 ft based on split spoon refusal.	
45								99.8		Light to medium grey, fine grained, slightly weathered (W2), strong (R4), SCHIST; with thin white quartz veins, thin bands of biotite and small pyrite crystals throughout.; planar discontinuities, 30 degrees from vertical, smooth, closely spaced (6 in.) apart, minor (<1mm) calcite and pyrite infilling on fracture surface [Windham Formation]. Rock Mass Quality: Good Core Times (min:sec): 40.5' - 41.5': (3:43) 41.5' - 42.5': (3:47) 42.5' - 43.5': (4:05) 43.5' - 44.5': (4:55)	
50											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-204
WIN: 18821.00

Driller:	T. Dagget	**Elevation (ft.)**	145.3	**Auger ID/OD:**	SSA
Operator:	B. Wilder	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	12/15/16(11:35) to 12/21/16(10:40)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	14+51.1, 20.4 ft Lt.	**Casing ID/OD:**	HW	**Water Level*:**	5.5'b.g.s. 12/21/2016 (10:35)
Hammer Efficiency Factor:	0.943	**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.
50										44.5' - 45.5': (5:15) 92% Recovery	
										45.5	
										Bottom of Exploration at 45.5 feet below ground surface.	
55											
60											
65											
70											
75											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-205
WIN: 18821.00

Driller:	C. Dupuis	**Elevation (ft.)**	151.8	**Auger ID/OD:**	SSA
Operator:	NEBC	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown	**Rig Type:**	Mobile B53	**Hammer Wt./Fall:**	140/30 SS; 300/15 casing
Date Start/Finish:	1/13/17 (9:50) to 1/17/17 (13:30)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	N30925.09 E958638.47	**Casing ID/OD:**	HW	**Water Level*:**	6.17' b.g.s. 1/17/2017 (12:14)
Hammer Efficiency Factor: 0.569		**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							SSA			Asphalt Pavement.	
								150.8		1.0	
	1D	2.5/1	1.00 - 1.21	50(2.4")	---					Grey-brown, dry, very dense, fine to coarse SAND, trace silt (Fill).	
	2D	24/16	3.00 - 5.00	14/10/7/5	17	16				Brown, damp, medium dense, fine to coarse SAND, trace silt (Fill). In spoon tip: Brown-grey, damp, medium stiff, Silty CLAY, trace sand.	
5	3D	24/6	5.00 - 7.00	3/3/5/5	8	8	HP_a			Brown-grey, damp, medium stiff, fine to coarse SAND, some clay, little silt, some mottling/ iron staining in the clay (Fill). HP_a = Casing pushed with drill rig hydraulics.	
								144.8		7.0	
	4D	24/11	7.00 - 9.00	5/4/4/3	8	8				Blue-grey, moist, medium stiff, Sandy SILT, some clay, more sandy towards top of sample, trace gravel, thin seam of black/dark brown fine sand and organics 4" from bottom of sample (Presumpscot Formation). PP = 1.15, 1.0 TSF	WC = 17.4% Fines: 58.6% LL = 24 PL = 18 PI = 6 LI = -0.1 A-4, CL-ML
10								141.8		10.0	
	5D	24/5.5	10.00 - 12.00	13/4/1/2	5	5				Grey-tan, wet, medium stiff, Silty CLAY, trace sand (Presumpscot Formation).	
15	6D MV	24/11	15.00 - 17.00	3/3/2/2 Could Not Push	5	5				Tan/grey, wet, medium stiff, Silty CLAY, little sand, trace gravel towards top/middle, fine sand seam 4" from bottom, bottom 3" of sample dark brown, trace organics (roots?), trace sand (Presumpscot Formation). PP = 1.25, 1.0 TSF; T_V = 0.15 TSF MV: Failed 55x110 mm vane attempt.	WC = 34.9% Fines: 68.9% A-4, CL
										Dark brown wash with wood fibres.	
20	7D MV	24/24	20.00 - 22.00	WOH/WOH/WOH/1 Could Not Push	- -					Top 4" of sample: Dark brown, moist, Silty CLAY, trace organic woody bits, trace sand. Bottom 20" of sample: Tan/grey, wet, very soft, Silty CLAY, trace fine sand (Presumpscot Formation). MV: Failed 55x110 mm vane attempt. Vane only pushed 1"	
25											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-205
WIN: 18821.00

Driller:	C. Dupuis	**Elevation (ft.)**	151.8	**Auger ID/OD:**	SSA
Operator:	NEBC	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown	**Rig Type:**	Mobile B53	**Hammer Wt./Fall:**	140/30 SS; 300/15 casing
Date Start/Finish:	1/13/17 (9:50) to 1/17/17 (13:30)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	N30925.09 E958638.47	**Casing ID/OD:**	HW	**Water Level*:**	6.17' b.g.s. 1/17/2017 (12:14)
Hammer Efficiency Factor:	0.569	**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	1U	24/18	25.00 - 27.00	Hydraulic Push						Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation).	
	V1		27.60 - 28.00	Su = 982/179 psf						55x110 mm vane raw torque readings: V1: 22/4 ft-lbs V2: 20/5 ft-lbs	
	V2		28.60 - 29.00	Su = 893/223 psf							
30	8D ~~MV~~	24/24	30.00 - 32.00	WOH/WOH/WOH/3 ~~Could Not Push~~	- -					Grey/tan, wet, very soft, Silty CLAY (Presumpscot Formation). PP = 0 TSF MV: Failed 55x110 mm vane attempt.	WC = 38.9% LL = 37 PL = 23 PI = 14 LI = 1.1
								118.8		33.0	A-6, CL
										Driller noted transition to coarser material.	
35	9D	24/4	35.00 - 37.00	13/11/8/11	19	18				Grey-brown, wet, medium dense, medium to coarse SAND, trace silt, one large piece of gravel stuck in spoon tip, little gravel, trace clay (Glacial Outwash).	
40	10D	24/9	40.00 - 42.00	11/11/10/15	21	20				Light-brown, wet, medium dense, fine to coarse SAND, little silt, some angular gravel at bottom (Glacial Outwash).	WC = 10.2% Fines: 12.4% A-1-b, SM
45	11D	24/5	45.00 - 47.00	25/18/15/10	33	31				Tan-brown, wet, dense, fine to coarse SAND, little clay, trace gravel; sand in most of spoon, sandy clay at bottom of spoon and in tip (Glacial Outwash).	
50											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MEDOT Gorham Brandy Brook Culvert Replacement
Location: Rt. 25 Gorham, Maine

Boring No.: HB-GBB-205
WIN: 18821.00

Driller:	C. Dupuis	**Elevation (ft.)**	151.8	**Auger ID/OD:**	SSA
Operator:	NEBC	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	L. McKeown	**Rig Type:**	Mobile B53	**Hammer Wt./Fall:**	140/30 SS; 300/15 casing
Date Start/Finish:	1/13/17 (9:50) to 1/17/17 (13:30)	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2
Boring Location:	N30925.09 E958638.47	**Casing ID/OD:**	HW	**Water Level*:**	6.17' b.g.s. 1/17/2017 (12:14)
Hammer Efficiency Factor:	0.569	**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.
50	R1			RQD = 74%%			NQ-2	101.8		50.0 Top of bedrock at Elev. 101.8 ft based on casing driving refusal. R1: Light to dark grey, fine grained, slightly weathered (W2), strong (R4), SCHIST; with white quartz veins (up to 1" thick), thin bands of biotite, and small pyrite crystals throughout.; planar to wavy discontinuities, smooth to rough, discontinuities extremely close to moderatly spaced (0.5" to 21.5"); [Windham Formation]. Rock Mass Quality: Good R1: Core Times (min: sec): 50' - 51': (2:15) 51' - 52': (1:55) 52' - 53': (1:56) 53' - 54': (2:04) 54' - 55': (2:12) 83% Recovery	
55	R2			RQD = 63%%						R2: Light to dark grey, fine grained, slightly weathered (W2), strong (R4), SCHIST; with white quartz veins (up to 1" thick), thin bands of biotite, and small pyrite crystals throughout.; planar to wavy discontinuities, smooth to rough, discontinuities extremely close to moderatly spaced (0.5" to 21.5"); 56.5 ft. - 58.5 ft. silt/clay infilling of discontinuities (<1mm to 2mm thick); broken core from 59 ft. to 60.5 ft. [Windham Formation]. Rock Mass Quality: Good R2 Core Times (min:sec:) 55' - 56.5': (2:10) - Lock Up 56.5' - 57.5': (2:03) 57.5' - 58.5': (1:36) 58.5' - 59.5': (1:28) 59.5' - 60.5': (1:44) 99% Recovery	
60								91.3		60.5 **Bottom of Exploration at 60.5 feet below ground surface.**	
65											
70											
75											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MaineDOT Gorham Culvert & Wall
Location: Gorham, Maine

Boring No.: HB-GBB-301
WIN: 18821.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	138.3	**Auger ID/OD:**	4"
Operator:	Mike Nadeau	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	T. Mantey	**Rig Type:**	Diedrich D-50	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	01.09.18(1230)/01.09.18(1530)	**Drilling Method:**	SSA/Cased Wash Boring	**Core Barrel:**	N/A
Boring Location:	12+86.1, 99.0 ft. (L)	**Casing ID/OD:**	4"	**Water Level*:**	6.8' b.g.s. 01.09.18(1530)
Hammer Efficiency Factor:	0.979	**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 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.
0	1D	24/9	0.00 - 2.00	4/4/4/3	8	13	SSA			Brown-grey, dry to damp, loose, Silty fine to coarse SAND, trace fine gravel, occasional organics (Fill).	
5	2D	24/3	5.00 - 7.00	2/3/2/2	5	8				Brown-grey, damp to moist, loose, Silty fine to coarse SAND, trace fine gravel, trace organics (Fill).	WC = 17.9% Fines: 30.5% A-2-4, SM
10	3D	24/16	10.00 - 12.00	1/2/2/3	4	7	Push	128.3		10.0 Grey, very moist, soft, Silty CLAY, trace fine to coarse sand, occasional reeds (organics) (Presumpscot Formation).	WC = 26.8% Fines: 66.8% LL = 26 PL = 19 PI = 7 LI = 1.1 A-4, CL-ML
15	MU	30/1.5	15.00 - 17.50	Piston Sampler			Open			Grey, wet, soft, Silty CLAY, trace fine sand (Presumpscot Formation).	
	4D ~~MU~~	24/21 ~~30/0~~	17.00 - 19.00 ~~17.00 - 19.50~~	WOR(24") ~~Piston Sampler~~	-					Grey, wet, very soft, Silty CLAY (Presumpscot Formation).	
20	1U	30/20	20.00 - 22.50	Piston Sampler						Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation). 65x130 mm vane raw torque readings: V1: 21.5/0.5 ft-lbs V2: 26.5/1.0 ft-lbs	WC = 44.2% Fines: 98.2% LL = 37 PL = 25 PI = 12 LI = 1.6 A-6, CL
	V1		22.60 - 23.00	Su = 590/13 psf							
	V2		23.60 - 24.00	Su = 728/27 psf							
25											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MaineDOT Gorham Culvert & Wall
Location: Gorham, Maine

Boring No.: HB-GBB-301
WIN: 18821.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	138.3	**Auger ID/OD:**	4"
Operator:	Mike Nadeau	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	T. Mantey	**Rig Type:**	Diedrich D-50	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	01.09.18(1230)/01.09.18(1530)	**Drilling Method:**	SSA/Cased Wash Boring	**Core Barrel:**	N/A
Boring Location:	12+86.1, 99.0 ft. (L)	**Casing ID/OD:**	4"	**Water Level*:**	6.8' b.g.s. 01.09.18(1530)
Hammer Efficiency Factor:	0.979	**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	5D	24/24	25.00 - 27.00	WOH(12")/1/1	-					Grey, wet, soft, Silty CLAY (Presumpscot Formation). Sand seam 5" thick from 26.6' to 27'.	WC = 33.9%
	V3		25.60 - 26.00	Su = 371/55 psf						65x130 mm vane raw torque readings:	Fines: 98.9%
	MV		26.60 - 27.00	Could Not Push						V3: 13.5/2.0 ft-lbs	LL = 29
										MV: Failed vane attempt.	PL = 21
											PI = 8
											LI = 1.6
											A-4, CL
30	2U	30/25	30.00 - 32.50	Piston Sampler						Grey, wet, very soft, Silty CLAY (Presumpscot Formation).	WC = 40.3%
											Fines: 98.3%
											LL = 35
											PL = 24
	MV		32.60 - 33.00	Could Not Push							PI = 11
	MV		33.60 - 34.00	Could Not Push						65x130 mm vane raw torque readings:	LI = 1.5
										MV: Failed vane attempt.	A-6, CL
										MV: Failed vane attempt.	
35	6D	24/24	35.00 - 37.00	2/3/2/3	5	8				Grey, wet, medium stiff, Silty CLAY, trace fine sand (Presumpscot Formation).	WC = 34.9%
										T_V = 0.5 TSF	
40	7D	24/10	40.00 - 42.00	7/12/7/6	19	31		98.3		40.0	
										Grey, very wet, medium dense, fine to coarse SAND, some fine gravel, some silt (Glacial Outwash).	
45								93.6		44.7	
										Bottom of Exploration at 44.7 feet below ground surface.	
										Top of bedrock at Elev. 93.6 ft based on roller cone refusal.	
50											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MaineDOT Gorham Culvert & Wall
Location: Gorham, Maine

Boring No.: HB-GBB-302
WIN: 18821.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	149.2	**Auger ID/OD:**	4"
Operator:	Mike Nadeau	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	T. Mantey	**Rig Type:**	Diedrich D-50	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	01.09.18(0745)/01.09.18(1030)	**Drilling Method:**	SSA/Cased Wash Boring	**Core Barrel:**	N/A
Boring Location:	13+68.3, 156.6 ft. (L)	**Casing ID/OD:**	4"	**Water Level*:**	10.1' b.g.s. 01.09.18(1023)
Hammer Efficiency Factor:	0.979	**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	0.00 - 2.00	7/12/14/14	26	42	SSA			Brown, dry, medium dense, Silty fine to coarse SAND, some fine gravel (Fill). Organics and root layer 1" thick at top of sample.	
	2D	24/12	2.00 - 4.00	11/14/15/8	29	47				Grey-brown, very moist, medium dense, Silty fine to coarse SAND, trace fine gravel (Fill).	WC = 21.3% Fines: 22.9% A-2-4, SM
	3D	24/15	4.00 - 6.00	4/4/4/5	8	13		144.7		Top 6": Brown-grey, moist, loose, Silty fine to medium SAND. 4.5	
5	4D	24/15	6.00 - 8.00	3/3/3/3	6	10				Bottom 9": Grey, moist, stiff, Silty CLAY (Presumpscot Formation). PP = 3.5, 2.0, 2.5 TSF; T_V = 2.5 TSF Grey, damp to moist, medium stiff, Silty CLAY, trace fine sand (Presumpscot Formation).	WC = 21.0% Fines: 70.2% LL = 26 PL = 18 PI = 8 LI = 0.4 A-4, CL
	5D	24/24	8.00 - 10.00	3/2/2/2	4	7				Dark grey, moist, soft, Silty CLAY, trace fine sand (Presumpscot Formation). Sand seam 1" thick at 9.8' b.g.s. with reeds (organics).	
10	6D	24/23	10.00 - 12.00	2/3/2/2	5	8				Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation). PP = 1.5, 1.5, 1.75 TSF; T_V = 3.25 TSF	WC = 32.7%
	7D	24/24	12.00 - 14.00	3/3/3/3	6	10	Open			Grey, moist, medium stiff, Silty CLAY (Presumpscot Formation). PP = 1.0, 1.25, 1.0 TSF; T_V = 2.0 TSF	
15	8D V1 V2	24/24	15.00 - 17.00 15.60 - 16.00 16.60 - 17.00	WOR(24") Su = 670/89 psf Su = 446/45 psf	-					Grey, wet, soft to medium stiff, Silty CLAY (Presumpscot Formation). 55x110 mm vane raw torque readings: V1: 15.0/2.0 ft-lbs V2: 10.0/1.0 ft-lbs	WC = 42.4% Fines: 99.0% A-4, CL
20	9D V3 V4	24/24	20.00 - 22.00 20.60 - 21.00 21.60 - 22.00	WOR(24") Su = 412/41 psf Su = 425/41 psf	-					Grey, wet to moist, soft, Silty CLAY (Presumpscot Formation). 65x130 mm vane raw torque readings: V3: 15.0/1.5 ft-lbs V4: 15.5/1.5 ft-lbs	WC = 37.4% LL = 31 PL = 22 PI = 9 LI = 1.7 A-4, CL
25											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MaineDOT Gorham Culvert & Wall
Location: Gorham, Maine

Boring No.: HB-GBB-302
WIN: 18821.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	149.2	**Auger ID/OD:**	4"
Operator:	Mike Nadeau	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	T. Mantey	**Rig Type:**	Diedrich D-50	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	01.09.18(0745)/01.09.18(1030)	**Drilling Method:**	SSA/Cased Wash Boring	**Core Barrel:**	N/A
Boring Location:	13+68.3, 156.6 ft. (L)	**Casing ID/OD:**	4"	**Water Level*:**	10.1' b.g.s. 01.09.18(1023)
Hammer Efficiency Factor:	0.979	**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	10D	24/24	25.00 - 27.00	WOR(24")	-					Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation). 65x130 mm vane raw torque readings: V5: 23.5/1.5 ft-lbs V6: 22.5/1.0 ft-lbs	
	~~V5~~		~~25.60 - 26.00~~	~~Su = 645/41 psf~~							
	V6		26.60 - 27.00	Su = 618/27 psf							
30	11D	24/24	30.00 - 32.00	WOR(24")	-					Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation). 65x130 mm vane raw torque readings: V7: 30.0/2.0 ft-lbs V8: 27.0/1.5 ft-lbs	
	~~V7~~		~~30.60 - 31.00~~	~~Su = 824/55 psf~~							
	V8		31.60 - 32.00	Su = 741/41 psf							
35	12D	24/24	35.00 - 37.00	WOR(24")	-					Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation). 65x130 mm vane raw torque readings: V9: 28.0/3.0 ft-lbs V10: 27.0/2.0 ft-lbs	
	~~V9~~		~~35.60 - 36.00~~	~~Su = 769/82 psf~~							
	V10		36.60 - 37.00	Su = 741/55 psf							
40	13D	24/24	40.00 - 42.00	WOH(12")/1/6	-					Top 12": Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation). Bottom 12": Grey, damp, loose, Silty fine to medium SAND, trace clay. 65x130 mm vane raw torque readings: V11: 36.0/4.0 ft-lbs MV: Failed vane attempt.	
	~~V11~~		~~40.60 - 41.00~~	~~Su = 989/110 psf~~							
	MV		41.60 - 42.00	Could Not Push							
	14D	24/24	42.00 - 44.00	7/4/3/7	7	11				Grey, wet, loose, Silty fine to medium SAND, some clay (Presumpscot Formation).	
45								104.2		45.0	
	15D	24/15	45.00 - 47.00	12/14/20/20	34	55				Grey, wet, dense, Gravelly fine to coarse SAND, some silt (Glacial Outwash).	
								103.0		46.2	
50										**Bottom of Exploration at 46.2 feet below ground surface.**	

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MaineDOT Gorham Culvert & Wall
Location: Gorham, Maine

Boring No.: HB-GBB-303
WIN: 18821.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	147.7	**Auger ID/OD:**	4"
Operator:	Mike Nadeau	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	T. Mantey	**Rig Type:**	Dietrich D-50	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	01.03.18(0845)/01.03.18(1345)	**Drilling Method:**	SSA/Cased Wash Boring	**Core Barrel:**	N/A
Boring Location:	13+93.6, 83.4 ft. (L)	**Casing ID/OD:**	4"	**Water Level*:**	10.1' b.g.s. 01/03/18(1330)
Hammer Efficiency Factor: 0.979		**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	24/14	0.00 - 2.00	3/8/16/17	24	39	SSA			Brown, moist, medium dense, fine to coarse SAND, some angular gravel, little silt (Fill). Gravel size up to 1". Broken and fractured pieces of gravel.	WC = 7.3% Fines: 19.9% A-1-b, SM
5	2D	24/10	5.00 - 7.00	15/20/10/9	30	49				Top 8": Brown, moist, medium dense, fine to coarse SAND, trace subangular gravel (Fill). Bottom 2": Brown-grey, damp, Silty fine SAND (Fill).	WC = 17.8% Fines: 20.2% A-2-4, SM
10	3D	24/17	10.00 - 12.00	2/2/3/4	5	8	44	137.7		10.0 Brown-grey, very moist, medium stiff, Silty CLAY, little fine to medium sand (Presumpscot Formation) .	WC = 14.3% Fines: 81.0% A-4, CL
							46				
							55				
							56				
15							52				
	4D	24/24	15.00 - 17.00	WOH(24")	- -		Open			Grey, very moist, very soft, Silty CLAY (Presumpscot Formation). T_V = 0.5, 0.5 TSF	WC = 45.1% PL = 24
20	5D	24/24	20.00 - 22.00	WOR(24")	-					Grey, very moist, medium stiff, Silty CLAY (Presumpscot Formation). T_V = 0.5, 0.5 TSF 65x130 mm vane raw torque readings: V1: 23.0/2.5 ft-lbs V2: 21.0/2.0 ft-lbs	
	V1		20.60 - 21.00	Su = 632/69 psf							
	V2		21.60 - 22.00	Su = 577/55 psf							
25											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MaineDOT Gorham Culvert & Wall
Location: Gorham, Maine

Boring No.: HB-GBB-303
WIN: 18821.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	147.7	**Auger ID/OD:**	4"
Operator:	Mike Nadeau	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	T. Mantey	**Rig Type:**	Dietrich D-50	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	01.03.18(0845)/01.03.18(1345)	**Drilling Method:**	SSA/Cased Wash Boring	**Core Barrel:**	N/A
Boring Location:	13+93.6, 83.4 ft. (L)	**Casing ID/OD:**	4"	**Water Level*:**	10.1' b.g.s. 01/03/18(1330)
Hammer Efficiency Factor:	0.979	**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	6D	24/24	25.00 - 27.00	WOR(24")	-					Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation).	
	~~V3~~		~~25.60 - 26.00~~	~~Su = 605/42 psf~~						T_V = 0.5, 0.5 TSF	
	V4		26.60 - 27.00	Su = 715/55 psf						65x130 mm vane raw torque readings:	
										V3: 22.0/1.5 ft-lbs	
										V4: 26.0/2.0 ft-lbs	
30	7D	24/24	30.00 - 32.00	WOR(24")	-					Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation).	WC = 37.5%
	~~V5~~		~~30.60 - 31.00~~	~~Su = 715/55 psf~~						T_V = 0.2 TSF	
	V6		31.30 - 31.70	Su = 852/55 psf						65x130 mm vane raw torque readings:	
										V5: 26.0/2.0 ft-lbs	
										V6: 31.0/2.0 ft-lbs (Vane only advanced 0. 7')	
35	8D	24/24	35.00 - 37.00	WOR(24")	-					Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation).	
	~~V7~~		~~35.60 - 36.00~~	~~Su = 852/69 psf~~						T_V = 0.4 TSF	
	V8		36.60 - 37.00	Su = 824/55 psf						65x130 mm vane raw torque readings:	
										V7: 31.0/2.5 ft-lbs	
										V8: 30.0/2.0 ft-lbs	
40	9D	24/24	40.00 - 42.00	WOH(12")/2/3	-					Top 12": Grey, wet, stiff, Silty CLAY (Presumpscot Formation).	
	~~V9~~		~~40.60 - 41.00~~	~~Su = 1217/NA psf~~						Bottom 12": Brown-grey, damp, medium stiff, Silty CLAY (Presumpscot Formation).	
	MV		41.60 - 42.00	Could Not Push						PP = 0.75, 0.75, 1.0 TSF; T_V = 1.0 TSF (Readings taken in bottom 12" of sample)	
										65x130 mm vane raw torque readings:	
										V9: MAX (44.3) ft-lbs	
										MV: Failed vane attempt.	
45								102.7		45.0	
	10D	24/13	45.00 - 47.00	3/2/10/7	12	20				Brown-grey, wet, medium dense, fine to medium SAND, little silt, trace clay (Glacial Outwash).	
50											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MaineDOT Gorham Culvert & Wall
Location: Gorham, Maine

Boring No.: HB-GBB-303
WIN: 18821.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	147.7	**Auger ID/OD:**	4"
Operator:	Mike Nadeau	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	T. Mantey	**Rig Type:**	Dietrich D-50	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	01.03.18(0845)/01.03.18(1345)	**Drilling Method:**	SSA/Cased Wash Boring	**Core Barrel:**	N/A
Boring Location:	13+93.6, 83.4 ft. (L)	**Casing ID/OD:**	4"	**Water Level*:**	10.1' b.g.s. 01/03/18(1330)
Hammer Efficiency Factor:	0.979	**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.
50	11D	19/13	50.00 - 51.58	9/6/52/50(1")	58	95		96.5		Grey, very moist, hard, fine to medium SAND, some fine gravel, trace clay (Glacial Till).	
										51.2	
										Bottom of Exploration at 51.2 feet below ground surface. Top of bedrock at Elev. 96.5 ft based on split spoon and roller cone refusal.	
55											
60											
65											
70											
75											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MaineDOT Gorham Culvert & Wall
Location: Gorham, Maine

Boring No.: HB-GBB-304
WIN: 18821.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	152.1	**Auger ID/OD:**	4"
Operator:	Mike Nadeau	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375" ID
Logged By:	T. Mantey	**Rig Type:**	Diedrich D-50	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	01.03.18(1415)/01.08.18(0945)	**Drilling Method:**	SSA/Cased Wash Boring	**Core Barrel:**	N/A
Boring Location:	14+75.2, 135.0 ft. (L)	**Casing ID/OD:**	4"	**Water Level*:**	9.4' b.g.s. 01.08.18(0955)
Hammer Efficiency Factor:	0.979	**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	24/15	0.00 - 2.00	7/13/23/38	36	59	SSA			Brown, dry to damp, dense, Silty fine to medium SAND, some fine to coarse angular gravel (Fill). Broken and fractured gravel pieces throughout.	
	2D	24/15	2.00 - 4.00	40/42/18/23	60	98				Brown-tan, slightly moist, very dense, Silty fine to coarse SAND, little fine subangular gravel (Fill). Broken and fractured gravel pieces throughout.	WC = 5.9% Fines: 17.6% A-1-b, SM
	3D	24/22	4.00 - 6.00	12/15/10/7	25	41				Top 17": Brown-tan, slightly moist, medium dense, Silty fine to coarse SAND , some fine subangular gravel (Fill). Bottom 5": Grey, slightly moist, medium dense, Silty fine SAND, trace clay (Fill).	
5								146.1		6.0	
	4D	24/19	6.00 - 8.00	6/6/7/8	13	21				Brown-tan, moist, medium dense, Silty fine to coarse SAND (Fill). Organic layer at 7.5' b.g.s. with a thickness of 0.5".	WC = 17.6% Fines: 11.4% A-2-4, SP-SM
	5D	24/24	8.00 - 10.00	3/2/1/1	3	5				Top 18": Brown-tan, moist, very loose, fine to medium Silty SAND.	
								142.6		9.5	
10	6D	24/24	10.00 - 12.00	1/1/1/1	2	3	Push			Bottom 6": Brown, damp, soft, Silty CLAY with some oxidation staining. Material rolls to less than 2 mm. Grey, very moist, soft, Silty CLAY (Presumpscot Formation). PP = 0.75, 0.75, 0.75 TSF; T_V = 0.75 TSF	WC = 35.7% Fines: 92.1% LL = 32 PL = 21 PI = 11 LI = 1.3 A-6, CL
15	7D ~~V1~~ V2	24/22	15.00 - 17.00 ~~15.60 - 16.00~~ 16.60 - 17.00	WOR(24") ~~Su = 604/137 psf~~ Su = 508/110 psf	-		Open			Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation). PP = 1.0, 0.75, 0.75 TSF; T_V = 1.0, 0.75 TSF 65x130 mm vane raw torque readings: V1: 22.0/5.0 ft-lbs V2: 18.5/4.0 ft-lbs	WC = 39.9% LL = 34 PL = 23 PI = 11 LI = 1.5 A-6, CL
20	8D ~~V3~~ V4	24/24	20.00 - 22.00 ~~20.60 - 21.00~~ 21.60 - 22.00	WOR(24") ~~Su = 714/82 psf~~ Su = 783/82 psf	-					Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation). T_V = 0.4 TSF 65x130 mm vane raw torque readings: V3: 26.0/3.0 ft-lbs V4: 28.5/3.0 ft-lbs	
25											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MaineDOT Gorham Culvert & Wall
Location: Gorham, Maine

Boring No.: HB-GBB-304
WIN: 18821.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	152.1	**Auger ID/OD:**	4"
Operator:	Mike Nadeau	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375" ID
Logged By:	T. Mantey	**Rig Type:**	Diedrich D-50	**Hammer Wt./Fall:**	140lb/30"
Date Start/Finish:	01.03.18(1415)/01.08.18(0945)	**Drilling Method:**	SSA/Cased Wash Boring	**Core Barrel:**	N/A
Boring Location:	14+75.2, 135.0 ft. (L)	**Casing ID/OD:**	4"	**Water Level*:**	9.4' b.g.s. 01.08.18(0955)
Hammer Efficiency Factor: 0.979		**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	9D	24/24	25.00 - 27.00	WOR(24")	-					Grey, wet, medium stiff to stiff, Silty CLAY (Presumpscot Formation).	
	~~V5~~		~~25.60 - 26.00~~	~~Su = 961/110 psf~~						T_V = 0.4 TSF	
	V6		26.60 - 27.00	Su= 1016/137 psf						65x130 mm vane raw torque readings:	
										V5: 35.0/4.0 ft-lbs	
										V6: 37.0/5.0 ft-lbs	
30	10D	24/23	30.00 - 32.00	1/1/1/5	-			121.5		Top 15": Brown-grey, wet, soft, Silty CLAY (Presumpscot Formation).	
	~~MV~~		~~30.60 - 31.00~~	~~Could Not Push~~						MV: Failed vane attempt.	
								120.2		30.6	
										Bottom 8": Brown-grey, wet, loose, Silty fine to coarse SAND, trace fine gravel (Glacial Outwash).	
35										31.9	
										Bottom of Exploration at 31.9 feet below ground surface.	
40											
45											
50											

Remarks:

1. Maine DOT provided boring locations and surface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MaineDOT Gorham Culvert & Wall
Location: Gorham, Maine

Boring No.: HB-GBB-305
WIN: 18821.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	149.4	**Auger ID/OD:**	4"
Operator:	Mike Nadeau	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	T. Mantey	**Rig Type:**	Diedrich D-50	**Hammer Wt./Fall:**	140lb./30"
Date Start/Finish:	01.08.18(1050)/01.08.18(1545)	**Drilling Method:**	SSA/Cased Wash Boring	**Core Barrel:**	N/A
Boring Location:	15+18.2, 68.1 ft. (L)	**Casing ID/OD:**	4"	**Water Level*:**	9.9' b.g.s. 01.08.18(1510)
Hammer Efficiency Factor:	0.979	**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	0.00 - 2.00	2/5/18/16	23	38	SSA			Brown, dry, medium dense, Silty fine to coarse SAND, little fine to coarse gravel. Gravel up to 1" in size. Roots and organic material in top 2" of sample (Fill).	
5	2D	24/19	5.00 - 7.00	5/5/6/7	11	18		143.6		Top 10": Brown, moist, medium dense, Silty fine to coarse SAND. 5.8 Bottom 9": Brown, moist, medium dense, Silty fine SAND.	WC = 66.7% Fines: 21.1% A-2-4, SC-SM
10	3D	24/24	10.00 - 12.00	2/2/3/3	5	8	Open	139.4		10.0 Grey, moist, medium stiff, Silty CLAY (Presumpscot Formation). PP = 1.75, 1.5, 1.75 TSF; T_V = 2.25 TSF	WC = 33.6%
15	4D V1 V2	24/24	15.00 - 17.00 15.60 - 16.00 16.60 - 17.00	Su = 659/82 psf Su = 741/82 psf	-					Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation). 65x130 mm vane raw torque readings: V1: 24.0/3.0 ft-lbs V2: 27.0/3.0 ft-lbs	WC = 29.0% LL = 35 PL = 22 PI = 13 LI = 0.5 A-6, CL
20	1U V3 V4	30/23	20.00 - 22.50 22.60 - 23.00 23.60 - 24.00	Piston Sampler Su = 824/82 psf Su = 632/82 psf						Grey, wet, medium stiff, Silty CLAY (Presumpscot Formation). 65x130 mm vane raw torque readings: V3: 30.0/3.0 ft-lbs V4: 23.0/3.0 ft-lbs	
25											

Remarks:

1. Main DOT provided boring locations and subsurface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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: MaineDOT Gorham Culvert & Wall
Location: Gorham, Maine

Boring No.: HB-GBB-305
WIN: 18821.00

Driller:	Northern Test Boring, Inc.	**Elevation (ft.)**	149.4	**Auger ID/OD:**	4"
Operator:	Mike Nadeau	**Datum:**	NAVD88	**Sampler:**	Split Spoon 1.375 ID
Logged By:	T. Mantey	**Rig Type:**	Diedrich D-50	**Hammer Wt./Fall:**	140lb./30"
Date Start/Finish:	01.08.18(1050)/01.08.18(1545)	**Drilling Method:**	SSA/Cased Wash Boring	**Core Barrel:**	N/A
Boring Location:	15+18.2, 68.1 ft. (L)	**Casing ID/OD:**	4"	**Water Level*:**	9.9' b.g.s. 01.08.18(1510)
Hammer Efficiency Factor:	0.979	**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	5D V5 MV	24/24	25.00 - 27.00 ~~25.60 - 26.00~~	WOR(24") ~~Su = 961/110 psf~~ Could Not Push	-			124.4		25.0 Grey, moist to wet, medium stiff, SILT (Presumpscot Formation). 65x130 mm vane raw torque readings: V5: 35.0/4.0 ft-lbs MV: Failed vane attempt.	WC = 41.9% LL = 33 PL = 25 PI = 8 LI = 2.1 A-4, ML
30	6D V6 MV	24/24	30.00 - 32.00 ~~30.60 - 31.00~~	WOR(12")/3/3 ~~Su= 1786/223 psf~~ Could Not Push	-			119.4 118.2		30.0 Top 15": Grey, moist to wet, stiff Silty CLAY (Presumpscot Formation). 65x130 mm vane raw torque readings: V6: 40.0/5.0 ft-lbs MV: Failed vane attempt. 31.2 Bottom 9": Brown, damp to moist, loose, Silty fine to coarse SAND, some clay (Glacial Outwash).	
35	7D	24/12	35.00 - 37.00	8/8/8/11	16	26				Brownish grey, wet, medium dense, Silty fine to coarse SAND, little fine to coarse gravel (Glacial Outwash).	WC = 11.0% Fines: 24.4% A-2-4, SM
40	8D	24/15	40.00 - 42.00	5/8/20/23	28	46				Grey, wet, medium dense, Silty fine to coarse SAND, some fine gravel (Glacial Outwash).	
45								104.5		44.9 **Bottom of Exploration at 44.9 feet below ground surface.** Top of bedrock at Elev. 104.5 ft based on roller cone refusal.	
50											

Remarks:

1. Main DOT provided boring locations and subsurface elevations.
2. "-" Blow counts for spoons driven through a disturbed field vane test location cannot be used to determine N-value.

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.

APPENDIX B

Rock Core Photos

APPENDIX B
Rock Core Photos
Brandy Brook Culvert & Stream Relocation
Gorham, Maine
MaineDOT WIN 18821.00

Boring	Run	Depth	Recovery		RQD	
			in	%	in	%
HB-GBB-201	R1	56.6 – 61.6	58”/60”	97%	55”/60”	92%
HB-GBB-204	R1	40.5 – 45.5	55”/60”	92%	52”/60”	87%
HB-GBB-203	R1	51.2 – 56.2	43.8”/60”	73%	27”/60”	45%



Row 1 = HB-GBB-201 Run 1: 56.6 - 61.6 ft-bgs
Row 2 = HB-GBB-204 Run 1: 40.5 - 45.5 ft-bgs
Row 3 = HB-GBB-203 Run 1: 51.2 - 56.2 ft-bgs

GOLDER

APPENDIX B
Rock Core Photos
Brandy Brook Culvert & Stream Relocation
Gorham, Maine
MaineDOT WIN 18821.00

Boring	Run	Depth	Recovery		RQD	
			in	%	in	%
HB-GBB-202A	R1	59' – 64'	43.5/60	73%	41.25/60	69%
	R2	64' – 69'	60/60	100%	59/60	98%



Row 1 = HB-GBB-202A Run 1: 59 - 64 ft-bgs
Row 2 = HB-GBB-202A Run 2: 64 - 69 ft-bgs.

GOLDER

APPENDIX B
Rock Core Photos
Brandy Brook Culvert & Stream Relocation
Gorham, Maine
MaineDOT WIN 18821.00

Boring	Run	Depth	Recovery		RQD	
			in	%	in	%
HB-GBB-205	R1	50' – 55'	50/60	83%	44.5/60	74%
	R2	55' – 60.5'	65.5/66	99%	41.75/66	63%



Row 1 = HB-GBB-205 Run 1: 50 - 55 ft-bgs
Row 2 = HB-GBB-205 Run 2: 55 - 60 ft-bgs
Row 3 = HB-GBB-205 Run 2: 60 - 60.5 ft-bgs

GOLDER

APPENDIX C

Laboratory Test Results

State of Maine - Department of Transportation

Laboratory Testing Summary Sheet

Town(s): Gorham Work Number: 18821.00

Boring & Sample Identification Number	Station (Feet)	Offset (Feet)	Depth (Feet)	Reference Number	G.S.D.C. Sheet	W.C. %	L.L.	P.I.	Classification		
									Unified	AASHTO	Frost
HB-GBB-201, 2D	12+75.8	10.3 Lt.	3.5-5.5	270147	1	4.8			SM	A-1-b	II
HB-GBB-201, 7D	12+75.8	10.3 Lt.	15.0-17.0	270148	---	26.4	39	17	CL	A-6	III
HB-GBB-201, 8D	12+75.8	10.3 Lt.	17.0-19.0	270149	1	32.9			CL	A-6	III
HB-GBB-201, 9D	12+75.8	10.3 Lt.	20.0-22.0	270150	---	37.2	43	19	CL	A-7-6	III
HB-GBB-201, 12D	12+75.8	10.3 Lt.	45.0-47.0	243326	1	39.3			CL	A-7-6	III
HB-GBB-202A, 7D	12+92.3	10.2 Rt.	12.0-14.0	304339	2	24.6			SC-SM	A-4	II
HB-GBB-202A, 9D	12+92.3	10.2 Rt.	16.0-18.0	304340	2	32.5			CL	A-4	IV
HB-GBB-202A, 12D	12+92.3	10.2 Rt.	35.0-37.0	304341	---	32.0	28	8	CL	A-4	IV
HB-GBB-202A, 14D	12+92.3	10.2 Rt.	50.0-52.0	304342	2	37.0			CL	A-4	IV
HB-GBB-203, 1D	14+26.4	10.7 Rt.	1.5-3.5	243327	3	5.6			SM	A-1-b	II
HB-GBB-203, 5D	14+26.4	10.7 Rt.	15.5-17.5	243328	3	35.0			CL	A-7-6	III
HB-GBB-203, 6D	14+26.4	10.7 Rt.	17.5-19.5	243329	---	33.1	43	19	CL	A-7-6	III
HB-GBB-203, 7D	14+26.4	10.7 Rt.	30.0-32.0	243330	3	36.3			CL	A-7-6	III
HB-GBB-203, 9D	14+26.4	10.7 Rt.	40.0-42.0	243331	---	37.9	41	19	CL	A-7-6	III
HB-GBB-204, 1D	14+51.1	20.4 Lt.	1.0-3.0	243332	4	4.6			SM	A-1-b	II
HB-GBB-204, 2D	14+51.1	20.4 Lt.	3.0-5.0	243333	4	25.6			CL	A-7-6	III
HB-GBB-204, 5D	14+51.1	20.4 Lt.	10.0-12.0	243334	4	25.2			CL	A-7-6	III
HB-GBB-204, 7D	14+51.1	20.4 Lt.	25.0-27.0	243335	---	42.5	41	18	CL	A-7-6	III
HB-GBB-204, 8D/A	14+51.1	20.4 Lt.	35.0-37.0	243336	---	37.3	33	14	CL	A-6	III
	Northern	Easting									
HB-GBB-205, 4D	30925.09	958638.47	7.0-9.0	304343	5	17.4	24	6	CL-ML	A-4	IV
HB-GBB-205, 6D	30925.09	958638.47	15.0-17.0	304344	5	34.9			CL	A-4	IV
HB-GBB-205, 8D	30925.09	958638.47	30.0-32.0	304345	---	38.9	37	14	CL	A-6	III
HB-GBB-205, 10D	30925.09	958638.47	40.0-42.0	304346	5	10.2			SM	A-1-b	II
HB-GBB-301, 2D	12+86.1	99.0 Lt.	5.0-7.0	303041	6	17.9			SM	A-2-4	II
HB-GBB-301, 3D	12+86.1	99.0 Lt.	10.0-12.0	303042	6	26.8	26	7	CL-ML	A-4	IV
HB-GBB-301, 1U	12+86.1	99.0 Lt.	20.0-22.5	303043	6	44.2	37	12	CL	A-6	III
HB-GBB-301, 5D	12+86.1	99.0 Lt.	25.0-27.0	303044	6	33.9	29	8	CL	A-4	IV
HB-GBB-301, 2U	12+86.1	99.0 Lt.	30.0-32.5	303046	6	40.3	35	11	CL	A-6	IV
HB-GBB-301, 6D	12+86.1	99.0 Lt.	35.0-37.0	303045	---	34.9					
HB-GBB-302, 2D	13+68.3	156.6 Lt.	2.0-4.0	303047	7	21.3			SM	A-2-4	II
HB-GBB-302, 3D	13+68.3	156.6 Lt.	4.0-6.0	303048	7	21.0	26	8	CL	A-4	IV
HB-GBB-302, 6D	13+68.3	156.6 Lt.	10.0-12.0	303049	---	32.7					
HB-GBB-302, 8D	13+68.3	156.6 Lt.	15.0-17.0	303050	7	42.4			CL	A-4	IV
HB-GBB-302, 9D	13+68.3	156.6 Lt.	20.0-22.0	303063	---	37.4	31	9	CL	A-4	IV
HB-GBB-303, 1D	13+93.6	83.4 Lt.	0.0-2.0	303064	8	7.3			SM	A-1-b	II
HB-GBB-303, 2D	13+93.6	83.4 Lt.	5.0-7.0	303065	8	17.8			SM	A-2-4	II
HB-GBB-303, 3D	13+93.6	83.4 Lt.	10.0-12.0	303066	8	14.3			CL	A-4	IV
HB-GBB-303, 4D	13+93.6	83.4 Lt.	15.0-17.0	303067	---	45.1					
HB-GBB-303, 7D	13+93.6	83.4 Lt.	30.0-32.0	303068	---	37.5					

Classification of these soil samples is in accordance with AASHTO Classification System M-145-40. This classification is followed by the "Frost Susceptibility Rating" from zero (non-frost susceptible) to Class IV (highly frost susceptible). The "Frost Susceptibility Rating" is based upon the MaineDOT and Corps of Engineers Classification Systems.

GSDC = Grain Size Distribution Curve as determined by AASHTO T 88-93 (1996) and/or ASTM D 422-63 (Reapproved 1998)

WC = water content as determined by AASHTO T 265-93 and/or ASTM D 2216-98

LL = Liquid limit as determined by AASHTO T 89-96 and/or ASTM D 4318-98 NP = Non Plastic

PI = Plasticity Index as determined by AASHTO 90-96 and/or ASTM D4318-98

State of Maine - Department of Transportation

Laboratory Testing Summary Sheet

Town(s): Gorham Work Number: 18821.00

Boring & Sample Identification Number	Station (Feet)	Offset (Feet)	Depth (Feet)	Reference Number	G.S.D.C. Sheet	W.C. %	L.L.	P.I.	Classification		
									Unified	AASHTO	Frost
HB-GBB-304, 2D	14+75.2	135.0 Lt.	2.0-4.0	303069	9	5.9			SM	A-1-b	II
HB-GBB-304, 4D	14+75.2	135.0 Lt.	6.0-8.0	303070	9	17.6			SP-SM	A-2-4	0
HB-GBB-304, 6D	14+75.2	135.0 Lt.	10.0-12.0	303071	9	35.7	32	11	CL	A-6	IV
HB-GBB-304, 7D	14+75.2	135.0 Lt.	15.0-17.0	303072	---	39.9	34	11	CL	A-6	IV
HB-GBB-305, 2D	15+18.2	68.1 Lt.	5.0-7.0	303073	10	66.7	-N	P-	SC-SM	A-2-4	II
HB-GBB-305, 3D	15+18.2	68.1 Lt.	10.0-12.0	303074	---	33.6					
HB-GBB-305, 4D	15+18.2	68.1 Lt.	15.0-17.0	303075	---	29.0	35	13	CL	A-6	III
HB-GBB-305, 1U	15+18.2	68.1 Lt.	20.0-22.5	303077	10	46.4	41	4	ML	A-5	IV
HB-GBB-305, 5D	15+18.2	68.1 Lt.	25.0-27.0	303078	---	41.9	33	8	ML	A-4	IV
HB-GBB-305, 7D	15+18.2	68.1 Lt.	35.0-37.0	303079	10	11.0			SM	A-2-4	II
HB-GBB-101, 1U	12+19.7	25.0 Rt.	20.0-22.0	210291	11	35.5	33	12	CL	A-6	III

Classification of these soil samples is in accordance with AASHTO Classification System M-145-40. This classification is followed by the "Frost Susceptibility Rating" from zero (non-frost susceptible) to Class IV (highly frost susceptible). The "Frost Susceptibility Rating" is based upon the MaineDOT and Corps of Engineers Classification Systems.

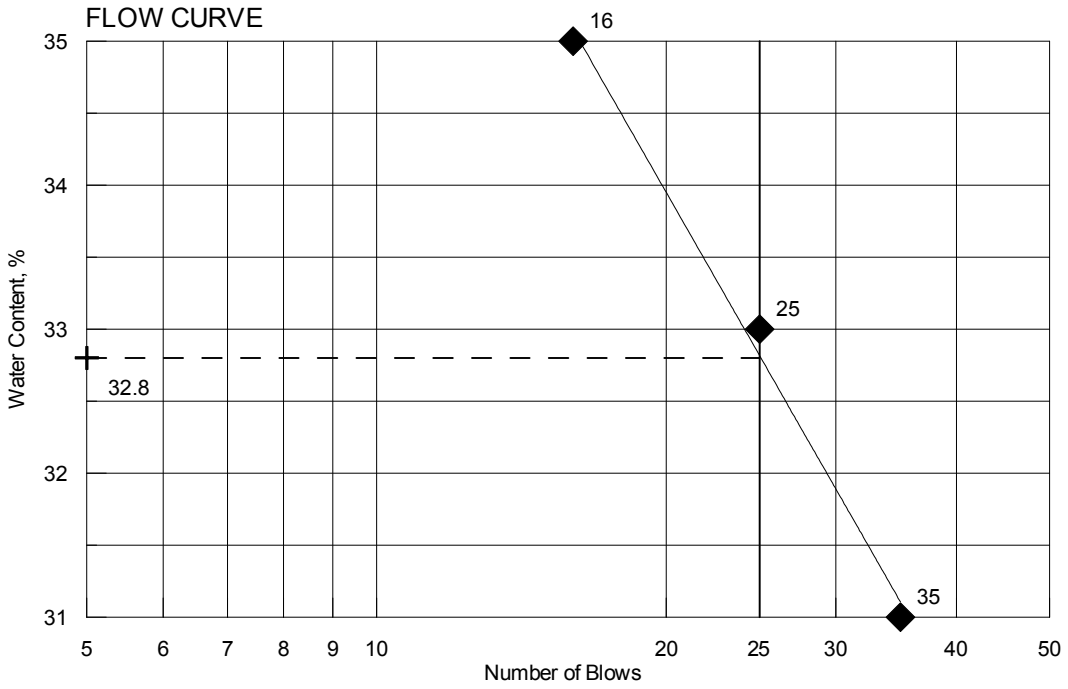
GSDC = Grain Size Distribution Curve as determined by AASHTO T 88-93 (1996) and/or ASTM D 422-63 (Reapproved 1998)

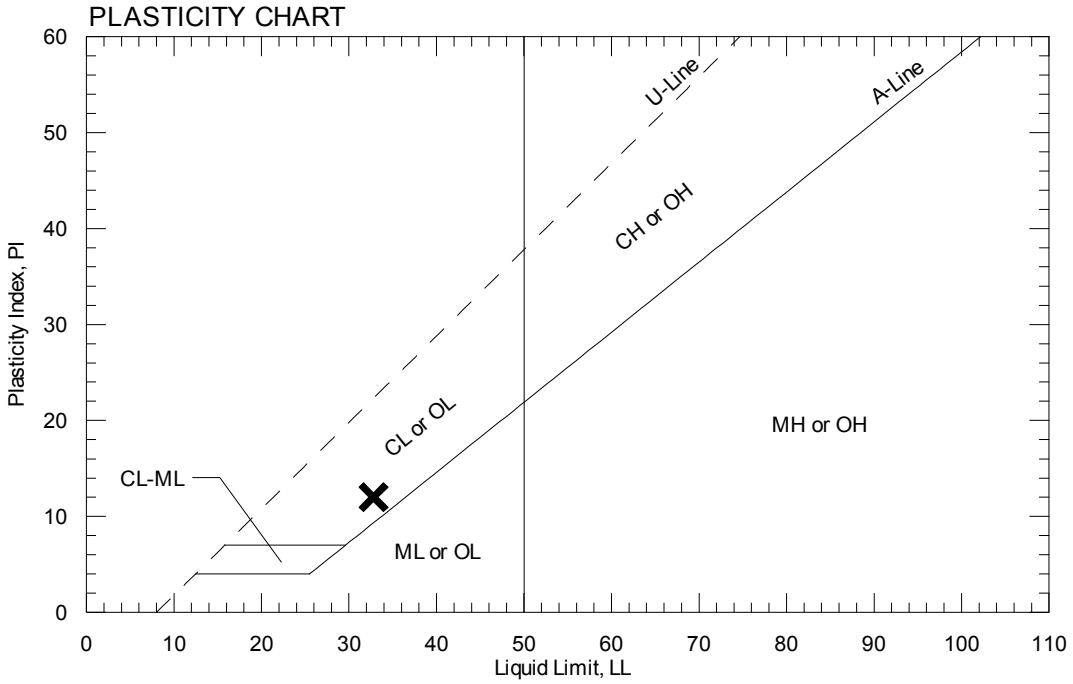
WC = water content as determined by AASHTO T 265-93 and/or ASTM D 2216-98

LL = Liquid limit as determined by AASHTO T 89-96 and/or ASTM D 4318-98 NP = Non Plastic

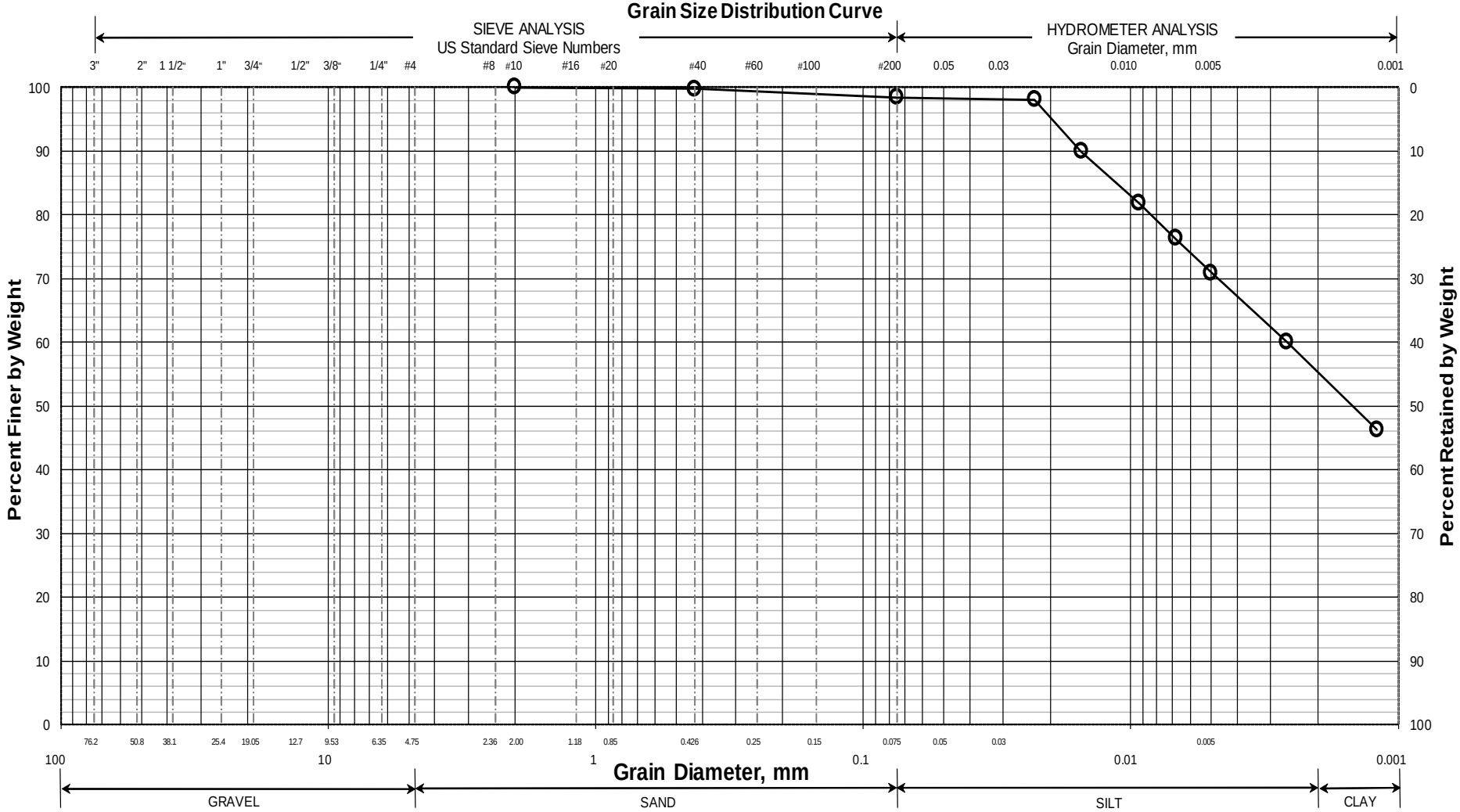
PI = Plasticity Index as determined by AASHTO 90-96 and/or ASTM D4318-98

TOWN	Gorham	Reference No.	210291
WIN	010801.00	Water Content, %	35.4
Sampled	4/30/2008	Liquid Limit @ 25 blows (T 89), %	33
Boring No./Sample No.	BB-GBB-101/1U	Plastic Limit (T 90), %	21
Station	12+19.7	Plasticity Index (T 90), %	12
Depth	20.0-22.0	Tested By	BBURR





Maine Department of Transportation
Grain Size Distribution Curve



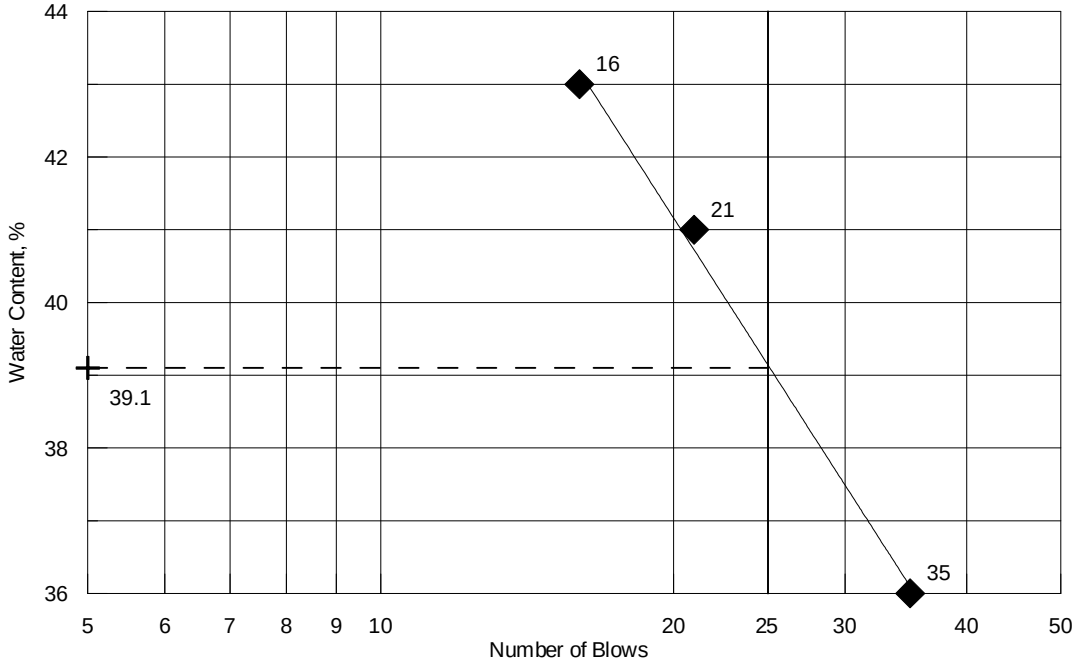
UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-GBB-101/1U	12+19.7	25.0 RT	20.0-22.0	Silty CLAY, trace sand.	35.4	33	21	12
◆									
■									
●									
▲									
×									

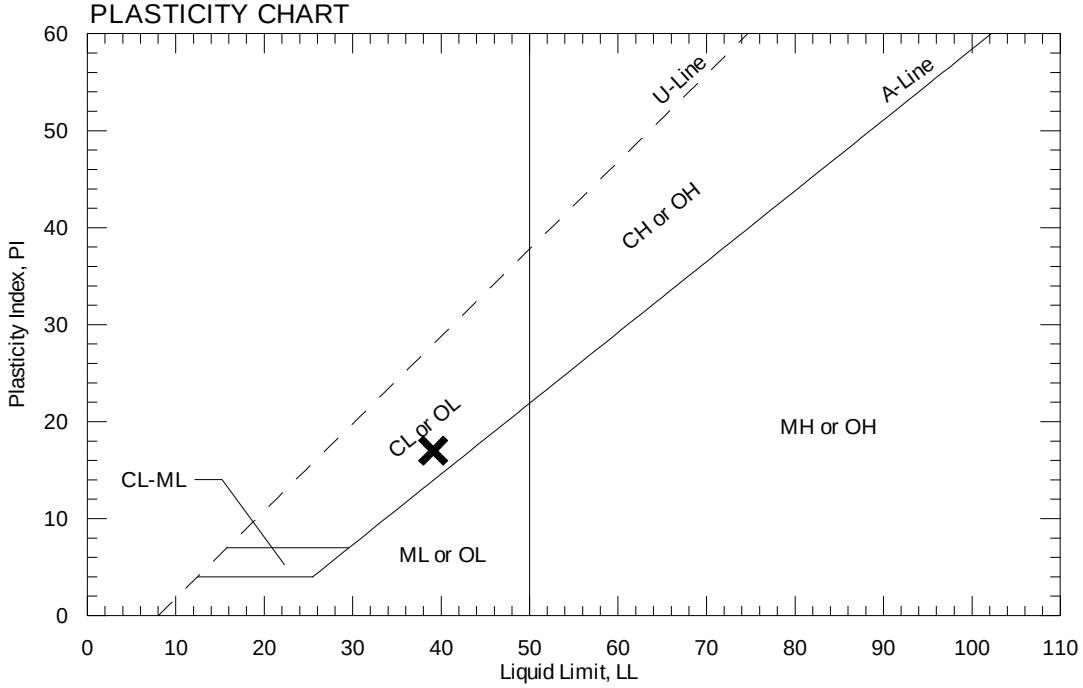
WIN
018821.00
Town
Gorham
Reported by/Date
WHITE, TERRY A 2/28/2020

TOWN	Gorham	Reference No.	270148
WIN	018821.00	Water Content, %	26.4
Sampled	12/13/2016	Liquid Limit @ 25 blows (T 89), %	39
Boring No./Sample No.	HB-GBB-201/7D	Plastic Limit (T 90), %	22
Station	12+75.8	Plasticity Index (T 90), %	17
Depth	15.0-17.0	Tested By	BBURR

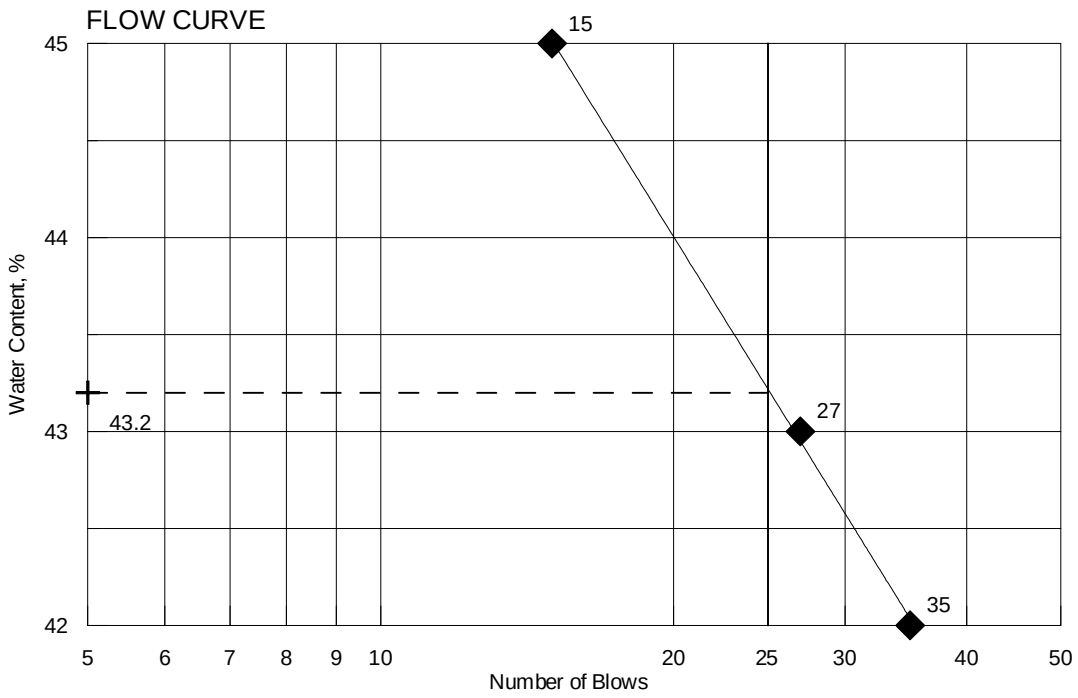
FLOW CURVE

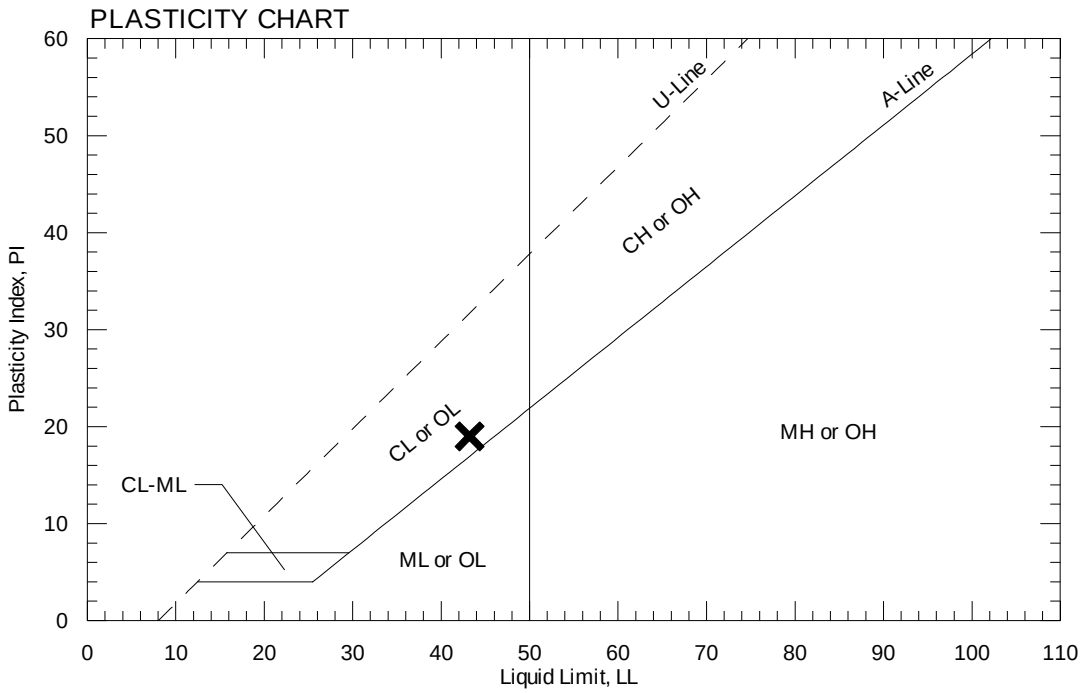


PLASTICITY CHART

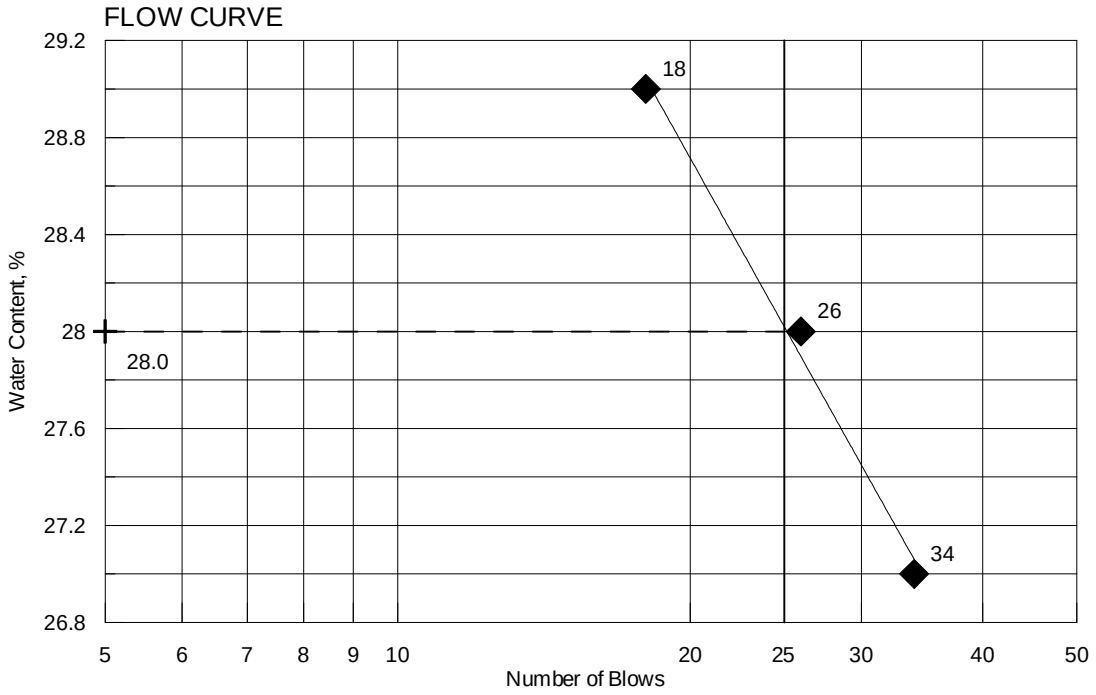


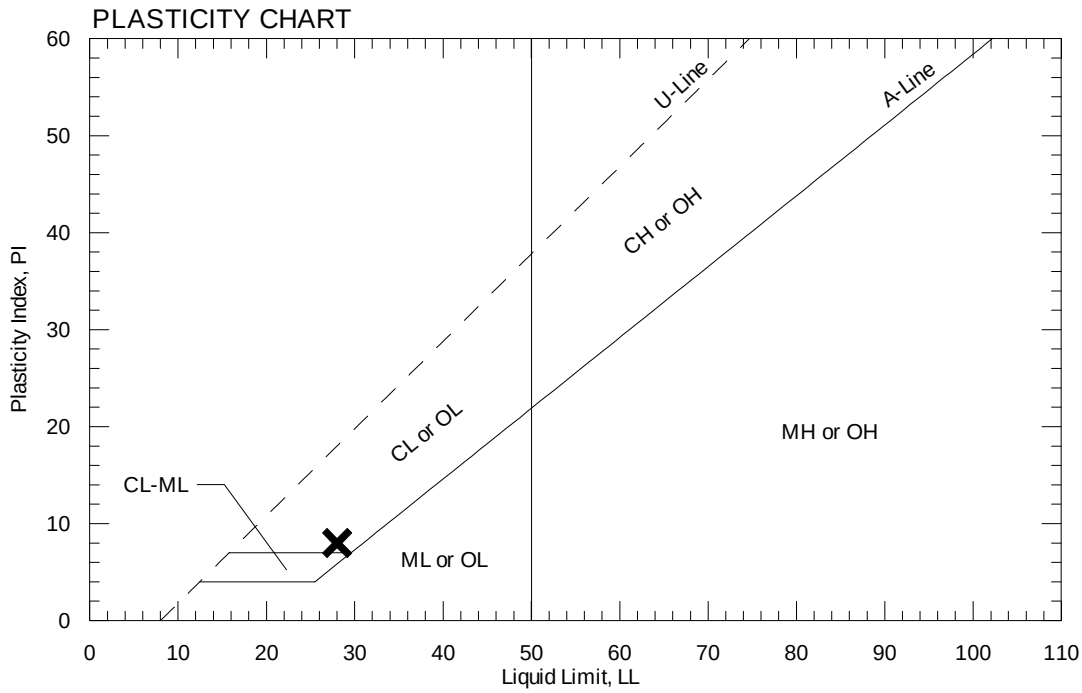
TOWN	Gorham	Reference No.	270150
WIN	018821.00	Water Content, %	37.2
Sampled	12/13/2016	Liquid Limit @ 25 blows (T 89), %	43
Boring No./Sample No.	HB-GBB-201/9D	Plastic Limit (T 90), %	24
Station	12+75.8	Plasticity Index (T 90), %	19
Depth	20.0-22.0	Tested By	BBURR



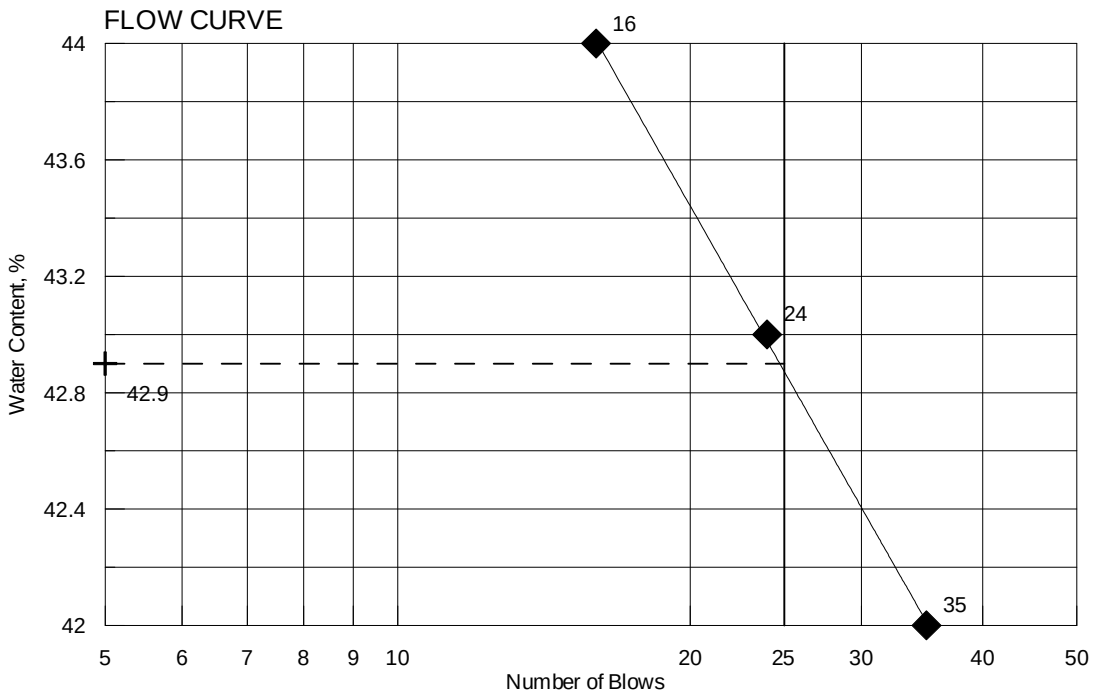


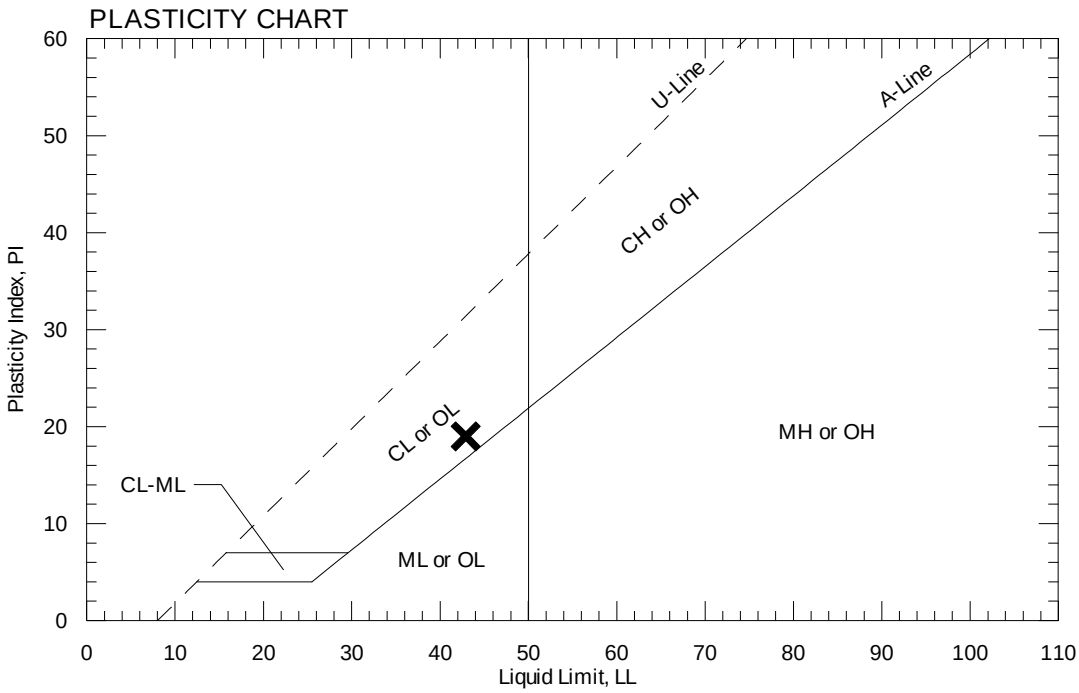
TOWN	Gorham	Reference No.	304341
WIN	018821.00	Water Content, %	32
Sampled	1/11/2017	Liquid Limit @ 25 blows (T 89), %	28
Boring No./Sample No.	HB-GBB-202A/12D	Plastic Limit (T 90), %	20
Station	12+92.3	Plasticity Index (T 90), %	8
Depth	35.0-37.0	Tested By	BBURR



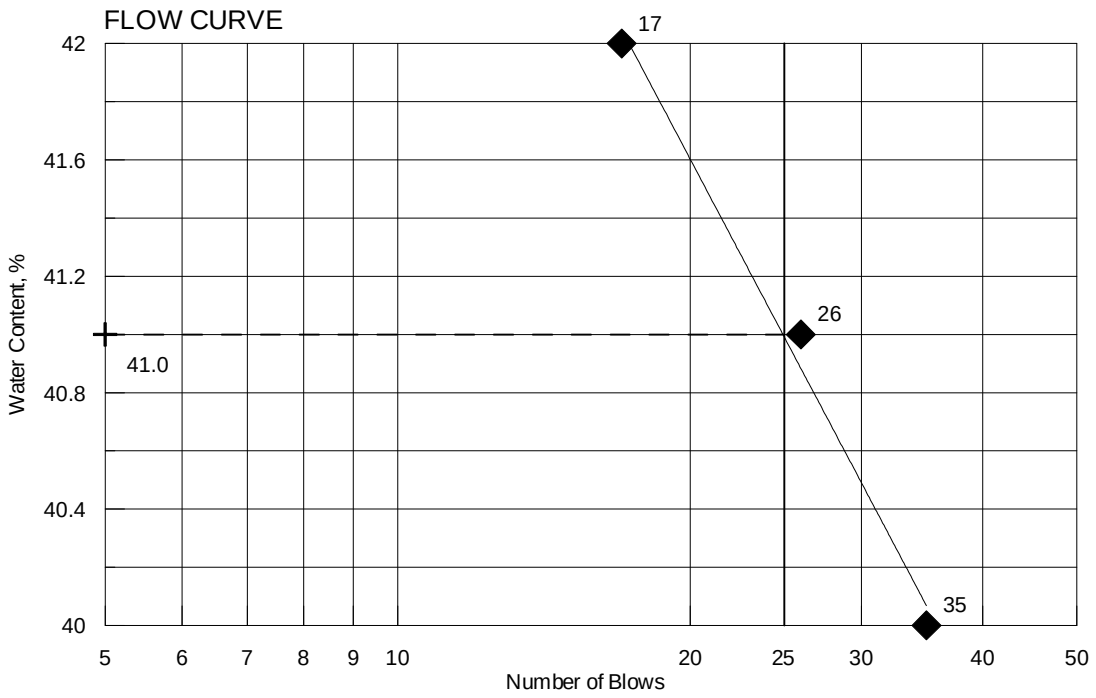


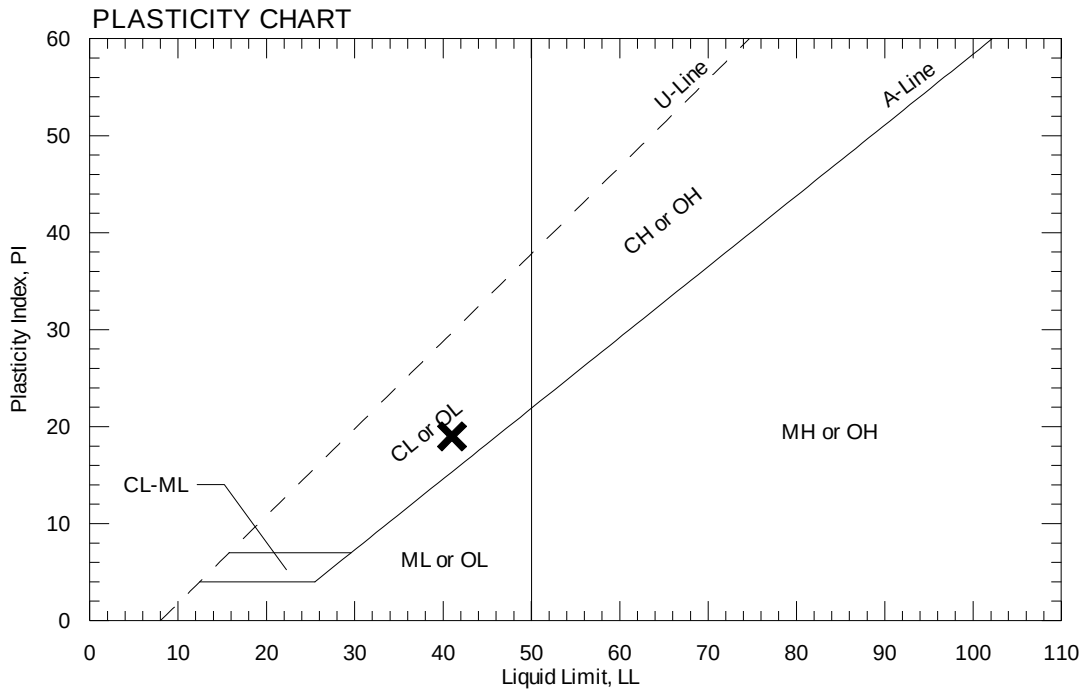
TOWN	Gorham	Reference No.	243329
WIN	018821.00	Water Content, %	33.1
Sampled	12/27/2016	Liquid Limit @ 25 blows (T 89), %	43
Boring No./Sample No.	HB-GBB-203/6D	Plastic Limit (T 90), %	24
Station	14+26.4	Plasticity Index (T 90), %	19
Depth	17.5-19.5	Tested By	BBURR



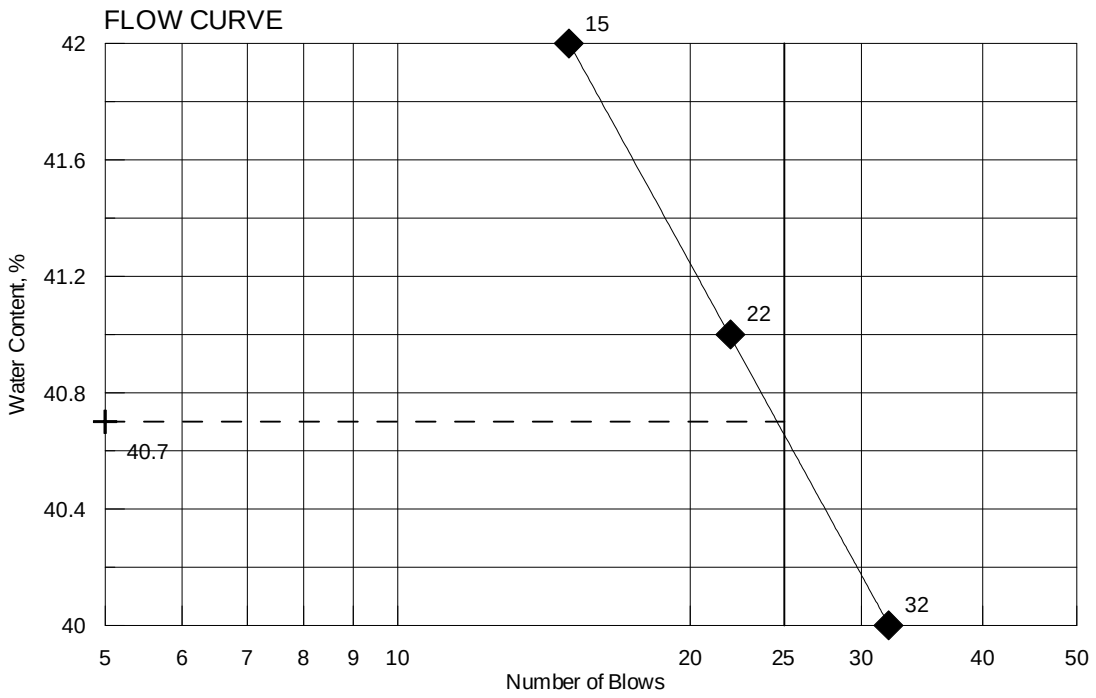


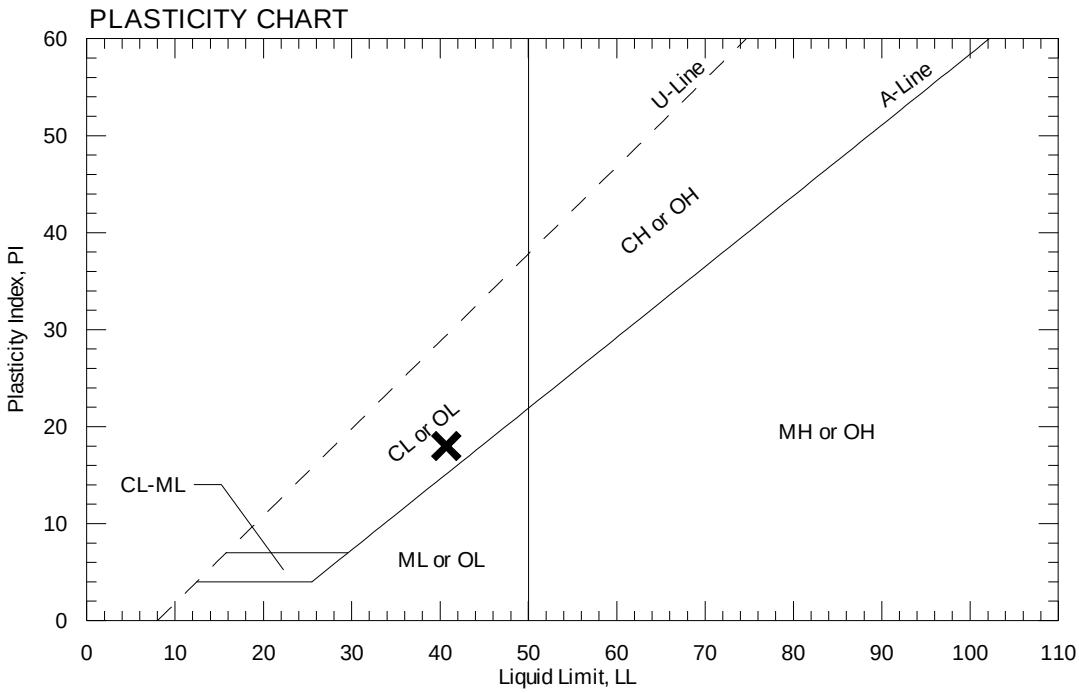
TOWN	Gorham	Reference No.	243331
WIN	018821.00	Water Content, %	37.9
Sampled	12/27/2016	Liquid Limit @ 25 blows (T 89), %	41
Boring No./Sample No.	HB-GBB-203/9D	Plastic Limit (T 90), %	22
Station	14+26.4	Plasticity Index (T 90), %	19
Depth	40.0-42.0	Tested By	BBURR



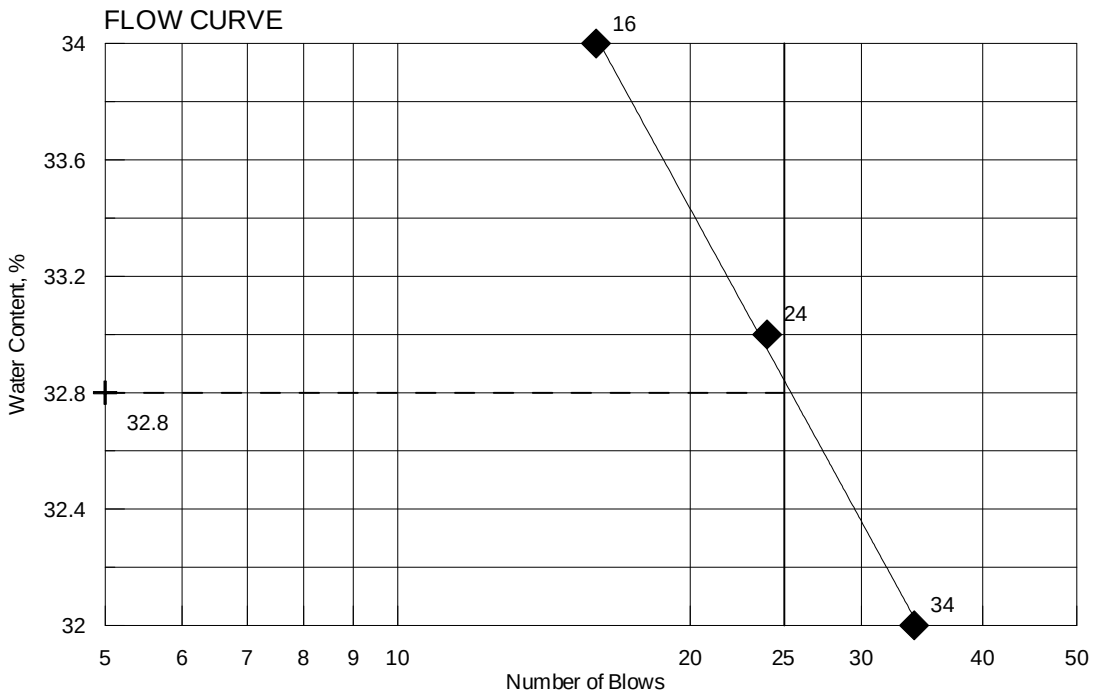


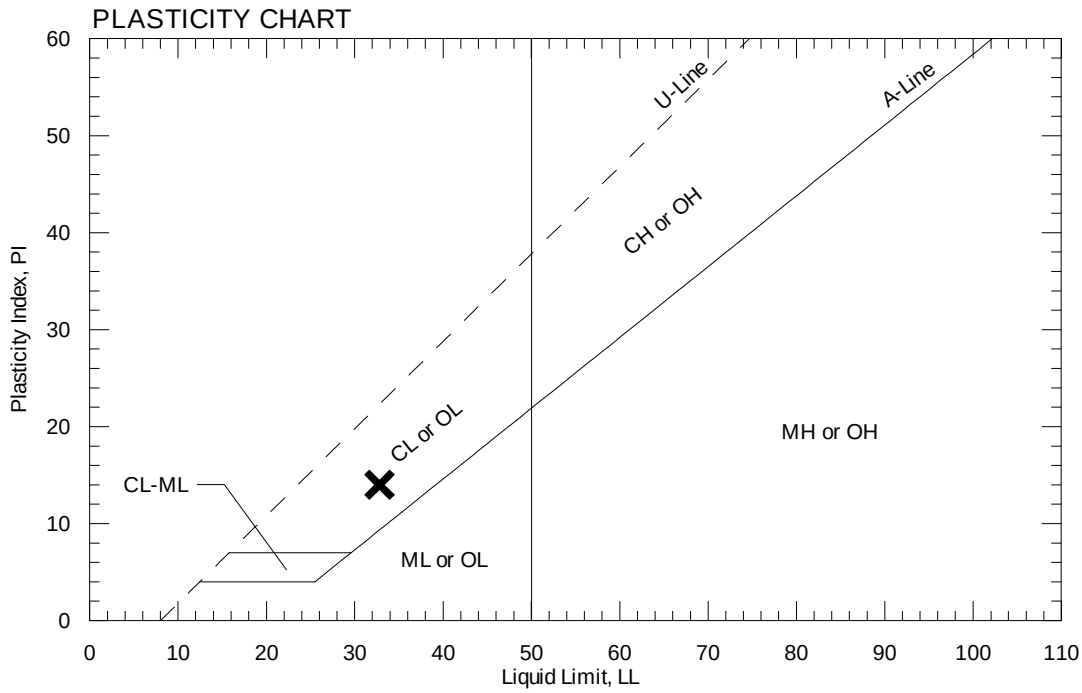
TOWN	Gorham	Reference No.	243335
WIN	018821.00	Water Content, %	42.5
Sampled	12/20/2016	Liquid Limit @ 25 blows (T 89), %	41
Boring No./Sample No.	HB-GBB-204/7D	Plastic Limit (T 90), %	23
Station	14+51.1	Plasticity Index (T 90), %	18
Depth	25.0-27.0	Tested By	BBURR



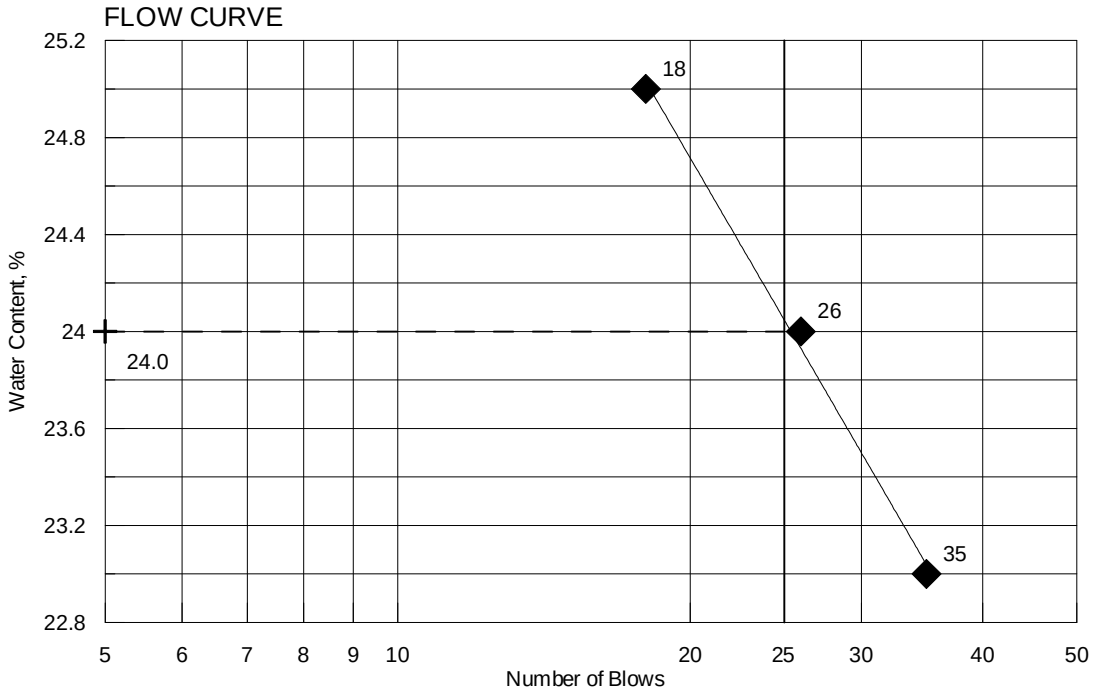


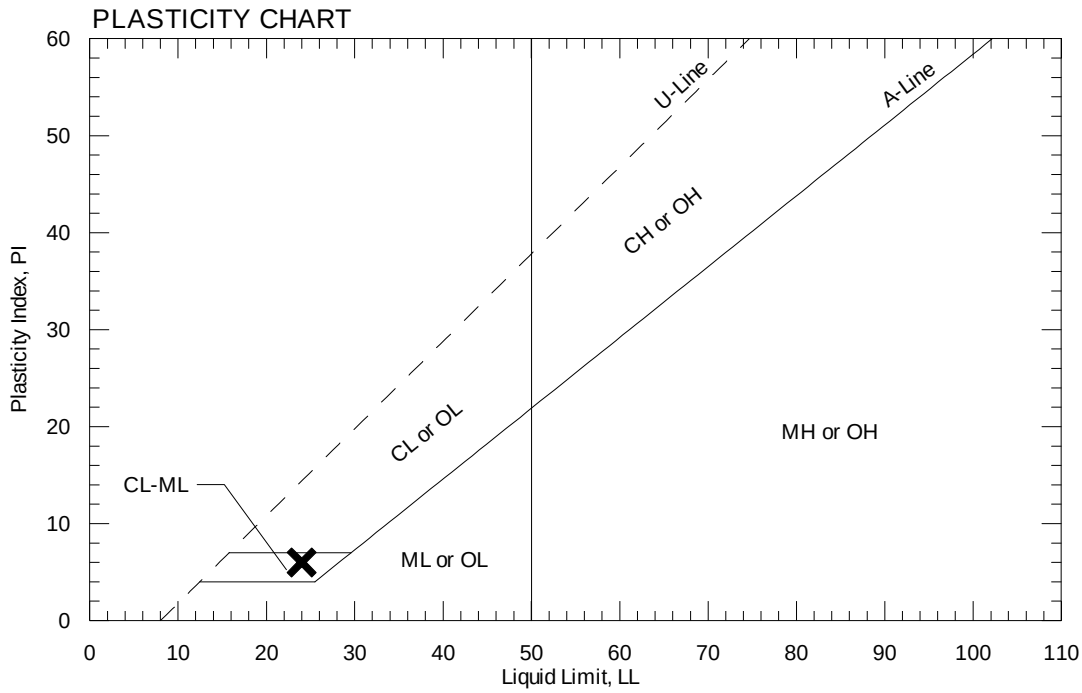
TOWN	Gorham	Reference No.	243336
WIN	018821.00	Water Content, %	37.3
Sampled	12/20/2016	Liquid Limit @ 25 blows (T 89), %	33
Boring No./Sample No.	HB-GBB-204/8DA	Plastic Limit (T 90), %	19
Station	14+51.1	Plasticity Index (T 90), %	14
Depth	35.0-37.0	Tested By	BBURR



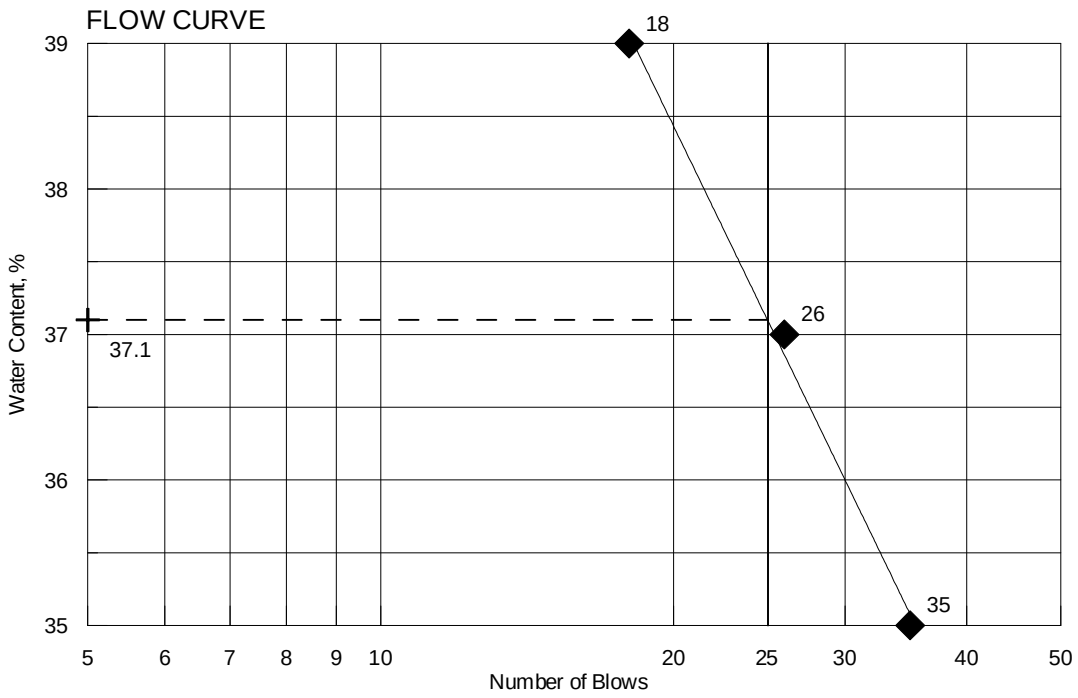


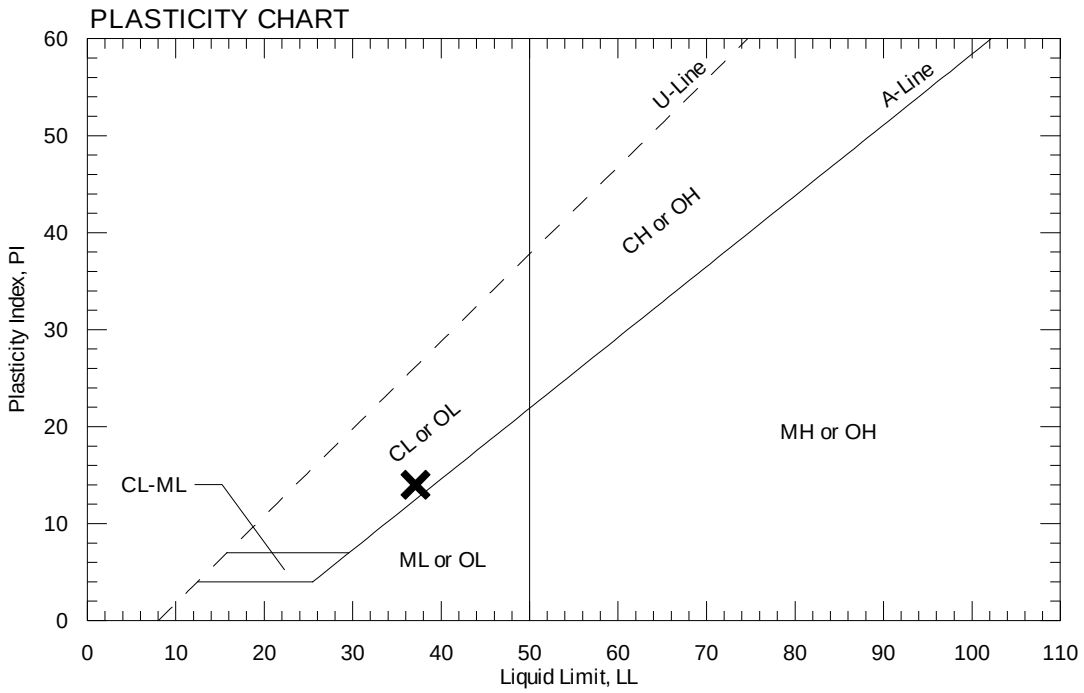
TOWN	Gorham	Reference No.	304343
WIN	018821.00	Water Content, %	17.4
Sampled	1/13/2017	Liquid Limit @ 25 blows (T 89), %	24
Boring No./Sample No.	HB-GBB-205/4D	Plastic Limit (T 90), %	18
Station	TBD	Plasticity Index (T 90), %	6
Depth	7.0-9.0	Tested By	BBURR



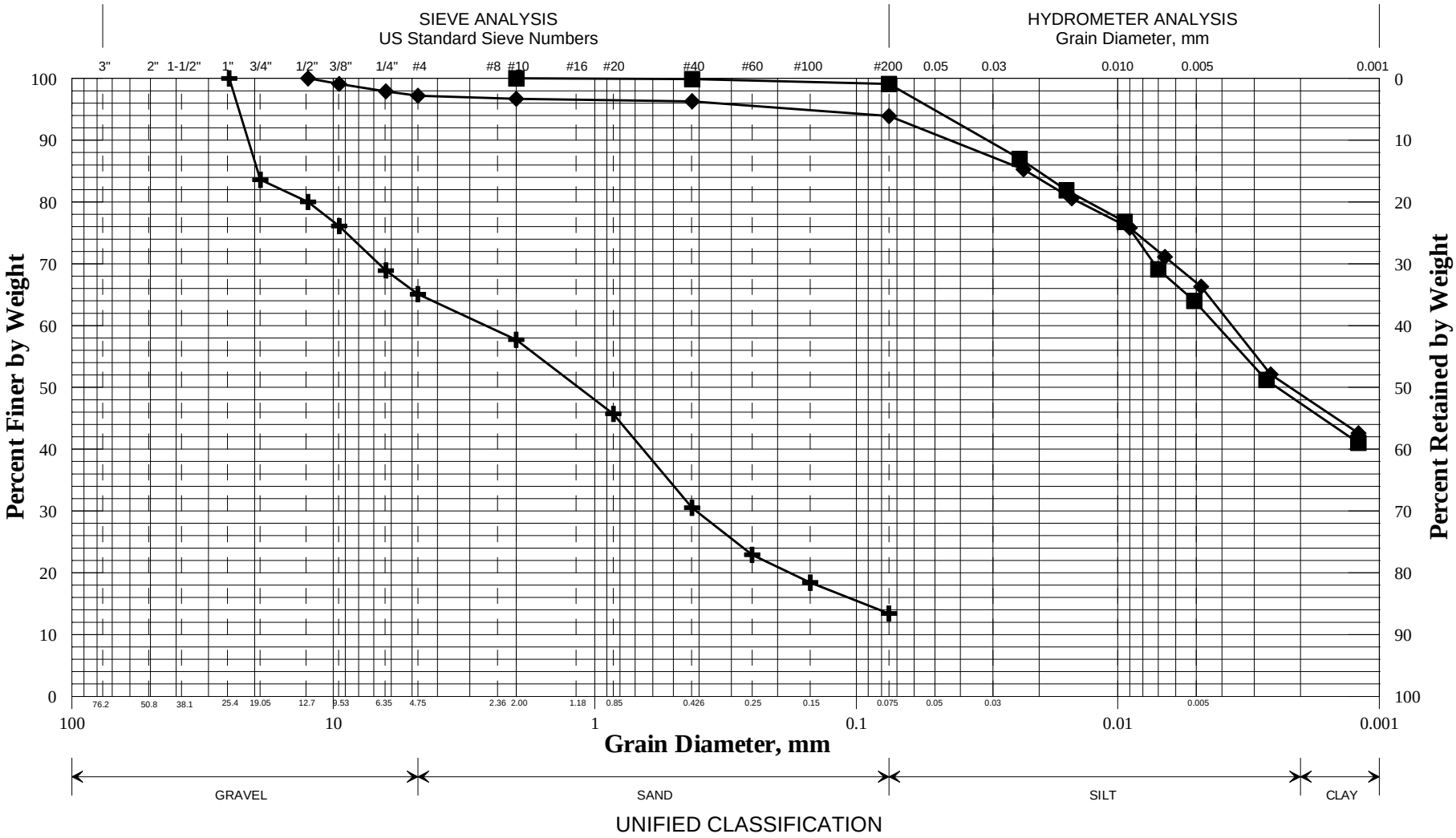


TOWN	Gorham	Reference No.	304345
WIN	018821.00	Water Content, %	38.9
Sampled	1/13/2017	Liquid Limit @ 25 blows (T 89), %	37
Boring No./Sample No.	HB-GBB-205/8D	Plastic Limit (T 90), %	23
Station	TBD	Plasticity Index (T 90), %	14
Depth	30.0-32.0	Tested By	BBURR





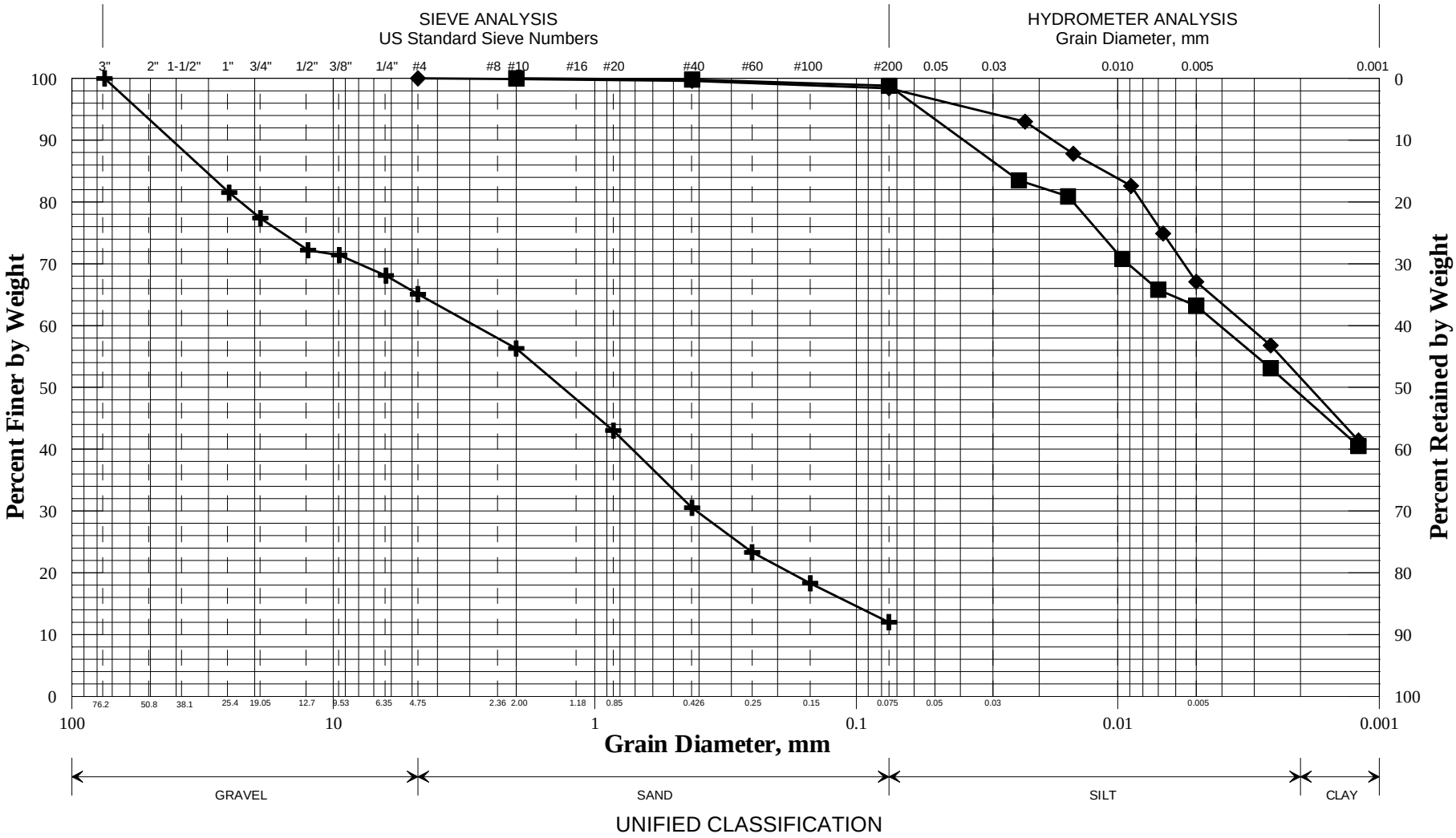
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-GBB-201/2D	12+75.8	10.3 LT	3.5-5.5	SAND, some gravel, little silt.	4.8			
◆	HB-GBB-201/8D	12+75.8	10.3 LT	17.0-19.0	Silty CLAY, trace sand, trace gravel.	32.9			
■	HB-GBB-201/12D	12+75.8	10.3 LT	50.0-52.0	Clayey SILT, trace sand.	39.3			
●									
▲									
✖									

WIN
018821.00
Town
Gorham
Reported by/Date
WHITE, TERRY A 2/2/2017

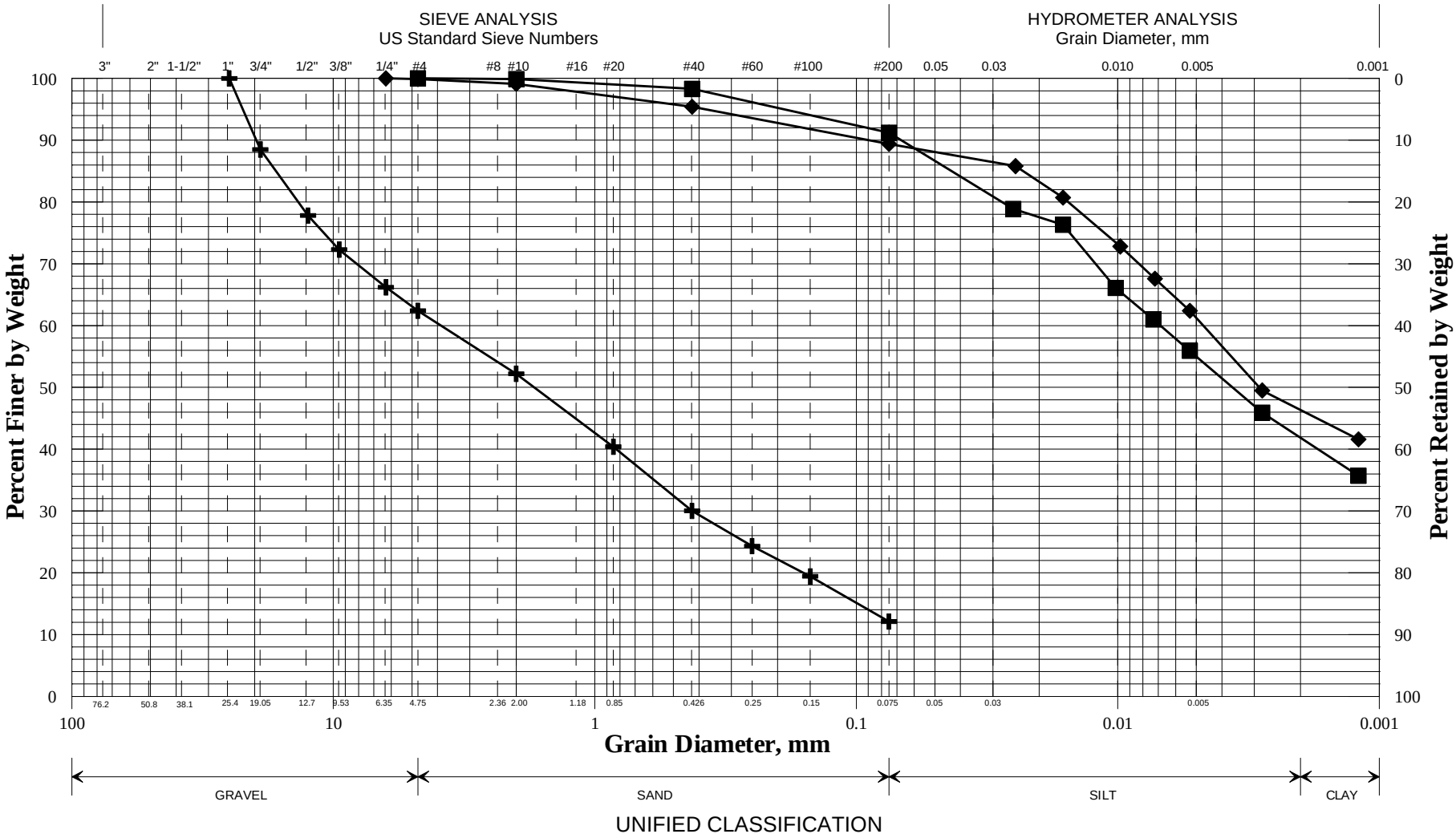
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-GBB-203/1D	14+26.4	10.7 RT	1.5-3.5	SAND, some gravel, little silt.	5.6			
◆	HB-GBB-203/5D	14+26.4	10.7 RT	15.5-17.5	Silty CLAY, trace sand.	35.0			
■	HB-GBB-203/7D	14+26.4	10.7 RT	30.0-32.0	Clayey SILT, trace sand.	36.3			
●									
▲									
✖									

WIN
018821.00
Town
Gorham
Reported by/Date
WHITE, TERRY A 2/2/2017

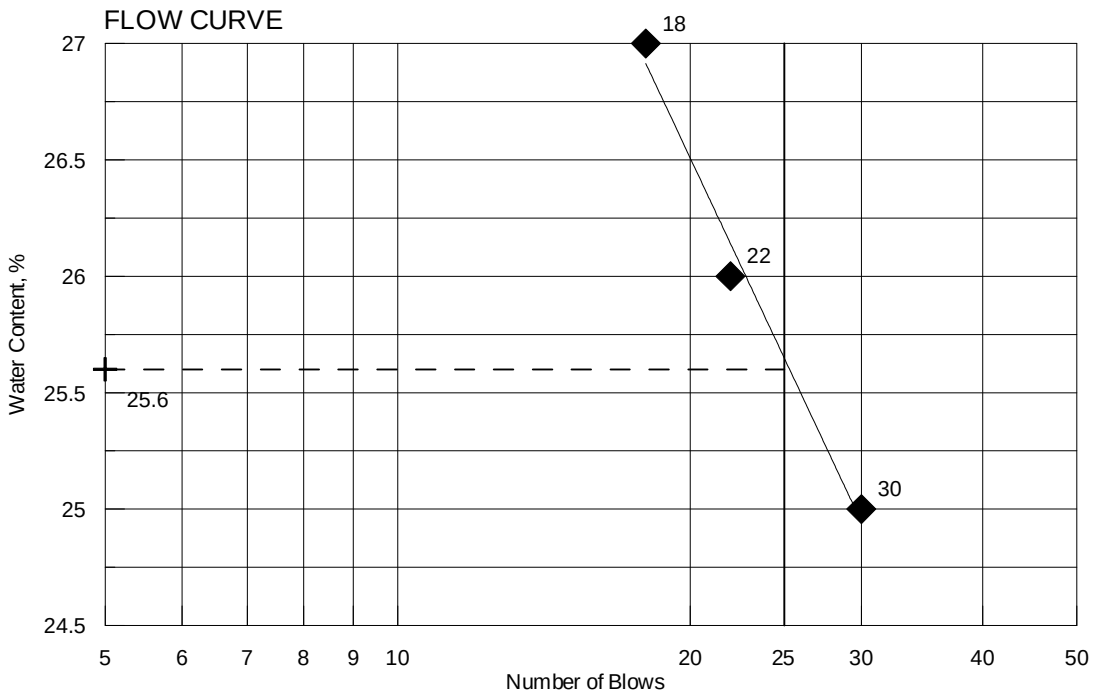
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE

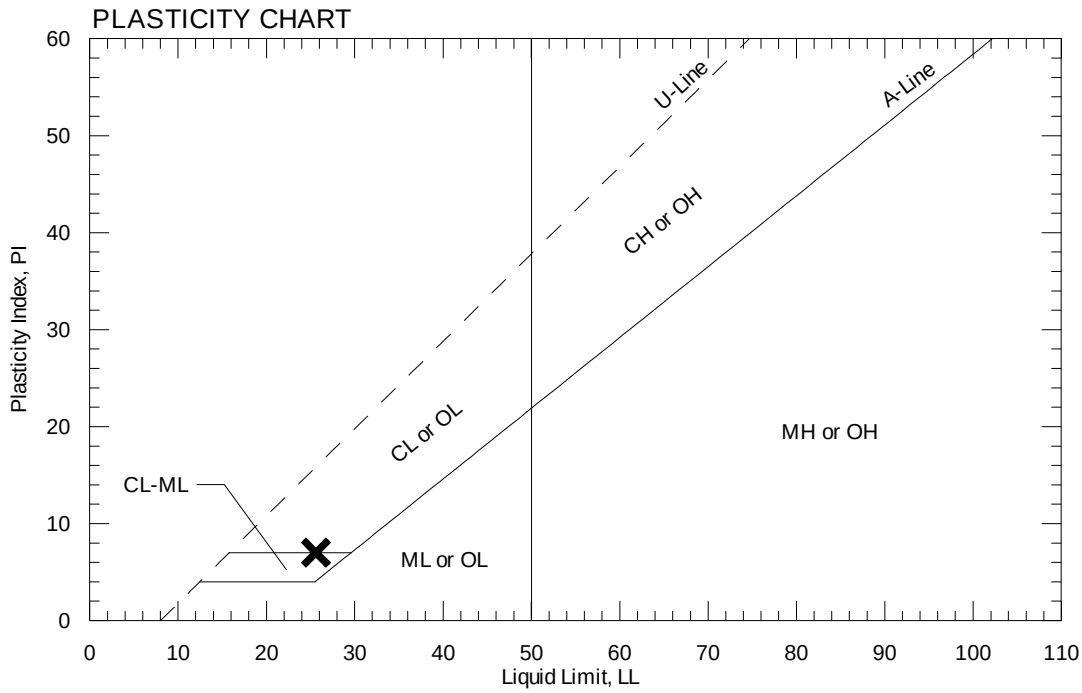


	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-GBB-204/1D	14+51.1	20.4 LT	1.0-3.0	Gravelly SAND, little silt.	4.6			
◆	HB-GBB-204/2D	14+51.1	20.4 LT	3.0-5.0	Silty CLAY, trace sand, trace gravel.	25.6			
■	HB-GBB-204/5D	14+51.1	20.4 LT	10.0-12.0	Clayey SILT, trace sand.	25.2			
●									
▲									
✖									

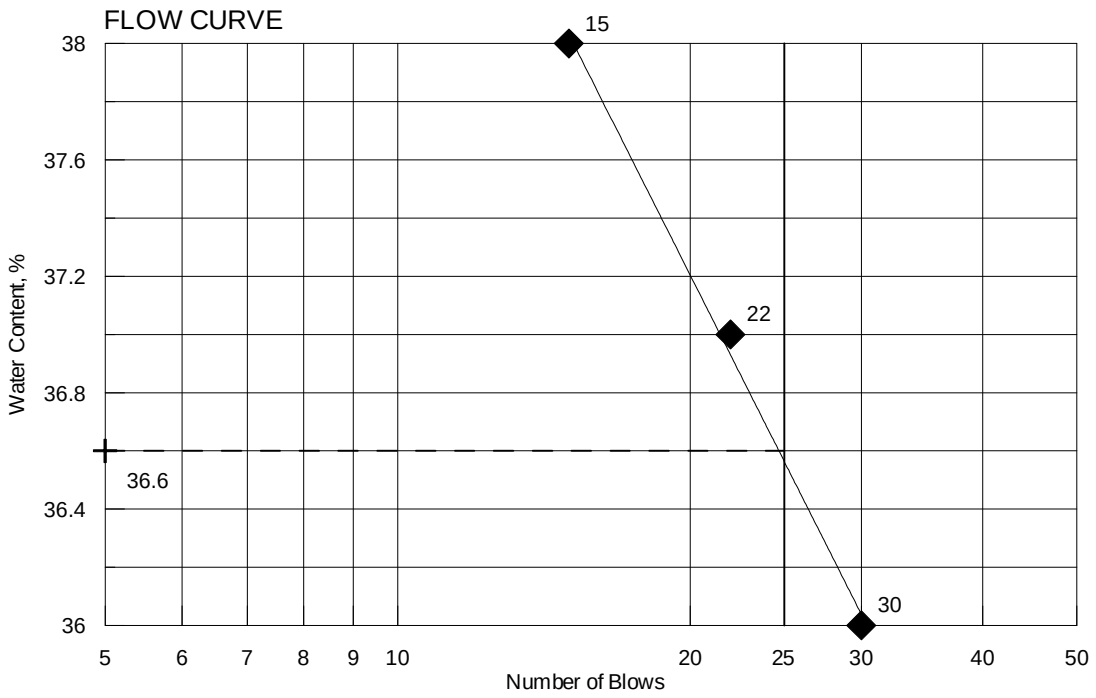
WIN
018821.00
Town
Gorham
Reported by/Date
WHITE, TERRY A 2/2/2017

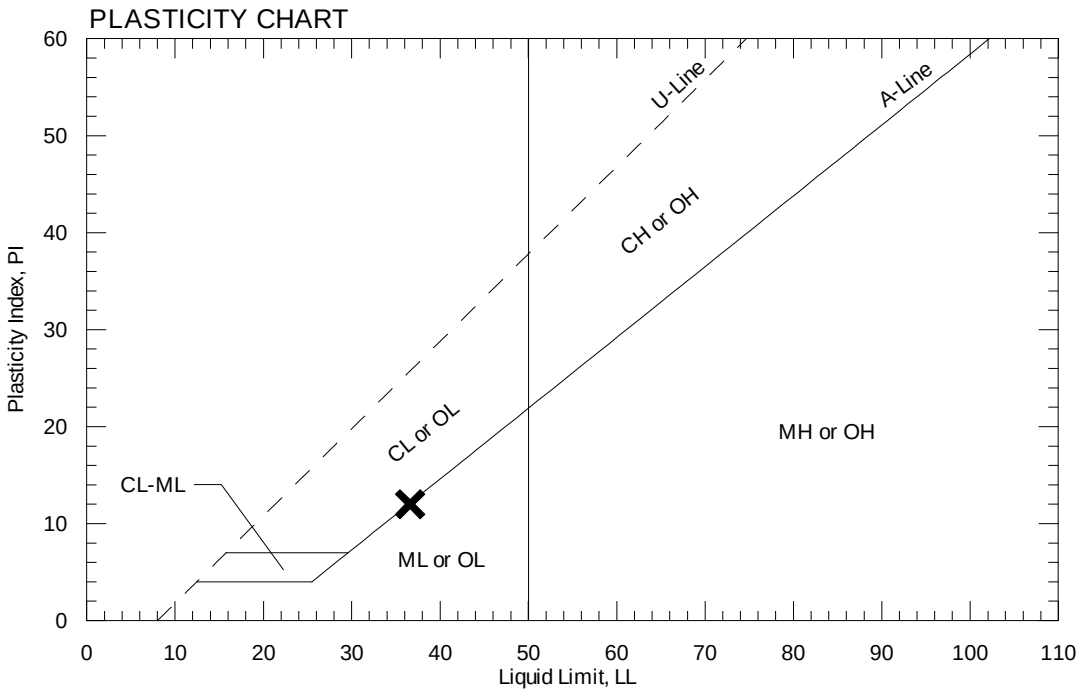
TOWN	Gorham	Reference No.	303042
WIN	018821.00	Water Content, %	26.8
Sampled	1/9/2018	Liquid Limit @ 25 blows (T 89), %	26
Boring No./Sample No.	HB-GBB-301/3D	Plastic Limit (T 90), %	19
Station	12+86.1	Plasticity Index (T 90), %	7
Depth	10.0-12.0	Tested By	BBURR



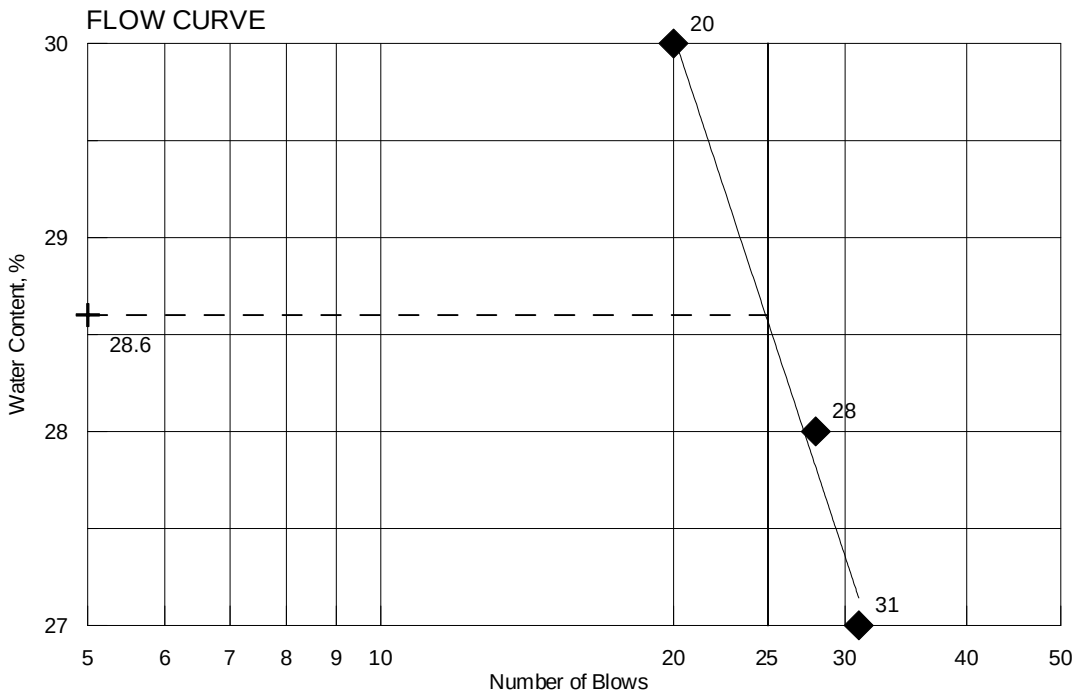


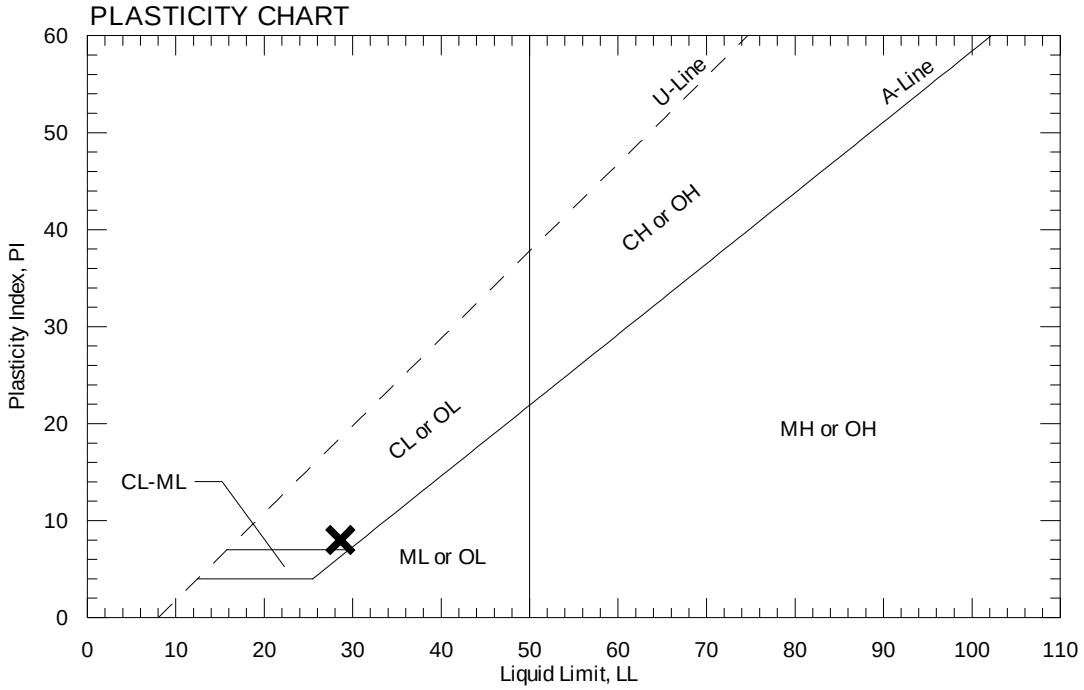
TOWN	Gorham	Reference No.	303043
WIN	018821.00	Water Content, %	44.2
Sampled	1/9/2018	Liquid Limit @ 25 blows (T 89), %	37
Boring No./Sample No.	HB-GBB-301/1U	Plastic Limit (T 90), %	25
Station	12+86.1	Plasticity Index (T 90), %	12
Depth	20.0-22.5	Tested By	BBURR



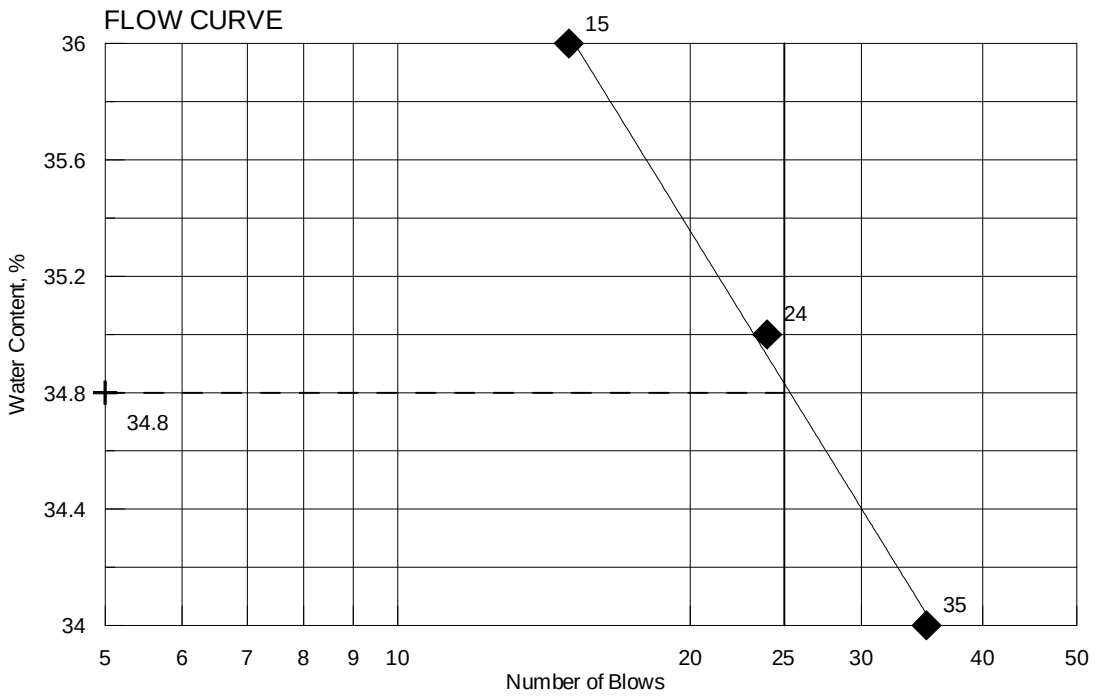


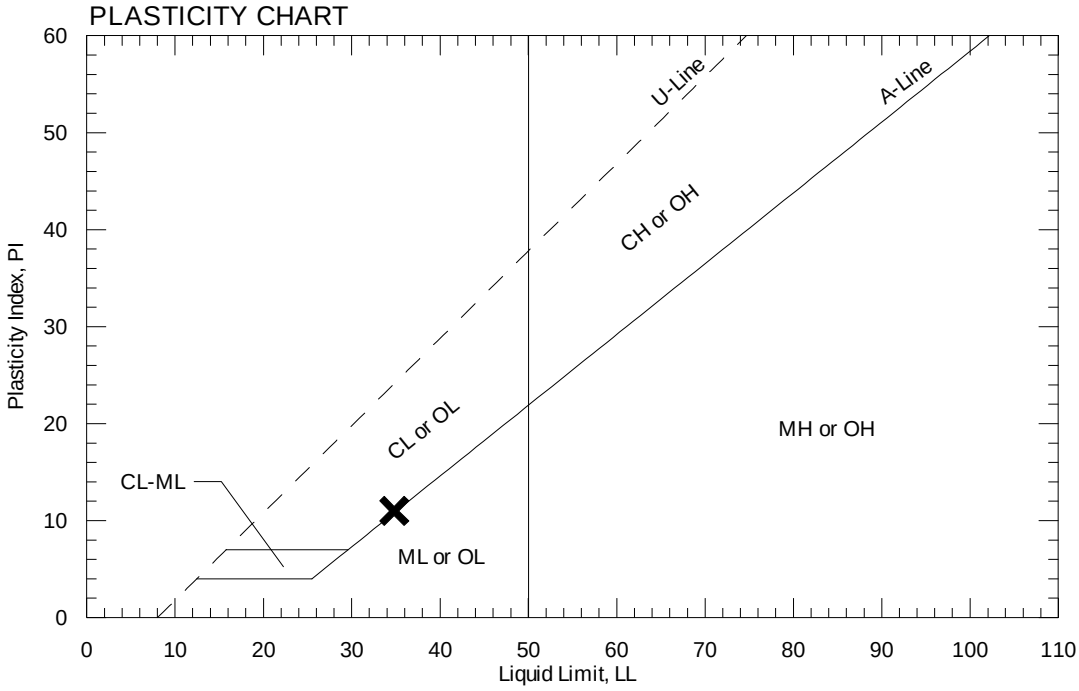
TOWN	Gorham	Reference No.	303044
WIN	018821.00	Water Content, %	33.9
Sampled	1/9/2018	Liquid Limit @ 25 blows (T 89), %	29
Boring No./Sample No.	HB-GBB-301/5D	Plastic Limit (T 90), %	21
Station	12+86.1	Plasticity Index (T 90), %	8
Depth	25.0-27.0	Tested By	BBURR



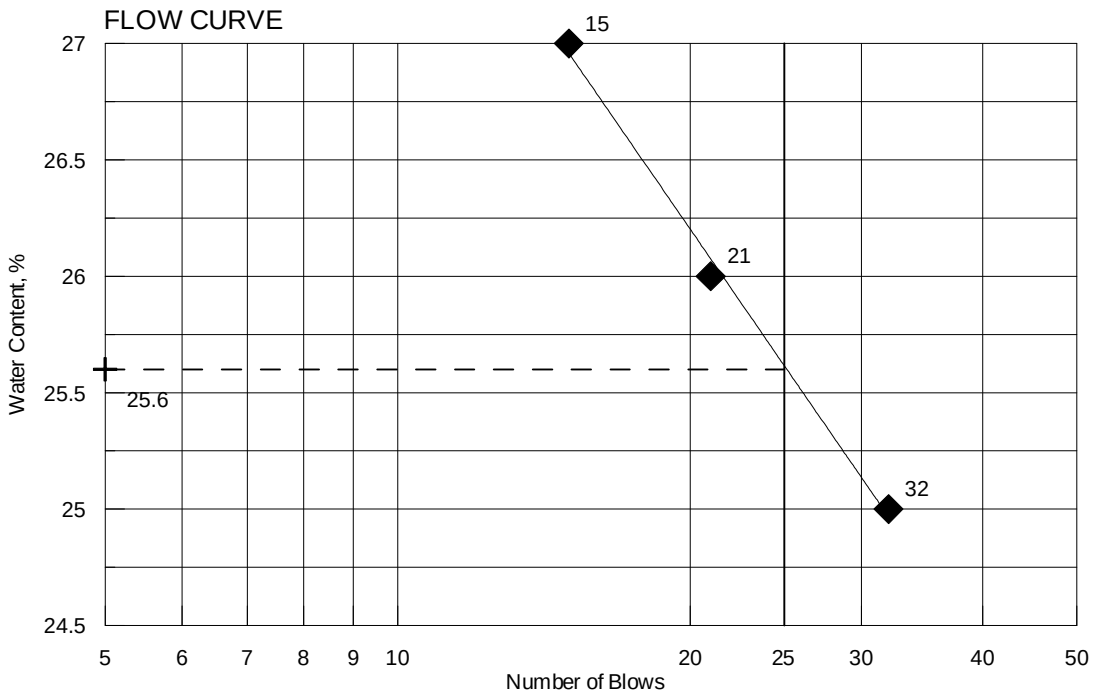


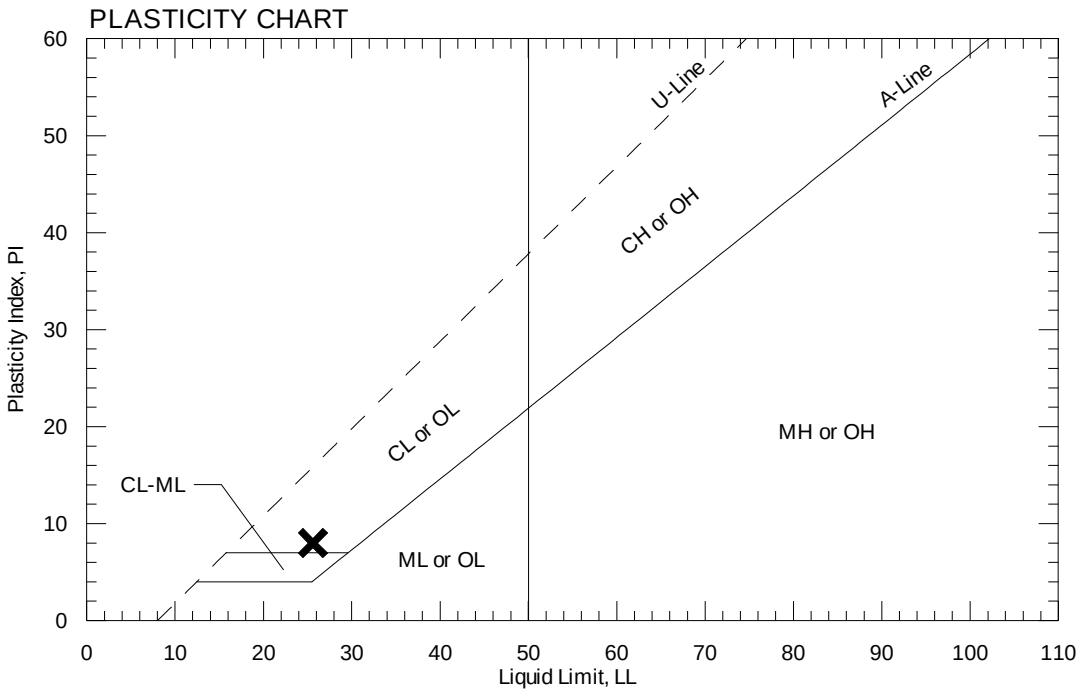
TOWN	Gorham	Reference No.	303046
WIN	018821.00	Water Content, %	40.3
Sampled	1/9/2018	Liquid Limit @ 25 blows (T 89), %	35
Boring No./Sample No.	HB-GBB-301/2U	Plastic Limit (T 90), %	24
Station	12+86.1	Plasticity Index (T 90), %	11
Depth	30.0-32.5	Tested By	BBURR



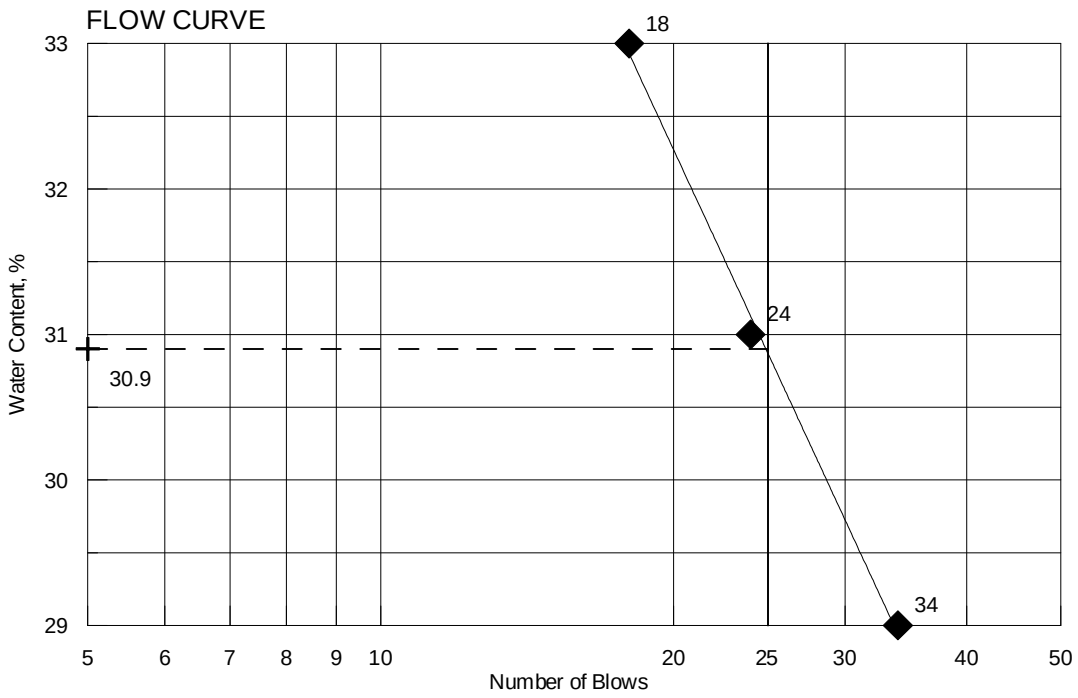


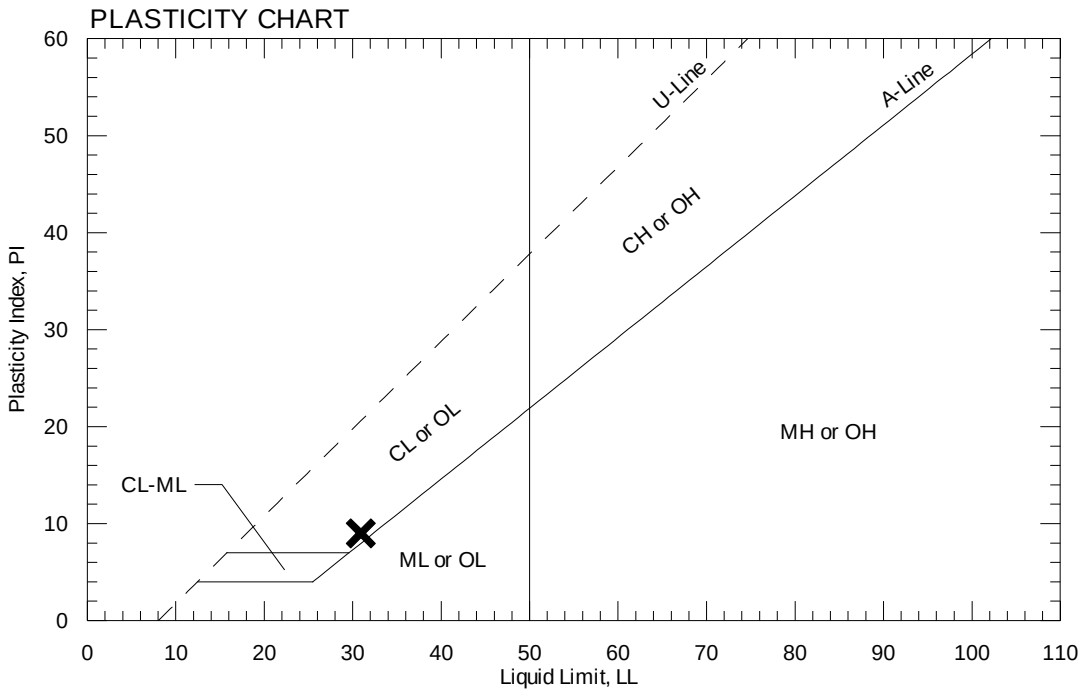
TOWN	Gorham	Reference No.	303048
WIN	018821.00	Water Content, %	21
Sampled	1/9/2018	Liquid Limit @ 25 blows (T 89), %	26
Boring No./Sample No.	HB-GBB-302/3D	Plastic Limit (T 90), %	18
Station	13+68.3	Plasticity Index (T 90), %	8
Depth	4.0-6.0	Tested By	BBURR





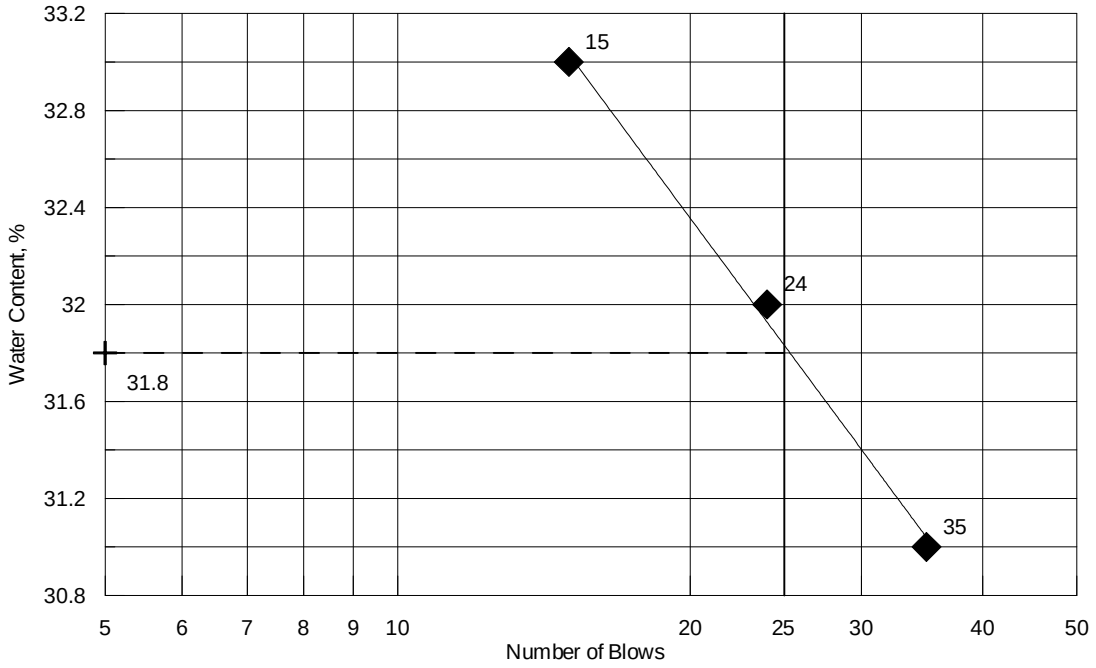
TOWN	Gorham	Reference No.	303063
WIN	018821.00	Water Content, %	37.4
Sampled	1/9/2018	Liquid Limit @ 25 blows (T 89), %	31
Boring No./Sample No.	HB-GBB-302/9D	Plastic Limit (T 90), %	22
Station	13+68.3	Plasticity Index (T 90), %	9
Depth	20.0-22.0	Tested By	BBURR



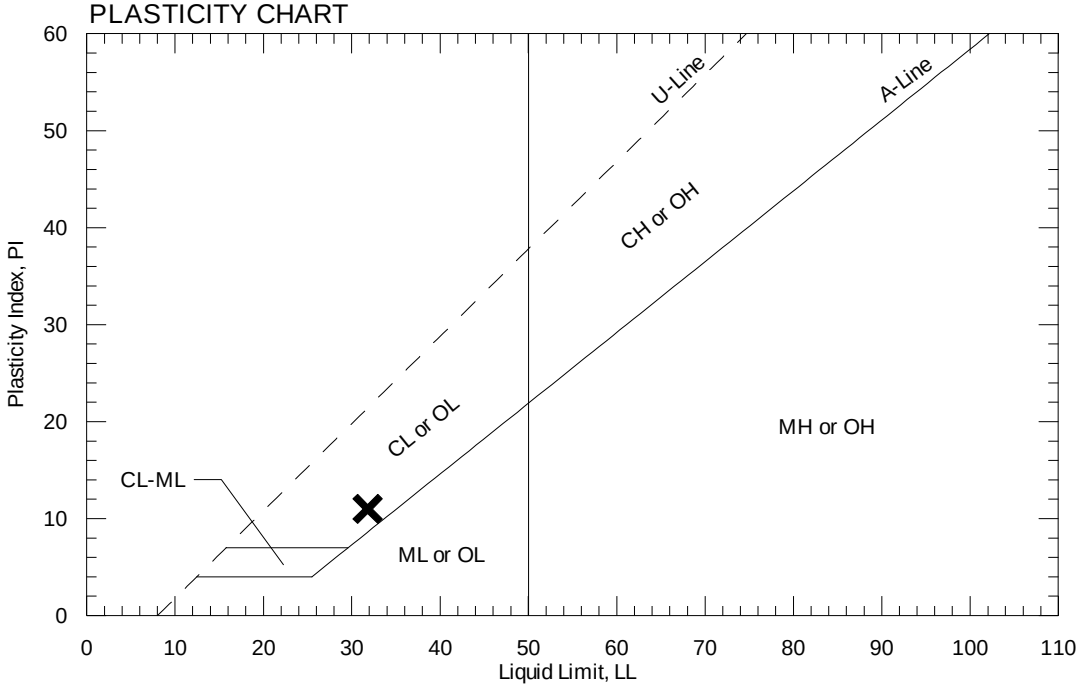


TOWN	Gorham	Reference No.	303071
WIN	018821.00	Water Content, %	35.7
Sampled	1/3/2018	Liquid Limit @ 25 blows (T 89), %	32
Boring No./Sample No.	HB-GBB-304/6D	Plastic Limit (T 90), %	21
Station	14+75.2	Plasticity Index (T 90), %	11
Depth	10.0-12.0	Tested By	BBURR

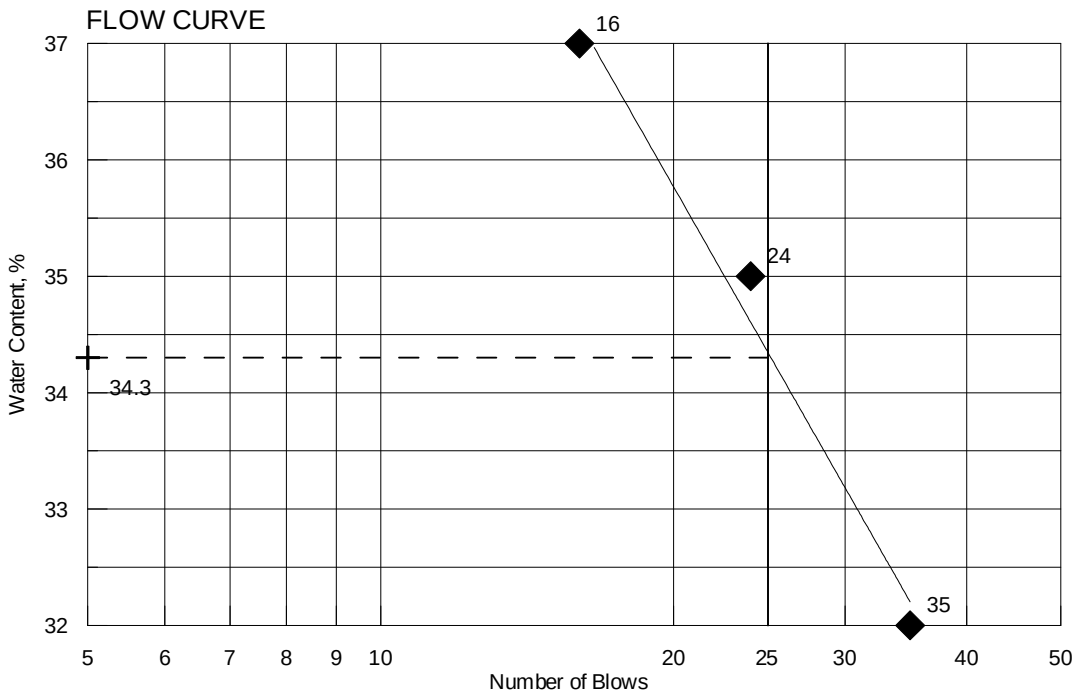
FLOW CURVE

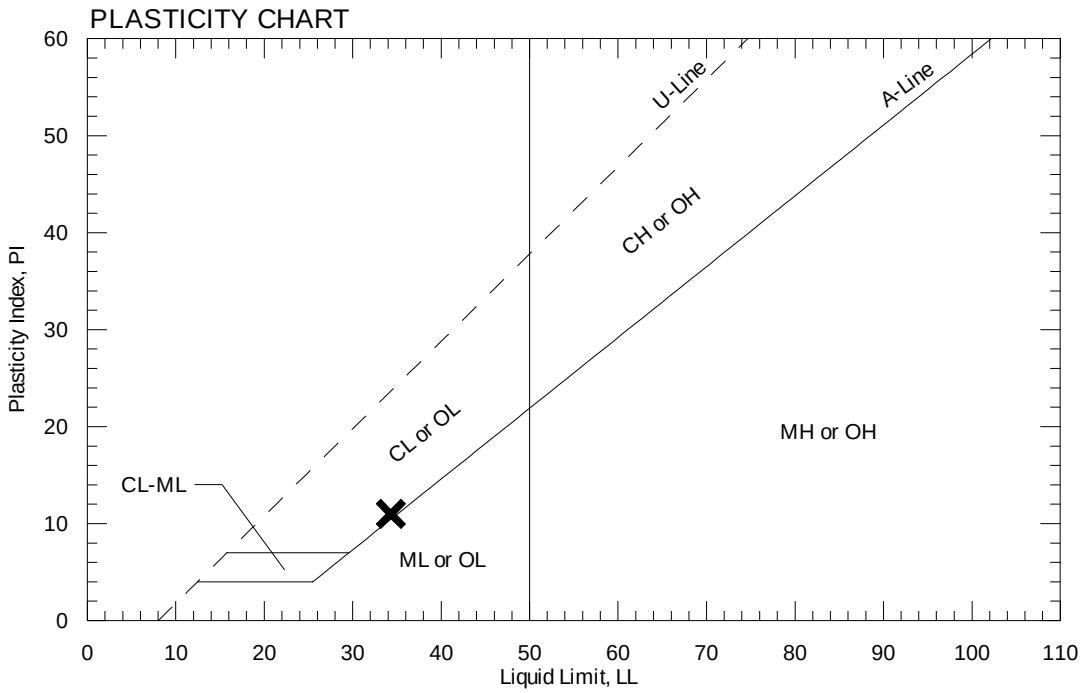


PLASTICITY CHART

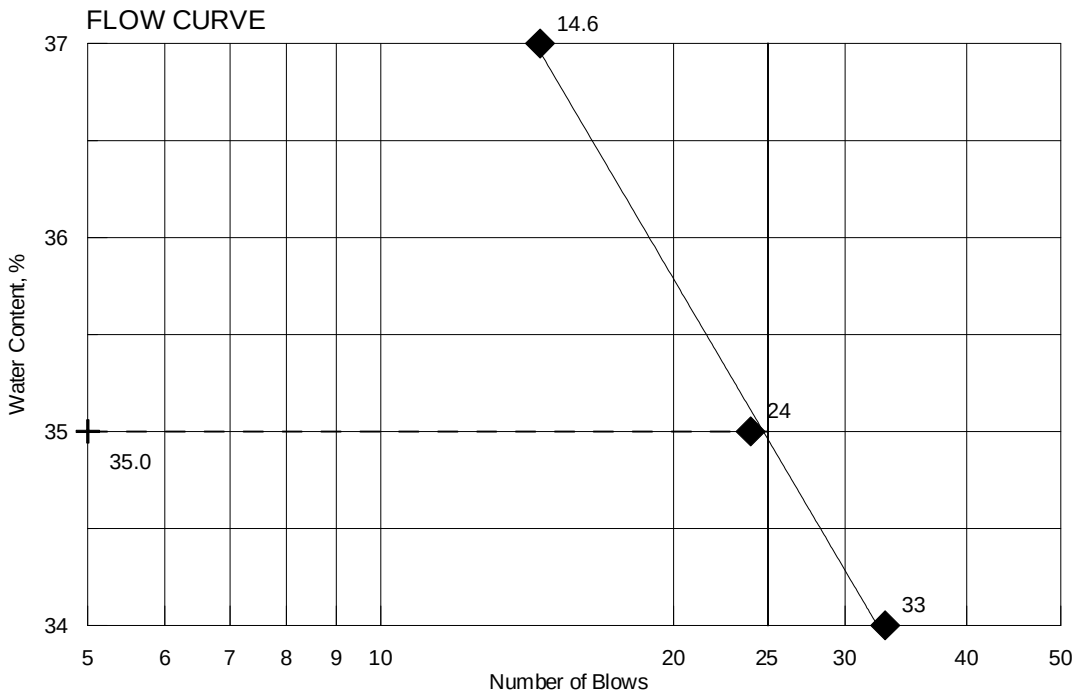


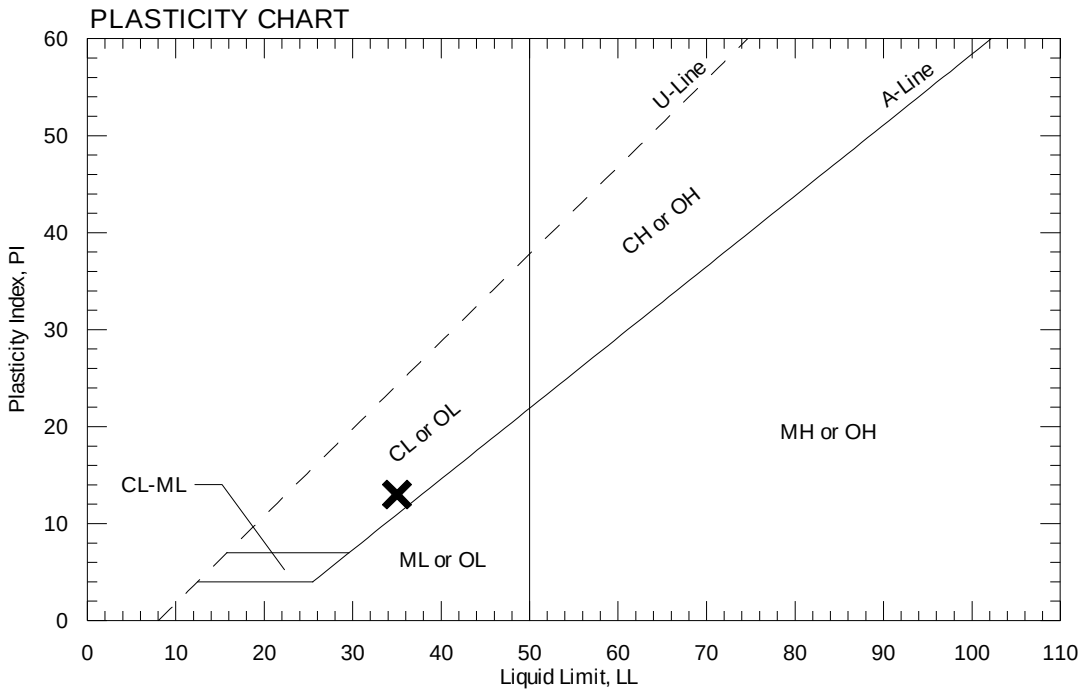
TOWN	Gorham	Reference No.	303072
WIN	018821.00	Water Content, %	39.9
Sampled	1/8/2018	Liquid Limit @ 25 blows (T 89), %	34
Boring No./Sample No.	HB-GBB-304/7D	Plastic Limit (T 90), %	23
Station	14+75.2	Plasticity Index (T 90), %	11
Depth	15.0-17.0	Tested By	BBURR



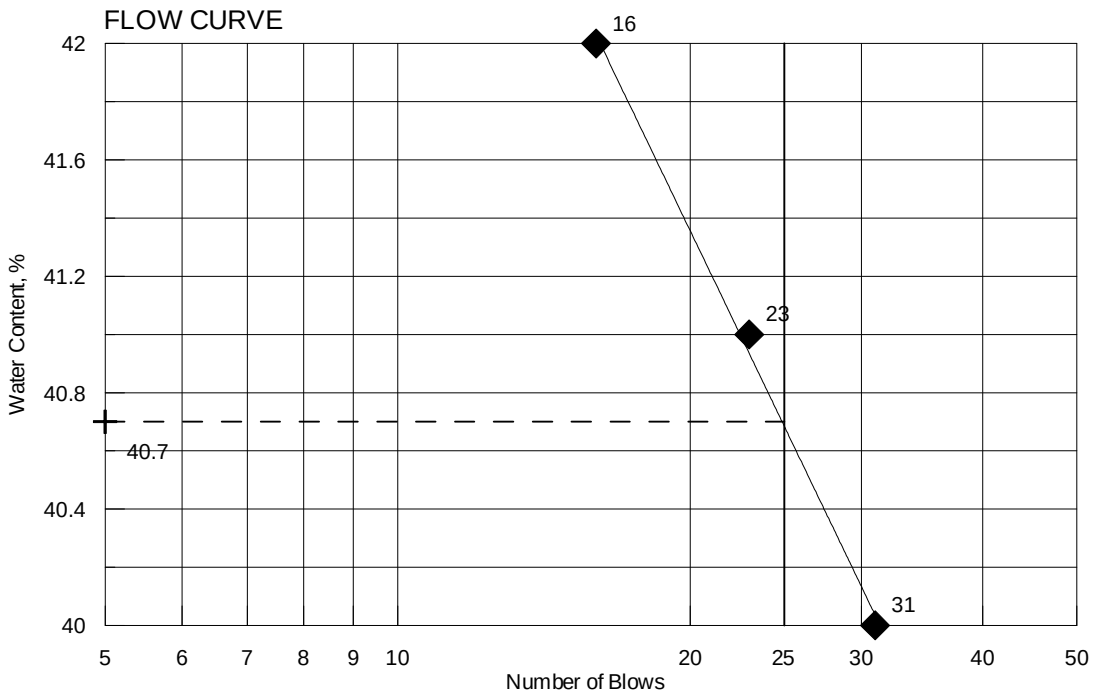


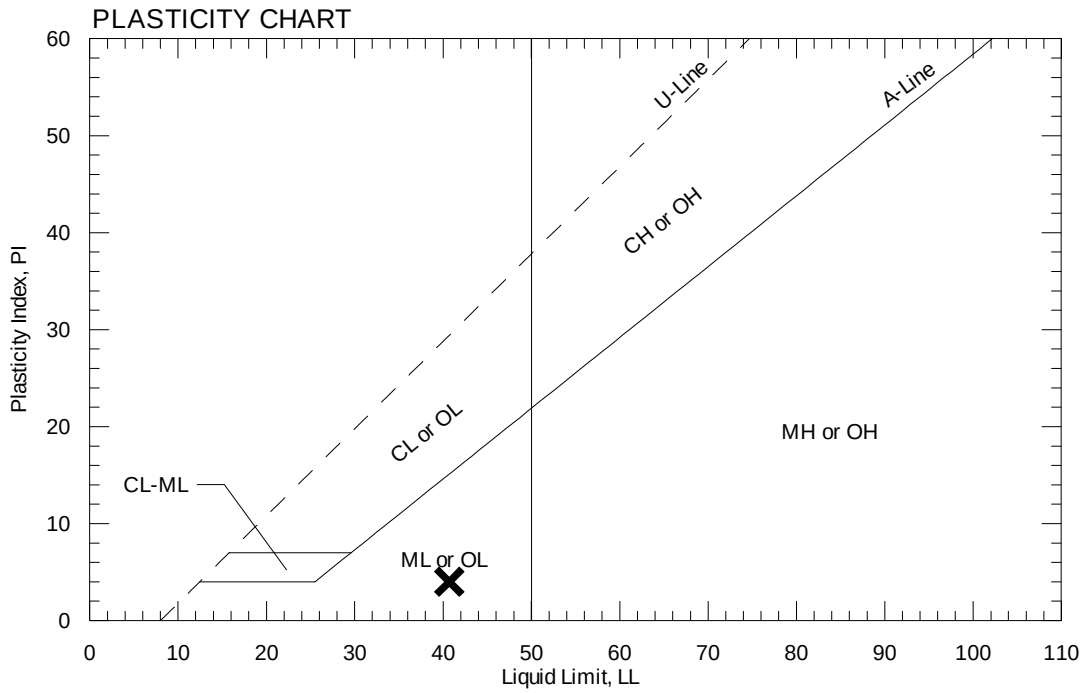
TOWN	Gorham	Reference No.	303075
WIN	018821.00	Water Content, %	29
Sampled	1/8/2018	Liquid Limit @ 25 blows (T 89), %	35
Boring No./Sample No.	HB-GBB-305/4D	Plastic Limit (T 90), %	22
Station	15+18.2	Plasticity Index (T 90), %	13
Depth	15.0-17.0	Tested By	BBURR



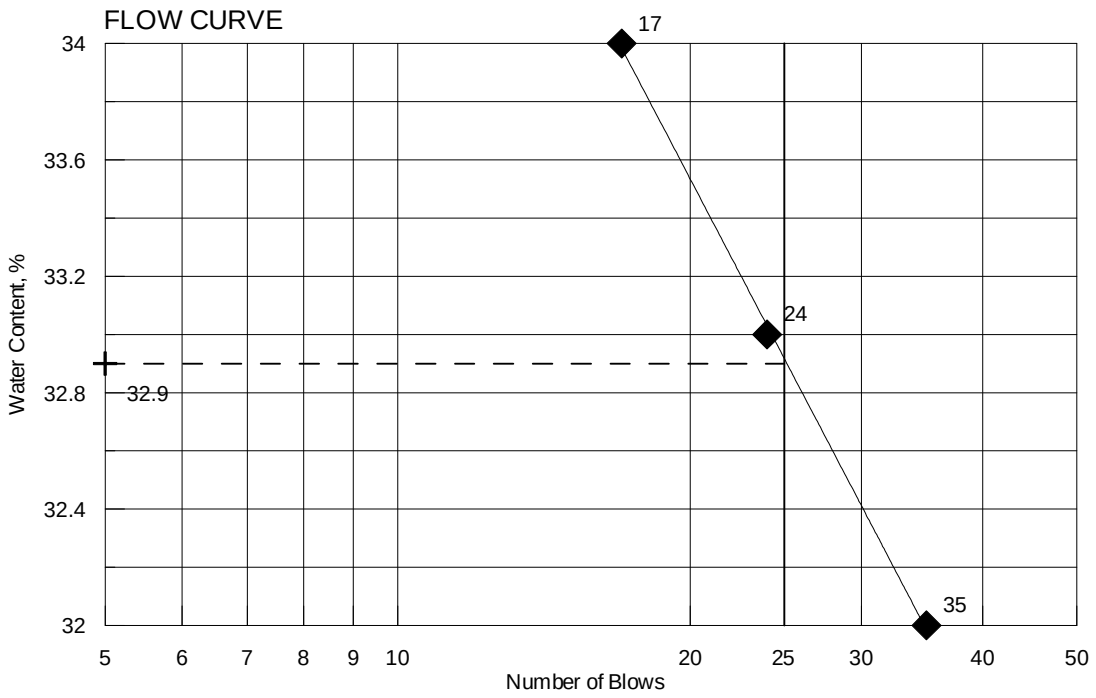


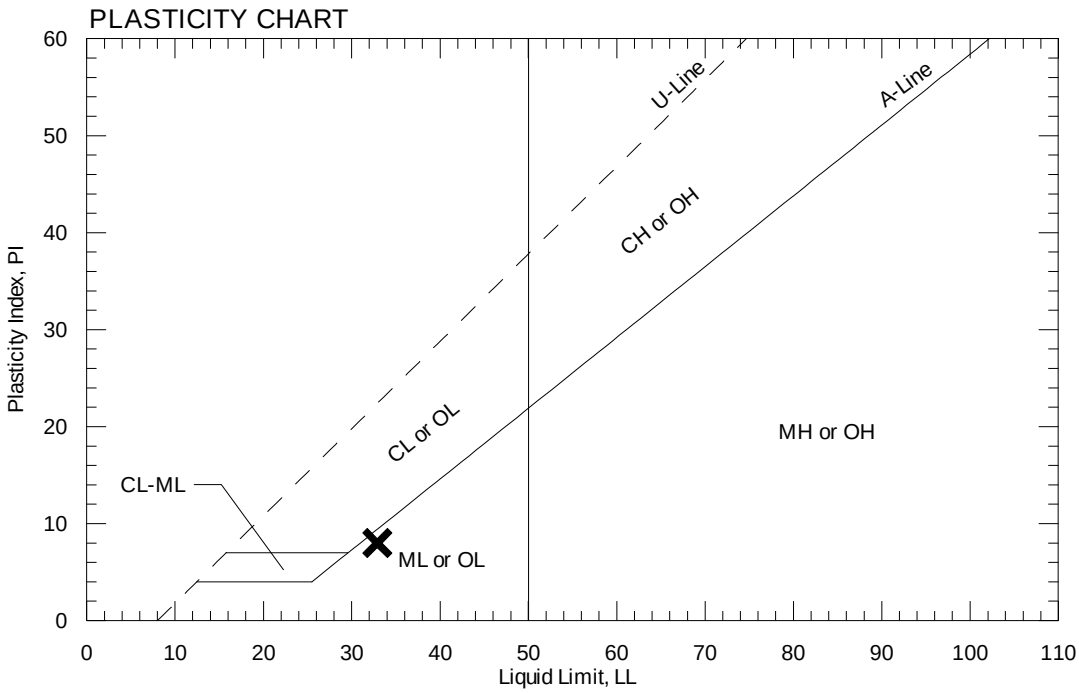
TOWN	Gorham	Reference No.	303077
WIN	018821.00	Water Content, %	46.4
Sampled	1/8/2018	Liquid Limit @ 25 blows (T 89), %	41
Boring No./Sample No.	HB-GBB-305/1U	Plastic Limit (T 90), %	37
Station	15+18.2	Plasticity Index (T 90), %	4
Depth	20.0-22.5	Tested By	BBURR



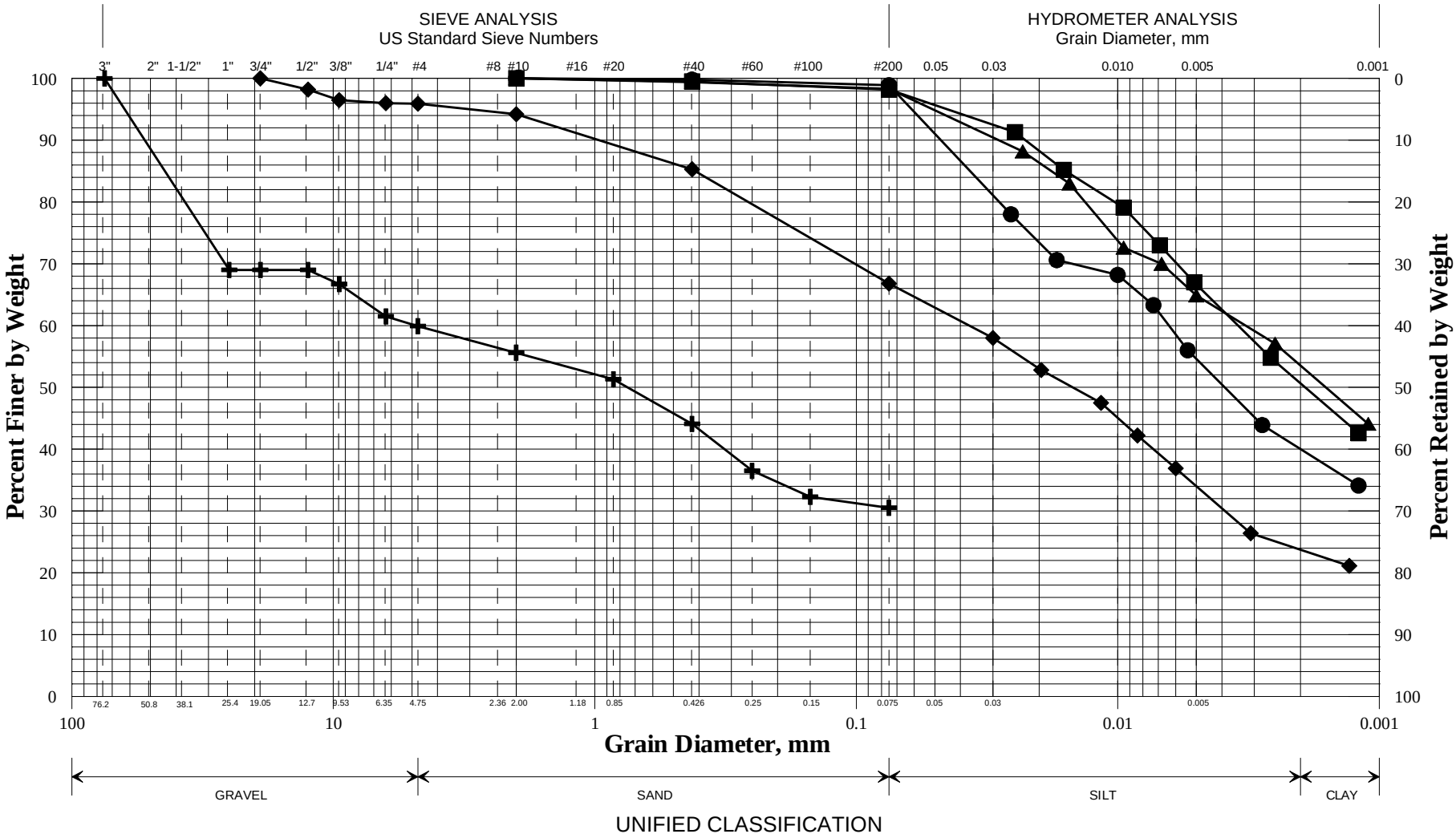


TOWN	Gorham	Reference No.	303078
WIN	018821.00	Water Content, %	41.9
Sampled	1/8/2018	Liquid Limit @ 25 blows (T 89), %	33
Boring No./Sample No.	HB-GBB-305/5D	Plastic Limit (T 90), %	25
Station	15+18.2	Plasticity Index (T 90), %	8
Depth	25.0-27.0	Tested By	BBURR





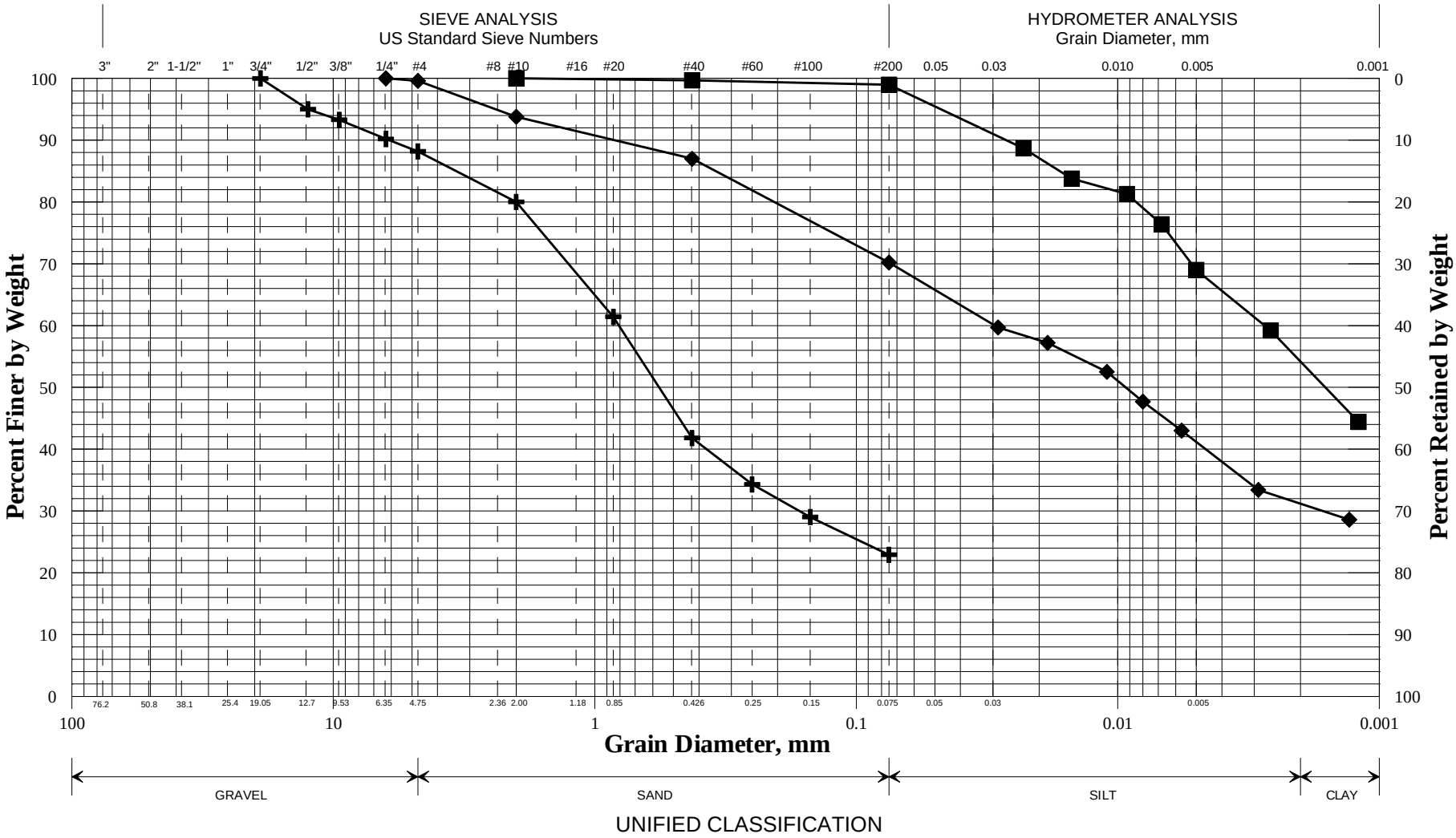
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-GBB-301/2D	12+86.1	99.0 LT	5.0-7.0	GRAVEL, some silt, some sand.	17.9			
◆	HB-GBB-301/3D	12+86.1	99.0 LT	10.0-12.0	SILT, some sand, some clay, trace gravel.	26.8	26	19	7
■	HB-GBB-301/1U	12+86.1	99.0 LT	20.0-22.5	Silty CLAY, trace sand.	44.2	37	25	12
●	HB-GBB-301/5D	12+86.1	99.0 LT	25.0-27.0	Clayey SILT, trace sand.	33.9	29	21	8
▲	HB-GBB-301/2U	12+86.1	99.0 LT	30.0-32.5	Silty CLAY, trace sand.	40.3	35	24	11
✖									

WIN
018821.00
Town
Gorham
Reported by/Date
WHITE, TERRY A 3/1/2018

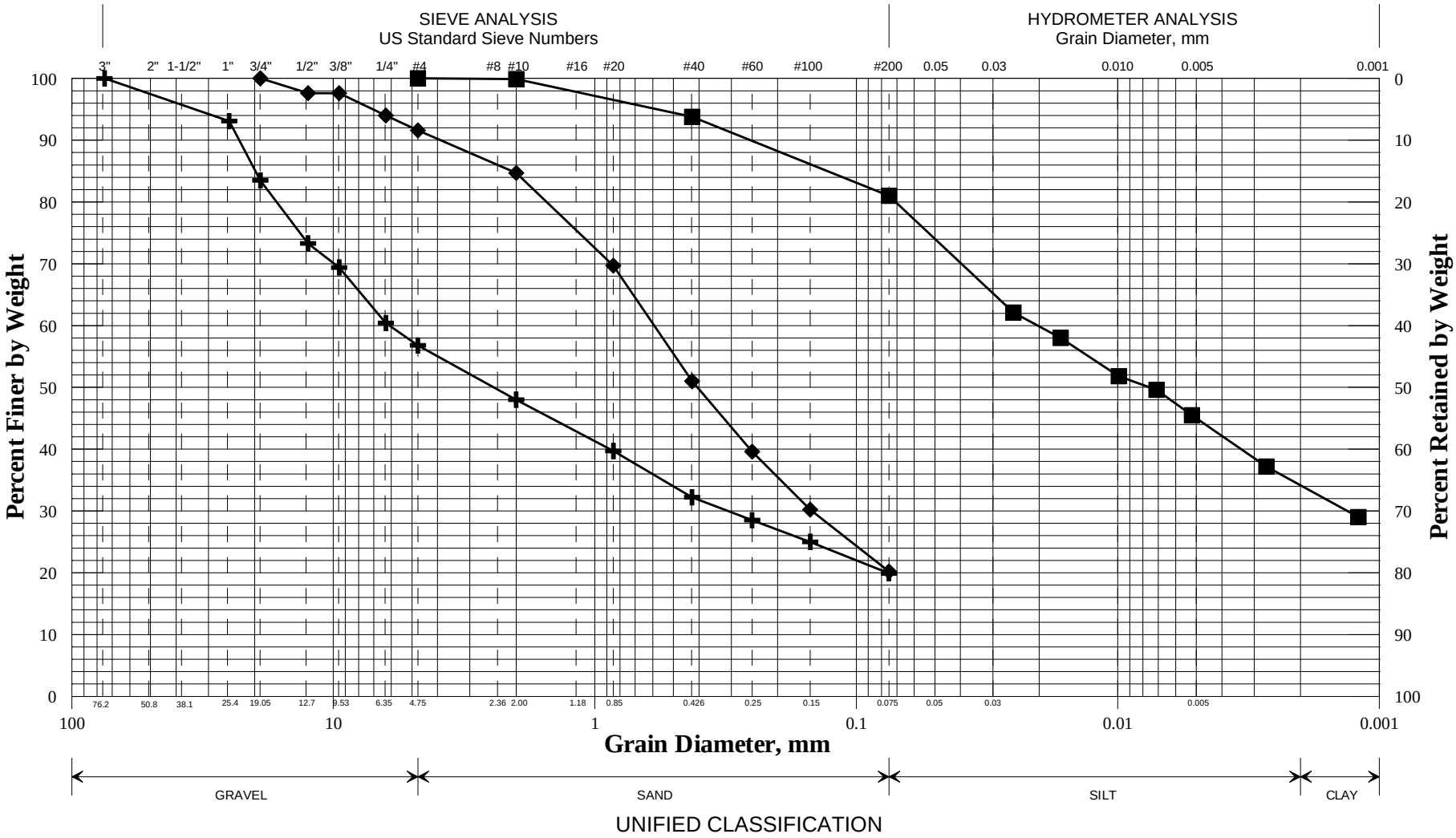
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-GBB-302/2D	13+68.3	156.6 LT	2.0-4.0	SAND, some silt, little gravel.	21.3			
◆	HB-GBB-302/3D	13+68.3	156.6 LT	4.0-6.0	SILT, some clay, some sand, trace gravel.	21.0	26	18	8
■	HB-GBB-302/8D	13+68.3	156.6 LT	15.0-17.0	Silty CLAY, trace sand.	42.4			
●									
▲									
✖									

WIN
018821.00
Town
Gorham
Reported by/Date
WHITE, TERRY A 3/1/2018

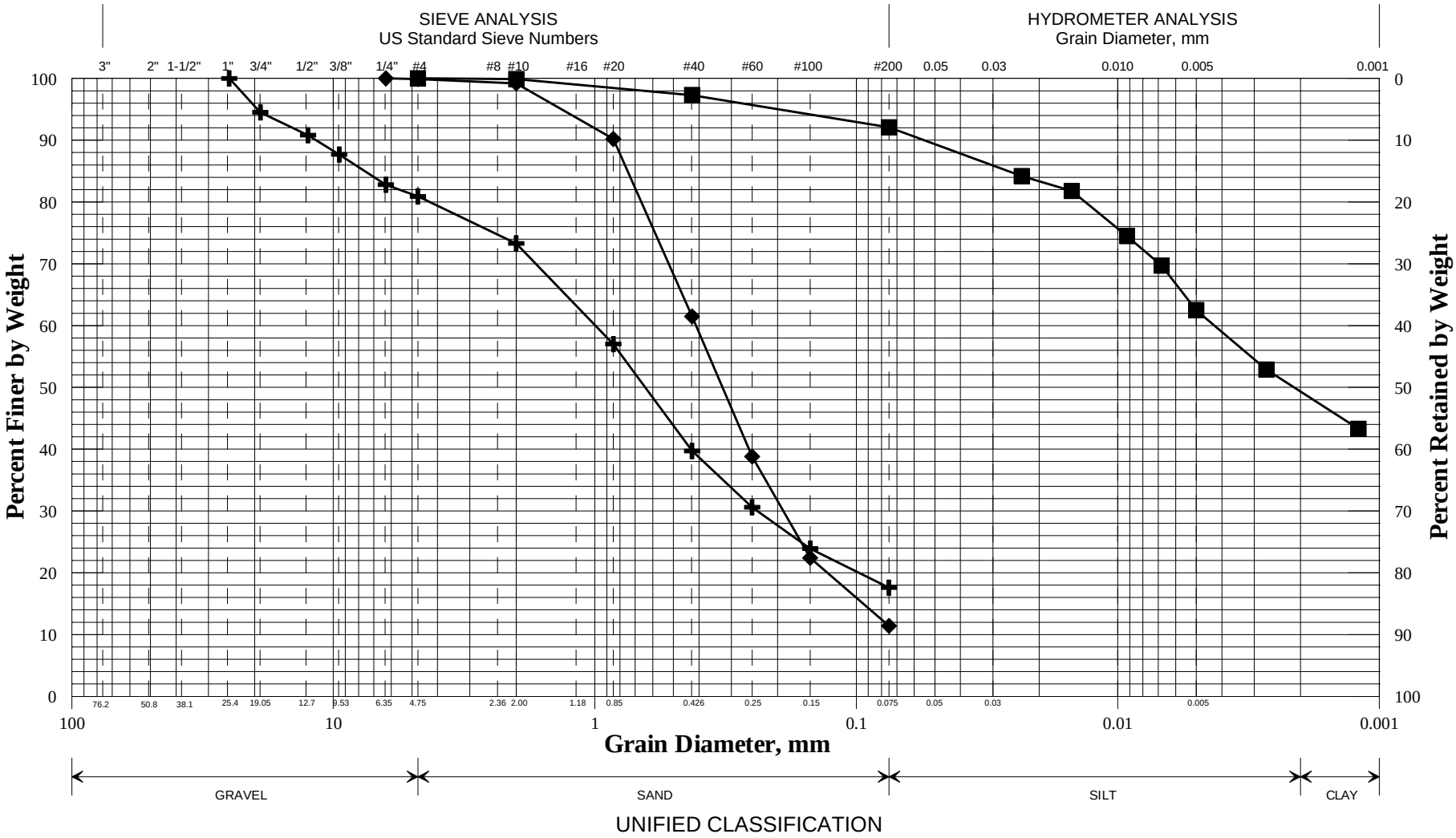
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-GBB-303/1D	13+93.6	83.4 LT	0.0-2.0	Sandy GRAVEL, little silt.	7.3			
◆	HB-GBB-305/2D	13+93.6	83.4 LT	5.0-7.0	SAND, little silt, trace gravel.	17.8			
■	HB-GBB-303/3D	13+93.6	83.4 LT	10.0-12.0	SILT, some clay, little sand,	14.3			
●									
▲									
✖									

WIN
018821.00
Town
Gorham
Reported by/Date
WHITE, TERRY A 3/1/2018

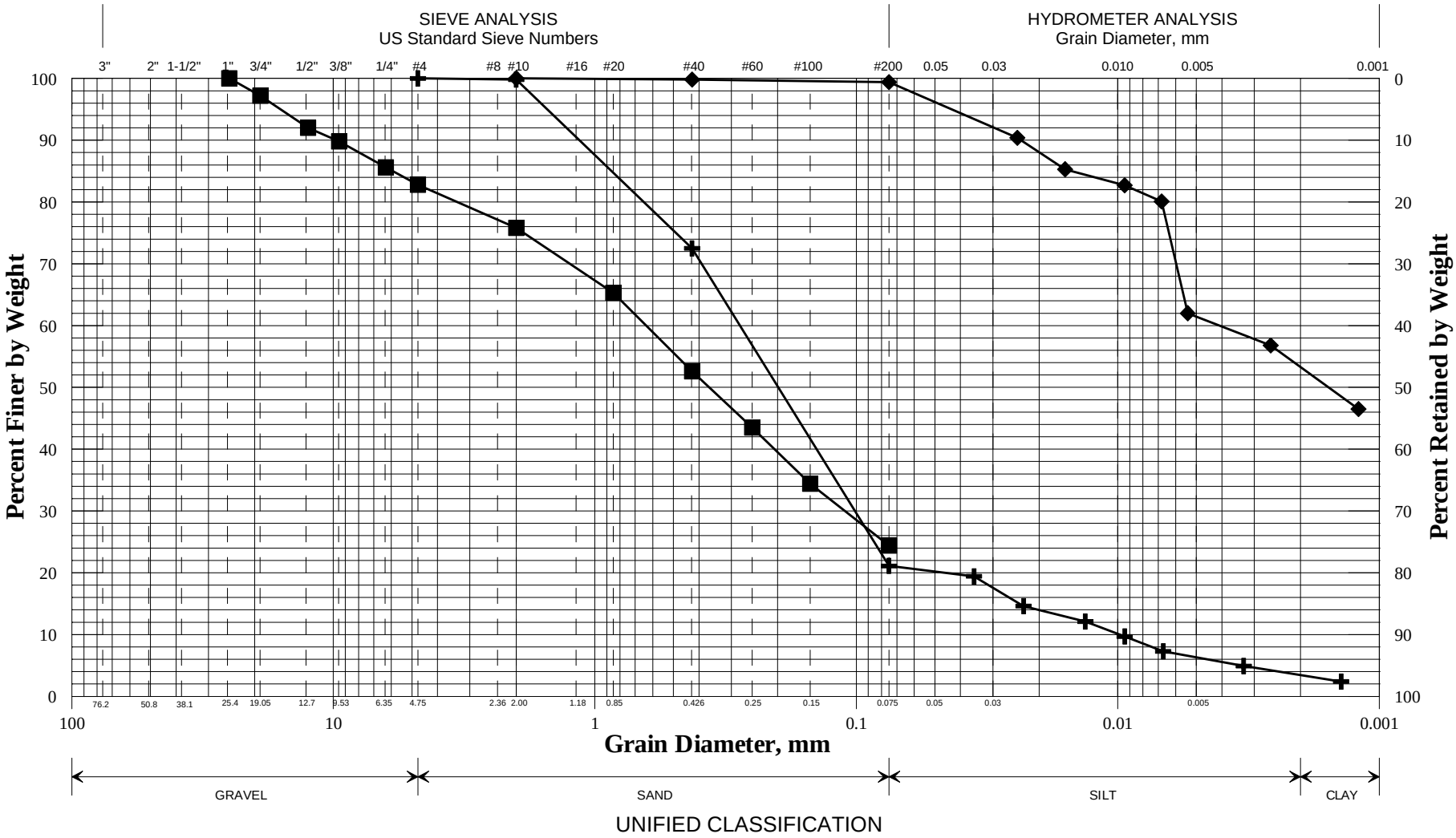
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-GBB-304/2D	14+75.2	135.0 LT	2.0-4.0	SAND, little gravel, little silt.	5.9			
◆	HB-GBB-304/4D	14+75.2	135.0 LT	6.0-8.0	SAND, little silt, trace gravel.	17.6			
■	HB-GBB-304/6D	14+75.2	135.0 LT	10.0-12.0	Silty CLAY, trace sand.	35.7	32	21	11
●									
▲									
✖									

WIN
018821.00
Town
Gorham
Reported by/Date
WHITE, TERRY A 3/1/2018

State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-GBB-305/2D	15+18.2	68.1 LT	5.0-7.0	SAND, little silt, trace clay.	66.7			NP
◆	HB-GBB-305/1U	15+18.2	68.1 LT	20.0-22.5	Silty CLAY, trace sand.	46.4	41	37	4
■	HB-GBB-305/7D	15+18.2	68.1 LT	35.0-37.0	SAND, some silt, little gravel.	11.0			
●									
▲									
✖									

WIN
018821.00
Town
Gorham
Reported by/Date
WHITE, TERRY A 4/9/2018

CONSOLIDATION TEST DATA

Project:
Boring No.: BB-GBB-101
Sample No.: 1U
Test No.: 210291

Location: GORHAM
Tested By: Brian Fogg
Test Date: 5/21/08
Sample Type: Shelby Tube

Project No.: 010801.00
Checked By:
Depth: 20-22 FT
Elevation: ---

Soil Description: GRAY CLAY
Remarks:

Specific Gravity: 2.76
Initial Void Ratio: 1.10
Final Void Ratio: 0.65

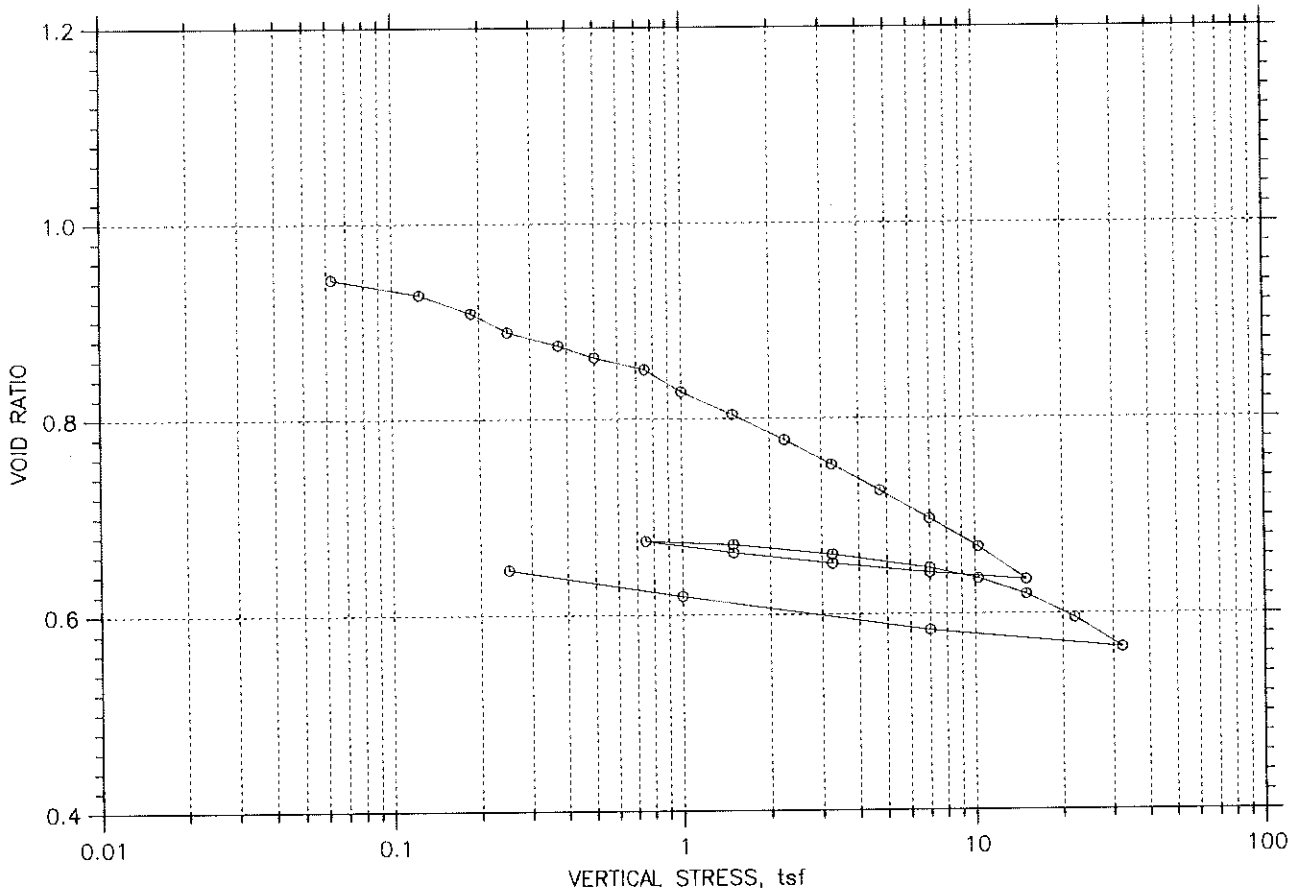
Liquid Limit: 34
Plastic Limit: 20
Plasticity Index: 14

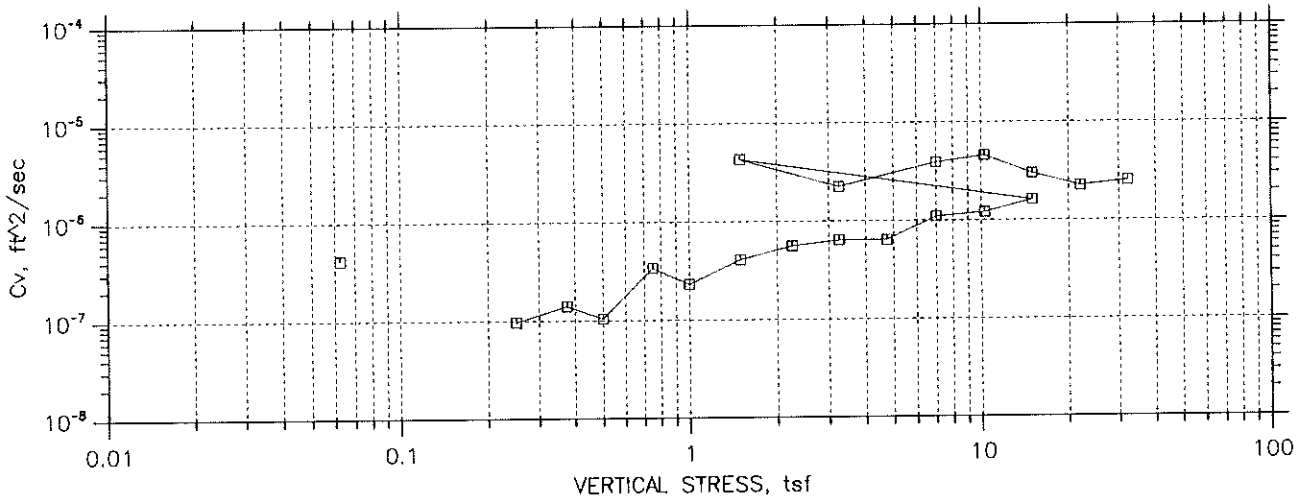
Initial Height: 1.06 in
Specimen Diameter: 2.48 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	104	RING	RING	75
Wt. Container + Wet Soil, gm	188.28	412.93	399.51	187.31
Wt. Container + Dry Soil, gm	153.36	373.44	373.44	161.28
Wt. Container, gm	51.45	262.11	262.11	50.13
Wt. Dry Soil, gm	101.91	111.33	111.33	111.15
Water Content, %	34.27	35.47	23.42	23.42
Void Ratio	---	1.10	0.65	---
Degree of Saturation, %	---	89.39	100.00	---
Dry Unit Weight, pcf	---	82.232	104.66	---

CONSOLIDATION TEST DATA

SUMMARY REPORT

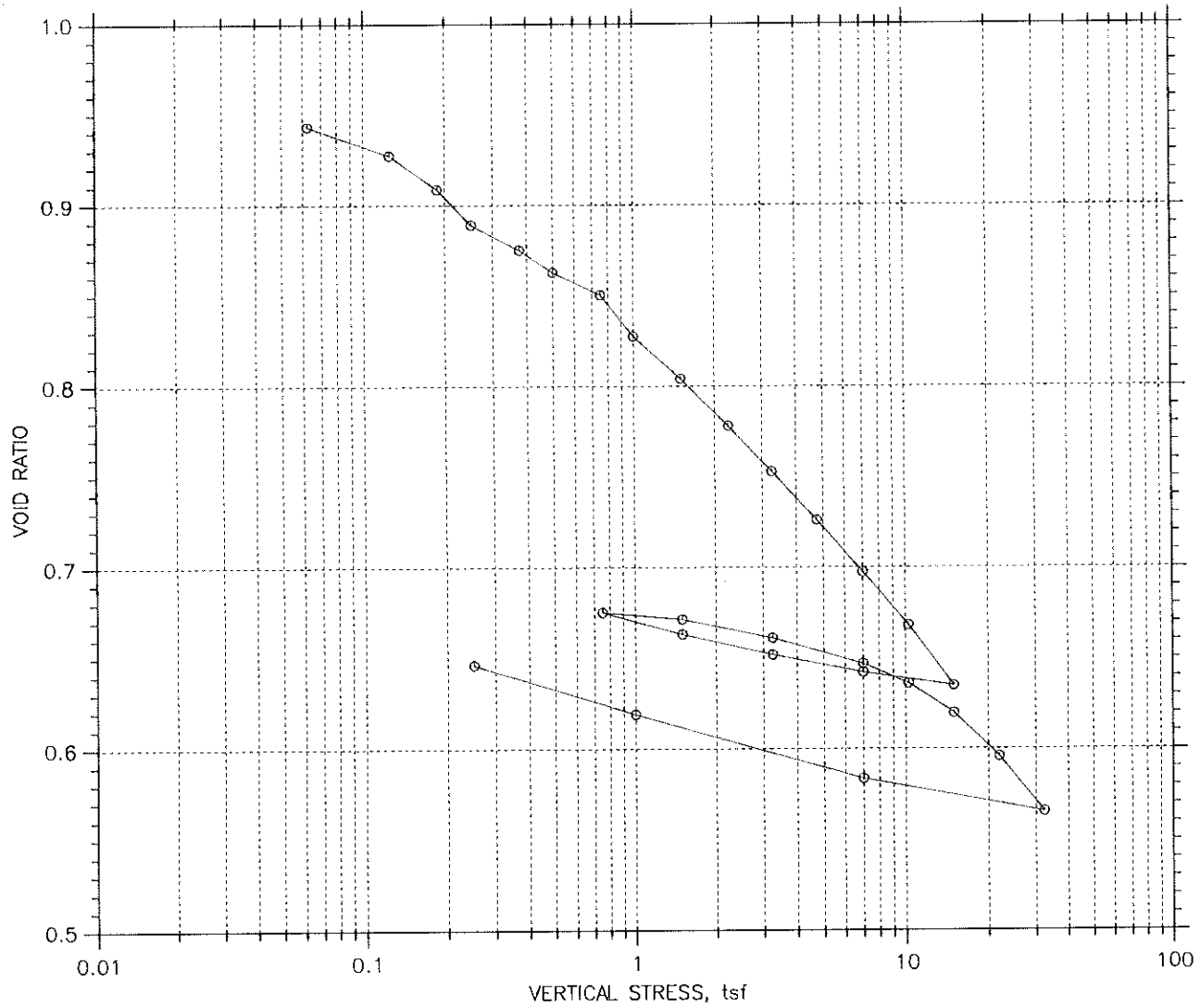




Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

CONSOLIDATION TEST DATA

SUMMARY REPORT



					Before Test	After Test
Overburden Pressure, tsf:				Water Content, %	35.47	23.42
Preconsolidation Pressure, tsf:				Dry Unit Weight, pcf	82.232	104.66
Compression Index:				Saturation, %	89.39	100.00
Diameter: 2.485 in		Height: 1.063 in		Void Ratio	1.10	0.65
LL: 34	PL: 20	PI: 14	GS: 2.76			

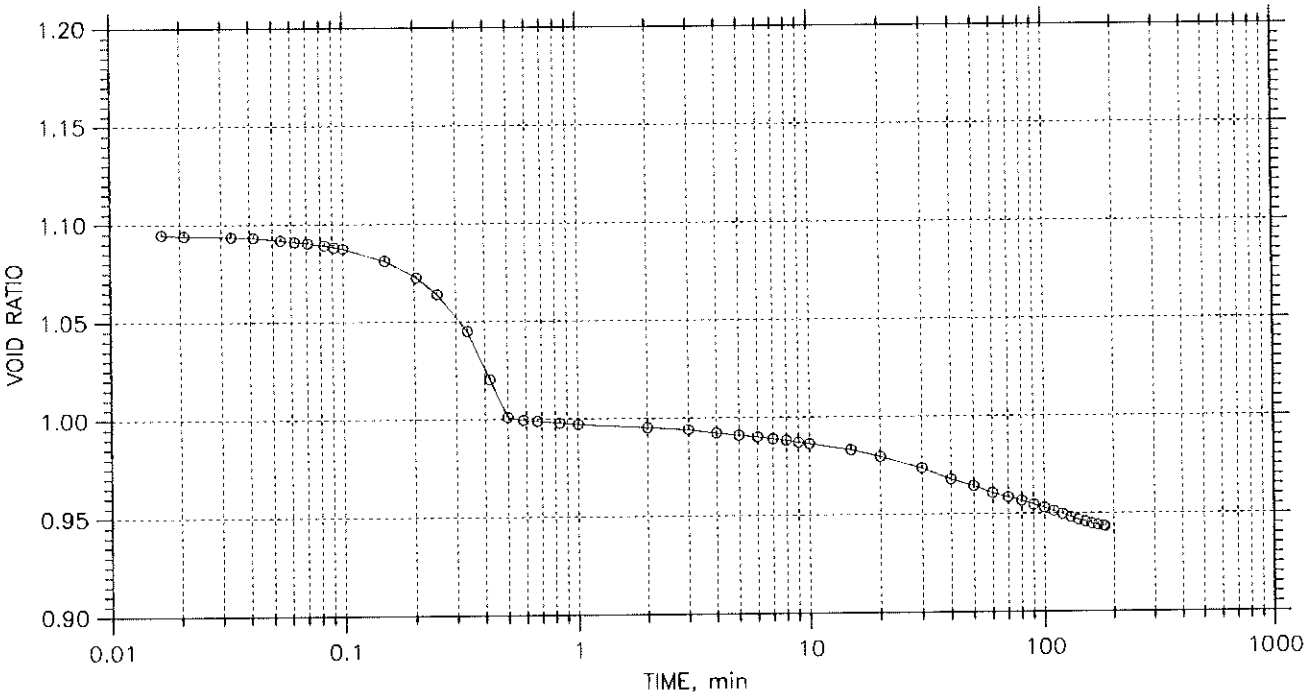
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

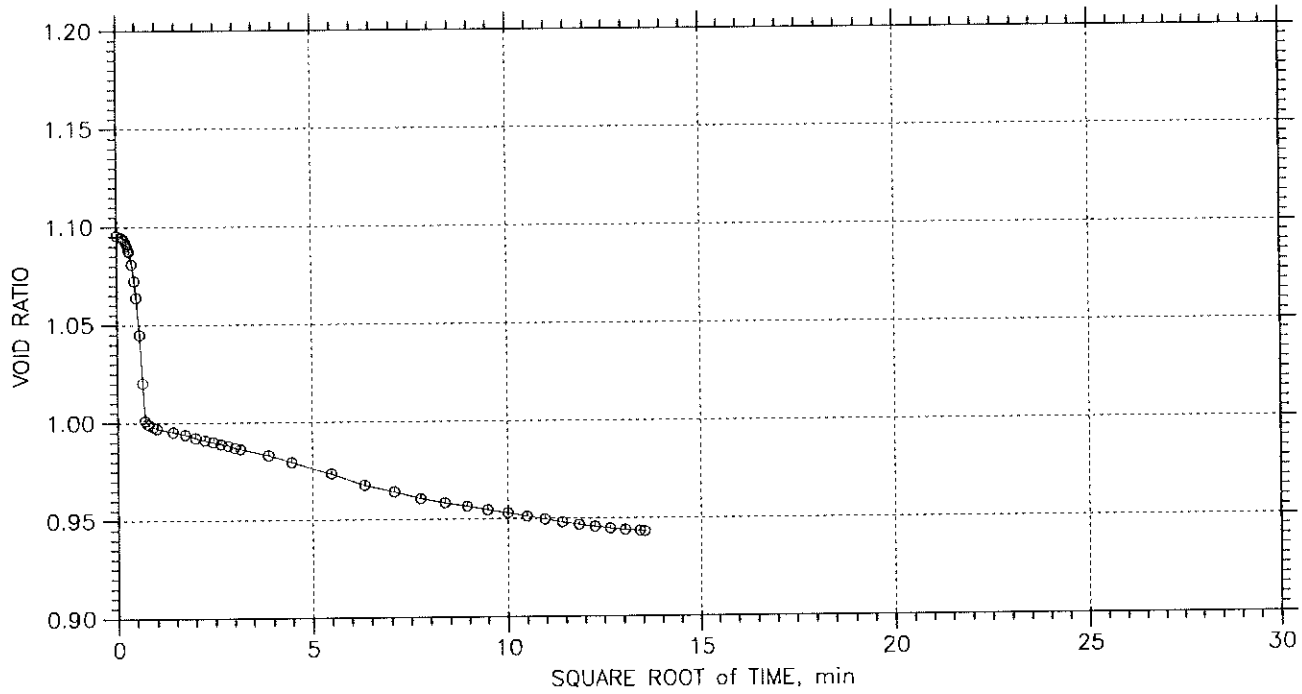
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 1 of 29

Stress: 6.25e-002 tsf





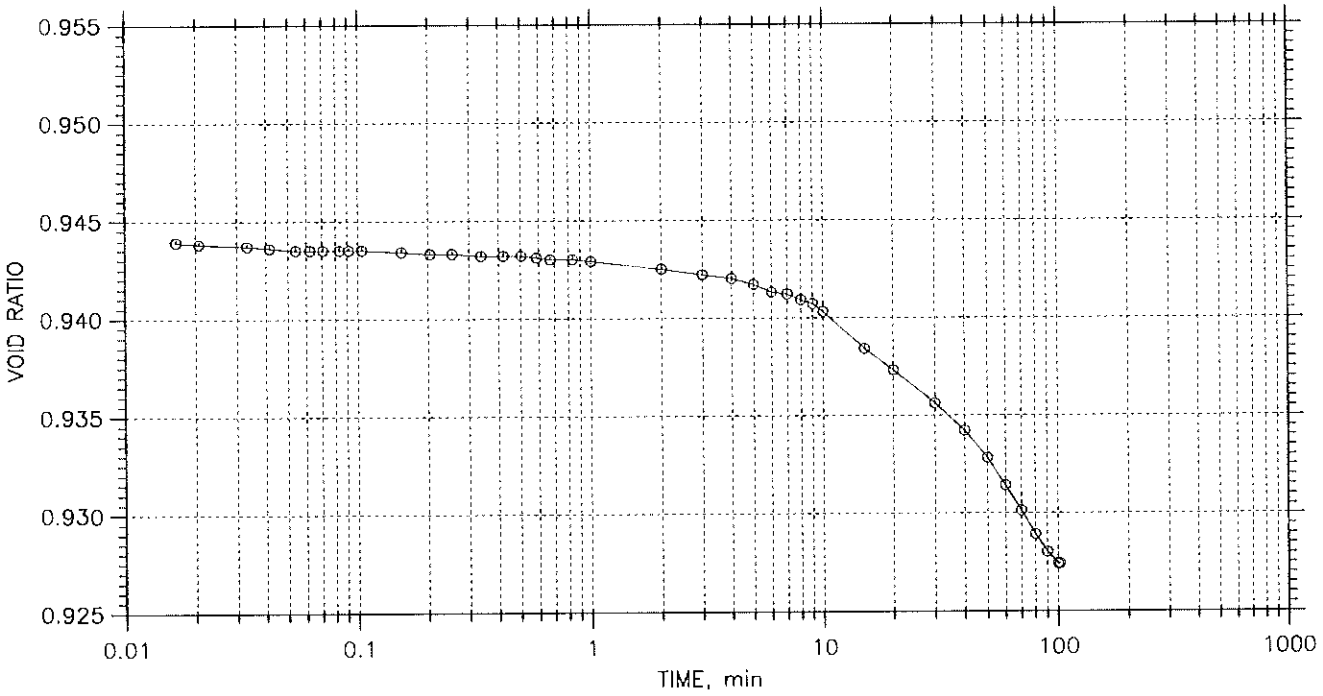
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

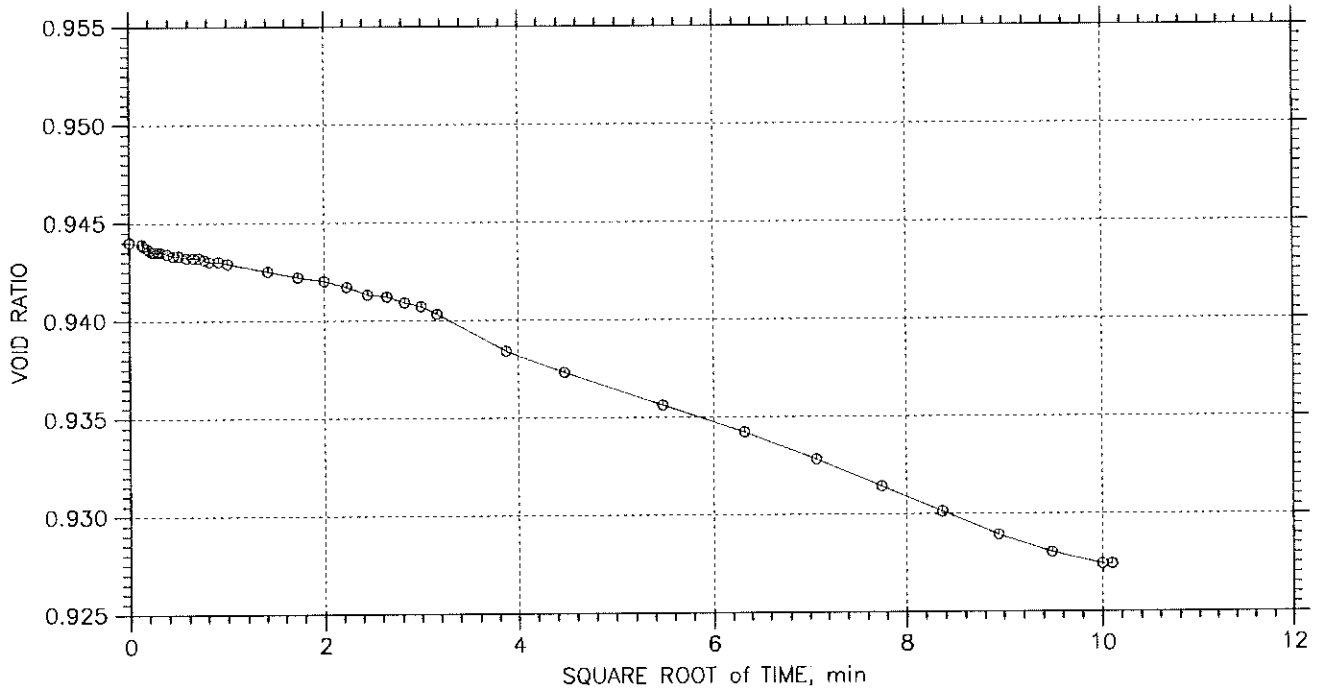
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 2 of 29

Stress: 0.125 tsf





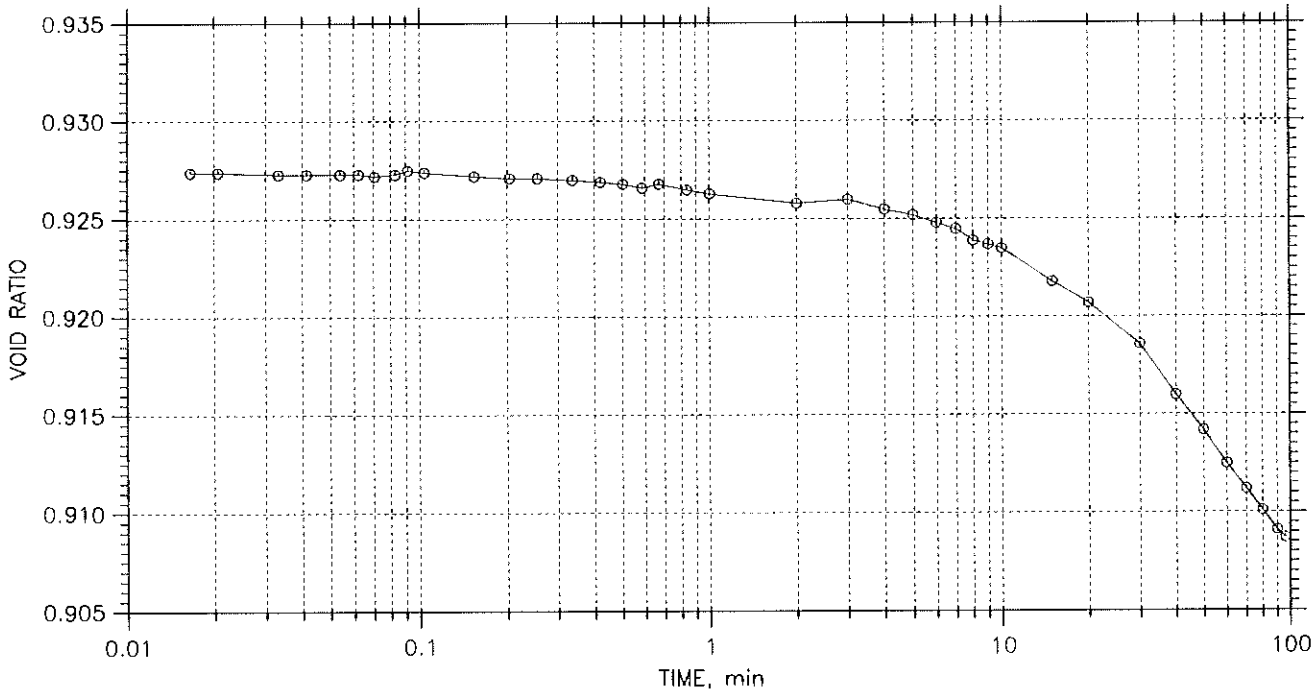
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

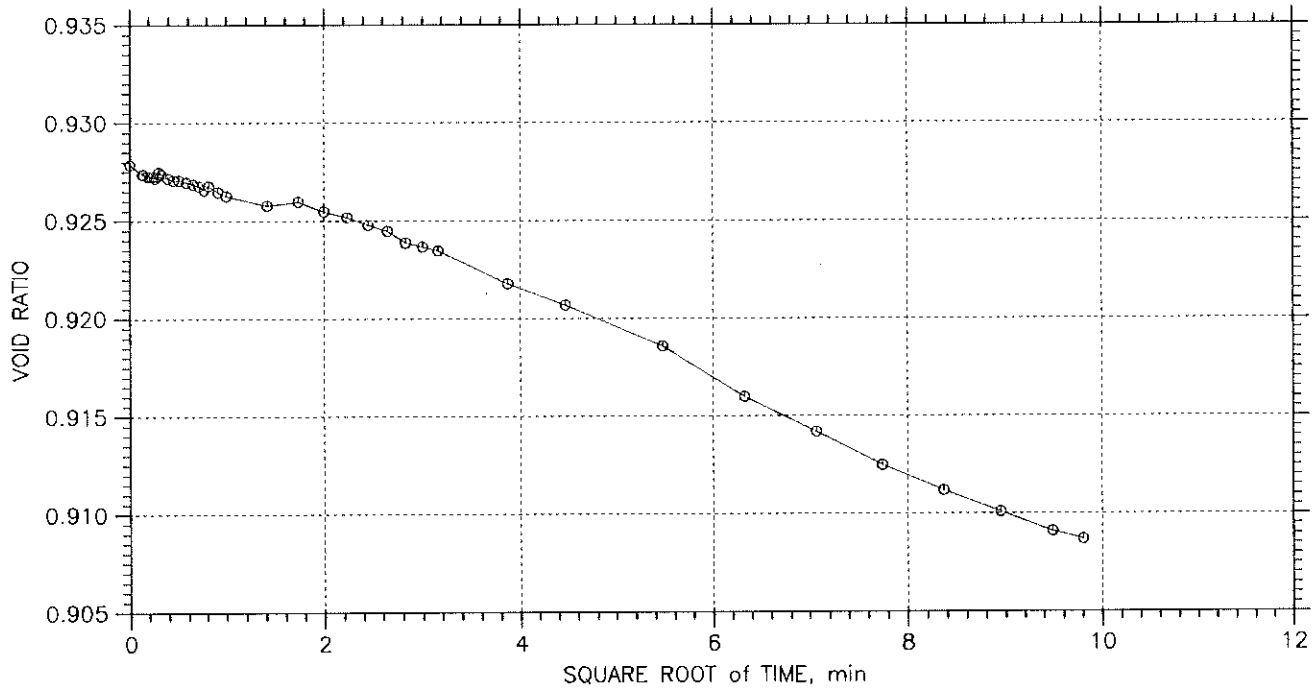
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 3 of 29

Stress: 0.1875 tsf





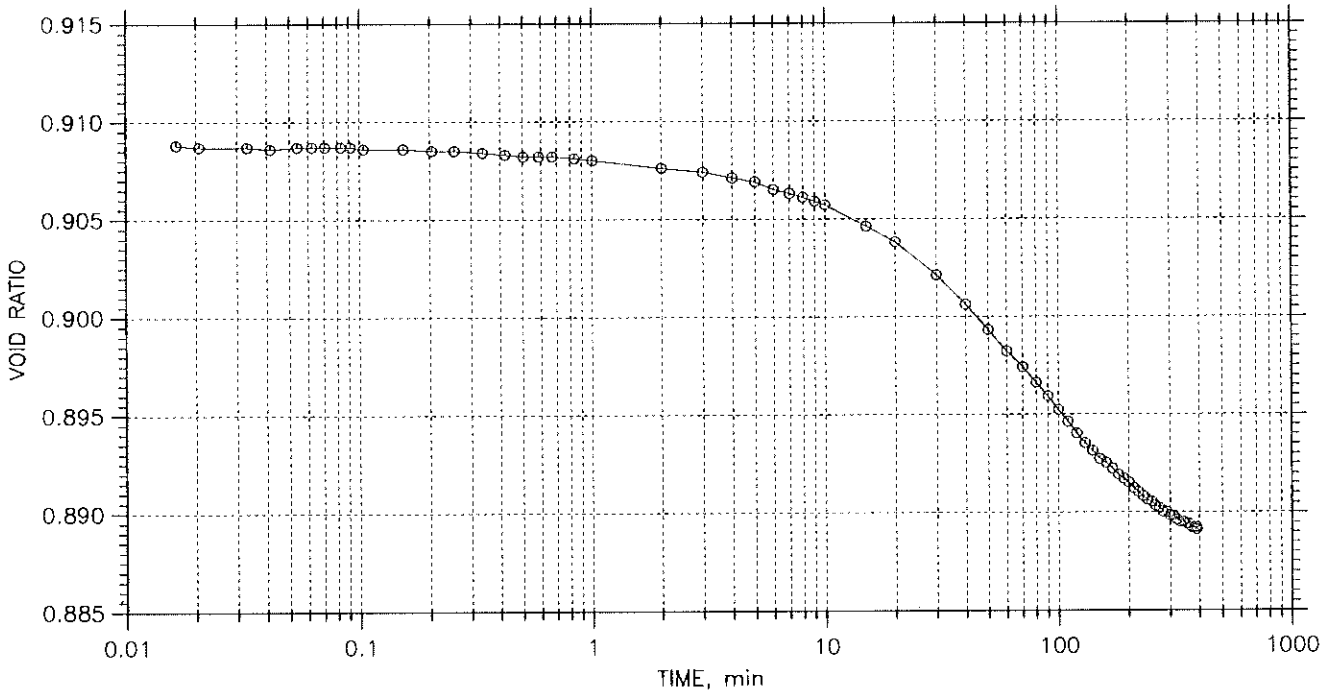
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

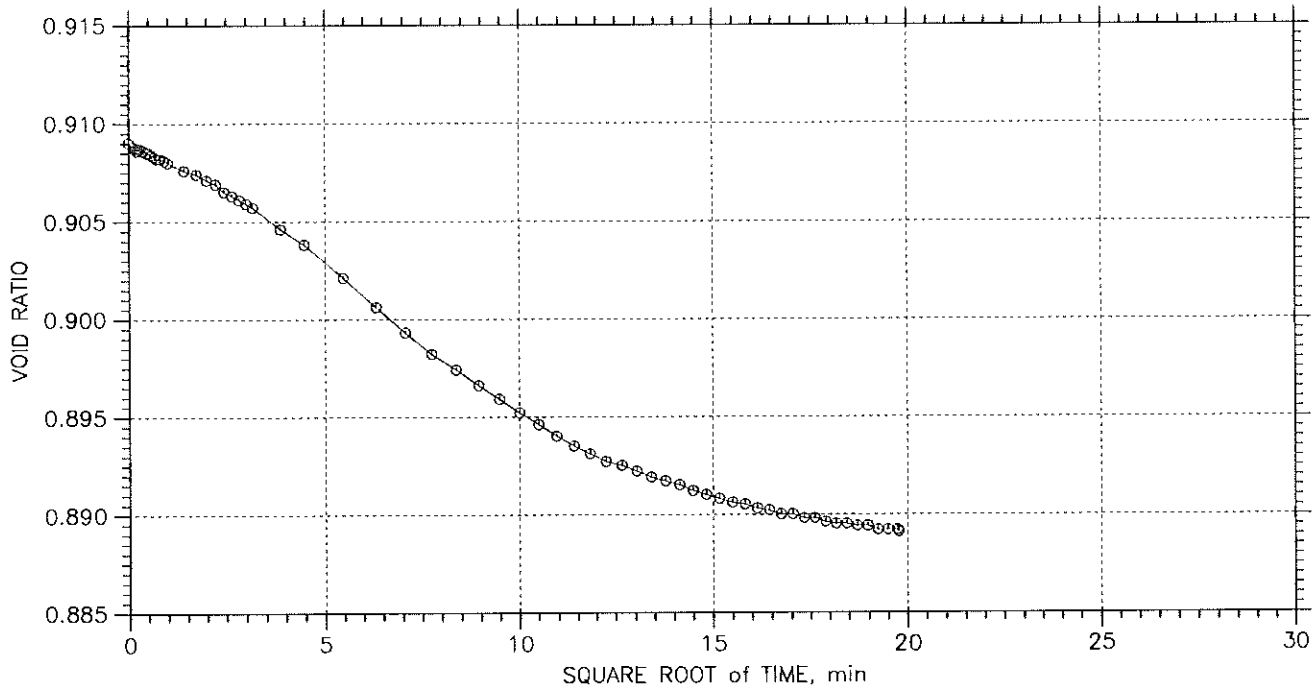
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 4 of 29

Stress: 0.25 tsf





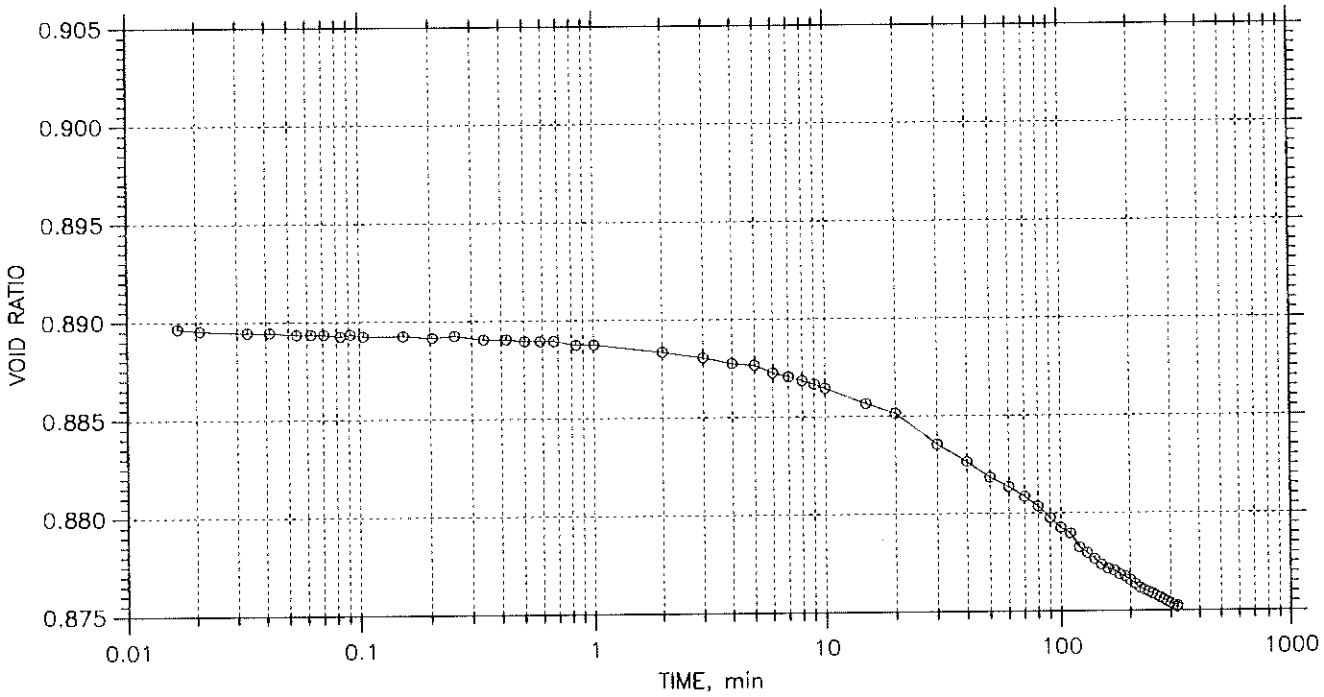
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

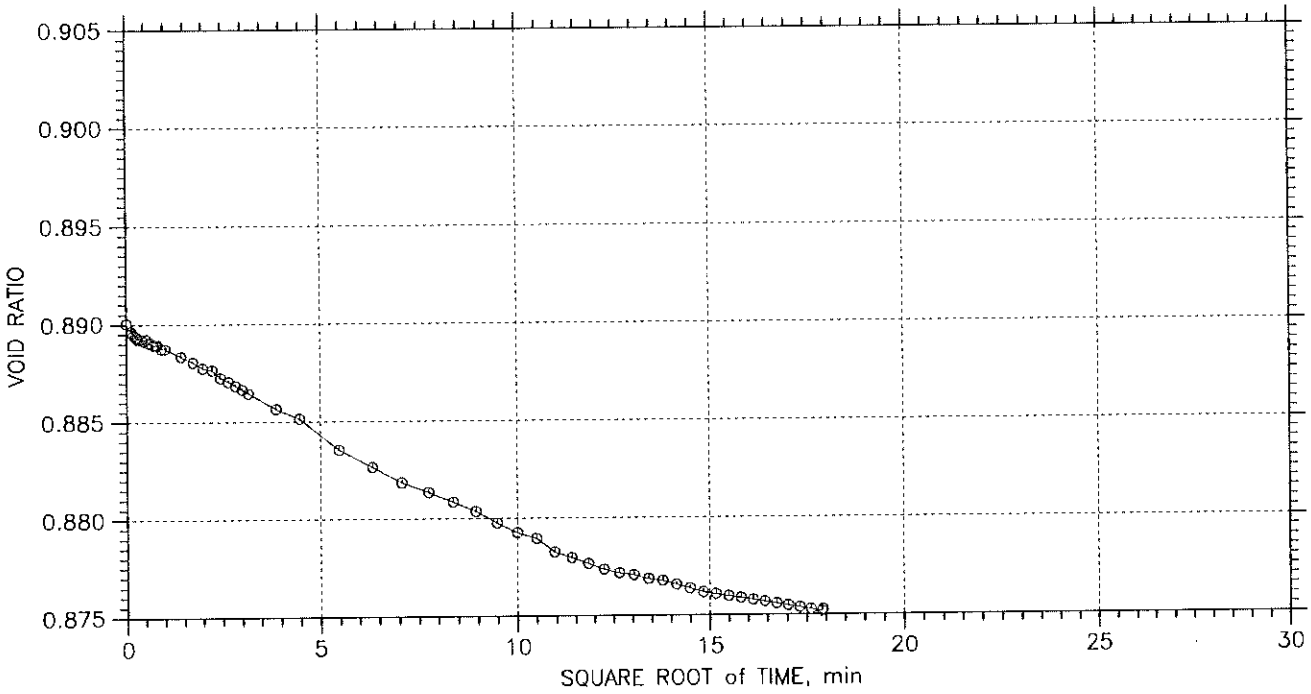
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 5 of 29

Stress: 0.375 tsf





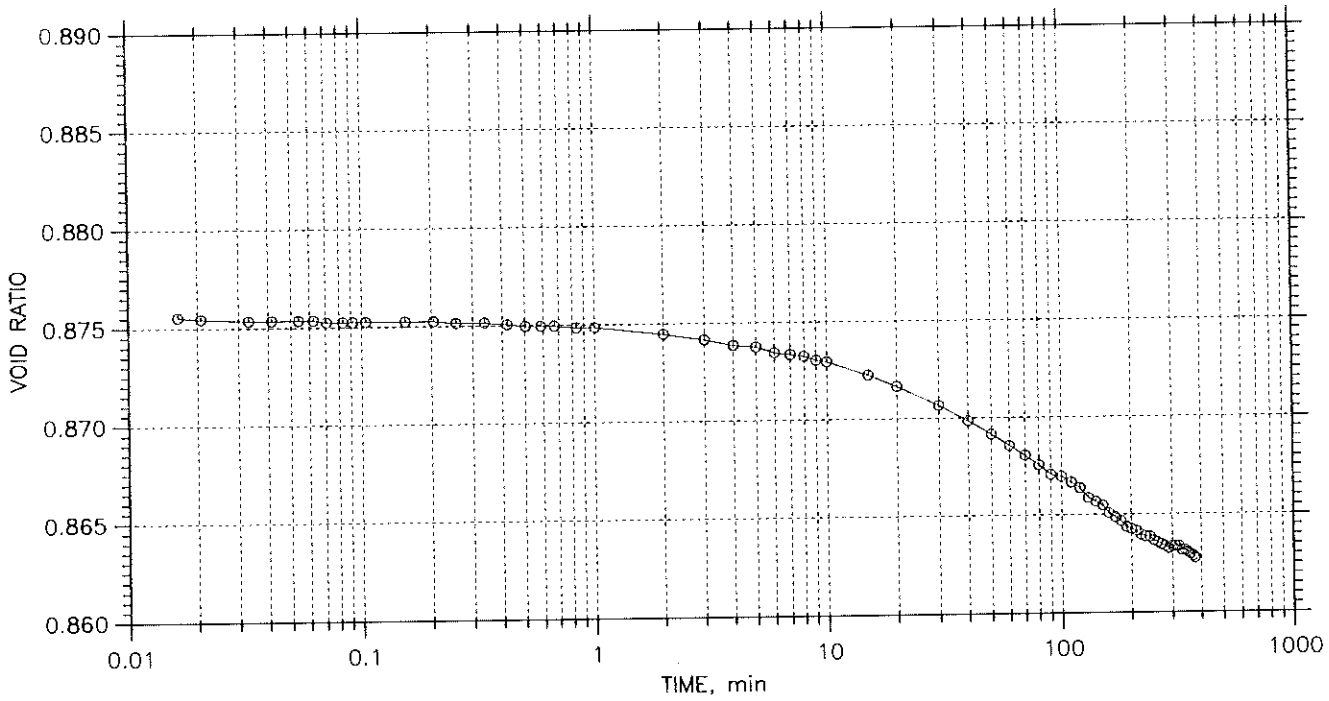
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

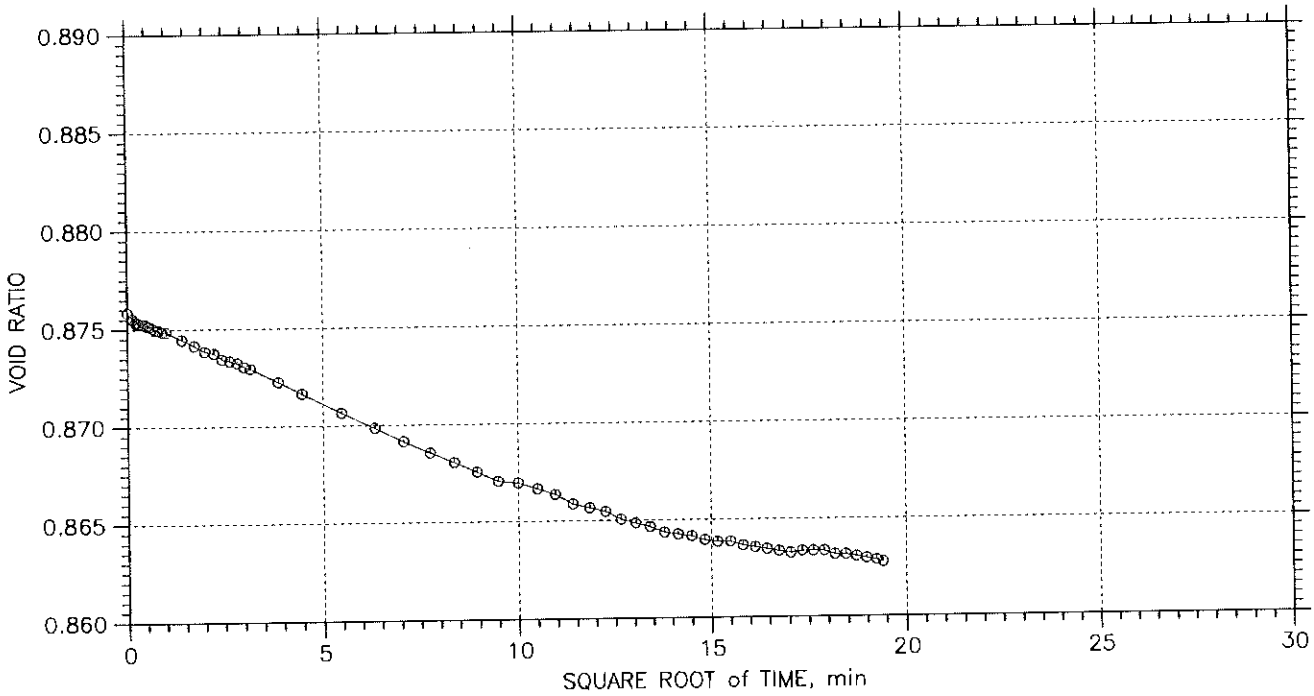
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 6 of 29

Stress: 0.5 tsf





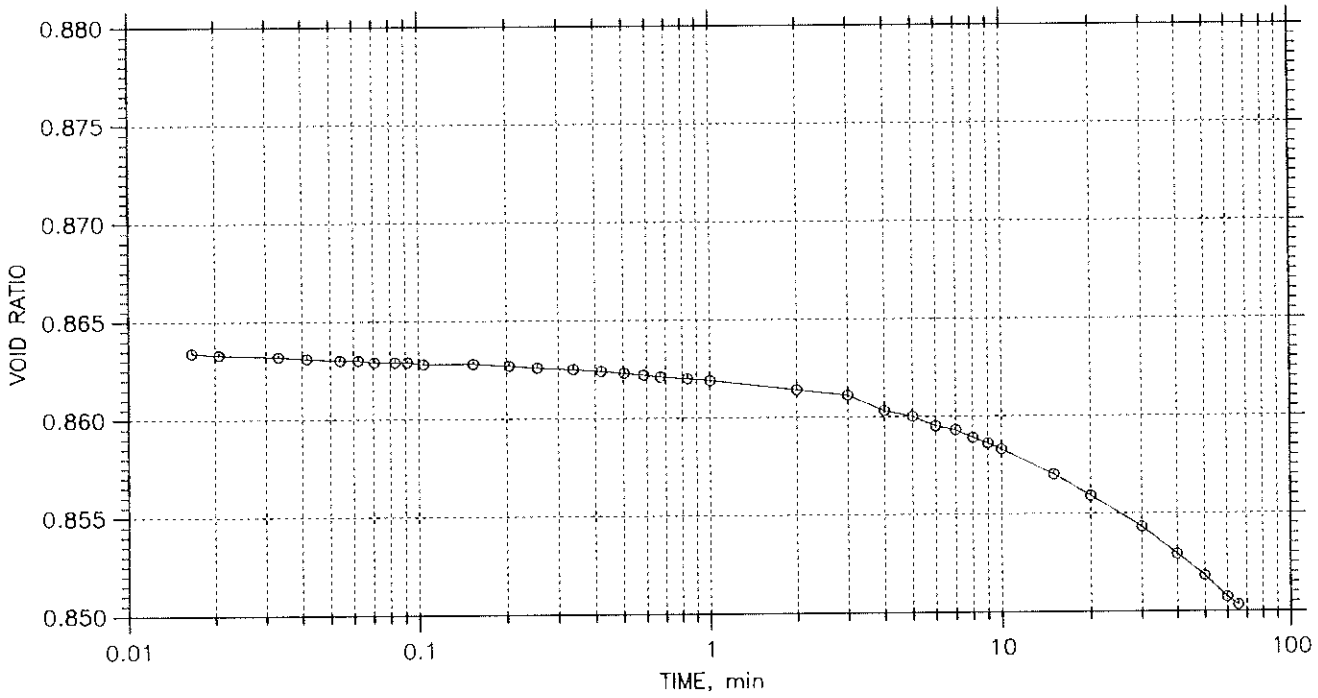
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brion Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

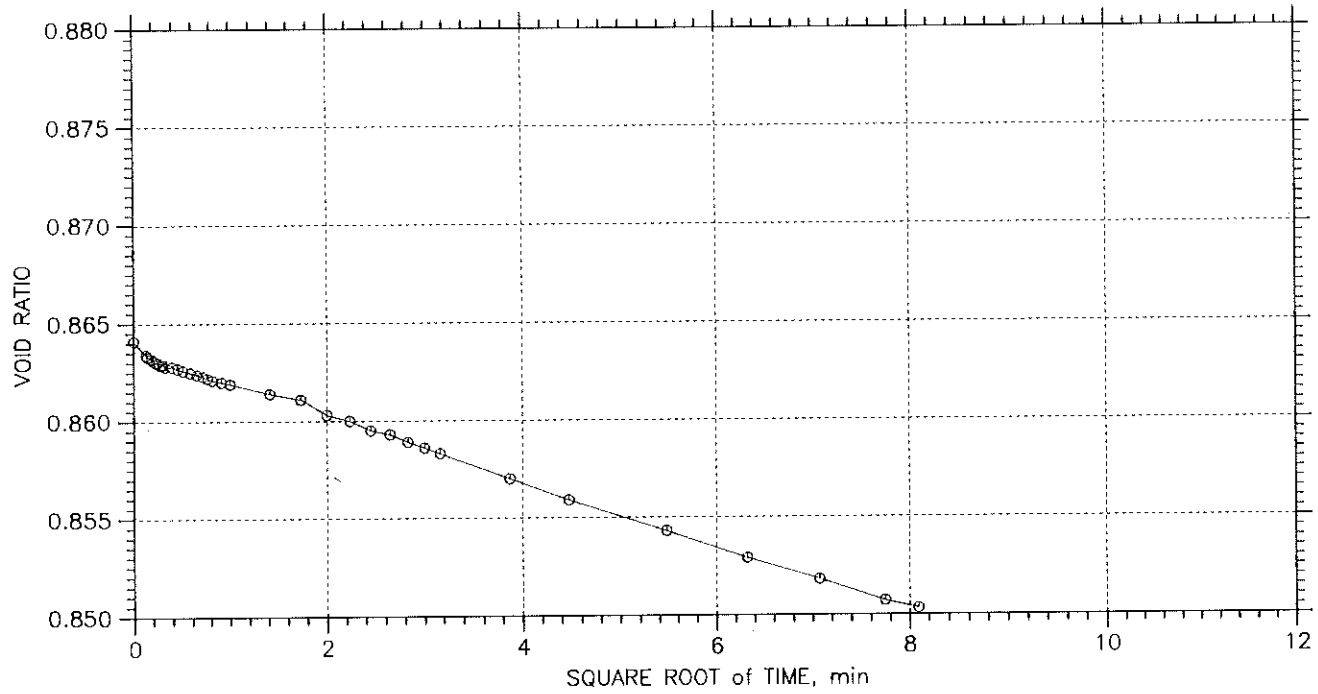
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 7 of 29

Stress: 0.75 tsf





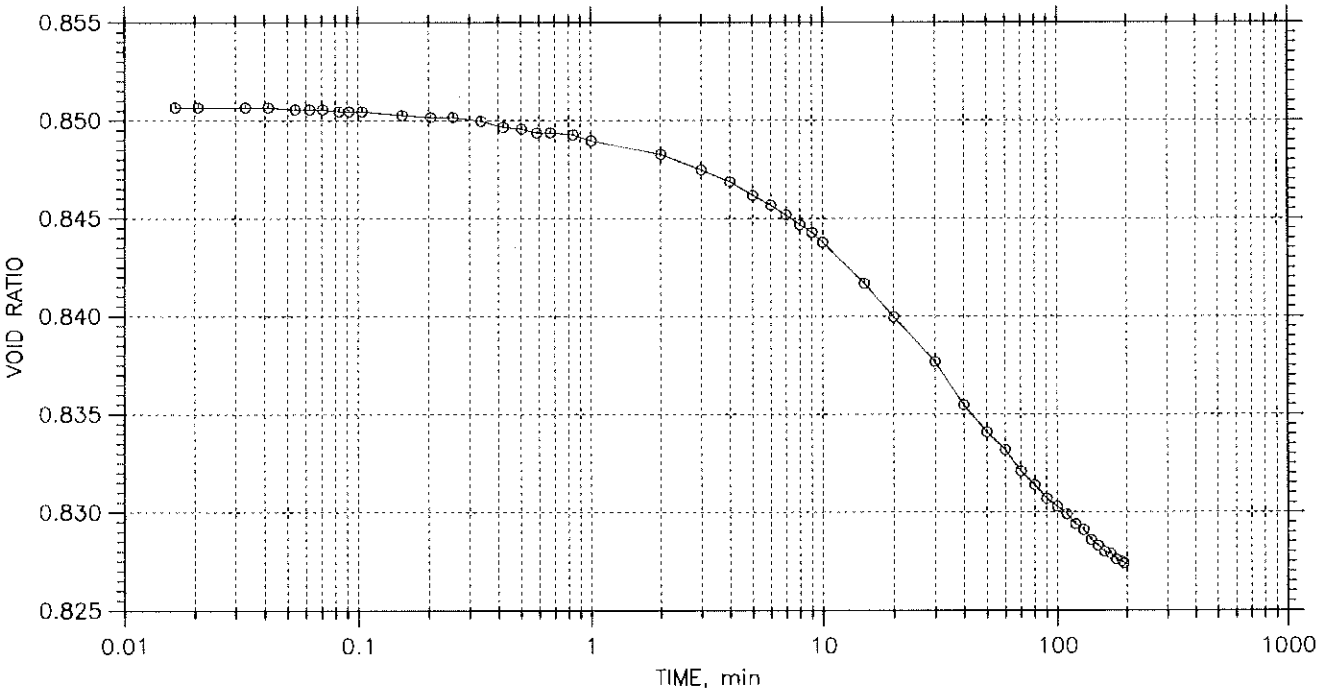
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

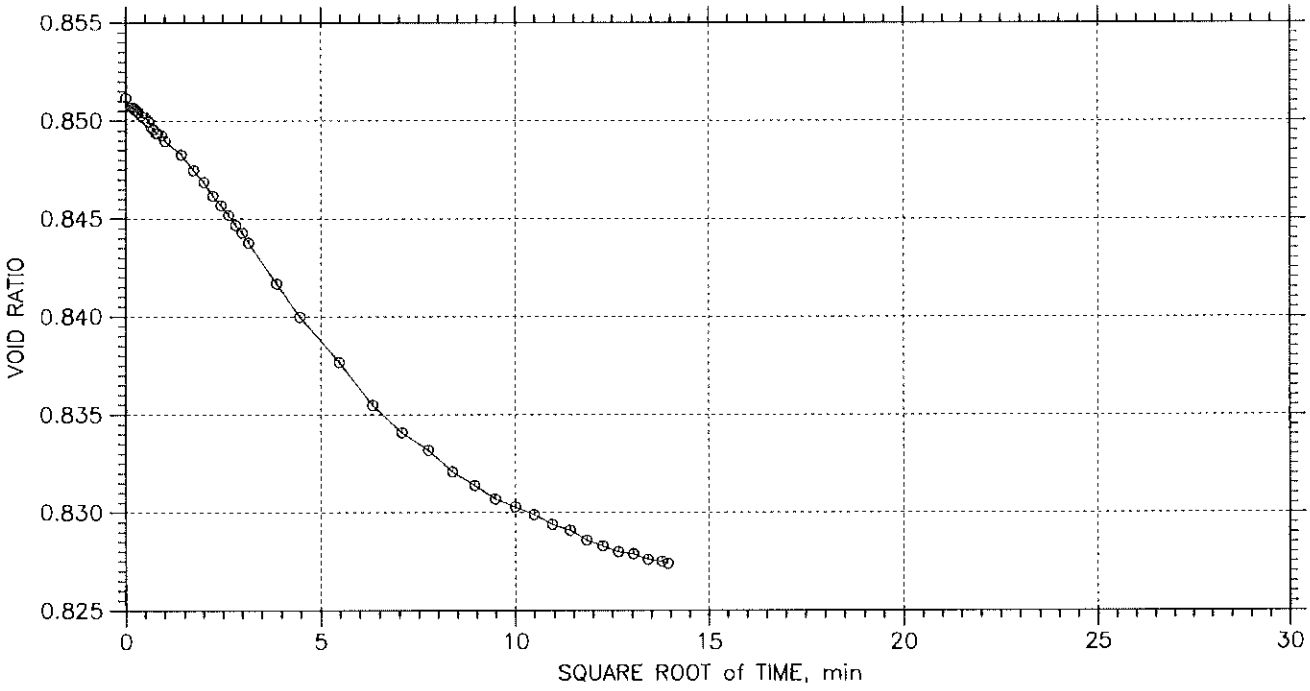
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 8 of 29

Stress: 1. tsf





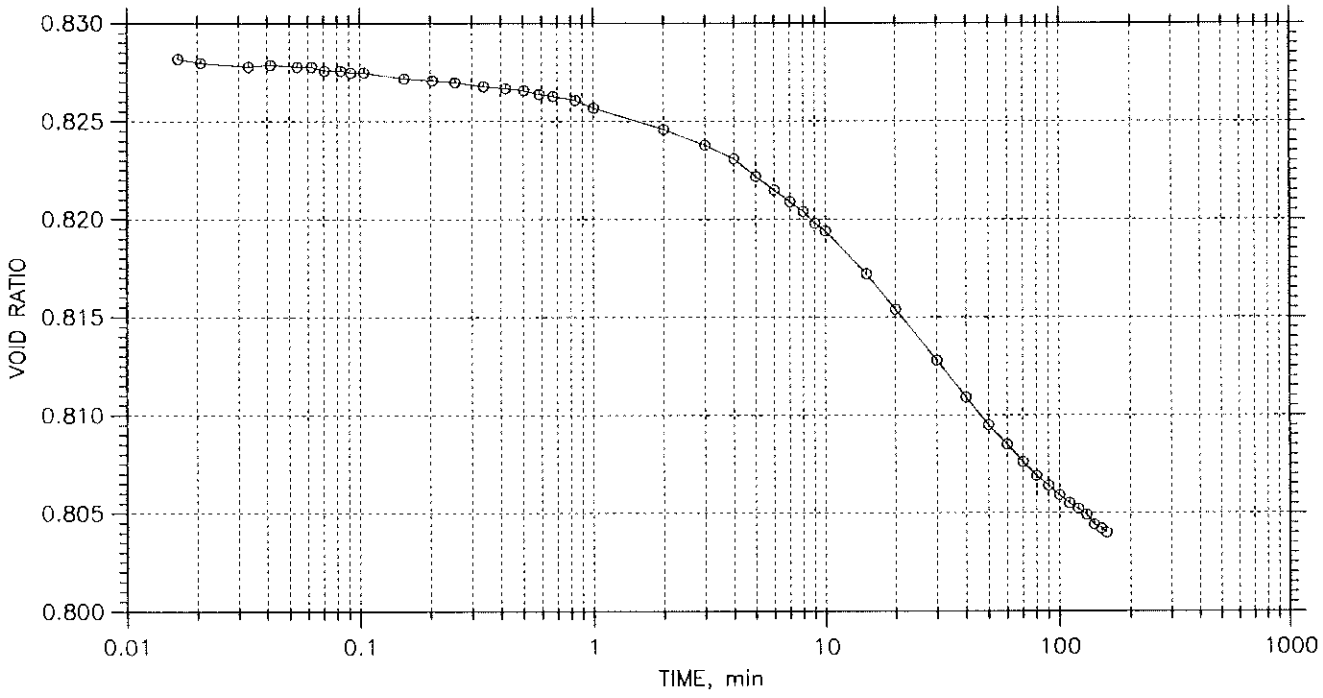
Project:	Location: GORHAM	Project No.: 010801.00
Baring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remorks:		

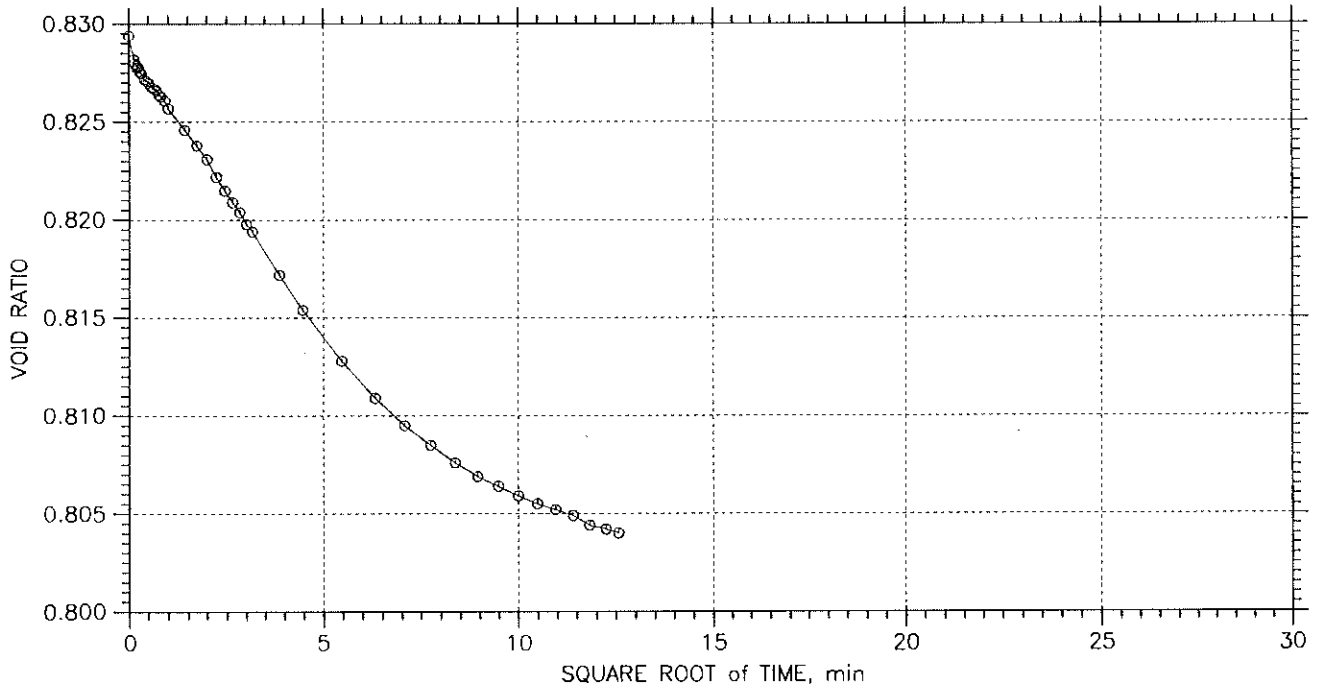
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 9 of 29

Stress: 1.5 tsf





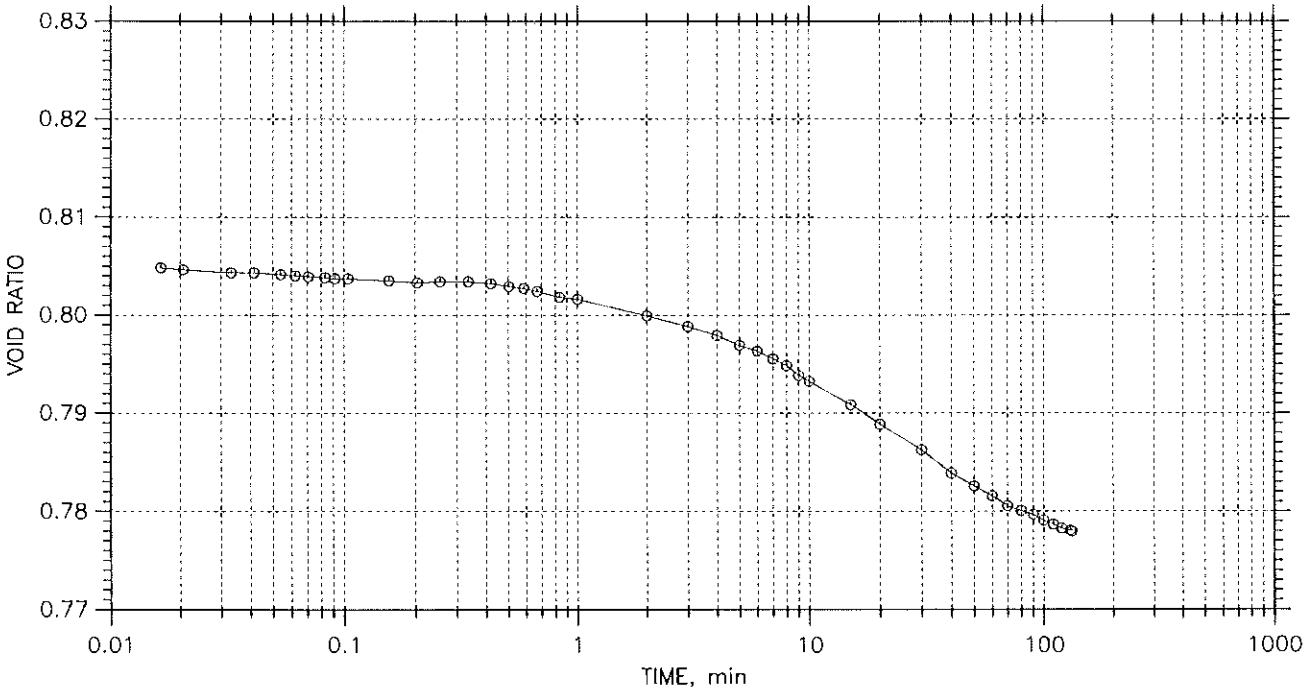
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

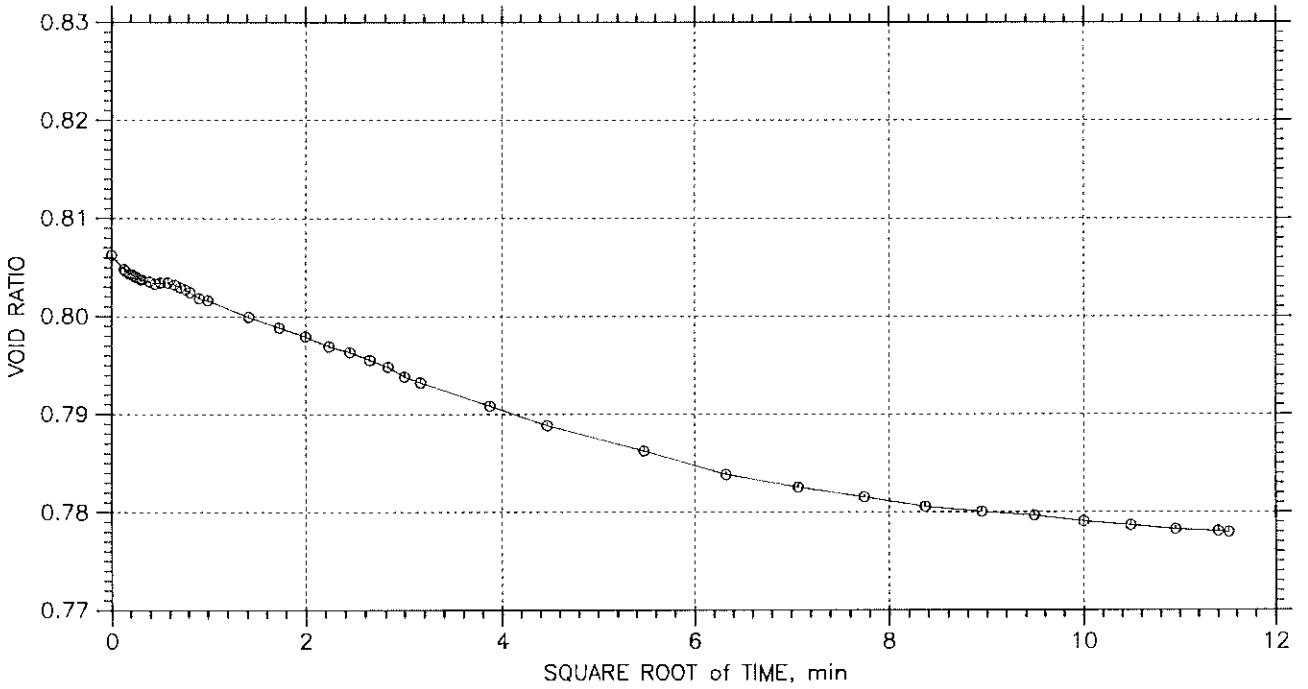
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 10 of 29

Stress: 2.25 tsf





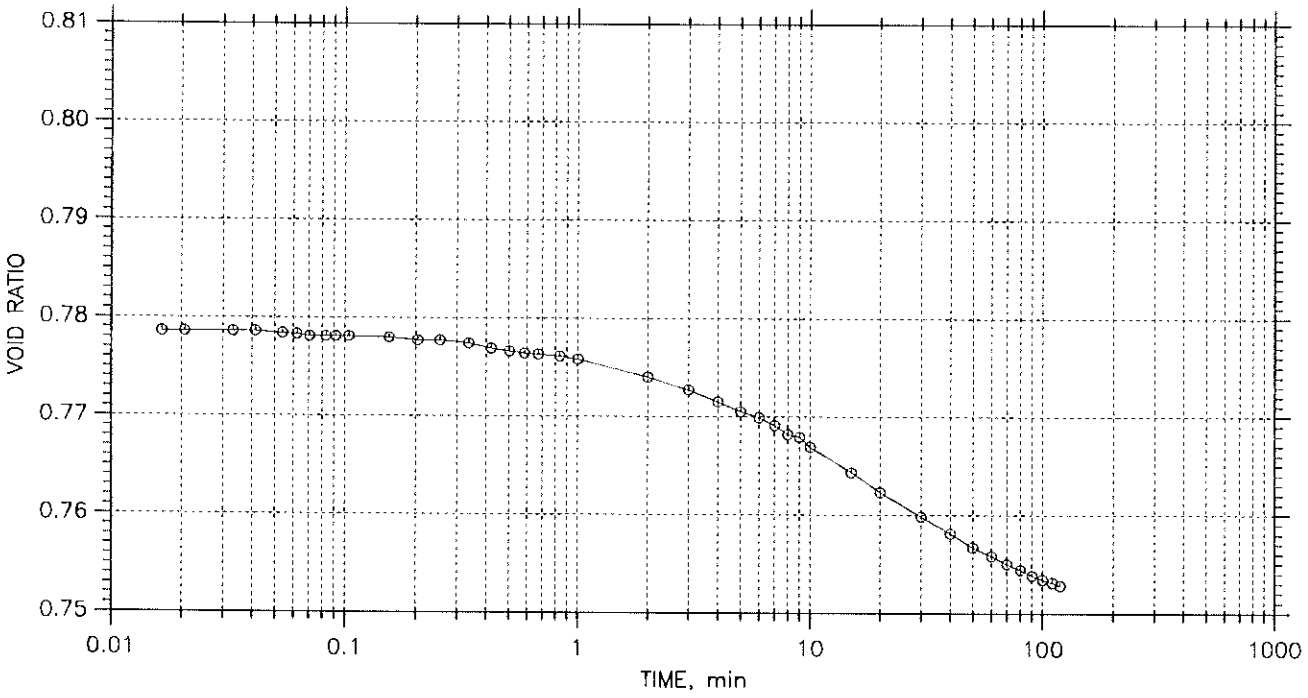
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

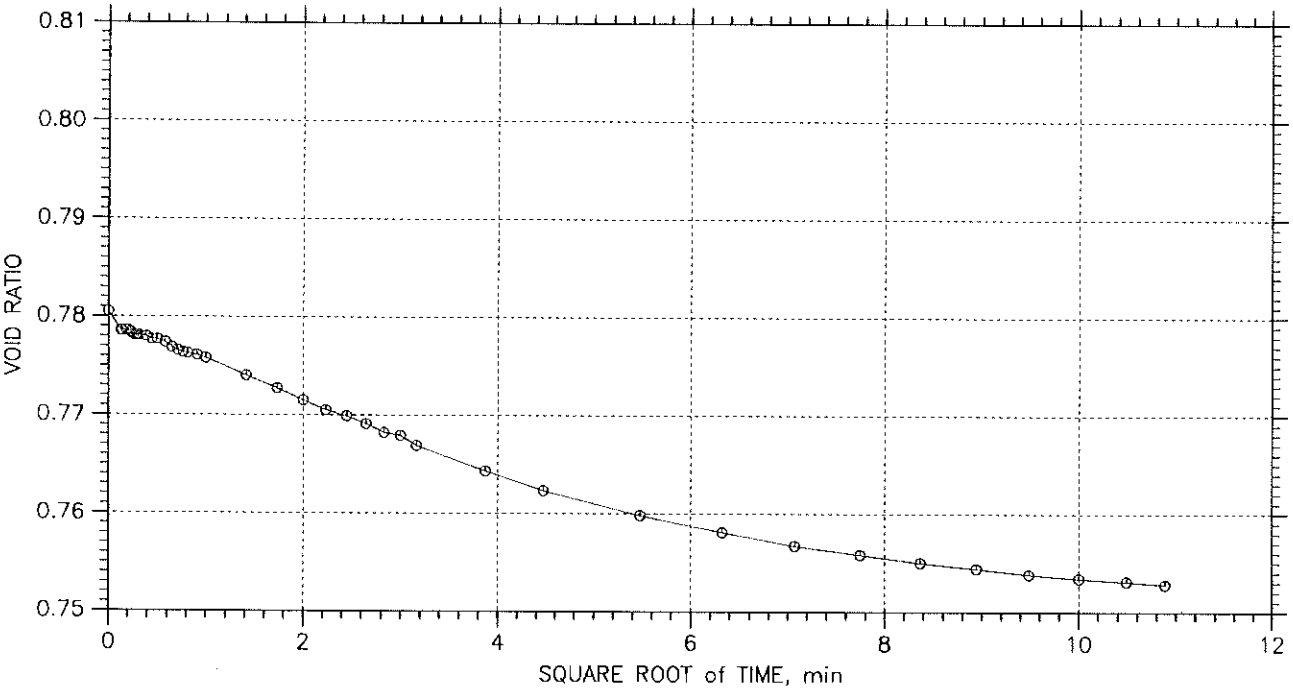
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 11 of 29

Stress: 3.25 tsf





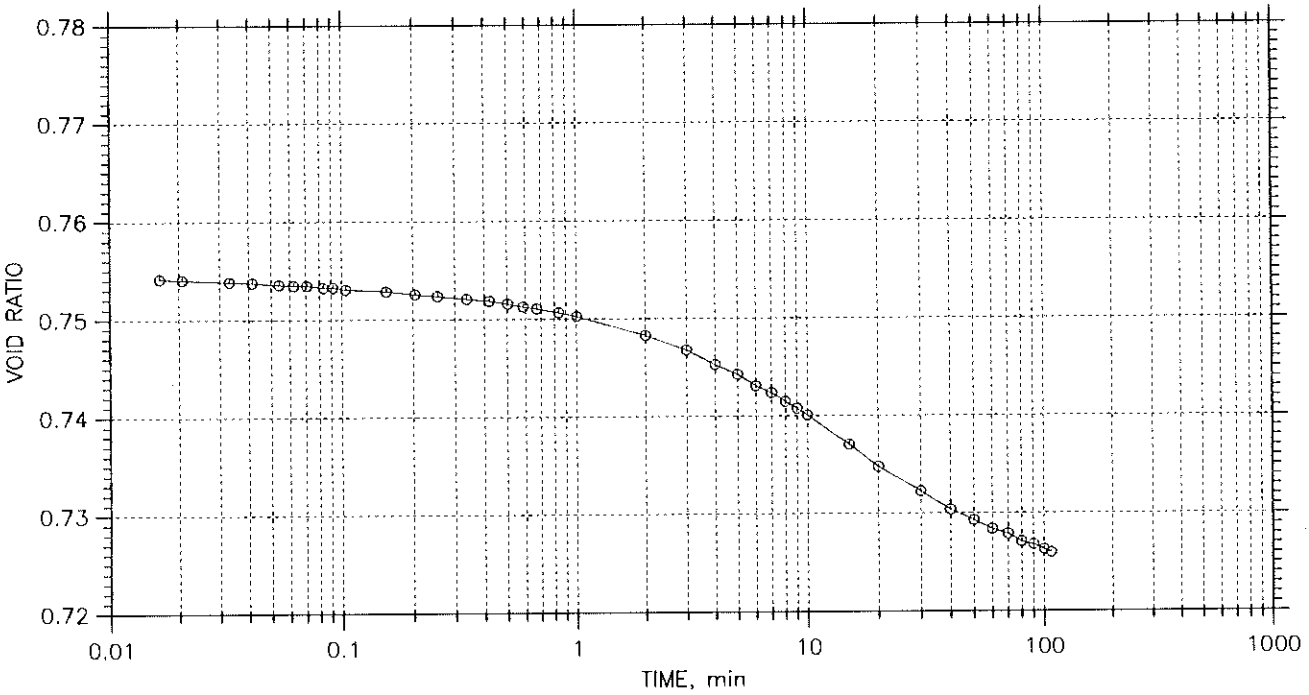
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

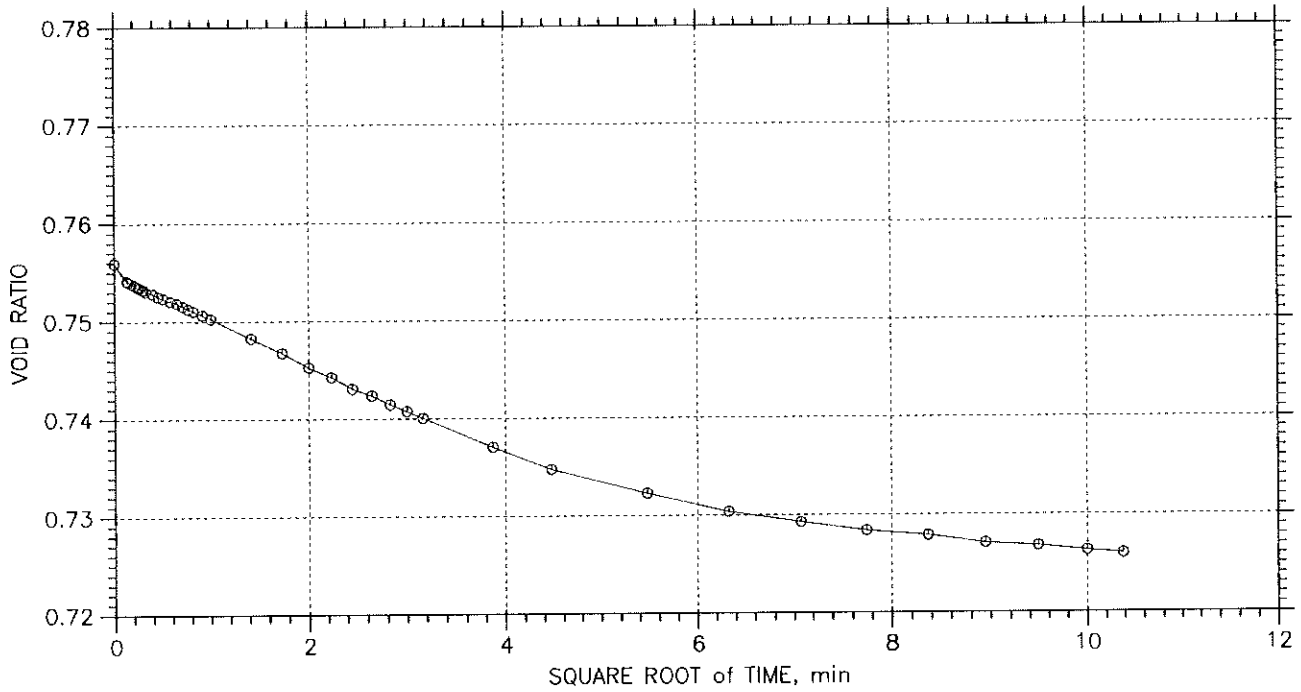
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 12 of 29

Stress: 4.75 tsf





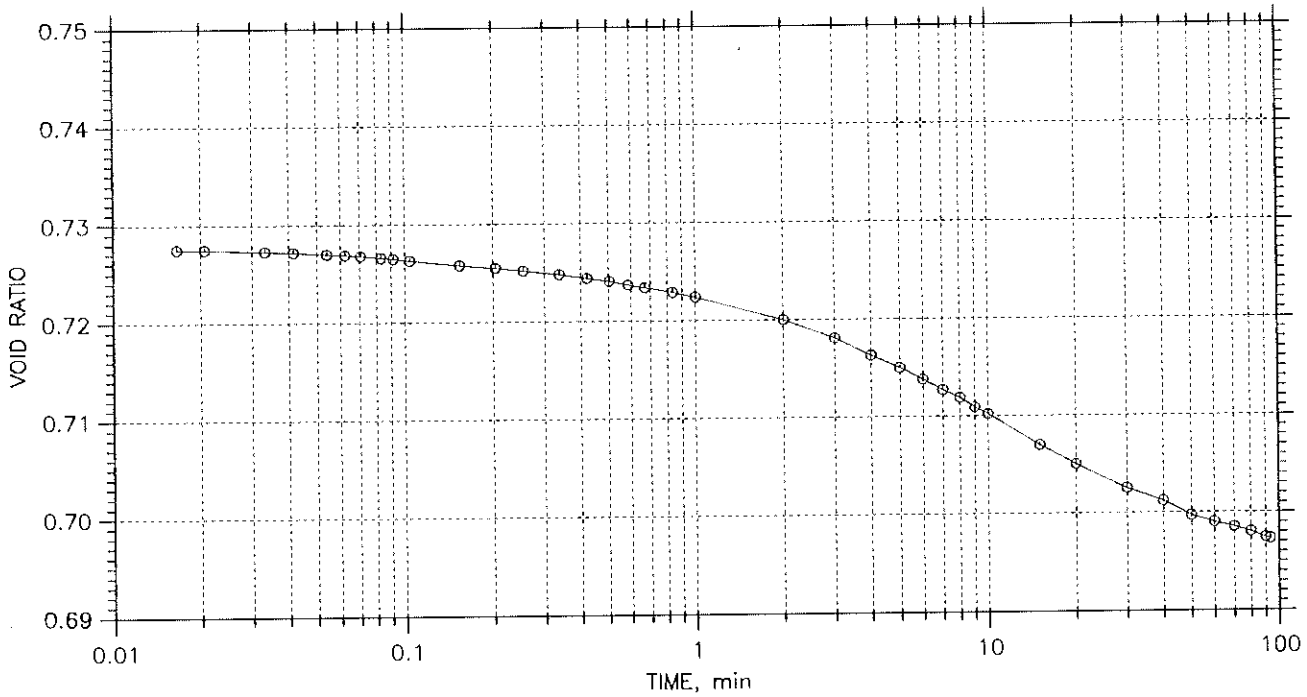
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

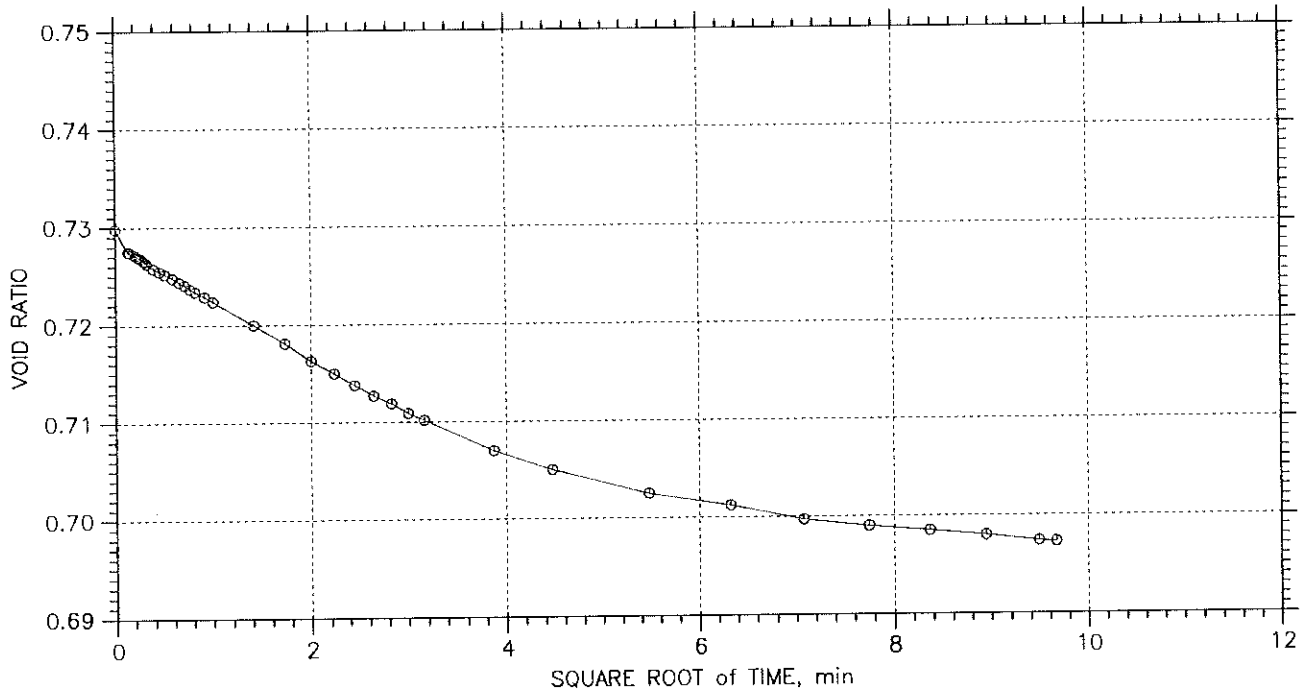
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 13 of 29

Stress: 7. tsf





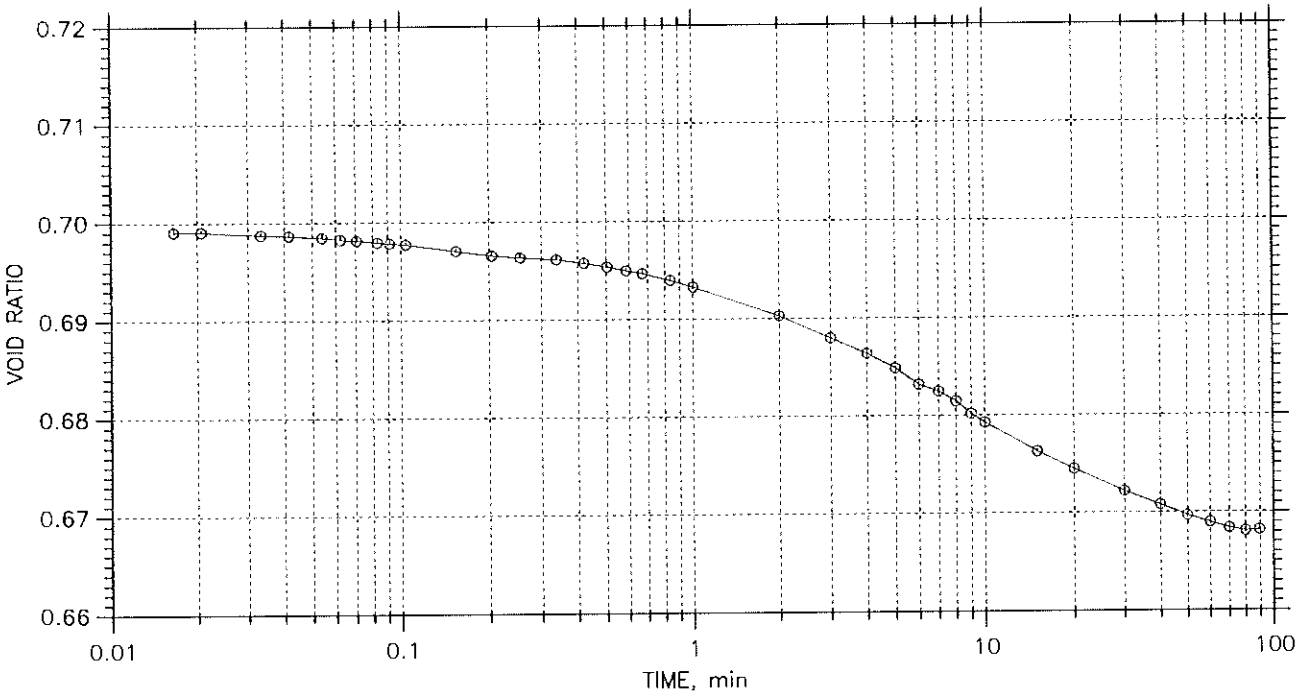
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fagg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

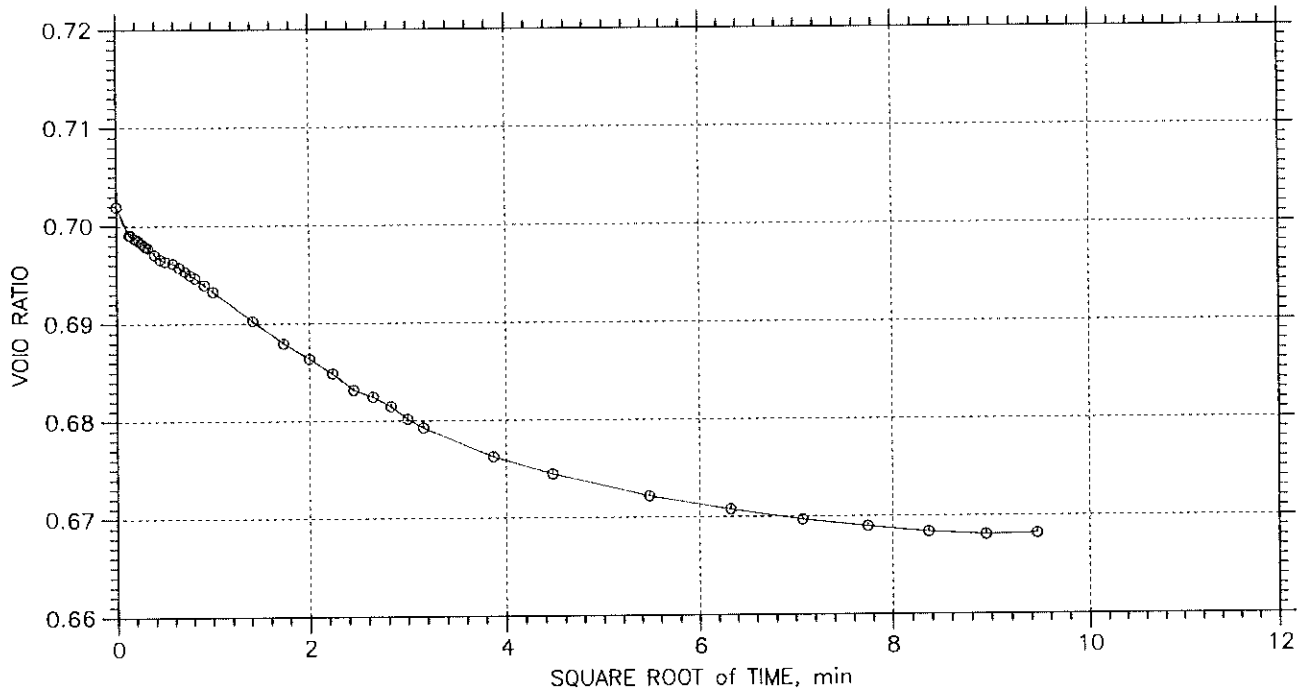
CONSOLIDATION TEST DATA

TIME CURVES

Constant Lood Step: 14 of 29

Stress: 10.25 tsf





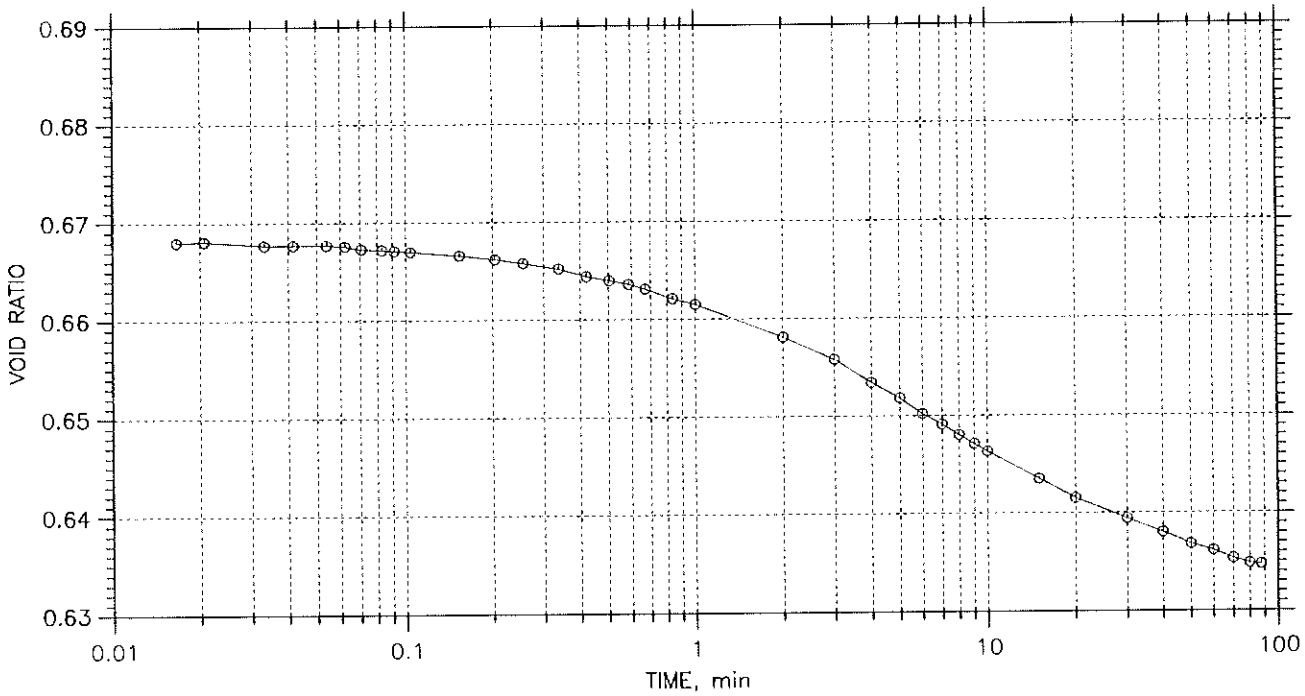
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

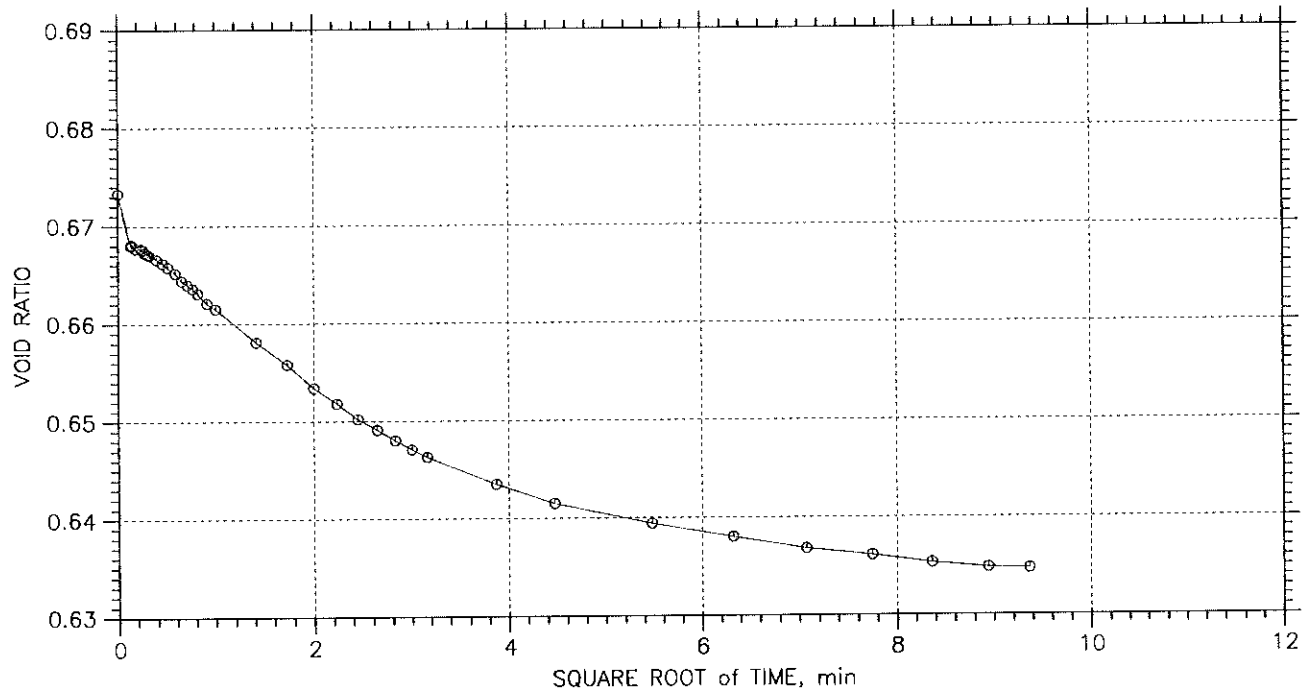
CONSOLIDATION TEST DATA

TIME CURVES

Constant Lood Step: 15 of 29

Stress: 15. tsf





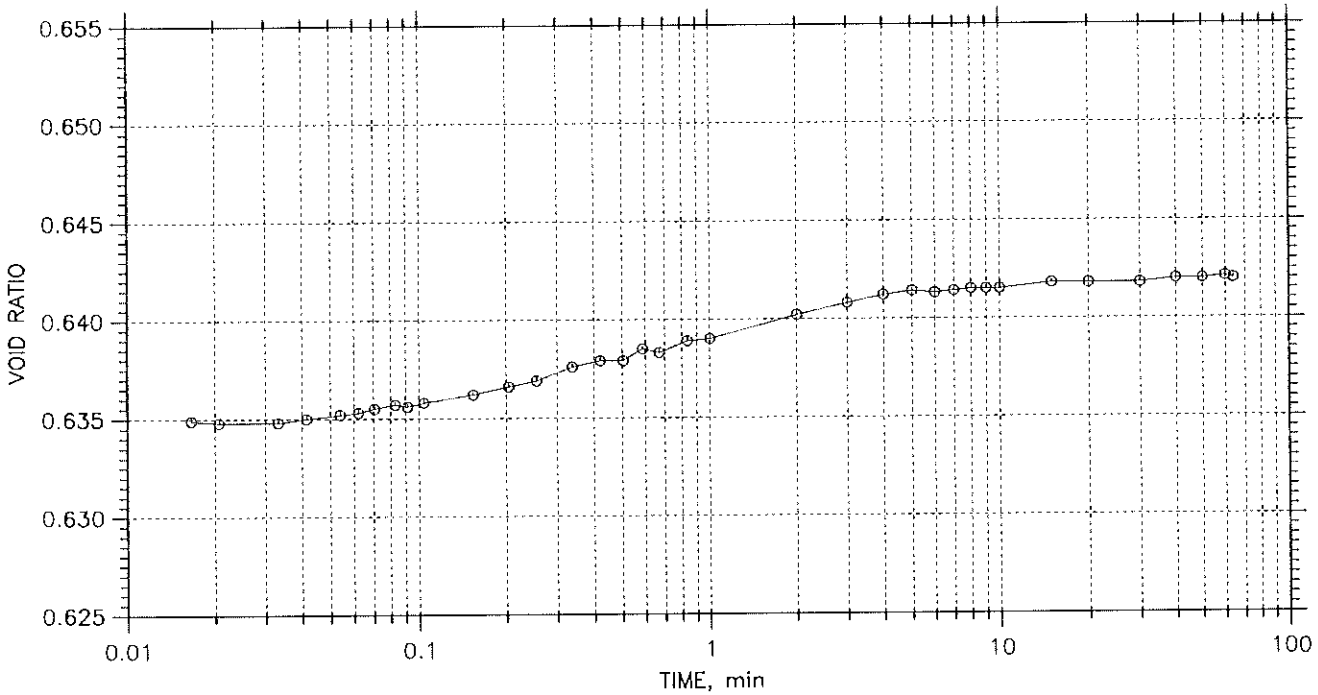
Project:	Locotion: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Dote: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevotion: ---
Description: GRAY CLAY		
Remorks:		

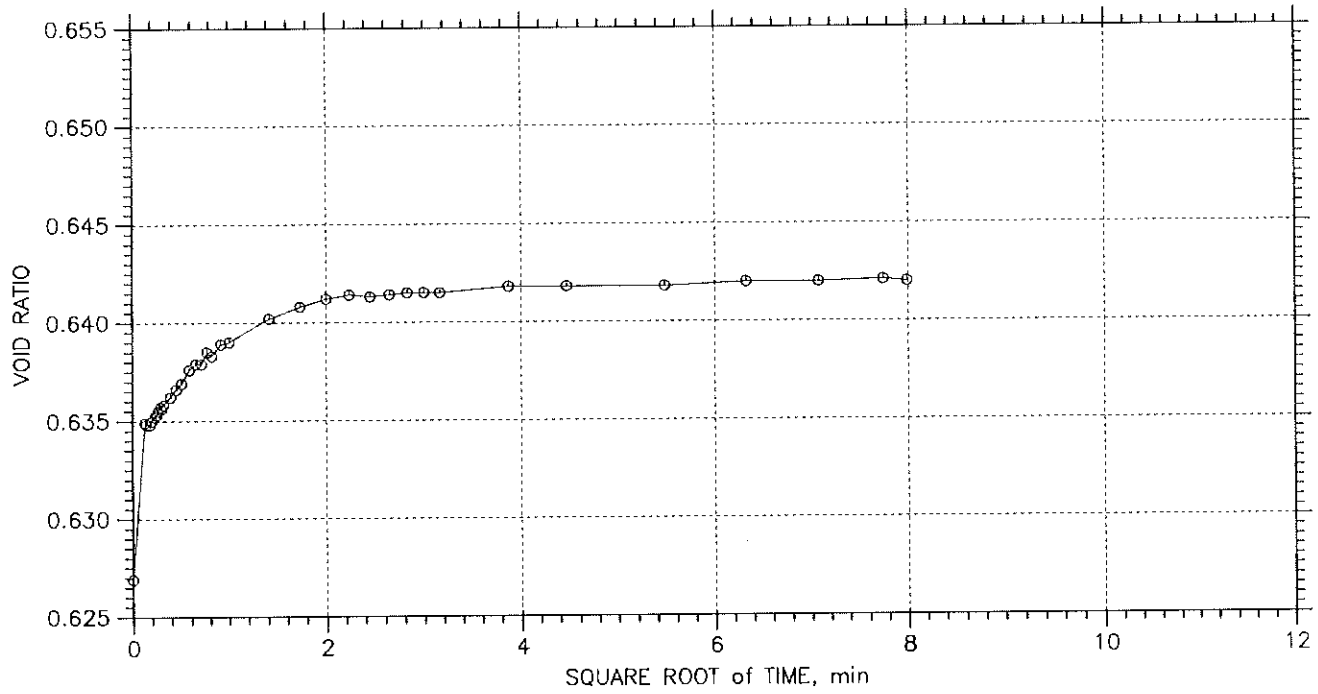
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 16 of 29

Stress: 7. tsf





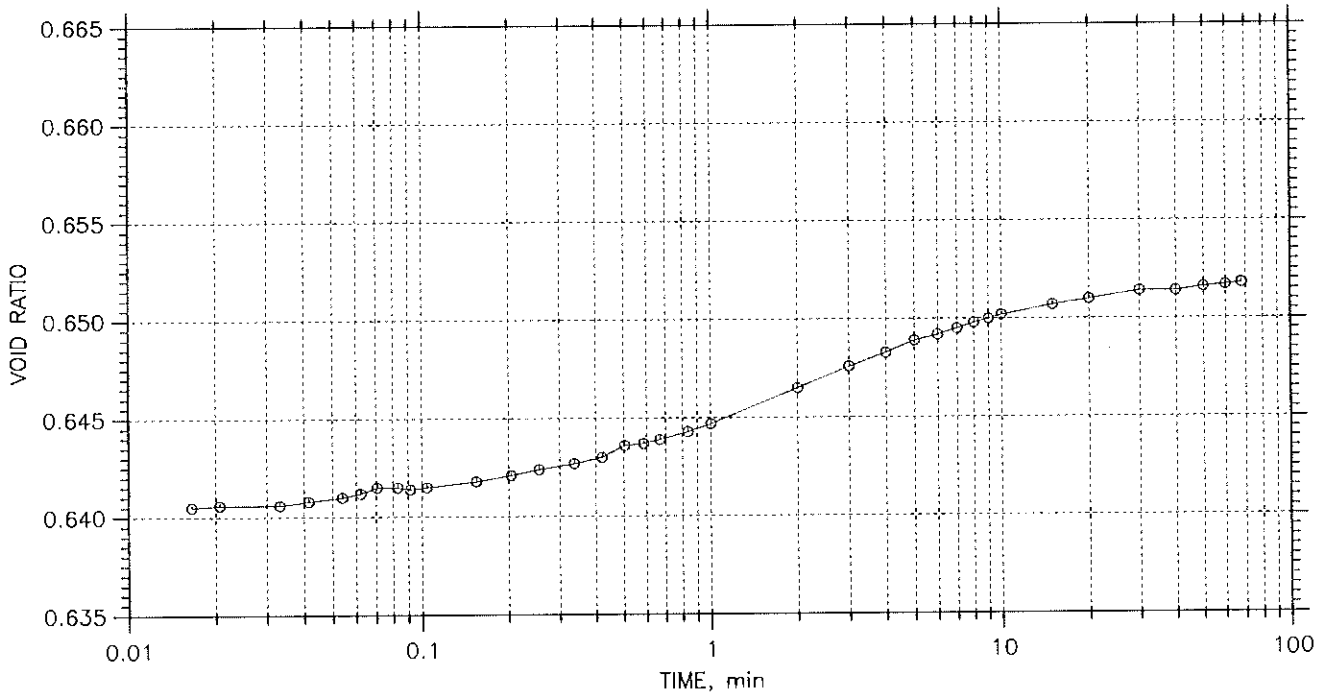
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

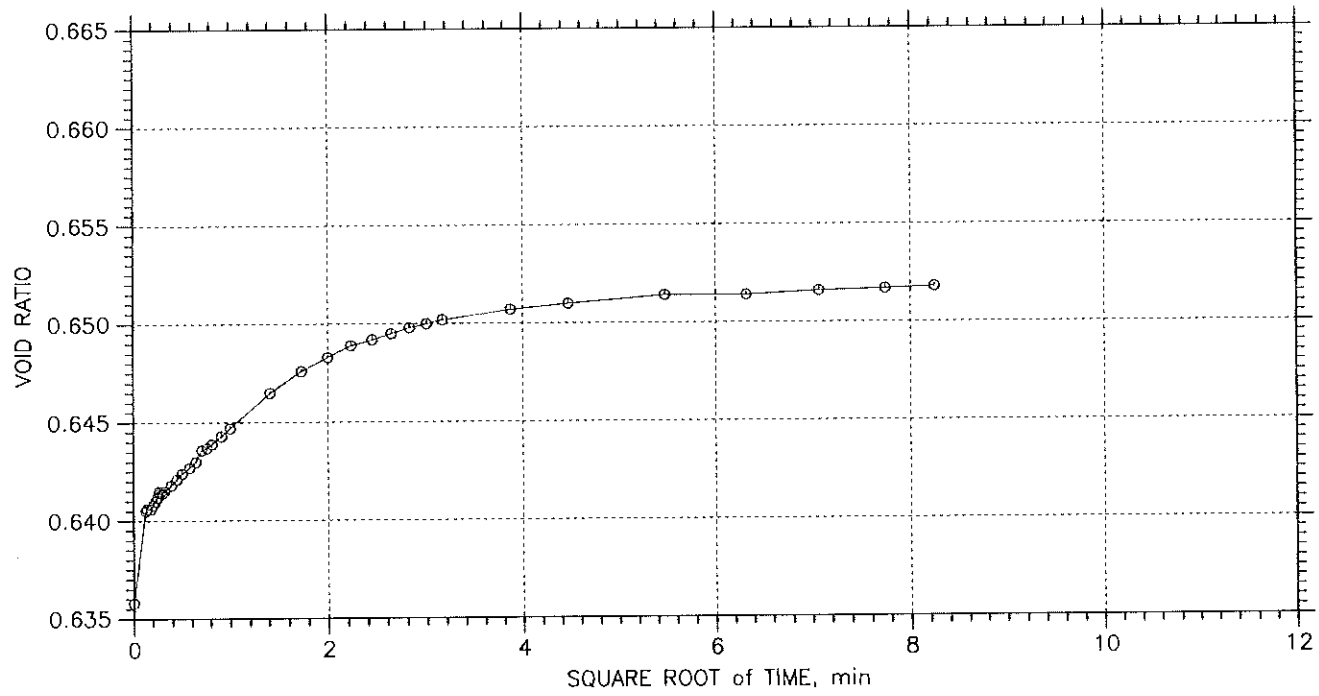
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 17 of 29

Stress: 3.25 tsf





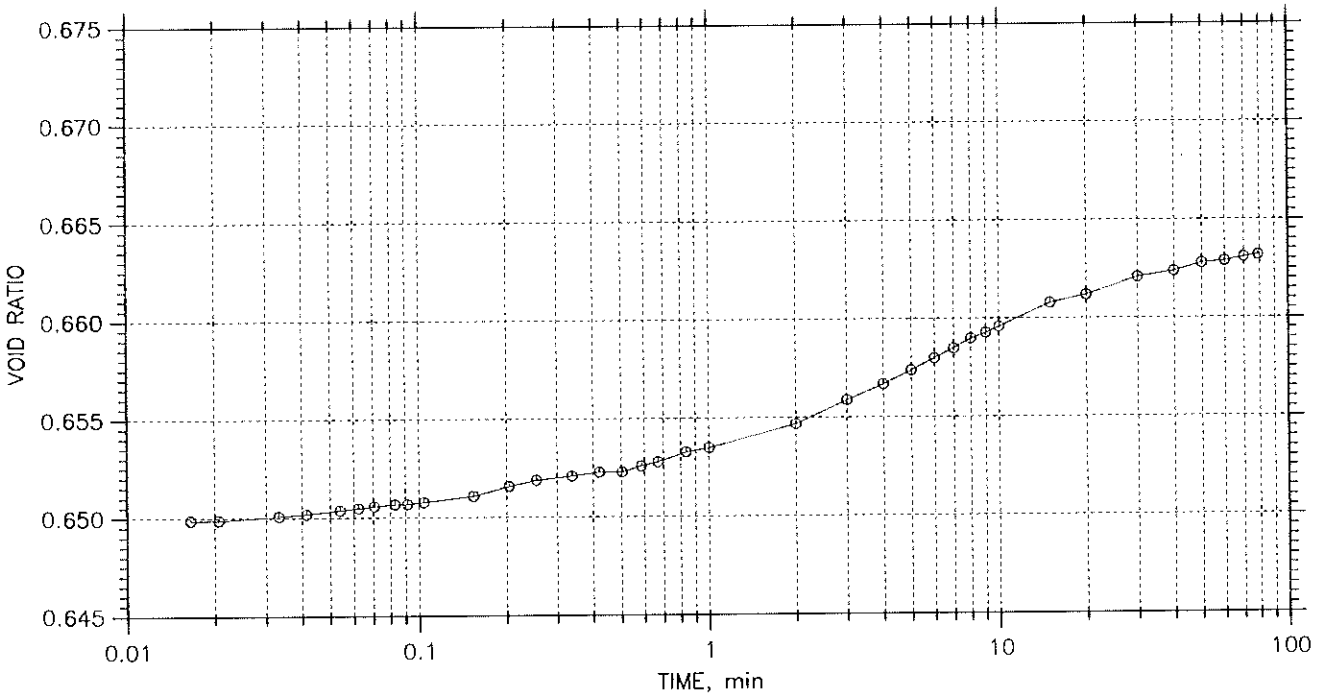
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

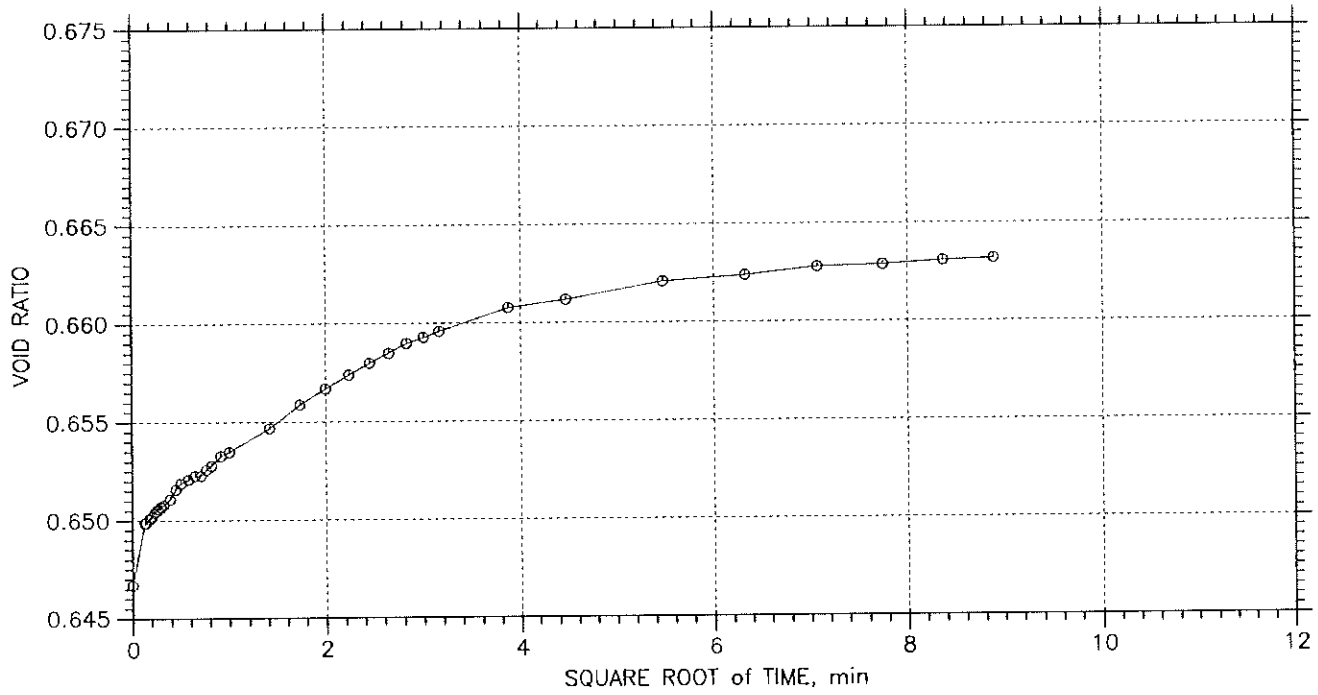
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 18 of 29

Stress: 1.5 tsf





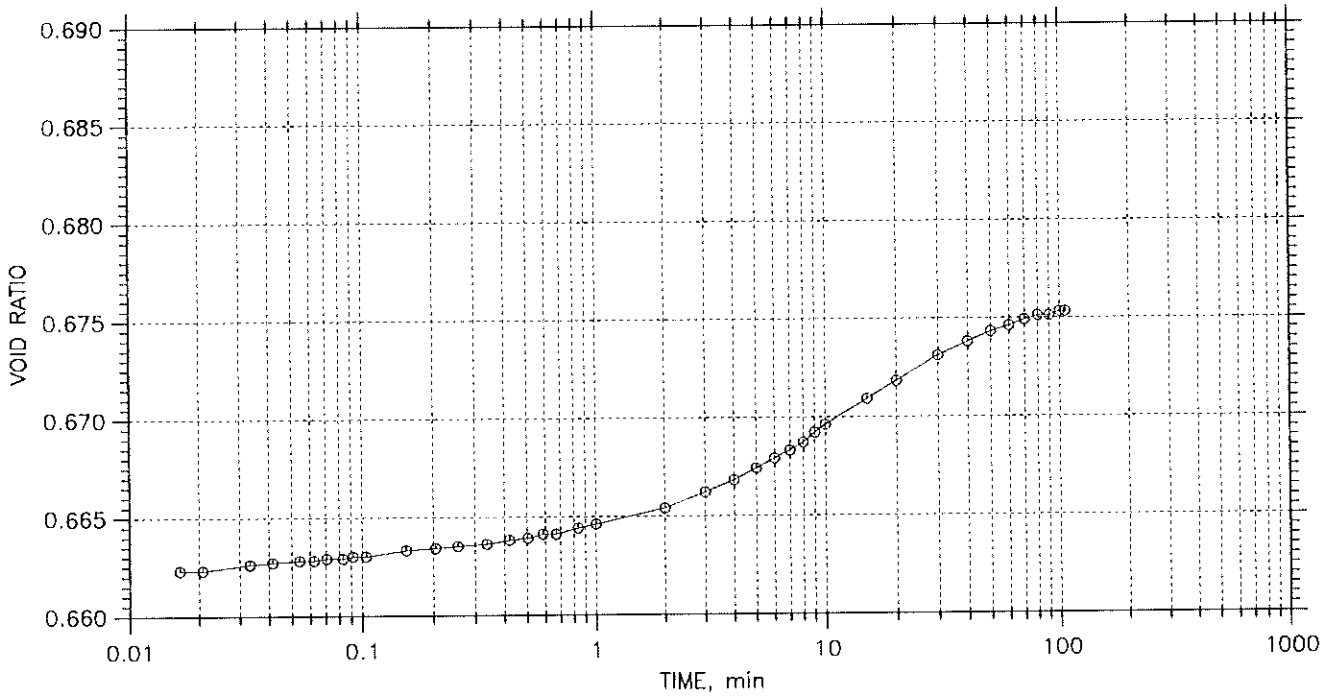
Project:	Locotion: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

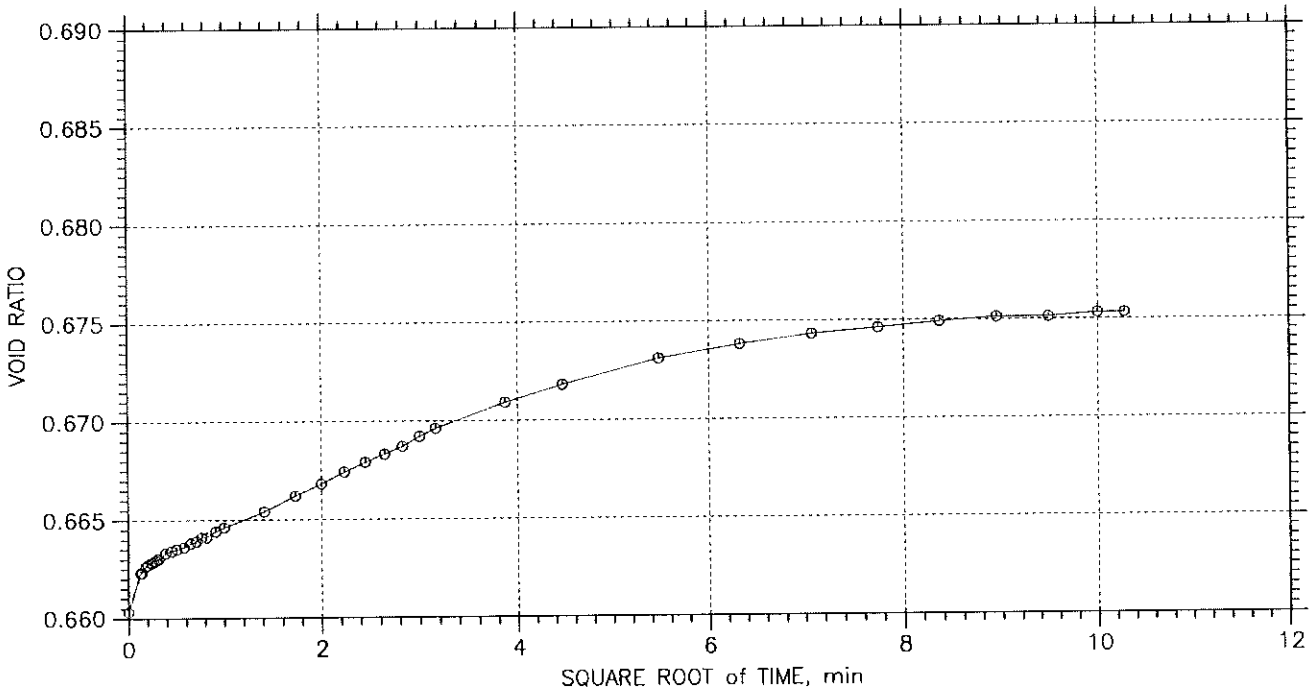
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 19 of 29

Stress: 0.75 tsf





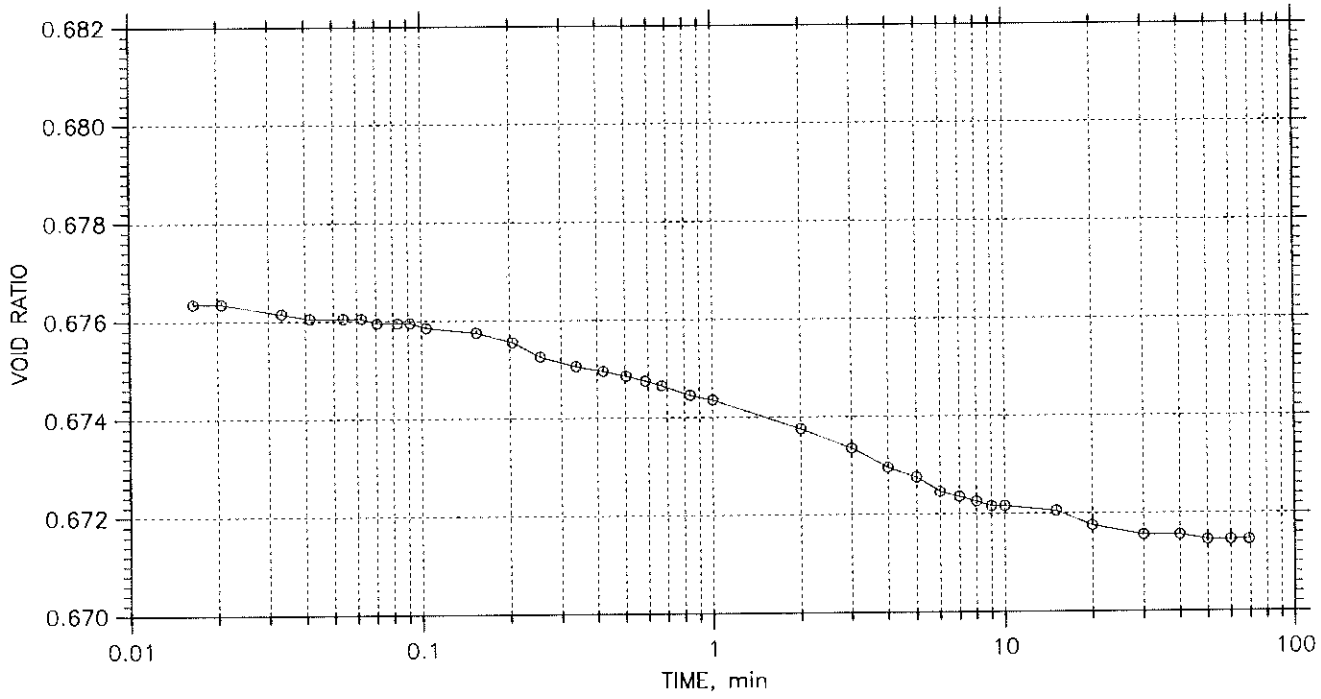
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

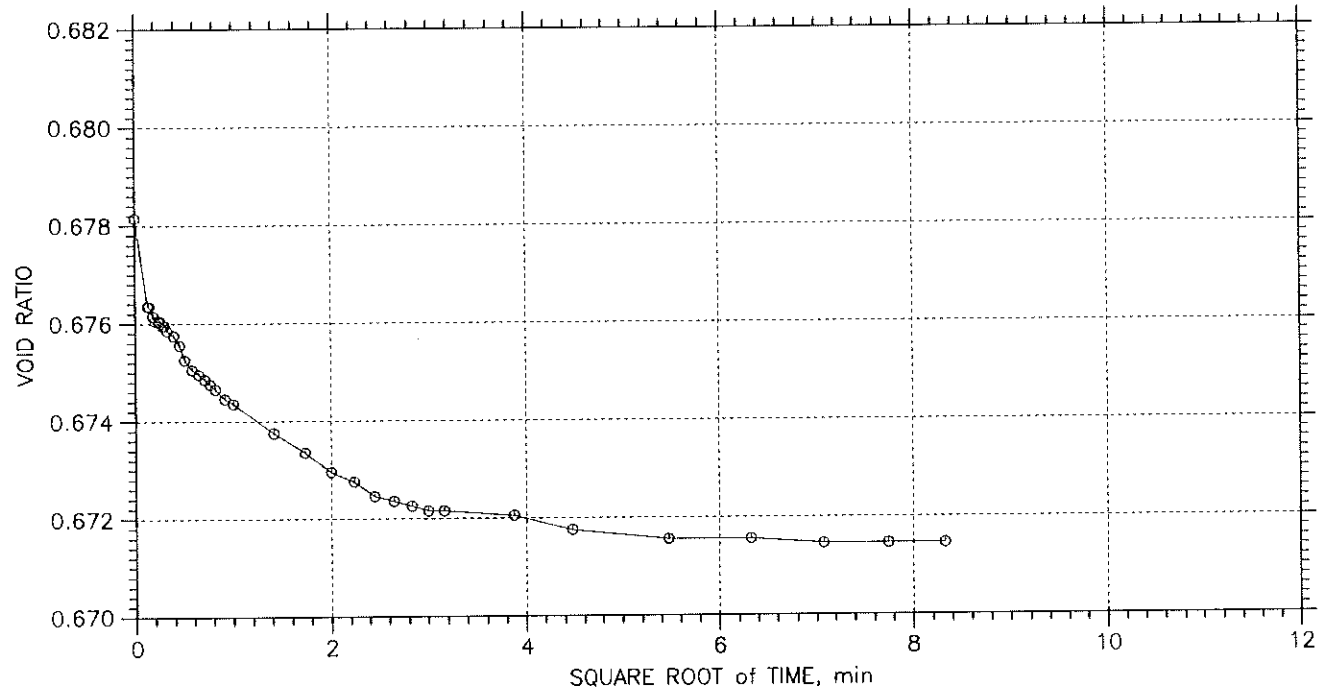
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 20 of 29

Stress: 1.5 tsf





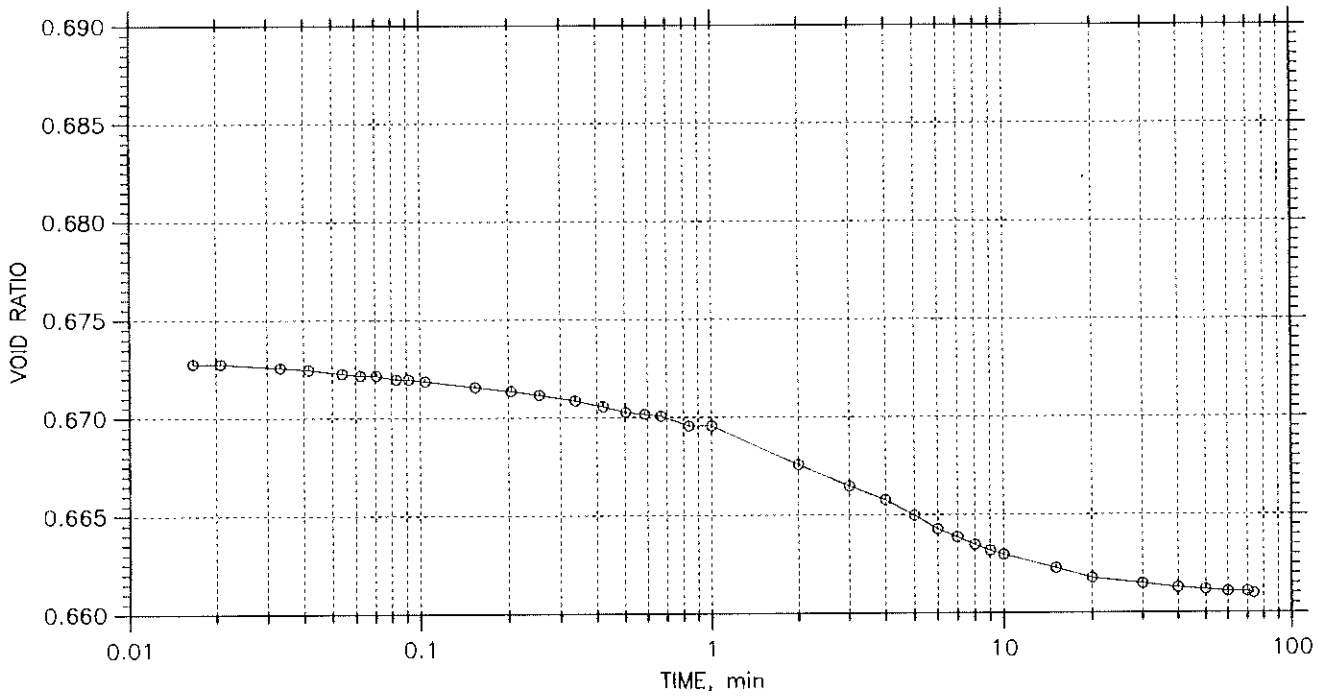
Project:	Locotion: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

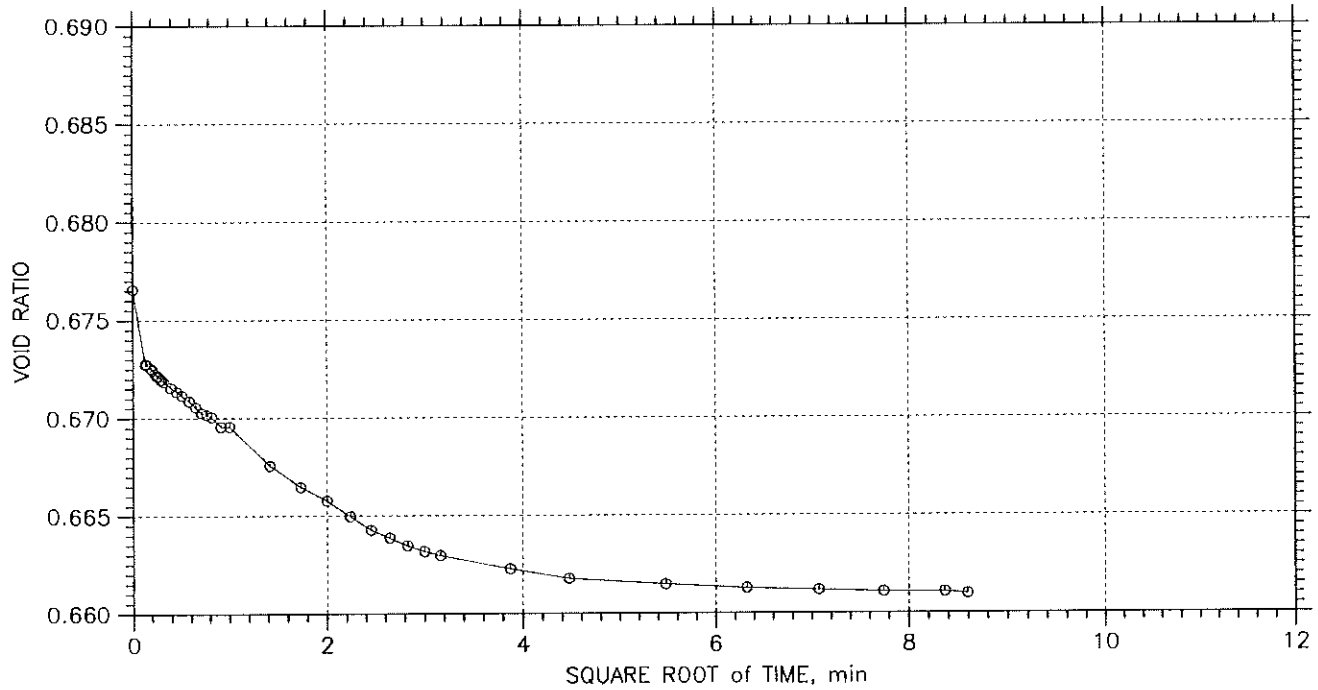
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 21 of 29

Stress: 3.25 tsf





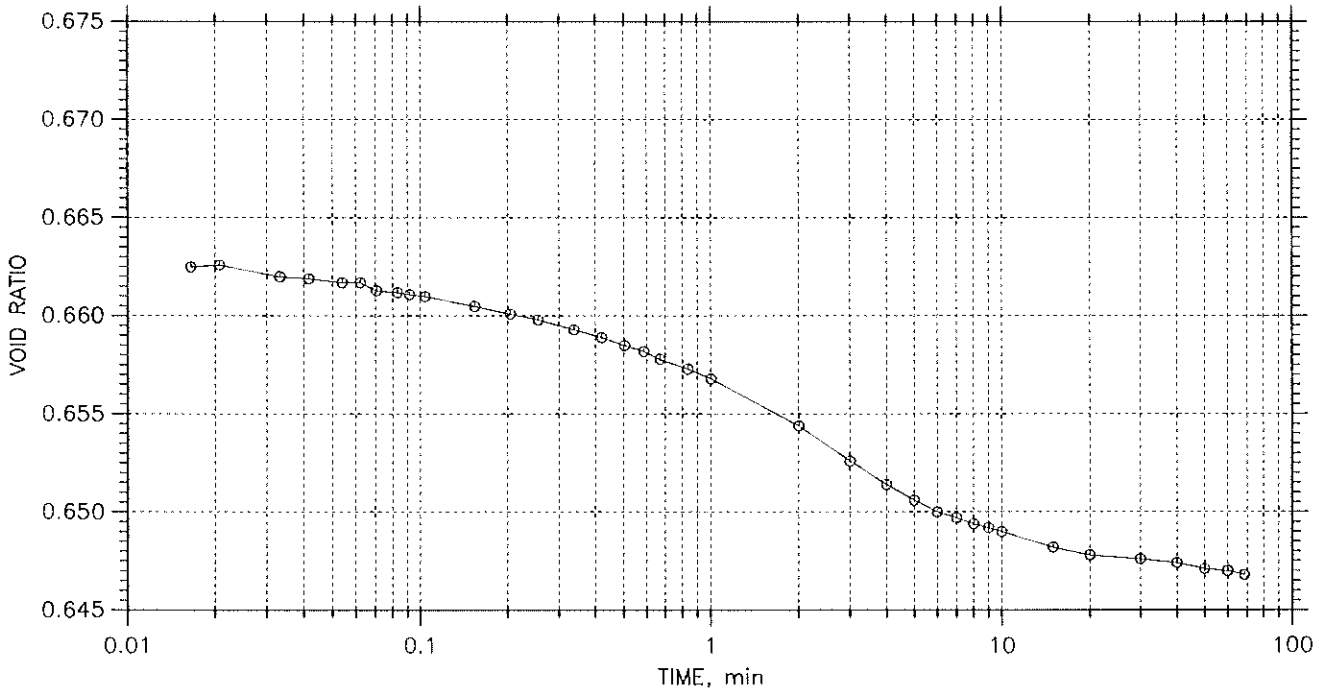
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

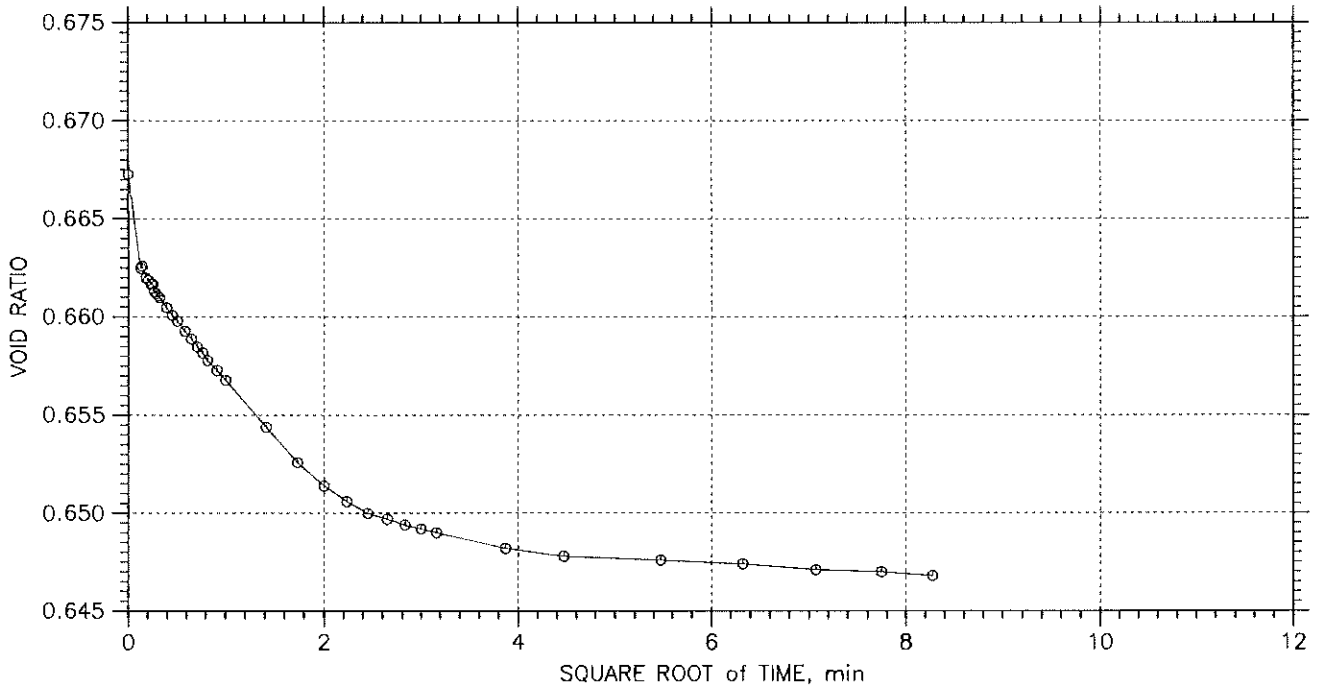
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 22 of 29

Stress: 7. tsf





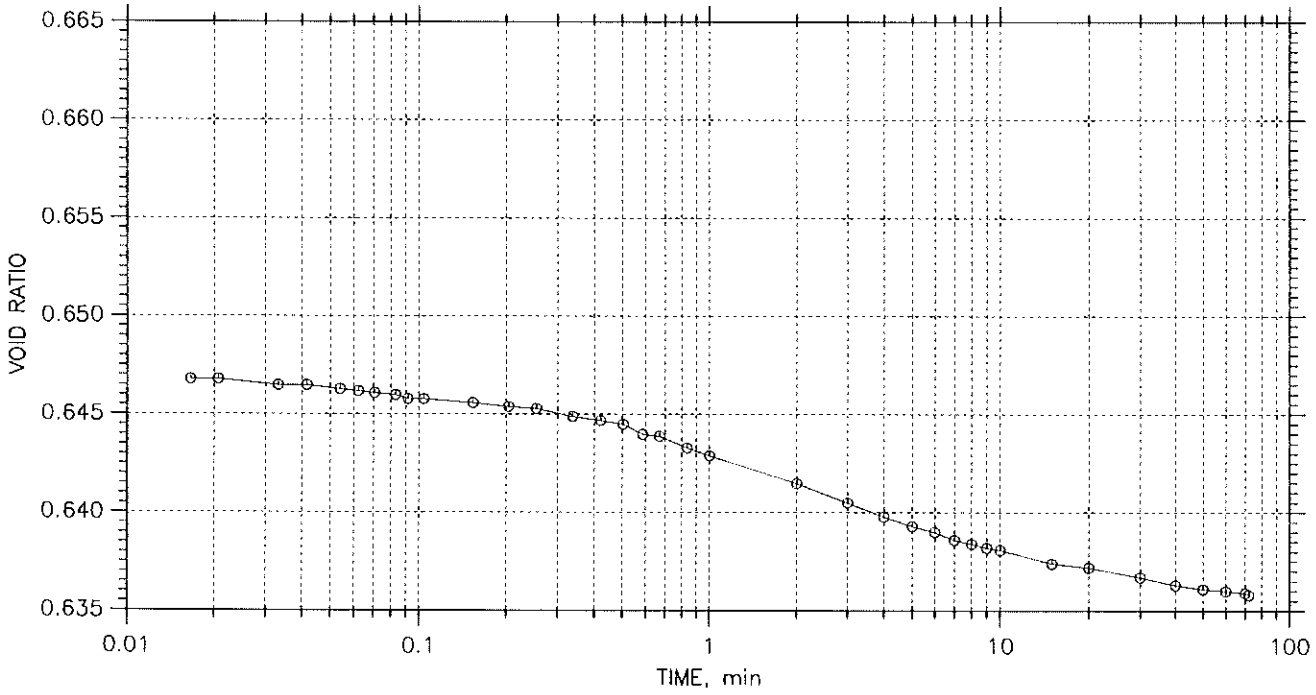
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

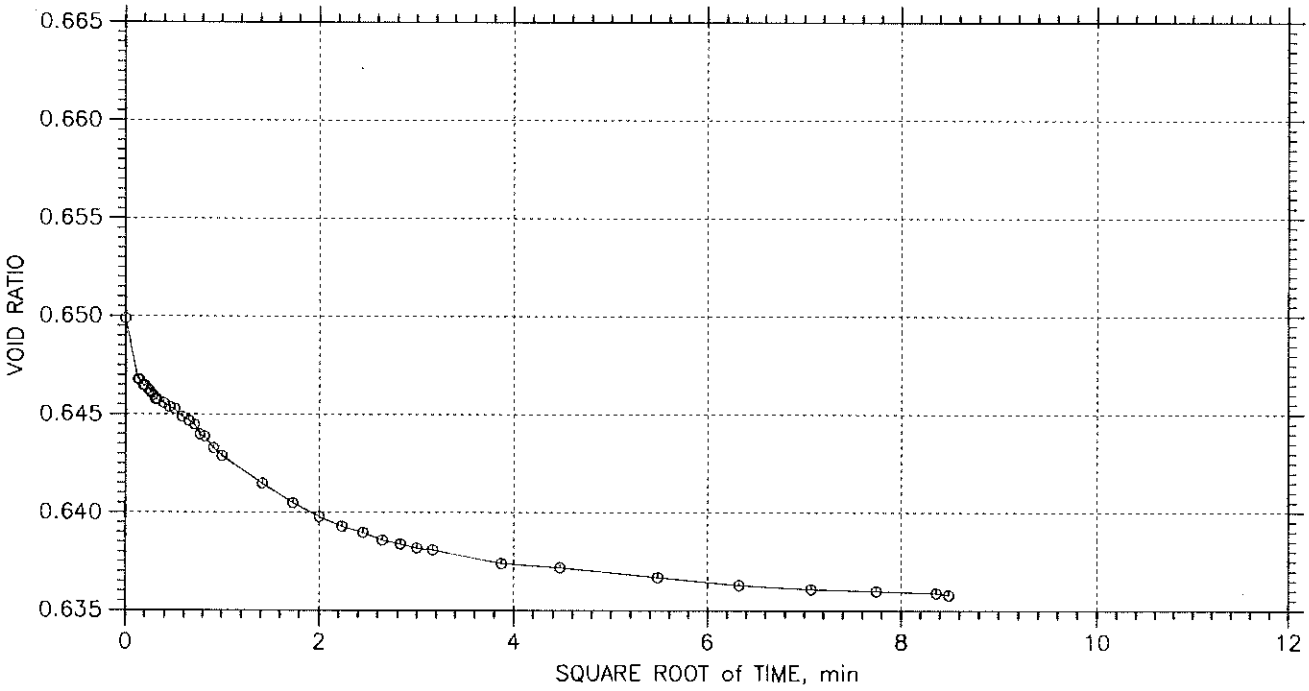
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 23 of 29

Stress: 10.25 tsf





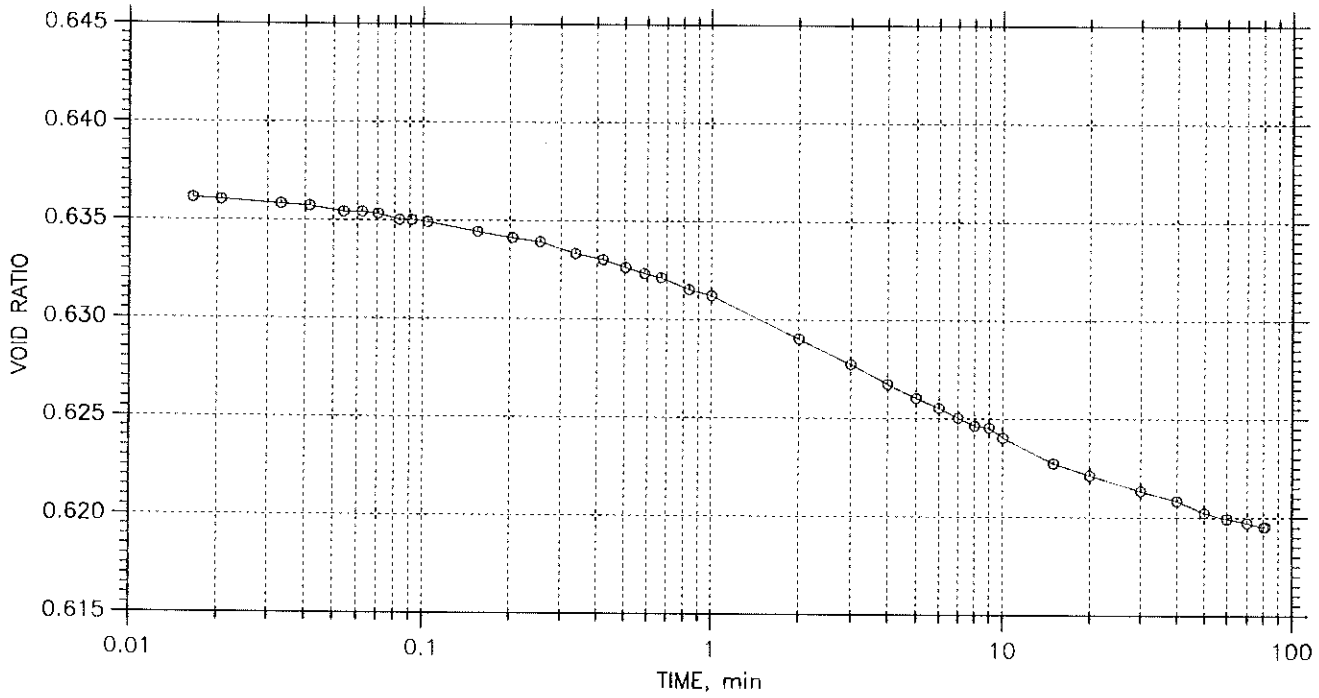
Project:	Locotion: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Somple No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remorks:		

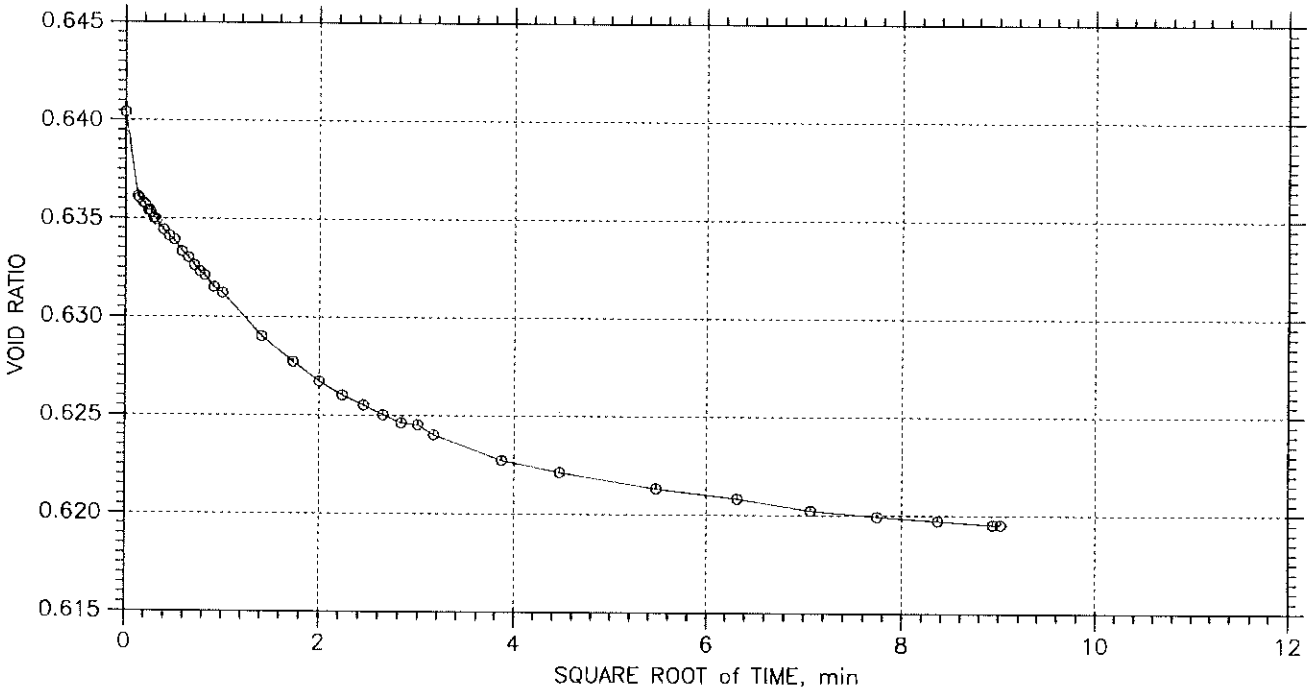
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 24 of 29

Stress: 15. tsf





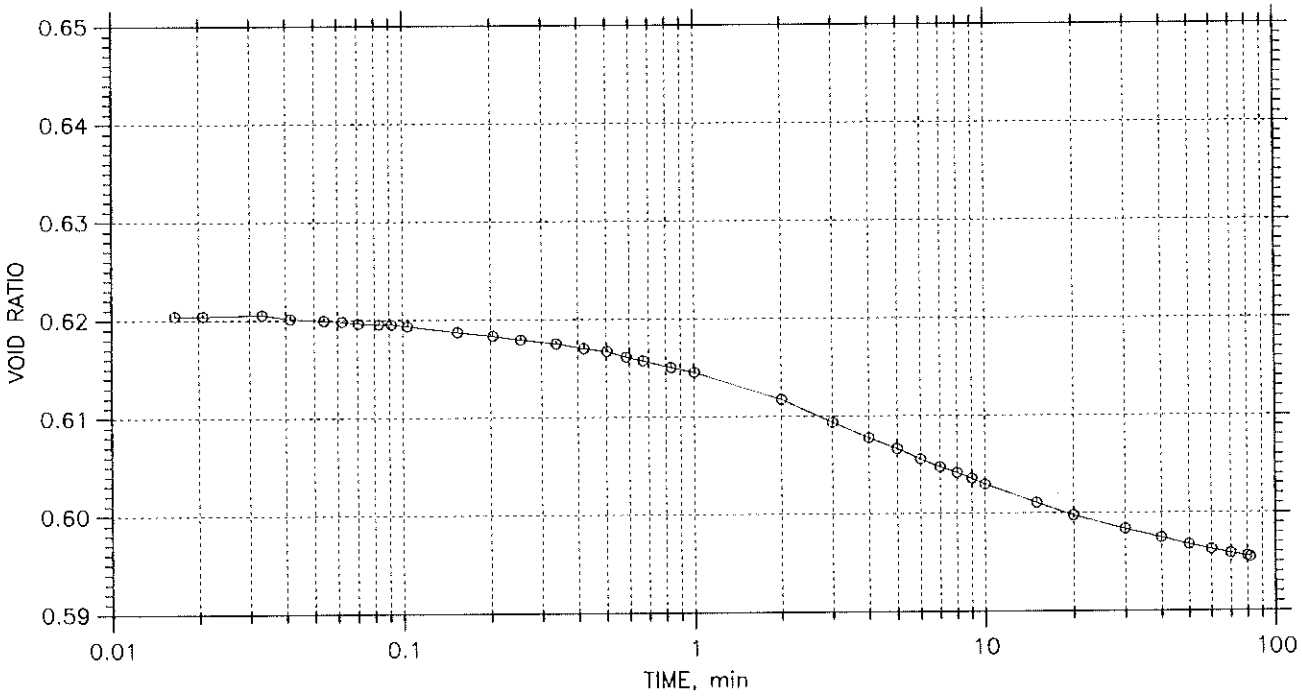
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

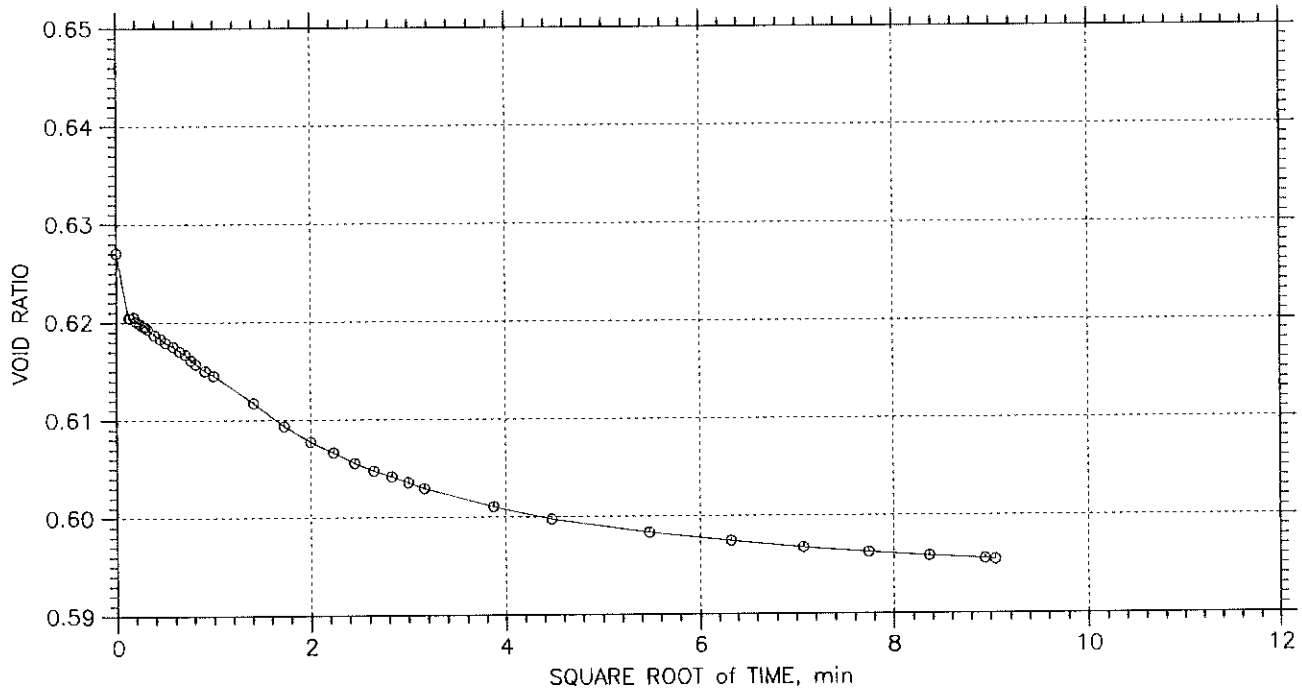
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 25 of 29

Stress: 22. tsf





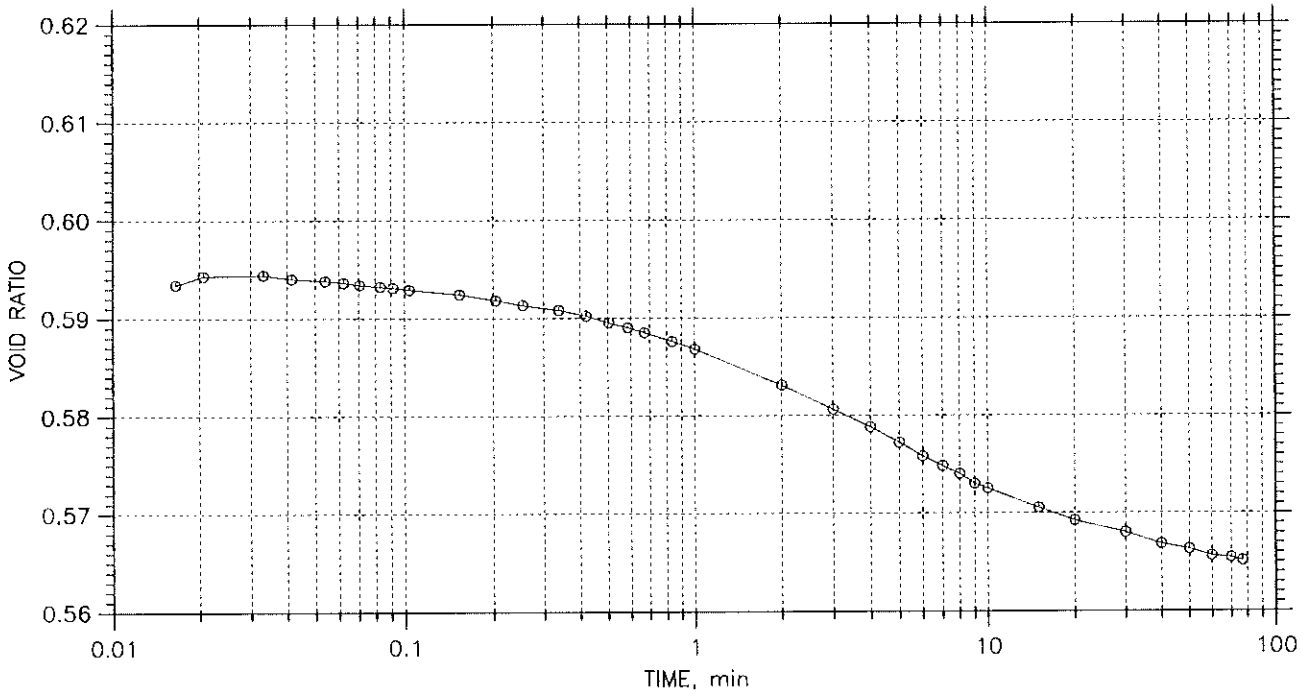
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

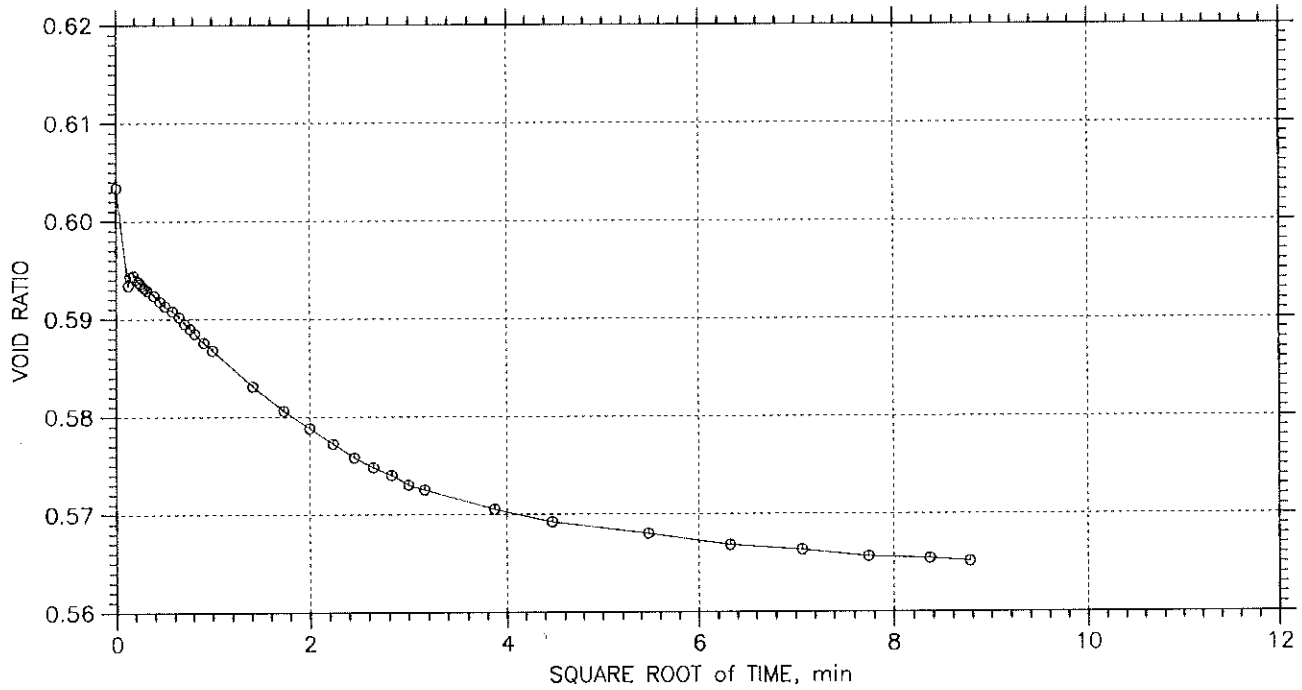
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 26 of 29

Stress: 32.25 tsf





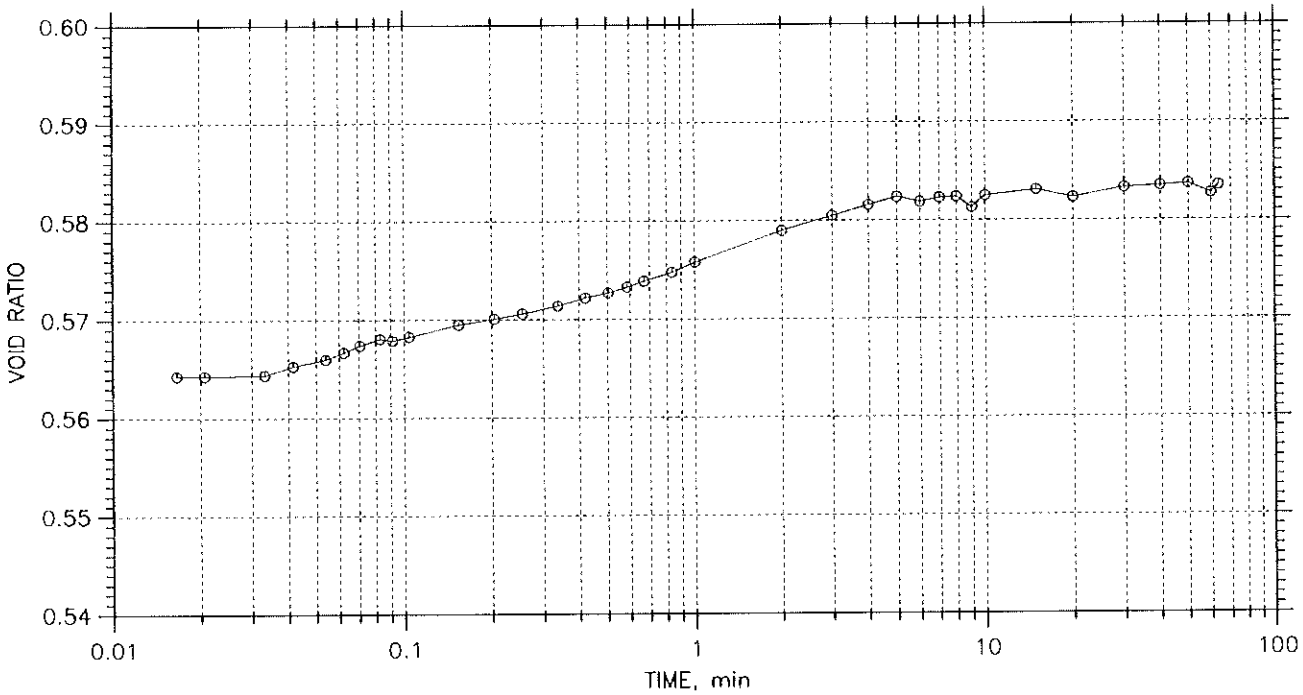
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

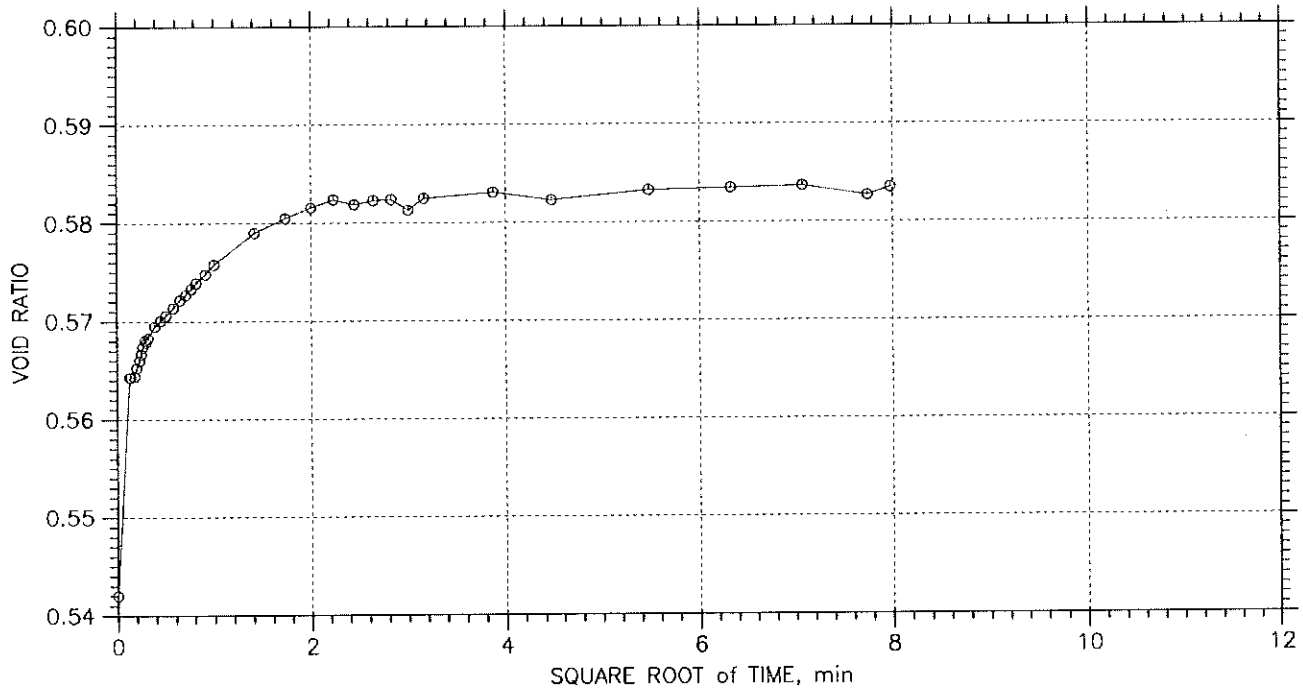
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 27 of 29

Stress: 7. tsf





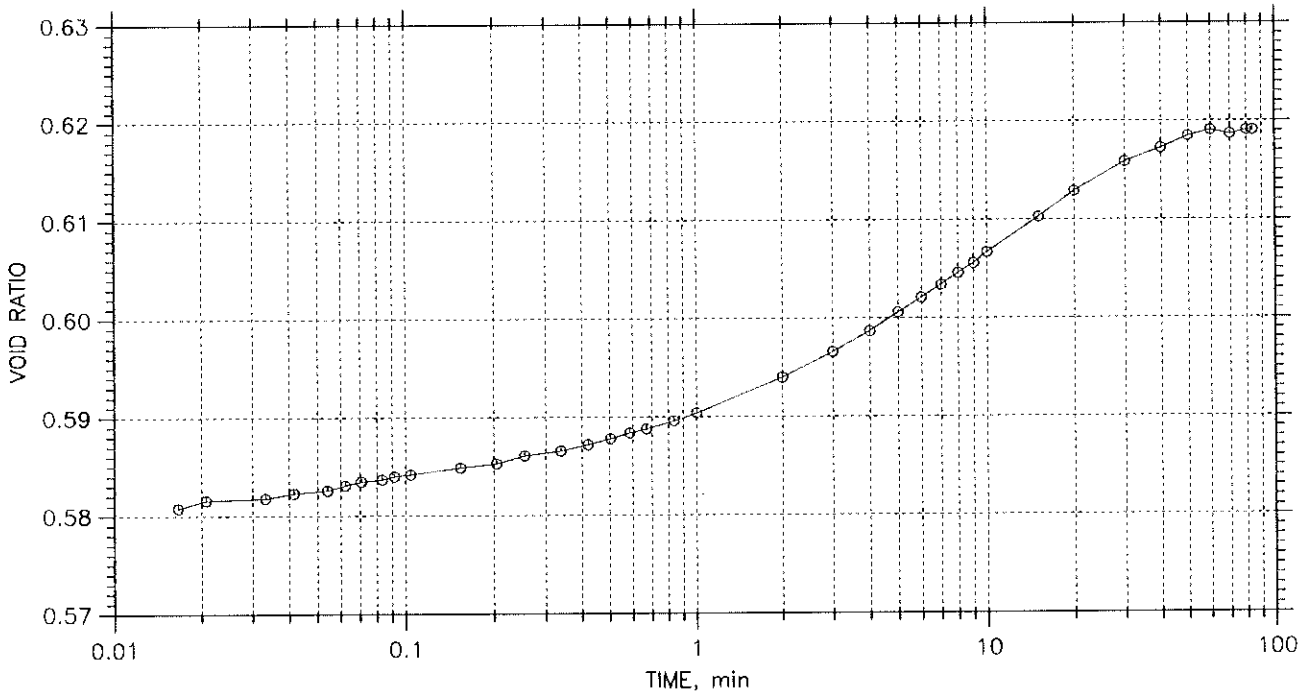
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

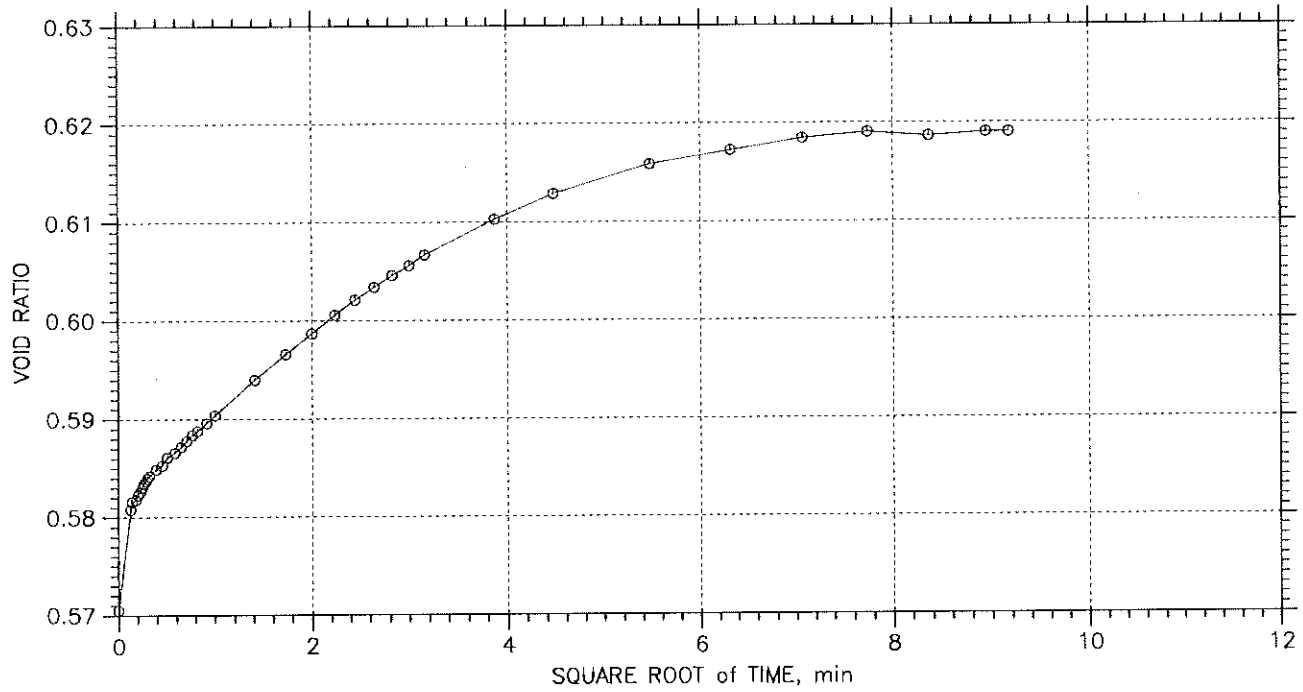
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 28 of 29

Stress: 1. tsf





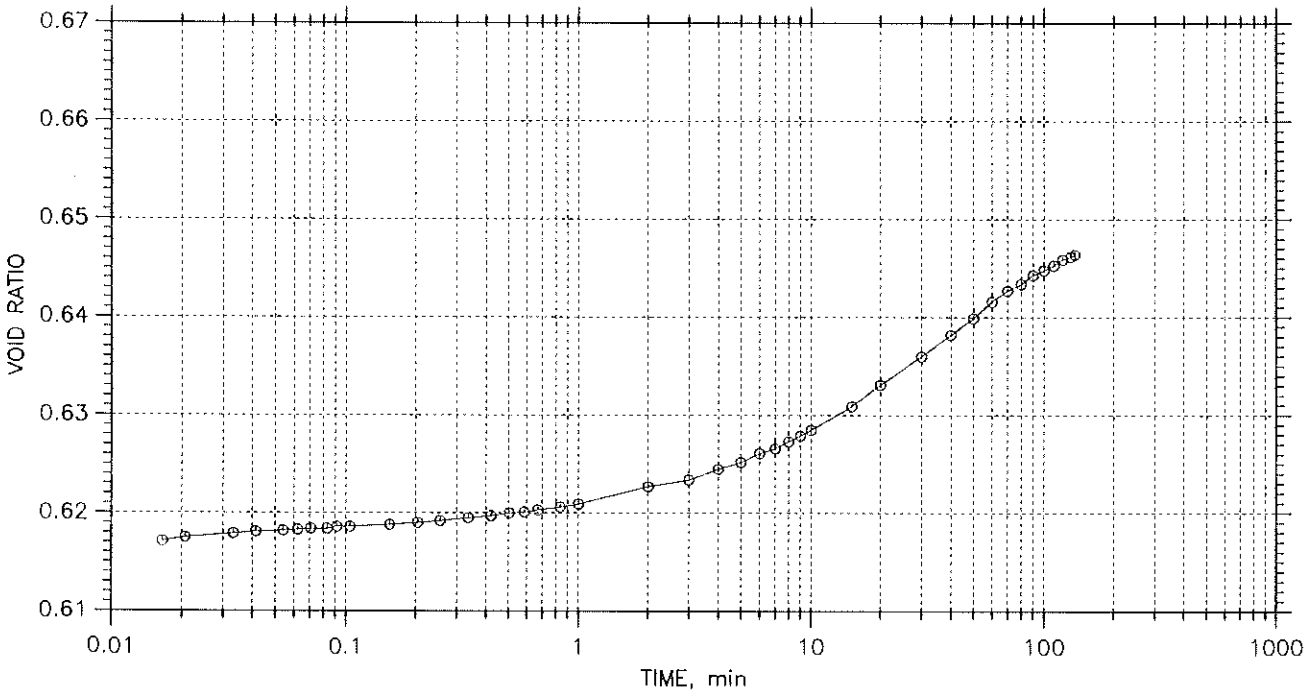
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Dote: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remorks:		

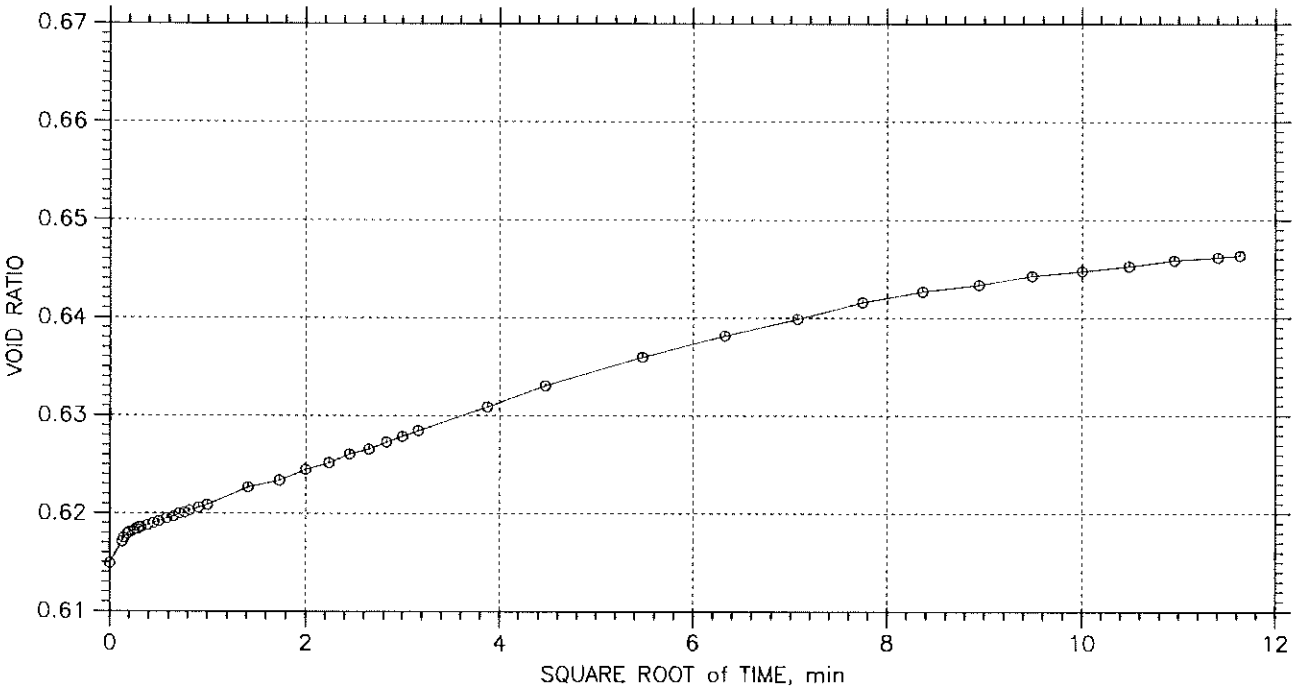
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 29 of 29

Stress: 0.25 tsf



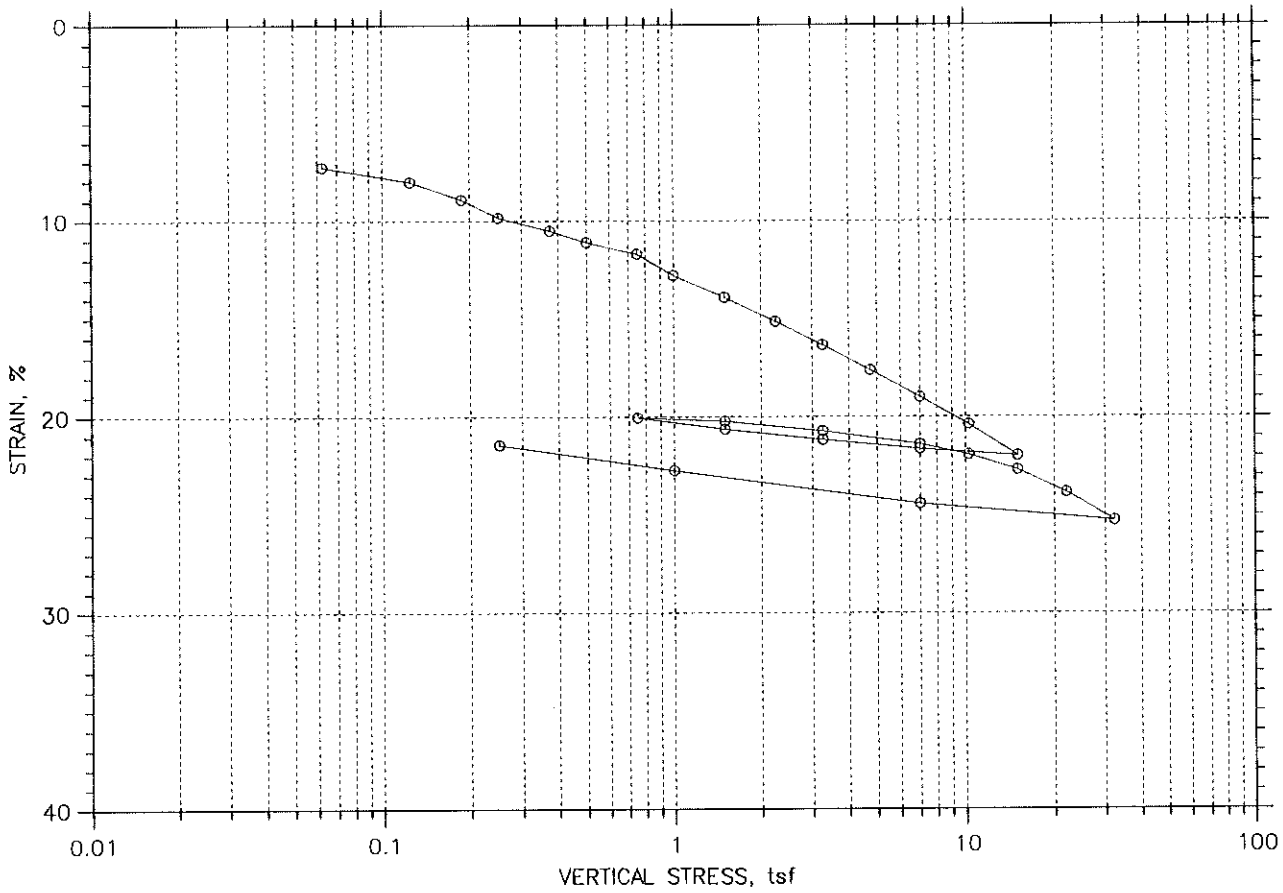


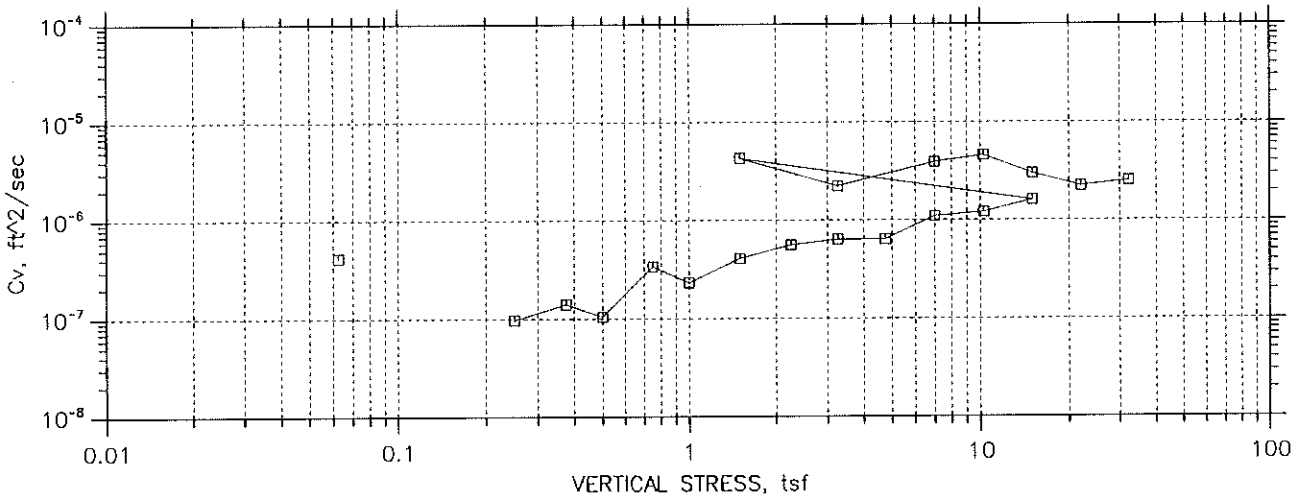
Project:	Locotion: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevotion: ---
Description: GRAY CLAY		
Remarks:		

Tue, 03-JUN-2008 09:40:11

CONSOLIDATION TEST DATA

SUMMARY REPORT

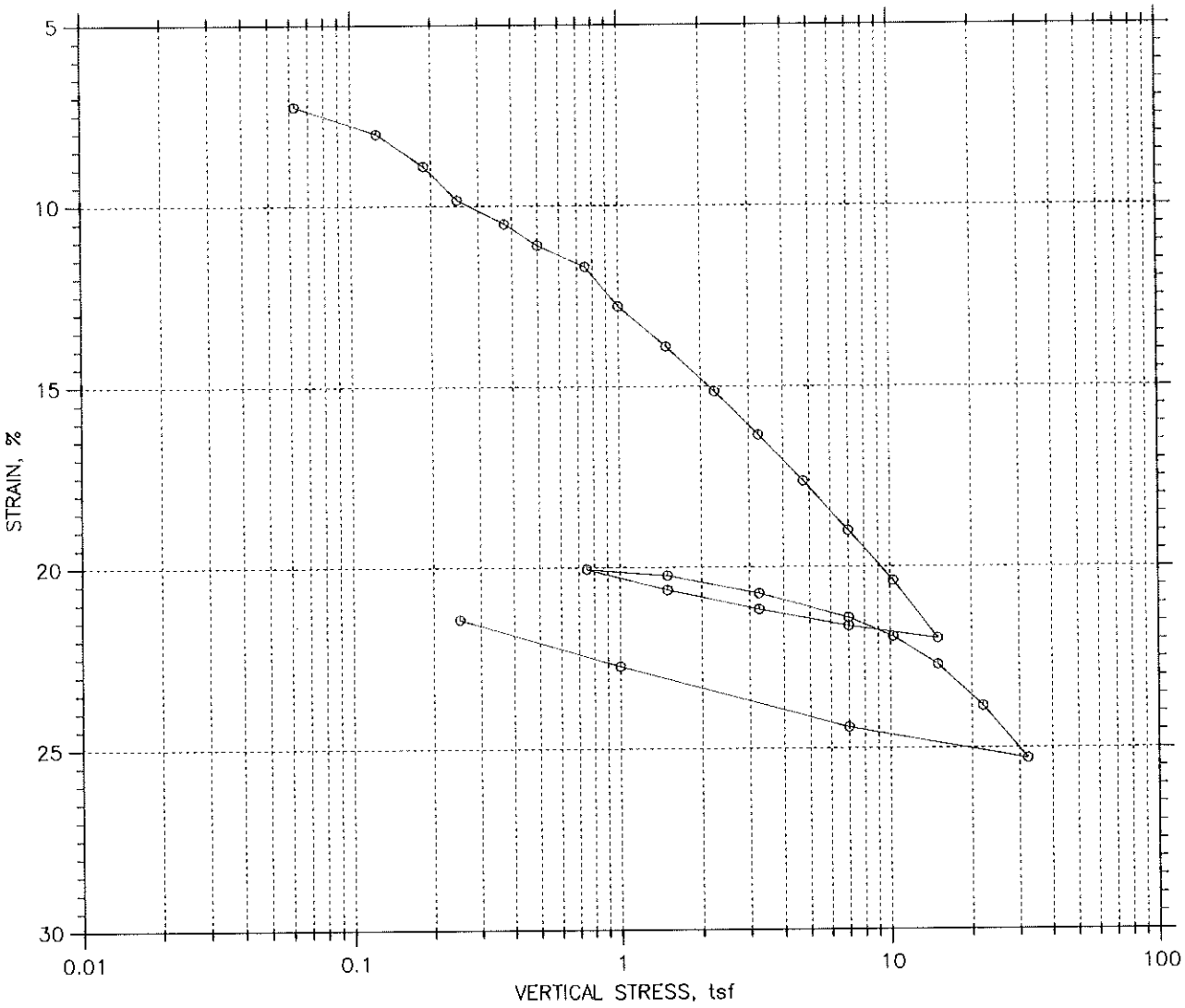




Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

CONSOLIDATION TEST DATA

SUMMARY REPORT



				Before Test	After Test
Overburden Pressure, tsf:				Water Content, %	35.47	23.42
Preconsolidation Pressure, tsf:				Dry Unit Weight, pcf	82.232	104.66
Compression Index:				Saturation, %	89.39	100.00
Diameter: 2.485 in		Height: 1.063 in		Void Ratio	1.10	0.65
LL: 34	PL: 20	PI: 14	GS: 2.76			

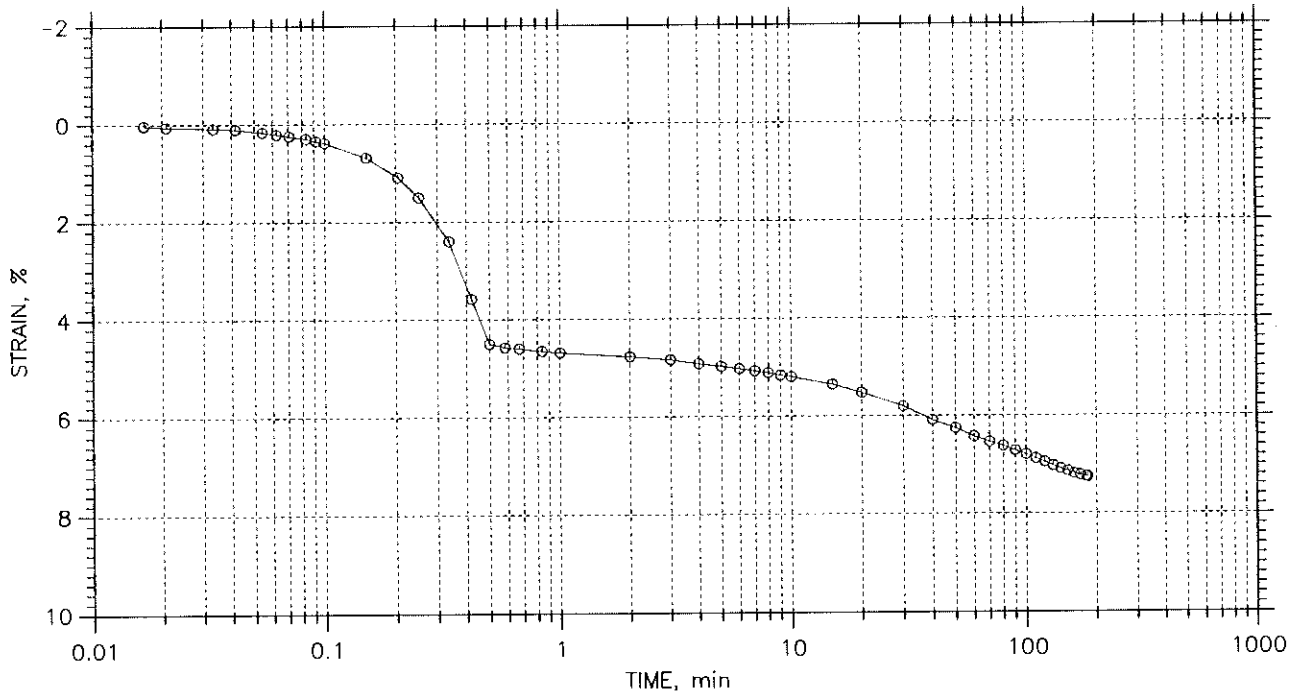
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

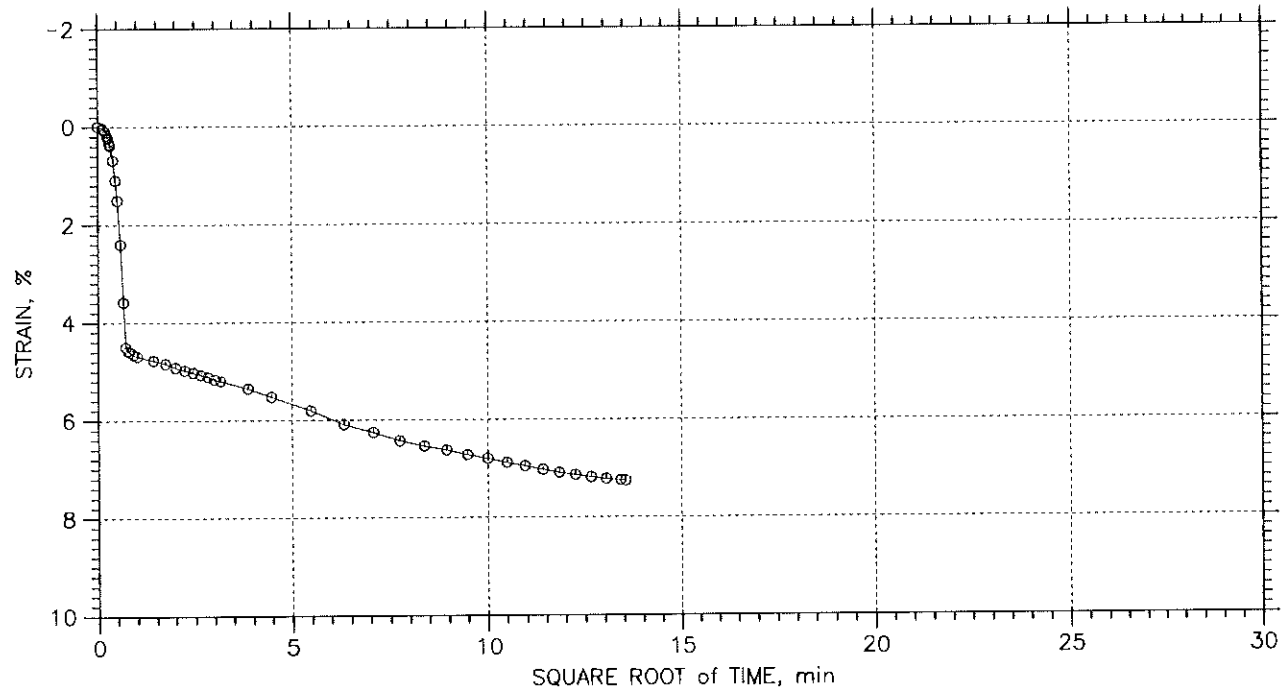
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 1 of 29

Stress: 6.25e-002 tsf





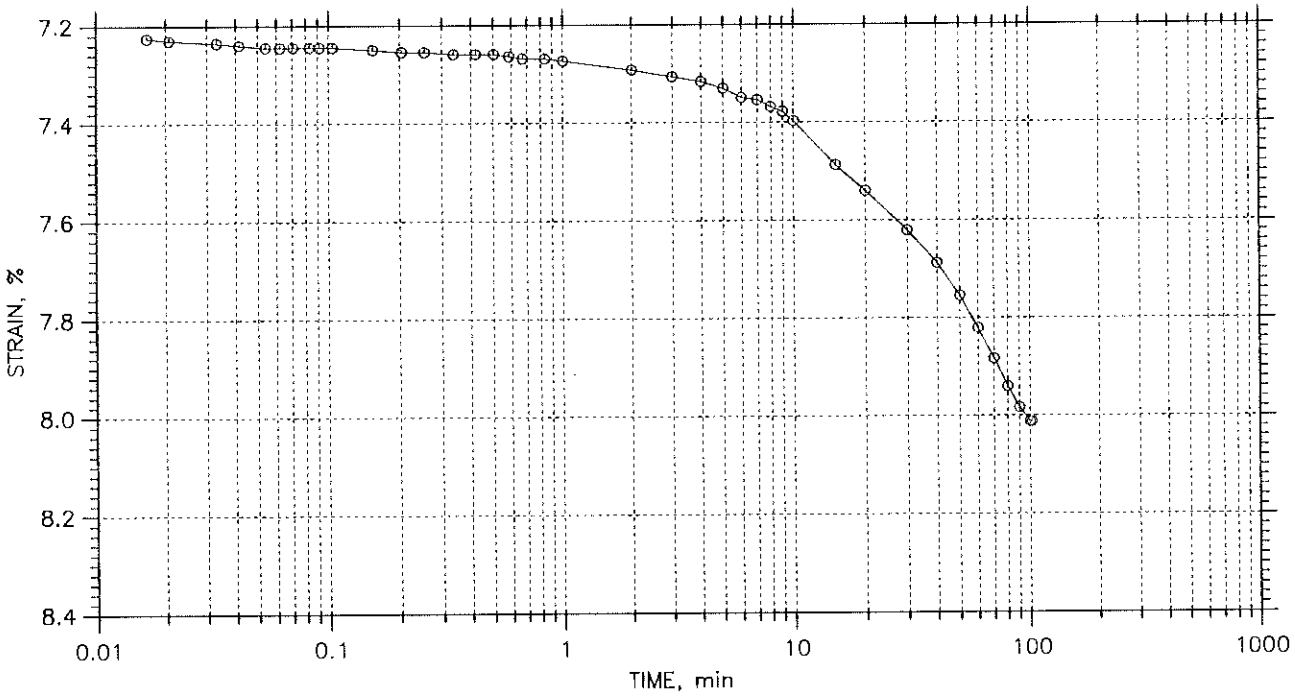
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

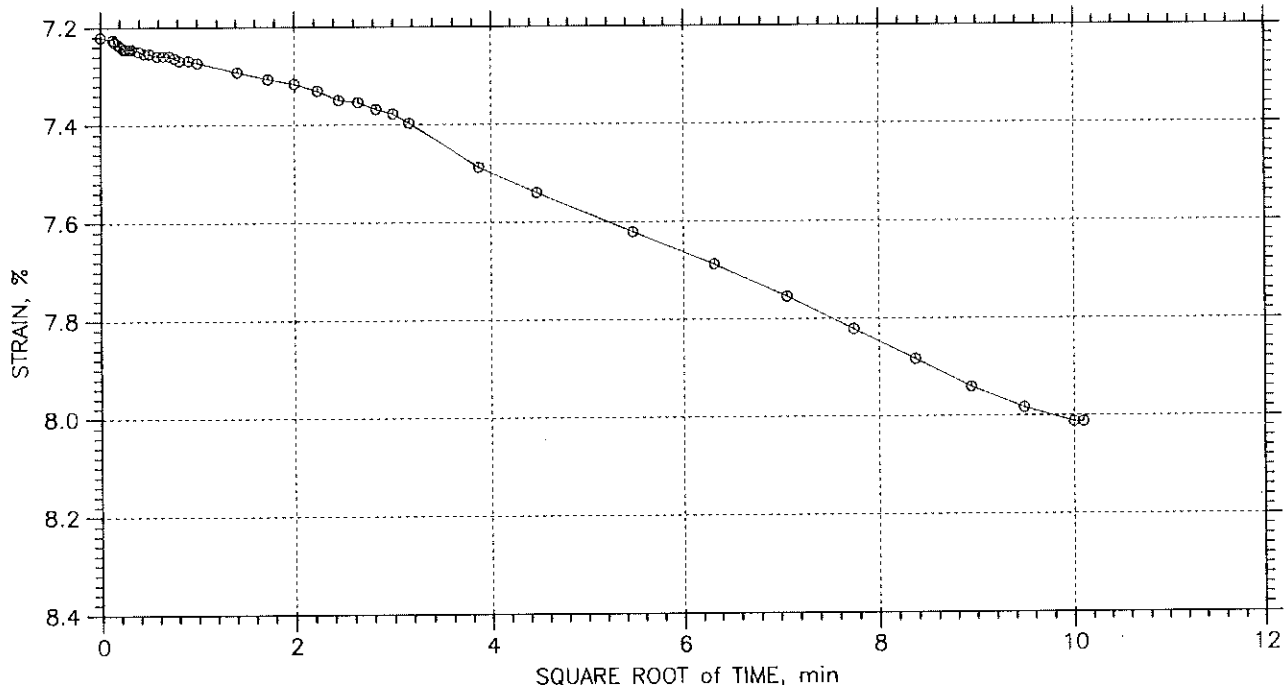
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 2 of 29

Stress: 0.125 tsf





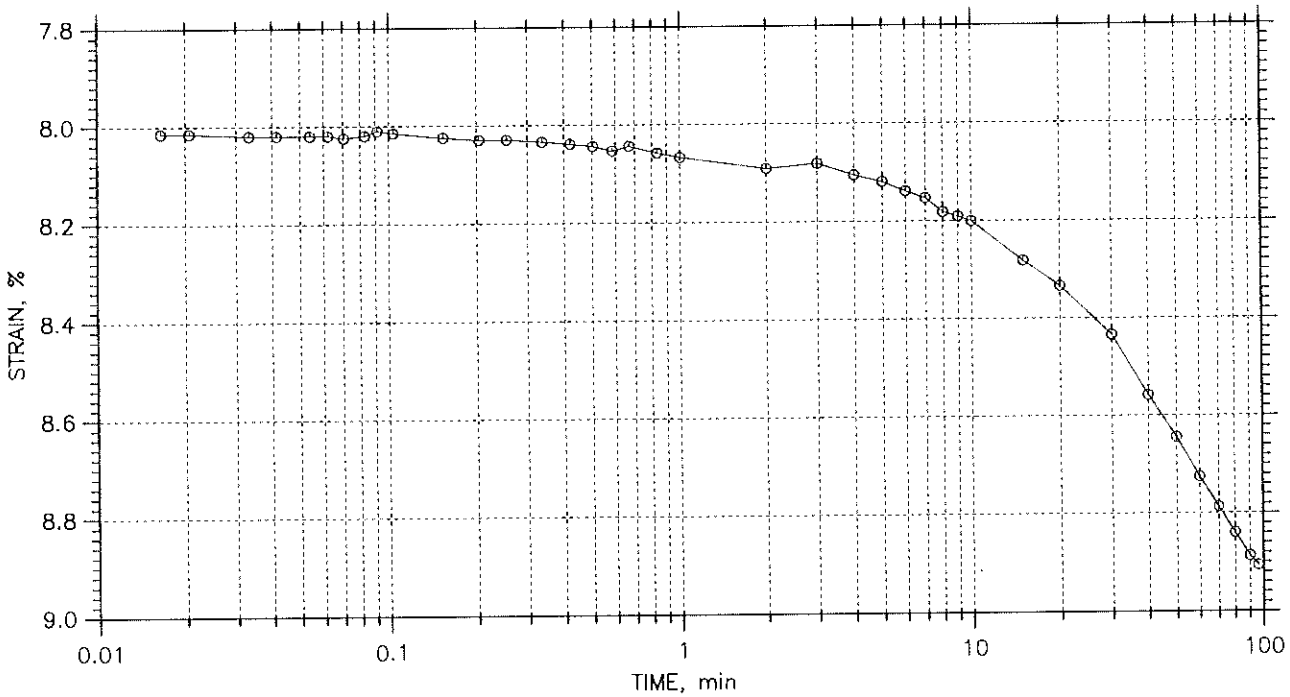
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

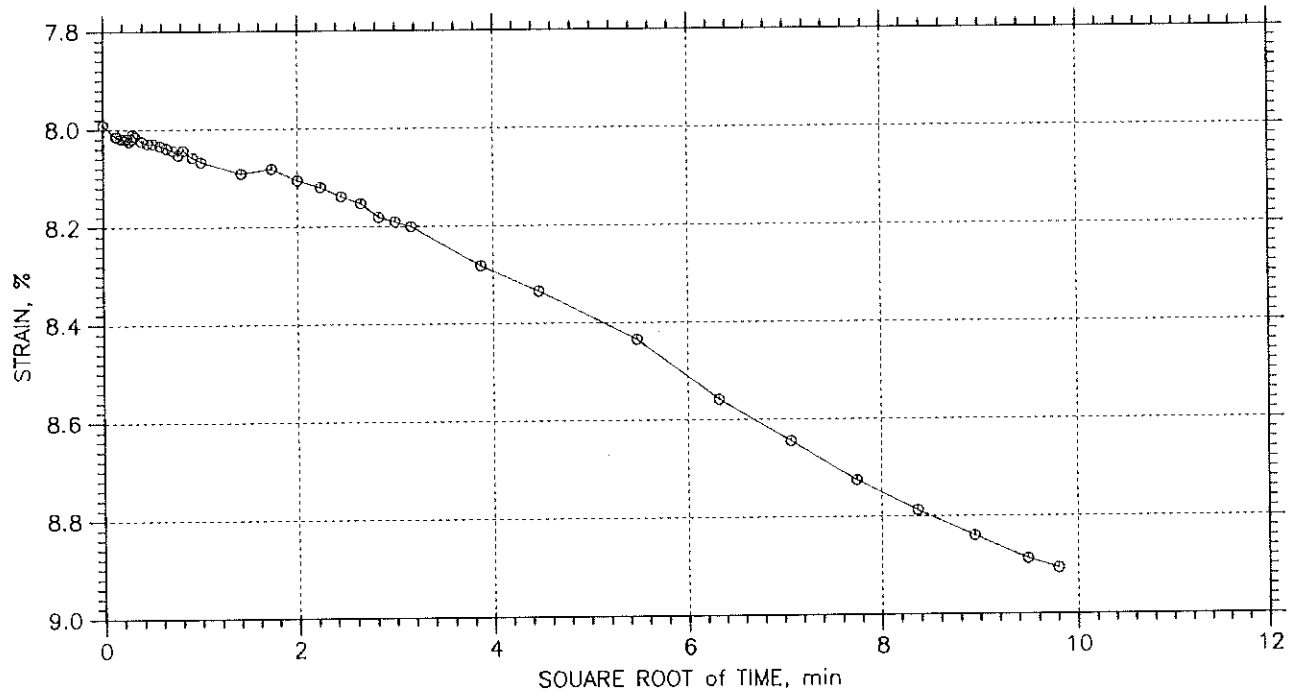
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 3 of 29

Stress: 0.1875 tsf





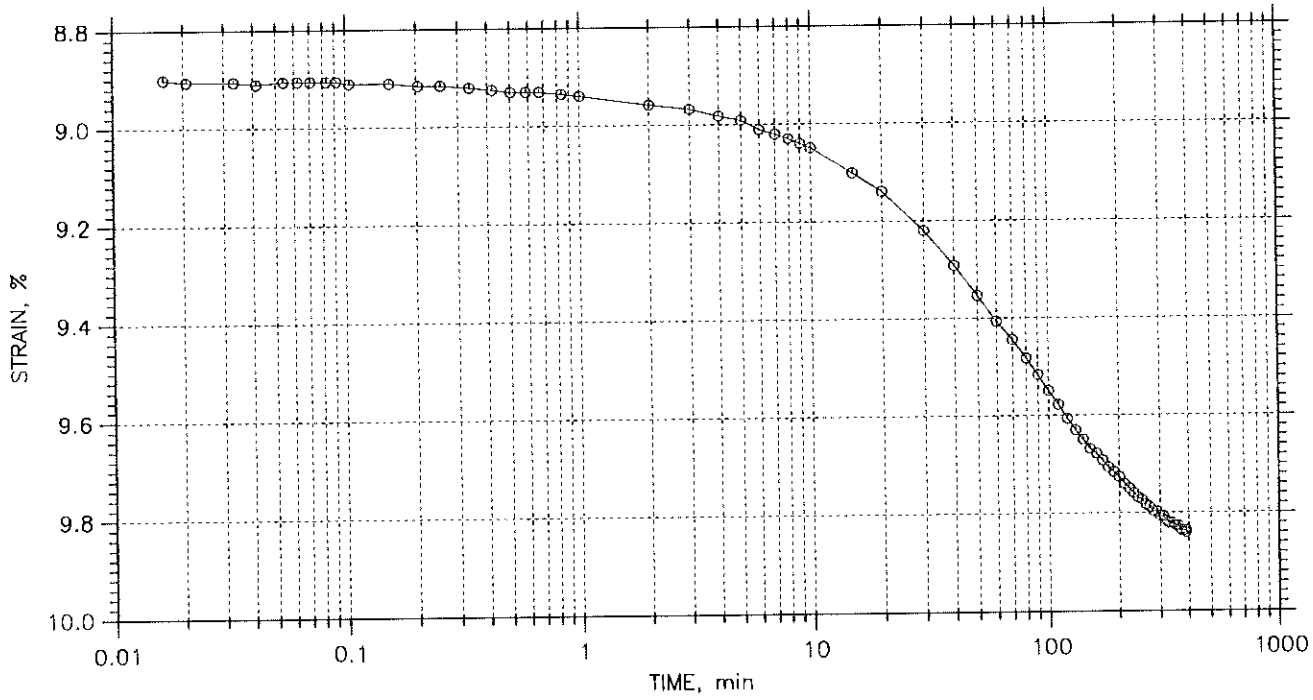
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

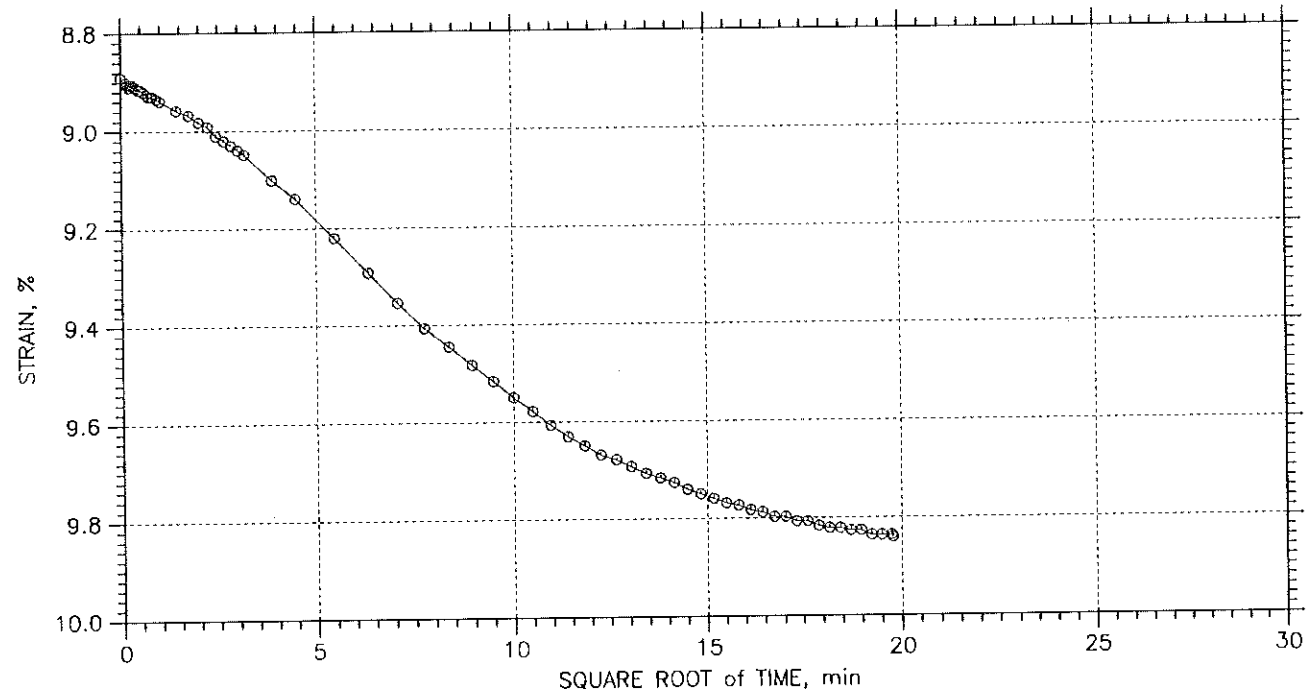
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 4 of 29

Stress: 0.25 tsf





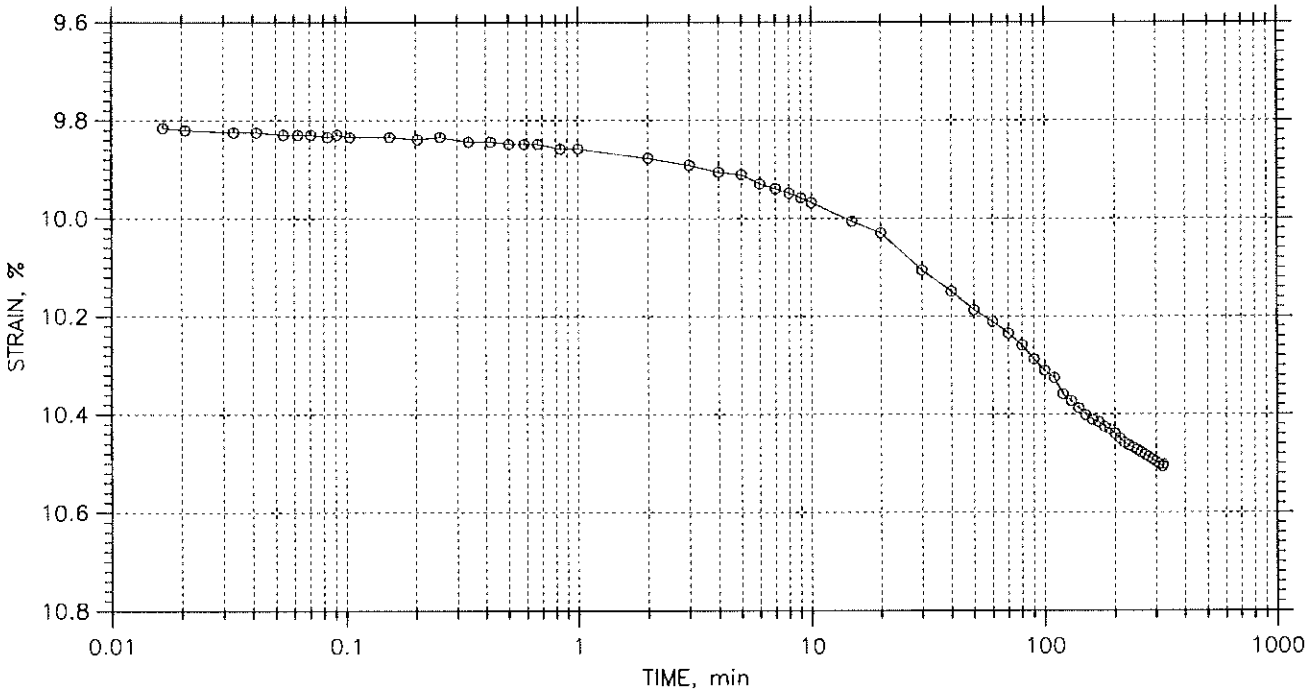
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

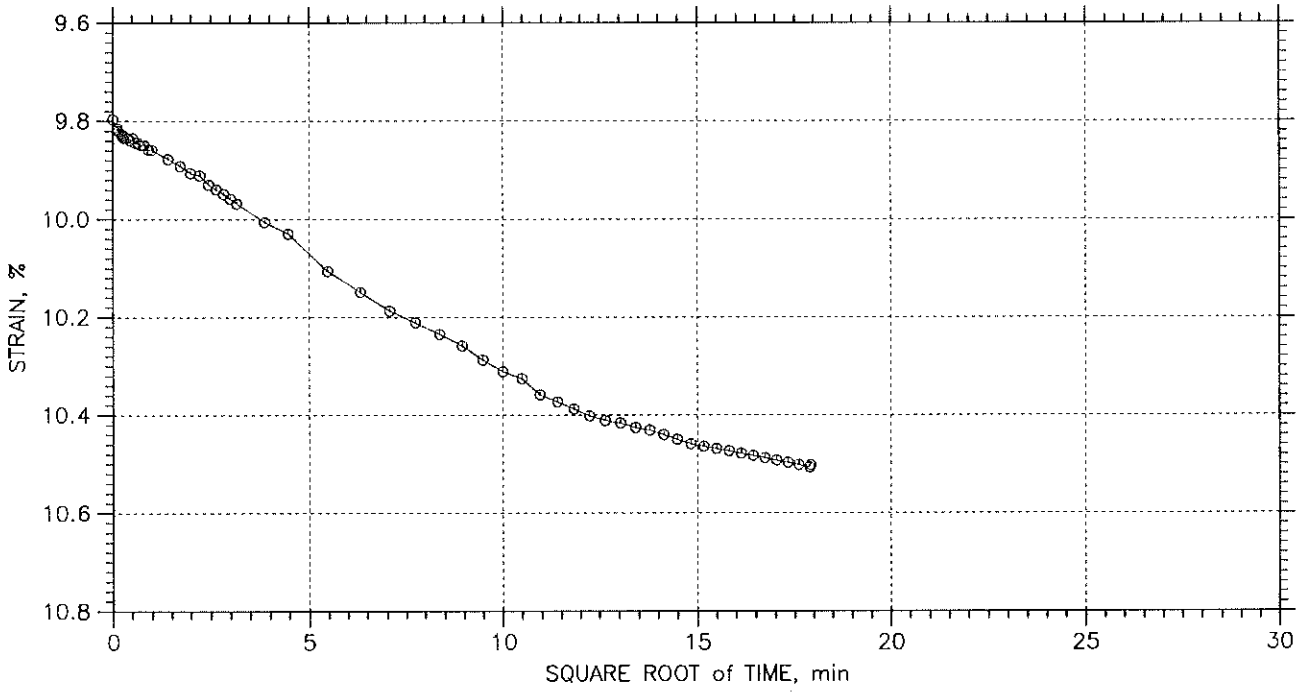
CONSOLIDATION TEST DATA

TIME CURVES

Constant Laad Step: 5 of 29

Stress: 0.375 tsf





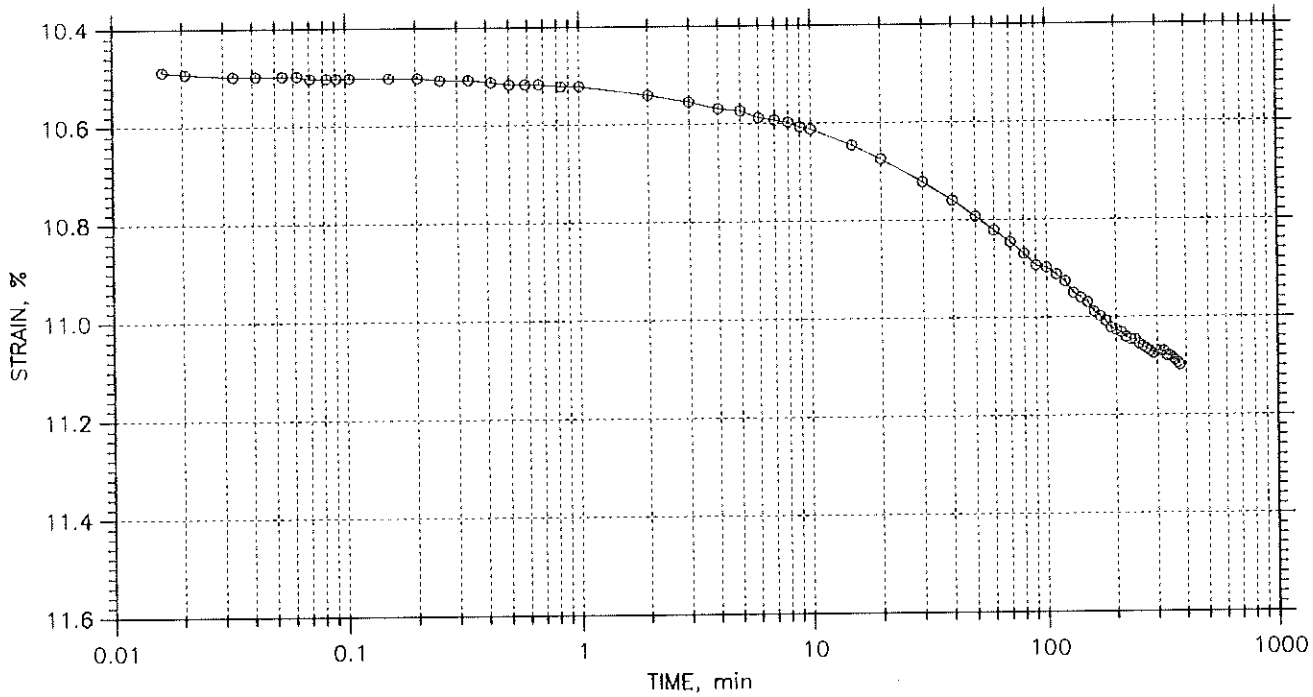
Project:	Locotion: GORHAM	Project No.: 010801.00
Baring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevotion: ---
Description: GRAY CLAY		
Remarks:		

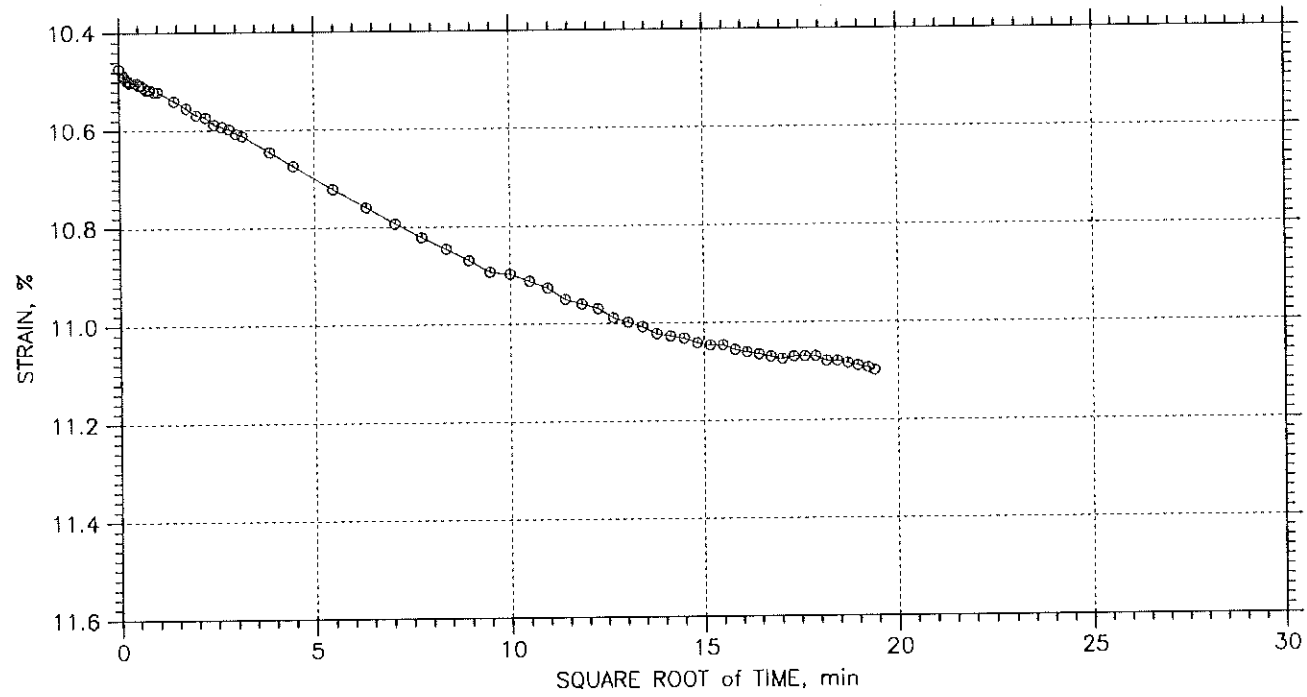
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 6 of 29

Stress: 0.5 tsf





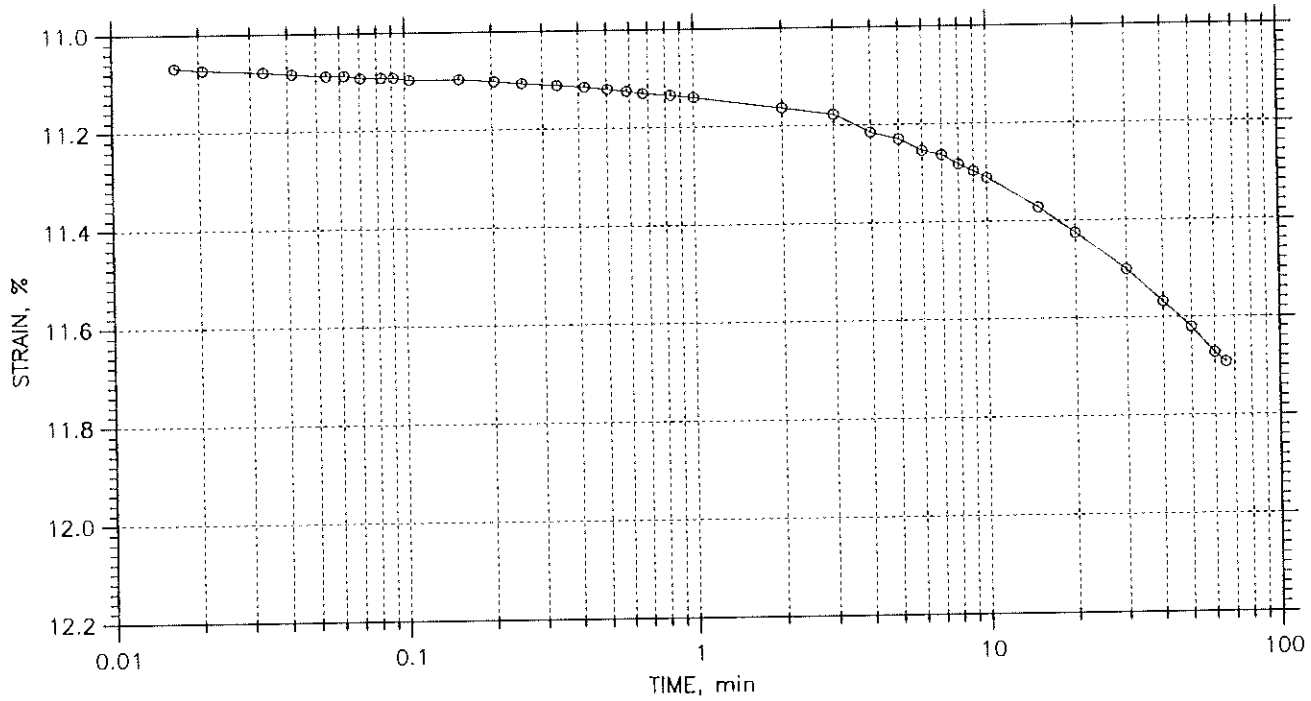
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

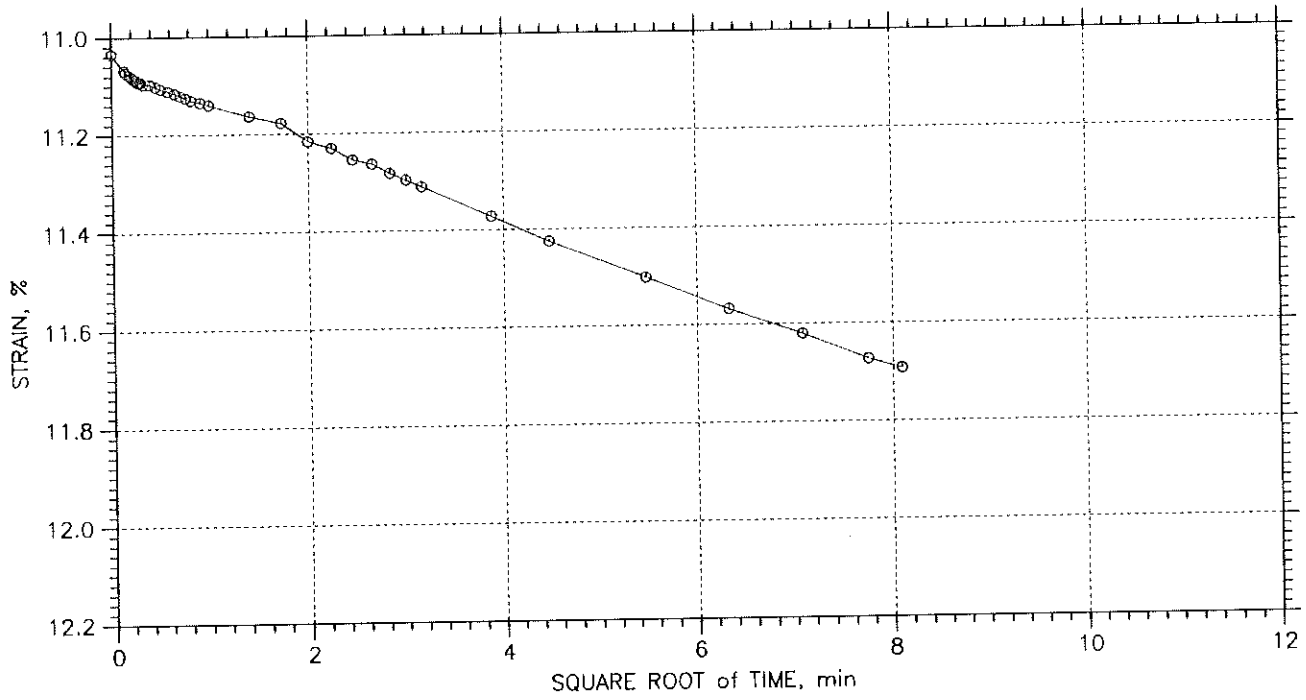
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 7 of 29

Stress: 0.75 tsf





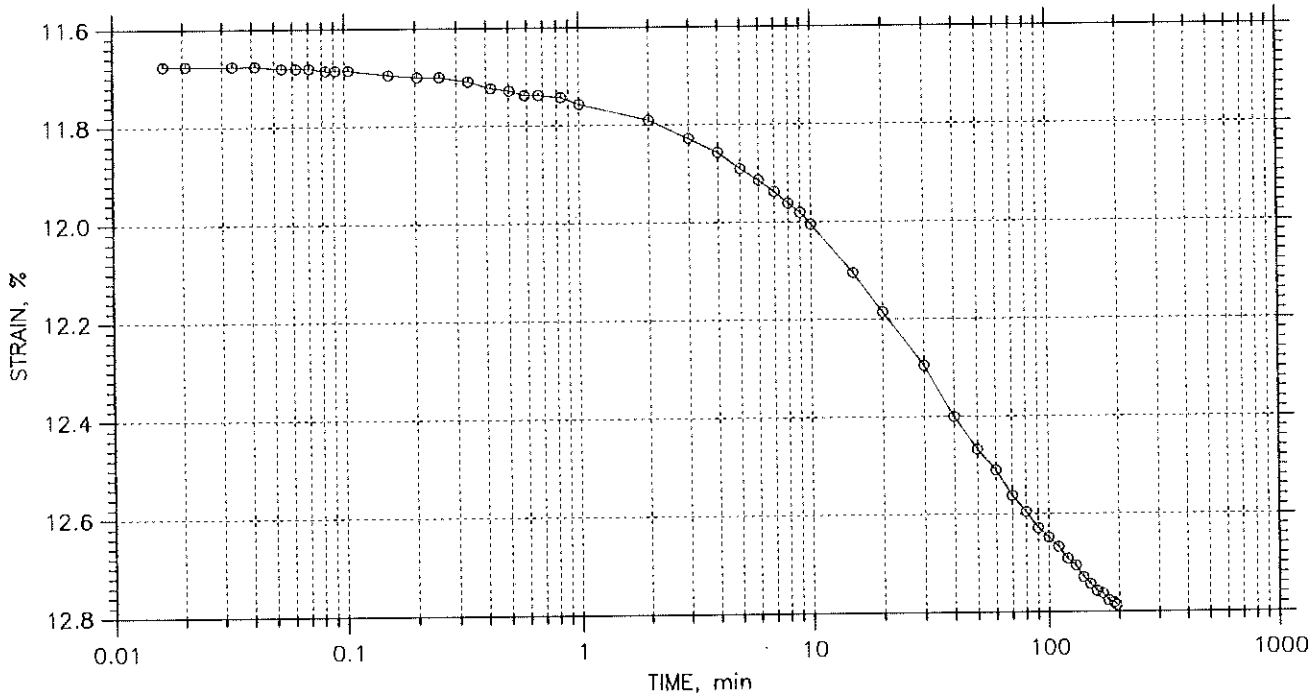
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

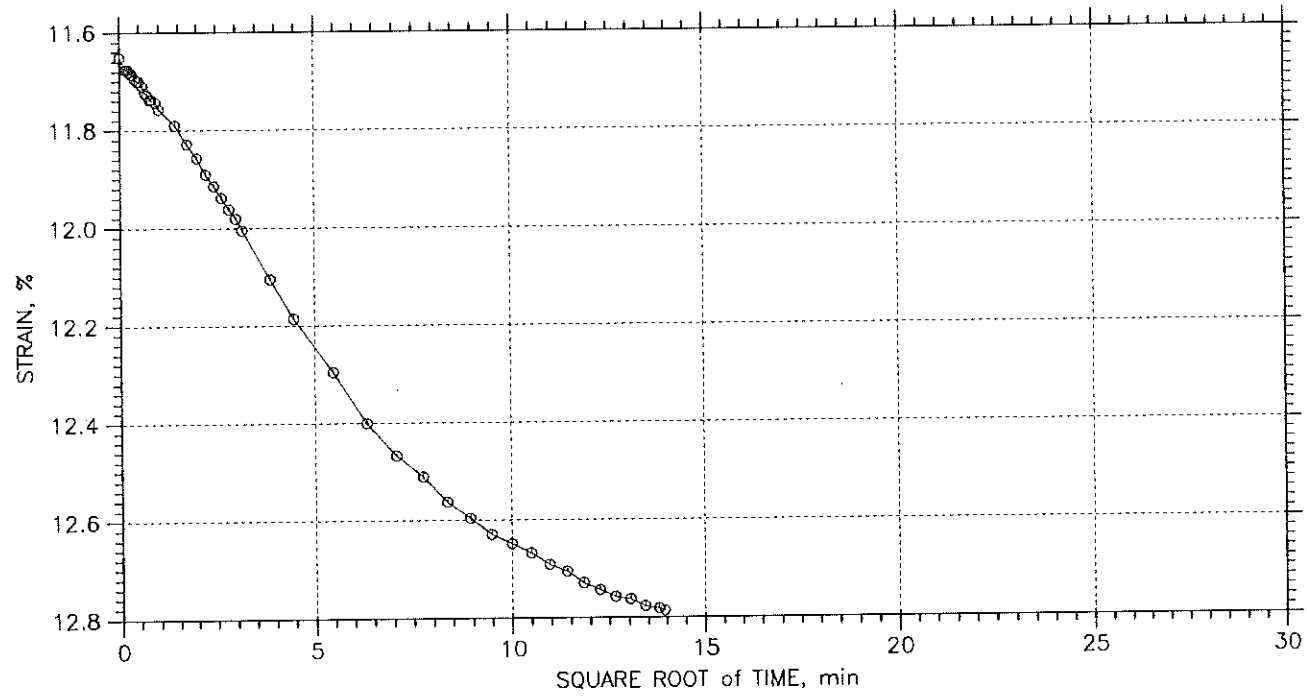
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 8 of 29

Stress: 1. tsf





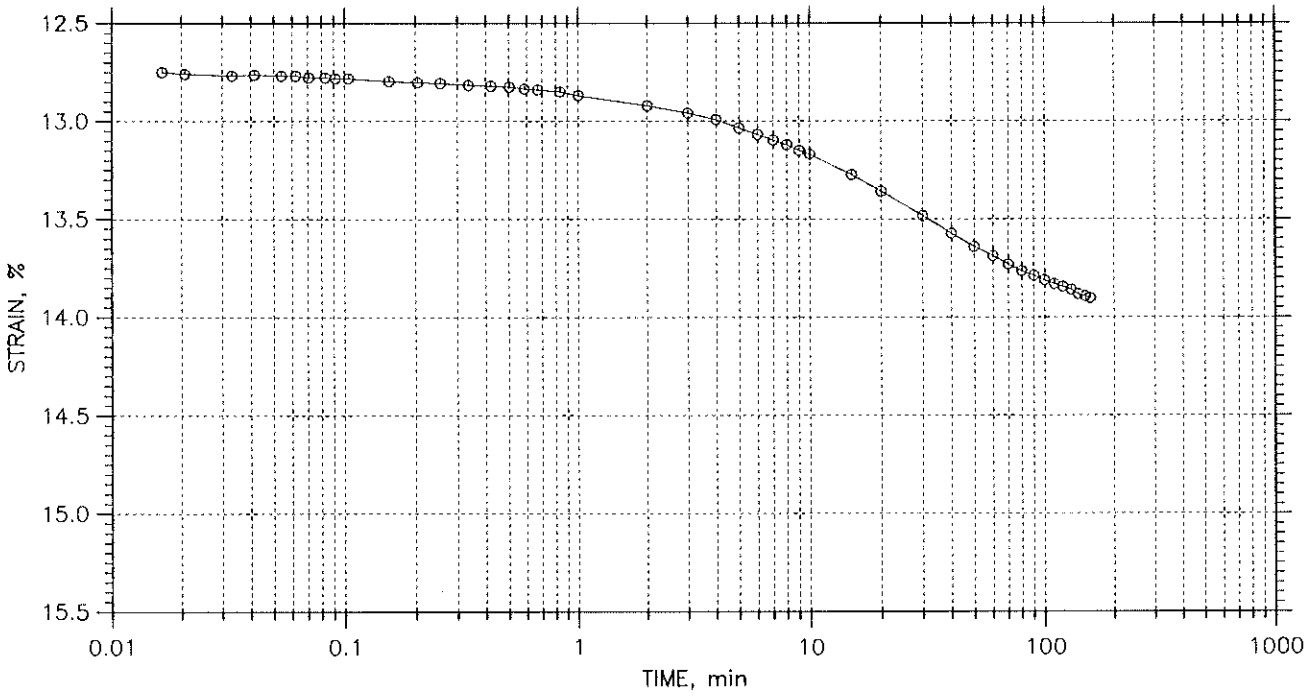
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

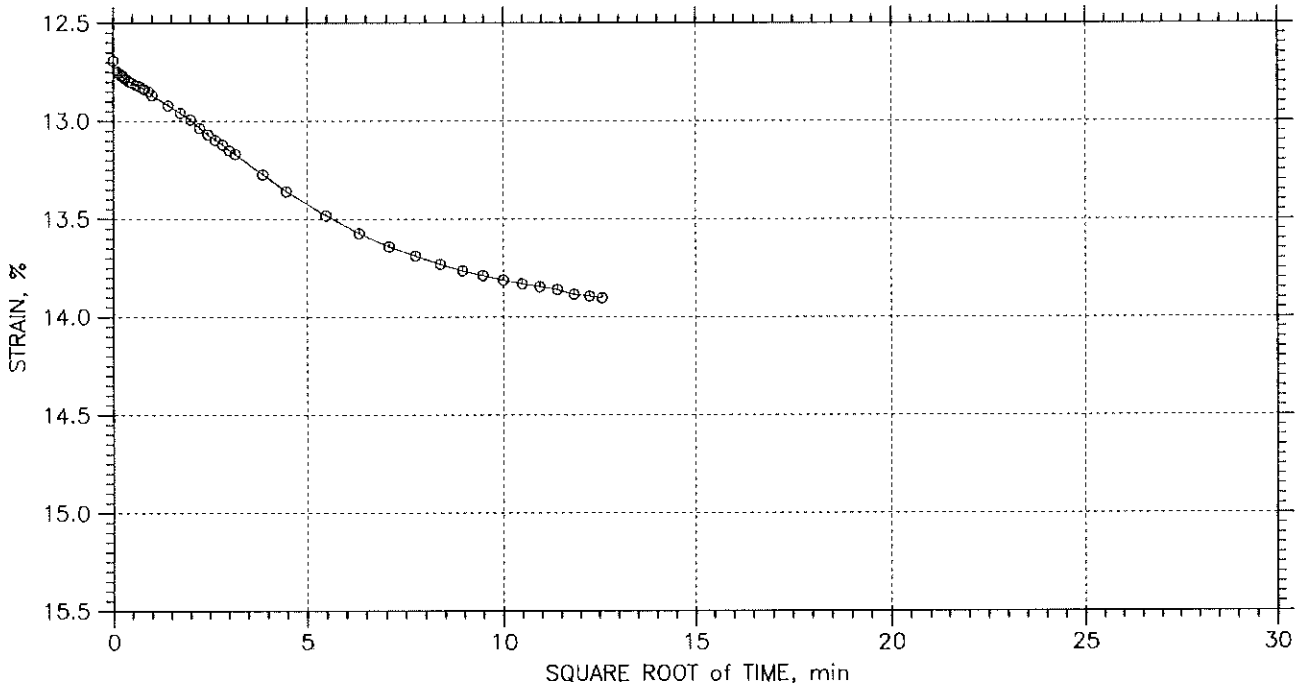
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 9 of 29

Stress: 1.5 tsf





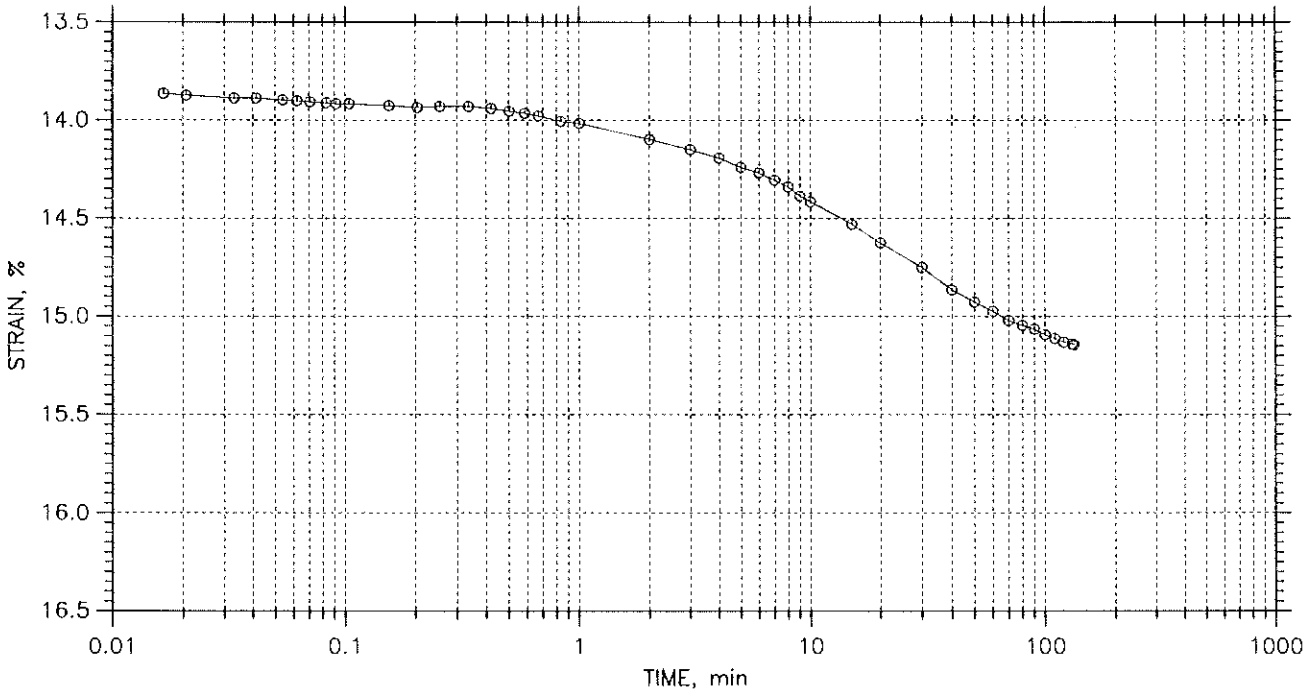
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

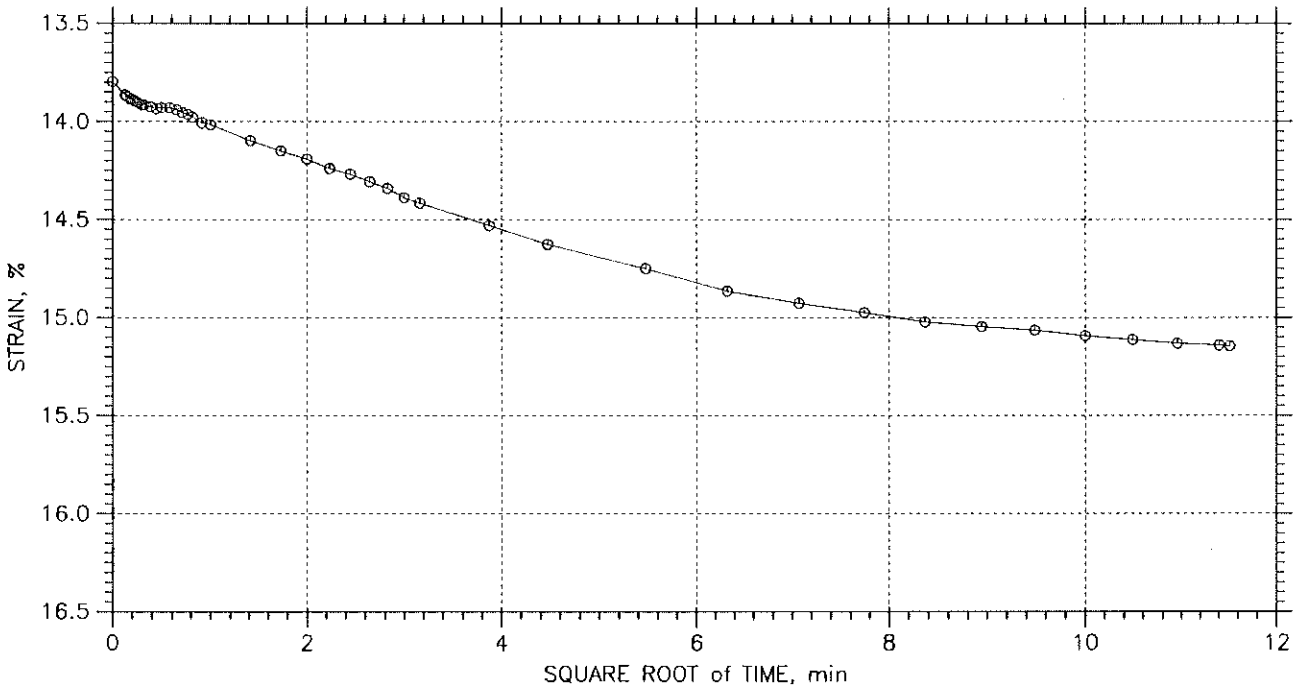
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 10 of 29

Stress: 2.25 tsf





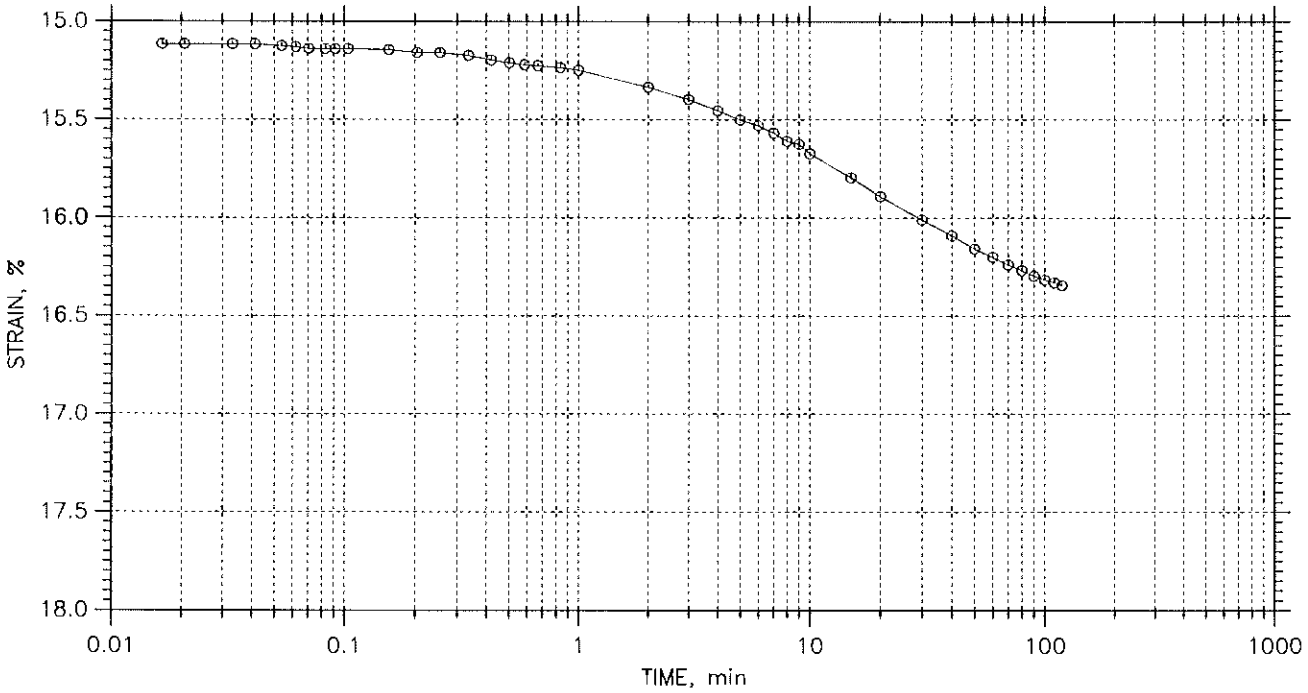
Project:	Locotion: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

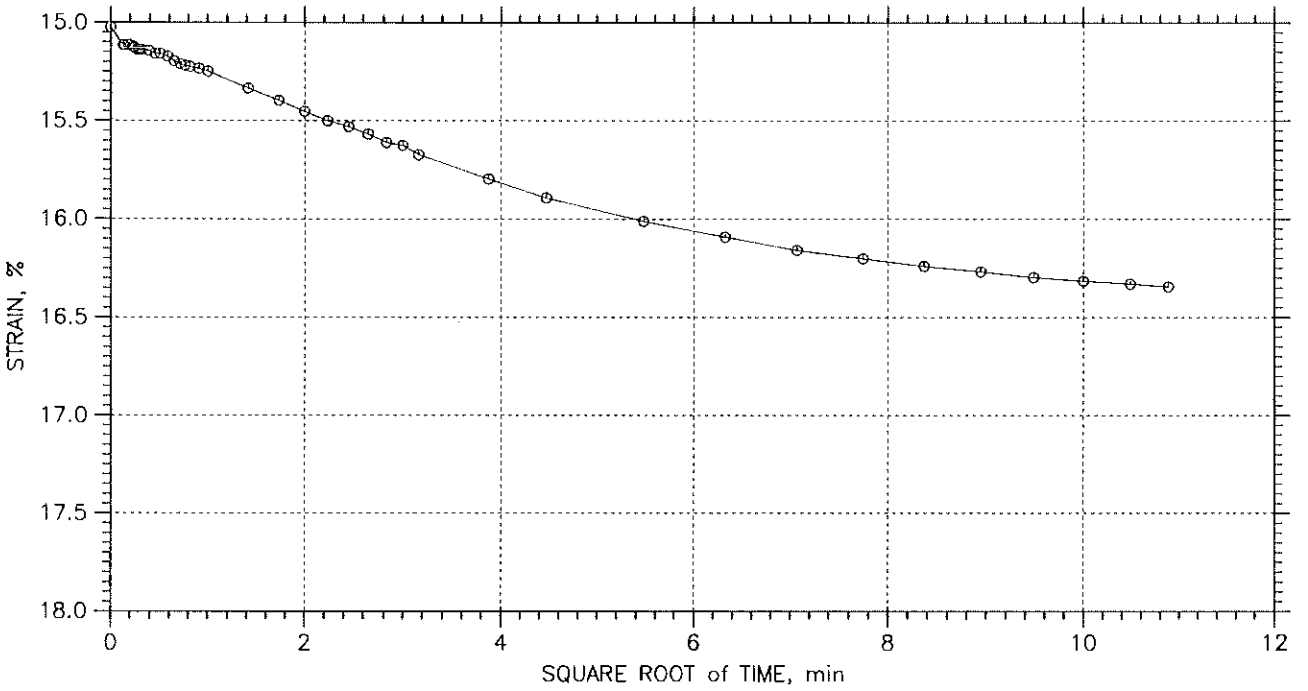
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 11 of 29

Stress: 3.25 tsf





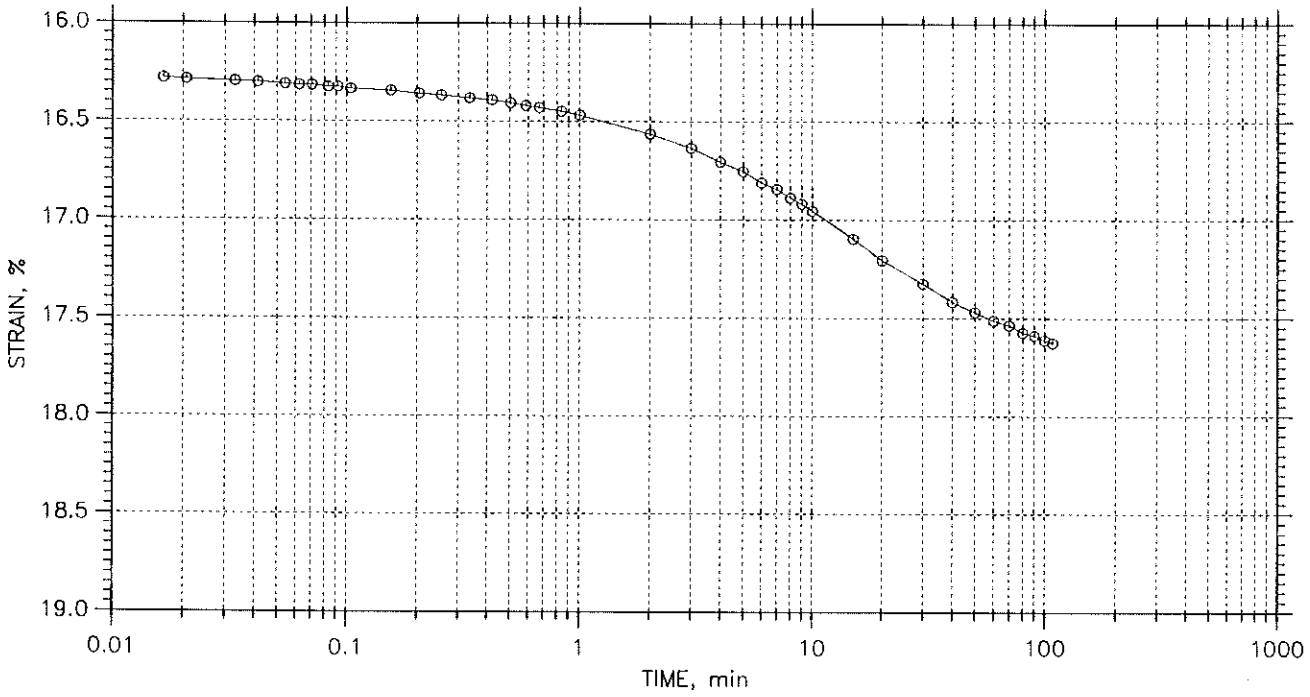
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

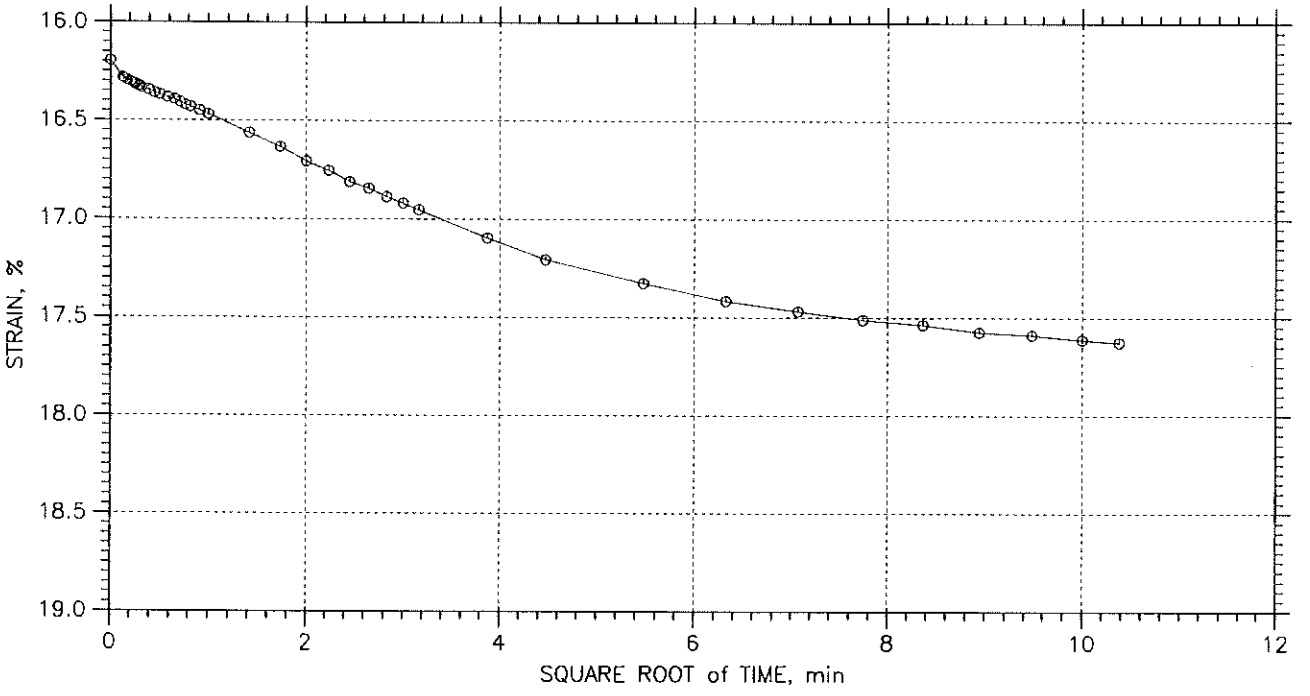
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 12 of 29

Stress: 4.75 tsf





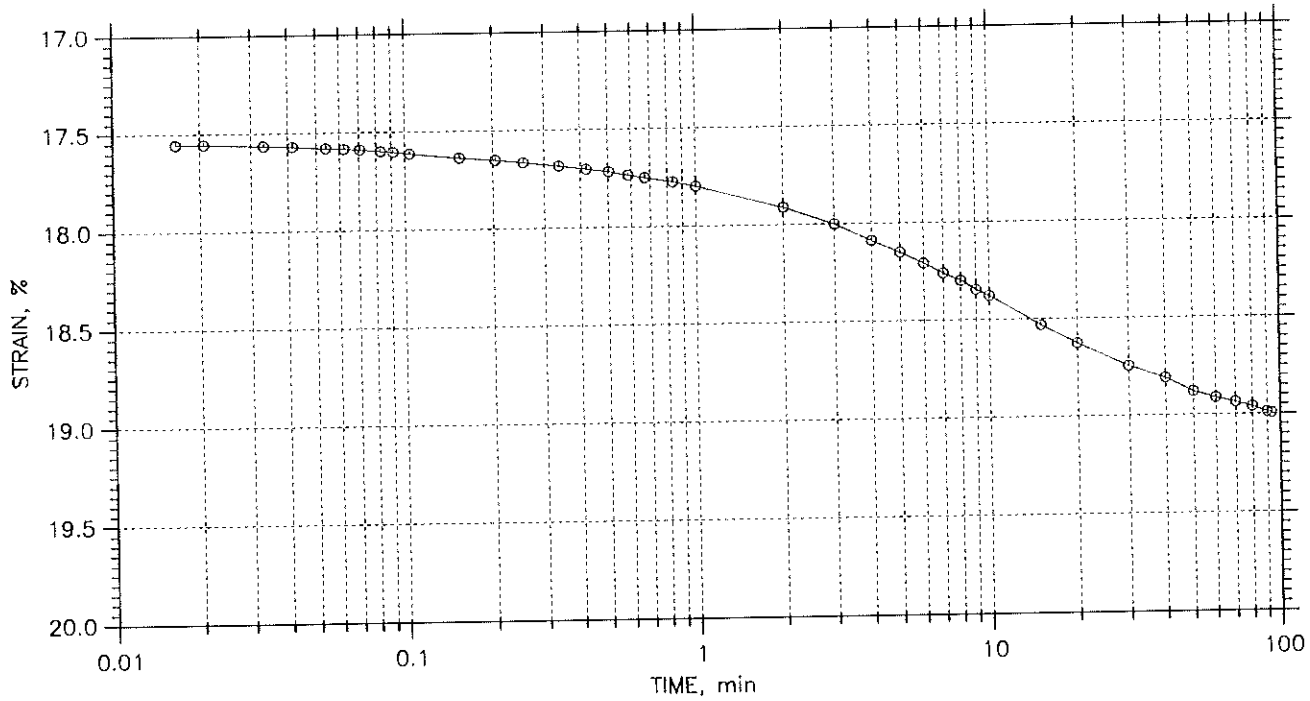
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

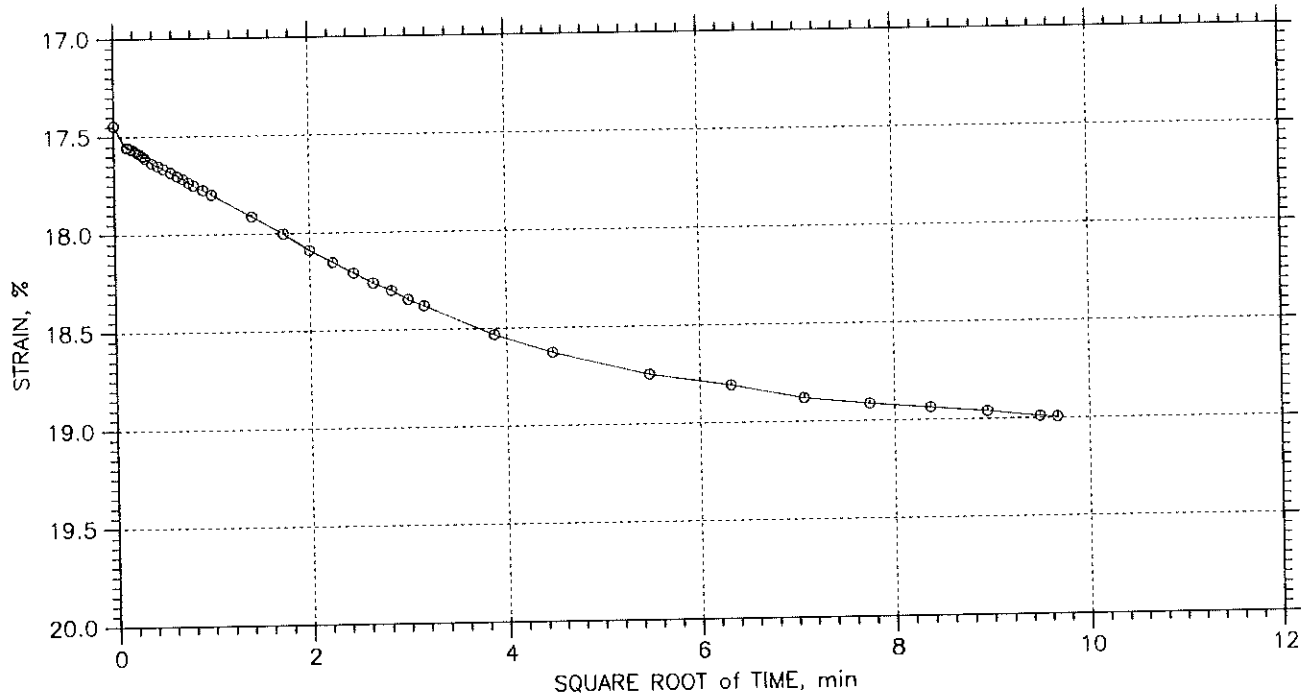
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 13 of 29

Stress: 7. tsf





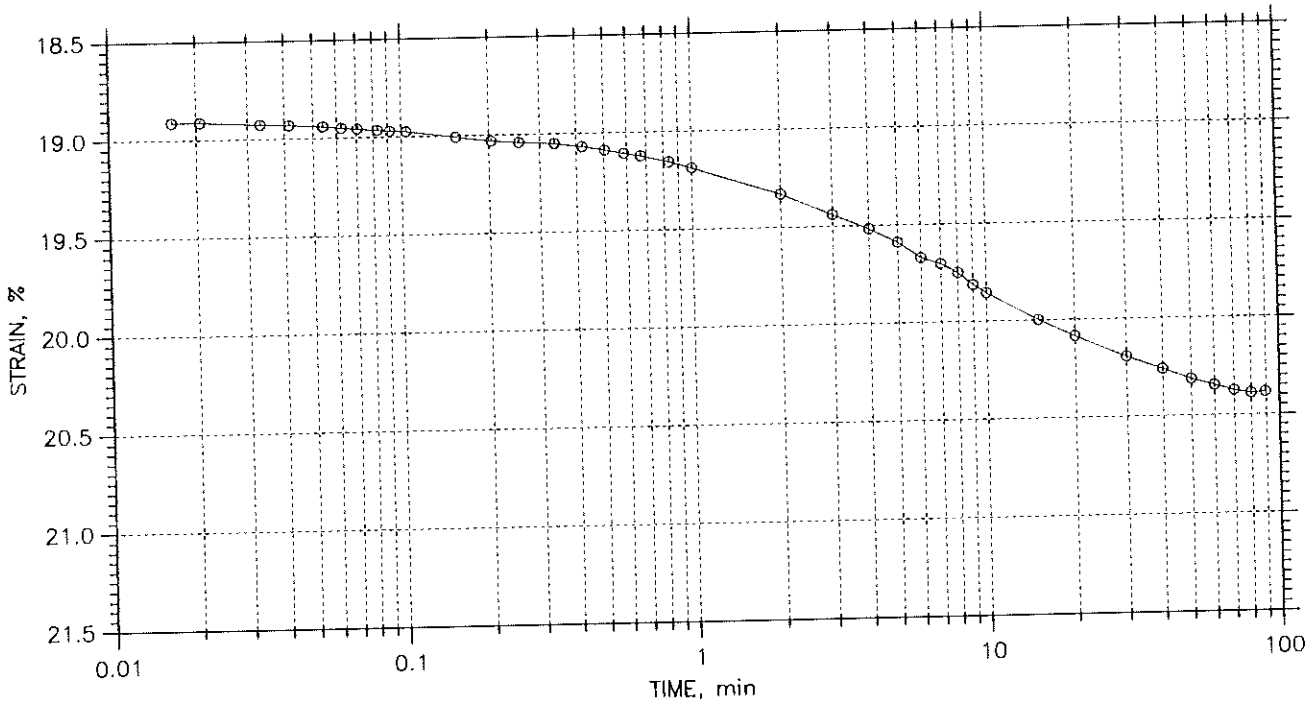
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

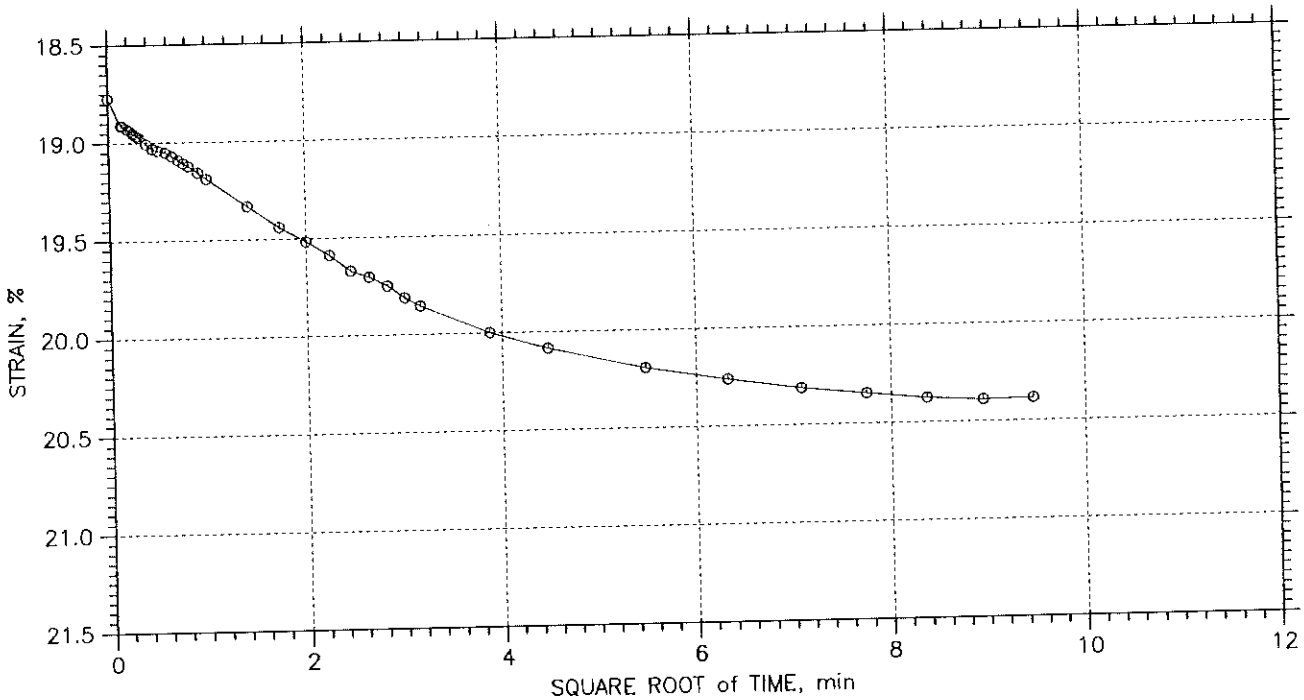
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 14 of 29

Stress: 10.25 tsf





Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Dote: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

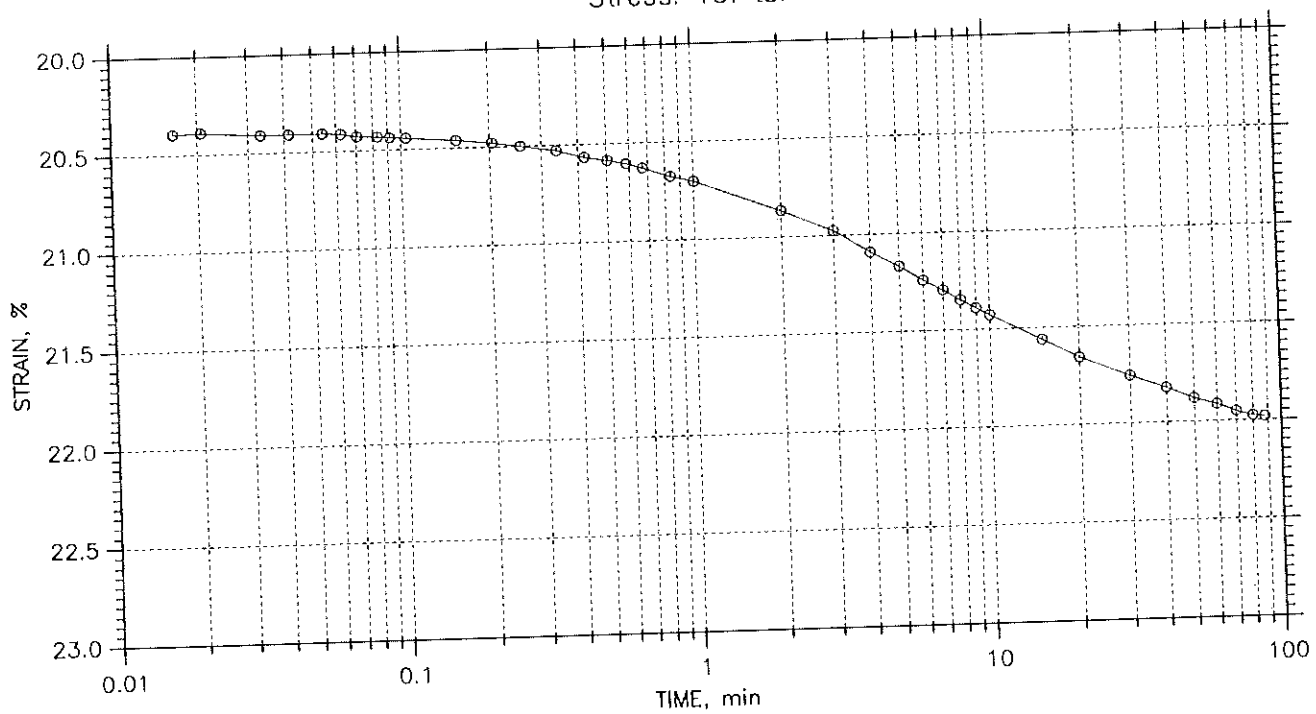
Tue, 03-JUN-2008 10:36:04

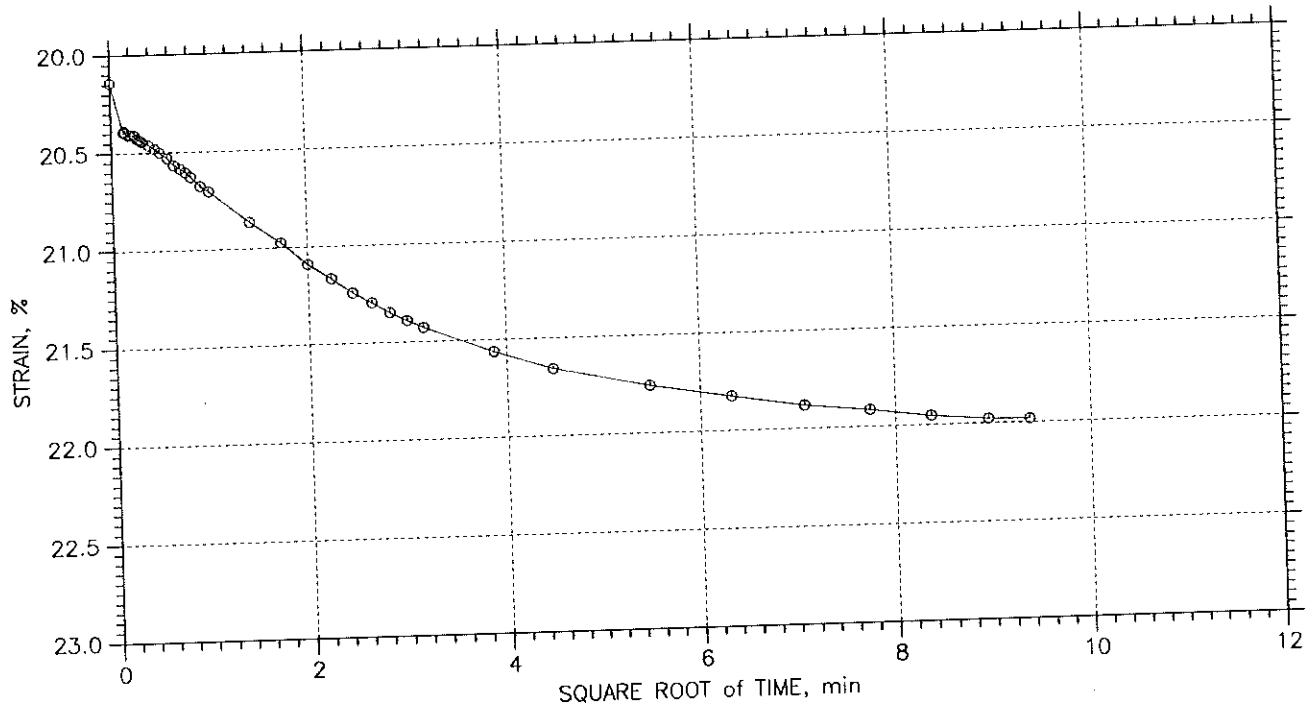
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 15 of 29

Stress: 15. tsf





Project:	Locotion: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

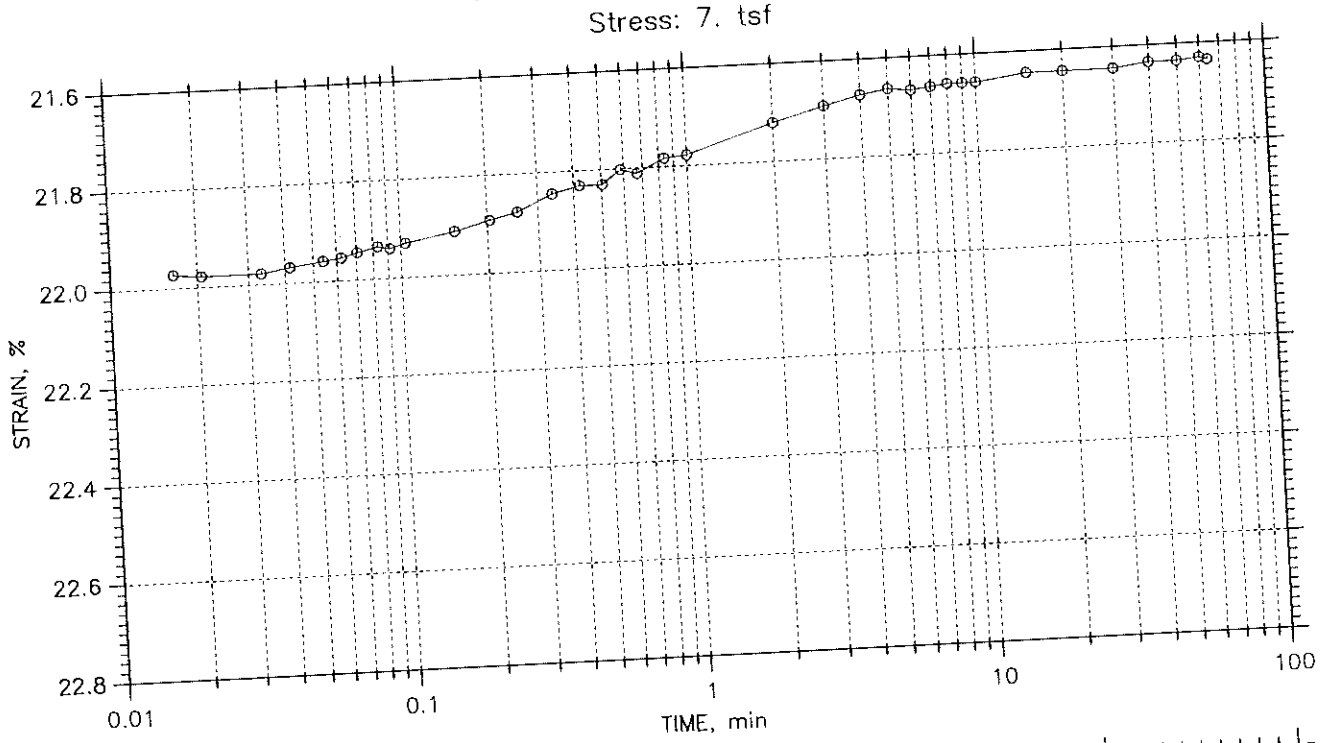
Tue, 03-JUN-2008 10:36:04

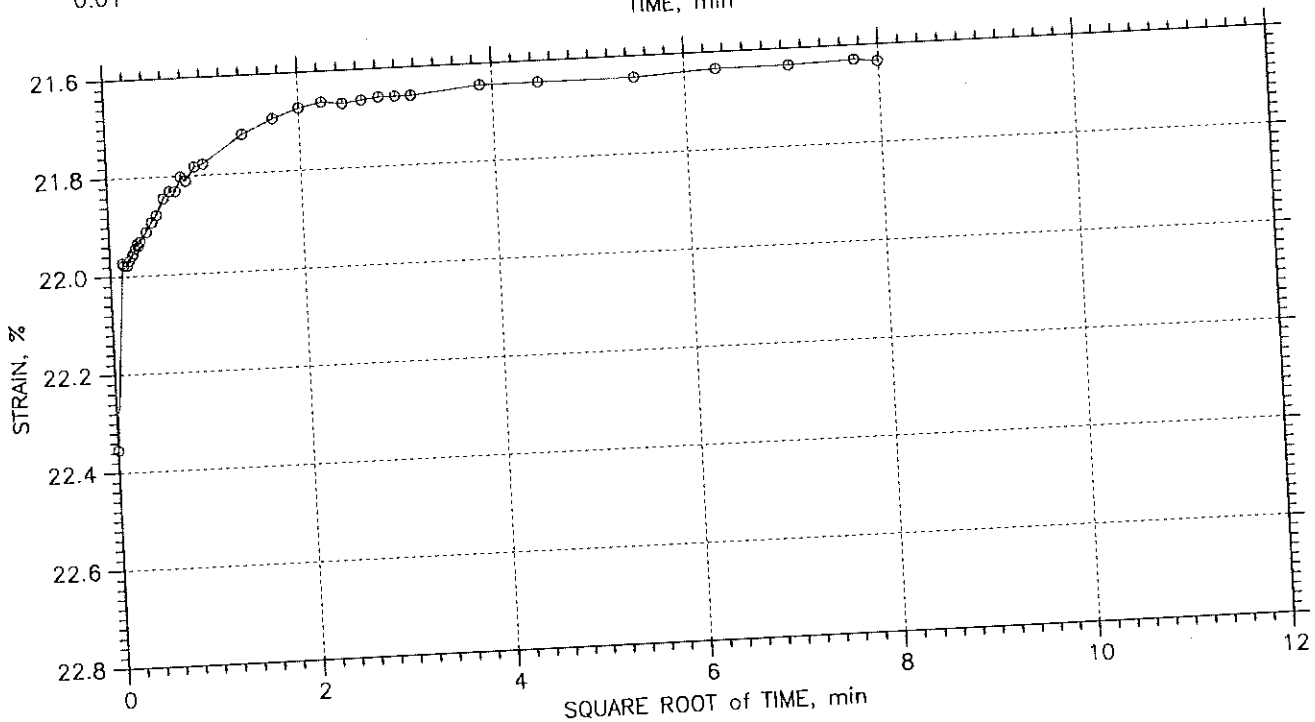
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 16 of 29

Stress: 7. tsf





Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

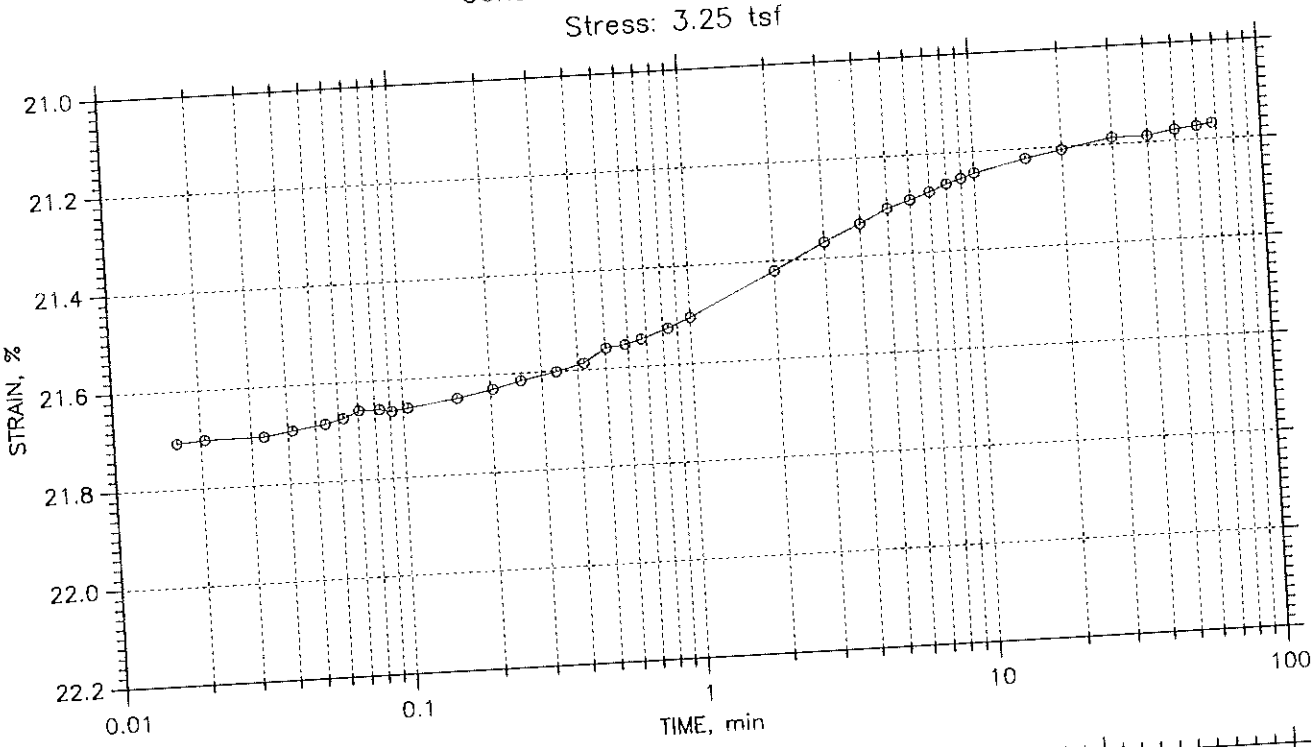
Tue 03-JUN-2008 10:36:04

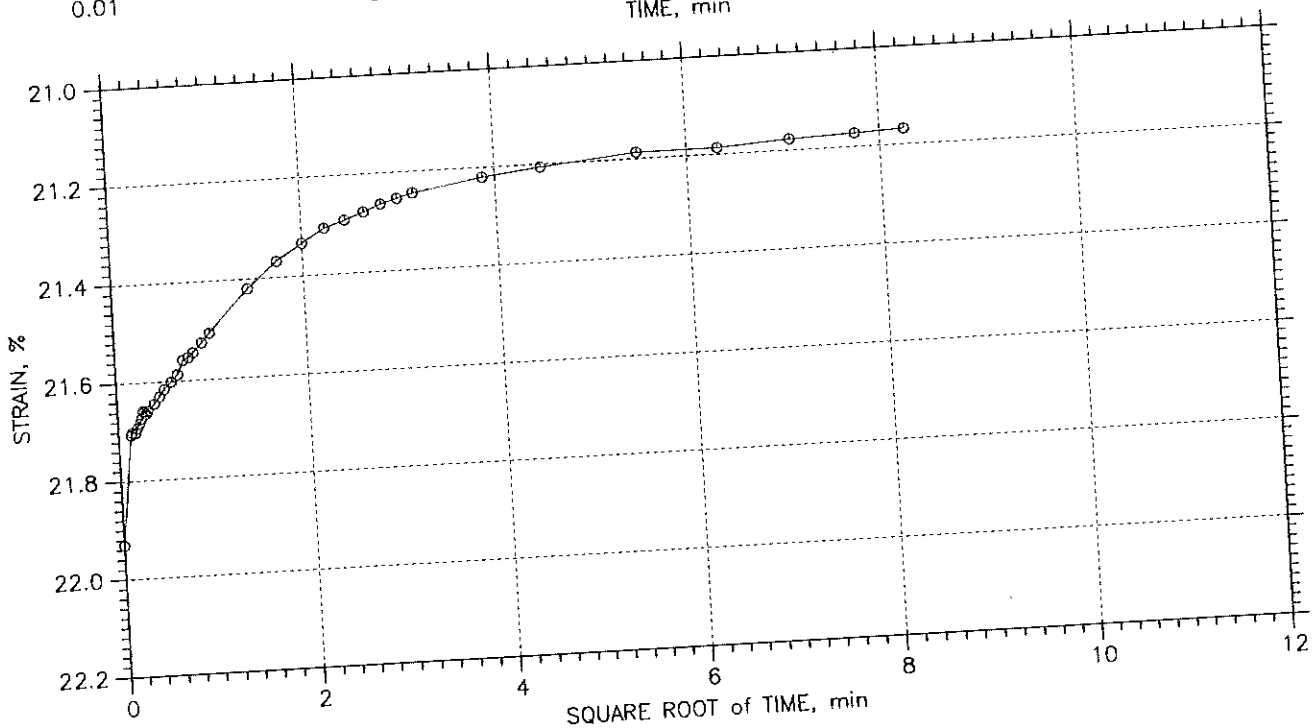
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 17 of 29

Stress: 3.25 tsf





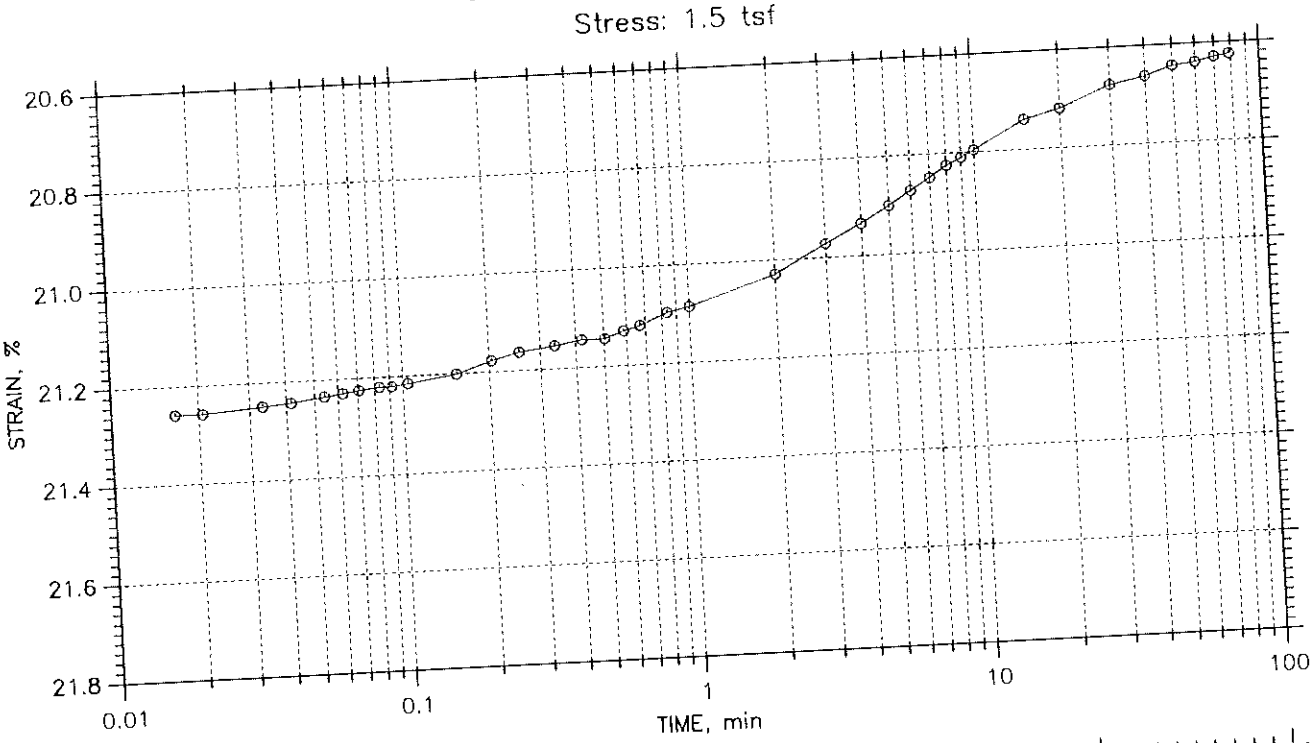
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

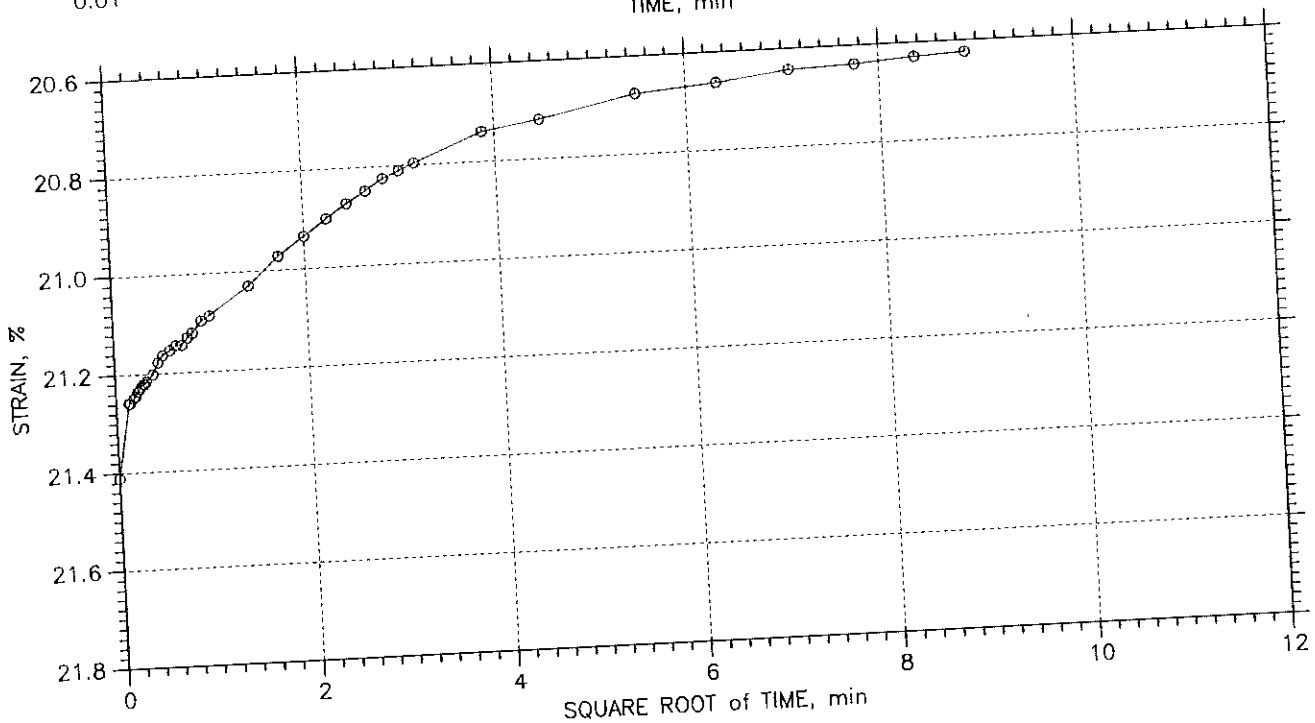
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 18 of 29

Stress: 1.5 tsf





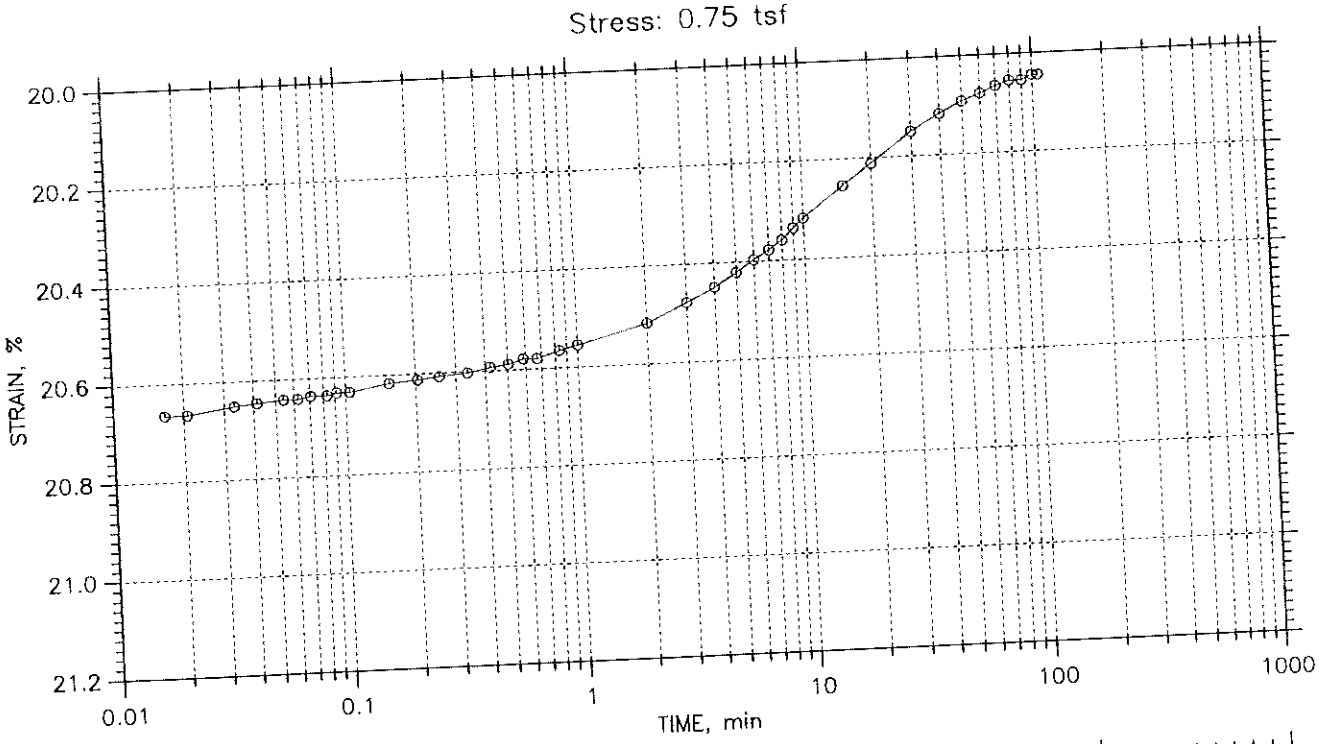
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

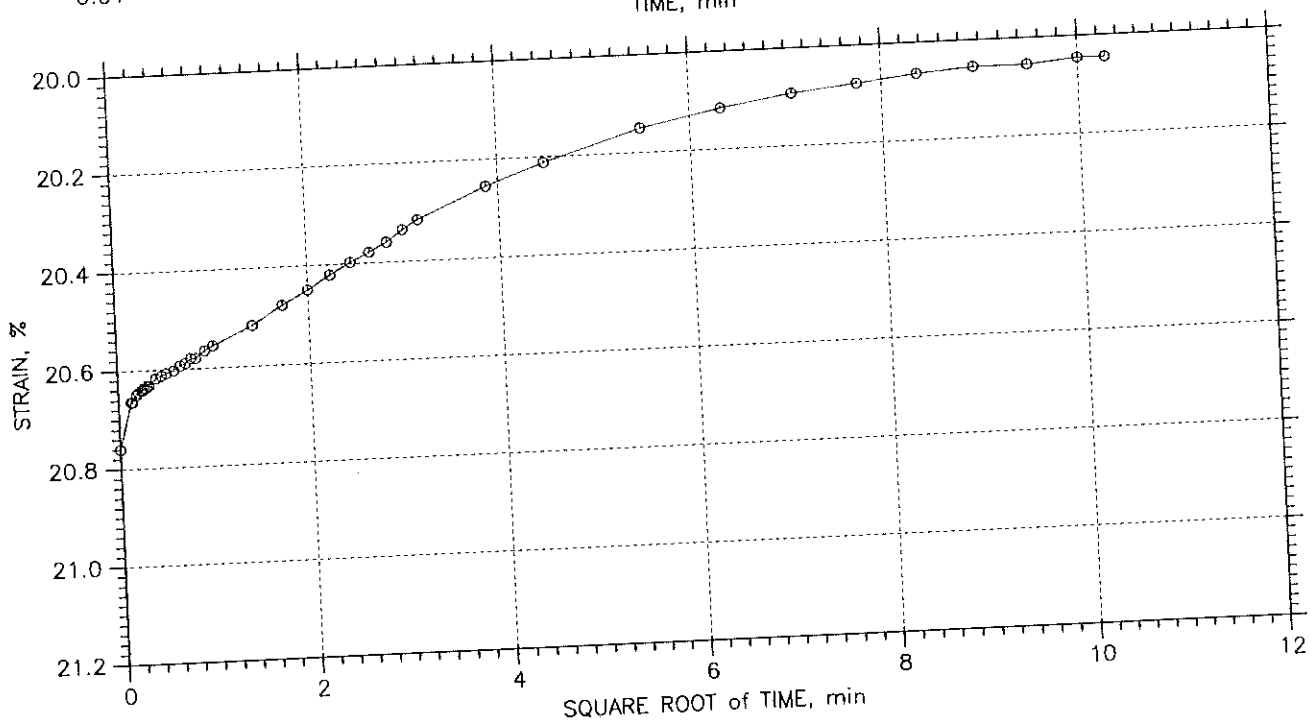
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 19 of 29

Stress: 0.75 tsf





Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevotian: ---
Description: GRAY CLAY		
Remarks:		

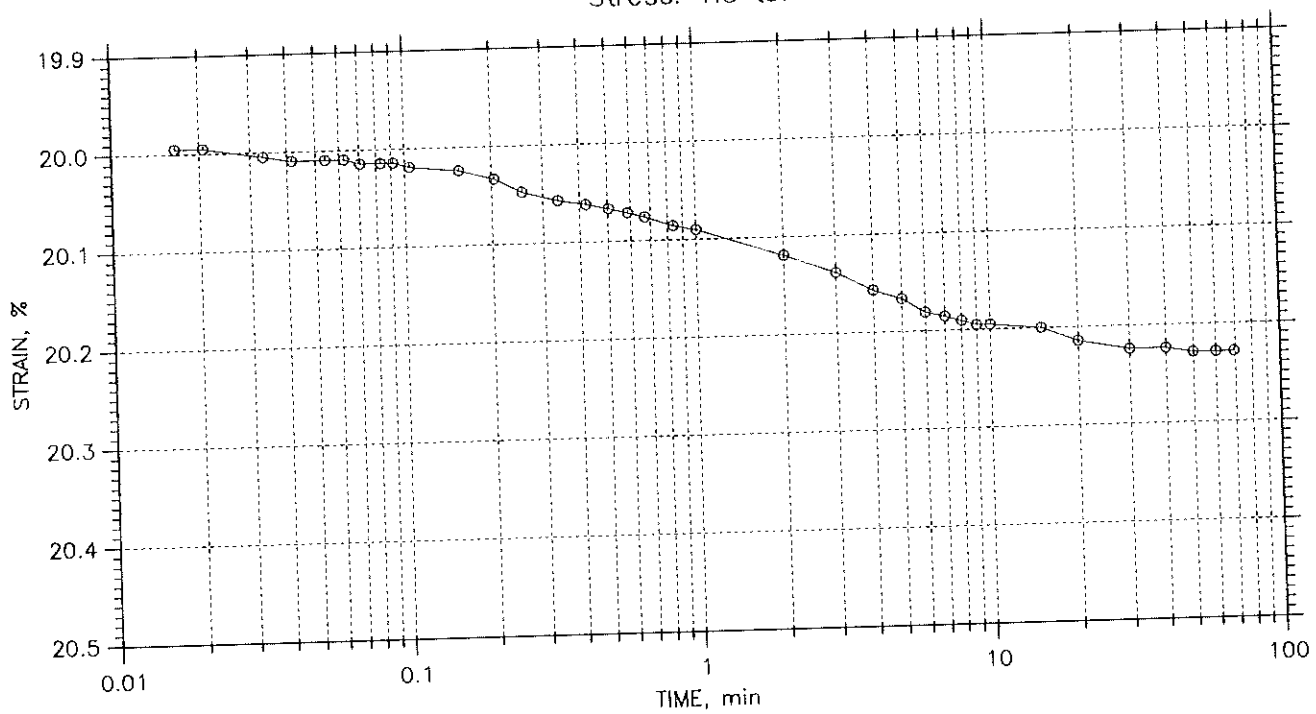
Tue, 03-JUN-2008 10:36:05

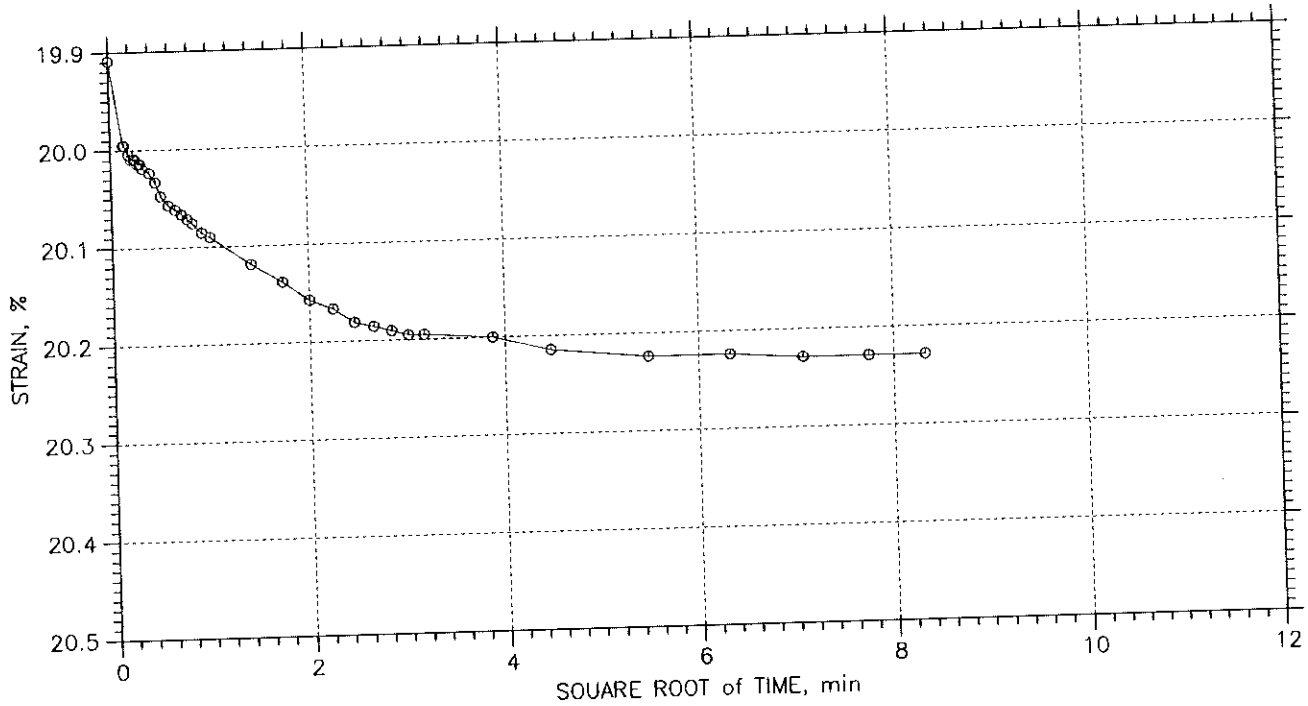
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 20 of 29

Stress: 1.5 tsf





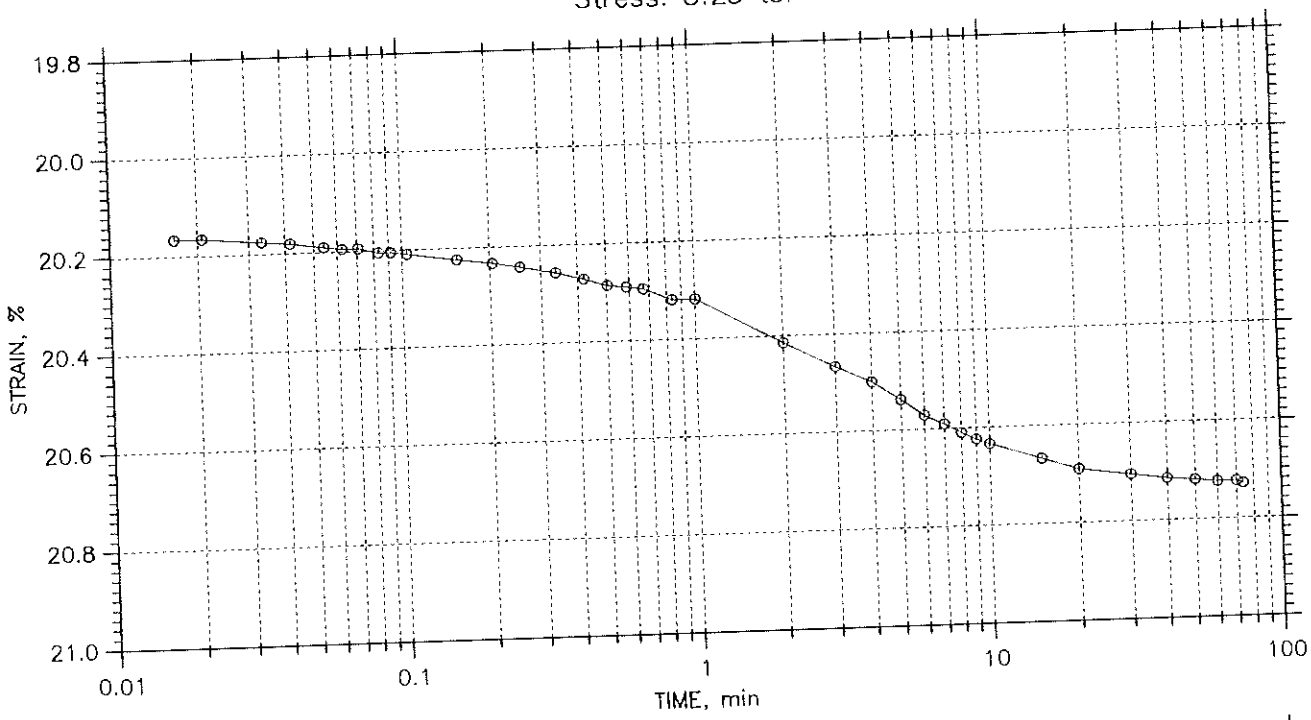
Project:	Lacation: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

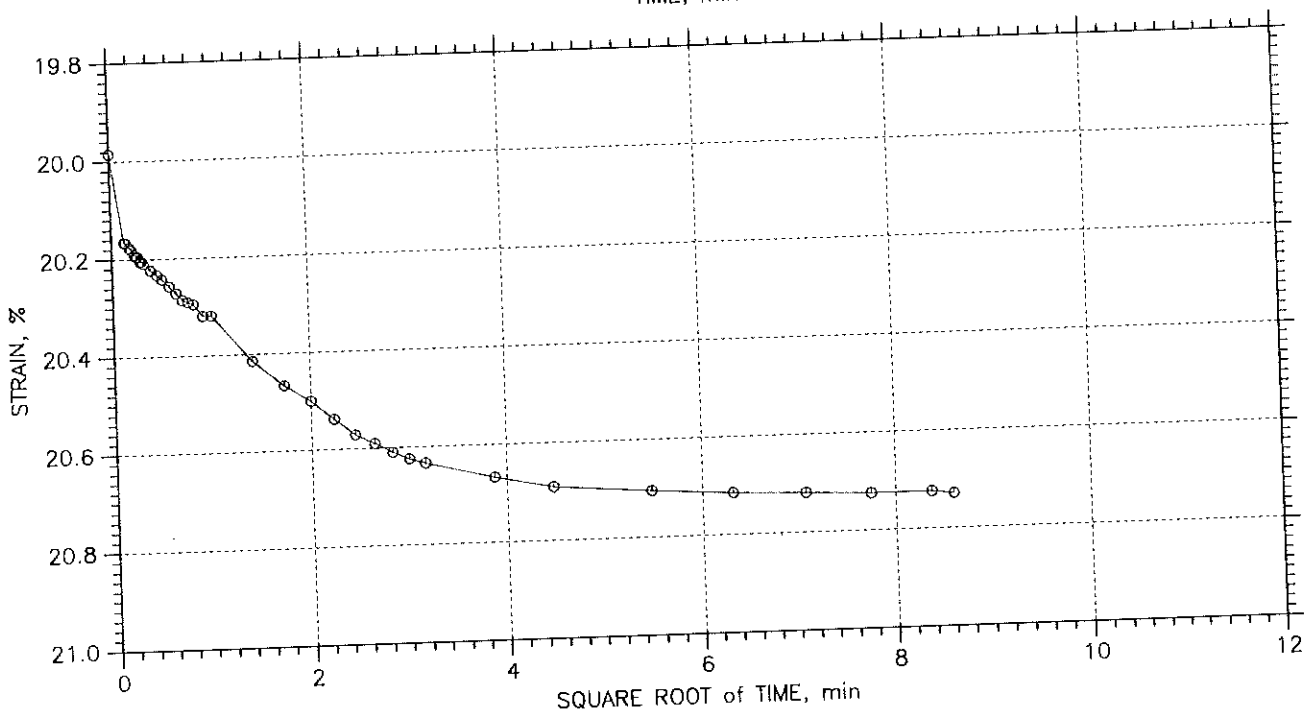
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 21 of 29

Stress: 3.25 tsf





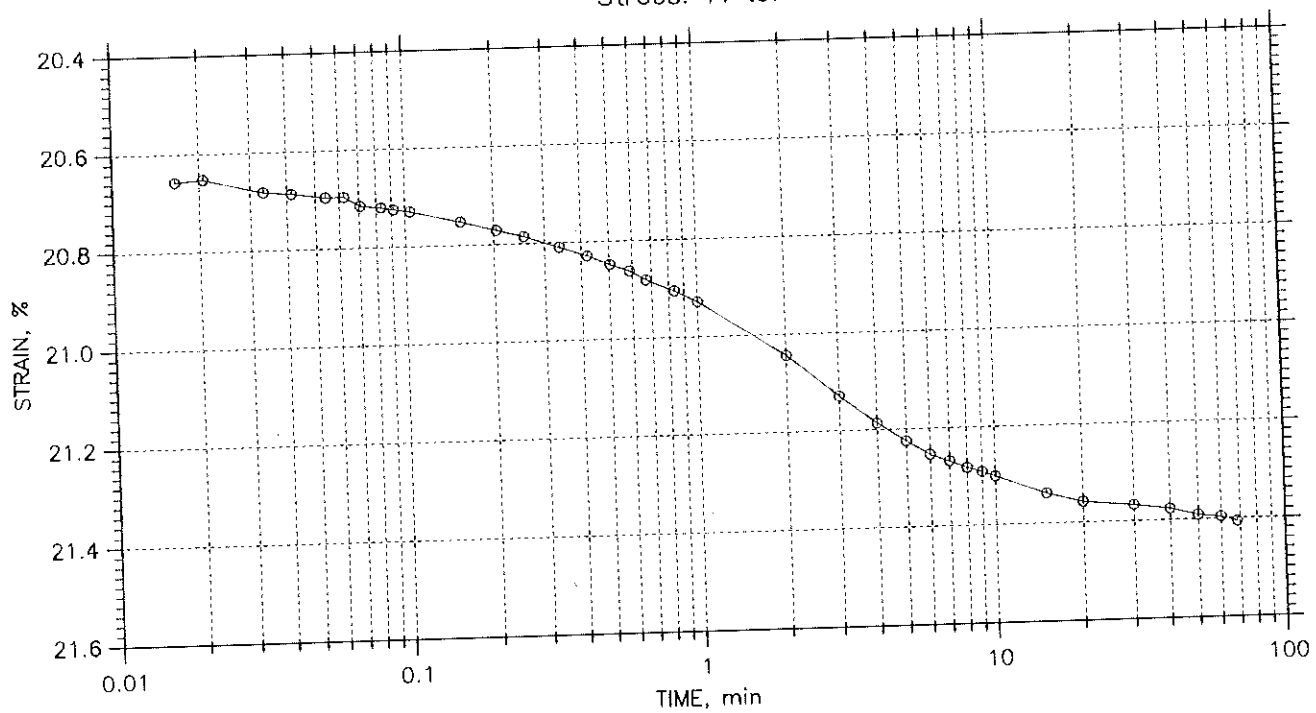
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remorks:		

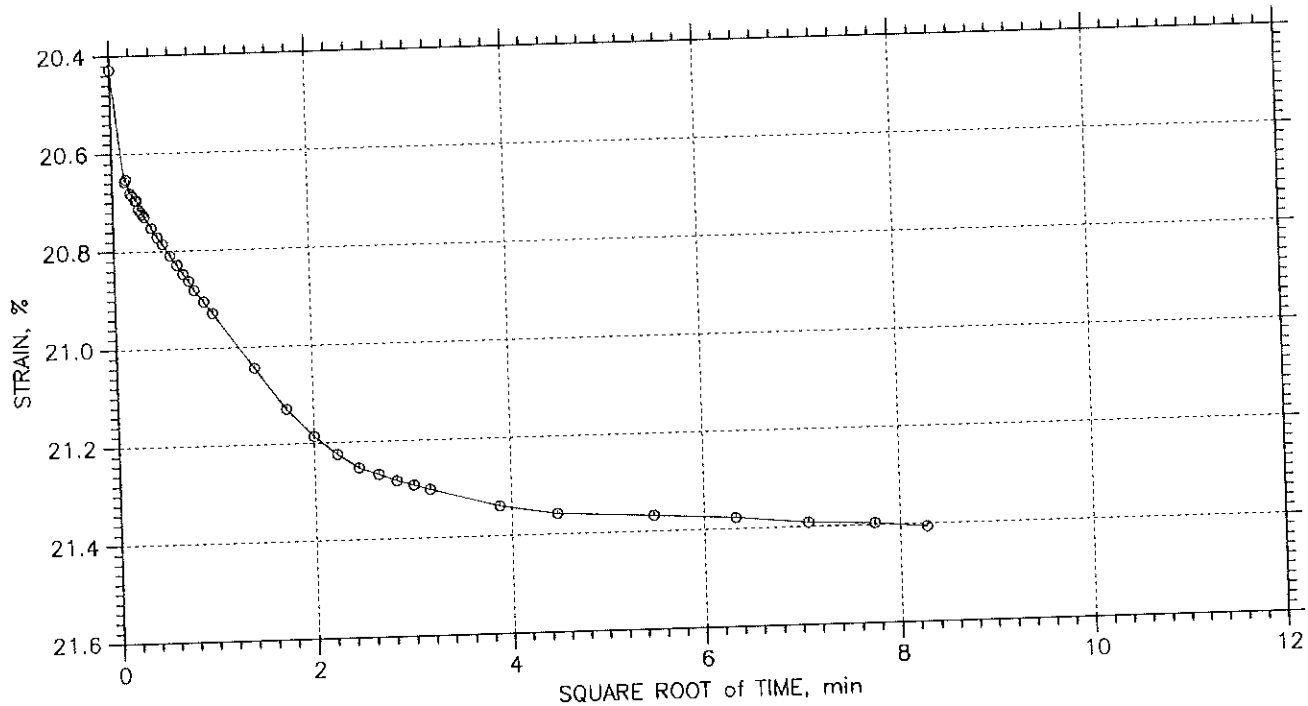
CONSOLIDATION TEST DATA

TIME CURVES

Constont Load Step: 22 of 29

Stress: 7. tsf





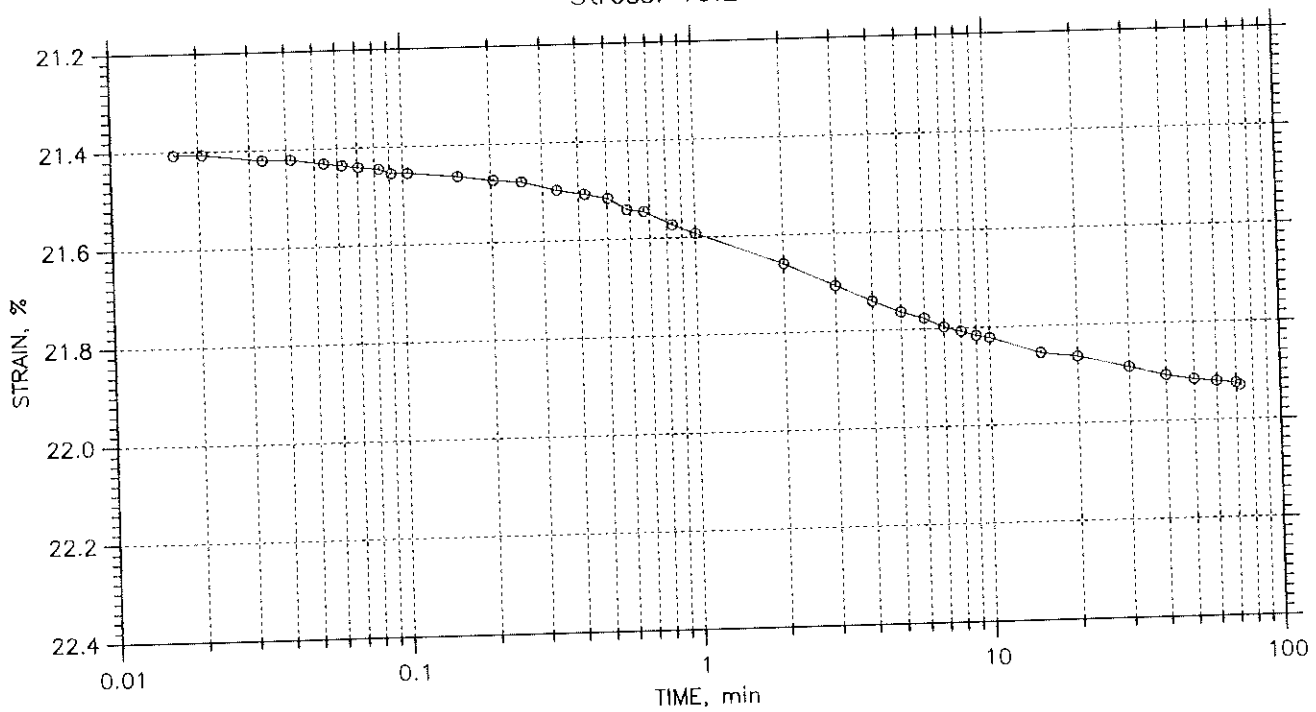
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brion Fogg	Checked By:
Sample No.: 1U	Test Dote: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevotion: ---
Description: GRAY CLAY		
Remorks:		

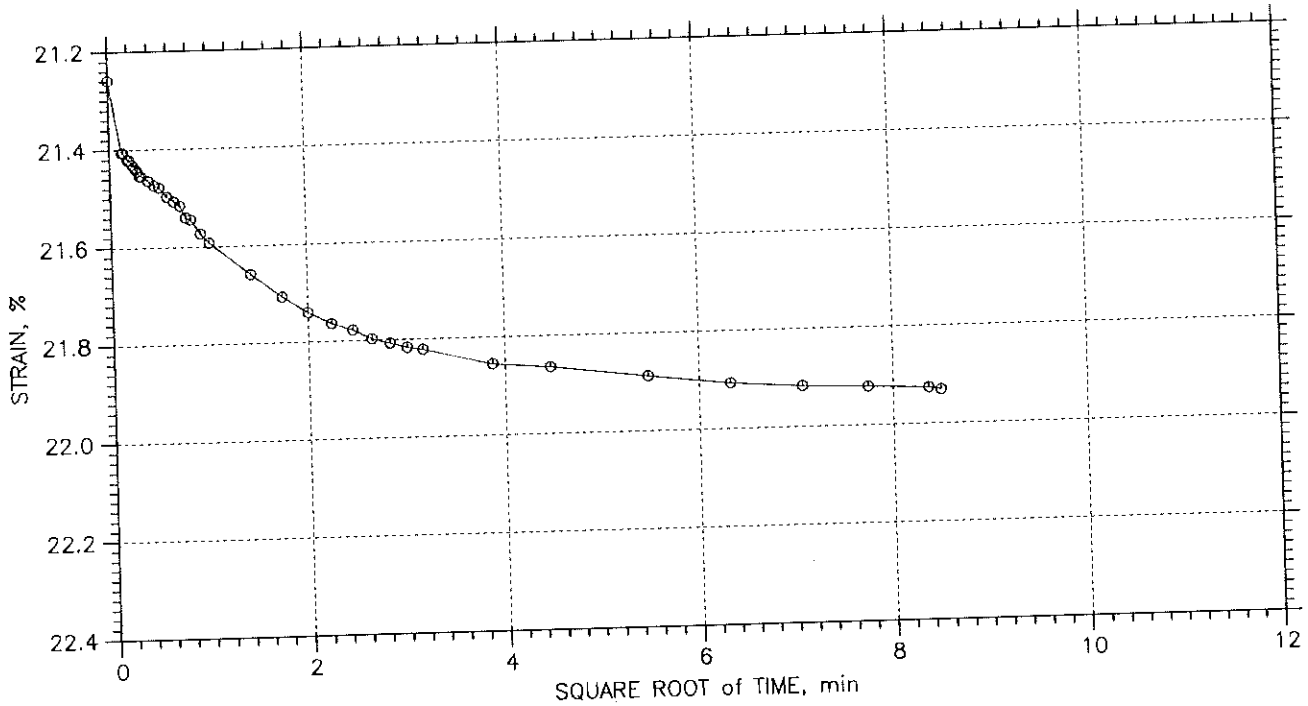
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 23 of 29

Stress: 10.25 tsf





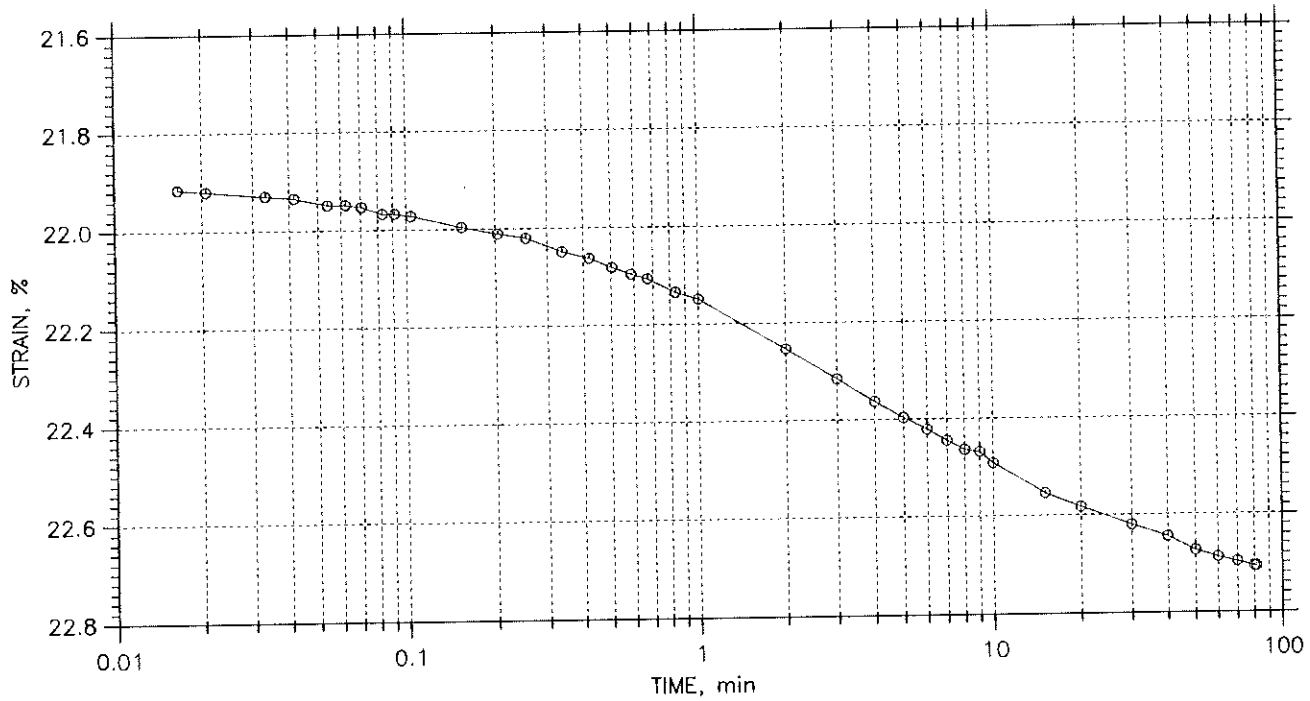
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevotion: ---
Description: GRAY CLAY		
Remarks:		

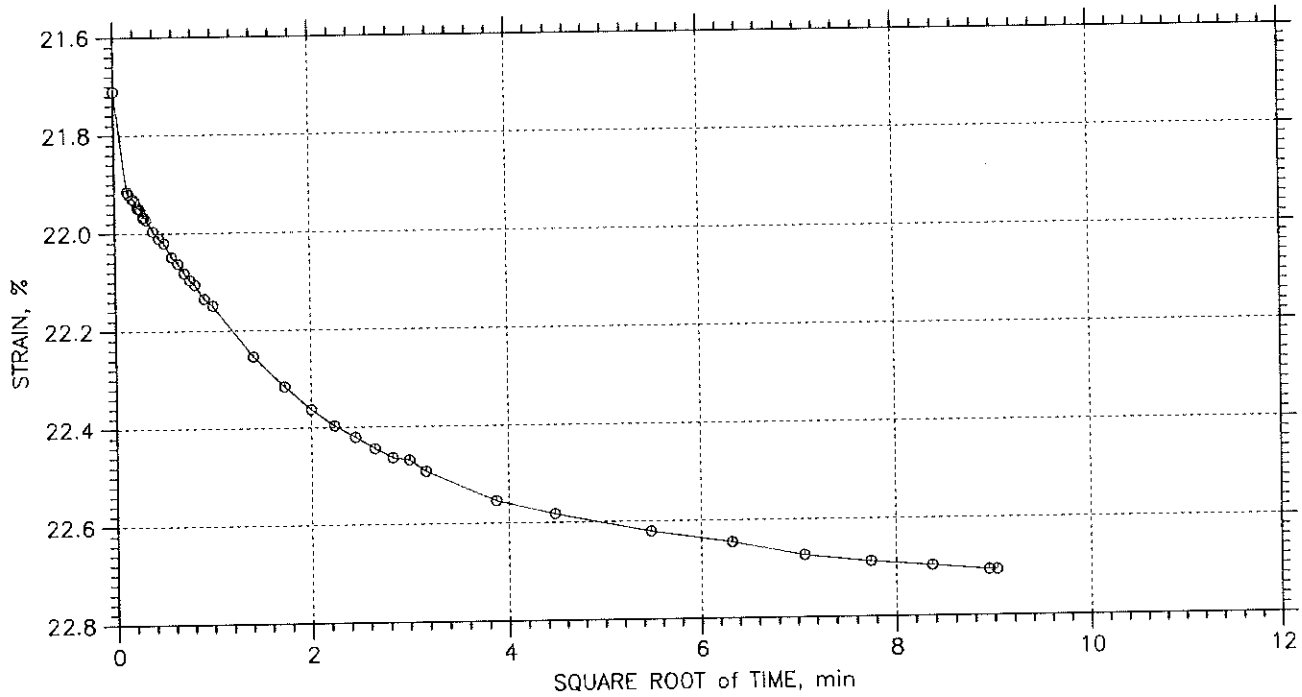
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 24 of 29

Stress: 15. tsf





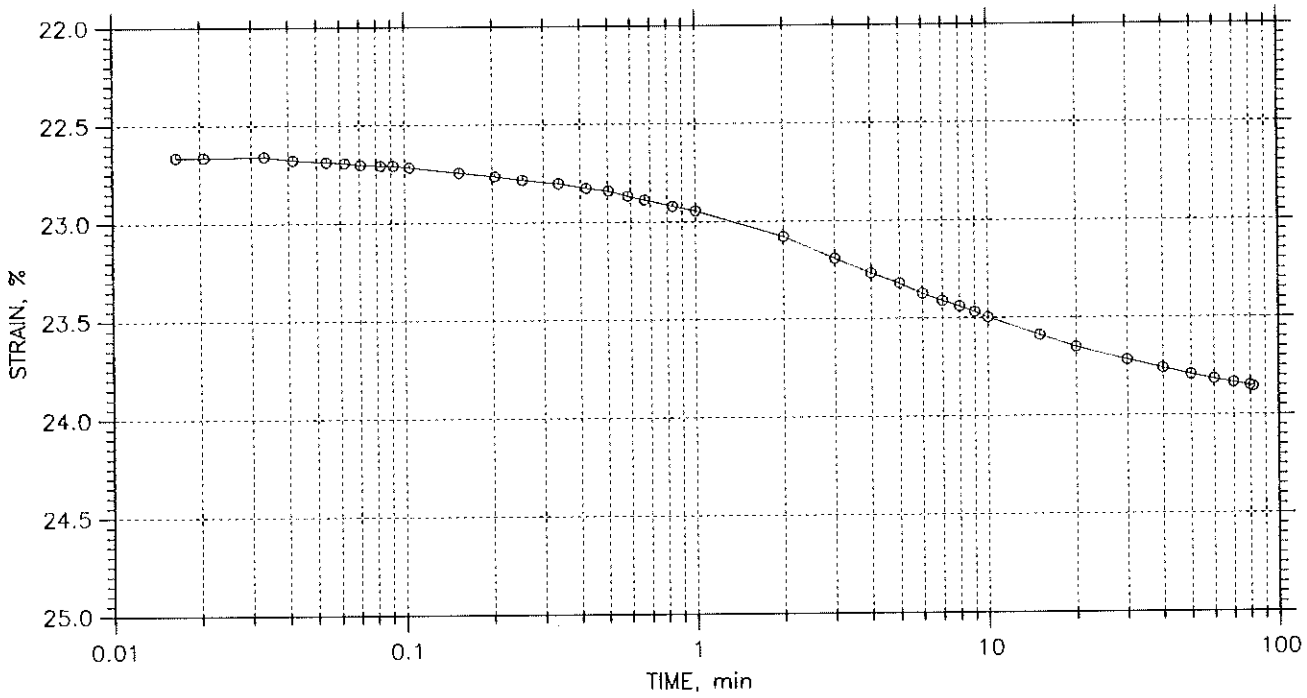
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

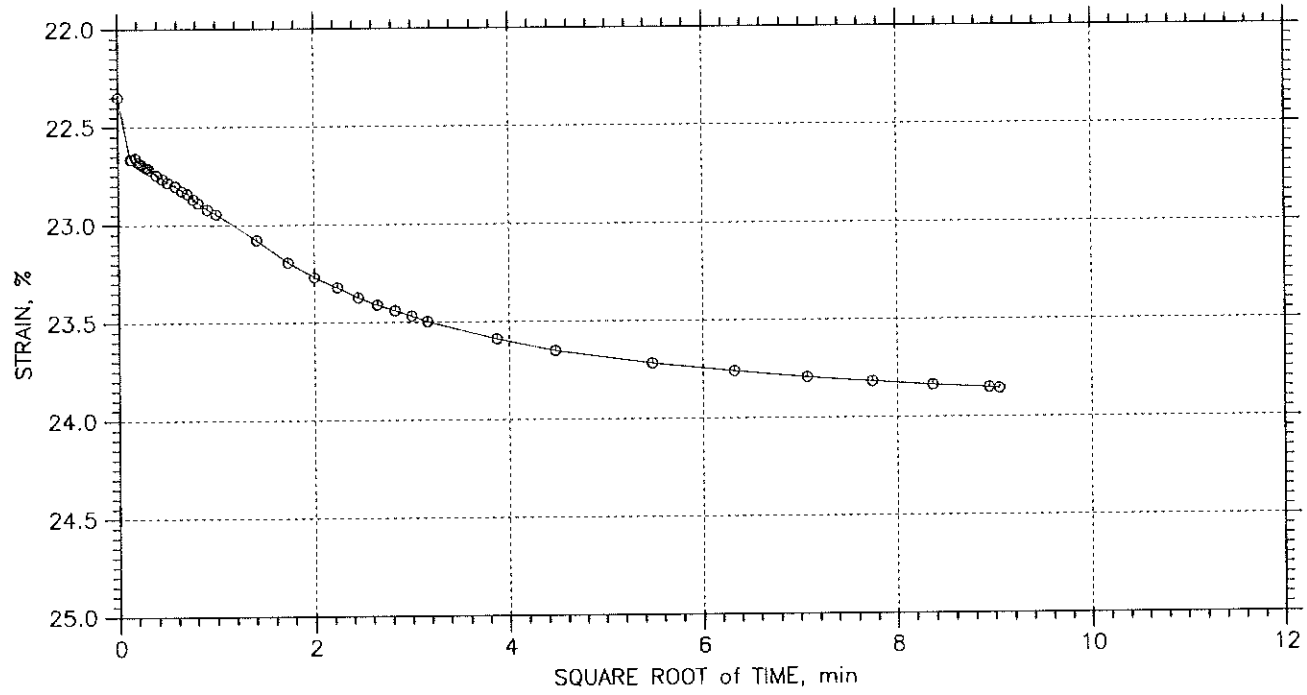
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 25 of 29

Stress: 22. tsf





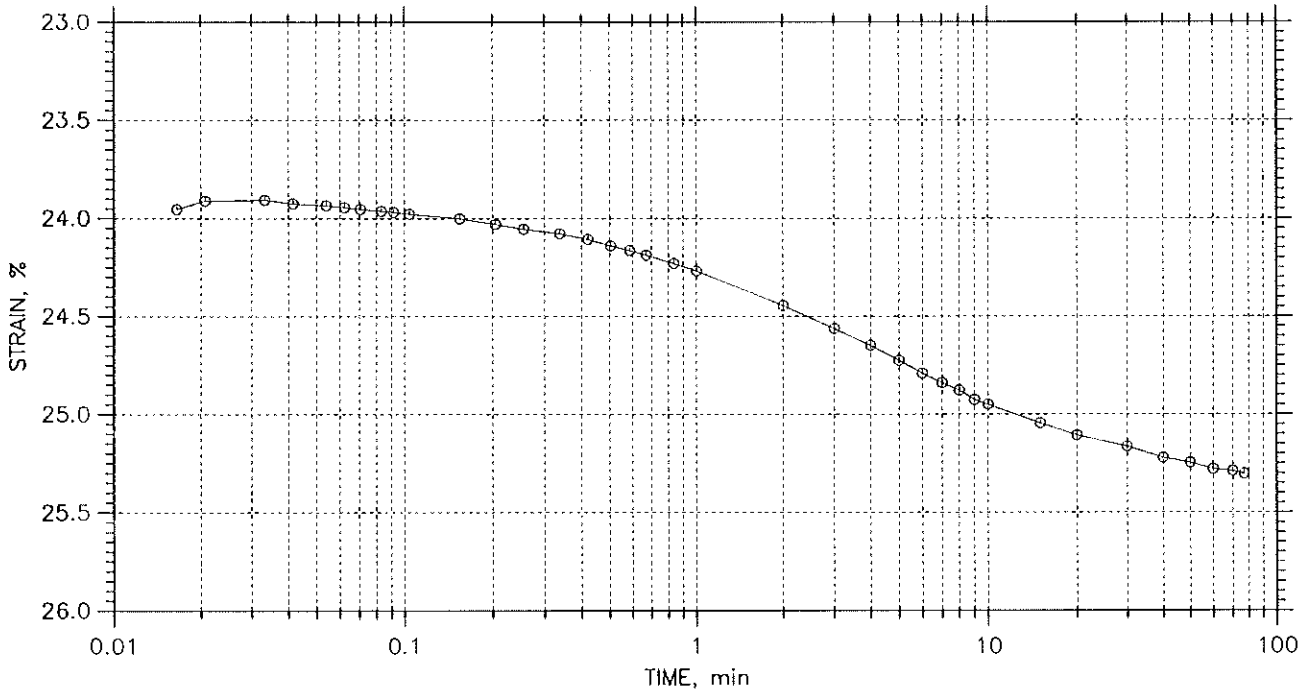
Project:	Locotion: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

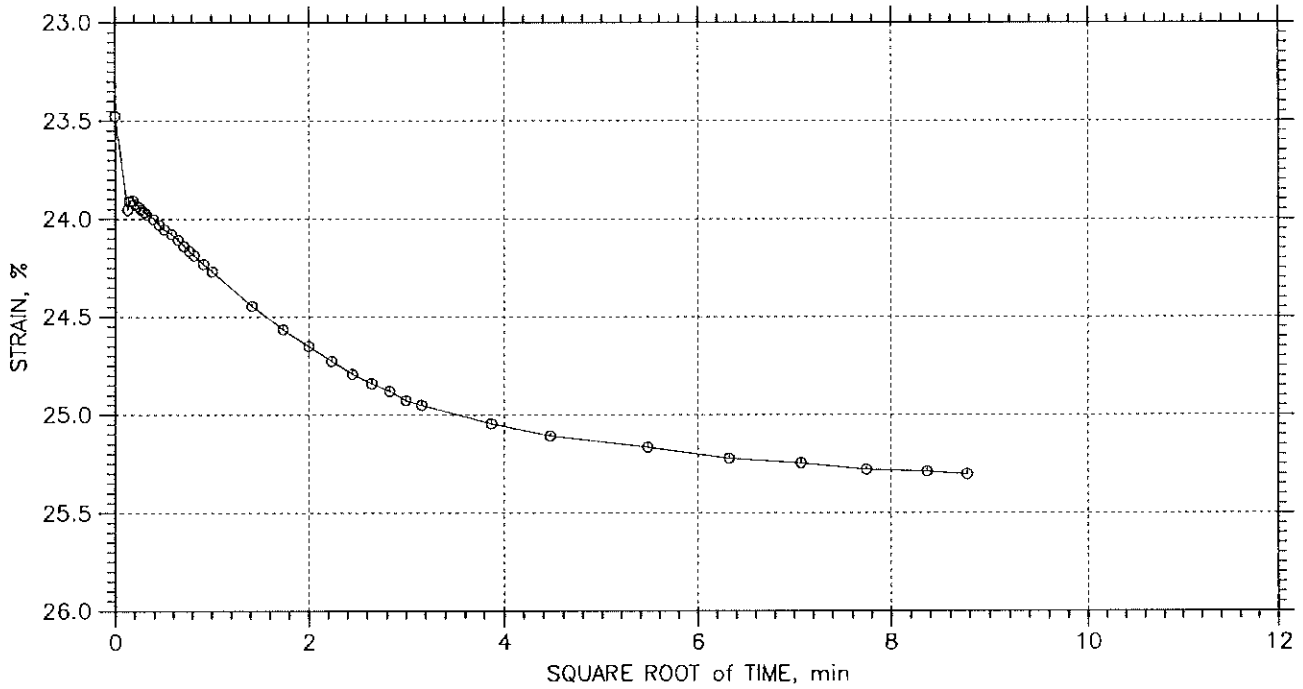
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 26 of 29

Stress: 32.25 tsf





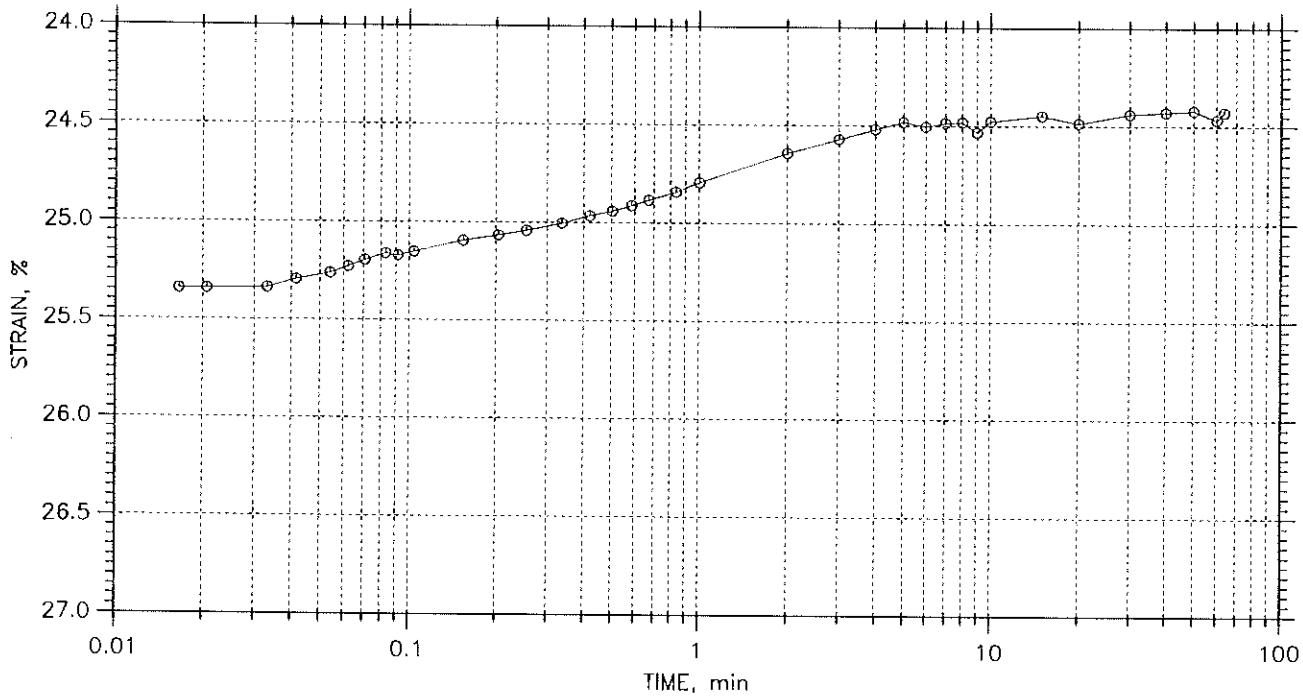
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

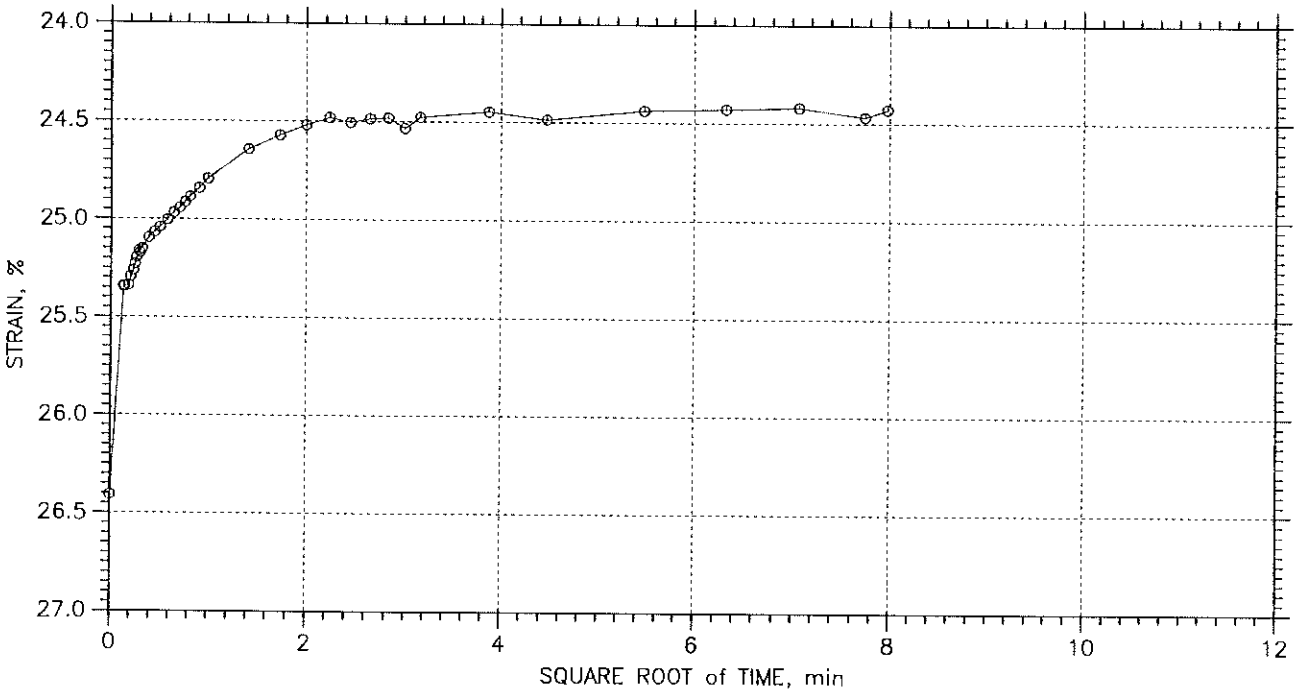
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 27 of 29

Stress: 7. tsf





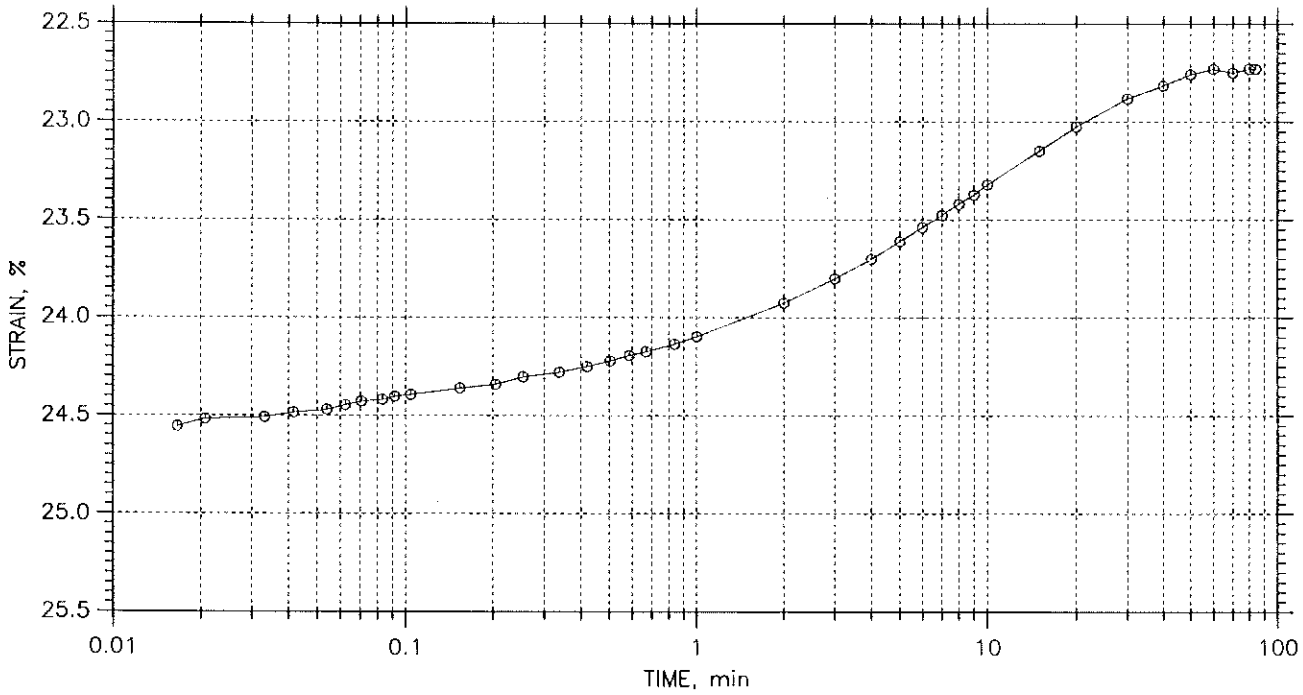
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

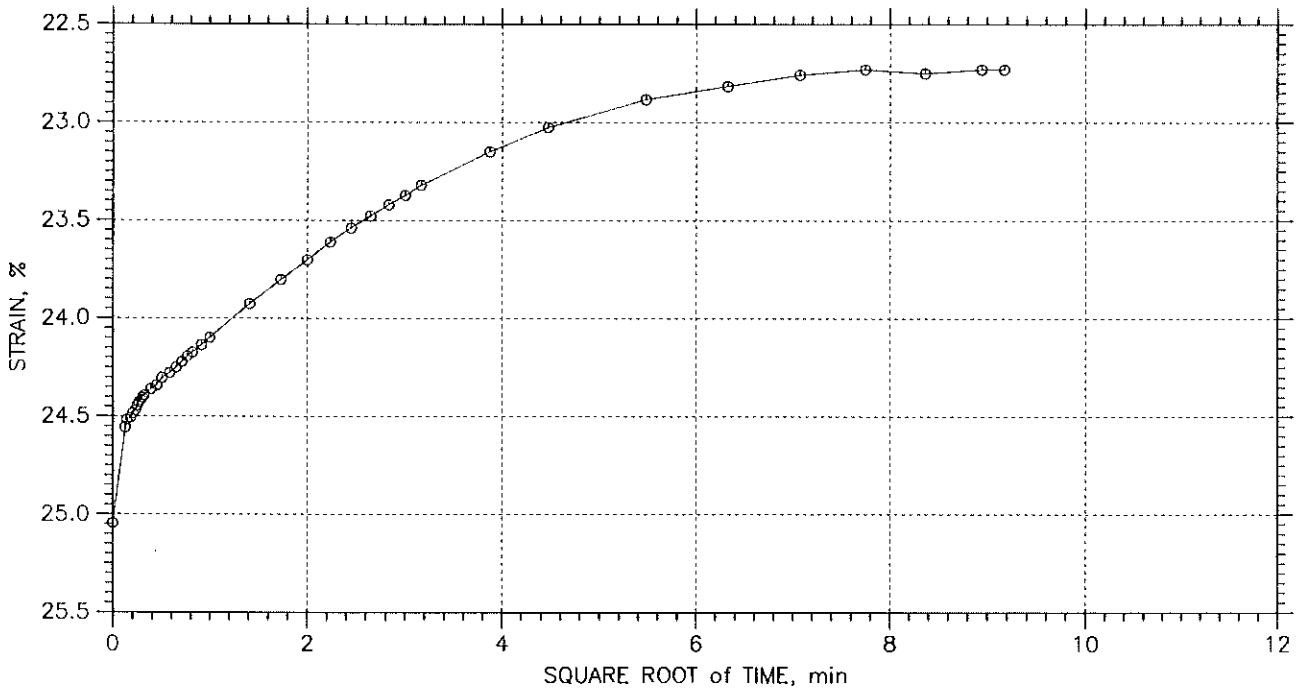
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 28 of 29

Stress: 1. tsf





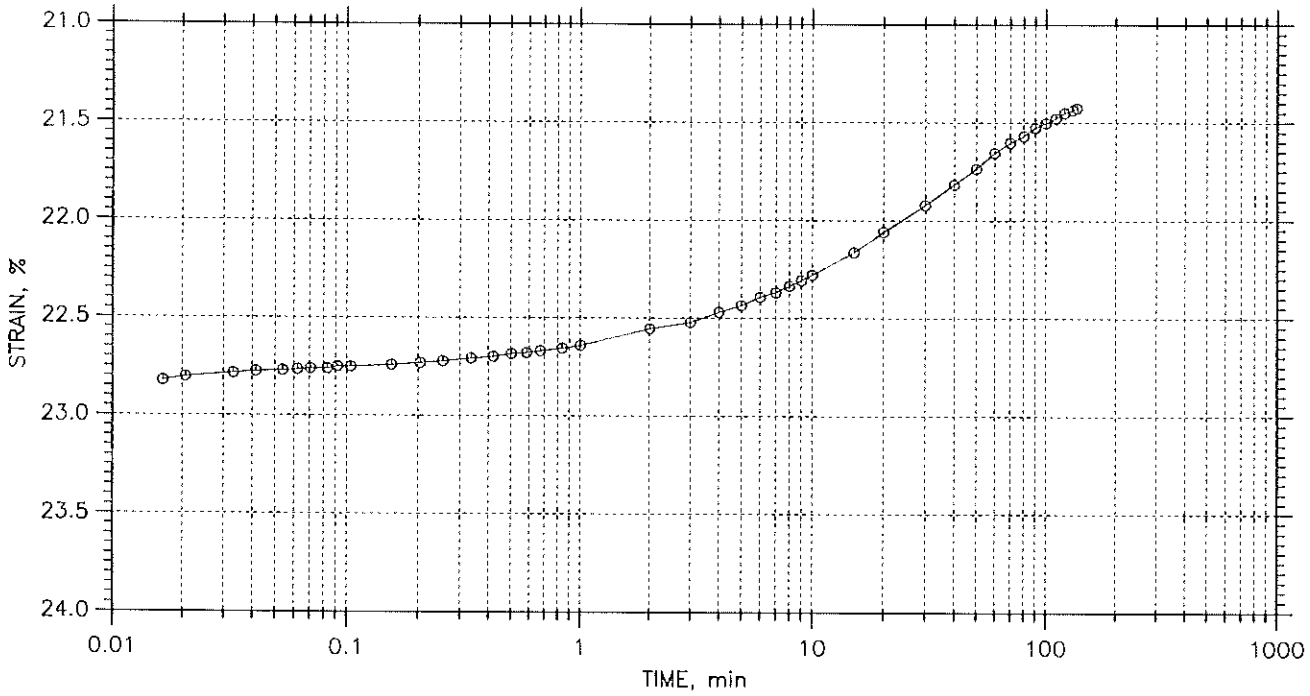
Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

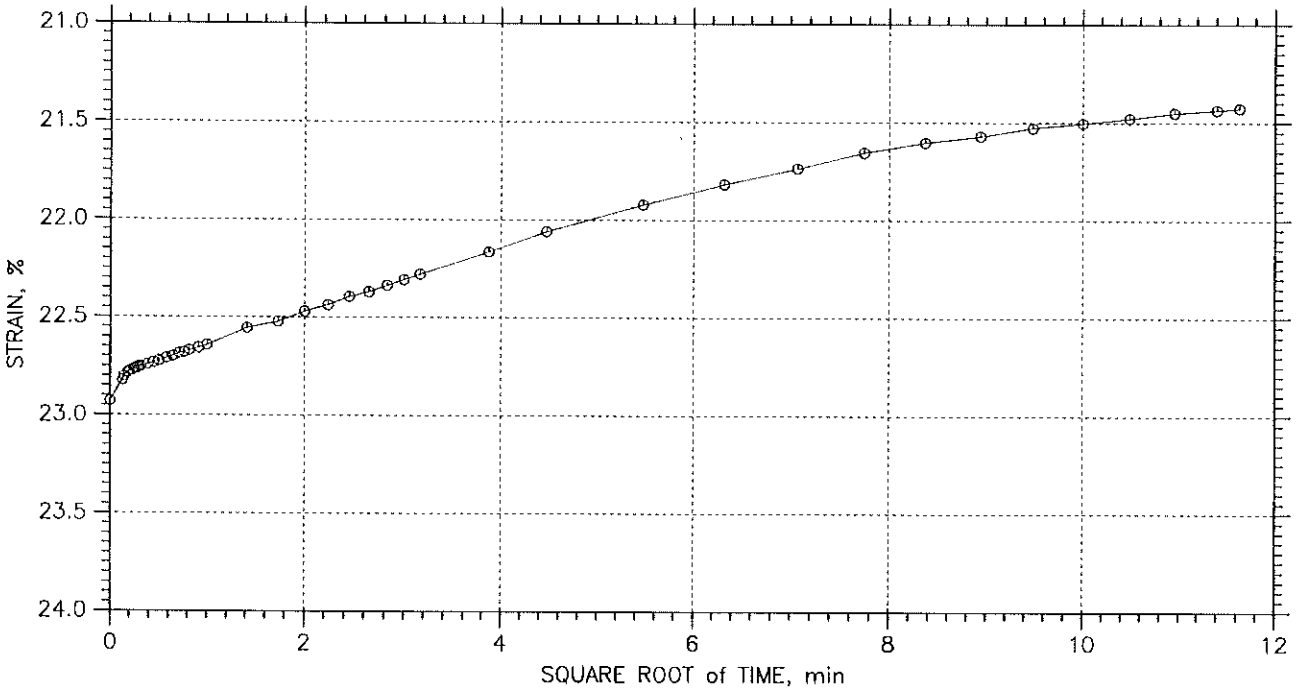
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 29 of 29

Stress: 0.25 tsf





Project:	Location: GORHAM	Project No.: 010801.00
Boring No.: BB-GBB-101	Tested By: Brian Fogg	Checked By:
Sample No.: 1U	Test Date: 5/21/08	Depth: 20-22 FT
Test No.: 210291	Sample Type: Shelby Tube	Elevation: ---
Description: GRAY CLAY		
Remarks:		

Tue, 03-JUN-2008 10:36:08





GeoTesting EXPRESS

Technologies to manage risk for infrastructure

Boston
Atlanta
Chicago
Los Angeles
New York

www.geotesting.com

Transmittal

TO:

Jeffrey Lloyd

Golder Associates

670 N. Commercial Street, Suite 103

Manchester, NH 03101-1146

DATE: 3/2/2017	GTX NO: 305885
RE: Gorham, ME	

COPIES	DATE	DESCRIPTION
	3/2/2017	**February 2017 Laboratory Test Report**

REMARKS:

SIGNED:

Ethan Marro, Assistant Laboratory Manager

CC:

APPROVED BY:

Joe Tomei, Laboratory Manager

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

Boston
Atlanta
Chicago
Los Angeles
New York
www.geotesting.com

March 2, 2017

Jeffrey Lloyd
Golder Associates
670 N. Commercial Street, Suite 103
Manchester, NH 03101-1146

RE: Gorham, ME, (GTX-305885)

Dear Jeffrey:

Enclosed are the test results you requested for the above referenced project. GeoTesting Express, Inc. (GTX) received five samples from you between 1/16/2017 and 1/27/2017. These samples were labeled as follows:

Boring	Sample	Depth
HB-GBB-201	U2	35-37 ft
HB-GBB-201/202	Composite	2-10 ft
HB-GBB-202	U1	20-22 ft
HB-GBB-203	U1	25-27 ft
HB-GBB-205	Composite	3-7 ft

GTX performed the following tests on these samples:

2 ASTM G51 - pH
2 ASTM G 57 - Electrical Resistivity (Laboratory)
3 ASTM D4318 - Atterberg Limits
3 Tube Handling and Log (density; moisture content; torvane; description)
3 ASTM D4767 - CU Triaxial Shear tests
3 ASTM D2435 - Incremental Consolidations
3 ASTM D4452 - X-Ray of Shelby Tubes - Digital Imaging

GTX also subcontracted Fugro Consultants, Inc. of Houston, TX to perform Sulfate analysis by ASTM D516 and Chloride analysis by ASTM D512 on two of these samples. See the attached Fugro test report for results.

A copy of your test request is attached.

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,



Ethan Marro
Assistant Laboratory Manager

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

Boston
Atlanta
Chicago
Los Angeles
New York

www.geotesting.com

Geotechnical Test Report **3/2/2017**

GTX-305885
Gorham, ME

Client Project No.: 1669139

Prepared for:

Golder Associates

Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/30/17
Tested By:	jbr
Checked By:	emm

pH of Soil by ASTM G51

Boring ID	Sample ID	Depth, ft	Description	pH Reading
HB-GBB-205	Composite	3-7	Moist, brown clayey sand	5.00
HB-GBB-201/202	Composite	2-10	Moist, dark brown clayey sand	5.82

Notes:

Client:	Golder Associates
Project:	Gorham, ME
Location:	---
GTX#:	305885
Test Date:	01/31/17
Tested By:	jbr
Checked By:	emm

Laboratory Measurement of Soil Resistivity Using the Wenner Four-Electrode Method by ASTM G57 (Laboratory Measurement)

Boring ID	Sample ID	Depth, ft.	Sample Description	Electrical Resistivity, ohm-cm	Electrical Conductivity, $(ohm\text{-}cm)^{-1}$
HB-GBB-205	Composite	3-7	Moist, brown clayey sand	2,583	3.87E-04
HB-GBB-201/202	Composite	2-10	Moist, dark brown clayey sand	1,033	9.68E-04

Notes: Test Equipment: Nilsson Model 400 Soil Resistance Meter, MC Miller Soil Box

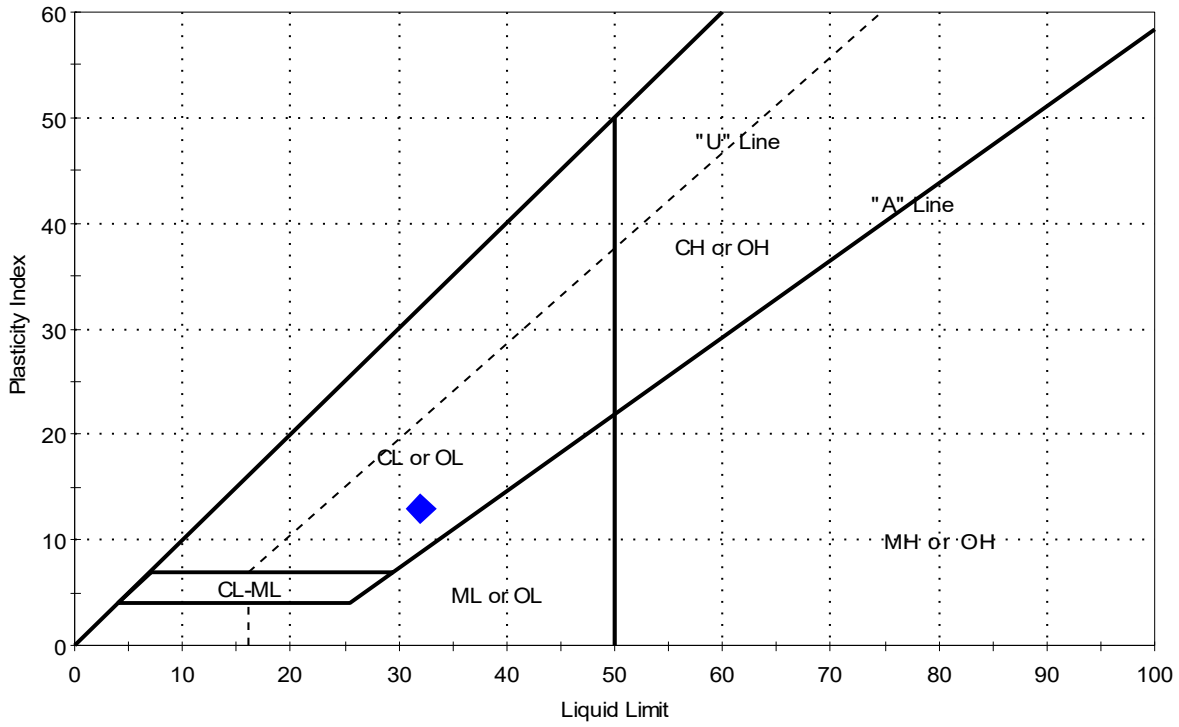
Water added to sample to create a thick slurry prior to testing (saturated condition).

Electrical Conductivity is calculated as inverse of Electrical Resistivity (per ASTM G57)

Test conducted in standard laboratory atmosphere: 68-73 F

Client:	Golder Associates				
Project:	Gorham, ME				
Location:	---			Project No:	GTX-305885
Boring ID:	HB-GBB-201	Sample Type:	tube	Tested By:	cam
Sample ID:	U2	Test Date:	01/31/17	Checked By:	emm
Depth :	35-37 ft	Test Id:	402891		
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
◆	U2	B-GBB-20	35-37 ft	31	32	19	13	0.9	

Sample Prepared using the WET method

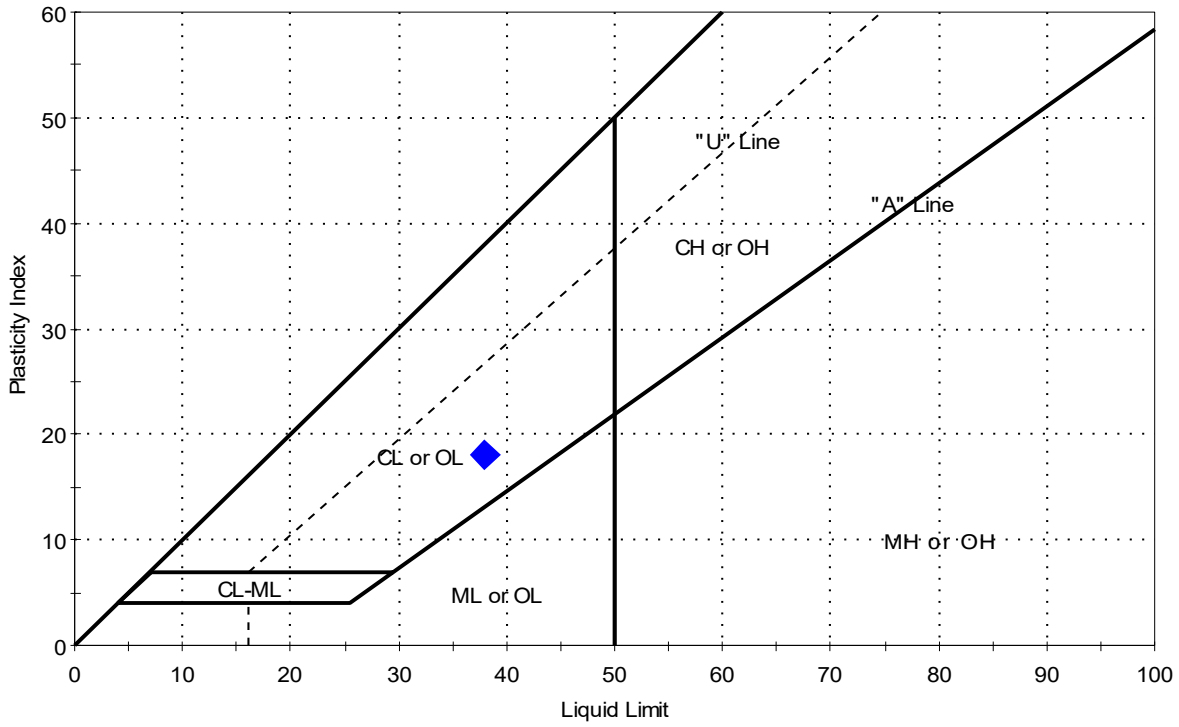
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Golder Associates				
Project:	Gorham, ME				
Location:	---			Project No:	GTX-305885
Boring ID:	HB-GBB-202	Sample Type:	tube	Tested By:	cam
Sample ID:	U1	Test Date:	01/31/17	Checked By:	emm
Depth :	20-22 ft	Test Id:	402892		
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
◆	U1	B-GBB-20	20-22 ft	40	38	20	18	1.1	

Sample Prepared using the WET method

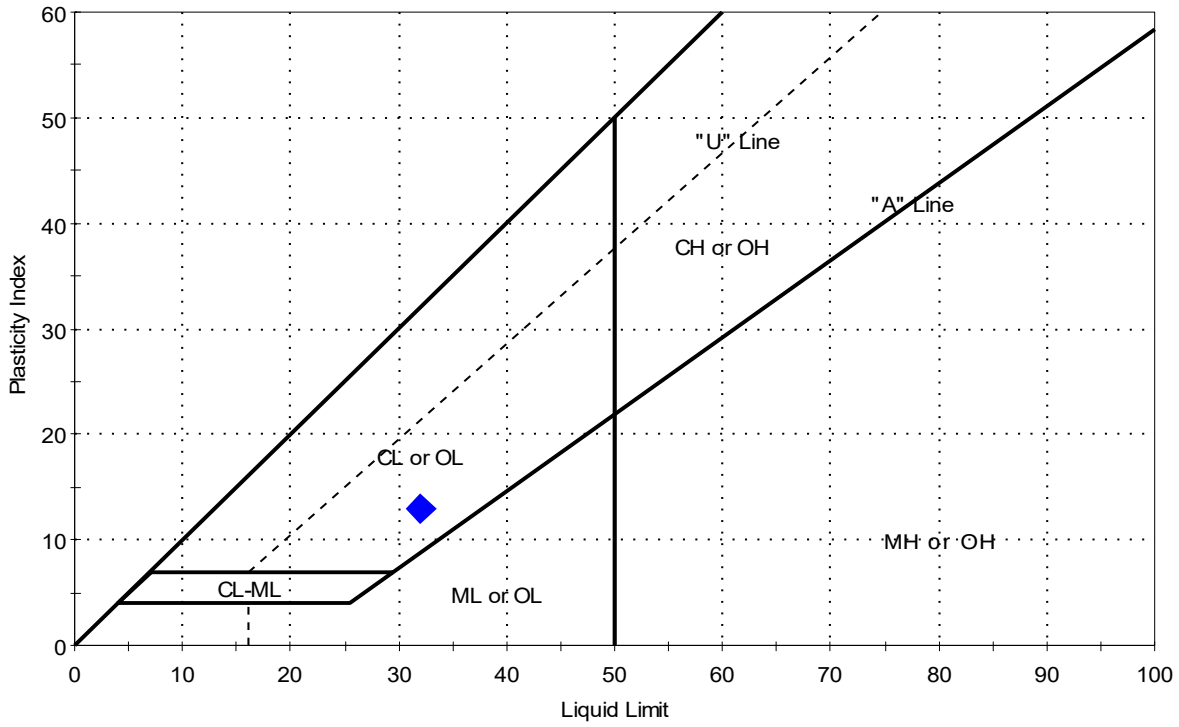
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Golder Associates				
Project:	Gorham, ME				
Location:	---			Project No:	GTX-305885
Boring ID:	HB-GBB-203	Sample Type:	tube	Tested By:	cam
Sample ID:	U1	Test Date:	01/27/17	Checked By:	emm
Depth :	25-27 ft	Test Id:	402893		
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
◆	U1	B-GBB-20	25-27 ft	38	32	19	13	1.5	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Golder Associates		
Project Name:	Gorham, ME		
Project Location:	---		
GTX #:	302234	Tested By:	md
Test Date:	08/26/14	Checked By:	emm

Tube Handling with Moisture Content (ASTM D2216), Density of Soil (ASTM D7263), Hand-Held Torvane, and Visual Description

Boring ID	Sample ID	Depth, ft	Section	Visual Description	Bulk Density, lb/ft^3	Moisture Content, %	Dry Density, lb/ft^3	Hand Held Torvane Readings, tsf			
								1	2	3	Average
HB-GBB-201	U2	35-37	Top	Moist, olive clay	111.6	35.6	82.3	0.20	0.22	0.23	0.22
			Middle	Moist, olive clay	128.0	30.6	98.0	0.22	0.20	0.23	0.22
			Bottom	Moist, olive clay	114.4	34.3	85.2	0.24	0.21	0.24	0.23
HB-GBB-202	U1	20-22	Top	Moist, olive clay	113.5	38.2	82.1	0.15	0.18	0.25	0.19
			Middle	Moist, olive clay	113.4	39.1	81.5	0.30	0.26	0.29	0.28
			Bottom	Moist, olive clay	115.4	39.6	82.7	0.15	0.16	0.18	0.16
HB-GBB-203	U1	25-27	Top	Wet, gray clay	109.7	45.0	75.7	0.19	0.18	0.22	0.20
			Middle	Wet, gray clay	107.6	46.6	73.4	0.19	0.17	0.20	0.19
			Bottom	Wet, gray clay	105.1	37.9	76.3	0.15	0.16	0.14	0.15

Notes: Density determined on undisturbed tube samples provided to GeoTesting Express in Shelby tubes
Moisture content determined by ASTM D2216 at 110^o C

FUGRO CONSULTANTS, INC.

6100 HILLCROFT
PHONE (713) 369-5400

HOUSTON, TEXAS 77081
FAX (713) 369-5518

RESULTS OF TESTS

PROJECT: GORHAM, ME (GTX 305885)
SAMPLE ID: HB-GBB 201/202 COMP 2 – 10'

FOR: GEOTESTING EXPRESS, INC.
125 NAGOG PARK ACTION, MA 01720

REPORTED TO: ETHAN MARRO

LAB NUMBER: 0130025

REPORT DATE: 02-02-17
CLIENT NUMBER:
JOB NUMBER: 04.1115-0003
REPORT NUMBER:
DATE SAMPLED:
TIME SAMPLED:
SAMPLED BY: CLIENT
DATE RECEIVED: 01-30-17
TIME RECEIVED: 1100
RECEIVED BY: SD

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
Sulfate, Soluble	297 *	mg/kg	ASTM D-516 **	1030/02-02-17	SD
Chloride, Soluble	700 *	mg/kg	ASTM D-512 **	1230/02-02-17	SD

SO4CL 012-17

Respectfully submitted,

* Dry weight basis

Steve DeGregorio
Chemist

SD

** WATER EXTRACTION PERFORMED BY USING A 1:10 RATIO OF SAMPLE AND REAGENT WATER FOLLOWED BY CENTRIFUGE AND VACUUME FILTRATION. THE WATER EXTRACT IS THEN ANALYZED USING THE ASTM D-512 AND D-516 METHODS.

THE RESULTS RELATE AS TO THE LOCATION TESTED AND NO OTHER REFERENCE SHALL BE MADE.
THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

END OF REPORT

FUGRO CONSULTANTS, INC.

6100 HILLCROFT
PHONE (713) 369-5400

HOUSTON, TEXAS 77081
FAX (713) 369-5518

RESULTS OF TESTS

PROJECT: GORHAM, ME (GTX 305885)
SAMPLE ID: HB-GBB 205 COMP 3 – 7'

FOR: GEOTESTING EXPRESS, INC.
125 NAGOG PARK ACTION, MA 01720

REPORTED TO: ETHAN MARRO

LAB NUMBER: 0130026

REPORT DATE: 02-02-17
CLIENT NUMBER:
JOB NUMBER: 04.1115-0003
REPORT NUMBER:
DATE SAMPLED:
TIME SAMPLED:
SAMPLED BY: CLIENT
DATE RECEIVED: 01-30-17
TIME RECEIVED: 1100
RECEIVED BY: SD

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
Sulfate, Soluble	165 *	mg/kg	ASTM D-516 **	1030/02-02-17	SD
Chloride, Soluble	330 *	mg/kg	ASTM D-512 **	1230/02-02-17	SD

SO4CL 012-17

Respectfully submitted,

* Dry weight basis

Steve DeGregorio
Chemist

SD

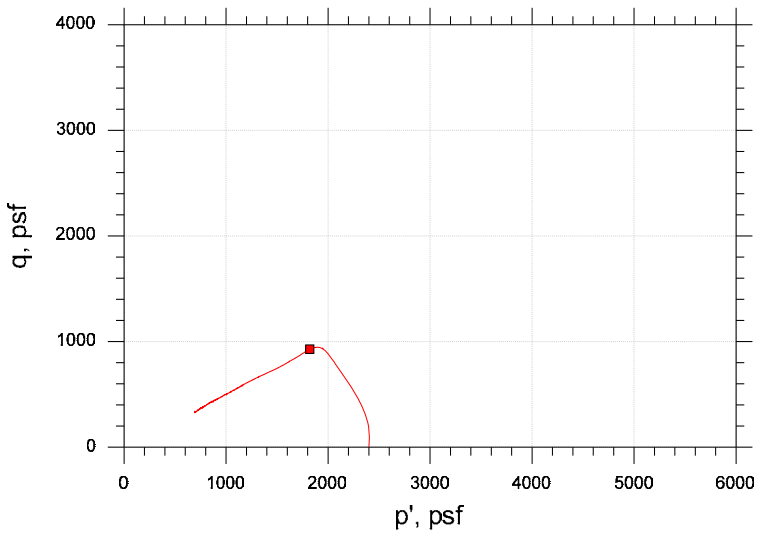
** WATER EXTRACTION PERFORMED BY USING A 1:10 RATIO OF SAMPLE AND REAGENT WATER FOLLOWED BY CENTRIFUGE AND VACUUME FILTRATION. THE WATER EXTRACT IS THEN ANALYZED USING THE ASTM D-512 AND D-516 METHODS.

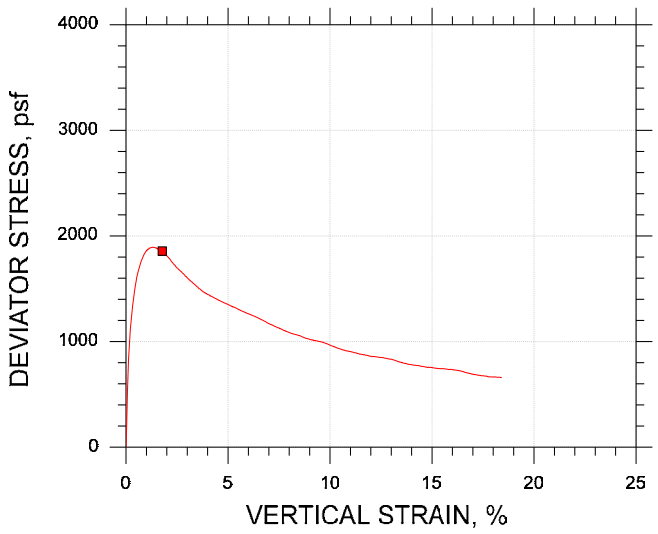
THE RESULTS RELATE AS TO THE LOCATION TESTED AND NO OTHER REFERENCE SHALL BE MADE.
THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

END OF REPORT

Client: Golder Associates	
Project Name: Gorham, ME	
Project Location: ---	
Project Number: GTX-305885	
Tested By: md	Checked By: mcm
Boring ID: HB-GBB-201	
Preparation: intact	
Description: Moist, olive clay	
Classification: ---	
Group Symbol: ---	
Liquid Limit: 32	Plastic Limit: 19
Plasticity Index: 13	Estimated Specific Gravity: 2.7

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





Symbol		■			
Sample ID		U2			
Depth, ft		35-37 ft			
Test Number		CU-2-1			
Initial	Height, in	6.100			
	Diameter, in	2.870			
	Moisture Content (from Cuttings), %	35.6			
	Dry Density, pcf	81.7			
	Saturation (Wet Method), %	90.3			
	Void Ratio	1.06			
Before Shear	Moisture Content, %	37.5			
	Dry Density, pcf	83.7			
	Cross-sectional Area (Method A), in²	6.354			
	Saturation, %	100.0			
	Void Ratio	1.01			
	Back Pressure, psf	2.146e+004			
Vertical Effective Consolidation Stress, psf		2395.			
Horizontal Effective Consolidation Stress, psf		2400.			
Vertical Strain after Consolidation, %		0.7016			
Volumetric Strain after Consolidation, %		2.525			
Time to 50% Consolidation, min		121.0			
Shear Strength, psf		928.2			
Strain at Failure, %		1.78			
Strain Rate, %/min		0.01600			
Deviator Stress at Failure, psf		1856.			
Effective Minor Principal Stress at Failure, psf		892.8			
Effective Major Principal Stress at Failure, psf		2749.			
B-Value		0.95			

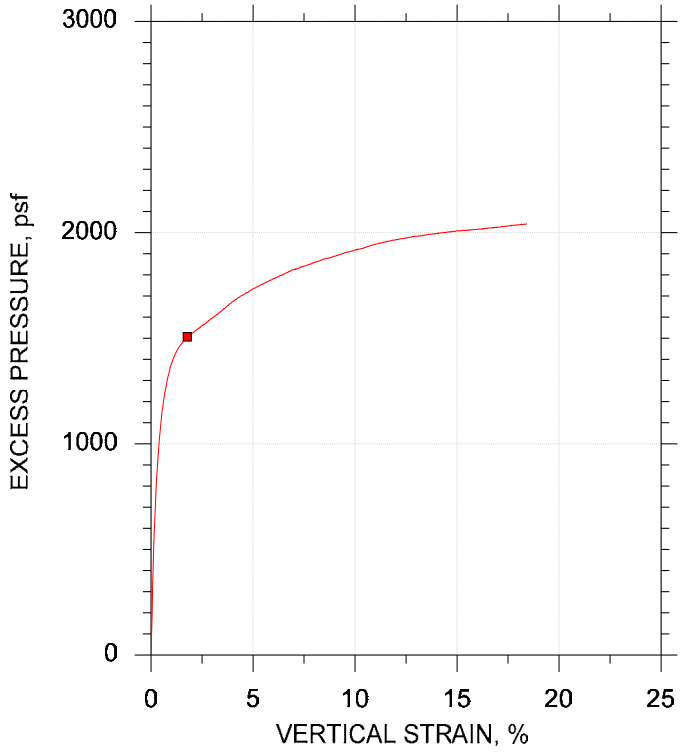
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Atterberg Limits determined by ASTM D4318.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

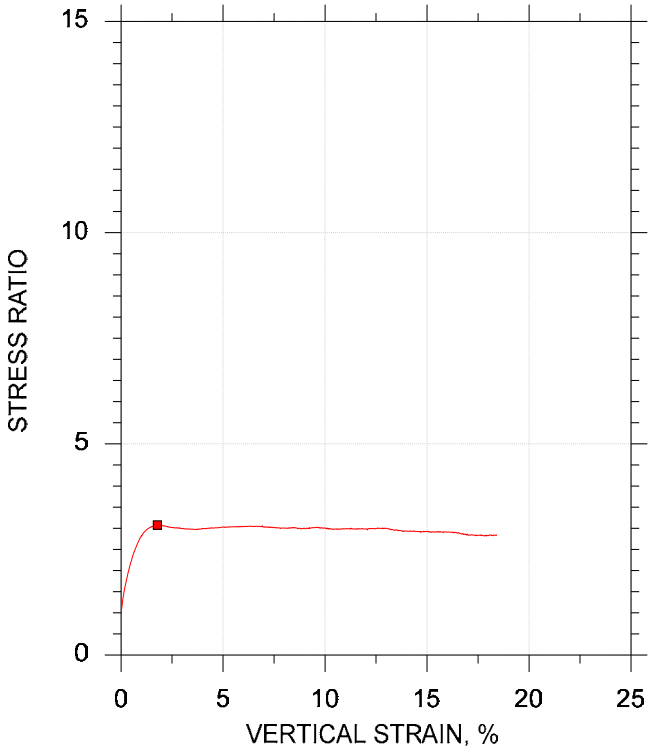
Remarks:

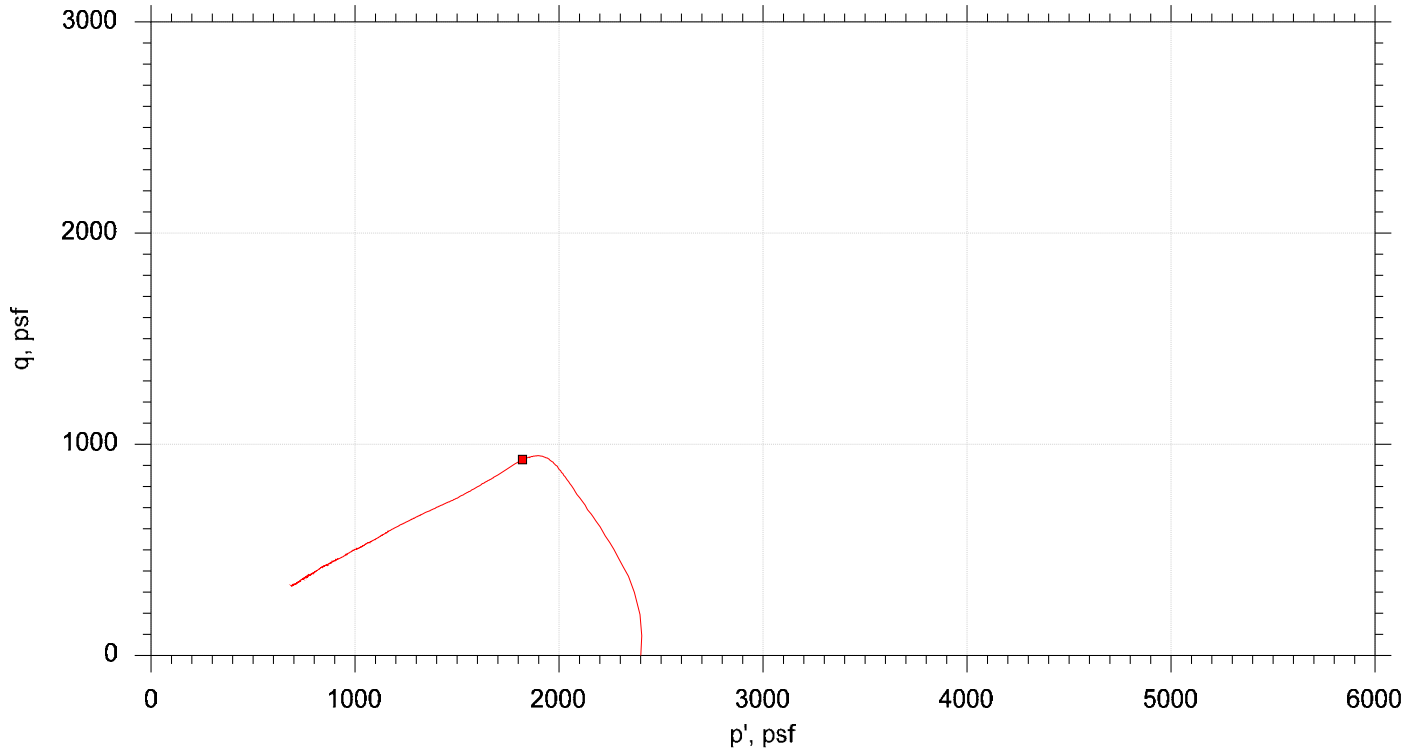


System D

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







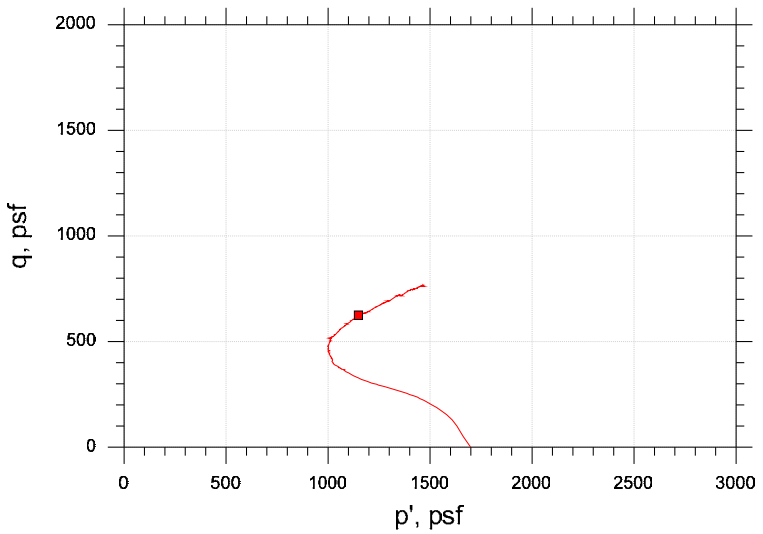
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	U2	CU-2-1	35-37 ft	md	01/30/17	mcm	2/3/17	305885-CU-2-1m.dat

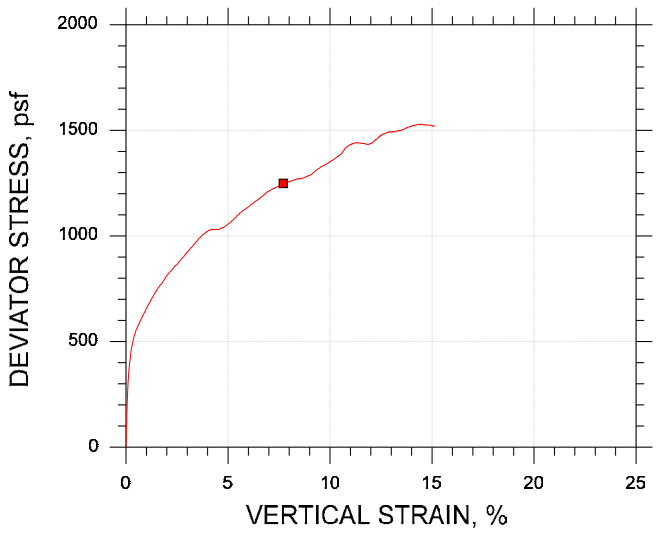
GeoTesting EXPRESS

Project: Gorham, ME	Location: ---	Project No.: GTX-305885
Boring No.: HB-GBB-201	Sample Type: intact	
Description: Moist, olive clay		
Remarks: System D		

Client: Golder Associates	
Project Name: Gorham, ME	
Project Location: ---	
Project Number: GTX-305885	
Tested By: md	Checked By: mcm
Boring ID: HB-GBB-202	
Preparation: intact	
Description: Moist, olive clay	
Classification: ---	
Group Symbol: ---	
Liquid Limit: 38	Plastic Limit: 20
Plasticity Index: 18	Estimated Specific Gravity: 2.7

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767

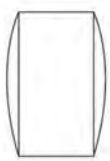




Symbol		■			
Sample ID		U1			
Depth, ft		20-22 ft			
Test Number		CU-3-1			
Initial	Height, in	6.120			
	Diameter, in	2.880			
	Moisture Content (from Cuttings), %	38.2			
	Dry Density, pcf	82.3			
	Saturation (Wet Method), %	98.4			
	Void Ratio	1.05			
Before Shear	Moisture Content, %	34.3			
	Dry Density, pcf	87.5			
	Cross-sectional Area (Method A), in²	6.185			
	Saturation, %	100.0			
	Void Ratio	0.927			
	Back Pressure, psf	1.195e+004			
Vertical Effective Consolidation Stress, psf		1692.			
Horizontal Effective Consolidation Stress, psf		1698.			
Vertical Strain after Consolidation, %		0.7723			
Volumetric Strain after Consolidation, %		5.525			
Time to 50% Consolidation, min		441.0			
Shear Strength, psf		624.4			
Strain at Failure, %		7.70			
Strain Rate, %/min		0.01600			
Deviator Stress at Failure, psf		1249.			
Effective Minor Principal Stress at Failure, psf		524.5			
Effective Major Principal Stress at Failure, psf		1773.			
B-Value		0.95			

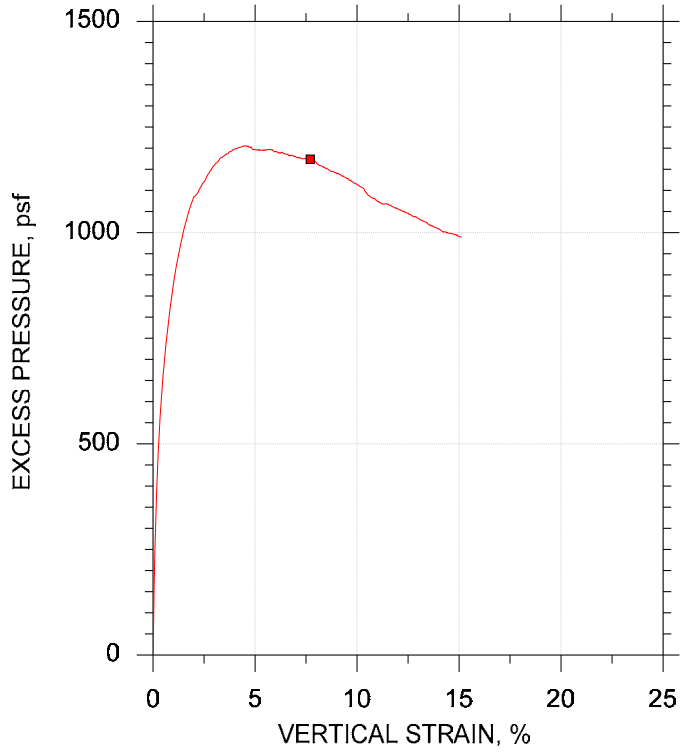
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Atterberg Limits determined by ASTM D4318.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

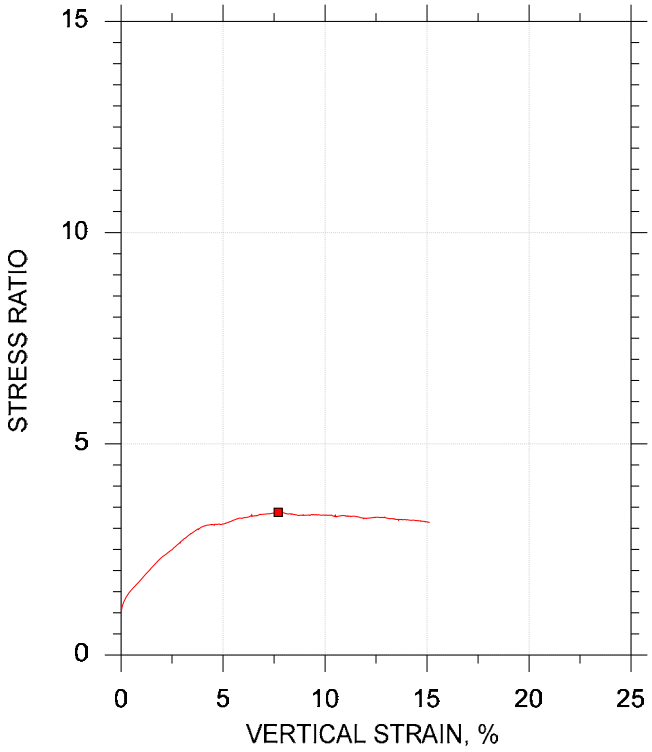
Remarks:

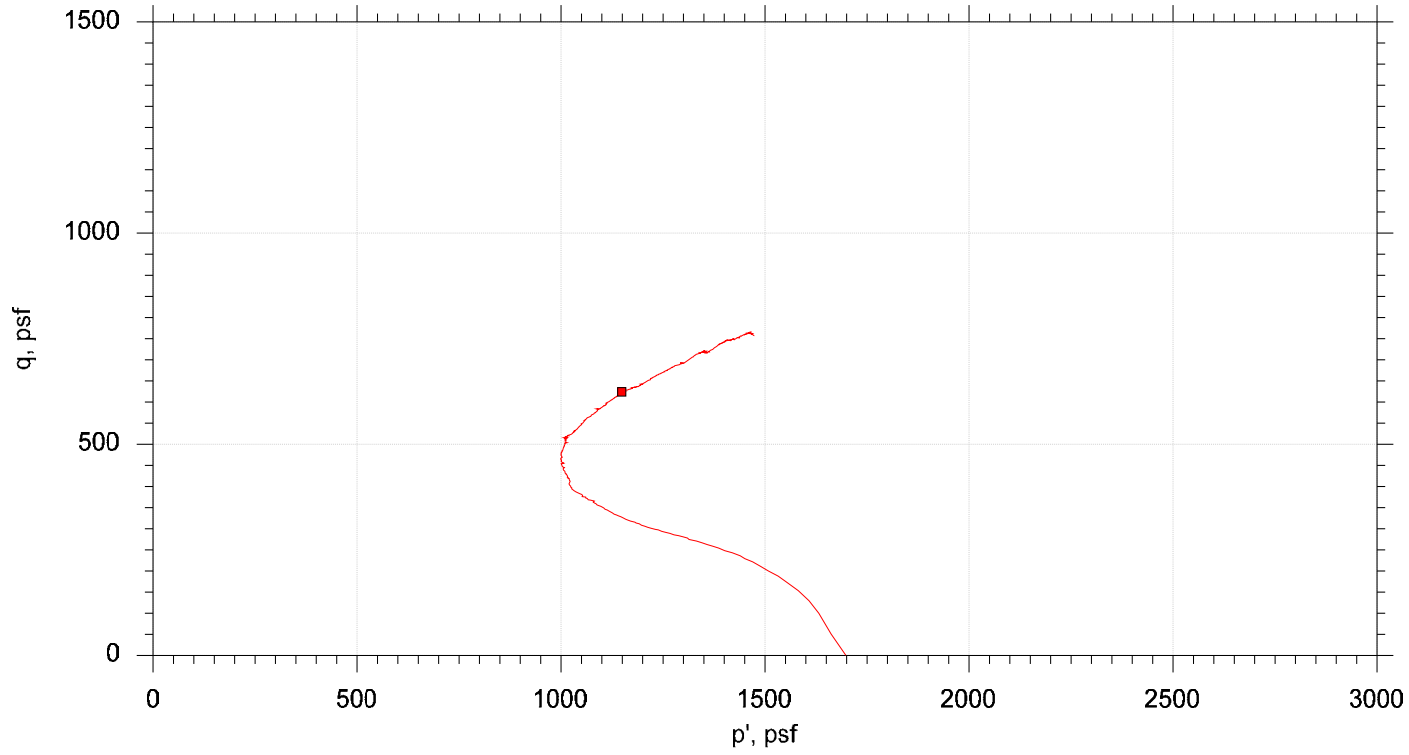


System B

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







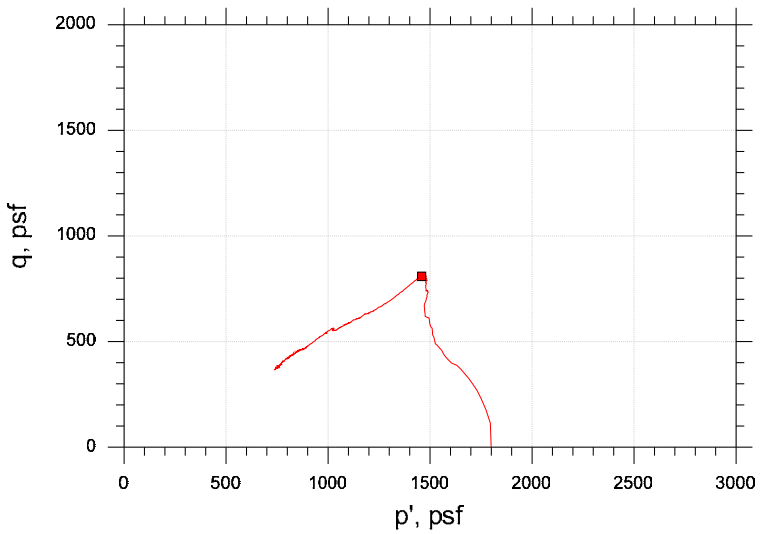
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	U1	CU-3-**1**	20-22 ft	md	01/30/17	mcm	2/3/17	305885-CU-3-1m.dat

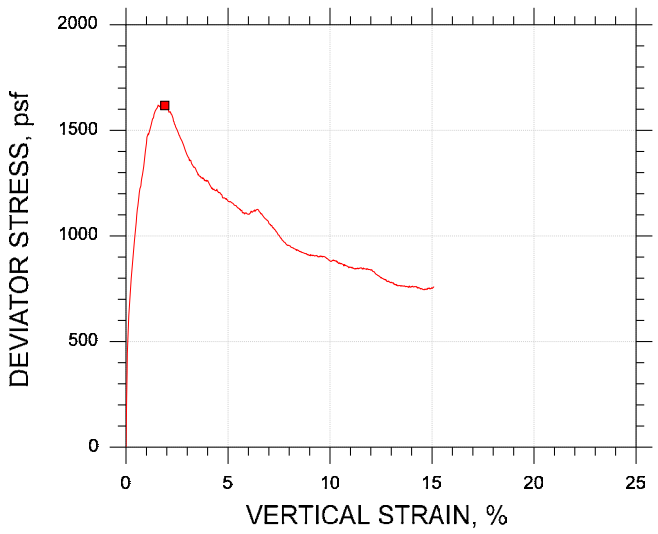
GeoTesting EXPRESS

Project: Gorham, ME	Location: ---	Project No.: GTX-305885
Boring No.: HB-GBB-202	Sample Type: intact	
Description: Moist, olive clay		
Remarks: System B		

Client: Golder Associates	
Project Name: Gorham ME	
Project Location: ---	
Project Number: GTX-305885	
Tested By: md	Checked By: mcm
Boring ID: HB-GBB-203	
Preparation: intact	
Description: Wet, gray clay	
Classification: ---	
Group Symbol: ---	
Liquid Limit: 32	Plastic Limit: 19
Plasticity Index: 13	Estimated Specific Gravity: 2.7

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767

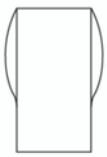




Symbol		■			
Sample ID		U1			
Depth, ft		25-27 ft			
Test Number		CU-1-1			
Initial	Height, in	4.300			
	Diameter, in	2.030			
	Moisture Content (from Cuttings), %	46.6			
	Dry Density, pcf	71.9			
	Saturation (Wet Method), %	93.8			
	Void Ratio	1.34			
Before Shear	Moisture Content, %	47.5			
	Dry Density, pcf	73.8			
	Cross-sectional Area (Method A), in²	3.178			
	Saturation, %	100.0			
	Void Ratio	1.28			
	Back Pressure, psf	1.940e+004			
Vertical Effective Consolidation Stress, psf		1793.			
Horizontal Effective Consolidation Stress, psf		1799.			
Vertical Strain after Consolidation, %		0.5918			
Volumetric Strain after Consolidation, %		2.017			
Time to 50% Consolidation, min		30.25			
Shear Strength, psf		808.9			
Strain at Failure, %		1.90			
Strain Rate, %/min		0.01600			
Deviator Stress at Failure, psf		1618.			
Effective Minor Principal Stress at Failure, psf		649.8			
Effective Major Principal Stress at Failure, psf		2268.			
B-Value		0.95			

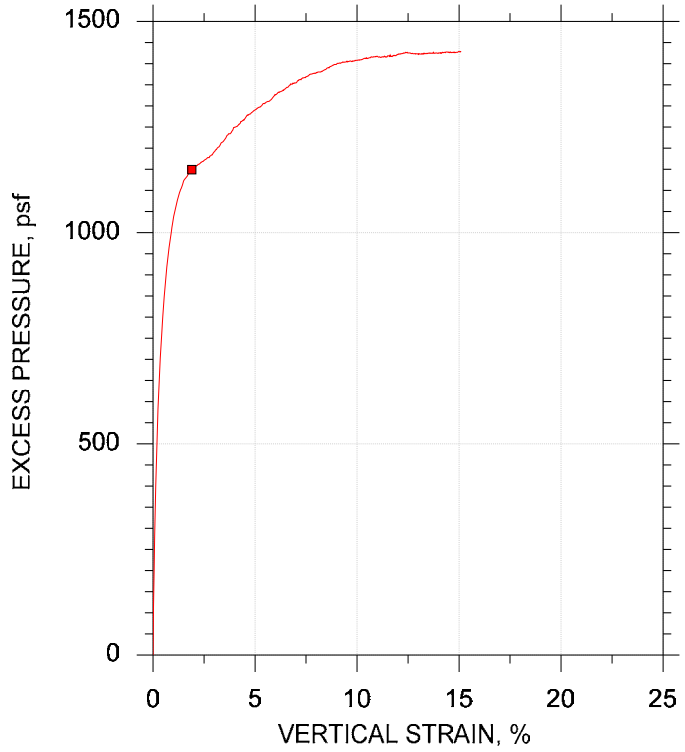
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Atterberg Limits determined by ASTM D4318.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

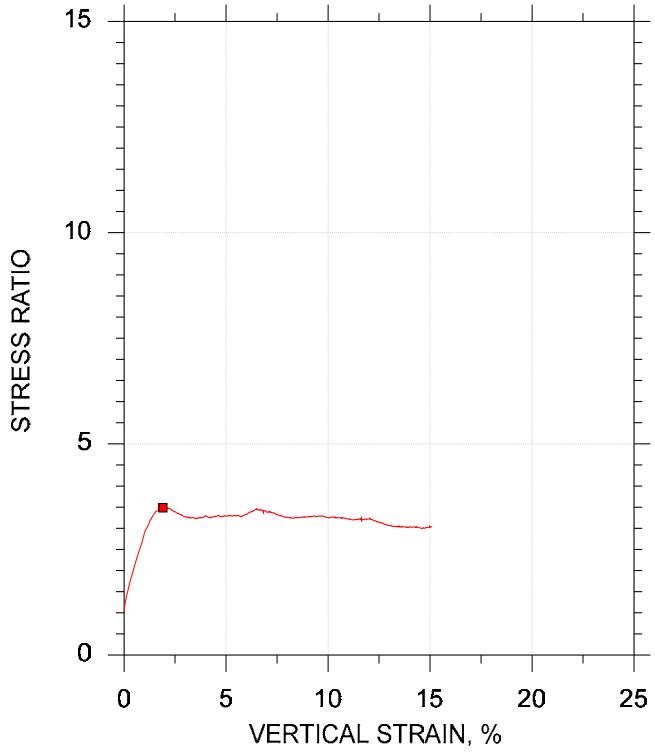
Remarks:

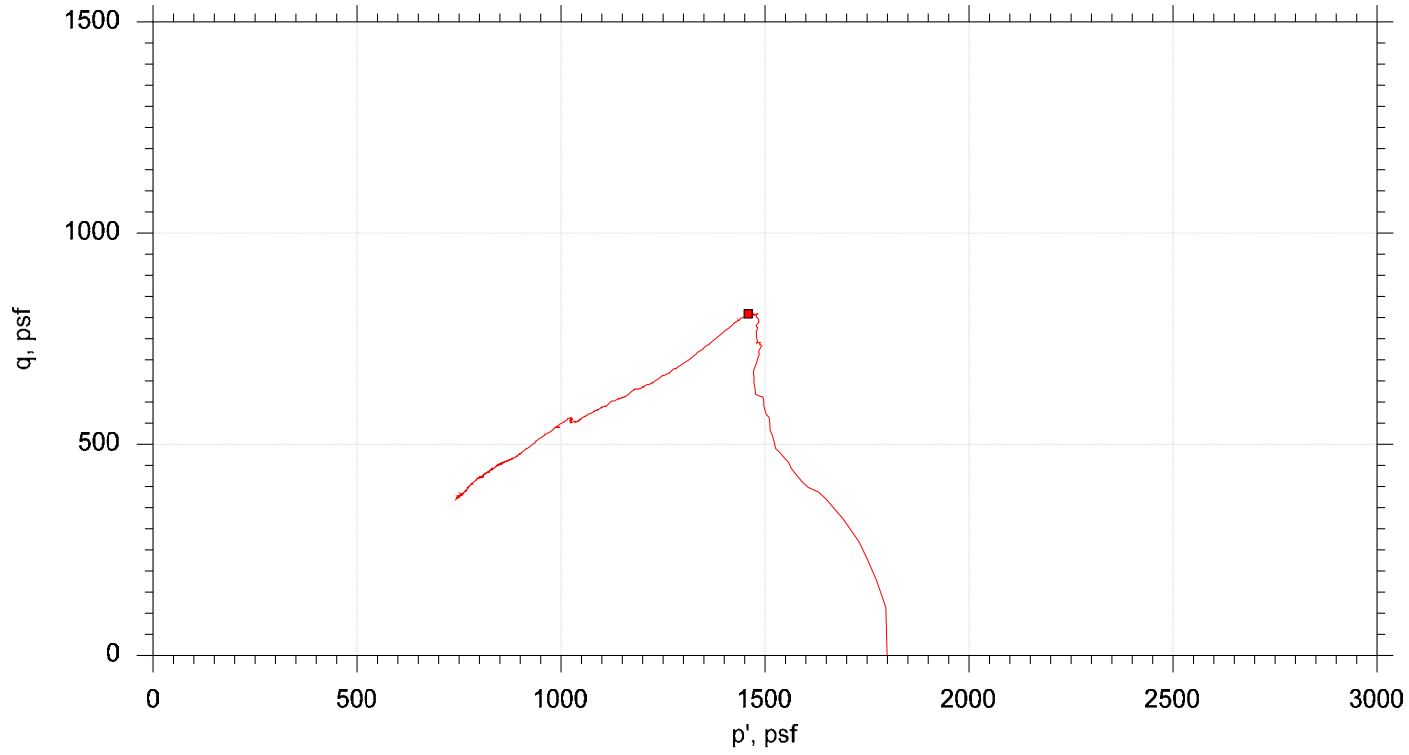


System B

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







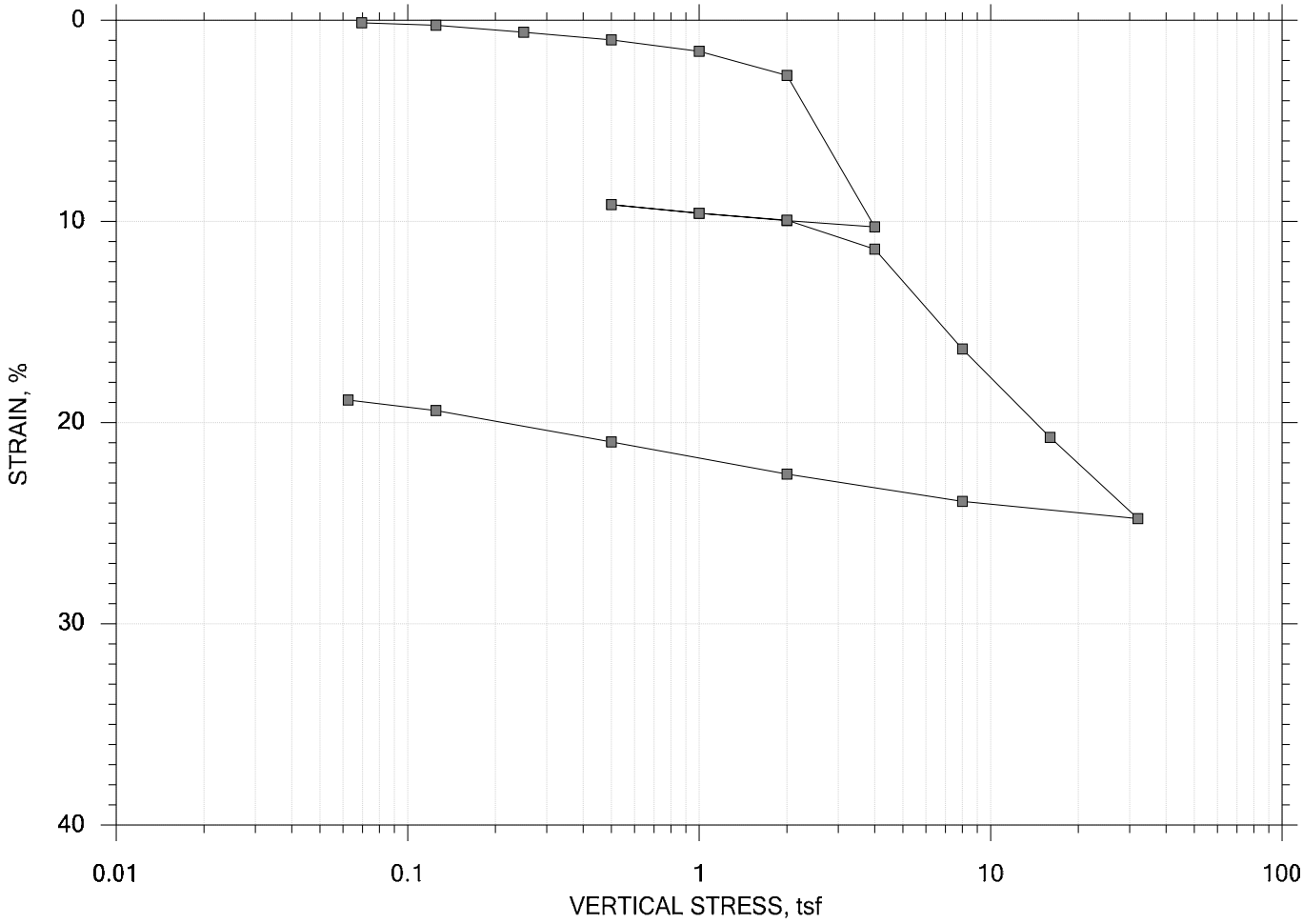
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	U1	CU-1-1	25-27 ft	md	1/28/17	mcm	2/3/17	305885-CU-1-1m.dat

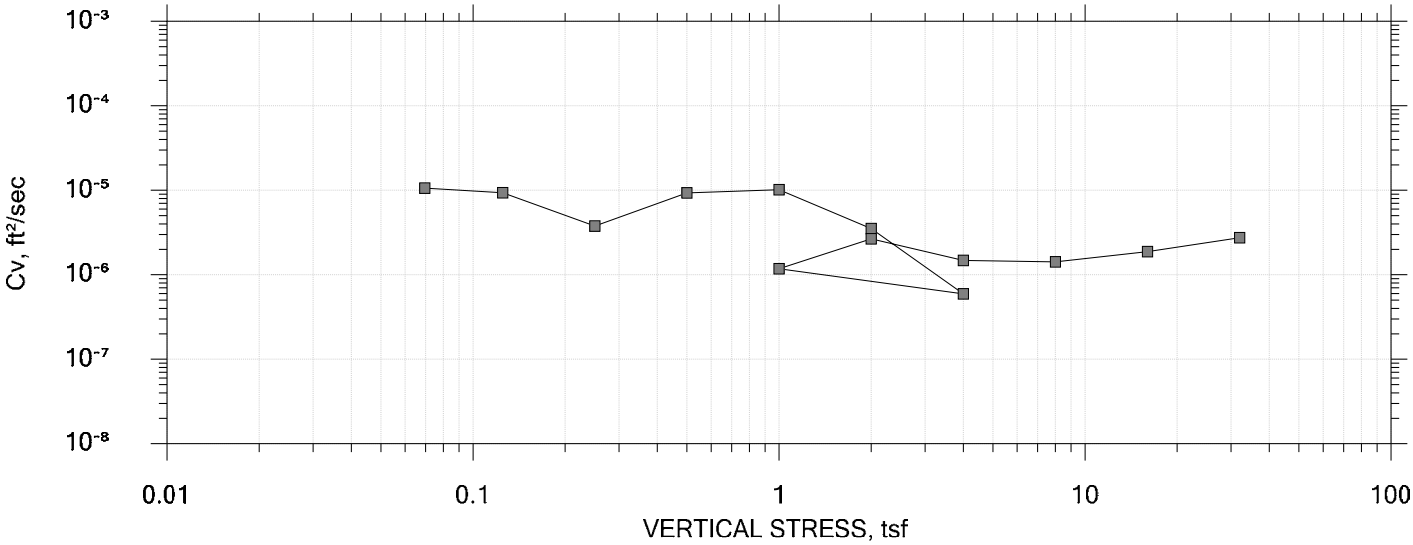
GeoTesting EXPRESS

Project: Gorham ME	Location: ---	Project No.: GTX-305885
Boring No.: HB-GBB-203	Sample Type: intact	
Description: Wet, gray clay		
Remarks: System B		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

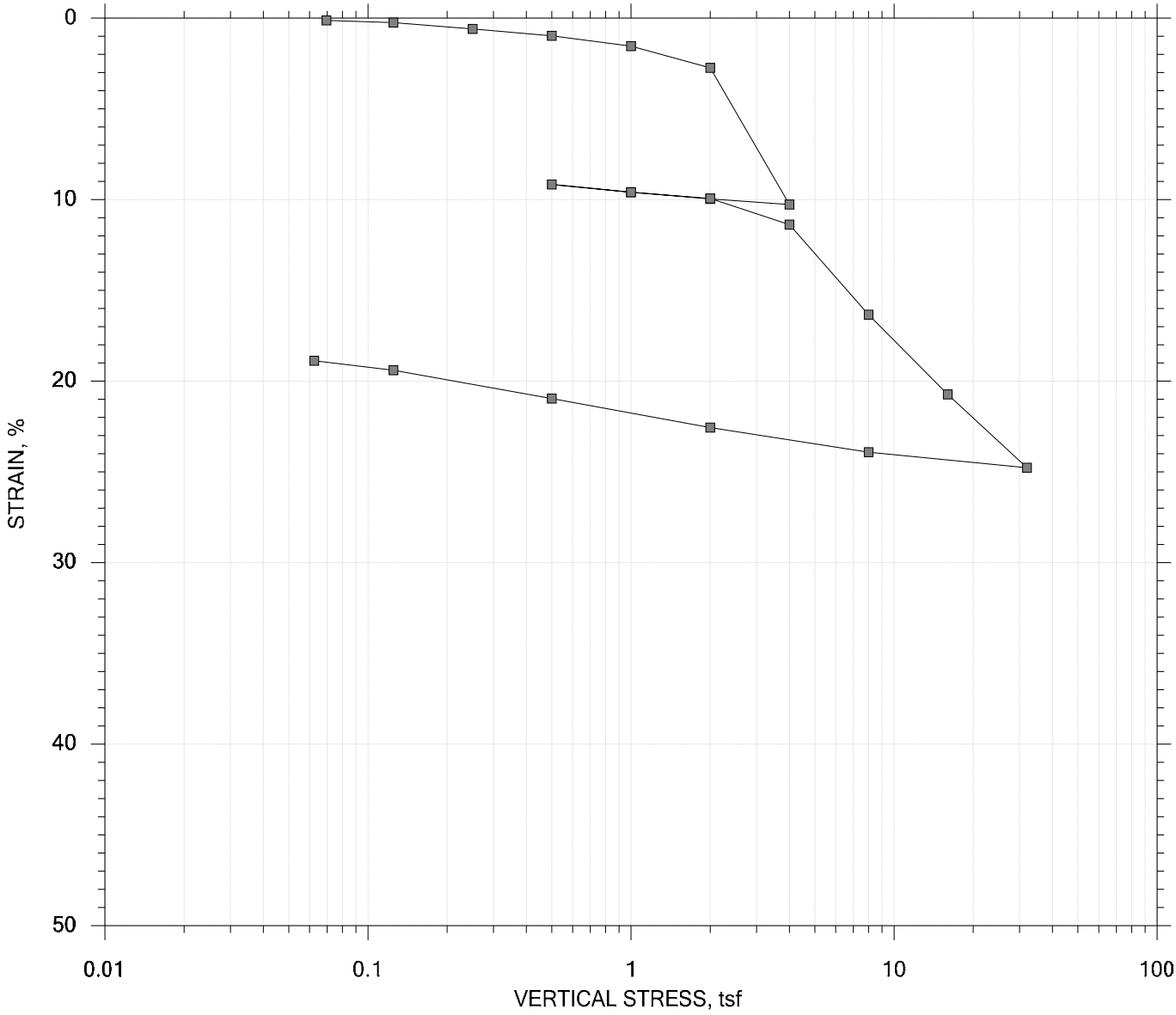




GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



				Before Test	After Test
Current Vertical Effective Stress: ---				Water Content, %	39.01	24.90
Preconsolidation Stress: ---				Dry Unit Weight, pcf	82.972	102.43
Compression Ratio: ---				Saturation, %	99.54	100.00
Diameter: 2.5 in		Height: 1 in		Void Ratio	1.09	0.69
LL: 32	PL: 19	PI: 13	GS: 2.77			

GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
Sample No.: U2	Test Date: 01/27/17	Depth: 35-37 ft
Test No.: IP-2	Sample Type: intact	Elevation: ---

Soil Description: Moist, olive clay
Remarks: System R, Swell Pressure = 0.0695 tsf

Estimated Specific Gravity: 2.77	Liquid Limit: 32	Specimen Diameter: 2.50 in
Initial Void Ratio: 1.09	Plastic Limit: 19	Initial Height: 1.00 in
Final Void Ratio: 0.691	Plasticity Index: 13	Final Height: 0.81 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	A-985	RING		C-1239
Wt. Container + Wet Soil, gm	130.09	260.14	245.05	143.18
Wt. Container + Dry Soil, gm	99.010	218.43	218.43	116.30
Wt. Container, gm	8.4500	111.52	111.52	8.3400
Wt. Dry Soil, gm	90.560	106.91	106.91	107.96
Water Content, %	34.32	39.01	24.90	24.90
Void Ratio	---	1.09	0.691	---
Degree of Saturation, %	---	99.54	100.00	---
Dry Unit Weight, pcf	---	82.972	102.43	---

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

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham, ME
Boring No.: HB-GBB-201
Sample No.: U2
Test No.: IP-2

Location: Gorham, ME
Tested By: md
Test Date: 01/27/17
Sample Type: intact

Project No.: GTX-305885
Checked By: jdt
Depth: 35-37 ft
Elevation: ---

Soil Description: Moist, olive clay
Remarks: System R, Swell Pressure = 0.0695 tsf

Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/sec	Mv 1/tsf	k ft/day
1	0.0695	0.001257	1.08	0.126	2.720	9.01e-006	1.81e-002	4.40e-004
2	0.125	0.002458	1.08	0.246	3.280	7.45e-006	2.16e-002	4.35e-004
3	0.250	0.005914	1.07	0.591	7.342	3.31e-006	2.76e-002	2.47e-004
4	0.500	0.009733	1.07	0.973	3.177	7.60e-006	1.53e-002	3.13e-004
5	1.00	0.01542	1.06	1.54	2.503	9.56e-006	1.14e-002	2.93e-004
6	2.00	0.02743	1.03	2.74	8.141	2.89e-006	1.20e-002	9.34e-005
7	4.00	0.1027	0.873	10.3	29.080	7.38e-007	3.76e-002	7.49e-005
8	2.00	0.09962	0.879	9.96	1.233	1.61e-005	1.54e-003	6.66e-005
9	1.00	0.09590	0.887	9.59	3.601	5.55e-006	3.72e-003	5.57e-005
10	0.500	0.09160	0.896	9.16	24.701	8.16e-007	8.58e-003	1.89e-005
11	1.00	0.09593	0.887	9.59	15.684	1.28e-006	8.65e-003	3.00e-005
12	2.00	0.09938	0.880	9.94	8.861	2.25e-006	3.45e-003	2.10e-005
13	4.00	0.1137	0.850	11.4	15.875	1.23e-006	7.17e-003	2.39e-005
14	8.00	0.1634	0.746	16.3	13.964	1.30e-006	1.24e-002	4.36e-005
15	16.0	0.2073	0.655	20.7	8.127	2.00e-006	5.49e-003	2.97e-005
16	32.0	0.2477	0.570	24.8	5.330	2.75e-006	2.53e-003	1.87e-005
17	8.00	0.2391	0.588	23.9	1.189	1.18e-005	3.59e-004	1.14e-005
18	2.00	0.2255	0.617	22.6	7.368	1.96e-006	2.26e-003	1.20e-005
19	0.500	0.2096	0.650	21.0	42.465	3.54e-007	1.06e-002	1.01e-005
20	0.125	0.1940	0.682	19.4	161.279	9.69e-008	4.16e-002	1.09e-005
21	0.0625	0.1888	0.693	18.9	0.000	0.00e+000	8.42e-002	0.00e+000

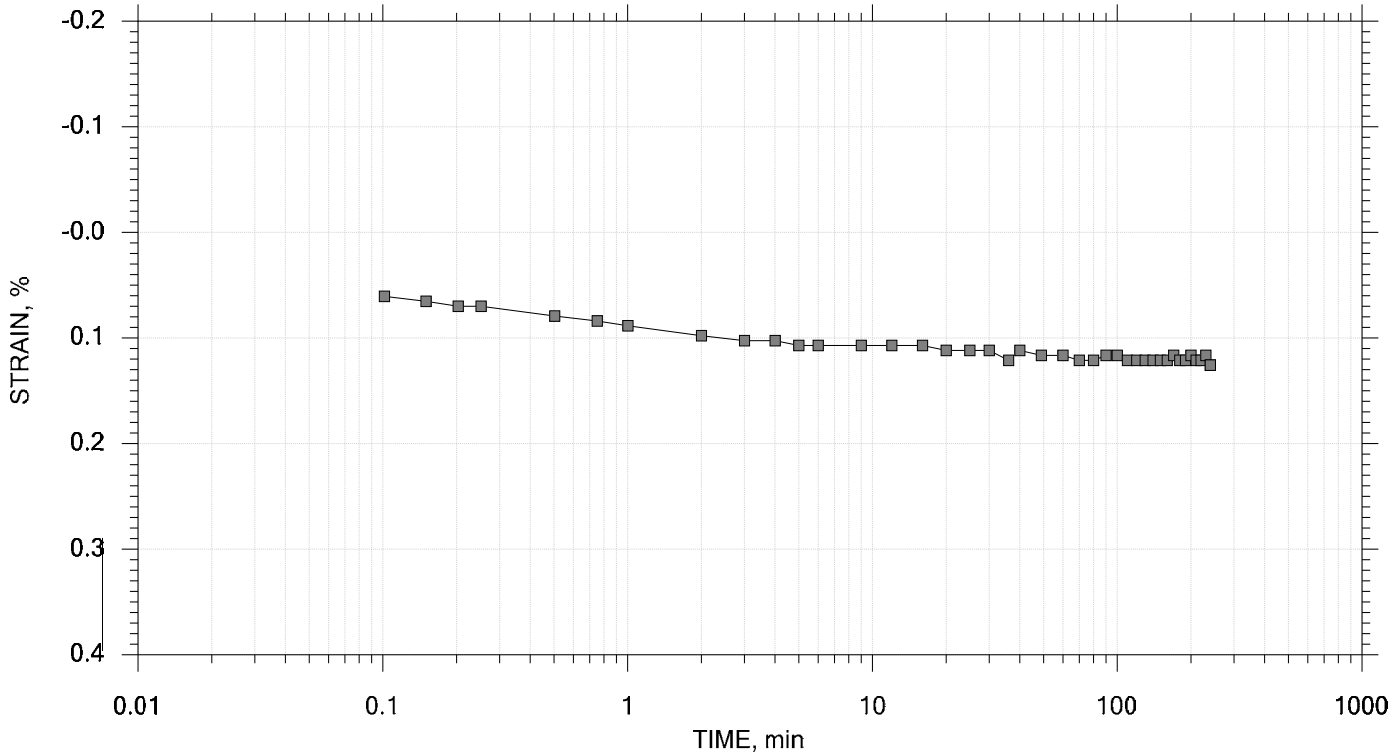
	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/sec	Mv 1/tsf	k ft/day	Ca %
1	0.0695	0.001257	1.08	0.126	0.000	0.00e+000	1.81e-002	0.00e+000	0.00e+000
2	0.125	0.002458	1.08	0.246	0.000	0.00e+000	2.16e-002	0.00e+000	0.00e+000
3	0.250	0.005914	1.07	0.591	0.000	0.00e+000	2.76e-002	0.00e+000	0.00e+000
4	0.500	0.009733	1.07	0.973	0.000	0.00e+000	1.53e-002	0.00e+000	0.00e+000
5	1.00	0.01542	1.06	1.54	0.546	1.02e-005	1.14e-002	3.12e-004	0.00e+000
6	2.00	0.02743	1.03	2.74	0.000	0.00e+000	1.20e-002	0.00e+000	0.00e+000
7	4.00	0.1027	0.873	10.3	10.145	4.91e-007	3.76e-002	4.98e-005	0.00e+000
8	2.00	0.09962	0.879	9.96	0.000	0.00e+000	1.54e-003	0.00e+000	0.00e+000
9	1.00	0.09590	0.887	9.59	0.000	0.00e+000	3.72e-003	0.00e+000	0.00e+000
10	0.500	0.09160	0.896	9.16	0.000	0.00e+000	8.58e-003	0.00e+000	0.00e+000
11	1.00	0.09593	0.887	9.59	0.000	0.00e+000	8.65e-003	0.00e+000	0.00e+000
12	2.00	0.09938	0.880	9.94	1.703	2.72e-006	3.45e-003	2.53e-005	0.00e+000
13	4.00	0.1137	0.850	11.4	0.000	0.00e+000	7.17e-003	0.00e+000	0.00e+000
14	8.00	0.1634	0.746	16.3	2.866	1.48e-006	1.24e-002	4.94e-005	0.00e+000
15	16.0	0.2073	0.655	20.7	2.199	1.72e-006	5.49e-003	2.55e-005	0.00e+000
16	32.0	0.2477	0.570	24.8	1.308	2.60e-006	2.53e-003	1.77e-005	0.00e+000
17	8.00	0.2391	0.588	23.9	0.000	0.00e+000	3.59e-004	0.00e+000	0.00e+000
18	2.00	0.2255	0.617	22.6	1.899	1.77e-006	2.26e-003	1.08e-005	0.00e+000
19	0.500	0.2096	0.650	21.0	7.885	4.43e-007	1.06e-002	1.27e-005	0.00e+000
20	0.125	0.1940	0.682	19.4	41.153	8.82e-008	4.16e-002	9.90e-006	0.00e+000
21	0.0625	0.1888	0.693	18.9	0.000	0.00e+000	8.42e-002	0.00e+000	0.00e+000

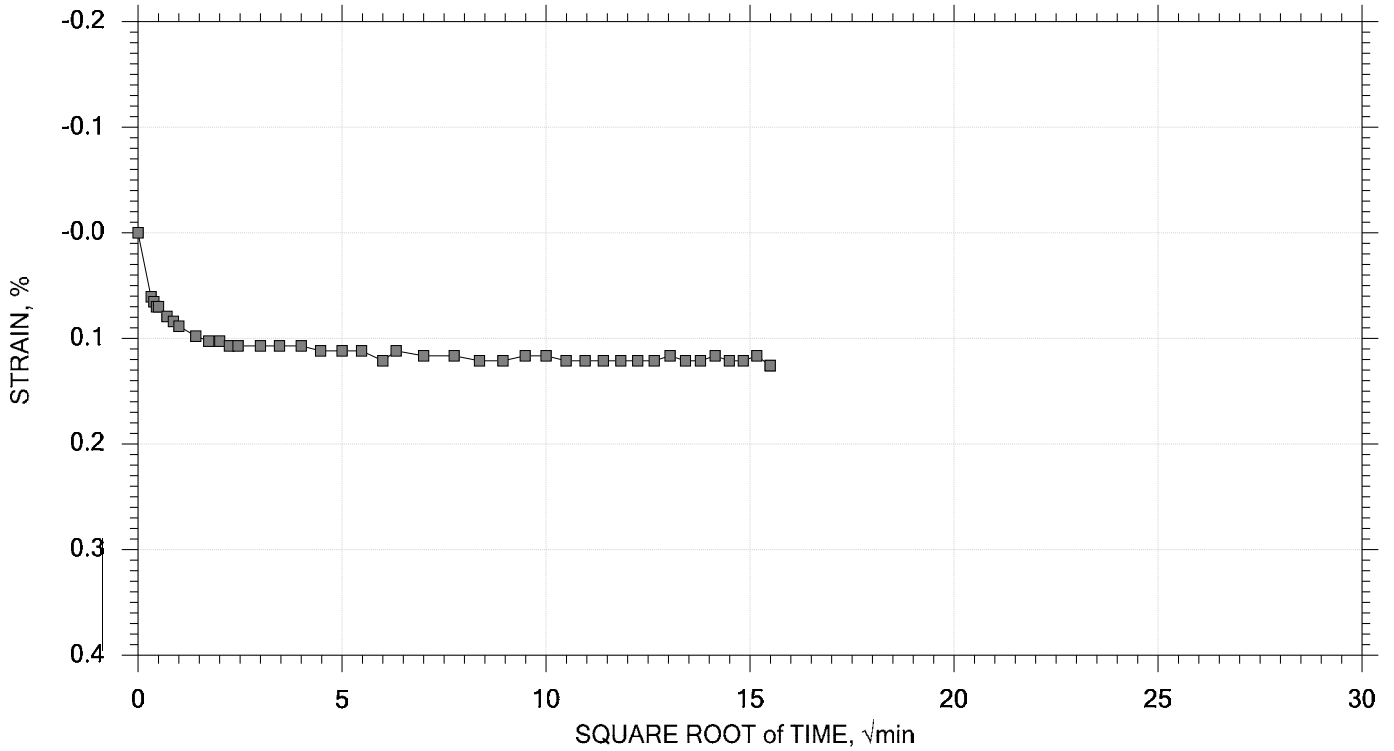
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 21

Stress: 0.06952 tsf





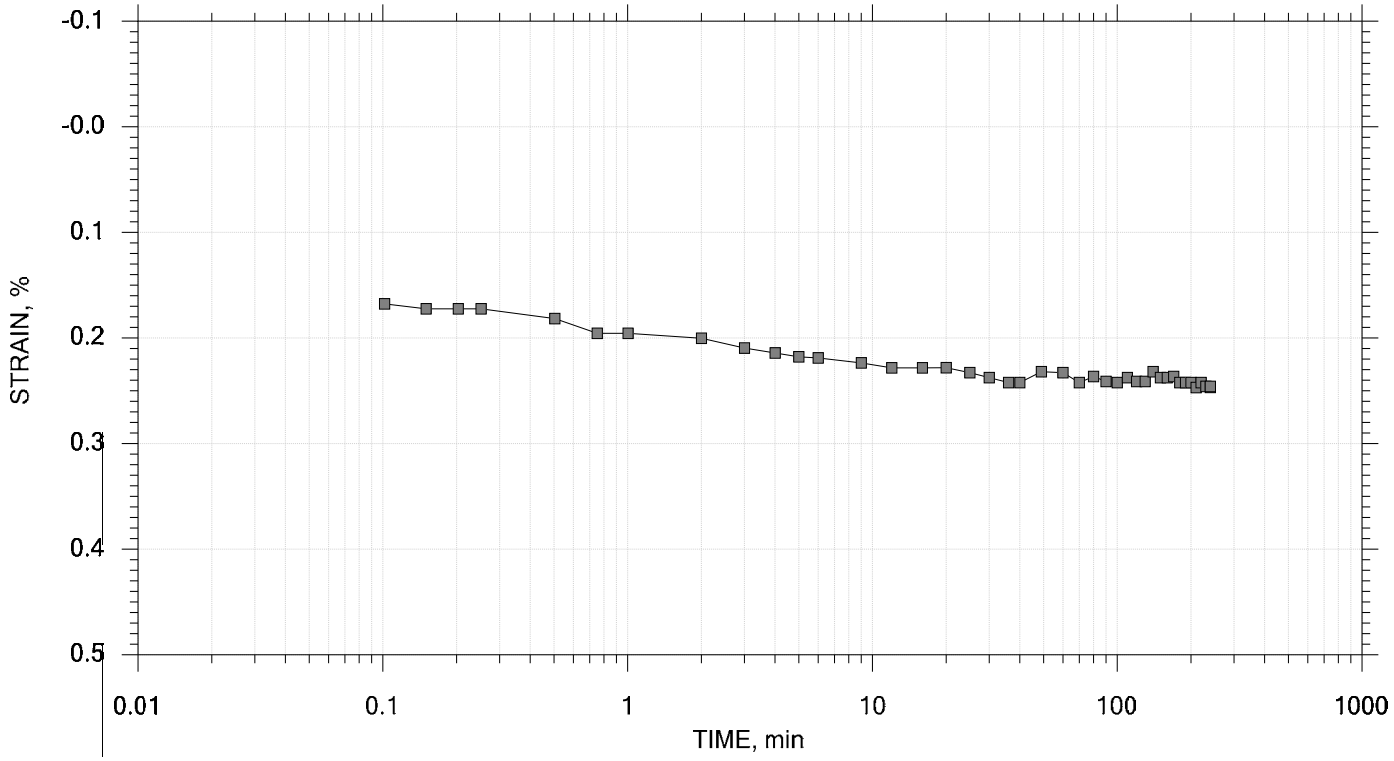
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

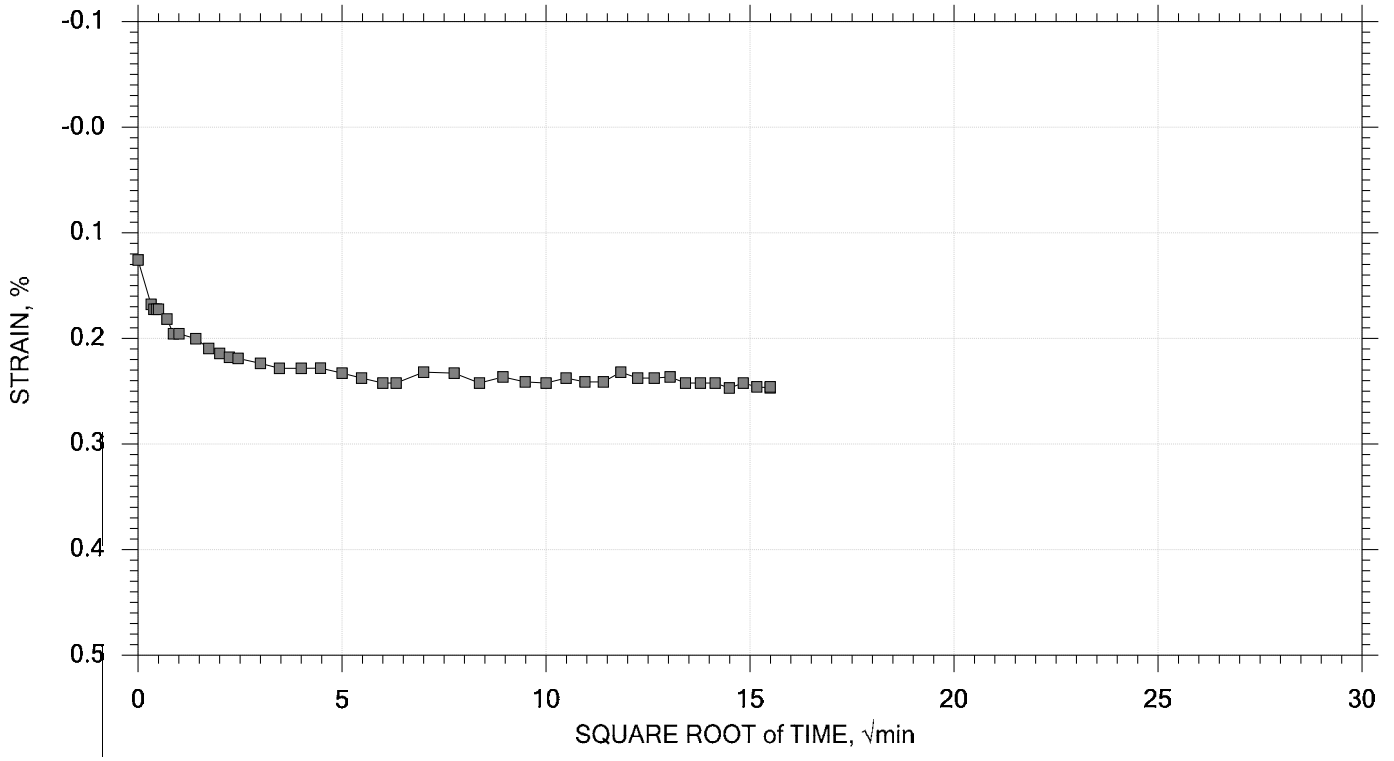
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 21

Stress: 0.125 tsf





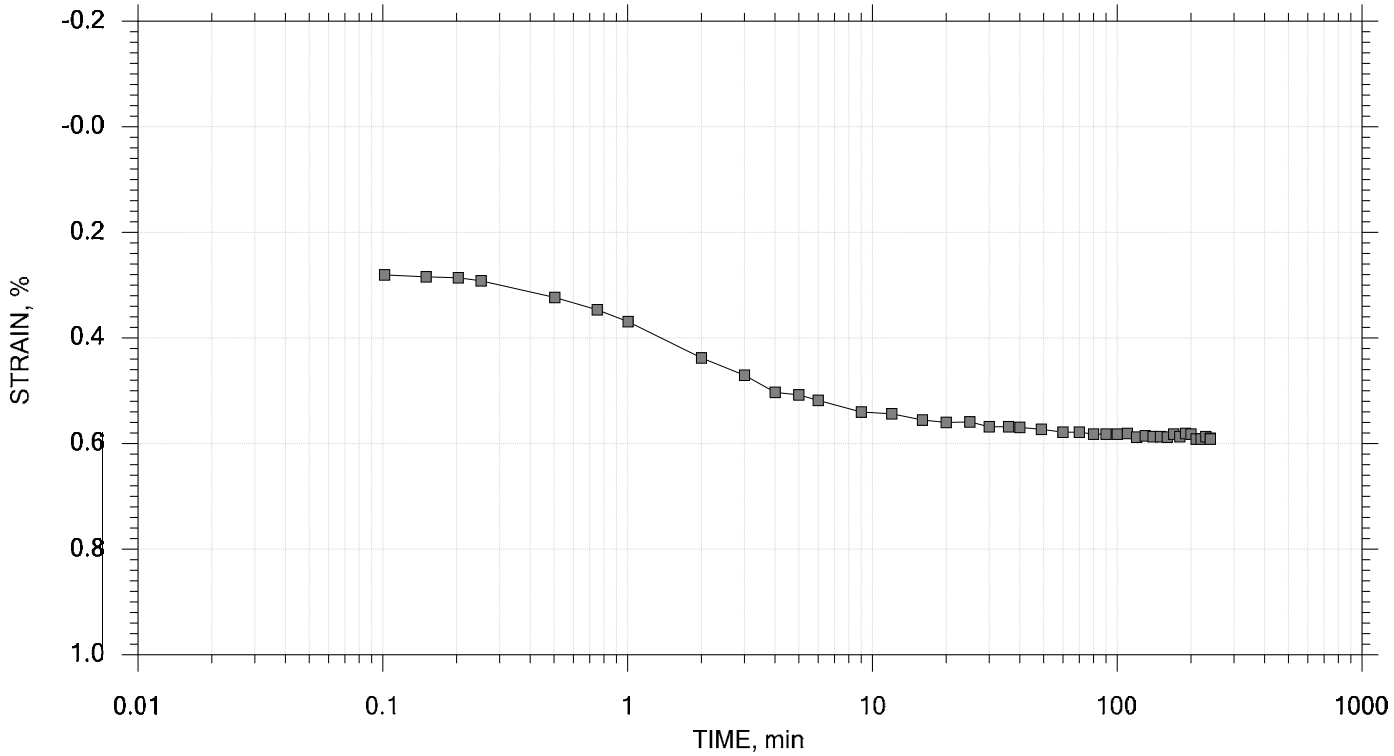
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

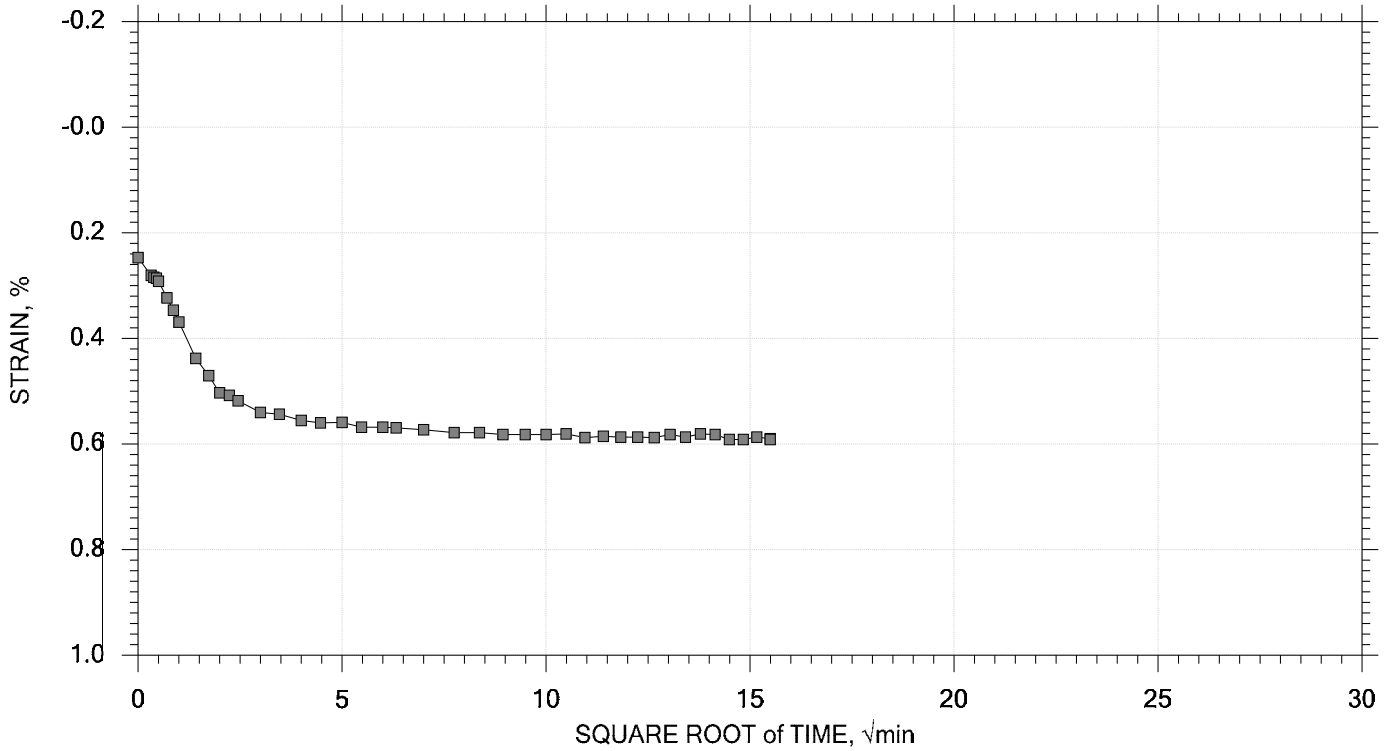
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 21

Stress: 0.25 tsf





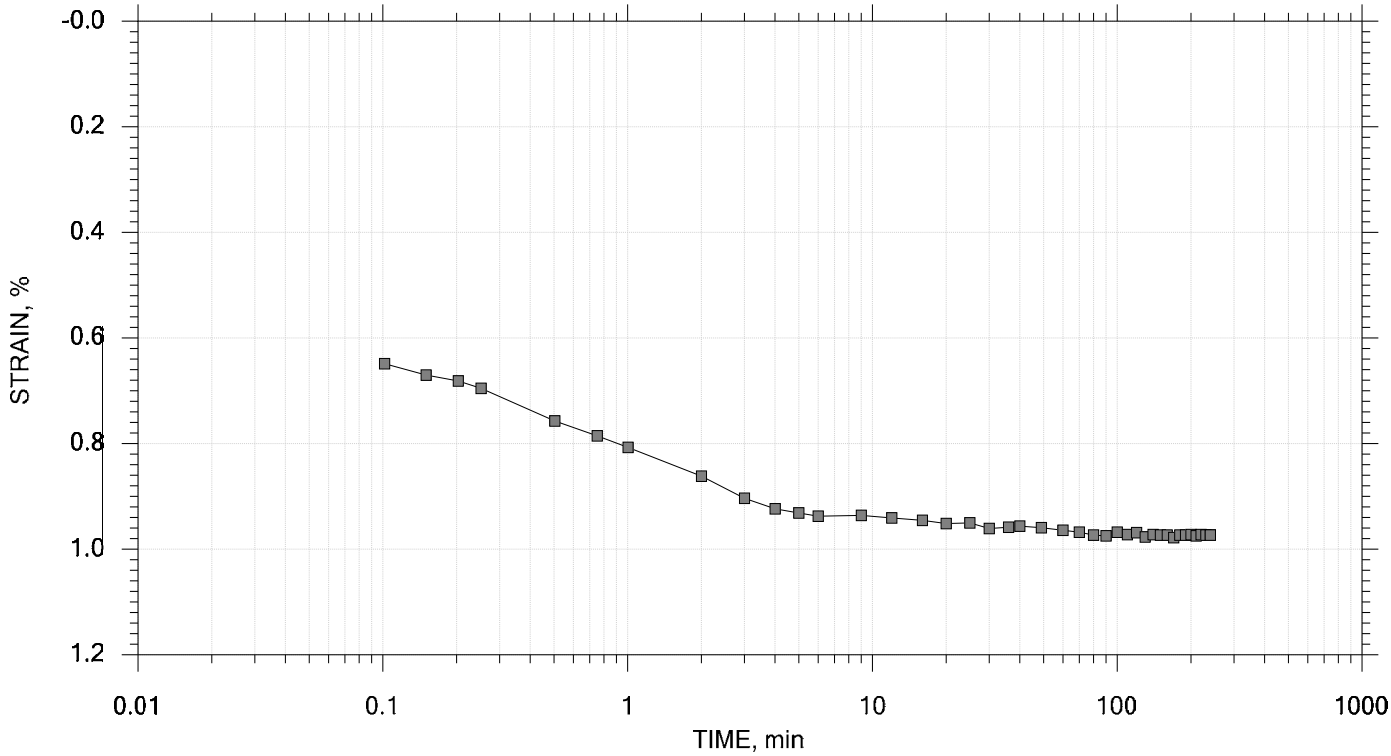
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

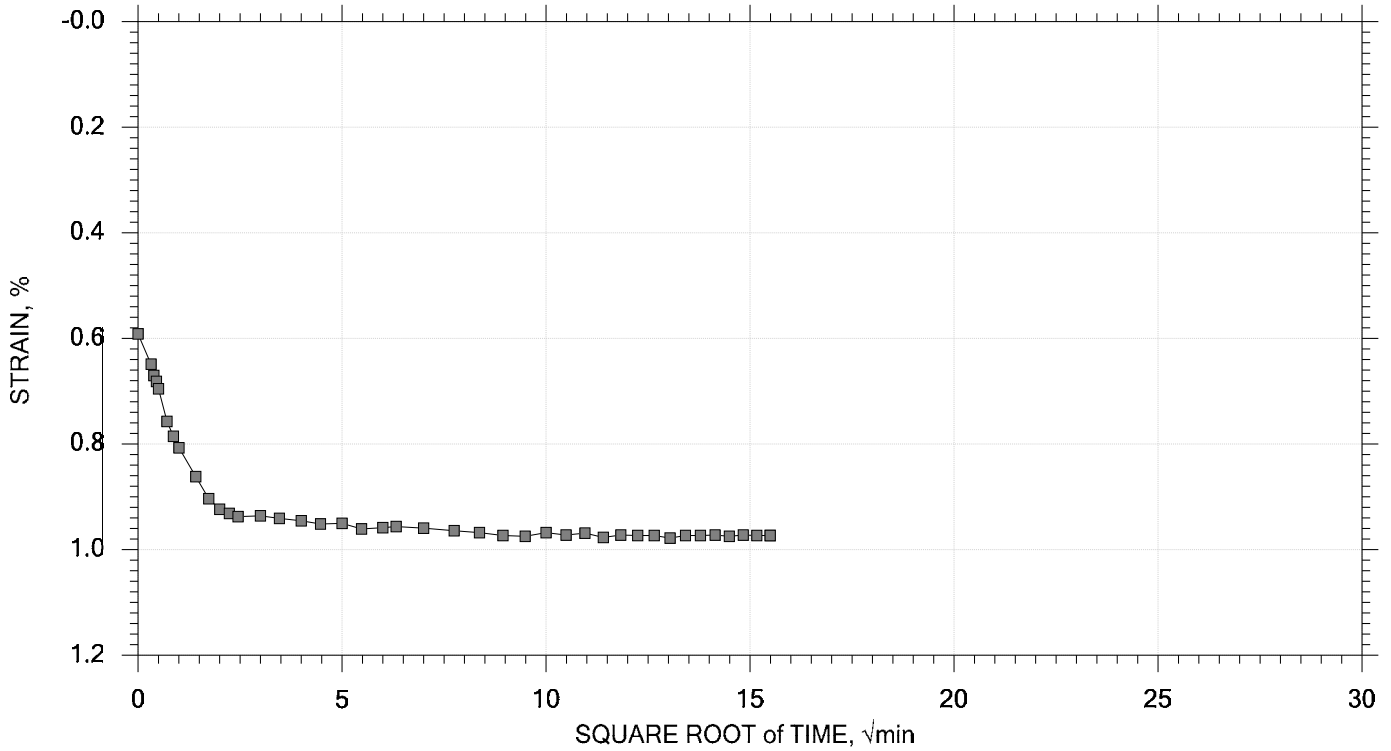
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 21

Stress: 0.5 tsf





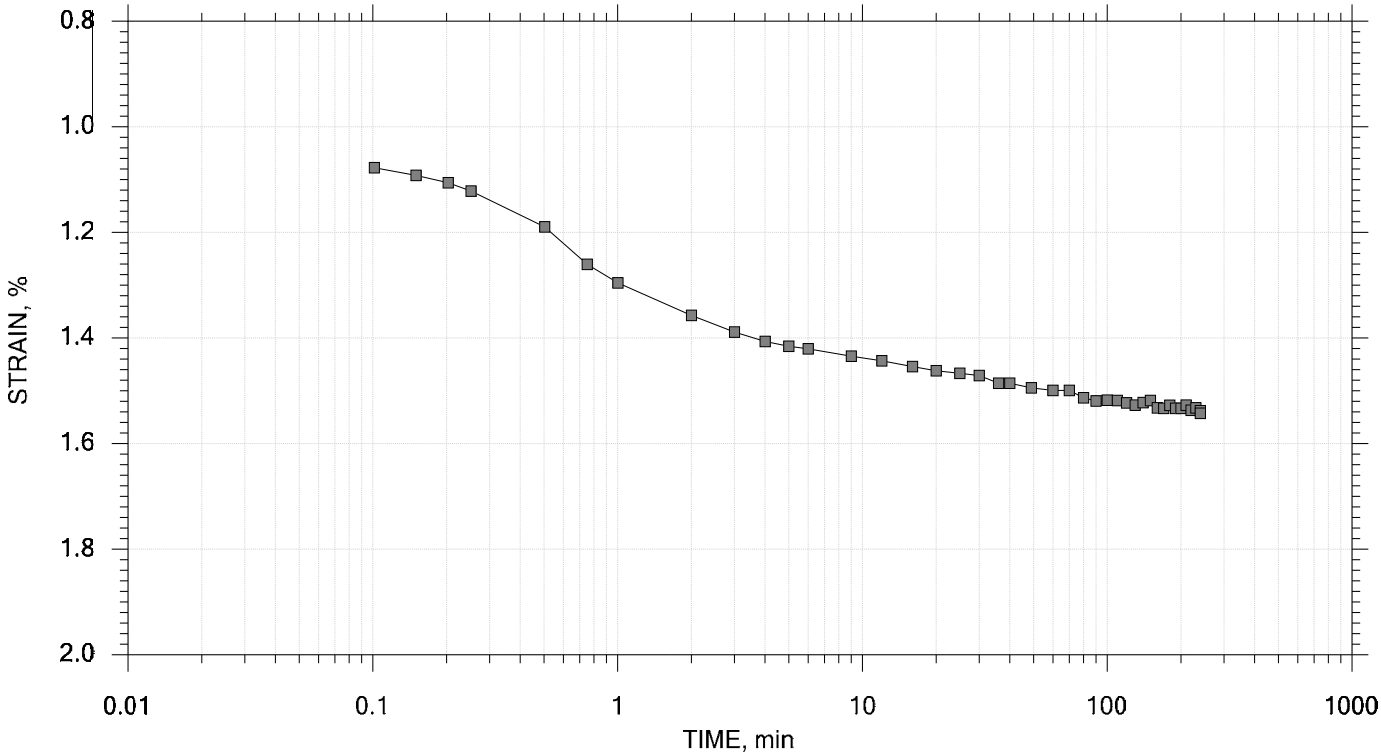
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

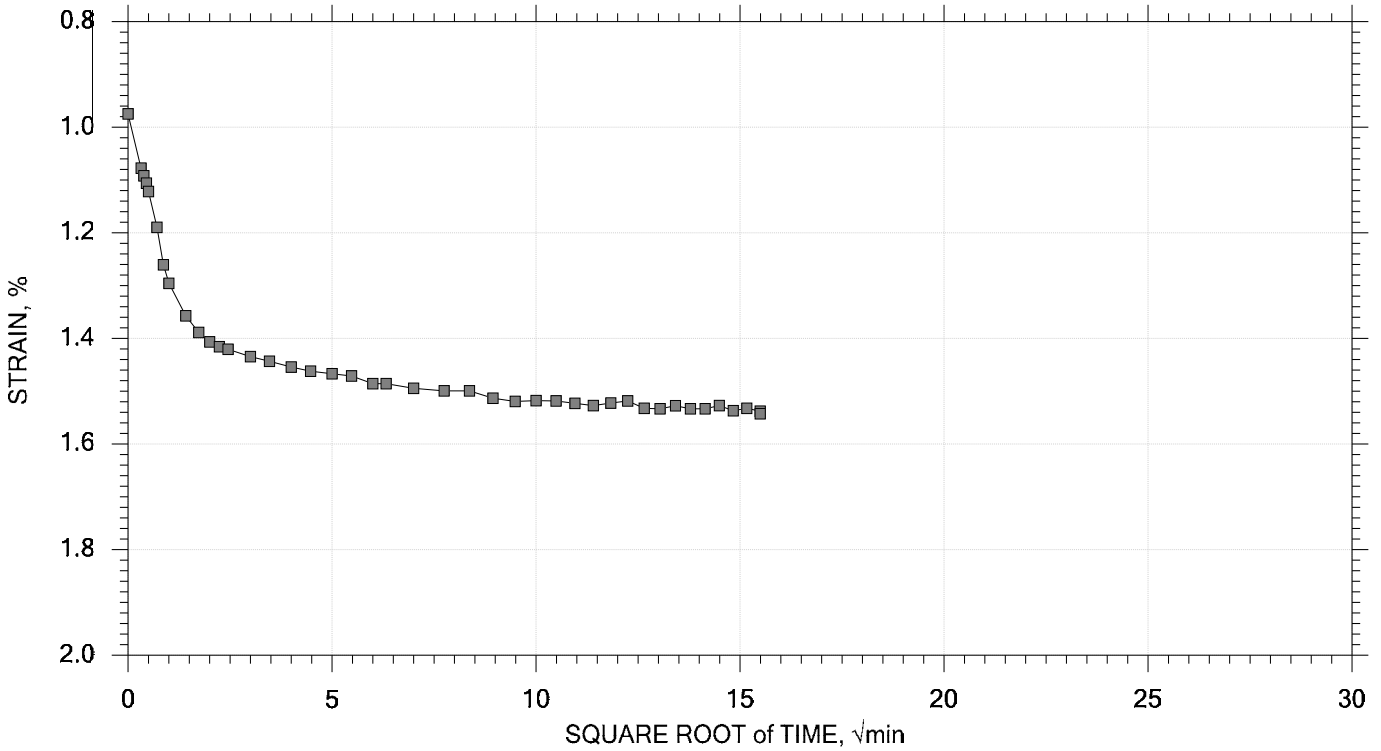
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 21

Stress: 1 tsf





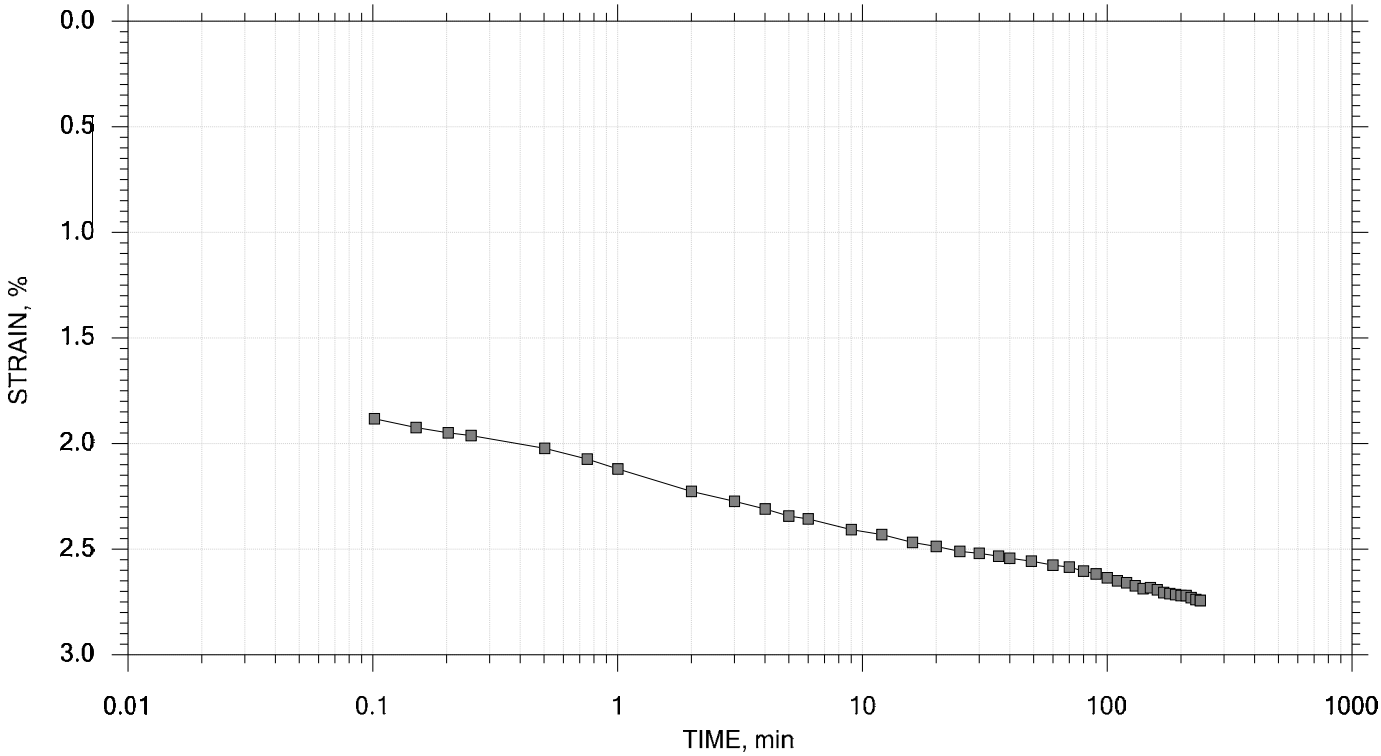
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

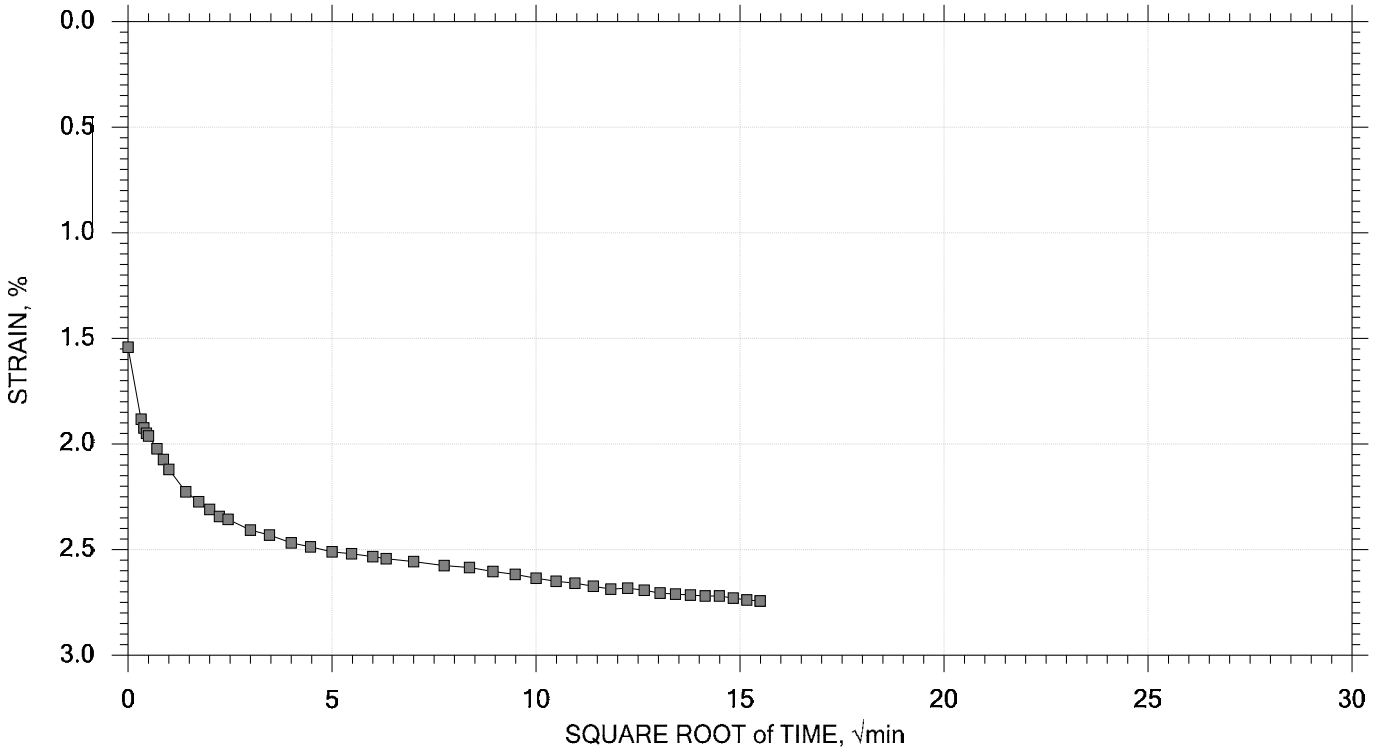
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 21

Stress: 2 tsf





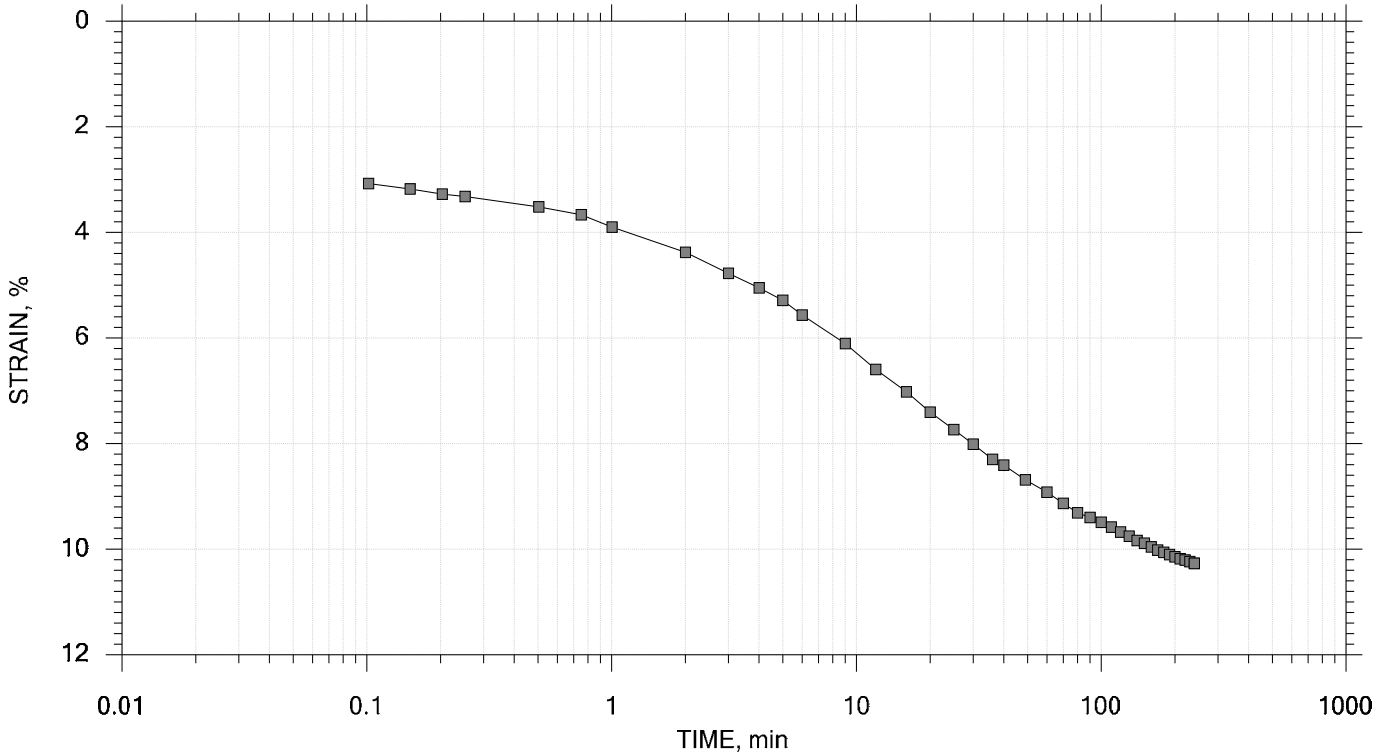
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

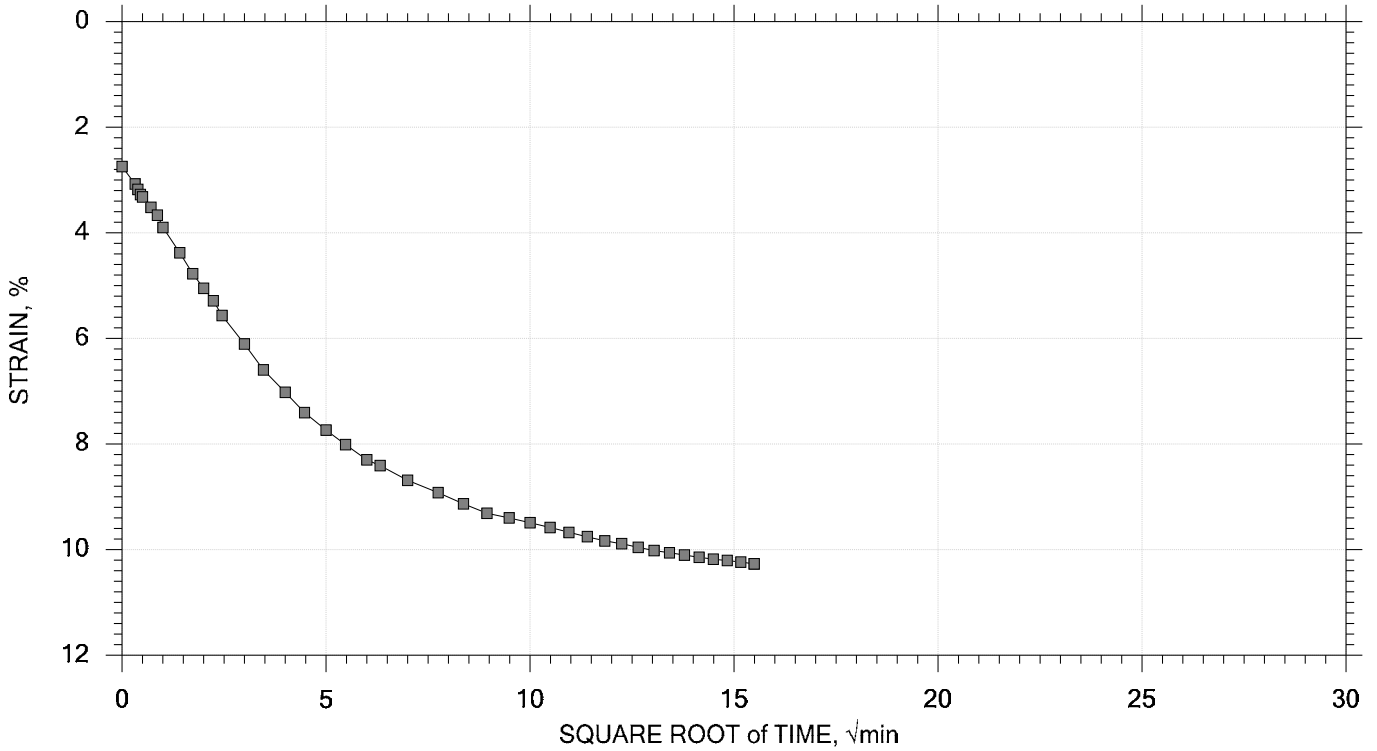
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 21

Stress: 4 tsf





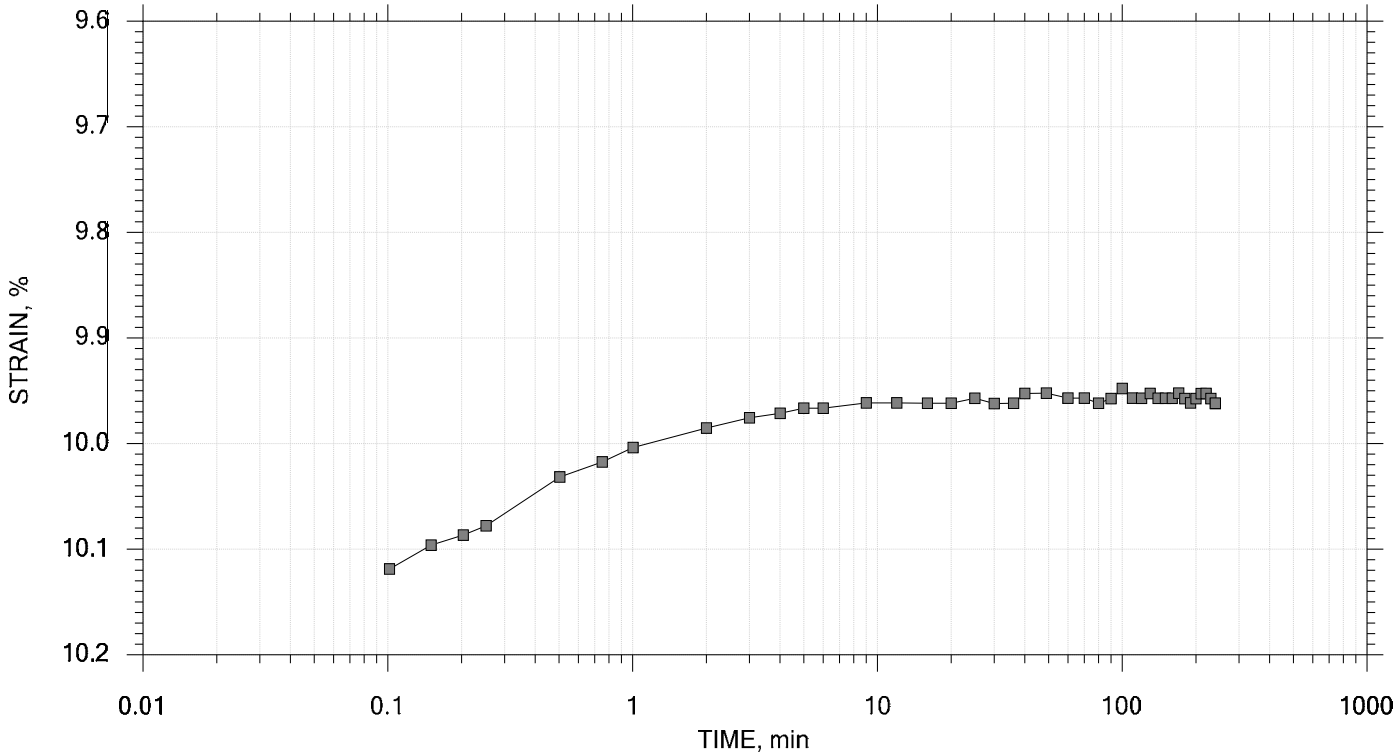
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

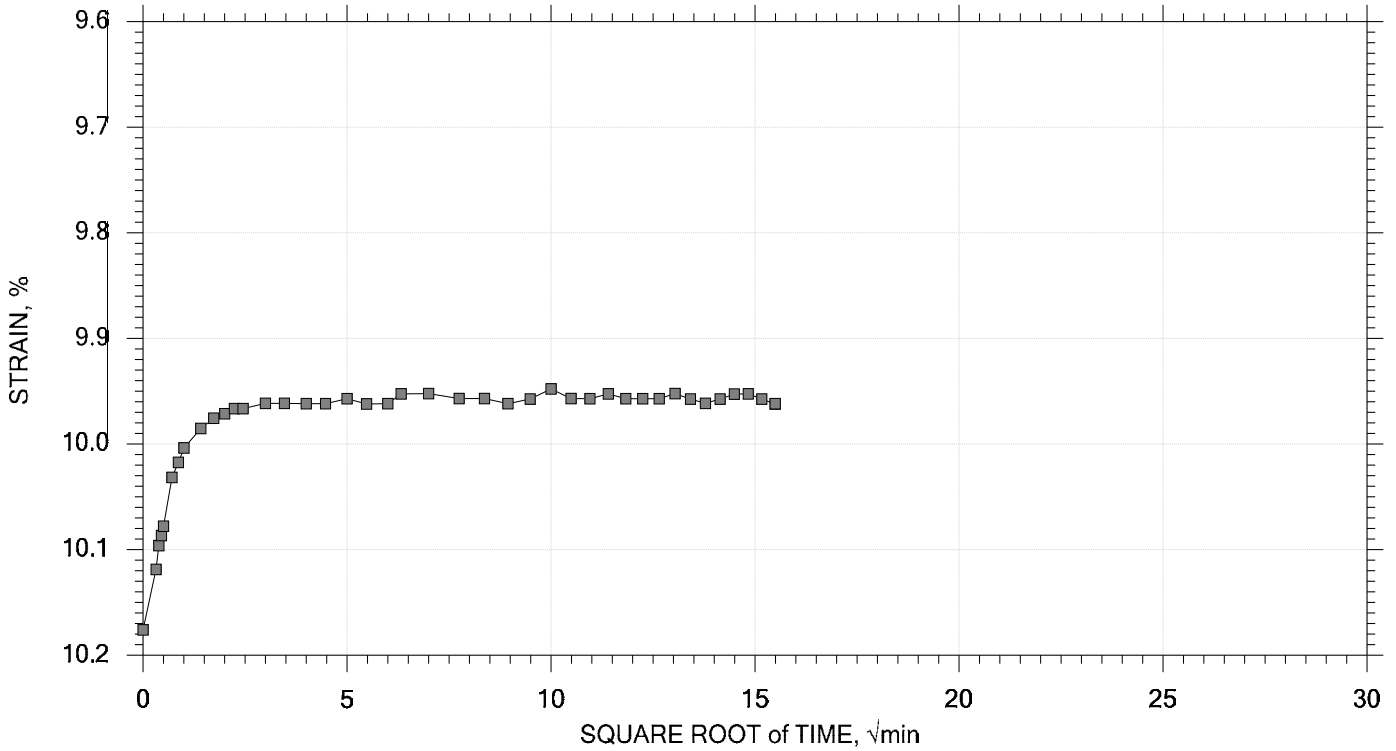
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 21

Stress: 2 tsf





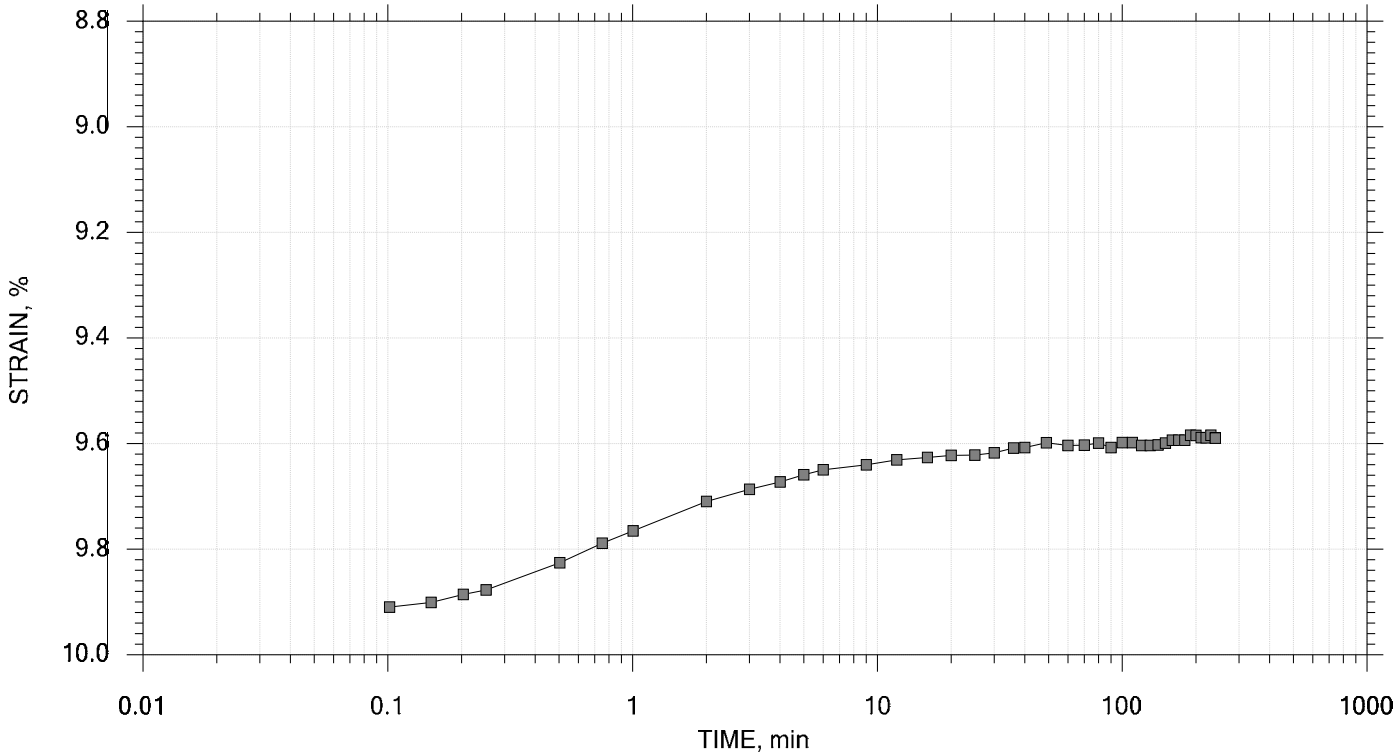
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

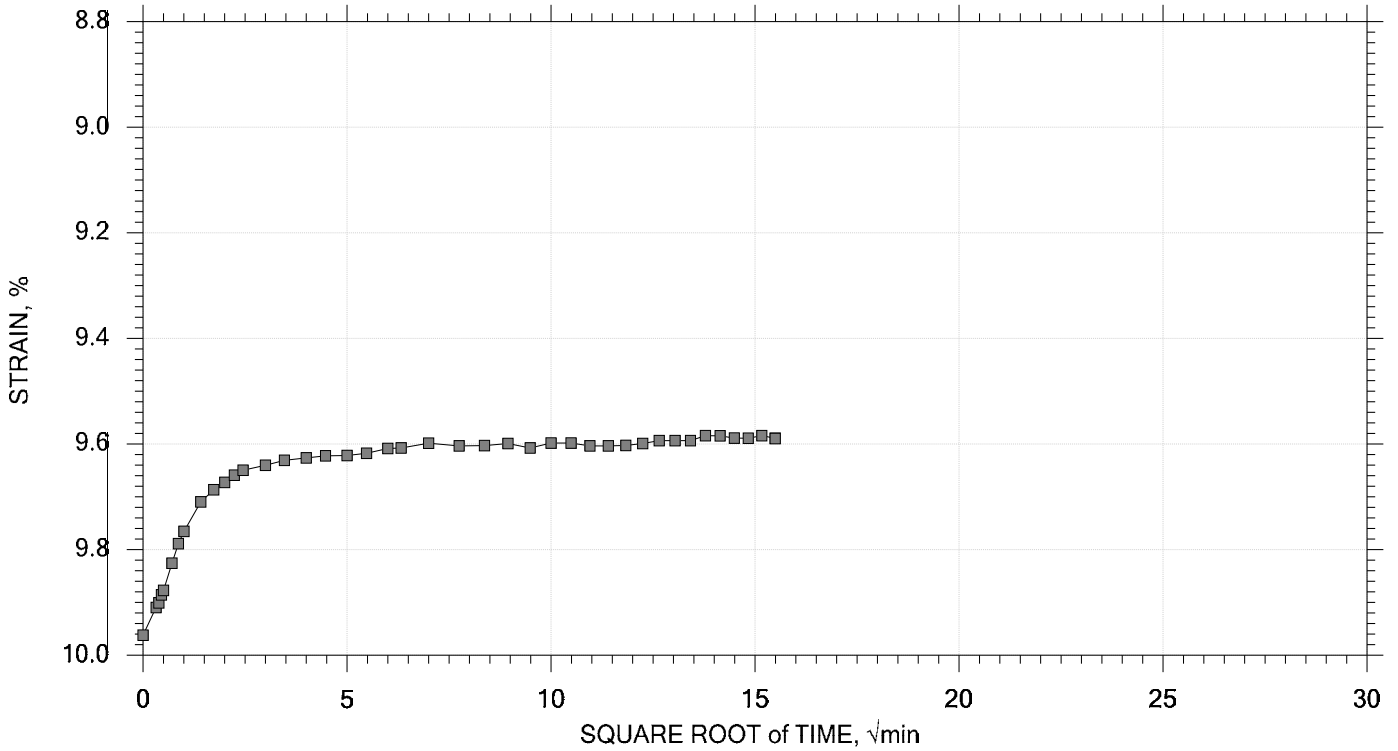
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 21

Stress: 1 tsf





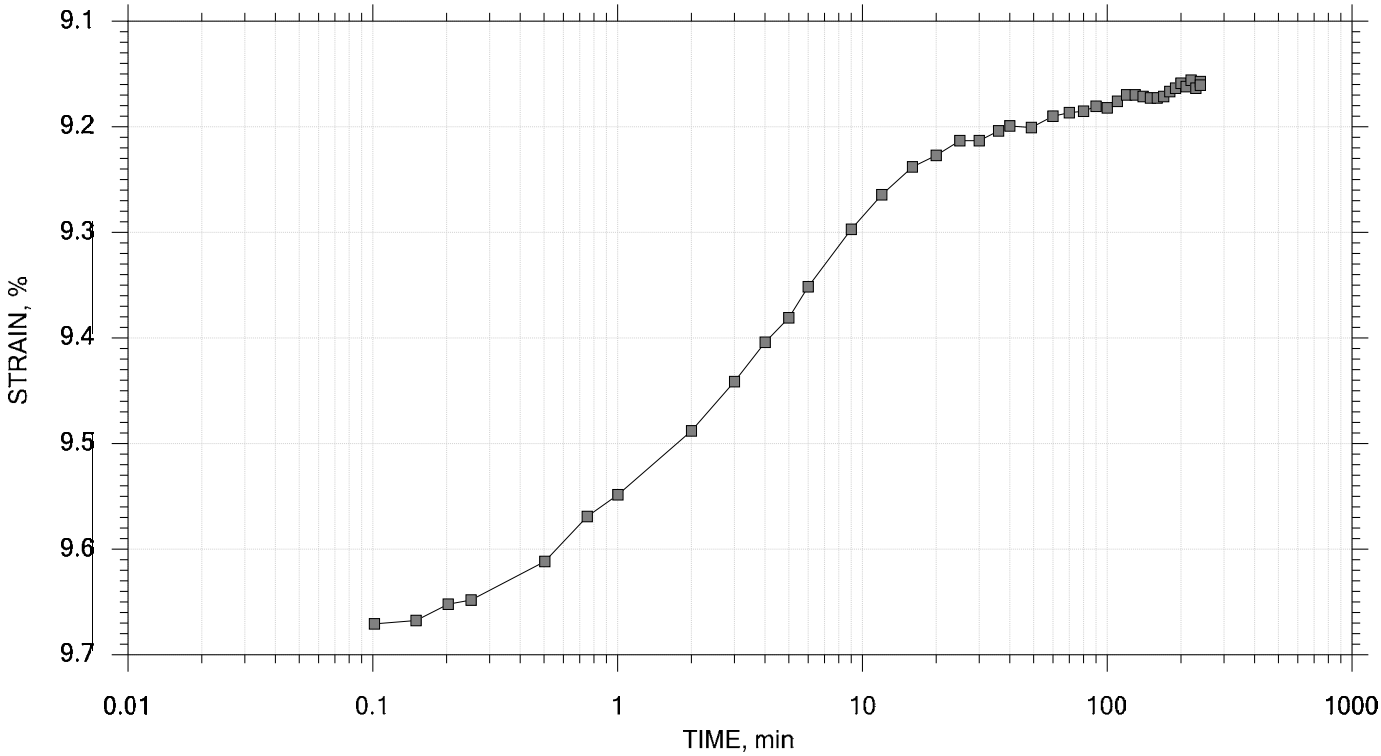
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

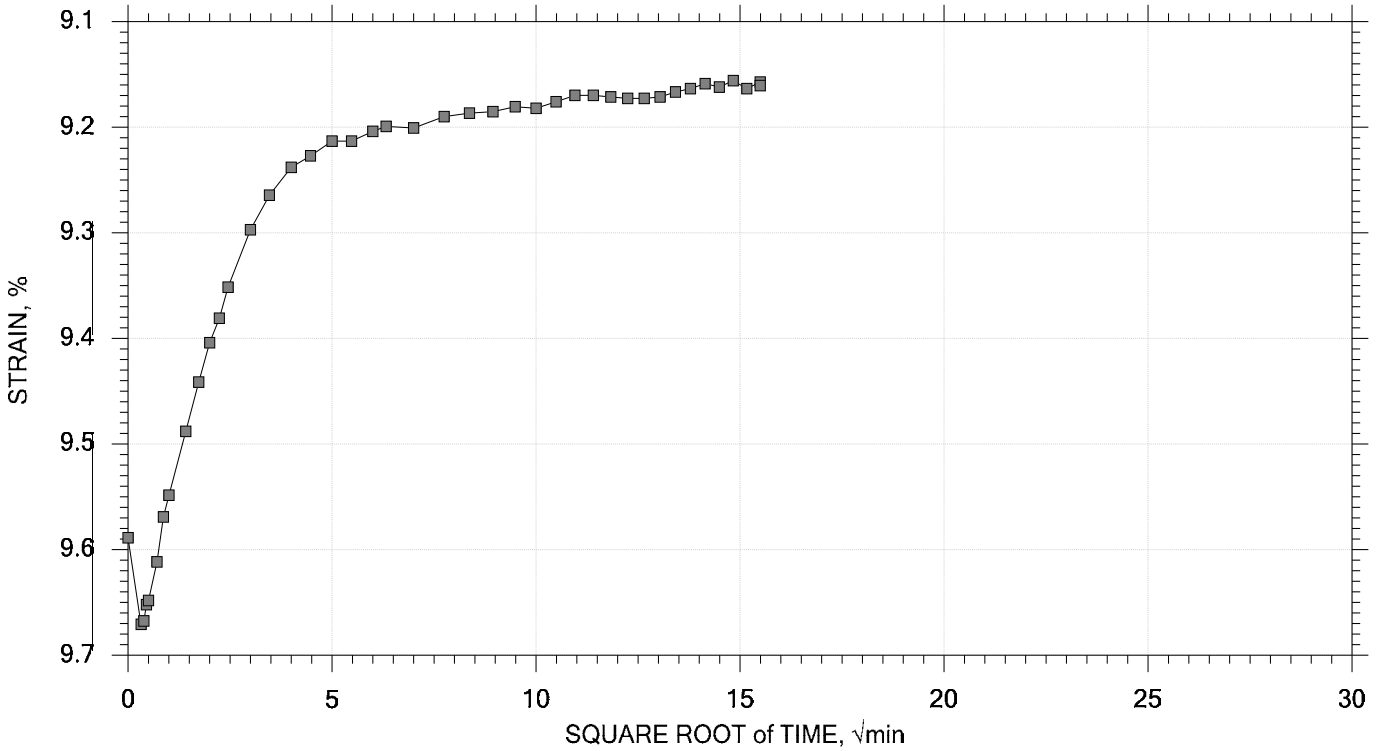
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 21

Stress: 0.5 tsf





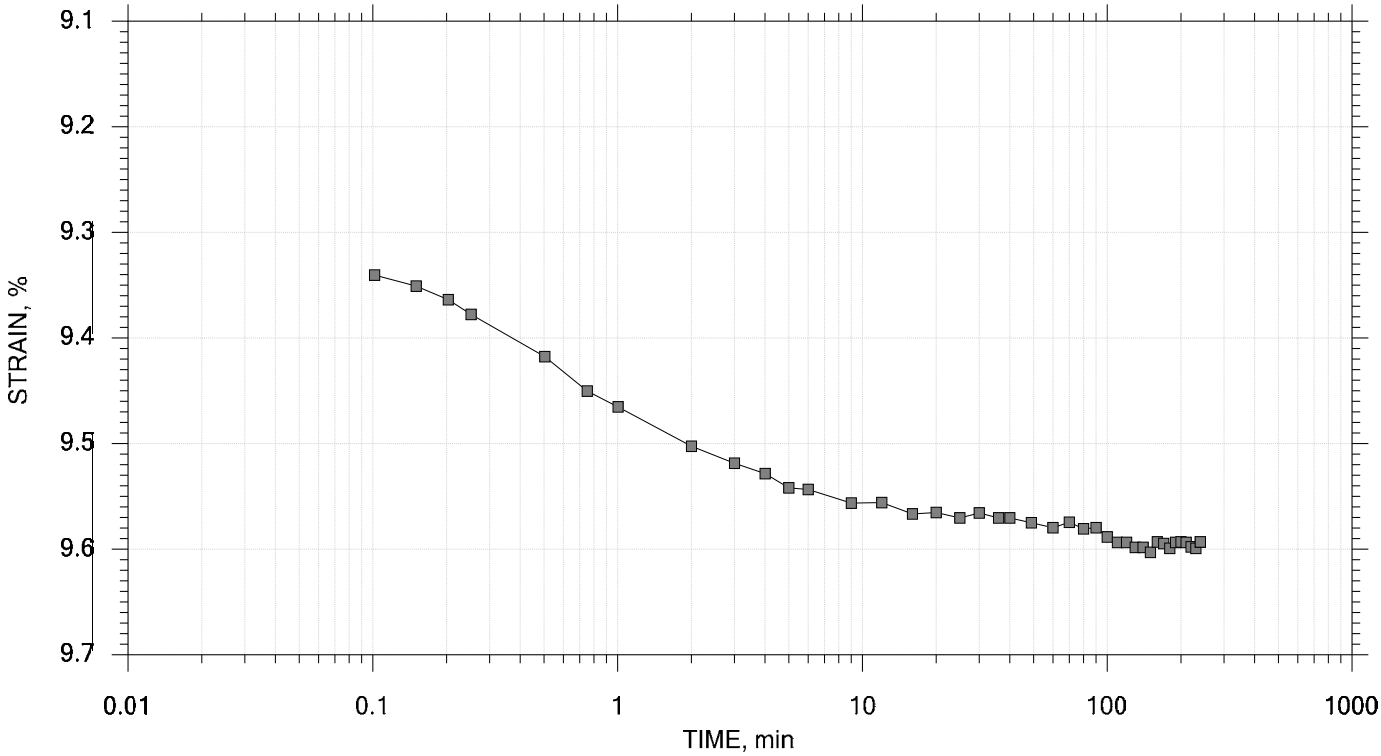
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

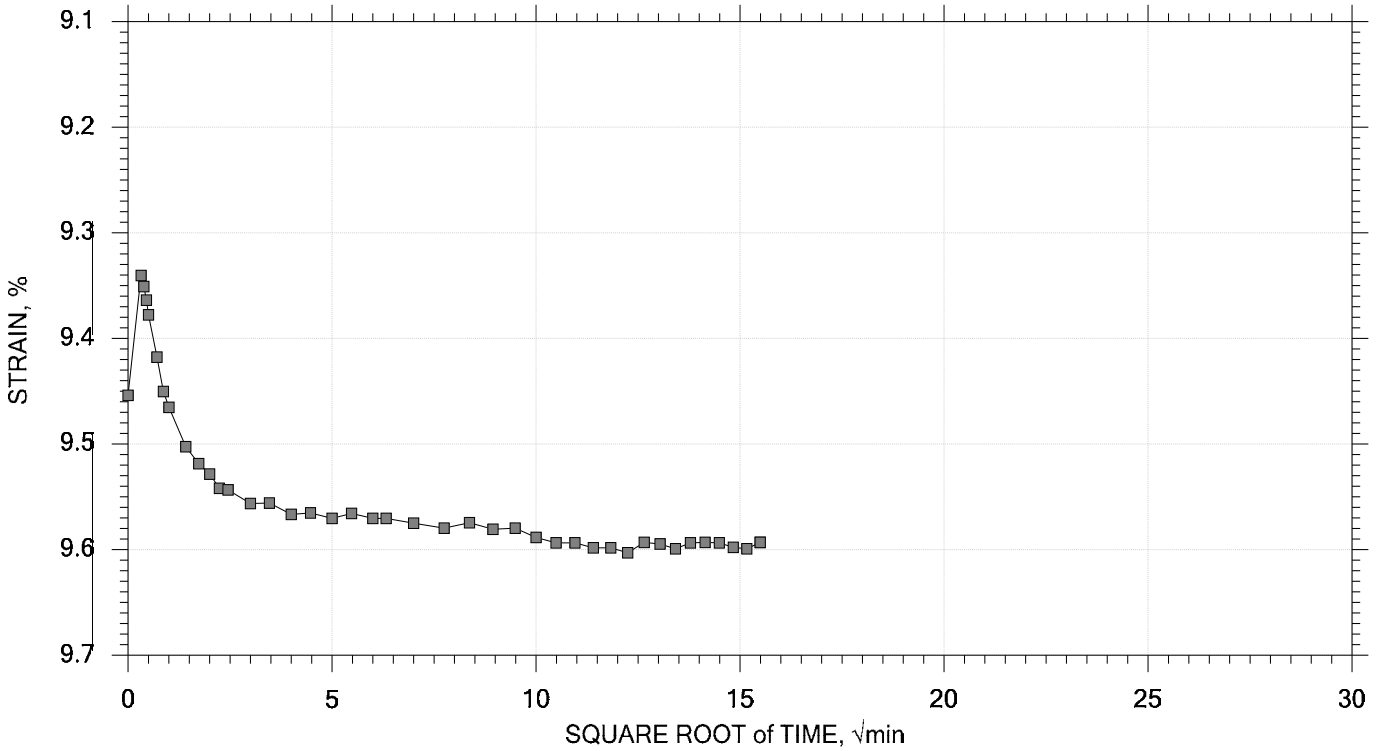
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 11 of 21

Stress: 1 tsf





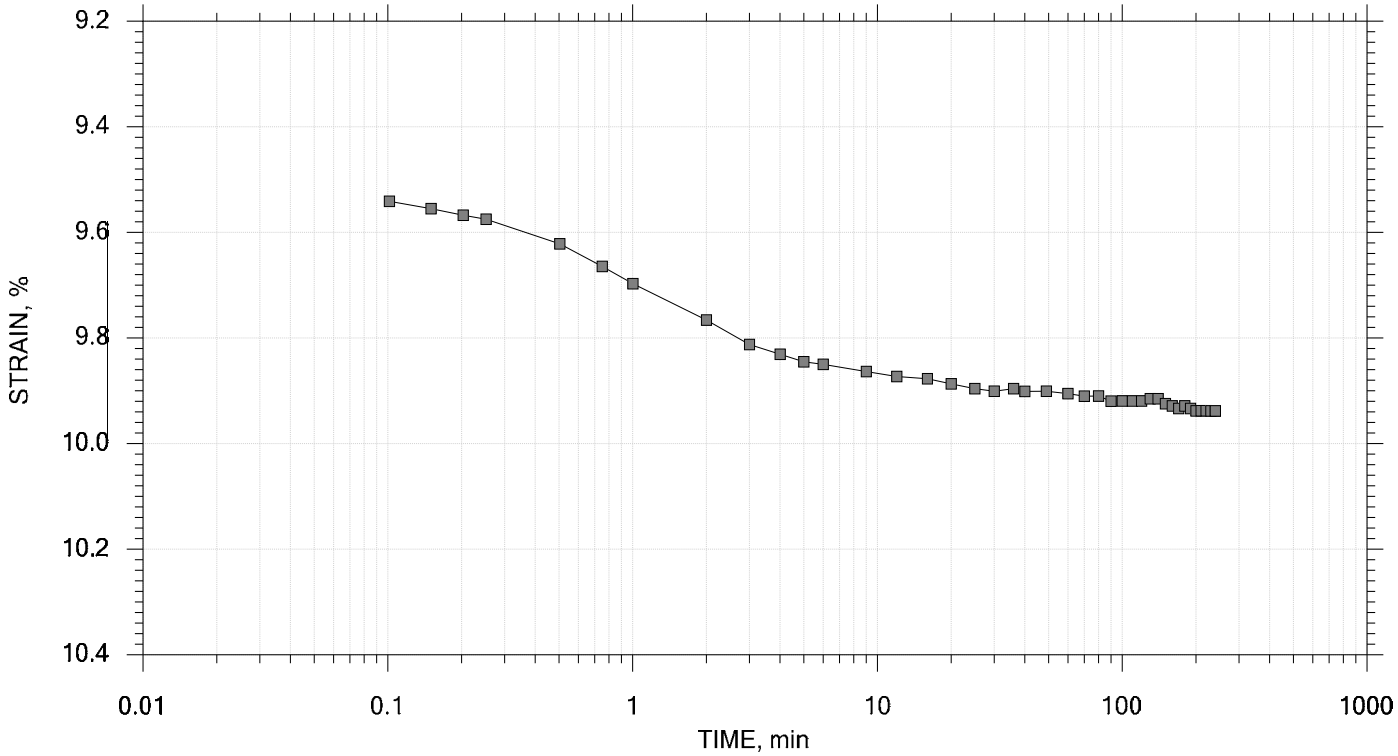
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

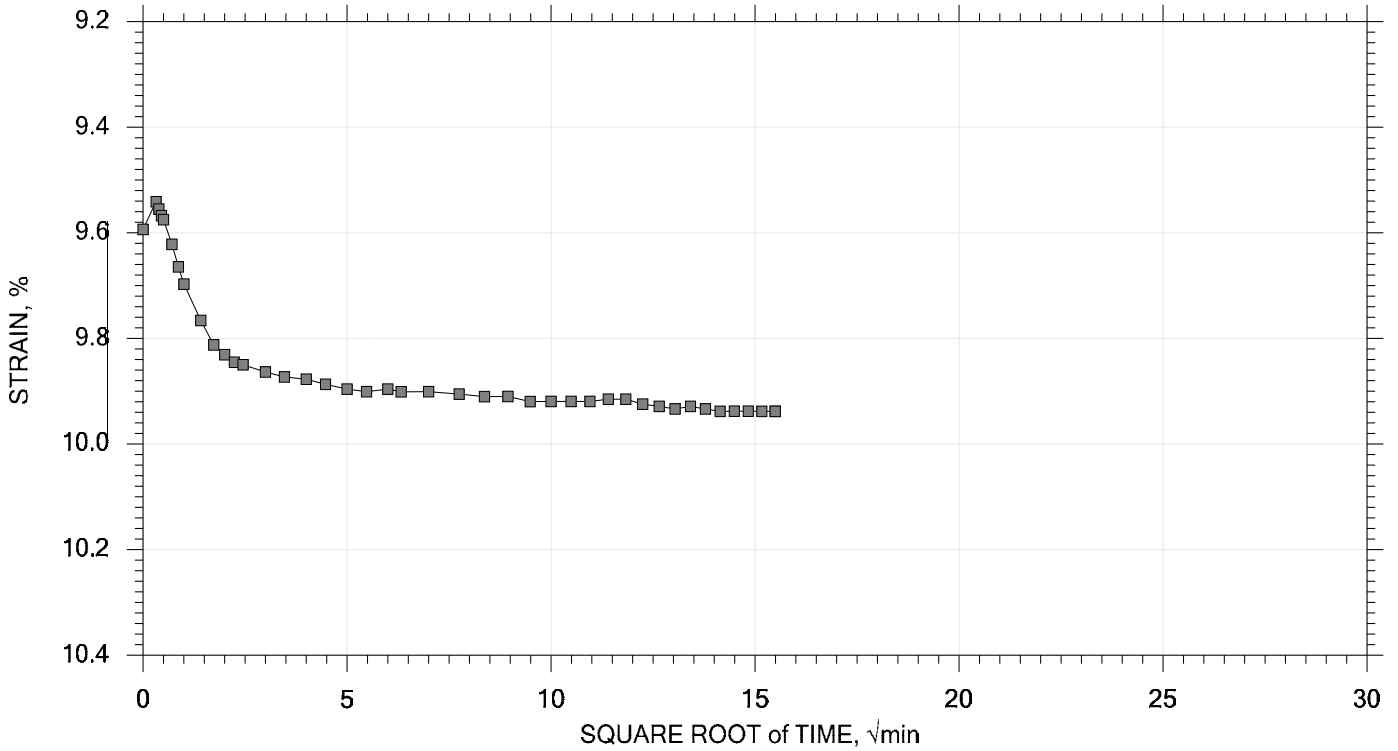
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 12 of 21

Stress: 2 tsf





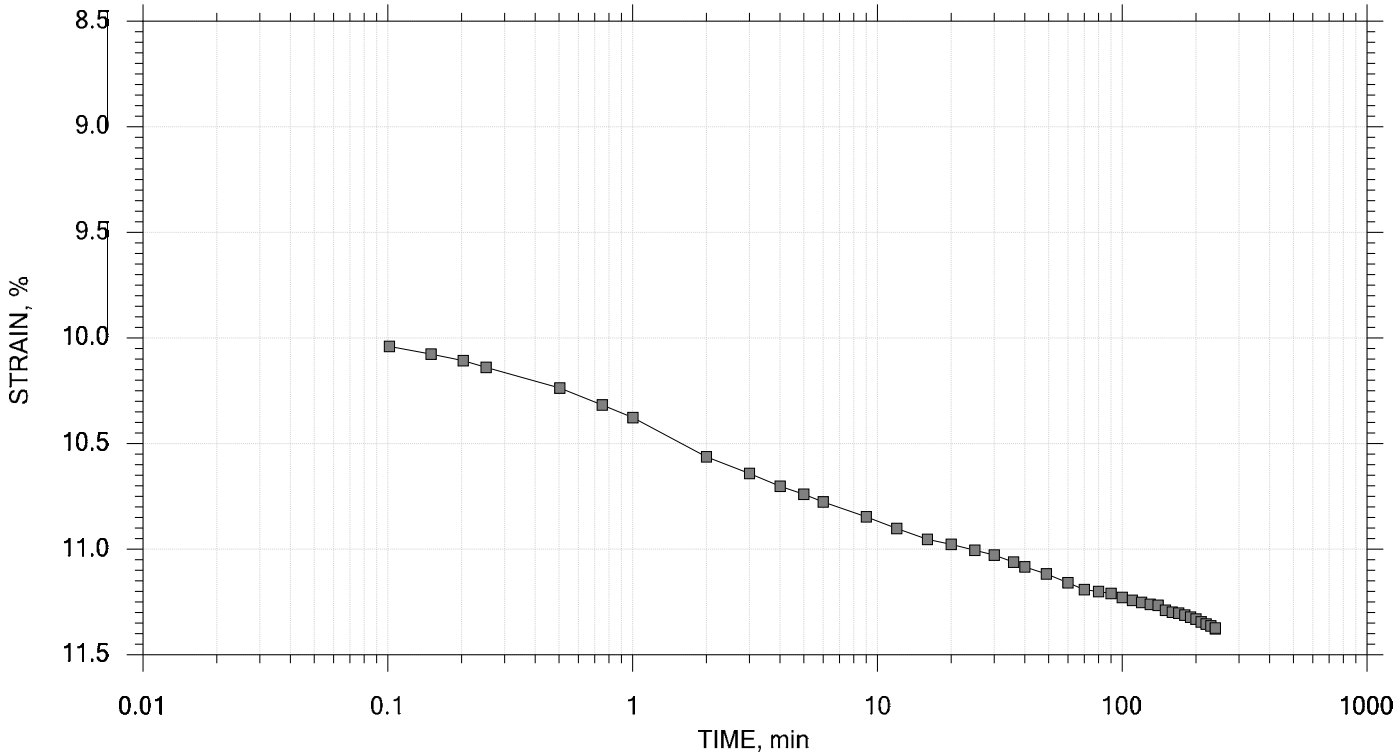
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

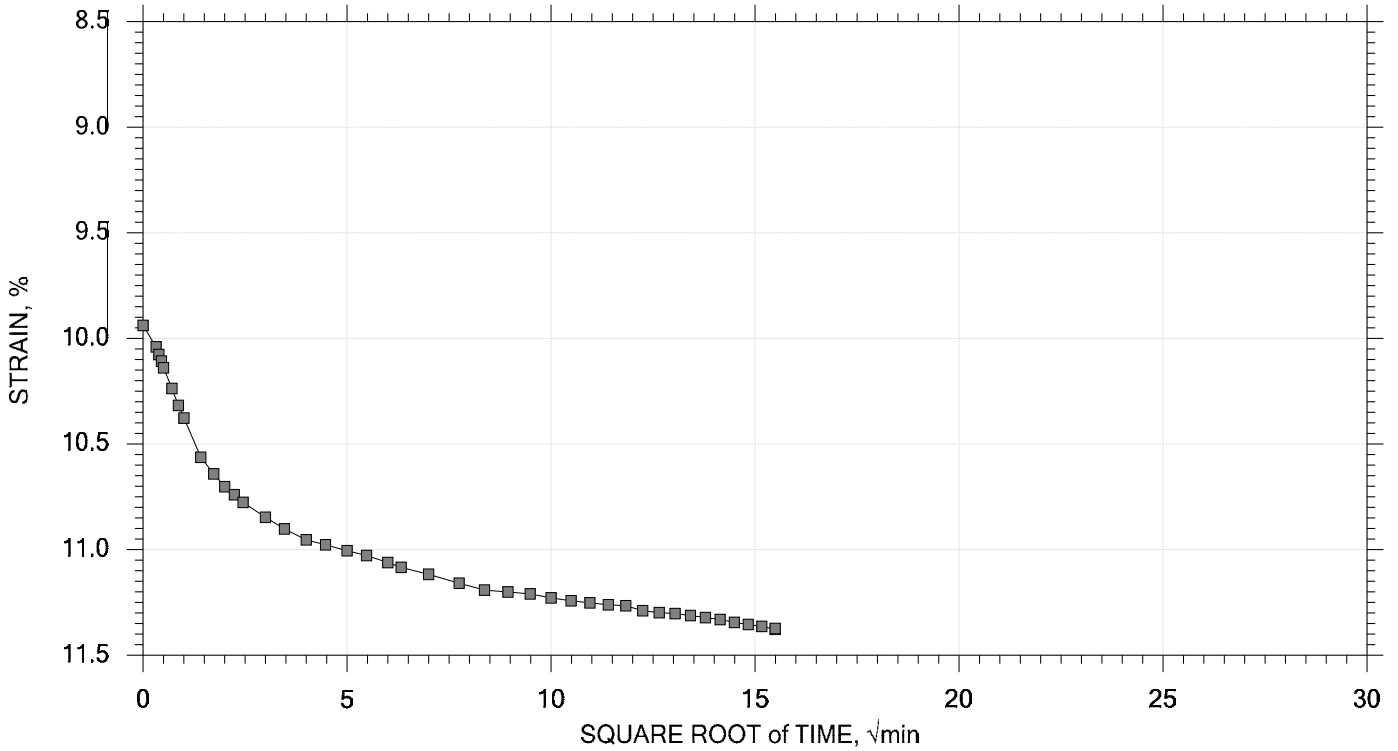
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 21

Stress: 4 tsf





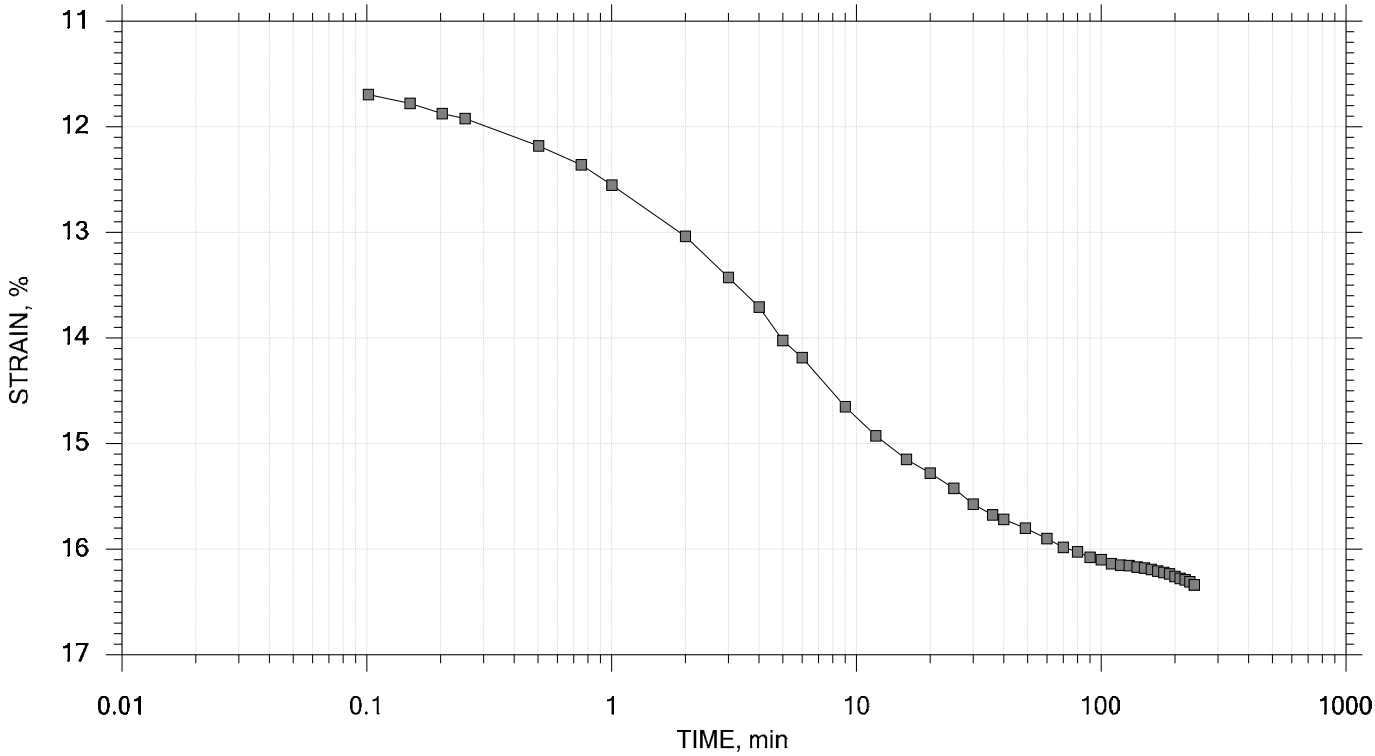
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

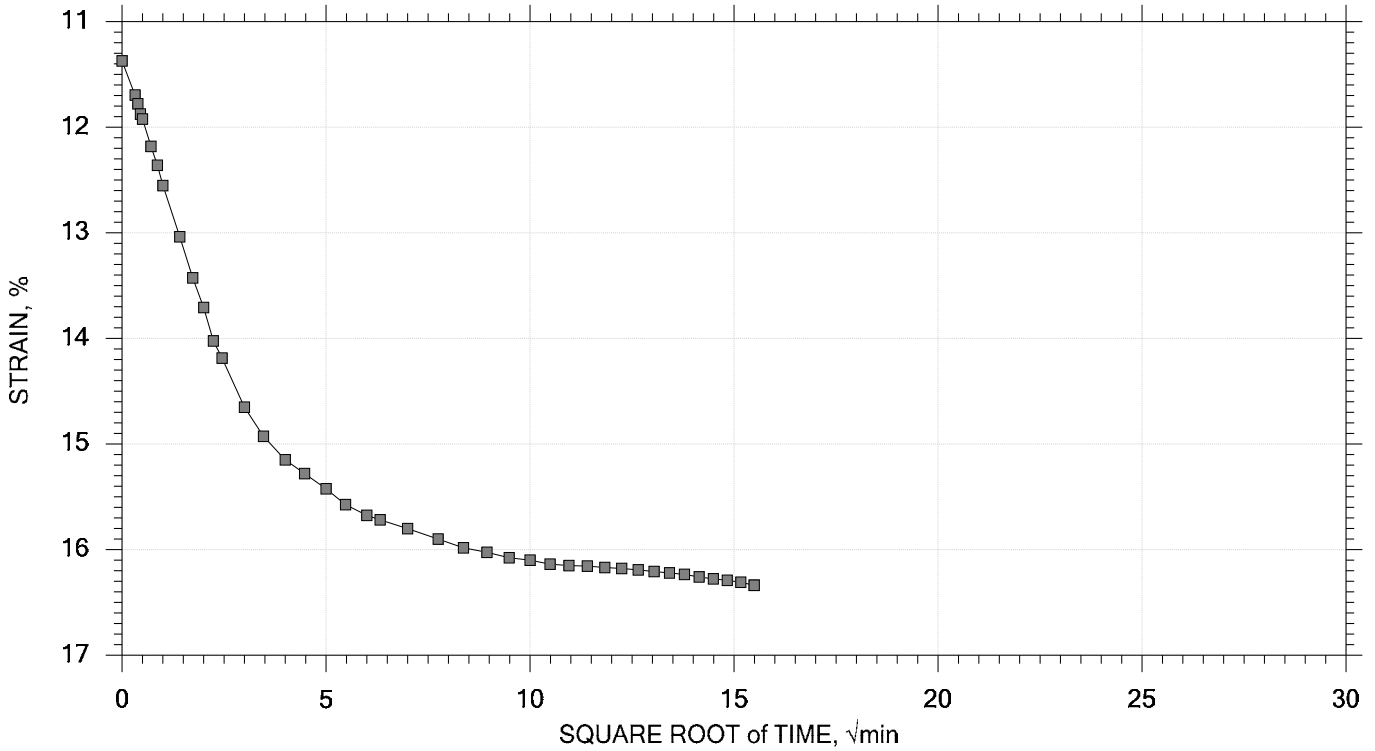
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 21

Stress: 8 tsf





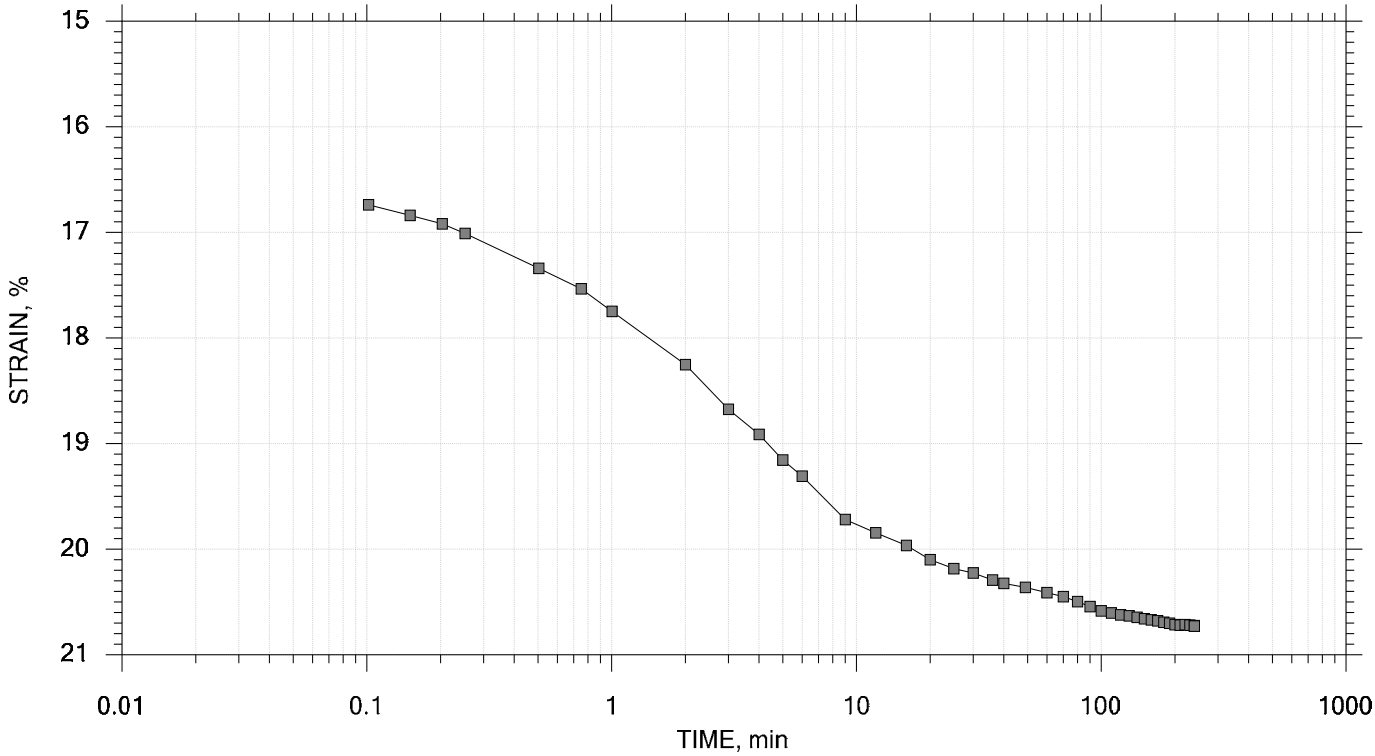
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

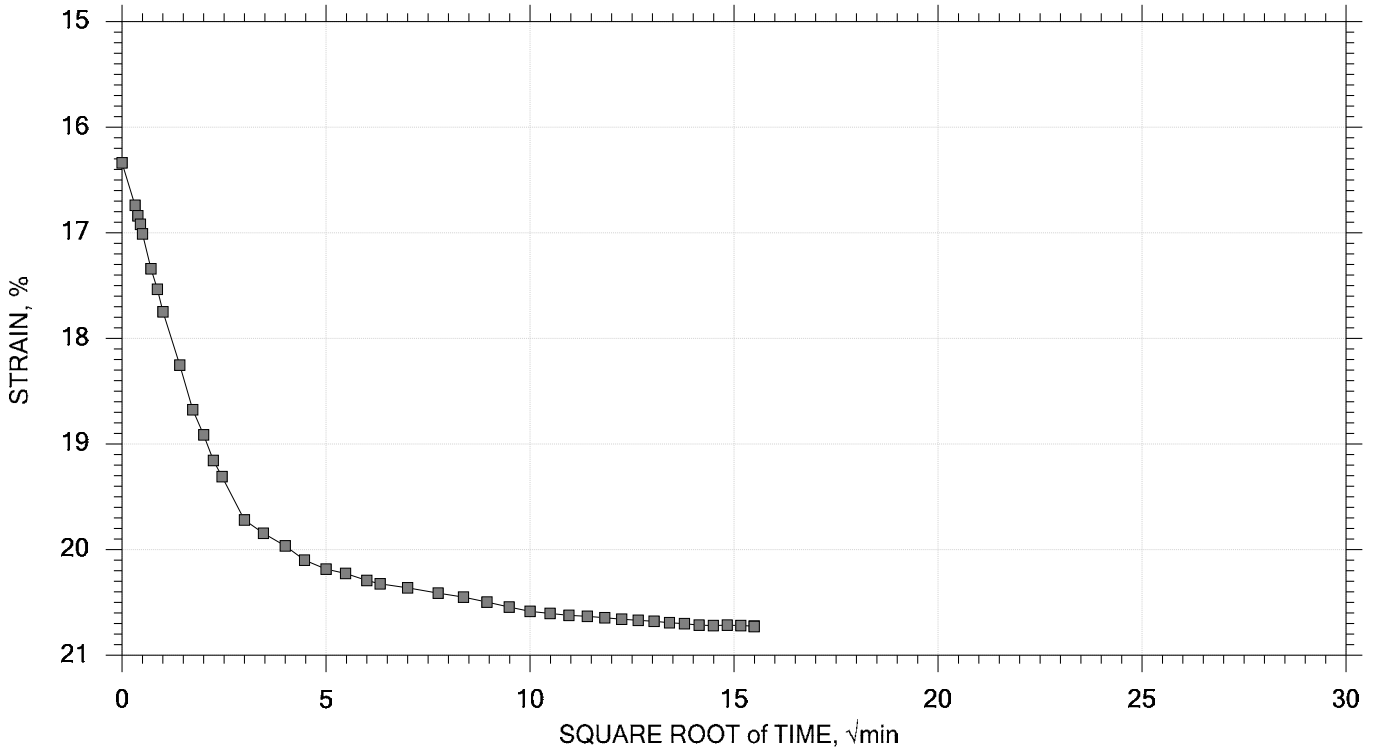
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 15 of 21

Stress: 16 tsf





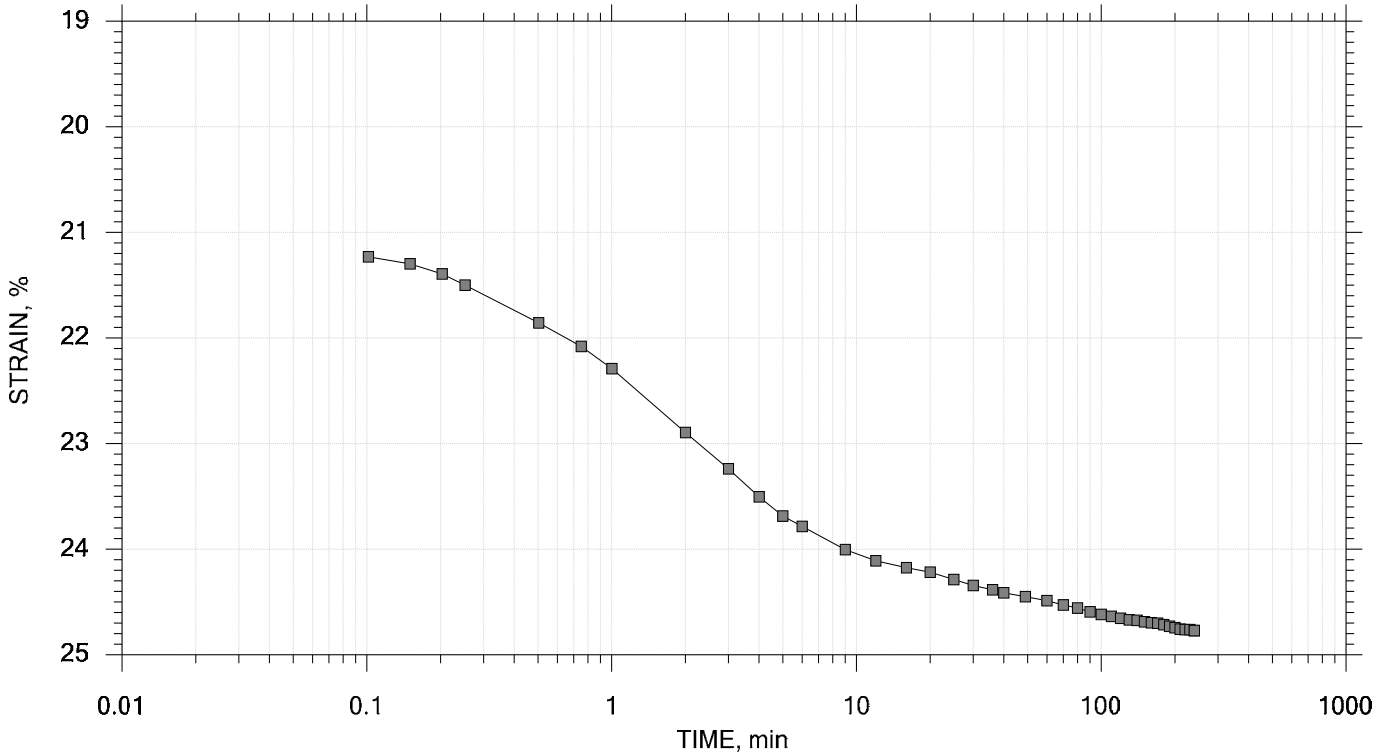
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

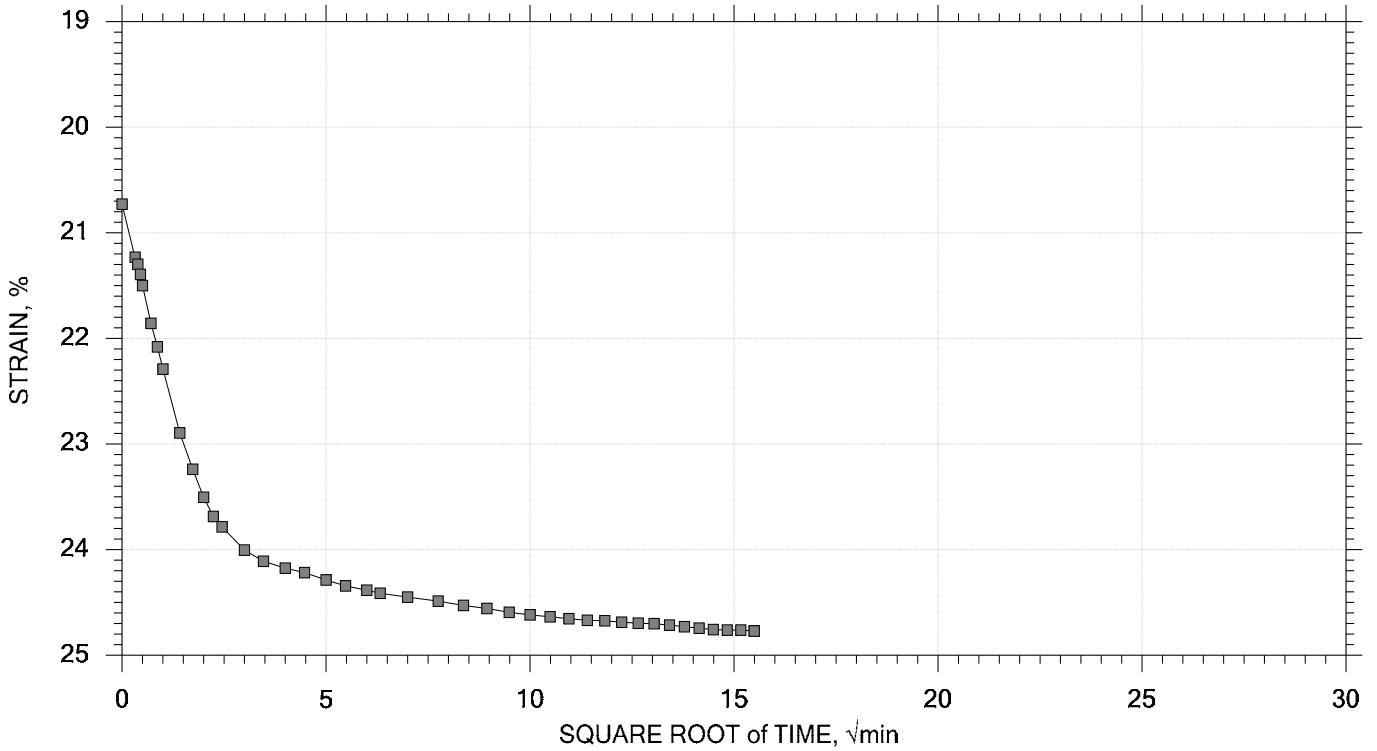
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 16 of 21

Stress: 32 tsf





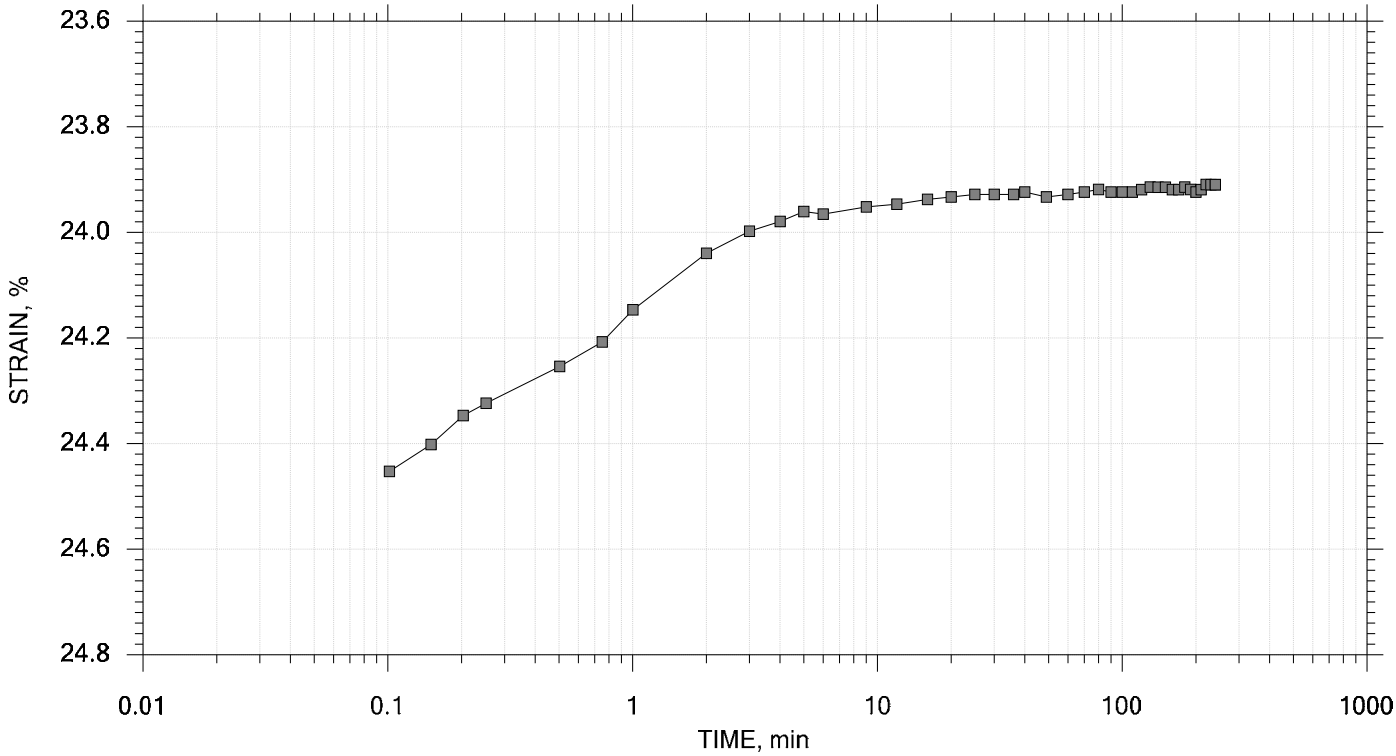
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

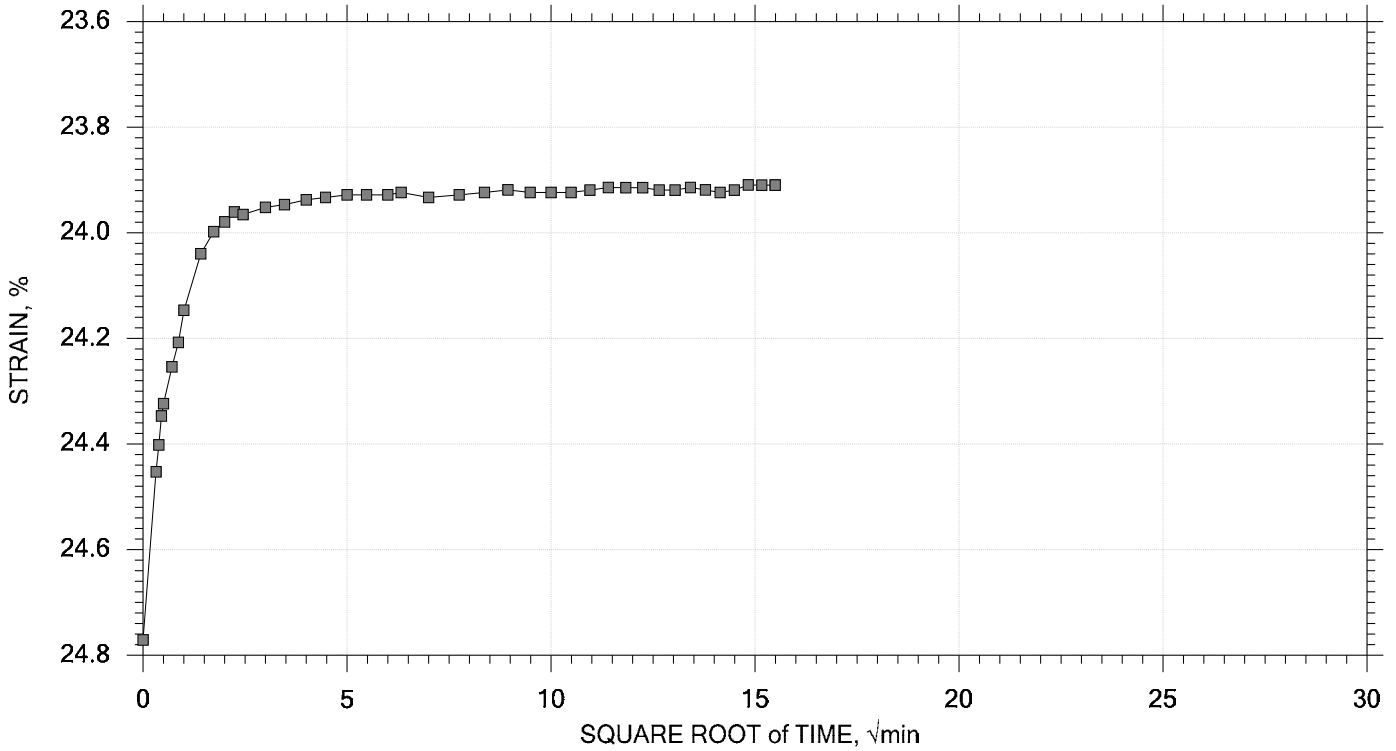
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 17 of 21

Stress: 8 tsf





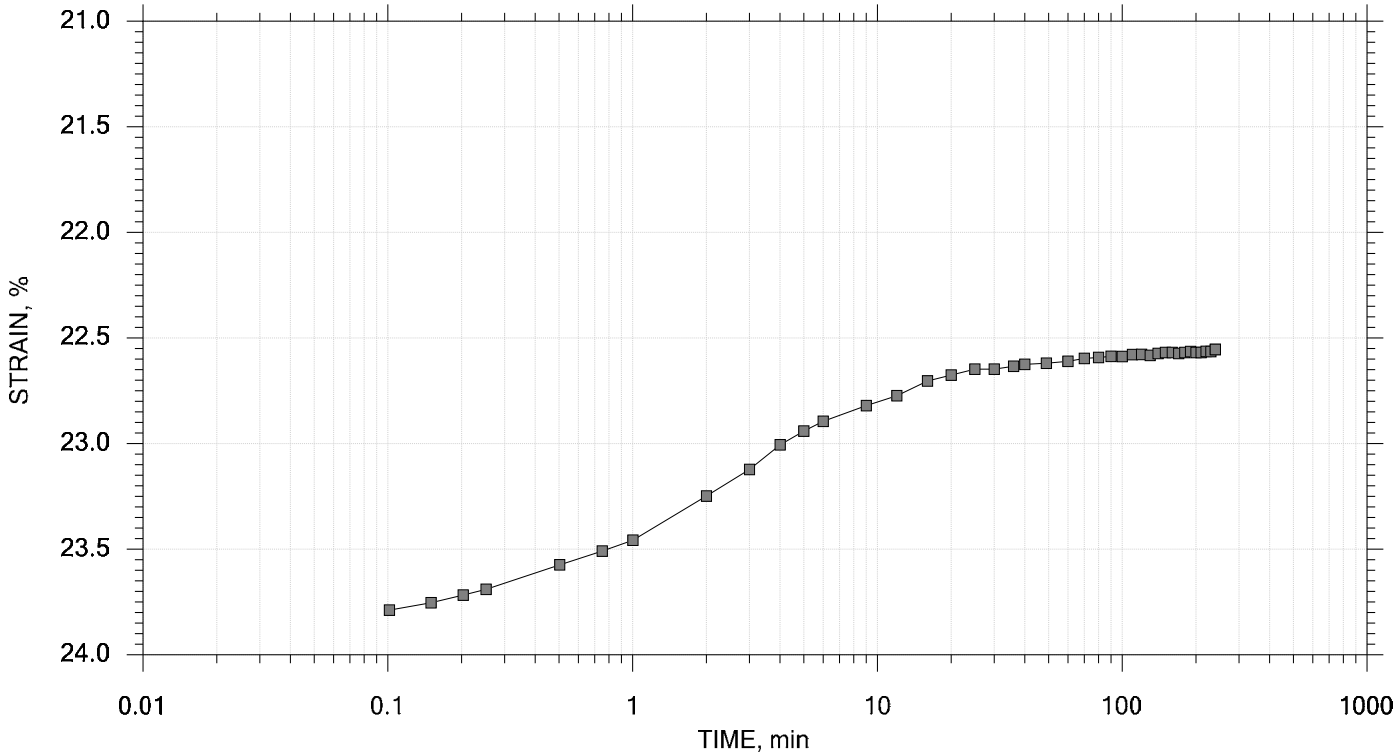
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

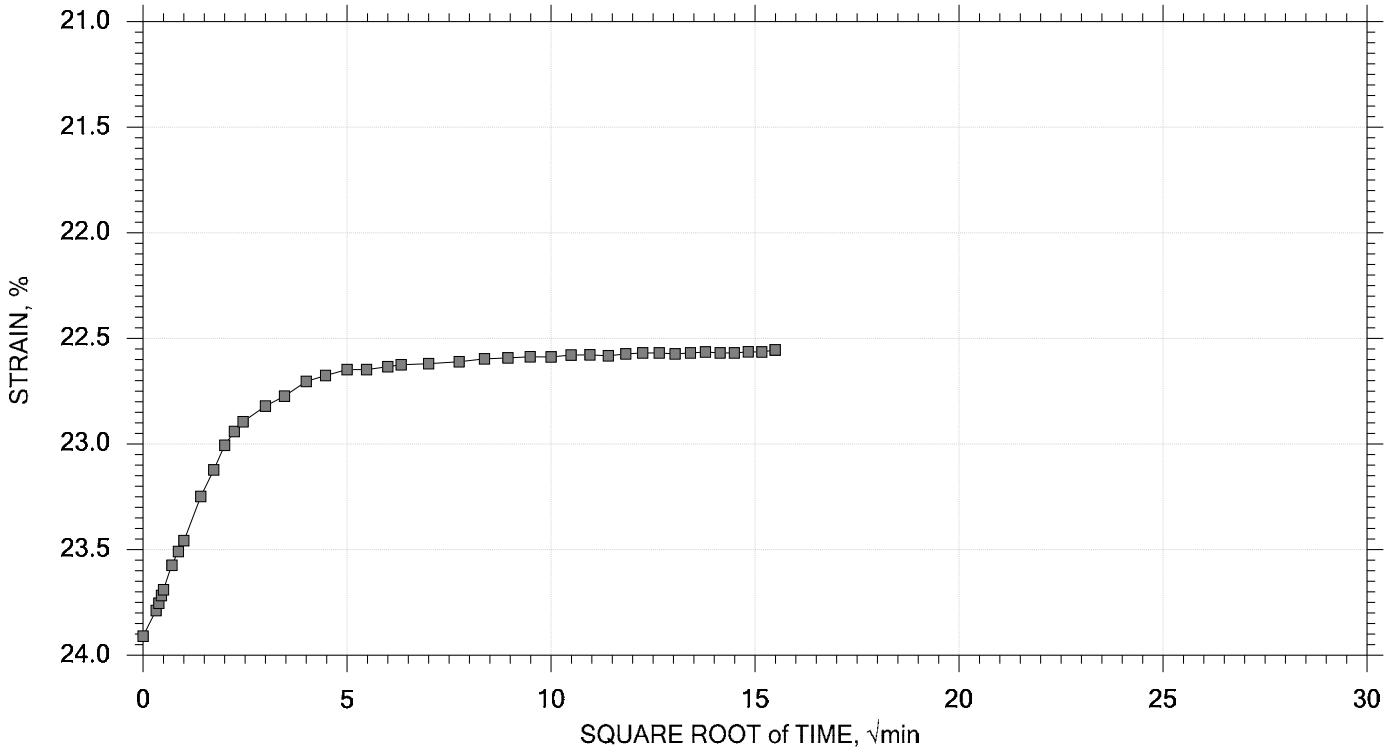
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 18 of 21

Stress: 2 tsf





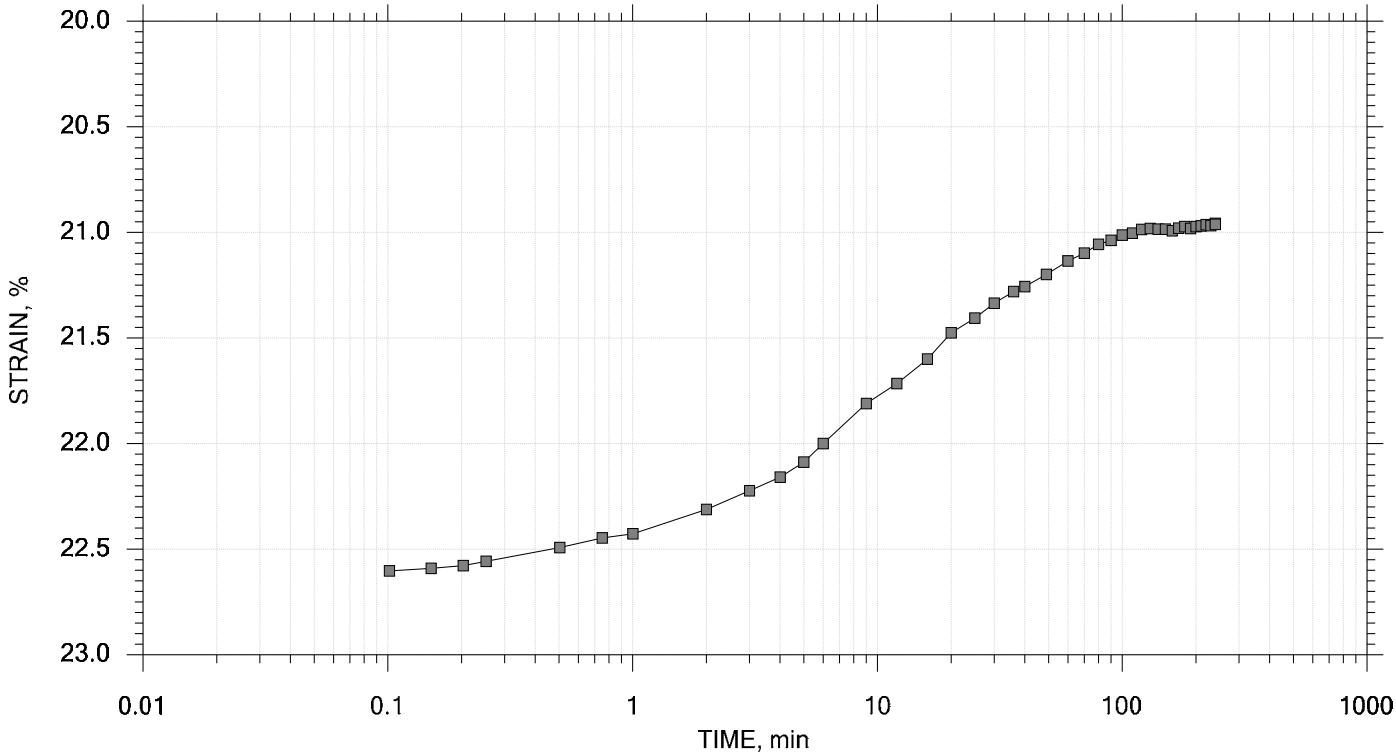
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

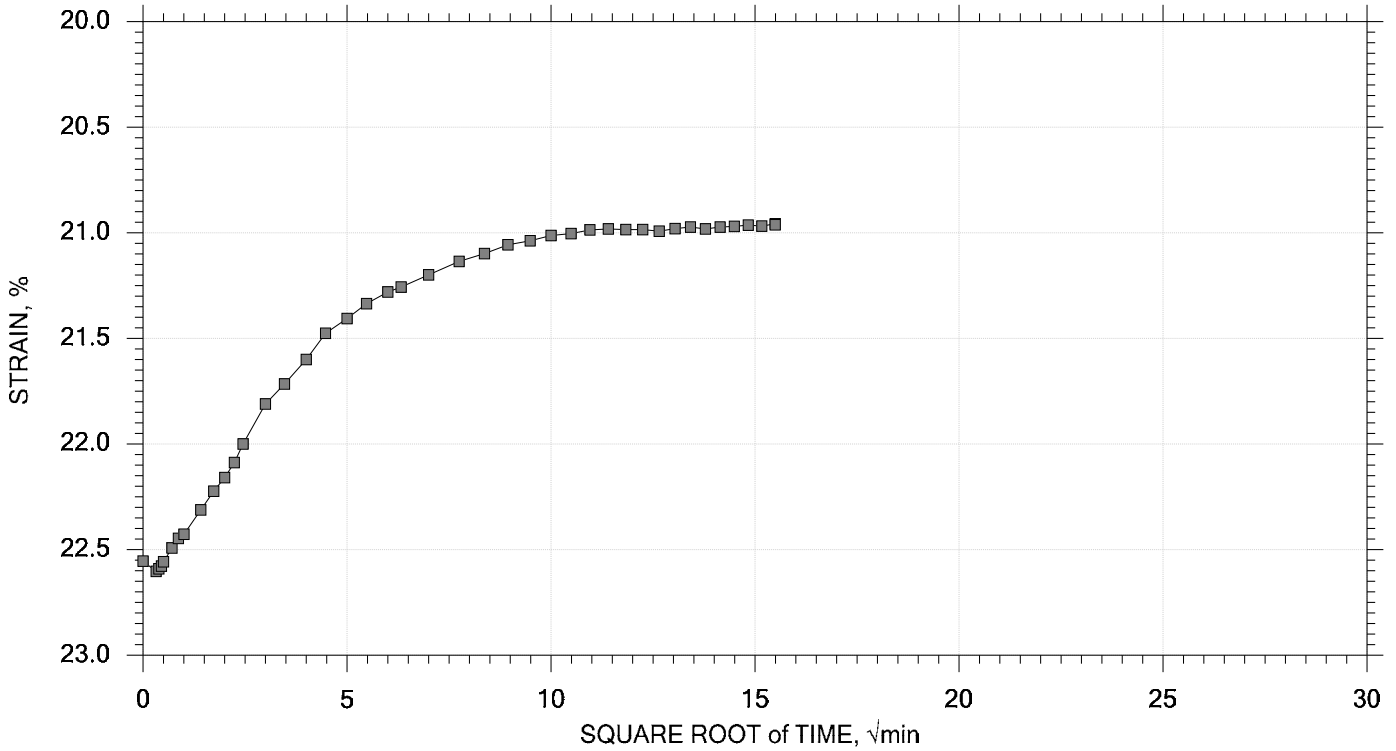
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 19 of 21

Stress: 0.5 tsf





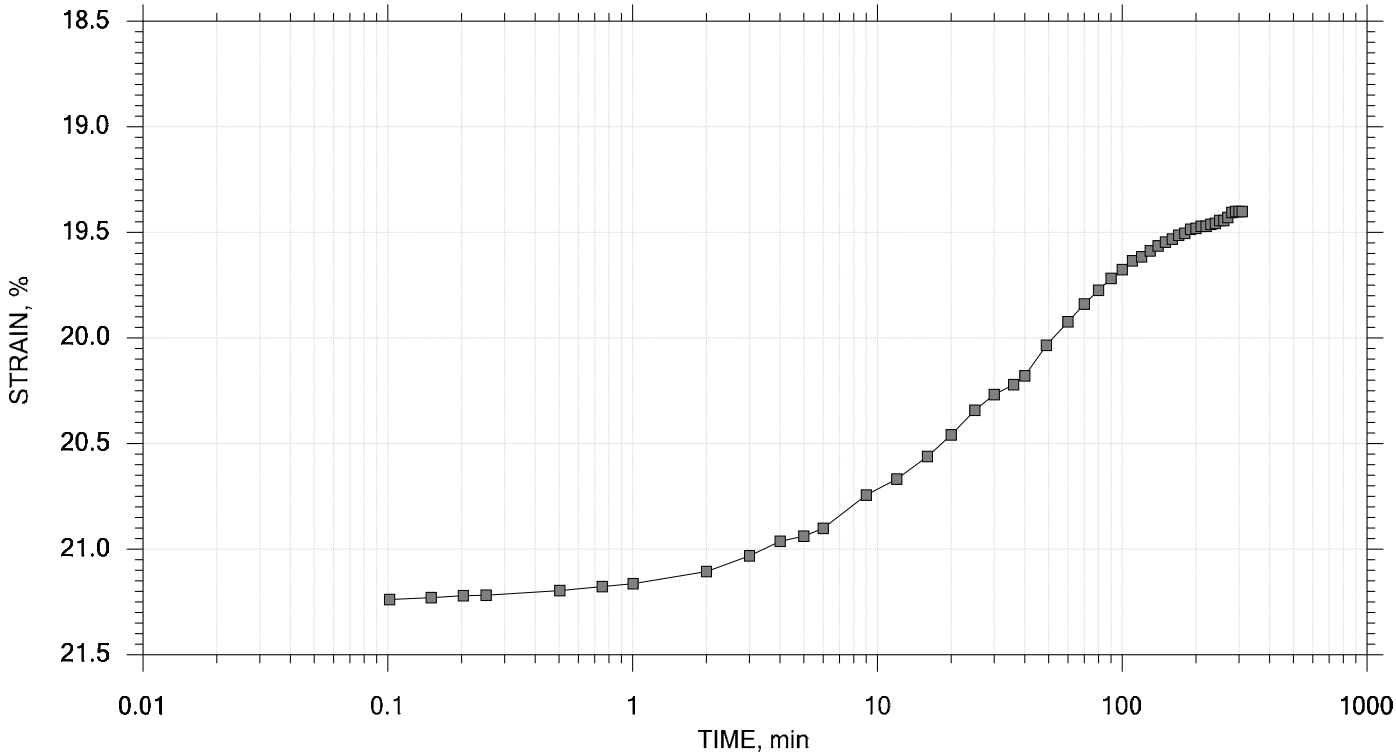
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

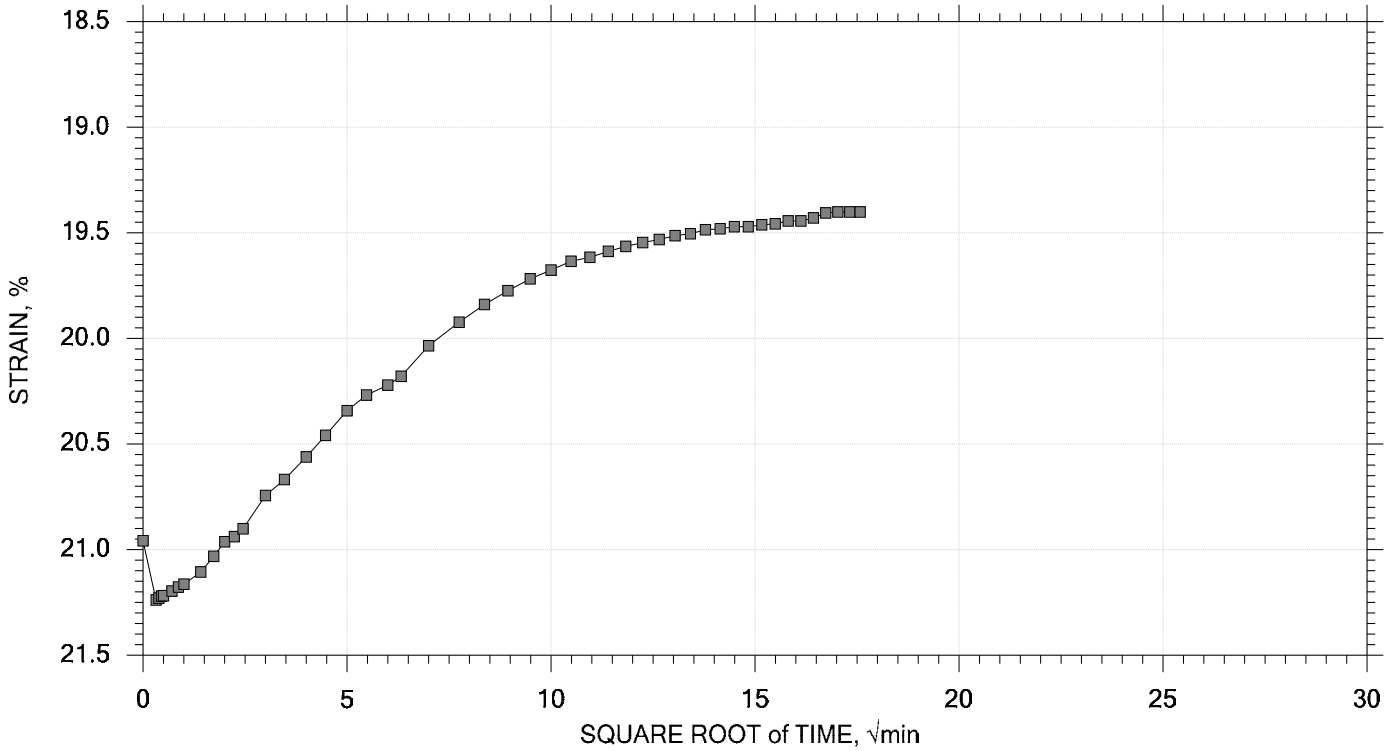
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 20 of 21

Stress: 0.125 tsf





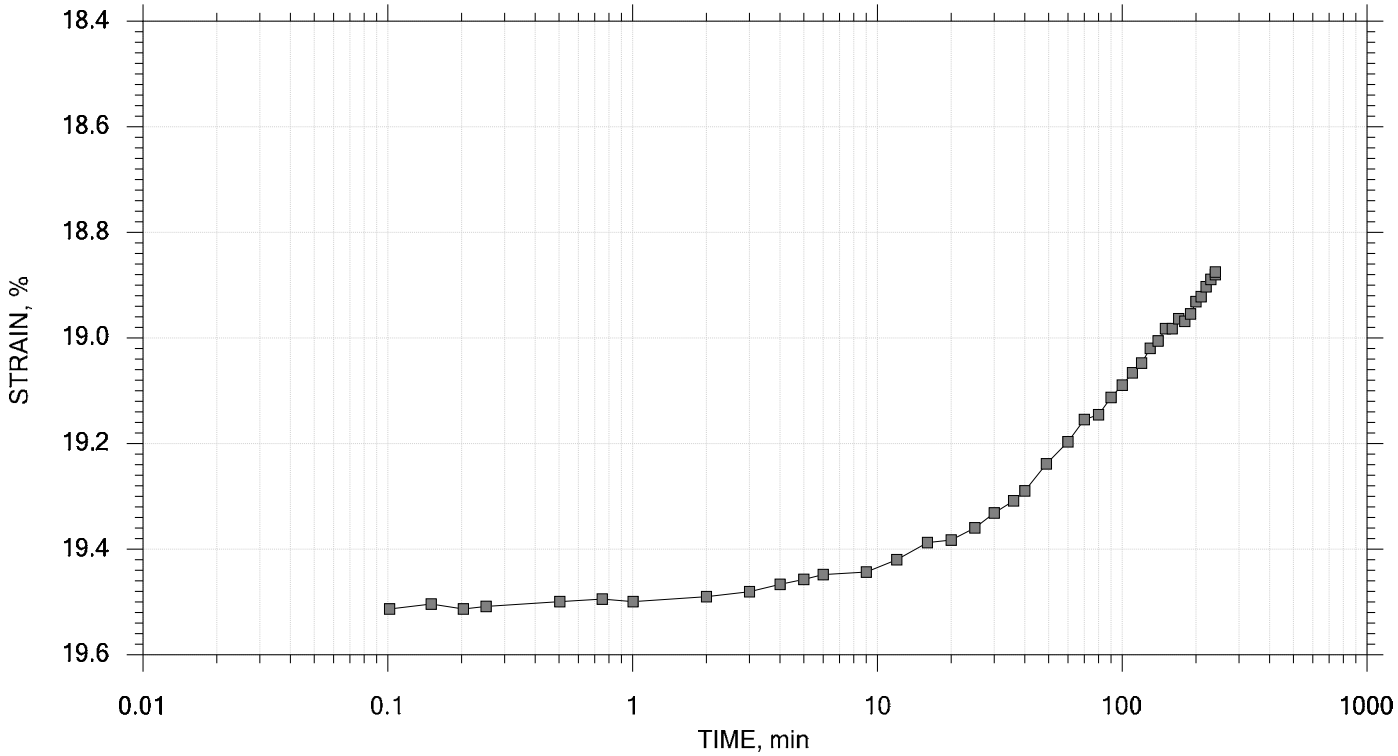
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

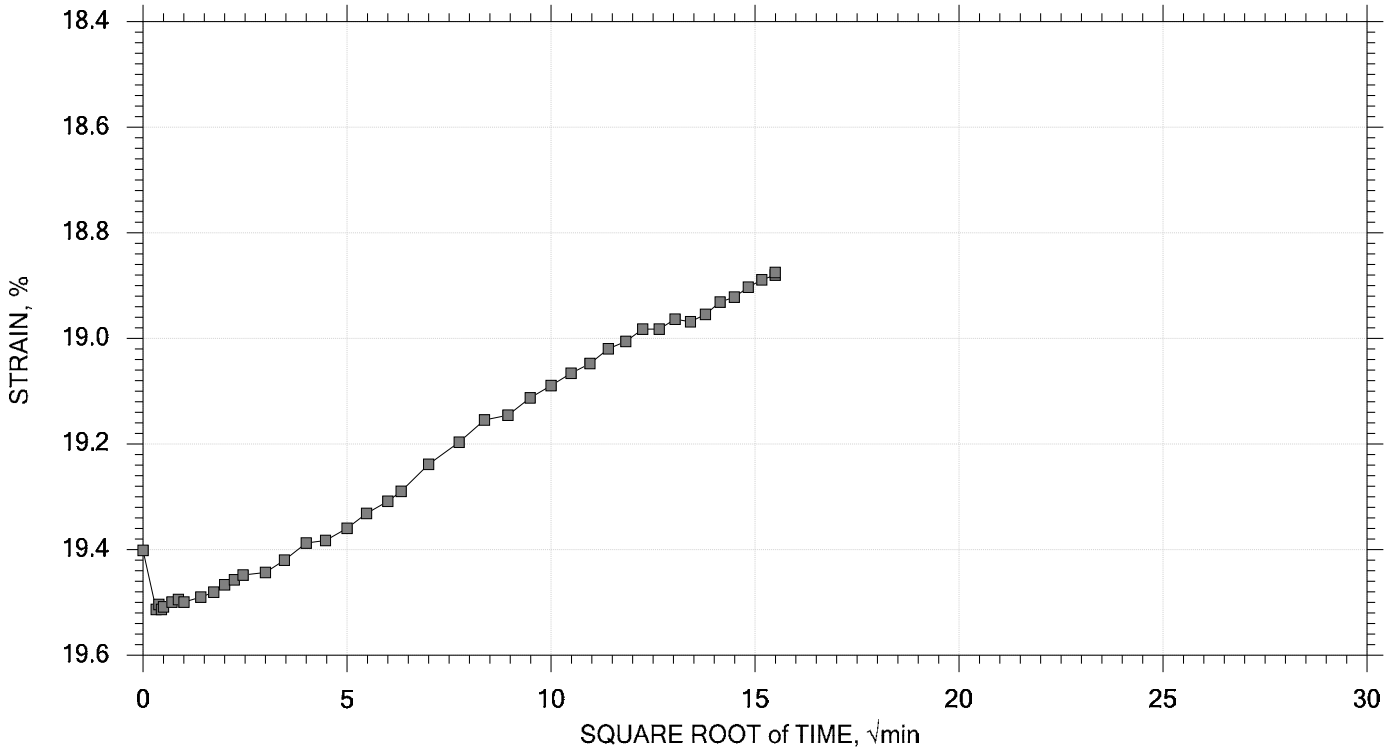
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 21 of 21

Stress: 0.0625 tsf

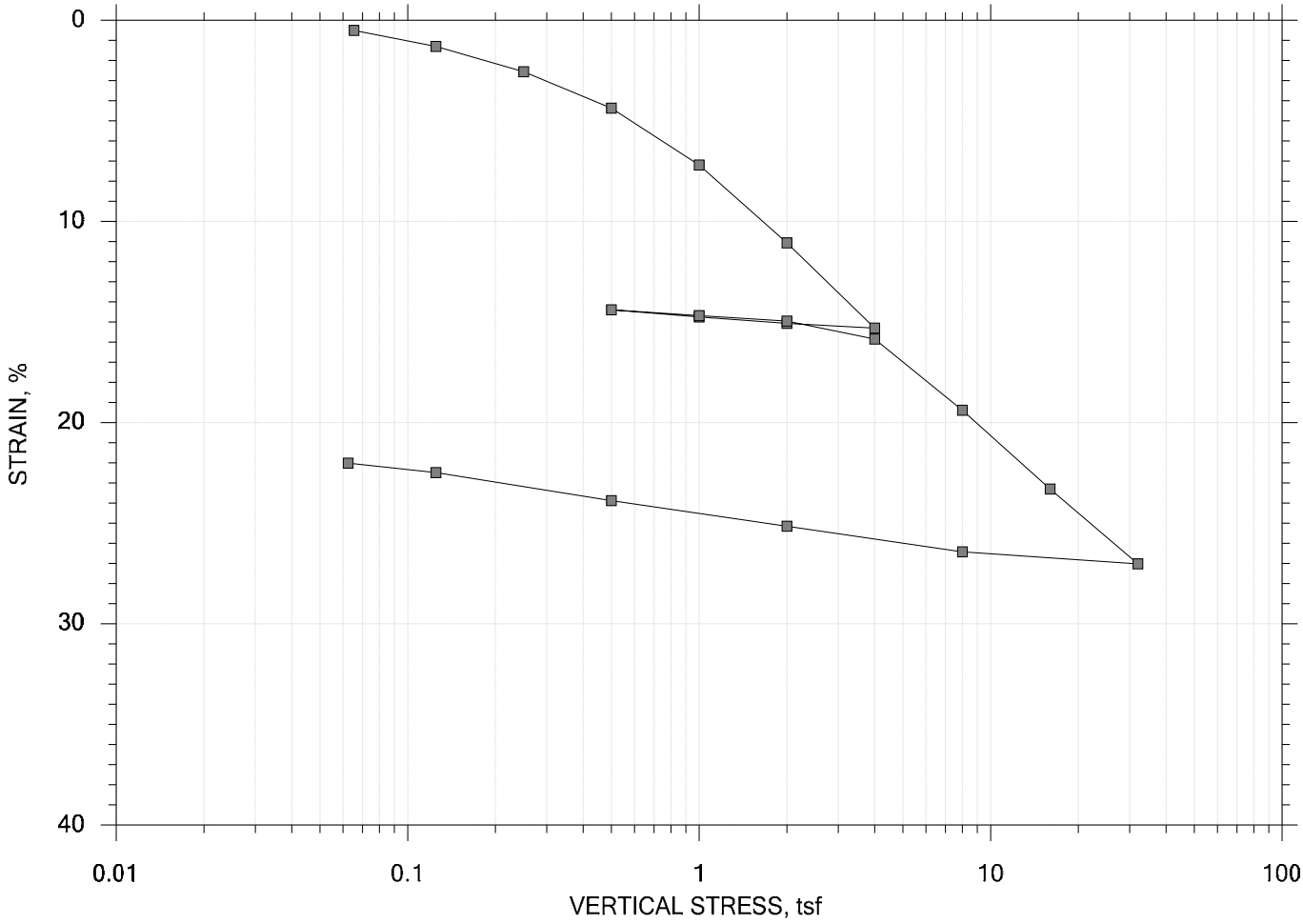


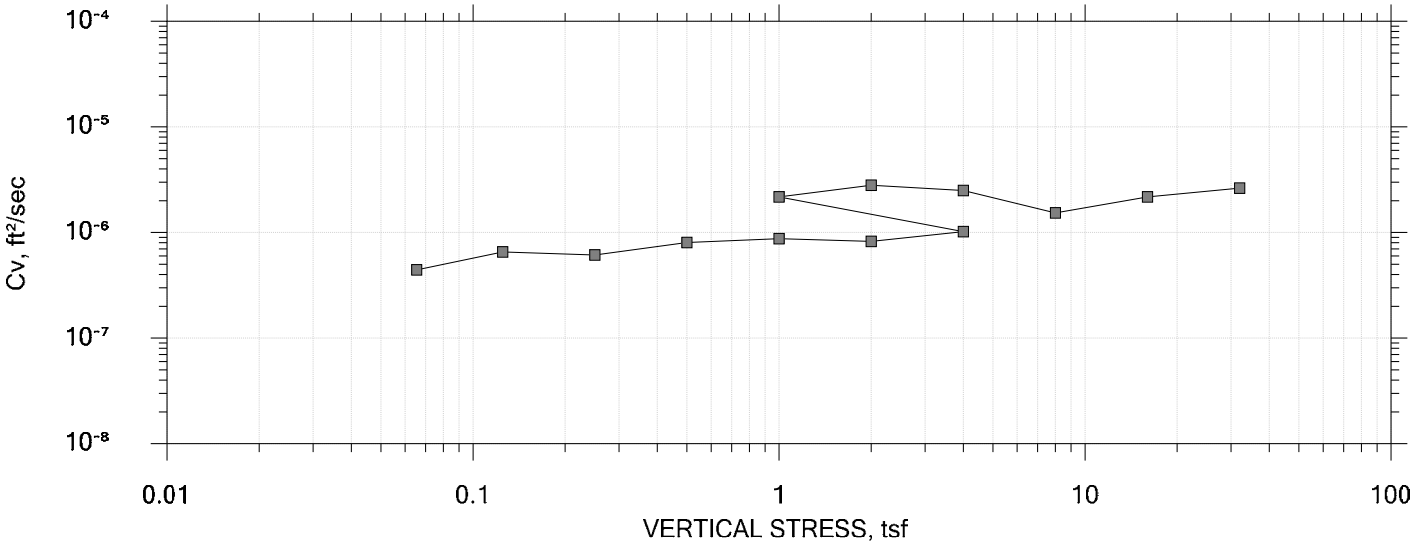


GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-201	Tested By: md	Checked By: jdt
	Sample No.: U2	Test Date: 01/27/17	Test No.: IP-2
	Depth: 35-37 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System R, Swell Pressure = 0.0695 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

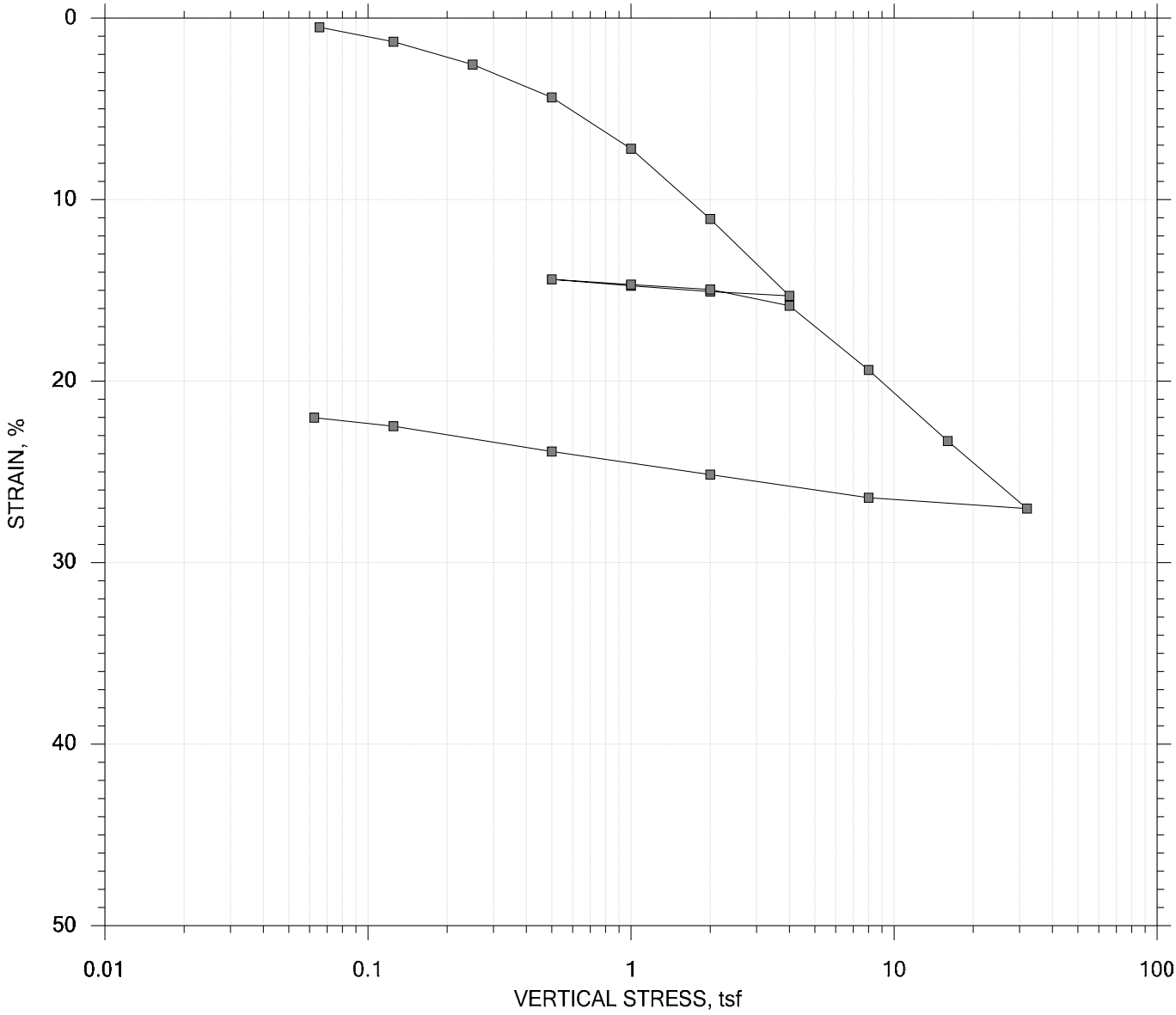




GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



					Before Test	After Test
Current Vertical Effective Stress: ---				Water Content, %	39.27	24.45
Preconsolidation Stress: ---				Dry Unit Weight, pcf	82.918	103.65
Compression Ratio: ---				Saturation, %	99.41	100.00
Diameter: 2.5 in		Height: 1 in		Void Ratio	1.10	0.68
LL: 38	PL: 20	PI: 18	GS: 2.79			

GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
Sample No.: U1	Test Date: 01/29/17	Depth: 20-22 ft
Test No.: IP-3	Sample Type: intact	Elevation: ---

Soil Description: Moist, olive clay
Remarks: System K, Swell Pressure = 0.0654 tsf

Estimated Specific Gravity: 2.79	Liquid Limit: 38	Specimen Diameter: 2.50 in
Initial Void Ratio: 1.10	Plastic Limit: 20	Initial Height: 1.00 in
Final Void Ratio: 0.683	Plasticity Index: 18	Final Height: 0.80 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	C-1956	RING		C1546
Wt. Container + Wet Soil, gm	148.06	260.67	244.83	140.65
Wt. Container + Dry Soil, gm	108.51	218.71	218.71	114.63
Wt. Container, gm	8.5800	111.87	111.87	8.1900
Wt. Dry Soil, gm	99.930	106.84	106.84	106.44
Water Content, %	39.58	39.27	24.45	24.45
Void Ratio	---	1.10	0.683	---
Degree of Saturation, %	---	99.41	100.00	---
Dry Unit Weight, pcf	---	82.918	103.65	---

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

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham, ME
Boring No.: HB-GBB-202
Sample No.: U1
Test No.: IP-3

Location: Gorham, ME
Tested By: md
Test Date: 01/29/17
Sample Type: intact

Project No.: GTX-305885
Checked By: jdt
Depth: 20-22 ft
Elevation: ---

Soil Description: Moist, olive clay
Remarks: System K, Swell Pressure = 0.0654 tsf

Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/sec	Mv 1/tsf	k ft/day
1	0.0654	0.005075	1.09	0.508	53.360	4.58e-007	7.76e-002	9.57e-005
2	0.125	0.01302	1.08	1.30	41.648	5.79e-007	1.33e-001	2.08e-004
3	0.250	0.02558	1.05	2.56	28.321	8.33e-007	1.01e-001	2.26e-004
4	0.500	0.04368	1.01	4.37	27.126	8.43e-007	7.24e-002	1.65e-004
5	1.00	0.07195	0.953	7.20	21.760	1.00e-006	5.65e-002	1.53e-004
6	2.00	0.1106	0.871	11.1	18.599	1.09e-006	3.87e-002	1.14e-004
7	4.00	0.1530	0.782	15.3	15.018	1.23e-006	2.12e-002	7.03e-005
8	2.00	0.1506	0.787	15.1	3.001	5.88e-006	1.17e-003	1.86e-005
9	1.00	0.1474	0.794	14.7	5.888	3.02e-006	3.19e-003	2.60e-005
10	0.500	0.1439	0.801	14.4	27.828	6.44e-007	7.09e-003	1.23e-005
11	1.00	0.1468	0.795	14.7	9.716	1.84e-006	5.79e-003	2.88e-005
12	2.00	0.1495	0.789	14.9	8.198	2.17e-006	2.69e-003	1.58e-005
13	4.00	0.1584	0.771	15.8	6.323	2.78e-006	4.46e-003	3.34e-005
14	8.00	0.1938	0.696	19.4	10.919	1.53e-006	8.85e-003	3.64e-005
15	16.0	0.2330	0.614	23.3	6.436	2.36e-006	4.90e-003	3.12e-005
16	32.0	0.2702	0.536	27.0	5.039	2.73e-006	2.32e-003	1.71e-005
17	8.00	0.2642	0.548	26.4	1.656	7.95e-006	2.47e-004	5.30e-006
18	2.00	0.2515	0.575	25.1	6.009	2.25e-006	2.13e-003	1.29e-005
19	0.500	0.2387	0.602	23.9	36.352	3.85e-007	8.48e-003	8.80e-006
20	0.125	0.2248	0.631	22.5	101.968	1.42e-007	3.72e-002	1.42e-005
21	0.0625	0.2201	0.641	22.0	167.606	8.85e-008	7.51e-002	1.79e-005

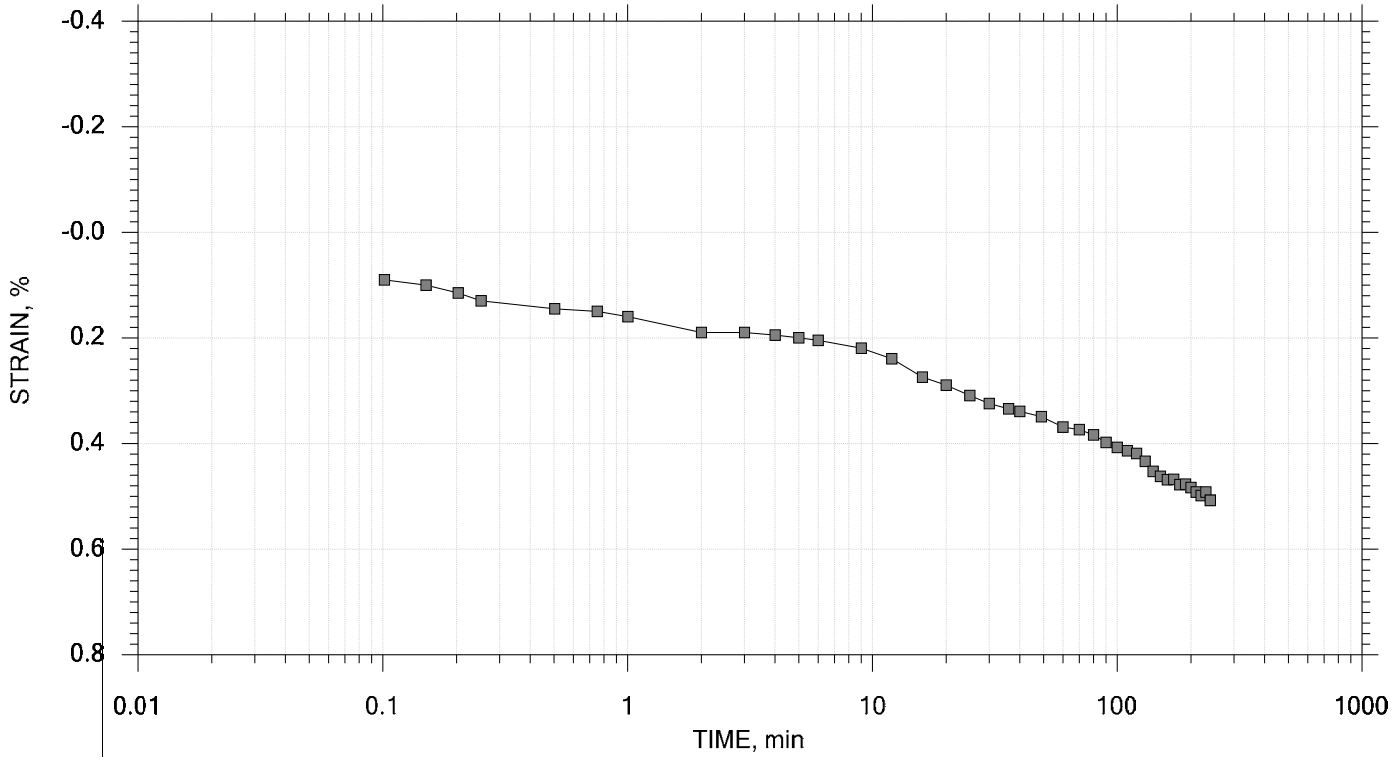
	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/sec	Mv 1/tsf	k ft/day	Ca %
1	0.0654	0.005075	1.09	0.508	0.000	0.00e+000	7.76e-002	0.00e+000	0.00e+000
2	0.125	0.01302	1.08	1.30	8.022	6.98e-007	1.33e-001	2.51e-004	0.00e+000
3	0.250	0.02558	1.05	2.56	11.519	4.76e-007	1.01e-001	1.29e-004	0.00e+000
4	0.500	0.04368	1.01	4.37	6.724	7.90e-007	7.24e-002	1.54e-004	0.00e+000
5	1.00	0.07195	0.953	7.20	6.393	7.92e-007	5.65e-002	1.21e-004	0.00e+000
6	2.00	0.1106	0.871	11.1	6.597	7.13e-007	3.87e-002	7.45e-005	0.00e+000
7	4.00	0.1530	0.782	15.3	4.874	8.81e-007	2.12e-002	5.03e-005	0.00e+000
8	2.00	0.1506	0.787	15.1	0.531	7.72e-006	1.17e-003	2.44e-005	0.00e+000
9	1.00	0.1474	0.794	14.7	0.000	0.00e+000	3.19e-003	0.00e+000	0.00e+000
10	0.500	0.1439	0.801	14.4	5.331	7.80e-007	7.09e-003	1.49e-005	0.00e+000
11	1.00	0.1468	0.795	14.7	0.000	0.00e+000	5.79e-003	0.00e+000	0.00e+000
12	2.00	0.1495	0.789	14.9	0.000	0.00e+000	2.69e-003	0.00e+000	0.00e+000
13	4.00	0.1584	0.771	15.8	1.859	2.20e-006	4.46e-003	2.64e-005	0.00e+000
14	8.00	0.1938	0.696	19.4	2.507	1.54e-006	8.85e-003	3.68e-005	0.00e+000
15	16.0	0.2330	0.614	23.3	1.757	2.01e-006	4.90e-003	2.65e-005	0.00e+000
16	32.0	0.2702	0.536	27.0	1.318	2.42e-006	2.32e-003	1.52e-005	0.00e+000
17	8.00	0.2642	0.548	26.4	0.000	0.00e+000	2.47e-004	0.00e+000	0.00e+000
18	2.00	0.2515	0.575	25.1	0.000	0.00e+000	2.13e-003	0.00e+000	0.00e+000
19	0.500	0.2387	0.602	23.9	0.000	0.00e+000	8.48e-003	0.00e+000	0.00e+000
20	0.125	0.2248	0.631	22.5	16.173	2.08e-007	3.72e-002	2.09e-005	0.00e+000
21	0.0625	0.2201	0.641	22.0	0.000	0.00e+000	7.51e-002	0.00e+000	0.00e+000

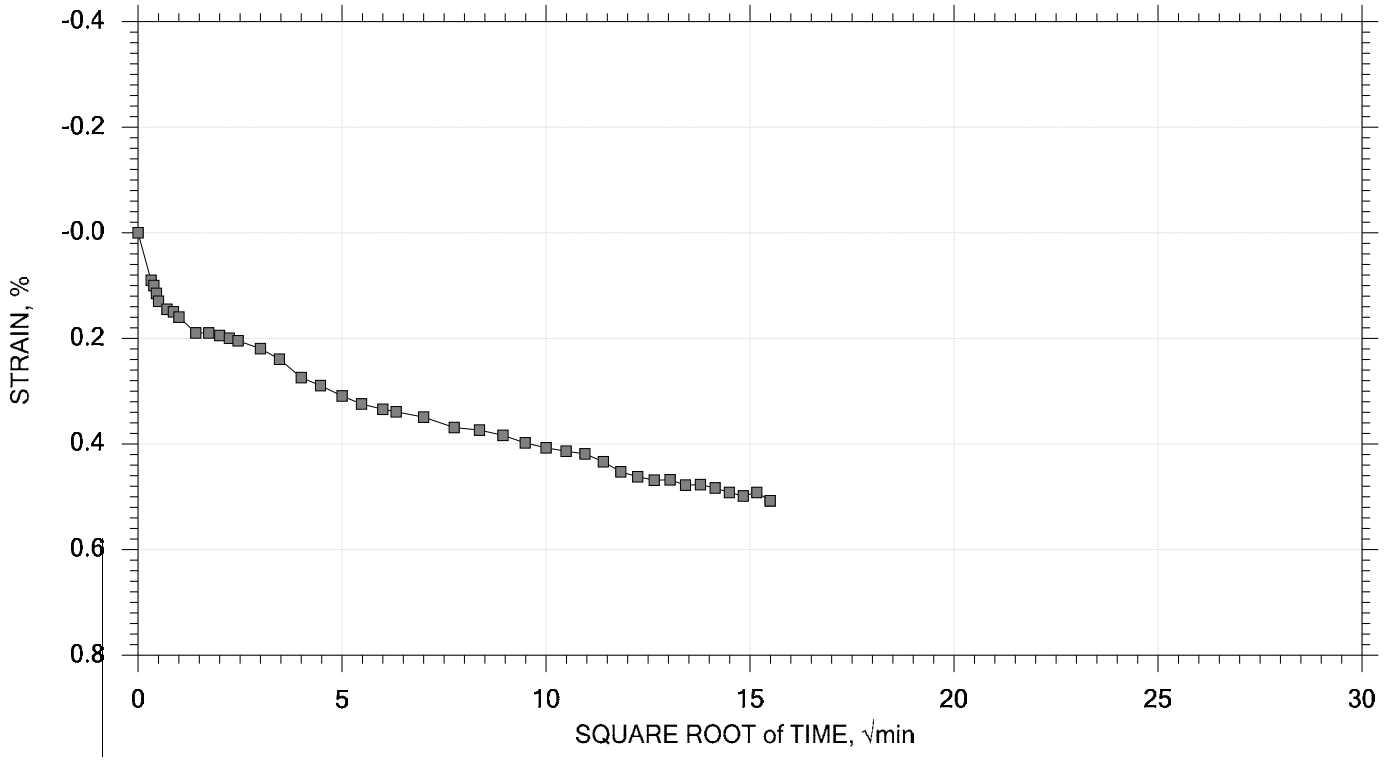
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 21

Stress: 0.065439 tsf





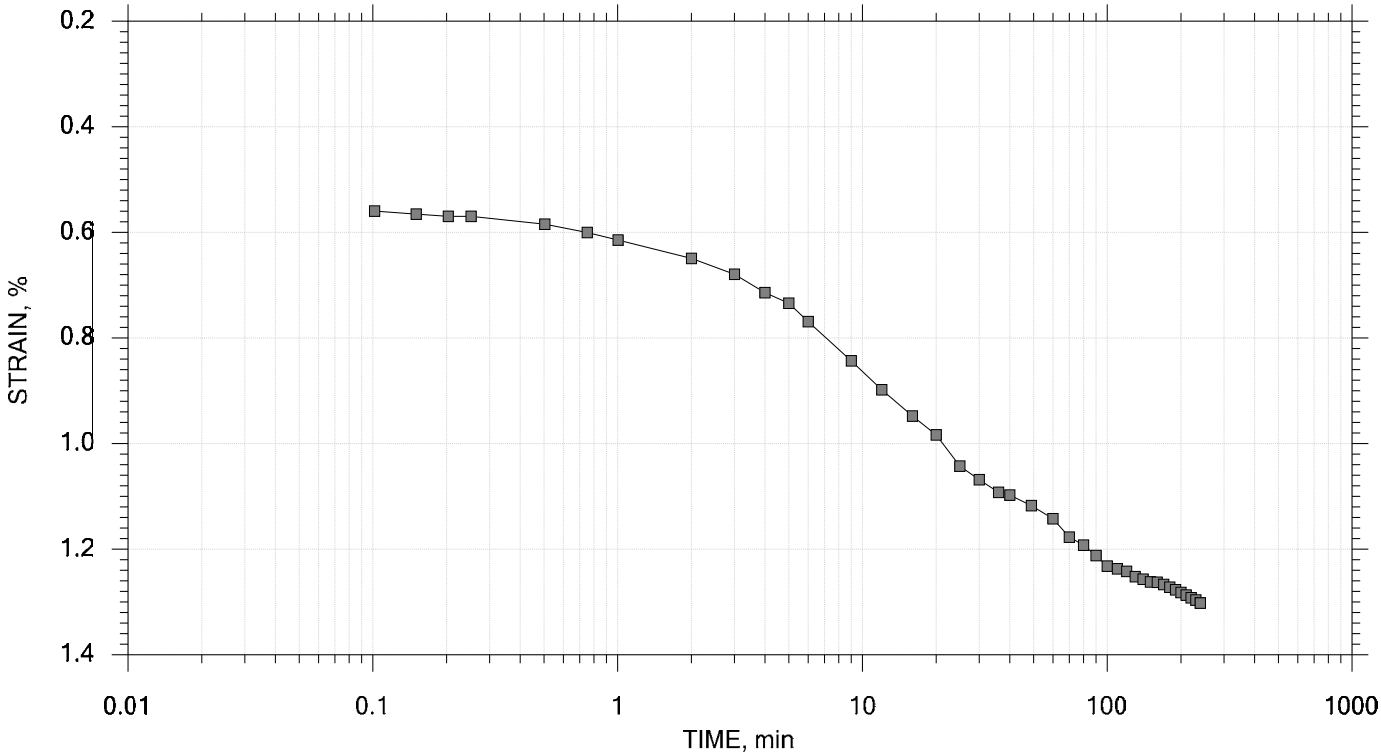
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

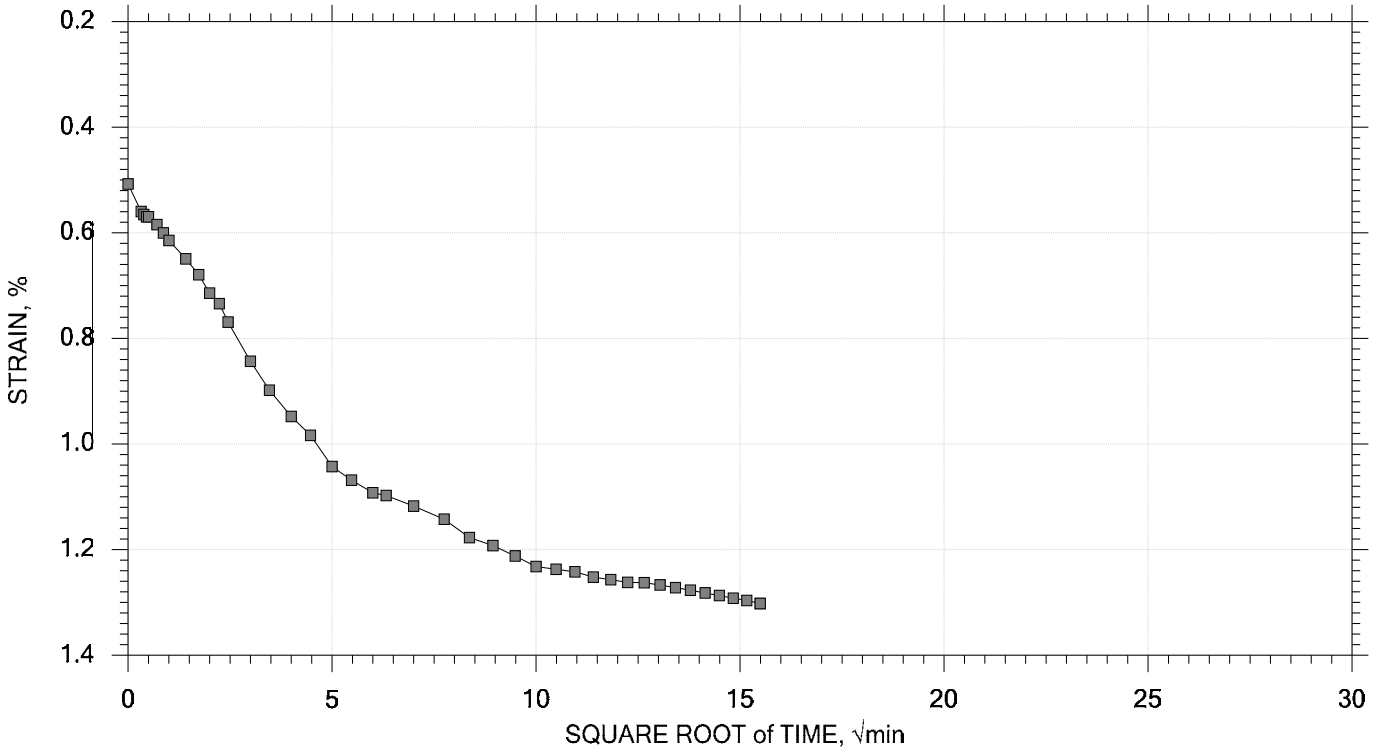
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 21

Stress: 0.125 tsf





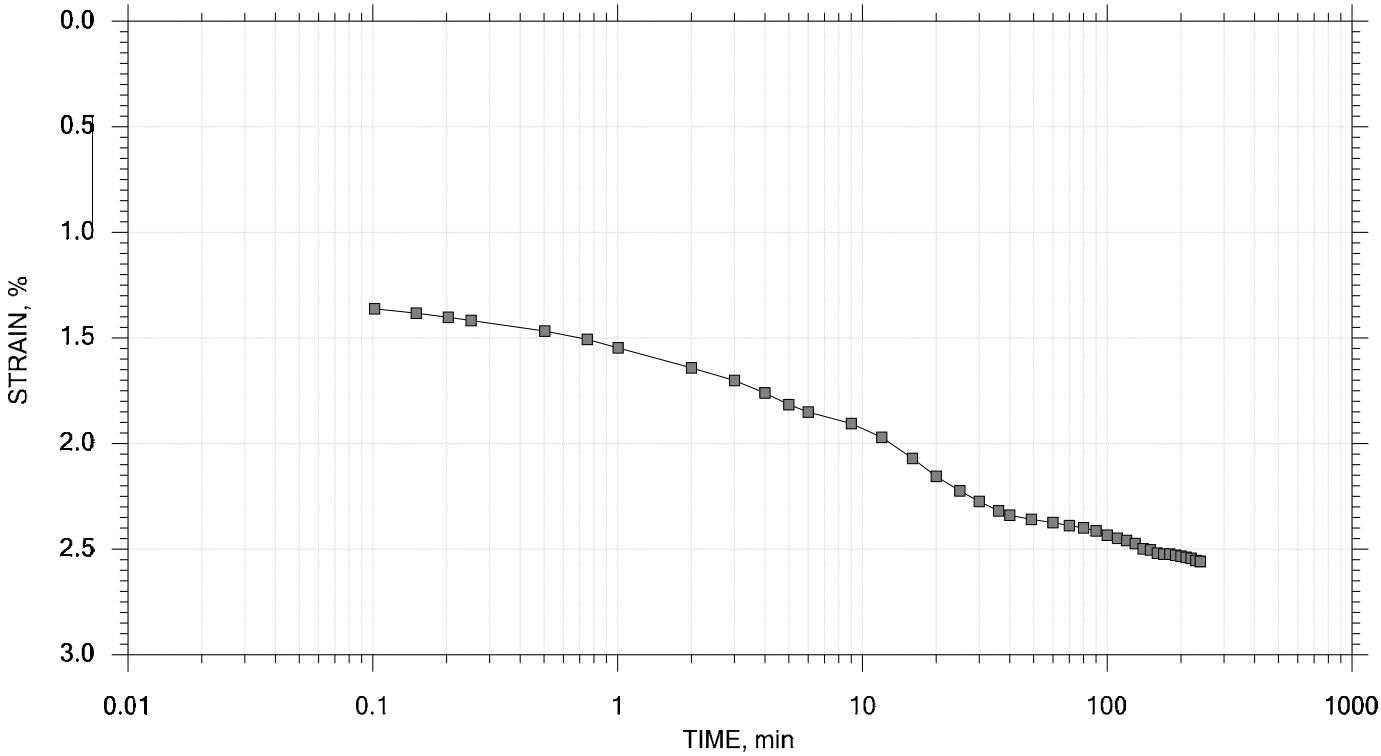
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

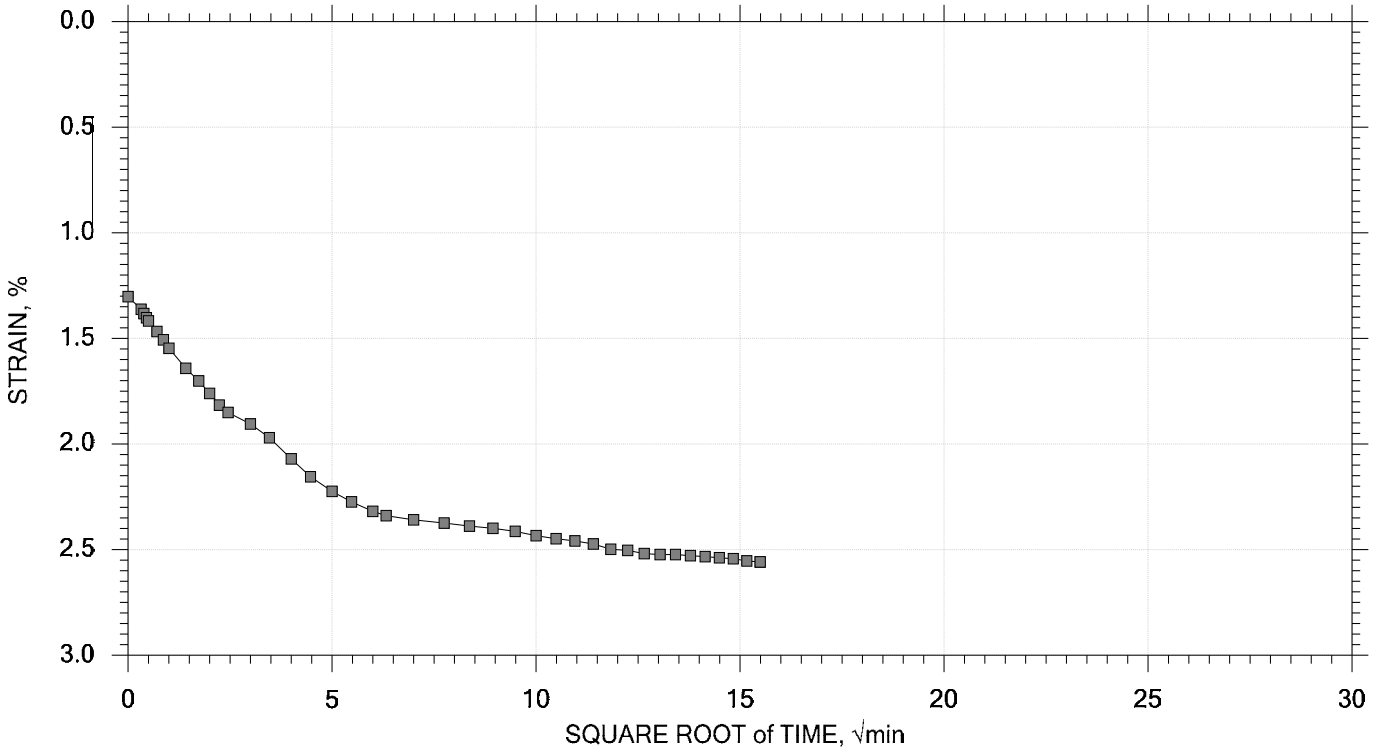
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 21

Stress: 0.25 tsf





GeoTesting EXPRESS

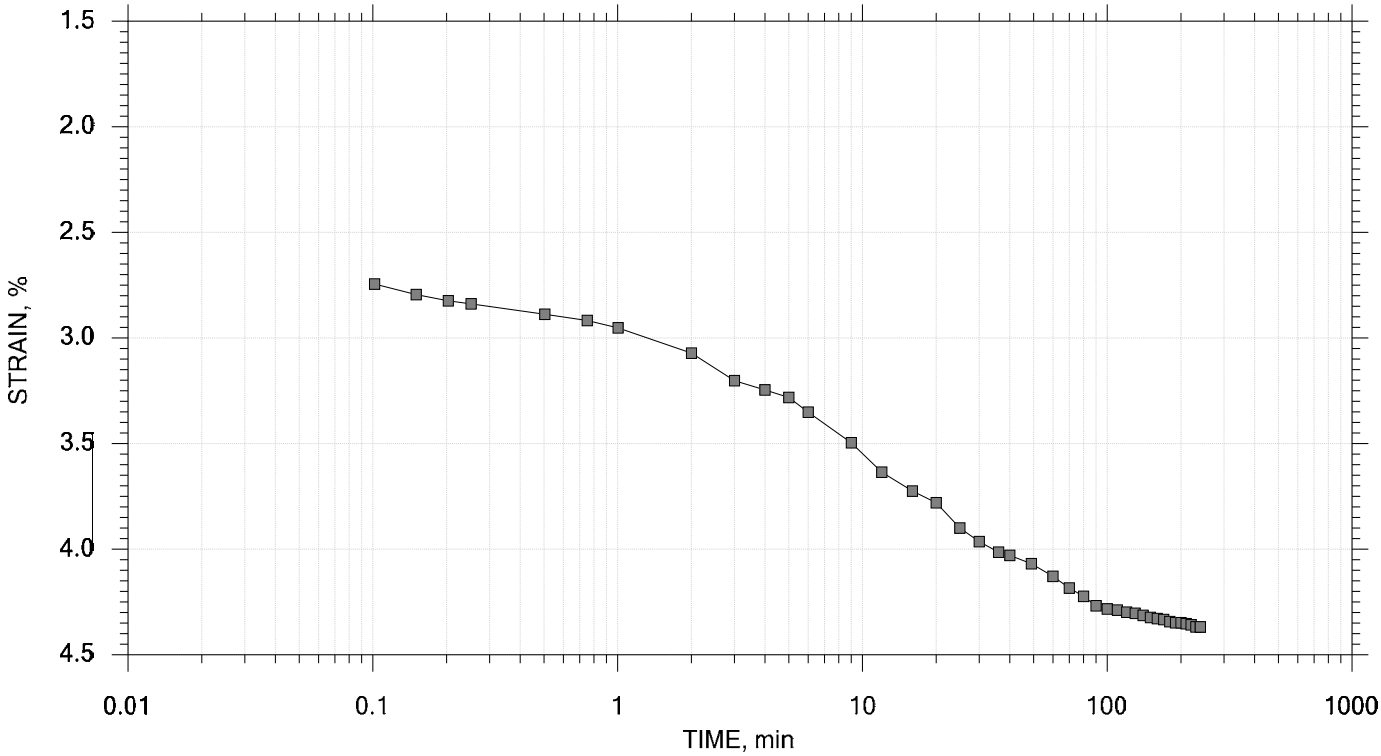
Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
Depth: 20-22 ft	Sample Type: intact	Elevation: ---
Description: Moist, olive clay		
Remarks: System K, Swell Pressure = 0.0654 tsf		

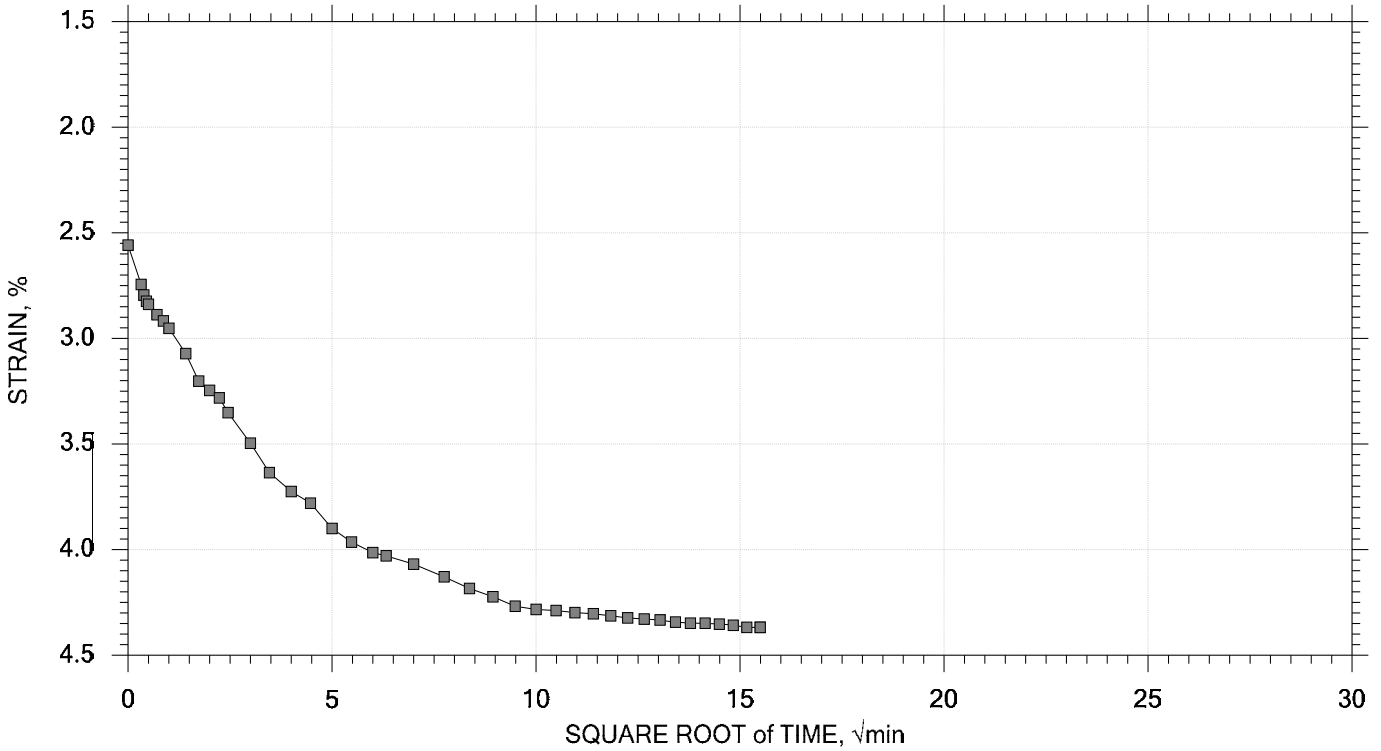
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 21

Stress: 0.5 tsf





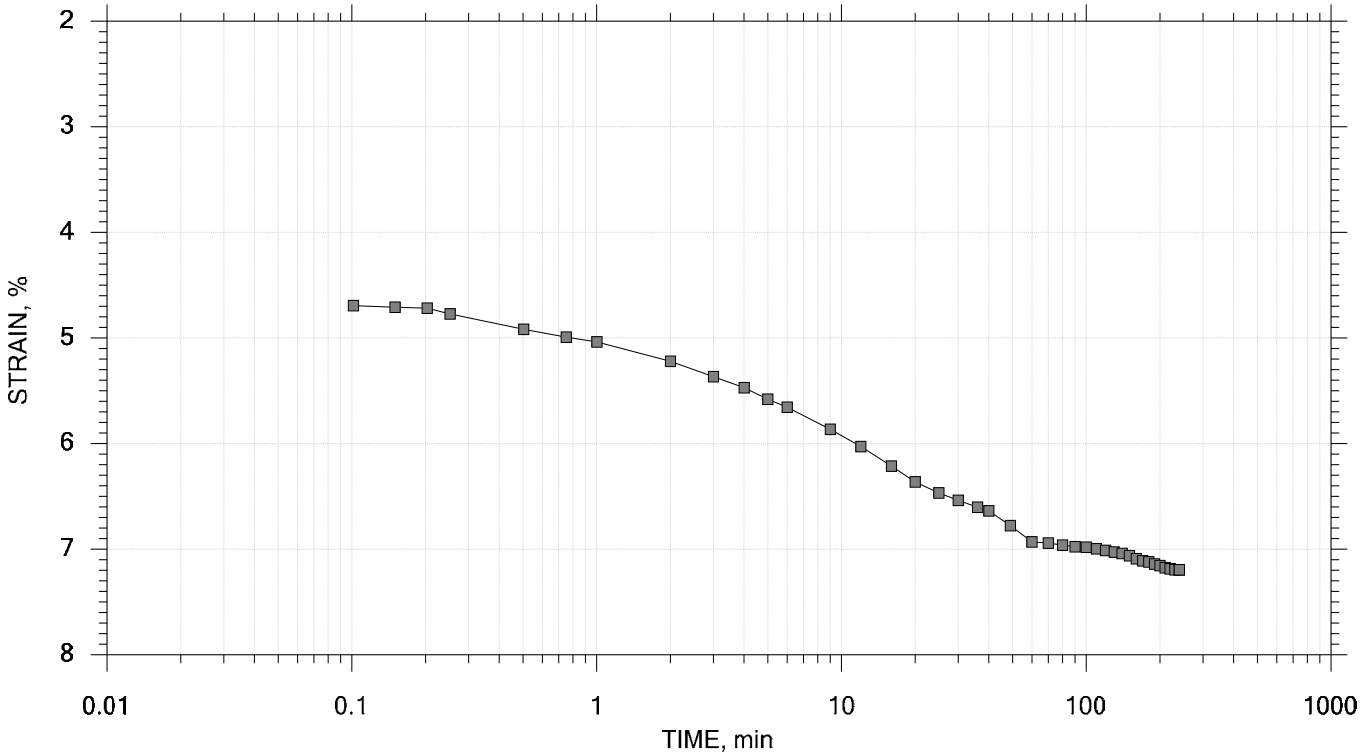
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

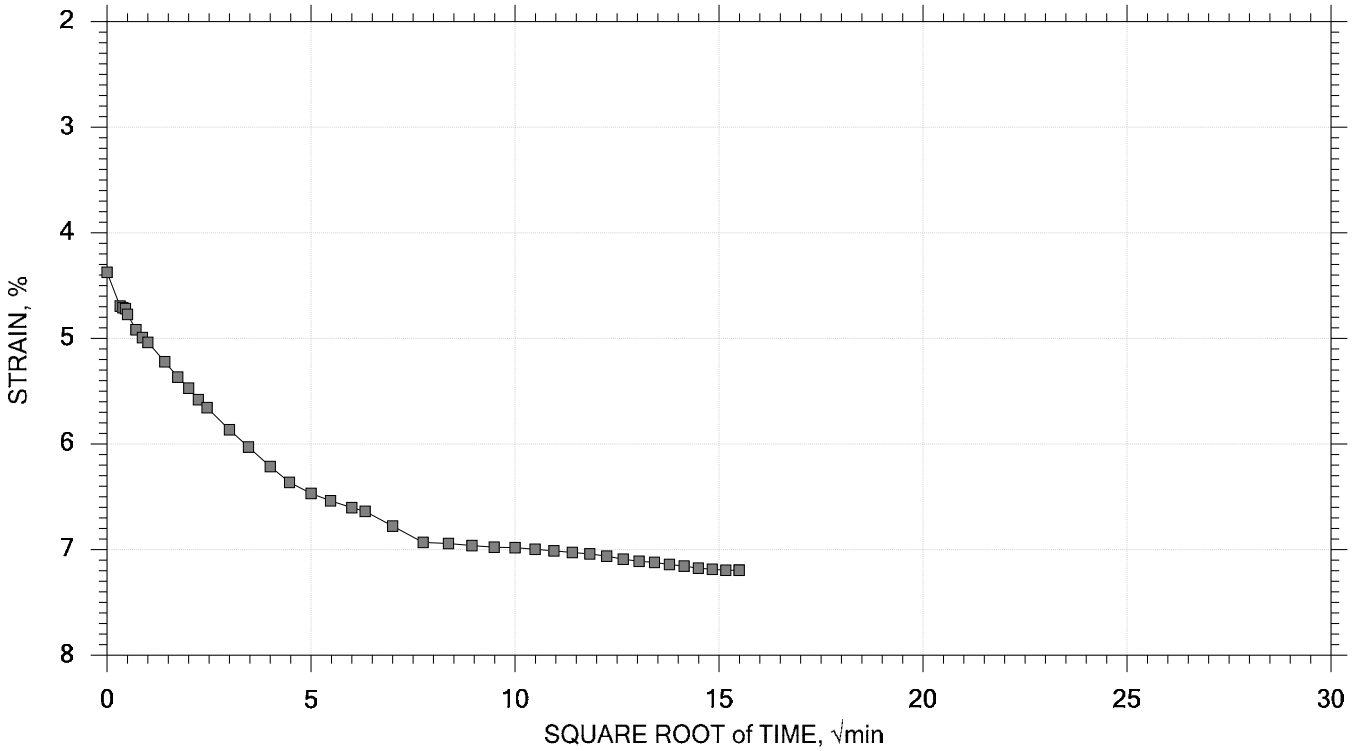
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 21

Stress: 1 tsf





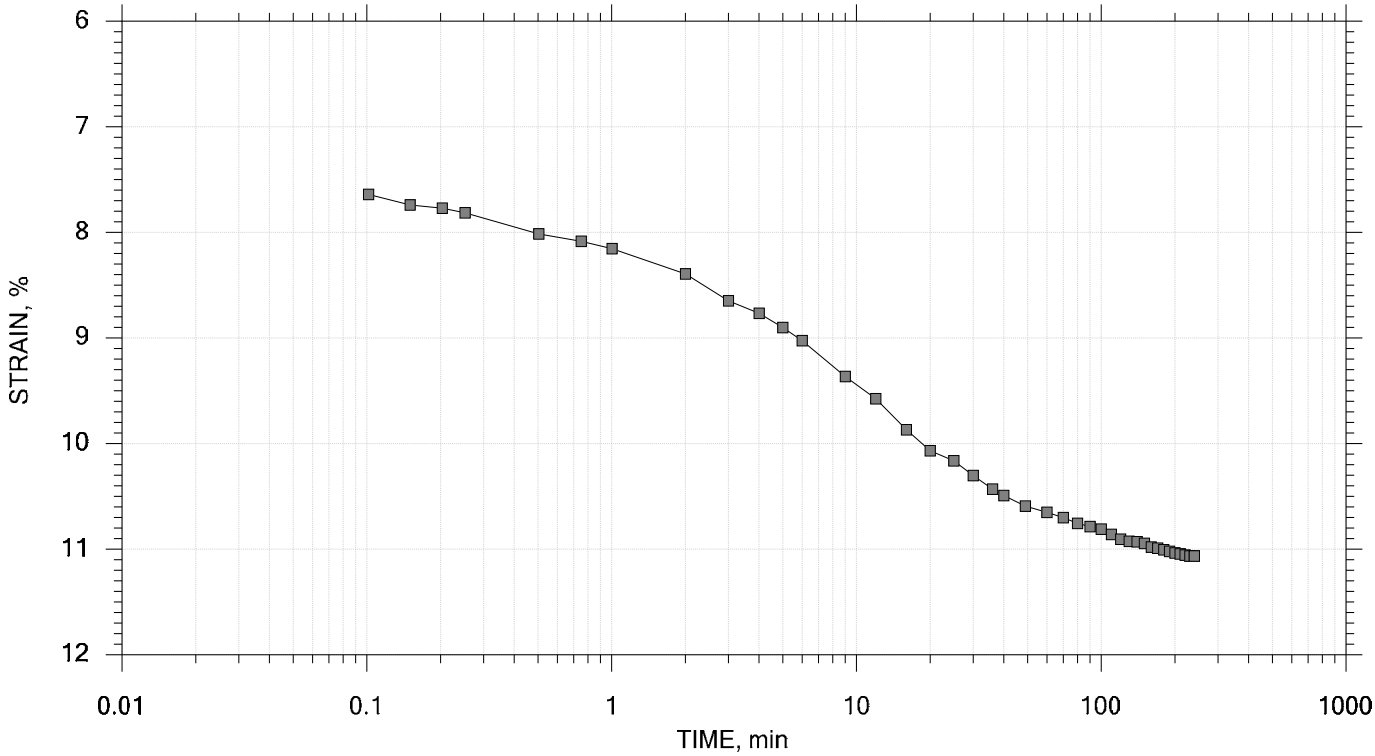
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

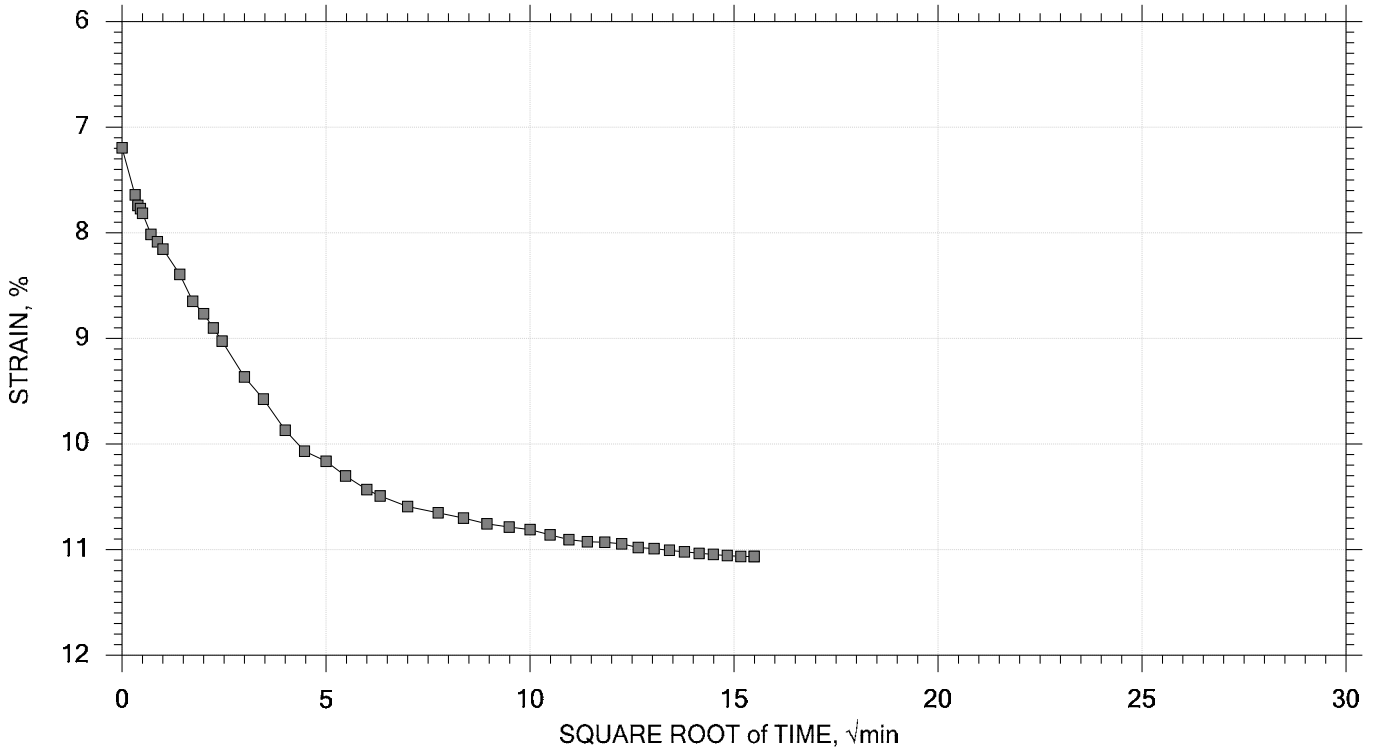
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 21

Stress: 2 tsf





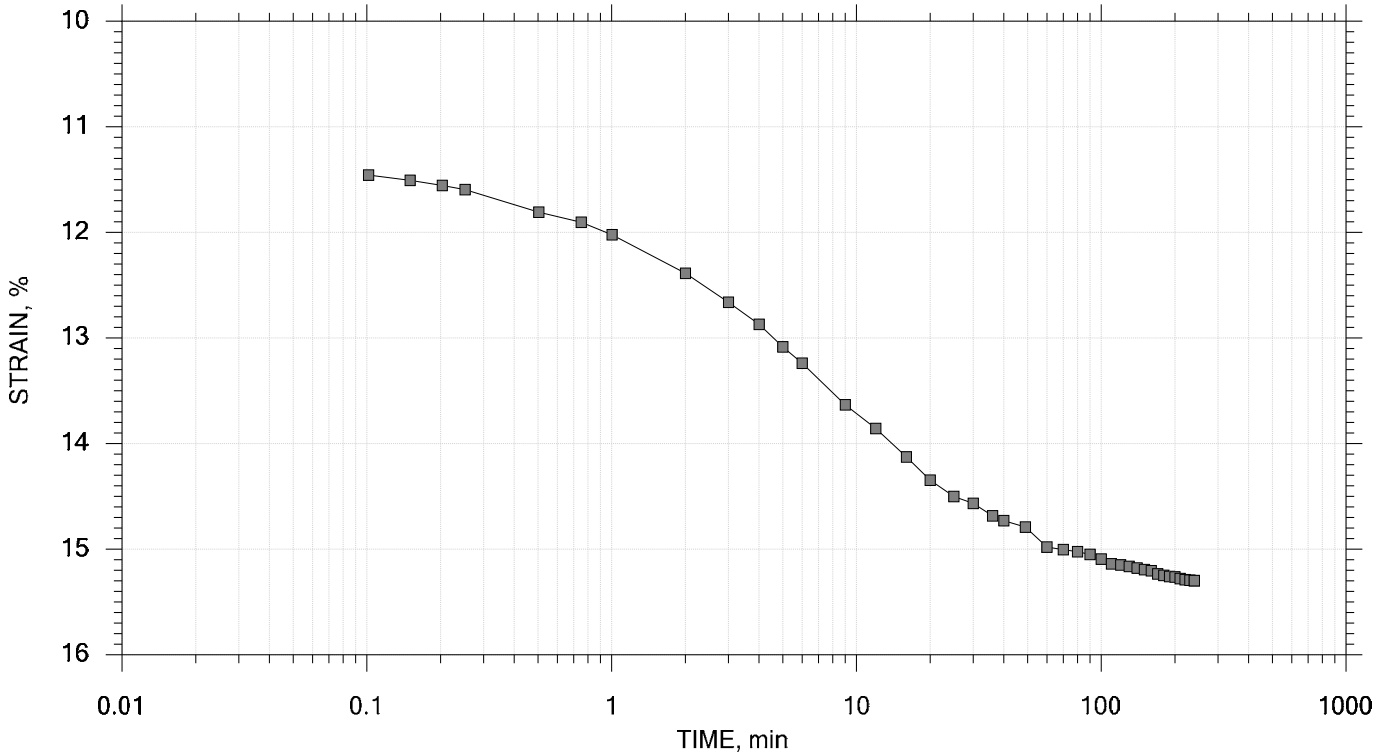
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

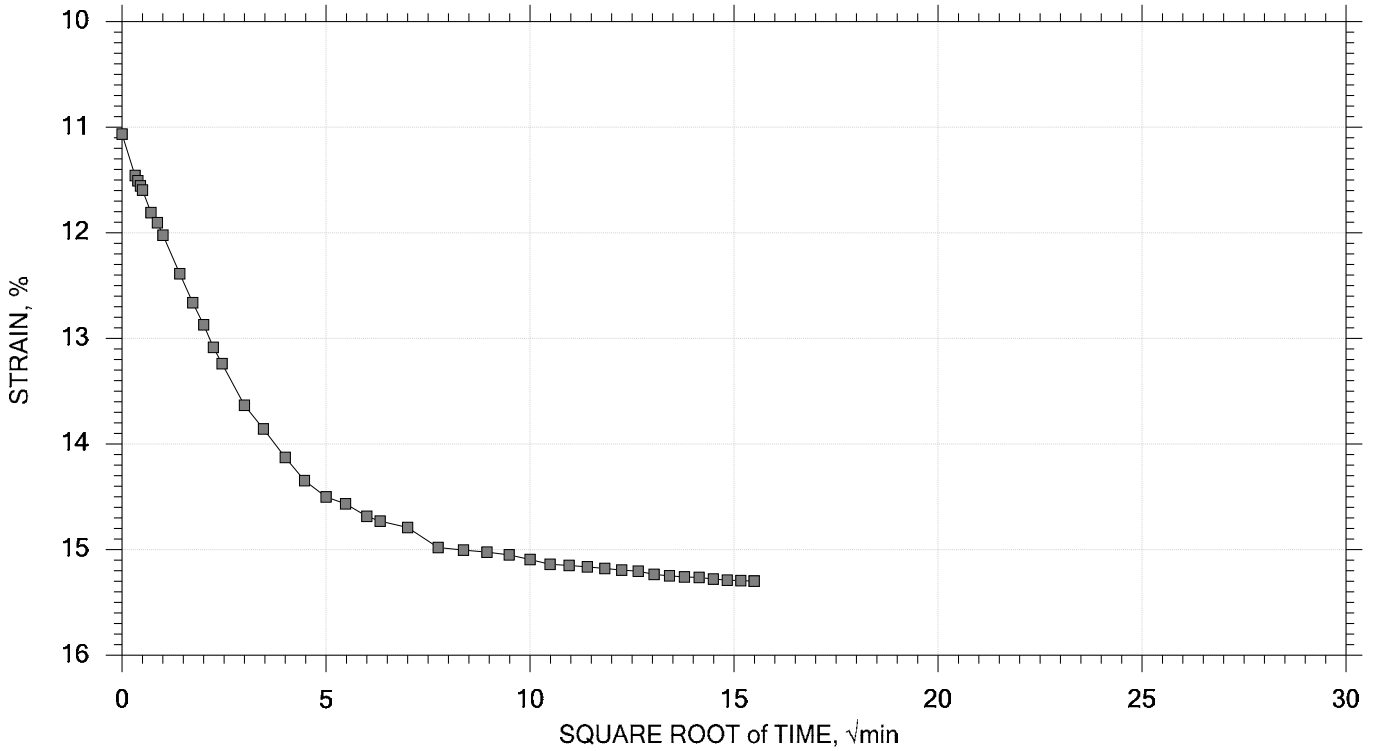
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 21

Stress: 4 tsf





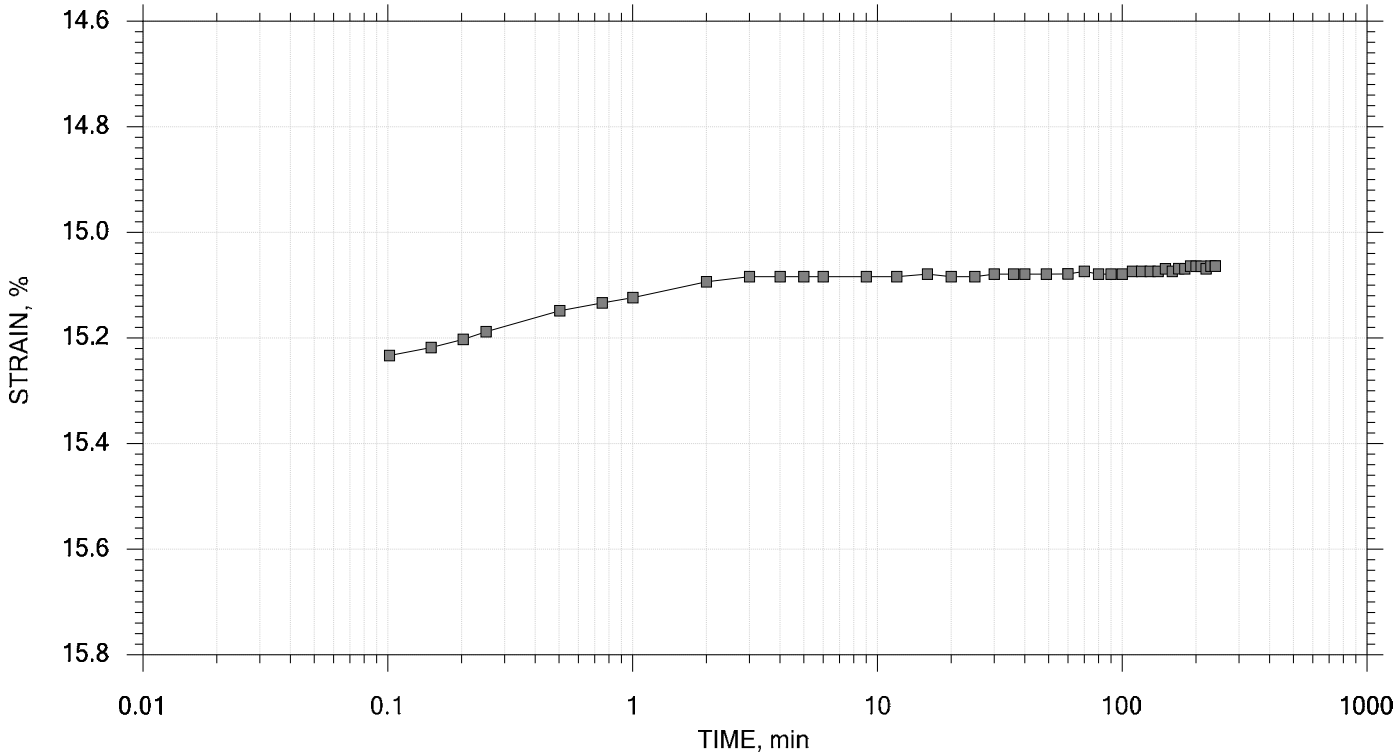
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

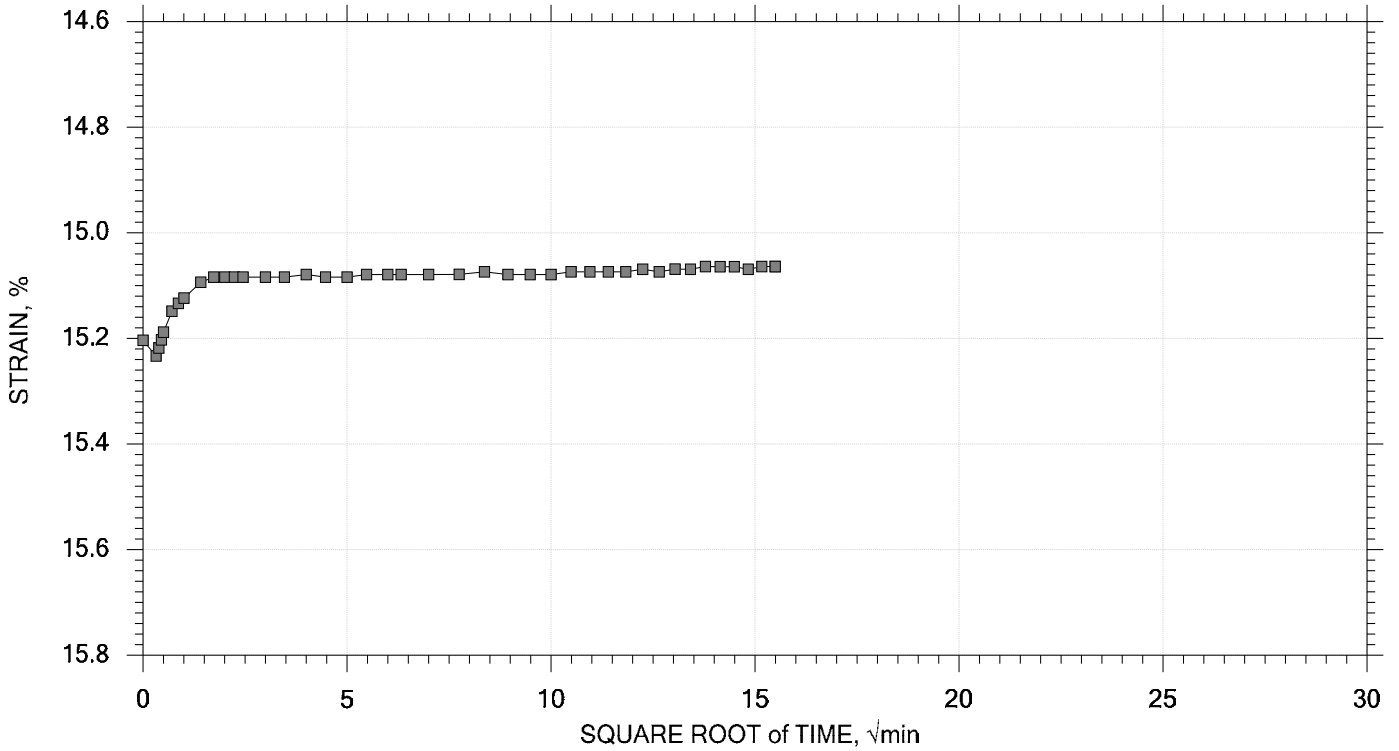
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 21

Stress: 2 tsf





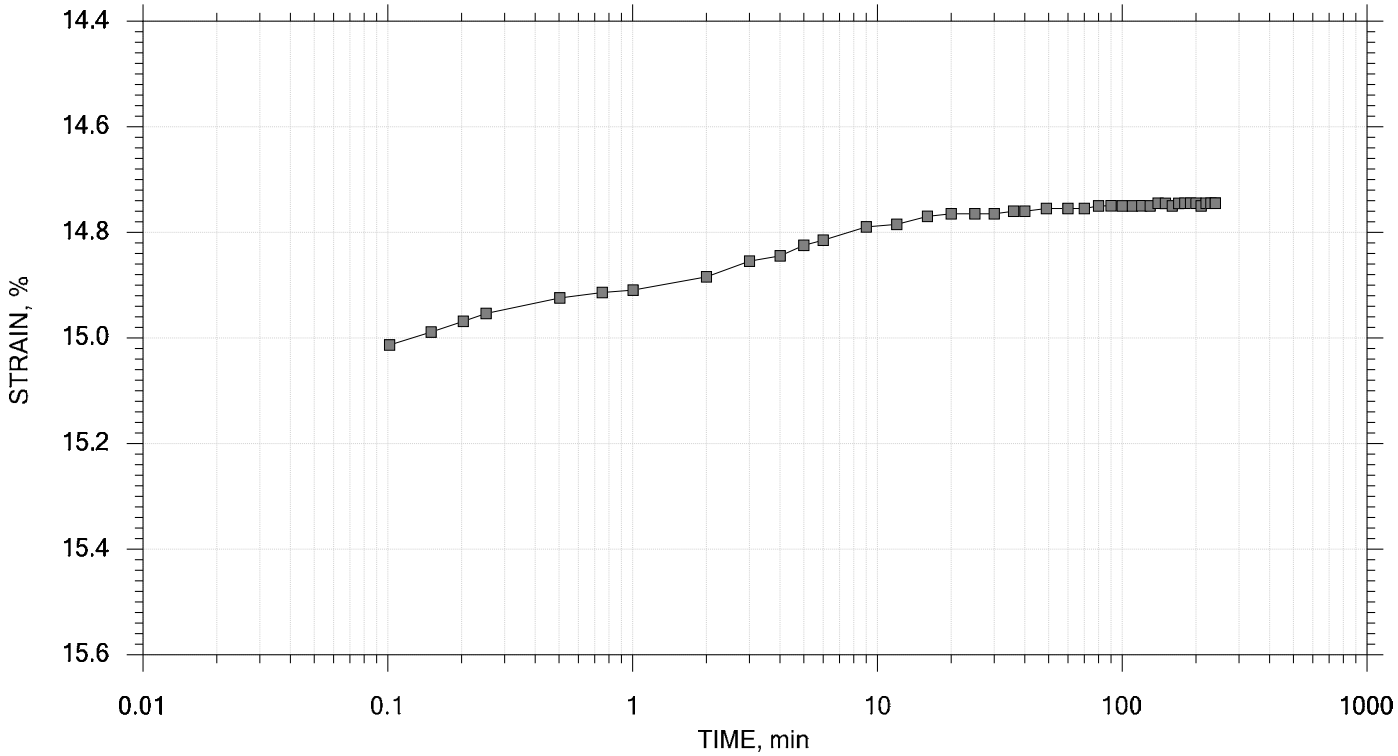
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

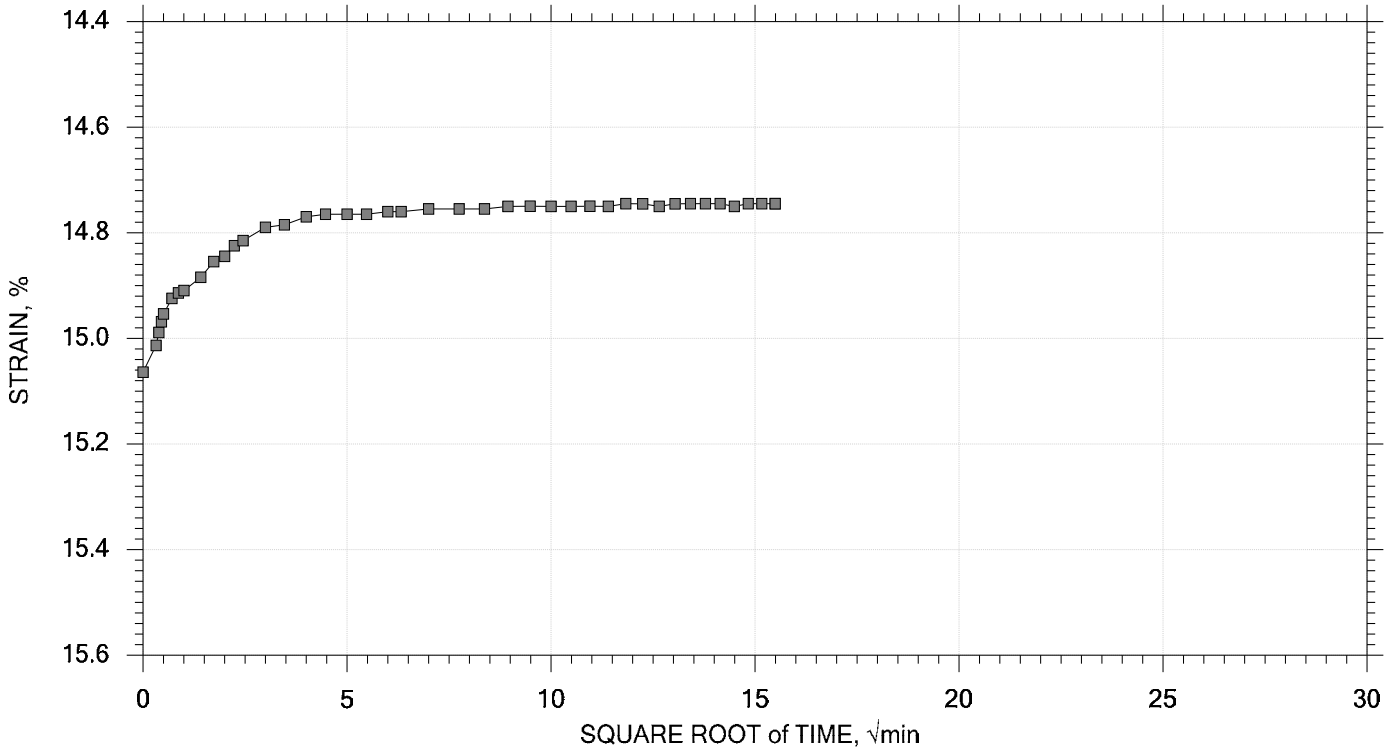
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 21

Stress: 1 tsf





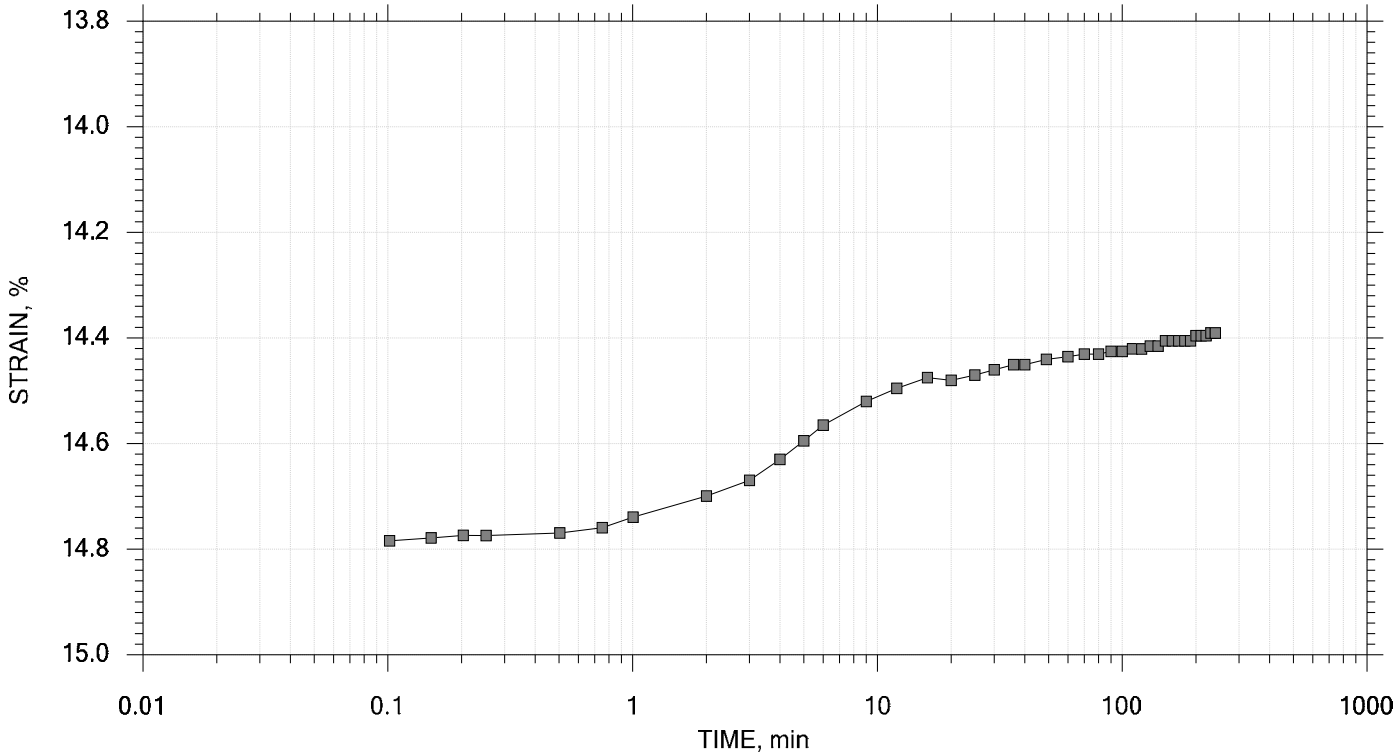
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

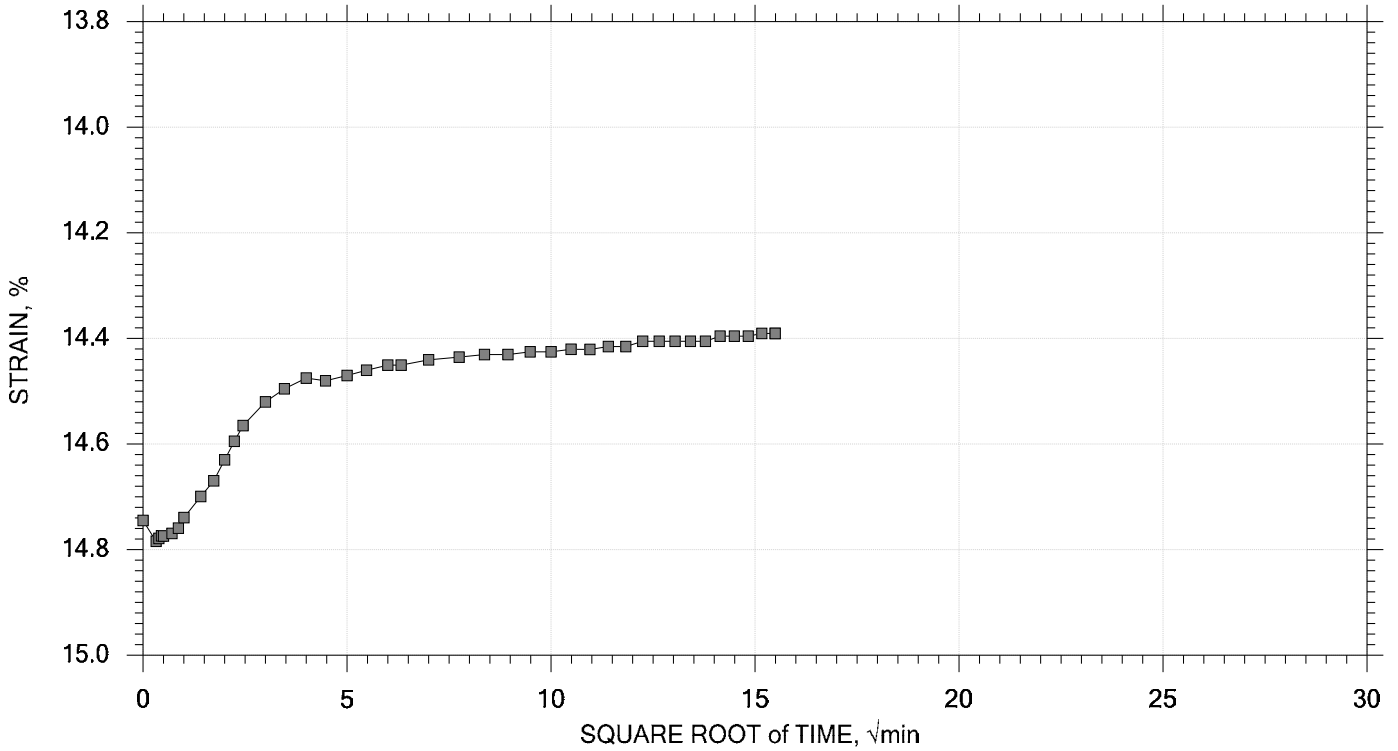
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 21

Stress: 0.5 tsf





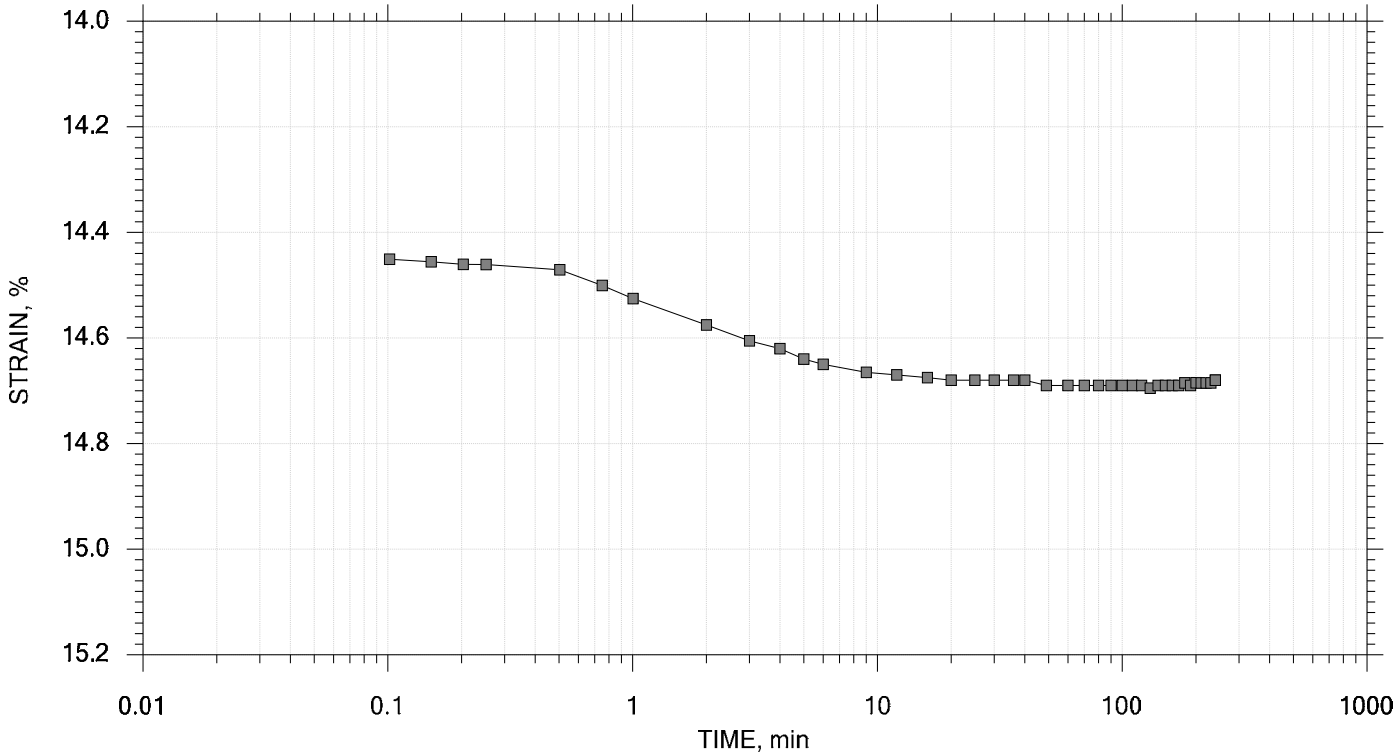
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

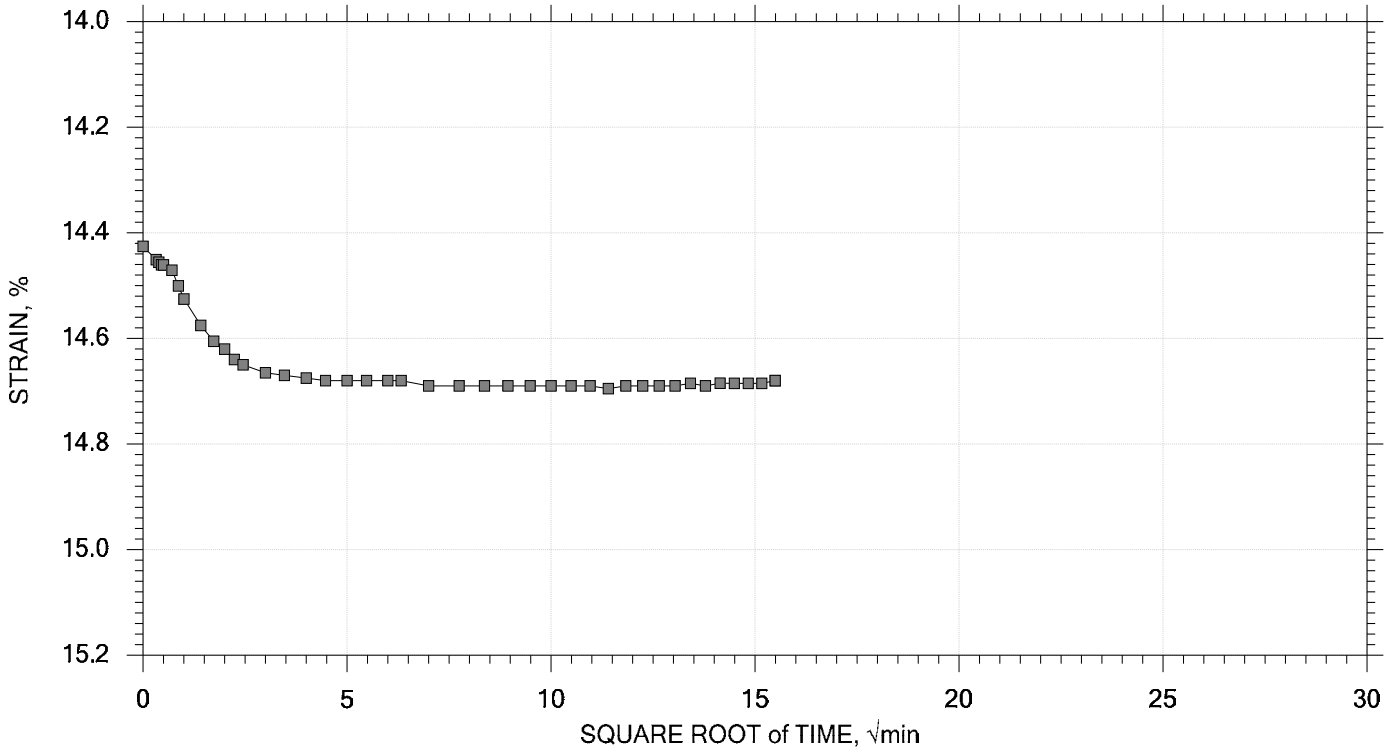
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 11 of 21

Stress: 1 tsf





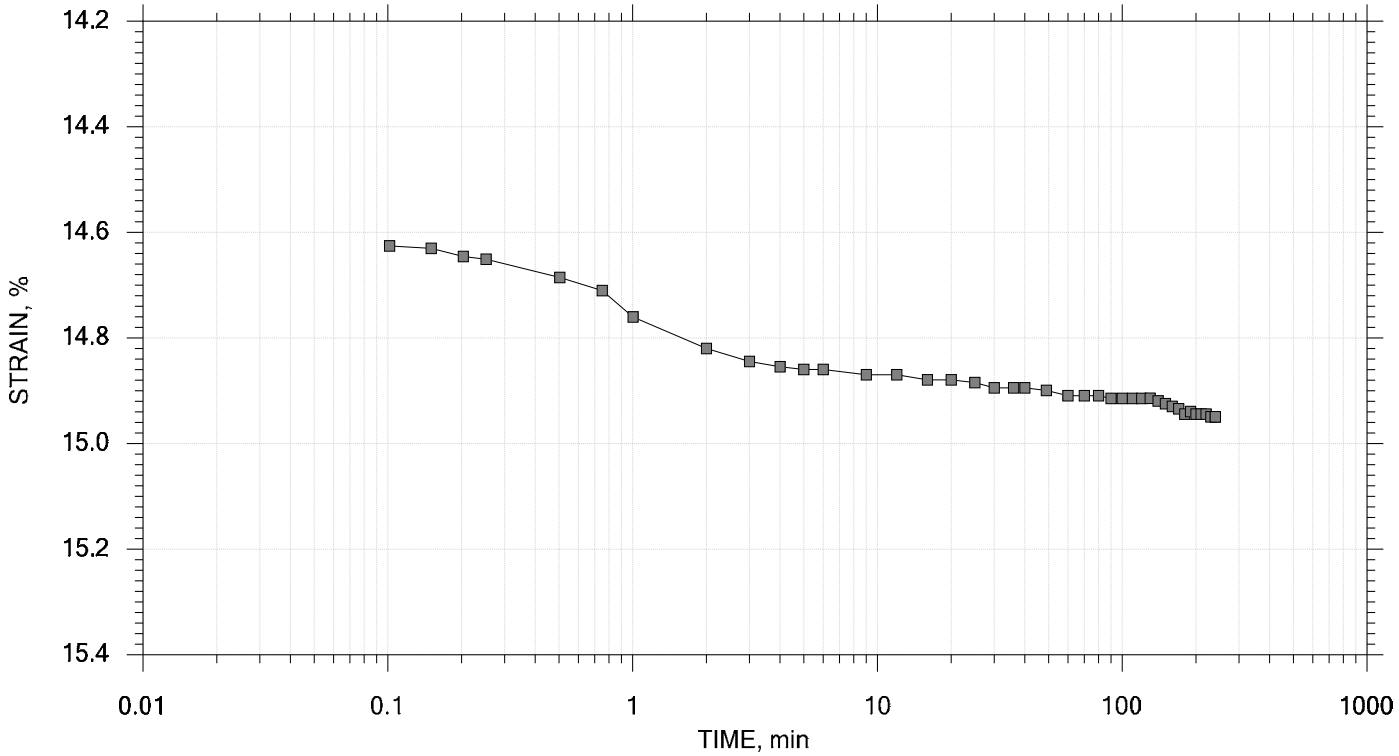
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

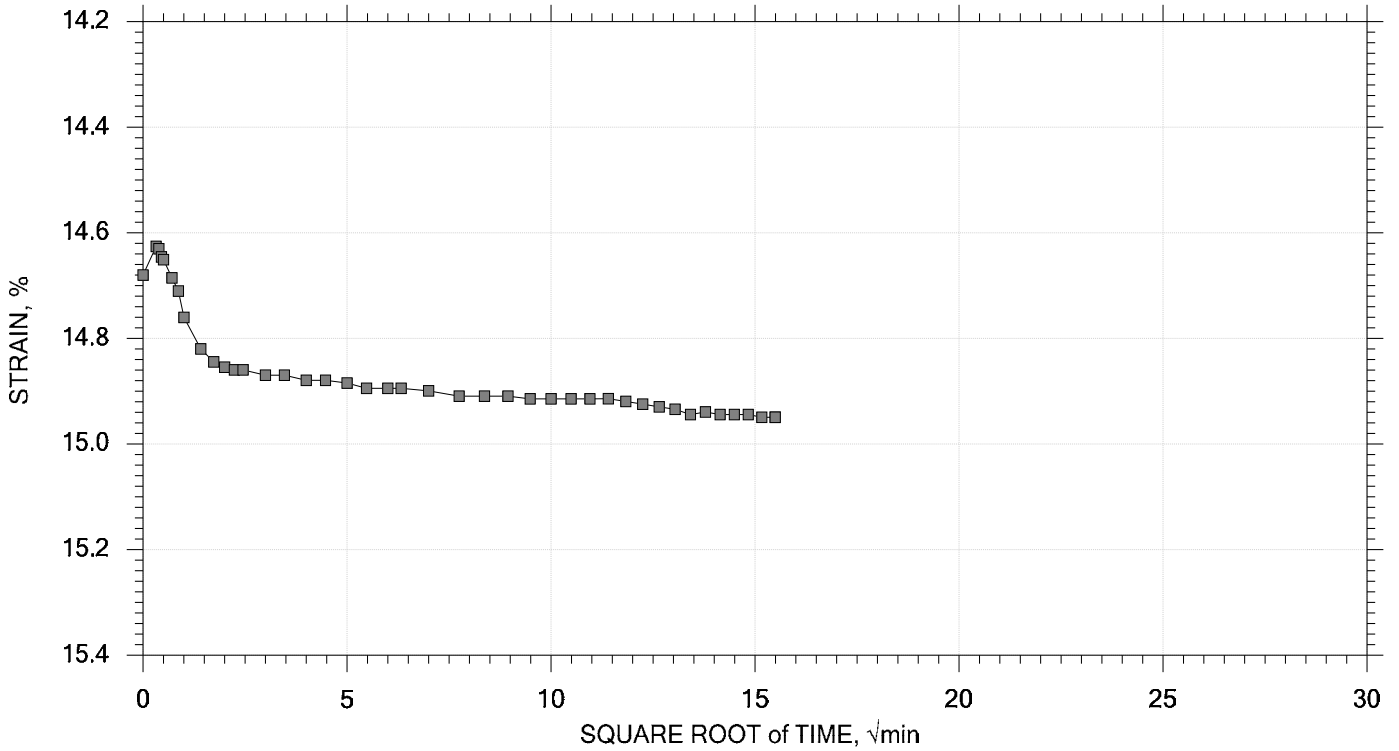
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 12 of 21

Stress: 2 tsf





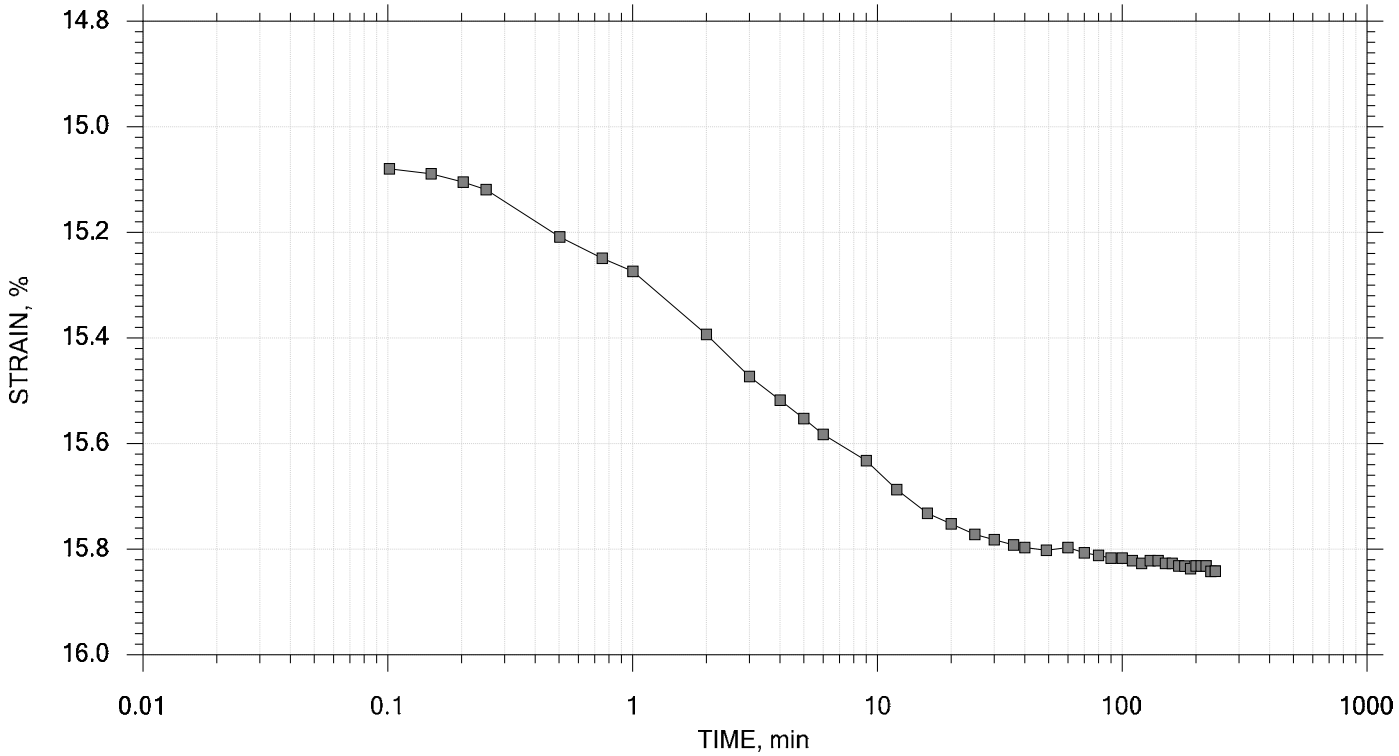
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

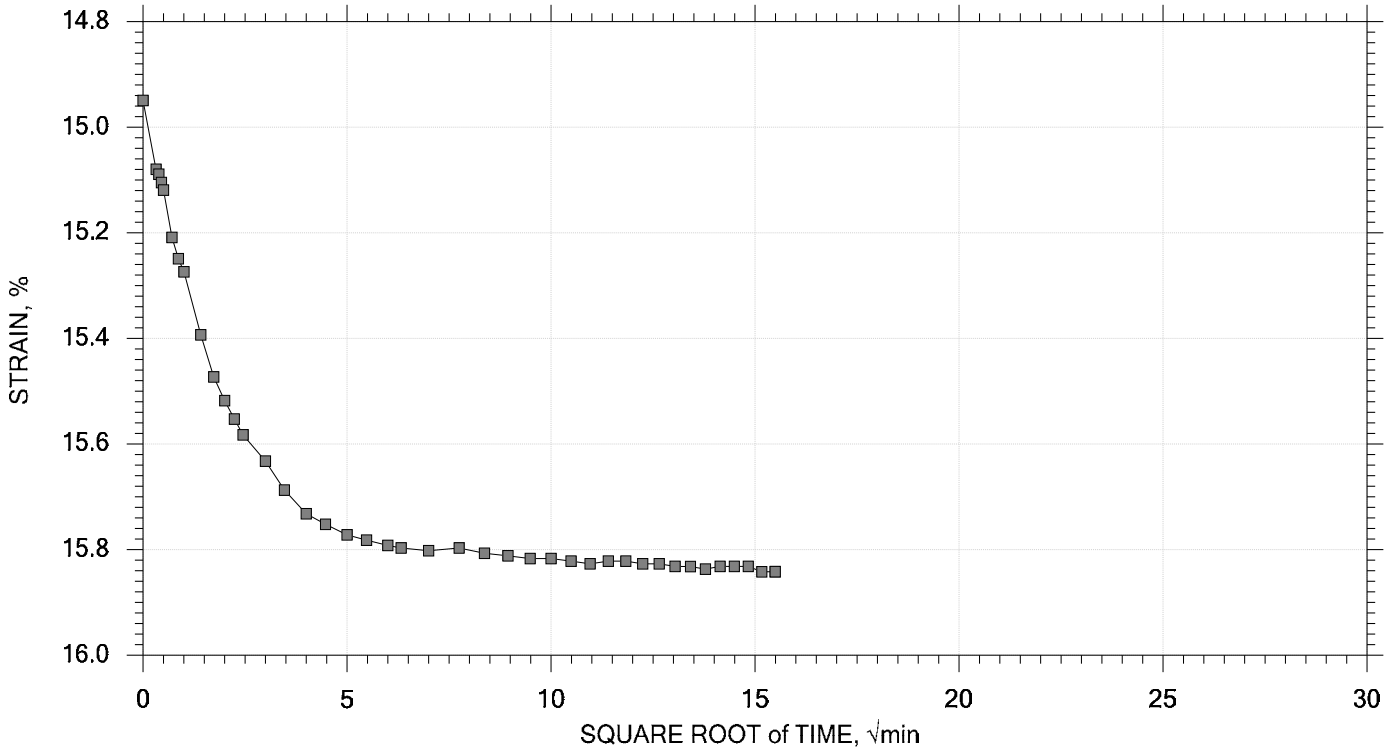
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 21

Stress: 4 tsf





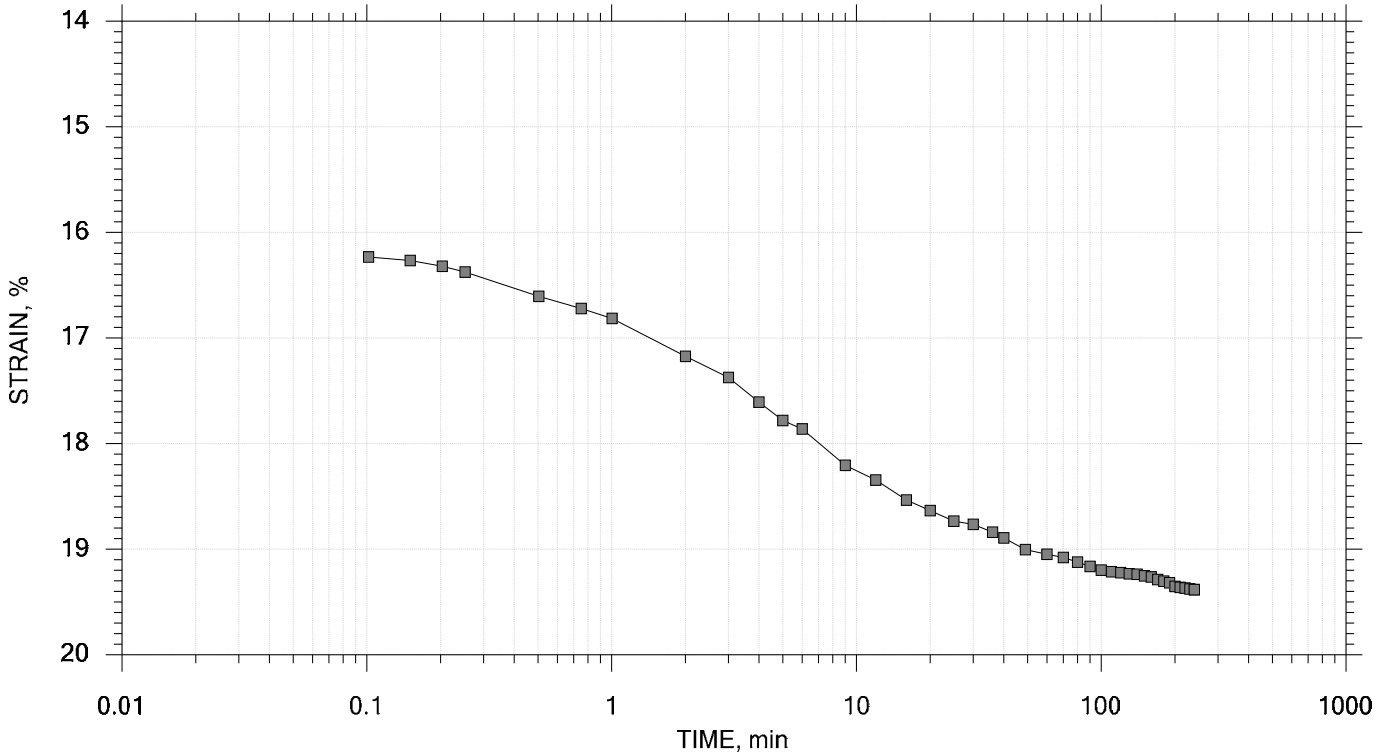
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

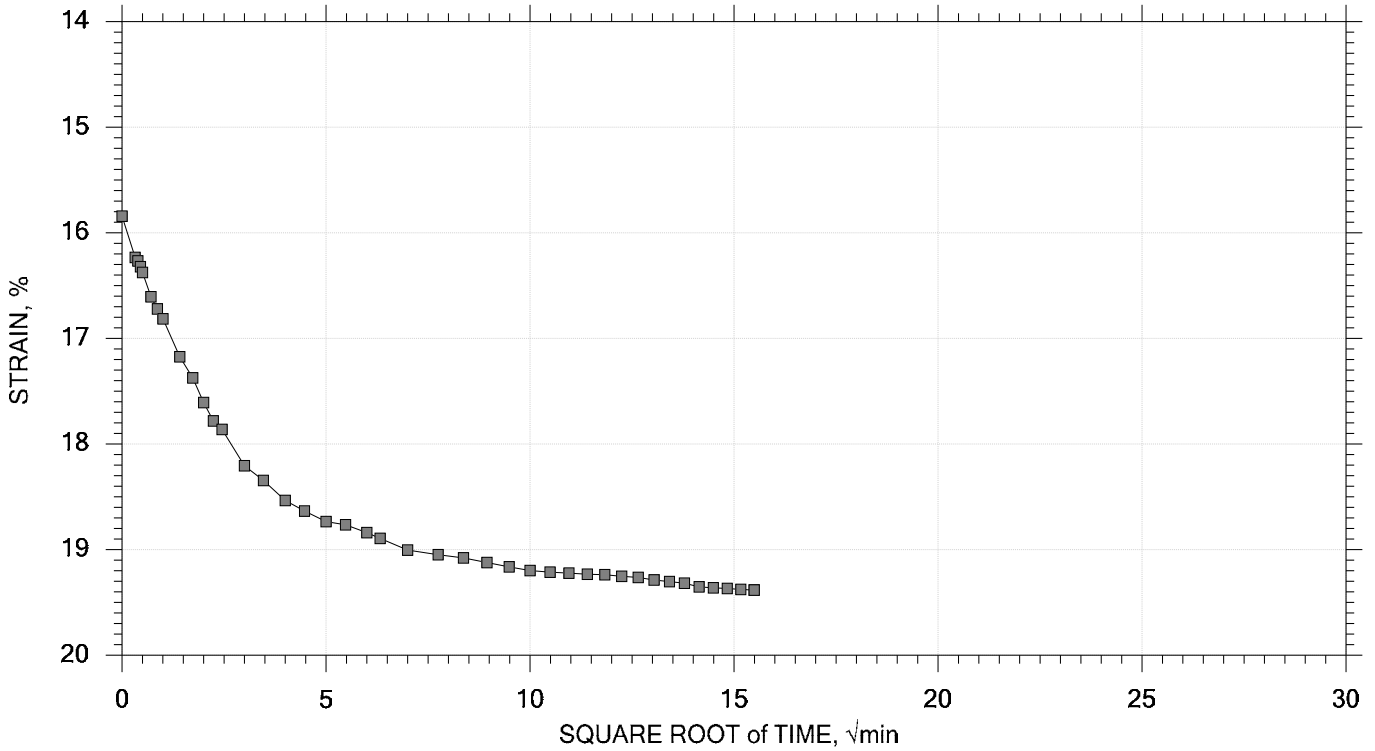
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 21

Stress: 8 tsf





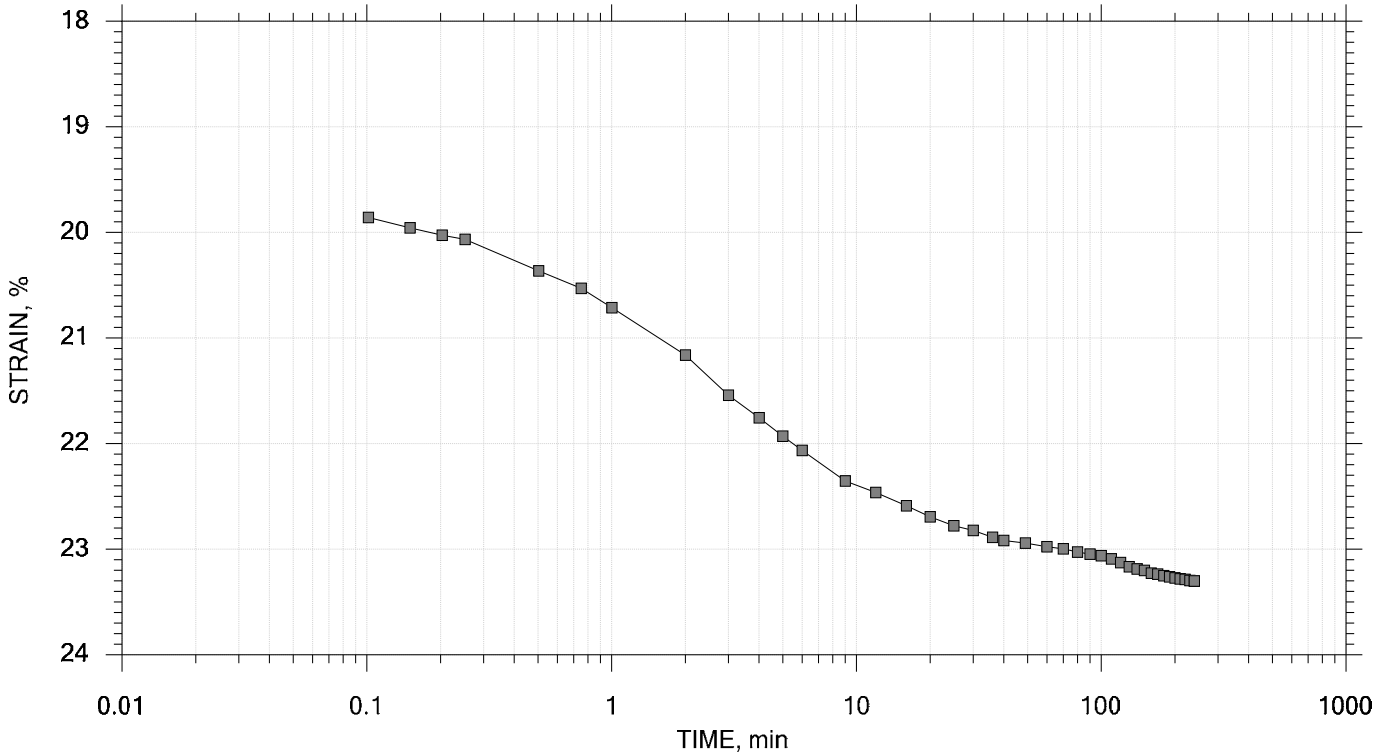
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

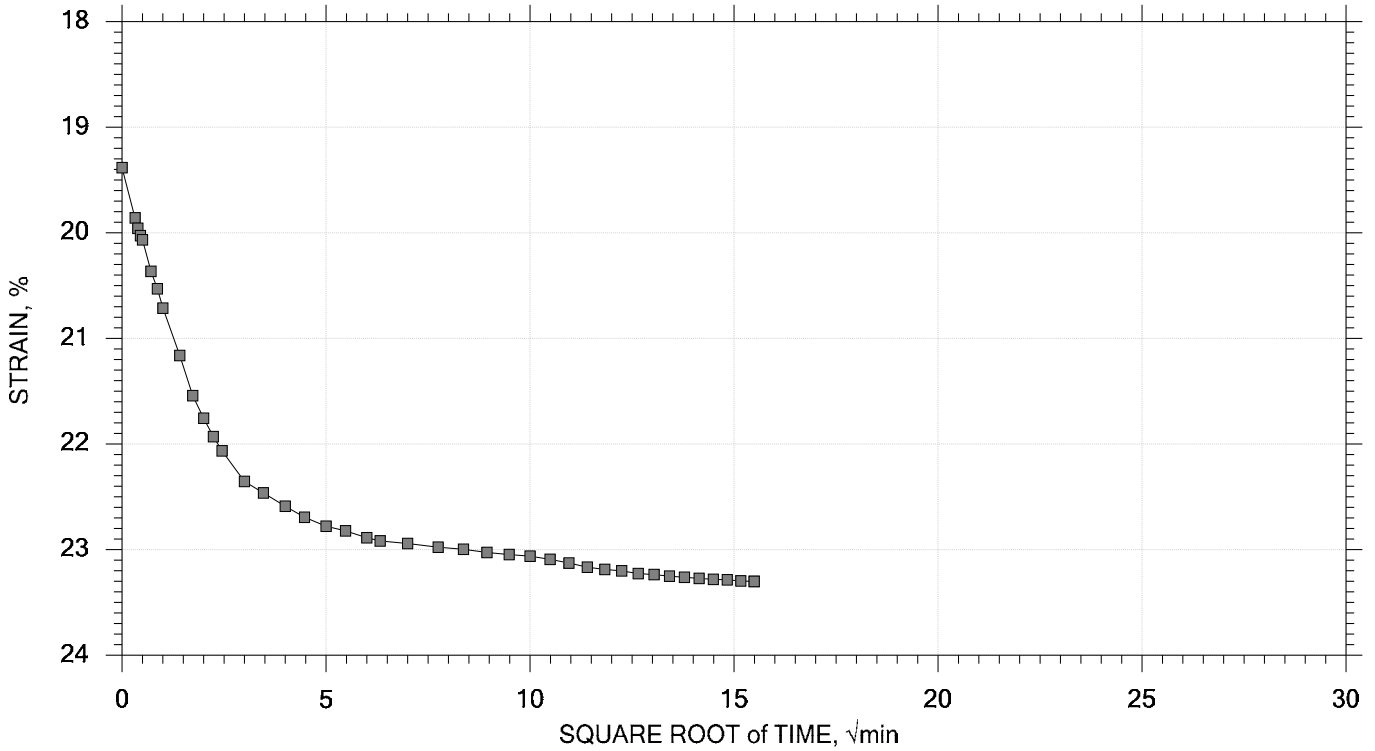
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 15 of 21

Stress: 16 tsf





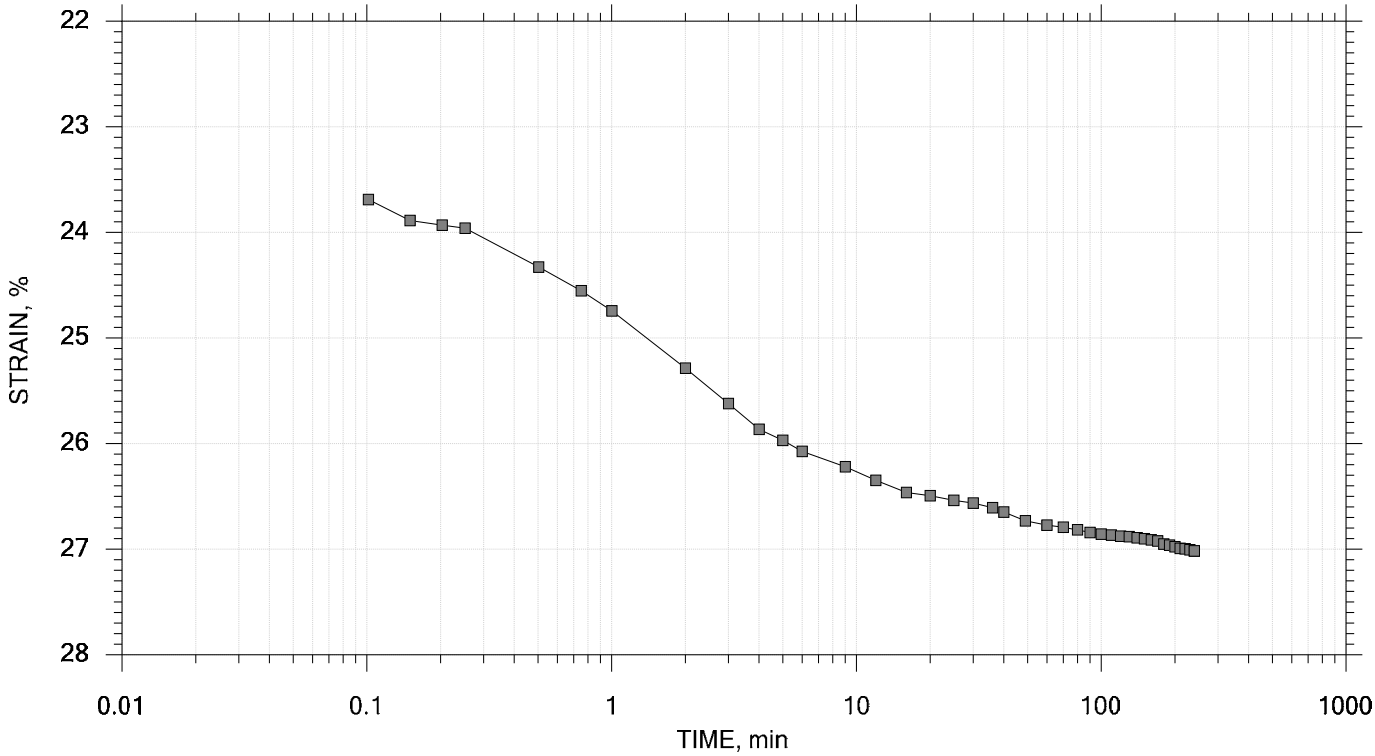
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

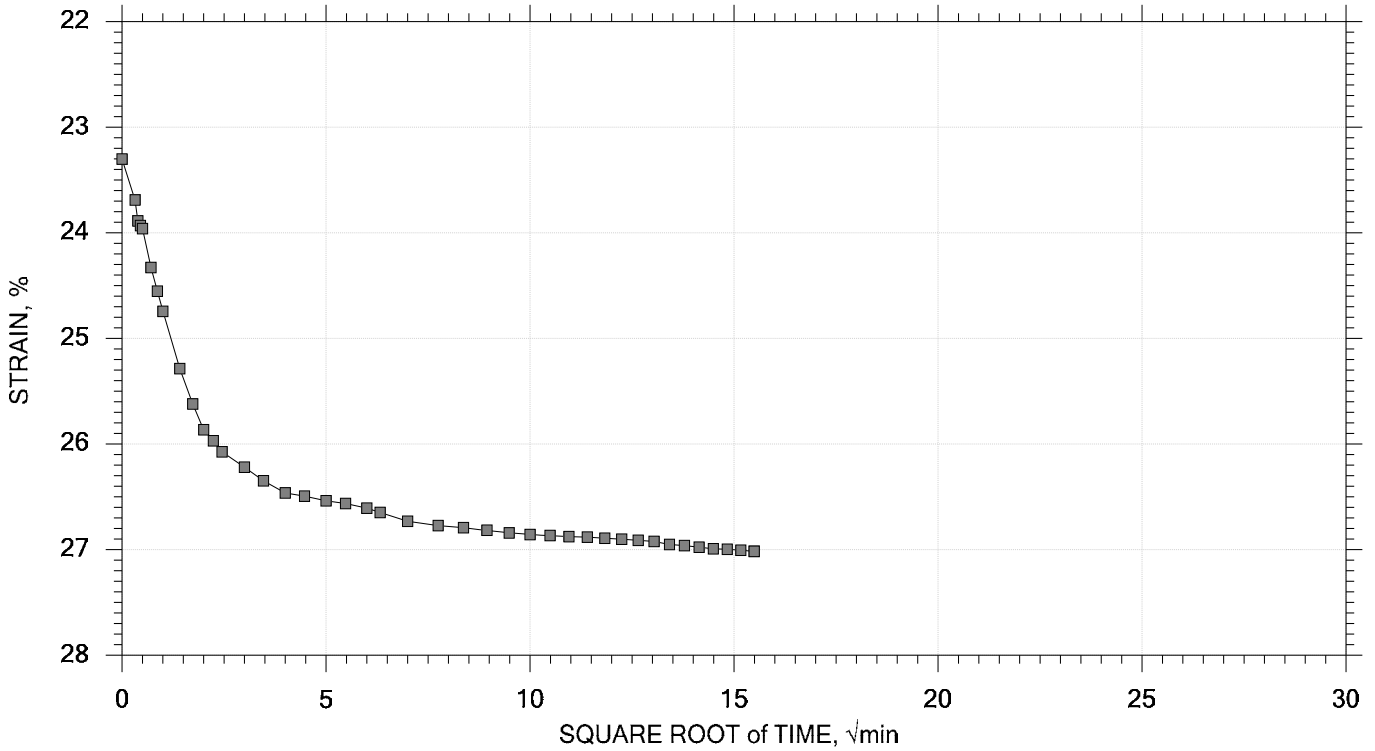
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 16 of 21

Stress: 32 tsf





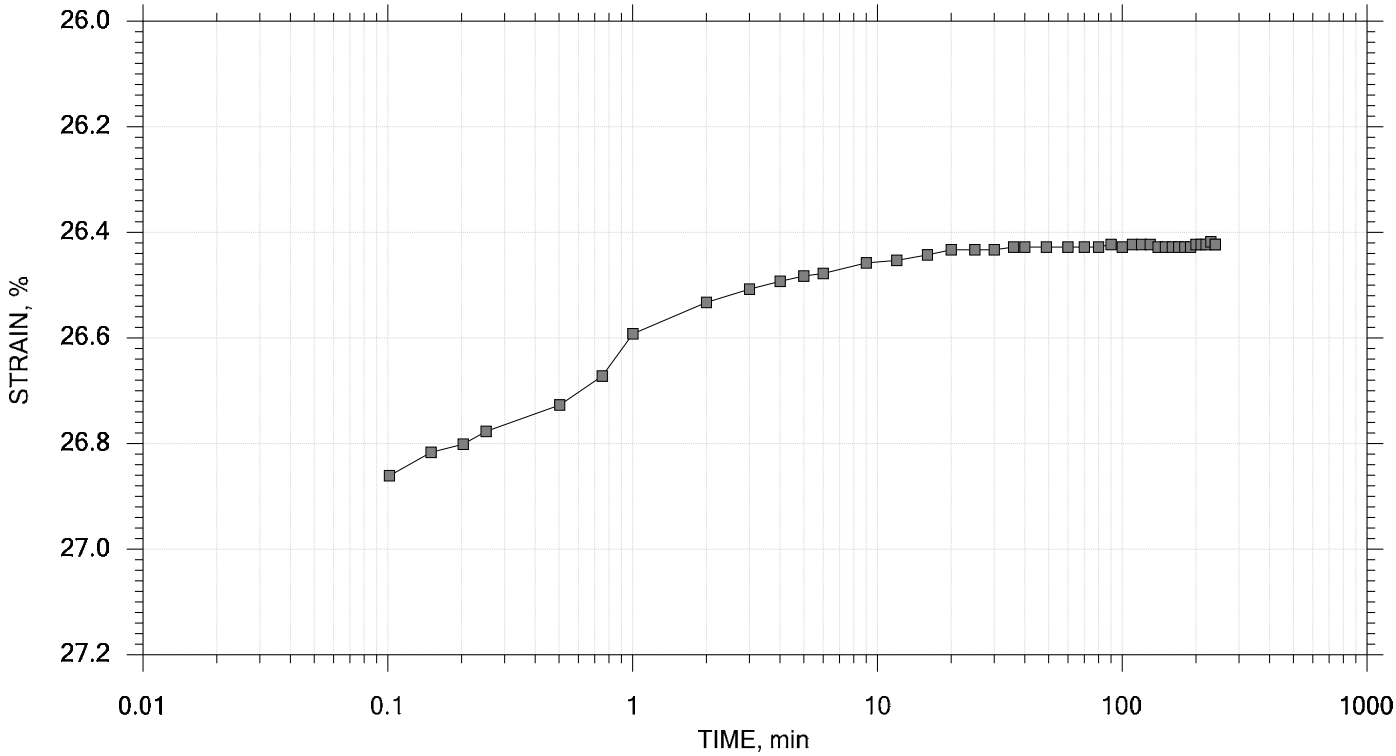
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

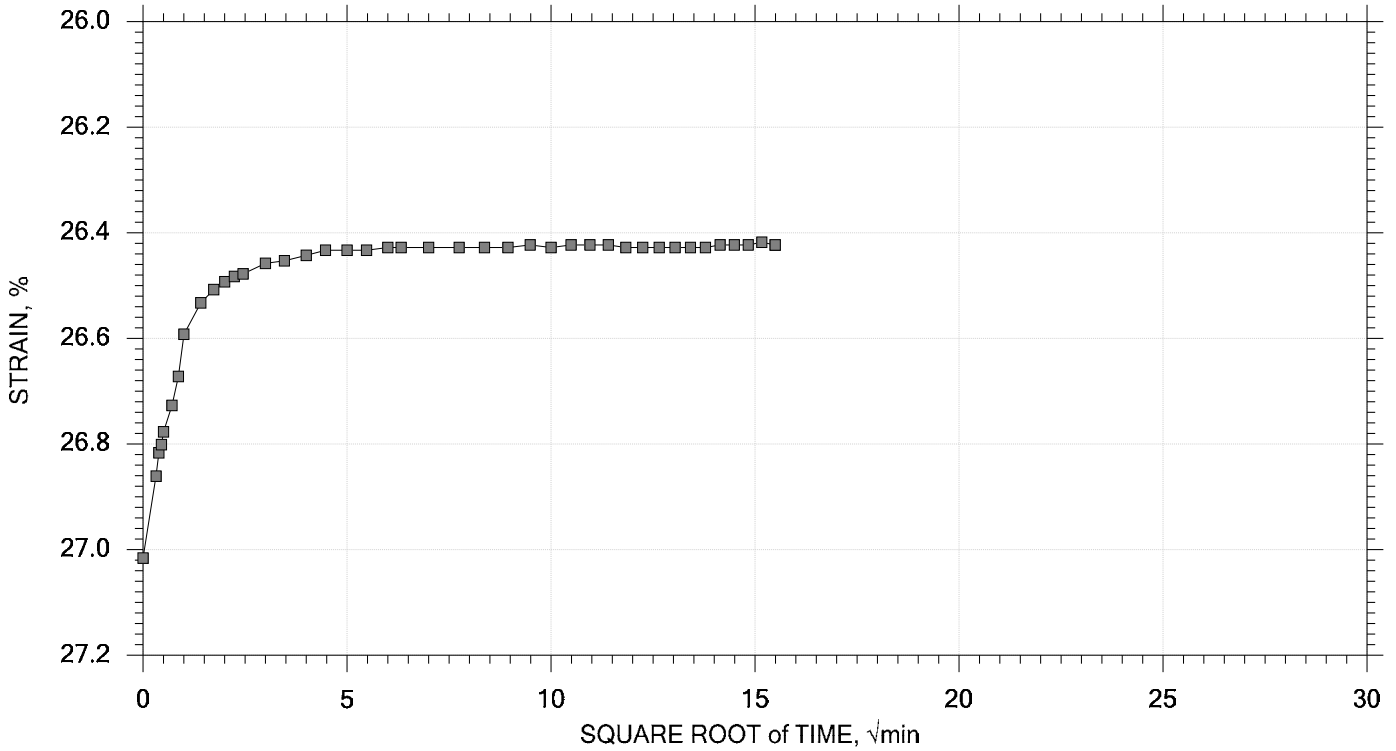
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 17 of 21

Stress: 8 tsf





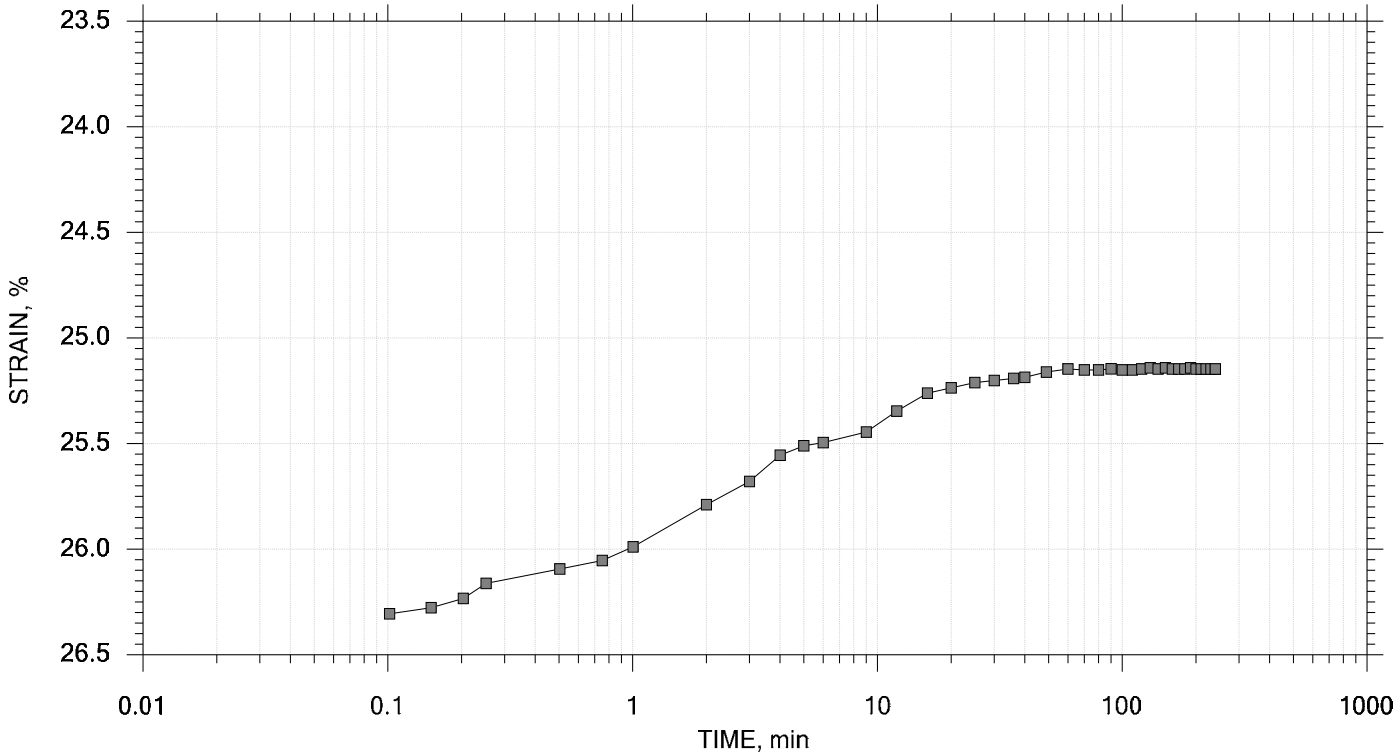
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

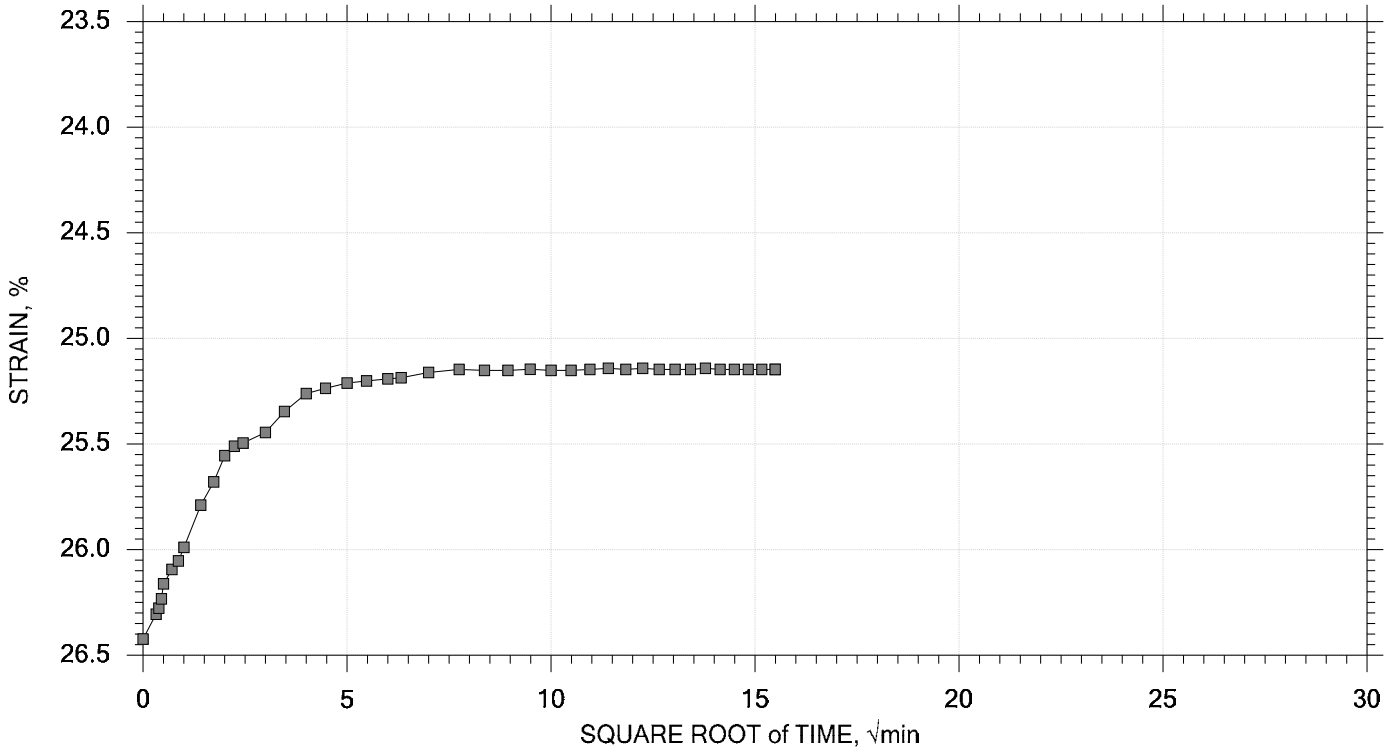
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 18 of 21

Stress: 2 tsf





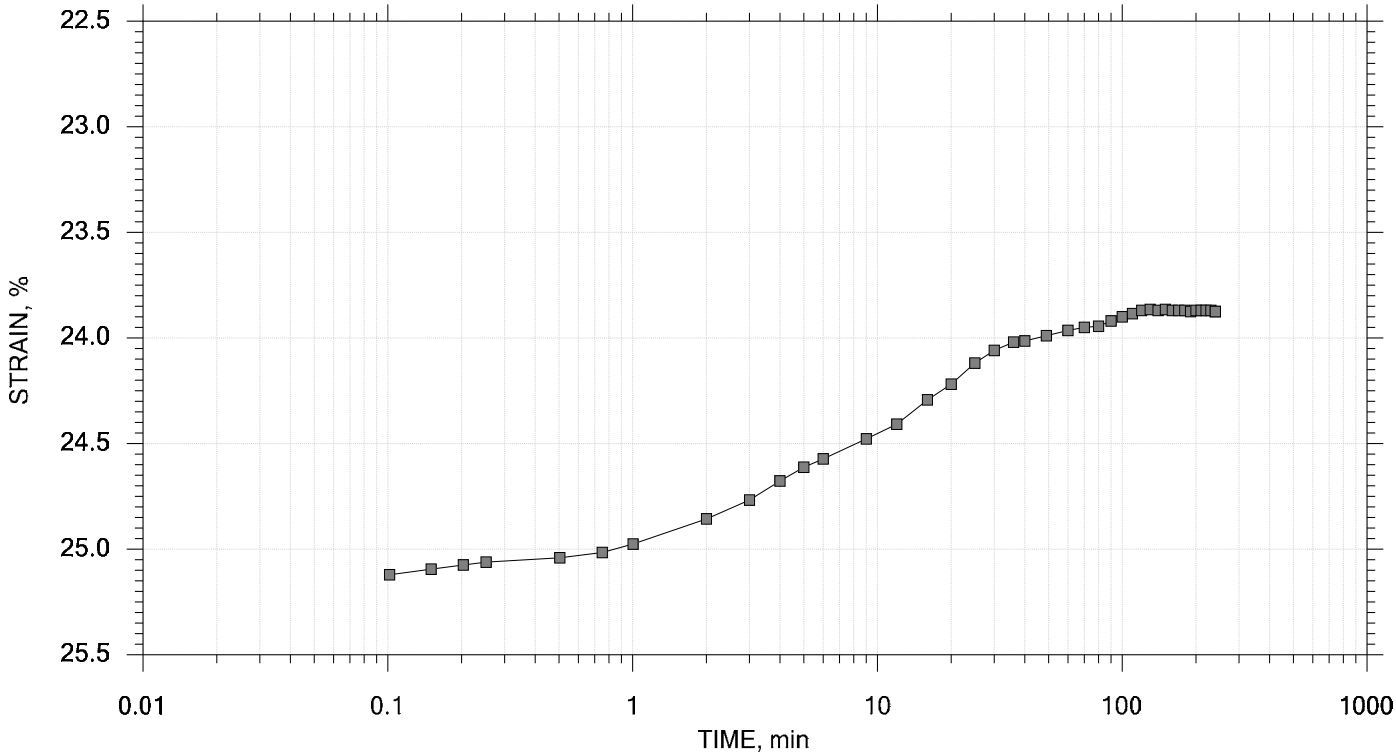
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

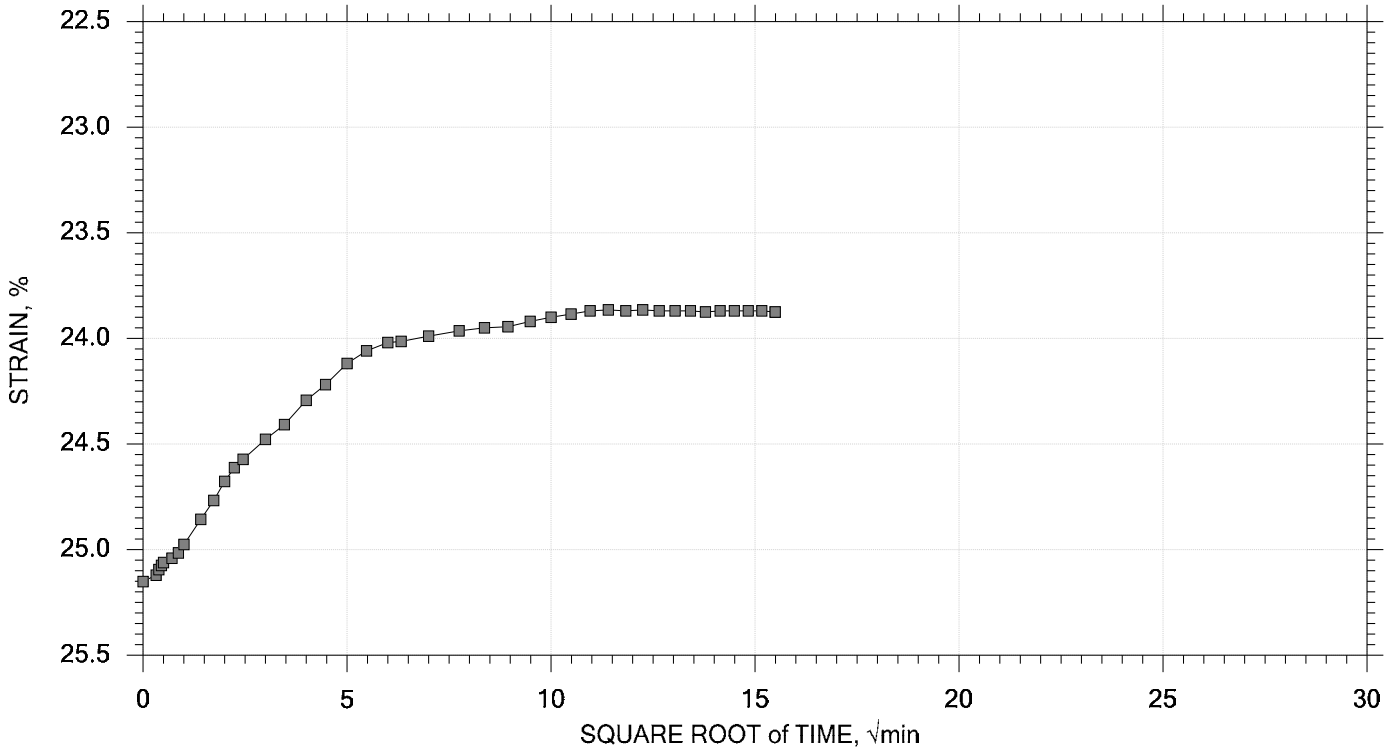
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 19 of 21

Stress: 0.5 tsf





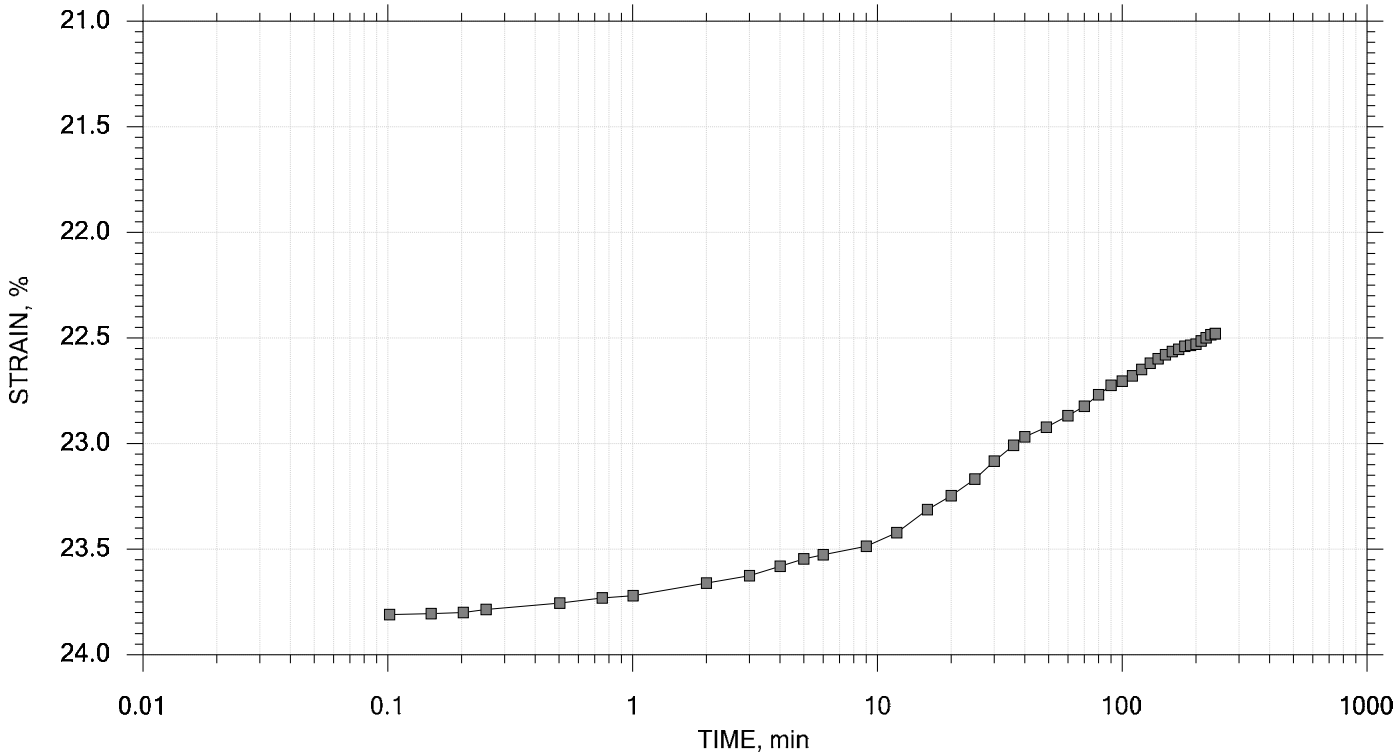
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

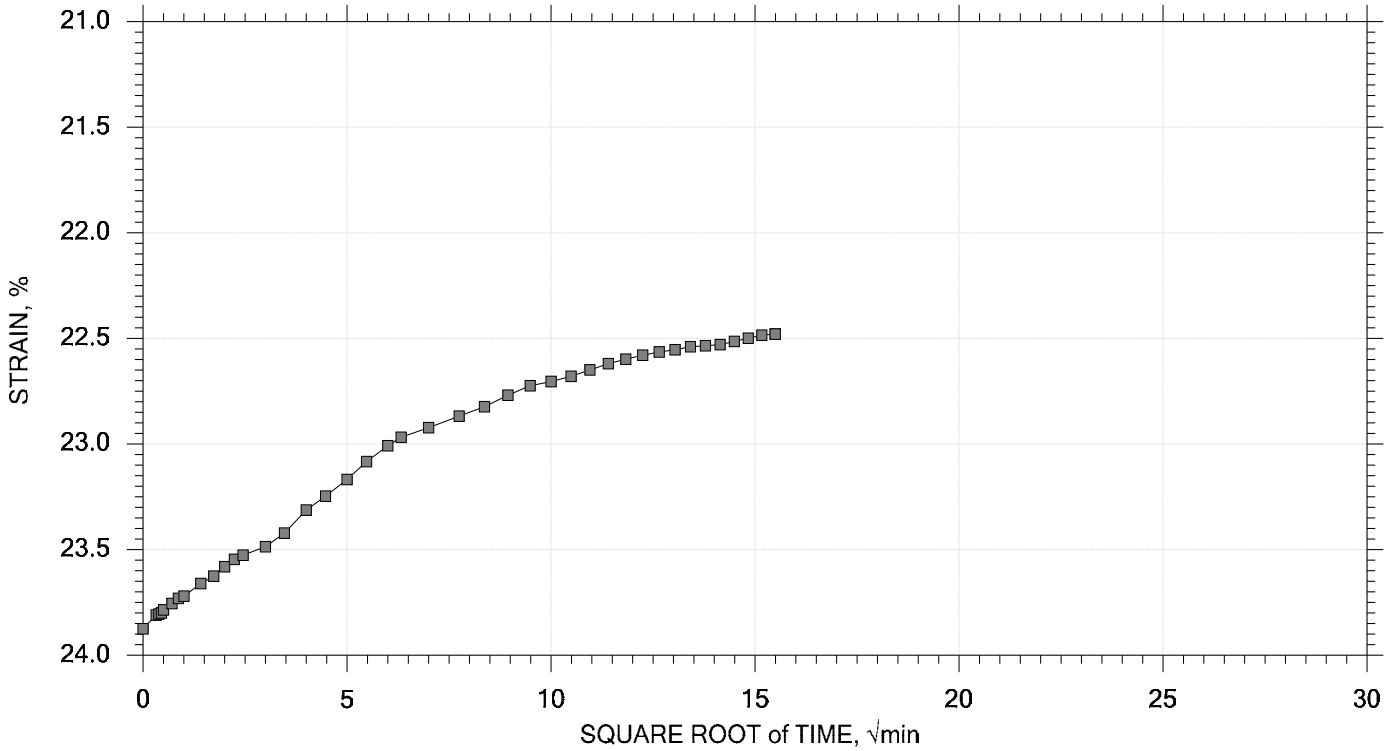
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 20 of 21

Stress: 0.125 tsf





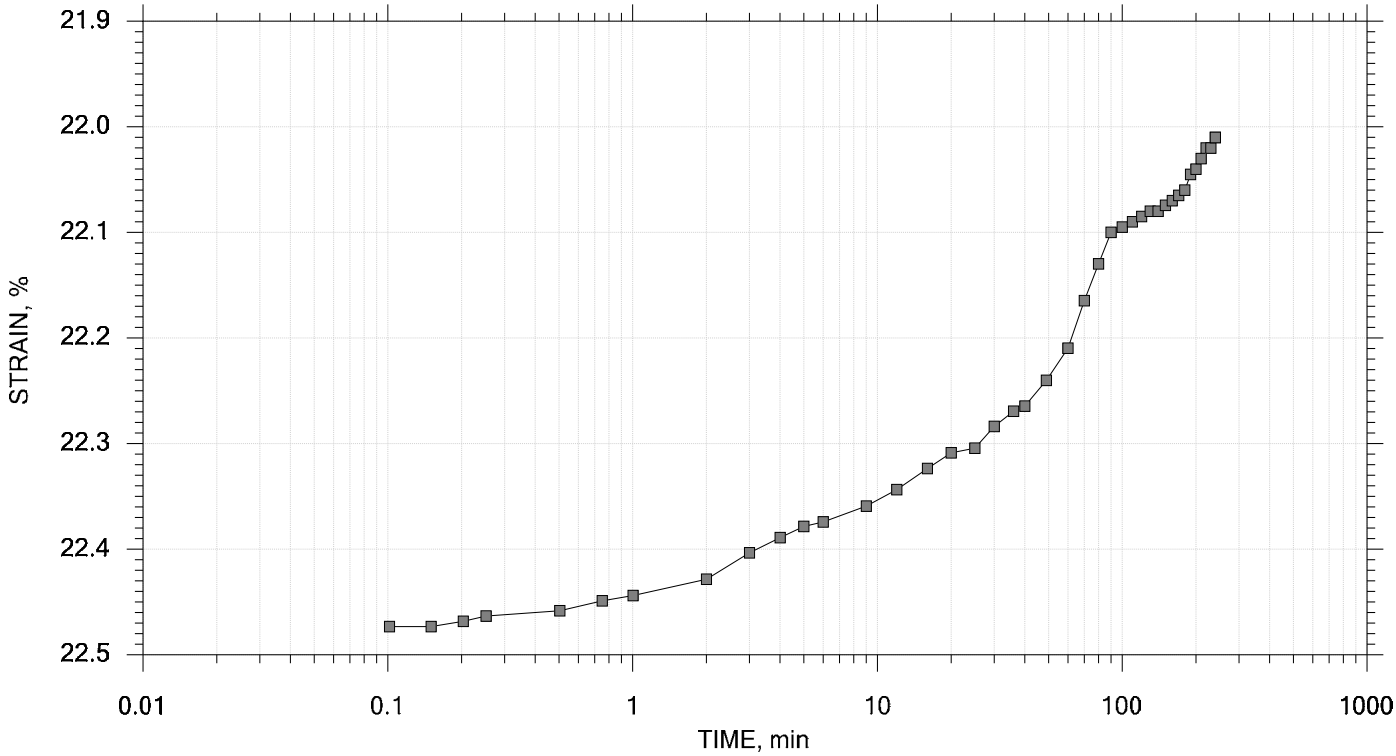
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

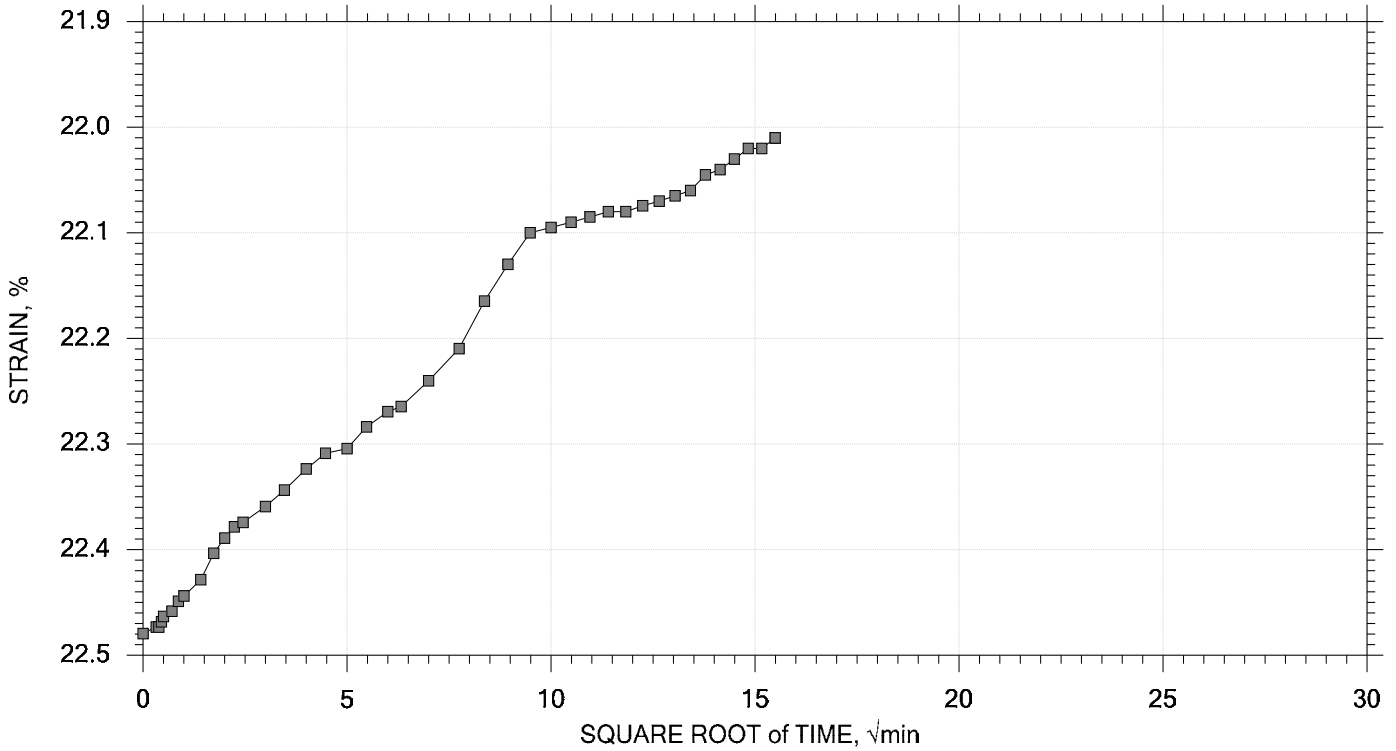
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 21 of 21

Stress: 0.0625 tsf

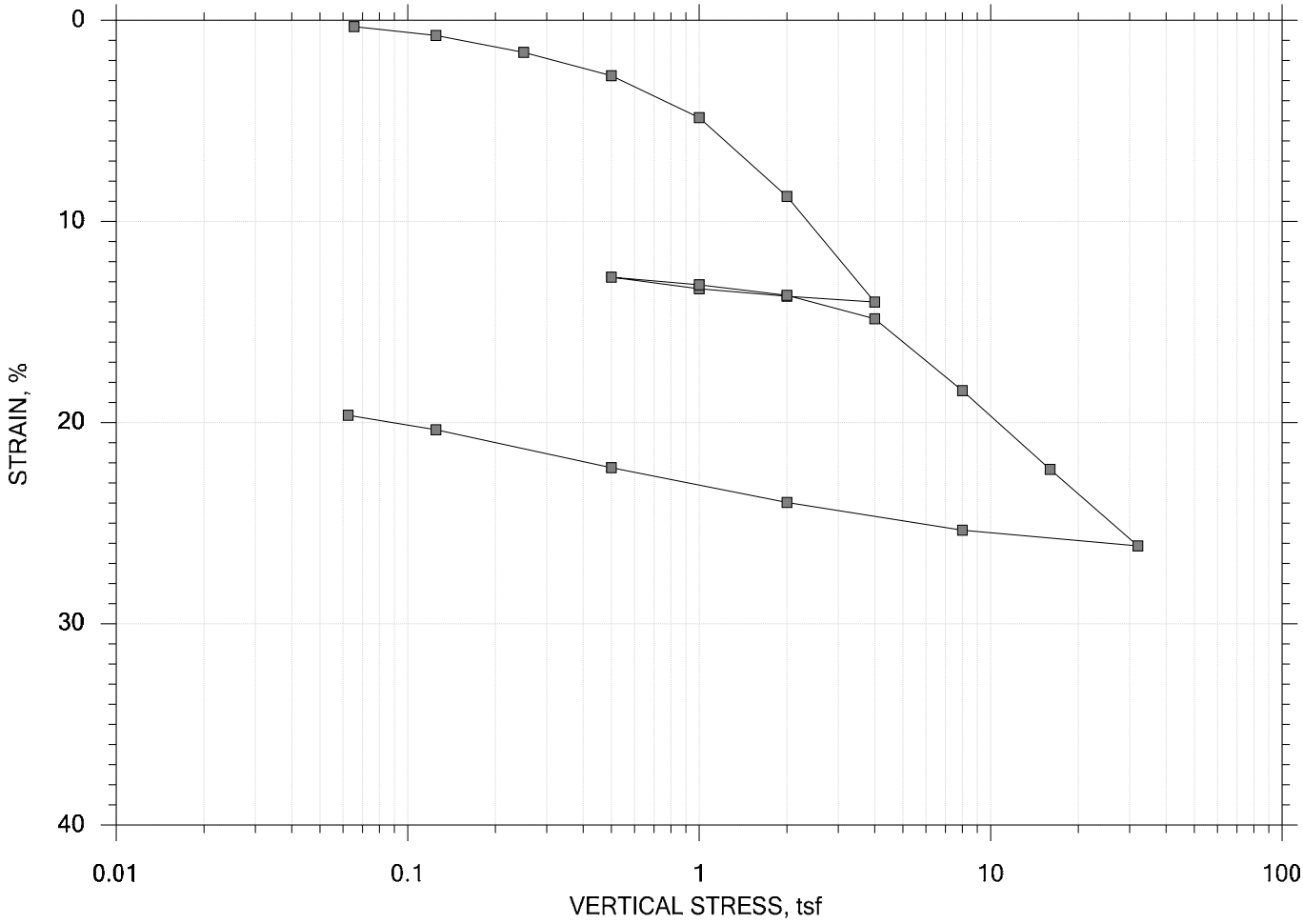


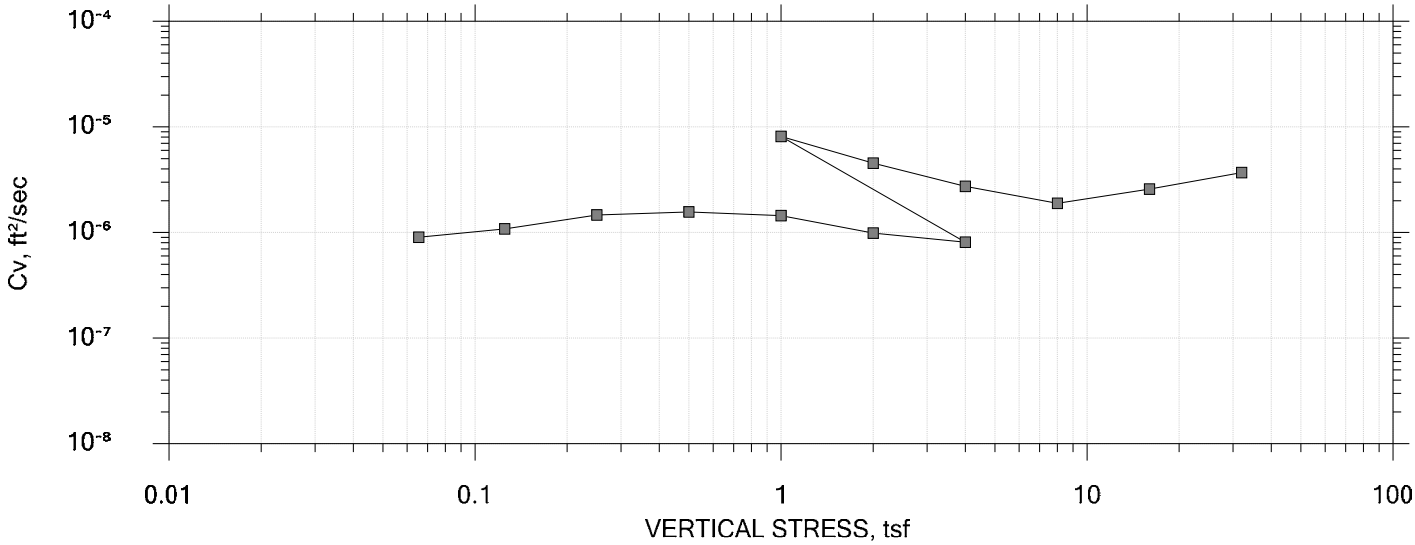


GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-202	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/29/17	Test No.: IP-3
	Depth: 20-22 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive clay		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

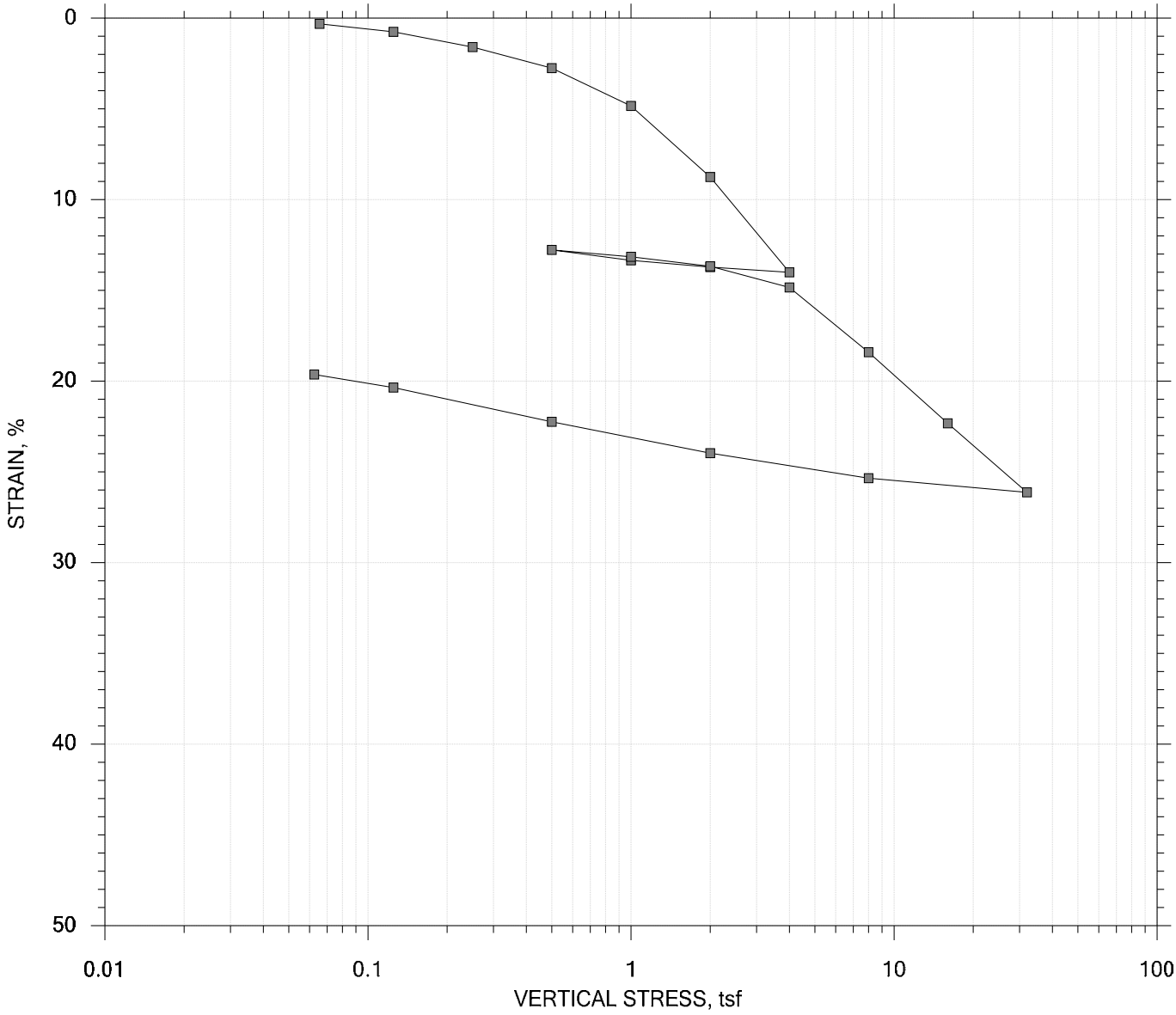




GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



				Before Test	After Test
Current Vertical Effective Stress: ---			Water Content, %	42.59	26.95
Preconsolidation Stress: ---			Dry Unit Weight, pcf	79.414	99.267
Compression Ratio: ---			Saturation, %	99.82	100.00
Diameter: 2.5 in		Height: 1 in	Void Ratio	1.19	0.75
LL: 32	PL: 19	PI: 13	GS: 2.78		

GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
Sample No.: U1	Test Date: 01/25/17	Depth: 25-27 ft
Test No.: IP-1	Sample Type: intact	Elevation: ---

Soil Description: Moist, gray clay
Remarks: System Y, Swell Pressure = 0.0655 tsf

Estimated Specific Gravity: 2.78	Liquid Limit: 32	Specimen Diameter: 2.50 in
Initial Void Ratio: 1.19	Plastic Limit: 19	Initial Height: 1.00 in
Final Void Ratio: 0.750	Plasticity Index: 13	Final Height: 0.80 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	B-817	RING		B-887
Wt. Container + Wet Soil, gm	111.77	257.41	241.40	139.23
Wt. Container + Dry Soil, gm	83.490	213.83	213.83	111.51
Wt. Container, gm	8.8300	111.50	111.50	8.6400
Wt. Dry Soil, gm	74.660	102.33	102.33	102.87
Water Content, %	37.88	42.59	26.95	26.95
Void Ratio	---	1.19	0.750	---
Degree of Saturation, %	---	99.82	100.00	---
Dry Unit Weight, pcf	---	79.414	99.267	---

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

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham, ME
Boring No.: HB-GBB-203
Sample No.: U1
Test No.: IP-1

Location: Gorham, ME
Tested By: md
Test Date: 01/25/17
Sample Type: intact

Project No.: GTX-305885
Checked By: jdt
Depth: 25-27 ft
Elevation: ---

Soil Description: Moist, gray clay
Remarks: System Y, Swell Pressure = 0.0655 tsf

Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/sec	Mv 1/tsf	k ft/day
1	0.0655	0.003162	1.18	0.316	30.031	8.14e-007	4.83e-002	1.06e-004
2	0.125	0.007526	1.17	0.753	21.431	1.13e-006	7.33e-002	2.24e-004
3	0.250	0.01597	1.15	1.60	16.588	1.44e-006	6.75e-002	2.63e-004
4	0.500	0.02752	1.13	2.75	16.990	1.38e-006	4.62e-002	1.72e-004
5	1.00	0.04837	1.08	4.84	11.685	1.94e-006	4.17e-002	2.19e-004
6	2.00	0.08755	0.996	8.75	23.640	9.02e-007	3.92e-002	9.53e-005
7	4.00	0.1400	0.881	14.0	23.892	8.07e-007	2.62e-002	5.71e-005
8	2.00	0.1371	0.887	13.7	2.237	8.14e-006	1.44e-003	3.16e-005
9	1.00	0.1335	0.895	13.3	4.491	4.08e-006	3.66e-003	4.04e-005
10	0.500	0.1277	0.908	12.8	21.300	8.71e-007	1.15e-002	2.70e-005
11	1.00	0.1315	0.900	13.1	2.111	8.80e-006	7.50e-003	1.78e-004
12	2.00	0.1367	0.888	13.7	4.399	4.18e-006	5.24e-003	5.91e-005
13	4.00	0.1484	0.863	14.8	8.820	2.05e-006	5.85e-003	3.22e-005
14	8.00	0.1841	0.785	18.4	8.648	1.97e-006	8.92e-003	4.74e-005
15	16.0	0.2232	0.699	22.3	4.855	3.20e-006	4.90e-003	4.23e-005
16	32.0	0.2612	0.616	26.1	4.470	3.15e-006	2.37e-003	2.02e-005
17	8.00	0.2534	0.633	25.3	1.107	1.22e-005	3.25e-004	1.07e-005
18	2.00	0.2396	0.663	24.0	6.556	2.12e-006	2.30e-003	1.32e-005
19	0.500	0.2224	0.701	22.2	28.381	5.11e-007	1.15e-002	1.59e-005
20	0.125	0.2035	0.742	20.4	69.192	2.20e-007	5.03e-002	2.98e-005
21	0.0625	0.1963	0.758	19.6	133.019	1.18e-007	1.15e-001	3.66e-005

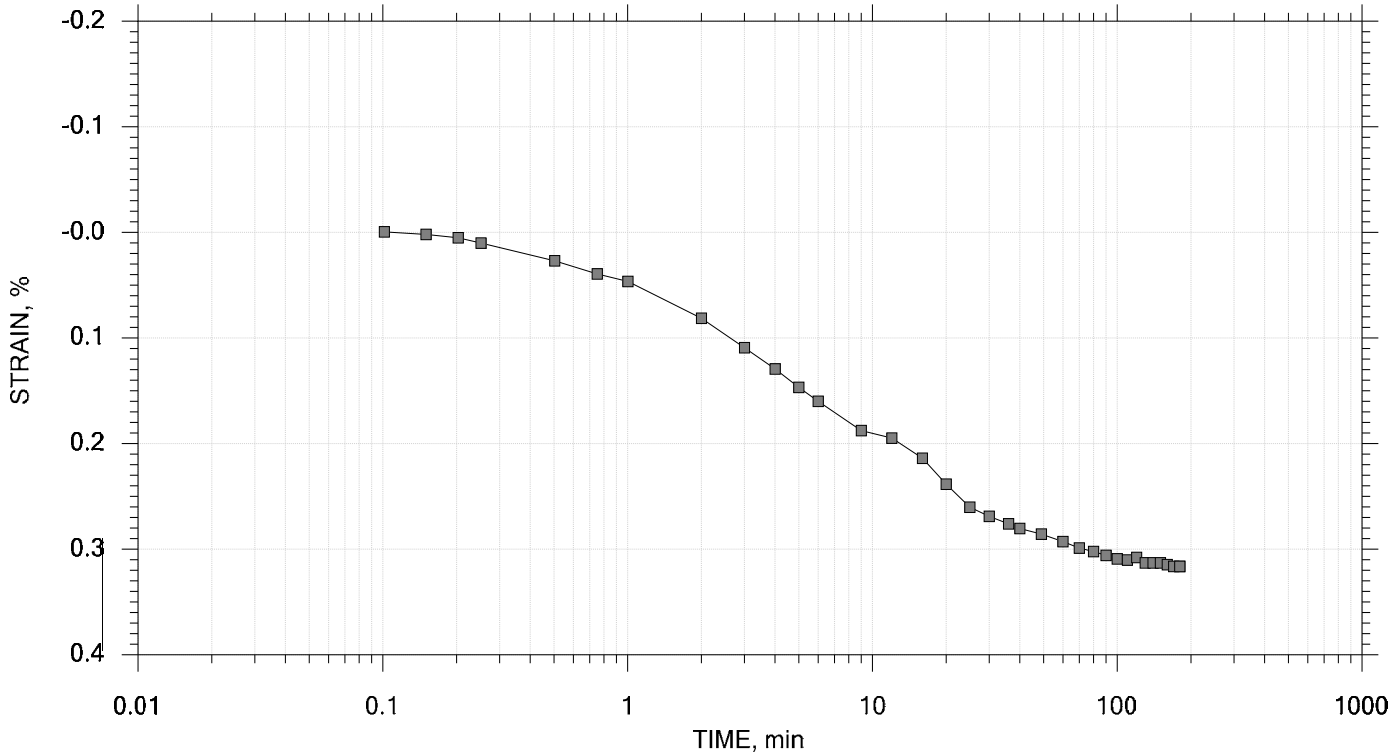
	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/sec	Mv 1/tsf	k ft/day	Ca %
1	0.0655	0.003162	1.18	0.316	0.000	0.00e+000	4.83e-002	0.00e+000	0.00e+000
2	0.125	0.007526	1.17	0.753	5.258	1.07e-006	7.33e-002	2.12e-004	0.00e+000
3	0.250	0.01597	1.15	1.60	0.000	0.00e+000	6.75e-002	0.00e+000	0.00e+000
4	0.500	0.02752	1.13	2.75	3.018	1.81e-006	4.62e-002	2.25e-004	0.00e+000
5	1.00	0.04837	1.08	4.84	4.538	1.16e-006	4.17e-002	1.31e-004	0.00e+000
6	2.00	0.08755	0.996	8.75	4.685	1.06e-006	3.92e-002	1.12e-004	0.00e+000
7	4.00	0.1400	0.881	14.0	5.604	7.99e-007	2.62e-002	5.65e-005	0.00e+000
8	2.00	0.1371	0.887	13.7	0.000	0.00e+000	1.44e-003	0.00e+000	0.00e+000
9	1.00	0.1335	0.895	13.3	0.917	4.65e-006	3.66e-003	4.59e-005	0.00e+000
10	0.500	0.1277	0.908	12.8	0.000	0.00e+000	1.15e-002	0.00e+000	0.00e+000
11	1.00	0.1315	0.900	13.1	0.542	7.96e-006	7.50e-003	1.61e-004	0.00e+000
12	2.00	0.1367	0.888	13.7	0.000	0.00e+000	5.24e-003	0.00e+000	0.00e+000
13	4.00	0.1484	0.863	14.8	1.240	3.38e-006	5.85e-003	5.33e-005	0.00e+000
14	8.00	0.1841	0.785	18.4	2.272	1.74e-006	8.92e-003	4.20e-005	0.00e+000
15	16.0	0.2232	0.699	22.3	1.637	2.21e-006	4.90e-003	2.92e-005	0.00e+000
16	32.0	0.2612	0.616	26.1	0.859	3.81e-006	2.37e-003	2.44e-005	0.00e+000
17	8.00	0.2534	0.633	25.3	0.000	0.00e+000	3.25e-004	0.00e+000	0.00e+000
18	2.00	0.2396	0.663	24.0	1.880	1.72e-006	2.30e-003	1.07e-005	0.00e+000
19	0.500	0.2224	0.701	22.2	5.490	6.14e-007	1.15e-002	1.91e-005	0.00e+000
20	0.125	0.2035	0.742	20.4	0.000	0.00e+000	5.03e-002	0.00e+000	0.00e+000
21	0.0625	0.1963	0.758	19.6	0.000	0.00e+000	1.15e-001	0.00e+000	0.00e+000

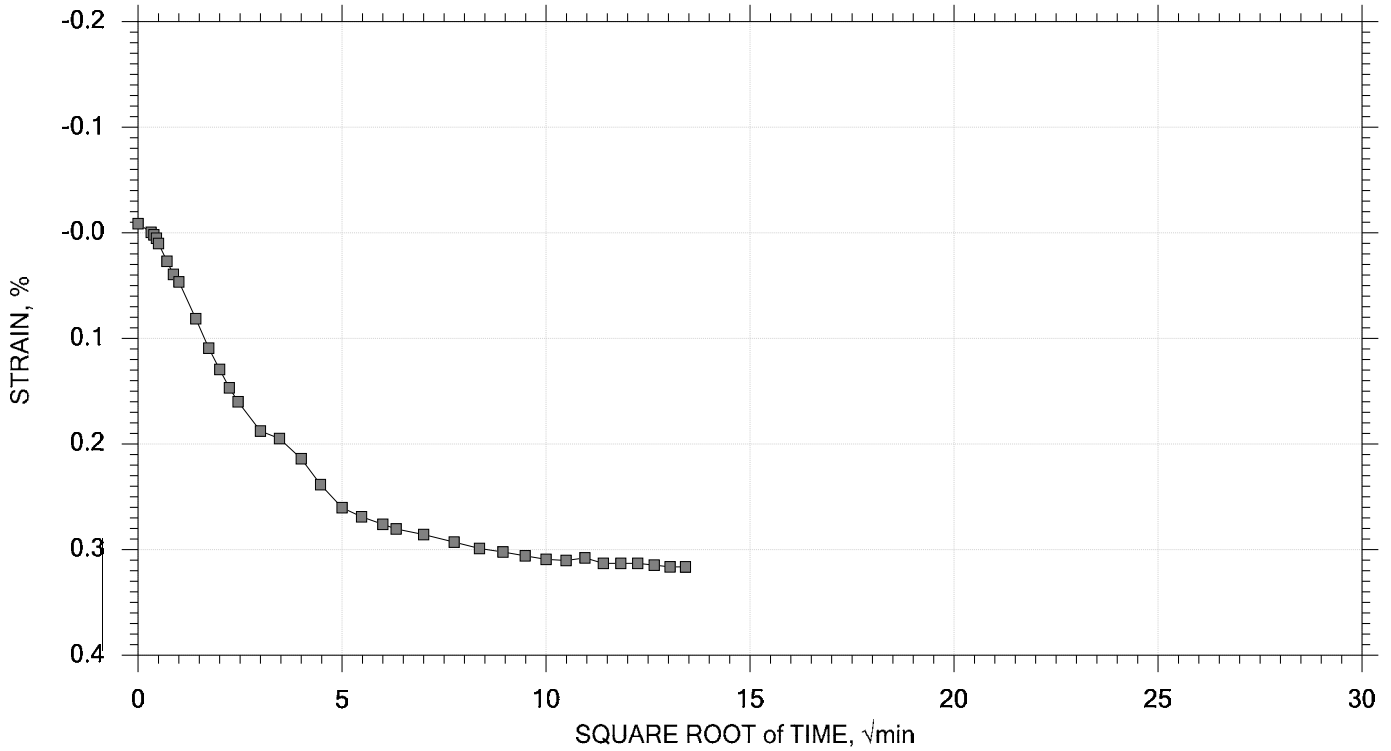
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 21

Stress: 0.065471 tsf





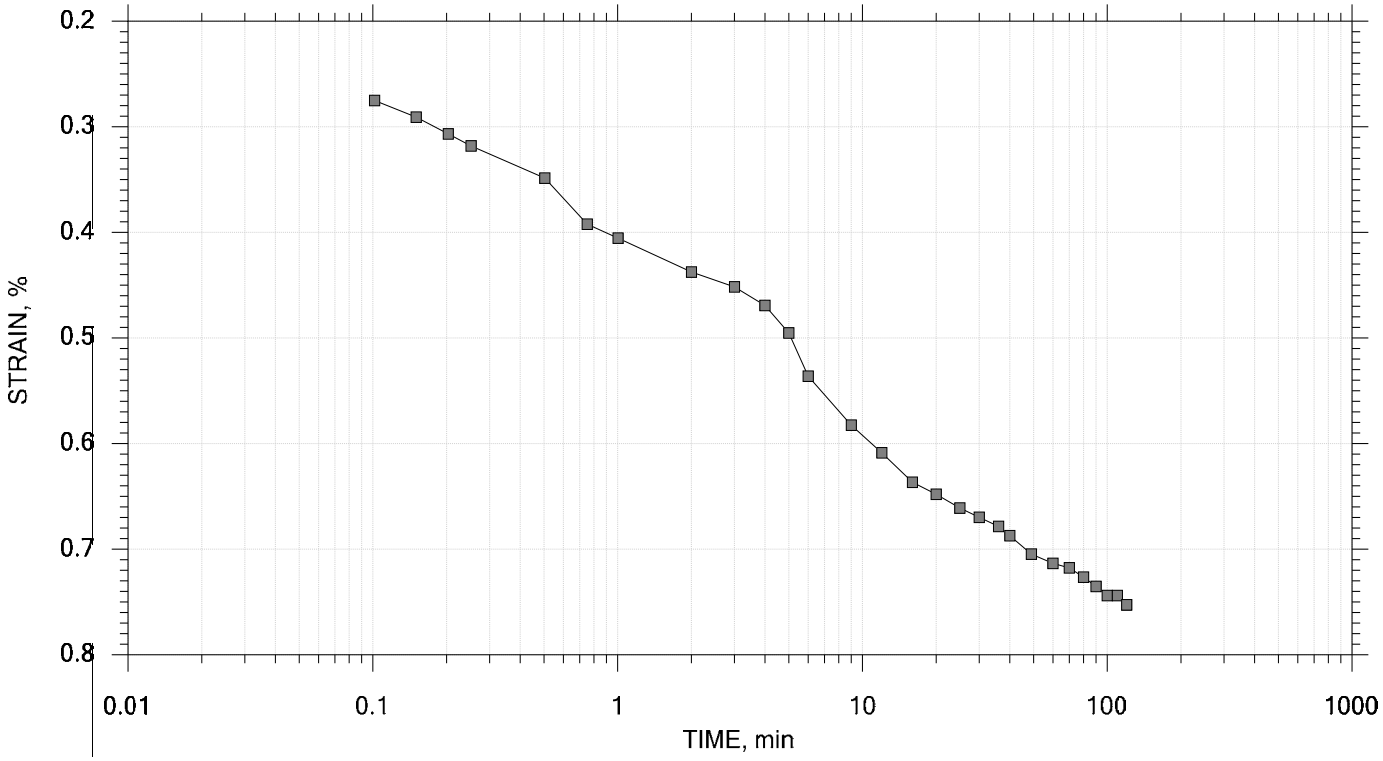
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

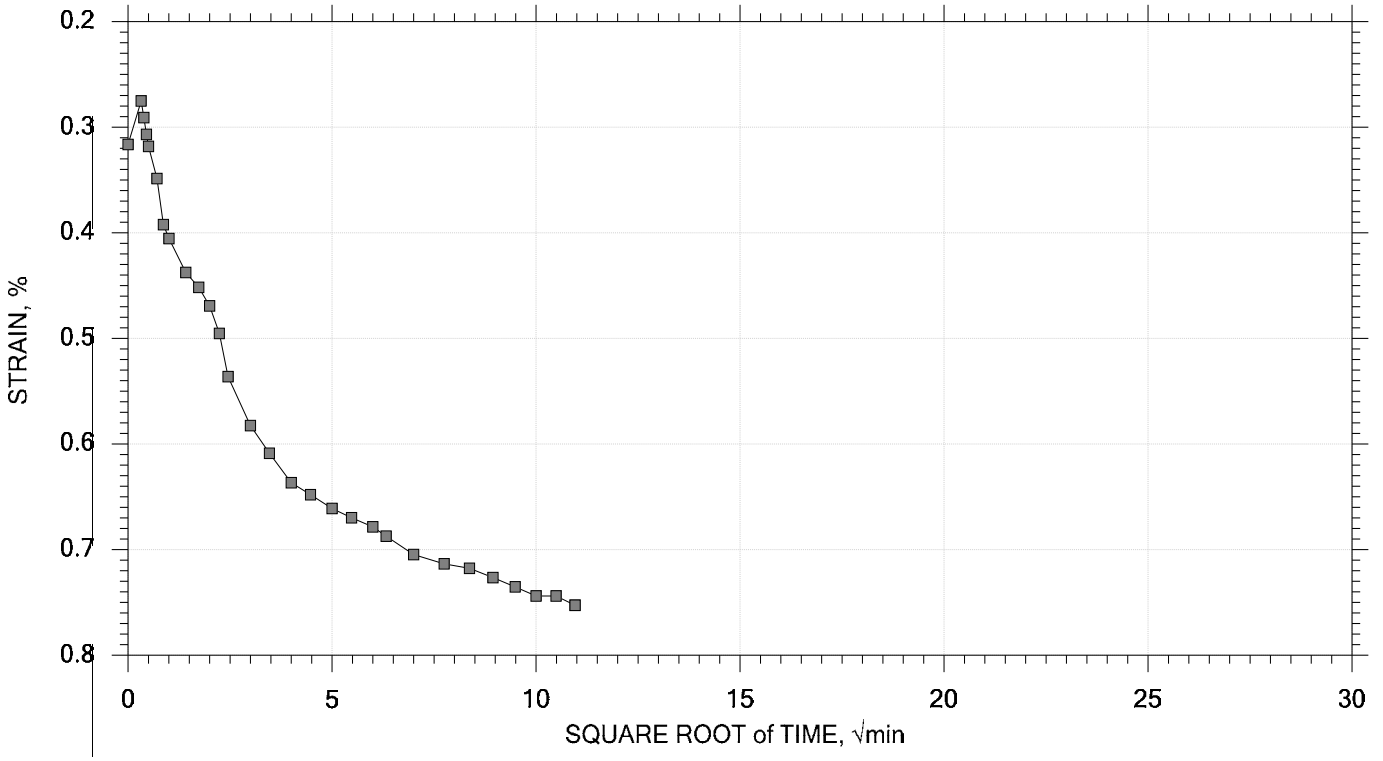
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 21

Stress: 0.125 tsf





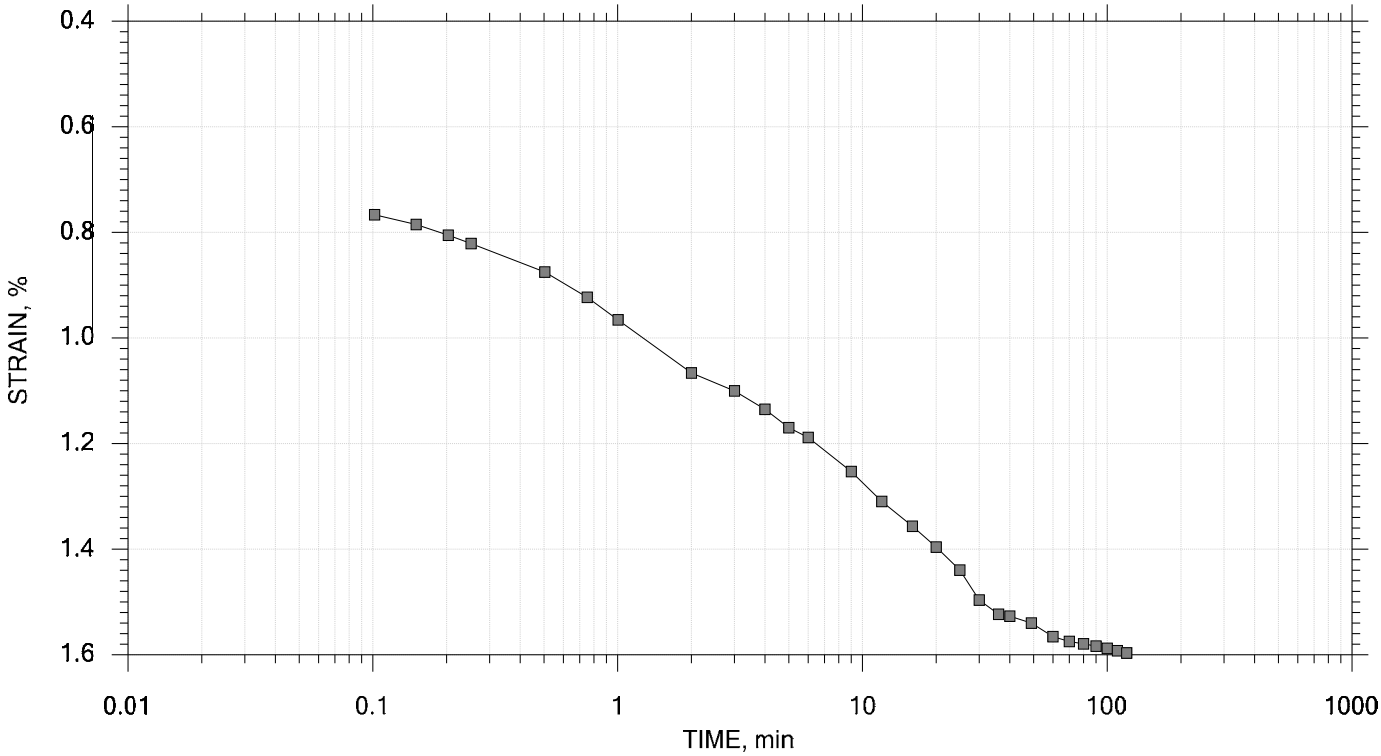
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

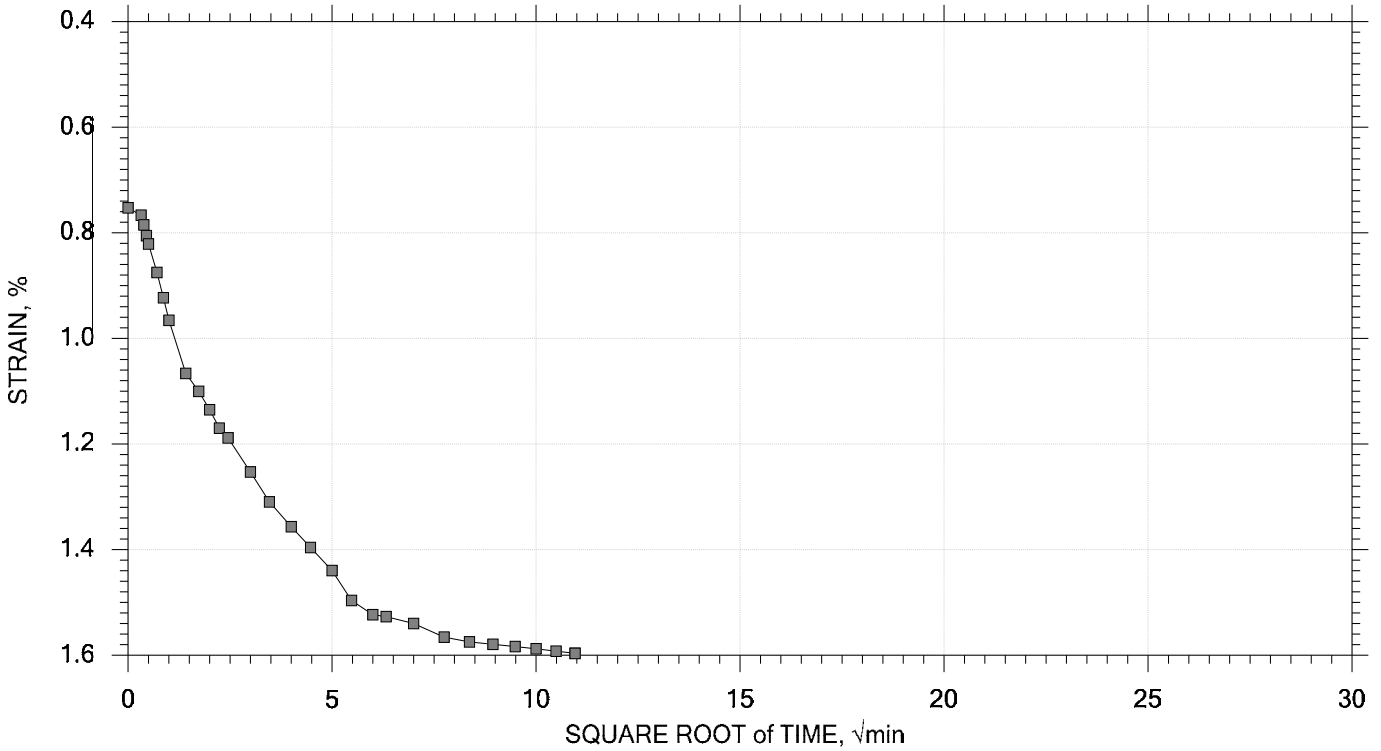
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 21

Stress: 0.25 tsf





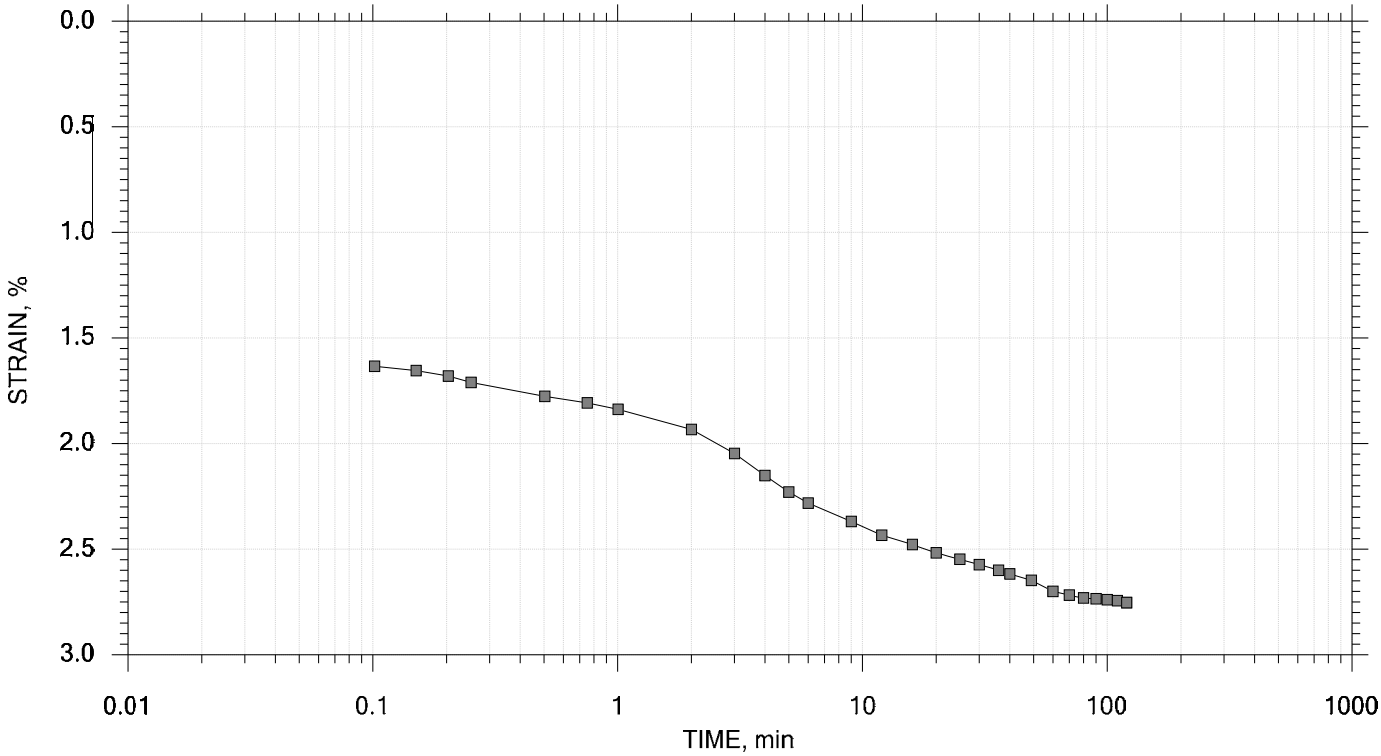
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

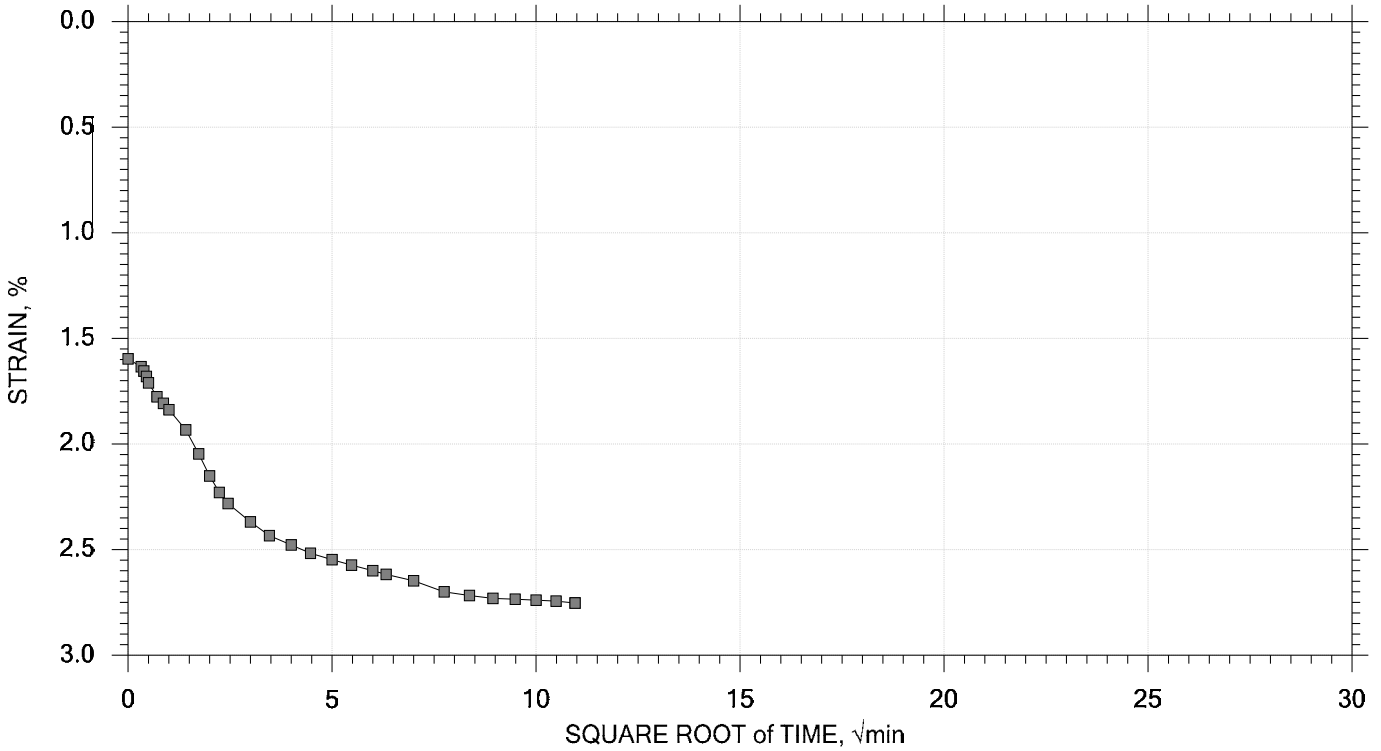
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 21

Stress: 0.5 tsf





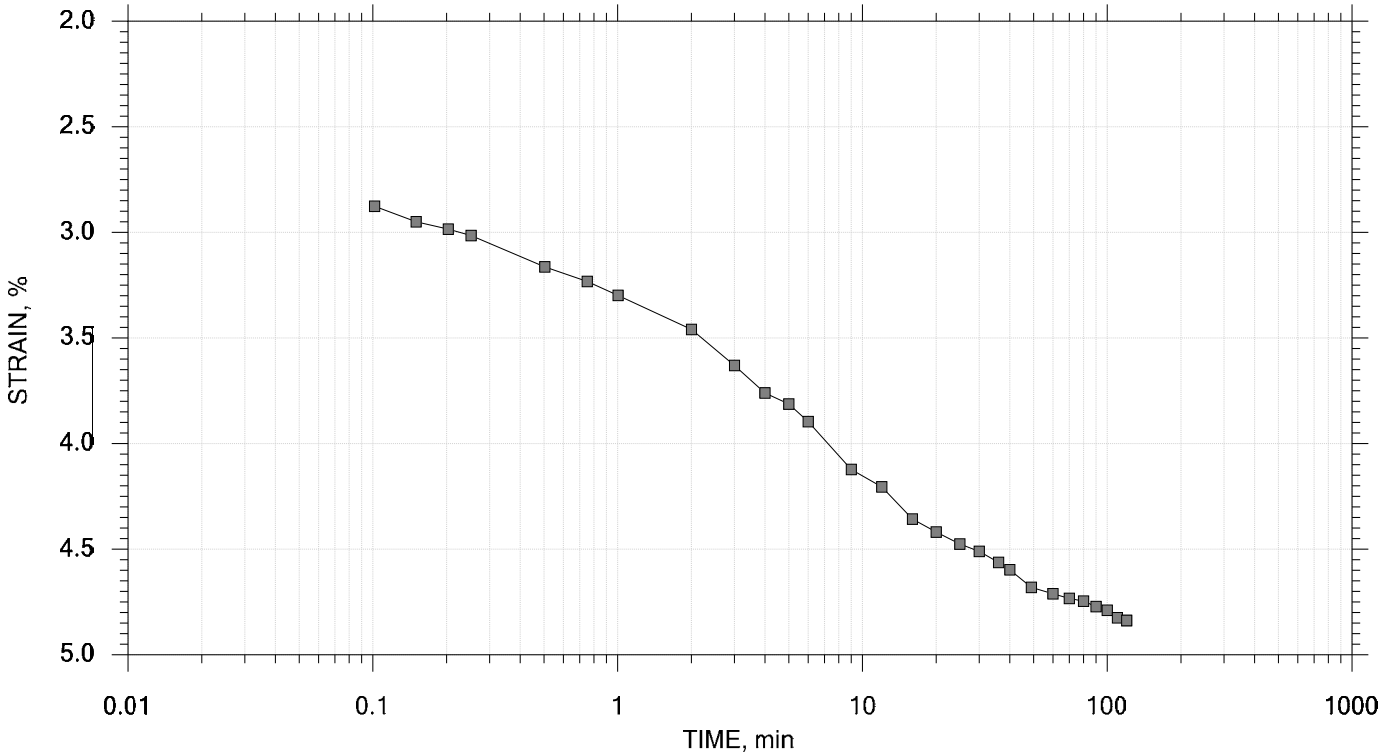
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

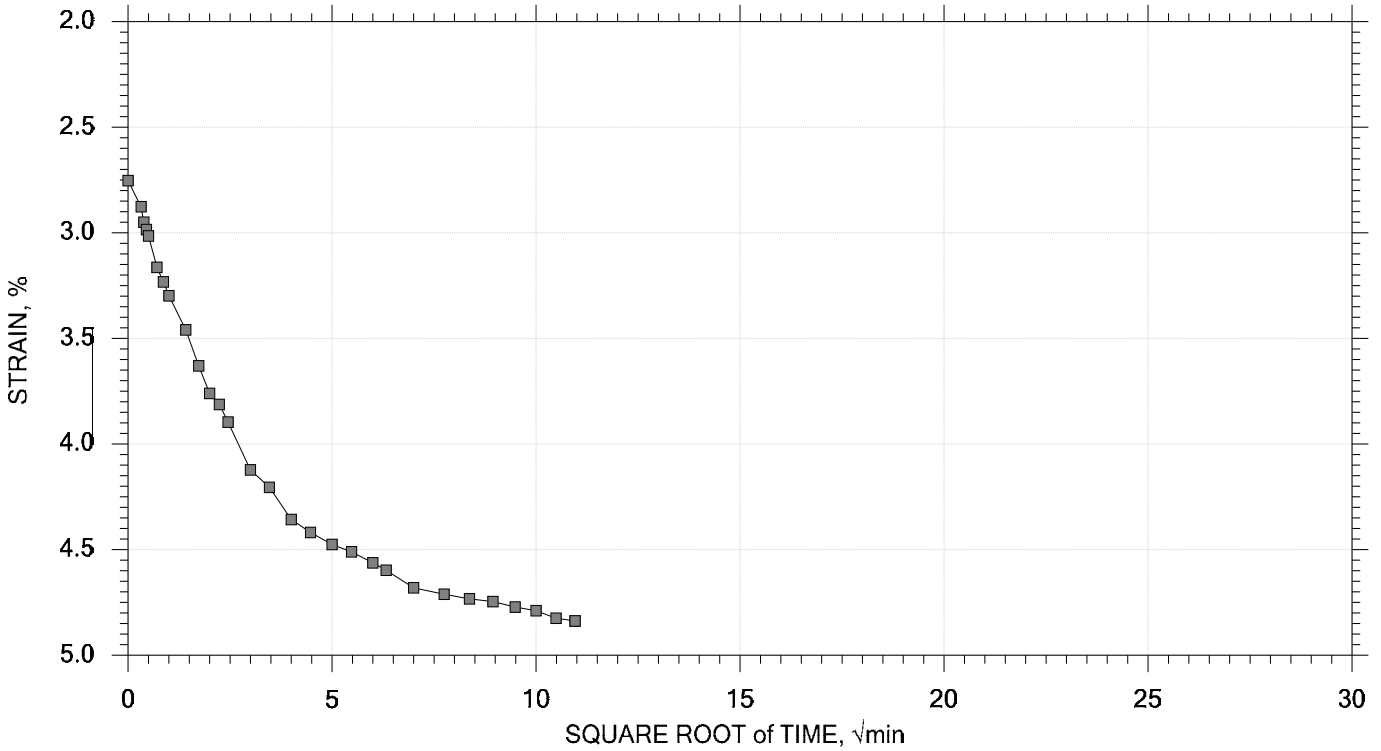
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 21

Stress: 1 tsf





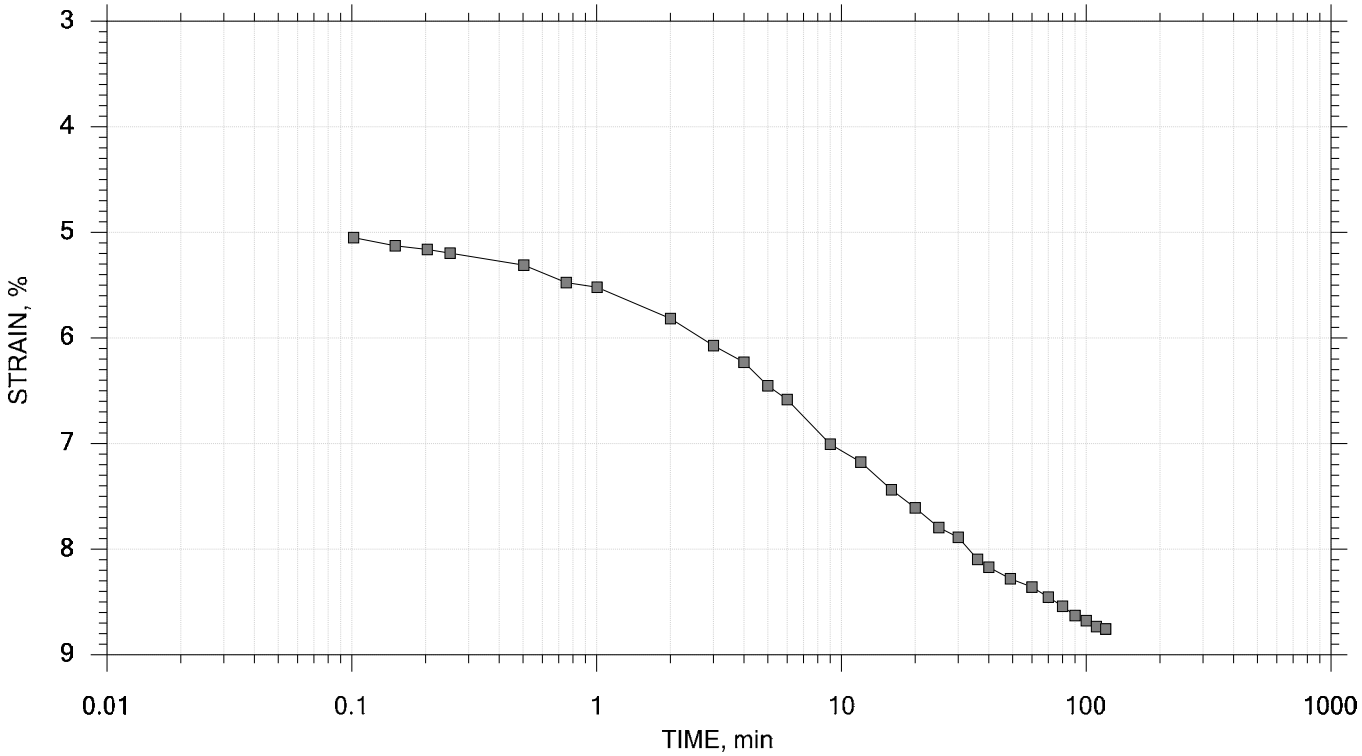
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

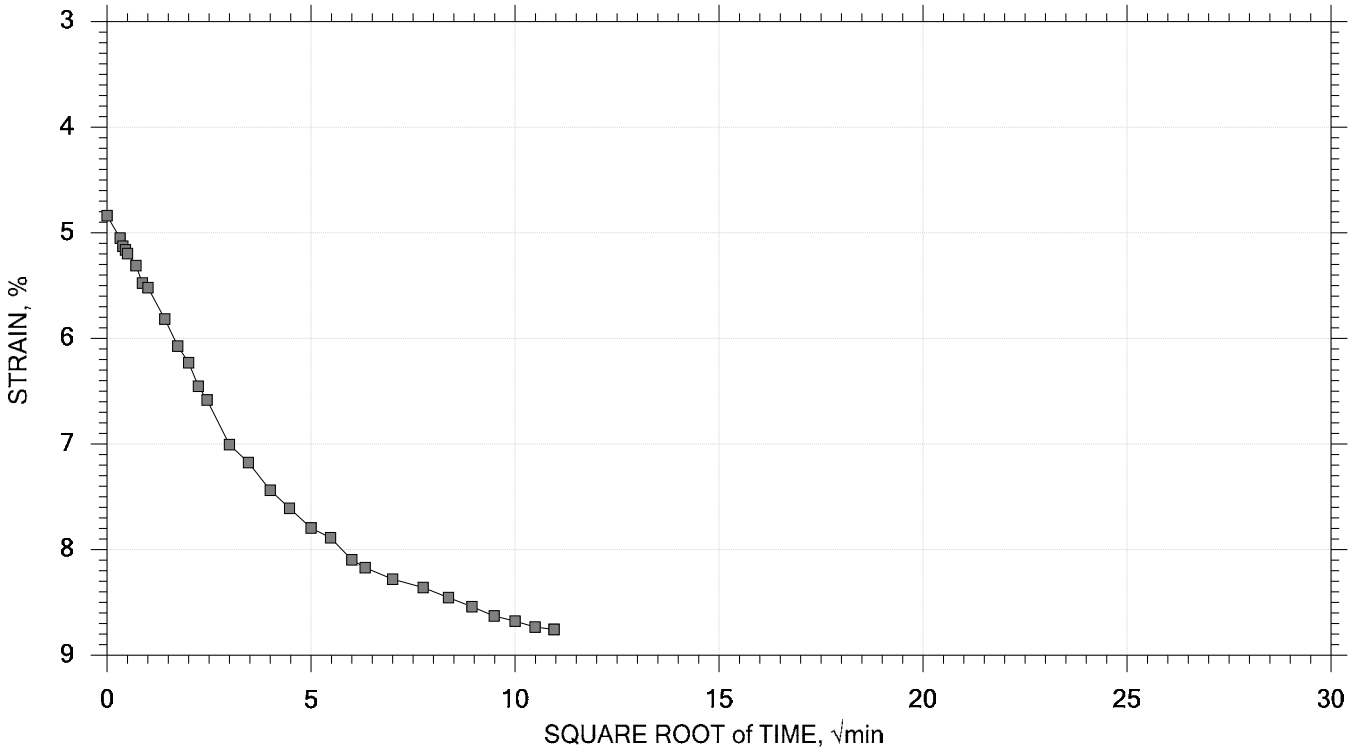
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 21

Stress: 2 tsf





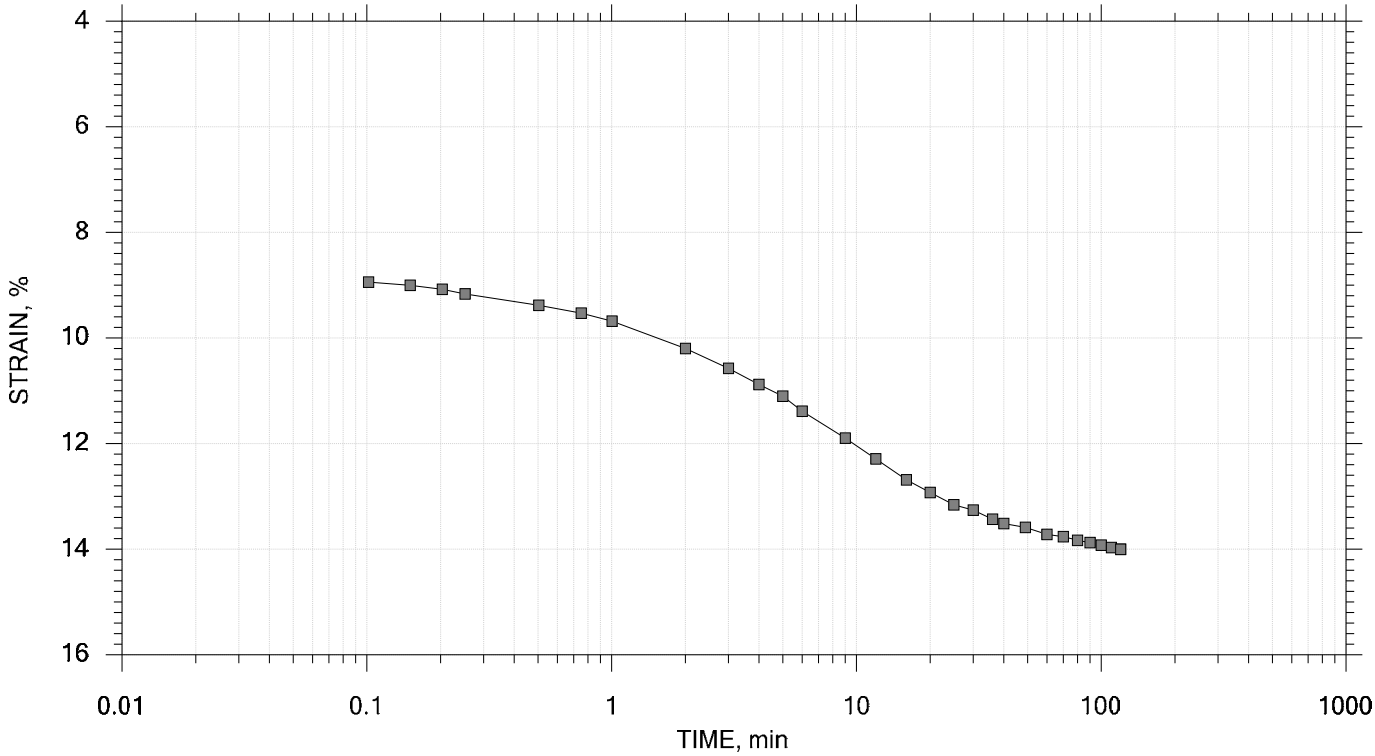
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

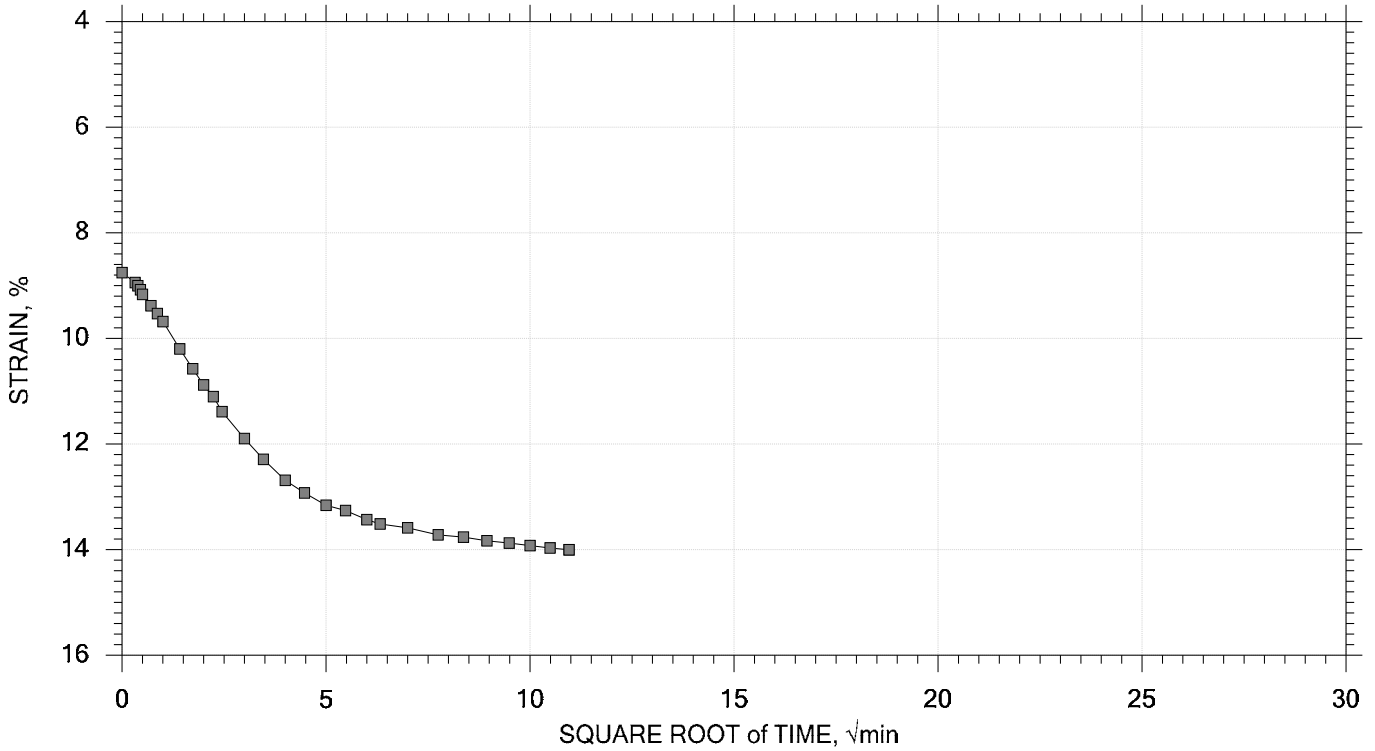
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 21

Stress: 4 tsf





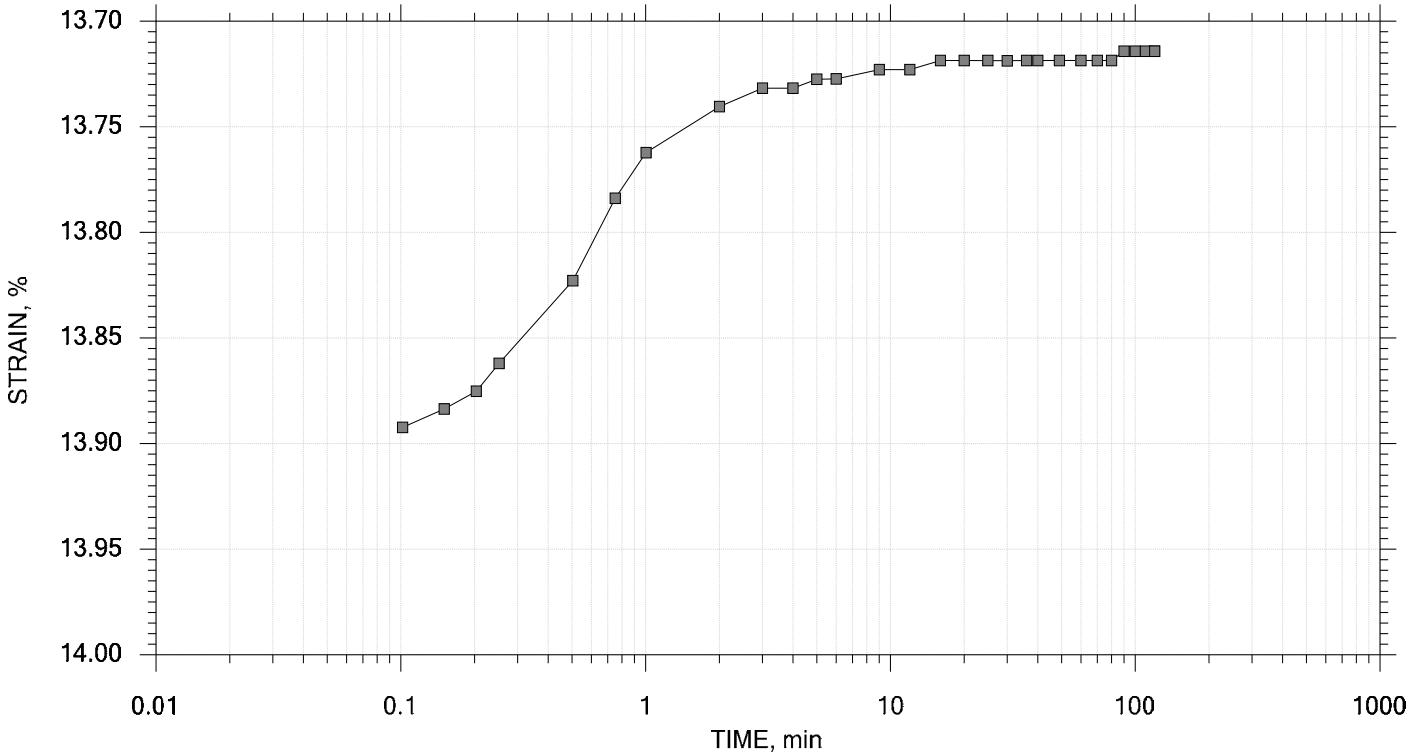
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

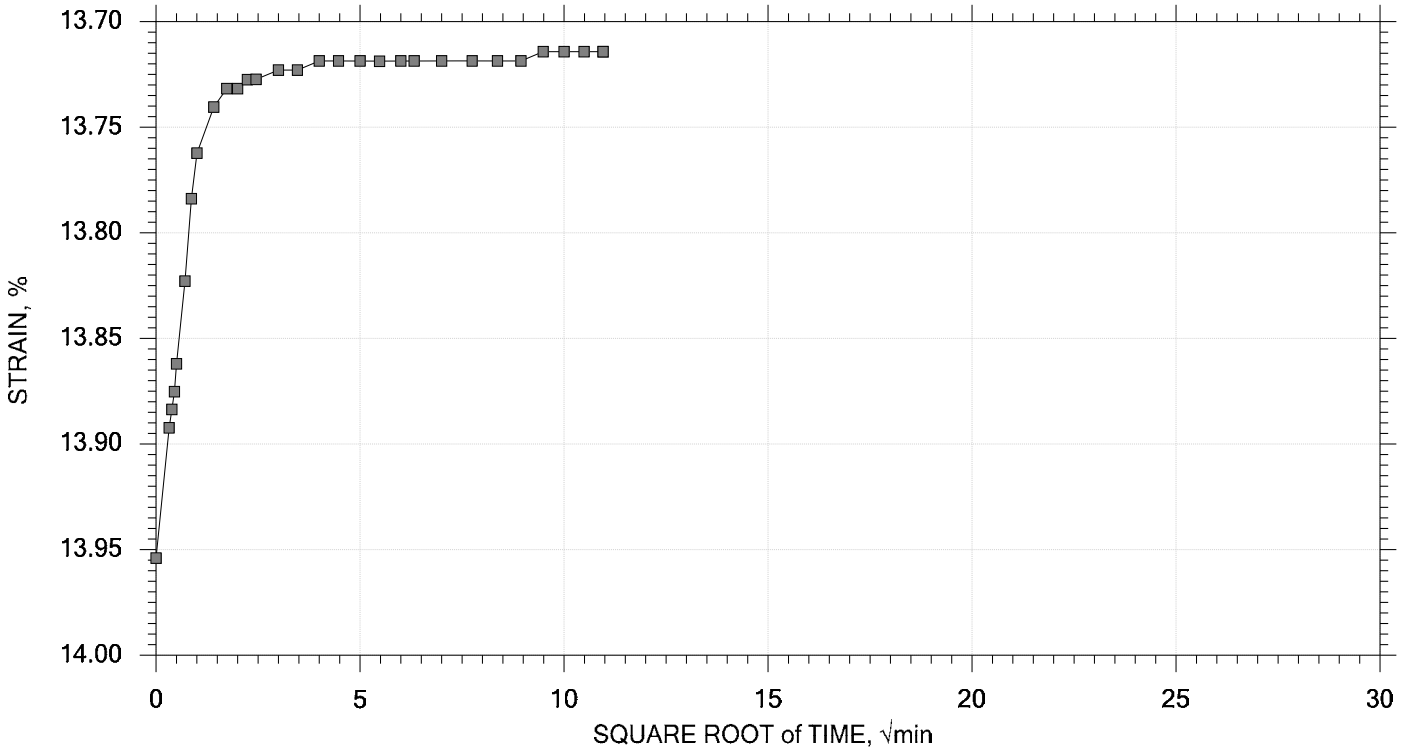
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 21

Stress: 2 tsf





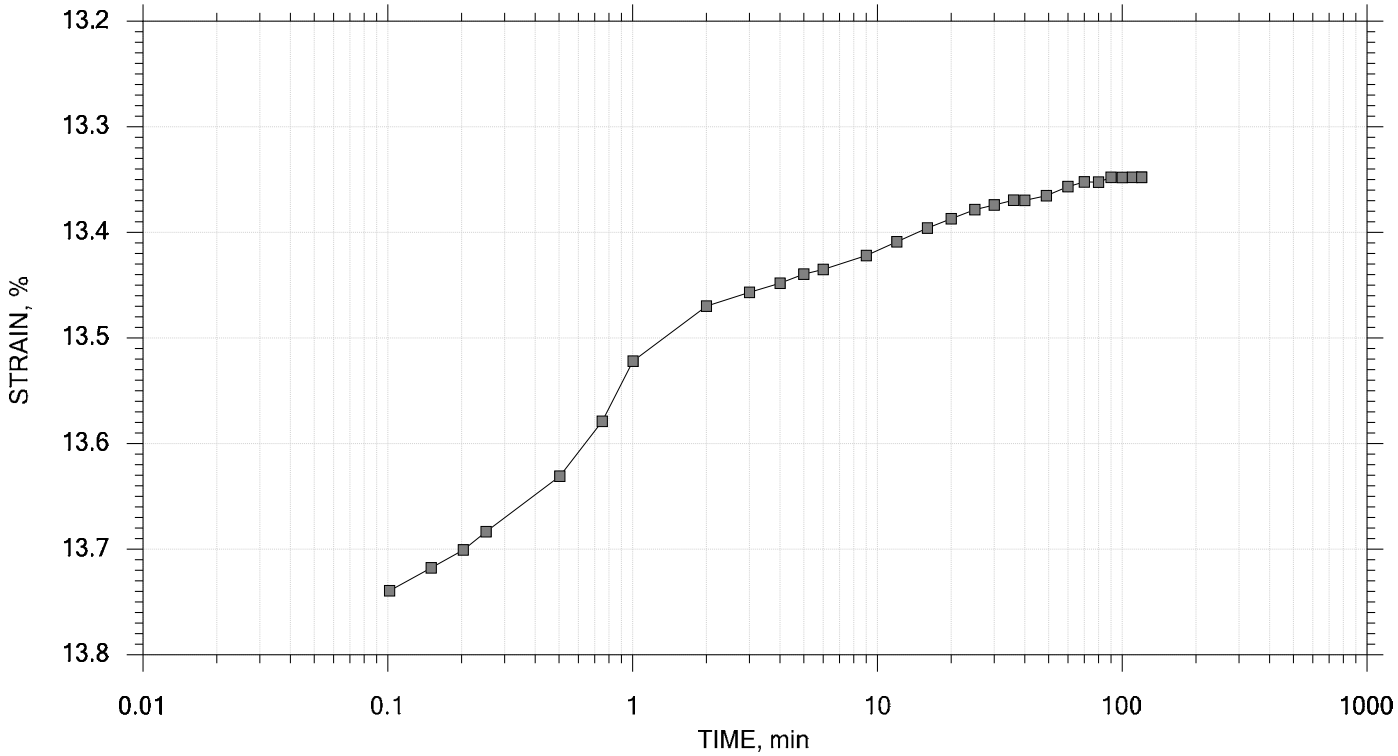
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

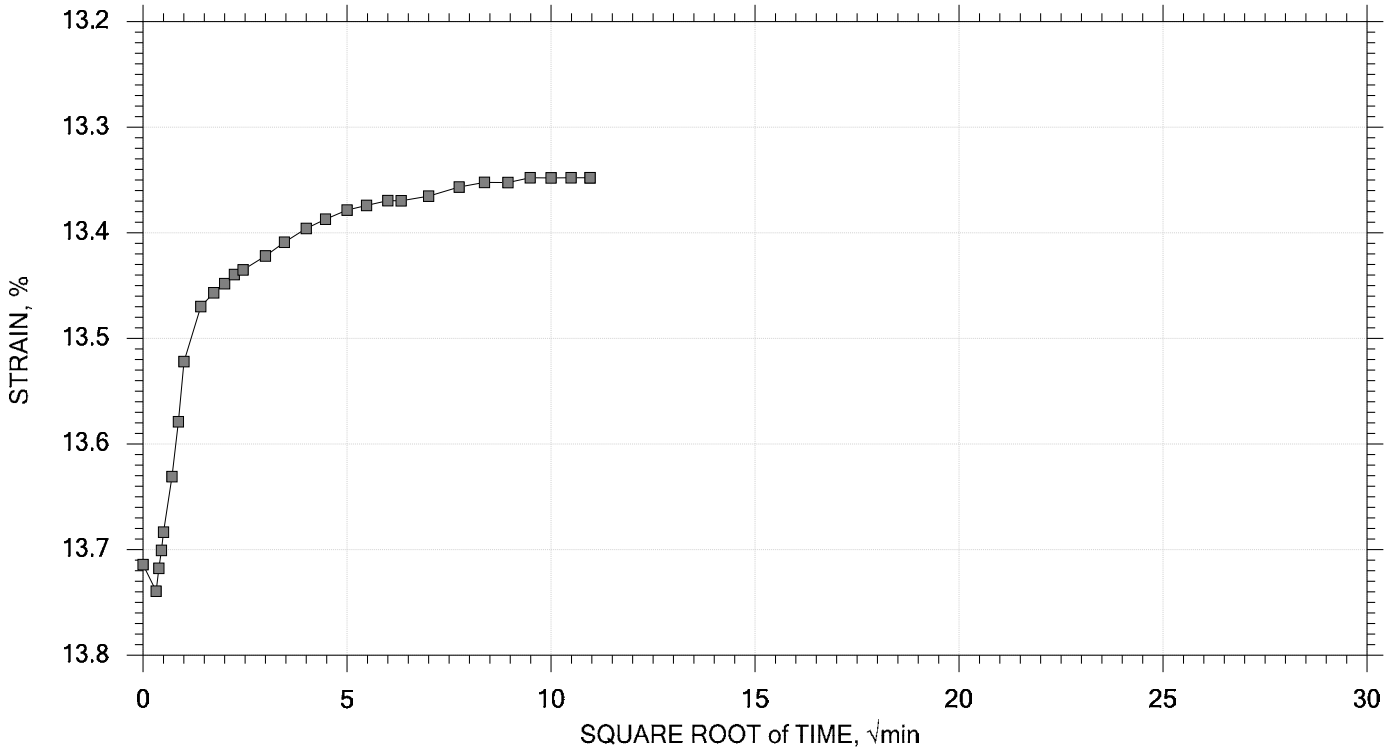
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 21

Stress: 1 tsf





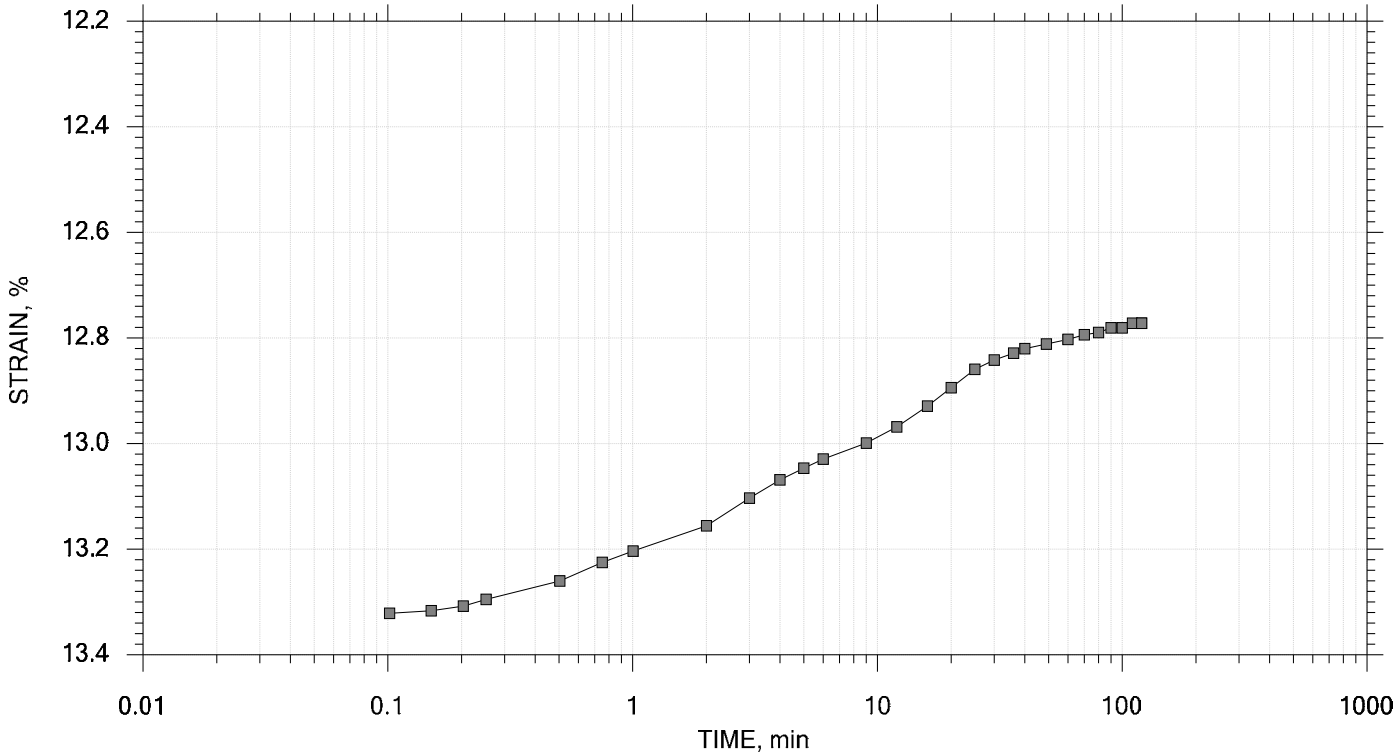
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

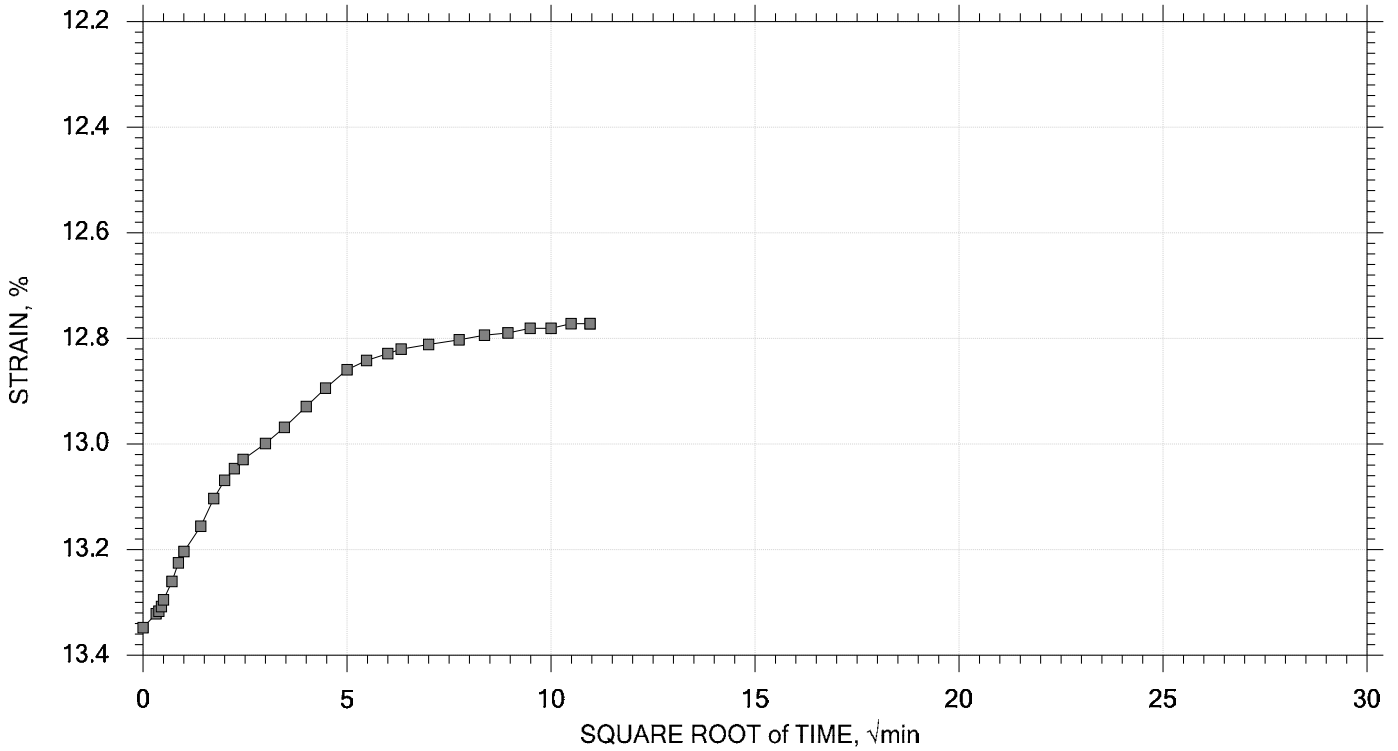
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 21

Stress: 0.5 tsf





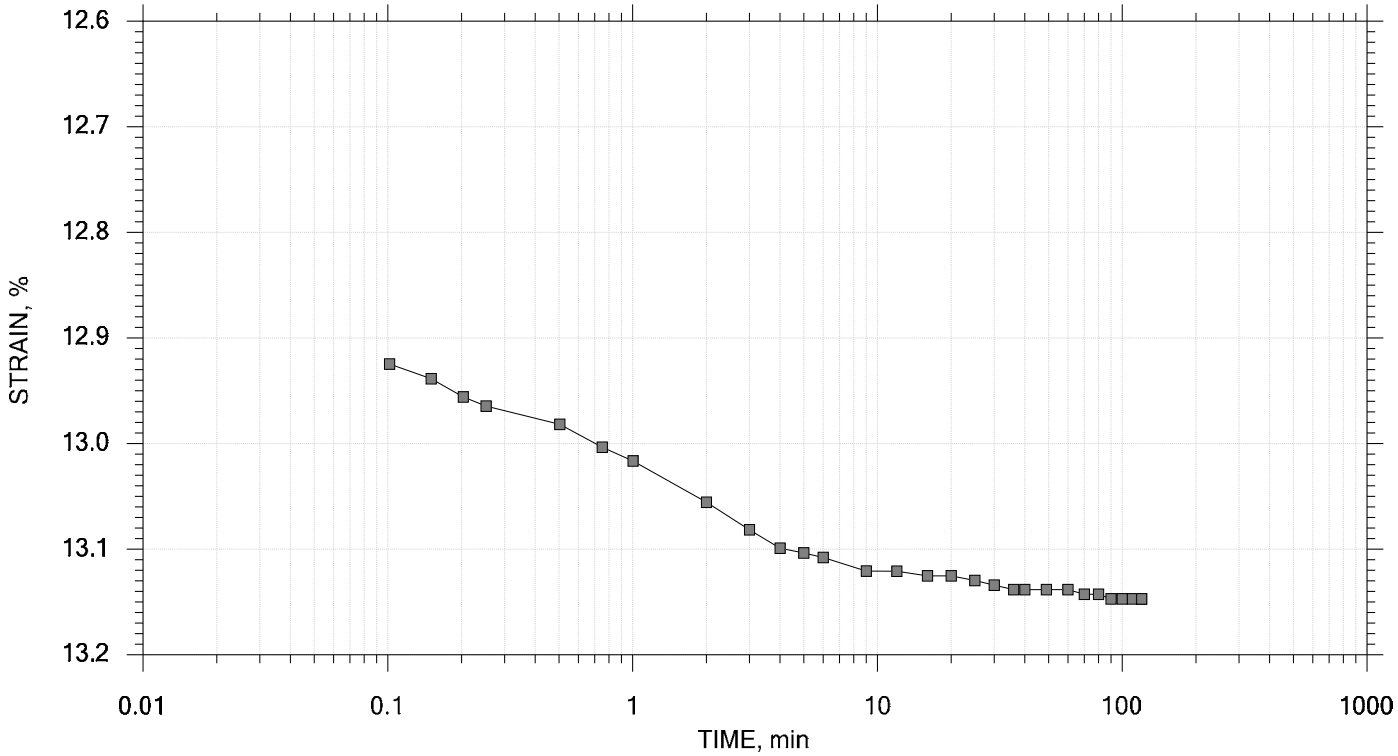
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

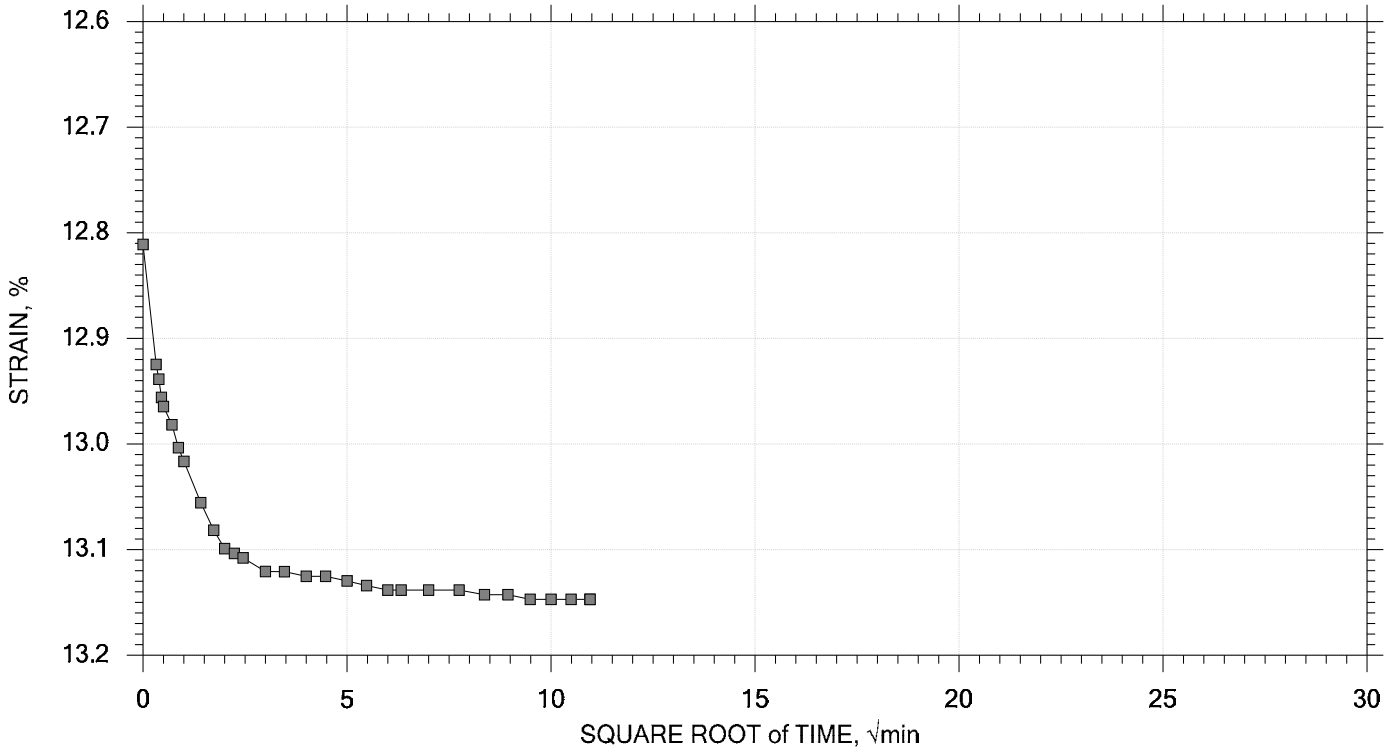
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 11 of 21

Stress: 1 tsf





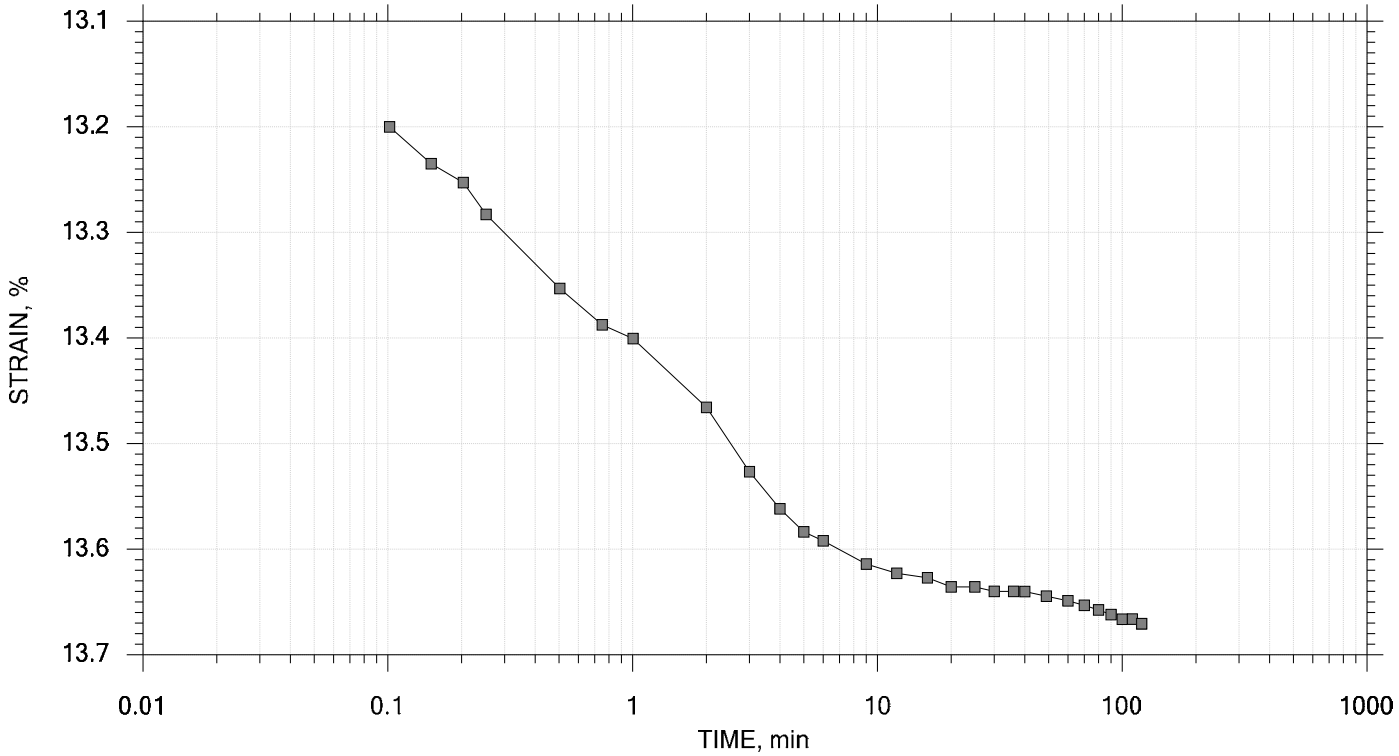
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

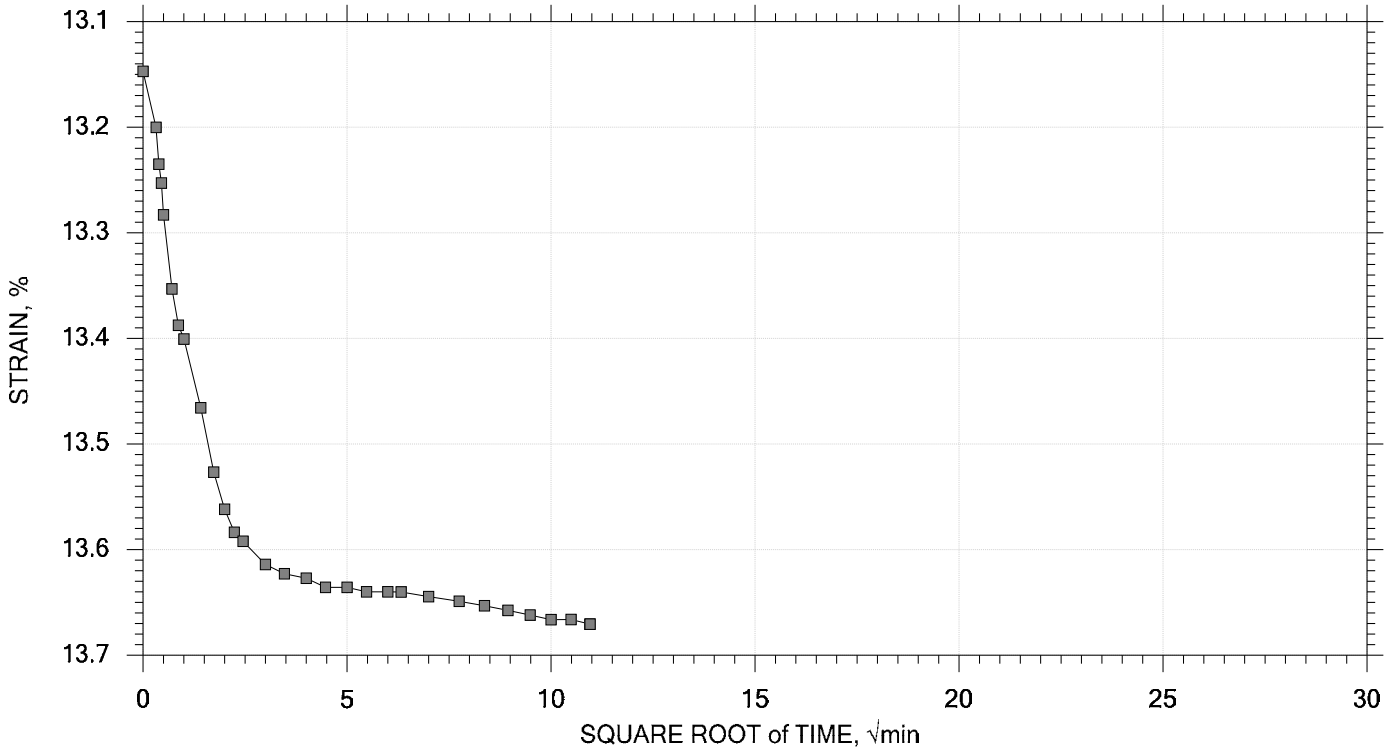
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 12 of 21

Stress: 2 tsf





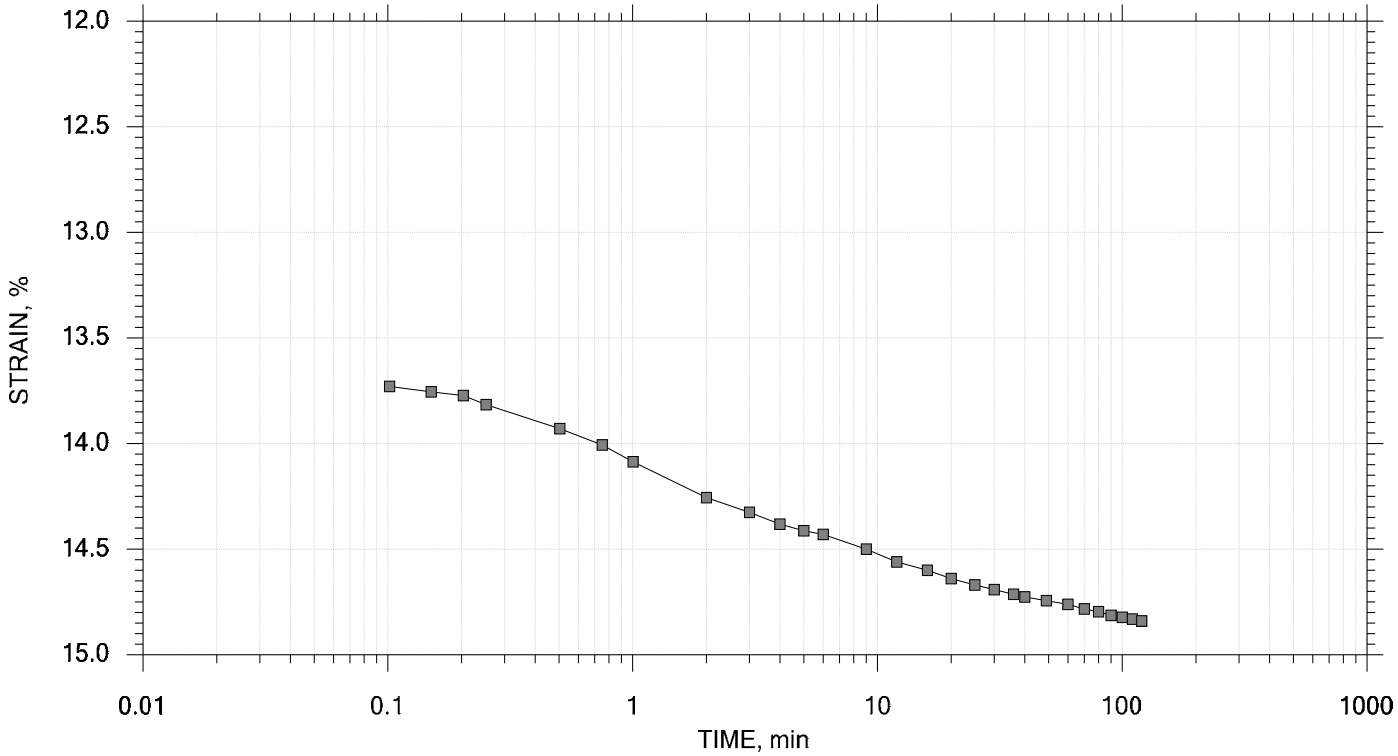
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

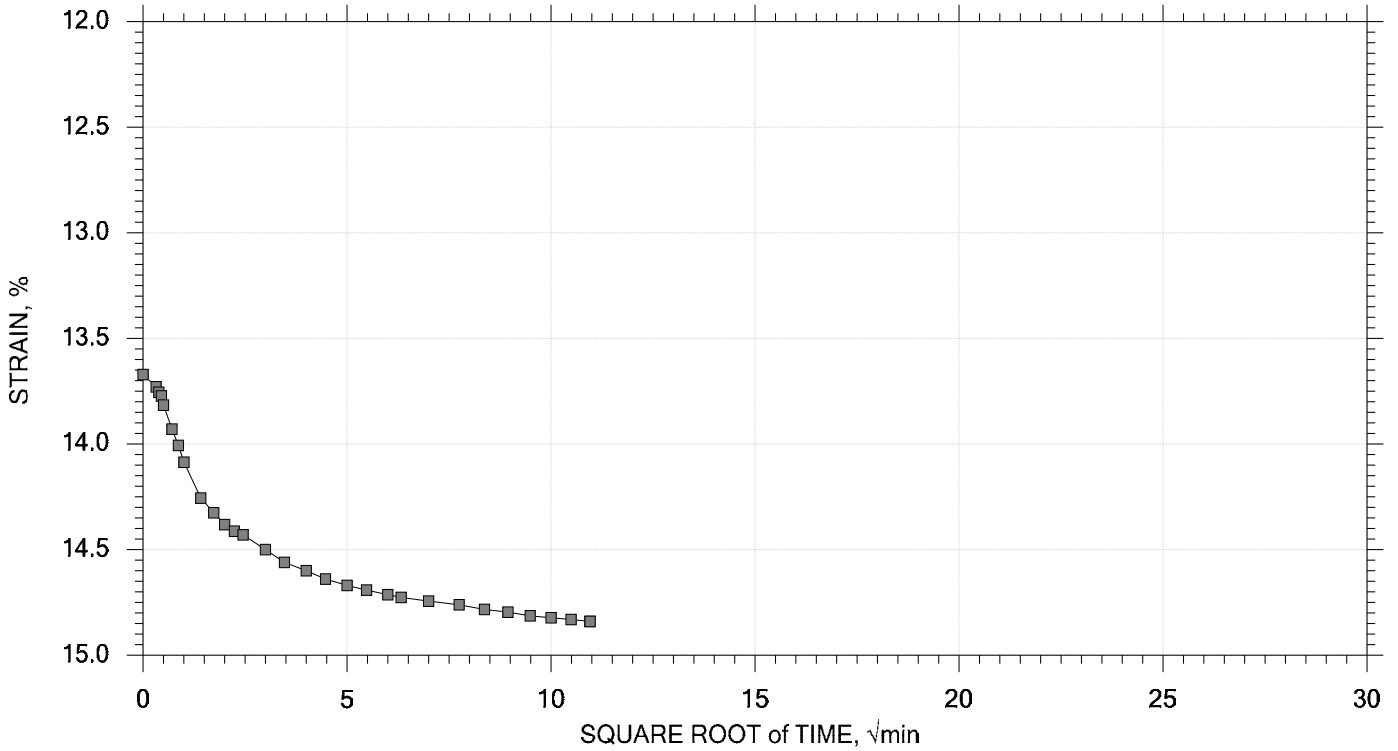
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 21

Stress: 4 tsf





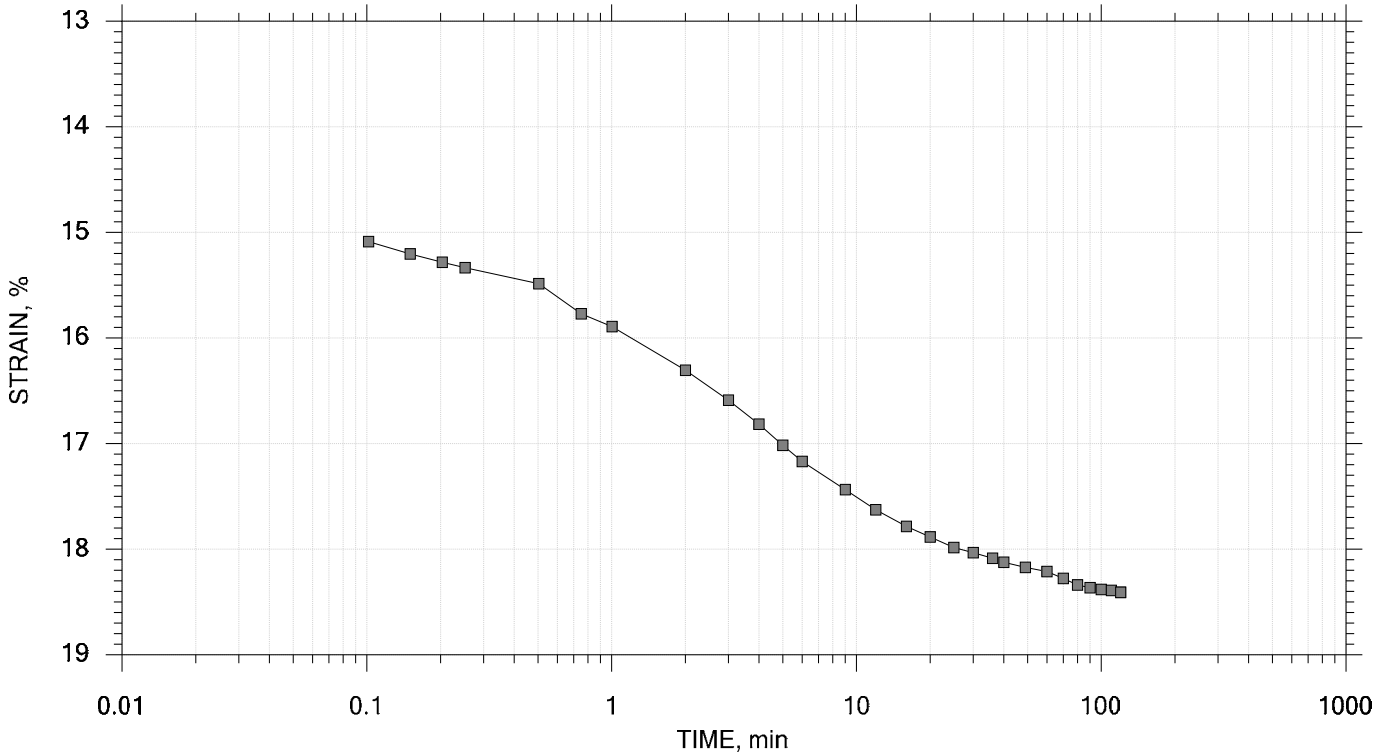
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

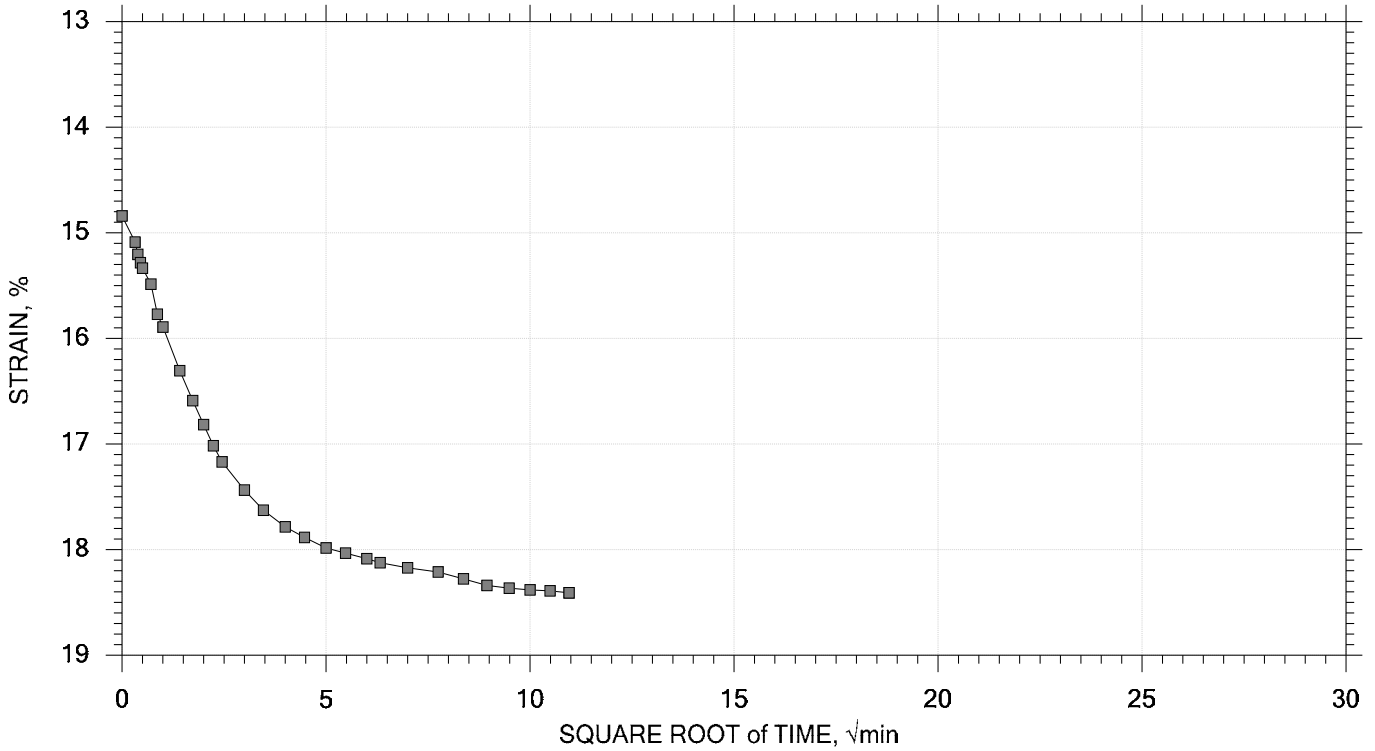
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 21

Stress: 8 tsf





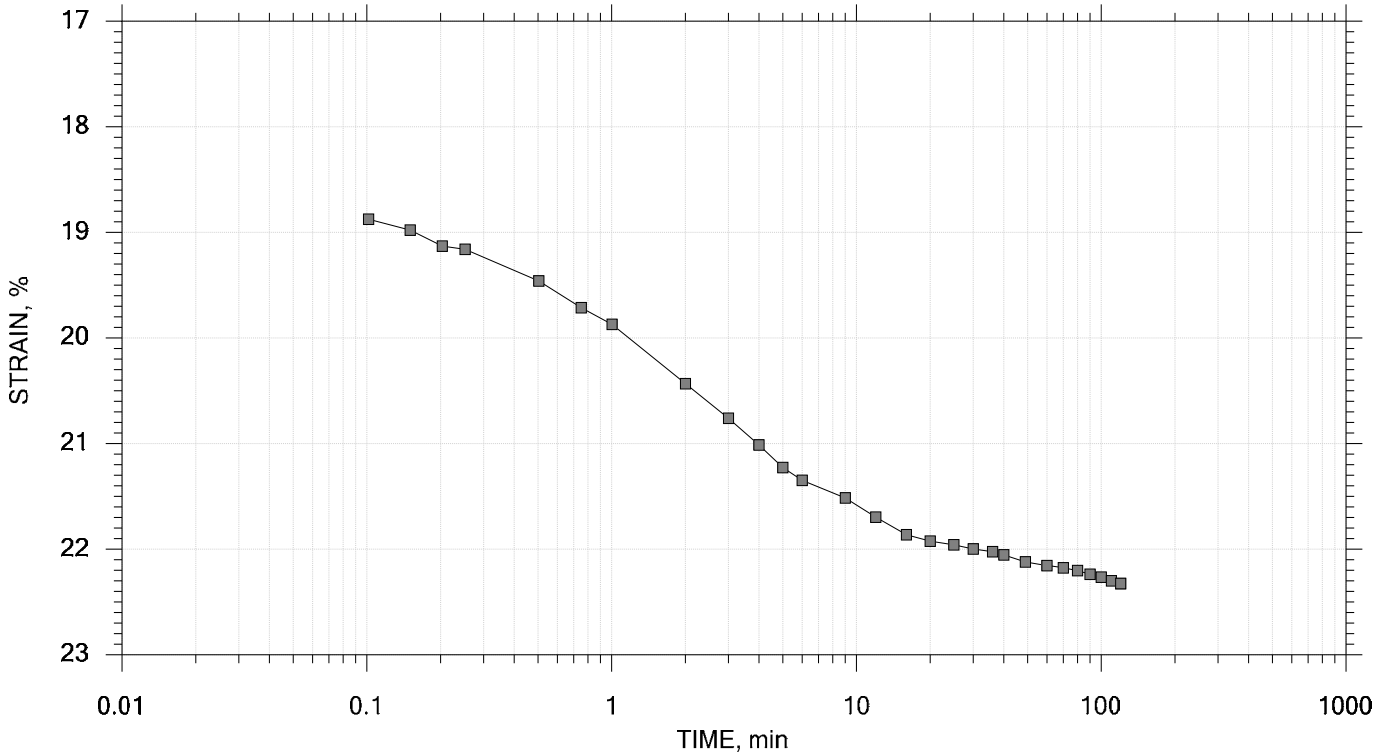
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

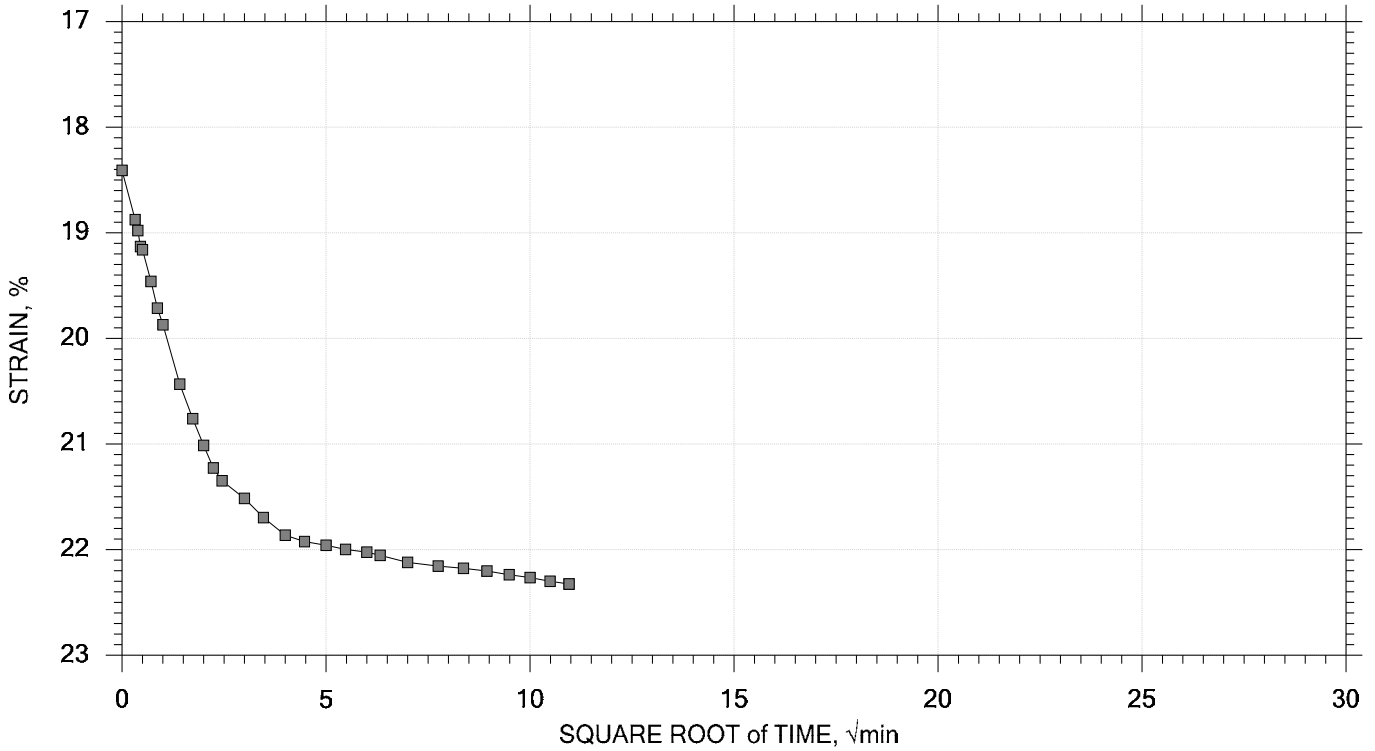
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 15 of 21

Stress: 16 tsf





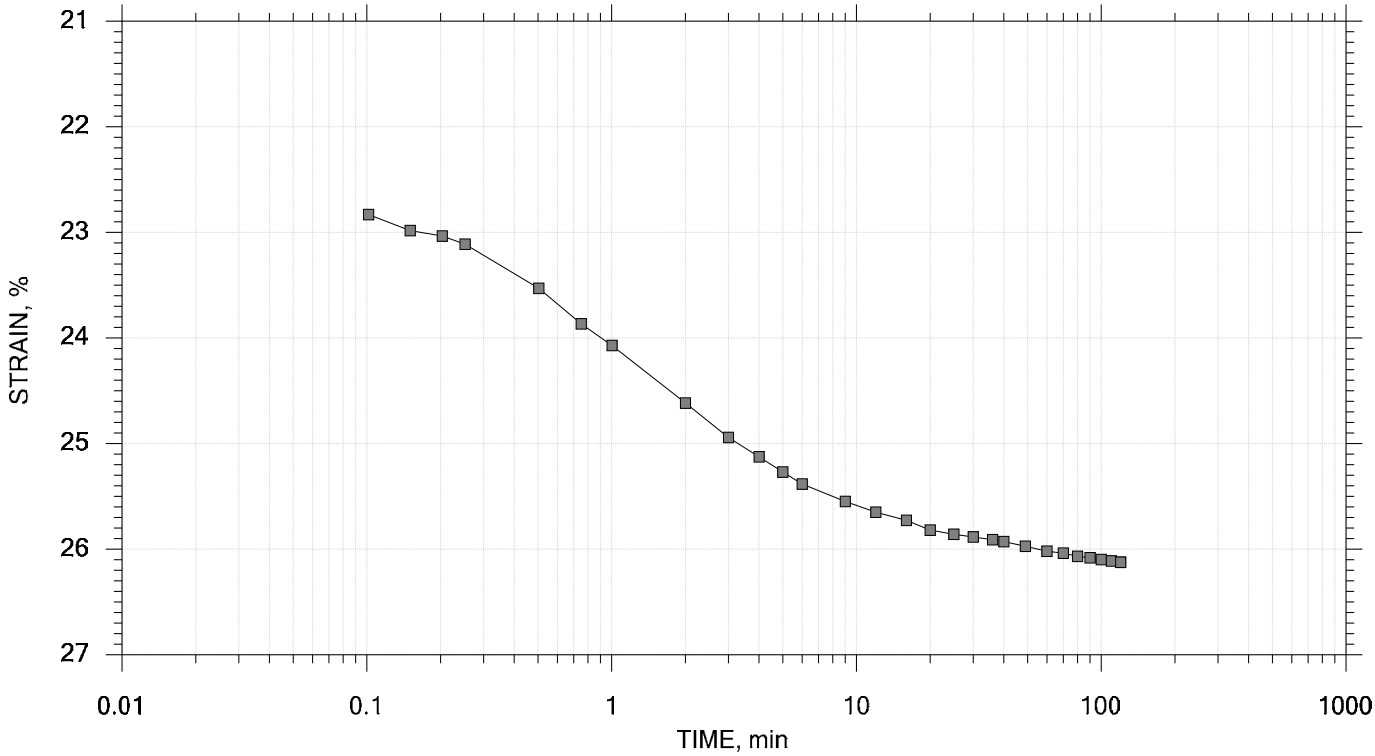
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

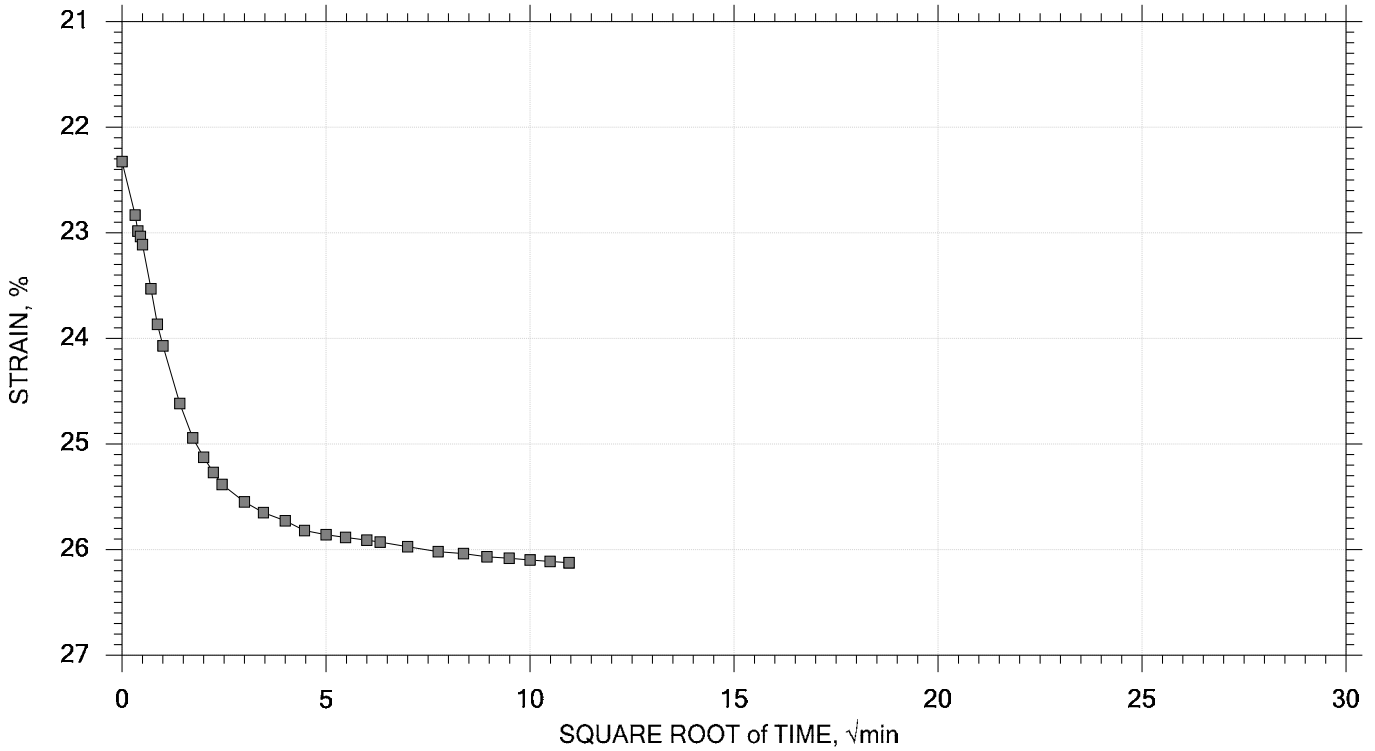
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 16 of 21

Stress: 32 tsf





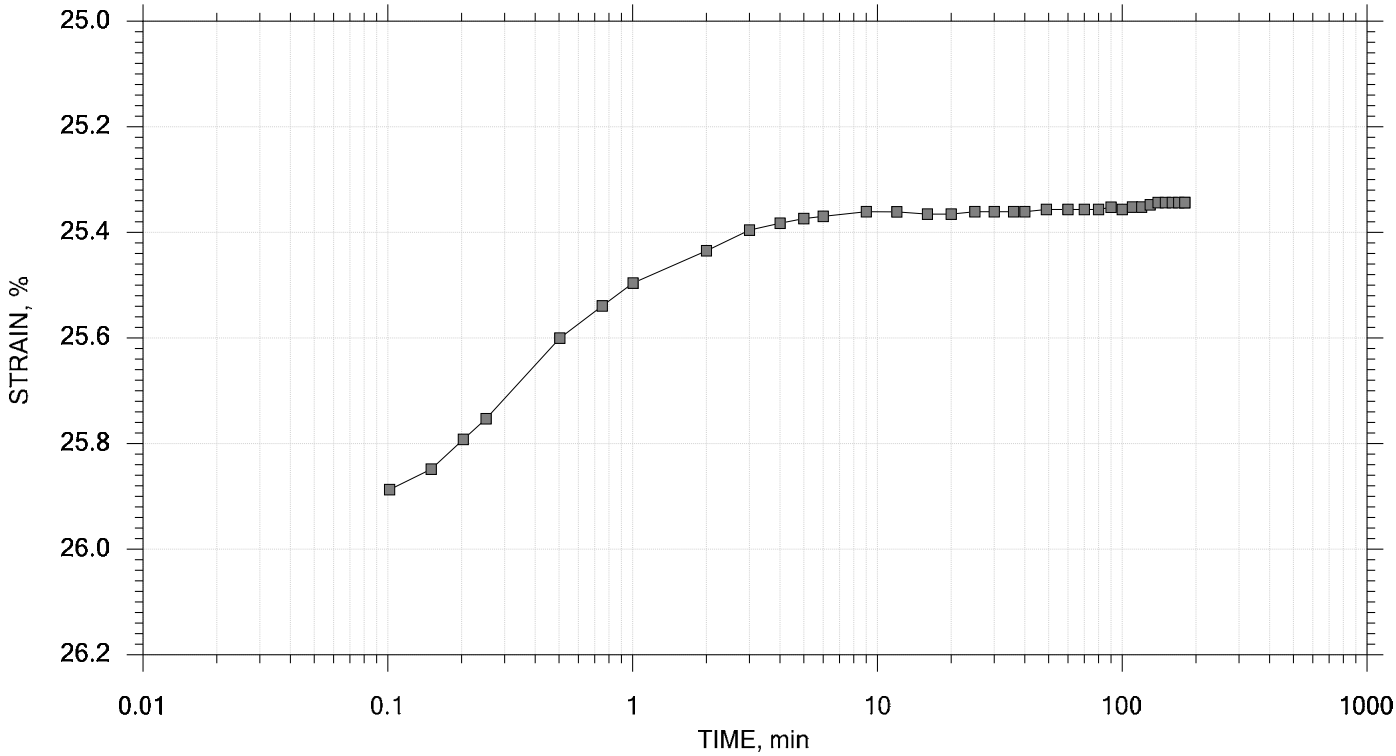
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

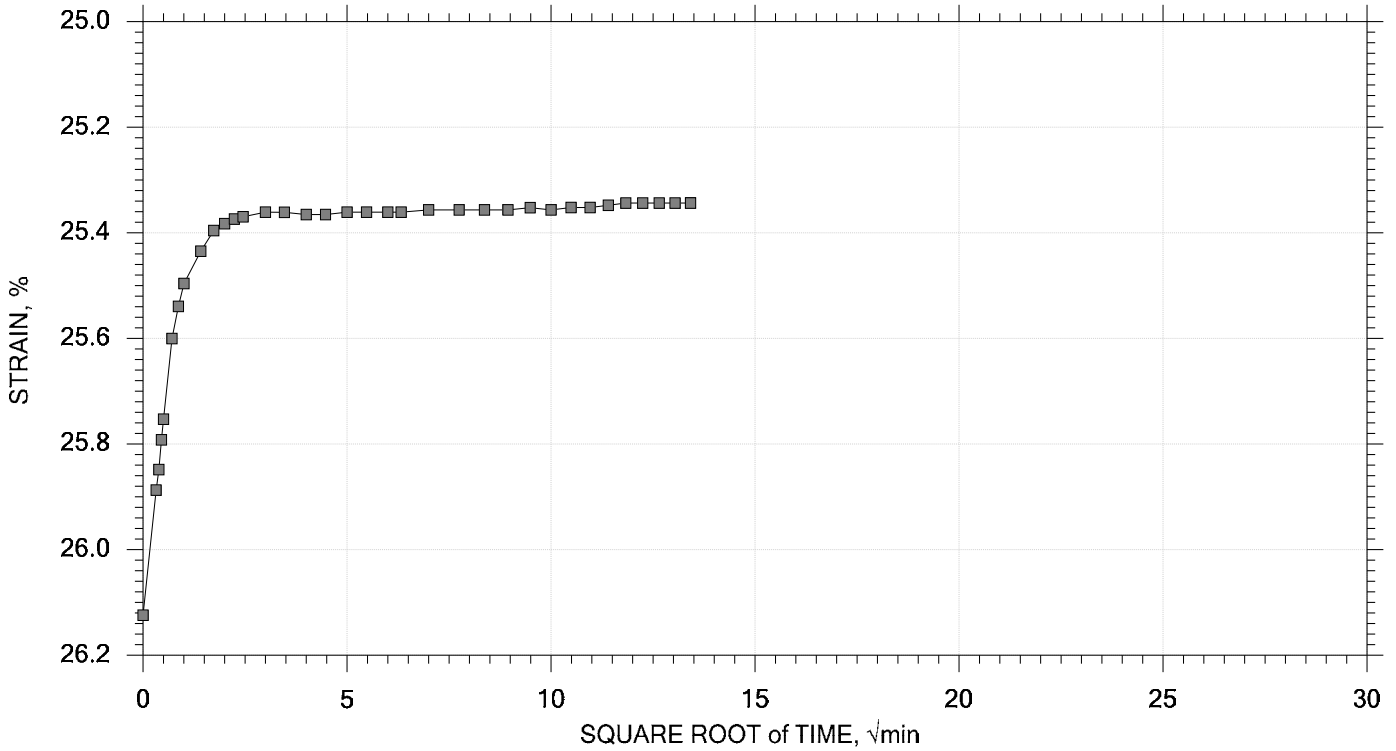
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 17 of 21

Stress: 8 tsf





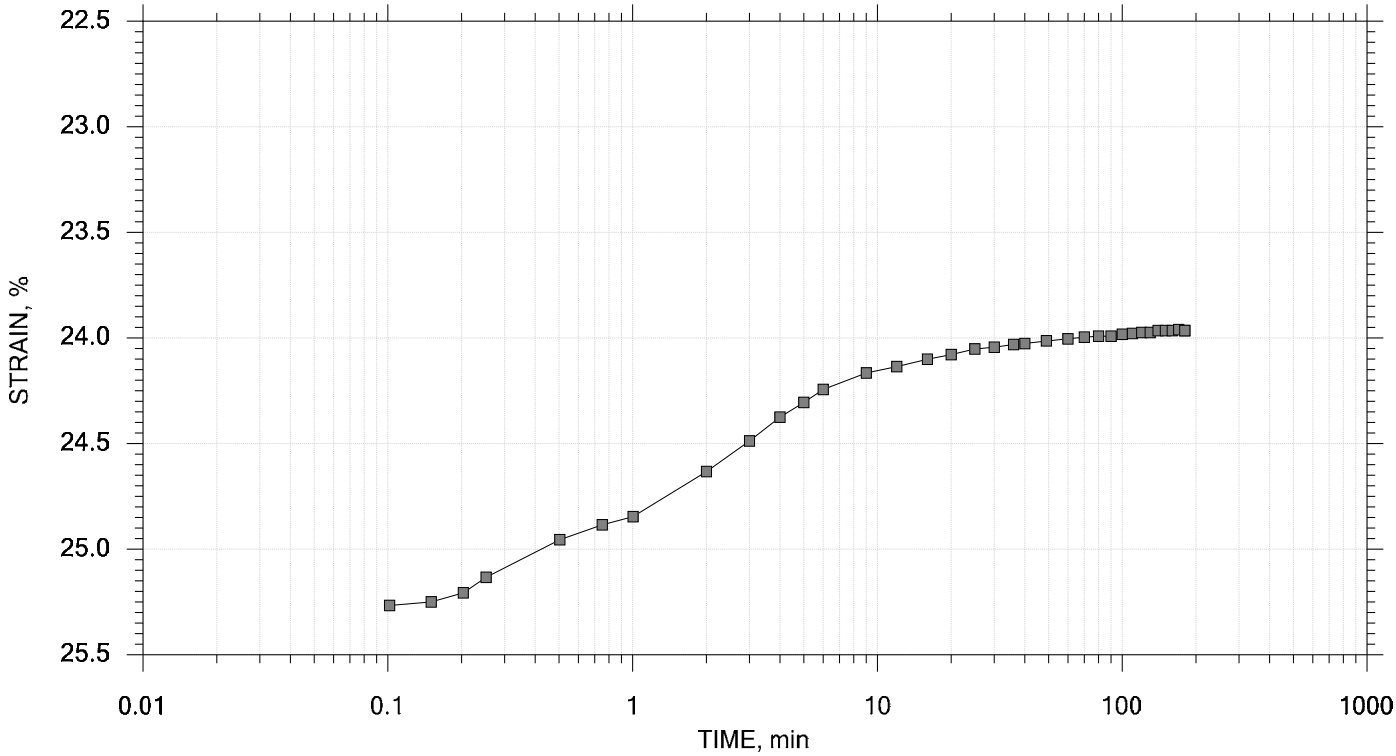
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

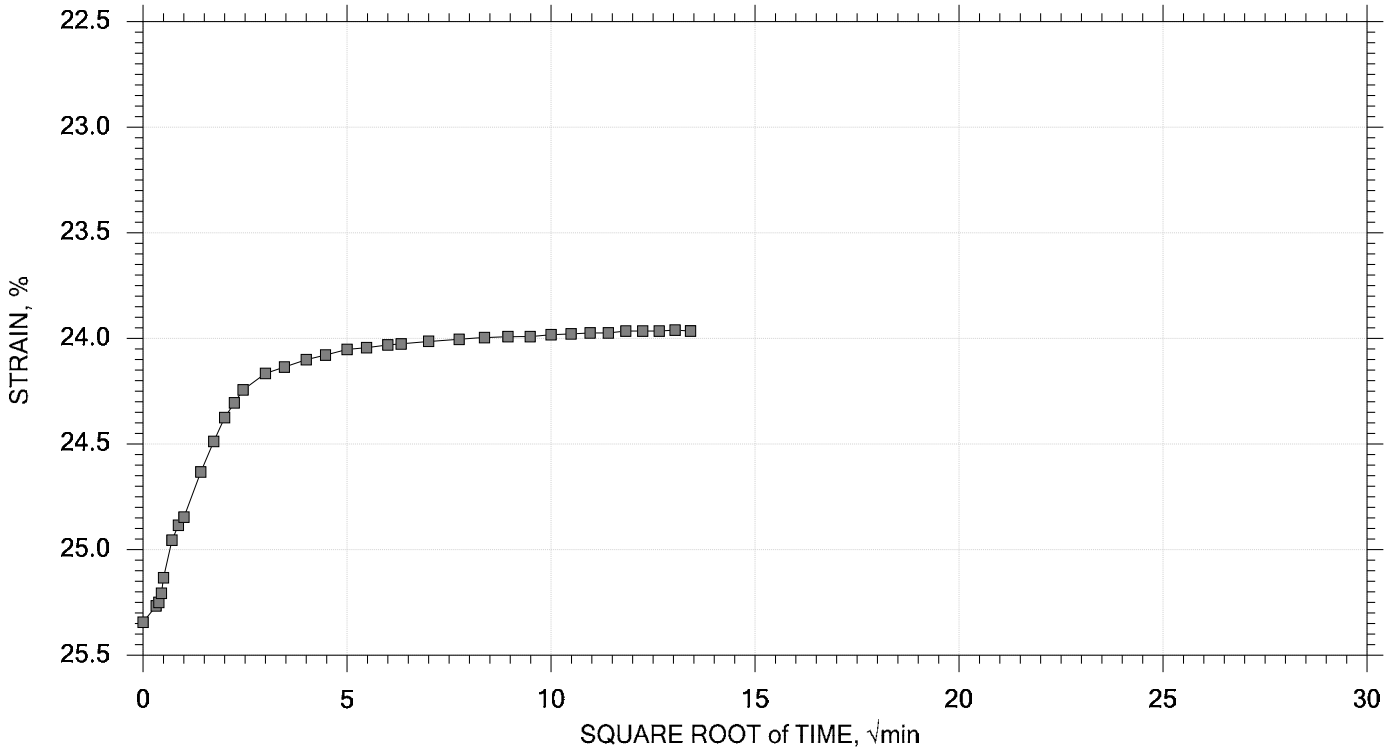
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 18 of 21

Stress: 2 tsf





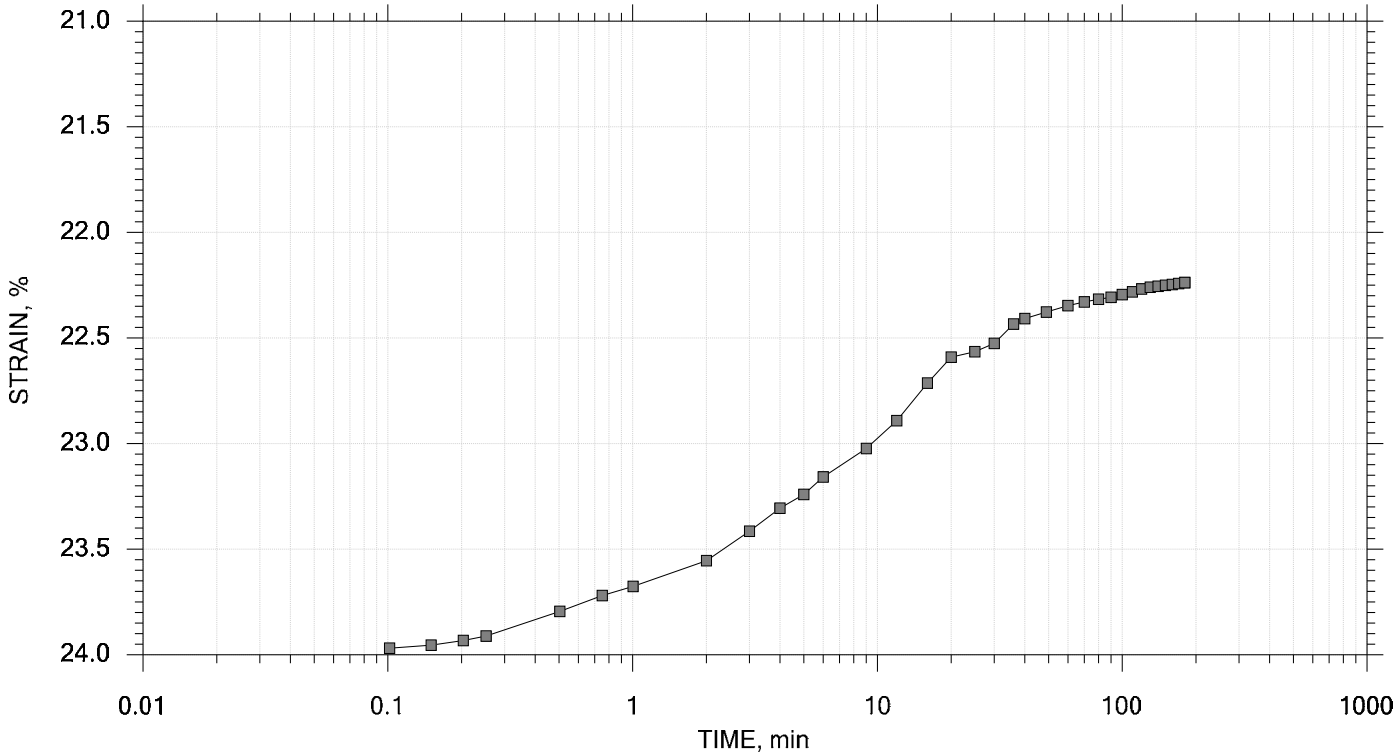
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

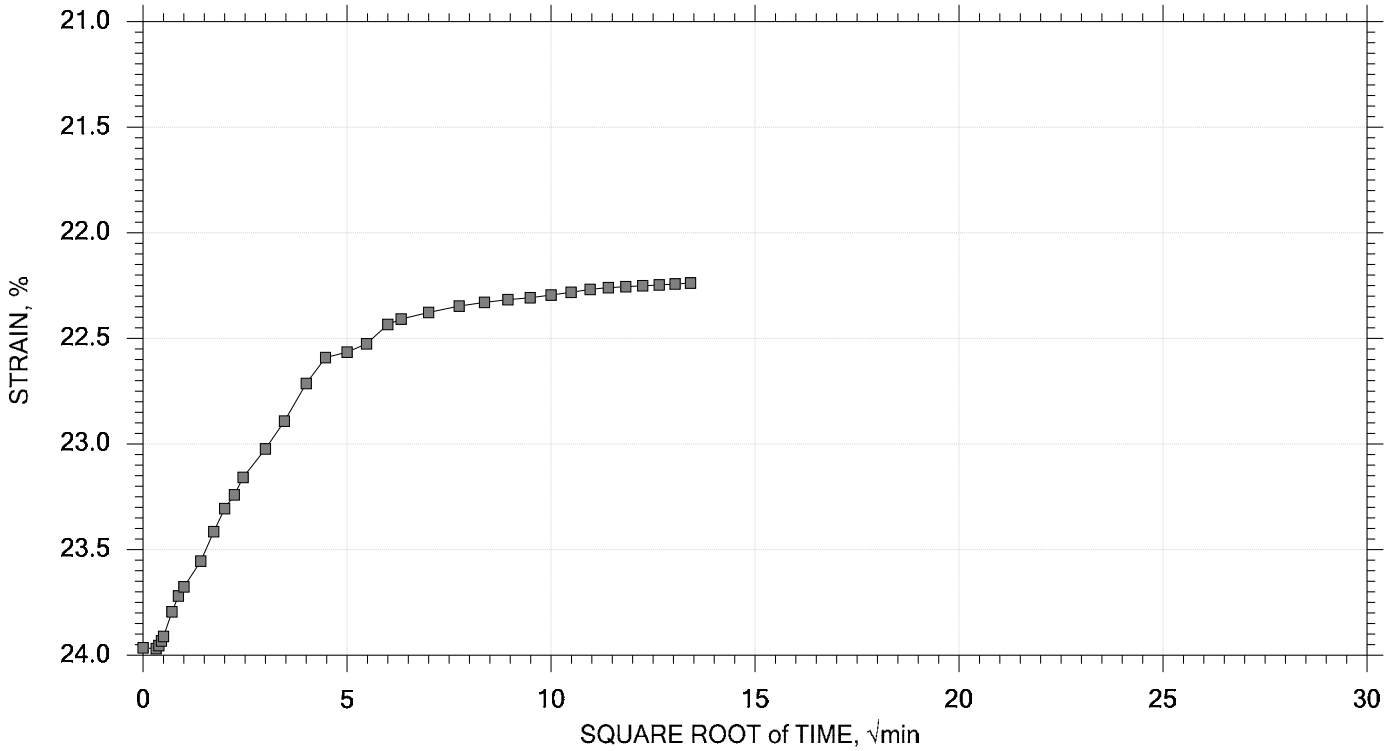
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 19 of 21

Stress: 0.5 tsf





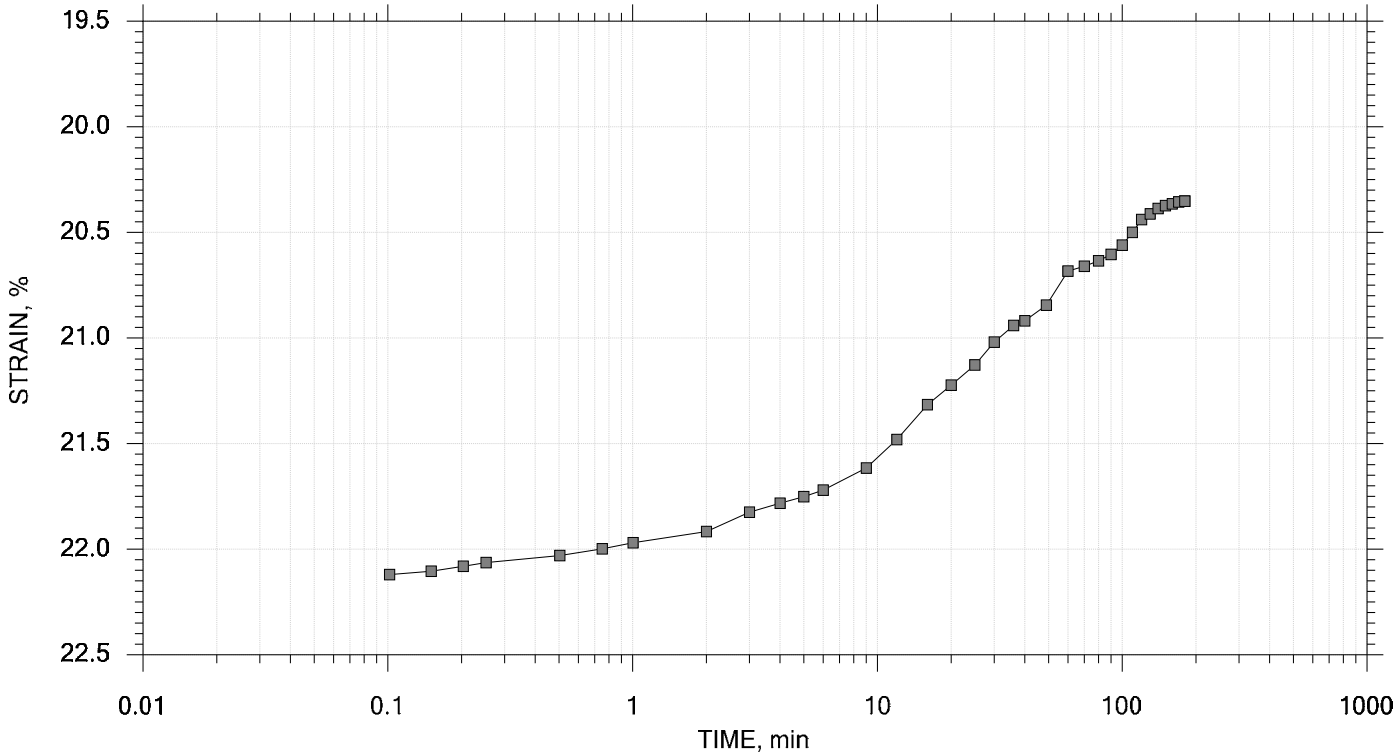
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

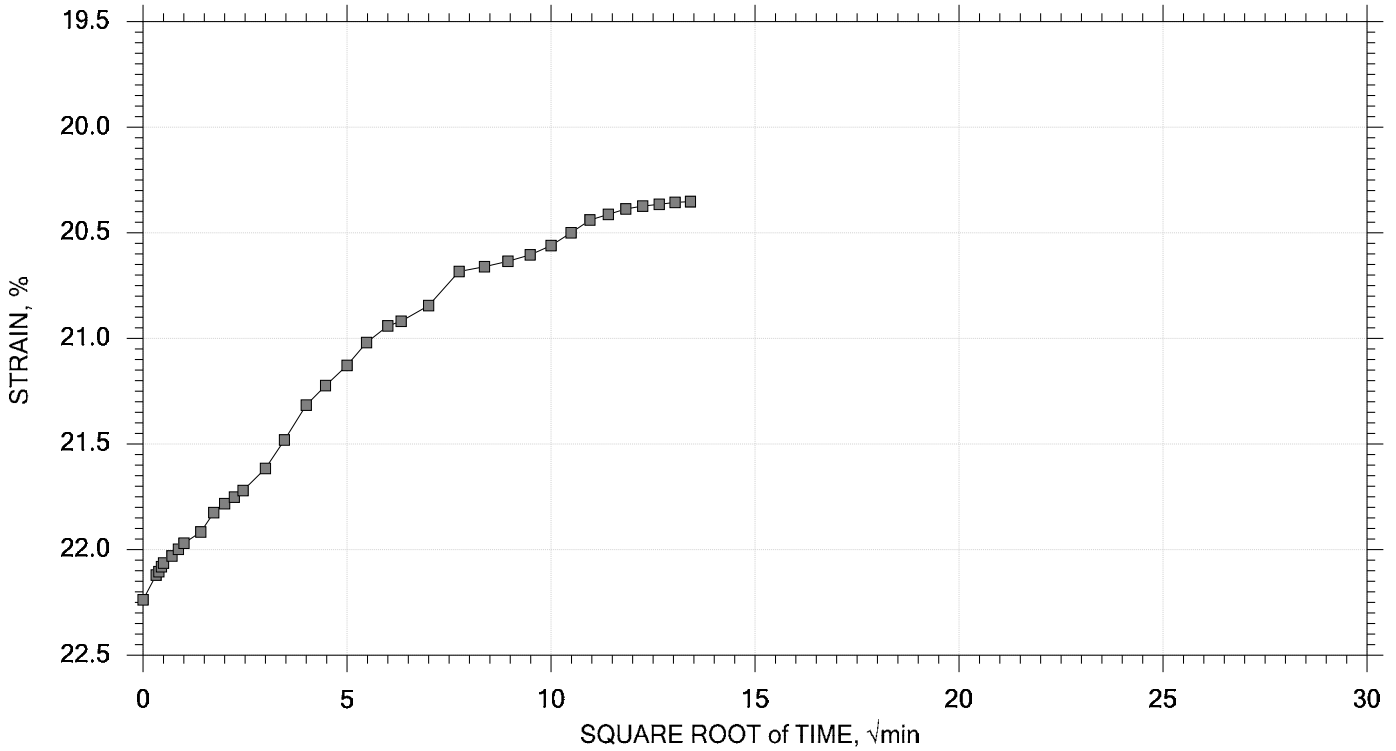
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 20 of 21

Stress: 0.125 tsf





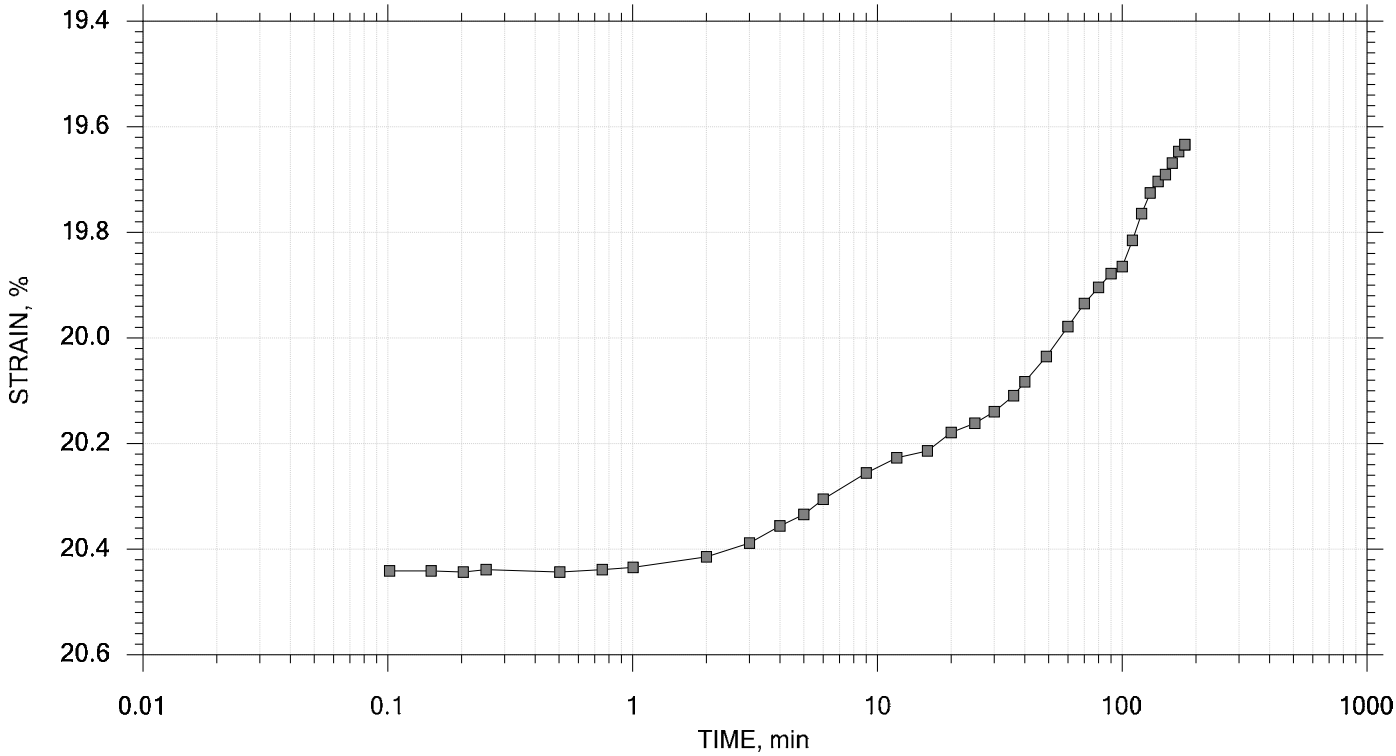
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

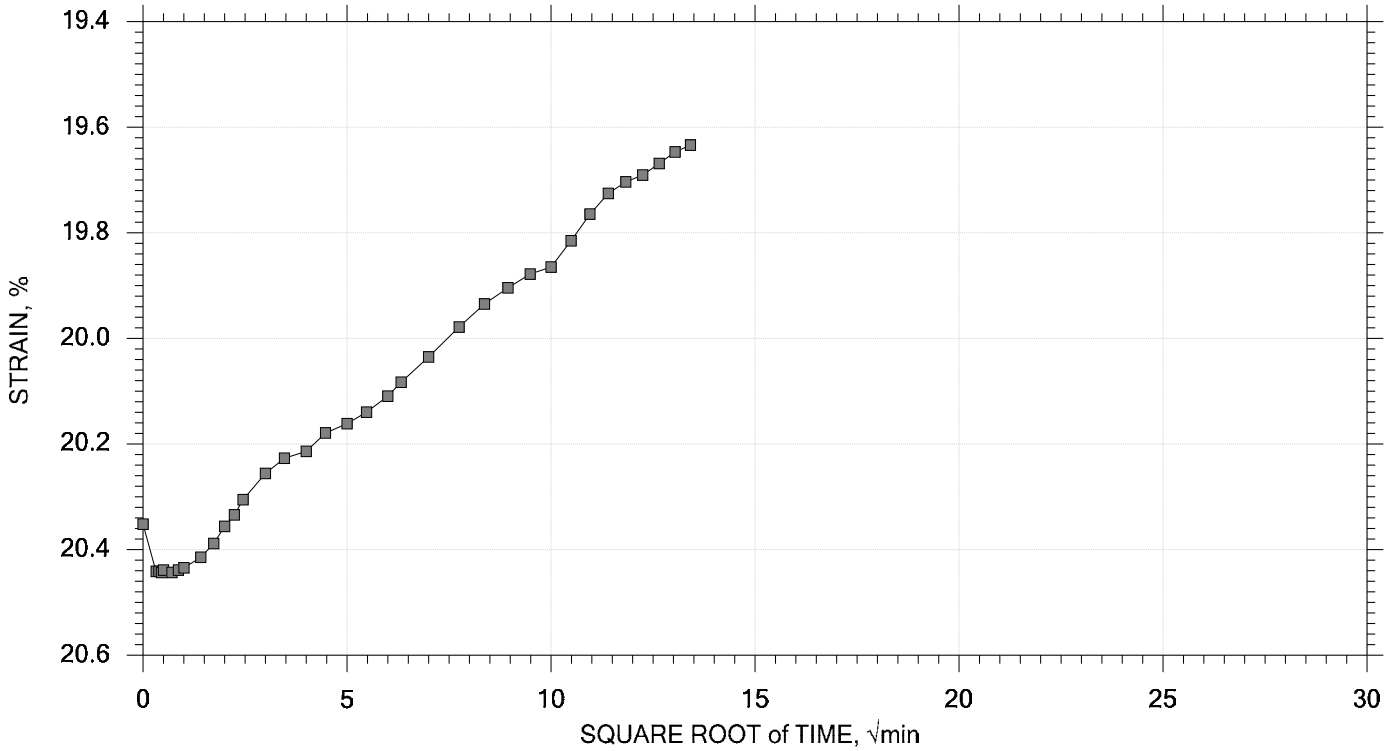
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 21 of 21

Stress: 0.0625 tsf

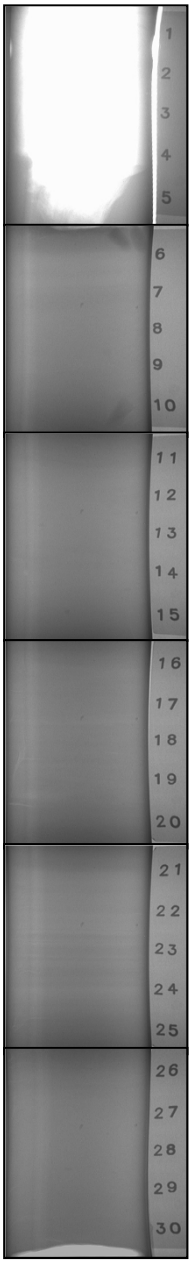




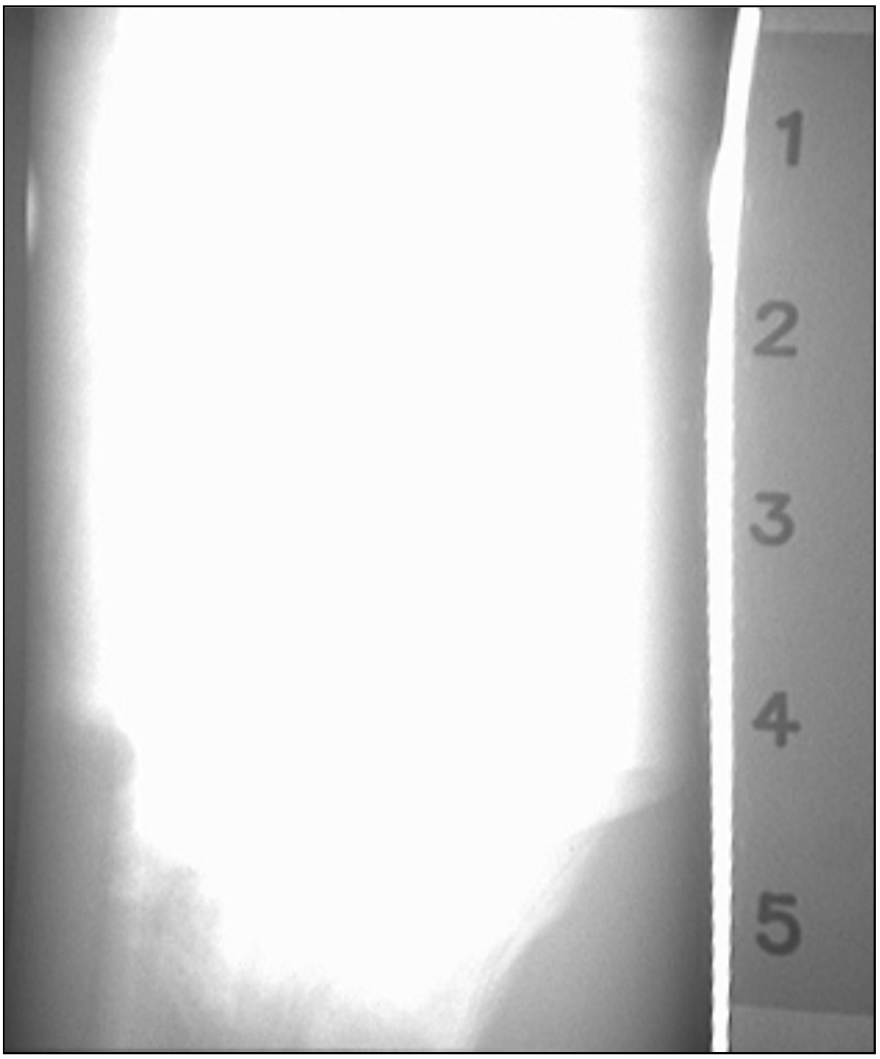
GeoTesting EXPRESS	Project: Gorham, ME	Location: Gorham, ME	Project No.: GTX-305885
	Boring No.: HB-GBB-203	Tested By: md	Checked By: jdt
	Sample No.: U1	Test Date: 01/25/17	Test No.: IP-1
	Depth: 25-27 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System Y, Swell Pressure = 0.0655 tsf		

Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-201
Sample ID:	U2
Depth:	35-37 ft

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

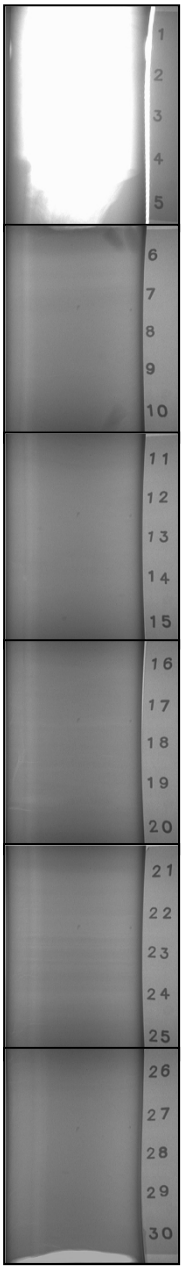
SECTION 1



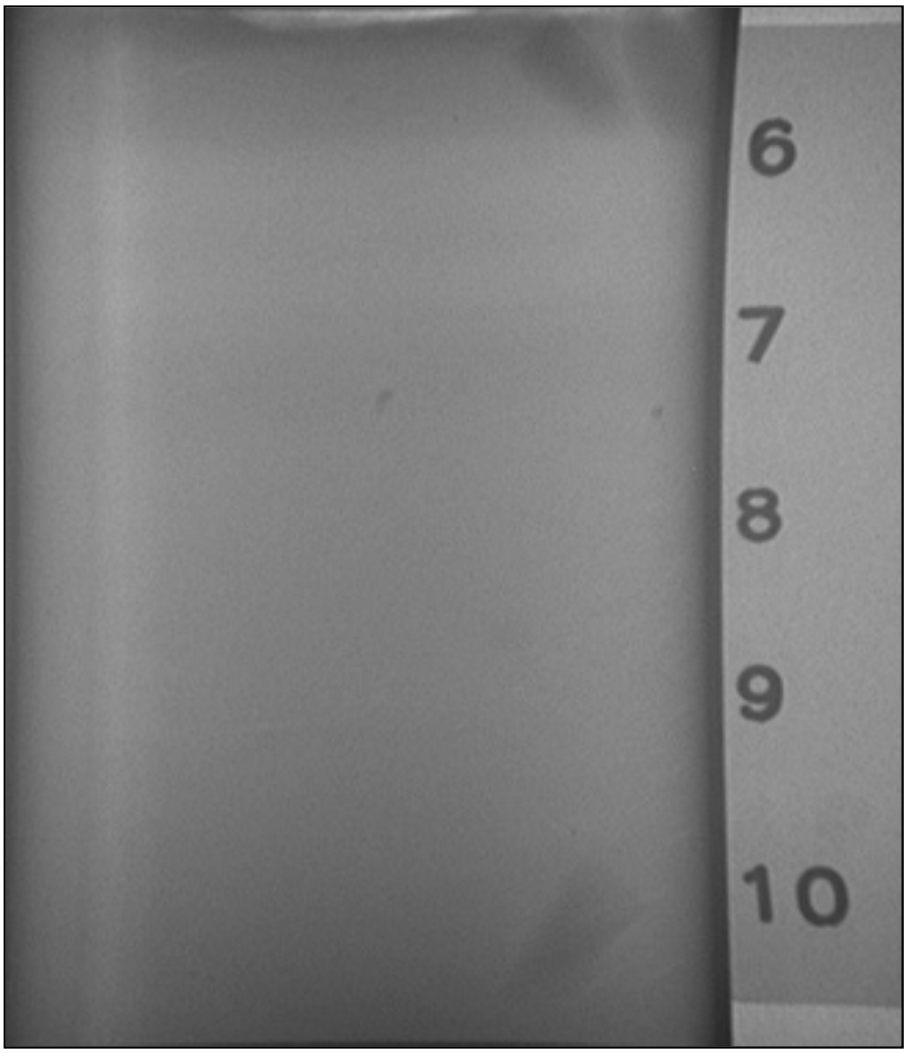
Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-201
Sample ID:	U2
Depth:	35-37 ft

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube



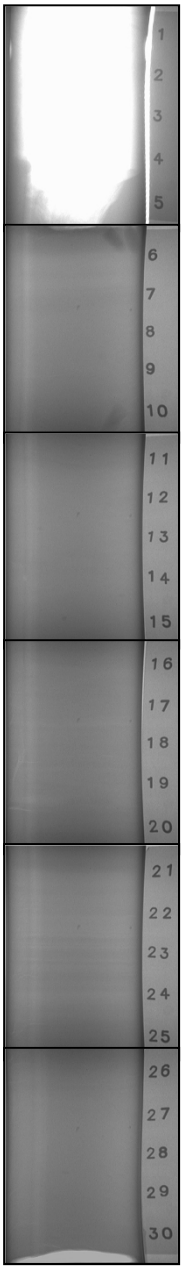
SECTION 2



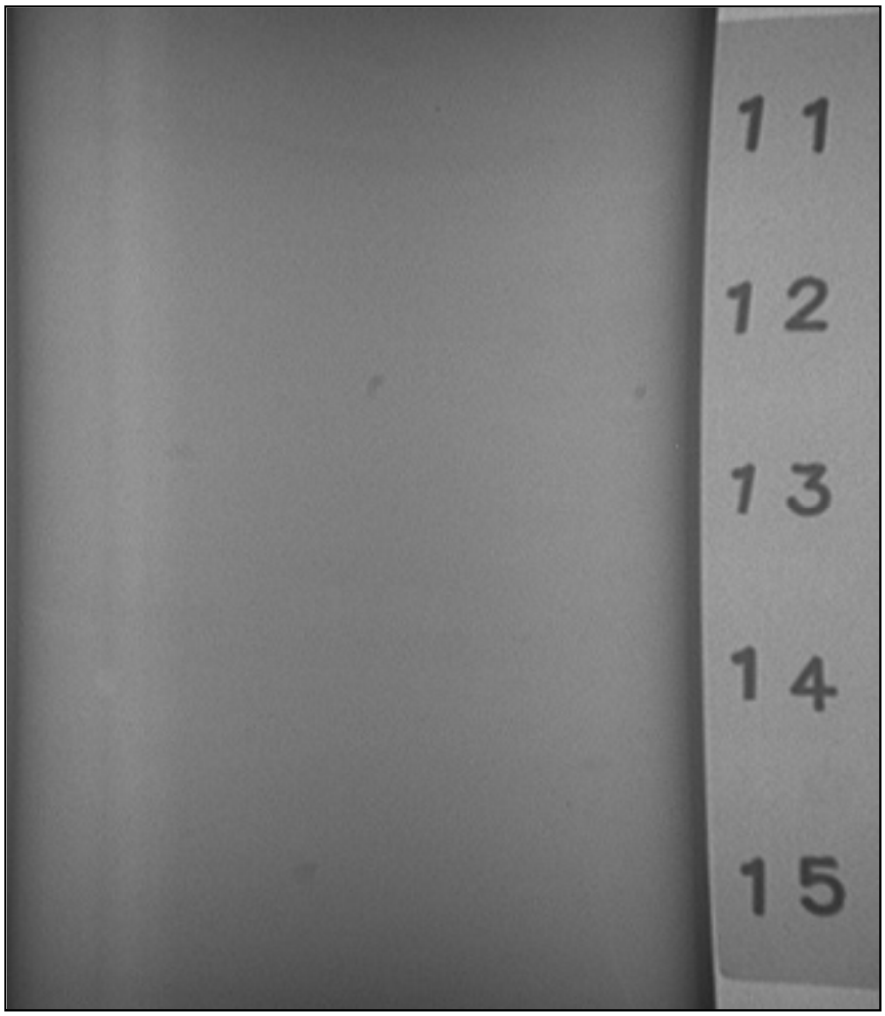
Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-201
Sample ID:	U2
Depth:	35-37 ft

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

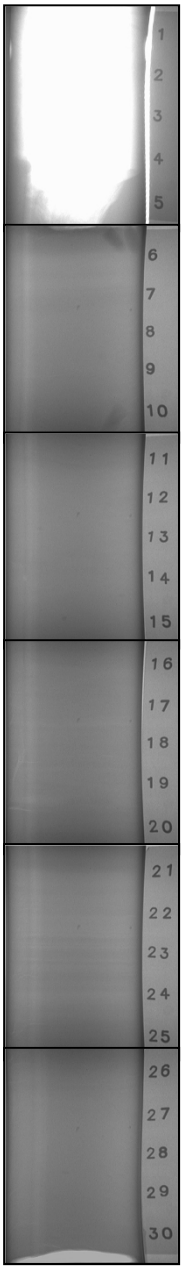


SECTION 3

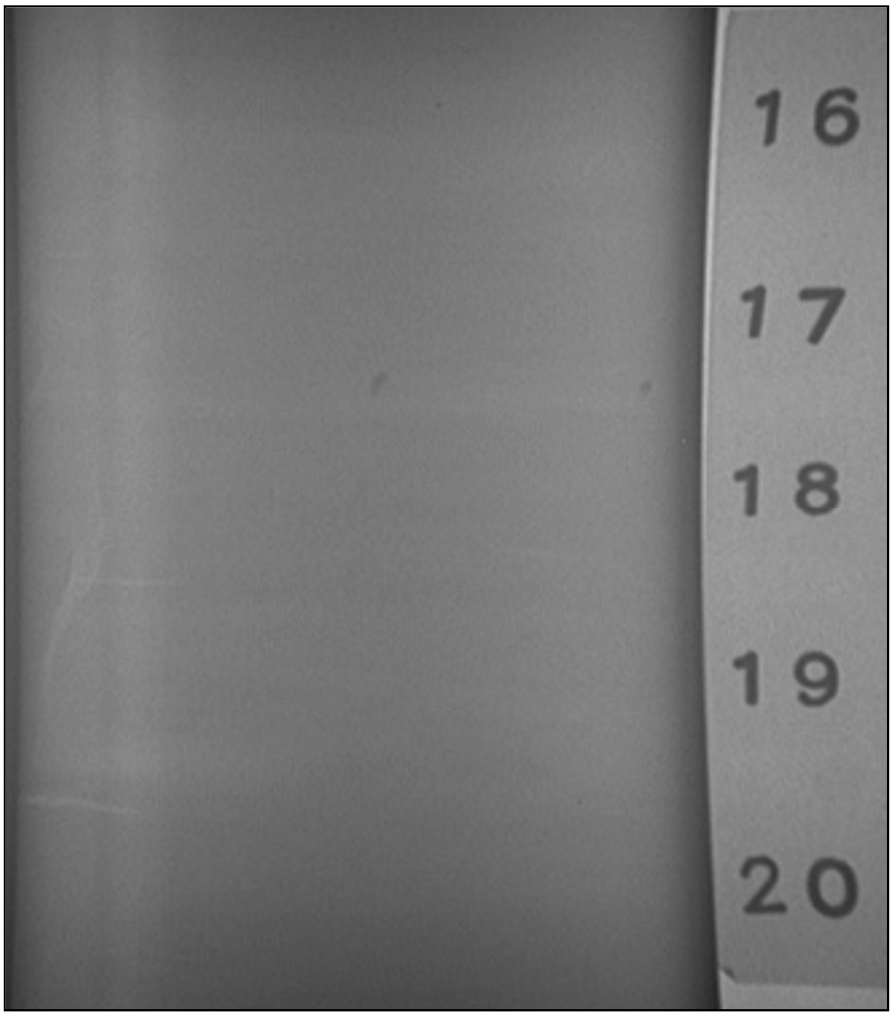


Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-201
Sample ID:	U2
Depth:	35-37 ft

X-Ray of Soil Sample by ASTM D4452

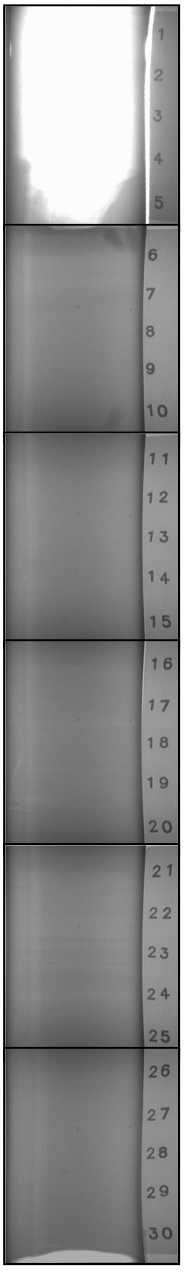
Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

SECTION 4

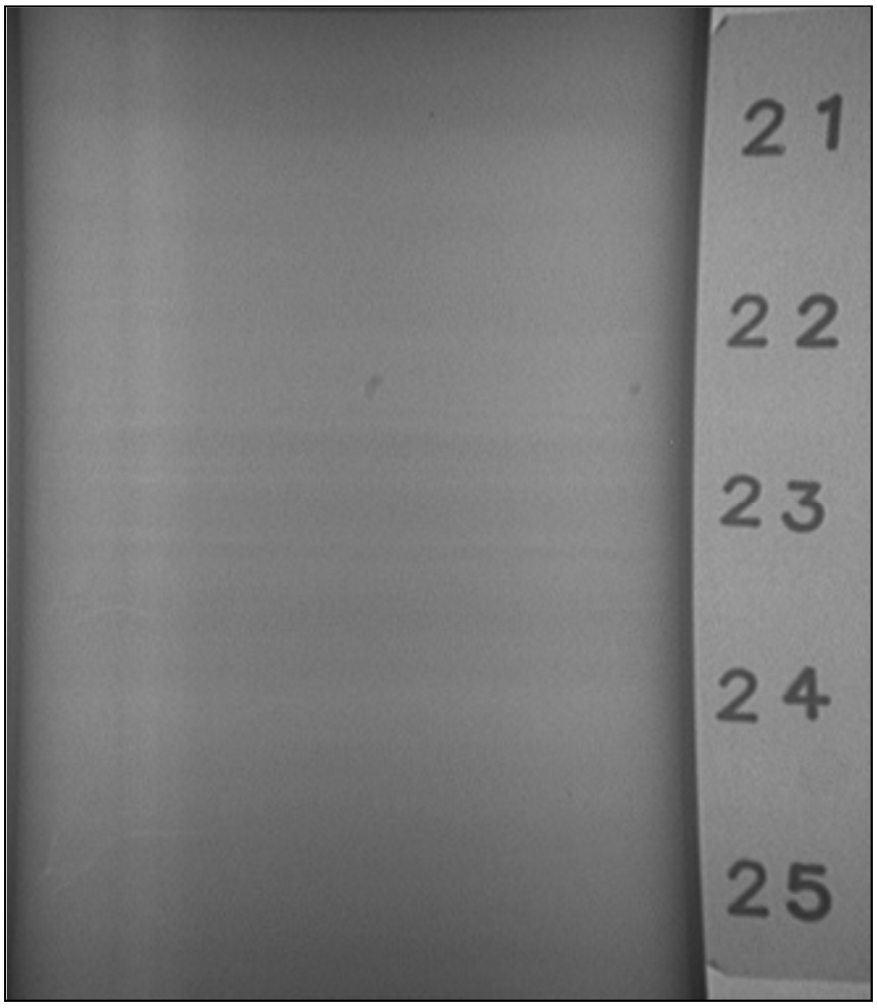


Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-201
Sample ID:	U2
Depth:	35-37 ft

X-Ray of Soil Sample by ASTM D4452

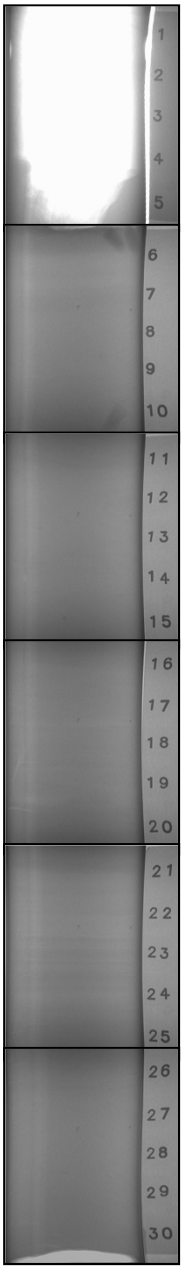
Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

SECTION 5



Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-201
Sample ID:	U2
Depth:	35-37 ft

X-Ray of Soil Sample by ASTM D4452

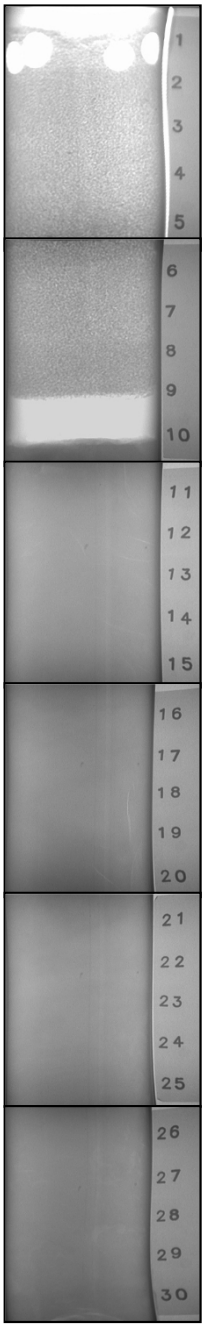
Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

SECTION 6

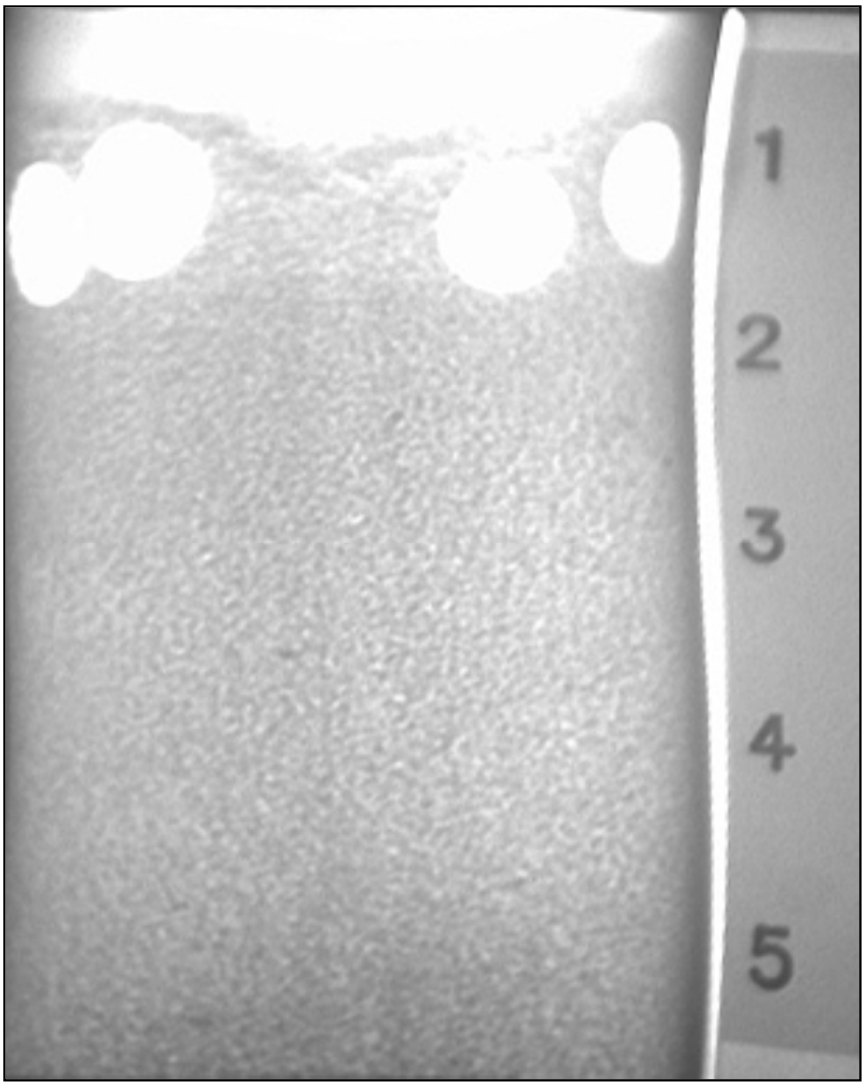


Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-202
Sample ID:	U1
Depth:	20-22 ft

X-Ray of Soil Sample by ASTM D4452

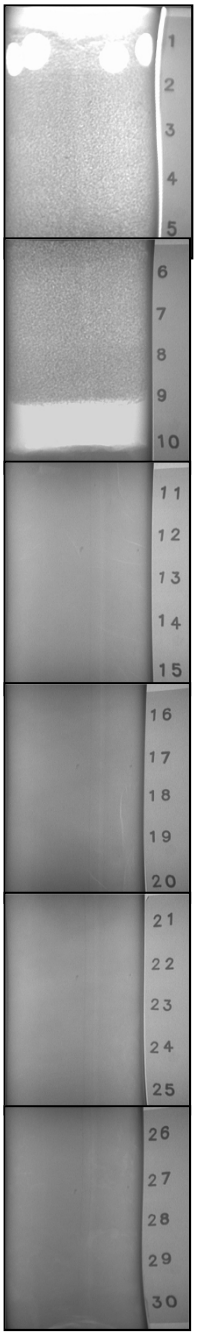
Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

SECTION 1

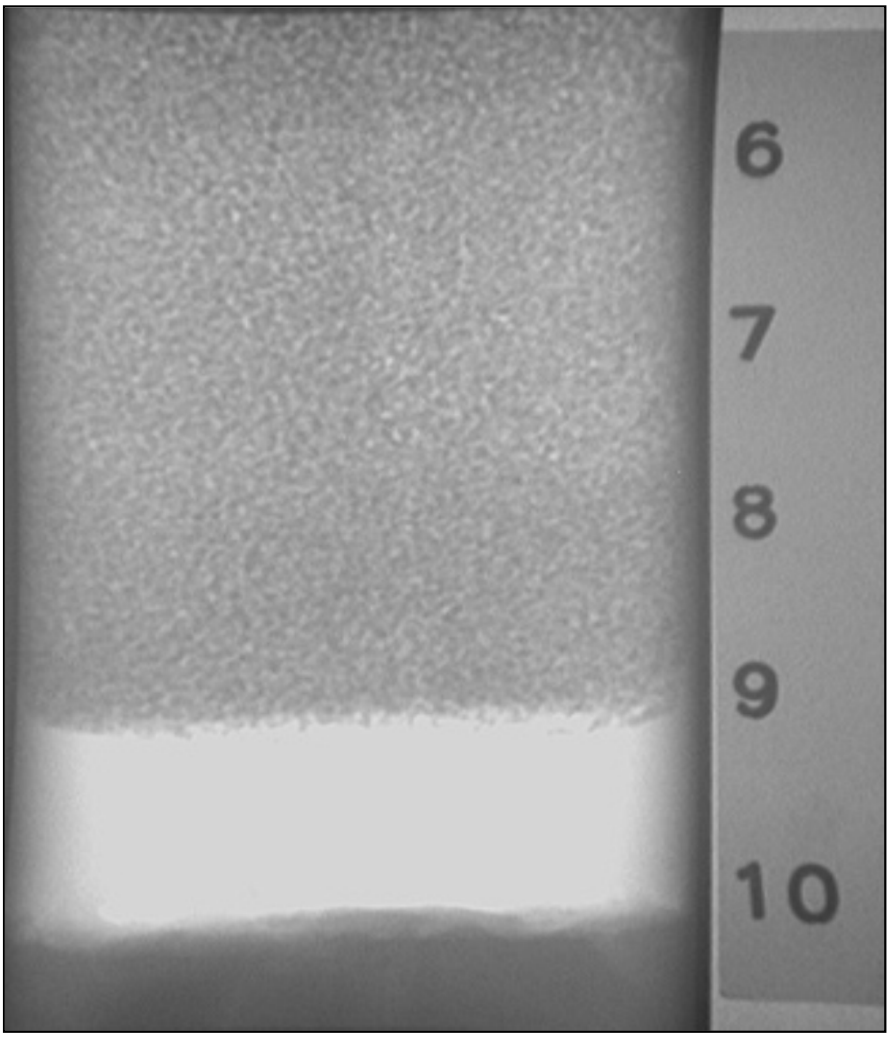


Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-202
Sample ID:	U1
Depth:	20-22 ft

X-Ray of Soil Sample by ASTM D4452

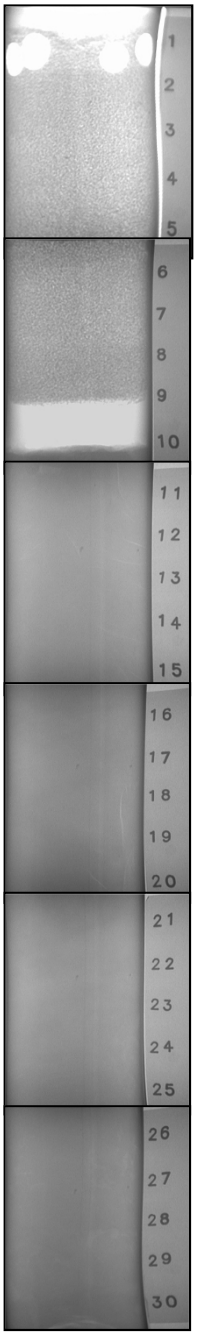
Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

SECTION 2

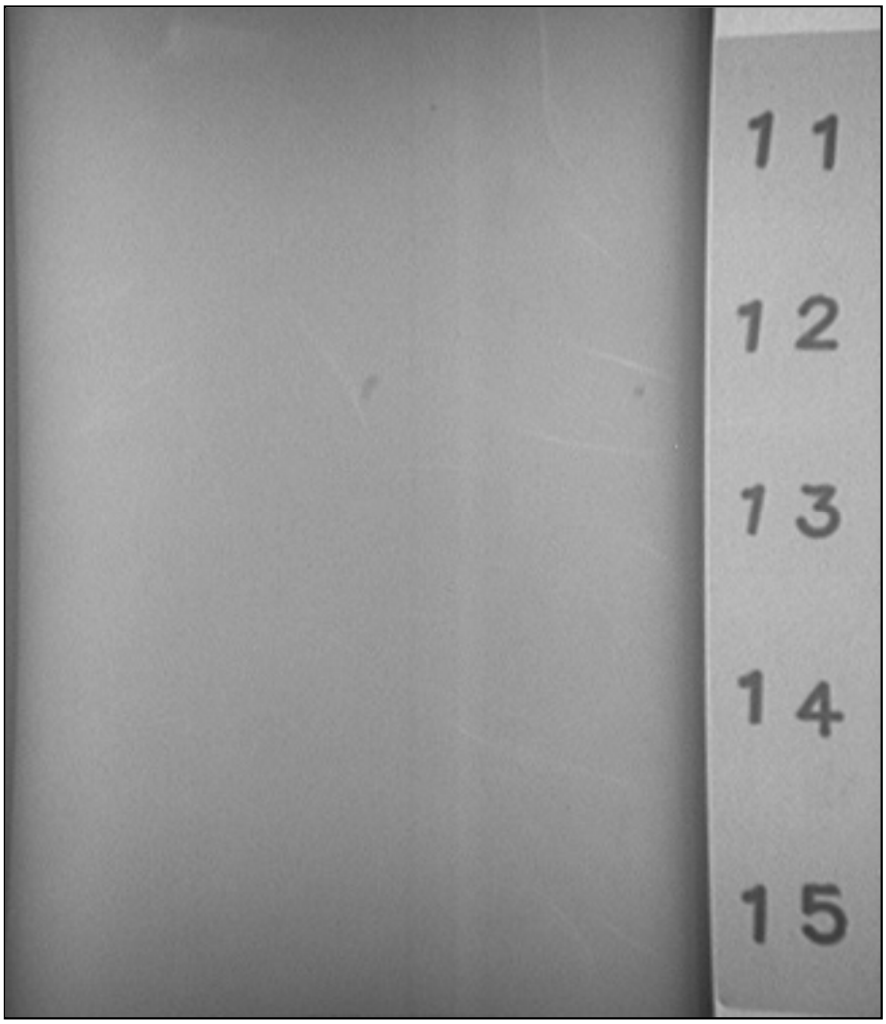


Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-202
Sample ID:	U1
Depth:	20-22 ft

X-Ray of Soil Sample by ASTM D4452

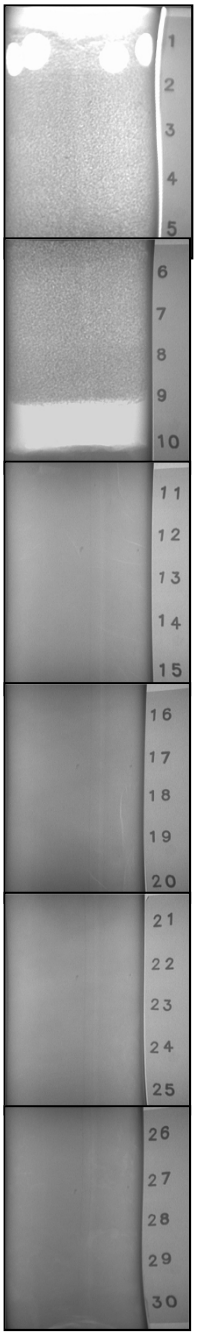
Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

SECTION 3

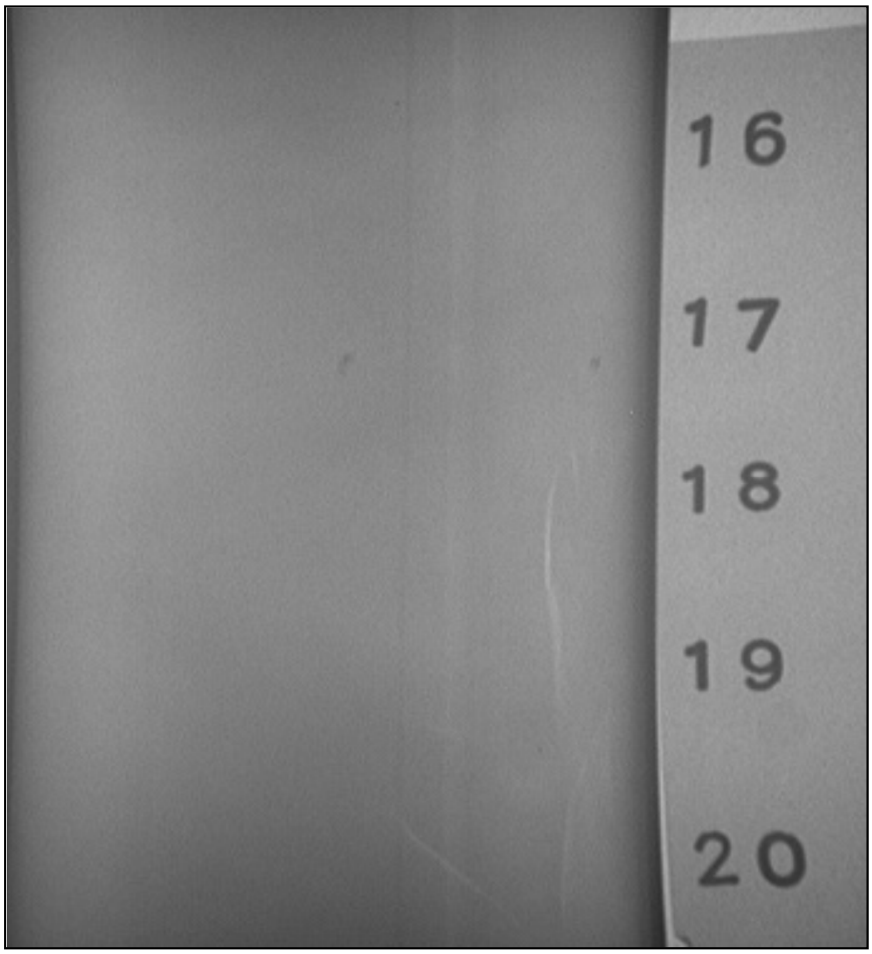


Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-202
Sample ID:	U1
Depth:	20-22 ft

X-Ray of Soil Sample by ASTM D4452

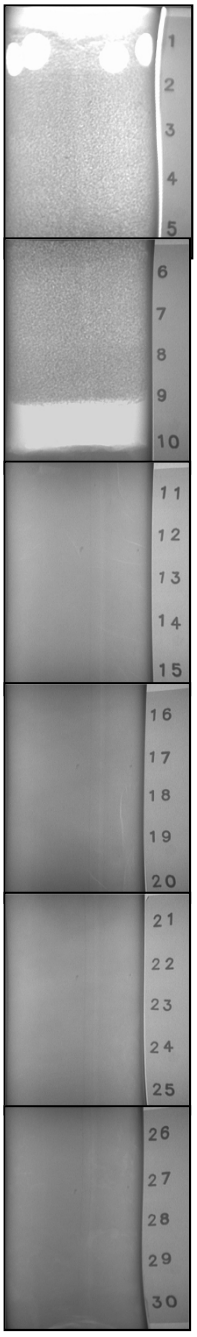
Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

SECTION 4



Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-202
Sample ID:	U1
Depth:	20-22 ft

X-Ray of Soil Sample by ASTM D4452

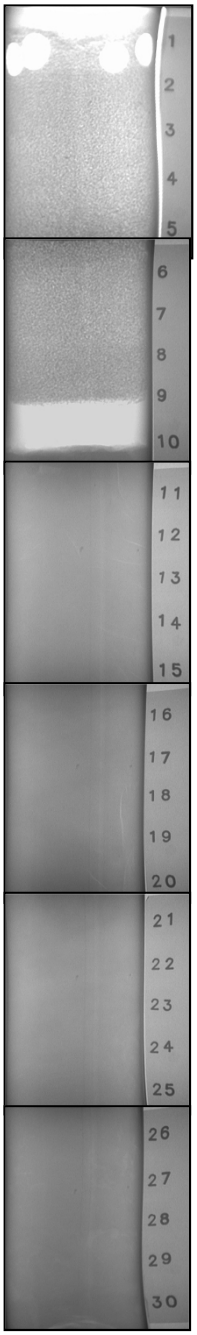
Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

SECTION 5

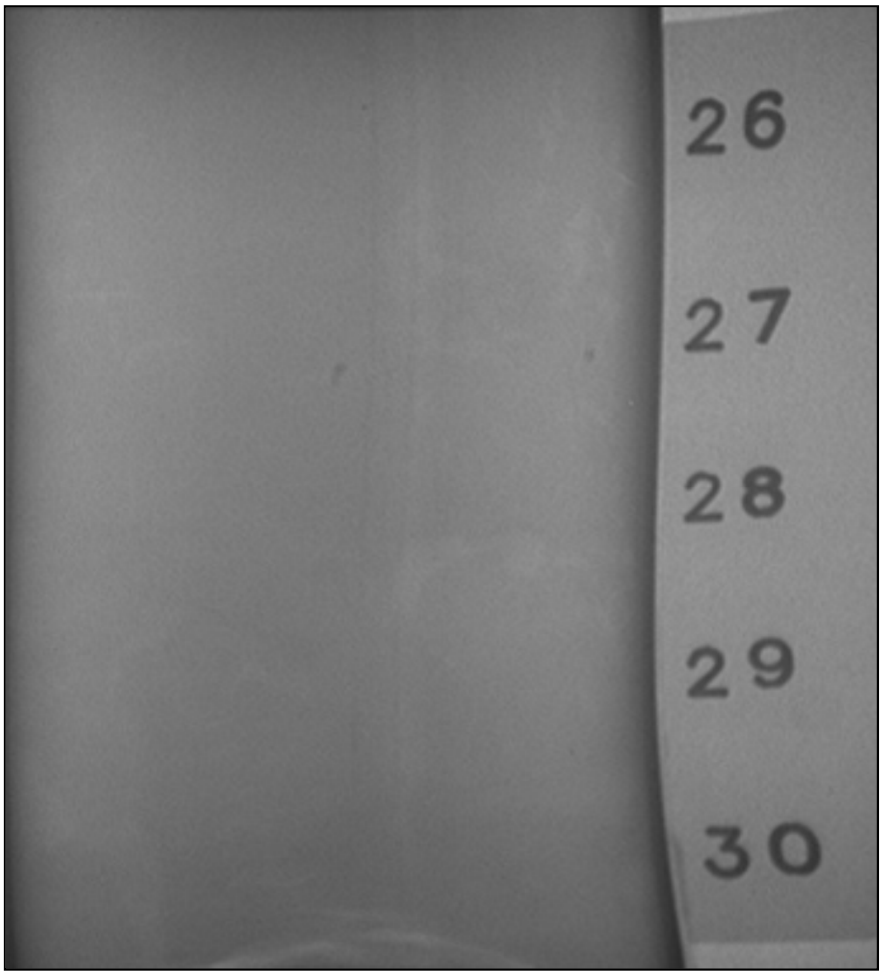


Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-202
Sample ID:	U1
Depth:	20-22 ft

X-Ray of Soil Sample by ASTM D4452

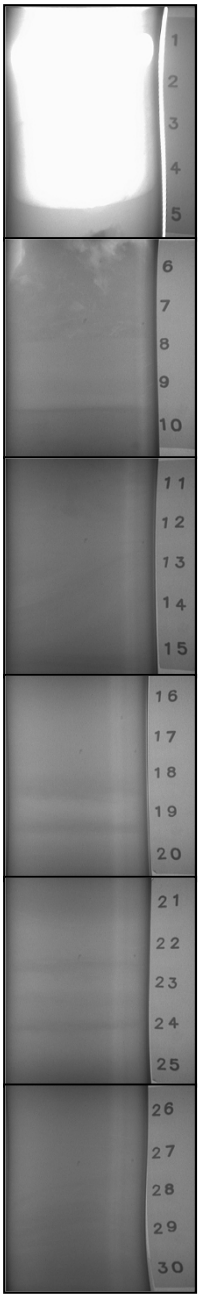
Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

SECTION 6

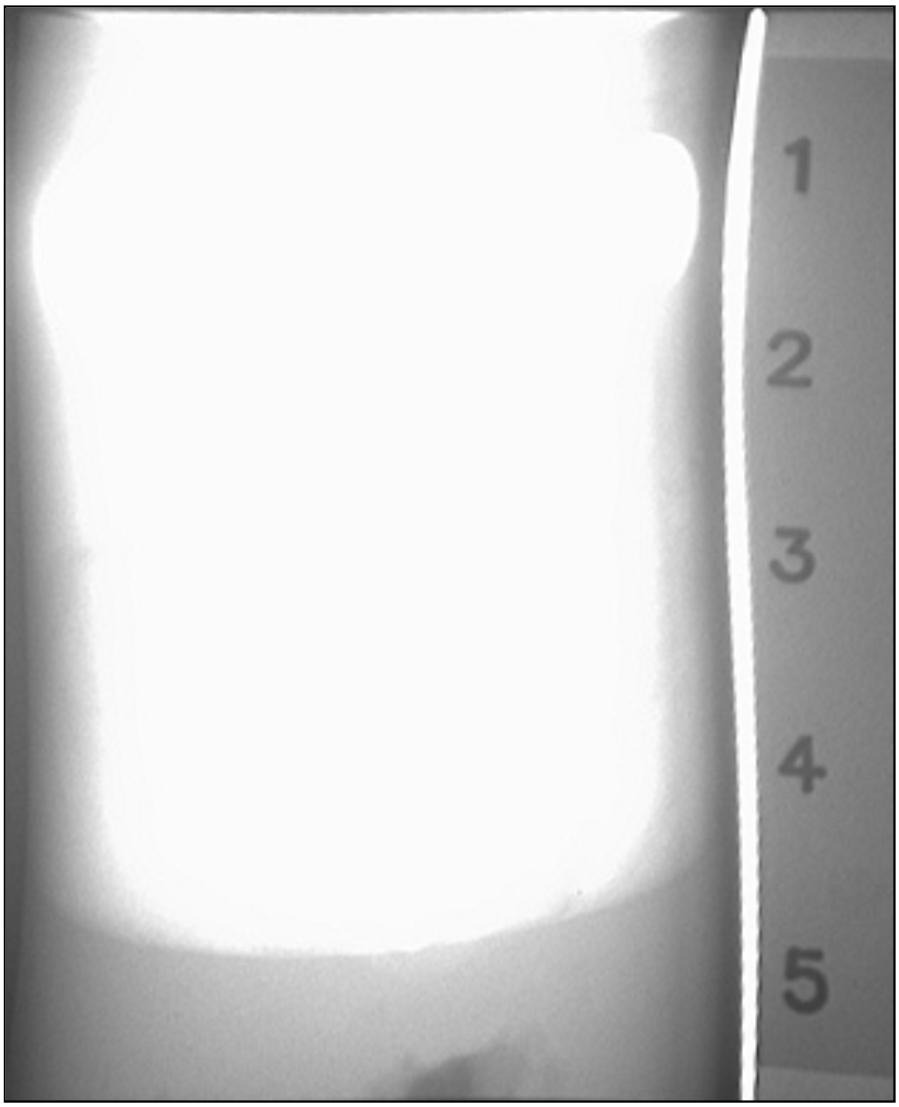


Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-203
Sample ID:	U1
Depth:	25-27 ft

X-Ray of Soil Sample by ASTM D4452

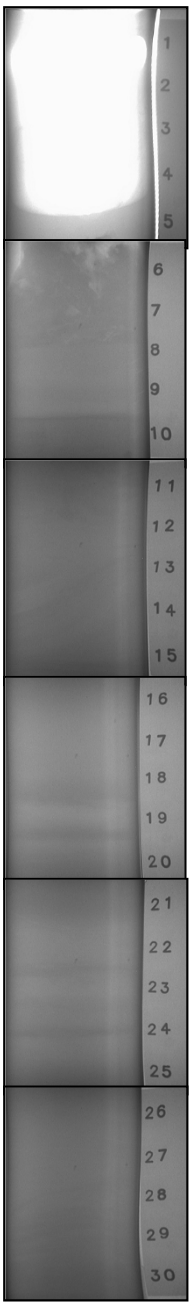
Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

SECTION 1

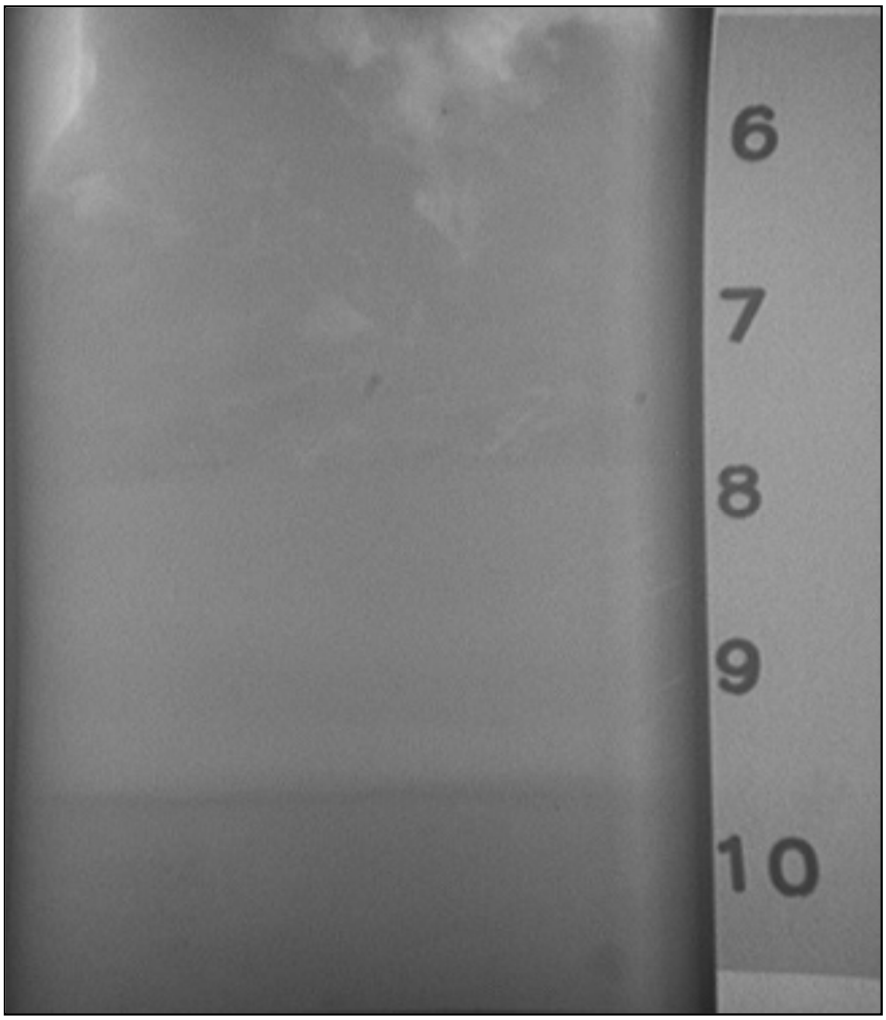


Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-203
Sample ID:	U1
Depth:	25-27 ft

X-Ray of Soil Sample by ASTM D4452

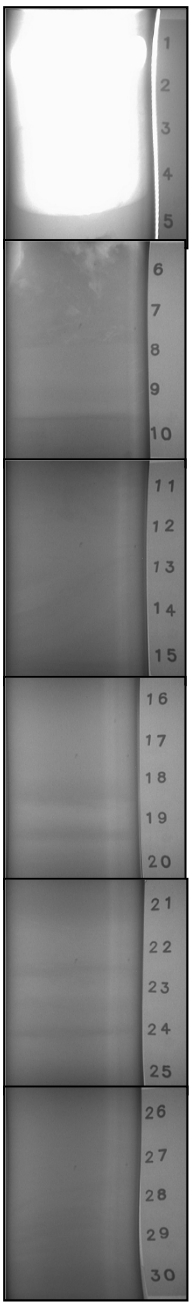
Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

SECTION 2

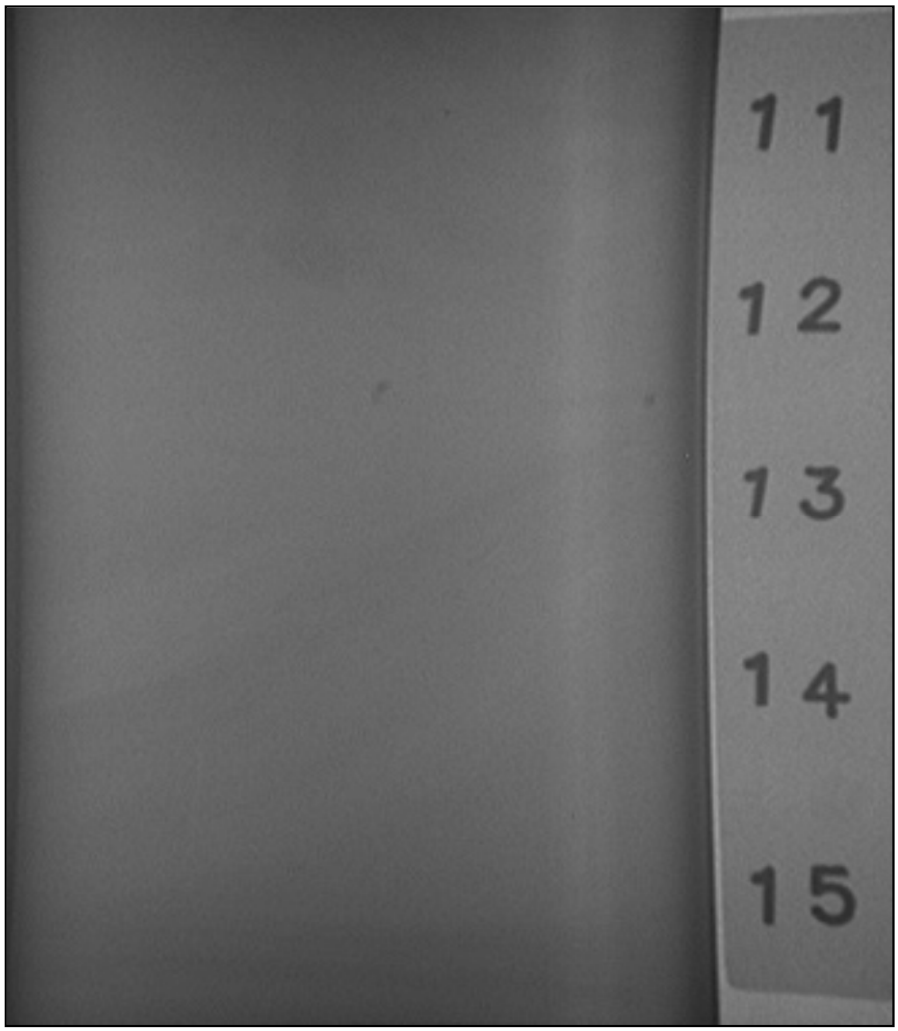


Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-203
Sample ID:	U1
Depth:	25-27 ft

X-Ray of Soil Sample by ASTM D4452

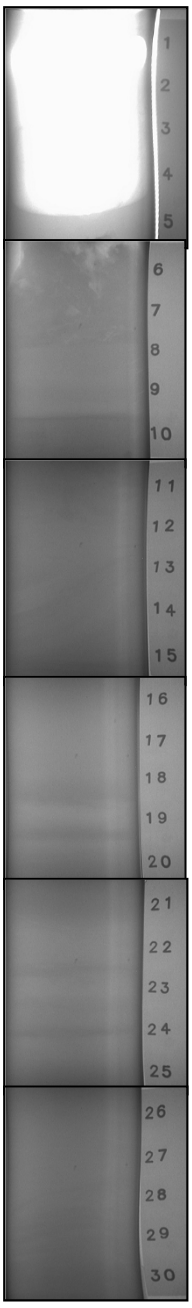
Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

SECTION 3

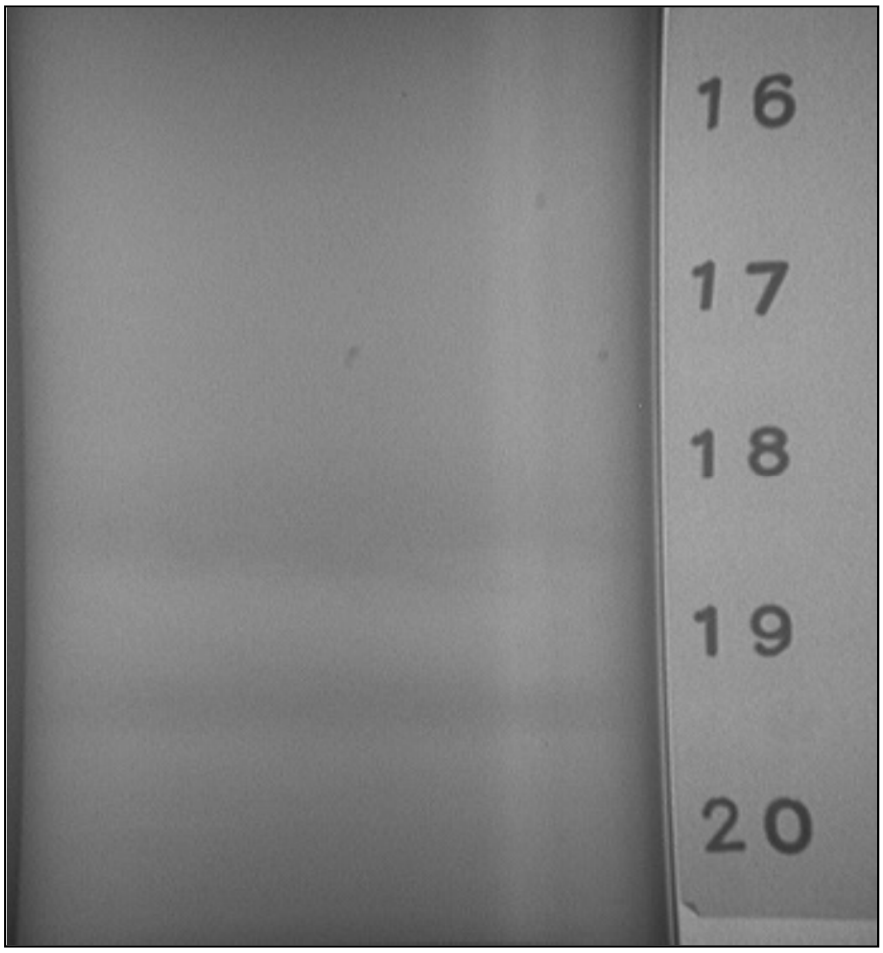


Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-203
Sample ID:	U1
Depth:	25-27 ft

X-Ray of Soil Sample by ASTM D4452

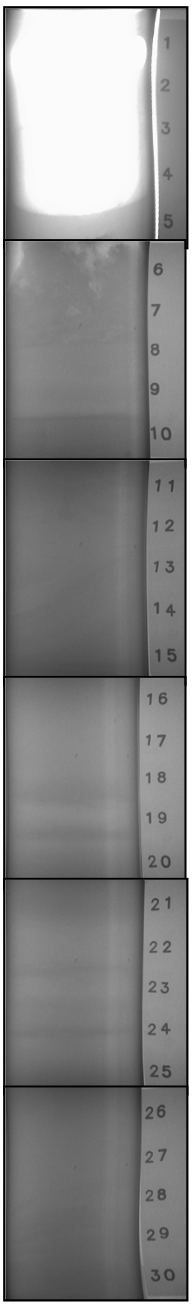
Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

SECTION 4

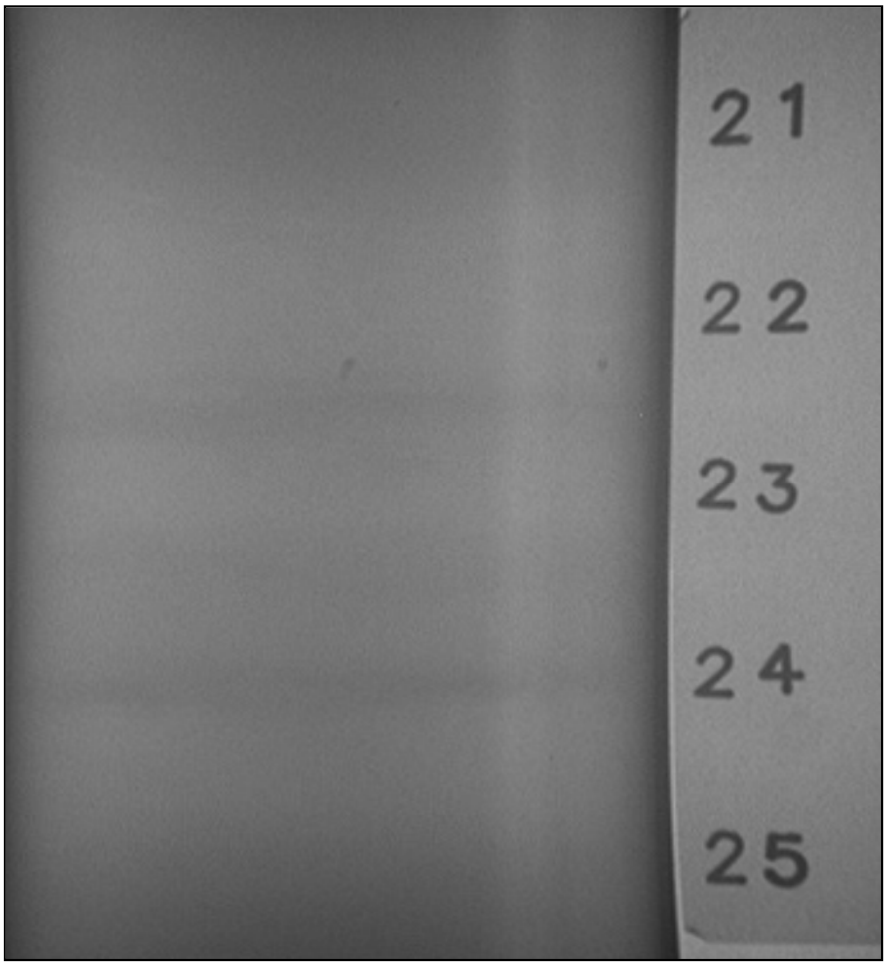


Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-203
Sample ID:	U1
Depth:	25-27 ft

X-Ray of Soil Sample by ASTM D4452

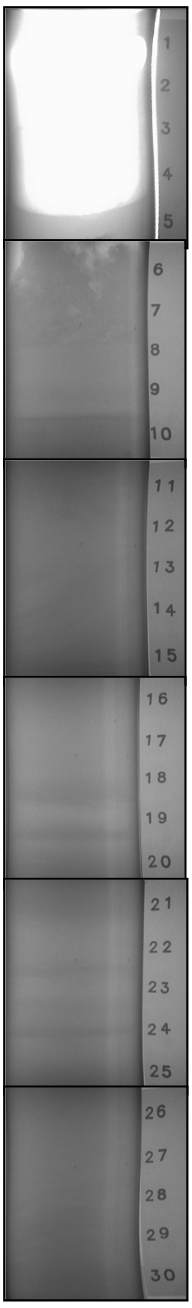
Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

SECTION 5

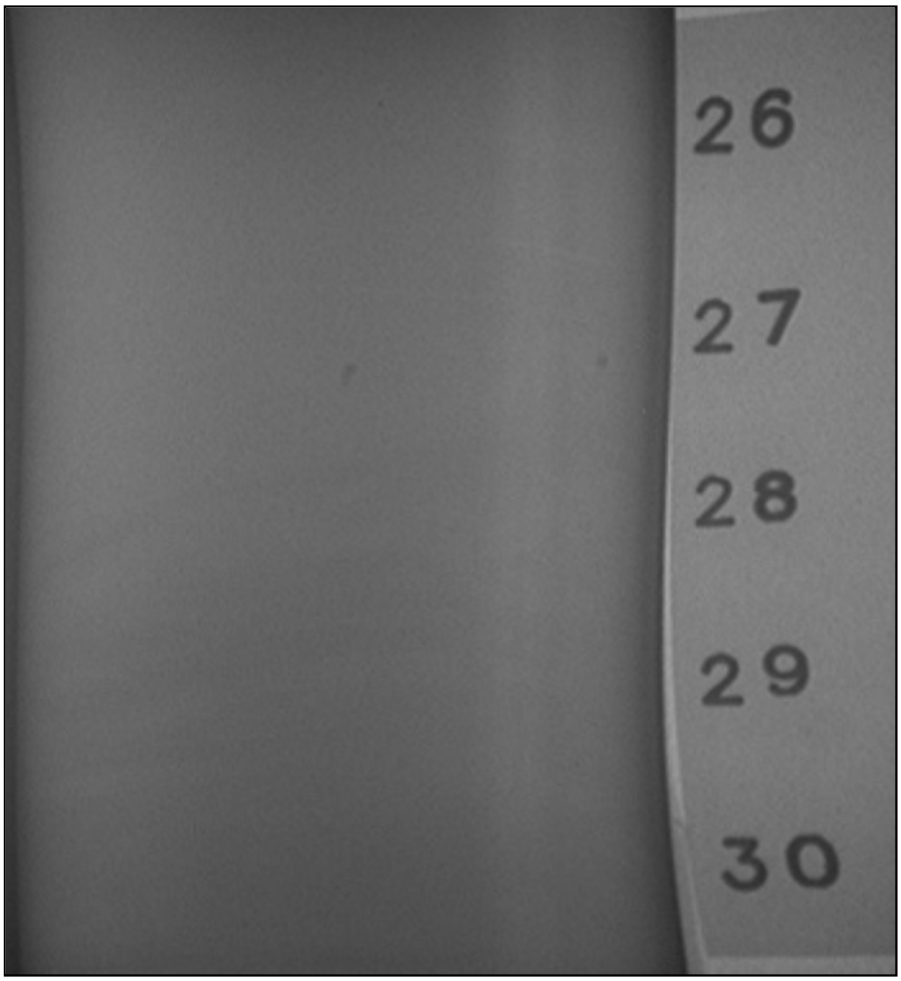


Client:	Golder Associates
Project Name:	Gorham, ME
Project Location:	---
GTX #:	305885
Test Date:	01/19/17
Tested By:	md
Checked By:	emm
Boring ID:	HB-GBB-203
Sample ID:	U1
Depth:	25-27 ft

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube

SECTION 6



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.

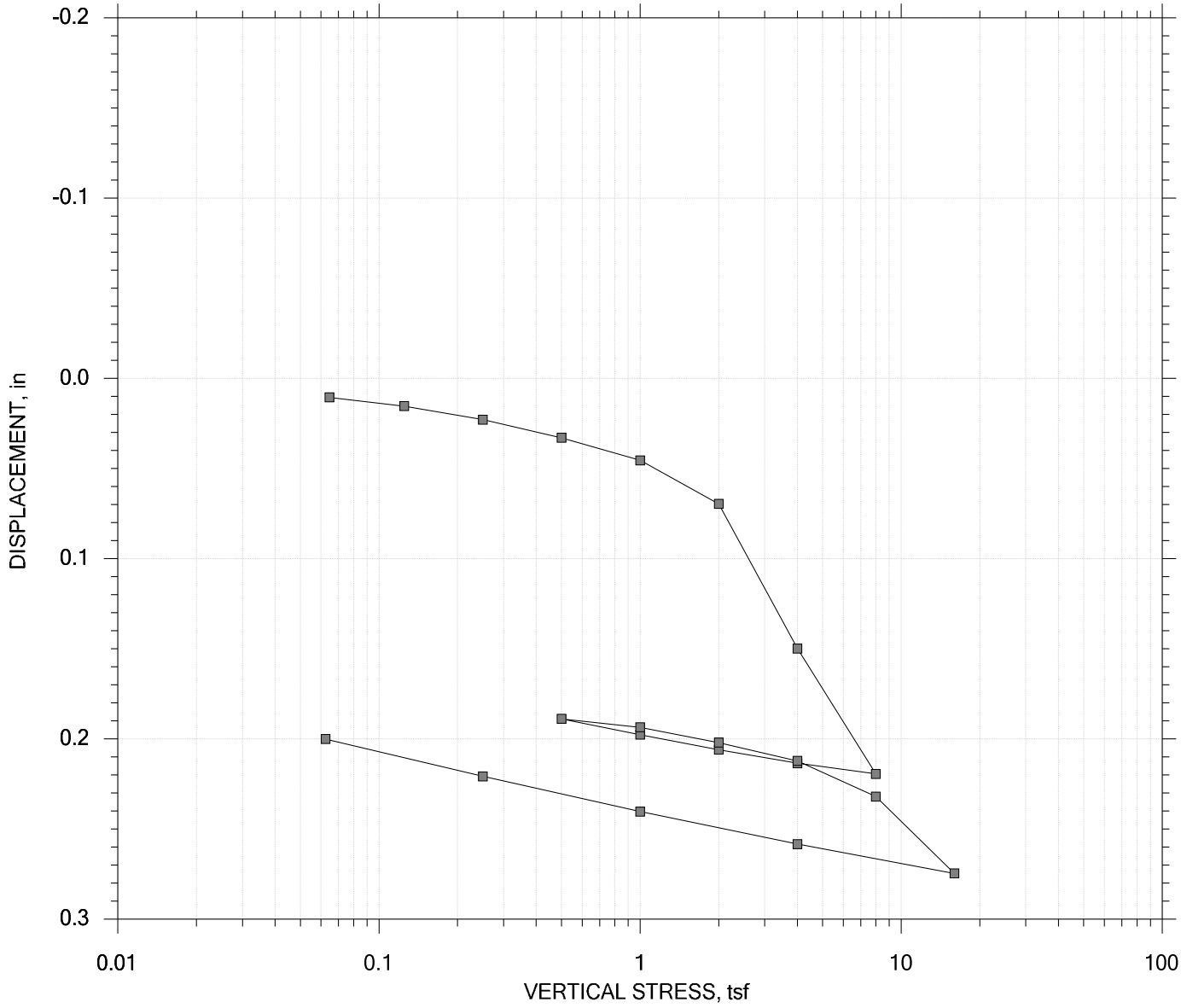
GTX's liability will be limited to correcting or repeating a test which fails our warranty. GTX's liability for damages to the Purchaser of testing services for any cause whatsoever shall be limited to the amount GTX received for the testing services. GTX will not be liable for any damages, or for any 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

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

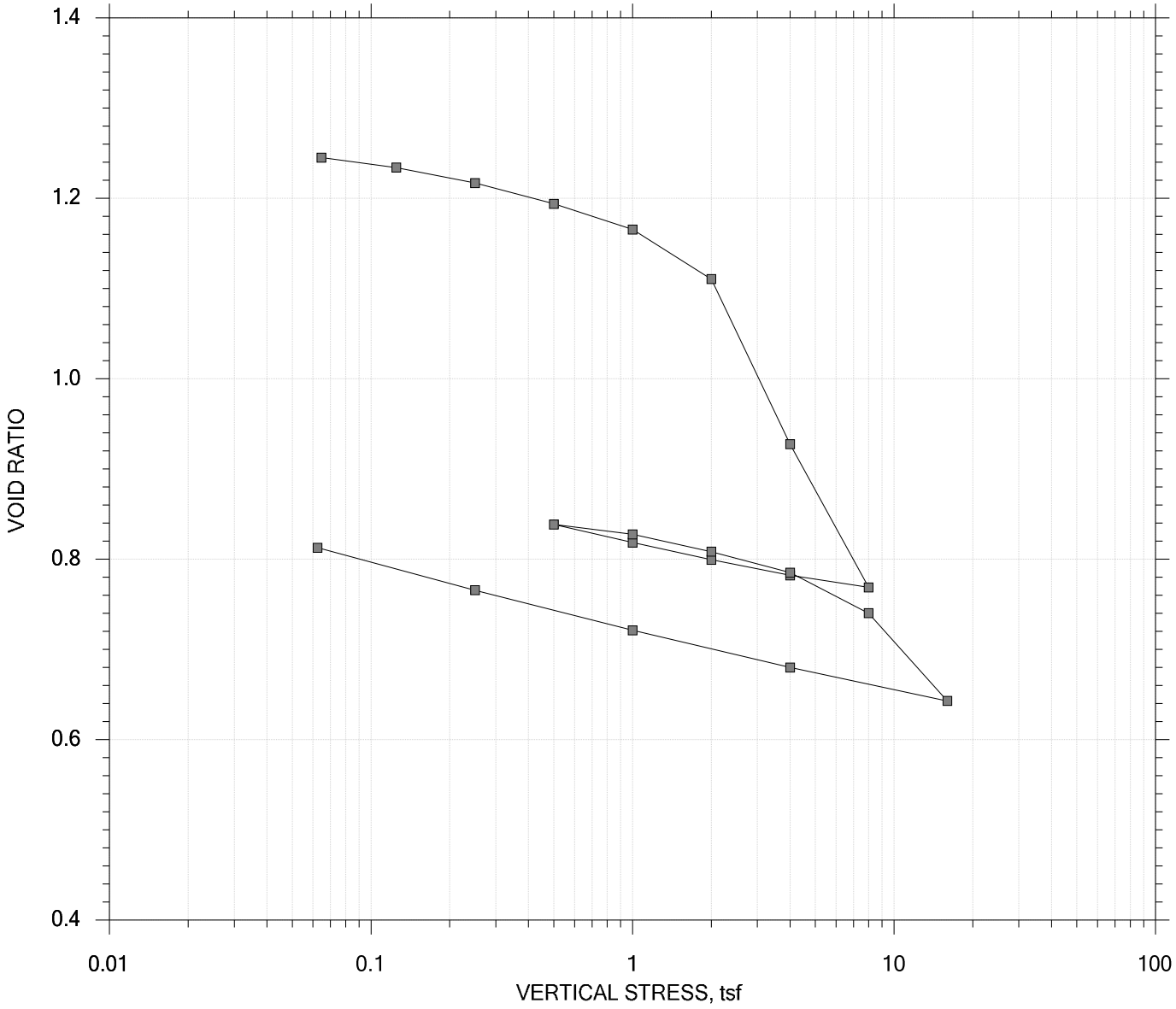


				Before Test	After Test
Current Vertical Effective Stress: 0 tsf			Water Content, %	45.80	31.41
Preconsolidation Stress: 0 tsf			Dry Unit Weight, pcf	76.209	92.473
Compression Ratio: 0			Saturation, %	99.97	100.00
Diameter: 2.495 in		Height: 0.995 in	Void Ratio	1.27	0.87
LL: 37	PL: 25	PI: 12	GS: 2.77		

	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

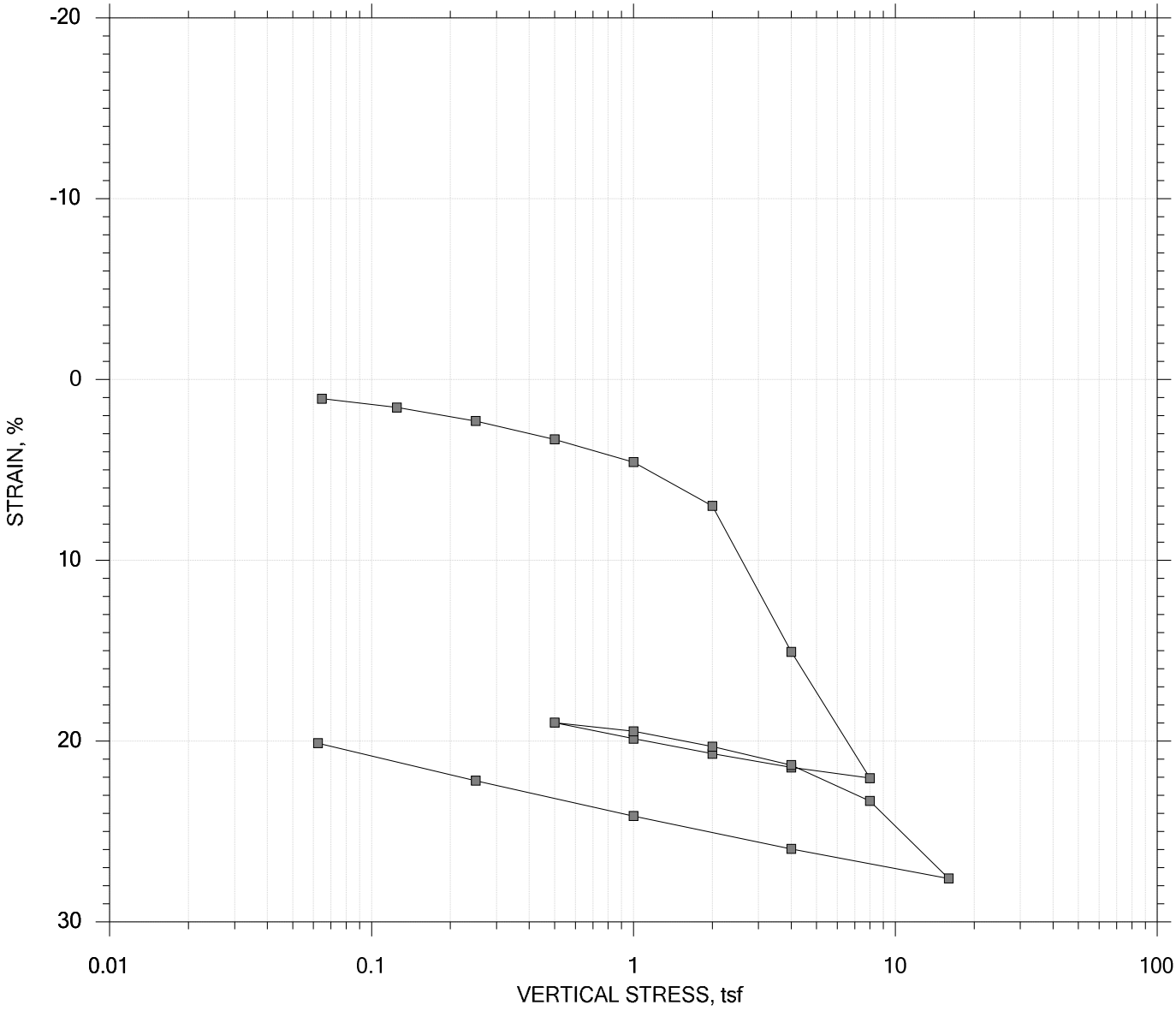


				Before Test	After Test
Current Vertical Effective Stress: 0 tsf				Water Content, %	45.80	31.41
Preconsolidation Stress: 0 tsf				Dry Unit Weight, pcf	76.209	92.473
Compression Ratio: 0				Saturation, %	99.97	100.00
Diameter: 2.495 in		Height: 0.995 in		Void Ratio	1.27	0.87
LL: 37	PL: 25	PI: 12	GS: 2.77			

	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

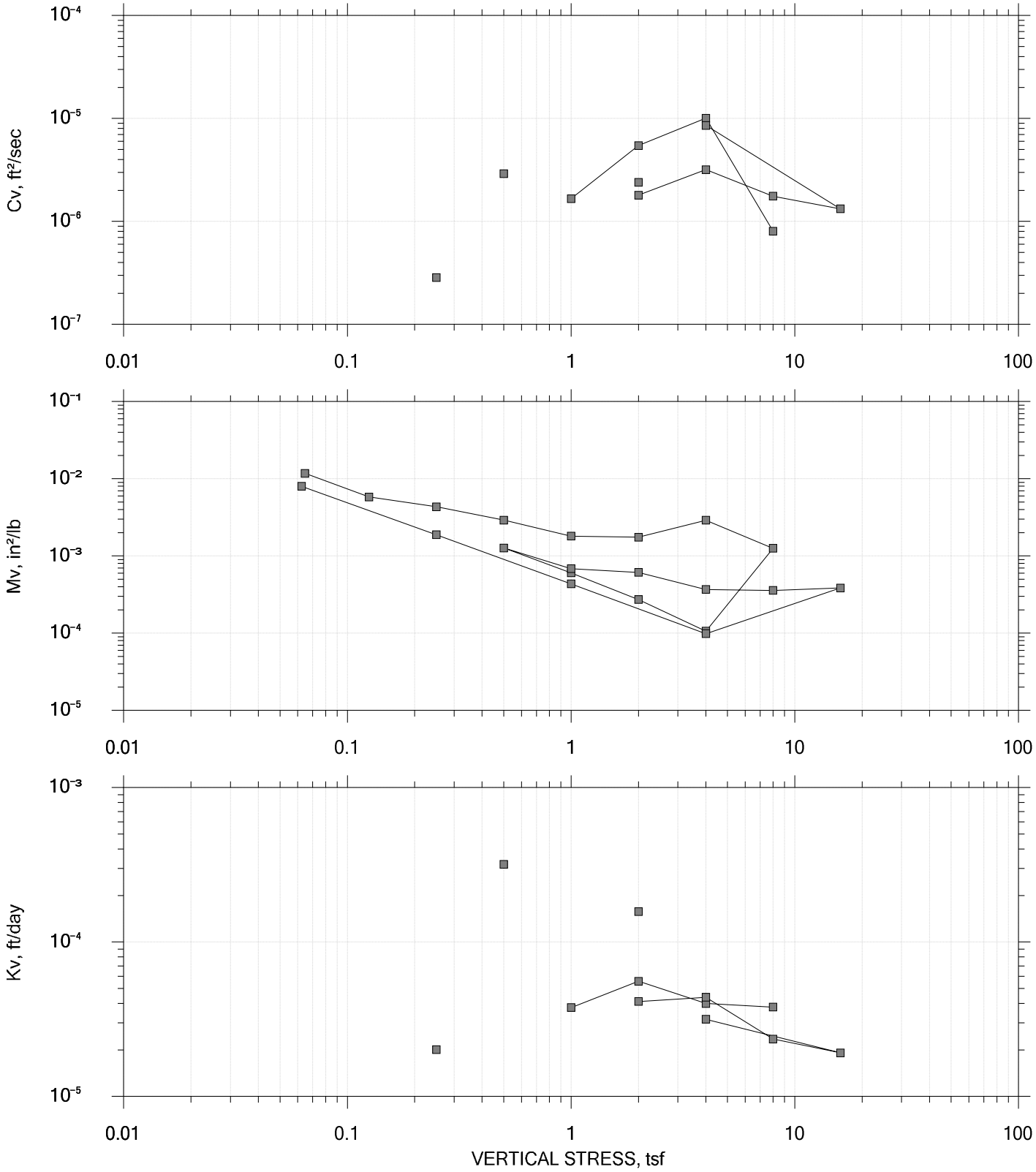


					Before Test	After Test
Current Vertical Effective Stress: 0 tsf				Water Content, %	45.80	31.41
Preconsolidation Stress: 0 tsf				Dry Unit Weight, pcf	76.209	92.473
Compression Ratio: 0				Saturation, %	99.97	100.00
Diameter: 2.495 in		Height: 0.995 in		Void Ratio	1.27	0.87
LL: 37	PL: 25	PI: 12	GS: 2.77			

	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

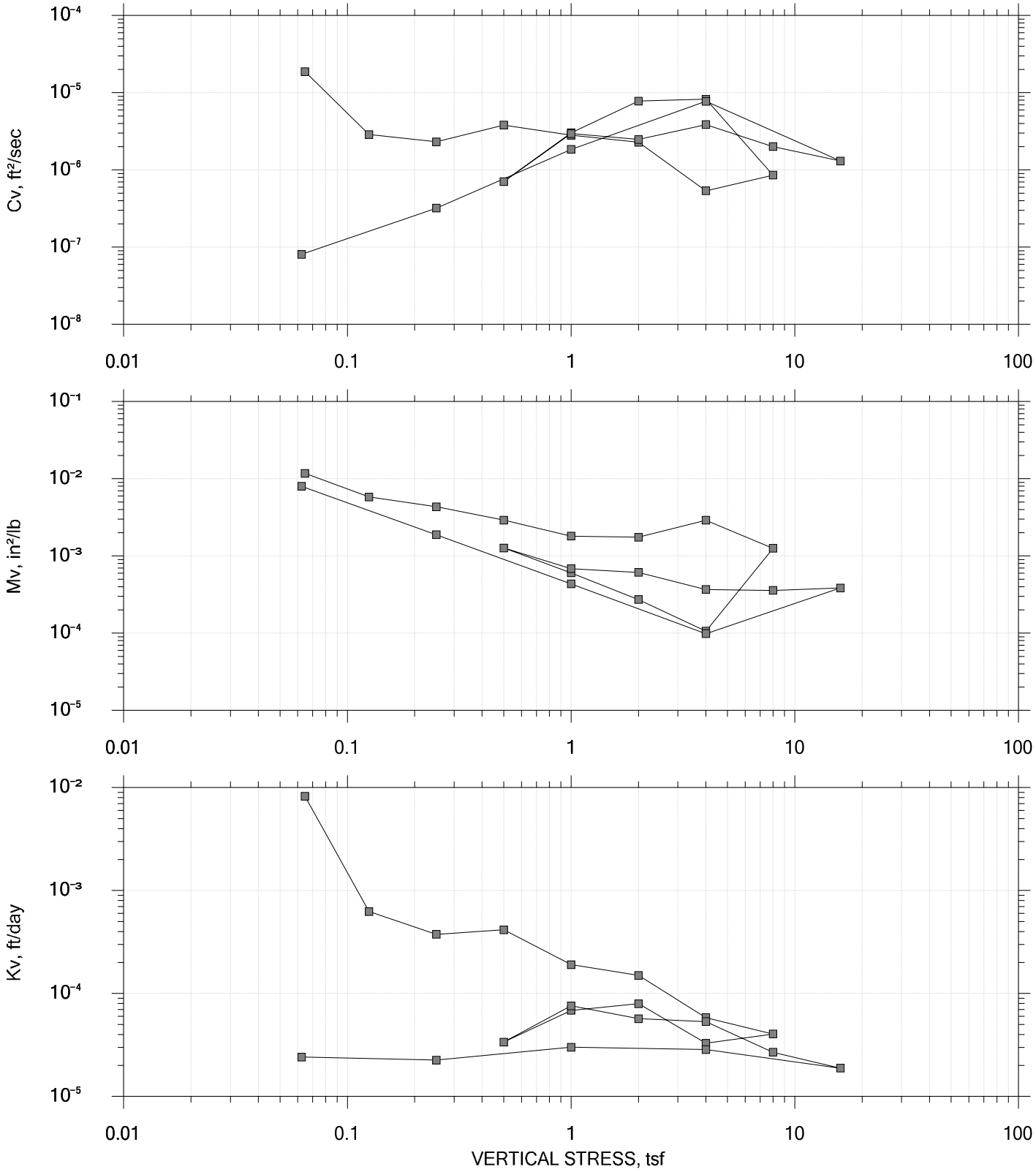
LOG of TIME COEFFICIENTS



	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SQUARE ROOT of TIME COEFFICIENTS



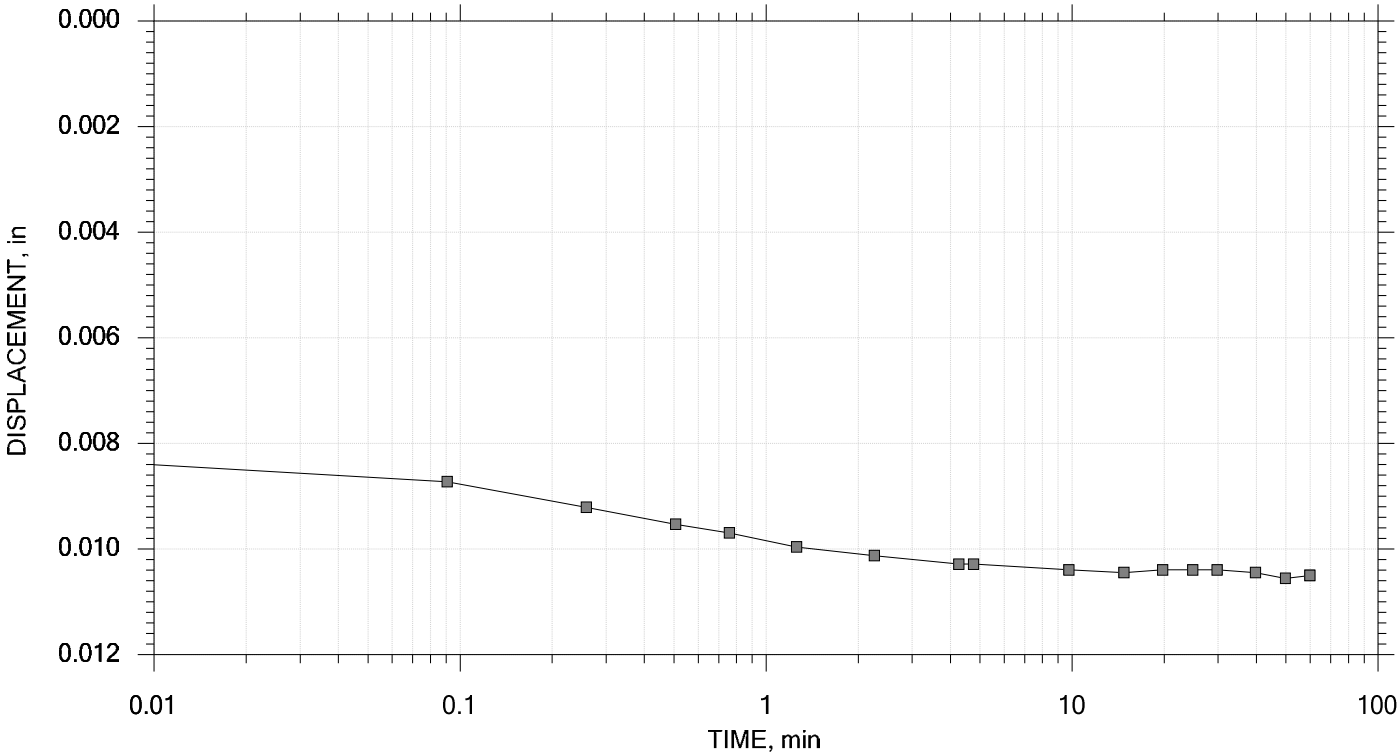
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

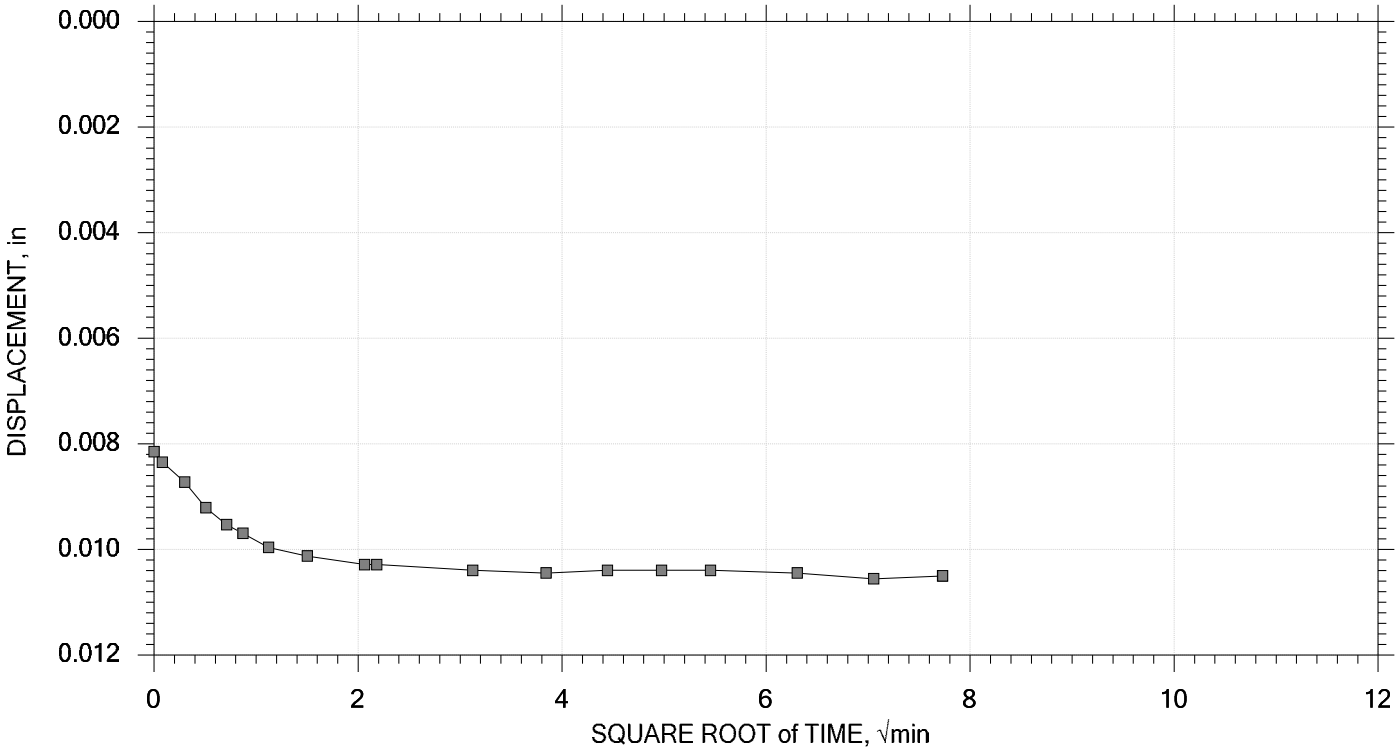
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 21

Stress: 0.064562 tsf





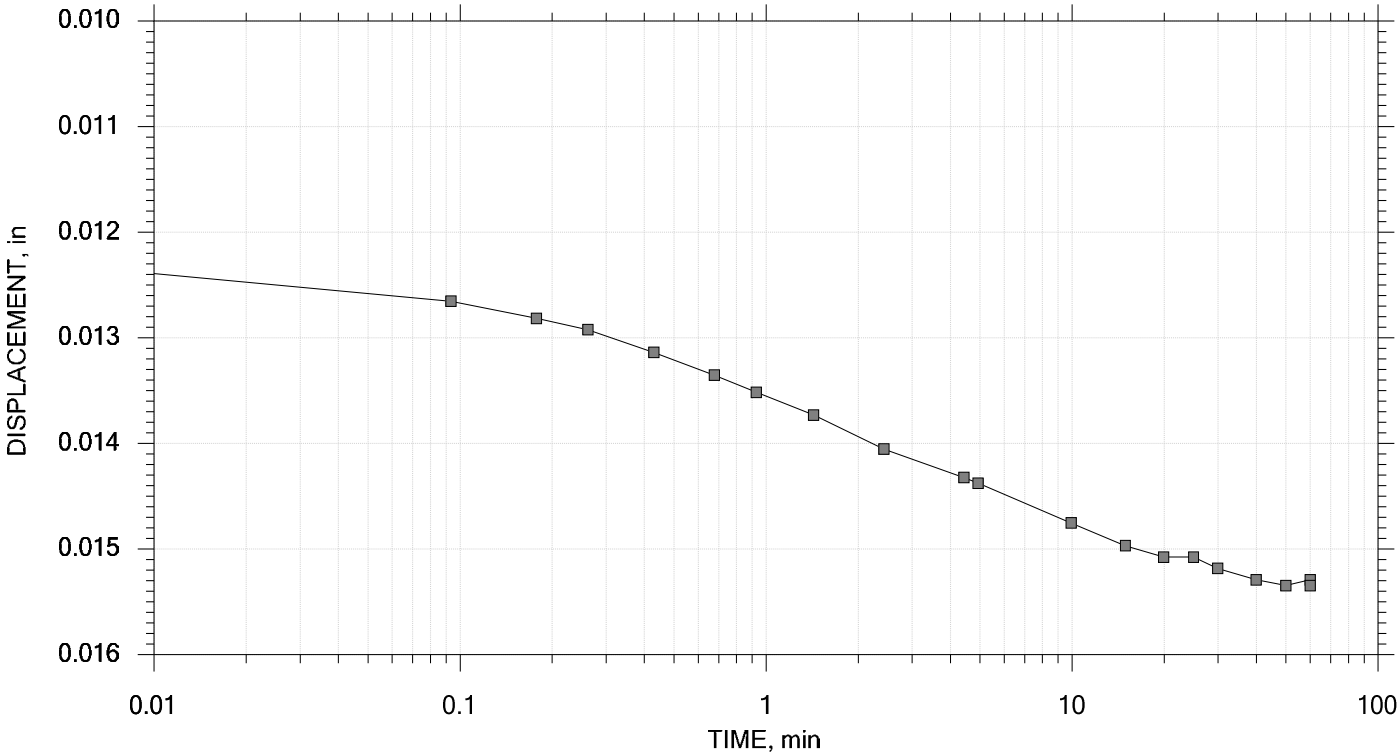
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

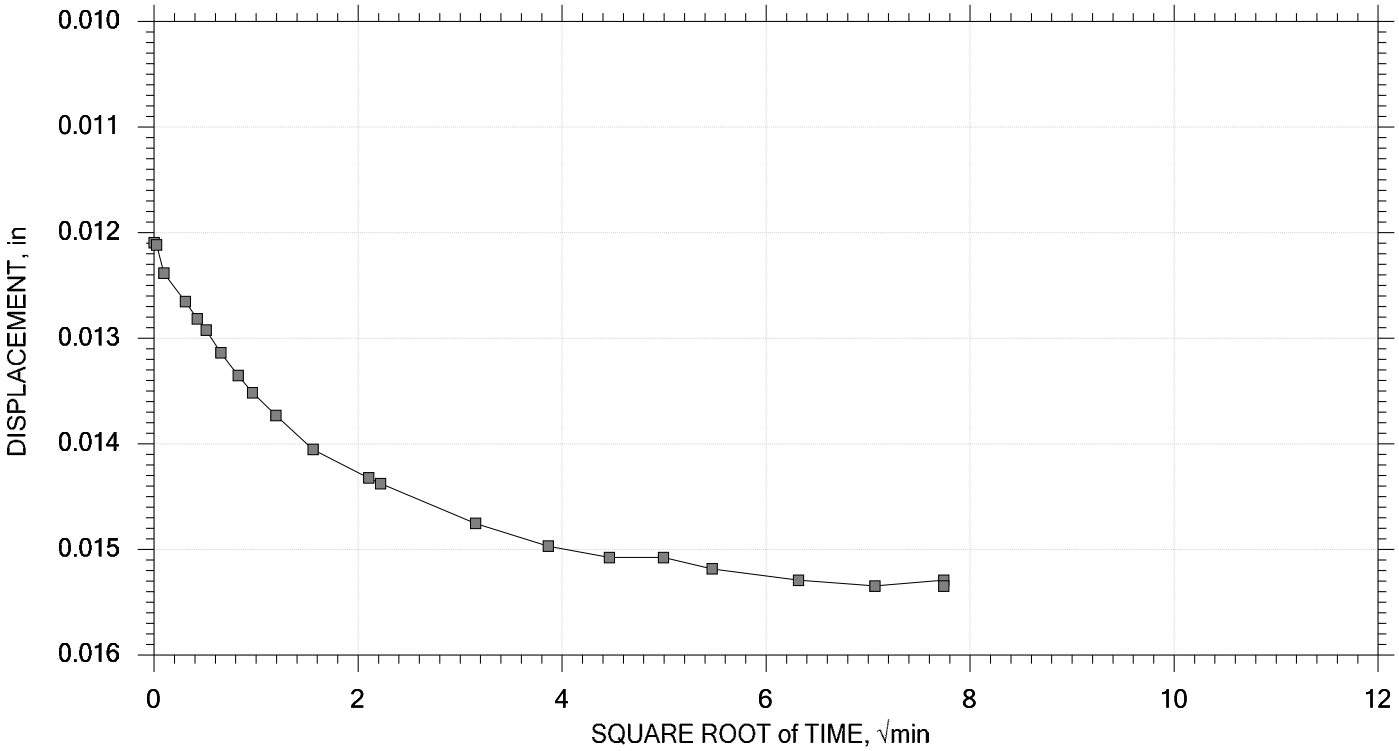
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 21

Stress: 0.125 tsf





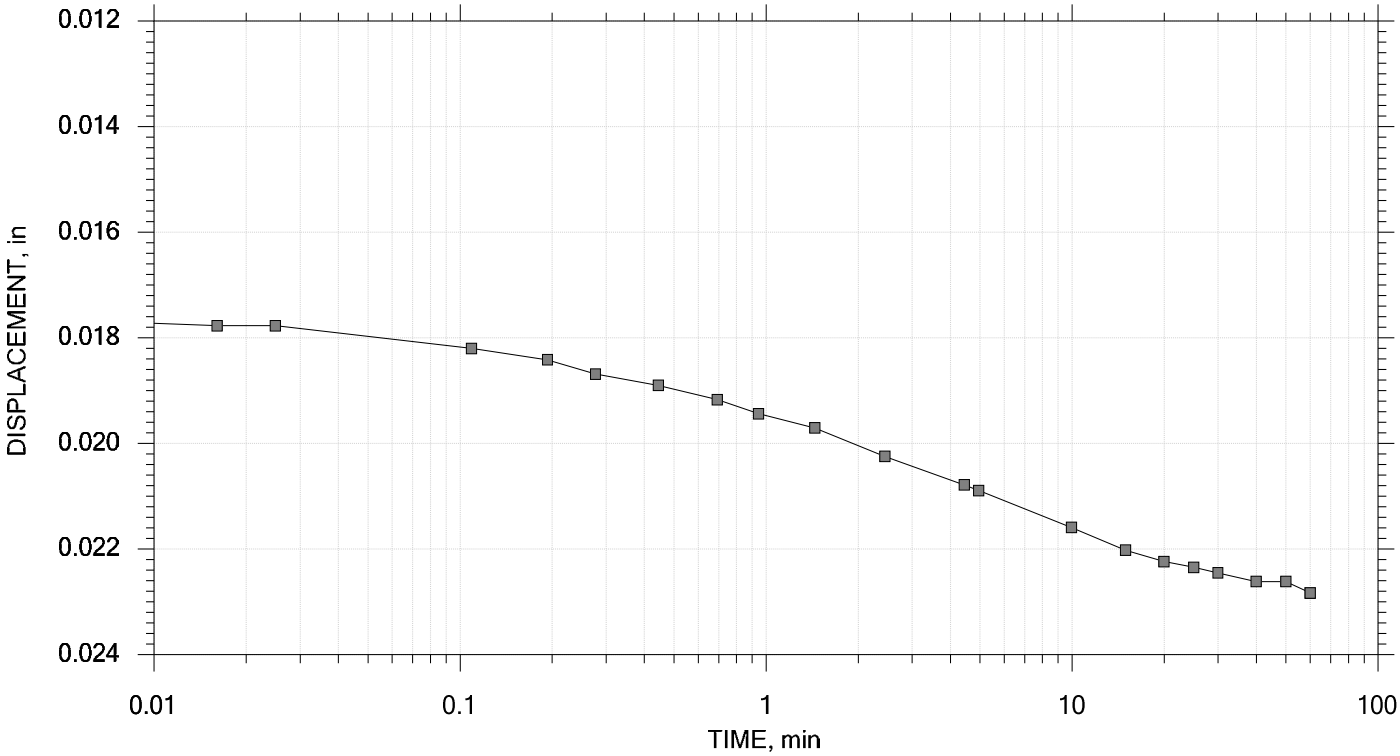
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

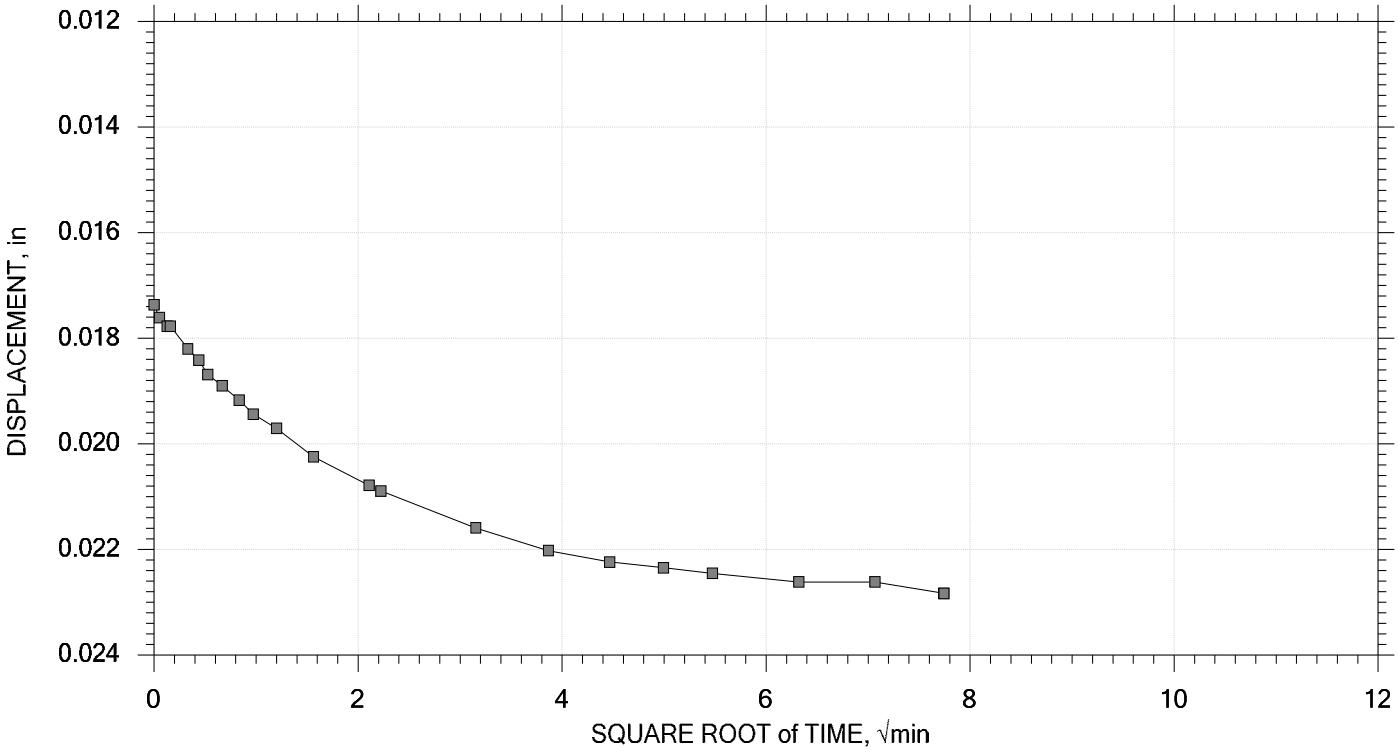
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 21

Stress: 0.25 tsf





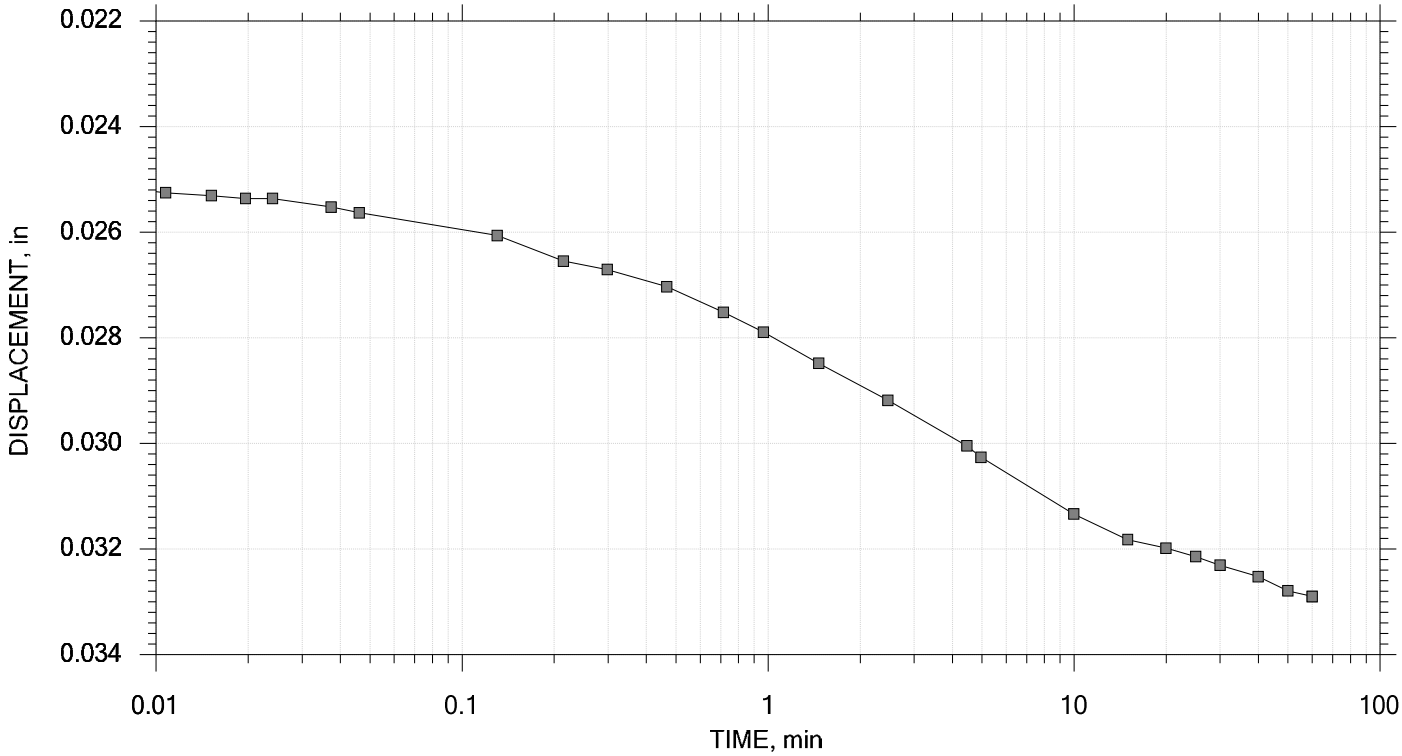
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

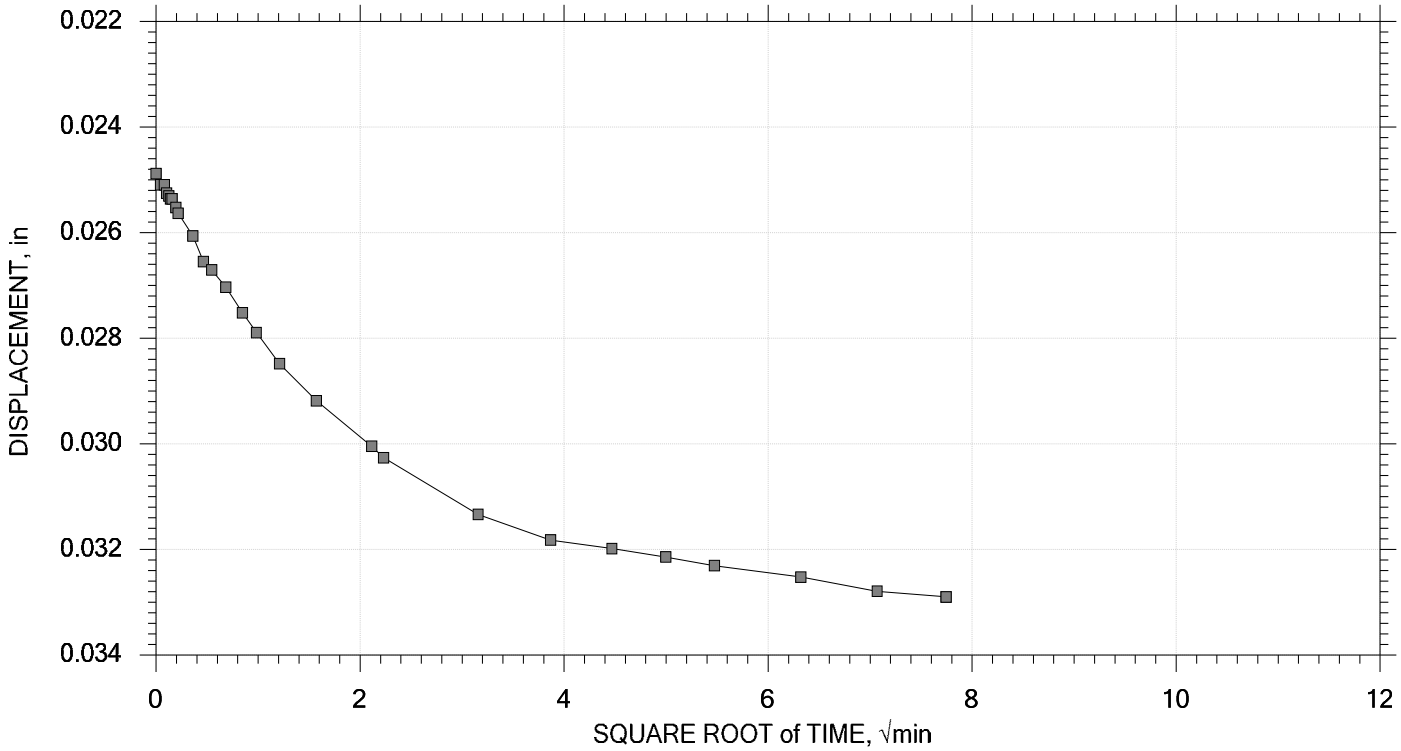
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 21

Stress: 0.5 tsf





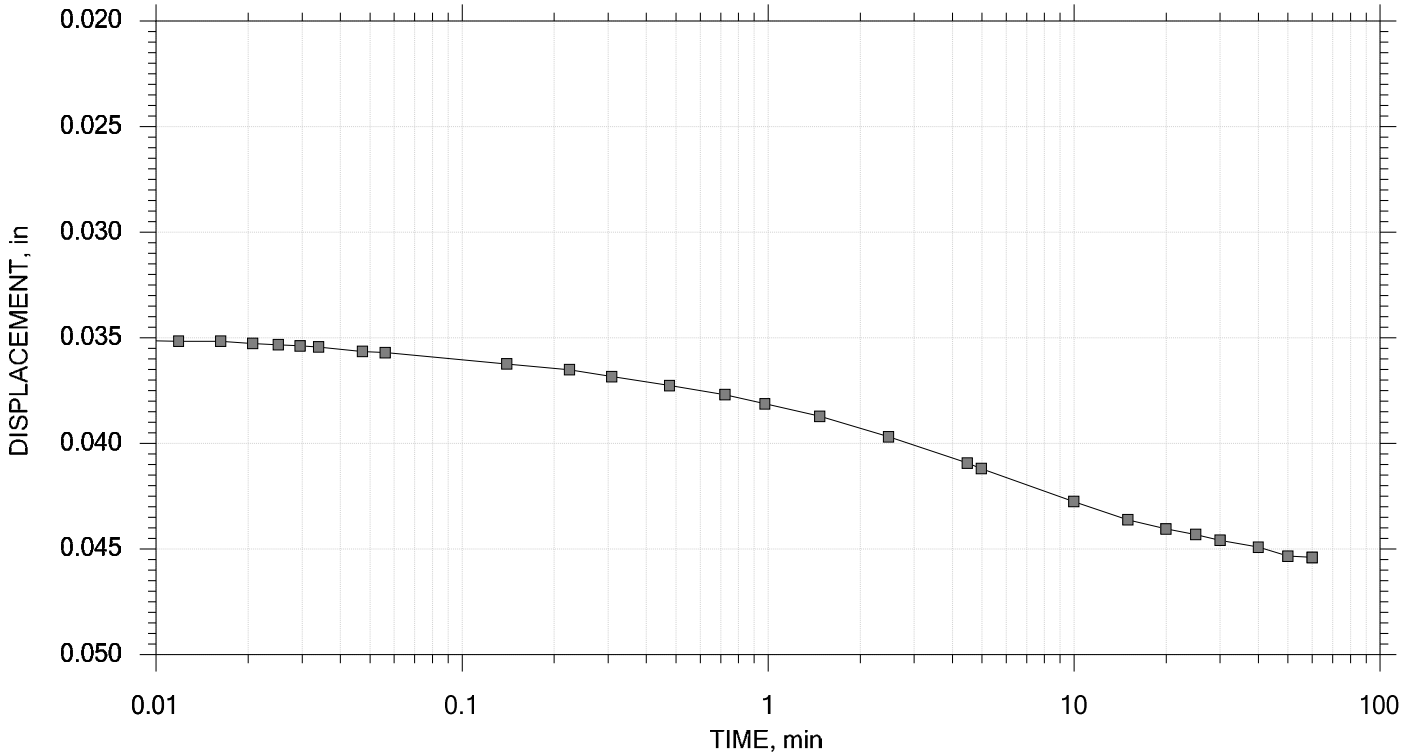
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

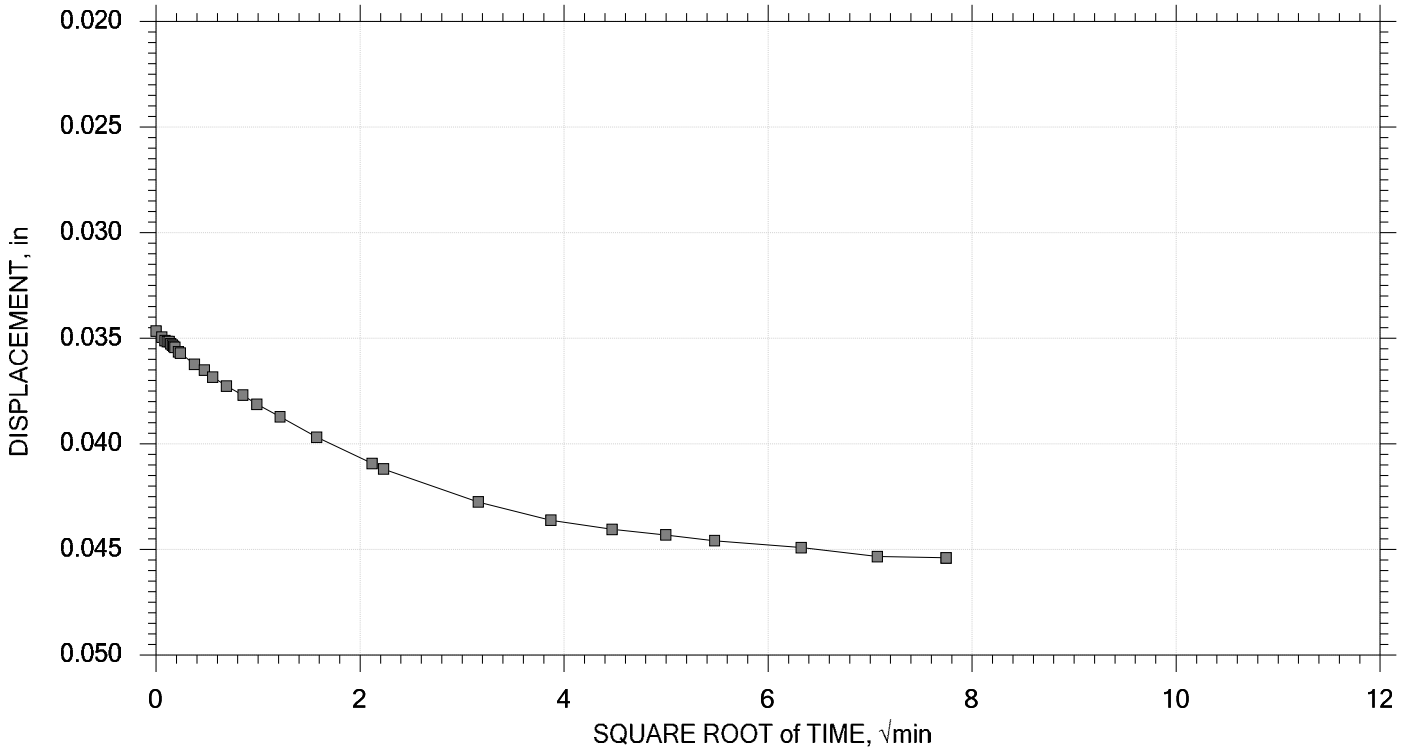
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 21

Stress: 1 tsf





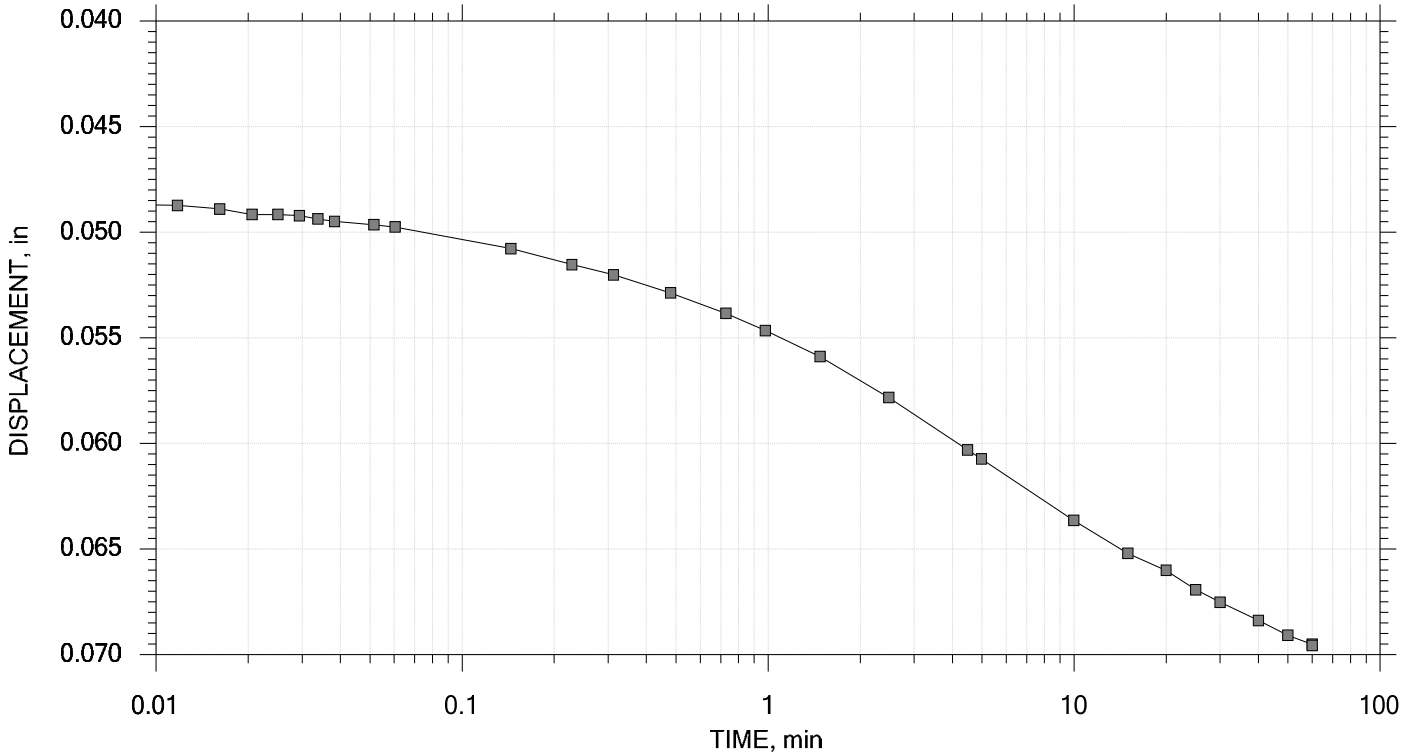
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

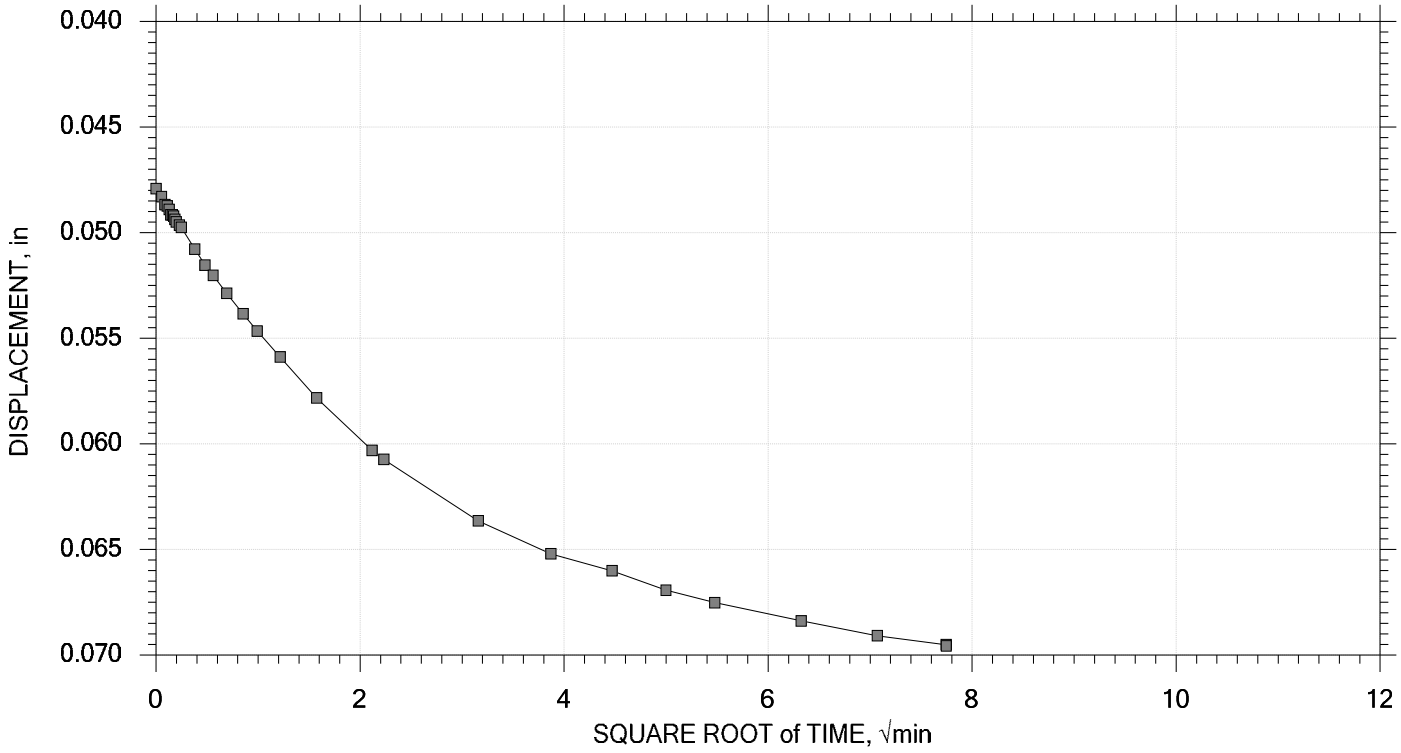
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 21

Stress: 2 tsf





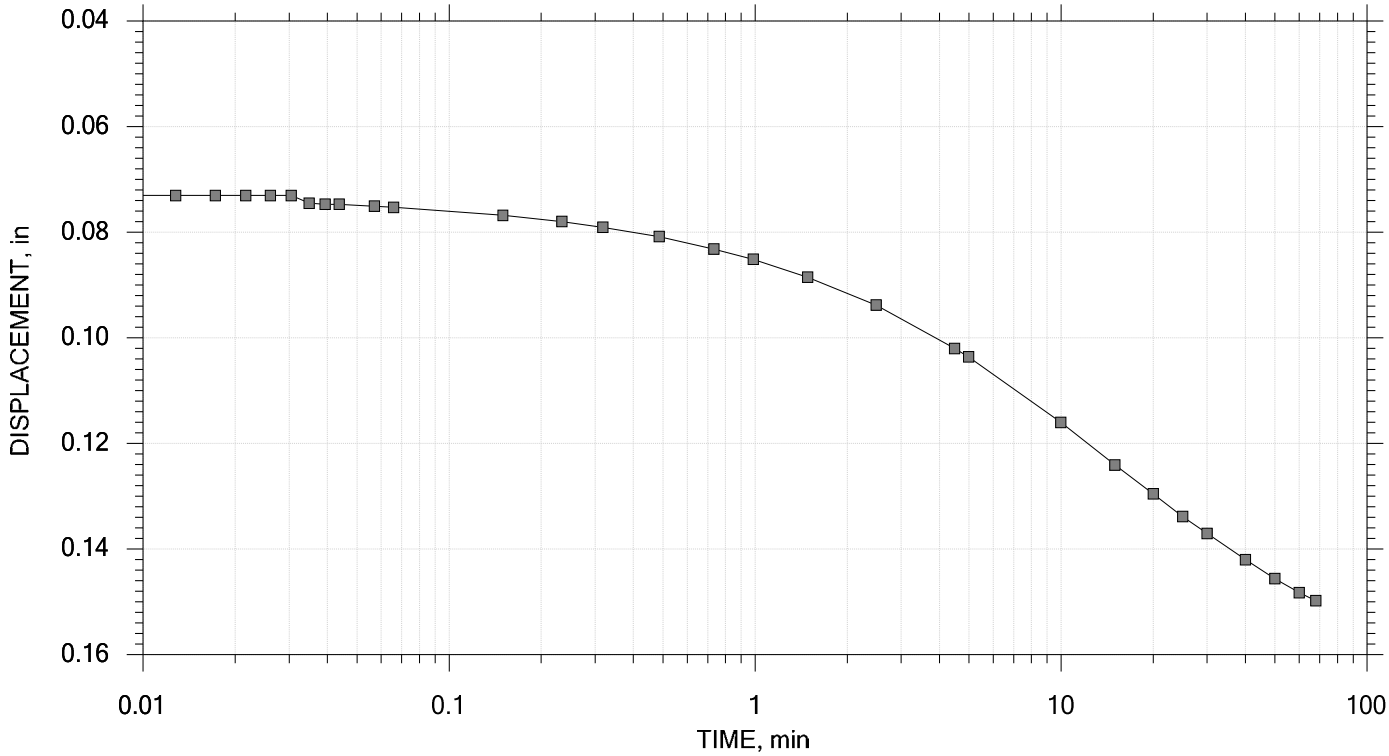
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

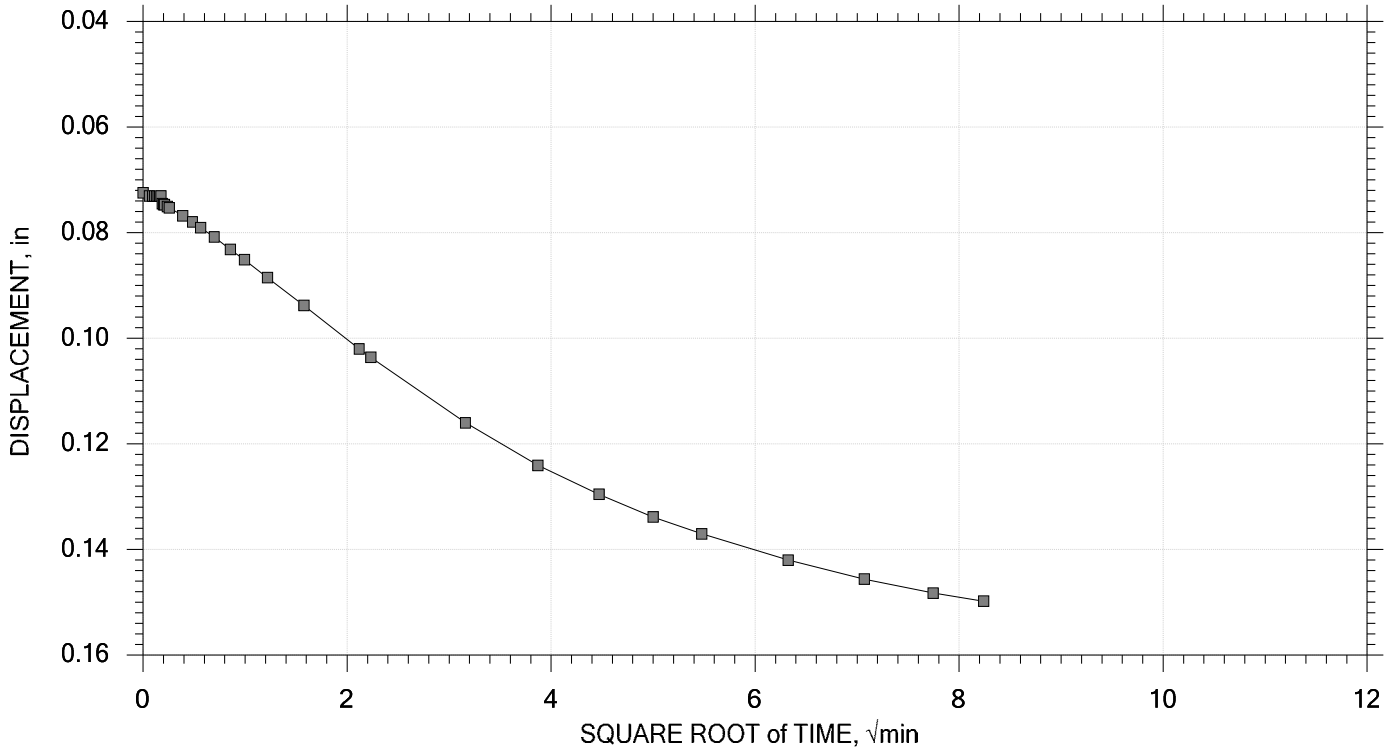
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 21

Stress: 4 tsf





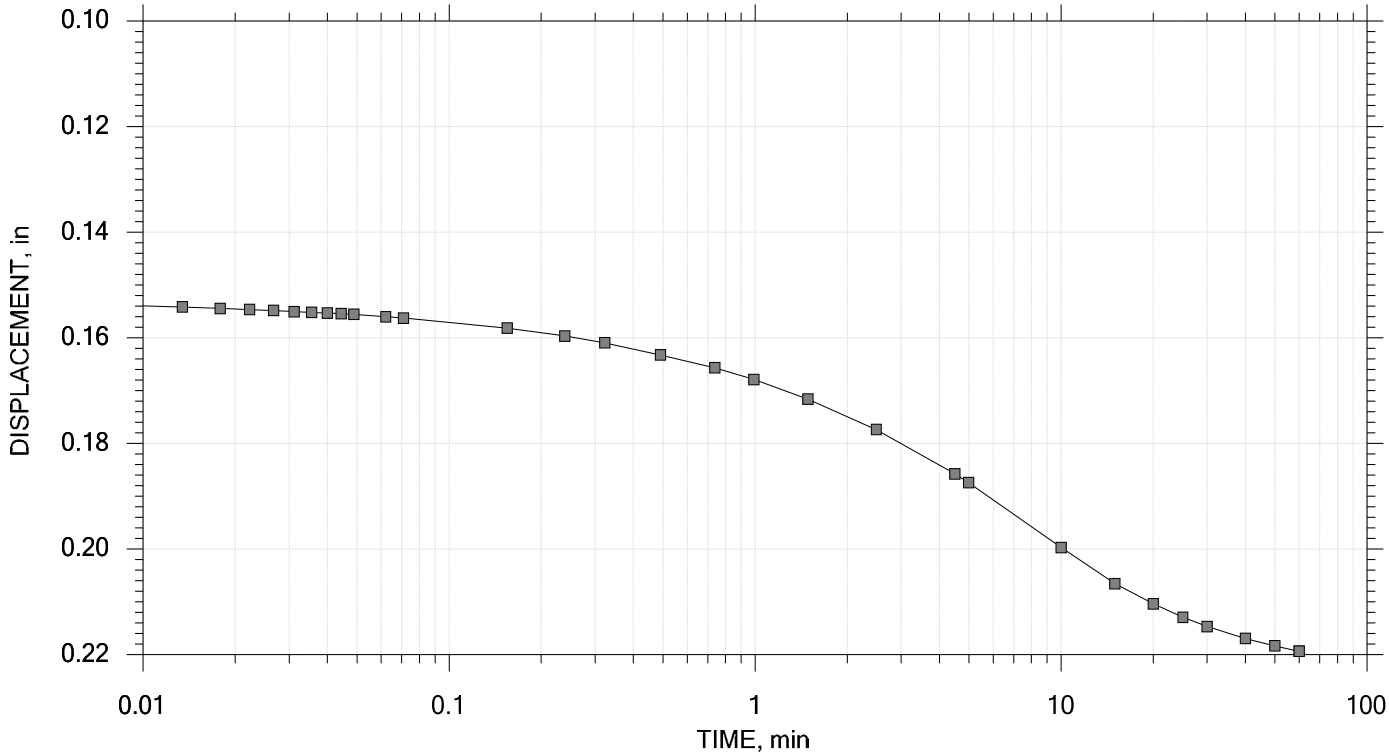
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

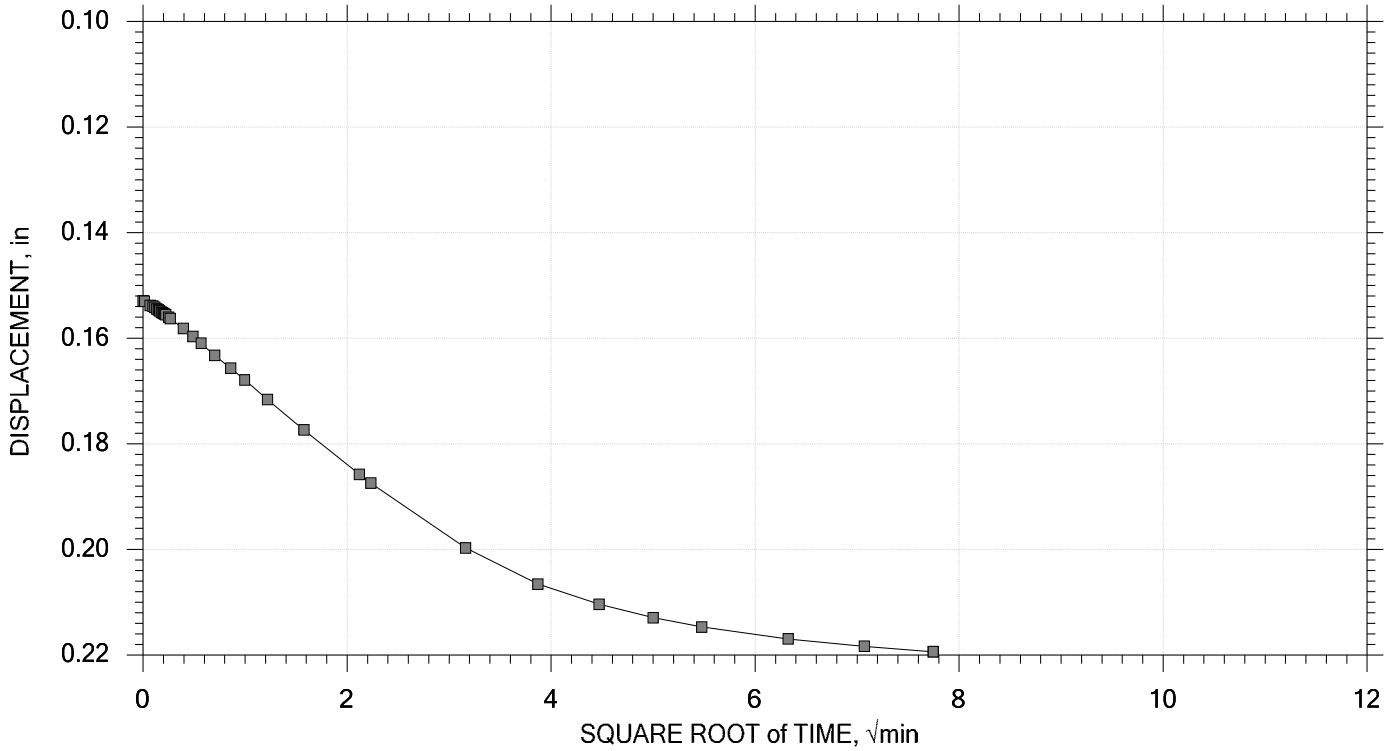
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 21

Stress: 8 tsf





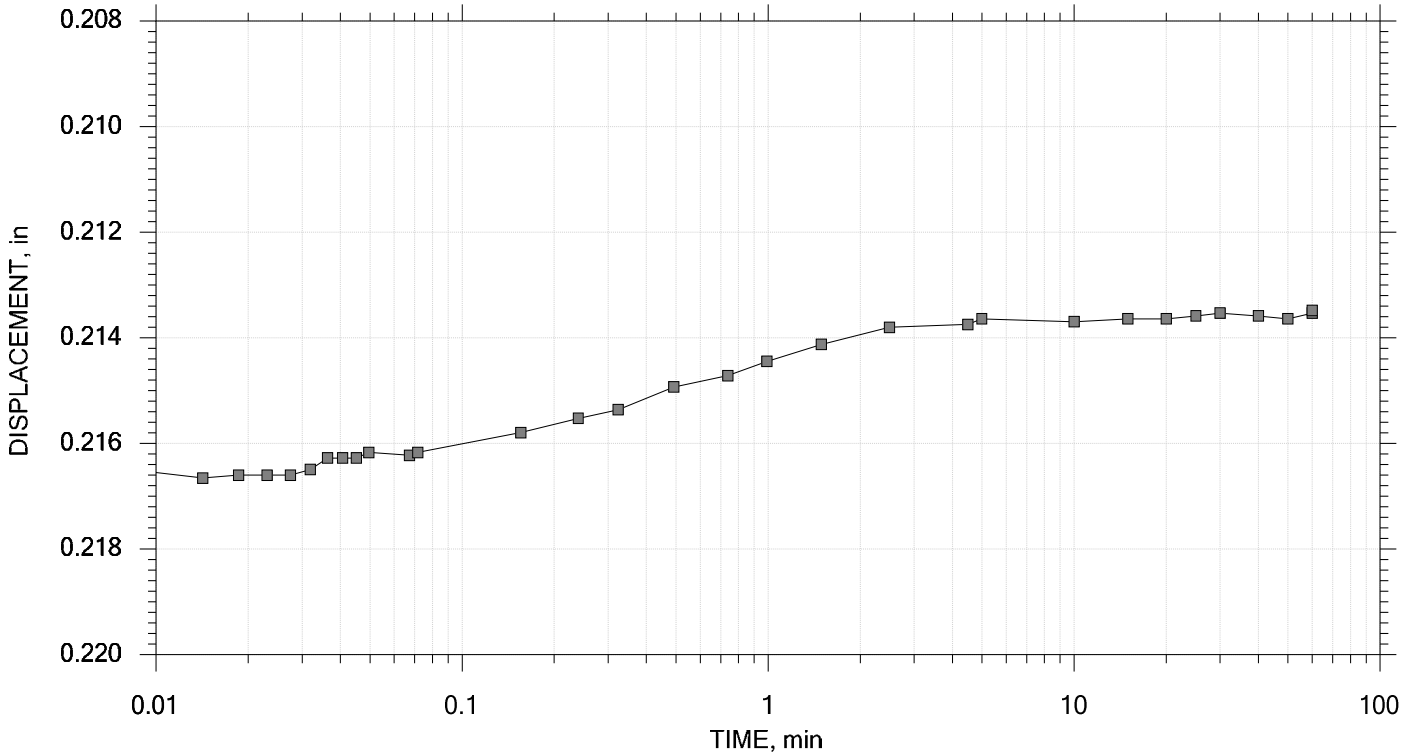
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

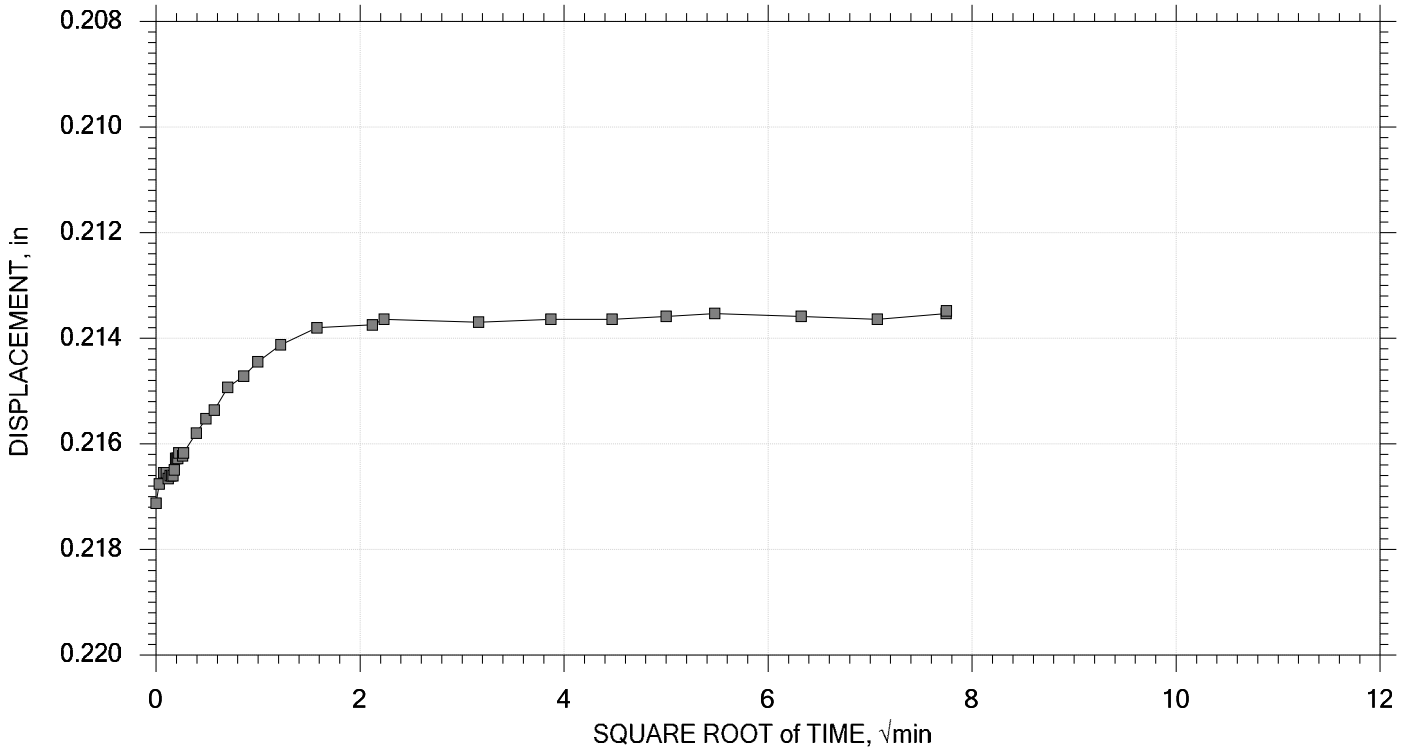
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 21

Stress: 4 tsf





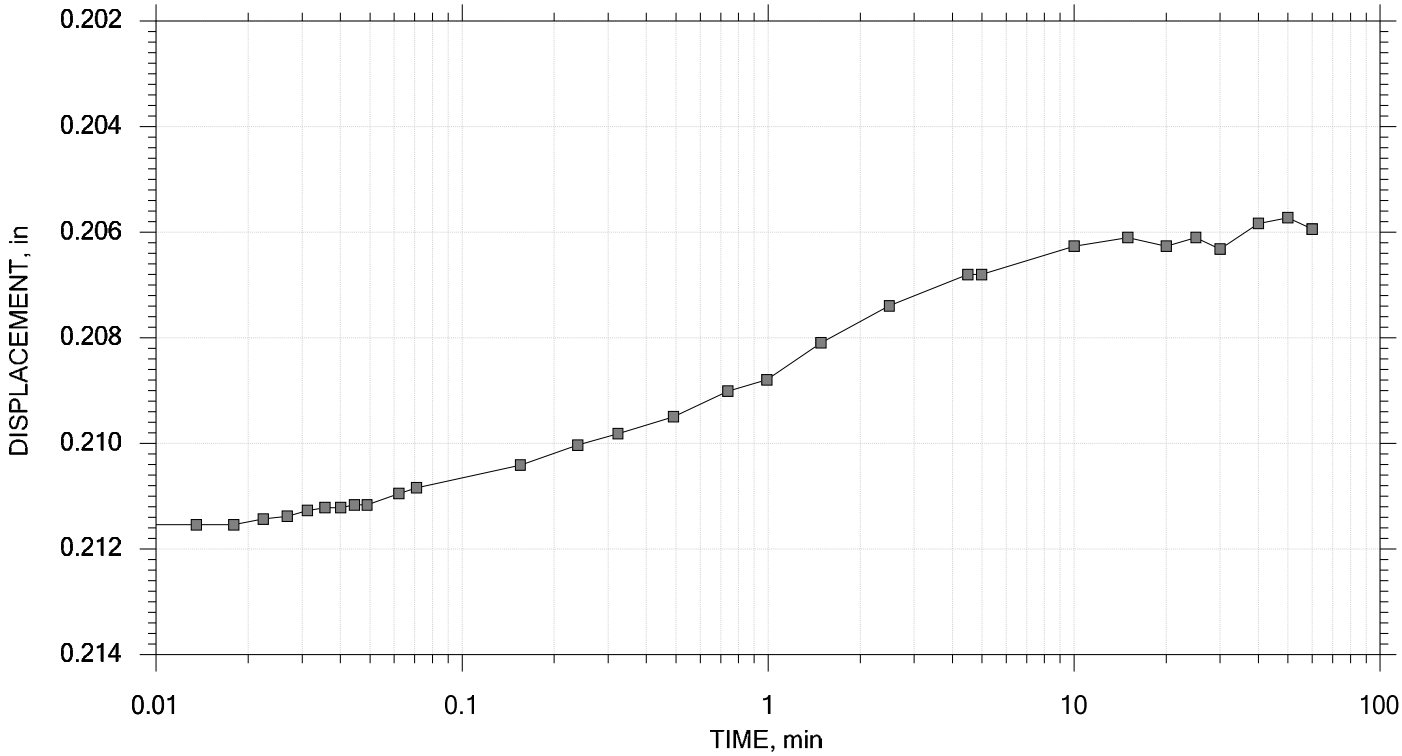
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

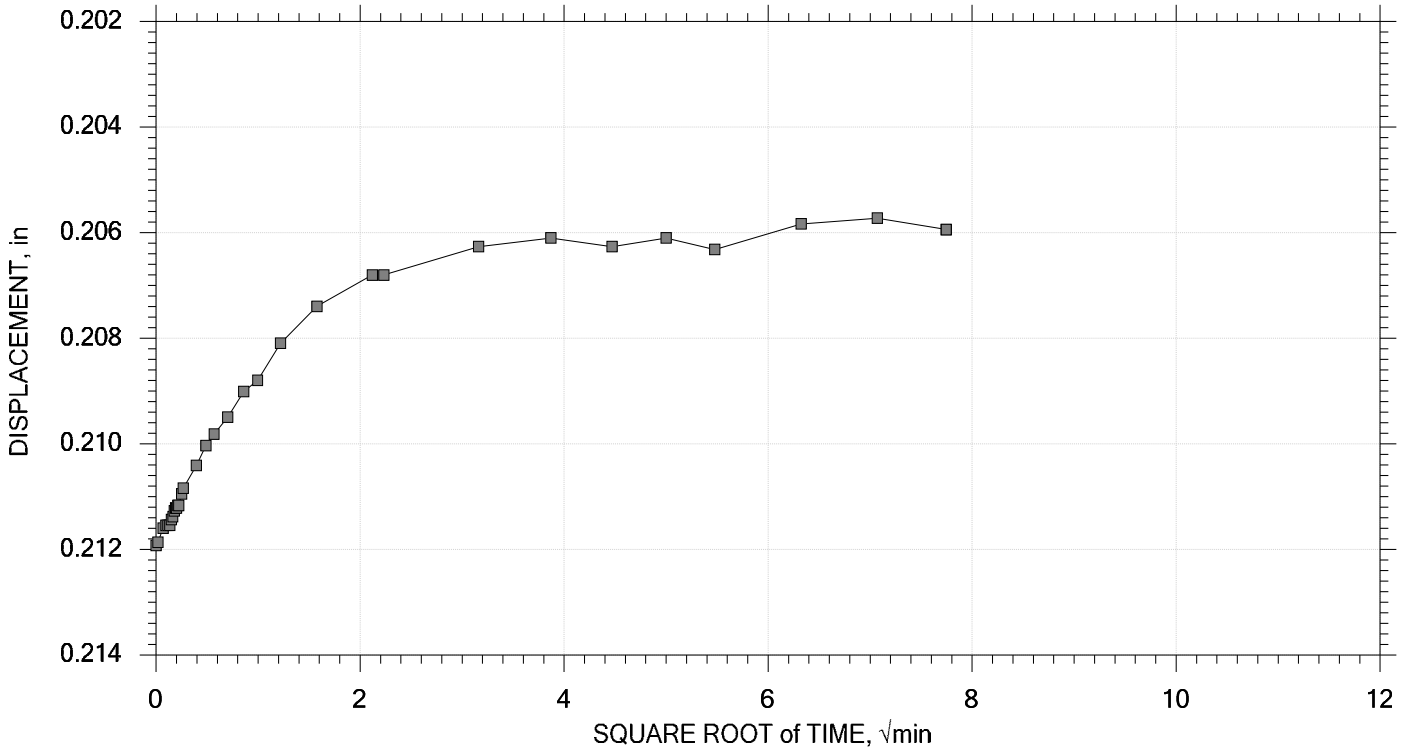
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 21

Stress: 2 tsf





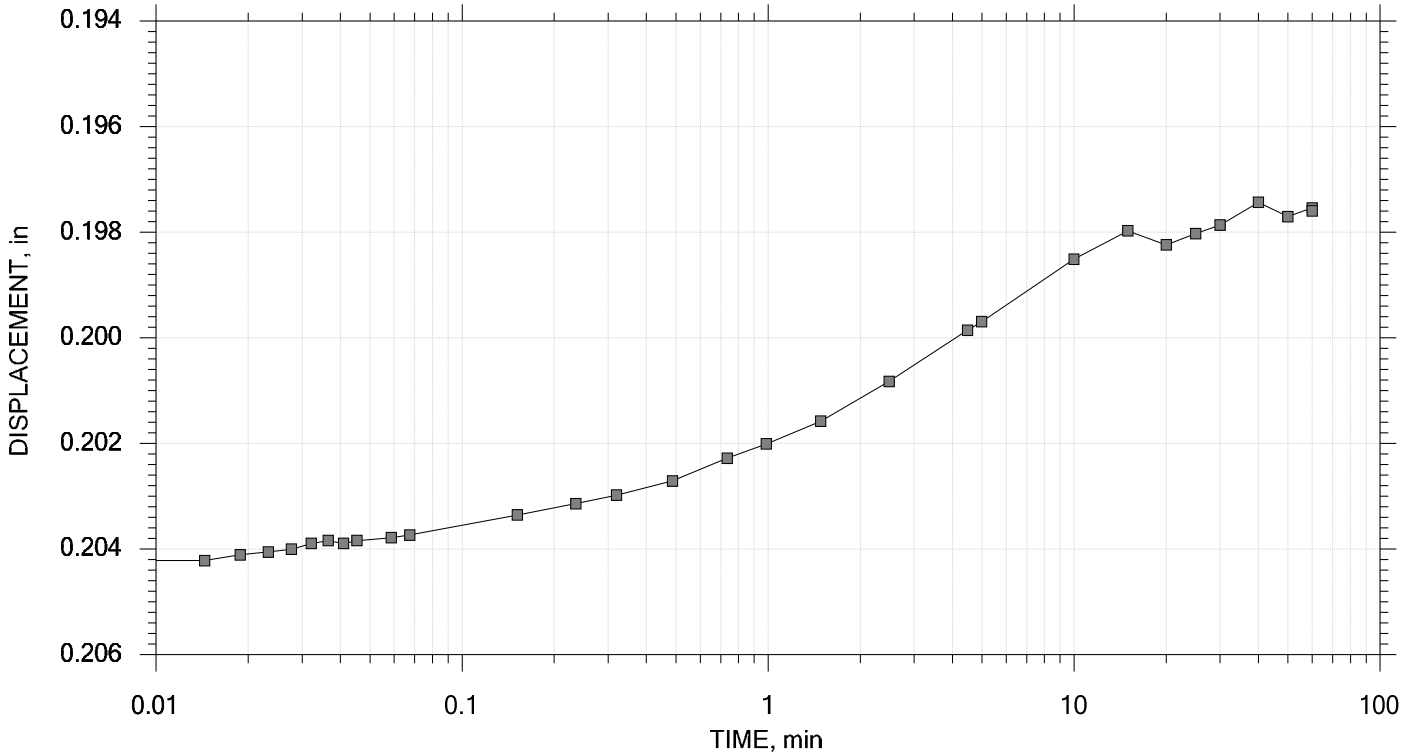
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

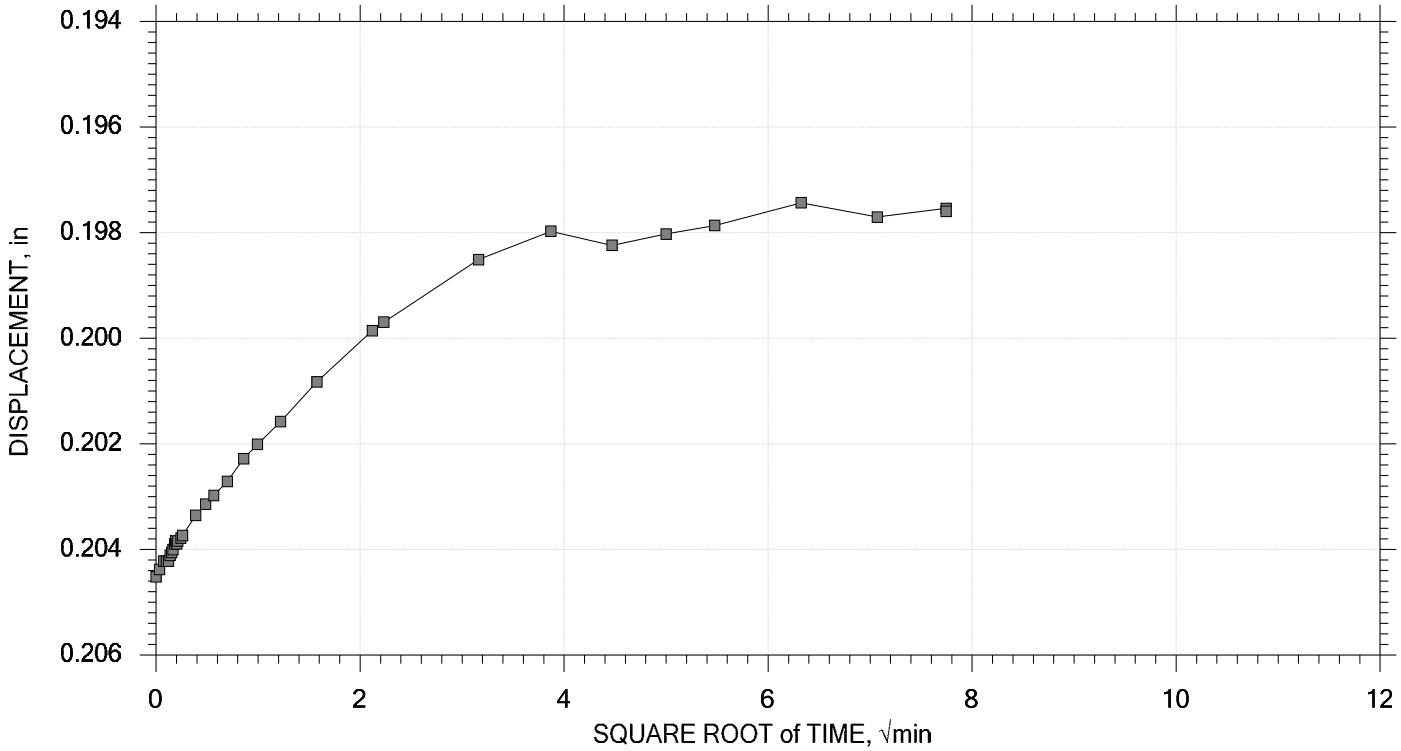
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 11 of 21

Stress: 1 tsf





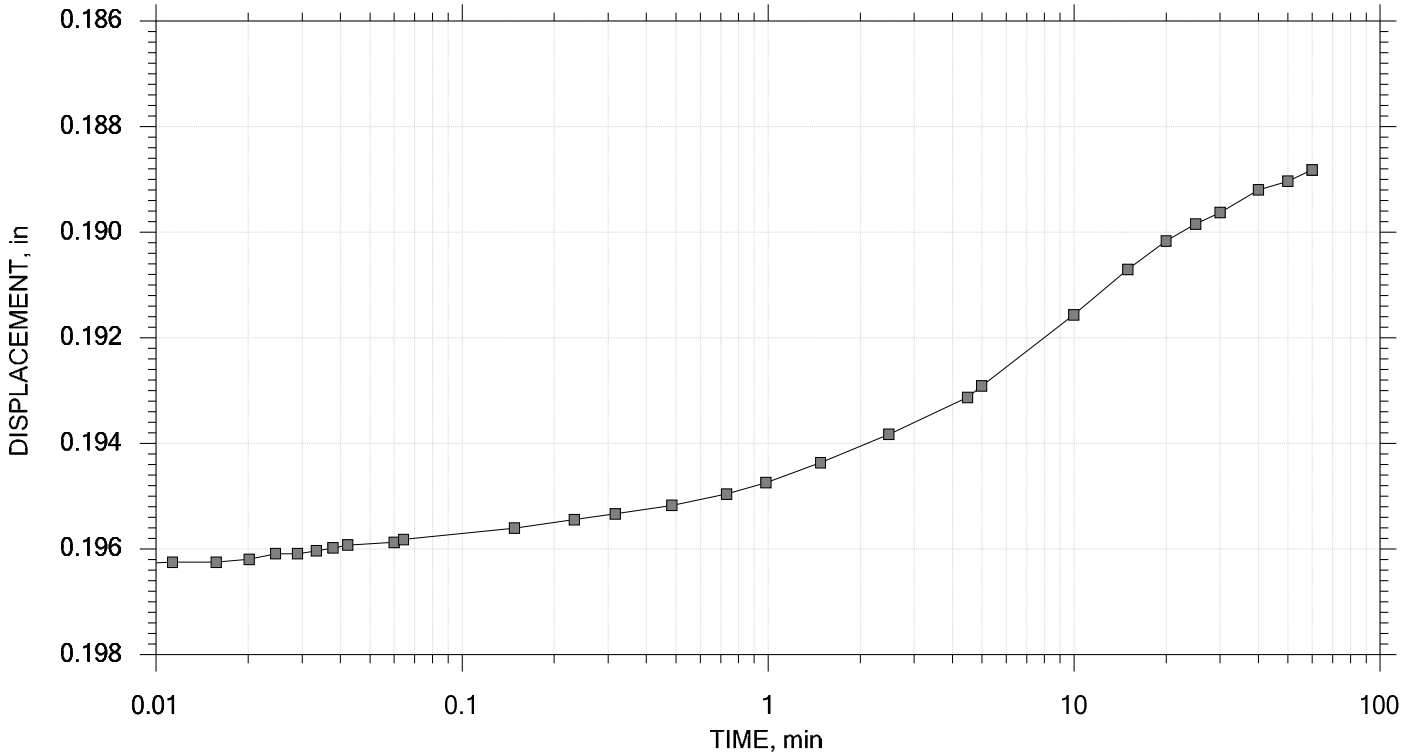
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

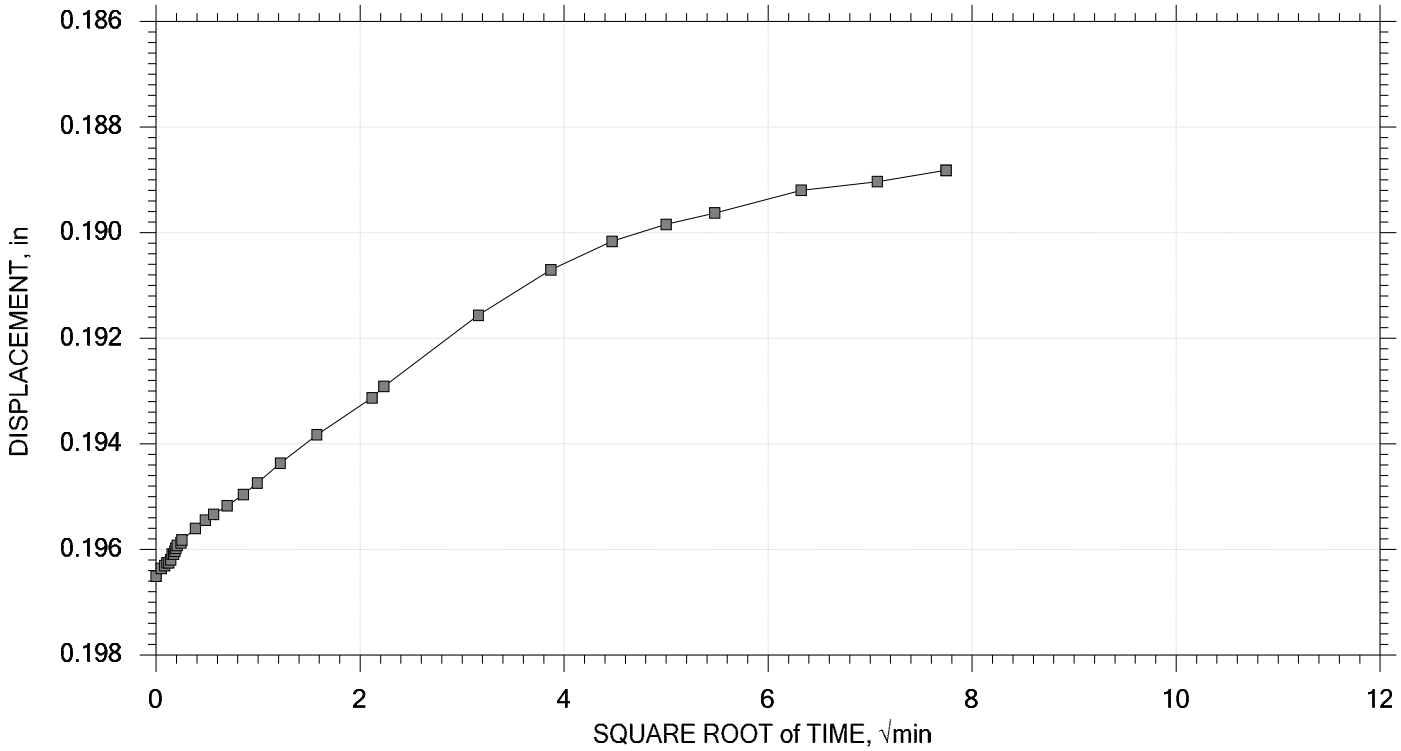
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 12 of 21

Stress: 0.5 tsf





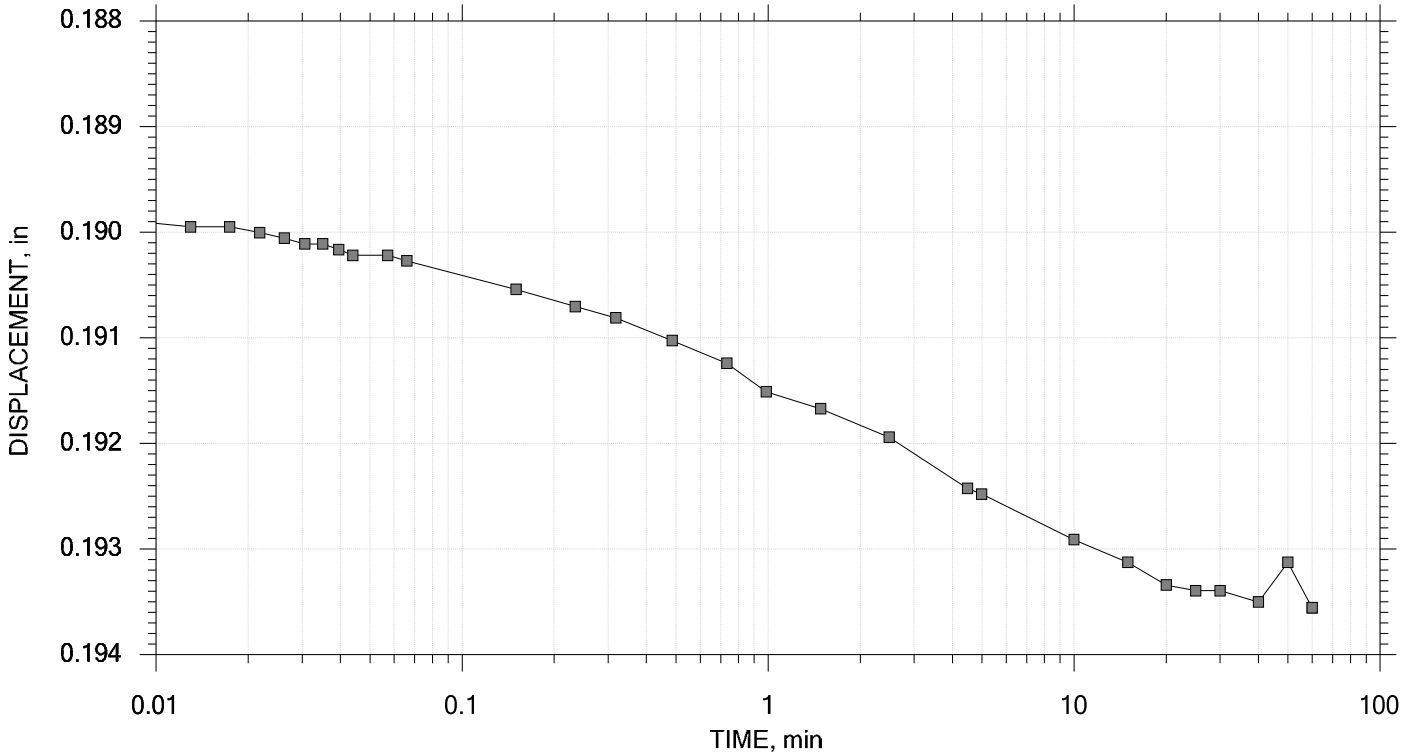
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

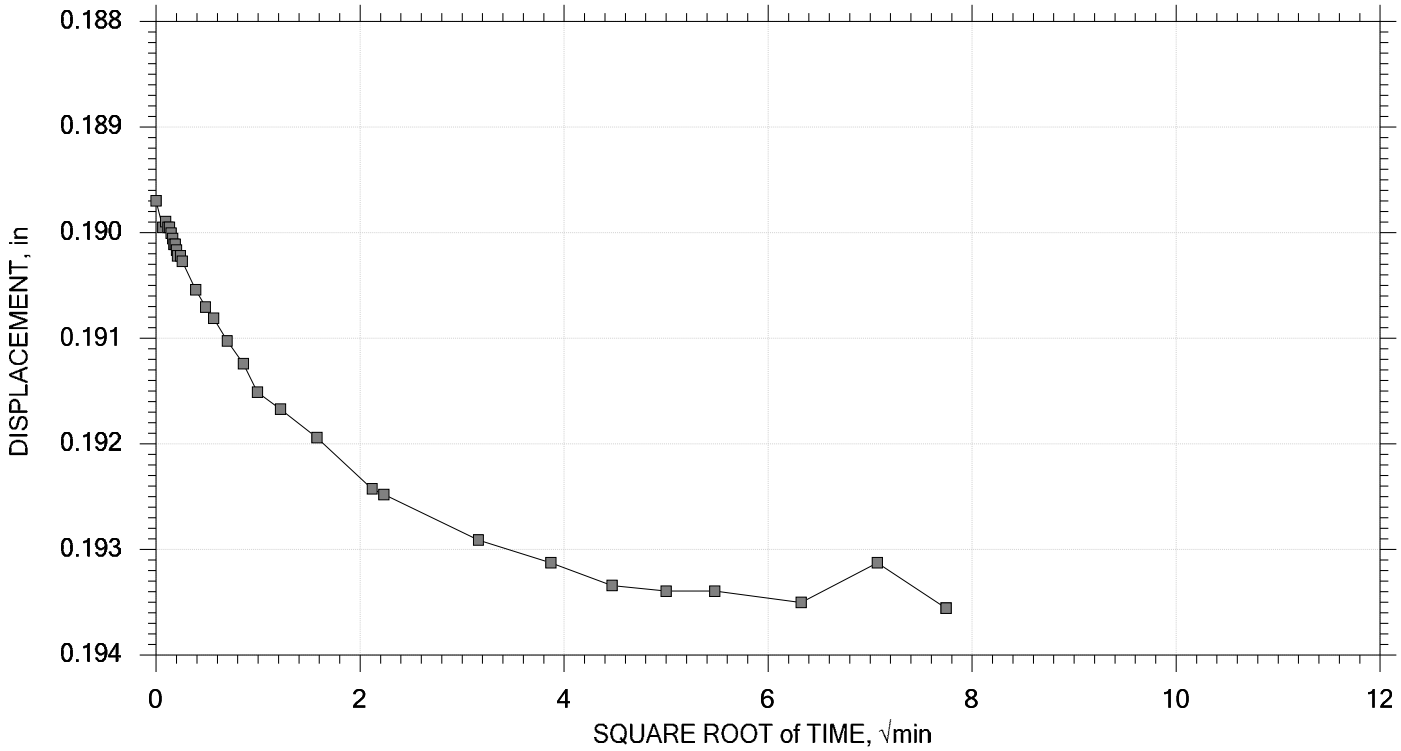
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 21

Stress: 1 tsf





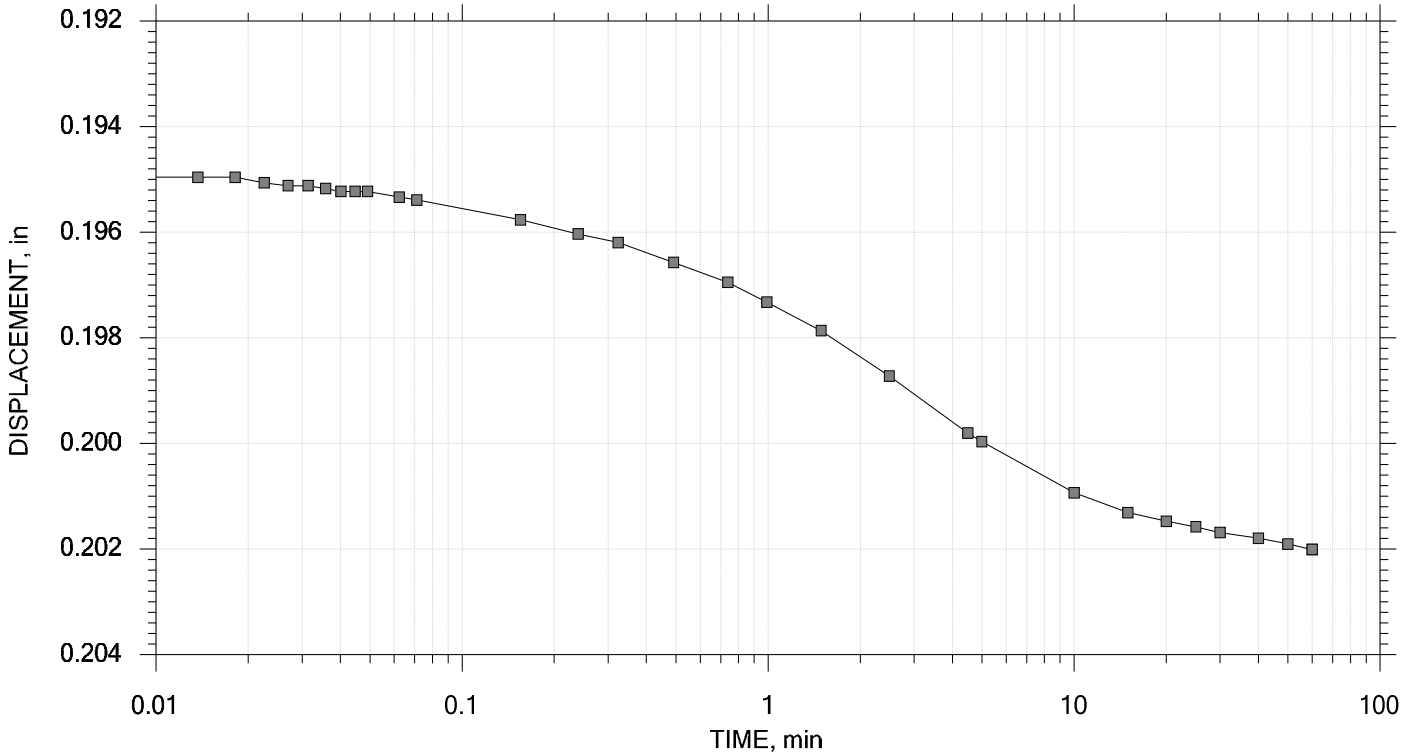
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

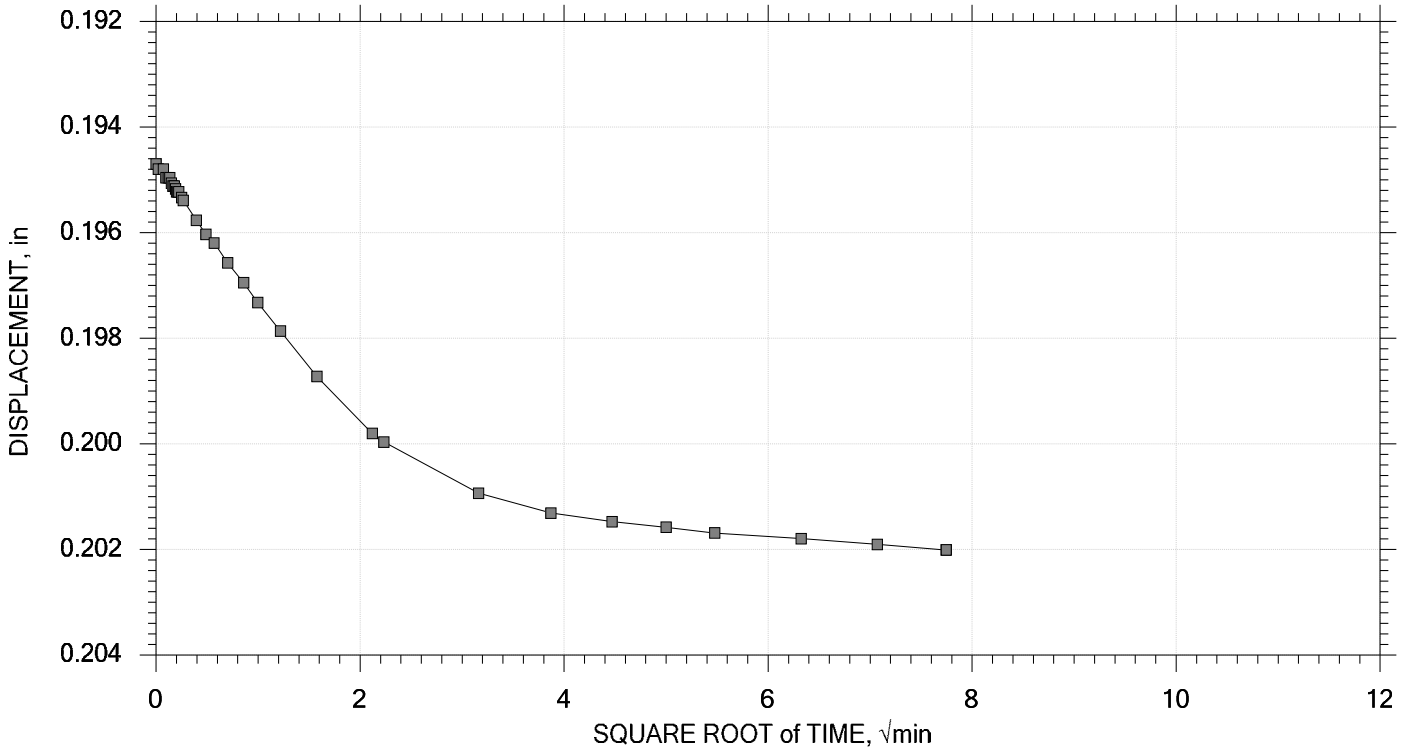
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 21

Stress: 2 tsf





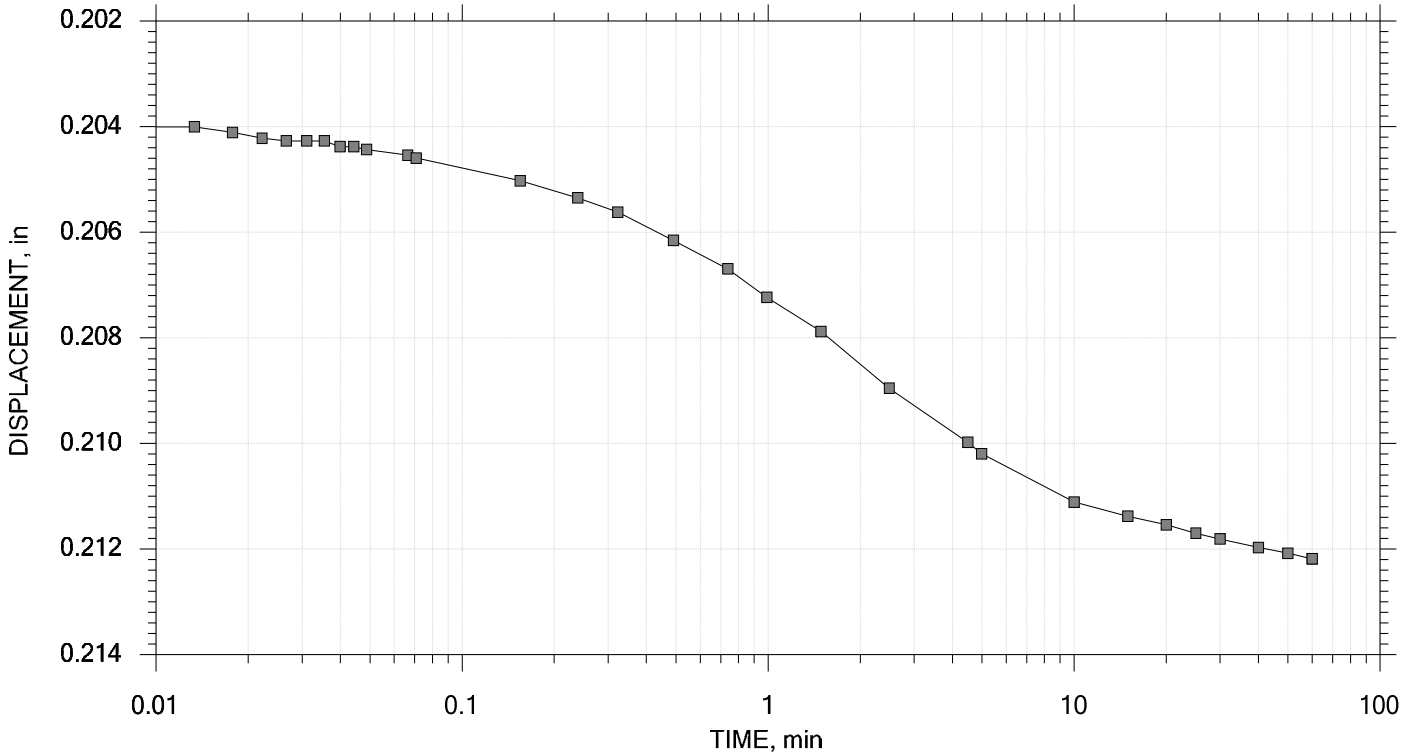
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

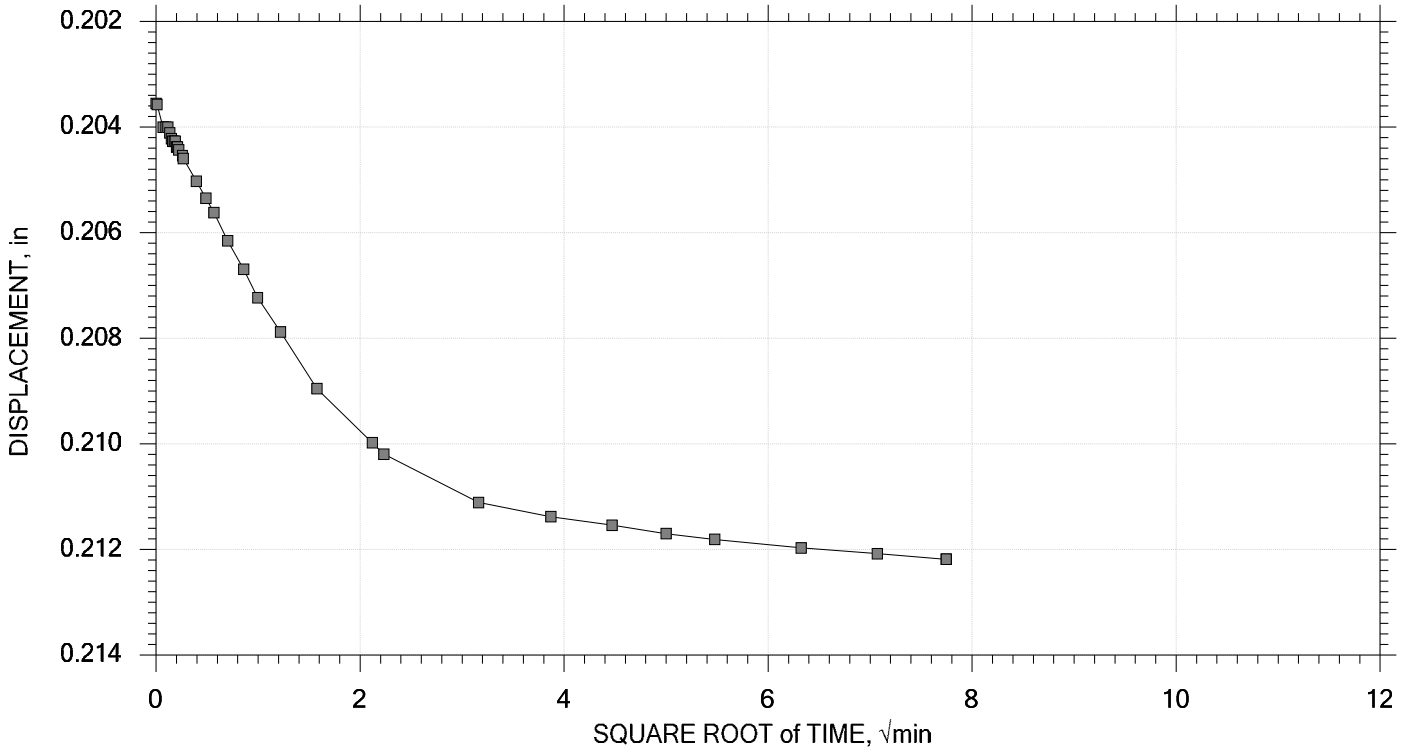
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 15 of 21

Stress: 4 tsf





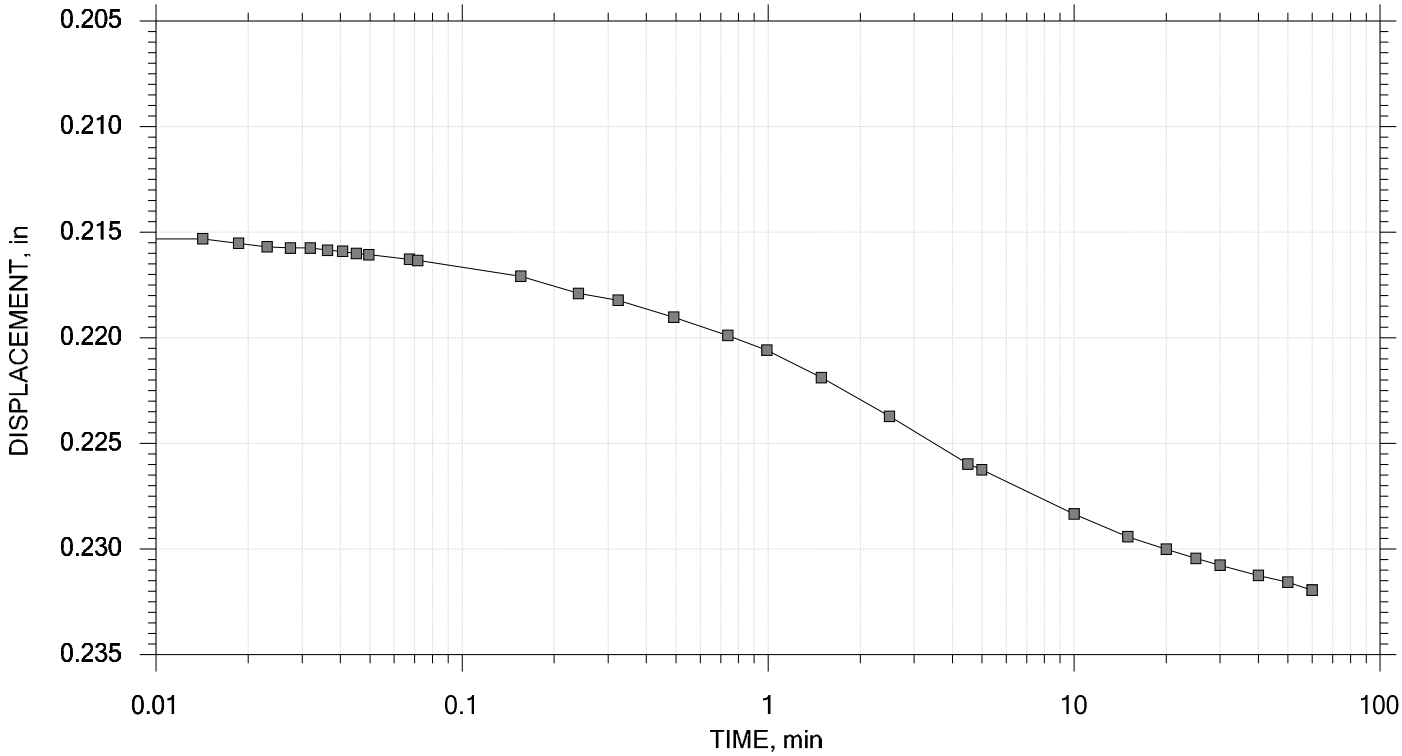
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

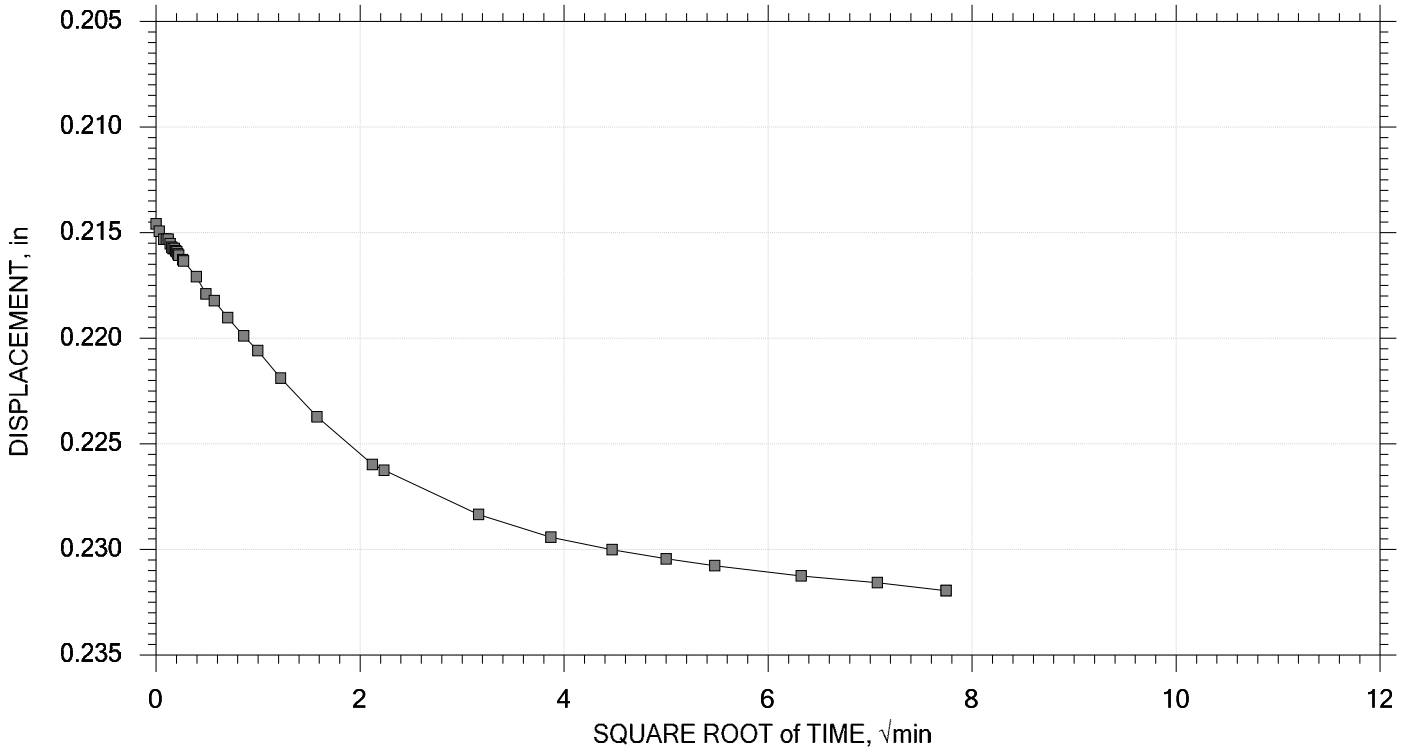
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 16 of 21

Stress: 8 tsf





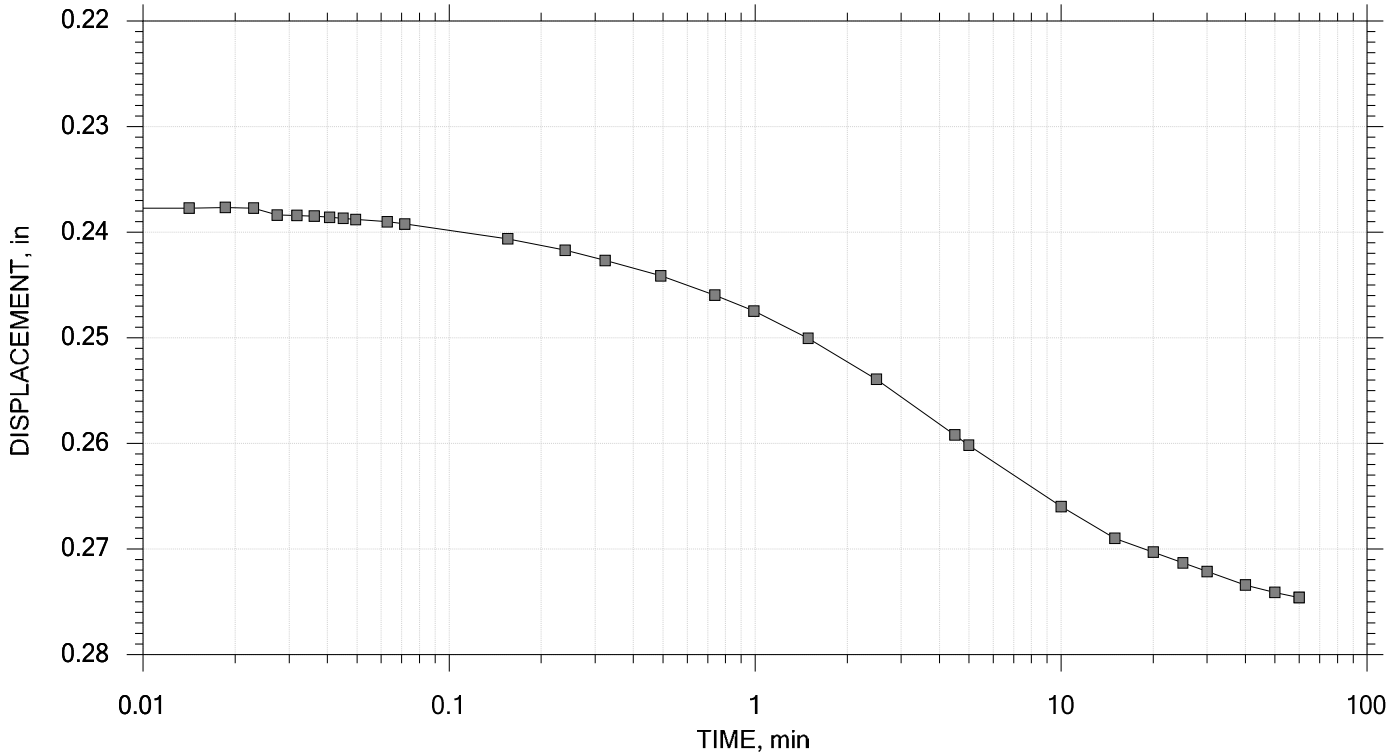
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

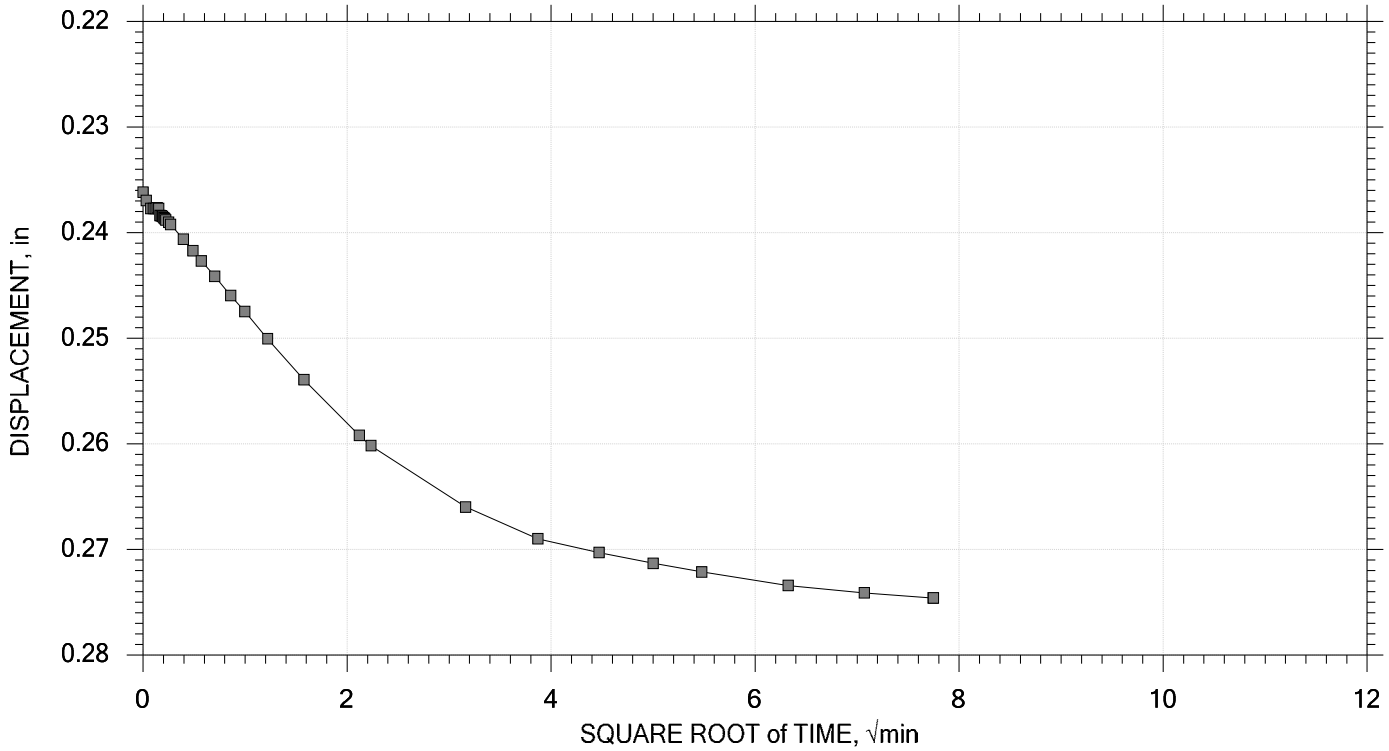
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 17 of 21

Stress: 16 tsf





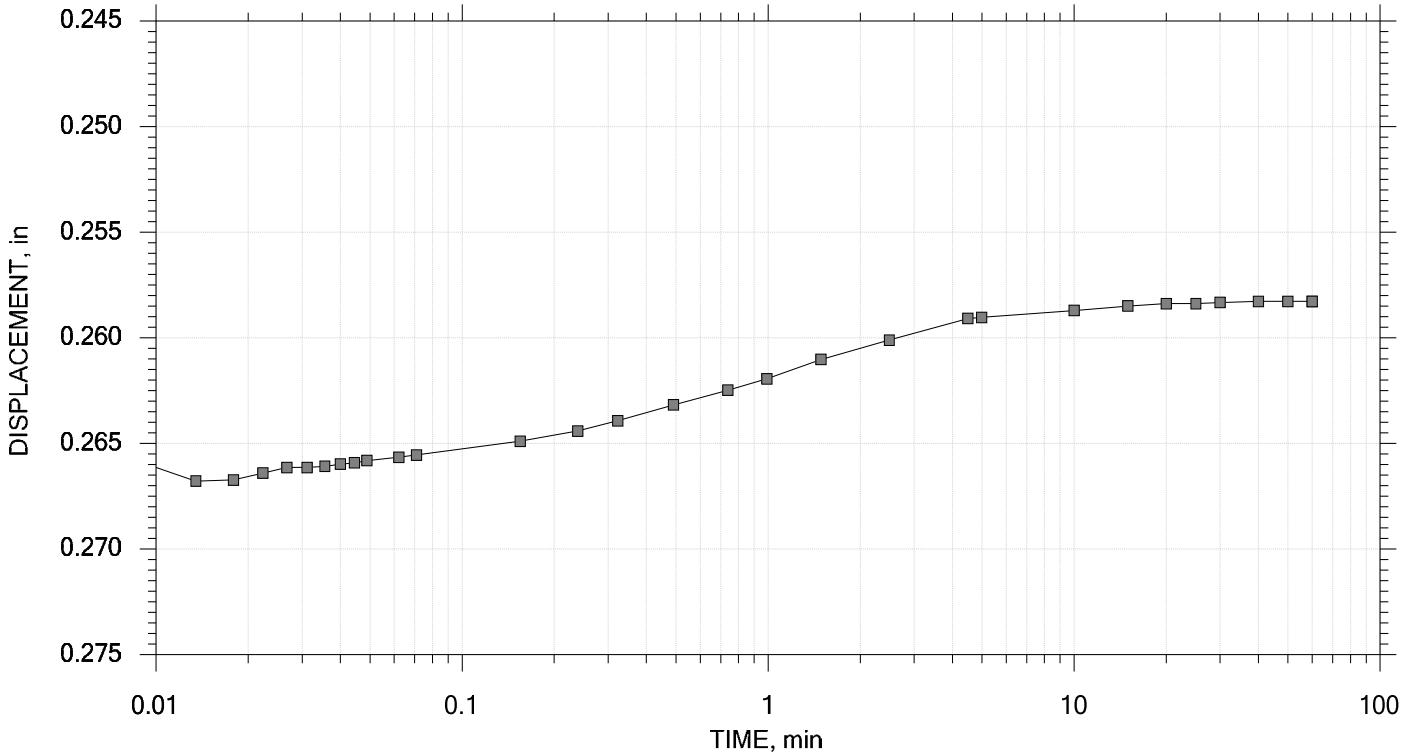
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

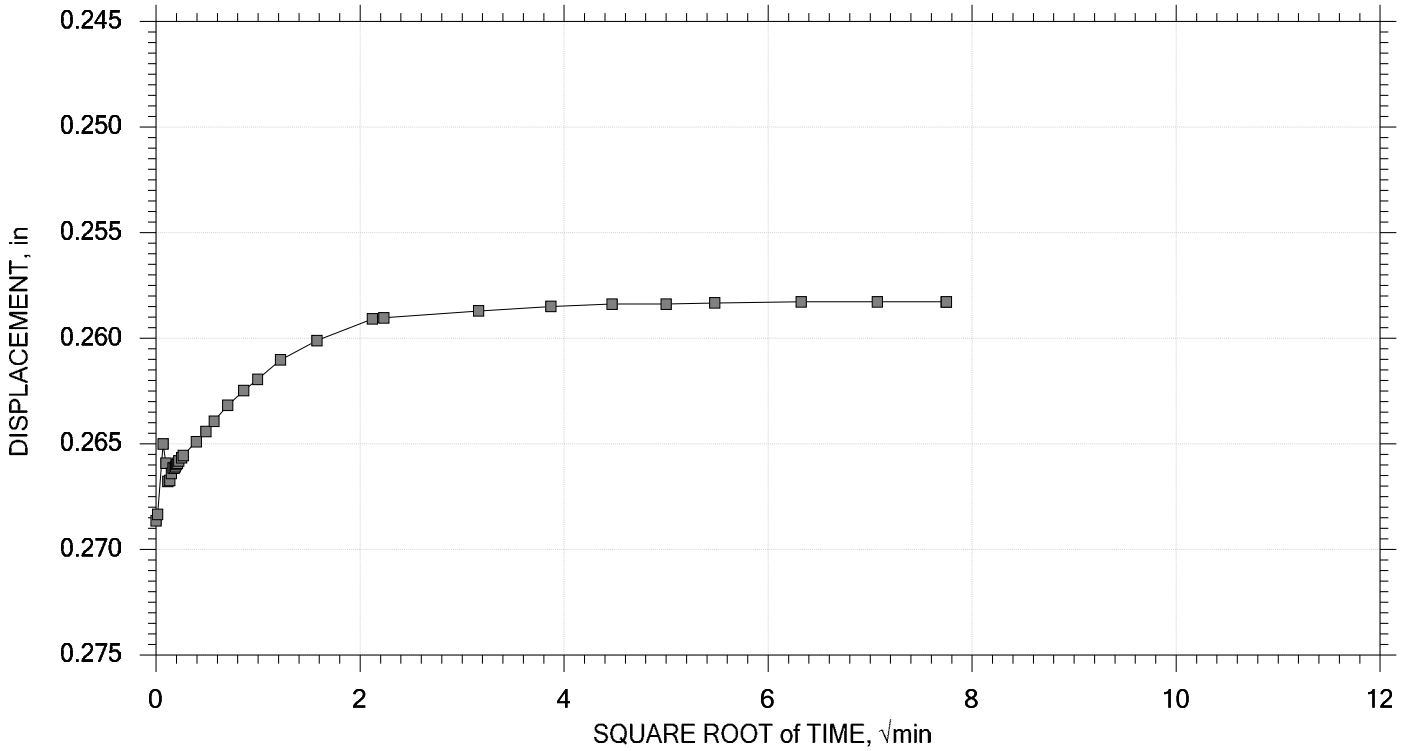
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 18 of 21

Stress: 4 tsf





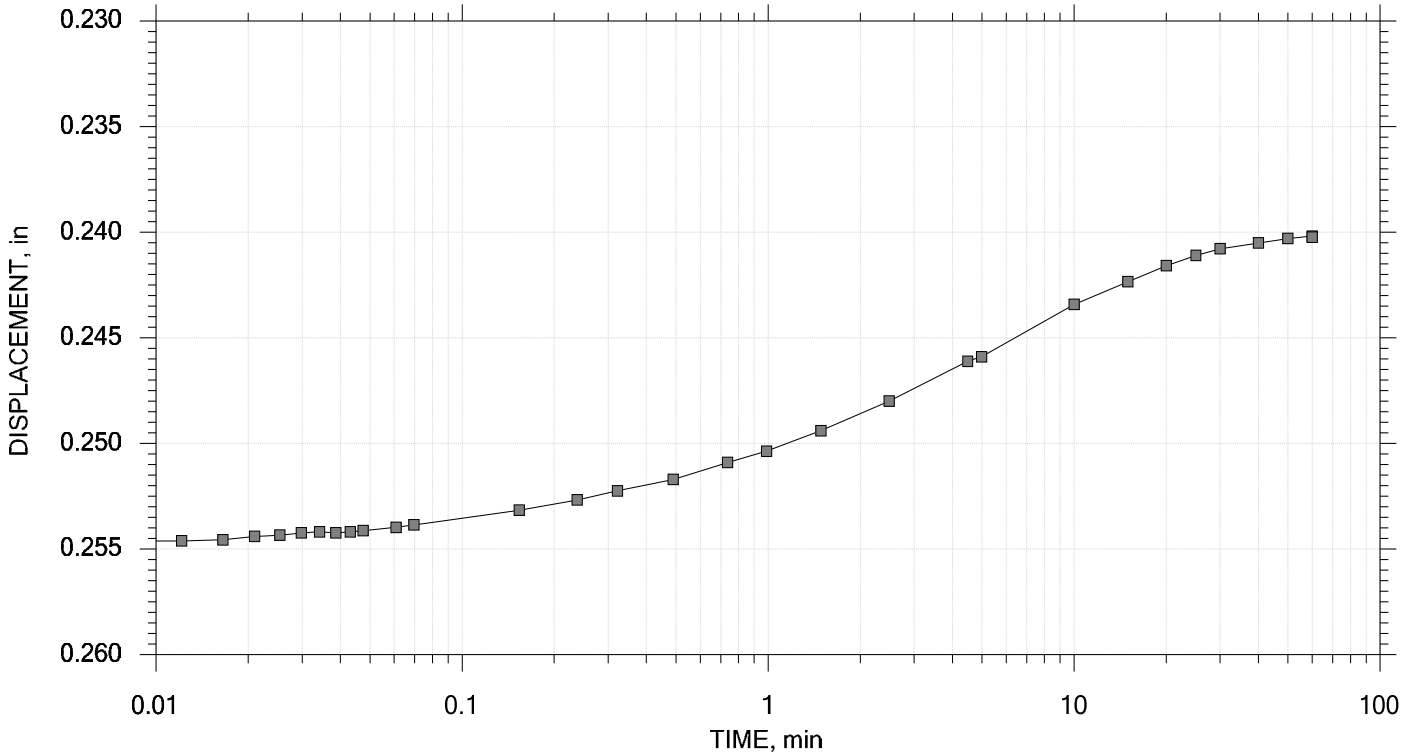
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

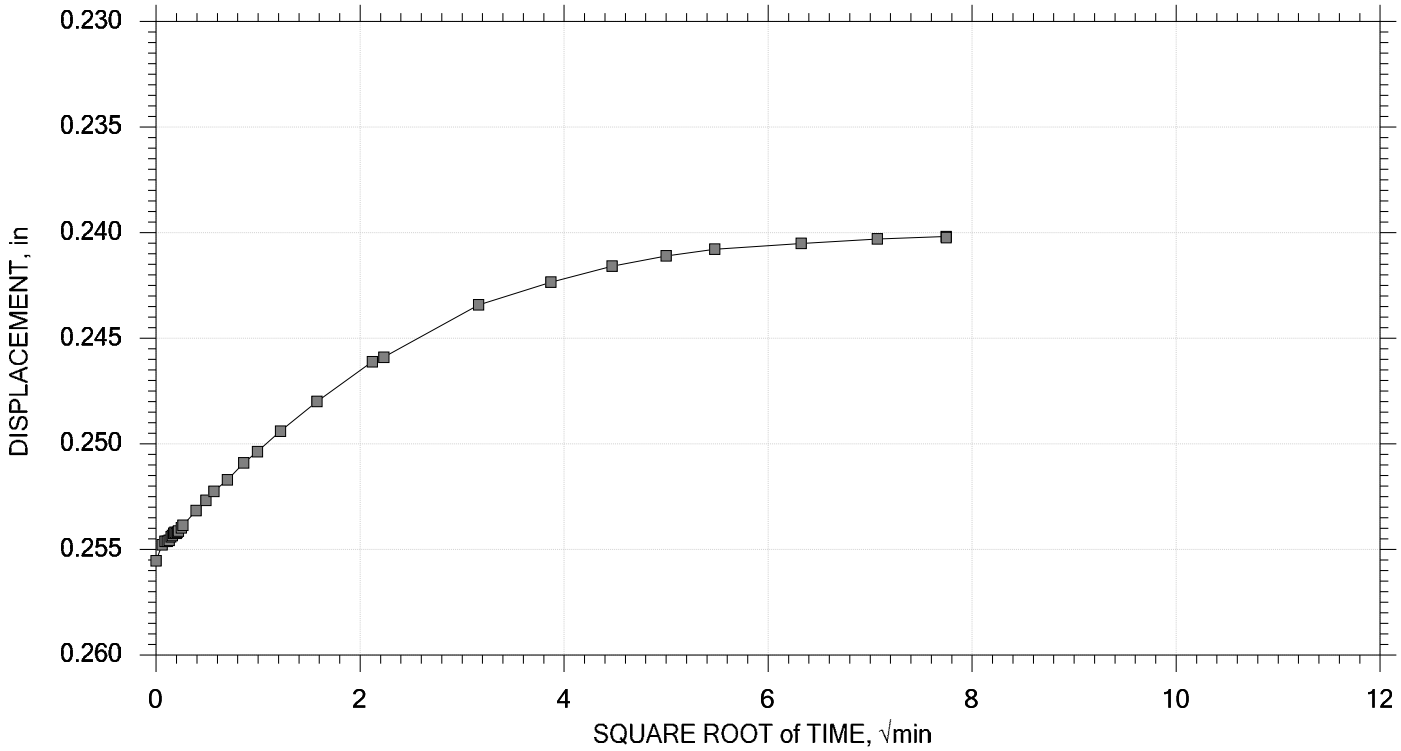
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 19 of 21

Stress: 1 tsf





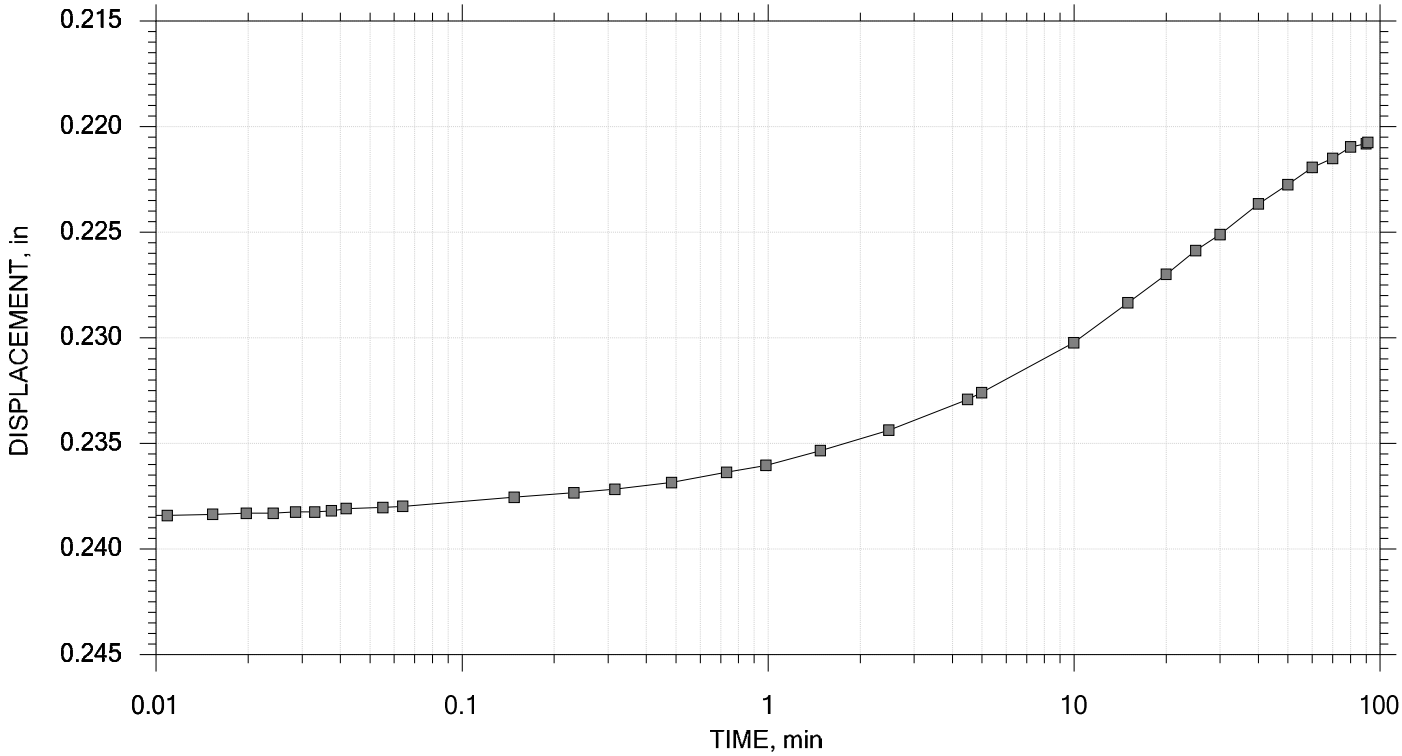
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

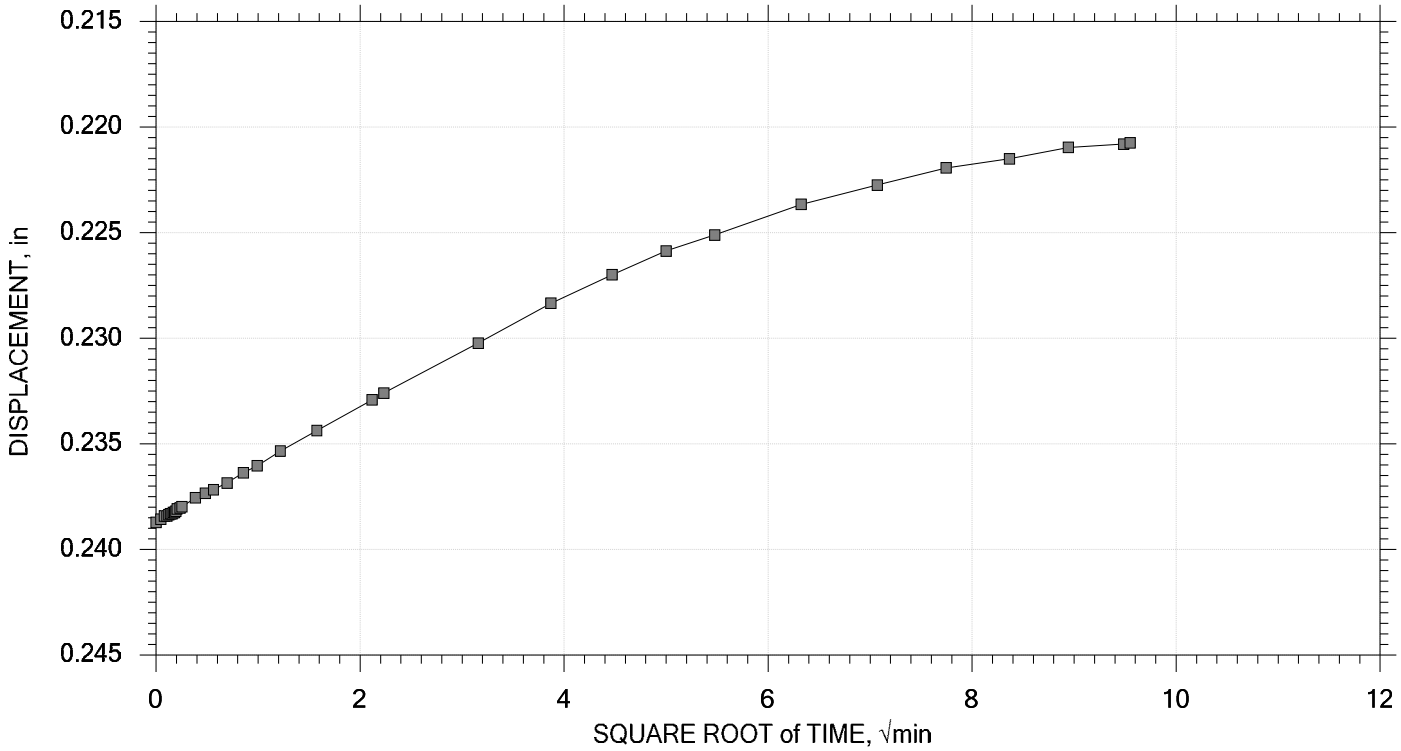
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 20 of 21

Stress: 0.25 tsf





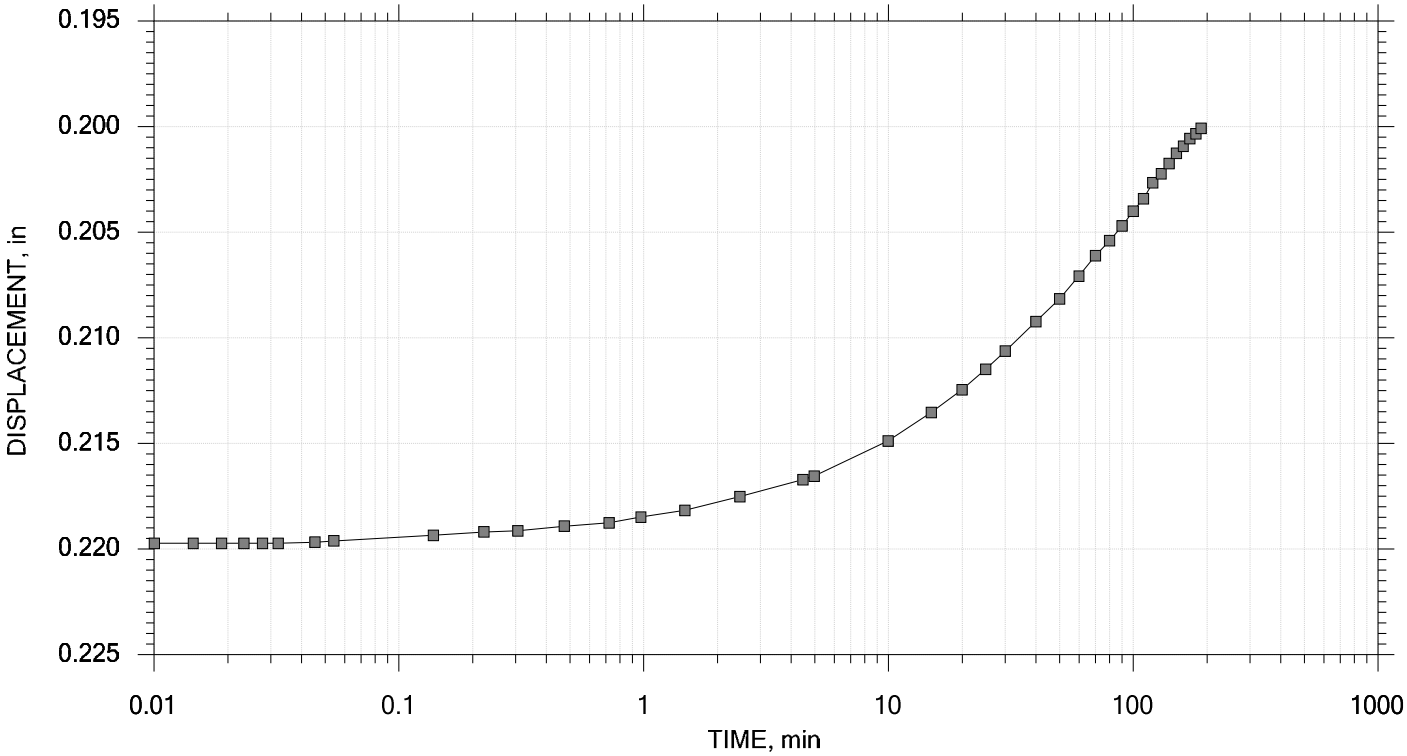
	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

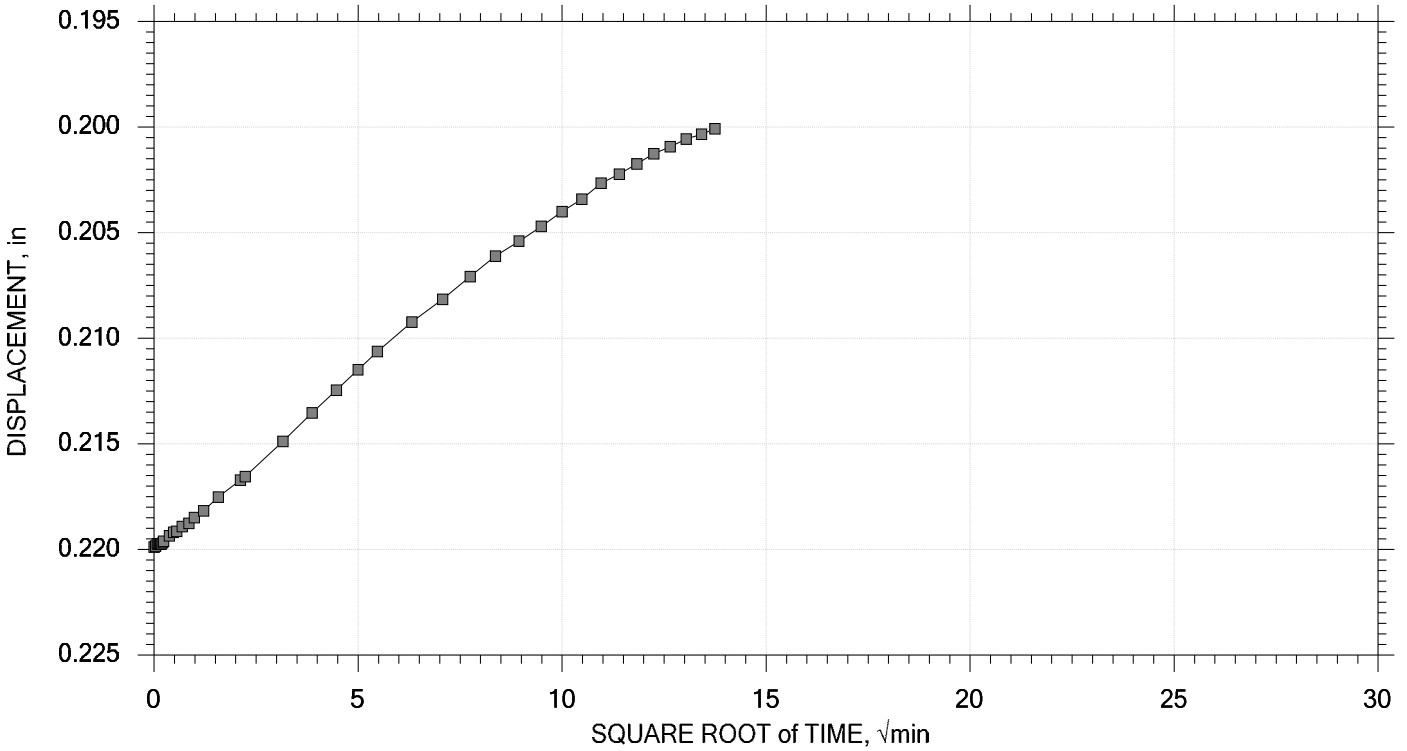
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 21 of 21

Stress: 0.0625 tsf





	Project: GORHAM	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 2/7/2018	Test No.: 303043
	Depth: 20-22.5	Sample Type: Intact	Elevation: --
	Description: Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM | Location: -- | Project No.: 18821.00
Boring No.: HB-GBB-301 | Tested By: GSL | Checked By: --
Sample No.: 1U | Test Date: 2/7/2018 | Depth: 20-22.5
Test No.: 303043 | Sample Type: Intact | Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Measured Specific Gravity: 2.77 | Liquid Limit: 37 | Specimen Diameter: 2.50 in
Initial Void Ratio: 1.27 | Plastic Limit: 25 | Initial Height: 1.00 in
Final Void Ratio: 0.870 | Plasticity Index: 12 | Final Height: 0.82 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	126	RING	RING	79
Wt. Container + Wet Soil, gm	171.57	403.89	389.88	176.88
Wt. Container + Dry Soil, gm	137.95	359.32	359.32	146.39
Wt. Container, gm	62.830	262.00	262.00	49.310
Wt. Dry Soil, gm	75.120	97.316	97.316	97.080
Water Content, %	44.76	45.80	31.41	31.41
Void Ratio	---	1.27	0.870	---
Degree of Saturation, %	---	99.97	100.00	---
Dry Unit Weight, pcf	---	76.209	92.473	---

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Boring No.: HB-GBB-301
Sample No.: 1U
Test No.: 303043

Location: --
Tested By: GSL
Test Date: 2/7/2018
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 20-22.5
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/sec	Mv 1/tsf	k ft/day
1	0.0646	0.01050	1.25	1.06	1.283	1.87e-005	1.63e-001	8.26e-003
2	0.125	0.01534	1.23	1.54	8.229	2.88e-006	8.06e-002	6.25e-004
3	0.250	0.02283	1.22	2.29	10.096	2.31e-006	6.02e-002	3.76e-004
4	0.500	0.03290	1.19	3.31	6.029	3.81e-006	4.05e-002	4.15e-004
5	1.00	0.04539	1.17	4.56	7.959	2.82e-006	2.51e-002	1.91e-004
6	2.00	0.06956	1.11	6.99	9.444	2.28e-006	2.43e-002	1.50e-004
7	4.00	0.1498	0.928	15.1	35.893	5.36e-007	4.03e-002	5.83e-005
8	8.00	0.2193	0.769	22.0	18.836	8.56e-007	1.75e-002	4.03e-005
9	4.00	0.2135	0.782	21.5	1.803	8.25e-006	1.47e-003	3.28e-005
10	2.00	0.2059	0.799	20.7	1.944	7.78e-006	3.79e-003	7.95e-005
11	1.00	0.1976	0.818	19.9	5.101	3.03e-006	8.39e-003	6.85e-005
12	0.500	0.1888	0.838	19.0	22.289	7.08e-007	1.76e-002	3.37e-005
13	1.00	0.1936	0.828	19.5	5.372	2.95e-006	9.52e-003	7.58e-005
14	2.00	0.2020	0.808	20.3	6.283	2.48e-006	8.50e-003	5.69e-005
15	4.00	0.2122	0.785	21.3	3.939	3.87e-006	5.11e-003	5.33e-005
16	8.00	0.2319	0.740	23.3	7.311	2.00e-006	4.96e-003	2.68e-005
17	16.0	0.2746	0.643	27.6	10.357	1.30e-006	5.36e-003	1.88e-005
18	4.00	0.2583	0.680	26.0	1.684	7.73e-006	1.37e-003	2.85e-005
19	1.00	0.2402	0.721	24.1	7.406	1.84e-006	6.04e-003	3.00e-005
20	0.250	0.2207	0.766	22.2	44.863	3.20e-007	2.61e-002	2.25e-005
21	0.0625	0.2001	0.813	20.1	187.257	8.07e-008	1.11e-001	2.41e-005

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/sec	Mv 1/tsf	k ft/day	Ca %
1	0.0646	0.01050	1.25	1.06	0.000	0.00e+000	1.63e-001	0.00e+000	0.00e+000
2	0.125	0.01534	1.23	1.54	0.000	0.00e+000	8.06e-002	0.00e+000	0.00e+000
3	0.250	0.02283	1.22	2.29	0.000	0.00e+000	6.02e-002	0.00e+000	0.00e+000
4	0.500	0.03290	1.19	3.31	1.831	2.91e-006	4.05e-002	3.18e-004	0.00e+000
5	1.00	0.04539	1.17	4.56	0.000	0.00e+000	2.51e-002	0.00e+000	0.00e+000
6	2.00	0.06956	1.11	6.99	2.086	2.40e-006	2.43e-002	1.57e-004	0.00e+000
7	4.00	0.1498	0.928	15.1	0.000	0.00e+000	4.03e-002	0.00e+000	0.00e+000
8	8.00	0.2193	0.769	22.0	4.662	8.03e-007	1.75e-002	3.79e-005	0.00e+000
9	4.00	0.2135	0.782	21.5	0.344	1.01e-005	1.47e-003	4.00e-005	0.00e+000
10	2.00	0.2059	0.799	20.7	0.645	5.45e-006	3.79e-003	5.57e-005	0.00e+000
11	1.00	0.1976	0.818	19.9	2.157	1.66e-006	8.39e-003	3.76e-005	0.00e+000
12	0.500	0.1888	0.838	19.0	0.000	0.00e+000	1.76e-002	0.00e+000	0.00e+000
13	1.00	0.1936	0.828	19.5	0.000	0.00e+000	9.52e-003	0.00e+000	0.00e+000
14	2.00	0.2020	0.808	20.3	2.016	1.80e-006	8.50e-003	4.12e-005	0.00e+000
15	4.00	0.2122	0.785	21.3	1.113	3.18e-006	5.11e-003	4.39e-005	0.00e+000
16	8.00	0.2319	0.740	23.3	1.939	1.76e-006	4.96e-003	2.35e-005	0.00e+000
17	16.0	0.2746	0.643	27.6	2.366	1.33e-006	5.36e-003	1.92e-005	0.00e+000
18	4.00	0.2583	0.680	26.0	0.353	8.57e-006	1.37e-003	3.16e-005	0.00e+000
19	1.00	0.2402	0.721	24.1	0.000	0.00e+000	6.04e-003	0.00e+000	0.00e+000
20	0.250	0.2207	0.766	22.2	11.684	2.85e-007	2.61e-002	2.01e-005	0.00e+000
21	0.0625	0.2001	0.813	20.1	0.000	0.00e+000	1.11e-001	0.00e+000	0.00e+000

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 18821.00
Boring No.: HB-GBB-301
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 2/7/2018
Depth: 20-22.5
Test No.: 303043
Sample Type: Intact
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 1 of 21
Applied Stress: 0.0646 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.245		0.0251	0.0000	0.0000	0.000	1.27
2	-0.241		0.0251	0.0000	0.0000	0.000	1.27
3	-0.236		0.0251	0.0000	0.0000	0.000	1.27
4	-0.232		0.0266	0.0000	0.0001077	0.0108	1.27
5	-0.228		0.0251	0.0000	0.0001077	0.0108	1.27
6	-0.223		0.0266	0.0000	0.0001615	0.0162	1.27
7	-0.219		0.0266	0.0000	0.0002154	0.0216	1.27
8	-0.214		0.0266	0.0000	0.0003230	0.0325	1.27
9	-0.210		0.0266	0.0000	0.0003769	0.0379	1.27
10	-0.206		0.0281	0.0000	0.0004846	0.0487	1.27
11	-0.201		0.0266	0.0000	0.0005922	0.0595	1.27
12	-0.197		0.0266	0.0000	0.0006461	0.0649	1.27
13	-0.192		0.0281	0.0000	0.0007538	0.0758	1.27
14	-0.188		0.0281	0.0000	0.0009153	0.0920	1.27
15	-0.183		0.0281	0.0000	0.001023	0.103	1.27
16	-0.166		0.0296	0.0000	0.001615	0.162	1.27
17	-0.161		0.0312	0.0000	0.001777	0.179	1.27
18	-0.077		0.0479	0.0000	0.005815	0.584	1.26
19	0.000	0.000	0.0563	0.0000	0.008145	0.819	1.25
20	0.007	0.082	0.0570	0.0000	0.008345	0.839	1.25
21	0.091	0.301	0.0585	0.0000	0.008722	0.877	1.25
22	0.259	0.509	0.0600	0.0000	0.009207	0.925	1.25
23	0.506	0.711	0.0615	0.0000	0.009530	0.958	1.25
24	0.758	0.871	0.0615	0.0000	0.009691	0.974	1.25
25	1.257	1.121	0.0600	0.0000	0.009960	1.00	1.25
26	2.256	1.502	0.0600	0.0000	0.01012	1.02	1.25
27	4.259	2.064	0.0615	0.0000	0.01028	1.03	1.25
28	4.758	2.181	0.0615	0.0000	0.01028	1.03	1.25
29	9.757	3.124	0.0615	0.0000	0.01039	1.04	1.25
30	14.756	3.841	0.0615	0.0000	0.01044	1.05	1.25
31	19.755	4.445	0.0615	0.0000	0.01039	1.04	1.25
32	24.758	4.976	0.0615	0.0000	0.01039	1.04	1.25
33	29.757	5.455	0.0630	0.0000	0.01039	1.04	1.25
34	39.755	6.305	0.0630	0.0000	0.01044	1.05	1.25
35	49.758	7.054	0.0646	0.0000	0.01055	1.06	1.25
36	59.756	7.730	0.0646	0.0000	0.01050	1.06	1.25
37	59.765	7.731	0.0646	0.0000	0.01050	1.06	1.25

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 18821.00
Boring No.: HB-GBB-301
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 2/7/2018
Depth: 20-22.5
Test No.: 303043
Sample Type: Intact
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 2 of 21
Applied Stress: 0.125 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.075		0.0646	0.0000	0.01050	1.06	1.25
2	-0.070		0.0646	0.0000	0.01050	1.06	1.25
3	-0.066		0.0676	0.0000	0.01050	1.06	1.25
4	-0.061		0.0706	0.0000	0.01061	1.07	1.24
5	-0.057		0.0722	0.0000	0.01071	1.08	1.24
6	-0.052		0.0782	0.0000	0.01082	1.09	1.24
7	-0.048		0.0813	0.0000	0.01093	1.10	1.24
8	-0.044		0.0843	0.0000	0.01093	1.10	1.24
9	-0.039		0.0873	0.0000	0.01109	1.11	1.24
10	-0.035		0.0919	0.0000	0.01114	1.12	1.24
11	-0.030		0.0964	0.0000	0.01125	1.13	1.24
12	-0.026		0.0995	0.0000	0.01136	1.14	1.24
13	-0.022		0.103	0.0000	0.01147	1.15	1.24
14	-0.017		0.106	0.0000	0.01152	1.16	1.24
15	-0.013		0.109	0.0000	0.01168	1.17	1.24
16	0.000	0.000	0.119	0.0000	0.01210	1.22	1.24
17	0.001	0.024	0.119	0.0000	0.01211	1.22	1.24
18	0.009	0.097	0.125	0.0000	0.01238	1.24	1.24
19	0.093	0.306	0.124	0.0000	0.01265	1.27	1.24
20	0.177	0.421	0.124	0.0000	0.01281	1.29	1.24
21	0.261	0.511	0.122	0.0000	0.01292	1.30	1.24
22	0.429	0.655	0.125	0.0000	0.01314	1.32	1.24
23	0.677	0.823	0.125	0.0000	0.01335	1.34	1.24
24	0.929	0.964	0.125	0.0000	0.01351	1.36	1.24
25	1.428	1.195	0.125	0.0000	0.01373	1.38	1.24
26	2.427	1.558	0.125	0.0000	0.01405	1.41	1.24
27	4.429	2.105	0.125	0.0000	0.01432	1.44	1.24
28	4.929	2.220	0.125	0.0000	0.01438	1.44	1.24
29	9.928	3.151	0.125	0.0000	0.01475	1.48	1.24
30	14.927	3.864	0.125	0.0000	0.01497	1.50	1.23
31	19.926	4.464	0.125	0.0000	0.01508	1.52	1.23
32	24.929	4.993	0.125	0.0000	0.01508	1.52	1.23
33	29.928	5.471	0.125	0.0000	0.01518	1.53	1.23
34	39.926	6.319	0.125	0.0000	0.01529	1.54	1.23
35	49.928	7.066	0.125	0.0000	0.01534	1.54	1.23
36	59.926	7.741	0.125	0.0000	0.01529	1.54	1.23
37	59.935	7.742	0.125	0.0000	0.01534	1.54	1.23

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 18821.00
Boring No.: HB-GBB-301
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 2/7/2018
Depth: 20-22.5
Test No.: 303043
Sample Type: Intact
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 3 of 21
Applied Stress: 0.250 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.059		0.125	0.0000	0.01529	1.54	1.23
2	-0.055		0.125	0.0000	0.01529	1.54	1.23
3	-0.050		0.147	0.0000	0.01551	1.56	1.23
4	-0.046		0.147	0.0000	0.01551	1.56	1.23
5	-0.041		0.159	0.0000	0.01556	1.56	1.23
6	-0.037		0.168	0.0000	0.01578	1.59	1.23
7	-0.033		0.178	0.0000	0.01599	1.61	1.23
8	-0.028		0.188	0.0000	0.01615	1.62	1.23
9	-0.024		0.198	0.0000	0.01631	1.64	1.23
10	-0.019		0.206	0.0000	0.01642	1.65	1.23
11	-0.015		0.212	0.0000	0.01664	1.67	1.23
12	-0.010		0.219	0.0000	0.01680	1.69	1.23
13	-0.006		0.227	0.0000	0.01707	1.72	1.23
14	-0.002		0.233	0.0000	0.01723	1.73	1.23
15	0.000	0.000	0.238	0.0000	0.01737	1.75	1.23
16	0.003	0.053	0.245	0.0000	0.01761	1.77	1.23
17	0.016	0.127	0.239	0.0000	0.01777	1.79	1.23
18	0.025	0.158	0.238	0.0000	0.01777	1.79	1.23
19	0.109	0.330	0.242	0.0000	0.01820	1.83	1.23
20	0.193	0.439	0.245	0.0000	0.01841	1.85	1.23
21	0.277	0.526	0.245	0.0000	0.01868	1.88	1.23
22	0.445	0.667	0.247	0.0000	0.01890	1.90	1.23
23	0.692	0.832	0.248	0.0000	0.01917	1.93	1.23
24	0.944	0.972	0.248	0.0000	0.01944	1.95	1.22
25	1.444	1.202	0.248	0.0000	0.01971	1.98	1.22
26	2.443	1.563	0.248	0.0000	0.02024	2.03	1.22
27	4.445	2.108	0.250	0.0000	0.02078	2.09	1.22
28	4.944	2.224	0.250	0.0000	0.02089	2.10	1.22
29	9.943	3.153	0.250	0.0000	0.02159	2.17	1.22
30	14.942	3.866	0.250	0.0000	0.02202	2.21	1.22
31	19.941	4.466	0.250	0.0000	0.02224	2.23	1.22
32	24.945	4.994	0.250	0.0000	0.02234	2.25	1.22
33	29.944	5.472	0.250	0.0000	0.02245	2.26	1.22
34	39.941	6.320	0.250	0.0000	0.02261	2.27	1.22
35	49.944	7.067	0.250	0.0000	0.02261	2.27	1.22
36	59.942	7.742	0.250	0.0000	0.02283	2.29	1.22
37	59.960	7.743	0.250	0.0000	0.02283	2.29	1.22

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Boring No.: HB-GBB-301
Sample No.: 1U
Test No.: 303043

Location: --
Tested By: GSL
Test Date: 2/7/2018
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 20-22.5
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 4 of 21
Applied Stress: 0.500 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.038		0.250	0.0000	0.02288	2.30	1.22
2	-0.033		0.250	0.0000	0.02288	2.30	1.22
3	-0.029		0.263	0.0000	0.02294	2.31	1.22
4	-0.025		0.282	0.0000	0.02310	2.32	1.22
5	-0.020		0.332	0.0000	0.02347	2.36	1.22
6	-0.016		0.394	0.0000	0.02407	2.42	1.21
7	-0.011		0.415	0.0000	0.02423	2.43	1.21
8	-0.007		0.415	0.0000	0.02423	2.43	1.21
9	-0.003		0.452	0.0000	0.02460	2.47	1.21
10	0.000	0.000	0.475	0.0000	0.02488	2.50	1.21
11	0.002	0.044	0.493	0.0000	0.02509	2.52	1.21
12	0.006	0.079	0.493	0.0000	0.02509	2.52	1.21
13	0.011	0.104	0.490	0.0000	0.02525	2.54	1.21
14	0.015	0.123	0.477	0.0000	0.02530	2.54	1.21
15	0.020	0.140	0.473	0.0000	0.02536	2.55	1.21
16	0.024	0.155	0.473	0.0000	0.02536	2.55	1.21
17	0.037	0.193	0.484	0.0000	0.02552	2.56	1.21
18	0.046	0.215	0.488	0.0000	0.02563	2.58	1.21
19	0.130	0.361	0.500	0.0000	0.02606	2.62	1.21
20	0.214	0.463	0.493	0.0000	0.02654	2.67	1.21
21	0.298	0.546	0.496	0.0000	0.02670	2.68	1.21
22	0.466	0.683	0.502	0.0000	0.02703	2.72	1.21
23	0.714	0.845	0.499	0.0000	0.02751	2.77	1.21
24	0.966	0.983	0.499	0.0000	0.02789	2.80	1.21
25	1.465	1.210	0.500	0.0000	0.02848	2.86	1.20
26	2.464	1.570	0.500	0.0000	0.02918	2.93	1.20
27	4.466	2.113	0.502	0.0000	0.03004	3.02	1.20
28	4.966	2.228	0.502	0.0000	0.03026	3.04	1.20
29	9.964	3.157	0.502	0.0000	0.03133	3.15	1.20
30	14.963	3.868	0.500	0.0000	0.03182	3.20	1.20
31	19.962	4.468	0.502	0.0000	0.03198	3.21	1.20
32	24.966	4.997	0.502	0.0000	0.03214	3.23	1.20
33	29.965	5.474	0.500	0.0000	0.03230	3.25	1.20
34	39.963	6.322	0.502	0.0000	0.03252	3.27	1.19
35	49.965	7.069	0.502	0.0000	0.03279	3.30	1.19
36	59.963	7.744	0.502	0.0000	0.03290	3.31	1.19
37	59.994	7.746	0.502	0.0000	0.03290	3.31	1.19

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 18821.00
Boring No.: HB-GBB-301
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 2/7/2018
Depth: 20-22.5
Test No.: 303043
Sample Type: Intact
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 5 of 21
Applied Stress: 1.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.028		0.502	0.0000	0.03290	3.31	1.19
2	-0.024		0.502	0.0000	0.03290	3.31	1.19
3	-0.019		0.594	0.0000	0.03317	3.33	1.19
4	-0.015		0.695	0.0000	0.03354	3.37	1.19
5	-0.010		0.784	0.0000	0.03392	3.41	1.19
6	-0.006		0.863	0.0000	0.03424	3.44	1.19
7	-0.001		0.931	0.0000	0.03451	3.47	1.19
8	0.000	0.000	0.950	0.0000	0.03465	3.48	1.19
9	0.003	0.055	0.989	0.0000	0.03494	3.51	1.19
10	0.007	0.086	0.983	0.0000	0.03510	3.53	1.19
11	0.012	0.109	0.959	0.0000	0.03516	3.53	1.19
12	0.016	0.128	0.956	0.0000	0.03516	3.53	1.19
13	0.021	0.144	0.957	0.0000	0.03527	3.54	1.19
14	0.025	0.158	0.965	0.0000	0.03532	3.55	1.19
15	0.030	0.172	0.974	0.0000	0.03537	3.56	1.19
16	0.034	0.184	0.981	0.0000	0.03543	3.56	1.19
17	0.047	0.217	1.00	0.0000	0.03564	3.58	1.19
18	0.056	0.237	0.983	0.0000	0.03570	3.59	1.19
19	0.140	0.374	1.00	0.0000	0.03623	3.64	1.19
20	0.224	0.473	0.995	0.0000	0.03650	3.67	1.19
21	0.308	0.555	0.995	0.0000	0.03683	3.70	1.19
22	0.476	0.690	0.997	0.0000	0.03726	3.74	1.18
23	0.723	0.851	1.00	0.0000	0.03769	3.79	1.18
24	0.975	0.988	1.00	0.0000	0.03812	3.83	1.18
25	1.475	1.214	1.00	0.0000	0.03871	3.89	1.18
26	2.474	1.573	1.00	0.0000	0.03968	3.99	1.18
27	4.476	2.116	1.00	0.0000	0.04092	4.11	1.18
28	4.975	2.231	1.00	0.0000	0.04119	4.14	1.18
29	9.974	3.158	1.00	0.0000	0.04275	4.30	1.17
30	14.973	3.870	1.00	0.0000	0.04361	4.38	1.17
31	19.972	4.469	1.00	0.0000	0.04404	4.43	1.17
32	24.976	4.998	1.00	0.0000	0.04431	4.45	1.17
33	29.975	5.475	1.00	0.0000	0.04458	4.48	1.17
34	39.973	6.322	1.00	0.0000	0.04490	4.51	1.17
35	49.975	7.069	1.00	0.0000	0.04533	4.56	1.17
36	59.973	7.744	1.00	0.0000	0.04539	4.56	1.17
37	60.000	7.746	1.00	0.0000	0.04539	4.56	1.17

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 18821.00
Boring No.: HB-GBB-301
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 2/7/2018
Depth: 20-22.5
Test No.: 303043
Sample Type: Intact
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 6 of 21
Applied Stress: 2.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.024		1.00	0.0000	0.04539	4.56	1.17
2	-0.019		1.00	0.0000	0.04539	4.56	1.17
3	-0.015		1.27	0.0000	0.04593	4.62	1.16
4	-0.010		1.52	0.0000	0.04652	4.68	1.16
5	-0.006		1.69	0.0000	0.04716	4.74	1.16
6	-0.002		1.86	0.0000	0.04770	4.79	1.16
7	0.000	0.000	1.90	0.0000	0.04791	4.81	1.16
8	0.003	0.054	1.98	0.0000	0.04829	4.85	1.16
9	0.007	0.085	1.98	0.0000	0.04867	4.89	1.16
10	0.012	0.108	1.91	0.0000	0.04873	4.90	1.16
11	0.016	0.127	1.91	0.0000	0.04889	4.91	1.16
12	0.021	0.143	1.94	0.0000	0.04916	4.94	1.16
13	0.025	0.158	1.94	0.0000	0.04916	4.94	1.16
14	0.029	0.171	1.96	0.0000	0.04921	4.95	1.16
15	0.034	0.184	1.98	0.0000	0.04937	4.96	1.16
16	0.038	0.196	2.00	0.0000	0.04948	4.97	1.16
17	0.052	0.227	1.96	0.0000	0.04964	4.99	1.16
18	0.060	0.246	1.96	0.0000	0.04975	5.00	1.16
19	0.144	0.380	1.98	0.0000	0.05077	5.10	1.15
20	0.228	0.478	2.00	0.0000	0.05153	5.18	1.15
21	0.312	0.559	2.00	0.0000	0.05201	5.23	1.15
22	0.480	0.693	2.00	0.0000	0.05287	5.31	1.15
23	0.728	0.853	2.01	0.0000	0.05384	5.41	1.15
24	0.980	0.990	2.00	0.0000	0.05465	5.49	1.14
25	1.479	1.216	2.00	0.0000	0.05589	5.62	1.14
26	2.478	1.574	2.01	0.0000	0.05782	5.81	1.14
27	4.480	2.117	2.00	0.0000	0.06030	6.06	1.13
28	4.980	2.232	2.01	0.0000	0.06073	6.10	1.13
29	9.979	3.159	2.01	0.0000	0.06364	6.40	1.12
30	14.978	3.870	2.01	0.0000	0.06520	6.55	1.12
31	19.977	4.470	2.01	0.0000	0.06601	6.63	1.12
32	24.980	4.998	2.01	0.0000	0.06692	6.73	1.12
33	29.979	5.475	2.01	0.0000	0.06752	6.79	1.12
34	39.977	6.323	2.01	0.0000	0.06838	6.87	1.11
35	49.979	7.070	2.01	0.0000	0.06908	6.94	1.11
36	59.977	7.744	2.01	0.0000	0.06951	6.99	1.11
37	60.004	7.746	2.01	0.0000	0.06956	6.99	1.11

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 18821.00
Boring No.: HB-GBB-301
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 2/7/2018
Depth: 20-22.5
Test No.: 303043
Sample Type: Intact
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 7 of 21
Applied Stress: 4.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.018		2.01	0.0000	0.06956	6.99	1.11
2	-0.014		2.01	0.0000	0.06956	6.99	1.11
3	-0.009		2.73	0.0000	0.07026	7.06	1.11
4	-0.005		3.39	0.0000	0.07134	7.17	1.11
5	-0.000		3.78	0.0000	0.07236	7.27	1.10
6	0.000	0.000	3.80	0.0000	0.07243	7.28	1.10
7	0.004	0.063	3.95	0.0000	0.07301	7.34	1.10
8	0.008	0.091	3.95	0.0000	0.07301	7.34	1.10
9	0.013	0.113	3.95	0.0000	0.07301	7.34	1.10
10	0.017	0.131	3.95	0.0000	0.07301	7.34	1.10
11	0.022	0.147	3.95	0.0000	0.07301	7.34	1.10
12	0.026	0.161	3.95	0.0000	0.07301	7.34	1.10
13	0.030	0.175	3.95	0.0000	0.07301	7.34	1.10
14	0.035	0.187	3.99	0.0000	0.07446	7.48	1.10
15	0.039	0.198	4.01	0.0000	0.07468	7.51	1.10
16	0.044	0.209	3.94	0.0000	0.07468	7.51	1.10
17	0.057	0.239	3.94	0.0000	0.07505	7.54	1.10
18	0.066	0.257	3.98	0.0000	0.07527	7.56	1.10
19	0.150	0.387	3.98	0.0000	0.07678	7.72	1.09
20	0.234	0.484	3.97	0.0000	0.07796	7.84	1.09
21	0.318	0.564	4.00	0.0000	0.07904	7.94	1.09
22	0.486	0.697	4.00	0.0000	0.08081	8.12	1.08
23	0.733	0.856	4.01	0.0000	0.08318	8.36	1.08
24	0.985	0.993	4.01	0.0000	0.08512	8.55	1.07
25	1.485	1.218	4.00	0.0000	0.08851	8.90	1.07
26	2.484	1.576	3.99	0.0000	0.09379	9.43	1.06
27	4.486	2.118	4.00	0.0000	0.1020	10.2	1.04
28	4.985	2.233	4.01	0.0000	0.1036	10.4	1.03
29	9.984	3.160	4.01	0.0000	0.1160	11.7	1.00
30	14.983	3.871	4.01	0.0000	0.1240	12.5	0.986
31	19.982	4.470	4.01	0.0000	0.1295	13.0	0.974
32	24.986	4.999	4.01	0.0000	0.1338	13.5	0.964
33	29.984	5.476	4.01	0.0000	0.1370	13.8	0.957
34	39.982	6.323	4.01	0.0000	0.1420	14.3	0.945
35	49.985	7.070	4.01	0.0000	0.1456	14.6	0.937
36	59.983	7.745	4.01	0.0000	0.1482	14.9	0.931
37	67.926	8.242	4.02	0.0000	0.1498	15.1	0.928

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 18821.00
Boring No.: HB-GBB-301
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 2/7/2018
Depth: 20-22.5
Test No.: 303043
Sample Type: Intact
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 8 of 21
Applied Stress: 8.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.013		4.02	0.0000	0.1498	15.1	0.928
2	-0.009		4.02	0.0000	0.1498	15.1	0.928
3	-0.004		5.70	0.0000	0.1510	15.2	0.925
4	0.000	0.000	7.60	0.0000	0.1529	15.4	0.920
5	0.000	0.013	7.68	0.0000	0.1530	15.4	0.920
6	0.005	0.068	8.06	0.0000	0.1538	15.5	0.918
7	0.009	0.095	7.72	0.0000	0.1539	15.5	0.918
8	0.013	0.116	7.81	0.0000	0.1541	15.5	0.918
9	0.018	0.134	7.89	0.0000	0.1544	15.5	0.917
10	0.022	0.149	7.95	0.0000	0.1546	15.5	0.916
11	0.027	0.163	7.99	0.0000	0.1548	15.6	0.916
12	0.031	0.176	8.02	0.0000	0.1550	15.6	0.916
13	0.036	0.189	8.00	0.0000	0.1552	15.6	0.915
14	0.040	0.200	7.87	0.0000	0.1553	15.6	0.915
15	0.044	0.211	7.89	0.0000	0.1554	15.6	0.915
16	0.049	0.221	7.93	0.0000	0.1555	15.6	0.914
17	0.062	0.249	8.01	0.0000	0.1560	15.7	0.913
18	0.071	0.266	8.03	0.0000	0.1562	15.7	0.913
19	0.155	0.394	8.03	0.0000	0.1581	15.9	0.908
20	0.239	0.489	8.00	0.0000	0.1596	16.0	0.905
21	0.323	0.568	7.97	0.0000	0.1609	16.2	0.902
22	0.491	0.701	8.03	0.0000	0.1632	16.4	0.897
23	0.738	0.859	8.03	0.0000	0.1657	16.6	0.891
24	0.990	0.995	7.99	0.0000	0.1679	16.9	0.886
25	1.490	1.221	8.01	0.0000	0.1716	17.2	0.878
26	2.489	1.578	8.03	0.0000	0.1773	17.8	0.865
27	4.491	2.119	8.02	0.0000	0.1857	18.7	0.845
28	4.990	2.234	8.02	0.0000	0.1874	18.8	0.842
29	9.989	3.161	8.03	0.0000	0.1997	20.1	0.814
30	14.988	3.871	8.03	0.0000	0.2065	20.8	0.798
31	19.987	4.471	8.03	0.0000	0.2104	21.1	0.789
32	24.991	4.999	8.03	0.0000	0.2129	21.4	0.784
33	29.990	5.476	8.02	0.0000	0.2147	21.6	0.780
34	39.987	6.324	8.04	0.0000	0.2169	21.8	0.774
35	49.990	7.070	8.03	0.0000	0.2183	21.9	0.771
36	59.988	7.745	8.03	0.0000	0.2193	22.0	0.769
37	60.006	7.746	8.03	0.0000	0.2193	22.0	0.769

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Boring No.: HB-GBB-301
Sample No.: 1U
Test No.: 303043

Location: --
Tested By: GSL
Test Date: 2/7/2018
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 20-22.5
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 9 of 21
Applied Stress: 4.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.012		8.03	0.0000	0.2193	22.0	0.769
2	-0.008		8.03	0.0000	0.2193	22.0	0.769
3	-0.003		6.28	0.0000	0.2185	22.0	0.771
4	0.000	0.000	4.40	0.0000	0.2171	21.8	0.774
5	0.001	0.030	3.90	0.0000	0.2168	21.8	0.775
6	0.005	0.073	3.78	0.0000	0.2165	21.8	0.775
7	0.010	0.099	3.89	0.0000	0.2165	21.8	0.775
8	0.014	0.119	4.07	0.0000	0.2167	21.8	0.775
9	0.019	0.136	4.12	0.0000	0.2166	21.8	0.775
10	0.023	0.152	4.16	0.0000	0.2166	21.8	0.775
11	0.027	0.166	4.18	0.0000	0.2166	21.8	0.775
12	0.032	0.179	4.04	0.0000	0.2165	21.8	0.775
13	0.036	0.191	4.02	0.0000	0.2163	21.7	0.776
14	0.041	0.202	4.05	0.0000	0.2163	21.7	0.776
15	0.045	0.212	4.05	0.0000	0.2163	21.7	0.776
16	0.050	0.223	4.04	0.0000	0.2162	21.7	0.776
17	0.067	0.259	4.03	0.0000	0.2162	21.7	0.776
18	0.072	0.268	4.04	0.0000	0.2162	21.7	0.776
19	0.156	0.394	4.02	0.0000	0.2158	21.7	0.777
20	0.240	0.490	4.02	0.0000	0.2155	21.7	0.778
21	0.324	0.569	4.02	0.0000	0.2154	21.6	0.778
22	0.492	0.701	4.02	0.0000	0.2149	21.6	0.779
23	0.739	0.860	4.02	0.0000	0.2147	21.6	0.779
24	0.991	0.996	4.02	0.0000	0.2144	21.6	0.780
25	1.490	1.221	4.02	0.0000	0.2141	21.5	0.781
26	2.489	1.578	4.01	0.0000	0.2138	21.5	0.782
27	4.492	2.119	4.01	0.0000	0.2137	21.5	0.782
28	4.991	2.234	4.02	0.0000	0.2136	21.5	0.782
29	9.990	3.161	4.02	0.0000	0.2137	21.5	0.782
30	14.989	3.872	4.01	0.0000	0.2136	21.5	0.782
31	19.988	4.471	4.01	0.0000	0.2136	21.5	0.782
32	24.991	4.999	4.02	0.0000	0.2136	21.5	0.782
33	29.990	5.476	4.01	0.0000	0.2135	21.5	0.782
34	39.988	6.324	4.01	0.0000	0.2136	21.5	0.782
35	49.991	7.070	4.01	0.0000	0.2136	21.5	0.782
36	59.989	7.745	4.02	0.0000	0.2135	21.5	0.782
37	60.015	7.747	4.02	0.0000	0.2135	21.5	0.782

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 18821.00
Boring No.: HB-GBB-301
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 2/7/2018
Depth: 20-22.5
Test No.: 303043
Sample Type: Intact
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 10 of 21
Applied Stress: 2.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.013		4.01	0.0000	0.2135	21.5	0.782
2	-0.009		3.39	0.0000	0.2129	21.4	0.784
3	-0.004		3.39	0.0000	0.2129	21.4	0.784
4	0.000	0.000	2.20	0.0000	0.2119	21.3	0.786
5	0.000	0.017	2.12	0.0000	0.2119	21.3	0.786
6	0.005	0.069	1.96	0.0000	0.2116	21.3	0.787
7	0.009	0.096	2.06	0.0000	0.2115	21.3	0.787
8	0.014	0.116	2.06	0.0000	0.2115	21.3	0.787
9	0.018	0.134	2.08	0.0000	0.2115	21.3	0.787
10	0.022	0.150	2.04	0.0000	0.2114	21.2	0.787
11	0.027	0.164	2.02	0.0000	0.2114	21.2	0.787
12	0.031	0.177	2.01	0.0000	0.2113	21.2	0.787
13	0.036	0.189	2.03	0.0000	0.2112	21.2	0.787
14	0.040	0.200	2.04	0.0000	0.2112	21.2	0.787
15	0.044	0.211	2.03	0.0000	0.2112	21.2	0.788
16	0.049	0.221	2.03	0.0000	0.2112	21.2	0.788
17	0.062	0.249	2.01	0.0000	0.2109	21.2	0.788
18	0.071	0.266	2.03	0.0000	0.2108	21.2	0.788
19	0.155	0.394	2.01	0.0000	0.2104	21.1	0.789
20	0.239	0.489	2.02	0.0000	0.2100	21.1	0.790
21	0.323	0.568	2.01	0.0000	0.2098	21.1	0.791
22	0.491	0.701	2.01	0.0000	0.2095	21.1	0.791
23	0.738	0.859	2.01	0.0000	0.2090	21.0	0.792
24	0.990	0.995	2.01	0.0000	0.2088	21.0	0.793
25	1.490	1.221	2.01	0.0000	0.2081	20.9	0.795
26	2.489	1.578	2.01	0.0000	0.2074	20.8	0.796
27	4.491	2.119	2.01	0.0000	0.2068	20.8	0.797
28	4.990	2.234	2.01	0.0000	0.2068	20.8	0.797
29	9.989	3.161	2.01	0.0000	0.2063	20.7	0.799
30	14.988	3.871	2.01	0.0000	0.2061	20.7	0.799
31	19.987	4.471	2.01	0.0000	0.2063	20.7	0.799
32	24.991	4.999	2.01	0.0000	0.2061	20.7	0.799
33	29.990	5.476	2.01	0.0000	0.2063	20.7	0.799
34	39.988	6.324	2.01	0.0000	0.2058	20.7	0.800
35	49.990	7.070	2.01	0.0000	0.2057	20.7	0.800
36	59.988	7.745	2.01	0.0000	0.2059	20.7	0.799
37	60.006	7.746	2.01	0.0000	0.2059	20.7	0.799

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Boring No.: HB-GBB-301
Sample No.: 1U
Test No.: 303043

Location: --
Tested By: GSL
Test Date: 2/7/2018
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 20-22.5
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 11 of 21
Applied Stress: 1.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.016		2.01	0.0000	0.2059	20.7	0.799
2	-0.012		2.01	0.0000	0.2059	20.7	0.799
3	-0.008		1.79	0.0000	0.2057	20.7	0.800
4	-0.003		1.30	0.0000	0.2049	20.6	0.802
5	0.000	0.000	1.10	0.0000	0.2045	20.6	0.803
6	0.001	0.034	1.03	0.0000	0.2044	20.5	0.803
7	0.006	0.075	0.988	0.0000	0.2042	20.5	0.803
8	0.010	0.100	1.02	0.0000	0.2042	20.5	0.803
9	0.014	0.120	1.05	0.0000	0.2042	20.5	0.803
10	0.019	0.137	1.05	0.0000	0.2041	20.5	0.804
11	0.023	0.153	1.03	0.0000	0.2041	20.5	0.804
12	0.028	0.166	1.02	0.0000	0.2040	20.5	0.804
13	0.032	0.179	1.01	0.0000	0.2039	20.5	0.804
14	0.037	0.191	1.01	0.0000	0.2038	20.5	0.804
15	0.041	0.202	1.02	0.0000	0.2039	20.5	0.804
16	0.045	0.213	1.02	0.0000	0.2038	20.5	0.804
17	0.059	0.242	1.01	0.0000	0.2038	20.5	0.804
18	0.067	0.260	1.00	0.0000	0.2037	20.5	0.804
19	0.151	0.389	1.01	0.0000	0.2034	20.4	0.805
20	0.235	0.485	1.00	0.0000	0.2031	20.4	0.806
21	0.319	0.565	1.01	0.0000	0.2030	20.4	0.806
22	0.487	0.698	1.00	0.0000	0.2027	20.4	0.807
23	0.735	0.857	1.01	0.0000	0.2023	20.3	0.808
24	0.987	0.993	1.01	0.0000	0.2020	20.3	0.808
25	1.486	1.219	1.01	0.0000	0.2016	20.3	0.809
26	2.485	1.576	1.01	0.0000	0.2008	20.2	0.811
27	4.487	2.118	1.00	0.0000	0.1999	20.1	0.813
28	4.987	2.233	1.00	0.0000	0.1997	20.1	0.814
29	9.986	3.160	1.00	0.0000	0.1985	20.0	0.816
30	14.985	3.871	1.00	0.0000	0.1980	19.9	0.818
31	19.984	4.470	1.00	0.0000	0.1982	19.9	0.817
32	24.987	4.999	1.00	0.0000	0.1980	19.9	0.817
33	29.986	5.476	1.01	0.0000	0.1979	19.9	0.818
34	39.984	6.323	1.01	0.0000	0.1974	19.8	0.819
35	49.986	7.070	1.00	0.0000	0.1977	19.9	0.818
36	59.984	7.745	1.00	0.0000	0.1975	19.9	0.819
37	60.002	7.746	1.00	0.0000	0.1976	19.9	0.818

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM | Location: -- | Project No.: 18821.00
Boring No.: HB-GBB-301 | Tested By: GSL | Checked By: --
Sample No.: 1U | Test Date: 2/7/2018 | Depth: 20-22.5
Test No.: 303043 | Sample Type: Intact | Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 12 of 21
Applied Stress: 0.500 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.019		1.00	0.0000	0.1975	19.9	0.819
2	-0.015		1.00	0.0000	0.1975	19.9	0.819
3	-0.011		0.928	0.0000	0.1974	19.8	0.819
4	-0.006		0.720	0.0000	0.1970	19.8	0.820
5	-0.002		0.588	0.0000	0.1966	19.8	0.821
6	0.000	0.000	0.550	0.0000	0.1965	19.7	0.821
7	0.002	0.050	0.502	0.0000	0.1964	19.7	0.821
8	0.007	0.083	0.503	0.0000	0.1963	19.7	0.821
9	0.011	0.106	0.517	0.0000	0.1962	19.7	0.822
10	0.016	0.125	0.525	0.0000	0.1962	19.7	0.822
11	0.020	0.142	0.523	0.0000	0.1962	19.7	0.822
12	0.025	0.157	0.520	0.0000	0.1961	19.7	0.822
13	0.029	0.170	0.515	0.0000	0.1961	19.7	0.822
14	0.033	0.183	0.511	0.0000	0.1960	19.7	0.822
15	0.038	0.194	0.506	0.0000	0.1960	19.7	0.822
16	0.042	0.206	0.502	0.0000	0.1959	19.7	0.822
17	0.060	0.245	0.512	0.0000	0.1959	19.7	0.822
18	0.064	0.254	0.511	0.0000	0.1958	19.7	0.823
19	0.148	0.385	0.503	0.0000	0.1956	19.7	0.823
20	0.232	0.482	0.505	0.0000	0.1954	19.6	0.823
21	0.316	0.562	0.505	0.0000	0.1953	19.6	0.824
22	0.484	0.696	0.506	0.0000	0.1952	19.6	0.824
23	0.732	0.855	0.505	0.0000	0.1950	19.6	0.824
24	0.984	0.992	0.505	0.0000	0.1947	19.6	0.825
25	1.483	1.218	0.503	0.0000	0.1944	19.5	0.826
26	2.482	1.575	0.505	0.0000	0.1938	19.5	0.827
27	4.484	2.118	0.502	0.0000	0.1931	19.4	0.829
28	4.984	2.232	0.503	0.0000	0.1929	19.4	0.829
29	9.983	3.160	0.503	0.0000	0.1916	19.3	0.832
30	14.982	3.871	0.503	0.0000	0.1907	19.2	0.834
31	19.981	4.470	0.502	0.0000	0.1902	19.1	0.835
32	24.984	4.998	0.502	0.0000	0.1898	19.1	0.836
33	29.983	5.476	0.503	0.0000	0.1896	19.1	0.837
34	39.981	6.323	0.500	0.0000	0.1892	19.0	0.838
35	49.983	7.070	0.502	0.0000	0.1890	19.0	0.838
36	59.981	7.745	0.502	0.0000	0.1888	19.0	0.838
37	59.999	7.746	0.502	0.0000	0.1888	19.0	0.838

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Boring No.: HB-GBB-301
Sample No.: 1U
Test No.: 303043

Location: --
Tested By: GSL
Test Date: 2/7/2018
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 20-22.5
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 13 of 21
Applied Stress: 1.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.018		0.502	0.0000	0.1888	19.0	0.839
2	-0.014		0.502	0.0000	0.1888	19.0	0.839
3	-0.009		0.643	0.0000	0.1890	19.0	0.838
4	-0.005		0.813	0.0000	0.1894	19.0	0.837
5	-0.000		0.945	0.0000	0.1897	19.1	0.837
6	0.000	0.000	0.950	0.0000	0.1897	19.1	0.836
7	0.004	0.064	1.02	0.0000	0.1899	19.1	0.836
8	0.009	0.092	0.997	0.0000	0.1899	19.1	0.836
9	0.013	0.114	0.983	0.0000	0.1899	19.1	0.836
10	0.017	0.132	0.981	0.0000	0.1899	19.1	0.836
11	0.022	0.148	0.985	0.0000	0.1900	19.1	0.836
12	0.026	0.162	0.991	0.0000	0.1901	19.1	0.836
13	0.031	0.175	0.995	0.0000	0.1901	19.1	0.836
14	0.035	0.187	1.00	0.0000	0.1901	19.1	0.836
15	0.039	0.199	1.00	0.0000	0.1902	19.1	0.835
16	0.044	0.210	1.00	0.0000	0.1902	19.1	0.835
17	0.057	0.239	0.992	0.0000	0.1902	19.1	0.835
18	0.066	0.257	0.995	0.0000	0.1903	19.1	0.835
19	0.150	0.387	1.00	0.0000	0.1905	19.1	0.835
20	0.234	0.484	1.00	0.0000	0.1907	19.2	0.834
21	0.318	0.564	0.998	0.0000	0.1908	19.2	0.834
22	0.486	0.697	1.00	0.0000	0.1910	19.2	0.833
23	0.733	0.856	1.00	0.0000	0.1912	19.2	0.833
24	0.985	0.993	1.00	0.0000	0.1915	19.2	0.832
25	1.485	1.219	1.00	0.0000	0.1917	19.3	0.832
26	2.484	1.576	1.00	0.0000	0.1919	19.3	0.831
27	4.486	2.118	1.00	0.0000	0.1924	19.3	0.830
28	4.985	2.233	1.00	0.0000	0.1925	19.3	0.830
29	9.984	3.160	1.00	0.0000	0.1929	19.4	0.829
30	14.983	3.871	1.01	0.0000	0.1931	19.4	0.829
31	19.982	4.470	1.00	0.0000	0.1933	19.4	0.828
32	24.986	4.999	1.00	0.0000	0.1934	19.4	0.828
33	29.985	5.476	1.00	0.0000	0.1934	19.4	0.828
34	39.983	6.323	1.00	0.0000	0.1935	19.4	0.828
35	49.985	7.070	1.00	0.0000	0.1931	19.4	0.829
36	59.983	7.745	1.00	0.0000	0.1936	19.5	0.828
37	60.001	7.746	1.00	0.0000	0.1936	19.5	0.828

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Boring No.: HB-GBB-301
Sample No.: 1U
Test No.: 303043

Location: --
Tested By: GSL
Test Date: 2/7/2018
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 20-22.5
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 14 of 21
Applied Stress: 2.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.013		1.00	0.0000	0.1936	19.5	0.828
2	-0.008		1.00	0.0000	0.1936	19.5	0.828
3	-0.004		1.36	0.0000	0.1939	19.5	0.827
4	0.000	0.000	1.90	0.0000	0.1947	19.6	0.825
5	0.000	0.021	1.96	0.0000	0.1948	19.6	0.825
6	0.005	0.070	1.96	0.0000	0.1948	19.6	0.825
7	0.009	0.096	2.01	0.0000	0.1950	19.6	0.824
8	0.014	0.117	1.96	0.0000	0.1950	19.6	0.824
9	0.018	0.135	1.96	0.0000	0.1950	19.6	0.824
10	0.023	0.150	1.97	0.0000	0.1951	19.6	0.824
11	0.027	0.164	1.99	0.0000	0.1951	19.6	0.824
12	0.031	0.177	2.00	0.0000	0.1951	19.6	0.824
13	0.036	0.189	2.00	0.0000	0.1952	19.6	0.824
14	0.040	0.201	2.00	0.0000	0.1952	19.6	0.824
15	0.045	0.211	1.98	0.0000	0.1952	19.6	0.824
16	0.049	0.222	1.98	0.0000	0.1952	19.6	0.824
17	0.062	0.250	2.00	0.0000	0.1953	19.6	0.824
18	0.071	0.267	2.01	0.0000	0.1954	19.6	0.824
19	0.155	0.394	2.00	0.0000	0.1958	19.7	0.823
20	0.239	0.489	2.01	0.0000	0.1960	19.7	0.822
21	0.323	0.568	2.00	0.0000	0.1962	19.7	0.822
22	0.491	0.701	2.00	0.0000	0.1966	19.8	0.821
23	0.739	0.859	2.00	0.0000	0.1969	19.8	0.820
24	0.991	0.995	2.00	0.0000	0.1973	19.8	0.819
25	1.490	1.221	2.01	0.0000	0.1979	19.9	0.818
26	2.489	1.578	2.01	0.0000	0.1987	20.0	0.816
27	4.491	2.119	2.01	0.0000	0.1998	20.1	0.813
28	4.991	2.234	2.01	0.0000	0.2000	20.1	0.813
29	9.990	3.161	2.01	0.0000	0.2009	20.2	0.811
30	14.989	3.871	2.01	0.0000	0.2013	20.2	0.810
31	19.987	4.471	2.01	0.0000	0.2015	20.2	0.810
32	24.991	4.999	2.01	0.0000	0.2016	20.3	0.809
33	29.990	5.476	2.01	0.0000	0.2017	20.3	0.809
34	39.988	6.324	2.01	0.0000	0.2018	20.3	0.809
35	49.990	7.070	2.01	0.0000	0.2019	20.3	0.809
36	59.988	7.745	2.01	0.0000	0.2020	20.3	0.808
37	60.006	7.746	2.01	0.0000	0.2020	20.3	0.808

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM | Location: -- | Project No.: 18821.00
Boring No.: HB-GBB-301 | Tested By: GSL | Checked By: --
Sample No.: 1U | Test Date: 2/7/2018 | Depth: 20-22.5
Test No.: 303043 | Sample Type: Intact | Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 15 of 21
Applied Stress: 4.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.013		2.01	0.0000	0.2020	20.3	0.808
2	-0.009		2.01	0.0000	0.2020	20.3	0.808
3	-0.004		2.88	0.0000	0.2028	20.4	0.807
4	0.000	0.000	3.80	0.0000	0.2036	20.5	0.805
5	0.000	0.010	3.82	0.0000	0.2036	20.5	0.805
6	0.005	0.067	4.08	0.0000	0.2040	20.5	0.804
7	0.009	0.094	3.96	0.0000	0.2040	20.5	0.804
8	0.013	0.116	3.90	0.0000	0.2040	20.5	0.804
9	0.018	0.133	3.95	0.0000	0.2041	20.5	0.804
10	0.022	0.149	3.99	0.0000	0.2042	20.5	0.803
11	0.027	0.163	4.01	0.0000	0.2043	20.5	0.803
12	0.031	0.176	4.01	0.0000	0.2043	20.5	0.803
13	0.035	0.188	3.97	0.0000	0.2043	20.5	0.803
14	0.040	0.200	3.98	0.0000	0.2044	20.5	0.803
15	0.044	0.210	3.99	0.0000	0.2044	20.5	0.803
16	0.049	0.221	4.00	0.0000	0.2044	20.5	0.803
17	0.066	0.258	3.99	0.0000	0.2045	20.6	0.803
18	0.071	0.266	3.98	0.0000	0.2046	20.6	0.803
19	0.155	0.393	4.01	0.0000	0.2050	20.6	0.802
20	0.239	0.489	4.01	0.0000	0.2053	20.6	0.801
21	0.323	0.568	4.00	0.0000	0.2056	20.7	0.800
22	0.491	0.701	4.01	0.0000	0.2062	20.7	0.799
23	0.738	0.859	4.01	0.0000	0.2067	20.8	0.798
24	0.990	0.995	4.01	0.0000	0.2072	20.8	0.796
25	1.490	1.220	4.01	0.0000	0.2079	20.9	0.795
26	2.489	1.578	4.02	0.0000	0.2090	21.0	0.793
27	4.491	2.119	4.01	0.0000	0.2100	21.1	0.790
28	4.990	2.234	4.02	0.0000	0.2102	21.1	0.790
29	9.989	3.161	4.02	0.0000	0.2111	21.2	0.788
30	14.988	3.871	4.01	0.0000	0.2114	21.2	0.787
31	19.987	4.471	4.01	0.0000	0.2115	21.3	0.787
32	24.990	4.999	4.02	0.0000	0.2117	21.3	0.786
33	29.989	5.476	4.02	0.0000	0.2118	21.3	0.786
34	39.987	6.324	4.01	0.0000	0.2120	21.3	0.786
35	49.990	7.070	4.01	0.0000	0.2121	21.3	0.785
36	59.988	7.745	4.01	0.0000	0.2122	21.3	0.785
37	60.006	7.746	4.01	0.0000	0.2122	21.3	0.785

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Boring No.: HB-GBB-301
Sample No.: 1U
Test No.: 303043

Location: --
Tested By: GSL
Test Date: 2/7/2018
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 20-22.5
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 16 of 21
Applied Stress: 8.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.012		4.01	0.0000	0.2122	21.3	0.785
2	-0.008		4.01	0.0000	0.2122	21.3	0.785
3	-0.003		5.81	0.0000	0.2133	21.4	0.783
4	0.000	0.000	7.60	0.0000	0.2146	21.6	0.780
5	0.001	0.031	8.09	0.0000	0.2149	21.6	0.779
6	0.005	0.073	8.12	0.0000	0.2153	21.6	0.778
7	0.010	0.099	7.91	0.0000	0.2153	21.6	0.778
8	0.014	0.119	7.78	0.0000	0.2153	21.6	0.778
9	0.019	0.136	7.94	0.0000	0.2155	21.7	0.778
10	0.023	0.152	8.03	0.0000	0.2157	21.7	0.777
11	0.027	0.166	7.97	0.0000	0.2157	21.7	0.777
12	0.032	0.179	7.95	0.0000	0.2157	21.7	0.777
13	0.036	0.191	7.97	0.0000	0.2158	21.7	0.777
14	0.041	0.202	7.99	0.0000	0.2159	21.7	0.777
15	0.045	0.212	8.01	0.0000	0.2160	21.7	0.776
16	0.050	0.223	8.02	0.0000	0.2161	21.7	0.776
17	0.067	0.259	7.98	0.0000	0.2163	21.7	0.776
18	0.072	0.268	8.00	0.0000	0.2163	21.7	0.776
19	0.156	0.395	8.03	0.0000	0.2171	21.8	0.774
20	0.240	0.490	8.00	0.0000	0.2179	21.9	0.772
21	0.324	0.569	8.01	0.0000	0.2182	21.9	0.771
22	0.492	0.701	8.03	0.0000	0.2190	22.0	0.770
23	0.739	0.860	8.02	0.0000	0.2199	22.1	0.768
24	0.991	0.996	8.02	0.0000	0.2206	22.2	0.766
25	1.490	1.221	8.02	0.0000	0.2219	22.3	0.763
26	2.489	1.578	8.03	0.0000	0.2237	22.5	0.759
27	4.492	2.119	8.03	0.0000	0.2260	22.7	0.754
28	4.991	2.234	8.03	0.0000	0.2262	22.7	0.753
29	9.990	3.161	8.02	0.0000	0.2283	22.9	0.748
30	14.989	3.872	8.04	0.0000	0.2294	23.1	0.746
31	19.988	4.471	8.03	0.0000	0.2300	23.1	0.745
32	24.991	4.999	8.03	0.0000	0.2304	23.2	0.744
33	29.990	5.476	8.04	0.0000	0.2308	23.2	0.743
34	39.988	6.324	8.03	0.0000	0.2312	23.2	0.742
35	49.991	7.070	8.03	0.0000	0.2316	23.3	0.741
36	59.989	7.745	8.03	0.0000	0.2319	23.3	0.740
37	60.002	7.746	8.03	0.0000	0.2319	23.3	0.740

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Boring No.: HB-GBB-301
Sample No.: 1U
Test No.: 303043

Location: --
Tested By: GSL
Test Date: 2/7/2018
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 20-22.5
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 17 of 21
Applied Stress: 16.0 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.012		8.03	0.0000	0.2319	23.3	0.740
2	-0.008		9.82	0.0000	0.2329	23.4	0.738
3	-0.004		9.82	0.0000	0.2329	23.4	0.738
4	0.000	0.000	15.2	0.0000	0.2362	23.7	0.731
5	0.001	0.029	16.5	0.0000	0.2370	23.8	0.729
6	0.005	0.073	16.6	0.0000	0.2377	23.9	0.727
7	0.010	0.099	16.2	0.0000	0.2377	23.9	0.727
8	0.014	0.119	15.8	0.0000	0.2377	23.9	0.727
9	0.019	0.136	15.5	0.0000	0.2377	23.9	0.727
10	0.023	0.152	15.3	0.0000	0.2377	23.9	0.727
11	0.027	0.166	16.2	0.0000	0.2384	24.0	0.726
12	0.032	0.178	16.0	0.0000	0.2384	24.0	0.725
13	0.036	0.190	15.9	0.0000	0.2385	24.0	0.725
14	0.041	0.202	16.0	0.0000	0.2386	24.0	0.725
15	0.045	0.212	16.0	0.0000	0.2387	24.0	0.725
16	0.049	0.222	16.0	0.0000	0.2388	24.0	0.725
17	0.063	0.250	16.0	0.0000	0.2390	24.0	0.724
18	0.072	0.268	16.0	0.0000	0.2392	24.0	0.724
19	0.156	0.394	16.0	0.0000	0.2406	24.2	0.720
20	0.240	0.489	16.0	0.0000	0.2417	24.3	0.718
21	0.324	0.569	16.0	0.0000	0.2427	24.4	0.716
22	0.492	0.701	16.0	0.0000	0.2441	24.5	0.712
23	0.739	0.860	16.0	0.0000	0.2459	24.7	0.708
24	0.991	0.995	16.1	0.0000	0.2474	24.9	0.705
25	1.490	1.221	16.1	0.0000	0.2500	25.1	0.699
26	2.489	1.578	16.1	0.0000	0.2539	25.5	0.690
27	4.492	2.119	16.1	0.0000	0.2592	26.0	0.678
28	4.991	2.234	16.1	0.0000	0.2602	26.1	0.676
29	9.990	3.161	16.0	0.0000	0.2660	26.7	0.663
30	14.989	3.872	16.1	0.0000	0.2690	27.0	0.656
31	19.988	4.471	16.0	0.0000	0.2703	27.2	0.653
32	24.991	4.999	15.9	0.0000	0.2713	27.3	0.650
33	29.990	5.476	16.0	0.0000	0.2721	27.3	0.649
34	39.988	6.324	16.1	0.0000	0.2734	27.5	0.646
35	49.991	7.070	16.1	0.0000	0.2741	27.5	0.644
36	59.988	7.745	16.0	0.0000	0.2746	27.6	0.643
37	60.011	7.747	15.9	0.0000	0.2746	27.6	0.643

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Boring No.: HB-GBB-301
Sample No.: 1U
Test No.: 303043

Location: --
Tested By: GSL
Test Date: 2/7/2018
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 20-22.5
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 18 of 21
Applied Stress: 4.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.013		16.1	0.0000	0.2747	27.6	0.643
2	-0.009		16.1	0.0000	0.2747	27.6	0.643
3	-0.004		15.1	0.0000	0.2743	27.6	0.644
4	0.000	0.000	5.20	0.0000	0.2686	27.0	0.656
5	0.000	0.015	4.69	0.0000	0.2683	27.0	0.657
6	0.005	0.068	1.95	0.0000	0.2650	26.6	0.665
7	0.009	0.095	3.25	0.0000	0.2659	26.7	0.663
8	0.013	0.116	4.31	0.0000	0.2668	26.8	0.661
9	0.018	0.134	4.36	0.0000	0.2667	26.8	0.661
10	0.022	0.149	4.19	0.0000	0.2664	26.8	0.662
11	0.027	0.164	4.00	0.0000	0.2661	26.7	0.662
12	0.031	0.176	4.07	0.0000	0.2661	26.7	0.662
13	0.036	0.189	4.09	0.0000	0.2661	26.7	0.662
14	0.040	0.200	4.07	0.0000	0.2660	26.7	0.663
15	0.044	0.211	4.05	0.0000	0.2659	26.7	0.663
16	0.049	0.221	4.04	0.0000	0.2658	26.7	0.663
17	0.062	0.249	4.06	0.0000	0.2656	26.7	0.663
18	0.071	0.266	4.06	0.0000	0.2655	26.7	0.664
19	0.155	0.394	4.02	0.0000	0.2649	26.6	0.665
20	0.239	0.489	4.03	0.0000	0.2644	26.6	0.666
21	0.323	0.568	4.02	0.0000	0.2639	26.5	0.667
22	0.491	0.701	4.02	0.0000	0.2632	26.4	0.669
23	0.738	0.859	4.02	0.0000	0.2625	26.4	0.671
24	0.990	0.995	4.02	0.0000	0.2619	26.3	0.672
25	1.490	1.221	4.02	0.0000	0.2610	26.2	0.674
26	2.489	1.578	4.02	0.0000	0.2601	26.1	0.676
27	4.491	2.119	4.01	0.0000	0.2591	26.0	0.678
28	4.990	2.234	4.01	0.0000	0.2590	26.0	0.678
29	9.989	3.161	4.02	0.0000	0.2587	26.0	0.679
30	14.988	3.871	4.01	0.0000	0.2585	26.0	0.680
31	19.987	4.471	4.02	0.0000	0.2584	26.0	0.680
32	24.991	4.999	4.01	0.0000	0.2584	26.0	0.680
33	29.990	5.476	4.02	0.0000	0.2583	26.0	0.680
34	39.988	6.324	4.02	0.0000	0.2583	26.0	0.680
35	49.990	7.070	4.01	0.0000	0.2583	26.0	0.680
36	59.988	7.745	4.01	0.0000	0.2583	26.0	0.680
37	60.028	7.748	4.01	0.0000	0.2583	26.0	0.680

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 18821.00
Boring No.: HB-GBB-301
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 2/7/2018
Depth: 20-22.5
Test No.: 303043
Sample Type: Intact
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 19 of 21
Applied Stress: 1.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.014		4.01	0.0000	0.2583	26.0	0.680
2	-0.010		4.01	0.0000	0.2583	26.0	0.680
3	-0.006		2.82	0.0000	0.2574	25.9	0.682
4	-0.001		1.43	0.0000	0.2558	25.7	0.686
5	0.000	0.000	1.30	0.0000	0.2555	25.7	0.686
6	0.003	0.057	0.915	0.0000	0.2548	25.6	0.688
7	0.008	0.088	1.01	0.0000	0.2546	25.6	0.688
8	0.012	0.110	1.07	0.0000	0.2546	25.6	0.688
9	0.017	0.129	1.09	0.0000	0.2546	25.6	0.689
10	0.021	0.145	1.07	0.0000	0.2544	25.6	0.689
11	0.025	0.159	1.05	0.0000	0.2543	25.6	0.689
12	0.030	0.173	1.03	0.0000	0.2542	25.6	0.689
13	0.034	0.185	1.01	0.0000	0.2542	25.5	0.689
14	0.039	0.197	1.01	0.0000	0.2542	25.6	0.689
15	0.043	0.208	1.04	0.0000	0.2542	25.5	0.689
16	0.047	0.218	1.05	0.0000	0.2541	25.5	0.690
17	0.061	0.246	1.02	0.0000	0.2540	25.5	0.690
18	0.070	0.264	1.01	0.0000	0.2539	25.5	0.690
19	0.154	0.392	1.00	0.0000	0.2532	25.4	0.692
20	0.238	0.487	1.02	0.0000	0.2527	25.4	0.693
21	0.322	0.567	1.02	0.0000	0.2522	25.4	0.694
22	0.490	0.700	1.01	0.0000	0.2517	25.3	0.695
23	0.737	0.859	1.01	0.0000	0.2509	25.2	0.697
24	0.989	0.994	1.01	0.0000	0.2504	25.2	0.698
25	1.488	1.220	1.01	0.0000	0.2494	25.1	0.700
26	2.487	1.577	1.00	0.0000	0.2480	24.9	0.704
27	4.490	2.119	1.01	0.0000	0.2461	24.7	0.708
28	4.989	2.234	1.01	0.0000	0.2459	24.7	0.708
29	9.988	3.160	1.00	0.0000	0.2434	24.5	0.714
30	14.987	3.871	1.00	0.0000	0.2423	24.4	0.716
31	19.986	4.471	1.00	0.0000	0.2416	24.3	0.718
32	24.989	4.999	1.00	0.0000	0.2411	24.2	0.719
33	29.988	5.476	1.00	0.0000	0.2408	24.2	0.720
34	39.986	6.323	1.00	0.0000	0.2405	24.2	0.721
35	49.988	7.070	1.00	0.0000	0.2403	24.1	0.721
36	59.986	7.745	1.00	0.0000	0.2402	24.1	0.721
37	60.004	7.746	1.00	0.0000	0.2402	24.1	0.721

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 18821.00
Boring No.: HB-GBB-301
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 2/7/2018
Depth: 20-22.5
Test No.: 303043
Sample Type: Intact
Elevation: --

Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 20 of 21
Applied Stress: 0.250 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.020		1.00	0.0000	0.2402	24.1	0.721
2	-0.016		1.00	0.0000	0.2402	24.1	0.721
3	-0.011		0.767	0.0000	0.2399	24.1	0.722
4	-0.007		0.534	0.0000	0.2394	24.1	0.723
5	-0.002		0.382	0.0000	0.2389	24.0	0.724
6	0.000	0.000	0.325	0.0000	0.2387	24.0	0.725
7	0.002	0.045	0.277	0.0000	0.2386	24.0	0.725
8	0.006	0.080	0.247	0.0000	0.2384	24.0	0.725
9	0.011	0.104	0.268	0.0000	0.2384	24.0	0.725
10	0.015	0.124	0.274	0.0000	0.2384	24.0	0.726
11	0.020	0.140	0.276	0.0000	0.2383	23.9	0.726
12	0.024	0.155	0.273	0.0000	0.2383	23.9	0.726
13	0.029	0.169	0.270	0.0000	0.2382	23.9	0.726
14	0.033	0.182	0.263	0.0000	0.2382	23.9	0.726
15	0.037	0.193	0.259	0.0000	0.2382	23.9	0.726
16	0.042	0.204	0.254	0.0000	0.2381	23.9	0.726
17	0.055	0.235	0.263	0.0000	0.2380	23.9	0.726
18	0.064	0.253	0.265	0.0000	0.2380	23.9	0.726
19	0.148	0.385	0.260	0.0000	0.2375	23.9	0.727
20	0.232	0.482	0.257	0.0000	0.2373	23.9	0.728
21	0.316	0.562	0.256	0.0000	0.2372	23.8	0.728
22	0.484	0.696	0.256	0.0000	0.2368	23.8	0.729
23	0.731	0.855	0.256	0.0000	0.2364	23.8	0.730
24	0.983	0.992	0.254	0.0000	0.2360	23.7	0.731
25	1.483	1.218	0.253	0.0000	0.2353	23.7	0.732
26	2.482	1.575	0.251	0.0000	0.2344	23.6	0.735
27	4.484	2.118	0.251	0.0000	0.2329	23.4	0.738
28	4.983	2.232	0.253	0.0000	0.2326	23.4	0.739
29	9.982	3.159	0.251	0.0000	0.2302	23.1	0.744
30	14.981	3.871	0.253	0.0000	0.2283	22.9	0.748
31	19.980	4.470	0.251	0.0000	0.2270	22.8	0.751
32	24.984	4.998	0.250	0.0000	0.2259	22.7	0.754
33	29.983	5.476	0.250	0.0000	0.2251	22.6	0.756
34	39.980	6.323	0.250	0.0000	0.2237	22.5	0.759
35	49.983	7.070	0.250	0.0000	0.2227	22.4	0.761
36	59.981	7.745	0.250	0.0000	0.2219	22.3	0.763
37	69.983	8.366	0.250	0.0000	0.2215	22.3	0.764
38	79.981	8.943	0.250	0.0000	0.2210	22.2	0.765
39	89.983	9.486	0.251	0.0000	0.2208	22.2	0.766
40	91.195	9.550	0.250	0.0000	0.2207	22.2	0.766

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM | Location: -- | Project No.: 18821.00
Boring No.: HB-GBB-301 | Tested By: GSL | Checked By: --
Sample No.: 1U | Test Date: 2/7/2018 | Depth: 20-22.5
Test No.: 303043 | Sample Type: Intact | Elevation: --

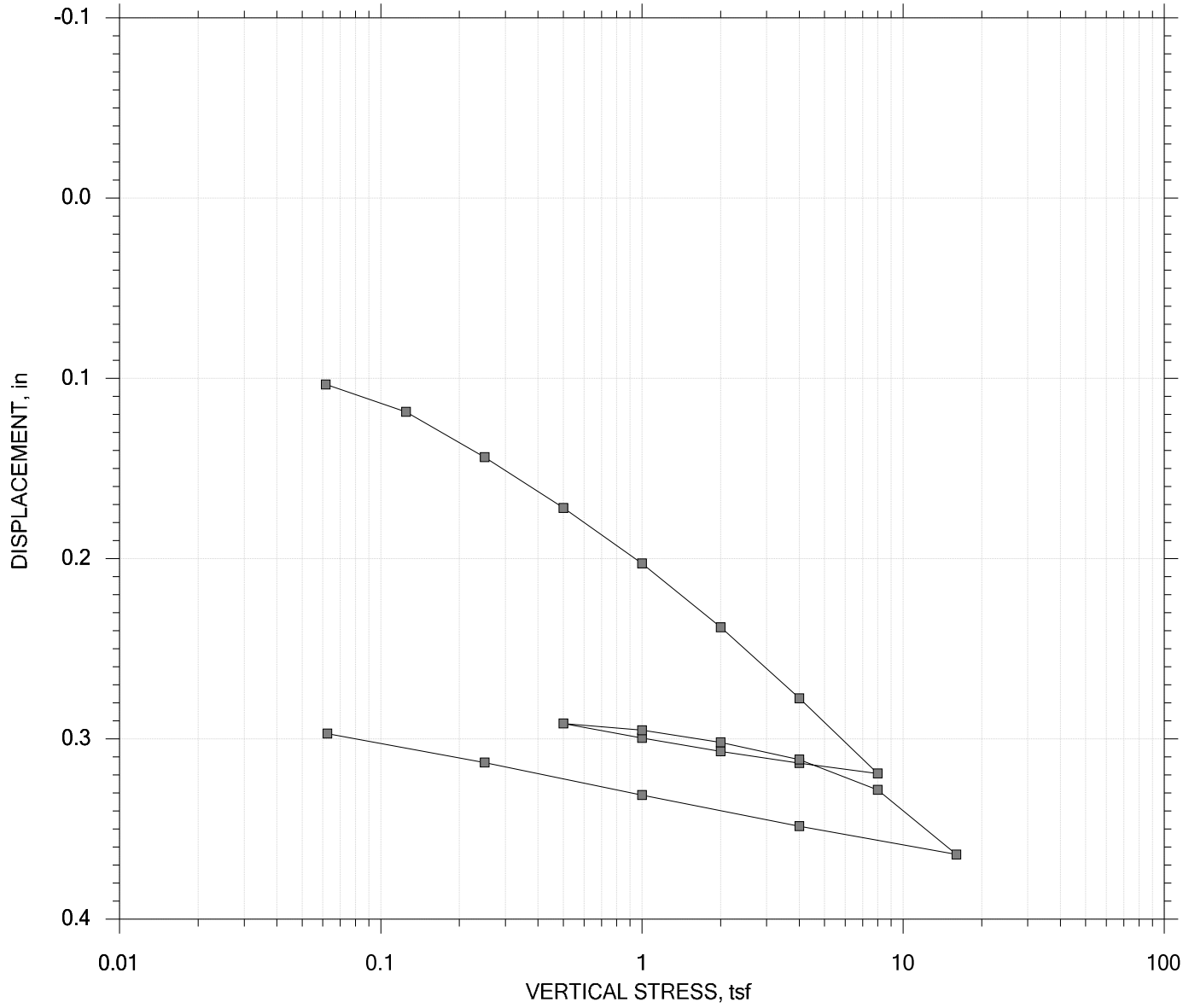
Soil Description: Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 21 of 21
Applied Stress: 0.0625 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.030		0.251	0.0000	0.2207	22.2	0.766
2	-0.025		0.251	0.0000	0.2207	22.2	0.766
3	-0.021		0.222	0.0000	0.2207	22.2	0.766
4	-0.017		0.162	0.0000	0.2204	22.2	0.766
5	-0.012		0.128	0.0000	0.2203	22.1	0.767
6	-0.008		0.110	0.0000	0.2201	22.1	0.767
7	-0.003		0.0980	0.0000	0.2200	22.1	0.767
8	0.000	0.000	0.0812	0.0000	0.2199	22.1	0.768
9	0.001	0.034	0.0752	0.0000	0.2198	22.1	0.768
10	0.006	0.075	0.0600	0.0000	0.2197	22.1	0.768
11	0.010	0.100	0.0661	0.0000	0.2197	22.1	0.768
12	0.014	0.120	0.0691	0.0000	0.2197	22.1	0.768
13	0.019	0.137	0.0706	0.0000	0.2197	22.1	0.768
14	0.023	0.153	0.0722	0.0000	0.2197	22.1	0.768
15	0.028	0.166	0.0706	0.0000	0.2197	22.1	0.768
16	0.032	0.179	0.0691	0.0000	0.2197	22.1	0.768
17	0.045	0.213	0.0661	0.0000	0.2197	22.1	0.768
18	0.054	0.233	0.0630	0.0000	0.2196	22.1	0.768
19	0.138	0.372	0.0661	0.0000	0.2193	22.0	0.769
20	0.222	0.471	0.0646	0.0000	0.2192	22.0	0.769
21	0.306	0.553	0.0661	0.0000	0.2191	22.0	0.769
22	0.474	0.689	0.0646	0.0000	0.2189	22.0	0.770
23	0.722	0.850	0.0630	0.0000	0.2188	22.0	0.770
24	0.974	0.987	0.0630	0.0000	0.2185	22.0	0.771
25	1.473	1.214	0.0646	0.0000	0.2182	21.9	0.772
26	2.472	1.572	0.0630	0.0000	0.2175	21.9	0.773
27	4.474	2.115	0.0630	0.0000	0.2167	21.8	0.775
28	4.974	2.230	0.0630	0.0000	0.2165	21.8	0.775
29	9.973	3.158	0.0615	0.0000	0.2149	21.6	0.779
30	14.972	3.869	0.0630	0.0000	0.2135	21.5	0.782
31	19.971	4.469	0.0630	0.0000	0.2125	21.4	0.785
32	24.974	4.997	0.0630	0.0000	0.2115	21.3	0.787
33	29.973	5.475	0.0630	0.0000	0.2106	21.2	0.789
34	39.971	6.322	0.0615	0.0000	0.2092	21.0	0.792
35	49.973	7.069	0.0615	0.0000	0.2081	20.9	0.794
36	59.971	7.744	0.0630	0.0000	0.2071	20.8	0.797
37	69.973	8.365	0.0630	0.0000	0.2061	20.7	0.799
38	79.971	8.943	0.0615	0.0000	0.2054	20.6	0.801
39	89.974	9.485	0.0615	0.0000	0.2047	20.6	0.802
40	99.972	9.999	0.0630	0.0000	0.2040	20.5	0.804
41	109.974	10.487	0.0615	0.0000	0.2034	20.4	0.805
42	119.972	10.953	0.0630	0.0000	0.2027	20.4	0.807
43	129.974	11.401	0.0630	0.0000	0.2022	20.3	0.808
44	139.972	11.831	0.0615	0.0000	0.2017	20.3	0.809
45	149.975	12.246	0.0615	0.0000	0.2013	20.2	0.810
46	159.972	12.648	0.0615	0.0000	0.2009	20.2	0.811
47	169.970	13.037	0.0615	0.0000	0.2006	20.2	0.812
48	179.973	13.415	0.0615	0.0000	0.2003	20.1	0.812
49	188.945	13.746	0.0615	0.0000	0.2001	20.1	0.813

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

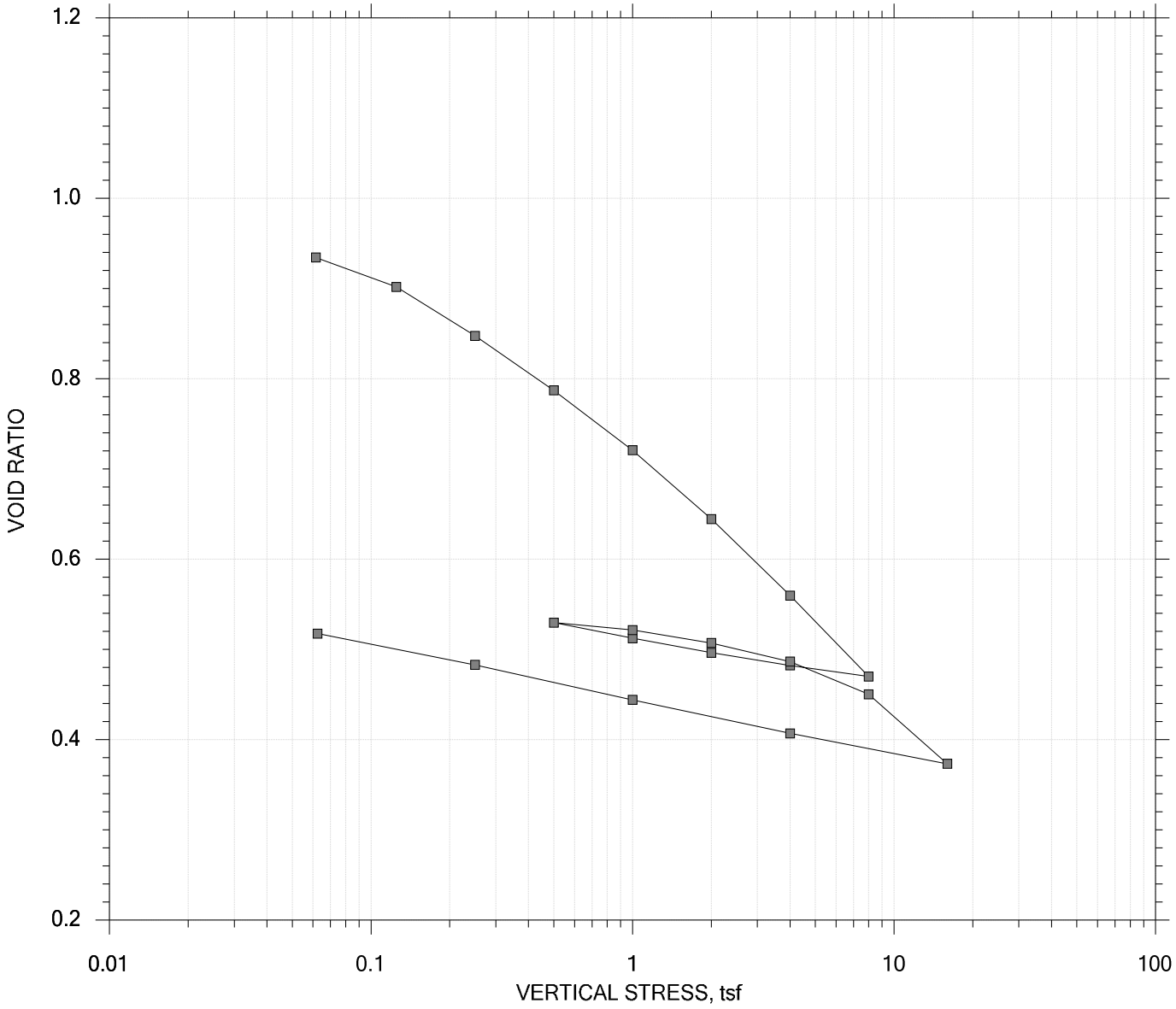


					Before Test	After Test
Current Vertical Effective Stress: 0 tsf				Water Content, %	41.36	27.52
Preconsolidation Stress: 0 tsf				Dry Unit Weight, pcf	78.436	96.908
Compression Ratio: 0				Saturation, %	96.88	100.00
Diameter: 2.495 in		Height: 1.002 in		Void Ratio	1.16	0.75
LL: 35	PL: 24	PI: 11	GS: 2.71			

	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

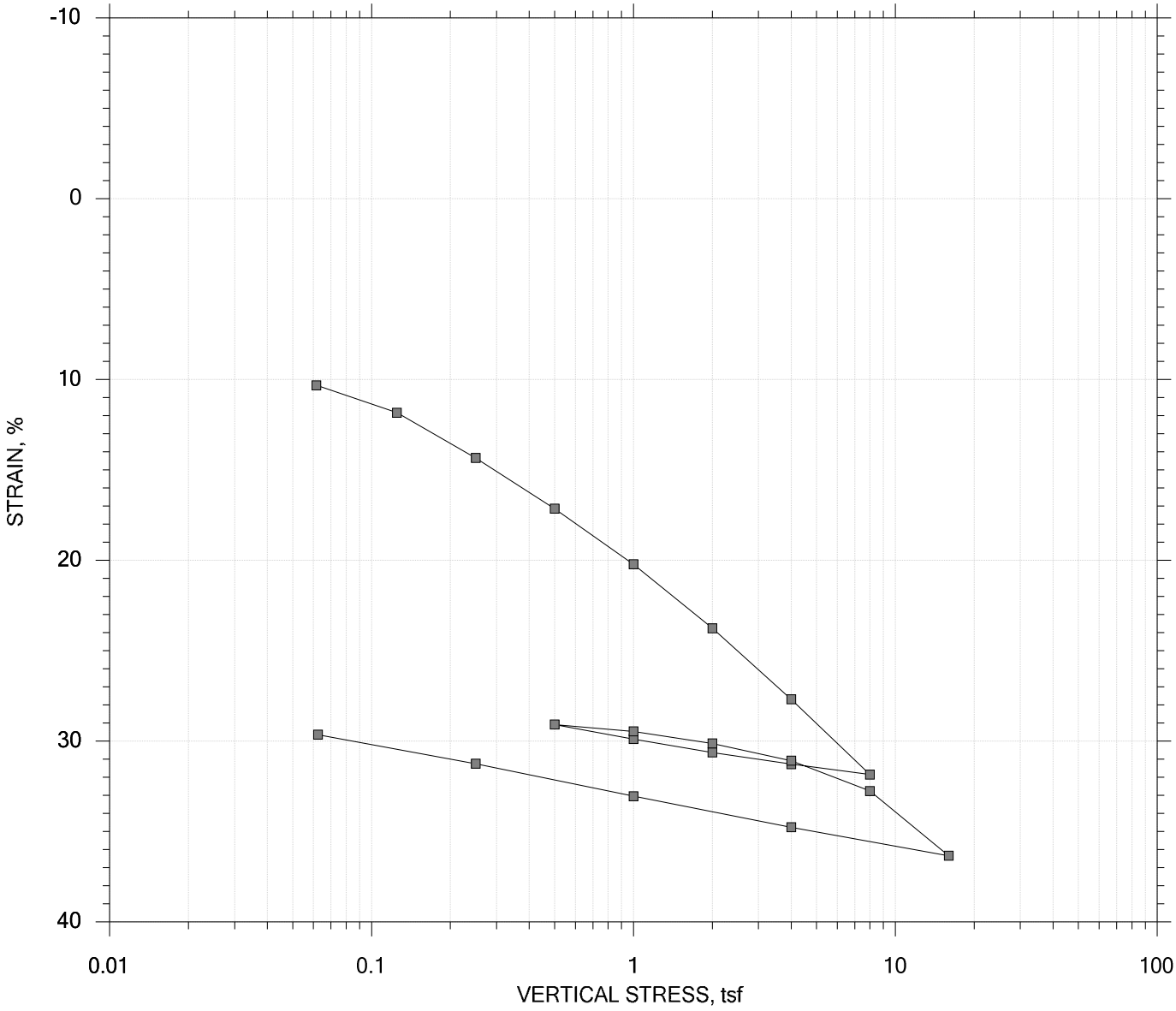


					Before Test	After Test
Current Vertical Effective Stress: 0 tsf				Water Content, %	41.36	27.52
Preconsolidation Stress: 0 tsf				Dry Unit Weight, pcf	78.436	96.908
Compression Ratio: 0				Saturation, %	96.88	100.00
Diameter: 2.495 in		Height: 1.002 in		Void Ratio	1.16	0.75
LL: 35	PL: 24	PI: 11	GS: 2.71			

	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

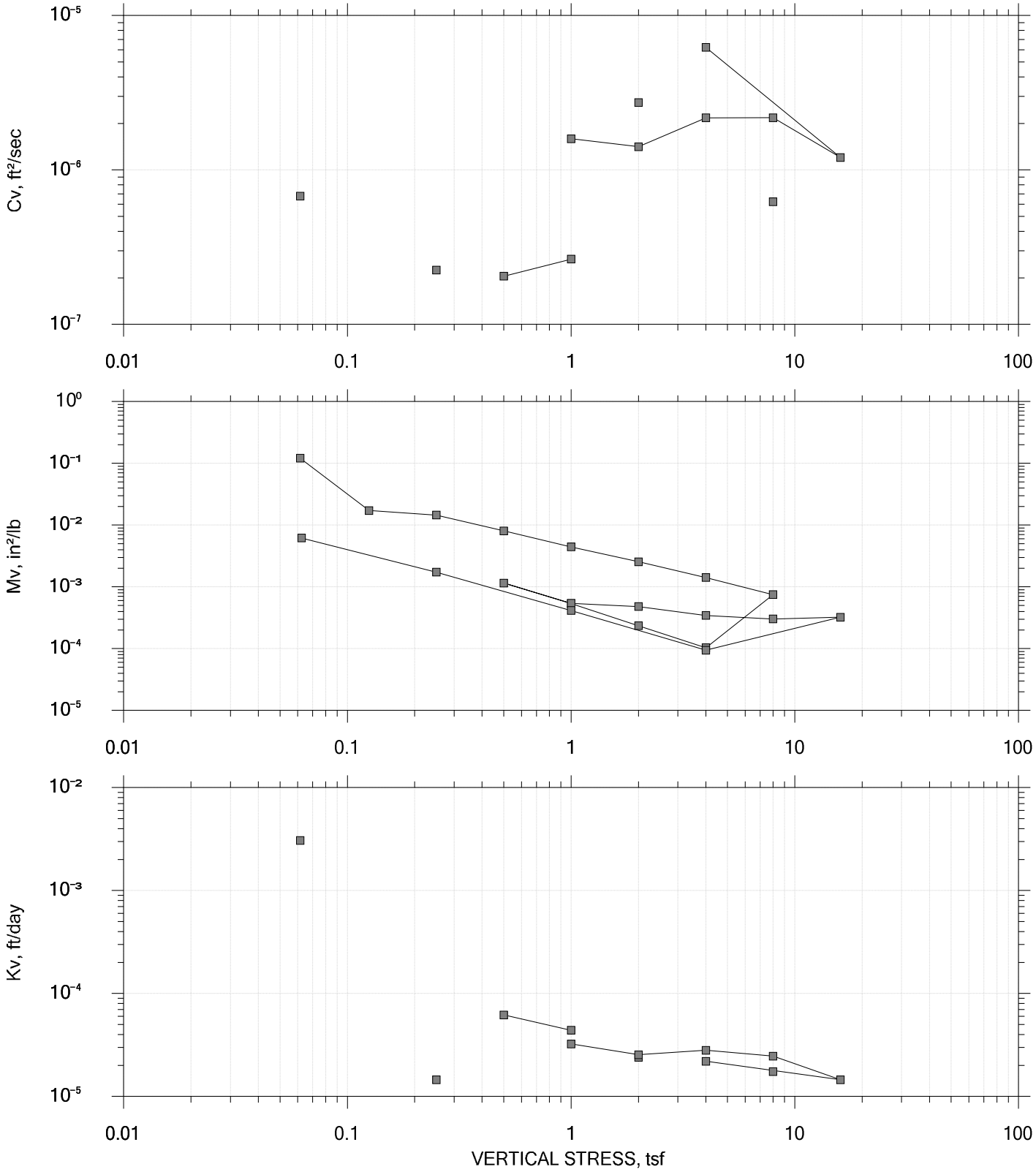


					Before Test	After Test
Current Vertical Effective Stress: 0 tsf				Water Content, %	41.36	27.52
Preconsolidation Stress: 0 tsf				Dry Unit Weight, pcf	78.436	96.908
Compression Ratio: 0				Saturation, %	96.88	100.00
Diameter: 2.495 in		Height: 1.002 in		Void Ratio	1.16	0.75
LL: 35	PL: 24	PI: 11	GS: 2.71			

	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

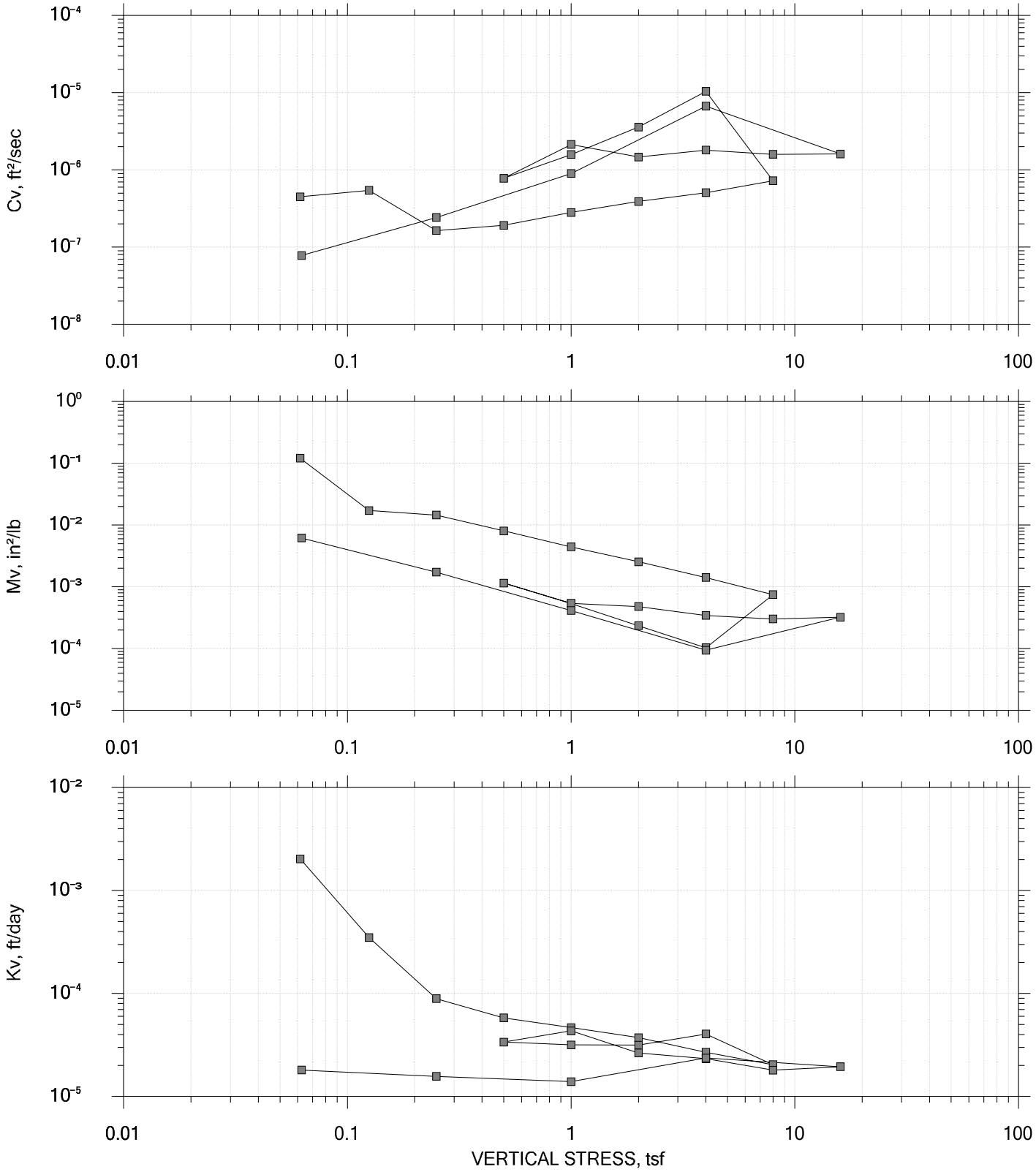
LOG of TIME COEFFICIENTS



	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SQUARE ROOT of TIME COEFFICIENTS



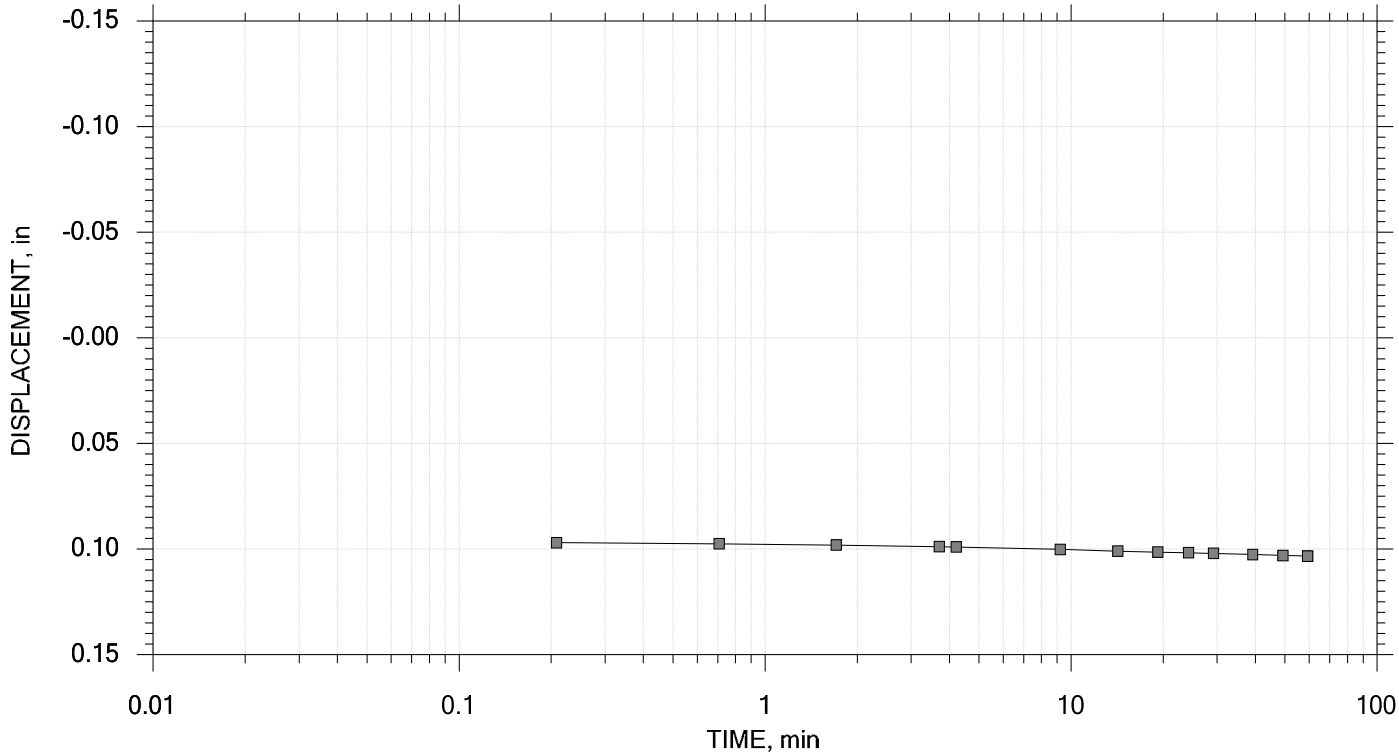
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

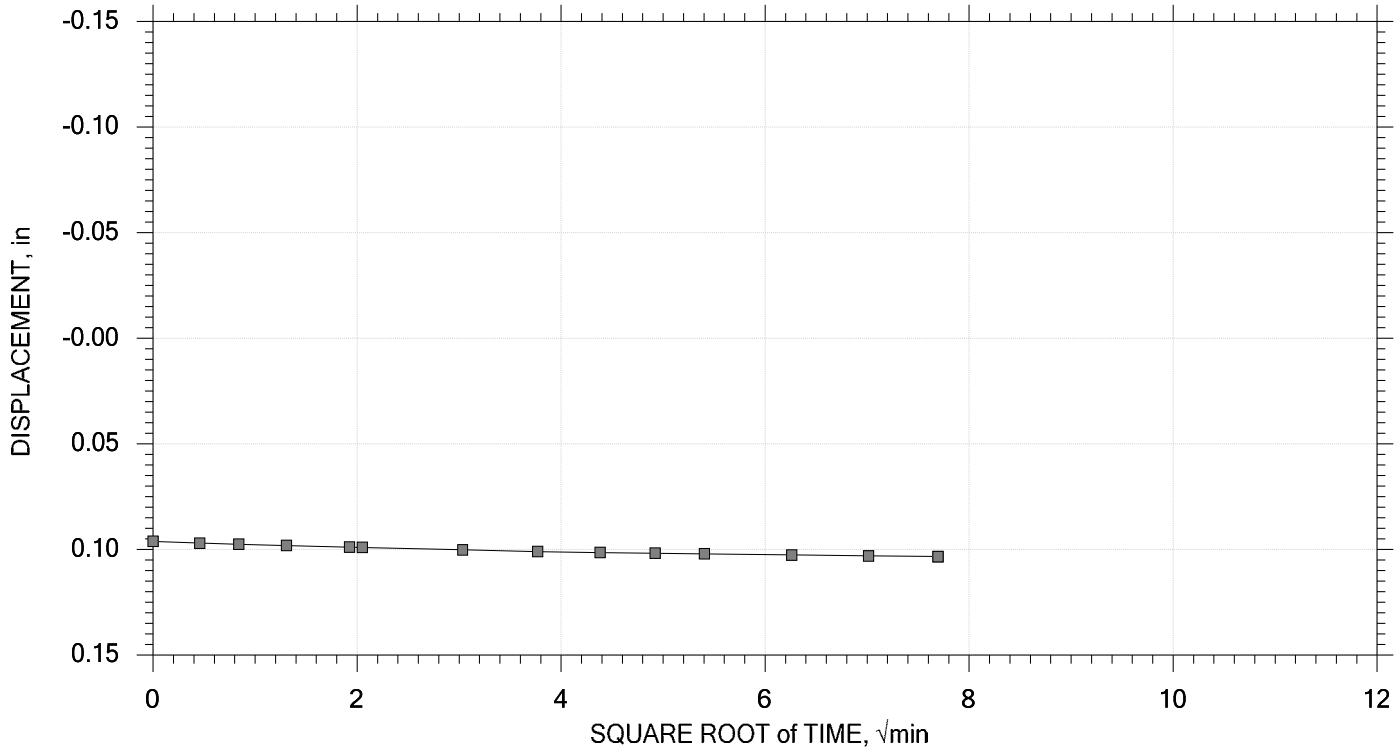
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 21

Stress: 0.061526 tsf





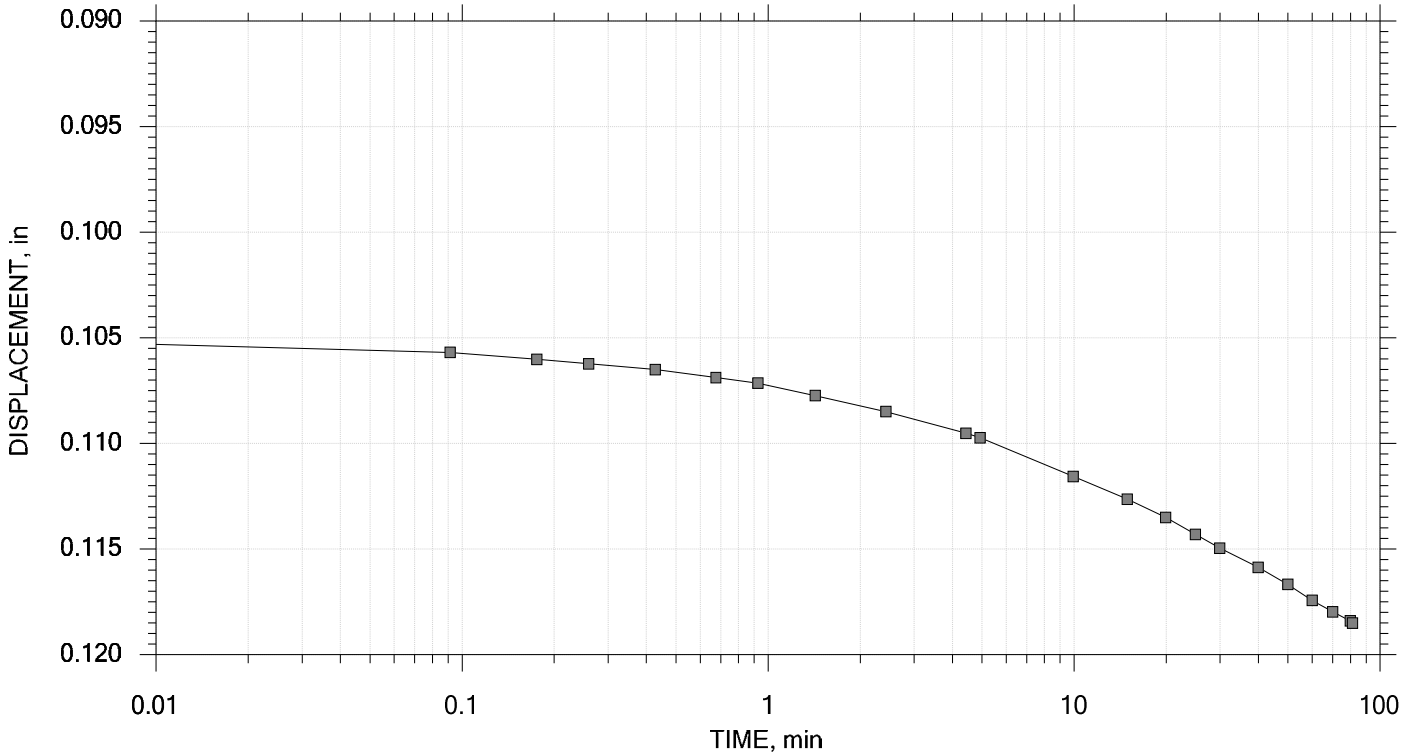
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

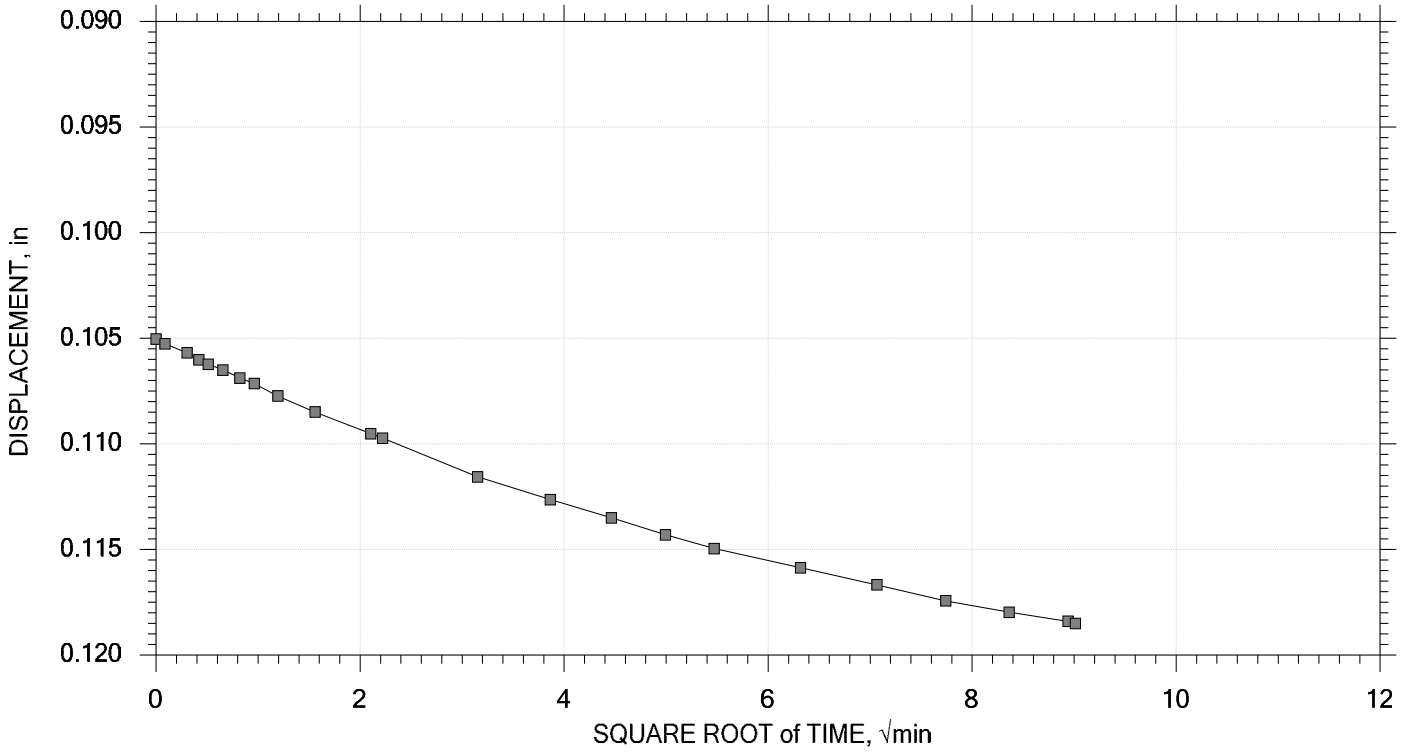
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 21

Stress: 0.125 tsf





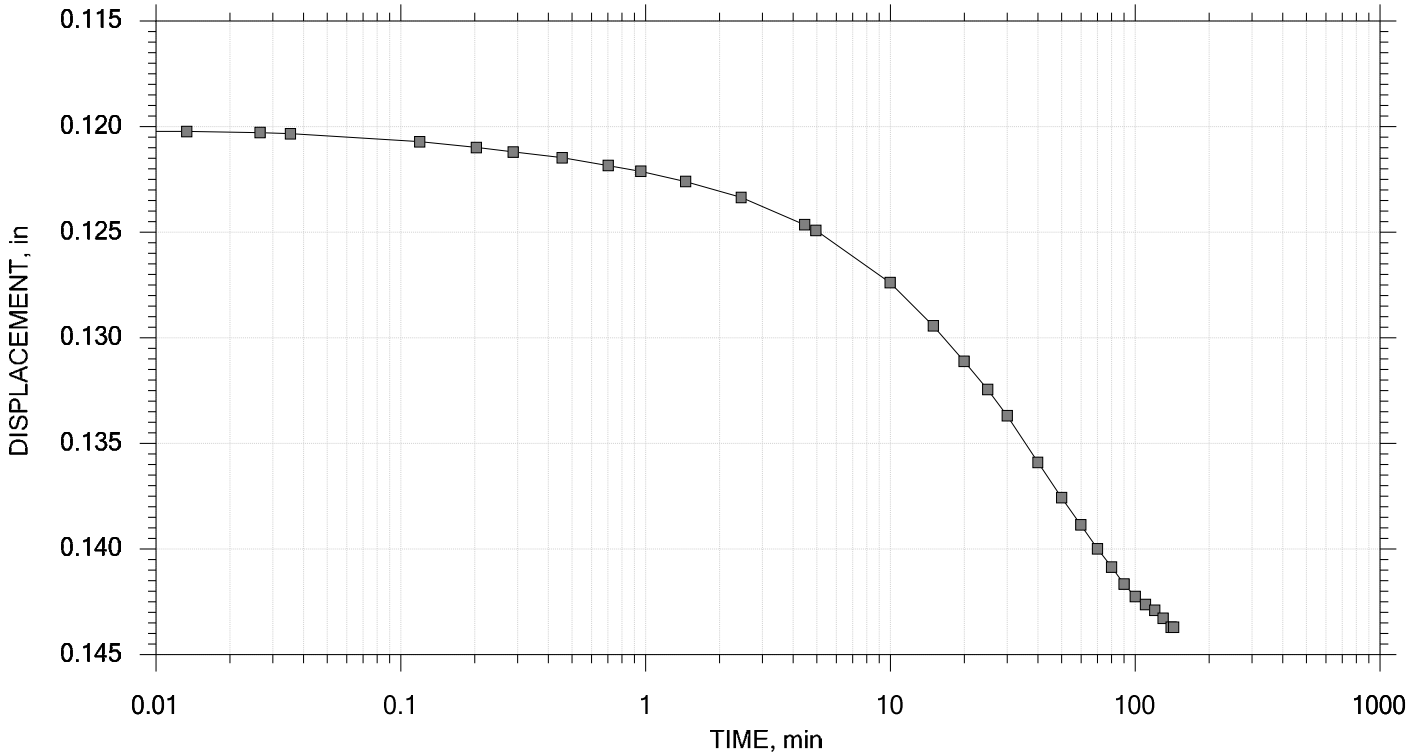
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

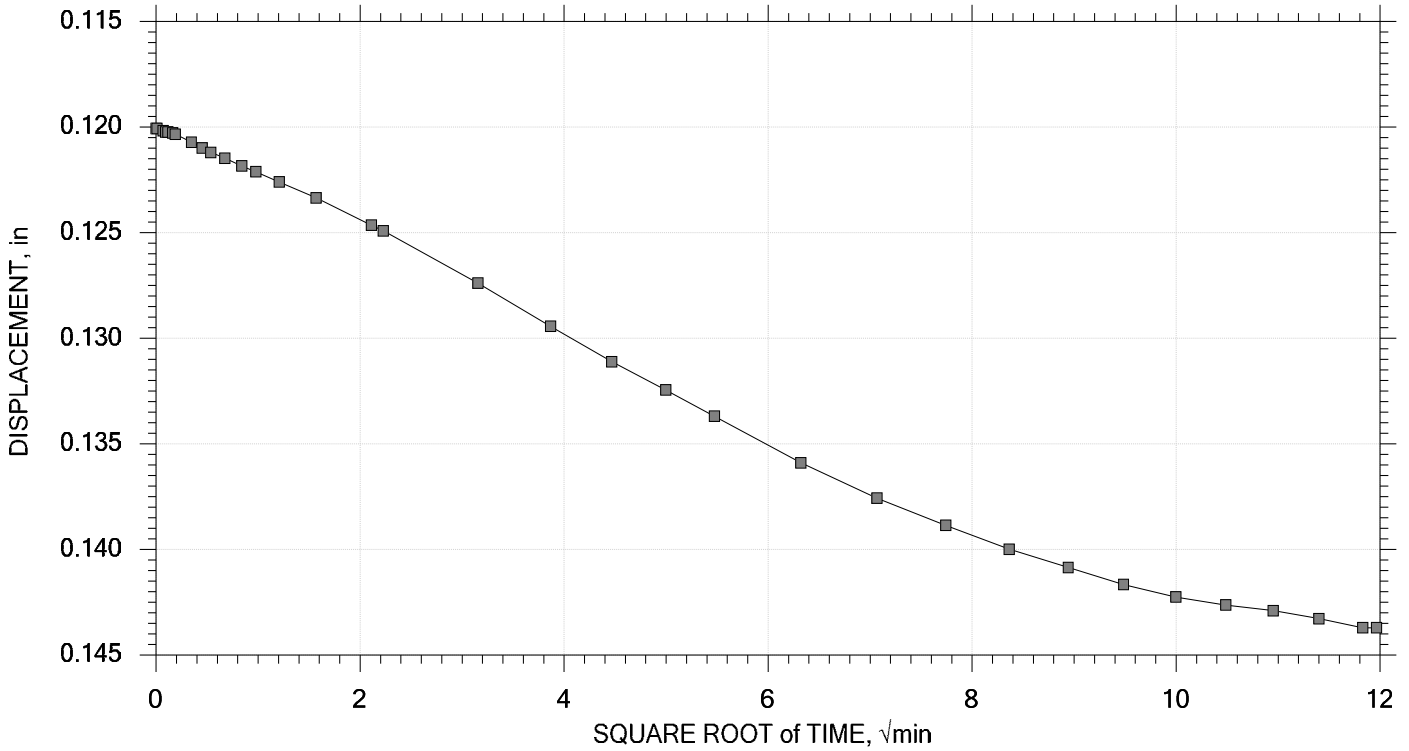
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 21

Stress: 0.25 tsf





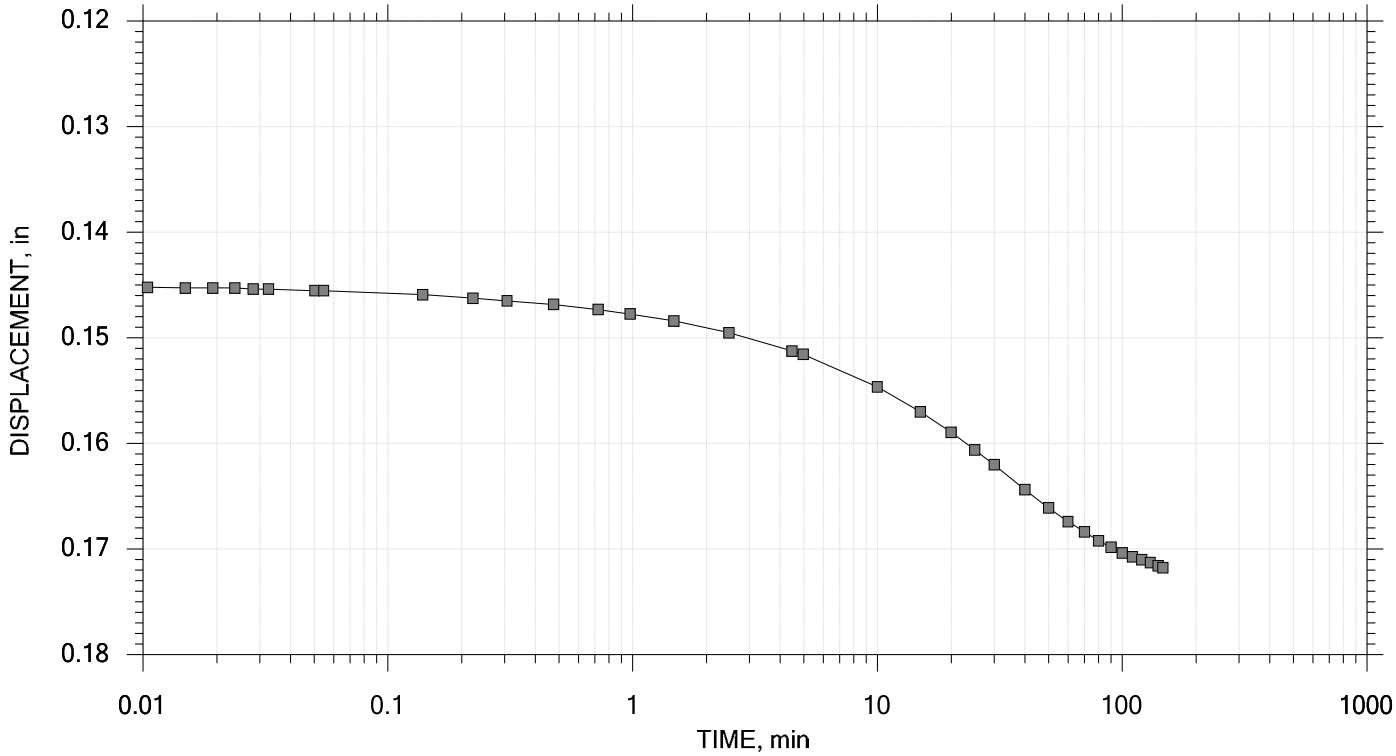
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

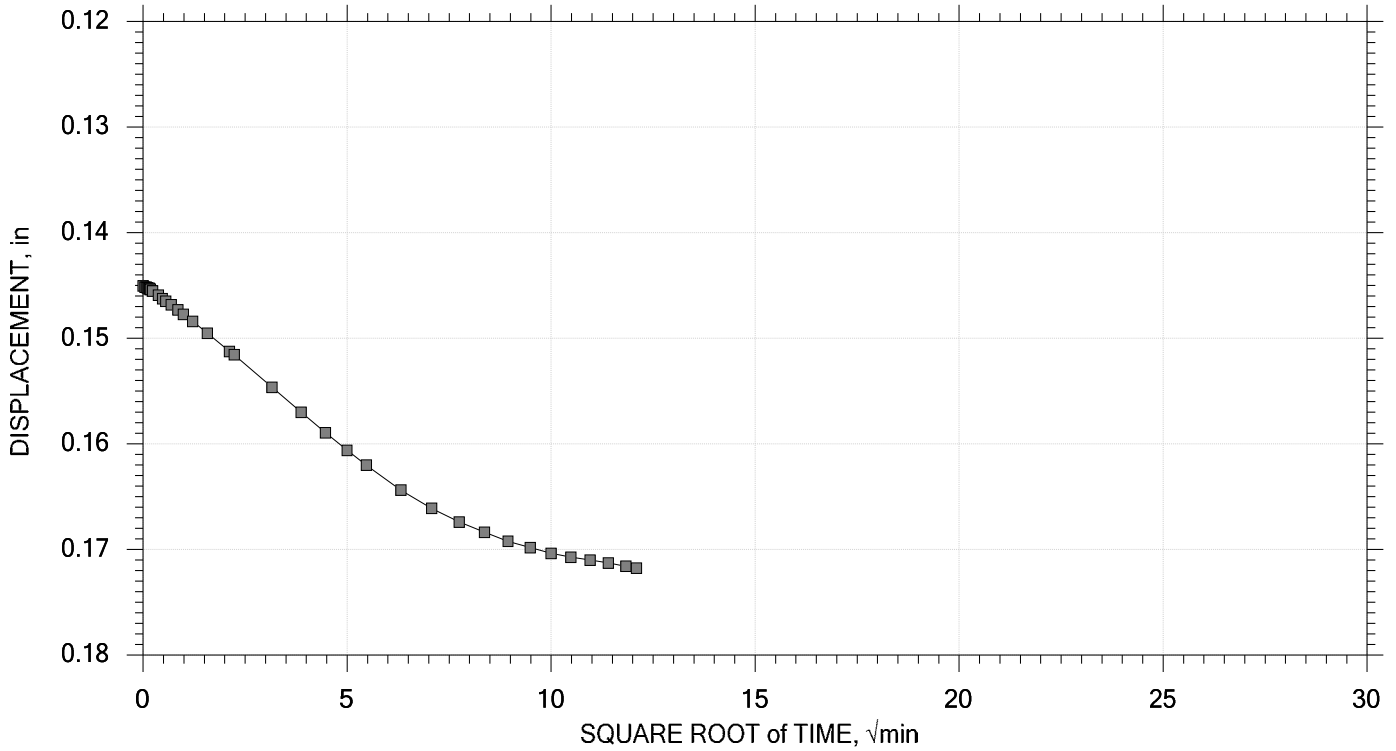
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 21

Stress: 0.5 tsf





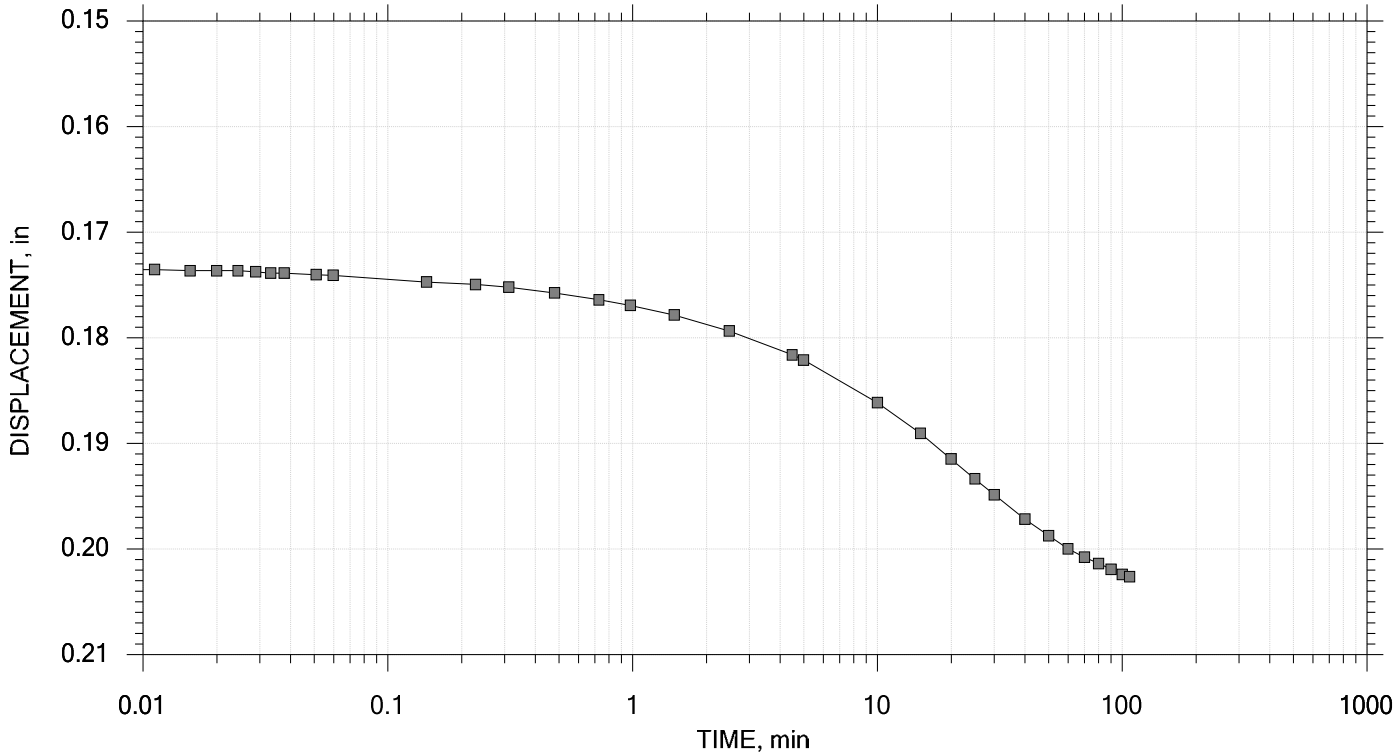
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

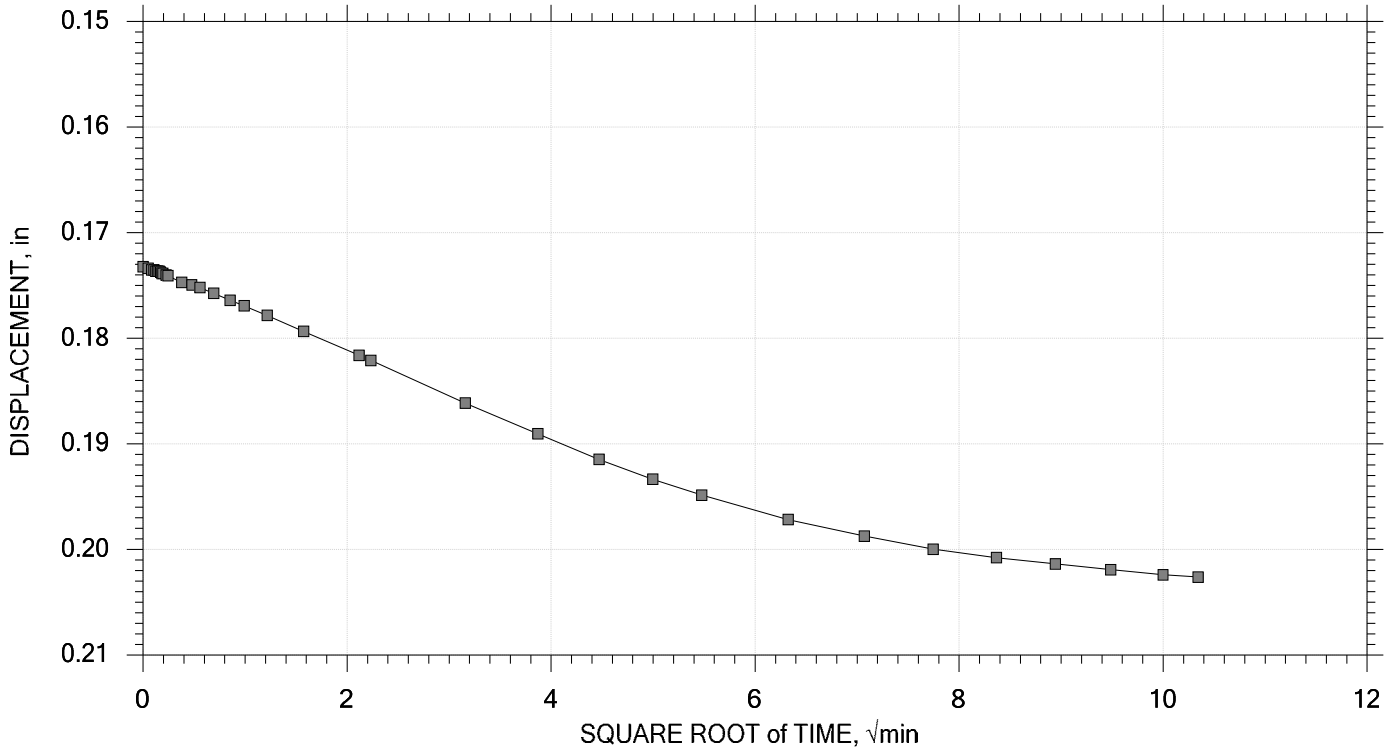
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 21

Stress: 1 tsf





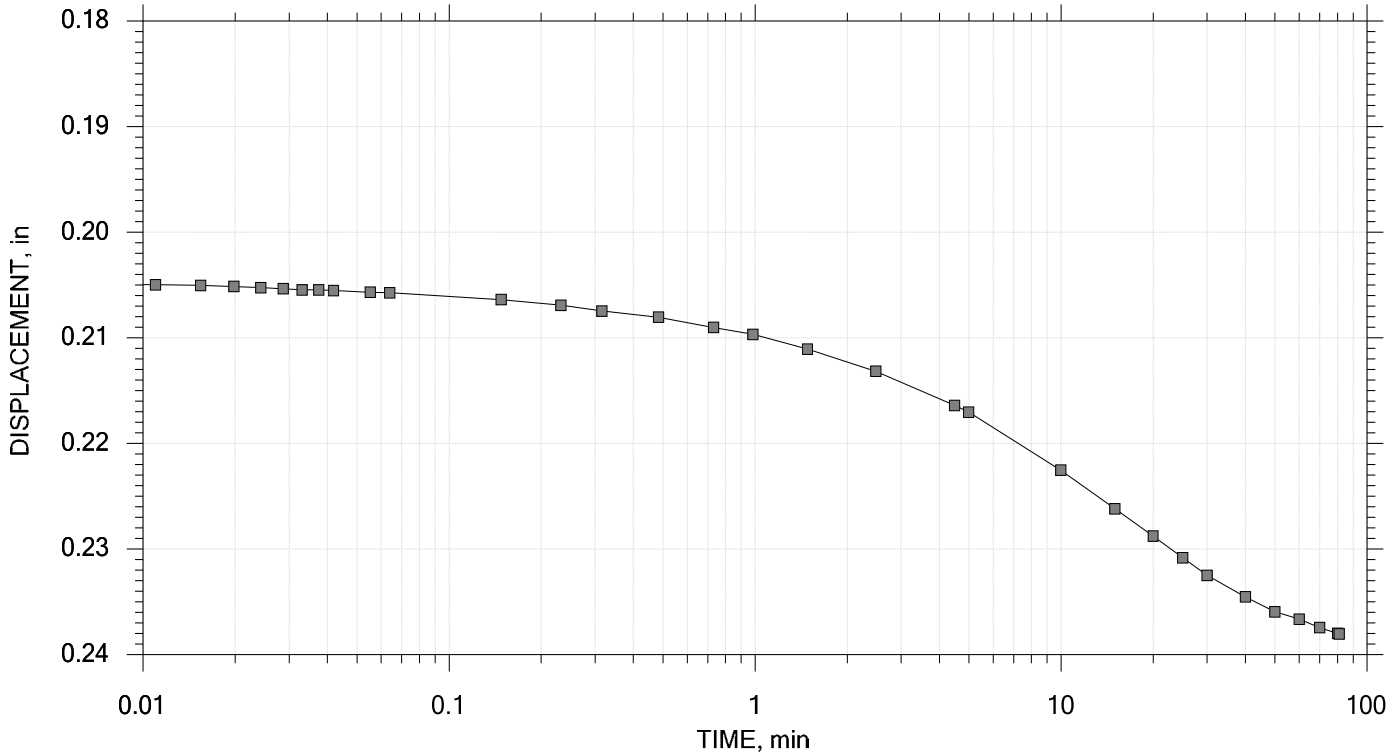
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

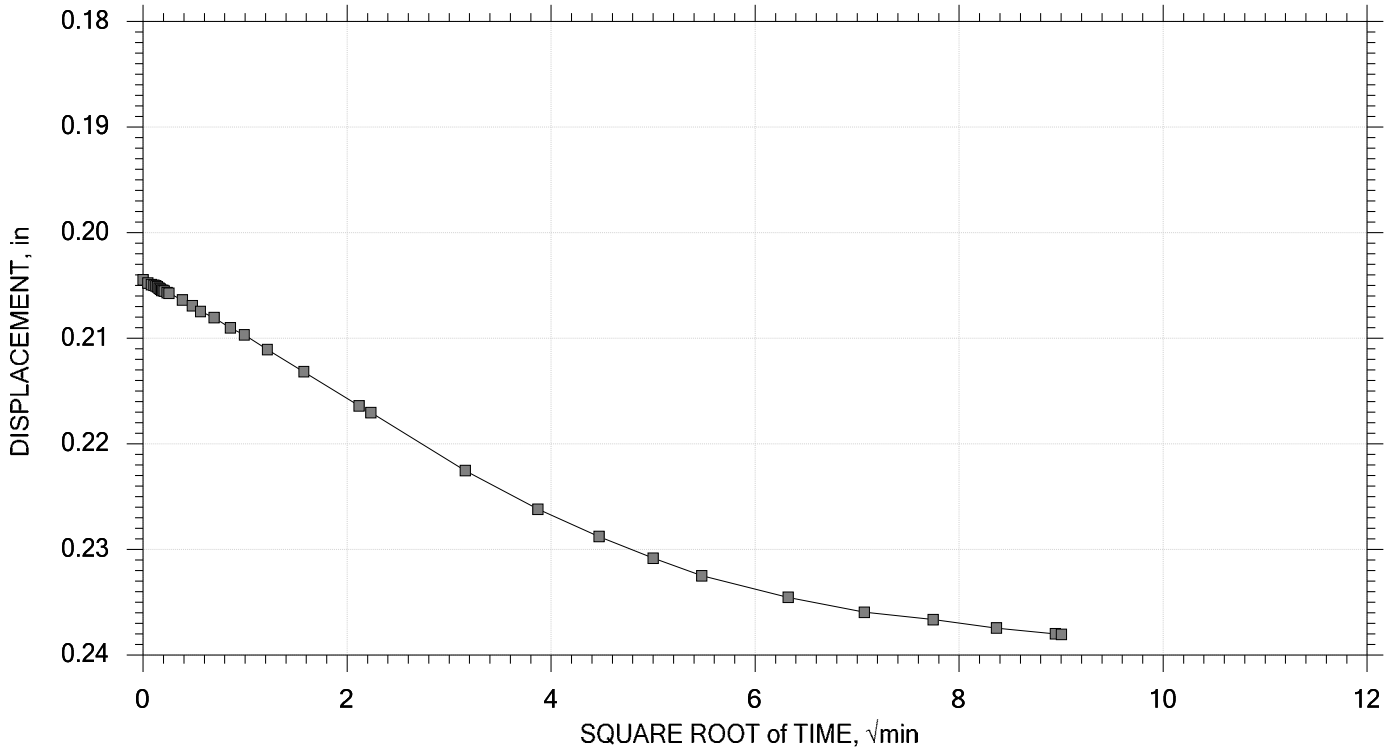
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 21

Stress: 2 tsf





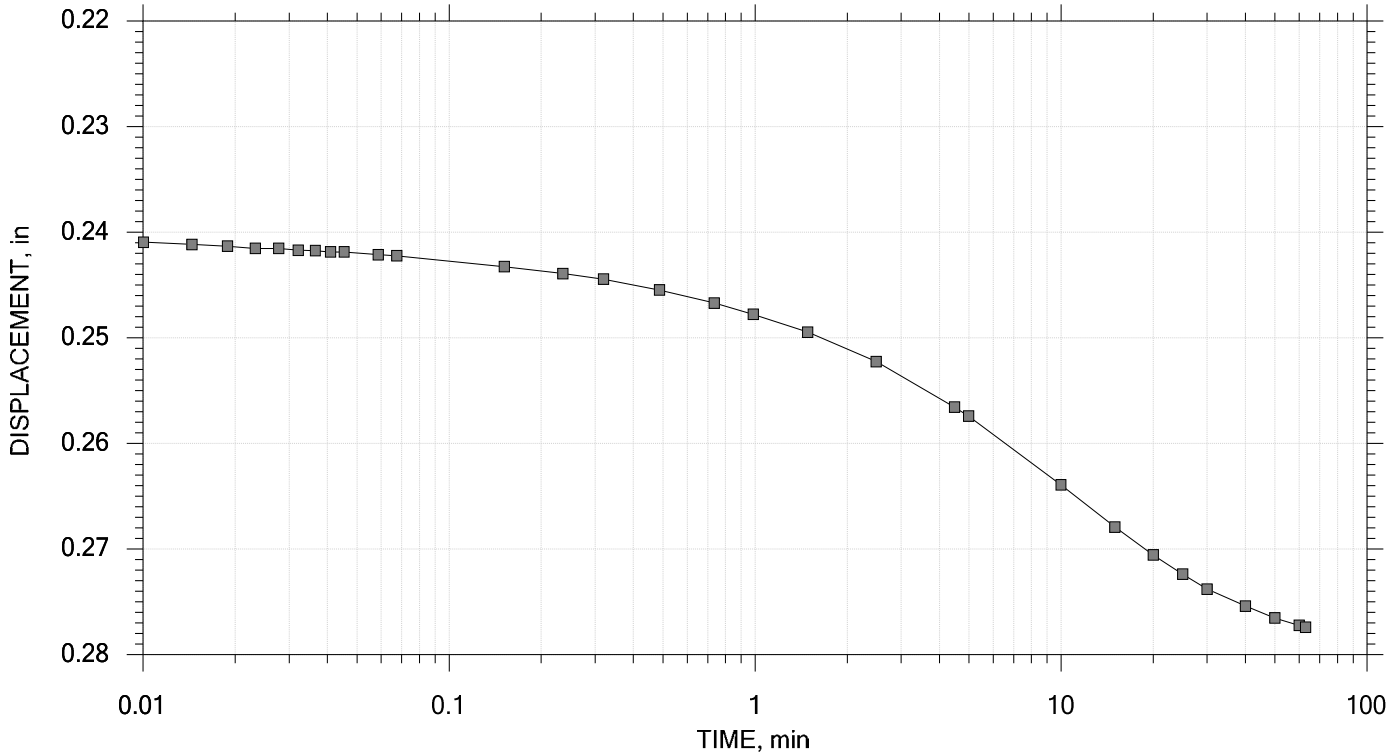
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

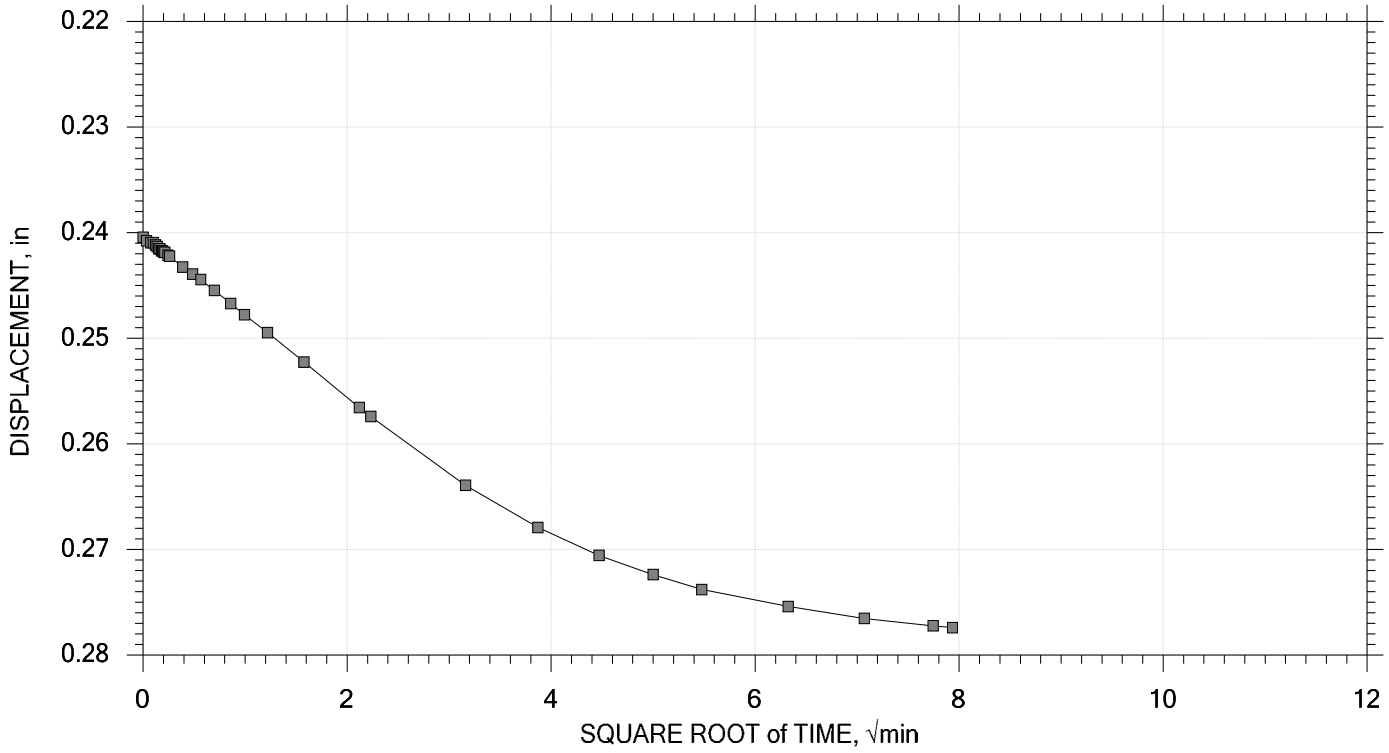
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 21

Stress: 4 tsf





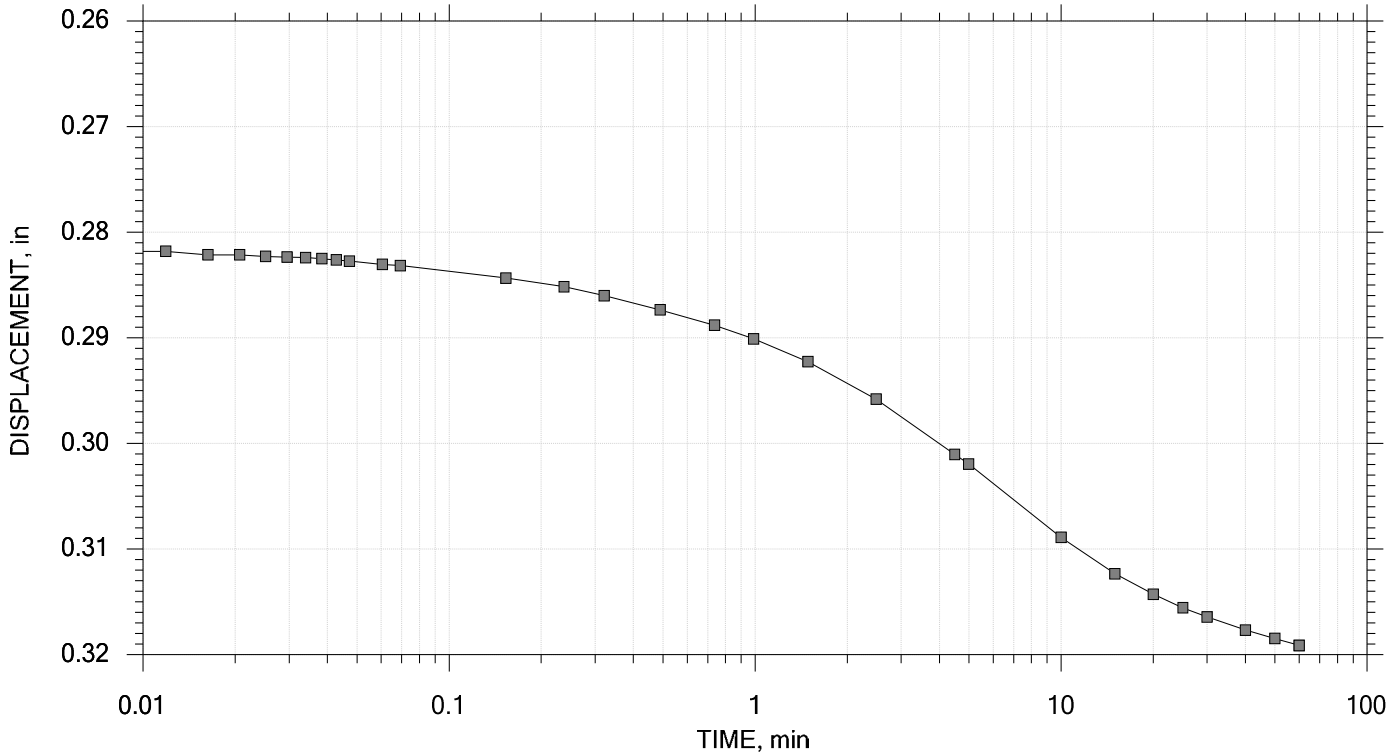
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

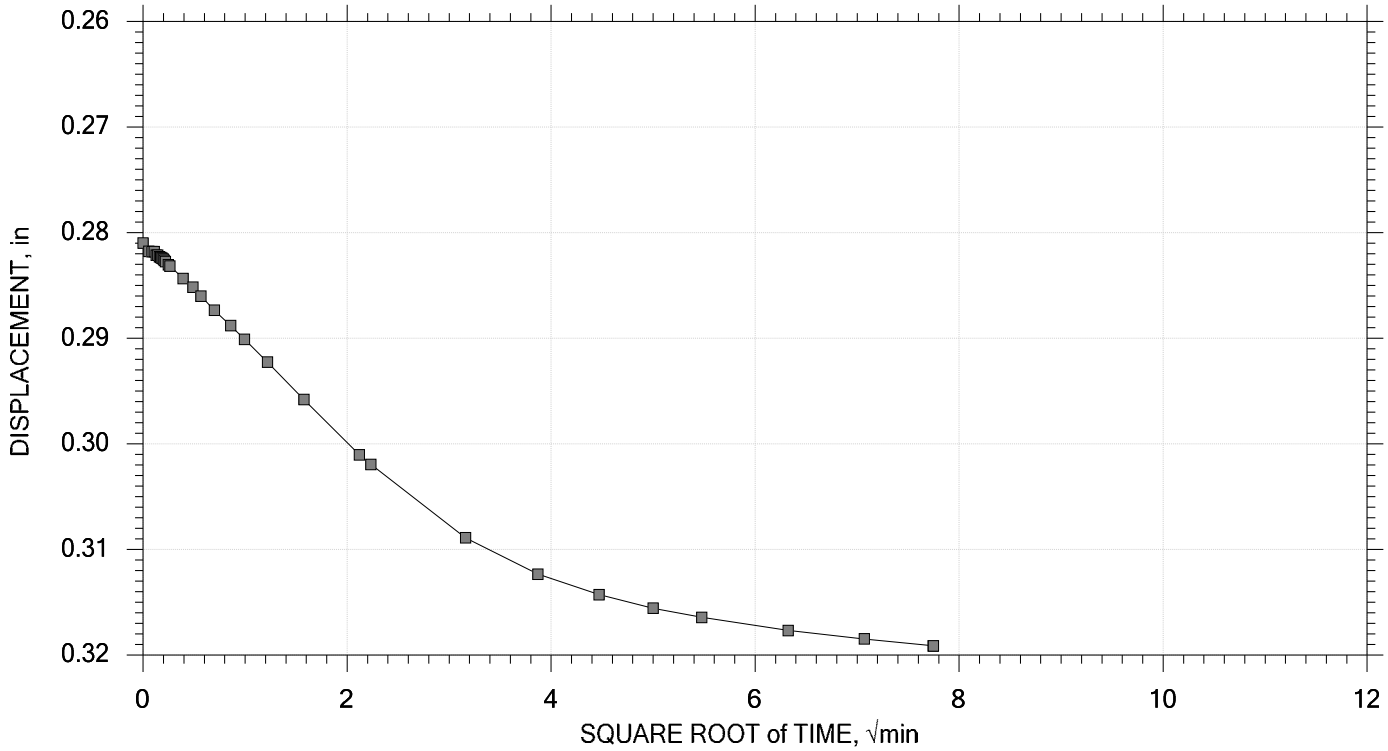
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 21

Stress: 8 tsf





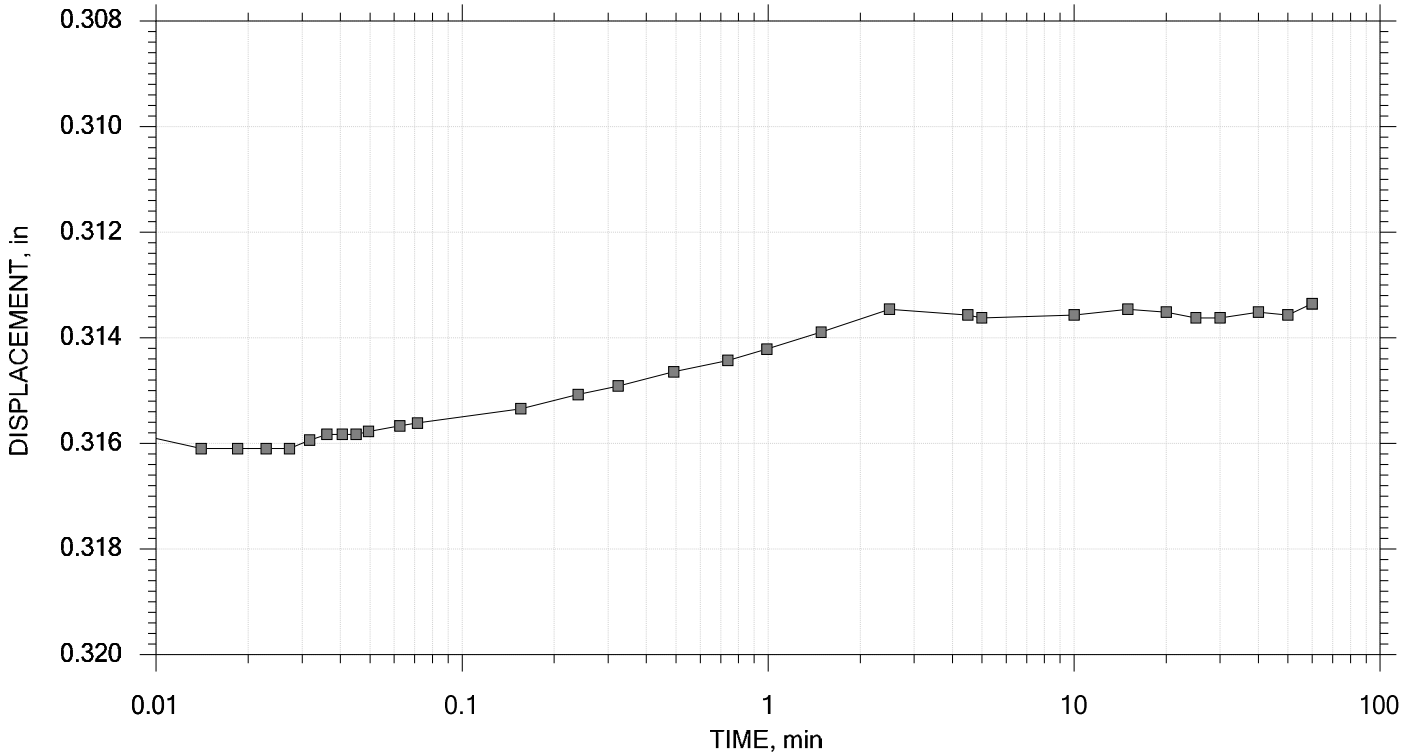
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

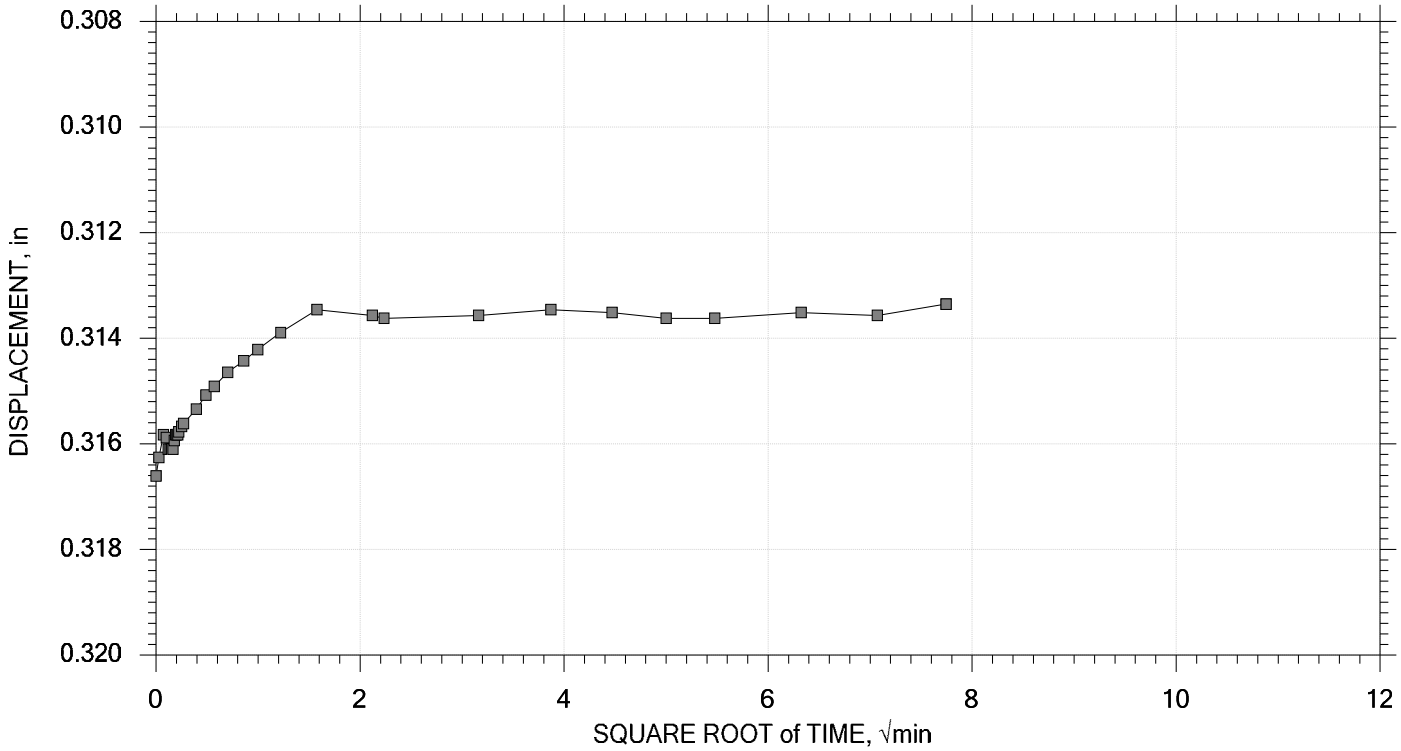
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 21

Stress: 4 tsf





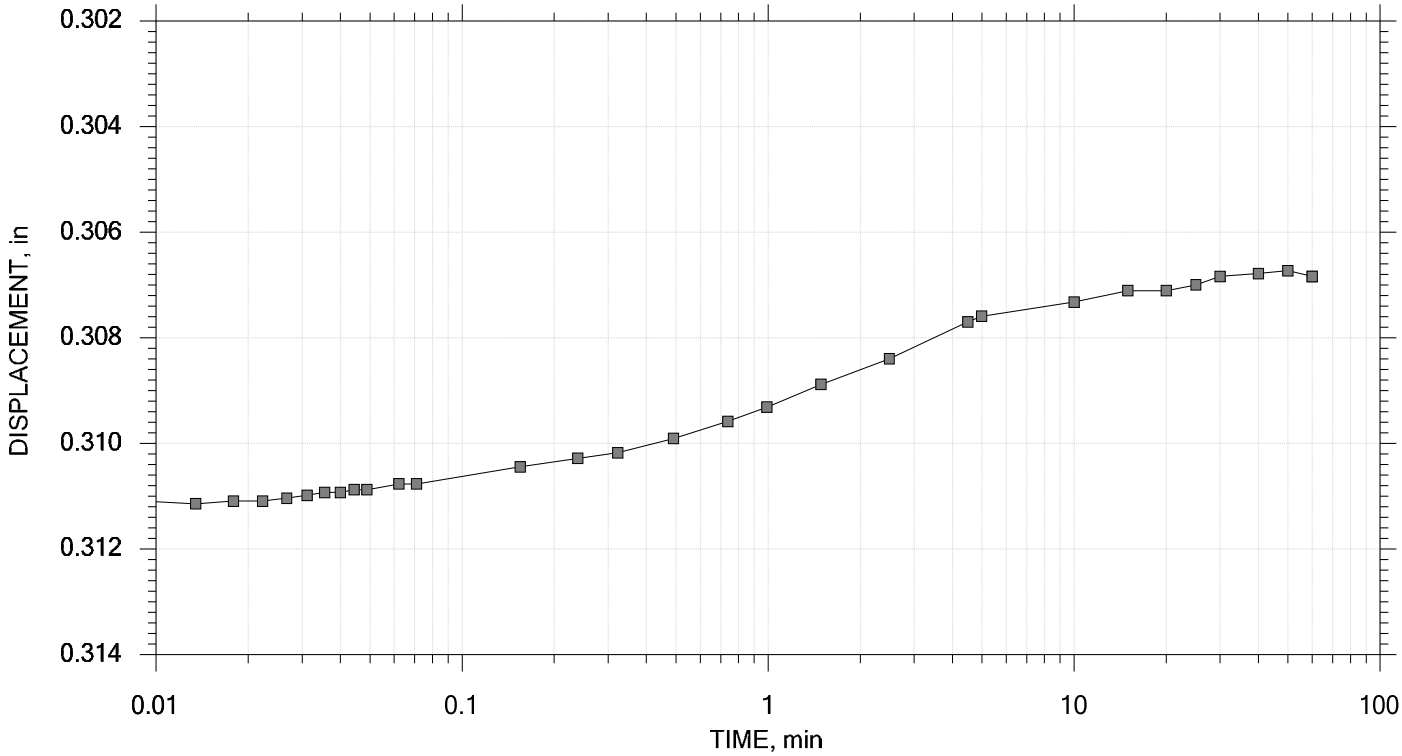
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

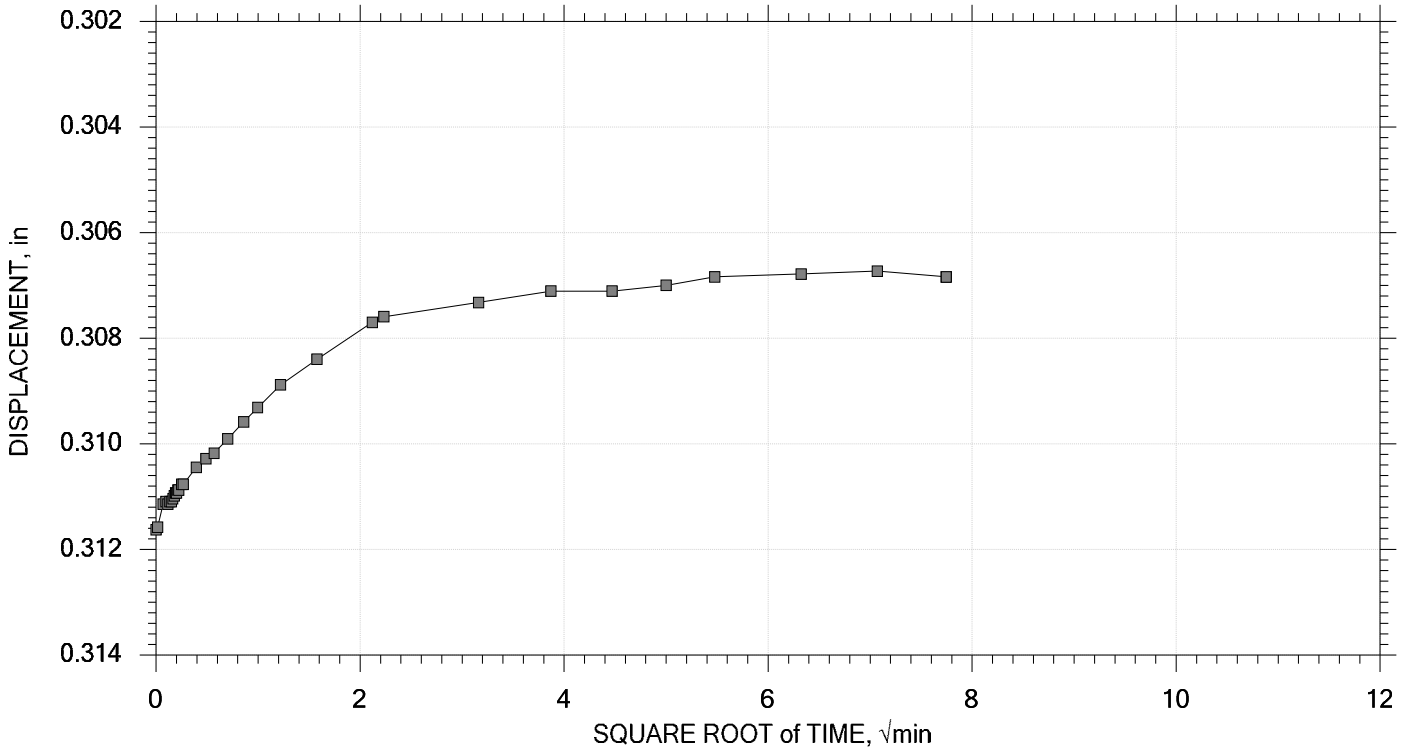
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 21

Stress: 2 tsf





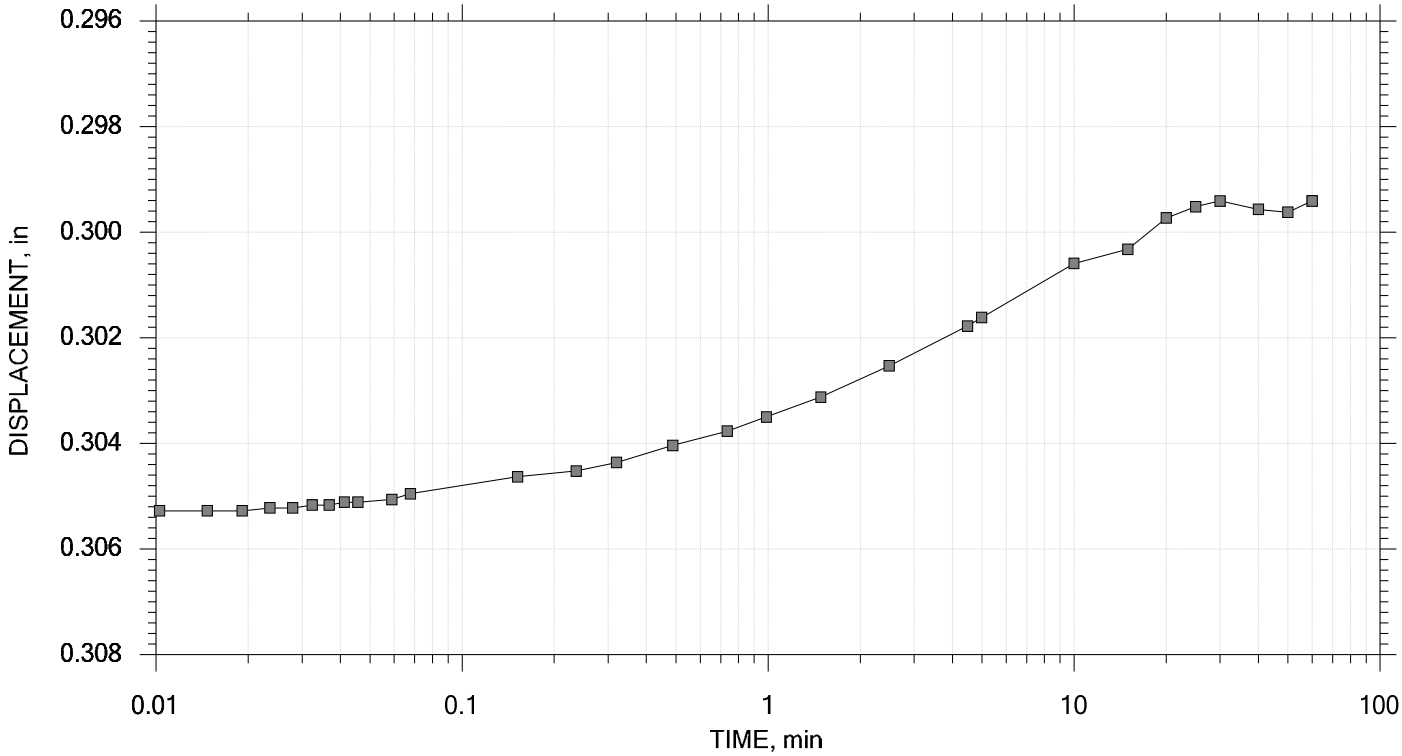
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

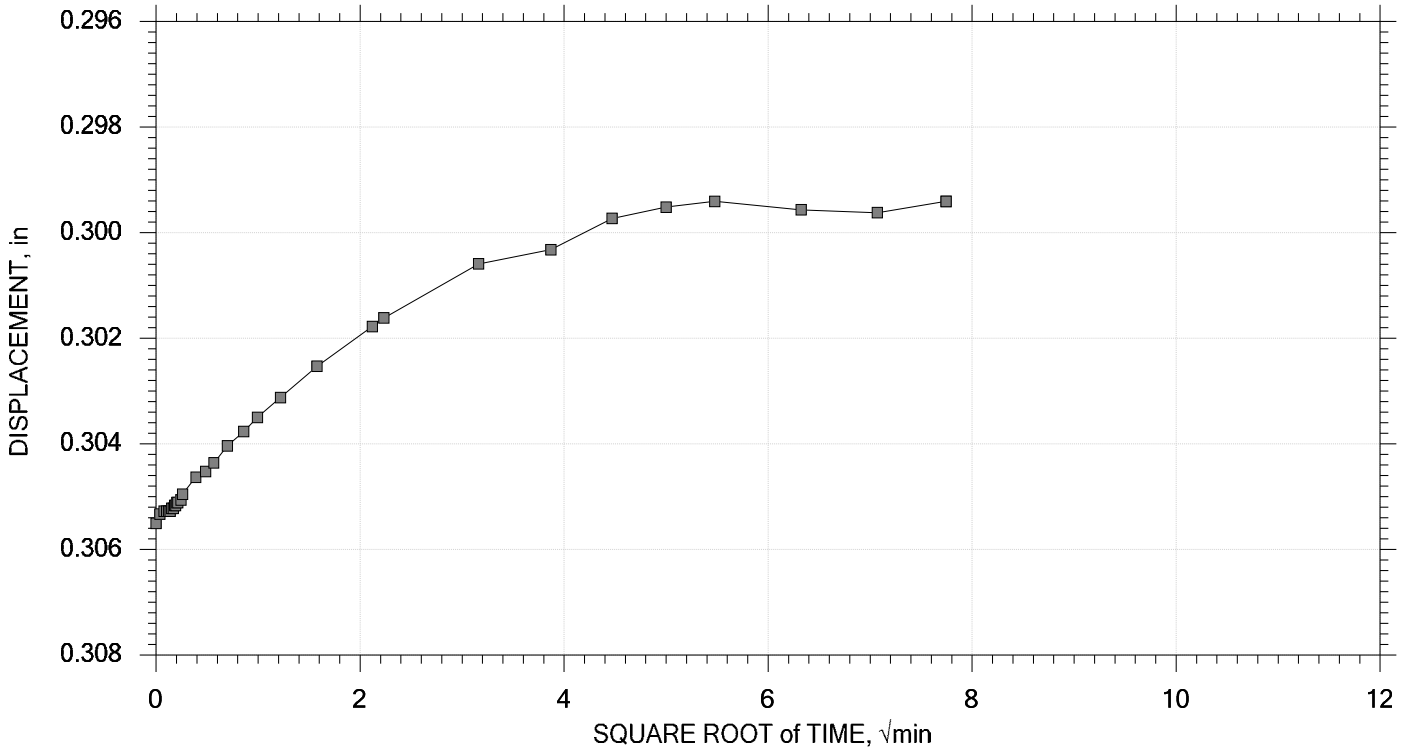
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 11 of 21

Stress: 1 tsf





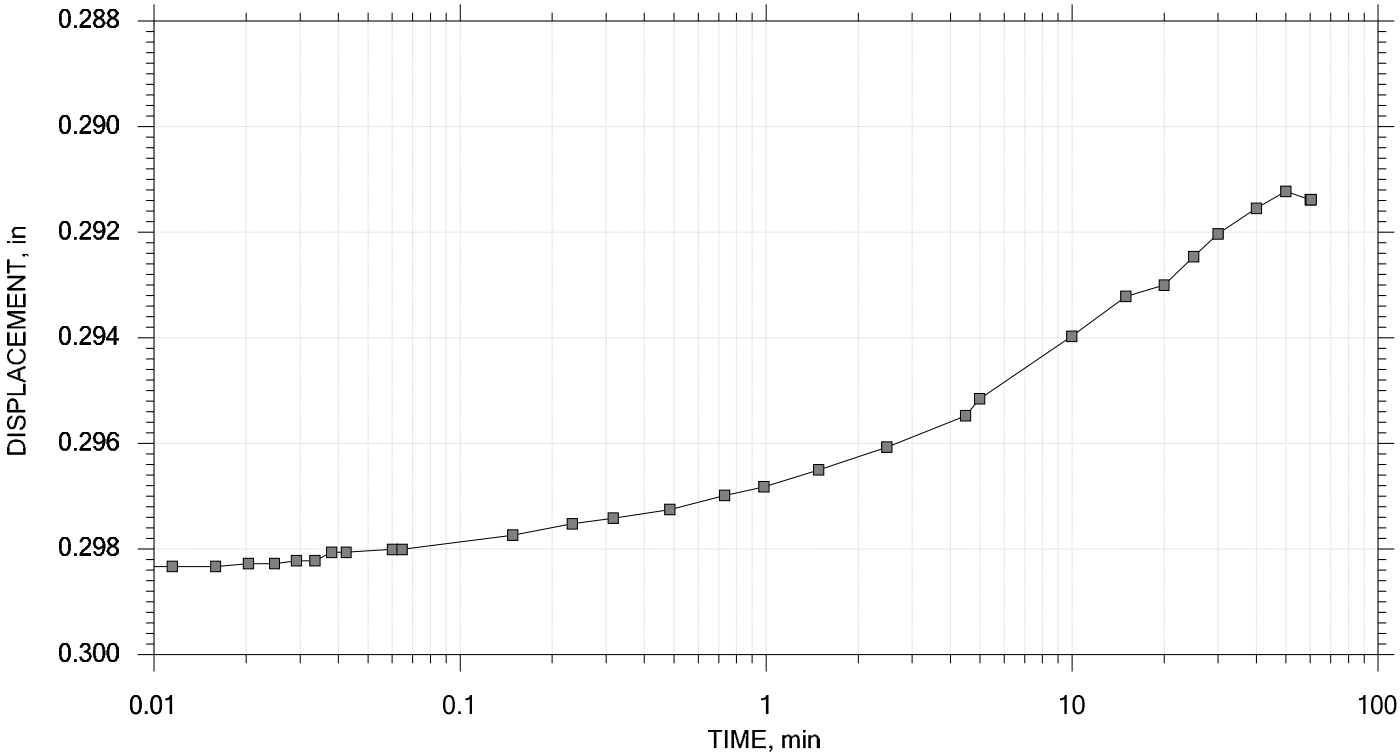
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

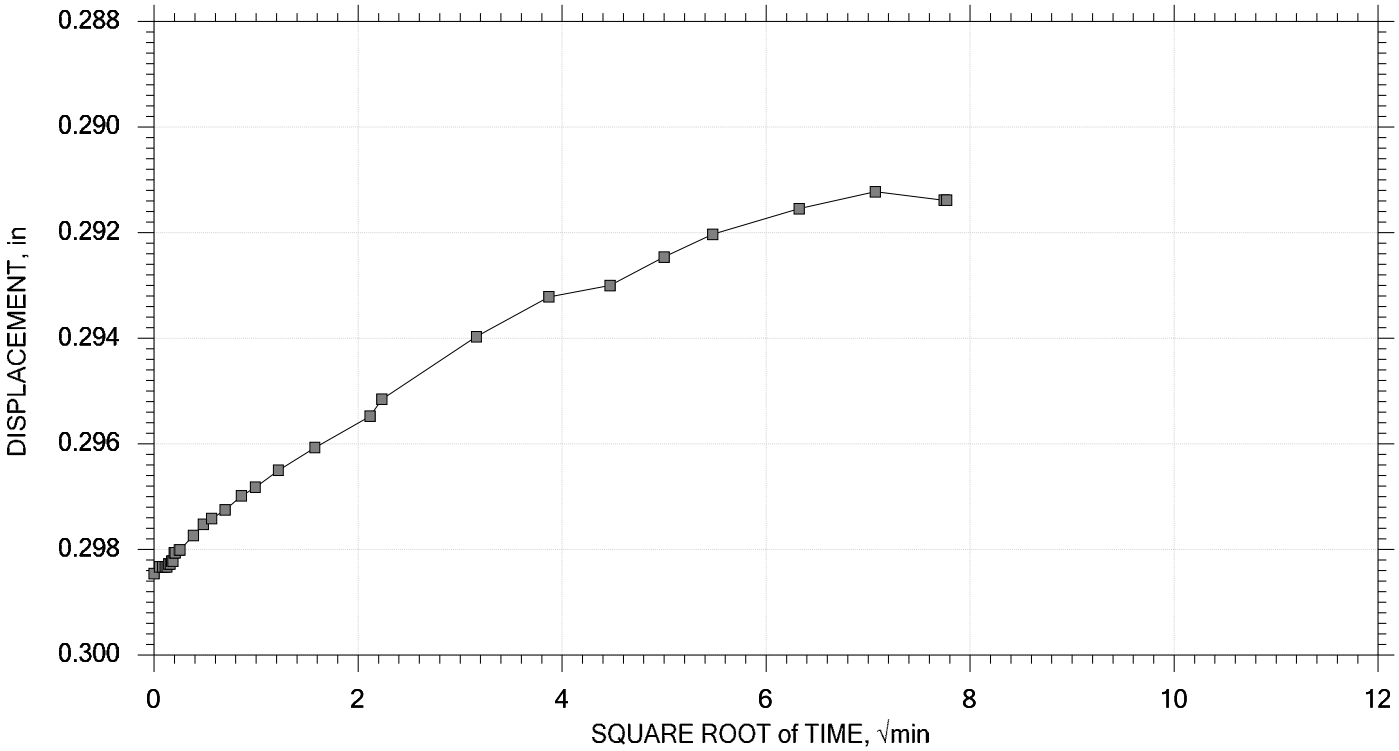
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 12 of 21

Stress: 0.5 tsf





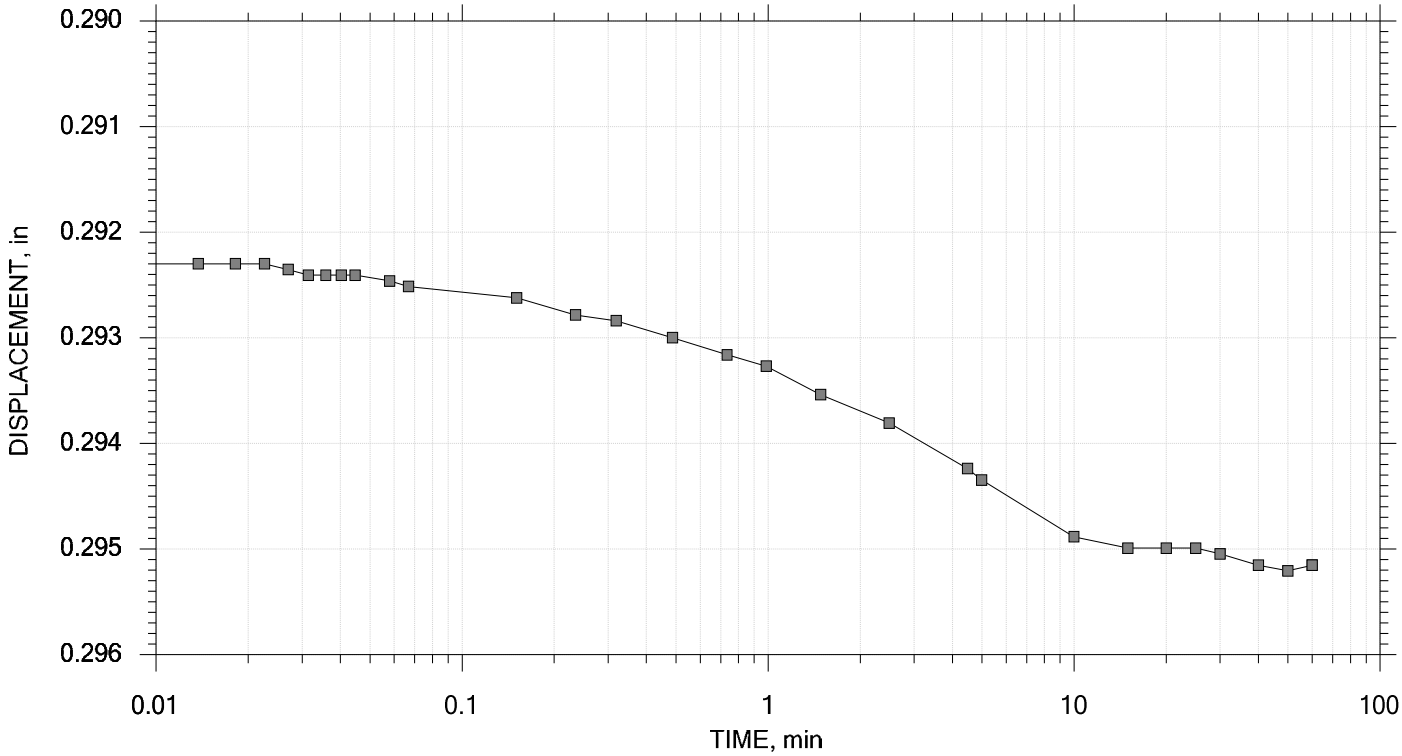
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

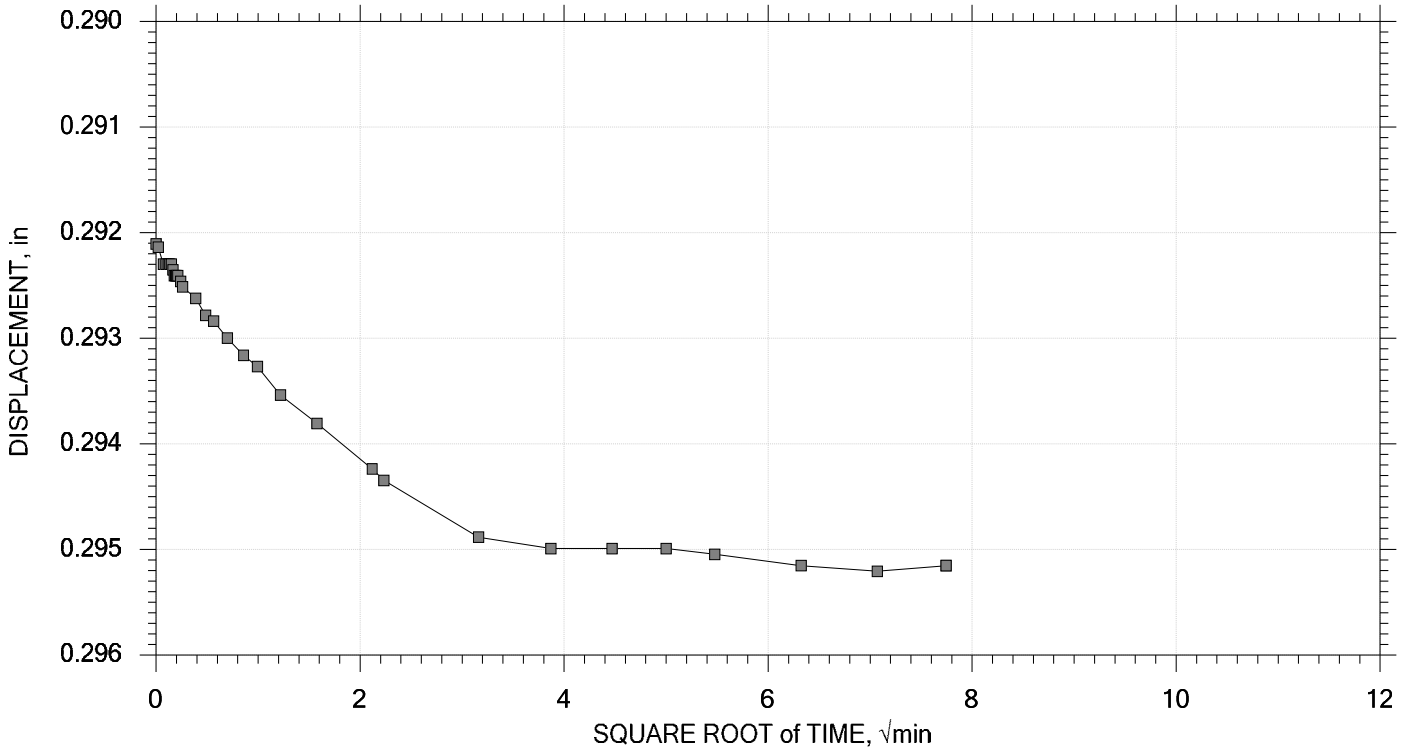
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 21

Stress: 1 tsf





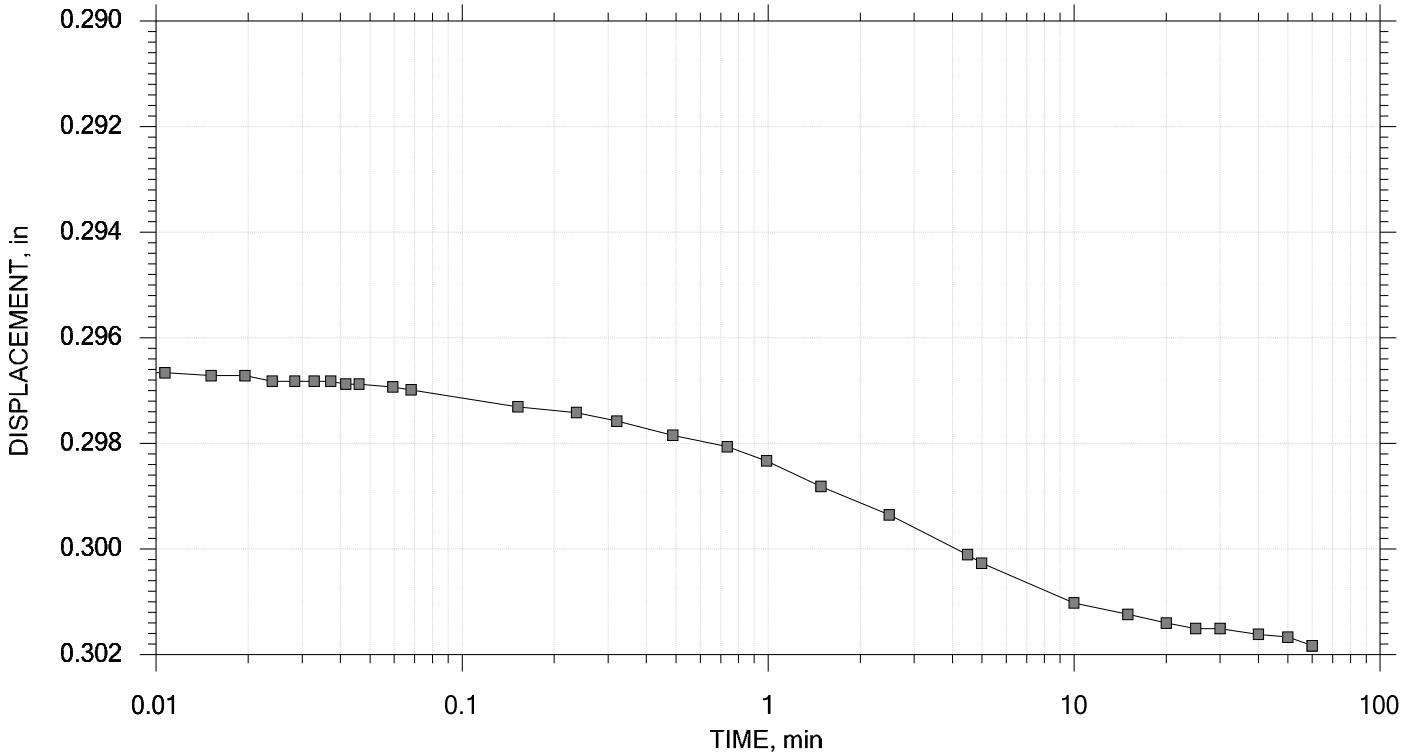
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

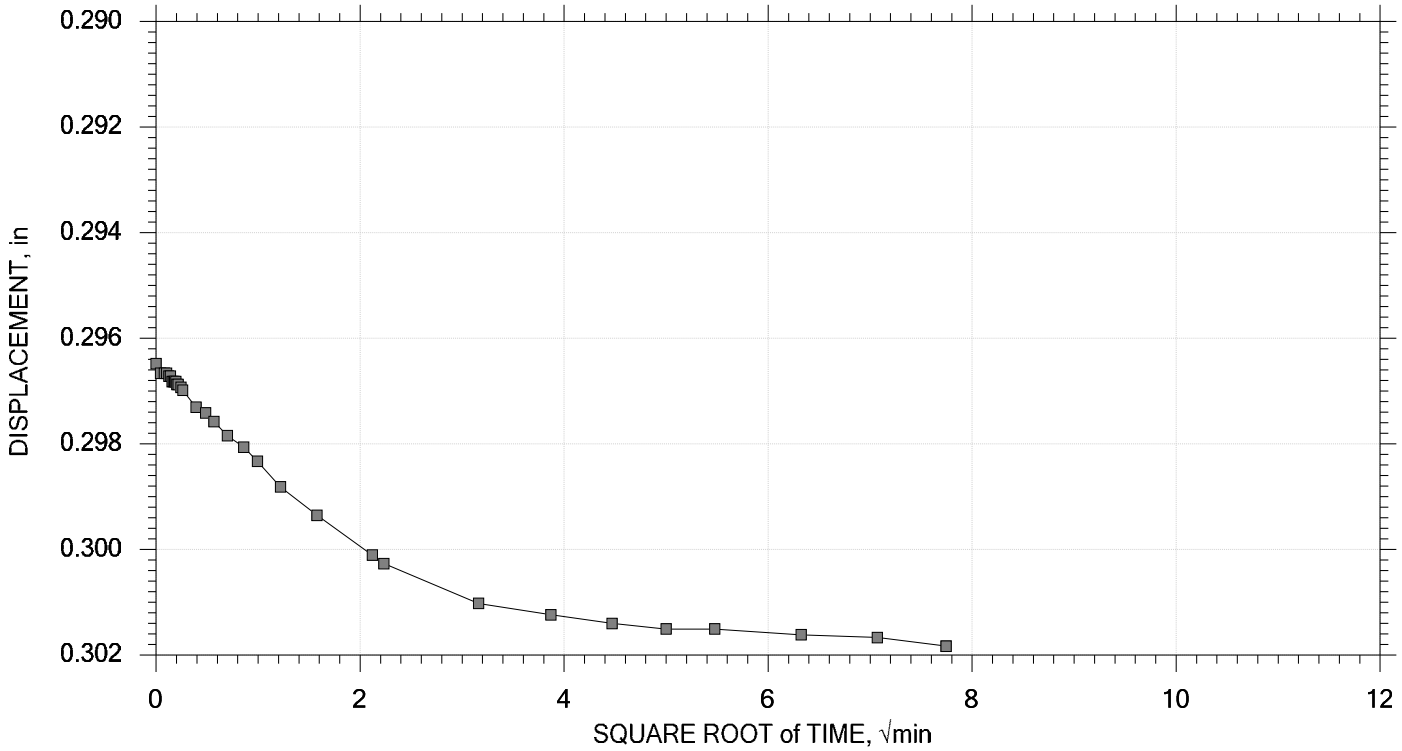
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 21

Stress: 2 tsf





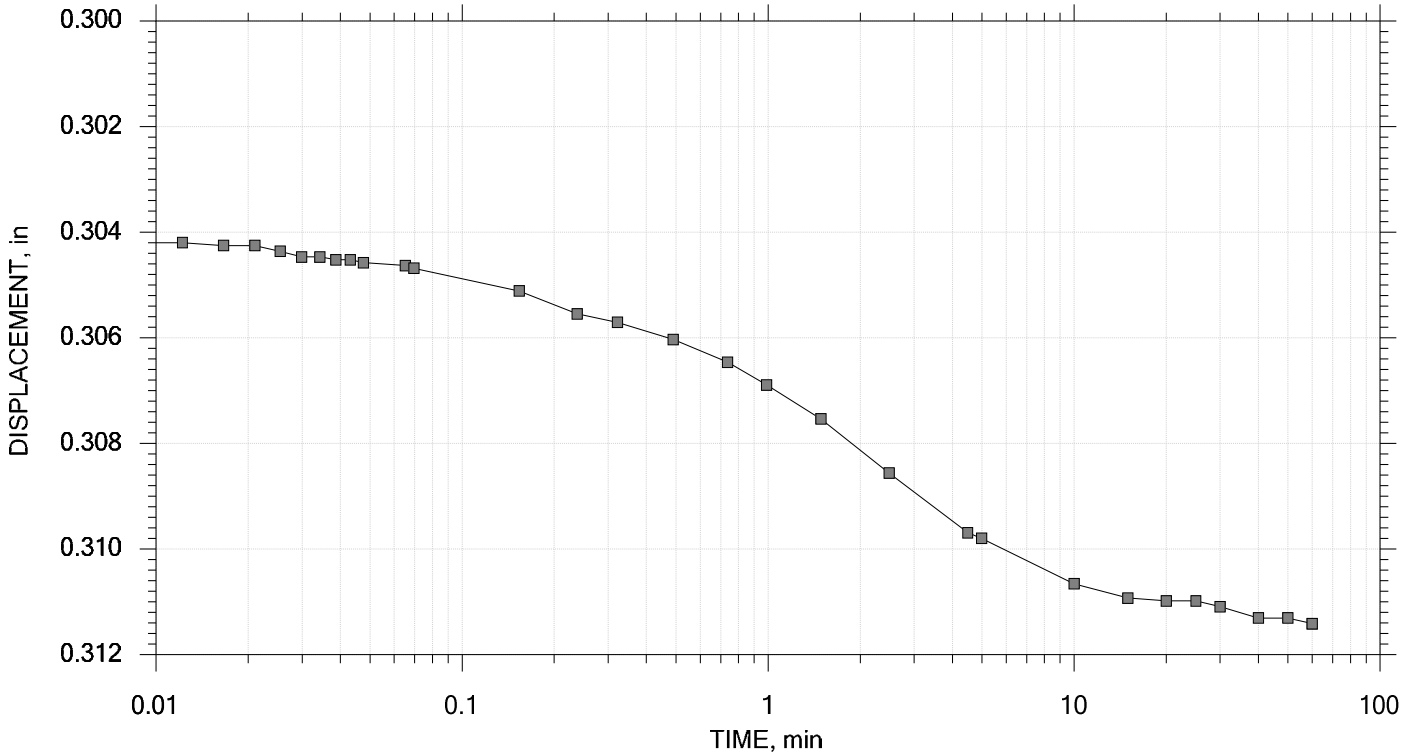
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

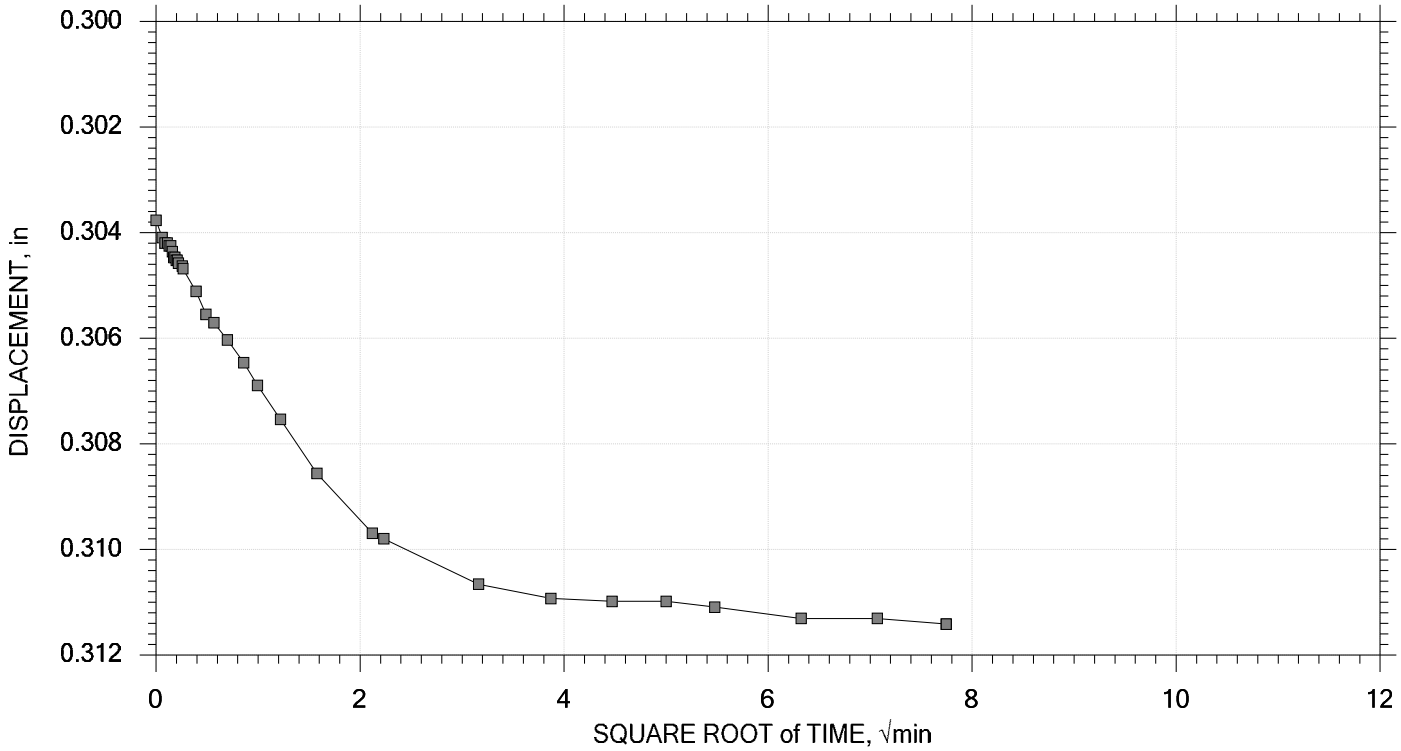
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 15 of 21

Stress: 4 tsf





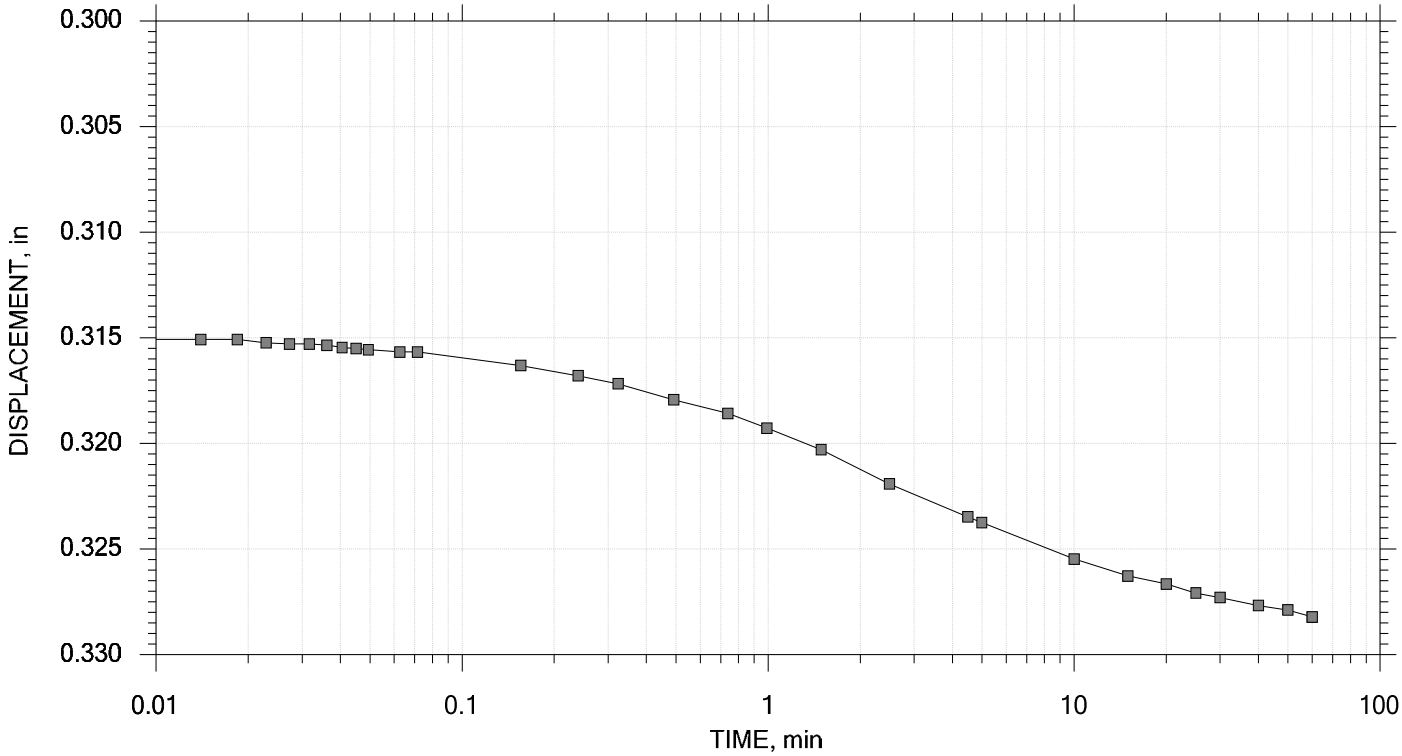
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

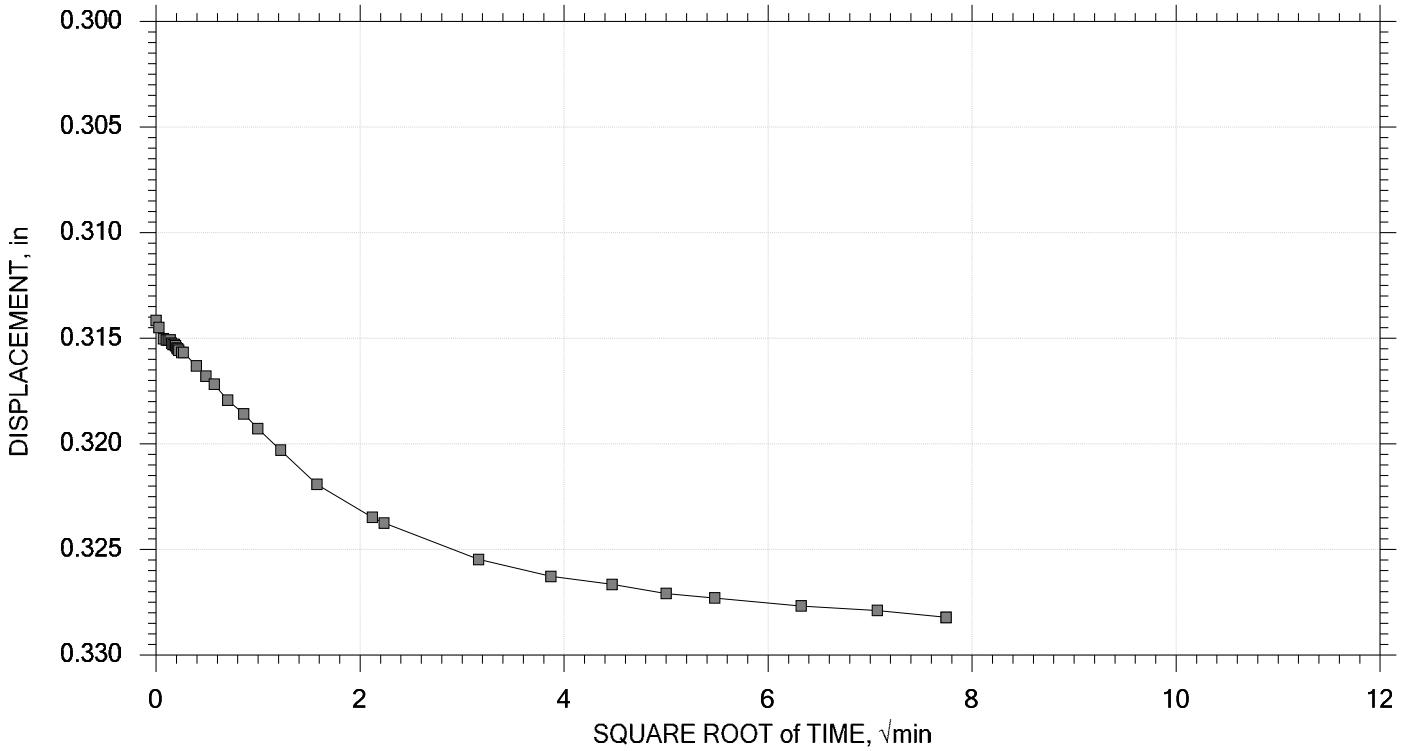
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 16 of 21

Stress: 8 tsf





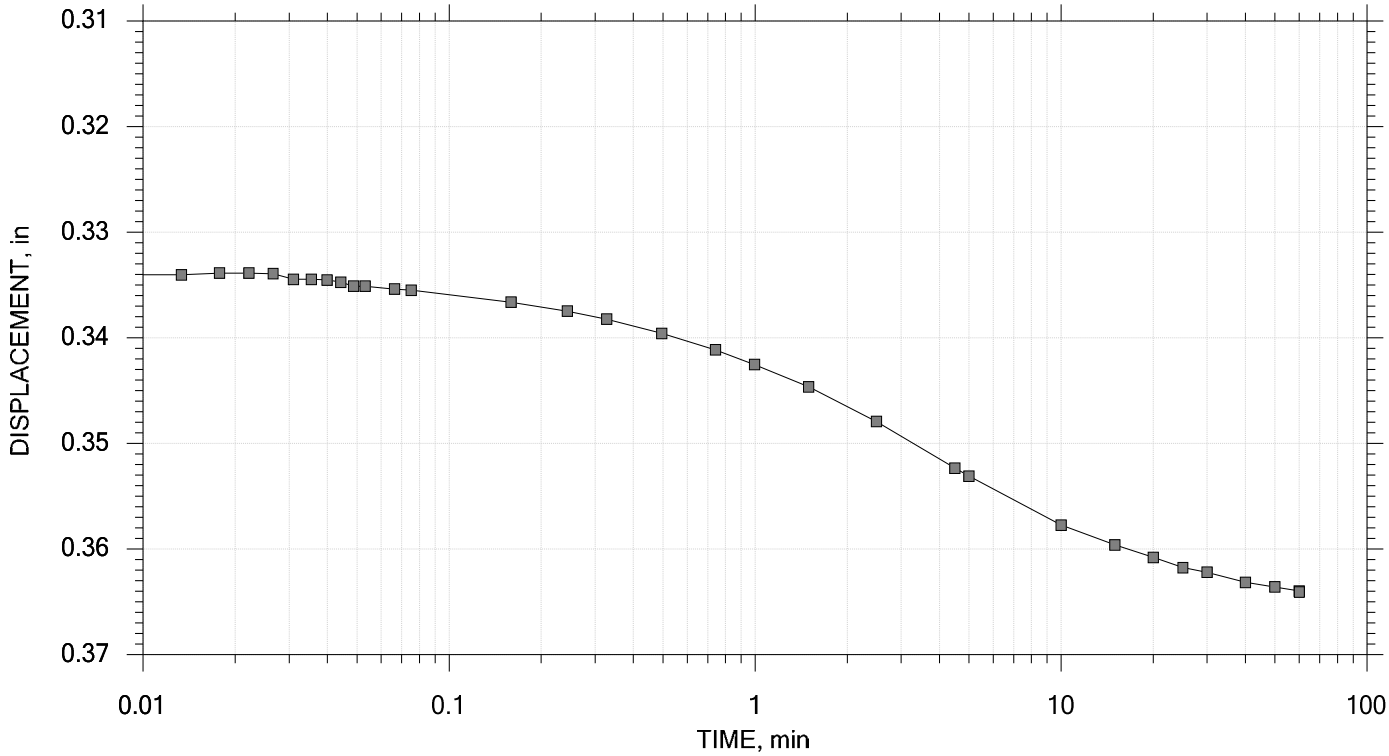
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

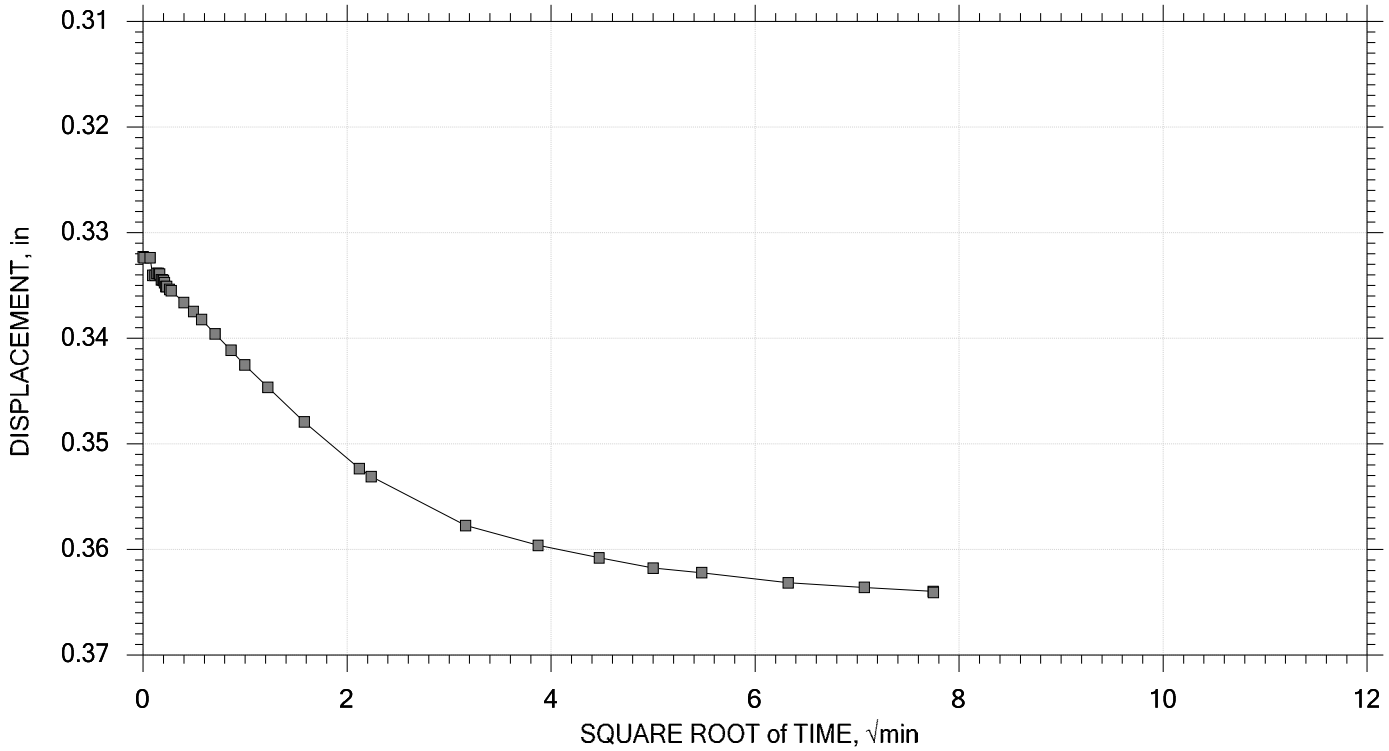
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 17 of 21

Stress: 16 tsf





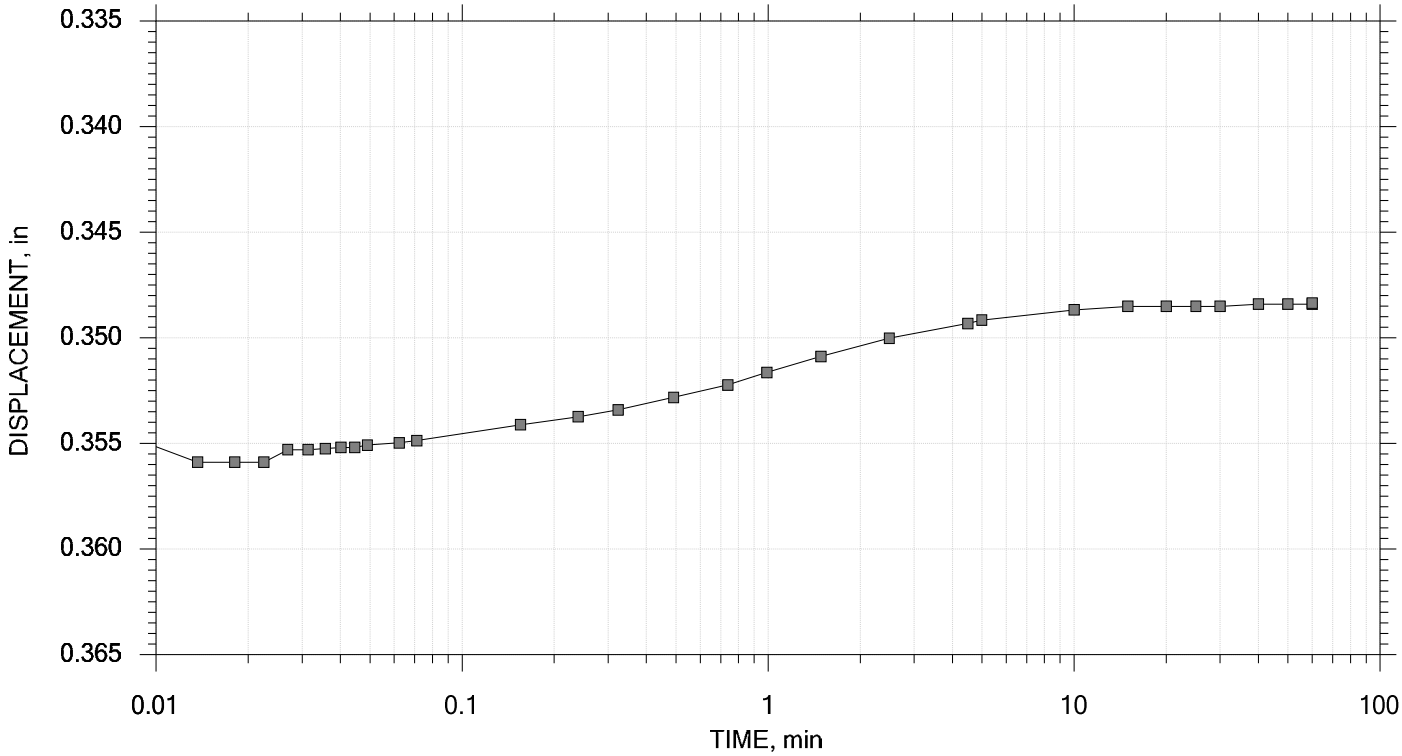
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

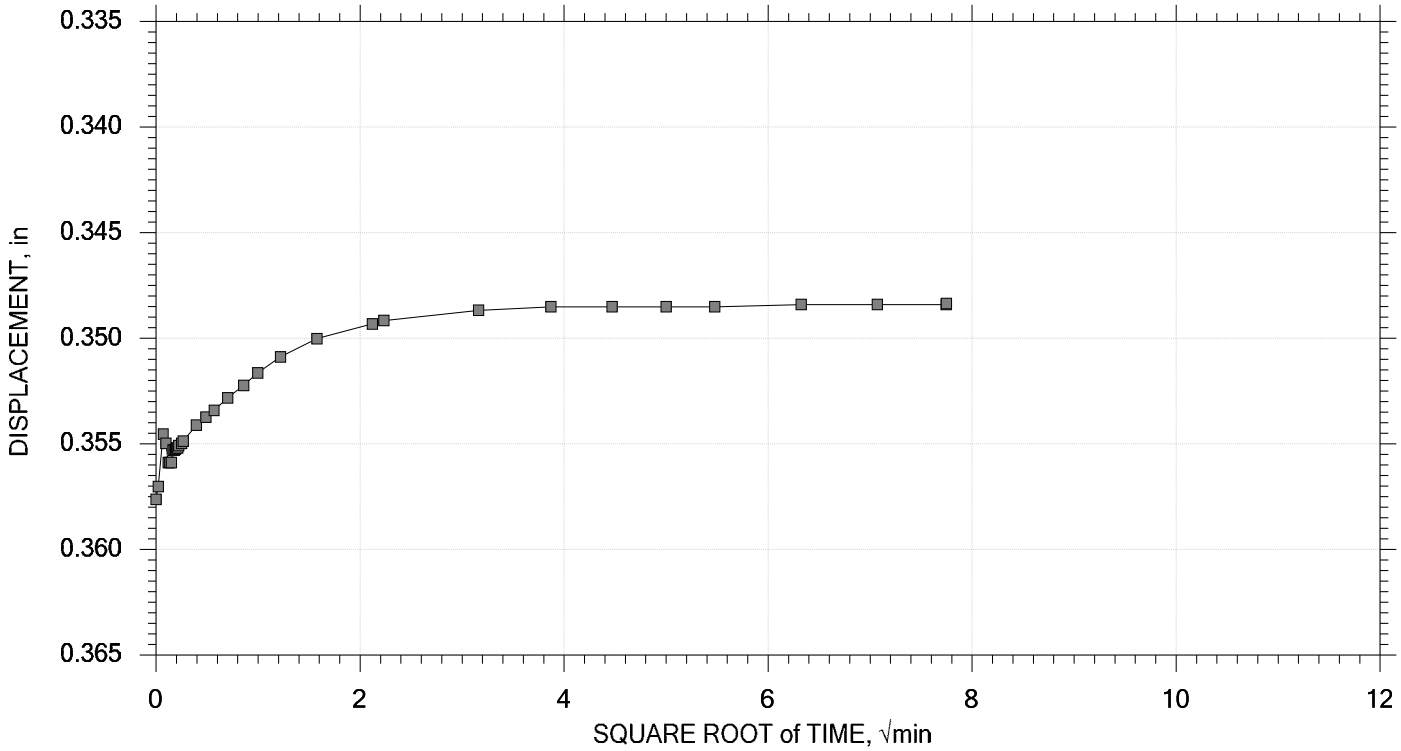
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 18 of 21

Stress: 4 tsf





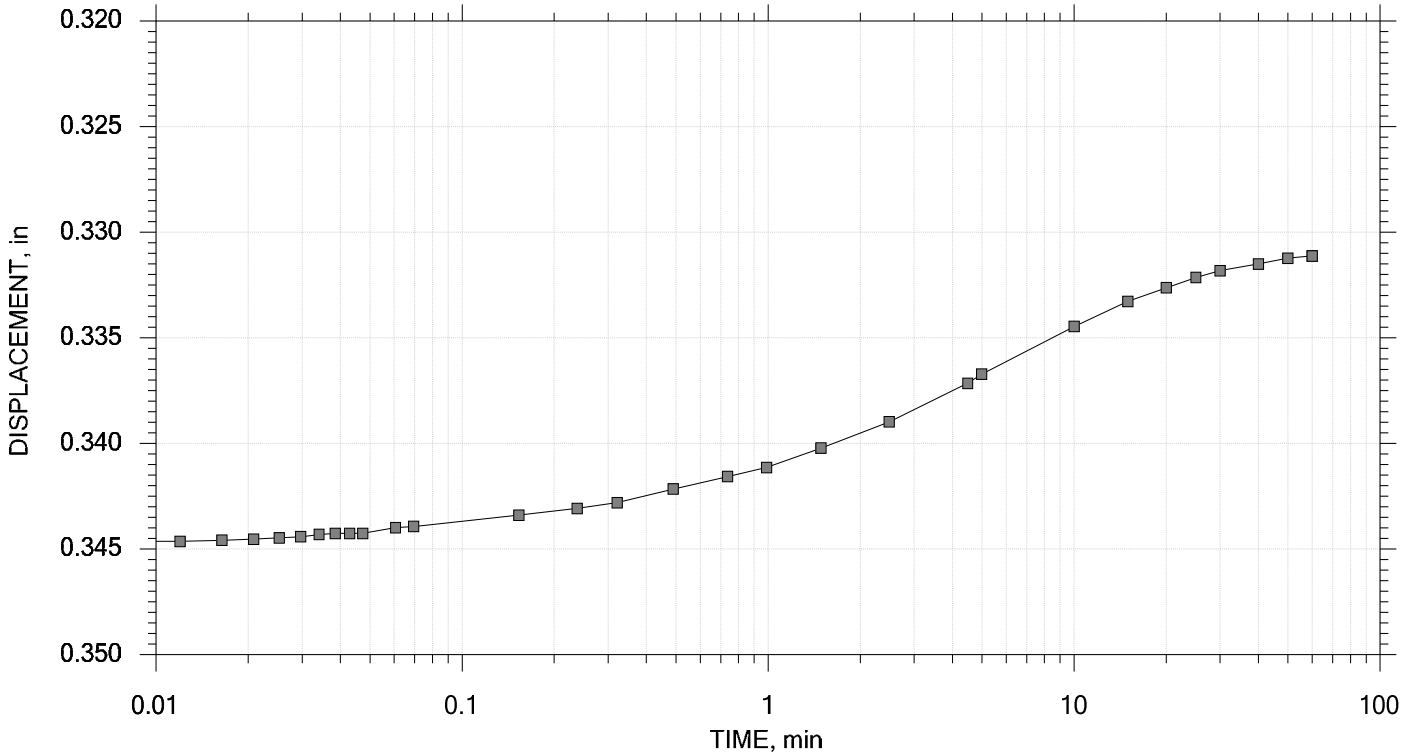
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

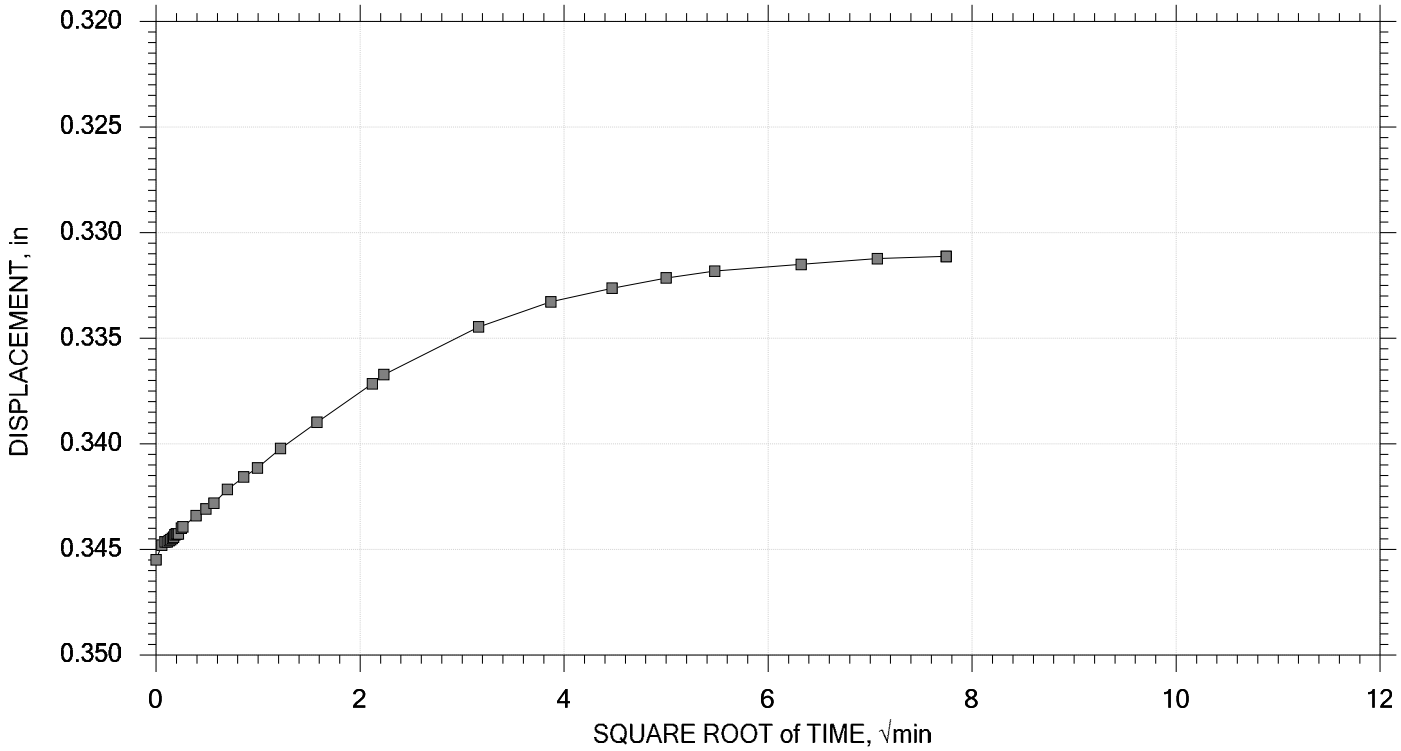
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 19 of 21

Stress: 1 tsf





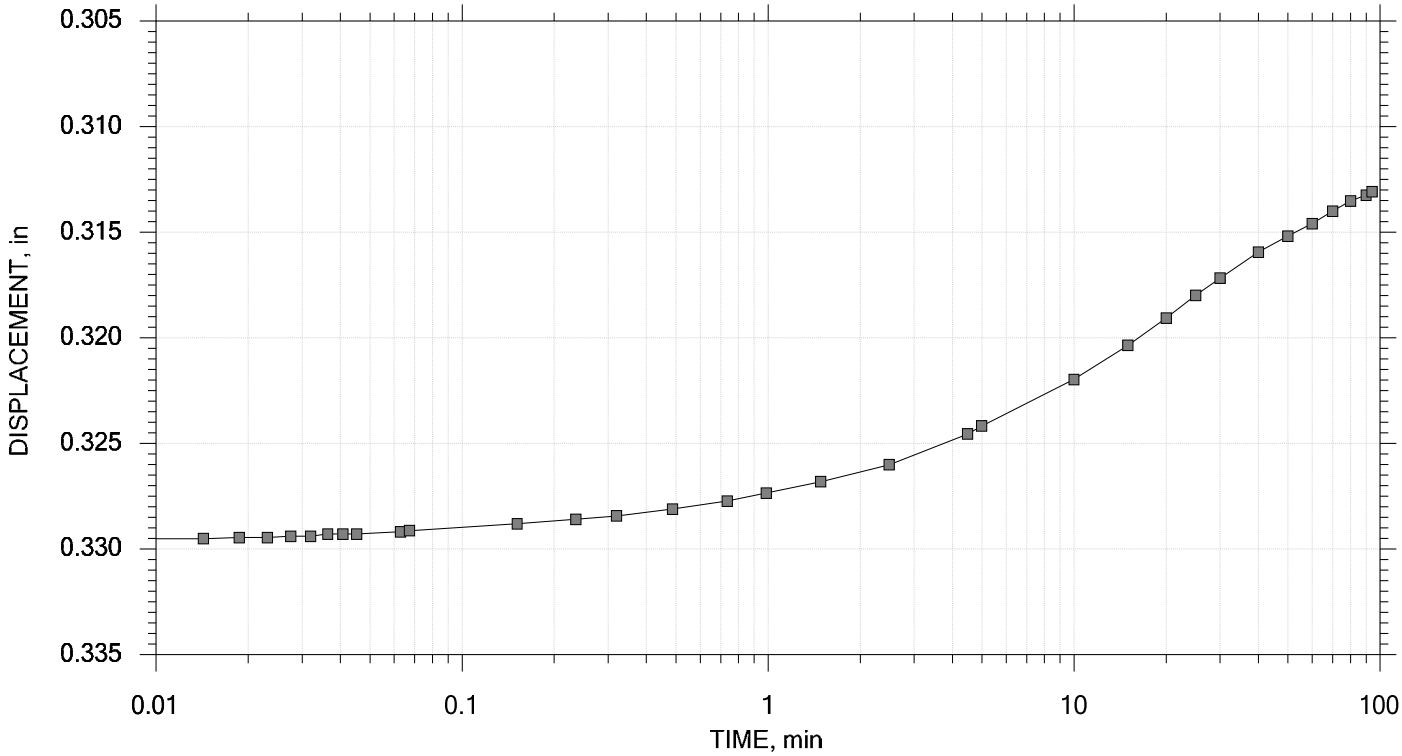
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

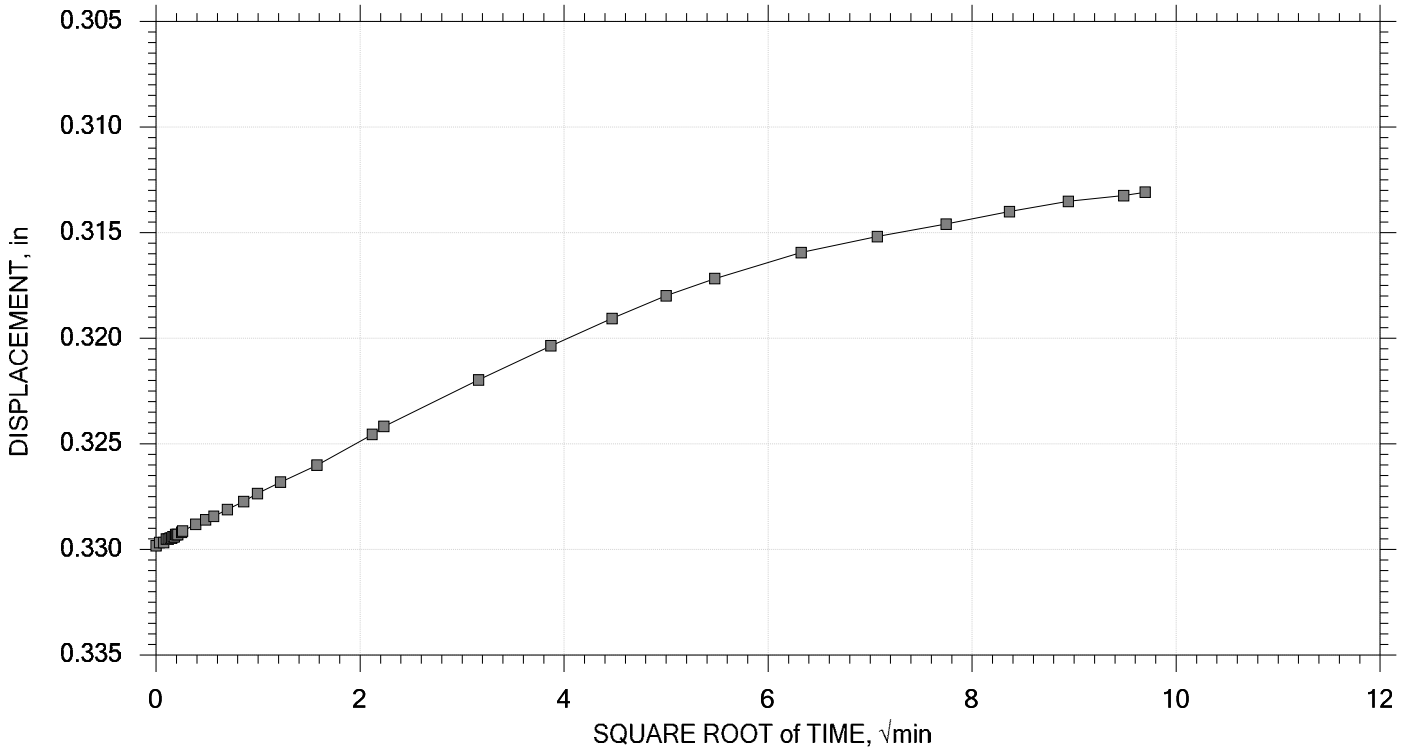
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 20 of 21

Stress: 0.25 tsf





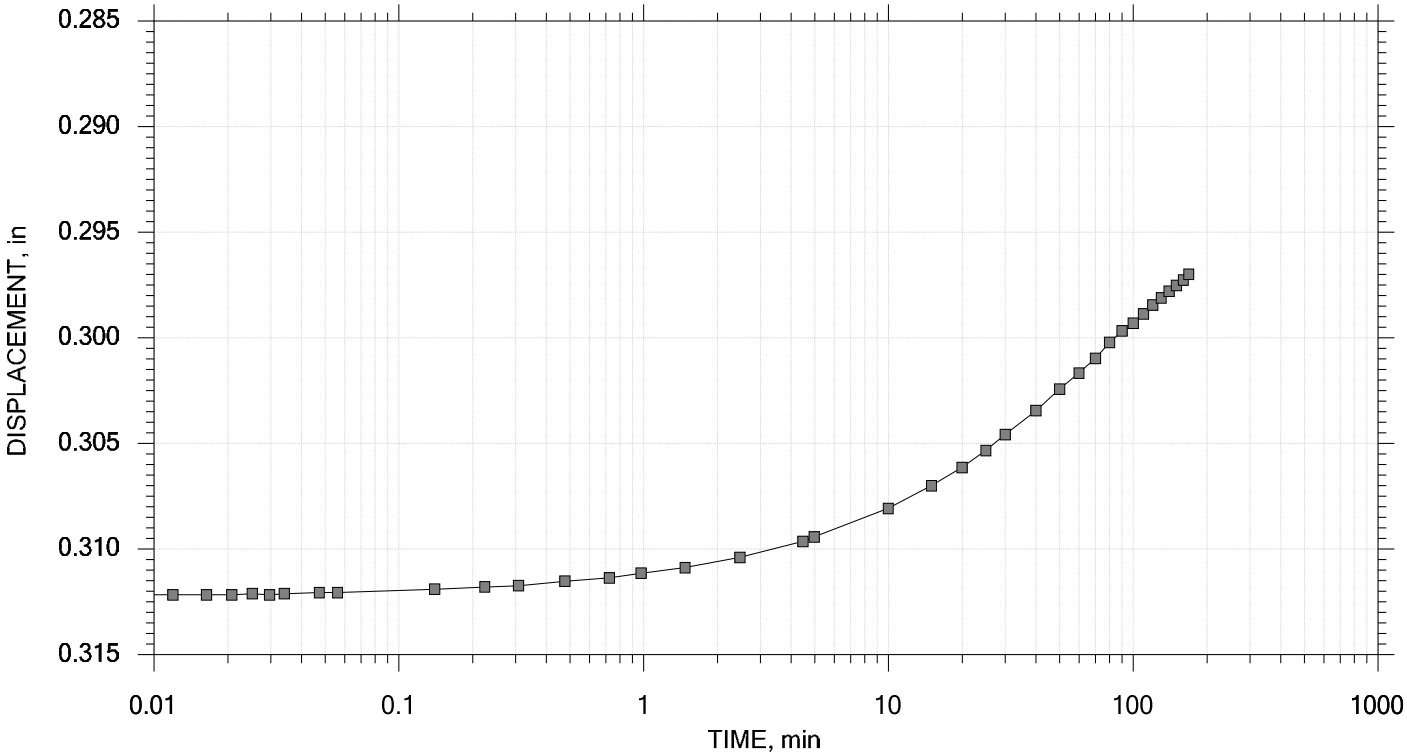
	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

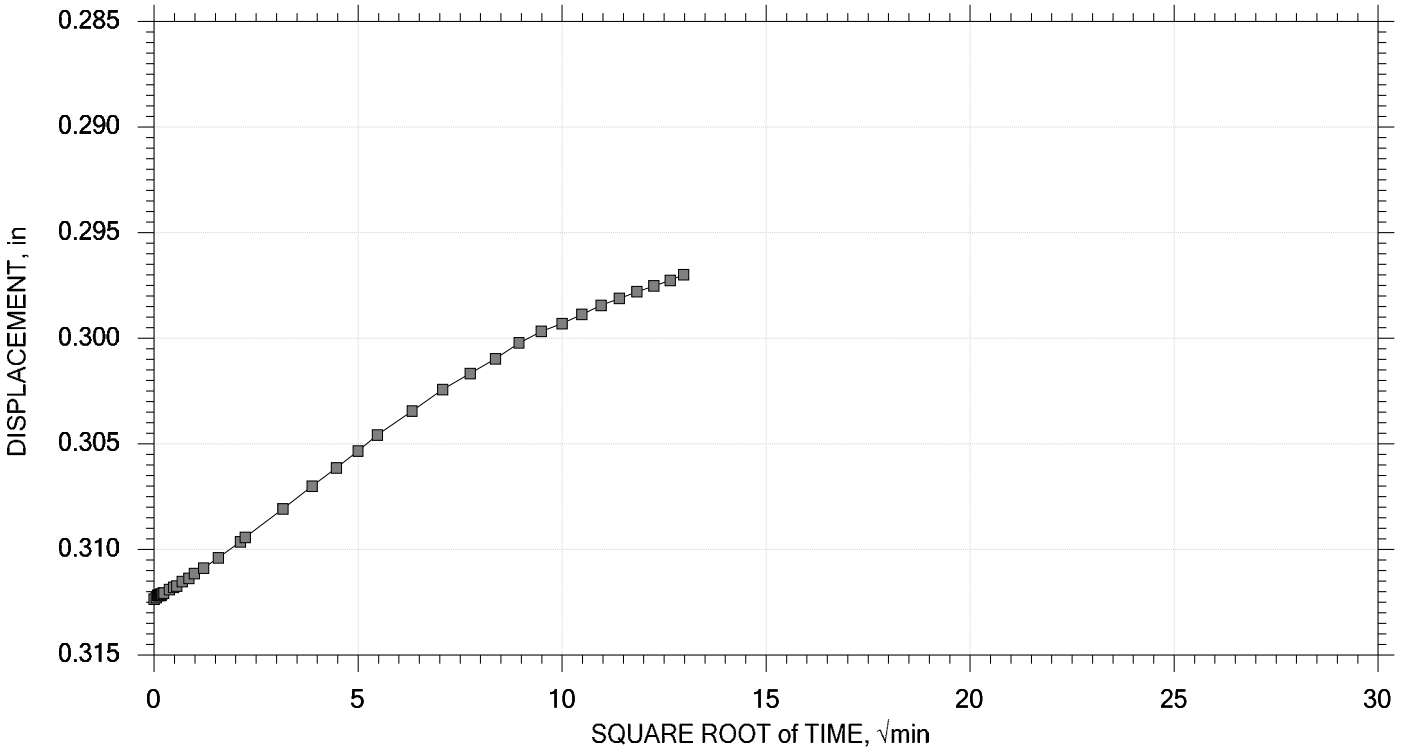
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 21 of 21

Stress: 0.0625 tsf





	Project: Gorham	Location: --	Project No.: 18821.00
	Boring No.: HB-GBB-301	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 2/21/18	Test No.: 303046A
	Depth: 32.0-32.5 FT	Sample Type: Intact	Elevation: --
	Description: Very Soft Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Measured Specific Gravity: 2.71
Initial Void Ratio: 1.16
Final Void Ratio: 0.746

Liquid Limit: 35
Plastic Limit: 24
Plasticity Index: 11

Specimen Diameter: 2.50 in
Initial Height: 1.00 in
Final Height: 0.81 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	82	RING	RING	118
Wt. Container + Wet Soil, gm	192.61	404.58	390.62	197.38
Wt. Container + Dry Soil, gm	154.74	362.86	362.86	169.74
Wt. Container, gm	64.910	262.00	262.00	69.300
Wt. Dry Soil, gm	89.830	100.86	100.86	100.44
Water Content, %	42.16	41.36	27.52	27.52
Void Ratio	---	1.16	0.746	---
Degree of Saturation, %	---	96.88	100.00	---
Dry Unit Weight, pcf	---	78.436	96.908	---

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/sec	Mv 1/tsf	k ft/day
1	0.0615	0.1033	0.935	10.3	49.401	4.49e-007	1.68e+000	2.03e-003
2	0.125	0.1185	0.902	11.8	35.838	5.44e-007	2.39e-001	3.50e-004
3	0.250	0.1437	0.848	14.3	113.476	1.64e-007	2.01e-001	8.90e-005
4	0.500	0.1718	0.787	17.1	91.118	1.92e-007	1.12e-001	5.80e-005
5	1.00	0.2026	0.721	20.2	57.980	2.81e-007	6.16e-002	4.67e-005
6	2.00	0.2380	0.645	23.8	38.411	3.90e-007	3.54e-002	3.72e-005
7	4.00	0.2774	0.560	27.7	26.824	5.07e-007	1.96e-002	2.68e-005
8	8.00	0.3191	0.470	31.8	16.768	7.25e-007	1.04e-002	2.03e-005
9	4.00	0.3133	0.482	31.3	1.109	1.04e-005	1.44e-003	4.03e-005
10	2.00	0.3068	0.496	30.6	3.267	3.60e-006	3.25e-003	3.15e-005
11	1.00	0.2994	0.512	29.9	7.568	1.58e-006	7.42e-003	3.17e-005
12	0.500	0.2914	0.530	29.1	15.704	7.80e-007	1.60e-002	3.37e-005
13	1.00	0.2952	0.522	29.5	5.768	2.14e-006	7.52e-003	4.34e-005
14	2.00	0.3018	0.507	30.1	8.251	1.47e-006	6.66e-003	2.64e-005
15	4.00	0.3114	0.487	31.1	6.576	1.80e-006	4.78e-003	2.33e-005
16	8.00	0.3282	0.450	32.8	7.166	1.59e-006	4.19e-003	1.80e-005
17	16.0	0.3641	0.373	36.3	6.561	1.61e-006	4.47e-003	1.94e-005
18	4.00	0.3483	0.407	34.8	1.527	6.70e-006	1.31e-003	2.36e-005
19	1.00	0.3311	0.444	33.0	11.962	9.00e-007	5.73e-003	1.39e-005
20	0.250	0.3131	0.483	31.2	46.911	2.42e-007	2.40e-002	1.57e-005
21	0.0625	0.2970	0.518	29.6	152.774	7.80e-008	8.57e-002	1.80e-005

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/sec	Mv 1/tsf	k ft/day	Ca %
1	0.0615	0.1033	0.935	10.3	7.600	6.77e-007	1.68e+000	3.06e-003	0.00e+000
2	0.125	0.1185	0.902	11.8	0.000	0.00e+000	2.39e-001	0.00e+000	0.00e+000
3	0.250	0.1437	0.848	14.3	0.000	0.00e+000	2.01e-001	0.00e+000	0.00e+000
4	0.500	0.1718	0.787	17.1	19.812	2.05e-007	1.12e-001	6.19e-005	0.00e+000
5	1.00	0.2026	0.721	20.2	14.316	2.64e-007	6.16e-002	4.39e-005	0.00e+000
6	2.00	0.2380	0.645	23.8	0.000	0.00e+000	3.54e-002	0.00e+000	0.00e+000
7	4.00	0.2774	0.560	27.7	0.000	0.00e+000	1.96e-002	0.00e+000	0.00e+000
8	8.00	0.3191	0.470	31.8	4.545	6.21e-007	1.04e-002	1.74e-005	0.00e+000
9	4.00	0.3133	0.482	31.3	0.000	0.00e+000	1.44e-003	0.00e+000	0.00e+000
10	2.00	0.3068	0.496	30.6	0.998	2.74e-006	3.25e-003	2.40e-005	0.00e+000
11	1.00	0.2994	0.512	29.9	0.000	0.00e+000	7.42e-003	0.00e+000	0.00e+000
12	0.500	0.2914	0.530	29.1	0.000	0.00e+000	1.60e-002	0.00e+000	0.00e+000
13	1.00	0.2952	0.522	29.5	1.798	1.59e-006	7.52e-003	3.23e-005	0.00e+000
14	2.00	0.3018	0.507	30.1	1.994	1.41e-006	6.66e-003	2.54e-005	0.00e+000
15	4.00	0.3114	0.487	31.1	1.268	2.17e-006	4.78e-003	2.80e-005	0.00e+000
16	8.00	0.3282	0.450	32.8	1.217	2.18e-006	4.19e-003	2.46e-005	0.00e+000
17	16.0	0.3641	0.373	36.3	2.038	1.20e-006	4.47e-003	1.45e-005	0.00e+000
18	4.00	0.3483	0.407	34.8	0.382	6.22e-006	1.31e-003	2.19e-005	0.00e+000
19	1.00	0.3311	0.444	33.0	0.000	0.00e+000	5.73e-003	0.00e+000	0.00e+000
20	0.250	0.3131	0.483	31.2	11.746	2.24e-007	2.40e-002	1.45e-005	0.00e+000
21	0.0625	0.2970	0.518	29.6	0.000	0.00e+000	8.57e-002	0.00e+000	0.00e+000

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 1 of 21
Applied Stress: 0.0615 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.795		0.0236	0.0000	0.0000	0.000	1.16
2	-0.791		0.0236	0.0000	0.0000	0.000	1.16
3	-0.787		0.0251	0.0000	-5.384e-005	-0.00537	1.16
4	-0.782		0.0266	0.0000	5.384e-005	0.00537	1.16
5	-0.778		0.0281	0.0000	0.0000	0.000	1.16
6	-0.773		0.0296	0.0000	0.0001615	0.0161	1.16
7	-0.769		0.0296	0.0000	0.0001615	0.0161	1.16
8	-0.765		0.0281	0.0000	0.0002154	0.0215	1.16
9	-0.760		0.0281	0.0000	0.0002692	0.0269	1.16
10	-0.756		0.0296	0.0000	0.0003230	0.0322	1.16
11	-0.751		0.0296	0.0000	0.0003230	0.0322	1.16
12	-0.747		0.0296	0.0000	0.0004307	0.0430	1.16
13	-0.742		0.0281	0.0000	0.0005922	0.0591	1.16
14	-0.738		0.0281	0.0000	0.0006999	0.0699	1.16
15	-0.734		0.0296	0.0000	0.0007538	0.0752	1.16
16	-0.720		0.0251	0.0000	0.001131	0.113	1.15
17	-0.711		0.0236	0.0000	0.001508	0.150	1.15
18	-0.628		0.0221	0.0000	0.006245	0.623	1.14
19	-0.543		0.0236	0.0000	0.01432	1.43	1.13
20	-0.460		0.0221	0.0000	0.02557	2.55	1.10
21	-0.292		0.0266	0.0000	0.05723	5.71	1.03
22	-0.044		0.0555	0.0000	0.09589	9.57	0.951
23	0.000	0.000	0.0563	0.0000	0.09608	9.59	0.950
24	0.208	0.456	0.0600	0.0000	0.09697	9.68	0.948
25	0.707	0.841	0.0615	0.0000	0.09745	9.73	0.947
26	1.706	1.306	0.0615	0.0000	0.09804	9.78	0.946
27	3.708	1.926	0.0600	0.0000	0.09880	9.86	0.944
28	4.208	2.051	0.0615	0.0000	0.09896	9.88	0.944
29	9.207	3.034	0.0615	0.0000	0.1001	9.99	0.941
30	14.206	3.769	0.0615	0.0000	0.1010	10.1	0.940
31	19.205	4.382	0.0615	0.0000	0.1014	10.1	0.939
32	24.208	4.920	0.0615	0.0000	0.1017	10.2	0.938
33	29.207	5.404	0.0615	0.0000	0.1020	10.2	0.937
34	39.205	6.261	0.0615	0.0000	0.1026	10.2	0.936
35	49.207	7.015	0.0615	0.0000	0.1030	10.3	0.935
36	59.205	7.694	0.0615	0.0000	0.1033	10.3	0.935
37	59.214	7.695	0.0615	0.0000	0.1033	10.3	0.935

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 2 of 21
Applied Stress: 0.125 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.077		0.0615	0.0000	0.1033	10.3	0.935
2	-0.072		0.0615	0.0000	0.1033	10.3	0.935
3	-0.068		0.0630	0.0000	0.1033	10.3	0.935
4	-0.063		0.0691	0.0000	0.1035	10.3	0.934
5	-0.059		0.0691	0.0000	0.1035	10.3	0.934
6	-0.055		0.0752	0.0000	0.1036	10.3	0.934
7	-0.050		0.0782	0.0000	0.1036	10.3	0.934
8	-0.046		0.0797	0.0000	0.1037	10.4	0.934
9	-0.041		0.0828	0.0000	0.1038	10.4	0.933
10	-0.037		0.0889	0.0000	0.1039	10.4	0.933
11	-0.032		0.0934	0.0000	0.1040	10.4	0.933
12	-0.028		0.0964	0.0000	0.1042	10.4	0.933
13	-0.024		0.101	0.0000	0.1043	10.4	0.932
14	-0.019		0.104	0.0000	0.1044	10.4	0.932
15	-0.015		0.112	0.0000	0.1047	10.4	0.932
16	-0.002		0.118	0.0000	0.1050	10.5	0.931
17	0.000	0.000	0.119	0.0000	0.1050	10.5	0.931
18	0.007	0.086	0.124	0.0000	0.1053	10.5	0.930
19	0.091	0.302	0.122	0.0000	0.1057	10.5	0.929
20	0.175	0.419	0.121	0.0000	0.1060	10.6	0.929
21	0.259	0.509	0.122	0.0000	0.1062	10.6	0.928
22	0.427	0.654	0.124	0.0000	0.1065	10.6	0.928
23	0.675	0.821	0.124	0.0000	0.1069	10.7	0.927
24	0.927	0.963	0.125	0.0000	0.1071	10.7	0.926
25	1.426	1.194	0.124	0.0000	0.1077	10.8	0.925
26	2.425	1.557	0.125	0.0000	0.1085	10.8	0.923
27	4.427	2.104	0.125	0.0000	0.1095	10.9	0.921
28	4.927	2.220	0.125	0.0000	0.1097	11.0	0.921
29	9.926	3.150	0.125	0.0000	0.1116	11.1	0.917
30	14.925	3.863	0.125	0.0000	0.1126	11.2	0.914
31	19.924	4.464	0.125	0.0000	0.1135	11.3	0.913
32	24.927	4.993	0.125	0.0000	0.1143	11.4	0.911
33	29.926	5.470	0.125	0.0000	0.1149	11.5	0.909
34	39.924	6.319	0.124	0.0000	0.1159	11.6	0.908
35	49.926	7.066	0.125	0.0000	0.1167	11.6	0.906
36	59.924	7.741	0.125	0.0000	0.1174	11.7	0.904
37	69.926	8.362	0.125	0.0000	0.1180	11.8	0.903
38	79.924	8.940	0.125	0.0000	0.1184	11.8	0.902
39	81.224	9.012	0.124	0.0000	0.1185	11.8	0.902

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 3 of 21
Applied Stress: 0.250 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.048		0.125	0.0000	0.1184	11.8	0.902
2	-0.044		0.125	0.0000	0.1184	11.8	0.902
3	-0.040		0.134	0.0000	0.1185	11.8	0.902
4	-0.035		0.150	0.0000	0.1187	11.8	0.901
5	-0.031		0.163	0.0000	0.1188	11.9	0.901
6	-0.026		0.184	0.0000	0.1190	11.9	0.901
7	-0.022		0.184	0.0000	0.1190	11.9	0.901
8	-0.018		0.198	0.0000	0.1192	11.9	0.900
9	-0.013		0.215	0.0000	0.1196	11.9	0.900
10	-0.009		0.215	0.0000	0.1196	11.9	0.900
11	-0.004		0.229	0.0000	0.1199	12.0	0.899
12	0.000	0.000	0.238	0.0000	0.1201	12.0	0.898
13	0.000	0.008	0.238	0.0000	0.1201	12.0	0.898
14	0.004	0.067	0.250	0.0000	0.1202	12.0	0.898
15	0.009	0.094	0.245	0.0000	0.1202	12.0	0.898
16	0.013	0.115	0.239	0.0000	0.1202	12.0	0.898
17	0.027	0.163	0.236	0.0000	0.1203	12.0	0.898
18	0.035	0.188	0.238	0.0000	0.1203	12.0	0.898
19	0.119	0.346	0.245	0.0000	0.1207	12.0	0.897
20	0.203	0.451	0.250	0.0000	0.1210	12.1	0.897
21	0.287	0.536	0.250	0.0000	0.1212	12.1	0.896
22	0.455	0.675	0.247	0.0000	0.1215	12.1	0.895
23	0.703	0.838	0.247	0.0000	0.1218	12.2	0.895
24	0.955	0.977	0.250	0.0000	0.1221	12.2	0.894
25	1.454	1.206	0.248	0.0000	0.1226	12.2	0.893
26	2.453	1.566	0.248	0.0000	0.1233	12.3	0.891
27	4.455	2.111	0.248	0.0000	0.1246	12.4	0.889
28	4.955	2.226	0.248	0.0000	0.1249	12.5	0.888
29	9.954	3.155	0.250	0.0000	0.1274	12.7	0.883
30	14.953	3.867	0.250	0.0000	0.1294	12.9	0.878
31	19.952	4.467	0.250	0.0000	0.1311	13.1	0.875
32	24.955	4.996	0.250	0.0000	0.1324	13.2	0.872
33	29.954	5.473	0.248	0.0000	0.1337	13.3	0.869
34	39.952	6.321	0.248	0.0000	0.1359	13.6	0.864
35	49.954	7.068	0.250	0.0000	0.1376	13.7	0.861
36	59.952	7.743	0.250	0.0000	0.1389	13.9	0.858
37	69.954	8.364	0.251	0.0000	0.1400	14.0	0.856
38	79.952	8.942	0.250	0.0000	0.1408	14.1	0.854
39	89.955	9.484	0.250	0.0000	0.1417	14.1	0.852
40	99.953	9.998	0.250	0.0000	0.1422	14.2	0.851
41	109.955	10.486	0.250	0.0000	0.1426	14.2	0.850
42	119.953	10.952	0.250	0.0000	0.1429	14.3	0.849
43	129.955	11.400	0.250	0.0000	0.1433	14.3	0.849
44	139.953	11.830	0.250	0.0000	0.1437	14.3	0.848
45	143.167	11.965	0.250	0.0000	0.1437	14.3	0.848

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 4 of 21
Applied Stress: 0.500 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.029		0.250	0.0000	0.1437	14.3	0.848
2	-0.025		0.250	0.0000	0.1437	14.3	0.848
3	-0.021		0.295	0.0000	0.1439	14.4	0.847
4	-0.016		0.329	0.0000	0.1441	14.4	0.847
5	-0.012		0.359	0.0000	0.1443	14.4	0.846
6	-0.007		0.406	0.0000	0.1446	14.4	0.846
7	-0.003		0.441	0.0000	0.1448	14.4	0.845
8	0.000	0.000	0.475	0.0000	0.1450	14.5	0.845
9	0.002	0.040	0.494	0.0000	0.1452	14.5	0.844
10	0.006	0.078	0.494	0.0000	0.1452	14.5	0.844
11	0.010	0.102	0.488	0.0000	0.1452	14.5	0.844
12	0.015	0.122	0.476	0.0000	0.1453	14.5	0.844
13	0.019	0.139	0.476	0.0000	0.1453	14.5	0.844
14	0.024	0.154	0.476	0.0000	0.1453	14.5	0.844
15	0.028	0.168	0.479	0.0000	0.1454	14.5	0.844
16	0.033	0.180	0.484	0.0000	0.1454	14.5	0.844
17	0.050	0.224	0.499	0.0000	0.1455	14.5	0.844
18	0.055	0.234	0.499	0.0000	0.1455	14.5	0.844
19	0.139	0.372	0.493	0.0000	0.1459	14.6	0.843
20	0.223	0.472	0.500	0.0000	0.1462	14.6	0.842
21	0.307	0.554	0.494	0.0000	0.1465	14.6	0.842
22	0.475	0.689	0.496	0.0000	0.1468	14.7	0.841
23	0.722	0.850	0.500	0.0000	0.1473	14.7	0.840
24	0.974	0.987	0.499	0.0000	0.1477	14.7	0.839
25	1.473	1.214	0.499	0.0000	0.1484	14.8	0.838
26	2.472	1.572	0.499	0.0000	0.1495	14.9	0.835
27	4.475	2.115	0.502	0.0000	0.1512	15.1	0.831
28	4.974	2.230	0.499	0.0000	0.1516	15.1	0.831
29	9.973	3.158	0.499	0.0000	0.1546	15.4	0.824
30	14.972	3.869	0.500	0.0000	0.1570	15.7	0.819
31	19.971	4.469	0.502	0.0000	0.1589	15.9	0.815
32	24.974	4.997	0.502	0.0000	0.1606	16.0	0.811
33	29.973	5.475	0.502	0.0000	0.1620	16.2	0.808
34	39.971	6.322	0.502	0.0000	0.1644	16.4	0.803
35	49.973	7.069	0.502	0.0000	0.1661	16.6	0.799
36	59.971	7.744	0.502	0.0000	0.1674	16.7	0.797
37	69.974	8.365	0.502	0.0000	0.1684	16.8	0.795
38	79.972	8.943	0.500	0.0000	0.1692	16.9	0.793
39	89.974	9.485	0.503	0.0000	0.1698	16.9	0.791
40	99.972	9.999	0.500	0.0000	0.1704	17.0	0.790
41	109.974	10.487	0.502	0.0000	0.1707	17.0	0.789
42	119.972	10.953	0.503	0.0000	0.1710	17.1	0.789
43	129.975	11.401	0.500	0.0000	0.1713	17.1	0.788
44	139.973	11.831	0.502	0.0000	0.1716	17.1	0.788
45	146.280	12.095	0.502	0.0000	0.1718	17.1	0.787

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 5 of 21
Applied Stress: 1.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.024		0.502	0.0000	0.1718	17.1	0.787
2	-0.020		0.502	0.0000	0.1718	17.1	0.787
3	-0.015		0.622	0.0000	0.1720	17.2	0.787
4	-0.011		0.739	0.0000	0.1723	17.2	0.786
5	-0.007		0.839	0.0000	0.1727	17.2	0.785
6	-0.002		0.918	0.0000	0.1730	17.3	0.784
7	0.000	0.000	0.950	0.0000	0.1732	17.3	0.784
8	0.002	0.048	0.985	0.0000	0.1734	17.3	0.784
9	0.007	0.082	0.997	0.0000	0.1735	17.3	0.783
10	0.011	0.106	0.965	0.0000	0.1735	17.3	0.783
11	0.016	0.125	0.962	0.0000	0.1736	17.3	0.783
12	0.020	0.141	0.962	0.0000	0.1736	17.3	0.783
13	0.024	0.156	0.966	0.0000	0.1736	17.3	0.783
14	0.029	0.170	0.975	0.0000	0.1737	17.3	0.783
15	0.033	0.182	0.991	0.0000	0.1738	17.4	0.783
16	0.038	0.194	0.991	0.0000	0.1738	17.4	0.783
17	0.051	0.226	0.992	0.0000	0.1740	17.4	0.782
18	0.060	0.244	0.978	0.0000	0.1741	17.4	0.782
19	0.144	0.379	1.00	0.0000	0.1747	17.4	0.781
20	0.228	0.477	1.00	0.0000	0.1749	17.5	0.780
21	0.312	0.558	0.992	0.0000	0.1752	17.5	0.780
22	0.480	0.693	1.00	0.0000	0.1757	17.5	0.779
23	0.727	0.853	0.998	0.0000	0.1764	17.6	0.777
24	0.979	0.990	1.00	0.0000	0.1769	17.7	0.776
25	1.479	1.216	0.998	0.0000	0.1778	17.7	0.774
26	2.477	1.574	1.00	0.0000	0.1793	17.9	0.771
27	4.480	2.117	0.998	0.0000	0.1816	18.1	0.766
28	4.979	2.231	1.00	0.0000	0.1821	18.2	0.765
29	9.978	3.159	1.00	0.0000	0.1861	18.6	0.756
30	14.977	3.870	1.00	0.0000	0.1890	18.9	0.750
31	19.976	4.469	1.00	0.0000	0.1915	19.1	0.745
32	24.979	4.998	1.00	0.0000	0.1933	19.3	0.741
33	29.978	5.475	1.00	0.0000	0.1948	19.4	0.737
34	39.976	6.323	1.00	0.0000	0.1972	19.7	0.733
35	49.979	7.070	1.00	0.0000	0.1987	19.8	0.729
36	59.976	7.744	1.00	0.0000	0.2000	20.0	0.726
37	69.979	8.365	1.00	0.0000	0.2008	20.0	0.725
38	79.977	8.943	1.00	0.0000	0.2014	20.1	0.723
39	89.979	9.486	1.00	0.0000	0.2019	20.1	0.722
40	99.977	9.999	1.00	0.0000	0.2024	20.2	0.721
41	106.965	10.342	1.00	0.0000	0.2026	20.2	0.721

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 6 of 21
Applied Stress: 2.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.020		1.00	0.0000	0.2026	20.2	0.721
2	-0.016		1.00	0.0000	0.2026	20.2	0.721
3	-0.011		1.31	0.0000	0.2030	20.3	0.720
4	-0.007		1.79	0.0000	0.2041	20.4	0.718
5	-0.002		1.79	0.0000	0.2041	20.4	0.718
6	0.000	0.000	1.90	0.0000	0.2044	20.4	0.717
7	0.002	0.046	2.01	0.0000	0.2048	20.4	0.716
8	0.007	0.081	1.96	0.0000	0.2049	20.5	0.716
9	0.011	0.105	1.93	0.0000	0.2050	20.5	0.716
10	0.015	0.124	1.93	0.0000	0.2050	20.5	0.716
11	0.020	0.141	1.95	0.0000	0.2051	20.5	0.715
12	0.024	0.156	1.97	0.0000	0.2052	20.5	0.715
13	0.029	0.169	1.98	0.0000	0.2053	20.5	0.715
14	0.033	0.182	2.00	0.0000	0.2055	20.5	0.715
15	0.037	0.194	2.01	0.0000	0.2055	20.5	0.715
16	0.042	0.205	1.97	0.0000	0.2055	20.5	0.715
17	0.055	0.235	1.97	0.0000	0.2057	20.5	0.714
18	0.064	0.253	1.98	0.0000	0.2057	20.5	0.714
19	0.148	0.385	1.99	0.0000	0.2064	20.6	0.713
20	0.232	0.482	1.99	0.0000	0.2069	20.6	0.712
21	0.316	0.562	1.99	0.0000	0.2074	20.7	0.710
22	0.484	0.696	2.01	0.0000	0.2080	20.8	0.709
23	0.731	0.855	2.01	0.0000	0.2090	20.9	0.707
24	0.983	0.992	2.00	0.0000	0.2097	20.9	0.706
25	1.483	1.218	2.00	0.0000	0.2111	21.1	0.703
26	2.482	1.575	2.01	0.0000	0.2132	21.3	0.698
27	4.484	2.118	2.01	0.0000	0.2164	21.6	0.691
28	4.983	2.232	2.01	0.0000	0.2170	21.7	0.690
29	9.982	3.159	2.01	0.0000	0.2225	22.2	0.678
30	14.981	3.871	2.00	0.0000	0.2262	22.6	0.670
31	19.980	4.470	2.01	0.0000	0.2288	22.8	0.664
32	24.984	4.998	2.01	0.0000	0.2308	23.0	0.660
33	29.983	5.476	2.00	0.0000	0.2325	23.2	0.656
34	39.980	6.323	2.00	0.0000	0.2345	23.4	0.652
35	49.983	7.070	2.01	0.0000	0.2359	23.5	0.649
36	59.981	7.745	2.02	0.0000	0.2366	23.6	0.648
37	69.983	8.366	2.01	0.0000	0.2374	23.7	0.646
38	79.981	8.943	2.01	0.0000	0.2380	23.7	0.645
39	81.064	9.004	2.01	0.0000	0.2380	23.8	0.645

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 7 of 21
Applied Stress: 4.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.016		2.01	0.0000	0.2380	23.8	0.645
2	-0.012		2.01	0.0000	0.2380	23.8	0.645
3	-0.008		3.30	0.0000	0.2395	23.9	0.641
4	-0.003		3.30	0.0000	0.2395	23.9	0.641
5	0.000	0.000	3.80	0.0000	0.2404	24.0	0.639
6	0.001	0.034	3.98	0.0000	0.2408	24.0	0.639
7	0.006	0.075	3.88	0.0000	0.2409	24.0	0.638
8	0.010	0.100	3.88	0.0000	0.2409	24.0	0.638
9	0.014	0.120	3.91	0.0000	0.2412	24.1	0.638
10	0.019	0.137	3.94	0.0000	0.2413	24.1	0.637
11	0.023	0.153	3.99	0.0000	0.2415	24.1	0.637
12	0.028	0.166	3.99	0.0000	0.2415	24.1	0.637
13	0.032	0.179	4.01	0.0000	0.2417	24.1	0.637
14	0.037	0.191	3.98	0.0000	0.2417	24.1	0.637
15	0.041	0.202	3.95	0.0000	0.2419	24.1	0.636
16	0.045	0.213	3.95	0.0000	0.2419	24.1	0.636
17	0.059	0.242	4.00	0.0000	0.2421	24.2	0.636
18	0.067	0.260	4.01	0.0000	0.2422	24.2	0.636
19	0.151	0.389	4.01	0.0000	0.2432	24.3	0.633
20	0.235	0.485	4.00	0.0000	0.2439	24.3	0.632
21	0.319	0.565	4.01	0.0000	0.2444	24.4	0.631
22	0.487	0.698	4.01	0.0000	0.2455	24.5	0.629
23	0.735	0.857	4.00	0.0000	0.2467	24.6	0.626
24	0.987	0.993	4.00	0.0000	0.2478	24.7	0.624
25	1.486	1.219	4.00	0.0000	0.2494	24.9	0.620
26	2.485	1.576	4.01	0.0000	0.2522	25.2	0.614
27	4.487	2.118	4.01	0.0000	0.2565	25.6	0.605
28	4.987	2.233	4.01	0.0000	0.2574	25.7	0.603
29	9.986	3.160	4.01	0.0000	0.2639	26.3	0.589
30	14.985	3.871	4.02	0.0000	0.2679	26.7	0.580
31	19.984	4.470	4.01	0.0000	0.2705	27.0	0.575
32	24.987	4.999	4.01	0.0000	0.2724	27.2	0.571
33	29.986	5.476	4.01	0.0000	0.2738	27.3	0.568
34	39.984	6.323	4.01	0.0000	0.2754	27.5	0.564
35	49.986	7.070	4.01	0.0000	0.2765	27.6	0.562
36	59.984	7.745	4.01	0.0000	0.2772	27.7	0.560
37	62.959	7.935	4.01	0.0000	0.2774	27.7	0.560

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 8 of 21
Applied Stress: 8.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.015		4.01	0.0000	0.2774	27.7	0.560
2	-0.010		4.01	0.0000	0.2774	27.7	0.560
3	-0.006		5.07	0.0000	0.2781	27.8	0.558
4	-0.001		7.46	0.0000	0.2806	28.0	0.553
5	0.000	0.000	7.60	0.0000	0.2810	28.0	0.552
6	0.003	0.055	7.90	0.0000	0.2817	28.1	0.550
7	0.007	0.086	7.77	0.0000	0.2818	28.1	0.550
8	0.012	0.109	7.77	0.0000	0.2818	28.1	0.550
9	0.016	0.128	7.97	0.0000	0.2821	28.2	0.550
10	0.021	0.144	7.97	0.0000	0.2821	28.2	0.550
11	0.025	0.159	8.02	0.0000	0.2823	28.2	0.549
12	0.030	0.172	8.04	0.0000	0.2823	28.2	0.549
13	0.034	0.184	7.92	0.0000	0.2824	28.2	0.549
14	0.038	0.196	7.93	0.0000	0.2825	28.2	0.549
15	0.043	0.207	7.97	0.0000	0.2826	28.2	0.549
16	0.047	0.217	7.99	0.0000	0.2827	28.2	0.548
17	0.060	0.246	8.03	0.0000	0.2830	28.2	0.548
18	0.069	0.263	7.95	0.0000	0.2831	28.3	0.547
19	0.153	0.392	7.99	0.0000	0.2843	28.4	0.545
20	0.237	0.487	8.00	0.0000	0.2851	28.5	0.543
21	0.321	0.567	8.00	0.0000	0.2860	28.5	0.541
22	0.489	0.699	8.01	0.0000	0.2873	28.7	0.538
23	0.737	0.858	8.02	0.0000	0.2888	28.8	0.535
24	0.989	0.994	8.03	0.0000	0.2901	29.0	0.532
25	1.488	1.220	8.03	0.0000	0.2922	29.2	0.528
26	2.487	1.577	8.02	0.0000	0.2958	29.5	0.520
27	4.489	2.119	8.02	0.0000	0.3010	30.0	0.509
28	4.989	2.234	8.03	0.0000	0.3019	30.1	0.507
29	9.988	3.160	8.03	0.0000	0.3089	30.8	0.492
30	14.987	3.871	8.02	0.0000	0.3123	31.2	0.485
31	19.986	4.471	8.03	0.0000	0.3143	31.4	0.480
32	24.989	4.999	8.03	0.0000	0.3156	31.5	0.478
33	29.988	5.476	8.04	0.0000	0.3164	31.6	0.476
34	39.986	6.323	8.03	0.0000	0.3177	31.7	0.473
35	49.988	7.070	8.03	0.0000	0.3185	31.8	0.471
36	59.986	7.745	8.03	0.0000	0.3191	31.8	0.470
37	60.022	7.747	8.03	0.0000	0.3191	31.8	0.470

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 9 of 21
Applied Stress: 4.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.012		8.03	0.0000	0.3191	31.8	0.470
2	-0.008		8.03	0.0000	0.3191	31.8	0.470
3	-0.004		6.51	0.0000	0.3182	31.8	0.472
4	0.000	0.000	4.40	0.0000	0.3166	31.6	0.475
5	0.001	0.028	3.95	0.0000	0.3163	31.6	0.476
6	0.005	0.072	3.74	0.0000	0.3158	31.5	0.477
7	0.010	0.098	3.82	0.0000	0.3159	31.5	0.477
8	0.014	0.118	4.07	0.0000	0.3161	31.5	0.476
9	0.018	0.136	4.11	0.0000	0.3161	31.5	0.476
10	0.023	0.151	4.15	0.0000	0.3161	31.5	0.476
11	0.027	0.165	4.18	0.0000	0.3161	31.5	0.476
12	0.032	0.178	4.10	0.0000	0.3159	31.5	0.477
13	0.036	0.190	3.99	0.0000	0.3158	31.5	0.477
14	0.041	0.201	4.03	0.0000	0.3158	31.5	0.477
15	0.045	0.212	4.05	0.0000	0.3158	31.5	0.477
16	0.049	0.222	4.04	0.0000	0.3158	31.5	0.477
17	0.063	0.250	4.02	0.0000	0.3157	31.5	0.477
18	0.071	0.267	4.04	0.0000	0.3156	31.5	0.478
19	0.155	0.394	4.03	0.0000	0.3153	31.5	0.478
20	0.239	0.489	4.02	0.0000	0.3151	31.4	0.479
21	0.323	0.569	4.02	0.0000	0.3149	31.4	0.479
22	0.491	0.701	4.02	0.0000	0.3146	31.4	0.480
23	0.739	0.860	4.02	0.0000	0.3144	31.4	0.480
24	0.991	0.995	4.02	0.0000	0.3142	31.4	0.481
25	1.490	1.221	4.02	0.0000	0.3139	31.3	0.481
26	2.489	1.578	4.01	0.0000	0.3135	31.3	0.482
27	4.491	2.119	4.01	0.0000	0.3136	31.3	0.482
28	4.991	2.234	4.02	0.0000	0.3136	31.3	0.482
29	9.990	3.161	4.02	0.0000	0.3136	31.3	0.482
30	14.989	3.872	4.01	0.0000	0.3135	31.3	0.482
31	19.988	4.471	4.01	0.0000	0.3135	31.3	0.482
32	24.991	4.999	4.01	0.0000	0.3136	31.3	0.482
33	29.990	5.476	4.01	0.0000	0.3136	31.3	0.482
34	39.988	6.324	4.01	0.0000	0.3135	31.3	0.482
35	49.990	7.070	4.02	0.0000	0.3136	31.3	0.482
36	59.988	7.745	4.02	0.0000	0.3133	31.3	0.482
37	60.002	7.746	4.02	0.0000	0.3133	31.3	0.482

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 10 of 21
Applied Stress: 2.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.013		4.02	0.0000	0.3134	31.3	0.482
2	-0.009		4.02	0.0000	0.3134	31.3	0.482
3	-0.004		3.05	0.0000	0.3126	31.2	0.484
4	0.000	0.000	2.20	0.0000	0.3116	31.1	0.486
5	0.000	0.014	2.16	0.0000	0.3116	31.1	0.486
6	0.005	0.068	1.93	0.0000	0.3111	31.1	0.487
7	0.009	0.095	1.99	0.0000	0.3111	31.0	0.487
8	0.013	0.116	2.03	0.0000	0.3111	31.1	0.487
9	0.018	0.134	2.06	0.0000	0.3111	31.0	0.487
10	0.022	0.149	2.09	0.0000	0.3111	31.0	0.487
11	0.027	0.163	2.04	0.0000	0.3110	31.0	0.487
12	0.031	0.176	2.01	0.0000	0.3110	31.0	0.488
13	0.036	0.189	2.02	0.0000	0.3109	31.0	0.488
14	0.040	0.200	2.03	0.0000	0.3109	31.0	0.488
15	0.044	0.211	2.03	0.0000	0.3109	31.0	0.488
16	0.049	0.221	2.02	0.0000	0.3109	31.0	0.488
17	0.062	0.249	2.01	0.0000	0.3108	31.0	0.488
18	0.071	0.266	2.02	0.0000	0.3108	31.0	0.488
19	0.155	0.394	2.01	0.0000	0.3104	31.0	0.489
20	0.239	0.489	2.01	0.0000	0.3103	31.0	0.489
21	0.323	0.568	2.01	0.0000	0.3102	31.0	0.489
22	0.491	0.701	2.01	0.0000	0.3099	30.9	0.490
23	0.738	0.859	2.01	0.0000	0.3096	30.9	0.491
24	0.990	0.995	2.01	0.0000	0.3093	30.9	0.491
25	1.490	1.221	2.01	0.0000	0.3089	30.8	0.492
26	2.489	1.578	2.01	0.0000	0.3084	30.8	0.493
27	4.491	2.119	2.01	0.0000	0.3077	30.7	0.495
28	4.990	2.234	2.01	0.0000	0.3076	30.7	0.495
29	9.989	3.161	2.01	0.0000	0.3073	30.7	0.495
30	14.988	3.871	2.01	0.0000	0.3071	30.6	0.496
31	19.987	4.471	2.01	0.0000	0.3071	30.6	0.496
32	24.991	4.999	2.01	0.0000	0.3070	30.6	0.496
33	29.989	5.476	2.01	0.0000	0.3068	30.6	0.496
34	39.987	6.324	2.01	0.0000	0.3068	30.6	0.497
35	49.990	7.070	2.01	0.0000	0.3067	30.6	0.497
36	59.988	7.745	2.01	0.0000	0.3068	30.6	0.496
37	60.006	7.746	2.01	0.0000	0.3068	30.6	0.496

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 11 of 21
Applied Stress: 1.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.016		2.01	0.0000	0.3068	30.6	0.496
2	-0.012		2.01	0.0000	0.3068	30.6	0.496
3	-0.007		1.30	0.0000	0.3059	30.5	0.499
4	-0.003		1.30	0.0000	0.3059	30.5	0.499
5	0.000	0.000	1.10	0.0000	0.3055	30.5	0.499
6	0.001	0.038	1.00	0.0000	0.3053	30.5	0.500
7	0.006	0.076	0.985	0.0000	0.3053	30.5	0.500
8	0.010	0.101	1.03	0.0000	0.3053	30.5	0.500
9	0.015	0.121	1.04	0.0000	0.3053	30.5	0.500
10	0.019	0.138	1.04	0.0000	0.3053	30.5	0.500
11	0.024	0.153	1.03	0.0000	0.3052	30.5	0.500
12	0.028	0.167	1.01	0.0000	0.3052	30.5	0.500
13	0.032	0.180	1.00	0.0000	0.3052	30.5	0.500
14	0.037	0.192	1.00	0.0000	0.3052	30.5	0.500
15	0.041	0.203	1.02	0.0000	0.3051	30.5	0.500
16	0.046	0.214	1.02	0.0000	0.3051	30.5	0.500
17	0.059	0.243	1.01	0.0000	0.3051	30.4	0.500
18	0.068	0.260	1.01	0.0000	0.3050	30.4	0.500
19	0.152	0.390	1.01	0.0000	0.3046	30.4	0.501
20	0.236	0.486	1.01	0.0000	0.3045	30.4	0.501
21	0.320	0.565	1.01	0.0000	0.3044	30.4	0.502
22	0.488	0.698	1.01	0.0000	0.3040	30.3	0.502
23	0.735	0.857	1.00	0.0000	0.3038	30.3	0.503
24	0.987	0.994	1.01	0.0000	0.3035	30.3	0.504
25	1.487	1.219	1.00	0.0000	0.3031	30.3	0.504
26	2.485	1.577	1.00	0.0000	0.3025	30.2	0.506
27	4.488	2.118	1.00	0.0000	0.3018	30.1	0.507
28	4.987	2.233	1.01	0.0000	0.3016	30.1	0.508
29	9.986	3.160	1.00	0.0000	0.3006	30.0	0.510
30	14.985	3.871	1.01	0.0000	0.3003	30.0	0.510
31	19.984	4.470	1.01	0.0000	0.2997	29.9	0.512
32	24.987	4.999	1.00	0.0000	0.2995	29.9	0.512
33	29.986	5.476	1.00	0.0000	0.2994	29.9	0.512
34	39.984	6.323	1.00	0.0000	0.2996	29.9	0.512
35	49.987	7.070	1.00	0.0000	0.2996	29.9	0.512
36	59.984	7.745	1.00	0.0000	0.2994	29.9	0.512
37	60.002	7.746	1.00	0.0000	0.2994	29.9	0.512

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 12 of 21
Applied Stress: 0.500 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.019		1.00	0.0000	0.2994	29.9	0.512
2	-0.015		1.00	0.0000	0.2994	29.9	0.512
3	-0.011		0.754	0.0000	0.2991	29.8	0.513
4	-0.006		0.593	0.0000	0.2985	29.8	0.514
5	-0.002		0.593	0.0000	0.2985	29.8	0.514
6	0.000	0.000	0.550	0.0000	0.2985	29.8	0.514
7	0.003	0.051	0.487	0.0000	0.2983	29.8	0.515
8	0.007	0.084	0.514	0.0000	0.2983	29.8	0.515
9	0.011	0.107	0.521	0.0000	0.2983	29.8	0.515
10	0.016	0.126	0.521	0.0000	0.2983	29.8	0.515
11	0.020	0.143	0.517	0.0000	0.2983	29.8	0.515
12	0.025	0.157	0.517	0.0000	0.2983	29.8	0.515
13	0.029	0.171	0.509	0.0000	0.2982	29.8	0.515
14	0.034	0.183	0.509	0.0000	0.2982	29.8	0.515
15	0.038	0.195	0.502	0.0000	0.2981	29.7	0.515
16	0.042	0.206	0.502	0.0000	0.2981	29.7	0.515
17	0.060	0.245	0.512	0.0000	0.2980	29.7	0.515
18	0.065	0.254	0.511	0.0000	0.2980	29.7	0.515
19	0.148	0.385	0.503	0.0000	0.2977	29.7	0.516
20	0.233	0.482	0.503	0.0000	0.2975	29.7	0.516
21	0.316	0.563	0.506	0.0000	0.2974	29.7	0.517
22	0.484	0.696	0.506	0.0000	0.2973	29.7	0.517
23	0.732	0.856	0.506	0.0000	0.2970	29.6	0.518
24	0.984	0.992	0.506	0.0000	0.2968	29.6	0.518
25	1.483	1.218	0.505	0.0000	0.2965	29.6	0.519
26	2.482	1.576	0.503	0.0000	0.2961	29.5	0.520
27	4.484	2.118	0.512	0.0000	0.2955	29.5	0.521
28	4.984	2.232	0.505	0.0000	0.2952	29.5	0.522
29	9.983	3.160	0.503	0.0000	0.2940	29.3	0.524
30	14.982	3.871	0.502	0.0000	0.2932	29.3	0.526
31	19.981	4.470	0.508	0.0000	0.2930	29.2	0.526
32	24.984	4.998	0.503	0.0000	0.2925	29.2	0.527
33	29.983	5.476	0.502	0.0000	0.2920	29.1	0.528
34	39.981	6.323	0.502	0.0000	0.2915	29.1	0.529
35	49.983	7.070	0.503	0.0000	0.2912	29.1	0.530
36	59.981	7.745	0.502	0.0000	0.2914	29.1	0.530
37	60.384	7.771	0.502	0.0000	0.2914	29.1	0.530

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 13 of 21
Applied Stress: 1.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.017		0.502	0.0000	0.2914	29.1	0.530
2	-0.013		0.651	0.0000	0.2915	29.1	0.529
3	-0.008		0.651	0.0000	0.2915	29.1	0.529
4	-0.004		0.831	0.0000	0.2919	29.1	0.529
5	0.000	0.000	0.950	0.0000	0.2921	29.2	0.528
6	0.000	0.022	0.965	0.0000	0.2921	29.2	0.528
7	0.005	0.070	1.01	0.0000	0.2923	29.2	0.528
8	0.009	0.097	0.995	0.0000	0.2923	29.2	0.528
9	0.014	0.117	0.983	0.0000	0.2923	29.2	0.528
10	0.018	0.135	0.983	0.0000	0.2923	29.2	0.528
11	0.023	0.150	0.988	0.0000	0.2923	29.2	0.528
12	0.027	0.164	0.992	0.0000	0.2924	29.2	0.528
13	0.031	0.177	0.998	0.0000	0.2924	29.2	0.527
14	0.036	0.189	1.00	0.0000	0.2924	29.2	0.527
15	0.040	0.201	1.00	0.0000	0.2924	29.2	0.527
16	0.045	0.211	0.995	0.0000	0.2924	29.2	0.527
17	0.058	0.241	0.995	0.0000	0.2925	29.2	0.527
18	0.067	0.258	1.00	0.0000	0.2925	29.2	0.527
19	0.151	0.388	1.00	0.0000	0.2926	29.2	0.527
20	0.235	0.485	1.00	0.0000	0.2928	29.2	0.527
21	0.319	0.565	0.998	0.0000	0.2928	29.2	0.527
22	0.487	0.698	1.00	0.0000	0.2930	29.2	0.526
23	0.734	0.857	1.00	0.0000	0.2932	29.3	0.526
24	0.986	0.993	1.00	0.0000	0.2933	29.3	0.526
25	1.486	1.219	1.00	0.0000	0.2935	29.3	0.525
26	2.484	1.576	1.00	0.0000	0.2938	29.3	0.524
27	4.487	2.118	1.00	0.0000	0.2942	29.4	0.524
28	4.986	2.233	0.997	0.0000	0.2943	29.4	0.523
29	9.985	3.160	1.00	0.0000	0.2949	29.4	0.522
30	14.984	3.871	1.00	0.0000	0.2950	29.4	0.522
31	19.983	4.470	1.00	0.0000	0.2950	29.4	0.522
32	24.986	4.999	1.00	0.0000	0.2950	29.4	0.522
33	29.985	5.476	1.00	0.0000	0.2950	29.4	0.522
34	39.983	6.323	1.00	0.0000	0.2952	29.5	0.522
35	49.986	7.070	1.00	0.0000	0.2952	29.5	0.521
36	59.983	7.745	1.00	0.0000	0.2952	29.5	0.522
37	60.001	7.746	1.00	0.0000	0.2952	29.5	0.522

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 14 of 21
Applied Stress: 2.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.016		1.00	0.0000	0.2952	29.5	0.522
2	-0.011		1.00	0.0000	0.2952	29.5	0.522
3	-0.007		1.30	0.0000	0.2955	29.5	0.521
4	-0.003		1.74	0.0000	0.2962	29.6	0.519
5	0.000	0.000	1.90	0.0000	0.2965	29.6	0.519
6	0.002	0.043	2.02	0.0000	0.2967	29.6	0.518
7	0.006	0.079	1.98	0.0000	0.2967	29.6	0.518
8	0.011	0.103	1.98	0.0000	0.2967	29.6	0.518
9	0.015	0.123	1.97	0.0000	0.2967	29.6	0.518
10	0.020	0.140	1.97	0.0000	0.2967	29.6	0.518
11	0.024	0.155	2.00	0.0000	0.2968	29.6	0.518
12	0.028	0.168	2.00	0.0000	0.2968	29.6	0.518
13	0.033	0.181	2.00	0.0000	0.2968	29.6	0.518
14	0.037	0.193	2.00	0.0000	0.2968	29.6	0.518
15	0.042	0.204	1.99	0.0000	0.2969	29.6	0.518
16	0.046	0.215	1.99	0.0000	0.2969	29.6	0.518
17	0.059	0.244	2.00	0.0000	0.2969	29.6	0.518
18	0.068	0.261	2.00	0.0000	0.2970	29.6	0.518
19	0.152	0.390	2.00	0.0000	0.2973	29.7	0.517
20	0.236	0.486	2.00	0.0000	0.2974	29.7	0.517
21	0.320	0.566	2.00	0.0000	0.2976	29.7	0.516
22	0.488	0.699	2.01	0.0000	0.2978	29.7	0.516
23	0.736	0.858	2.01	0.0000	0.2981	29.7	0.515
24	0.988	0.994	2.01	0.0000	0.2983	29.8	0.515
25	1.487	1.219	2.00	0.0000	0.2988	29.8	0.514
26	2.486	1.577	2.01	0.0000	0.2994	29.9	0.513
27	4.488	2.119	2.01	0.0000	0.3001	30.0	0.511
28	4.988	2.233	2.01	0.0000	0.3003	30.0	0.511
29	9.986	3.160	2.01	0.0000	0.3010	30.0	0.509
30	14.985	3.871	2.01	0.0000	0.3012	30.1	0.508
31	19.984	4.470	2.01	0.0000	0.3014	30.1	0.508
32	24.988	4.999	2.01	0.0000	0.3015	30.1	0.508
33	29.987	5.476	2.01	0.0000	0.3015	30.1	0.508
34	39.985	6.323	2.01	0.0000	0.3016	30.1	0.508
35	49.987	7.070	2.01	0.0000	0.3017	30.1	0.508
36	59.985	7.745	2.01	0.0000	0.3018	30.1	0.507
37	60.003	7.746	2.01	0.0000	0.3018	30.1	0.507

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 15 of 21
Applied Stress: 4.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.014		2.01	0.0000	0.3018	30.1	0.507
2	-0.010		2.42	0.0000	0.3022	30.2	0.506
3	-0.005		2.42	0.0000	0.3022	30.2	0.506
4	-0.001		3.70	0.0000	0.3037	30.3	0.503
5	0.000	0.000	3.80	0.0000	0.3038	30.3	0.503
6	0.003	0.058	4.10	0.0000	0.3041	30.3	0.502
7	0.008	0.088	4.01	0.0000	0.3042	30.4	0.502
8	0.012	0.110	3.96	0.0000	0.3042	30.4	0.502
9	0.017	0.129	3.96	0.0000	0.3043	30.4	0.502
10	0.021	0.145	3.96	0.0000	0.3043	30.4	0.502
11	0.025	0.159	4.00	0.0000	0.3044	30.4	0.502
12	0.030	0.173	4.02	0.0000	0.3045	30.4	0.502
13	0.034	0.185	3.98	0.0000	0.3045	30.4	0.502
14	0.039	0.197	3.99	0.0000	0.3045	30.4	0.501
15	0.043	0.208	3.99	0.0000	0.3045	30.4	0.501
16	0.048	0.218	4.00	0.0000	0.3046	30.4	0.501
17	0.065	0.255	4.00	0.0000	0.3046	30.4	0.501
18	0.070	0.264	3.99	0.0000	0.3047	30.4	0.501
19	0.154	0.392	4.00	0.0000	0.3051	30.5	0.500
20	0.238	0.487	4.01	0.0000	0.3055	30.5	0.499
21	0.322	0.567	4.01	0.0000	0.3057	30.5	0.499
22	0.490	0.700	4.01	0.0000	0.3060	30.5	0.498
23	0.737	0.859	4.01	0.0000	0.3065	30.6	0.497
24	0.989	0.994	4.01	0.0000	0.3069	30.6	0.496
25	1.488	1.220	4.01	0.0000	0.3075	30.7	0.495
26	2.487	1.577	4.01	0.0000	0.3086	30.8	0.493
27	4.490	2.119	4.01	0.0000	0.3097	30.9	0.490
28	4.989	2.234	4.01	0.0000	0.3098	30.9	0.490
29	9.988	3.160	4.01	0.0000	0.3107	31.0	0.488
30	14.987	3.871	4.01	0.0000	0.3109	31.0	0.488
31	19.986	4.471	4.01	0.0000	0.3110	31.0	0.488
32	24.989	4.999	4.03	0.0000	0.3110	31.0	0.488
33	29.988	5.476	4.00	0.0000	0.3111	31.0	0.487
34	39.986	6.323	4.02	0.0000	0.3113	31.1	0.487
35	49.988	7.070	4.00	0.0000	0.3113	31.1	0.487
36	59.986	7.745	4.02	0.0000	0.3114	31.1	0.487
37	60.004	7.746	4.02	0.0000	0.3114	31.1	0.487

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 16 of 21
Applied Stress: 8.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.012		4.02	0.0000	0.3114	31.1	0.487
2	-0.008		4.02	0.0000	0.3114	31.1	0.487
3	-0.004		5.65	0.0000	0.3125	31.2	0.484
4	0.000	0.000	7.60	0.0000	0.3141	31.4	0.481
5	0.001	0.028	8.01	0.0000	0.3145	31.4	0.480
6	0.005	0.072	8.20	0.0000	0.3150	31.4	0.479
7	0.010	0.098	8.01	0.0000	0.3151	31.4	0.479
8	0.014	0.118	7.88	0.0000	0.3151	31.4	0.479
9	0.018	0.136	7.78	0.0000	0.3151	31.4	0.479
10	0.023	0.151	7.96	0.0000	0.3152	31.5	0.478
11	0.027	0.165	8.03	0.0000	0.3153	31.5	0.478
12	0.032	0.178	7.96	0.0000	0.3153	31.5	0.478
13	0.036	0.190	7.97	0.0000	0.3153	31.5	0.478
14	0.041	0.201	7.99	0.0000	0.3154	31.5	0.478
15	0.045	0.212	8.01	0.0000	0.3155	31.5	0.478
16	0.049	0.222	8.02	0.0000	0.3156	31.5	0.478
17	0.063	0.250	7.98	0.0000	0.3157	31.5	0.477
18	0.071	0.267	8.01	0.0000	0.3157	31.5	0.477
19	0.155	0.394	8.03	0.0000	0.3163	31.6	0.476
20	0.239	0.489	8.03	0.0000	0.3168	31.6	0.475
21	0.323	0.569	8.01	0.0000	0.3172	31.7	0.474
22	0.491	0.701	8.01	0.0000	0.3179	31.7	0.473
23	0.739	0.860	8.02	0.0000	0.3186	31.8	0.471
24	0.991	0.995	8.02	0.0000	0.3193	31.9	0.470
25	1.490	1.221	8.03	0.0000	0.3203	32.0	0.467
26	2.489	1.578	8.03	0.0000	0.3219	32.1	0.464
27	4.491	2.119	8.03	0.0000	0.3235	32.3	0.461
28	4.991	2.234	8.03	0.0000	0.3237	32.3	0.460
29	9.990	3.161	8.03	0.0000	0.3255	32.5	0.456
30	14.989	3.872	8.04	0.0000	0.3263	32.6	0.455
31	19.988	4.471	8.03	0.0000	0.3266	32.6	0.454
32	24.991	4.999	8.03	0.0000	0.3271	32.6	0.453
33	29.990	5.476	8.03	0.0000	0.3273	32.7	0.452
34	39.988	6.324	8.03	0.0000	0.3277	32.7	0.452
35	49.990	7.070	8.03	0.0000	0.3279	32.7	0.451
36	59.988	7.745	8.03	0.0000	0.3282	32.8	0.450
37	60.002	7.746	8.03	0.0000	0.3282	32.8	0.450

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 17 of 21
Applied Stress: 16.0 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.009		8.03	0.0000	0.3282	32.8	0.450
2	-0.004		8.03	0.0000	0.3282	32.8	0.450
3	0.000	0.000	15.2	0.0000	0.3323	33.2	0.442
4	0.000	0.009	15.3	0.0000	0.3324	33.2	0.441
5	0.004	0.067	15.3	0.0000	0.3324	33.2	0.441
6	0.009	0.094	16.7	0.0000	0.3340	33.3	0.438
7	0.013	0.116	16.2	0.0000	0.3340	33.3	0.438
8	0.018	0.133	15.6	0.0000	0.3339	33.3	0.438
9	0.022	0.149	15.6	0.0000	0.3339	33.3	0.438
10	0.027	0.163	15.3	0.0000	0.3339	33.3	0.438
11	0.031	0.176	16.2	0.0000	0.3345	33.4	0.437
12	0.035	0.188	16.0	0.0000	0.3345	33.4	0.437
13	0.040	0.200	15.9	0.0000	0.3345	33.4	0.437
14	0.044	0.210	16.0	0.0000	0.3347	33.4	0.436
15	0.049	0.221	16.0	0.0000	0.3351	33.4	0.436
16	0.053	0.230	16.0	0.0000	0.3351	33.4	0.436
17	0.066	0.258	16.0	0.0000	0.3354	33.5	0.435
18	0.075	0.274	16.0	0.0000	0.3355	33.5	0.435
19	0.159	0.399	16.0	0.0000	0.3366	33.6	0.432
20	0.243	0.493	16.1	0.0000	0.3375	33.7	0.430
21	0.327	0.572	16.1	0.0000	0.3382	33.8	0.429
22	0.495	0.704	16.1	0.0000	0.3396	33.9	0.426
23	0.743	0.862	16.1	0.0000	0.3411	34.0	0.423
24	0.995	0.997	16.0	0.0000	0.3425	34.2	0.420
25	1.494	1.222	16.1	0.0000	0.3446	34.4	0.415
26	2.493	1.579	16.1	0.0000	0.3479	34.7	0.408
27	4.495	2.120	16.1	0.0000	0.3523	35.2	0.398
28	4.995	2.235	16.1	0.0000	0.3531	35.2	0.397
29	9.994	3.161	16.1	0.0000	0.3577	35.7	0.387
30	14.993	3.872	16.1	0.0000	0.3596	35.9	0.383
31	19.991	4.471	15.9	0.0000	0.3608	36.0	0.380
32	24.995	4.999	16.2	0.0000	0.3618	36.1	0.378
33	29.994	5.477	15.9	0.0000	0.3622	36.1	0.377
34	39.992	6.324	16.2	0.0000	0.3632	36.2	0.375
35	49.994	7.071	15.9	0.0000	0.3636	36.3	0.374
36	59.992	7.745	15.9	0.0000	0.3640	36.3	0.373
37	60.036	7.748	16.2	0.0000	0.3641	36.3	0.373

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 18 of 21
Applied Stress: 4.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.013		16.2	0.0000	0.3641	36.3	0.373
2	-0.008		15.1	0.0000	0.3637	36.3	0.374
3	-0.004		15.1	0.0000	0.3637	36.3	0.374
4	0.000	0.000	5.20	0.0000	0.3576	35.7	0.387
5	0.000	0.020	4.21	0.0000	0.3570	35.6	0.388
6	0.005	0.069	2.55	0.0000	0.3545	35.4	0.394
7	0.009	0.096	3.19	0.0000	0.3550	35.4	0.393
8	0.014	0.117	4.15	0.0000	0.3559	35.5	0.391
9	0.018	0.134	4.32	0.0000	0.3559	35.5	0.391
10	0.023	0.150	4.32	0.0000	0.3559	35.5	0.391
11	0.027	0.164	3.99	0.0000	0.3553	35.5	0.392
12	0.031	0.177	3.99	0.0000	0.3553	35.5	0.392
13	0.036	0.189	4.08	0.0000	0.3552	35.5	0.392
14	0.040	0.200	4.07	0.0000	0.3552	35.4	0.392
15	0.045	0.211	4.07	0.0000	0.3552	35.4	0.392
16	0.049	0.221	4.04	0.0000	0.3551	35.4	0.393
17	0.062	0.250	4.03	0.0000	0.3550	35.4	0.393
18	0.071	0.267	4.05	0.0000	0.3549	35.4	0.393
19	0.155	0.394	4.01	0.0000	0.3541	35.3	0.395
20	0.239	0.489	4.02	0.0000	0.3537	35.3	0.395
21	0.323	0.568	4.02	0.0000	0.3534	35.3	0.396
22	0.491	0.701	4.03	0.0000	0.3528	35.2	0.397
23	0.739	0.859	4.02	0.0000	0.3522	35.2	0.399
24	0.991	0.995	4.02	0.0000	0.3516	35.1	0.400
25	1.490	1.221	4.02	0.0000	0.3509	35.0	0.402
26	2.489	1.578	4.02	0.0000	0.3500	34.9	0.403
27	4.491	2.119	4.01	0.0000	0.3493	34.9	0.405
28	4.991	2.234	4.01	0.0000	0.3492	34.8	0.405
29	9.989	3.161	4.01	0.0000	0.3487	34.8	0.406
30	14.988	3.871	4.01	0.0000	0.3485	34.8	0.407
31	19.987	4.471	4.01	0.0000	0.3485	34.8	0.407
32	24.991	4.999	4.01	0.0000	0.3485	34.8	0.407
33	29.990	5.476	4.02	0.0000	0.3485	34.8	0.407
34	39.988	6.324	4.01	0.0000	0.3484	34.8	0.407
35	49.990	7.070	4.02	0.0000	0.3484	34.8	0.407
36	59.988	7.745	4.01	0.0000	0.3484	34.8	0.407
37	60.028	7.748	4.01	0.0000	0.3483	34.8	0.407

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 19 of 21
Applied Stress: 1.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.015		4.01	0.0000	0.3483	34.8	0.407
2	-0.010		4.01	0.0000	0.3483	34.8	0.407
3	-0.006		2.75	0.0000	0.3473	34.7	0.409
4	-0.001		1.46	0.0000	0.3458	34.5	0.413
5	0.000	0.000	1.30	0.0000	0.3455	34.5	0.413
6	0.003	0.056	0.913	0.0000	0.3448	34.4	0.415
7	0.008	0.087	0.997	0.0000	0.3446	34.4	0.415
8	0.012	0.109	1.06	0.0000	0.3446	34.4	0.415
9	0.016	0.128	1.09	0.0000	0.3446	34.4	0.415
10	0.021	0.144	1.07	0.0000	0.3445	34.4	0.415
11	0.025	0.159	1.04	0.0000	0.3445	34.4	0.415
12	0.030	0.172	1.02	0.0000	0.3444	34.4	0.416
13	0.034	0.185	1.01	0.0000	0.3443	34.4	0.416
14	0.038	0.196	1.01	0.0000	0.3443	34.4	0.416
15	0.043	0.207	1.04	0.0000	0.3443	34.4	0.416
16	0.047	0.218	1.04	0.0000	0.3443	34.4	0.416
17	0.061	0.246	1.02	0.0000	0.3440	34.3	0.416
18	0.069	0.264	1.01	0.0000	0.3439	34.3	0.417
19	0.153	0.392	1.01	0.0000	0.3434	34.3	0.418
20	0.237	0.487	1.02	0.0000	0.3431	34.2	0.418
21	0.321	0.567	1.01	0.0000	0.3428	34.2	0.419
22	0.489	0.700	1.01	0.0000	0.3422	34.1	0.420
23	0.737	0.858	1.01	0.0000	0.3416	34.1	0.422
24	0.989	0.994	1.00	0.0000	0.3411	34.0	0.423
25	1.488	1.220	1.01	0.0000	0.3402	34.0	0.425
26	2.487	1.577	1.01	0.0000	0.3390	33.8	0.427
27	4.489	2.119	1.01	0.0000	0.3371	33.6	0.431
28	4.989	2.234	1.00	0.0000	0.3367	33.6	0.432
29	9.988	3.160	1.01	0.0000	0.3345	33.4	0.437
30	14.987	3.871	1.00	0.0000	0.3333	33.3	0.440
31	19.986	4.471	1.00	0.0000	0.3326	33.2	0.441
32	24.989	4.999	1.00	0.0000	0.3321	33.1	0.442
33	29.988	5.476	1.00	0.0000	0.3318	33.1	0.443
34	39.986	6.323	1.00	0.0000	0.3315	33.1	0.443
35	49.988	7.070	1.00	0.0000	0.3312	33.1	0.444
36	59.986	7.745	1.00	0.0000	0.3311	33.0	0.444
37	60.004	7.746	1.00	0.0000	0.3311	33.0	0.444

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 20 of 21
Applied Stress: 0.250 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.016		1.00	0.0000	0.3311	33.0	0.444
2	-0.012		1.00	0.0000	0.3311	33.0	0.444
3	-0.008		0.755	0.0000	0.3308	33.0	0.445
4	-0.003		0.511	0.0000	0.3304	33.0	0.446
5	0.000	0.000	0.325	0.0000	0.3298	32.9	0.447
6	0.001	0.032	0.270	0.0000	0.3297	32.9	0.447
7	0.005	0.074	0.270	0.0000	0.3297	32.9	0.447
8	0.010	0.099	0.256	0.0000	0.3295	32.9	0.448
9	0.014	0.119	0.276	0.0000	0.3295	32.9	0.448
10	0.019	0.137	0.276	0.0000	0.3294	32.9	0.448
11	0.023	0.152	0.276	0.0000	0.3294	32.9	0.448
12	0.028	0.166	0.271	0.0000	0.3294	32.9	0.448
13	0.032	0.179	0.265	0.0000	0.3294	32.9	0.448
14	0.036	0.191	0.260	0.0000	0.3293	32.9	0.448
15	0.041	0.202	0.257	0.0000	0.3293	32.9	0.448
16	0.045	0.213	0.251	0.0000	0.3293	32.9	0.448
17	0.063	0.251	0.263	0.0000	0.3292	32.9	0.448
18	0.067	0.259	0.262	0.0000	0.3291	32.8	0.448
19	0.151	0.389	0.257	0.0000	0.3288	32.8	0.449
20	0.235	0.485	0.257	0.0000	0.3286	32.8	0.450
21	0.319	0.565	0.256	0.0000	0.3284	32.8	0.450
22	0.487	0.698	0.251	0.0000	0.3281	32.7	0.451
23	0.735	0.857	0.251	0.0000	0.3277	32.7	0.451
24	0.987	0.993	0.254	0.0000	0.3273	32.7	0.452
25	1.486	1.219	0.253	0.0000	0.3268	32.6	0.453
26	2.485	1.576	0.253	0.0000	0.3260	32.5	0.455
27	4.487	2.118	0.253	0.0000	0.3245	32.4	0.458
28	4.987	2.233	0.251	0.0000	0.3242	32.4	0.459
29	9.986	3.160	0.253	0.0000	0.3220	32.1	0.464
30	14.985	3.871	0.250	0.0000	0.3203	32.0	0.467
31	19.984	4.470	0.251	0.0000	0.3191	31.8	0.470
32	24.987	4.999	0.251	0.0000	0.3180	31.7	0.472
33	29.986	5.476	0.251	0.0000	0.3172	31.7	0.474
34	39.984	6.323	0.248	0.0000	0.3159	31.5	0.477
35	49.986	7.070	0.250	0.0000	0.3152	31.5	0.478
36	59.984	7.745	0.250	0.0000	0.3146	31.4	0.480
37	69.986	8.366	0.250	0.0000	0.3140	31.3	0.481
38	79.984	8.943	0.251	0.0000	0.3135	31.3	0.482
39	89.987	9.486	0.250	0.0000	0.3132	31.3	0.483
40	94.035	9.697	0.250	0.0000	0.3131	31.2	0.483

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Gorham
Boring No.: HB-GBB-301
Sample No.: 2U
Test No.: 303046A

Location: --
Tested By: GSL
Test Date: 2/21/18
Sample Type: Intact

Project No.: 18821.00
Checked By: --
Depth: 32.0-32.5 FT
Elevation: --

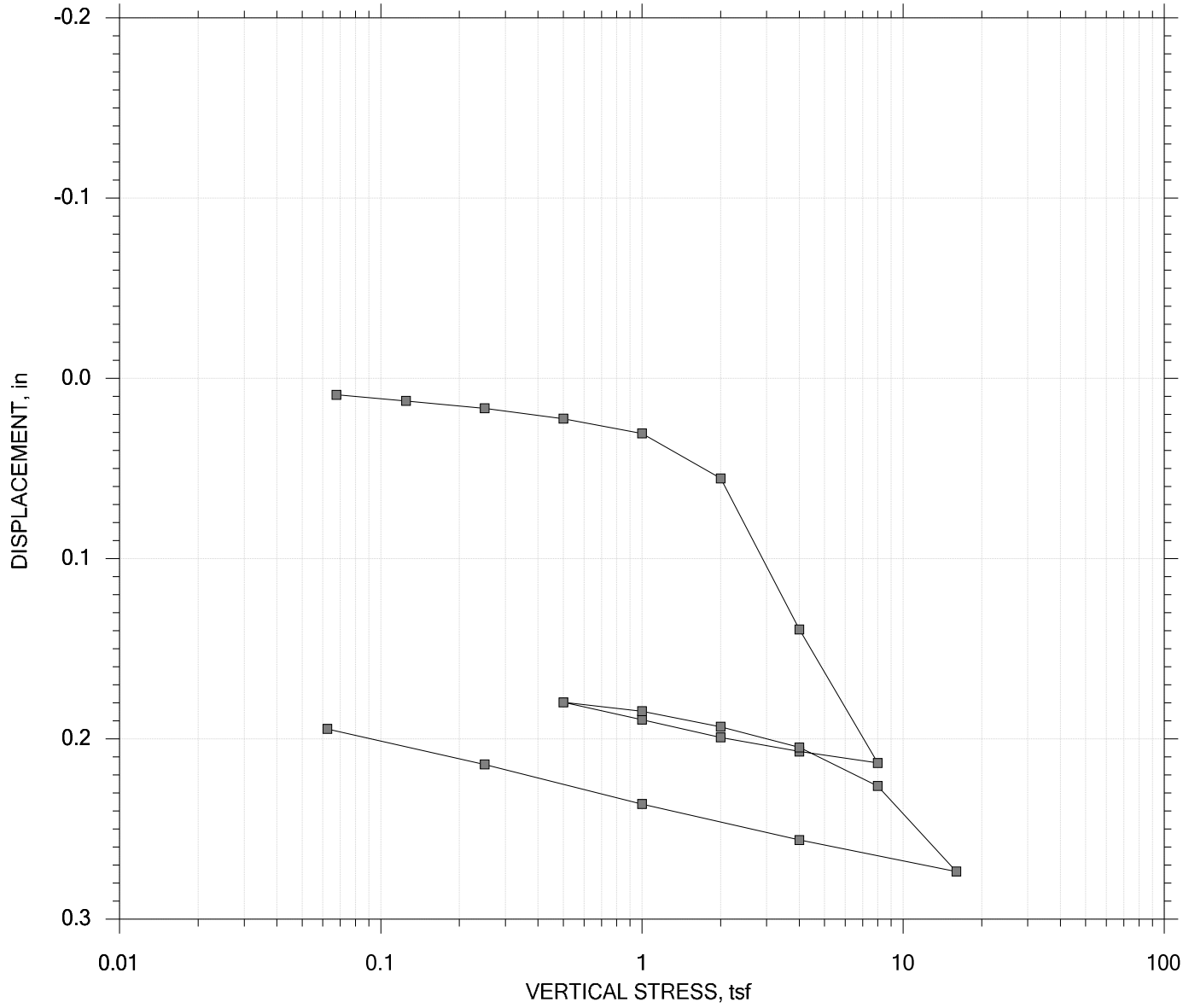
Soil Description: Very Soft Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 21 of 21
Applied Stress: 0.0625 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.028		0.251	0.0000	0.3131	31.2	0.483
2	-0.023		0.251	0.0000	0.3131	31.2	0.483
3	-0.019		0.198	0.0000	0.3129	31.2	0.483
4	-0.015		0.154	0.0000	0.3128	31.2	0.484
5	-0.010		0.122	0.0000	0.3126	31.2	0.484
6	-0.006		0.106	0.0000	0.3125	31.2	0.484
7	-0.001		0.0858	0.0000	0.3124	31.2	0.484
8	0.000	0.000	0.0812	0.0000	0.3123	31.2	0.485
9	0.003	0.056	0.0706	0.0000	0.3123	31.2	0.485
10	0.008	0.087	0.0615	0.0000	0.3122	31.2	0.485
11	0.012	0.109	0.0691	0.0000	0.3122	31.2	0.485
12	0.016	0.128	0.0706	0.0000	0.3122	31.2	0.485
13	0.021	0.144	0.0706	0.0000	0.3122	31.2	0.485
14	0.025	0.159	0.0722	0.0000	0.3121	31.1	0.485
15	0.030	0.172	0.0706	0.0000	0.3122	31.2	0.485
16	0.034	0.184	0.0691	0.0000	0.3121	31.1	0.485
17	0.047	0.217	0.0646	0.0000	0.3121	31.1	0.485
18	0.056	0.237	0.0630	0.0000	0.3121	31.1	0.485
19	0.140	0.374	0.0646	0.0000	0.3119	31.1	0.486
20	0.224	0.473	0.0646	0.0000	0.3118	31.1	0.486
21	0.308	0.555	0.0646	0.0000	0.3117	31.1	0.486
22	0.476	0.690	0.0630	0.0000	0.3115	31.1	0.486
23	0.724	0.851	0.0630	0.0000	0.3114	31.1	0.487
24	0.976	0.988	0.0630	0.0000	0.3111	31.1	0.487
25	1.475	1.214	0.0630	0.0000	0.3109	31.0	0.488
26	2.474	1.573	0.0630	0.0000	0.3104	31.0	0.489
27	4.476	2.116	0.0630	0.0000	0.3096	30.9	0.490
28	4.976	2.231	0.0630	0.0000	0.3094	30.9	0.491
29	9.974	3.158	0.0630	0.0000	0.3081	30.7	0.494
30	14.973	3.870	0.0630	0.0000	0.3070	30.6	0.496
31	19.972	4.469	0.0615	0.0000	0.3061	30.6	0.498
32	24.976	4.998	0.0630	0.0000	0.3053	30.5	0.500
33	29.975	5.475	0.0615	0.0000	0.3046	30.4	0.501
34	39.973	6.322	0.0630	0.0000	0.3034	30.3	0.504
35	49.975	7.069	0.0615	0.0000	0.3024	30.2	0.506
36	59.973	7.744	0.0615	0.0000	0.3017	30.1	0.508
37	69.975	8.365	0.0615	0.0000	0.3010	30.0	0.509
38	79.973	8.943	0.0615	0.0000	0.3002	30.0	0.511
39	89.975	9.486	0.0615	0.0000	0.2997	29.9	0.512
40	99.973	9.999	0.0615	0.0000	0.2993	29.9	0.513
41	109.976	10.487	0.0615	0.0000	0.2989	29.8	0.514
42	119.973	10.953	0.0630	0.0000	0.2984	29.8	0.515
43	129.976	11.401	0.0615	0.0000	0.2981	29.8	0.515
44	139.974	11.831	0.0600	0.0000	0.2978	29.7	0.516
45	149.976	12.246	0.0615	0.0000	0.2975	29.7	0.516
46	159.974	12.648	0.0615	0.0000	0.2973	29.7	0.517
47	168.399	12.977	0.0615	0.0000	0.2970	29.6	0.518

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

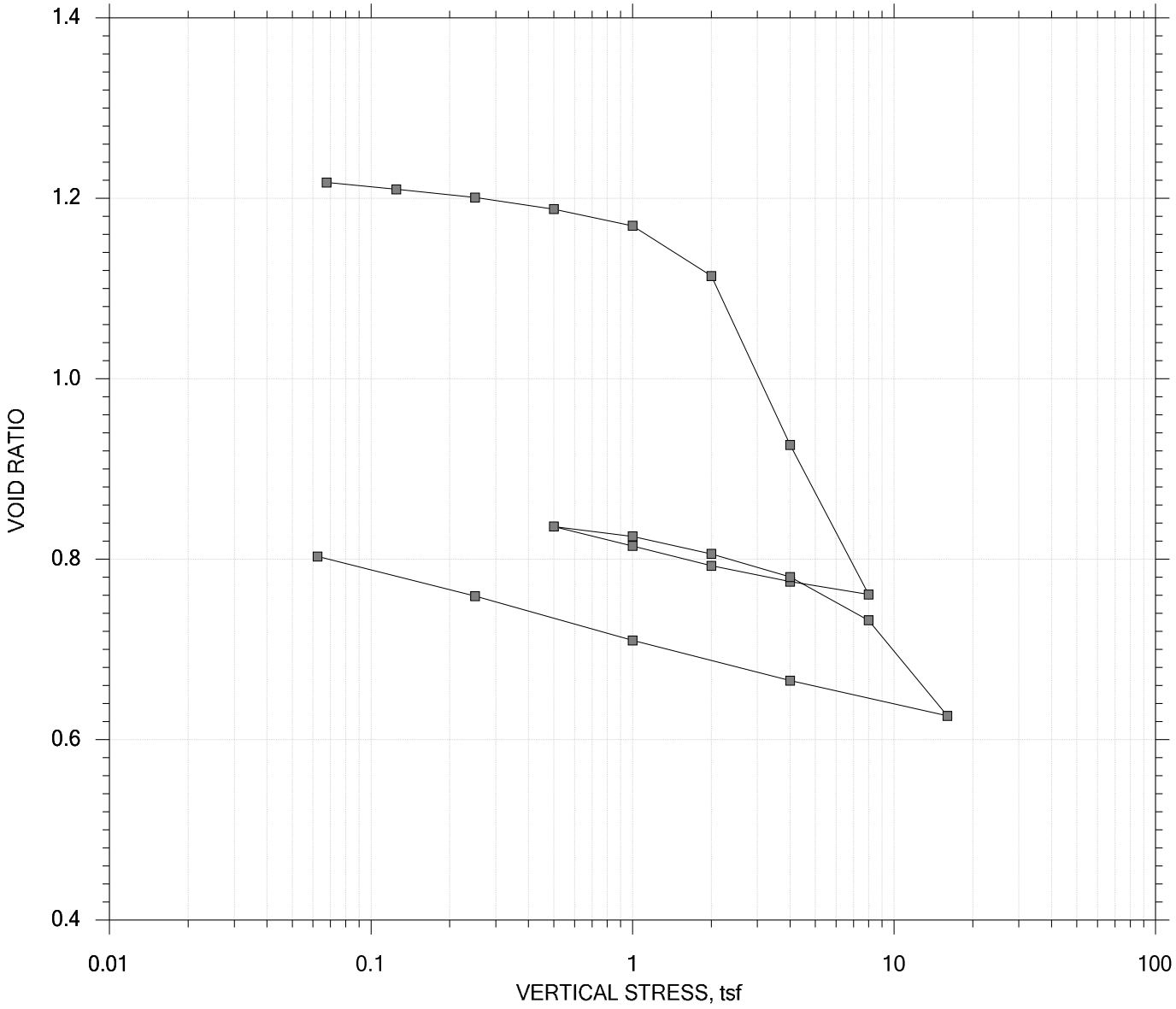


					Before Test	After Test
Current Vertical Effective Stress: ---				Water Content, %	45.16	31.77
Preconsolidation Stress: ---				Dry Unit Weight, pcf	75.317	90.725
Compression Ratio: ---				Saturation, %	98.49	100.00
Diameter: 2.495 in		Height: 1.001 in		Void Ratio	1.24	0.86
LL: 41	PL: 37	PI: 4	GS: 2.70			

	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

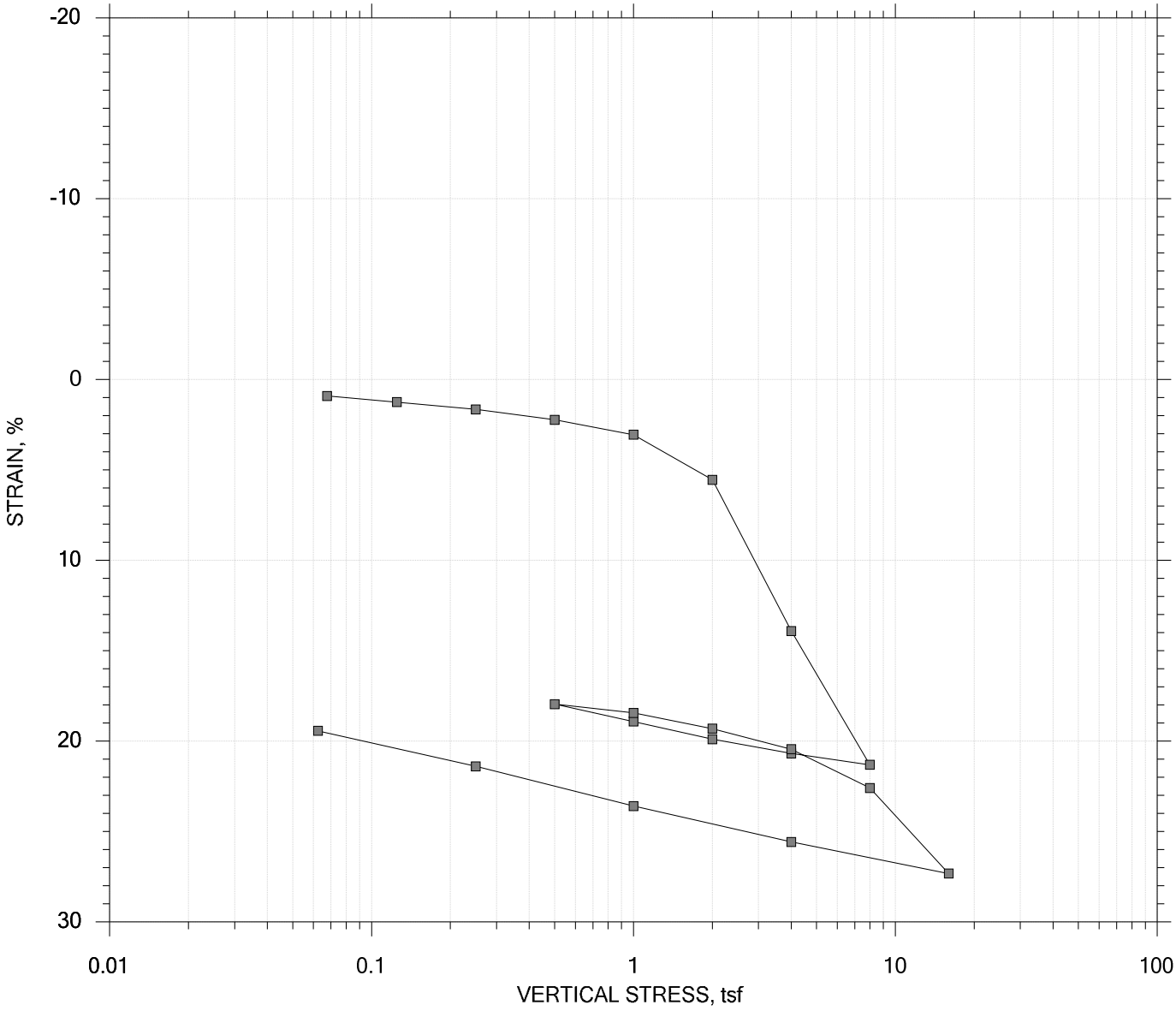


					Before Test	After Test
Current Vertical Effective Stress: ---				Water Content, %	45.16	31.77
Preconsolidation Stress: ---				Dry Unit Weight, pcf	75.317	90.725
Compression Ratio: ---				Saturation, %	98.49	100.00
Diameter: 2.495 in		Height: 1.001 in		Void Ratio	1.24	0.86
LL: 41	PL: 37	PI: 4	GS: 2.70			

	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

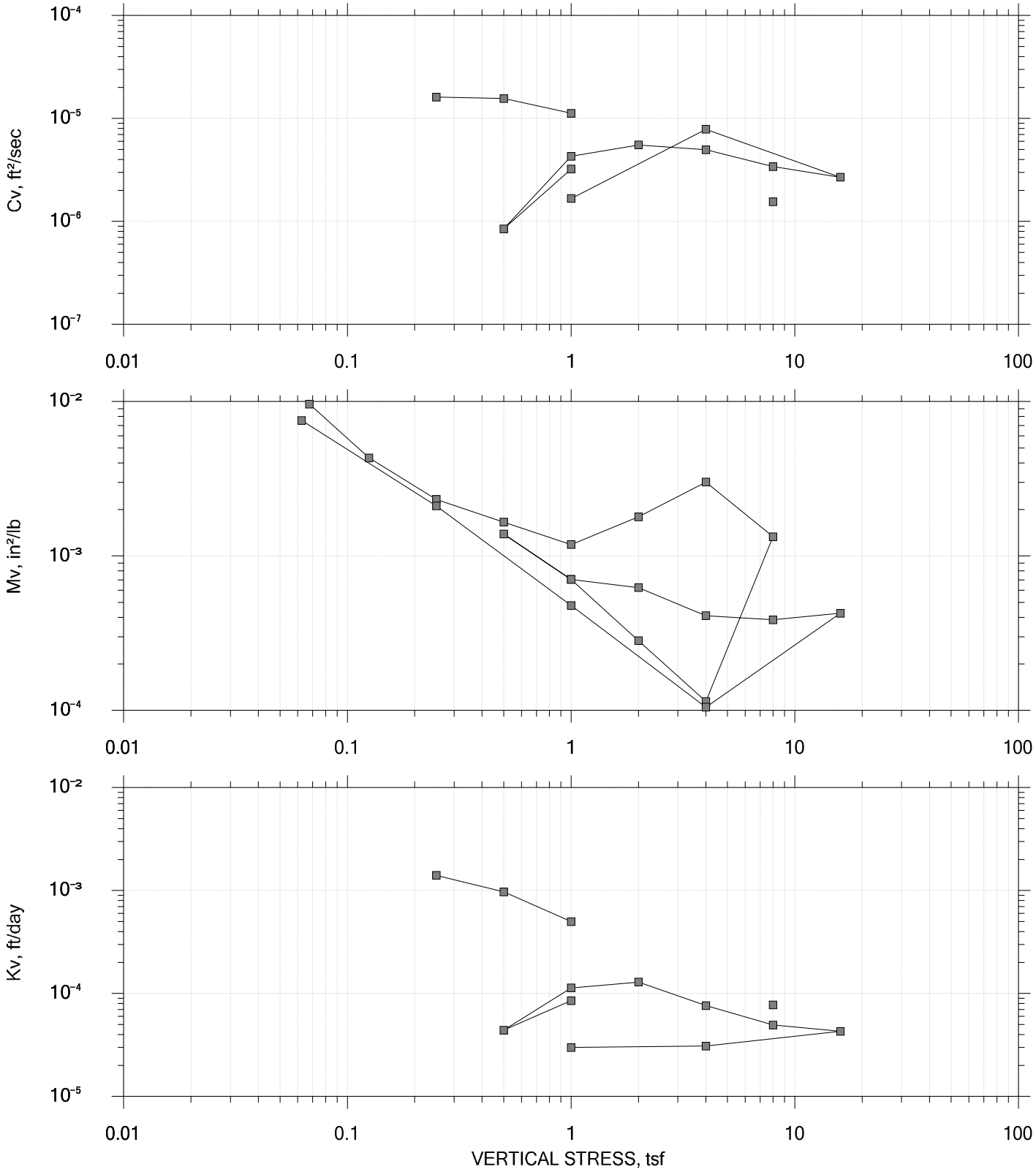


					Before Test	After Test
Current Vertical Effective Stress: ---				Water Content, %	45.16	31.77
Preconsolidation Stress: ---				Dry Unit Weight, pcf	75.317	90.725
Compression Ratio: ---				Saturation, %	98.49	100.00
Diameter: 2.495 in		Height: 1.001 in		Void Ratio	1.24	0.86
LL: 41	PL: 37	PI: 4	GS: 2.70			

	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

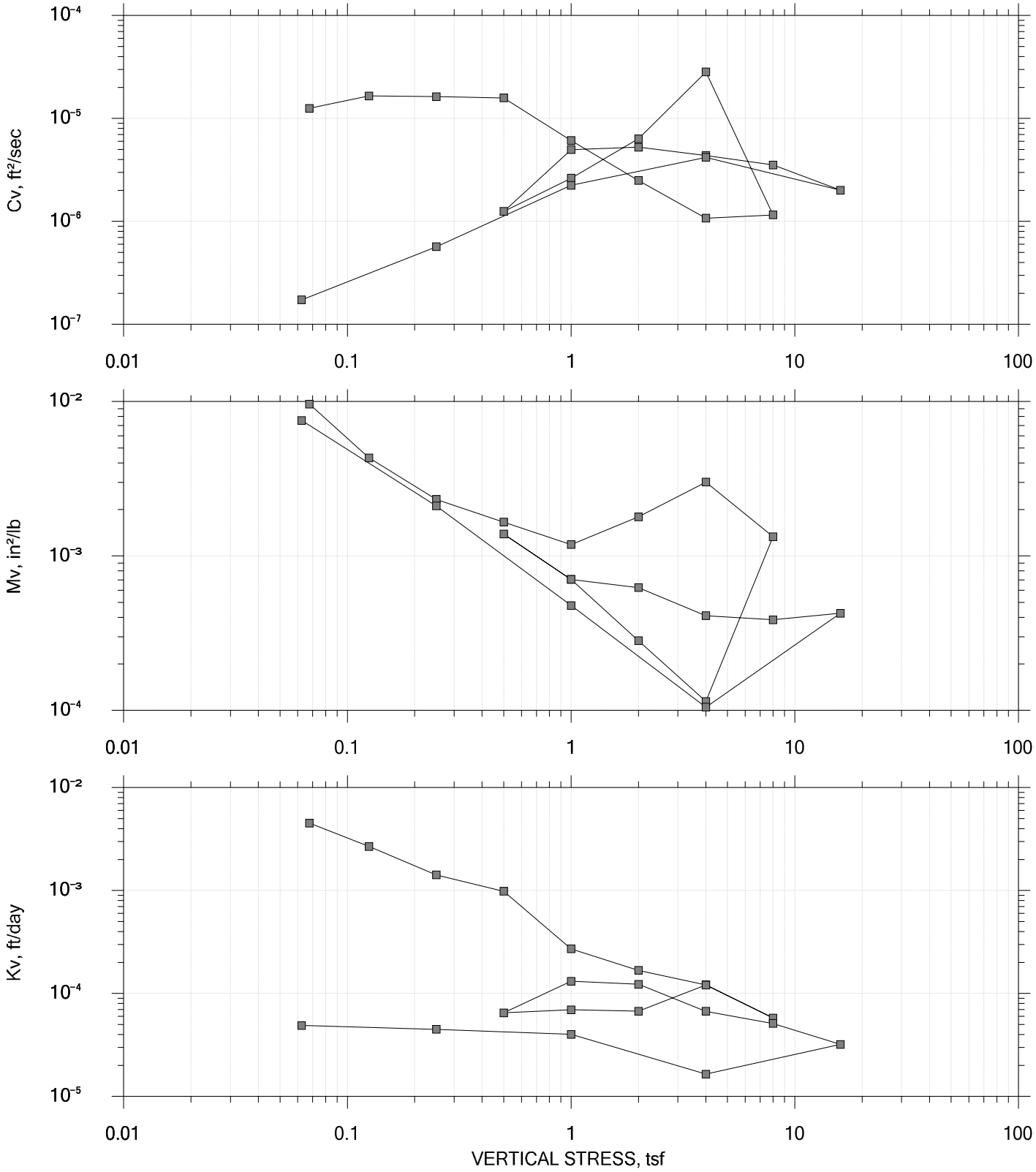
LOG of TIME COEFFICIENTS



	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SQUARE ROOT of TIME COEFFICIENTS



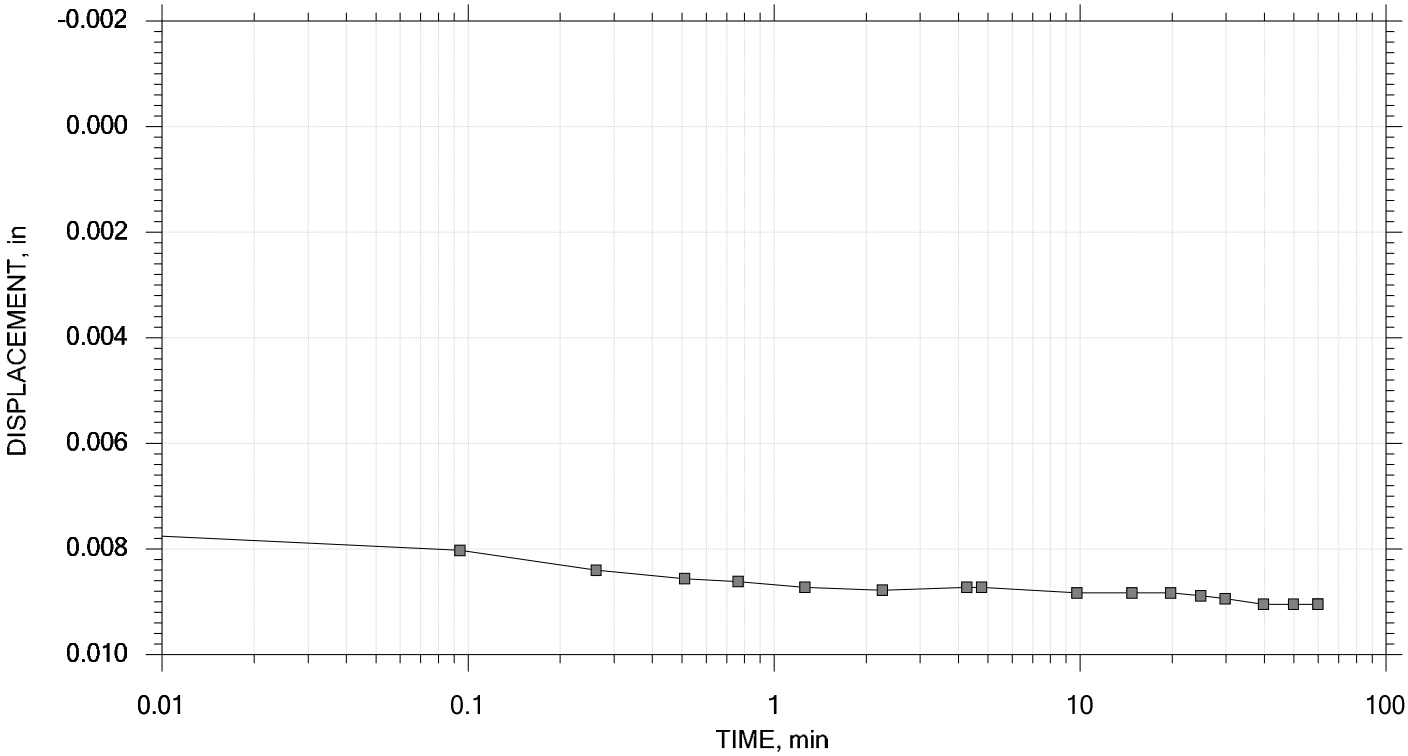
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

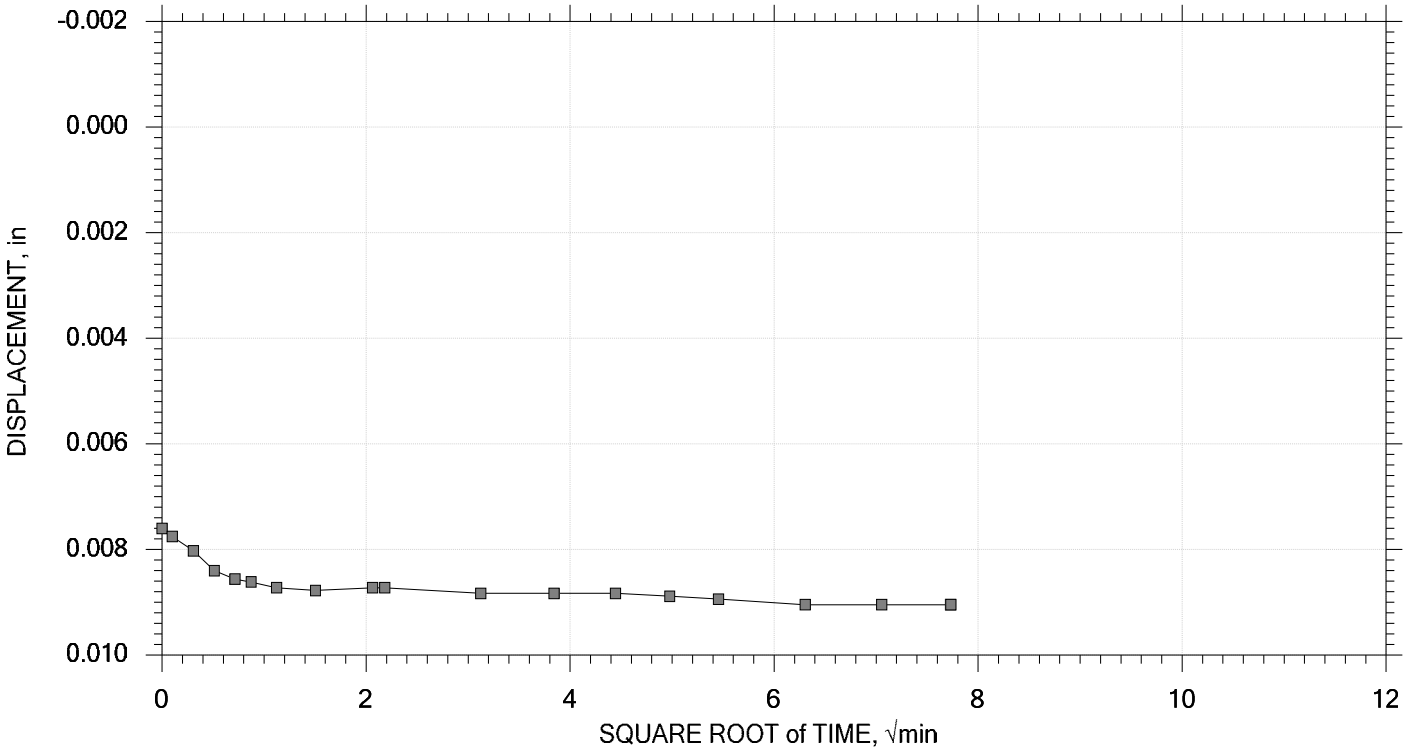
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 21

Stress: 0.067599 tsf





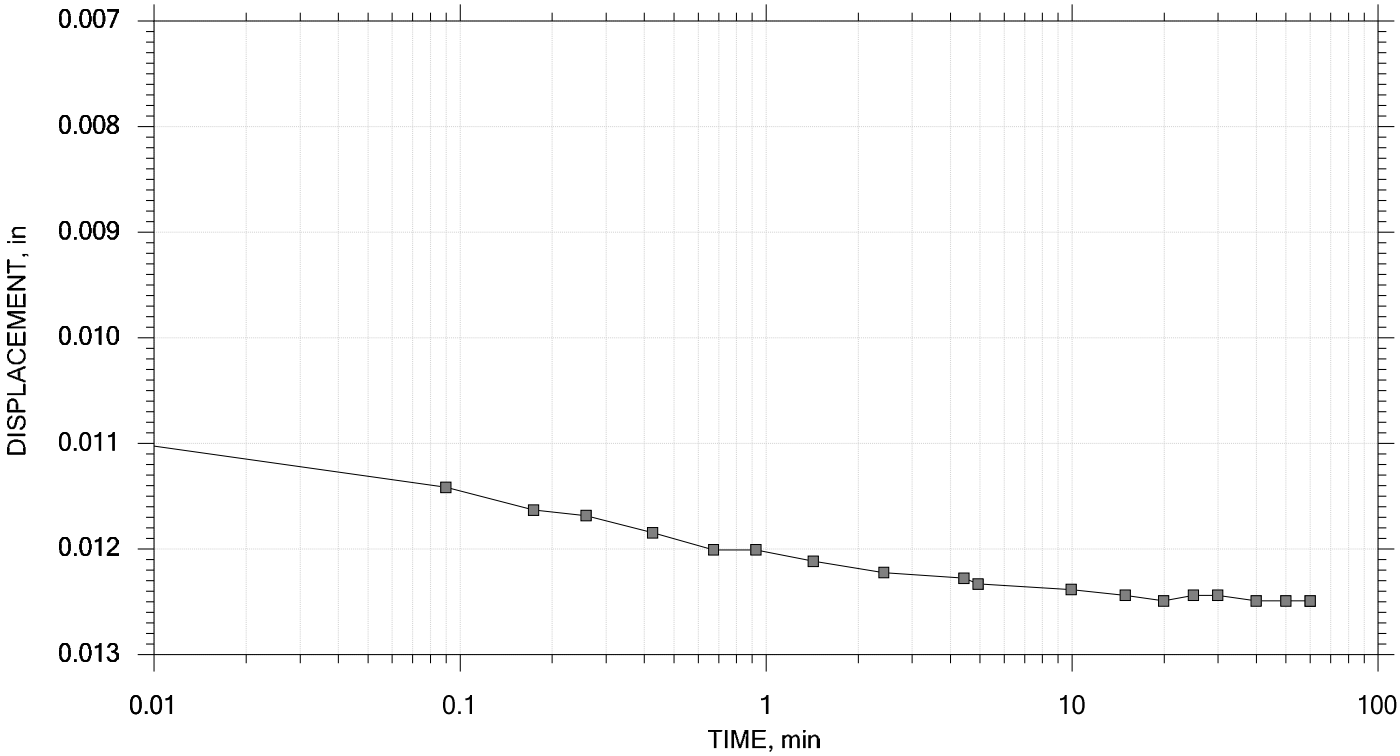
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

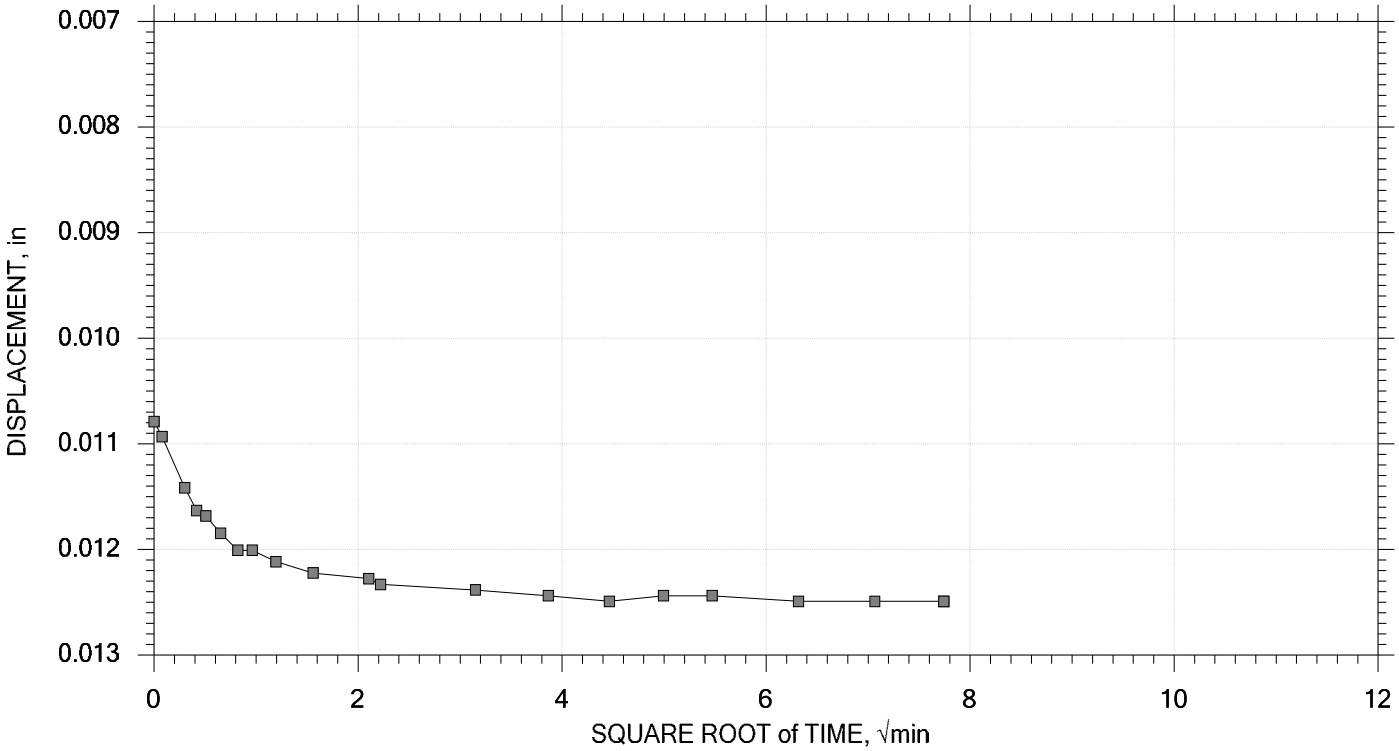
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 21

Stress: 0.125 tsf





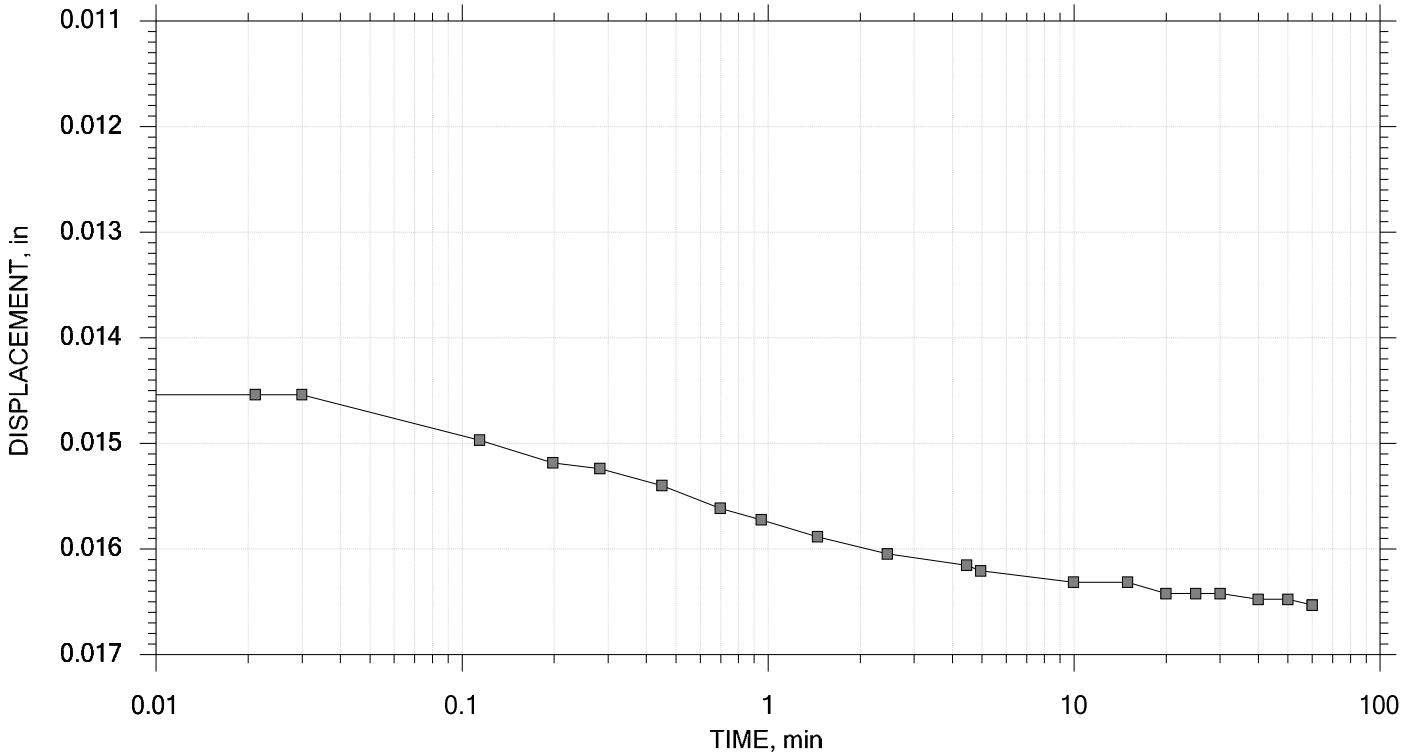
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

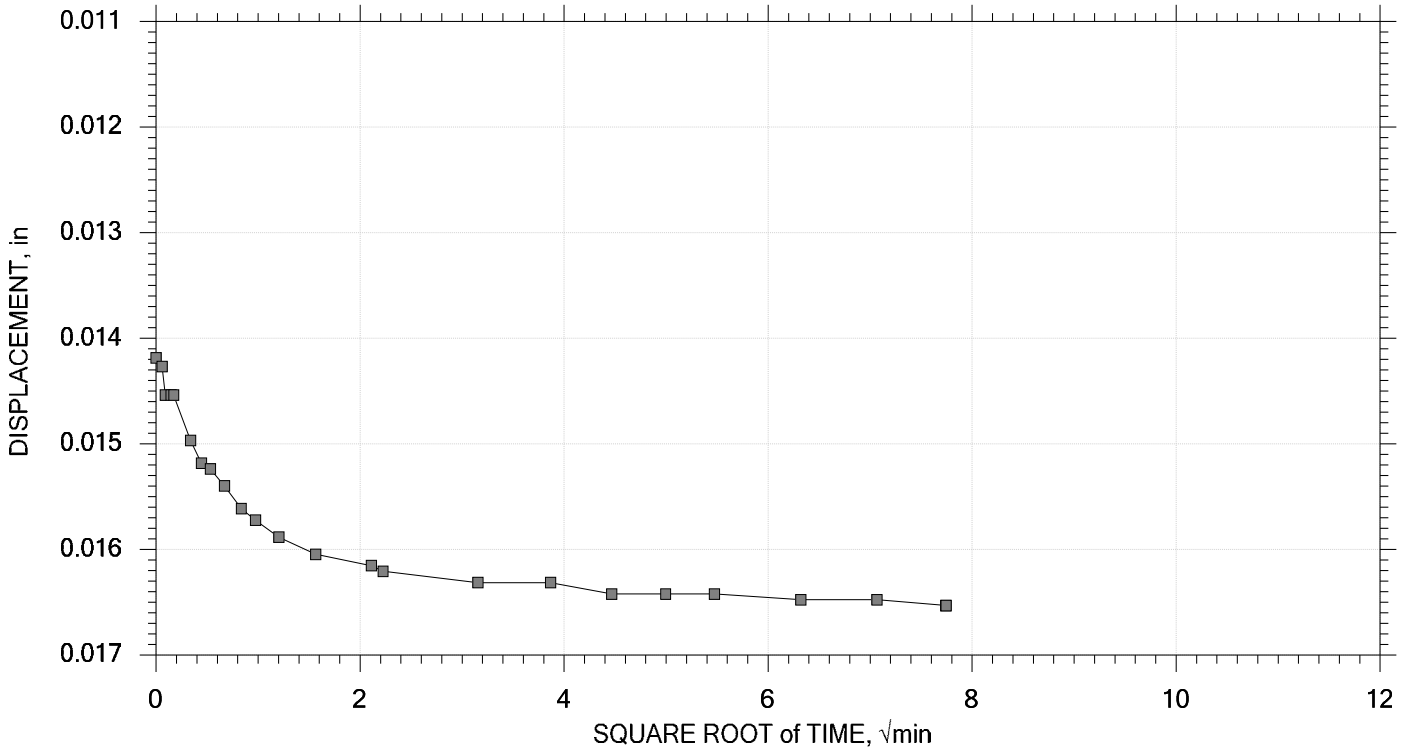
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 21

Stress: 0.25 tsf





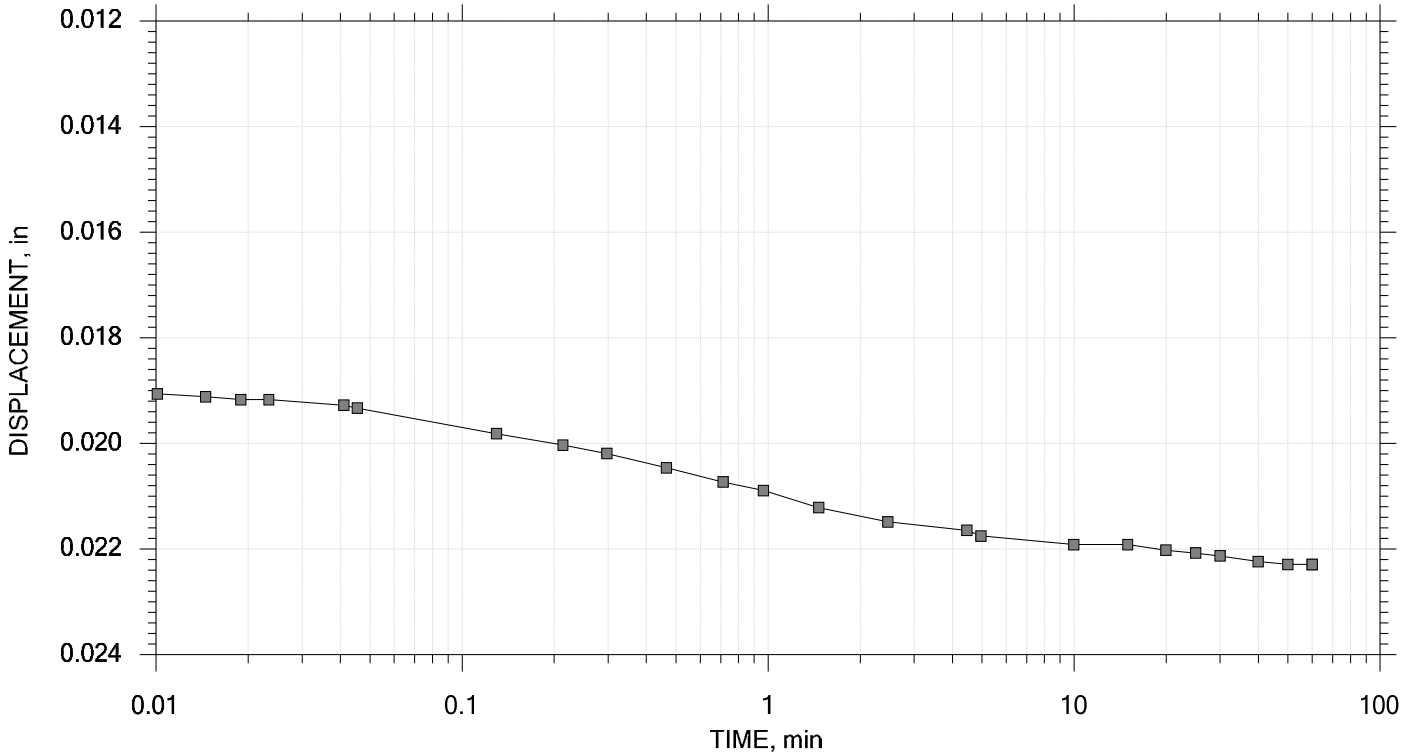
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

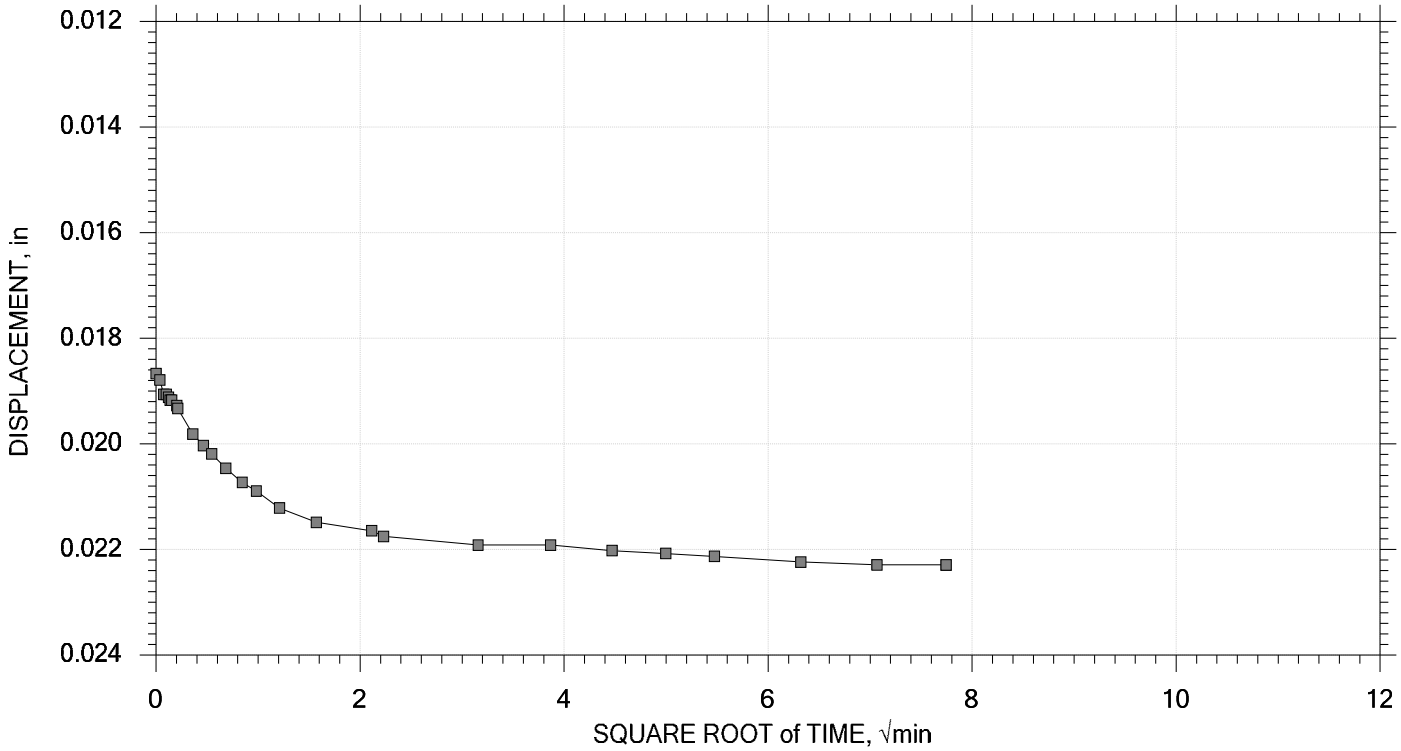
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 21

Stress: 0.5 tsf





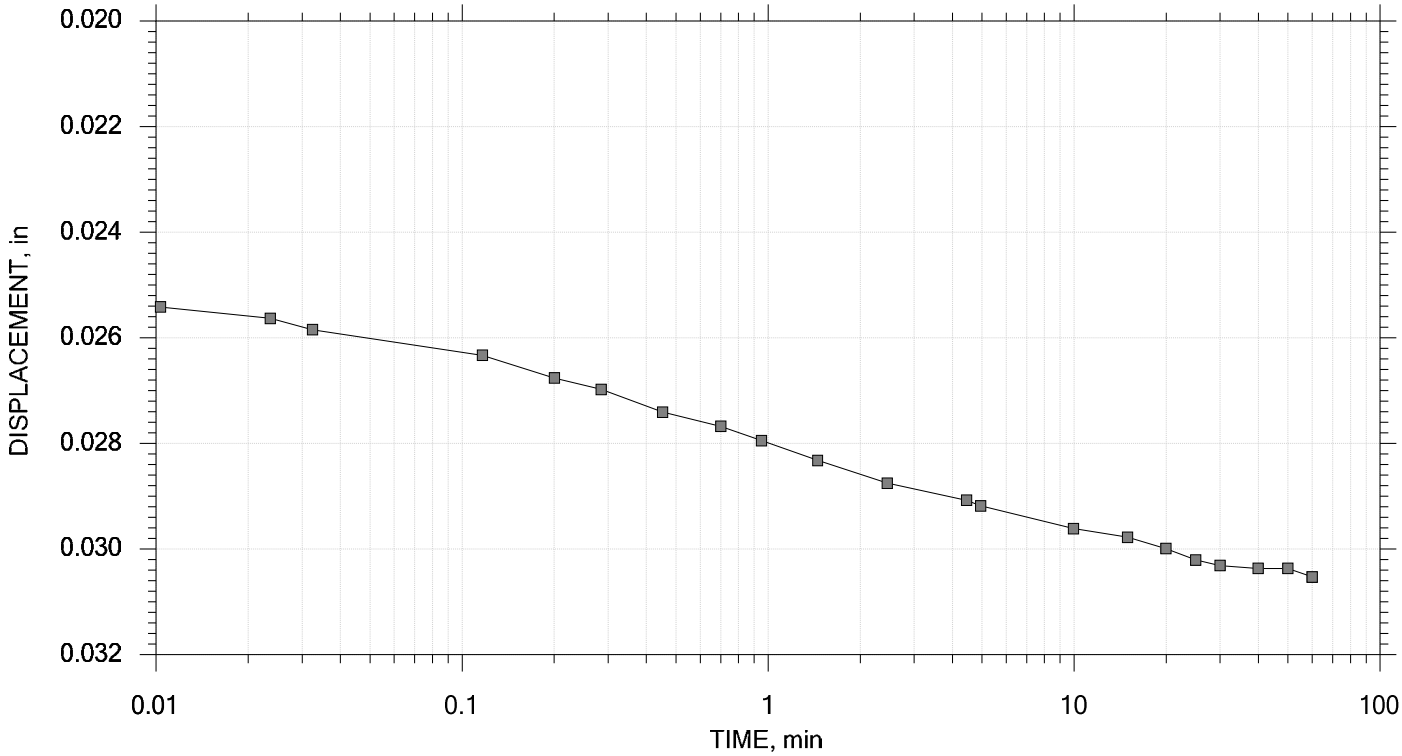
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

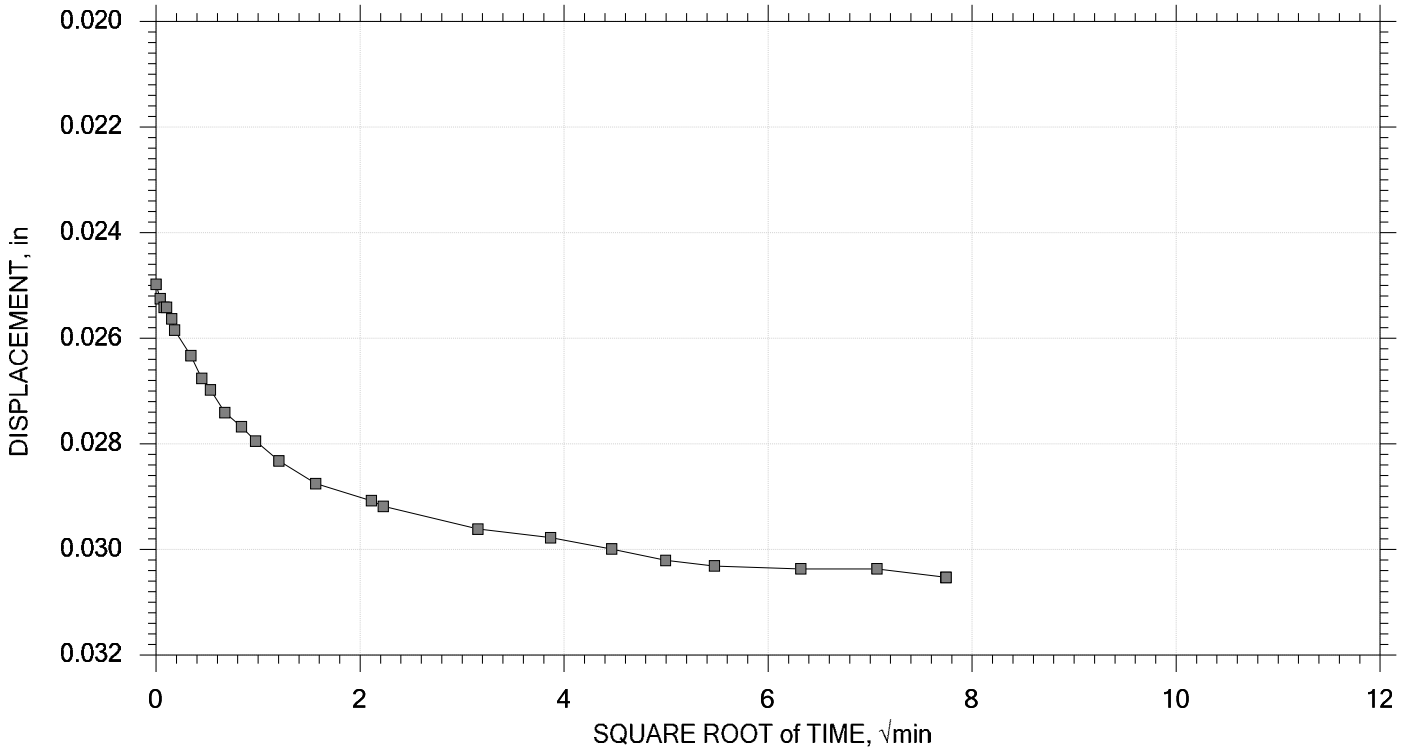
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 21

Stress: 1 tsf





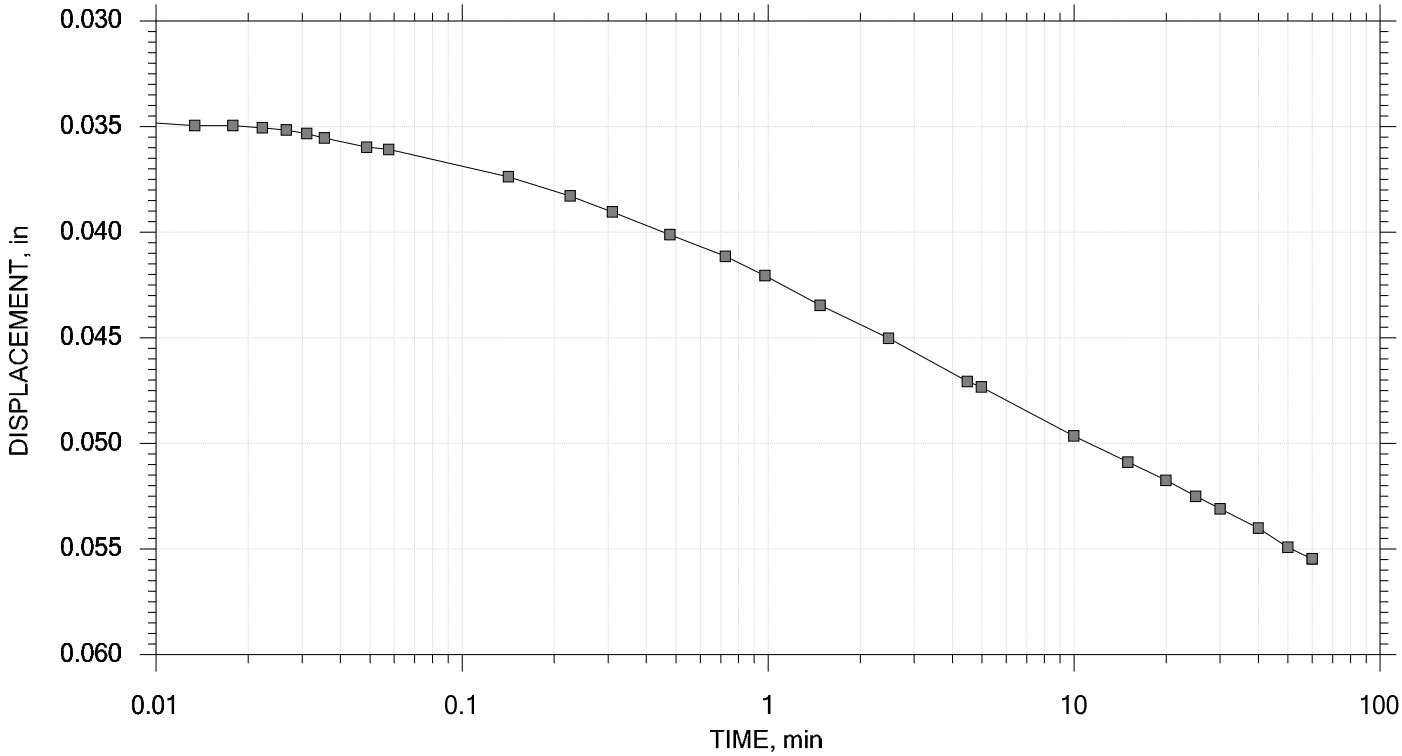
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

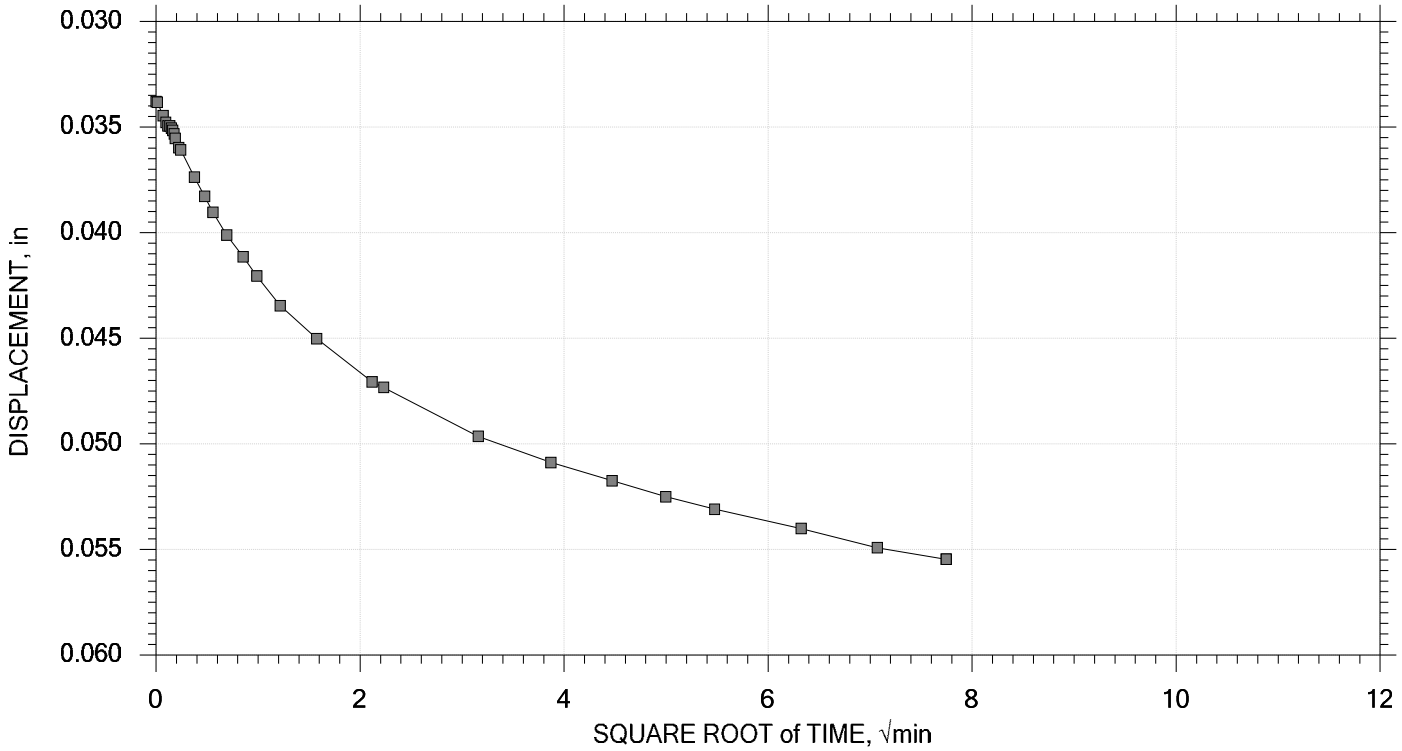
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 21

Stress: 2 tsf





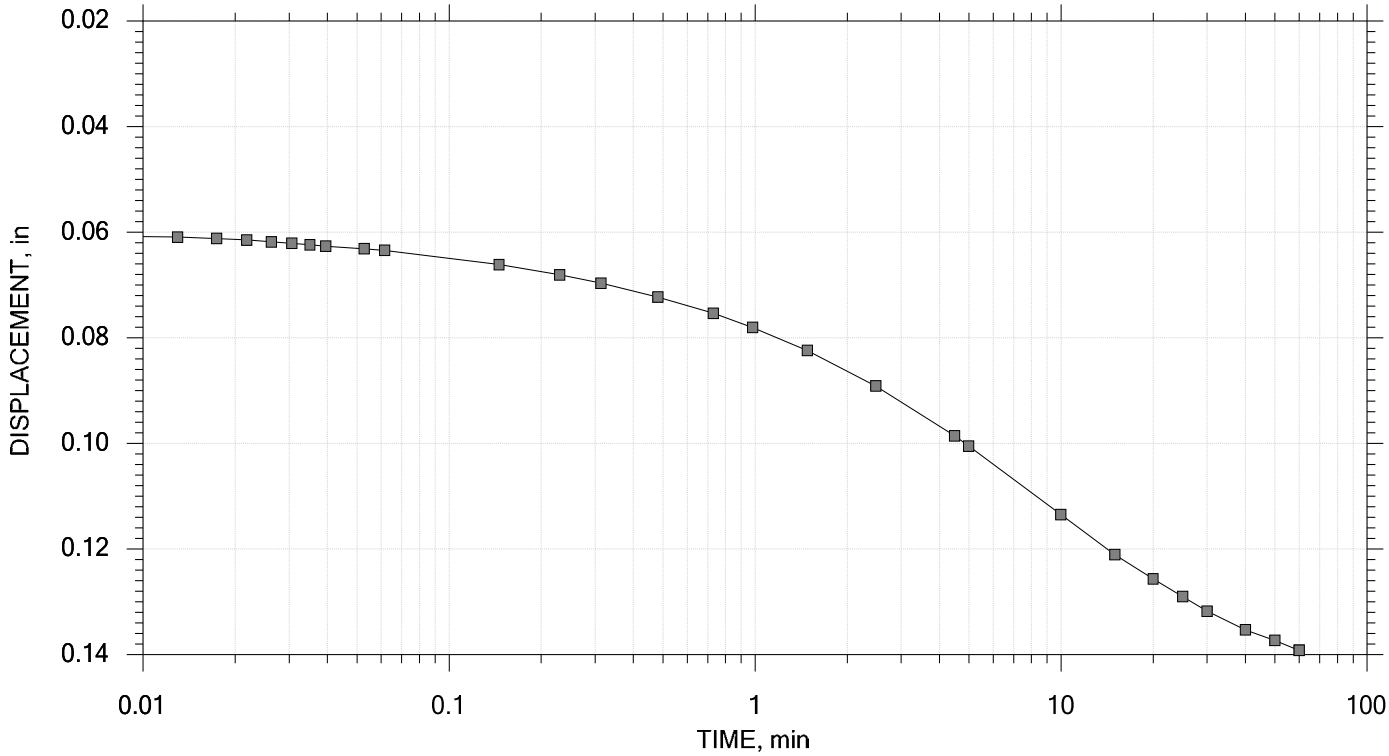
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

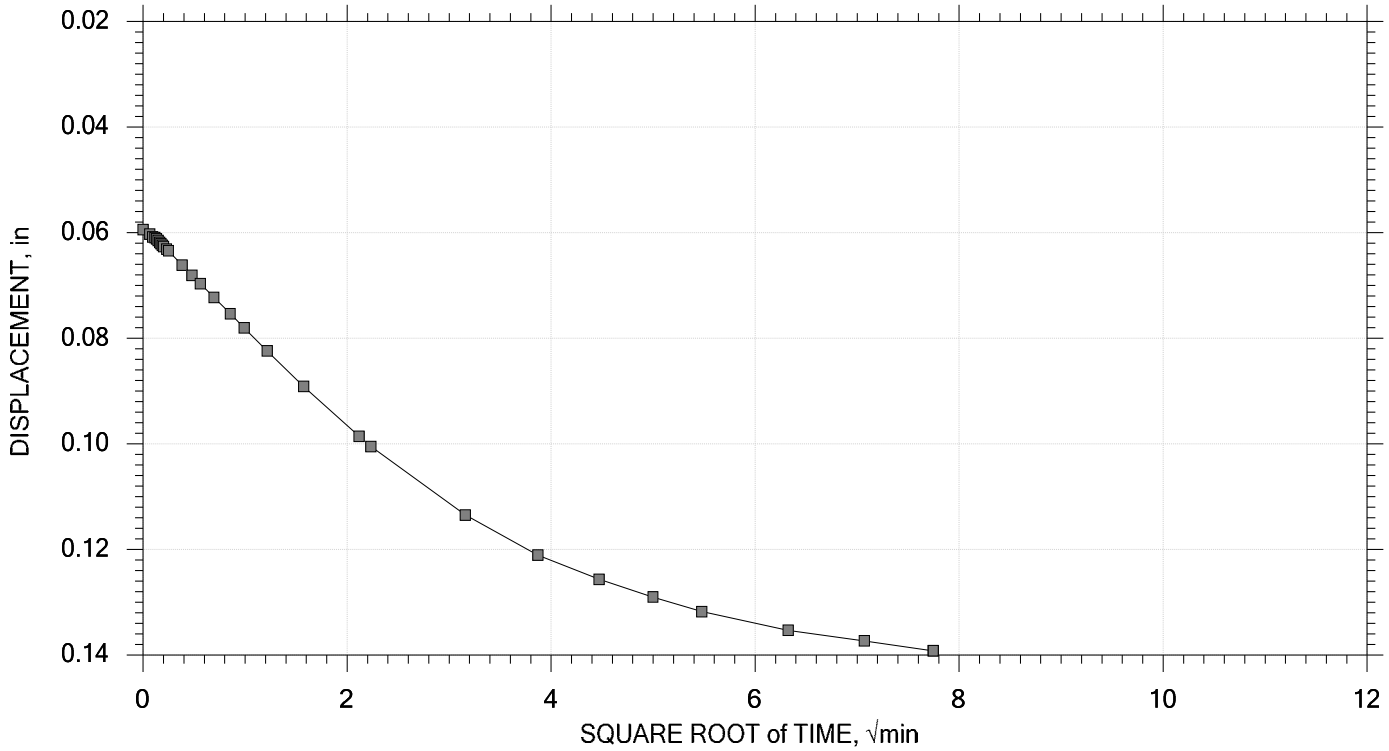
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 21

Stress: 4 tsf





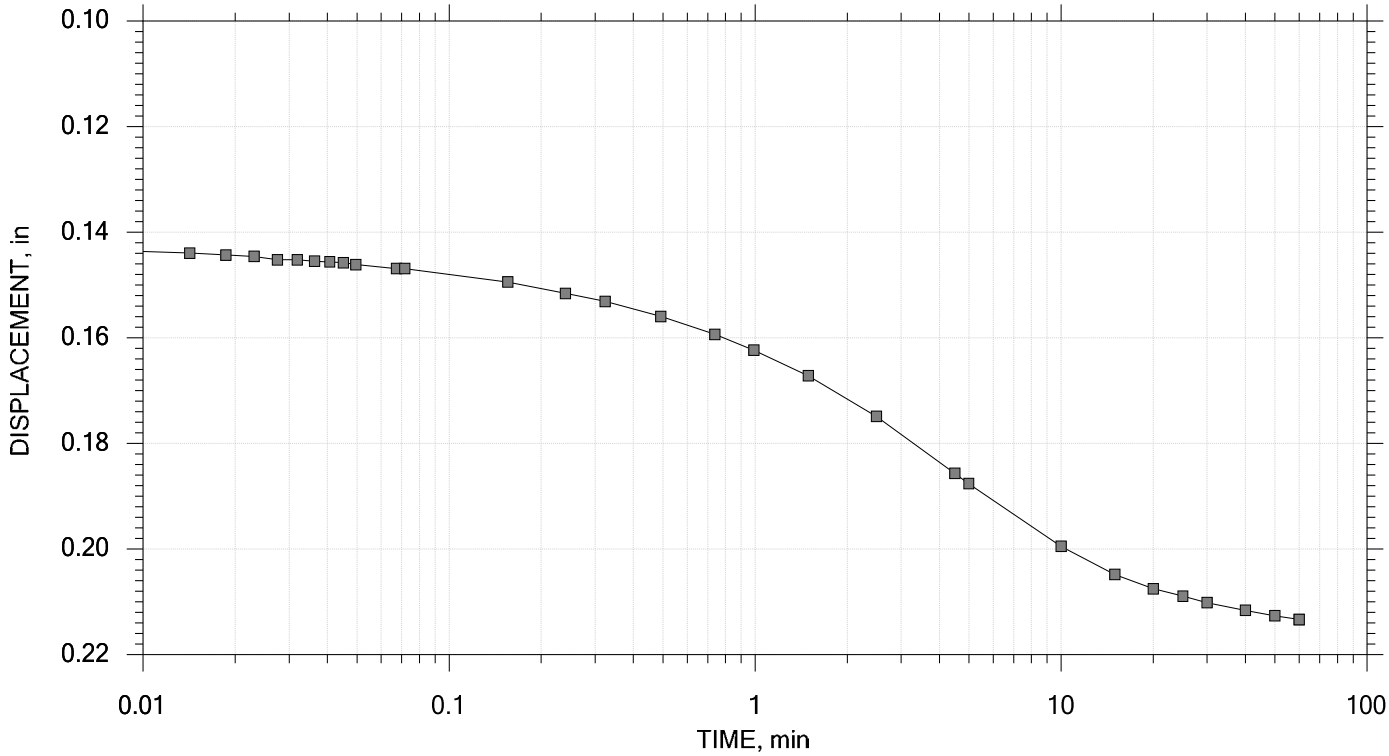
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

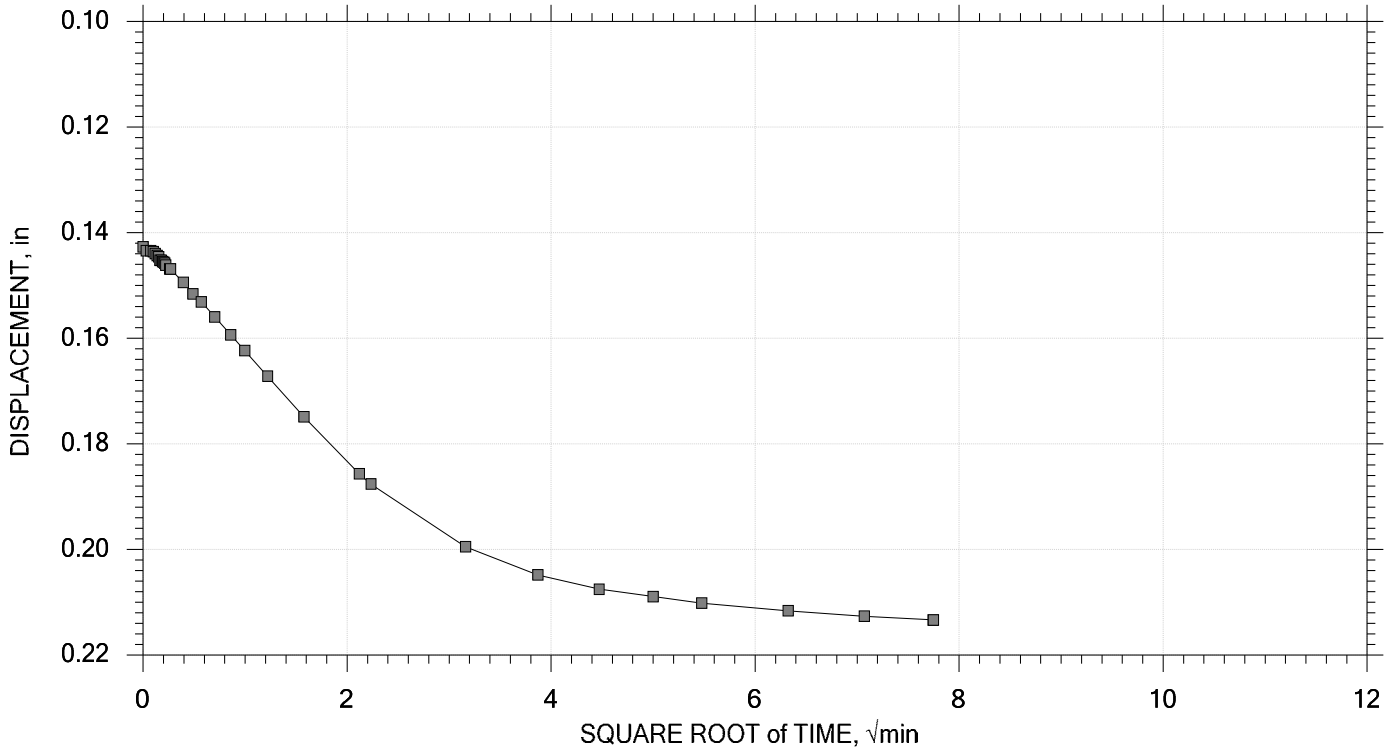
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 21

Stress: 8 tsf





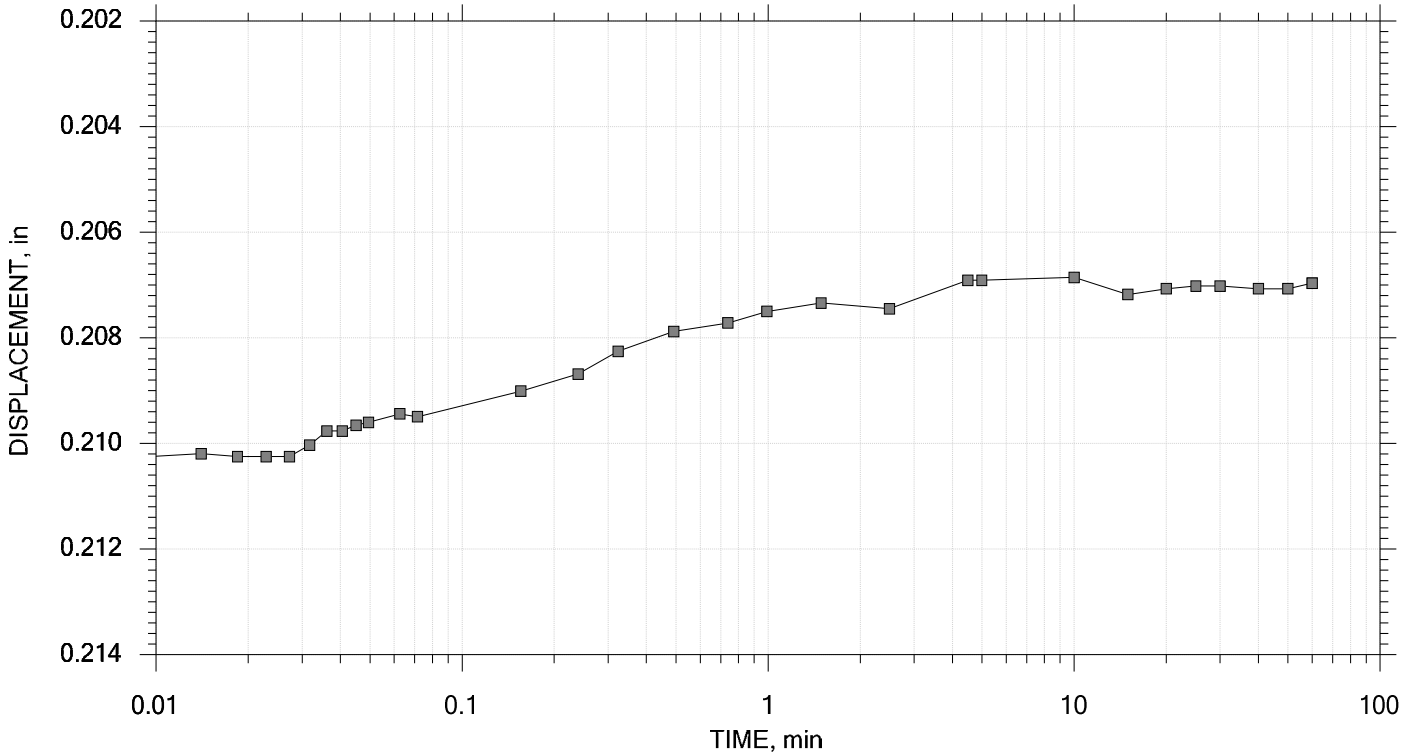
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

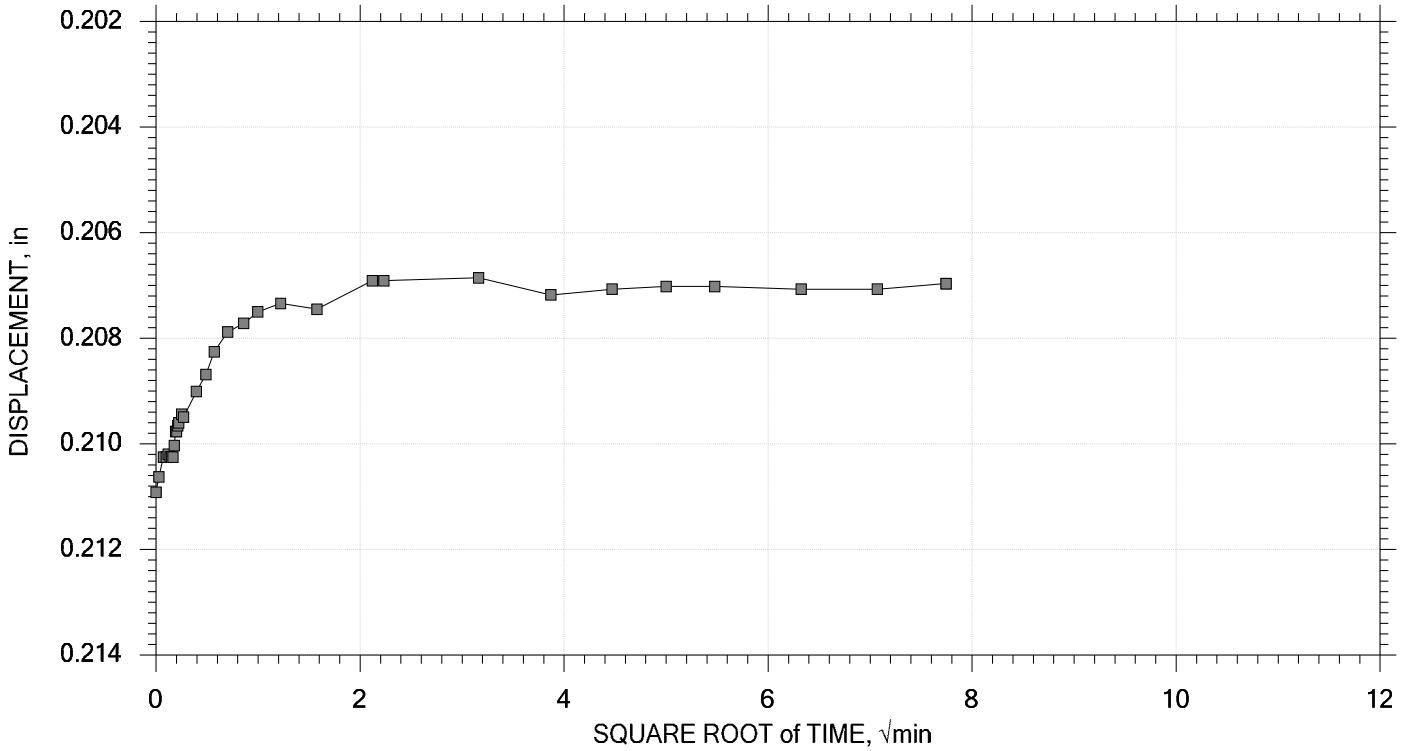
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 21

Stress: 4 tsf





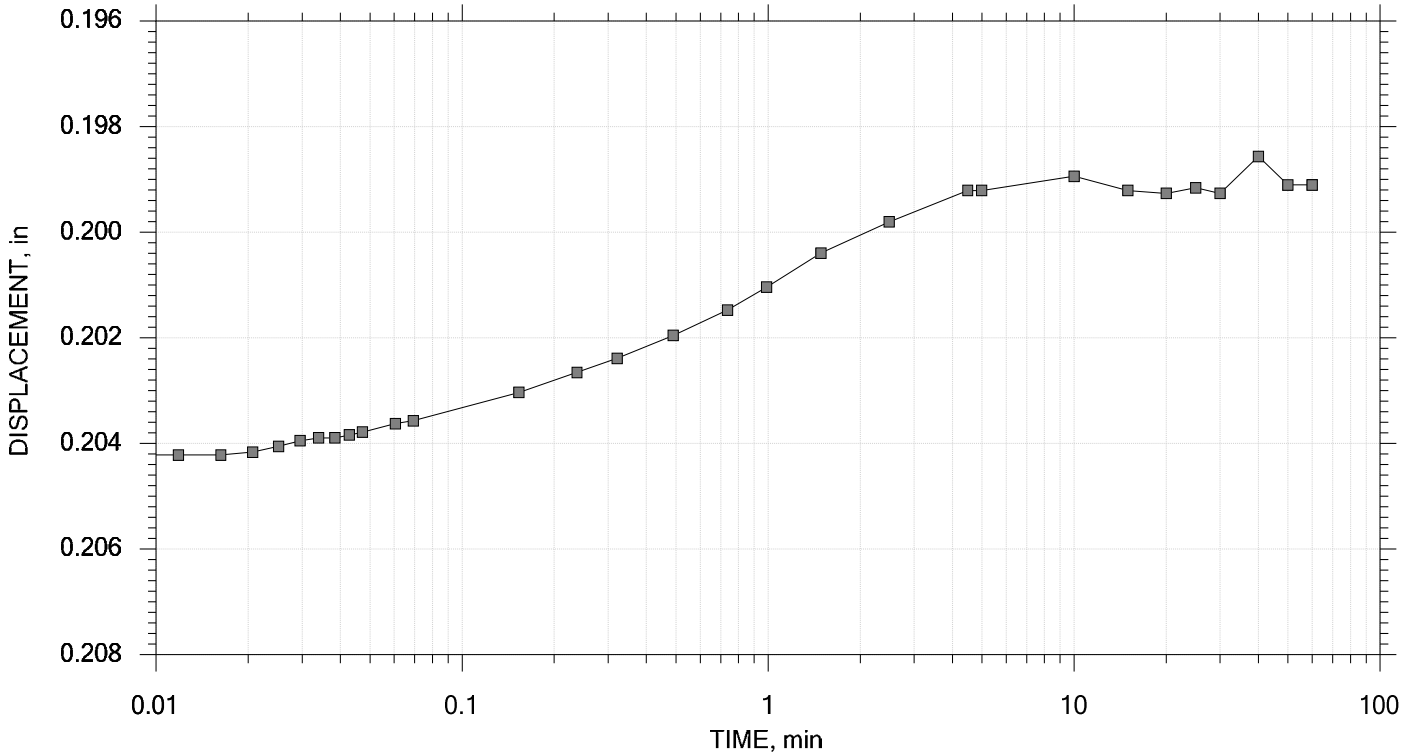
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

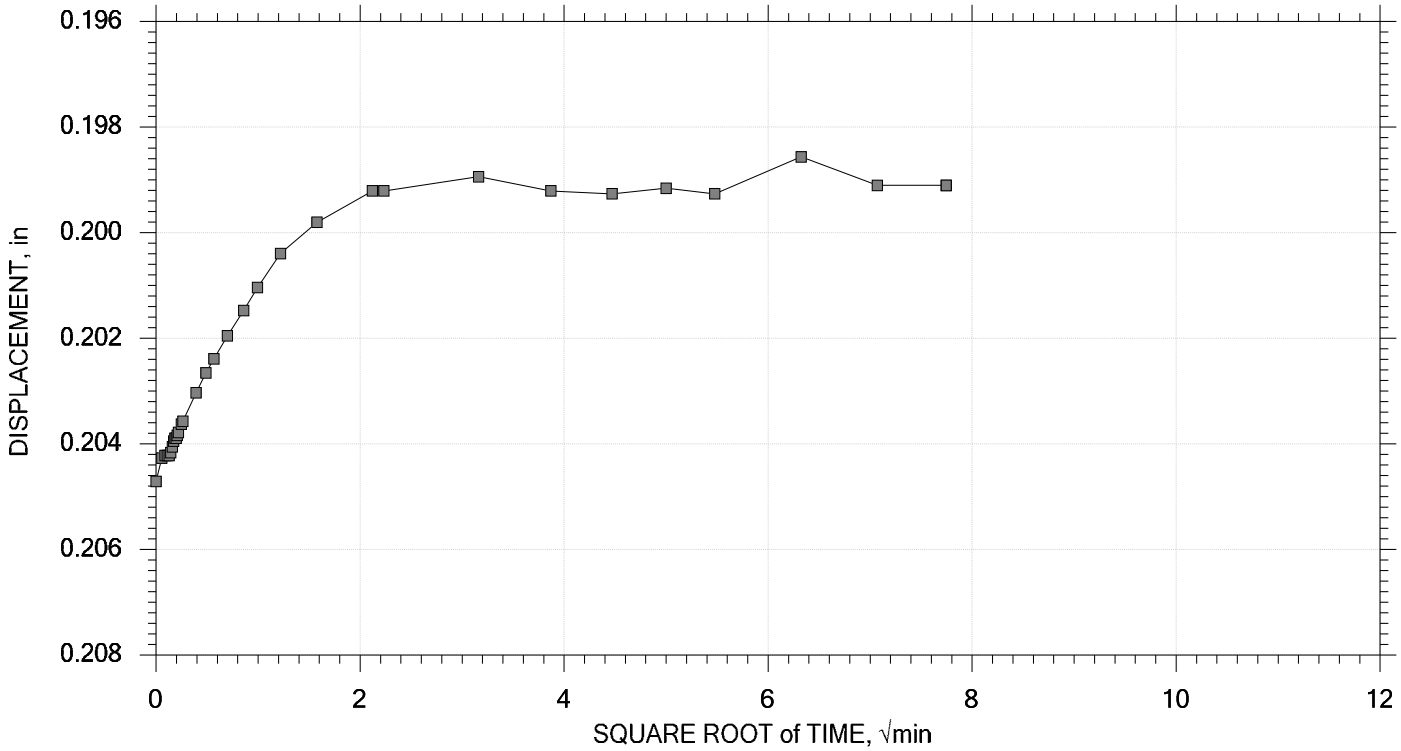
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 21

Stress: 2 tsf





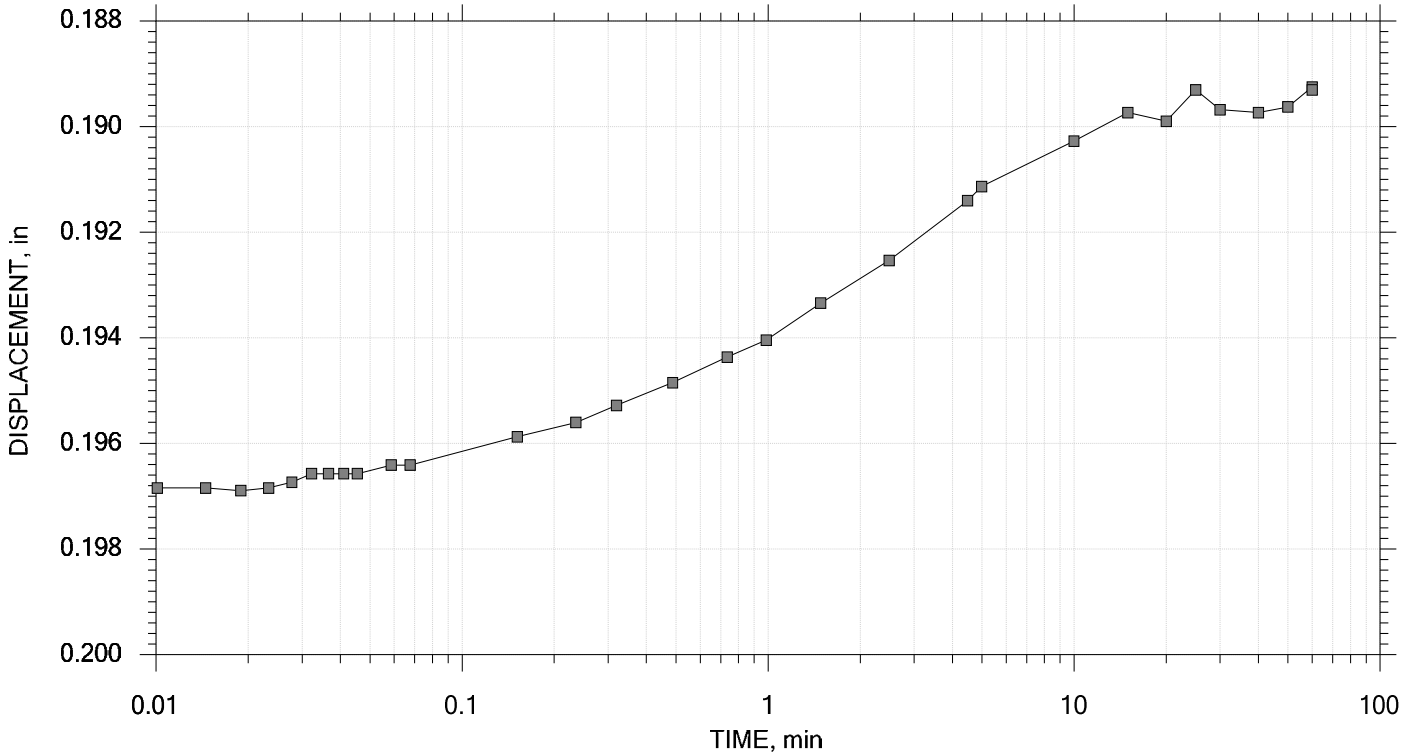
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

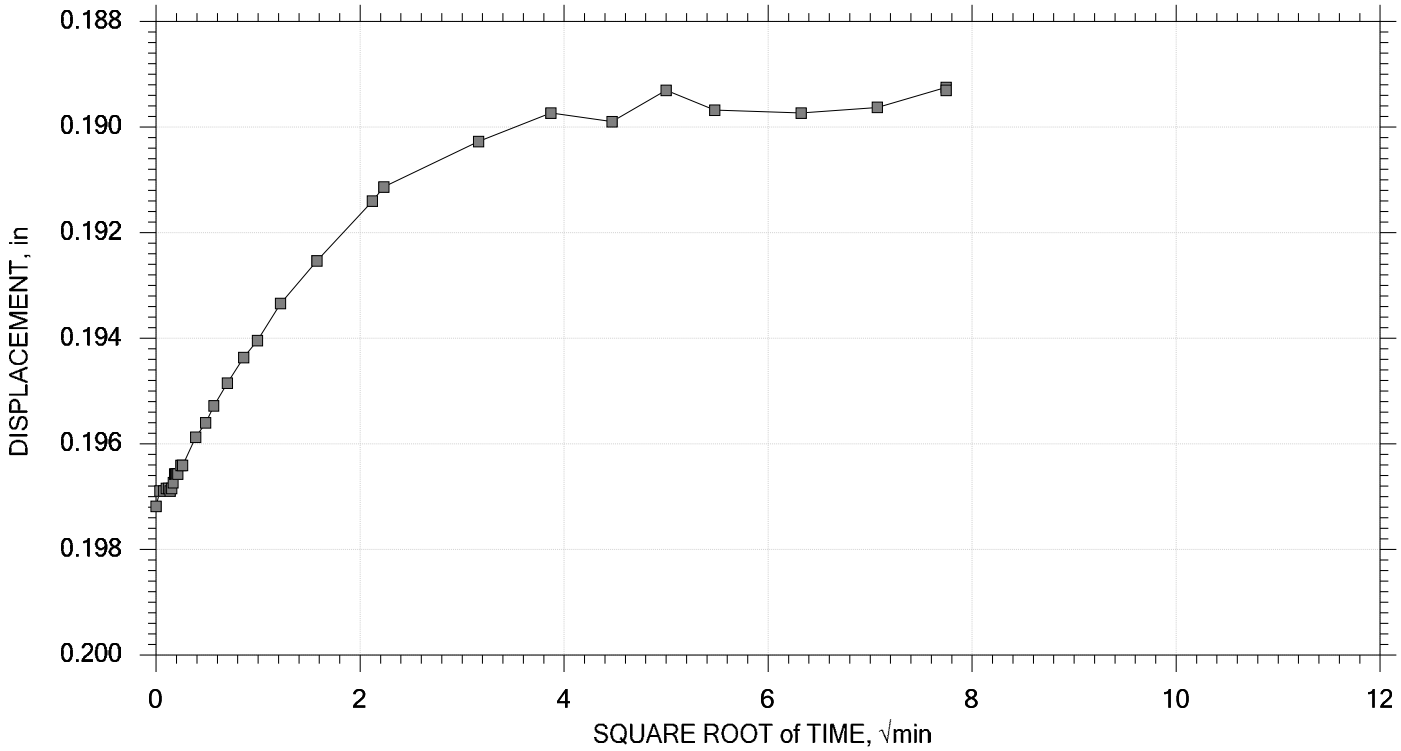
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 11 of 21

Stress: 1 tsf





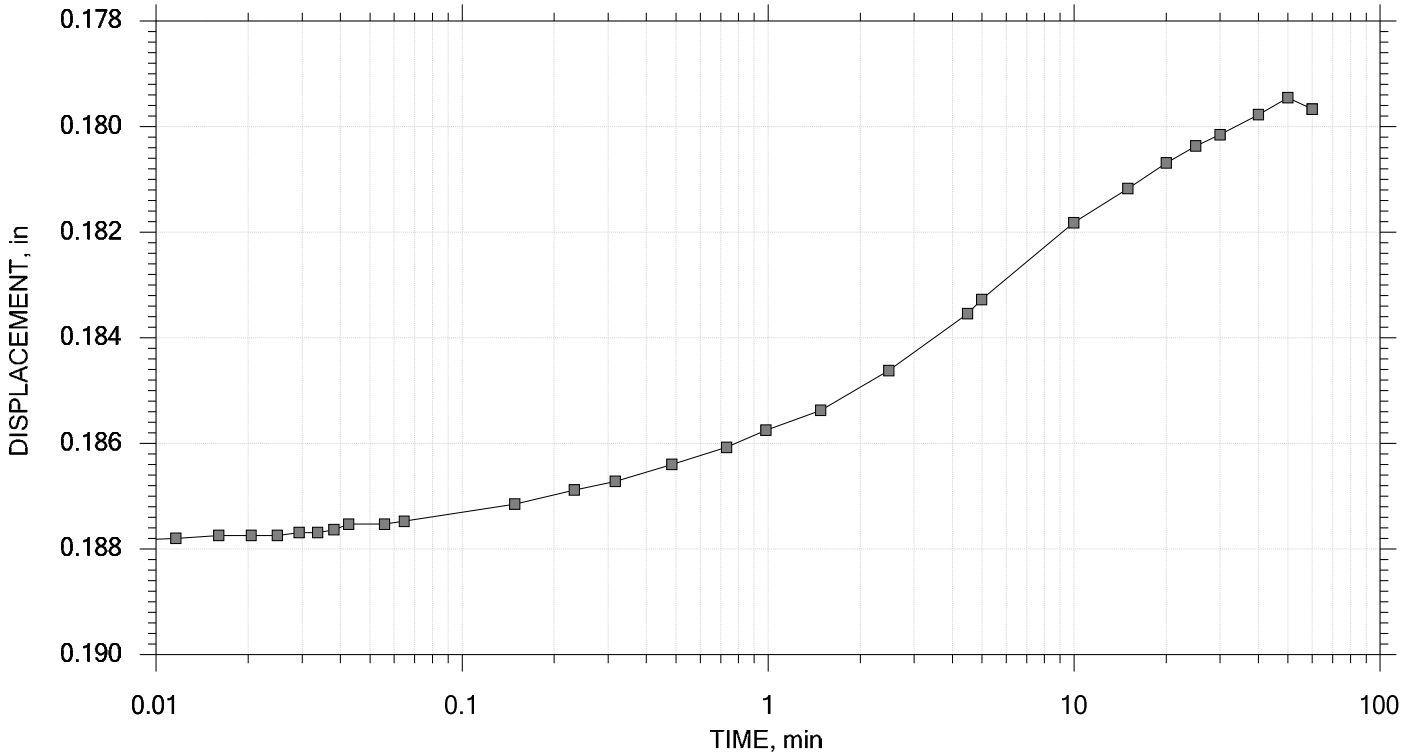
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

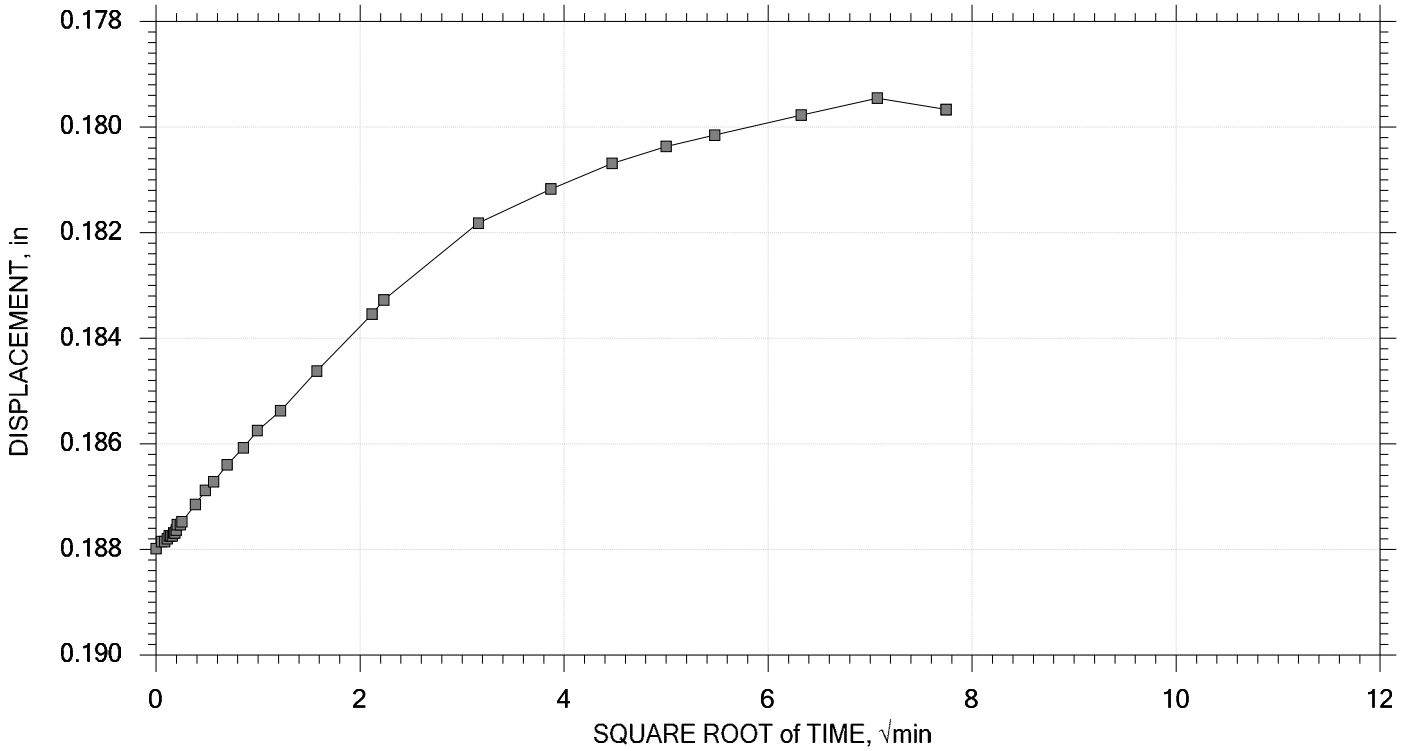
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 12 of 21

Stress: 0.5 tsf





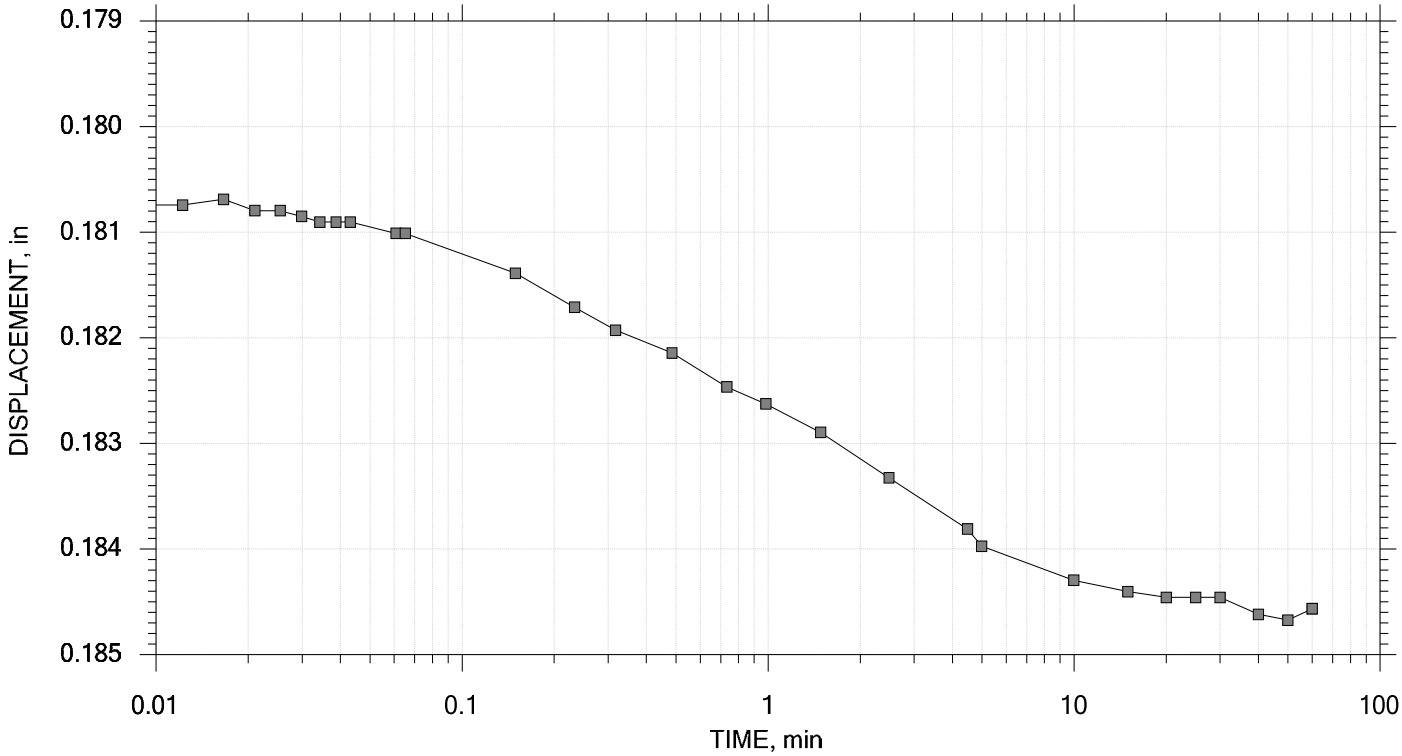
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

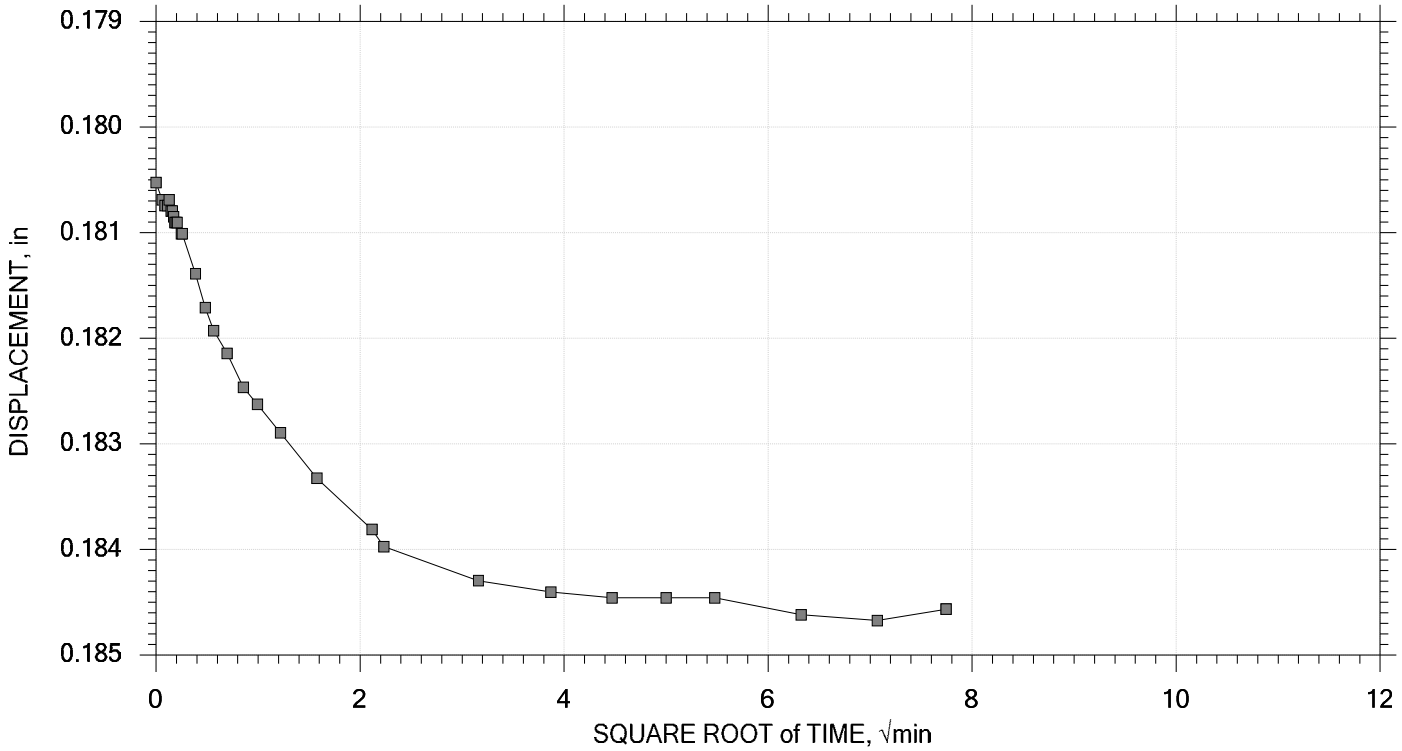
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 21

Stress: 1 tsf





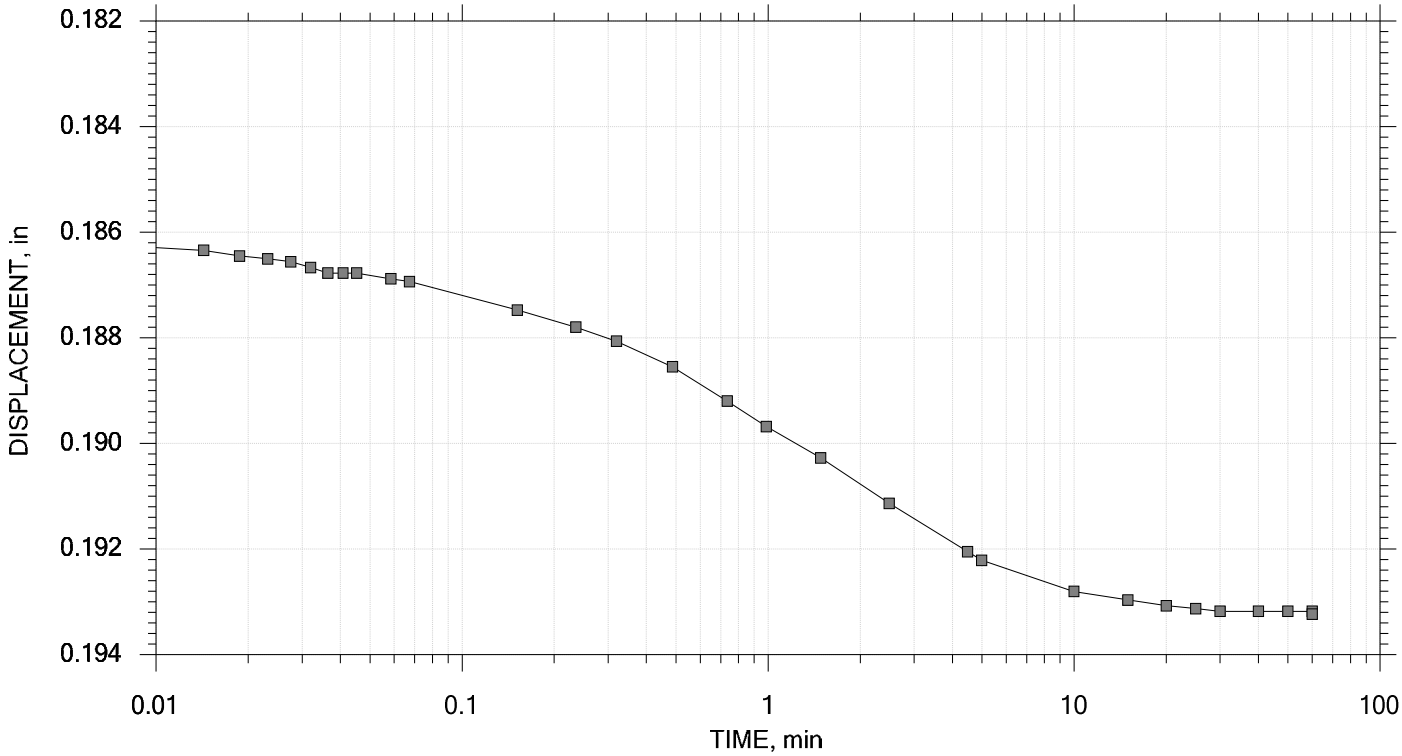
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

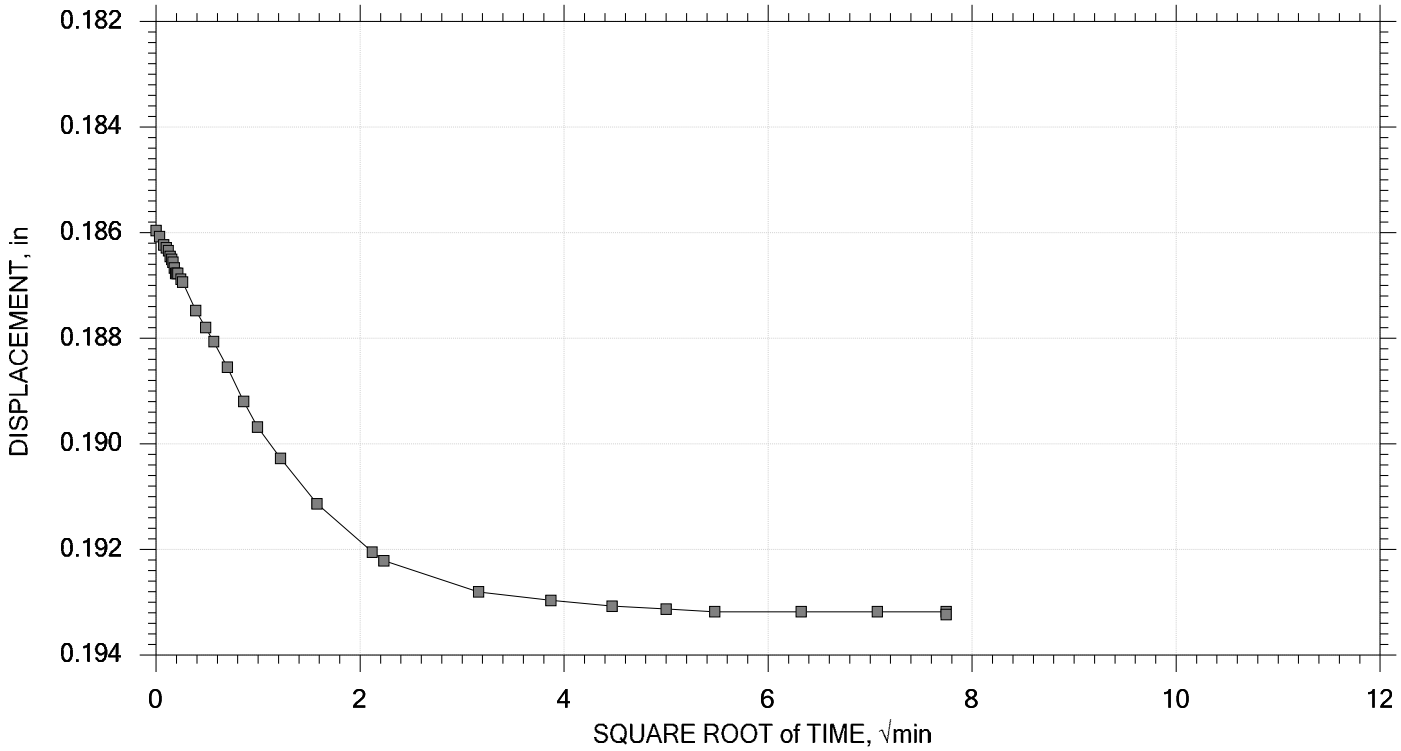
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 21

Stress: 2 tsf





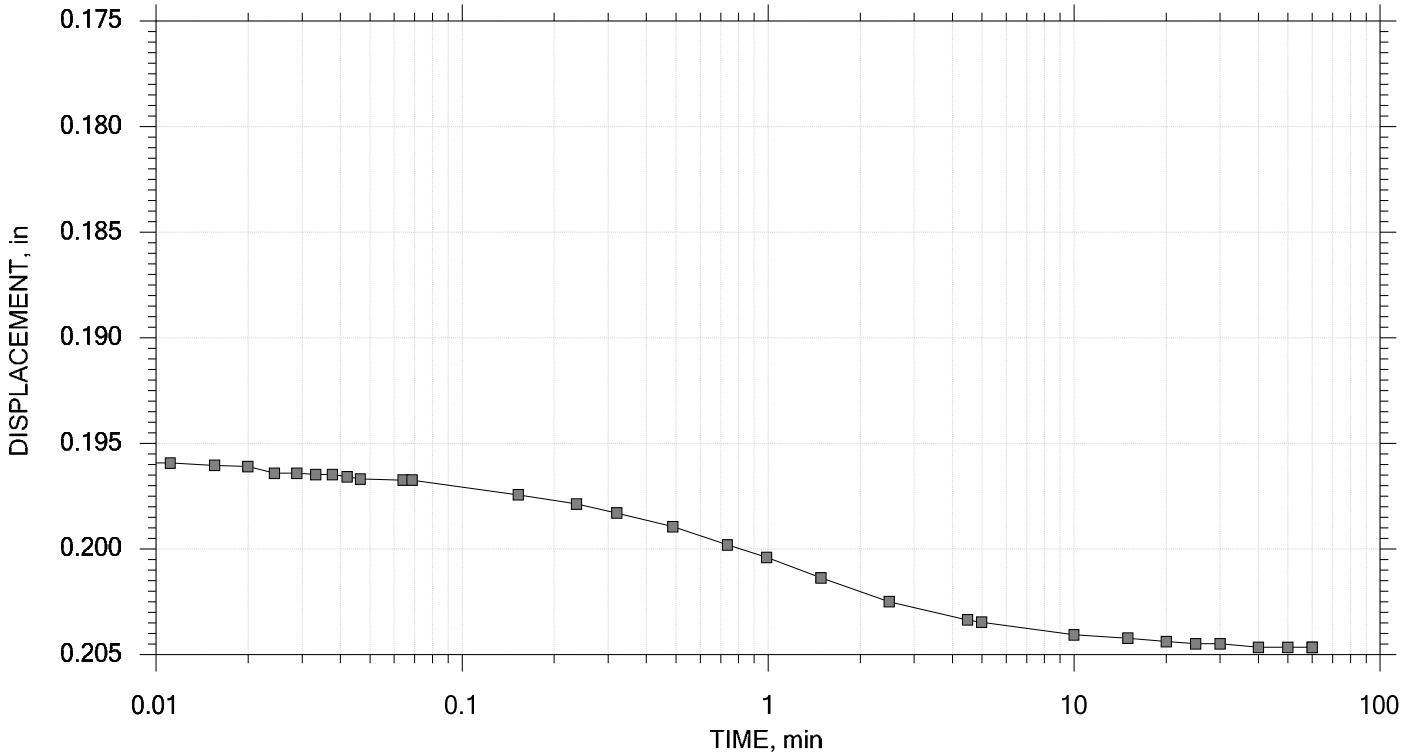
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

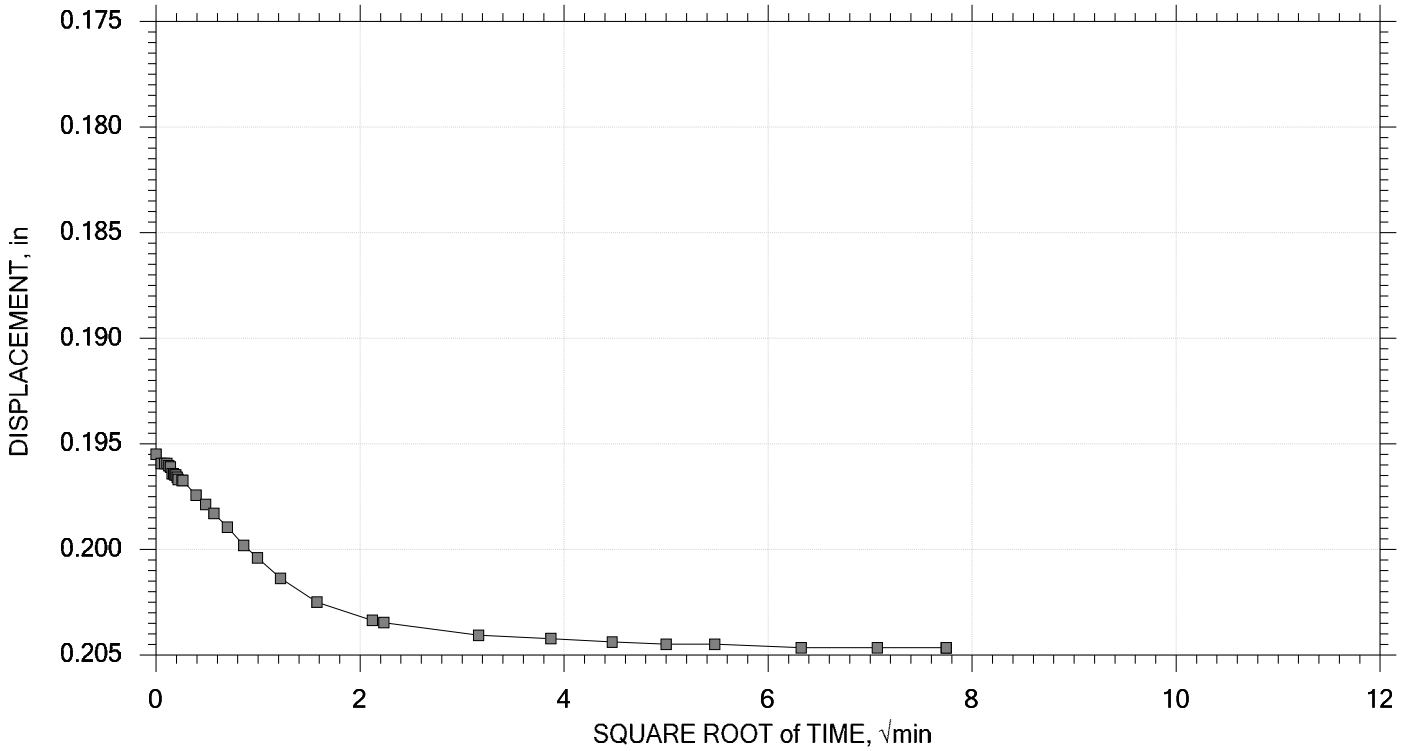
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 15 of 21

Stress: 4 tsf





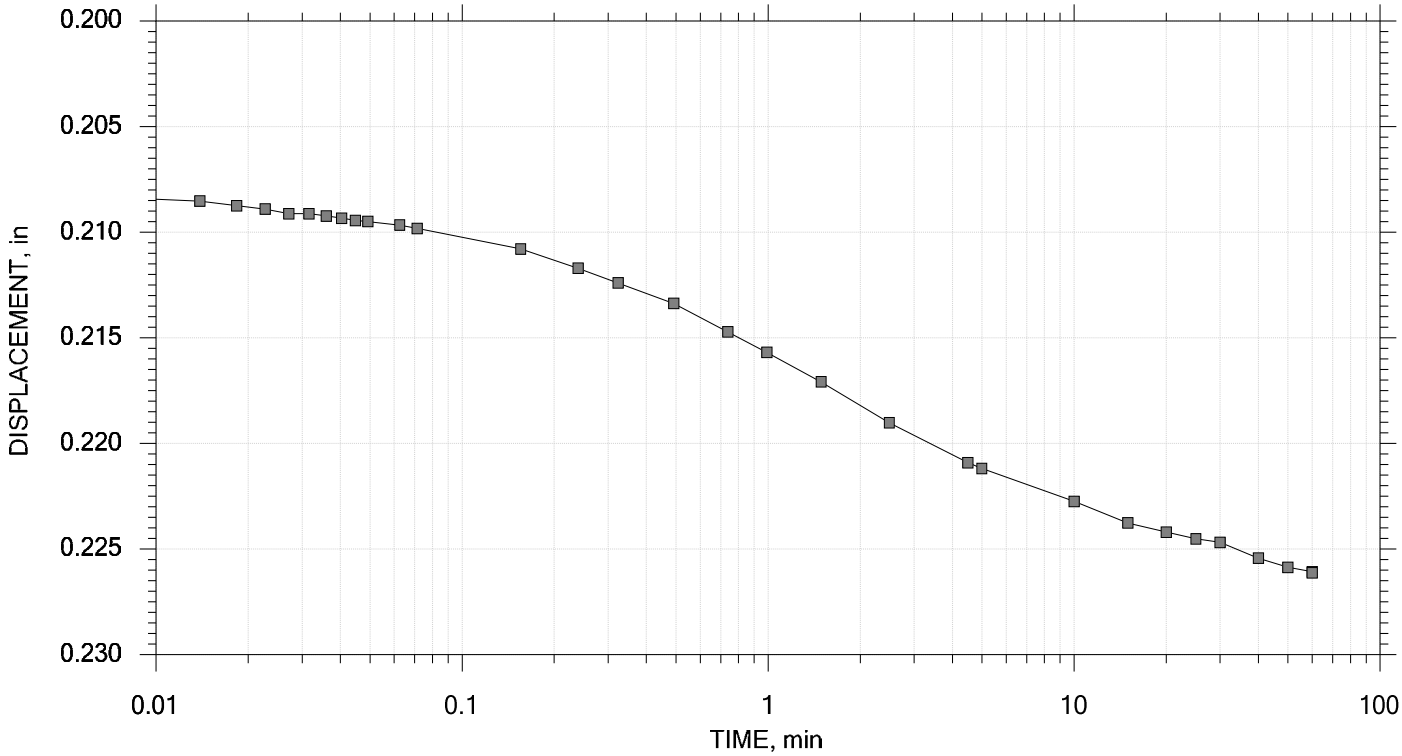
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

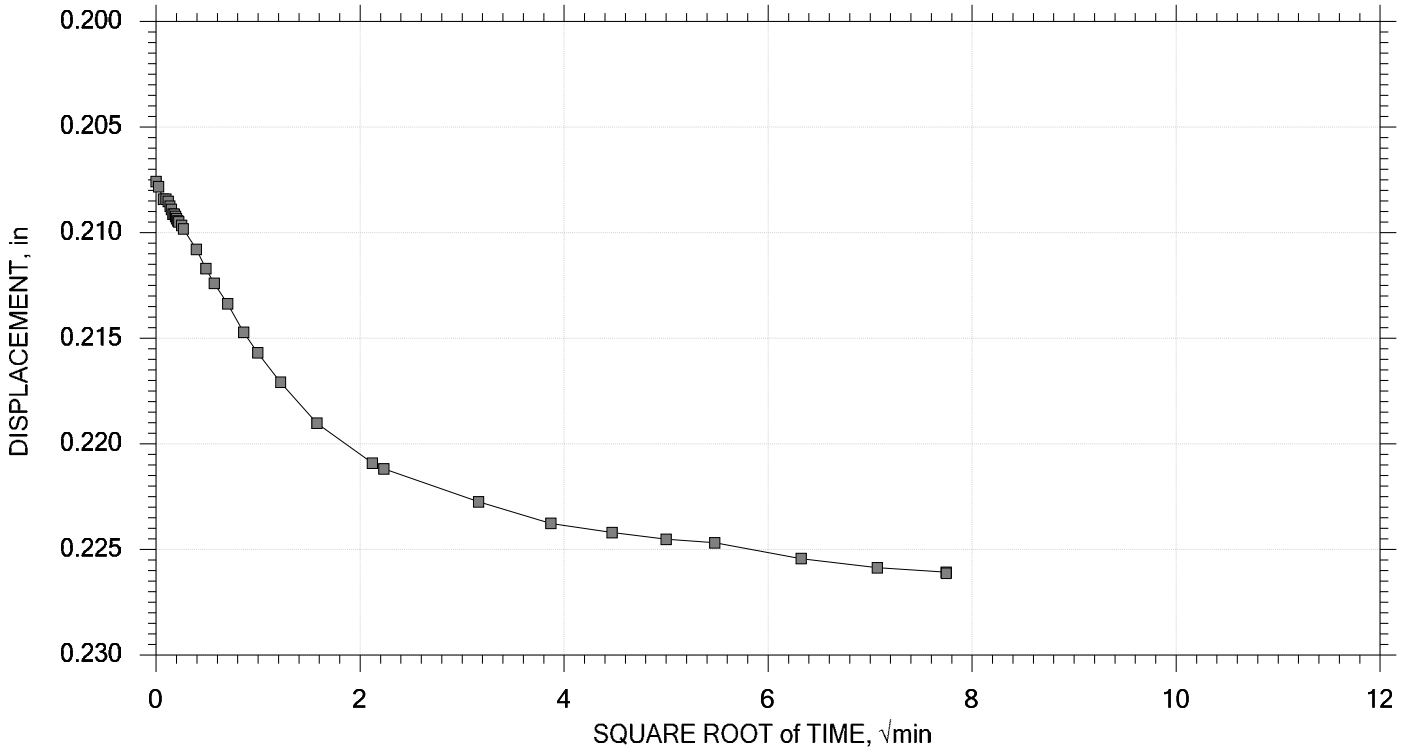
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 16 of 21

Stress: 8 tsf





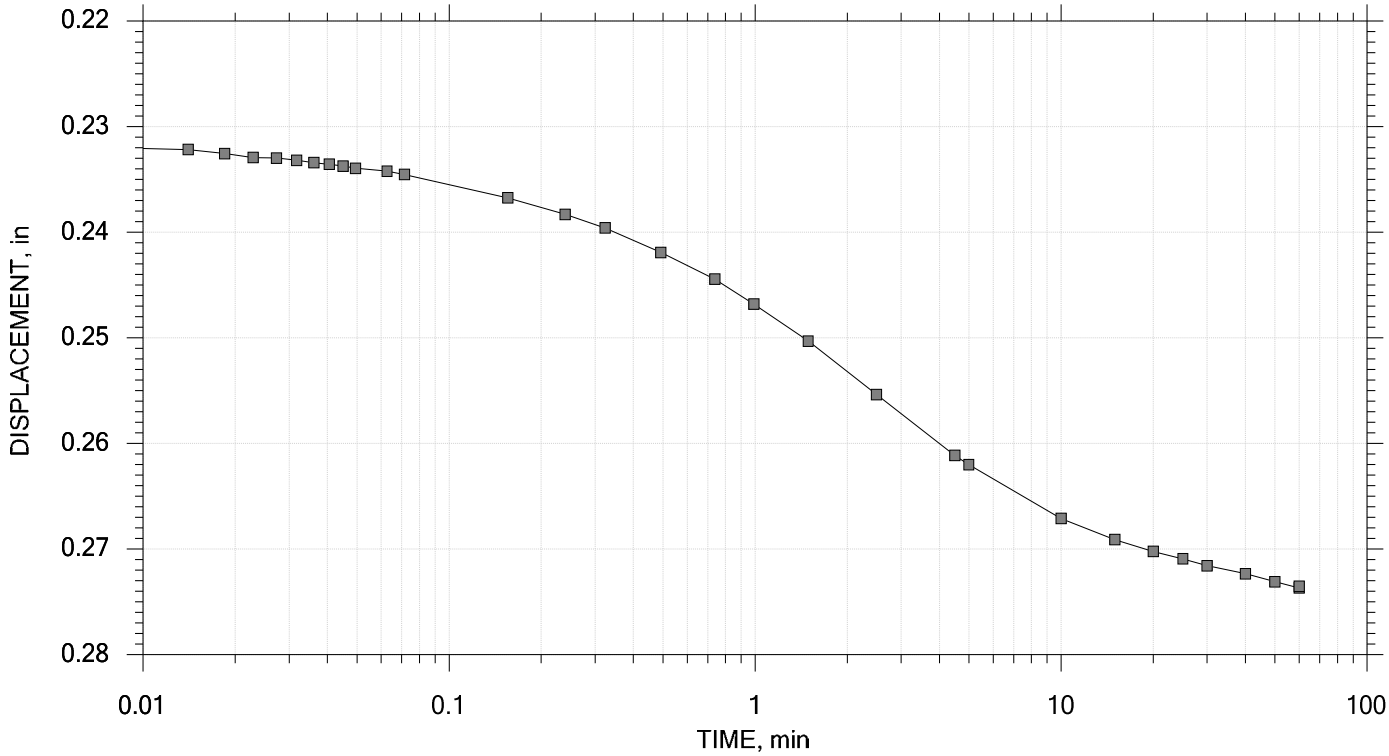
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

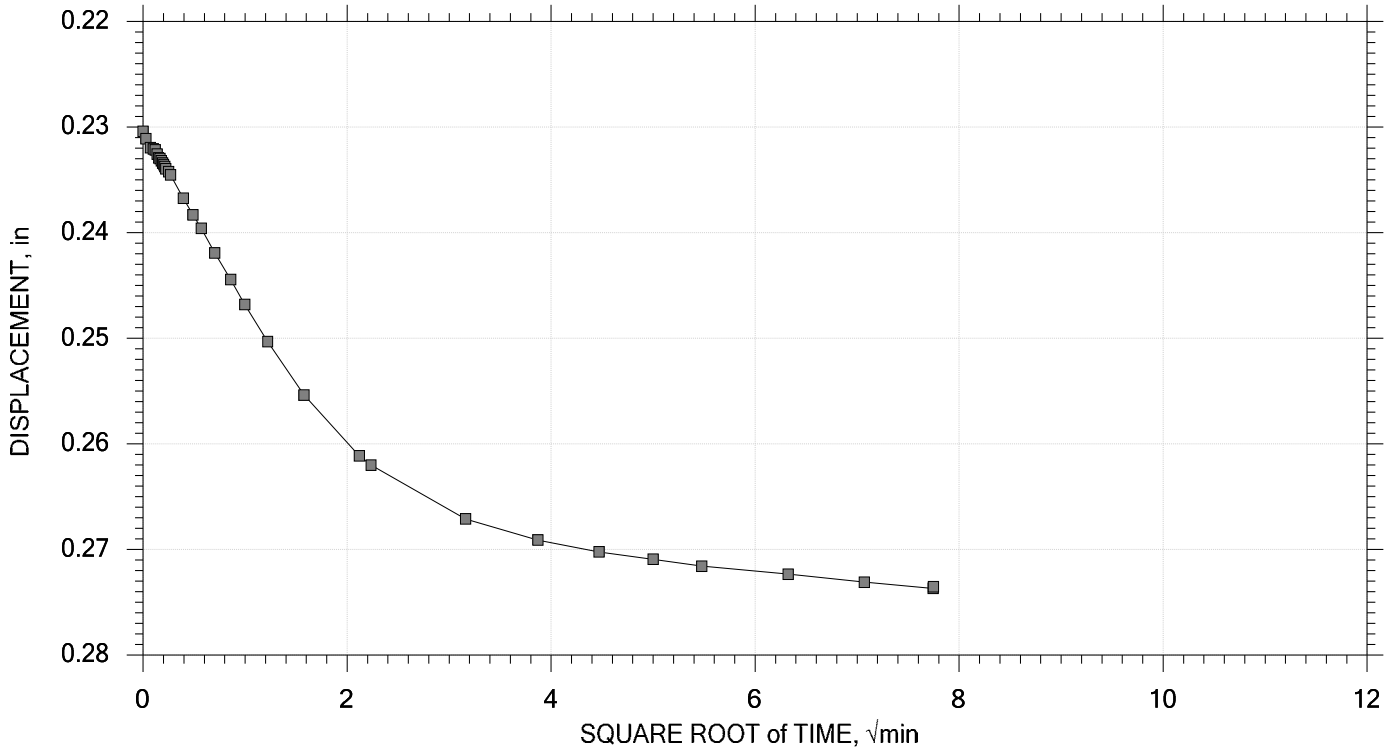
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 17 of 21

Stress: 16 tsf





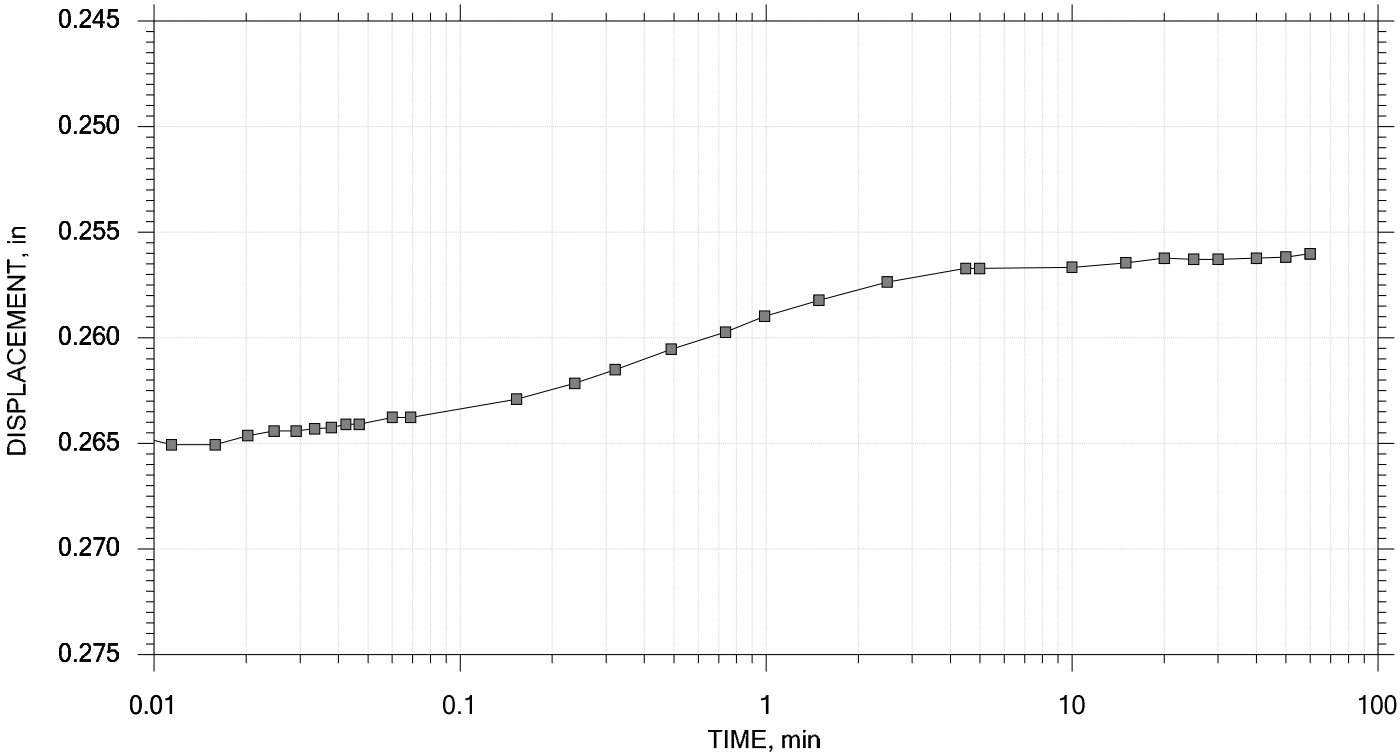
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

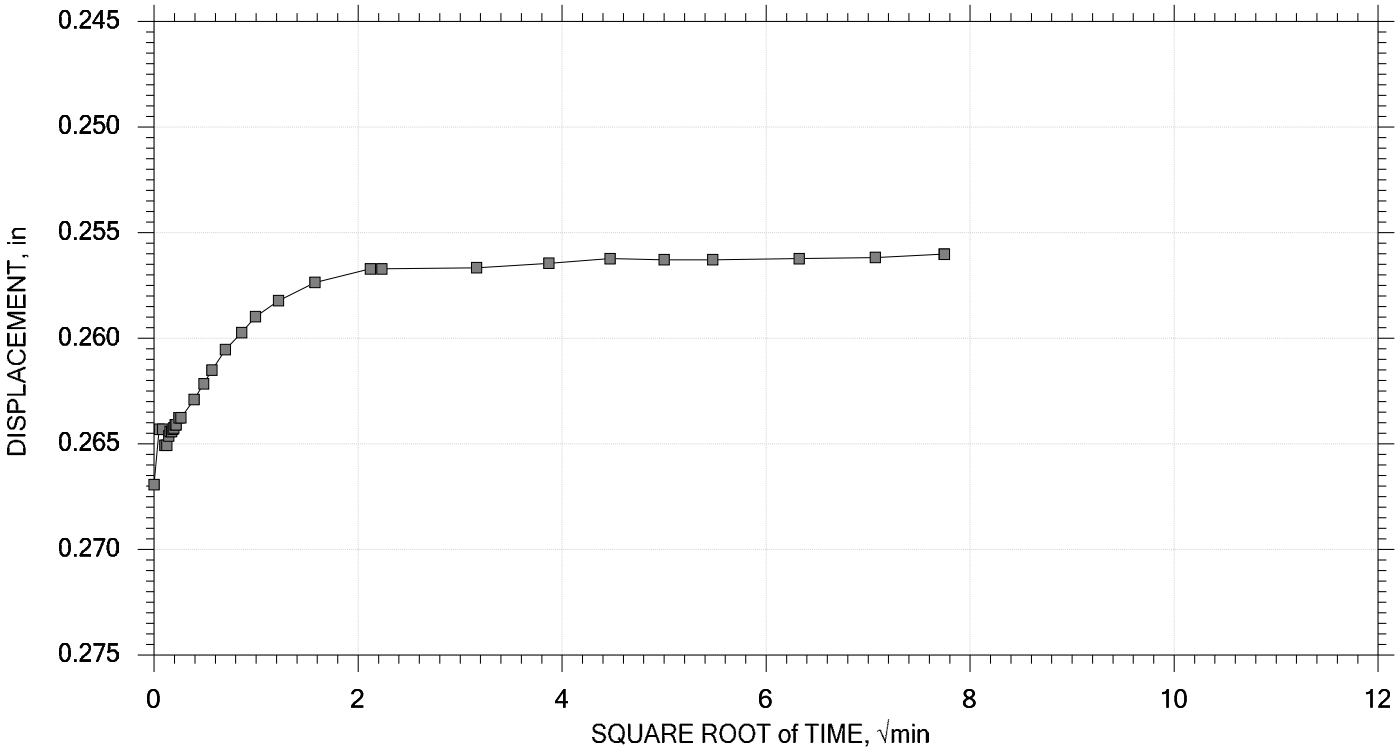
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 18 of 21

Stress: 4 tsf





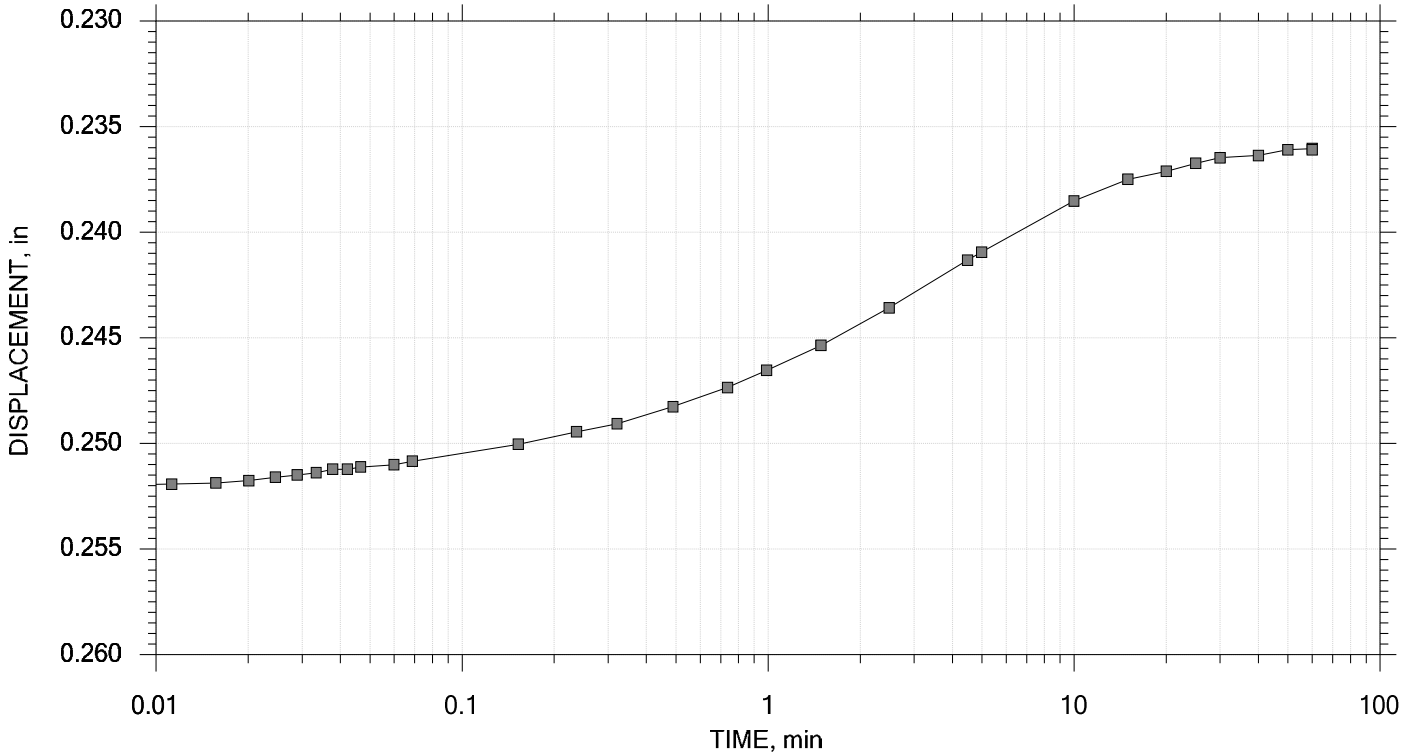
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

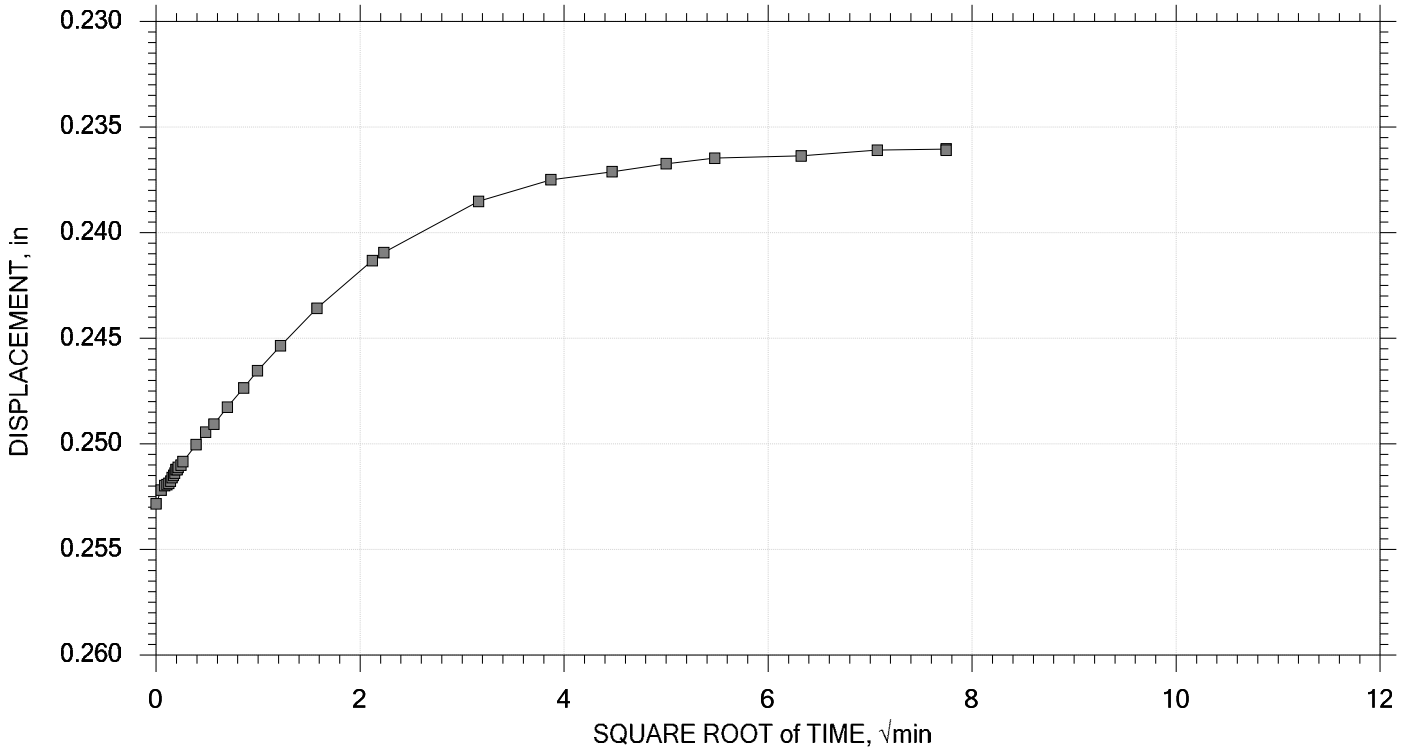
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 19 of 21

Stress: 1 tsf





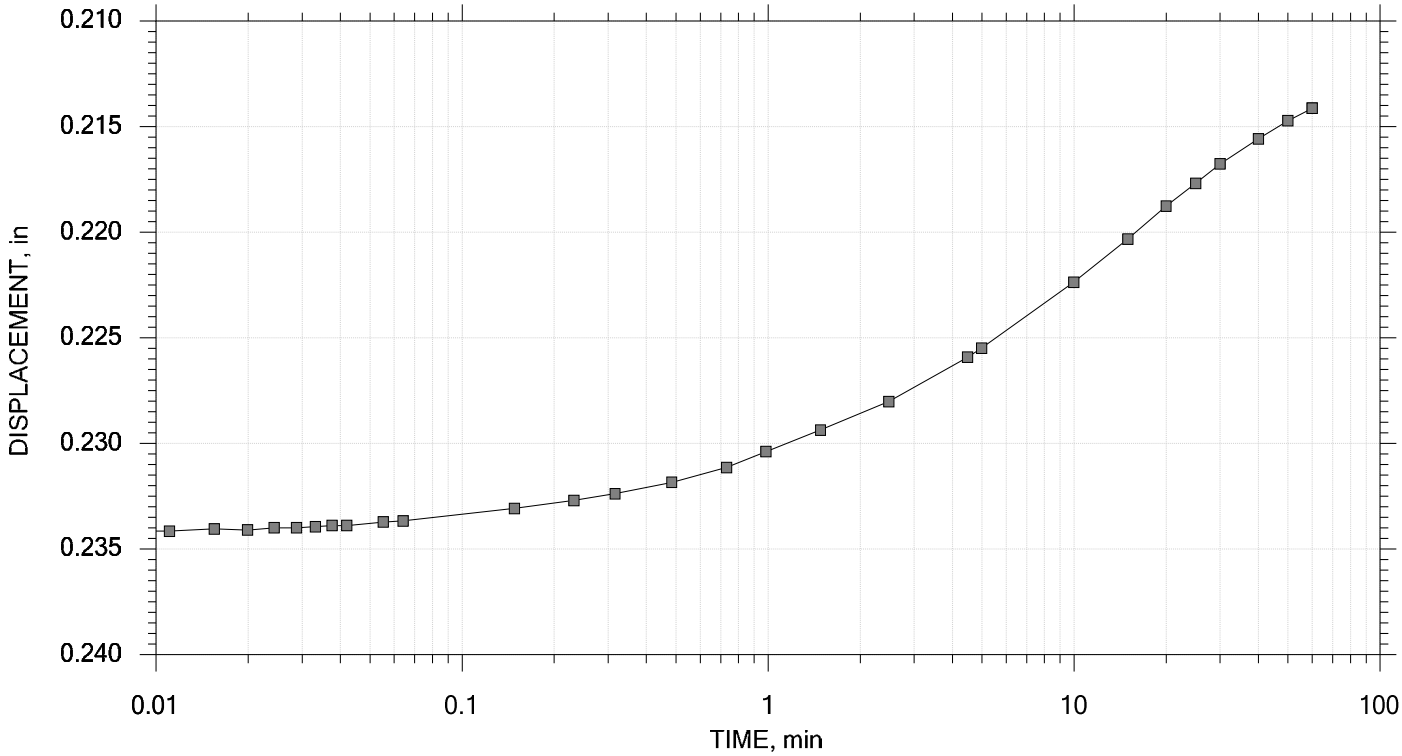
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

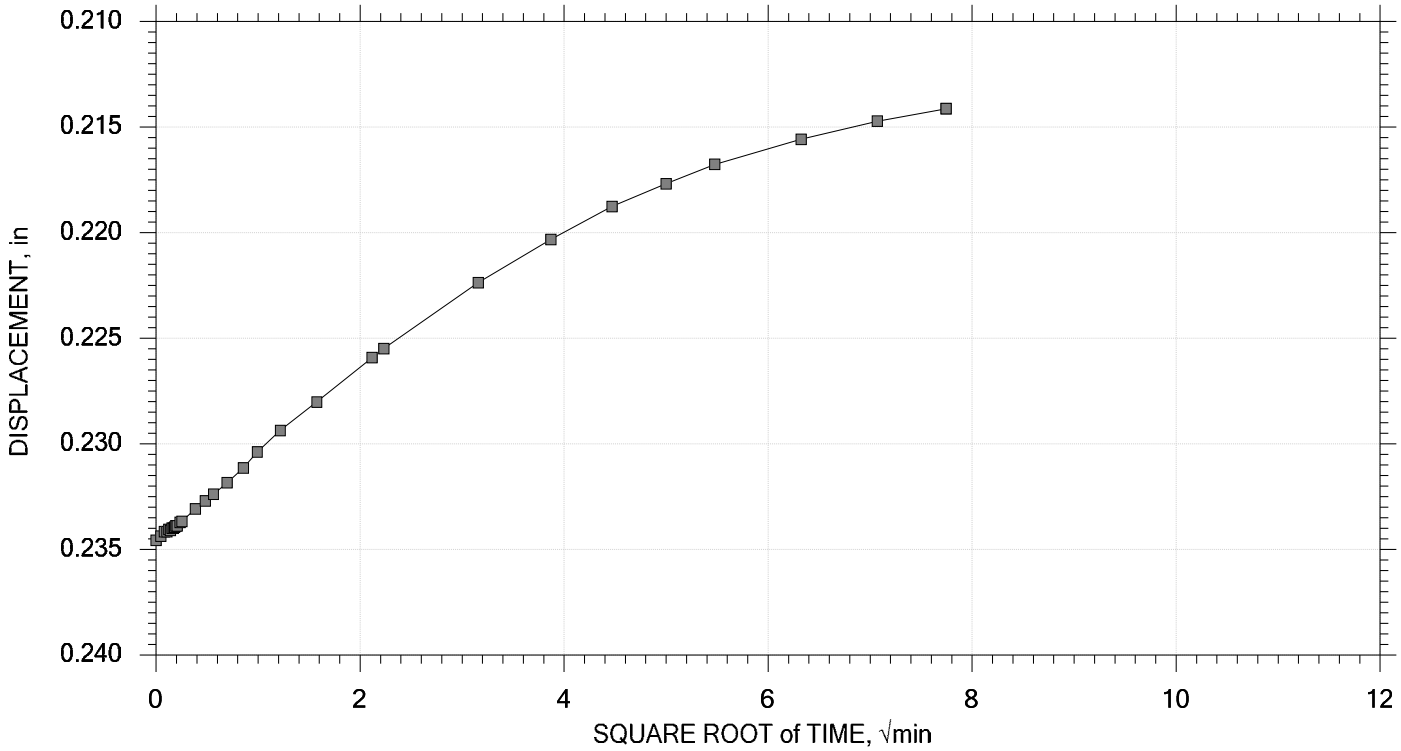
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 20 of 21

Stress: 0.25 tsf





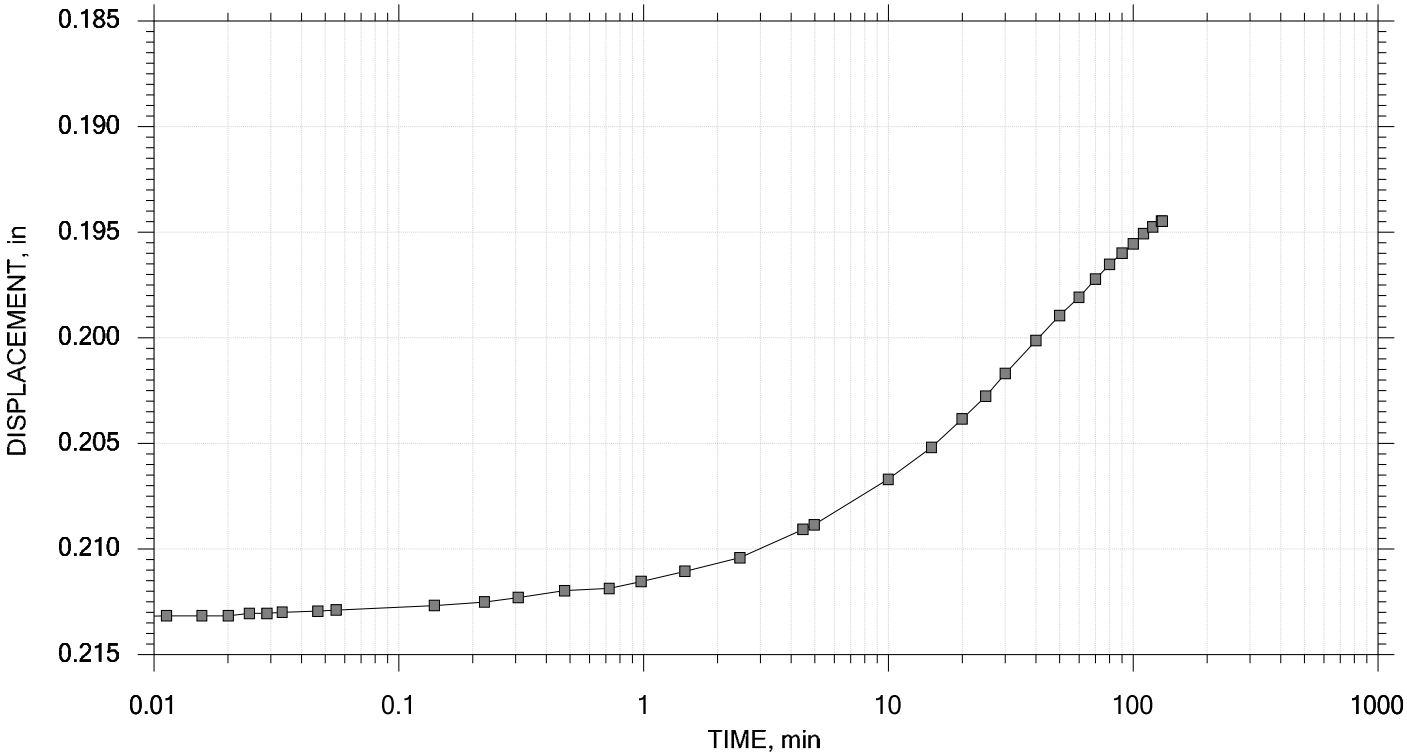
	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

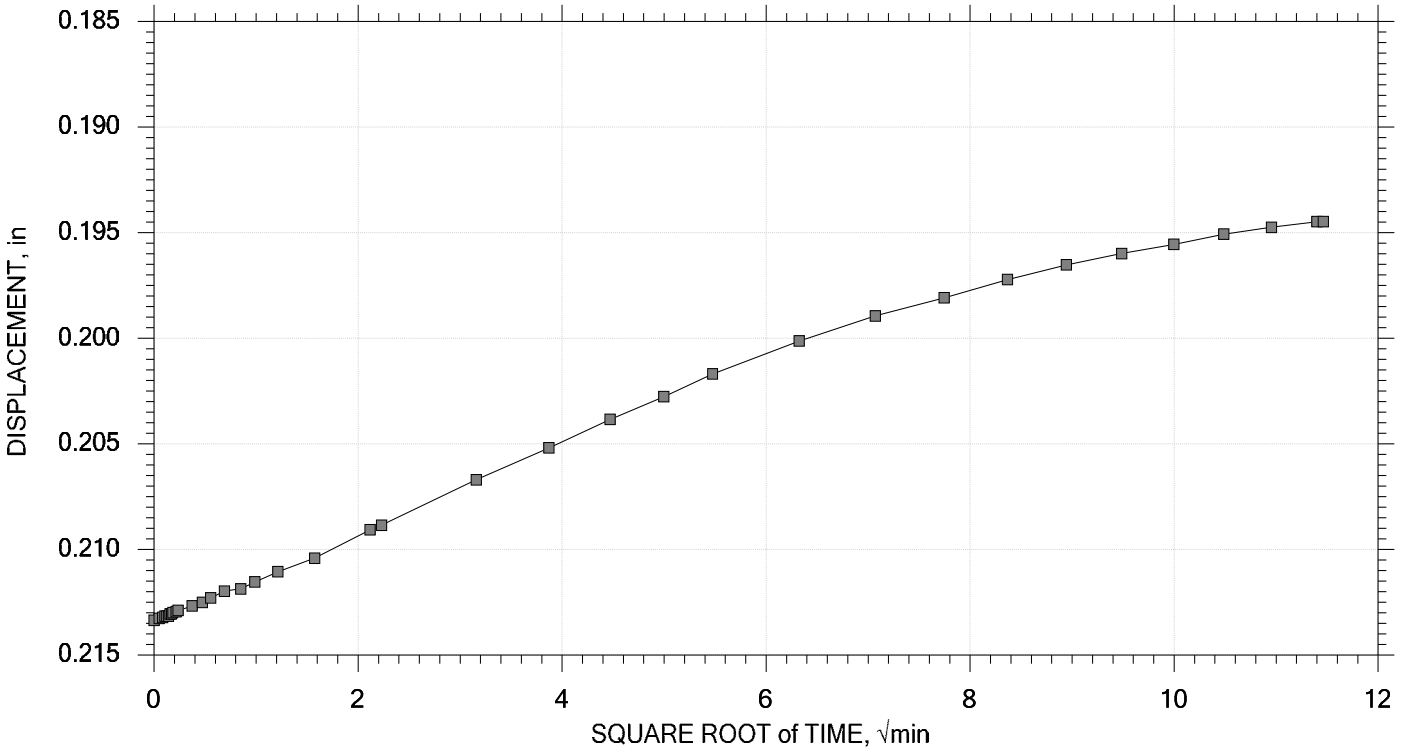
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 21 of 21

Stress: 0.0625 tsf





	Project: GORHAM	Location: --	Project No.: 018821.00
	Boring No.: HB-GBB-305	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 3/1/2018	Test No.: 303077
	Depth: 20.0-22.5	Sample Type: INTACT	Elevation: --
	Description: Medium Stiff Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM | Location: -- | Project No.: 018821.00
Boring No.: HB-GBB-305 | Tested By: GSL | Checked By: --
Sample No.: 1U | Test Date: 3/1/2018 | Depth: 20.0-22.5
Test No.: 303077 | Sample Type: INTACT | Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Measured Specific Gravity: 2.70 | Liquid Limit: 41 | Specimen Diameter: 2.50 in
Initial Void Ratio: 1.24 | Plastic Limit: 37 | Initial Height: 1.00 in
Final Void Ratio: 0.858 | Plasticity Index: 4 | Final Height: 0.83 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	57	RING	RING	46
Wt. Container + Wet Soil, gm	145.51	402.45	389.50	164.35
Wt. Container + Dry Soil, gm	119.73	358.76	358.76	133.66
Wt. Container, gm	61.630	262.00	262.00	37.070
Wt. Dry Soil, gm	58.100	96.757	96.757	96.590
Water Content, %	44.37	45.16	31.77	31.77
Void Ratio	---	1.24	0.858	---
Degree of Saturation, %	---	98.49	100.00	---
Dry Unit Weight, pcf	---	75.317	90.725	---

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM | Location: -- | Project No.: 018821.00
Boring No.: HB-GBB-305 | Tested By: GSL | Checked By: --
Sample No.: 1U | Test Date: 3/1/2018 | Depth: 20.0-22.5
Test No.: 303077 | Sample Type: INTACT | Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/sec	Mv 1/tsf	k ft/day
1	0.0676	0.009045	1.22	0.904	1.943	1.25e-005	1.34e-001	4.52e-003
2	0.125	0.01249	1.21	1.25	1.455	1.65e-005	6.00e-002	2.67e-003
3	0.250	0.01653	1.20	1.65	1.467	1.63e-005	3.23e-002	1.42e-003
4	0.500	0.02229	1.19	2.23	1.494	1.58e-005	2.30e-002	9.83e-004
5	1.00	0.03053	1.17	3.05	3.818	6.10e-006	1.65e-002	2.71e-004
6	2.00	0.05546	1.11	5.54	9.031	2.49e-006	2.49e-002	1.67e-004
7	4.00	0.1392	0.927	13.9	18.637	1.08e-006	4.18e-002	1.21e-004
8	8.00	0.2133	0.761	21.3	14.429	1.16e-006	1.85e-002	5.78e-005
9	4.00	0.2070	0.775	20.7	0.543	2.83e-005	1.59e-003	1.21e-004
10	2.00	0.1991	0.793	19.9	2.461	6.35e-006	3.93e-003	6.72e-005
11	1.00	0.1893	0.815	18.9	6.072	2.63e-006	9.79e-003	6.94e-005
12	0.500	0.1797	0.836	17.9	13.091	1.25e-006	1.93e-002	6.49e-005
13	1.00	0.1846	0.825	18.4	3.302	4.98e-006	9.79e-003	1.32e-004
14	2.00	0.1932	0.806	19.3	3.079	5.26e-006	8.66e-003	1.23e-004
15	4.00	0.2046	0.780	20.4	3.615	4.37e-006	5.70e-003	6.71e-005
16	8.00	0.2261	0.732	22.6	4.285	3.53e-006	5.37e-003	5.11e-005
17	16.0	0.2735	0.626	27.3	6.903	2.01e-006	5.92e-003	3.20e-005
18	4.00	0.2560	0.666	25.6	3.174	4.19e-006	1.46e-003	1.65e-005
19	1.00	0.2361	0.710	23.6	6.238	2.24e-006	6.63e-003	4.01e-005
20	0.250	0.2141	0.759	21.4	26.005	5.68e-007	2.93e-002	4.48e-005
21	0.0625	0.1945	0.803	19.4	89.998	1.73e-007	1.05e-001	4.89e-005

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/sec	Mv 1/tsf	k ft/day	Ca %
1	0.0676	0.009045	1.22	0.904	0.000	0.00e+000	1.34e-001	0.00e+000	0.00e+000
2	0.125	0.01249	1.21	1.25	0.000	0.00e+000	6.00e-002	0.00e+000	0.00e+000
3	0.250	0.01653	1.20	1.65	0.344	1.61e-005	3.23e-002	1.40e-003	0.00e+000
4	0.500	0.02229	1.19	2.23	0.351	1.56e-005	2.30e-002	9.71e-004	0.00e+000
5	1.00	0.03053	1.17	3.05	0.481	1.12e-005	1.65e-002	4.99e-004	0.00e+000
6	2.00	0.05546	1.11	5.54	0.000	0.00e+000	2.49e-002	0.00e+000	0.00e+000
7	4.00	0.1392	0.927	13.9	0.000	0.00e+000	4.18e-002	0.00e+000	0.00e+000
8	8.00	0.2133	0.761	21.3	2.500	1.55e-006	1.85e-002	7.75e-005	0.00e+000
9	4.00	0.2070	0.775	20.7	0.000	0.00e+000	1.59e-003	0.00e+000	0.00e+000
10	2.00	0.1991	0.793	19.9	0.000	0.00e+000	3.93e-003	0.00e+000	0.00e+000
11	1.00	0.1893	0.815	18.9	1.150	3.23e-006	9.79e-003	8.52e-005	0.00e+000
12	0.500	0.1797	0.836	17.9	4.485	8.47e-007	1.93e-002	4.40e-005	0.00e+000
13	1.00	0.1846	0.825	18.4	0.892	4.28e-006	9.79e-003	1.13e-004	0.00e+000
14	2.00	0.1932	0.806	19.3	0.679	5.53e-006	8.66e-003	1.29e-004	0.00e+000
15	4.00	0.2046	0.780	20.4	0.739	4.96e-006	5.70e-003	7.63e-005	0.00e+000
16	8.00	0.2261	0.732	22.6	1.032	3.41e-006	5.37e-003	4.93e-005	0.00e+000
17	16.0	0.2735	0.626	27.3	1.197	2.69e-006	5.92e-003	4.29e-005	0.00e+000
18	4.00	0.2560	0.666	25.6	0.393	7.86e-006	1.46e-003	3.09e-005	0.00e+000
19	1.00	0.2361	0.710	23.6	1.947	1.67e-006	6.63e-003	2.99e-005	0.00e+000
20	0.250	0.2141	0.759	21.4	0.000	0.00e+000	2.93e-002	0.00e+000	0.00e+000
21	0.0625	0.1945	0.803	19.4	0.000	0.00e+000	1.05e-001	0.00e+000	0.00e+000

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 1 of 21
Applied Stress: 0.0676 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.242		0.0221	0.0000	0.0000	0.000	1.24
2	-0.238		0.0221	0.0000	0.0000	0.000	1.24
3	-0.233		0.0221	0.0000	5.384e-005	0.00538	1.24
4	-0.229		0.0221	0.0000	5.384e-005	0.00538	1.24
5	-0.224		0.0221	0.0000	0.0001615	0.0161	1.24
6	-0.220		0.0221	0.0000	0.0002692	0.0269	1.24
7	-0.215		0.0221	0.0000	0.0003230	0.0323	1.24
8	-0.211		0.0236	0.0000	0.0003769	0.0377	1.24
9	-0.207		0.0236	0.0000	0.0004846	0.0484	1.24
10	-0.202		0.0236	0.0000	0.0005384	0.0538	1.24
11	-0.198		0.0236	0.0000	0.0006461	0.0645	1.24
12	-0.193		0.0251	0.0000	0.0007538	0.0753	1.24
13	-0.189		0.0251	0.0000	0.0008614	0.0861	1.24
14	-0.185		0.0251	0.0000	0.001077	0.108	1.24
15	-0.180		0.0251	0.0000	0.001184	0.118	1.24
16	-0.167		0.0266	0.0000	0.001615	0.161	1.23
17	-0.158		0.0281	0.0000	0.001992	0.199	1.23
18	-0.074		0.0509	0.0000	0.006461	0.645	1.22
19	0.000	0.000	0.0563	0.0000	0.007599	0.759	1.22
20	0.010	0.100	0.0570	0.0000	0.007753	0.775	1.22
21	0.094	0.306	0.0570	0.0000	0.008022	0.801	1.22
22	0.262	0.512	0.0600	0.0000	0.008399	0.839	1.22
23	0.509	0.714	0.0600	0.0000	0.008561	0.855	1.22
24	0.761	0.873	0.0615	0.0000	0.008614	0.861	1.22
25	1.261	1.123	0.0615	0.0000	0.008722	0.871	1.22
26	2.260	1.503	0.0615	0.0000	0.008776	0.877	1.22
27	4.262	2.064	0.0615	0.0000	0.008722	0.871	1.22
28	4.761	2.182	0.0615	0.0000	0.008722	0.871	1.22
29	9.760	3.124	0.0615	0.0000	0.008830	0.882	1.22
30	14.759	3.842	0.0615	0.0000	0.008830	0.882	1.22
31	19.758	4.445	0.0630	0.0000	0.008830	0.882	1.22
32	24.761	4.976	0.0661	0.0000	0.008884	0.887	1.22
33	29.760	5.455	0.0646	0.0000	0.008937	0.893	1.22
34	39.758	6.305	0.0661	0.0000	0.009045	0.904	1.22
35	49.760	7.054	0.0676	0.0000	0.009045	0.904	1.22
36	59.758	7.730	0.0676	0.0000	0.009045	0.904	1.22
37	59.767	7.731	0.0676	0.0000	0.009045	0.904	1.22

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 2 of 21
Applied Stress: 0.125 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.078		0.0661	0.0000	0.009045	0.904	1.22
2	-0.074		0.0661	0.0000	0.009045	0.904	1.22
3	-0.069		0.0691	0.0000	0.009099	0.909	1.22
4	-0.065		0.0722	0.0000	0.009153	0.914	1.22
5	-0.060		0.0737	0.0000	0.009207	0.920	1.22
6	-0.056		0.0782	0.0000	0.009261	0.925	1.22
7	-0.052		0.0813	0.0000	0.009368	0.936	1.22
8	-0.047		0.0843	0.0000	0.009476	0.947	1.22
9	-0.043		0.0873	0.0000	0.009637	0.963	1.22
10	-0.038		0.0889	0.0000	0.009745	0.974	1.22
11	-0.034		0.0934	0.0000	0.009799	0.979	1.22
12	-0.030		0.0964	0.0000	0.009960	0.995	1.22
13	-0.025		0.0995	0.0000	0.01001	1.00	1.22
14	-0.021		0.107	0.0000	0.01023	1.02	1.22
15	-0.016		0.107	0.0000	0.01023	1.02	1.22
16	-0.003		0.116	0.0000	0.01071	1.07	1.21
17	0.000	0.000	0.119	0.0000	0.01079	1.08	1.21
18	0.006	0.076	0.124	0.0000	0.01093	1.09	1.21
19	0.090	0.300	0.122	0.0000	0.01141	1.14	1.21
20	0.174	0.417	0.124	0.0000	0.01163	1.16	1.21
21	0.258	0.508	0.124	0.0000	0.01168	1.17	1.21
22	0.426	0.653	0.125	0.0000	0.01184	1.18	1.21
23	0.673	0.821	0.125	0.0000	0.01201	1.20	1.21
24	0.925	0.962	0.125	0.0000	0.01201	1.20	1.21
25	1.425	1.194	0.125	0.0000	0.01211	1.21	1.21
26	2.424	1.557	0.125	0.0000	0.01222	1.22	1.21
27	4.426	2.104	0.125	0.0000	0.01228	1.23	1.21
28	4.925	2.219	0.125	0.0000	0.01233	1.23	1.21
29	9.924	3.150	0.125	0.0000	0.01238	1.24	1.21
30	14.923	3.863	0.125	0.0000	0.01244	1.24	1.21
31	19.926	4.464	0.125	0.0000	0.01249	1.25	1.21
32	24.925	4.993	0.125	0.0000	0.01244	1.24	1.21
33	29.924	5.470	0.125	0.0000	0.01244	1.24	1.21
34	39.922	6.318	0.125	0.0000	0.01249	1.25	1.21
35	49.924	7.066	0.125	0.0000	0.01249	1.25	1.21
36	59.922	7.741	0.125	0.0000	0.01249	1.25	1.21
37	59.931	7.742	0.125	0.0000	0.01249	1.25	1.21

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 3 of 21
Applied Stress: 0.250 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.054		0.125	0.0000	0.01249	1.25	1.21
2	-0.050		0.125	0.0000	0.01249	1.25	1.21
3	-0.045		0.140	0.0000	0.01260	1.26	1.21
4	-0.041		0.140	0.0000	0.01260	1.26	1.21
5	-0.036		0.154	0.0000	0.01271	1.27	1.21
6	-0.032		0.163	0.0000	0.01287	1.29	1.21
7	-0.028		0.172	0.0000	0.01303	1.30	1.21
8	-0.023		0.184	0.0000	0.01324	1.32	1.21
9	-0.019		0.197	0.0000	0.01341	1.34	1.21
10	-0.014		0.207	0.0000	0.01362	1.36	1.21
11	-0.010		0.225	0.0000	0.01394	1.39	1.21
12	-0.005		0.225	0.0000	0.01394	1.39	1.21
13	-0.001		0.236	0.0000	0.01416	1.41	1.21
14	0.000	0.000	0.238	0.0000	0.01418	1.42	1.21
15	0.003	0.058	0.242	0.0000	0.01427	1.43	1.21
16	0.008	0.088	0.242	0.0000	0.01454	1.45	1.21
17	0.021	0.145	0.235	0.0000	0.01454	1.45	1.21
18	0.030	0.173	0.235	0.0000	0.01454	1.45	1.21
19	0.114	0.337	0.244	0.0000	0.01497	1.50	1.20
20	0.198	0.445	0.247	0.0000	0.01518	1.52	1.20
21	0.282	0.531	0.248	0.0000	0.01524	1.52	1.20
22	0.450	0.671	0.250	0.0000	0.01540	1.54	1.20
23	0.697	0.835	0.250	0.0000	0.01561	1.56	1.20
24	0.949	0.974	0.250	0.0000	0.01572	1.57	1.20
25	1.449	1.204	0.250	0.0000	0.01588	1.59	1.20
26	2.448	1.564	0.250	0.0000	0.01604	1.60	1.20
27	4.450	2.109	0.250	0.0000	0.01615	1.61	1.20
28	4.949	2.225	0.250	0.0000	0.01621	1.62	1.20
29	9.948	3.154	0.250	0.0000	0.01631	1.63	1.20
30	14.947	3.866	0.250	0.0000	0.01631	1.63	1.20
31	19.946	4.466	0.250	0.0000	0.01642	1.64	1.20
32	24.949	4.995	0.250	0.0000	0.01642	1.64	1.20
33	29.948	5.473	0.250	0.0000	0.01642	1.64	1.20
34	39.946	6.320	0.250	0.0000	0.01648	1.65	1.20
35	49.948	7.067	0.250	0.0000	0.01648	1.65	1.20
36	59.946	7.742	0.250	0.0000	0.01653	1.65	1.20
37	59.964	7.744	0.250	0.0000	0.01653	1.65	1.20

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 4 of 21
Applied Stress: 0.500 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.038		0.250	0.0000	0.01653	1.65	1.20
2	-0.034		0.263	0.0000	0.01658	1.66	1.20
3	-0.030		0.295	0.0000	0.01685	1.68	1.20
4	-0.025		0.295	0.0000	0.01685	1.68	1.20
5	-0.021		0.353	0.0000	0.01739	1.74	1.20
6	-0.016		0.353	0.0000	0.01739	1.74	1.20
7	-0.012		0.411	0.0000	0.01793	1.79	1.20
8	-0.008		0.411	0.0000	0.01793	1.79	1.20
9	-0.003		0.446	0.0000	0.01836	1.83	1.20
10	0.000	0.000	0.475	0.0000	0.01867	1.86	1.20
11	0.001	0.035	0.487	0.0000	0.01879	1.88	1.20
12	0.006	0.075	0.506	0.0000	0.01906	1.90	1.20
13	0.010	0.100	0.506	0.0000	0.01906	1.90	1.20
14	0.015	0.120	0.477	0.0000	0.01911	1.91	1.20
15	0.019	0.138	0.474	0.0000	0.01917	1.91	1.20
16	0.023	0.153	0.474	0.0000	0.01917	1.91	1.20
17	0.041	0.203	0.484	0.0000	0.01927	1.93	1.19
18	0.045	0.213	0.488	0.0000	0.01933	1.93	1.19
19	0.129	0.360	0.497	0.0000	0.01981	1.98	1.19
20	0.213	0.462	0.496	0.0000	0.02003	2.00	1.19
21	0.297	0.545	0.500	0.0000	0.02019	2.02	1.19
22	0.465	0.682	0.499	0.0000	0.02046	2.04	1.19
23	0.713	0.844	0.500	0.0000	0.02073	2.07	1.19
24	0.965	0.982	0.502	0.0000	0.02089	2.09	1.19
25	1.464	1.210	0.502	0.0000	0.02121	2.12	1.19
26	2.463	1.569	0.502	0.0000	0.02148	2.15	1.19
27	4.465	2.113	0.502	0.0000	0.02164	2.16	1.19
28	4.965	2.228	0.502	0.0000	0.02175	2.17	1.19
29	9.964	3.157	0.502	0.0000	0.02191	2.19	1.19
30	14.963	3.868	0.502	0.0000	0.02191	2.19	1.19
31	19.966	4.468	0.500	0.0000	0.02202	2.20	1.19
32	24.965	4.996	0.502	0.0000	0.02207	2.21	1.19
33	29.964	5.474	0.502	0.0000	0.02213	2.21	1.19
34	39.962	6.322	0.502	0.0000	0.02224	2.22	1.19
35	49.964	7.069	0.502	0.0000	0.02229	2.23	1.19
36	59.962	7.744	0.502	0.0000	0.02229	2.23	1.19
37	59.993	7.746	0.502	0.0000	0.02229	2.23	1.19

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Boring No.: HB-GBB-305
Sample No.: 1U
Test No.: 303077

Location: --
Tested By: GSL
Test Date: 3/1/2018
Sample Type: INTACT

Project No.: 018821.00
Checked By: --
Depth: 20.0-22.5
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 5 of 21
Applied Stress: 1.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.051		0.502	0.0000	0.02229	2.23	1.19
2	-0.047		0.502	0.0000	0.02229	2.23	1.19
3	-0.043		0.590	0.0000	0.02251	2.25	1.19
4	-0.038		0.684	0.0000	0.02288	2.29	1.19
5	-0.034		0.760	0.0000	0.02326	2.32	1.19
6	-0.029		0.827	0.0000	0.02364	2.36	1.19
7	-0.025		0.887	0.0000	0.02401	2.40	1.18
8	-0.021		0.942	0.0000	0.02444	2.44	1.18
9	-0.016		0.942	0.0000	0.02444	2.44	1.18
10	-0.012		0.942	0.0000	0.02444	2.44	1.18
11	-0.007		0.942	0.0000	0.02444	2.44	1.18
12	-0.003		0.942	0.0000	0.02444	2.44	1.18
13	0.000	0.000	0.950	0.0000	0.02498	2.50	1.18
14	0.002	0.039	0.954	0.0000	0.02525	2.52	1.18
15	0.006	0.077	0.968	0.0000	0.02541	2.54	1.18
16	0.010	0.102	0.968	0.0000	0.02541	2.54	1.18
17	0.024	0.154	0.994	0.0000	0.02563	2.56	1.18
18	0.032	0.180	1.00	0.0000	0.02584	2.58	1.18
19	0.116	0.341	0.992	0.0000	0.02633	2.63	1.18
20	0.200	0.448	0.991	0.0000	0.02676	2.67	1.18
21	0.284	0.533	1.00	0.0000	0.02697	2.69	1.18
22	0.452	0.673	1.00	0.0000	0.02740	2.74	1.18
23	0.700	0.837	1.00	0.0000	0.02767	2.76	1.18
24	0.952	0.976	1.00	0.0000	0.02794	2.79	1.18
25	1.451	1.205	1.00	0.0000	0.02832	2.83	1.17
26	2.450	1.565	1.00	0.0000	0.02875	2.87	1.17
27	4.452	2.110	1.00	0.0000	0.02907	2.90	1.17
28	4.952	2.225	1.00	0.0000	0.02918	2.92	1.17
29	9.951	3.154	1.00	0.0000	0.02961	2.96	1.17
30	14.950	3.866	1.00	0.0000	0.02977	2.97	1.17
31	19.949	4.466	1.00	0.0000	0.02999	3.00	1.17
32	24.952	4.995	1.00	0.0000	0.03020	3.02	1.17
33	29.951	5.473	1.00	0.0000	0.03031	3.03	1.17
34	39.949	6.320	1.00	0.0000	0.03037	3.03	1.17
35	49.951	7.068	1.00	0.0000	0.03037	3.03	1.17
36	59.949	7.743	1.00	0.0000	0.03053	3.05	1.17
37	59.980	7.745	1.00	0.0000	0.03053	3.05	1.17

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 6 of 21
Applied Stress: 2.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.026		1.00	0.0000	0.03053	3.05	1.17
2	-0.022		1.00	0.0000	0.03053	3.05	1.17
3	-0.018		1.24	0.0000	0.03112	3.11	1.17
4	-0.013		1.48	0.0000	0.03177	3.17	1.17
5	-0.009		1.64	0.0000	0.03247	3.24	1.17
6	-0.004		1.78	0.0000	0.03311	3.31	1.16
7	0.000	0.000	1.90	0.0000	0.03379	3.38	1.16
8	0.000	0.010	1.90	0.0000	0.03381	3.38	1.16
9	0.005	0.067	2.00	0.0000	0.03446	3.44	1.16
10	0.009	0.095	1.94	0.0000	0.03478	3.47	1.16
11	0.013	0.116	1.90	0.0000	0.03494	3.49	1.16
12	0.018	0.133	1.90	0.0000	0.03494	3.49	1.16
13	0.022	0.149	1.91	0.0000	0.03505	3.50	1.16
14	0.027	0.163	1.93	0.0000	0.03516	3.51	1.16
15	0.031	0.176	1.95	0.0000	0.03532	3.53	1.16
16	0.035	0.188	1.97	0.0000	0.03553	3.55	1.16
17	0.049	0.221	2.01	0.0000	0.03597	3.59	1.16
18	0.058	0.240	1.95	0.0000	0.03607	3.60	1.16
19	0.142	0.376	2.00	0.0000	0.03737	3.73	1.15
20	0.226	0.475	2.00	0.0000	0.03828	3.82	1.15
21	0.310	0.556	1.99	0.0000	0.03903	3.90	1.15
22	0.478	0.691	2.00	0.0000	0.04011	4.01	1.15
23	0.725	0.851	1.99	0.0000	0.04113	4.11	1.15
24	0.977	0.988	2.00	0.0000	0.04205	4.20	1.14
25	1.476	1.215	2.00	0.0000	0.04345	4.34	1.14
26	2.475	1.573	2.01	0.0000	0.04501	4.50	1.14
27	4.477	2.116	2.00	0.0000	0.04706	4.70	1.13
28	4.977	2.231	2.00	0.0000	0.04733	4.73	1.13
29	9.976	3.158	2.01	0.0000	0.04964	4.96	1.13
30	14.975	3.870	2.01	0.0000	0.05088	5.08	1.12
31	19.974	4.469	2.01	0.0000	0.05174	5.17	1.12
32	24.977	4.998	2.01	0.0000	0.05249	5.24	1.12
33	29.976	5.475	2.01	0.0000	0.05309	5.30	1.12
34	39.974	6.322	2.01	0.0000	0.05400	5.39	1.12
35	49.976	7.069	2.01	0.0000	0.05492	5.49	1.12
36	59.974	7.744	2.01	0.0000	0.05546	5.54	1.11
37	60.005	7.746	2.01	0.0000	0.05546	5.54	1.11

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 7 of 21
Applied Stress: 4.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.022		2.01	0.0000	0.05551	5.55	1.11
2	-0.018		2.01	0.0000	0.05551	5.55	1.11
3	-0.014		2.64	0.0000	0.05610	5.60	1.11
4	-0.009		3.21	0.0000	0.05739	5.73	1.11
5	-0.005		3.45	0.0000	0.05842	5.84	1.11
6	-0.000		3.79	0.0000	0.05933	5.93	1.11
7	0.000	0.000	3.80	0.0000	0.05939	5.93	1.11
8	0.004	0.064	3.98	0.0000	0.06025	6.02	1.10
9	0.009	0.092	3.86	0.0000	0.06079	6.07	1.10
10	0.013	0.114	3.77	0.0000	0.06089	6.08	1.10
11	0.017	0.132	3.79	0.0000	0.06116	6.11	1.10
12	0.022	0.148	3.83	0.0000	0.06143	6.14	1.10
13	0.026	0.162	3.88	0.0000	0.06181	6.17	1.10
14	0.031	0.175	3.92	0.0000	0.06208	6.20	1.10
15	0.035	0.187	3.96	0.0000	0.06235	6.23	1.10
16	0.039	0.199	3.99	0.0000	0.06262	6.26	1.10
17	0.053	0.230	3.86	0.0000	0.06310	6.30	1.10
18	0.062	0.248	3.91	0.0000	0.06342	6.34	1.10
19	0.146	0.382	3.92	0.0000	0.06612	6.60	1.09
20	0.230	0.479	4.01	0.0000	0.06805	6.80	1.09
21	0.314	0.560	3.99	0.0000	0.06962	6.95	1.08
22	0.482	0.694	4.01	0.0000	0.07225	7.22	1.08
23	0.729	0.854	4.01	0.0000	0.07532	7.52	1.07
24	0.981	0.990	4.01	0.0000	0.07801	7.79	1.06
25	1.480	1.217	4.01	0.0000	0.08238	8.23	1.05
26	2.479	1.575	4.01	0.0000	0.08911	8.90	1.04
27	4.482	2.117	4.00	0.0000	0.09853	9.84	1.02
28	4.981	2.232	4.00	0.0000	0.1005	10.0	1.01
29	9.980	3.159	4.01	0.0000	0.1134	11.3	0.984
30	14.979	3.870	4.01	0.0000	0.1210	12.1	0.967
31	19.978	4.470	4.01	0.0000	0.1256	12.5	0.957
32	24.981	4.998	4.01	0.0000	0.1290	12.9	0.950
33	29.980	5.475	4.01	0.0000	0.1317	13.2	0.943
34	39.978	6.323	4.02	0.0000	0.1353	13.5	0.935
35	49.980	7.070	4.01	0.0000	0.1373	13.7	0.931
36	59.978	7.745	4.02	0.0000	0.1392	13.9	0.927
37	60.005	7.746	4.01	0.0000	0.1392	13.9	0.927

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 8 of 21
Applied Stress: 8.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.012		4.01	0.0000	0.1392	13.9	0.927
2	-0.008		4.01	0.0000	0.1392	13.9	0.927
3	-0.003		5.51	0.0000	0.1402	14.0	0.924
4	0.000	0.000	7.60	0.0000	0.1427	14.3	0.919
5	0.001	0.031	8.17	0.0000	0.1434	14.3	0.917
6	0.005	0.073	8.17	0.0000	0.1434	14.3	0.917
7	0.010	0.099	7.68	0.0000	0.1436	14.3	0.917
8	0.014	0.119	7.71	0.0000	0.1439	14.4	0.916
9	0.019	0.136	7.81	0.0000	0.1443	14.4	0.915
10	0.023	0.152	7.88	0.0000	0.1446	14.4	0.915
11	0.027	0.166	8.00	0.0000	0.1452	14.5	0.913
12	0.032	0.179	8.00	0.0000	0.1452	14.5	0.913
13	0.036	0.191	8.03	0.0000	0.1455	14.5	0.913
14	0.041	0.202	7.84	0.0000	0.1456	14.5	0.912
15	0.045	0.212	7.83	0.0000	0.1457	14.6	0.912
16	0.050	0.223	7.92	0.0000	0.1461	14.6	0.911
17	0.067	0.259	8.03	0.0000	0.1469	14.7	0.910
18	0.072	0.268	8.03	0.0000	0.1469	14.7	0.910
19	0.156	0.395	8.03	0.0000	0.1494	14.9	0.904
20	0.240	0.490	8.02	0.0000	0.1516	15.1	0.899
21	0.324	0.569	7.98	0.0000	0.1531	15.3	0.896
22	0.492	0.701	8.03	0.0000	0.1559	15.6	0.889
23	0.739	0.860	8.03	0.0000	0.1593	15.9	0.882
24	0.991	0.996	8.03	0.0000	0.1623	16.2	0.875
25	1.490	1.221	8.03	0.0000	0.1672	16.7	0.864
26	2.489	1.578	8.03	0.0000	0.1749	17.5	0.847
27	4.492	2.119	8.02	0.0000	0.1856	18.5	0.823
28	4.991	2.234	8.03	0.0000	0.1876	18.7	0.819
29	9.990	3.161	8.02	0.0000	0.1995	19.9	0.792
30	14.989	3.872	8.02	0.0000	0.2048	20.5	0.780
31	19.992	4.471	8.03	0.0000	0.2075	20.7	0.774
32	24.991	4.999	8.03	0.0000	0.2089	20.9	0.771
33	29.990	5.476	8.03	0.0000	0.2101	21.0	0.768
34	39.988	6.324	8.03	0.0000	0.2116	21.1	0.765
35	49.990	7.070	8.03	0.0000	0.2126	21.2	0.763
36	59.988	7.745	8.03	0.0000	0.2133	21.3	0.761
37	60.028	7.748	8.03	0.0000	0.2133	21.3	0.761

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 9 of 21
Applied Stress: 4.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.012		8.03	0.0000	0.2133	21.3	0.761
2	-0.008		8.03	0.0000	0.2133	21.3	0.761
3	-0.004		6.13	0.0000	0.2123	21.2	0.763
4	0.000	0.000	4.40	0.0000	0.2109	21.1	0.766
5	0.001	0.028	4.03	0.0000	0.2106	21.0	0.767
6	0.005	0.072	3.93	0.0000	0.2102	21.0	0.768
7	0.010	0.098	3.93	0.0000	0.2102	21.0	0.768
8	0.014	0.118	4.05	0.0000	0.2102	21.0	0.768
9	0.018	0.136	4.12	0.0000	0.2102	21.0	0.768
10	0.023	0.151	4.21	0.0000	0.2102	21.0	0.768
11	0.027	0.165	4.21	0.0000	0.2102	21.0	0.768
12	0.032	0.178	4.04	0.0000	0.2100	21.0	0.768
13	0.036	0.190	4.06	0.0000	0.2098	21.0	0.769
14	0.041	0.201	4.06	0.0000	0.2098	21.0	0.769
15	0.045	0.212	4.06	0.0000	0.2097	20.9	0.769
16	0.049	0.222	4.04	0.0000	0.2096	20.9	0.769
17	0.063	0.250	4.02	0.0000	0.2094	20.9	0.770
18	0.071	0.267	4.05	0.0000	0.2095	20.9	0.770
19	0.155	0.394	4.02	0.0000	0.2090	20.9	0.771
20	0.239	0.489	4.02	0.0000	0.2087	20.8	0.771
21	0.323	0.569	4.03	0.0000	0.2083	20.8	0.772
22	0.491	0.701	4.02	0.0000	0.2079	20.8	0.773
23	0.739	0.860	4.02	0.0000	0.2077	20.8	0.774
24	0.991	0.995	4.02	0.0000	0.2075	20.7	0.774
25	1.490	1.221	4.02	0.0000	0.2073	20.7	0.774
26	2.489	1.578	4.02	0.0000	0.2074	20.7	0.774
27	4.491	2.119	4.01	0.0000	0.2069	20.7	0.775
28	4.991	2.234	4.01	0.0000	0.2069	20.7	0.775
29	9.990	3.161	4.01	0.0000	0.2069	20.7	0.775
30	14.989	3.872	4.02	0.0000	0.2072	20.7	0.775
31	19.988	4.471	4.02	0.0000	0.2071	20.7	0.775
32	24.991	4.999	4.01	0.0000	0.2070	20.7	0.775
33	29.990	5.476	4.02	0.0000	0.2070	20.7	0.775
34	39.988	6.324	4.01	0.0000	0.2071	20.7	0.775
35	49.990	7.070	4.02	0.0000	0.2071	20.7	0.775
36	59.988	7.745	4.01	0.0000	0.2070	20.7	0.775
37	60.001	7.746	4.01	0.0000	0.2070	20.7	0.775

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 10 of 21
Applied Stress: 2.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.015		4.01	0.0000	0.2070	20.7	0.775
2	-0.010		4.01	0.0000	0.2070	20.7	0.775
3	-0.006		3.38	0.0000	0.2063	20.6	0.777
4	-0.001		2.34	0.0000	0.2049	20.5	0.780
5	0.000	0.000	2.20	0.0000	0.2047	20.5	0.780
6	0.003	0.055	1.91	0.0000	0.2043	20.4	0.781
7	0.007	0.086	1.99	0.0000	0.2042	20.4	0.781
8	0.012	0.109	2.06	0.0000	0.2042	20.4	0.781
9	0.016	0.128	2.10	0.0000	0.2042	20.4	0.781
10	0.021	0.144	2.08	0.0000	0.2042	20.4	0.781
11	0.025	0.158	2.05	0.0000	0.2041	20.4	0.782
12	0.030	0.172	2.02	0.0000	0.2039	20.4	0.782
13	0.034	0.184	2.01	0.0000	0.2039	20.4	0.782
14	0.038	0.196	2.04	0.0000	0.2039	20.4	0.782
15	0.043	0.207	2.04	0.0000	0.2038	20.4	0.782
16	0.047	0.217	2.04	0.0000	0.2038	20.4	0.782
17	0.060	0.246	2.02	0.0000	0.2036	20.3	0.783
18	0.069	0.263	2.02	0.0000	0.2036	20.3	0.783
19	0.153	0.391	2.02	0.0000	0.2030	20.3	0.784
20	0.237	0.487	2.01	0.0000	0.2027	20.2	0.785
21	0.321	0.567	2.02	0.0000	0.2024	20.2	0.785
22	0.489	0.699	2.02	0.0000	0.2020	20.2	0.786
23	0.737	0.858	2.01	0.0000	0.2015	20.1	0.788
24	0.989	0.994	2.01	0.0000	0.2010	20.1	0.788
25	1.488	1.220	2.01	0.0000	0.2004	20.0	0.790
26	2.487	1.577	2.01	0.0000	0.1998	20.0	0.791
27	4.489	2.119	2.01	0.0000	0.1992	19.9	0.793
28	4.989	2.234	2.00	0.0000	0.1992	19.9	0.793
29	9.988	3.160	2.00	0.0000	0.1989	19.9	0.793
30	14.987	3.871	2.01	0.0000	0.1992	19.9	0.793
31	19.985	4.471	2.01	0.0000	0.1993	19.9	0.792
32	24.989	4.999	2.01	0.0000	0.1992	19.9	0.793
33	29.988	5.476	2.01	0.0000	0.1993	19.9	0.792
34	39.986	6.323	2.01	0.0000	0.1986	19.8	0.794
35	49.988	7.070	2.01	0.0000	0.1991	19.9	0.793
36	59.986	7.745	2.01	0.0000	0.1991	19.9	0.793
37	60.008	7.746	2.01	0.0000	0.1991	19.9	0.793

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 11 of 21
Applied Stress: 1.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.016		2.01	0.0000	0.1991	19.9	0.793
2	-0.012		2.01	0.0000	0.1991	19.9	0.793
3	-0.008		1.83	0.0000	0.1988	19.9	0.794
4	-0.003		1.45	0.0000	0.1979	19.8	0.795
5	0.000	0.000	1.10	0.0000	0.1972	19.7	0.797
6	0.001	0.035	0.965	0.0000	0.1969	19.7	0.798
7	0.006	0.075	0.965	0.0000	0.1969	19.7	0.798
8	0.010	0.100	1.05	0.0000	0.1968	19.7	0.798
9	0.015	0.120	1.05	0.0000	0.1968	19.7	0.798
10	0.019	0.138	1.05	0.0000	0.1969	19.7	0.798
11	0.023	0.153	1.04	0.0000	0.1968	19.7	0.798
12	0.028	0.167	1.02	0.0000	0.1967	19.7	0.798
13	0.032	0.179	1.01	0.0000	0.1966	19.6	0.798
14	0.037	0.191	1.01	0.0000	0.1966	19.6	0.798
15	0.041	0.203	1.00	0.0000	0.1966	19.6	0.798
16	0.045	0.213	1.02	0.0000	0.1966	19.6	0.798
17	0.059	0.242	1.02	0.0000	0.1964	19.6	0.799
18	0.068	0.260	1.01	0.0000	0.1964	19.6	0.799
19	0.152	0.389	1.01	0.0000	0.1959	19.6	0.800
20	0.236	0.485	1.01	0.0000	0.1956	19.5	0.801
21	0.319	0.565	1.01	0.0000	0.1953	19.5	0.801
22	0.487	0.698	1.01	0.0000	0.1948	19.5	0.802
23	0.735	0.857	1.01	0.0000	0.1944	19.4	0.803
24	0.987	0.993	1.01	0.0000	0.1940	19.4	0.804
25	1.486	1.219	1.01	0.0000	0.1933	19.3	0.806
26	2.485	1.576	1.01	0.0000	0.1925	19.2	0.807
27	4.487	2.118	1.00	0.0000	0.1914	19.1	0.810
28	4.987	2.233	1.00	0.0000	0.1911	19.1	0.811
29	9.986	3.160	1.00	0.0000	0.1903	19.0	0.813
30	14.985	3.871	1.00	0.0000	0.1897	19.0	0.814
31	19.984	4.470	1.01	0.0000	0.1899	19.0	0.813
32	24.987	4.999	1.00	0.0000	0.1893	18.9	0.815
33	29.986	5.476	1.00	0.0000	0.1897	18.9	0.814
34	39.984	6.323	1.00	0.0000	0.1897	19.0	0.814
35	49.986	7.070	1.00	0.0000	0.1896	18.9	0.814
36	59.984	7.745	1.00	0.0000	0.1892	18.9	0.815
37	60.002	7.746	1.01	0.0000	0.1893	18.9	0.815

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 12 of 21
Applied Stress: 0.500 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.019		1.01	0.0000	0.1892	18.9	0.815
2	-0.015		1.01	0.0000	0.1892	18.9	0.815
3	-0.010		0.977	0.0000	0.1891	18.9	0.815
4	-0.006		0.746	0.0000	0.1884	18.8	0.817
5	-0.002		0.587	0.0000	0.1881	18.8	0.817
6	0.000	0.000	0.550	0.0000	0.1880	18.8	0.818
7	0.003	0.053	0.488	0.0000	0.1878	18.8	0.818
8	0.007	0.085	0.508	0.0000	0.1878	18.8	0.818
9	0.012	0.108	0.523	0.0000	0.1878	18.8	0.818
10	0.016	0.127	0.526	0.0000	0.1877	18.8	0.818
11	0.020	0.143	0.523	0.0000	0.1877	18.8	0.818
12	0.025	0.158	0.520	0.0000	0.1877	18.8	0.818
13	0.029	0.171	0.514	0.0000	0.1877	18.7	0.818
14	0.034	0.184	0.509	0.0000	0.1877	18.7	0.818
15	0.038	0.195	0.505	0.0000	0.1876	18.7	0.818
16	0.043	0.206	0.505	0.0000	0.1875	18.7	0.819
17	0.056	0.236	0.515	0.0000	0.1875	18.7	0.819
18	0.065	0.254	0.514	0.0000	0.1875	18.7	0.819
19	0.149	0.386	0.508	0.0000	0.1871	18.7	0.820
20	0.233	0.482	0.503	0.0000	0.1869	18.7	0.820
21	0.317	0.563	0.506	0.0000	0.1867	18.7	0.820
22	0.485	0.696	0.505	0.0000	0.1864	18.6	0.821
23	0.732	0.856	0.506	0.0000	0.1861	18.6	0.822
24	0.984	0.992	0.503	0.0000	0.1857	18.6	0.823
25	1.483	1.218	0.503	0.0000	0.1854	18.5	0.824
26	2.482	1.576	0.505	0.0000	0.1846	18.4	0.825
27	4.485	2.118	0.502	0.0000	0.1835	18.3	0.828
28	4.984	2.232	0.503	0.0000	0.1833	18.3	0.828
29	9.983	3.160	0.505	0.0000	0.1818	18.2	0.831
30	14.982	3.871	0.502	0.0000	0.1812	18.1	0.833
31	19.985	4.470	0.502	0.0000	0.1807	18.1	0.834
32	24.984	4.998	0.503	0.0000	0.1804	18.0	0.835
33	29.983	5.476	0.505	0.0000	0.1801	18.0	0.835
34	39.981	6.323	0.500	0.0000	0.1798	18.0	0.836
35	49.983	7.070	0.502	0.0000	0.1794	17.9	0.837
36	59.981	7.745	0.502	0.0000	0.1797	17.9	0.836
37	59.999	7.746	0.502	0.0000	0.1797	17.9	0.836

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Boring No.: HB-GBB-305
Sample No.: 1U
Test No.: 303077

Location: --
Tested By: GSL
Test Date: 3/1/2018
Sample Type: INTACT

Project No.: 018821.00
Checked By: --
Depth: 20.0-22.5
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 13 of 21
Applied Stress: 1.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.019		0.502	0.0000	0.1797	17.9	0.836
2	-0.014		0.502	0.0000	0.1797	17.9	0.836
3	-0.010		0.625	0.0000	0.1798	18.0	0.836
4	-0.005		0.795	0.0000	0.1801	18.0	0.835
5	-0.001		0.927	0.0000	0.1805	18.0	0.834
6	0.000	0.000	0.950	0.0000	0.1805	18.0	0.834
7	0.003	0.058	1.02	0.0000	0.1807	18.1	0.834
8	0.008	0.088	0.997	0.0000	0.1807	18.1	0.834
9	0.012	0.110	0.977	0.0000	0.1807	18.1	0.834
10	0.017	0.129	0.975	0.0000	0.1807	18.1	0.834
11	0.021	0.145	0.980	0.0000	0.1808	18.1	0.834
12	0.025	0.160	0.986	0.0000	0.1808	18.1	0.834
13	0.030	0.173	0.992	0.0000	0.1808	18.1	0.834
14	0.034	0.185	0.998	0.0000	0.1809	18.1	0.833
15	0.039	0.197	1.00	0.0000	0.1809	18.1	0.833
16	0.043	0.208	0.998	0.0000	0.1809	18.1	0.833
17	0.061	0.247	0.992	0.0000	0.1810	18.1	0.833
18	0.065	0.255	0.995	0.0000	0.1810	18.1	0.833
19	0.149	0.386	0.997	0.0000	0.1814	18.1	0.832
20	0.233	0.483	0.995	0.0000	0.1817	18.2	0.832
21	0.317	0.563	1.00	0.0000	0.1819	18.2	0.831
22	0.485	0.697	0.998	0.0000	0.1821	18.2	0.831
23	0.733	0.856	1.00	0.0000	0.1825	18.2	0.830
24	0.985	0.992	1.00	0.0000	0.1826	18.2	0.830
25	1.484	1.218	1.00	0.0000	0.1829	18.3	0.829
26	2.483	1.576	1.00	0.0000	0.1833	18.3	0.828
27	4.485	2.118	1.00	0.0000	0.1838	18.4	0.827
28	4.985	2.233	1.00	0.0000	0.1840	18.4	0.827
29	9.984	3.160	1.00	0.0000	0.1843	18.4	0.826
30	14.982	3.871	1.00	0.0000	0.1844	18.4	0.826
31	19.986	4.471	1.00	0.0000	0.1845	18.4	0.826
32	24.985	4.998	1.00	0.0000	0.1845	18.4	0.826
33	29.984	5.476	1.00	0.0000	0.1845	18.4	0.826
34	39.981	6.323	1.00	0.0000	0.1846	18.4	0.825
35	49.984	7.070	1.00	0.0000	0.1847	18.4	0.825
36	59.982	7.745	1.00	0.0000	0.1846	18.4	0.825
37	60.000	7.746	1.00	0.0000	0.1846	18.4	0.825

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 14 of 21
Applied Stress: 2.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.017		1.00	0.0000	0.1846	18.4	0.825
2	-0.012		1.00	0.0000	0.1846	18.4	0.825
3	-0.008		1.33	0.0000	0.1850	18.5	0.824
4	-0.003		1.70	0.0000	0.1856	18.5	0.823
5	0.000	0.000	1.90	0.0000	0.1860	18.6	0.822
6	0.001	0.032	1.96	0.0000	0.1861	18.6	0.822
7	0.005	0.074	2.01	0.0000	0.1862	18.6	0.822
8	0.010	0.099	1.95	0.0000	0.1863	18.6	0.821
9	0.014	0.120	1.95	0.0000	0.1863	18.6	0.821
10	0.019	0.137	1.96	0.0000	0.1864	18.6	0.821
11	0.023	0.152	1.98	0.0000	0.1865	18.6	0.821
12	0.028	0.166	1.99	0.0000	0.1866	18.6	0.821
13	0.032	0.179	2.00	0.0000	0.1867	18.6	0.821
14	0.036	0.191	2.01	0.0000	0.1868	18.7	0.820
15	0.041	0.202	1.99	0.0000	0.1868	18.7	0.820
16	0.045	0.213	1.98	0.0000	0.1868	18.7	0.820
17	0.059	0.242	1.99	0.0000	0.1869	18.7	0.820
18	0.067	0.259	2.00	0.0000	0.1869	18.7	0.820
19	0.151	0.389	2.01	0.0000	0.1875	18.7	0.819
20	0.235	0.485	2.01	0.0000	0.1878	18.8	0.818
21	0.319	0.565	2.01	0.0000	0.1881	18.8	0.817
22	0.487	0.698	2.00	0.0000	0.1885	18.8	0.816
23	0.735	0.857	2.00	0.0000	0.1892	18.9	0.815
24	0.987	0.993	2.01	0.0000	0.1897	18.9	0.814
25	1.486	1.219	2.00	0.0000	0.1903	19.0	0.813
26	2.485	1.576	2.01	0.0000	0.1911	19.1	0.811
27	4.487	2.118	2.00	0.0000	0.1920	19.2	0.809
28	4.987	2.233	2.01	0.0000	0.1922	19.2	0.808
29	9.986	3.160	2.01	0.0000	0.1928	19.3	0.807
30	14.985	3.871	2.01	0.0000	0.1930	19.3	0.807
31	19.983	4.470	2.01	0.0000	0.1931	19.3	0.806
32	24.987	4.999	2.01	0.0000	0.1931	19.3	0.806
33	29.986	5.476	2.01	0.0000	0.1932	19.3	0.806
34	39.984	6.323	2.01	0.0000	0.1932	19.3	0.806
35	49.986	7.070	2.01	0.0000	0.1932	19.3	0.806
36	59.984	7.745	2.01	0.0000	0.1932	19.3	0.806
37	60.002	7.746	2.01	0.0000	0.1932	19.3	0.806

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 15 of 21
Applied Stress: 4.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.015		2.01	0.0000	0.1932	19.3	0.806
2	-0.011		2.47	0.0000	0.1937	19.3	0.805
3	-0.007		2.47	0.0000	0.1937	19.3	0.805
4	-0.002		3.63	0.0000	0.1951	19.5	0.802
5	0.000	0.000	3.80	0.0000	0.1955	19.5	0.801
6	0.002	0.048	3.98	0.0000	0.1959	19.6	0.800
7	0.007	0.082	3.89	0.0000	0.1959	19.6	0.800
8	0.011	0.105	3.89	0.0000	0.1959	19.6	0.800
9	0.016	0.125	3.92	0.0000	0.1960	19.6	0.800
10	0.020	0.141	3.95	0.0000	0.1961	19.6	0.800
11	0.024	0.156	4.01	0.0000	0.1964	19.6	0.799
12	0.029	0.170	4.01	0.0000	0.1964	19.6	0.799
13	0.033	0.182	3.96	0.0000	0.1965	19.6	0.799
14	0.038	0.194	3.96	0.0000	0.1965	19.6	0.799
15	0.042	0.205	3.97	0.0000	0.1966	19.6	0.798
16	0.046	0.216	3.99	0.0000	0.1967	19.6	0.798
17	0.064	0.253	4.01	0.0000	0.1967	19.7	0.798
18	0.069	0.262	4.00	0.0000	0.1967	19.7	0.798
19	0.153	0.391	3.99	0.0000	0.1974	19.7	0.797
20	0.237	0.486	3.99	0.0000	0.1979	19.8	0.796
21	0.321	0.566	4.00	0.0000	0.1983	19.8	0.795
22	0.489	0.699	4.01	0.0000	0.1989	19.9	0.793
23	0.736	0.858	4.00	0.0000	0.1998	20.0	0.791
24	0.988	0.994	4.01	0.0000	0.2004	20.0	0.790
25	1.487	1.220	4.01	0.0000	0.2014	20.1	0.788
26	2.486	1.577	4.01	0.0000	0.2025	20.2	0.785
27	4.488	2.119	4.01	0.0000	0.2034	20.3	0.783
28	4.988	2.233	4.02	0.0000	0.2035	20.3	0.783
29	9.987	3.160	4.02	0.0000	0.2041	20.4	0.782
30	14.986	3.871	4.01	0.0000	0.2042	20.4	0.781
31	19.989	4.471	4.01	0.0000	0.2044	20.4	0.781
32	24.988	4.999	4.02	0.0000	0.2045	20.4	0.781
33	29.987	5.476	4.02	0.0000	0.2045	20.4	0.781
34	39.985	6.323	4.01	0.0000	0.2046	20.4	0.780
35	49.987	7.070	4.01	0.0000	0.2046	20.4	0.780
36	59.985	7.745	4.01	0.0000	0.2046	20.4	0.780
37	60.007	7.746	4.02	0.0000	0.2046	20.4	0.780

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 16 of 21
Applied Stress: 8.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.013		4.02	0.0000	0.2046	20.4	0.780
2	-0.008		4.02	0.0000	0.2046	20.4	0.780
3	-0.004		5.79	0.0000	0.2060	20.6	0.777
4	0.000	0.000	7.60	0.0000	0.2076	20.7	0.774
5	0.001	0.025	7.90	0.0000	0.2078	20.8	0.773
6	0.005	0.071	8.10	0.0000	0.2084	20.8	0.772
7	0.009	0.097	7.82	0.0000	0.2084	20.8	0.772
8	0.014	0.118	7.81	0.0000	0.2085	20.8	0.772
9	0.018	0.135	7.94	0.0000	0.2087	20.9	0.771
10	0.023	0.151	8.00	0.0000	0.2089	20.9	0.771
11	0.027	0.165	8.03	0.0000	0.2091	20.9	0.770
12	0.032	0.178	7.94	0.0000	0.2091	20.9	0.770
13	0.036	0.190	7.93	0.0000	0.2092	20.9	0.770
14	0.040	0.201	7.95	0.0000	0.2093	20.9	0.770
15	0.045	0.212	7.98	0.0000	0.2094	20.9	0.770
16	0.049	0.222	8.00	0.0000	0.2095	20.9	0.770
17	0.063	0.250	7.98	0.0000	0.2097	20.9	0.769
18	0.071	0.267	7.97	0.0000	0.2098	21.0	0.769
19	0.155	0.394	8.01	0.0000	0.2108	21.1	0.767
20	0.239	0.489	8.03	0.0000	0.2117	21.1	0.765
21	0.323	0.569	8.02	0.0000	0.2124	21.2	0.763
22	0.491	0.701	8.03	0.0000	0.2134	21.3	0.761
23	0.739	0.860	8.02	0.0000	0.2147	21.5	0.758
24	0.991	0.995	8.03	0.0000	0.2157	21.5	0.756
25	1.490	1.221	8.03	0.0000	0.2171	21.7	0.753
26	2.489	1.578	8.03	0.0000	0.2190	21.9	0.748
27	4.491	2.119	8.03	0.0000	0.2209	22.1	0.744
28	4.991	2.234	8.03	0.0000	0.2212	22.1	0.743
29	9.990	3.161	8.03	0.0000	0.2227	22.3	0.740
30	14.989	3.872	8.03	0.0000	0.2238	22.4	0.738
31	19.987	4.471	8.03	0.0000	0.2242	22.4	0.737
32	24.991	4.999	8.03	0.0000	0.2245	22.4	0.736
33	29.990	5.476	8.03	0.0000	0.2247	22.4	0.736
34	39.988	6.324	8.05	0.0000	0.2254	22.5	0.734
35	49.990	7.070	7.99	0.0000	0.2259	22.6	0.733
36	59.988	7.745	7.99	0.0000	0.2261	22.6	0.733
37	60.006	7.746	8.06	0.0000	0.2261	22.6	0.732

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Boring No.: HB-GBB-305
Sample No.: 1U
Test No.: 303077

Location: --
Tested By: GSL
Test Date: 3/1/2018
Sample Type: INTACT

Project No.: 018821.00
Checked By: --
Depth: 20.0-22.5
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 17 of 21
Applied Stress: 16.0 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.012		8.06	0.0000	0.2261	22.6	0.732
2	-0.008		8.06	0.0000	0.2261	22.6	0.732
3	-0.004		10.4	0.0000	0.2272	22.7	0.730
4	0.000	0.000	15.2	0.0000	0.2304	23.0	0.723
5	0.001	0.028	16.2	0.0000	0.2311	23.1	0.721
6	0.005	0.072	16.4	0.0000	0.2319	23.2	0.719
7	0.010	0.098	15.8	0.0000	0.2321	23.2	0.719
8	0.014	0.119	15.3	0.0000	0.2322	23.2	0.719
9	0.018	0.136	15.8	0.0000	0.2325	23.2	0.718
10	0.023	0.151	16.1	0.0000	0.2329	23.3	0.717
11	0.027	0.165	15.8	0.0000	0.2330	23.3	0.717
12	0.032	0.178	15.9	0.0000	0.2332	23.3	0.717
13	0.036	0.190	15.9	0.0000	0.2334	23.3	0.716
14	0.041	0.201	16.0	0.0000	0.2336	23.3	0.716
15	0.045	0.212	16.0	0.0000	0.2337	23.3	0.715
16	0.049	0.222	16.0	0.0000	0.2339	23.4	0.715
17	0.063	0.250	15.9	0.0000	0.2342	23.4	0.714
18	0.071	0.267	16.0	0.0000	0.2345	23.4	0.714
19	0.155	0.394	16.0	0.0000	0.2367	23.6	0.709
20	0.239	0.489	16.0	0.0000	0.2383	23.8	0.705
21	0.323	0.569	16.0	0.0000	0.2396	23.9	0.702
22	0.491	0.701	16.1	0.0000	0.2419	24.2	0.697
23	0.739	0.860	16.0	0.0000	0.2444	24.4	0.691
24	0.991	0.995	16.1	0.0000	0.2468	24.7	0.686
25	1.490	1.221	16.0	0.0000	0.2503	25.0	0.678
26	2.489	1.578	16.1	0.0000	0.2554	25.5	0.667
27	4.491	2.119	16.1	0.0000	0.2611	26.1	0.654
28	4.991	2.234	16.0	0.0000	0.2620	26.2	0.652
29	9.990	3.161	16.1	0.0000	0.2671	26.7	0.641
30	14.989	3.872	16.1	0.0000	0.2691	26.9	0.636
31	19.988	4.471	16.1	0.0000	0.2702	27.0	0.634
32	24.991	4.999	16.1	0.0000	0.2709	27.1	0.632
33	29.990	5.476	16.1	0.0000	0.2716	27.1	0.631
34	39.988	6.324	16.0	0.0000	0.2723	27.2	0.629
35	49.990	7.070	15.9	0.0000	0.2731	27.3	0.627
36	59.988	7.745	16.2	0.0000	0.2737	27.3	0.626
37	60.023	7.747	15.9	0.0000	0.2735	27.3	0.626

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 18 of 21
Applied Stress: 4.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.015		15.9	0.0000	0.2736	27.3	0.626
2	-0.011		15.9	0.0000	0.2736	27.3	0.626
3	-0.006		6.66	0.0000	0.2688	26.9	0.637
4	-0.002		6.66	0.0000	0.2688	26.9	0.637
5	0.000	0.000	5.20	0.0000	0.2669	26.7	0.641
6	0.003	0.051	3.19	0.0000	0.2643	26.4	0.647
7	0.007	0.084	3.19	0.0000	0.2643	26.4	0.647
8	0.011	0.107	4.18	0.0000	0.2651	26.5	0.645
9	0.016	0.126	4.27	0.0000	0.2651	26.5	0.645
10	0.020	0.142	4.13	0.0000	0.2646	26.4	0.646
11	0.025	0.157	4.01	0.0000	0.2644	26.4	0.647
12	0.029	0.171	4.01	0.0000	0.2644	26.4	0.647
13	0.033	0.183	4.09	0.0000	0.2643	26.4	0.647
14	0.038	0.195	4.11	0.0000	0.2642	26.4	0.647
15	0.042	0.206	4.07	0.0000	0.2641	26.4	0.648
16	0.047	0.216	4.07	0.0000	0.2641	26.4	0.648
17	0.060	0.245	4.05	0.0000	0.2638	26.3	0.648
18	0.069	0.262	4.08	0.0000	0.2638	26.3	0.648
19	0.153	0.391	4.03	0.0000	0.2629	26.3	0.650
20	0.237	0.487	4.02	0.0000	0.2621	26.2	0.652
21	0.321	0.566	4.03	0.0000	0.2615	26.1	0.653
22	0.489	0.699	4.04	0.0000	0.2605	26.0	0.655
23	0.736	0.858	4.03	0.0000	0.2597	25.9	0.657
24	0.988	0.994	4.02	0.0000	0.2590	25.9	0.659
25	1.488	1.220	4.02	0.0000	0.2582	25.8	0.661
26	2.487	1.577	4.02	0.0000	0.2574	25.7	0.663
27	4.489	2.119	4.01	0.0000	0.2567	25.6	0.664
28	4.988	2.233	4.02	0.0000	0.2567	25.6	0.664
29	9.987	3.160	4.01	0.0000	0.2567	25.6	0.664
30	14.986	3.871	4.01	0.0000	0.2564	25.6	0.665
31	19.985	4.470	4.01	0.0000	0.2562	25.6	0.665
32	24.988	4.999	4.02	0.0000	0.2563	25.6	0.665
33	29.987	5.476	4.01	0.0000	0.2563	25.6	0.665
34	39.985	6.323	4.02	0.0000	0.2562	25.6	0.665
35	49.987	7.070	4.01	0.0000	0.2562	25.6	0.665
36	59.985	7.745	4.01	0.0000	0.2560	25.6	0.666
37	60.030	7.748	4.01	0.0000	0.2560	25.6	0.666

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 19 of 21
Applied Stress: 1.00 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.015		4.01	0.0000	0.2560	25.6	0.666
2	-0.011		4.01	0.0000	0.2560	25.6	0.666
3	-0.006		2.66	0.0000	0.2549	25.5	0.668
4	-0.002		1.53	0.0000	0.2534	25.3	0.671
5	0.000	0.000	1.30	0.0000	0.2528	25.3	0.673
6	0.002	0.049	1.02	0.0000	0.2522	25.2	0.674
7	0.007	0.083	1.00	0.0000	0.2520	25.2	0.675
8	0.011	0.106	1.09	0.0000	0.2519	25.2	0.675
9	0.016	0.125	1.10	0.0000	0.2519	25.2	0.675
10	0.020	0.142	1.09	0.0000	0.2518	25.2	0.675
11	0.025	0.157	1.07	0.0000	0.2516	25.1	0.675
12	0.029	0.170	1.04	0.0000	0.2515	25.1	0.676
13	0.033	0.183	1.02	0.0000	0.2514	25.1	0.676
14	0.038	0.194	1.00	0.0000	0.2512	25.1	0.676
15	0.042	0.205	1.03	0.0000	0.2512	25.1	0.676
16	0.047	0.216	1.05	0.0000	0.2511	25.1	0.677
17	0.060	0.245	1.04	0.0000	0.2510	25.1	0.677
18	0.069	0.262	1.01	0.0000	0.2508	25.1	0.677
19	0.153	0.391	1.01	0.0000	0.2500	25.0	0.679
20	0.237	0.487	1.00	0.0000	0.2494	24.9	0.680
21	0.321	0.566	1.01	0.0000	0.2491	24.9	0.681
22	0.489	0.699	1.02	0.0000	0.2483	24.8	0.683
23	0.736	0.858	1.01	0.0000	0.2473	24.7	0.685
24	0.988	0.994	1.01	0.0000	0.2465	24.6	0.687
25	1.487	1.220	1.01	0.0000	0.2453	24.5	0.689
26	2.486	1.577	1.01	0.0000	0.2436	24.3	0.693
27	4.489	2.119	1.00	0.0000	0.2413	24.1	0.698
28	4.988	2.233	1.00	0.0000	0.2409	24.1	0.699
29	9.987	3.160	1.00	0.0000	0.2385	23.8	0.705
30	14.986	3.871	1.00	0.0000	0.2375	23.7	0.707
31	19.985	4.470	1.00	0.0000	0.2371	23.7	0.708
32	24.988	4.999	1.00	0.0000	0.2367	23.6	0.709
33	29.987	5.476	1.00	0.0000	0.2365	23.6	0.709
34	39.985	6.323	1.00	0.0000	0.2364	23.6	0.710
35	49.987	7.070	1.00	0.0000	0.2361	23.6	0.710
36	59.985	7.745	1.00	0.0000	0.2360	23.6	0.710
37	60.003	7.746	1.00	0.0000	0.2361	23.6	0.710

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Location: --
Project No.: 018821.00
Boring No.: HB-GBB-305
Tested By: GSL
Checked By: --
Sample No.: 1U
Test Date: 3/1/2018
Depth: 20.0-22.5
Test No.: 303077
Sample Type: INTACT
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 20 of 21
Applied Stress: 0.250 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.020		1.00	0.0000	0.2360	23.6	0.710
2	-0.015		1.00	0.0000	0.2360	23.6	0.710
3	-0.011		0.859	0.0000	0.2359	23.6	0.711
4	-0.007		0.559	0.0000	0.2353	23.5	0.712
5	-0.002		0.383	0.0000	0.2347	23.5	0.713
6	0.000	0.000	0.325	0.0000	0.2346	23.4	0.714
7	0.002	0.047	0.266	0.0000	0.2344	23.4	0.714
8	0.007	0.082	0.254	0.0000	0.2342	23.4	0.714
9	0.011	0.105	0.279	0.0000	0.2342	23.4	0.714
10	0.015	0.124	0.285	0.0000	0.2340	23.4	0.715
11	0.020	0.141	0.286	0.0000	0.2341	23.4	0.715
12	0.024	0.156	0.282	0.0000	0.2340	23.4	0.715
13	0.029	0.170	0.276	0.0000	0.2340	23.4	0.715
14	0.033	0.182	0.268	0.0000	0.2339	23.4	0.715
15	0.038	0.194	0.262	0.0000	0.2339	23.4	0.715
16	0.042	0.205	0.256	0.0000	0.2339	23.4	0.715
17	0.055	0.235	0.268	0.0000	0.2337	23.3	0.715
18	0.064	0.253	0.271	0.0000	0.2337	23.3	0.716
19	0.148	0.385	0.256	0.0000	0.2331	23.3	0.717
20	0.232	0.482	0.253	0.0000	0.2327	23.2	0.718
21	0.316	0.562	0.256	0.0000	0.2324	23.2	0.718
22	0.484	0.696	0.259	0.0000	0.2318	23.2	0.720
23	0.732	0.855	0.259	0.0000	0.2311	23.1	0.721
24	0.983	0.992	0.257	0.0000	0.2304	23.0	0.723
25	1.483	1.218	0.254	0.0000	0.2294	22.9	0.725
26	2.482	1.575	0.251	0.0000	0.2280	22.8	0.728
27	4.484	2.118	0.253	0.0000	0.2259	22.6	0.733
28	4.983	2.232	0.251	0.0000	0.2255	22.5	0.734
29	9.982	3.159	0.251	0.0000	0.2224	22.2	0.741
30	14.981	3.871	0.253	0.0000	0.2203	22.0	0.745
31	19.980	4.470	0.251	0.0000	0.2188	21.9	0.749
32	24.984	4.998	0.251	0.0000	0.2177	21.7	0.751
33	29.982	5.476	0.250	0.0000	0.2168	21.7	0.753
34	39.980	6.323	0.251	0.0000	0.2156	21.5	0.756
35	49.983	7.070	0.250	0.0000	0.2147	21.5	0.758
36	59.980	7.745	0.250	0.0000	0.2141	21.4	0.759
37	60.003	7.746	0.250	0.0000	0.2141	21.4	0.759

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: GORHAM
Boring No.: HB-GBB-305
Sample No.: 1U
Test No.: 303077

Location: --
Tested By: GSL
Test Date: 3/1/2018
Sample Type: INTACT

Project No.: 018821.00
Checked By: --
Depth: 20.0-22.5
Elevation: --

Soil Description: Medium Stiff Gray Clay
Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Load Increment: 21 of 21
Applied Stress: 0.0625 tsf

	Elapsed Time min	Sq.Rt. of Time min	Stress tsf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1	-0.028		0.250	0.0000	0.2141	21.4	0.759
2	-0.024		0.250	0.0000	0.2141	21.4	0.759
3	-0.020		0.204	0.0000	0.2140	21.4	0.759
4	-0.015		0.160	0.0000	0.2139	21.4	0.760
5	-0.011		0.139	0.0000	0.2137	21.4	0.760
6	-0.006		0.118	0.0000	0.2136	21.3	0.760
7	-0.002		0.0889	0.0000	0.2134	21.3	0.761
8	0.000	0.000	0.0812	0.0000	0.2133	21.3	0.761
9	0.002	0.049	0.0722	0.0000	0.2133	21.3	0.761
10	0.007	0.083	0.0630	0.0000	0.2132	21.3	0.761
11	0.011	0.106	0.0661	0.0000	0.2132	21.3	0.761
12	0.016	0.125	0.0722	0.0000	0.2132	21.3	0.761
13	0.020	0.142	0.0737	0.0000	0.2132	21.3	0.761
14	0.025	0.157	0.0737	0.0000	0.2130	21.3	0.762
15	0.029	0.170	0.0737	0.0000	0.2130	21.3	0.762
16	0.033	0.183	0.0722	0.0000	0.2130	21.3	0.762
17	0.047	0.216	0.0676	0.0000	0.2129	21.3	0.762
18	0.055	0.235	0.0630	0.0000	0.2129	21.3	0.762
19	0.139	0.373	0.0676	0.0000	0.2127	21.2	0.762
20	0.223	0.473	0.0630	0.0000	0.2125	21.2	0.763
21	0.307	0.554	0.0630	0.0000	0.2123	21.2	0.763
22	0.475	0.689	0.0661	0.0000	0.2120	21.2	0.764
23	0.723	0.850	0.0646	0.0000	0.2119	21.2	0.764
24	0.975	0.987	0.0615	0.0000	0.2115	21.1	0.765
25	1.474	1.214	0.0630	0.0000	0.2111	21.1	0.766
26	2.473	1.573	0.0646	0.0000	0.2104	21.0	0.768
27	4.475	2.116	0.0615	0.0000	0.2091	20.9	0.771
28	4.975	2.230	0.0630	0.0000	0.2088	20.9	0.771
29	9.974	3.158	0.0630	0.0000	0.2067	20.6	0.776
30	14.973	3.869	0.0630	0.0000	0.2052	20.5	0.779
31	19.972	4.469	0.0630	0.0000	0.2038	20.4	0.782
32	24.975	4.997	0.0630	0.0000	0.2028	20.3	0.785
33	29.974	5.475	0.0630	0.0000	0.2017	20.1	0.787
34	39.972	6.322	0.0630	0.0000	0.2001	20.0	0.791
35	49.974	7.069	0.0630	0.0000	0.1989	19.9	0.793
36	59.972	7.744	0.0615	0.0000	0.1981	19.8	0.795
37	69.974	8.365	0.0630	0.0000	0.1972	19.7	0.797
38	79.972	8.943	0.0615	0.0000	0.1965	19.6	0.799
39	89.974	9.485	0.0615	0.0000	0.1960	19.6	0.800
40	99.972	9.999	0.0615	0.0000	0.1955	19.5	0.801
41	109.974	10.487	0.0615	0.0000	0.1951	19.5	0.802
42	119.972	10.953	0.0615	0.0000	0.1947	19.5	0.803
43	129.974	11.401	0.0615	0.0000	0.1945	19.4	0.803
44	131.398	11.463	0.0615	0.0000	0.1945	19.4	0.803

APPENDIX D

Calculations

GOLDER

CALCULATIONS

Date:	11/12/2019	**Made by:**	MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Subgrade Modulus	**Reviewed by:**	JDL
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

OBJECTIVE

Determine the subgrade modulus for the culvert.

METHOD

Use Figure 8-3 from FHWA (2002), Table 6.2 from Das (2003), and Equations 9-4 and 9-7 from Bowles (1982).

REFERENCES

1. GEOTECHNICAL ENGINEERING CIRCULAR NO. 6: Shallow Foundations. FHWA: September 2002 (FHWA).
2. Das, Baraja M. Principles of Foundation Engineering, 7th ed. Thomson Brooks/Cole, 2003.
3. Bowles, Joseph E. Foundation Analysis and Design, 3rd ed. McGraw-Hill, 1982.
4. Foundation Engineering Manual, 4th Edition. (2006). Canadian Geotechnical Society.
5. Golder Associates Inc. Geotechnical Boring Logs HB-GBB-205 and HB-GBB-305.
6. MaineDOT (2019). WIN 18821.00 Gorham Draft PDR-PIC Plan Set, Received April 22, 2019.

ASSUMPTIONS

1. Plan dimensions of the new culvert are 12.0 feet x 176.0 feet with an 8 feet rise (Ref 6)
2. The culvert invert is at elevation 130.64 feet in the south and elevation 128.44 feet in the north. Based on boring logs HB-GBB-205 and HB-GBB-305, the invert will be founded within the clay layer.

CALCULATION

A. Determine the subgrade modulus.

According to Das, the value of the subgrade modulus, k, also known as the coefficient of subgrade reaction, is not a constant for a given soil type and depends on several factors, including the size of the foundation and the depth of embedment. The subgrade modulus of a 1 square ft bearing plate at the ground surface, k_1, can be estimated from FHWA (2002) Figure 8-3 (Ref 1, Attachment 1).

Based on FHWA (2002) Figure 8-3 and the corrected N_{60} blowcounts from References 4 and 5, the average consistency of the lower fill is "very soft". The k_1 values cannot be determined from the graph because the soil is too soft.

Table 6.2 from Das (2003) only includes k_1 values for hard, very stiff, and stiff clay.

These values are consistant with Table 9-1 from Bowles (1982) k_1 = 43-87 lb/in^3 for clayey soils with q_u ≤ 4 ksf.

Table 7.1 from the Canadian Geotechnical Society (2006) gives a range of 18 ft/in^3 to 37 ft/in^3 for soft to firm cohesive soils.

Based on the values presented above use a conservative k_1 value of 25 lb/in^3 for the clay.

B.) Determine $k_{(BxL)}$ for the 12.0 feet x 176.0 feet culvert using typical k_1 values.

1. Use assumed k_1 value from Step A to determine a k value for 12.0 foot square slab.

$$k_{(B\times B)} = k_1 \times \frac{1}{B} \qquad \text{(Eq. 6.44b, Ref. 2)}$$

Date:	11/12/2019	**Made by:**	MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Subgrade Modulus	**Reviewed by:**	JDL
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

where:

k_1 =	25	coefficient of subgrade reaction (lb/in^3)
B =	12	width of culvert (ft)

$k_{(12.0'x12.0')}$ = 2.08 lb/in^3

2. Use calculated *k* (12.0' x 12.0') value to determine equivalent *k* value for 12.0 feet x 176.0 feet culvert.

$$k_{(B\times L)} = \frac{k_{(B\times B)}\left(1 + 0.5\frac{B}{L}\right)}{1.5}$$ (Eq. 6.45, Ref. 2)

where:

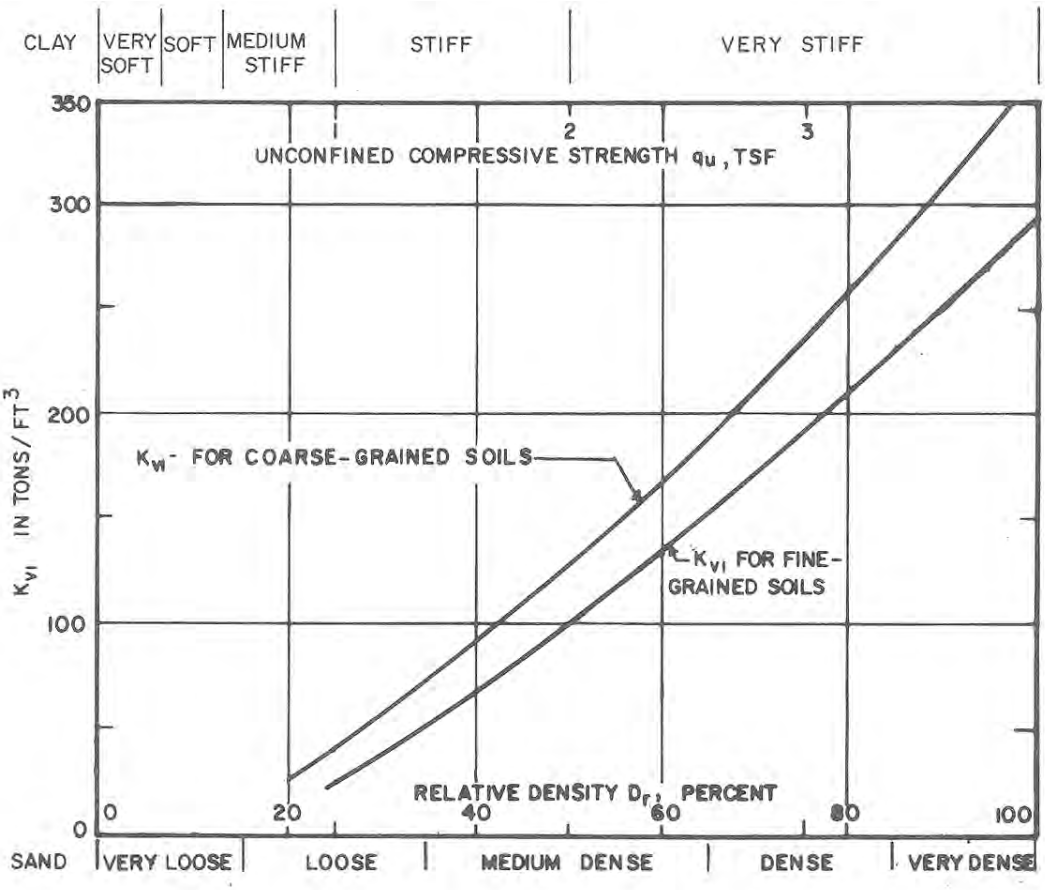
$k_{(BxB)}$ =	2.08	coefficient of subgrade reaction for 12.0 feet x 12.0 feet calculated in Step 1 (lb/in^3)
B =	12	width of culvert (feet)
L =	176	length of culvert (feet)

$k_{(12.0'x176.0')}$ = 1.44 lb/in^3

CONCLUSIONS

For the proposed 12.0 feet x 176 feet slab the subgrade modulus, *k*, is 1.44 lb/in^3.

Reference 1



DEFINITIONS

ΔH_i = IMMEDIATE SETTLEMENT OF FOOTING
q = FOOTING UNIT LOAD IN tsf
B = FOOTING WIDTH
D = DEPTH OF FOOTING BELOW GROUND SURFACE
K_{vl} = MODULUS OF VERTICAL SUBGRADE REACTION

COARSE-GRAINED SOILS

(MODULUS OF ELASTICITY INCREASING LINEARLY WITH DEPTH)
SHALLOW FOOTINGS $D \leq B$
FOR $B \leq 20$ FT:

$$\Delta H_i = \frac{4\, q\, B^2}{K_{vl}\,(B+1)^2}$$

FOR $B \geq 40$ FT:

$$\Delta H_i = \frac{2\, q\, B^2}{K_{vl}\,(B+1)^2}$$

INTERPOLATE FOR INTERMEDIATE VALUES OF B

DEEP FOUNDATION $D \geq 5B$
FOR $B \leq 20$ FT:

$$\Delta H_i = \frac{2\, q\, B^2}{K_{vl}\,(B+1)^2}$$

NOTES: 1. NONPLASTIC SILT IS ANALYZED AS COARSE-GRAINED SOIL WITH MODULUS OF ELASTICITY INCREASING LINEARLY WITH DEPTH.
2. VALUES OF K_{vl} SHOWN FOR COARSE-GRAINED SOILS APPLY TO DRY OR MOIST MATERIAL WITH THE GROUNDWATER LEVEL AT A DEPTH OF AT LEAST 1.5B BELOW BASE OF FOOTING. IF GROUNDWATER IS AT BASE OF FOOTING, USE $K_{vl}/2$ IN COMPUTING SETTLEMENT

Figure 8-3: Modulus of Subgrade Reaction (NAVFAC, 1986a)

Reference 2

The unit of k is kN/m^3. The value of the coefficient of subgrade reaction is not a constant for a given soil, but rather depends on several factors, such as the length L and width B of the foundation and also the depth of embedment of the foundation. A comprehensive study by Terzaghi (1955) of the parameters affecting the coefficient of subgrade reaction indicated that the value of the coefficient decreases with the width of the foundation. In the field, load tests can be carried out by means of square plates measuring 0.3 m $\times$ 0.3 m, and values of k can be calculated. The value of k can be related to large foundations measuring $B \times B$ in the following ways:

Foundations on Sandy Soils

For foundations on sandy soils,

$$k = k_{0.3}\left(\frac{B + 0.3}{2B}\right)^2 \tag{6.42}$$

where $k_{0.3}$ and k = coefficients of subgrade reaction of foundations measuring 0.3 m $\times$ 0.3 m and $B\,(\text{m}) \times B\,(\text{m})$, respectively (unit is kN/m^3).

Foundations on Clays

For foundations on clays,

$$k(\text{kN/m}^3) = k_{0.3}(\text{kN/m}^3)\left[\frac{0.3\ (\text{m})}{B(\text{m})}\right] \tag{6.43}$$

The definitions of k and $k_{0.3}$ in Eq. (6.43) are the same as in Eq. (6.42).

For rectangular foundations having dimensions of $B \times L$ (for similar soil and q),

$$k = \frac{k_{(B\times B)}\left(1 + 0.5\dfrac{B}{L}\right)}{1.5} \tag{6.44}$$

where

k = coefficient of subgrade modulus of the rectangular foundation $(L \times B)$
$k_{(B\times B)}$ = coefficient of subgrade modulus of a square foundation having dimension of $B \times B$

Equation (6.44) indicates that the value of k for a very long foundation with a width B is approximately $0.67k_{(B\times B)}$.

The modulus of elasticity of granular soils increases with depth. Because the settlement of a foundation depends on the modulus of elasticity, the value of k increases with the depth of the foundation.

Table 6.2 provides typical ranges of values for the coefficient of subgrade reaction, $k_{0.3}(k_1)$, for sandy and clayey soils.

For long beams, Vesic (1961) proposed an equation for estimating subgrade reaction, namely,

$$k' = Bk = 0.65\sqrt[12]{\frac{E_s B^4}{E_F I_F}}\frac{E_s}{1-\mu_s^2}$$

or

$$k = 0.65\sqrt[12]{\frac{E_s B^4}{E_F I_F}}\frac{E_s}{B(1-\mu_s^2)} \tag{6.45}$$

where

E_s = modulus of elasticity of soil
B = foundation width
E_F = modulus of elasticity of foundation material
I_F = moment of inertia of the cross section of the foundation
μ_s = Poisson's ratio of soil

Table 6.2 Typical Subgrade Reaction Values, $k_{0.3}(k_1)$

Soil type	$k_{0.3}(k_1)$ MN/m^3
Dry or moist sand:	
Loose	8–25
Medium	25–125
Dense	125–375
Saturated sand:	
Loose	10–15
Medium	35–40
Dense	130–150
Clay:	
Stiff	10–25
Very stiff	25–50
Hard	>50

TABLE 9-1
Range of modulus of subgrade reaction k_s
Use values as guide and for comparison when using approximate equations

Soil	k_s, kN/m³
Loose sand	4800–16 000
Medium dense sand	9600–80 000
Dense sand	64 000–128 000
Clayey medium dense sand	32 000–80 000
Silty medium dense sand	24 000–48 000
Clayey soil:	
$q_a \le 200$ kPa	12 000–24 000
$200 < q_a \le 800$ kPa	24 000–48 000
$q_a > 800$ kPa	> 48 000

The 1.5 to $2B$ dimension is an approximation of the depth of significant stress-strain influence (Boussinesq theory) for the structural member. The structural member may be either a *footing* or a *pile*.

Example 9-5. Estimate the modulus of subgrade reaction k_s for the following design parameters:

$$B = 1.22 \text{ m} \qquad L = 1.83 \text{ m} \qquad D = 0.610 \text{ m}$$
$$q_a = 200 \text{ kPa (clayey sand approximately 10 m deep)}$$
$$E_s = 11.72 \text{ MPa (average in depth } 5B \text{ below base)}$$

Solution. Estimate Poisson's ratio $\mu = 0.30$ so that

$$E_s' = \frac{1-\mu^2}{E_s} = \frac{1-0.3^2}{11.72} = 0.077\,65 \text{ m}^2/\text{MN}$$

For **center:**

$$H/B' = 5B/(B/2) = 10 \text{ (taking } H = 5B \text{ as recommended in Chap. 5)}$$
$$L/B = 1.83/1.22 = 1.5$$

From these we may write

$$I_s = 0.584 + \frac{1-2(0.3)}{1-0.3}0.023 = \mathbf{0.597}$$

using Eq. (5-16) and Table 5-2 (or your program FFACTOR) for factors 0.584 and 0.023.

At $D/B = 0.61/1.22 = 0.5$, we obtain $I_F = 0.80$ from Fig. 5-7 (or when using FFACTOR for the I_s factors). Substitution into Eq. (9-7) with $B' = 1.22/2 = 0.61$, and $m = 4$ yields

$$k_s = \frac{1}{0.61(0.077\,65)(4 \times 0.597)(0.8)} = \mathbf{11.05} \text{ MN/m}^3$$

You should note that k_s does not depend on the contact pressure of the base q_o.

For **corner:**

$$H/B' = 5B/B = 5(1.22)/1.22 = 5$$

[from Table 5-2 with $L/B = 1.5$ obtained for Eq. (5-16)]

Reference 4

take place during excavation and placement of steel reinforcing, and limitations of the theory, only approximate indications of the magnitude of the coefficient of subgrade reaction can be given. In addition, because the stresses from the raft affect the soil to considerable depth below bearing level, longer-term consolidation settlements may develop; these settlements also may vary, depending on the differences in soil compressibility existing at different points under the raft. Such considerations need to be taken into account by the geotechnical engineer when assessing appropriate values for subgrade reaction.

Unlike strength and compressibility, the modulus of subgrade reaction is not a fundamental soil property. Rather, it is a common design approach used by structural engineers to model the interface between the foundation soil and concrete footing (i.e., soil-structure interaction). The modulus of subgrade reaction is a number required by structural engineers to model the deformation and stiffness response of a footing (raft) on soil. The modulus of subgrade reaction is defined as:

$$k = q/\delta \tag{7.1}$$

where

k = modulus of subgrade reaction
q = applied bearing or contact pressure on footing
δ = settlement of footing under applied pressure q

The modulus of subgrade reaction, though simple in its definition, is a very difficult parameter to evaluate properly because it is not a unique fundamental property that is readily measured. Its value depends on many factors, including size and shape of footing (raft), type of soil, relative stiffness of footing and soil, duration of loading relative to the hydraulic conductivity of the loaded soil, and others. The value of modulus of subgrade reaction can also vary from one point to another beneath a footing or raft (e.g., centre, edge or corner) and can change with time, in particular for soils with low hydraulic conductivity such as clays.

Field plate load tests are commonly used to determine numerical values for the modulus of subgrade reaction. A database of numerical values and types of soil has been developed. Because the modulus value can change with size of footing, a one foot (300 mm) square footing has been adopted as the standard basis for comparison purposes, and frequently serves as the starting point for design. The technical literature cites typical values for the modulus of subgrade reaction, k_{v1}, (for a one-foot square plate) for a variety of soil types. Typical ranges in k_{v1} are summarized in Table 7.1. Appropriate design values for modulus of subgrade reaction generally decrease if the size of the loaded plate (or footing) is larger than one foot (300 mm) by one foot (300 mm). The manner in which the value of modulus of subgrade reaction decreases with increasing footing size varies with the type of foundation soil. Additional information is provided below, as well as by Terzaghi (1955), NavFac (1982) and Winterkorn and Fang (1975).

TABLE 7.1 *Typical Ranges In Vertical Modulus Of Subgrade Reaction*

Soil Type	k_{v1} (MPa/m) [1]
Granular Soils (Moist or Dry) [2]	
Loose	5 - 20
Compact Sand	20 – 60
Dense	60 – 160
Very Dense	160 – 300 [3]
Cohesive Soils	
Soft	< 5
Firm	5 – 10
Stiff	10 – 30
Very Stiff	30 - 80
Hard	80 – 200 [3]

GOLDER

CALCULATIONS

Date:	2/8/2017, 11/12/2019	**Made by:**	CJS / MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Bearing Capacity & Settlement Proposed Culvert	**Reviewed by:**	JDL
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

OBJECTIVE

To calculate the bearing resistance of the proposed culvert for the strength limit state and the service limit state.

METHOD

Use the method described in the AASHTO LRFD Bridge Design Specifications, 8th Ed, 2017. Calculate the factored bearing resistance for both the strength limit state and the service limit state. Determine footing size and allowable bearing capacity based on a maximum allowable settlement of 1 inch.

REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 8th Ed, 2017 (LRFD)
2. GEOTECHNICAL ENGINEERING CIRCULAR NO. 6: Shallow Foundations. FHWA: September 2002 (FHWA).
3. Das, Braja M. Principles of Foundation Engineering, 7th Ed. Brooks/Cole, 2011.
4. MaineDOT (2019). WIN 18821.00 Gorham Dradt PDR-PIC Plan Set, Received April 22, 2019.
5. Golder Associates Inc. Geotechnical Boring Logs HB-GBB-205 and HB-GBB-305.

ASSUMPTIONS

1. Ground water table is at the ground surface at culvert inlet. D_w (ft): 0

2. Clay consolidation parameters (for both the Presumpscot Crust and Presumpscot Clay) C_c = 0.61, C_r = 0.035, e_0 = 1.24. Use these values to calculate modified compression indicies.

3. The culvert invert is at elevation 130.64 feet in the south and elevation 128.44 feet in the north. Based on boring logs HB-GBB-205 and HB-GBB-305, the invert will be founded within the clay layer. (Reference 3).

CALCULATION

A. Determine the bearing resistance at the strength limit state. Use Article 10.6.3, Strength Limit Design, from the AASHTO LRFD Bridge Design Specifications.

Per FHWA, clay loaded rapidly will have general shear (undrained loading) and clay loaded slowly (drained) will have punching shear.
Assume fill below footing will be compacted Crushed Stone.

		existing fill	compacted structural
ϕ_f	internal friction angle, degree	0	36
c	cohesion for Presumpscot material, psf	500	n/a
γ	bulk unit weight, pcf	115	125

Calculate the nominal and factored bearing resistance at the strength limit state for the abutment if the native material below the footing elevation was compacted or removed/replaced. The structural fill properties are tabulated above.

H	thickness of upper soil layer below footing (structural fill), ft	1.0

(continued next page)

Date:	2/8/2017, 11/12/2019	**Made by:**	CJS / MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Bearing Capacity & Settlement Proposed Culvert	**Reviewed by:**	JDL
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

According to LRFD Article 10.6.3.1.2d, when the soil profile contains a second soil layer of different properties within a distance below the footing less than H_{crit}, then the bearing resistance needs to be calculated for a two-layered soil system.

$$H_{crit} = \frac{(3 * B_f) \ln\left(\frac{q_1}{q_2}\right)}{2\left(1 + \frac{B_f}{L_f}\right)}$$ Eq 10.6.3.1.2d-1

where:

- q_1 nominal bearing resistance of a footing supported by the upper soil assuming the layer is infinitely thick
- q_2 nominal bearing resistance of a fictitious footing supported on the surface of the second layer

Calculate q_1:

$$q_1 = \gamma_1 D_{f1} N_{qm1} C_{wq1} + \frac{1}{2}\gamma_1 B_f N_{\gamma m1} C_{w\gamma}$$ LRFD Eq 10.6.3.1.2a-1

where:		**Fill**		
B_f	footing width, ft	12.0		
γ_1	total unit weight, kcf	0.125		
ϕ^*_{f1}	effective friction angle (reduced for failure mode)	36		
D_f	footing embedment depth, ft	0		
L_f	footing length, ft	176.0		
$N_{qm1} = N_{q1} s_q d_q$		39.6	LRFD Eq 10.6.3.1.2a-3	
N_{q1}	surcharge factor, Table 10.6.3.1.2a-1	37.8		
$s_q = 1 + \left(\frac{B_f}{L_f}\tan\phi_{f1}\right)$		1.05	LRFD Table 10.6.3.1.2a-3	
d_q	depth correction factor, Table 10.6.3.1.2a-4	1.00		
$N_{\gamma m1} = N_{\gamma q1} s_\gamma$		54.8	LRFD Eq 10.6.3.1.2a-4	
$N_{\gamma 1}$	unit weight factor, Table 10.6.3.1.2a-1	56.3		
$s_\gamma = 1 - 0.4\left(\frac{B_f}{L_f}\right)$		0.97	LRFD Table 10.6.3.1.2a-3	

(continued next page)

Date:	2/8/2017, 11/12/2019	**Made by:**	CJS / MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Bearing Capacity & Settlement Proposed Culvert	**Reviewed by:**	JDL
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

D_w	depth to water, ft	0
C_{wq}	coefficient of groundwater, FHWA eq 5-10	
$C_{wq} = 0.5 + 0.5\left(\frac{D_w}{D_f}\right) \le 1.0$		0.50
$C_{w\gamma}$	coefficient of groundwater, FHWA eq 5-9	
$C_{w\gamma} = 0.5 + 0.5\left(\frac{D_w}{1.5B_f + D_f}\right) \le 1.0$		0.50

q_1 (ksf) =	**20.5**

Calculate q_2:

$$q_2 = cN_{cm2} + \gamma_2 D_{f2} N_{qm2} C_{wq2} + \frac{1}{2}\gamma_2 B_f N_{\gamma m2} C_{w\gamma}$$ LRFD Eq 10.6.3.1.2a-1

where:		**Presumpscot**	
B_f	footing width, ft	12	
γ_2	total unit weight, kcf	0.115	
ϕ^*_{f2}	effective friction angle (reduced for failure mode)	0	
c^*	effective cohesion (reduced for failure mode), ksf	0.500	
D_f	footing embedment depth = $D_{f(1)}$+H, ft	1.0	
L_f	footing length, ft	176	
$N_{qm2} = N_{q2} s_q d_q$		1.0	LRFD Eq 10.6.3.1.2a-3
N_{q2}	surcharge factor, Table 10.6.3.1.2a-1	1.0	
$s_q = 1 + \left(\frac{B_f}{L_f}\tan\phi_{f2}\right)$		1.00	LRFD Table 10.6.3.1.2a-3
d_q	depth correction factor, Table 10.6.3.1.2a-4	1.00	
$N_{\gamma m2} = N_{\gamma 2} s_\gamma$		0.0	LRFD Eq 10.6.3.1.2a-4
$N_{\gamma 2}$	unit weight factor, Table 10.6.3.1.2a-1	0.0	
$s_\gamma = 1 - 0.4\left(\frac{B_f}{L_f}\right)$		1.00	LRFD Table 10.6.3.1.2a-3
D_w	depth to water, ft	0	

(continued next page)

Date:	2/8/2017, 11/12/2019	**Made by:**	CJS / MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Bearing Capacity & Settlement Proposed Culvert	**Reviewed by:**	JDL
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

C_{wq} coefficient of groundwater, FHWA eq 5-10

$$C_{wq} = 0.5 + 0.5\left(\frac{D_w}{D_f}\right) \le 1.0$$ 0.50

C_{wg} coefficient of groundwater, FHWA eq 5-9

$$C_{w\gamma} = 0.5 + 0.5\left(\frac{D_w}{1.5B_f + D_f}\right) \le 1.0$$ 0.50

$$N_{cm2} = N_c s_c$$ 5.2 LRFD Eq 10.6.3.1.2a-2

N_{c2} cohesion factor, Table 10.6.3.1.2a-1 5.1

$$s_c = 1 + \left(\frac{B}{5L}\right)$$ 1.01 LRFD Table 10.6.3.1.2a-3

q_2 (ksf) =	**2.7**

Calculate H_{crit}

$$H_{crit} = \frac{(3 * B_f)\ln\left(\frac{q_1}{q_2}\right)}{2\left(1 + \frac{B_f}{L_f}\right)}$$ Eq 10.6.3.1.2d-1

H_{crit} (ft) =	**34.4**

Is H_{crit} < H?	No

If H_{crit} < H, then a two-layer system does not apply.

Calculate q_n for two-layer system

$$q_n = q_2 e^{2\left[1+\left(\frac{B_f}{L_f}\right)\right]K\tan\phi_{f1}\left(\frac{H}{B}\right)}$$ Eq 10.6.3.1.2f-1

where:

$$K = \frac{1-\sin^2\phi_{f1}}{1+\sin^2\phi_{f1}}$$ Eq 10.6.3.1.2f-2 0.5

q_n (ksf) =	2.8

(continued next page)

q_n for two-layer system: use $q_n = q_1$ if $H_{crit} < H$, otherwise use q_n calculated for two-layers.

q_n (ksf) =	2.8

Apply resistance factor:

$$q_R = \varphi_b q_n$$

j_b resistance factor specified in Article 10.5.5.2.2 — 0.45
(Table 10.5.5.2.2-1: Semi-empirical methods, all soils)

$q_{R\text{-}2}$ (ksf) =	1.28

B. Determine the change in effective stress state within the soil at the new culvert location to identify if settlement or heave will occur.

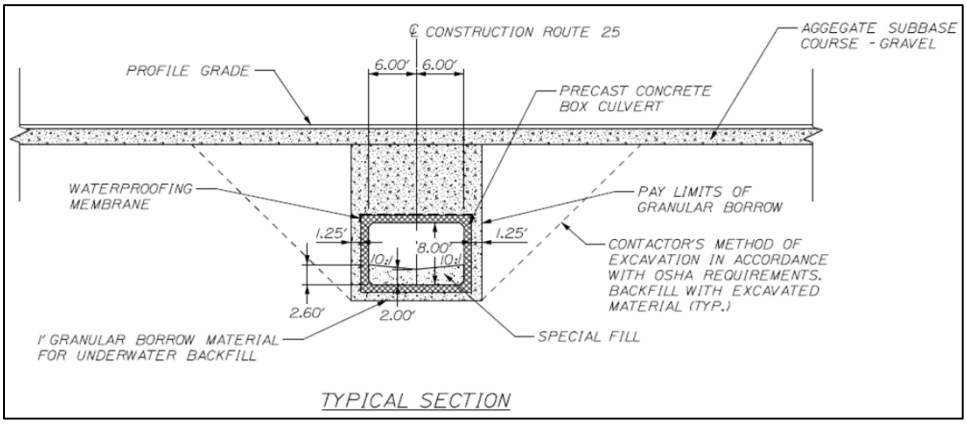
The culvert invert is at elevation 130.64 feet in the south and elevation 128.44 feet in the north. Based on boring logs HB-GBB-205 and HB-GBB-305, the invert will be founded within the clay layer. Invert below centerline of road about 129.7 ft. elevation. (Reference 4).

HB-GBB-205

	Start Elev.	End Elev.	Thick. (ft)
Asphalt	151.8	150.8	1.0
Fill	150.8	144.8	6.0
Clay	144.8	118.8	26.0

This boring profile is nearest to the culvert along the roadway and represents the initial conditions.

Water table at z (ft) = 6.6
γ_w (pcf) = 62.4



Culvert walls are 1.25 ft thick, γ_{conc} = 140 pcf, average weight per linear foot. Area of culvert concrete per linear foot is 1 ft x 10.5 ft x 14.5 ft less 1 ft x 8 ft x 12 ft.

Culvert: Vol. (ft^3): 56.25 Weight (lb): 7875 Dist. weight (psf): 543.1

Special Fill in the culvert: 2.6 ft thick, 12 ft. wide per linear foot

Sp.Fill: Vol. (ft^3): 31.2 Weight (lb): 4056 Dist. weight (psf): 338.0

(continued next page)

GOLDER

CALCULATIONS

Date:	2/8/2017, 11/12/2019	**Made by:**	CJS / MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Bearing Capacity & Settlement Proposed Culvert	**Reviewed by:**	JDL
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

Remove soil to 127.45 ft. elev. (invert at elev. 129.7 - 1.25 ft. concrete wall - 1 ft. base fill)

Soil thickness estimated from elevation 150.55 ft to 127.45 ft: 23.10

Layer	Elev. (ft) top	Elev. (ft) bottom	Thick. (ft)	γ_{bulk} (pcf)	$\Delta\sigma_{v\text{-}layer}$ (psf)
Asphalt	150.55	149.55	1	140	140.0
Fill	149.55	143.55	6	125	750.0
Clay	143.55	127.45	16.10	115	1851.5

Existing Road	
$\sigma_{v\ @\ 126.45\ ft}$ (psf)	2741.5
$\sigma'_{v\ @\ 126.45\ ft}$ (psf)	1711.9

Add the following layers from elev. 126.45 to the ground surface at elev. 150.55 ft

Layer	Elev. (ft) top	Elev. (ft) bottom	Thick. (ft)	γ_{bulk} (pcf)	$\Delta\sigma_{v\text{-}layer}$ (psf)
Asphalt	150.55	149.55	1.0	140	140.0
Structural Fill	149.55	138.95	10.6	125	1325.0
Special Fill (inside)	*131.05*	*128.45*	*2.6*	*130*	*338.0*
Culvert	*138.95*	*128.45*	*10.5*	*140*	*543.1*
Structural Fill	128.45	127.45	1.0	125	125.0

New Culvert	
$\sigma_{v\ @\ 126.45\ ft}$ (psf)	2471.1
$\sigma'_{v\ @\ 126.45\ ft}$ (psf)	1441.5

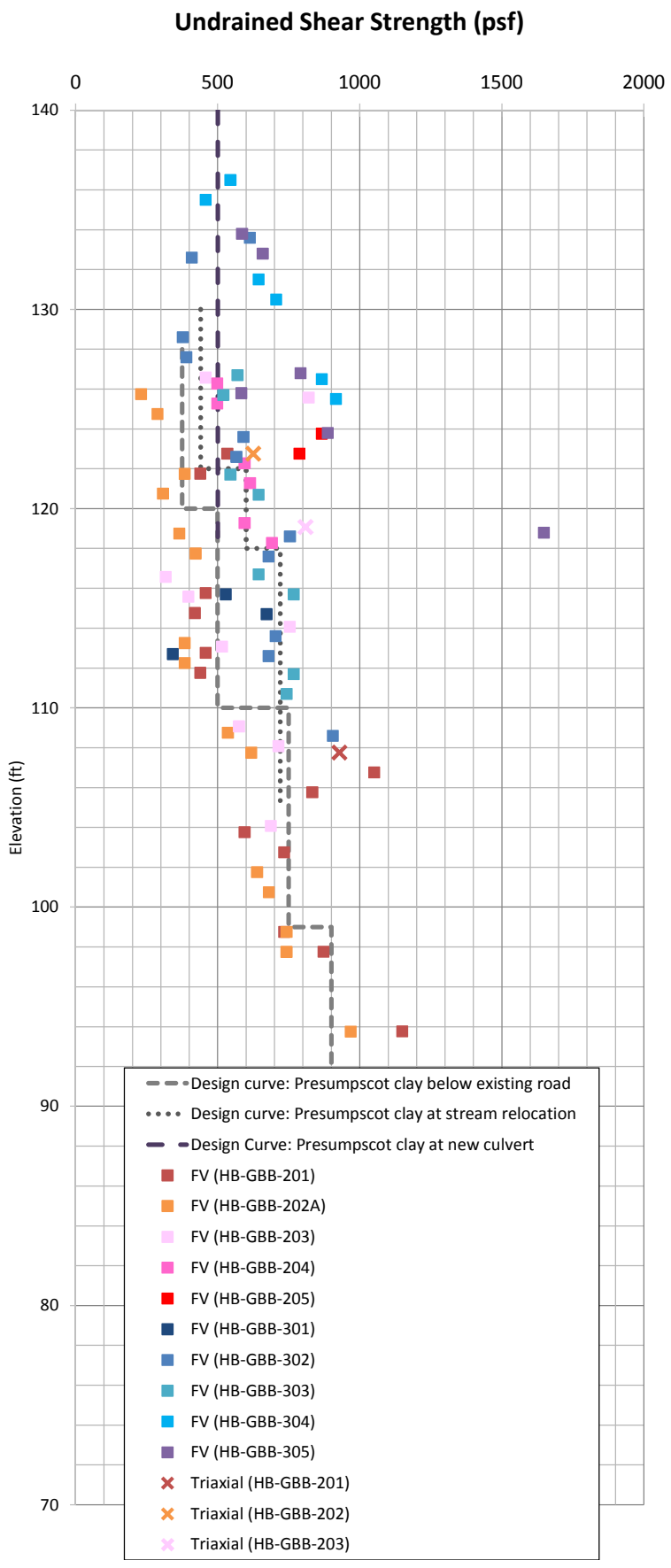
Calculate the increase or decrease in effective stress as a result of the new culvert placement.

Existing Culvert $\sigma'_{v\ @\ 126.45\ ft}$ (psf)	New Culvert $\sigma'_{v\ @\ 126.45\ ft}$ (psf)	Difference $\Delta\sigma'_{v\ @\ 126.45\ ft}$ (psf)		

1711.9	1441.5	**-270.4**	**heave**	If (-), heave
				If (+), settlement
				If (0), no change

CONCLUSIONS

Bearing capacity is 1.28 ksf for the strength limit state. The soil in the area of the culvert will be unloaded by approximately 270 psf, resulting in heave in the area of the new proposed culvert rather than settlement. Heave is calculated separately.


Undrained Shear Strength (psf)
0
500
1000
1500
2000
140
130
120
110
100
90
80
70
Elevation (ft)
Design curve: Presumpscot clay below existing road
Design curve: Presumpscot clay at stream relocation
Design Curve: Presumpscot clay at new culvert
FV (HB-GBB-201)
FV (HB-GBB-202A)
FV (HB-GBB-203)
FV (HB-GBB-204)
FV (HB-GBB-205)
FV (HB-GBB-301)
FV (HB-GBB-302)
FV (HB-GBB-303)
FV (HB-GBB-304)
FV (HB-GBB-305)
Triaxial (HB-GBB-201)
Triaxial (HB-GBB-202)
Triaxial (HB-GBB-203)

GOLDER

CALCULATIONS

Date:	11/13/2019	**Made by:**	SKB / MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Heaving at Proposed Culvert Location - As Excavated	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

OBJECTIVE

Determine the change in effective stress state within the soil at the new culvert location after excavation to identify if settlement or heave will occur. Estimate the amount of heave that may occur in clays deeper than elevation 127.45 ft during construction. Determine the time-rate of heave that will occur for the culvert excavation. Determine the factor of safety against heave after the excavation

REFERENCES

1. Puller, Malcolm. Deep Excavations: a Practical Manual, 2nd Ed. Thomas Telford Publishing, 2003.
2. Construction plans from Maine Department of Transportation, dated April 16, 2019.
3. Golder boring logs.
4. Winterkorn & Fang, 1975. Foundation Engineering Handbook, Litton Educational Publishing, Inc.
5. Holtz & Kovaks, An Introduction To Geotechnical Engineering, 1st Ed., Prentice-Hall, Inc. (1981)
6. Table 5 Engineering Soil Tests - 1669139 Final Report Golder Associates

ASSUMPTIONS

1. The uniform soil properties are cohesion = 500 psf (based on attached design curve) and unit weight = 115 pcf. The cohesion is consistent with the clay layer in the base of the stream used in the slope stability models.
2. A consistent amount of soil is excavated across the culvert alignment (i.e. depth of cut constant across the proposed culvert alignment).

APPROACH

This approach is conservative in that we assume the excavation is uniform and the influence of the adjacent soil embankment is not considered in the stress change calculation.

CALCULATION

A. Determine the change in effective stress state within the soil at the new culvert location to identify if settlement or heave will occur.

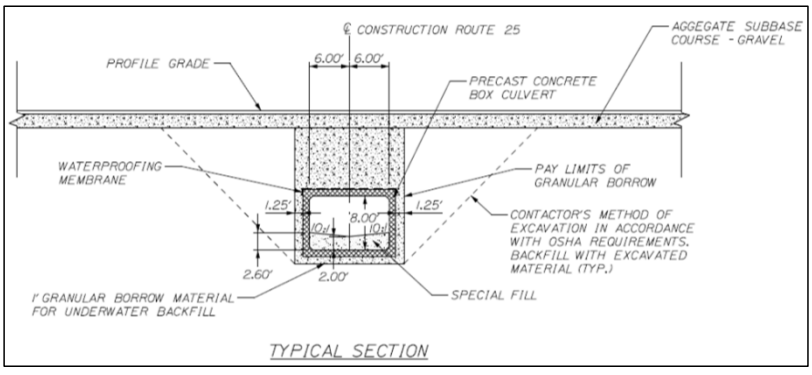
The culvert invert is at elevation 130.64 feet in the south and elevation 128.44 feet in the north. Based on boring logs HB-GBB-205 and HB-GBB-305, the invert will be founded within the clay layer. Invert below centerline of road about 129.7 ft. elevation. (Reference 2).

HB-GBB-205

	Start Elev.	End Elev.	Thick. (ft)
Asphalt	151.8	150.8	1.0
Fill	150.8	144.8	6.0
Clay	144.8	118.8	26.0

This boring profile is nearest to the culvert along the roadway and represents the initial conditions.

Water table at z (ft) = 6.6 (Reference 3)
γ_w (pcf) = 62.4



Culvert walls are 1.25 ft thick, average unit weight of concrete is γ_{conc} = 150 pcf
Area of culvert concrete per linear foot is 1 ft x 10.5 ft x 14.5 ft less 1 ft x 8 ft x 12 ft.

Culvert: Vol. (ft^3): 56.25 Weight (lb): 8437.5 Dist. weight (psf): 581.9

Special Fill in the culvert: 2.0 ft thick, 12 ft. wide per linear foot (Reference 2) 130 pcf = γ_{bulk} (Assumption)

Sp.Fill: Vol. (ft^3): 24 Weight (lb): 3120 Dist. weight (psf): 260.0

Remove soil to 127.45 ft. elev. (invert at elev. 129.7 - 1.25 ft. concrete wall - 1 ft. base fill)

Date:	11/13/2019	**Made by:**	SKB / MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Heaving at Proposed Culvert Location - As Excavated	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

Soil thickness estimated from elevation 150.55 ft to 127.45 ft: 23.10 Water table elevation (ft) = 144.0

Layer	Elev. (ft) top	Elev. (ft) bottom	Thick. (ft)	γ_{bulk} (pcf)	$\Delta\sigma_{v\text{-layer}}$ (psf)	Existing Road
Asphalt	150.55	149.55	1	140	140.0	2741.5 $\sigma_{v\ @\ 127.45\ ft}$ (psf)
Fill	149.55	143.55	6	125	750.0	1711.9 $\sigma'_{v\ @\ 127.45\ ft}$ (psf)
Clay	143.55	127.45	16.10	115	1851.5	

Calculate the increase or decrease in effective stress as a result of the new culvert placement.

Existing Road $\sigma'_{v\ @\ 126.45\ ft}$ (psf)	Excavated Area $\sigma'_{v\ @\ 126.45\ ft}$ (psf)	Difference $\Delta\sigma'_{v\ @\ 126.45\ ft}$ (psf)		

1711.9	0.0	**-1711.9**	**heave**	If (-), potential heave
				If (+), potential settlement
				If (0), no change

B. Estimate the amount of heave that may occur in clays deeper than elevation 127.45 ft during excavation.

Clay layer between bottom of the layer at elevation 118.8 ft and bottom of the excavation at 127.45 feet will experience heave.

Existing stresses above elevation 127.45 ft. $\sigma_{v\ @\ 127.45\ ft}$ (psf) 2741.5 $\sigma'_{v\ @\ 127.45\ ft}$ (psf) 1711.9

Divide the clay beneath the culvert into layers. Determine the initial effective stress.
Determine the post excavation effective stress assuming the new water table is at elevation 127.45

Layer	Elev. (ft) top	Elev. (ft) bottom	Thickness (ft)	Pre-excavation $\sigma_{v\text{-midlayer}}$ (psf)	Pre-excavation $\sigma'_{v\text{-midlayer}}$ (psf)	Post-excavation $\sigma_{v\text{-midlayer}}$ (psf)	Post-excavation $\sigma'_{v\text{-midlayer}}$ (psf)	Post-Pre Difference $\sigma'_{v\text{-midlayer}}$ (psf)
clay	127.45	126.45	1	2799.0	1738.2	57.5	26.3	-1711.9
	126.45	125.45	1	2914.0	1790.8	172.5	78.9	-1711.9
	125.45	124.45	1	3029.0	1843.4	287.5	131.5	-1711.9
	124.45	123.45	1	3144.0	1896.0	402.5	184.1	-1711.9
	123.45	122.45	1	3259.0	1948.6	517.5	236.7	-1711.9
	122.45	121.45	1	3374.0	2001.2	632.5	289.3	-1711.9
	121.45	120.45	1	3489.0	2053.8	747.5	341.9	-1711.9
	120.45	118.8	1.65	3641.4	2123.5	899.9	411.6	-1711.9

Calculate heave using the settlement equations below for overconsolidated soil, as the clay will be unloading.

$$\Delta H_i = \frac{C_r H_{layer}}{1 + e_0} \log \frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_{v0}}$$

for overconsolidated clay, $\sigma'_{v0} + \Delta\sigma_v \le \sigma'_p$

Average clay properties	
C_r	0.07
e_0	1.18

Elev. (ft) top	Elev. (ft) bottom	Thickness (ft)	Initial $\sigma'_{v\text{-midlayer}}$ (psf)	Final $\sigma'_{v\text{-midlayer}}$ (psf)	Heave, ΔH (in)	
127.45	126.45	1	1738.2	26.3	-0.70	
126.45	125.45	1	1790.8	78.9	-0.52	
125.45	124.45	1	1843.4	131.5	-0.44	
124.45	123.45	1	1896.0	184.1	-0.39	
123.45	122.45	1	1948.6	236.7	-0.35	
122.45	121.45	1	2001.2	289.3	-0.32	
121.45	120.45	1	2053.8	341.9	-0.30	
120.45	118.8	1.65	2123.5	411.6	-0.45	
					-3.49	**Total (in)**

Date:	11/13/2019	**Made by:**	SKB / MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Heaving at Proposed Culvert Location - As Excavated	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

C. Determine the Time-Rate of Heave that will occur for the culvert excavation and construction

Use single layer analysis to determine the time the entire heave to occur.
Assume double drainage condition. Assumption based on structural fill above and glacial outwash below the clay layer (Reference 3). The soil types above and below have a higher permeabilty relative to the clay layer.
Subsurface conditions are simplified to a single soil layer with uniform soil properties for the purpose of the calculation.

Clay layer thickness is below excavation, not overall clay layer thickness from Golder boring logs.
Thickness of clay below excavation (ft): 8.65 (Reference 3)

Double Drainage Condition:
H_{dr} (ft): 4.33

$$T_v = \frac{c_V t}{H^2_{dr}}$$ (Reference 5, via Eqn 9-5)

$$T_v = \frac{\pi}{4}\left(\frac{U\%}{100}\right)^2$$ For U = 0% to 60% (Reference 5, via Eqn 9-10)

$$T_v = 1.781 - 0.933\log(100 - U\%)$$ For U = > 60% (Reference 5, via Eqn 9-11)

$$U_{avg} = \frac{s(t)}{S_c}$$ (Reference 5, via Eqn 9-12)

Average clay properties		
c_v (ft^2/day)	0.24	(Reference 6)
e_0	1.18	(Reference 6)

T_v = Time factor (dimensionless)
C_v = Coefficent of Consolidation (ft^2/day)
t = time (day)
H_{dr} = Drainage Path (ft)
U_{avg} = Average Degree or Percent Consolidation
s(t) = settlement/heave at any time (in)
s(c) = final or ultimate settlement/heave (in)

Determine time factor using Reference 5, Eqn. 9-11

U_{avg} = 95 (Calculate time to reach 95% consolidation)
T_v = 1.13

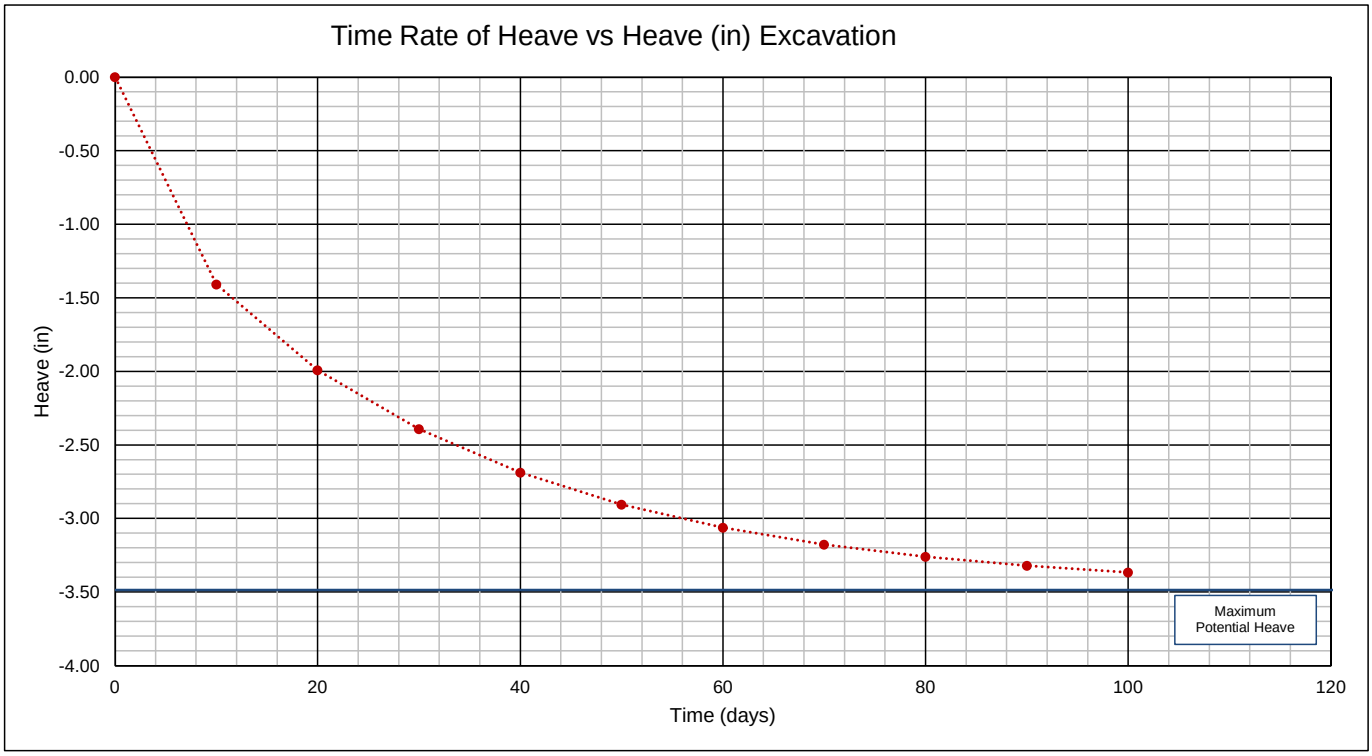
Determine time required for entire heave using Reference 5, Eqn. 9-5

C_v (ft^2/day) = 0.24
H_{dr} (ft) = 4.33
T_v = 1.13
t (days)= 88

ΔH (in)= -3.49 (final potential heave)

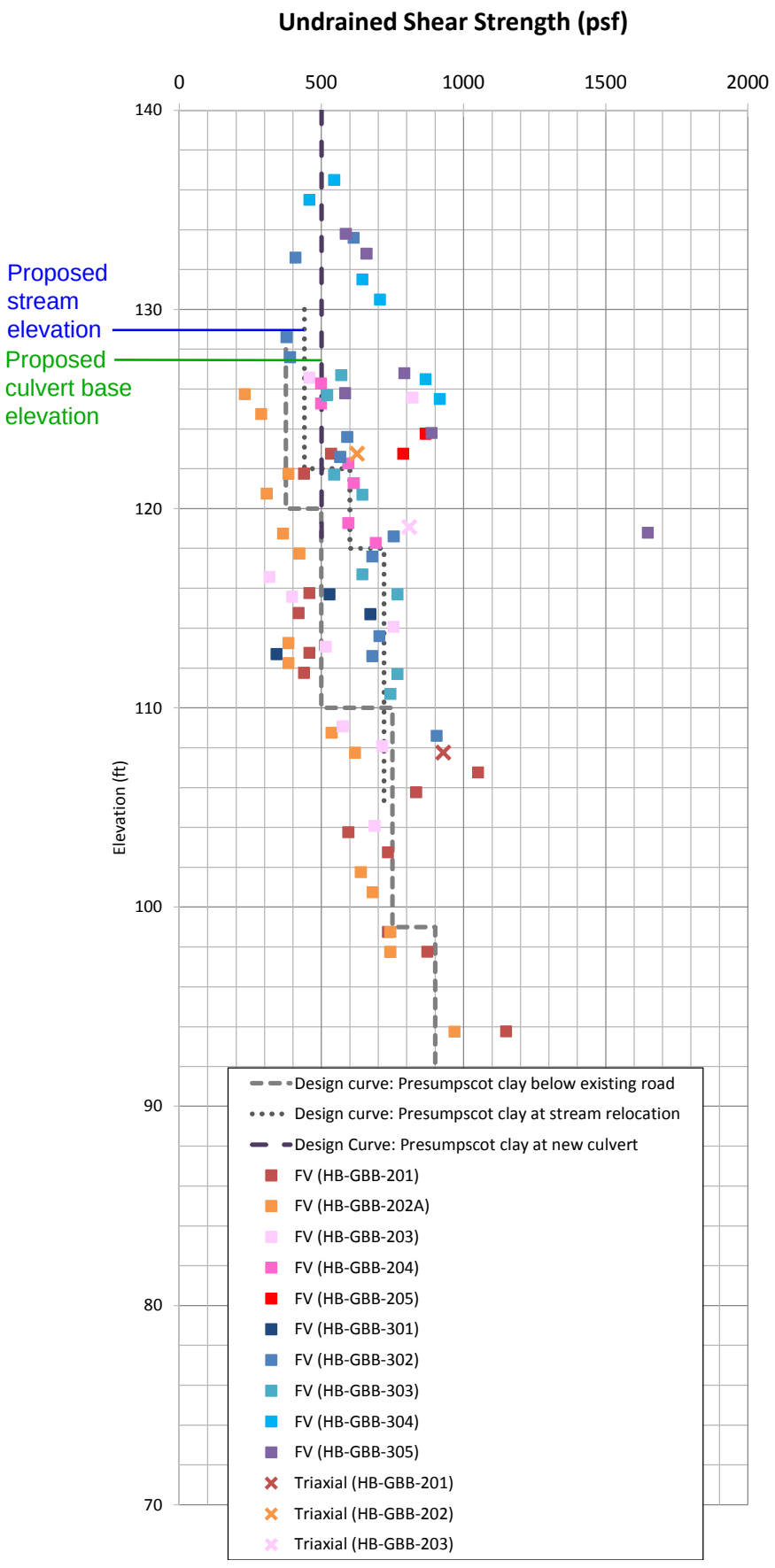
Date:	11/13/2019	**Made by:**	SKB / MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Heaving at Proposed Culvert Location - As Excavated	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

Time (days)	Time (years)	Tv	U_{avg} (%)	s(t) (in)
0	0.00	0.00	0.00	0.00
10	0.03	0.13	40.42	-1.41
20	0.05	0.26	57.16	-1.99
30	0.08	0.38	68.64	-2.39
40	0.11	0.51	77.15	-2.69
50	0.14	0.64	83.35	-2.91
60	0.16	0.77	87.87	-3.06
70	0.19	0.90	91.16	-3.18
80	0.22	1.03	93.56	-3.26
90	0.25	1.15	95.31	-3.32
100	0.27	1.28	96.58	-3.37

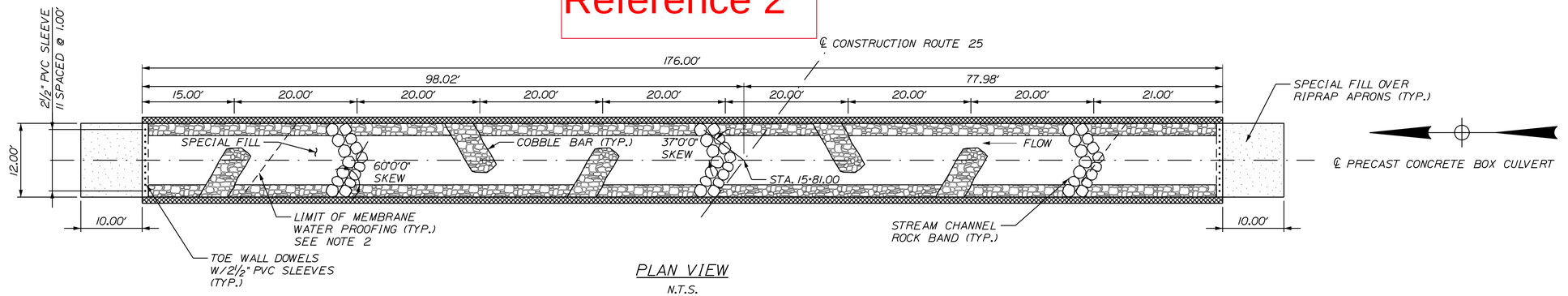


CONCLUSIONS

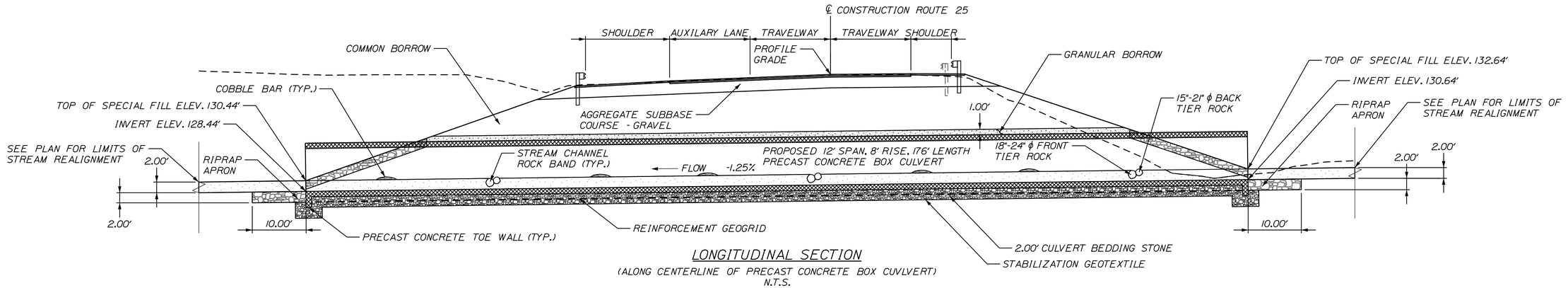
The change in effective stress from existing conditions to new culvert installation within the soil is about -1712 psf. This value indicates there is a potential of ground heaving at the new culvert location. There is potential ground heave of about 3.5 in from excavating at the new culvert location. It is estimated that it will take 88 days for 95% of the heave deformation to occur.


Undrained Shear Strength (psf)
0
500
1000
1500
2000
140
130
120
110
100
90
80
70
Elevation (ft)
Proposed stream elevation
Proposed culvert base elevation
Design curve: Presumpscot clay below existing road
Design curve: Presumpscot clay at stream relocation
Design Curve: Presumpscot clay at new culvert
FV (HB-GBB-201)
FV (HB-GBB-202A)
FV (HB-GBB-203)
FV (HB-GBB-204)
FV (HB-GBB-205)
FV (HB-GBB-301)
FV (HB-GBB-302)
FV (HB-GBB-303)
FV (HB-GBB-304)
FV (HB-GBB-305)
Triaxial (HB-GBB-201)
Triaxial (HB-GBB-202)
Triaxial (HB-GBB-203)

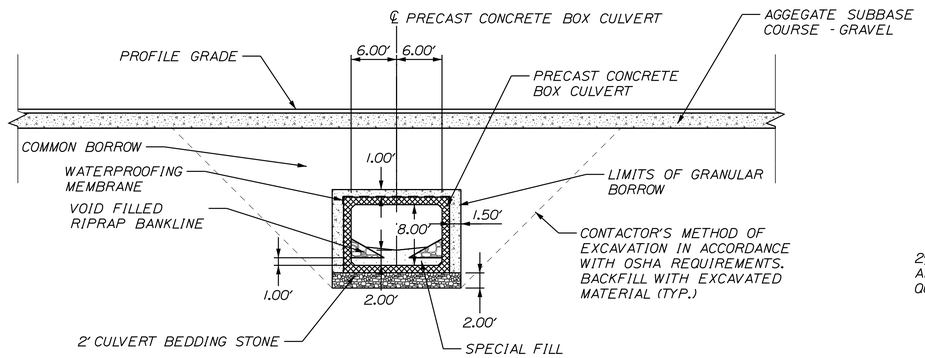
Reference 2



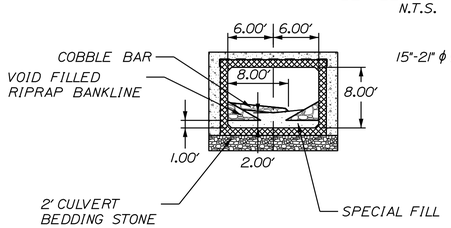
PLAN VIEW
N.T.S.



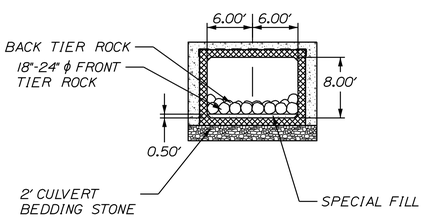
LONGITUDINAL SECTION
(ALONG CENTERLINE OF PRECAST CONCRETE BOX CUVLVERT)
N.T.S.



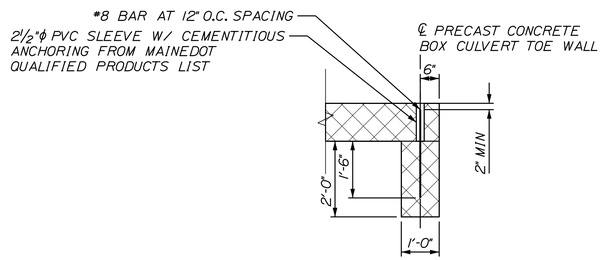
TYPICAL SECTION
(BETWEEN FEATURES)
N.T.S.



TYPICAL SECTION
(AT COBBLE BAR)
N.T.S.



TYPICAL SECTION
(AT STREAM CHANNEL ROCK BAND)
N.T.S.



PRECAST CONCRETE TOE WALL DETAIL
N.T.S.

PRECAST CONCRETE BOX NOTES:

1. THE PRECAST UNITS SHALL BE DESIGNED TO CARRY CONSTRUCTION LOADINGS WITH MINIMUM FILL COVER OF 18" OVER THE TOP OF THE UNITS.

2. INSTALL SHEET MEMBRANE WATERPROOFING OVER THE TOP AND TO 12" DOWN THE EXTERIOR SIDES OF THE PRECAST UNITS WITHIN THE LIMITS OF THE BACKFILL OVER THE TOP OF THE STRUCTURE.

3. THE PIPE SHALL BE BEDDED ON A 2' THICK GEOTEXTILE WRAPPED, UNDERDRAIN BACKFILL MATERIAL, TYPE C WITH A LAYER OF GEOGRID AT THE CENTER. PAYMENT WILL BE MADE UNDER THE APPROPRIATE CONTRACT ITEMS.

4. BEDDING MATERIAL SHALL MEET THE REQUIREMENTS OF SPECIAL PROVISION 203 - CULVERT BEDDING STONE AND 703.22 - UNDERDRAIN BACKFILL MATERIAL TYPE C.

5. COFFERDAMS ARE TO BE PLACED AT BOTH THE DOWNSTREAM AND UPSTREAM ENDS OF THE PRECAST CONCRETE BOX CULVERT TO ALLOW FOR THE CONSTRUCTION OF THE PRECAST CONCRETE BOX CULVERT IN THE DRY.

6. RIPRAP WILL BE USED TO INSLOPE AROUND THE CULVERT ENDS AT BOTH THE INLET AND OUTLET. SEE PLAN AND PROFILE FOR LOCATIONS.

7. ALL REBAR IS INCIDENTAL TO ITEM 534.71, PRECAST CONCRETE BOX CULVERT.

8. VOIDS IN THE RIPRAP APRONS SHALL BE IN FILLED WITH SPECIAL FILL WATERED-IN AND TAMPED PRIOR TO COVERING WITH 2 FT OF SPECIAL FILL.

9. THE CULVERT SHALL BE LINED WITH SPECIAL FILL IN ACCORDANCE WITH SPECIAL PROVISION 203 AND STREAM CHANNEL ROCK IN ACCORDANCE WITH SPECIAL PROVISION 610.

10. EXCAVATED BACKFILL MATERIAL WILL BE PLACED TO SUBGRADE WITH MATERIAL CONSISTENT WITH THE SURROUNDING MATERIAL.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

18821.00

WIN 18821.00

HIGHWAY PLANS

PROJ. MANAGER	L. HAMILTON		
DESIGN-DETAILED	T. WOLFEL	11/2019	T. WOLFEL
CHECKED-REVIEWED	K. WOOD	11/2019	M. STEELE
DESIGN2-DETAILED2			
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

P.E. NUMBER

DATE

GORHAM - BRANDY BROOK
ROUTE 25

SPECIAL DETAILS - CULVERT

SHEET NUMBER
5
OF 22

Filename: ...\MSTA\005_Culvert Details.dgn Division: HIGHWAY Username: Date:11/18/2019

Filename: ...\006_SpecialDetails_Streambed.dgn Division: HIGHWAY Username: Date:11/18/2019

CURVE DATA #1
PI = 400+88.95
D =114°35'29.6"
Δ = 16°11'13.6" Rt.
R = 50.00'
L = 14.13'
T = 7.11'
E = 0.50'

CURVE DATA #2
PI = 401+11.31
D =114°35'29.6"
Δ = 15°00'00.0" Lt.
R = 50.00'
L = 13.09'
T = 6.58'
E = 0.43'

CURVE DATA #3
PI = 401+36.23
D =114°35'29.6"
Δ = 15°00'00.0" Lt.
R = 50.00'
L = 13.09'
T = 6.58'
E = 0.43'

CURVE DATA #4
PI = 401+60.33
D =114°35'29.6"
Δ = 15°25'29.3" Lt.
R = 50.00'
L = 13.46'
T = 6.77'
E = 0.46'

CURVE DATA #5
PI = 402+37.41
D =114°35'29.6"
Δ = 18°07'57.7" Lt.
R = 50.00'
L = 15.82'
T = 7.98'
E = 0.63'

CURVE DATA #6
PI = 402+78.81
D =572°57'28.1"
Δ = 75°00'00.4" Lt.
R = 10.00'
L = 13.09'
T = 7.67'
E = 2.60'

ROCK BAND (TYP.)
SPECIAL FILL REALIGNED STREAM
VOID FILLED PLAIN RIPRAP
COBBLE BAR (TYP.)
SPECIAL FILL REALIGNED STREAM
STREAM CHANNEL ROCK ALONG BANKLINE
S52°58'13.4"E
S 00°01'47.0" W

POB = STA. 400+00.00
PC = STA. 400+81.84
PT = STA. 400+95.97
PI = STA. 400+31.83
PI = STA. 400+41.83
PC = STA. 401+04.78
PT = STA. 401+17.82
PC = STA. 401+29.65
PT = STA. 401+42.74
PT = STA. 401+56.60
PT = STA. 401+67.02
PC = STA. 402+29.43
PT = STA. 402+45.26
PC = STA. 402+71.14
PT = STA. 402+84.23
PI = STA. 404+96.75
PI = STA. 405+14.45
PI = STA. 405+44.77
PI = STA. 405+69.29
PI = STA. 405+88.58
PI = STA. 405+99.50
PI = STA. 406+35.71
POE = STA. 406+55.00

11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00
400+00 401+00 402+00 403+00 404+00 405+00 406+00 407+00

PLAN/PROFILE

HORIZ. 25 0 25 50
VERT. 5 0 5 10
Scale of Feet

PLAN

155 150 145 140 135 130 125 120

EXISTING GROUND
PROPOSED STREAM PROFILE GRADE
PVI = STA. 400+00.00 ELEV. = 126.90
STA. 402+34.52 RIPRAP OUTLET
12' SPAN x 8' RISE 176' LENGTH PRECAST CONCRETE BOX CULVERT
G = 1.25%
PVI = STA. 405+14.46 ELEV. = 133.33
PVI = STA. 405+80.79 ELEV. = 135.14
EXISTING 78" x 108" OVAL CONCRETE CULVERT (REMOVE)
PVI = STA. 406+40.79 ELEV. = 137.42
G1 = 3.80%
PROPOSED STREAM PROFILE GRADE

EL. 126.79 EL. 126.90
EL. 129.60 EL. 127.21
EL. 131.09 EL. 127.52
EL. 142.08 EL. 127.84
EL. 142.84 EL. 128.15
EL. 146.43 EL. 128.46
EL. 147.08 EL. 128.77
EL. 147.96 EL. 129.09
EL. 148.63 EL. 129.40
EL. 149.11 EL. 129.71
EL. 148.46 EL. 130.02
EL. 150.16 EL. 130.34
EL. 150.21 EL. 130.65
EL. 147.86 EL. 130.96
EL. 148.87 EL. 131.27
EL. 149.95 EL. 131.59
EL. 150.07 EL. 131.90
EL. 141.53 EL. 132.21
EL. 131.42 EL. 132.52
EL. 133.95 EL. 132.84
EL. 134.93 EL. 133.15
EL. 133.58
EL. 133.72
EL. 135.00
EL. 134.47 EL. 135.87
EL. 150.94 EL. 136.82
EL. 138.33

STREAM PROFILE

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

18821.00

WIN 18821.00

HIGHWAY PLANS

PROJ. MANAGER	L. HAMILTON	BY	DATE
DESIGN-DETAILED	T. WOLFEL	T. WOLFEL	11/2019
CHECKED-REVIEWED	K. WOOD	M. STEELE	11/2019
DESIGN2-DETAILED2			
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

GORHAM - BRANDY BROOK
ROUTE 25

SPECIAL DETAILS -
STREAM PLAN & PROFILE

SHEET NUMBER
6
OF 22

Reference 5

Equation 9-2 is the *Terzaghi one-dimensional consolidation equation*. It could just as easily be written in three dimensions, but most of the time in engineering practice one-dimensional consolidation is assumed. Basically, the equation is a form of the diffusion equation from mathematical physics. Many physical diffusion phenomena are described by this equation, for example, heat flow in a solid body. The "diffusion constant" for the soil is the c_v. Note that we called the c_v a constant. It really isn't, but we must assume it is, that is, that k, a_v, and e_o are constants, in order to make the equation linear and easily solvable.

So how do we solve the Terzaghi consolidation equation? Just like we solve all other second-order partial differential equations with constant coefficients. There are a variety of ways; some are mathematically exact; others are only approximate. For example, Harr (1966) presents an approximate solution by using the method of finite differences. Taylor (1948), following Terzaghi (1925), gives a mathematically rigorous solution in terms of a Fourier series expansion, and this is what we do in detail in Appendix B-2. Here we shall just give an outline of the solution. First, the boundary and initial conditions for the case of one-dimensional consolidation are:

1. There is complete drainage at the top and bottom of the compressible layer.
2. The initial *excess* hydrostatic pressure $\Delta u = u_i$ is equal to the applied increment of stress at the boundary, $\Delta\sigma$.

We can write these boundary and initial conditions as follows:

$$\text{When } z = 0 \text{ and when}$$
$$z = 2H, u = 0$$
$$\text{When } t = 0, \Delta u = u_i = \Delta\sigma = (\sigma_2' - \sigma_1')$$

We usually take the thickness of the consolidating layer to be $2H$, so that the *length of the longest drainage path* is equal to H or H_{dr}. Of course at $t = \infty$, $\Delta u = 0$, or complete dissipation of the pore pressure will have occurred.

Terzaghi (1925) was obviously familiar with the early work on heat transfer, and he adapted those closed-form solutions to the consolidation problem. The solution comes out in terms of a Fourier series expansion of the form

$$u = (\sigma_2' - \sigma_1') \sum_{n=0}^{\infty} f_1(Z) f_2(T) \tag{9-4}$$

where Z and T are dimensionless parameters (see also Taylor, 1948). The first term, Z, is a geometry parameter, and it is equal to z/H. The second term, T, is known as the *time factor*, and it is related to the coefficient of

consolidation c_v by

$$T = c_v \frac{t}{H_{dr}^2} \tag{9-5}$$

where t = time, and
H_{dr} = length of the longest drainage path.

We have already mentioned that c_v has dimensions of L^2T^{-1} or units of m^2/s (or equivalent).

From Eq. 9-3, the time factor can also be written as

$$T = \frac{k(1 + e_o)}{a_v \rho_w g} \frac{t}{H_{dr}^2} \tag{9-6}$$

Note that t has the same time units as k. That is, if k is in centimetres per second, then t must be in seconds. The drainage path for double drainage would be equal to half the thickness H of the clay layer, or $2H/2 = H_{dr}$. If we had only a singly drained layer, the drainage path would still be H_{dr}, but then it would be equal to the thickness H of the layer.

The progress of consolidation after some time t and at any depth z in the consolidating layer can be related to the void ratio at that time and the final change in void ratio. This relationship is called the *consolidation ratio*, and it is expressed as

$$U_z = \frac{e_1 - e}{e_1 - e_2} \tag{9-7}$$

where e is some intermediate void ratio, as shown on Fig. 9.2. What we are looking at graphically in that figure is the ratio of ordinates corresponding to AB and AC. In terms of stresses and pore pressures, Eq. 9-7 becomes

$$U_z = \frac{\sigma' - \sigma_1'}{\sigma_2' - \sigma_1'} = \frac{\sigma' - \sigma_1'}{\Delta\sigma'} = \frac{u_i - u}{u_i} = 1 - \frac{u}{u_i} \tag{9-8}$$

where σ' and u are intermediate values corresponding to e in Eq. 9-7, and u_i is the initial *excess* pore pressure induced by the applied stress $\Delta\sigma'$. You should satisfy yourself that these equations are correct from the relationships shown in Fig. 9.2 and from $\Delta\sigma' = -\Delta u$. (See also Appendix B-2.)

From Eqs. 9-7 and 9-8, it is evident that U_z is zero at the start of loading, and it gradually increases to 1 (or 100%) as the void ratio decreases from e_1 to e_2. At the same time, of course, as long as the total stress remains constant, the effective stress increases from σ_1' to σ_2' as the excess hydrostatic stress (pore water pressure) dissipates from u_i to zero. The consolidation ratio U_z is sometimes called the *degree or percent consolidation*, and it represents conditions *at a point* in the consolidating layer. It is now possible to put our solution for u in Eq. 9-4 in terms of the

TABLE 9-1

U_{avg}	T
0.1	0.008
0.2	0.031
0.3	0.071
0.4	0.126
0.5	0.197
0.6	0.287
0.7	0.403
0.8	0.567
0.9	0.848
0.95	1.163
1.0	∞

where the initial pore pressure distribution is sinusoidal, half sine, and triangular are presented by Leonards (1962).

Casagrande (1938) and Taylor (1948) provide the following useful approximations:

For $U < 60\%$,

$$T = \frac{\pi}{4}U^2 = \frac{\pi}{4}\left(\frac{U\%}{100}\right)^2 \tag{9-10}$$

For $U > 60\%$,

$$T = 1.781 - 0.933 \log (100 - U\%) \tag{9-11}$$

EXAMPLE 9.3

Given:

$T = 0.05$ for a compressible clay deposit.

Required:

Average degree of consolidation and the percent consolidation at the center and at $z/H = 0.1$.

Solution:

From Table 9-1 and Fig. 9.5, $U_{avg} = 26\%$. Therefore the clay is 26% consolidated, on the average. From Fig. 9.3 you can see that the center of

the layer is less than 0.5% consolidated, while at the "10%" depth ($z/H = 0.1$) the clay is 73% consolidated. But, *on the average* throughout the layer, the clay is 26% consolidated.

What does the average consolidation mean in terms of settlements? U_{avg} can be expressed as

$$U_{avg} = \frac{s(t)}{s_c} \tag{9-12}$$

where $s(t)$ is the settlement at any time, and s_c is the final or ultimate consolidation (primary) settlement at $t = \infty$.

EXAMPLE 9.4

Given:

The data of Example 9.3.

Required:

Find the settlement when U_{avg} is 26%, if the final consolidation settlement is 1 m.

Solution:

From Eq. 9-12, $s(t) = U_{avg}(s_c)$. Therefore

$$s(t) = 26\%\,(1\text{ m}) = 0.26\text{ m}$$

EXAMPLE 9.5

Given:

The soil profile and properties of Examples 9.1 and 9.2.

Required:

Compute the time required for the clay layer to settle 0.25 m.

GOLDER

CALCULATIONS

Date:	11/13/2019	**Made by:**	SKB / MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Heaving at Proposed Culvert Location - As Installed	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

OBJECTIVE

Determine the change in effective stress state within the soil at the new culvert location after construction to identify if settlement or heave will occur. Estimate the amount of heave that may occur in clays deeper than elevation 127.45 ft after construction. Determine the time-rate of heave that will occur for the culvert construction.

REFERENCES

1. Puller, Malcolm. Deep Excavations: a Practical Manual, 2nd Ed. Thomas Telford Publishing, 2003.
2. Construction plans from Maine Department of Transportation, dated April 16, 2019.
3. Golder boring logs.
4. Winterkorn & Fang, 1975. Foundation Engineering Handbook, Litton Educational Publishing, Inc.
5. Holtz & Kovaks, An Introduction To Geotechnical Engineering, 1st Ed., Prentice-Hall, Inc. (1981)
6. Table 5 Engineering Soil Tests - 1669139 Final Report Golder Associates

ASSUMPTIONS

1. The uniform soil properties are cohesion = 500 psf (based on attached design curve) and unit weight = 115 pcf. The cohesion is consistent with the clay layer in the base of the stream used in the slope stability models.
2. A consistent amount of soil is excavated across the culvert alignment (i.e. depth of cut constant across the proposed culvert alignment).

APPROACH

This approach is conservative in that we assume the excavation is uniform and the influence of the adjacent soil embankment is not considered in the stress change calculation.

CALCULATION

A. Determine the change in effective stress state within the soil at the new culvert location to identify if settlement or heave will occur.

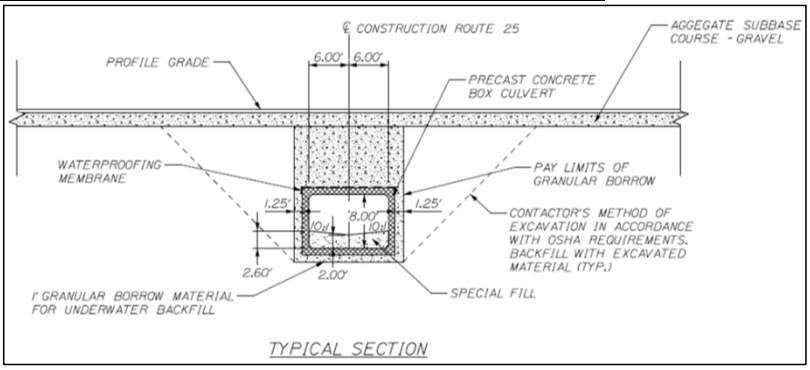
The culvert invert is at elevation 130.64 feet in the south and elevation 128.44 feet in the north. Based on boring logs HB-GBB-205 and HB-GBB-305, the invert will be founded within the clay layer. Invert below centerline of road about 129.7 ft. elevation. (Reference 2).

HB-GBB-205

	Start Elev.	End Elev.	Thick. (ft)
Asphalt	151.8	150.8	1.0
Fill	150.8	144.8	6.0
Clay	144.8	118.8	26.0

This boring profile is nearest to the culvert along the roadway and represents the initial conditions.

Water table at
z (ft) = 6.6 (Reference 3)
γ_w (pcf) = 62.4



Culvert walls are 1.25 ft thick, average unit weight of concrete is γ_{conc} = 150 pcf
Area of culvert concrete per linear foot is 1 ft x 10.5 ft x 14.5 ft less 1 ft x 8 ft x 12 ft.

Culvert:	Vol. (ft^3): 56.25	Weight (lb): 8437.5	Dist. weight (psf): 581.9

Special Fill in the culvert: 2.6 ft thick, 12 ft. wide per linear foot

Sp.Fill:	Vol. (ft^3): 31.2	Weight (lb): 4056	Dist. weight (psf): 338.0

Date:	11/13/2019	**Made by:**	SKB / MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Heaving at Proposed Culvert Location - As Installed	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

Remove soil to 127.45 ft. elev. (invert at elev. 129.7 - 1.25 ft. concrete wall - 1 ft. base fill)

Soil thickness estimated from elevation 150.55 ft to 127.45 ft: 23.10 Water table elevation (ft) = 144.0

Layer	Elev. (ft) top	Elev. (ft) bottom	Thick. (ft)	γ_{bulk} (pcf)	$\Delta\sigma_{v\text{-layer}}$ (psf)	Existing Road
Asphalt	150.55	149.55	1	140	140.0	2741.5 $\sigma_{v\ @\ 127.45\ ft}$ (psf)
Fill	149.55	143.55	6	125	750.0	1711.9 $\sigma'_{v\ @\ 127.45\ ft}$ (psf)
Clay	143.55	127.45	16.10	115	1851.5	

Add the following layers from elev. 127.45 to the ground surface at elev. 150.55 ft

Layer	Elev. (ft) top	Elev. (ft) bottom	Thick. (ft)	γ_{bulk} (pcf)	$\Delta\sigma_{v\text{-layer}}$ (psf)	New Culvert Fully Installed
Asphalt	150.55	149.55	1.0	140	140.0	2509.9 $\sigma_{v\ @\ 127.45\ ft}$ (psf)
Structural Fill	149.55	138.95	10.6	125	1325.0	1480.3 $\sigma'_{v\ @\ 127.45\ ft}$ (psf)
Special Fill (inside)	*131.05*	*128.45*	*2.6*	*130*	*338.0*	
Culvert	*138.95*	*128.45*	*10.5*	*150*	*581.9*	
Structural Fill	128.45	127.45	1.0	125	125.0	

Calculate the increase or decrease in effective stress as a result of the new culvert placement.

Existing Culvert $\sigma'_{v\ @\ 126.45\ ft}$ (psf)	New Culvert Fully Installed $\sigma'_{v\ @\ 126.45\ ft}$ (psf)	Difference $\Delta\sigma'_{v\ @\ 126.45\ ft}$ (psf)		

1711.9	1480.3	**-231.6**	**heave**	If (-), potential heave
				If (+), potential settlement
				If (0), no change

B. Estimate the amount of heave that may occur in clays deeper than elevation 127.45 ft after new culvert installation.

Clay layer between bottom of the layer at elevation 118.8 ft and bottom of the excavation at 127.45 feet will experience heave.

Existing stresses above elevation 127.45 ft. $\sigma_{v\ @\ 127.45\ ft}$ (psf) 2741.5 $\sigma'_{v\ @\ 127.45\ ft}$ (psf) 1711.9

Divide the clay beneath the culvert into layers. Determine the initial effective stress.
Determine the post excavation effective stress assuming the new water table is at elevation 127.45

Layer	Elev. (ft) top	Elev. (ft) bottom	Thickness (ft)	Pre-excavation with old culvert $\sigma_{v\text{-midlayer}}$ (psf)	Pre-excavation with old culvert $\sigma'_{v\text{-midlayer}}$ (psf)	Post-excavation with new culvert $\sigma_{v\text{-midlayer}}$ (psf)	Post-excavation with new culvert $\sigma'_{v\text{-midlayer}}$ (psf)	Post-Pre Difference $\sigma'_{v\text{-midlayer}}$ (psf)
clay	127.45	126.45	1	2799.0	1738.2	2567.4	1506.60	-231.6
	126.45	125.45	1	2914.0	1790.8	2682.4	1559.20	-231.6
	125.45	124.45	1	3029.0	1843.4	2797.4	1611.80	-231.6
	124.45	123.45	1	3144.0	1896.0	2912.4	1664.40	-231.6
	123.45	122.45	1	3259.0	1948.6	3027.4	1717.00	-231.6
	122.45	121.45	1	3374.0	2001.2	3142.4	1769.60	-231.6
	121.45	120.45	1	3489.0	2053.8	3257.4	1822.20	-231.6
	120.45	118.8	1.65	3641.4	2123.5	3409.8	1891.89	-231.6

Calculate heave using the settlement equations below for overconsolidated soil, as the clay will be unloading.

$$\Delta H_i = \frac{C_r H_{layer}}{1 + e_0} \log \frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_{v0}}$$

for overconsolidated clay, $\sigma'_{v0} + \Delta\sigma_v \leq \sigma'_p$

Average clay properties	
C_r	0.07
e_0	1.18

Date:	11/13/2019	**Made by:**	SKB / MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Heaving at Proposed Culvert Location - As Installed	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

Elev. (ft) top	Elev. (ft) bottom	Thickness (ft)	Initial $\sigma'_{v\text{-midlayer}}$ (psf)	Final $\sigma'_{v\text{-midlayer}}$ (psf)	Heave, ΔH (in)	
127.45	126.45	1	1738.2	1506.6	-0.02	
126.45	125.45	1	1790.8	1559.2	-0.02	
125.45	124.45	1	1843.4	1611.8	-0.02	
124.45	123.45	1	1896.0	1664.4	-0.02	
123.45	122.45	1	1948.6	1717.0	-0.02	
122.45	121.45	1	2001.2	1769.6	-0.02	
121.45	120.45	1	2053.8	1822.2	-0.02	
120.45	118.8	1.65	2123.5	1891.9	-0.03	
					-0.19	**Total (in)**

C. Determine the Time-Rate of Heave that will occur for the culvert excavation and construction

Use single layer analysis to determine the time the entire heave to occur.
Assume double drainage condition. Assumption based on structural fill above and glacial outwash below the clay layer (Reference 3). The soil types above and below have a higher permeabilty relative to the clay layer.
Subsurface conditions are simplified to a single soil layer with uniform soil properties for the purpose of the calculation.

Clay layer thickness (ft): 8.65 (Reference 3)

Double Drainage Condition:
H_{dr} (ft): 4.33

$$T_v = \frac{c_v t}{H^2_{dr}}$$ (Reference 5, via Eqn 9-5)

$$T_v = \frac{\pi}{4}\left(\frac{U\%}{100}\right)^2$$ For U = 0% to 60% (Reference 5, via Eqn 9-10)

$$T_v = 1.781 - 0.933\log(100 - U\%)$$ For U = > 60% (Reference 5, via Eqn 9-11)

$$U_{avg} = \frac{s(t)}{s_c}$$ (Reference 5, via Eqn 9-12)

Average clay properties		
c_v (ft^2/day)	0.24	(Reference 6)
e_0	1.18	(Reference 6)

T_v = Time factor (dimensionless)
c_v = Coefficent of Consolidation (ft^2/day)
t = time (day)
H_{dr} = Drainage Path (ft)
U_{avg} = Average Degree or Percent Consolidation
s(t) = settlement/heave at any time (in)
s(c) = final or ultimate settlement/heave (in)

Determine time factor using Reference 5, Eqn. 9-11

U_{avg} = 95 (Calculate time to reach 95% consolidation)
T_v = 1.13

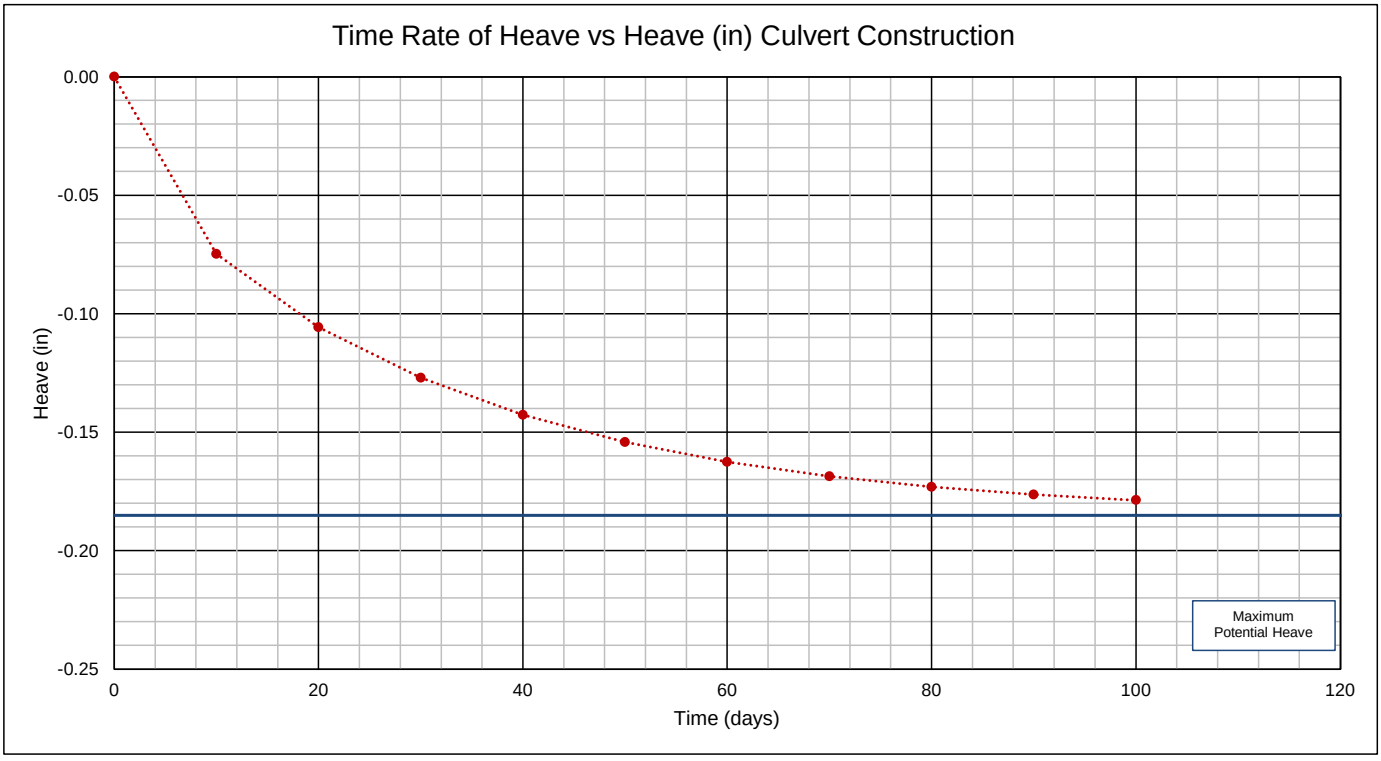
Determine time required for entire heave using Reference 5, Eqn. 9-5

c_v (ft^2/day) = 0.24
H_{dr} (ft) = 4.33
T_v = 1.13
t (days)= 88

ΔH (in)= -0.19 (final potential heave)

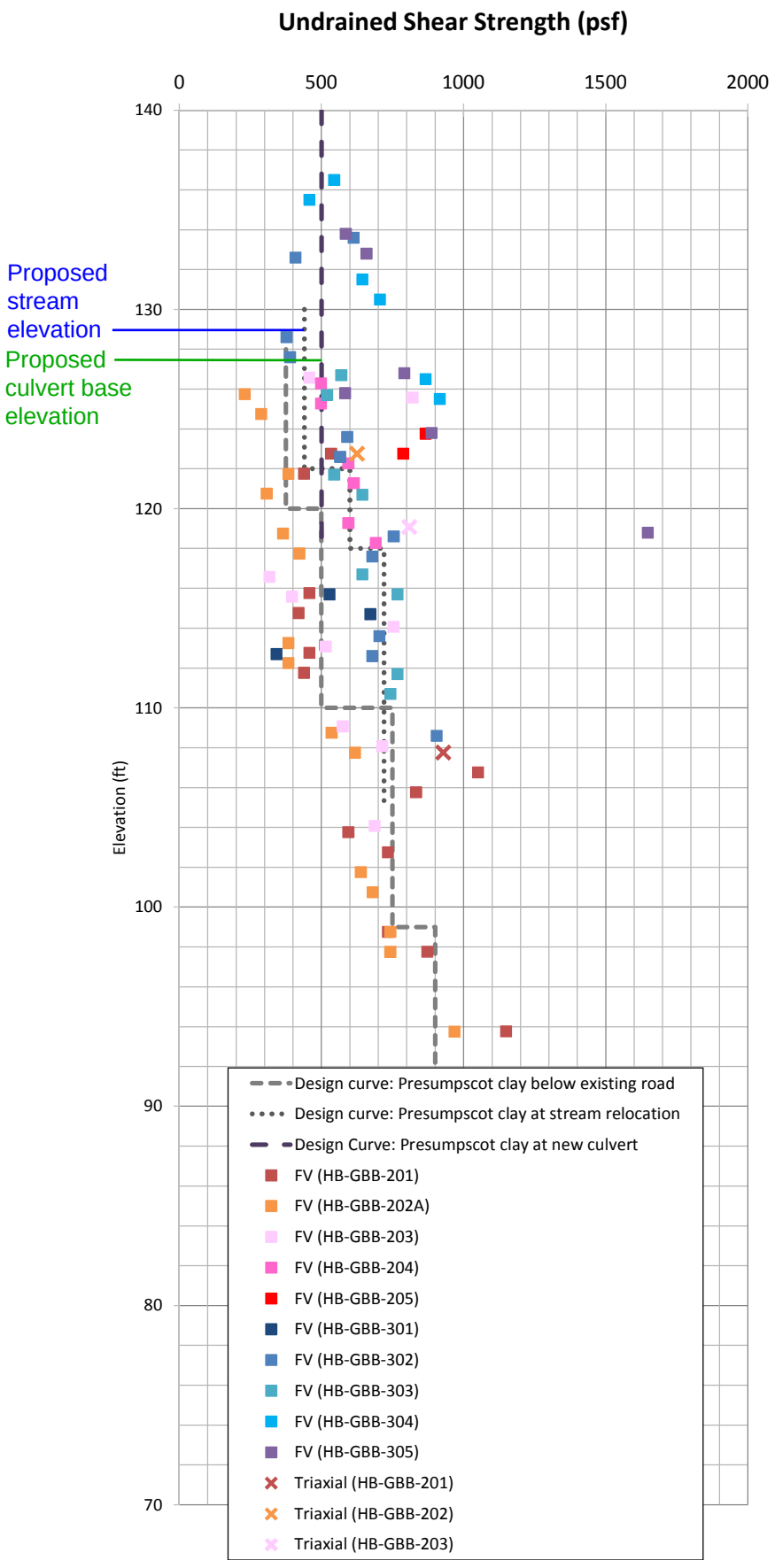
Date:	11/13/2019	**Made by:**	SKB / MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Heaving at Proposed Culvert Location - As Installed	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

Time (days)	Time (years)	Tv	U_{avg} (%)	s(t) (in)
0	0.00	0.00	0.00	0.00
10	0.03	0.13	40.42	-0.07
20	0.05	0.26	57.16	-0.11
30	0.08	0.38	68.64	-0.13
40	0.11	0.51	77.15	-0.14
50	0.14	0.64	83.35	-0.15
60	0.16	0.77	87.87	-0.16
70	0.19	0.90	91.16	-0.17
80	0.22	1.03	93.56	-0.17
90	0.25	1.15	95.31	-0.18
100	0.27	1.28	96.58	-0.18

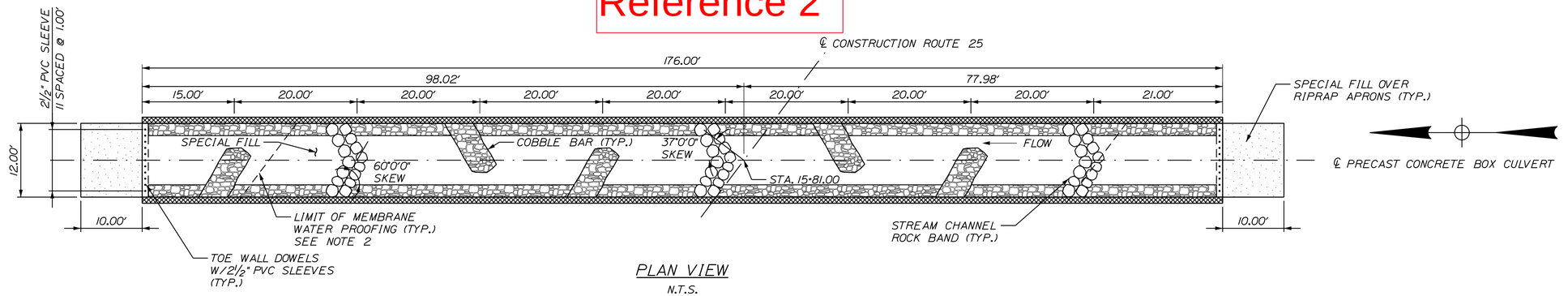


CONCLUSIONS

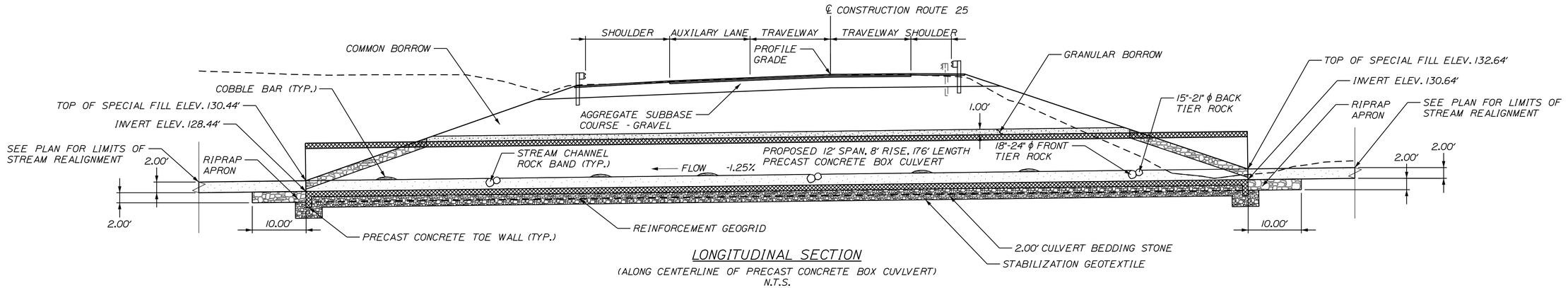
The change in effective stress from existing conditions to new culvert installation within the soil is about -230 psf. This value indicates there is a potential of ground heaving at the new culvert location after culvert construction. There is potential ground heave of about 0.2 in from construction at the new culvert location. It is estimated that it will take 88 days for 95% of the heave deformation to occur.


Undrained Shear Strength (psf)
0
500
1000
1500
2000
140
130
120
110
100
90
80
70
Elevation (ft)
Proposed stream elevation
Proposed culvert base elevation
Design curve: Presumpscot clay below existing road
Design curve: Presumpscot clay at stream relocation
Design Curve: Presumpscot clay at new culvert
FV (HB-GBB-201)
FV (HB-GBB-202A)
FV (HB-GBB-203)
FV (HB-GBB-204)
FV (HB-GBB-205)
FV (HB-GBB-301)
FV (HB-GBB-302)
FV (HB-GBB-303)
FV (HB-GBB-304)
FV (HB-GBB-305)
Triaxial (HB-GBB-201)
Triaxial (HB-GBB-202)
Triaxial (HB-GBB-203)

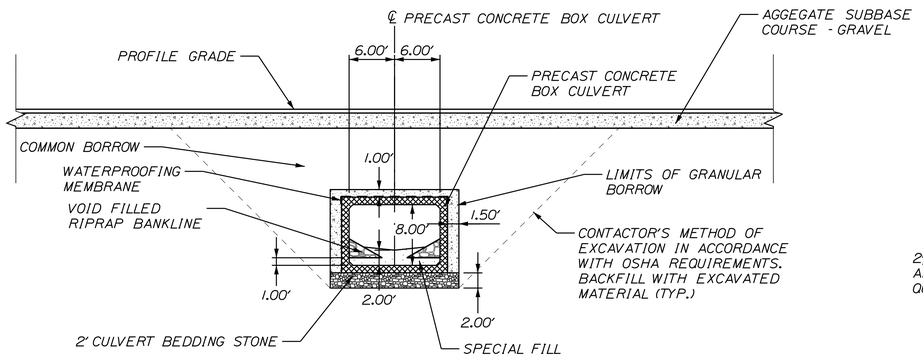
Reference 2



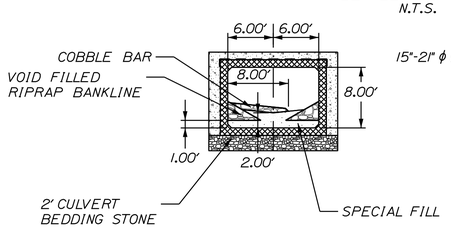
PLAN VIEW
N.T.S.



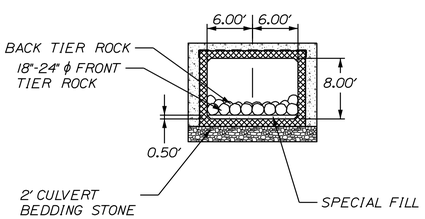
LONGITUDINAL SECTION
(ALONG CENTERLINE OF PRECAST CONCRETE BOX CUVLVERT)
N.T.S.



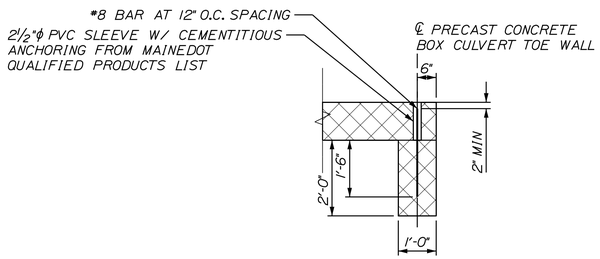
TYPICAL SECTION
(BETWEEN FEATURES)
N.T.S.



TYPICAL SECTION
(AT COBBLE BAR)
N.T.S.



TYPICAL SECTION
(AT STREAM CHANNEL ROCK BAND)
N.T.S.



PRECAST CONCRETE TOE WALL DETAIL
N.T.S.

PRECAST CONCRETE BOX NOTES:

1. THE PRECAST UNITS SHALL BE DESIGNED TO CARRY CONSTRUCTION LOADINGS WITH MINIMUM FILL COVER OF 18" OVER THE TOP OF THE UNITS.

2. INSTALL SHEET MEMBRANE WATERPROOFING OVER THE TOP AND TO 12" DOWN THE EXTERIOR SIDES OF THE PRECAST UNITS WITHIN THE LIMITS OF THE BACKFILL OVER THE TOP OF THE STRUCTURE.

3. THE PIPE SHALL BE BEDDED ON A 2' THICK GEOTEXTILE WRAPPED, UNDERDRAIN BACKFILL MATERIAL, TYPE C WITH A LAYER OF GEOGRID AT THE CENTER. PAYMENT WILL BE MADE UNDER THE APPROPRIATE CONTRACT ITEMS.

4. BEDDING MATERIAL SHALL MEET THE REQUIREMENTS OF SPECIAL PROVISION 203 - CULVERT BEDDING STONE AND 703.22 - UNDERDRAIN BACKFILL MATERIAL TYPE C.

5. COFFERDAMS ARE TO BE PLACED AT BOTH THE DOWNSTREAM AND UPSTREAM ENDS OF THE PRECAST CONCRETE BOX CULVERT TO ALLOW FOR THE CONSTRUCTION OF THE PRECAST CONCRETE BOX CULVERT IN THE DRY.

6. RIPRAP WILL BE USED TO INSLOPE AROUND THE CULVERT ENDS AT BOTH THE INLET AND OUTLET. SEE PLAN AND PROFILE FOR LOCATIONS.

7. ALL REBAR IS INCIDENTAL TO ITEM 534.71, PRECAST CONCRETE BOX CULVERT.

8. VOIDS IN THE RIPRAP APRONS SHALL BE IN FILLED WITH SPECIAL FILL WATERED-IN AND TAMPED PRIOR TO COVERING WITH 2 FT OF SPECIAL FILL.

9. THE CULVERT SHALL BE LINED WITH SPECIAL FILL IN ACCORDANCE WITH SPECIAL PROVISION 203 AND STREAM CHANNEL ROCK IN ACCORDANCE WITH SPECIAL PROVISION 610.

10. EXCAVATED BACKFILL MATERIAL WILL BE PLACED TO SUBGRADE WITH MATERIAL CONSISTENT WITH THE SURROUNDING MATERIAL.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

18821.00

WIN 18821.00

HIGHWAY PLANS

PROJ. MANAGER	L. HAMILTON		
DESIGN-DETAILED	T. WOLFEL	BY	11/2019
CHECKED-REVIEWED	K. WOOD	M. STEELE	11/2019
DESIGN2-DETAILED2			
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

GORHAM - BRANDY BROOK
ROUTE 25

SPECIAL DETAILS - CULVERT

SHEET NUMBER
5
OF 22

Filename: ...\MSTA\005_Culvert Details.dgn Division: HIGHWAY Username: Date:11/18/2019

Filename: ...\006_SpecialDetails_Streambed.dgn Division: HIGHWAY Username: Date:11/18/2019

CURVE DATA #1
PI = 400+88.95
D =114°35'29.6"
Δ = 16°11'13.6" Rt.
R = 50.00'
L = 14.13'
T = 7.11'
E = 0.50'

CURVE DATA #2
PI = 401+11.31
D =114°35'29.6"
Δ = 15°00'00.0" Lt.
R = 50.00'
L = 13.09'
T = 6.58'
E = 0.43'

CURVE DATA #3
PI = 401+36.23
D =114°35'29.6"
Δ = 15°00'00.0" Lt.
R = 50.00'
L = 13.09'
T = 6.58'
E = 0.43'

CURVE DATA #4
PI = 401+60.33
D =114°35'29.6"
Δ = 15°25'29.3" Lt.
R = 50.00'
L = 13.46'
T = 6.77'
E = 0.46'

CURVE DATA #5
PI = 402+37.41
D =114°35'29.6"
Δ = 18°07'57.7" Lt.
R = 50.00'
L = 15.82'
T = 7.98'
E = 0.63'

CURVE DATA #6
PI = 402+78.81
D =572°57'28.1"
Δ = 75°00'00.4" Lt.
R = 10.00'
L = 13.09'
T = 7.67'
E = 2.60'

ROCK BAND (TYP.)
SPECIAL FILL REALIGNED STREAM
VOID FILLED PLAIN RIPRAP
COBBLE BAR (TYP.)
SPECIAL FILL REALIGNED STREAM
STREAM CHANNEL ROCK ALONG BANKLINE
S52°58'13.4"E
S 00°01'47.0" W

POB = STA. 400+00.00
PC = STA. 400+81.84
PT = STA. 400+95.97
PI = STA. 400+31.83
PI = STA. 400+41.83
PC = STA. 401+04.78
PT = STA. 401+17.82
PC = STA. 401+29.65
PT = STA. 401+42.74
PT = STA. 401+56.60
PT = STA. 401+67.02
PC = STA. 402+29.43
PT = STA. 402+45.26
PC = STA. 402+71.14
PT = STA. 402+84.23
PI = STA. 404+96.75
PI = STA. 405+14.45
PI = STA. 405+44.77
PI = STA. 405+69.29
PI = STA. 405+88.58
PI = STA. 405+99.50
PI = STA. 406+35.71
POE = STA. 406+55.00

11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00
400+00 401+00 402+00 403+00 404+00 405+00 406+00 407+00

PLAN/PROFILE

HORIZ. 25 0 25 50
VERT. 5 0 5 10
Scale of Feet

PLAN

155 150 145 140 135 130 125 120

EXISTING GROUND
PROPOSED STREAM PROFILE GRADE
PVI = STA. 400+00.00 ELEV. = 126.90
STA. 402+34.52 RIPRAP OUTLET
12' SPAN x 8' RISE 176' LENGTH PRECAST CONCRETE BOX CULVERT
G = 1.25%
PVI = STA. 405+14.46 ELEV. = 133.33
PVI = STA. 405+80.79 ELEV. = 135.14
EXISTING 78" x 108" OVAL CONCRETE CULVERT (REMOVE)
PVI = STA. 406+40.79 ELEV. = 137.42
G1 = 3.80%
PROPOSED STREAM PROFILE GRADE

EL. 126.79 EL. 126.90
EL. 129.60 EL. 127.21
EL. 131.09 EL. 127.52
EL. 142.08 EL. 127.84
EL. 142.84 EL. 128.15
EL. 146.43 EL. 128.46
EL. 147.08 EL. 128.77
EL. 147.96 EL. 129.09
EL. 148.63 EL. 129.40
EL. 149.11 EL. 129.71
EL. 148.46 EL. 130.02
EL. 150.16 EL. 130.34
EL. 150.21 EL. 130.65
EL. 147.86 EL. 130.96
EL. 148.87 EL. 131.27
EL. 149.95 EL. 131.59
EL. 150.07 EL. 131.90
EL. 141.53 EL. 132.21
EL. 131.42 EL. 132.52
EL. 133.95 EL. 132.84
EL. 134.93 EL. 133.15
EL. 133.58
EL. 133.72
EL. 135.00
EL. 134.47 EL. 135.87
EL. 150.94 EL. 136.82
EL. 138.33

STREAM PROFILE

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

18821.00

WIN 18821.00

HIGHWAY PLANS

PROJ. MANAGER	L. HAMILTON	BY	DATE
DESIGN-DETAILED	T. WOLFEL	T. WOLFEL	11/2019
CHECKED-REVIEWED	K. WOOD	M. STEELE	11/2019
DESIGN2-DETAILED2			
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

GORHAM - BRANDY BROOK
ROUTE 25

SPECIAL DETAILS -
STREAM PLAN & PROFILE

SHEET NUMBER
6
OF 22

Reference 5

Equation 9-2 is the *Terzaghi one-dimensional consolidation equation*. It could just as easily be written in three dimensions, but most of the time in engineering practice one-dimensional consolidation is assumed. Basically, the equation is a form of the diffusion equation from mathematical physics. Many physical diffusion phenomena are described by this equation, for example, heat flow in a solid body. The "diffusion constant" for the soil is the c_v. Note that we called the c_v a constant. It really isn't, but we must assume it is, that is, that k, a_v, and e_o are constants, in order to make the equation linear and easily solvable.

So how do we solve the Terzaghi consolidation equation? Just like we solve all other second-order partial differential equations with constant coefficients. There are a variety of ways; some are mathematically exact; others are only approximate. For example, Harr (1966) presents an approximate solution by using the method of finite differences. Taylor (1948), following Terzaghi (1925), gives a mathematically rigorous solution in terms of a Fourier series expansion, and this is what we do in detail in Appendix B-2. Here we shall just give an outline of the solution. First, the boundary and initial conditions for the case of one-dimensional consolidation are:

1. There is complete drainage at the top and bottom of the compressible layer.
2. The initial *excess* hydrostatic pressure $\Delta u = u_i$ is equal to the applied increment of stress at the boundary, $\Delta\sigma$.

We can write these boundary and initial conditions as follows:

$$\text{When } z = 0 \text{ and when}$$
$$z = 2H, u = 0$$
$$\text{When } t = 0, \Delta u = u_i = \Delta\sigma = (\sigma_2' - \sigma_1')$$

We usually take the thickness of the consolidating layer to be $2H$, so that the *length of the longest drainage path* is equal to H or H_{dr}. Of course at $t = \infty$, $\Delta u = 0$, or complete dissipation of the pore pressure will have occurred.

Terzaghi (1925) was obviously familiar with the early work on heat transfer, and he adapted those closed-form solutions to the consolidation problem. The solution comes out in terms of a Fourier series expansion of the form

$$u = (\sigma_2' - \sigma_1') \sum_{n=0}^{\infty} f_1(Z) f_2(T) \tag{9-4}$$

where Z and T are dimensionless parameters (see also Taylor, 1948). The first term, Z, is a geometry parameter, and it is equal to z/H. The second term, T, is known as the *time factor*, and it is related to the coefficient of

consolidation c_v by

$$T = c_v \frac{t}{H_{dr}^2} \tag{9-5}$$

where t = time, and
H_{dr} = length of the longest drainage path.

We have already mentioned that c_v has dimensions of L^2T^{-1} or units of m^2/s (or equivalent).

From Eq. 9-3, the time factor can also be written as

$$T = \frac{k(1 + e_o)}{a_v \rho_w g} \frac{t}{H_{dr}^2} \tag{9-6}$$

Note that t has the same time units as k. That is, if k is in centimetres per second, then t must be in seconds. The drainage path for double drainage would be equal to half the thickness H of the clay layer, or $2H/2 = H_{dr}$. If we had only a singly drained layer, the drainage path would still be H_{dr}, but then it would be equal to the thickness H of the layer.

The progress of consolidation after some time t and at any depth z in the consolidating layer can be related to the void ratio at that time and the final change in void ratio. This relationship is called the *consolidation ratio*, and it is expressed as

$$U_z = \frac{e_1 - e}{e_1 - e_2} \tag{9-7}$$

where e is some intermediate void ratio, as shown on Fig. 9.2. What we are looking at graphically in that figure is the ratio of ordinates corresponding to AB and AC. In terms of stresses and pore pressures, Eq. 9-7 becomes

$$U_z = \frac{\sigma' - \sigma_1'}{\sigma_2' - \sigma_1'} = \frac{\sigma' - \sigma_1'}{\Delta\sigma'} = \frac{u_i - u}{u_i} = 1 - \frac{u}{u_i} \tag{9-8}$$

where σ' and u are intermediate values corresponding to e in Eq. 9-7, and u_i is the initial *excess* pore pressure induced by the applied stress $\Delta\sigma'$. You should satisfy yourself that these equations are correct from the relationships shown in Fig. 9.2 and from $\Delta\sigma' = -\Delta u$. (See also Appendix B-2.)

From Eqs. 9-7 and 9-8, it is evident that U_z is zero at the start of loading, and it gradually increases to 1 (or 100%) as the void ratio decreases from e_1 to e_2. At the same time, of course, as long as the total stress remains constant, the effective stress increases from σ_1' to σ_2' as the excess hydrostatic stress (pore water pressure) dissipates from u_i to zero. The consolidation ratio U_z is sometimes called the *degree or percent consolidation*, and it represents conditions *at a point* in the consolidating layer. It is now possible to put our solution for u in Eq. 9-4 in terms of the

TABLE 9-1

U_{avg}	T
0.1	0.008
0.2	0.031
0.3	0.071
0.4	0.126
0.5	0.197
0.6	0.287
0.7	0.403
0.8	0.567
0.9	0.848
0.95	1.163
1.0	∞

where the initial pore pressure distribution is sinusoidal, half sine, and triangular are presented by Leonards (1962).

Casagrande (1938) and Taylor (1948) provide the following useful approximations:

For $U < 60\%$,

$$T = \frac{\pi}{4}U^2 = \frac{\pi}{4}\left(\frac{U\%}{100}\right)^2 \tag{9-10}$$

For $U > 60\%$,

$$T = 1.781 - 0.933 \log (100 - U\%) \tag{9-11}$$

EXAMPLE 9.3

Given:

$T = 0.05$ for a compressible clay deposit.

Required:

Average degree of consolidation and the percent consolidation at the center and at $z/H = 0.1$.

Solution:

From Table 9-1 and Fig. 9.5, $U_{avg} = 26\%$. Therefore the clay is 26% consolidated, on the average. From Fig. 9.3 you can see that the center of

the layer is less than 0.5% consolidated, while at the "10%" depth ($z/H = 0.1$) the clay is 73% consolidated. But, *on the average* throughout the layer, the clay is 26% consolidated.

What does the average consolidation mean in terms of settlements? U_{avg} can be expressed as

$$U_{avg} = \frac{s(t)}{s_c} \tag{9-12}$$

where $s(t)$ is the settlement at any time, and s_c is the final or ultimate consolidation (primary) settlement at $t = \infty$.

EXAMPLE 9.4

Given:

The data of Example 9.3.

Required:

Find the settlement when U_{avg} is 26%, if the final consolidation settlement is 1 m.

Solution:

From Eq. 9-12, $s(t) = U_{avg}(s_c)$. Therefore

$$s(t) = 26\%\,(1\text{ m}) = 0.26\text{ m}$$

EXAMPLE 9.5

Given:

The soil profile and properties of Examples 9.1 and 9.2.

Required:

Compute the time required for the clay layer to settle 0.25 m.

GOLDER

CALCULATIONS

Date:	9/16/2019	**Made by:**	KAR
Project No.:	1669139	**Checked by:**	CJS
Subject:	Settlement of Streambed at Existing Culvert	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

OBJECTIVE

To calculate the primary settlement of the streambed at the base of the existing culvert when the culvert is removed and replaced with fill.

REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 8th Ed, 2017. (LRFD)
2. GEOTECHNICAL ENGINEERING CIRCULAR NO. 6: Shallow Foundations. FHWA: September 2002. (FHWA)
3. Das, Braja M. Principles of Foundation Engineering, 7th Ed. Brooks/Cole, 2011. (Das)
4. State of Maine Department of Transportation, Plans: Gorham Cumberland County Route 25 State Project No. 01882100 Large Culvert Replacement, dated 4/16/2019
5. State of Maine Department of Transportation, Gorham Brandy Brook Route 25 Cross Sections: Sheet Number 9 of 10, Sta. 12+77.73 to Sta. 12+77.73, dated 1/26/2017.
6. Golder boring logs and subsurface profiles.
7. Subsurface investigation laboratory testing results.

ASSUMPTIONS

1. Ground water table is at the ground surface at culvert invert (El. 127.5 ft).	D_w =	0	ft
2. Clay consolidation parameters for both the Presumpscot Crust and Presumpscot Clay, based on laboratory test results for borings HB-GBB-201 and HB-GBB-202A (Golder design report Table 5 and Appendix C):	C_c =	0.43	
	C_r =	0.07	
Use these values to calculate modified compression indicies.	e_0 =	1.10	
3. N_{60} value for the Glacial Outwash (from boring logs) is:	N_{60} =	36	
4. Existing stress above culvert is 1.33ksf (9.75 ft of fill with UW = 0.125kcf plus 0.75 ft of concrete from the culvert with UW = 0.150kcf) and filled stress is 2.06ksf (16.5 ft of fill above culvert flowline with UW = 0.125kcf). This results in a net loading stress (q) of:	q =	0.731	ksf
5. Existing culvert flowline elevation is at El. 127.5 ft.			
6. Road grade is El. 144 ft.			

CALCULATION

Use consolidation theory to estimate settlement of the clay layers beneath the culvert (Layers 1-5); use the Hough method to estimate settlement of the glacial outwash beneath the culvert (Layer 6).

1 Subdivide the subsurface soils into layers no larger than 10 ft thick and to a depth of either twice the footing width or to bedrock. Calculate the vertical stress increase at each layer, assuming a 2-to-1 stress distribution method.

$$\Delta\sigma_v = \frac{B_f L_f}{(B_f + Z)(L_f + Z)} \times q$$ FHWA, Eqn. 5-17

where:

$\Delta\sigma_v$	vertical stress increase, ksf			
q	stress applied by footing (Asmpt. 4)	q =	0.731	ksf
B_f	width of the footing, ft	B_f =	9	ft
L_f	length of the footing, ft	L_f =	68	ft
Z	depth to midpoint of layer, ft			

Layer		Depth below footing (ft)	Thickness	Z (ft)	Stress Increase $\Delta\sigma_v$ (ksf)
Presumpscot Crust	1	0-4	4	2	0.58
Presumpscot	2	4-14	10	9	0.32
Presumpscot	3	14-24	10	19	0.18
Presumpscot	4	24-34	10	29	0.12
Presumpscot	5	34-40	6	37	0.09
Outwash	6	40-41.5	1.5	40.75	0.08

Date:	9/16/2019	**Made by:**	KAR
Project No.:	1669139	**Checked by:**	CJS
Subject:	Settlement of Streambed at Existing Culvert	**Reviewed by:**	
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

2 Determine C' and σ'_{v0} for in situ existing soil. Use FHWA Figure 5-19 to obtain a C' for Layer 6, assuming the glacial outwash is "well graded fine to medium silty SAND".

	Existing fill thickness (ft)	Existing fill unit weight (kcf)	Culvert concrete thickness (ft)	Culvert concrete unit weight (kcf)	σ'_{v0} (ksf)		Water unit weight (kcf)
Stress due to existing soil and culvert concrete above footing	9.75	0.125	0.75	0.150	1.33		0.0624

Layer		Depth Below Footing (ft)	Layer Thickness (ft)	Z (ft)	$(N_1)_{60}$ avg	C'	Unit Weight of Layer (kcf)	σ'_{v0} (ksf)
Presumpscot Crust	1	0-4	4	2	Not required for clay consolidation analysis		0.120	1.45
Presumpscot	2	4-14	10	9			0.115	1.82
Presumpscot	3	14-24	10	19			0.115	2.35
Presumpscot	4	24-34	10	29			0.115	2.88
Presumpscot	5	34-40	6	37			0.115	3.30
Outwash	6	40-41.5	1.5	40.75	36	87	0.125	3.50

3 Calculate the total settlement of the glacial outwash (Layer 6) using the Hough method:

General Equation (FHWA, Eqn 5-24)

$$\Delta H_i = H_c \frac{1}{C'} \log\left(\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_{v0}}\right)$$

where:

- ΔH_i settlement in each layer, ft
- H_c initial height of layer i, ft
- C' bearing capacity index from FHWA Figure 5-19
- $\Delta\sigma_v$ vertical stress increase, ksf

ΔH_i (Layer 6)	ft	0.0002
	in	0.002

4 Calculate the total settlement of the clays (Layers 1-5) using the consolidation theory:

General Equation (Das, Eqn 5.81, 5.82, 5.83)

$$\Delta H_i = C_{r\varepsilon} H_c \log\frac{\sigma'_p}{\sigma'_{v0}} + C_{c\varepsilon} H_c \log\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_p}$$ for overconsolidated clay, $\sigma'_{v0} + \Delta\sigma_v > \sigma'_p$

$$\Delta H_i = C_{r\varepsilon} H_c \log\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_{v0}}$$ for overconsolidated clay, $\sigma'_{v0} + \Delta\sigma_v \le \sigma'_p$

$$\Delta H_i = C_{c\varepsilon} H_c \log\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_{v0}}$$ for normally consolidated clay

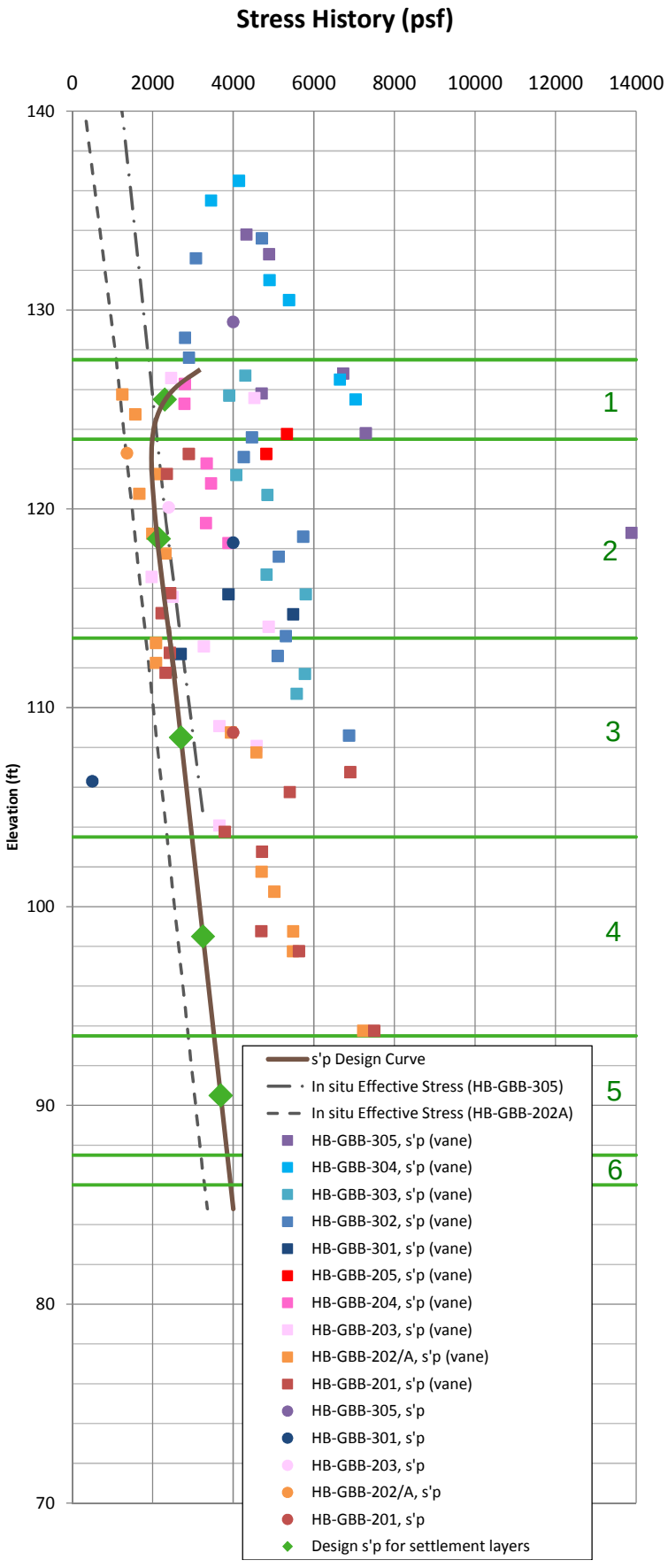
Date:	9/16/2019	**Made by:**	KAR
Project No.:	1669139	**Checked by:**	CJS
Subject:	Settlement of Streambed at Existing Culvert	**Reviewed by:**	
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

where:			Layer 1 - Clay Crust	Layer 2 - Clay	Layer 3 - Clay	Layer 4 - Clay	Layer 5 - Clay
H_c	initial height of layer i, ft		4	10	10	10	6
$\Delta\sigma_v$	surcharge load, psf		581	323	184	121	93
σ'_{v0}	in situ vertical effective stress, psf		1446	1825	2351	2877	3297
$\sigma'_{v0} + \Delta\sigma_v$	(check against σ'_p to select equation)		2028	2148	2534	2998	3390
σ'_p	preconsolidated stress, psf		2300	2153	2701	3249	3688
$C_{r\varepsilon}$	modified recompression index		0.03	0.03	0.03	0.03	0.03
$C_{c\varepsilon}$	modified compression index		0.20	0.20	0.20	0.20	0.20
ΔH_i		ft	0.018	0.022	0.010	0.006	0.002
		in	0.218	0.263	0.122	0.067	0.027

	Settlement Based on Calculated Loading Stress
Layer	ΔH_i (in)
1	0.218
2	0.263
3	0.122
4	0.067
5	0.027
6	0.002
Total Settlement (in)	0.70

CONCLUSIONS

The primary settlement at the base of the existing culvert when the culvert is removed and replaced with fill is estimated to be 0.7 inches.


Stress History (psf)
0
2000
4000
6000
8000
10000
12000
14000
140
130
120
110
100
90
80
70
Elevation (ft)
1
2
3
4
5
6
s'p Design Curve
In situ Effective Stress (HB-GBB-305)
In situ Effective Stress (HB-GBB-202A)
HB-GBB-305, s'p (vane)
HB-GBB-304, s'p (vane)
HB-GBB-303, s'p (vane)
HB-GBB-302, s'p (vane)
HB-GBB-301, s'p (vane)
HB-GBB-205, s'p (vane)
HB-GBB-204, s'p (vane)
HB-GBB-203, s'p (vane)
HB-GBB-202/A, s'p (vane)
HB-GBB-201, s'p (vane)
HB-GBB-305, s'p
HB-GBB-301, s'p
HB-GBB-203, s'p
HB-GBB-202/A, s'p
HB-GBB-201, s'p
Design s'p for settlement layers

Alternatively, stress distributions can also be obtained by assuming a 2-to-1 distribution of stress below the footing, as shown in Figure 5-12. This is much simpler to compute and is a reasonably accurate approximation of the decrease in stress with depth due to an applied surficial load of limited areal extent.

A comparison of the simplified 2-to-1 distribution with the actual distributed stress according to elastic theory is shown in Figure 5-13. This distribution can be computed as a function of applied stress according to:

$$\frac{\Delta\sigma_v}{q} = \frac{B_f L_f}{(B_f + Z)(L_f + Z)} \qquad (5\text{-}17)$$

where: $\Delta\sigma_V$ = Change in vertical stress at depth Z below the footing bearing elevation
q = Stress applied by the footing at the bearing elevation
Z = Depth below footing bearing elevation to point of interest, usually the center or midpoint of a soil layer or sublayer where a settlement computation is to be made
B_f = Width of footing
L_f = Length of footing

5.3.3 Footings on Cohesive Soils

Primary and secondary consolidation of clays or clayey deposits may result in substantial settlements when the structure is founded on saturated cohesive soils. Settlement resulting from primary consolidation may take weeks to years to be completed. Furthermore, because soil properties may vary beneath the foundation, the duration of the primary consolidation and the amount of settlement may also vary with the location of the footing, resulting in differential settlement between footing locations. If such settlements are not within tolerable limits, the structure may not perform as expected or intended.

When a foundation is wide compared to the compressible layer thickness beneath it, a large portion of the soil will settle vertically (one-dimensionally) with very little lateral displacement because of the constraining forces exerted by the neighboring soil elements. Based on measurements of lateral displacements beneath embankments and tanks, it is usually reasonable to assume that the settlements beneath a foundation will be one-dimensional even for narrow foundations, provided an adequate factor of safety is applied to bearing capacity (Terzaghi & Peck, 1967). Desiccated crust or overburden above the base of the footing will tend to minimize the amount of lateral displacements. Experience suggests that reasonably good estimates of settlement can be predicted assuming one-dimensional compression as long as the factor of safety is at least three (3) against bearing capacity failure. One-dimensional consolidation theory is presented in this section and is used to calculate settlement estimates for shallow foundations on cohesive soils.

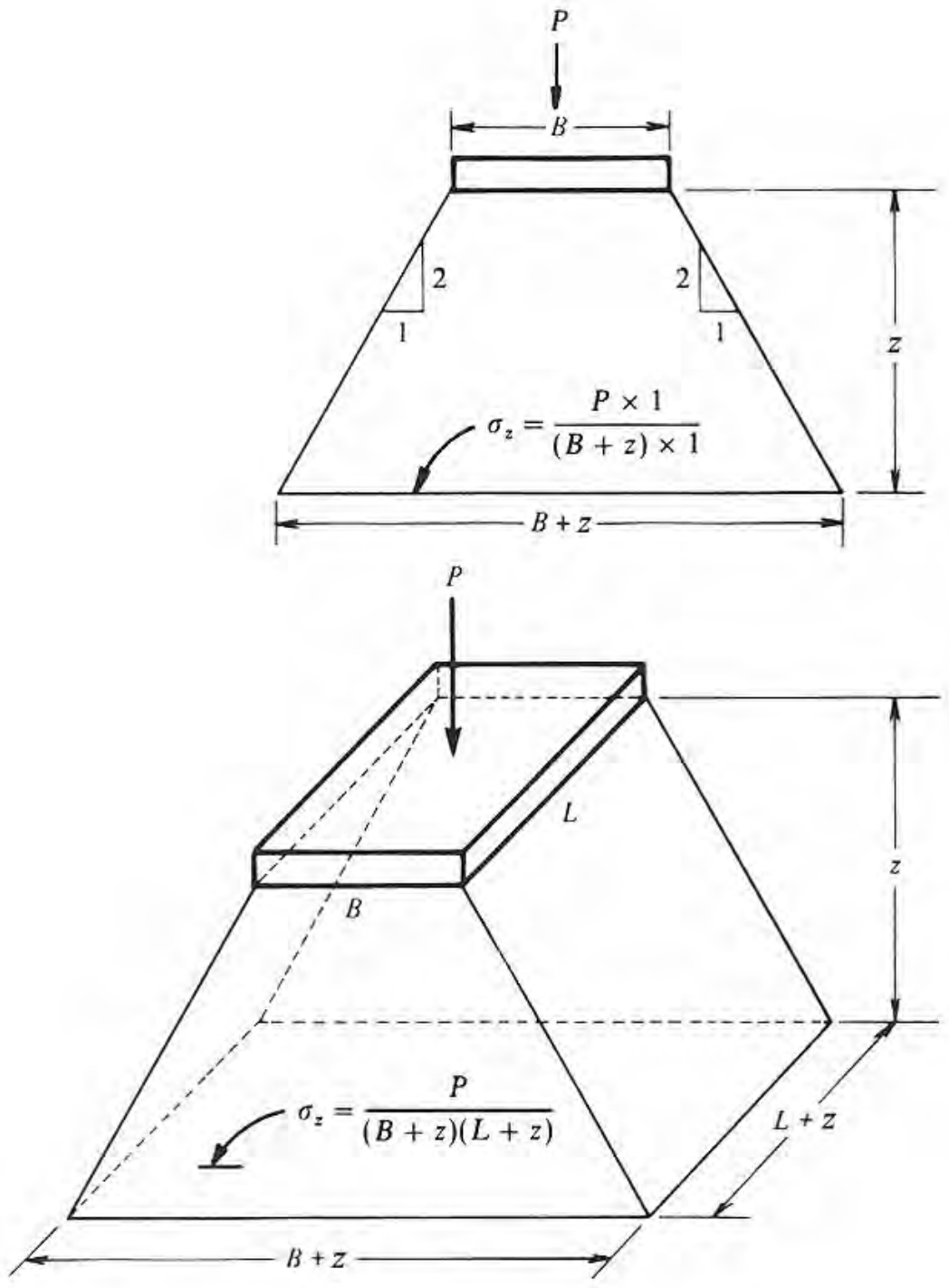


Figure 5-12: Distribution of Vertical Stress by the 2:1 Method
(Chen and McCarron, 1991)

- The D'Appolonia method under-predicted the settlement by an average factor of about 0.77 for the five footings, but the accuracy was generally better than Hough, and the scatter in the predicted settlement values was also less (standard deviation, $s_o = 0.22$).

The data from the five load tests therefore generally corroborate the conclusions from the Gifford et al. and Burland & Burbidge studies.

Therefore, it is currently recommended that the Hough method be used as a primary design and analysis tool. The D'Appolonia or load-settlement methods could be employed as alternates, or when a more accurate estimate of settlement is desired, recognizing that these alternate methods have less history of use in the design of highway bridges. Naturally, if another method is locally or regionally known to provide more reliable estimates of settlement on granular soils, and the method meets the criteria noted above, the geotechnical engineer should exercise judgment and use the best method available.

5.3.4.1 Hough Method

Hough (1959) developed an empirical method for predicting settlements of shallow foundations on cohesionless soils that follows the same approach as that used for calculating consolidation settlement of clay layers. Note that the method is applicable only for normally consolidated cohesionless soils. Cheney and Chassie (2000) recommend that the SPT blowcounts be corrected for overburden pressure before correlating the N-values to the bearing capacity index, C′. An overburden correction by Bazaraa (1967) was recommended by Cheney and Chassie (2000). Since that time, many researchers have studied the effect of overburden stress on the SPT N-value, largely in support of liquefaction hazard assessment procedures. Recent consensus by the 1996 and 1998 National Center for Earthquake Engineering Research (NCEER) (Youd et al., 2001) concluded that the correction proposed by Liao & Whitman (1986) (shown in Figure 5-18) could be used for routine engineering applications. Therefore, the correction by Liao & Whitman is included here as part of the Hough procedure, in particular because it is easy to calculate and can be used without charts in simple computation spreadsheets. The soil is divided into layers, and the change in effective vertical stress at the mid-height of the layer as a result of the applied load is estimated using elastic theory.

The total settlement by the Hough method is calculated as follows:

1. Correct SPT blowcounts for overburden stress using Figure 5-18.

2. Determine bearing capacity index (C′) from Figure 5-19 using corrected SPT blowcounts, N′, determined in Step 1.

3. Subdivide subsurface soil profile into approximately 3-m (10-ft) layers based on stratigraphy to a depth of about three times the footing width.

4. Calculate the effective vertical stress, σ'_{vo}, at the midpoint of each layer and the average bearing capacity index for that layer.

5. Calculate the increase in stress at the midpoint of each layer, $\Delta\sigma_v$, using either Figure 5-9, 5-10 or 5-11, or the 2:1 method (Figure 5-12).

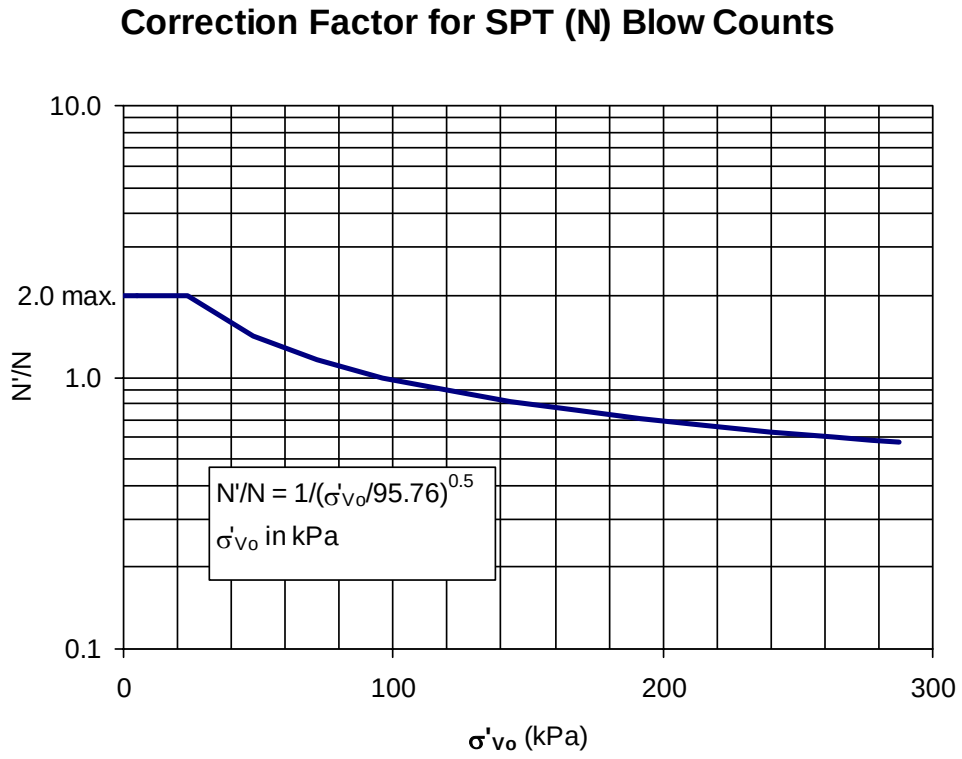


Figure 5-18: Corrected SPT (N) versus Overburden Pressure (after Liao & Whitman, 1986)

6. Calculate the settlement in each layer, ΔH, under the applied load using the following formula:

$$\Delta H = H_o \frac{1}{C'} \log\left(\frac{\sigma'_{vo} + \Delta\sigma_{v_f}}{\sigma'_{vo}}\right) \qquad (5\text{-}24)$$

7. Sum the incremental settlements to determine the total settlement.

5.3.4.2 D'Appolonia Method

The D'Appolonia method calculates settlement using the following basic equation:

$$\Delta H = \left(\frac{\Delta\sigma_V B_f}{M}\right)\mu_o\mu_1 \qquad (5\text{-}25)$$

where: ΔH = settlement in sand or sand and gravel
$\Delta\sigma_v$ = applied stress beneath footing
B_f = footing width
μ_O = correction factor for embedment – see Figure 5-20 (dimensionless)
μ_1 = correction factor for thickness of sand layer – see Figure 5-20 (dimensionless)
M = modulus of compressibility of sand – see Figure 5-21

Any consistent set of units can be used for ΔH, $\Delta\sigma_v$, B_f and M.

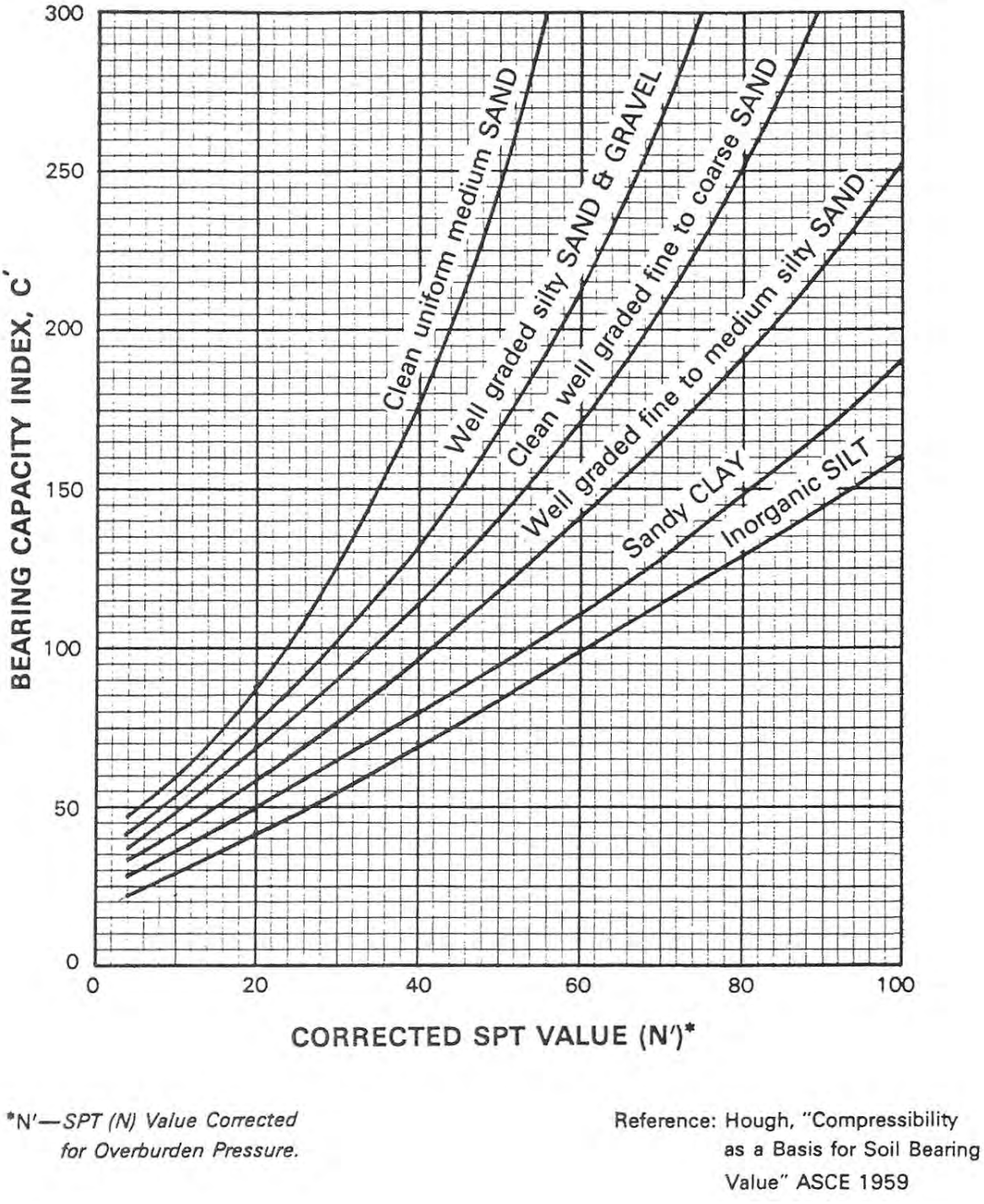


Figure 5-19: Bearing Capacity Index versus Corrected SPT
(Cheney & Chassie, 2000, modified from Hough, 1959)

Reference 3

Referring to Figure 5.7, $I_{a(H_1)} = 0.175$, so

$$\Delta\sigma_{\text{av}\,(H_2/H_1)} = 100\left[\frac{(5)(0.126) - (3)(0.175)}{5-3}\right] = \mathbf{5.25\ kN/m^2}$$

The stress increase between $z = 3$ m to $z = 5$ m below the center of the loaded area is equal to

$$4\Delta\sigma_{\text{av}\,(H_2/H_1)} = (4)(5.25) = \mathbf{21\ kN/m^2}$$ ■

5.6 Stress Increase under an Embankment

Figure 5.10 shows the cross section of an embankment of height H. For this two-dimensional loading condition, the vertical stress increase may be expressed as

$$\Delta\sigma = \frac{q_o}{\pi}\left[\left(\frac{B_1 + B_2}{B_2}\right)(\alpha_1 + \alpha_2) - \frac{B_1}{B_2}(\alpha_2)\right] \tag{5.20}$$

where

$q_o = \gamma H$
γ = unit weight of the embankment soil
H = height of the embankment

$$\alpha_1 = \tan^{-1}\left(\frac{B_1 + B_2}{z}\right) - \tan^{-1}\left(\frac{B_1}{z}\right) \tag{5.21}$$

$$\alpha_2 = \tan^{-1}\left(\frac{B_1}{z}\right) \tag{5.22}$$

(Note that α_1 and α_2 are in radians.)

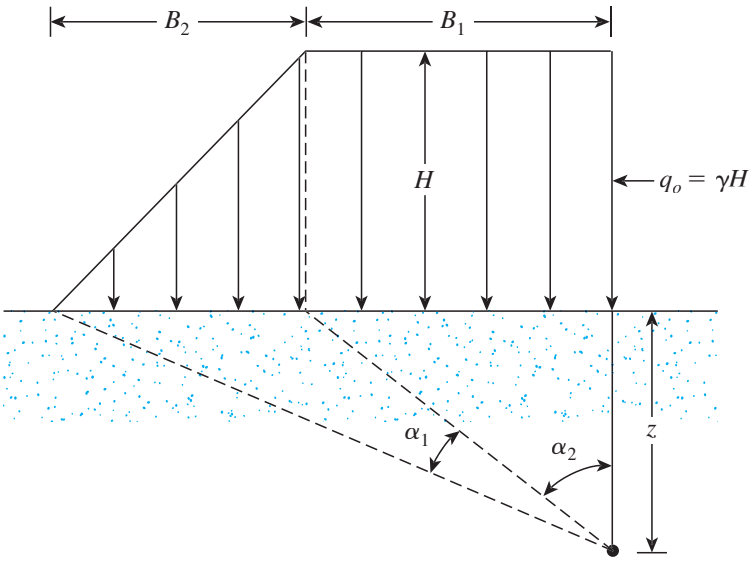


Figure 5.10 Embankment loading

Consolidation Settlement

5.15 Primary Consolidation Settlement Relationships

As mentioned before, consolidation settlement occurs over time in saturated clayey soils subjected to an increased load caused by construction of the foundation. (See Figure 5.29.) On the basis of the one-dimensional consolidation settlement equations given in Chapter 1, we write

$$S_{c(p)} = \int \varepsilon_z dz \tag{5.80}$$

where

ε_z = vertical strain

$$= \frac{\Delta e}{1 + e_o}$$

Δe = change of void ratio

$= f(\sigma'_o, \sigma'_c, \text{and } \Delta\sigma')$

So,

$$S_{c(p)} = \frac{C_c H_c}{1 + e_o} \log \frac{\sigma'_o + \Delta\sigma'_{av}}{\sigma'_o} \qquad \text{(for normally consolidated clays)} \tag{5.81}$$

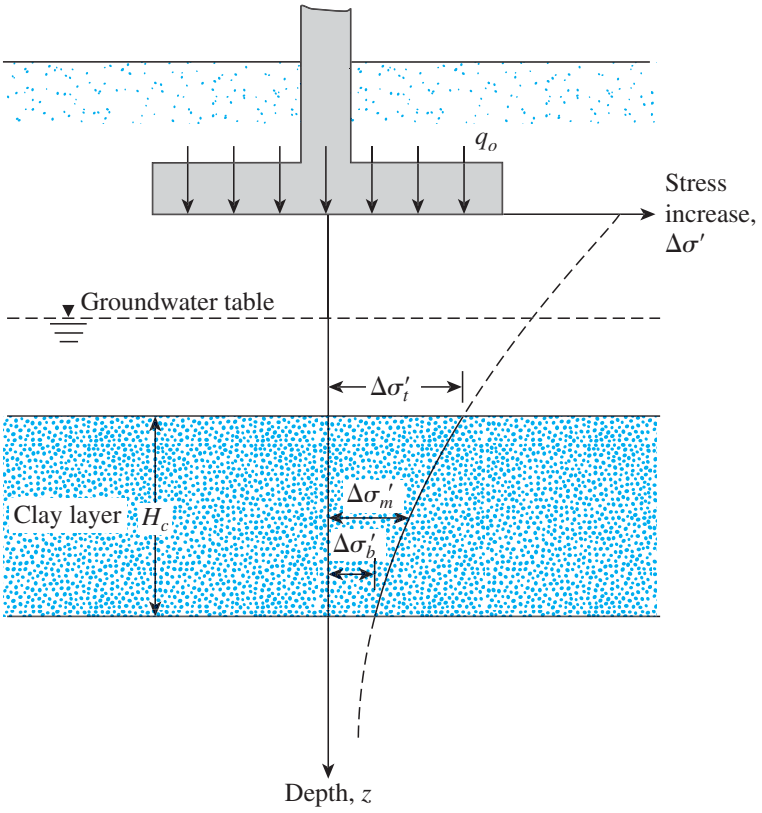


Figure 5.29 Consolidation settlement calculation

$$S_{c(p)} = \frac{C_s H_c}{1 + e_o} \log \frac{\sigma'_o + \Delta\sigma'_{av}}{\sigma'_o} \qquad \text{(for overconsolidated clays with } \sigma'_o + \Delta\sigma'_{av} < \sigma'_c\text{)} \tag{5.82}$$

$$S_{c(p)} = \frac{C_s H_c}{1 + e_o} \log \frac{\sigma'_c}{\sigma'_o} + \frac{C_c H_c}{1 + e_o} \log \frac{\sigma'_o + \Delta\sigma'_{av}}{\sigma'_c} \qquad \text{(for overconsolidated clays with } \sigma'_o < \sigma'_c < \sigma'_o + \Delta\sigma'_{av}\text{)} \tag{5.83}$$

where

σ'_o = average effective pressure on the clay layer before the construction of the foundation
$\Delta\sigma'_{av}$ = average increase in effective pressure on the clay layer caused by the construction of the foundation
σ'_c = preconsolidation pressure
e_o = initial void ratio of the clay layer
C_c = compression index
C_s = swelling index
H_c = thickness of the clay layer

The procedures for determining the compression and swelling indexes were discussed in Chapter 1.

Note that the increase in effective pressure, $\Delta\sigma'$, on the clay layer is not constant with depth: The magnitude of $\Delta\sigma'$ will decrease with the increase in depth measured from the bottom of the foundation. However, the average increase in pressure may be approximated by

$$\Delta\sigma'_{av} = \tfrac{1}{6}(\Delta\sigma'_t + 4\Delta\sigma'_m + \Delta\sigma'_b) \tag{5.84}$$

where $\Delta\sigma'_t$, $\Delta\sigma'_m$, and $\Delta\sigma'_b$ are, respectively, the effective pressure increases at the *top, middle,* and *bottom* of the clay layer that are caused by the construction of the foundation.

The method of determining the pressure increase caused by various types of foundation load using Boussinesq's solution is discussed in Sections 5.2 through 5.6. $\Delta\sigma'_{av}$ can also be directly obtained from the method presented in Section 5.5.

5.16 Three-Dimensional Effect on Primary Consolidation Settlement

The consolidation settlement calculation presented in the preceding section is based on Eqs. (1.61), (1.63), and (1.65). These equations, as shown in Chapter 1, are in turn based on one-dimensional laboratory consolidation tests. The underlying assumption is that the increase in pore water pressure, Δu, immediately after application of the load equals the increase in stress, $\Delta\sigma$, at any depth. In this case,

$$S_{c(p)-\text{oed}} = \int \frac{\Delta e}{1 + e_o} dz = \int m_v \Delta\sigma'_{(1)} dz$$

where

$S_{c(p)-\text{oed}}$ = consolidation settlement calculated by using Eqs. (1.61), (1.63), and (1.65)
$\Delta\sigma'_{(1)}$ = effective vertical stress increase
m_v = volume coefficient of compressibility (see Chapter 1)

Reference 4

VERTICAL DATUM - NAVD 88
COMBINED SCALE FACTOR - 0.9999707

GRONDIN AGGREGATES, LLC
TAX MAP 42 LOT 5
C.C.R.D. BOOK 13590 PAGE 310
POR NO. 1

DAVID G. IRVING, JR.
DONNA M. IRVING
TAX MAP 42 LOT 3
C.C.R.D. BOOK 20515 PAGE 324
POR NO. 4

ZACHARY J. FANCY
ERIN E. FANCY
TAX MAP 37 LOT 2
C.C.R.D. BOOK 29267 PAGE 269
POR NO. 2

PREVIOUS
TAX MAP 37 LOT 2
C.C.R.D. BOOK 17396 PAGE 47
POR NO. 2

STA. 11+50.00
BEGIN TRANSITION
MATCH EXISTING
ROADWAY PAVEMENT

STA. 11+25.00
BEGIN GUARDRAIL
WIDENING
LIMIT OF WORK

W-BEAM GUARDRAIL
- MID-WAY SPLICE
FLARED TERMINAL

STA. 11+75.00
END TRANSITION
BEGIN PROJECT
WIN 18821.00

RELOCATED LEVEL LIP
SPREADER. LEVEL LIP
SPREADER
DIMENSIONS AND
SLOPE TO MATCH
EXISTING.

SPECIAL FILL
REALIGNED
STREAM

PLAIN
RIPRAP

VOID FILLED
PLAIN RIPRAP

COBBLE BAR (TYP.)

ROCK BAND (TYP.)

RIPRAP DOWNSPOUT

REMOVE SIGN

REMOVE

TERMINAL END,
SINGLE RAIL

STA. 16+25.00
BEGIN TRANSITION
END PROJECT
WIN 18821.00

STA. 16+50.00
END TRANSITION
MATCH EXISTING
ROADWAY PAVEMENT

R = 53'

24" X 128'
OPT III

℄ 12' SPAN X 8' RISE,
176' LENGTH PRECAST
CONCRETE BOX CULVERT
STA. 15+81.00

37° SKEW

ROUTE 25

S52°58'13.4"E
STATE HIGHWAY "12" / ROUTE 25 / OSSIPEE TRAIL

15" X 46' OPT I

ANCHORAGE ASSEMBLY
FOR DRIVEWAY RADIUS
R = 15'

PLUG & FILL EXISTING
CULVERT WITH FLOWABLE FILL

BRANDY BROOK

REMOVE

REMOVE

REMOVE

SPECIAL FILL
REALIGNED
STREAM

STREAM
CHANNEL ROCK
ALONG BANKLINE

REMOVE
EXISTING
CULVERT

49.8200
N23°16'8"W

128.9600
N23°16'8"W

PLAN

PLAN/PROFILE
HORIZ. 25 0 25 50
VERT. 5 0 5 10
Scale of Feet

PROFILE

EXISTING
GROUND

PROPOSED PROFILE GRADE

STA. 11+57.50
PVCC = STA. 11+57.50
ELEV. = 143.75

V.C.L. = 95'
HLSD = 46'
E = 0.107'

PVT = STA. 12+52.50
ELEV. = 143.80

PVC = STA. 13+20.00
ELEV. = 144.13

V.C.L. = 360'
HLSD = 332'
E = 2.295'

PVT = STA. 16+80.00
ELEV. = 155.11

PVI = STA. 11+00.00
ELEV. = 143.94

V.C.L. = 95'
SSD = 1317'
E = -0.101'

PVI = STA. 12+05.00
ELEV. = 143.56

LOW POINT = STA. 11+99.72
ELEV. = 143.66

PVI = STA. 15+00.00
ELEV. = 145.03

G = -0.45%
G = -0.40%
G = -0.40%
G = +0.50%
G = +0.50%
G = +0.50%
G = +5.60%

108" x 72" CONCRETE BOX
(PLUG & FILL EXISTING
CULVERT WITH FLOWABLE FILL)

STA. 16+25.00
BEGIN TRANSITION
END PROJECT
WIN 18821.00

STA. 16+50.00
END TRANSITION
MATCH EXISTING
ROADWAY PAVEMENT

STA. 15+81.00
℄ 12' SPAN x 8' RISE,
176' LENGTH PRECAST
CONCRETE BOX CULVERT

EL. 143.80 EL. 143.83 EL. 143.78 EL. 143.78 EL. 143.73 EL. 143.69 EL. 143.65 EL. 143.66 EL. 143.74 EL. 143.69 EL. 143.87 EL. 143.78 EL. 143.98 EL. 143.91 EL. 144.08 EL. 144.03 EL. 144.15 EL. 144.16 EL. 144.28 EL. 144.35 EL. 144.61 EL. 144.62 EL. 144.98 EL. 144.99 EL. 145.39 EL. 145.44 EL. 145.96 EL. 145.98 EL. 146.57 EL. 146.61 EL. 147.31 EL. 147.33 EL. 148.12 EL. 148.13 EL. 149.08 EL. 149.03 EL. 150.01 EL. 150.01 EL. 151.02 EL. 151.09 EL. 152.13 EL. 152.25 EL. 153.50 EL. 153.50 EL. 154.86 EL. 156.18

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

18821.00

WIN
18821.00

HIGHWAY PLANS

	L. HAMILTON	T. WOLFEL	K. WOOD	M. STEELE				
PROJ. MANAGER								
DESIGN-DETAILED	T. WOLFEL	11/2019						
CHECKED-REVIEWED	K. WOOD	M. STEELE	11/2019					
DESIGN2-DETAILED2								
DESIGN3-DETAILED3								
REVISIONS 1								
REVISIONS 2								
REVISIONS 3								
REVISIONS 4								
FIELD CHANGES								

BY | DATE | SIGNATURE | P.E. NUMBER | DATE

GORHAM - BRANDY BROOK
ROUTE 25

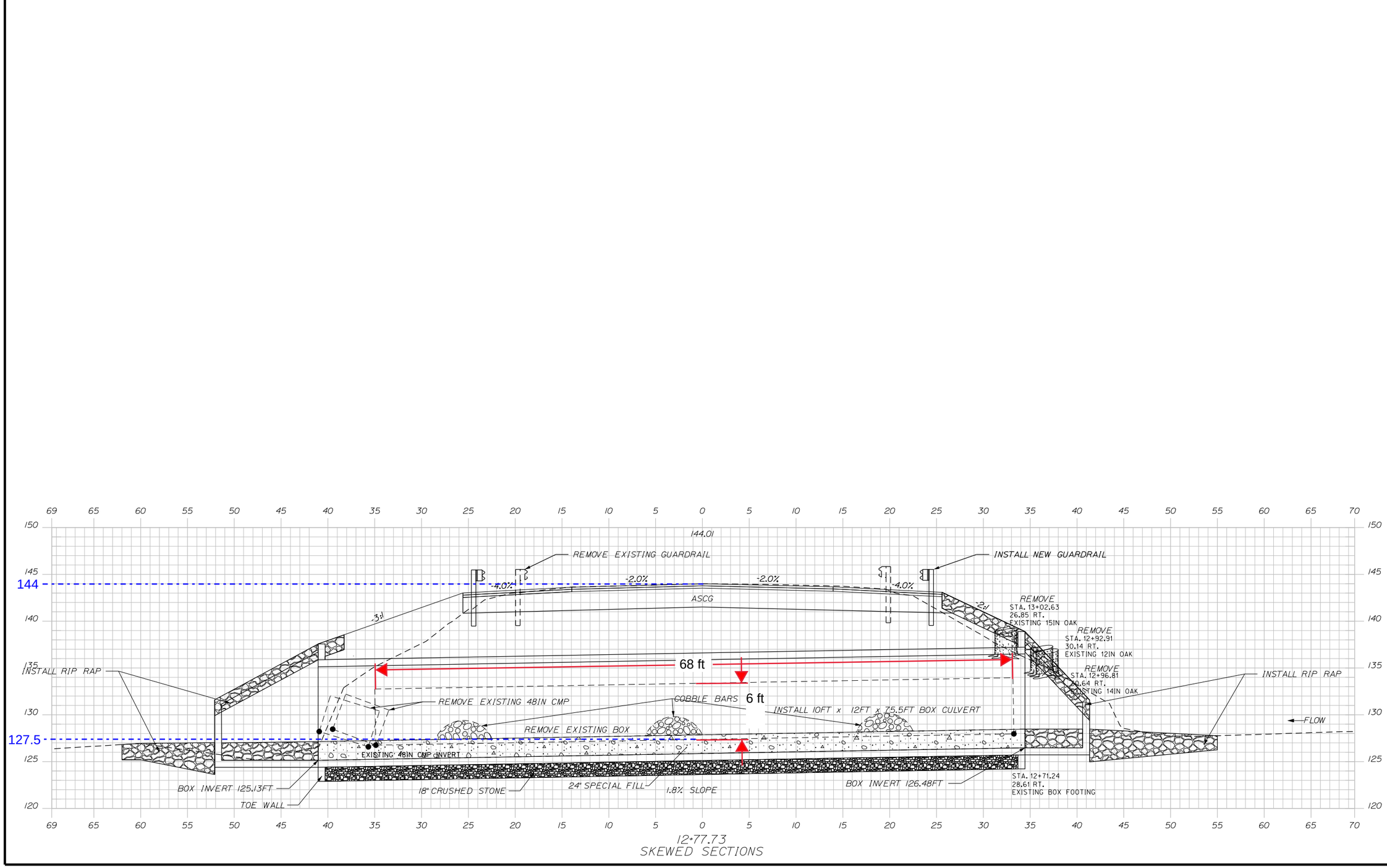
PLAN AND PROFILE

SHEET NUMBER
11
OF 22

Date:11/18/2019
Username:
Division: HIGHWAY
Filename: ...\HIGHWAY\MSTA\011_Hdplan1.dgn

Reference 5

Filename: ...\00\HIGHWAY\MSTA\009_Xsect.dgn Division: HIGHWAY Username: lucas.p.soo Date:1/26/2017



PROJ. MANAGER	Robert Hough	BY	DATE
DESIGN-DETAILED	Aaron Eaton	Wyatt Johnson	
CHECKED-REVIEWED	------	------	------ SIGNATURE
DESIGN2-DETAILED2	------	------	------
DESIGN3-DETAILED3	------	------	------ P.E. NUMBER
REVISIONS 1	------	------	------
REVISIONS 2	------	------	------ DATE
REVISIONS 3	------	------	------
REVISIONS 4	------	------	------
FIELD CHANGES	------	------	------

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

10801.00

PIN
10801.00
HIGHWAY PLANS

GORHAM BRANDY BROOK
Route 25

CROSS SECTIONS

SHEET NUMBER

9

OF 10

Sta. 12+77.73 to Sta. 12+77.73

GOLDER

CALCULATIONS

Date:	11/27/2019	**Made by:**	KAR
Project No.:	1669139	**Checked by:**	CJS
Subject:	Settlement of Filled Existing Culvert	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

OBJECTIVE

To calculate the primary settlement at the base of the existing culvert when the culvert is filled with flowable fill.

REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 8th Ed, 2017. (LRFD)
2. GEOTECHNICAL ENGINEERING CIRCULAR NO. 6: Shallow Foundations. FHWA: September 2002. (FHWA)
3. Das, Braja M. Principles of Foundation Engineering, 7th Ed. Brooks/Cole, 2011. (Das)
4. State of Maine Department of Transportation, Plans: Gorham Cumberland County Route 25 State Project No. 01882100 Large Culvert
5. State of Maine Department of Transportation, Gorham Brandy Brook Route 25 Cross Sections: Sheet Number 9 of 10, Sta. 12+77.73 to Sta.
6. Golder boring logs and subsurface profiles.
7. Subsurface investigation laboratory testing results.
8. FHWA, 2016. User Guidelines for Waste and Byproduct Materials in Pavement Construction, FHWA-RD-97-148.

ASSUMPTIONS

1. Ground water table is at the ground surface at culvert invert (El. 127.5 ft). — D_w = 0 ft
2. Clay consolidation parameters for both the Presumpscot Crust and Presumpscot Clay, based on laboratory test results for borings HB-GBB-201 and HB-GBB-202A (Golder design report Table 5 and Appendix C): — C_c = 0.43; C_r = 0.07; e_0 = 1.10
   Use these values to calculate modified compression indicies.
3. N_{60} value for the Glacial Outwash (from boring logs) is: — N_{60} = 36
4. Existing stress above culvert is 1.33 ksf (9.75 ft of fill with UW = 0.125 kcf plus 0.75 ft of concrete from the culvert with γ = 0.150 kcf) and filled stress is 1.87 ksf (1.33 ksf from the existing fill and concrete plus the addition of 6 ft of flowable fill γ_{avg} = 0.090 kcf - Reference 8) above culvert flowline. The net loading stress (q) is: — q = 0.540 ksf
5. Existing culvert flowline elevation is at El. 127.5 ft.
6. Road grade is El. 144 ft.

CALCULATION

Use consolidation theory to estimate settlement of the clay layers beneath the culvert (Layers 1-5); use the Hough method to estimate settlement of the glacial outwash beneath the culvert (Layer 6).

1 Subdivide the subsurface soils into layers no larger than 10 ft thick and to a depth of either twice the footing width or to bedrock. Calculate the vertical stress increase at each layer, assuming a 2-to-1 stress distribution method.

$$\Delta\sigma_v = \frac{B_f L_f}{(B_f + Z)(L_f + Z)} \times q$$ FHWA, Eqn. 5-17

where:

$\Delta\sigma_v$	vertical stress increase, ksf			
q	stress applied by footing (Asmpt. 4)	q =	0.540	ksf
B_f	width of the footing, ft	B_f =	9	ft
L_f	length of the footing, ft	L_f =	68	ft
Z	depth to midpoint of layer, ft			

Layer		Depth below footing (ft)	Thickness	Z (ft)	Stress Increase $\Delta\sigma_v$ (ksf)
Presumpscot Crust	1	0-4	4	2	0.43
Presumpscot	2	4-14	10	9	0.24
Presumpscot	3	14-24	10	19	0.14
Presumpscot	4	24-34	10	29	0.09
Presumpscot	5	34-40	6	37	0.07
Outwash	6	40-41.5	1.5	40.75	0.06

Date:	11/27/2019	**Made by:**	KAR
Project No.:	1669139	**Checked by:**	CJS
Subject:	Settlement of Filled Existing Culvert	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

2 Determine C' and σ'_{v0} for in situ existing soil. Use FHWA Figure 5-19 to obtain a C' for Layer 6, assuming the glacial outwash is "well graded fine to medium silty SAND".

	Existing fill thickness (ft)	Existing fill unit weight (kcf)	Culvert concrete thickness (ft)	Culvert concrete unit weight (kcf)	σ'_{v0} (ksf)		Water unit weight (kcf)
Stress due to existing soil and culvert concrete above footing	9.75	0.125	0.75	0.150	1.33		0.0624

Layer		Depth Below Footing (ft)	Layer Thickness (ft)	Z (ft)	$(N_1)_{60}$ avg	C'	Unit Weight of Layer (kcf)	σ'_{v0} (ksf)
Presumpscot Crust	1	0-4	4	2	Not required for clay consolidation analysis		0.120	1.45
Presumpscot	2	4-14	10	9			0.115	1.82
Presumpscot	3	14-24	10	19			0.115	2.35
Presumpscot	4	24-34	10	29			0.115	2.88
Presumpscot	5	34-40	6	37			0.115	3.30
Outwash	6	40-41.5	1.5	40.75	36	87	0.125	3.50

3 Calculate the total settlement of the glacial outwash (Layer 6) using the Hough method:

General Equation (FHWA, Eqn 5-24)

$$\Delta H_i = H_c \frac{1}{C'} \log\left(\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_{v0}}\right)$$

where:

- ΔH_i settlement in each layer, ft
- H_c initial height of layer i, ft
- C' bearing capacity index from FHWA Figure 5-19
- $\Delta\sigma_v$ vertical stress increase, ksf

ΔH_i (Layer 6)	ft	0.0001
	in	0.002

4 Calculate the total settlement of the clays (Layers 1-5) using the consolidation theory:

General Equation (Das, Eqn 5.81, 5.82, 5.83)

$$\Delta H_i = C_{r\varepsilon} H_c \log\frac{\sigma'_p}{\sigma'_{v0}} + C_{c\varepsilon} H_c \log\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_p}$$ for overconsolidated clay, $\sigma'_{v0} + \Delta\sigma_v > \sigma'_p$

$$\Delta H_i = C_{r\varepsilon} H_c \log\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_{v0}}$$ for overconsolidated clay, $\sigma'_{v0} + \Delta\sigma_v \le \sigma'_p$

$$\Delta H_i = C_{c\varepsilon} H_c \log\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_{v0}}$$ for normally consolidated clay

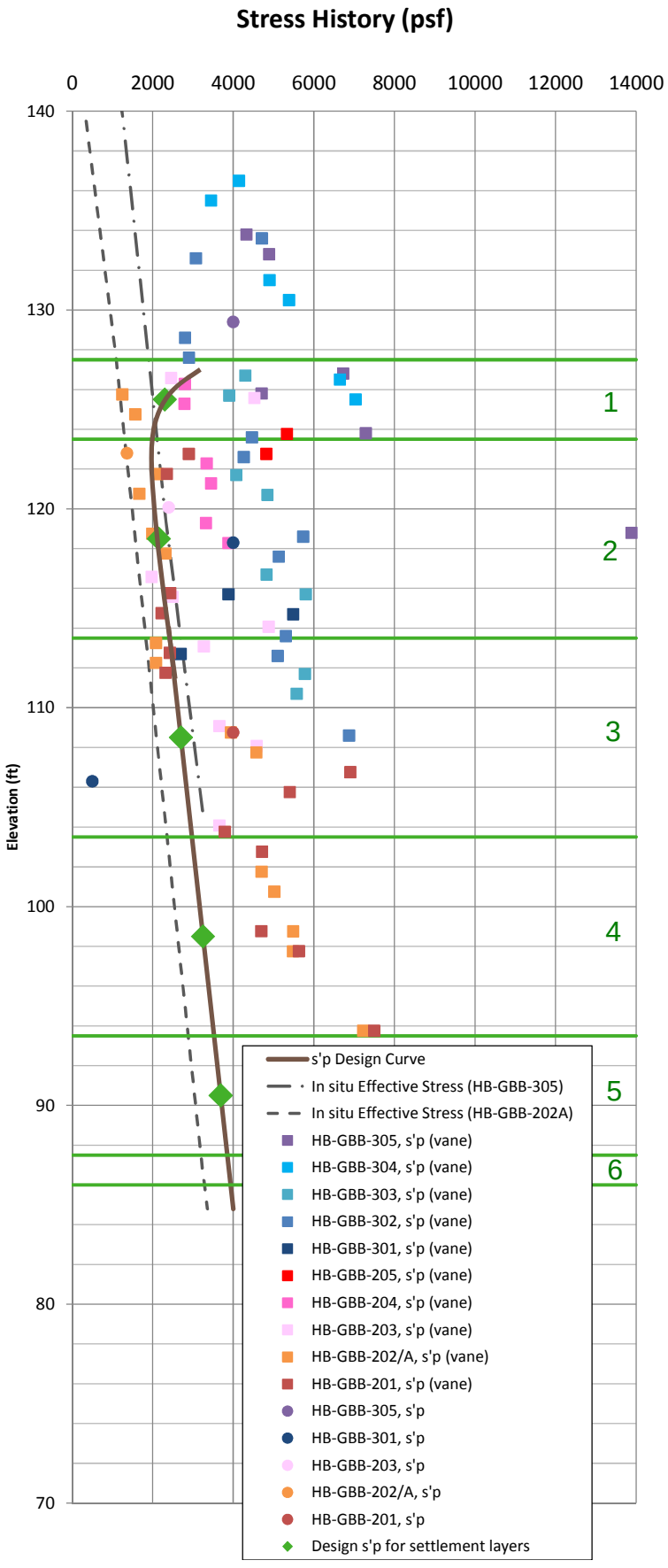
Date:	11/27/2019	**Made by:**	KAR
Project No.:	1669139	**Checked by:**	CJS
Subject:	Settlement of Filled Existing Culvert	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

where:			Layer 1 - Clay Crust	Layer 2 - Clay	Layer 3 - Clay	Layer 4 - Clay	Layer 5 - Clay
H_c	initial height of layer i, ft		4	10	10	10	6
$\Delta\sigma_v$	surcharge load, psf		429	238	136	90	68
σ'_{v0}	in situ vertical effective stress, psf		1446	1825	2351	2877	3297
$\sigma'_{v0} + \Delta\sigma_v$	(check against σ'_p to select equation)		1876	2063	2486	2966	3366
σ'_p	preconsolidated stress, psf		2300	2153	2701	3249	3688
$C_{r\varepsilon}$	modified recompression index		0.03	0.03	0.03	0.03	0.03
$C_{c\varepsilon}$	modified compression index		0.20	0.20	0.20	0.20	0.20
ΔH_i		ft	0.014	0.017	0.008	0.004	0.002
		in	0.168	0.199	0.091	0.050	0.020

	Settlement Based on Calculated Loading Stress
Layer	ΔH_i (in)
1	0.168
2	0.199
3	0.091
4	0.050
5	0.020
6	0.002
Total Settlement (in)	0.53

CONCLUSIONS

The primary settlement at the base of the existing culvert when the culvert is filled with flowable fill is estimated to be 0.5 inches.


Stress History (psf)
0
2000
4000
6000
8000
10000
12000
14000
140
130
120
110
100
90
80
70
Elevation (ft)
1
2
3
4
5
6
s'p Design Curve
In situ Effective Stress (HB-GBB-305)
In situ Effective Stress (HB-GBB-202A)
HB-GBB-305, s'p (vane)
HB-GBB-304, s'p (vane)
HB-GBB-303, s'p (vane)
HB-GBB-302, s'p (vane)
HB-GBB-301, s'p (vane)
HB-GBB-205, s'p (vane)
HB-GBB-204, s'p (vane)
HB-GBB-203, s'p (vane)
HB-GBB-202/A, s'p (vane)
HB-GBB-201, s'p (vane)
HB-GBB-305, s'p
HB-GBB-301, s'p
HB-GBB-203, s'p
HB-GBB-202/A, s'p
HB-GBB-201, s'p
Design s'p for settlement layers

Alternatively, stress distributions can also be obtained by assuming a 2-to-1 distribution of stress below the footing, as shown in Figure 5-12. This is much simpler to compute and is a reasonably accurate approximation of the decrease in stress with depth due to an applied surficial load of limited areal extent.

A comparison of the simplified 2-to-1 distribution with the actual distributed stress according to elastic theory is shown in Figure 5-13. This distribution can be computed as a function of applied stress according to:

$$\frac{\Delta\sigma_v}{q} = \frac{B_f L_f}{(B_f + Z)(L_f + Z)} \qquad (5\text{-}17)$$

where: $\Delta\sigma_V$ = Change in vertical stress at depth Z below the footing bearing elevation
q = Stress applied by the footing at the bearing elevation
Z = Depth below footing bearing elevation to point of interest, usually the center or midpoint of a soil layer or sublayer where a settlement computation is to be made
B_f = Width of footing
L_f = Length of footing

5.3.3 Footings on Cohesive Soils

Primary and secondary consolidation of clays or clayey deposits may result in substantial settlements when the structure is founded on saturated cohesive soils. Settlement resulting from primary consolidation may take weeks to years to be completed. Furthermore, because soil properties may vary beneath the foundation, the duration of the primary consolidation and the amount of settlement may also vary with the location of the footing, resulting in differential settlement between footing locations. If such settlements are not within tolerable limits, the structure may not perform as expected or intended.

When a foundation is wide compared to the compressible layer thickness beneath it, a large portion of the soil will settle vertically (one-dimensionally) with very little lateral displacement because of the constraining forces exerted by the neighboring soil elements. Based on measurements of lateral displacements beneath embankments and tanks, it is usually reasonable to assume that the settlements beneath a foundation will be one-dimensional even for narrow foundations, provided an adequate factor of safety is applied to bearing capacity (Terzaghi & Peck, 1967). Desiccated crust or overburden above the base of the footing will tend to minimize the amount of lateral displacements. Experience suggests that reasonably good estimates of settlement can be predicted assuming one-dimensional compression as long as the factor of safety is at least three (3) against bearing capacity failure. One-dimensional consolidation theory is presented in this section and is used to calculate settlement estimates for shallow foundations on cohesive soils.

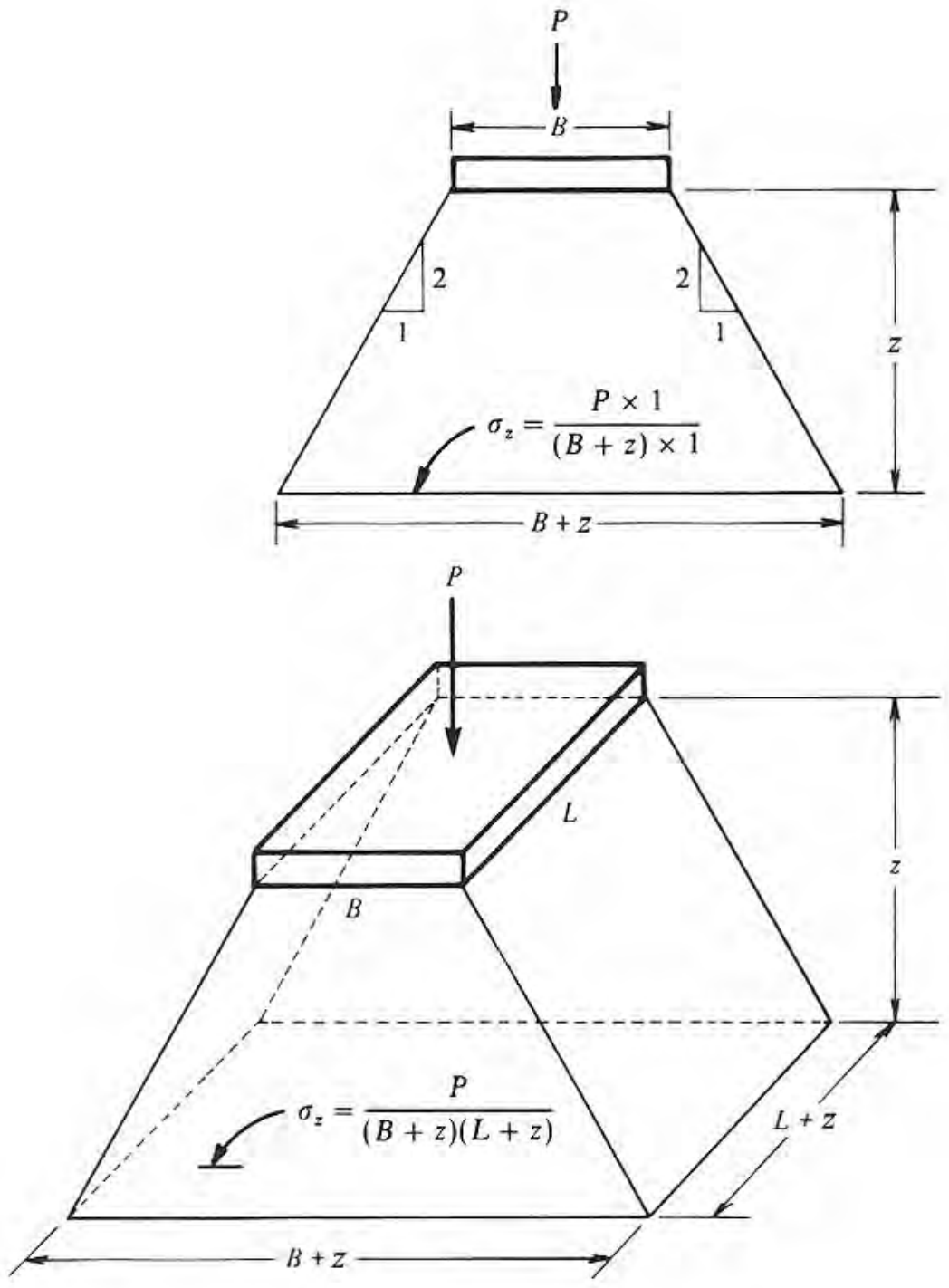


Figure 5-12: Distribution of Vertical Stress by the 2:1 Method
(Chen and McCarron, 1991)

- The D'Appolonia method under-predicted the settlement by an average factor of about 0.77 for the five footings, but the accuracy was generally better than Hough, and the scatter in the predicted settlement values was also less (standard deviation, $s_o = 0.22$).

The data from the five load tests therefore generally corroborate the conclusions from the Gifford et al. and Burland & Burbidge studies.

Therefore, it is currently recommended that the Hough method be used as a primary design and analysis tool. The D'Appolonia or load-settlement methods could be employed as alternates, or when a more accurate estimate of settlement is desired, recognizing that these alternate methods have less history of use in the design of highway bridges. Naturally, if another method is locally or regionally known to provide more reliable estimates of settlement on granular soils, and the method meets the criteria noted above, the geotechnical engineer should exercise judgment and use the best method available.

5.3.4.1 Hough Method

Hough (1959) developed an empirical method for predicting settlements of shallow foundations on cohesionless soils that follows the same approach as that used for calculating consolidation settlement of clay layers. Note that the method is applicable only for normally consolidated cohesionless soils. Cheney and Chassie (2000) recommend that the SPT blowcounts be corrected for overburden pressure before correlating the N-values to the bearing capacity index, C′. An overburden correction by Bazaraa (1967) was recommended by Cheney and Chassie (2000). Since that time, many researchers have studied the effect of overburden stress on the SPT N-value, largely in support of liquefaction hazard assessment procedures. Recent consensus by the 1996 and 1998 National Center for Earthquake Engineering Research (NCEER) (Youd et al., 2001) concluded that the correction proposed by Liao & Whitman (1986) (shown in Figure 5-18) could be used for routine engineering applications. Therefore, the correction by Liao & Whitman is included here as part of the Hough procedure, in particular because it is easy to calculate and can be used without charts in simple computation spreadsheets. The soil is divided into layers, and the change in effective vertical stress at the mid-height of the layer as a result of the applied load is estimated using elastic theory.

The total settlement by the Hough method is calculated as follows:

1. Correct SPT blowcounts for overburden stress using Figure 5-18.

2. Determine bearing capacity index (C′) from Figure 5-19 using corrected SPT blowcounts, N′, determined in Step 1.

3. Subdivide subsurface soil profile into approximately 3-m (10-ft) layers based on stratigraphy to a depth of about three times the footing width.

4. Calculate the effective vertical stress, σ'_{vo}, at the midpoint of each layer and the average bearing capacity index for that layer.

5. Calculate the increase in stress at the midpoint of each layer, $\Delta\sigma_v$, using either Figure 5-9, 5-10 or 5-11, or the 2:1 method (Figure 5-12).

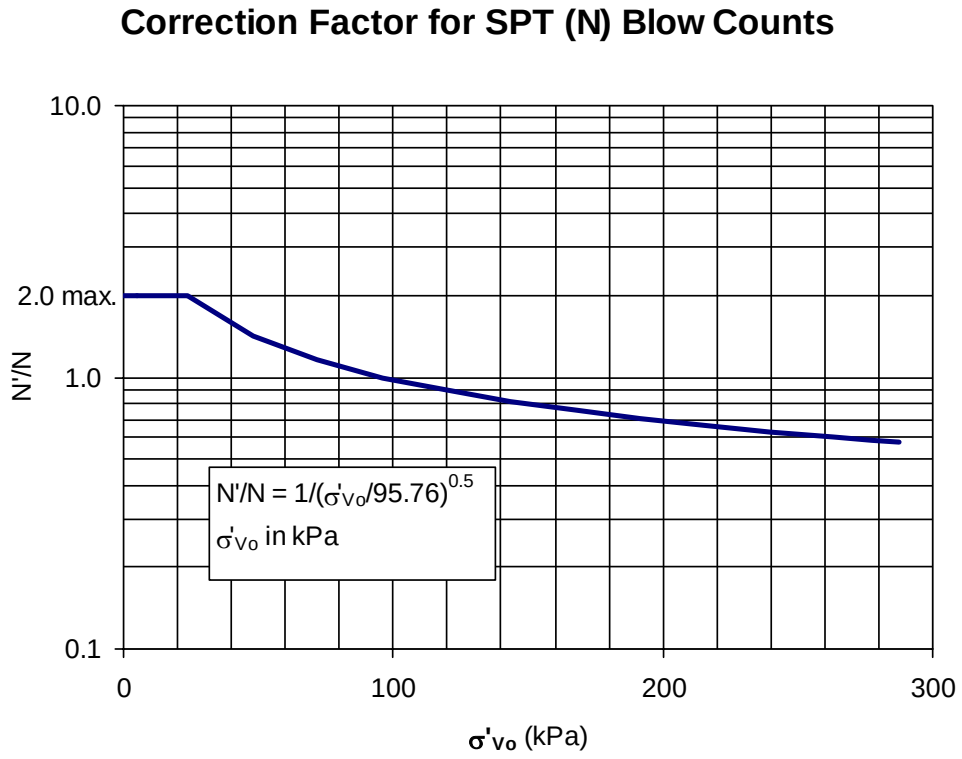


Figure 5-18: Corrected SPT (N) versus Overburden Pressure (after Liao & Whitman, 1986)

6. Calculate the settlement in each layer, ΔH, under the applied load using the following formula:

$$\Delta H = H_o \frac{1}{C'} \log\left(\frac{\sigma'_{vo} + \Delta\sigma_{v_f}}{\sigma'_{vo}}\right) \qquad (5\text{-}24)$$

7. Sum the incremental settlements to determine the total settlement.

5.3.4.2 D'Appolonia Method

The D'Appolonia method calculates settlement using the following basic equation:

$$\Delta H = \left(\frac{\Delta\sigma_V B_f}{M}\right)\mu_o\mu_1 \qquad (5\text{-}25)$$

where: ΔH = settlement in sand or sand and gravel
$\Delta\sigma_v$ = applied stress beneath footing
B_f = footing width
μ_O = correction factor for embedment – see Figure 5-20 (dimensionless)
μ_1 = correction factor for thickness of sand layer – see Figure 5-20 (dimensionless)
M = modulus of compressibility of sand – see Figure 5-21

Any consistent set of units can be used for ΔH, $\Delta\sigma_v$, B_f and M.

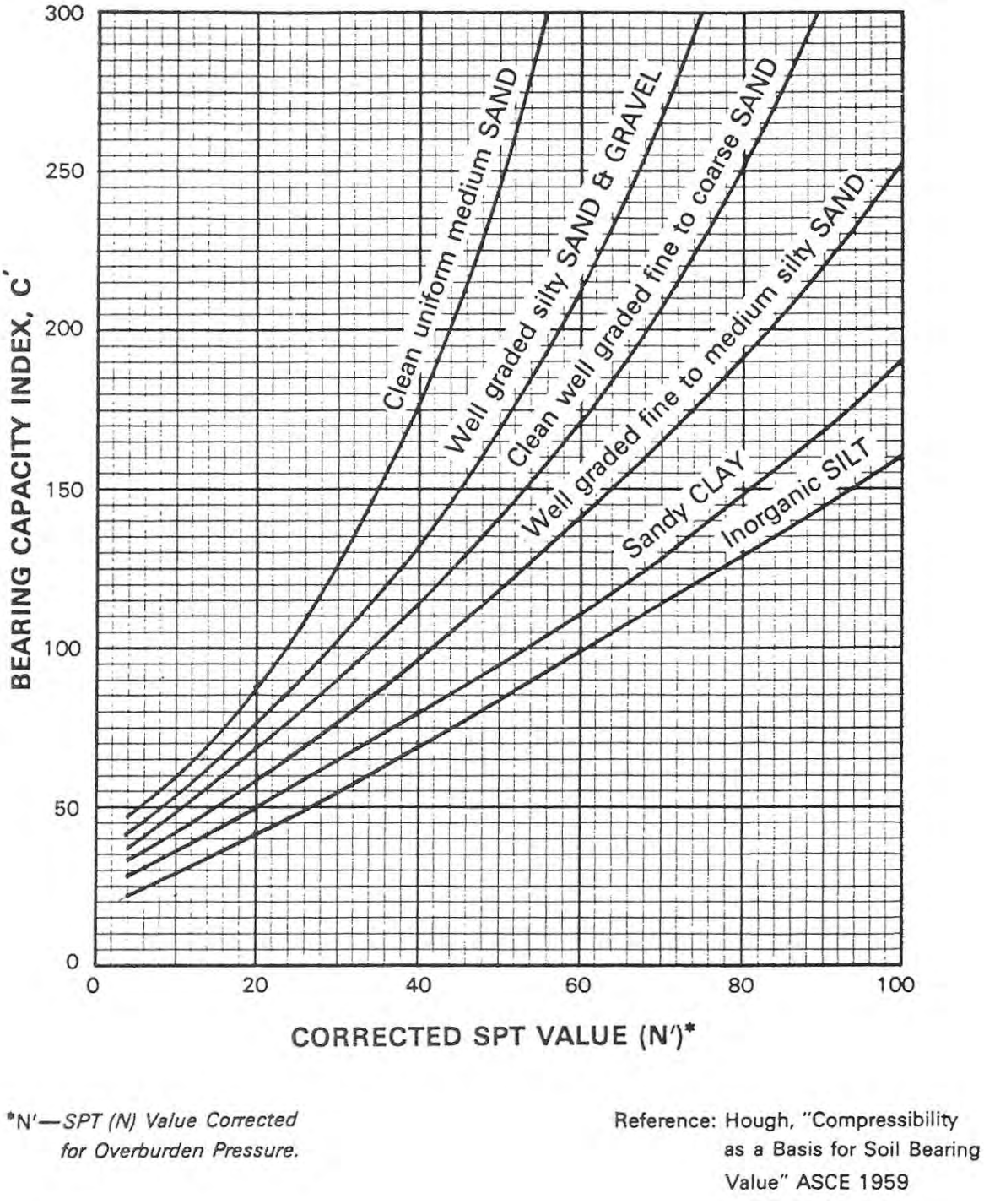


Figure 5-19: Bearing Capacity Index versus Corrected SPT
(Cheney & Chassie, 2000, modified from Hough, 1959)

Reference 3

Referring to Figure 5.7, $I_{a(H_1)} = 0.175$, so

$$\Delta\sigma_{\text{av}\,(H_2/H_1)} = 100\left[\frac{(5)(0.126) - (3)(0.175)}{5-3}\right] = \mathbf{5.25\ kN/m^2}$$

The stress increase between $z = 3$ m to $z = 5$ m below the center of the loaded area is equal to

$$4\Delta\sigma_{\text{av}\,(H_2/H_1)} = (4)(5.25) = \mathbf{21\ kN/m^2}$$ ■

5.6 Stress Increase under an Embankment

Figure 5.10 shows the cross section of an embankment of height H. For this two-dimensional loading condition, the vertical stress increase may be expressed as

$$\Delta\sigma = \frac{q_o}{\pi}\left[\left(\frac{B_1 + B_2}{B_2}\right)(\alpha_1 + \alpha_2) - \frac{B_1}{B_2}(\alpha_2)\right] \tag{5.20}$$

where

$q_o = \gamma H$
γ = unit weight of the embankment soil
H = height of the embankment

$$\alpha_1 = \tan^{-1}\left(\frac{B_1 + B_2}{z}\right) - \tan^{-1}\left(\frac{B_1}{z}\right) \tag{5.21}$$

$$\alpha_2 = \tan^{-1}\left(\frac{B_1}{z}\right) \tag{5.22}$$

(Note that α_1 and α_2 are in radians.)

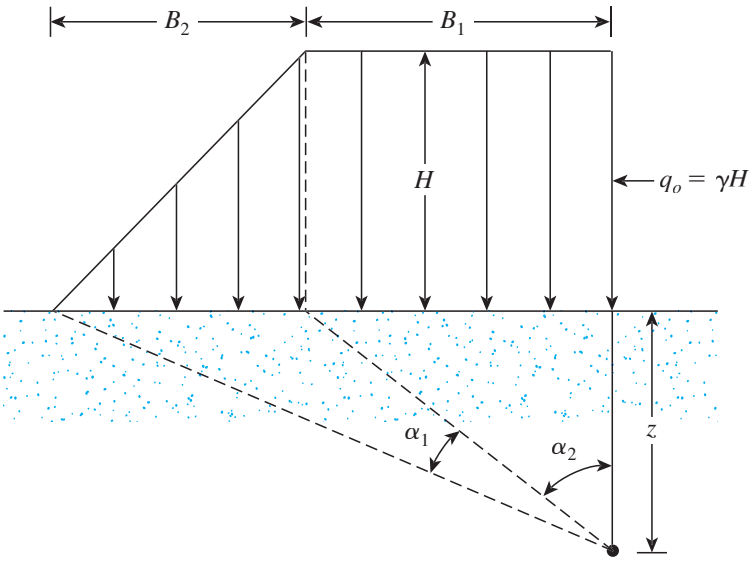


Figure 5.10 Embankment loading

Consolidation Settlement

5.15 Primary Consolidation Settlement Relationships

As mentioned before, consolidation settlement occurs over time in saturated clayey soils subjected to an increased load caused by construction of the foundation. (See Figure 5.29.) On the basis of the one-dimensional consolidation settlement equations given in Chapter 1, we write

$$S_{c(p)} = \int \varepsilon_z dz \tag{5.80}$$

where

ε_z = vertical strain

$$= \frac{\Delta e}{1 + e_o}$$

Δe = change of void ratio

$= f(\sigma'_o, \sigma'_c, \text{and } \Delta\sigma')$

So,

$$S_{c(p)} = \frac{C_c H_c}{1 + e_o} \log \frac{\sigma'_o + \Delta\sigma'_{av}}{\sigma'_o} \qquad \text{(for normally consolidated clays)} \tag{5.81}$$

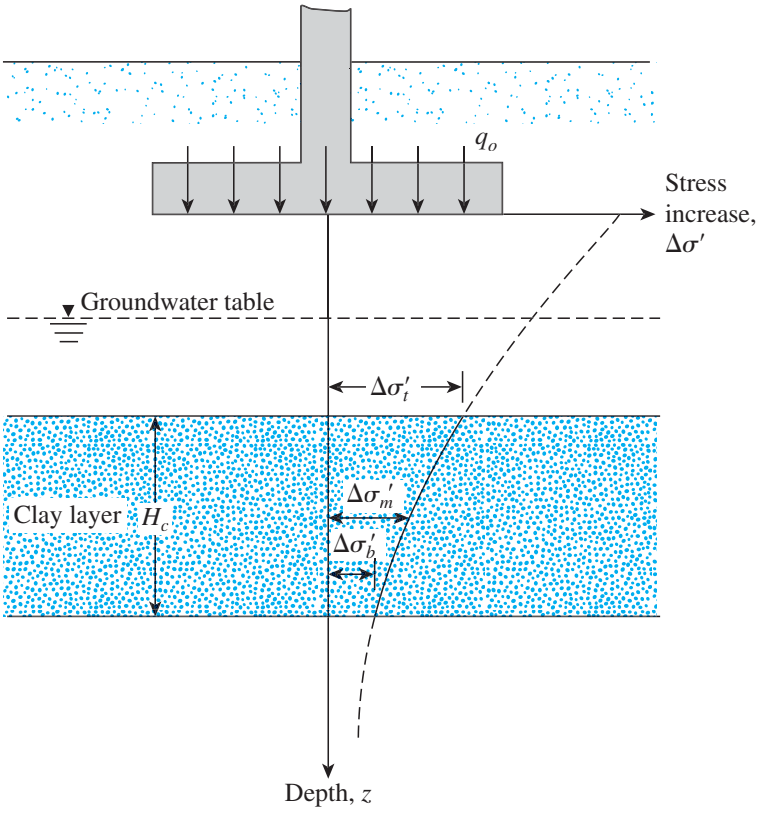


Figure 5.29 Consolidation settlement calculation

$$S_{c(p)} = \frac{C_s H_c}{1 + e_o} \log \frac{\sigma'_o + \Delta\sigma'_{av}}{\sigma'_o} \qquad \text{(for overconsolidated clays with } \sigma'_o + \Delta\sigma'_{av} < \sigma'_c\text{)} \tag{5.82}$$

$$S_{c(p)} = \frac{C_s H_c}{1 + e_o} \log \frac{\sigma'_c}{\sigma'_o} + \frac{C_c H_c}{1 + e_o} \log \frac{\sigma'_o + \Delta\sigma'_{av}}{\sigma'_c} \qquad \text{(for overconsolidated clays with } \sigma'_o < \sigma'_c < \sigma'_o + \Delta\sigma'_{av}\text{)} \tag{5.83}$$

where

σ'_o = average effective pressure on the clay layer before the construction of the foundation
$\Delta\sigma'_{av}$ = average increase in effective pressure on the clay layer caused by the construction of the foundation
σ'_c = preconsolidation pressure
e_o = initial void ratio of the clay layer
C_c = compression index
C_s = swelling index
H_c = thickness of the clay layer

The procedures for determining the compression and swelling indexes were discussed in Chapter 1.

Note that the increase in effective pressure, $\Delta\sigma'$, on the clay layer is not constant with depth: The magnitude of $\Delta\sigma'$ will decrease with the increase in depth measured from the bottom of the foundation. However, the average increase in pressure may be approximated by

$$\Delta\sigma'_{av} = \tfrac{1}{6}(\Delta\sigma'_t + 4\Delta\sigma'_m + \Delta\sigma'_b) \tag{5.84}$$

where $\Delta\sigma'_t$, $\Delta\sigma'_m$, and $\Delta\sigma'_b$ are, respectively, the effective pressure increases at the *top, middle,* and *bottom* of the clay layer that are caused by the construction of the foundation.

The method of determining the pressure increase caused by various types of foundation load using Boussinesq's solution is discussed in Sections 5.2 through 5.6. $\Delta\sigma'_{av}$ can also be directly obtained from the method presented in Section 5.5.

5.16 Three-Dimensional Effect on Primary Consolidation Settlement

The consolidation settlement calculation presented in the preceding section is based on Eqs. (1.61), (1.63), and (1.65). These equations, as shown in Chapter 1, are in turn based on one-dimensional laboratory consolidation tests. The underlying assumption is that the increase in pore water pressure, Δu, immediately after application of the load equals the increase in stress, $\Delta\sigma$, at any depth. In this case,

$$S_{c(p)-\text{oed}} = \int \frac{\Delta e}{1 + e_o} dz = \int m_v \Delta\sigma'_{(1)} dz$$

where

$S_{c(p)-\text{oed}}$ = consolidation settlement calculated by using Eqs. (1.61), (1.63), and (1.65)
$\Delta\sigma'_{(1)}$ = effective vertical stress increase
m_v = volume coefficient of compressibility (see Chapter 1)

Reference 4

VERTICAL DATUM - NAVD 88
COMBINED SCALE FACTOR - 0.9999707

GRONDIN AGGREGATES, LLC
TAX MAP 42 LOT 5
C.C.R.D. BOOK 13590 PAGE 310
POR NO. 1

DAVID G. IRVING, JR.
DONNA M. IRVING
TAX MAP 42 LOT 3
C.C.R.D. BOOK 20515 PAGE 324
POR NO. 4

STA. 11+50.00
BEGIN TRANSITION
MATCH EXISTING
ROADWAY PAVEMENT

STA. 11+25.00
BEGIN GUARDRAIL
WIDENING
LIMIT OF WORK

W-BEAM GUARDRAIL
- MID-WAY SPLICE
FLARED TERMINAL

STA. 11+75.00
END TRANSITION
BEGIN PROJECT
WIN 18821.00

RELOCATED LEVEL LIP SPREADER. LEVEL LIP SPREADER DIMENSIONS AND SLOPE TO MATCH EXISTING.

SPECIAL FILL REALIGNED STREAM

PLAIN RIPRAP

VOID FILLED PLAIN RIPRAP

COBBLE BAR (TYP.)

ROCK BAND (TYP.)

RIPRAP DOWNSPOUT

REMOVE SIGN

REMOVE

TERMINAL END, SINGLE RAIL

STA. 16+25.00
BEGIN TRANSITION
END PROJECT
WIN 18821.00

STA. 16+50.00
END TRANSITION
MATCH EXISTING
ROADWAY PAVEMENT

R = 53'

24" X 128'
OPT III

℄ 12' SPAN X 8' RISE,
176' LENGTH PRECAST
CONCRETE BOX CULVERT
STA. 15+81.00

37° SKEW

S52°58'13.4"E
STATE HIGHWAY "12" / ROUTE 25 / OSSIPEE TRAIL

ROUTE 25

15" X 46' OPT I

ANCHORAGE ASSEMBLY
FOR DRIVEWAY RADIUS
R = 15'

PLUG & FILL EXISTING
CULVERT WITH FLOWABLE FILL

BRANDY BROOK

REMOVE

49.8200
N23°16'8"W

128.9600
N23°16'8"W

PLAN

ZACHARY J. FANCY
ERIN E. FANCY
TAX MAP 37 LOT 2
C.C.R.D. BOOK 29267 PAGE 269
POR NO. 2

PREVIOUS
TAX MAP 37 LOT 2
C.C.R.D. BOOK 17396 PAGE 47
POR NO. 2

REMOVE
EXISTING
CULVERT

SPECIAL FILL
REALIGNED
STREAM

STREAM
CHANNEL ROCK
ALONG BANKLINE

PLAN/PROFILE
HORIZ. 25 0 25 50
VERT. 5 0 5 10
Scale of Feet

EXISTING GROUND

PROPOSED PROFILE GRADE

STA. 11+50.00
BEGIN TRANSITION
MATCH EXISTING
ROADWAY PAVEMENT

V.C.L. = 95'
HLSD = 461'
E = 0.107'

STA. 11+75.00
END TRANSITION
BEGIN PROJECT
WIN 18821.00

PVCC = STA. 11+57.50
ELEV. = 143.75

PVT = STA. 12+52.50
ELEV. = 143.80

PVC = STA. 13+20.00
ELEV. = 144.13

V.C.L. = 360'
HLSD = 332'
E = 2.295'

PVT = STA. 16+80.00
ELEV. = 155.11

G = -0.45%
G = -0.40%
G = -0.40%
G = +0.50%
G = +0.50%
G = +0.50%
G = +5.60%

PVI = STA. 11+00.00
ELEV. = 143.94

LOW POINT = STA. 11+99.72
ELEV. = 143.66

PVI = STA. 12+05.00
ELEV. = 143.56

PVI = STA. 15+00.00
ELEV. = 145.03

STA. 16+25.00
BEGIN TRANSITION
END PROJECT
WIN 18821.00

STA. 16+50.00
END TRANSITION
MATCH EXISTING
ROADWAY PAVEMENT

V.C.L. = 95'
SSD = 1317'
E = -0.101'

108" x 72" CONCRETE BOX
(PLUG & FILL EXISTING
CULVERT WITH FLOWABLE FILL)

STA. 15+81.00
℄ 12' SPAN x 8' RISE,
176' LENGTH PRECAST
CONCRETE BOX CULVERT

EL. 143.80 EL. 143.83 EL. 143.78 EL. 143.78 EL. 143.73 EL. 143.69 EL. 143.65 EL. 143.66 EL. 143.74 EL. 143.69 EL. 143.87 EL. 143.78 EL. 143.98 EL. 143.91 EL. 144.08 EL. 144.03 EL. 144.15 EL. 144.16 EL. 144.28 EL. 144.35 EL. 144.61 EL. 144.62 EL. 144.98 EL. 144.99 EL. 145.39 EL. 145.44 EL. 145.96 EL. 145.98 EL. 146.57 EL. 146.61 EL. 147.31 EL. 147.33 EL. 148.12 EL. 148.13 EL. 149.08 EL. 149.03 EL. 150.01 EL. 150.01 EL. 151.02 EL. 151.09 EL. 152.13 EL. 152.25 EL. 153.50 EL. 153.50 EL. 154.86 EL. 156.18

PROFILE

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

18821.00

WIN
18821.00

HIGHWAY PLANS

	L. HAMILTON	DATE
PROJ. MANAGER		
DESIGN-DETAILED	T. WOLFEL	11/2019
CHECKED-REVIEWED	K. WOOD	11/2019
DESIGN2-DETAILED2		
DESIGN3-DETAILED3		

REVISIONS	BY	DATE
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE

P.E. NUMBER

DATE

GORHAM - BRANDY BROOK
ROUTE 25

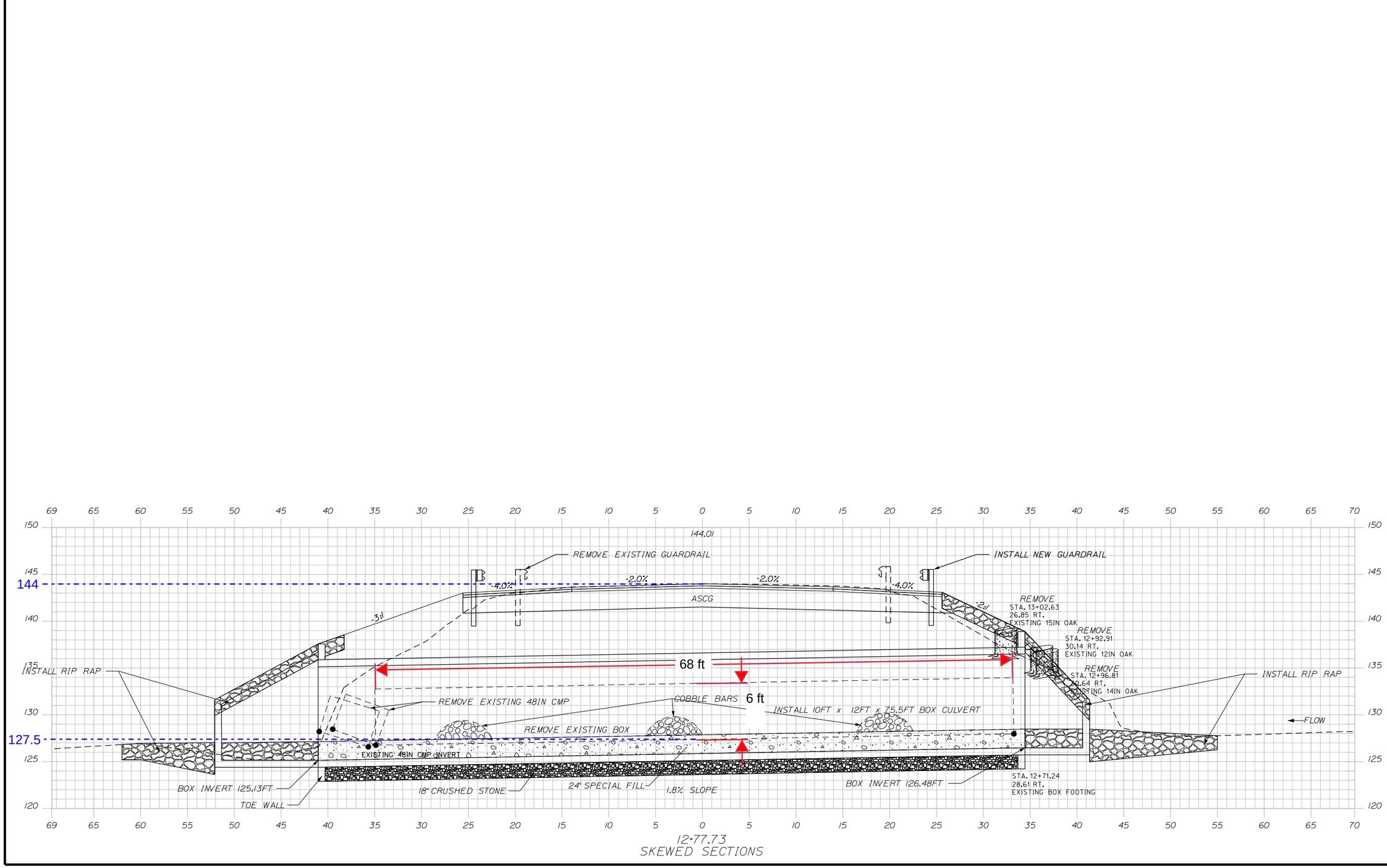
PLAN AND PROFILE

SHEET NUMBER
11
OF 22

Date:11/18/2019
Username:
Division: HIGHWAY
Filename: ...\HIGHWAY\MSTA\011_Hdplan1.dgn

Reference 5

Filename: ...\00\HIGHWAY\MSTA\009_Xsect.dgn Division: HIGHWAY Username: lucas.p.soo Date:1/26/2017



PROJ. MANAGER	Robert Hough	BY	DATE
DESIGN-DETAILED	Aaron Eaton	Wyatt Johnson	
CHECKED-REVIEWED	------	------	------ SIGNATURE
DESIGN2-DETAILED2	------	------	------
DESIGN3-DETAILED3	------	------	------ P.E. NUMBER
REVISIONS 1	------	------	------
REVISIONS 2	------	------	------ DATE
REVISIONS 3	------	------	------
REVISIONS 4	------	------	------
FIELD CHANGES	------	------	------

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

10801.00

PIN
10801.00
HIGHWAY PLANS

GORHAM BRANDY BROOK
Route 25

CROSS SECTIONS

SHEET NUMBER

9

OF 10

Sta. 12+77.73 to Sta. 12+77.73

Reference 8

U.S. Department of Transportation
Federal Highway Administration
1200 New Jersey Avenue, SE
Washington, DC 20590
202-366-4000

Federal Highway Administration Research and Technology
Coordinating, Developing, and Delivering Highway Transportation Innovations

REPORT

This report is an archived publication and may contain dated technical, contact, and link information

Publication Number: FHWA-RD-97-148

User Guidelines for Waste and Byproduct Materials in Pavement Construction

FLOWABLE FILL **Application Description**

INTRODUCTION

Flowable fill refers to a cementitious slurry consisting of a mixture of fine aggregate or filler, water, and cementitious material(s), which is used primarily as a backfill in lieu of compacted earth. This mixture is capable of filling all voids in irregular excavations and hard to reach places (such as under and around pipes), is self-leveling, and hardens in a matter of a few hours without the need for compaction in layers. Flowable fill is sometimes referred to as controlled density fill (CDF), controlled low strength material (CLSM), lean concrete slurry, and unshrinkable fill.

Flowable fill is defined by the American Concrete Institute (ACI) as a self-compacting cementitious material that is in a flowable state at placement and has a compressive strength of 8.3 MPa (1,200 lb/in^2) or less at 28 days. Most current applications for flowable fill involve unconfined compressive strengths of 2.1 MPa (300 lb/in^3) or less.

Flowable fill materials are primarily used in below grade applications such as utility trenches, where low strength and ease of placement are required. Flowable fill is typically placed using conventional ready-mix concrete trucks. In many cases, these materials are designed so that they are comparable in strength to the surrounding soil after hardening, making excavation at a later time possible.

MATERIALS

Fine aggregates or fillers (usually sand) are often used in flowable fill mixtures that are produced at ready-mix plants, especially higher strength CLSM mixtures. Portland cement and/or supplementary cementitious materials and water are essential ingredients in all flowable fill mixtures, since it is the hydration of these cementitious materials that enables the flowable fill mixture to harden and develop strength.

Fine Aggregate or Filler

Fine aggregate or filler material provides the solids to develop compressive strength, as well as load-carrying capability. For purposes of this discussion, fine aggregates are materials with particles in a size range of 4.75 mm (No. 4 sieve) to 0.075 mm (No. 200 sieve), and filler refers to those materials with a size range of less than

- **Flowability** – flowability in the placement of flowable fill mixtures is primarily a function of the water content, although fly ash improves the flowability in the same way that fly ash makes concrete more pumpable. The higher the water content, the more flowable the mix. Flowability can be measured by one of several different methods, including slump and flow cone tests. The normal slump range for flowable fill mixtures is 150 to 250 mm (6 to 10 in). This range of slump corresponds to a flow time of 30 to 60 seconds through a standard flow cone.

- **Hardening Time** – the hardening time of flowable fill mixtures is directly related to the cement type, its content, the filler content (including fly ash), as well as the water content and weather conditions. Hardening of flowable fill mixes containing 5 percent cement (that is sufficient to support the weight of an average person) can usually be expected in about 1 to 4 hours. Within 24 hours, construction equipment is usually able to move across the surface of the flowable fill without any apparent damage.

- **Bleeding and Shrinkage** – some bleeding and shrinkage is possible in flowable fill mixes with relatively high water contents. Evaporation of bleed water from such mixes often results in a shrinkage of the flowable fill. The shrinkage may occur laterally as well as vertically, and may manifest itself as shrinkage cracks in the top surface of the material. No shrinkage or settlement is expected in flowable fill mixes once initial hardening has occurred. The main concern with shrinkage cracking is most likely to be the potential for water infiltration, freezing, and subsequent frost damage.

- **Unit Weight** – the density or unit weight of flowable fill mixtures is dependent primarily on the unit weight of the filler or aggregate material. The unit weight of mixtures with high sand filler content is normally in the range of 1900 to 2350 kg/m^3 (115 to 145 lb/ft^3). The unit weight of flowable fill mixtures in which fly ash is used as the filler material is normally in the range of 1500 to 1900 kg/m^3 (90 to 115 lb/ft^3). Where poor soil bearing conditions require the use of a lightweight fill material, low-density CLSM mixtures can be produced by the introduction of a preformed foaming agent, with higher dosages resulting in a greater reduction in mix density. The unit weight of low density CLSM mixtures can range from 320 to 1300 kg/m^3 (20 to 80 lb/ft^3), depending on the amount of preformed foam that is injected into the mixture during batching.

- **Bearing Strength** – the bearing strength of flowable fill mixtures is directly related to their unconfined compressive strength. A flowable fill mixture with a 28-day unconfined compressive strength of 1.0 MPa (150 lb/in^2) has a bearing strength of approximately 9000 kg/m^2 (10 tons/ft^2). This is roughly three times greater than the bearing strength of a high quality, well-compacted granular borrow soil As the unconfined compressive strength of the mixture increases over time, so does the bearing strength.

- **Shear Strength** – triaxial shear strength testing of flowable fill mixes has shown internal friction angles ranging from 20 degrees for mixes using fine sand to 30 degrees for mixes using concrete sand. The cohesion of hardened flowable fill mixes has been found to be approximately 30 percent of the unconfined compressive strength.

- **Corrosion Resistance** – contact between flowable fill and metal pipes or concrete should be avoided so as not to promote corrosion of these materials. Corrosion is usually associated with acidity (low pH) and low electrical resistivity, although the solubility of constituents such as sulfates also affects corrosion. Flowable fill is ordinarily slightly alkaline and its resistivity increases as the material hardens and the cement continues to hydrate, so that within a few days, flowable fill usually has an electrical resistivity that is sufficient to alleviate most corrosivity concerns.

A list of the standard test methods usually used to evaluate flowable fill materials is given in Table 24-17.

Table 24-17. Flowable fill test procedures.

Property	Test Method	References
Strength Development	Unconfined Compressive Strength of Cohesive Soil	ASTM D2166
	Unconfined Compressive Strength Index of Chemical-Grouted Soils	ASTM D4219
Flowability	Slump of Portland Cement Concrete	ASTM C143
	Flow of Grout for Preplaced-Aggregate (Flow Cone Method)	ASTM C939
Hardening Time	Time of Setting of Concrete Mixtures by Penetration Resistance	ASTM C403
Bleeding and Shrinkage	Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures	ASTM C827

GOLDER

CALCULATIONS

Date:	12/2/2019	**Made by:**	SKB
Project No.:	1669139	**Checked by:**	KAR / MEL
Subject:	Heaving in Proposed Stream Excavation	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

OBJECTIVE

Determine the most critical section that may undergo heave. Determine the change in effective stress state within the soil at the proposed stream location to identify if settlement or heave will occur. Estimate the amount of heave that may occur in clays deeper than elevation 126.55 ft after construction. Determine the time-rate of heave that will occur at the critical section.

REFERENCES

1. Puller, Malcolm. Deep Excavations: a Practical Manual, 2nd Ed. Thomas Telford Publishing, 2003.
2. Construction plans from Maine Department of Transportation, dated April 16, 2019.
3. Golder boring logs.
4. Winterkorn & Fang, 1975. Foundation Engineering Handbook, Litton Educational Publishing, Inc.
5. Holtz & Kovaks, An Introduction To Geotechnical Engineering, 1st Ed., Prentice-Hall, Inc. (1981)
6. Table 5 Engineering Soil Tests - 1669139 Final Report Golder Associates
7. Slide Models Profiles - 1669139 Final Report Golder Associates
8. State of Maine Department of Transportation, Gorham - Brandy Brook Route 25: Cross Sections, dated June 13, 2019.

ASSUMPTIONS

1. The cohesions and unit weights are consistent with the clay layer in the base of the stream used in the slope stability models.

APPROACH

This approach conservative because we are assuming the excavation is uniform and the influence of the adjacent soil embankmnet is not considered in the stress change calculation.

CALCULATIONS

A. Determine the most critical section that may undergo heave

The section with the most soil removed will experience the most stress reduction and thus heave. However, the one with the thickest deposit below the excavated stream bed may have the most heave because the greater mass of soil influenced.

Use Reference 3 to determine Station 13+75 has the thickest deposit below excavated stream bed.
Use Reference 8 to determine Station 13+75 has the most soil removed

B. Determine the change in effective stress state within the soil at station 13+75 location to identify if settlement or heave will occur.

Use References 3, 7, and 8 to determine soil layer properties and thickness
Proposed water table elev at or above the special fill results in the lowest effective stress

Existing water table elevation (ft) = 137.6
Proposed water table elevation (ft) = 128.55
Proposed water table depth (ft) = 18.0
γ_w (pcf) = 62.4

Soil thickness estimated from elevation 146.50 ft to 126.55 ft: 19.95

Layer	Elev. (ft) top	Elev. (ft) bottom	Thick. (ft)	γ_{bulk} (pcf)	$\Delta\sigma_{v\text{-}layer}$ (psf)	Station 13+75 Existing Conditions
Fill	146.50	140.00	6.5	125	812.5	2359.3 $\sigma_{v\ @\ 126.55\ ft}$ (psf)
Clay	140.00	126.55	13.5	115	1546.8	1669.7 $\sigma'_{v\ @\ 126.55\ ft}$ (psf)

Add the following layers from elev. 126.55 to the new ground surface at elevation 128.55 ft
Use Reference 2 to determine thickness of fill

Layer	Elev. (ft) top	Elev. (ft) bottom	Thick. (ft)	γ_{bulk} (pcf)	$\Delta\sigma_{v\text{-}layer}$ (psf)	Station 13+75 Proposed Stream Location
Special Fill	128.55	126.55	2.0	125	250.0	250.0 $\sigma_{v\ @\ 126.55\ ft}$ (psf)
						125.2 $\sigma'_{v\ @\ 126.55\ ft}$ (psf)

Date:	12/2/2019	**Made by:**	SKB
Project No.:	1669139	**Checked by:**	KAR / MEL
Subject:	Heaving in Proposed Stream Excavation	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

Calculate the increase or decrease in effective stress as a result of the new culvert placement.

Station 13+75 Existing Conditions	Station 13+75 Proposed Stream	Difference		
$\sigma'_{v\ @\ 126.55\ ft}$ (psf)	$\sigma'_{v\ @\ 126.55\ ft}$ (psf)	$\sigma'_{v\ @\ 126.55\ ft}$ (psf)		

1669.7	125.2	**-1544.5**	**heave**	If (-), potential heave
				If (+), potential settlement
				If (0), no change

C. Estimate the amount of heave that may occur in clays deeper than elevation 126.55 ft at station 13+75 .

Clay layer between bottom of the layer at elevation 102.7 ft and bottom of the excavation at 126.55 feet will experience heave.

Existing stresses above elevation 126.55 ft. $\sigma_{v\ @\ 126.55\ ft}$ (psf) 2359.3 $\sigma'_{v\ @\ 126.55\ ft}$ (psf) 1669.7

Proposed stress increase above elevation 126.55 ft (special fill) $\sigma_{v\ @\ 126.55\ ft}$ (psf) 250.0 $\sigma'_{v\ @\ 126.55\ ft}$ (psf) 125.2

Divide the clay beneath the proposed stream at station 13+75 with existing conditions into layers. Determine the initial effective stress.
Determine the effective stress at station 13+75 once location excavated and special fill has been placed assuming the new water table is at proposed elevation 128.55 ft.
Based on boring logs HB-GBB-303 (Reference 3), the clay layer below the centerline of streambed ends at about 102.70 ft. elevation.

				Station 13+75 Existing Conditions		Station 13+75 Proposed Stream Location		Post-Pre Difference
Layer	Elev. (ft)		Thickness	$\sigma_{v\text{-midlayer}}$	$\sigma'_{v\text{-midlayer}}$	$\sigma_{v\text{-midlayer}}$	$\sigma'_{v\text{-midlayer}}$	$\sigma'_{v\text{-midlayer}}$
	top	bottom	(ft)	(psf)	(psf)	(psf)	(psf)	(psf)
clay	126.55	124.55	2.0	2474.3	1722.3	365.0	177.8	-1544.5
	124.55	122.55	2.0	2704.3	1827.5	595.0	283.0	-1544.5
	122.55	120.55	2.0	2934.3	1932.7	825.0	388.2	-1544.5
	120.55	118.55	2.0	3164.3	2037.9	1055.0	493.4	-1544.5
	118.55	116.55	2.0	3394.3	2143.1	1285.0	598.6	-1544.5
	116.55	114.55	2.0	3624.3	2248.3	1515.0	703.8	-1544.5
	114.55	112.55	2.0	3854.3	2353.5	1745.0	809.0	-1544.5
	112.55	110.55	2.0	4084.3	2458.7	1975.0	914.2	-1544.5
	110.55	108.55	2.0	4314.3	2563.9	2205.0	1019.4	-1544.5
	108.55	106.55	2.0	4544.3	2669.1	2435.0	1124.6	-1544.5
	106.55	104.55	2.0	4774.3	2774.3	2665.0	1229.8	-1544.5
	104.55	102.70	1.8	4995.6	2875.6	2886.4	1331.1	-1544.5

Calculate heave using the settlement equations below for overconsolidated soil, as the clay will be unloading.

$$\Delta H_i = \frac{C_r H_{layer}}{1 + e_0} \log \frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_{v0}}$$

for overconsolidated clay, $\sigma'_{v0} + \Delta\sigma_v \leq \sigma'_p$

Average clay properties	
C_r	0.07
e_0	1.18

Reference 6

Date:	12/2/2019	**Made by:**	SKB
Project No.:	1669139	**Checked by:**	KAR / MEL
Subject:	Heaving in Proposed Stream Excavation	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

Elev. (ft) top	Elev. (ft) bottom	Thickness (ft)	Initial $\sigma'_{v\text{-midlayer}}$ (psf)	Final $\sigma'_{v\text{-midlayer}}$ (psf)	Heave, ΔH (in)	
126.55	124.55	2.0	1722.3	177.8	-0.76	
124.55	122.55	2.0	1827.5	283.0	-0.62	
122.55	120.55	2.0	1932.7	388.2	-0.54	
120.55	118.55	2.0	2037.9	493.4	-0.47	
118.55	116.55	2.0	2143.1	598.6	-0.43	
116.55	114.55	2.0	2248.3	703.8	-0.39	
114.55	112.55	2.0	2353.5	809.0	-0.36	
112.55	110.55	2.0	2458.7	914.2	-0.33	
110.55	108.55	2.0	2563.9	1019.4	-0.31	
108.55	106.55	2.0	2669.1	1124.6	-0.29	
106.55	104.55	2.0	2774.3	1229.8	-0.27	
104.55	102.7	1.8	2875.6	1331.1	-0.24	
					-5.0	**Total (in)**

D. Determine the Time-Rate of Heave that will occur at station 13+75 after excavation

Use single layer analysis to determine the time the entire heave to occur.
Assume double drainage condition. Assumption based on structural fill above and glacial outwash below the clay layer (Reference 3). The soil types above and below have a higher permeabilty relative to the clay layer.
Subsurface conditions are simplified to a single soil layer with uniform soil properties for the purpose of the calculation.

Clay layer thickness (ft): 23.85 (Reference 3)

Double Drainage Condition:
H_{dr} (ft): 11.93

$$T_v = \frac{c_V t}{H^2_{dr}}$$ (Reference 5, via Eqn 9-5)

$$T_v = \frac{\pi}{4}\left(\frac{U\%}{100}\right)^2$$ For U_{avg} = 0% to 60% (Reference 5, via Eqn 9-10)

$$T_v = 1.781 - 0.933\log(100 - U\%)$$ For U_{avg} = > 60% (Reference 5, via Eqn 9-11)

$$U_{avg} = \frac{s(t)}{s_c}$$ (Reference 5, via Eqn 9-12)

Average clay properties		
c_v (ft^2/day)	0.24	(Reference 6)
e_0	1.18	(Reference 6)

T_v = Time factor (dimensionless)
c_v = Coefficent of Consolidation (ft^2/day)
t = time (day)
H_{dr} = Drainage Path (ft)
U_{avg} = Average Degree or Percent Consolidation
s(t) = settlement/heave at any time (in)
s(c) = final or ultimate settlement/heave (in)

Determine time factor using Reference 5, Eqn. 9-11

U_{avg} = 95 (Calculate time to reach 95% consolidation)
T_v = 1.13

Date:	12/2/2019	**Made by:**	SKB
Project No.:	1669139	**Checked by:**	KAR / MEL
Subject:	Heaving in Proposed Stream Excavation	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

Determine time required for entire heave using Reference 5, Eqn. 9-5

c_v (ft^2/day) = 0.24

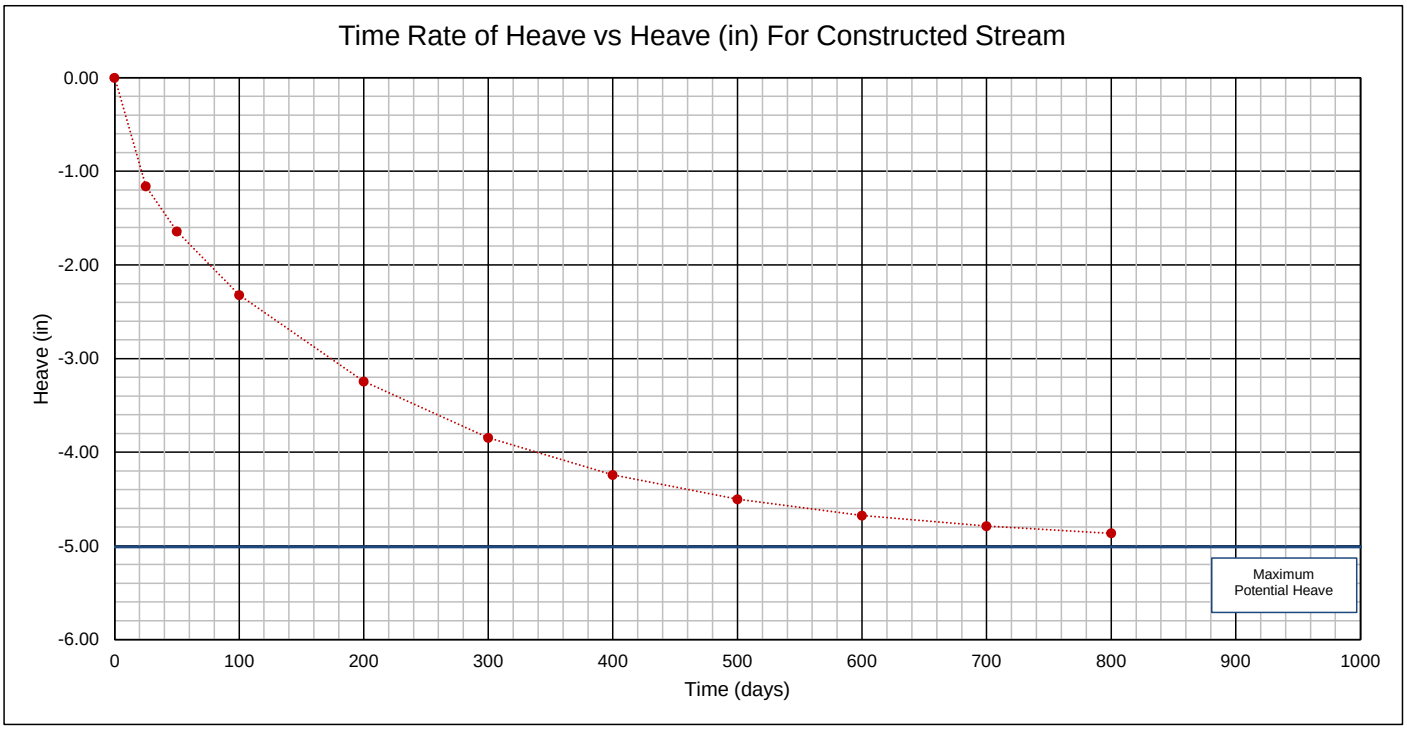
H_{dr} (ft) = 11.93

T_v = 1.13

t (days)=	669	or	1.8	years

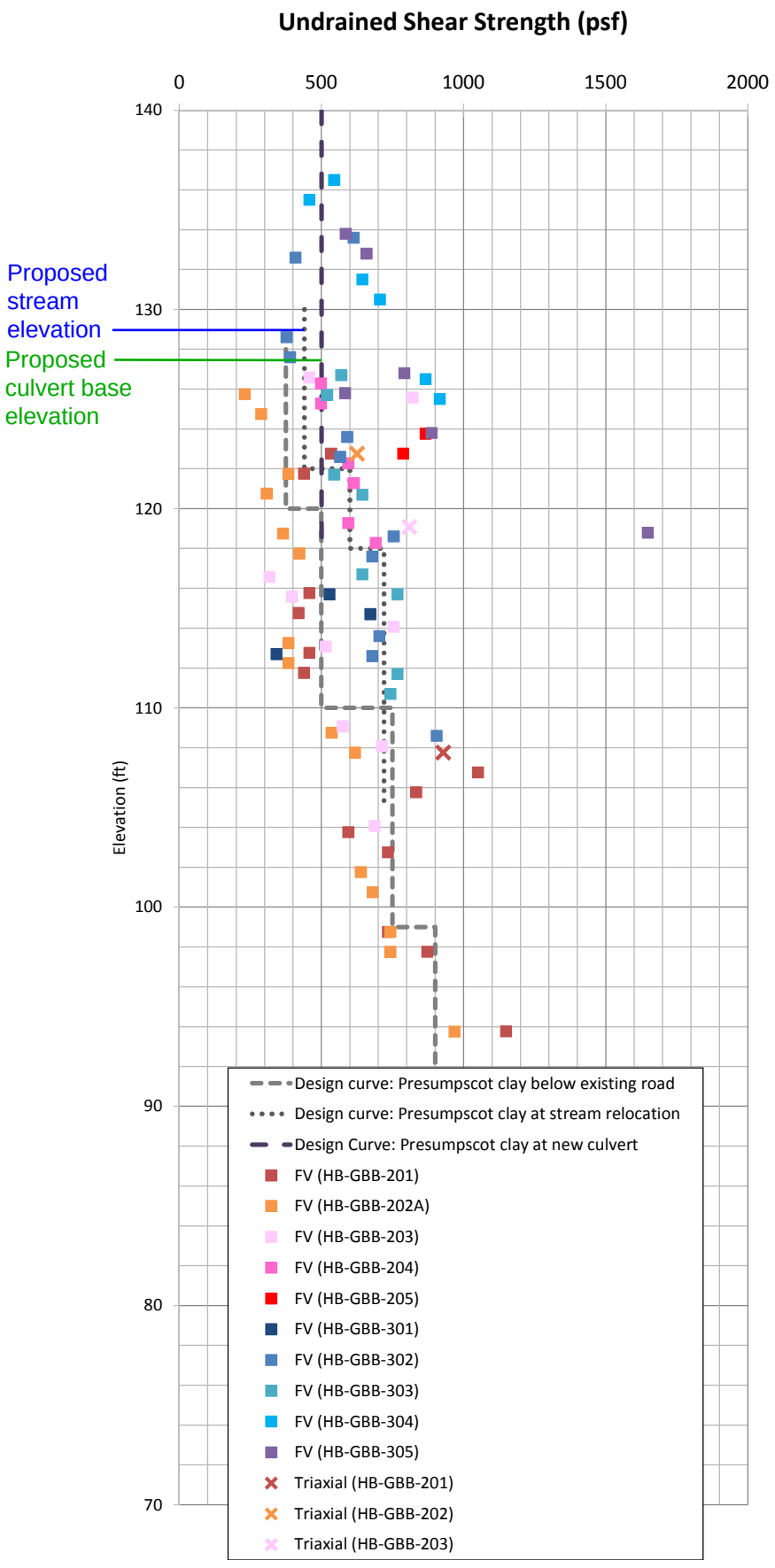
ΔH (in)= -5.01 (final potential heave)

Time (days)	Time (years)	Tv	U_{avg} (%)	s(t) (in)
0	0.00	0.00	0.00	0.00
25	0.07	0.04	23.18	-1.16
50	0.14	0.08	32.78	-1.64
100	0.27	0.17	46.36	-2.32
200	0.55	0.34	64.75	-3.24
300	0.82	0.51	76.76	-3.84
400	1.10	0.68	84.68	-4.24
500	1.37	0.84	89.90	-4.50
600	1.64	1.01	93.34	-4.68
700	1.92	1.18	95.61	-4.79
800	2.19	1.35	97.10	-4.86

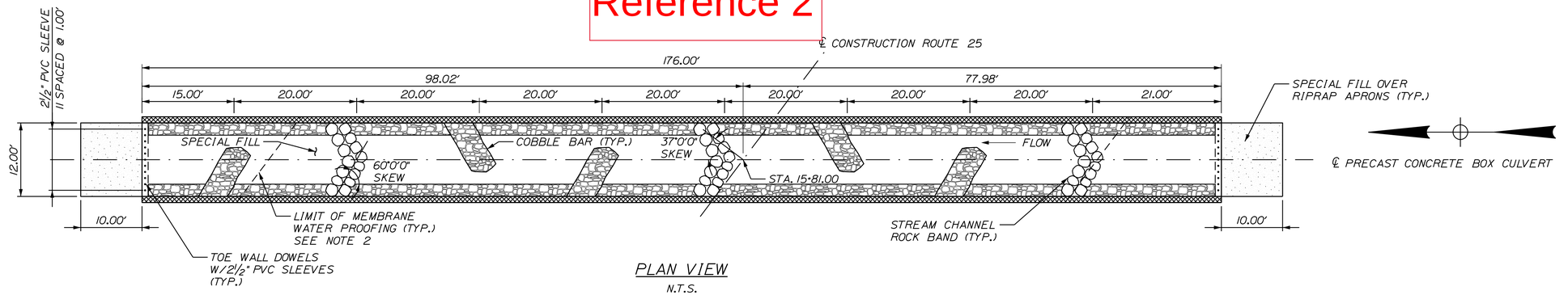


CONCLUSIONS

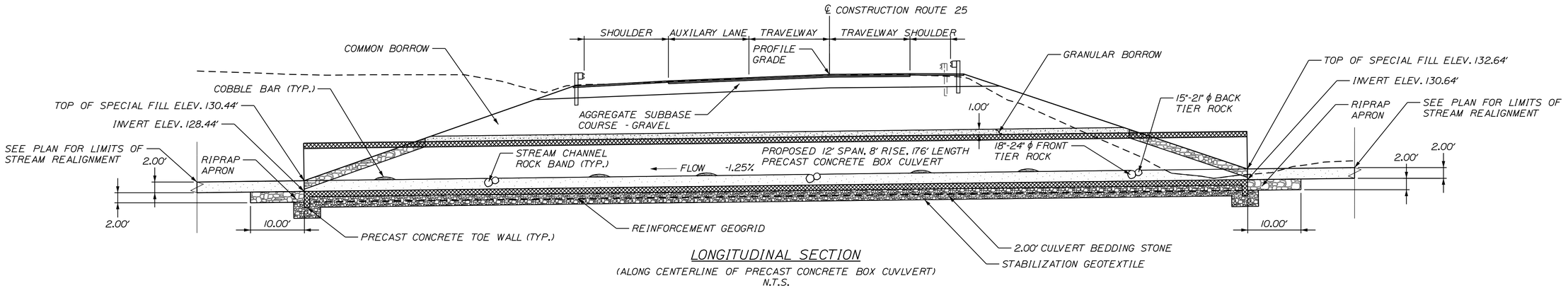
The most critical section that may undergo heave is station 13+75. The change in effective stress state within the soil at the proposed stream location is -1545 psf. The amount of heave that may occur in clays deeper than elevation 126.55 ft is 5.0 in. It will take about 1.8 years for 95% of potential heave to occur at station 13+75.


Undrained Shear Strength (psf)
0
500
1000
1500
2000
140
130
120
110
100
90
80
70
Elevation (ft)
Proposed stream elevation
Proposed culvert base elevation
Design curve: Presumpscot clay below existing road
Design curve: Presumpscot clay at stream relocation
Design Curve: Presumpscot clay at new culvert
FV (HB-GBB-201)
FV (HB-GBB-202A)
FV (HB-GBB-203)
FV (HB-GBB-204)
FV (HB-GBB-205)
FV (HB-GBB-301)
FV (HB-GBB-302)
FV (HB-GBB-303)
FV (HB-GBB-304)
FV (HB-GBB-305)
Triaxial (HB-GBB-201)
Triaxial (HB-GBB-202)
Triaxial (HB-GBB-203)

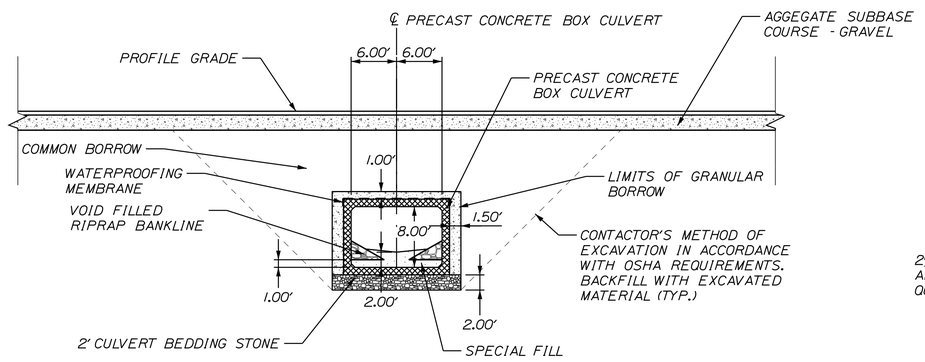
Reference 2



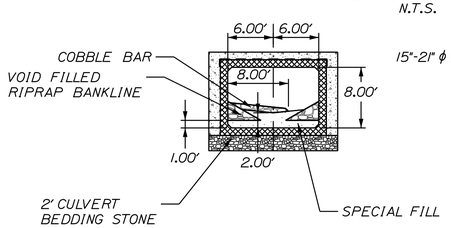
PLAN VIEW
N.T.S.



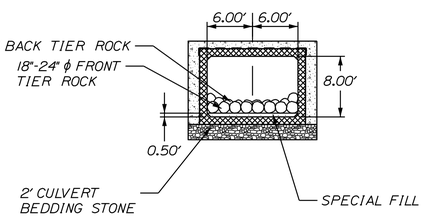
LONGITUDINAL SECTION
(ALONG CENTERLINE OF PRECAST CONCRETE BOX CUVLVERT)
N.T.S.



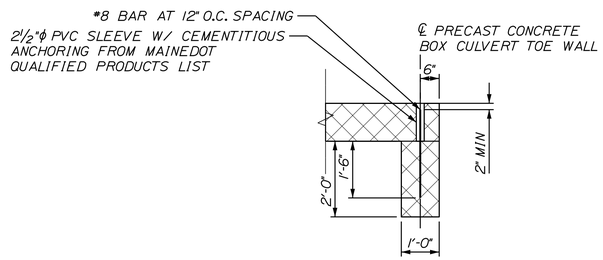
TYPICAL SECTION
(BETWEEN FEATURES)
N.T.S.



TYPICAL SECTION
(AT COBBLE BAR)
N.T.S.



TYPICAL SECTION
(AT STREAM CHANNEL ROCK BAND)
N.T.S.



PRECAST CONCRETE TOE WALL DETAIL
N.T.S.

PRECAST CONCRETE BOX NOTES:

1. THE PRECAST UNITS SHALL BE DESIGNED TO CARRY CONSTRUCTION LOADINGS WITH MINIMUM FILL COVER OF 18" OVER THE TOP OF THE UNITS.

2. INSTALL SHEET MEMBRANE WATERPROOFING OVER THE TOP AND TO 12" DOWN THE EXTERIOR SIDES OF THE PRECAST UNITS WITHIN THE LIMITS OF THE BACKFILL OVER THE TOP OF THE STRUCTURE.

3. THE PIPE SHALL BE BEDDED ON A 2' THICK GEOTEXTILE WRAPPED, UNDERDRAIN BACKFILL MATERIAL, TYPE C WITH A LAYER OF GEOGRID AT THE CENTER. PAYMENT WILL BE MADE UNDER THE APPROPRIATE CONTRACT ITEMS.

4. BEDDING MATERIAL SHALL MEET THE REQUIREMENTS OF SPECIAL PROVISION 203 - CULVERT BEDDING STONE AND 703.22 - UNDERDRAIN BACKFILL MATERIAL TYPE C.

5. COFFERDAMS ARE TO BE PLACED AT BOTH THE DOWNSTREAM AND UPSTREAM ENDS OF THE PRECAST CONCRETE BOX CULVERT TO ALLOW FOR THE CONSTRUCTION OF THE PRECAST CONCRETE BOX CULVERT IN THE DRY.

6. RIPRAP WILL BE USED TO INSLOPE AROUND THE CULVERT ENDS AT BOTH THE INLET AND OUTLET. SEE PLAN AND PROFILE FOR LOCATIONS.

7. ALL REBAR IS INCIDENTAL TO ITEM 534.71, PRECAST CONCRETE BOX CULVERT.

8. VOIDS IN THE RIPRAP APRONS SHALL BE IN FILLED WITH SPECIAL FILL WATERED-IN AND TAMPED PRIOR TO COVERING WITH 2 FT OF SPECIAL FILL.

9. THE CULVERT SHALL BE LINED WITH SPECIAL FILL IN ACCORDANCE WITH SPECIAL PROVISION 203 AND STREAM CHANNEL ROCK IN ACCORDANCE WITH SPECIAL PROVISION 610.

10. EXCAVATED BACKFILL MATERIAL WILL BE PLACED TO SUBGRADE WITH MATERIAL CONSISTENT WITH THE SURROUNDING MATERIAL.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

18821.00

WIN 18821.00

HIGHWAY PLANS

PROJ. MANAGER	L. HAMILTON		
DESIGN-DETAILED	T. WOLFEL	11/2019	T. WOLFEL
CHECKED-REVIEWED	K. WOOD	11/2019	M. STEELE
DESIGN2-DETAILED2			
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

GORHAM - BRANDY BROOK
ROUTE 25

SPECIAL DETAILS - CULVERT

SHEET NUMBER
5
OF 22

Filename: ...\MSTA\005_Culvert Details.dgn Division: HIGHWAY Username: Date:11/18/2019

Filename: ...\006_SpecialDetails_Streambed.dgn Division: HIGHWAY Username: Date:11/18/2019

CURVE DATA #1
PI = 400+88.95
D =114°35'29.6"
Δ = 16°11'13.6" Rt.
R = 50.00'
L = 14.13'
T = 7.11'
E = 0.50'

CURVE DATA #2
PI = 401+11.31
D =114°35'29.6"
Δ = 15°00'00.0" Lt.
R = 50.00'
L = 13.09'
T = 6.58'
E = 0.43'

CURVE DATA #3
PI = 401+36.23
D =114°35'29.6"
Δ = 15°00'00.0" Lt.
R = 50.00'
L = 13.09'
T = 6.58'
E = 0.43'

CURVE DATA #4
PI = 401+60.33
D =114°35'29.6"
Δ = 15°25'29.3" Lt.
R = 50.00'
L = 13.46'
T = 6.77'
E = 0.46'

CURVE DATA #5
PI = 402+37.41
D =114°35'29.6"
Δ = 18°07'57.7" Lt.
R = 50.00'
L = 15.82'
T = 7.98'
E = 0.63'

CURVE DATA #6
PI = 402+78.81
D =572°57'28.1"
Δ = 75°00'00.4" Lt.
R = 10.00'
L = 13.09'
T = 7.67'
E = 2.60'

ROCK BAND (TYP.)
SPECIAL FILL REALIGNED STREAM
VOID FILLED PLAIN RIPRAP
COBBLE BAR (TYP.)
SPECIAL FILL REALIGNED STREAM
STREAM CHANNEL ROCK ALONG BANKLINE
S52°58'13.4"E
S 00°01'47.0" W

POB = STA. 400+00.00
PC = STA. 400+81.84
PT = STA. 400+95.97
PI = STA. 400+31.83
PI = STA. 400+41.83
PC = STA. 401+04.78
PT = STA. 401+17.82
PC = STA. 401+29.65
PT = STA. 401+42.74
PT = STA. 401+56.60
PT = STA. 401+67.02
PC = STA. 402+29.43
PT = STA. 402+45.26
PC = STA. 402+71.14
PT = STA. 402+84.23
PI = STA. 404+96.75
PI = STA. 405+14.45
PI = STA. 405+44.77
PI = STA. 405+69.29
PI = STA. 405+88.58
PI = STA. 405+99.50
PI = STA. 406+35.71
POE = STA. 406+55.00

11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00
400+00 401+00 402+00 403+00 404+00 405+00 406+00 407+00

PLAN/PROFILE

HORIZ. 25 0 25 50
VERT. 5 0 5 10
Scale of Feet

PLAN

155 150 145 140 135 130 125 120

EXISTING GROUND
PROPOSED STREAM PROFILE GRADE
PVI = STA. 400+00.00 ELEV. = 126.90
STA. 402+34.52 RIPRAP OUTLET
12' SPAN x 8' RISE 176' LENGTH PRECAST CONCRETE BOX CULVERT
G = 1.25%
PVI = STA. 405+14.46 ELEV. = 133.33
PVI = STA. 405+80.79 ELEV. = 135.14
EXISTING 78" x 108" OVAL CONCRETE CULVERT (REMOVE)
PVI = STA. 406+40.79 ELEV. = 137.42
G1 = 3.80%
PROPOSED STREAM PROFILE GRADE

EL. 126.79 EL. 126.90
EL. 129.60 EL. 127.21
EL. 131.09 EL. 127.52
EL. 142.08 EL. 127.84
EL. 142.84 EL. 128.15
EL. 146.43 EL. 128.46
EL. 147.08 EL. 128.77
EL. 147.96 EL. 129.09
EL. 148.63 EL. 129.40
EL. 149.11 EL. 129.71
EL. 148.46 EL. 130.02
EL. 150.16 EL. 130.34
EL. 150.21 EL. 130.65
EL. 147.86 EL. 130.96
EL. 148.87 EL. 131.27
EL. 149.95 EL. 131.59
EL. 150.07 EL. 131.90
EL. 141.53 EL. 132.21
EL. 131.42 EL. 132.52
EL. 133.95 EL. 132.84
EL. 134.93 EL. 133.15
EL. 133.58
EL. 133.72
EL. 135.00
EL. 134.47 EL. 135.87
EL. 150.94 EL. 136.82
EL. 138.33

STREAM PROFILE

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

18821.00

WIN 18821.00

HIGHWAY PLANS

PROJ. MANAGER	L. HAMILTON	BY	DATE
DESIGN-DETAILED	T. WOLFEL	T. WOLFEL	11/2019
CHECKED-REVIEWED	K. WOOD	M. STEELE	11/2019
DESIGN2-DETAILED2			
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

GORHAM - BRANDY BROOK
ROUTE 25

SPECIAL DETAILS -
STREAM PLAN & PROFILE

SHEET NUMBER
6
OF 22

Reference 5

Equation 9-2 is the *Terzaghi one-dimensional consolidation equation*. It could just as easily be written in three dimensions, but most of the time in engineering practice one-dimensional consolidation is assumed. Basically, the equation is a form of the diffusion equation from mathematical physics. Many physical diffusion phenomena are described by this equation, for example, heat flow in a solid body. The "diffusion constant" for the soil is the c_v. Note that we called the c_v a constant. It really isn't, but we must assume it is, that is, that k, a_v, and e_o are constants, in order to make the equation linear and easily solvable.

So how do we solve the Terzaghi consolidation equation? Just like we solve all other second-order partial differential equations with constant coefficients. There are a variety of ways; some are mathematically exact; others are only approximate. For example, Harr (1966) presents an approximate solution by using the method of finite differences. Taylor (1948), following Terzaghi (1925), gives a mathematically rigorous solution in terms of a Fourier series expansion, and this is what we do in detail in Appendix B-2. Here we shall just give an outline of the solution. First, the boundary and initial conditions for the case of one-dimensional consolidation are:

1. There is complete drainage at the top and bottom of the compressible layer.
2. The initial *excess* hydrostatic pressure $\Delta u = u_i$ is equal to the applied increment of stress at the boundary, $\Delta\sigma$.

We can write these boundary and initial conditions as follows:

$$\text{When } z = 0 \text{ and when}$$
$$z = 2H, u = 0$$
$$\text{When } t = 0, \Delta u = u_i = \Delta\sigma = (\sigma_2' - \sigma_1')$$

We usually take the thickness of the consolidating layer to be $2H$, so that the *length of the longest drainage path* is equal to H or H_{dr}. Of course at $t = \infty$, $\Delta u = 0$, or complete dissipation of the pore pressure will have occurred.

Terzaghi (1925) was obviously familiar with the early work on heat transfer, and he adapted those closed-form solutions to the consolidation problem. The solution comes out in terms of a Fourier series expansion of the form

$$u = (\sigma_2' - \sigma_1') \sum_{n=0}^{\infty} f_1(Z) f_2(T) \tag{9-4}$$

where Z and T are dimensionless parameters (see also Taylor, 1948). The first term, Z, is a geometry parameter, and it is equal to z/H. The second term, T, is known as the *time factor*, and it is related to the coefficient of

consolidation c_v by

$$T = c_v \frac{t}{H_{dr}^2} \tag{9-5}$$

where t = time, and
H_{dr} = length of the longest drainage path.

We have already mentioned that c_v has dimensions of L^2T^{-1} or units of m^2/s (or equivalent).

From Eq. 9-3, the time factor can also be written as

$$T = \frac{k(1 + e_o)}{a_v \rho_w g} \frac{t}{H_{dr}^2} \tag{9-6}$$

Note that t has the same time units as k. That is, if k is in centimetres per second, then t must be in seconds. The drainage path for double drainage would be equal to half the thickness H of the clay layer, or $2H/2 = H_{dr}$. If we had only a singly drained layer, the drainage path would still be H_{dr}, but then it would be equal to the thickness H of the layer.

The progress of consolidation after some time t and at any depth z in the consolidating layer can be related to the void ratio at that time and the final change in void ratio. This relationship is called the *consolidation ratio*, and it is expressed as

$$U_z = \frac{e_1 - e}{e_1 - e_2} \tag{9-7}$$

where e is some intermediate void ratio, as shown on Fig. 9.2. What we are looking at graphically in that figure is the ratio of ordinates corresponding to AB and AC. In terms of stresses and pore pressures, Eq. 9-7 becomes

$$U_z = \frac{\sigma' - \sigma_1'}{\sigma_2' - \sigma_1'} = \frac{\sigma' - \sigma_1'}{\Delta\sigma'} = \frac{u_i - u}{u_i} = 1 - \frac{u}{u_i} \tag{9-8}$$

where σ' and u are intermediate values corresponding to e in Eq. 9-7, and u_i is the initial *excess* pore pressure induced by the applied stress $\Delta\sigma'$. You should satisfy yourself that these equations are correct from the relationships shown in Fig. 9.2 and from $\Delta\sigma' = -\Delta u$. (See also Appendix B-2.)

From Eqs. 9-7 and 9-8, it is evident that U_z is zero at the start of loading, and it gradually increases to 1 (or 100%) as the void ratio decreases from e_1 to e_2. At the same time, of course, as long as the total stress remains constant, the effective stress increases from σ_1' to σ_2' as the excess hydrostatic stress (pore water pressure) dissipates from u_i to zero. The consolidation ratio U_z is sometimes called the *degree or percent consolidation*, and it represents conditions *at a point* in the consolidating layer. It is now possible to put our solution for u in Eq. 9-4 in terms of the

TABLE 9-1

U_{avg}	T
0.1	0.008
0.2	0.031
0.3	0.071
0.4	0.126
0.5	0.197
0.6	0.287
0.7	0.403
0.8	0.567
0.9	0.848
0.95	1.163
1.0	∞

where the initial pore pressure distribution is sinusoidal, half sine, and triangular are presented by Leonards (1962).

Casagrande (1938) and Taylor (1948) provide the following useful approximations:

For $U < 60\%$,

$$T = \frac{\pi}{4}U^2 = \frac{\pi}{4}\left(\frac{U\%}{100}\right)^2 \tag{9-10}$$

For $U > 60\%$,

$$T = 1.781 - 0.933 \log (100 - U\%) \tag{9-11}$$

EXAMPLE 9.3

Given:

$T = 0.05$ for a compressible clay deposit.

Required:

Average degree of consolidation and the percent consolidation at the center and at $z/H = 0.1$.

Solution:

From Table 9-1 and Fig. 9.5, $U_{avg} = 26\%$. Therefore the clay is 26% consolidated, on the average. From Fig. 9.3 you can see that the center of

the layer is less than 0.5% consolidated, while at the "10%" depth ($z/H = 0.1$) the clay is 73% consolidated. But, *on the average* throughout the layer, the clay is 26% consolidated.

What does the average consolidation mean in terms of settlements? U_{avg} can be expressed as

$$U_{avg} = \frac{s(t)}{s_c} \tag{9-12}$$

where $s(t)$ is the settlement at any time, and s_c is the final or ultimate consolidation (primary) settlement at $t = \infty$.

EXAMPLE 9.4

Given:

The data of Example 9.3.

Required:

Find the settlement when U_{avg} is 26%, if the final consolidation settlement is 1 m.

Solution:

From Eq. 9-12, $s(t) = U_{avg}(s_c)$. Therefore

$$s(t) = 26\%\,(1\text{ m}) = 0.26\text{ m}$$

EXAMPLE 9.5

Given:

The soil profile and properties of Examples 9.1 and 9.2.

Required:

Compute the time required for the clay layer to settle 0.25 m.

GOLDER

CALCULATIONS

Date:	10/17/2019	**Made by:**	KAR
Project No.:	1669139	**Checked by:**	CJS / MEL
Subject:	Global Stability Analysis	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

OBJECTIVE

Calculate global factor of safety for the slopes next to the relocated stream at proposed grading and with proposed slope armoring.

REFERENCES

1. State of Maine Department of Transportation, Gorham - Brandy Brook Route 25: Cross Sections, dated June 13, 2019 and August 2019.
2. Bowles, J.E. (1982), Foundation Analysis and Design, 3rd edition, McGraw-Hill.
3. Maine Department of Transportation Geotechnical Section, Key to Soil and Rock Descriptions and Terms: Field Identification Information, dated October 2016.
4. AASHTO LRFD Bridge Design Specifications, 8th Ed, 2017.
5. Rocscience Slide Software Package Version 2018 8.026, build date June 14, 2019.

ATTACHMENTS

1. Undrained shear strength design curves for the Presumpscot layers.
2. Slide output figures.
3. Section location plan.

ASSUMPTIONS

1. The load applied by the road and traffic for final design conditions is modeled as a 2 ft equivalent load of soil (Reference 4, Table 3.11.6.4-1): 2 ft x 125 pcf (fill) = 250 psf.
2. A FS ≥ 1.3 is required for final design conditions.
3. Circular surfaces were analyzed using the Spencer and Bishop simplified methods and auto refine search. Non-circular surfaces were analyzed using the Spencer method and cuckoo search with monte carlo optimization.
4. The water table surface is estimated from groundwater measurements taken during drilling.
5. Three locations at approximately 50%, 65%, and 85% along the proposed stream were analysed. The sections are referred to by the corresponding Route 25 stationing: Station 13+75 (located approximately 50% along the proposed stream), Station 14+25 (located nearest the northeast slope drainage), and Station 14+75 (located near the drainage for a pipe passing underneath the Grodin Quarry entrance drive) .

CALCULATION

1. Determine input parameters to build the soil model in Slide.

The material parameters selected for use in the Slide models are shown in the table below and in Attachment 2, Figure A.0. The cohesion parameters for the clay cohesive layers were selected from the undrained shear strength design curves (Attachment 1) and are based on shear strength measurements made in the field and on laboratory data. The cohesion parameter for the crust layer and the friction angle parameters for the fill and outwash layers are based on empirical correlations (References 2 and 3) to the N_{60}-values encountered in the borings. The friction angle and unit weight parameters for the riprap were selected based on common values for riprap slope covering material.

Material Name	Unit Weight (pcf)	Strength Type	Cohesion (psf)	Friction Angle (°)
Fill	125	Mohr-Coulomb	0	32
Presumpscot Crust	120	Mohr-Coulomb	1500	0
Presumpscot (1a)	115	Mohr-Coulomb	375	0
Presumpscot (1b)	115	Mohr-Coulomb	440	0
Presumpscot (1c)	115	Mohr-Coulomb	600	0
Presumpscot (1d)	115	Mohr-Coulomb	840	0
Presumpscot (1e)	115	Mohr-Coulomb	720	0
Presumpscot (2)	115	Mohr-Coulomb	500	0
Presumpscot (3)	115	Mohr-Coulomb	750	0
Presumpscot (4)	115	Mohr-Coulomb	900	0
Outwash	130	Mohr-Coulomb	0	38
Bedrock	120	Infinite Strength	N/A	N/A
Riprap	140	Mohr-Coulomb	0	42

Date:	10/17/2019	**Made by:**	KAR
Project No.:	1669139	**Checked by:**	CJS / MEL
Subject:	Global Stability Analysis	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

2. Use the soil layer parameters listed above to analyze the slope stability with Slide.

The soil layer properties above were used to analyze the following scenarios at three different locations: Station 13+75, Station 14+25, and Station 14+75.

1. Design graded slope to the south of the relocated stream ("Left to Right Analysis"), with no slope armoring
2. Design graded slope to the north of the relocated stream ("Right to Left Analysis"), with no slope armoring
3. Design graded slope to the south of the relocated stream, with proposed slope armoring
4. Design graded slope to the north of the relocated stream, with proposed slope armoring

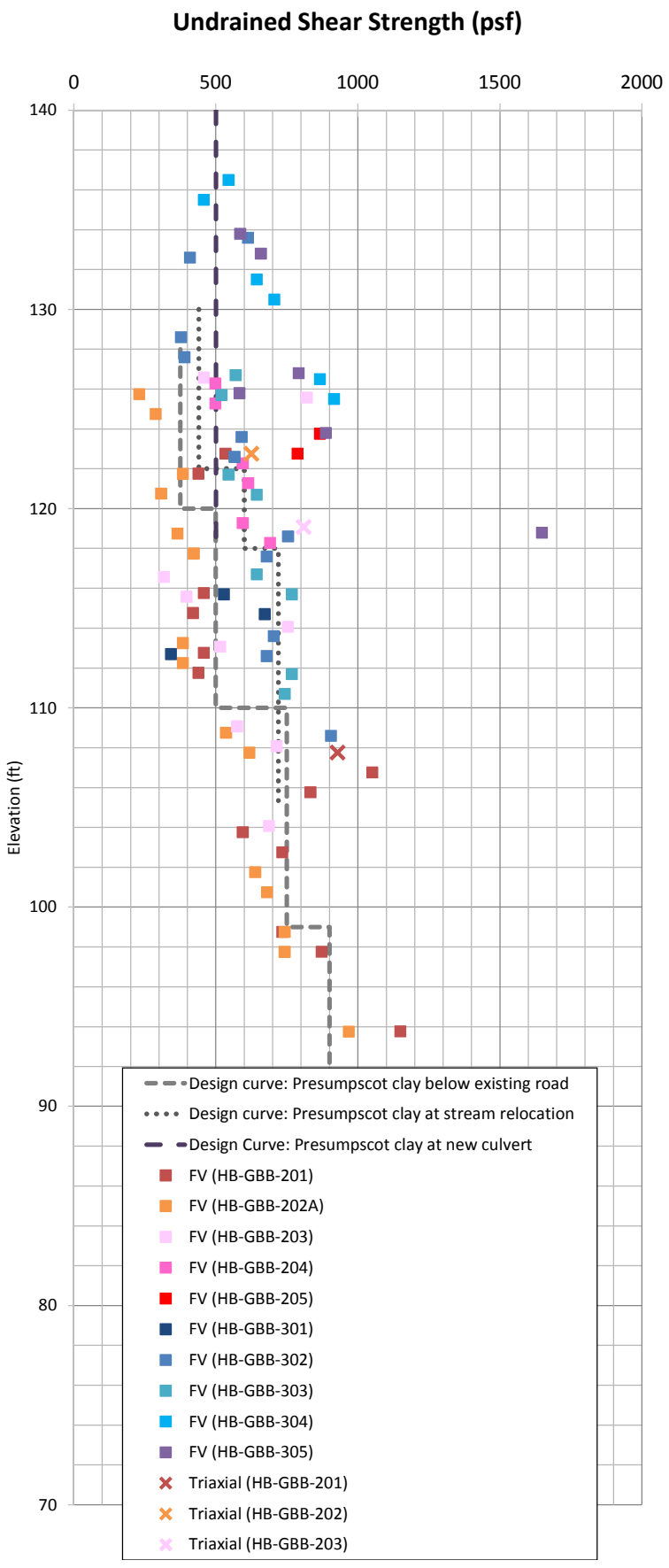
The results of the Slide stability analyses are summarized in the following table.

Station	Riprap	Slope	Analysis Method	Factor of Safety	Figure # (Attach. 2)
13+75	No	Left to Right	Circular - Spencer	1.43	A.1
13+75	No	Left to Right	Circular - Bishop	1.44	A.2
13+75	No	Left to Right	Non Circular - Spencer	1.36	A.3
13+75	No	Right to Left	Circular - Spencer	1.63	A.4
13+75	No	Right to Left	Circular - Bishop	1.64	A.5
13+75	No	Right to Left	Non Circular - Spencer	1.60	A.6
13+75	Yes	Left to Right	Circular - Spencer	1.40	A.7
13+75	Yes	Left to Right	Circular - Bishop	1.40	A.8
13+75	Yes	Left to Right	Non Circular - Spencer	1.36	A.9
13+75	Yes	Right to Left	Circular - Spencer	1.59	A.10
13+75	Yes	Right to Left	Circular - Bishop	1.59	A.11
13+75	Yes	Right to Left	Non Circular - Spencer	1.50	A.12
14+25	No	Left to Right	Circular - Spencer	1.40	B.1
14+25	No	Left to Right	Circular - Bishop	1.40	B.2
14+25	No	Left to Right	Non Circular - Spencer	1.36	B.3
14+25	No	Right to Left	Circular - Spencer	1.57	B.4
14+25	No	Right to Left	Circular - Bishop	1.58	B.5
14+25	No	Right to Left	Non Circular - Spencer	1.53	B.6
14+25	Yes	Left to Right	Circular - Spencer	1.38	B.7
14+25	Yes	Left to Right	Circular - Bishop	1.38	B.8
14+25	Yes	Left to Right	Non Circular - Spencer	1.36	B.9
14+25	Yes	Right to Left	Circular - Spencer	1.54	B.10
14+25	Yes	Right to Left	Circular - Bishop	1.54	B.11
14+25	Yes	Right to Left	Non Circular - Spencer	1.51	B.12
14+75	No	Left to Right	Circular - Spencer	1.33	C.1
14+75	No	Left to Right	Circular - Bishop	1.34	C.2
14+75	No	Left to Right	Non Circular - Spencer	1.30	C.3
14+75	No	Right to Left	Circular - Spencer	1.43	C.4
14+75	No	Right to Left	Circular - Bishop	1.43	C.5
14+75	No	Right to Left	Non Circular - Spencer	1.35	C.6
14+75	Yes	Left to Right	Circular - Spencer	1.32	C.7
14+75	Yes	Left to Right	Circular - Bishop	1.32	C.8
14+75	Yes	Left to Right	Non Circular - Spencer	1.30	C.9
14+75	Yes	Right to Left	Circular - Spencer	1.37	C.10
14+75	Yes	Right to Left	Circular - Bishop	1.37	C.11
14+75	Yes	Right to Left	Non Circular - Spencer	1.31	C.12

CONCLUSIONS

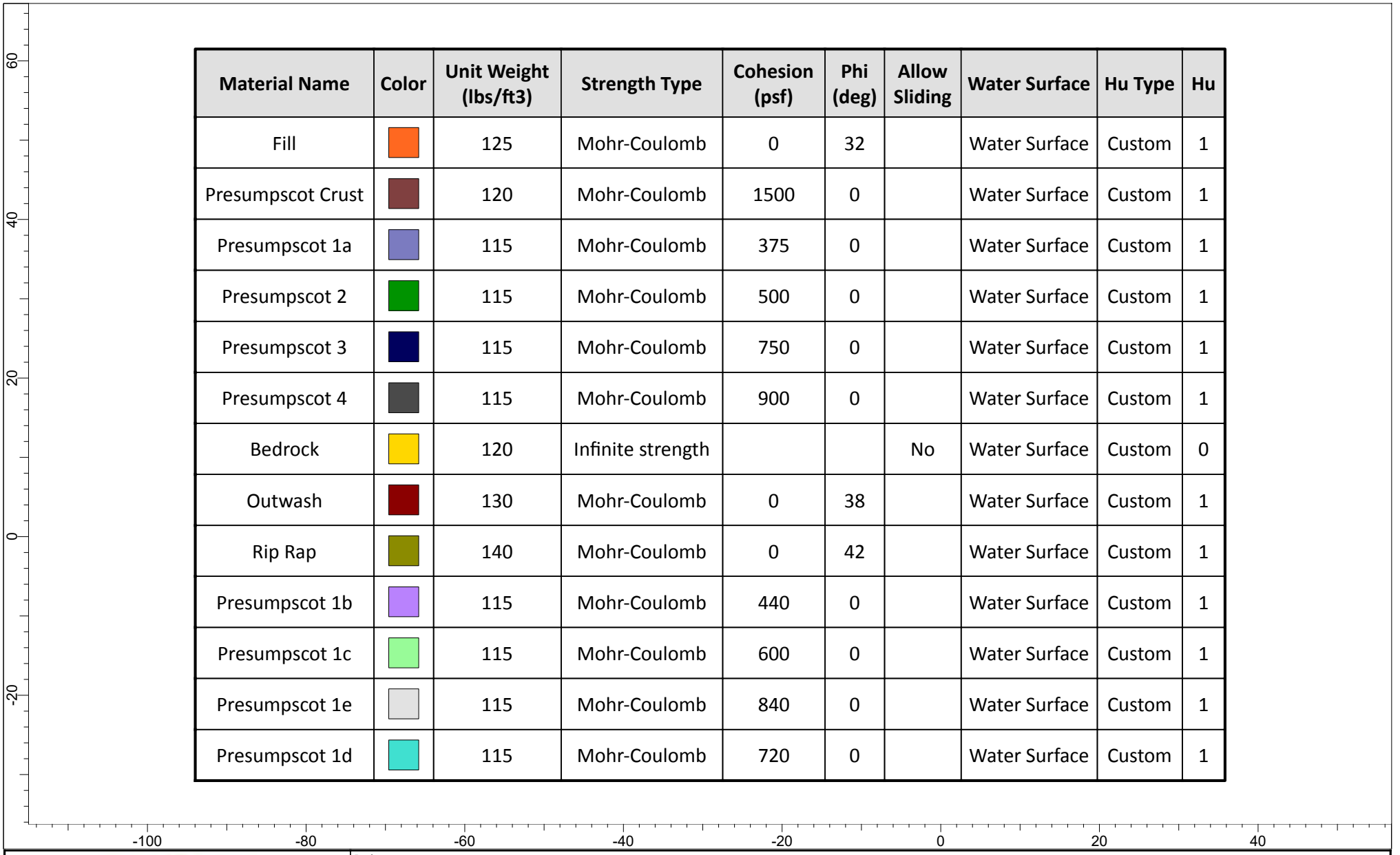
The proposed slope grading and slope armoring system maintains acceptable factors of safety.

Attachment 1



Attachment 2

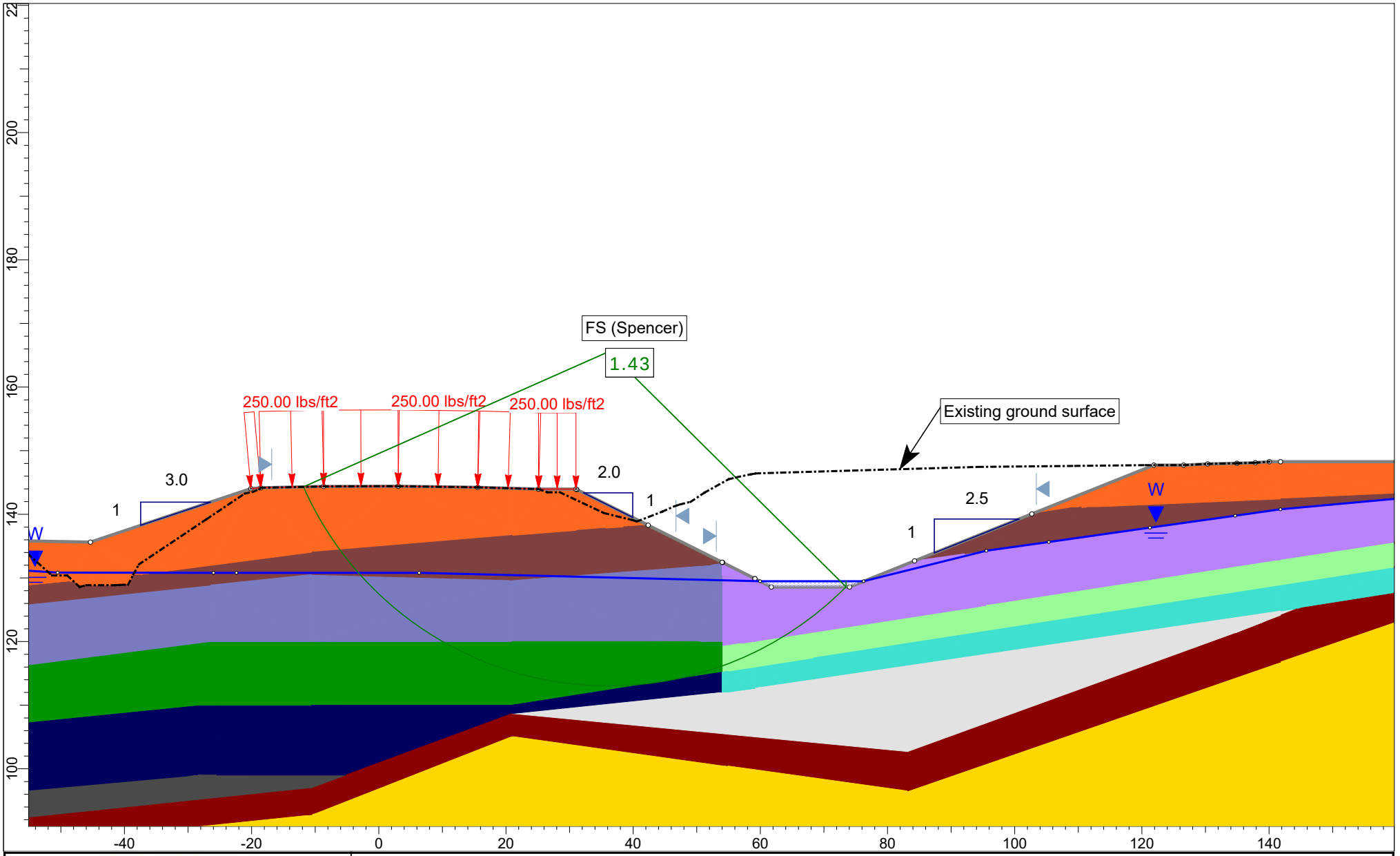
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Allow Sliding	Water Surface	Hu Type	Hu
Fill		125	Mohr-Coulomb	0	32		Water Surface	Custom	1
Presumpscot Crust		120	Mohr-Coulomb	1500	0		Water Surface	Custom	1
Presumpscot 1a		115	Mohr-Coulomb	375	0		Water Surface	Custom	1
Presumpscot 2		115	Mohr-Coulomb	500	0		Water Surface	Custom	1
Presumpscot 3		115	Mohr-Coulomb	750	0		Water Surface	Custom	1
Presumpscot 4		115	Mohr-Coulomb	900	0		Water Surface	Custom	1
Bedrock		120	Infinite strength			No	Water Surface	Custom	0
Outwash		130	Mohr-Coulomb	0	38		Water Surface	Custom	1
Rip Rap		140	Mohr-Coulomb	0	42		Water Surface	Custom	1
Presumpscot 1b		115	Mohr-Coulomb	440	0		Water Surface	Custom	1
Presumpscot 1c		115	Mohr-Coulomb	600	0		Water Surface	Custom	1
Presumpscot 1e		115	Mohr-Coulomb	840	0		Water Surface	Custom	1
Presumpscot 1d		115	Mohr-Coulomb	720	0		Water Surface	Custom	1



GOLDER

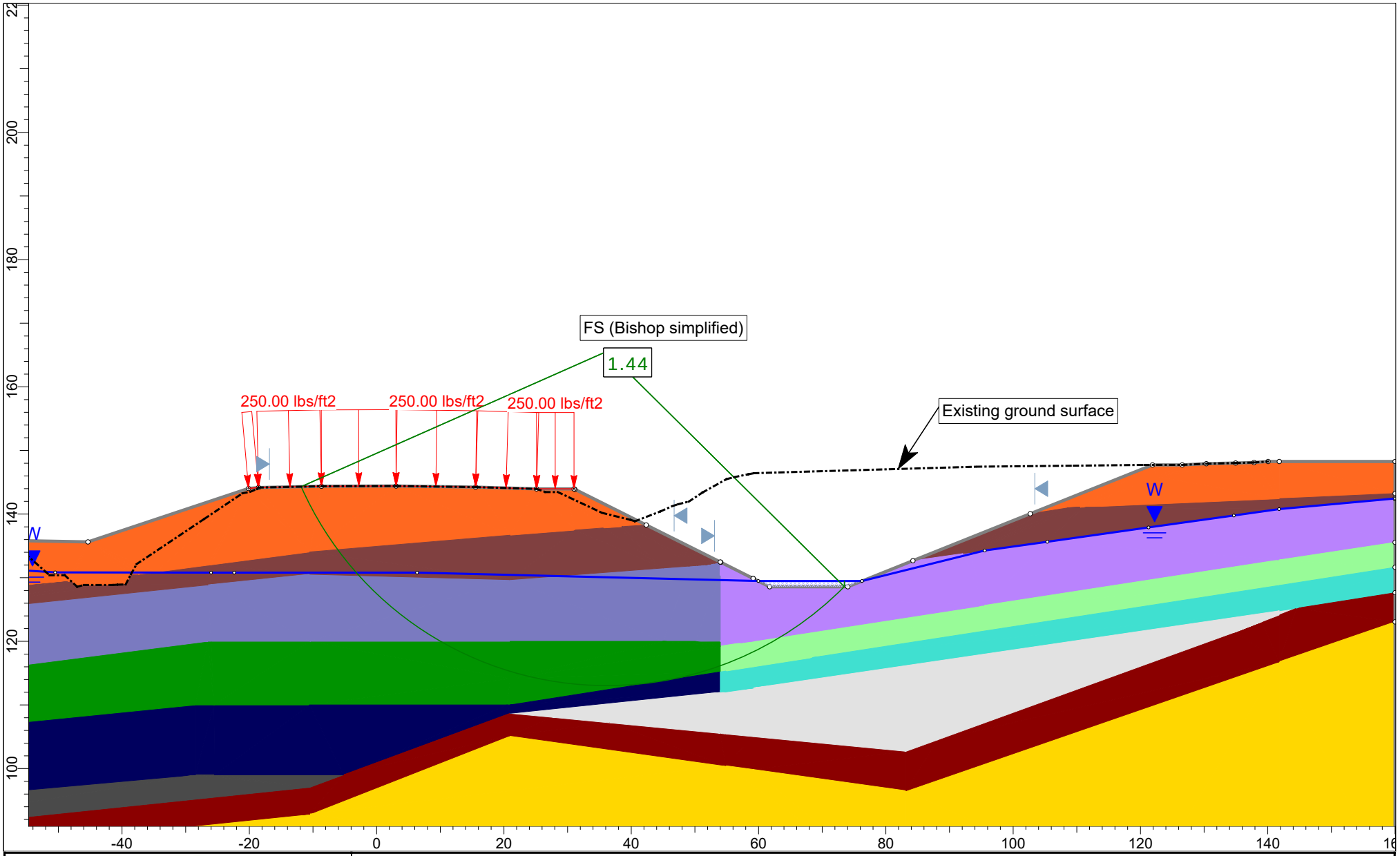
SLIDEINTERPRET 8.026

Project	WIN 18821.00 Gorham Brandy Brook			
Analysis Description	Material Properties			
Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:200	**Figure A.0**
Date: 11/21/2019				



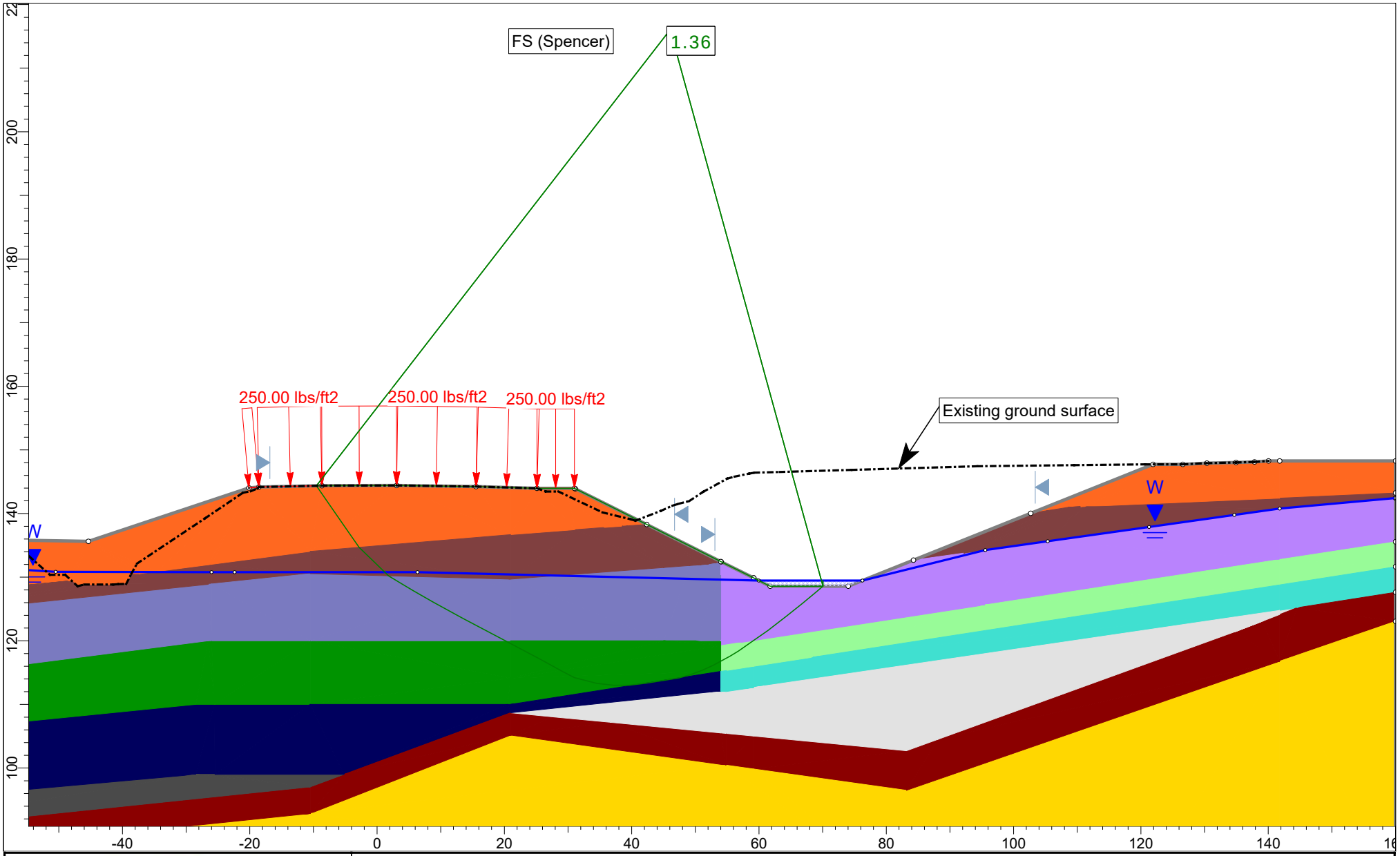
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 13+75: No Riprap - Circular - Left to Right Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure A.1**

SLIDEINTERPRET 8.026



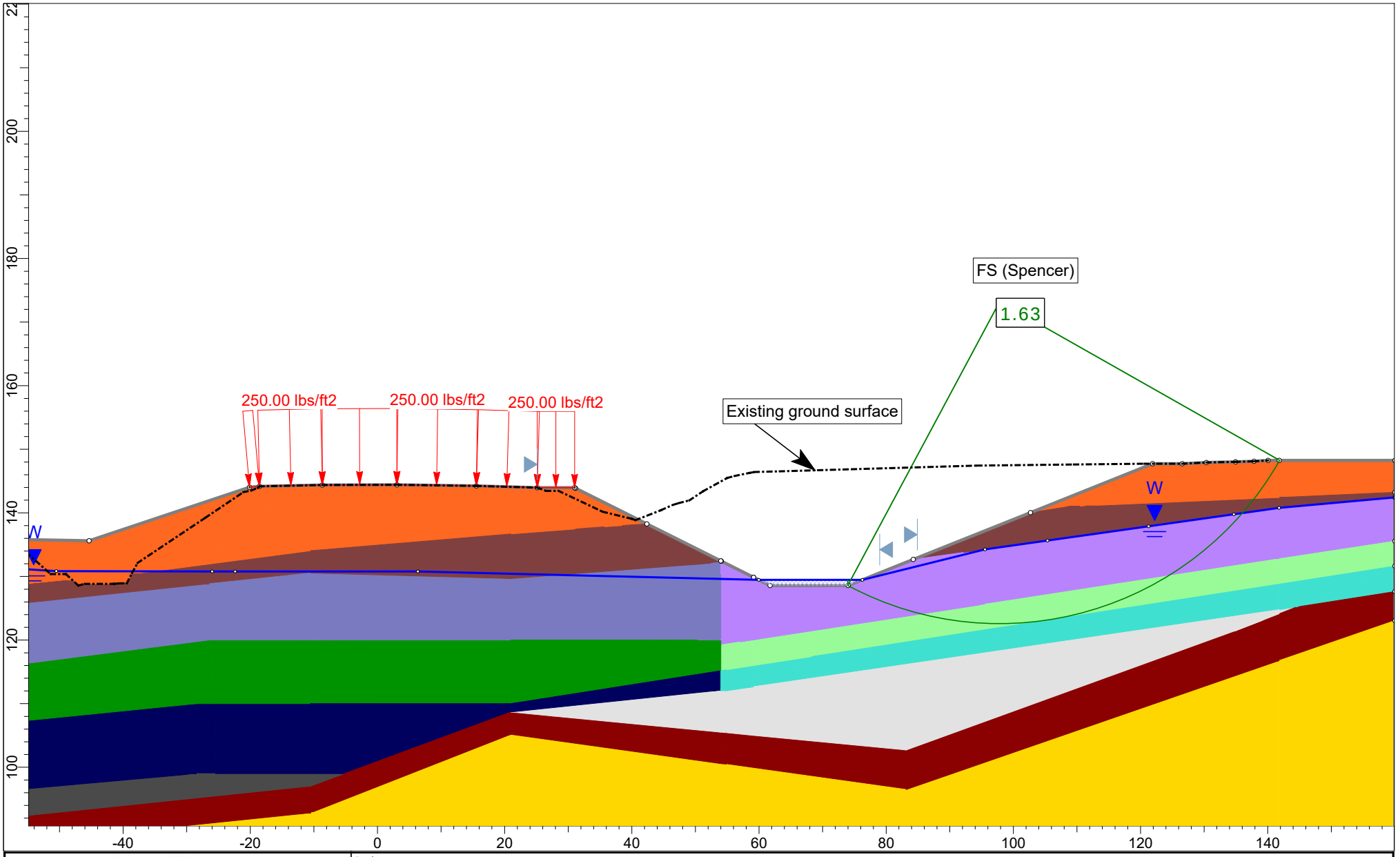
GOLDER	*Project* WIN 18821.00 Gorham Brandy Brook			
	Analysis Description Station 13+75: No Riprap - Circular - Left to Right Analysis			
	Drawn By KAR	*Checked by:*	*Reviewed by:*	*Scale* 1:250
	Date 11/21/2019			**Figure A.2**

SLIDEINTERPRET 8.026



GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 13+75: No Riprap - Non-Circular - Left to Right Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure A.3**

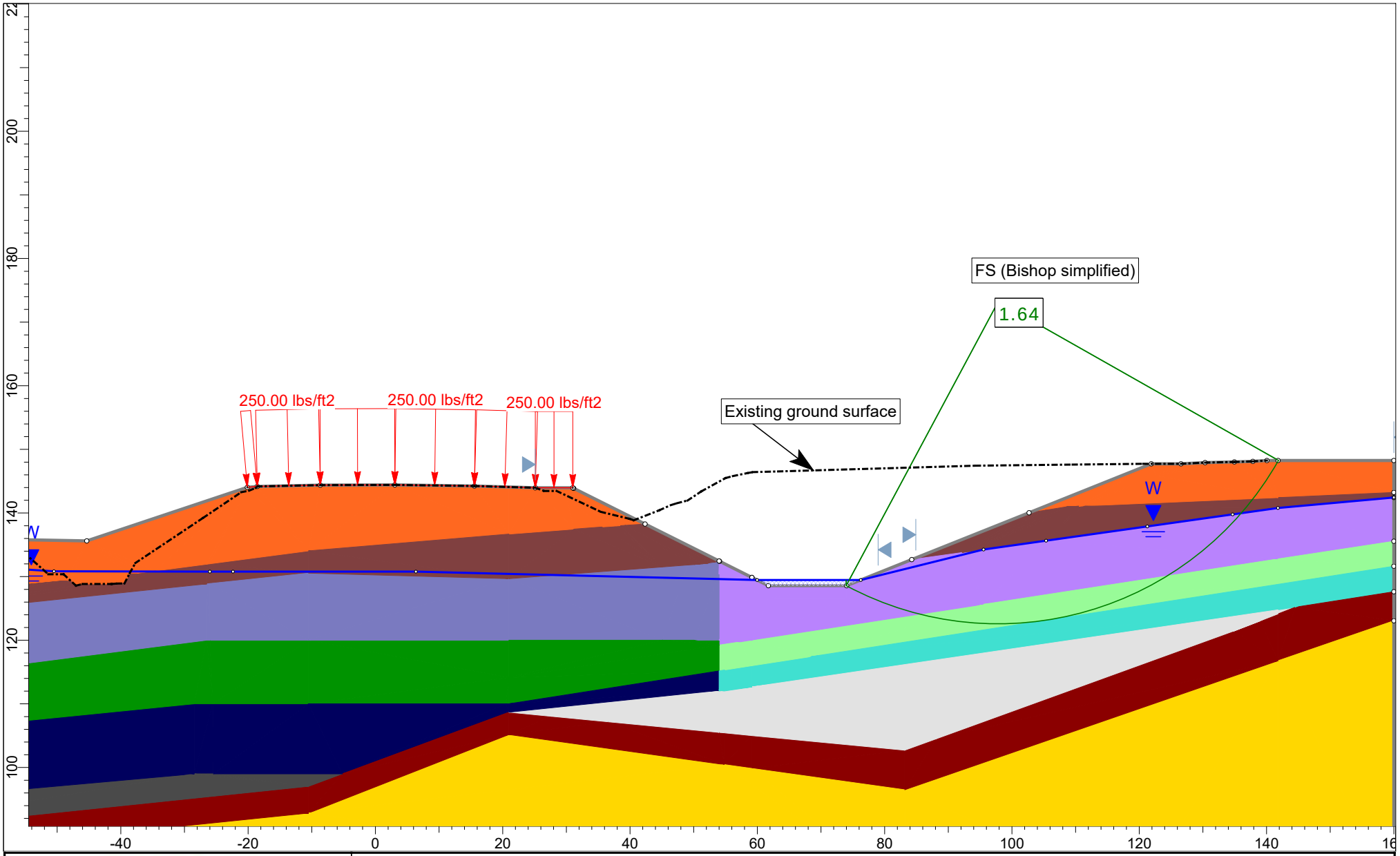
SLIDEINTERPRET 8.026



GOLDER

SLIDEINTERPRET 8.026

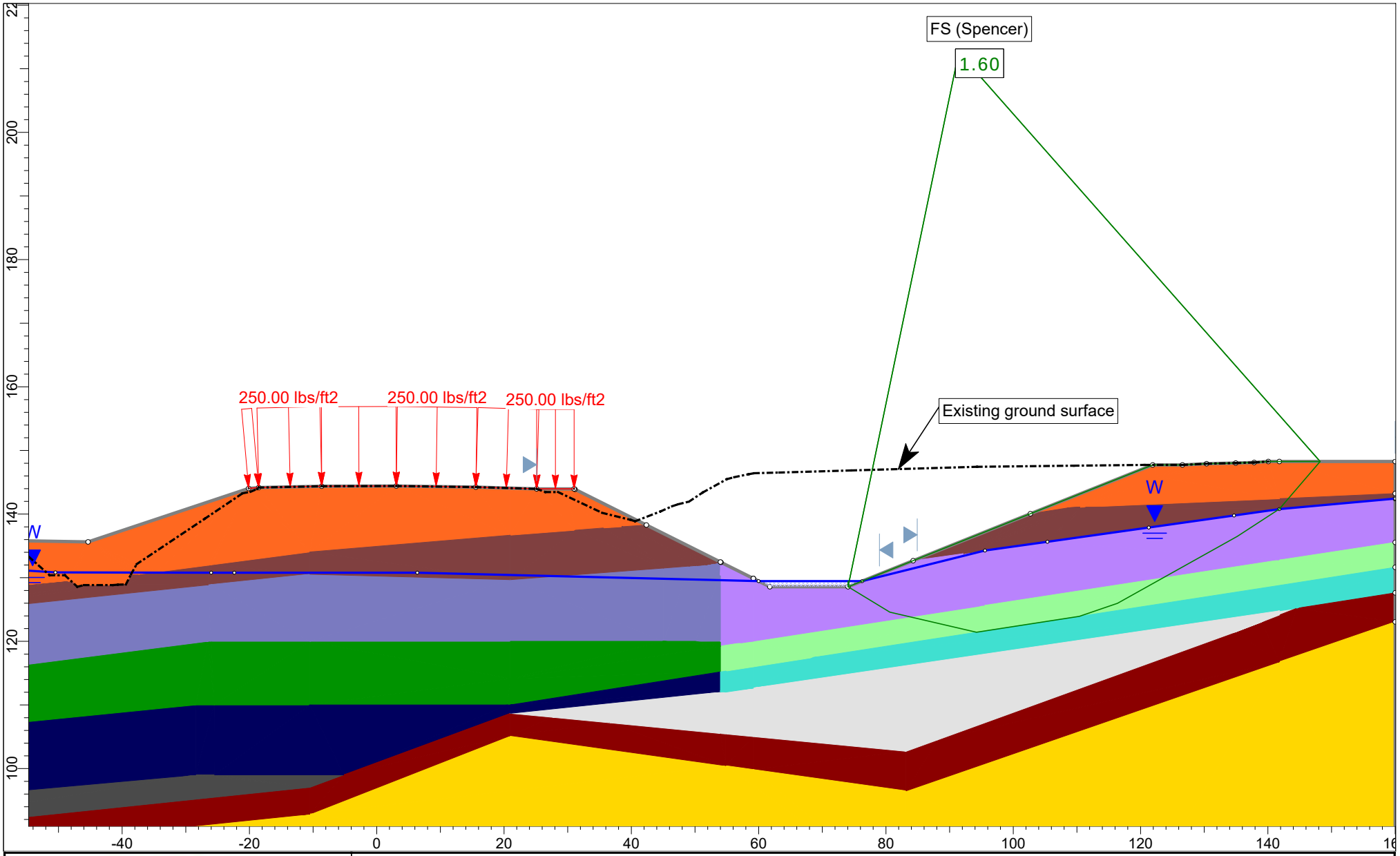
Project	WIN 18821.00 Gorham Brandy Brook			
Analysis Description	Station 13+75: No Riprap - Circular - Right to Left Analysis			
Drawn By KAR	*Checked by:*	*Reviewed by:*	*Scale* 1:250	**Figure A.4**
Date 11/21/2019				



GOLDER

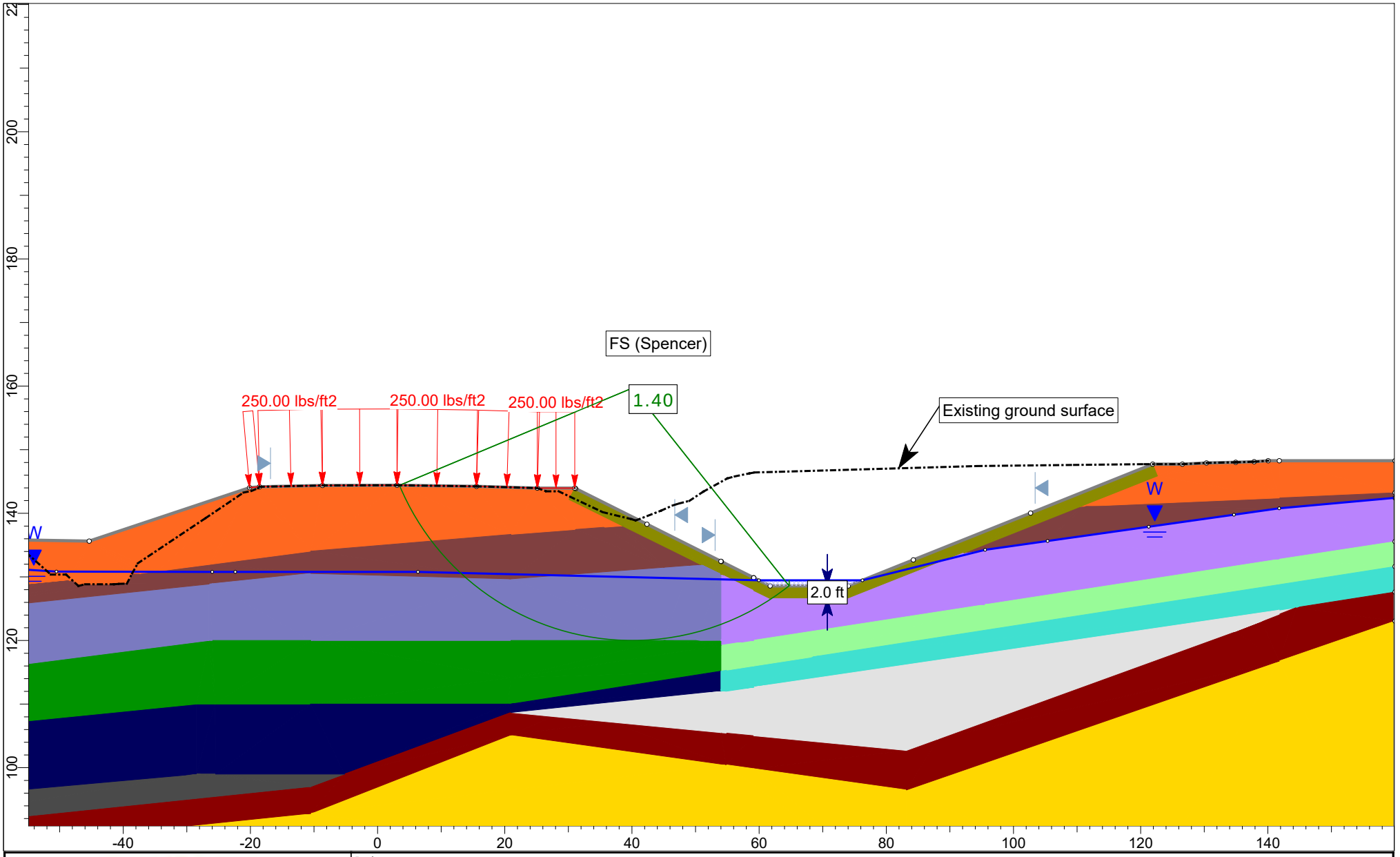
SLIDEINTERPRET 8.026

Project	WIN 18821.00 Gorham Brandy Brook			
Analysis Description	Station 13+75: No Riprap - Circular - Right to Left Analysis			
Drawn By KAR	*Checked by:*	*Reviewed by:*	*Scale* 1:250	**Figure A.5**
Date 11/21/2019				



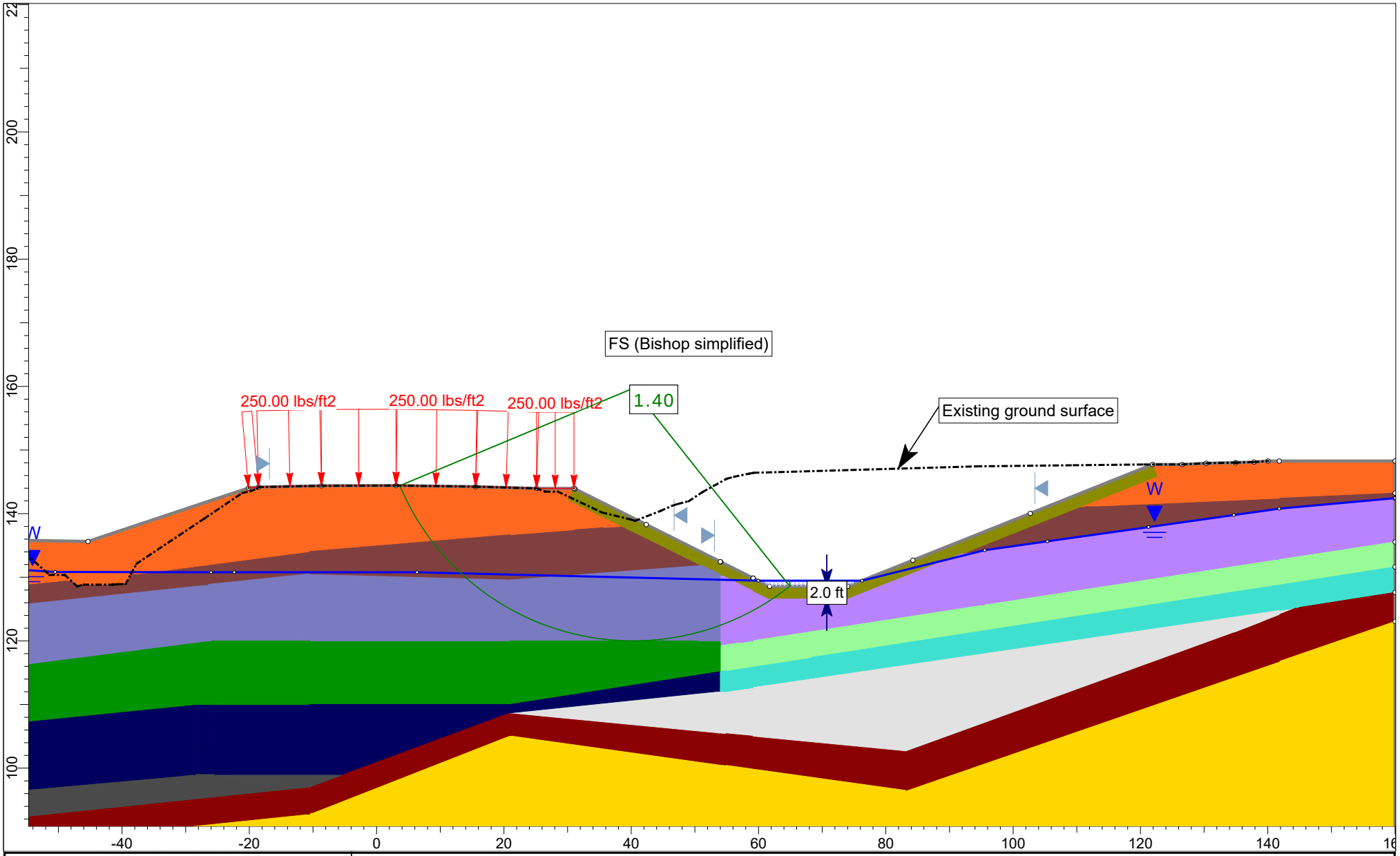
GOLDER	*Project*	WIN 18821.00 Gorham Brandy Brook		
	Analysis Description	Station 13+75: No Riprap - Non-Circular - Right to Left Analysis		
	Drawn By KAR	*Checked by:*	*Reviewed by:*	*Scale* 1:250
	Date 11/21/2019			**Figure A.6**

SLIDEINTERPRET 8.026



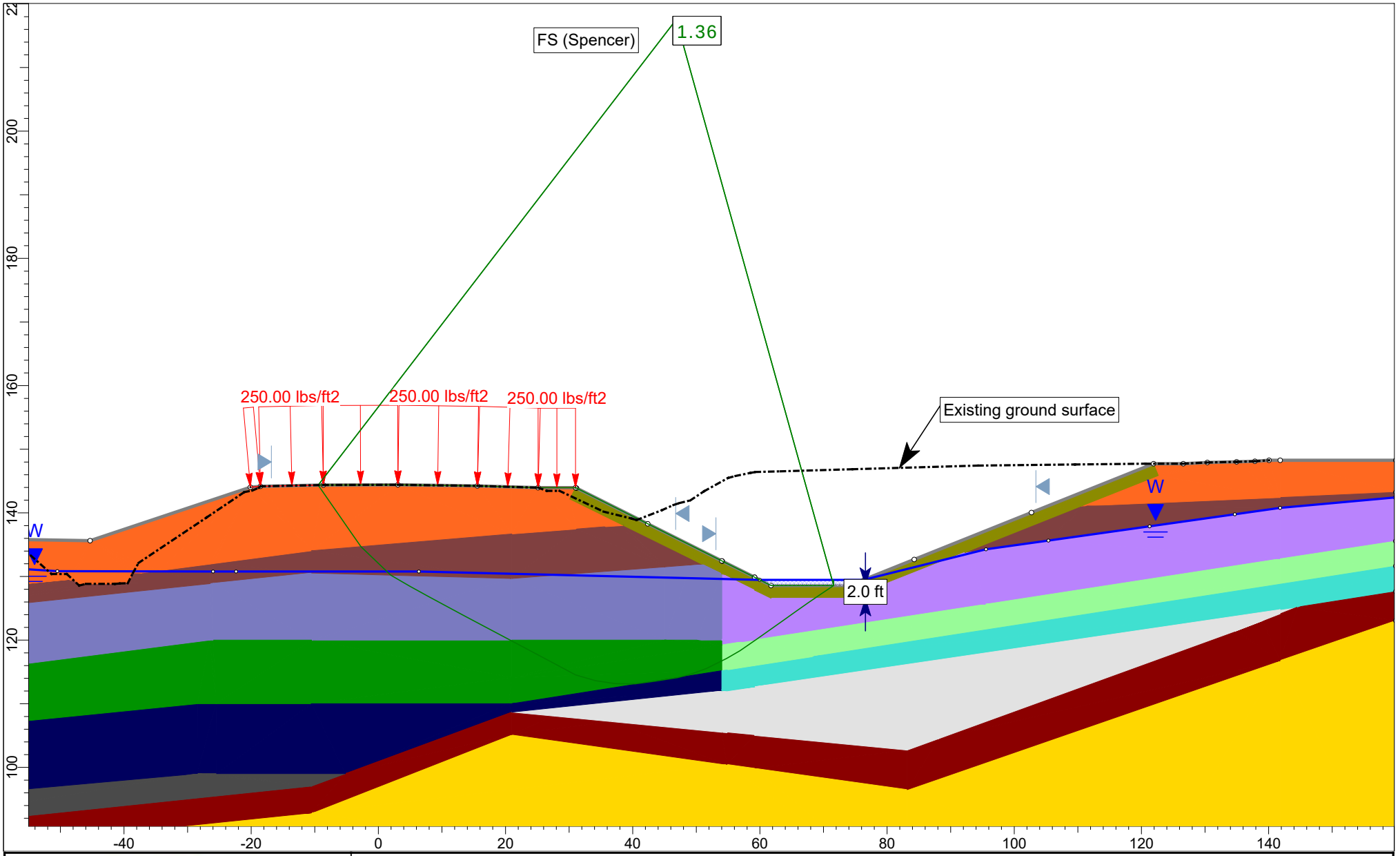
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 13+75: Riprap - Circular - Left to Right Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure A.7**

SLIDEINTERPRET 8.026



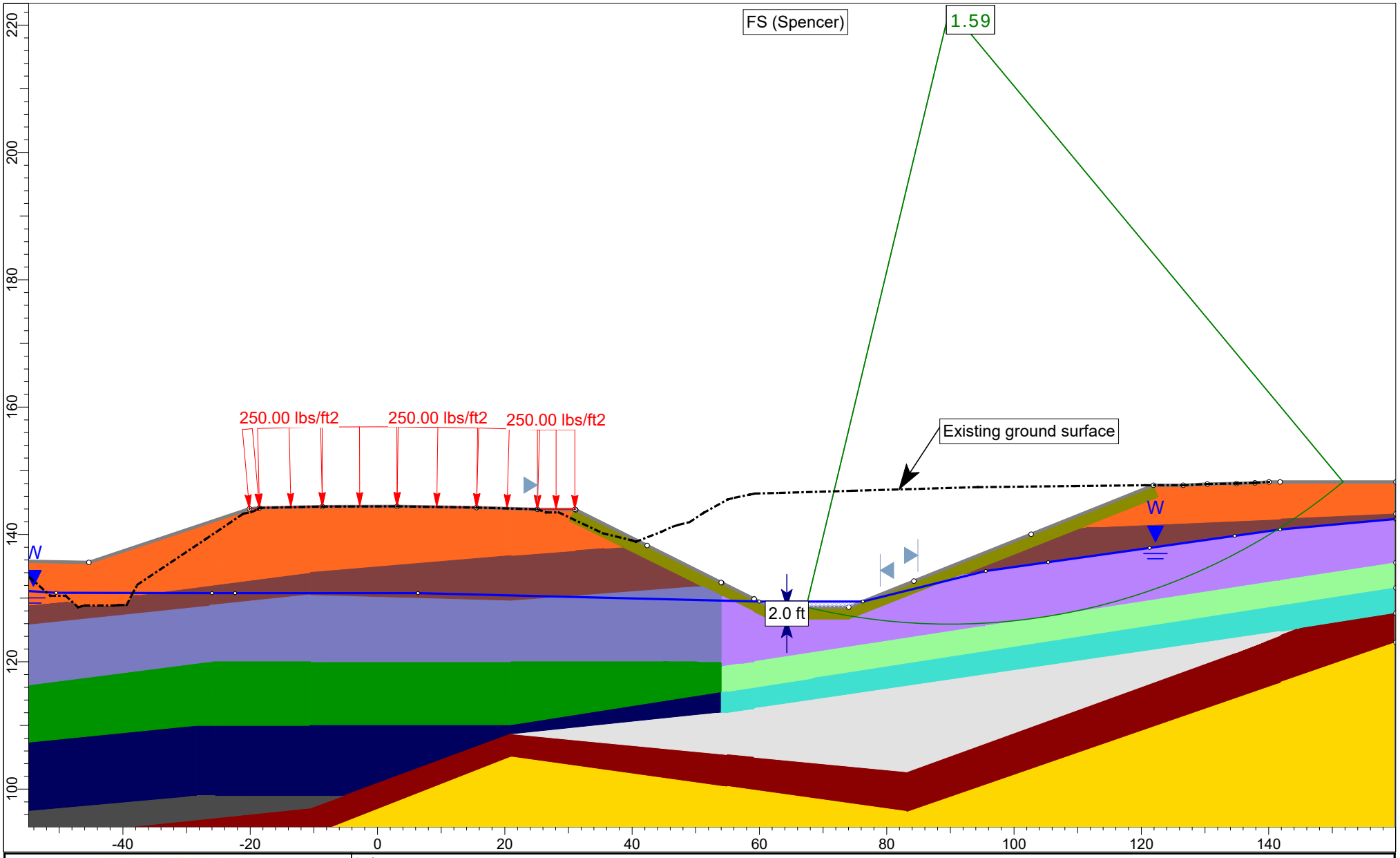
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 13+75: Riprap - Circular - Left to Right Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure A.8**

SLIDEINTERPRET 8.026



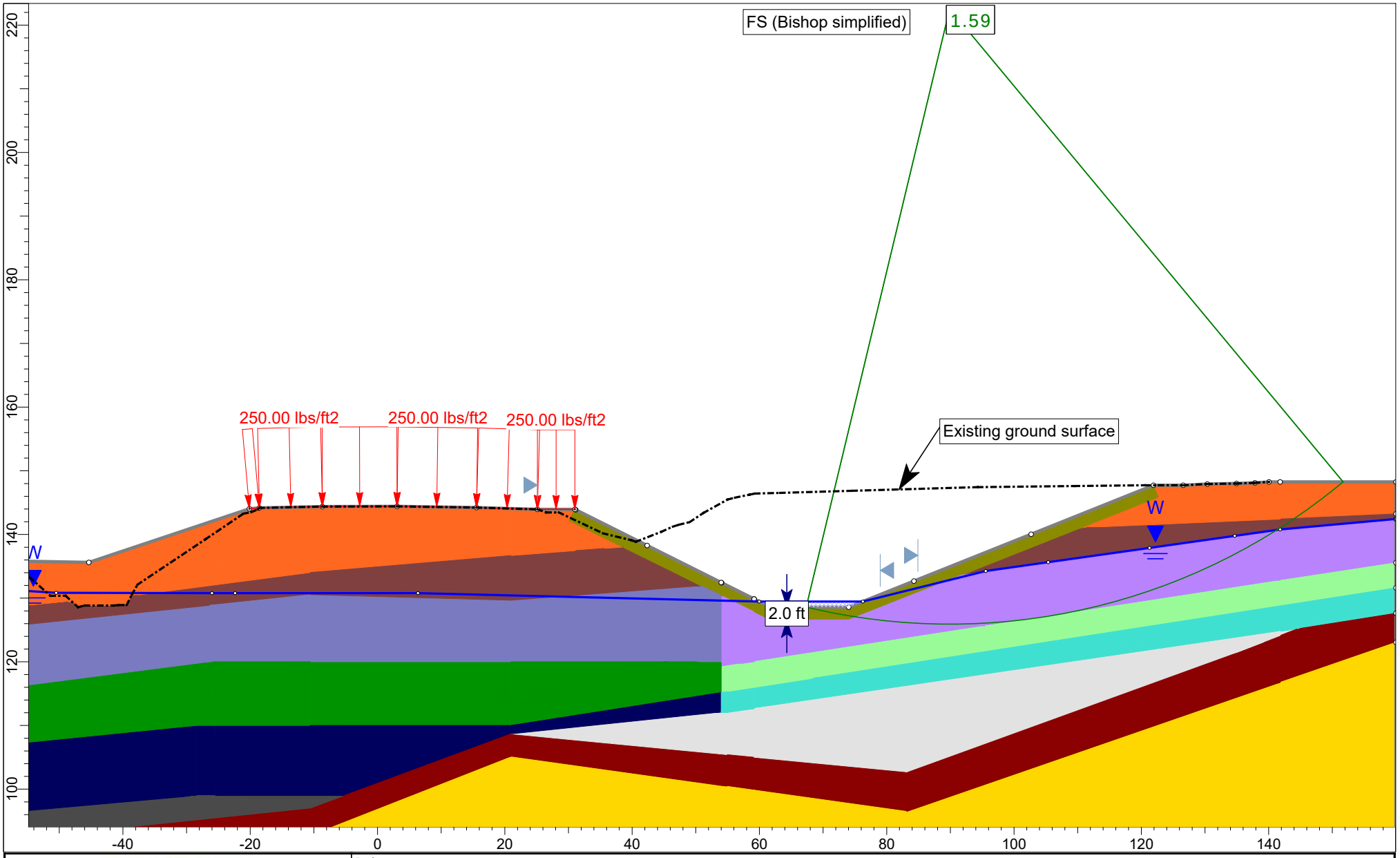
GOLDER	*Project* WIN 18821.00 Gorham Brandy Brook			
	Analysis Description Station 13+75: Riprap - Non-Circular - Left to Right Analysis			
	Drawn By KAR	*Checked by:*	*Reviewed by:*	*Scale* 1:250
	Date 11/21/2019			**Figure A.9**

SLIDEINTERPRET 8.026



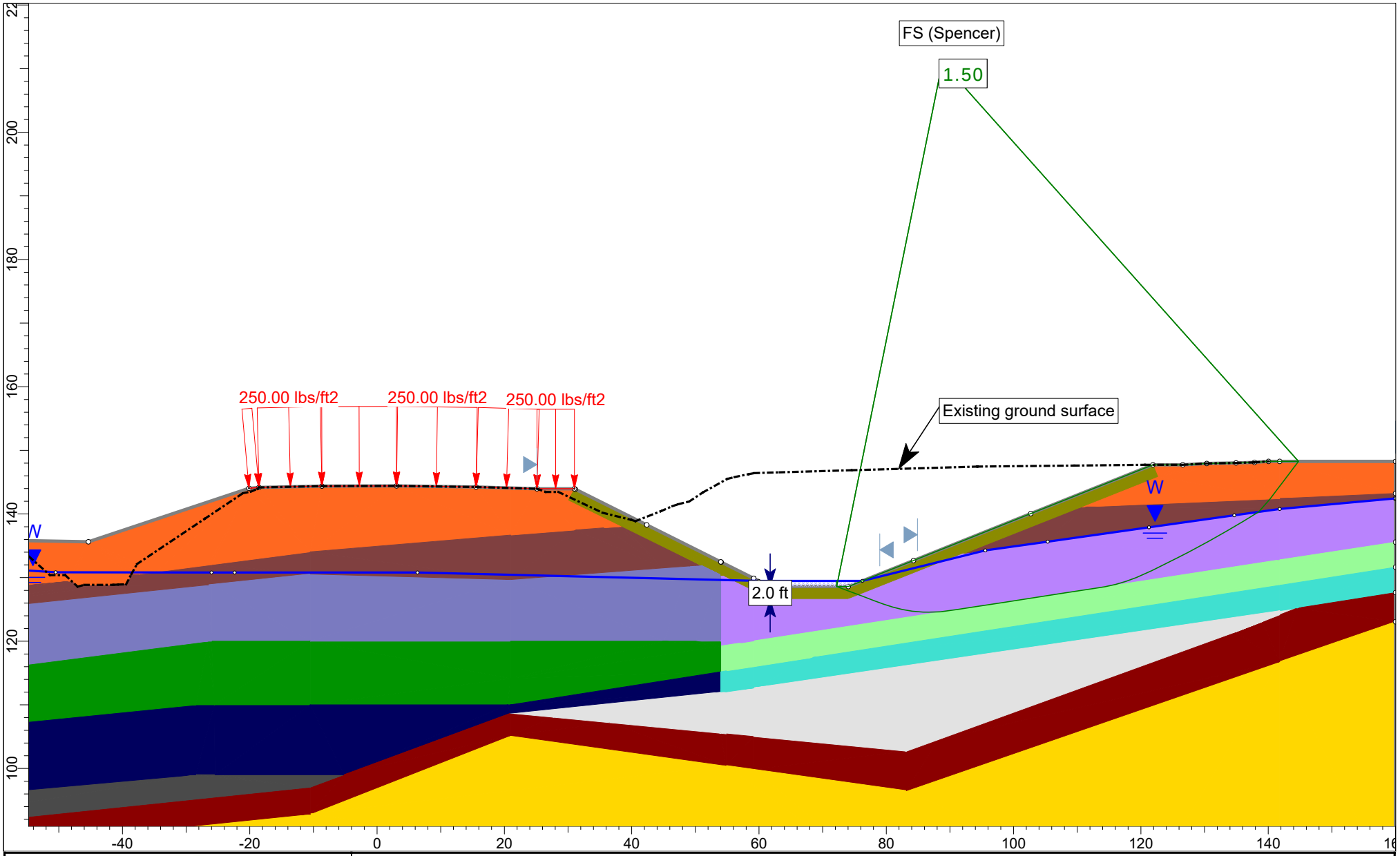
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 13+75: Riprap - Circular - Right to Left Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure A.10**

SLIDEINTERPRET 8.026



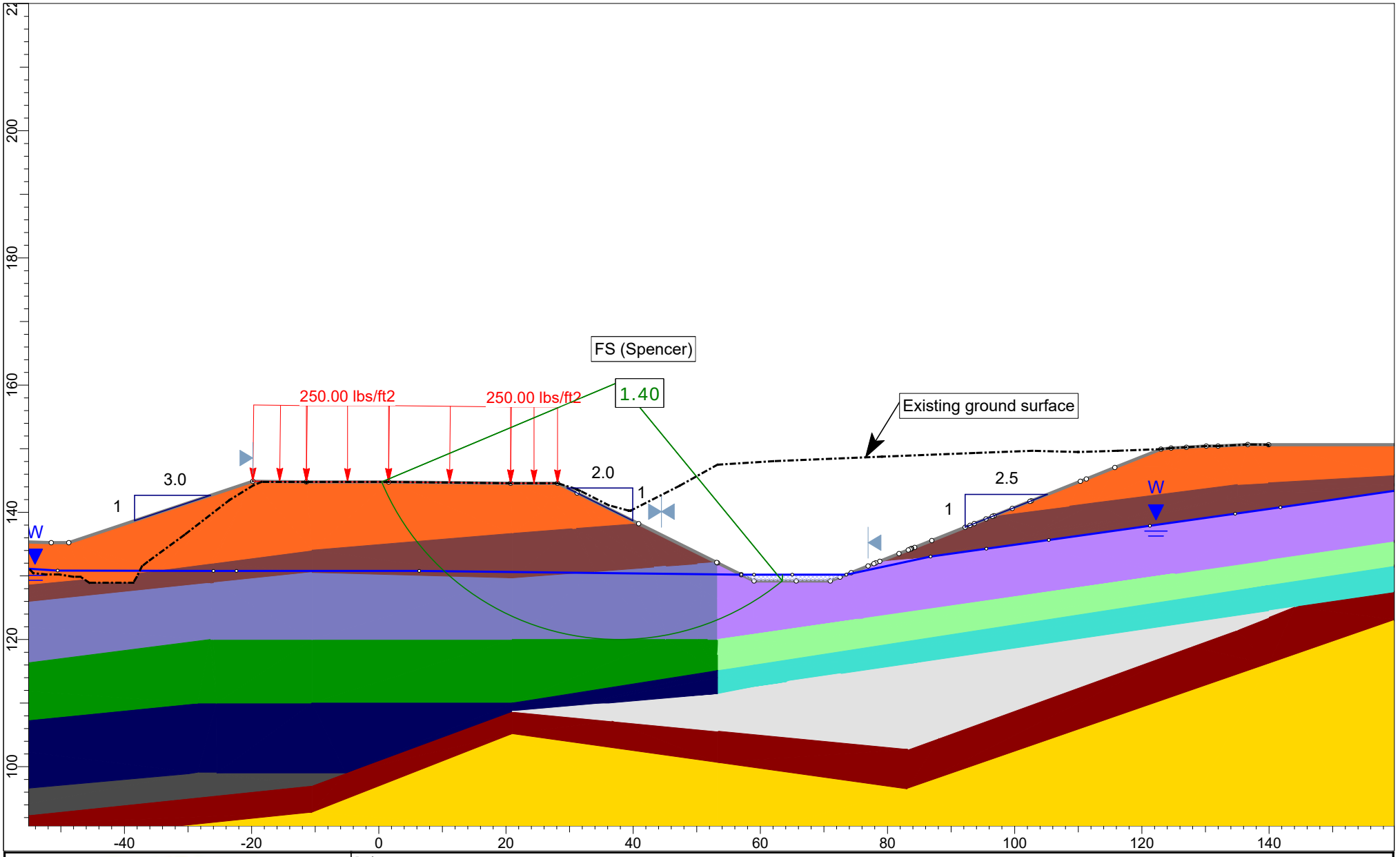
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 13+75: Riprap - Circular - Right to Left Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure A.11**

SLIDEINTERPRET 8.026



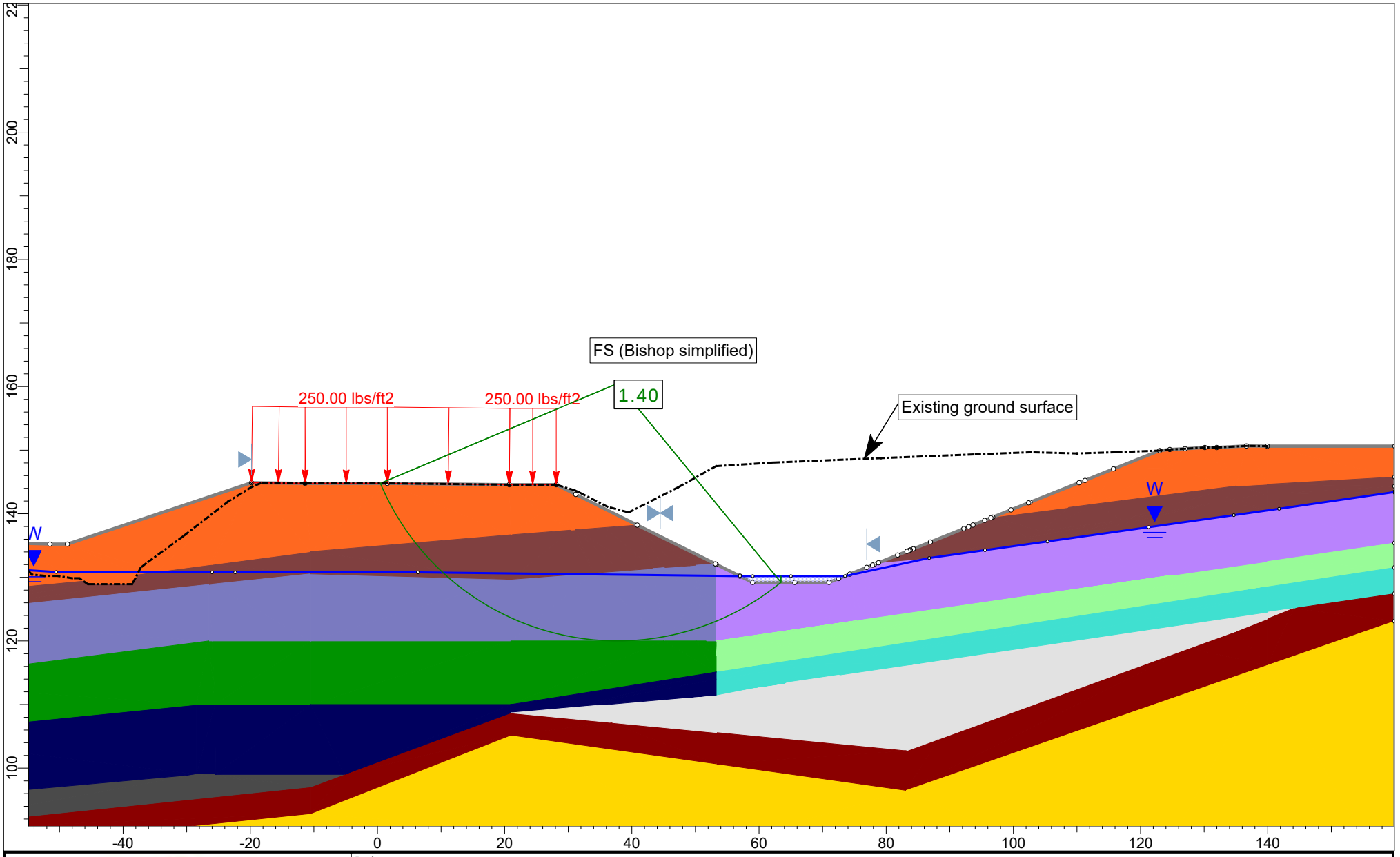
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 13+75: Riprap - Non-Circular - Right to Left Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure A.12**

SLIDEINTERPRET 8.026



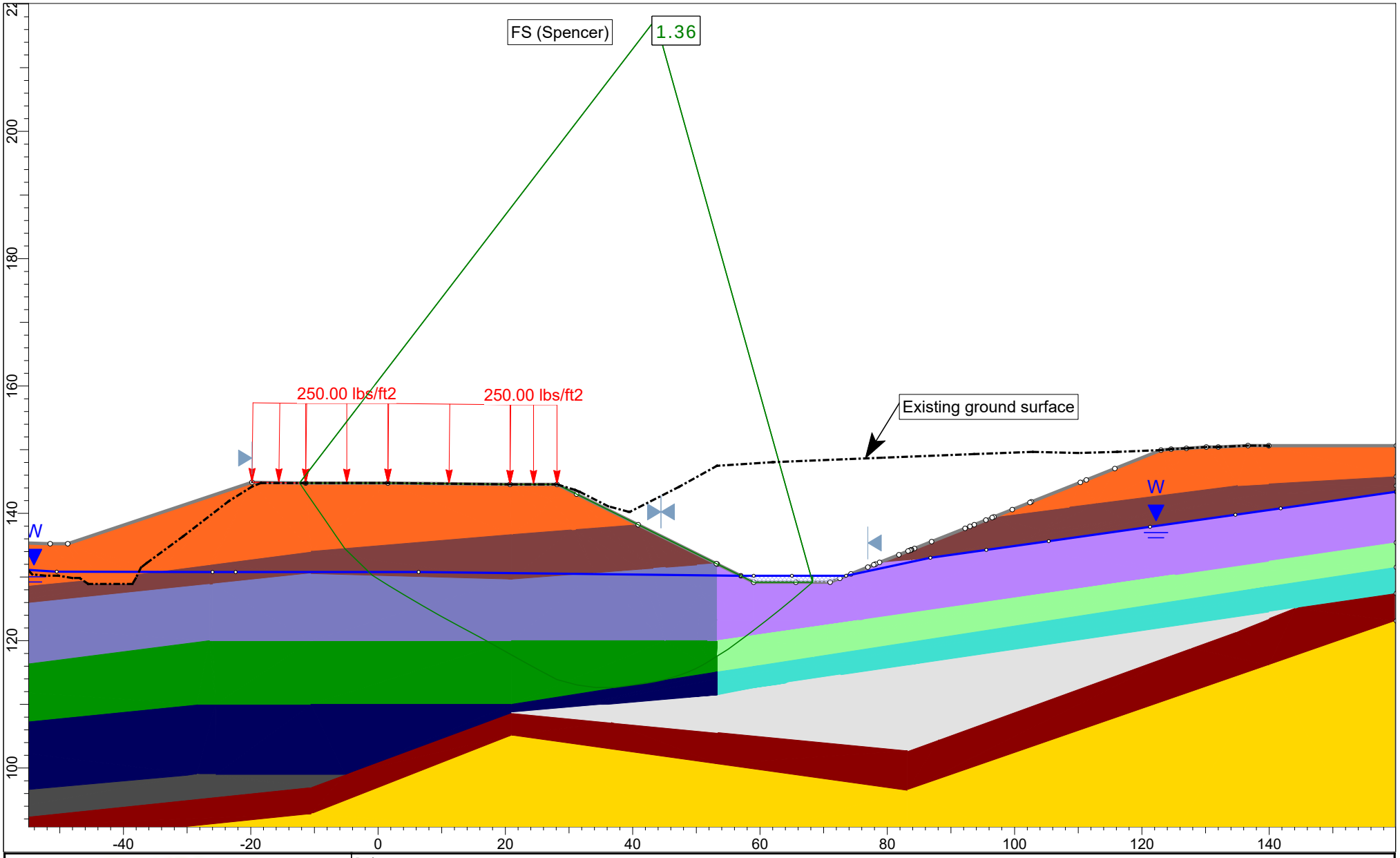
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 14+25: No Riprap - Circular - Left to Right Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure B.1**

SLIDEINTERPRET 8.026



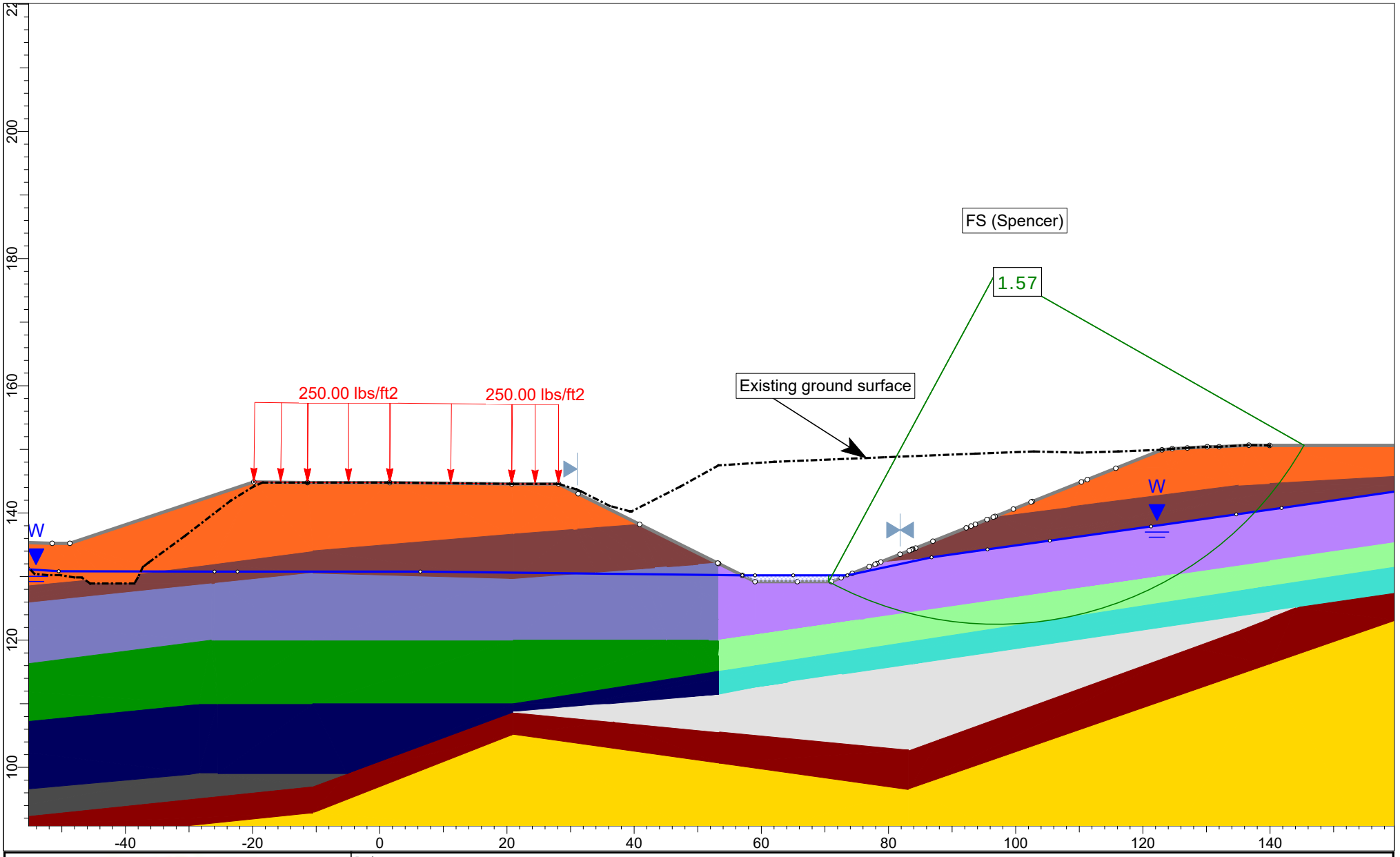
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 14+25: No Riprap - Circular - Left to Right Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure B.2**

SLIDEINTERPRET 8.026



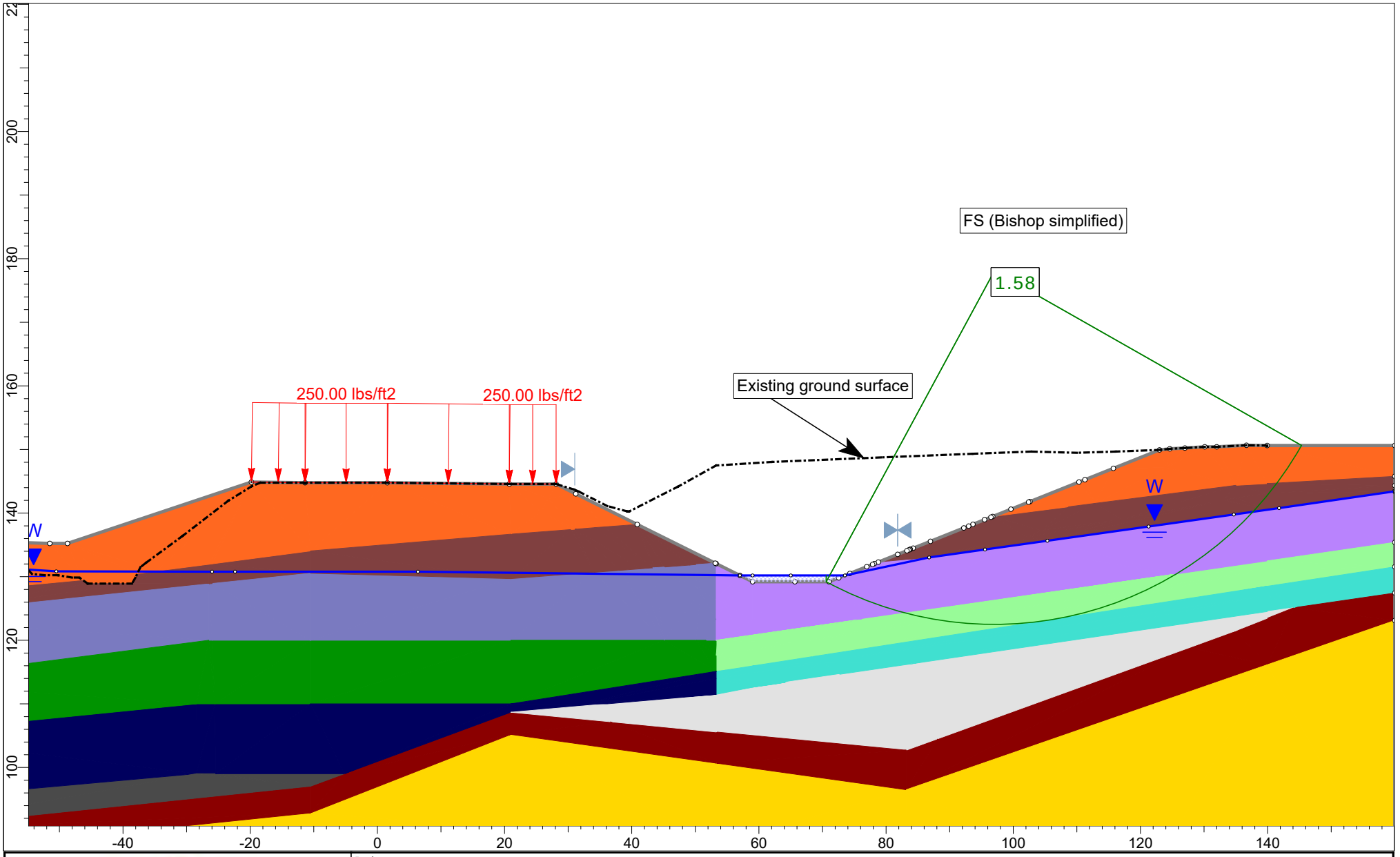
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 14+25: No Riprap - Non-Circular - Left to Right Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure B.3**

SLIDEINTERPRET 8.026



GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 14+25: No Riprap - Circular - Right to Left Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure B.4**

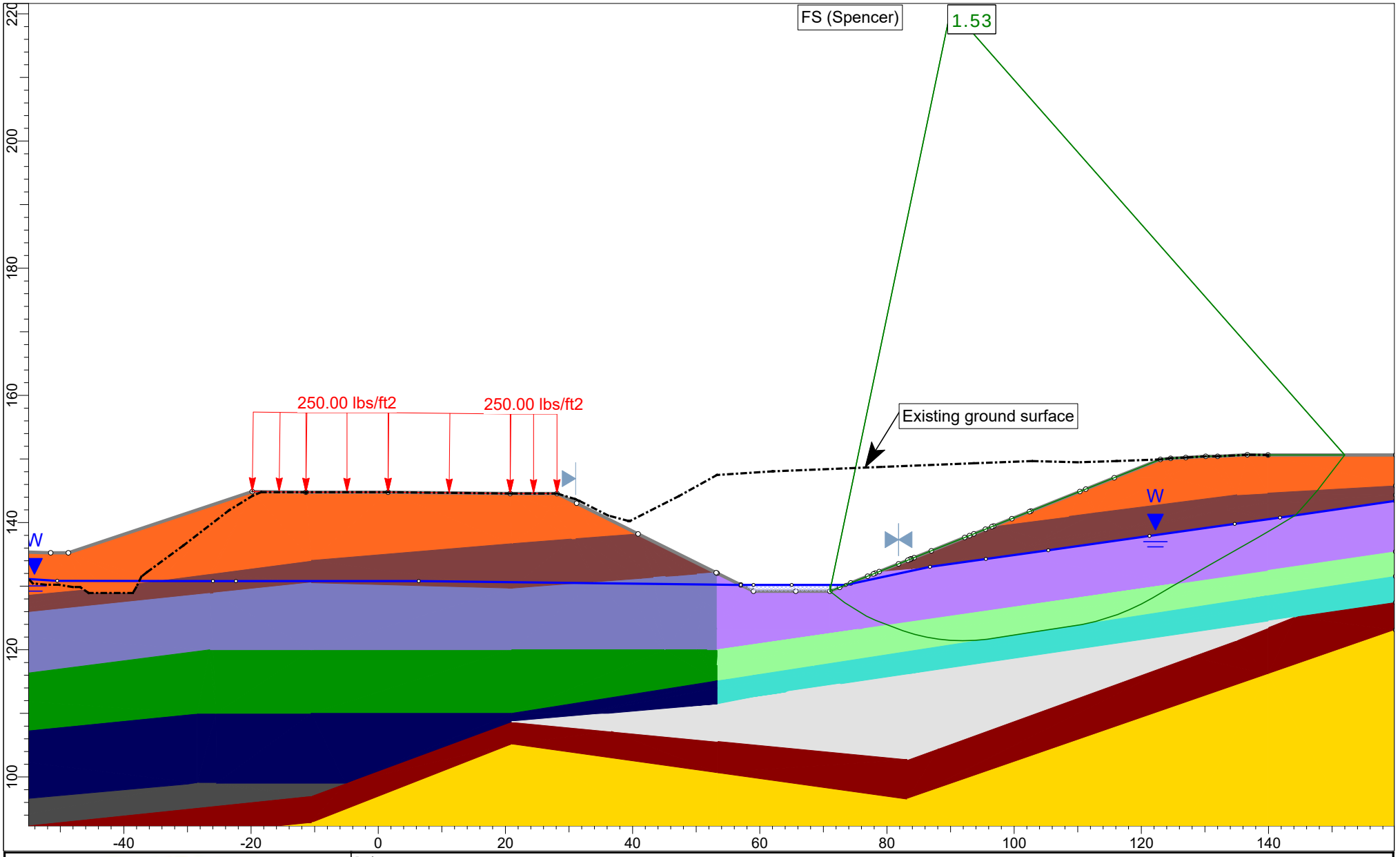
SLIDEINTERPRET 8.026



GOLDER

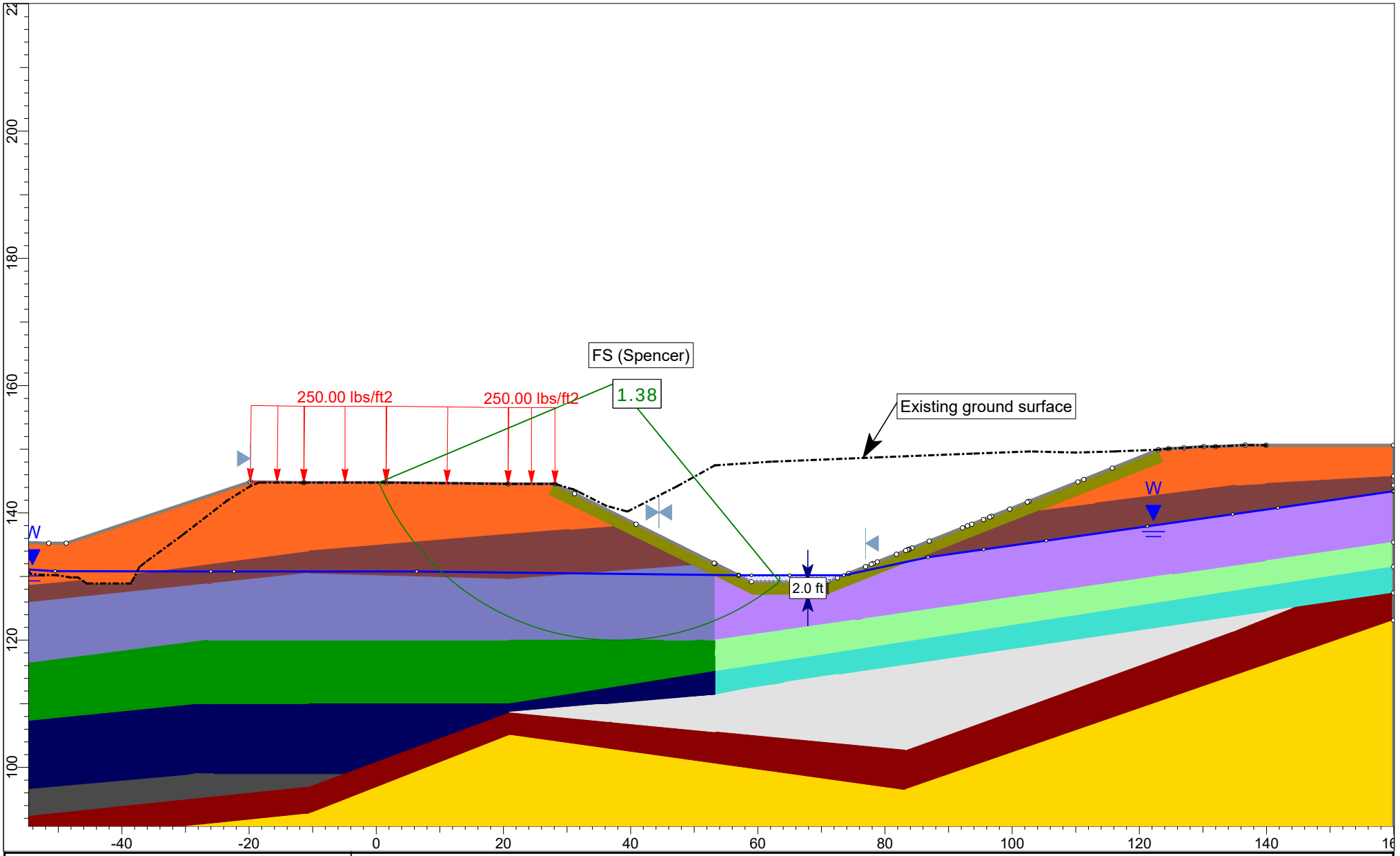
SLIDEINTERPRET 8.026

Project	WIN 18821.00 Gorham Brandy Brook			
Analysis Description	Station 14+25: No Riprap - Circular - Right to Left Analysis			
Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250	**Figure B.5**
Date: 11/21/2019				



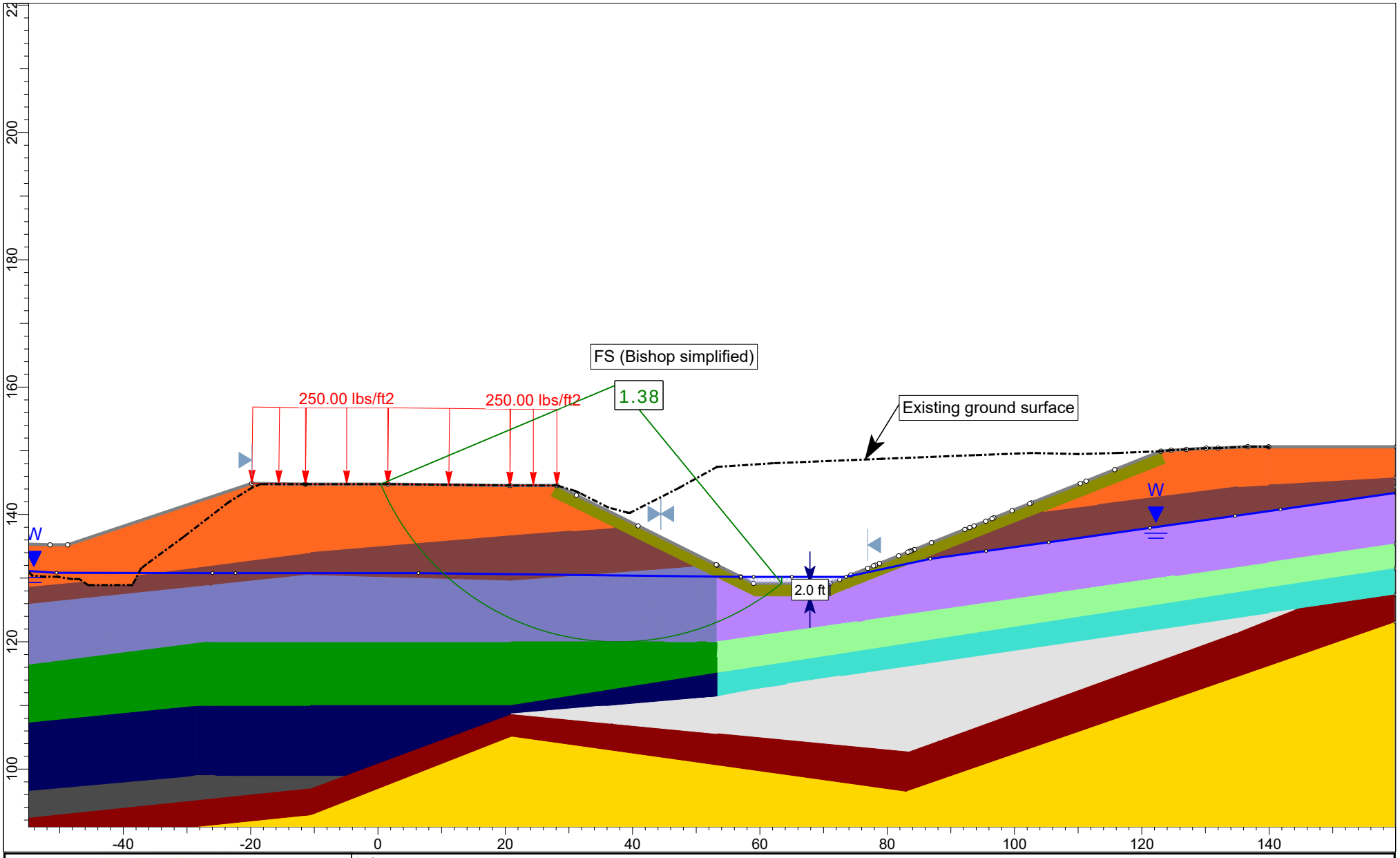
GOLDER	*Project*	WIN 18821.00 Gorham Brandy Brook		
	Analysis Description	Station 14+25: No Riprap - Non-Circular - Right to Left Analysis		
	Drawn By KAR	*Checked by:*	*Reviewed by:*	*Scale* 1:250
	Date 11/21/2019			**Figure B.6**

SLIDEINTERPRET 8.026



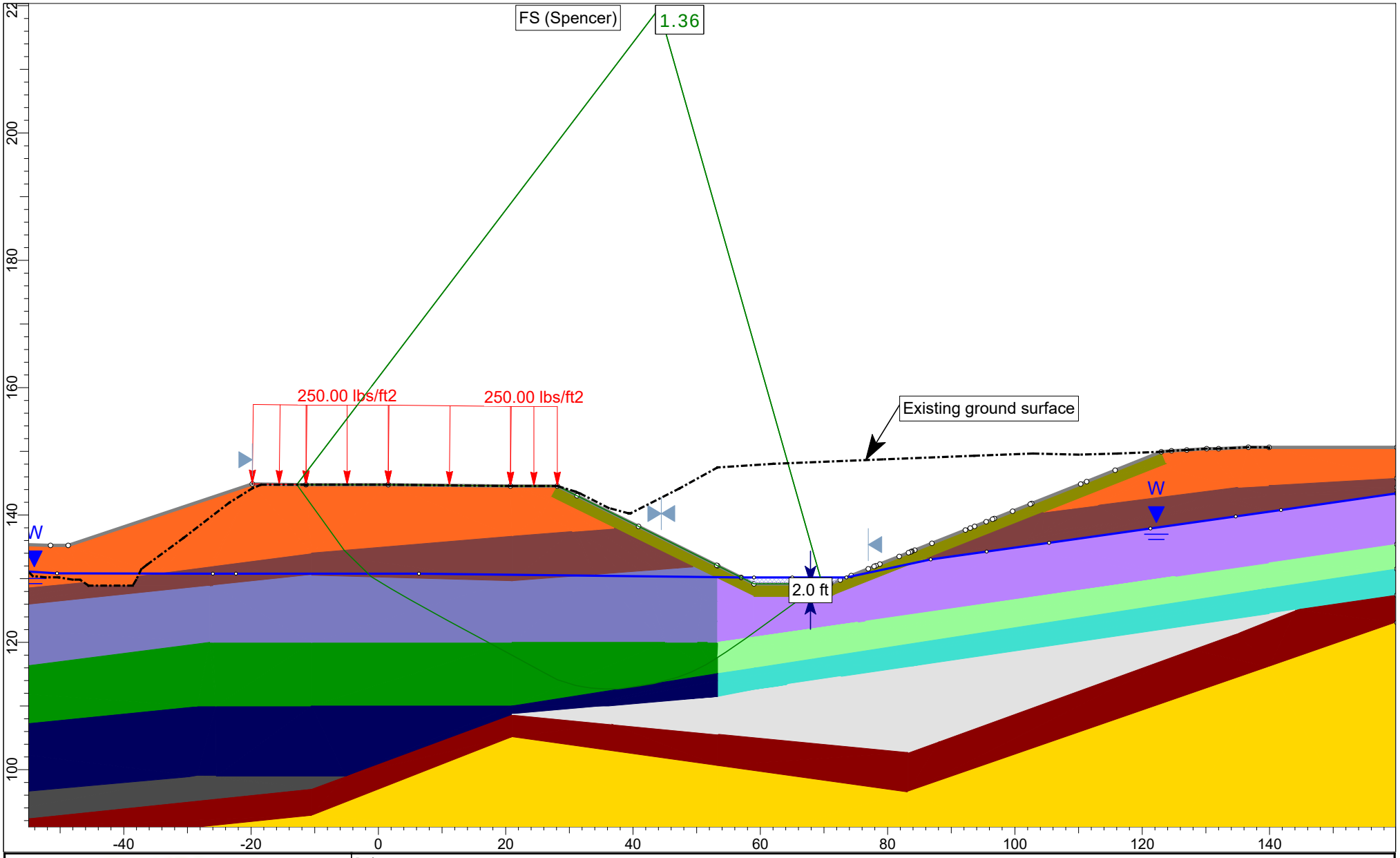
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 14+25: Riprap - Circular - Left to Right Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure B.7**

SLIDEINTERPRET 8.026



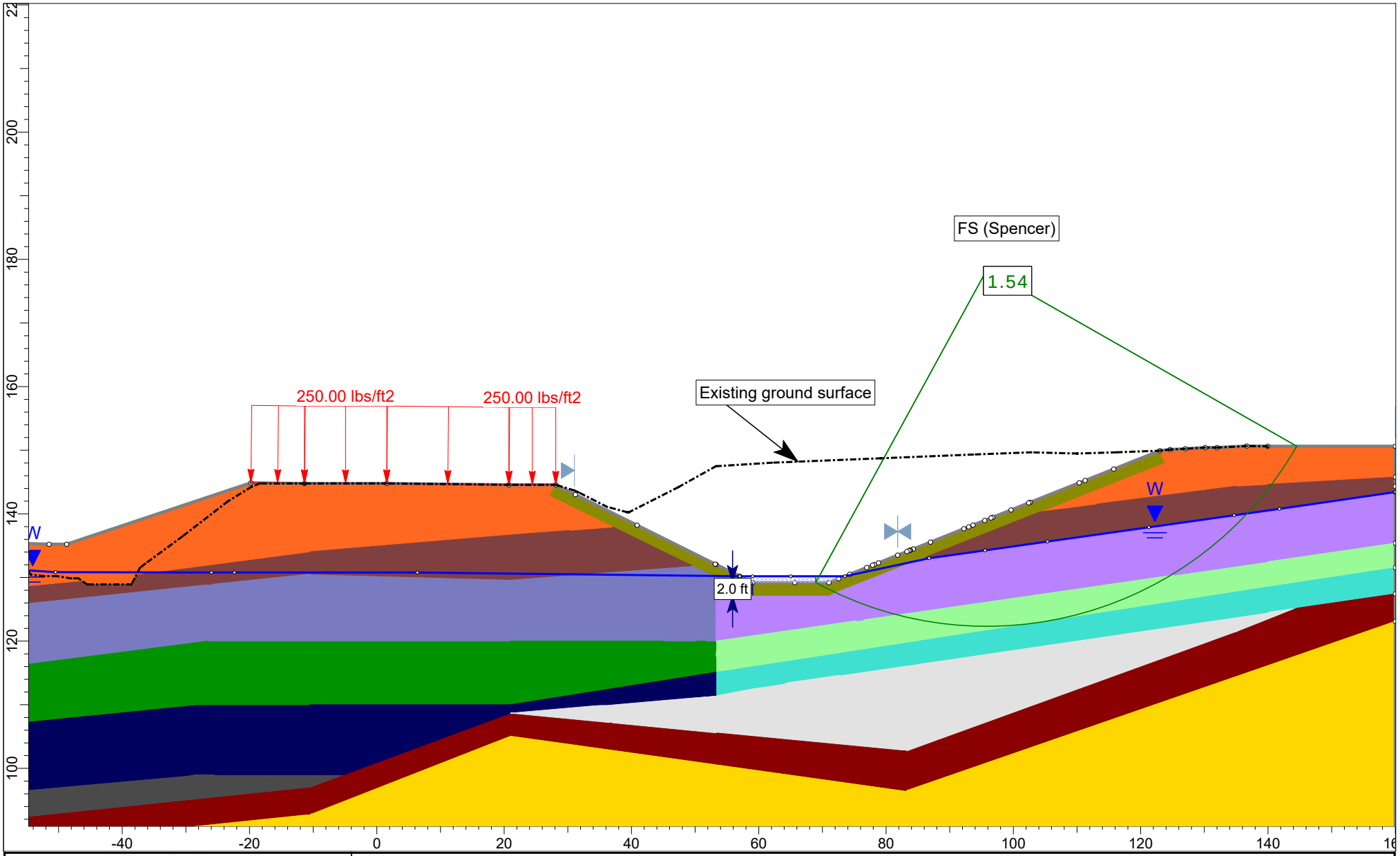
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 14+25: Riprap - Circular - Left to Right Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure B.8**

SLIDEINTERPRET 8.026



GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 14+25: Riprap - Non-Circular - Left to Right Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure B.9**

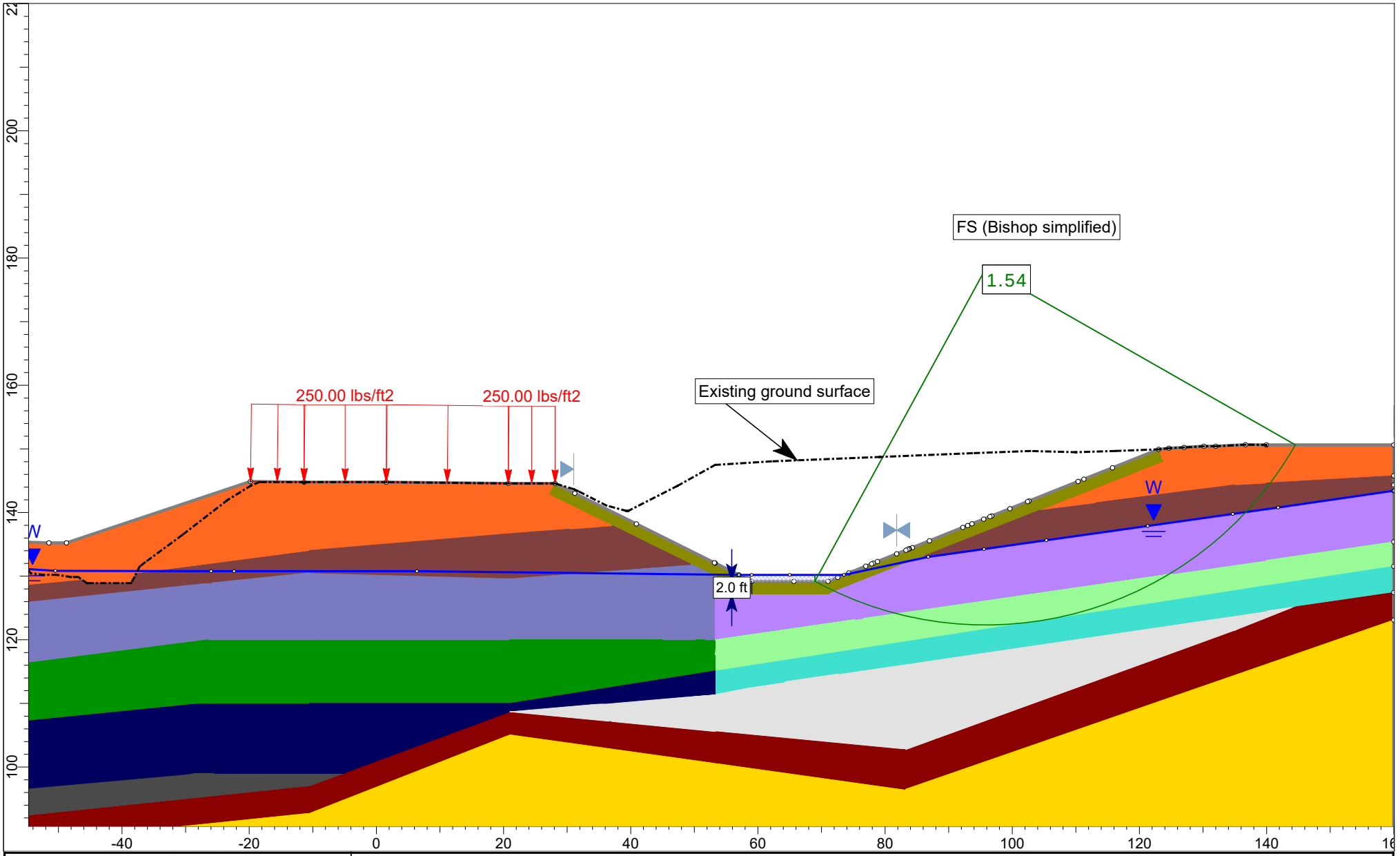
SLIDEINTERPRET 8.026



GOLDER

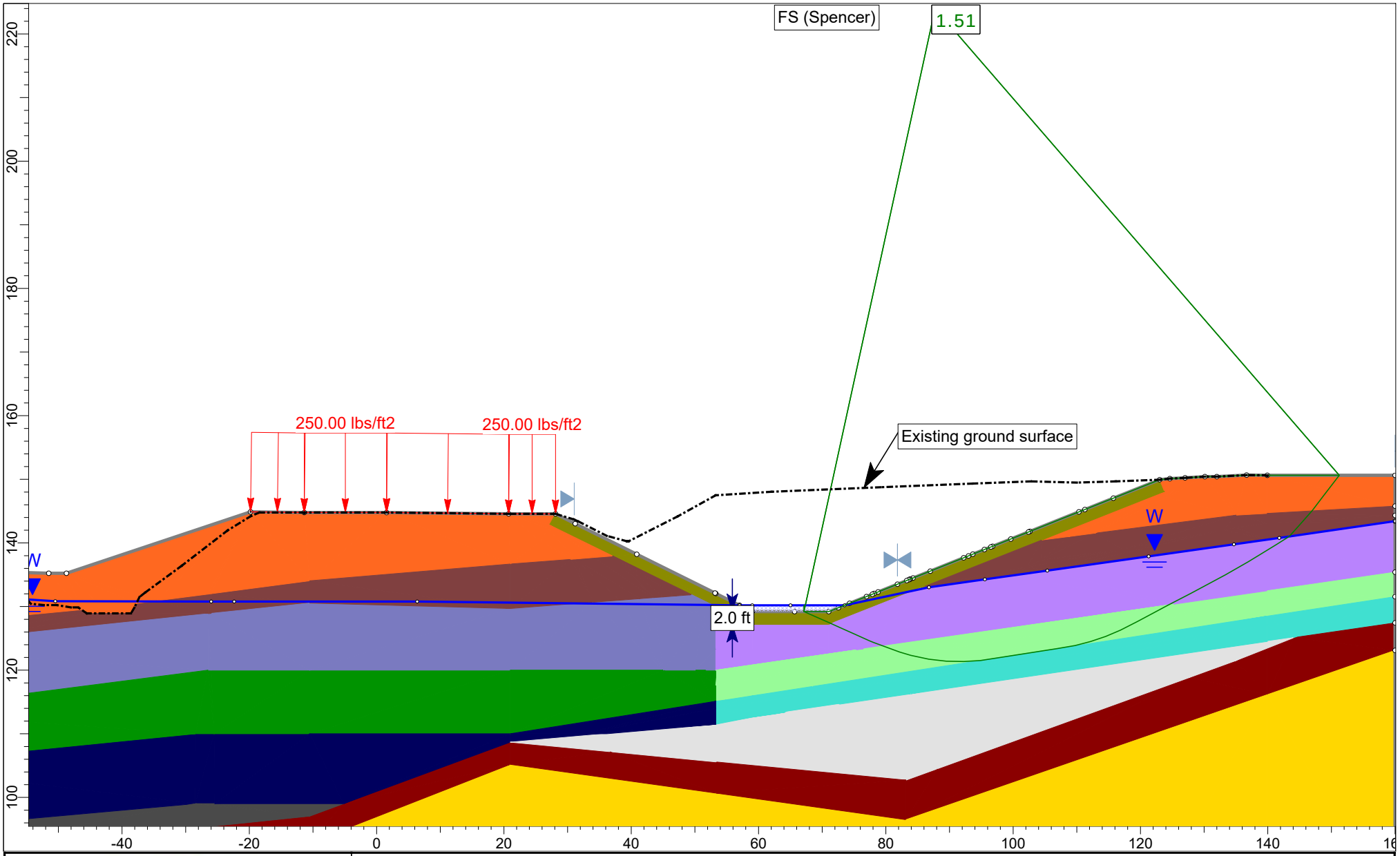
SLIDEINTERPRET 8.026

Project	WIN 18821.00 Gorham Brandy Brook			
Analysis Description	Station 14+25: Riprap - Circular - Right to Left Analysis			
Drawn By KAR	*Checked by:*	*Reviewed by:*	*Scale* 1:250	**Figure B.10**
Date 11/21/2019				



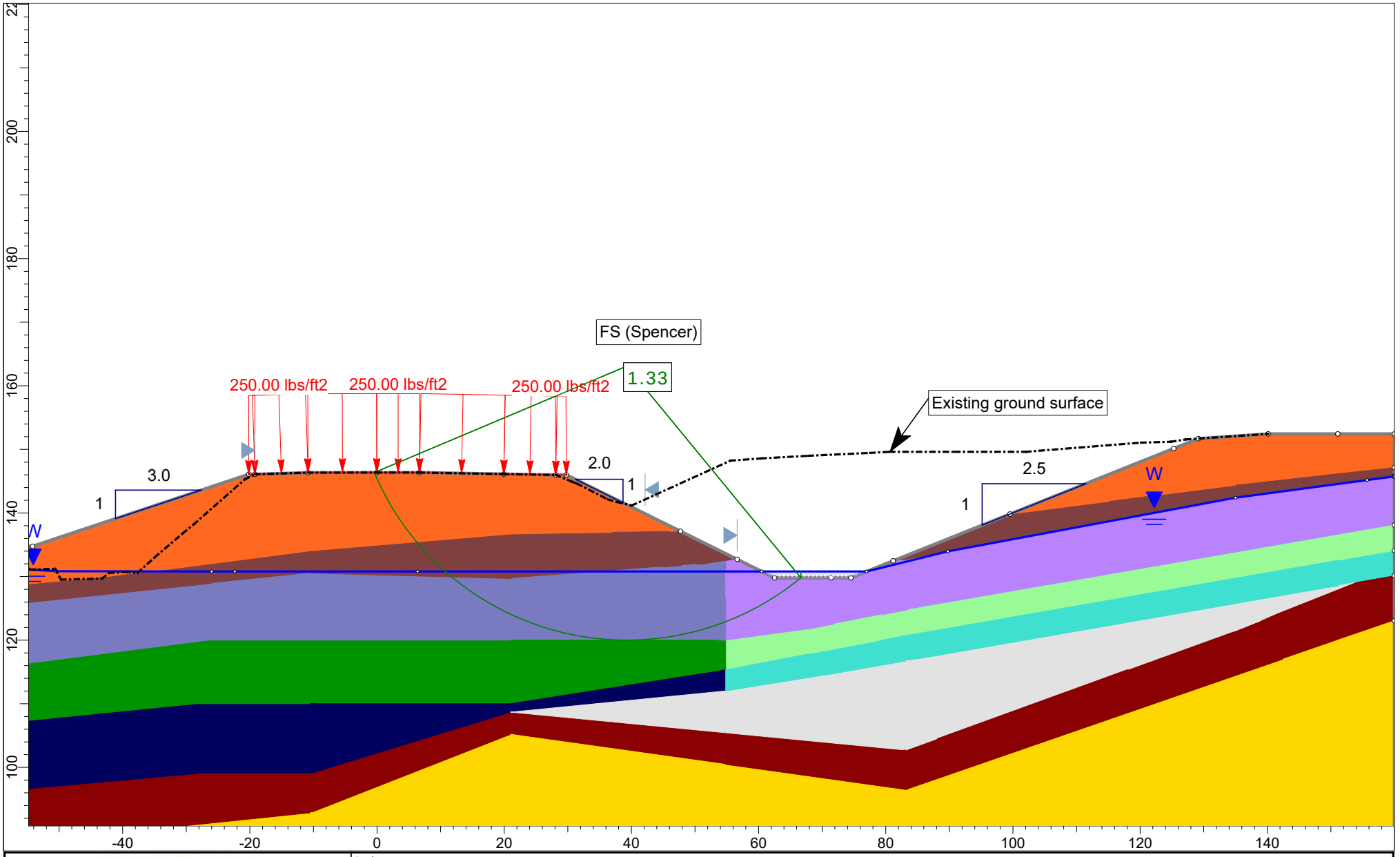
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 14+25: Riprap - Circular - Right to Left Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure B.11**

SLIDEINTERPRET 8.026



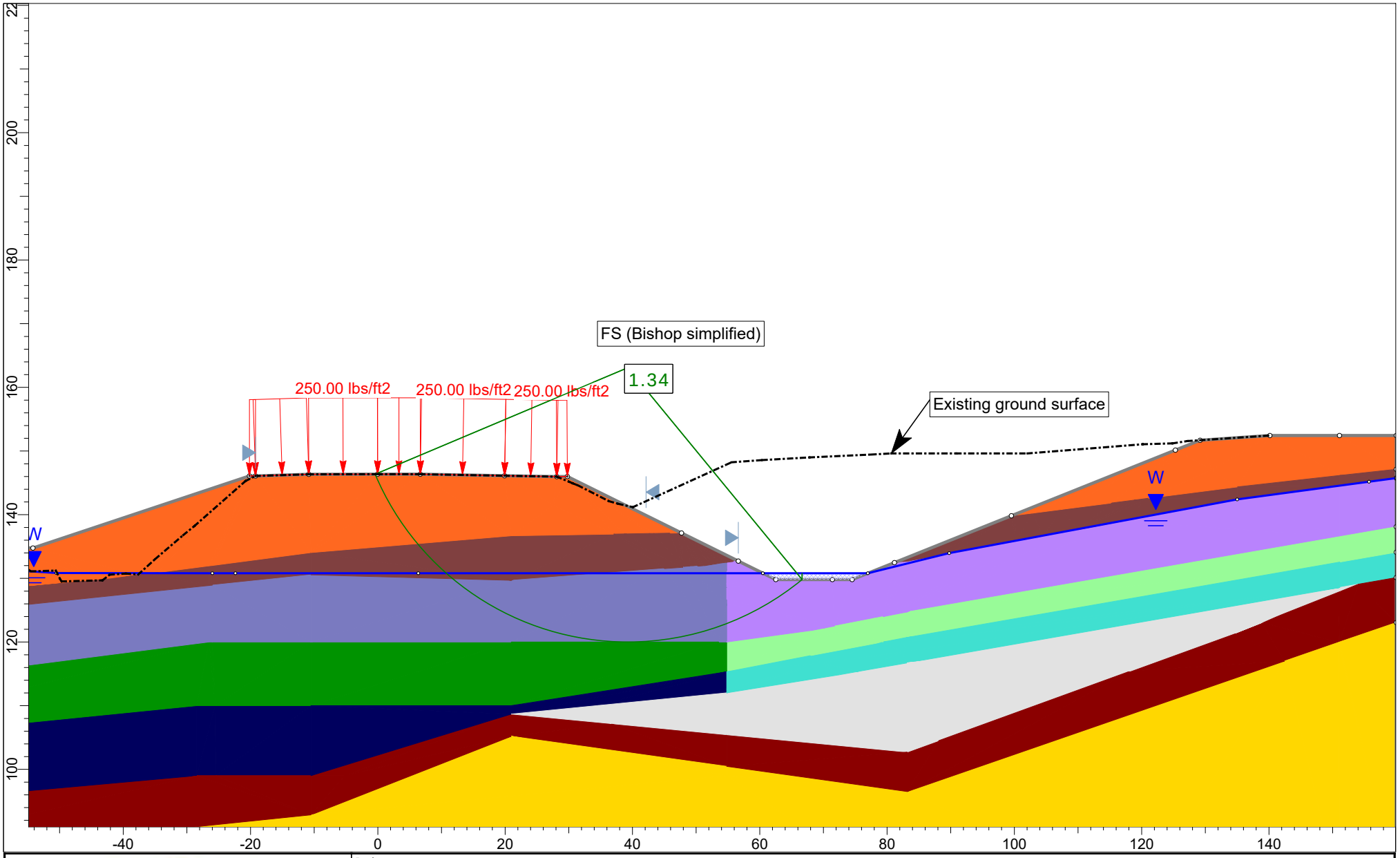
GOLDER	*Project* WIN 18821.00 Gorham Brandy Brook			
	Analysis Description Station 14+25: Riprap - Non-Circular - Right to Left Analysis			
	Drawn By KAR	*Checked by:*	*Reviewed by:*	*Scale* 1:250
	Date 11/21/2019			**Figure B.12**

SLIDEINTERPRET 8.026



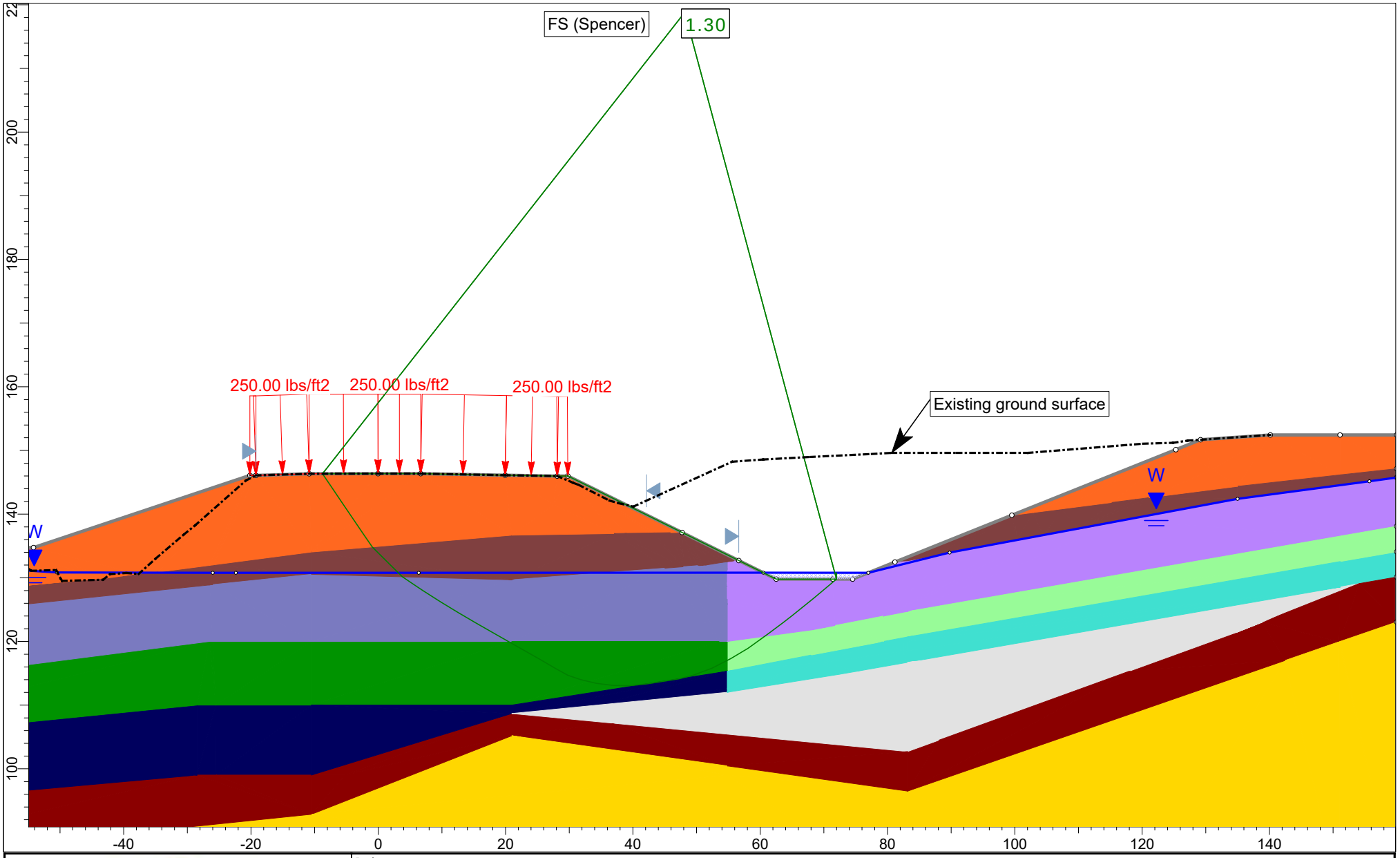
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 14+75: No Riprap - Circular - Left to Right Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/21/2019			**Figure C.1**

SLIDEINTERPRET 8.026



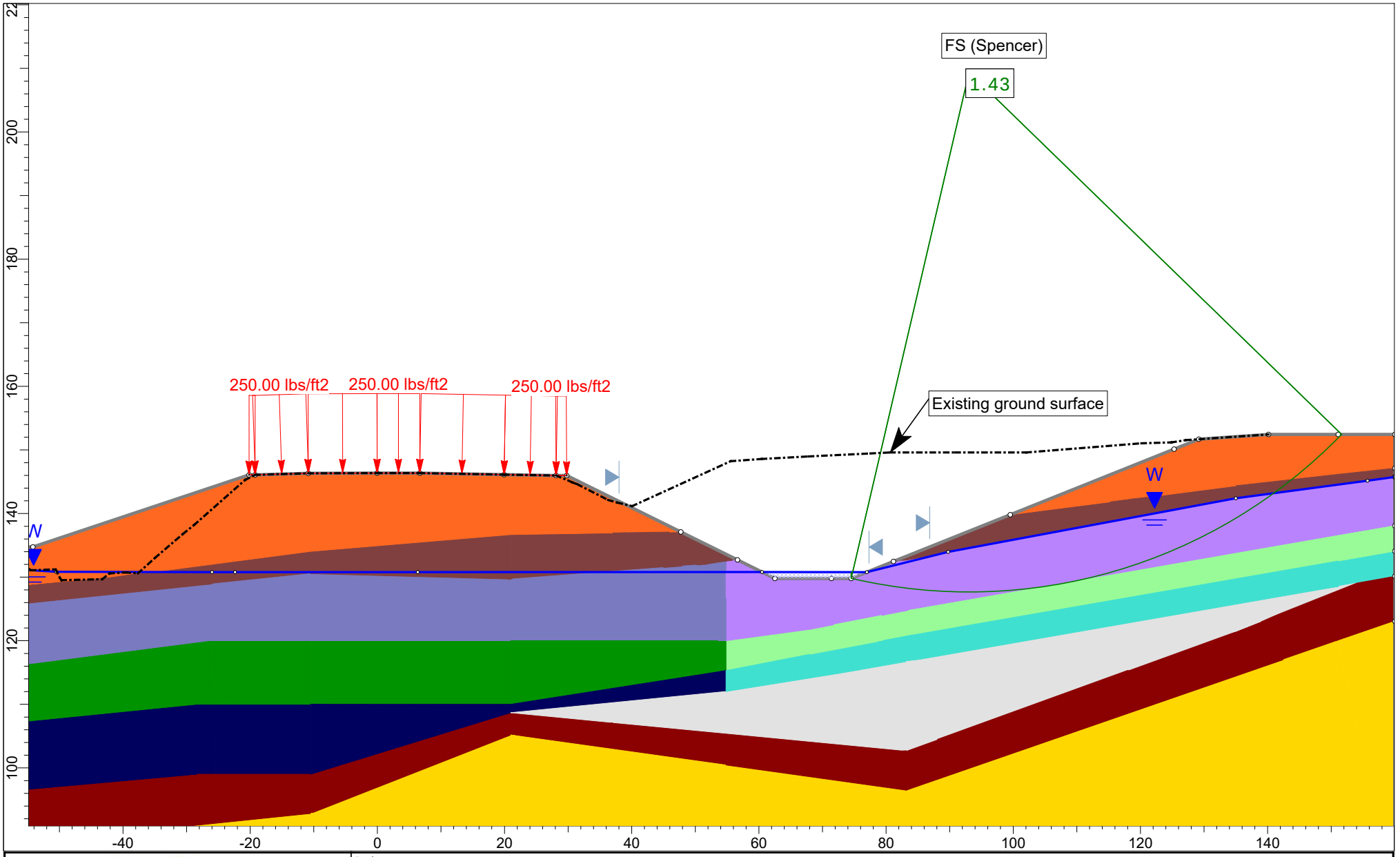
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 14+75: No Riprap - Circular - Left to Right Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/20/2019			**Figure C.2**

SLIDEINTERPRET 8.026



GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 14+75: No Riprap - Non-Circular - Left to Right Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/20/2019			**Figure C.3**

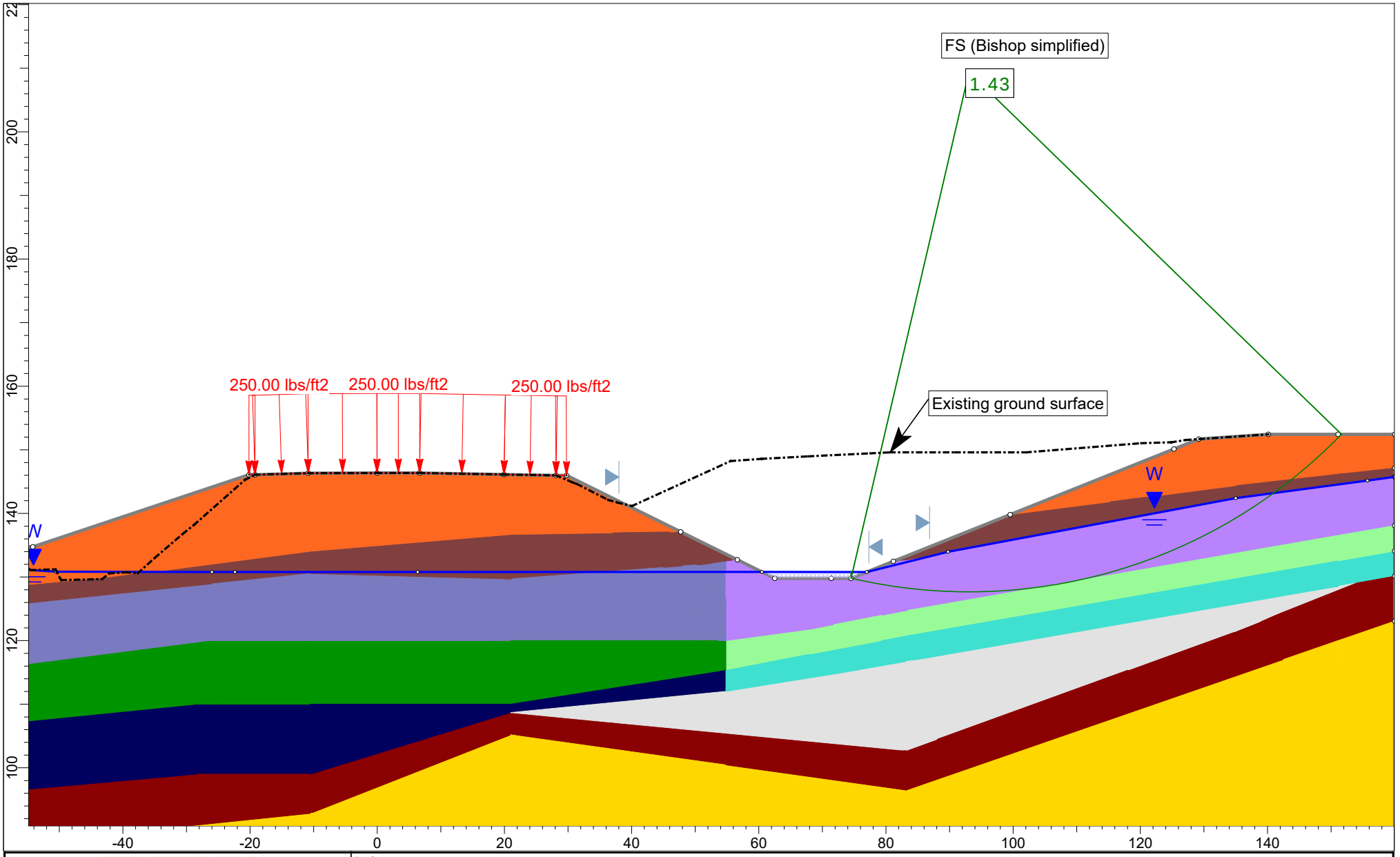
SLIDEINTERPRET 8.026



GOLDER

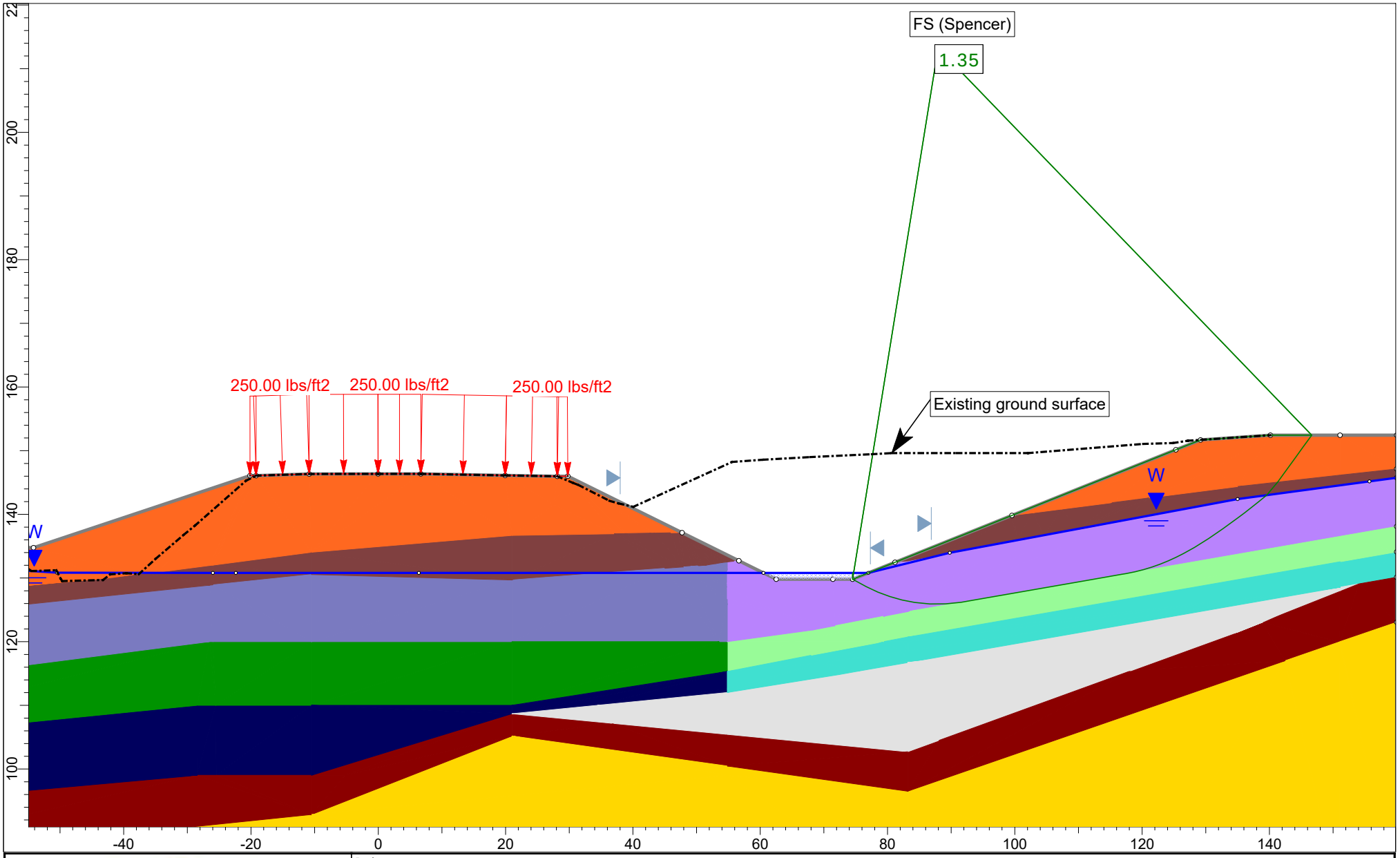
SLIDEINTERPRET 8.026

Project	WIN 18821.00 Gorham Brandy Brook			
Analysis Description	Station 14+75: No Riprap - Circular - Right to Left Analysis			
Drawn By KAR	*Checked by:*	*Reviewed by:*	*Scale* 1:250	**Figure C.4**
Date 11/20/2019				



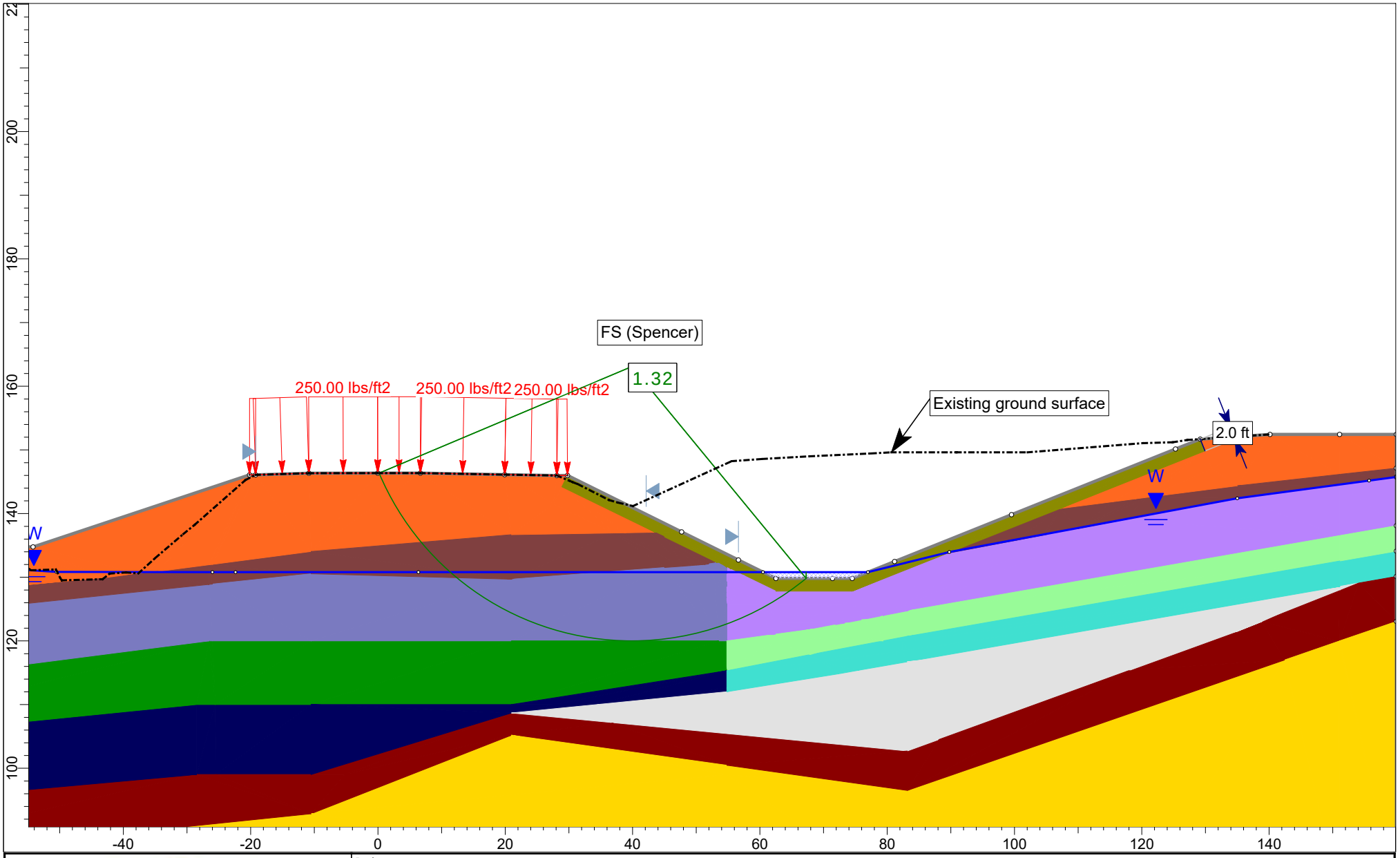
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 14+75: No Riprap - Circular - Right to Left Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/20/2019			**Figure C.5**

SLIDEINTERPRET 8.026



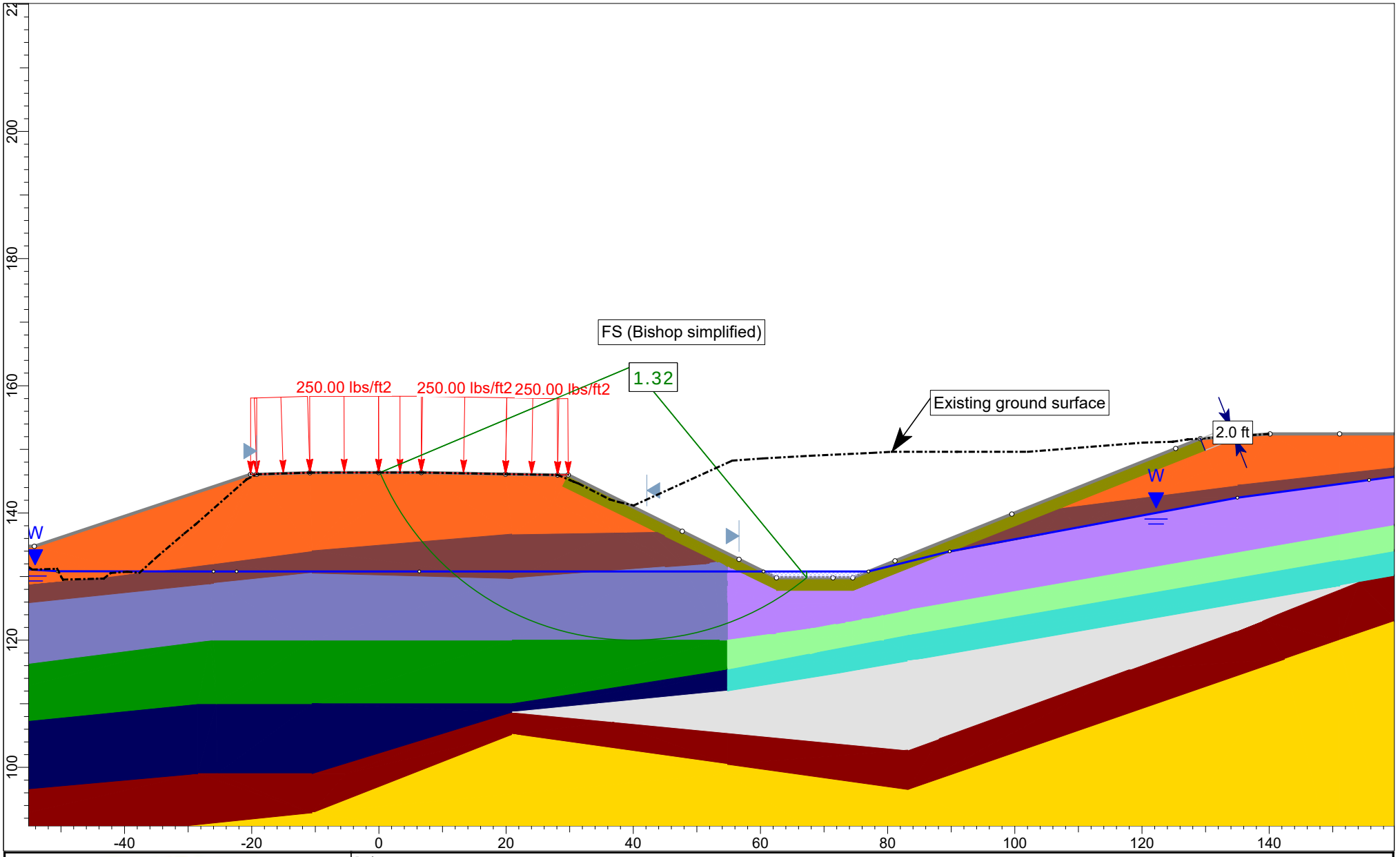
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 14+75: No Riprap - Non-Circular - Right to Left Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/20/2019			**Figure C.6**

SLIDEINTERPRET 8.026



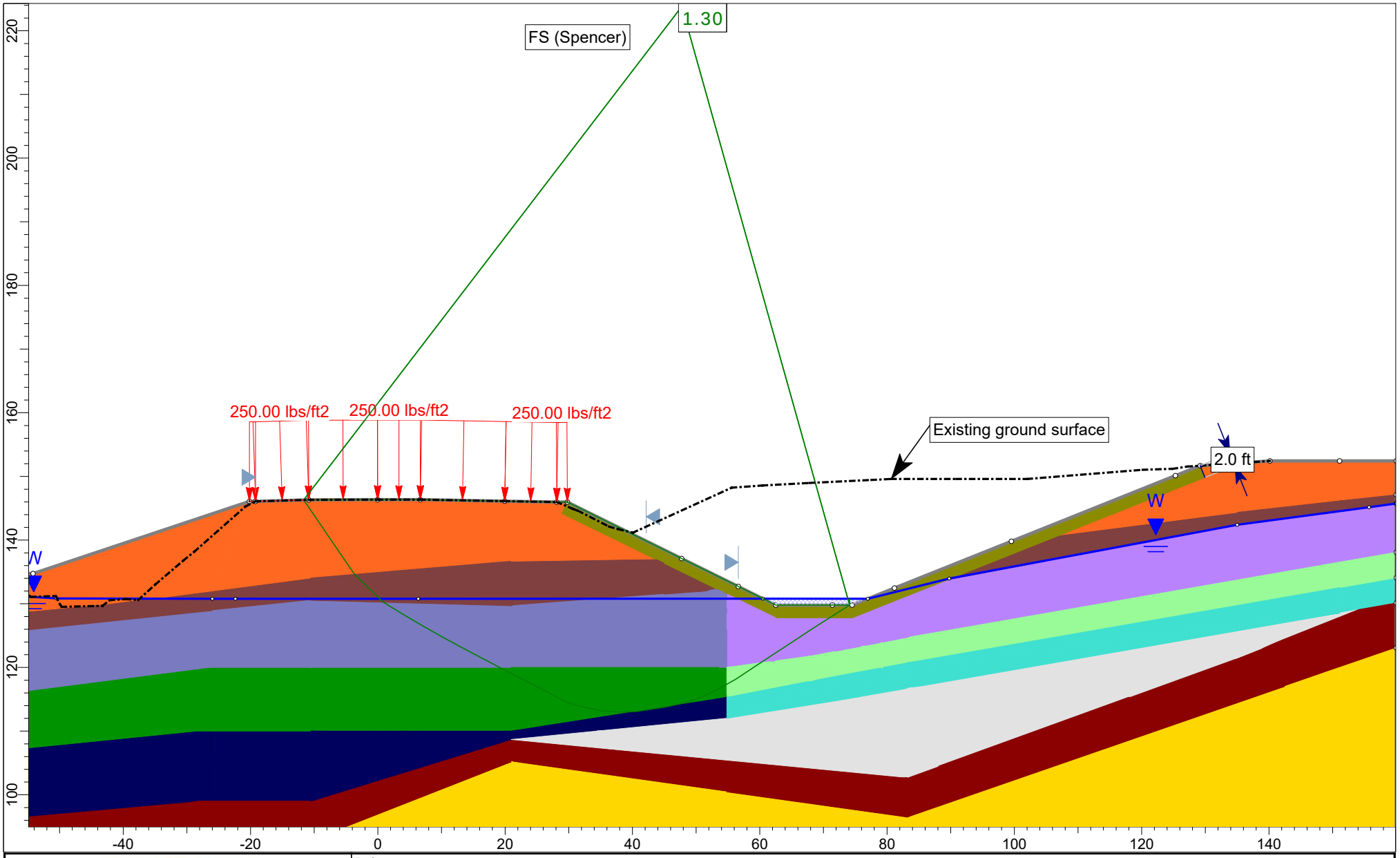
GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 14+75: Riprap - Circular - Left to Right Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/20/2019			**Figure C.7**

SLIDEINTERPRET 8.026



GOLDER	Project: WIN 18821.00 Gorham Brandy Brook			
	Analysis Description: Station 14+75: Riprap - Circular - Left to Right Analysis			
	Drawn By: KAR	Checked by:	Reviewed by:	Scale: 1:250
	Date: 11/20/2019			**Figure C.8**

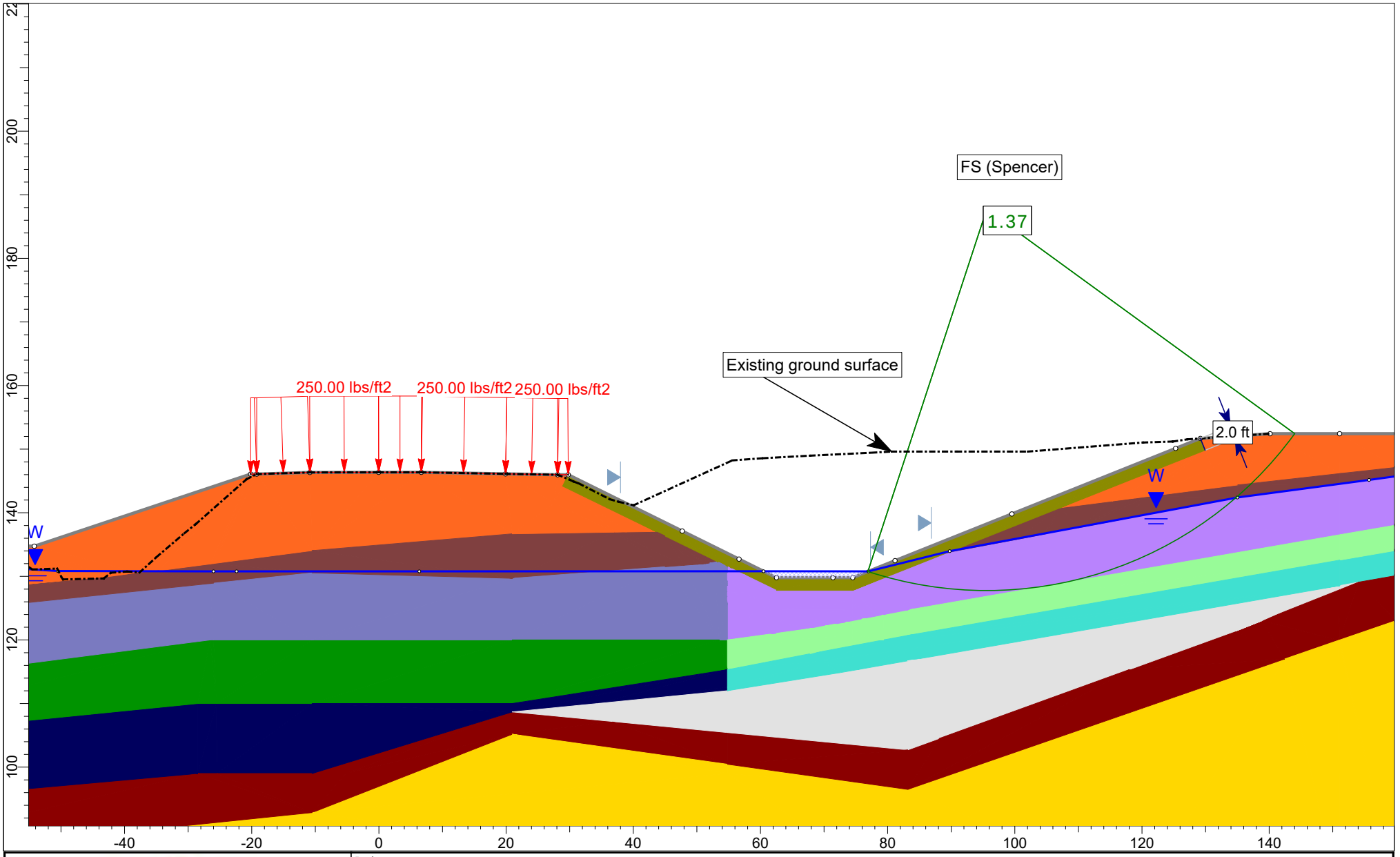
SLIDEINTERPRET 8.026



GOLDER

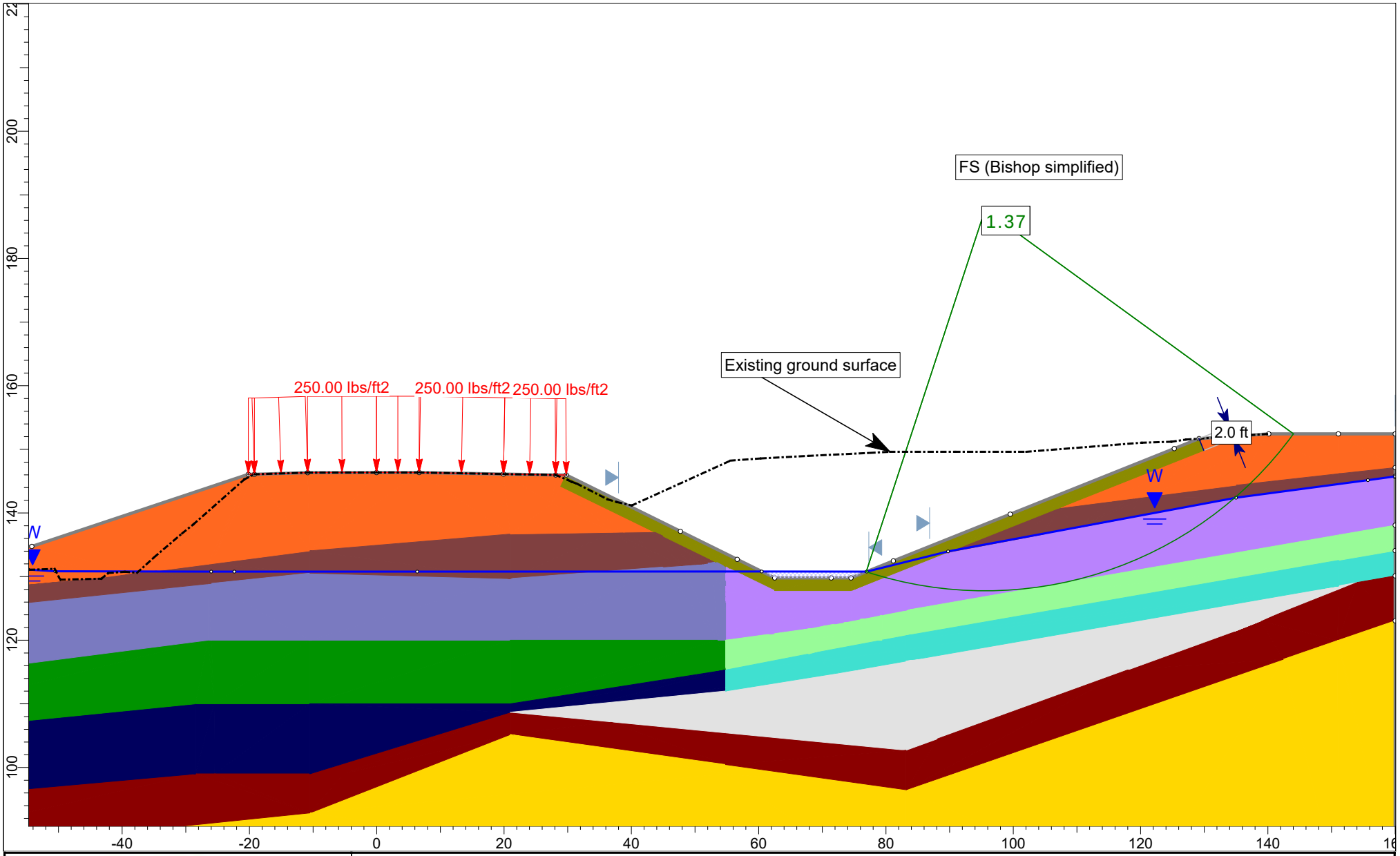
SLIDEINTERPRET 8.026

Project	WIN 18821.00 Gorham Brandy Brook			
Analysis Description	Station 14+75: Riprap - Non-Circular - Left to Right Analysis			
Drawn By KAR	*Checked by:*	*Reviewed by:*	*Scale* 1:250	**Figure C.9**
Date 11/20/2019				



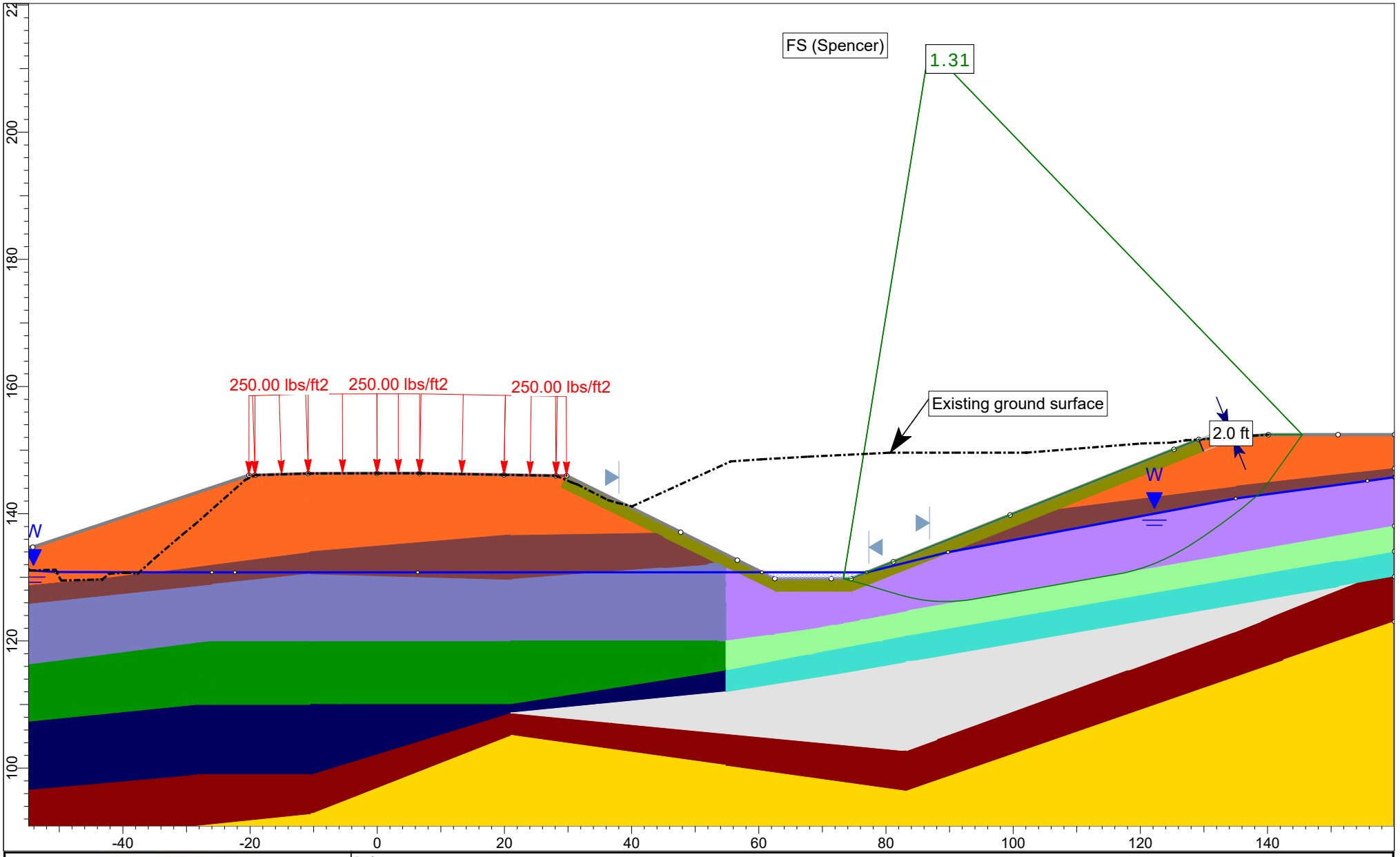
GOLDER	Project	WIN 18821.00 Gorham Brandy Brook			
	Analysis Description	Station 14+75: Riprap - Circular - Right to Left Analysis			
	Drawn By KAR	Checked by:	Reviewed by:	Scale 1:250	**Figure C.10**
	Date 11/20/2019				

SLIDEINTERPRET 8.026



GOLDER	*Project*	WIN 18821.00 Gorham Brandy Brook			
	Analysis Description	Station 14+75: Riprap - Circular - Right to Left Analysis			
	Drawn By KAR	*Checked by:*	*Reviewed by:*	*Scale* 1:250	**Figure C.11**
	Date 11/20/2019				

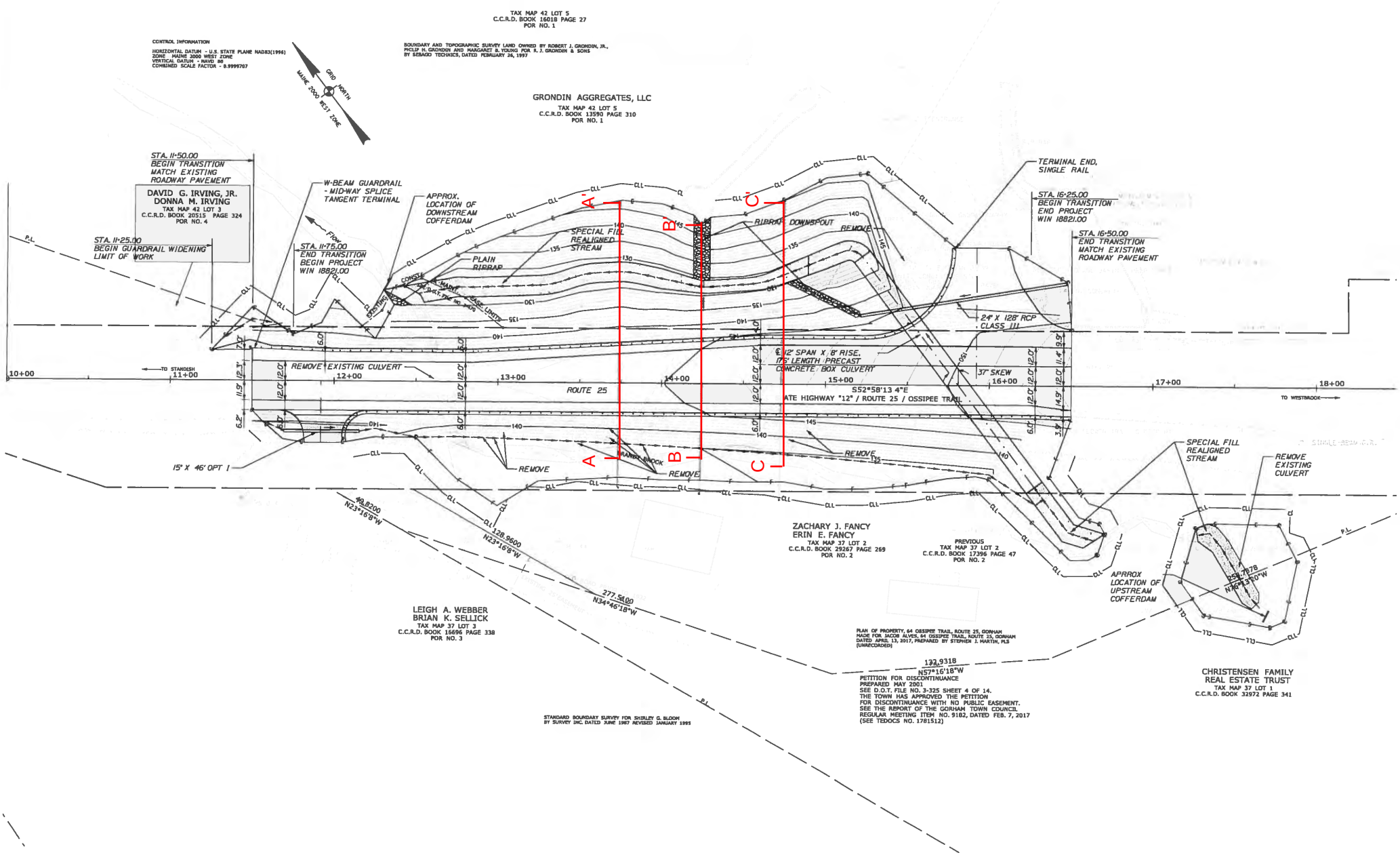
SLIDEINTERPRET 8.026



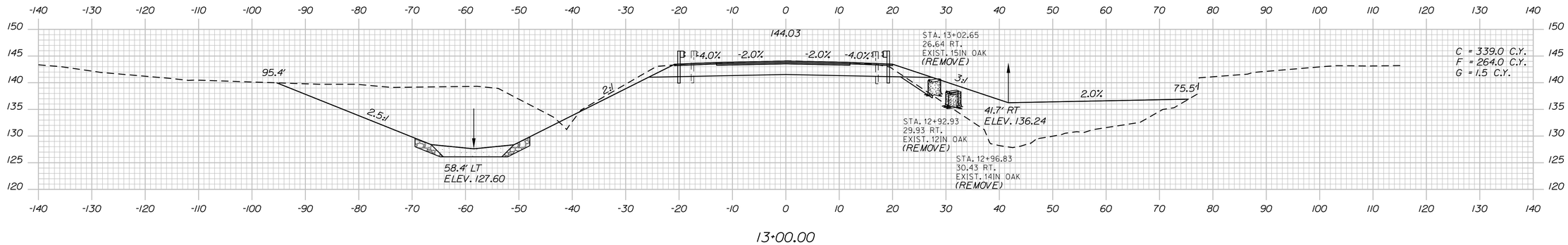
GOLDER	*Project*	WIN 18821.00 Gorham Brandy Brook			
	Analysis Description	Station 14+75: Riprap - Non-Circular - Right to Left Analysis			
	Drawn By KAR	*Checked by:*	*Reviewed by:*	*Scale* 1:250	**Figure C.12**
	Date 11/20/2019				

SLIDEINTERPRET 8.026

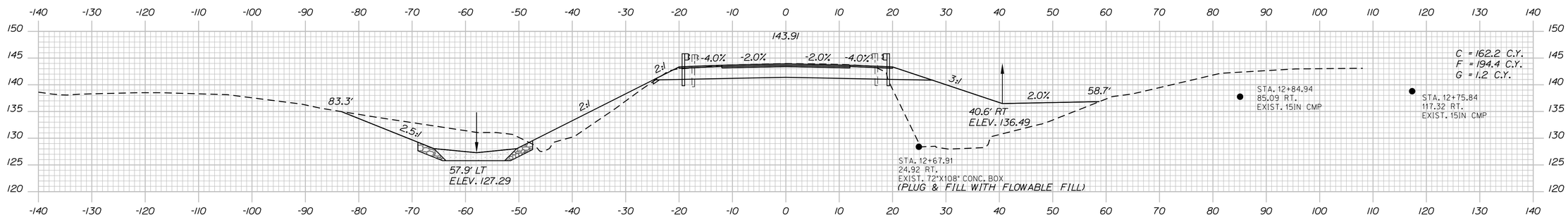
Attachment 3



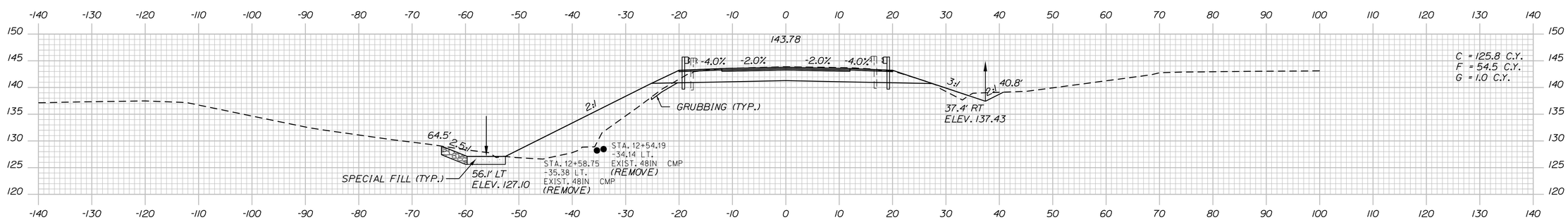
Reference 1



13+00.00



12+75.00



12+50.00

Sta. 12+50.00 to Sta. 13+00.00

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

18821.00

WIN
18821.00

HIGHWAY PLANS

PROJ. MANAGER	L. HAMILTON		
DESIGN-DETAILED	T. WOLFEL	BY	DATE
CHECKED-REVIEWED	K. WOOD	T. WOLFEL	11/2019
DESIGN2-DETAILED2		M. STEELE	11/2019
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

GORHAM - BRANDY BROOK
ROUTE 25

CROSS SECTIONS

SHEET NUMBER

14

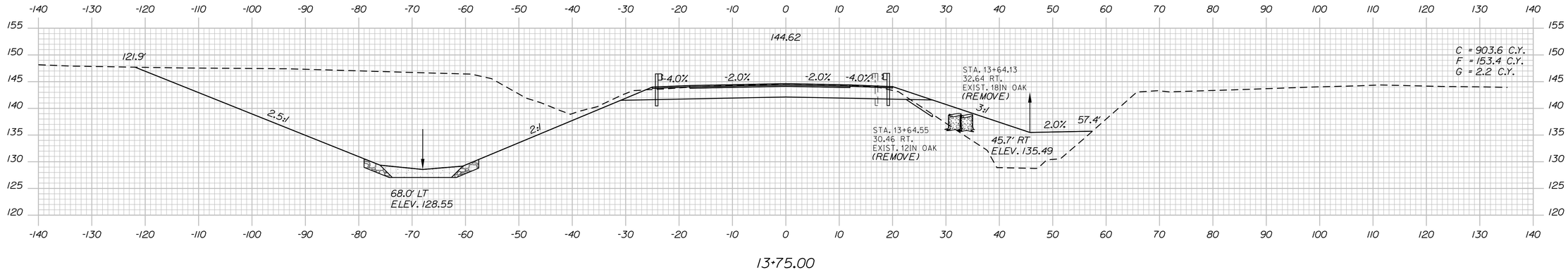
OF 22

Date:11/18/2019

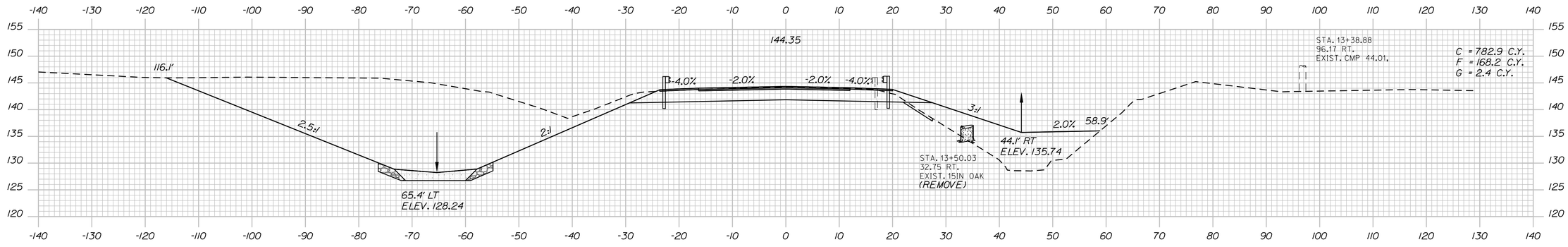
Username:

Division: HIGHWAY

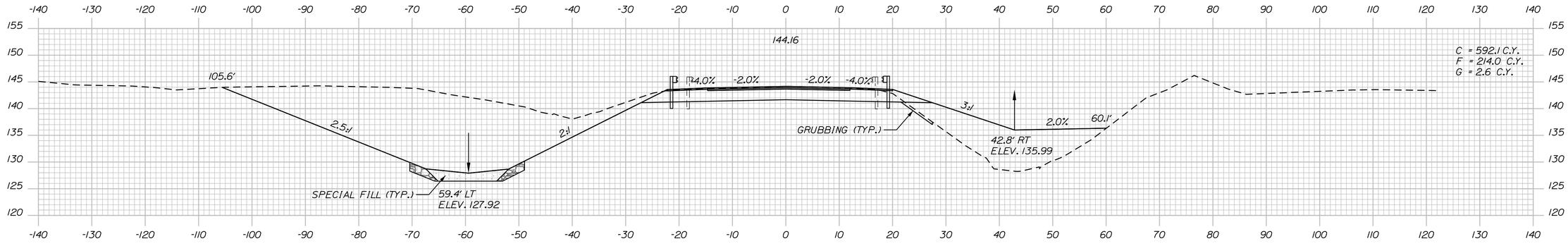
Filename: ...\HIGHWAY\MSTA\Xsect.dgn



13+75.00



13+50.00



13+25.00

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

18821.00

WIN
18821.00

HIGHWAY PLANS

	BY	DATE
L. HAMILTON		
DESIGN-DETAILED	T. WOLFEL	11/2019
CHECKED-REVIEWED	M. STEELE	11/2019
DESIGN2-DETAILED2	K. WOOD	
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

PROJ. MANAGER

SIGNATURE

P.E. NUMBER

DATE

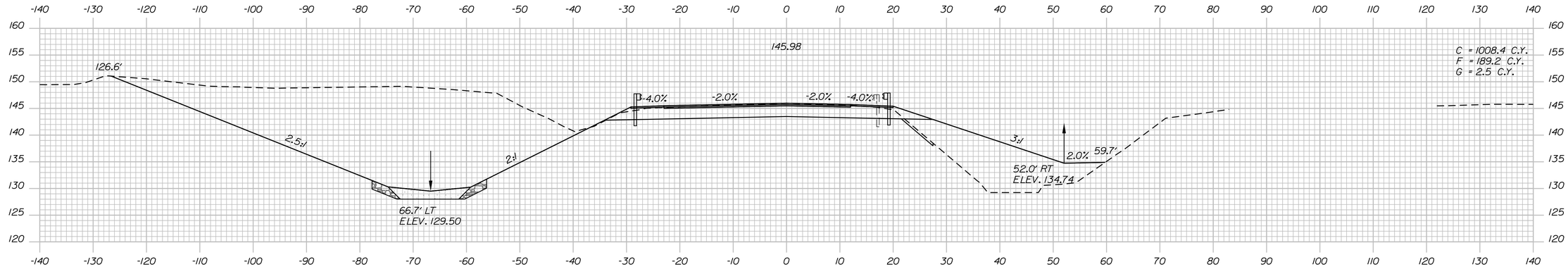
GORHAM - BRANDY BROOK
ROUTE 25

CROSS SECTIONS

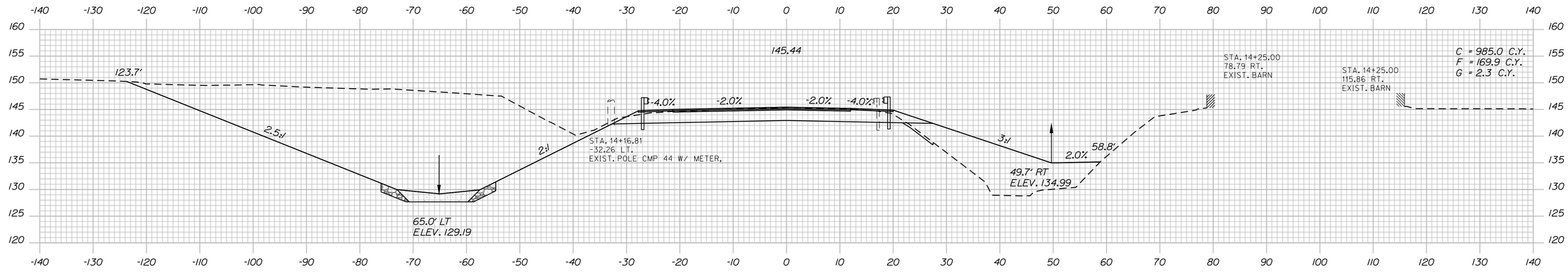
SHEET NUMBER
15
OF 22

Sta. 13+25.00 to Sta. 13+75.00

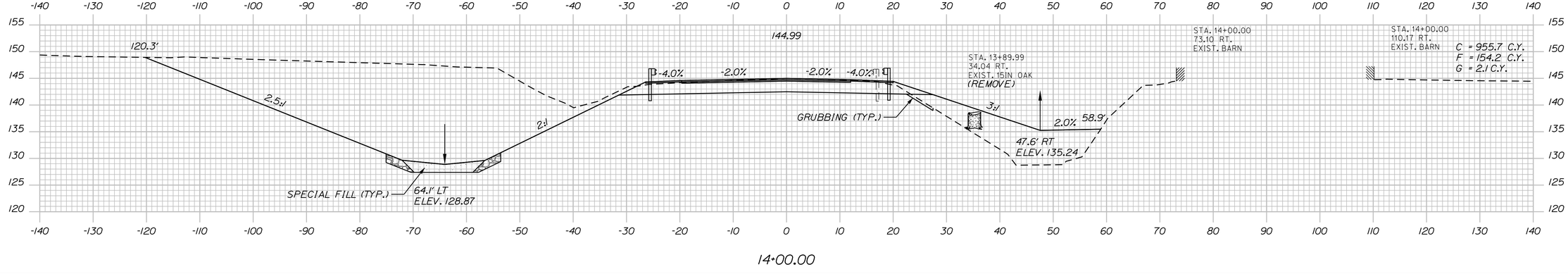
Date:11/18/2019
Username:
Division: HIGHWAY
Filename: ...\HIGHWAY\MSTA\Xsect.dgn



14+50.00



14+25.00



14+00.00

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

18821.00

WIN
18821.00

HIGHWAY PLANS

PROJ. MANAGER	L. HAMILTON		
DESIGN-DETAILED	T. WOLFEL	BY	T. WOLFEL
CHECKED-REVIEWED	K. WOOD	BY	M. STEELE
DESIGN2-DETAILED2		ED2	
DESIGN3-DETAILED3		ED3	
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

DATE 11/2019 11/2019

SIGNATURE

P.E. NUMBER

DATE

GORHAM - BRANDY BROOK
ROUTE 25

CROSS SECTIONS

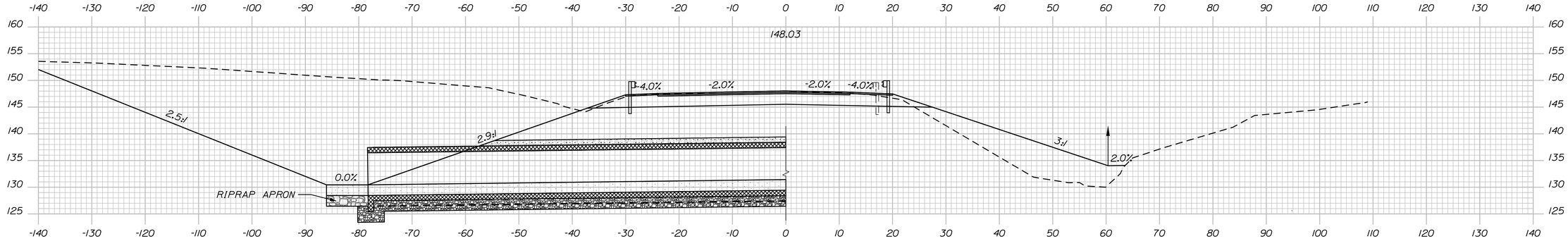
SHEET NUMBER

16

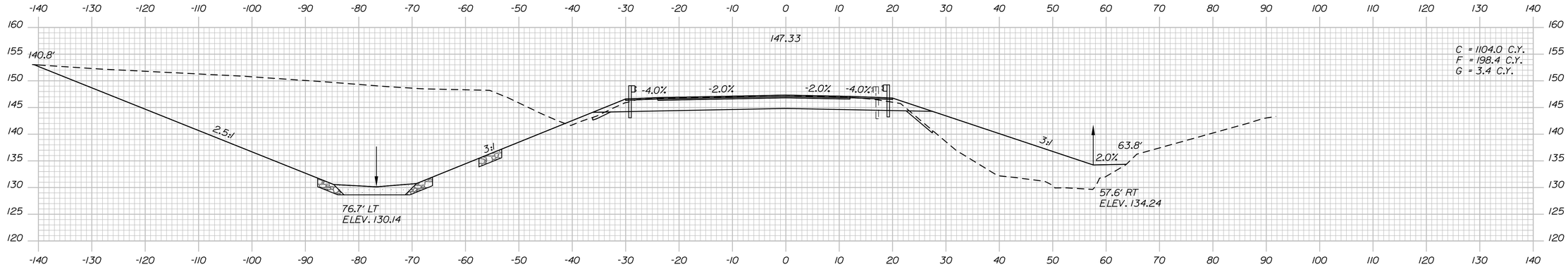
OF 22

Sta. 14+00.00 to Sta. 14+50.00

Date:11/18/2019 Username: Division: HIGHWAY Filename: ...\HIGHWAY\MSTA\Xsect.dgn

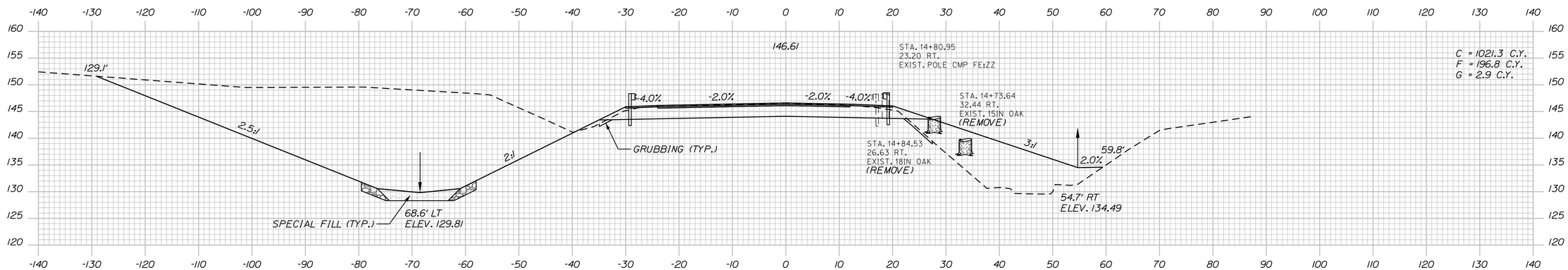


15+22.00



STA. 14+82 TO STA. 15+20 LT.
INSTALL RIPRAP DOWNSPOUT

15+00.00



14+75.00

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

18821.00

WIN
18821.00

HIGHWAY PLANS

PROJ. MANAGER	L. HAMILTON		
DESIGN-DETAILED	T. WOLFEL	BY	T. WOLFEL
CHECKED-REVIEWED	K. WOOD	BY	M. STEELE
DESIGN2-DETAILED2			
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

P.E. NUMBER

DATE

DATE 11/2019 11/2019

SIGNATURE

GORHAM - BRANDY BROOK
ROUTE 25

CROSS SECTIONS

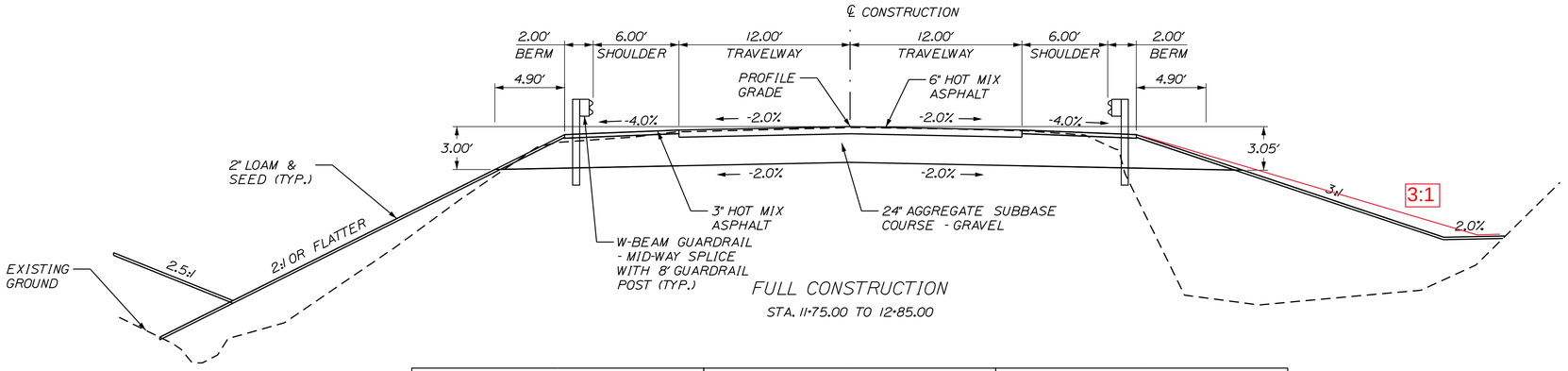
SHEET NUMBER

17

OF 22

Sta. 14+75.00 to Sta. 15+24.00

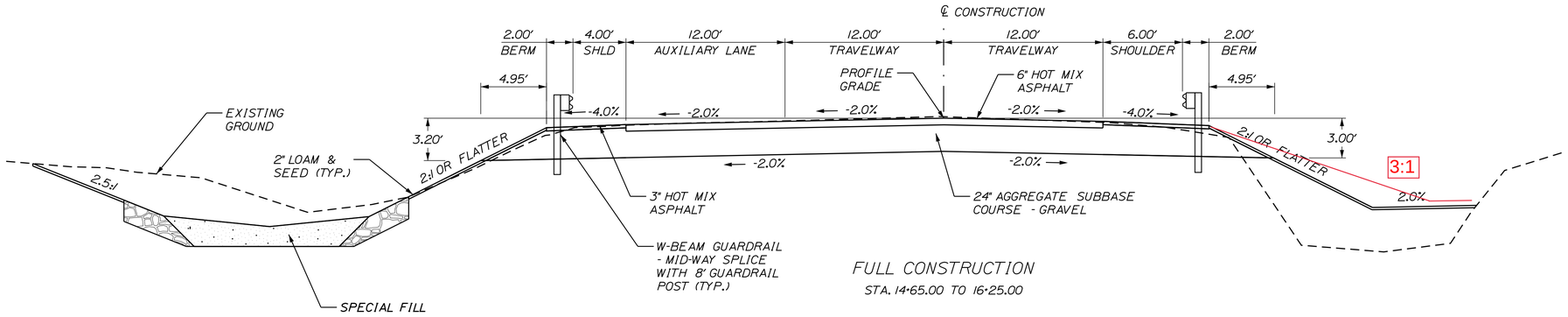
Filename: ...\HIGHWAY\MSTA\Xsect.dgn Division: HIGHWAY Username: Date:11/18/2019



FULL CONSTRUCTION

STA. 11+75.00 TO 12+85.00

AGGREGATE SUBBASE COURSE GRAVEL	AGGREGATE SUBBASE COURSE GRAVEL	AGGREGATE SUBBASE COURSE GRAVEL
GUARDRAIL SHOULDER	12' - 12' TRAVEL LANES	GUARDRAIL SHOULDER
82.2 CY/100 LF	177.8 CY/100 LF	91.7 CY/100 LF
STATION TO STATION	STATION TO STATION	STATION TO STATION
11+75.00 TO 12+85.00	11+75.00 TO 12+85.00	11+75.00 TO 12+85.00



FULL CONSTRUCTION

STA. 14+65.00 TO 16+25.00

AGGREGATE SUBBASE COURSE GRAVEL	AGGREGATE SUBBASE COURSE GRAVEL	AGGREGATE SUBBASE COURSE GRAVEL
4' GUARDRAIL SHOULDER	12' - 12' - 12' LANES	6' GUARDRAIL SHOULDER
67.4 CY/100 LF	266.7 CY/100 LF	82.2 CY/100 LF
STATION TO STATION	STATION TO STATION	STATION TO STATION
14+65.00 TO 16+25.00	14+65.00 TO 16+25.00	14+65.00 TO 16+25.00

ROUTE 25 CROSS SLOPES (e)					
LEFT %			STATION	RIGHT %	
SHOULDER	AUXILIARY LANE	TRAVELWAY		TRAVELWAY	SHOULDER
MATCH EXISTING	-	MATCH EXISTING	11+50	MATCH EXISTING	MATCH EXISTING
-4.0	-	-2.0	11+75	-2.0	-4.0
			TO		
-4.0	-	-2.0	14+50	-2.0	-4.0
-4.0	-2.0	-2.0	14+75	-2.0	-4.0
			TO		
-4.0	-2.0	-2.0	16+00	-2.0	-4.0
-4.0	-2.0	-2.0	16+25	-2.7	-5.0
MATCH EXISTING	MATCH EXISTING	MATCH EXISTING	16+50	MATCH EXISTING	MATCH EXISTING

NOTES:

1. THE PAVEMENT, BASE AND SUBBASE DEPTHS AS SHOWN ON THE PLANS ARE INTENDED TO BE NOMINAL.

2. WHEN SUPERELEVATION EXCEEDS THE SLOPE OF THE LOW SIDE SHOULDER, THE LOW SIDE SHOULDER SHALL HAVE THE SAME SLOPE AS THE TRAVELWAY.

3. CROSS SLOPES FOR BOTH NORMAL AND SUPERELEVATION SECTIONS SHALL BE STRAIGHT UNLESS OTHERWISE DIRECTED BY THE DEPARTMENT.

4. THE GRAVEL QUANTITY CALCULATION IS BASED ON 2" LOAM DEPTH. THE ACTUAL DEPTH MAY VARY. SEE GENERAL NOTES.

5. THE ALGEBRAIC DIFFERENCE BETWEEN TRAVELWAY AND SHOULDER CROSS SLOPE SHALL NOT EXCEED 8 PERCENT.

6. THE STATIONING SHOWN UNDER EACH TYPICAL SECTION IS APPROXIMATE.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

18821.00

WIN 18821.00

HIGHWAY PLANS

	BY	DATE
PROJ. MANAGER	L. HAMILTON	
DESIGN-DETAILED	T. WOLFEL	11/2019
CHECKED-REVIEWED	M. STEELE	11/2019
DESIGN2-DETAILED2	K. WOOD	
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE

P.E. NUMBER

DATE

GORHAM - BRANDY BROOK
ROUTE 25

TYPICAL SECTIONS

SHEET NUMBER

2

OF 22

Filename: ...\MSTA\002_Typical Sections.dgn Division: HIGHWAY Username: Date:11/18/2019

 Reference 2

Table 3-2 Empirical values for ϕ, D_r, and unit weight of granular soils based on the standard penetration number with corrections for depth and for fine saturated sands.

Description	Very loose	Loose	Medium	Dense	Very dense
Relative density D_r*	0 0.15	0.35	0.65	0.85	1.00
Standard penetration no. N	5–10	8–15	10–40	20–70	> 35
Approx. angle of internal friction ϕ°†	25 –30°	27–32°	30–35°	35–40°	38–43°
Approx. range of moist unit weight γ, pcf (kN/m^3)	70–100‡ (11–16)	90–115 (14–18)	110–130 (17–20)	110–140 (17–22)	130–150 (20–23)

* Depends on p_o ranging from 70 to 500 kPa. Low value of N corresponds to lesser p_o.

† After Meyerhof (1956). $\phi = 25 + 25D_r$ with more than 5 percent fines and $\phi = 30 + 25D_r$ with less than 5 percent fines. Use larger values for granular material with 5 percent or less fine sand and silt. See also Eq. (4-10) for estimate of ϕ.

‡ It should be noted that excavated material or material dumped from a truck will weigh 70 to 90 pcf. Material must be quite dense and hard to weigh much over 130 pcf. Values of 105 to 115 pcf for nonsaturated soils are common.

than 15 as

$$N' = 15 + \tfrac{1}{2}(N - 15) \tag{3-5}$$

Bazaraa (1967) also made a recommendation for correcting N in these soils as

$$N' = 0.6N \tag{3-5a}$$

where $N > 15$. The rationale for these corrections was that the soil must be dense if the blow count is greater than 15; therefore, the volume displacement at a high penetration rate of the SPT would produce high pore pressures which would further increase the blow count. It appears that not many persons use any correction for the blow count in these soils at present.

The penetration test in gravel or gravelly soils requires careful interpretation, since pushing a piece of gravel can greatly change the blow count. Generally if one uses a statistical average of the blow count in the stratum from the several borings, either excessively high or very low (pushing a gravel or creating a void space) values will be averaged out so that approximately the correct blow count can be estimated for design.

The SPT was originally developed for cohesionless soils so that samples would not have to be taken. The test has evolved to the current practice of routinely determining N for all soils supplemented with on-site determinations of q_u for cohesive strata. The test is usually performed every 2.5 ft or 1 m of depth starting at about 2.5 ft or 1 m below the ground surface. The boring is extended to two or three times the estimated base width of the foundation below the

Bowles, Joseph E. (1982). "Foundation Analysis and Design," 3rd ed., McGraw Hill, NY.

Table 3-3 Empirical values for q_u* and consistency of cohesive soils based on the standard penetration number.

Consistency	Very soft	Soft	Medium	Stiff	Very stiff	Hard
q_u, ksf	0	0.5	1.0	2.0	4.0	8.0
(kPa)		(25)	(50)	(100)	(200)	(400)
N, standard penetration resistance	0	2	4	8	16	32
γ_{sat}, pcf		100–120	110–130		120–140	
(kN/m^3)		(16–19)	(17–20)		(19–22)	

* These values should be used as a guide only. Local cohesive samples should be tested, and the relationship between N and the unconfined compressive strength q_u established as $q_u = KN$.

estimated foundation base. Sometimes the borings are extended to bedrock; however, at greater depths the SPT may be done at 5-ft or 2-m increments. The term "estimated" is used extensively here since these data are not precisely known at the time of the exploration.

Empirical correlations, such as Table 3-2, between N and various soil properties have been made for cohesionless soils. The low values for N correspond roughly to p_o of 75 kPa, the higher to about 500 kPa. Tables such as Table 3-2 should always be used with caution.

Table 3-3 is an empirical correlation between N and unconfined compressive strength. These should be used even more cautiously than for cohesionless soils. It is preferable to measure q_u directly on samples than use a table such as this. Alternatively, a table might be developed locally which has some validity by measuring q_u and N and solving

$$q_u = KN$$

for the constant of proportionality K. The reason for poor correlation of q_u versus N tables is that inadvertent changes in water content, excess pore pressures during sampling, and other factors may give very low blow counts, say 6 to 10, on soils where the measured q_u may be on the order of 300 to 600 kPa. Note in Table 3-3 the value of K is approximately 0.25.

There are varied opinions on how to use N when it is obtained. In a given stratum of finite thickness the values may range by a factor of 2 or more. Early recommendations were to use the smallest value in the stratum—which is certainly conservative. Current thinking is to use a statistical average for N (as from several adjacent borings) and only for the zone of interest. That is, rather than use the entire stratum, use that zone just above to about two times the footing width below the footing. Of course, one should not ignore low blow counts in a layer which may cause settlement problems.

Reference 3

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

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

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):

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

*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))

Sample Container Labeling Requirements:

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

January 2020

Reference 4

$$\Delta_p = k\gamma_s h_{eq} \qquad (3.11.6.4\text{-}1)$$

where:

Δ_p = constant horizontal earth pressure due to live load surcharge (ksf)
γ_s = total unit weight of soil (kcf)
k = coefficient of lateral earth pressure
h_{eq} = equivalent height of soil for vehicular load (ft)

Equivalent heights of soil, h_{eq}, for highway loadings on abutments and retaining walls may be taken from Tables 3.11.6.4-1 and 3.11.6.4-2. Linear interpolation shall be used for intermediate wall heights.

The wall height shall be taken as the distance between the surface of the backfill and the bottom of the footing along the pressure surface being considered.

Table 3.11.6.4-1—Equivalent Height of Soil for Vehicular Loading on Abutments Perpendicular to Traffic

Abutment Height (ft)	h_{eq} (ft)
5.0	4.0
10.0	3.0
≥20.0	2.0

Table 3.11.6.4-2—Equivalent Height of Soil for Vehicular Loading on Retaining Walls Parallel to Traffic

Retaining Wall Height (ft)	h_{eq} (ft) Distance from wall backface to edge of traffic	
	0.0 ft	1.0 ft or Further
5.0	5.0	2.0
10.0	3.5	2.0
≥20.0	2.0	2.0

The load factor for both vertical and horizontal components of live load surcharge shall be taken as specified in Table 3.4.1-1 for live load surcharge.

3.11.6.5—Reduction of Surcharge

If the vehicular loading is transmitted through a structural slab, which is also supported by means other than earth, a corresponding reduction in the surcharge loads may be permitted.

- Poisson's ratio for the pavement and subgrade materials are 0.2 and 0.4, respectively
- Wheel loads were modeled as a finite number of point loads distributed across the tire area to produce an equivalent tire contact stress
- The process for equating wall moments resulting from the elastic solution with the equivalent surcharge method used a wall height increment of 0.25 ft.

The value of the coefficient of lateral earth pressure k is taken as k_o, specified in Article 3.11.5.2, for walls that do not deflect or move, or k_a, specified in Articles 3.11.5.3, 3.11.5.6 and 3.11.5.7, for walls that deflect or move sufficiently to reach minimum active conditions.

The analyses used to develop Tables 3.11.6.4-1 and 3.11.6.4-2 are presented in Kim and Barker (1998).

The values for h_{eq} given in Tables 3.11.6.4-1 and 3.11.6.4-2 are generally greater than the traditional 2.0 ft of earth load historically used in the AASHTO specifications, but less than those prescribed in previous editions (i.e., before 1998) of this specification. The traditional value corresponds to a 20.0-kip single unit truck formerly known as an H10 truck, Peck et al. (1974). This partially explains the increase in h_{eq} in previous editions of this specification. Subsequent analyses, i.e., Kim and Barker (1998) show the importance of the direction of traffic, i.e., parallel for a wall and perpendicular for an abutment on the magnitude of h_{eq}. The magnitude of h_{eq} is greater for an abutment than for a wall due to the proximity and closer spacing of wheel loads to the back of an abutment compared to a wall.

The backface of the wall should be taken as the pressure surface being considered. Refer to Article C11.5.5 for application of surcharge pressures on retaining walls.

C3.11.6.5

This Article relates primarily to approach slabs which are supported at one edge by the backwall of an abutment, thus transmitting load directly thereto.

© 2017 by the American Association of State Highway and Transportation Officials.
All rights reserved. Duplication is a violation of applicable law.

GOLDER

CALCULATIONS

Date:	12/11/2019	**Made by:**	MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Settlement of Filled Stream - Top of Slope at State Route 25	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

OBJECTIVE

To calculate the primary settlement at the existing stream location when the stream is filled.

REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 8th Ed, 2017. (LRFD)
2. GEOTECHNICAL ENGINEERING CIRCULAR NO. 6: Shallow Foundations. FHWA: September 2002. (FHWA)
3. Das, Braja M. Principles of Foundation Engineering, 7th Ed. Brooks/Cole, 2011. (Das)
4. Golder boring logs and subsurface profiles.
5. Subsurface investigation laboratory testing results.
6. Holtz, R.D., Kovacs, W.D., Sheahan, T.C (2011). Introduction to Geotechnical Engineering, 2nd Ed. Pearson, Upper Saddle River, NJ

ASSUMPTIONS

1. Clay consolidation parameters for both the Presumpscot Crust and Presumpscot Clay, based on laboratory test results for borings HB-GBB-201, HB-GBB-202A, & HB-GBB-203 (Golder design report Table 5 and Appendix C): Use these values to calculate modified compression indicies.	C_c =	0.42	
	C_r =	0.06	
	e_0 =	1.13	
2. N_{60} value for the Glacial Outwash (from boring logs)	N_{60} =	36	
3. γ of fill (unit weight)	γ =	0.125	kcf
4. γ of water (unit weight)	γ =	0.0624	kcf
5. Water table one foot below ground surface	z_w =	1	ft

CALCULATION

Use consolidation theory to estimate settlement of the clay layers beneath the existing stream (Layers 1-5); use the Hough method to estimate settlement of the glacial outwash beneath the existing stream (Layer 6).

1 Calculate the stress increase for the subsurface soils at the center of the stream
See Schematic at Station 14+25
Use Rectangular and Triangular Load Distribution Influence Diagrams from Holtz et al. (2011) - Figure 10.4, Figure 10.7.

See stresses below

Layer		Depth below ground surface (ft)	Layer thickness (ft)	Depth z (ft)	$\Delta\sigma_{z\text{-}D}$ (ksf)	$\Delta\sigma_{z\text{-}E}$ (ksf)	$\Delta\sigma_{z,(D\text{-}E)}$ (ksf)
Sand / Fill	0	0-12.3	12.3	6.2	0.08	0.04	0.04
Presumpscot Crust	1	12.3-15.6	3.3	14.0	0.14	0.06	0.08
Presumpscot	2	15.6-24.2	8.6	19.9	0.16	0.07	0.09
Presumpscot	3	24.2-32.8	8.6	28.5	0.14	0.06	0.08
Presumpscot	4	32.8-41.4	8.6	37.1	0.13	0.06	0.07
Presumpscot	5	41.4-49.1	7.7	45.3	0.13	0.06	0.07
Outwash	6	49.1-53.3	4.2	51.2	0.11	0.05	0.06

D. Triangular Loading (Fig. 10.7) at edge of SR 25 (Fill height (ft) = 16 q_0 (ksf) = 2.0

Layer		L	B	z	m	n	I_Q	$\Delta\sigma_{z\text{-}D}$ (ksf)
Sand / Fill	0	∞	21.3	6.2	∞	3.5	0.04	0.08
Presumpscot Crust	1	∞	21.3	14.0	∞	1.5	0.07	0.14
Presumpscot	2	∞	21.3	19.9	∞	1.1	0.08	0.16
Presumpscot	3	∞	21.3	28.5	∞	0.7	0.07	0.14
Presumpscot	4	∞	21.3	37.1	∞	0.6	0.065	0.13
Presumpscot	5	∞	21.3	45.3	∞	0.5	0.063	0.13
Outwash	6	∞	21.3	51.2	∞	0.4	0.055	0.11

Date:	12/11/2019	**Made by:**	MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Settlement of Filled Stream - Top of Slope at State Route 25	**Reviewed by:**	
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

E. Triangular Loading (Fig. 10.7) at edge of SR 25 Fill height (ft) = 7.4 q_0 (ksf) = 0.925

Layer		L	B	z	m	n	I_Q	$\Delta\sigma_{z\text{-}E}$ (ksf)
Sand / Fill	0	∞	21.3	6.2	∞	3.5	0.04	0.04
Presumpscot Crust	1	∞	21.3	14.0	∞	1.5	0.07	0.06
Presumpscot	2	∞	21.3	19.9	∞	1.1	0.08	0.07
Presumpscot	3	∞	21.3	28.5	∞	0.7	0.07	0.06
Presumpscot	4	∞	21.3	37.1	∞	0.6	0.065	0.06
Presumpscot	5	∞	21.3	45.3	∞	0.5	0.063	0.06
Outwash	6	∞	21.3	51.2	∞	0.4	0.055	0.05

2 Determine C' and σ'_{v0} for in situ existing soil. Use FHWA Figure 5-19 to obtain a C' for Layer 0 and Layer 6, assuming the glacial outwash is "well graded fine to medium silty SAND".

Layer		Depth Below Ground Surface (ft)	Layer Thickness (ft)	z (ft)	$(N_1)_{60}$ avg	C'	Unit Weight of Layer (kcf)	σ'_{v0} (ksf)
Sand / Fill	0	0-12.3	12.3	6.15	25	65	0.125	0.45
Presumpscot Crust	1	12.3-15.6	3.3	13.95			0.120	0.93
Presumpscot	2	15.6-24.2	8.6	19.9	Not required for clay consolidation analysis		0.115	1.25
Presumpscot	3	24.2-32.8	8.6	28.5			0.115	1.70
Presumpscot	4	32.8-41.4	8.6	37.1			0.115	2.15
Presumpscot	5	41.4-49.1	7.7	45.25			0.115	2.58
Outwash	6	49.1-53.3	4.2	51.2	36	87	0.125	2.92

3 Calculate the total settlement of the sand/fill (Layer 0) and glacial outwash (Layer 6) using the Hough method:

General Equation (FHWA, Eqn 5-24)

$$\Delta H_i = H_c \frac{1}{C'} \log\left(\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_{v0}}\right)$$

where:

- ΔH_i settlement in each layer, ft
- H_c initial height of layer i, ft
- C' bearing capacity index from FHWA Figure 5-19
- $\Delta\sigma_v$ vertical stress increase, ksf

ΔH_i (Layer 0)	ft	0.0075
	in	0.091

ΔH_i (Layer 6)	ft	0.0004
	in	0.005

4 Calculate the total settlement of the clays (Layers 1-5) using the consolidation theory:

General Equation (Das, Eqn 5.81, 5.82, 5.83)

$$\Delta H_i = C_{r\varepsilon} H_c \log\frac{\sigma'_p}{\sigma'_{v0}} + C_{c\varepsilon} H_c \log\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_p}$$ for overconsolidated clay, $\sigma'_{v0} + \Delta\sigma_v > \sigma'_p$

$$\Delta H_i = C_{r\varepsilon} H_c \log\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_{v0}}$$ for overconsolidated clay, $\sigma'_{v0} + \Delta\sigma_v \le \sigma'_p$

$$\Delta H_i = C_{c\varepsilon} H_c \log\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_{v0}}$$ for normally consolidated clay

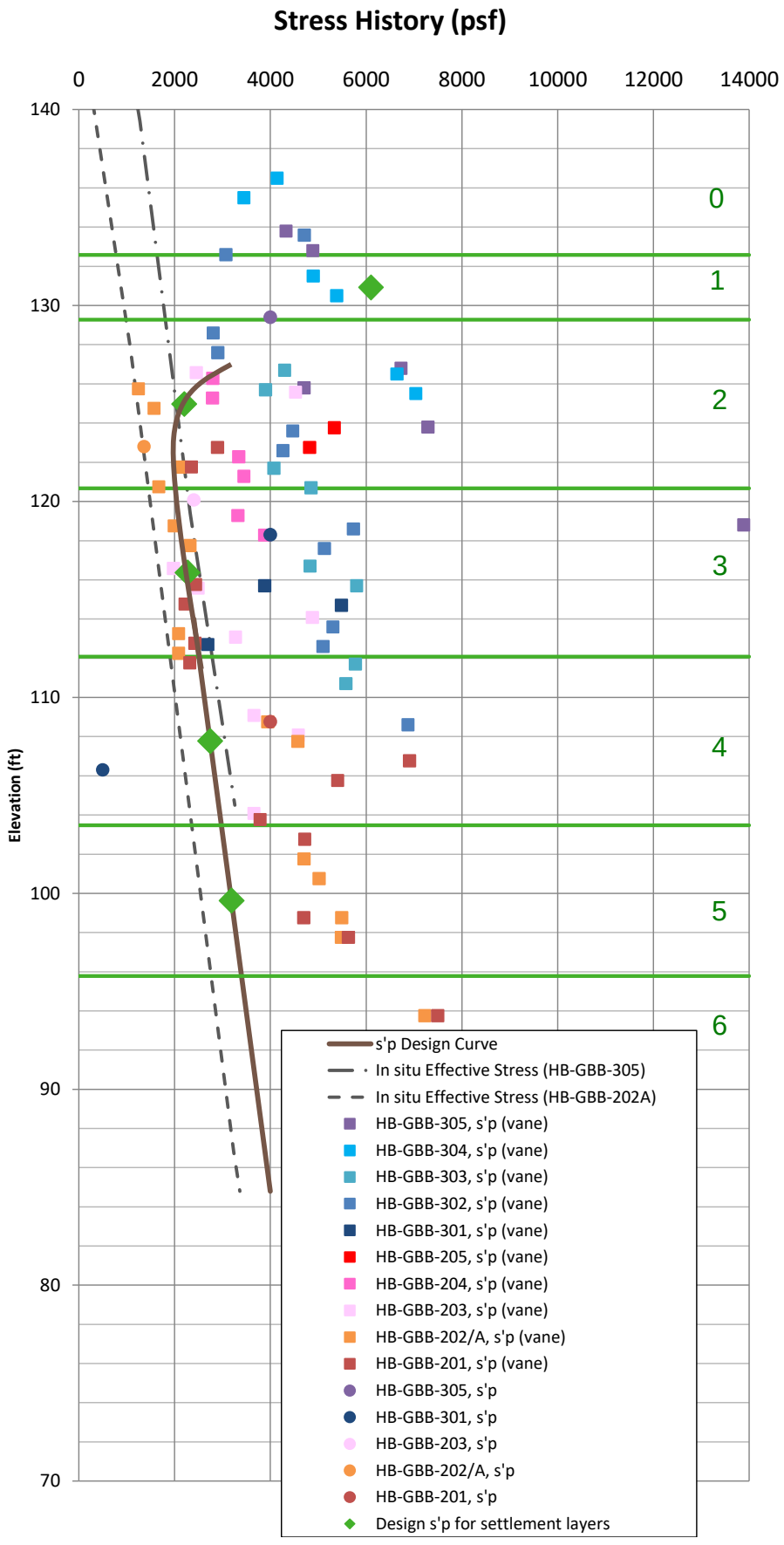
Date:	12/11/2019	**Made by:**	MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Settlement of Filled Stream - Top of Slope at State Route 25	**Reviewed by:**	
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

where:			Layer 1 - Clay Crust	Layer 2 - Clay	Layer 3 - Clay	Layer 4 - Clay	Layer 5 - Clay
H_c	initial height of layer i, ft		3.3	8.6	8.6	8.6	7.7
$\Delta\sigma_v$	surcharge load, psf		75	86	75	70	68
σ'_{v0}	in situ vertical effective stress, psf		927	1249	1701	2153	2582
$\sigma'_{v0} + \Delta\sigma_v$	(check against σ'_p to select equation)		1003	1335	1776	2223	2650
σ'_p	preconsolidated stress, psf		6100	2200	2270	2741	3188
$C_{r\varepsilon}$	modified recompression index		0.03	0.03	0.03	0.03	0.03
$C_{c\varepsilon}$	modified compression index		0.20	0.20	0.20	0.20	0.20
ΔH_i		ft	0.003	0.007	0.005	0.004	0.003
		in	0.04	0.09	0.06	0.04	0.03

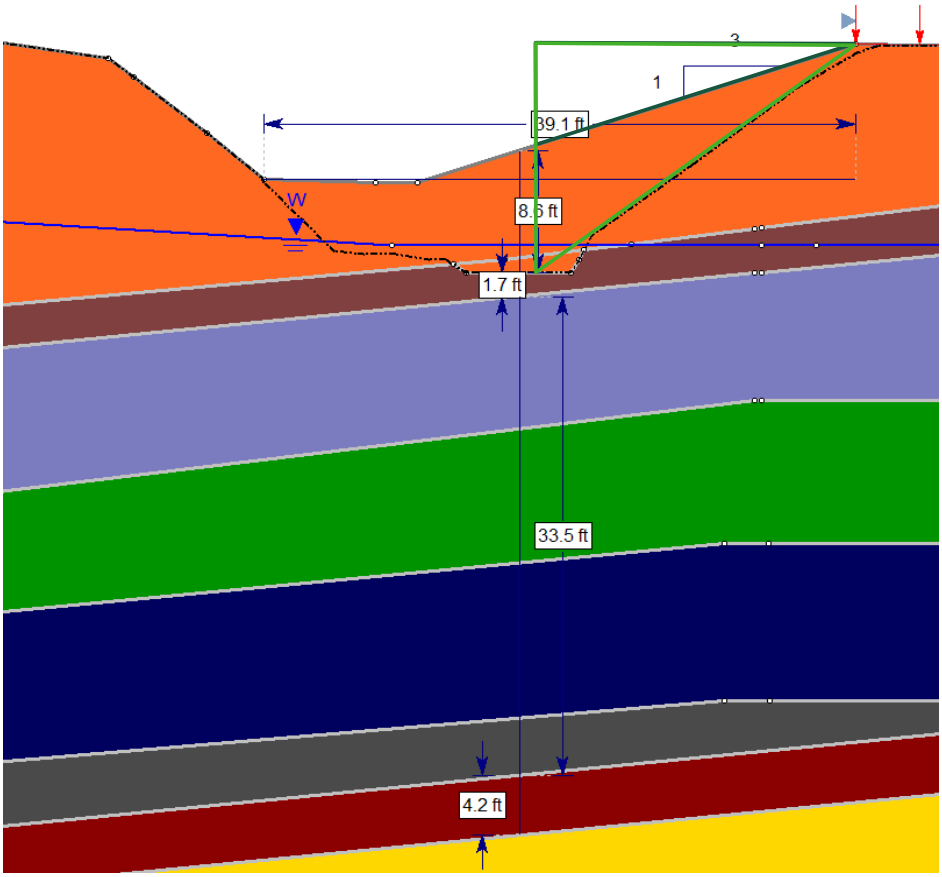
	Settlement Based on Calculated Loading Stress
Layer	ΔH_i (in)
0	0.09
1	0.04
2	0.09
3	0.06
4	0.04
5	0.03
6	0.01
Total Settlement (in)	0.36

CONCLUSIONS

The primary settlement at the existing stream location when the stream is filled is estimated to be 0.4 inches.


Stress History (psf)
0
2000
4000
6000
8000
10000
12000
14000
140
130
120
110
100
90
80
70
Elevation (ft)
0
1
2
3
4
5
6
s'p Design Curve
In situ Effective Stress (HB-GBB-305)
In situ Effective Stress (HB-GBB-202A)
HB-GBB-305, s'p (vane)
HB-GBB-304, s'p (vane)
HB-GBB-303, s'p (vane)
HB-GBB-302, s'p (vane)
HB-GBB-301, s'p (vane)
HB-GBB-205, s'p (vane)
HB-GBB-204, s'p (vane)
HB-GBB-203, s'p (vane)
HB-GBB-202/A, s'p (vane)
HB-GBB-201, s'p (vane)
HB-GBB-305, s'p
HB-GBB-301, s'p
HB-GBB-203, s'p
HB-GBB-202/A, s'p
HB-GBB-201, s'p
Design s'p for settlement layers

Stream Bed
Station 14+25



Both edges for all touch the mid-point of the stream and the edge of the roadway

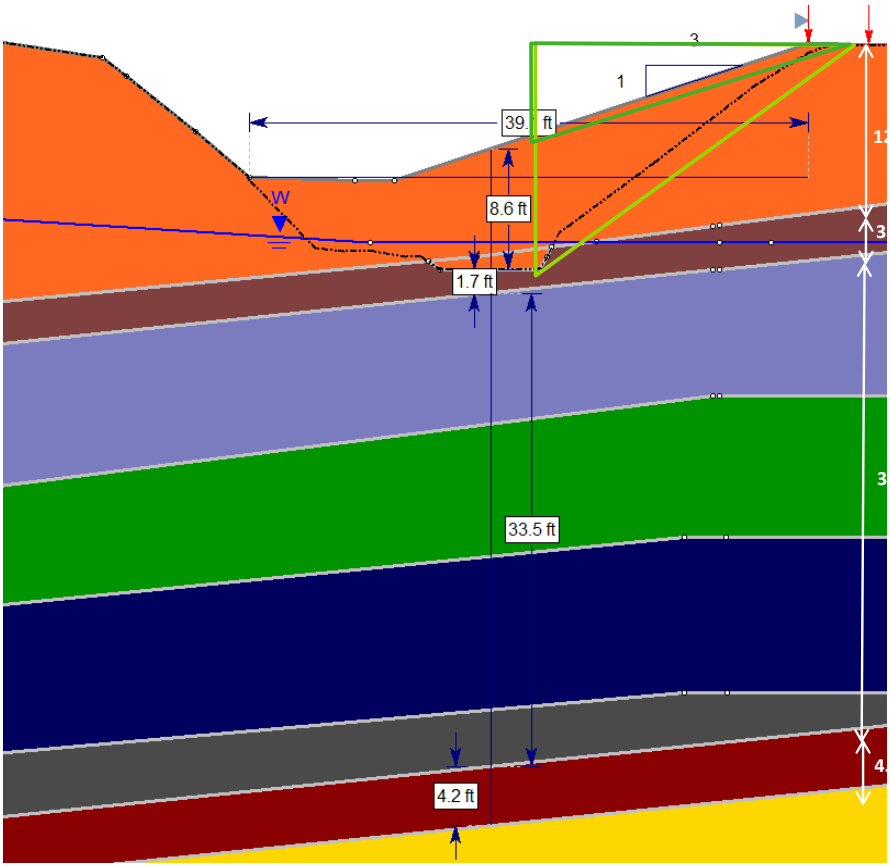
21.3 ft wide, 16 ft tall

A: Add

21.3 ft wide, 7.4 ft tall

B: subtract

Elevation of Top of SR25
Station 14+25



Both edges for all touch the mid-point of the stream and the edge of the roadway

21.3 ft wide, 16 ft tall

D: Add

21.3 ft wide, 7.4 ft tall

E: Subtract

Alternatively, stress distributions can also be obtained by assuming a 2-to-1 distribution of stress below the footing, as shown in Figure 5-12. This is much simpler to compute and is a reasonably accurate approximation of the decrease in stress with depth due to an applied surficial load of limited areal extent.

A comparison of the simplified 2-to-1 distribution with the actual distributed stress according to elastic theory is shown in Figure 5-13. This distribution can be computed as a function of applied stress according to:

$$\frac{\Delta\sigma_v}{q} = \frac{B_f L_f}{(B_f + Z)(L_f + Z)} \qquad (5\text{-}17)$$

where: $\Delta\sigma_V$ = Change in vertical stress at depth Z below the footing bearing elevation
q = Stress applied by the footing at the bearing elevation
Z = Depth below footing bearing elevation to point of interest, usually the center or midpoint of a soil layer or sublayer where a settlement computation is to be made
B_f = Width of footing
L_f = Length of footing

5.3.3 Footings on Cohesive Soils

Primary and secondary consolidation of clays or clayey deposits may result in substantial settlements when the structure is founded on saturated cohesive soils. Settlement resulting from primary consolidation may take weeks to years to be completed. Furthermore, because soil properties may vary beneath the foundation, the duration of the primary consolidation and the amount of settlement may also vary with the location of the footing, resulting in differential settlement between footing locations. If such settlements are not within tolerable limits, the structure may not perform as expected or intended.

When a foundation is wide compared to the compressible layer thickness beneath it, a large portion of the soil will settle vertically (one-dimensionally) with very little lateral displacement because of the constraining forces exerted by the neighboring soil elements. Based on measurements of lateral displacements beneath embankments and tanks, it is usually reasonable to assume that the settlements beneath a foundation will be one-dimensional even for narrow foundations, provided an adequate factor of safety is applied to bearing capacity (Terzaghi & Peck, 1967). Desiccated crust or overburden above the base of the footing will tend to minimize the amount of lateral displacements. Experience suggests that reasonably good estimates of settlement can be predicted assuming one-dimensional compression as long as the factor of safety is at least three (3) against bearing capacity failure. One-dimensional consolidation theory is presented in this section and is used to calculate settlement estimates for shallow foundations on cohesive soils.

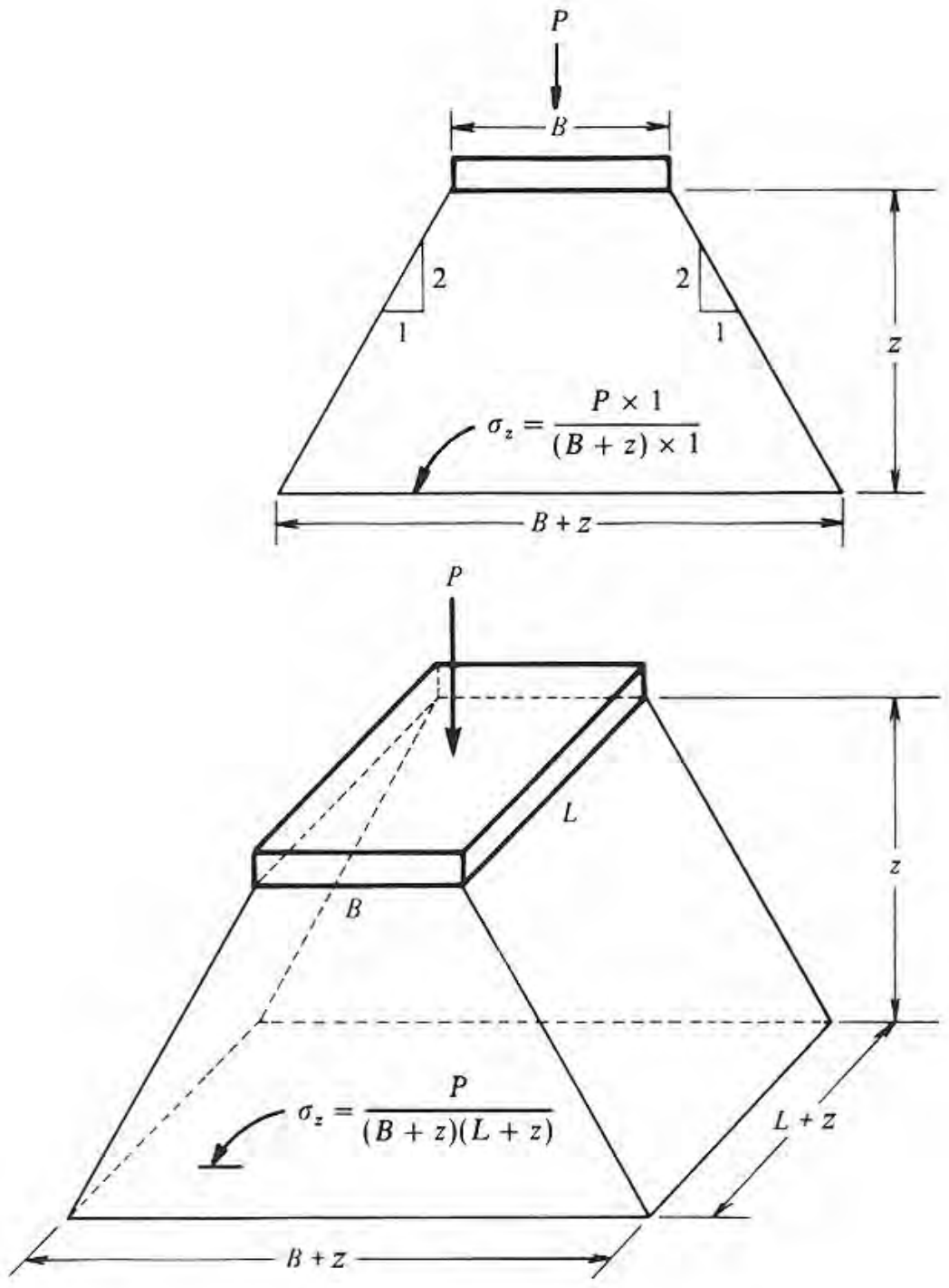


Figure 5-12: Distribution of Vertical Stress by the 2:1 Method
(Chen and McCarron, 1991)

- The D'Appolonia method under-predicted the settlement by an average factor of about 0.77 for the five footings, but the accuracy was generally better than Hough, and the scatter in the predicted settlement values was also less (standard deviation, $s_o = 0.22$).

The data from the five load tests therefore generally corroborate the conclusions from the Gifford et al. and Burland & Burbidge studies.

Therefore, it is currently recommended that the Hough method be used as a primary design and analysis tool. The D'Appolonia or load-settlement methods could be employed as alternates, or when a more accurate estimate of settlement is desired, recognizing that these alternate methods have less history of use in the design of highway bridges. Naturally, if another method is locally or regionally known to provide more reliable estimates of settlement on granular soils, and the method meets the criteria noted above, the geotechnical engineer should exercise judgment and use the best method available.

5.3.4.1 Hough Method

Hough (1959) developed an empirical method for predicting settlements of shallow foundations on cohesionless soils that follows the same approach as that used for calculating consolidation settlement of clay layers. Note that the method is applicable only for normally consolidated cohesionless soils. Cheney and Chassie (2000) recommend that the SPT blowcounts be corrected for overburden pressure before correlating the N-values to the bearing capacity index, C′. An overburden correction by Bazaraa (1967) was recommended by Cheney and Chassie (2000). Since that time, many researchers have studied the effect of overburden stress on the SPT N-value, largely in support of liquefaction hazard assessment procedures. Recent consensus by the 1996 and 1998 National Center for Earthquake Engineering Research (NCEER) (Youd et al., 2001) concluded that the correction proposed by Liao & Whitman (1986) (shown in Figure 5-18) could be used for routine engineering applications. Therefore, the correction by Liao & Whitman is included here as part of the Hough procedure, in particular because it is easy to calculate and can be used without charts in simple computation spreadsheets. The soil is divided into layers, and the change in effective vertical stress at the mid-height of the layer as a result of the applied load is estimated using elastic theory.

The total settlement by the Hough method is calculated as follows:

1. Correct SPT blowcounts for overburden stress using Figure 5-18.

2. Determine bearing capacity index (C′) from Figure 5-19 using corrected SPT blowcounts, N′, determined in Step 1.

3. Subdivide subsurface soil profile into approximately 3-m (10-ft) layers based on stratigraphy to a depth of about three times the footing width.

4. Calculate the effective vertical stress, σ'_{vo}, at the midpoint of each layer and the average bearing capacity index for that layer.

5. Calculate the increase in stress at the midpoint of each layer, $\Delta\sigma_v$, using either Figure 5-9, 5-10 or 5-11, or the 2:1 method (Figure 5-12).

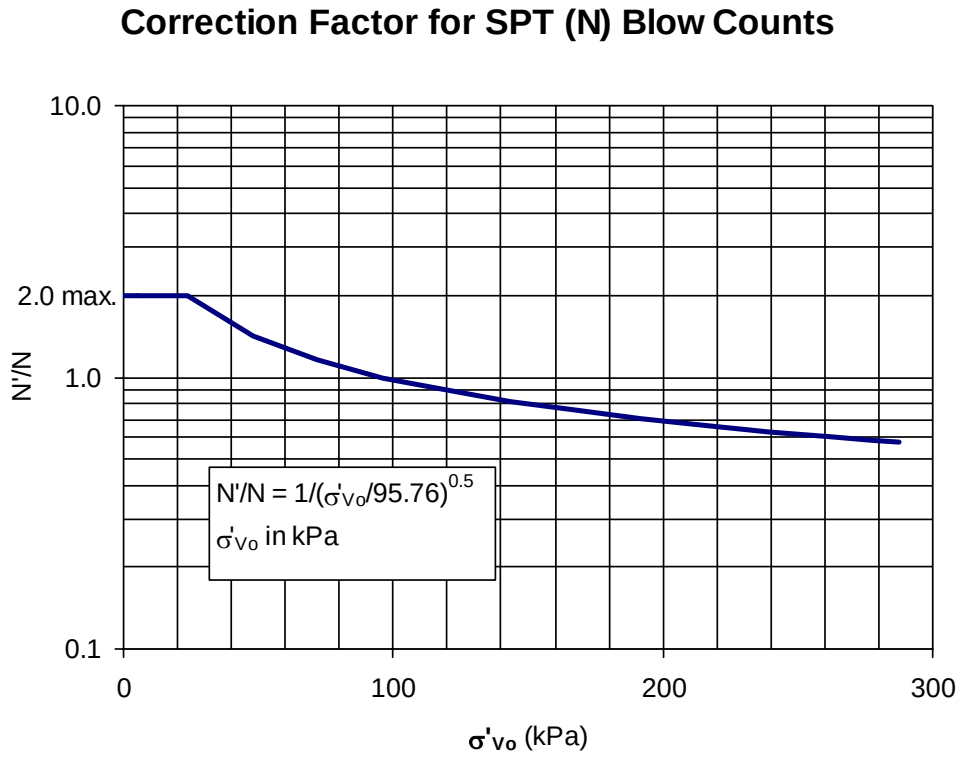


Figure 5-18: Corrected SPT (N) versus Overburden Pressure (after Liao & Whitman, 1986)

6. Calculate the settlement in each layer, ΔH, under the applied load using the following formula:

$$\Delta H = H_o \frac{1}{C'} \log\left(\frac{\sigma'_{vo} + \Delta\sigma_{v_f}}{\sigma'_{vo}}\right) \qquad (5\text{-}24)$$

7. Sum the incremental settlements to determine the total settlement.

5.3.4.2 D'Appolonia Method

The D'Appolonia method calculates settlement using the following basic equation:

$$\Delta H = \left(\frac{\Delta\sigma_V B_f}{M}\right)\mu_o\mu_1 \qquad (5\text{-}25)$$

where: ΔH = settlement in sand or sand and gravel
$\Delta\sigma_v$ = applied stress beneath footing
B_f = footing width
μ_O = correction factor for embedment – see Figure 5-20 (dimensionless)
μ_1 = correction factor for thickness of sand layer – see Figure 5-20 (dimensionless)
M = modulus of compressibility of sand – see Figure 5-21

Any consistent set of units can be used for ΔH, $\Delta\sigma_v$, B_f and M.

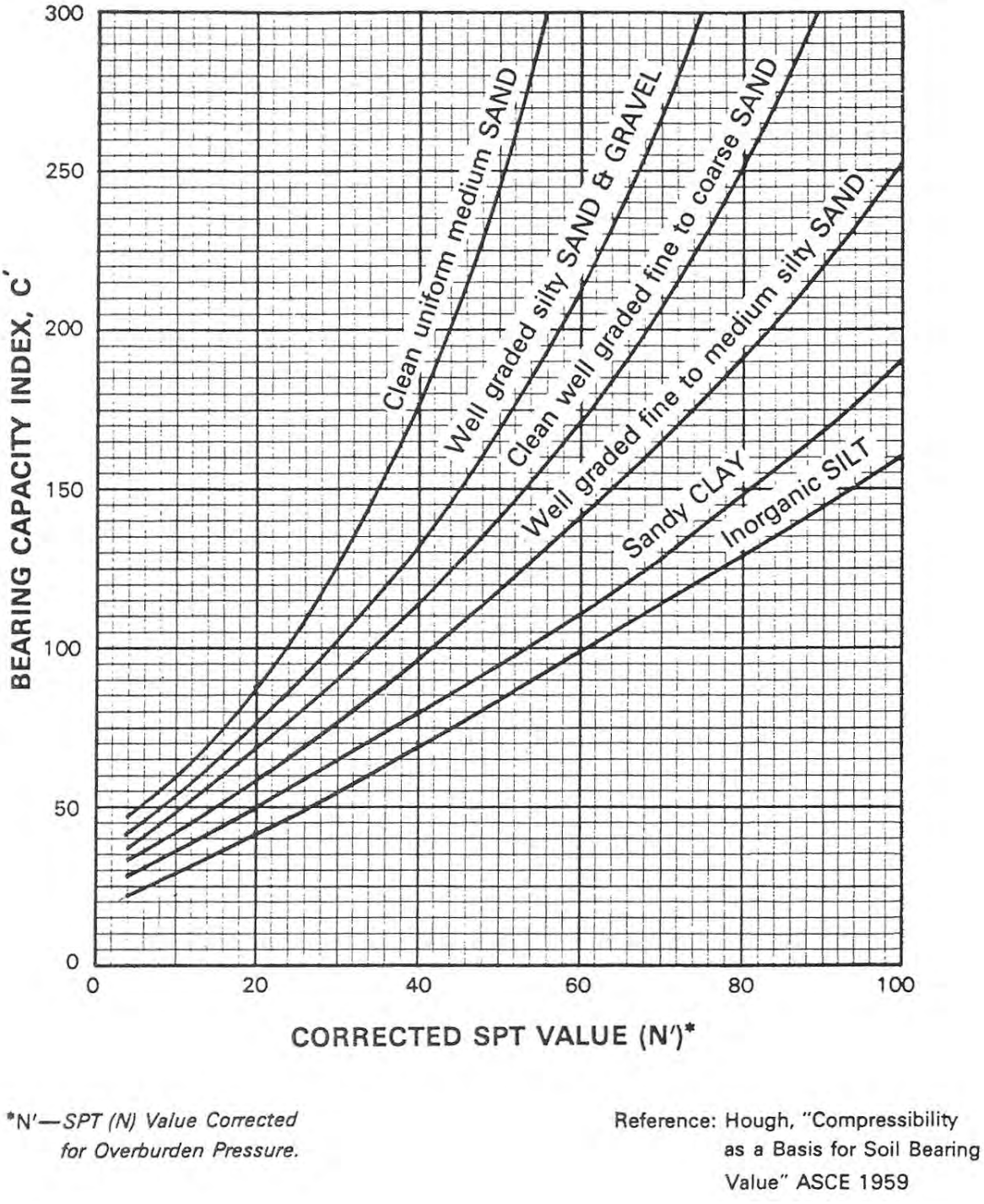


Figure 5-19: Bearing Capacity Index versus Corrected SPT
(Cheney & Chassie, 2000, modified from Hough, 1959)

Reference 3

Consolidation Settlement

5.15 Primary Consolidation Settlement Relationships

As mentioned before, consolidation settlement occurs over time in saturated clayey soils subjected to an increased load caused by construction of the foundation. (See Figure 5.29.) On the basis of the one-dimensional consolidation settlement equations given in Chapter 1, we write

$$S_{c(p)} = \int \varepsilon_z dz \tag{5.80}$$

where

ε_z = vertical strain

$$= \frac{\Delta e}{1 + e_o}$$

Δe = change of void ratio

$= f(\sigma'_o, \sigma'_c, \text{and } \Delta\sigma')$

So,

$$S_{c(p)} = \frac{C_c H_c}{1 + e_o} \log \frac{\sigma'_o + \Delta\sigma'_{av}}{\sigma'_o} \qquad \text{(for normally consolidated clays)} \tag{5.81}$$

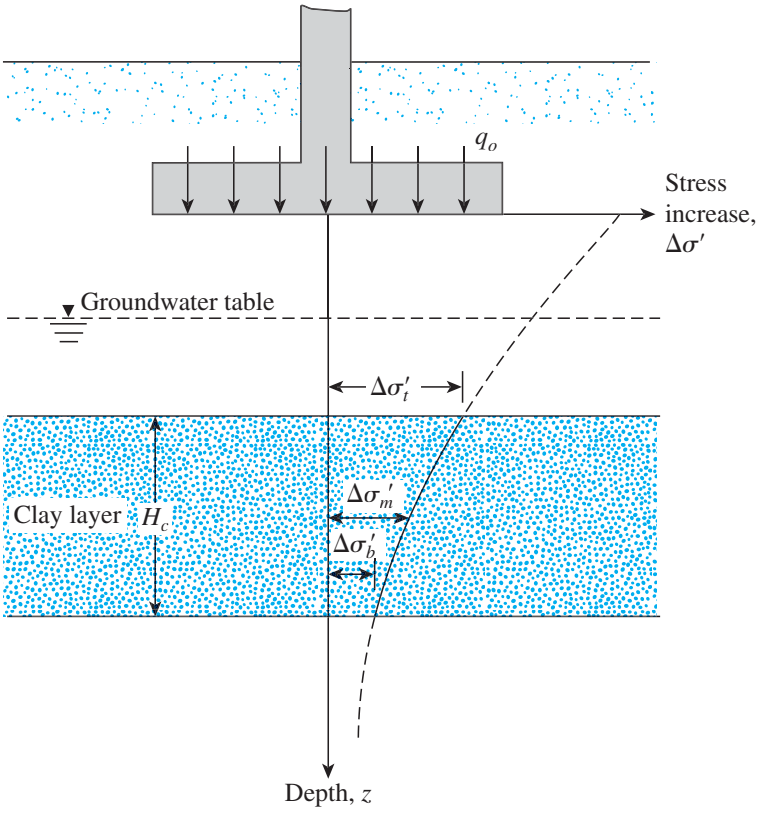


Figure 5.29 Consolidation settlement calculation

$$S_{c(p)} = \frac{C_s H_c}{1 + e_o} \log \frac{\sigma'_o + \Delta\sigma'_{av}}{\sigma'_o} \qquad \text{(for overconsolidated clays with } \sigma'_o + \Delta\sigma'_{av} < \sigma'_c\text{)} \tag{5.82}$$

$$S_{c(p)} = \frac{C_s H_c}{1 + e_o} \log \frac{\sigma'_c}{\sigma'_o} + \frac{C_c H_c}{1 + e_o} \log \frac{\sigma'_o + \Delta\sigma'_{av}}{\sigma'_c} \qquad \text{(for overconsolidated clays with } \sigma'_o < \sigma'_c < \sigma'_o + \Delta\sigma'_{av}\text{)} \tag{5.83}$$

where

σ'_o = average effective pressure on the clay layer before the construction of the foundation
$\Delta\sigma'_{av}$ = average increase in effective pressure on the clay layer caused by the construction of the foundation
σ'_c = preconsolidation pressure
e_o = initial void ratio of the clay layer
C_c = compression index
C_s = swelling index
H_c = thickness of the clay layer

The procedures for determining the compression and swelling indexes were discussed in Chapter 1.

Note that the increase in effective pressure, $\Delta\sigma'$, on the clay layer is not constant with depth: The magnitude of $\Delta\sigma'$ will decrease with the increase in depth measured from the bottom of the foundation. However, the average increase in pressure may be approximated by

$$\Delta\sigma'_{av} = \tfrac{1}{6}(\Delta\sigma'_t + 4\Delta\sigma'_m + \Delta\sigma'_b) \tag{5.84}$$

where $\Delta\sigma'_t$, $\Delta\sigma'_m$, and $\Delta\sigma'_b$ are, respectively, the effective pressure increases at the *top, middle,* and *bottom* of the clay layer that are caused by the construction of the foundation.

The method of determining the pressure increase caused by various types of foundation load using Boussinesq's solution is discussed in Sections 5.2 through 5.6. $\Delta\sigma'_{av}$ can also be directly obtained from the method presented in Section 5.5.

5.16 Three-Dimensional Effect on Primary Consolidation Settlement

The consolidation settlement calculation presented in the preceding section is based on Eqs. (1.61), (1.63), and (1.65). These equations, as shown in Chapter 1, are in turn based on one-dimensional laboratory consolidation tests. The underlying assumption is that the increase in pore water pressure, Δu, immediately after application of the load equals the increase in stress, $\Delta\sigma$, at any depth. In this case,

$$S_{c(p)-\text{oed}} = \int \frac{\Delta e}{1 + e_o} dz = \int m_v \Delta\sigma'_{(1)} dz$$

where

$S_{c(p)-\text{oed}}$ = consolidation settlement calculated by using Eqs. (1.61), (1.63), and (1.65)
$\Delta\sigma'_{(1)}$ = effective vertical stress increase
m_v = volume coefficient of compressibility (see Chapter 1)

Reference 6

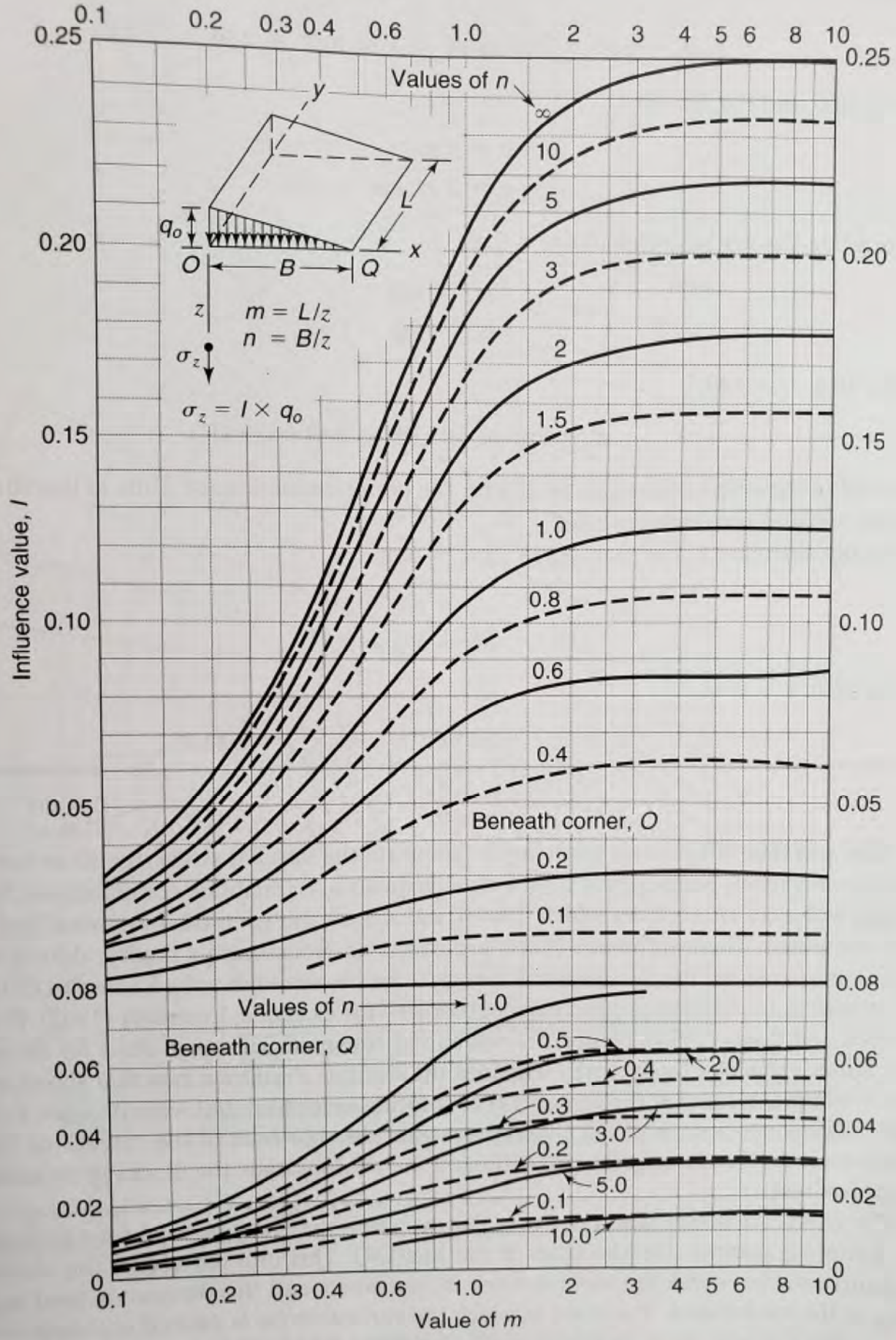


FIGURE 10.7 Influence values for vertical stress under the corners of a triangular load of limited length (after U.S. Navy, 1986).

GOLDER

CALCULATIONS

Date:	12/11/2019	**Made by:**	MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Settlement of Filled Stream - Middle of Streambed	**Reviewed by:**	CCB
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

OBJECTIVE

To calculate the primary settlement at the existing stream location when the stream is filled.

REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 8th Ed, 2017. (LRFD)
2. GEOTECHNICAL ENGINEERING CIRCULAR NO. 6: Shallow Foundations. FHWA: September 2002. (FHWA)
3. Das, Braja M. Principles of Foundation Engineering, 7th Ed. Brooks/Cole, 2011. (Das)
4. Golder boring logs and subsurface profiles.
5. Subsurface investigation laboratory testing results.
6. Holtz, R.D., Kovacs, W.D., Sheahan, T.C (2011). Introduction to Geotechnical Engineering, 2nd Ed. Pearson, Upper Saddle River, NJ

ASSUMPTIONS

1. Clay consolidation parameters for both the Presumpscot Crust and Presumpscot Clay, based on laboratory test results for borings HB-GBB-201, HB-GBB-202A, & HB-GBB-203 (Golder design report Table 5 and Appendix C): Use these values to calculate modified compression indicies.	C_c =	0.42	
	C_r =	0.06	
	e_0 =	1.13	
2. N_{60} value for the Glacial Outwash (from boring logs)	N_{60} =	36	
3. γ of fill (unit weight)	γ =	0.125	kcf
4. γ of water (unit weight)	γ =	0.0624	kcf
5. Water table one foot below ground surface	z_w =	0	ft

CALCULATION

Use consolidation theory to estimate settlement of the clay layers beneath the existing stream (Layers 1-5); use the Hough method to estimate settlement of the glacial outwash beneath the existing stream (Layer 6).

1 Calculate the stress increase for the subsurface soils at the center of the stream
See Schematic at Station 14+25
Use Rectangular and Triangular Load Distribution Influence Diagrams from Holtz et al. (2011) - Figure 10.4, Figure 10.7.

See stresses below

Layer		Depth below ground surface (ft)	Layer thickness (ft)	Depth z (ft)	$\Delta\sigma_{z\text{-}A}$ (ksf)	$\Delta\sigma_{z\text{-}B}$ (ksf)	$\Delta\sigma_{z\text{-}(A\text{-}B)}$ (ksf)
Presumpscot Crust	1	0-2	2	1	0.50	0.23	0.27
Presumpscot	2	2-12	10	7	0.40	0.19	0.22
Presumpscot	3	12-22	10	17	0.29	0.13	0.15
Presumpscot	4	22-32	10	27	0.21	0.10	0.12
Presumpscot	5	32-34	2	33	0.17	0.08	0.09
Outwash	6	34-40	6	37	0.17	0.08	0.09

A. Triangular Loading (Fig. 10.7) at Center of Stream — Fill height (ft) = 16 — q_0 (ksf) = 2

Layer		L	B	z	m	n	I_O	$\Delta\sigma_{z\text{-}A}$ (ksf)
Presumpscot Crust	1	∞	21.3	1	∞	21.3	0.25	0.50
Presumpscot	2	∞	21.3	7	∞	3.0	0.2	0.40
Presumpscot	3	∞	21.3	17	∞	1.3	0.143	0.29
Presumpscot	4	∞	21.3	27	∞	0.8	0.107	0.21
Presumpscot	5	∞	21.3	33	∞	0.6	0.087	0.17
Outwash	6	∞	21.3	37	∞	0.6	0.087	0.17

B. Triangular Loading (Fig. 10.7) at Center of Stream — Fill height (ft) = 7.4 — q_0 (ksf) = 0.925

Layer		L	B	z	m	n	I_O	$\Delta\sigma_{z\text{-}B}$ (ksf)
Presumpscot Crust	1	∞	21.3	1	∞	21.3	0.25	0.23
Presumpscot	2	∞	21.3	7	∞	3.0	0.2	0.19
Presumpscot	3	∞	21.3	17	∞	1.3	0.143	0.13
Presumpscot	4	∞	21.3	27	∞	0.8	0.107	0.10
Presumpscot	5	∞	21.3	33	∞	0.6	0.087	0.08
Outwash	6	∞	21.3	37	∞	0.6	0.087	0.08

Date:	12/11/2019	**Made by:**	MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Settlement of Filled Stream - Middle of Streambed	**Reviewed by:**	
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

2 Determine C' and σ'_{v0} for in situ existing soil. Use FHWA Figure 5-19 to obtain a C' for Layer 6, assuming the glacial outwash is "well graded fine to medium silty SAND".

Layer		Depth Below Ground Surface (ft)	Layer Thickness (ft)	Z (ft)	$(N_1)_{60}$ avg	C'	Unit Weight of Layer (kcf)	σ'_{v0} (ksf)
Presumpscot Crust	1	0-2	2	1			0.120	0.06
Presumpscot	2	2-12	10	7	Not required for clay consolidation analysis		0.115	0.38
Presumpscot	3	12-22	10	17			0.115	0.90
Presumpscot	4	22-32	10	27			0.115	1.43
Presumpscot	5	32-34	2	33			0.115	1.75
Outwash	6	34-40	6	37	36	87	0.125	1.99

3 Calculate the total settlement of the glacial outwash (Layer 6) using the Hough method:

General Equation (FHWA, Eqn 5-24)

$$\Delta H_i = H_c \frac{1}{C'} \log\left(\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_{v0}}\right)$$

where:

ΔH_i	settlement in each layer, ft
H_c	initial height of layer i, ft
C'	bearing capacity index from FHWA Figure 5-19
$\Delta\sigma_v$	vertical stress increase, ksf

ΔH_i (Layer 6)	ft	0.001
	in	0.02

4 Calculate the total settlement of the clays (Layers 1-5) using the consolidation theory:

General Equation (Das, Eqn 5.81, 5.82, 5.83)

$$\Delta H_i = C_{r\varepsilon} H_c \log\frac{\sigma'_p}{\sigma'_{v0}} + C_{c\varepsilon} H_c \log\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_p}$$ for overconsolidated clay, $\sigma'_{v0} + \Delta\sigma_v > \sigma'_p$

$$\Delta H_i = C_{r\varepsilon} H_c \log\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_{v0}}$$ for overconsolidated clay, $\sigma'_{v0} + \Delta\sigma_v \le \sigma'_p$

$$\Delta H_i = C_{c\varepsilon} H_c \log\frac{\sigma'_{v0} + \Delta\sigma_v}{\sigma'_{v0}}$$ for normally consolidated clay

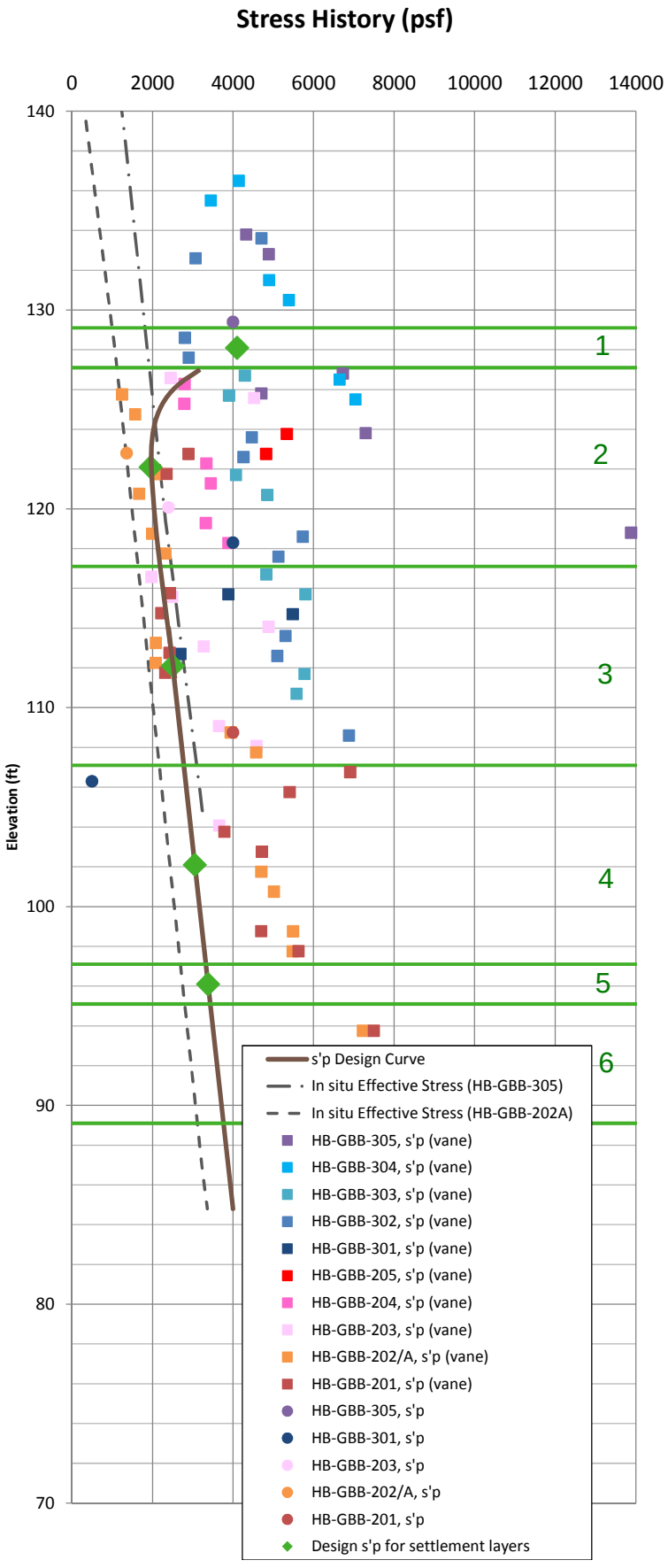
where:			Layer 1 - Clay Crust	Layer 2 - Clay	Layer 3 - Clay	Layer 4 - Clay	Layer 5 - Clay
H_c	initial height of layer i, ft		2	10	10	10	2
$\Delta\sigma_v$	surcharge load, psf		269	215	154	115	94
σ'_{v0}	in situ vertical effective stress, psf		58	378	904	1430	1746
$\sigma'_{v0} + \Delta\sigma_v$	(check against σ'_p to select equation)		326	593	1058	1545	1839
σ'_p	preconsolidated stress, psf		4100	1956	2504	3052	3381
$C_{r\varepsilon}$	modified recompression index		0.03	0.03	0.03	0.03	0.03
$C_{c\varepsilon}$	modified compression index		0.20	0.20	0.20	0.20	0.20
ΔH_i		ft	0.045	0.058	0.020	0.010	0.001
		in	0.54	0.70	0.24	0.12	0.02

Date:	12/11/2019	**Made by:**	MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Settlement of Filled Stream - Middle of Streambed	**Reviewed by:**	
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

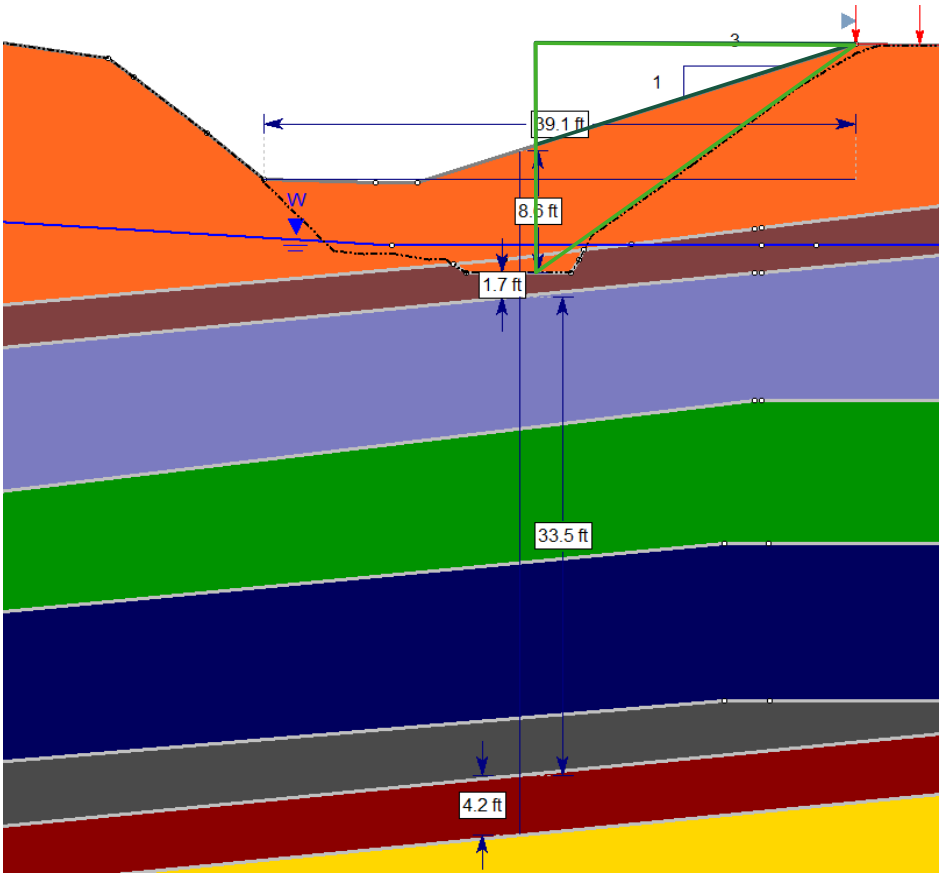
	Settlement Based on Calculated Loading Stress
Layer	ΔH_i (in)
1	0.54
2	0.70
3	0.24
4	0.12
5	0.02
6	0.02
Total Settlement (in)	1.63

CONCLUSIONS

The primary settlement at the middle of the existing stream location when the stream is filled is estimated to be 1.6 inches.


Stress History (psf)
0
2000
4000
6000
8000
10000
12000
14000
140
130
120
110
100
90
80
70
Elevation (ft)
1
2
3
4
5
6
s'p Design Curve
In situ Effective Stress (HB-GBB-305)
In situ Effective Stress (HB-GBB-202A)
HB-GBB-305, s'p (vane)
HB-GBB-304, s'p (vane)
HB-GBB-303, s'p (vane)
HB-GBB-302, s'p (vane)
HB-GBB-301, s'p (vane)
HB-GBB-205, s'p (vane)
HB-GBB-204, s'p (vane)
HB-GBB-203, s'p (vane)
HB-GBB-202/A, s'p (vane)
HB-GBB-201, s'p (vane)
HB-GBB-305, s'p
HB-GBB-301, s'p
HB-GBB-203, s'p
HB-GBB-202/A, s'p
HB-GBB-201, s'p
Design s'p for settlement layers

Stream Bed
Station 14+25



Both edges for all touch the mid-point of the stream and the edge of the roadway

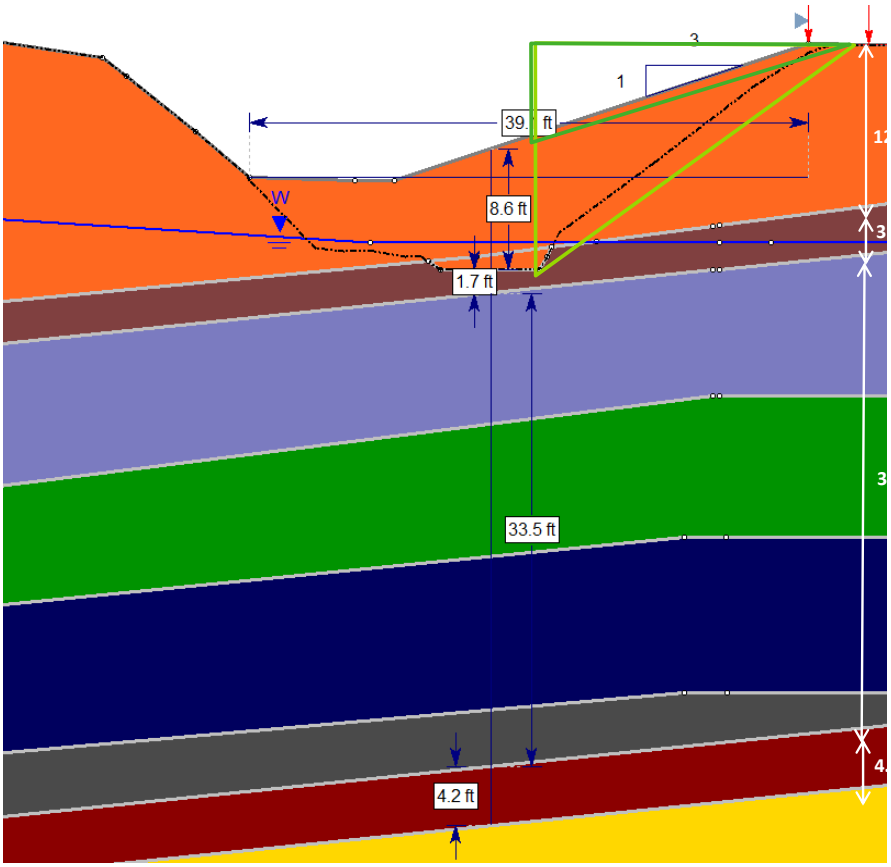
21.3 ft wide, 16 ft tall

A: Add

21.3 ft wide, 7.4 ft tall

B: subtract

Elevation of Top of SR25
Station 14+25



Both edges for all touch the mid-point of the stream and the edge of the roadway

21.3 ft wide, 16 ft tall

D: Add

21.3 ft wide, 7.4 ft tall

E: Subtract

Alternatively, stress distributions can also be obtained by assuming a 2-to-1 distribution of stress below the footing, as shown in Figure 5-12. This is much simpler to compute and is a reasonably accurate approximation of the decrease in stress with depth due to an applied surficial load of limited areal extent.

A comparison of the simplified 2-to-1 distribution with the actual distributed stress according to elastic theory is shown in Figure 5-13. This distribution can be computed as a function of applied stress according to:

$$\frac{\Delta\sigma_v}{q} = \frac{B_f L_f}{(B_f + Z)(L_f + Z)} \qquad (5\text{-}17)$$

where: $\Delta\sigma_V$ = Change in vertical stress at depth Z below the footing bearing elevation
q = Stress applied by the footing at the bearing elevation
Z = Depth below footing bearing elevation to point of interest, usually the center or midpoint of a soil layer or sublayer where a settlement computation is to be made
B_f = Width of footing
L_f = Length of footing

5.3.3 Footings on Cohesive Soils

Primary and secondary consolidation of clays or clayey deposits may result in substantial settlements when the structure is founded on saturated cohesive soils. Settlement resulting from primary consolidation may take weeks to years to be completed. Furthermore, because soil properties may vary beneath the foundation, the duration of the primary consolidation and the amount of settlement may also vary with the location of the footing, resulting in differential settlement between footing locations. If such settlements are not within tolerable limits, the structure may not perform as expected or intended.

When a foundation is wide compared to the compressible layer thickness beneath it, a large portion of the soil will settle vertically (one-dimensionally) with very little lateral displacement because of the constraining forces exerted by the neighboring soil elements. Based on measurements of lateral displacements beneath embankments and tanks, it is usually reasonable to assume that the settlements beneath a foundation will be one-dimensional even for narrow foundations, provided an adequate factor of safety is applied to bearing capacity (Terzaghi & Peck, 1967). Desiccated crust or overburden above the base of the footing will tend to minimize the amount of lateral displacements. Experience suggests that reasonably good estimates of settlement can be predicted assuming one-dimensional compression as long as the factor of safety is at least three (3) against bearing capacity failure. One-dimensional consolidation theory is presented in this section and is used to calculate settlement estimates for shallow foundations on cohesive soils.

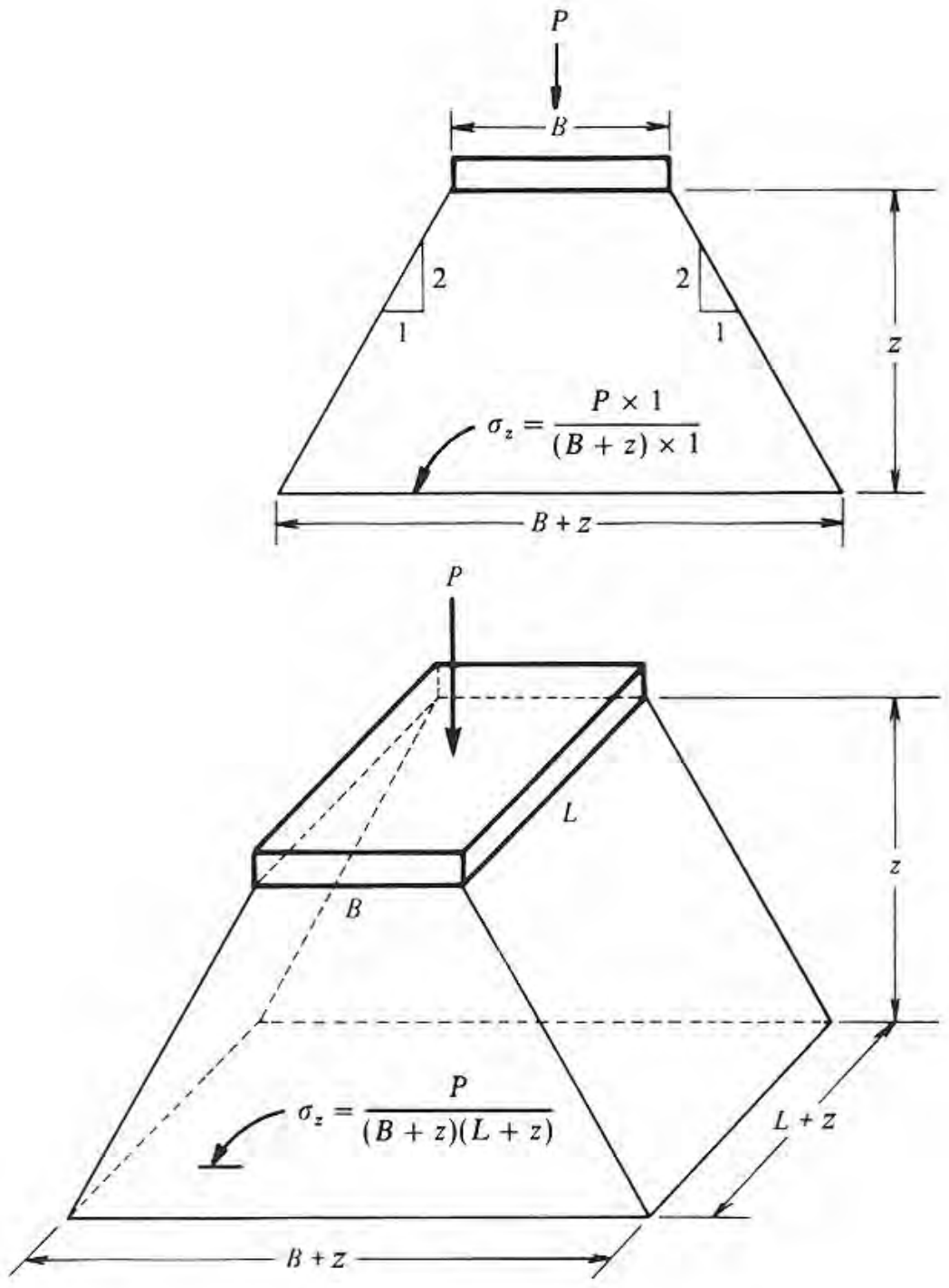


Figure 5-12: Distribution of Vertical Stress by the 2:1 Method
(Chen and McCarron, 1991)

- The D'Appolonia method under-predicted the settlement by an average factor of about 0.77 for the five footings, but the accuracy was generally better than Hough, and the scatter in the predicted settlement values was also less (standard deviation, $s_o = 0.22$).

The data from the five load tests therefore generally corroborate the conclusions from the Gifford et al. and Burland & Burbidge studies.

Therefore, it is currently recommended that the Hough method be used as a primary design and analysis tool. The D'Appolonia or load-settlement methods could be employed as alternates, or when a more accurate estimate of settlement is desired, recognizing that these alternate methods have less history of use in the design of highway bridges. Naturally, if another method is locally or regionally known to provide more reliable estimates of settlement on granular soils, and the method meets the criteria noted above, the geotechnical engineer should exercise judgment and use the best method available.

5.3.4.1 Hough Method

Hough (1959) developed an empirical method for predicting settlements of shallow foundations on cohesionless soils that follows the same approach as that used for calculating consolidation settlement of clay layers. Note that the method is applicable only for normally consolidated cohesionless soils. Cheney and Chassie (2000) recommend that the SPT blowcounts be corrected for overburden pressure before correlating the N-values to the bearing capacity index, C′. An overburden correction by Bazaraa (1967) was recommended by Cheney and Chassie (2000). Since that time, many researchers have studied the effect of overburden stress on the SPT N-value, largely in support of liquefaction hazard assessment procedures. Recent consensus by the 1996 and 1998 National Center for Earthquake Engineering Research (NCEER) (Youd et al., 2001) concluded that the correction proposed by Liao & Whitman (1986) (shown in Figure 5-18) could be used for routine engineering applications. Therefore, the correction by Liao & Whitman is included here as part of the Hough procedure, in particular because it is easy to calculate and can be used without charts in simple computation spreadsheets. The soil is divided into layers, and the change in effective vertical stress at the mid-height of the layer as a result of the applied load is estimated using elastic theory.

The total settlement by the Hough method is calculated as follows:

1. Correct SPT blowcounts for overburden stress using Figure 5-18.

2. Determine bearing capacity index (C′) from Figure 5-19 using corrected SPT blowcounts, N′, determined in Step 1.

3. Subdivide subsurface soil profile into approximately 3-m (10-ft) layers based on stratigraphy to a depth of about three times the footing width.

4. Calculate the effective vertical stress, σ'_{vo}, at the midpoint of each layer and the average bearing capacity index for that layer.

5. Calculate the increase in stress at the midpoint of each layer, $\Delta\sigma_v$, using either Figure 5-9, 5-10 or 5-11, or the 2:1 method (Figure 5-12).

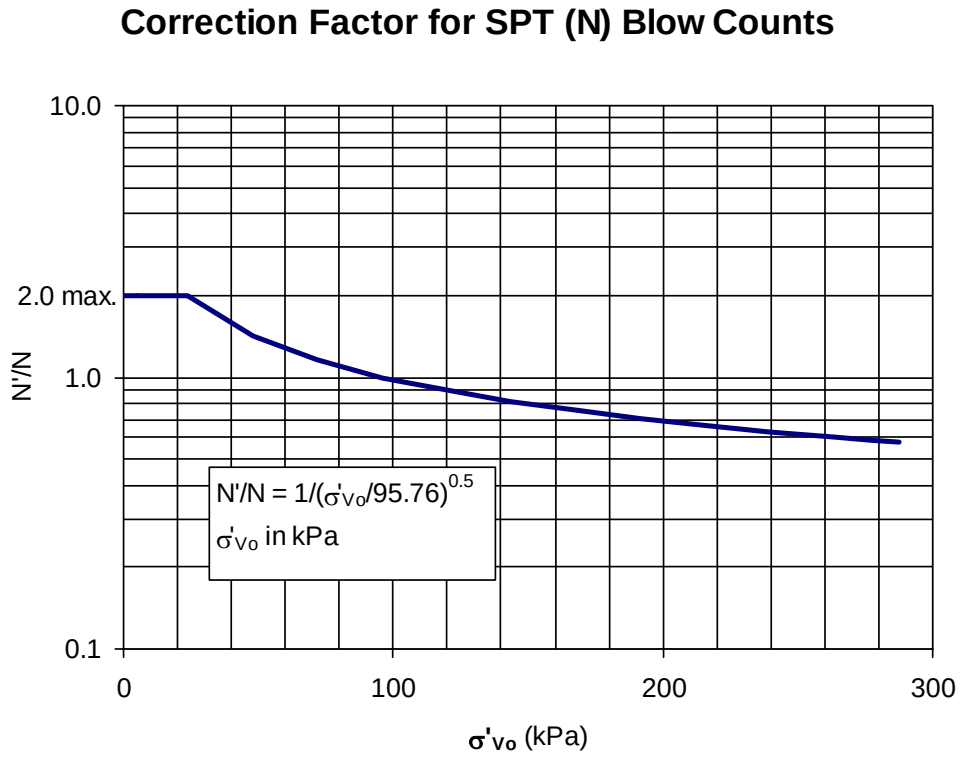


Figure 5-18: Corrected SPT (N) versus Overburden Pressure (after Liao & Whitman, 1986)

6. Calculate the settlement in each layer, ΔH, under the applied load using the following formula:

$$\Delta H = H_o \frac{1}{C'} \log\left(\frac{\sigma'_{vo} + \Delta\sigma_{v_f}}{\sigma'_{vo}}\right) \qquad (5\text{-}24)$$

7. Sum the incremental settlements to determine the total settlement.

5.3.4.2 D'Appolonia Method

The D'Appolonia method calculates settlement using the following basic equation:

$$\Delta H = \left(\frac{\Delta\sigma_V B_f}{M}\right)\mu_o\mu_1 \qquad (5\text{-}25)$$

where: ΔH = settlement in sand or sand and gravel
$\Delta\sigma_v$ = applied stress beneath footing
B_f = footing width
μ_O = correction factor for embedment – see Figure 5-20 (dimensionless)
μ_1 = correction factor for thickness of sand layer – see Figure 5-20 (dimensionless)
M = modulus of compressibility of sand – see Figure 5-21

Any consistent set of units can be used for ΔH, $\Delta\sigma_v$, B_f and M.

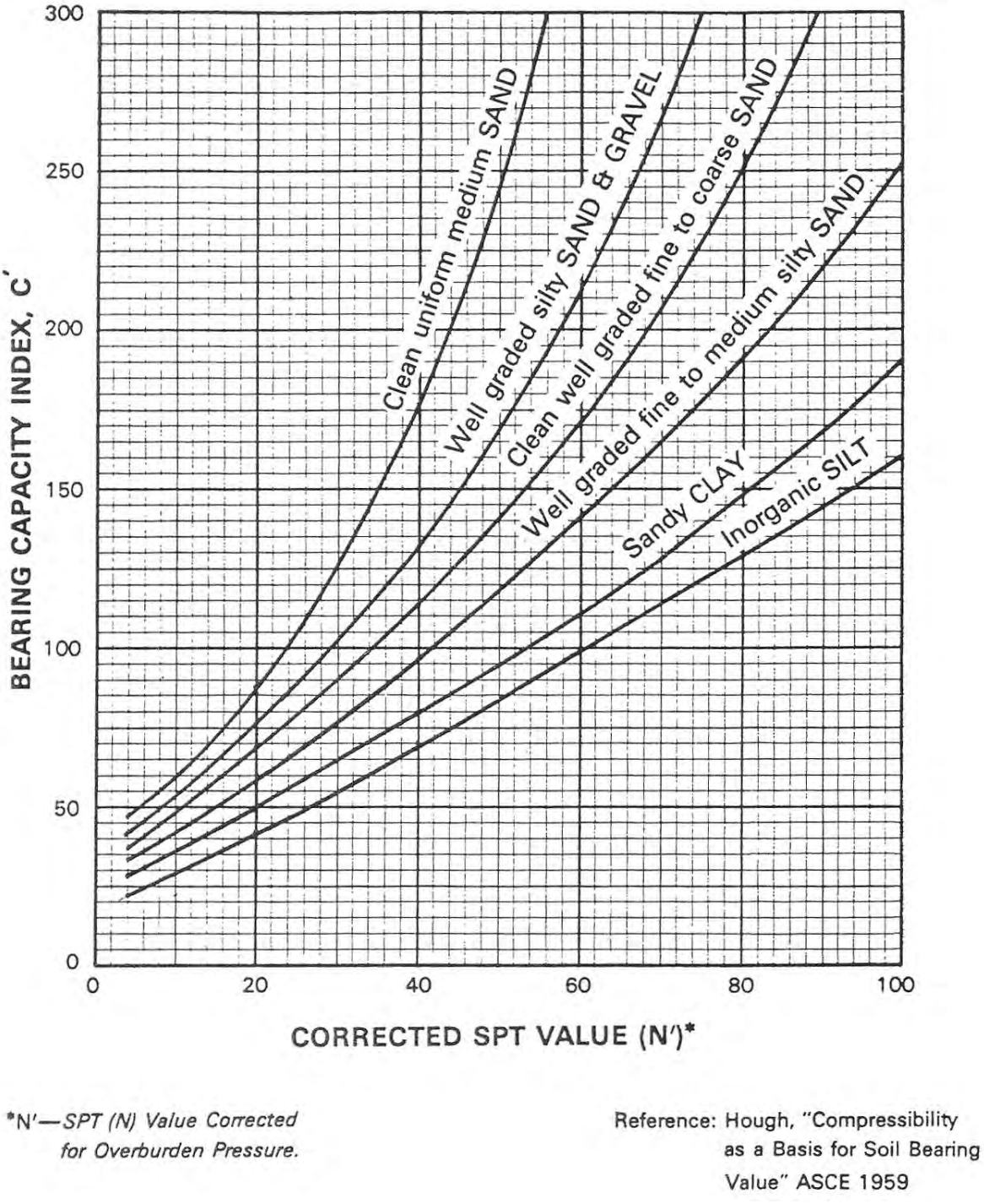


Figure 5-19: Bearing Capacity Index versus Corrected SPT
(Cheney & Chassie, 2000, modified from Hough, 1959)

Reference 3

Consolidation Settlement

5.15 Primary Consolidation Settlement Relationships

As mentioned before, consolidation settlement occurs over time in saturated clayey soils subjected to an increased load caused by construction of the foundation. (See Figure 5.29.) On the basis of the one-dimensional consolidation settlement equations given in Chapter 1, we write

$$S_{c(p)} = \int \varepsilon_z dz \tag{5.80}$$

where

ε_z = vertical strain

$$= \frac{\Delta e}{1 + e_o}$$

Δe = change of void ratio

$= f(\sigma'_o, \sigma'_c, \text{and } \Delta\sigma')$

So,

$$S_{c(p)} = \frac{C_c H_c}{1 + e_o} \log \frac{\sigma'_o + \Delta\sigma'_{av}}{\sigma'_o} \qquad \text{(for normally consolidated clays)} \tag{5.81}$$

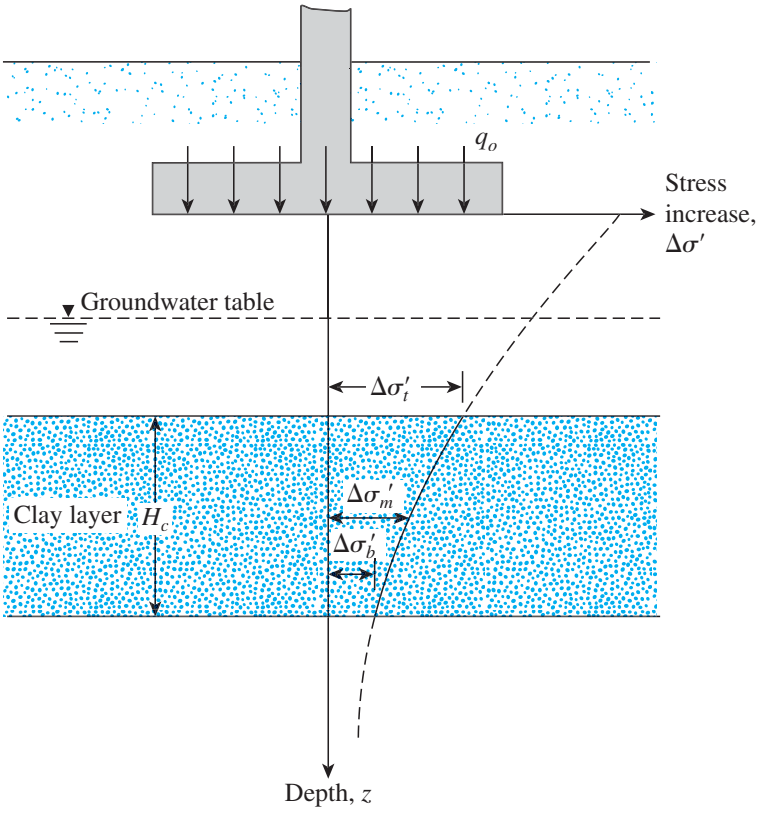


Figure 5.29 Consolidation settlement calculation

$$S_{c(p)} = \frac{C_s H_c}{1 + e_o} \log \frac{\sigma'_o + \Delta\sigma'_{av}}{\sigma'_o} \qquad \text{(for overconsolidated clays with } \sigma'_o + \Delta\sigma'_{av} < \sigma'_c\text{)} \tag{5.82}$$

$$S_{c(p)} = \frac{C_s H_c}{1 + e_o} \log \frac{\sigma'_c}{\sigma'_o} + \frac{C_c H_c}{1 + e_o} \log \frac{\sigma'_o + \Delta\sigma'_{av}}{\sigma'_c} \qquad \text{(for overconsolidated clays with } \sigma'_o < \sigma'_c < \sigma'_o + \Delta\sigma'_{av}\text{)} \tag{5.83}$$

where

σ'_o = average effective pressure on the clay layer before the construction of the foundation
$\Delta\sigma'_{av}$ = average increase in effective pressure on the clay layer caused by the construction of the foundation
σ'_c = preconsolidation pressure
e_o = initial void ratio of the clay layer
C_c = compression index
C_s = swelling index
H_c = thickness of the clay layer

The procedures for determining the compression and swelling indexes were discussed in Chapter 1.

Note that the increase in effective pressure, $\Delta\sigma'$, on the clay layer is not constant with depth: The magnitude of $\Delta\sigma'$ will decrease with the increase in depth measured from the bottom of the foundation. However, the average increase in pressure may be approximated by

$$\Delta\sigma'_{av} = \tfrac{1}{6}(\Delta\sigma'_t + 4\Delta\sigma'_m + \Delta\sigma'_b) \tag{5.84}$$

where $\Delta\sigma'_t$, $\Delta\sigma'_m$, and $\Delta\sigma'_b$ are, respectively, the effective pressure increases at the *top, middle,* and *bottom* of the clay layer that are caused by the construction of the foundation.

The method of determining the pressure increase caused by various types of foundation load using Boussinesq's solution is discussed in Sections 5.2 through 5.6. $\Delta\sigma'_{av}$ can also be directly obtained from the method presented in Section 5.5.

5.16 Three-Dimensional Effect on Primary Consolidation Settlement

The consolidation settlement calculation presented in the preceding section is based on Eqs. (1.61), (1.63), and (1.65). These equations, as shown in Chapter 1, are in turn based on one-dimensional laboratory consolidation tests. The underlying assumption is that the increase in pore water pressure, Δu, immediately after application of the load equals the increase in stress, $\Delta\sigma$, at any depth. In this case,

$$S_{c(p)-\text{oed}} = \int \frac{\Delta e}{1 + e_o} dz = \int m_v \Delta\sigma'_{(1)} dz$$

where

$S_{c(p)-\text{oed}}$ = consolidation settlement calculated by using Eqs. (1.61), (1.63), and (1.65)
$\Delta\sigma'_{(1)}$ = effective vertical stress increase
m_v = volume coefficient of compressibility (see Chapter 1)

Reference 6

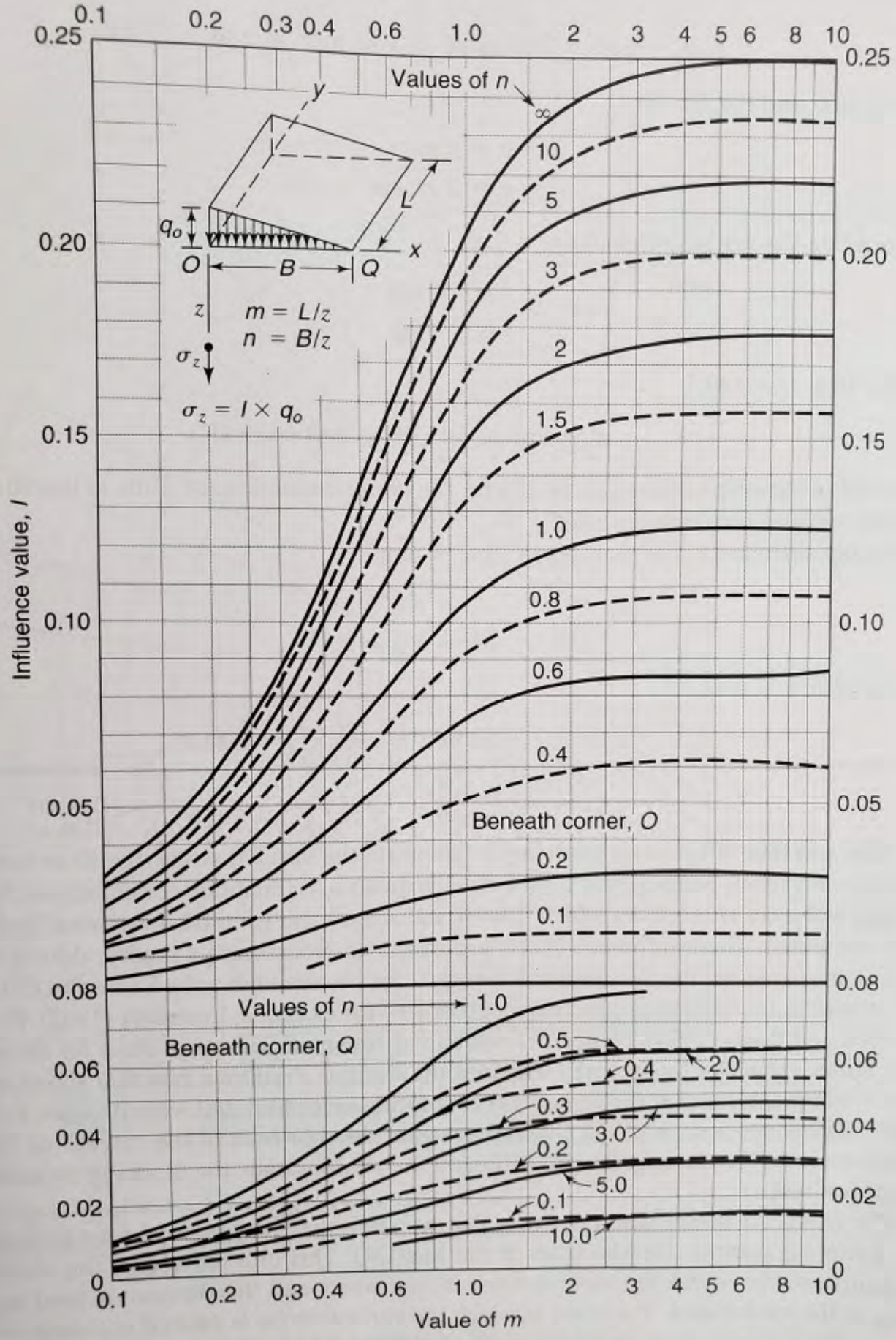


FIGURE 10.7 Influence values for vertical stress under the corners of a triangular load of limited length (after U.S. Navy, 1986).

GOLDER

CALCULATIONS

Date:	11/12/2019	**Made by:**	MEL
Project No.:	1669139	**Checked by:**	KAR
Subject:	Frost Depth Calculation	**Reviewed by:**	JDL
Project Short Title:	MaineDOT Brandy Brook Culvert, Gorham, ME		

OBJECTIVE

Determine the frost depth penetration depth in Gorham, ME.

METHOD

Use MaineDOT design methods for determining frost depth.

REFERENCES

1. MaineDOT (2018). "Bridge Design Guide", includes updates through (2018).
2. Golder Associates Inc. Geotechnical Boring Logs HB-GBB-205 and HB-GBB-305.
3. MaineDOT (2019). WIN 18821.00 Gorham Dradt PDR-PIC Plan Set, Received April 22, 2019.

ASSUMPTIONS

1. The culvert invert is at elevation 130.64 feet in the south and elevation 128.44 feet in the north. Based on boring logs HB-BGG-205 and HB-BGG-305, the invert will be founded within the clay layer. (Reference 3).

CALCULATION

Use Figure 5-1 (MaineDOT 2018) to determine the design freezing index in Gorham ME.

Design Freezing	1300	degree days

Water content within the soil below elevation 130.64 feet (culvert invert) for a maximum frost depth of 76.3 inches (from Table 5-1, MaineDOT 2018) based on the laboratory water data from HB-GBB-205 and HB-BGG-305 soils. Assume the water content is uniform over this culvert area. Also assume that subsurface is composed of 0.75 feet of coarse grained fill over the in situ clay deposit.

Determine the minimum and average water contents for assessing the range of possible frost depths within the clay layer.

Use Table 5-1 (MaineDOT 2018) with design freezing index and soil water content. Use linear interpolation to determine design value for fine grained soils

Assume same slope between w=30% and w=50% as slope between w=20% and w=30%

(Depth per given water content)

Index	**10%**	**20%**	**30%**	**40%**	**50%**
1300	*54.2*	*46.6*	*42.2*	*37.8*	*33.4*
	From Table 5-1 (MaineDOT 2018)			Interpreted as assumed	

Test Boring Designation[1]	Sample Number	Approximate Sample Elevation (ft)	Water Content (%)	Frost Depth (in)	Frost Depth (ft)	
HB-GBB-205	6D	136.8 - 134.8	34.9	-	-	
	8D	121.8 - 119.8	38.9			
HB-GBB-305	4D	134.4 - 132.4	29.0			
	1U	129.4 - 127.4	46.4			
	5D	124.4 - 122.4	41.9			
	minimum water content		29	42.6	3.6	maximum depth
	average water content		38	38.6	3.2	average depth

CONCLUSIONS

For the existing design conditions at the proposed culvert location a design frost depth of 43 inches or 3.6 feet should be used.

5.2 General

5.2.1 Frost

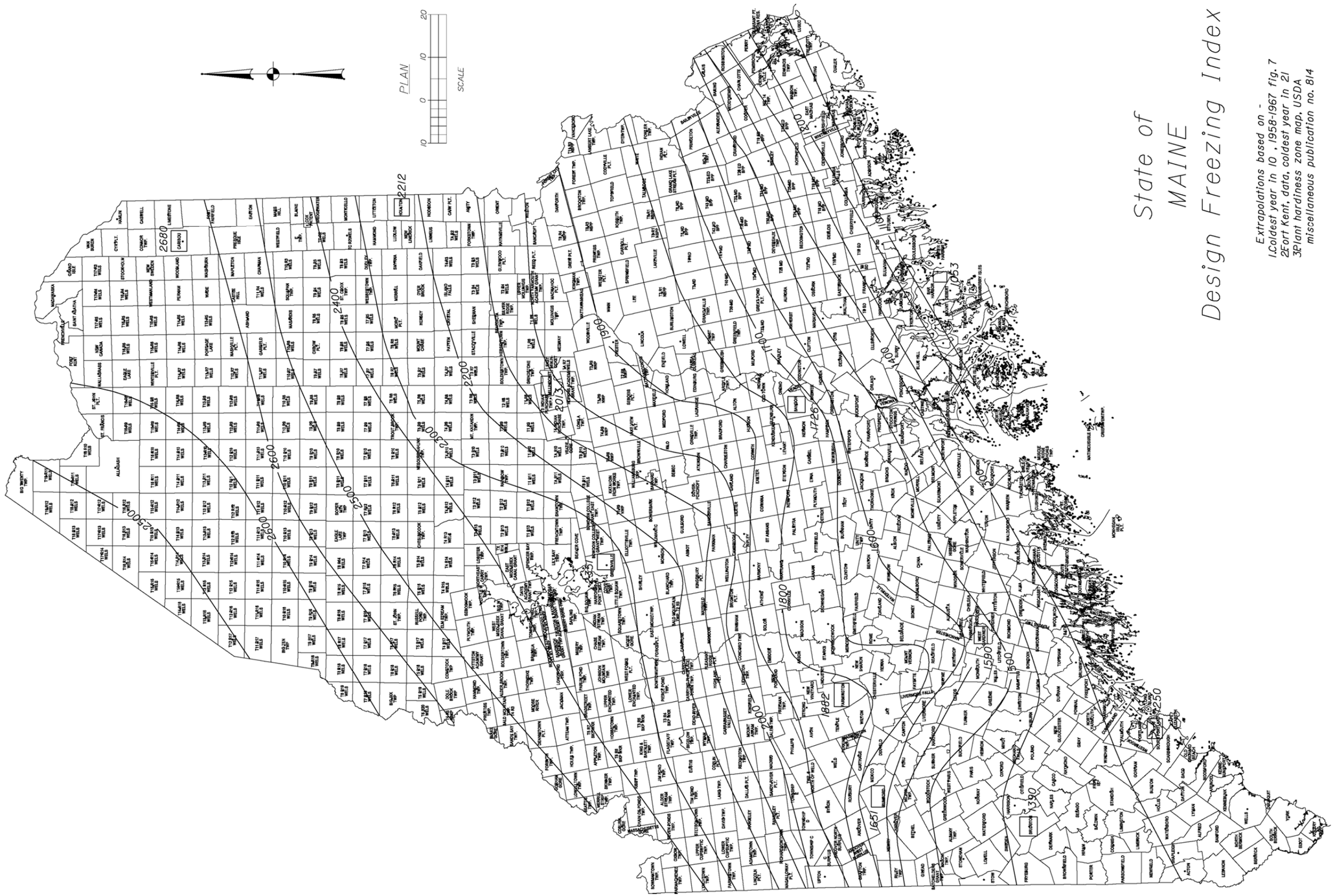
Any foundation placed on seasonally frozen soils must be embedded below the depth of frost penetration to provide adequate frost protection and to minimize the potential for freeze/thaw movements. Fine-grained soils with low cohesion tend to be most frost susceptible. Soils containing a high percentage of particles smaller than the No. 200 sieve also tend to promote frost penetration.

In order to estimate the depth of frost penetration at a site, Table 5-1 has been developed using the Modified Berggren equation and Figure 5-1 Maine Design Freezing Index Map. The use of Table 5-1 assumes site specific, uniform soil conditions where the Geotechnical Designer has evaluated subsurface conditions. Coarse-grained soils are defined as soils with sand as the major constituent. Fine-grained soils are those having silt and/or clay as the major constituent. If the make-up of the soil is not easily discerned, consult the Geotechnical Designer for assistance. In the event that specific site soil conditions vary, the depth of frost penetration should be calculated by the Geotechnical Designer.

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

Notes: 1. w = water content
2. Where the Freezing Index and/or water content is between the presented values, linear interpretation may be used to determine the frost penetration.



State of MAINE
Design Freezing Index

Extrapolations based on -
1.Coldest year in 10 , 1958-1967 fig. 7
2Fort Kent, data, coldest year in 21
3Plant hardiness zone map, USDA
miscellaneous publication no. 814

Figure 5-1 Maine Design Freezing Index Map

Example 5-1 illustrates how to use Table 5-1 and Figure 5-1 to determine the depth of frost penetration:

Example 5-1 Depth of Frost Penetration

Given: Site location is Freeport, Maine
Soil conditions: Silty fine to coarse Sand

Step 1. From Figure 5-1 Design Freezing Index = 1300 degree-days
Step 2. From laboratory results: soil water content = 28% and major constituent Sand
Step 3. From Table 5-1: Depth of frost penetration = 56 inches = 4.7 feet

Spread footings founded on bedrock require no minimum embedment depth. Pile supported footings will be embedded for frost protection. The minimum depth of embedment will be calculated using the techniques discussed in Example 5-1. Pile supported integral abutments will be embedded no less than 4.0 feet for frost protection.

Riprap is not to be considered as contributing to the overall thickness of soils required for frost protection.

The final depth of footing embedment may be controlled by the calculated scour depth and be deeper than the depth required for frost protection. Refer to Section 2.3.11 Scour for information regarding scour depth.

5.2.2 Seal Cofferdams

Seal cofferdams are used when a substructure unit must be constructed with its foundation more than 4 feet below the water table, to counteract the buoyant forces produced during pumping of the cofferdam. Once the cofferdam is constructed, the seal is placed under water and water is then pumped out of the cofferdam. This provides a dry platform for construction of the spread footing, or in the case of a pile foundation, the distribution slab. When a seal is needed, the top of footing or distribution slab is located approximately at streambed, and the depth of seal is calculated based upon the buoyancy of the concrete under the expected water surface during construction. The following formula can be used:

$$145 \cdot y = 62.4 \cdot z$$

where:

145 lb/ft^3 =	unit weight of concrete
62.4 lb/ft^3 =	unit weight of water
y =	the depth of seal from top of seal to bottom of seal
z =	the depth of water from water surface to bottom of seal



golder.com