Stantec

Stantec Consulting Services Inc.
1500 Lake Shore Dr Suite 100, Columbus, OH 43204

June 24, 2024
File: 173608714

Mr. Brandon McNeal, PE
Senior Structural Engineer
Stantec Consulting Services Inc.
1500 Lake Shore Drive, Suite 100
Columbus, Ohio 43204

Reference: Report of Structure Foundation Exploration – FINAL
Bridge No. LAW-7-0370 L&R (PID 75923)
State Route 7 over County Road 104

Dear Mr. McNeal:

Stantec Consulting Services Inc. (Stantec) has completed a geotechnical report for the referenced project based on geotechnical data collected by BBC&M Engineering, Inc., dated September 2002, and a supplemental CPT Soundings Report by ODOT, dated November 2021. The enclosed geotechnical report contains a brief description of the site, apparent geology, the scope of work performed, and recommendations for the design and construction of the bridge.

OGE comments from May 2, 2024 on the previous submittal of this report and Stantec responses to these comments follow this cover letter. If you have any questions or need more information, please contact our office.

Respectfully,

STANTEC CONSULTING SERVICES INC.

Darren Pleiman

Darren Pleiman, PE
Senior Project Engineer
Tel: (513) 827-7837

E M Kistner

Eric M. Kistner, PE
Principal
Tel: (513) 842-8213

c. Mr. Thomas C. Morman, PE - Stantec

STATE OF OHIO
ERIC M. KISTNER
E-65507
6/24/24
REGISTERED
PROFESSIONAL ENGINEER

INTEROFFICE COMMUNICATION

To: Thomas M. Barnitz, P.E., Planning and Engineering, District 9
COPY: Justin A. Gardner, P.E., District 9 Geotechnical Engineer
FROM: Amal Mohi, P.E., Office of Geotechnical Engineering
DATE: May 2, 2024
SUBJECT: LAW-7-0370 (B16), PID 75923, Stage 3 Geotechnical Review

We have completed our review of the Stage 3 Submission, received on April 8, 2024 for the subject project. We were supplied with the following documents for this review:

I. Stage 3 Plan Set – Bridge sheets only, prepared by Stantec, dated March 2024.
II. Structure Foundation Exploration (SFE) Report- Bridge No. LAW-7-0370, prepared by Stantec, dated August 25, 2022.

To assist our review, we have consulted the previously submitted Disposition of Comments to our Stage 2 Review, prepared by Stantec, received on August 3, 2022, for the subject project. We have included our Stage 2 Comments and the Consultant Disposition along with our responses for the comments that are still outstanding. For consistency, we have used the same comment numbers from our previous IOCs.

I. DISPOSITION OF COMMENTS:

5. ESTIMATED QUANTITIES, WALL 1 AND WALL 2: since this is a fill project, we don't think that "Item 503 Cofferdams and Excavation Bracing" is required. Determine the use of this item or delete from estimate.

   Stantec Disposition: Item has been removed.

   OGE Response: This comment has not been addressed.

   Stantec: Concur. Item has been removed.

STAGE 2 RESUBMISSION REVIEW:

Our comments regarding the Stage 2 submittal (items II through III on page 1 of this IOC) are presented as follows, under headed sections for each of the submitted documents that is still outstanding from the previous submittal. We have continued numbering our comments from our previous review.

I. STAGE 3 PLAN SET – BRIDGE:

17. Wall 1 and 2 Elevation, Sheet 26, Rear Abutment Detail, Sheet 7, and Forward Abutment Detail, Sheet 9: do not use the term "*strap length*" with regards to the proposed temporary MSE walls. It is very likely that geogrids and not metal straps would be used to reinforce these walls. Use the term "soil reinforcement" per ODOT SS 840.

    Stantec: Concur. References to "strap length" have been replaced with "soil reinforcement".

II. SFE REPORT- BRIDGE NO. LAW-7-0370:

18. In accordance with the GDM Section 1304.1.1: For piles installed within an MSE abutment, place the water level in the analyses at the top of the leveling pad elevation, where the MSE wall drain is to be installed. Rectify this.

    Stantec: The water level was conservatively modelled 6 inches above the top of the levelling pad. When discussed during a conference call held on March 23, 2024, it was decided that this was satisfactory.

19. Since the Bearing Resistance checks using MSEW analyses have very low CDR values, in some cases between 0.18 and 0.29, and those using limit equilibrium analyses have CDR values between to 1.21 to 1.41, this seems to indicate that the soil parameters used in MSEW are very low and could be minimum values instead of averages, which is not acceptable. Keep in mind that MSEW analyses can only be used in a uniform soil profile or using averaged soil strength values. Fix this.

    Stantec: When discussed during the March 23 conference call, ODOT agreed with the use of the limit equilibrium method to evaluate bearing capacity, but instructed Stantec to remove MSEW analysis results showing unacceptable CDR values. Stantec agreed to this approach and updated the appendices accordingly.

20. In the MSEW analyses at the top and bottom of the foundation preparation layer, the MSE Wall Heights were assumed to be 2.00 ft different between the two different analyses. In accordance with the BDM Figure 201-3, a minimum of 1 ft of Item 203, Granular Material, Type C must be installed below the leveling pad, also see the BDM Section 307.4.F. Per the BDM Section 307.4, "Determine sliding resistance and bearing resistance of MSE wall foundations both at the top and bottom of the foundation preparation layer." Therefore, the notional height (h) is measured from either the top or bottom of the foundation preparation layer, depending on at which level the analysis is being performed. For these analyses, the height is measured up to the profile grade elevation at the face of the wall, per SS840.04.A.2. This makes the difference in height typically 1.00 ft between the analysis performed at the top and bottom of the foundation preparation layer. Fix this.

    Stantec: Does not concur. In the analyses of the MSE walls it was determined that an undercut and additional 1-ft of Type C material (total of 2 feet) improved the overall results of the limit equilibrium bearing analyses. This additional 1-ft of Type C was incorporated into the overall height of the wall for the top and bottom checks. In the March 23 conference call, ODOT agreed that the analysis should incorporate the additional Type C material thickness.

21. Rear and Forward Abutment, Bridge: For the Final MSE Wall, two bearing analyses have been performed: 1. Short Term (Undrained Condition) and 2. Long Term (Drained Condition). Both analyses were performed at the top of the foundation preparation layer. Also perform bearing and sliding resistance checks at the bottom of the foundation preparation layer, which should produce more critical conditions due to the increased height and foundation soils weaker than the foundation preparation layer. A sliding resistance check at the top of the foundation preparation layer, although it can be done, is predicted to produce less critical results.

    Stantec: When discussed during the March 23 conference call, ODOT indicated that they were not that concerned with the sliding and bearing on top of the foundation preparation layer based on the relatively high internal friction angle (34 degrees) of the foundation prep material and that focus should be directed to the sliding and bearing at the bottom of the foundation preparation layer. For the Temporary Walls, Stantec performed top and bottom of foundation preparation analyses for both short and long term conditions. For the Final Walls, Stantec performed bottom of foundation preparation analyses for both the short and long term conditions. In comparing the results for the respective Temp and Final wall analyses, Stantec concluded that the bottom of foundation preparation analyses were the more critical analysis for the Final Walls.

22. Forward Abutment, for the Temporary MSE Wall, Short Term (Undrained Condition) and Long Term (Drained Condition), analyses performed at the top of the foundation preparation layer, change the foundation soil unit weight from 120 pcf to 130 pcf, per the BDM Table 307-1 for MSE Foundation Preparation layer. Fix this.

    Stantec: Concur. Corrections to the unit weights were made.

23. Forward Abutment, Temporary MSE Wall, at top of preparation layer: MSEW analyses performed at report page numbers 169 and 219 are identical even though the analysis starting at page 169 is labeled Short Term (Undrained) and the analysis starting at page 219 is labeled Long Term (Drained). Review this and delete one of them.

    Stantec: Does not concur. Both analyses are essentially the same due to the bearing material (Type C) with a phi angle of 34 degrees, which does not change from Short Term (Undrained) to Long Term (Drained) conditions. Analysis is left within the appendix to provide continuity and completeness to the design process. This was explained to ODOT in the March 23 conference call with agreement to leave in the analyses.

24. Rear Abutment, Temporary MSE Wall, at top of preparation layer: MSEW analyses performed at report page numbers 179 and 230 are identical even though the analysis starting at page 179 is labeled Short Term (Undrained) and the analysis starting at page 230 is labeled Long Term (Drained). Review this and delete one of them.

Stantec: Does not concur. Both analyses are essentially the same due to the bearing material, Type C with a phi angle of 34 degrees, which does not change from Short Term (Undrained) to Long Term (Drained) conditions. Analysis is left within the appendix to provide continuity and consistency to the design process. This was explained to ODOT in the March 23 conference call with agreement to leave in the analyses.

25. Rear and Forward Abutments, Wing Walls: No sliding resistance checks have been performed at the top or the bottom of the foundation preparation layer. At a minimum, perform sliding resistance check at the bottom of the foundation preparation layer (see comment 21). Rectify this.

    Stantec: Concur. Sliding and Bearing Resistance checks at the top and bottom of the foundation preparation were performed for the Temp Wing Walls.

26. Rear and Forward Abutments, Wing Walls: All bearing resistance checks have been performed at the top of the foundation preparation layer. Also perform bearing resistance checks at the bottom of the foundation preparation layer, which we predict to produce more critical analyses. Rectify this.

    Stantec: Concur. Sliding and Bearing Resistance checks at the bottom of the foundation preparation layer were performed for both the Temp and Final Walls.

Nothing in these comments is to be construed as authorizing extra work for which additional compensation may be claimed. If you believe that these comments require work outside the limits of the Scope of Services for this project, please contact this office before proceeding.

If you have any questions, please feel free to contact either myself at 614-387-2379, or Alex Dettloff, at 614-275-1308.

Thank you,
AM

PC: Reading File, File
Attachments: None.

Report of Structure Foundation Exploration
Bridge No. LAW-7-0370
(PID No. 75923)

State Route 7 over CR 104
Lawrence County, Ohio

Stantec

June 24, 2024

Table of Contents

EXECUTIVE SUMMARY II

1.0 INTRODUCTION 1

2.0 GEOLOGY AND OBSERVATIONS OF THE PROJECT 1

3.0 EXPLORATION 3

4.0 FINDINGS 4

5.0 ANALYSIS AND RECOMMENDATIONS 4
5.1 GENERAL 4
5.2 DRIVEN PILE RECOMMENDATIONS 5
5.3 MSE WALLS 7

LIST OF TABLES

Table 1. Exploration Location Information; LAW-7-0370 3
Table 2. Summary of Borings; LAW-7-0370 4
Table 3. Estimated Pile Elevation Information; LAW-7-0370 6
Table 4. Rear Abutment Soil Parameters 8
Table 5. Forward Abutment Soil Parameters 9
Table 6. Summary of External Stability Analysis – Short Term (Undrained), Temporary Facing 10
Table 7. Summary of External Stability Analysis – Long Term (Drained), Temporary Facing....................11
Table 8. Summary of External Stability Analysis – Short Term (Undrained), Final Facing....................12
Table 9. Summary of External Stability Analysis – Long Term (Drained), Final Facing........13

LIST OF FIGURES

Figure 1. Aerial Map of Bridge Location, LAW-7-0370.................... 2

LIST OF APPENDICES

A Bridge Site Plan
B September 2002 BBC&M Report and Stantec Boring Log
C ODOT CPT Soundings Report, November 17, 2021
D Supplemental CPT Analysis Spreadsheets
E Settlement Analysis
F MSE Wall Analyses
G Applicable Engineering Checklists

Executive Summary

Stantec Consulting Services Inc. (Stantec) has been retained by the Ohio Department of Transportation (ODOT) District 9 to perform design of the LAW-7-2.17 Chesapeake Bypass project. The proposed State Route 7 Bridge over County Road 104 (LAW-7-0370) is a part of this overall project. The project was initially designed in the early 2000's and is currently being redesigned with horizontal and vertical grade adjustments and structural changes. A geotechnical exploration was performed by BBC&M Engineering (BBC&M) for the referenced bridge during the initial design with the field exploration being performed from October 1998 to May 2002. A geotechnical report was submitted from BBC&M to RD Zande & Associates, Inc. (now Stantec) dated September 2002 and titled "Subsurface Investigation, LAW-7-2.17 (Chesapeake Bypass), SR 7 Bridge over CR 104 (Booth-Eaton Rd.), Lawrence County, Ohio". In addition, ODOT provided a supplemental exploration report, Cone Penetration Test Soundings Report, dated November 17, 2021.

This structure foundation exploration report prepared by Stantec summarizes the results from the previous BBC&M report and updates the recommendations, where necessary, according to current design standards and design changes. The current design site plan for the bridge is included in Appendix A, and the BBC&M report from September 2002 is provided in Appendix B. This bridge was initially planned to be a three-span bridge, as shown in the BBC&M report. The design was then changed to a single-span bridge with the abutments supported by mechanically stabilized embankment (MSE) walls, which was the focus of Stantec's previously submitted draft version of this report. The current design consists of a bridge supported by steel H-piles driven to refusal on bedrock with MSE wall approaches. The MSE walls will bear upon existing soils or structural fill and the piles supporting the bridge will be sleeved through the MSE wall fill.

Four borings were advanced at the site by BBC&M, with surface elevations ranging from 552 to 577 feet. Bedrock was encountered at elevations ranging from 509 to 519 feet. The bedrock was described as alternating layers of shale, siltstone, limestone, and coal. One additional boring was advanced near the bridge location by Stantec (surface Elevation 565.5 feet). Bedrock, described as mudstone, was encountered in this boring at an elevation of 520.2 feet. ODOT performed four CPT test soundings in the vicinity of the bridge to supplement the existing test boring information.

It is recommended that the substructures of the bridge be supported by steel H-piles driven to refusal on bedrock. The estimated pile lengths are 75 and 80 feet for the west and east abutments, respectively. Based upon the results of the settlement and downdrag analysis for the structure, a waiting period of approximately 1 month is recommended between the completion of the MSE wall and application of the abutment surcharge and the installation of the piles. It is estimated that sufficient settlement will have occurred during that waiting period that no downdrag loads will develop along the piles for the structure. For the MSE walls an additional 1-ft undercut and replacement with Type C foundation preparation material is required to provide stability to the MSE walls.

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec) has been retained by the Ohio Department of Transportation (ODOT) District 9 to perform design of the LAW-7-2.17 Chesapeake Bypass project. The State Route 7 Bridge over County Road 104 (LAW-7-0370) is a part of this overall project. The project was initially designed in the early 2000's and is currently being redesigned with horizontal and vertical grade adjustments and structural changes. A geotechnical exploration was performed by BBC&M Engineering (BBC&M) for the referenced bridge during the initial design with the field exploration being performed from October 1998 to May 2002. A geotechnical report was submitted from BBC&M to RD Zande & Associates, Inc. (now Stantec) dated July 2002 and titled "Subsurface Investigation, LAW-7-2.17 (Chesapeake Bypass), SR 7 Bridge over CR 104 (Booth-Eaton Rd.), Lawrence County, Ohio".

This bridge was initially planned to be a three-span bridge, as shown in the BBC&M report. The design was then changed to a single-span bridge with the abutments supported by mechanically stabilized embankment (MSE) walls then changed again to a precast reinforced concrete round section structure bearing on pedestal walls, which was the focus of Stantec's previously submitted draft version of this report. The current design consists of a bridge supported by steel H-piles driven to refusal on bedrock with MSE wall approaches. The MSE walls will bear upon existing soils or structural fill and the piles supporting the bridge will be sleeved through the MSE wall fill.

This structure foundation exploration report summarizes the results from the previous BBC&M report and updates the recommendations, where necessary, according to current design standards and design changes. The current design site plan for the bridge is included in Appendix A, and the BBC&M report from September 2002 is provided in Appendix B. Appendix C presents the results of the supplemental ODOT Exploration Report and Appendix D presents additional CPT analyses and soil parameter derivation. The settlement and MSE wall analyses are presented in Appendix E and F. The ODOT Geotechnical Engineering Design Checklists are included in Appendix G.

2.0 GEOLOGY AND OBSERVATIONS OF THE PROJECT

The Physiographic Regions of Ohio Map (Ohio Division of Geological Survey, 1998) shows that the site is near the boundary of the Ironton and Marietta Plateaus within the Appalachian Plateau. The Ironton Plateau is described as a moderately high relief dissected plateau. Coarse grained, coal-bearing rock sequences are common, along with lacustrine clay-filled Teays River valley remnants. The bedrock includes Pennsylvanian-age sandstones, siltstones, shales, and coal from the Pottsville, Allegheny, and Conemaugh Groups. The Marietta Plateau is a dissected plateau of mostly fine-grained rocks. Red shales and red soils are relatively common, along with landslides. The bedrock includes Pennsylvanian-age Upper Conemaugh Group through Permian-age Dunkard Group cyclic sequences of red and gray shales, siltstones, sandstones, limestones, and coals. Figure 1 shows the site location on an aerial map with the proposed roadway configuration.

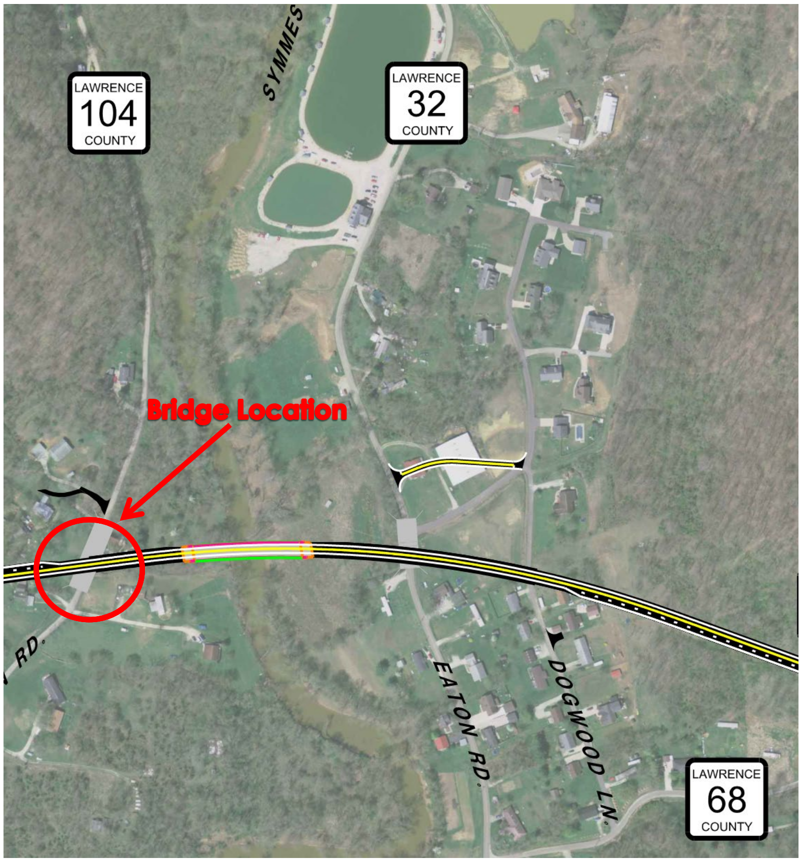


Figure 1. Aerial Map of Bridge Location, LAW-7-0370

The Quaternary Geology of Ohio Map (ODGS, 1999) indicates that the site is underlain by Cenozoic-age colluvium derived from local bedrock and includes scattered areas of residuum, weathered material, landslides, and bedrock outcrop. Alluvium and alluvial terraces can also be encountered along streams and creeks. According to the Web Soil Survey (NRCS), the site is underlain by many soil types, but predominantly those of the Upshur-Gilpin complex (UgF) and Vandalia silty clay loam unit (VaD3). The UgF complex consists of 40 to 70 percent slopes, while the VaD3 unit consists of 15 to 25 percent, severely eroded slopes. Both units would classify as A-6 according to the American Association of State Highway and Transportation Officials (AASHTO) method.

The Bedrock Geologic Map of Ohio (ODGS, 2006) shows that the site is underlain by Pennsylvanian-age sedimentary rocks, mainly shale, sandstone, siltstone, mudstone, limestone, and some coal. The Reconnaissance Bedrock Geology of the Huntington, Ohio Quadrangle Map (ODNR, 1996) indicates that the site is underlain by bedrock of the Pennsylvanian-age Conemaugh Formations. This formation consists of alternating cycles of shale, siltstone, limestone, sandstone, mudstone, and coal. They are described as nonbedded to massive, with colors of gray, green, red, brown, and black. The Conemaugh Formation is further described as containing multicolored mudstones and having rapid vertical and horizontal changes of rock types.

Lawrence County is known for being susceptible to landslides and slope failures because of the hilly terrain. Along existing side roads through the LAW-7-2.17 corridor, signs of failures, such as repaired pavement, pavement cracking, pile and lagging retaining walls, and leaning guard rail sections and utility poles were observed during the exploration, however, no specific signs of slope instability were observed in the immediate site vicinity.

A review of the Ohio Karst Areas map (ODNR) indicates that no known karst features are located near the project limits. No oil or gas wells were observed during the field reconnaissance. The Ohio Geological Survey Abandoned Underground Mine Locator website application indicates that there are no abandoned underground coal mines in the project vicinity.

3.0 EXPLORATION

Four borings were advanced at the site by BBC&M in the vicinity of the bridge, with one additional boring performed by Stantec. The borings were drilled using 3¼-inch diameter hollow-stem augers powered by an ATV-mounted drill rig. Standard penetration test (SPT) samples were obtained at 2.5-foot intervals. It is assumed that BBC&M SPT sampling was performed with a cathead-operated SPT hammer or an uncalibrated automatic hammer. The Stantec SPT sampling was performed with a calibrated automatic hammer with an energy ratio (ER) of 85.9 percent. Upon encountering bedrock, approximately 5 to 10 feet of NXM or NQ-size rock core was obtained in all borings. ODOT performed four CPT test soundings in the vicinity of the bridge to supplement the existing test boring information. Three of the four CPT soundings were extended to apparent refusal (depths of 44.5 to 50.4 feet).

Table 1 shows the locations of the borings and soundings. The stations and offsets in the following table are based on current project stationing for State Route 7, which is different than the stationing provided in the 2002 BBC&M report included in Appendix B.

Table 1. Exploration Location Information; LAW-7-0370

Exploration No.	Station (feet)	Offset (feet)	Nearest Substructure
B16-314-0-99	195+10	40 Left	West Abutment
B16-315-0-99	195+61	Centerline	West Abutment
B-2BP1-0-00	195+76	98 Right	East Abutment
B-2EBP1-0-00	196+94	12 Right	East Abutment
B-009-1-12	196+24	100 Left	West Abutment
C-009-2-21	195+71	65 Right	East Abutment
C-009-3-21	196+32	17 Left	West Abutment
C-009-4-21	196+29	21 Left	West Abutment
C-009-5-21	196+26	11 Left	West Abutment

B – Boring, C – CPT Sounding

4.0 FINDINGS

Boring logs and detailed descriptions of soils and bedrock encountered are included in Appendices B and C. In summary, overburden soils were identified primarily as silt and clay (A-6a) with lesser amounts of silty clay (A-6b), clay (A-7-6), sandy silt (A-4a), coarse and fine sand (A-3a), gravel with sand, silt, and clay (A-2-4) and gravel with sand (A-1-b). SPT N-values varied from 0 to over 50 blows per foot, with an average of approximately 20 blows per foot. Water contents ranged from 10 to 25 percent, with an average of 17 percent. Atterberg limit testing performed on selected fine-grained samples yielded liquid limits ranging from 24 to 44 and plasticity indices varying from 5 to 19. In general, the CPT soundings and test borings appear to be similar in stratigraphy. ODOT's supplemental exploration report is included in Appendix C.

Bedrock was encountered at elevations ranging from approximately 509 to 520 feet. The bedrock was described as shale interbedded with siltstone (Boring B16-314), shale (Boring B16-315), limestone/shale/coal (Boring B-2BP1), shale/coal (Boring B2EBP1-215), and mudstone (B-009-1-12). Table 2 presents a summary of the borings.

Table 2. Summary of Borings; LAW-7-0370

Boring No.	Surface Elevation	Depth to Bedrock	Top of Rock Elevation	Bottom of Boring Elevation
B16-314-0-99	577[1]	58.0	519[1]	513.5[1]
B16-315-0-99	566[1]	49.0	517[1]	511[1]
B-2BP1-0-00	567.6	52.5	515.1	501.1
B-2EBP1-0-00	552[1]	43.0	509[1]	501[1]
B-009-1-12	565.5	45.3	520.2	506.8

Note: All values shown with feet as unit of measure.

[1] Elevations are noted as being approximate on the boring logs.

5.0 ANALYSIS AND RECOMMENDATIONS

5.1 GENERAL

5.1.1. The conclusions and recommendations presented herein are based on information collected from the borings performed during this and previous explorations using that degree of care and skill ordinarily exercised under similar circumstances by competent members of the engineering profession. CPT soundings were performed by ODOT. No warranties can be made regarding the continuity of conditions between borings and soundings.

5.1.2. The proposed design of the structure consists of a pile supported single span bridge with MSE approaches and wing walls. The piles (HP 10x42) will be sleeved through the reinforced fill of the MSE wall and driven to the underlying bedrock.

5.1.3. Stability analyses performed by Stantec generally yielded unacceptable factors of safety for 2H:1V embankment slopes. The analyses yielded acceptable factors of safety for 3H:1V slopes, provided that a controlled rate of embankment construction is used. Details of these analyses are provided under a separate cover in the "Report of Roadway Exploration" for the project. This controlled rate of construction should apply to the embankments adjacent to the proposed MSE walls.

5.1.4. It is recommended that a free-draining granular material be used for backfill behind the concrete abutment and wingwalls to reduce the potential for static water pressures to build up behind the structures. Drainage of the material should be provided by placing a perforated pipe at the bottom of the pile cap/wall footing leading to existing drainage to transport water away from the structure.

5.1.5. In accordance with ODOT's Seismic Design Policy (2016) and AASHTO 3.10.3.1 a seismic analysis of the subsurface conditions based on the test borings was performed to evaluate the Site Class. The shear wave velocities for the overburden soils were derived from the CPT data and are presented on the spreadsheets in Appendix D. Based on the CPT data provided in the ODOT soundings an average shear wave velocity of about 925 ft/sec was determined for the overburden soils above the bedrock. The bedrock varies from shale to sandstone. Based on various literature sources the shear wave velocity in rock can range significantly (e.g., 600 to 8000 ft/sec) depending on the rock type. Stantec used a value of 1500 ft/sec for a shale (conservative) and combined with the shear wave velocity for the overburden the weighted average over a depth of 100 feet is about 1212 ft/sec. Based on Table 3.10.3.1-1 Site Class Definitions, an average V_S between 1200 and 2500 ft/sec results in Site Class C. Based on the figures in AASHTO 3.10.2.1 the values for PGA, S_S, and S_1 are 0.05g, 0.11g, and 0.044g, respectively.

5.2 DRIVEN PILE RECOMMENDATIONS

5.2.1. It is recommended that the substructures of the bridge be supported by steel H-piles driven to refusal on bedrock. According to the ODOT Bridge Design Manual (BDM), tip and side resistance should be calculated for deep foundations. Since the piles for this structure are end bearing, any side resistance from the soil overburden is ignored. Based upon the results of the unconfined compressive strength tests performed on bedrock samples collected for this project, an average strength of the shale bedrock is 246 tons per square foot. Based upon this, a calculated tip resistance of 3.4 kips per square inch is recommended for design of the foundations.

There is a potential for downdrag loading on the piles based upon the calculated settlement, as discussed in Section 5.2.3 below. However, it is recommended that a waiting period after MSE wall construction be planned prior to driving the abutment piles to reduce the potential for downdrag.

The estimated pile tip elevations and pile lengths are provided in Table 3. The estimated pile tip elevations are equal to where bedrock coring began in the borings located closest to the substructure unit. The estimated pile lengths were rounded up to the nearest 5-foot interval.

Table 3. Estimated Pile Elevation Information; LAW-7-0370

Substructure (Nearest Boring)	Top of Pile Elevation	Estimated Top of Bedrock Elevation	Estimated Pile Tip Elevation	Estimated Pile Length
Rear Abutment (B16-315-0-99)	588.4	517.0	516.0	75
Forward Abutment (B2EBP1-215-0-00)	585.2	509.0	508.0	80

Note: All values shown with feet as unit of measure.

5.2.2. Because the predominate bedrock type is shale, it is recommended that steel pile points not be used, according to the ODOT Bridge Design Manual Section 305.3.5.6.

5.2.3. A settlement analysis was performed for the approaches to determine the potential for development of downdrag forces on the driven piles at the abutment walls. The modeling program Settle3D v. 5.001 (2019) was used to model the MSE walls abutment and calculate the consolidation and immediate settlement. An analysis was performed, using the eastern/forward abutment as the design case. The total settlement is estimated to be about 9 to 10 inches.

Settlement was also estimated using the CPT data and the Constrained Modulus Method to determine consolidation settlement. This method yielded total settlement values that were less than the Settle3D analysis of 9 to 10 inches. Stantec recommends using the more conservative settlement amount of 9 to 10 inches.

Stantec also reviewed the Coefficient of Consolidation (C_v) values derived from the CPT data. Based on a comparison of the CPT-derived C_v and the C_v value from the consolidation test the CPT-derived C_v is more than twice the consolidation value. This would lead to a significantly faster time-rate of settlement. Stantec recommends using the more conservative consolidation test C_v value to determine the time-rate for consolidation.

The plan is to mitigate downdrag before driving piles. The "full loading" case includes the MSE walls and fill behind the concrete abutment walls. Since the concrete abutment walls can't be constructed until the piles are driven a surcharge load consisting of soil fill or stacked New Jersey barriers equivalent to the proposed fill above the MSE wall must be temporarily constructed. Once the consolidation settlement has occurred then the temporary load can be removed, the piles driven, and the abutment construction completed. The Settle3D output is provided in Appendix E. This preloading configuration should mitigate the need to design the bridge piling for downdrag forces.

The material properties for the settlement analyses were developed from the results of one-dimensional laboratory consolidation tests performed on undisturbed soil samples obtained from the alignment. The results of the consolidation tests are also included in Appendix E.

A time-rate of consolidation analysis was performed to determine a waiting period between end of embankment construction and pile installation necessary to reduce, or eliminate, downdrag forces on the piles. Based upon the results of the analysis, it is recommended that a waiting period of approximately 1 months (30 days) be used from end of MSE wall construction and temporary surcharge application to installation of piles. However, ODOT typically uses a minimum consolidation time of 3-months. After the waiting period, it is estimated that sufficient settlement will have occurred to eliminate the downdrag potential at the abutment locations.

Settlement platforms should be installed on the natural subgrade soils prior to MSE wall construction at the substructure locations, as specified in ODOT Geotechnical Bulletin 4, Section 7. The exact locations should be determined by the engineer on site, but it is recommended that the instrumentation be placed within the MSE wall footprint and within a few feet of the pile sleeves. A minimum of 2 settlement platforms should be installed per abutment.

The reading of the settlement platforms should be performed in accordance with Geotechnical Bulletin 4 “Guidelines for the Use of Geotechnical Instrumentation”. Settlement readings should begin with an initial reading upon placement of the platform to record the elevation prior to embankment construction. Settlement platforms are typically read weekly during both times of construction and waiting periods. The reading frequency may be increased once the consolidation curve begins to level off and the time to restart construction draws near. The engineer should be responsible for evaluation of the actual settlement data. Installation of the abutment piles should not begin until the engineer has determined that an adequate amount of consolidation of the foundation and embankment soils has occurred.

5.3 MSE WALLS

Based on the preliminary plans, Mechanically Stabilized Earth (MSE) retaining walls are planned for the two U-shaped abutment approaches for the new bridge. Analysis of the MSE walls were performed in general accordance with ODOT Supplemental Specification 840, “Mechanically Stabilized Earth Walls”, dated January 18, 2019, and AASHTO LRFD Bridge Design Specifications, 8th edition, 2017. The maximum wall height was determined based on the top of wall elevation and an embedment depth of 3-feet as required by AASHTO 11.10.2.2 and for frost penetration. The planned rear and forward MSE faces will be established at about elevation 559.5 and 557.5, respectively. The bridge will be supported by driven piling sleeved through the MSE wall. The MSE wing walls will turn back from the abutment face and then step up the new fill embankment. Beyond the bridge abutment wing walls, the MSE walls will have a maximum 2H:1V fill/back slope above the wall to the roadway grade. Based on National Flood Hazard Mapping (FIRMette) the bridge in not located in a flood zone.

In evaluating the design for a "gravity-type" reinforced soil retaining wall (MSE), the external and internal stability should be analyzed. The internal stability analysis will be performed by the wall designer. The external stability analysis for eccentricity, sliding, bearing resistance and global stability considered the subsurface conditions, the height of the MSE wall and an initial minimum reinforced length of 0.7 times the height of the wall. The reinforcement length was increased/decreased in increments of 0.5 feet to meet external stability requirements. Stantec utilized the computer program MSEW Version 3.0 in the analysis of the MSE walls. Global stability was analyzed using Slope/W by GeoStudio, 2019. The MSE wall analyses are presented in Appendix F.

In accordance with ODOT SS 840 for design, the reinforced fill portion of the wall must have an internal friction angle (φ) equal to 34 degrees, a cohesion of 0, and a unit weight of 120 pounds per cubic foot (pcf). The retained soil must have an internal friction angle (φ) equal to 30 degrees, a cohesion of 0, and a unit weight of 120 pcf. ODOT requires a foundation preparation layer beneath the MSE wall in accordance with the ODOT Bridge Design Manual, Section 307.4 D. From BDM Table 307-1, the foundation preparation material (granular Type C) must have an internal friction angle (φ) equal to 34 degrees, a cohesion of 0, and a unit weight of 130 pcf. The subsurface conditions beneath the walls were estimated based on the additional CPT borings performed by ODOT. ODOT provided the CPT Raw Data and typical Basic Correlation Results in spreadsheet form. Stantec utilized this information along with the Guide to Cone Penetrometer Testing, 6th Edition, 2015 and ODOT Geotechnical Bulletin GB2, dated January 17, 2020, to establish soil parameters for the analyses. The tables below summarize the soil parameters used in the MSE wall analyses.

Table 4. **Rear Abutment Soil Parameters**

Elevation Range	**Depth below MSE wall foundation (feet)**	**Soil Type**	**Unit Weight (pcf)**	**qn (tsf)**	**Short Term**		**Long Term**	
					Friction Angle (φ)	**Cohesion (c)**	**Friction Angle (φ')**	**Cohesion (c')**
559.5 – 556.0	0 – 3.5	Silty Clay	119.1	12.2	0	2400	23	150
556.0 – 546.0	3.5 – 13.5	Silty Clay	122.3	36.5	0	6000	25	175
546.0 – 540.5	13.5 – 19.0	Silty Clay	126.3	52.1	0	7500	26	175
540.5 – 532.0	19.0 – 27.5	Silty Clay	127.7	42.1	0	6000	25	175
532.0 – 524.0	27.5 – 35.5	Silty Clay	124.1	35.7	0	6000	25	175
524.0 – 519.5	35.5 – 40.0	Silty Clay	121.5	44.9	0	5500	24	160
519.5 – 514.7	40.0 – 44.8	Sand	121.8	76.2	35	0	35	0

Based on C-009-2-21

Table 5. Forward Abutment Soil Parameters

Elevation Range	Depth below MSE wall foundation (feet)	Soil Type	Unit Weight (pcf)	qn (tsf)	Short Term		Long Term	
					Friction Angle (φ)	Cohesion (c)	Friction Angle (φ')	Cohesion (c')
557.5 – 552.5	0 – 5	Silty Clay	121.6	31.2	0	4000	24	150
552.5 – 544.5	5 – 13	Silty Clay	126.7	50.8	0	6500	25	175
544.5 – 536.0	13 – 21.5	Silty Clay	127.5	48.1	0	4500	24	150
536.0 – 526.0	21.5 – 31.5	Silty Clay	118.6	26.6	0	3500	23	150
526.0 – 519.2	31.5 – 38.0	Silty Clay	120.2	34.7	0	4000	24	150
519.2 – 511.6	38.0 – 45.6	Sand	131	191.0	39	0	39	0

Based on C-009-3-21

The short- and long-term soil parameters should be relatively conservative based on the results from the CPT soundings. Stantec compared the overall average and weighted average of the shear strength values over the depth of the soundings and used c and φ values that were lower than the averages. The global stability and limit equilibrium bearing capacity analyses utilized the respective profiles from the tables above.

For external stability, the following four standard modes of failure are typically evaluated:

1) sliding using a resistance factor (φ = 1);
2) limiting eccentricity (overturning);
3) bearing resistance using a resistance factor (φ = 0.65); and
4) global stability using a resistance factor (φ = 0.65).

The load factors and geotechnical resistance factors used in the analyses are presented in Appendix F. With LRFD, the goal is to have the factored resistance greater than the factored load. The term capacity to demand ratio, CDR, is used to quantify the ratio of the factored resistance to the factored load. CDR values of one or greater indicate acceptable results. The global stability analyses display the results as a factor of safety. The inverse of the factor of safety is equivalent to the resistance factor. For global stability, a factor of safety (FOS) greater than 1.5 is required.

In addition to typical MSE wall external stability analyses, ODOT requires the analysis of bearing resistance and sliding at the top and bottom of the foundation preparation material. A limitation with the MSEW program occurs in the calculation of bearing resistance. The program utilizes only one set of soil parameters in the calculation of bearing resistance (those at the bearing elevation) instead of all the parameters for a soil profile. To compensate for this limitation, a limit equilibrium bearing resistance analysis was performed when an MSEW bearing resistance CDR value was less than 1. This allowed consideration of the layered subsurface profile beneath the base of the wall, including the foundation preparation material. Tables 6 and 7 present a summary of the external stability analyses performed for the MSE wall configurations with temporary facings. As shown in Tables 6 and 7, sliding and bearing were also evaluated at both the top and bottom of the foundation preparation layer for the temporary facing condition.

Table 6. Summary of External Stability Analysis – Short Term (Undrained), Temporary Facing

MSE Wall Analysis Condition		**Sliding**	**Limiting Eccentricity**	**Bearing**	**Global Stability**
Wall Location & Backslope	**Approx. Height & Reinforcement Length (L)**	CDR ≥ 1	e/L ≤ 0.333	CDR ≥ 1	FOS ≥ 1.5
Forward Abutment Level Backslope	Wall Height: 38.2 ft L=31.0 ft	1.91	0.153	1.61	2.72
Forward Wing Wall 2H:1V Toe slope	Wall Height: 35.7 ft L=28.0 ft	1.83	0.166	1.36	2.33
Rear Abutment Level Backslope	Wall Height: 39.9 ft L=33.0 ft	1.48	0.146	1.93 [a]	2.09
Rear Wing Wall 2H:1V Toe slope	Wall Height: 37.4 ft L=28.0 ft	1.42	0.180	2.13 [a]	2.81
Forward Abutment On Top of Foundation Prep	Wall Height: 38.2 ft L=31.0 ft	1.91	---	2.26	---
Forward Abutment On Bottom of Foundation Prep	Wall Height: 40.2 ft L=31.0 ft	1.83	---	1.49	---
Rear Abutment On Top of Foundation Prep	Wall Height: 39.9 ft L=33.0 ft	1.96	---	2.77	---
Rear Abutment On Bottom of Foundation Prep	Wall Height: 41.9 ft L=33.0 ft	1.35	---	1.80 [a]	---
Forward Wing Wall On Top of Foundation Prep	Wall Height: 35.7 ft L=28 ft	1.83	---	1.69 [a]	---
Forward Wing Wall On Bottom of Foundation Prep	Wall Height: 37.7 ft L=28.0 ft	1.74	---	1.25	---
Rear Wing Wall On Top of Foundation Prep	Wall Height: 37.4 ft L=28 ft	1.76	---	2.13 [a]	---
Rear Wing Wall On Bottom of Foundation Prep	Wall Height: 39.4 ft L=28.0 ft	1.28	---	1.96 [a]	---

a - Bearing required the use of limit equilibrium bearing analysis.

Table 7. Summary of External Stability Analysis – Long Term (Drained), Temporary Facing

MSE Wall Analysis Condition		**Sliding**	**Limiting Eccentricity**	**Bearing**	**Global Stability**
Wall Location & Backslope	**Approx. Height & Reinforcement Length (L)**	CDR ≥ 1	e/L ≤ 0.333	CDR ≥ 1	FOS ≥ 1.5
Forward Abutment Level Backslope	Wall Height: 38.2 ft L=31.0 ft	1.36	0.153	1.12[a]	1.51
Forward Wing Wall 2H:1V Backslope	Wall Height: 35.7 ft L=28.0 ft	1.31	0.166	1.12[a]	1.87
Rear Abutment Level Backslope	Wall Height: 39.9 ft L=33.0 ft	1.33	0.146	1.34[a]	1.50
Rear Wing Wall 2H:1V Backslope	Wall Height: 37.4 ft L=28.0 ft	1.20	0.180	1.20[a]	1.92
Forward Abutment On Top of Foundation Prep	Wall Height: 38.2 ft L=31.0 ft	1.91	---	2.26	---
Forward Abutment On Bottom of Foundation Prep	Wall Height: 40.2 ft L=31.0 ft	1.29	---	1.04[a]	---
Rear Abutment On Top of Foundation Prep	Wall Height: 39.9 ft L=33.0 ft	1.96	---	2.77	---
Rear Abutment On Bottom of Foundation Prep	Wall Height: 41.9 ft L=33.0 ft	1.27	---	1.25[a]	---
Forward Wing Wall On Top of Foundation Prep	Wall Height: 35.7 ft L=28 ft	1.83	---	1.11[a]	---
Forward Wing Wall On Bottom of Foundation Prep	Wall Height: 37.7 ft L=28.0 ft	1.24	---	1.03[a]	---
Rear Wing Wall On Top of Foundation Prep	Wall Height: 37.4 ft L=28 ft	1.76	---	1.21[a]	---
Rear Wing Wall On Bottom of Foundation Prep	Wall Height: 39.4 ft L=28.0 ft	1.14	---	1.11[a]	---

a - Bearing required the use of limit equilibrium bearing analysis.

The analyses include a water level within the MSE wall at the invert level of the wall drain in accordance with ODOT Supplemental Specification SS 840.04.A.6. The MSEW program ignores passive resistance in the analysis of MSE walls. ODOT requires additional MSE wall analyses for the final stage wall where the panels are affixed to the first/temporary stage flexible faced MSE wall. Stantec added three additional feet to the temporary reinforcement length (L) used in the first/temporary stage analysis of the MSE wall to arrive at the final facing base length, B (B = L + 3). Because the cohesive subgrade conditions below the wall are more critical to bearing resistance, additional analyses for determining sliding and bearing resistance at the top of the foundation preparation layer for the final conditions were not performed. The results of these analyses are presented in Tables 8 and 9, below.

Table 8. Summary of External Stability Analysis – Short Term (Undrained), Final Facing

MSE Wall Analysis Condition		Sliding	Limiting Eccentricity	Bearing	Global Stability
Wall Location & Backslope	**Approx. Height & Reinforcement Length + Facing (B)**	CDR ≥ 1	e/L ≤ 0.333	CDR ≥ 1	FOS ≥ 1.5
Forward Abutment Level Backslope	Wall Height: 38.2 ft L=34.0 ft	2.10	0.127	1.68	2.84
Forward Wing Wall 2H:1V Backslope	Wall Height: 35.7 ft L=31.0 ft	2.03	0.135	1.44	2.37
Rear Abutment Level Backslope	Wall Height: 39.9 ft L=36.0 ft	1.61	0.123	2.03 [a]	2.14
Rear Wing Wall 2H:1V Backslope	Wall Height: 37.4 ft L=31.0 ft	1.57	0.147	2.06 [a]	2.79
Forward Abutment On Bottom of Foundation Prep	Wall Height: 40.2 ft L=34.0 ft	2.01	---	1.56	---
Forward Wing Wall On Bottom of Foundation Prep	Wall Height: 37.7 ft L=31.0 ft	1.94	---	1.33	---
Rear Abutment On Bottom of Foundation Prep	Wall Height: 41.9 ft L=36.0 ft	1.47	---	1.90 [a]	---
Rear Wing Wall On Bottom of Foundation Prep	Wall Height: 39.4 ft L=31.0 ft	1.42	---	1.91 [a]	---

a - Bearing required the use of limit equilibrium bearing analysis.

Table 9. Summary of External Stability Analysis – Long Term (Drained), Final Facing

MSE Wall Analysis Condition		**Sliding**	**Limiting Eccentricity**	**Bearing**	**Global Stability**
Wall Location & Backslope	**Approx. Height & Reinforcement Length + Facing (B)**	CDR ≥ 1	e/L ≤ 0.333	CDR ≥ 1	FOS ≥ 1.5
Forward Abutment Level Backslope	Wall Height: 38.2 ft L=34.0 ft	1.49	0.127	1.24 [a]	1.57
Forward Wing Wall 2H:1V Backslope	Wall Height: 35.7 ft L=31.0 ft	1.45	0.135	1.26 [a]	1.92
Rear Abutment Level Backslope	Wall Height: 39.9 ft L=36.0 ft	1.45	0.123	1.48 [a]	1.56
Rear Wing Wall 2H:1V Backslope	Wall Height: 37.4 ft L=31.0 ft	1.33	0.147	1.39 [a]	2.30
Forward Abutment On Bottom of Foundation Prep	Wall Height: 40.2 ft L=34.0 ft	1.42	---	1.16 [a]	---
Forward Wing Wall On Bottom of Foundation Prep	Wall Height: 37.7 ft L=31.0 ft	1.38	---	1.16 [a]	---
Rear Abutment On Bottom of Foundation Prep	Wall Height: 41.9 ft L=36.0 ft	1.38	---	1.39 [a]	---
Rear Wing Wall On Bottom of Foundation Prep	Wall Height: 39.4 ft L=31.0 ft	1.26	---	1.29 [a]	---

a - Bearing required the use of limit equilibrium bearing analysis.

For the rear and forward abutment MSE walls the subgrade beneath the foundation preparation layer should be **undercut an additional 1 foot** and backfilled with additional foundation preparation material. The foundation preparation layer should extend a minimum of 1 foot beyond the final facing of the MSE wall.

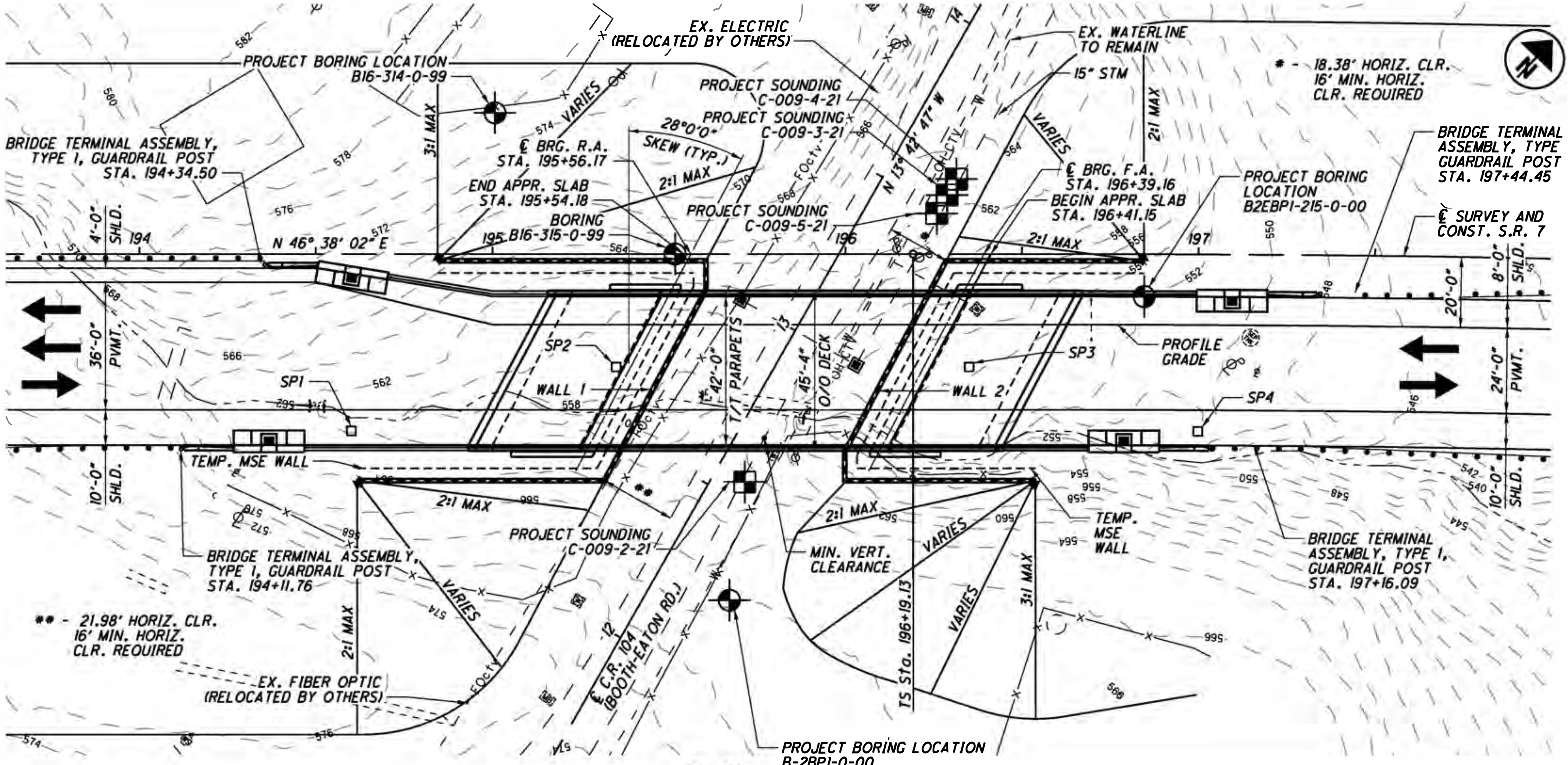
The total settlement is estimated to be about 9 inches. Based on FHWA NHI-10-024 (MSE Walls), concrete-faced MSE structures using discrete articulating panels can accommodate maximum longitudinal differential settlements of about 1 inch per 100 feet, without the introduction of special sliding joints between panels. Due to the amount of total settlement and anticipated differential settlement along the walls, a 2-stage wall system will be required where the core of the MSE structure is constructed first to allow the settlement to occur and then the panels are affixed to the core to reduce the risk of damage to the panels. In addition, down drag on the driven piles can be mitigated prior to pile driving by reducing the remaining settlement after construction of the wall to less than 0.4 inches. The estimated time to achieve less than 0.4 inches of settlement is approximately 1 month.

The analyses assume proper drainage is maintained and that no hydrostatic water pressure is developed behind the walls. Therefore, for naturally occurring soils, consideration should be given to the installation of a permanent subsurface drainage system located at or near the base of the MSE walls. It is important that the drainage system be protected by a filter fabric to prevent fines from clogging the pipe. MSE walls shall be constructed in accordance with the current ODOT Supplemental Specification SS 840 and SS 867 for Temporary Wire Faced MSE Walls.

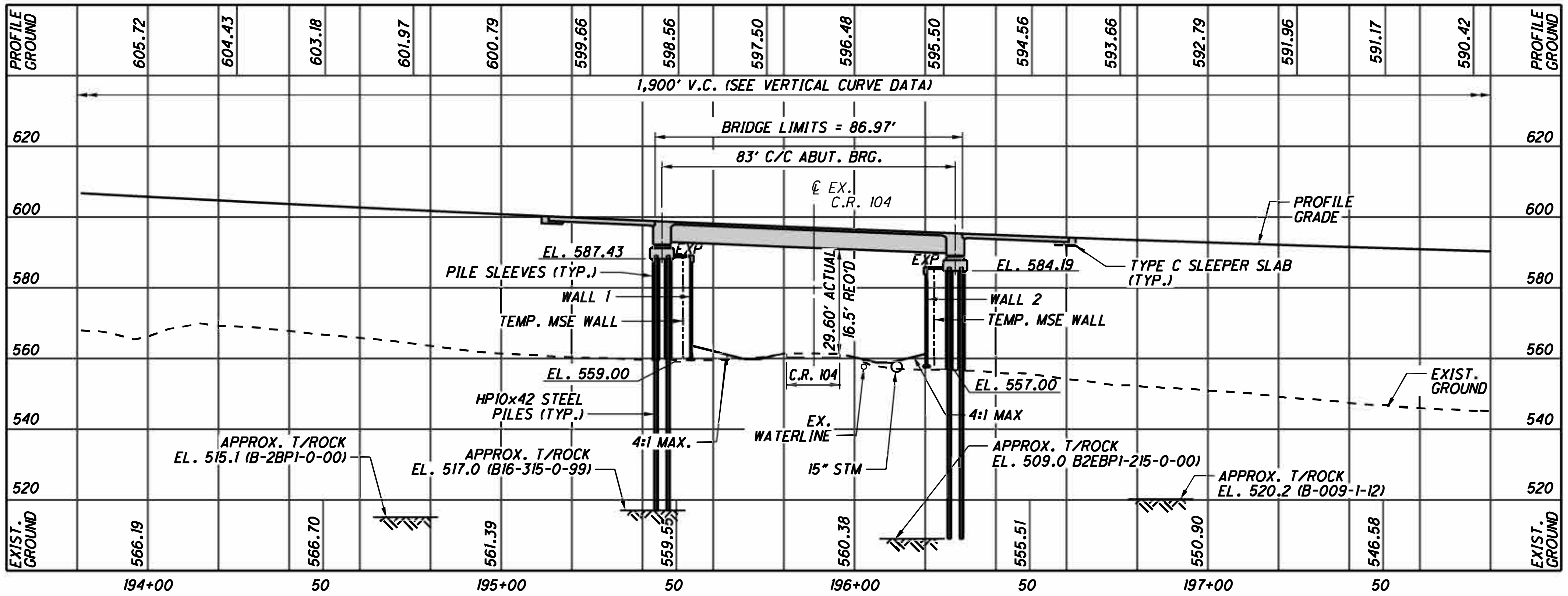
Appendix A

Bridge Site Plan

BRIDGE NO. B-16



PLAN



PROFILE ALONG PROFILE GRADE LINE

BENCHMARK DATA

BM #1 STA. 182+35.75, ELEV. 568.32, OFFSET 560.76', RT.
BM #2 STA. 207+14.67, ELEV. 575.38, OFFSET 966.60', LT.

FOR ADDITIONAL BENCHMARK INFORMATION. SEE ROADWAY PLAN SHEET ⊖

NOTES

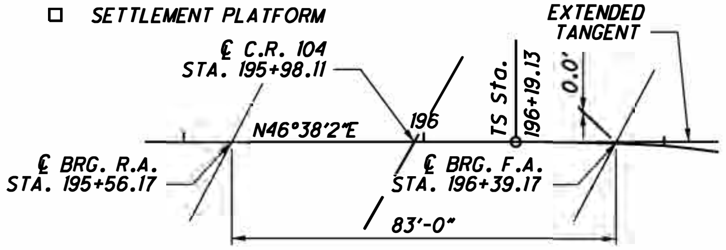
1. EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.
2. FOR PRIMARY PROJECT CONTROL INFORMATION TABLE SEE ROADWAY GENERAL NOTES.
3. FOR LIST OF ABBREVIATIONS SEE SHEET 2/26.

DESIGN TRAFFIC:

2028 ADT = 13,400 2028 ADTT = 1,072
2048 ADT = 17,500 2048 ADTT = 1,400
DIRECTIONAL DISTRIBUTION = 69/31

LEGEND

⊕	PROJECT BORING LOCATION
▣	PROJECT CPT SOUNDING LOCATION
□	SETTLEMENT PLATFORM



GEOMETRIC LAYOUT

BRIDGE BUILT PARALLEL TO EXTENDED TANGENT

ESTIMATED PILE LENGTHS	
LOCATION	LENGTH
REAR ABUTMENT	75'
FORWARD ABUTMENT	80'

VERTICAL CURVE DATA

LENGTH = 1900'

PVC STA. = 192+75.00	PVC ELEV. = 612.74
PVI STA. = 202+25.00	PVI ELEV. = 555.74
PVT STA. = 211+75.00	PVT ELEV. = 609.67
G1 = -6.00%	G2 = 5.68%

CURVE (S.R. 7 CURVE NO. 3)

P.I. STA. 205+33.31	E = 70.53'	LT = 150.01'
Δ = 27° 30' 45" (RT)	TS STA. = 196+19.13	ST = 75.01'
Dc = 1° 45' 00"	SC STA. = 198+44.13	e_{max} = 4.60%
R = 3,274.04'	θs = 1° 58' 07"	CS STA. 211+91.27
T = 683.24'	Ls = 225.00'	ST STA. 214+16.27
L = 1,347.14'	Ts = 914.18'	

PROPOSED STRUCTURE

TYPE: PRESTRESSED CONCRETE I-BEAMS (AASHTO TYPE 4) WITH COMPOSITE CONCRETE SLAB SUPPORTED BY SEMI-INTEGRAL ABUTMENTS ON SLEEVED PILES THROUGH MSE WALL FILL.

SPANS: 83'-0" C/C ABUTMENT BEARINGS (MEASURED ALONG EXTENDED TANGENT)
ROADWAY: 42'-0" TOE/TOE PARAPET
LOADING: HL-93 AND 60 LBS/FT² FUTURE WEARING SURFACE
WEARING SURFACE: 1" MONOLITHIC WEARING SURFACE
SKEW: 28°00'00" LEFT FORWARD
APPROACH SLABS: 30'-0" (AS-1-15 & AS-2-15)
ALIGNMENT: TANGENT
CROWN: VARIES (SEE TRANSITION DIAGRAM)
COORDINATES: LATITUDE 38°26'50.63" N
LONGITUDE 82°26'09.82" W
DECK AREA: 3943 SQ. FT.

DESIGN AGENCY
Stantec Consulting Services Inc.
1500 Lake Shore Drive, Suite 100
Columbus, Ohio 43204
(614) 486-4383

DESIGNED	DRAWN	REVIEWED	DATE
BSM	JWS	MRS	04/2022
CHECKED	REVISED	STRUCTURE FILE NUMBER	
EDA		4400194	

LAWRENCE COUNTY
STA. 195+54.18
STA. 196+41.15

SITE PLAN
BRIDGE NO. LAW-7-0370
S.R. 7 OVER C.R. 104 (BOOTHE EATON ROAD)

LAW-7-2.17
PID No. 75923

0
0

U:\173608714\LAW\75923\structures\LAW007_0370C\sheets\007_75923CSP001.dgn 4/22/2022 3:51:40 PM jsnair

Appendix B

September 2002 BBC&M Report

and Stantec Boring B-009-1-12

SUBSURFACE INVESTIGATION
LAW-7-2.17 (CHESAPEAKE BYPASS)
S.R. 7 BRIDGE OVER
C.R. 104 (BOOTHE-EATON RD.)
LAWRENCE COUNTY, OHIO

Report to

R. D. ZANDE & ASSOCIATES, INC.
COLUMBUS, OHIO

Prepared by

BBC&M ENGINEERING, INC.
GEOSCIENCES AND MATERIALS CONSULTANTS
DUBLIN, OHIO

September 2002

BBCM

BBC&M ENGINEERING, INC.
6190 Enterprise Court, Dublin, Ohio 43016-7297
Phone (614) 793-2226 Fax (614) 793-2410

September 10, 2002
011-06405-002

Mr. Thomas C. Morman, P.E.
R.D. Zande & Associates, Inc.
1237 Dublin Road
Columbus, OH 43215

Re: Subsurface Investigation - Bridge-16
LAW-7-2.17 (Chesapeake Bypass)
S.R. 7 Bridge Over C.R. 104 (Boothe-Eaton Rd.)
Bridge No. LAW-7-0369 L & R
Lawrence County, Ohio

Dear Mr. Morman:

In accordance with our proposal dated June 25, 1998, which was authorized by R. D. Zande & Associates, Inc. on September 9, 1998, as well as specific structure arrangement information supplied by R. D. Zande on March 15, 2002, BBC&M Engineering, Inc., has completed a subsurface investigation for the proposed three-span bridge which is to carry proposed S.R. 7 over existing C.R. 104 (Boothe-Eaton Rd.) as part of the LAW-007-2.17 (Chesapeake Bypass) project in Lawrence County, Ohio. A Vicinity Map showing the location of this bridge site is presented as Plate 1 in Appendix A to this report. Our report of this investigation is herewith submitted.

FIELD INVESTIGATION

During the Preliminary Field Investigation (October 12 through November 27, 1998), Boring B-2BP1 was drilled near the proposed easternmost intermediate pier location to a depth of 66.5 feet below the existing ground surface. An additional boring was drilled at the location of this proposed structure during the Secondary Investigation (Phase 2) of this project. This boring, B2EBP1-215, was drilled on April 5, 2000 near the proposed eastern (forward) abutment location to a depth of 51.0 feet below the existing ground surface. As a result of the redesign of this structure in early 2002, the original configuration was separated into three independent structures (Bridges 2, 16 and 17), all incorporating shorter spans. Due to these changes, two structure borings were added to this Bridge-16 (L & R) investigation. On May 1 and 2, 2002, Boring B16-314 was drilled near the proposed western (rear) abutment location to a depth of 63.5 feet, and on May 2 and 3, 2002, Boring B16-315 was drilled near the proposed westernmost intermediate pier location to a depth of 55.0 feet. All boring locations are shown on the Plan of Borings, submitted as Plate 2 in

Appendix A. The boring locations were selected by personnel of BBC&M based on structure site plan information provided by R.D. Zande. The borings were located and staked in the field by personnel from R. D. Zande and stationing, offsets and ground surface elevations at the boring locations were also provided to BBC&M by R. D. Zande.

The structure borings were made with an all-terrain vehicle (ATV) mounted drill rig using a 3¼-inch I.D. hollow-stem auger to advance the borings through soil between sampling attempts. At regular intervals, disturbed but representative samples were obtained by driving a 2-inch O.D. split-barrel sampler into the soil with blows from a 140-pound hammer freely falling 30 inches (Standard Penetration Test). Upon encountering bedrock in each of these four structure borings, between 5.0 and 10.0 feet of bedrock were cored using either a NX or NXM rock core barrel and diamond bit with water used as circulating/cooling fluid. Retrieved core samples were stored in compartmented core boxes. After the drilling was completed and groundwater measurements were obtained, all borings were backfilled or sealed in accordance with ODOT requirements.

In the field, experienced personnel from this office provided overall supervision of drilling procedures and performed the following specific duties: examined all samples recovered from the borings; cleaned and preserved representative portions of all samples; prepared a log of each boring; recorded seepage and groundwater observations; made hand-penetrometer measurements in soil samples exhibiting cohesion; and, provided liaison between the field work and the Project Engineer so that the investigation could be modified in the event unusual or unexpected subsurface conditions were encountered. All samples were transported to the soils laboratory of BBC&M Engineering, Inc., for further testing.

LABORATORY TESTING

In the laboratory, the soil samples were visually classified and, on representative specimens, natural moisture content, and liquid and plastic limit determinations were performed. The results of these tests are useful in the classification of soils, and permit an evaluation of the strength and compressibility characteristics of the soils encountered at this site by comparison with similar soils for which these characteristics have been previously determined. In addition, grain-size analyses were performed on selected samples to measure the mean-particle size. The results of all tests are recorded on the individual boring logs and a summary of the test results are presented on Plates 13 and 14 in Appendix A.

Based on the results of the laboratory testing program, soil descriptions contained on the field logs were modified, if necessary, and laboratory-corrected borings logs are submitted as Plates 5 through 12 in Appendix A. Shown on these logs are: descriptions of the soil stratigraphy encountered; depths from which samples were preserved; sampling efforts (blow counts) required to obtain the specimens in the borings; seepage and groundwater observations; and, values of hand-penetrometer measurements made in soil samples exhibiting cohesion. For your reference, hand-penetrometer values reported on the logs are roughly equivalent to the unconfined compressive strength of the cohesive fraction of the soil sample.

In addition to the percentage of recovery for rock core, the logs also list the Rock Quality Designation (RQD). This value is expressed as a percentage and is obtained by summing the total length of all core pieces which are at least 4-inches long and then dividing this sum by the total length of the core run. It has been found that there is a reasonably good relationship between the RQD value and the general quality of the rock for engineering purposes. This relationship is shown in Table 1.

TABLE 1: Relationship Between RQD Value And The General Quality of Rock

RQD - %	General Quality
0 - 25	Very-poor
26 - 50	Poor
51 - 75	Fair
76 - 90	Good
91 - 100	Excellent

Soil described in this report has been classified generally in accordance with the Unified Soil Classification System. However, the system has been augmented by the use of special adjectives to designate approximate percentages of minor soil components. An explanation of the symbols and terms used on the boring logs, and definitions of the special adjectives used to denote the minor soil components and rock hardness are presented on Plates 3 and 4 in Appendix A. Highway Research Board Symbols, as modified by ODOT, have also been included on the logs, along with Group Indices determined from the laboratory testing program.

GENERAL SUBSURFACE CONDITIONS

One Preliminary Investigation boring, B-2BP1, was drilled near the easternmost intermediate pier of this proposed bridge and encountered 4 inches of topsoil overlying predominantly very-stiff to hard silty clay interbedded with occasional seams of medium-dense fine to coarse sand and gravel. Bedrock at this location consists of very-soft to soft shale (partly similar to hard silty clay) encountered at El. 515.1, becoming medium-hard limestone at El. 511.0, very-soft shale at El. 510.8, medium-hard coal at El. 507.9, and very-soft to soft shale at El. 506.7.

An additional boring, B2EBP1-215, was drilled near the easternmost abutment of this proposed bridge during the Secondary Investigation (Phase 2). Boring B2EBP1-215, encountered 6 inches of topsoil overlying approximately 39.5 feet of predominantly very-stiff to hard silty clay interbedded with occasional seams of medium-dense to dense fine to coarse sand. This boring encountered bedrock consisting of medium-hard coal at approximate El. 509, becoming very-soft to soft shale (similar to hard silty clay) at approximate El. 507.

Due to changes in the proposed structure at this location, two structure borings were added to this Bridge-16 investigation. Boring B16-314 was drilled near the proposed western (rear) abutment and Boring B16-315 was drilled near the proposed westernmost intermediate pier. Both of these borings, drilled in an existing gravel driveway, encountered predominantly very-stiff to hard silty clay interbedded with occasional seams of loose to medium-dense fine to coarse sand. Boring B16-314 encountered bedrock consisting of soft to medium-hard shale at approximate El. 519, and Boring B16-315 encountered bedrock consisting of highly fragmented soft sandstone at approximate El. 517, becoming soft to medium-hard shale at approximate El. 515. If more detailed descriptions of the soils are desired in general or at a specific location, the logs of the individual borings should be examined.

During drilling, seepage was noted only in Boring B16-315 at depths between 38.5 and 45.0 feet below the existing ground surface. More significant quantities of groundwater were encountered during drilling in Borings B-2BP1 at a depth of 52.5 feet, and B2EBP1-215 at a depth of 35.0 feet. The measured water level in Borings B16-315 and B-2BP1, at the completion of drilling and prior to rock coring, were 34.0 and 19.2 feet, respectively, below the existing ground surface. Boring B16-314 was "dry" prior to changing over to mud rotary drilling techniques at a depth of 17.5 feet.

ANALYSES AND RECOMMENDATIONS

General Geotechnical Evaluation

It is understood that this structure will require approach embankments as high as 32 feet at the western (rear) abutment and 38 feet at the eastern (forward) abutment. **According to plans provided to BBC&M by R.D. Zande, only the eastern approach embankment for this structure is within the floodplain of the Ohio River which has a 100-year flood event back-up elevation of 553.2. Therefore, the rapid drawdown condition, wherein the Ohio River rises to the flood elevation and then rapidly recedes, is addressed in this report for the eastern embankment only**. It is also understood that both approach embankment side slopes for this structure are desired to be constructed with 2H:1V side slopes and 2H:1V spill-through abutment slopes. If the embankments for this structure will be constructed primarily of broken down compacted shale fill, it is our opinion that the eastern approach embankment may be designed and constructed with external slopes of 2H:1V, **provided that internal geogrid-reinforcement is utilized**.

Since the rapid drawdown condition is no longer of concern at the location of the western approach embankment, it is our opinion that 2½H:1V *unreinforced* side slopes may be constructed in this area, as our analyses indicate that the long term factor of safety with respect to shear strength would be unacceptably low for 2H:1V *unreinforced* western embankment side slopes. Please note that utilizing internal geogrid-reinforcement in the 2½H:1V side sloped western approach embankment (not subjected to the rapid drawdown condition), would assist in reducing differential settlements and surface sloughing of the compacted embankment fill.

Regardless of the embankment slope configuration, it is recommended that vegetative cover be established as soon as possible on all fill embankment slopes. The general goal of slope erosion control would be to protect the slope from sheet, gully, or rill erosion. Specialty geotextiles are available to protect slopes from erosion until vegetation can establish itself.

Based on the results of the borings, laboratory tests and our analyses, it is our opinion that the existing primarily very-stiff to hard silty clay and medium-dense sand deposits encountered in all four borings of the borings performed at this structure location will adequately support the proposed approach embankments. It will be necessary to construct the embankments carefully in order to prevent embankment slope and/or foundation failures, since the existing deposits are compressible and will experience elevated pore pressures as well as undergo deformation under the new embankment load. Long-term consolidation of these natural deposits will result in increased shear strength; however, differential settlements caused by varying embankment heights and variable soil deposit thicknesses will remain unacceptable without internal geogrid-reinforcement or increased embankment shear strength.

Also based on the results of the borings, laboratory tests and our analyses, BBC&M recommends that the proposed structure be supported on extended foundations consisting of steel H-piles driven to refusal in the underlying bedrock. Steel H-piles driven to refusal in the underlying very-soft to medium-hard shale or medium-hard limestone bedrock may be designed for the structural capacity of the pile section using AASHTO guidelines. It is also estimated that the total settlement for H-piles founded on this bedrock will be limited to the elastic compression of the structural members. It should be noted that weathered bedrock was encountered in all four borings above the intact bedrock, and therefore the actual elevation at which pile refusal will occur is difficult to predict. More specific details and recommendations are given in the following sections.

Slope Stability Analysis

Using proposed S.R. 7 embankment plan and cross-section information provided by R.D. Zande, schematic subsurface sections were developed and used as a basis for performing slope stability analyses. These sections were analyzed utilizing the desired embankment slope geometry of 2H:1V as well as using estimated properties of compacted soil fill for the new embankment portion. The analyses considered short term conditions (end of construction) and "normal" long term conditions. Plans provided to BBC&M by R.D. Zande, show that only the eastern approach embankment for this structure is within the floodplain of the Ohio River which has a 100-year flood event back-up elevation of 553.2. Therefore, the rapid drawdown condition, wherein the Ohio River rises to the flood elevation and then rapidly recedes, is addressed in this report for the eastern embankment only.

The cross-section at Sta. 197+50 (proposed eastern approach embankment) and a section (along the centerline) through the proposed eastern approach embankment were chosen for analysis. Slope stability analyses were performed on embankment geometry utilizing both non-internally-reinforced 2H:1V slopes and 2H:1V slopes incorporating primary internal geogrid-reinforced soil. The PCSTBL5M and STABL6H computer programs, which were developed by Purdue University, were used for these analyses to assist with identifying potential failure surfaces. Estimated values for soil strength parameters were used in these analyses for both short term (end of construction) and "normal" long term conditions. Target ranges of factors of safety used in these analyses are 1.1-1.3 for the short term condition, 1.4-1.6 for the long term condition and 1.0-1.2 for the rapid drawdown condition. The strength parameters used in these analyses were obtained from past BBC&M projects, from site-specific laboratory triaxial tests, and from available literature.

BBC&M performed slope stability analyses on the embankment geometry incorporating geogrid-reinforced soil parameters in accordance with FHWA-SA-96-071, (Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines). Perceived advantages for using internally-reinforced slopes are:

- ability to construct the embankment with external slope faces that are steeper than could otherwise be safely constructed with the same fill material in an unreinforced condition. This would provide the economic advantage of material and right-of-way savings, as well as reducing the environmental impact to the adjacent area.

- provide improved lateral resistance during compaction at the edges of the compacted fill slopes, thereby decreasing the tendency for surface sloughing.

- reduce local differential settlements to magnitudes that are not detrimental to roadway pavements.

The results of the slope stability analyses at Station 197+50 indicate that factors of safety with respect to shear strength exceed minimum acceptable values for the short term, long term and the rapid drawdown cases for 2H:1V *geogrid-reinforced* side slopes; however, the long term factor of safety would be unacceptably low for 2H:1V *unreinforced* side slopes. For the cross-section representing the proposed embankment at Station 197+50, the plots of the ten most critical failure surfaces for the *unreinforced* and *geogrid-reinforced* cases are included in Appendix B as Plates 1 through 5. All geogrid-reinforced slope stability analyses were conducted using eleven primary layers of moderate strength uniaxial geogrid (force = 3500 lb/ft) extending the entire width of the embankment and a geogrid layer spacing of 3 feet. The minimum factors of safety determined from the slope stability analyses for the embankment cross-section at Station 197+50 (S.R. 7) are summarized in Tables 2 and 3 of this report. It must be noted that these embankment slope analyses do not account for seismic effects.

The results of the slope stability analyses for the section (along the centerline) through the eastern approach embankment indicate that factors of safety with respect to shear strength exceed minimum acceptable values for the rapid drawdown case for 2H:1V *geogrid-reinforced* abutment foreslopes; however, the long term factor of safety would be unacceptably low for 2H:1V *unreinforced* eastern abutment foreslopes during a rapid drawdown event. For the section (along the centerline) through the eastern approach embankment, including the proposed 2H:1V abutment foreslope, the plots of the ten most critical failure surfaces for the rapid drawdown *unreinforced* and *geogrid-reinforced* cases are included in Appendix B as Plates 6 and 7. The minimum factors of safety determined from the slope stability analyses for the eastern approach embankment section are summarized in Table 4.

TABLE 2: 2H:1V *Unreinforced* Embankment Slopes
Minimum Factors of Safety

Embankment Location	*Unreinforced* Embankment Side Slopes	FACTOR OF SAFETY			Meets All 3 Conditions?
		Short Term Condition	Long Term Condition	Rapid Drawdown Condition	
Sta. 197+50 (S.R. 7) **No Drainage Layer**	**2H:1V**	1.84	1.10	0.83	**No**

TABLE 3: 2H:1V *Reinforced* Embankment Slopes
Minimum Long Term Factor of Safety

Embankment Location	*Reinforced* Embankment Side Slopes	FACTOR OF SAFETY		Meets Both Conditions?
		Long Term Condition	Rapid Drawdown Condition	
Sta. 197+50 (S.R. 7) **No Drainage Layer**	**2H:1V**	1.46	1.18	**Yes**

TABLE 4: Eastern Approach Embankment (2H:1V Abutment Foreslope)
Minimum Long Term Factor of Safety

Embankment Location	Abutment Foreslope	FACTOR OF SAFETY	
		Unreinforced Rapid Drawdown Condition	*Reinforced* Rapid Drawdown Condition
Eastern Approach Embankment **No Drainage Layer**	**2H:1V**	1.38	2.44

Based on the results of these analyses, BBC&M recommends that the planned 2H:1V sloped eastern approach embankment and eastern abutment foreslope for the S.R. 7 over C.R. 104 structure (Bridge-16) incorporate primary internal reinforcement.

Since the rapid drawdown condition is no longer of concern at the location of the western approach embankment, it is our opinion that 2½H:1V *unreinforced* side slopes may be constructed in this area, as our analyses indicate that the long term factor of safety with respect to shear strength would be unacceptably low for 2H:1V *unreinforced* western embankment side slopes. Please note that utilizing internal geogrid-reinforcement in the 2½H:1V side sloped western approach embankment (not subjected to the rapid drawdown condition), would assist in reducing differential settlements and surface sloughing of the compacted embankment fill.

Mr. Gene Geiger of the Ohio Department of Transportation requested that BBC&M include secondary or intermediate internal reinforcement in the design for the portions of the S.R. 7 embankments incorporating 2H:1V slopes. Though secondary reinforcement is not required to achieve the necessary overall stability, incorporating secondary reinforcement in the engineered 2H:1V slopes will augment resistance to surface erosion forces as well as provide additional lateral resistance during compaction at the edges of the fill slope. This increased lateral resistance will allow compaction equipment to operate more safely near the edge of the slope and improve face stability. The following recommendations pertaining to secondary reinforcement are provided in accordance with FHWA-SA-96-071, (Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines). BBC&M recommends that secondary reinforcement be placed in-between the layers of primary geogrid. This would allow for a vertical spacing of 1.5 feet between layers of primary and secondary geogrid. Secondary reinforcement of one-half of a standard roll width (approx. 6 feet) may be installed at the face of the fill slope and may include a biaxial or uniaxial geogrid of moderate to low strength (such as ODOT Type P1 having a Long-Term Design Strength, T_A = 1300 lb/ft).

Though a drainage layer is not required at the base of the 2H:1V reinforced embankments in order to achieve a factor of safety above 1.0, such a layer would assist in reducing saturation of the compacted embankment fill.

Approach Embankment Construction and Settlements

It is recommended that both approach embankments, including the spill-thru slopes between the abutments and the intermediate piers, for the S.R. 7 over C.R. 104 structure be completed well in advance of bridge construction and pile driving. Construction of the embankments as early as possible in the construction schedule should allow the maximum amount of time possible for settlement of the new embankment fill and the natural soil beneath the proposed abutments to occur. The presence of primarily very-stiff to hard silty clay and medium-dense sand deposits encountered in the borings at the anticipated foundation levels of the proposed approach embankments will require that construction of the fill embankments be performed carefully in order to prevent embankment slope and/or foundation soils failures, since many of these underlying natural deposits are compressible and will undergo deformation under the new embankment load. The consolidation of such compressible soils may result in an unacceptably low factor of safety if pore water pressure in the cohesive foundation soils and in the embankment fill itself is not allowed to sufficiently dissipate during embankment construction. The elevated pore pressures may compromise the strength and possibly result in local instability. Piezometers should be placed in the foundation soils at 500-foot intervals, along the alignment centerline, prior to placing the embankment fill and should be monitored to determine if an unsatisfactory buildup in the pore water pressure within the soil is occurring during construction. In order to increase the survivability of the piezometers in the presence of operating construction equipment traffic, it is recommended that every other piezometer be placed on alternating shoulders of the embankment. If the pore water pressure is not dissipating, it will be necessary to temporarily suspend construction of the embankment in this area until the pore water pressure has dropped to a satisfactory level.

The approach embankment foundation soils may be expected to undergo estimated total consolidation settlements ranging from 4 to 6 inches under the new fill height of up to approximately 32 feet at the western (rear) abutments and 38 feet at the eastern (forward) abutments. Additionally, it is estimated that up to 12 months will be required to realize approximately 80% of this estimated settlement. Settlements of as much as 3 inches (over a period of 15 to 20 years) associated with the embankment fill soils will also occur in addition to the estimated 4 to 6 inches of settlement of the foundation soils. It should be noted that a portion of the embankment foundation materials encountered in the borings were granular soils and it is therefore anticipated that a portion of the estimated settlement will occur quickly as the fill is placed. However, total settlements of the magnitude calculated may be detrimental to the new bridge structure. For this reason it is recommended that embankment settlement be monitored both during and after embankment fill placement using settlement platforms placed at approximate 500-foot intervals along the alignment centerline. In order to increase the survivability of the settlement platforms in the presence of operating construction equipment traffic, it is recommended that every third settlement platform be placed on alternating shoulders of the embankment. Monitoring of settlement platforms can be used as a basis to decide when the rate of settlement has decreased to an acceptable rate. Additionally, final roadway grading and paving as well as bridge construction, including pile installation, should not proceed until the rate of settlement has reduced to less than 10 mm (0.39 inches) in three months (FHWA criteria).

If the construction schedule will not permit sufficient time for this amount of settlement to occur, the allowable structural load carrying capacity of the bridge foundation elements will need to be reduced, due to the effects of soil "downdrag" on the piles as the soil consolidates. This topic is discussed in the **"Downdrag and Capacity"** section of this report. The extent of the load reduction required will depend on the planned construction schedule of the embankments and the field-measured soil settlements.

Installation of sand drains or wick drains into the eastern embankment foundation soil stratigraphy may provide additional paths for more rapid dissipation of excess pore water pressure. This soil improvement technique may also shorten the estimated time to realize the estimated consolidation portion of the estimated total embankment settlement. Additional techniques to reduce anticipated embankments settlements include the use of light-weight fill or geofoam blocks in order to reduce the additional load imposed on the existing weak foundation soils. Although analysis pertaining to these types of alternatives were not included in the scope of these services, BBC&M would be pleased to provide these services if it is desired to investigate these alternatives.

Long-term settlement of the broken down compacted shale embankment fill may become significant due to the proposed height of the approach embankments. Such long-term effects may be minimized with proper breakdown and moisture management of the shale fill materials during compaction operations. Secondary compression and settlement due to shear strain may still occur, even in well compacted fills. For the proposed embankment heights, BBC&M estimates that these settlements may amount to as much as 3 inches of additional settlement over a period of 15 to 20 years.

Site Preparation

All vegetation, topsoil, construction debris, and other unsuitable materials should be removed from proposed embankment construction areas. The entire exposed embankment foundation area should then be proofrolled in accordance with the equipment and guidelines set forth in the Manual of Procedures for Earthwork, Vol. 1, ODOT, January, 1996, and Item 204.06 of the Construction and Material Specifications, ODOT, January 1, 2002, to detect soft, wet, or weak zones which might not have been revealed by the explorations. If weak zones are present or areas begin pumping and weaving because of construction traffic, the materials contained in these zones should be either scarified, dried, and thoroughly compacted in place, or be removed and the overexcavations filled in a controlled manner.

Consideration should be given to surface water diversion. The embankment foundation in areas consisting of cohesive soils should be graded to prevent surface runoff from pooling on the subgrade during construction; exposure of cohesive soils to moisture will result in a decrease in strength and an increase in compressibility.

Fill Material and Placement

It is anticipated that the material which will be used for embankment fill construction will be composed of the soil and rock removed from the large mainline cut sections. Based on the borings performed in the proposed cut areas, this material will consist primarily of silty clay derived from the weathered shale, shale and, to a much lesser extent, sandstone and siltstone. **In order to use these materials as fill, rock fragments (excluding shales) should be broken down to a maximum particle size of 8 inches (ODOT Item 203.06c). The shale, due to its generally weak structure, will require reduction to a maximum particle size of less than 3 inches prior to further processing for use as fill material. Beyond simply breaking down the rock, the shale will also require significant moisture conditioning. Moisture conditioning involves the repeated application of water to the shale stockpile, followed by plowing or discing to thoroughly incorporate the water throughout the material. Fill material derived from the relatively intact and unweathered shale strata will likely posses an in-situ moisture content considerably below the optimum moisture content required for proper compaction and, accordingly, multiple applications of significant quantities of water as well as**

considerable effort will likely be required to properly break down and moisture condition the shale for use in embankment construction. Sources of borrow should be designated well in advance of construction and bulk samples should be procured and tested in a laboratory to determine compaction parameters so that this data will be available for the control of embankment fill prior to the start of construction.

All fill should be thoroughly compacted in accordance with Item 203, "Roadway Excavation and Embankment", of the Construction and Materials Specifications, ODOT, January 1, 2002. It is recommended that all shale fill be compacted at a moisture content in excess of the optimum moisture content. Where new fill is required to be compacted adjacent to existing sloping surfaces, it is recommended that horizontal benches be cut into existing embankments or slopes to permit placement and compaction of new fill in horizontal lifts. Because of the use of soil, shale, sandstone and siltstone as embankment fill materials, the use of conventional compaction control specifications may be difficult. Large variations of materials occurring within a confined area may make conventional density testing impractical and alternative methods of compaction control may be required. These methods could include one-point tests or test strips. Control of moisture and lift thickness should continue to be maintained in situations where alternative test methods are used. Compaction control will likely be more straightforward if care is taken during excavation to avoid mixing the shale or silty clay soil with other types of rock.

Bridge Foundations

A) Type and Installation

It is understood that the proposed S.R. 7 bridge (L & R) over C.R. 104 will most likely be a three-span structure, having a total length of 212 feet. Based on the subsurface conditions encountered in Borings B16-314, B16-315, B-2BP1 and B2EBP1-215, it is recommended that the proposed bridges be supported on steel H-piles driven to refusal in the underlying **intact** very-soft to medium-hard shale or medium-hard limestone bedrock. Weathered bedrock was encountered in all four borings performed at this structure location above the intact bedrock, and therefore the actual elevation at which pile refusal will occur is difficult to predict. At the locations of these four borings, it is estimated that extended foundations will encounter **intact** bedrock at the approximate elevations listed in Table 5.

TABLE 5: Bedrock Depth Information

Boring	Location	Ground Surface Elevation	Approx. Top of Rock Elevation*	Estimated Pile Tip Refusal Elevation**
B16-314	Western (Rear) Abutment	+/- 577	+/- 519	+/- 517
B16-315	Westernmost Intermediate Pier	+/- 566	+/- 517	+/- 515
B-2BP1	Easternmost Intermediate Pier	567.6	515.1	511.0
B2EBP1-215	Eastern (Forward) Abutment	+/- 552	+/- 509	+/- 507

* Approximate elevation of the top of the **intact** very-soft to medium-hard shale (partly similar to hard silty clay) or soft to medium-hard sandstone or coal stratum.

** It should be noted that weathered bedrock consisting of hard silty clay/clayey silt (similar to very-soft shale) or soft sandstone fragments was encountered in all four borings performed at this structure location, and therefore the actual elevation at which pile refusal will occur at these locations is difficult to predict.

It is recommended that a lateral load analysis be performed on all proposed foundations. If insufficient capacity is predicted from this analysis, consideration may be given to the use of socketed drilled shafts in place of the H-piles, to support the proposed bridge. It may also be possible to utilize larger H-pile sections, predrilling bedrock, or H-pile driving shoes to achieve greater bedrock penetration.

Please note that H-pile refusal is defined as less than 1 inch of penetration for 20 blows of the pile hammer. The hammer type should be selected in accordance with Item 507 "Bearing Piles", of the Construction and Materials Specifications, ODOT, January 1, 2002. Testing research has shown that steel H-piles driven to this degree of penetration in rock cannot be forced deeper by static load and, when loaded to the yield point of the steel, will fail instead of the rock. It is recommended that consideration be given to specifying hardened pile tips to reduce the potential for damage of the piles on the medium-hard siltstone and sandstone interbedded with shale bedrock.

It is imperative that all H-piles be advanced below the elevations where intact bedrock was encountered in the borings before being permitted to "refuse".

Steel H-piles driven to refusal in the underlying bedrock may be designed as fully-supported columns with the piles carrying the maximum allowable load of the H-section using AASHTO guidelines. It is estimated that the total settlement of the H-piles will be limited to the elastic compression of the structural members. If battered piles are necessary, they should be placed with inclinations no greater than 1 (horizontal) on 4 (vertical), and the horizontal component of the force should be taken into consideration in the analysis. It is also recommended that H-piles be installed at a center-to-center spacing of no less than 3 times the largest diagonal dimension of the H-section.

It must also be recognized that the structural capacity of the piles may have to be reduced to reflect the possible influence of soil downdrag, if applicable, and this condition is discussed in the following section.

B) Downdrag and Capacity

FHWA foundation design guidelines state that downdrag forces will develop on a pile when more than 10mm (0.39 inches) of settlement occurs within *any* soil layer through which a pile is advanced, including the new roadway embankment fill. The downdrag (or negative skin friction) forces effectively reduce the allowable structural load carrying capacity of the pile section.

In order to mitigate the potential for downdrag forces, and as previously discussed in the "Embankment Settlement" section of this report, BBC&M recommends that the entire proposed roadway embankment be placed well in advance of the bridge construction to permit the anticipated settlements to occur in **both** the new embankment fill and within the significant thickness of potentially compressible soil encountered at this site below the proposed approach embankments.

During construction of the proposed embankments, BBC&M recommends that provisions be made to monitor and record both the total, and rate of, settlement which occurs beneath the new embankment adjacent to this bridge site, both during and after construction. In order to prevent a reduction of the working pile capacity as a result of downdrag, BBC&M recommends that installation of pile foundations not commence until the rate of settlement has been reduced to less than 10 mm (0.39 inches) in three months.

If, however, the construction schedule does not permit this amount of waiting time, the allowable structural load that each H-pile may carry will need to be reduced to reflect downdrag influences. Assuming that each abutment pile is completely "sleeved" through the new embankment fill in order to eliminate the development of downdrag as a result of settlement of the new fill, BBC&M estimates that downdrag forces of 23 tons per HP10x42 pile and 28 tons per HP12x53 pile may develop as a result of settlement of the natural soils below the new proposed eastern embankment. **These downdrag forces effectively reduce the allowable working capacity of an HP10x42 pile to 32 tons per pile, and the allowable working capacity of an HP12x53 pile to 42 tons per pile.**

C) Reducing Downdrag

Downdrag can be reduced or minimized by:

- Construction of the eastern approach embankment prior to pile driving and as early as possible in the construction schedule in order to allow for the maximum amount of time possible for consolidation settlement of the natural foundation soils beneath the new embankment to occur.
- Using lightweight fill materials to construct the eastern approach embankment such as geofoam, foamed concrete or slag.
- Applying special coatings to the pile shaft such as bitumen or plastic wrap. Note that unless the coating is adequately thick, driving the pile through fill and/or sands and gravels may remove some or all of the coating, decreasing its effectiveness.
- Enlarging the pile tip to exceed the shaft diameter will reduce shaft friction.
- Using pile sleeves to eliminate direct contact between the pile shaft and the new embankment fill soils. The pile sleeves should be installed during construction of the geogrid reinforced embankment, so that the piles can be installed at a later date without disturbing the embankment reinforcement. Sections of sleeving, up to the bottom of the abutment footing, should be added as the embankment height increases or an oversized steel pipe pile sleeve can be driven after construction of the reinforced embankment. It is recommended that consideration be given to specifying hardened/sharpened pile tips on the oversized steel pipe pile sleeves to reduce the potential for damage of the geogrid-reinforcement in the previously constructed embankment. During reinforced embankment construction, care should be exercised to keep the sleeving as near to vertical as possible. The sleeving should be either smooth or corrugated galvanized steel pipe or PVC pipe. The sleeving should be filled with sand following installation of the piles and just prior to abutment footing construction.

Groundwater and Excavation Considerations

Based upon observations made at the time of this investigation, significant groundwater problems are not anticipated in connection with the proposed embankment construction.

However, seepage may be encountered in utility and culvert excavations at depths greater than 3 feet below the existing ground surface elevation. Although typically limited in quantity, such seepage may flood excavations allowed to remain open for extended periods of time and may contribute to instability of the excavation walls. To prevent caving, provisions should be made to brace the walls of excavations in accordance with OSHA excavation guidelines. Sloughing and caving of open excavation walls should be anticipated where any granular seams and lenses are encountered. Water should not be permitted to accumulate in the bottom of excavations. Soil softened by standing water or disturbed by construction activities should be removed before proceeding with construction.

Lateral Earth Pressures

The bridge abutments must be designed to withstand lateral earth pressures, as well as hydrostatic pressures, that may develop behind the structures. The magnitude of the lateral earth pressure varies on the basis of soil type, permissible abutment movement and abutment height.

To minimize lateral pressures, the zone behind the bridge abutments should be backfilled with granular soils and the backfill should be effectively drained. For effective drainage, a zone of free-draining gravel, such as ODOT Item 703 (No. 57 stone), should be used directly behind the abutments for a minimum thickness of two to three feet along practically the entire height of the structure. This granular zone should provide drainage to either weepholes or a pipe drain, so that hydrostatic pressures do not develop against the abutments. The type of backfill beyond the drain will, however, govern the magnitude of the horizontal pressure to be used for structural design. Lateral pressures of a relatively low magnitude will be developed by the use of free-draining granular backfill (soils containing no more than 10 percent passing a No. 200 sieve), whereas a cohesive (clay) backfill will result in creep and the development of much higher pressures with time. The granular backfill should be placed in a wedge formed by the back of the abutment wall and a line rising from the base of the footing (or pile cap) at a maximum 60-degree angle from the horizontal. Granular backfill placed behind these structures should be compacted in accordance with Item 203, "Embankment Compaction", of the Construction and Materials Specifications, Department of Transportation, State of Ohio. Overcompaction in areas directly behind the abutments should be avoided as this might cause damage to the structures.

If proper drainage is provided and the granular backfill material is placed and compacted as specified, an equivalent fluid unit weight of 40 pounds per cubic foot (lb/ft^3) may be used when a movement equivalent to 1.8/1000 times the height of the structure (H) is allowed to occur (ie., the "active" earth pressure condition). In this case, the resultant lateral force should be taken as acting at 0.42 (H). If "at-rest" conditions are expected -- that is to say

-- no lateral wall movement can occur, an equivalent fluid unit weight of 55 lb/ft^3 should be used for design of the abutments.

If granular backfill is used and compacted as specified without providing either a pipe drain or weepholes, an undrained equivalent fluid unit weight of 85 lb/ft^3 should be used if the above-mentioned wall movement is allowed to occur. If "at-rest" conditions are expected without providing the proper drainage, an undrained equivalent fluid unit weight of 95 lb/ft^3 should be used for design.

Compacted cohesive materials tend alternatively to shrink, expand, and creep over periods of time and create significant lateral pressures. Because of the long-term adverse effects, it is believed that, if proper drainage is provided, an equivalent fluid unit weight of 80 lb/ft^3 should be used for design of the abutment walls. Without proper drainage, the design should be based on an equivalent fluid unit weight of 105 lb/ft^3.

We appreciate being given the opportunity to be of continued service on this project. If you have any questions, or require additional information, please do not hesitate to contact this office.

Respectfully submitted,

BBC&M ENGINEERING, INC.
Dublin, Ohio

Steven A. Hurt

STATE OF OHIO
STEVEN
A.
HURT
E-67092
REGISTERED
PROFESSIONAL ENGINEER

Steven A. Hurt, P.E.
Project Engineer

Richard L. Williams, Ph.D., P.E.
Vice President/Chief Engineer

SAH/sh

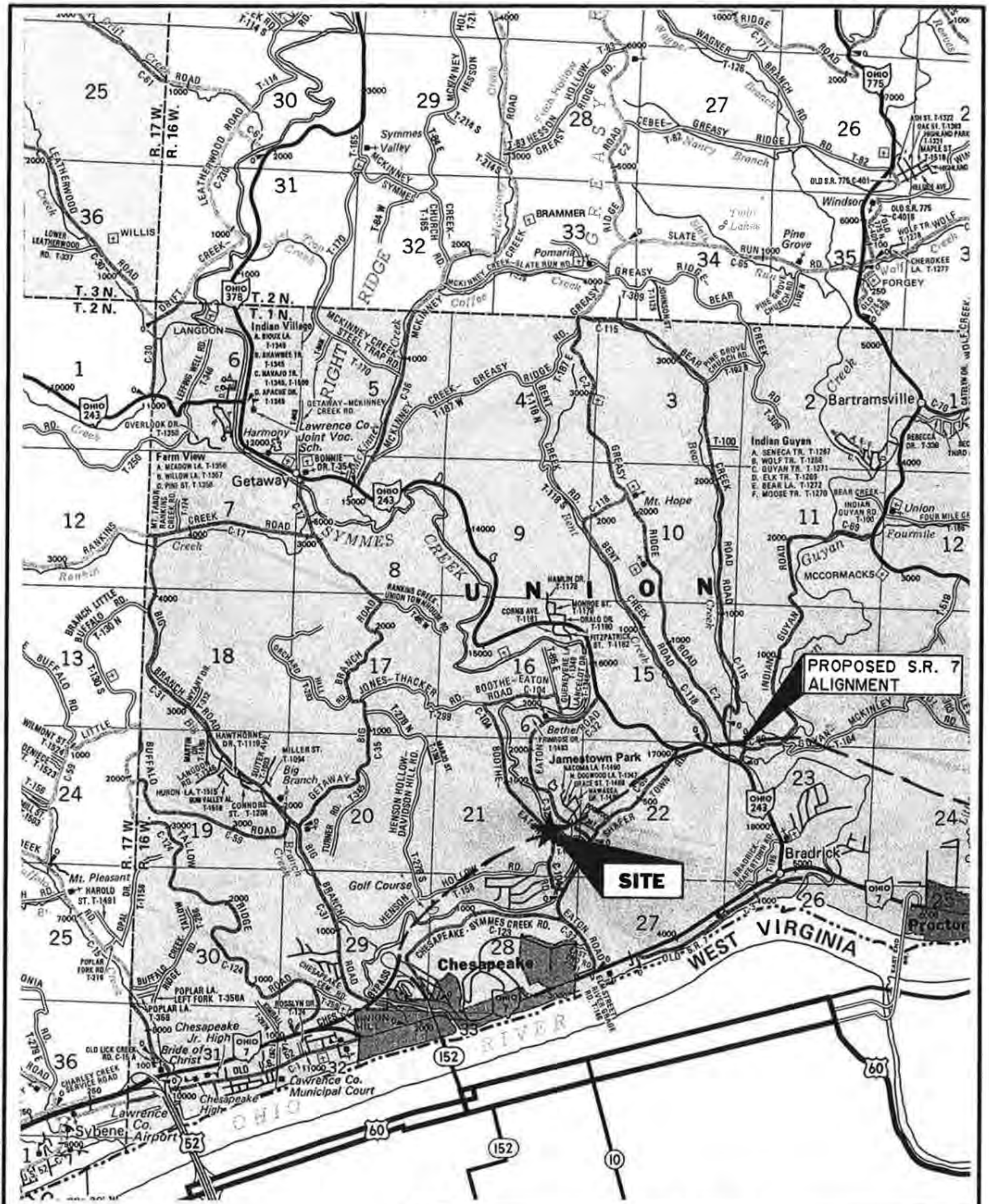
Attachments: Appendix A:

- **Plate 1** - Vicinity Map
- **Plate 2** - Plan of Borings
- **Plates 3 and 4** - Explanation of the Boring Log Symbols and Terms
- **Plates 5 through 12** - Boring Logs
- **Plates 13 and 14** - Summary of Laboratory Test Results

Appendix B:

- **Plates 1 through 3** - Critical Failure Surfaces for Short Term, Long Term and Rapid Drawdown ***Unreinforced*** Slope Stability Analyses at Sta. 197+50
- **Plates 4 and 5** - Critical Failure Surfaces for Long Term and Rapid Drawdown ***Reinforced*** Slope Stability Analyses at Sta. 197+50
- **Plates 6 and 7** - Critical Failure Surfaces for Rapid Drawdown ***Unreinforced*** and ***Reinforced*** Slope Stability Analyses Along Centerline of the Proposed Eastern Approach Embankment

APPENDIX A



VICINITY MAP

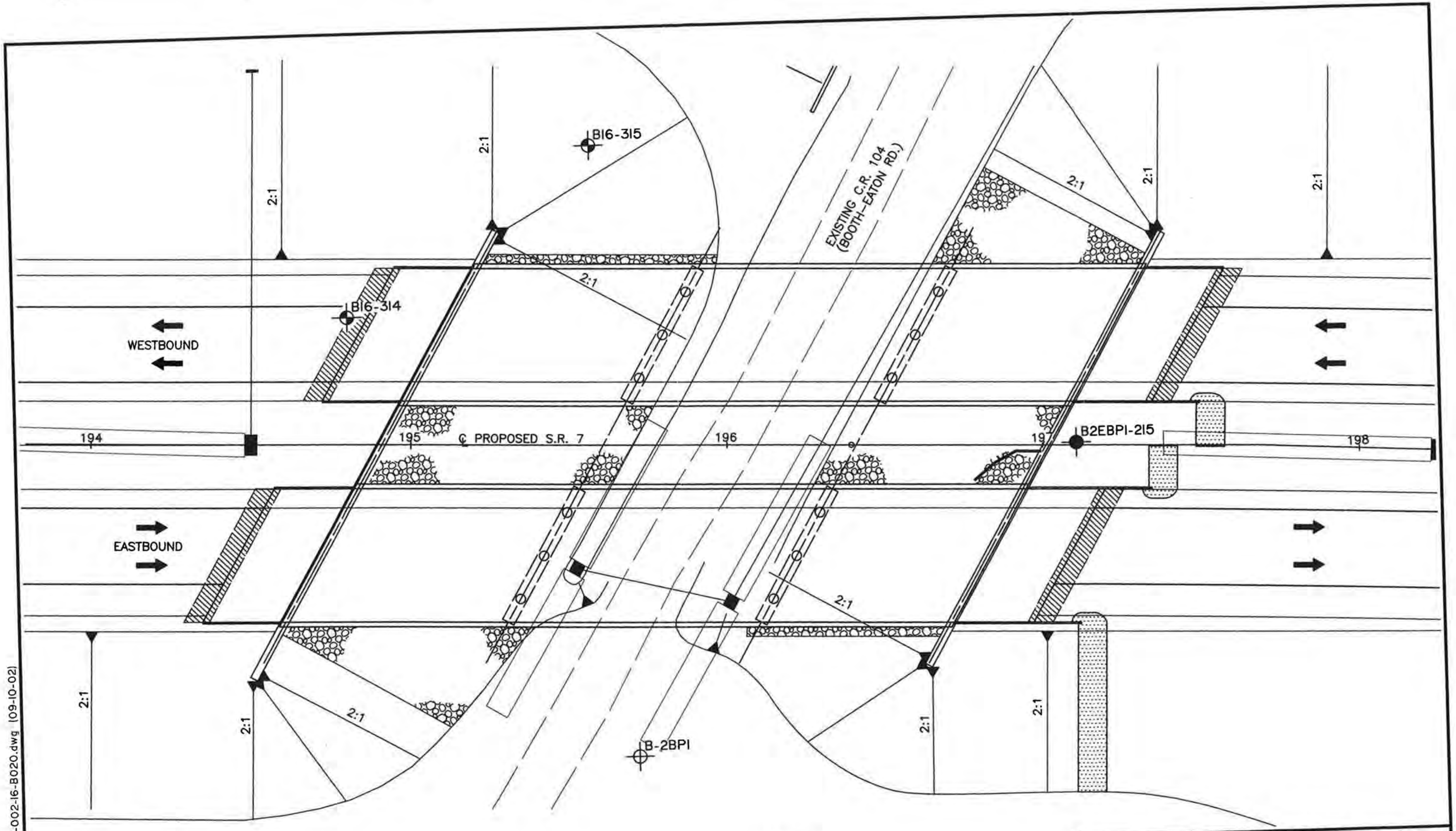
BRIDGE NO. LAW-7-0369 L&R
S.R. 7 OVER C.R. 104
LAWRENCE CO., OHIO

Project: 011-06405-002	Drawn By: DJH
Drawing Date: 9/03/02	Approved By: SAH
Revision Date:	Scale:

BBCM
Columbus
(614) 793-2226
Cleveland
(440) 585-9995
Cincinnati
(513) 771-8471

BBC&M Filename: Drawing2.dwg (09-03-02)

PLATE I



LEGEND

⊕ B-2BPI	PRIMARY INVESTIGATION (1998) BORING NUMBER AND LOCATION
● B2EBPI-215	SECONDARY INVESTIGATION (2000) BORING NUMBER AND LOCATION
⊕ B16-314	BORING NUMBER AND LOCATION (2002)

PLAN OF BORINGS

BRIDGE NO. LAW-7-0369 L&R
S.R. 7 OVER C.R. 104
LAWRENCE CO., OHIO

Project: 011-06405-002	Drawn By: DJH
Drawing Date: 9/03/02	Approved By: SAH
Revision Date:	Scale: 1" = 30'

BBCM
Columbus
(614) 793-2226
Cleveland
(440) 585-9995
Cincinnati
(513) 771-8471

PLATE 2

BBC&M Filename: 011-06405-002-16-B020.dwg (09-10-02)

EXPLANATION OF SYMBOLS AND TERMS USED ON BORING LOGS

SAMPLING DATA

▮ - Blocked-in "SAMPLES" column indicates sample was attempted and recovered within this depth interval.

▯ - Sample was attempted within this interval but not recovered.

2/5/9 - The number of blows required for each 6-inch increment of penetration of a "Standard" 2-inch O.D. split-barrel sampler, driven a distance of 18 inches by a 140-pound hammer freely falling 30 inches. Addition of one of the following symbols indicates the use of a split-barrel other than the 2" O.D. sampler:

2S - 2½"O.D. split-barrel sampler

3S - 3" O.D. split-barrel sampler

P - Shelby tube sampler, 3" O.D., hydraulically pushed.

R - Refusal of sampler in very-hard or dense soil, or on a resistant surface.

50-2" - Number of blows (50) to drive a split-barrel sampler a certain number of inches (2), other than the normal 6-inch increment.

S/D - Split-barrel sampler (S) advanced by weight of drill rods (D),

S/H - Split-barrel sampler (S) advanced by combined weight of rods and drive hammer (H).

SOIL DESCRIPTIONS - All soils have been classified basically in accordance with the Unified Soil Classification System, but this system has been augmented by the use of special adjectives to designate the approximate percentages of minor components as follows:

Adjective	Percent by Weight
trace	1 to 10
little	11 to 20
some	21 to 35
"and"	36 to 50

The following terms are used to describe density and consistency of soils:

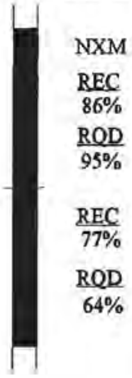
Term (Granular Soils)	Blows per foot
Very-loose	Less than 5
Loose	5 to 10
Medium-dense	11 to 30
Dense	31 to 50
Very-dense	Over 50

Term (Cohesive Soils)	Qu (tsf)
Very-soft	Less than 0.25
Soft	0.25 to 0.5
Medium-stiff	0.5 to 1.0
Stiff	1.0 to 2.0
Very-stiff	2.0 to 4.0
Hard	Over 4.0

PLATE 3

EXPLANATION OF SYMBOLS AND TERMS USED ON BORING LOGS FOR SAMPLING AND DESCRIPTION OF ROCK

SAMPLING DATA



When bedrock is encountered and rock core samples are attempted, the "SAMPLING EFFORT" column is used to record the type of core barrel used (NXM), the percentage of core recovered (REC) for each run of the sampler, and the Rock Quality Designation (RQD) value. Rock-core barrels can be of either single- or double-tube construction, and a special series of double-tube barrels, designated by the suffix M, is commonly used to obtain maximum core recovery in very-soft or fractured rock. Three basic groups of barrels are used most often in subsurface investigations for engineering purposes, and these groups and the diameters of the cores obtained are as follows:

AX, AW, AXM, AWM - 1⅛ inches
BX, BW, BXM, BWM - 1⅝ inches
NX, NW, NXM, NWM - 2⅛ inches

Rock Quality Designation (RQD) is expressed as a percentage and is obtained by summing the total length of all core pieces which are at least 4 inches long and then dividing this sum by the total length of core run. It has been found that there is a reasonably good relationship between the RQD value and the general quality of rock for engineering purposes. This relationship is shown as follows:

RQD - %	General Quality
0 - 25	Very-poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

ROCK HARDNESS

The following terms are used to describe rock hardness:

Term	Meaning	Mohs' Hardness
Very-soft	Rock such as shale can be easily picked apart by the fingers. Sandstone is poorly cemented and very friable. The rock resembles hard clay or dense sand, but has rock structure.	Less than 1
Soft	Rock such as shale, siltstone or limestone can be scratched or powdered by fingernail pressure. Sandstone is mostly poorly cemented, and individual sand grains can be separated from the main rock mass by a fingernail.	1 to 1½
Medium-hard	Rock cannot be scratched by a fingernail, but can be powdered by a knife. Sandstone is mostly well cemented, but individual grains can be removed by scratching with a knife.	2½ to 5½
Hard	Rock is well cemented and cannot be powdered by a knife. Rock can be powdered by a steel file.	5½ to 6½
Very-hard	Rock cannot be scratched by a steel file and the core sample rings when struck with a hammer.	Greater than 6½

BBCM

LOG OF BORING NO. B16-314
PHASE 2 SUBSURFACE INVESTIGATION, LAW-7-2.17
LAWRENCE COUNTY, OHIO

TYPE: **3-1/4" I.D. Hollow-stem Auger**
3-7/8" Tricone Bit w/ Drilling Mud
2" O.D. Split-barrel Sampler
NX Rock Core Barrel

LOCATION: **Sta. 194+80, 40' Lt. of Proposed SR 7 Centerline**

COMPLETION DEPTH: **63.5'** ELEVATION: **577+/-** DATE: **5/1/02 - 5/2/02**

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													EXISTING GRAVEL DRIVEWAY - 1 INCH
	1	■	2/4/5	2.6-4.5									Very-stiff to hard brown mottled with gray silty clay, trace to little fine to coarse sand, trace fine gravel, contains few silt lenses, desiccated.
5	2	■	4/6/9	3.7-4.5									
	3	■	10/12/13	4.5+	22	40	24	0	0	1	33	66	
10	4	■	12/16/15	4.2-4.5									A-6b (10)
	5	■	3/6/9	4.5+									Very-stiff to hard brown silty clay, trace to little fine to coarse sand, trace fine gravel, contains silt lenses.
15	6	■	6/7/8	4.5+									
	7	■	5/7/10	3.0-4.5									Est. A-6b
20	8	■	4/6/8	2.7-4.5+									Very-stiff to hard reddish-brown silty clay, little to some fine to coarse sand, trace fine to coarse gravel.
	9	■	7/13/14	2.3-4.5									
25	10	■	5/8/11	3.0-3.7									Est. A-6a
	11	■	5/9/10	2.3-3.6									Very-stiff reddish-brown mottled with dark-gray silty clay, some fine to coarse sand, trace to little fine to coarse gravel, contains few sand pockets, few cobbles.
30 ∇													
	12	■	10/10/14	2.2-2.7	16	31	18	15	12	32	19	22	A-6a (2)
35													

WATER LEVEL: ∇ **30.0**
WATER NOTE: **Before Mud Rotary**
DATE: **5/02/02**

LOG OF BORING NO. B16-314
PHASE 2 SUBSURFACE INVESTIGATION, LAW-7-2.17
LAWRENCE COUNTY, OHIO

TYPE: **3-1/4" I.D. Hollow-stem Auger**
3-7/8" Tricone Bit w/ Drilling Mud
2" O.D. Split-barrel Sampler
NX Rock Core Barrel

LOCATION: **Sta. 194+80,**
40' Lt. of Proposed
SR 7 Centerline

COMPLETION DEPTH: **63.5'** ELEVATION: **577+/-** DATE: **5/1/02 - 5/2/02**

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
				tsf	%	%	%						
35													Very-stiff reddish-brown mottled with dark-gray silty clay, some fine to coarse sand, trace to little fine to coarse gravel, contains few sand pockets, few cobbles.
	13		5/9/11	2.0-2.9									
40													
													A-6a (2)
													Stiff to very-stiff reddish-brown silty clay interbedded with many seams and pockets of fine to medium sand, trace fine to coarse gravel.
	14		6/6/10	1.5-2.2									
45													
	15		3/7/17	2.0-2.7									
50													
													Est. A-6a
													Hard reddish-brown mottled with gray and brown silty clay, similar to very soft shale, little fine to coarse sand, trace fine gravel.
	16		12/21/34	4.5+									
55													
	18		50-0"R										Visual
			NX										Soft to medium-hard gray shale interbedded with siltstone, nearly horizontally bedded, few diagonal fractures.
60	17		REC 87% RQD 83%										
													Visual
65													- No seepage or groundwater encountered before switching to mud rotary at 17.5'.
70													

WATER LEVEL: ▽ 30.0
WATER NOTE: **Before Mud Rotary**
DATE: **5/02/02**

ODOTLJ 16405002.GPJ BBCM.GDT 9/9/02

LOG OF BORING NO. B16-315
PHASE 2 SUBSURFACE INVESTIGATION, LAW-7-2.17
LAWRENCE COUNTY, OHIO

TYPE: **3-1/4" I.D. Hollow-stem Auger**
2" O.D. Split-barrel Sampler
NX Rock Core Barrel

LOCATION: **Sta. 195+56,**
95' Lt. of Proposed
SR 7 Centerline

COMPLETION DEPTH: 55.0' **ELEVATION: 566+/-** **DATE: 5/2/02 - 5/3/02**

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												EXISTING GRAVEL DRIVEWAY - 1 INCH
	1	4/4/4	3.4-4.3									Very-stiff to hard brown mottled with gray silty clay, little to some fine to coarse sand, trace fine to coarse gravel, contains few fine to medium sand seams, desiccated, contains few roots.
5	2	4/5/7	2.1-2.9									Est. A-6b
	3	5/7/10	2.4-4.5									Very-stiff to hard brown mottled with reddish-brown silty clay, some to "and" fine to coarse sand, trace fine gravel.
10	4	13/15/17	3.2-4.5									
	5	6/7/13	3.5-4.5+	13	31	18	15	8	25	25	27	A-6a (5)
15	6	9/10/12										Medium-dense brown and reddish-brown fine to coarse sand, "and" silty clay, trace fine gravel.
	7	10/13/13										Est. A-1-b
20	8	4/5/11	2.4-3.7									Very-stiff reddish-brown mottled with gray silty clay, little to some fine to coarse sand, trace fine to coarse gravel.
	9	3/4/6	2.4-3.1	20	35	19	0	1	17	37	45	
25	10	4/4/7	1.5-3.5									A-6b (10)
	11	3/5/7	2.9-3.1									Very-stiff reddish-brown mottled with brown and gray silty clay, little becoming "and" fine to coarse sand, trace fine to coarse gravel, contains few fine sand and silt lenses.
30												
	∇ 12	5/5/5	1.4-3.8									Est. A-6a
35												

WATER LEVEL: ∇ **34.0**
WATER NOTE: **Before Rock Coring**
DATE: **5/03/02**

-CONTINUED-

BBCM

LOG OF BORING NO. B16-315
PHASE 2 SUBSURFACE INVESTIGATION, LAW-7-2.17
LAWRENCE COUNTY, OHIO

TYPE: **3-1/4" I.D. Hollow-stem Auger**
2" O.D. Split-barrel Sampler
NX Rock Core Barrel

LOCATION: **Sta. 195+56,**
95' Lt. of Proposed
SR 7 Centerline

COMPLETION DEPTH: **55.0'** ELEVATION: **566+/-** DATE: **5/2/02 - 5/3/02**

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
35													Very-stiff reddish-brown mottled with brown and gray silty clay, little becoming "and" fine to coarse sand, trace fine to coarse gravel, contains few fine sand and silt lenses. Est. A-6a
													Loose to medium-dense brown fine to medium sand, trace coarse sand, little to some silt, trace clay.
	13	■	2/3/5					0	1	78	21		
40													
	14	■	5/6/7										
45													A-3a (0)
													Hard reddish-brown mottled with gray silty clay, little fine to coarse sand, trace fine to coarse gravel, similar to very-soft shale. Visual
	15A 15B	■	4/7/50	4.5+									Soft gray fine-grained sandstone fragments. Visual
50	15C												
	16	■	NX REC 82% RQD 51%										Soft to medium-hard reddish-brown and light-gray shale, nearly horizontally bedded, few diagonal and vertical clay filled fractures. Visual
55													
60													- Encountered seepage from 38.5' to 45.0'. - Lost partial water circulation below 52.0' while rock coring.
65													
70													

WATER LEVEL: ∇ **34.0**
WATER NOTE: **Before Rock Coring**
DATE: **5/03/02**

BBCM

LOG OF BORING NO. B-2BP1
LAW-7, PRELIMINARY SUBSURFACE INVESTIGATION
LAWRENCE COUNTY, OHIO

TYPE: **3-1/4" I.D. Hollow-stem Auger**
2" O.D. Split-barrel Sampler
NXM Rock-core Barrel

LOCATION: **Sta. 2+512.11**
29.86m Rt.
Alt. B4 Centerline
Metric

COMPLETION DEPTH: 66.5' **ELEVATION:** 567.6(ft) **DATE:** 10/29/98

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 4 INCHES Hard brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel. Est. A-7-6
	1	5/7/9	4.5+									
5	2	5/7/8	4.5+									Hard brown becoming brown mottled with gray silty clay, trace fine to coarse sand. A-7-6(13)
	3	4/5/7	4.5+	22	44	23	0	1	5	24	70	
10	4	5/7/10	4.5+									
	5	5/5/9	4.5+	25								
15	6	4/6/8	4.5+									
	7	7/7/7		13	24	17	26	12	28	14	20	Medium-dense brown fine to coarse sand, some clayey silt, little fine to coarse gravel. A-2-4(0)
∇ 20	8	4/6/8	3.2-4.2									Very-stiff to hard brown mottled with dark-brown silty clay, trace fine sand, contains silt seams and lenses. Est. A-7-6
												Very-stiff to hard brown mottled with gray silty clay, some fine to coarse sand, little becoming some fine to coarse gravel. Est. A-6a
25	9	3/4/7	3.0-4.0	18								
30	10	6/7/10	4.5+									
35												

WATER LEVEL:	∇ 19.2	▼	∇	∇	∇	▼	
WATER NOTE:	**After Rock Coring**						
DATE:	**10/29/98**						

BBCM

LOG OF BORING NO. B-2BP1
LAW-7, PRELIMINARY SUBSURFACE INVESTIGATION
LAWRENCE COUNTY, OHIO

TYPE: **3-1/4" I.D. Hollow-stem Auger**
2" O.D. Split-barrel Sampler
NXM Rock-core Barrel

LOCATION: **Sta. 2+512.11**
29.86m Rt.
Alt. B4 Centerline
Metric

COMPLETION DEPTH: **66.5'** **ELEVATION:** **567.6(ft)** **DATE:** **10/29/98**

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	AGG.	C.S.	F.S.	SILT	CLAY
35	11	3/6/11	2.5-2.75	14	29	17					
40	12	3/4/7	2.7-3.2								
45	13	7/9/12	2.5-4.5+	17							
50	14	5/13/12									
55	15	8/21/33									
	16	NXM REC 98% RQD 98% NXM REC									
60											
	17	REC 93% RQD 57% REC									
65											
70											

DESCRIPTION - CONTINUED

Very-stiff to hard brown mottled with gray silty clay, some fine to coarse sand, little becoming some fine to coarse gravel.
Est. A-6a

Very-stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel.
Est. A-7-6

Very-stiff to hard brown silty clay, "and" fine to coarse sand, little fine to coarse gravel.
Est. A-6a

Medium-dense brown fine to coarse gravel, some fine to coarse sand, little silty clay.
Est. A-2-6

Very-soft to soft gray weathered shale, nearly horizontally bedded, partly similar to hard silty clay.
Visual

Medium-hard light-gray limestone, nearly horizontally bedded.
Visual

Very-soft gray weathered shale, nearly horizontally bedded, partly similar to hard silty clay, becoming carbonaceous with depth.
Visual

Medium-hard black coal, nearly horizontally bedded.
Visual

Very-soft to soft gray weathered shale, partly similar to silty clay, nearly horizontally bedded with many fractures.
Visual

- Encountered water at 52.5'.

WATER LEVEL:	∇ **19.2**	▼	∇	∇	∇	▼
WATER NOTE:	**After Rock Coring**					
DATE:	**10/29/98**					

BBCM

LOG OF BORING NO. B2EBP1-215
PHASE 2 SUBSURFACE INVESTIGATION, LAW-7-2.17
LAWRENCE COUNTY, OHIO

TYPE: **4-1/4" I.D. Hollow-stem Auger**
2" O.D. Split-barrel Sampler
NX Rock Core Barrel

LOCATION: **Sta. 197+9.5, 1' Lt. of proposed SR 7 centerline**

COMPLETION DEPTH: **51.0'** **ELEVATION:** **552+/-** **DATE:** **4/5/00**

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
			tsf	%	%	%						
0												TOPSOIL - 6 INCHES
												Very-stiff to hard brown silty clay, trace fine to coarse sand, trace fine to coarse gravel, slightly organic.
	1	3/5/10	3.0-4.25									
5												Est. A-6a
												Medium-dense to dense brown, gray and reddish-brown fine to coarse sand, "and" clayey silt, trace to little fine to coarse gravel, few silt seams, contains sandstone and shale fragments.
	2	8/15/20		11	27	19	7	24	33	36		
	3	7/13/14										
10												Est. A-4a (0)
												Very-stiff to hard brown mottled with gray and reddish-brown silty clay, little to some fine to coarse sand, trace to little fine to coarse gravel, contains sandstone and shale fragments.
	4	5/10/13	4.5+									
15												
	5	7/14/24	4.5+									
	6	4/9/19	2.0-4.5+									
20	7	7/18/26	3.0-4.5+									Est. A-6a
	8	9/18/27		14	26	21	13	22	31	34		Dense brown and gray fine to coarse sand, some clayey silt, trace fine gravel.
												A-3a (0)
												Very-stiff to hard brown silty clay, little fine to coarse sand, trace fine to coarse gravel, contains sandstone fragments.
25	9	3/9/12	2.0-4.5+									Est. A-6a
												Medium-stiff to stiff brown mottled with gray silty clay, trace fine to medium sand.
	10	2/2/5	0.5-1.25									Est. A-6a
30												Very-stiff to hard brown mottled with gray silty clay, trace fine to medium sand, few silt seams.
	11	4/6/14	3.0-4.5+									
	12	5/8/10	2.0-3.0									
35												Est. A-6a

WATER LEVEL: ▽ ▼ ▽ ▽ ▽ ▼
WATER NOTE:
DATE:

-CONTINUED-

BBCM

LOG OF BORING NO. B2EBP1-215
PHASE 2 SUBSURFACE INVESTIGATION, LAW-7-2.17
LAWRENCE COUNTY, OHIO

TYPE: **4-1/4" I.D. Hollow-stem Auger**
2" O.D. Split-barrel Sampler
NX Rock Core Barrel

LOCATION: **Sta. 197+9.5, 1' Lt. of proposed SR 7 centerline**

COMPLETION DEPTH: **51.0'** ELEVATION: **552+/-** DATE: **4/5/00**

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
35	13		3 / 6 / 9										Medium-dense becoming very-loose brown fine to medium sand, trace coarse sand, trace fine gravel, trace to little clayey silt.
	14		S/D-18"					0	10	84	6		A-3 (0)
40													Hard (est.) gray mottled with brown silty clay, similar to very-soft shale.
													Medium-hard to hard black coal. Visual
45	15		REC 87% RQD 40%										Very-soft to soft gray shale, nearly horizontally bedded, similar to hard silty clay, fragmented below 50.5'.
	16		REC 80% RQD 67%										Visual
50													
55													-Encountered water at 35.0
60													
65													
70													

WATER LEVEL: ▽ ▼ ▽ ▼ ▽ ▼
WATER NOTE:
DATE:

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC %	LL %	PL %	PI %	AGGREGATE %	COARSE SAND %	FINE SAND %	SILT %	CLAY %	SILT/CLAY %	D / 50 mm	D / 90 mm	HRB ODOT CLASSIFICATION
B-2BP1	**7.75**	**22**	**44**	**23**	**21**	**0**	**1**	**5**	**24**	**70**			**0.0466**	**A-7-6(13)**
B-2BP1	**12.75**	**25**												
B-2BP1	**17.75**	**13**	**24**	**17**	**7**	**26**	**12**	**28**	**14**	**20**		**0.2331**	**8.7666**	**A-2-4(0)**
B-2BP1	**25.25**	**18**												
B-2BP1	**35.25**	**14**	**29**	**17**	**12**									
B-2BP1	**45.25**	**17**												

BBCM

PROJECT LAW-7, PRELIMINARY SUBSURFACE INVESTIGATION
LOCATION LAWRENCE COUNTY, OHIO
JOB NO. 01106405.001 DATE 9/10/02

SUMMARY OHDOT (PORTRAIT)

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC %	LL %	PL %	PI %	AGGREGATE %	COARSE SAND %	FINE SAND %	SILT %	CLAY %	SILT/CLAY %	D / 50 m m	D / 90 m m	HRB ODOT CLASSIFICATION
B2EBP1-215	6.75	**11**	**27**	19	**8**	**7**	**24**	**33**			**36**	**0.1757**	**1.6705**	**A-4a(0)**
B2EBP1-215	21.25	**14**	**26**	**21**	**5**	**13**	**22**	**31**			**34**	**0.2067**	**2.7344**	**A-3a(0)**
B2EBP1-215	38.25					**0**	**10**	**84**			**6**	**0.2713**	**0.4250**	
B16-314	9.25	**22**	**40**	**24**	**16**	**0**	**0**	**1**	**33**	**66**			**0.0362**	**A-6b(10)**
B16-314	34.25	**16**	**31**	**18**	**13**	**15**	**12**	**32**	**19**	**22**		**0.1380**	**3.7621**	**A-6a(2)**
B16-315	13.25	**13**	**31**	**18**	**13**	**15**	**8**	**25**	**25**	**27**		**0.0637**	**6.3954**	**A-6a(4)**
B16-315	23.25	**20**	**35**	**19**	**16**	**0**	**1**	**17**	**37**	**45**		**0.0071**	**0.1486**	**A-6b(10)**
B16-315	39.25					**0**	**1**	**78**			**21**	**0.1450**	**0.3496**	

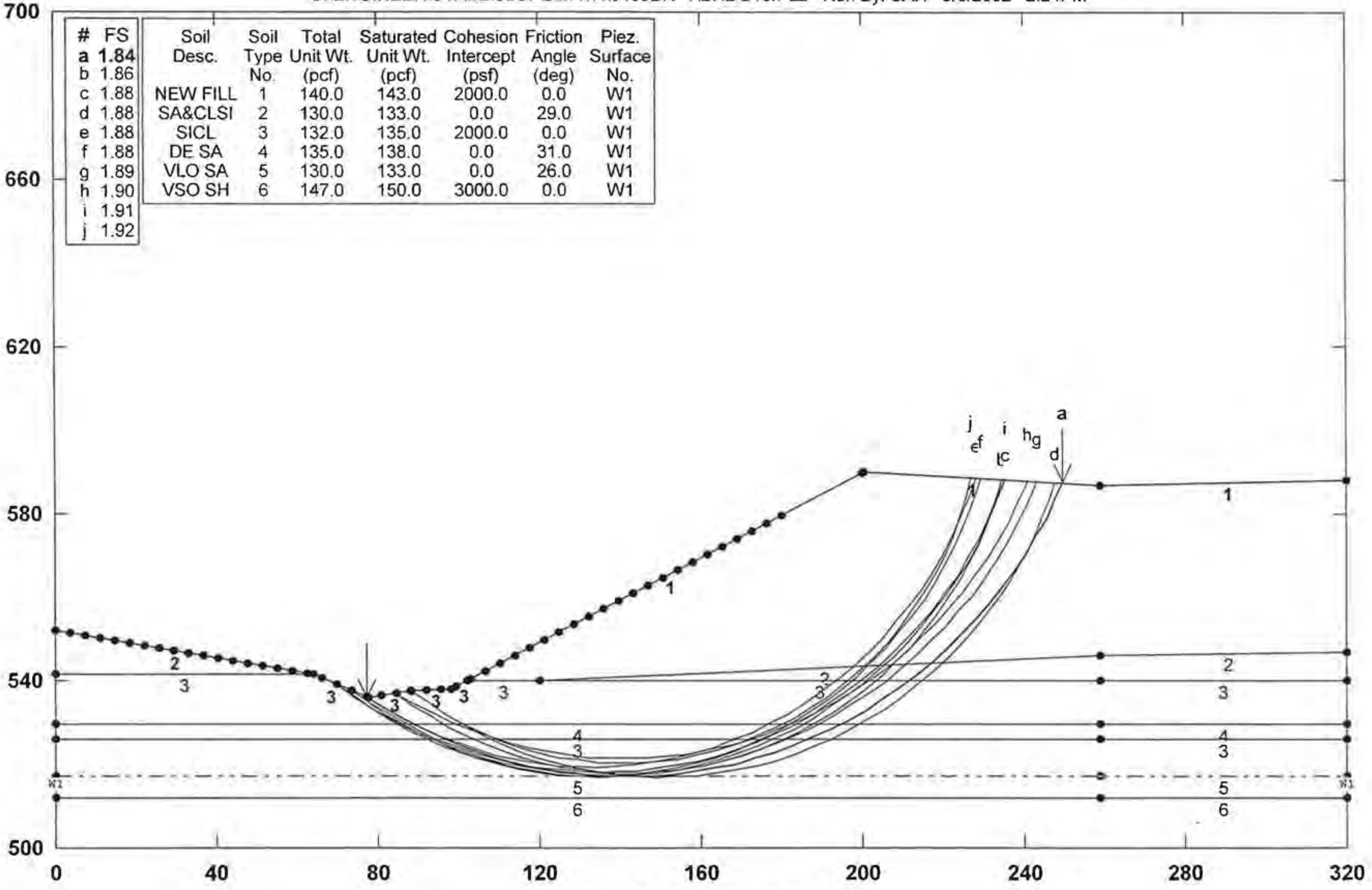
BBCM

PROJECT PHASE 2 SUBSURFACE INVESTIGATION, LAW-7-2.17
LOCATION LAWRENCE COUNTY, OHIO
JOB NO. 01106405.002 DATE 9/9/02

APPENDIX B

LAW-7, Bridge-16, Sta. 197+50, 2:1 Approach Embankment, Short Term

C:\ENGINEER\STABL\SLOPE\DATA\6405BR~1\BRDG16.PL2 Run By: SAH 9/8/2002 2:24PM



#	FS
a	**1.84**
b	1.86
c	1.88
d	1.88
e	1.88
f	1.88
g	1.89
h	1.90
i	1.91
j	1.92

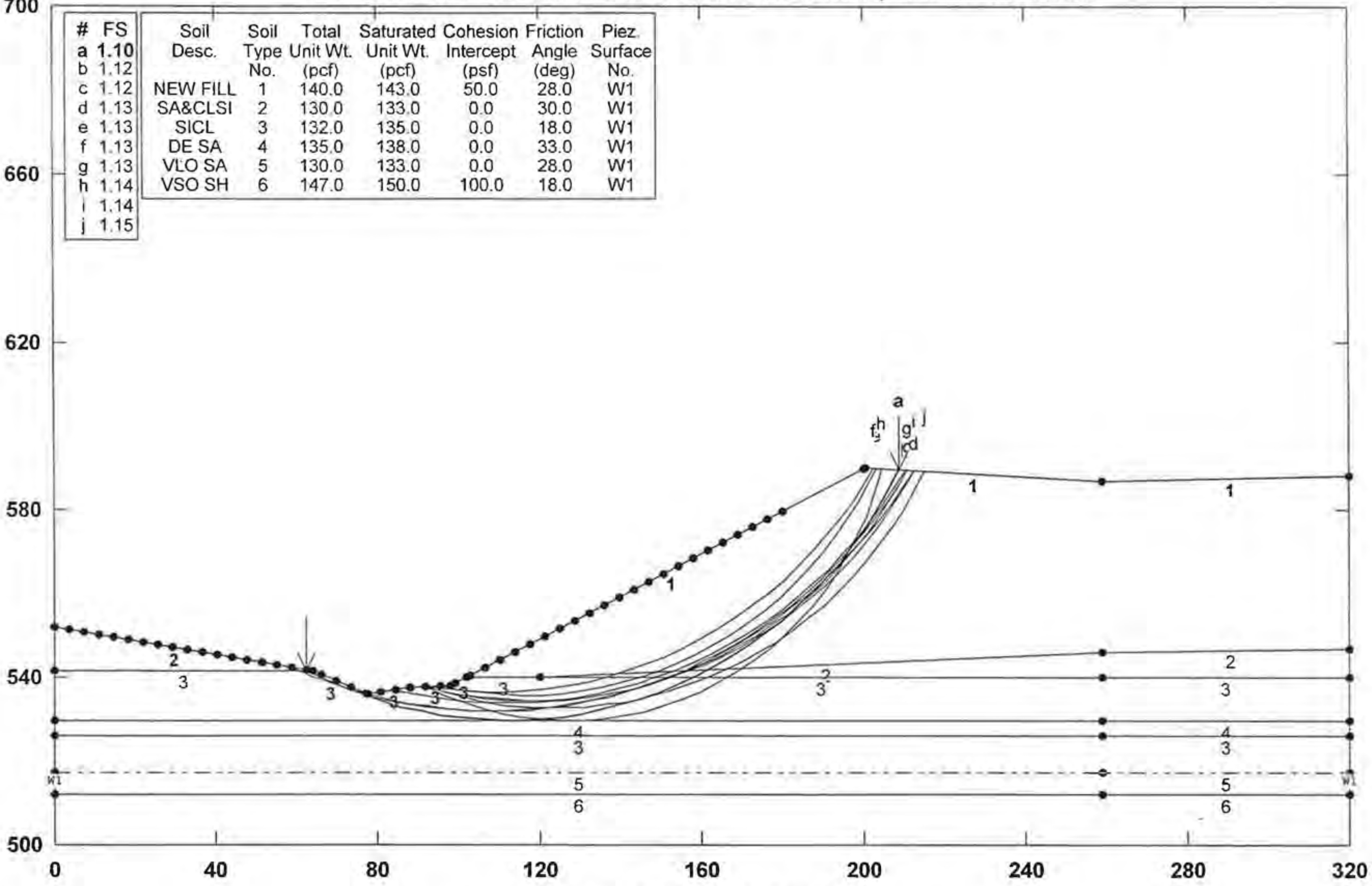
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
NEW FILL	1	140.0	143.0	2000.0	0.0	W1
SA&CLSI	2	130.0	133.0	0.0	29.0	W1
SICL	3	132.0	135.0	2000.0	0.0	W1
DE SA	4	135.0	138.0	0.0	31.0	W1
VLO SA	5	130.0	133.0	0.0	26.0	W1
VSO SH	6	147.0	150.0	3000.0	0.0	W1

PCSTABL5M/si FSmin=1.84

Safety Factors Are Calculated By The Modified Bishop Method

STED

PLATE 1



LAW-7, Bridge-16, Sta. 197+50, 2:1 Approach Embankment, LongTerm

C:\ENGINEER\STABL\SLOPE\DATA\6405BR~1\BRDG16A.PL2 Run By: SAH 9/8/2002 2:23PM

#	FS
a	**1.10**
b	1.12
c	1.12
d	1.13
e	1.13
f	1.13
g	1.13
h	1.14
i	1.14
j	1.15

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
NEW FILL	1	140.0	143.0	50.0	28.0	W1
SA&CLSI	2	130.0	133.0	0.0	30.0	W1
SICL	3	132.0	135.0	0.0	18.0	W1
DE SA	4	135.0	138.0	0.0	33.0	W1
VLO SA	5	130.0	133.0	0.0	28.0	W1
VSO SH	6	147.0	150.0	100.0	18.0	W1

PCSTABL5M/si FSmin=1.10

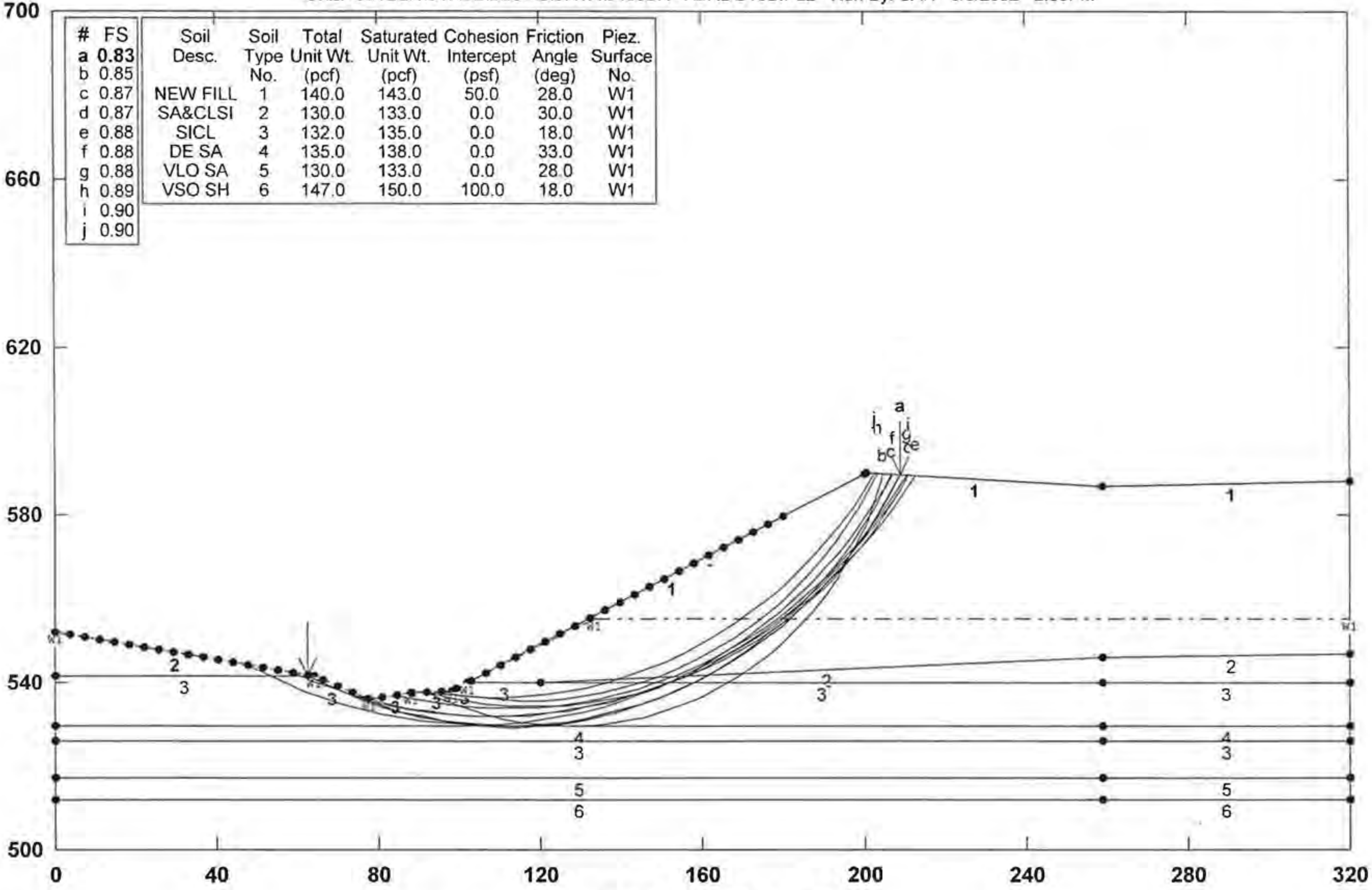
Safety Factors Are Calculated By The Modified Bishop Method

STED

PLATE 2

LAW-7, Bridge-16, Sta. 197+50, 2:1 Approach Embankment, Rapid Drawdown

C:\ENGINEER\STABL\SLOPE\DATA\6405BR~1\BRDG16B.PL2 Run By: SAH 9/8/2002 2:30PM



#	FS
a	**0.83**
b	0.85
c	0.87
d	0.87
e	0.88
f	0.88
g	0.88
h	0.89
i	0.90
j	0.90

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
NEW FILL	1	140.0	143.0	50.0	28.0	W1
SA&CLSI	2	130.0	133.0	0.0	30.0	W1
SICL	3	132.0	135.0	0.0	18.0	W1
DE SA	4	135.0	138.0	0.0	33.0	W1
VLO SA	5	130.0	133.0	0.0	28.0	W1
VSO SH	6	147.0	150.0	100.0	18.0	W1

PCSTABL5M/si FSmin=0.83

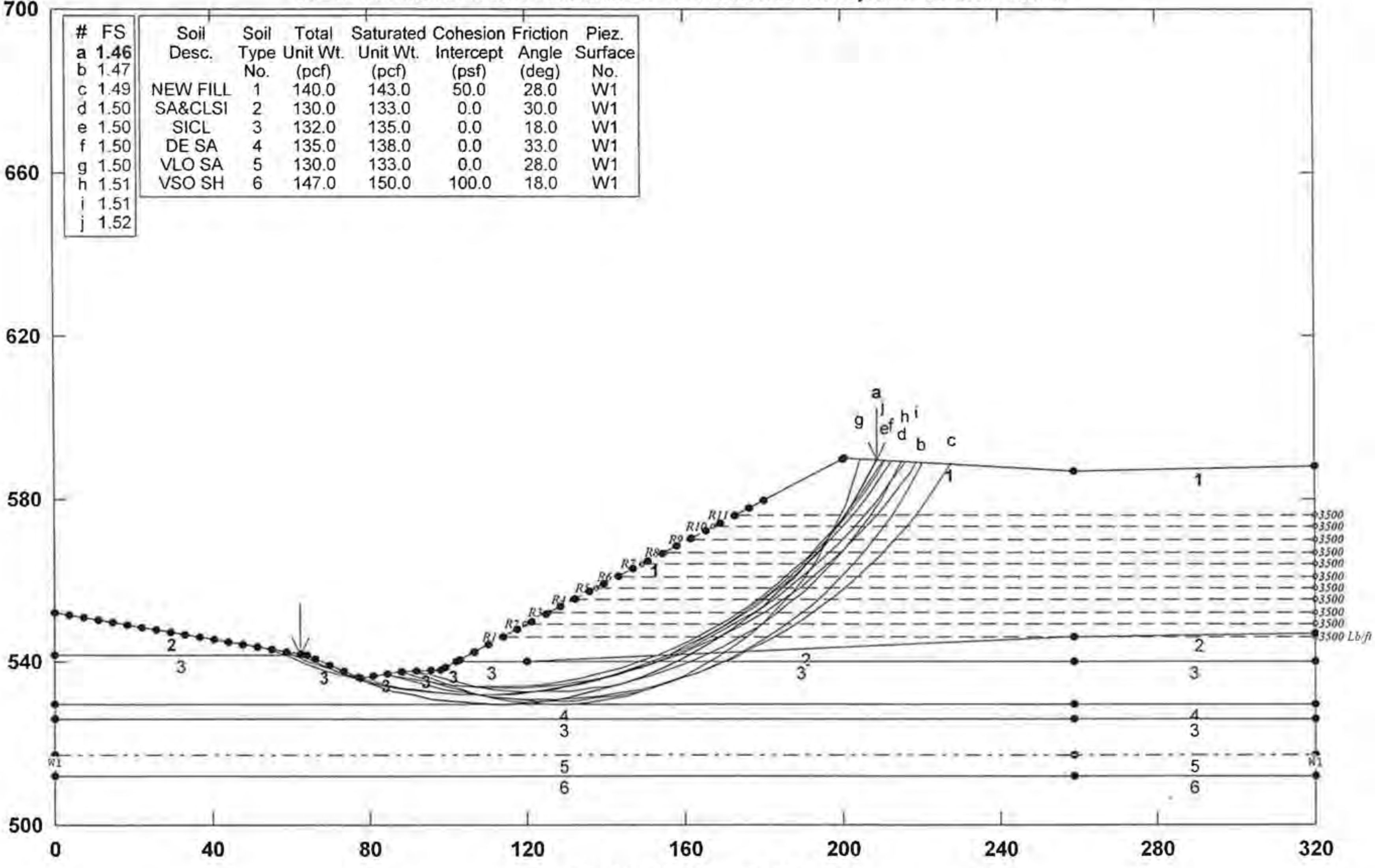
Safety Factors Are Calculated By The Modified Bishop Method

STED

PLATE 3

LAW-7, Bridge-16, Sta. 197+50, 2:1 Reinforced Embankment, LongTerm

C:\ENGINEER\STABL\SLOPE\DATA\6405BR~1\BRDG16C.PL2 Run By: SAH 9/8/2002 2:35PM



#	FS
a	**1.46**
b	1.47
c	1.49
d	1.50
e	1.50
f	1.50
g	1.50
h	1.51
i	1.51
j	1.52

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
NEW FILL	1	140.0	143.0	50.0	28.0	W1
SA&CLSI	2	130.0	133.0	0.0	30.0	W1
SICL	3	132.0	135.0	0.0	18.0	W1
DE SA	4	135.0	138.0	0.0	33.0	W1
VLO SA	5	130.0	133.0	0.0	28.0	W1
VSO SH	6	147.0	150.0	100.0	18.0	W1

STABL6H FSmin=1.46

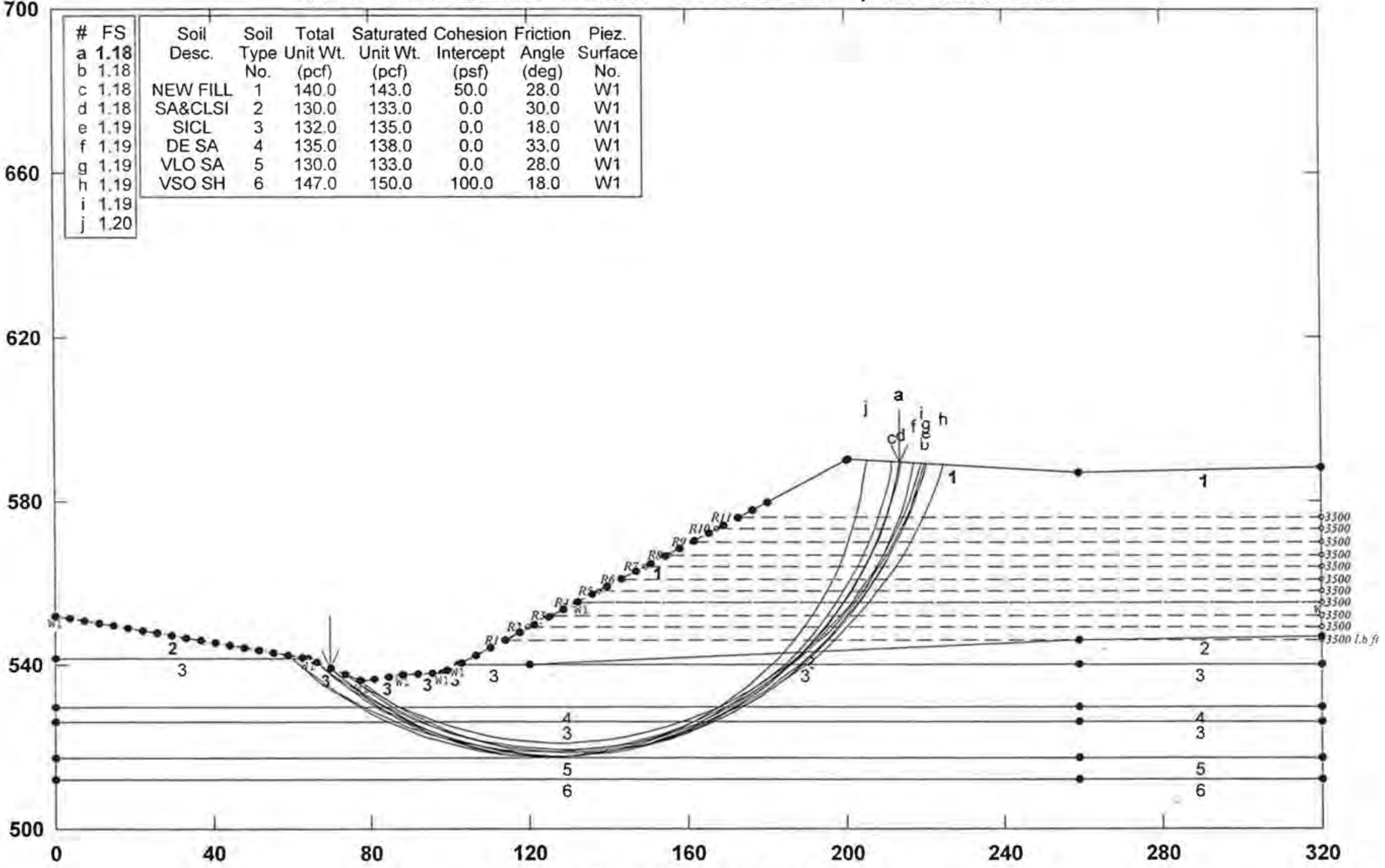
Safety Factors Are Calculated By The Modified Bishop Method

STED

PLATE 4

LAW-7, Bridge-16, Sta. 197+50, 2:1 Reinforced Embankment, Rapid Drawdown

C:\ENGINEER\STABL\SLOPE\DATA\6405BR~1\BRDG16D.PL2 Run By: SAH 9/8/2002 2:39PM



#	FS
a	**1.18**
b	1.18
c	1.18
d	1.18
e	1.19
f	1.19
g	1.19
h	1.19
i	1.19
j	1.20

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
NEW FILL	1	140.0	143.0	50.0	28.0	W1
SA&CLSI	2	130.0	133.0	0.0	30.0	W1
SICL	3	132.0	135.0	0.0	18.0	W1
DE SA	4	135.0	138.0	0.0	33.0	W1
VLO SA	5	130.0	133.0	0.0	28.0	W1
VSO SH	6	147.0	150.0	100.0	18.0	W1

STABL6H FSmin=1.18

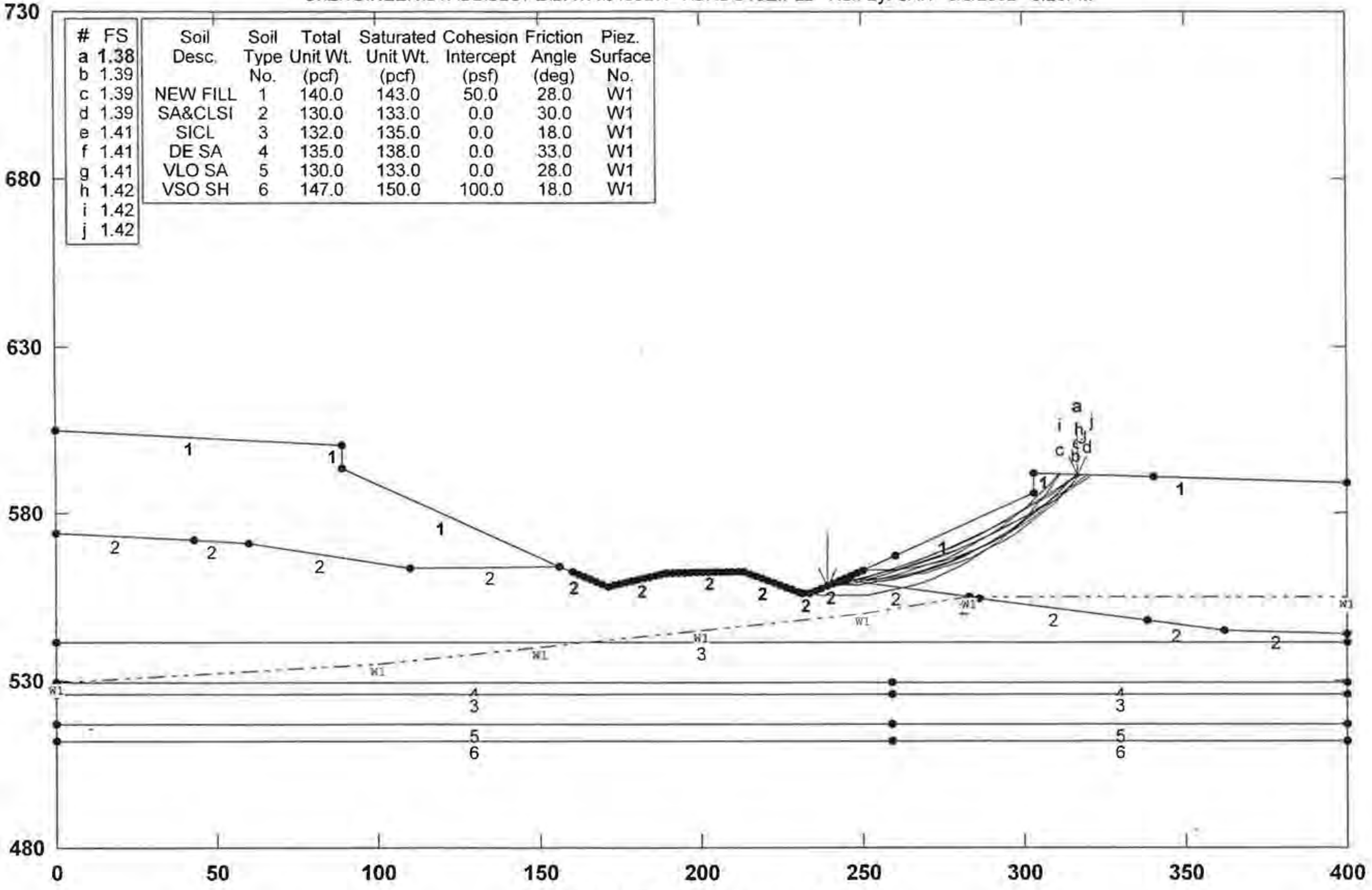
Safety Factors Are Calculated By The Modified Bishop Method

STED

PLATE 5

LAW-7, Bridge-16, 2:1 Eastern Abutment Foreslope, Rapid Drawdown

C:\ENGINEER\STABL\SLOPE\DATA\6405BR~1\BRDG16E.PL2 Run By: SAH 9/8/2002 3:20PM



#	FS
a	1.38
b	1.39
c	1.39
d	1.39
e	1.41
f	1.41
g	1.41
h	1.42
i	1.42
j	1.42

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
NEW FILL	1	140.0	143.0	50.0	28.0	W1
SA&CLSI	2	130.0	133.0	0.0	30.0	W1
SICL	3	132.0	135.0	0.0	18.0	W1
DE SA	4	135.0	138.0	0.0	33.0	W1
VLO SA	5	130.0	133.0	0.0	28.0	W1
VSO SH	6	147.0	150.0	100.0	18.0	W1

PCSTABL5M/si FSmin=1.38

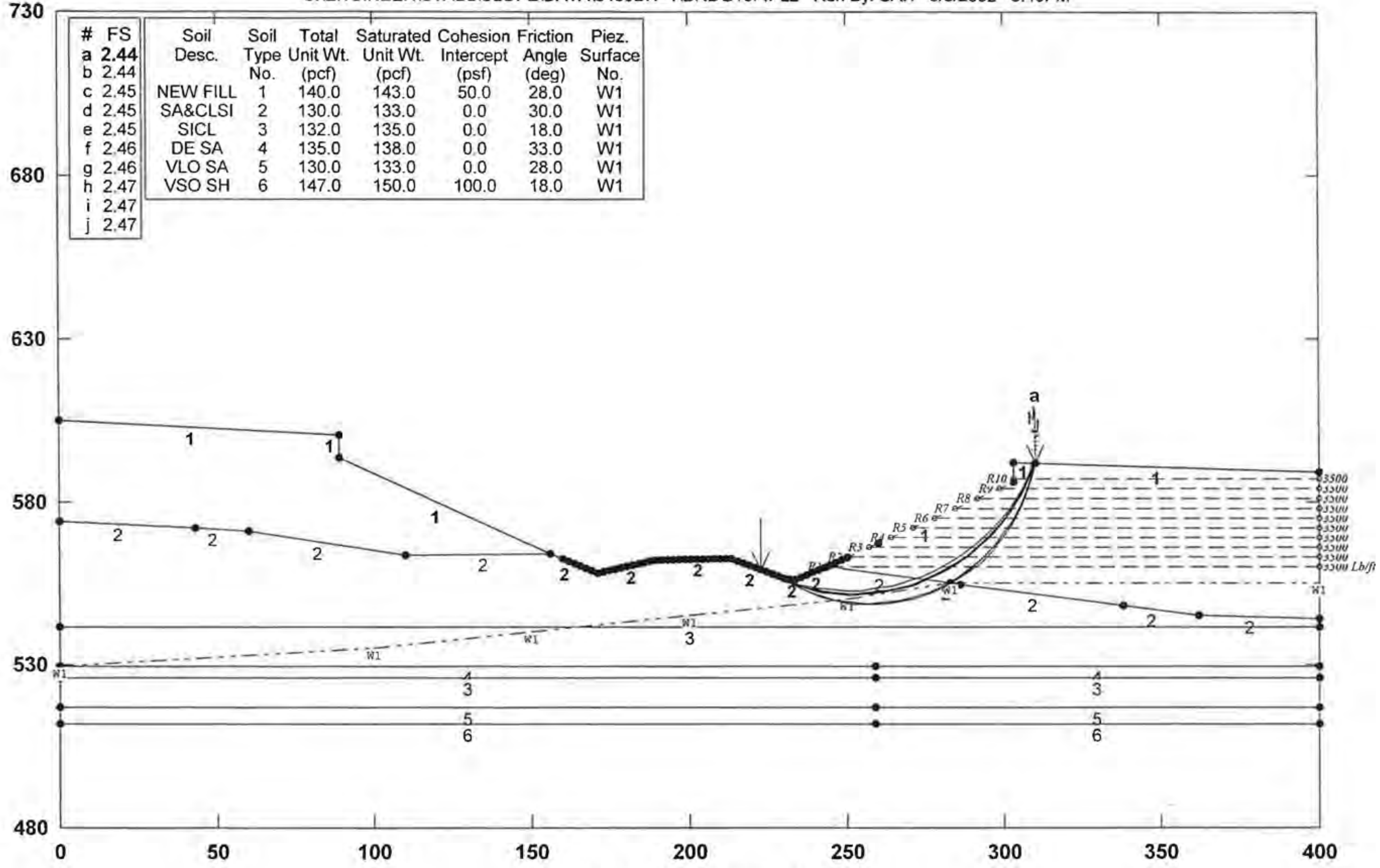
Safety Factors Are Calculated By The Modified Bishop Method

STED

PLATE 6

LAW-7, Bridge-16, 2:1 Eastern Abutment Foreslope, Rapid Drawdown-Reinforced

C:\ENGINEER\STABL\SLOPE\DATA\6405BR~1\BRDG16F.PL2 Run By: SAH 9/8/2002 3:40PM



#	FS
a	**2.44**
b	2.44
c	2.45
d	2.45
e	2.45
f	2.46
g	2.46
h	2.47
i	2.47
j	2.47

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
NEW FILL	1	140.0	143.0	50.0	28.0	W1
SA&CLSI	2	130.0	133.0	0.0	30.0	W1
SICL	3	132.0	135.0	0.0	18.0	W1
DE SA	4	135.0	138.0	0.0	33.0	W1
VLO SA	5	130.0	133.0	0.0	28.0	W1
VSO SH	6	147.0	150.0	100.0	18.0	W1

STABL6H FSmin=2.44

Safety Factors Are Calculated By The Modified Bishop Method

STED

PLATE 7

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 6/4/21 09:12 - \\US0268-PPFSS01\SHARED_PROJECTS\1736\173608714 (173609006) LAW-7-2.17\GINT LOGS-IN PROGRESS\173

PROJECT: LAW - 7 - 2.17
TYPE: STRUCTURE
PID: 75923 SFN: N/A
START: 5/1/13 END: 5/1/13

DRILLING FIRM / OPERATOR: HORN / T.L.
SAMPLING FIRM / LOGGER: HORN / T.L.
DRILLING METHOD: 3.25" HSA / NQ
SAMPLING METHOD: SPT/ST/NQ

DRILL RIG: CME 55 TRACK
HAMMER: CME AUTOMATIC
CALIBRATION DATE: 4/30/13
ENERGY RATIO (%): 85.9

STATION / OFFSET: 196+24, 100' LT.
ALIGNMENT: MAINLINE
ELEVATION: 565.5 (MSL) EOB: 58.7 ft.
LAT / LONG: 38.447742, -82.436578

EXPLORATION ID
B-009-1-12

PAGE
1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV. 565.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI			
MEDIUM STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE TO NO GRAVEL, MOIST			1 1 2	4	100	SS-1	-	-	-	-	-	-	-	-	-	21	A-4a (V)	
		2.5	0 0 0	0	100	SS-2	-	0	0	29	44	27	29	19	10	23	A-4a (7)	
		5.0	3 2 2	6	100	SS-3	-	-	-	-	-	-	-	-	-	24	A-4a (V)	
	556.0	7.5			92	ST-4	-	12	14	27	27	20	27	17	10	10	A-4a (2)	
VERY STIFF TO HARD, BROWN, **SILT AND CLAY**, AND SAND, TRACE GRAVEL, DAMP TO MOIST		10.0	5 11 10	30	100	SS-5	-	-	-	-	-	-	-	-	-	13	A-6a (V)	
		12.5			100	ST-6	-	9	14	28	23	26	28	16	12	-	A-6a (3)	
		15.0	4 10 8	26	100	SS-7	-	-	-	-	-	-	-	-	-	17	A-6a (V)	
	546.0	17.5	6 6 7	19	100	SS-8	-	-	-	-	-	-	-	-	-	19	A-6a (V)	
VERY STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, MOIST		20.0			100	ST-9	-	0	1	16	38	45	35	17	18	-	A-6b (11)	
		22.5	4 7 8	21	100	SS-10	-	-	-	-	-	-	-	-	-	21	A-6b (V)	
		25.0	4 5 6	16	100	SS-11	-	-	-	-	-	-	-	-	-	24	A-6b (V)	
		27.5	4 6 7	19	100	SS-12	-	-	-	-	-	-	-	-	-	20	A-6b (V)	
	533.5	30.0	3 3 4	10	100	SS-13	-	-	-	-	-	-	-	-	-	18	A-6b (V)	
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT AND CLAY, WET		W 532.5 32.5	6 7 7	20	100	SS-14	-	0	1	74	14	11	NP	NP	NP	25	A-3a (0)	
		35.0	4 4 6	14	100	SS-15	-	-	-	-	-	-	-	-	-	23	A-3a (V)	

PID: 75923	SFN: N/A	PROJECT: LAW - 7 - 2.17	STATION / OFFSET: 196+24, 100' LT.	START: 5/1/13	END: 5/1/13	PG 2 OF 2	B-009-1-12

MATERIAL DESCRIPTION AND NOTES	ELEV. 528.8	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG				ODOT CLASS (GI)	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI	WC		
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT AND CLAY, WET *(continued)*		37.5																
		40.0	3 8 8	23	100	SS-16	-	-	-	-	-	-	-	-	-	22	A-3a (V)	
		42.5																
	520.2	TR 45.0	6 13 17	43	100	SS-17A	-	-	-	-	-	-	-	-	-	17	A-3a (V)	
MUDSTONE, BROWN, SEVERELY WEATHERED, (AUGERED).						SS-17B	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	516.8	47.5																
MUDSTONE, GRAY AND BROWN, SLIGHTLY WEATHERED, WEAK, THIN BEDDED, GRAY SANDSTONE SEAM 51.3' - 52.2', COAL SEAM 55.5' - 55.9'; RQD 8%, REC 94%.		50.0 52.5	17		90	NQ-1											CORE	
	506.8	55.0 57.5 EOB	0		98	NQ-2											CORE	

NOTES: BORING LOCATION ESTIMATED FROM CADD DRAWING.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 100 GAL. BENTONITE GROUT

Appendix C

ODOT CPT Soundings Report

CONE PENETRATION TEST SOUNDINGS REPORT

Office of Geotechnical Engineering
Division of Engineering

Project: LAW-7-2.17
PID: 75923
Date: November 17, 2021
Number of Soundings: 7
Equipment: A.P. van den Berg, 23 Ton Crawler, Hyson 200kN

Sounding ID	Completion Date	Probe SN	Calibration Date	Elevation	Latitude	Longitude	Depth (ft.)
C-009-2-21	11/8/2021	090304	8/19/2020	562.5	38.447334°	-82.436009°	47.80
C-009-3-21	11/8/2021	160701	1/29/2019	562.0	38.447604°	-82.436058°	50.36
C-009-4-21	11/8/2021	200723	10/12/2020	562.8	38.447618°	-82.436062°	24.52
C-009-5-21	11/9/2021	090304	8/19/2020	562.5	38.447588°	-82.436053°	44.51
C-013-1-21	11/9/2021	160701	1/29/2019	561.3	38.44887°	-82.433455°	65.82
C-013-2-21	11/9/2021	090304	8/19/2020	560.7	38.449142°	-82.43351°	63.87
C-013-3-21	11/9/2021	200723	10/12/2020	560.5	8.449152°	-82.433503°	28.54

Project Information

Seven soundings were completed for this project. The static water levels reported on the attached logs were determined from dissipation tests. The dissipation test data indicates soundings C-009-4-21 and C-013-3-21 did not encounter the static water level. The latitude, longitude, and elevation values for the soundings are from a Trimble Geo7X handheld GPS with an external Trimble Tornado antenna utilizing the ODOT VRS network.

After completing soundings C-009-4-21 and C-013-3-21, Geokon 350 kPa (51 psi) drive point vibrating wire piezometers were installed. At sounding C-009-4-21, a vibrating wire piezometer was installed at a depth of 29.77 feet. At sounding C-013-3-21, a vibrating wire piezometer was installed at depth of 33.70 feet. The vibrating wire piezometers were data logged during the installation and continue to be logged. The data collected as of November 16, 2021 is presented in the attached vibrating wire piezometer data summary pages.

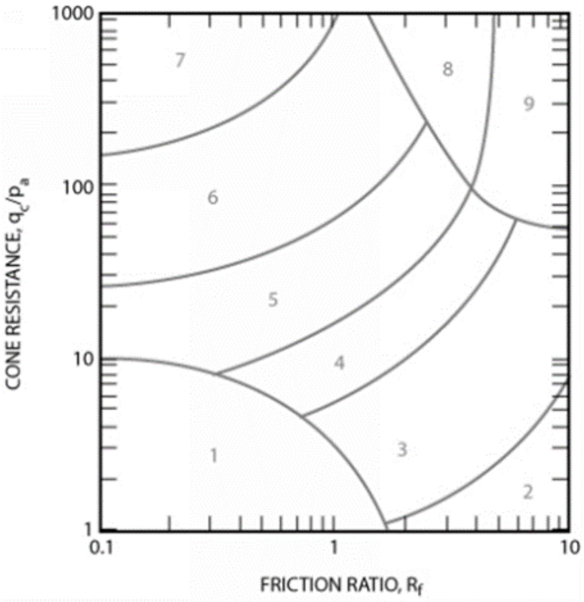
The raw CPT data and vibrating wire piezometer data is is available upon request. The included CPT logs and vibrating wire piezometer pressure data are for informational purposes only. The CPT logs have been filtered for negative values, corrected for inclination at depth, and filtered for data spikes. Additionally, for each sounding, the measured values of q_c and f_s were shifted relative to one another with a cross correlation function.

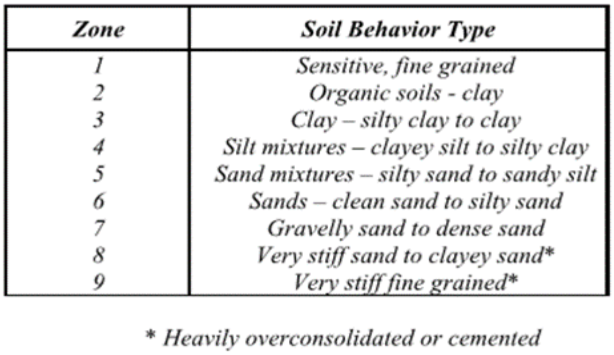
Cone Penetration Test Data and Interpretation

These Cone Penetration Test (CPT) Soundings follow ASTM D 5778 and were made by ordinary and conventional methods and with care deemed adequate for the Department’s design purposes. Since subsurface conditions outside each CPT sounding are unknown, and soil, rock, and water conditions cannot be relied upon to be consistent or uniform, no warrant is made that conditions adjacent to this sounding will necessarily be the same as or similar to those shown in this report.

The CPT data collected are presented as graphical plots in the report, generated by CPeT-IT software. The plots include interpreted Soil Behavior Type (SBT) based on the method described by Robertson (2010). The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed.

The department does not warrant the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software. Furthermore, the Department will not be responsible for an interpretations, assumptions, projections, or interpolations made by the contractor, or other users of this report. While the Department believes that the information as to the condition and materials reported is accurate, it does not warrant that the information is necessarily complete. Water pressure measurements and subsequent interpreted water levels shown in this report should be used with discretion since they represent dynamic conditions. Dynamic pore water pressure measurements may deviate substantially from hydrostatic conditions, especially in cohesive soils.





Zone	*Soil Behavior Type*
1	*Sensitive, fine grained*
2	*Organic soils - clay*
3	*Clay – silty clay to clay*
4	*Silt mixtures – clayey silt to silty clay*
5	*Sand mixtures – silty sand to sandy silt*
6	*Sands – clean sand to silty sand*
7	*Gravelly sand to dense sand*
8	*Very stiff sand to clayey sand**
9	*Very stiff fine grained**

** Heavily overconsolidated or cemented*

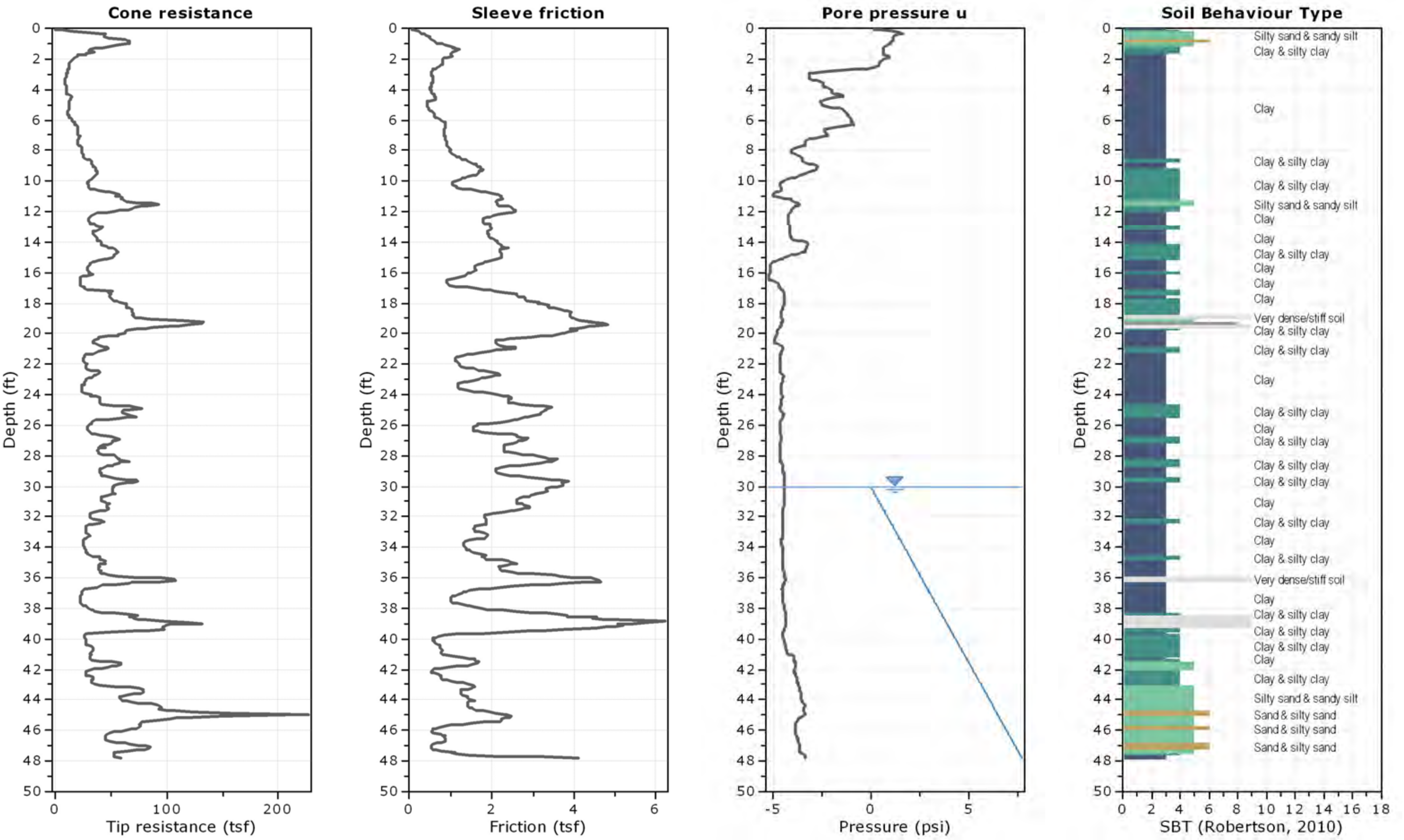
Non-normalized CPT Soil Behavior Type (SBT) chart

Robertson, P.K. and Cabal, K.L, 2016. *Guide to Cone Penetration Testing for Geotechnical Engineering, 6th Edition.* Signal Hill, California: 34.
http://www.greggdrilling.com/wp-content/uploads/2017/07/CPT-Guide-6th-Edition-2016.pdf
Accessed May 21, 2019

Office of Geotechnical Engineering
Geology, Exploration and, Laboratory Section
http://www.dot.state.oh.us/Divisions/Engineering/Geotechnical

CPT: C-009-2-21
Total depth: 47.80 ft, Date: 11/8/2021
Surface Elevation: 562.5 ft
Coords: lat 38.447334° lon -82.436009°

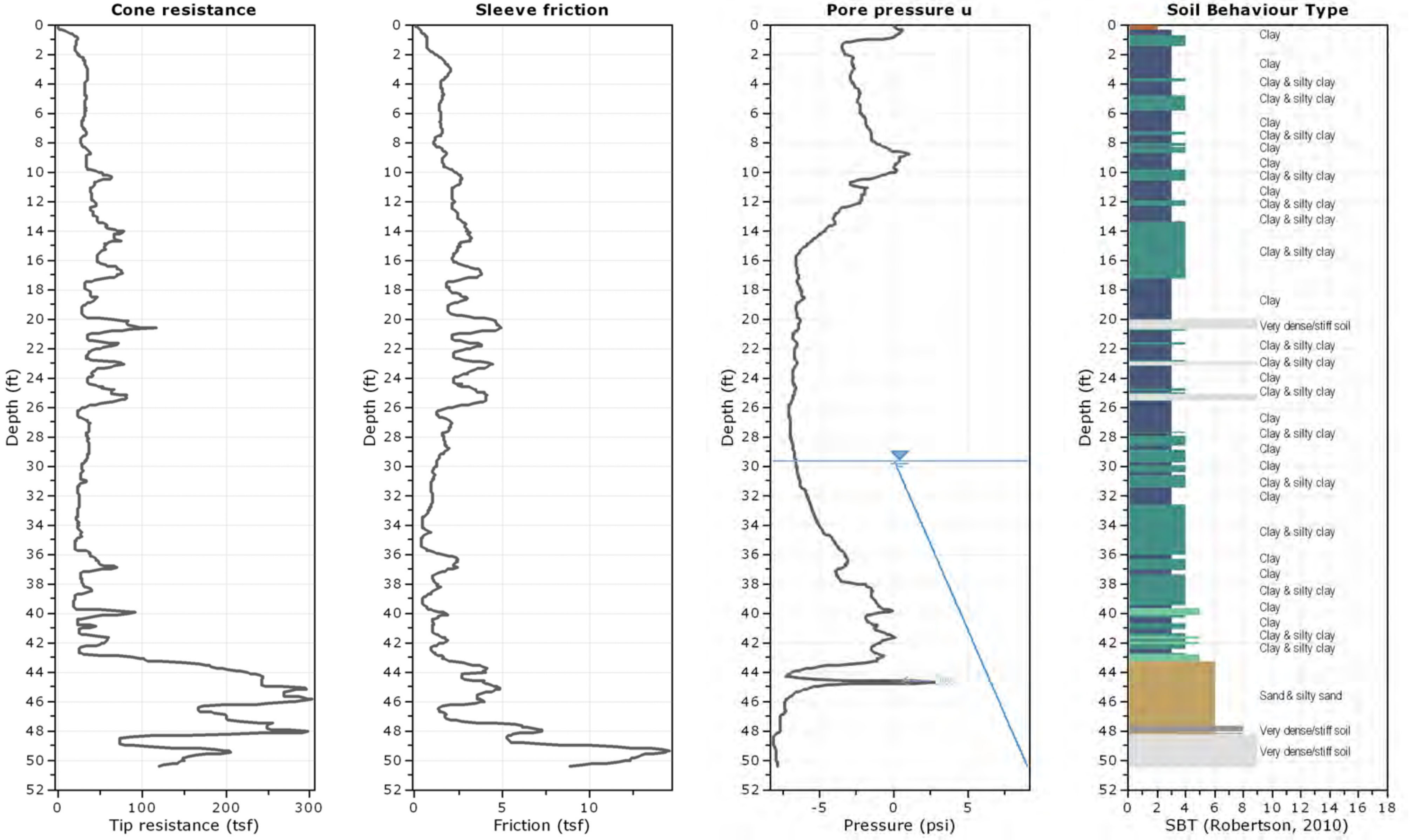
Project: LAW-7-2.17
Location: Lawrence County



Office of Geotechnical Engineering
Geology, Exploration and, Laboratory Section
http://www.dot.state.oh.us/Divisions/Engineering/Geotechnical

CPT: C-009-3-21
Total depth: 50.36 ft, Date: 11/8/2021
Surface Elevation: 562.0 ft
Coords: lat 38.447604° lon -82.436058°

Project: LAW-7-2.17
Location: Lawrence County



Dissipation Tests Results

Dissipation tests

Dissipation tests consists of stopping the piezocone penetration and observing porepressures (u) with elapsed time (t). The data are automatic recorded by the field computer and should take place until a minimum of 50% dissipation.

The porepressures are plotted as a function of square root of (t). The graphical technique suggested by Robertson and Campanella (1989), yields a value for t_{50}, which corresponds to the time for 50% consolidation.

The value of the coefficient of consolidation in the radial or horizontal direction c_h was then calculated by Houlsby and Teh's (1988) theory using the following equation:

$$c_h = \frac{T \times r^2 \times I_r^{0.5}}{t_{50}}$$

where:

T: time factor given by Houlsby and Teh's (1988) theory corresponding to the porepressure position
r: piezocone radius
I_r: stiffness index, equal to shear modulus G divided by the undrained strength of clay (S_u).
t_{50}: time corresponding to 50% consolidation

Permeability estimates based on dissipation test

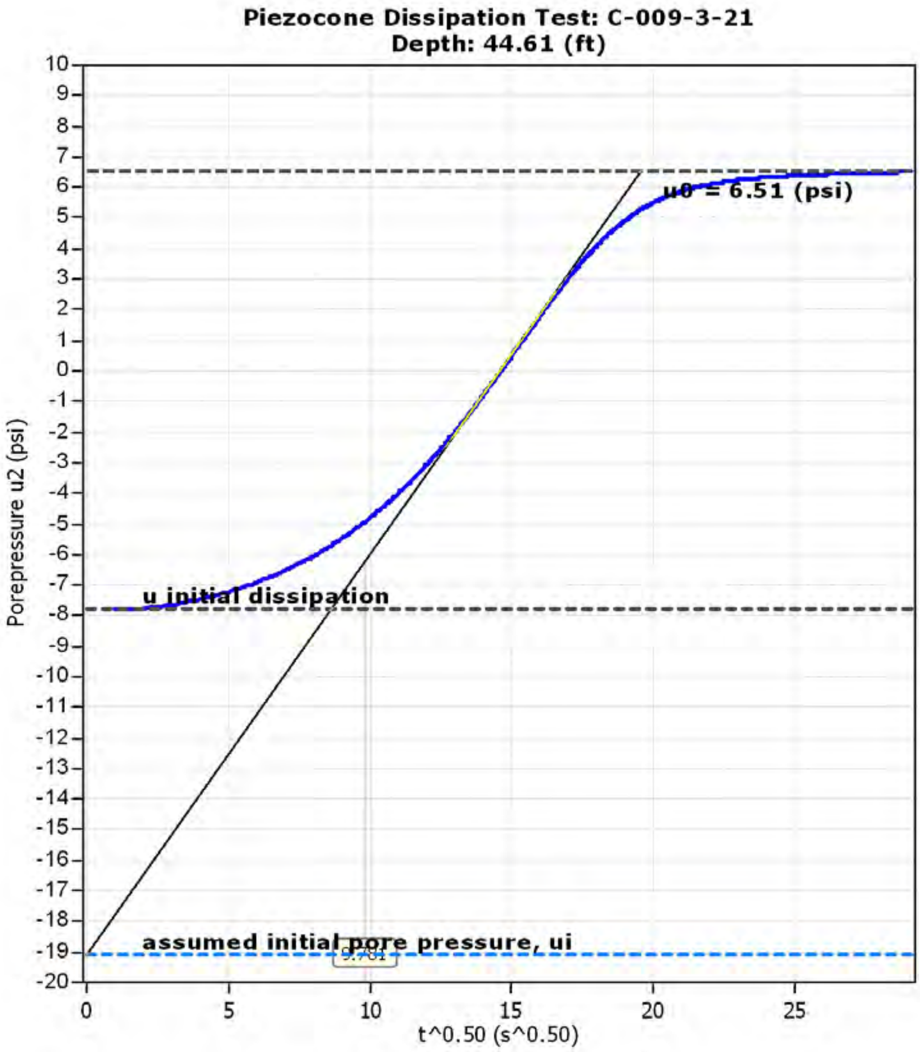
The dissipation of pore pressures during a CPTu dissipation test is controlled by the coefficient of consolidation in the horizontal direction (c_h) which is influenced by a combination of the soil permeability (k_h) and compressibility (M), as defined by the following:

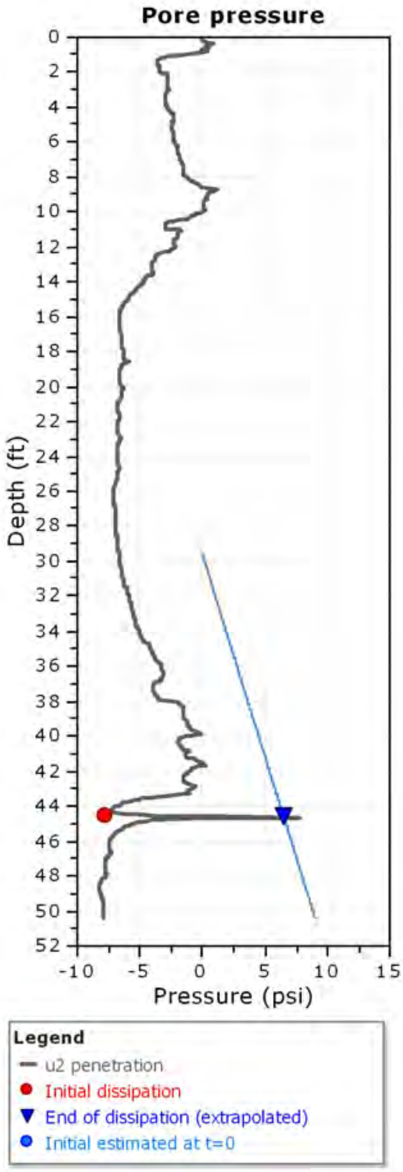
$$k_h = c_h \times \gamma_w / M$$

where: M is the 1-D constrained modulus and γ_w is the unit weight of water, in compatible units.

Tabular results

CPTU Borehole	Depth (ft)	$(t_{50})^{0.50}$	t_{50} (s)	t_{50} (years)	G/S_u	c_h (ft^2/s)	c_h ($ft^2/year$)	M (tsf)	k_h (ft/s)
C-009-3-21	44.61	9.8	96	3.03E-006	100.00	1.32E-004	4152	2225.57	1.85E-009

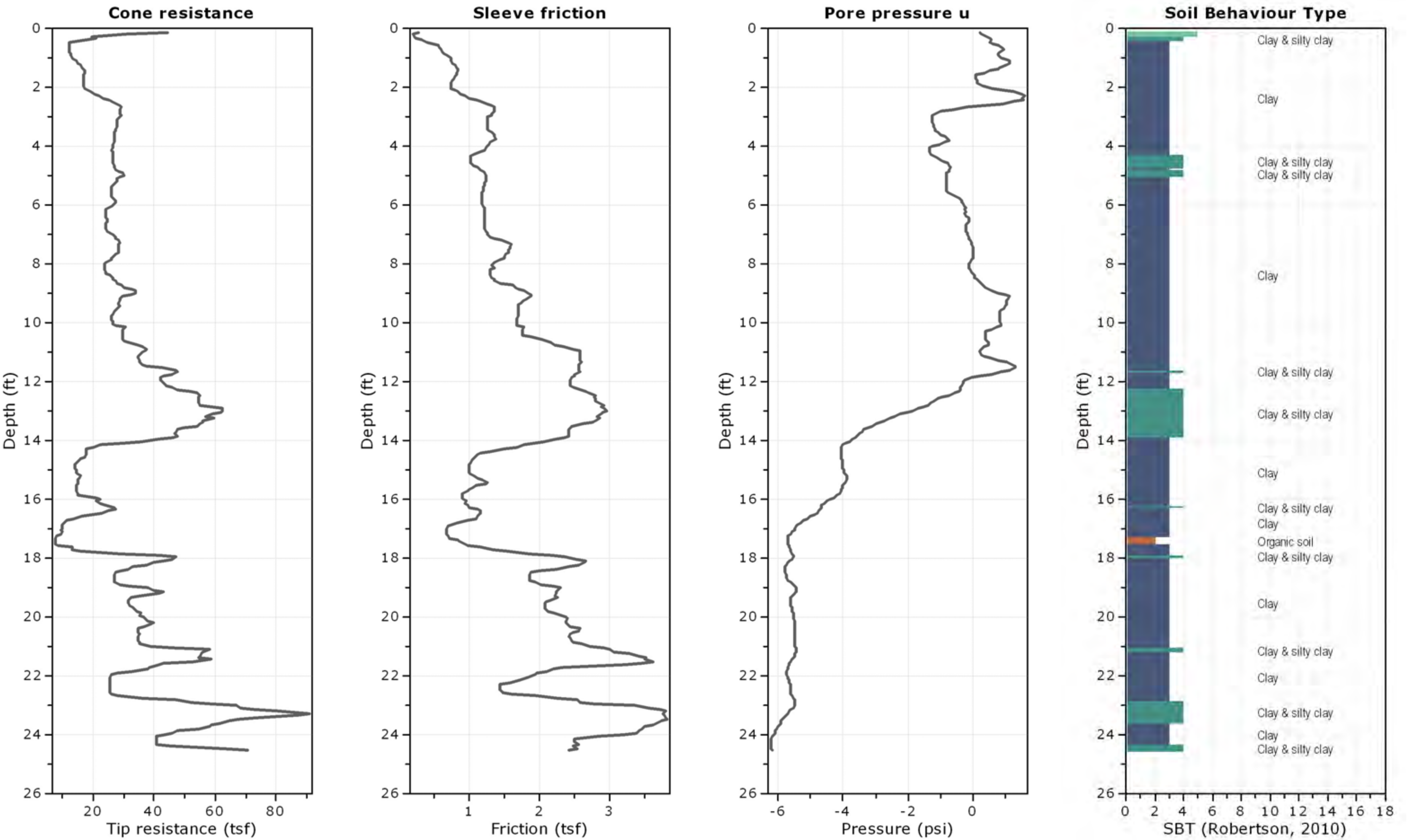

Piezocone Dissipation Test: C-009-3-21
Depth: 44.61 (ft)
Porepressure u2 (psi)
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
-16
-17
-18
-19
-20
u0 = 6.51 (psi)
u initial dissipation
assumed initial pore pressure, ui
9.781
0
5
10
15
20
25
t^0.50 (s^0.50)


Pore pressure
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
-10
-5
0
5
10
15
Pressure (psi)
Legend
u2 penetration
Initial dissipation
End of dissipation (extrapolated)
Initial estimated at t=0

Office of Geotechnical Engineering
Geology, Exploration and, Laboratory Section
http://www.dot.state.oh.us/Divisions/Engineering/Geotechnical

CPT: C-009-4-21
Total depth: 24.52 ft, Date: 11/8/2021
Surface Elevation: 562.8 ft
Coords: lat 38.447618° lon -82.436062°

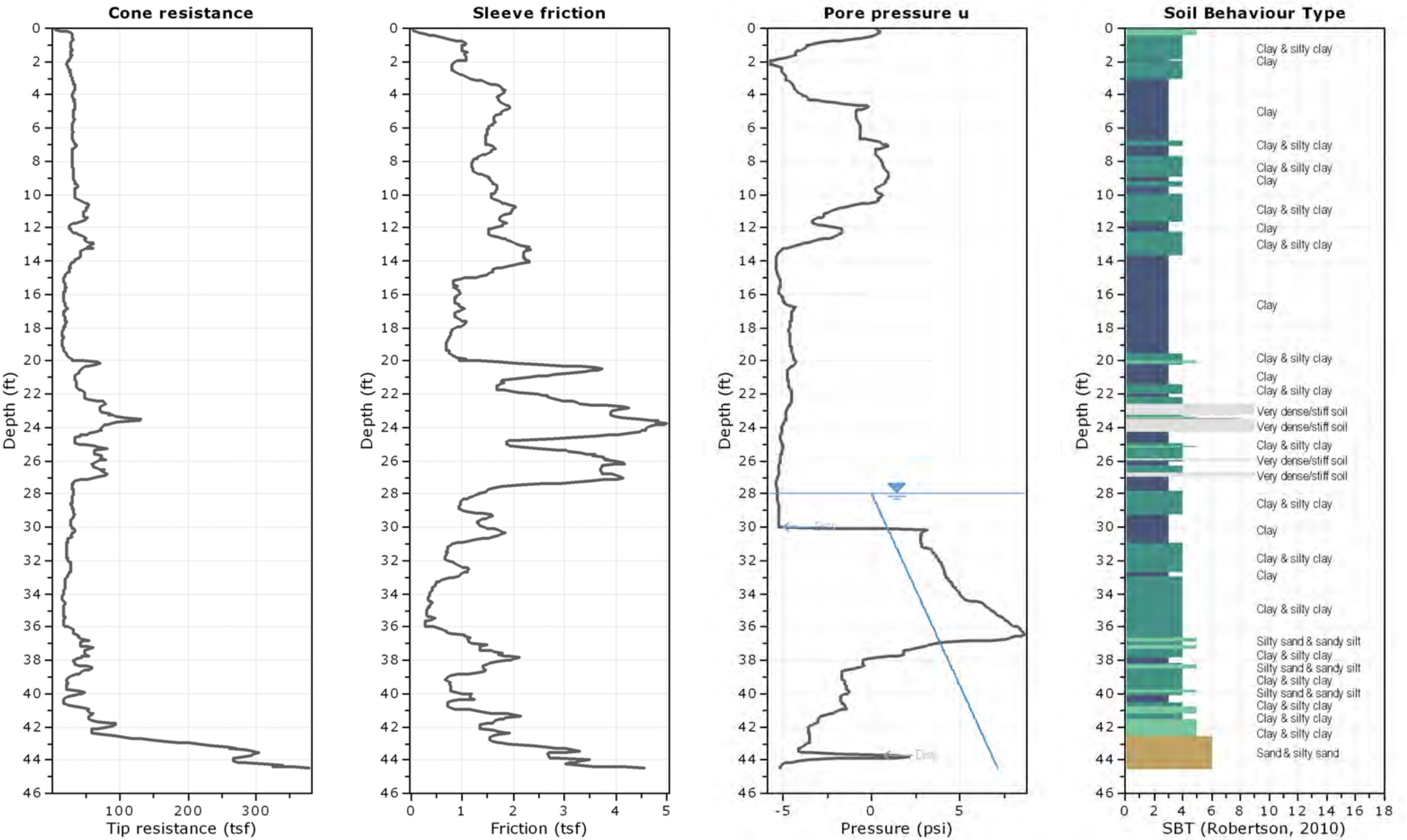
Project: LAW-7-2.17
Location: Lawrence County



CPT: C-009-5-21

Total depth: 44.51 ft, Date: 11/8/2021
Surface Elevation: 562.5 ft
Coords: lat 38.447588° lon -82.436053°

Project: LAW-7-2.17
Location: Lawrence County



Dissipation Tests Results

Dissipation tests

Dissipation tests consists of stopping the piezocone penetration and observing porepressures (u) with elapsed time (t). The data are automatic recorded by the field computer and should take place until a minimum of 50% dissipation.

The porepressures are plotted as a function of square root of (t). The graphical technique suggested by Robertson and Campanella (1989), yields a value for t_{50}, which corresponds to the time for 50% consolidation.

The value of the coefficient of consolidation in the radial or horizontal direction c_h was then calculated by Houlsby and Teh's (1988) theory using the following equation:

$$c_h = \frac{T \times r^2 \times I_r^{0.5}}{t_{50}}$$

where:

T: time factor given by Houlsby and Teh's (1988) theory corresponding to the porepressure position
r: piezocone radius
I_r: stiffness index, equal to shear modulus G divided by the undrained strength of clay (S_u).
t_{50}: time corresponding to 50% consolidation

Permeability estimates based on dissipation test

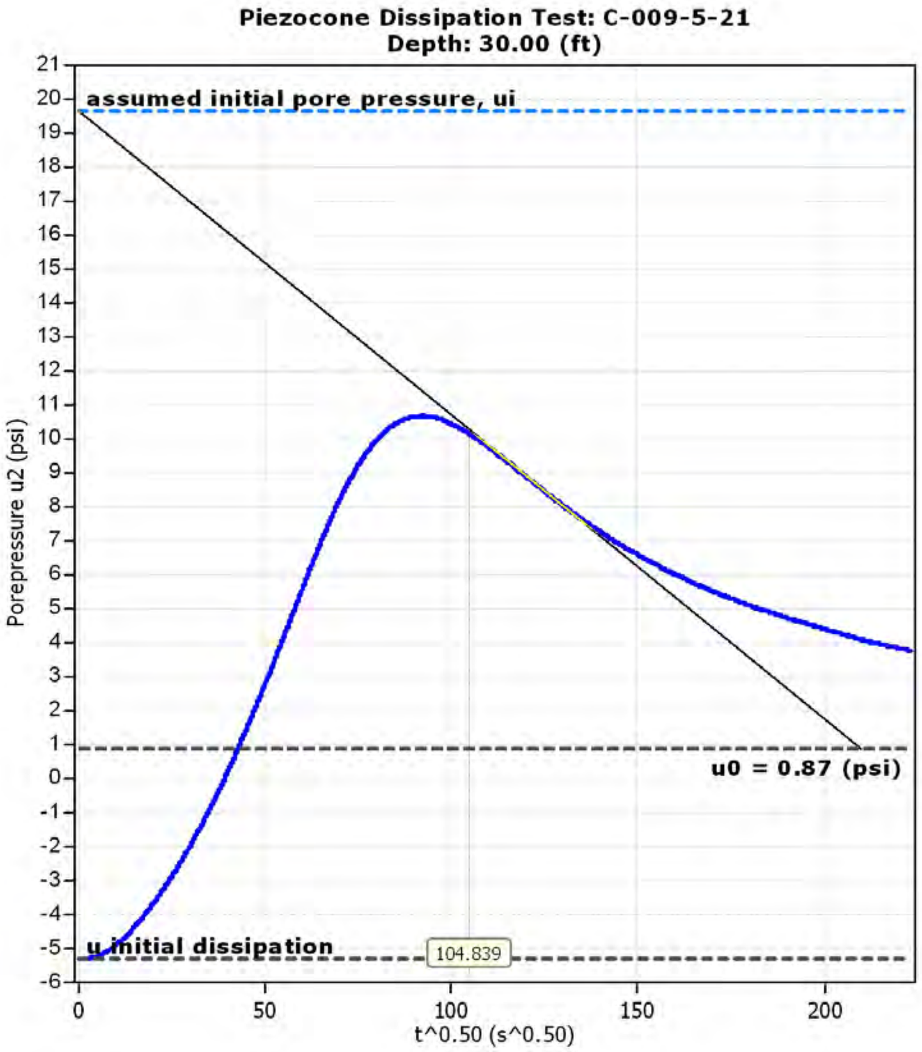
The dissipation of pore pressures during a CPTu dissipation test is controlled by the coefficient of consolidation in the horizontal direction (c_h) which is influenced by a combination of the soil permeability (k_h) and compressibility (M), as defined by the following:

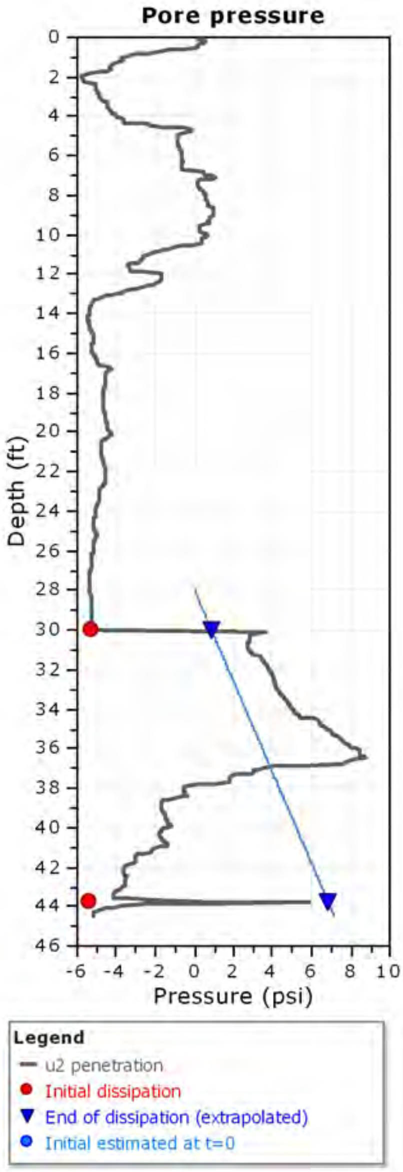
$$k_h = c_h \times \gamma_w / M$$

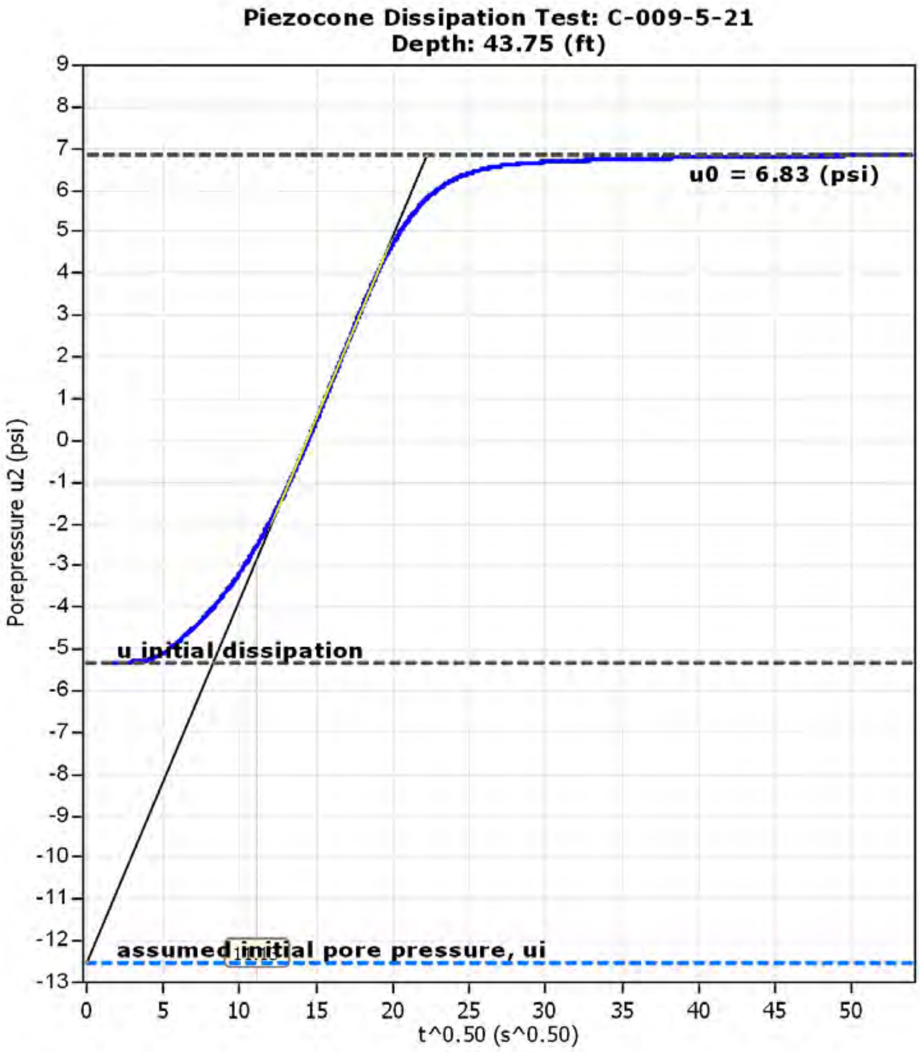
where: M is the 1-D constrained modulus and γ_w is the unit weight of water, in compatible units.

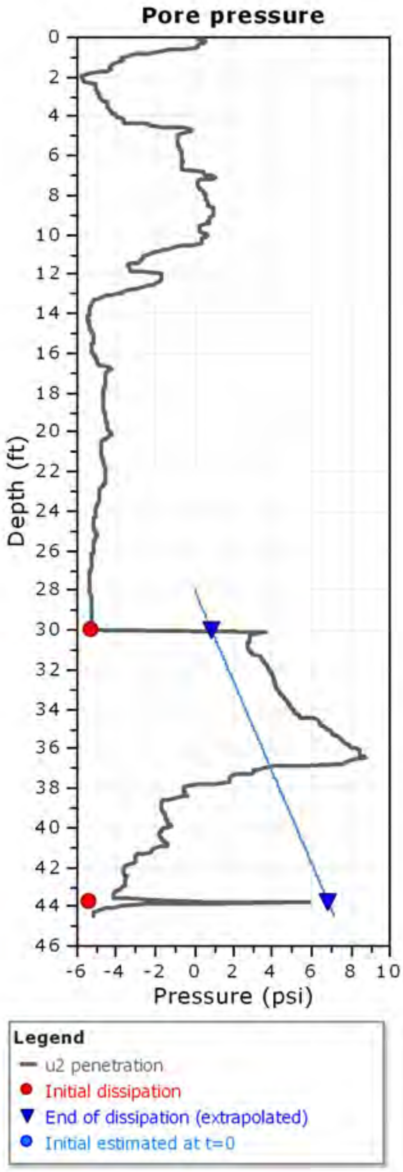
Tabular results

CPTU Borehole	Depth (ft)	$(t_{50})^{0.50}$	t_{50} (s)	t_{50} (years)	G/S_u	c_h (ft^2/s)	c_h ($ft^2/year$)	M (tsf)	k_h (ft/s)
C-009-5-21	30.00	104.8	10991	3.49E-004	424124.88	7.46E-005	2353	391.27	5.95E-009
C-009-5-21	43.75	11.1	124	3.93E-006	100.00	1.02E-004	3206	1976.67	1.61E-009


Piezocone Dissipation Test: C-009-5-21
Depth: 30.00 (ft)
assumed initial pore pressure, ui
u0 = 0.87 (psi)
u initial dissipation
104.839
Porepressure u2 (psi)
t^0.50 (s^0.50)
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
0
50
100
150
200


Pore pressure
Depth (ft)
Pressure (psi)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
-6
-4
-2
0
2
4
6
8
10
Legend
— u2 penetration
● Initial dissipation
▼ End of dissipation (extrapolated)
● Initial estimated at t=0

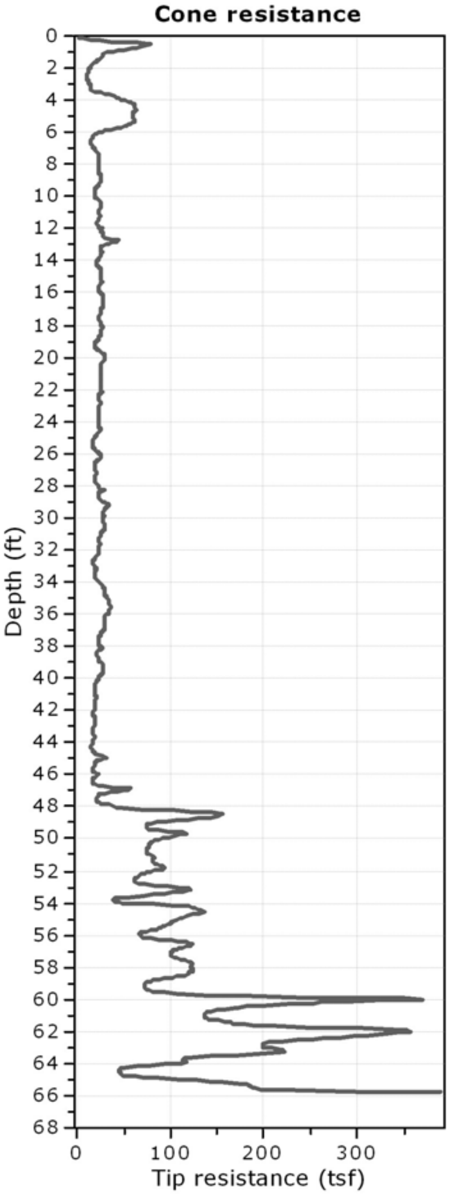

Piezocone Dissipation Test: C-009-5-21
Depth: 43.75 (ft)
u0 = 6.83 (psi)
u initial dissipation
assumed initial pore pressure, ui
Porepressure u2 (psi)
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
0
5
10
15
20
25
30
35
40
45
50
t^0.50 (s^0.50)

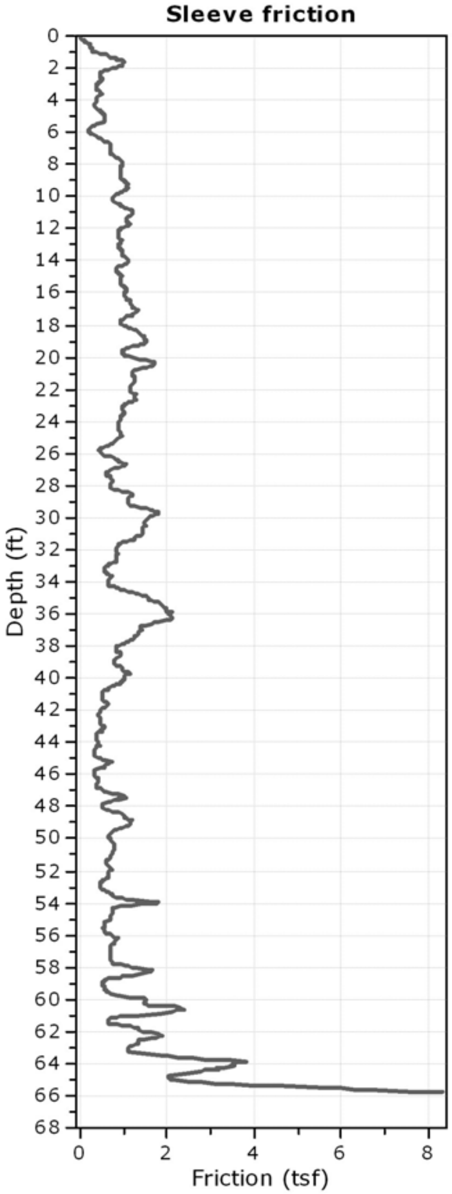

Pore pressure
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
-6
-4
-2
0
2
4
6
8
10
Pressure (psi)
Legend
u2 penetration
Initial dissipation
End of dissipation (extrapolated)
Initial estimated at t=0

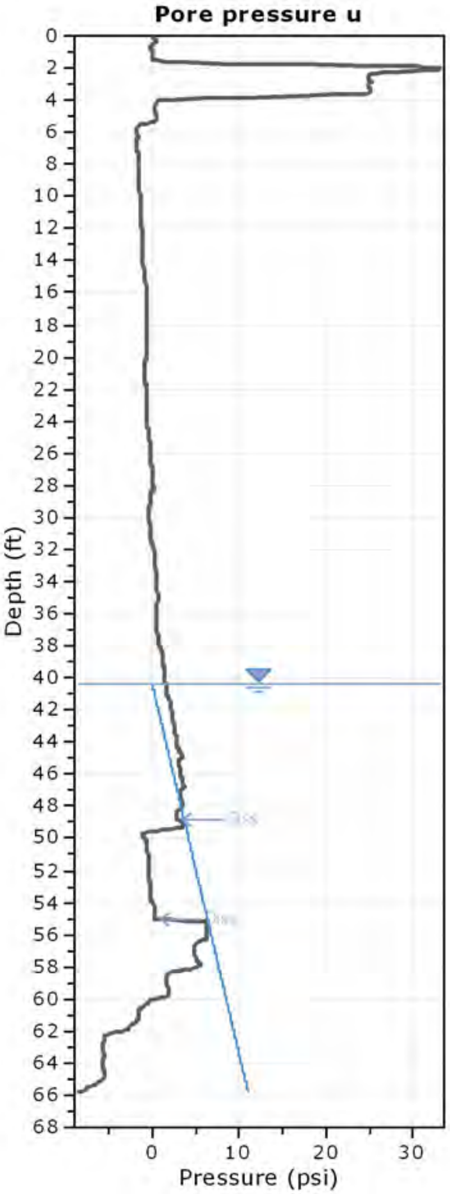
Office of Geotechnical Engineering
Geology, Exploration and, Laboratory Section
http://www.dot.state.oh.us/Divisions/Engineering/Geotechnical

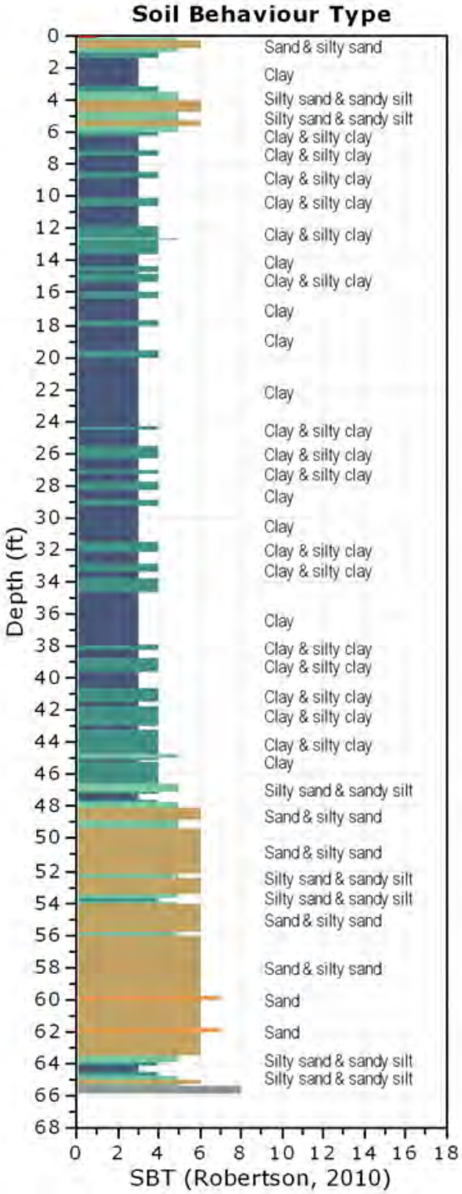
CPT: C-013-1-21
Total depth: 65.82 ft, Date: 11/9/2021
Surface Elevation: 561.3 ft
Coords: lat 38.44887° lon -82.433455°

Project: LAW-7-2.17
Location: Lawrence County









Dissipation Tests Results

Dissipation tests

Dissipation tests consists of stopping the piezocone penetration and observing porepressures (u) with elapsed time (t). The data are automatic recorded by the field computer and should take place until a minimum of 50% dissipation.

The porepressures are plotted as a function of square root of (t). The graphical technique suggested by Robertson and Campanella (1989), yields a value for t_{50}, which corresponds to the time for 50% consolidation.

The value of the coefficient of consolidation in the radial or horizontal direction c_h was then calculated by Houlsby and Teh's (1988) theory using the following equation:

$$c_h = \frac{T \times r^2 \times I_r^{0.5}}{t_{50}}$$

where:

T: time factor given by Houlsby and Teh's (1988) theory corresponding to the porepressure position
r: piezocone radius
I_r: stiffness index, equal to shear modulus G divided by the undrained strength of clay (S_u).
t_{50}: time corresponding to 50% consolidation

Permeability estimates based on dissipation test

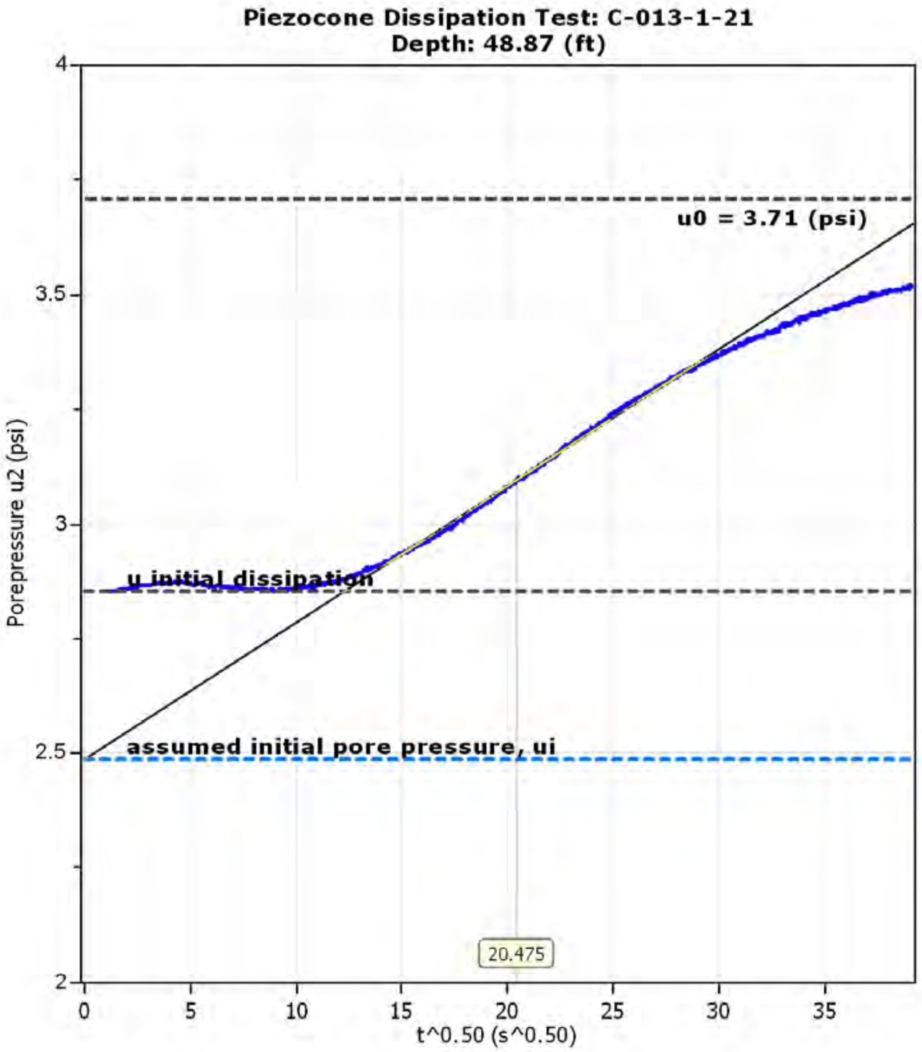
The dissipation of pore pressures during a CPTu dissipation test is controlled by the coefficient of consolidation in the horizontal direction (c_h) which is influenced by a combination of the soil permeability (k_h) and compressibility (M), as defined by the following:

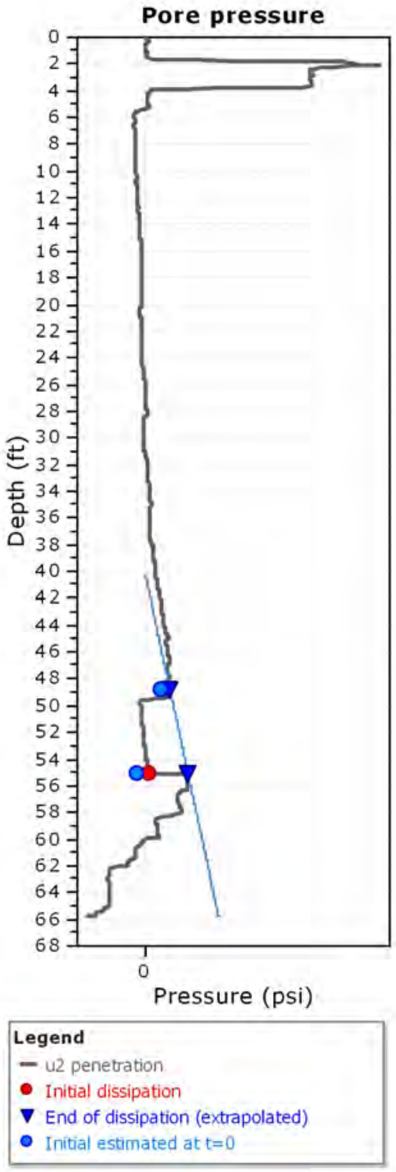
$$k_h = c_h \times \gamma_w / M$$

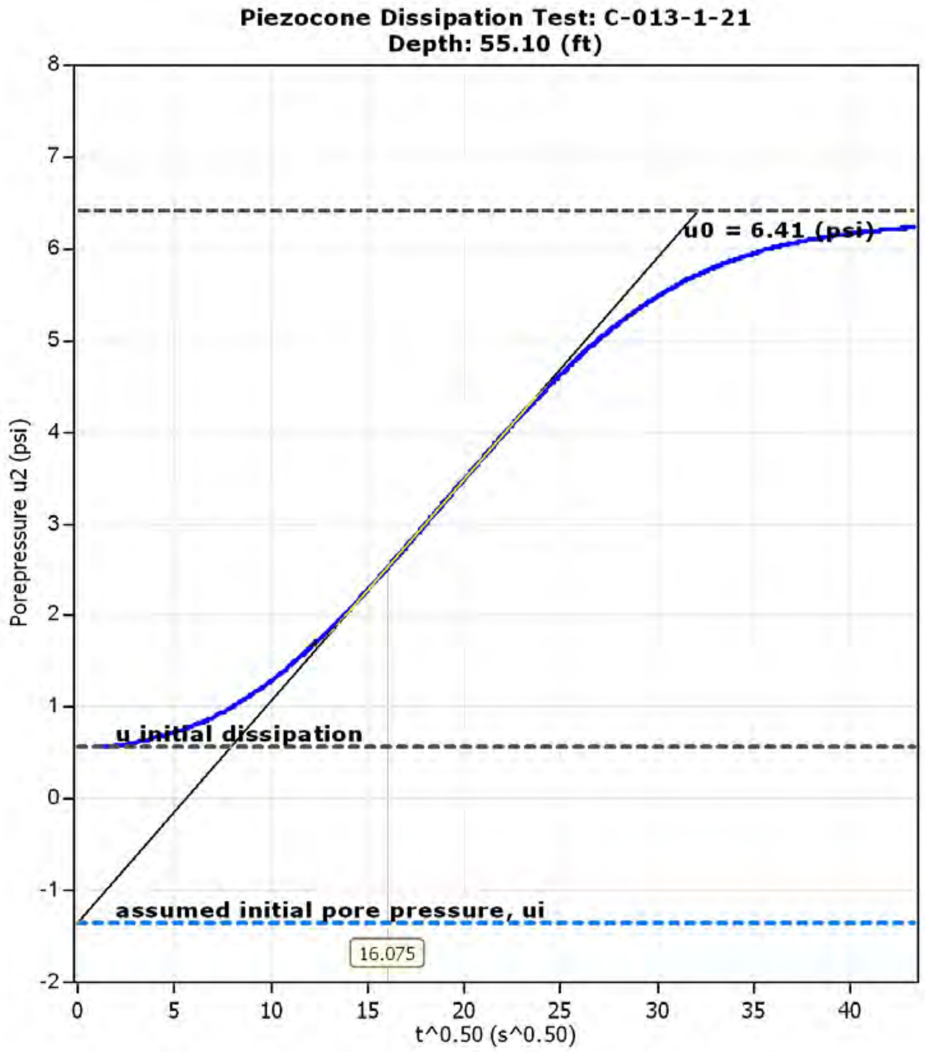
where: M is the 1-D constrained modulus and γ_w is the unit weight of water, in compatible units.

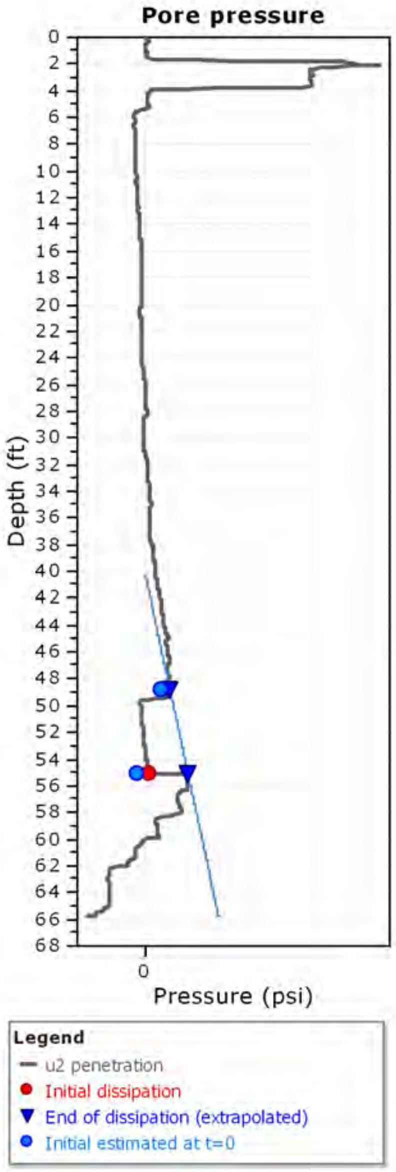
Tabular results

CPTU Borehole	Depth (ft)	$(t_{50})^{0.50}$	t_{50} (s)	t_{50} (years)	G/S_u	c_h (ft^2/s)	c_h ($ft^2/year$)	M (tsf)	k_h (ft/s)
C-013-1-21	48.87	20.5	419	1.33E-005	100.00	3.00E-005	947	1170.47	8.01E-010
C-013-1-21	55.10	16.1	258	8.19E-006	100.00	4.87E-005	1537	993.97	1.53E-009


Piezocone Dissipation Test: C-013-1-21
Depth: 48.87 (ft)
u0 = 3.71 (psi)
u initial dissipation
assumed initial pore pressure, ui
20.475
Porepressure u2 (psi)
t^0.50 (s^0.50)
4
3.5
3
2.5
2
0
5
10
15
20
25
30
35


Pore pressure
Depth (ft)
Pressure (psi)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
66
68
Legend
u2 penetration
Initial dissipation
End of dissipation (extrapolated)
Initial estimated at t=0

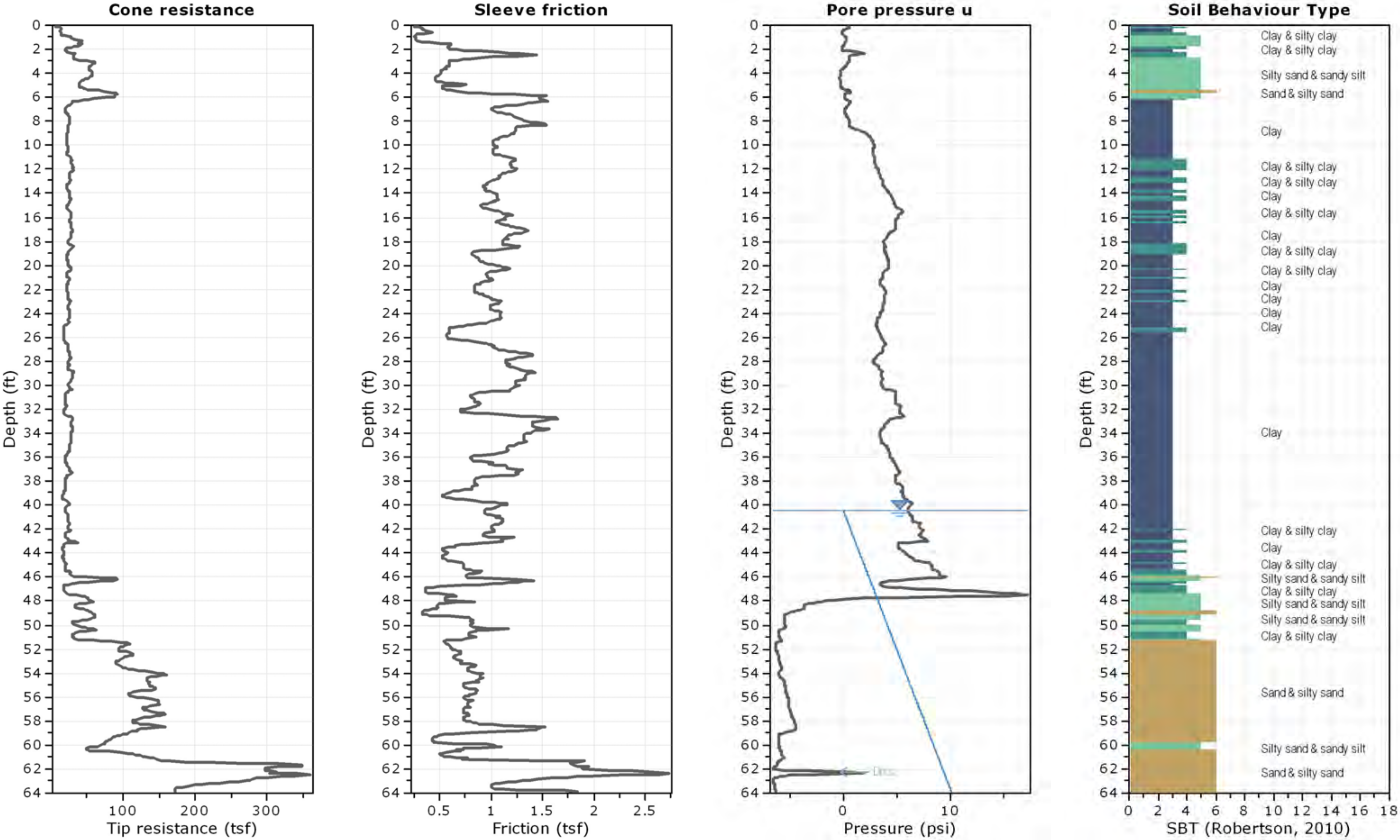

Piezocone Dissipation Test: C-013-1-21
Depth: 55.10 (ft)
u0 = 6.41 (psi)
u initial dissipation
assumed initial pore pressure, ui
16.075
Porepressure u2 (psi)
8
7
6
5
4
3
2
1
0
-1
-2
0
5
10
15
20
25
30
35
40
t^0.50 (s^0.50)


Pore pressure
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
66
68
0
Pressure (psi)
Legend
u2 penetration
Initial dissipation
End of dissipation (extrapolated)
Initial estimated at t=0

Office of Geotechnical Engineering
Geology, Exploration and, Laboratory Section
http://www.dot.state.oh.us/Divisions/Engineering/Geotechnical

CPT: C-013-2-21
Total depth: 63.87 ft, Date: 11/9/2021
Surface Elevation: 560.7 ft
Coords: lat 38.449142° lon -82.43351°

Project: LAW-7-2.17
Location: Lawrence County



Dissipation Tests Results

Dissipation tests

Dissipation tests consists of stopping the piezocone penetration and observing porepressures (u) with elapsed time (t). The data are automatic recorded by the field computer and should take place until a minimum of 50% dissipation.

The porepressures are plotted as a function of square root of (t). The graphical technique suggested by Robertson and Campanella (1989), yields a value for t_{50}, which corresponds to the time for 50% consolidation.

The value of the coefficient of consolidation in the radial or horizontal direction c_h was then calculated by Houlsby and Teh's (1988) theory using the following equation:

$$c_h = \frac{T \times r^2 \times I_r^{0.5}}{t_{50}}$$

where:

T: time factor given by Houlsby and Teh's (1988) theory corresponding to the porepressure position
r: piezocone radius
I_r: stiffness index, equal to shear modulus G divided by the undrained strength of clay (S_u).
t_{50}: time corresponding to 50% consolidation

Permeability estimates based on dissipation test

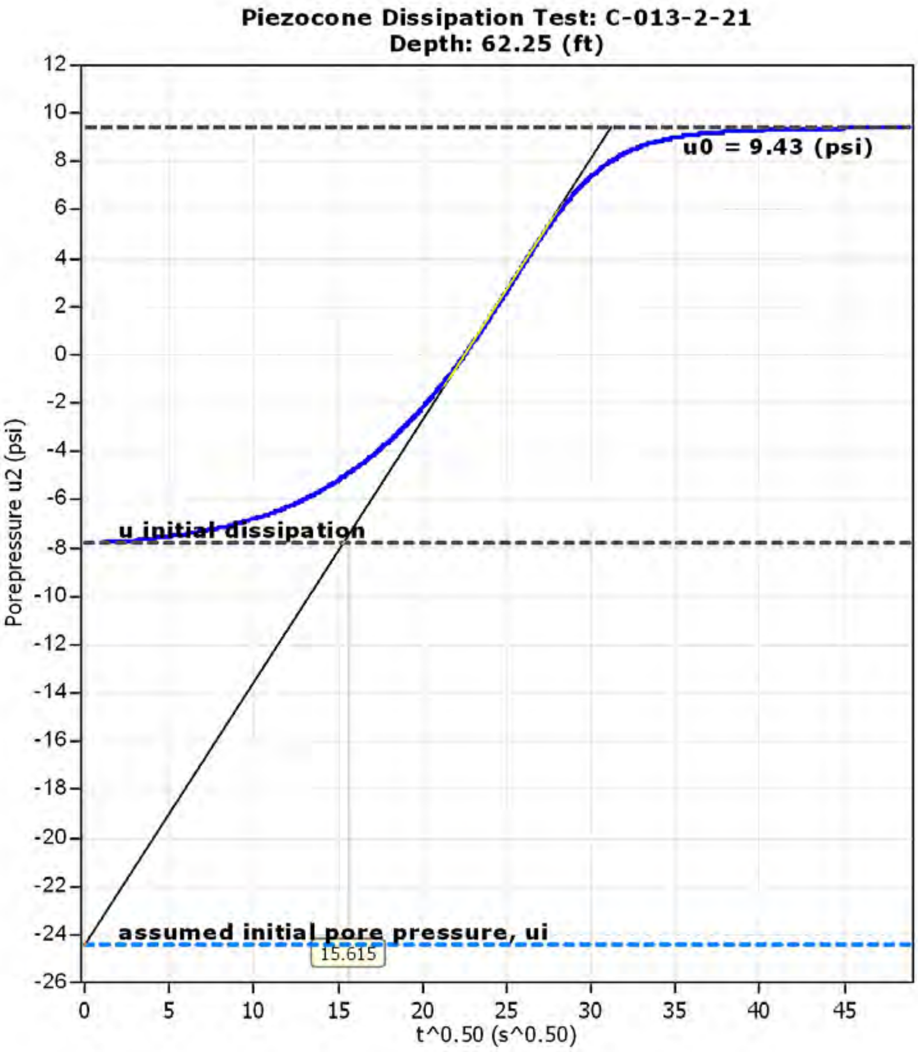
The dissipation of pore pressures during a CPTu dissipation test is controlled by the coefficient of consolidation in the horizontal direction (c_h) which is influenced by a combination of the soil permeability (k_h) and compressibility (M), as defined by the following:

$$k_h = c_h \times \gamma_w / M$$

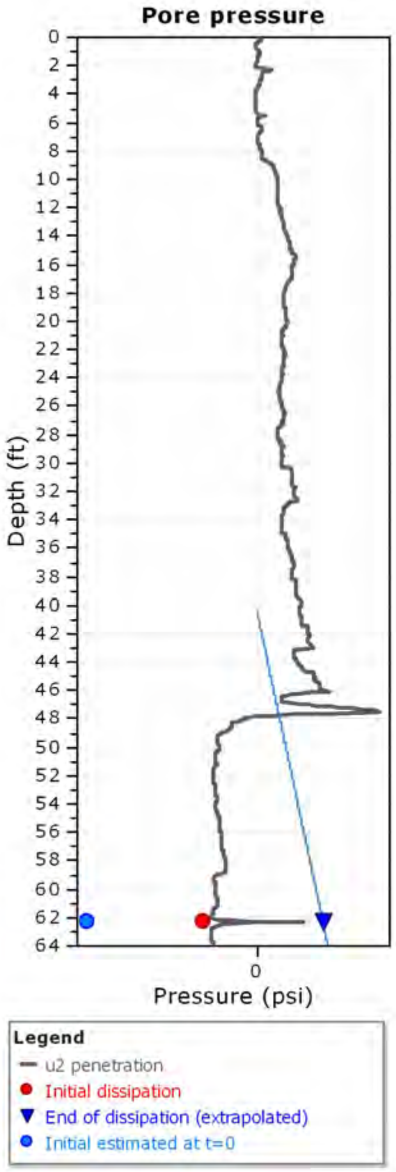
where: M is the 1-D constrained modulus and γ_w is the unit weight of water, in compatible units.

Tabular results

CPTU Borehole	Depth (ft)	$(t_{50})^{0.50}$	t_{50} (s)	t_{50} (years)	G/S_u	c_h (ft^2/s)	c_h ($ft^2/year$)	M (tsf)	k_h (ft/s)
C-013-2-21	62.25	15.6	244	7.73E-006	100.00	5.17E-005	1629	2090.05	7.72E-010



Piezocone Dissipation Test: C-013-2-21
Depth: 62.25 (ft)



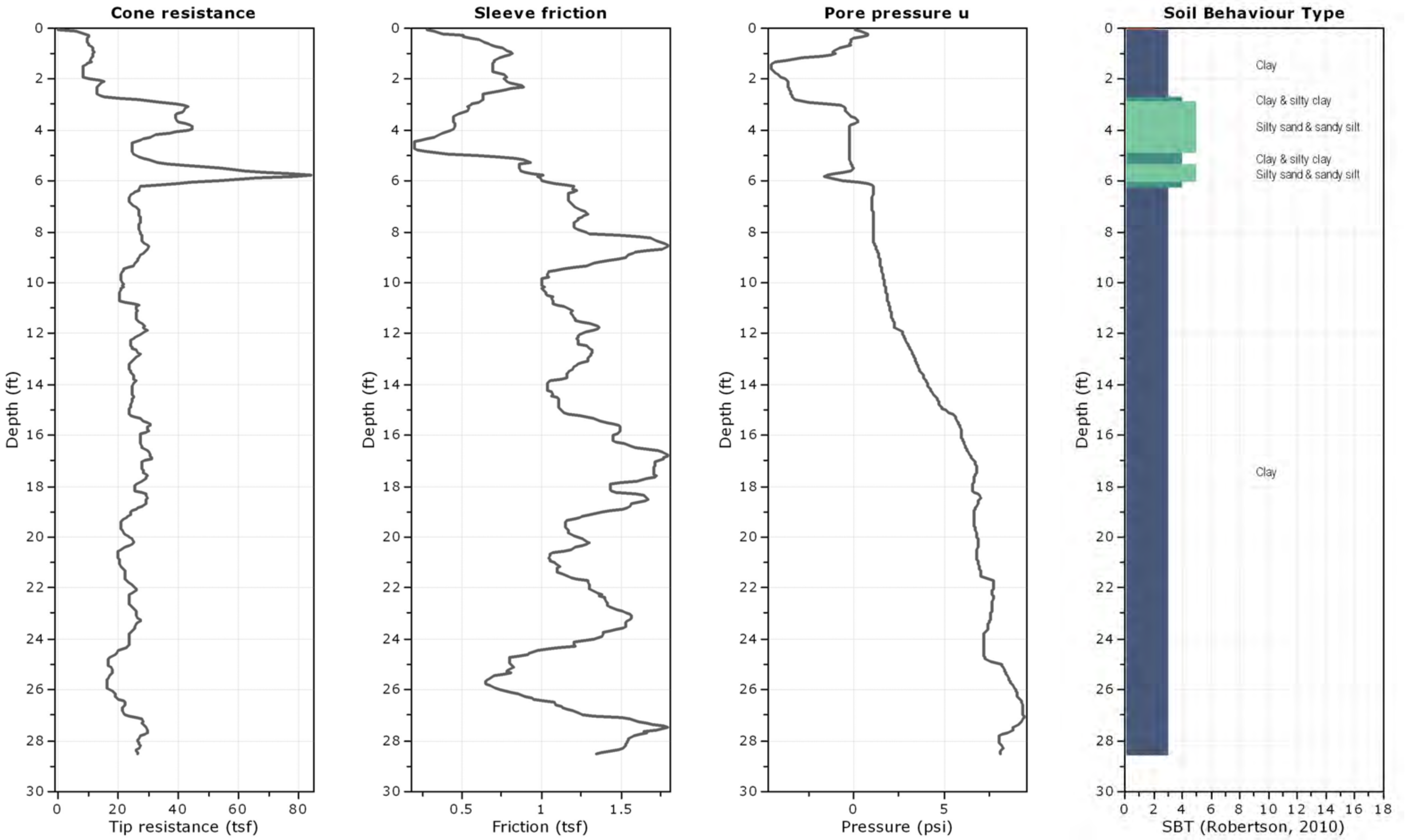
Pore pressure

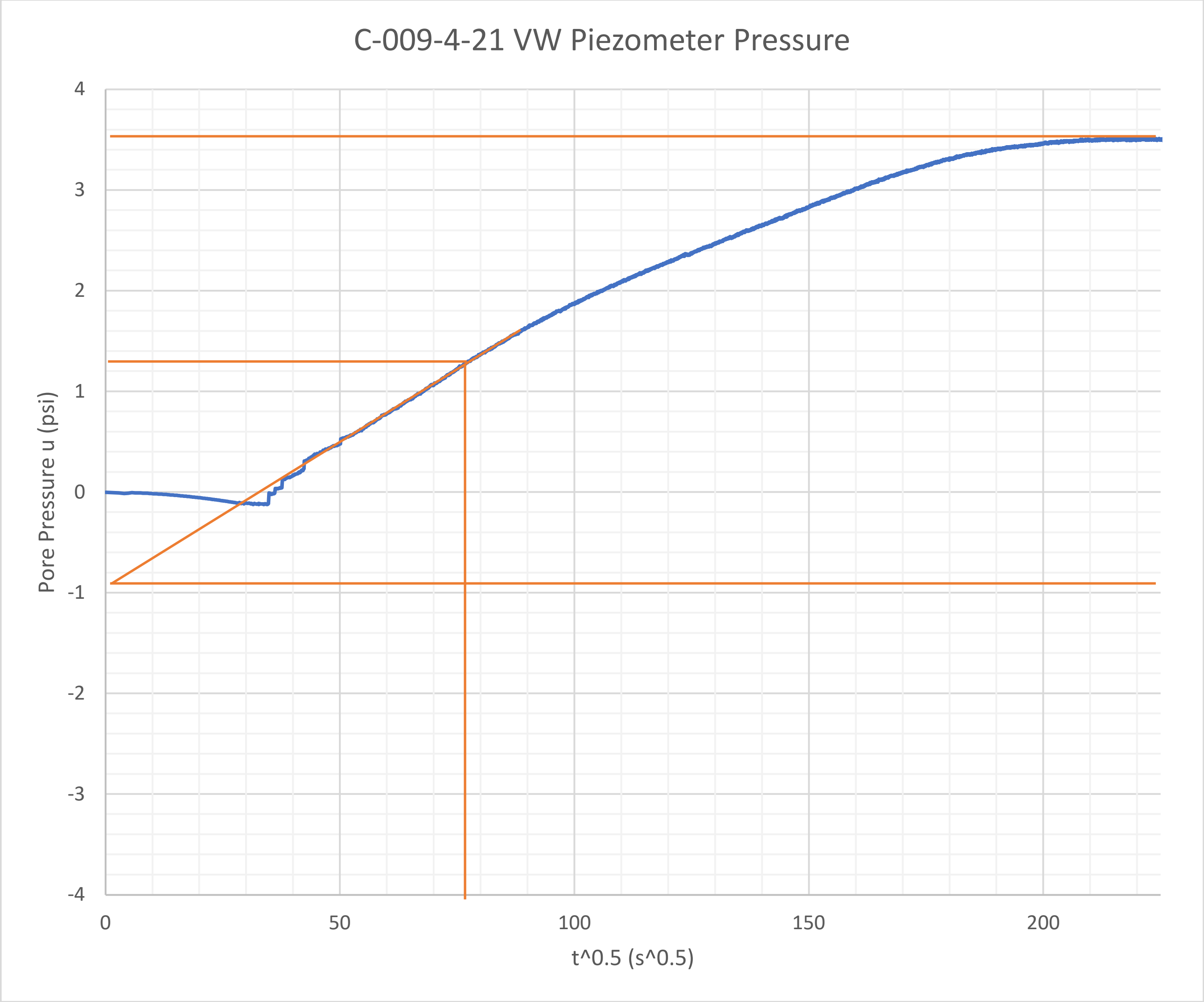
Office of Geotechnical Engineering
Geology, Exploration and, Laboratory Section
http://www.dot.state.oh.us/Divisions/Engineering/Geotechnical

CPT: C-013-3-21

Total depth: 28.54 ft, Date: 11/9/2021
Surface Elevation: 560.5 ft
Coords: lat 38.449152° lon -82.433503°

Project: LAW-7-2.17
Location: Lawrence County





t_{50}^0.5	t_{50} (s)	t_{50} (min)	t_{50} (hr)	t_{50} (day)
77.82031	6056	100.9333	1.682222	0.070093

	r_o (in)	r_o (ft)
r_o =	1.000	0.083333

T_{50} = 0.197

$c_h = r_o^2(T_{50}/t_{50})$ = 0.019518 ft^2/day

d_{piez} = 29.77 ft

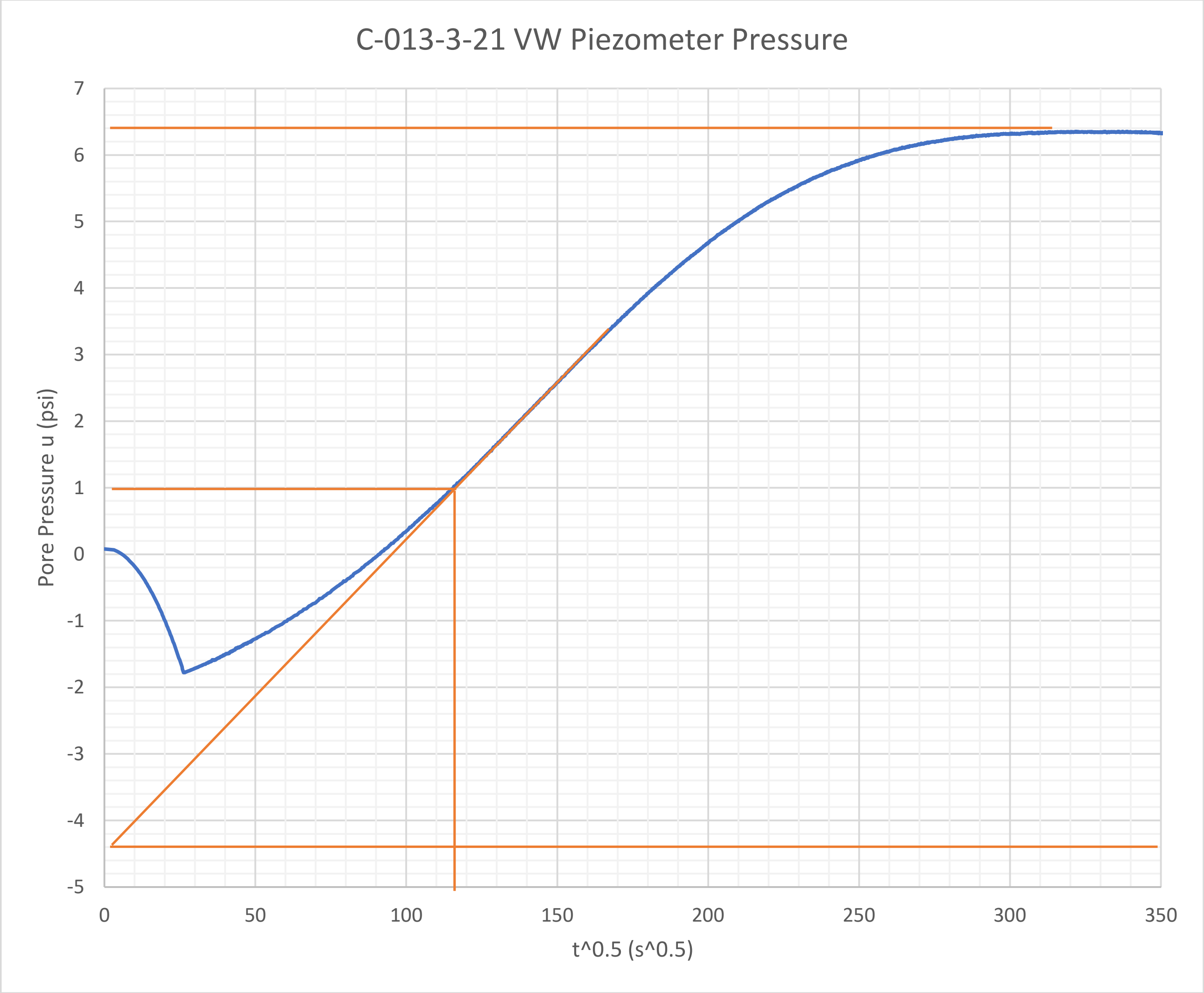
u_f = 10.89 psi

u_f = 1567.58 psf

head = 25.12 ft

D_w = 4.65 ft Perched Groundwater

D_w = 1.42 m



t_{50}^0.5	t_{50} (s)	t_{50} (min)	t_{50} (hr)	t_{50} (day)
115.3	13294.09	221.5682	3.692803	0.153867

	r_o (in)	r_o (ft)
r_o =	1.000	0.083333

T_{50} = 0.197

$c_h = r_o^2(T_{50}/t_{50})$ = 0.008891 ft^2/day

d_{piez} = 33.70 ft

u_f = 6.34 psi

u_f = 913.10 psf

head = 14.63 ft

D_w = 19.07 ft Perched Groundwater

D_w = 5.81 m

Appendix D

CPT Data and Soil Parameter Derivation

Four CPT soundings were performed by ODOT in the vicinity of the bridge in November of 2021. ODOT provided the raw data and the basic results for each CPT sounding. Stantec utilized The Guide to Cone Penetration Testing, 6th Edition, 2015, by Gregg Drilling and Testing, Inc. to convert the CPT test results into typical geotechnical soil strength parameters. The following is a summary of the subsurface profile and soil parameters to be used in the analyses for the proposed MSE retaining walls.

Soil parameters were determined based on the following:

- Undrained Shear Strength (Su, tsf):

$$S_u = \frac{q_t - \sigma_v}{N_{kt}}$$

Where q_t is the corrected cone resistance, σ_v is the effective overburden stress, and $N_{kt} = 10.5 + 7\log(Fr)$.

- Friction Angle, Phi (φ', degrees):
  The friction angle is derived by determining N_{60} from the formula:

$$\left({}^{q_t}/_{p_a}\right)/N_{60} = 10^{(1.1268-0.2817I_c)}$$

Where q_t is the corrected cone resistance, p_a is the atmospheric pressure, and I_c is the soil behavior type index generated by the CPT software. The N_{60} value is then corrected for overburden pressure ($N1_{60}$) based on AASHTO 10.4.6.2.4.

$$N1_{60} = C_N N_{60}$$

Where $C_N = 0.77\log(40/\sigma'_v)$. The $N1_{60}$ values are then correlated to friction angle values as shown in the attached tables. A friction angle adjustment is applied based on the soil behavior type index (I_c) to arrive at the final friction angle.

- Net cone resistance (qn, tsf):

$$q_n = q_t - \sigma_{v0}$$

Where q_t is the corrected cone resistance and σ_{v0} is the vertical total stress.

The Basic Results provided by ODOT and calculated soil parameters were averaged over depth increments of about 10 ft or less to obtain the layers for the subsurface profile. The Guide to Cone Penetration Testing, 6th Edition provides multiple methods for calculating various soil parameters. The table below (Table 5-2) is from the “field review draft” of EM 1110-2-2502, April 2020 and was used to correlate an N_{60} value with the net cone resistance (q_n). This N_{60} value was then used in Table 2 of ODOT GB7(below) to estimate the long-term soil properties for cohesive soils.

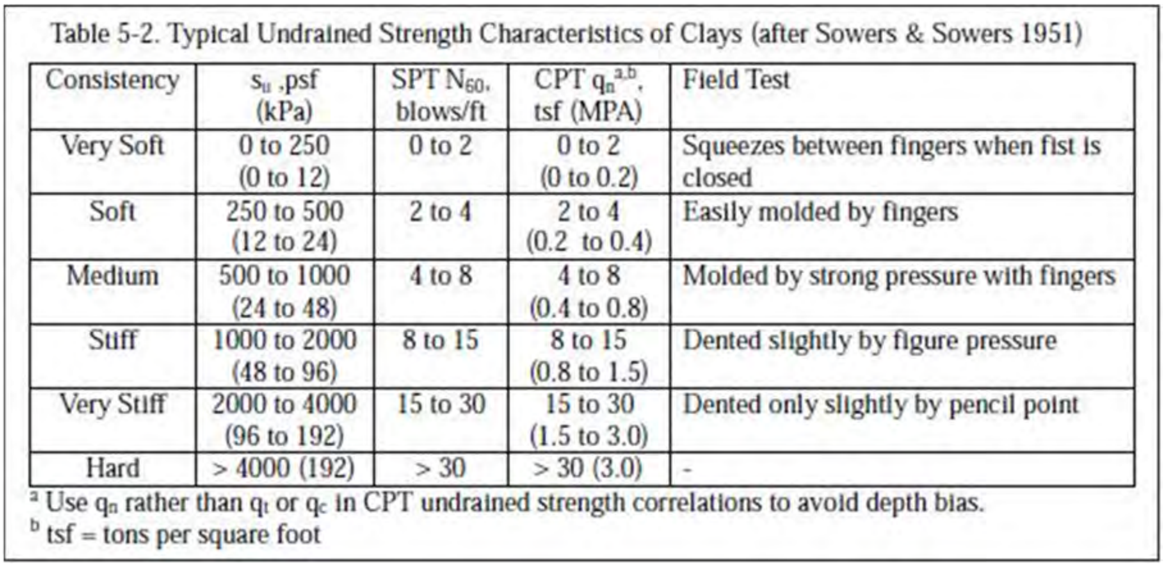


Table 5-2. Typical Undrained Strength Characteristics of Clays (after Sowers & Sowers 1951)

Consistency	s_u ,psf (kPa)	SPT N_{60}, blows/ft	CPT $q_n^{a,b}$, tsf (MPA)	Field Test
Very Soft	0 to 250 (0 to 12)	0 to 2	0 to 2 (0 to 0.2)	Squeezes between fingers when fist is closed
Soft	250 to 500 (12 to 24)	2 to 4	2 to 4 (0.2 to 0.4)	Easily molded by fingers
Medium	500 to 1000 (24 to 48)	4 to 8	4 to 8 (0.4 to 0.8)	Molded by strong pressure with fingers
Stiff	1000 to 2000 (48 to 96)	8 to 15	8 to 15 (0.8 to 1.5)	Dented slightly by figure pressure
Very Stiff	2000 to 4000 (96 to 192)	15 to 30	15 to 30 (1.5 to 3.0)	Dented only slightly by pencil point
Hard	> 4000 (192)	> 30	> 30 (3.0)	-

[a] Use q_n rather than q_t or q_c in CPT undrained strength correlations to avoid depth bias.
[b] tsf = tons per square foot

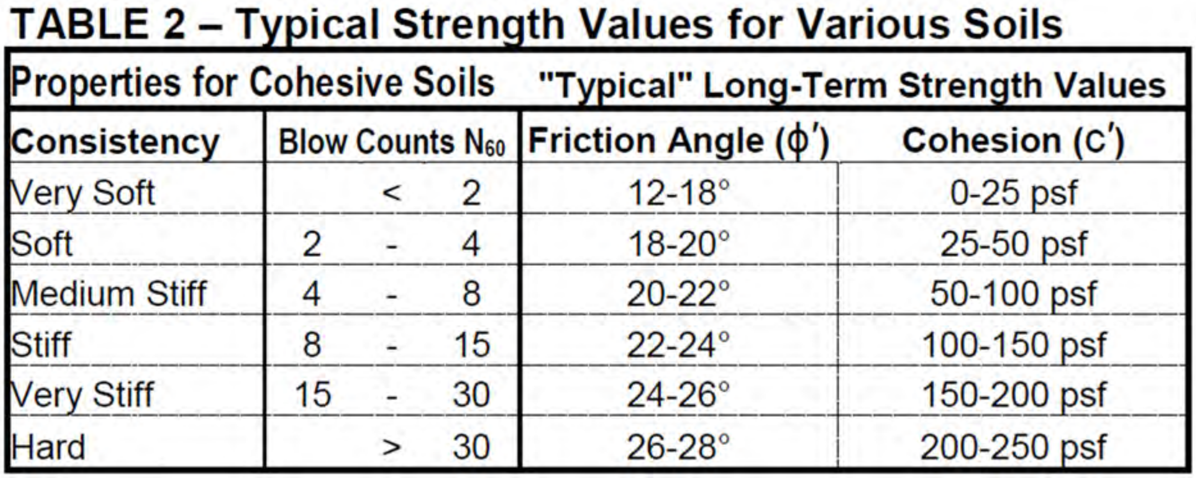


TABLE 2 – Typical Strength Values for Various Soils

Properties for Cohesive Soils		"Typical" Long-Term Strength Values	
Consistency	Blow Counts N_{60}	Friction Angle (ϕ')	Cohesion (c')
Very Soft	< 2	12-18°	0-25 psf
Soft	2 - 4	18-20°	25-50 psf
Medium Stiff	4 - 8	20-22°	50-100 psf
Stiff	8 - 15	22-24°	100-150 psf
Very Stiff	15 - 30	24-26°	150-200 psf
Hard	> 30	26-28°	200-250 psf

LAW-7-0370

Subsurface Profile Derivation

Rear Abutment:

Bottom of MSE wall elevation = 559.5

Based on C-009-2-21.

Table 1. Rear Abutment Soil Parameters

Elevation Range	Depth below MSE wall foundation (feet)	Soil Type	Unit Weight (pcf)	qn (tsf)	Short Term		Long Term	
					Friction Angle (φ)	**Cohesion (c)**	**Friction Angle (φ')**	**Cohesion (c')**
559.5 – 556.0	0 – 3.5	Silty Clay	119.1	12.2	0	2400	23	150
556.0 – 546.0	3.5 – 13.5	Silty Clay	122.3	36.5	0	6000	25	175
546.0 – 540.5	13.5 – 19.0	Silty Clay	126.3	52.1	0	7500	26	175
540.5 – 532.0	19.0 – 27.5	Silty Clay	127.7	42.1	0	6000	25	175
532.0 – 524.0	27.5 – 35.5	Silty Clay	124.1	35.7	0	6000	25	175
524.0 – 519.5	35.5 – 40.0	Silty Clay	121.5	44.9	0	5500	24	160
519.5 – 514.7	40.0 – 44.8	Sand	121.8	76.2	35	0	35	0

Forward Abutment:

Bottom of MSE wall elevation = 557.5

Based on C-009-3-21.

Table 2. Forward Abutment Soil Parameters

Elevation Range	Depth below MSE wall foundation (feet)	Soil Type	Unit Weight (pcf)	qn (tsf)	Short Term		Long Term	
					Friction Angle (φ)	**Cohesion (c)**	**Friction Angle (φ')**	**Cohesion (c')**
557.5 – 552.5	0 – 5	Silty Clay	121.6	31.2	0	4000	24	150
552.5 – 544.5	5 – 13	Silty Clay	126.7	50.8	0	6500	25	175
544.5 – 536.0	13 – 21.5	Silty Clay	127.5	48.1	0	4500	24	150
536.0 – 526.0	21.5 – 31.5	Silty Clay	118.6	26.6	0	3500	23	150
526.0 – 519.2	31.5 – 38.0	Silty Clay	120.2	34.7	0	4000	24	150
519.2 – 511.6	38.0 – 45.6	Sand	131	191.0	39	0	39	0

Based on the distance between the MSE wing walls the walls will be in a back-to-back condition. The depth of influence is expected to be about 1.5B or about 40 to 45 feet below the base of the wall.

Analysis by: Darren Pleiman Checked by:

C-009-2-21

Surface Elev.:		562.5														Surcharge Load:	2.3940	tsf	
No	Depth (ft)	Elev (ft)	Soil Type	γ (pcf)	qn (tsf)	σ',vo (tsf)	Nkt	su (psf)	su,avg (psf)	N60 (bpf)	N160	Phi Adjustment	Phi	Phi avg	Constrained Modulus (tsf)	Change in Stress Δσ' (tsf)	Settlement S (ft)	Settlement (in)	Shear Wave Velocity (ft/s)
44	2.89	559.6	silt&clay	111.65	10.6	0.17	10	2127							149.1	2.564	0.0010	0.0124	728.7
45	2.95	559.6	silt&clay	111.57	10.3	0.17	10	2053	Rear Wall						144.6	2.564	0.0012	0.0149	728.7
46	3.02	559.5	silt&clay	111.54	10.1	0.17	10	2001							140.7	2.564	0.0011	0.0131	728.7
47	3.08	559.4	silt&clay	111.53	9.8	0.18	10	1942							139.6	2.574	0.0013	0.0155	731.8
48	3.15	559.4	silt&clay	111.58	9.6	0.18	10	1885							133.8	2.574	0.0012	0.0139	731.8
49	3.21	559.3	silt&clay	111.56	9.3	0.18	10	1821							129.5	2.574	0.0014	0.0167	734.8
50	3.28	559.2	silt&clay	111.55	9.1	0.19	10	1782							127.1	2.584	0.0012	0.0146	734.8
51	3.34	559.2	silt&clay	111.49	9.0	0.19	10	1764							125.9	2.584	0.0014	0.0172	734.8
52	3.41	559.1	silt&clay	111.45	8.9	0.19	10	1751							125.4	2.584	0.0014	0.0173	734.8
53	3.48	559.0	silt&clay	111.43	8.9	0.2	10	1747							125.1	2.594	0.0012	0.0149	731.8
54	3.54	559.0	silt&clay	111.39	8.9	0.2	10	1747							125.2	2.594	0.0015	0.0174	734.8
55	3.61	558.9	silt&clay	111.31	9.0	0.21	10	1758							125.3	2.604	0.0012	0.0150	731.8
56	3.67	558.8	silt&clay	111.19	9.1	0.21	10	1784							128.1	2.604	0.0014	0.0171	725.5
57	3.74	558.8	silt&clay	111.11	9.4	0.21	10	1837							130.5	2.604	0.0012	0.0144	722.3
58	3.8	558.7	silt&clay	111.09	9.6	0.22	10	1882							135.0	2.614	0.0014	0.0163	722.3
59	3.87	558.6	silt&clay	111.11	9.8	0.22	10	1932							138.1	2.614	0.0011	0.0136	719.0
60	3.93	558.6	silt&clay	111.09	9.8	0.22	10	1930							139.4	2.614	0.0013	0.0158	719.0
61	4	558.5	silt&clay	111.08	9.7	0.23	10	1906							134.3	2.624	0.0014	0.0164	719.0
62	4.07	558.4	silt&clay	111.08	9.6	0.23	10	1886							134.7	2.624	0.0012	0.0140	722.3
63	4.13	558.4	silt&clay	111.16	9.6	0.23	10	1892							134.9	2.624	0.0014	0.0163	722.3
64	4.2	558.3	silt&clay	111.43	9.7	0.24	10	1907							135.7	2.634	0.0012	0.0140	725.5
65	4.26	558.2	silt&clay	111.95	10.3	0.24	10	2014							139.4	2.634	0.0013	0.0159	737.8
66	4.33	558.2	silt&clay	112.62	11.6	0.25	10	2302							156.3	2.644	0.0010	0.0122	749.3
67	4.39	558.1	silt&clay	113.12	13.5	0.25	10	2679							193.9	2.644	0.0010	0.0115	752.0
68	4.46	558.0	silt&clay	113.37	14.6	0.25	10	2933							215.3	2.644	0.0007	0.0088	749.3
69	4.52	558.0	silt&clay	113.43	14.7	0.26	10	2932							205.5	2.654	0.0009	0.0108	752.0
70	4.59	557.9	silt&clay	113.41	14.1	0.26	10	2806							196.4	2.654	0.0009	0.0114	754.8
71	4.66	557.8	silt&clay	112.78	13.4	0.26	10	2665							190.7	2.654	0.0008	0.0100	754.8
72	4.72	557.8	silt&clay	111.79	12.7	0.27	10	2524							175.8	2.664	0.0011	0.0127	715.6
73	4.79	557.7	silt&clay	110.63	12.1	0.27	10	2402							166.8	2.664	0.0010	0.0115	690.1
74	4.85	557.7	silt&clay	110.18	11.8	0.28	10	2344							164.9	2.674	0.0011	0.0136	686.1
75	4.92	557.6	silt&clay	110.14	11.7	0.28	10	2334	Fwd Wall						164.0	2.674	0.0010	0.0117	686.1
76	4.98	557.5	silt&clay	110.16	11.7	0.28	10	2334							164.4	2.674	0.0011	0.0137	690.1
77	5.05	557.5	silt&clay	110.23	11.8	0.29	10	2352							164.8	2.684	0.0010	0.0117	690.1
78	5.11	557.4	silt&clay	110.41	12.1	0.29	10	2404							168.1	2.684	0.0011	0.0134	690.1
79	5.18	557.3	silt&clay	110.58	12.2	0.29	10	2432							175.0	2.684	0.0011	0.0129	697.8
80	5.25	557.3	silt&clay	110.7	12.1	0.3	10	2410							170.6	2.694	0.0009	0.0114	697.8
81	5.31	557.2	silt&clay	110.84	11.8	0.3	10	2342							165.1	2.694	0.0011	0.0137	701.5
82	5.38	557.1	silt&clay	111.14	11.7	0.3	10	2297							162.5	2.694	0.0010	0.0119	712.2
83	5.44	557.1	silt&clay	111.69	11.6	0.31	10	2275							162.2	2.704	0.0012	0.0140	722.3
84	5.51	557.0	silt&clay	112.23	11.6	0.31	10	2273							162.1	2.704	0.0010	0.0120	737.8
85	5.57	556.9	silt&clay	112.51	11.6	0.32	10	2266							162.2	2.714	0.0012	0.0141	749.3
86	5.64	556.9	silt&clay	112.64	11.6	0.32	10	2270							162.2	2.714	0.0010	0.0120	740.8
87	5.7	556.8	silt&clay	112.68	11.7	0.32	10	2287							162.8	2.714	0.0012	0.0140	746.5

C-009-2-21

88	5.77	556.7	silt&clay	113.01	12.0	0.33	10	2348			166.0	2.724	0.0011	0.0138	749.3
89	5.84	556.7	silt&clay	113.43	12.6	0.33	10	2465			175.3	2.724	0.0009	0.0112	760.0
90	5.9	556.6	silt&clay	114.01	13.4	0.33	10	2629			188.0	2.724	0.0010	0.0122	767.7
91	5.97	556.5	silt&clay	114.61	14.1	0.34	10	2778			199.1	2.734	0.0008	0.0099	779.7
92	6.03	556.5	silt&clay	115.17	14.8	0.34	10	2906			207.1	2.734	0.0009	0.0111	793.1
93	6.1	556.4	silt&clay	115.7	15.7	0.35	10	3099			215.3	2.744	0.0008	0.0092	801.4
94	6.16	556.3	silt&clay	116.07	16.5	0.35	10	3245			238.4	2.744	0.0008	0.0097	807.4
95	6.23	556.3	silt&clay	116.35	17.2	0.35	10	3398			238.1	2.744	0.0007	0.0083	811.3
96	6.29	556.2	silt&clay	116.52	17.8	0.36	10	3521			245.2	2.754	0.0008	0.0094	813.2
97	6.36	556.1	silt&clay	116.64	18.7	0.36	10	3710			265.0	2.754	0.0006	0.0075	813.2
98	6.42	556.1	silt&clay	116.65	19.3	0.36	10	3850			275.3	2.754	0.0007	0.0084	811.3
99	6.49	556.0	silt&clay	116.57	19.6	0.37	10	3900			272.2	2.764	0.0007	0.0085	807.4
100	6.56	555.9	silt&clay	116.5	19.7	0.37	10	3918	**2788**	Fwd	275.6	2.764	0.0006	0.0072	805.5
101	6.62	555.9	silt&clay	116.48	19.9	0.38	10	3984	**2442**	Rear	279.2	2.774	0.0007	0.0083	805.5
102	6.69	555.8	silt&clay	116.49	20.1	0.38	10	4012			283.6	2.774	0.0006	0.0070	805.5
103	6.75	555.8	silt&clay	116.5	20.1	0.38	10	4026			281.4	2.774	0.0007	0.0083	805.5
104	6.82	555.7	silt&clay	116.5	20.1	0.39	10	4018			281.8	2.784	0.0006	0.0071	805.5
105	6.88	555.6	silt&clay	116.54	20.2	0.39	10	4015			282.2	2.784	0.0007	0.0083	805.5
106	6.95	555.6	silt&clay	116.59	20.4	0.39	10	4082			283.7	2.784	0.0006	0.0071	807.4
107	7.01	555.5	silt&clay	116.67	20.9	0.4	10	4174			292.3	2.794	0.0007	0.0080	807.4
108	7.08	555.4	silt&clay	116.74	21.2	0.4	10	4243			301.9	2.794	0.0006	0.0078	807.4
109	7.15	555.4	silt&clay	116.78	21.1	0.41	10	4223			298.6	2.804	0.0006	0.0068	809.4
110	7.21	555.3	silt&clay	116.82	20.7	0.41	10	4121			288.2	2.804	0.0007	0.0082	809.4
111	7.28	555.2	silt&clay	116.81	20.1	0.41	10	3981			283.6	2.804	0.0006	0.0071	813.2
112	7.34	555.2	silt&clay	116.82	19.6	0.42	10	3894			271.8	2.814	0.0007	0.0087	813.2
113	7.41	555.1	silt&clay	116.79	19.4	0.42	10	3827			270.4	2.814	0.0006	0.0075	813.2
114	7.47	555.0	silt&clay	116.8	19.4	0.43	10	3833			271.8	2.824	0.0007	0.0087	813.2
115	7.54	555.0	silt&clay	116.82	19.5	0.43	10	3865			273.5	2.824	0.0006	0.0074	813.2
116	7.6	554.9	silt&clay	116.88	19.9	0.43	10	3928			277.1	2.824	0.0007	0.0086	813.2
117	7.67	554.8	silt&clay	117.03	20.5	0.44	10	4075			284.9	2.834	0.0007	0.0084	815.1
118	7.74	554.8	silt&clay	117.29	21.7	0.44	10	4324			302.1	2.834	0.0006	0.0068	818.9
119	7.8	554.7	silt&clay	117.6	22.7	0.44	10	4527			326.4	2.834	0.0006	0.0073	822.5
120	7.87	554.6	silt&clay	117.88	23.4	0.45	10	4679			327.7	2.844	0.0005	0.0062	827.8
121	7.93	554.6	silt&clay	118	23.6	0.45	10	4711			331.2	2.844	0.0006	0.0072	833.0
122	8	554.5	silt&clay	118.05	23.7	0.46	10	4739			333.0	2.854	0.0005	0.0062	831.3
123	8.06	554.4	silt&clay	118.05	23.8	0.46	10	4755			333.7	2.854	0.0006	0.0072	831.3
124	8.13	554.4	silt&clay	118.1	23.8	0.46	10	4748			334.3	2.854	0.0005	0.0061	831.3
125	8.19	554.3	silt&clay	118.24	23.9	0.47	10	4758			335.0	2.864	0.0006	0.0072	833.0
126	8.26	554.2	silt&clay	118.53	24.0	0.47	10	4770			335.9	2.864	0.0005	0.0061	841.2
127	8.32	554.2	silt&clay	118.89	24.1	0.48	10	4773			336.7	2.874	0.0006	0.0072	852.2
128	8.39	554.1	silt&clay	119.25	24.3	0.48	10	4823			339.6	2.874	0.0006	0.0071	856.6
129	8.46	554.0	silt&clay	119.63	25.1	0.48	10	4972			345.8	2.874	0.0005	0.0060	863.8
130	8.52	554.0	silt&clay	120.03	26.3	0.49	10	5224			368.2	2.884	0.0005	0.0066	872.1
131	8.59	553.9	silt&clay	120.52	28.3	0.49	10	5639			393.4	2.884	0.0004	0.0053	876.1
132	8.65	553.9	silt&clay	120.98	30.3	0.5	10	6050			429.0	2.894	0.0005	0.0057	886.3
133	8.72	553.8	silt&clay	121.45	31.8	0.5	10	6373			450.7	2.894	0.0004	0.0046	893.5
134	8.78	553.7	silt&clay	121.82	32.4	0.5	10	6496			456.2	2.894	0.0004	0.0053	900.5
135	8.85	553.7	silt&clay	122.15	32.5	0.51	10	6500			454.5	2.904	0.0004	0.0046	909.3

C-009-2-21

136	8.91	553.6	silt&clay	122.38	32.7	0.51	10	6536						456.6	2.904	0.0004	0.0053	915.7
137	8.98	553.5	silt&clay	122.54	33.1	0.52	10	6620						463.6	2.914	0.0004	0.0053	915.7
138	9.05	553.5	silt&clay	122.71	33.8	0.52	10	6750						472.4	2.914	0.0004	0.0044	917.8
139	9.11	553.4	silt&clay	122.91	34.5	0.52	10	6902						483.7	2.914	0.0004	0.0051	923.8
140	9.18	553.3	silt&clay	123.15	35.2	0.53	10	7044						495.1	2.924	0.0004	0.0043	926.7
141	9.24	553.3	silt&clay	123.26	35.8	0.53	10	7150						502.7	2.924	0.0004	0.0049	931.5
142	9.31	553.2	silt&clay	123.24	36.1	0.54	10	7246						505.6	2.934	0.0003	0.0042	928.7
143	9.37	553.1	silt&clay	123.13	36.4	0.54	10	7306						510.4	2.934	0.0004	0.0048	923.8
144	9.44	553.1	silt&clay	122.99	36.6	0.54	10	7334						515.1	2.934	0.0003	0.0041	921.8
145	9.5	553.0	silt&clay	122.85	36.5	0.55	10	7322						511.2	2.944	0.0004	0.0048	918.8
146	9.57	552.9	silt&clay	122.63	36.3	0.55	10	7278						508.2	2.944	0.0004	0.0049	914.6
147	9.64	552.9	silt&clay	122.24	35.8	0.56	10	7174						505.7	2.954	0.0004	0.0042	908.3
148	9.7	552.8	silt&clay	121.74	34.9	0.56	10	7035						489.7	2.954	0.0004	0.0051	893.5
149	9.77	552.7	silt&clay	121.21	33.8	0.56	10	6786						473.9	2.954	0.0004	0.0045	882.5
150	9.83	552.7	silt&clay	120.76	32.7	0.57	10	6560						459.0	2.964	0.0005	0.0054	877.4
151	9.9	552.6	silt&clay	120.27	31.4	0.57	10	6307						442.5	2.964	0.0004	0.0048	868.0
152	9.96	552.5	silt&clay	119.68	30.3	0.58	10	6086						420.9	2.974	0.0005	0.0059	855.2
153	10.03	552.5	silt&clay	119.19	29.4	0.58	10	5900						413.1	2.974	0.0004	0.0052	841.2
154	10.09	552.4	silt&clay	118.94	29.0	0.58	10	5817						403.5	2.974	0.0005	0.0062	841.2
155	10.16	552.3	silt&clay	118.93	28.8	0.59	10	5751						403.4	2.984	0.0004	0.0053	841.2
156	10.22	552.3	silt&clay	118.93	28.8	0.59	10	5757						403.9	2.984	0.0005	0.0062	841.2
157	10.29	552.2	silt&clay	119.14	28.9	0.59	10	5767						404.5	2.984	0.0005	0.0062	841.2
158	10.36	552.1	silt&clay	119.37	29.2	0.6	10	5843						405.5	2.994	0.0004	0.0053	853.7
159	10.42	552.1	silt&clay	119.95	29.9	0.6	10	5963						420.0	2.994	0.0005	0.0060	855.2
160	10.49	552.0	silt&clay	120.79	31.6	0.61	10	6296						433.8	3.004	0.0004	0.0050	877.4
161	10.55	552.0	silt&clay	121.86	34.5	0.61	10	6886						476.1	3.004	0.0004	0.0053	900.5
162	10.62	551.9	silt&clay	122.89	39.2	0.61	10	7888						539.0	3.004	0.0003	0.0040	915.7
163	10.68	551.8	silt&clay	123.68	43.8	0.62	10	8851						632.3	3.014	0.0003	0.0040	927.7
164	10.75	551.8	silt&clay	124.45	48.7	0.62	10	9925						670.4	3.014	0.0003	0.0032	938.0
165	10.81	551.7	silt&clay	125.16	52.7	0.63	10	10727						746.4	3.024	0.0003	0.0034	951.2
166	10.88	551.6	silt&clay	125.7	54.6	0.63	10	11126						798.4	3.024	0.0003	0.0032	964.1
167	10.95	551.6	silt&clay	125.96	55.9	0.63	10	11423						752.3	3.024	0.0002	0.0029	969.5
168	11.01	551.5	silt&clay	126.05	56.5	0.64	10	11554						798.3	3.034	0.0003	0.0032	965.7
169	11.08	551.4	silt&clay	126.14	58.0	0.64	10	11857						825.5	3.034	0.0002	0.0026	968.7
170	11.14	551.4	silt&clay	126.25	58.8	0.65	10	12016						814.2	3.044	0.0003	0.0031	971.0
171	11.21	551.3	silt&clay	126.16	59.3	0.65	10	12127						831.0	3.044	0.0002	0.0026	971.0
172	11.27	551.2	silt&clay	126.06	60.9	0.66	10	12505						847.9	3.054	0.0003	0.0030	961.0
173	11.34	551.2	sand&grav	126.08	65.6	0.66			22	35	-2.5	36		882.1	3.054	0.0002	0.0025	959.4
174	11.4	551.1	sand&grav	126.38	74.2	0.66			24	38	-2.5	36		1028.5	3.054	0.0002	0.0025	960.2
175	11.47	551.0	sand&grav	126.71	83.7	0.67			26	41	-2.5	37		1121.4	3.064	0.0002	0.0023	961.0
176	11.54	551.0	sand&grav	126.86	86.5	0.67			26	42	-2.5	37		1143.6	3.064	0.0002	0.0019	962.6
177	11.6	550.9	sand&grav	127.09	83.3	0.68			26	41	-2.5	37		1123.8	3.074	0.0002	0.0023	964.9
178	11.67	550.8	sand&grav	127.23	76.3	0.68			25	40	-2.5	37	**37**	1074.0	3.074	0.0002	0.0021	982.6
179	11.73	550.8	silt&clay	127.43	71.8	0.68	10	14846						986.8	3.074	0.0002	0.0026	986.7
180	11.8	550.7	silt&clay	127.38	67.6	0.69	10	13864						954.0	3.084	0.0002	0.0023	989.4
181	11.86	550.6	silt&clay	127.3	63.1	0.69	10	12897						898.0	3.084	0.0002	0.0029	990.1
182	11.93	550.6	silt&clay	127.14	57.5	0.7	10	11618						799.3	3.094	0.0002	0.0028	992.1
183	11.99	550.5	silt&clay	126.78	50.8	0.7	10	10191						719.5	3.094	0.0003	0.0036	993.4

C-009-2-21

184	12.06	550.4	silt&clay	126.28	44.2	0.71	10	8777	616.4	3.104	0.0003	0.0036	986.1
185	12.12	550.4	silt&clay	125.53	38.4	0.71	10	7535	523.5	3.104	0.0004	0.0050	981.2
186	12.19	550.3	silt&clay	124.8	34.3	0.71	10	6701	472.9	3.104	0.0005	0.0055	964.9
187	12.26	550.2	silt&clay	124.16	32.1	0.72	10	6247	447.2	3.114	0.0004	0.0050	952.8
188	12.32	550.2	silt&clay	123.72	30.9	0.72	10	6018	430.8	3.114	0.0005	0.0061	947.8
189	12.39	550.1	silt&clay	123.36	30.2	0.73	10	5878	423.3	3.124	0.0004	0.0053	940.7
190	12.45	550.1	silt&clay	123.1	29.9	0.73	10	5817	417.1	3.124	0.0005	0.0063	931.5
191	12.52	550.0	silt&clay	122.95	29.8	0.73	10	5792	417.3	3.124	0.0004	0.0054	931.5
192	12.58	549.9	silt&clay	122.96	29.8	0.74	10	5796	417.7	3.134	0.0005	0.0063	931.5
193	12.65	549.9	silt&clay	122.98	29.9	0.74	10	5810	418.3	3.134	0.0004	0.0054	932.5
194	12.71	549.8	silt&clay	123.08	30.2	0.75	10	5882	419.9	3.144	0.0005	0.0063	932.5
195	12.78	549.7	silt&clay	123.41	31.6	0.75	10	6176	433.6	3.144	0.0005	0.0061	936.2
196	12.85	549.7	silt&clay	123.77	33.7	0.75	10	6593	477.2	3.144	0.0004	0.0047	946.9
197	12.91	549.6	silt&clay	124.13	36.6	0.76	10	7187	505.3	3.154	0.0004	0.0052	947.8
198	12.98	549.5	silt&clay	124.3	39.1	0.76	10	7724	555.9	3.154	0.0003	0.0041	947.8
199	13.04	549.5	silt&clay	124.42	40.7	0.77	10	8058	580.7	3.164	0.0004	0.0046	947.8
200	13.11	549.4	silt&clay	124.38	40.3	0.77	10	7969	576.5	3.164	0.0003	0.0040	948.6
201	13.17	549.3	silt&clay	124.16	38.1	0.77	10	7516	537.0	3.164	0.0004	0.0049	946.9
202	13.24	549.3	silt&clay	123.89	35.6	0.78	10	6996	489.6	3.174	0.0004	0.0047	941.6
203	13.3	549.2	silt&clay	123.7	33.8	0.78	10	6605	471.2	3.174	0.0005	0.0057	941.6
204	13.37	549.1	silt&clay	123.66	33.1	0.79	10	6461	462.1	3.184	0.0004	0.0050	941.6
205	13.43	549.1	silt&clay	123.67	33.0	0.79	10	6433	458.9	3.184	0.0005	0.0058	942.5
206	13.5	549.0	silt&clay	123.71	33.2	0.79	10	6480	465.3	3.184	0.0005	0.0057	943.4
207	13.57	548.9	silt&clay	123.8	34.3	0.8	10	6687	471.7	3.194	0.0004	0.0049	943.4
208	13.63	548.9	silt&clay	123.96	35.5	0.8	10	6954	504.0	3.194	0.0004	0.0053	943.4
209	13.7	548.8	silt&clay	124.13	36.6	0.81	10	7165	517.6	3.204	0.0004	0.0045	947.8
210	13.76	548.7	silt&clay	124.32	36.9	0.81	10	7232	517.3	3.204	0.0004	0.0052	950.3
211	13.83	548.7	silt&clay	124.49	37.0	0.81	10	7236	517.8	3.204	0.0004	0.0045	955.3
212	13.89	548.6	silt&clay	124.69	37.8	0.82	10	7392	518.2	3.214	0.0004	0.0052	959.4
213	13.96	548.5	silt&clay	124.85	39.1	0.82	10	7684	551.2	3.214	0.0003	0.0042	961.0
214	14.02	548.5	silt&clay	125.01	40.2	0.83	10	7894	574.8	3.224	0.0004	0.0047	961.0
215	14.09	548.4	silt&clay	125.14	40.6	0.83	10	7981	563.4	3.224	0.0004	0.0048	964.9
216	14.16	548.3	silt&clay	125.27	40.6	0.84	10	7983	569.4	3.234	0.0003	0.0041	968.7
217	14.22	548.3	silt&clay	125.45	42.6	0.84	10	8394	575.3	3.234	0.0004	0.0047	969.5
218	14.29	548.2	silt&clay	125.67	44.6	0.84	10	8818	645.4	3.234	0.0003	0.0036	970.3
219	14.35	548.2	silt&clay	126.02	47.8	0.85	10	9495	653.2	3.244	0.0003	0.0042	976.2
220	14.42	548.1	silt&clay	126.11	50.3	0.85	10	10022	712.5	3.244	0.0003	0.0033	981.9
221	14.48	548.0	silt&clay	126.09	52.7	0.86	10	10526	749.2	3.254	0.0003	0.0036	968.0
222	14.55	548.0	silt&clay	125.93	54.0	0.86	10	10833	751.8	3.254	0.0003	0.0031	967.2
223	14.61	547.9	silt&clay	125.94	54.6	0.86	10	10945	768.2	3.254	0.0003	0.0036	967.2
224	14.68	547.8	silt&clay	125.98	55.0	0.87	10	11023	772.8	3.264	0.0003	0.0030	967.2
225	14.74	547.8	silt&clay	125.98	54.0	0.87	10	10835	768.5	3.264	0.0003	0.0036	968.7
226	14.81	547.7	silt&clay	125.97	52.9	0.88	10	10580	728.5	3.274	0.0003	0.0038	970.3
227	14.88	547.6	silt&clay	125.94	51.8	0.88	10	10352	727.6	3.274	0.0003	0.0032	970.3
228	14.94	547.6	silt&clay	125.91	51.5	0.88	10	10247	720.9	3.274	0.0003	0.0038	969.5
229	15.01	547.5	silt&clay	125.69	49.3	0.89	10	9815	714.1	3.284	0.0003	0.0033	968.7
230	15.07	547.4	silt&clay	125.47	46.9	0.89	10	9313	636.8	3.284	0.0004	0.0043	961.8
231	15.14	547.4	silt&clay	124.95	42.5	0.9	10	8372	621.6	3.294	0.0003	0.0038	962.6

C-009-2-21

232	15.2	547.3	silt&clay	124.41	38.8	0.9	10	7598		527.7	3.294	0.0004	0.0052	949.5
233	15.27	547.2	silt&clay	123.76	35.1	0.91	10	6819		482.4	3.304	0.0004	0.0049	938.9
234	15.33	547.2	silt&clay	123.35	32.8	0.91	10	6365		464.5	3.304	0.0005	0.0060	934.4
235	15.4	547.1	silt&clay	122.96	31.3	0.91	10	6048		433.9	3.304	0.0005	0.0064	932.5
236	15.47	547.0	silt&clay	122.53	29.8	0.92	10	5760		417.3	3.314	0.0005	0.0057	919.8
237	15.53	547.0	silt&clay	122.14	29.0	0.92	10	5584		402.4	3.314	0.0006	0.0069	912.5
238	15.6	546.9	silt&clay	121.96	28.5	0.93	10	5492		399.2	3.324	0.0005	0.0060	910.4
239	15.66	546.8	silt&clay	121.92	28.4	0.93	10	5467		397.6	3.324	0.0006	0.0070	910.4
240	15.73	546.8	silt&clay	121.9	28.3	0.93	10	5455		396.8	3.324	0.0005	0.0060	909.3
241	15.79	546.7	silt&clay	121.99	28.3	0.94	10	5457		396.5	3.334	0.0006	0.0071	909.3
242	15.86	546.6	silt&clay	121.97	28.4	0.94	10	5470		398.1	3.334	0.0005	0.0060	915.7
243	15.92	546.6	silt&clay	121.88	28.9	0.95	10	5567		399.7	3.344	0.0006	0.0070	908.3
244	15.99	546.5	silt&clay	121.59	29.3	0.95	10	5663		417.7	3.344	0.0005	0.0058	900.5
245	16.05	546.5	silt&clay	121.43	30.9	0.95	10	6016		415.0	3.344	0.0006	0.0068	893.5
246	16.12	546.4	silt&clay	121.14	30.4	0.96	10	5919		468.3	3.354	0.0005	0.0060	887.5
247	16.19	546.3	silt&clay	120.83	28.7	0.96	10	5563		396.7	3.354	0.0005	0.0061	882.5
248	16.25	546.3	silt&clay	120.19	24.7	0.97	10	4749		342.0	3.364	0.0007	0.0083	882.5
249	16.32	546.2	silt&clay	119.4	22.3	0.97	10	4264		301.6	3.364	0.0007	0.0080	866.6
250	16.38	546.1	silt&clay	118.39	21.2	0.97	10	4052		296.1	3.364	0.0008	0.0095	842.8
251	16.45	546.1	silt&clay	117.63	21.1	0.98	10	4035		295.5	3.374	0.0007	0.0082	818.9
252	16.51	546.0	silt&clay	117.21	21.0	0.98	10	4031	**5995**	295.3	3.374	0.0008	0.0096	817.0
253	16.58	545.9	silt&clay	117.14	21.1	0.98	10	4033		295.3	3.374	0.0007	0.0082	815.1
254	16.64	545.9	silt&clay	117.16	21.0	0.99	10	4031		295.3	3.384	0.0008	0.0096	815.1
255	16.71	545.8	silt&clay	117.25	21.1	0.99	10	4043		295.4	3.384	0.0007	0.0082	818.9
256	16.77	545.7	silt&clay	117.46	21.4	1	10	4108		297.5	3.394	0.0008	0.0096	820.7
257	16.84	545.7	silt&clay	118.14	22.6	1	10	4345		310.0	3.394	0.0008	0.0092	826.1
258	16.91	545.6	silt&clay	119.4	24.1	1	10	4608		344.2	3.394	0.0006	0.0071	855.2
259	16.97	545.5	silt&clay	120.72	25.0	1.01	10	4776		357.8	3.404	0.0007	0.0080	893.5
260	17.04	545.5	silt&clay	121.9	26.0	1.01	11	4950		350.2	3.404	0.0006	0.0070	913.6
261	17.1	545.4	silt&clay	122.78	27.5	1.02	10	5251		385.7	3.414	0.0006	0.0074	933.4
262	17.17	545.3	silt&clay	124.01	35.8	1.02	10	6938		421.1	3.414	0.0005	0.0058	946.0
263	17.23	545.3	silt&clay	125	42.3	1.02	10	8283		697.7	3.414	0.0003	0.0041	957.0
264	17.3	545.2	silt&clay	126.03	48.2	1.03	10	9474		659.9	3.424	0.0003	0.0037	974.0
265	17.36	545.1	silt&clay	126.52	47.8	1.03	10	9360		669.8	3.424	0.0004	0.0043	994.7
266	17.43	545.1	silt&clay	126.85	48.1	1.04	10	9427		679.7	3.434	0.0004	0.0042	994.1
267	17.5	545.0	silt&clay	126.91	48.3	1.04	10	9456		674.6	3.434	0.0003	0.0037	996.0
268	17.56	544.9	silt&clay	127.09	48.2	1.04	10	9416		676.0	3.434	0.0004	0.0043	998.0
269	17.63	544.9	silt&clay	127.28	48.4	1.05	10	9441		677.3	3.444	0.0003	0.0037	1006.7
270	17.69	544.8	silt&clay	127.46	48.9	1.05	10	9541		680.5	3.444	0.0004	0.0043	1009.1
271	17.76	544.7	silt&clay	127.56	50.0	1.06	10	9756		697.1	3.454	0.0003	0.0036	1008.5
272	17.82	544.7	silt&clay	127.66	51.7	1.06	10	10116		723.9	3.454	0.0003	0.0040	1009.7
273	17.89	544.6	silt&clay	128.02	53.8	1.07	10	10535		750.8	3.464	0.0003	0.0033	1010.3
274	17.95	544.6	silt&clay	128.39	57.0	1.07	10	11199		787.1	3.464	0.0003	0.0037	1026.7
275	18.02	544.5	silt&clay	128.8	60.2	1.07	10	11869		858.0	3.464	0.0002	0.0029	1025.6
276	18.08	544.4	silt&clay	129.09	62.5	1.08	10	12362		885.5	3.474	0.0003	0.0033	1030.4
277	18.15	544.4	silt&clay	129.3	63.1	1.08	10	12445		883.7	3.474	0.0003	0.0033	1040.2
278	18.22	544.3	silt&clay	129.44	63.1	1.09	10	12437		884.1	3.484	0.0002	0.0028	1038.7
279	18.28	544.2	silt&clay	129.56	63.7	1.09	10	12551		884.3	3.484	0.0003	0.0033	1040.2

C-009-2-21

280	18.35	544.2	silt&clay	129.83	65.4	1.1	10	12890						907.6	3.494	0.0002	0.0028	1046.5
281	18.41	544.1	silt&clay	130.13	66.8	1.1	10	13162						956.6	3.494	0.0003	0.0031	1053.5
282	18.48	544.0	silt&clay	130.37	67.7	1.1	10	13349						942.1	3.494	0.0002	0.0027	1057.6
283	18.54	544.0	silt&clay	130.54	67.6	1.11	10	13330						947.3	3.504	0.0003	0.0031	1060.3
284	18.61	543.9	silt&clay	130.64	68.2	1.11	10	13434						952.6	3.504	0.0002	0.0026	1065.5
285	18.67	543.8	silt&clay	130.69	68.4	1.12	10	13474						964.3	3.514	0.0003	0.0031	1063.4
286	18.74	543.8	silt&clay	130.67	68.6	1.12	10	13523						956.1	3.514	0.0003	0.0031	1063.4
287	18.81	543.7	silt&clay	130.68	68.7	1.13	10	13549						962.9	3.524	0.0002	0.0026	1063.4
288	18.87	543.6	sand&grav	130.72	69.4	1.13			28	40	-2.5	37		969.7	3.524	0.0003	0.0031	1063.8
289	18.94	543.6	sand&grav	130.84	71.3	1.13			29	41	-2.5	37		983.5	3.524	0.0002	0.0026	1065.1
290	19	543.5	sand&grav	131.06	76.0	1.14			30	43	-2.5	37		1044.4	3.534	0.0002	0.0028	1066.8
291	19.07	543.4	sand&grav	131.59	89.9	1.14			33	47	-2.5	38		1167.2	3.534	0.0002	0.0022	1068.9
292	19.13	543.4	sand&grav	132.32	108.5	1.15			37	53	-2.5	38		1564.5	3.544	0.0002	0.0019	1073.1
293	19.2	543.3	sand&grav	132.84	124.5	1.15			41	58	-2.5	39		1826.9	3.544	0.0001	0.0014	1085.7
294	19.26	543.2	sand&grav	133.3	130.9	1.16			42	60	-2.5	39		1839.2	3.554	0.0001	0.0016	1082.3
295	19.33	543.2	sand&grav	133.42	126.7	1.16			42	59	-2.5	39		1832.5	3.554	0.0001	0.0014	1096.4
296	19.39	543.1	sand&grav	133.35	119.4	1.16			41	57	-2.5	39		1651.5	3.554	0.0002	0.0018	1099.6
297	19.46	543.0	sand&grav	132.97	110.1	1.17			38	54	-2.5	39		1531.3	3.564	0.0002	0.0020	1087.6
298	19.53	543.0	sand&grav	132.4	99.2	1.17			36	51	-2.5	38		1444.7	3.564	0.0001	0.0018	1083.0
299	19.59	542.9	sand&grav	131.86	88.9	1.18			33	47	-2.5	38		1190.9	3.574	0.0002	0.0025	1077.9
300	19.66	542.8	sand&grav	131.26	78.3	1.18			31	43	-2.5	37		1101.0	3.574	0.0002	0.0023	1068.1
301	19.72	542.8	sand&grav	130.91	70.8	1.19			29	41	-2.5	37	**38**	1000.5	3.584	0.0003	0.0030	1062.9
302	19.79	542.7	silt&clay	130.63	65.1	1.19	10	12754						873.5	3.584	0.0002	0.0030	1070.6
303	19.85	542.7	silt&clay	130.44	61.6	1.19	10	11993						863.6	3.584	0.0003	0.0035	1062.9
304	19.92	542.6	silt&clay	130.22	61.5	1.2	10	11996						853.8	3.594	0.0003	0.0030	1058.1
305	19.98	542.5	silt&clay	129.97	59.5	1.2	10	11571						866.2	3.594	0.0003	0.0035	1056.3
306	20.05	542.5	silt&clay	129.66	57.4	1.21	10	11166						779.7	3.604	0.0003	0.0033	1050.8
307	20.11	542.4	silt&clay	129.04	52.3	1.21	10	10104						766.8	3.604	0.0003	0.0039	1042.6
308	20.18	542.3	silt&clay	128.27	46.1	1.22	10	8863						650.7	3.614	0.0004	0.0047	1028.8
309	20.25	542.3	silt&clay	127.09	40.3	1.22	10	7691						522.1	3.614	0.0004	0.0050	1017.3
310	20.31	542.2	silt&clay	126.02	36.1	1.22	11	6884						520.5	3.614	0.0005	0.0058	980.5
311	20.38	542.1	silt&clay	125.06	34.8	1.23	11	6630						477.3	3.624	0.0005	0.0055	971.8
312	20.44	542.1	silt&clay	124.65	33.4	1.23	11	6360						466.5	3.624	0.0005	0.0065	960.2
313	20.51	542.0	silt&clay	124.43	32.9	1.24	11	6272						460.9	3.634	0.0005	0.0057	959.4
314	20.57	541.9	silt&clay	124.45	33.3	1.24	11	6335						458.2	3.634	0.0006	0.0067	959.4
315	20.64	541.9	silt&clay	124.53	34.2	1.24	11	6518						479.7	3.634	0.0005	0.0055	959.4
316	20.7	541.8	silt&clay	124.78	36.3	1.25	10	6931						501.3	3.644	0.0005	0.0061	960.2
317	20.77	541.7	silt&clay	125.24	38.9	1.25	10	7481						544.9	3.644	0.0005	0.0056	966.5
318	20.84	541.7	silt&clay	125.93	42.2	1.26	10	8125						590.9	3.654	0.0004	0.0045	979.8
319	20.9	541.6	silt&clay	126.43	44.6	1.26	10	8593						636.7	3.654	0.0004	0.0048	994.1
320	20.97	541.5	silt&clay	126.23	45.2	1.26	10	8739						646.8	3.654	0.0003	0.0041	992.8
321	21.03	541.5	silt&clay	125.67	44.2	1.27	10	8536						616.7	3.664	0.0004	0.0050	962.6
322	21.1	541.4	silt&clay	124.86	41.3	1.27	10	7993						592.7	3.664	0.0004	0.0045	959.4
323	21.16	541.3	silt&clay	124.17	38.3	1.28	10	7390						528.8	3.674	0.0005	0.0058	948.6
324	21.23	541.3	silt&clay	123.22	35.0	1.28	10	6706						490.9	3.674	0.0004	0.0054	925.8
325	21.29	541.2	silt&clay	122.12	31.3	1.28	10	5983						452.2	3.674	0.0006	0.0068	907.2
326	21.36	541.1	silt&clay	121.18	28.1	1.29	11	5356						374.3	3.684	0.0006	0.0071	891.1
327	21.42	541.1	silt&clay	120.32	25.7	1.29	11	4891						356.7	3.684	0.0007	0.0087	878.7

C-009-2-21

328	21.49	541.0	silt&clay	119.7	24.9	1.3	11	4743		349.4	3.694	0.0007	0.0089	862.4
329	21.56	540.9	silt&clay	119.29	24.5	1.3	11	4672		342.1	3.694	0.0006	0.0078	853.7
330	21.62	540.9	silt&clay	119.13	24.3	1.3	11	4634		340.9	3.694	0.0008	0.0091	852.2
331	21.69	540.8	silt&clay	119.12	24.3	1.31	11	4629		340.8	3.704	0.0007	0.0078	853.7
332	21.75	540.8	silt&clay	119.14	24.3	1.31	11	4629		340.8	3.704	0.0008	0.0091	853.7
333	21.82	540.7	silt&clay	119.31	24.4	1.32	11	4655		340.9	3.714	0.0007	0.0078	853.7
334	21.88	540.6	silt&clay	119.52	24.9	1.32	11	4741		347.0	3.714	0.0007	0.0090	863.8
335	21.95	540.6	silt&clay	119.77	25.8	1.32	11	4909		359.5	3.714	0.0006	0.0074	865.2
336	22.01	540.5	silt&clay	119.87	26.3	1.33	11	5006	**7732**	377.8	3.724	0.0007	0.0083	866.6
337	22.08	540.4	silt&clay	119.95	26.5	1.33	11	5051		368.5	3.724	0.0007	0.0085	866.6
338	22.15	540.4	silt&clay	120.29	26.3	1.34	11	5015		369.4	3.734	0.0006	0.0073	869.4
339	22.21	540.3	silt&clay	120.88	26.4	1.34	11	5032		370.2	3.734	0.0007	0.0085	889.9
340	22.28	540.2	silt&clay	121.56	26.8	1.34	11	5101		372.1	3.734	0.0006	0.0072	906.1
341	22.34	540.2	silt&clay	122.16	28.3	1.35	11	5394		384.5	3.744	0.0007	0.0082	915.7
342	22.41	540.1	silt&clay	122.87	31.9	1.35	11	6067		434.9	3.744	0.0005	0.0062	922.8
343	22.47	540.0	silt&clay	123.63	35.4	1.36	10	6763		520.4	3.754	0.0005	0.0061	936.2
344	22.54	540.0	silt&clay	124.39	37.6	1.36	10	7183		533.6	3.754	0.0004	0.0051	950.3
345	22.6	539.9	silt&clay	124.75	36.9	1.36	11	7029		527.3	3.754	0.0005	0.0060	964.9
346	22.67	539.8	silt&clay	124.75	35.3	1.37	11	6724		490.9	3.764	0.0005	0.0055	965.7
347	22.73	539.8	silt&clay	124.4	33.6	1.37	11	6390		466.7	3.764	0.0006	0.0068	957.8
348	22.8	539.7	silt&clay	123.86	32.2	1.38	11	6133		453.3	3.774	0.0006	0.0070	948.6
349	22.87	539.6	silt&clay	123.33	30.7	1.38	11	5850		434.5	3.774	0.0005	0.0063	934.4
350	22.93	539.6	silt&clay	122.77	28.7	1.38	11	5459		403.8	3.774	0.0007	0.0079	928.7
351	23	539.5	silt&clay	122.25	27.0	1.39	11	5141		367.3	3.784	0.0006	0.0074	921.8
352	23.06	539.4	silt&clay	121.57	25.9	1.39	11	4926		364.7	3.784	0.0007	0.0087	907.2
353	23.13	539.4	silt&clay	120.9	25.4	1.4	11	4836		356.3	3.794	0.0006	0.0077	888.7
354	23.19	539.3	silt&clay	120.22	25.1	1.4	11	4777		347.8	3.794	0.0008	0.0092	878.7
355	23.26	539.2	silt&clay	119.8	24.7	1.4	11	4712		351.1	3.794	0.0006	0.0078	862.4
356	23.32	539.2	silt&clay	119.49	24.1	1.41	11	4587		342.1	3.804	0.0008	0.0093	861.0
357	23.39	539.1	silt&clay	119.4	23.1	1.41	11	4406		320.4	3.804	0.0007	0.0085	862.4
358	23.45	539.1	silt&clay	119.32	22.3	1.42	11	4240		310.8	3.814	0.0009	0.0103	862.4
359	23.52	539.0	silt&clay	119.31	21.9	1.42	11	4175		306.1	3.814	0.0009	0.0105	862.4
360	23.59	538.9	silt&clay	119.42	21.8	1.42	11	4156		305.9	3.814	0.0007	0.0090	863.8
361	23.65	538.9	silt&clay	119.87	21.8	1.43	11	4156		306.3	3.824	0.0009	0.0105	869.4
362	23.72	538.8	silt&clay	120.54	21.9	1.43	11	4168		306.5	3.824	0.0007	0.0090	892.3
363	23.78	538.7	silt&clay	121.44	22.1	1.44	11	4215		308.3	3.834	0.0009	0.0104	909.3
364	23.85	538.7	silt&clay	122.32	23.2	1.44	11	4421		317.0	3.834	0.0007	0.0087	929.6
365	23.91	538.6	silt&clay	123.36	26.3	1.44	11	5006		351.6	3.834	0.0008	0.0092	946.0
366	23.98	538.5	silt&clay	124.16	28.8	1.45	11	5488		436.9	3.844	0.0005	0.0063	961.8
367	24.04	538.5	silt&clay	124.94	32.2	1.45	11	6131		423.6	3.844	0.0006	0.0076	971.0
368	24.11	538.4	silt&clay	125.45	34.5	1.46	11	6564		493.4	3.854	0.0005	0.0056	981.9
369	24.17	538.3	silt&clay	125.86	37.3	1.46	11	7112		532.6	3.854	0.0005	0.0061	986.7
370	24.24	538.3	silt&clay	125.9	38.3	1.46	11	7295		544.6	3.854	0.0005	0.0059	987.4
371	24.31	538.2	silt&clay	125.82	38.4	1.47	11	7312		533.5	3.864	0.0004	0.0052	980.5
372	24.37	538.1	silt&clay	125.71	38.3	1.47	11	7291		536.5	3.864	0.0005	0.0060	980.5
373	24.44	538.1	silt&clay	125.73	38.4	1.48	11	7320		539.7	3.874	0.0004	0.0052	980.5
374	24.5	538.0	silt&clay	125.88	38.5	1.48	11	7335		539.9	3.874	0.0005	0.0060	981.2
375	24.57	537.9	silt&clay	126.19	39.0	1.48	11	7421		540.0	3.874	0.0004	0.0052	990.1

376	24.63	537.9	silt&clay	127.04	43.2	1.49	11	8221	558.1	3.884	0.0005	0.0058	999.9
377	24.7	537.8	silt&clay	128.09	51.9	1.49	10	9981	716.5	3.884	0.0003	0.0039	1021.8
378	24.76	537.7	silt&clay	129.13	61.8	1.5	10	11992	908.6	3.894	0.0003	0.0036	1033.0
379	24.83	537.7	silt&clay	129.64	70.1	1.5	10	13683	974.0	3.894	0.0002	0.0029	1044.1
380	24.89	537.6	silt&clay	129.66	69.8	1.51	10	13632	1063.7	3.904	0.0003	0.0031	1037.6
381	24.96	537.5	silt&clay	129.43	66.7	1.51	10	12968	897.9	3.904	0.0003	0.0037	1034.6
382	25.03	537.5	silt&clay	129.15	61.0	1.51	10	11796	840.0	3.904	0.0003	0.0033	1036.1
383	25.09	537.4	silt&clay	128.99	59.2	1.52	10	11437	826.5	3.914	0.0003	0.0040	1032.5
384	25.16	537.3	silt&clay	128.88	58.6	1.52	10	11301	819.9	3.914	0.0003	0.0034	1029.4
385	25.22	537.3	silt&clay	128.87	59.7	1.53	10	11545	817.7	3.924	0.0003	0.0040	1029.9
386	25.29	537.2	silt&clay	128.85	62.3	1.53	10	12075	872.3	3.924	0.0003	0.0032	1028.8
387	25.35	537.2	silt&clay	128.75	66.3	1.54	10	12943	926.8	3.934	0.0003	0.0036	1020.6
388	25.42	537.1	silt&clay	128.48	67.0	1.54	10	13110	988.2	3.934	0.0002	0.0029	1012.1
389	25.48	537.0	silt&clay	128.09	63.8	1.54	10	12449	899.1	3.934	0.0003	0.0037	1008.5
390	25.55	537.0	silt&clay	127.52	55.2	1.55	10	10677	793.5	3.944	0.0003	0.0036	1001.8
391	25.61	536.9	silt&clay	126.82	45.5	1.55	11	8669	628.8	3.944	0.0004	0.0053	996.7
392	25.68	536.8	silt&clay	126.09	37.6	1.56	11	7156	491.1	3.954	0.0006	0.0068	991.4
393	25.75	536.8	silt&clay	125.35	32.8	1.56	11	6251	460.1	3.954	0.0005	0.0062	981.9
394	25.81	536.7	silt&clay	124.5	31.5	1.56	11	5990	429.2	3.954	0.0006	0.0077	966.5
395	25.88	536.6	silt&clay	123.54	30.5	1.57	11	5802	433.4	3.964	0.0005	0.0066	938.0
396	25.94	536.6	silt&clay	122.74	29.7	1.57	11	5657	418.8	3.964	0.0007	0.0080	919.8
397	26.01	536.5	silt&clay	122.22	28.5	1.58	11	5430	397.3	3.974	0.0006	0.0072	917.8
398	26.07	536.4	silt&clay	121.98	27.6	1.58	11	5265	383.6	3.974	0.0007	0.0087	909.3
399	26.14	536.4	silt&clay	121.81	27.3	1.58	11	5200	382.0	3.974	0.0006	0.0075	908.3
400	26.2	536.3	silt&clay	121.81	27.3	1.59	11	5202	383.0	3.984	0.0007	0.0087	908.3
401	26.27	536.2	silt&clay	121.85	27.6	1.59	11	5251	383.9	3.984	0.0006	0.0075	909.3
402	26.33	536.2	silt&clay	122.03	28.0	1.6	11	5341	392.9	3.994	0.0007	0.0085	909.3
403	26.4	536.1	silt&clay	122.4	28.7	1.6	11	5474	402.8	3.994	0.0007	0.0083	917.8
404	26.47	536.0	silt&clay	123.27	29.6	1.6	11	5642	413.5	3.994	0.0006	0.0070	929.6
405	26.53	536.0	silt&clay	124.41	31.3	1.61	11	5960	429.7	4.004	0.0007	0.0078	962.6
406	26.6	535.9	silt&clay	125.52	34.2	1.61	11	6520	473.2	4.004	0.0005	0.0061	986.1
407	26.66	535.8	silt&clay	126.34	40.0	1.62	11	7611	536.6	4.014	0.0005	0.0063	995.4
408	26.73	535.8	silt&clay	126.92	46.0	1.62	11	8762	670.7	4.014	0.0004	0.0043	996.0
409	26.79	535.7	silt&clay	127.38	50.6	1.63	10	9657	726.9	4.024	0.0004	0.0047	1003.0
410	26.86	535.6	silt&clay	127.7	53.2	1.63	10	10201	727.8	4.024	0.0003	0.0040	1011.5
411	26.92	535.6	silt&clay	127.71	53.3	1.63	10	10212	783.6	4.024	0.0004	0.0043	1010.3
412	26.99	535.5	silt&clay	127.47	52.4	1.64	10	10042	729.2	4.034	0.0003	0.0040	1003.0
413	27.05	535.5	silt&clay	127.16	50.3	1.64	10	9613	690.7	4.034	0.0004	0.0049	997.3
414	27.12	535.4	silt&clay	126.9	49.2	1.65	10	9397	695.5	4.044	0.0004	0.0049	996.0
415	27.19	535.3	silt&clay	126.51	47.5	1.65	10	9076	682.3	4.044	0.0004	0.0043	988.8
416	27.25	535.3	silt&clay	126.05	44.7	1.65	11	8514	619.6	4.044	0.0005	0.0055	975.4
417	27.32	535.2	silt&clay	125.64	41.2	1.66	11	7844	577.2	4.054	0.0004	0.0051	974.7
418	27.38	535.1	silt&clay	125.6	40.8	1.66	11	7762	534.7	4.054	0.0005	0.0064	974.0
419	27.45	535.1	silt&clay	125.51	39.3	1.67	11	7491	601.5	4.064	0.0004	0.0049	974.0
420	27.51	535.0	silt&clay	125.48	38.8	1.67	11	7387	517.8	4.064	0.0005	0.0066	974.0
421	27.58	534.9	silt&clay	125.34	36.6	1.67	11	6979	511.5	4.064	0.0005	0.0057	974.0
422	27.64	534.9	silt&clay	125.35	36.5	1.68	11	6950	511.5	4.074	0.0006	0.0067	974.0
423	27.71	534.8	silt&clay	125.47	36.5	1.68	11	6952	511.6	4.074	0.0005	0.0057	975.4

424	27.77	534.7	silt&clay	125.81	36.8	1.69	11	7004		511.8	4.084	0.0006	0.0067	982.6
425	27.84	534.7	silt&clay	126.33	38.2	1.69	11	7282		523.1	4.084	0.0005	0.0066	995.4
426	27.91	534.6	silt&clay	127.12	43.1	1.7	11	8202		573.0	4.094	0.0004	0.0051	1004.8
427	27.97	534.5	silt&clay	127.81	48.0	1.7	11	9150		714.6	4.094	0.0004	0.0048	1017.8
428	28.04	534.5	silt&clay	128.43	52.3	1.7	11	9964		732.3	4.094	0.0003	0.0040	1026.1
429	28.1	534.4	silt&clay	128.82	53.9	1.71	11	10263		752.0	4.104	0.0004	0.0046	1034.1
430	28.17	534.3	silt&clay	129.19	54.6	1.71	11	10408		780.9	4.104	0.0003	0.0038	1040.2
431	28.23	534.3	silt&clay	129.43	55.9	1.72	11	10640		763.7	4.114	0.0004	0.0045	1049.4
432	28.3	534.2	silt&clay	129.6	59.0	1.72	10	11269		803.6	4.114	0.0003	0.0037	1047.5
433	28.36	534.1	silt&clay	129.44	59.7	1.72	10	11429		912.4	4.114	0.0003	0.0038	1042.6
434	28.43	534.1	silt&clay	129.16	59.3	1.73	10	11367		791.2	4.124	0.0003	0.0038	1036.1
435	28.49	534.0	silt&clay	128.56	54.7	1.73	11	10419		790.6	4.124	0.0004	0.0044	1028.8
436	28.56	533.9	silt&clay	127.91	52.4	1.74	11	9975		717.6	4.134	0.0004	0.0048	1013.8
437	28.63	533.9	silt&clay	127.01	48.2	1.74	11	9187		693.3	4.134	0.0004	0.0043	997.3
438	28.69	533.8	silt&clay	126.2	45.0	1.75	11	8573		616.8	4.144	0.0005	0.0056	980.5
439	28.76	533.7	silt&clay	125.48	41.6	1.75	11	7916		582.6	4.144	0.0004	0.0051	968.7
440	28.82	533.7	silt&clay	125.05	39.8	1.75	11	7577		548.3	4.144	0.0005	0.0063	961.0
441	28.89	533.6	silt&clay	124.84	38.7	1.76	11	7379		541.9	4.154	0.0005	0.0055	958.6
442	28.95	533.6	silt&clay	124.8	38.5	1.76	11	7333		538.8	4.154	0.0005	0.0065	958.6
443	29.02	533.5	silt&clay	124.82	38.4	1.77	11	7316		538.3	4.164	0.0005	0.0056	959.4
444	29.08	533.4	silt&clay	124.88	38.7	1.77	11	7370		538.2	4.164	0.0005	0.0065	960.2
445	29.15	533.4	silt&clay	125.09	39.3	1.77	11	7482		550.5	4.164	0.0005	0.0054	961.8
446	29.21	533.3	silt&clay	125.49	39.8	1.78	11	7583		562.9	4.174	0.0005	0.0062	971.0
447	29.28	533.2	silt&clay	126.07	40.9	1.78	11	7785		560.6	4.174	0.0005	0.0063	984.7
448	29.35	533.2	silt&clay	126.77	43.1	1.79	11	8217		595.1	4.184	0.0004	0.0051	998.0
449	29.41	533.1	silt&clay	127.64	47.3	1.79	11	9017		658.5	4.184	0.0004	0.0053	1010.9
450	29.48	533.0	silt&clay	128.6	53.7	1.8	11	10232		736.7	4.194	0.0003	0.0041	1028.8
451	29.54	533.0	silt&clay	129.5	61.8	1.8	10	11831		863.4	4.194	0.0003	0.0041	1044.1
452	29.61	532.9	silt&clay	130.22	68.3	1.8	10	13131		995.4	4.194	0.0003	0.0030	1051.2
453	29.67	532.8	silt&clay	130.44	70.3	1.81	10	13556		1012.9	4.204	0.0003	0.0035	1062.5
454	29.74	532.8	silt&clay	130.39	67.3	1.81	10	12891		947.7	4.204	0.0003	0.0032	1054.5
455	29.8	532.7	silt&clay	130.06	61.3	1.82	11	11674		867.2	4.214	0.0003	0.0041	1054.9
456	29.87	532.6	silt&clay	129.86	55.8	1.82	11	10629		761.5	4.214	0.0003	0.0040	1055.4
457	29.93	532.6	silt&clay	129.62	51.9	1.82	11	9878		716.8	4.214	0.0004	0.0049	1055.8
458	30	532.5	silt&clay	129.39	50.6	1.83	11	9640		701.8	4.224	0.0004	0.0051	1050.3
459	30.07	532.4	silt&clay	129.1	50.1	1.83	11	9543		709.0	4.224	0.0004	0.0043	1043.6
460	30.13	532.4	silt&clay	128.9	49.9	1.83	11	9512		695.2	4.224	0.0004	0.0051	1037.1
461	30.2	532.3	silt&clay	128.78	49.6	1.84	11	9446		694.7	4.234	0.0004	0.0044	1037.1
462	30.26	532.2	silt&clay	128.8	49.6	1.84	11	9444		694.7	4.234	0.0004	0.0051	1036.6
463	30.33	532.2	silt&clay	128.75	49.7	1.84	11	9470		694.8	4.234	0.0004	0.0044	1038.1
464	30.39	532.1	silt&clay	128.58	50.6	1.84	11	9638		700.6	4.234	0.0004	0.0051	1033.6
465	30.46	532.0	silt&clay	128.35	50.5	1.85	11	9621		731.5	4.244	0.0003	0.0042	1021.2
466	30.52	532.0	silt&clay	128.05	49.1	1.85	11	9352		691.1	4.244	0.0004	0.0052	1023.4
467	30.59	531.9	silt&clay	127.74	45.3	1.85	11	8625	**6989**	641.1	4.244	0.0004	0.0048	1016.7
468	30.65	531.9	silt&clay	127.32	41.9	1.85	11	7983		570.9	4.244	0.0005	0.0062	1013.2
469	30.72	531.8	silt&clay	126.96	39.7	1.85	11	7566		549.2	4.244	0.0005	0.0065	1006.7
470	30.79	531.7	silt&clay	126.67	39.2	1.86	11	7467		549.2	4.254	0.0005	0.0056	1000.5
471	30.85	531.7	silt&clay	126.51	39.2	1.86	11	7470		549.1	4.254	0.0005	0.0065	995.4

C-009-2-21

472	30.92	531.6	silt&clay	126.44	39.4	1.86	11	7497	549.9	4.254	0.0005	0.0056	995.4
473	30.98	531.5	silt&clay	126.53	40.7	1.86	11	7752	554.7	4.254	0.0005	0.0064	995.4
474	31.05	531.5	silt&clay	126.63	42.3	1.86	11	8059	605.6	4.254	0.0004	0.0051	996.0
475	31.11	531.4	silt&clay	126.88	44.6	1.87	11	8493	617.1	4.264	0.0005	0.0058	996.7
476	31.18	531.3	silt&clay	127.06	45.0	1.87	11	8573	650.8	4.264	0.0004	0.0047	1003.6
477	31.24	531.3	silt&clay	127.34	45.2	1.87	11	8615	623.1	4.264	0.0005	0.0057	1007.3
478	31.31	531.2	silt&clay	127.45	44.7	1.87	11	8520	626.3	4.264	0.0004	0.0049	1014.4
479	31.37	531.1	silt&clay	127.5	45.3	1.88	11	8621	629.4	4.274	0.0005	0.0057	1013.2
480	31.44	531.1	silt&clay	127.33	45.6	1.88	11	8680	645.6	4.274	0.0005	0.0056	1008.5
481	31.51	531.0	silt&clay	126.99	45.0	1.88	11	8570	639.1	4.274	0.0004	0.0048	1001.8
482	31.57	530.9	silt&clay	126.54	42.5	1.88	11	8090	605.2	4.274	0.0005	0.0059	992.1
483	31.64	530.9	silt&clay	125.92	38.4	1.88	11	7314	539.6	4.274	0.0005	0.0057	986.7
484	31.7	530.8	silt&clay	125.08	33.8	1.89	11	6429	467.9	4.284	0.0006	0.0077	974.7
485	31.77	530.7	silt&clay	124.17	30.7	1.89	11	5840	410.1	4.284	0.0006	0.0075	952.8
486	31.83	530.7	silt&clay	123.48	29.3	1.89	11	5573	409.4	4.284	0.0007	0.0088	938.9
487	31.9	530.6	silt&clay	123.22	29.2	1.89	11	5568	409.0	4.284	0.0006	0.0075	935.3
488	31.96	530.5	silt&clay	123.19	29.4	1.89	11	5590	408.8	4.284	0.0007	0.0088	935.3
489	32.03	530.5	silt&clay	123.22	29.6	1.9	11	5636	414.1	4.294	0.0006	0.0075	936.2
490	32.09	530.4	silt&clay	123.31	30.5	1.9	11	5817	419.4	4.294	0.0007	0.0086	936.2
491	32.16	530.3	silt&clay	123.58	34.0	1.9	11	6478	448.6	4.294	0.0007	0.0080	937.1
492	32.23	530.3	silt&clay	123.84	37.8	1.9	11	7198	559.7	4.294	0.0005	0.0055	937.1
493	32.29	530.2	silt&clay	124.02	40.8	1.9	11	7768	577.8	4.294	0.0005	0.0062	937.1
494	32.36	530.1	silt&clay	124.03	40.2	1.91	11	7651	574.2	4.304	0.0004	0.0054	938.0
495	32.42	530.1	silt&clay	123.83	36.6	1.91	11	6979	534.4	4.304	0.0006	0.0068	939.8
496	32.49	530.0	silt&clay	123.45	32.3	1.91	11	6143	429.4	4.304	0.0006	0.0072	938.9
497	32.55	530.0	silt&clay	122.76	28.2	1.91	11	5366	389.7	4.304	0.0008	0.0093	932.5
498	32.62	529.9	silt&clay	122.22	26.5	1.91	11	5055	351.1	4.304	0.0007	0.0088	912.5
499	32.68	529.8	silt&clay	121.82	25.9	1.92	11	4924	347.2	4.314	0.0009	0.0104	910.4
500	32.75	529.8	silt&clay	121.77	25.8	1.92	11	4914	346.7	4.314	0.0007	0.0090	909.3
501	32.81	529.7	silt&clay	121.78	25.8	1.92	11	4916	346.3	4.314	0.0009	0.0105	909.3
502	32.88	529.6	silt&clay	121.83	25.8	1.92	11	4916	345.8	4.314	0.0009	0.0105	911.5
503	32.95	529.6	silt&clay	122.04	25.8	1.92	11	4920	345.6	4.314	0.0007	0.0090	912.5
504	33.01	529.5	silt&clay	122.37	25.9	1.93	11	4930	346.8	4.324	0.0009	0.0105	923.8
505	33.08	529.4	silt&clay	122.85	26.5	1.93	11	5053	349.2	4.324	0.0007	0.0089	933.4
506	33.14	529.4	silt&clay	123.2	27.7	1.93	11	5267	387.7	4.324	0.0008	0.0094	941.6
507	33.21	529.3	silt&clay	123.39	28.8	1.93	11	5476	408.5	4.324	0.0006	0.0076	941.6
508	33.27	529.2	silt&clay	123.34	28.6	1.93	11	5444	409.2	4.324	0.0007	0.0089	940.7
509	33.34	529.2	silt&clay	123.12	27.2	1.94	11	5179	380.5	4.334	0.0007	0.0082	939.8
510	33.4	529.1	silt&clay	122.63	25.3	1.94	11	4827	323.8	4.334	0.0009	0.0112	934.4
511	33.47	529.0	silt&clay	121.9	23.9	1.94	11	4549	288.6	4.334	0.0009	0.0108	916.7
512	33.53	529.0	silt&clay	121.07	23.1	1.94	11	4394	267.7	4.334	0.0011	0.0136	897.0
513	33.6	528.9	silt&clay	120.48	22.7	1.94	11	4330	262.9	4.334	0.0012	0.0138	882.5
514	33.67	528.8	silt&clay	120.19	22.7	1.94	11	4320	263.0	4.334	0.0010	0.0119	880.0
515	33.73	528.8	silt&clay	120.13	22.7	1.95	11	4324	263.4	4.344	0.0012	0.0139	877.4
516	33.8	528.7	silt&clay	120.12	22.8	1.95	11	4341	263.9	4.344	0.0010	0.0119	877.4
517	33.86	528.6	silt&clay	120.15	23.0	1.95	11	4387	268.5	4.344	0.0011	0.0136	877.4
518	33.93	528.6	silt&clay	120.28	23.5	1.95	11	4478	278.6	4.344	0.0009	0.0112	878.7
519	33.99	528.5	silt&clay	120.46	24.1	1.95	11	4590	297.7	4.344	0.0010	0.0123	883.8

C-009-2-21

520	34.06	528.4	silt&clay	120.67	24.7	1.96	11	4707						310.5	4.354	0.0008	0.0101	886.3
521	34.12	528.4	silt&clay	120.86	25.0	1.96	11	4770						324.1	4.354	0.0009	0.0113	888.7
522	34.19	528.3	silt&clay	121.1	25.3	1.96	11	4815						321.3	4.354	0.0008	0.0098	894.7
523	34.25	528.3	silt&clay	121.38	25.4	1.96	11	4842						327.4	4.354	0.0009	0.0112	901.6
524	34.32	528.2	silt&clay	121.61	25.8	1.96	11	4909						333.7	4.354	0.0009	0.0110	907.2
525	34.39	528.1	silt&clay	122	26.3	1.97	11	5004						347.2	4.364	0.0008	0.0091	909.3
526	34.45	528.1	silt&clay	122.55	27.5	1.97	11	5234						366.9	4.364	0.0008	0.0100	924.8
527	34.52	528.0	silt&clay	122.97	29.3	1.97	11	5579						408.7	4.364	0.0006	0.0077	938.0
528	34.58	527.9	silt&clay	123.32	32.8	1.97	11	6248						441.5	4.364	0.0007	0.0083	928.7
529	34.65	527.9	silt&clay	123.46	35.8	1.97	11	6813						523.6	4.364	0.0005	0.0060	931.5
530	34.71	527.8	silt&clay	123.75	38.0	1.98	11	7234						533.2	4.374	0.0006	0.0069	933.4
531	34.78	527.7	silt&clay	124.35	38.6	1.98	11	7354						534.2	4.374	0.0005	0.0059	938.9
532	34.84	527.7	silt&clay	125.13	40.3	1.98	11	7669						550.0	4.374	0.0006	0.0067	968.7
533	34.91	527.6	silt&clay	125.87	41.6	1.98	11	7918						602.5	4.374	0.0004	0.0052	980.5
534	34.97	527.5	silt&clay	126.32	42.7	1.98	11	8135						589.1	4.374	0.0005	0.0062	986.7
535	35.04	527.5	silt&clay	126.32	41.1	1.99	11	7834						597.4	4.384	0.0005	0.0062	996.0
536	35.11	527.4	silt&clay	126.12	39.4	1.99	11	7509						536.8	4.384	0.0005	0.0059	986.7
537	35.17	527.3	silt&clay	125.62	38.0	1.99	11	7242						517.0	4.384	0.0006	0.0071	979.8
538	35.24	527.3	silt&clay	125.27	37.6	1.99	11	7152						538.3	4.384	0.0005	0.0059	966.5
539	35.3	527.2	silt&clay	125.05	37.5	1.99	11	7149						516.8	4.384	0.0006	0.0071	964.9
540	35.37	527.1	silt&clay	125.03	37.1	2	11	7065						515.9	4.394	0.0005	0.0061	965.7
541	35.43	527.1	silt&clay	125.09	37.3	2	11	7099						520.1	4.394	0.0006	0.0071	966.5
542	35.5	527.0	silt&clay	125.26	38.0	2	11	7244						524.2	4.394	0.0005	0.0060	968.0
543	35.56	526.9	silt&clay	125.6	38.1	2	11	7265						547.7	4.394	0.0006	0.0067	974.7
544	35.63	526.9	silt&clay	126.05	38.8	2	11	7387						524.7	4.394	0.0005	0.0060	988.8
545	35.69	526.8	silt&clay	126.73	39.5	2.01	11	7516						550.7	4.404	0.0006	0.0067	996.7
546	35.76	526.7	silt&clay	127.74	42.1	2.01	11	8023						576.8	4.404	0.0005	0.0064	1018.4
547	35.83	526.7	silt&clay	128.78	46.9	2.01	11	8939						636.2	4.404	0.0004	0.0050	1046.5
548	35.89	526.6	silt&clay	129.93	57.3	2.01	11	10916						752.2	4.404	0.0004	0.0049	1052.6
549	35.96	526.5	sand&grav	131.07	73.1	2.02			33	41	-2.5	37		1012.9	4.414	0.0003	0.0031	1066.8
550	36.02	526.5	sand&grav	132.07	90.2	2.02			38	46	-2.5	38		1301.2	4.414	0.0002	0.0028	1084.2
551	36.09	526.4	sand&grav	132.69	101.3	2.02			41	50	-2.5	38		1469.1	4.414	0.0002	0.0022	1088.4
552	36.15	526.4	sand&grav	132.81	100.9	2.02			41	50	-2.5	38		1478.2	4.414	0.0002	0.0025	1091.7
553	36.22	526.3	sand&grav	132.38	88.0	2.02			38	46	-2.5	38		1284.4	4.414	0.0002	0.0025	1092.8
554	36.28	526.2	sand&grav	131.5	74.4	2.03			34	41	-2.5	37	**38**	927.3	4.424	0.0003	0.0040	1080.7
555	36.35	526.2	silt&clay	130.27	60.9	2.03	11	11600						907.9	4.424	0.0003	0.0035	1056.7
556	36.41	526.1	silt&clay	129.01	52.1	2.03	11	9922						716.6	4.424	0.0004	0.0052	1040.6
557	36.48	526.0	silt&clay	127.61	43.3	2.03	11	8240						556.9	4.424	0.0006	0.0067	1019.0
558	36.55	526.0	silt&clay	126.23	38.0	2.04	11	7234						536.9	4.434	0.0005	0.0059	988.1
559	36.61	525.9	silt&clay	124.83	33.3	2.04	11	6333						494.9	4.434	0.0006	0.0075	965.7
560	36.68	525.8	silt&clay	123.52	28.5	2.04	11	5419						321.5	4.434	0.0008	0.0099	944.3
561	36.74	525.8	silt&clay	122.16	24.1	2.04	11	4587						280.4	4.434	0.0011	0.0133	921.8
562	36.81	525.7	silt&clay	121.21	22.9	2.04	11	4356						242.2	4.434	0.0011	0.0132	897.0
563	36.87	525.6	silt&clay	120.51	22.2	2.05	11	4221						235.9	4.444	0.0013	0.0158	887.5
564	36.94	525.6	silt&clay	120.16	22.0	2.05	11	4190						232.8	4.444	0.0011	0.0137	880.0
565	37	525.5	silt&clay	119.77	21.8	2.05	11	4145						230.8	4.444	0.0013	0.0162	873.4
566	37.07	525.4	silt&clay	119.31	21.3	2.05	11	4063						219.4	4.444	0.0012	0.0146	862.4
567	37.13	525.4	silt&clay	118.81	20.9	2.05	11	3981						205.7	4.444	0.0015	0.0181	850.6

568	37.2	525.3	silt&clay	118.38	20.4	2.05	11	3890							203.2	4.444	0.0015	0.0184	842.8
569	37.27	525.2	silt&clay	118.12	20.1	2.06	11	3832							189.7	4.454	0.0014	0.0169	836.3
570	37.33	525.2	silt&clay	118.01	19.9	2.06	11	3790							188.1	4.454	0.0017	0.0199	836.3
571	37.4	525.1	silt&clay	118.01	19.9	2.06	11	3794							189.2	4.454	0.0014	0.0169	836.3
572	37.46	525.0	silt&clay	118.02	20.0	2.06	11	3815							190.5	4.454	0.0016	0.0196	836.3
573	37.53	525.0	silt&clay	118.13	20.2	2.06	11	3853							193.5	4.454	0.0014	0.0166	836.3
574	37.59	524.9	silt&clay	118.45	20.6	2.07	11	3920							200.5	4.464	0.0016	0.0187	841.2
575	37.66	524.8	silt&clay	119.07	21.2	2.07	11	4032							210.4	4.464	0.0013	0.0153	855.2
576	37.72	524.8	silt&clay	119.88	21.9	2.07	11	4162							228.9	4.464	0.0014	0.0164	873.4
577	37.79	524.7	silt&clay	120.63	23.4	2.07	11	4448							241.9	4.464	0.0013	0.0155	892.3
578	37.86	524.6	silt&clay	121.3	24.9	2.07	11	4747							309.7	4.464	0.0009	0.0104	898.2
579	37.92	524.6	silt&clay	121.97	26.8	2.08	11	5097							337.8	4.474	0.0009	0.0111	910.4
580	37.99	524.5	silt&clay	122.73	28.3	2.08	11	5392							375.3	4.474	0.0007	0.0086	926.7
581	38.05	524.5	silt&clay	123.75	29.9	2.08	11	5703							419.6	4.474	0.0007	0.0090	940.7
582	38.12	524.4	silt&clay	124.79	31.5	2.08	11	6004							438.8	4.474	0.0006	0.0073	971.0
583	38.18	524.3	silt&clay	126.04	34.5	2.08	11	6566							456.7	4.474	0.0007	0.0082	990.8
584	38.25	524.3	silt&clay	127.32	40.4	2.09	11	7691							543.6	4.484	0.0005	0.0059	1014.4
585	38.31	524.2	silt&clay	128.65	50.0	2.09	11	9520							687.0	4.484	0.0005	0.0055	1034.1
586	38.38	524.1	silt&clay	129.77	60.9	2.09	11	11592							859.6	4.484	0.0003	0.0038	1048.9
587	38.44	524.1	silt&clay	130.32	65.7	2.09	11	12516	**6139**						1000.5	4.484	0.0003	0.0038	1060.8
588	38.51	524.0	sand&grav	131	67.7	2.09				32	39	-3.5	36		890.5	4.484	0.0004	0.0042	1061.2
589	38.58	523.9	sand&grav	131.3	66.5	2.1				32	39	-3.5	36		944.1	4.494	0.0003	0.0034	1089.5
590	38.64	523.9	sand&grav	131.92	69.7	2.1				33	41	-3.5	36		947.3	4.494	0.0003	0.0040	1085.3
591	38.71	523.8	sand&grav	132.32	73.4	2.1				35	42	-3.5	36		1024.5	4.494	0.0003	0.0032	1096.8
592	38.77	523.7	sand&grav	133.44	81.9	2.1				38	46	-3.5	37		1101.7	4.494	0.0003	0.0034	1108.1
593	38.84	523.7	sand&grav	134.27	95.9	2.11				42	51	-2.5	38		1302.7	4.504	0.0002	0.0025	1142.4
594	38.9	523.6	sand&grav	134.81	112.7	2.11				46	56	-2.5	39		1615.4	4.504	0.0002	0.0023	1130.0
595	38.97	523.5	sand&grav	134.37	115.4	2.11				46	56	-2.5	39		1804.2	4.504	0.0001	0.0018	1120.0
596	39.03	523.5	sand&grav	133.97	109.3	2.11				44	54	-2.5	39		1418.8	4.504	0.0002	0.0027	1108.1
597	39.1	523.4	sand&grav	133.5	98.0	2.12				41	50	-2.5	38		1357.4	4.514	0.0002	0.0024	1111.8
598	39.16	523.3	sand&grav	133.31	95.8	2.12				41	50	-2.5	38		1331.8	4.514	0.0002	0.0028	1105.4
599	39.23	523.3	sand&grav	132.97	94.8	2.12				40	49	-2.5	38		1324.3	4.514	0.0002	0.0029	1098.9
600	39.3	523.2	sand&grav	132.29	94.8	2.12				39	48	-2.5	38	**37**	1316.9	4.514	0.0002	0.0025	1089.1
601	39.36	523.1	silt&clay	131.22	89.9	2.12	10	17432							1331.8	4.514	0.0002	0.0028	1055.8
602	39.43	523.1	silt&clay	129.84	81.5	2.13	10	15756							1115.9	4.524	0.0002	0.0029	1030.9
603	39.49	523.0	silt&clay	128.15	64.3	2.13	10	12274							964.5	4.524	0.0003	0.0039	1012.1
604	39.56	522.9	silt&clay	126.01	46.1	2.13	11	8779							607.6	4.524	0.0004	0.0054	976.2
605	39.62	522.9	silt&clay	123.09	31.4	2.13	11	5975							298.8	4.524	0.0011	0.0127	932.5
606	39.69	522.8	silt&clay	120.21	25.1	2.13	11	4775							286.7	4.524	0.0009	0.0114	861.0
607	39.75	522.8	silt&clay	117.72	24.8	2.14	11	4722							280.9	4.534	0.0011	0.0136	805.5
608	39.82	522.7	silt&clay	116.04	24.7	2.14	11	4701							278.5	4.534	0.0010	0.0117	775.0
609	39.88	522.6	silt&clay	115.04	24.7	2.14	11	4699							278.7	4.534	0.0011	0.0137	752.0
610	39.95	522.6	silt&clay	114.52	24.9	2.14	11	4735							279.0	4.534	0.0011	0.0136	737.8
611	40.02	522.5	silt&clay	114.32	25.1	2.14	11	4779							290.7	4.534	0.0009	0.0112	737.8
612	40.08	522.4	silt&clay	114.38	25.3	2.15	11	4815							293.4	4.544	0.0011	0.0130	737.8
613	40.15	522.4	silt&clay	114.49	25.3	2.15	11	4823							292.2	4.544	0.0009	0.0112	740.8
614	40.21	522.3	silt&clay	114.73	25.3	2.15	11	4821							292.1	4.544	0.0011	0.0131	746.5
615	40.28	522.2	silt&clay	115.14	25.4	2.15	11	4832							292.0	4.544	0.0009	0.0112	754.8

C-009-2-21

616	40.34	522.2	silt&clay	115.74	25.9	2.15	11	4930							295.5	4.544	0.0011	0.0129	770.2
617	40.41	522.1	silt&clay	116.27	27.5	2.15	11	5234							327.8	4.544	0.0008	0.0100	784.3
618	40.47	522.0	silt&clay	116.63	29.6	2.16	11	5632							413.9	4.554	0.0008	0.0092	782.0
619	40.54	522.0	silt&clay	116.74	31.2	2.16	11	5947							440.6	4.554	0.0006	0.0074	782.0
620	40.6	521.9	silt&clay	116.84	31.8	2.16	11	6061							441.0	4.554	0.0007	0.0087	782.0
621	40.67	521.8	silt&clay	117.06	31.7	2.16	11	6030							442.9	4.554	0.0007	0.0086	786.5
622	40.74	521.8	silt&clay	117.09	31.2	2.16	11	5935							433.6	4.554	0.0006	0.0076	799.4
623	40.8	521.7	silt&clay	117.08	30.5	2.16	11	5808							416.1	4.554	0.0008	0.0092	788.7
624	40.87	521.6	silt&clay	116.94	30.0	2.17	11	5709							405.2	4.564	0.0007	0.0081	788.7
625	40.93	521.6	silt&clay	117.04	29.7	2.17	11	5661							399.9	4.564	0.0008	0.0096	790.9
626	41	521.5	silt&clay	117.28	29.7	2.17	11	5657							394.5	4.564	0.0007	0.0083	797.3
627	41.06	521.4	silt&clay	118.06	29.6	2.17	11	5642							401.8	4.564	0.0008	0.0095	805.5
628	41.13	521.4	silt&clay	119.24	29.6	2.17	11	5636							391.9	4.564	0.0007	0.0084	842.8
629	41.19	521.3	silt&clay	120.47	29.5	2.18	11	5615							391.2	4.574	0.0008	0.0098	874.8
630	41.26	521.2	silt&clay	121.43	29.5	2.18	11	5623							392.4	4.574	0.0007	0.0084	894.7
631	41.32	521.2	silt&clay	121.96	29.9	2.18	11	5693							393.6	4.574	0.0008	0.0098	910.4
632	41.39	521.1	silt&clay	122.43	32.9	2.18	11	6267							420.1	4.574	0.0008	0.0091	911.5
633	41.46	521.0	silt&clay	123	39.4	2.18	11	7507							535.0	4.574	0.0005	0.0062	913.6
634	41.52	521.0	silt&clay	123.56	48.1	2.19	11	9152							683.2	4.584	0.0005	0.0056	920.8
635	41.59	520.9	sand&grav	123.68	54.1	2.19				24	29	-2.5	35		787.0	4.584	0.0003	0.0042	917.8
636	41.65	520.9	sand&grav	123.3	55.3	2.19				24	29	-2.5	35		786.7	4.584	0.0004	0.0049	902.7
637	41.72	520.8	sand&grav	122.39	52.7	2.19				23	28	-2.5	34		735.3	4.584	0.0004	0.0045	889.9
638	41.78	520.7	sand&grav	121.14	48.9	2.19				21	26	-2.5	34		678.2	4.584	0.0005	0.0057	861.0
639	41.85	520.7	sand&grav	119.34	44.4	2.19				20	24	-2.5	33		626.4	4.584	0.0004	0.0053	824.3
640	41.91	520.6	sand&grav	117.42	39.2	2.2				18	21	-2.5	33		546.1	4.594	0.0006	0.0071	777.4
641	41.98	520.5	sand&grav	115.74	34.0	2.2				16	19	-2.5	32		459.4	4.594	0.0006	0.0072	749.3
642	42.04	520.5	sand&grav	114.66	29.4	2.2				14	17	-3.5	31	**33**	387.3	4.594	0.0008	0.0100	734.8
643	42.11	520.4	silt&clay	114.08	26.9	2.2	11	5116							290.8	4.594	0.0009	0.0114	728.7
644	42.17	520.3	silt&clay	114.19	25.5	2.2	11	4857							286.4	4.594	0.0011	0.0135	725.5
645	42.24	520.3	silt&clay	114.83	25.5	2.21	11	4851							285.2	4.604	0.0011	0.0136	749.3
646	42.31	520.2	silt&clay	115.73	25.6	2.21	11	4870							288.8	4.604	0.0010	0.0115	770.2
647	42.37	520.1	silt&clay	116.26	26.3	2.21	11	5002							292.1	4.604	0.0011	0.0132	788.7
648	42.44	520.1	silt&clay	116.64	28.1	2.21	11	5354							333.2	4.604	0.0008	0.0099	784.3
649	42.5	520.0	silt&clay	116.8	29.9	2.21	11	5699							427.9	4.604	0.0008	0.0090	786.5
650	42.57	519.9	silt&clay	117.08	31.1	2.21	11	5922							429.6	4.604	0.0006	0.0077	788.7
651	42.63	519.9	silt&clay	117.49	31.0	2.22	11	5905							423.4	4.614	0.0008	0.0092	797.3
652	42.7	519.8	silt&clay	118.16	30.9	2.22	11	5884							419.9	4.614	0.0007	0.0079	815.1
653	42.76	519.7	silt&clay	119.11	30.9	2.22	11	5876							419.2	4.614	0.0008	0.0092	834.7
654	42.83	519.7	silt&clay	120.03	30.9	2.22	11	5876							418.7	4.614	0.0007	0.0079	861.0
655	42.89	519.6	silt&clay	120.91	31.6	2.22	11	6015							418.6	4.614	0.0008	0.0093	878.7
656	42.96	519.5	silt&clay	121.74	34.1	2.23	11	6491							457.4	4.624	0.0007	0.0085	894.7
657	43.03	519.5	silt&clay	122.59	40.8	2.23	11	7779	**5689**						531.9	4.624	0.0005	0.0063	907.2
658	43.09	519.4	sand&grav	123.3	51.2	2.23				23	28	-2.5	34		710.8	4.624	0.0005	0.0055	909.3
659	43.16	519.3	sand&grav	123.72	62.6	2.23				26	31	-2.5	35		890.1	4.624	0.0003	0.0037	907.2
660	43.22	519.3	sand&grav	123.76	71.0	2.23				27	33	-2.5	36		1013.1	4.624	0.0003	0.0038	902.7
661	43.29	519.2	sand&grav	123.38	74.9	2.24				28	33	-2.5	36		1063.4	4.634	0.0003	0.0031	892.3
662	43.35	519.2	sand&grav	122.94	76.1	2.24				28	33	-2.5	36		1052.3	4.634	0.0003	0.0037	872.1
663	43.42	519.1	sand&grav	122.61	76.0	2.24				27	33	-2.5	36		1063.2	4.634	0.0003	0.0031	870.8

C-009-2-21

664	43.48	519.0	sand&grav	122.58	75.5	2.24	27	33	-2.5	35	1061.7	4.634	0.0003	0.0037	869.4
665	43.55	519.0	sand&grav	122.51	72.6	2.24	27	32	-2.5	35	1031.2	4.634	0.0003	0.0032	869.4
666	43.61	518.9	sand&grav	122.4	67.6	2.25	26	31	-2.5	35	939.7	4.644	0.0003	0.0042	872.1
667	43.68	518.8	sand&grav	122.53	61.7	2.25	25	30	-2.5	35	853.5	4.644	0.0004	0.0046	874.8
668	43.75	518.8	sand&grav	122.6	57.8	2.25	24	29	-2.5	35	782.5	4.644	0.0004	0.0043	893.5
669	43.81	518.7	sand&grav	122.76	55.9	2.25	24	29	-2.5	35	776.3	4.644	0.0004	0.0050	887.5
670	43.88	518.6	sand&grav	122.81	56.2	2.25	24	29	-2.5	35	773.3	4.644	0.0004	0.0043	891.1
671	43.94	518.6	sand&grav	123.2	57.0	2.25	24	29	-2.5	35	793.0	4.644	0.0004	0.0049	895.9
672	44.01	518.5	sand&grav	123.37	58.9	2.26	25	30	-2.5	35	812.5	4.654	0.0003	0.0041	911.5
673	44.07	518.4	sand&grav	123.42	61.9	2.26	26	30	-2.5	35	852.6	4.654	0.0004	0.0046	898.2
674	44.14	518.4	sand&grav	123.29	66.9	2.26	26	31	-2.5	35	919.2	4.654	0.0003	0.0036	891.1
675	44.2	518.3	sand&grav	123.45	74.7	2.26	28	33	-2.5	36	1021.4	4.654	0.0003	0.0038	891.1
676	44.27	518.2	sand&grav	123.68	82.6	2.26	29	35	-2.5	36	1181.1	4.654	0.0002	0.0028	891.1
677	44.33	518.2	sand&grav	123.88	89.0	2.27	30	36	-2.5	36	1251.3	4.664	0.0003	0.0031	891.1
678	44.4	518.1	sand&grav	124.01	91.6	2.27	31	37	-2.5	36	1287.4	4.664	0.0003	0.0030	892.3
679	44.47	518.0	sand&grav	124.23	92.2	2.27	31	37	-2.5	36	1292.5	4.664	0.0002	0.0026	894.7
680	44.53	518.0	sand&grav	124.44	91.6	2.27	32	38	-2.5	36	1275.6	4.664	0.0003	0.0031	905.0
681	44.6	517.9	sand&grav	124.76	93.2	2.28	32	38	-2.5	36	1261.0	4.674	0.0002	0.0027	908.3
682	44.66	517.8	sand&grav	125.28	97.5	2.28	33	39	-2.5	37	1359.4	4.674	0.0002	0.0029	914.6
683	44.73	517.8	sand&grav	126.1	107.7	2.28	36	42	-2.5	37	1457.9	4.674	0.0002	0.0023	932.5
684	44.79	517.7	sand&grav	127.14	127.0	2.28	39	47	-2.5	38	1689.5	4.674	0.0002	0.0023	947.8
685	44.86	517.6	sand&grav	128.45	167.1	2.28	47	56	-2.5	39	2060.8	4.674	0.0001	0.0016	960.2
686	44.92	517.6	sand&grav	129.27	195.3	2.29	52	61	-2.2	40	2323.3	4.684	0.0001	0.0017	977.6
687	44.99	517.5	sand&grav	129.6	192.3	2.29	52	62	-2.3	39	2285.2	4.684	0.0001	0.0015	979.1
688	45.05	517.5	sand&grav	129.2	156.8	2.29	46	55	-2.5	39	2043.3	4.684	0.0002	0.0019	986.1
689	45.12	517.4	sand&grav	128.61	123.9	2.29	41	48	-2.5	38	1651.0	4.684	0.0002	0.0020	983.3
690	45.18	517.3	sand&grav	128.06	108.7	2.29	38	45	-2.5	37	1490.0	4.684	0.0002	0.0026	976.9
691	45.25	517.3	sand&grav	127.63	98.9	2.3	36	42	-2.5	37	1406.9	4.694	0.0002	0.0024	969.5
692	45.31	517.2	sand&grav	127.24	89.0	2.3	34	40	-2.5	37	1240.1	4.694	0.0003	0.0032	969.5
693	45.38	517.1	sand&grav	126.52	80.4	2.3	31	37	-2.5	36	1072.8	4.694	0.0003	0.0037	967.2
694	45.45	517.1	sand&grav	125.45	75.4	2.3	30	35	-2.5	36	1045.1	4.694	0.0003	0.0032	934.4
695	45.51	517.0	sand&grav	124.15	74.3	2.3	28	34	-2.5	36	1031.2	4.694	0.0003	0.0038	902.7
696	45.58	516.9	sand&grav	122.79	73.8	2.31	27	32	-2.5	35	1027.1	4.704	0.0003	0.0033	881.3
697	45.64	516.9	sand&grav	121.51	73.9	2.31	26	31	-2.5	35	1023.0	4.704	0.0003	0.0039	838.0
698	45.71	516.8	sand&grav	120.01	73.5	2.31	25	30	-2.5	35	1036.5	4.704	0.0003	0.0033	813.2
699	45.77	516.7	sand&grav	118.74	72.6	2.31	25	29	-2.5	35	1007.6	4.704	0.0003	0.0039	782.0
700	45.84	516.7	sand&grav	117.56	70.0	2.31	24	28	-2.5	34	986.0	4.704	0.0003	0.0034	752.0
701	45.9	516.6	sand&grav	116.72	66.4	2.32	23	27	-2.5	34	926.7	4.714	0.0004	0.0043	740.8
702	45.97	516.5	sand&grav	116.2	61.4	2.32	21	25	-2.5	34	856.8	4.714	0.0003	0.0040	731.8
703	46.03	516.5	sand&grav	115.87	56.1	2.32	20	24	-2.5	34	777.9	4.714	0.0004	0.0051	728.7
704	46.1	516.4	sand&grav	115.65	51.0	2.32	19	23	-2.5	33	701.6	4.714	0.0004	0.0048	731.8
705	46.16	516.3	sand&grav	116.37	46.8	2.32	19	22	-2.5	33	644.3	4.714	0.0005	0.0061	731.8
706	46.23	516.3	sand&grav	117.2	44.4	2.32	19	22	-2.5	33	601.7	4.714	0.0005	0.0066	786.5
707	46.3	516.2	sand&grav	118.13	43.2	2.33	19	23	-2.5	33	597.1	4.724	0.0005	0.0057	797.3
708	46.36	516.1	sand&grav	118.39	43.0	2.33	19	23	-2.5	33	594.8	4.724	0.0006	0.0067	807.4
709	46.43	516.1	sand&grav	118.55	43.0	2.33	19	23	-2.5	33	594.6	4.724	0.0005	0.0057	805.5
710	46.49	516.0	sand&grav	118.6	43.0	2.33	19	23	-2.5	33	594.6	4.724	0.0006	0.0067	809.4
711	46.56	515.9	sand&grav	118.66	43.1	2.33	19	23	-2.5	33	596.1	4.724	0.0005	0.0057	811.3

C-009-2-21

712	46.62	515.9	sand&grav	118.71	44.2	2.34				20	23	-2.5	33		597.7	4.734	0.0006	0.0067	811.3
713	46.69	515.8	sand&grav	118.53	47.5	2.34				20	24	-2.5	33		642.6	4.734	0.0004	0.0053	807.4
714	46.75	515.8	sand&grav	118.18	53.1	2.34				21	25	-2.5	34		733.4	4.734	0.0005	0.0054	786.5
715	46.82	515.7	sand&grav	117.49	59.2	2.34				22	26	-2.5	34		834.6	4.734	0.0003	0.0041	765.2
716	46.88	515.6	sand&grav	116.79	65.4	2.34				22	27	-2.5	34		898.6	4.734	0.0004	0.0044	740.8
717	46.95	515.6	sand&grav	116.32	71.5	2.34				23	27	-2.5	34		992.3	4.734	0.0003	0.0034	722.3
718	47.01	515.5	sand&grav	116.24	77.4	2.35				24	28	-2.5	35		1089.4	4.744	0.0003	0.0037	722.3
719	47.08	515.4	sand&grav	116.42	80.7	2.35				25	29	-2.5	35		1174.1	4.744	0.0002	0.0029	725.5
720	47.14	515.4	sand&grav	116.58	80.4	2.35				25	29	-2.5	35		1169.5	4.744	0.0003	0.0034	725.5
721	47.21	515.3	sand&grav	116.93	76.7	2.35				24	29	-2.5	35		1079.7	4.744	0.0003	0.0037	731.8
722	47.28	515.2	sand&grav	117.73	70.6	2.35				24	28	-2.5	35		992.3	4.744	0.0003	0.0034	754.8
723	47.34	515.2	sand&grav	119.27	61.6	2.36				23	27	-2.5	34		870.8	4.754	0.0004	0.0046	793.1
724	47.41	515.1	sand&grav	120.01	54.4	2.36				22	26	-2.5	34		701.2	4.754	0.0004	0.0049	852.2
725	47.47	515.0	sand&grav	120.66	50.0	2.36				22	26	-2.5	34		689.6	4.754	0.0005	0.0058	836.3
726	47.54	515.0	sand&grav	121.36	49.8	2.36				22	26	-2.5	34	**35**	689.0	4.754	0.0004	0.0050	855.2
727	47.6	514.9	silt&clay	123.49	49.9	2.36	11	9495							690.8	4.754	0.0005	0.0058	897.0
728	47.67	514.8	silt&clay	126.15	50.1	2.37	11	9550							692.5	4.764	0.0004	0.0050	969.5
729	47.73	514.8	silt&clay	128.62	52.6	2.37	11	10013							701.3	4.764	0.0005	0.0057	1032.5
730	47.8	514.7	silt&clay	130.02	55.0	2.37	11	10470	**9882**						792.8	4.764		0.0000	1071.4

Total Settlement (ft, in): **0.4202** **5.0430**

Average Shear Wave Velocity (ft/s): **906.6**

C-009-3-21

Surface Elev.: 562

Surcharge Load: 2.3400 tsf

No	Depth (ft)	Elev (ft)	Soil Type	γ (pcf)	qn (tsf)	σ',vo (tsf)	Nkt	su (psf)	su,avg (psf)	N60 (bpf)	N160	Phi Adjustment	Phi	Phi avg	Fr (%)	Ic	Constrained Modulus (tsf)	Change in Stress Δσ' (tsf)	Settlement S (ft)	Settlement (in)	Shear Wave Velocity (ft/s)
35	2.3	559.7	silt&clay	122	29.8	0.13	16	3832							5.31	2.36	417.9	2.47	0.0008	0.0101	911.5
36	2.36	559.6	silt&clay	122.33	30.5	0.13	16	3912							5.38	2.36	429.1	2.47	0.0010	0.0122	917.8
37	2.43	559.6	silt&clay	122.55	31.1	0.14	16	3974	Rear Wall						5.42	2.37	437.0	2.48	0.0009	0.0105	921.8
38	2.49	559.5	silt&clay	122.72	31.6	0.14	16	4044							5.42	2.37	440.2	2.48	0.0010	0.0125	923.8
39	2.56	559.4	silt&clay	122.91	31.9	0.15	16	4074							5.48	2.37	452.0	2.49	0.0009	0.0106	926.7
40	2.62	559.4	silt&clay	123.14	32.2	0.15	16	4092							5.6	2.38	450.1	2.49	0.0011	0.0127	933.4
41	2.69	559.3	silt&clay	123.37	32.3	0.15	16	4079							5.76	2.39	451.5	2.49	0.0011	0.0129	938.0
42	2.76	559.2	silt&clay	123.58	32.6	0.16	16	4105							5.85	2.4	455.1	2.5	0.0009	0.0114	941.6
43	2.82	559.2	silt&clay	123.77	33.2	0.16	16	4175							5.87	2.4	462.9	2.5	0.0011	0.0136	946.0
44	2.89	559.1	silt&clay	123.99	34.1	0.17	16	4302							5.82	2.4	475.7	2.51	0.0010	0.0121	948.6
45	2.95	559.1	silt&clay	124.18	34.9	0.17	16	4408							5.79	2.39	495.0	2.51	0.0012	0.0146	952.0
46	3.02	559.0	silt&clay	124.32	35.3	0.17	16	4450							5.82	2.4	496.9	2.51	0.0011	0.0128	955.3
47	3.08	558.9	silt&clay	124.33	35.2	0.18	16	4428							5.86	2.4	491.1	2.52	0.0013	0.0152	957.0
48	3.15	558.9	silt&clay	124.22	35.0	0.18	16	4414							5.81	2.41	490.1	2.52	0.0013	0.0158	952.8
49	3.22	558.8	silt&clay	124.07	34.9	0.19	16	4423							5.7	2.4	489.4	2.53	0.0012	0.0141	948.6
50	3.28	558.7	silt&clay	123.92	34.9	0.19	16	4436							5.59	2.4	488.8	2.53	0.0014	0.0167	946.0
51	3.35	558.7	silt&clay	123.79	34.9	0.19	16	4447							5.5	2.4	488.5	2.53	0.0012	0.0145	943.4
52	3.41	558.6	silt&clay	123.62	34.9	0.2	16	4472							5.37	2.4	488.5	2.54	0.0014	0.0170	939.8
53	3.48	558.5	silt&clay	123.43	35.0	0.2	16	4508							5.21	2.39	490.3	2.54	0.0012	0.0146	934.4
54	3.54	558.5	silt&clay	123.22	35.1	0.21	15	4560							5.03	2.38	491.9	2.55	0.0014	0.0171	929.6
55	3.61	558.4	silt&clay	123.04	35.4	0.21	15	4617							4.87	2.37	495.3	2.55	0.0012	0.0147	924.8
56	3.67	558.3	silt&clay	122.77	35.1	0.21	15	4605							4.75	2.37	499.0	2.55	0.0014	0.0167	920.8
57	3.74	558.3	silt&clay	122.42	34.3	0.22	15	4518							4.66	2.37	480.1	2.56	0.0014	0.0165	911.5
58	3.81	558.2	silt&clay	122.02	33.1	0.22	15	4360							4.64	2.38	462.4	2.56	0.0011	0.0137	903.9
59	3.87	558.1	silt&clay	121.78	32.2	0.23	15	4241							4.65	2.39	447.4	2.57	0.0013	0.0156	899.3
60	3.94	558.1	silt&clay	121.67	31.7	0.23	15	4176							4.67	2.4	443.0	2.57	0.0011	0.0133	900.5
61	4	558.0	silt&clay	121.65	31.6	0.23	15	4160							4.68	2.41	442.7	2.57	0.0013	0.0161	898.2
62	4.07	557.9	silt&clay	121.63	31.6	0.24	15	4158							4.67	2.41	442.5	2.58	0.0011	0.0138	898.2
63	4.13	557.9	silt&clay	121.64	31.7	0.24	15	4181							4.65	2.41	442.3	2.58	0.0013	0.0161	898.2
64	4.2	557.8	silt&clay	121.65	31.6	0.25	15	4165							4.67	2.41	448.7	2.59	0.0011	0.0137	899.3
65	4.26	557.7	silt&clay	121.79	31.5	0.25	15	4123							4.79	2.43	438.7	2.59	0.0013	0.0156	899.3
66	4.33	557.7	silt&clay	121.93	31.1	0.25	15	4051							4.96	2.44	435.5	2.59	0.0012	0.0139	909.3
67	4.4	557.6	silt&clay	122.08	31.0	0.26	15	4019	Fwd Wall						5.08	2.45	434.6	2.6	0.0008	0.0097	910.4
68	4.46	557.5	silt&clay	122.11	31.0	0.26	15	4012							5.11	2.46	434.5	2.6	0.0008	0.0101	911.5
69	4.53	557.5	silt&clay	122.13	31.0	0.27	15	4010							5.12	2.46	434.6	2.61	0.0008	0.0091	911.5
70	4.59	557.4	silt&clay	122.2	31.1	0.27	15	4020							5.15	2.46	434.5	2.61	0.0009	0.0112	911.5
71	4.66	557.3	silt&clay	122.29	31.5	0.27	15	4076							5.12	2.46	439.2	2.61	0.0008	0.0099	915.7
72	4.72	557.3	silt&clay	122.35	32.3	0.28	15	4189							5.01	2.45	451.0	2.62	0.0010	0.0125	914.6
73	4.79	557.2	silt&clay	122.33	32.9	0.28	15	4304							4.86	2.44	465.4	2.62	0.0011	0.0132	912.5
74	4.86	557.1	silt&clay	122.29	33.4	0.29	15	4389							4.74	2.43	468.2	2.63	0.0010	0.0115	910.4
75	4.92	557.1	silt&clay	122.26	33.6	0.29	15	4425							4.68	2.43	471.1	2.63	0.0011	0.0135	909.3
76	4.99	557.0	silt&clay	122.22	33.5	0.29	15	4405							4.68	2.43	473.5	2.63	0.0010	0.0115	909.3
77	5.05	557.0	silt&clay	122.09	32.9	0.3	15	4329							4.7	2.44	461.7	2.64	0.0011	0.0135	908.3
78	5.12	556.9	silt&clay	121.91	32.3	0.3	15	4248							4.71	2.45	448.5	2.64	0.0009	0.0113	903.9
79	5.18	556.8	silt&clay	121.73	32.0	0.31	15	4213							4.65	2.45	447.7	2.65	0.0011	0.0127	899.3
80	5.25	556.8	silt&clay	121.56	31.9	0.31	15	4229							4.55	2.45	447.5	2.65	0.0009	0.0112	897.0
81	5.31	556.7	silt&clay	121.45	31.9	0.31	15	4242							4.48	2.44	447.5	2.65	0.0011	0.0135	892.3
82	5.38	556.6	silt&clay	121.37	31.9	0.32	15	4250							4.43	2.44	447.5	2.66	0.0011	0.0138	892.3
83	5.45	556.6	silt&clay	121.35	32.0	0.32	15	4258							4.42	2.44	447.5	2.66	0.0010	0.0118	891.1
84	5.51	556.5	silt&clay	121.35	32.1	0.33	15	4273							4.4	2.44	448.7	2.67	0.0012	0.0138	891.1
85	5.58	556.4	silt&clay	121.35	32.1	0.33	15	4279							4.39	2.45	451.6	2.67	0.0010	0.0118	891.1
86	5.64	556.4	silt&clay	121.37	32.1	0.33	15	4283							4.4	2.45	448.8	2.67	0.0012	0.0138	891.1
87	5.71	556.3	silt&clay	121.41	32.1	0.34	15	4276							4.43	2.45	450.1	2.68	0.0010	0.0118	892.3
88	5.77	556.2	silt&clay	121.47	32.0	0.34	15	4255							4.48	2.46	451.6	2.68	0.0011	0.0136	893.5
89	5.84	556.2	silt&clay	121.52	31.7	0.35	15	4195							4.57	2.47	445.1	2.69	0.0011	0.0129	895.9
90	5.91	556.1	silt&clay	121.55	31.2	0.35	15	4113							4.68	2.48	436.4	2.69	0.0009	0.0103	897.0
91	5.97	556.0	silt&clay	121.57	30.9	0.35	15	4056							4.76	2.49	432.0	2.69	0.0009	0.0114	898.2
92	6.04	556.0	silt&clay	121.61	30.8	0.36	15	4029							4.81	2.5	430.8	2.7	0.0008	0.0094	899.3
93	6.1	555.9	silt&clay	121.64	30.7	0.36	15	4019							4.84	2.5	430.5	2.7	0.0009	0.0105	900.5
94	6.17	555.8	silt&clay	121.65	30.8	0.37	15	4023							4.84	2.51	430.2	2.71	0.0007	0.0082	900.5
95	6.23	555.8	silt&clay	121.63	30.7	0.37	15	4009							4.85	2.51	432.5	2.71	0.0008	0.0096	900.5
96	6.3	555.7	silt&clay	121.6	30.4	0.37	15	3966							4.89	2.52	426.6	2.71	0.0007	0.0080	899.3
97	6.36	555.6	silt&clay	121.52	29.8	0.38	15	3873							4.97	2.53	418.1	2.72	0.0007	0.0086	900.5
98	6.43	555.6	silt&clay	121.43	29.2	0.38	15	3784							5.04	2.54	406.7	2.72	0.0007	0.0083	898.2
99	6.5	555.5	silt&clay	121.33	28.6	0.39	15	3695							5.11	2.55	401.2	2.73	0.0006	0.0072	897.0
100	6.56	555.4	silt&clay	121.28	28.2	0.39	15	3645							5.16	2.56	392.6	2.73	0.0007	0.0083	897.0
101	6.63	555.4	silt&clay	121.27	28.1	0.39	16	3617							5.2	2.57	392.9	2.73	0.0006	0.0070	897.0
102	6.69	555.3	silt&clay	121.28	28.1	0.4	16	3622							5.19	2.57	393.2	2.74	0.0007	0.0081	897.0

C-009-3-21

103	6.76	555.2	silt&clay	121.32	28.2	0.4	16	3633			5.2	2.57	394.3	2.74	0.0006	0.0070	897.0
104	6.82	555.2	silt&clay	121.4	28.4	0.41	16	3656			5.21	2.57	396.8	2.75	0.0007	0.0082	899.3
105	6.89	555.1	silt&clay	121.54	28.9	0.41	16	3721			5.19	2.57	401.8	2.75	0.0006	0.0070	901.6
106	6.95	555.1	silt&clay	121.71	29.5	0.41	15	3813			5.15	2.56	414.0	2.75	0.0007	0.0081	903.9
107	7.02	555.0	silt&clay	121.86	30.2	0.42	15	3914			5.1	2.55	424.8	2.76	0.0007	0.0079	907.2
108	7.09	554.9	silt&clay	121.99	30.9	0.42	15	4015			5.03	2.55	432.1	2.76	0.0005	0.0066	908.3
109	7.15	554.9	silt&clay	122.07	31.5	0.43	15	4105			4.96	2.54	443.3	2.77	0.0006	0.0078	908.3
110	7.22	554.8	silt&clay	122.13	32.1	0.43	15	4194			4.88	2.53	450.2	2.77	0.0006	0.0069	909.3
111	7.28	554.7	silt&clay	122.18	32.7	0.43	15	4285			4.8	2.52	456.6	2.77	0.0007	0.0082	909.3
112	7.35	554.7	silt&clay	122.1	32.8	0.44	15	4309			4.72	2.52	467.5	2.78	0.0006	0.0074	909.3
113	7.41	554.6	silt&clay	121.88	32.2	0.44	15	4243			4.69	2.52	454.0	2.78	0.0007	0.0086	902.7
114	7.48	554.5	silt&clay	121.38	30.8	0.45	15	4058			4.66	2.54	433.2	2.79	0.0007	0.0086	897.0
115	7.55	554.5	silt&clay	120.67	29.1	0.45	15	3848			4.56	2.55	407.4	2.79	0.0006	0.0073	881.3
116	7.61	554.4	silt&clay	119.99	27.5	0.45	15	3657			4.47	2.56	381.7	2.79	0.0007	0.0085	862.4
117	7.68	554.3	silt&clay	119.52	26.4	0.46	15	3513			4.43	2.57	367.4	2.8	0.0006	0.0071	859.6
118	7.74	554.3	silt&clay	119.38	25.9	0.46	15	3436			4.47	2.58	360.3	2.8	0.0006	0.0078	856.6
119	7.81	554.2	silt&clay	119.28	25.7	0.47	15	3419			4.44	2.58	359.2	2.81	0.0005	0.0062	855.2
120	7.87	554.1	silt&clay	119.24	25.8	0.47	15	3435			4.4	2.58	360.9	2.81	0.0006	0.0072	853.7
121	7.94	554.1	silt&clay	119.24	26.0	0.47	15	3467			4.36	2.58	362.9	2.81	0.0005	0.0061	853.7
122	8	554.0	silt&clay	119.28	26.5	0.48	15	3546			4.28	2.57	367.0	2.82	0.0006	0.0071	853.7
123	8.07	553.9	silt&clay	119.45	27.3	0.48	15	3675			4.2	2.55	381.6	2.82	0.0006	0.0071	853.7
124	8.14	553.9	silt&clay	119.61	28.1	0.49	15	3792			4.13	2.54	399.0	2.83	0.0005	0.0061	859.6
125	8.2	553.8	silt&clay	120	28.7	0.49	15	3864			4.22	2.55	399.4	2.83	0.0006	0.0071	859.6
126	8.27	553.7	silt&clay	120.61	29.5	0.49	15	3929			4.43	2.55	408.9	2.83	0.0005	0.0061	876.1
127	8.33	553.7	silt&clay	121.37	30.9	0.5	15	4081			4.62	2.56	431.7	2.84	0.0006	0.0071	895.9
128	8.4	553.6	silt&clay	122.02	32.5	0.5	15	4274			4.72	2.55	458.2	2.84	0.0005	0.0060	906.1
129	8.46	553.5	silt&clay	122.5	34.2	0.51	15	4492			4.72	2.54	476.1	2.85	0.0006	0.0069	913.6
130	8.53	553.5	silt&clay	122.9	35.4	0.51	15	4638			4.76	2.53	501.8	2.85	0.0005	0.0056	921.8
131	8.59	553.4	silt&clay	123.27	36.8	0.51	15	4834			4.75	2.52	507.2	2.85	0.0005	0.0061	927.7
132	8.66	553.3	silt&clay	123.49	37.4	0.52	15	4904			4.79	2.52	537.9	2.86	0.0005	0.0056	933.4
133	8.73	553.3	silt&clay	123.52	37.2	0.52	15	4870			4.84	2.53	526.6	2.86	0.0004	0.0046	934.4
134	8.79	553.2	silt&clay	123.29	35.6	0.53	15	4633			4.98	2.55	499.1	2.87	0.0004	0.0053	930.6
135	8.86	553.1	silt&clay	122.97	34.1	0.53	15	4414			5.06	2.57	470.5	2.87	0.0004	0.0045	924.8
136	8.92	553.1	silt&clay	122.68	33.1	0.53	15	4288			5.05	2.58	460.4	2.87	0.0004	0.0053	919.8
137	8.99	553.0	silt&clay	122.49	32.7	0.54	15	4254			4.99	2.58	457.8	2.88	0.0004	0.0045	914.6
138	9.05	553.0	silt&clay	122.38	32.6	0.54	15	4251			4.94	2.58	456.6	2.88	0.0004	0.0051	913.6
139	9.12	552.9	silt&clay	122.36	32.7	0.55	15	4260			4.91	2.58	456.1	2.89	0.0004	0.0050	912.5
140	9.19	552.8	silt&clay	122.36	32.8	0.55	15	4283			4.89	2.58	459.6	2.89	0.0004	0.0042	912.5
141	9.25	552.8	silt&clay	122.38	33.1	0.55	15	4332			4.84	2.58	462.9	2.89	0.0004	0.0048	912.5
142	9.32	552.7	silt&clay	122.52	33.3	0.56	15	4350			4.89	2.58	468.9	2.9	0.0003	0.0041	913.6
143	9.38	552.6	silt&clay	122.58	33.4	0.56	15	4352			4.92	2.58	468.3	2.9	0.0004	0.0048	920.8
144	9.45	552.6	silt&clay	122.64	33.1	0.57	15	4297			5.02	2.59	465.2	2.91	0.0003	0.0041	916.7
145	9.51	552.5	silt&clay	122.64	32.9	0.57	15	4266	**4092**	Fwd	5.06	2.6	456.9	2.91	0.0004	0.0048	918.8
146	9.58	552.4	silt&clay	122.79	32.9	0.57	15	4245			5.17	2.61	460.5	2.91	0.0003	0.0041	921.8
147	9.64	552.4	silt&clay	123.14	33.3	0.58	16	4266			5.34	2.61	464.0	2.92	0.0004	0.0049	926.7
148	9.71	552.3	silt&clay	123.66	34.0	0.58	16	4320			5.58	2.62	472.5	2.92	0.0004	0.0050	940.7
149	9.78	552.2	silt&clay	124.23	35.4	0.59	16	4486			5.7	2.62	490.0	2.93	0.0004	0.0045	954.5
150	9.84	552.2	silt&clay	124.82	38.9	0.59	16	4964			5.46	2.58	525.2	2.93	0.0004	0.0054	960.2
151	9.91	552.1	silt&clay	125.33	43.0	0.59	15	5554			5.13	2.54	617.3	2.93	0.0004	0.0048	966.5
152	9.97	552.0	silt&clay	125.84	47.7	0.6	15	6252			4.78	2.49	661.7	2.94	0.0005	0.0059	972.5
153	10.04	552.0	silt&clay	126.27	50.6	0.6	15	6653			4.69	2.47	724.2	2.94	0.0004	0.0051	977.6
154	10.1	551.9	silt&clay	126.64	52.6	0.61	15	6919			4.69	2.46	737.8	2.95	0.0005	0.0061	986.7
155	10.17	551.8	silt&clay	126.98	54.8	0.61	15	7226			4.64	2.45	747.1	2.95	0.0005	0.0061	992.1
156	10.24	551.8	silt&clay	127.3	58.4	0.62	15	7767			4.46	2.42	816.8	2.96	0.0004	0.0053	994.7
157	10.3	551.7	silt&clay	127.55	61.4	0.62	15	8220			4.31	2.4	891.1	2.96	0.0005	0.0061	998.0
158	10.37	551.6	silt&clay	127.64	62.2	0.62	15	8327			4.3	2.4	871.9	2.96	0.0004	0.0053	1001.1
159	10.43	551.6	silt&clay	127.49	58.6	0.63	15	7764			4.55	2.43	849.1	2.97	0.0005	0.0059	998.6
160	10.5	551.5	silt&clay	127.23	54.1	0.63	15	7054			4.89	2.48	743.1	2.97	0.0004	0.0049	998.0
161	10.56	551.4	silt&clay	126.94	48.8	0.64	16	6241			5.4	2.54	679.1	2.98	0.0004	0.0053	996.7
162	10.63	551.4	silt&clay	126.76	45.4	0.64	16	5732			5.79	2.58	627.2	2.98	0.0003	0.0040	996.0
163	10.69	551.3	silt&clay	126.64	43.3	0.64	16	5421			6.06	2.61	601.4	2.98	0.0003	0.0040	997.3
164	10.76	551.2	silt&clay	126.53	42.4	0.65	16	5289			6.15	2.62	591.7	2.99	0.0003	0.0037	996.0
165	10.83	551.2	silt&clay	126.33	42.4	0.65	16	5317			5.98	2.61	587.8	2.99	0.0002	0.0029	992.1
166	10.89	551.1	silt&clay	126.01	42.0	0.66	16	5300			5.79	2.61	601.4	3	0.0003	0.0032	982.6
167	10.96	551.0	silt&clay	125.6	41.0	0.66	16	5197			5.66	2.61	575.3	3	0.0002	0.0029	974.7
168	11.02	551.0	silt&clay	125.17	39.4	0.67	16	5004			5.62	2.62	545.8	3.01	0.0003	0.0032	968.0
169	11.09	550.9	silt&clay	124.88	38.4	0.67	16	4878			5.6	2.62	535.2	3.01	0.0002	0.0026	959.4
170	11.15	550.9	silt&clay	124.74	38.0	0.67	16	4841			5.56	2.63	531.7	3.01	0.0003	0.0031	959.4
171	11.22	550.8	silt&clay	124.74	37.9	0.68	16	4827			5.57	2.63	531.4	3.02	0.0002	0.0026	959.4
172	11.28	550.7	silt&clay	124.74	38.0	0.68	16	4828			5.57	2.63	531.6	3.02	0.0002	0.0030	959.4
173	11.35	550.7	silt&clay	124.78	38.4	0.69	16	4897			5.51	2.62	532.0	3.03	0.0002	0.0029	960.2
174	11.42	550.6	silt&clay	124.82	39.1	0.69	16	4999			5.42	2.62	551.0	3.03	0.0002	0.0021	960.2
175	11.48	550.5	silt&clay	124.84	39.6	0.69	16	5075			5.34	2.61	559.7	3.03	0.0002	0.0023	959.4

C-009-3-21

176	11.55	550.5	silt&clay	124.8	39.3	0.7	16	5044	5.35	2.61	551.9	3.04	0.0002	0.0019	958.6
177	11.61	550.4	silt&clay	124.78	38.9	0.7	16	4975	5.42	2.62	541.6	3.04	0.0002	0.0023	958.6
178	11.68	550.3	silt&clay	124.78	38.6	0.71	16	4930	5.47	2.63	541.0	3.05	0.0002	0.0020	959.4
179	11.74	550.3	silt&clay	124.83	38.6	0.71	16	4926	5.51	2.63	540.7	3.05	0.0002	0.0026	960.2
180	11.81	550.2	silt&clay	124.92	38.7	0.71	16	4928	5.56	2.63	542.5	3.05	0.0002	0.0027	962.6
181	11.88	550.1	silt&clay	125.11	39.7	0.72	16	5057	5.52	2.63	544.1	3.06	0.0002	0.0025	965.7
182	11.94	550.1	silt&clay	125.33	41.2	0.72	16	5269	5.41	2.61	581.3	3.06	0.0003	0.0032	969.5
183	12.01	550.0	silt&clay	125.46	43.0	0.73	16	5544	5.2	2.59	605.1	3.07	0.0003	0.0031	971.0
184	12.07	549.9	silt&clay	125.43	44.2	0.73	15	5740	5	2.57	621.1	3.07	0.0003	0.0042	967.2
185	12.14	549.9	silt&clay	125.34	44.7	0.73	15	5845	4.86	2.56	630.6	3.07	0.0004	0.0042	963.3
186	12.2	549.8	silt&clay	125.27	44.6	0.74	15	5837	4.83	2.56	628.3	3.08	0.0005	0.0055	962.6
187	12.27	549.7	silt&clay	125.14	42.2	0.74	15	5464	5.1	2.59	616.5	3.08	0.0004	0.0050	962.6
188	12.33	549.7	silt&clay	125	39.9	0.75	16	5102	5.4	2.63	529.7	3.09	0.0005	0.0060	962.6
189	12.4	549.6	silt&clay	124.9	37.8	0.75	16	4783	5.72	2.66	529.5	3.09	0.0005	0.0061	962.6
190	12.47	549.5	silt&clay	125.04	37.8	0.76	16	4763	5.83	2.67	529.4	3.1	0.0004	0.0054	964.9
191	12.53	549.5	silt&clay	125.22	37.8	0.76	16	4740	5.98	2.68	529.5	3.1	0.0005	0.0062	972.5
192	12.6	549.4	silt&clay	125.54	38.9	0.76	16	4882	6	2.67	529.4	3.1	0.0004	0.0053	975.4
193	12.66	549.3	silt&clay	125.76	40.2	0.77	16	5060	5.92	2.66	578.0	3.11	0.0005	0.0062	981.2
194	12.73	549.3	silt&clay	126.01	41.4	0.77	16	5216	5.89	2.65	584.3	3.11	0.0004	0.0053	982.6
195	12.79	549.2	silt&clay	126.05	41.5	0.78	16	5224	5.91	2.65	580.0	3.12	0.0005	0.0060	987.4
196	12.86	549.1	silt&clay	126.12	41.5	0.78	16	5215	5.96	2.66	582.1	3.12	0.0004	0.0047	984.0
197	12.92	549.1	silt&clay	126.1	41.9	0.78	16	5275	5.88	2.65	584.1	3.12	0.0004	0.0052	987.4
198	12.99	549.0	silt&clay	126.19	43.3	0.79	16	5490	5.69	2.63	595.7	3.13	0.0004	0.0047	984.7
199	13.06	548.9	silt&clay	126.24	44.6	0.79	16	5679	5.52	2.62	641.9	3.13	0.0003	0.0039	985.4
200	13.12	548.9	silt&clay	126.32	45.5	0.8	16	5823	5.42	2.61	635.9	3.14	0.0004	0.0046	985.4
201	13.19	548.8	silt&clay	126.48	45.4	0.8	16	5780	5.56	2.62	636.6	3.14	0.0004	0.0042	987.4
202	13.25	548.8	silt&clay	126.74	45.7	0.8	16	5787	5.71	2.63	637.3	3.14	0.0004	0.0054	996.0
203	13.32	548.7	silt&clay	127.08	46.7	0.81	16	5890	5.82	2.63	647.9	3.15	0.0004	0.0048	1002.4
204	13.38	548.6	silt&clay	127.41	49.1	0.81	16	6222	5.69	2.61	678.1	3.15	0.0005	0.0057	1007.9
205	13.45	548.6	silt&clay	127.76	52.4	0.82	16	6686	5.48	2.58	738.6	3.16	0.0005	0.0058	1010.3
206	13.52	548.5	silt&clay	127.97	55.5	0.82	16	7149	5.22	2.55	785.7	3.16	0.0004	0.0049	1015.5
207	13.58	548.4	silt&clay	128.05	56.6	0.83	15	7317	5.14	2.54	808.0	3.17	0.0005	0.0056	1012.6
208	13.65	548.4	silt&clay	128.02	56.8	0.83	15	7345	5.1	2.54	786.5	3.17	0.0004	0.0045	1013.2
209	13.71	548.3	silt&clay	128.04	56.5	0.83	15	7292	5.15	2.54	790.9	3.17	0.0004	0.0051	1013.2
210	13.78	548.2	silt&clay	128.12	57.1	0.84	15	7378	5.13	2.54	795.5	3.18	0.0004	0.0044	1015.0
211	13.84	548.2	silt&clay	128.35	60.5	0.84	15	7894	4.9	2.51	812.6	3.18	0.0004	0.0052	1016.7
212	13.91	548.1	silt&clay	128.54	64.5	0.85	15	8512	4.62	2.48	935.5	3.19	0.0004	0.0044	1019.5
213	13.97	548.0	silt&clay	128.83	70.8	0.85	15	9503	4.25	2.42	962.6	3.19	0.0004	0.0049	1017.3
214	14.04	548.0	silt&clay	129.05	73.9	0.86	15	9980	4.13	2.4	1077.3	3.2	0.0004	0.0047	1021.2
215	14.11	547.9	silt&clay	129.16	75.2	0.86	15	10165	4.1	2.4	1066.9	3.2	0.0003	0.0041	1027.2
216	14.17	547.8	silt&clay	129.07	71.5	0.86	15	9558	4.33	2.43	1015.4	3.2	0.0004	0.0047	1022.3
217	14.24	547.8	silt&clay	128.9	67.9	0.87	15	8998	4.53	2.46	921.9	3.21	0.0003	0.0040	1023.4
218	14.3	547.7	silt&clay	128.9	65.5	0.87	15	8603	4.75	2.49	917.0	3.21	0.0003	0.0042	1024.0
219	14.37	547.6	silt&clay	129.03	65.5	0.88	15	8564	4.84	2.49	916.2	3.22	0.0003	0.0035	1028.3
220	14.43	547.6	silt&clay	129.11	65.7	0.88	15	8575	4.88	2.5	920.4	3.22	0.0003	0.0038	1032.0
221	14.5	547.5	silt&clay	129.17	66.4	0.88	15	8674	4.85	2.49	924.7	3.22	0.0003	0.0031	1029.4
222	14.56	547.4	silt&clay	129.23	69.0	0.89	15	9090	4.65	2.47	944.2	3.23	0.0003	0.0036	1030.9
223	14.63	547.4	silt&clay	129.18	68.6	0.89	15	9038	4.65	2.47	1030.0	3.23	0.0003	0.0035	1030.4
224	14.7	547.3	silt&clay	128.61	65.8	0.9	15	8721	4.54	2.48	907.8	3.24	0.0003	0.0030	1026.7
225	14.76	547.2	silt&clay	127.88	60.2	0.9	15	7951	4.62	2.51	830.3	3.24	0.0003	0.0035	995.4
226	14.83	547.2	silt&clay	127.2	56.7	0.91	15	7499	4.57	2.52	794.7	3.25	0.0003	0.0032	995.4
227	14.89	547.1	silt&clay	127.05	55.4	0.91	15	7310	4.62	2.53	759.1	3.25	0.0003	0.0038	991.4
228	14.96	547.0	silt&clay	126.99	54.4	0.91	15	7166	4.68	2.55	774.8	3.25	0.0003	0.0032	988.8
229	15.02	547.0	silt&clay	126.93	54.2	0.92	15	7141	4.67	2.55	754.6	3.26	0.0003	0.0038	993.4
230	15.09	546.9	silt&clay	126.84	53.6	0.92	15	7048	4.69	2.55	750.7	3.26	0.0004	0.0043	988.1
231	15.16	546.8	silt&clay	126.73	54.2	0.93	15	7172	4.55	2.54	746.9	3.27	0.0003	0.0038	984.7
232	15.22	546.8	silt&clay	126.59	53.0	0.93	15	7002	4.6	2.55	780.7	3.27	0.0004	0.0052	984.0
233	15.29	546.7	silt&clay	126.57	52.1	0.94	15	6864	4.68	2.56	701.2	3.28	0.0004	0.0049	982.6
234	15.35	546.7	silt&clay	126.38	49.8	0.94	15	6504	4.85	2.59	711.2	3.28	0.0005	0.0059	986.1
235	15.42	546.6	silt&clay	126.25	48.9	0.94	15	6384	4.88	2.6	680.6	3.28	0.0005	0.0054	977.6
236	15.48	546.5	silt&clay	125.97	47.6	0.95	15	6221	4.86	2.6	664.8	3.29	0.0006	0.0066	976.9
237	15.55	546.5	silt&clay	125.82	46.9	0.95	15	6122	4.87	2.61	657.3	3.29	0.0005	0.0059	971.0
238	15.61	546.4	silt&clay	125.68	46.4	0.96	15	6070	4.84	2.61	649.6	3.3	0.0006	0.0069	970.3
239	15.68	546.3	silt&clay	125.63	46.1	0.96	15	6034	4.84	2.62	646.1	3.3	0.0006	0.0070	968.7
240	15.75	546.3	silt&clay	125.53	46.1	0.96	15	6045	4.78	2.61	645.6	3.3	0.0005	0.0060	968.7
241	15.81	546.2	silt&clay	125.43	46.2	0.97	15	6080	4.7	2.61	648.2	3.31	0.0006	0.0070	963.3
242	15.88	546.1	silt&clay	125.36	46.3	0.97	15	6103	4.65	2.61	650.8	3.31	0.0005	0.0060	961.0
243	15.94	546.1	silt&clay	125.39	46.3	0.98	15	6105	4.66	2.61	648.6	3.32	0.0006	0.0070	963.3
244	16.01	546.0	silt&clay	125.51	46.4	0.98	15	6089	4.73	2.61	650.0	3.32	0.0005	0.0057	964.9
245	16.07	545.9	silt&clay	125.74	46.5	0.98	15	6072	4.87	2.62	651.5	3.32	0.0006	0.0067	969.5
246	16.14	545.9	silt&clay	126.08	47.3	0.99	15	6158	4.97	2.62	654.3	3.33	0.0004	0.0051	978.3
247	16.2	545.8	silt&clay	126.73	50.5	0.99	15	6564	4.99	2.61	685.9	3.33	0.0006	0.0071	985.4
248	16.27	545.7	silt&clay	127.41	54.0	1	15	7017	5.01	2.59	783.7	3.34	0.0007	0.0082	1003.6

C-009-3-21

249	16.34	545.7	silt&clay	128.16	60.4	1	15	7916						4.79	2.54	803.0	3.34	0.0007	0.0080	1014.4
250	16.4	545.6	silt&clay	128.72	64.8	1.01	15	8513						4.71	2.52	953.7	3.35	0.0008	0.0095	1020.1
251	16.47	545.5	silt&clay	129.28	68.6	1.01	15	9017						4.71	2.51	966.1	3.35	0.0007	0.0082	1030.4
252	16.53	545.5	silt&clay	129.77	69.7	1.01	15	9081						4.93	2.52	964.0	3.35	0.0008	0.0095	1043.6
253	16.6	545.4	silt&clay	130.16	71.2	1.02	15	9223						5.06	2.52	1000.3	3.36	0.0007	0.0082	1051.2
254	16.66	545.3	silt&clay	130.39	72.9	1.02	15	9455						5.05	2.51	1027.4	3.36	0.0008	0.0096	1054.9
255	16.73	545.3	silt&clay	130.52	74.0	1.03	15	9609						5.03	2.51	1037.7	3.37	0.0008	0.0096	1055.4
256	16.8	545.2	silt&clay	130.6	74.9	1.03	15	9727						5.02	2.51	1048.0	3.37	0.0007	0.0082	1057.2
257	16.86	545.1	silt&clay	130.63	73.9	1.04	15	9550						5.13	2.52	1064.0	3.38	0.0008	0.0092	1058.5
258	16.93	545.1	silt&clay	130.64	72.2	1.04	16	9278						5.29	2.54	993.7	3.38	0.0006	0.0071	1059.9
259	16.99	545.0	silt&clay	130.5	70.1	1.04	16	8974						5.4	2.55	977.6	3.38	0.0007	0.0079	1061.2
260	17.06	544.9	silt&clay	130.26	68.3	1.05	16	8730						5.42	2.56	976.7	3.39	0.0006	0.0070	1054.0
261	17.12	544.9	silt&clay	129.62	65.0	1.05	16	8353						5.3	2.57	915.7	3.39	0.0006	0.0074	1047.5
262	17.19	544.8	silt&clay	128.71	58.4	1.06	16	7476						5.39	2.61	841.6	3.4	0.0005	0.0058	1024.0
263	17.25	544.8	silt&clay	127.57	50.6	1.06	16	6432						5.58	2.66	698.2	3.4	0.0003	0.0041	1007.9
264	17.32	544.7	silt&clay	126.4	43.7	1.07	16	5526						5.77	2.72	587.6	3.41	0.0004	0.0043	992.8
265	17.39	544.6	silt&clay	125.12	37.8	1.07	16	4752						5.89	2.77	554.1	3.41	0.0003	0.0037	966.5
266	17.45	544.6	silt&clay	123.98	34.0	1.07	16	4292						5.79	2.79	447.1	3.41	0.0004	0.0042	941.6
267	17.52	544.5	silt&clay	123.25	30.9	1.08	16	3885	**6656**					5.94	2.83	429.4	3.42	0.0003	0.0037	933.4
268	17.58	544.4	silt&clay	123.08	30.4	1.08	16	3820						5.94	2.84	425.6	3.42	0.0004	0.0043	932.5
269	17.65	544.4	silt&clay	123.08	30.3	1.09	16	3802						5.96	2.84	424.7	3.43	0.0003	0.0036	932.5
270	17.71	544.3	silt&clay	123.08	30.3	1.09	16	3800						5.97	2.84	424.8	3.43	0.0004	0.0042	933.4
271	17.78	544.2	silt&clay	123.27	30.3	1.09	16	3782						6.12	2.85	424.7	3.43	0.0003	0.0035	933.4
272	17.84	544.2	silt&clay	123.51	30.3	1.1	16	3762						6.32	2.86	425.0	3.44	0.0003	0.0040	945.2
273	17.91	544.1	silt&clay	123.83	31.5	1.1	16	3913						6.28	2.85	425.7	3.44	0.0003	0.0038	949.5
274	17.98	544.0	silt&clay	124.01	32.8	1.11	16	4099						6.09	2.83	473.8	3.45	0.0003	0.0032	949.5
275	18.04	544.0	silt&clay	124.22	35.0	1.11	16	4432						5.74	2.79	480.4	3.45	0.0003	0.0034	951.2
276	18.11	543.9	silt&clay	124.47	35.9	1.11	16	4538						5.76	2.79	520.5	3.45	0.0002	0.0028	952.8
277	18.17	543.8	silt&clay	124.97	36.6	1.12	16	4595						6	2.79	509.7	3.46	0.0003	0.0033	962.6
278	18.24	543.8	silt&clay	125.57	36.5	1.12	16	4504						6.54	2.82	512.0	3.46	0.0002	0.0028	981.9
279	18.3	543.7	silt&clay	126.06	36.8	1.13	16	4491						6.92	2.84	514.3	3.47	0.0003	0.0033	994.7
280	18.37	543.6	silt&clay	126.44	37.4	1.13	16	4536						7.14	2.85	521.7	3.47	0.0002	0.0028	996.7
281	18.43	543.6	silt&clay	126.93	40.5	1.13	16	4957						6.86	2.81	536.7	3.47	0.0003	0.0030	1006.1
282	18.5	543.5	silt&clay	127.37	42.8	1.14	16	5243						6.78	2.79	646.4	3.48	0.0003	0.0031	1015.0
283	18.57	543.4	silt&clay	127.62	44.3	1.14	16	5447						6.69	2.78	616.7	3.48	0.0002	0.0026	1018.4
284	18.63	543.4	silt&clay	127.49	43.1	1.15	16	5275						6.83	2.79	601.5	3.49	0.0003	0.0031	1017.8
285	18.7	543.3	silt&clay	127.15	42.0	1.15	16	5157						6.74	2.8	595.2	3.49	0.0002	0.0026	1010.9
286	18.76	543.2	silt&clay	126.59	40.1	1.16	16	4933						6.64	2.81	571.6	3.5	0.0003	0.0031	998.6
287	18.83	543.2	silt&clay	125.87	37.5	1.16	16	4618						6.58	2.83	520.1	3.5	0.0002	0.0026	986.7
288	18.89	543.1	silt&clay	125.07	34.3	1.16	16	4226						6.63	2.86	484.9	3.5	0.0003	0.0030	971.0
289	18.96	543.0	silt&clay	124.33	31.9	1.17	16	3926						6.6	2.88	440.3	3.51	0.0002	0.0030	957.8
290	19.03	543.0	silt&clay	123.7	29.8	1.17	16	3662						6.64	2.9	416.7	3.51	0.0002	0.0024	946.9
291	19.09	542.9	silt&clay	123.3	28.3	1.18	16	3481						6.7	2.92	395.8	3.52	0.0002	0.0025	938.9
292	19.16	542.8	silt&clay	123.11	27.5	1.18	16	3367						6.8	2.94	381.2	3.52	0.0001	0.0016	938.0
293	19.22	542.8	silt&clay	123.08	27.2	1.18	16	3318						6.88	2.95	380.9	3.52	0.0001	0.0016	938.9
294	19.29	542.7	silt&clay	123.12	27.2	1.19	16	3318						6.91	2.95	381.5	3.53	0.0001	0.0014	938.9
295	19.35	542.7	silt&clay	123.21	27.2	1.19	16	3321						6.98	2.95	382.1	3.53	0.0001	0.0016	940.7
296	19.42	542.6	silt&clay	123.31	27.3	1.2	16	3320						7.05	2.96	383.5	3.54	0.0001	0.0015	944.3
297	19.48	542.5	silt&clay	123.4	27.4	1.2	16	3323						7.11	2.96	384.0	3.54	0.0002	0.0019	946.0
298	19.55	542.5	silt&clay	123.56	27.5	1.2	17	3333						7.22	2.96	384.5	3.54	0.0002	0.0021	946.9
299	19.62	542.4	silt&clay	124.06	27.7	1.21	17	3324						7.65	2.98	389.8	3.55	0.0002	0.0021	955.3
300	19.68	542.3	silt&clay	124.82	28.1	1.21	17	3310						8.36	3	393.8	3.55	0.0002	0.0027	977.6
301	19.75	542.3	silt&clay	125.93	28.9	1.22	17	3338						9.35	3.03	397.8	3.56	0.0002	0.0026	996.7
302	19.81	542.2	silt&clay	127.01	30.9	1.22	17	3540						9.91	3.03	424.3	3.56	0.0003	0.0034	1026.1
303	19.88	542.1	silt&clay	128.49	37.4	1.22	17	4319						9.43	2.96	480.0	3.56	0.0002	0.0030	1042.1
304	19.94	542.1	silt&clay	129.92	48.4	1.23	17	5735						8.15	2.84	669.9	3.57	0.0003	0.0035	1068.1
305	20.01	542.0	silt&clay	131.25	62.4	1.23	16	7609						6.98	2.71	885.9	3.57	0.0002	0.0030	1083.4
306	20.07	541.9	sand&grav	131.97	73.7	1.24				31	43	-2.5	37	6.17	2.63	1068.8	3.58	0.0003	0.0039	1093.5
307	20.14	541.9	sand&grav	132.29	79.2	1.24				32	45	-2.5	37	5.86	2.59	1144.8	3.58	0.0003	0.0039	1091.7
308	20.21	541.8	sand&grav	132.35	80.8	1.25				33	45	-2.5	38	5.75	2.58	1117.1	3.59	0.0003	0.0040	1093.2
309	20.27	541.7	sand&grav	132.42	81.1	1.25				33	46	-2.5	38	5.78	2.58	1135.7	3.59	0.0005	0.0058	1094.6
310	20.34	541.7	sand&grav	132.49	81.6	1.25				33	46	-2.5	38	5.79	2.58	1154.2	3.59	0.0004	0.0050	1096.0
311	20.4	541.6	sand&grav	132.67	85.0	1.26				34	47	-2.5	38	5.62	2.56	1139.9	3.6	0.0005	0.0063	1097.1
312	20.47	541.5	sand&grav	132.93	90.1	1.26				35	49	-2.5	38	5.39	2.53	1279.7	3.6	0.0005	0.0056	1099.9
313	20.53	541.5	sand&grav	133.29	101.6	1.27				38	52	-2.5	38	4.82	2.46	1367.0	3.61	0.0005	0.0066	1104.4
314	20.6	541.4	sand&grav	133.18	99.1	1.27				37	52	-2.5	38	4.92	2.47	1624.1	3.61	0.0005	0.0057	1101.7
315	20.66	541.3	sand&grav	132.81	91.8	1.28				35	49	-2.5	38	5.17	2.51	1172.1	3.62	0.0005	0.0063	1096.8
316	20.73	541.3	sand&grav	131.79	74.5	1.28				31	43	-2.5	37	5.94	2.62	1060.6	3.62	0.0005	0.0061	1091.7
317	20.8	541.2	silt&clay	130.69	64.2	1.29	16	8002						6.22	2.68	897.8	3.63	0.0004	0.0048	1063.4
318	20.86	541.1	silt&clay	129.35	54.6	1.29	16	6763						6.42	2.74	743.1	3.63	0.0004	0.0052	1043.6
319	20.93	541.1	silt&clay	127.96	46.3	1.29	16	5705						6.61	2.8	656.5	3.63	0.0003	0.0041	1026.7
320	20.99	541.0	silt&clay	126.44	39.8	1.3	16	4914						6.55	2.84	549.5	3.64	0.0004	0.0047	992.8
321	21.06	540.9	silt&clay	125.12	35.4	1.3	16	4383						6.4	2.87	470.6	3.64	0.0004	0.0042	960.2

C-009-3-21

322	21.12	540.9	silt&clay	124.47	33.5	1.31	16	4156						6.31	2.89	469.1	3.65	0.0004	0.0052	958.6
323	21.19	540.8	silt&clay	124.46	33.4	1.31	16	4154						6.3	2.89	468.9	3.65	0.0004	0.0050	959.4
324	21.25	540.8	silt&clay	124.48	33.4	1.31	16	4153						6.32	2.89	469.2	3.65	0.0005	0.0062	959.4
325	21.32	540.7	silt&clay	124.71	34.1	1.32	16	4222						6.37	2.89	469.2	3.66	0.0006	0.0068	960.2
326	21.39	540.6	silt&clay	125.34	35.6	1.32	16	4399						6.53	2.88	494.9	3.66	0.0006	0.0070	971.8
327	21.45	540.6	silt&clay	126.42	41.0	1.33	16	5099						6.29	2.83	536.1	3.67	0.0007	0.0086	994.1
328	21.52	540.5	silt&clay	127.7	49.5	1.33	16	6240						5.84	2.75	695.2	3.67	0.0006	0.0076	1012.1
329	21.58	540.4	silt&clay	129	60.0	1.33	16	7674						5.41	2.66	851.0	3.67	0.0008	0.0090	1029.9
330	21.65	540.4	silt&clay	129.92	66.3	1.34	16	8492						5.37	2.63	975.9	3.68	0.0006	0.0078	1052.2
331	21.71	540.3	silt&clay	130.35	66.5	1.34	16	8427						5.67	2.65	960.1	3.68	0.0008	0.0091	1059.9
332	21.78	540.2	silt&clay	130.19	63.2	1.35	16	7935						5.94	2.68	858.5	3.69	0.0006	0.0078	1060.3
333	21.84	540.2	silt&clay	129.67	57.8	1.35	16	7202						6.22	2.72	836.9	3.69	0.0008	0.0091	1049.8
334	21.91	540.1	silt&clay	129.03	53.5	1.36	16	6644						6.32	2.75	736.1	3.7	0.0007	0.0090	1037.6
335	21.98	540.0	silt&clay	128.29	48.3	1.36	16	5952						6.55	2.8	677.4	3.7	0.0006	0.0074	1029.4
336	22.04	540.0	silt&clay	127.52	43.5	1.36	16	5341						6.75	2.84	616.0	3.7	0.0007	0.0082	1015.0
337	22.11	539.9	silt&clay	126.58	39.5	1.37	16	4839						6.76	2.87	538.3	3.71	0.0006	0.0072	1000.5
338	22.17	539.8	silt&clay	125.76	36.4	1.37	16	4473						6.71	2.89	506.6	3.71	0.0007	0.0084	979.1
339	22.24	539.8	silt&clay	125.14	35.1	1.38	16	4341						6.48	2.9	488.6	3.72	0.0006	0.0072	971.8
340	22.3	539.7	silt&clay	124.88	34.3	1.38	16	4244						6.45	2.9	483.5	3.72	0.0007	0.0084	964.9
341	22.37	539.6	silt&clay	124.73	33.6	1.39	16	4152						6.49	2.91	472.4	3.73	0.0006	0.0070	964.9
342	22.43	539.6	silt&clay	124.67	32.9	1.39	16	4045						6.63	2.93	459.0	3.73	0.0006	0.0072	964.9
343	22.5	539.5	silt&clay	124.64	32.4	1.39	16	3973						6.74	2.94	452.4	3.73	0.0005	0.0060	964.9
344	22.57	539.4	silt&clay	124.86	32.2	1.4	16	3924						6.99	2.95	451.9	3.74	0.0004	0.0050	964.9
345	22.63	539.4	silt&clay	125.31	33.0	1.4	17	3995						7.21	2.95	451.7	3.74	0.0005	0.0060	980.5
346	22.7	539.3	silt&clay	126.01	34.5	1.41	17	4153						7.47	2.95	484.1	3.75	0.0005	0.0055	992.1
347	22.76	539.2	silt&clay	127.42	44.0	1.41	16	5421						6.57	2.84	516.6	3.75	0.0006	0.0067	1006.1
348	22.83	539.2	silt&clay	128.86	54.2	1.41	16	6786						6.06	2.75	849.3	3.75	0.0005	0.0060	1036.1
349	22.89	539.1	silt&clay	130.35	66.4	1.42	16	8418						5.68	2.67	913.9	3.76	0.0006	0.0073	1057.2
350	22.96	539.0	sand&grav	131.21	71.3	1.42				30	41	-2.5	37	5.81	2.65	1029.6	3.76	0.0006	0.0067	1077.5
351	23.02	539.0	sand&grav	131.7	75.2	1.43				32	43	-2.5	37	5.79	2.64	1053.4	3.77	0.0007	0.0086	1085.0
352	23.09	538.9	sand&grav	131.63	72.6	1.43				31	42	-2.5	37	6.01	2.66	1078.5	3.77	0.0007	0.0087	1083.8
353	23.16	538.8	sand&grav	131.34	68.1	1.44				30	40	-2.5	37	6.29	2.7	920.2	3.78	0.0006	0.0076	1078.3
354	23.22	538.8	silt&clay	130.78	59.8	1.44	16	7308						6.91	2.77	864.2	3.78	0.0008	0.0091	1075.1
355	23.29	538.7	silt&clay	130.07	53.1	1.44	17	6418						7.34	2.82	732.1	3.78	0.0006	0.0078	1066.0
356	23.35	538.7	silt&clay	129.28	47.3	1.45	17	5661						7.69	2.87	638.8	3.79	0.0008	0.0093	1047.9
357	23.42	538.6	silt&clay	128.57	43.8	1.45	17	5238						7.73	2.9	617.8	3.79	0.0007	0.0085	1039.2
358	23.48	538.5	silt&clay	128.16	41.7	1.46	17	4987						7.78	2.92	585.3	3.8	0.0009	0.0103	1030.4
359	23.55	538.5	silt&clay	127.76	40.1	1.46	17	4793						7.77	2.93	552.9	3.8	0.0007	0.0089	1027.2
360	23.61	538.4	silt&clay	127.53	39.2	1.47	17	4684						7.76	2.94	549.1	3.81	0.0009	0.0105	1018.4
361	23.68	538.3	silt&clay	127.24	39.0	1.47	17	4693						7.5	2.93	547.2	3.81	0.0009	0.0104	1017.8
362	23.75	538.3	silt&clay	126.94	39.1	1.47	16	4746						7.17	2.91	545.5	3.81	0.0007	0.0089	1007.9
363	23.81	538.2	silt&clay	126.41	38.8	1.48	16	4759						6.75	2.9	553.8	3.82	0.0009	0.0104	996.7
364	23.88	538.1	silt&clay	125.85	37.4	1.48	16	4613						6.56	2.9	533.6	3.82	0.0007	0.0087	982.6
365	23.94	538.1	silt&clay	125.31	35.6	1.49	16	4400						6.5	2.92	486.8	3.83	0.0008	0.0092	974.7
366	24.01	538.0	silt&clay	124.99	34.2	1.49	16	4220						6.56	2.93	479.0	3.83	0.0005	0.0063	967.2
367	24.07	537.9	silt&clay	124.86	33.9	1.49	16	4189						6.52	2.93	474.5	3.83	0.0006	0.0076	967.2
368	24.14	537.9	silt&clay	124.86	33.8	1.5	16	4175						6.54	2.94	474.8	3.84	0.0005	0.0056	967.2
369	24.2	537.8	silt&clay	124.87	33.9	1.5	16	4187						6.53	2.94	475.2	3.84	0.0005	0.0061	967.2
370	24.27	537.7	silt&clay	125.07	34.4	1.51	16	4232						6.6	2.94	477.8	3.85	0.0005	0.0059	968.0
371	24.34	537.7	silt&clay	125.63	35.0	1.51	16	4276						6.94	2.95	493.3	3.85	0.0004	0.0052	979.1
372	24.4	537.6	silt&clay	126.09	38.0	1.51	16	4670						6.65	2.91	503.7	3.85	0.0005	0.0060	1001.8
373	24.47	537.5	silt&clay	126.67	42.0	1.52	16	5220						6.3	2.86	601.0	3.86	0.0004	0.0051	987.4
374	24.53	537.5	silt&clay	127.29	47.4	1.52	16	5967						5.85	2.8	663.2	3.86	0.0005	0.0060	1003.0
375	24.6	537.4	silt&clay	128.07	49.9	1.53	16	6251						6.06	2.8	727.9	3.87	0.0004	0.0052	1023.4
376	24.66	537.3	silt&clay	128.8	54.3	1.53	16	6817						5.99	2.77	709.7	3.87	0.0005	0.0058	1033.6
377	24.73	537.3	silt&clay	129.3	59.0	1.54	16	7456						5.75	2.73	847.6	3.88	0.0003	0.0039	1040.6
378	24.79	537.2	silt&clay	129.59	62.6	1.54	16	7969						5.53	2.7	922.6	3.88	0.0003	0.0036	1045.1
379	24.86	537.1	silt&clay	129.72	62.9	1.54	16	7992						5.6	2.7	860.2	3.88	0.0003	0.0033	1044.1
380	24.93	537.1	silt&clay	130	61.5	1.55	16	7707						6	2.73	861.4	3.89	0.0002	0.0026	1049.4
381	24.99	537.0	silt&clay	130.35	61.7	1.55	16	7672						6.26	2.75	862.7	3.89	0.0003	0.0036	1067.2
382	25.06	536.9	silt&clay	130.83	65.7	1.56	16	8196						6.15	2.72	869.2	3.9	0.0003	0.0033	1067.7
383	25.12	536.9	sand&grav	131.13	71.7	1.56				31	41	-2.5	37	5.7	2.67	1029.3	3.9	0.0003	0.0040	1073.1
384	25.19	536.8	sand&grav	131.34	76.9	1.57				32	42	-2.5	37	5.35	2.63	1115.2	3.91	0.0003	0.0034	1073.5
385	25.25	536.8	sand&grav	131.37	79.4	1.57				33	43	-2.5	37	5.15	2.61	1088.6	3.91	0.0003	0.0040	1070.6
386	25.32	536.7	sand&grav	131.31	79.2	1.57				33	43	-2.5	37	5.12	2.61	1132.7	3.91	0.0003	0.0032	1069.8
387	25.38	536.6	sand&grav	131.27	78.5	1.58				33	43	-2.5	37	5.16	2.61	1107.5	3.92	0.0003	0.0036	1069.3
388	25.45	536.6	sand&grav	131.13	74.4	1.58				32	42	-2.5	37	5.43	2.65	1059.8	3.92	0.0003	0.0033	1069.3
389	25.52	536.5	sand&grav	130.86	68.8	1.59				30	39	-2.5	37	5.8	2.69	960.5	3.93	0.0003	0.0031	1069.3
390	25.58	536.4	silt&clay	130.45	63.4	1.59	16	7924						6.12	2.74	872.5	3.93	0.0003	0.0042	1062.9
391	25.65	536.4	silt&clay	129.75	56.9	1.6	16	7053						6.4	2.79	833.7	3.94	0.0004	0.0045	1054.9
392	25.71	536.3	silt&clay	128.94	50.6	1.6	16	6222						6.69	2.84	688.3	3.94	0.0006	0.0067	1037.1
393	25.78	536.2	silt&clay	127.81	43.0	1.6	16	5219						7.13	2.91	608.3	3.94	0.0005	0.0062	1025.6
394	25.84	536.2	silt&clay	126.71	37.7	1.61	17	4559	**4669**					7.3	2.96	511.7	3.95	0.0006	0.0077	1003.0

C-009-3-21

395	25.91	536.1	silt&clay	125.44	33.1	1.61	17	3997	7.3	3	467.2	3.95	0.0006	0.0077	981.2
396	25.98	536.0	silt&clay	124.31	29.7	1.62	16	3603	7.19	3.03	412.8	3.96	0.0006	0.0068	959.4
397	26.04	536.0	silt&clay	123.2	26.8	1.62	16	3258	7.08	3.06	371.7	3.96	0.0007	0.0084	941.6
398	26.11	535.9	silt&clay	121.99	24.6	1.62	16	3019	6.72	3.07	344.3	3.96	0.0006	0.0074	920.8
399	26.17	535.8	silt&clay	120.92	23.2	1.63	16	2881	6.28	3.07	319.8	3.97	0.0007	0.0087	887.5
400	26.24	535.8	silt&clay	120.15	22.3	1.63	16	2807	5.93	3.07	305.4	3.97	0.0006	0.0075	877.4
401	26.3	535.7	silt&clay	119.93	22.1	1.64	16	2781	5.85	3.07	298.1	3.98	0.0007	0.0087	876.1
402	26.37	535.6	silt&clay	119.9	22.0	1.64	16	2773	5.84	3.07	298.1	3.98	0.0006	0.0073	874.8
403	26.43	535.6	silt&clay	119.93	22.1	1.64	16	2779	5.85	3.07	297.9	3.98	0.0007	0.0083	876.1
404	26.5	535.5	silt&clay	120.04	22.2	1.65	16	2789	5.89	3.07	299.7	3.99	0.0007	0.0081	877.4
405	26.57	535.4	silt&clay	120.38	22.6	1.65	16	2833	6.02	3.07	305.0	3.99	0.0006	0.0067	881.3
406	26.63	535.4	silt&clay	121.02	23.7	1.66	16	2962	6.16	3.06	327.5	4	0.0006	0.0071	895.9
407	26.7	535.3	silt&clay	121.95	25.6	1.66	16	3175	6.34	3.05	359.0	4	0.0004	0.0054	913.6
408	26.76	535.2	silt&clay	122.89	28.2	1.66	16	3495	6.35	3.02	391.1	4	0.0004	0.0050	933.4
409	26.83	535.2	silt&clay	123.6	30.7	1.67	16	3822	6.25	2.99	436.3	4.01	0.0003	0.0040	946.0
410	26.89	535.1	silt&clay	124.08	32.7	1.67	16	4083	6.14	2.96	465.9	4.01	0.0004	0.0046	949.5
411	26.96	535.0	silt&clay	124.41	34.0	1.68	16	4248	6.1	2.95	474.3	4.02	0.0003	0.0037	957.0
412	27.02	535.0	silt&clay	124.65	34.9	1.68	16	4358	6.1	2.94	490.3	4.02	0.0004	0.0046	962.6
413	27.09	534.9	silt&clay	124.7	35.4	1.68	16	4433	6.02	2.93	502.8	4.02	0.0004	0.0049	962.6
414	27.16	534.8	silt&clay	124.59	35.4	1.69	16	4443	5.94	2.93	495.6	4.03	0.0003	0.0042	957.8
415	27.22	534.8	silt&clay	124.41	35.0	1.69	16	4412	5.87	2.93	490.0	4.03	0.0004	0.0050	955.3
416	27.29	534.7	silt&clay	124.3	34.8	1.7	16	4394	5.82	2.93	488.8	4.04	0.0004	0.0047	952.0
417	27.35	534.7	silt&clay	124.21	34.7	1.7	16	4387	5.77	2.93	487.6	4.04	0.0005	0.0059	951.2
418	27.42	534.6	silt&clay	124.11	34.6	1.7	16	4375	5.73	2.93	485.2	4.04	0.0005	0.0054	948.6
419	27.48	534.5	silt&clay	124.02	34.5	1.71	16	4367	5.68	2.93	482.6	4.05	0.0005	0.0057	946.0
420	27.55	534.5	silt&clay	123.87	34.4	1.71	16	4367	5.59	2.93	483.0	4.05	0.0005	0.0056	945.2
421	27.61	534.4	silt&clay	123.43	33.8	1.72	16	4334	5.37	2.92	480.6	4.06	0.0006	0.0067	938.9
422	27.68	534.3	silt&clay	122.92	33.1	1.72	15	4278	5.15	2.92	460.6	4.06	0.0006	0.0067	916.7
423	27.75	534.3	silt&clay	122.49	32.5	1.72	15	4221	4.99	2.92	453.3	4.06	0.0005	0.0057	913.6
424	27.81	534.2	silt&clay	122.43	32.3	1.73	15	4196	4.99	2.92	452.8	4.07	0.0006	0.0067	913.6
425	27.88	534.1	silt&clay	122.46	32.3	1.73	15	4201	5	2.92	452.7	4.07	0.0005	0.0056	913.6
426	27.94	534.1	silt&clay	122.53	32.4	1.74	15	4213	5.01	2.92	455.4	4.08	0.0005	0.0060	915.7
427	28.01	534.0	silt&clay	122.59	32.7	1.74	15	4246	5.01	2.92	458.0	4.08	0.0003	0.0041	917.8
428	28.07	533.9	silt&clay	122.67	33.2	1.74	15	4323	4.96	2.91	463.1	4.08	0.0004	0.0047	916.7
429	28.14	533.9	silt&clay	122.72	33.6	1.75	15	4371	4.93	2.91	477.4	4.09	0.0003	0.0039	917.8
430	28.2	533.8	silt&clay	122.83	33.9	1.75	15	4413	4.94	2.9	472.1	4.09	0.0004	0.0044	919.8
431	28.27	533.7	silt&clay	122.91	34.0	1.76	15	4416	4.98	2.91	476.5	4.1	0.0004	0.0045	922.8
432	28.34	533.7	silt&clay	122.98	34.1	1.76	15	4434	4.99	2.91	480.9	4.1	0.0003	0.0037	923.8
433	28.4	533.6	silt&clay	123	34.3	1.77	15	4458	4.97	2.9	478.4	4.11	0.0003	0.0038	922.8
434	28.47	533.5	silt&clay	123.07	34.5	1.77	15	4480	4.99	2.9	483.6	4.11	0.0003	0.0037	922.8
435	28.53	533.5	silt&clay	123.22	34.7	1.77	15	4493	5.05	2.91	488.9	4.11	0.0004	0.0044	927.7
436	28.6	533.4	silt&clay	123.36	34.7	1.78	15	4484	5.14	2.91	486.0	4.12	0.0003	0.0041	932.5
437	28.66	533.3	silt&clay	123.55	34.6	1.78	16	4450	5.29	2.92	485.9	4.12	0.0004	0.0050	932.5
438	28.73	533.3	silt&clay	123.74	34.6	1.79	16	4426	5.43	2.93	485.8	4.13	0.0004	0.0048	941.6
439	28.79	533.2	silt&clay	123.84	34.6	1.79	16	4415	5.5	2.93	485.9	4.13	0.0005	0.0060	945.2
440	28.86	533.1	silt&clay	123.66	34.9	1.79	16	4478	5.32	2.92	485.8	4.13	0.0005	0.0063	939.8
441	28.93	533.1	silt&clay	123.37	35.2	1.8	15	4558	5.06	2.91	497.0	4.14	0.0005	0.0055	927.7
442	28.99	533.0	silt&clay	123.14	35.4	1.8	15	4627	4.86	2.89	497.2	4.14	0.0005	0.0065	923.8
443	29.06	532.9	silt&clay	122.98	35.2	1.81	15	4606	4.8	2.89	496.0	4.15	0.0005	0.0056	922.8
444	29.12	532.9	silt&clay	122.59	34.4	1.81	15	4533	4.68	2.89	486.6	4.15	0.0005	0.0065	917.8
445	29.19	532.8	silt&clay	122.15	33.7	1.81	15	4462	4.53	2.89	466.4	4.15	0.0005	0.0054	899.3
446	29.25	532.8	silt&clay	121.75	33.1	1.82	15	4408	4.4	2.89	464.1	4.16	0.0005	0.0062	894.7
447	29.32	532.7	silt&clay	121.68	33.1	1.82	15	4428	4.34	2.89	461.8	4.16	0.0004	0.0053	894.7
448	29.38	532.6	silt&clay	121.62	32.9	1.83	15	4402	4.34	2.89	468.7	4.17	0.0005	0.0059	894.7
449	29.45	532.6	silt&clay	121.41	32.3	1.83	15	4320	4.33	2.9	455.9	4.17	0.0004	0.0053	892.3
450	29.52	532.5	silt&clay	121.08	31.4	1.83	15	4202	4.3	2.9	435.2	4.17	0.0003	0.0041	882.5
451	29.58	532.4	silt&clay	120.72	30.6	1.84	15	4114	4.23	2.91	429.7	4.18	0.0003	0.0041	876.1
452	29.65	532.4	silt&clay	120.52	30.2	1.84	15	4072	4.18	2.91	424.4	4.18	0.0003	0.0030	870.8
453	29.71	532.3	silt&clay	120.39	29.5	1.84	15	3955	4.25	2.92	418.9	4.18	0.0003	0.0035	870.8
454	29.78	532.2	silt&clay	120.27	28.1	1.84	15	3737	4.45	2.95	397.2	4.18	0.0003	0.0032	870.8
455	29.84	532.2	silt&clay	120.2	26.8	1.85	15	3524	4.69	2.98	366.9	4.19	0.0003	0.0041	870.8
456	29.91	532.1	silt&clay	120.09	26.0	1.85	15	3403	4.81	3	364.0	4.19	0.0004	0.0046	873.4
457	29.98	532.0	silt&clay	119.94	25.9	1.85	15	3406	4.73	3	363.4	4.19	0.0004	0.0042	868.0
458	30.04	532.0	silt&clay	119.59	26.0	1.85	15	3443	4.5	2.98	363.7	4.19	0.0004	0.0050	861.0
459	30.11	531.9	silt&clay	119.26	26.0	1.85	15	3491	4.28	2.97	364.0	4.19	0.0004	0.0043	849.1
460	30.17	531.8	silt&clay	119.01	26.2	1.85	15	3548	4.1	2.96	367.2	4.19	0.0004	0.0051	844.4
461	30.24	531.8	silt&clay	118.97	27.0	1.86	15	3691	3.92	2.93	372.6	4.2	0.0004	0.0044	842.8
462	30.3	531.7	silt&clay	118.93	27.1	1.86	15	3710	3.88	2.93	398.1	4.2	0.0004	0.0051	841.2
463	30.37	531.6	silt&clay	118.96	26.6	1.86	15	3607	4.01	2.95	370.6	4.2	0.0004	0.0044	841.2
464	30.43	531.6	silt&clay	119.03	25.3	1.86	15	3391	4.31	2.98	330.2	4.2	0.0004	0.0050	847.6
465	30.5	531.5	silt&clay	119.17	24.8	1.86	15	3281	4.53	3	327.9	4.2	0.0004	0.0048	853.7
466	30.57	531.4	silt&clay	119.11	24.7	1.87	15	3279	4.5	3	326.4	4.21	0.0004	0.0044	855.2
467	30.63	531.4	silt&clay	118.98	24.8	1.87	15	3299	4.41	3	326.0	4.21	0.0005	0.0055	842.8

C-009-3-21

468	30.7	531.3	silt&clay	118.82	24.9	1.87	15	3335	4.28	2.99	330.3	4.21	0.0004	0.0053	844.4
469	30.76	531.2	silt&clay	118.81	25.0	1.87	15	3363	4.24	2.98	335.0	4.21	0.0005	0.0064	842.8
470	30.83	531.2	silt&clay	118.78	25.2	1.87	15	3391	4.19	2.98	337.5	4.21	0.0005	0.0055	841.2
471	30.89	531.1	silt&clay	118.84	27.4	1.88	15	3763	3.79	2.92	341.4	4.22	0.0005	0.0065	841.2
472	30.96	531.0	silt&clay	118.77	29.4	1.88	14	4133	3.42	2.87	443.4	4.22	0.0005	0.0055	834.7
473	31.02	531.0	silt&clay	118.66	31.4	1.88	14	4516	3.08	2.82	438.3	4.22	0.0005	0.0064	826.1
474	31.09	530.9	silt&clay	118.25	29.1	1.88	14	4140	3.23	2.86	439.5	4.22	0.0005	0.0059	822.5
475	31.16	530.8	silt&clay	117.99	26.6	1.88	14	3714	3.51	2.92	322.9	4.22	0.0004	0.0049	818.9
476	31.22	530.8	silt&clay	117.71	24.1	1.88	15	3301	3.84	2.97	297.2	4.22	0.0005	0.0054	822.5
477	31.29	530.7	silt&clay	117.61	23.2	1.89	15	3164	3.97	3	300.3	4.23	0.0004	0.0049	817.0
478	31.35	530.7	silt&clay	117.46	22.6	1.89	15	3067	4.04	3.01	259.7	4.23	0.0005	0.0057	817.0
479	31.42	530.6	silt&clay	117.36	21.9	1.89	15	2950	4.16	3.03	250.8	4.23	0.0004	0.0048	817.0
480	31.48	530.5	silt&clay	117.32	21.7	1.89	15	2920	4.18	3.03	246.7	4.23	0.0005	0.0055	815.1
481	31.55	530.5	silt&clay	117.31	21.6	1.89	15	2909	4.19	3.04	244.8	4.23	0.0004	0.0048	815.1
482	31.61	530.4	silt&clay	117.31	21.6	1.9	15	2905	4.2	3.04	244.9	4.24	0.0005	0.0059	815.1
483	31.68	530.3	silt&clay	117.46	21.7	1.9	15	2906	4.27	3.04	245.0	4.24	0.0006	0.0066	817.0
484	31.75	530.3	silt&clay	117.74	21.8	1.9	15	2911	4.39	3.05	249.0	4.24	0.0005	0.0065	824.3
485	31.81	530.2	silt&clay	117.96	22.1	1.9	15	2944	4.44	3.05	255.4	4.24	0.0007	0.0087	834.7
486	31.88	530.1	silt&clay	118.08	22.5	1.9	15	2988	4.43	3.04	264.9	4.24	0.0006	0.0075	829.6
487	31.94	530.1	silt&clay	118.1	22.8	1.9	15	3047	4.36	3.03	270.0	4.24	0.0007	0.0087	831.3
488	32.01	530.0	silt&clay	118.19	23.1	1.91	15	3089	4.34	3.02	280.9	4.25	0.0006	0.0075	833.0
489	32.07	529.9	silt&clay	118.36	23.4	1.91	15	3121	4.37	3.02	285.7	4.25	0.0007	0.0086	834.7
490	32.14	529.9	silt&clay	118.47	23.5	1.91	15	3127	4.41	3.03	288.5	4.25	0.0006	0.0073	841.2
491	32.2	529.8	silt&clay	118.53	23.5	1.91	15	3117	4.46	3.03	286.4	4.25	0.0007	0.0080	841.2
492	32.27	529.7	silt&clay	118.5	23.4	1.91	15	3117	4.44	3.03	282.9	4.25	0.0005	0.0064	838.0
493	32.34	529.7	silt&clay	118.41	23.2	1.92	15	3091	4.44	3.03	285.4	4.26	0.0004	0.0053	838.0
494	32.4	529.6	silt&clay	118.38	23.0	1.92	15	3059	4.47	3.04	271.4	4.26	0.0005	0.0062	836.3
495	32.47	529.5	silt&clay	118.16	22.7	1.92	15	3019	4.43	3.04	267.2	4.26	0.0005	0.0057	838.0
496	32.53	529.5	silt&clay	117.94	22.5	1.92	15	3006	4.34	3.04	260.1	4.26	0.0007	0.0083	826.1
497	32.6	529.4	silt&clay	117.72	22.3	1.92	15	2995	4.26	3.04	256.6	4.26	0.0007	0.0079	820.7
498	32.66	529.3	silt&clay	117.62	22.2	1.92	15	2990	4.22	3.03	254.9	4.26	0.0008	0.0102	824.3
499	32.73	529.3	silt&clay	117.5	22.3	1.93	15	3007	4.14	3.03	253.2	4.27	0.0009	0.0103	818.9
500	32.8	529.2	silt&clay	117.22	22.2	1.93	15	3022	4	3.02	258.8	4.27	0.0007	0.0089	813.2
501	32.86	529.1	silt&clay	116.99	22.0	1.93	15	3008	3.92	3.02	250.7	4.27	0.0009	0.0104	805.5
502	32.93	529.1	silt&clay	116.71	21.7	1.93	15	2970	3.85	3.02	239.2	4.27	0.0007	0.0089	805.5
503	32.99	529.0	silt&clay	116.43	21.4	1.93	15	2949	3.77	3.02	233.6	4.27	0.0009	0.0104	795.2
504	33.06	528.9	silt&clay	116.06	21.4	1.93	14	2968	3.6	3.01	233.3	4.27	0.0007	0.0089	786.5
505	33.12	528.9	silt&clay	115.92	21.4	1.94	14	2979	3.53	3	233.3	4.28	0.0009	0.0103	779.7
506	33.19	528.8	silt&clay	115.8	21.4	1.94	14	2993	3.47	3	233.2	4.28	0.0007	0.0079	786.5
507	33.25	528.8	silt&clay	115.36	21.4	1.94	14	3043	3.26	2.98	233.8	4.28	0.0007	0.0088	777.4
508	33.32	528.7	silt&clay	114.54	21.3	1.94	14	3100	2.93	2.96	237.2	4.28	0.0007	0.0088	746.5
509	33.39	528.6	silt&clay	113.53	21.0	1.94	13	3136	2.6	2.94	225.4	4.28	0.0007	0.0081	728.7
510	33.45	528.6	silt&clay	112.79	20.6	1.95	13	3132	2.41	2.92	212.3	4.29	0.0009	0.0111	712.2
511	33.52	528.5	silt&clay	112.28	20.4	1.95	13	3140	2.28	2.92	211.8	4.29	0.0009	0.0107	701.5
512	33.58	528.4	silt&clay	111.96	20.4	1.95	13	3175	2.18	2.91	211.8	4.29	0.0011	0.0135	694.0
513	33.65	528.4	silt&clay	111.81	20.5	1.95	13	3199	2.13	2.9	211.7	4.29	0.0010	0.0117	690.1
514	33.71	528.3	silt&clay	111.83	21.4	1.95	13	3380	2.02	2.87	213.8	4.29	0.0011	0.0137	690.1
515	33.78	528.2	silt&clay	111.81	21.5	1.95	13	3406	2	2.87	270.0	4.29	0.0010	0.0117	690.1
516	33.84	528.2	silt&clay	111.84	21.9	1.95	13	3494	1.96	2.86	217.9	4.29	0.0011	0.0137	690.1
517	33.91	528.1	silt&clay	111.83	21.8	1.96	13	3471	1.97	2.86	241.7	4.3	0.0011	0.0135	690.1
518	33.98	528.0	silt&clay	111.9	22.2	1.96	13	3548	1.94	2.85	261.2	4.3	0.0009	0.0111	690.1
519	34.04	528.0	silt&clay	112.07	22.2	1.96	13	3537	1.98	2.85	243.3	4.3	0.0010	0.0121	690.1
520	34.11	527.9	silt&clay	112.32	22.0	1.96	13	3456	2.08	2.87	243.3	4.3	0.0008	0.0100	701.5
521	34.17	527.8	silt&clay	112.83	22.0	1.96	13	3401	2.23	2.89	243.2	4.3	0.0009	0.0111	708.7
522	34.24	527.8	silt&clay	113.46	22.2	1.96	13	3377	2.4	2.9	243.6	4.3	0.0008	0.0096	725.5
523	34.3	527.7	silt&clay	114.86	23.0	1.97	14	3386	2.77	2.92	256.9	4.31	0.0009	0.0111	740.8
524	34.37	527.6	silt&clay	116.34	24.3	1.97	14	3469	3.16	2.94	299.2	4.31	0.0008	0.0093	793.1
525	34.43	527.6	silt&clay	117.22	25.3	1.97	14	3563	3.38	2.94	333.7	4.31	0.0009	0.0104	818.9
526	34.5	527.5	silt&clay	116.91	25.3	1.97	14	3589	3.25	2.93	330.2	4.31	0.0008	0.0099	803.5
527	34.57	527.4	silt&clay	115.67	24.7	1.97	14	3619	2.82	2.9	295.9	4.31	0.0006	0.0076	770.2
528	34.63	527.4	silt&clay	114.33	24.1	1.98	13	3649	2.43	2.88	289.5	4.32	0.0007	0.0082	731.8
529	34.7	527.3	silt&clay	113.45	24.5	1.98	13	3834	2.11	2.84	283.5	4.32	0.0005	0.0059	719.0
530	34.76	527.2	silt&clay	112.83	24.1	1.98	13	3831	1.98	2.83	325.3	4.32	0.0006	0.0068	708.7
531	34.83	527.2	silt&clay	112.01	23.3	1.98	12	3759	1.85	2.83	260.5	4.32	0.0005	0.0058	690.1
532	34.89	527.1	silt&clay	111.04	21.2	1.98	12	3443	1.83	2.86	225.8	4.32	0.0005	0.0066	664.7
533	34.96	527.0	silt&clay	110.28	19.9	1.98	12	3239	1.8	2.88	188.7	4.32	0.0004	0.0052	655.3
534	35.02	527.0	silt&clay	109.97	19.0	1.98	12	3082	1.83	2.9	175.9	4.32	0.0005	0.0062	650.3
535	35.09	526.9	silt&clay	109.85	18.7	1.99	12	3026	1.84	2.91	171.6	4.33	0.0005	0.0061	650.3
536	35.16	526.8	silt&clay	109.83	18.6	1.99	12	3013	1.84	2.91	170.6	4.33	0.0005	0.0058	650.3
537	35.22	526.8	silt&clay	109.84	18.6	1.99	12	3009	1.85	2.91	170.8	4.33	0.0006	0.0070	650.3
538	35.29	526.7	silt&clay	109.91	18.6	1.99	12	3010	1.86	2.91	171.0	4.33	0.0005	0.0058	650.3
539	35.35	526.7	silt&clay	110.19	18.7	1.99	12	2986	1.93	2.92	171.6	4.33	0.0006	0.0070	655.3
540	35.42	526.6	silt&clay	111.25	18.7	1.99	13	2886	2.23	2.95	171.2	4.33	0.0005	0.0060	669.2

C-009-3-21

541	35.48	526.5	silt&clay	112.25	18.7	2	13	2794						2.56	2.99	171.2	4.34	0.0006	0.0070	719.0
542	35.55	526.5	silt&clay	113.55	18.7	2	14	2691						3.05	3.03	171.0	4.34	0.0006	0.0070	725.5
543	35.62	526.4	silt&clay	114.26	19.5	2	14	2778						3.18	3.02	171.9	4.34	0.0005	0.0057	760.0
544	35.68	526.3	silt&clay	115.95	23.5	2	14	3370						3.13	2.95	216.8	4.34	0.0006	0.0069	762.6
545	35.75	526.3	silt&clay	117.78	28.8	2	14	4145						3.07	2.88	429.8	4.34	0.0005	0.0057	811.3
546	35.81	526.2	silt&clay	119.55	33.8	2	14	4824						3.18	2.83	482.4	4.34	0.0005	0.0063	849.1
547	35.88	526.1	silt&clay	120.67	35.3	2.01	14	4941						3.49	2.84	501.1	4.35	0.0004	0.0049	866.6
548	35.94	526.1	silt&clay	121.67	35.7	2.01	15	4864						3.95	2.87	494.2	4.35	0.0004	0.0049	883.8
549	36.01	526.0	silt&clay	122.87	35.7	2.01	15	4705	**3645**					4.65	2.92	497.3	4.35	0.0003	0.0031	915.7
550	36.07	525.9	silt&clay	124.01	36.5	2.01	16	4696						5.27	2.94	500.6	4.35	0.0002	0.0028	947.8
551	36.14	525.9	silt&clay	125	38.4	2.01	16	4868						5.66	2.95	528.7	4.35	0.0002	0.0025	962.6
552	36.21	525.8	silt&clay	125.7	40.6	2.02	16	5134						5.77	2.94	575.6	4.36	0.0002	0.0021	978.3
553	36.27	525.7	silt&clay	126.14	42.5	2.02	16	5363						5.78	2.92	595.0	4.36	0.0002	0.0029	987.4
554	36.34	525.7	silt&clay	126.25	43.9	2.02	16	5569						5.62	2.91	605.6	4.36	0.0003	0.0034	986.7
555	36.4	525.6	silt&clay	126.26	45.2	2.02	16	5776						5.42	2.89	633.8	4.36	0.0003	0.0040	980.5
556	36.47	525.5	silt&clay	126.14	46.0	2.03	16	5928						5.2	2.87	649.6	4.37	0.0004	0.0044	983.3
557	36.53	525.5	silt&clay	126.02	46.4	2.03	15	6008						5.06	2.86	640.4	4.37	0.0005	0.0066	975.4
558	36.6	525.4	silt&clay	125.83	46.6	2.03	15	6075						4.9	2.85	649.4	4.37	0.0005	0.0059	971.0
559	36.66	525.3	silt&clay	125.85	48.7	2.03	15	6427						4.63	2.82	658.5	4.37	0.0006	0.0074	969.5
560	36.73	525.3	silt&clay	126.1	54.8	2.03	15	7420						4.09	2.74	730.2	4.37	0.0010	0.0114	969.5
561	36.8	525.2	silt&clay	126.59	61.6	2.04	15	8486						3.75	2.67	906.7	4.38	0.0009	0.0112	968.7
562	36.86	525.1	silt&clay	126.69	64.3	2.04	14	8945						3.59	2.64	942.6	4.38	0.0013	0.0152	984.0
563	36.93	525.1	silt&clay	126.19	60.0	2.04	14	8288						3.69	2.68	845.2	4.38	0.0011	0.0134	968.7
564	36.99	525.0	silt&clay	125.12	51.6	2.04	15	7057						3.88	2.75	722.7	4.38	0.0013	0.0158	944.3
565	37.06	524.9	silt&clay	124.05	42.7	2.04	15	5721						4.31	2.84	591.1	4.38	0.0011	0.0137	935.3
566	37.12	524.9	silt&clay	123.08	34.7	2.05	15	4515						4.97	2.95	473.3	4.39	0.0014	0.0168	926.7
567	37.19	524.8	silt&clay	121.94	28.8	2.05	16	3687						5.43	3.04	368.9	4.39	0.0013	0.0154	910.4
568	37.25	524.8	silt&clay	120.72	25.7	2.05	16	3295						5.35	3.07	294.0	4.39	0.0015	0.0181	883.8
569	37.32	524.7	silt&clay	119.56	24.6	2.05	15	3222						4.83	3.06	288.2	4.39	0.0016	0.0194	858.1
570	37.39	524.6	silt&clay	118.85	24.6	2.05	15	3276						4.4	3.04	286.9	4.39	0.0014	0.0168	836.3
571	37.45	524.6	silt&clay	118.53	24.6	2.06	15	3316						4.2	3.02	289.4	4.4	0.0016	0.0195	836.3
572	37.52	524.5	silt&clay	118.57	24.8	2.06	15	3342						4.18	3.02	291.9	4.4	0.0014	0.0166	838.0
573	37.58	524.4	silt&clay	118.66	25.2	2.06	15	3394						4.16	3.01	297.6	4.4	0.0016	0.0191	838.0
574	37.65	524.4	silt&clay	118.92	25.5	2.06	15	3426						4.23	3.01	314.5	4.4	0.0013	0.0158	841.2
575	37.71	524.3	silt&clay	119.04	25.8	2.06	15	3465						4.24	3.01	314.7	4.4	0.0015	0.0176	852.2
576	37.78	524.2	silt&clay	119.22	25.9	2.06	15	3471						4.31	3.01	318.7	4.4	0.0012	0.0138	844.4
577	37.84	524.2	silt&clay	119.36	26.2	2.07	15	3501						4.34	3.01	322.9	4.41	0.0013	0.0153	853.7
578	37.91	524.1	silt&clay	119.85	27.1	2.07	15	3610						4.43	3.01	333.5	4.41	0.0010	0.0120	859.6
579	37.98	524.0	silt&clay	120.28	27.6	2.07	15	3653						4.58	3.01	390.0	4.41	0.0008	0.0094	873.4
580	38.04	524.0	silt&clay	120.52	28.2	2.07	15	3728						4.61	3	359.8	4.41	0.0008	0.0099	880.0
581	38.11	523.9	silt&clay	120.66	28.4	2.07	15	3734						4.67	3.01	379.1	4.41	0.0006	0.0076	873.4
582	38.17	523.8	silt&clay	121	29.5	2.08	15	3883						4.65	2.99	398.6	4.42	0.0007	0.0085	882.5
583	38.24	523.8	silt&clay	121.28	31.9	2.08	15	4262						4.35	2.95	430.1	4.42	0.0006	0.0070	897.0
584	38.3	523.7	silt&clay	121.16	34.9	2.08	15	4794						3.8	2.88	495.6	4.42	0.0006	0.0068	881.3
585	38.37	523.6	silt&clay	120.4	37.4	2.08	14	5352						3.13	2.8	529.4	4.42	0.0004	0.0046	858.1
586	38.43	523.6	silt&clay	119.74	37.4	2.08	14	5458						2.86	2.78	534.3	4.42	0.0004	0.0043	831.3
587	38.5	523.5	silt&clay	119.12	34.9	2.09	14	5086						2.88	2.81	494.9	4.43	0.0003	0.0032	838.0
588	38.56	523.4	silt&clay	118.77	30.8	2.09	14	4384						3.23	2.88	425.1	4.43	0.0003	0.0042	827.8
589	38.63	523.4	silt&clay	117.68	26.2	2.09	14	3681						3.44	2.95	321.8	4.43	0.0003	0.0039	826.1
590	38.7	523.3	silt&clay	116.56	22.2	2.09	14	3074						3.68	3.03	221.8	4.43	0.0003	0.0034	784.3
591	38.76	523.2	silt&clay	115.09	19.3	2.09	14	2674						3.63	3.08	159.7	4.43	0.0003	0.0036	775.0
592	38.83	523.2	silt&clay	114.02	17.8	2.09	14	2490						3.48	3.1	139.6	4.43	0.0002	0.0029	749.3
593	38.89	523.1	silt&clay	113.03	17.4	2.1	14	2485						3.14	3.08	139.0	4.44	0.0002	0.0029	722.3
594	38.96	523.0	silt&clay	112.45	17.4	2.1	14	2529						2.9	3.06	138.3	4.44	0.0002	0.0020	712.2
595	39.02	523.0	silt&clay	112.25	17.3	2.1	14	2535						2.83	3.06	139.0	4.44	0.0002	0.0021	712.2
596	39.09	522.9	silt&clay	112.19	17.2	2.1	14	2508						2.85	3.06	135.9	4.44	0.0002	0.0023	708.7
597	39.15	522.9	silt&clay	112.12	16.8	2.1	14	2451						2.89	3.08	130.1	4.44	0.0002	0.0027	708.7
598	39.22	522.8	silt&clay	112.11	16.5	2.1	14	2397						2.96	3.09	122.5	4.44	0.0002	0.0028	708.7
599	39.29	522.7	silt&clay	112.15	16.4	2.11	14	2364						3.01	3.1	122.2	4.45	0.0002	0.0024	708.7
600	39.35	522.7	silt&clay	112.54	16.4	2.11	14	2337						3.18	3.11	122.4	4.45	0.0002	0.0028	712.2
601	39.42	522.6	silt&clay	113.39	16.4	2.11	14	2287						3.56	3.14	122.4	4.45	0.0002	0.0024	734.8
602	39.48	522.5	silt&clay	114.32	16.5	2.11	15	2245						4	3.16	123.6	4.45	0.0003	0.0033	765.2
603	39.55	522.5	silt&clay	114.88	16.9	2.11	15	2268						4.21	3.17	126.5	4.45	0.0003	0.0033	777.4
604	39.61	522.4	silt&clay	115.27	18.0	2.11	15	2439						4.07	3.14	137.6	4.45	0.0005	0.0062	772.6
605	39.68	522.3	silt&clay	117.03	28.1	2.12	14	4099						2.88	2.89	181.5	4.46	0.0009	0.0107	782.0
606	39.74	522.3	sand&grav	119.28	45.0	2.12				19	24	-2.5	33	2.1	2.63	653.6	4.46	0.0011	0.0131	826.1
607	39.81	522.2	sand&grav	121.73	67.6	2.12				25	30	-2.5	35	1.71	2.42	949.5	4.46	0.0011	0.0133	852.2
608	39.88	522.1	sand&grav	123.5	81.7	2.12				29	35	-2.5	36	1.69	2.34	1220.9	4.46	0.0010	0.0115	887.5
609	39.94	522.1	sand&grav	124.79	86.2	2.12				30	37	-2.5	36	1.88	2.35	1248.7	4.46	0.0011	0.0134	916.7
610	40.01	522.0	sand&grav	125.32	79.6	2.13				30	36	-2.5	36	2.25	2.44	1136.1	4.47	0.0010	0.0115	935.3
611	40.07	521.9	sand&grav	124.82	66.6	2.13				27	33	-2.5	35	2.66	2.55	943.5	4.47	0.0011	0.0129	939.8
612	40.14	521.9	sand&grav	123.58	53.2	2.13				24	29	-2.5	35	3.02	2.68	703.7	4.47	0.0009	0.0110	910.4
613	40.2	521.8	silt&clay	122.1	41.7	2.13	14	5855						3.42	2.8	575.3	4.47	0.0011	0.0129	882.5

C-009-3-21

614	40.27	521.7	silt&clay	120.66	33.0	2.13	15	4522						3.83	2.91	458.3	4.47	0.0009	0.0110	880.0
615	40.33	521.7	silt&clay	119.5	26.0	2.14	15	3453						4.47	3.04	271.3	4.48	0.0011	0.0129	847.6
616	40.4	521.6	silt&clay	118.42	21.8	2.14	15	2849						4.87	3.12	189.9	4.48	0.0011	0.0127	839.6
617	40.47	521.5	silt&clay	118.1	20.5	2.14	15	2660						5.05	3.15	189.6	4.48	0.0008	0.0098	834.7
618	40.53	521.5	silt&clay	118.1	20.6	2.14	15	2667						5.04	3.15	189.6	4.48	0.0008	0.0091	834.7
619	40.6	521.4	silt&clay	118.22	20.7	2.14	15	2682						5.08	3.15	191.9	4.48	0.0006	0.0073	838.0
620	40.66	521.3	silt&clay	118.49	21.1	2.14	15	2724						5.14	3.15	197.6	4.48	0.0007	0.0085	842.8
621	40.73	521.3	silt&clay	118.96	26.2	2.15	15	3545						4.11	3.01	210.2	4.49	0.0006	0.0073	850.6
622	40.79	521.2	silt&clay	119.42	33.3	2.15	14	4750						3.19	2.86	500.9	4.49	0.0007	0.0087	838.0
623	40.86	521.1	silt&clay	119.53	38.4	2.15	14	5679						2.69	2.77	585.9	4.49	0.0006	0.0078	836.3
624	40.92	521.1	silt&clay	119.35	35.7	2.15	14	5212						2.88	2.81	510.1	4.49	0.0008	0.0093	836.3
625	40.99	521.0	silt&clay	118.87	29.3	2.15	14	4087						3.51	2.93	360.1	4.49	0.0008	0.0094	836.3
626	41.06	520.9	silt&clay	118.47	24.5	2.16	15	3301						4.2	3.04	231.5	4.5	0.0007	0.0082	834.7
627	41.12	520.9	silt&clay	118.27	22.6	2.16	15	2996						4.55	3.09	228.8	4.5	0.0008	0.0094	834.7
628	41.19	520.8	silt&clay	118.33	22.7	2.16	15	3008						4.56	3.09	227.5	4.5	0.0007	0.0083	834.7
629	41.25	520.8	silt&clay	118.49	23.0	2.16	15	3040						4.59	3.09	236.5	4.5	0.0008	0.0097	838.0
630	41.32	520.7	silt&clay	119.09	24.0	2.16	15	3150						4.72	3.08	245.3	4.5	0.0007	0.0083	844.4
631	41.38	520.6	silt&clay	119.93	26.9	2.17	15	3570						4.53	3.03	289.3	4.51	0.0008	0.0096	869.4
632	41.45	520.6	silt&clay	121.12	33.7	2.17	15	4590						3.96	2.92	442.1	4.51	0.0006	0.0077	878.7
633	41.51	520.5	silt&clay	122.4	44.2	2.17	14	6265						3.29	2.78	606.9	4.51	0.0006	0.0071	892.3
634	41.58	520.4	sand&grav	123.45	52.8	2.17				23	28	-2.5	35	3.01	2.68	793.4	4.51	0.0005	0.0055	913.6
635	41.65	520.4	sand&grav	124.13	57.1	2.17				25	30	-2.5	35	2.97	2.65	801.3	4.51	0.0003	0.0041	922.8
636	41.71	520.3	sand&grav	124.48	56.5	2.18				25	30	-2.5	35	3.16	2.68	786.3	4.52	0.0004	0.0048	927.7
637	41.78	520.2	silt&clay	124.65	56.0	2.18	14	7931						3.28	2.69	771.5	4.52	0.0004	0.0044	938.9
638	41.84	520.2	silt&clay	124.72	55.4	2.18	14	7822						3.35	2.7	777.1	4.52	0.0005	0.0056	937.1
639	41.91	520.1	silt&clay	124.35	54.4	2.18	14	7708						3.27	2.7	764.1	4.52	0.0004	0.0052	933.4
640	41.97	520.0	sand&grav	123.62	52.5	2.18				24	28	-2.5	35	3.1	2.7	725.9	4.52	0.0006	0.0070	916.7
641	42.04	520.0	sand&grav	122.76	50.2	2.19				23	27	-2.5	34	2.93	2.7	697.4	4.53	0.0006	0.0071	889.9
642	42.1	519.9	sand&grav	121.89	46.8	2.19				21	26	-2.5	34	2.85	2.72	669.3	4.53	0.0008	0.0098	881.3
643	42.17	519.8	silt&clay	121.04	40.7	2.19	14	5855						3.06	2.79	585.1	4.53	0.0009	0.0112	868.0
644	42.23	519.8	silt&clay	119.72	32.6	2.19	14	4581						3.42	2.89	439.0	4.53	0.0011	0.0133	853.7
645	42.3	519.7	silt&clay	118.54	26.2	2.19	15	3577						3.9	3.01	251.9	4.53	0.0011	0.0133	822.5
646	42.37	519.6	silt&clay	117.79	23.1	2.19	15	3108						4.16	3.07	229.2	4.53	0.0009	0.0113	822.5
647	42.43	519.6	silt&clay	117.74	22.4	2.2	15	3008						4.28	3.09	218.7	4.54	0.0011	0.0131	822.5
648	42.5	519.5	silt&clay	117.87	22.3	2.2	15	2969						4.4	3.1	214.5	4.54	0.0008	0.0098	824.3
649	42.56	519.4	silt&clay	118.23	22.3	2.2	15	2947						4.61	3.11	217.8	4.54	0.0007	0.0089	833.0
650	42.63	519.4	silt&clay	118.78	23.1	2.2	15	3024						4.77	3.11	221.2	4.54	0.0006	0.0076	847.6
651	42.69	519.3	silt&clay	119.37	24.9	2.2	15	3284						4.66	3.07	259.0	4.54	0.0008	0.0090	858.1
652	42.76	519.2	silt&clay	120.53	33.9	2.21	14	4694	**4121**					3.64	2.9	341.4	4.55	0.0007	0.0078	861.0
653	42.82	519.2	sand&grav	122.15	49.1	2.21				22	26	-2.5	34	2.77	2.69	685.6	4.55	0.0008	0.0091	878.7
654	42.89	519.1	sand&grav	123.69	68.6	2.21				27	32	-2.5	35	2.2	2.5	974.1	4.55	0.0008	0.0091	907.2
655	42.96	519.0	sand&grav	124.63	83.8	2.21				30	36	-2.5	36	1.91	2.38	1204.0	4.55	0.0007	0.0078	914.6
656	43.02	519.0	sand&grav	125.02	93.5	2.21				32	38	-2.5	36	1.74	2.31	1325.2	4.55	0.0007	0.0084	913.6
657	43.09	518.9	sand&grav	125.42	98.5	2.22				33	40	-2.5	37	1.72	2.29	1379.4	4.56	0.0005	0.0062	916.7
658	43.15	518.9	sand&grav	126.05	101.8	2.22				34	41	-2.5	37	1.79	2.29	1413.9	4.56	0.0004	0.0054	933.4
659	43.22	518.8	sand&grav	126.86	108.9	2.22				36	43	-2.5	37	1.83	2.27	1466.9	4.56	0.0003	0.0037	950.3
660	43.28	518.7	sand&grav	128.29	124.4	2.22				40	48	-2.5	38	1.86	2.23	1674.7	4.56	0.0003	0.0038	962.6
661	43.35	518.7	sand&grav	129.62	144.5	2.22				45	54	-2.5	39	1.83	2.17	2064.1	4.56	0.0003	0.0031	1006.1
662	43.41	518.6	sand&grav	130.91	162.6	2.23				49	59	-2.5	39	1.87	2.14	2348.1	4.57	0.0003	0.0036	1018.4
663	43.48	518.5	sand&grav	131.8	172.7	2.23				52	62	-2.5	39	1.95	2.13	2467.5	4.57	0.0003	0.0036	1035.6
664	43.55	518.5	sand&grav	132.5	177.4	2.23				54	64	-2.5	39	2.06	2.14	2491.3	4.57	0.0003	0.0031	1057.2
665	43.61	518.4	sand&grav	133.1	181.5	2.23				55	66	-2.5	40	2.17	2.15	2511.2	4.57	0.0003	0.0037	1062.9
666	43.68	518.3	sand&grav	133.4	186.8	2.24				57	68	-2.5	40	2.18	2.15	2605.9	4.58	0.0003	0.0035	1074.3
667	43.74	518.3	sand&grav	133.58	193.4	2.24				58	70	-2.5	40	2.13	2.13	2762.2	4.58	0.0004	0.0045	1073.9
668	43.81	518.2	sand&grav	133.57	201.7	2.24				59	71	-2.5	40	2.01	2.09	2755.0	4.58	0.0004	0.0042	1069.8
669	43.87	518.1	sand&grav	133.51	208.6	2.24				60	72	-2.5	40	1.91	2.07	2769.3	4.58	0.0004	0.0050	1066.4
670	43.94	518.1	sand&grav	133.61	216.4	2.25				61	73	-2.5	40	1.84	2.04	2764.0	4.59	0.0004	0.0043	1063.8
671	44	518.0	sand&grav	132.83	221.4	2.25				61	73	-2.5	40	1.61	1.99	2829.8	4.59	0.0004	0.0049	1070.2
672	44.07	517.9	sand&grav	132.09	227.0	2.25				60	71	-2.2	40	1.41	1.93	2431.7	4.59	0.0003	0.0041	1000.5
673	44.13	517.9	sand&grav	130.98	232.1	2.25				59	70	-2.0	40	1.17	1.87	2480.9	4.59	0.0004	0.0045	1007.3
674	44.2	517.8	sand&grav	131.02	237.0	2.25				59	71	-1.9	40	1.15	1.85	2452.1	4.59	0.0003	0.0042	998.6
675	44.27	517.7	sand&grav	130.94	239.7	2.26				60	71	-1.9	40	1.12	1.84	2465.9	4.6	0.0003	0.0032	999.9
676	44.33	517.7	sand&grav	131.02	240.9	2.26				60	71	-1.9	41	1.12	1.84	2467.0	4.6	0.0003	0.0033	1000.5
677	44.4	517.6	sand&grav	131.16	240.7	2.26				60	72	-1.9	40	1.15	1.85	2486.7	4.6	0.0002	0.0026	1003.0
678	44.46	517.5	sand&grav	131.79	240.9	2.26				61	73	-2.0	40	1.25	1.87	2516.8	4.6	0.0003	0.0030	1009.1
679	44.53	517.5	sand&grav	132.74	240.4	2.27				63	75	-2.2	40	1.42	1.92	2704.7	4.61	0.0002	0.0026	1041.6
680	44.59	517.4	sand&grav	133.46	240.4	2.27				64	76	-2.3	40	1.57	1.95	2864.6	4.61	0.0003	0.0030	1066.8
681	44.66	517.3	sand&grav	133.83	240.4	2.27				65	77	-2.4	40	1.65	1.97	2840.8	4.61	0.0002	0.0026	1062.9
682	44.72	517.3	sand&grav	133.94	240.4	2.27				65	78	-2.4	40	1.68	1.98	2880.8	4.61	0.0002	0.0028	1068.9
683	44.79	517.2	sand&grav	134.22	240.4	2.27				66	78	-2.5	40	1.74	1.99	2917.8	4.61	0.0002	0.0027	1074.3
684	44.86	517.1	sand&grav	134.51	241.7	2.28				67	79	-2.5	40	1.8	2	2974.0	4.62	0.0002	0.0020	1082.3
685	44.92	517.1	sand&grav	134.87	249.7	2.28				68	81	-2.5	40	1.81	1.99	3024.9	4.62	0.0002	0.0019	1088.0
686	44.99	517.0	sand&grav	135.31	266.6	2.28				72	85	-2.3	40	1.76	1.96	3122.9	4.62	0.0001	0.0014	1093.9

C-009-3-21

687	45.05	517.0	sand&grav	135.64	283.0	2.28	74	89	-2.2	40	1.7	1.93	3249.1	4.62	0.0001	0.0017	1101.3
688	45.12	516.9	sand&grav	135.65	289.0	2.29	76	90	-2.2	40	1.66	1.92	3252.4	4.63	0.0001	0.0016	1101.0
689	45.18	516.8	sand&grav	135.42	283.8	2.29	74	88	-2.2	41	1.65	1.92	3153.9	4.63	0.0002	0.0024	1091.3
690	45.25	516.8	sand&grav	135.09	274.7	2.29	72	86	-2.2	40	1.64	1.93	3119.3	4.63	0.0002	0.0022	1088.7
691	45.31	516.7	sand&grav	134.74	269.3	2.29	71	84	-2.2	40	1.61	1.93	3055.6	4.63	0.0002	0.0028	1083.0
692	45.38	516.6	sand&grav	134.29	266.1	2.3	70	83	-2.2	41	1.54	1.92	2967.4	4.64	0.0002	0.0027	1070.2
693	45.44	516.6	sand&grav	133.79	266.1	2.3	68	81	-2.1	41	1.43	1.89	2896.4	4.64	0.0003	0.0036	1059.4
694	45.51	516.5	sand&grav	133.46	266.1	2.3	68	81	-2.0	41	1.37	1.88	2823.4	4.64	0.0003	0.0037	1047.9
695	45.58	516.4	sand&grav	133.34	271.6	2.3	68	81	-1.9	41	1.31	1.86	2824.6	4.64	0.0003	0.0032	1047.9
696	45.64	516.4	sand&grav	133.41	279.5	2.31	69	82	-1.9	41	1.28	1.84	2863.7	4.65	0.0003	0.0038	1047.9
697	45.71	516.3	sand&grav	133.54	289.4	2.31	71	84	-1.8	41	1.24	1.82	2884.2	4.65	0.0003	0.0033	1048.4
698	45.77	516.2	sand&grav	133.69	295.2	2.31	72	85	-1.7	41	1.23	1.81	2913.9	4.65	0.0003	0.0038	1050.8
699	45.84	516.2	sand&grav	133.89	294.7	2.31	72	86	-1.8	41	1.27	1.82	2951.8	4.65	0.0003	0.0033	1054.9
700	45.9	516.1	sand&grav	134.05	288.8	2.31	72	85	-1.9	41	1.33	1.84	2974.6	4.65	0.0003	0.0040	1062.1
701	45.97	516.0	sand&grav	134.01	279.2	2.32	71	84	-2.0	41	1.39	1.87	2975.1	4.66	0.0003	0.0036	1065.5
702	46.03	516.0	sand&grav	133.65	265.9	2.32	68	81	-2.1	41	1.41	1.89	2910.5	4.66	0.0004	0.0046	1058.1
703	46.1	515.9	sand&grav	132.72	250.9	2.32	64	76	-2.1	41	1.34	1.89	2772.5	4.66	0.0004	0.0043	1045.1
704	46.16	515.8	sand&grav	131.06	225.4	2.32	58	69	-2.1	40	1.23	1.9	2513.5	4.66	0.0005	0.0056	1006.7
705	46.23	515.8	sand&grav	128.8	199.5	2.33	52	61	-2.1	40	1.07	1.9	2154.6	4.67	0.0005	0.0061	952.0
706	46.3	515.7	sand&grav	126.75	176.9	2.33	46	55	-2.1	39	0.95	1.91	1913.0	4.67	0.0005	0.0056	907.2
707	46.36	515.6	sand&grav	125.6	166.7	2.33	43	51	-2.1	39	0.88	1.9	1855.7	4.67	0.0005	0.0066	894.7
708	46.43	515.6	sand&grav	125.26	164.7	2.33	43	51	-2.1	39	0.85	1.9	1828.7	4.67	0.0005	0.0057	887.5
709	46.49	515.5	sand&grav	125.2	164.6	2.33	43	51	-2.1	39	0.84	1.9	1821.6	4.67	0.0005	0.0066	885.0
710	46.56	515.4	sand&grav	125.32	165.0	2.34	43	51	-2.1	39	0.85	1.9	1839.9	4.68	0.0005	0.0057	889.9
711	46.62	515.4	sand&grav	125.67	170.3	2.34	44	52	-2.1	39	0.86	1.89	1859.3	4.68	0.0005	0.0066	894.7
712	46.69	515.3	sand&grav	126.32	176.1	2.34	45	54	-2.1	39	0.9	1.89	1934.7	4.68	0.0005	0.0056	905.0
713	46.75	515.3	sand&grav	127.01	186.5	2.34	48	56	-2.0	39	0.91	1.88	2031.5	4.68	0.0005	0.0061	928.7
714	46.82	515.2	sand&grav	127.42	192.1	2.34	49	58	-2.0	39	0.93	1.87	2088.0	4.68	0.0004	0.0054	933.4
715	46.89	515.1	sand&grav	127.43	197.1	2.35	49	58	-1.9	40	0.9	1.85	2073.9	4.69	0.0003	0.0040	929.6
716	46.95	515.1	sand&grav	127.3	197.3	2.35	49	58	-1.9	40	0.88	1.85	2055.6	4.69	0.0004	0.0044	924.8
717	47.02	515.0	sand&grav	127.23	197.5	2.35	49	58	-1.9	40	0.87	1.84	2056.3	4.69	0.0003	0.0034	924.8
718	47.08	514.9	sand&grav	127.39	197.8	2.35	50	59	-1.9	40	0.89	1.85	2058.3	4.69	0.0003	0.0036	924.8
719	47.15	514.9	sand&grav	127.84	198.5	2.36	50	59	-1.9	40	0.94	1.86	2103.2	4.7	0.0002	0.0029	935.3
720	47.21	514.8	sand&grav	128.69	199.7	2.36	52	61	-2.1	40	1.05	1.9	2185.4	4.7	0.0003	0.0034	953.7
721	47.28	514.7	sand&grav	129.69	205.4	2.36	54	64	-2.2	40	1.16	1.92	2316.0	4.7	0.0003	0.0031	980.5
722	47.34	514.7	sand&grav	131.17	217.3	2.36	58	68	-2.3	40	1.31	1.94	2449.8	4.7	0.0003	0.0040	999.9
723	47.41	514.6	sand&grav	132.86	234.5	2.36	63	74	-2.3	40	1.5	1.96	2750.0	4.7	0.0004	0.0045	1043.6
724	47.48	514.5	sand&grav	134.84	245.8	2.37	68	80	-2.5	40	1.84	2.01	3049.8	4.71	0.0004	0.0048	1081.9
725	47.54	514.5	sand&grav	136.22	249.3	2.37	72	85	-2.5	40	2.18	2.07	3392.3	4.71	0.0005	0.0057	1128.5
726	47.61	514.4	sand&grav	136.96	247.0	2.37	73	86	-2.5	40	2.44	2.11	3492.6	4.71	0.0004	0.0049	1141.6
727	47.67	514.3	sand&grav	137.21	246.0	2.37	74	87	-2.5	40	2.54	2.13	3484.6	4.71	0.0005	0.0057	1140.5
728	47.74	514.3	sand&grav	137.37	246.1	2.38	74	87	-2.5	40	2.62	2.14	3538.9	4.72	0.0004	0.0049	1146.7
729	47.8	514.2	sand&grav	137.37	248.1	2.38	76	89	-2.5	40	2.74	2.16	3441.0	4.72	0.0005	0.0057	1157.2
730	47.87	514.1	sand&grav	137.37	257.2	2.38	78	92	-2.5	40	2.76	2.15	3520.7	4.72	0.0004	0.0043	1167.2
731	47.93	514.1	sand&grav	137.37	273.4	2.38	81	95	-2.5	40	2.66	2.11	3826.6	4.72	0.0001	0.0010	1168.6
732	48	514.0	sand&grav	137.37	285.2	2.39	83	97	-2.5	40	2.5	2.08	3898.3	4.73	0.0001	0.0009	1169.0
733	48.06	513.9	sand&grav	137.37	275.5	2.39	80	94	-2.5	40	2.44	2.08	3769.0	4.73	0.0001	0.0011	1157.5
734	48.13	513.9	sand&grav	137.1	245.2	2.39	74	86	-2.5	40	2.52	2.13	3469.9	4.73	0.0001	0.0011	1138.3
735	48.2	513.8	sand&grav	136.06	198.8	2.39	64	75	-2.5	40	2.89	2.24	2847.2	4.73	0.0001	0.0012	1124.0
736	48.26	513.7	sand&grav	135.12	153.8	2.4	55	65	-2.5	39	3.58	2.4	2068.3	4.74	0.0002	0.0019	1122.2
737	48.33	513.7	sand&grav	134.26	113.7	2.4	47	55	-2.5	39	4.75	2.6	1523.2	4.74	0.0002	0.0022	1116.3
738	48.39	513.6	sand&grav	133.54	88.1	2.4	41	48	-3.5	37	6.05	2.77	1163.1	4.74	0.0003	0.0034	1114.3
739	48.46	513.5	sand&grav	133.14	75.1	2.4	37	43	-3.5	36	7.08	2.86	994.0	4.74	0.0003	0.0034	1114.7
740	48.52	513.5	sand&grav	133.01	70.7	2.41	36	42	-3.5	36	7.55	2.9	977.0	4.75	0.0003	0.0041	1114.7
741	48.59	513.4	sand&grav	133.05	70.3	2.41	36	42	-3.5	36	7.65	2.91	977.1	4.75	0.0003	0.0035	1115.6
742	48.65	513.4	sand&grav	133.16	70.3	2.41	36	42	-3.5	36	7.75	2.91	977.2	4.75	0.0003	0.0041	1118.2
743	48.72	513.3	sand&grav	133.51	70.4	2.41	36	43	-3.5	36	8.13	2.93	977.6	4.75	0.0003	0.0035	1121.9
744	48.78	513.2	sand&grav	134.25	70.7	2.41	37	44	-3.5	36	8.93	2.96	978.5	4.75	0.0003	0.0041	1139.4
745	48.85	513.2	sand&grav	135.39	73.0	2.42	39	46	-3.5	37	10.02	2.98	991.6	4.76	0.0003	0.0040	1166.2
746	48.92	513.1	sand&grav	136.79	78.7	2.42	42	49	-3.5	37	10.97	2.99	1073.1	4.76	0.0003	0.0032	1194.7
747	48.98	513.0	sand&grav	137.37	90.9	2.42	48	56	-3.5	38	11.11	2.96	1218.1	4.76	0.0003	0.0033	1223.8
748	49.05	513.0	sand&grav	137.37	109.6	2.42	54	63	-3.5	38	10.38	2.88	1505.2	4.76	0.0002	0.0023	1247.5
749	49.11	512.9	sand&grav	137.37	135.3	2.43	62	73	-3.5	39	9.24	2.78	1857.2	4.77	0.0002	0.0022	1257.8
750	49.18	512.8	sand&grav	137.37	161.0	2.43	70	82	-2.5	40	8.3	2.7	2300.0	4.77	0.0001	0.0015	1273.2
751	49.24	512.8	sand&grav	137.37	182.0	2.43	76	89	-2.5	40	7.75	2.64	2581.9	4.77	0.0001	0.0016	1281.6
752	49.31	512.7	sand&grav	137.37	193.9	2.43	80	93	-2.5	40	7.46	2.61	2739.6	4.77	0.0001	0.0013	1286.6
753	49.37	512.6	sand&grav	137.37	200.1	2.44	81	95	-2.5	40	7.26	2.59	2798.8	4.78	0.0001	0.0014	1286.2
754	49.44	512.6	sand&grav	137.37	198.5	2.44	80	94	-2.5	40	7.17	2.59	2845.2	4.78	0.0001	0.0014	1283.7
755	49.51	512.5	sand&grav	137.37	190.7	2.44	78	91	-2.5	40	7.23	2.6	2668.7	4.78	0.0001	0.0013	1275.6
756	49.57	512.4	sand&grav	137.37	176.2	2.44	74	86	-2.5	40	7.56	2.64	2470.8	4.78	0.0001	0.0016	1269.8
757	49.64	512.4	sand&grav	137.37	163.4	2.45	70	82	-2.5	40	7.98	2.68	2239.9	4.79	0.0001	0.0015	1266.7
758	49.7	512.3	sand&grav	137.37	153.8	2.45	68	79	-2.5	40	8.35	2.72	2130.0	4.79	0.0002	0.0019	1264.7
759	49.77	512.2	sand&grav	137.37	149.2	2.45	67	78	-2.5	40	8.49	2.73	2065.4	4.79	0.0001	0.0017	1261.9

C-009-3-21

760	49.83	512.2	sand&grav	137.37	146.9	2.45				66	77	-2.5	40		8.53	2.74	2048.6	4.79	0.0002	0.0020	1259.7
761	49.9	512.1	sand&grav	137.37	146.5	2.46				66	77	-2.5	40		8.49	2.74	2031.8	4.8	0.0001	0.0017	1258.8
762	49.96	512.0	sand&grav	137.37	145.7	2.46				65	76	-2.5	40		8.45	2.74	2051.6	4.8	0.0002	0.0020	1258.5
763	50.03	512.0	sand&grav	137.37	144.0	2.46				65	75	-2.5	40		8.38	2.74	2010.8	4.8	0.0001	0.0017	1254.1
764	50.09	511.9	sand&grav	137.37	141.3	2.46				63	74	-2.5	40		8.21	2.74	1960.6	4.8	0.0002	0.0021	1248.3
765	50.16	511.8	sand&grav	137.37	137.9	2.47				62	72	-2.5	40		7.96	2.73	1940.4	4.81	0.0002	0.0021	1238.6
766	50.23	511.8	sand&grav	137.37	132.0	2.47				59	69	-2.5	40		7.79	2.74	1866.0	4.81	0.0002	0.0019	1225.3
767	50.29	511.7	sand&grav	137.37	125.0	2.47				57	66	-2.5	40		7.68	2.75	1715.7	4.81	0.0002	0.0024	1215.7
768	50.36	511.6	sand&grav	137.37	119.7	2.47				55	64	-3.5	38	**39**	7.67	2.76	1642.8	4.81	-0.1474	-1.7694	1203.1

Total Settlement (ft, in): **0.3480** **4.1766**

Average Shear Wave Velocity (ft/s): **945.4**

Appendix E

Settlement Analysis

173608714 LAW-7
LEDT 4-2022

ESTIMATED SETTLEMENT ANALYSIS SUMMARY BRIDGE B-16 (0370): STATE ROUTE 7 OVER COUNTRY ROAD 104

BACKGROUND

Bridge Elevations:

- Bridge B16 East Abutment: Road Grade – 595.74, Bottom of Wall – 557.5 (fwd)
- Bridge B16 West Abutment: Road Grade – 599.38, Bottom of Wall – 559.5 (rear)

Existing Ground Surface Elevations:

- East abutment pile ~557’
- West abutment pile ~559’

Planned Layout for Pile Locations:

- Piles sit 3.5’ back from temporary facing parallel to CR104
- Final MSE wall face is ~3’ closer to CR104 than temporary facing
- Piles sit ~5.5’ back from final MSE wall face

Final Grading for Embankment:

- 2:1 parallel to SR7 for turn back wing wall
- 3:1 perpendicular to SR7
- 2:1 meets final MSE wall face parallel to CR104

Points of Interest (POI):

- Pile location
- Final MSE wall face parallel to CR104
- Maximum embankment settlement

Max Settlement of soils around Driven Piles:

- 0.4 inches for downdrag via FHWA GEC 012 – Volume I, September 2016

ANALYSIS OUTLINE

Modelled Embankment:

- Embankment height is based on the west side (rear abutment) of the proposed bridge structure, as this embankment will control magnitude of settlement
    - The west embankment requires ~5’ excavation into the existing soil (silty clay) which would decrease the silty clay layer thickness.

Modelled Loading Conditions:

- Dead loads only, no traffic surcharge or live loads
- Full embankment grading and final vertical abutment face modelled to represent final loading conditions
    - Loading may be smaller during settlement waiting period with temporary facing, and therefore field measurements of settlement should be used to compare predicted settlement with this model, rather than relying on time rates
    - It is assumed there may be an additional settlement waiting period after final MSE wall facing is constructed and before driving of piles in order to meet settlement requirements

ASSUMPTIONS

- 42’ wide top of embankment
- 39’ tall embankment
- 32' total silty clay in two double drained layers
- Bedrock at 50’ below existing ground surface (gs)
- Water at existing ground surface (gs)
- Consolidation settlement is in silty clay layers
- Immediate settlement in sand and gravel layers

RESULTS

- Full Loading at **Pile** Location:
  - Creates 7.12" total consolidation settlement
    - 95% of total consolidation settlement is 6.80"
    - 90% of total consolidation settlement is 6.47"
    - 80% of total consolidation settlement is 5.89"
- Estimated Time Rate at **Pile** Location:
  - 10 days for 80% of total consolidation settlement
  - 19 days for 90% of total consolidation settlement
  - 29 days for 95% of total consolidation settlement
- Requirement to mitigate Downdrag at **Pile** Locations:
  - Must be <0.4" difference between when piles are driven and final consolidation
  - (Full loading consolidation) - (95% preloading consolidation after 29 days)
    = 7.12” - 6.80” = 0.32”
    = 0.32” < 0.4” --> OK
- Immediate settlement for Embankment
  - Maximum Embankment Immediate settlement in sand & gravel layers is 2.58"
    - Es = 208.9ksf to 584.8ksf via lookup for loose sand
    - Minimum is 1.77" (tested full range of Es lookup values)
  - Immediate settlement at pile location is 2.58” (minimum is 0.87”)
- Estimated Total Settlement at Pile Location:
  - Consolidation + Immediate = Total
    - 7.12” + 2.58” = 9.7”

Table of Contents

Project Settings 2

Stage Settings 3

Results 4

- Stage: Stage 1 = 0 d 4
- Stage: 80% = 12 d 4
- Stage: 90% = 20 d 5
- Stage: 95% = 30 d 6
- Stage: 1 yr = 365 d 7
- Stage: 10 yr = 3650 d 8

Embankments 10

- 1. Embankment: "Embankment Load 1" 10
- 2. Embankment: "Embankment Load 2" 10

Soil Layers 11

Soil Properties 12

Groundwater 13

- Piezometric Line Entities 13

Time Points 14

Settle3 Analysis Information

LAW-7

Project Settings

Document Name	Law-7 B-16 (Full Loading)_4.19.2022
Project Title	LAW-7
Analysis	B-16 Full Loading
Author	J. Samples
Company	Stantec
Date Created	4/19/2022
Stress Computation Method	Boussinesq
Time-dependent Consolidation Analysis	
Time Units	days
Permeability Units	feet/day
Minimum settlement ratio for subgrade modulus	0.9
Use average properties to calculate layered stresses	
Improve consolidation accuracy	
Ignore negative effective stresses in settlement calculations	

Stage Settings

Stage #	Name	Time [days]
1	Stage 1	0
2	80%	12
3	90%	20
4	95%	30
5	1 yr	365
6	10 yr	3650

Results

Time taken to compute: 0.383515 seconds

Stage: Stage 1 = 0 d

Data Type	Minimum	Maximum
Total Settlement [in]	0	2.58456
Total Consolidation Settlement [in]	0	0
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	2.58456
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	1.73073	5.30382
Loading Stress XX [ksf]	1.78391	4.15802
Loading Stress YY [ksf]	0.796094	3.26732
Effective Stress ZZ [ksf]	0	2.79
Effective Stress XX [ksf]	2.82077	4.99604
Effective Stress YY [ksf]	0.825174	4.13451
Total Stress ZZ [ksf]	2.65206	7.92574
Total Stress XX [ksf]	5.53978	10.1318
Total Stress YY [ksf]	3.47724	9.27025
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	0	0.0169152
Pore Water Pressure [ksf]	2.65206	5.3596
Excess Pore Water Pressure [ksf]	1.73073	5.30382
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	0.8903	16
Over-consolidation Ratio	1	2777.78
Void Ratio	0	0.65
Permeability [ft/d]	0	0.166996
Coefficient of Consolidation [ft^2/d]	0	1.5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	-5.55112e-17	0

Stage: 80% = 12 d

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.47298
Total Consolidation Settlement [in]	0	5.88842
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	5.88842
Immediate Settlement [in]	0	2.58456
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	1.73073	5.30382
Loading Stress XX [ksf]	1.78391	4.15802
Loading Stress YY [ksf]	0.796094	3.26732
Effective Stress ZZ [ksf]	1.89735	5.31613
Effective Stress XX [ksf]	4.16235	9.46184
Effective Stress YY [ksf]	2.69345	8.57114
Total Stress ZZ [ksf]	2.65206	7.92574
Total Stress XX [ksf]	5.53978	10.1318
Total Stress YY [ksf]	3.47724	9.27025
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	0.00342118	0.0700708
Pore Water Pressure [ksf]	0	3.65656
Excess Pore Water Pressure [ksf]	0	2.11131
Degree of Consolidation [%]	0	99.2255
Pre-consolidation Stress [ksf]	3.3542	16
Over-consolidation Ratio	1	8.31913
Void Ratio	0	0.644355
Permeability [ft/d]	0	0.166996
Coefficient of Consolidation [ft^2/d]	0	1.5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	69.678
Undrained Shear Strength	0	0.419676

Stage: 90% = 20 d

Data Type	Minimum	Maximum
Total Settlement [in]	0	9.05471
Total Consolidation Settlement [in]	0	6.47015
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	6.47015
Immediate Settlement [in]	0	2.58456
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	1.73073	5.30382
Loading Stress XX [ksf]	1.78391	4.15802
Loading Stress YY [ksf]	0.796094	3.26732
Effective Stress ZZ [ksf]	2.53105	5.3275
Effective Stress XX [ksf]	4.64841	9.46184
Effective Stress YY [ksf]	3.32714	8.57114
Total Stress ZZ [ksf]	2.65206	7.92574
Total Stress XX [ksf]	5.53978	10.1318
Total Stress YY [ksf]	3.47724	9.27025
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	0.00525314	0.0700721
Pore Water Pressure [ksf]	0	3.12
Excess Pore Water Pressure [ksf]	0	1.21291
Degree of Consolidation [%]	0	99.4778
Pre-consolidation Stress [ksf]	3.3542	16
Over-consolidation Ratio	1	6.29656
Void Ratio	0	0.641332
Permeability [ft/d]	0	0.166996
Coefficient of Consolidation [ft^2/d]	0	1.5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	85.7368
Undrained Shear Strength	0	0.419676

Stage: 95% = 30 d

Data Type	Minimum	Maximum
Total Settlement [in]	0	9.3843
Total Consolidation Settlement [in]	0	6.79974
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	6.79974
Immediate Settlement [in]	0	2.58456
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	1.73073	5.30382
Loading Stress XX [ksf]	1.78391	4.15802
Loading Stress YY [ksf]	0.796094	3.26732
Effective Stress ZZ [ksf]	2.65206	5.34428
Effective Stress XX [ksf]	5.03543	9.46184
Effective Stress YY [ksf]	3.47724	8.57114
Total Stress ZZ [ksf]	2.65206	7.92574
Total Stress XX [ksf]	5.53978	10.1318
Total Stress YY [ksf]	3.47724	9.27025
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	0.00637332	0.0700728
Pore Water Pressure [ksf]	0	3.12
Excess Pore Water Pressure [ksf]	0	0.721128
Degree of Consolidation [%]	0	99.6874
Pre-consolidation Stress [ksf]	3.3542	16
Over-consolidation Ratio	1	6.02024
Void Ratio	0	0.639484
Permeability [ft/d]	0	0.166996
Coefficient of Consolidation [ft^2/d]	0	1.5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	94.4041
Undrained Shear Strength	0	0.419676

Stage: 1 yr = 365 d

Data Type	Minimum	Maximum
Total Settlement [in]	0	9.70702
Total Consolidation Settlement [in]	0	7.12246
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	7.12246
Immediate Settlement [in]	0	2.58456
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	1.73073	5.30382
Loading Stress XX [ksf]	1.78391	4.15802
Loading Stress YY [ksf]	0.796094	3.26732
Effective Stress ZZ [ksf]	2.65206	5.3548
Effective Stress XX [ksf]	5.41008	9.46184
Effective Stress YY [ksf]	3.47724	8.57114
Total Stress ZZ [ksf]	2.65206	7.92574
Total Stress XX [ksf]	5.53978	10.1318
Total Stress YY [ksf]	3.47724	9.27025
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	0.00671511	0.0700732
Pore Water Pressure [ksf]	0	3.12
Excess Pore Water Pressure [ksf]	0	1.71761e-08
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	3.3542	16
Over-consolidation Ratio	1	6.01996
Void Ratio	0	0.638947
Permeability [ft/d]	0	0.166996
Coefficient of Consolidation [ft^2/d]	0	1.5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.419676

Stage: 10 yr = 3650 d

Data Type	Minimum	Maximum
Total Settlement [in]	0	9.70702
Total Consolidation Settlement [in]	0	7.12246
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	7.12246
Immediate Settlement [in]	0	2.58456
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	1.73073	5.30382
Loading Stress XX [ksf]	1.78391	4.15802
Loading Stress YY [ksf]	0.796094	3.26732
Effective Stress ZZ [ksf]	2.65206	5.3548
Effective Stress XX [ksf]	5.41008	9.46184
Effective Stress YY [ksf]	3.47724	8.57114
Total Stress ZZ [ksf]	2.65206	7.92574
Total Stress XX [ksf]	5.53978	10.1318
Total Stress YY [ksf]	3.47724	9.27025
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	0.00671511	0.0700732
Pore Water Pressure [ksf]	0	3.12
Excess Pore Water Pressure [ksf]	-1.16611e-17	1.29102e-17
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	3.3542	16
Over-consolidation Ratio	1	6.01996
Void Ratio	0	0.638947
Permeability [ft/d]	0	0.166996
Coefficient of Consolidation [ft^2/d]	0	1.5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.419676

Embankments

<h4>Notes: </h4>
<p>
Embankment Unit Weights Utilized: 0.136 kips/ft3
</p>

1. Embankment: "Embankment Load 1"

Label	Embankment Load 1
Center Line	(-7.10543e-15, 66) to (0, 400)
Near End Angle	90 degrees
Far End Angle	90 degrees
Number of Zones	5
Number of Sections	1

Zone	Name	Unit Weight (kips/ft3)
1	New Zone	0.115
2	New Zone 2	0.115
3	New Zone 3	0.115
4	New Zone 4	0.13
5	New Zone 5	0.136

2. Embankment: "Embankment Load 2"

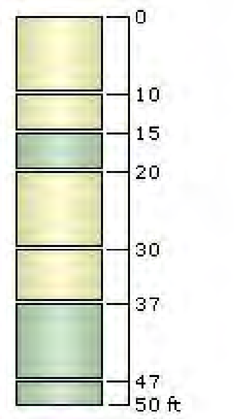
Label	Embankment Load 2
Center Line	(0, 131.899) to (0, 400)
Near End Angle	26.6 degrees
Far End Angle	90 degrees
Number of Zones	5
Number of Sections	2

Zone	Name	Unit Weight (kips/ft3)
1	New Zone	0.115
2	New Zone 2	0.115
3	New Zone 3	0.115
4	New Zone 4	0.136
5	New Zone 5	0.136

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	Silty Clay	10	0	No
2	Silty Clay	5	10	Yes
3	Sand and Gravel	5	15	Yes
4	Silty Clay	10	20	No
5	Silty Clay	7	30	Yes
6	Sand and Gravel	10	37	Yes
7	Sand and Gravel	3	47	Yes



Soil Properties

Property	Silty Clay	Sand and Gravel
Color	🟨	🟩
Unit Weight [kips/ft3]	0.12	0.115
Saturated Unit Weight [kips/ft3]	0.12	0.115
K0	1	1
Immediate Settlement	Disabled	Enabled
Es [ksf]	-	208.9
Esur [ksf]	-	208.9
Primary Consolidation	Enabled	Disabled
Material Type	Non-Linear	
Cc	0.18	-
Cr	0.039	-
e0	0.65	-
Pc [ksf]	16	-
Cv [ft2/d]	1.5	-
Cvr [ft2/d]	1.5	-
B-bar	1	-
Undrained Su A [kips/ft2]	0	0
Undrained Su S	0.2	0.2
Undrained Su m	0.8	0.8
Piezo Line ID	1	1

Groundwater

Groundwater method	Piezometric Lines
Water Unit Weight	0.0624 kips/ft3

Piezometric Line Entities

ID	Depth (ft)
1	0 ft

Time Points

Point #	(X,Y) Location	Depth	Goal Type	Goal	Time Until Goal
1	0, 71.5	0 ft	Degree of Consolidation	95%	28.603 d
2	0, 71.5	0 ft	Degree of Consolidation	90%	18.8889 d
3	0, 71.5	0 ft	Degree of Consolidation	80%	10.4246 d
4	0, 71.5	0 ft	Degree of Consolidation	99.9%	96.3214 d
5	-7.10543e-15, 66	0 ft	Degree of Consolidation	80%	11.1194 d
6	0, 66	0 ft	Degree of Consolidation	90%	19.872 d
7	-7.10543e-15, 66	0 ft	Degree of Consolidation	95%	29.7906 d
8	0, 66	0 ft	Degree of Consolidation	99.9%	97.9726 d

<h4>Notes: </h4>
<p>
Time points 1-4 at Pile Location. Time points 5-8 at Wall Face.
</p>

Appendix F

MSE Wall Analysis

MSEW Earth Pressure Equations

$$K_a = \tan^2(45 - \phi / 2) \qquad (15)$$

$$K_a = \cos\beta \; \frac{\cos\beta - \sqrt{\cos^2\beta - \cos^2\phi}}{\cos\beta + \sqrt{\cos^2\beta - \cos^2\phi}} \qquad (16)$$

$$K_a = \frac{\sin^2(\theta + \phi)}{\sin^2\theta \;\; \sin(\theta - \delta) \left(1 + \sqrt{\frac{\sin(\phi + \delta)\,\sin(\phi - \beta)}{\sin(\theta - \delta)\,\sin(\theta + \beta)}}\right)^2} \qquad (17)$$

$$K = \frac{\sin^2(\theta + \phi')}{\sin^3\theta \left[1 + \frac{\sin\phi'}{\sin\theta}\right]^2} \qquad (38)$$

Table 6 Analyses

AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Fwd Abutment - Short Term (Undrained) - Temporary

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....-Fwd-ST-b16 temp.BEN

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft^3
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft^3
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	120.0 lb/ft^3
Equivalent internal angle of friction, $\phi_{equiv.}$	0.0 °
Equivalent cohesion, $c_{equiv.}$	4000.0 lb/ft^2

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 5.14 $N\gamma = 0.00$

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 38.24 [ft] { Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 35.24 ft }

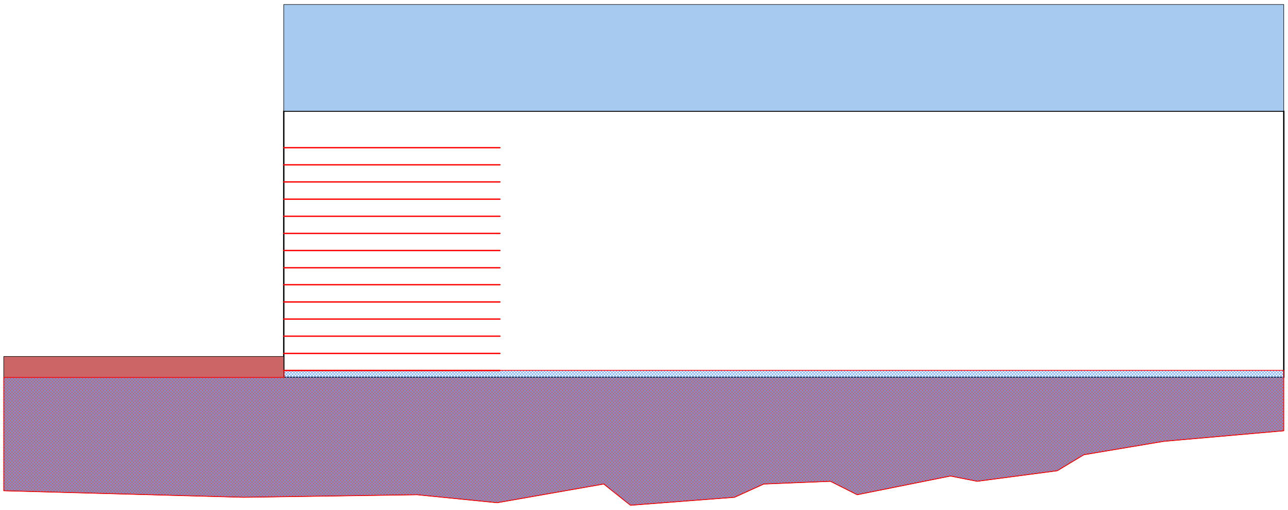
Batter, ω 0.0 [deg]
Backslope, β 0.0 [deg]
Backslope rise 0.0 [ft] Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

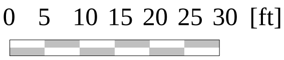
🟦 Uniformly distributed dead load is 0.0 [lb/ft ^{2}], and live load is 250.0 [lb/ft ^{2}]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 1.61, factored bearing load = 8326 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.913, Eccentricity, e/L = 0.1531, CDR-overturning = 3.27

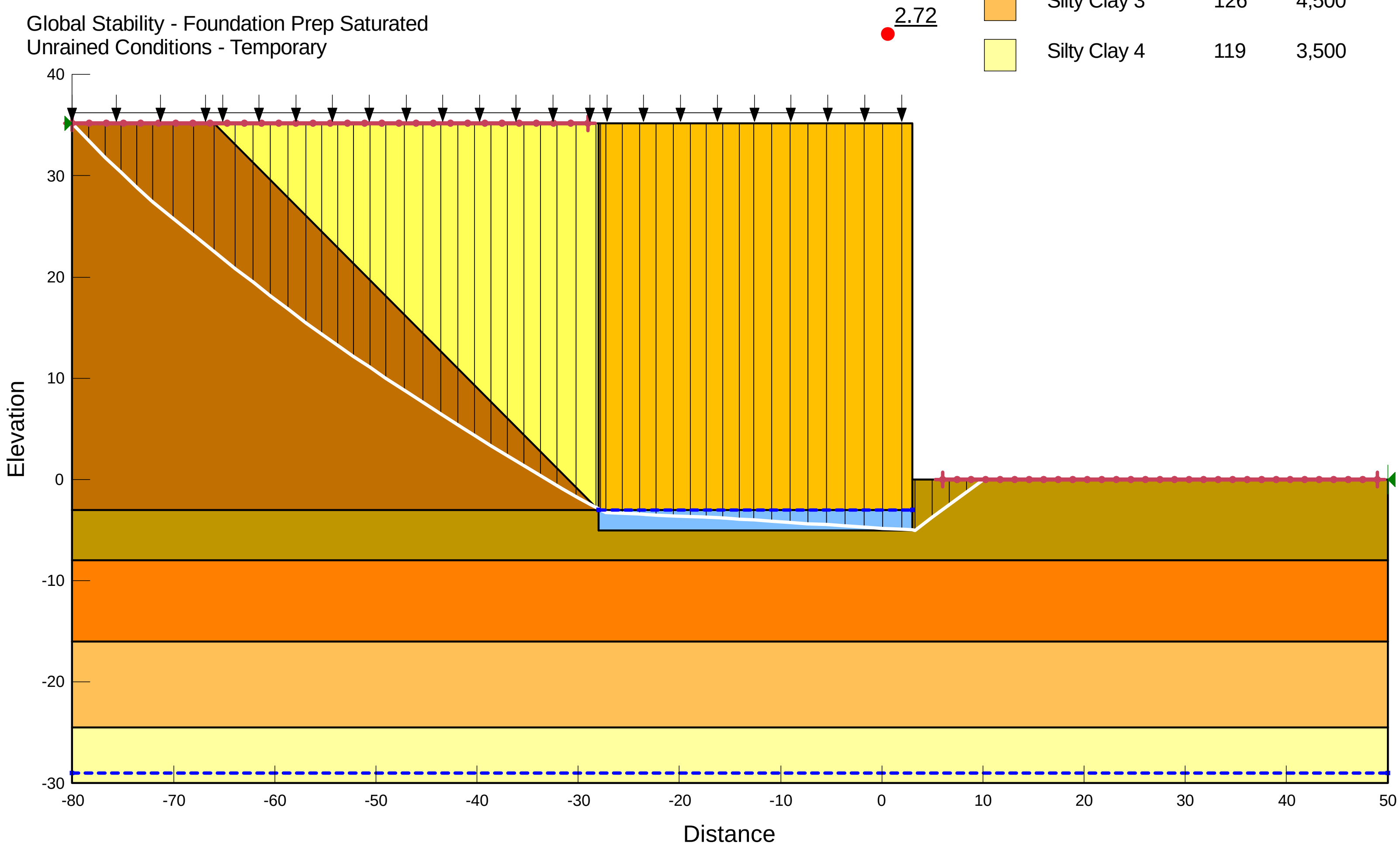
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	31.00	1								
2	3.44	31.00	1								
3	5.91	31.00	1								
4	8.37	31.00	1								
5	10.83	31.00	1								
6	13.29	31.00	1								
7	15.75	31.00	1								
8	18.21	31.00	1								
9	20.67	31.00	1								
10	23.13	31.00	1								
11	25.59	31.00	1								
12	28.05	31.00	1								
13	30.51	31.00	1								
14	32.97	31.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment
MSE Wall Stability Analysis
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟫	Embankment Fill	125	250	26
🟦	Foundation Prep	130	0	34
🟧	MSE Fill	120	3,000	34
🟨	Retained Fill	120	0	30
🟫	Silty Clay 1	122	4,000	0
🟧	Silty Clay 2	127	6,500	0
🟧	Silty Clay 3	126	4,500	0
🟨	Silty Clay 4	119	3,500	0

Global Stability - Foundation Prep Saturated
Unrained Conditions - Temporary



AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Wing Wall - Short Term (Undrained) - Temporary

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....WING-ST-b16 temp.BEN

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	0.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	4000.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 4.17 $N\gamma$= 0.00

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 35.70 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 31.70 ft }

Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

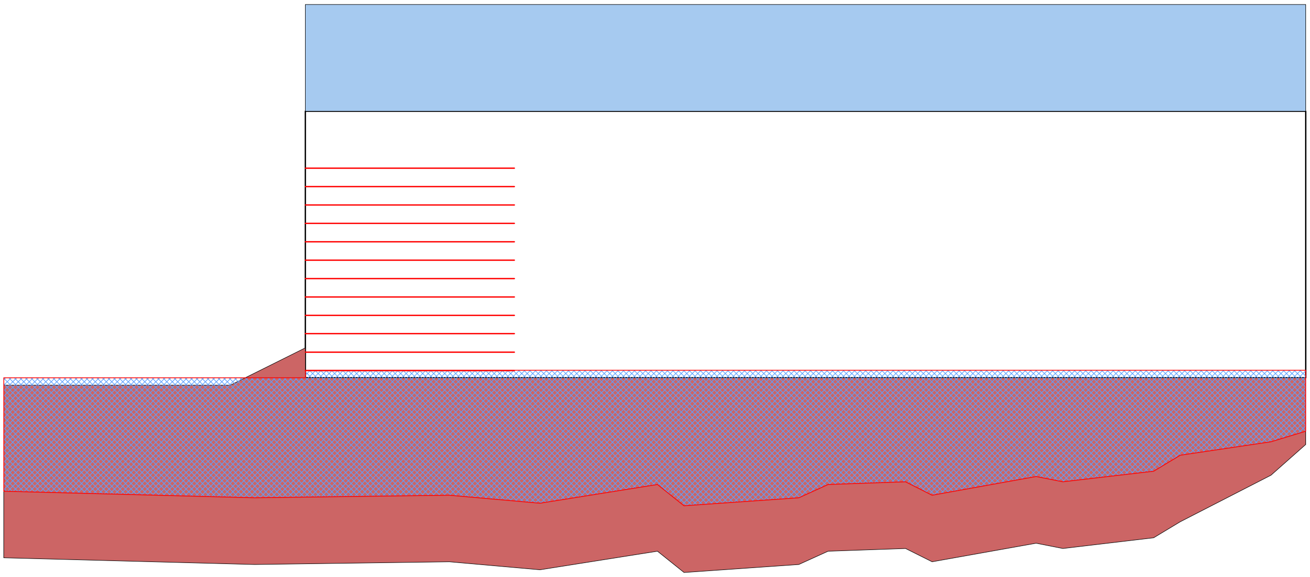
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 5 10 15 20 25 30 [ft]

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 1.36, factored bearing load = 7967 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.834, Eccentricity, e/L = 0.1656, CDR-overturning = 3.02

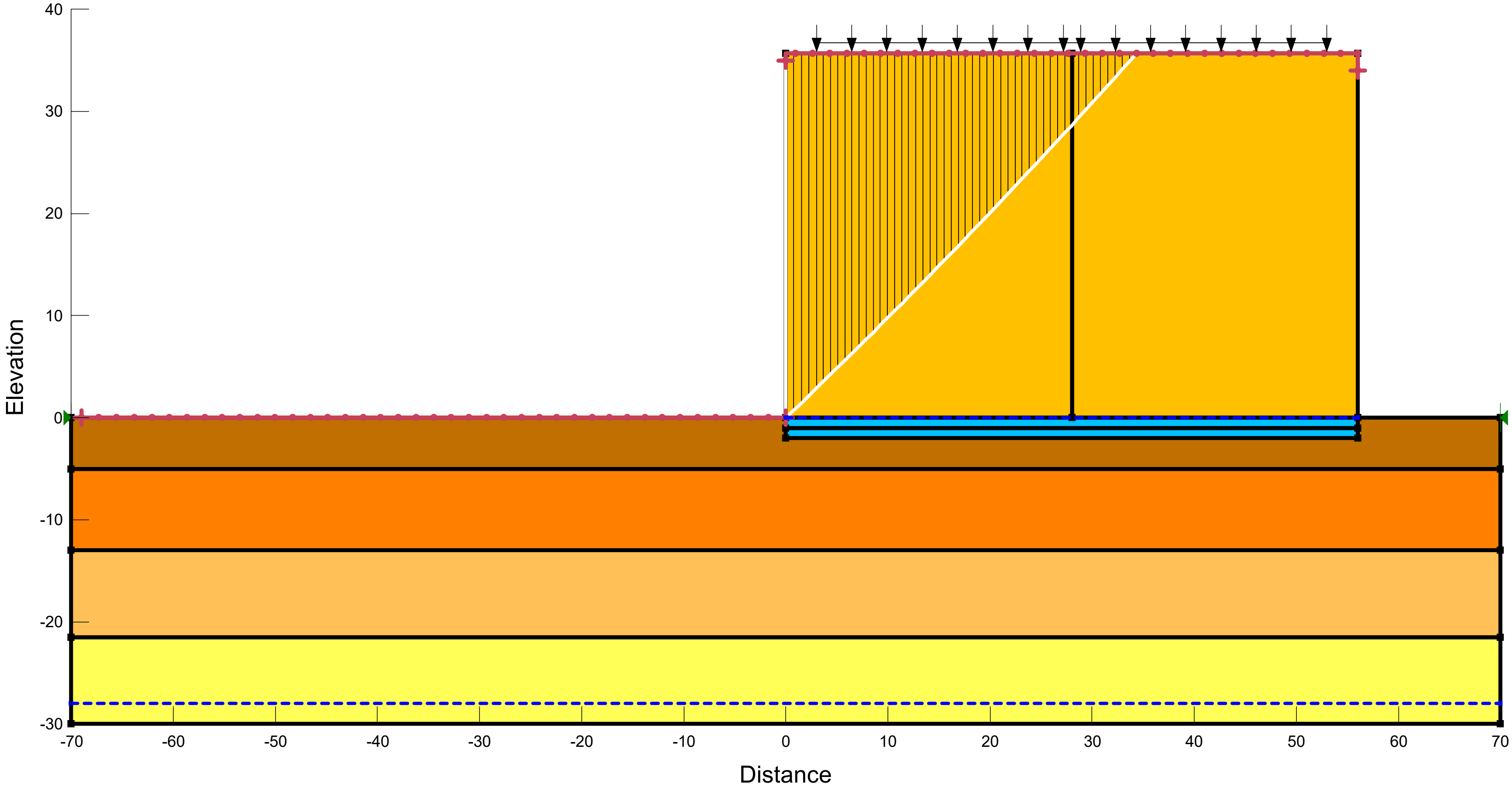
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	28.00	1								
2	3.44	28.00	1								
3	5.91	28.00	1								
4	8.37	28.00	1								
5	10.83	28.00	1								
6	13.29	28.00	1								
7	15.75	28.00	1								
8	18.21	28.00	1								
9	20.67	28.00	1								
10	23.13	28.00	1								
11	25.59	28.00	1								
12	28.05	28.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment - Wing Wall
MSE Wall Stability Analysis
Lawrence Co., OH

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟨	MSE Fill	120	2,000	34
🟫	Silty Clay 1	122	4,000	0
🟧	Silty Clay 2	127	6,500	0
🟧	Silty Clay 3	127	4,500	0
🟨	Silty Clay 4	119	3,500	0

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Undrained - Temporary ● 2.33



AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment
MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Rear Abutment - Short Term (Undrained) - Temporary

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....REAR-ST-b16 temp.BEN
Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	0.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	2400.0 lb/ft ²

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 5.14 N γ= 0.00

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	39.90	[ft]	{ Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 36.90 ft }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

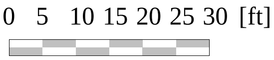
🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:

SCALE:

0 5 10 15 20 25 30 [ft]



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8567 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.477, Eccentricity, e/L = 0.1460, CDR-overturning = 3.42

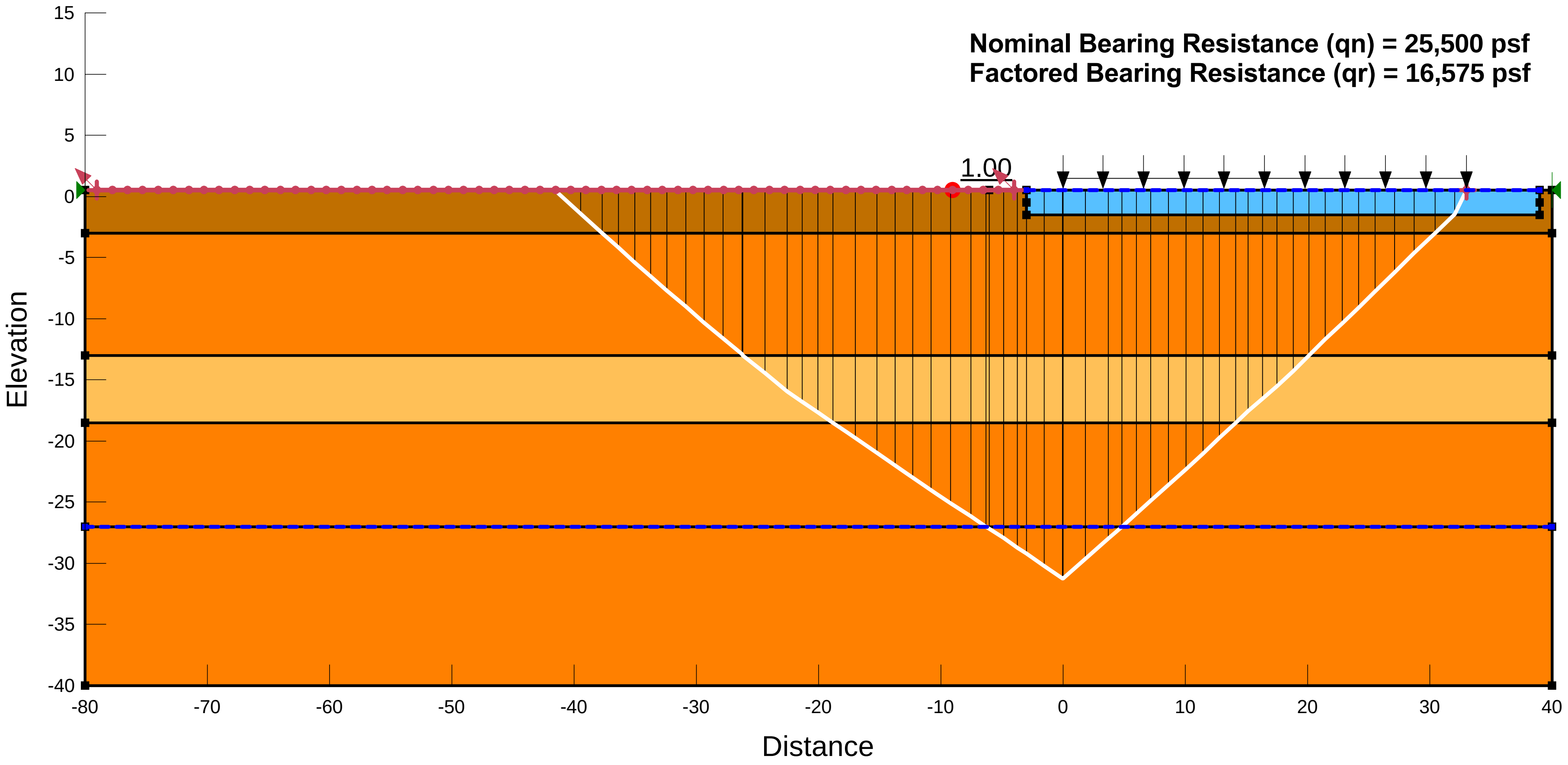
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	33.00	1								
2	3.44	33.00	1								
3	5.91	33.00	1								
4	8.37	33.00	1								
5	10.83	33.00	1								
6	13.29	33.00	1								
7	15.75	33.00	1								
8	18.21	33.00	1								
9	20.67	33.00	1								
10	23.13	33.00	1								
11	25.59	33.00	1								
12	28.05	33.00	1								
13	30.51	33.00	1								
14	32.97	33.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temp Facing
Undrained Conditions

Color	**Name**	**Unit Weight (pcf)**	**Cohesion' (psf)**	**Phi' (°)**
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	2,400	0
🟧	Silty Clay 2	122	6,000	0
🟨	Silty Clay 3	126	7,500	0

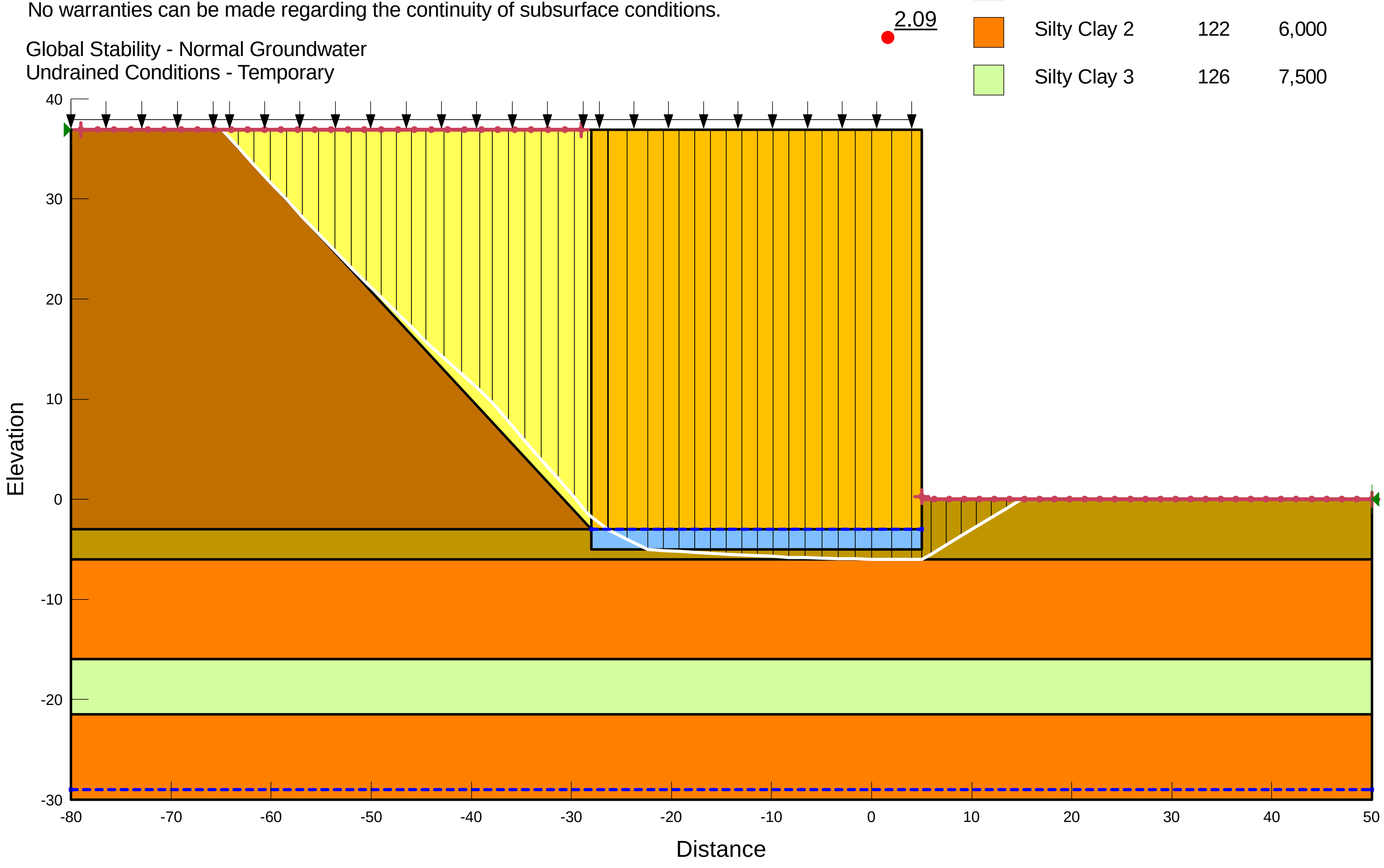

Nominal Bearing Resistance (qn) = 25,500 psf
Factored Bearing Resistance (qr) = 16,575 psf

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment
MSE Wall Stability Analysis
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Normal Groundwater
Undrained Conditions - Temporary

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟫	Embankment Fill	125	2,500	0
🟦	Foundation Prep	130	0	34
🟧	MSE Fill	120	3,000	34
🟨	Retained Fill	120	0	30
🟫	Silty Clay 1	119	2,400	0
🟧	Silty Clay 2	122	6,000	0
🟩	Silty Clay 3	126	7,500	0



AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment

MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Wing Wall - Short Term (Undrained) - Temporary

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....WING-ST-b16 temp.BEN

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	0.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	2400.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 4.11 $N\gamma$= 0.00

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	37.40	[ft]	{ Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 33.40 ft }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

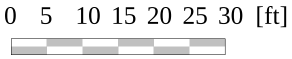
UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:

SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8554 lb/ft^2.

Foundation Interface: Direct sliding, CDR = 1.416, Eccentricity, e/L = 0.1802, CDR-overturning = 2.78

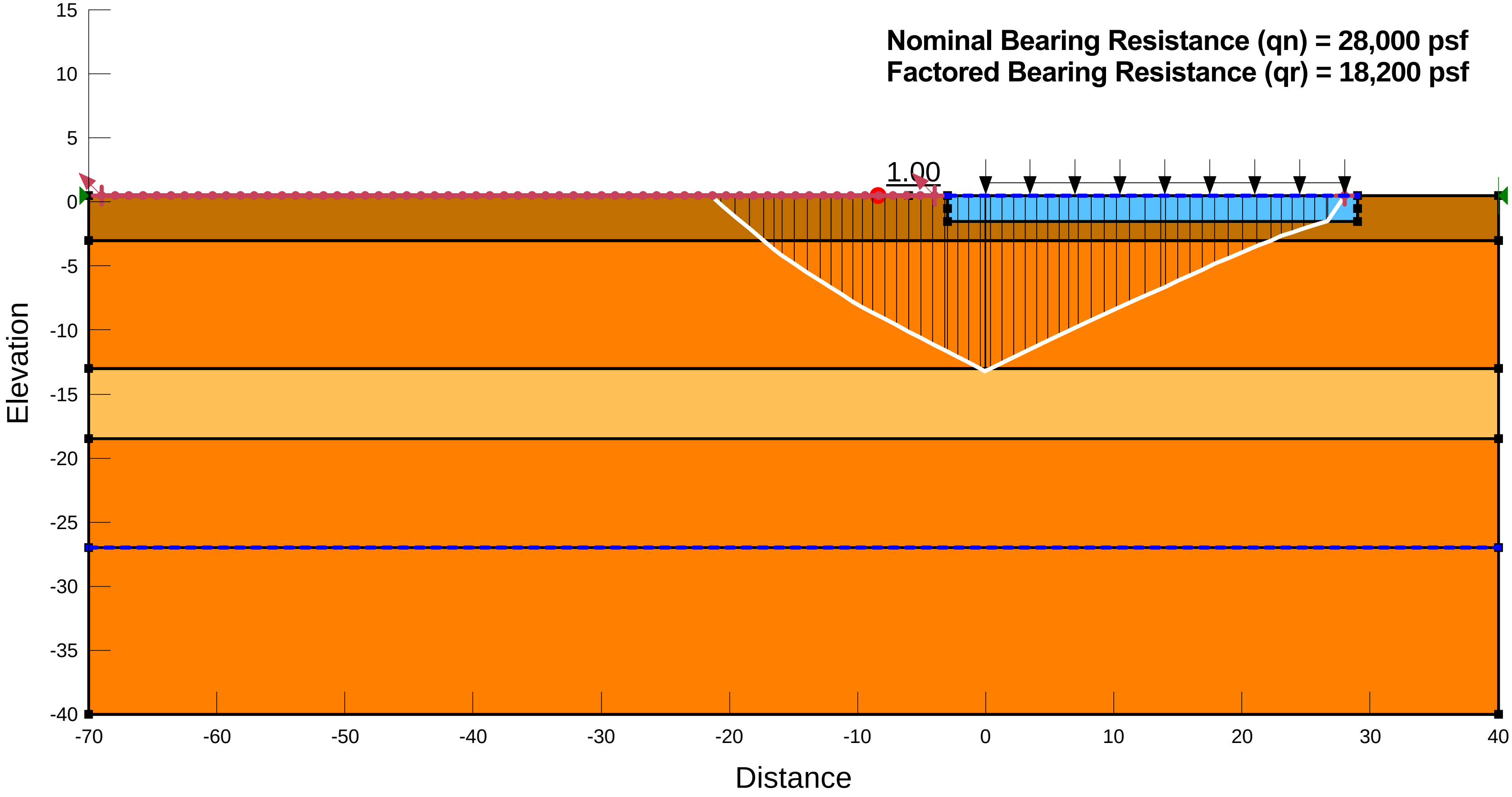
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	28.00	1								
2	3.44	28.00	1								
3	5.91	28.00	1								
4	8.37	28.00	1								
5	10.83	28.00	1								
6	13.29	28.00	1								
7	15.75	28.00	1								
8	18.21	28.00	1								
9	20.67	28.00	1								
10	23.13	28.00	1								
11	25.59	28.00	1								
12	28.05	28.00	1								
13	30.51	28.00	1								
14	32.97	28.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	2,400	0
🟧	Silty Clay 2	122	6,000	0
🟨	Silty Clay 3	126	7,500	0

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temporary Facing
Undrained Conditions


Nominal Bearing Resistance (qn) = 28,000 psf
Factored Bearing Resistance (qr) = 18,200 psf

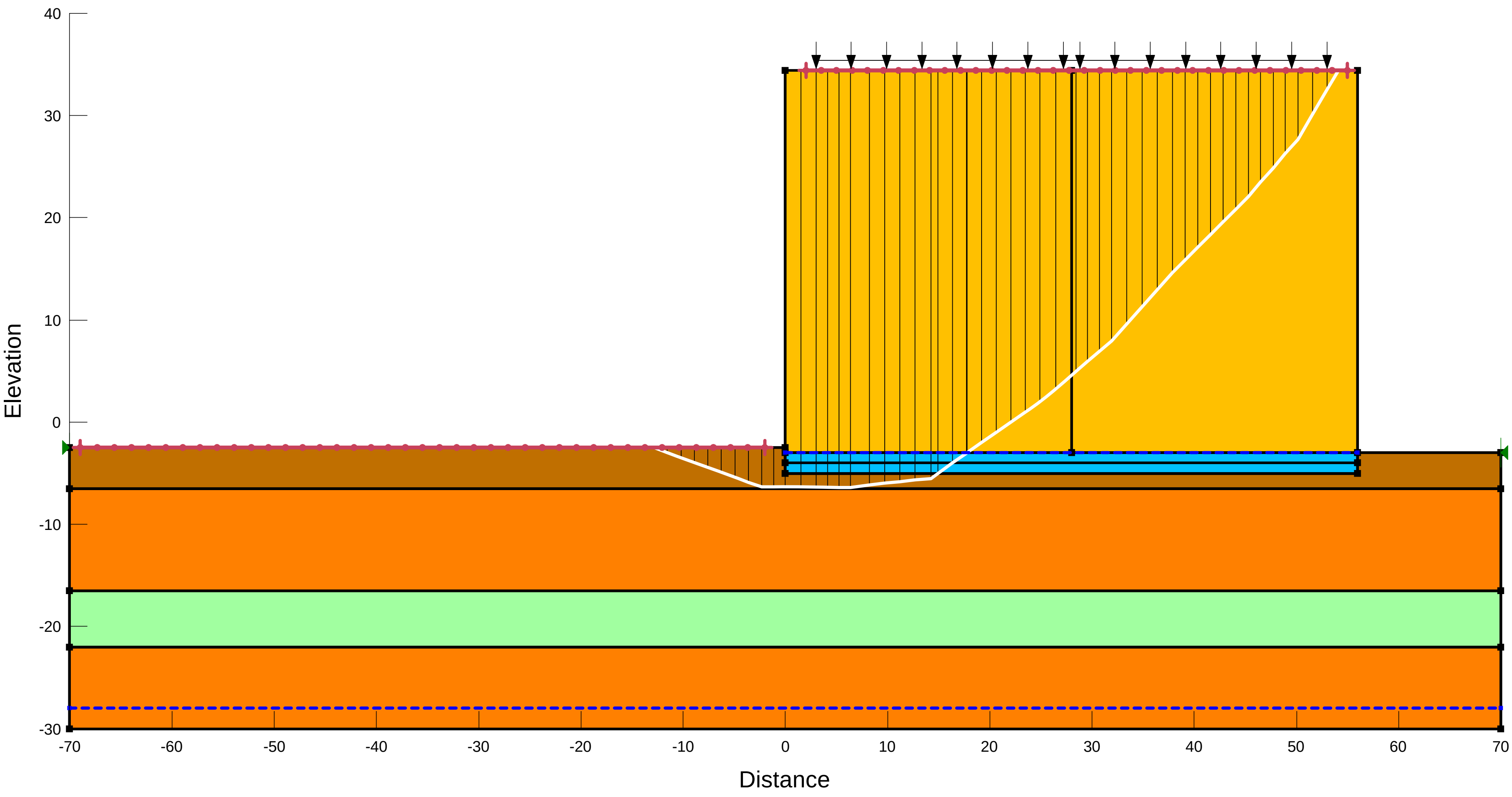
Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment - Wing Wall
MSE Wall Stability Analysis
Lawrence Co., OH

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟨	MSE Fill	120	2,000	34
🟫	Silty Clay 1	119	2,400	0
🟧	Silty Clay 2	122	6,000	0
🟩	Silty Clay 3	126	7,500	0

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Undrained - Temporary

● 2.81



AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Fwd Abutment - Short Term (Undrained) - Temporary - Top of Foundation Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....temp top of prep.BEN

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	34.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	0.0 lb/ft ²

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 42.16 $N\gamma = 41.06$

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

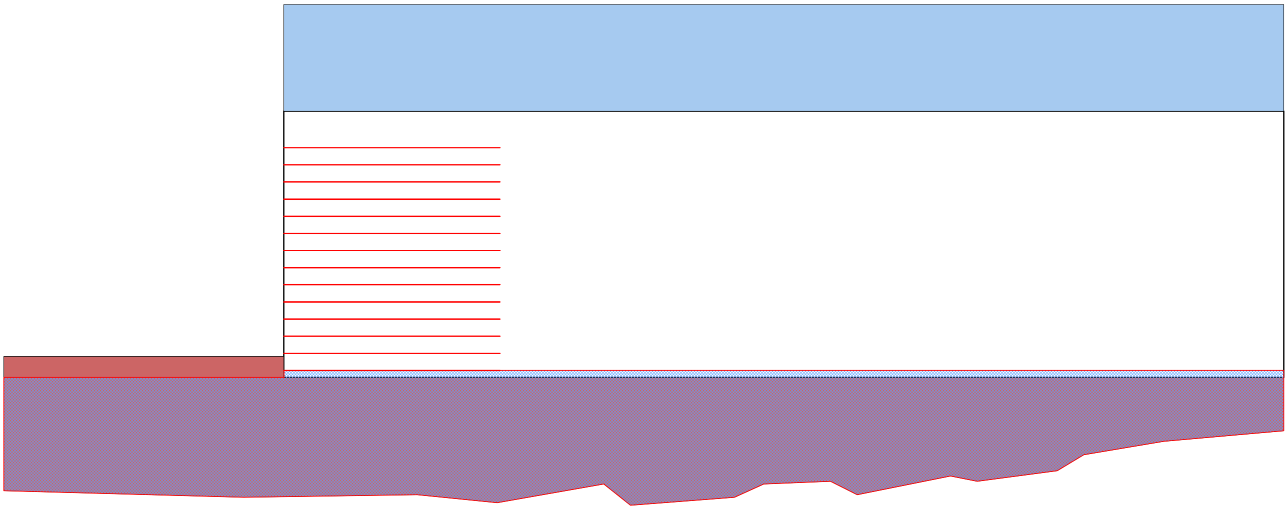
Design height, Hd	38.24	[ft]	{ Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 35.24 ft }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ^{2}], and live load is 250.0 [lb/ft ^{2}]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 5 10 15 20 25 30 [ft]

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 2.26, factored bearing load = 8326 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.913, Eccentricity, e/L = 0.1531, CDR-overturning = 3.27

METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	31.00	1								
2	3.44	31.00	1								
3	5.91	31.00	1								
4	8.37	31.00	1								
5	10.83	31.00	1								
6	13.29	31.00	1								
7	15.75	31.00	1								
8	18.21	31.00	1								
9	20.67	31.00	1								
10	23.13	31.00	1								
11	25.59	31.00	1								
12	28.05	31.00	1								
13	30.51	31.00	1								
14	32.97	31.00	1								

AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Fwd Abutment - Short Term (Undrained) - Temporary - Bottom of Foundation Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1..... .....temp bot of prep.BEN
Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	0.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	4000.0 lb/ft ²

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 5.14 N γ= 0.00

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

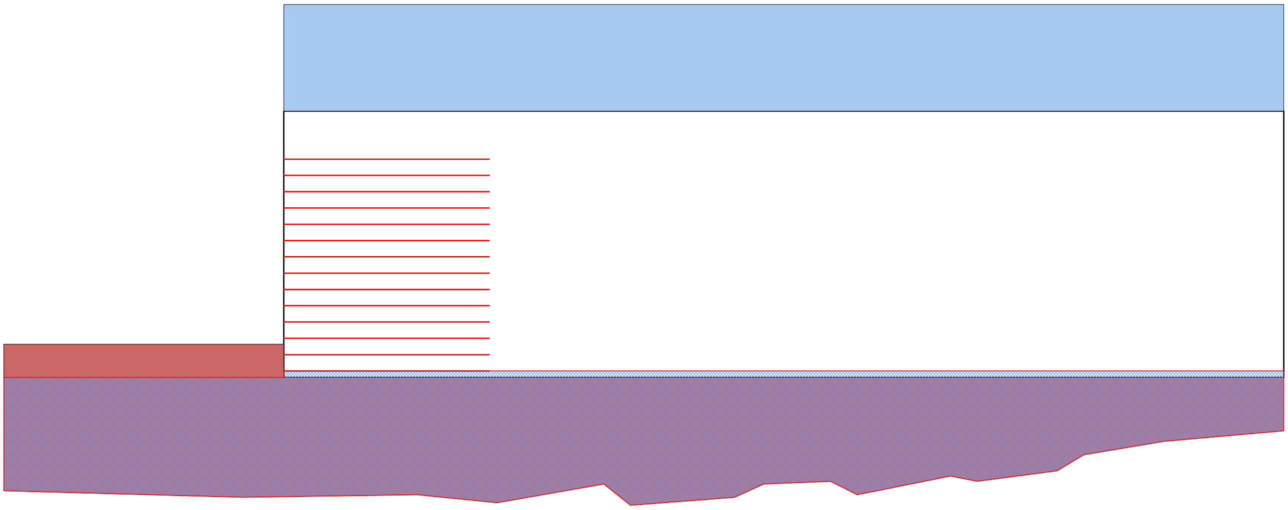
Design height, Hd	40.24	[ft]	{ Embedded depth is E = 5.00 ft, and height above top of finished bottom grade is H = 35.24 ft }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

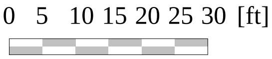
🟦 Uniformly distributed dead load is 0.0 [lb/ft ^{2}], and live load is 250.0 [lb/ft ^{2}]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 1.49, factored bearing load = 8981 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.829, Eccentricity, e/L = 0.1680, CDR-overturning = 2.98

METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	31.00									
2	3.44	31.00									
3	5.91	31.00									
4	8.37	31.00									
5	10.83	31.00									
6	13.29	31.00									
7	15.75	31.00									
8	18.21	31.00									
9	20.67	31.00									
10	23.13	31.00									
11	25.59	31.00									
12	28.05	31.00									
13	30.51	31.00									
14	32.97	31.00									

AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment

MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Rear Abutment - Short Term (Undrained) - Temporary - Top of Foundation Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1..... .....temp top of prep.BEN

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	130.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	34.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	0.0 lb/ft ²

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 42.16 $N\gamma$= 41.06

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	39.90	[ft]	{ Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 36.90 ft }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

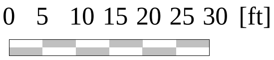
UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ^{2}], and live load is 250.0 [lb/ft ^{2}]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:

SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 2.77, factored bearing load = 8567 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.962, Eccentricity, e/L = 0.1460, CDR-overturning = 3.42

METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	33.00	1								
2	3.44	33.00	1								
3	5.91	33.00	1								
4	8.37	33.00	1								
5	10.83	33.00	1								
6	13.29	33.00	1								
7	15.75	33.00	1								
8	18.21	33.00	1								
9	20.67	33.00	1								
10	23.13	33.00	1								
11	25.59	33.00	1								
12	28.05	33.00	1								
13	30.51	33.00	1								
14	32.97	33.00	1								

AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment

MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Rear Abutment - Short Term (Undrained) - Temporary -
Bottom of Foundation Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....temp bot of prep.BEN

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	0.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	2400.0 lb/ft ²

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 5.14 $N\gamma = 0.00$

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

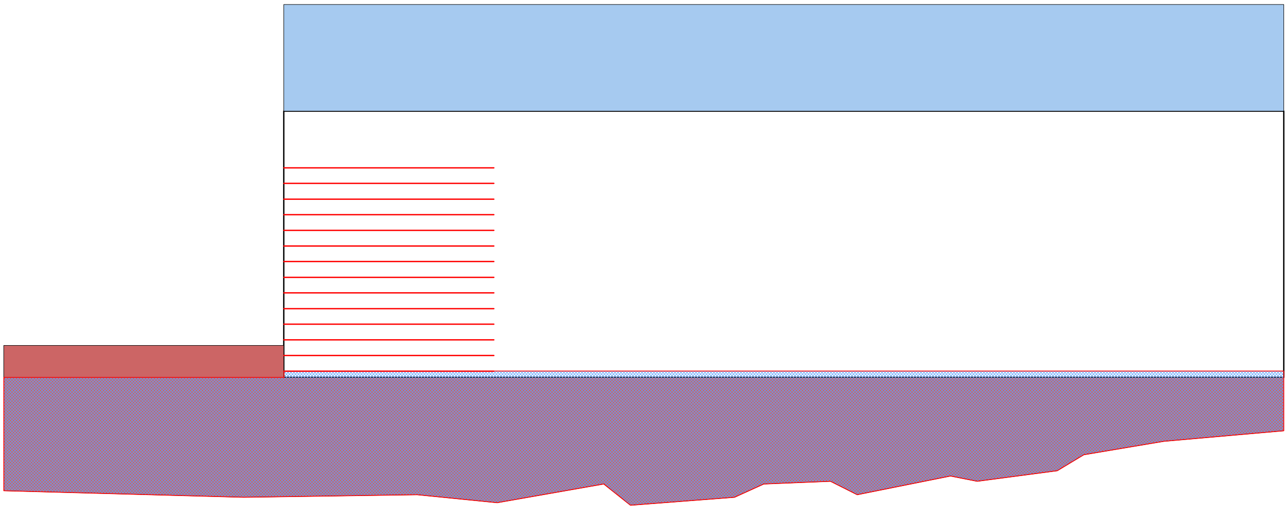
Design height, Hd	41.90	[ft]	{ Embedded depth is E = 5.00 ft, and height above top of finished bottom grade is H = 36.90 ft }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 5 10 15 20 25 30 [ft]

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis , factored bearing load = 9200 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.347, Eccentricity, e/L = 0.1597, CDR-overturning = 3.13

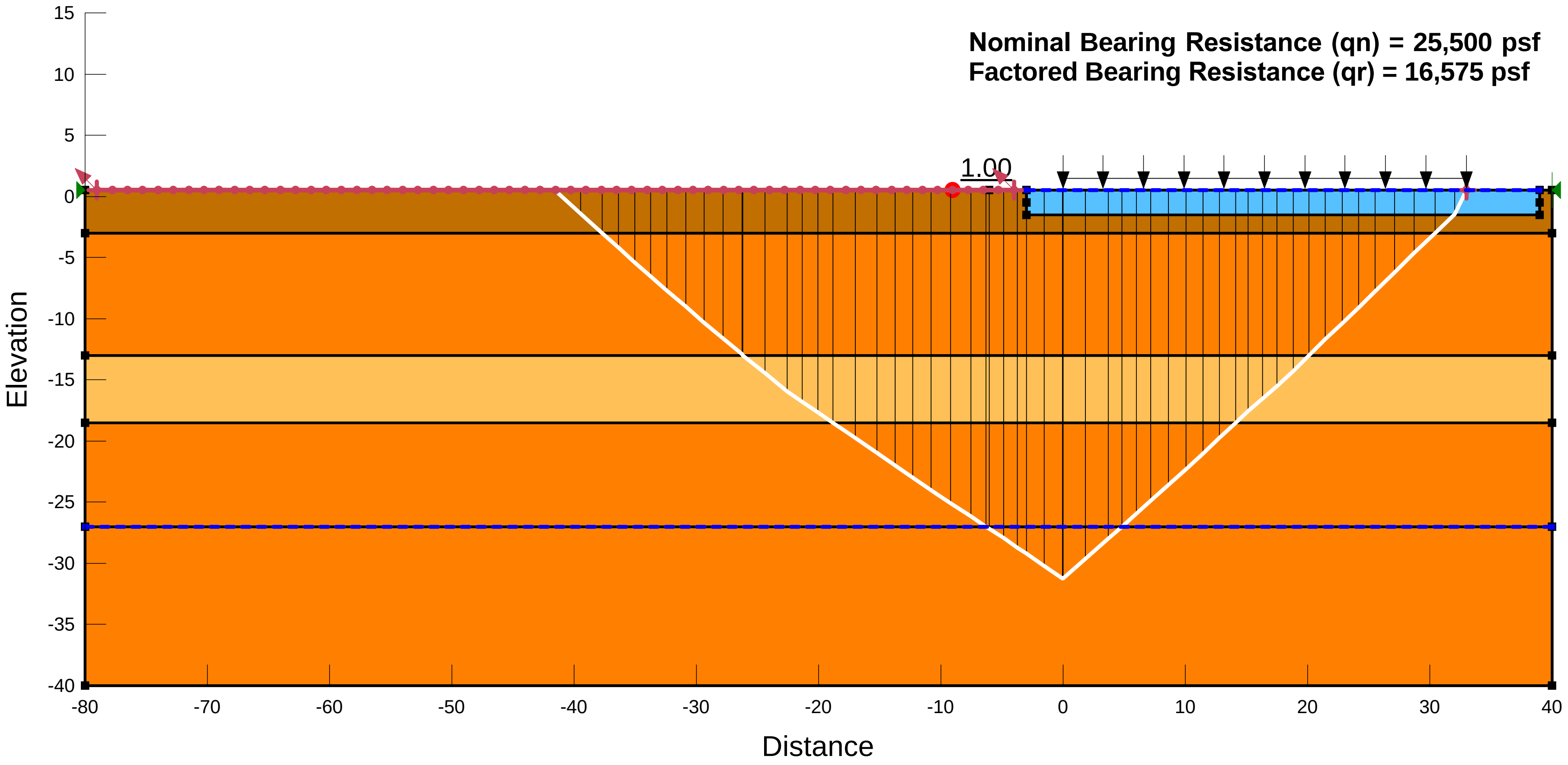
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	33.00	1								
2	3.44	33.00	1								
3	5.91	33.00	1								
4	8.37	33.00	1								
5	10.83	33.00	1								
6	13.29	33.00	1								
7	15.75	33.00	1								
8	18.21	33.00	1								
9	20.67	33.00	1								
10	23.13	33.00	1								
11	25.59	33.00	1								
12	28.05	33.00	1								
13	30.51	33.00	1								
14	32.97	33.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temp Facing
Undrained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	2,400	0
🟧	Silty Clay 2	122	6,000	0
🟨	Silty Clay 3	126	7,500	0



Nominal Bearing Resistance (qn) = 25,500 psf
Factored Bearing Resistance (qr) = 16,575 psf

AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Wing Wall - Short Term (Undrained) - Temporary - Top of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....emp top of prep.BENp

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	130.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	34.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	0.0 lb/ft ²

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 0.00 $N\gamma$= 11.49

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 35.70 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 31.70 ft }

Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

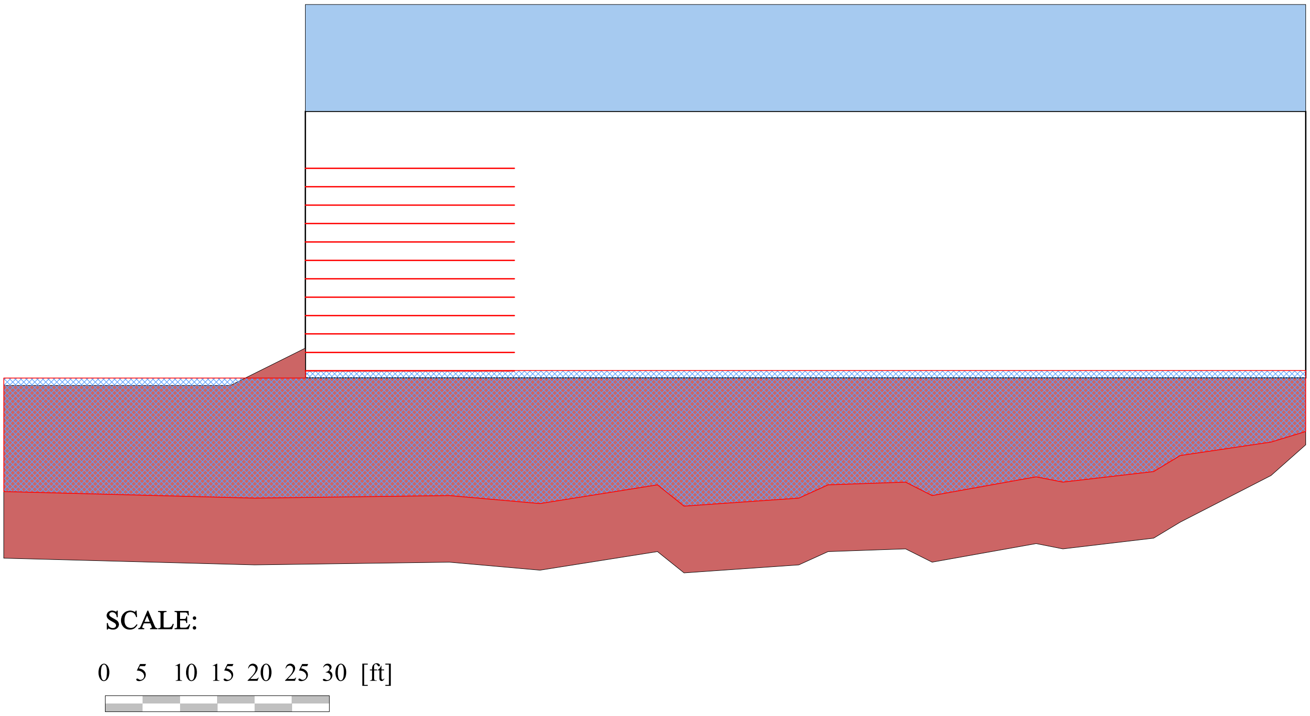
Batter, ω 0.0 [deg]
Backslope, β 0.0 [deg]
Backslope rise 0.0 [ft] Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 7967 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.834, Eccentricity, e/L = 0.1656, CDR-overturning = 3.02

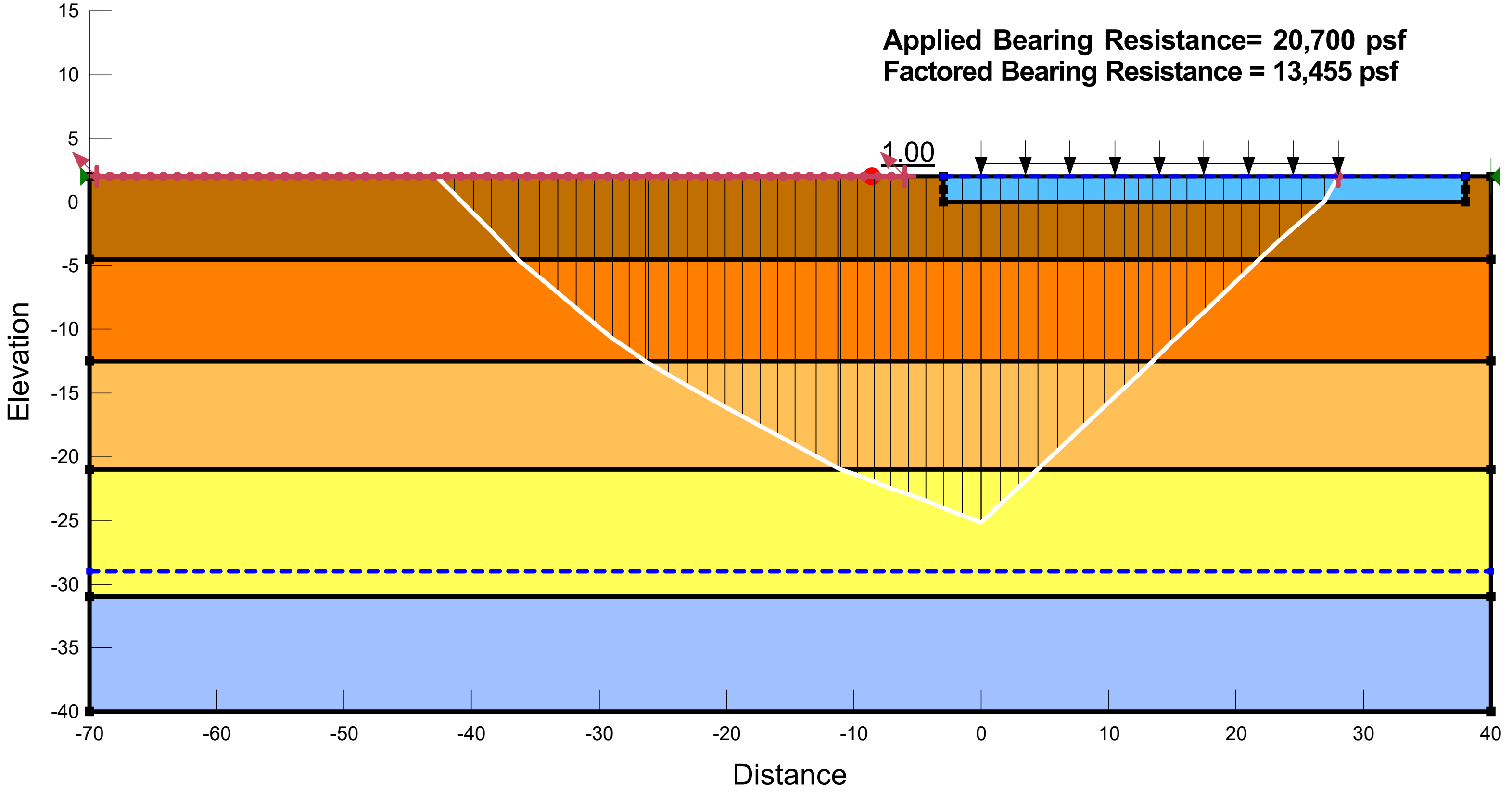
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	28.00	1								
2	3.44	28.00	1								
3	5.91	28.00	1								
4	8.37	28.00	1								
5	10.83	28.00	1								
6	13.29	28.00	1								
7	15.75	28.00	1								
8	18.21	28.00	1								
9	20.67	28.00	1								
10	23.13	28.00	1								
11	25.59	28.00	1								
12	28.05	28.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temporary Facing
Undrained Conditions

Color	**Name**	**Unit Weight (pcf)**	**Cohesion' (psf)**	**Phi' (°)**
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	122	4,000	0
🟧	Silty Clay 2	127	6,500	0
🟧	Silty Clay 3	127	4,500	0
🟨	Silty Clay 4	119	3,500	0
🟦	Silty Clay 5	120	4,000	0


Applied Bearing Resistance= 20,700 psf
Factored Bearing Resistance = 13,455 psf

AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Wing Wall - Short Term (Undrained) - Temporary - Bottom of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....emp bot of prep.BENp

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	0.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	4000.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 4.17 N γ= 0.00

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 37.70 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 33.70 ft }

Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

Batter, ω	0.0	[deg]
Backslope, β	0.0	[deg]
Backslope rise	0.0	[ft]

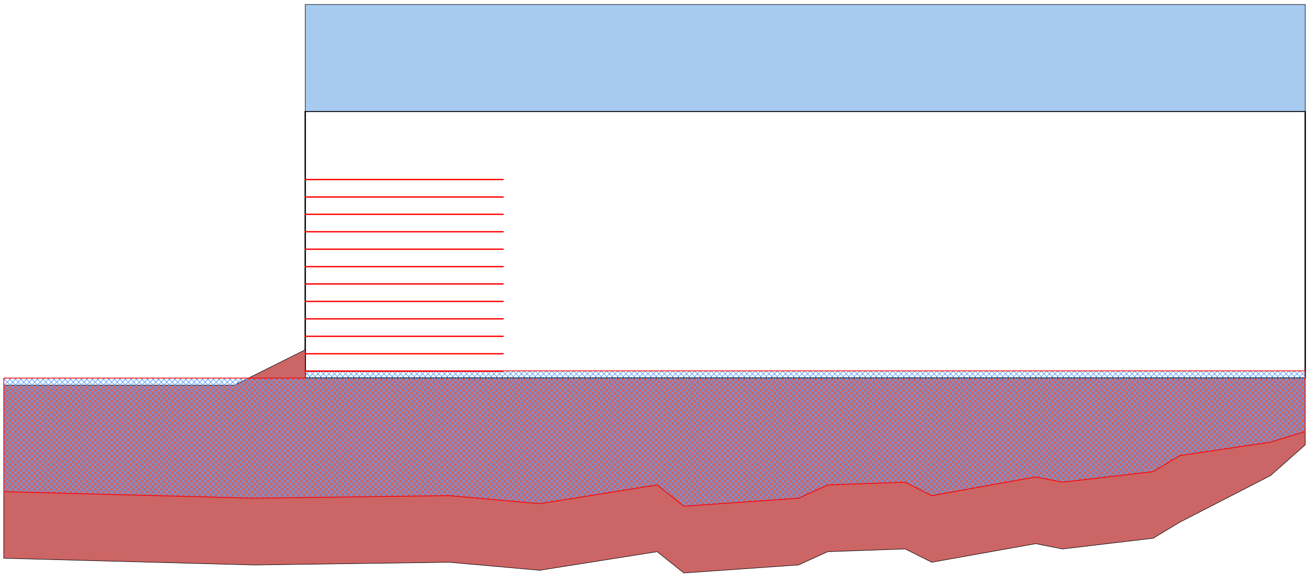
Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 5 10 15 20 25 30 [ft]

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 1.25, factored bearing load = 8662 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.749, Eccentricity, e/L = 0.1828, CDR-overturning = 2.73

METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	28.00	1								
2	3.44	28.00	1								
3	5.91	28.00	1								
4	8.37	28.00	1								
5	10.83	28.00	1								
6	13.29	28.00	1								
7	15.75	28.00	1								
8	18.21	28.00	1								
9	20.67	28.00	1								
10	23.13	28.00	1								
11	25.59	28.00	1								
12	28.05	28.00	1								

AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment
MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title: Bridge 16 - Rear Abutment
Project Number: LAW-7-0370 (PID-75923)
Client: ODOT
Designer: DRP
Station Number: 195+56.18

Description:

Bridge 16 - Wing Wall - Short Term (Undrained) - Temporary - Top of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1..... .....emp top of prep.BENp

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	130.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	34.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	0.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 0.00 $N\gamma$= 11.49

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 37.40 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 33.40 ft }

Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

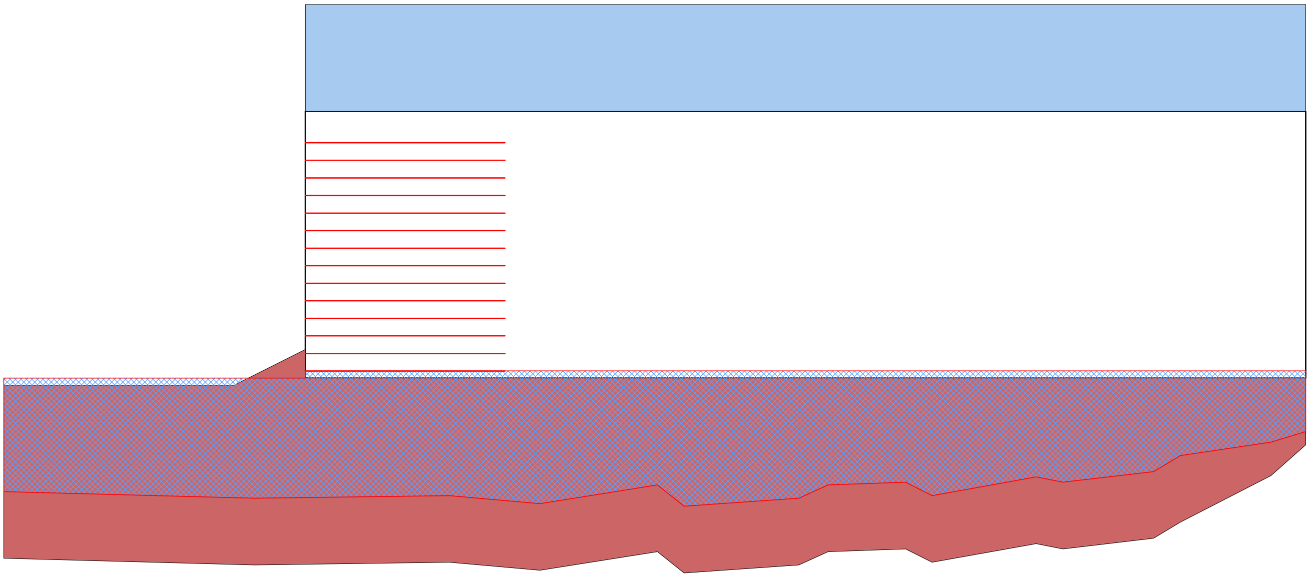
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

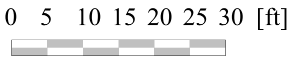
🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8554 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.762, Eccentricity, e/L = 0.1802, CDR-overturning = 2.78

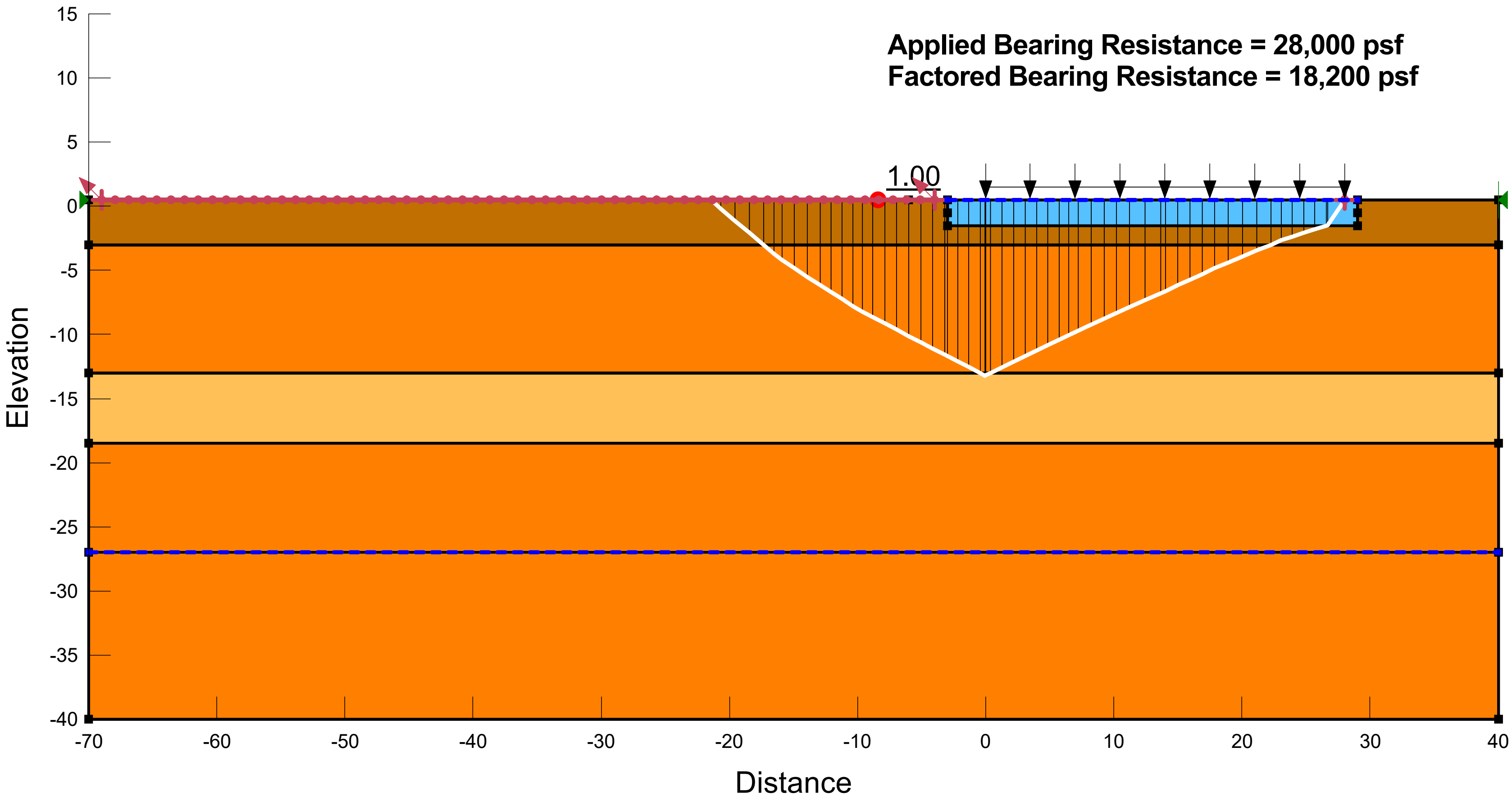
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	28.00	1								
2	3.44	28.00	1								
3	5.91	28.00	1								
4	8.37	28.00	1								
5	10.83	28.00	1								
6	13.29	28.00	1								
7	15.75	28.00	1								
8	18.21	28.00	1								
9	20.67	28.00	1								
10	23.13	28.00	1								
11	25.59	28.00	1								
12	28.05	28.00	1								
13	30.51	28.00	1								
14	32.97	28.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temporary Facing
Undrained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	2,400	0
🟧	Silty Clay 2	122	6,000	0
🟨	Silty Clay 3	126	7,500	0



Applied Bearing Resistance = 28,000 psf
Factored Bearing Resistance = 18,200 psf

AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment
MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Wing Wall - Short Term (Undrained) - Temporary - Bottom of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1..... .....emp bot of prep.BENp

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	0.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	2400.0 lb/ft ²

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 4.11 $N\gamma$= 0.00

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 39.40 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 35.40 ft }

Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

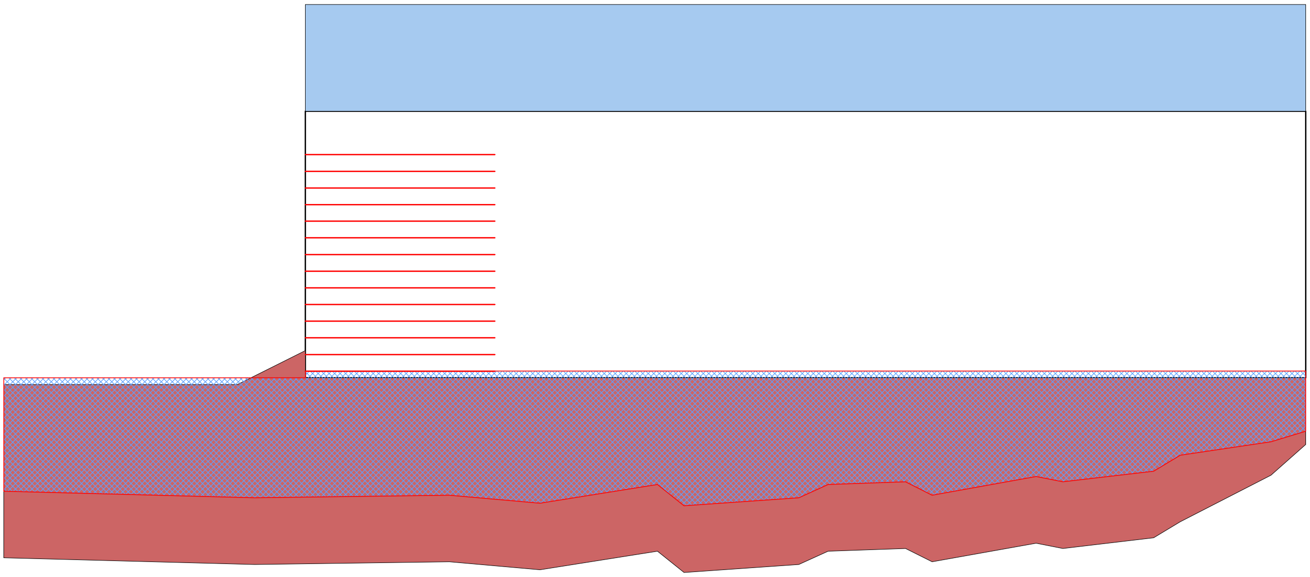
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 5 10 15 20 25 30 [ft]

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 9303 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.284, Eccentricity, e/L = 0.1982, CDR-overturning = 2.52

METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	28.00	1								
2	3.44	28.00	1								
3	5.91	28.00	1								
4	8.37	28.00	1								
5	10.83	28.00	1								
6	13.29	28.00	1								
7	15.75	28.00	1								
8	18.21	28.00	1								
9	20.67	28.00	1								
10	23.13	28.00	1								
11	25.59	28.00	1								
12	28.05	28.00	1								
13	30.51	28.00	1								
14	32.97	28.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	2,400	0
🟧	Silty Clay 2	122	6,000	0
🟨	Silty Clay 3	126	7,500	0

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temporary Facing
Undrained Conditions

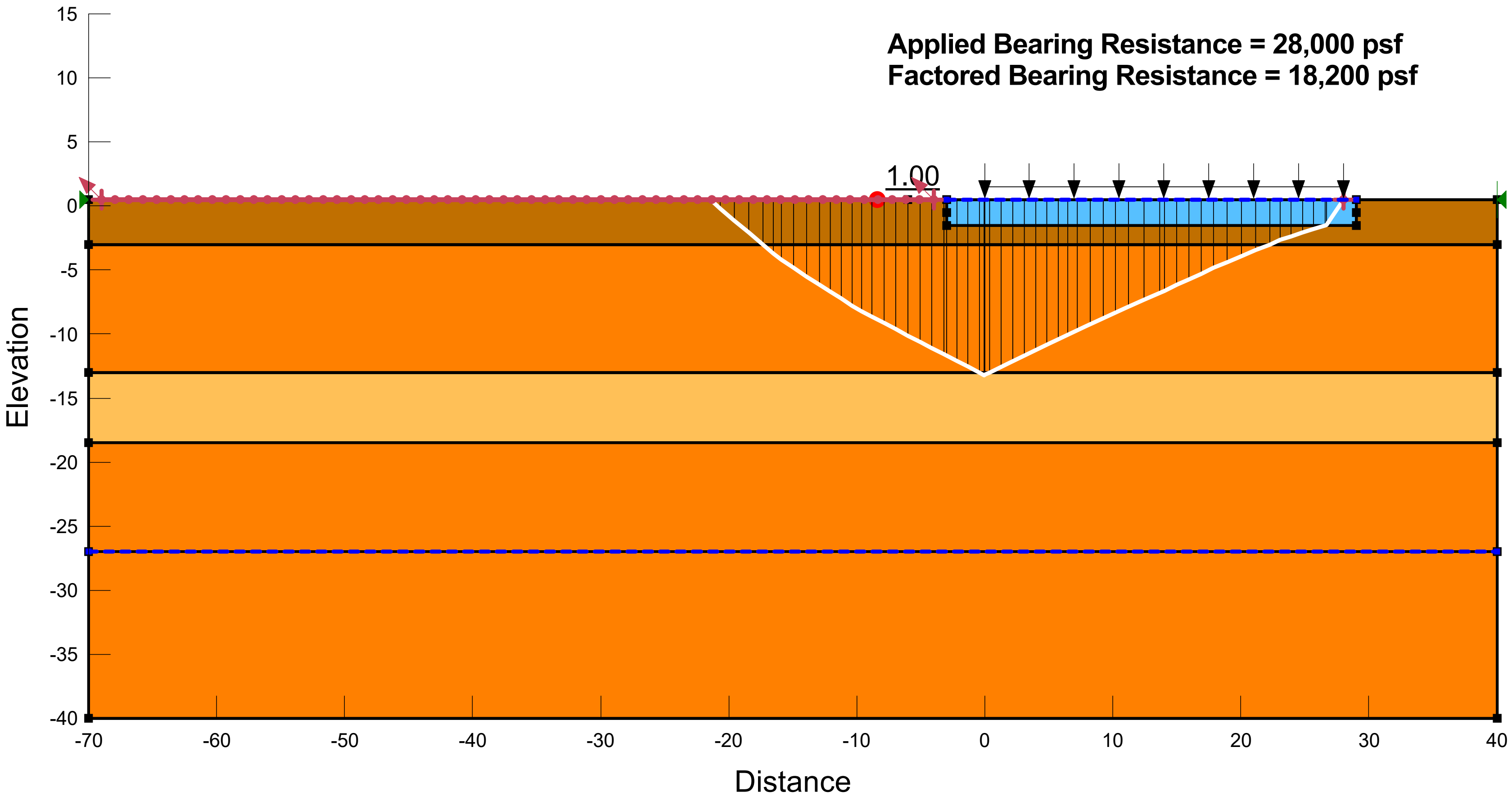

Applied Bearing Resistance = 28,000 psf
Factored Bearing Resistance = 18,200 psf

Table 7 Analyses

AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Fwd Abutment - Long Term (Drained) - Temporary

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....-Fwd-LT-b16 temp.BEN
Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	24.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft ²

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 19.32 N_γ= 9.44

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

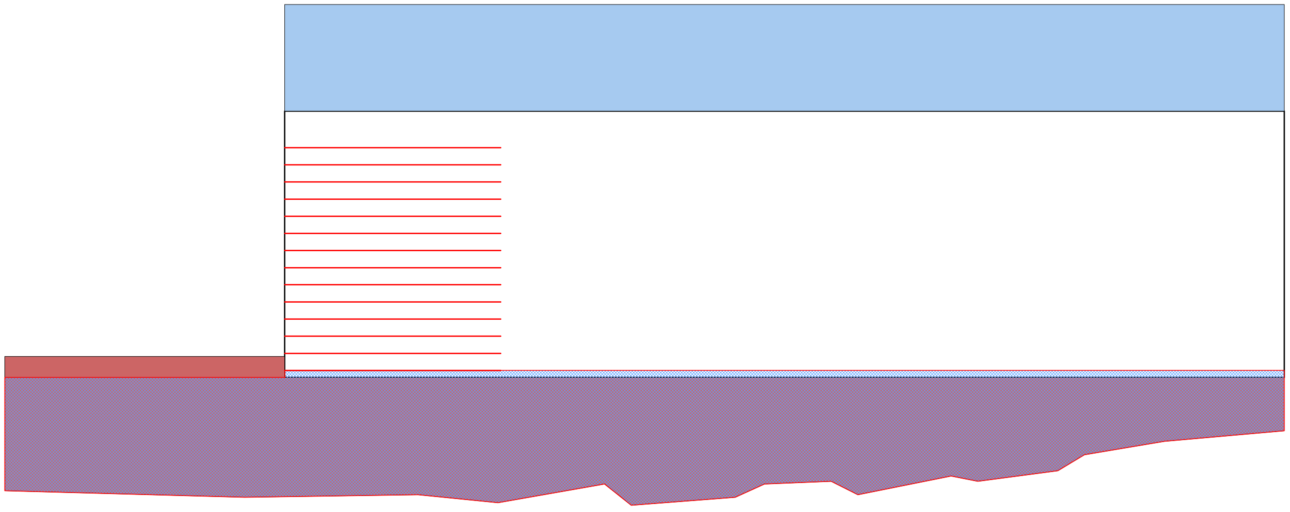
Design height, Hd	38.24	[ft]	{ Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 35.24 ft }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

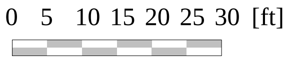
🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8326 lb/ft^2.

Foundation Interface: Direct sliding, CDR = 1.357, Eccentricity, e/L = 0.1531, CDR-overturning = 3.27

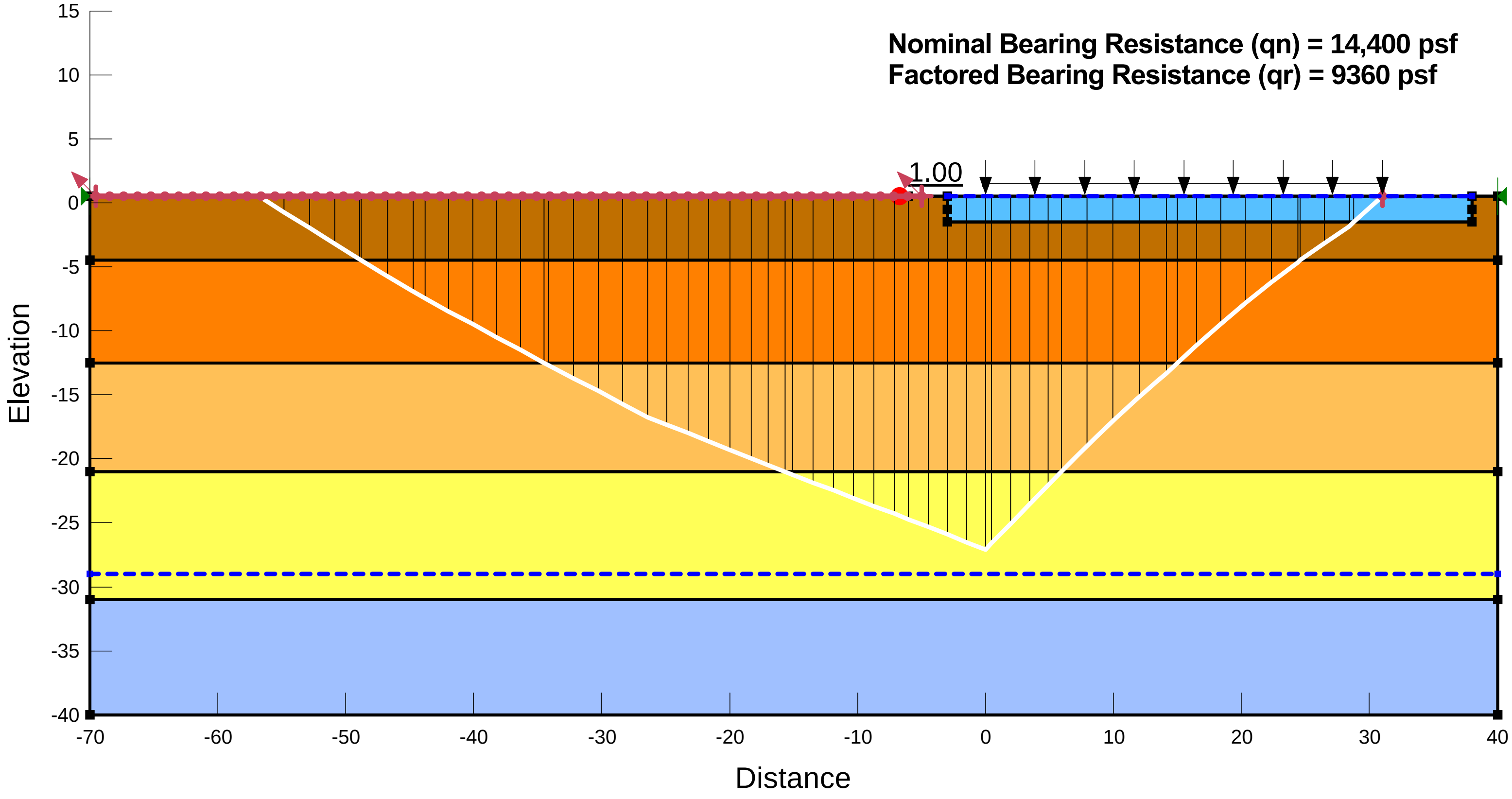
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	31.00	1								
2	3.44	31.00	1								
3	5.91	31.00	1								
4	8.37	31.00	1								
5	10.83	31.00	1								
6	13.29	31.00	1								
7	15.75	31.00	1								
8	18.21	31.00	1								
9	20.67	31.00	1								
10	23.13	31.00	1								
11	25.59	31.00	1								
12	28.05	31.00	1								
13	30.51	31.00	1								
14	32.97	31.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temporary Facing
Drained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	122	150	24
🟧	Silty Clay 2	127	175	25
🟧	Silty Clay 3	127	150	24
🟨	Silty Clay 4	119	150	23
🟦	Silty Clay 5	120	150	24



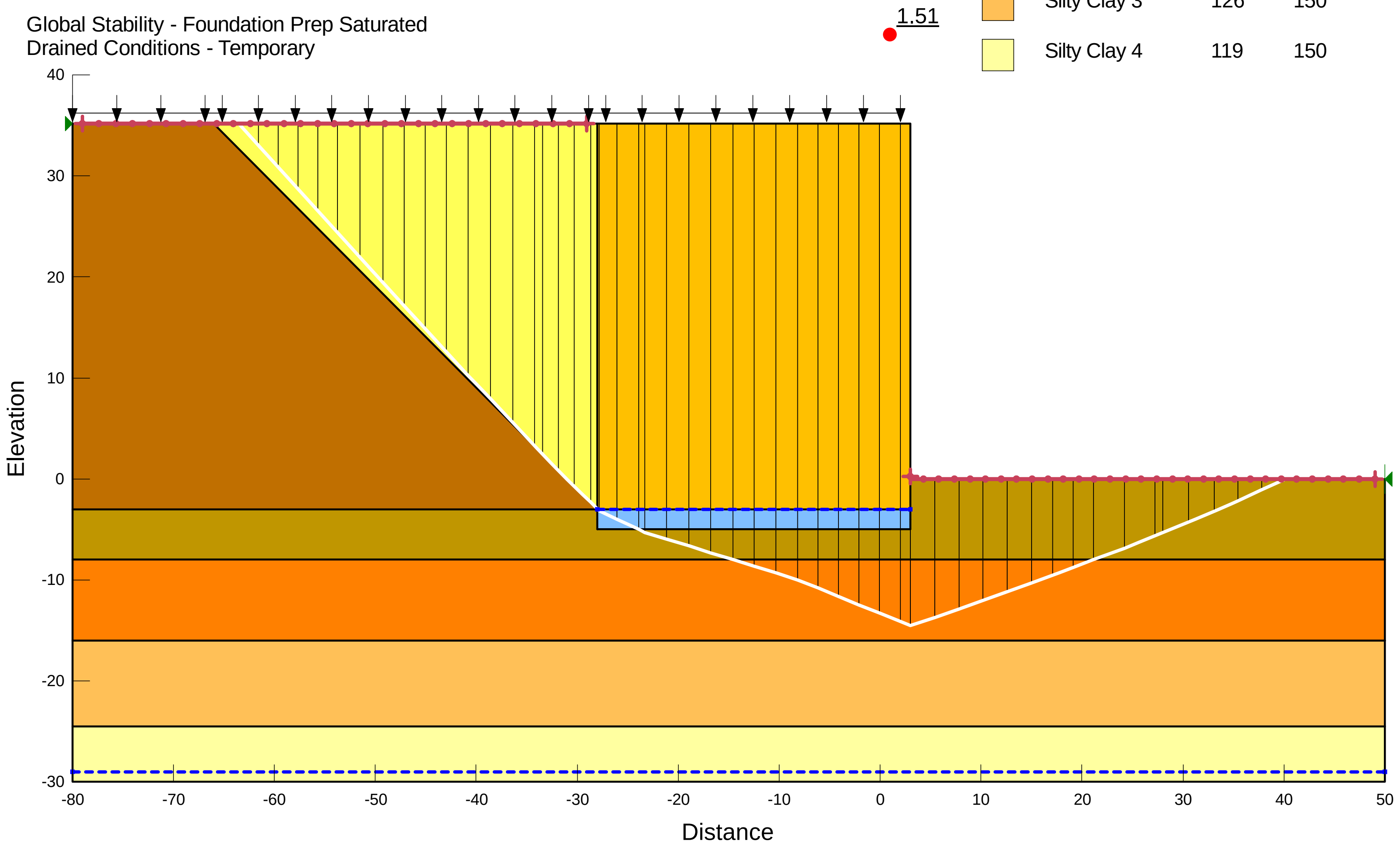
Nominal Bearing Resistance (qn) = 14,400 psf
Factored Bearing Resistance (qr) = 9360 psf

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment
MSE Wall Stability Analysis
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
■	Embankment Fill	125	250	26
■	Foundation Prep	130	0	34
■	MSE Fill	120	3,000	34
■	Retained Fill	120	0	30
■	Silty Clay 1	122	150	24
■	Silty Clay 2	127	175	25
■	Silty Clay 3	126	150	24
■	Silty Clay 4	119	150	23

Global Stability - Foundation Prep Saturated
Drained Conditions - Temporary



AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Wing Wall - Long Term (Drained) - Temporary

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....WING-LT-b16 temp.BEN

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft^3
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft^3
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft^3
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	24.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft^2

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): $N_c = 4.62$ $N_\gamma = 3.09$

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 35.70 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 31.70 ft }
Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

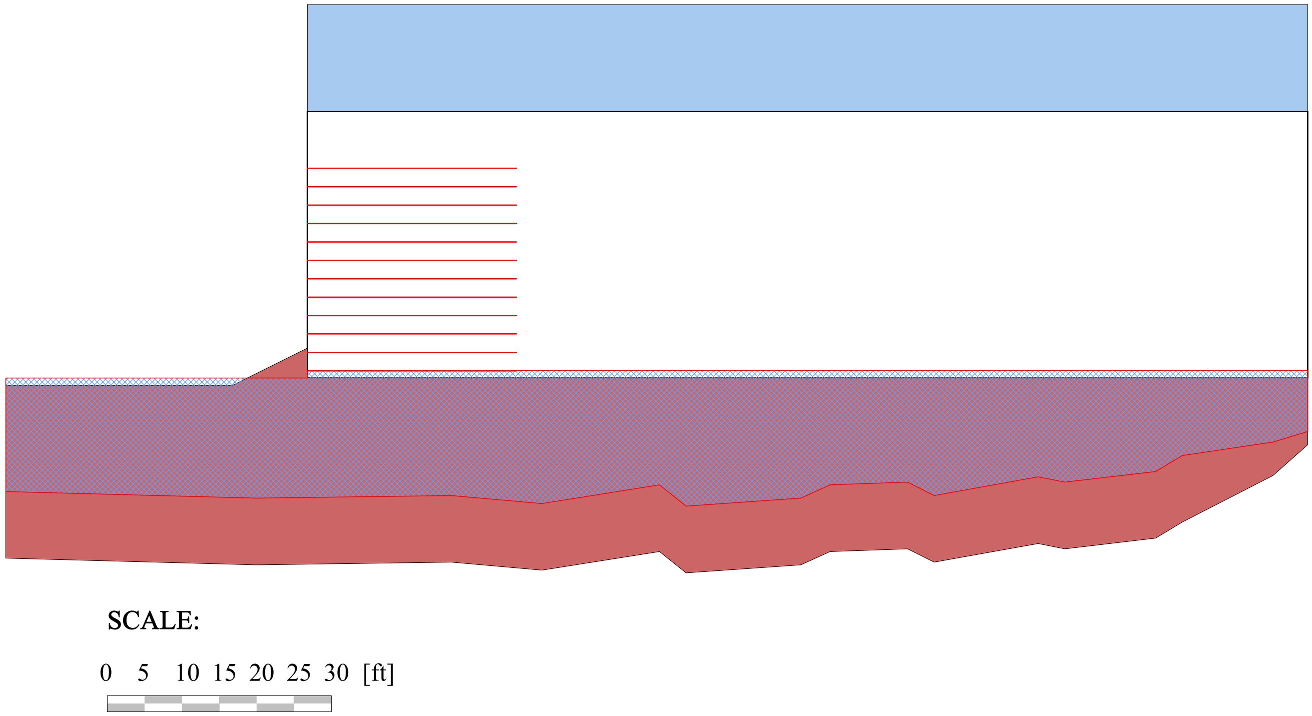
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 7967 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.307, Eccentricity, e/L = 0.1656, CDR-overturning = 3.02

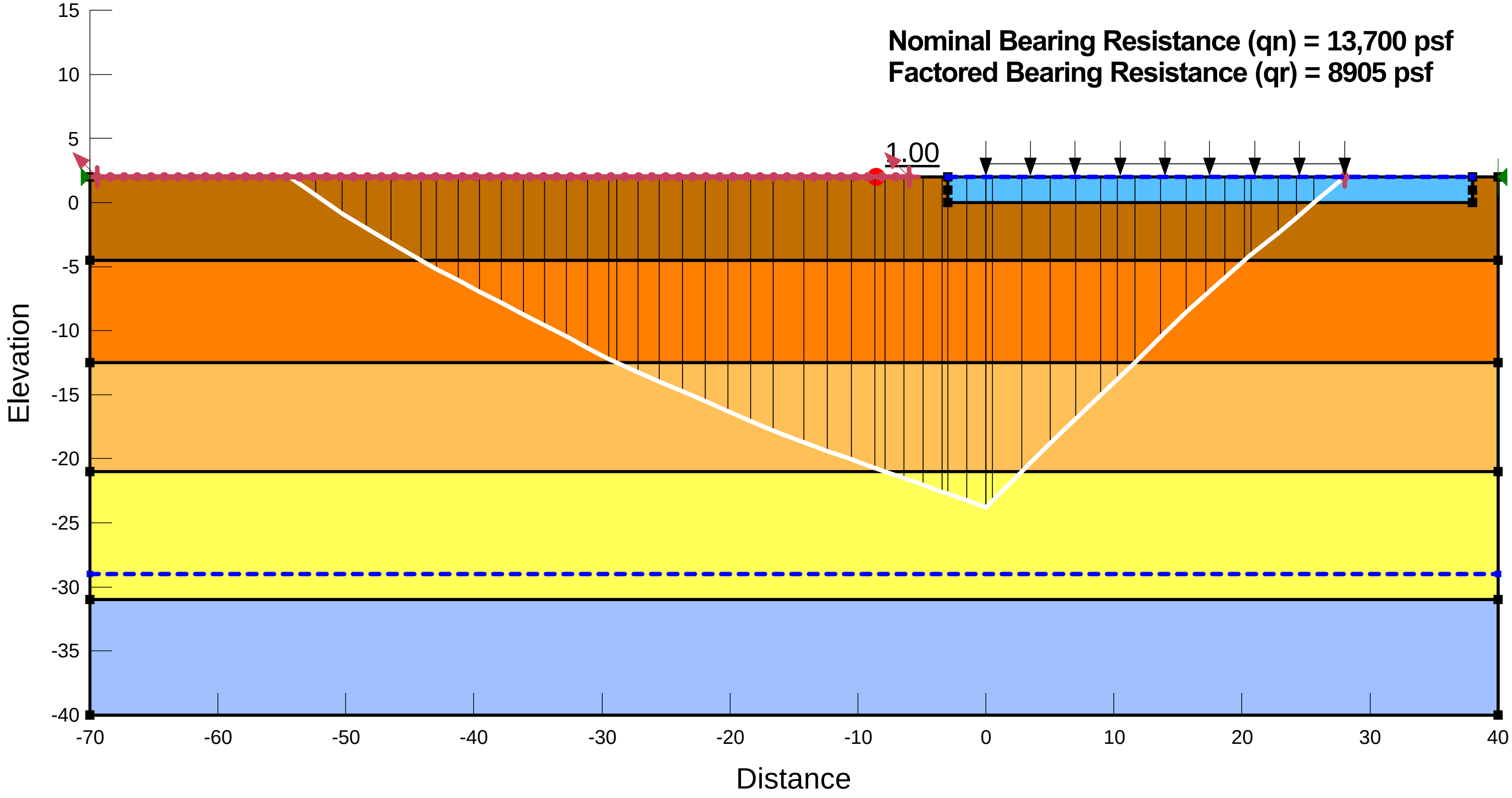
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	28.00	1								
2	3.44	28.00	1								
3	5.91	28.00	1								
4	8.37	28.00	1								
5	10.83	28.00	1								
6	13.29	28.00	1								
7	15.75	28.00	1								
8	18.21	28.00	1								
9	20.67	28.00	1								
10	23.13	28.00	1								
11	25.59	28.00	1								
12	28.05	28.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temporary Facing
Drained Conditions

Color	**Name**	**Unit Weight (pcf)**	**Cohesion' (psf)**	**Phi' (°)**
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	122	150	24
🟧	Silty Clay 2	127	175	25
🟧	Silty Clay 3	127	150	24
🟨	Silty Clay 4	119	150	23
🟦	Silty Clay 5	120	150	24



Nominal Bearing Resistance (qn) = 13,700 psf
Factored Bearing Resistance (qr) = 8905 psf

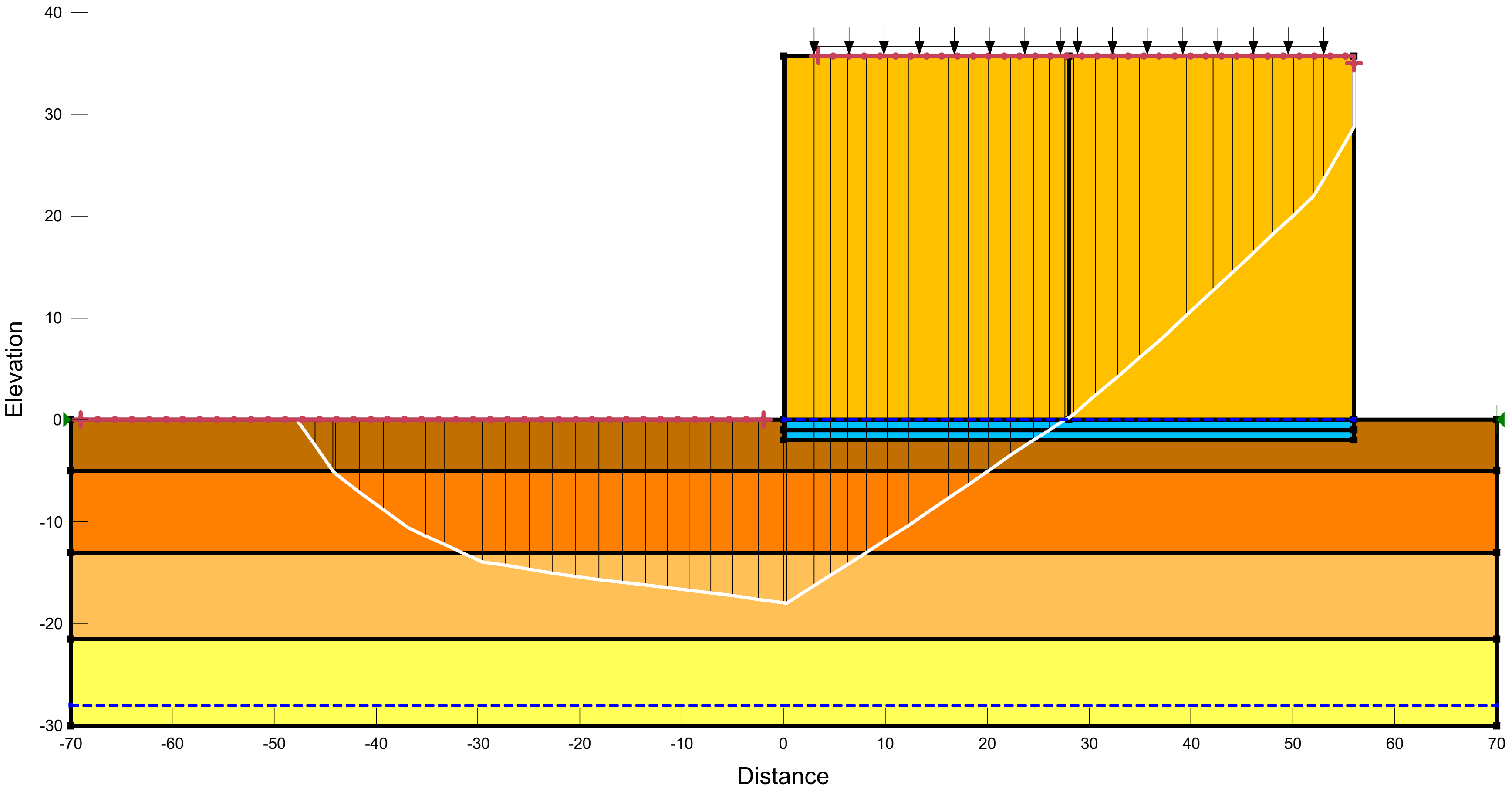
Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment - Wing Wall
MSE Wall Stability Analysis
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟨	MSE Fill	120	2,000	34
🟫	Silty Clay 1	122	150	24
🟧	Silty Clay 2	127	175	25
🟧	Silty Clay 3	127	150	24
🟨	Silty Clay 4	119	150	23

Global Stability - Foundation Prep Saturated
Drained - Temporary

● 1.87



AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment
MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Rear Abutment - Long Term (Drained) - Temporary

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....REAR-LT-b16 temp.BEN
Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	23.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 18.05 $N\gamma$= 8.20

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	39.90	[ft]	{ Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 36.90 ft }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

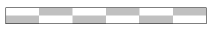
🟦 Uniformly distributed dead load is 0.0 [lb/ft ^{2}], and live load is 250.0 [lb/ft ^{2}]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:

SCALE:

0 5 10 15 20 25 30 [ft]



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8567 lb/ft^2.

Foundation Interface: Direct sliding, CDR = 1.327, Eccentricity, e/L = 0.1460, CDR-overturning = 3.42

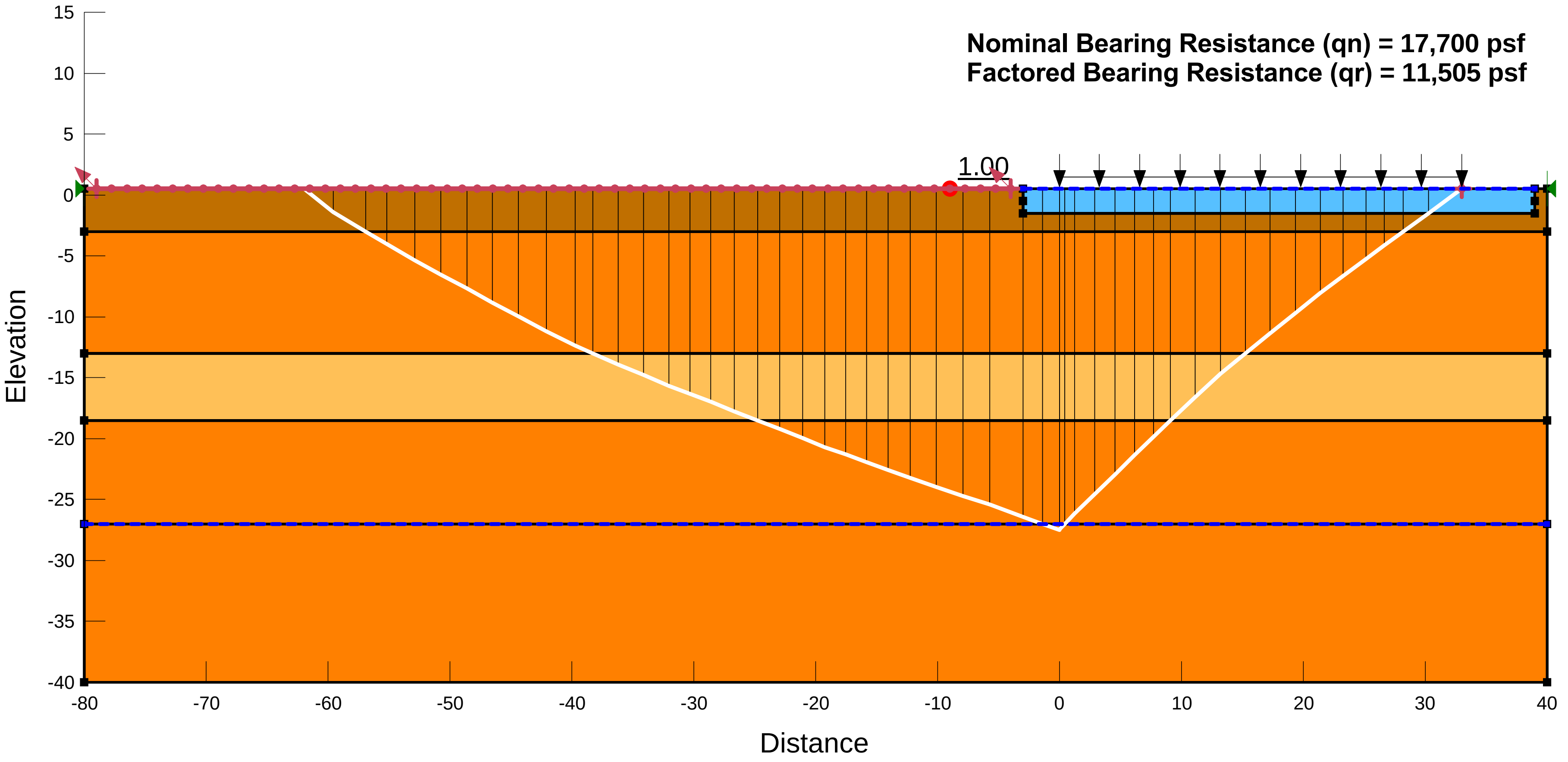
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	33.00	1								
2	3.44	33.00	1								
3	5.91	33.00	1								
4	8.37	33.00	1								
5	10.83	33.00	1								
6	13.29	33.00	1								
7	15.75	33.00	1								
8	18.21	33.00	1								
9	20.67	33.00	1								
10	23.13	33.00	1								
11	25.59	33.00	1								
12	28.05	33.00	1								
13	30.51	33.00	1								
14	32.97	33.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temp Facing
Drained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	150	23
🟧	Silty Clay 2	122	175	25
🟨	Silty Clay 3	126	175	26



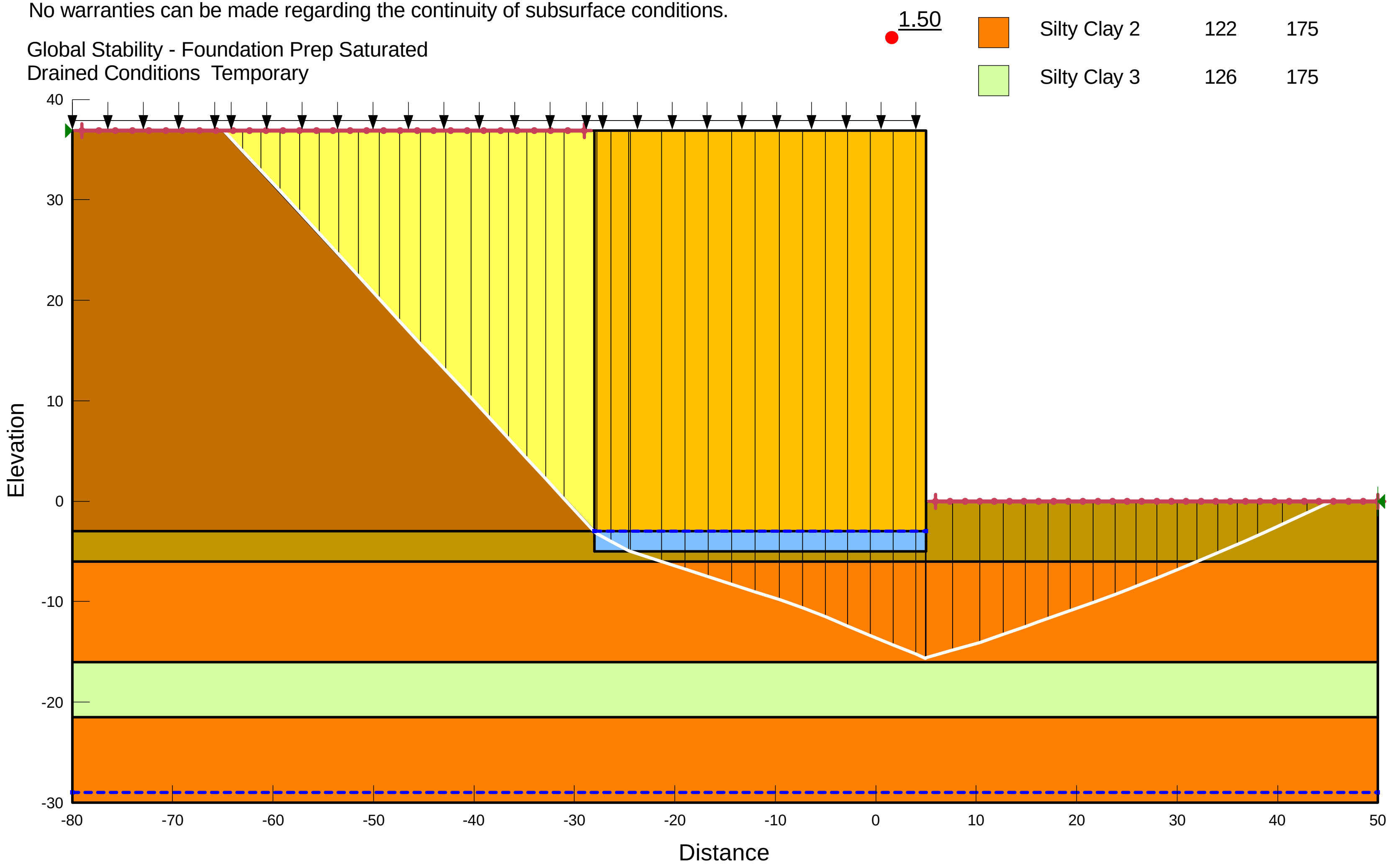
Nominal Bearing Resistance (qn) = 17,700 psf
Factored Bearing Resistance (qr) = 11,505 psf

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment
MSE Wall Stability Analysis
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Drained Conditions Temporary

Color	**Name**	**Unit Weight (pcf)**	**Cohesion' (psf)**	**Phi' (°)**
🟫	Embankment Fill	125	250	26
🟦	Foundation Prep	130	0	34
🟨	MSE Fill	120	3,000	34
🟨	Retained Fill	120	0	30
🟫	Silty Clay 1	119	150	23
🟧	Silty Clay 2	122	175	25
🟩	Silty Clay 3	126	175	26



AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment

MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Wing Wall - Long Term (Drained) - Temporary

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....WING-LT-b16 temp.BEN

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	23.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 4.32 N γ= 2.90

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 37.40 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 33.40 ft }

Batter, ω 0.0 [deg]
Backslope, β 0.0 [deg]
Backslope rise 0.0 [ft] Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

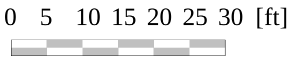
UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ^{2}], and live load is 250.0 [lb/ft ^{2}]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:

SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8554 lb/ft^2.

Foundation Interface: Direct sliding, CDR = 1.197, Eccentricity, e/L = 0.1802, CDR-overturning = 2.78

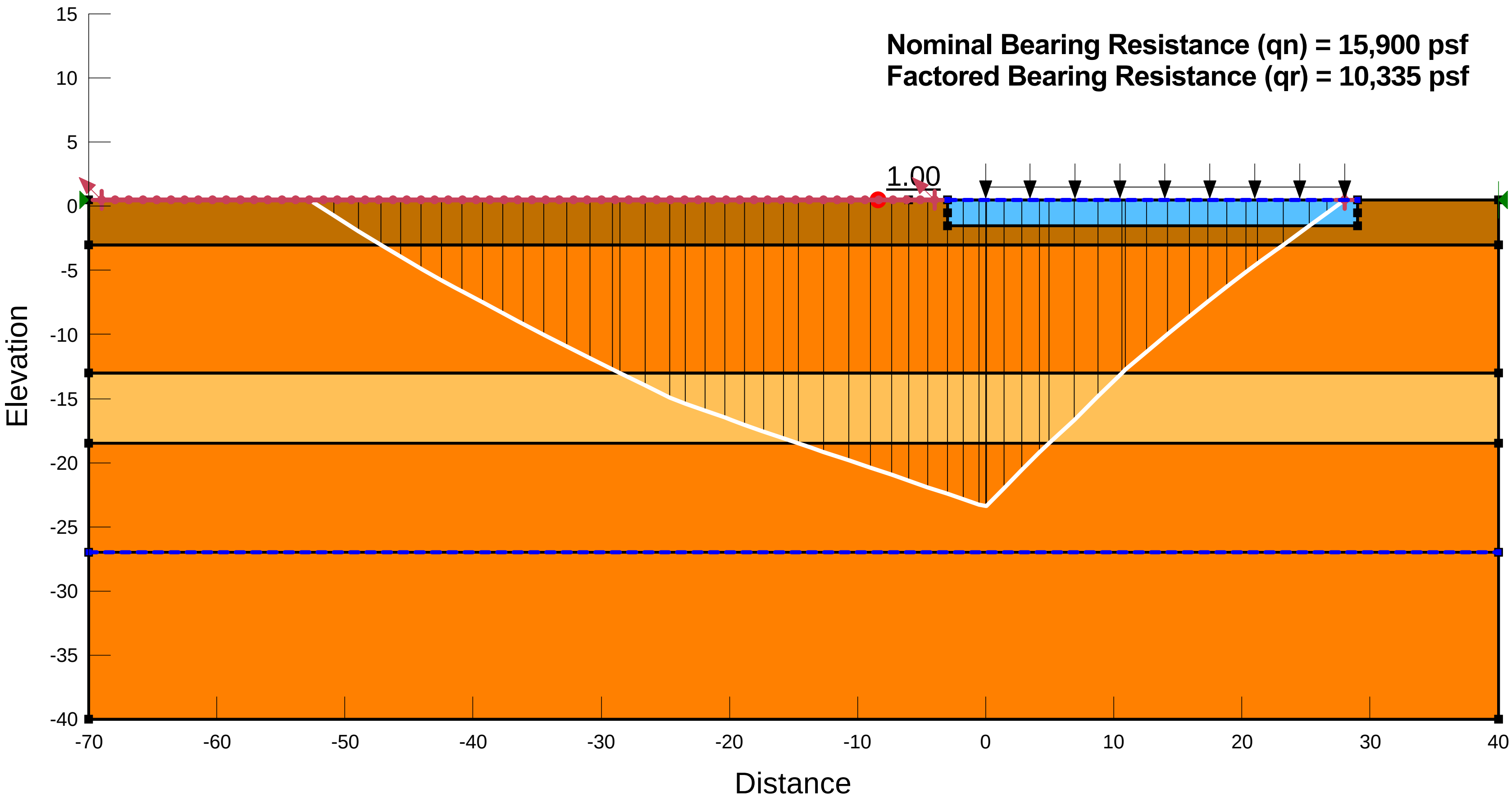
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	28.00	1								
2	3.44	28.00	1								
3	5.91	28.00	1								
4	8.37	28.00	1								
5	10.83	28.00	1								
6	13.29	28.00	1								
7	15.75	28.00	1								
8	18.21	28.00	1								
9	20.67	28.00	1								
10	23.13	28.00	1								
11	25.59	28.00	1								
12	28.05	28.00	1								
13	30.51	28.00	1								
14	32.97	28.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temporary Facing
Drained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	150	23
🟧	Silty Clay 2	122	175	25
🟨	Silty Clay 3	126	175	26



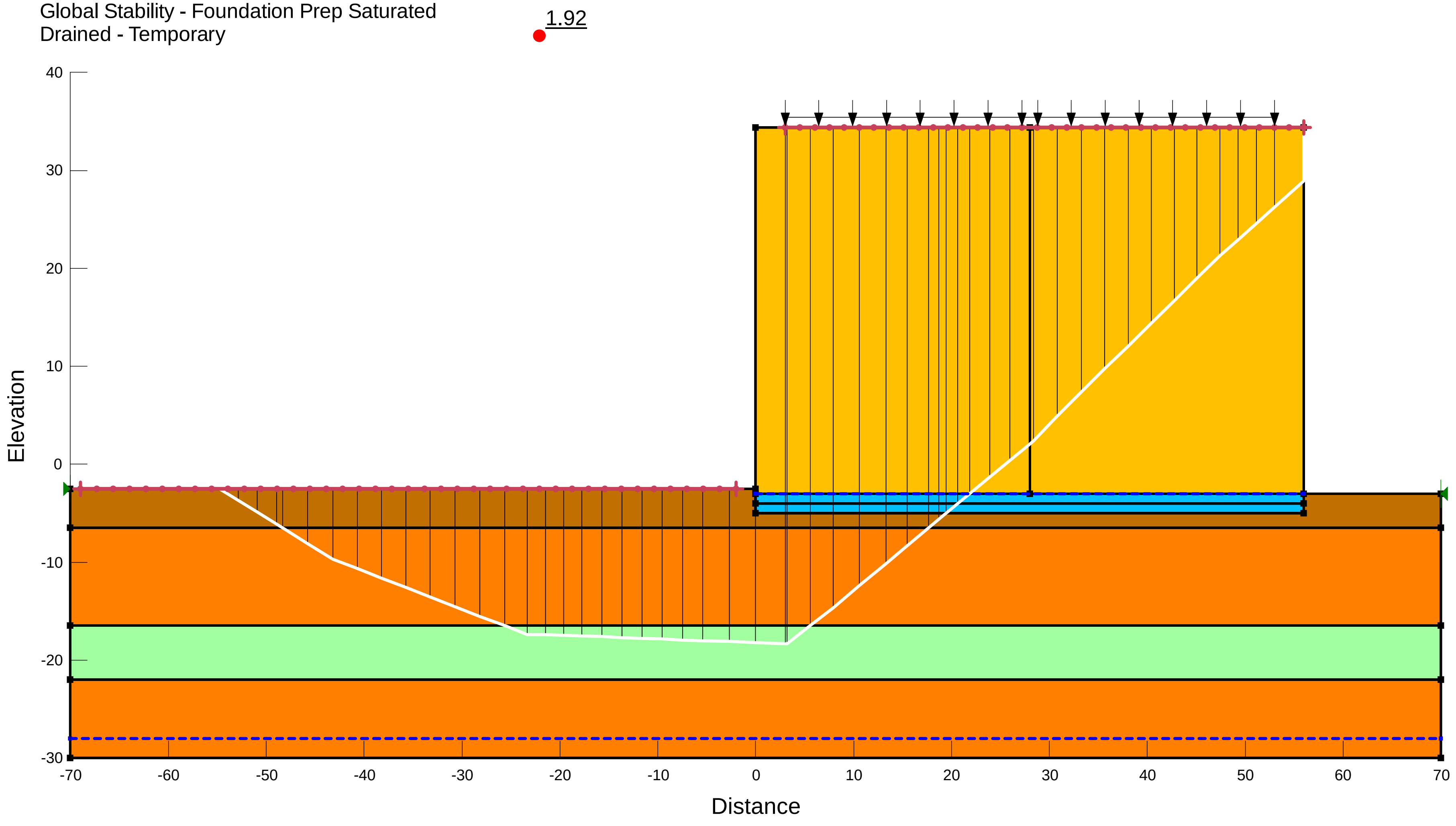
Nominal Bearing Resistance (qn) = 15,900 psf
Factored Bearing Resistance (qr) = 10,335 psf

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment - Wing Wall
MSE Wall Stability Analysis
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟨	MSE Fill	120	2,000	34
🟫	Silty Clay 1	119	150	23
🟧	Silty Clay 2	122	175	25
🟩	Silty Clay 3	126	175	26

Global Stability - Foundation Prep Saturated
Drained - Temporary



AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Fwd Abutment - Long Term (Drained) - Temporary - Top of Foundation Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1..... .....temp top of prep.BEN

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	34.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	0.0 lb/ft ²

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827   (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333   (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 42.16 $N\gamma$= 41.06

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

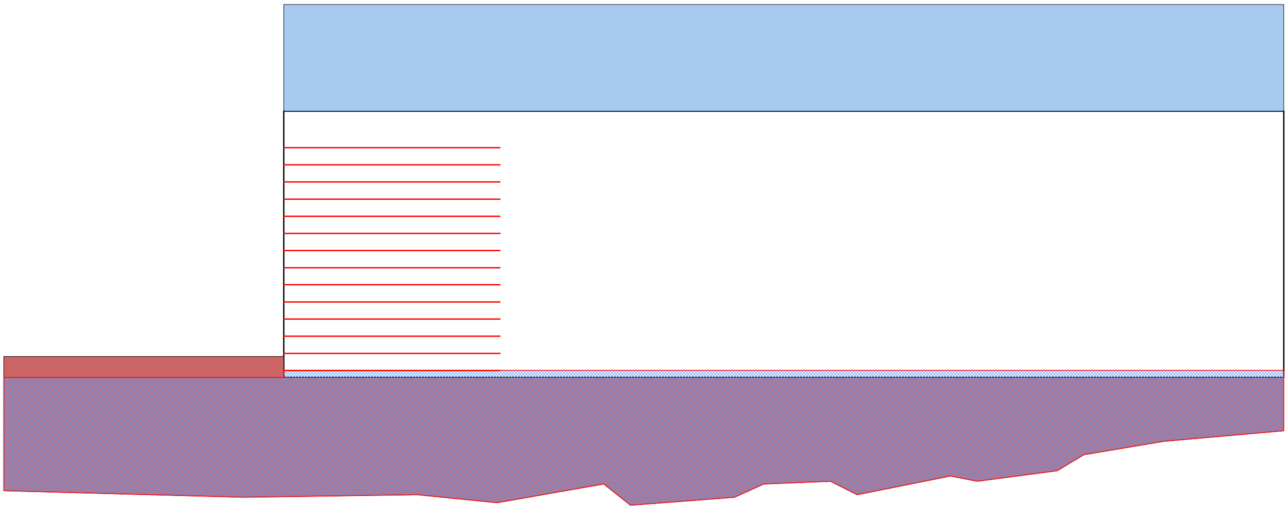
Design height, Hd	38.24	[ft]	{ Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 35.24 ft }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

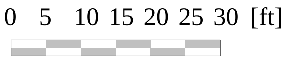
🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 2.26, factored bearing load = 8326 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.913, Eccentricity, e/L = 0.1531, CDR-overturning = 3.27

METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	31.00	1								
2	3.44	31.00	1								
3	5.91	31.00	1								
4	8.37	31.00	1								
5	10.83	31.00	1								
6	13.29	31.00	1								
7	15.75	31.00	1								
8	18.21	31.00	1								
9	20.67	31.00	1								
10	23.13	31.00	1								
11	25.59	31.00	1								
12	28.05	31.00	1								
13	30.51	31.00	1								
14	32.97	31.00	1								

AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment
MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Fwd Abutment - Long Term (Drained) - Temporary - Bottom of Foundation Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....temp bot of prep.BEN
Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	24.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 19.32 N_γ= 9.44

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 40.24 [ft] { Embedded depth is E = 5.00 ft, and height above top of finished bottom grade is H = 35.24 ft }

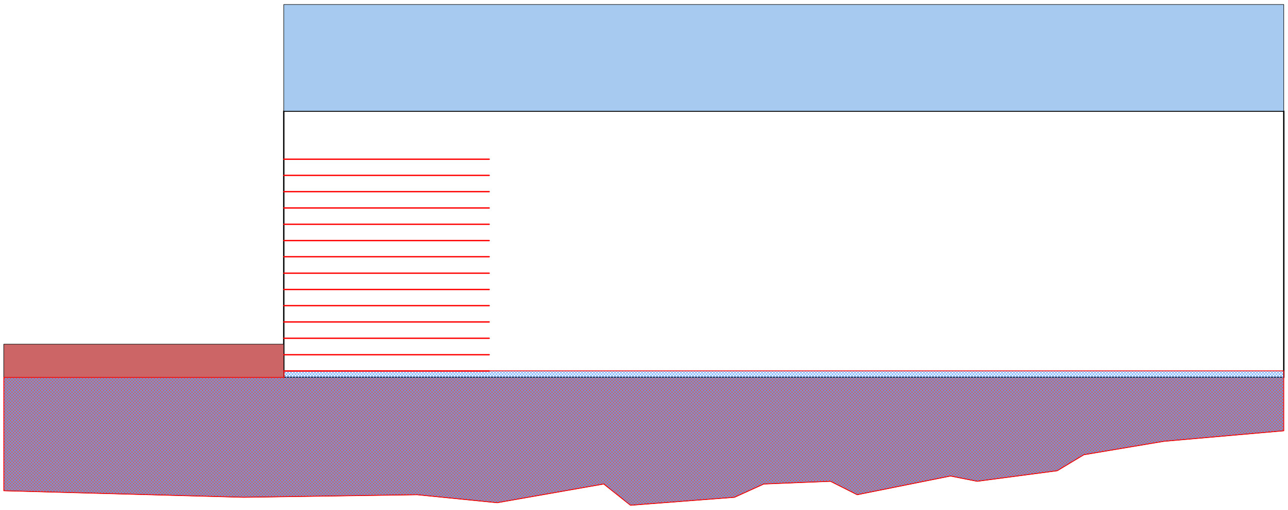
Batter, ω 0.0 [deg]
Backslope, β 0.0 [deg]
Backslope rise 0.0 [ft] Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

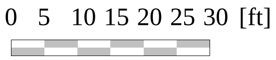
🟦 Uniformly distributed dead load is 0.0 [lb/ft ^{2}], and live load is 250.0 [lb/ft ^{2}]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Factored bearing load = 8981 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.293, Eccentricity, e/L = 0.1680, CDR-overturning = 2.98

	METAL STRIP			CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	31.00	1								
2	3.44	31.00	1								
3	5.91	31.00	1								
4	8.37	31.00	1								
5	10.83	31.00	1								
6	13.29	31.00	1								
7	15.75	31.00	1								
8	18.21	31.00	1								
9	20.67	31.00	1								
10	23.13	31.00	1								
11	25.59	31.00	1								
12	28.05	31.00	1								
13	30.51	31.00	1								
14	32.97	31.00	1								

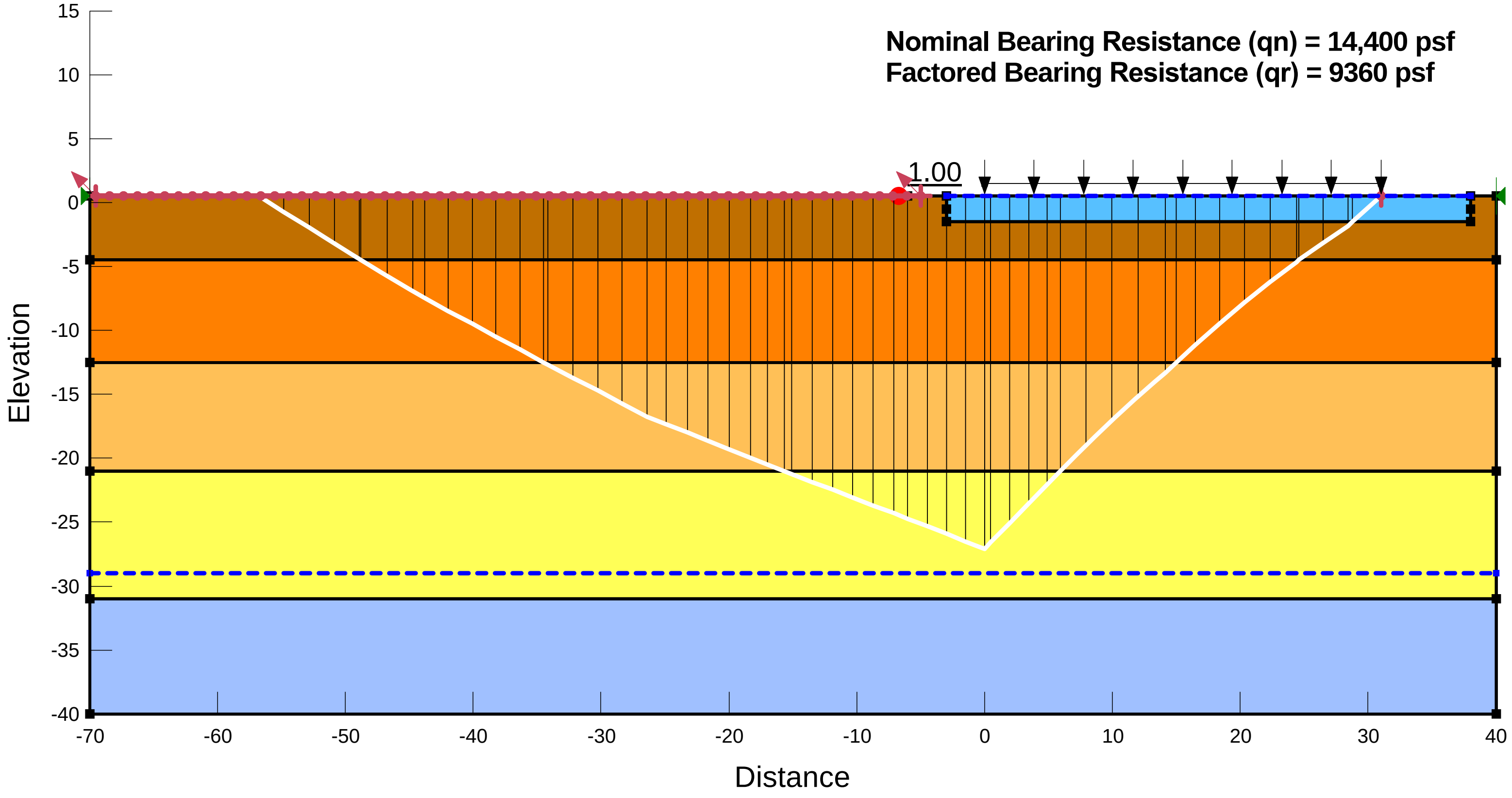
Using the Limit Equilibrium Bearing Capacity analysis below:
Bearing Capacity CDR = 9360/8981 = 1.04

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	122	150	24
🟧	Silty Clay 2	127	175	25
🟧	Silty Clay 3	127	150	24
🟨	Silty Clay 4	119	150	23
🟦	Silty Clay 5	120	150	24

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temporary Facing
Drained Conditions



Nominal Bearing Resistance (qn) = 14,400 psf
Factored Bearing Resistance (qr) = 9360 psf

AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment
MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Rear Abutment - Long Term (Drained) - Temporary - Top of Foundation Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....temp top of prep.BEN
Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	130.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$	34.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): $N_c = 42.16$ $N_\gamma = 41.06$

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 39.90 [ft] { Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 36.90 ft }

Batter, ω 0.0 [deg]

Backslope, β 0.0 [deg]

Backslope rise 0.0 [ft] Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

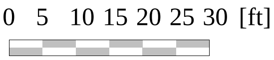
UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 $[lb/ft^2]$, and live load is 250.0 $[lb/ft^2]$

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:

SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 2.77, factored bearing load = 8567 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.962, Eccentricity, e/L = 0.1460, CDR-overturning = 3.42

METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	33.00	1								
2	3.44	33.00	1								
3	5.91	33.00	1								
4	8.37	33.00	1								
5	10.83	33.00	1								
6	13.29	33.00	1								
7	15.75	33.00	1								
8	18.21	33.00	1								
9	20.67	33.00	1								
10	23.13	33.00	1								
11	25.59	33.00	1								
12	28.05	33.00	1								
13	30.51	33.00	1								
14	32.97	33.00	1								

AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment
MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Rear Abutment - Long Term (Drained) - Temporary - Bottom of Foundation Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....temp bot of prep.BEN
Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	23.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 18.05 N_γ= 8.20

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

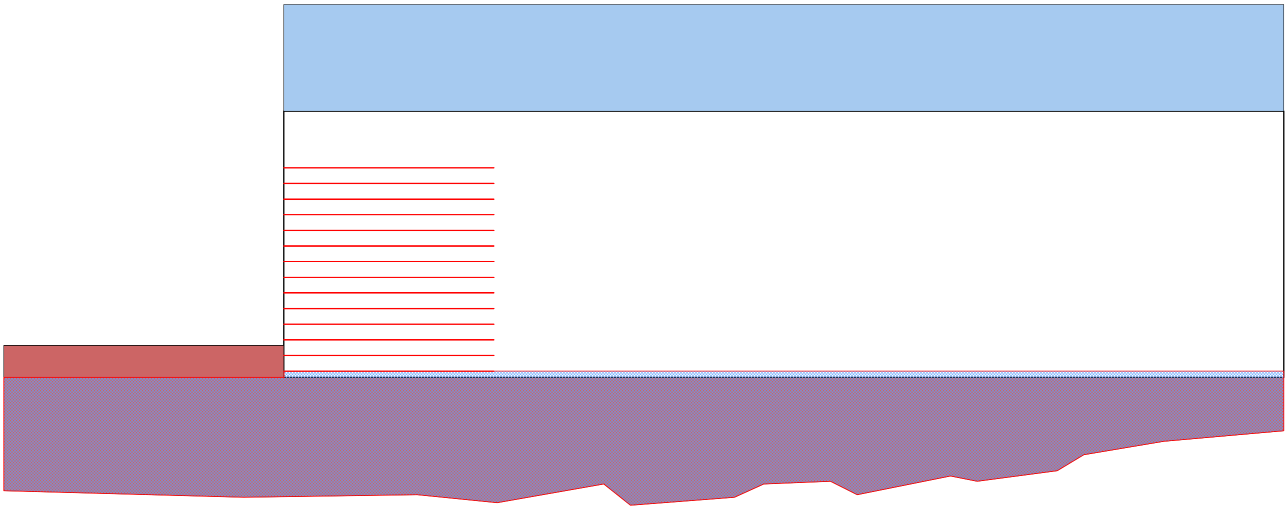
Design height, Hd 41.90 [ft] { Embedded depth is E = 5.00 ft, and height above top of finished bottom grade is H = 36.90 ft }
Batter, ω 0.0 [deg]
Backslope, β 0.0 [deg]
Backslope rise 0.0 [ft] Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

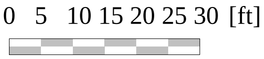
🟦 Uniformly distributed dead load is 0.0 [lb/ft ^{2}], and live load is 250.0 [lb/ft ^{2}]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 9200 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.267, Eccentricity, e/L = 0.1597, CDR-overturning = 3.13

METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	33.00	1								
2	3.44	33.00	1								
3	5.91	33.00	1								
4	8.37	33.00	1								
5	10.83	33.00	1								
6	13.29	33.00	1								
7	15.75	33.00	1								
8	18.21	33.00	1								
9	20.67	33.00	1								
10	23.13	33.00	1								
11	25.59	33.00	1								
12	28.05	33.00	1								
13	30.51	33.00	1								
14	32.97	33.00	1								

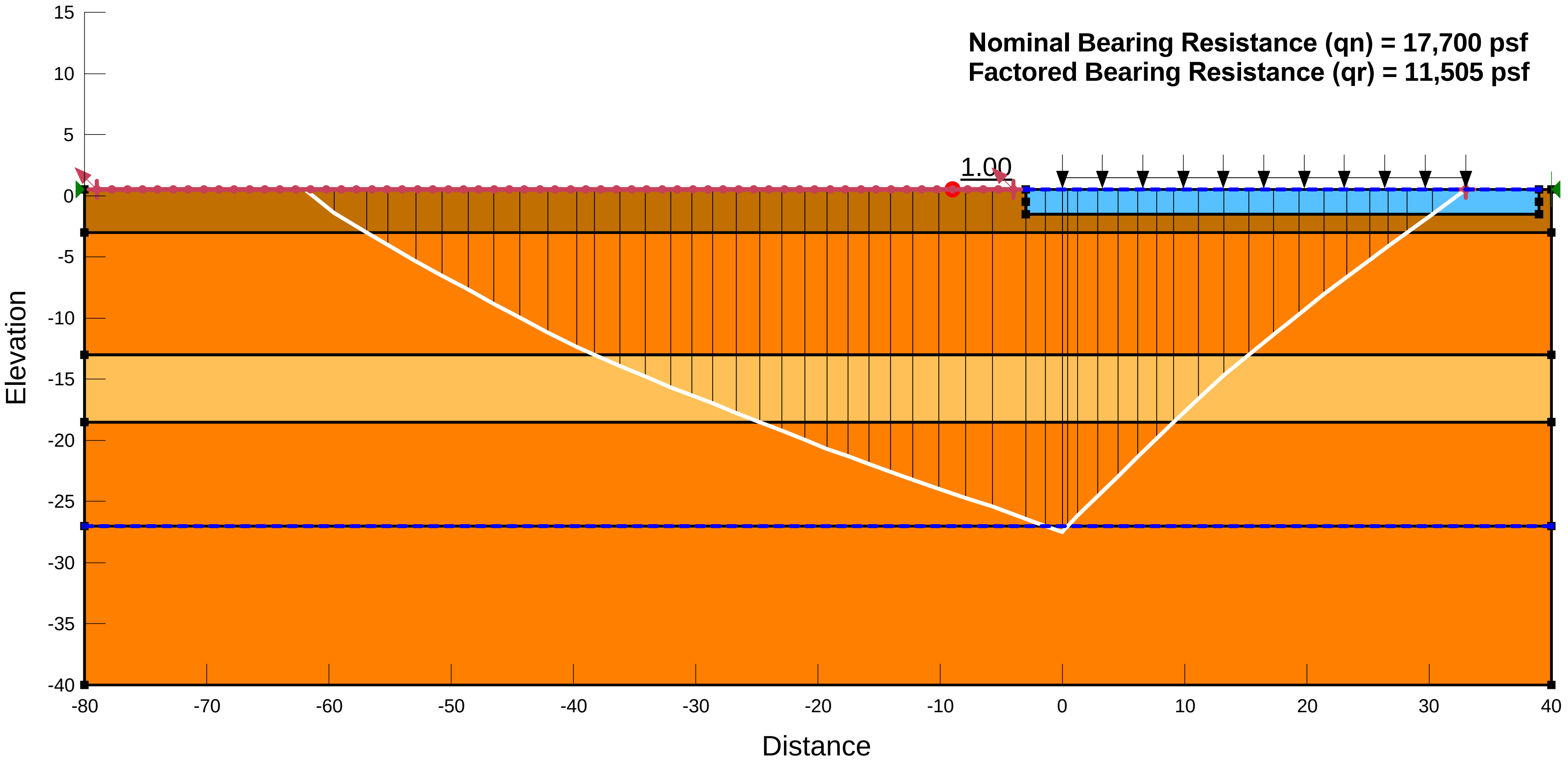
Using the Limit Equilibrium Bearing Capacity analysis below:
Bearing Capacity CDR = 11505/9200 = 1.25

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temp Facing
Drained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	150	23
🟧	Silty Clay 2	122	175	25
🟨	Silty Clay 3	126	175	26


Nominal Bearing Resistance (qn) = 17,700 psf
Factored Bearing Resistance (qr) = 11,505 psf

AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Wing Wall - Long Term (Drained) - Temporary - Top of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....emp top of prep.BENp

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	130.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	34.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	0.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 0.00 $N\gamma$= 11.49

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 35.70 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 31.70 ft }

Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

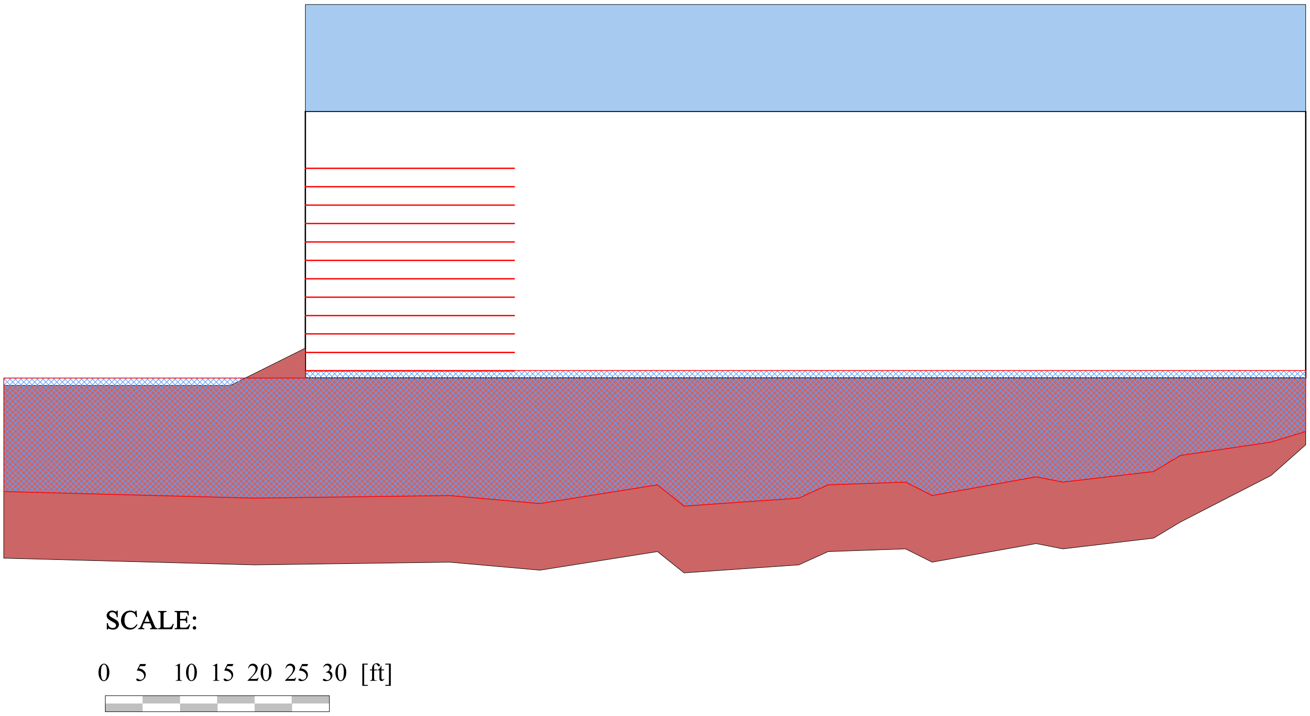
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 7967 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.834, Eccentricity, e/L = 0.1656, CDR-overturning = 3.02

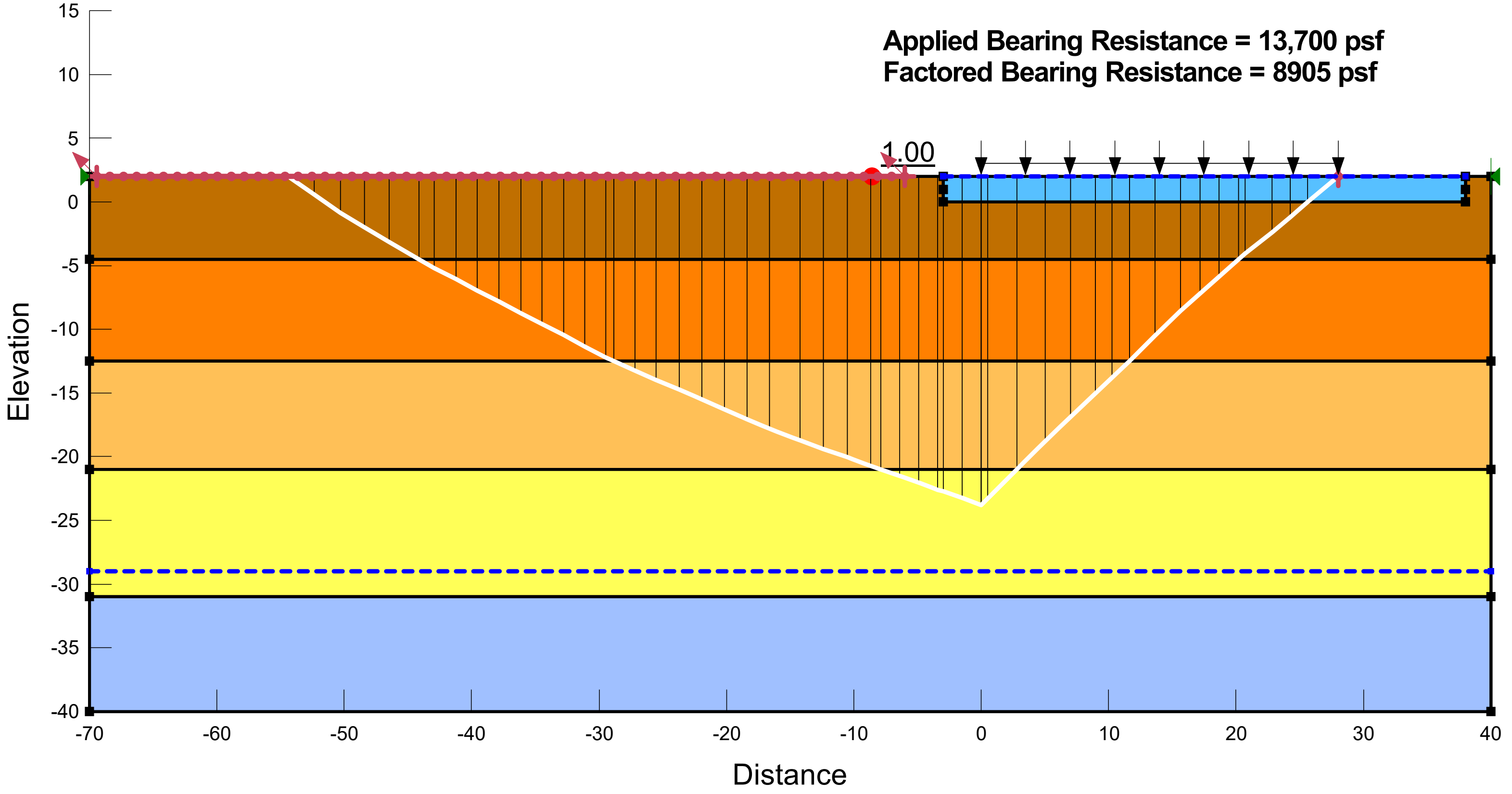
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	28.00	1								
2	3.44	28.00	1								
3	5.91	28.00	1								
4	8.37	28.00	1								
5	10.83	28.00	1								
6	13.29	28.00	1								
7	15.75	28.00	1								
8	18.21	28.00	1								
9	20.67	28.00	1								
10	23.13	28.00	1								
11	25.59	28.00	1								
12	28.05	28.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temporary Facing
Drained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	122	150	24
🟧	Silty Clay 2	127	175	25
🟧	Silty Clay 3	127	150	24
🟨	Silty Clay 4	119	150	23
🟦	Silty Clay 5	120	150	24



AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Wing Wall - Long Term (Drained) - Temporary - Bottom of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....emp bot of prep.BENp

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	24.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 4.62 $N\gamma$= 3.09

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 37.70 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 33.70 ft }
Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

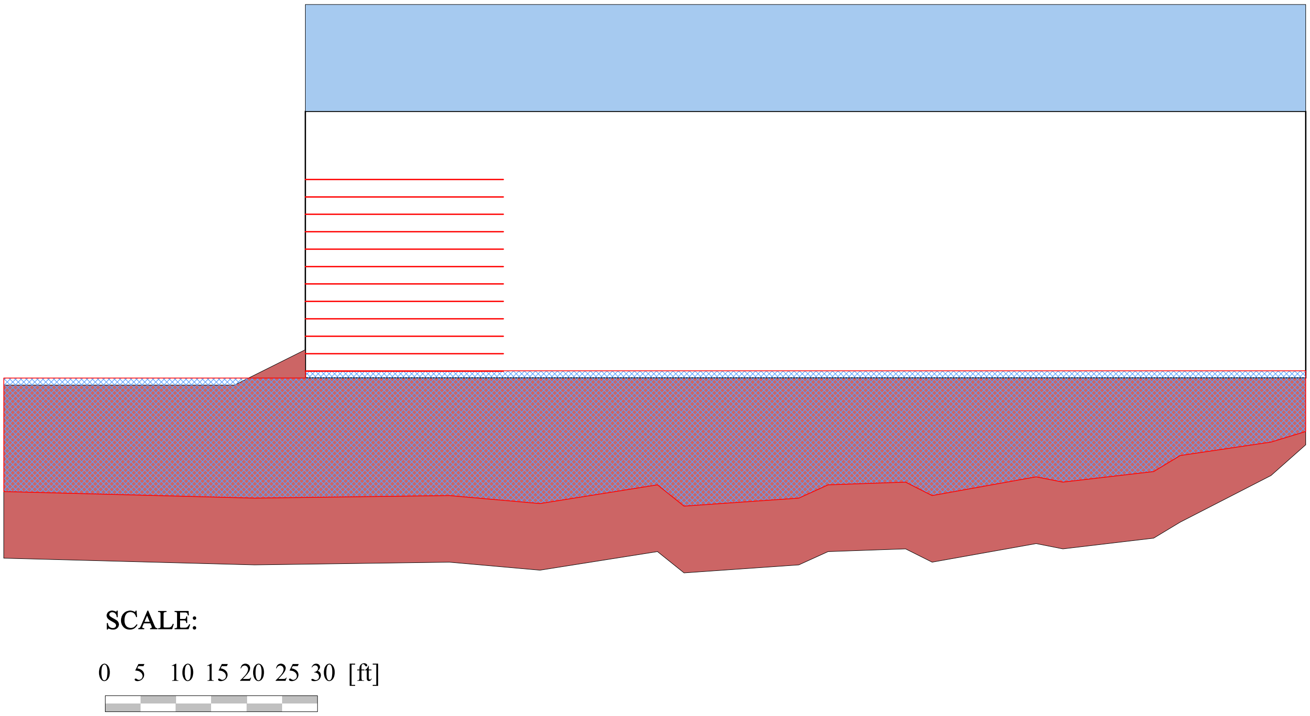
Batter, ω 0.0 [deg]
Backslope, β 0.0 [deg]
Backslope rise 0.0 [ft] Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8662 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.242, Eccentricity, e/L = 0.1828, CDR-overturning = 2.73

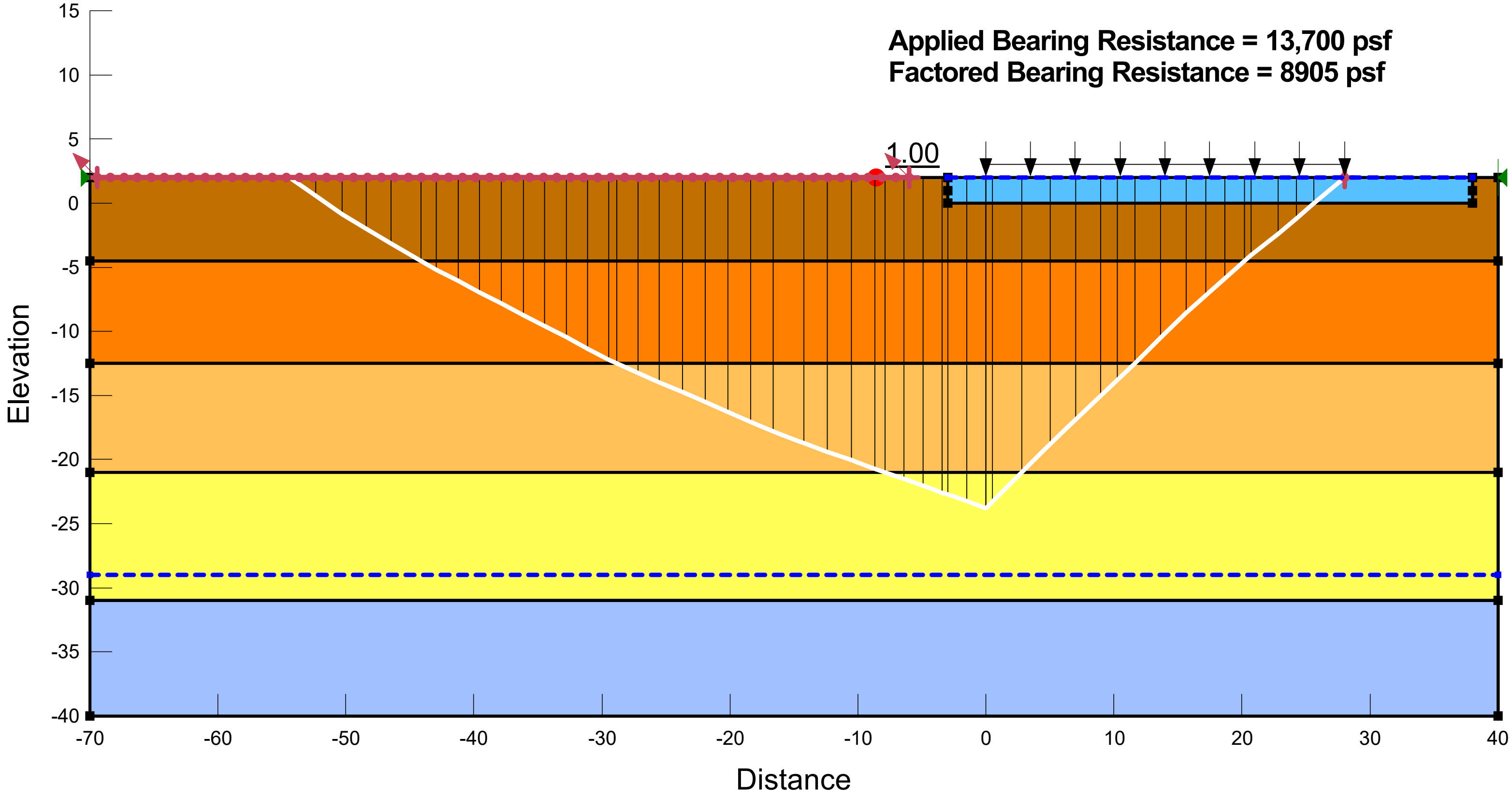
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	28.00	1								
2	3.44	28.00	1								
3	5.91	28.00	1								
4	8.37	28.00	1								
5	10.83	28.00	1								
6	13.29	28.00	1								
7	15.75	28.00	1								
8	18.21	28.00	1								
9	20.67	28.00	1								
10	23.13	28.00	1								
11	25.59	28.00	1								
12	28.05	28.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temporary Facing
Drained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	122	150	24
🟧	Silty Clay 2	127	175	25
🟧	Silty Clay 3	127	150	24
🟨	Silty Clay 4	119	150	23
🟦	Silty Clay 5	120	150	24



Applied Bearing Resistance = 13,700 psf
Factored Bearing Resistance = 8905 psf

AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Wing Wall - Long Term (Drained) - Temporary - Top of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....emp top of prep.BENp

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	130.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	34.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	0.0 lb/ft ²

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 0.00 N γ= 11.49

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 37.40 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 33.40 ft }
Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

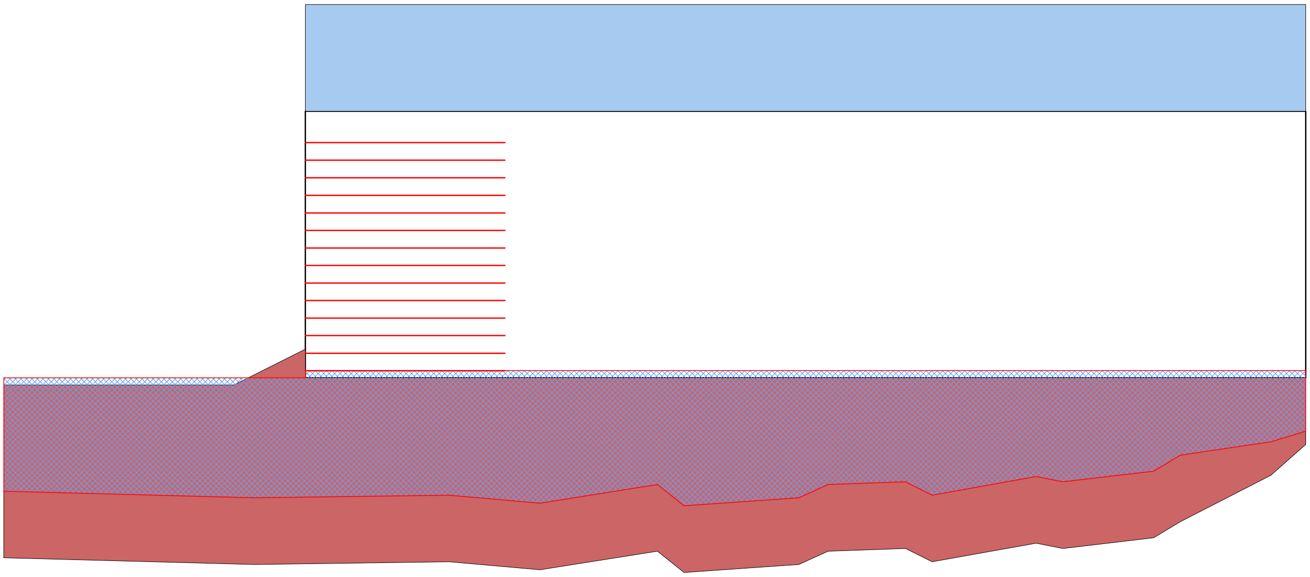
Batter, ω 0.0 [deg]
Backslope, β 0.0 [deg]
Backslope rise 0.0 [ft] Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

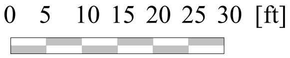
🟦 Uniformly distributed dead load is 0.0 [lb/ft ^{2}], and live load is 250.0 [lb/ft ^{2}]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8554 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.762, Eccentricity, e/L = 0.1802, CDR-overturning = 2.78

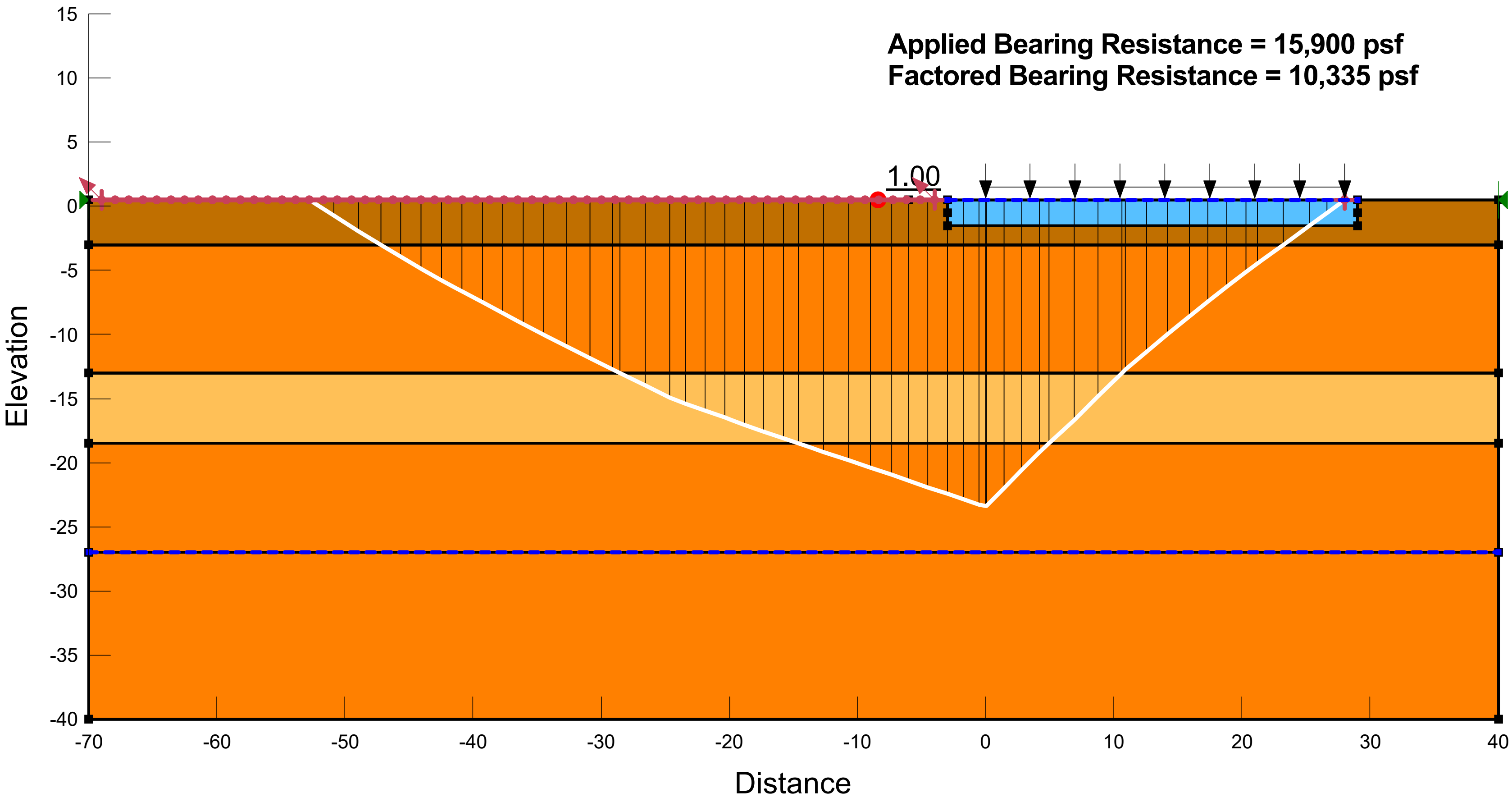
	METAL STRIP			CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	28.00	1								
2	3.44	28.00	1								
3	5.91	28.00	1								
4	8.37	28.00	1								
5	10.83	28.00	1								
6	13.29	28.00	1								
7	15.75	28.00	1								
8	18.21	28.00	1								
9	20.67	28.00	1								
10	23.13	28.00	1								
11	25.59	28.00	1								
12	28.05	28.00	1								
13	30.51	28.00	1								
14	32.97	28.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	150	23
🟧	Silty Clay 2	122	175	25
🟨	Silty Clay 3	126	175	26

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temporary Facing
Drained Conditions



Applied Bearing Resistance = 15,900 psf
Factored Bearing Resistance = 10,335 psf

AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Wing Wall - Long Term (Drained) - Temporary - Bottom of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....emp bot of prep.BENp

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	23.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft ²

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 4.32 N γ= 2.90

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 39.40 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 35.40 ft }
Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

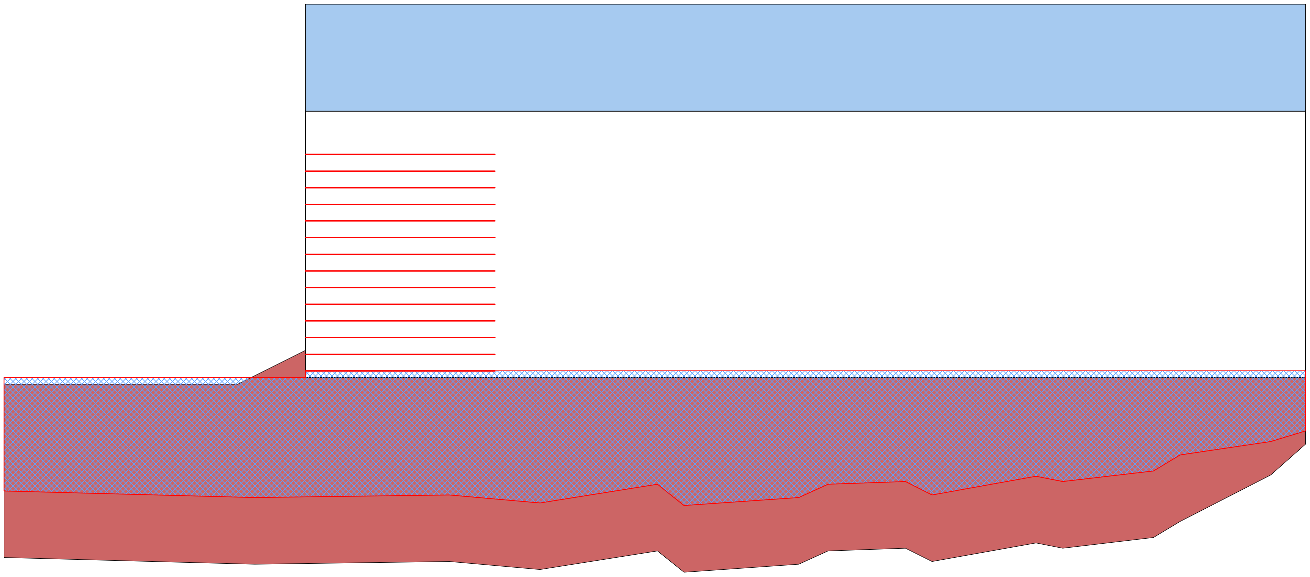
Batter, ω 0.0 [deg]
Backslope, β 0.0 [deg]
Backslope rise 0.0 [ft] Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 5 10 15 20 25 30 [ft]

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 9303 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.140, Eccentricity, e/L = 0.1982, CDR-overturning = 2.52

METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	28.00	1								
2	3.44	28.00	1								
3	5.91	28.00	1								
4	8.37	28.00	1								
5	10.83	28.00	1								
6	13.29	28.00	1								
7	15.75	28.00	1								
8	18.21	28.00	1								
9	20.67	28.00	1								
10	23.13	28.00	1								
11	25.59	28.00	1								
12	28.05	28.00	1								
13	30.51	28.00	1								
14	32.97	28.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	150	23
🟧	Silty Clay 2	122	175	25
🟨	Silty Clay 3	126	175	26

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Temporary Facing
Drained Conditions

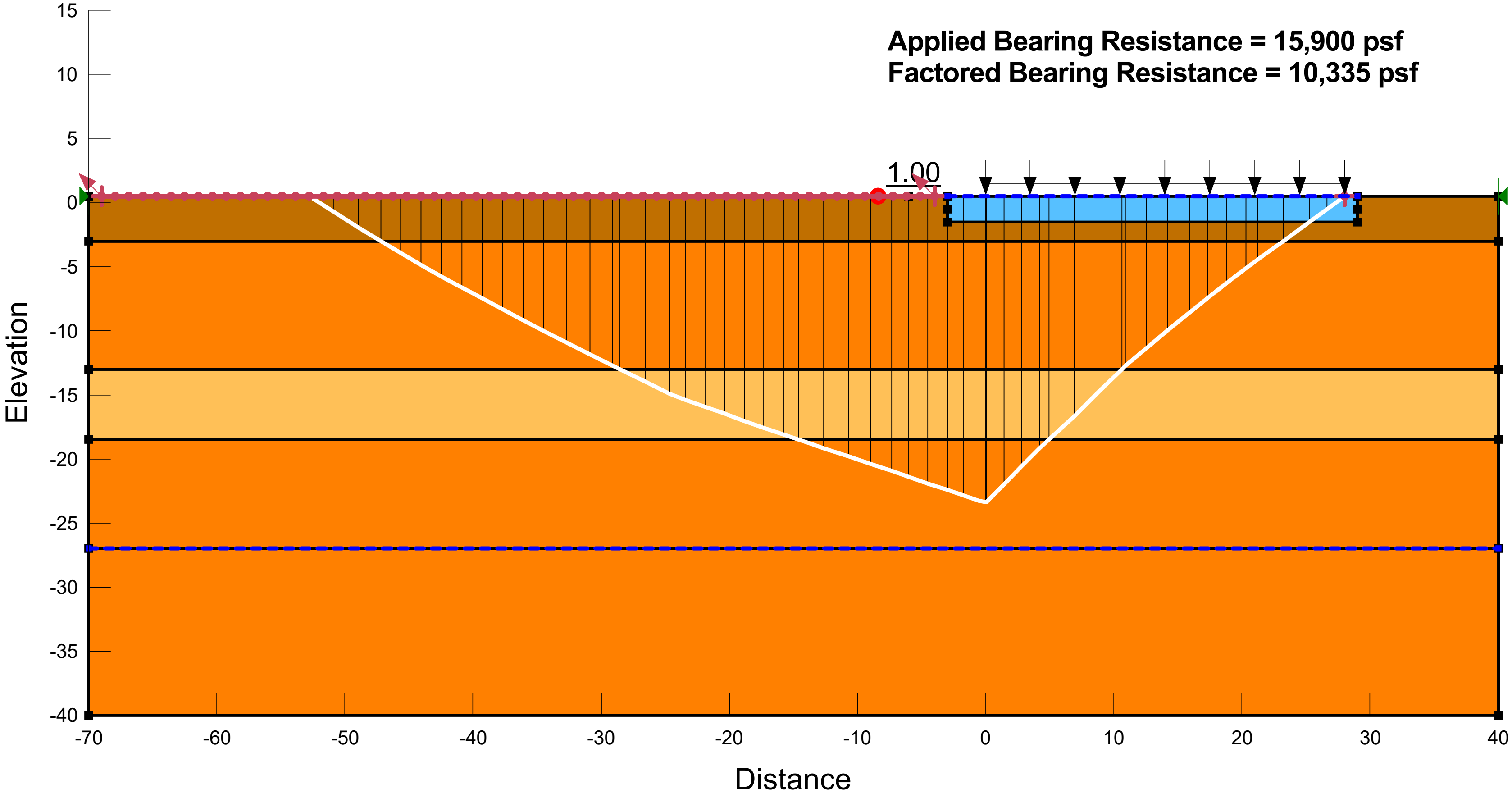

Applied Bearing Resistance = 15,900 psf
Factored Bearing Resistance = 10,335 psf

Table 8 Analyses

AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment
MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Fwd Abutment - Short Term (Undrained) - Final

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....Fwd-ST-b16 final.BEN
Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft^3
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft^3
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft^3
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	0.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	4000.0 lb/ft^2

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 5.14 $N\gamma = 0.00$

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

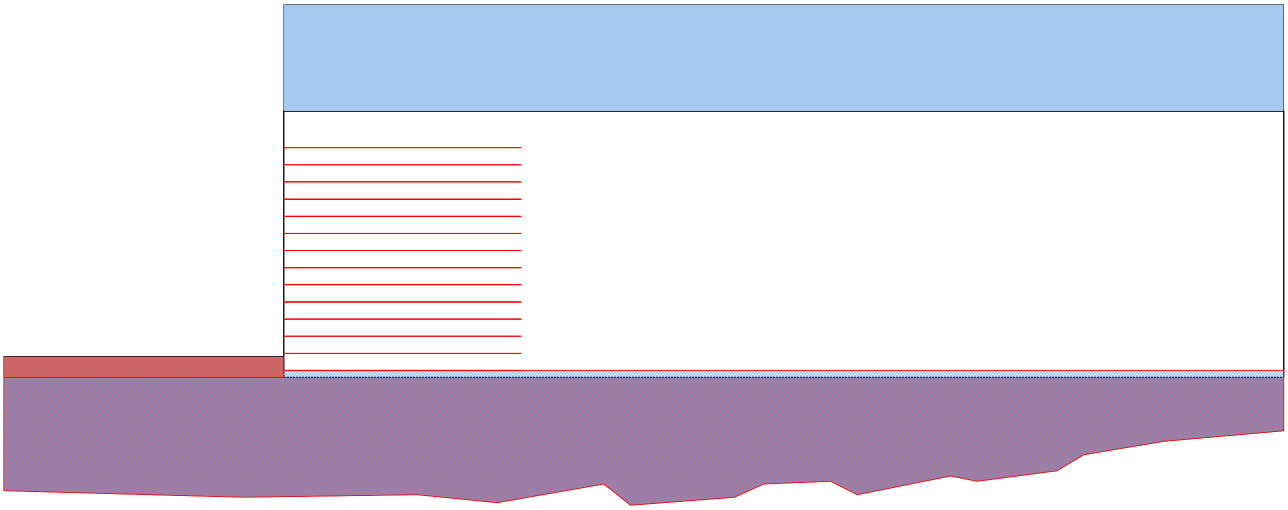
Design height, Hd	38.24	[ft]	{ Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 35.24 ft }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

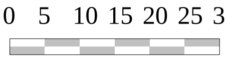
🟦 Uniformly distributed dead load is 0.0 [lb/ft ^{2}], and live load is 250.0 [lb/ft ^{2}]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 1.68, factored bearing load = 7967 lb/ft².

Foundation Interface: Direct sliding, CDR = 2.098, Eccentricity, e/L = 0.1272, CDR-overturning = 3.93

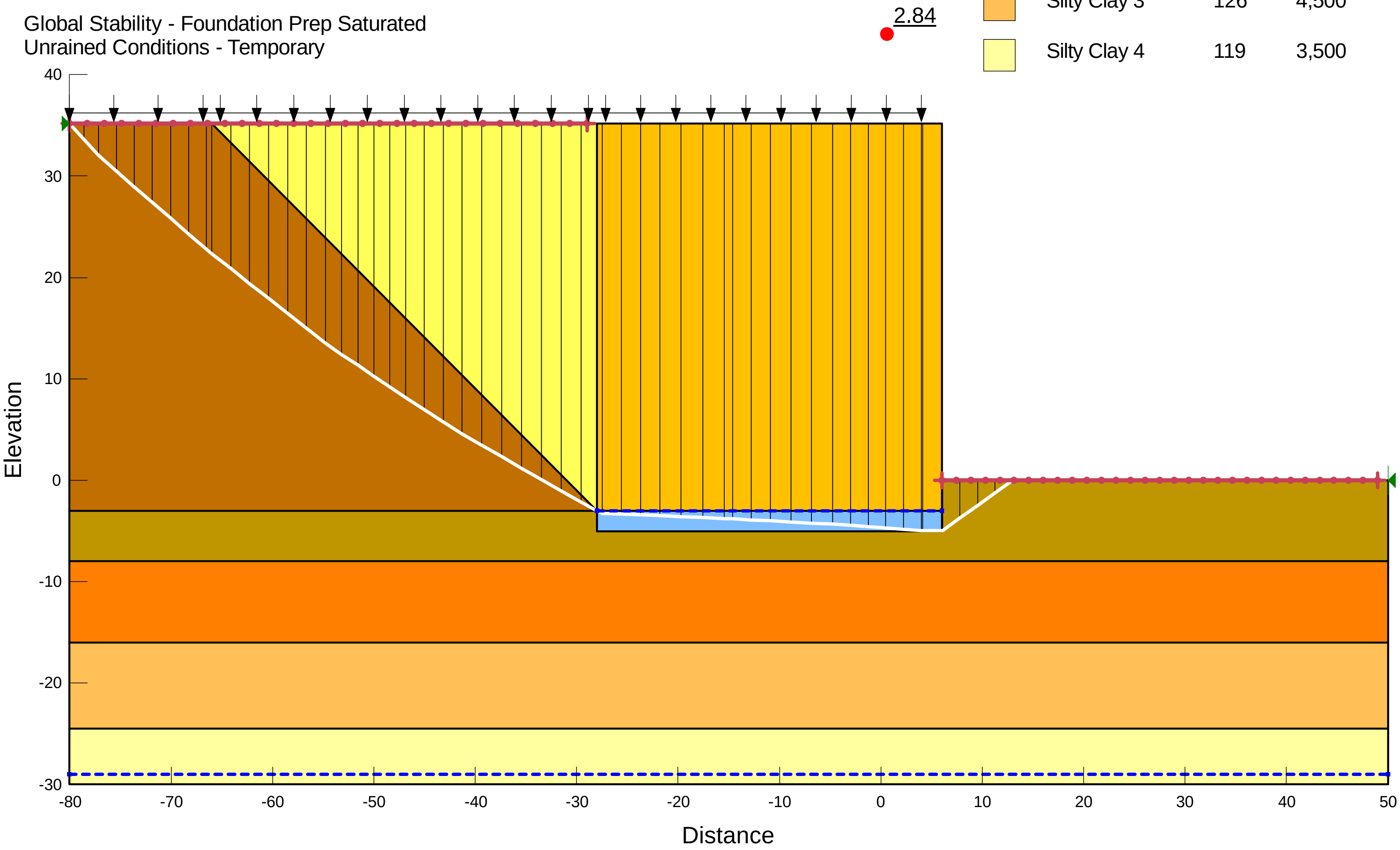
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	34.00	1								
2	3.44	34.00	1								
3	5.91	34.00	1								
4	8.37	34.00	1								
5	10.83	34.00	1								
6	13.29	34.00	1								
7	15.75	34.00	1								
8	18.21	34.00	1								
9	20.67	34.00	1								
10	23.13	34.00	1								
11	25.59	34.00	1								
12	28.05	34.00	1								
13	30.51	34.00	1								
14	32.97	34.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment
MSE Wall Stability Analysis
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Color	**Name**	**Unit Weight (pcf)**	**Cohesion' (psf)**	**Phi' (°)**
🟫	Embankment Fill	125	250	26
🟦	Foundation Prep	130	0	34
🟧	MSE Fill	120	4,000	34
🟨	Retained Fill	120	0	30
🟫	Silty Clay 1	122	4,000	0
🟧	Silty Clay 2	127	6,500	0
🟧	Silty Clay 3	126	4,500	0
🟨	Silty Clay 4	119	3,500	0

Global Stability - Foundation Prep Saturated
Unrained Conditions - Temporary



AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Wing Wall - Short Term (Undrained) - Final

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....ING-ST-b16 final.BEN

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$	0.0 °
Equivalent cohesion, $c_{equiv.}$	4000.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 4.17 $N\gamma = 0.00$

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 35.70 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 31.70 ft }
Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

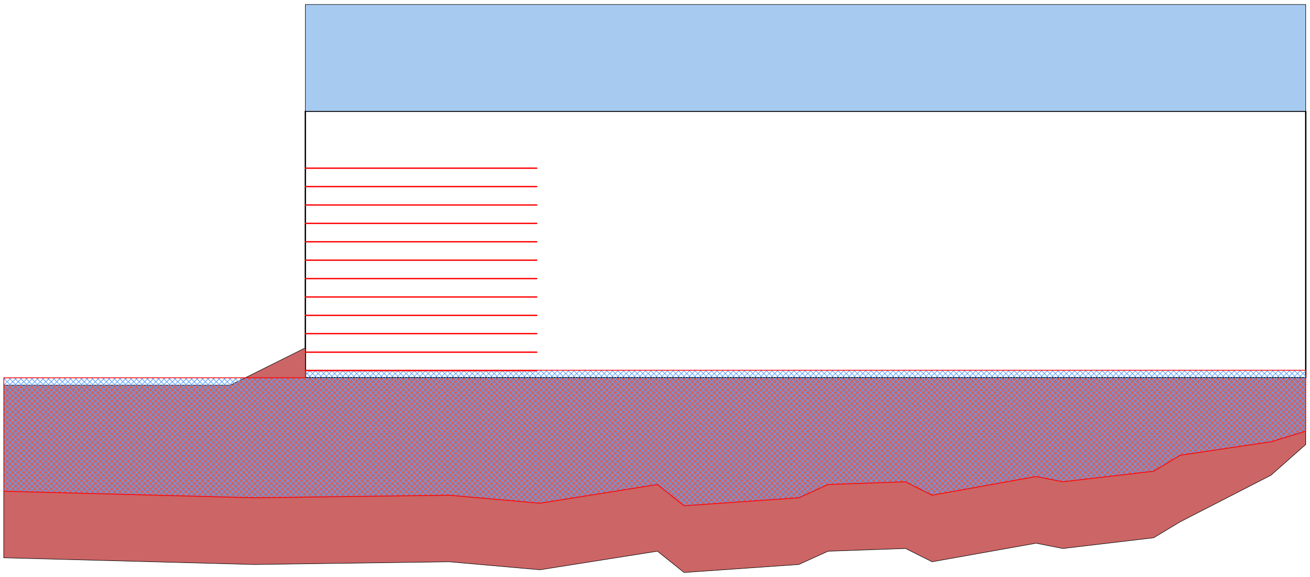
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 5 10 15 20 25 30 [ft]

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 1.44, factored bearing load = 7558 lb/ft².

Foundation Interface: Direct sliding, CDR = 2.031, Eccentricity, e/L = 0.1351, CDR-overturning = 3.70

METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	31.00	1								
2	3.44	31.00	1								
3	5.91	31.00	1								
4	8.37	31.00	1								
5	10.83	31.00	1								
6	13.29	31.00	1								
7	15.75	31.00	1								
8	18.21	31.00	1								
9	20.67	31.00	1								
10	23.13	31.00	1								
11	25.59	31.00	1								
12	28.05	31.00	1								

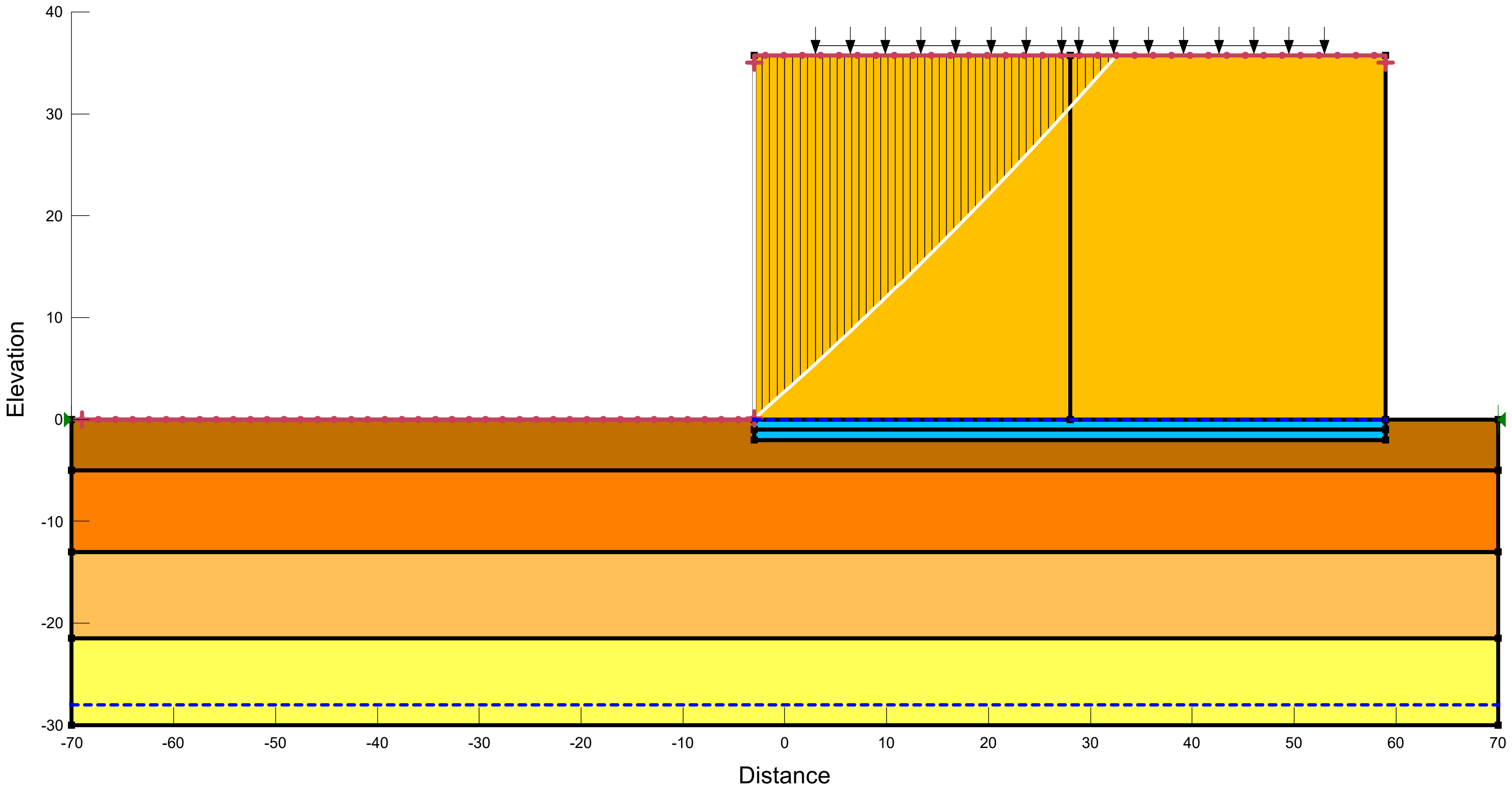
Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment - Wing Wall
MSE Wall Stability Analysis
Lawrence Co., OH

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟨	MSE Fill	120	2,000	34
🟫	Silty Clay 1	122	4,000	0
🟧	Silty Clay 2	127	6,500	0
🟧	Silty Clay 3	127	4,500	0
🟨	Silty Clay 4	119	3,500	0

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated Undrained - Final

● 2.37



AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment

MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Rear Abutment - Short Term (Undrained) - Final

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....EAR-ST-b16 final.BEN
Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	0.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	2400.0 lb/ft ²

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 5.14 $N\gamma = 0.00$

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	39.90	[ft]	{ Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 36.90 ft }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:

SCALE:

0 5 10 15 20 25 30 [ft]

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8235 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.612, Eccentricity, e/L = 0.1227, CDR-overturning = 4.08

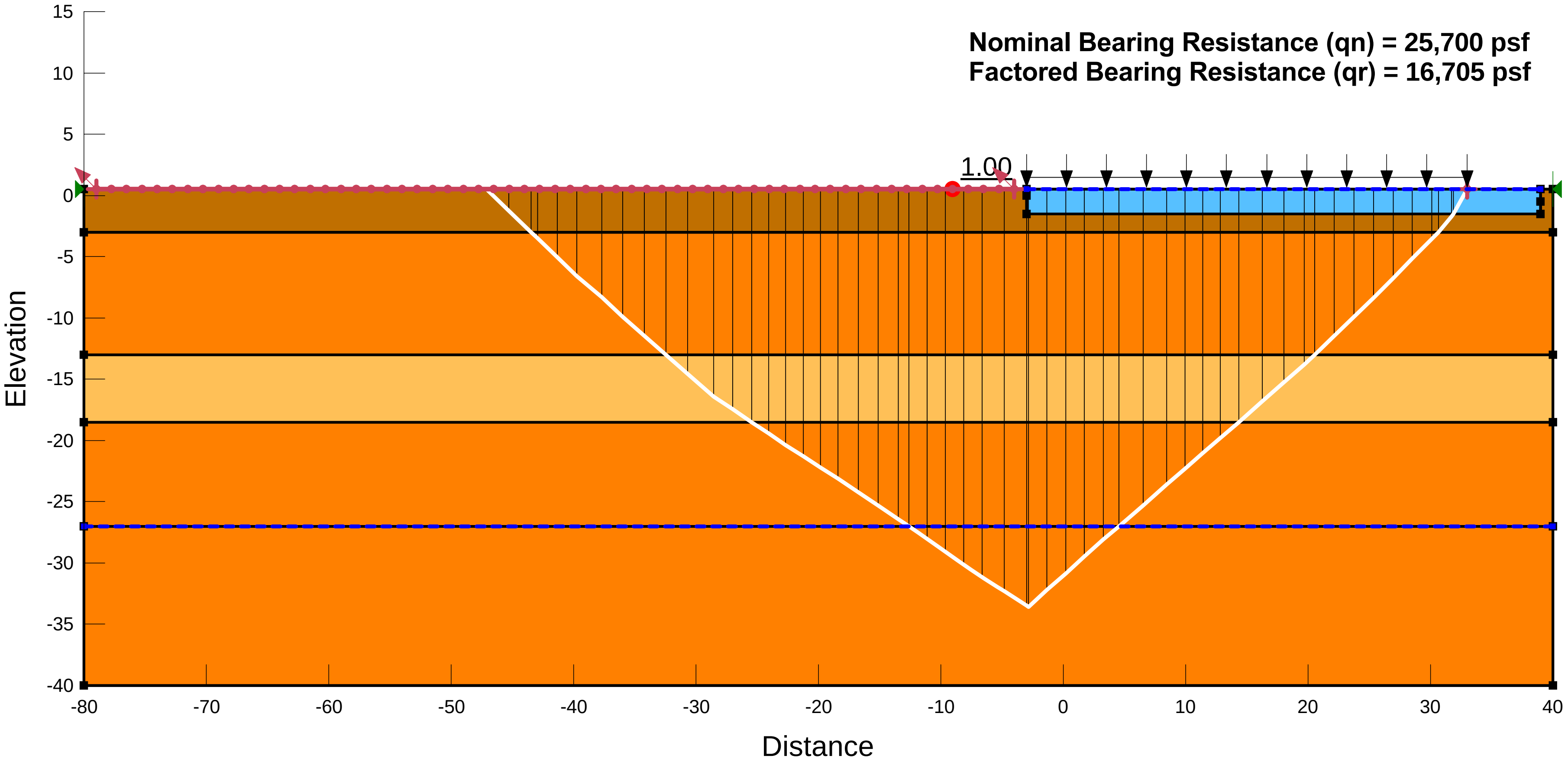
	METAL STRIP			CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	36.00	1								
2	3.44	36.00	1								
3	5.91	36.00	1								
4	8.37	36.00	1								
5	10.83	36.00	1								
6	13.29	36.00	1								
7	15.75	36.00	1								
8	18.21	36.00	1								
9	20.67	36.00	1								
10	23.13	36.00	1								
11	25.59	36.00	1								
12	28.05	36.00	1								
13	30.51	36.00	1								
14	32.97	36.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment
MSE Wall Bearing Capacity
Lawrence Co., OH

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	2,400	0
🟧	Silty Clay 2	122	6,000	0
🟨	Silty Clay 3	126	7,500	0

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Final Facing
Undrained Conditions



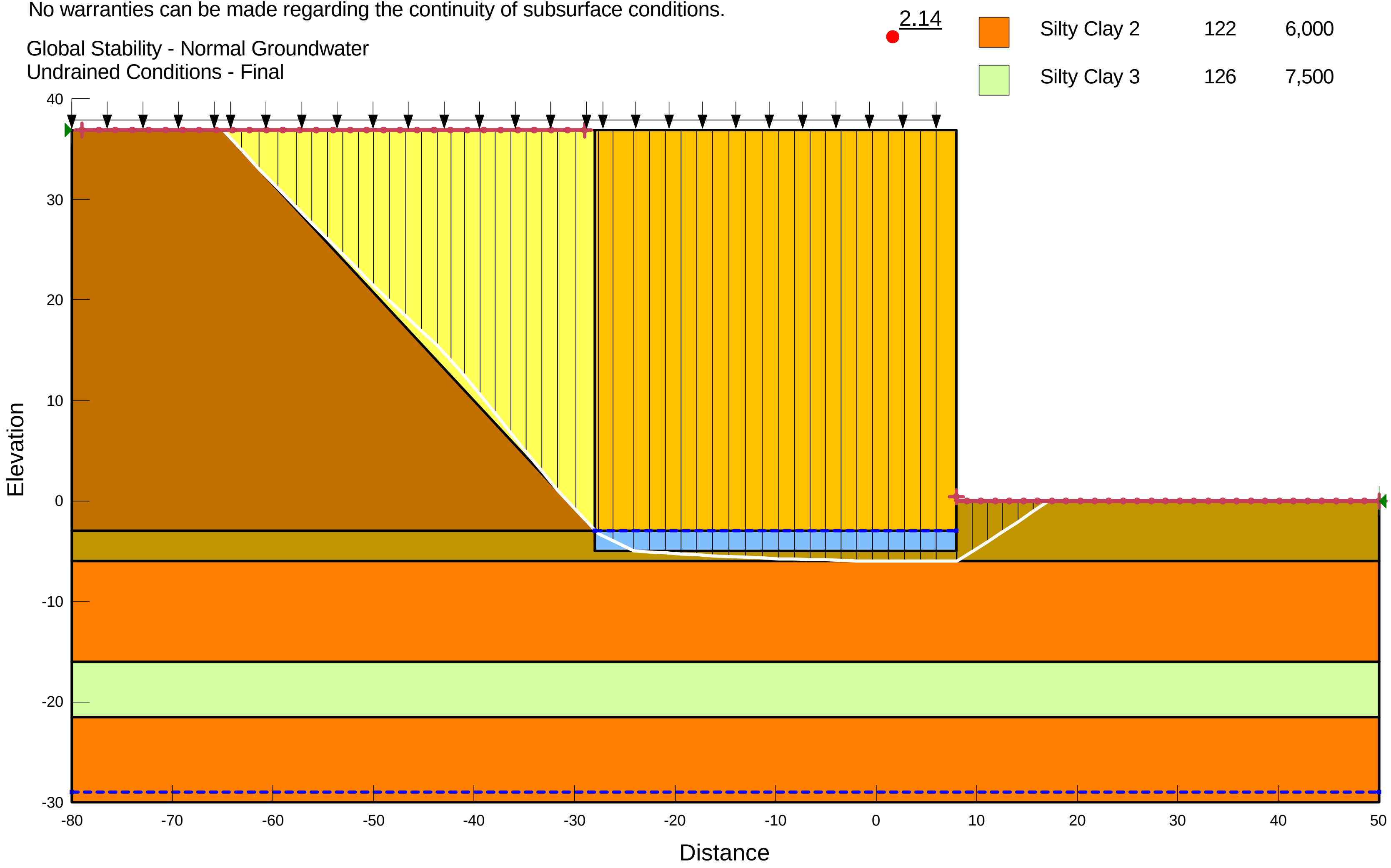
Nominal Bearing Resistance (qn) = 25,700 psf
Factored Bearing Resistance (qr) = 16,705 psf

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment
MSE Wall Stability Analysis
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟫	Embankment Fill	125	2,500	0
🟦	Foundation Prep	130	0	34
🟧	MSE Fill	120	3,000	34
🟨	Retained Fill	120	0	30
🟫	Silty Clay 1	119	2,400	0
🟧	Silty Clay 2	122	6,000	0
🟩	Silty Clay 3	126	7,500	0

Global Stability - Normal Groundwater
Undrained Conditions - Final



AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment
MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Wing Wall - Short Term (Undrained) - Final

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....ING-ST-b16 final.BEN
Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	0.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	2400.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 4.11 N γ= 0.00

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	37.40	[ft]	{ Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 33.40 ft }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

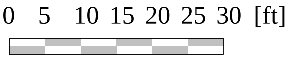
UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:

SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8065 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.568, Eccentricity, e/L = 0.1470, CDR-overturning = 3.40

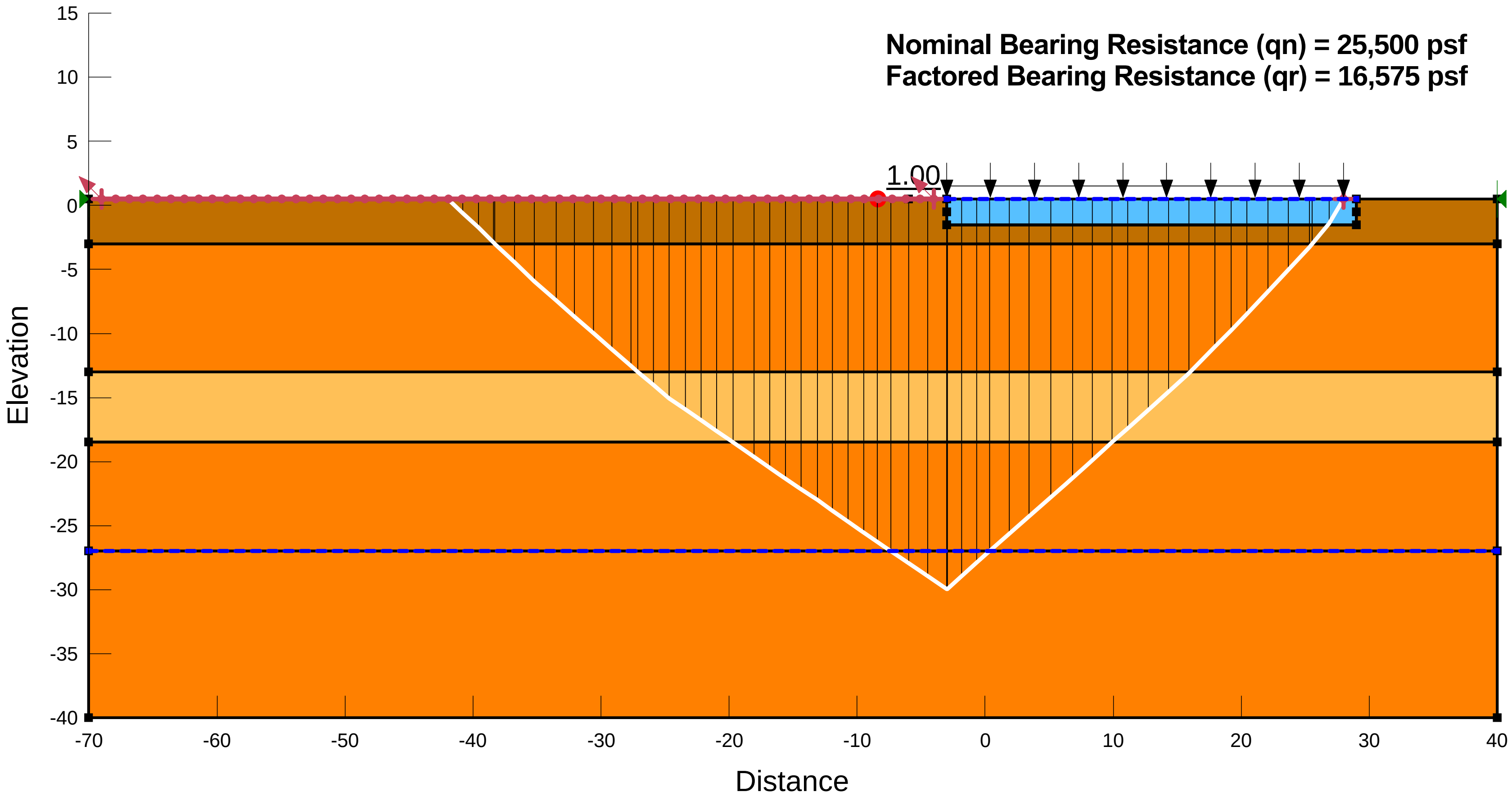
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	31.00	1								
2	3.44	31.00	1								
3	5.91	31.00	1								
4	8.37	31.00	1								
5	10.83	31.00	1								
6	13.29	31.00	1								
7	15.75	31.00	1								
8	18.21	31.00	1								
9	20.67	31.00	1								
10	23.13	31.00	1								
11	25.59	31.00	1								
12	28.05	31.00	1								
13	30.51	31.00	1								
14	32.97	31.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Final Facing
Undrained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	2,400	0
🟧	Silty Clay 2	122	6,000	0
🟨	Silty Clay 3	126	7,500	0



Nominal Bearing Resistance (qn) = 25,500 psf
Factored Bearing Resistance (qr) = 16,575 psf

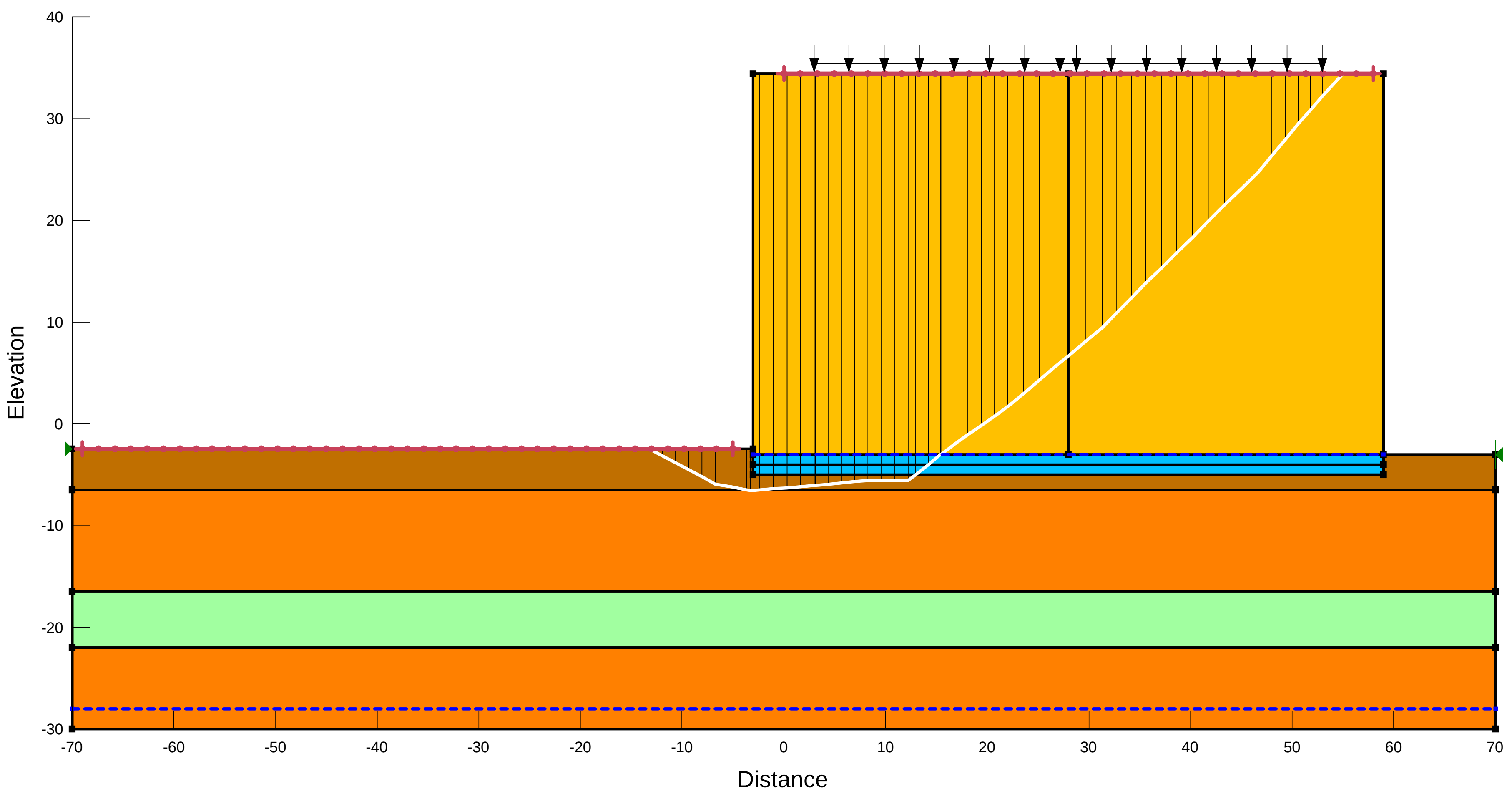
Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment - Wing Wall
MSE Wall Stability Analysis
Lawrence Co., OH

Color	**Name**	**Unit Weight (pcf)**	**Cohesion' (psf)**	**Phi' (°)**
🟦	Base Preparation	130	0	34
🟨	MSE Fill	120	2,000	34
🟫	Silty Clay 1	119	2,400	0
🟧	Silty Clay 2	122	6,000	0
🟩	Silty Clay 3	126	7,500	0

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Undrained - Final

● 2.79



AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title: Bridge 16 - Fwd Abutment
Project Number: LAW-7-0370 (PID-75923)
Client: ODOT
Designer: DRP
Station Number: 196+39.17

Description:

Bridge 16 - Fwd Abutment - Short Term (Undrained) - Final - Bottom of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....nal bot of prep.BENp

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	0.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	4000.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 5.14 $N\gamma = 0.00$

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 40.24 [ft] { Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 37.24 ft }

Soil in front of wall is Horizontal.

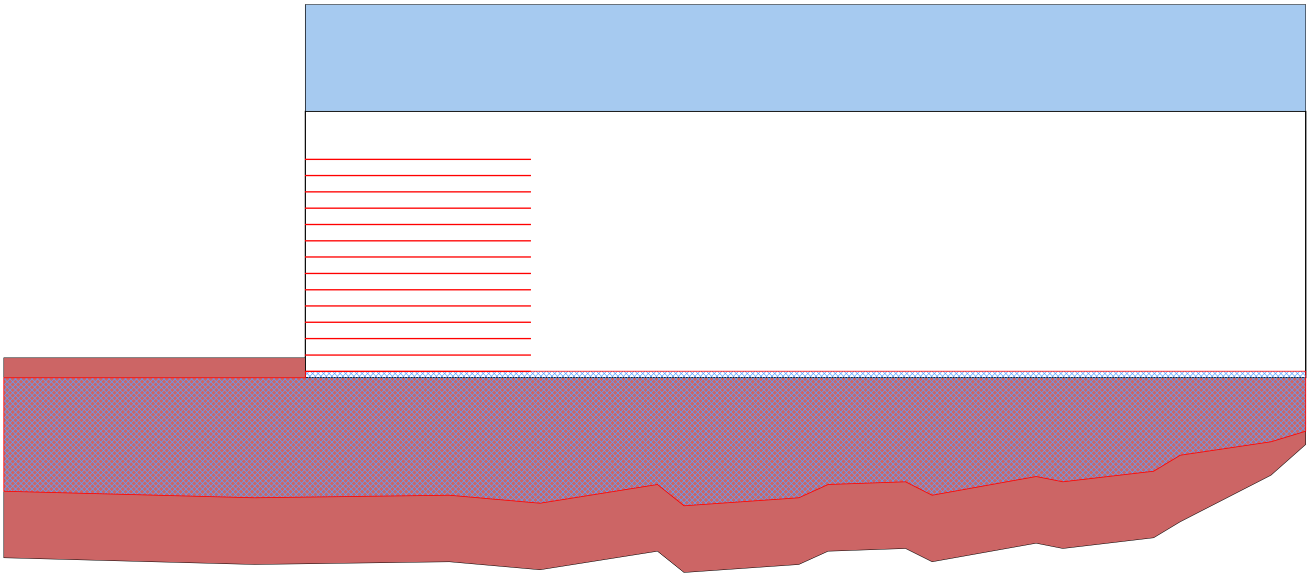
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 5 10 15 20 25 30 [ft]

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 1.56, factored bearing load = 8544 lb/ft².
Foundation Interface: Direct sliding, CDR = 2.006, Eccentricity, e/L = 0.1397, CDR-overturning = 3.58

METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	34.00	1								
2	3.44	34.00	1								
3	5.91	34.00	1								
4	8.37	34.00	1								
5	10.83	34.00	1								
6	13.29	34.00	1								
7	15.75	34.00	1								
8	18.21	34.00	1								
9	20.67	34.00	1								
10	23.13	34.00	1								
11	25.59	34.00	1								
12	28.05	34.00	1								
13	30.51	34.00	1								
14	32.97	34.00	1								

AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Wing Wall - Short Term (Undrained) - Final - Bottom of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1..... .....nal bot of prep.BENp

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	0.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	4000.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 4.17 N γ= 0.00

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 37.70 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 33.70 ft }
Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

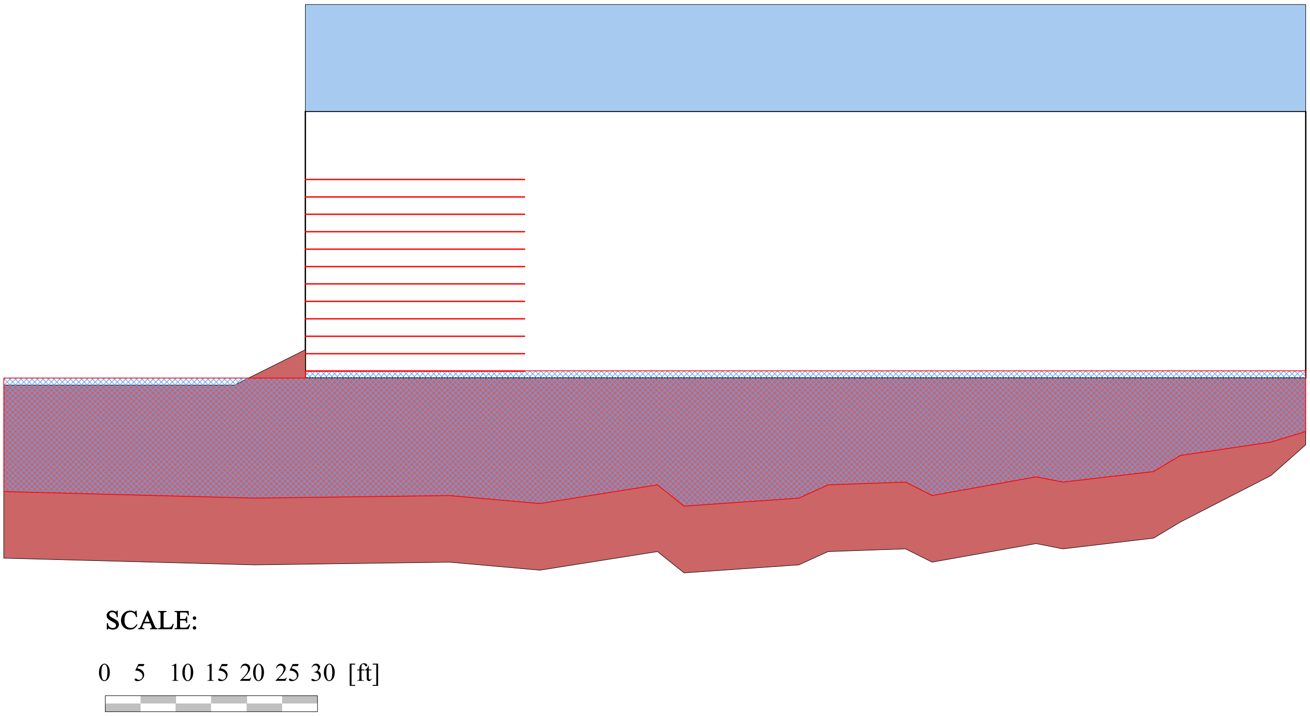
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 1.33, factored bearing load = 8157 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.937, Eccentricity, e/L = 0.1491, CDR-overturning = 3.35

METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	31.00	1								
2	3.44	31.00	1								
3	5.91	31.00	1								
4	8.37	31.00	1								
5	10.83	31.00	1								
6	13.29	31.00	1								
7	15.75	31.00	1								
8	18.21	31.00	1								
9	20.67	31.00	1								
10	23.13	31.00	1								
11	25.59	31.00	1								
12	28.05	31.00	1								

AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Rear Abutment - Short Term (Undrained) - Final - Bottom of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....nal bot of prep.BENp

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	0.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	2400.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 5.14 N_γ= 0.00

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 41.90 [ft] { Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 38.90 ft }

Soil in front of wall is Horizontal.

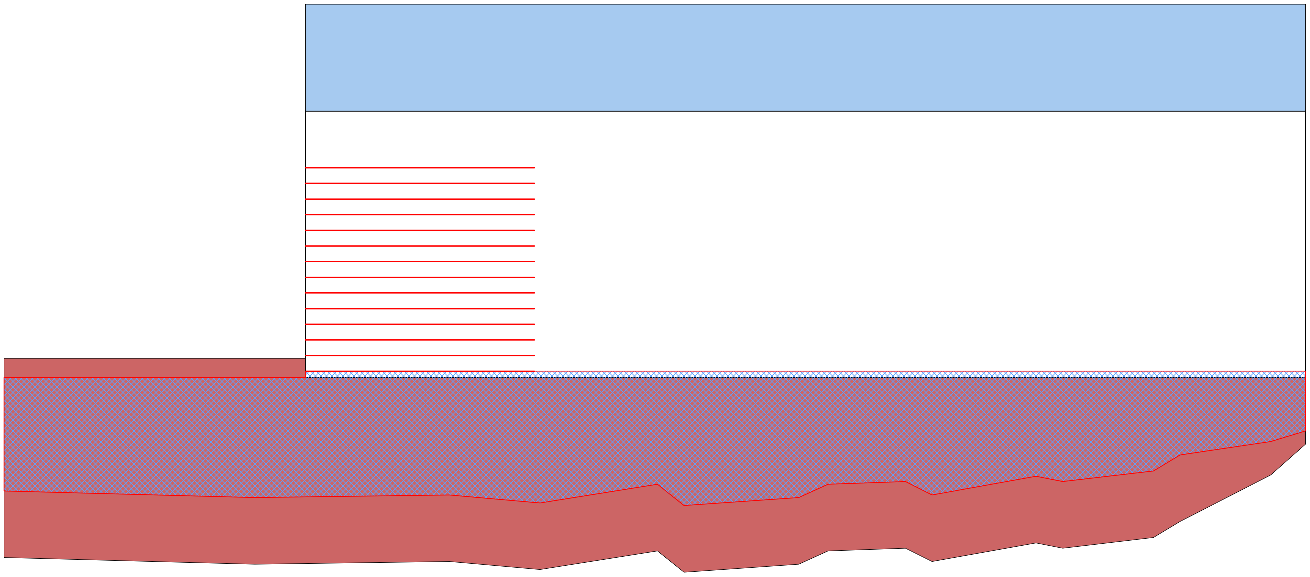
Batter, ω 0.0 [deg]
Backslope, β 0.0 [deg]
Backslope rise 0.0 [ft] Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ^{2}], and live load is 250.0 [lb/ft ^{2}]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 5 10 15 20 25 30 [ft]

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8800 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.469, Eccentricity, e/L = 0.1342, CDR-overturning = 3.73

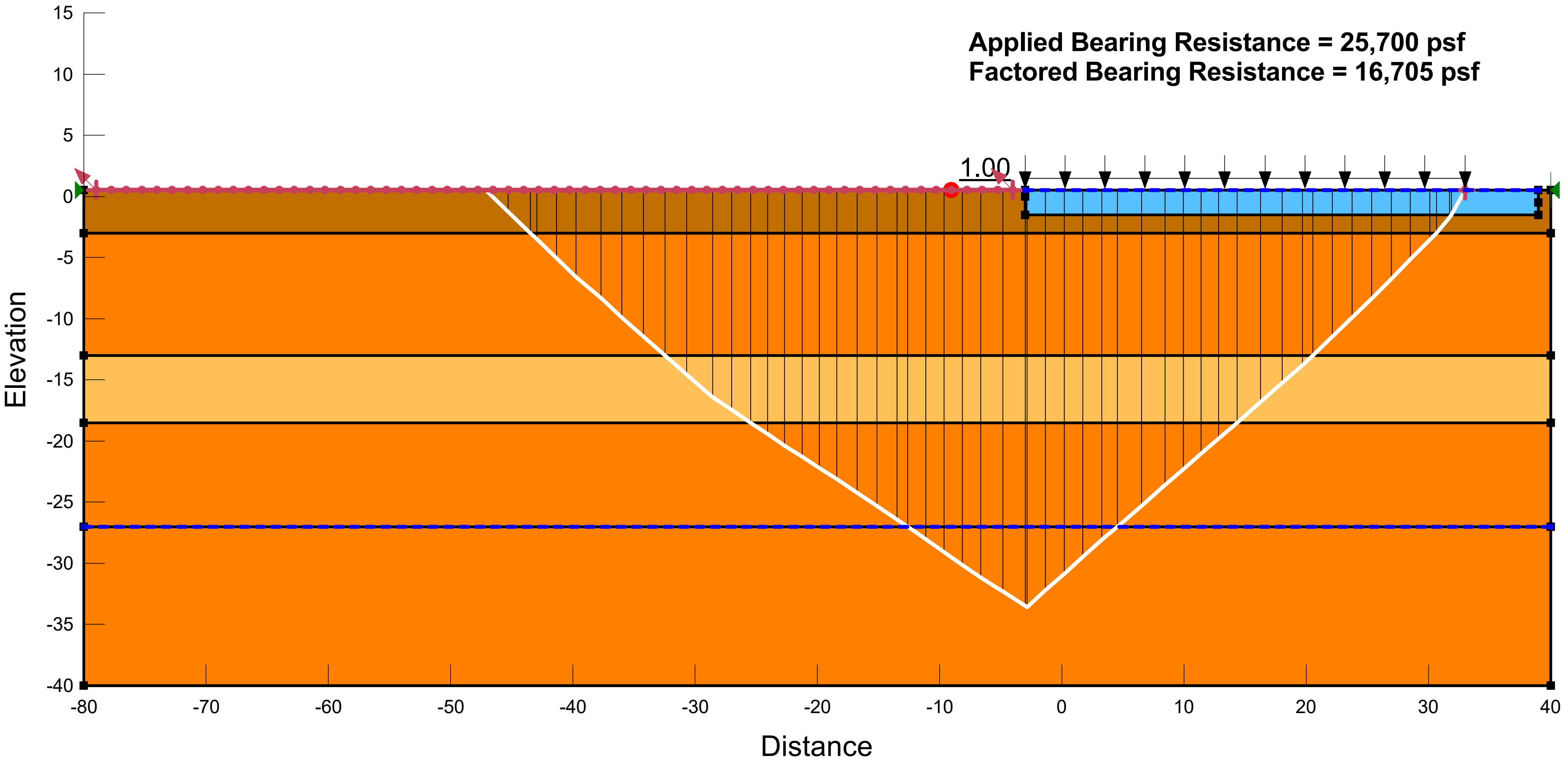
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	36.00									
2	3.44	36.00									
3	5.91	36.00									
4	8.37	36.00									
5	10.83	36.00									
6	13.29	36.00									
7	15.75	36.00									
8	18.21	36.00									
9	20.67	36.00									
10	23.13	36.00									
11	25.59	36.00									
12	28.05	36.00									
13	30.51	36.00									
14	32.97	36.00									

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available
subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided
drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Final Facing
Undrained Conditions

Color	**Name**	**Unit Weight (pcf)**	**Cohesion' (psf)**	**Phi' (°)**
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	2,400	0
🟧	Silty Clay 2	122	6,000	0
🟨	Silty Clay 3	126	7,500	0



Applied Bearing Resistance = 25,700 psf
Factored Bearing Resistance = 16,705 psf

AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Wing Wall - Short Term (Undrained) - Final - Bottom of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....nal bot of prep.BENp

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	0.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	2400.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 4.11 $N\gamma = 0.00$

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

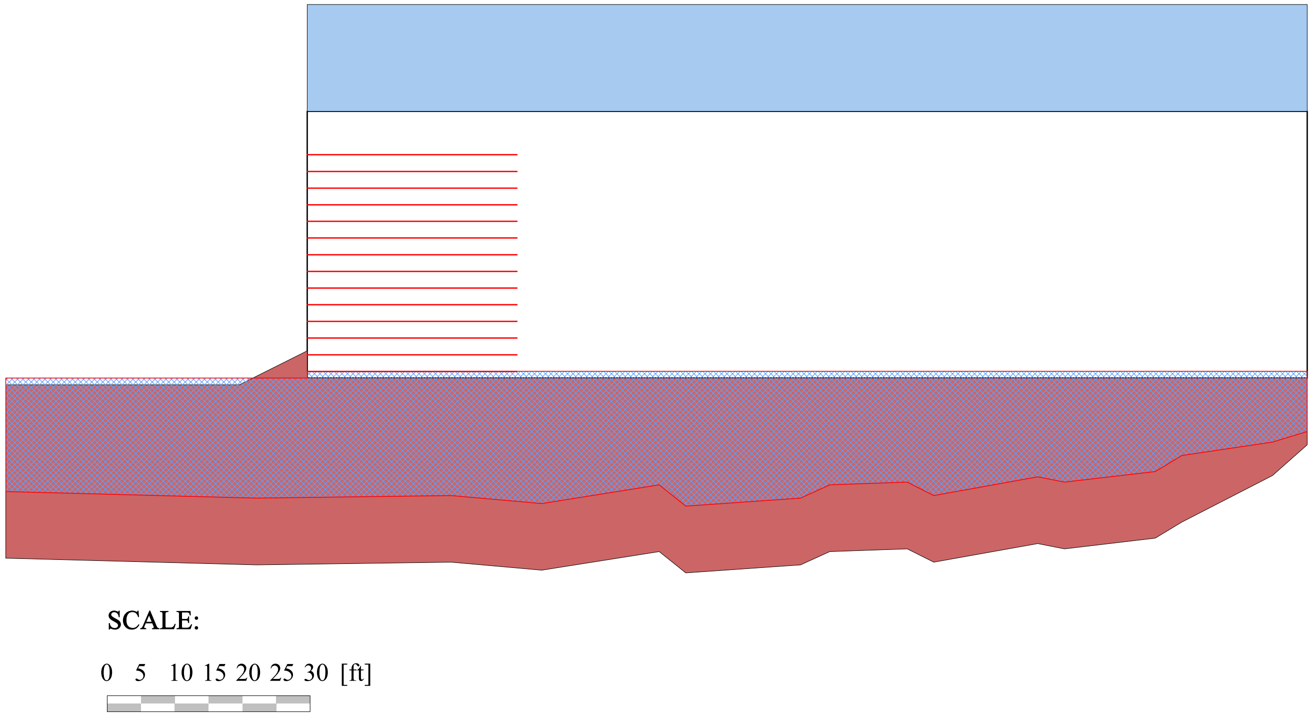
Design height, Hd 39.40 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished
bottom grade is H = 35.40 ft }
Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

Batter, ω 0.0 [deg]
Backslope, β 0.0 [deg]
Backslope rise 0.0 [ft] Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE
🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - seel imit equilibrium analysis, factored bearing load = 8700 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.421, Eccentricity, e/L = 0.1617, CDR-overturning = 3.09

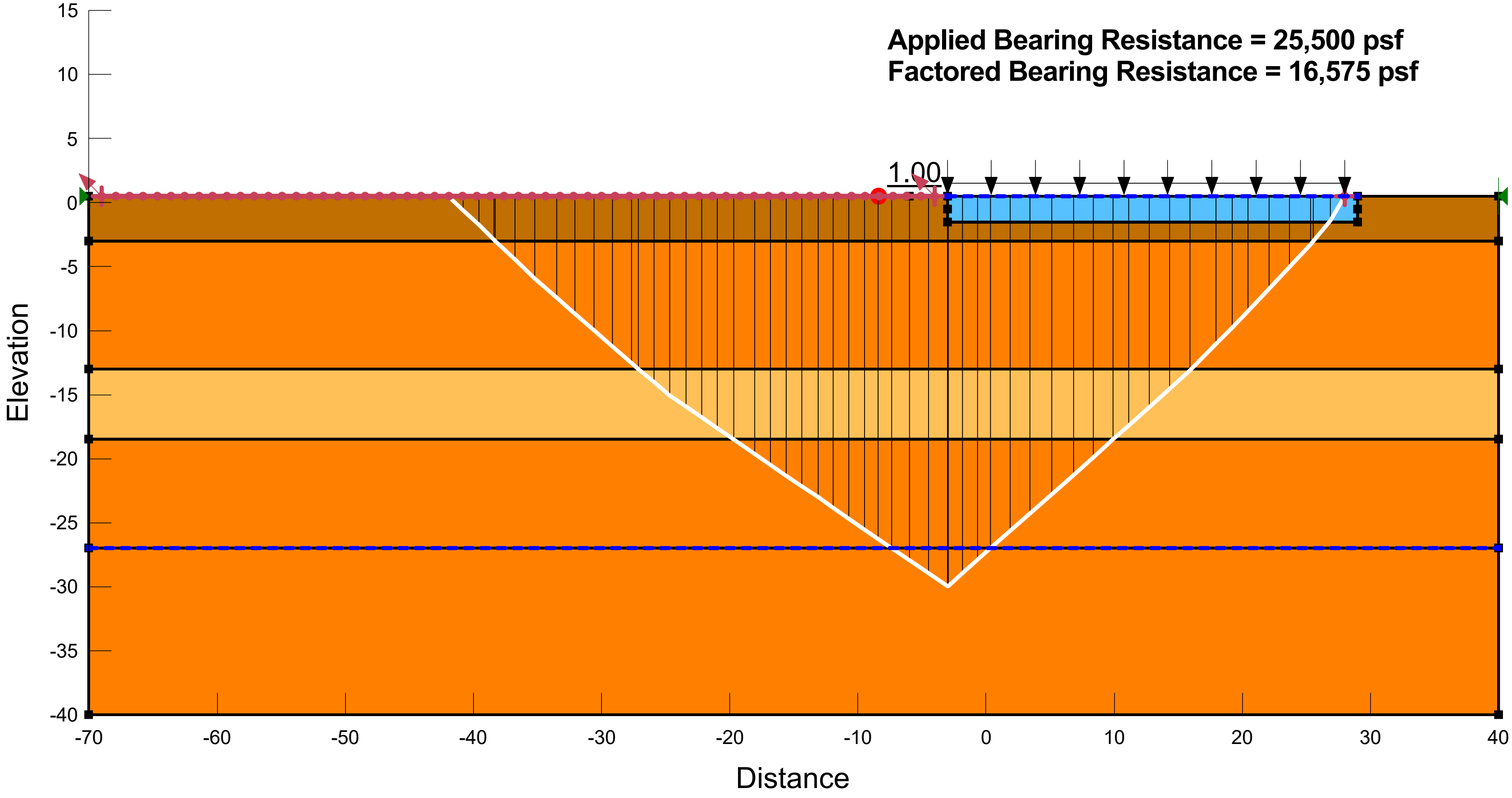
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	31.00	1								
2	3.44	31.00	1								
3	5.91	31.00	1								
4	8.37	31.00	1								
5	10.83	31.00	1								
6	13.29	31.00	1								
7	15.75	31.00	1								
8	18.21	31.00	1								
9	20.67	31.00	1								
10	23.13	31.00	1								
11	25.59	31.00	1								
12	28.05	31.00	1								
13	30.51	31.00	1								
14	32.97	31.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Final Facing
Undrained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	2,400	0
🟧	Silty Clay 2	122	6,000	0
🟨	Silty Clay 3	126	7,500	0



Applied Bearing Resistance = 25,500 psf
Factored Bearing Resistance = 16,575 psf

Table 9 Analyses

AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Fwd Abutment - Long Term (Drained) - Final

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....Fwd-LT-b16 final.BEN

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft^3
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft^3
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft^3
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	24.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft^2

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 19.32 N_γ= 9.44

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

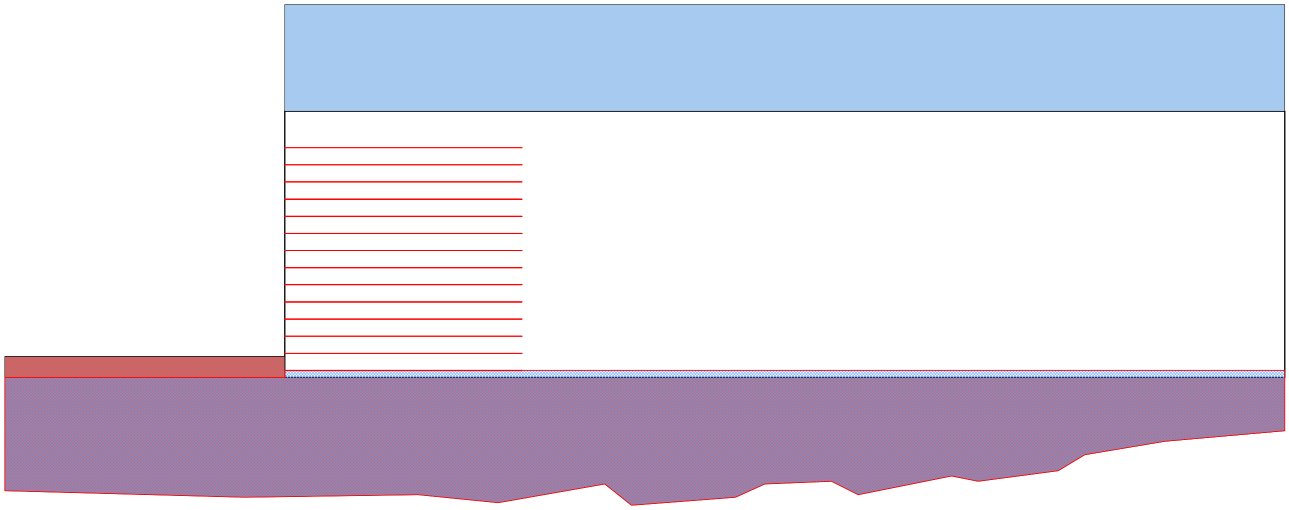
Design height, Hd	38.24	[ft]	{ Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 35.24 ft }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

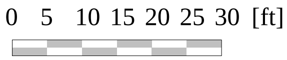
🟦 Uniformly distributed dead load is 0.0 [lb/ft ^{2}], and live load is 250.0 [lb/ft ^{2}]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 7967 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.488, Eccentricity, e/L = 0.1272, CDR-overturning = 3.93

METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	34.00	1								
2	3.44	34.00	1								
3	5.91	34.00	1								
4	8.37	34.00	1								
5	10.83	34.00	1								
6	13.29	34.00	1								
7	15.75	34.00	1								
8	18.21	34.00	1								
9	20.67	34.00	1								
10	23.13	34.00	1								
11	25.59	34.00	1								
12	28.05	34.00	1								
13	30.51	34.00	1								
14	32.97	34.00	1								

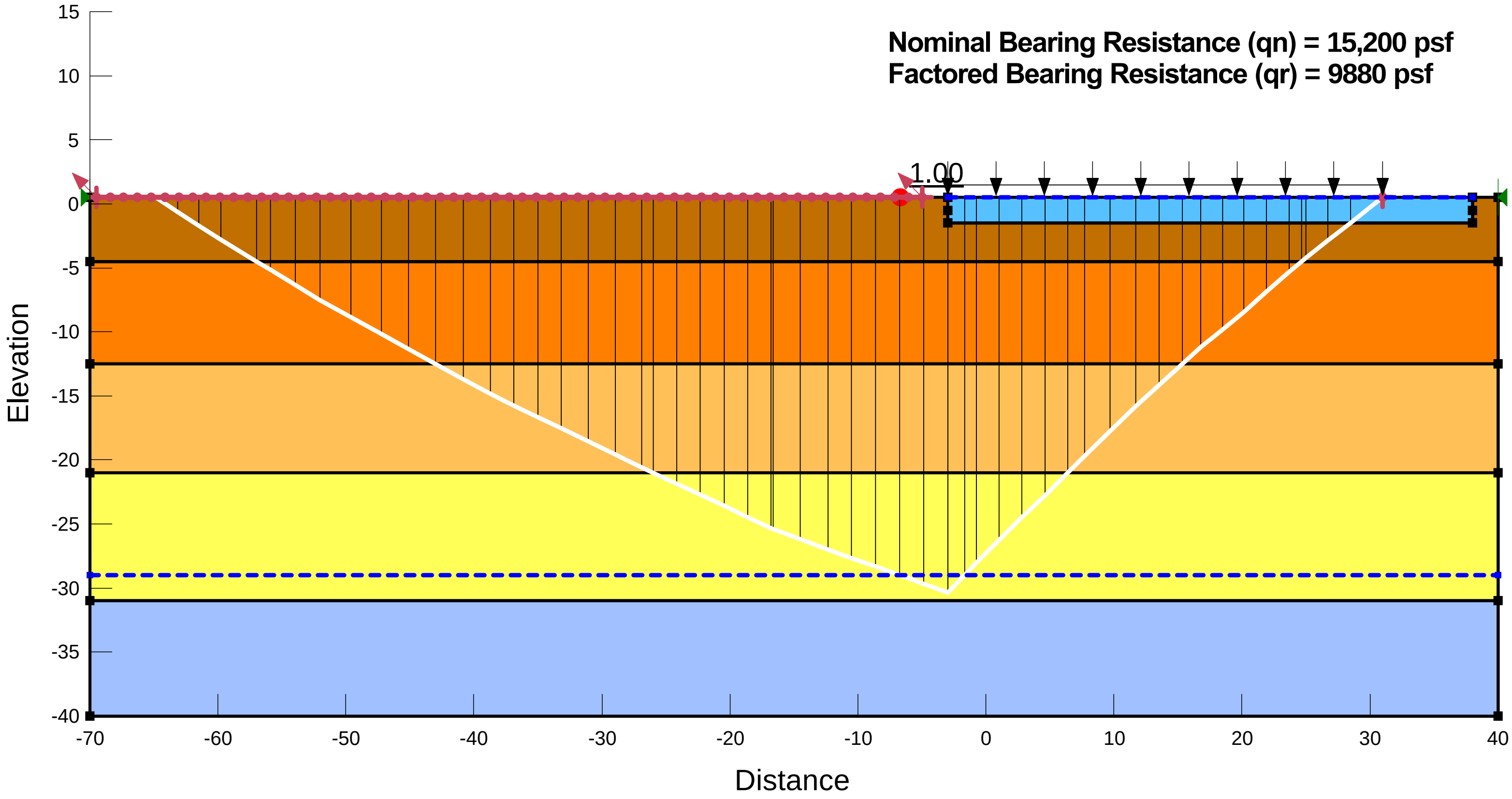
Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Final Facing
Drained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	122	150	24
🟧	Silty Clay 2	127	175	25
🟧	Silty Clay 3	127	150	24
🟨	Silty Clay 4	119	150	23
🟦	Silty Clay 5	120	150	24

Nominal Bearing Resistance (qn) = 15,200 psf
Factored Bearing Resistance (qr) = 9880 psf

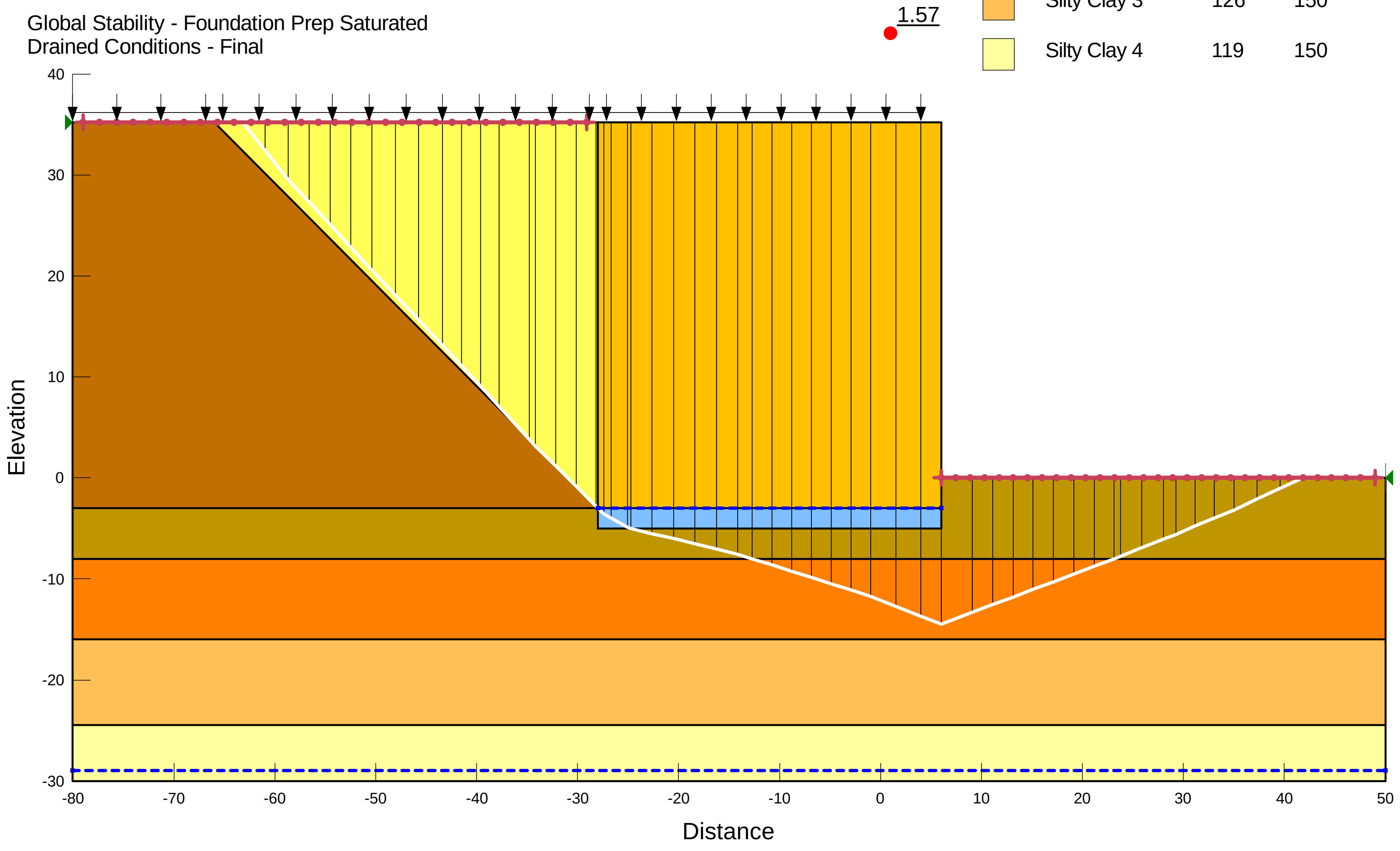


Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟫	Embankment Fill	125	250	26
🟦	Foundation Prep	130	0	34
🟨	MSE Fill	120	3,000	34
🟨	Retained Fill	120	0	30
🟫	Silty Clay 1	122	150	24
🟧	Silty Clay 2	127	175	25
🟧	Silty Clay 3	126	150	24
🟨	Silty Clay 4	119	150	23

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment
MSE Wall Stability Analysis
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Drained Conditions - Final



AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Wing Wall - Long Term (Drained) - Final

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....ING-LT-b16 final.BEN
Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	24.0 °
Equivalent cohesion, c $_{\text{equiv.}}$	150.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 4.62 N_γ= 3.09

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 35.70 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 31.70 ft }

Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

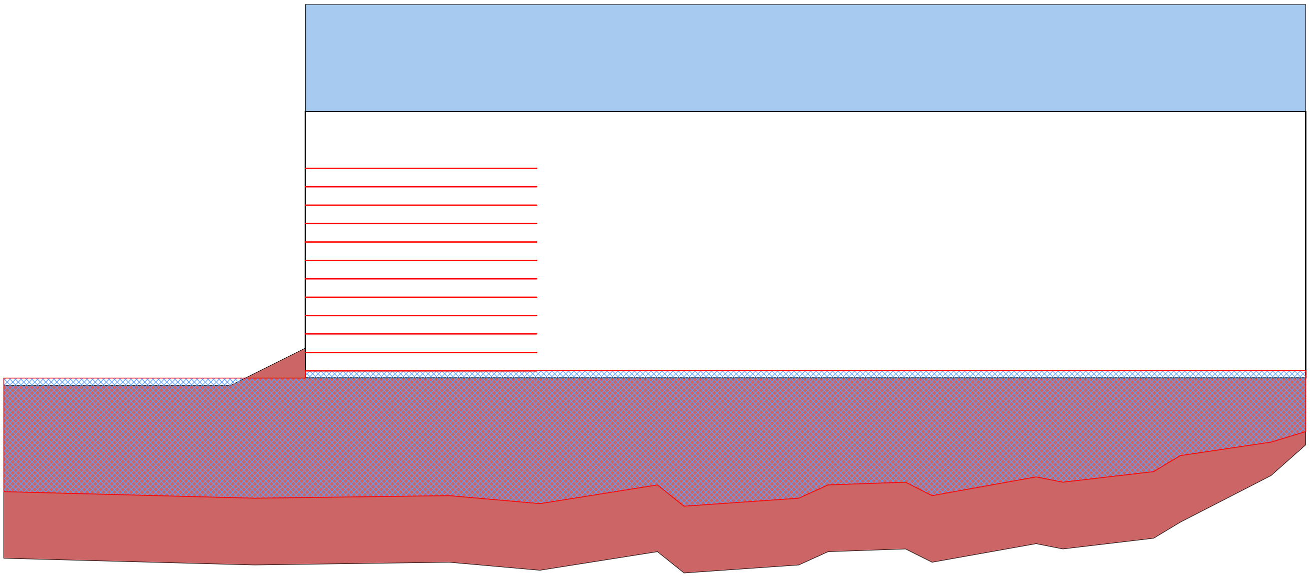
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

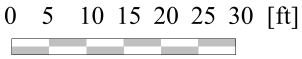
🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 7558 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.447, Eccentricity, e/L = 0.1351, CDR-overturning = 3.70

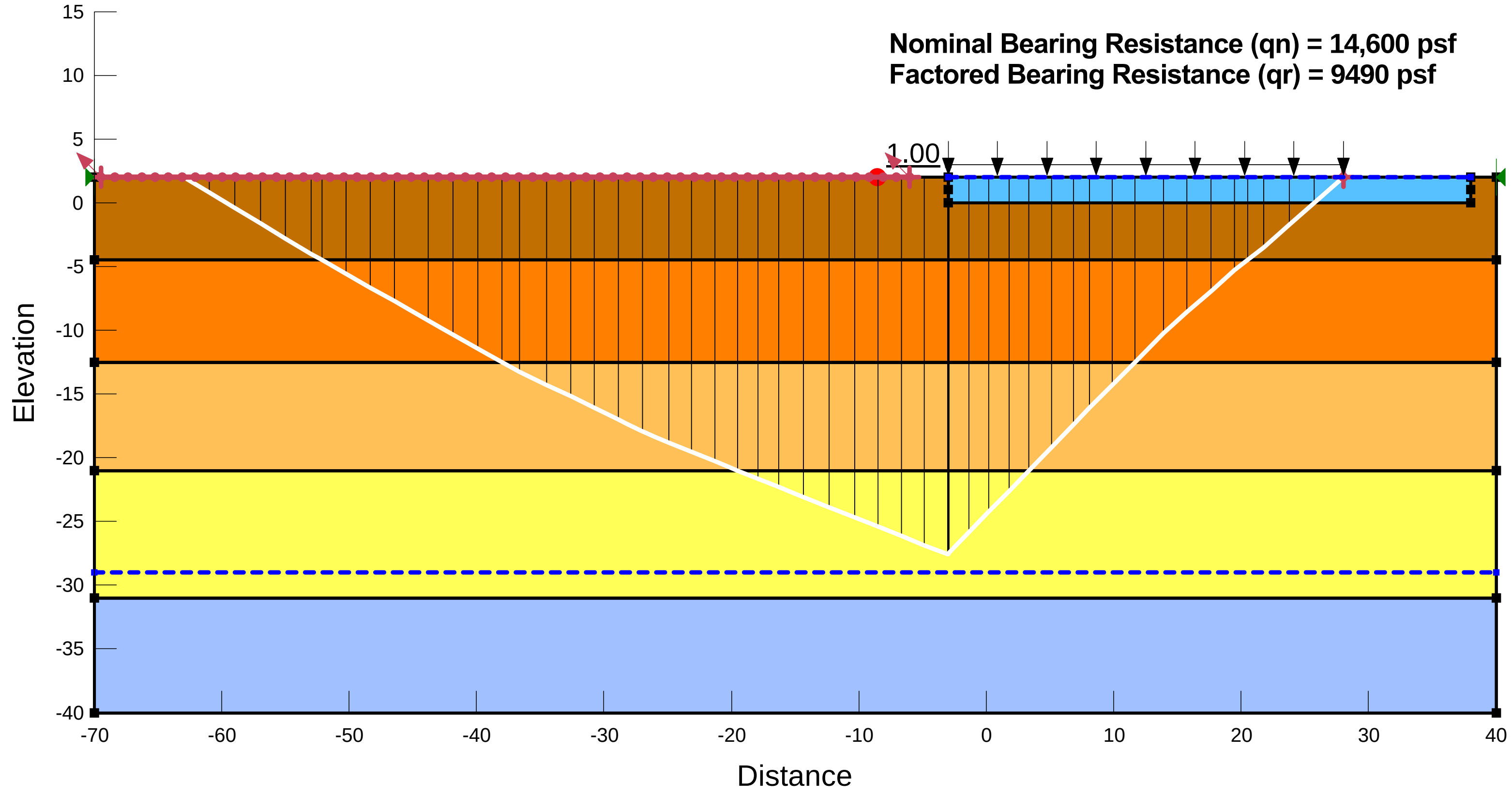
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	31.00	1								
2	3.44	31.00	1								
3	5.91	31.00	1								
4	8.37	31.00	1								
5	10.83	31.00	1								
6	13.29	31.00	1								
7	15.75	31.00	1								
8	18.21	31.00	1								
9	20.67	31.00	1								
10	23.13	31.00	1								
11	25.59	31.00	1								
12	28.05	31.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Final Facing
Drained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	122	150	24
🟧	Silty Clay 2	127	175	25
🟧	Silty Clay 3	127	150	24
🟨	Silty Clay 4	119	150	23
🟦	Silty Clay 5	120	150	24



Nominal Bearing Resistance (qn) = 14,600 psf
Factored Bearing Resistance (qr) = 9490 psf

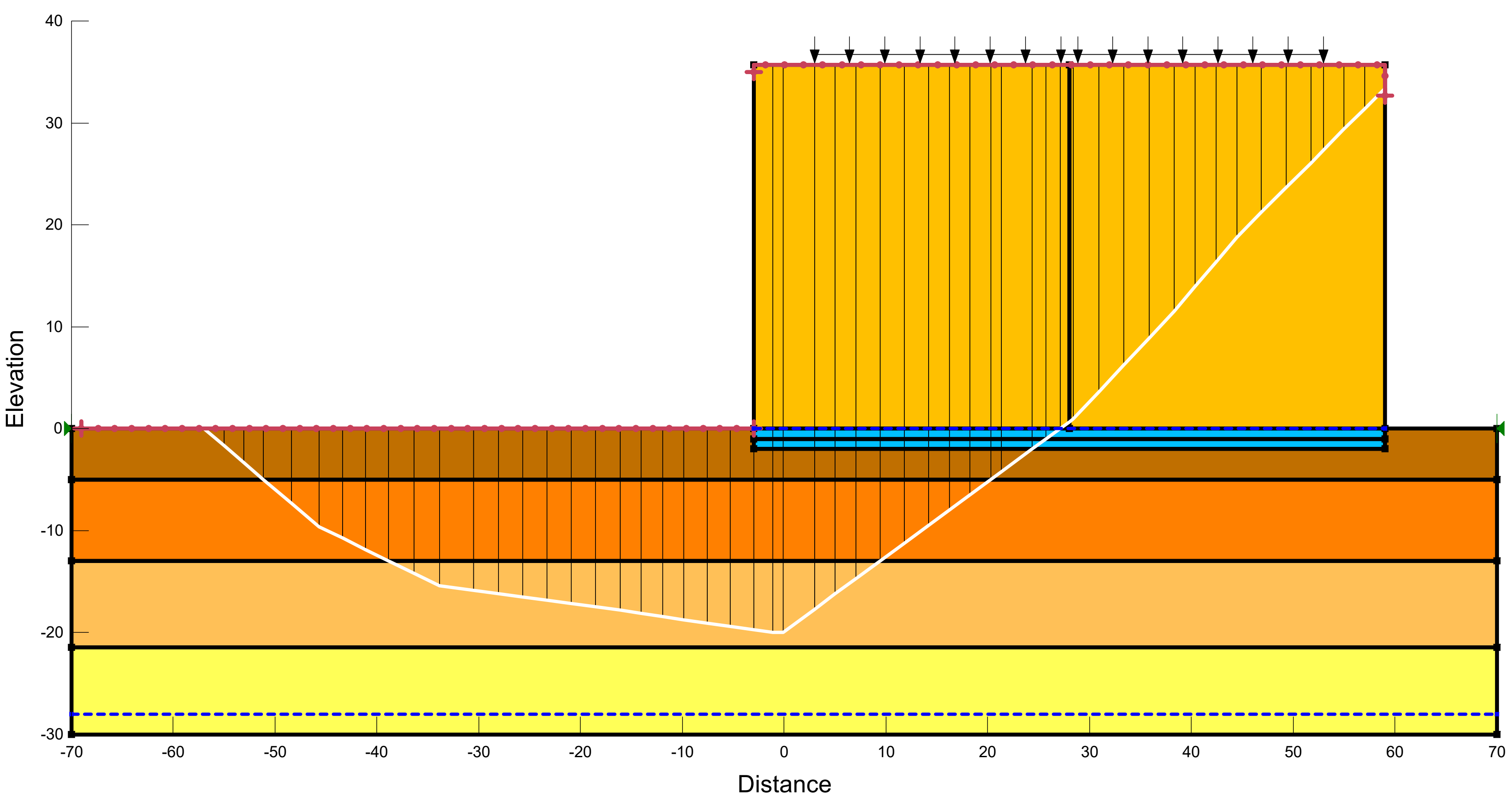
Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment - Wing Wall
MSE Wall Stability Analysis
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟨	MSE Fill	120	2,000	34
🟫	Silty Clay 1	122	150	24
🟧	Silty Clay 2	127	175	25
🟧	Silty Clay 3	127	150	24
🟨	Silty Clay 4	119	150	23

Global Stability - Foundation Prep Saturated
Drained - Final

1.92



AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment

MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Rear Abutment - Long Term (Drained) - Final

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....EAR-LT-b16 final.BEN

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	23.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 18.05 $N\gamma = 8.20$

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	39.90	[ft]	{ Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 36.90 ft }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

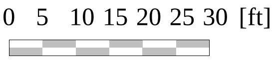
UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ^{2}], and live load is 250.0 [lb/ft ^{2}]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:

SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8235 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.448, Eccentricity, e/L = 0.1227, CDR-overturning = 4.08

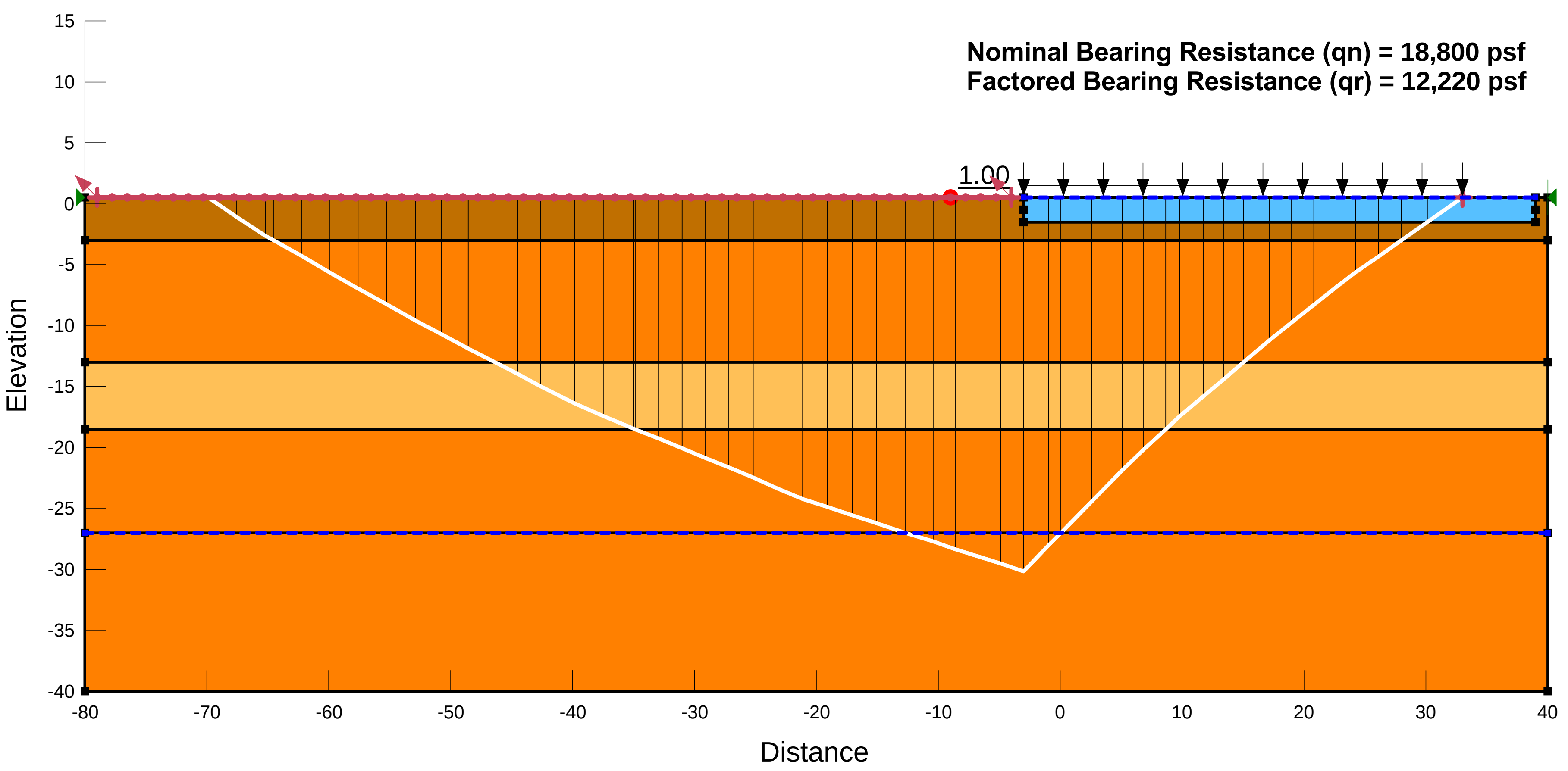
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	36.00	1								
2	3.44	36.00	1								
3	5.91	36.00	1								
4	8.37	36.00	1								
5	10.83	36.00	1								
6	13.29	36.00	1								
7	15.75	36.00	1								
8	18.21	36.00	1								
9	20.67	36.00	1								
10	23.13	36.00	1								
11	25.59	36.00	1								
12	28.05	36.00	1								
13	30.51	36.00	1								
14	32.97	36.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Final Facing
Drained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	150	23
🟧	Silty Clay 2	122	175	25
🟨	Silty Clay 3	126	175	26



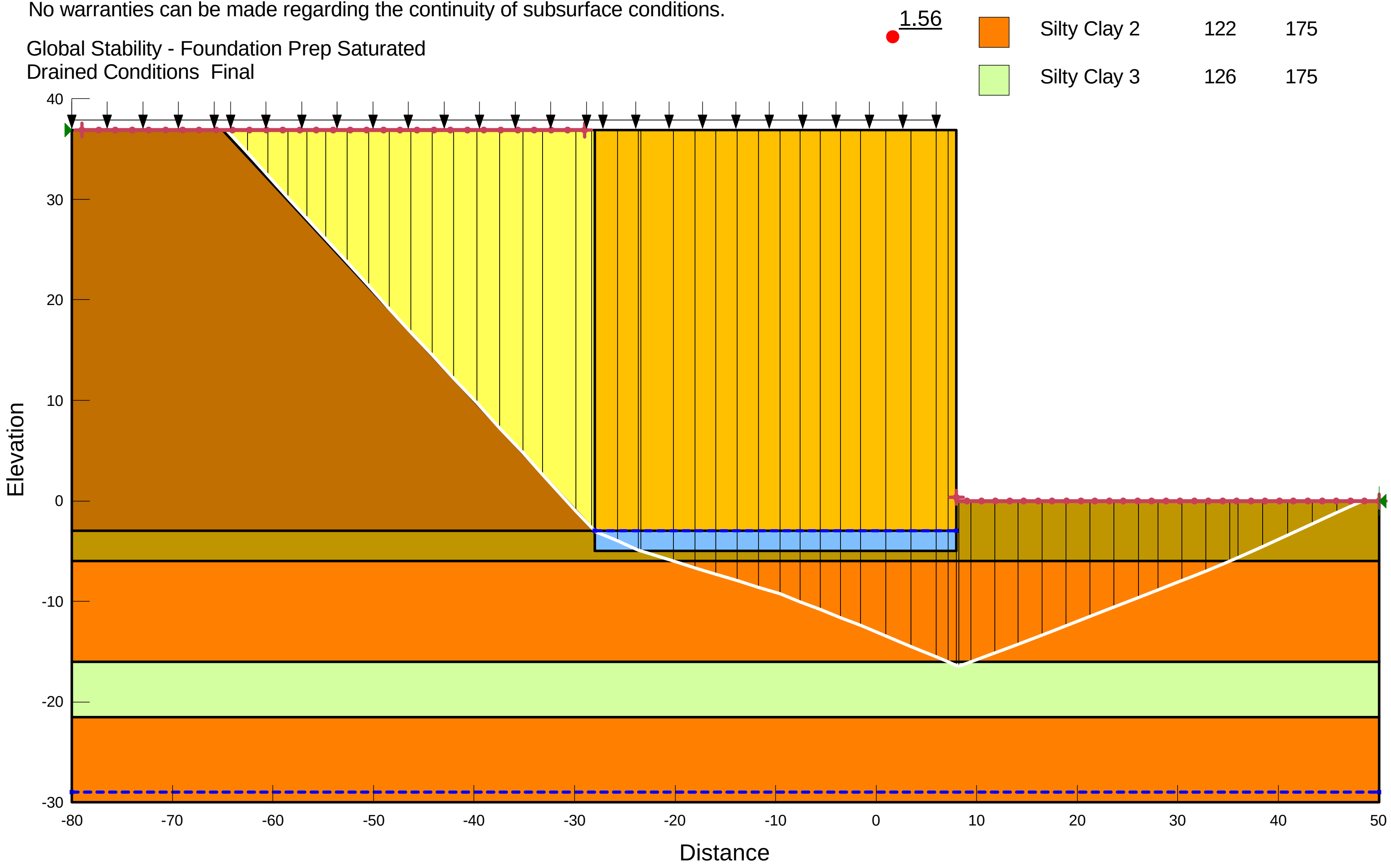
Nominal Bearing Resistance (qn) = 18,800 psf
Factored Bearing Resistance (qr) = 12,220 psf

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment
MSE Wall Stability Analysis
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟫	Embankment Fill	125	250	26
🟦	Foundation Prep	130	0	34
🟧	MSE Fill	120	3,000	34
🟨	Retained Fill	120	0	30
🟫	Silty Clay 1	119	150	23
🟧	Silty Clay 2	122	175	25
🟩	Silty Clay 3	126	175	26

Global Stability - Foundation Prep Saturated
Drained Conditions Final



AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment

MSEW(3.0): Update # 14.981

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Wing Wall - Long Term (Drained) - Final

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....ING-LT-b16 final.BEN

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	23.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 4.32 $N\gamma$= 2.90

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	37.40	[ft]	{ Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 33.40 ft }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:

SCALE:

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8065 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.325, Eccentricity, e/L = 0.1470, CDR-overturning = 3.40

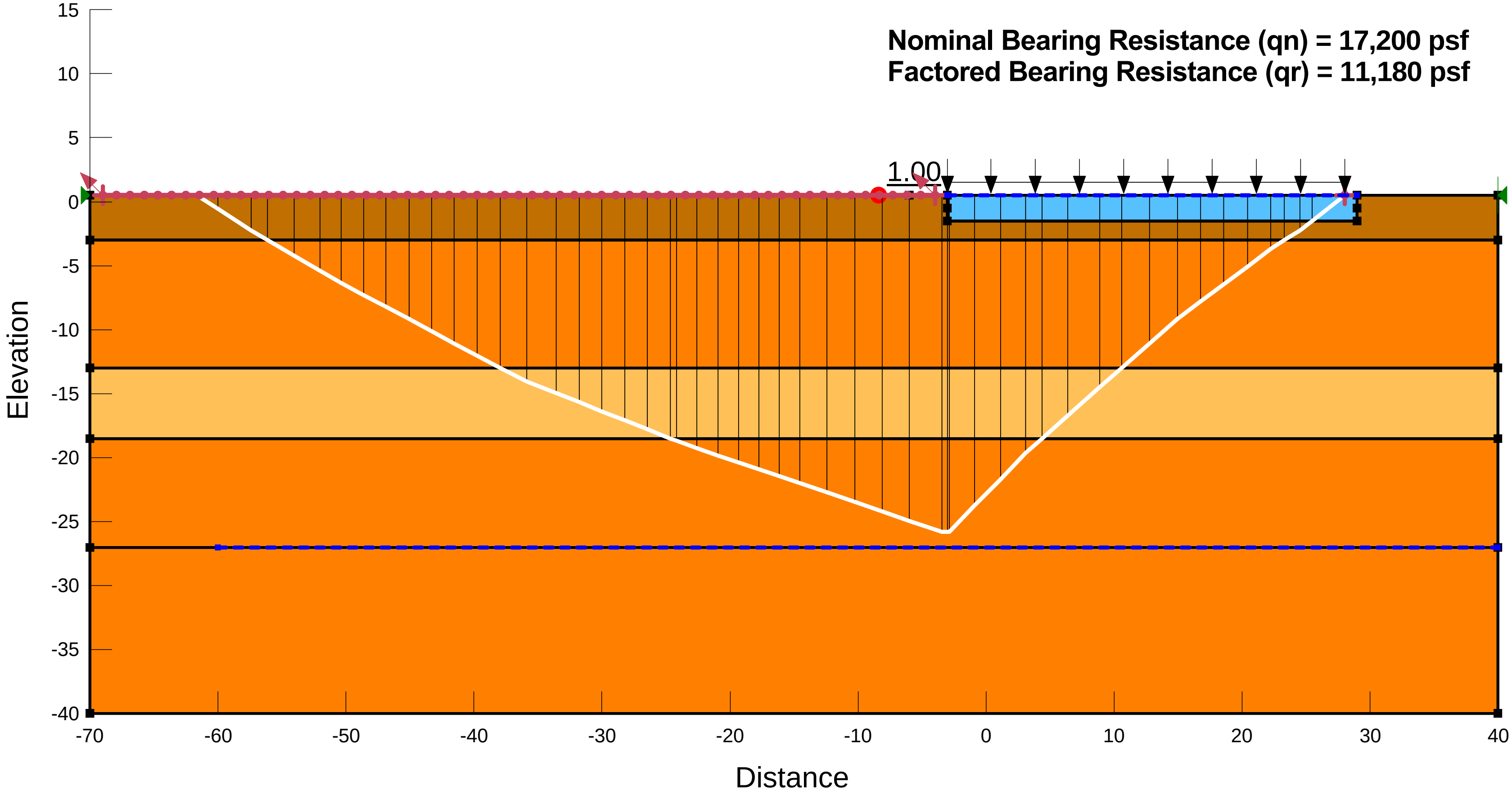
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	31.00	1								
2	3.44	31.00	1								
3	5.91	31.00	1								
4	8.37	31.00	1								
5	10.83	31.00	1								
6	13.29	31.00	1								
7	15.75	31.00	1								
8	18.21	31.00	1								
9	20.67	31.00	1								
10	23.13	31.00	1								
11	25.59	31.00	1								
12	28.05	31.00	1								
13	30.51	31.00	1								
14	32.97	31.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	150	23
🟧	Silty Clay 2	122	175	25
🟨	Silty Clay 3	126	175	26

Global Stability - Foundation Prep Saturated
Bearing Capacity for Final Facing
Drained Conditions



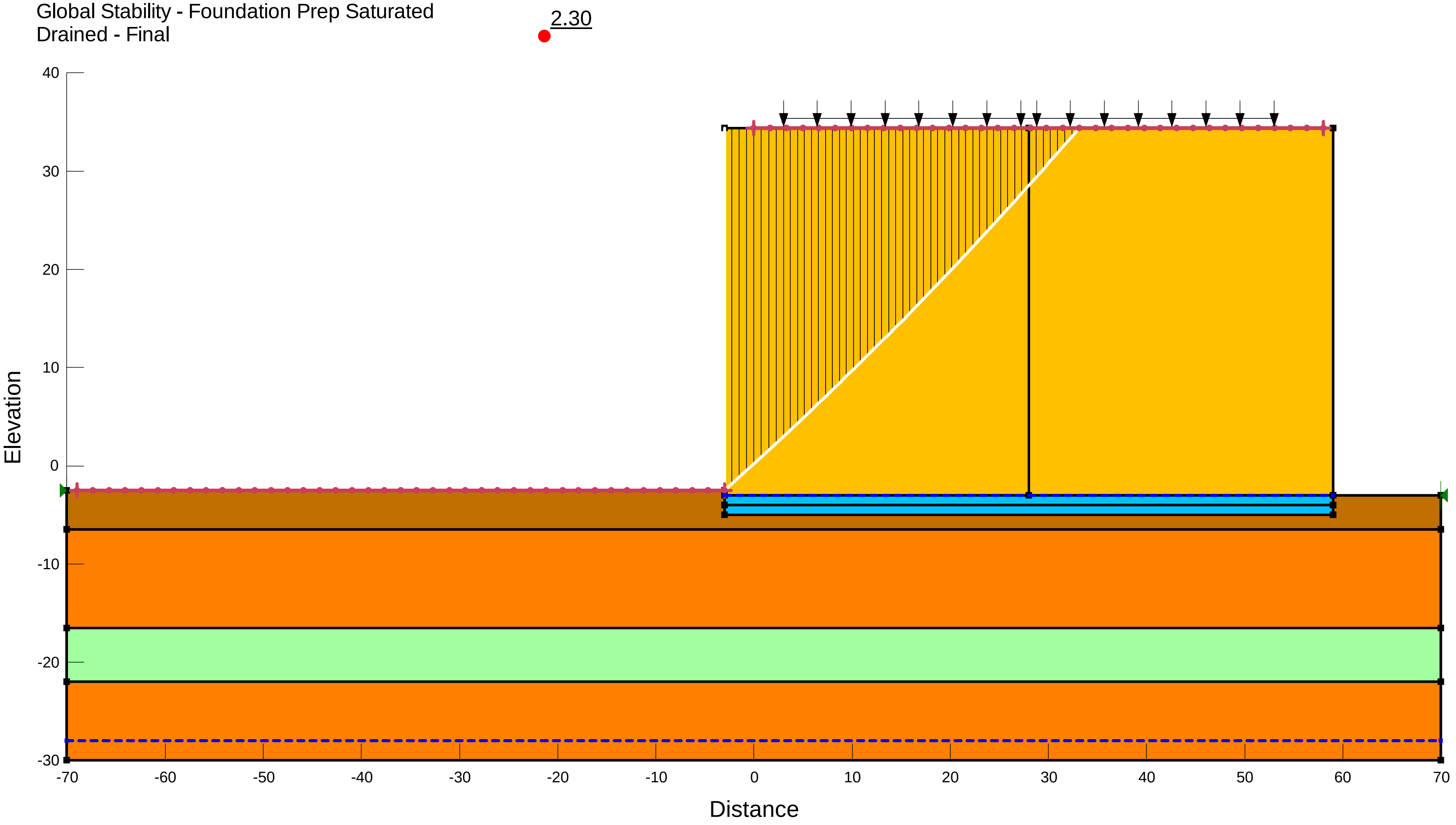
Nominal Bearing Resistance (qn) = 17,200 psf
Factored Bearing Resistance (qr) = 11,180 psf

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment - Wing Wall
MSE Wall Stability Analysis
Lawrence Co., OH

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟨	MSE Fill	120	2,000	34
🟫	Silty Clay 1	119	150	23
🟧	Silty Clay 2	122	175	25
🟩	Silty Clay 3	126	175	26

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Drained - Final



AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment
MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title: Bridge 16 - Fwd Abutment
Project Number: LAW-7-0370 (PID-75923)
Client: ODOT
Designer: DRP
Station Number: 196+39.17

Description:

Bridge 16 - Fwd Abutment - Long Term (Drained) - Final - Bottom of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....nal bot of prep.BENp
Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	24.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft ²

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 19.32 $N\gamma$= 9.44

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 40.24 [ft] { Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 37.24 ft }

Soil in front of wall is Horizontal.

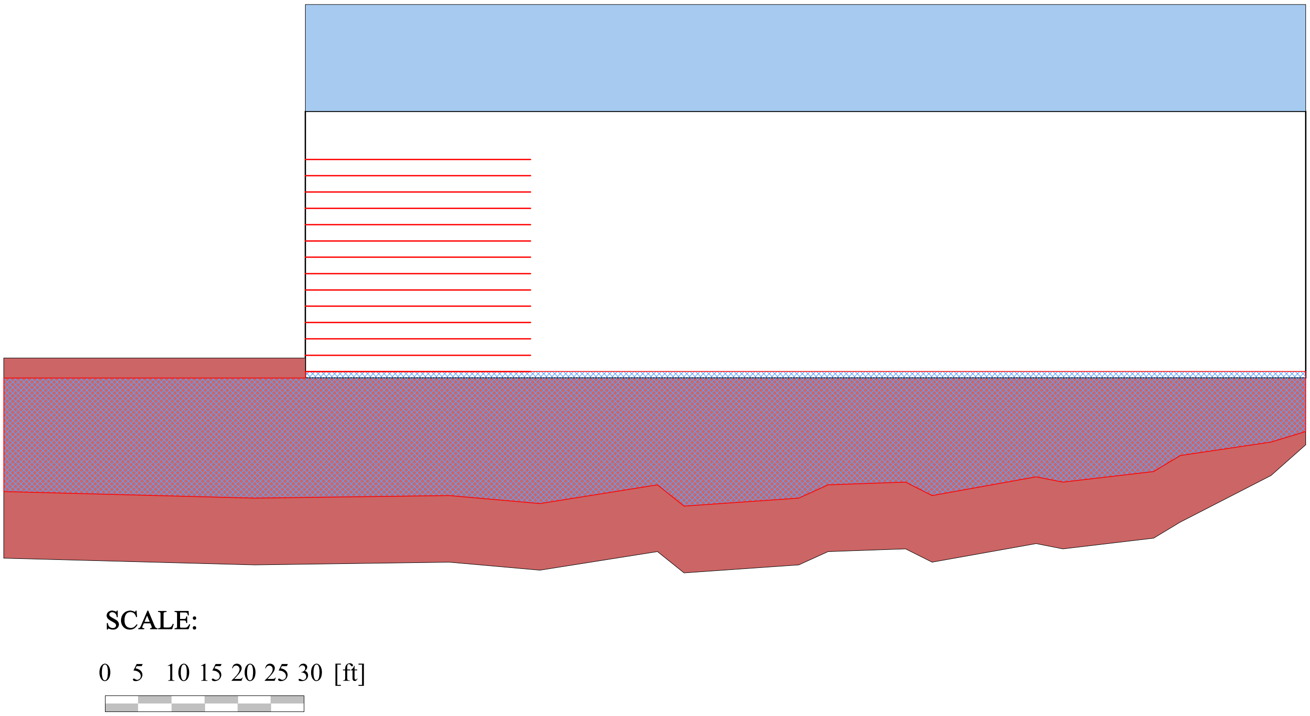
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8544 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.418, Eccentricity, e/L = 0.1397, CDR-overturning = 3.58

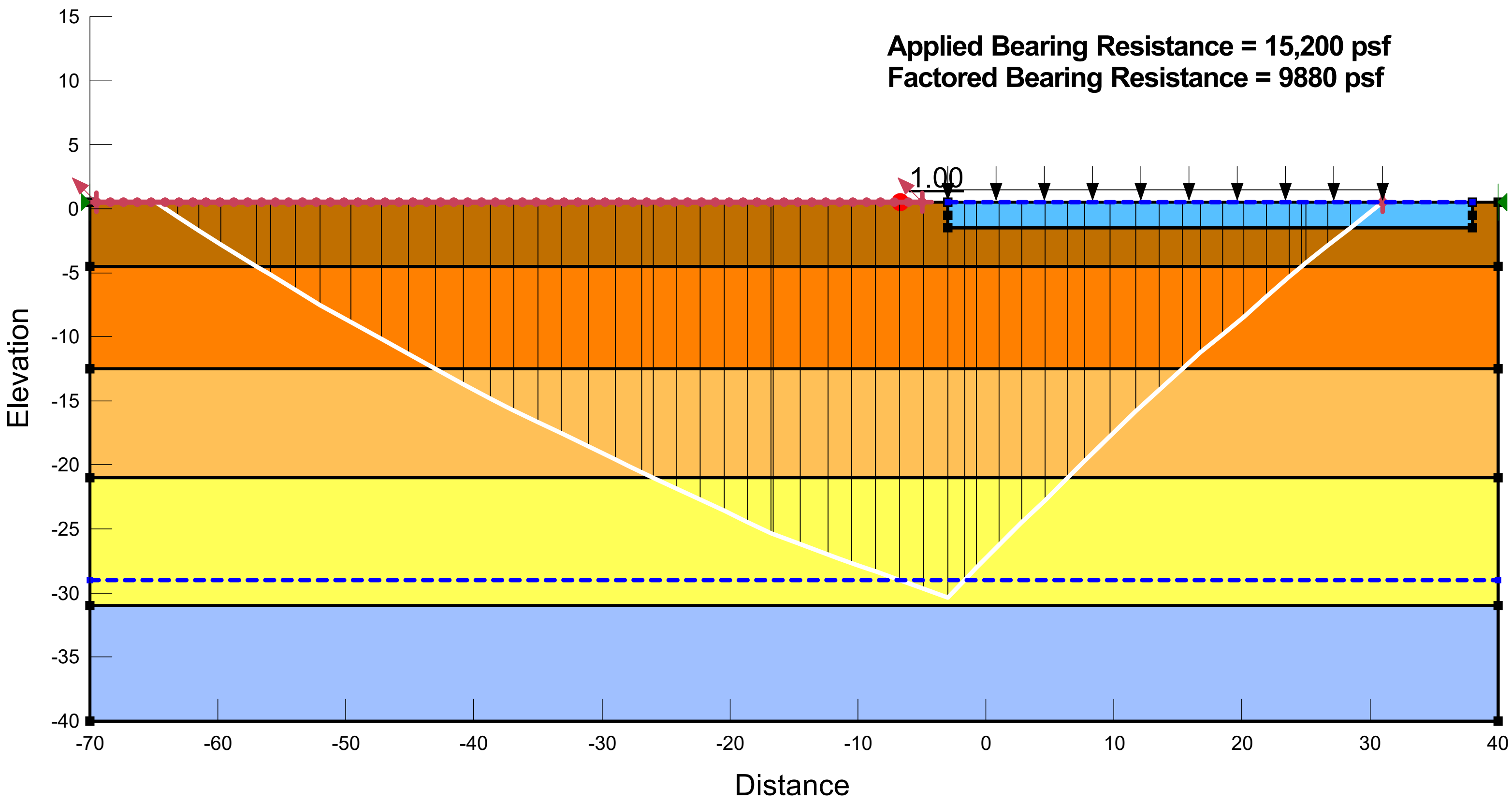
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	34.00	1								
2	3.44	34.00	1								
3	5.91	34.00	1								
4	8.37	34.00	1								
5	10.83	34.00	1								
6	13.29	34.00	1								
7	15.75	34.00	1								
8	18.21	34.00	1								
9	20.67	34.00	1								
10	23.13	34.00	1								
11	25.59	34.00	1								
12	28.05	34.00	1								
13	30.51	34.00	1								
14	32.97	34.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available
subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided
drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Final Facing
Drained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	122	150	24
🟧	Silty Clay 2	127	175	25
🟧	Silty Clay 3	127	150	24
🟨	Silty Clay 4	119	150	23
🟦	Silty Clay 5	120	150	24



Applied Bearing Resistance = 15,200 psf
Factored Bearing Resistance = 9880 psf

AASHTO 2007-2010 (LRFD)
Bridge 16 - Fwd Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Fwd Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	196+39.17

Description:

Bridge 16 - Wing Wall - Long Term (Drained) - Final - Bottom of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....nal bot of prep.BENp

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	24.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 4.62 N_γ= 3.09

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 37.70 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 33.70 ft }
Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

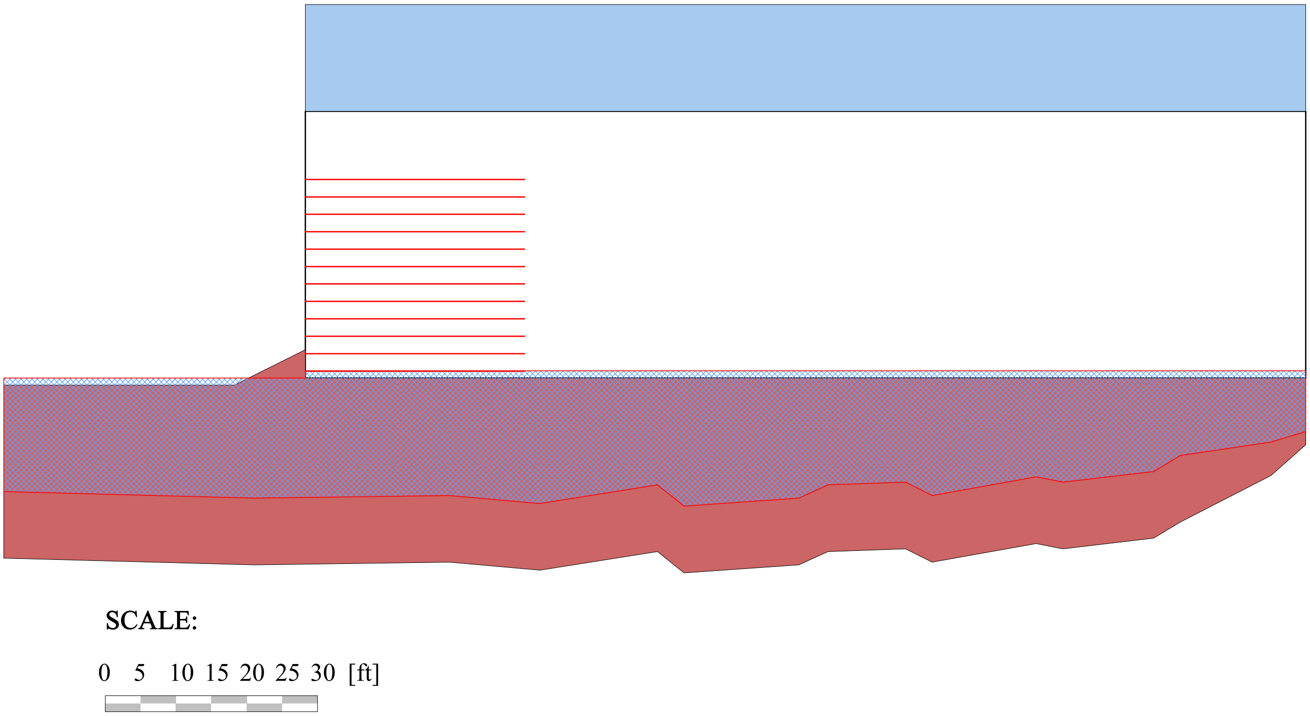
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8157 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.375, Eccentricity, e/L = 0.1491, CDR-overturning = 3.35

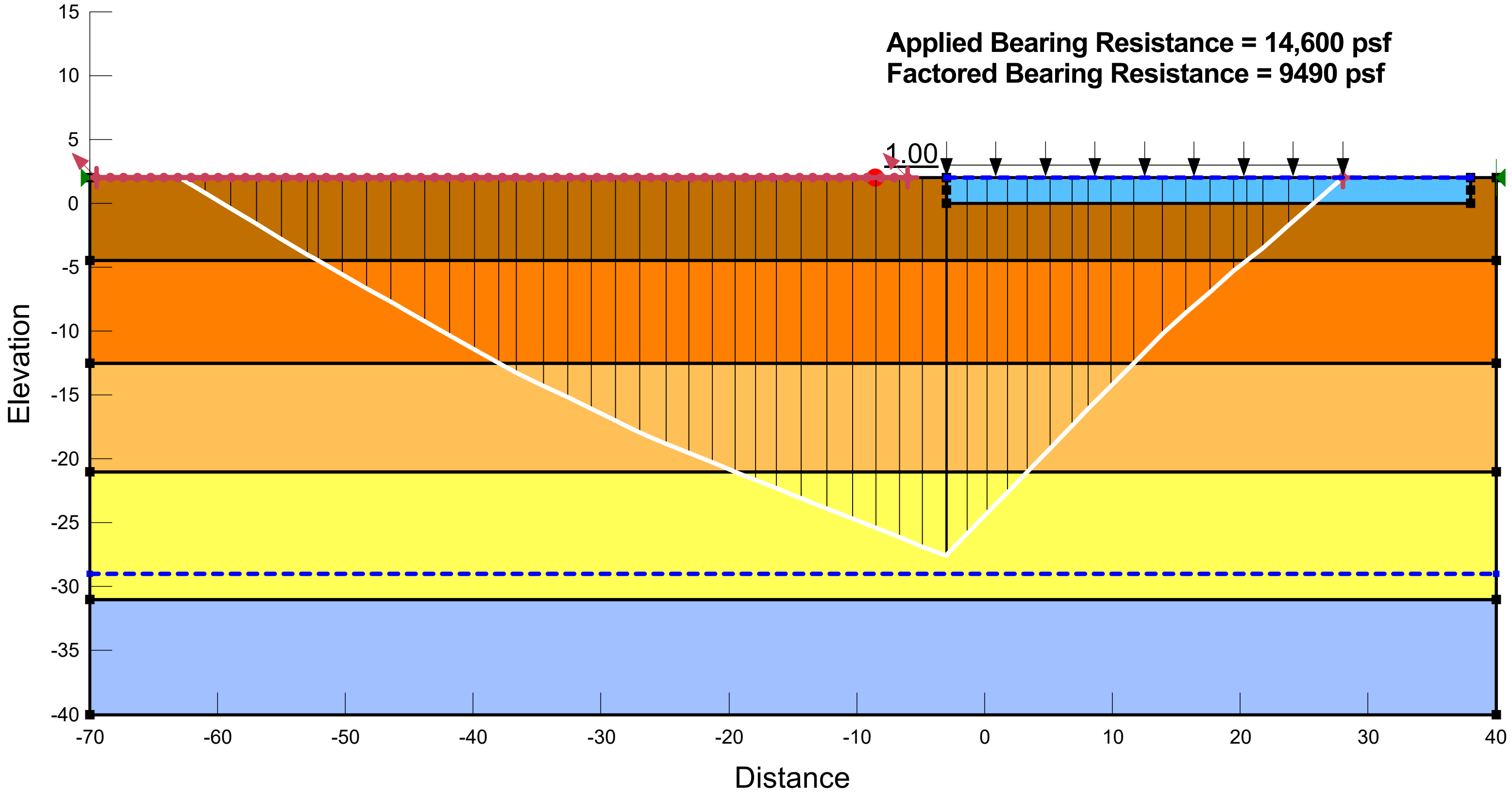
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	31.00	1								
2	3.44	31.00	1								
3	5.91	31.00	1								
4	8.37	31.00	1								
5	10.83	31.00	1								
6	13.29	31.00	1								
7	15.75	31.00	1								
8	18.21	31.00	1								
9	20.67	31.00	1								
10	23.13	31.00	1								
11	25.59	31.00	1								
12	28.05	31.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Fwd Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Final Facing
Drained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	122	150	24
🟧	Silty Clay 2	127	175	25
🟧	Silty Clay 3	127	150	24
🟨	Silty Clay 4	119	150	23
🟦	Silty Clay 5	120	150	24


Applied Bearing Resistance = 14,600 psf
Factored Bearing Resistance = 9490 psf

AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Rear Abutment - Long Term (Drained) - Final - Bottom of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....nal bot of prep.BENp

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	23.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 18.05 $N\gamma = 8.20$

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 41.90 [ft] { Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 38.90 ft }

Soil in front of wall is Horizontal.

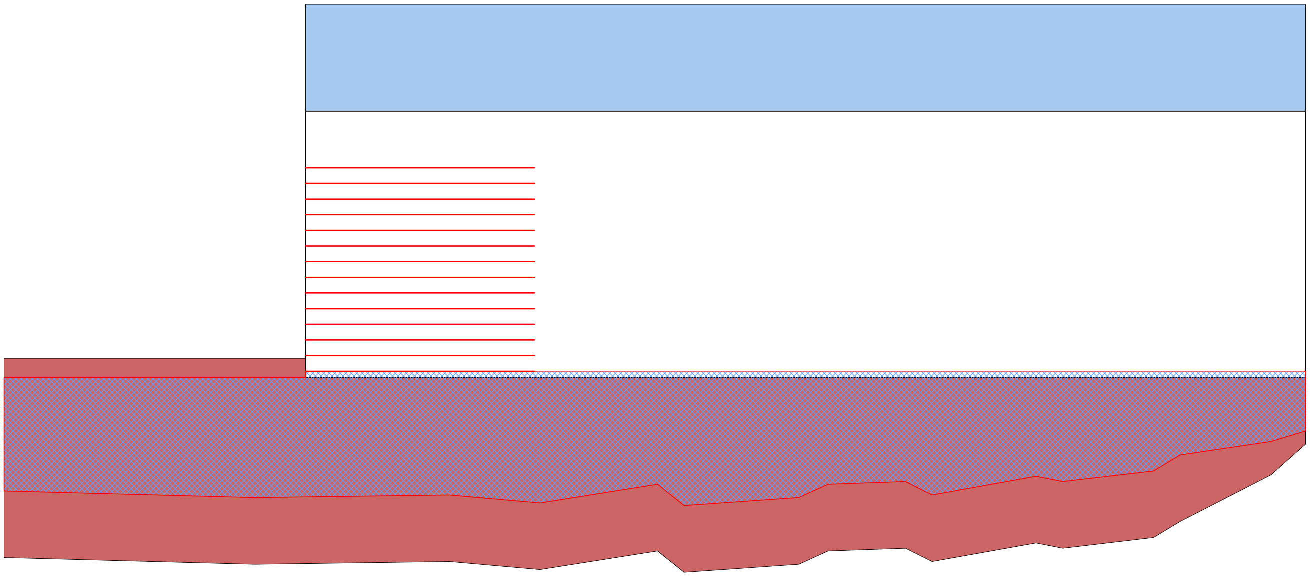
Batter, ω 0.0 [deg]
Backslope, β 0.0 [deg]
Backslope rise 0.0 [ft] Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 5 10 15 20 25 30 [ft]

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8800 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.382, Eccentricity, e/L = 0.1342, CDR-overturning = 3.73

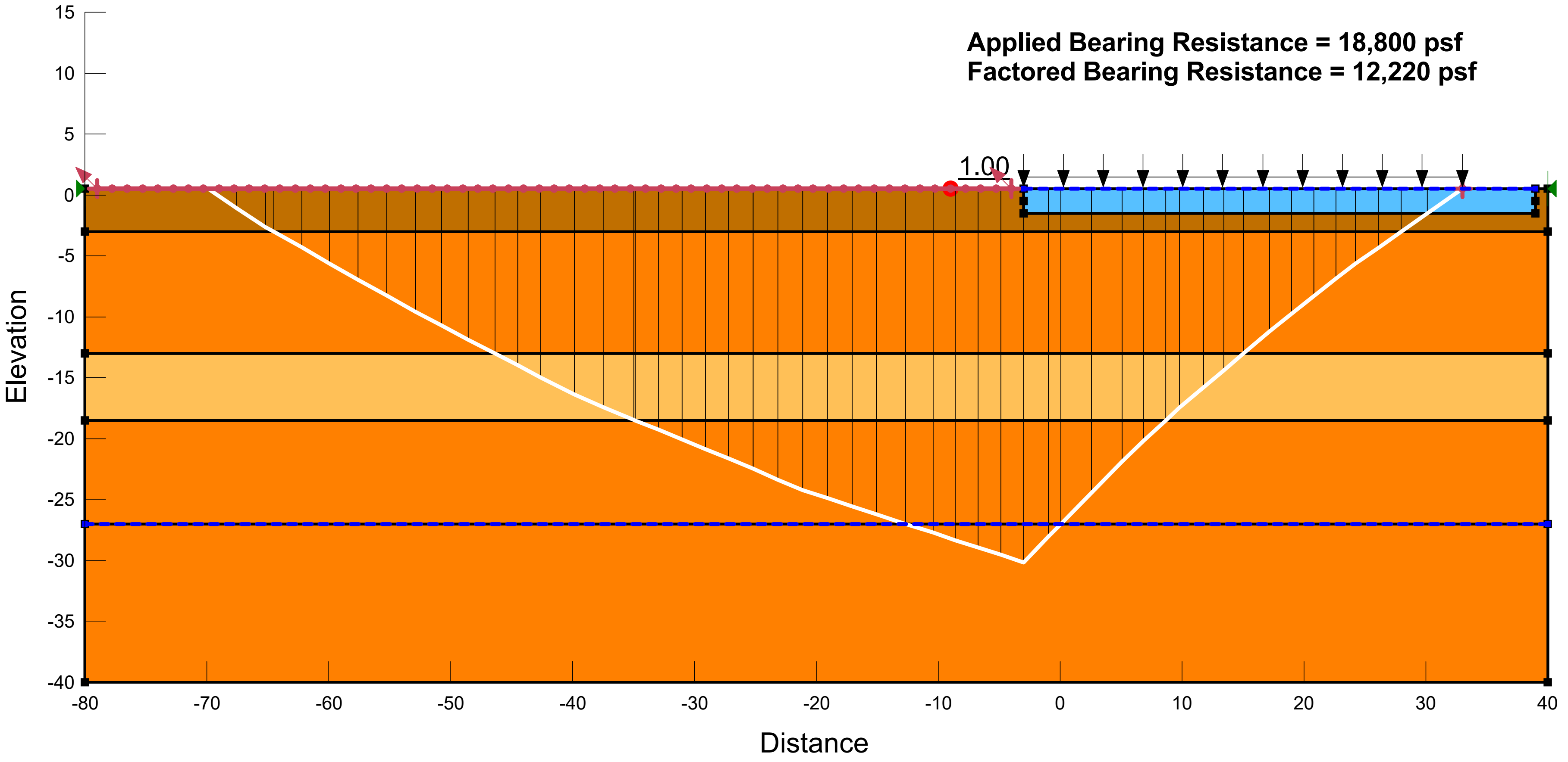
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	36.00	1								
2	3.44	36.00	1								
3	5.91	36.00	1								
4	8.37	36.00	1								
5	10.83	36.00	1								
6	13.29	36.00	1								
7	15.75	36.00	1								
8	18.21	36.00	1								
9	20.67	36.00	1								
10	23.13	36.00	1								
11	25.59	36.00	1								
12	28.05	36.00	1								
13	30.51	36.00	1								
14	32.97	36.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Final Facing
Drained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	150	23
🟧	Silty Clay 2	122	175	25
🟨	Silty Clay 3	126	175	26



Applied Bearing Resistance = 18,800 psf
Factored Bearing Resistance = 12,220 psf

AASHTO 2007-2010 (LRFD)
Bridge 16 - Rear Abutment

MSEW+: Update # 2023.21

PROJECT IDENTIFICATION

Title:	Bridge 16 - Rear Abutment
Project Number:	LAW-7-0370 (PID-75923)
Client:	ODOT
Designer:	DRP
Station Number:	195+56.18

Description:

Bridge 16 - Wing Wall - Long Term (Drained) - Final - Bottom of Prep

Company's information:

Name: Stantec
Street:

Cincinnati, OH
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\Dpleiman\OneDrive - Stantec\Documents\Law-7\B1.....
.....nal bot of prep.BENp

Original date and time of creating this file: Wed Apr 22 11:20:31 2020

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	23.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft ^{2}

Water table is at wall base elevation

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3333 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 4.32 $N\gamma = 2.90$

SEISMICITY

Not Applicable

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

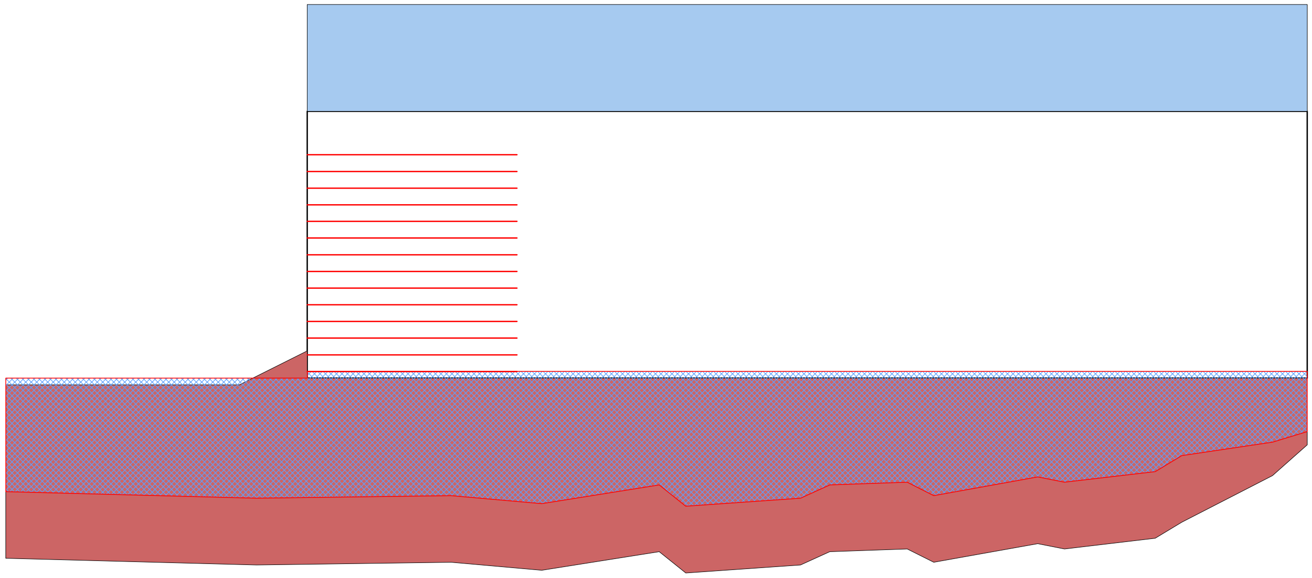
Design height, Hd 39.40 [ft] { Embedded depth is E = 4.00 ft, and height above top of finished bottom grade is H = 35.40 ft }
Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE
🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

Hydrostatic water pressure exist in analysis. hw1 = 0.00 and hw2 = 1.00 ft.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 5 10 15 20 25 30 [ft]

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity - see limit equilibrium analysis, factored bearing load = 8700 lb/ft².

Foundation Interface: Direct sliding, CDR = 1.262, Eccentricity, e/L = 0.1617, CDR-overturning = 3.09

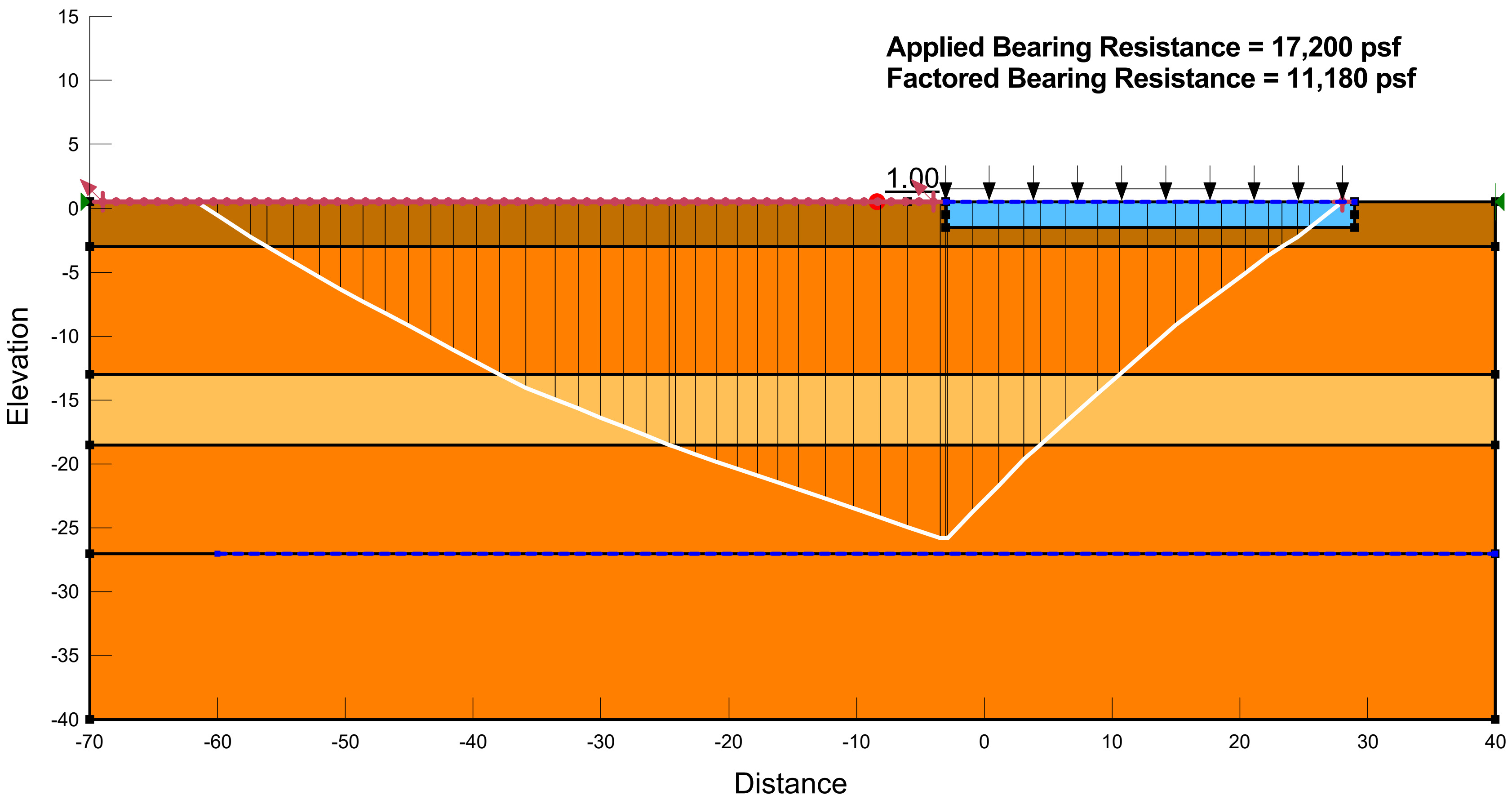
METAL STRIP				CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	0.98	31.00	1								
2	3.44	31.00	1								
3	5.91	31.00	1								
4	8.37	31.00	1								
5	10.83	31.00	1								
6	13.29	31.00	1								
7	15.75	31.00	1								
8	18.21	31.00	1								
9	20.67	31.00	1								
10	23.13	31.00	1								
11	25.59	31.00	1								
12	28.05	31.00	1								
13	30.51	31.00	1								
14	32.97	31.00	1								

Ohio Dept. of Transportation
SR 7 over CR 104
Bridge 16 Rear Abutment - Wing Wall
MSE Wall Bearing Capacity
Lawrence Co., OH

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Foundation Prep Saturated
Bearing Capacity for Final Facing
Drained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟦	Base Preparation	130	0	34
🟫	Silty Clay 1	119	150	23
🟧	Silty Clay 2	122	175	25
🟨	Silty Clay 3	126	175	26


Applied Bearing Resistance = 17,200 psf
Factored Bearing Resistance = 11,180 psf

Appendix G

Applicable Engineering Checklists

I. Geotechnical Design Checklists

Project:	**LAW-7-0370**	**PDP Path:**	**NA**
PID:	**75923**	**Review Stage:**	**Final**

Checklist	**Included in This Submission**
II. Reconnaissance and Planning	✓
III. A. Centerline Cuts	
III. B. Embankments	
III. C. Subgrade	
IV. A. Foundations of Structures	✓
IV. B. Retaining Wall	✓
V. A. Landslide Remediation	
V. B. Rockfall Remediation	
V. C. Wetland or Peat Remediation	
V. D. Underground Mine Remediation	
V. E. Surface Mine Remediation	
V. F. Karst Remediation	
VI. A. Soil Profile	
VI. D. Geotechnical Reports	✓

II. Reconnaissance and Planning Checklist

C-R-S:	LAW-7-0370	**PID:**	75923	**Reviewer:**	E. Kistner	**Date:**	6/22/2022

Reconnaissance		(Y/N/X)	Notes:
1	Based on Section 302.1 in the SGE, have the necessary plans been developed in the following areas prior to the commencement of the subsurface exploration reconnaissance:		
	Roadway plans		
	Structures plans	✓	
	Geohazards plans		
2	Have the resources listed in Section 302.2.1 of the SGE been reviewed as part of the office reconnaissance?	Y	
3	Have all the features listed in Section 302.3 of the SGE been observed and evaluated during the field reconnaissance?	Y	
4	If notable features were discovered in the field reconnaissance, were the GPS coordinates of these features recorded?	Y	

Planning - General		(Y/N/X)	Notes:
5	In planning the geotechnical exploration program for the project, have the specific geologic conditions, the proposed work, and historic subsurface exploration work been considered?	Y	
6	Has the ODOT Transportation Information Mapping System (TIMS) been accessed to find all available historic boring information and inventoried geohazards?	Y	
7	Have the borings been located to develop the maximum subsurface information while using a minimum number of borings, utilizing historic geotechnical explorations to the fullest extent possible?	Y	
8	Have the topography, geologic origin of materials, surface manifestation of soil conditions, and any other special design considerations been utilized in determining the spacing and depth of borings?	Y	
9	Have the borings been located so as to provide adequate overhead clearance for the equipment, clearance of underground utilities, minimize damage to private property, and minimize disruption of traffic, without compromising the quality of the exploration?	X	

II. Reconnaissance and Planning Checklist

Planning - General		(Y/N/X)	Notes:
10	Have the scaled boring plans, showing all project and historic borings, and a schedule of borings in tabular format, been submitted to the District Geotechnical Engineer?	X	Borings done in 1999 and 2012.
	The schedule of borings should present the following information for each boring:		
a.	exploration identification number	X	
b.	location by station and offset	X	
c.	estimated amount of rock and soil, including the total for each for the entire program.	X	
Planning – Exploration Number		(Y/N/X)	Notes:
11	Have the coordinates, stations and offsets of all explorations (borings, probes, test pits, etc.) been identified?	Y	
12	Has each exploration been assigned a unique identification number, in the following format X-ZZZ-W-YY, as per Section 303.2 of the SGE?	Y	
13	When referring to historic explorations that did not use the identification scheme in 12 above, have the historic explorations been assigned identification numbers according to Section 303.2 of the SGE?	Y	

II. Reconnaissance and Planning Checklist

Planning – Boring Types		(Y/N/X)	Notes:
14	Based on Sections 303.3 to 303.7.6 of the SGE, have the location, depth, and sampling requirements for the following boring types been determined for the project?	Y	
	Check all boring types utilized for this project:		
	Existing Subgrades (Type A)		
	Roadway Borings (Type B)		
	Embankment Foundations (Type B1)		
	Cut Sections (Type B2)		
	Sidehill Cut Sections (Type B3)		
	Sidehill Cut-Fill Sections (Type B4)		
	Sidehill Fill Sections on Unstable Slopes (Type B5)		
	Geohazard Borings (Type C)		
	Lakes, Ponds, and Low-Lying Areas (Type C1)		
	Peat Deposits, Compressible Soils, and Low Strength Soils (Type C2)		
	Uncontrolled Fills, Waste Pits, and Reclaimed Surface Mines (Type C3)		
	Underground Mines (C4)		
	Landslides (Type C5)		
	Rockfall (Type C6)		
	Karst (Type C7)		
	Proposed Underground Utilities (Type D)		
	Structure Borings (Type E)	✓	
	Bridges (Type E1)	✓	
	Culverts (Type E2 a,b,c)		
	Retaining Walls (Type E3 a,b,c)	✓	
	Noise Barrier (Type E4)		
	CCTV & High Mast Lighting Towers (Type E5)		
	Buildings and Salt Domes (Type E6)		

IV.A Foundations of Structures Checklist

C-R-S: LAW-7-0370	**PID:** 75923	**Reviewer:** E. Kistner	**Date:** 6/22/2022

If you do not have such a foundation or structure on the project, you do not have to fill out this checklist.

Soil and Bedrock Strength Data		(Y/N/X)	Notes:
1	Has the shear strength of the foundation soils been determined?	Y	
	Check method used:		
	laboratory shear tests		
	estimation from SPT or field tests	✓	
2	Have sufficient soil shear strength, consolidation, and other parameters been determined so that the required allowable loads for the foundation/structure can be designed?	Y	
3	Has the shear strength of the foundation bedrock been determined?	Y	
	Check method used:		
	laboratory shear tests	✓	
	other (describe other methods)		

Spread Footings		(Y/N/X)	Notes:
4	Are there spread footings on the project? If no, go to Question 11	N	
5	Have the recommended bottom of footing elevation and reason for this recommendation been provided?		
a.	Has the recommended bottom of footing elevation taken scour from streams or other water flow into account?		
6	Were representative sections analyzed for the entire length of the structure for the following:		
a.	factored bearing resistance?		
b.	factored sliding resistance?		
c.	eccentric load limitations (overturning)?		
d.	predicted settlement?		
e.	overall (global) stability?		
7	Has the need for a shear key been evaluated?		
a.	If needed, have the details been included in the plans?		
8	If special conditions exist (e.g. geometry, sloping rock, varying soil conditions), was the bottom of footing “stepped” to accommodate them?		
9	Have the Service I and Maximum Strength Limit States for bearing pressure on soil or rock been provided?		

IV.A Foundations of Structures Checklist

Spread Footings		(Y/N/X)	Notes:
10	If weak soil is present at the proposed foundation level, has the removal / treatment of this soil been developed and included in the plans?		
a.	Have the procedure and quantities related to this removal / treatment been included in the plans?		
Pile Structures		(Y/N/X)	Notes:
11	Are there piles on the project? If no, go to Question 17	Y	
12	Has an appropriate pile type been selected?		
	Check the type selected:		
	H-pile (driven)	✓	
	H-pile (prebored)		
	Cast In-place Reinforced Concrete Pipe		
	Micropile		
	Continuous Flight Auger (CFA)		
	other (describe other types)		
13	Have the estimated pile length or tip elevation and section (diameter) based on either the Ultimate Bearing Value (UBV) or the depth to top of bedrock been specified? Indicate method used.	Y	It is recommended that the piles be driven to refusal on bedrock.
14	If scour is predicted, has pile resistance in the scour zone been neglected?		
15	Has a wave equation drivability analysis been performed as per BDM 305.4.1.2 to determine whether the pile can be driven to either the UBV, the pile tip elevation, or refusal on bedrock without overstressing the pile?	N	Determined not to be necessary for the site conditions in conjunction with ODOT.
16	If required for design, have sufficient soil parameters been provided and calculations performed to evaluate the:		
a.	Nominal unit tip resistance and maximum settlement of the piles?	X	Settlement not an issue for piles driven to bedrock.
b.	Nominal unit side resistance for each contributing soil layer and maximum deflection of the piles?	X	
c.	Downdrag load on piles driven through new embankment or compressible soil layers, as per BDM 305.4.2.2?	Y	
d.	Potential for and impact of lateral squeeze from soft foundation soils?	N	Waiting period being used.

IV.A Foundations of Structures Checklist

Pile Structures		(Y/N/X)	Notes:
17	If piles are to be driven to strong bedrock (Q_u >7.5 ksi) or through very dense granular soils or overburden containing boulders, have “pile points” been recommended in order to protect the tips of the steel piling, as per BDM 305.4.5.6?	X	
18	If subsurface obstacles exist, has preboring been recommended to avoid these obstructions?	X	
19	If piles will be driven through 15 feet or more of new embankment, has preboring been specified as per BDM 305.4.5.7?	X	Piles sleeved through MSE approach embankment.

IV.A Foundations of Structures Checklist

Drilled Shafts		(Y/N/X)	Notes:
20	Are there drilled shafts on the project? If no, go to the next checklist.	N	
21	Have the drilled shaft diameter and embedment length been specified?		
22	Have the recommended drilled shaft diameter and embedment been developed based on the nominal unit side resistance and nominal unit tip resistance for vertical loading situations?		
23	For shafts undergoing lateral loading, have the following been determined:		
a.	total factored lateral shear?		
b.	total factored bending moment?		
c.	maximum deflection?		
d.	reinforcement design?		
24	If a bedrock socket is required, has a minimum rock socket length equal to 1.5 times the rock socket diameter been used, as per BDM 305.5.2?		
25	Generally, bedrock sockets are 6" smaller in diameter than the soil embedment section of the drilled shaft. Has this factor been accounted for in the drilled shaft design?		
26	If scour is predicted, has shaft resistance in the scour zone been neglected?		
27	Has the site been assessed for groundwater influence?		
a.	If yes, and if artesian flow is a potential concern, does the design address control of groundwater flow during construction?		
28	Have all the proper items been included in the plans for integrity testing?		
29	If special construction features (e.g., slurry, casing, load tests) are required, have all the proper items been included in the plans?		
30	If necessary, have wet construction methods been specified?		
General		(Y/N/X)	Notes:
31	Has the need for load testing of the foundations been evaluated?		
a.	If needed, have details and plan notes for load testing been included in the plans?		

IV.B. Retaining Wall Checklist

C-R-S: LAW-7-0370 **PID:** 75923 **Reviewer:** E. Kistner **Date:** 6/22/2022

PDP Path: NA

If you do not have a retaining wall on the project, you do not have to fill out this checklist.

Soil Data and Preliminary Calculations		(Y/N/X)	Notes:
1	Has a justification study been performed to determine the necessity of a wall as opposed to ROW purchase or other project alternatives?	Y	
2	Have the necessary soil strength parameters and unit weights been determined?	Y	
	Check method used:		
	laboratory shear tests		
	estimation from SPT or field tests	✓	
3	Has the groundwater elevation been determined?	X	Groundwater not encountered in borings.
4	Have the proper loading conditions been determined?		
a.	If yes, check which loading conditions apply:		
	Backfill (Active Earth Pressure Loading):	✓	
	Backfill (Apparent Earth Pressure (AEP) Loading for Ground Anchors):		
	Backfill (At-Rest Earth Pressure Loading):		
	Backfill (Flat, No Slope):	✓	
	Backfill (Infinite Slope):		
	Backfill (Broken Back Slope):		
	Earth Surcharge:		
	Live Load Surcharge:	✓	
	Other (describe):		
5	Have the correct Load Factors, Load Combinations, and Limit States been considered, per AASHTO LRFD 8th Ed. Articles 3.4.1, 10.5, and 11.5?	Y	
6	Are earth pressure loads inclined at the soil-structure interaction friction angle, δ and has δ been determined per BDM 307.1.1?	X	
7	Have the correct Resistance Factors been considered, per AASHTO LRFD 8th Ed. Articles 10.5 and 11.5?	Y	
8	If applicable, has the influence of groundwater been taken into account with regards to soil unit weights and active pressures?	X	
9	Has the Coulomb method been utilized to determine the lateral earth pressure?	Y	

IV.B. Retaining Wall Checklist

Design		(Y/N/X)	Notes:
10	For preliminary wall design, have the design criteria and wall type selection process been followed as instructed in BDM 201.2.5?	X	
11	Was an economic analysis performed to evaluate the cost benefits of the chosen wall type compared to others?	Y	
12	Were representative sections analyzed for the entire length of the retaining wall for the following:	Y	
a.	bearing resistance?	Y	
b.	sliding resistance?	Y	
c.	limiting eccentricity and overturning resistance? Analyze moment equilibrium about toe for non-gravity cantilever walls.	Y	
d.	total and differential settlement?	Y	
e.	overall (global) stability?	Y	
13	If poor foundation soils are present, has a solution been determined with respect to the following:	Y	
a.	excessive settlement?	Y	
b.	inadequate bearing resistance?	Y	
c.	inadequate sliding resistance?		
d.	overall (global) instability?		
14	For non-proprietary walls, each wall type has design recommendations which need to be determined. For the wall type being evaluated, have the following design recommendations been determined by accepted design methods or, where applicable, FHWA design guidelines:	Y	
a.	Rigid Gravity and Semigravity -- footing width and elevation, maximum factored Service and Strength Limit State bearing pressures, factored bearing resistance (BDM 307.1.5 & 307.2)	X	
b.	Drilled Shafts - diameter, spacing, embedment, arrangement and percent reinforcement, maximum moment and lateral shear, maximum deflection (see BDM 307.6)	X	
c.	Soldier Pile -pile size and type, drilled hole diameter, embedment, spacing, lagging design, facing, maximum moment and lateral shear, section modulus, maximum deflection	X	

IV.B. Retaining Wall Checklist

Design	(Y/N/X)	Notes:
d. Sheet Pile - pile size, embedment, maximum moment and lateral shear, section modulus, maximum deflection (BDM 307.7.1)	X	
e. Cellular - type, maximum factored Service and Strength Limit State bearing pressures, factored bearing resistance, fill material (BDM 307.7.2)	X	
f. Soil Anchor - load per anchor, number of rows, wale design, anchor inclination and minimum length, type of anchor, pile size, type, spacing, and embedment, maximum moment and lateral shear, section modulus, lagging design, facing (BDM 307.8)	X	
g. Soil Nail - nail size, spacing, inclination, and length, loading per nail, facing (BDM 307.9)	X	
15 Has the need for load testing of the retaining wall elements been evaluated?	X	
a. If needed, have details and plan notes for load testing been included in the plans?	X	
16 Proprietary wall designs require a special process for detail design, as outlined in BDM 307.3 and 307.4. Has this procedure been followed for this project?	X	
17 Temporary walls - have the same design requirements as permanent walls of the same type been followed, except the design service life is no more than three years (BDM 307.10)?	X	
18 The presence and quality of water behind the wall structure and in the backfill can be a major source of overloading and failure.	X	
a. Has the quality / chemistry of the groundwater been accounted for in the drainage system?	X	
b. Has an adequate drainage system been included in the detail wall design?	X	
c. If there is a water source behind the wall, has additional drainage been added to control the effect of this water source on the wall?	X	
19 Have the effects of the wall design and construction procedure been determined and accounted for on the construction schedule?	Y	

IV.B. Retaining Wall Checklist

IV.B. Retaining Wall Checklist

Design		(Y/N/X)	Notes:
20	Has the effect of the wall design and construction been evaluated with regard to structures (e.g., bridges, culverts, buildings, utilities), which may be subject to unusual stresses or require special design or construction considerations?	Y	
Plans and Contract Documents		(Y/N/X)	Notes:
21	Have all the necessary notes, specifications, special provisions, and details for the construction of the wall system been included in the plans?	X	
22	Have the need, location, type, plan notes, and reading schedule for any instrumentation been determined and included in the plans?	X	Contained in the construction plans
	Check the types of instrumentation specified:		
	settlement cells		
	settlement platforms	✓	
	inclinometers		
	monitoring wells / piezometers		
	load cells		
	strain gages		
	other (describe other types)		

VI.B. Geotechnical Reports

C-R-S: LAW-7-0370	**PID:** 75923	**Reviewer:** E. Kistner	**Date:** 6/22/2022

General		(Y/N/X)	Notes:
1	Has an electronic copy of all geotechnical submissions been provided to the District Geotechnical Engineer (DGE)?	Y	
2	Has the first complete version of a geotechnical report being submitted been labeled as ‘Draft’?	Y	
3	Subsequent to ODOT’s review and approval, has the complete version of the revised geotechnical report being submitted been labeled ‘Final’?	Y	Final
4	Has the boring data been submitted in a native format that is DIGGS (Data Interchange for Geotechnical and Geoenvironmental) compatable? gINT files may be used for this.	X	
5	Does the report cover format follow ODOT's Brand and Identity Guidelines Report Standards found at http://www.dot.state.oh.us/brand/Pages/default.aspx ?	Y	
6	Have all geotechnical reports being submitted been titled correctly as prescribed in Section 705.1 of the SGE?	Y	
Report Body		(Y/N/X)	Notes:
7	Do all geotechnical reports being submitted contain the following:		
a.	an Executive Summary as described in Section 705.2 of the SGE?	Y	
b.	an Introduction as described in Section 705.3 of the SGE?	Y	
c.	a section titled "Geology and Observations of the Project," as described in Section 705.4 of the SGE?	Y	
d.	a section titled "Exploration," as described in Section 705.5 of the SGE?	Y	
e.	a section titled "Findings," as described in Section 705.6 of the SGE?	Y	
f.	a section titled "Analyses and Recommendations," as described in Section 705.7 of the SGE?	Y	
Appendices		(Y/N/X)	Notes:
8	Do all geotechnical reports being submitted contain all applicable Appendices as described in Section 705.8 of the SGE?	Y	

VI.B. Geotechnical Reports

9	Do the Appendices present a site Boring Plan showing all boring locations as described in Section 705.8.1 of the SGE?	Y	

VI.B. Geotechnical Reports

Appendices		(Y/N/X)	Notes:
10	Do the Appendices include boring logs and color pictures of rock, if applicable, as described in Section 705.8.2 of the SGE?	Y	
11	Do the Appendices include reports of undisturbed test data as described in Section 705.8.3 of the SGE?	X	
12	Do the Appendices include calculations in a logical format to support recommendations as described in Section 705.8.4 of the SGE?	Y	