South Carolina
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MEMORANDUM

To: Steve A. Nanney, P.E.
RPG-3 Structural Design Lead

From: Renée S. Gardner, P.E.
RPG-3 Assistant Geotechnical Design Team Lead
Registered, South Carolina #29563

Date: November 30, 2016

Re: US 301 (Five Chop Road) - Replacement Bridge Over Four Hole Swamp
Project ID: 0040308
Final Bridge Geotechnical Engineering Report-100%

The Regional Production Group Three Geotechnical Design Section (RPG3 GDS) is 100% complete with the Final Bridge Geotechnical Report for the Replacement Bridge over Four Hole Swamp on US 301 (Five Chopt Road) in Orangeburg County, South Carolina.

The purpose of this report is to present subsurface conditions encountered and provide foundation recommendations. The recommendations are based on the geotechnical subsurface investigation and geotechnical analyses performed in accordance with the SCDOT Geotechnical Design Manual (GDM), 2010 version, and SCDOT Design Memorandums.

If you have questions or comments, please feel free to contact me at (803) 737-3987.

RSG:rsg
Attachment: Bridge Geotechnical Engineers Report
cc: Chris Lacy, RPG-3 Design Manager
File: PC/RSG

South Carolina
Department of Transportation

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FINAL BRIDGE GEOTECHNICAL ENGINEERS REPORT

November 2016

US 301 Replacement Bridge over Four Hole Swamp
Orangeburg County, SC

Prepared by:

Renée S. Gardner, PE

Regional Production Group 3 (Midlands)

Geotechnical Design Section

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1.0 **Project Description:** The project consists of a lane widening and a bridge replacement along US Route 301 Southbound, which is a 2-lane paved road of variable shoulder widths. The project will consist of removing the existing 247-foot concrete bridge supported by square cast-in-place columns on unknown footings under the main super-structure and HP10x42 battered piles under the widened portion of the super-structure, then constructing a multi-span, pre-stressed concrete flat slab bridge (Sta. 5949+30 to Sta. 5952+24). The proposed bridge is 294 feet in length with a 44-foot clear roadway width. The proposed centerline finished grade elevation will be raised approximately 2.0 feet. The new bridge will be placed on the existing horizontal alignment; therefore, the bridge will be closed and southbound traffic shifted to share the northbound lanes during construction. A site map is provided in Appendix I.

2.0 **Objective:** This report presents foundation recommendations and plan notes to be included in the final plans. Regional Production Group Three Geotechnical Design Section (RPG3 GDS) based the geotechnical recommendations herein on test logs B-1 through B-9, and an MASW obtained during the geotechnical exploration executed by ICA Engineering and test logs B-1A, B-3A, B-5A, B-6A, B-7A, DMT-1 and DMT-2 obtained during the geotechnical exploration executed by Professional Services Industries, Inc. (PSI). The geotechnical recommendations are also based on a geotechnical engineering evaluation of the subsurface soil explorations, a liquefaction assessment, a review of the bridge interior bent foundations and a review of embankment longitudinal slope stability performed by GeoStellar Engineering.

The exploration by ICA Engineering was conducted during the dates of April 3 through 25, 2014. The exploration by PSI was conducted during the dates of December 4 through 17, 2014. The GDM did not provide sufficient guidance to identify the geologic formations and classify the soil strength parameters for this project; therefore, GeoStellar Engineering provided support in research and an engineering evaluation. The engineering evaluation by GeoStellar Engineering was performed during the dates of June 2015 through April 2016. The subsurface explorations performed by ICA Engineering and PSI and the engineering evaluation performed by GeoStellar were conducted in general accordance with the 2010 Geotechnical Design Manual (GDM).

3.0 **Subsurface Investigation:** Test-holes were performed at or near the proposed bent locations of the bridge over Four Hole Swamp. In addition to typical test-hole sampling, shear wave velocity measurements and bulk samples were obtained at this site. When we identified a potential weak subsurface soil condition we requested a second phase of test-holes. All test locations were surveyed and are presented in Table 1 below. The Boring Layouts and test-hole records from both subsurface investigations are provided in Appendix II.

Table 1 – Subsurface Test Locations

Test-Hole Number	Location	Station	Offset Distance (ft)	Elevation (ft)	Soil Depth (ft)	Core Depth (ft)
*DMT-1	Road/Bridge	5949+27	8-L	120.1	15.1	N/A
B-1	Road/Bridge	5949+31	13-L	119.9	102.5	N/A
Bulk-1	Road/Bridge	5949+31	13-L	119.9	5.0	N/A
*B-1A	Road/Bridge	5949+32	9-R	119.9	120.0	N/A
B-2	Bridge	5949+65	9-R	108.8	111.5	N/A
B-3	Bridge	5950+02	3-R	108.8	101.5	N/A
*B-3A	Bridge	5950+11	6-L	120.3	120.0	N/A
B-4	Bridge	5950+42	8-R	107.9	101.5	N/A
B-5	Bridge	5950+98	8-L	105.5	80.3	21.0
*B-5A	Bridge	5950+99	8-R	120.3	120.0	N/A
B-6	Bridge	5951+41	8-R	107.8	15.2	20.0
*B-6A	Bridge	5951+43	7-L	120.3	120.0	N/A
B-7	Bridge	5951+86	8-L	105.0	20.0	21.0
*B-7A	Bridge	5951+88	8-R	120.3	120.0	N/A
B-8	Road/Bridge	5952+17	8-R	120.0	80.5	20.9
Bulk-2	Road/Bridge	5952+17	8-R	120.0	5.0	N/A
B-9	Road/Bridge	5952+28	8-L	120.0	101.5	N/A
*DMT-2	Road/Bridge	5952+32	8-L	120.0	15.1	N/A
SA-1	Road/Bridge	5952+40	14-R	119.5	92.6	N/A

*Performed by PSI. All others performed by ICA Engineering

As defined in Table 2 laboratory tests were performed on select split spoon samples, undisturbed samples, bulk samples and rock cores. Summaries of the laboratory test results are included in Appendix III.

Table 2 – Laboratory Tests

Test Type	Quantity
Natural Moisture Content (ICA)	69
Natural Moisture Content (PSI)	49
Atterberg Limits (ICA)	70
Atterberg Limits (PSI)	49
Grain Size with Wash 200 (ICA)	85
Grain Size with Wash 200 (PSI)	40
Grain Size with Hydrometer Analysis (ICA)	14
Grain Size with Hydrometer Analysis (PSI)	9
Corrosion Series (PSI)	4
Consolidation (PSI)	1
Triaxial Compression (PSI)	1
Direct Shear (ICA)	2
Rock Cores – Unconfined Compression (ICA)	17
MASW Shear Wave Velocity (ICA)	1

The project site is located within the USDA MLRA Atlantic Coast Flatwoods region (153A) of the Coastal Plain Province of the Atlantic Plain. This area is a relatively flat coastal plain crossed by many broad, shallow valleys which have widely meandering stream channels. The new bridge will cross over Four Hole Swamp which is a small black-water tributary to the Edisto River. The geology is defined as being located in the Middle Coastal Plain Province between the South Carolina geologic features referred to as the Orangeburg Scarp (OS) and the Surry Scarp (SS).

Three subsurface profiles are presented in Appendix IV. The first subsurface profile was prepared by ICA Engineering based on the initial subsurface investigation. The second subsurface profile was prepared by PSI based on the final subsurface investigation. The third subsurface profile was prepared by GeoStellar and is a compilation of both the initial and final subsurface investigations and interpretations based on consultations with William R. Doar, III, Senior Geologist for the Coastal Plains, South Carolina Geological Survey (SCGS). Table 3 outlines the generalized subsurface conditions encountered during the field exploration.

Table 3 – Generalized Subsurface Conditions

Geologic Formation	Elevations at Top of Layer (ft)	USCS Soil Type	SPT-N values (bpf)	Comments
Recent (Fill Embankment)	120	SM, SW-SM, SC, SP-SM	3 to 31	Very Loose to Medium Dense silty SANDs
Marietta Unit	105 - 112	SM, SW-SM, SC, SP-SM, SC-SM ,SP, ML, SW, CL	0 to 100	Very Loose to Medium Dense silty SANDs, Very Loose to Loose clayey SANDs, Very Soft sandy SILTs, Very Loose to Medium Dense SANDs with silt, Very Loose to Very Dense SANDs, and Very Soft lean CLAYs
Santee Limestone	92 - 101	SM, SW-SM, SC, SC-SM, SP, ML	6 to 50/2”	Medium Dense to Very Dense, silty SANDs, Firm to Very Hard sandy SILTs, Hard to Very Hard SILTs with sand, Very Dense SANDs with silt, Medium Dense to Very Dense clayey SANDs
Warley Hill	27 -51	SM, SW-SM, SC, SP-SM, SW, MH, CL	4 to 50/2”	Loose to Very Dense silty SANDs, Very Dense clayey SANDs, Very Soft Silty SAND, Very Soft sandy SILT, Loose to Very Dense SAND with silt, Very Loose SAND, Very Hard sandy lean CLAY
Congaree	8 - 14	SM, SW-SM, SP-SM, MH, CL, CH	30 to 50/3”	Dense to Very Dense silty SANDs, Medium Dense to Very Dense SAND with silt, Very Hard sandy SILT, Hard to Very Hard sandy lean CLAY, Hard sandy fat CLAY

As stated previously, potentially weak soil-zones were identified in test-holes B-3, B-5, and B-9. Test-holes B-7 and B-6 did not extend deep enough to capture a weak soil-zone layer. ICA initially classified this potentially weak layer as the Congaree Formation. Subsequent test-holes B-3A and B-7A indicated a weak soil-zone layer present while test-hole B-5A did not indicate a weak soil-zone layer present. After consulting with Mr. Doar we amended the classification of this layer below the Santee Limestone Formation to be the Warley Hill Formation. In follow up discussions between GSE and the South Carolina Geological Survey, Mr. Doar indicated that these weak soil-zones are most likely not the result of sinkholes found in karst terrain that is typically underlain by limestone, but are more likely to be the result of scour holes caused by wave action that were filled with loose soils and then overlain by the Santee Limestone Formation.

Soil strength parameters were calculated using the SPT-Based Soil Shear Strength Loss Evaluation spreadsheet created by Preconstruction Support – Geotechnical Design Section (PCS-GDS). This method of evaluating soil strength parameters initially indicated that the potentially weak soil zones would liquefy during a seismic event; however, this potentially weak soil zone is overlain by extremely strong non-liquefiable soils more than 50 feet in depth. While these soils have a reduced strength parameter any settlement will not propagate to the surface. The calculation package for Soil Strength Parameters is provided in Appendix V.

Groundwater is expected to fluctuate due to rainfall events, seasonal changes and construction practices. Groundwater levels were measured in test-holes at the time of boring (TOB) and 24-hours after drilling if possible. Test-holes cored in the roadway or bridge deck where not left open to measure groundwater depth. The depths to the ground water obtained are presented in Table 4. Hydrology data on the bridge plans indicate a 100-year high water elevation of 119.0 feet-msl. The groundwater measurements correspond to a high elevation of 109.6 feet-msl. **Groundwater elevation of 110 fee- msl was used for design.**

Table 4 – Depth to Ground Water

Test-Hole No.	Location	Station	Existing Ground Elevation (ft msl)	TOB (ft)	24 hour (ft)
B-1	Road/Bridge	5949+31	119.9	5.2	7.7
B-1A	Road/Bridge	5949+32	119.9	9.7	6.0
B-2	Bridge	5949+65	108.8*	NA	NA
B-3	Bridge	5950+02	108.8*	3.3	3.3
B-3A	Bridge	5950+11	120.3	9.5	NA
B-4	Bridge	5950+42	107.9*	NA	NA
B-5	Bridge	5950+98	105.5*	NA	NA
B-5A	Bridge	5950+99	120.3	9.7	NA
B-6	Bridge	5951+41	107.8*	NA	NA
B-6A	Bridge	5951+43	120.3	9.6	NA
B-7	Bridge	5951+86	105.0*	NA	NA
B-7A	Bridge	5951+88	120.3	9.5	NA
B-8	Road/Bridge	5952+17	120.0	12.0	10.4
B-9	Road/Bridge	5952+28	120.0	5.9	12.6

*Mudline

4.0 Scour Study: The RPG3 Hydraulic Design Section (HDS) provided bridge scour profiles for the 100-year and the 500-year scour. The Bridge Scour Summary is shown in Table 5. Because there is less than five feet difference between the two scour profiles we used the 500-yr scour elevation profile for design. However, soils that could potentially scour were modelled in place when evaluating driveability of the interior bent piles. We understand that rip rap will be placed on the end slopes following Standard Drawing 804-105-00 which includes riprap for 30 feet up station and down station on the side slopes at the end bent locations to prevent abutment scour.

Table 5 – Bridge Scour Summary

Bridge Bent	Elevation (ft-msl)		
	Ground Surface	100-Year Scour	500-Year Scour
End Bent 1	119	119.0 (no Scour)	119.0 (no Scour)
Interior Bent 2	114	99.0	99.0
Interior Bent 3	114	87.5	82.7
Interior Bent 4	114	96.6	94.4
Interior Bent 5	114	96.0	93.8
Interior Bent 6	114	84.4	81.4
Interior Bent 7	114	106.0	106.0
End Bent 8	119	119.0 (no Scour)	119.0 (no Scour)

5.0 Operational Classification: According to the GDM a Bridge Operational Classification (OC) shall be identified to determine resistance factors and performance limits of the project site. Based on Table 8-10 of the GDM the proposed bridge has an OC of “II”.

6.0 Seismic Conditions: A seismic Site Class evaluation was performed using the 2010 Geotechnical Design Manual (GDM). Based on the soil test boring logs and the shear wave velocity data obtained from the MASW/MAM, the seismic Site Class for the bridge was determined to be “D”. This Site Class was determined from data measured to a depth of approximately 100 feet below the existing ground surface. Based on Table 3.5 in the 2008 Seismic Design Specifications for Highway Bridges and the S_{D1SEE} value provided below, the Seismic Design Category (SDC) for this bridge structure is “C”. The RPG3 Structural Design Section (SDS) should verify the actual SDC. The S_{D1} values were defined using the three-point method and the ADRS curves are provided in Appendix VI. **The seismic design parameters to be shown on the plans are tabulated in Table 6.** The values associated with the curves and shown in Table 6 should be applied to the structure at the proposed finished grade.

The Site Class defined above and the corresponding seismic design parameters, defined in Table 6, were used for designing embankments, determining the potential for liquefaction and calculating the downdrag forces caused by liquefaction-induced settlements.

Table 6 – Seismic Design Parameters for Site Class D

	Acceleration, g
PGA_{FEE}	0.20
S_{DsFEE}	0.39
S_{D1FEE}	0.18
$k_{h\ FEE}$	0.19
$M_{w\ FEE}$	7.36
PGA_{SEE}	0.43
S_{DsSEE}	0.87
S_{D1SEE}	0.49
$k_{h\ SEE}$	0.41
$M_{w\ SEE}$	7.37

Note 1: k_h and M_w are only used in the embankment design and should not be shown on the bridge plans

7.0 Liquefaction Study: We utilized the laboratory index test results and visual soil classifications to evaluate the soil behavior of the subsurface soils in all of the soil borings. The criteria in the 2010 SCDOT GDM Section 13.6 were used to determine soil behavior as either sand-like or clay-like.

The laboratory index test results from both subsurface investigations were used to plot fines content (FC), plasticity index (PI), and natural moisture content (NMC) versus elevation and is included along with the combined subsurface profile in Appendix IV. The general trend for each of the formations is shown in Table 7.

Table 7 – Project Site Soil Behavior Trends

Geologic Formation	Approximate Elevation (ft-msl)		USCS Soil Type	Soil Behavior
	Bottom	Top		
Recent (Fill Embankment)	110	120	SM,SW-SM,SP	Sand-Like
			SC	Clay-Like
Marietta Unit	100	110	SP, SM, SP-SM	Sand-Like
			SC,SC-SM, CL,ML	Clay-Like
Santee Limestone	30	100	ML, SM, SW-SM, SW	Sand-Like
			ML, MH, SC	Clay-Like
Warley Hill	10	30	SM, SW-SM, SP-SM, SW	Sand-Like
			SC	Clay-Like
Congaree	--	10	SM, SP-SM, SW-SM	Sand-Like
			ML, CL, CH	Clay-Like

The trends observed in Table 7 were used to interpret subsurface soil behavior for soils that did not have index testing performed. The interpretation of soil behavior for all soil samples was achieved by utilizing the plots of the FC, PI, and NMC versus elevation. Additionally, Soil Shear Strength Loss (SSL) and seismic settlements were evaluated using the procedures outlined by Idriss and Boulanger in the 2008 EERI Monograph MNO-12, “Soil Liquefaction During Earthquakes” and Chapter 13 – “Geotechnical Seismic Hazards” of the 2010 GDM. The interpreted results were then applied to all borings and used to develop a Subsurface Soil Profile of Sand-Like and Clay-Like soils and evaluate potential for liquefaction-Induced Settlement as presented in Table 8.

Table 8 – Liquefaction-Induced Settlement (inches)

Location	Test-Hole Number	SEE	FEE
Roadway	RW-3B	0.00	0.00
EB-1	B-1	0.00	0.00
EB-1	B-1A	0.00	0.00
IB-2	B-2	1.12	1.12
IB-3	B-3	1.28	1.28
IB-3	B-3A	0.68	0.68
IB-4	B-4	1.93	0.44
IB-5	B-5	2.47	1.83
IB-5	B-5A	1.28	0.39
IB-6	B-6	3.17	2.53
IB-6	B-6A	1.46	1.00
IB-7	B-7	2.93	2.93
IB-7	B-7A	1.95	1.57
EB-8	B-8	8.42[1]	8.42[1]
EB-8	B-9	0.00	0.00
Roadway	RW-4	0.40	0.00

[1] Possible erroneous data. Soil test boring B8 includes a note related to drilling method difficulties near the groundwater table.

Soil layers considered to cause downdrag due to liquefaction were determined using the SSL spreadsheet. Soil layers had to displace at least 0.4 inches before downdrag would occur. Once 0.4 inches of displacement had occurred in a soil layer, all the Skin Friction, as determined in APile using the SEE soil strength parameters, from the bottom of that layer up to the ground surface was taken as the downdrag load. The most significant down drag load was determined to take place at IB 4 as 7.6 Tons. This is negligible in comparison to the Ultimate Capacity being achieved by installing the piles to elevation 10 feet-msl.

8.0 END BENTS 1 and 8

8.1 Foundation Recommendations

8.1.1 Pile Bearing: Use HP 14x73 (50 ksi) steel H-piles at end bents 1 and 8. The strength design load is 105 tons per pile. Use a geotechnical resistance factor of 0.65. The required ultimate bearing is 162 tons per pile.

8.1.2 Scour: Based on information provided by the RPG3 Hydraulic Design Section (HDS), rip rap will be placed on the end slopes following Standard Drawing 804-105-00 which includes rip rap for 30 feet up station and down station on the side slopes at the end bent locations to prevent abutment scour.

8.1.3 Axial Compression Load Evaluation: Based on the Strength I loads provided by the RPG3 SDS, the estimated pile tip elevation for End Bent 1 and 8 is 82 feet-msl (38 feet below the existing finished grade). Strength I static axial condition governs the pile design. APile version 2015.7.2 results are included in Appendix VII.

8.1.4 Axial Uplift Load Evaluation: Factored design uplift loads were not provided by the SDS.

8.1.5 Lateral Load Evaluation: The critical depth is the elevation where the stiffness of the soil overcomes the stiffness of the pile. The critical depth elevation is specified as the critical pile tip elevation and represents minimum penetration of each pile for lateral stability. After the SDS provided the Extreme Event Loads it was determine that the critical depth elevation of the HP 14x73 steel H-pile, oriented with the strong direction transverse to the roadway centerline, is at elevation 90 feet-msl (30 feet below the existing finished grade) for End Bent 1 and 8. The critical depth was determined from a seismic analysis using a liquefied soil condition. LPILE2015 results are presented in Appendix VIII.

LPILE2015 input files for non-liquefied and liquefied soil columns were developed and previously provided to the RPG3 SDS for use in a structural analysis. No p-multipliers were used in the analysis since the pile spacing is greater than 5B. These input files should be used to evaluate the lateral Service and Extreme Event I performance limits set forth in the GDM in Tables 10-32 and 10-35, respectively. We recommend the structural engineer not change the soil profile and parameters in LPile2015 as it will affect the lateral load analysis.

8.1.6 Pile Settlement: Axial compression loads can produce vertical displacements as a result of the pile-soil load transfer and elastic compression of the pile. The amount of settlement was determined using a pile group instead of individual piles.

To determine the maximum vertical differential settlement, the vertical settlement for each bent was calculated at the Service Limit state and compared to the vertical settlement for the next closest bent. According to Table 10-32 of the GDM the deformation ID No., EB-01 performance limits for a bridge with an OC II classification is 0.02 multiplied by the span length. The span length for this bridge connecting End Bent 1 to Interior Bent 2 is 44 feet. The corresponding vertical differential performance limit is 0.88 inches. The span length for this bridge connecting Interior Bent 7 to End Bent 8 is 30 feet. The corresponding vertical differential performance limit is 0.60 inches. The calculated vertical differential settlement between EB-1 and IB-2 is 0.14 and between IB-7 and EB-8 is 0.29 inches. Therefore, the calculated settlements are within the performance limits specified in the GDM.

Per 2008 SCDOT Seismic Specifications for Highway Bridges a detailed multi-mode spectral analysis model(s) is required to determine the global seismic displacement demand of the SDC “C” structure. EE I loads provided by the SDS exceeded the Service Limit Loads therefore, the performance limits were checked according to Table 10.35 of the GDM.

Detailed settlement calculations are presented in Appendix X.

8.1.7 Production Pile PDA Testing: We recommend Pile Driving Analyzer (PDA) testing be performed on the first production pile driven at End Bents 1 and 8. These piles shall include an additional two feet of HP 14x73 steel H-Pile lengths in order to accommodate PDA testing and potential restrikes.

8.1.8 Pile Hammer: Initially, a pile hammer having a rated energy between 29 kip-feet and 65 kip-feet should be suitable for driven pile installation. However, final hammer approval should be based on a wave equation analysis that accurately reflects the contractor's proposed driving system. The WEAP analysis conducted is presented in Appendix XI.

8.1.9 Corrosion: Based on the corrosion series test results summarized in Appendix III, all indicators were within the requirements outlined in the 6th Edition of AASHTO 10.7.5.

8.1.10 Abutment Passive Soil Pressure Parameters: We previously submitted the passive soil pressures that will act on both end bent backwalls and they are included herein in Appendix IX.

8.2 Foundation Plan Notes

Place the following notes on the plans for End Bents 1 and 8:

PILE BEARING END BENTS 1 and 8	
Factored Axial Compression Load	**105 Tons**
Geotechnical Resistance Factor	**0.65**
Nominal Resistance	**162 Tons**
Estimated loss of Resistance due to Scour	**0 Tons**
Estimated loss of Resistance due to Downdrag	**0 Tons**
Required Driving Resistance	**162 Tons**

Method of controlling installation of piles and verifying their capacity: Dynamic Testing with PDA and CAPWAP analysis

GOVERNING CONDITIONS	
Loading Type	**Loading Direction**
Static	Axial (Compression)

The following estimated parameters were used for performing a driveability analysis:

DRIVEABILITY PARAMETERS			
Skin Quake (QS)	**0.10 in**	**% Skin Friction**	**54%**
Toe Quake (QT)	**0.10 in**	**Distribution Shape No.**	**0.00**
Skin Damping (SD)	**0.05 s/ft**	**Pile Penetration**	**100%**
Toe Damping (TD)	**0.15 s/ft**	**Bearing Graph**	**Proportional**

Note: GRLWEAP (2010-6) was used to perform the wave equation analysis.

A pile hammer having a rated energy between 29 kip-feet and 65 kip-feet should be suitable for driven pile installation. However, the Contractor is responsible for selecting a hammer, based on a wave equation analysis that accurately reflects the Contractor's proposed pile driving system, which will properly install the piling.

The estimated pile tip elevation to achieve axial capacity (static) for the HP 14x73 steel H-pile for End Bents 1 and 8 is 79 feet-msl. The required minimum tip elevation to achieve critical depth (lateral stability) for the HP 14x73 steel H-pile is 90 feet-msl for End Bents 1 and 8. Piles must be installed as shown on plans.

Pile Driving Analyzer (PDA) testing shall be performed on the first production pile driven at End Bent 1 and End Bent 8. These piles shall include an additional two feet of HP14x73 steel H-pile length in order to accommodate the initial PDA testing. If a CAPWAP analysis determines that capacity has not been achieved, a restrike of one of the production piles may be required. The restrike shall be performed on the production pile exhibiting the lowest blows per foot. PDA testing shall also be performed on the restrike. The time between initial driving and restrike will be determined by the Engineer, but should be between a minimum of 3 days and a maximum of 7 days. Within seven days of completion of the PDA testing (on initial drive and/or restrike, if required), the results will be evaluated by the RPG3 GDS. Construction of the bent caps shall not proceed until the end bent piles have been accepted by the RPG3 GDS.

Reference the 2007 SCDOT Standard Specifications for Driven Pile Foundation (Section 711). Notes included in these plans are in addition to the requirements of the Standard Specifications.

8.3 Foundation Quantity Estimates

Consider the following for quantity estimation purposes:

- One pile driving set-up per pile
- Two PDA test setups per production pile tested
- Steel H Bearing Piling (HP 14x73) – Calculate pile quantity based on tip elevations provided. Provide piling with minimum yield strength of 50 ksi.

9.0 INTERIOR BENTS 2 through 7

9.1 Foundation Recommendations

9.1.1 Removal of Existing Structures: The existing 247-foot concrete bridge is supported by square cast-in-place columns on unknown footings under the main super-structure and HP10x42 battered piles under the widened portion of the super-structure. These existing foundations shall be removed and disposed of in accordance with Section 202 of SCDOT Standard Specifications for Highway Construction, 2007 Edition. Cofferdams are required to facilitate the removal of the unknown footings and make way for the proposed steel pipe piles that will support the new superstructure. The soil strength parameters needed for design of the cofferdams are tabulated in Section 9.2, Plan Notes. The existing H-piles will most likely have to be vibrated out. Since all traffic will be utilizing the adjacent bridge during construction a vibration monitoring plan is recommended to observe conditions of the adjacent bridge.

9.1.2 Pile Bearing: Use 48-inch pipe piles for Interior Bents 2 through 7. Use a factored design load of 186 tons per pile with a geotechnical resistance factor of 0.65, for an approximated required ultimate bearing capacity of 286 tons per pile. The driveability analysis indicated that a wall thickness of 1.5 inches is required to withstand driving stresses.

9.1.3 Axial Compression Load Evaluation: Because there is less than five feet difference between the 100-year and 500-year scour profiles we used the 500-yr scour elevation profile for design. Overburden material was neglected for axial support due to the potential for scour. Based on the Strength I loads provided by RPG3 SDS and the presence of a potentially weak soil zone below the Santee Formation, the estimated 48-inch pipe pile tip elevation for Interior Bents 2 through 7 is 10 feet-msl. This results in the Strength I static axial condition governing the pile design. Due to uncertainty of whether plugged conditions will develop during driving, both plugged and unplugged models were developed to determine ultimate capacity at 10 feet-msl. These values were then used in the driveability analysis. Results of the APile models are presented in Appendix VII.

9.1.4 Axial Uplift Load Evaluation: Factored design uplift loads were not provided by the SDS.

9.1.5 Lateral Load Evaluation: RPG3 GDS conducted lateral loading analyses using the software program LPILE version 2015 based upon the loading scenarios outlined in the bridge load data sheet provided by the RPG3 SDS on April 2, 2015, revised August 26, 2015 and again revised August 2, 2016. The lateral load analysis was performed to estimate the critical depth required to maintain a minimum lateral stability for the 48-inch pipe pile at each interior bent. Overburden material was neglected for lateral support due to the potential for scour. The RPG3 SDS provided Extreme Event load data on October 20, 2016 after which, critical depths were checked. The check for critical depths under Extreme Event loading did not include potential for scour.

Foundation group effects were accounted for by using p-multipliers (P_m). The appropriate p-multipliers for group effects depend on spacing and whether the piles are leading or trailing. Information provided in the sixth edition of the AASHTO LFRD Design (Table 10.7.2.4-1) suggests the P_m range from 0.3 to 1.0. A p-multiplier of 0.75 was used in the longitudinal direction and 0.328 in the transverse direction for static analysis. No p-multiplier was used for Extreme Event I analysis.

LPile2015 input files for non-liquefied and liquefied soil columns were developed and previously provided for use in the structural analysis. These input files should be used to evaluate the lateral Service and Extreme Event I performance limits set forth in the GDM in Tables 10-32 and 10-36, respectively. We recommend the structural engineer not change the soil profile and parameters in LPile2015 as it will affect the lateral load analysis. The soil profile starts at the scour elevations summarized in Table 5, presented previously in this report, and loads applied at elevation 117.5 feet-msl as provided by the RPG3 SDS. Soils on the interior of the pile within the scour zone provide negligible stiffness to the pile and therefore are neglected. If the elevations of the applied load changes, we will need to review our recommendations and provide additional analysis.

Initially, the critical depths were determined from a static analysis using a non-liquefied soil condition. Once Extreme Event I loads were provided by the SDS critical depths were checked. Even though the EEI loads were greater than the static load and the analysis predicted slightly longer pile lengths, the original design for the pile tip elevation was already set at 10 feet msl to ensure the pile tip is 20 feet beyond the potential weak soil zone. This elevation governs the design.

Based on our analyses, the critical depths and corresponding critical tip elevations of the 48-inch diameter pipe piles are listed below in Table 9. The results of the LPile 2015 analyses are presented in Appendix VIII.

Table 9: Lateral Capacity Summary

Interior Bent No.	Soil Test Boring No.	Top of Pile Elevation (ft-MSL)	Critical Depth (ft)	Lateral Capacity Minimum Tip Elevation (ft-MSL)
2	B-2	117.5	70	47.5
3	B-3A	117.5	64	53.5
4	B-4	117.5	65	52.5
5	B-5A	117.5	68	49.5
6	B-6A	117.5	70	47.5
7	B-7A	117.5	48	69.5

9.1.6 Pile Settlement: Axial compression loads can produce vertical displacements as a result of the pile-soil load transfer and elastic compression of the pile. The amount of settlement was determined using a pile group instead of individual piles.

To determine the maximum vertical differential settlement, the vertical settlement for each bent was calculated at the Service Limit state and compared to the vertical settlement for the next closest bent. According to Table 10-32, of the GDM, the deformation ID No., EB-01 performance limits for a bridge with an OC II classification is 0.02 multiplied by the span length. The span length for this bridge connecting End Bent 1 to Interior Bent 2 is 44 feet. The corresponding vertical differential performance limit is 0.88 inches. The span length for this bridge connecting Interior Bent 7 to End Bent 8 is 30 feet. The corresponding vertical differential performance limit is 0.60 inches. The calculated vertical differential settlement between EB-1 and IB-2 is 0.14 inches and between IB-7 and EB-8 is 0.29 inches. Therefore, the calculated settlements are within the performance limits specified in the GDM.

The deformation ID No., IB-01 performance limits for a bridge with an OC II classification is 0.02 multiplied by the span length. The span length for this bridge connecting Interior Bent 2 to Interior Bent 3 and Interior Bent 5 to Interior Bent 6 is 44 feet. The corresponding vertical differential performance limit is 0.88 inches. The calculated vertical differential settlement between IB-2 and IB-3 is 0.35 and between IB-5 and IB-6 is 0.30 inches. Therefore, the calculated settlements are within the limits specified in the GDM.

The deformation ID No., IB-02 performance limits for a bridge with an OC II classification is 0.04 multiplied by the span length. The span length for this bridge connecting Interior Bent 3 to Interior Bent 4 and Interior Bent 4 to Interior Bent 5 is 44 feet. The corresponding vertical differential performance limit is 1.76 inches. The calculated vertical differential settlement between IB-3 and IB-4 is 0.35 and between IB-4 and IB-5 is 0.21 inches. Therefore, the calculated settlements are within the limits specified in the GDM.

Per 2008 SCDOT Seismic Specifications for Highway Bridges a detailed multi-mode spectral analysis model(s) is required to determine the global seismic displacement demand of the SDC "C" structure. EE I loads provided by the SDS exceeded the Service Limit Loads therefore, the performance limits were checked according to Table 10.36 of the GDM. Detailed settlement calculations are presented in Appendix X.

9.1.7 Index Pile PDA Testing: We recommend Pile Driving Analyzer (PDA) testing be performed on the first production pile driven at Interior Bents 2 through 7. These piles shall include an additional two feet of 48-inch steel pipe pile length in order to accommodate PDA testing and potential restrikes.

9.1.8 Pile Hammer: The WEAP analysis conducted is presented in Appendix XI. Overburden material was included in the driveability analysis since scour will not have occurred yet and this material will be present during driving. A total pile length of 110 feet with 89% embedment was used for analysis. A variable frictional distribution and end bearing distribution was used in GRLWeap based on the nominal pile resistances obtained from APile. The range of energy required for plugged and unplugged pipe piles was evaluated. Table 10 presents the soil input parameters used in the Wave Equation analyses.

Table 10: Driveability Analysis WEAP Input Parameters

Description	WEAP Parameter
Pile Type	48-inch Steel Pipe Pile with 1.5-inch walls
Skin Quake (unplugged/plugged)	0.10/0.10
Toe Quake (unplugged/plugged)	0.10/0.40
Skin Damping	0.05
Toe Damping	0.15
% Skin Friction (unplugged/plugged)	92% / 66%
% End Bearing (unplugged/plugged)	8% / 34%
Distribution Shape No.	Variable
Pile Length/Penetration	110 / 98 feet
Hammer Rated Energy Range[1]	Unplugged: 51 kip-feet – 145 kip-feet
	Plugged: 280 kip-feet – 444 kip-feet
	[2]**Reserve Capacity**
	Unplugged: 66 kip-feet – 146 kip-feet
	Plugged: 292 kip-feet – 658 kip-feet

[1] Hammer rated energy is based on GRLWEAP maximum rated energy database for hydraulic hammers

[2] 15% Increase to account for hard layers

The results of the WEAP pile driveability analyses indicate that a double-acting hydraulic pile driving hammer with a maximum rated energy of 66 to 146 kip-feet should be suitable for pile installation at the interior bents under unplugged conditions. Larger hammers having a maximum rated energy between 292 kip-feet and 658 kip-feet may be suitable under plugged conditions; but, may require limiting the energy delivered. Final hammer approval should be based on a wave equation analysis that accurately reflects the contractor's proposed driving system.

For very hard or stiff soils (i.e., Santee Limestone) the inside of the pipe pile may need to be augered out in order to drive the pile. No pre-augering will be allowed. The inside of the pipe pile should not be augered out deeper than the bottom of the Santee Limestone Formation which varies from 51 to 24 feet-msl based on the boring logs. The Contractor is responsible for verifying the bottom of the Santee Limestone Formation by referring to the test-hole logs and Table 11. Boring logs will also be provided on the bridge plan and profile sheet.

Table 11: Approximate Formation Elevations

Bent No.	**IB-2**	**IB-3**	**IB-4**	**IB-5**	**IB-6**	**IB-7**
Offset direction	**(L/R)**	**(L/R)**	**(L/R)**	**(L/R)**	**(L/R)**	**(L/R)**
Top of SLF Elevation	Unk/91	92/99	Unk/98	96/99	97/93	100/100
Bottom of SLF Elevation & Top of WHF	Unk/36	51/50	Unk/24	42/32	31/Unk	Unk/38
Bottom of WHF & Top of CF	Unk/14	7/9	Unk/6	10/6	Unk/7	Unk/14
Pile Tip Elevation	10	10	10	10	10	10

The elevations presented in this table are approximate. Actual field conditions may vary
SLF = Santee Limestone Formation, WHF = Warley Hill Formation, CF = Congaree Formation

The final pipe pile tip elevation must not be shallower than 20 feet below the augered depth if no weak soil zone is encountered. If a weak soil zone is encountered the final pipe pile tip elevation must not be shallower than 20 feet below the weak soil zone.

Once the pipe pile is driven to the final bearing stratum, establish the final elevation of the material inside the pipe pile as the elevation of the bottom of the concrete plug as shown on the plans as Elevation C. If top elevation of material inside pipe pile is lower than the plans Elevation C, backfill with loose sand classified as A-1-a to the plans Elevation C. If top elevation of material inside pipe pile is higher than the plans Elevation C, remove material to the plans Elevation C. This soil shall be removed in order to construct the composite section at the top of the pile for connection to the pile cap.

9.1.9 Composite Pile Section: We understand that a composite section will be constructed at the pile top by backfilling with concrete to embed steel reinforcement and construct the connection to the pile cap. The composite section of the pile will be constructed from 117.5 feet-msl to 101.75 feet-msl. This will require removal of soil from within the pipe piles once they are driven and prior to placement of the steel reinforcement and concrete.

9.1.10 Pile Corrosion: Based on the corrosion series test results summarized in Appendix III, all indicators were within the requirements outlined in the 6th Edition of AASHTO 10.7.5. It is our understanding that the steel pipe piles will be encased in concrete to protect the pile against corrosion and flowable fill will be placed two feet above the mudline to further protect the steel pipe piles.

9.2 Foundation Plan Notes

Place the following notes on the plans for Interior Bents 2 through 7:

48-inch PIPE PILE BEARING INTERIOR BENTS	
Factored Axial Compression Load (Tons)	**186**
Geotechnical Resistance Factor	**0.65**
Required Nominal Resistance (Tons)	**286**
Estimated Pile Tip Penetration (feet)	**98**
Estimated Pile Tip Elevation (feet-msl)	**10**
Unplugged Required Pile Driving Resistance (Tons)	**1369**
Plugged Required Pile Driving Resistance (Tons)	**2801**

Method of controlling installation of piles and verifying their capacity: Capacity will be verified by pile driving analyzer and CAPWAP analysis of index piles(s). A Pile Installation Chart developed from the analysis will be used to verify the capacity of production piles.

GOVERNING CONDITIONS	
Loading Type	**Loading Direction**
Static	Axial (Compression)

The following estimated parameters were used for performing a driveability analysis:

DRIVEABILITY PARAMETERS - UNPLUGGED CONDITIONS			
Skin Quake (QS)	**0.10 in**	**% Skin Friction**	**92%**
Toe Quake (QT)	**0.10 in**	**Distribution Shape No.**	**Variable**
Skin Damping (SD)	**0.05 s/ft**	**Pile Penetration %**	**89%**
Toe Damping (TD)	**0.15 s/ft**	**Bearing Graph**	**Proportional**

Note: GRLWEAP (2010-6) was used to perform the wave equation analysis.

DRIVEABILITY PARAMETERS - PLUGGED CONDITIONS			
Skin Quake (QS)	**0.10 in**	**% Skin Friction**	**66%**
Toe Quake (QT)	**0.40 in**	**Distribution Shape No.**	**Variable**
Skin Damping (SD)	**0.05 s/ft**	**Pile Penetration %**	**89%**
Toe Damping (TD)	**0.15 s/ft**	**Bearing Graph**	**Proportional**

Note: GRLWEAP (2010-6) was used to perform the wave equation analysis.

A double-acting hydraulic pile driving hammer with monitoring and recording equipment capable of measuring continuously the hammer energy and rate of impact having a maximum rated energy between 66 kip-feet and 146 kip-feet should be suitable for driven pile installation under unplugged conditions. Larger hammers having a maximum rated energy between 292 kip-feet and 658 kip-feet may be suitable under plugged conditions; but, may require limiting the energy delivered. The Contractor is responsible for selecting a hammer(s), based on a wave equation analysis that accurately reflects the Contractor's proposed pile driving system, which will properly install the piling.

The estimated pile tip elevation for the 48-inch steel pipe piles at Interior Bents 2 through 7 is 10 feet-msl in order to achieve penetration 20 feet beyond a potentially weak soil

zone below the Santee Limestone Formation. For very hard or stiff soils (i.e., Santee Limestone Formation) the inside of the pipe pile may need to be augered out in order to drive the pile. No pre-augering will be allowed. The inside of the pipe pile should not be augered out deeper than the bottom of the Santee Limestone Formation which varies in elevation from 51 to 24 feet-msl based on the boring logs. The Contractor is responsible for verifying the bottom of the Santee Limestone formation by referring to the test-hole logs and the Table of Approximate Formation Elevations.

Approximate Formation Elevations

Bent No.	**IB-2**	**IB-3**	**IB-4**	**IB-5**	**IB-6**	**IB-7**
Offset direction	**(L/R)**	**(L/R)**	**(L/R)**	**(L/R)**	**(L/R)**	**(L/R)**
Top of SLF Elevation	Unk/91	92/99	Unk/98	96/99	97/93	100/100
Bottom of SLF Elevation & Top of WHF	Unk/36	51/50	Unk/24	42/32	31/Unk	Unk/38
Bottom of WHF & Top of CF	Unk/14	7/9	Unk/6	10/6	Unk/7	Unk/14
Pile Tip Elevation	10	10	10	10	10	10

The elevations presented in this table are approximate. Actual field conditions may vary
SLF = Santee Limestone Formation, WHF = Warley Hill Formation, CF = Congaree Formation

The final pipe pile tip elevation must not be shallower than 20 feet below the augered depth if no weak soil zone is encountered. If a weak soil zone (i.e., Warley Hill Formation) is encountered the final pipe pile tip elevation must not be shallower than 20 feet below the weak soil zone.

Once the pipe pile is driven to the final bearing stratum, establish the final elevation of the material inside the pipe pile as the elevation of the bottom of the concrete plug as shown on the plans as Elevation C. If top elevation of material inside pipe pile is lower than the plans Elevation C, backfill with loose sand classified as A-1-a to the plans Elevation C. If top elevation of material inside pipe pile is higher than the plans Elevation C, remove material to the plans Elevation C. This soil shall be removed in order to construct the composite section at the top of the pile for connection to the pile cap.

Perform Pile Driving Analyzer (PDA) on the first production pile driven at the Interior Bents 2 through Interior Bents 7. These piles shall include an additional two feet of 48-inch steel pipe pile length in order to accommodate the initial PDA testing. If a CAPWAP analysis determines that capacity has not been achieved, restrike one of the production piles. Perform the restrike on the production pile exhibiting the lowest blows per foot. On initial drive, piles shall be stopped at the highest allowable finished grade on the plans to accommodate a restrike while still remaining within an allowable plan finished grade elevation. Perform PDA testing during the restrike. Contact the Bridge Construction Office to determine the time between initial driving and restrike. Within seven days of completion of the PDA testing (on initial drive and/or restrike, if required), the results will be evaluated by the RPG3 GDS. Construction of the bent caps shall not proceed until the interior bent piles have been accepted by the RPG3 GDS. Payment for the restrike will be as indicated in the Standard Specifications.

Reference the 2007 SCDOT Standard Specifications for Driven Pile Foundation (Section 711). Notes included in these plans are in addition to the requirements of the Standard Specifications.

9.3 Cofferdam Plan Notes

Contractor is responsible for cofferdam design. For all soils, buoyant unit weights shall be used in computations for soils below the water level. The designer shall consider all unbalanced water forces. The designer is responsible for determining a design water level. The designer shall use the following soil strength parameters for determining earth pressure coefficients.

SOIL PARAMETERS FOR COFFERDAM DESIGN

Depth (ft)	IB2 (B-2)					
	c (psf)	ϕ	γ_{sat} (pcf)	K_o	K_a	K_p
0-5	-	31	115	0.485	0.320	3.124
5-9	-	36	120	0.412	0.260	3.852
9-11	-	36	115	0.412	0.260	3.852
11-12	-	36	110	0.412	0.260	3.852
12-19	1700	15	115	0.741	0.589	1.698
19-74	-	36	115	0.412	0.260	3.852
74+	-	36	120	0.412	0.260	3.852

Depth (ft)	IB3 (B-3)					
	c (psf)	ϕ	γ_{sat} (pcf)	K_o	K_a	K_p
0-5	-	31	120	0.485	0.320	3.124
5-9	-	36	120	0.412	0.260	3.852
'9-20	1700	15	110	0.741	0.589	1.698
20-59	-	36	115	0.412	0.260	3.852
59-78	-	24	120	0.593	0.422	2.371
78+	-	36	120	0.412	0.260	3.852

Depth (ft)	IB3 (B-3A)					
	c (psf)	ϕ	γ_{sat} (pcf)	K_o	K_a	K_p
0-4	400	0	110	1.000	1.000	1.000
4-13	-	32	120	0.470	0.307	3.255
13-18	1700	0	110	1.000	1.000	1.000
18-23	1780	15	115	0.741	0.589	1.698
23-47	-	36	110	0.412	0.260	3.852
47-59	2218	0	110	1.000	1.000	1.000
59-62	-	26	110	0.562	0.390	2.561
62-68	300	3	110	0.948	0.901	1.110
68-70	-	26	115	0.562	0.390	2.561
70-74	300	0	115	1.000	1.000	1.000
74+	-	36	120	0.412	0.260	3.852

Depth (ft)	IB4 (B-4)					
	c (psf)	ϕ	γ_{sat} (pcf)	K_o	K_a	K_p
0-10	-	32	120	0.470	0.307	3.255
10-18	-	36	110	0.412	0.260	3.852
18-84	-	36	115	0.412	0.260	3.852
84+	-	36	120	0.412	0.260	3.852

Depth (ft)	IB5 (B-5)					
	c (psf)	ϕ	γ_{sat} (pcf)	K_o	K_a	K_p
0-3	-	30	115	0.500	0.333	3.000
3-6	-	38	120	0.384	0.238	4.204
6-8	-	30	110	0.500	0.333	3.000
8-10	-	36	115	0.412	0.260	3.852
10-38	-	36	115	0.412	0.260	3.852
38-48	2125	15	110	0.741	0.589	1.698
48-58	-	30	110	0.500	0.333	3.000
58-63	-	36	115	0.412	0.260	3.852
63-72	-	24	120	0.593	0.422	2.371
72+	-	36	120	0.412	0.260	3.852

Depth (ft)	**IB5 (B-5A)**					
	c (psf)	**ϕ**	**γ_{sat} (pcf)**	**K_o**	**K_a**	**K_p**
0-6	-	35	115	0.426	0.271	3.690
6-9	-	32	120	0.470	0.307	3.255
9-21	-	36	115	0.412	0.260	3.852
21-76	-	30	110	0.500	0.333	3.000
76-101	-	36	115	0.412	0.260	3.852
101-	4000	0	110	1.000	1.000	1.000

Depth (ft)	**IB6 (B-6)**					
	c (psf)	**ϕ**	**γ_{sat} (pcf)**	**K_o**	**K_a**	**K_p**
0-3	-	34	115	0.441	0.283	3.537
3-9	-	32	120	0.470	0.307	3.255
9-13	-	30	120	0.500	0.333	3.000
13+	-	36	115	0.412	0.260	3.852

Depth (ft)	**IB6 (B-6A)**					
	c (psf)	**ϕ**	**γ_{sat} (pcf)**	**K_o**	**K_a**	**K_p**
0-1	-	20	110	0.658	0.490	2.040
1-5	-	32	120	0.470	0.307	3.255
5-10	-	36	120	0.412	0.260	3.852
10-25	-	36	115	0.412	0.260	3.852
25-54	-	30	110	0.500	0.333	3.000
54-76	2440	15	110	0.741	0.589	1.698
76-79	-	36	115	0.412	0.260	3.852
79-	-	36	120	0.412	0.260	3.852

Depth (ft)	**IB7 (B-7)**					
	c (psf)	**ϕ**	**γ_{sat} (pcf)**	**K_o**	**K_a**	**K_p**
0-3	-	30	120	0.500	0.333	3.000
3-5	-	32	120	0.470	0.307	3.255
5-10	-	36	110	0.412	0.260	3.852
10+	-	36	115	0.412	0.260	3.852

Depth (ft)	**IB7 (B-7A)**					
	c (psf)	**ϕ**	**γ_{sat} (pcf)**	**K_o**	**K_a**	**K_p**
0-3	-	24	110	0.593	0.422	2.371
3-7	-	29	120	0.515	0.347	2.882
7-21	-	36	115	0.412	0.260	3.852
21-47	-	30	110	0.500	0.333	3.000
47-61	-	34	110	0.441	0.283	3.537
61-69	2320	15	110	0.741	0.589	1.698
69-76	-	30	115	0.500	0.333	3.000
76	-	36	115	0.412	0.260	3.852

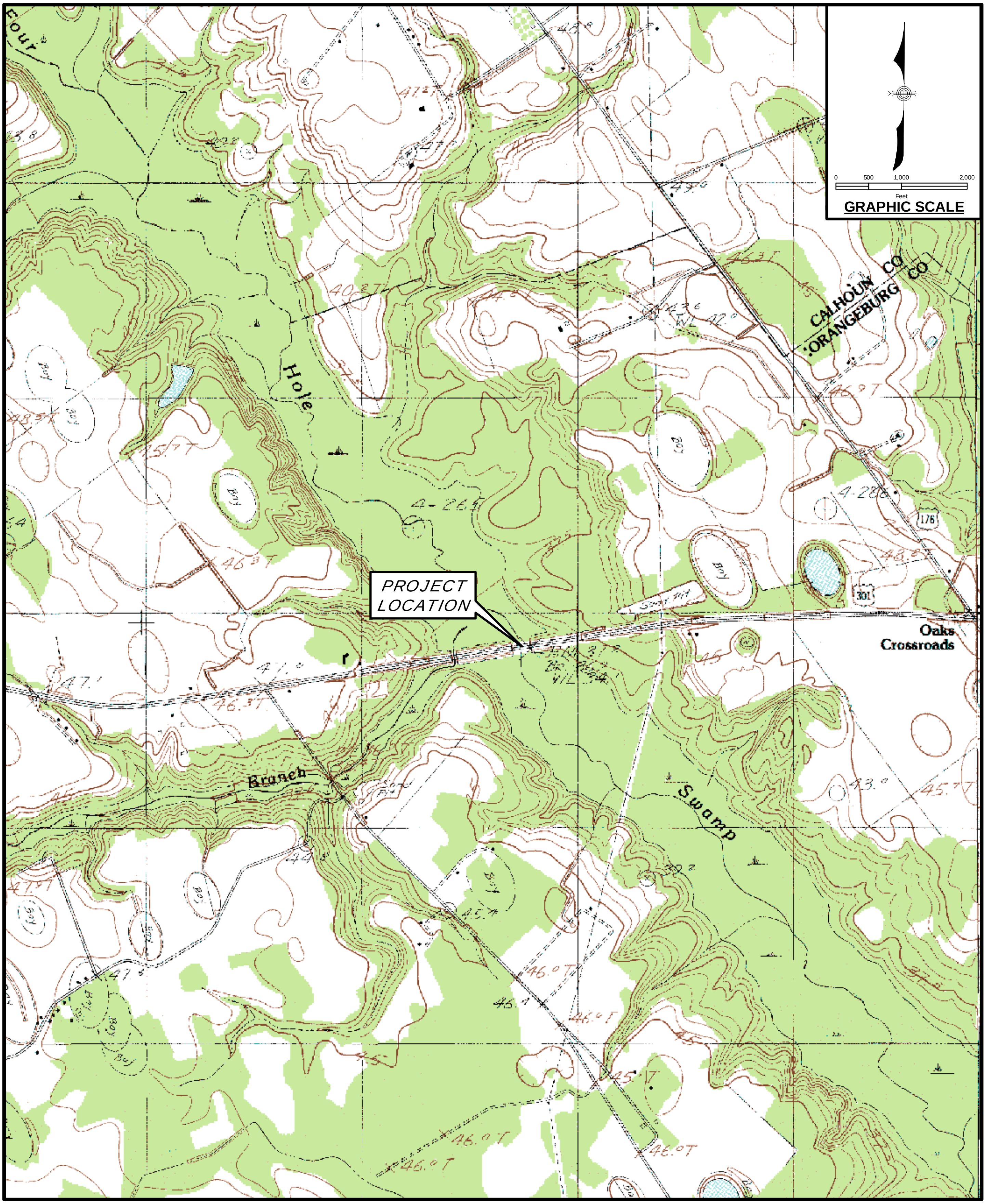
9.4 Foundation Quantity Estimates

Consider the following for quantity estimation purposes for 48-inch Pipe Pile:

- One pile driving set-up per pile
- Two PDA test setups per production pile tested
- 48-inch Steel Pipe Piling (wall thickness 1.5 inches) – Calculate pile quantity based on tip elevations provided. Provide piling with minimum yield strength of 50 ksi.
- Wet excavation of soil from within the piles from 110 feet-msl to 101.75 feet-msl per pile is required
- Wet excavation of soil from within each pile as necessary to facilitate driving the pile through very dense layers – for quantity estimation purposes use 54 feet per pile
- Backfill pipe piles with loose sand classified as A-1-a as necessary to a final elevation of 101.75 feet-msl – for quantity estimation purposes use 37 Tons per pile
- Monitoring of construction-related earthborne vibrations

Appendix I

Site Map



Bridge Replacement Over Four Hole Swamp

INDIAN CAMP BRANCH QUADRANGLE
7.5 MINUTE SERIES (TOPOGRAPHIC)
SOUTH CAROLINA - ORANGEBURG COUNTY

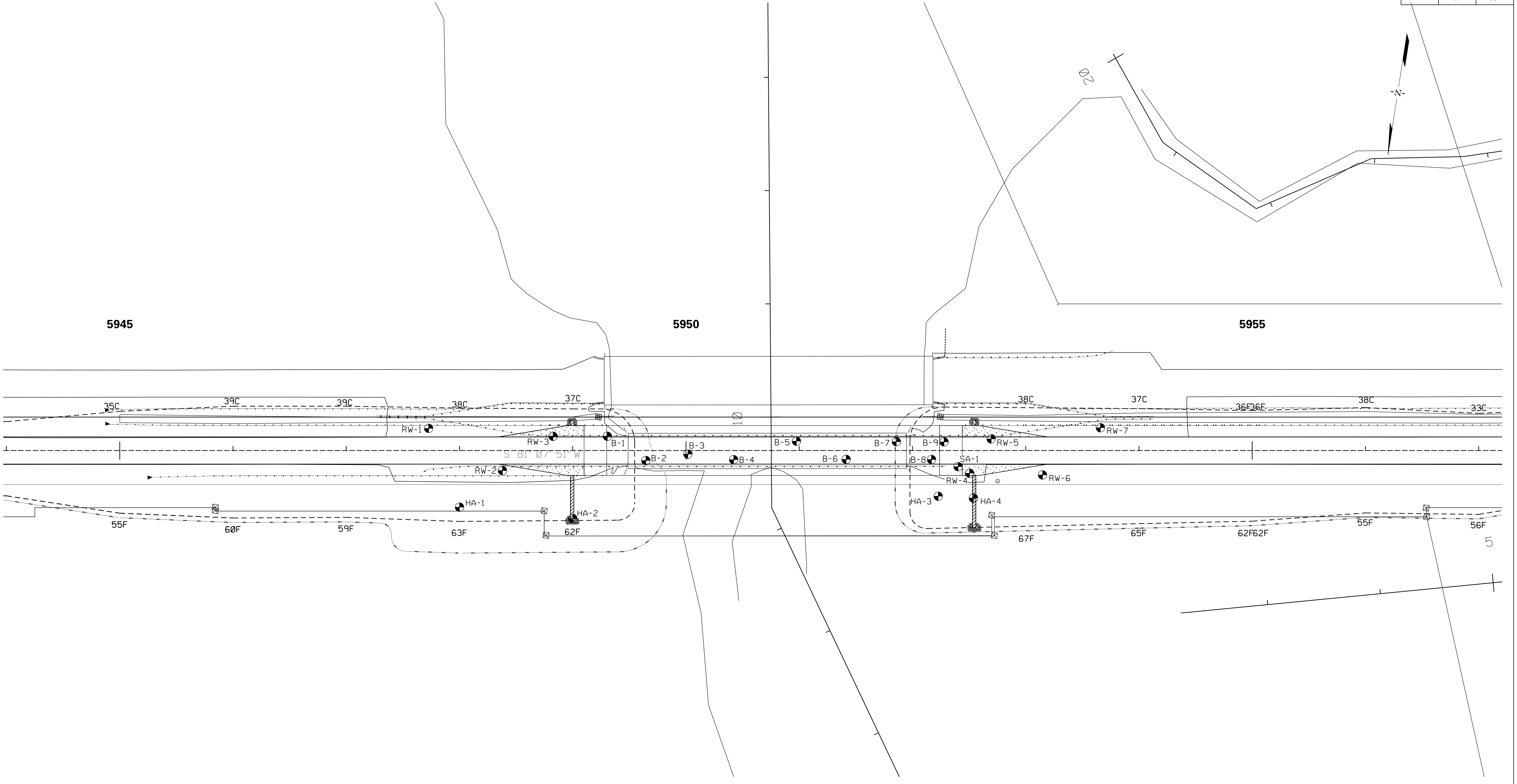
Appendix II

Boring Layout

Soil Test Borings

DMT Logs

PIN	SHEET NO.	TOTAL SHEETS
40308 BR01	??	??



REV.			
REV.			
REV.			
REVIEWED			
QUAN.			
DR.	TAR		8-14
DES.	KRB		8-14
	BY	CHK.	DATE

ICA Engineering

SCDOT

BRIDGE
DESIGN
COLUMBIA, S.C.

BRIDGE REPLACEMENT OVER FOUR HOLE SWAMP

FILE NO.	ROUTE	COUNTY	DRAWING NO.
38.040308	US 301	ORANGEBURG	??

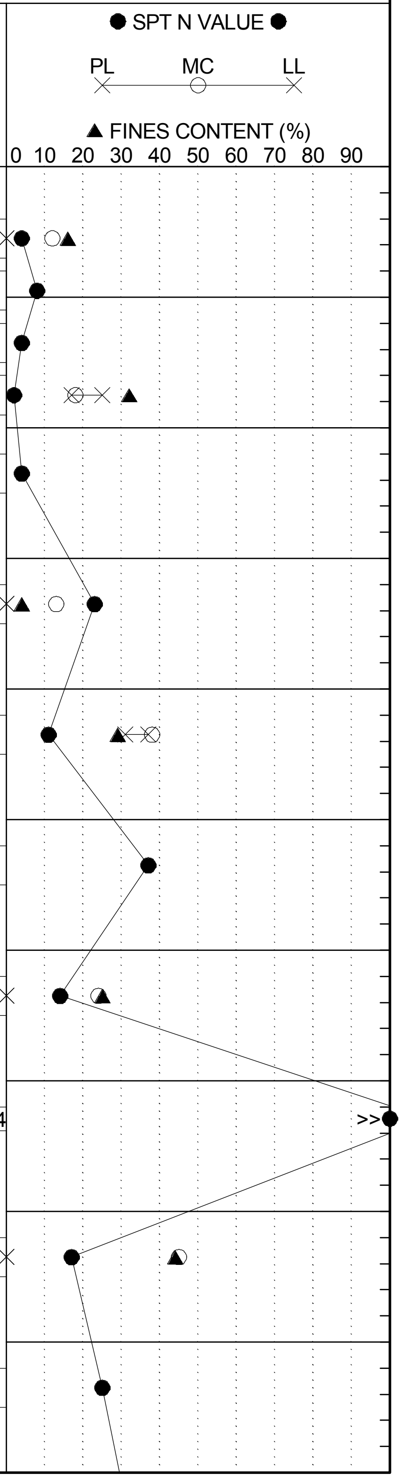
1/27/2015 $TIME$ G:\11200\10\Dwgs\Plan Sheet 1.dgn

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-1	**Boring Location:**	5949+31	**Offset:**	13' Lt.	**Alignment:**	US 301
Elev.:	119.9 ft	**Latitude:**	33.45753	**Longitude:**	80.64727	**Date Started:**	4/22/14
Total Depth:	102.5 ft	**Soil Depth:**	102.5 ft	**Core Depth:**	ft	**Date Completed:**	4/23/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 5.2 ft	**24HR**	7.7 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION
	0.0	Roadway Embankment: Very loose to loose, dry to wet, orange, tan, black, brown & gray, sub-angular, non-reactive, f. to med. grain silty SAND (SM/A-2-4). LL=NP, PL=NP, PI=NP, NMC=11.7, %#200=16.2
114.9	∇	
	7.8 ▼	Alluvium:
109.9	10.3	Very loose, moist, tan, brown & gray, non-reactive, clayey SAND (SC/A-2-4). LL=25, PL=17, PI=8, NMC=17.5, %#200=32.3
104.9	15.0	Very loose, moist, tan, brown & gray, non-reactive, silty, clayey SAND (SC-SM/A-4).
	19.5	Medium dense, wet, gray & white, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP/A-1-b). LL=NP, PL=NP, PI=NP, NMC=13.1, %#200=4.4
99.9		
94.9		Santee Formation: Medium dense to dense, moist, green & gray, strongly reactive, silty SAND (SM/A-2-4). LL=37, PL=31, PI=6, NMC=38.1, %#200=28.5
89.9	30.0	Medium dense to very dense, moist to wet, green & gray, sub-angular, strongly reactive, strongly cemented, f. grain, silty SAND (SM/A-2-4). LL=NP, PL=NP, PI=NP, NMC=23.5, %#200=24.5
84.9		
79.9	40.2	Medium dense, moist, green, gray & tan, strongly reactive, silty SAND (SM/A-4). LL=NP, PL=NP, PI=NP, NMC=44.9, %#200=44.0
74.9		
	49.3	

Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
2.0	SS-1	3	2	2	4
4.0	SS-2	3	4	4	8
6.0	SS-3	3	2	2	4
8.0	SS-4	1	1	1	2
11.0	SS-5	1	2	2	4
16.0	SS-6	10	11	12	23
21.0	SS-7	1	2	9	11
26.0	SS-8	8	16	21	37
31.0	SS-9	8	4	10	14
36.0	SS-10	16	50/0.4		50/0.4
41.0	SS-11	5	5	12	17
46.0	SS-12	6	9	16	25



LEGEND

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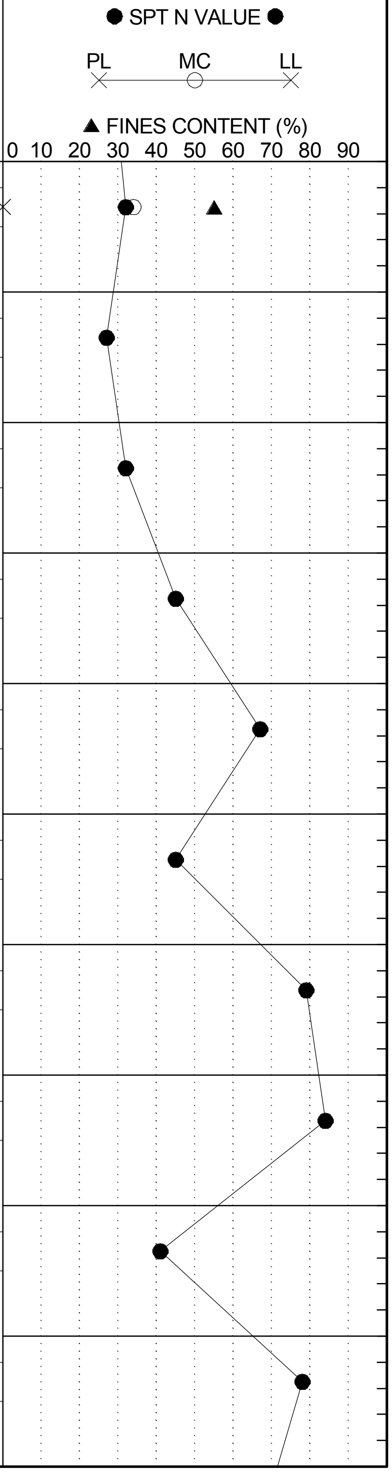
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-1	**Boring Location:**	5949+31	**Offset:**	13' Lt.	**Alignment:**	US 301
Elev.:	119.9 ft	**Latitude:**	33.45753	**Longitude:**	80.64727	**Date Started:**	4/22/14
Total Depth:	102.5 ft	**Soil Depth:**	102.5 ft	**Core Depth:**	ft	**Date Completed:**	4/23/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 5.2 ft	**24HR**	7.7 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		Very stiff to hard, moist, green, gray & tan, strongly reactive, med. to strongly cemented, sandy SILT (ML/A-4). LL=NP, PL=NP, PI=NP, NMC=33.9, %#200=55.3		51.0	SS-13	8	9	23	32
64.9				56.0	SS-14	6	10	17	27
59.9				61.0	SS-15	10	14	18	32
54.9				66.0	SS-16	9	17	28	45
49.9				71.0	SS-17	9	21	46	67
44.9				76.0	SS-18	12	18	27	45
39.9				81.0	SS-19	17	31	48	79
34.9				86.0	SS-20	19	34	50	84
29.9	90.6	Congaree Formatiom: Dense, moist, dark green, black & gray, weakly reactive, poorly graded SAND with silt (SP-SM/A-1-b).		91.0	SS-21	8	19	22	41
24.9	94.0	Very dense, moist, gray, sub-angular, weakly reactive, well-graded SAND with silt (SW-SM/A-1-b).		96.0	SS-22	19	28	50	78



LEGEND

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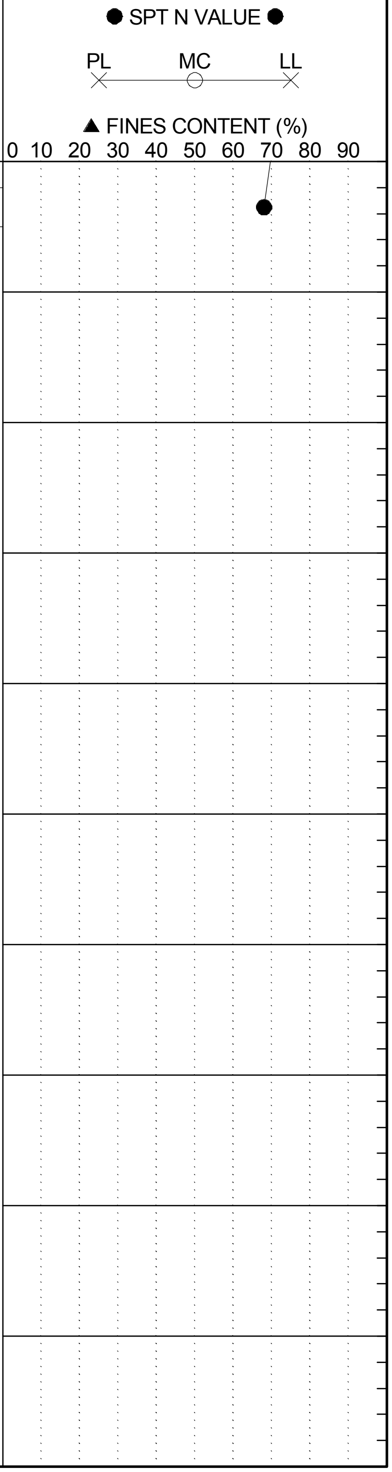
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-1	**Boring Location:**	5949+31	**Offset:**	13' Lt.	**Alignment:**	US 301
Elev.:	119.9 ft	**Latitude:**	33.45753	**Longitude:**	80.64727	**Date Started:**	4/22/14
Total Depth:	102.5 ft	**Soil Depth:**	102.5 ft	**Core Depth:**	ft	**Date Completed:**	4/23/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 5.2 ft	**24HR**	7.7 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
			▨	101.0					
	102.5		▨		SS-23	22	28	40	68
		No Casing Refusal & Boring Terminated @ 102.5' (Elev. 17.4).							
14.9									
		Bulk Sample #1 taken at 1' to 5' deep as per boring plan.							
9.9									
4.9									
-0.1									
-5.1									
-10.1									
-15.1									
-20.1									
-25.1									



LEGEND

SAMPLER TYPE

SS - Split Spoon
ST - Shelby Tube
AWG - Rock Core, 1-1/8"
NQ - Rock Core, 1-7/8"
CU - Cuttings
CT - Continuous Tube

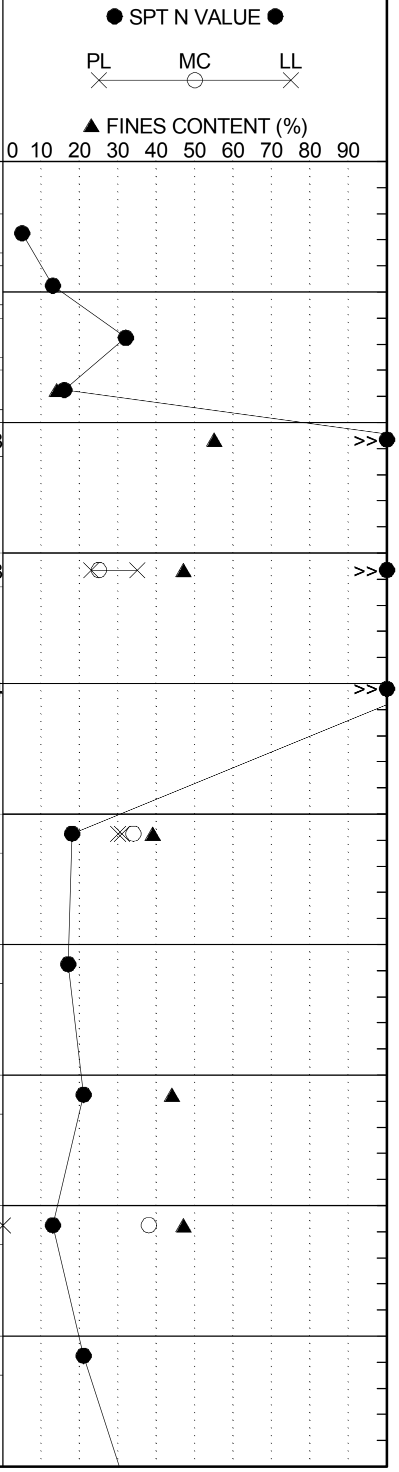
DRILLING METHOD

HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-2	**Boring Location:**	5949+65	**Offset:**	9' Rt.	**Alignment:**	US 301
Elev.:	108.8 ft	**Latitude:**	33.45757	**Longitude:**	80.6474	**Date Started:**	4/3/2014
Total Depth:	111.5 ft	**Soil Depth:**	111.5 ft	**Core Depth:**	ft	**Date Completed:**	4/5/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Mudline						
		Alluvium: Loose, wet, gray, sub-angular, non-reactive, med. to cse. grain, silty SAND (SM/A-2-4).	2.0	SS-1	1	2	3	5
	3.8	Medium dense to dense, wet, gray, sub-angular, non-reactive, med to cse. grain, poorly graded SAND (SP/A-1-b).	4.0	SS-2	3	6	7	13
103.8			6.0	SS-3	10	17	15	32
	7.8	Medium dense, wet, gray, sub-angular, strongly reactive, med. to cse. grazin, silty SAND (SM/A-1-b).	8.0	SS-4	7	8	8	16
98.8	9.8		10.0	SS-5	6	13	50/0.3	63/0.8
	11.0	LL=NA, PL=NA, PI=NA, NMC=NA, %#200=14.2						
		Hard, moist, green & gray, sub-angular, strongly reactive, f. to cse. grain, sandy SILT (ML/A-4).						
93.8			15.0	SS-6	20	38	50/0.3	88/0.8
	18.2	LL=NA, PL=NA, PI=NA, NMC=NA, %#200=55.1						
88.8		Santee Formation:	20.0	SS-7	50/0.4			50/0.4
		Very dense, moist, green and gray, sub-angular, strongly reactive, f. to cse. grain, clayey SAND (SC/A-6). LL=35, PL=23, PI=12, NMC=24.6, %#200=46.7						
83.8			25.0	SS-8	6	7	11	18
		Medium dense to very dense, moist, green, gray & tan, sub-angular, strongly reactive, strongly cemented in portions, f. to cse. grain, silty SAND (SM/A-4). LL=31, PL=30, PI=1, NMC=34.4, %#200=39.2						
78.8			30.0	SS-9	4	6	11	17
	33.3	Medium dense, moist, gray & green, sub-angular, strongly reactive, f. grain, silty SAND (SM/A-4).						
73.8			35.0	SS-10	6	8	13	21
	37.0	LL=NA, PL=NA, PI=NA, NMC=NA, %#200=43.8						
68.8		Medium dense to dense, moist, gray & green, sub-angular, strongly reactive, mod. cemented, f. grain, silty SAND (SM/A-4). LL=NP, PL=NP, PI=NP, NMC=38.1, %#200=47.1	40.0	SS-11	3	4	9	13
63.8			45.0	SS-12	4	8	13	21
			50.0					



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LEGEND

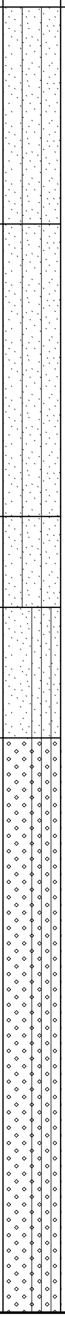
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

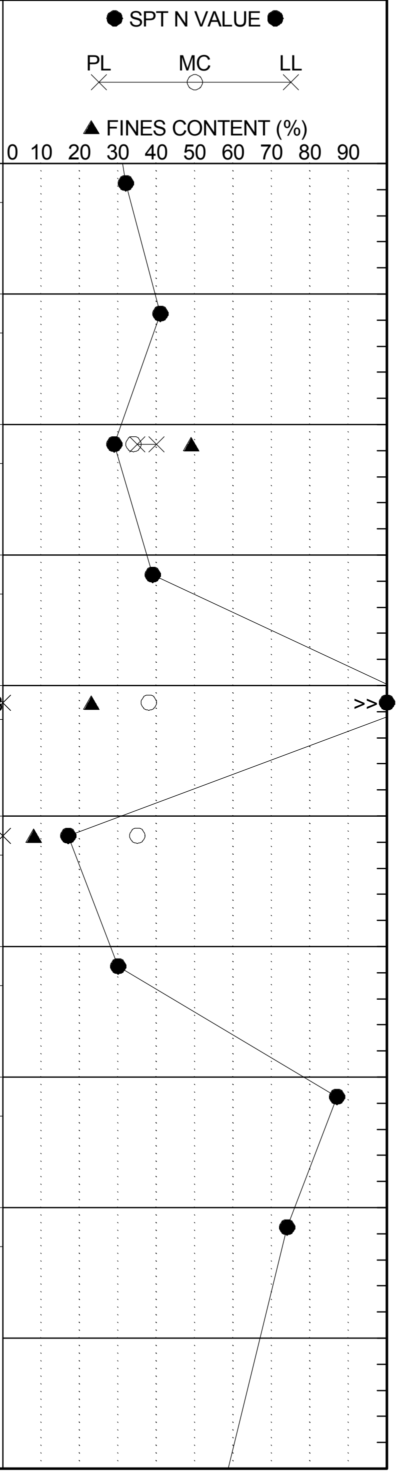
SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-2	**Boring Location:**	5949+65	**Offset:**	9' Rt.	**Alignment:**	US 301
Elev.:	108.8 ft	**Latitude:**	33.45757	**Longitude:**	80.6474	**Date Started:**	4/3/2014
Total Depth:	111.5 ft	**Soil Depth:**	111.5 ft	**Core Depth:**	ft	**Date Completed:**	4/5/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
				SS-13	6	13	19	32
53.8			55.0	SS-14	10	18	23	41
	58.3	Medium dense to dense, moist, gray & green, sub-angular, strongly reactive, mod. cemented, f. grain, silty SAND (SM/A-4). LL=40, PL=35, PI=5, NMC=33.8, %#200=48.7						
48.8			60.0	SS-15	5	12	17	29
43.8			65.0	SS-16	11	16	23	39
	69.5	Very dense, dry, green & gray, sub-angular, strongly reactive, strongly cemented, f. grain, silty SAND (SM/A-2-4).						
38.8			70.0	SS-17	34	43	50/0.3	93/0.8
	73.0	LL=NP, PL=NP, PI=NP, NMC=37.6, %#200=23.0 Congaree Formation: Medium dense, dark green, weakly reactive, sub-angular, f. to cse. grain, poorly graded SAND with silt (SP-SM/A-1-b).						
33.8			75.0	SS-18	4	7	10	17
	78.0	LL=NP, PL=NP, PI=NP, NMC=35.1, %#200=7.9 Medium dense to very dense, moist to wet, green & gray, sub-angular, non-reactive, f. to cse. grain, well-graded, SAND with silt (SW-SM/A-1-b).						
28.8			80.0	SS-19	9	12	18	30
23.8			85.0	SS-20	20	39	48	87
18.8			90.0	SS-21	25	30	43	74
13.8								

Graphic Log





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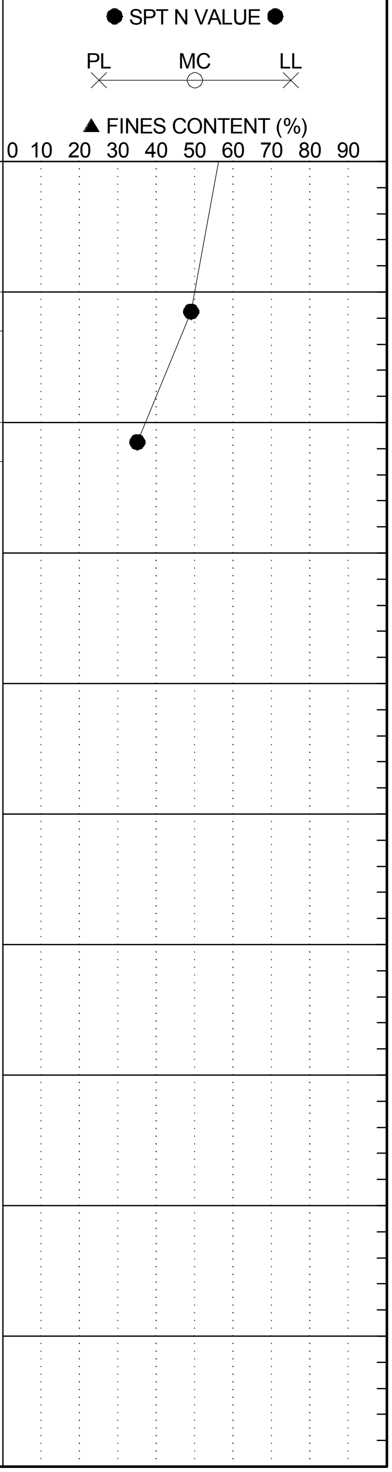
LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-2	**Boring Location:**	5949+65	**Offset:**	9' Rt.	**Alignment:**	US 301
Elev.:	108.8 ft	**Latitude:**	33.45757	**Longitude:**	80.6474	**Date Started:**	4/3/2014
Total Depth:	111.5 ft	**Soil Depth:**	111.5 ft	**Core Depth:**	ft	**Date Completed:**	4/5/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
3.8				105.0	SS-24	13	23	26	49
	108.0	Sub-Congaree Formation: Dense, moist, dark gray, f. to med. grain, non-reactive, silty SAND (SM/A-5).							
-1.2	111.5			110.0	SS-25	15	17	18	35
		No Casing Refusal & Boring Terminated @ 111.5' (Elev. 8.5).							
-6.2		Bridge deck to mudline 11.2'. Drilling ended for the day at 95.0', casing left overnight and it sank 10 feet into sand. Had to flush casing and resume sampling at 105.0' resulting in no sample obtained from 95.0'-101.5'							
-11.2									
-16.2									
-21.2									
-26.2									
-31.2									
-36.2									



LEGEND

SAMPLER TYPE

SS	Split Spoon	NQ	Rock Core, 1-7/8"
ST	Shelby Tube	CU	Cuttings
AWG	Rock Core, 1-1/8"	CT	Continuous Tube

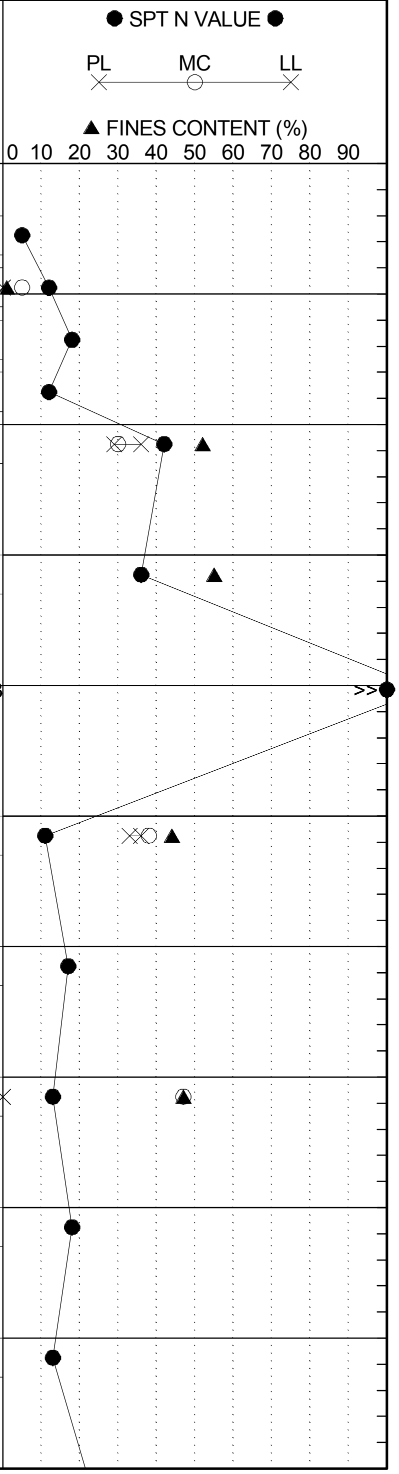
DRILLING METHOD

HSA	Hollow Stem Auger	RW	Rotary Wash
CFA	Continuous Flight Augers	RC	Rock Core
DC	Driving Casing		

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-3	**Boring Location:**	5950+02	**Offset:**	3' Rt.	**Alignment:**	US 301
Elev.:	108.8 ft	**Latitude:**	33.45751	**Longitude:**	80.64752	**Date Started:**	4/21/14
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/22/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 3.3 ft	**24HR**	3.3 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Mudline						
		Alluvium: Loose to medium dense, wet, white & gray, ▼ sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP-A-1-b). LL=NP, PL=NP, PI=NP, NMC=4.5, %#200=0.5	2.0	SS-1	1	2	3	5
			4.0	SS-2	1	3	9	12
103.8			6.0	SS-3	3	6	12	18
			8.0	SS-4	7	8	4	12
98.8	9.4	Santee Formation: Hard, moist, green, gray & tan, strongly reactive, f. to cse. grain, sandy SILT (ML/A-4). LL=36, PL=29, PI=7, NMC=30.2, %#200=51.9	10.0	SS-5	3	10	32	42
93.8	13.3	Hard, moist, green, gray & tan, strongly reactive, f. to cse. grain, sandy SILT (ML/A-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=55.2	15.0	SS-6	10	17	19	36
88.8	19.5	Medium dense to very dense, moist to wet, green, gray & tan, strongly reactive, weakly to strongly cemented, f. grain, silty SAND (SM/A-4). LL=36, PL=33, PI=3, NMC=37.9, %#200=43.6	20.0	SS-7	50/0.3			50/0.3
83.8			25.0	SS-8	3	4	7	11
78.8			30.0	SS-9	4	6	11	17
73.8	33.3	Medium dense, dry to wet, green & gray, strongly reactive, weakly cemented, f. grain, silty SAND (SM/A-4). LL=NP, PL=NP, PI=NP, NMC=46.7, %#200=47.3	35.0	SS-10	6	6	7	13
68.8			40.0	SS-11	16	10	8	18
63.8			45.0	SS-12	5	6	7	13
			50.0					



LEGEND

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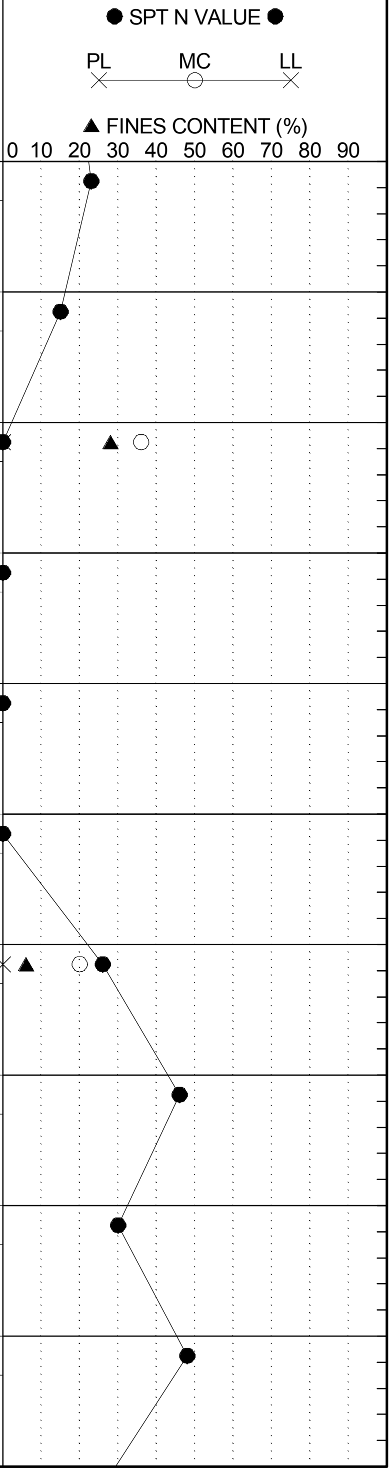
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-3	**Boring Location:**	5950+02	**Offset:**	3' Rt.	**Alignment:**	US 301
Elev.:	108.8 ft	**Latitude:**	33.45751	**Longitude:**	80.64752	**Date Started:**	4/21/14
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/22/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 3.3 ft	**24HR**	3.3 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
				SS-13	7	10	13	23
	53.3	Medium dense, moist, green & gray, strongly reactive, weakly cemented, f. grain, silty SAND (SM/A-2-4).						
53.8			55.0	SS-14	10	8	7	15
	58.7	Congaree Formation: Very loose, wet, dark green, weakly reactive, f. grain, silty SAND (SM/A-2-4). LL=NP, PL=NP, PI=NP, NMC=35.9, %#200=28.0						
48.8			60.0	SS-15	0	0	0	0
	63.3	Very loose, moist, dark green & tan, non-reactive, well-graded SAND (SW/A-1-b).						
43.8			65.0	SS-16	0	0	0	0
38.8			70.0	SS-17	0	0	0	0
33.8			75.0	SS-18	0	0	0	0
	78.0	Medium dense to dense, wet, gray, green, black & tan, sub-angular, non-reactive, med. to cde. grain, well-graded SAND with silt (SW-SM/A-1-b). LL=NP, PL=NP, PI=NP, NMC=19.7, %#200=5.7						
28.8			80.0	SS-19	4	11	15	26
23.8			85.0	SS-20	14	20	26	46
18.8			90.0	SS-21	11	14	16	30
13.8			95.0	SS-22	12	20	28	48
	100.0		100.0					



LEGEND

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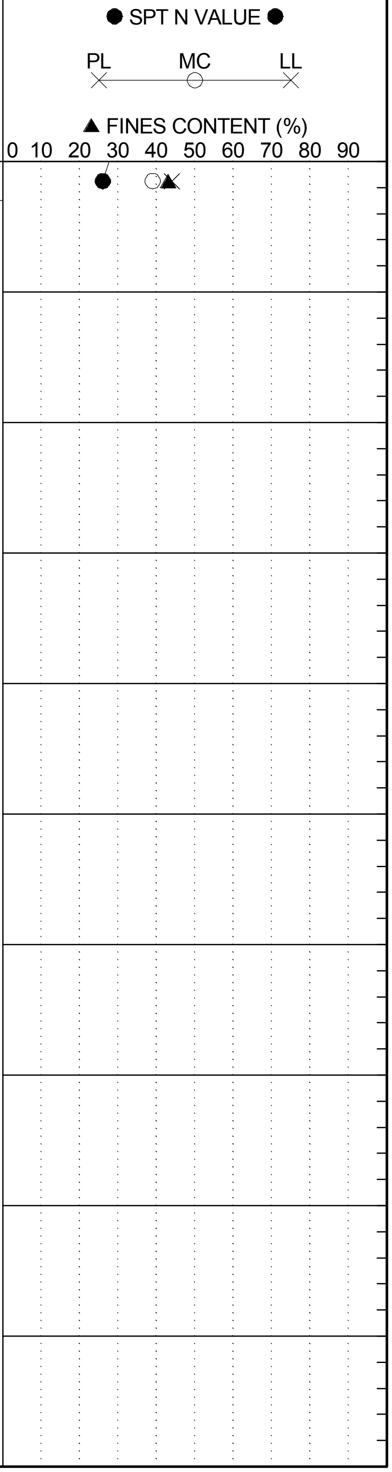
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-3	**Boring Location:**	5950+02	**Offset:**	3' Rt.	**Alignment:**	US 301
Elev.:	108.8 ft	**Latitude:**	33.45751	**Longitude:**	80.64752	**Date Started:**	4/21/14
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/22/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 3.3 ft	**24HR**	3.3 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	101.5	Sub-Congaree Formation: Medium dense, moist, dark gray, non-reactive, mod. cemented, silty SAND (SM/A-5). LL=44, PL=44, PI=NP, NMC=38.9, %#200=42.6			SS-23	10	11	15	26
3.8		No Casing Refusal & Boring Terminated @ 101.5' (Elev. 18.8).							
-1.2		Bridge deck to mudline 11.5'							
-6.2									
-11.2									
-16.2									
-21.2									
-26.2									
-31.2									
-36.2									



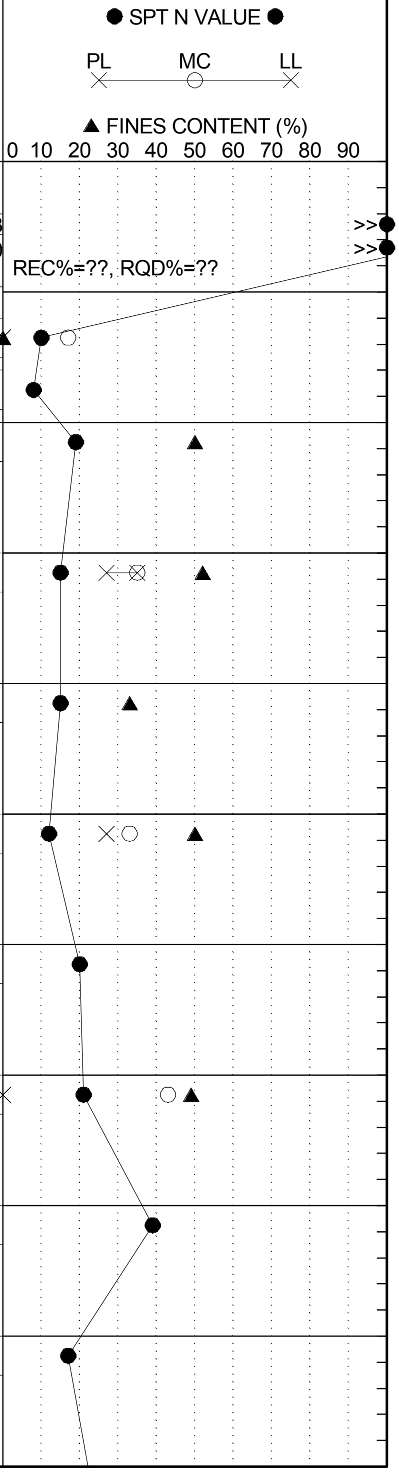
LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-4	**Boring Location:**	5950+42	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	107.9 ft	**Latitude:**	33.45754	**Longitude:**	80.64764	**Date Started:**	4/5/2014
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/6/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Mudline							
		Roadway Embankment: Loose to very dense, wet, gray & white, sub-angular, weakly reactive, strongly cemented, med. to cse. grain, poorly graded SAND (SP/A-1-b). LL=NP, PL=NP, PI=NP, NMC=17.2, %#200=0.1		2.0	SS-1	1	50/0.3		50/0.3
				3.3	SS-2	50/0.0			50/0.0
				3.3	NQ-1				
102.9				6.0	SS-3	2	7	3	10
				8.0	SS-4	4	3	5	8
97.9	9.8	Santee Formation: Very stiff, moist, gray & green, sub-angular, strongly reactive, sub-angular, f. grain, sandy SILT (ML/A-4).		10.0	SS-5	7	8	11	19
92.9	13.3	LL=NA, PL=NA, PI=NA, NMC=NA, %#200=50.2		15.0	SS-6	4	6	9	15
87.9	18.3	Stiff, moist, gray & green, sub-angular, strongly reactive, f. grain, sandy SILT, (ML/A-4). LL=35, PL=27, PI=8, NMC=34.8, %#200=52.4		20.0	SS-7	7	6	9	15
82.9	23.3	Medium dense, moist, gray & green, sub-angular, strongly reactive, f. grain, silty SAND with gravel (SM/A-2-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=32.8		25.0	SS-8	3	5	7	12
77.9	28.3	Medium dense, moist, gray & green, sub-angular, strongly reactive, f. grain, silty SAND (SM/A-4). LL=27, PL=27, PI=NP, NMC=33.2, %#200=49.8		30.0	SS-9	6	9	11	20
72.9		Medium dense to dense, moist, tan & gray, sub-angular, strongly reactive, f. grain, silty SAND (SM/A-4). LL=NP, PL=NP, PI=NP, NMC=43.4, %#200=49.4		35.0	SS-10	6	7	14	21
67.9				40.0	SS-11	21	17	22	39
62.9				45.0	SS-12	4	7	10	17
	47.0	Medium dense to dense, moist, gray, tan & green, strongly reactive, f. to cse. grain, silty SAND (SM/A-4).		50.0					



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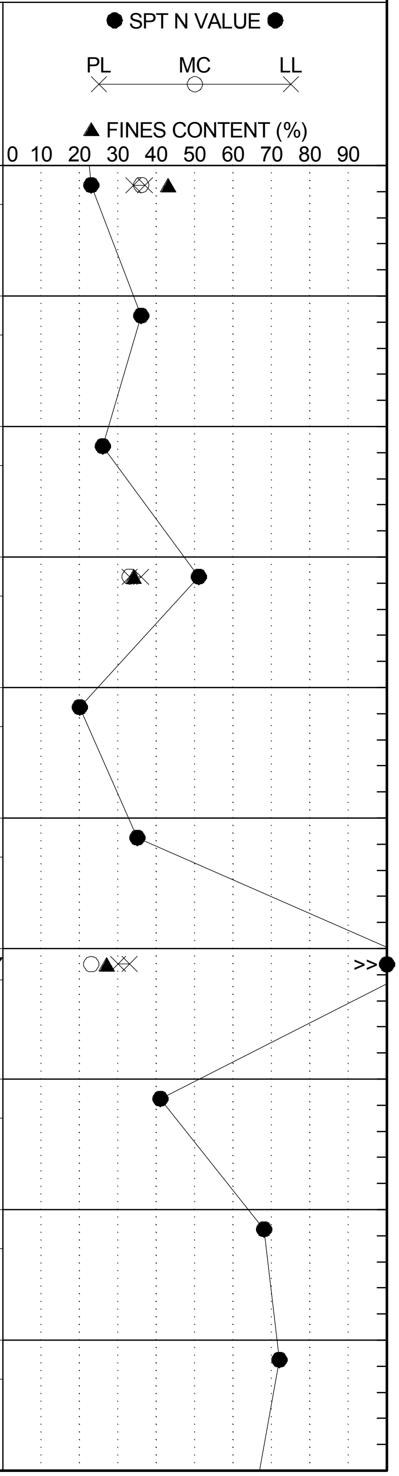
LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-4	**Boring Location:**	5950+42	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	107.9 ft	**Latitude:**	33.45754	**Longitude:**	80.64764	**Date Started:**	4/5/2014
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/6/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		LL=37, PL=34, PI=3, NMC=36.0, %#200=42.6		SS-13	8	10	13	23
52.9			55.0	SS-14	12	15	21	36
47.9			60.0	SS-15	10	12	14	26
	63.3	Medium dense to very dense, moist, gray, tan & green, strongly reactive, weakly cemented areas, f. grain, silty SAND (SM/A-2-4). LL=36, PL=33, PI=3, NMC=33.4, %#200=33.5						
42.9			65.0	SS-16	16	18	33	51
37.9			70.0	SS-17	6	7	13	20
32.9			75.0	SS-18	14	16	19	35
	78.3	Very dense, moist, gray, tan & green, weakly to strongly cemented, f. grain, silty SAND (SM/A-2-4). LL=33, PL=30, PI=3, NMC=22.7, %#200=27.3						
27.9			80.0	SS-19	23	38	50/0.2	88/0.7
	84.0	Congaree Formation: Dense, moist, dark green, gray & tan, sub-angular, strongly reactive, f. to med. grain, poorly graded SAND with silt (SP-SM/A-1-b).						
22.9			85.0	SS-20	15	16	25	41
	88.0	Very dense, wet, gray & green, sub-angular, non to weakly reactive, med. to cse. grain, well-graded SAND with silt (SW-SM/A-1-b).						
17.9			90.0	SS-21	20	28	48	68
12.9			95.0	SS-22	17	32	40	72
			100.0					



LEGEND

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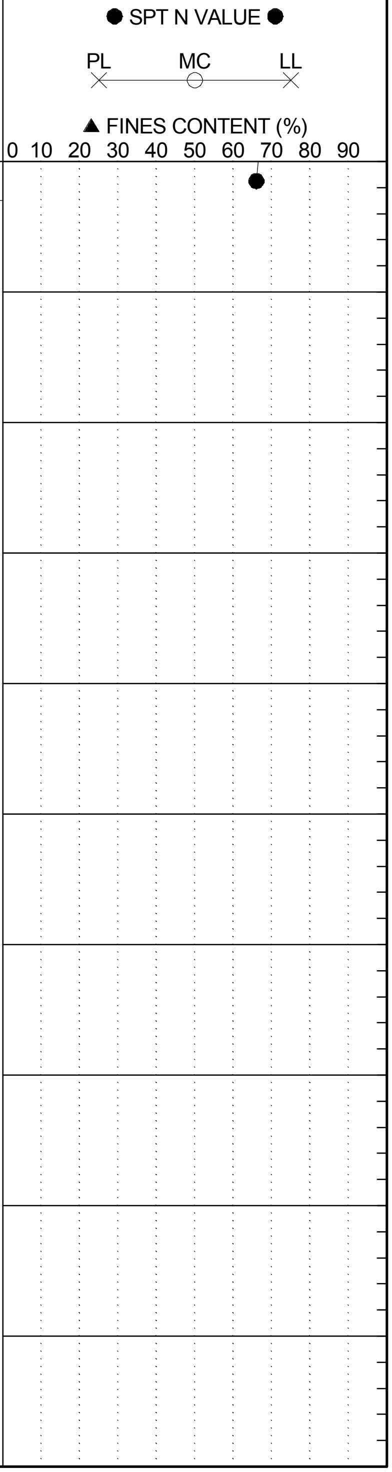
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-4	**Boring Location:**	5950+42	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	107.9 ft	**Latitude:**	33.45754	**Longitude:**	80.64764	**Date Started:**	4/5/2014
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/6/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	101.5		▨		SS-23	16	31	35	66
		No Casing Refusal & Boring Terminated @ 101.5' (Elev. 18.7).							
2.9		Bridge deck to mudline 12.3'.							
-2.1									
-7.1									
-12.1									
-17.1									
-22.1									
-27.1									
-32.1									
-37.1									



LEGEND

SAMPLER TYPE

SS - Split Spoon
ST - Shelby Tube
AWG - Rock Core, 1-1/8"
NQ - Rock Core, 1-7/8"
CU - Cuttings
CT - Continuous Tube

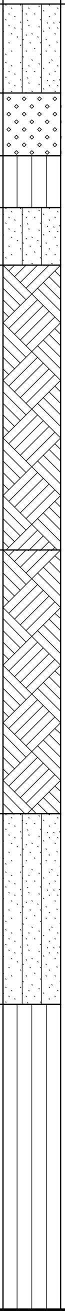
DRILLING METHOD

HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

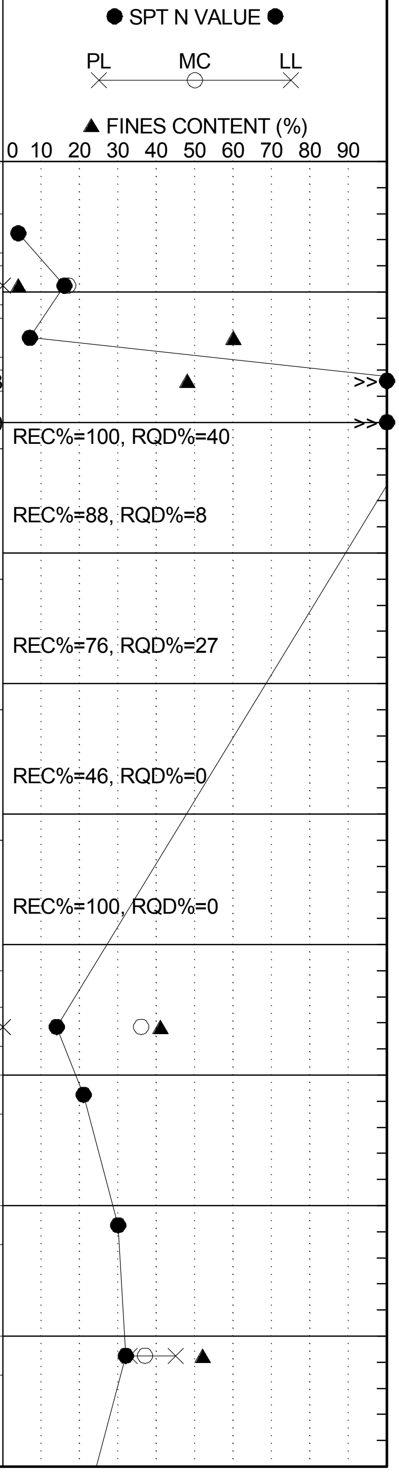
SCDOT Soil Test Boring Log

File No.: 38.040308	**Project No. (PIN):** BR38(019)		**County:** Orangeburg			**Eng./Geo.:** R. DeLost	
Site Description: Bridge Replacement over Four Hole Swamp						**Route:** US 301	
Boring No.: B-5	**Boring Location:** 5950+98		**Offset:** 8' Lt.			**Alignment:** US 301	
Elev.: 105.5 ft	**Latitude:** 33.45747		**Longitude:** 80.64781			**Date Started:** 4/12/2014	
Total Depth: 101.3 ft	**Soil Depth:** 80.3 ft		**Core Depth:** 21 ft			**Date Completed:** 4/13/2014	
Bore Hole Diameter (in): 4	**Sampler Configuration**		**Liner Required:** Y [✓ N]			**Liner Used:** Y [✓ N]	
Drill Machine: CME 45C	**Drill Method:** RW/RC/DC		**Hammer Type:** Automatic			**Energy Ratio:** 79%	
Core Size: NQ2	**Driller:** M. Morgan		**Groundwater:**	**TOB**	NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION
	0.0	Mudline
		Alluvium: Very loose, wet, gray & tan, sub-angular, non-reactive, med. to cse. grain, silty SAND (SM/A-2-4).
	3.4	Medium dense, wet, gray & tan, sub-angular, non-reactive, med. to cse. grain, well-graded SAND (SW/A-1-b). LL=NP, PL=NP, PI=NP, NMC=16.8, %#200=3.8
100.5	5.8	Firm, moist, green, gray & tan, non-reactive, f. grain, sandy SILT (ML/A-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=59.9
	7.8	Santee Formation: Very dense, moist, green & gray, strongly reactive, mod. to strongly cemented, f. grain, silty SAND (SM/A-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=47.8
95.5	10.0	Casing Refusal @ 10.0'. Begin coring in Calcareous Sandstone. Tan, lt. green, lt. gray, black-dk. brown, v.f. to scat. med. grain, thinly to thickly bedded, quartz-calcite-phosphate, mod. to highly weathered, v. weak to weak, friable in parts-seams low hardness, VC discontinuity spacing, seams calcarenite, fossiliferous (frags. & mega shells). med. strong 10.6'-11.0', 19.0'-20.0' & 20.5'-20.9'; 33+ 0° B, T-MW, No, Wa-Ir, SR
90.5		
85.5	20.9	Calcarenite: Tan-gray, v.f. to f. grain, v. thinly to thinly bedded, calcite-quartz, mod. to highly weathered, v. weak to weak, friable, VC discontinuity spacing, pods of calcareous sandstone, fossiliferous (frags. & trc. mega shells). 1 90° J, T, No, Pl, Slk; 49+ 0° B, T-MW, No, Wa-Ir, SR
80.5		
75.5	31.0	End Coring @ 31.0'. Return to Casing and Sample. Medium dense, moist, green & gray, strongly reactive, f. grain, silty SAND (SM/A-4). LL=NP, PL=NP, PI=NP, NMC=36.4,
70.5		
65.5	38.3	
60.5		



Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	
2.0	SS-1	2	1	3	4	
4.0	SS-2	8	8	8	16	
6.0	SS-3	3	3	4	7	
8.0	SS-4	10	50/0.3		50/0.3	
10.0	SS-5	50/0.0			50/0.0	
10.0	NQ-1					REC%=100, RQD%=40
11.0	NQ-2					REC%=88, RQD%=8
16.0	NQ-3					REC%=76, RQD%=27
21.0	NQ-4					REC%=46, RQD%=0
26.0	NQ-5					REC%=100, RQD%=0
32.4	SS-6	4	4	10	14	
35.0	SS-7	7	7	14	21	
40.0	SS-8	10	13	17	30	
45.0	SS-9	8	12	20	32	
50.0						



LEGEND

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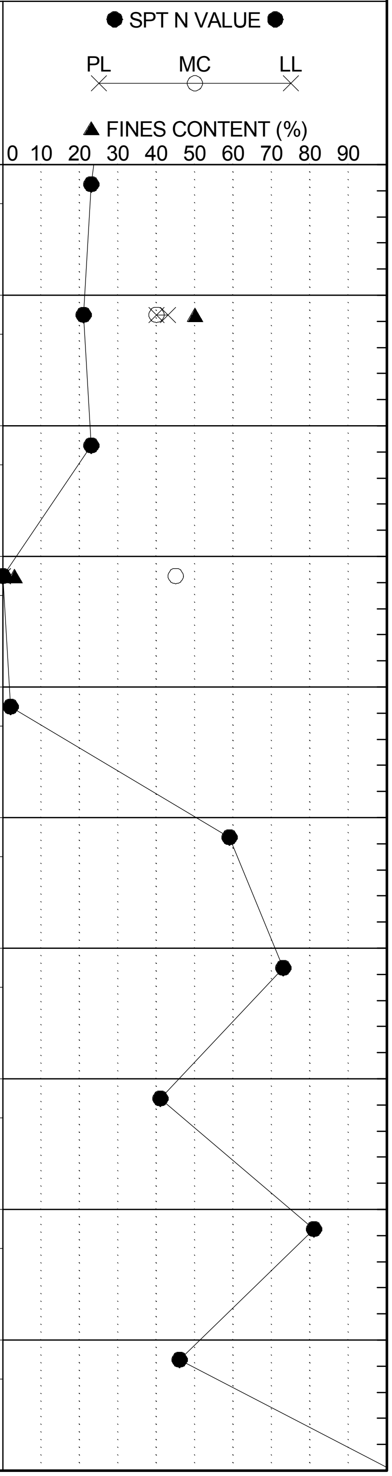
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.: 38.040308
Project No. (PIN): BR38(019)
County: Orangeburg
Eng./Geo.: R. DeLost
Site Description: Bridge Replacement over Four Hole Swamp
Route: US 301
Boring No.: B-5
Boring Location: 5950+98
Offset: 8' Lt.
Alignment: US 301
Elev.: 105.5 ft
Latitude: 33.45747
Longitude: 80.64781
Date Started: 4/12/2014
Total Depth: 101.3 ft
Soil Depth: 80.3 ft
Core Depth: 21 ft
Date Completed: 4/13/2014
Bore Hole Diameter (in): 4
Sampler Configuration
Liner Required: Y [✓ N]
Liner Used: Y [✓ N]
Drill Machine: CME 45C
Drill Method: RW/RC/DC
Hammer Type: Automatic
Energy Ratio: 79%
Core Size: NQ2
Driller: M. Morgan
Groundwater: **TOB** NA **24HR** NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		%#200=41.2		SS-10	7	10	13	23
	53.3	Very stiff to hard, moist, green & gray, strongly reactive, f. grain, sandy SILT (ML/A-7-5). LL=45, PL=33, PI=12, NMC=37.0, %#200=52.3						
50.5			55.0	SS-11	5	10	11	21
	58.3	Very stiff, moist, green & gray, strongly reactive, f. grain, sandy SILT (ML/A-5). LL=43, PL=40, PI=3, NMC=39.6, %#200=50.1						
45.5			60.0	SS-12	9	11	12	23
	63.3	Medium dense, wet, dark green & gray, strongly reactive, f. grain, silty SAND (SM/A-2-4). Congaree Formation: Very loose, wet, dark green, tan & black, non to weakly reactive, cse. grain, well-graded SAND (SW/A-1-b). LL=NP, PL=NP, PI=NP, NMC=45.4, %#200=2.6						
40.5			65.0	SS-13	0	0	0	0
35.5			70.0	SS-14	0	0	2	2
	73.0	Dense to very dense, moist, gray, sub-angular, non-reactive, f. to med. grain, well-graded SAND with silt (SW-SM/A-1-b).						
30.5			75.0	SS-15	13	24	35	59
25.5			80.0	SS-16	23	35	38	73
20.5			85.0	SS-17	10	18	23	41
15.5			90.0	SS-18	31	41	40	81
10.5			95.0	SS-19	7	13	33	46
			100.0					



LEGEND

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SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
AWG - Rock Core, 1-1/8"
NQ - Rock Core, 1-7/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-5	**Boring Location:**	5950+98	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	105.5 ft	**Latitude:**	33.45747	**Longitude:**	80.64781	**Date Started:**	4/12/2014
Total Depth:	101.3 ft	**Soil Depth:**	80.3 ft	**Core Depth:**	21 ft	**Date Completed:**	4/13/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	101.3				SS-20	15	42	50/0.3	92/0.8	>>●
		No Casing Refusal & Boring Terminated @ 101.3' (Elev. 19.0).								
0.5		Bridge deck to mudline 14.8'.								
-4.5										
-9.5										
-14.5										
-19.5										
-24.5										
-29.5										
-34.5										
-39.5										

LEGEND

SAMPLER TYPE

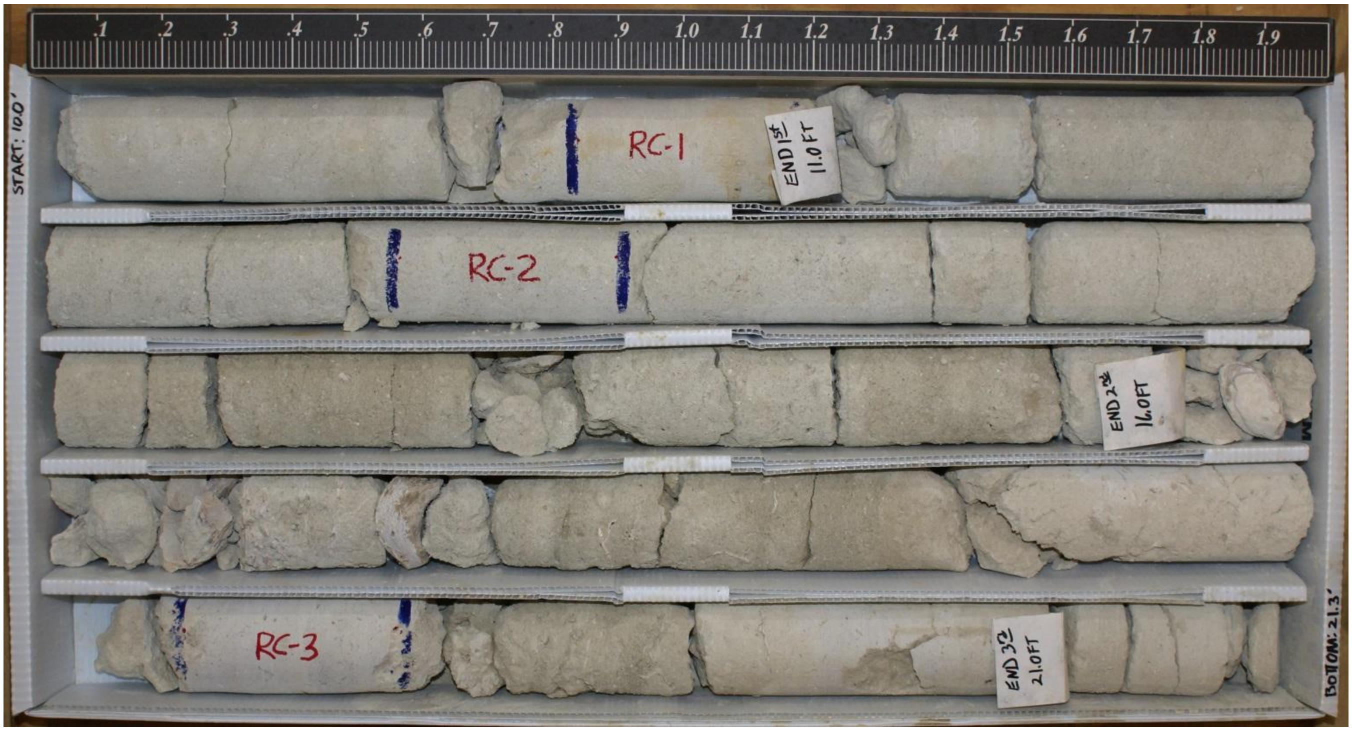
SS - Split Spoon	NQ - Rock Core, 1-7/8"
ST - Shelby Tube	CU - Cuttings
AWG - Rock Core, 1-1/8"	CT - Continuous Tube

DRILLING METHOD

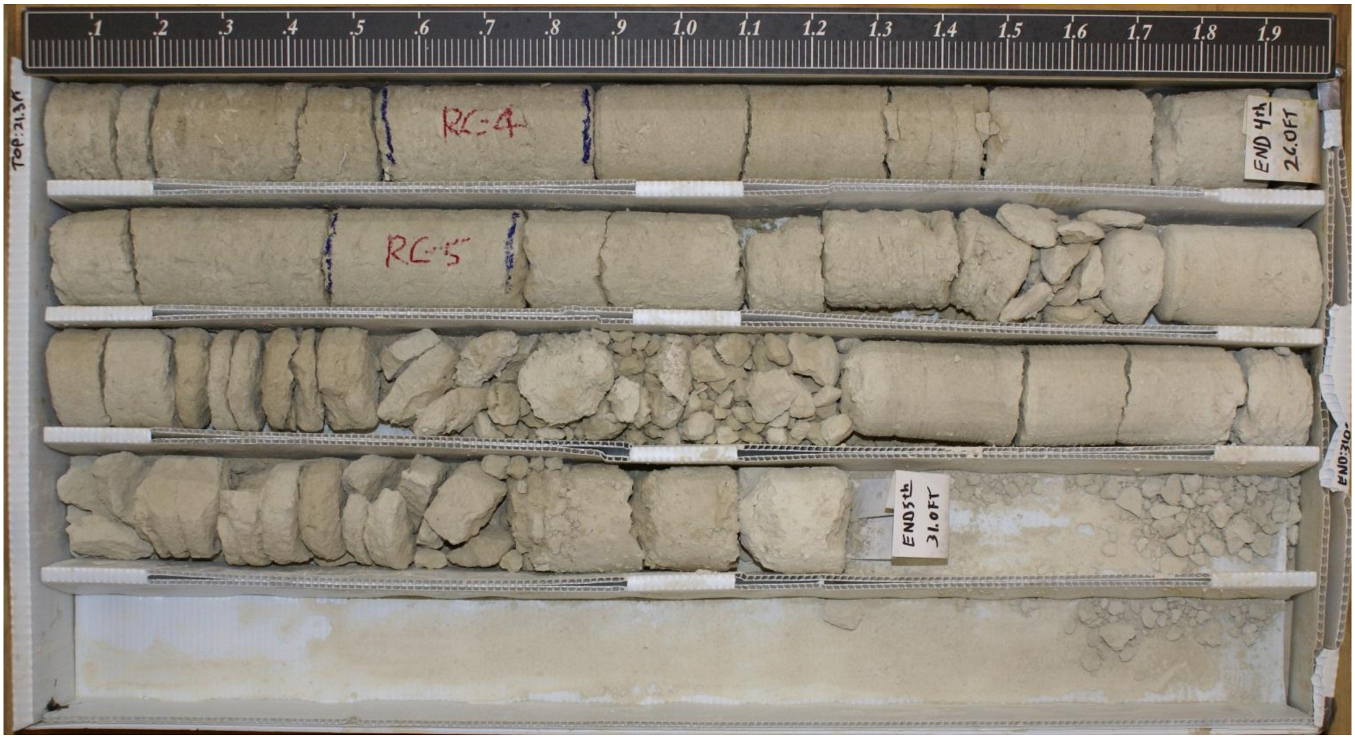
HSA - Hollow Stem Auger	RW - Rotary Wash
CFA - Continuous Flight Augers	RC - Rock Core
DC - Driving Casing	

CORE PHOTOGRAPHIC RECORD

Bridge Replacement over Four Hole Swamp



B5 – Box 1 of 2



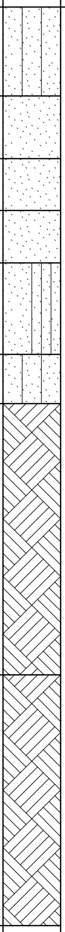
B5 – Box 2 of 2

SCDOT Soil Test Boring Log

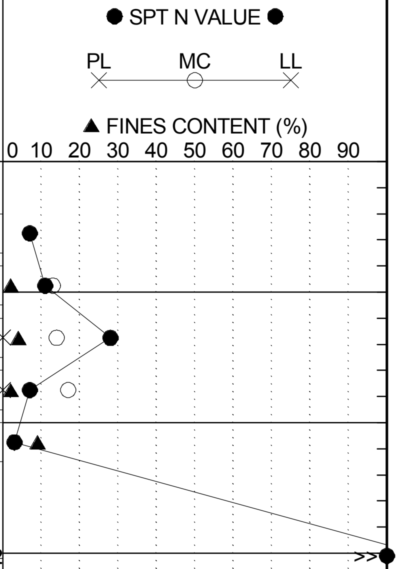
File No.: 38.040308	**Project No. (PIN):** BR38(019)	**County:** Orangeburg				**Eng./Geo.:** R. DeLost	
Site Description: Bridge Replacement over Four Hole Swamp						**Route:** US 301	
Boring No.: B-6	**Boring Location:** 5951+41	**Offset:** 8' Rt.				**Alignment:** US 301	
Elev.: 107.8 ft	**Latitude:** 33.4575	**Longitude:** 80.64796				**Date Started:** 4/6/2014	
Total Depth: 35.2 ft	**Soil Depth:** 15.2 ft	**Core Depth:** 20 ft				**Date Completed:** 4/8/2014	
Bore Hole Diameter (in): 4	**Sampler Configuration**	**Liner Required:** Y [✓ N]				**Liner Used:** Y [✓ N]	
Drill Machine: CME 45C	**Drill Method:** RW/RC/DC	**Hammer Type:** Automatic				**Energy Ratio:** 79%	
Core Size: NQ2	**Driller:** M. Morgan	**Groundwater:** **TOB** NA				**24HR** NA	

Depth (ft)	MATERIAL DESCRIPTION
0.0	Mudline
3.4	Alluvium: Loose, wet, brown, tan & gray, sub-angular, weakly reactive, med. to cse. grain, silty SAND (SM/A-2-4).
5.8	Medium dense, wet, brown, tan & gray, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP/A-1-b). LL=NA, PL=NA, PI=NA, NMC=12.7, %#200=1.6
7.8	Medium dense, wet, brown, tan & gray, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP/A-1-b). LL=NP, PL=NP, PI=NP, NMC=14.0, %#200=4.0
9.8	Loose, wet, brown, tan & gray, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP/A-1-b). LL=NP, PL=NP, PI=NP, NMC=17.0, %#200=2.1
13.3	Very loose, wet, gray & brown, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND with silt (SP-SM/A-2-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=8.8
15.2	Very dense, wet, gray & green, sub-angular, weakly reactive, med. to cse. grain, silty SAND (SM/A-4).
25.6	Casing Refusal @ 15.2'. Begin coring in Calcareous Sandstone. Santee Formation: Gray-tan, tan-lt. green, scat. black-dk. brown, f. to med. grain w/scat. cse. frags., thinly to thickly bedded, quartz-calcite-phosphate, mod. to highly weathered w/seams completely weathered, v. weak to weak, friable in parts-seams low hardness, VC discontinuity spacing, seams calcarenite, fossiliferous (frags. & mega shells), vugular texture. 23 0°-10° B, T-MW, No, Pl-Wa, SR
35.2	Calcarenite: Tan-gray, lt. green, v.f. to f. grain, thickly bedded, calcite-quartz, mod. weathered w/highly weathered seams, v. weak to weak, friable w/seams low hardness, VC discontinuity spacing, pods of calcareous

Elevation (ft): 102.8, 97.8, 92.8, 87.8, 82.8, 77.8, 72.8, 67.8, 62.8



Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	
2.0	SS-1	3	4	3	7	
4.0	SS-2	3	5	6	11	
6.0	SS-3	8	11	17	28	
8.0	SS-4	0	3	4	7	
10.0	SS-5	1	1	2	3	
15.0	SS-6	50/0.2			50/0.2	
15.2	NQ-1					REC%=100, RQD%=64
20.2	NQ-2					REC%=66, RQD%=16
25.2	NQ-3					REC%=98, RQD%=22
30.2	NQ-4					REC%=100, RQD%=50



LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-6	**Boring Location:**	5951+41	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	107.8 ft	**Latitude:**	33.4575	**Longitude:**	80.64796	**Date Started:**	4/6/2014
Total Depth:	35.2 ft	**Soil Depth:**	15.2 ft	**Core Depth:**	20 ft	**Date Completed:**	4/8/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

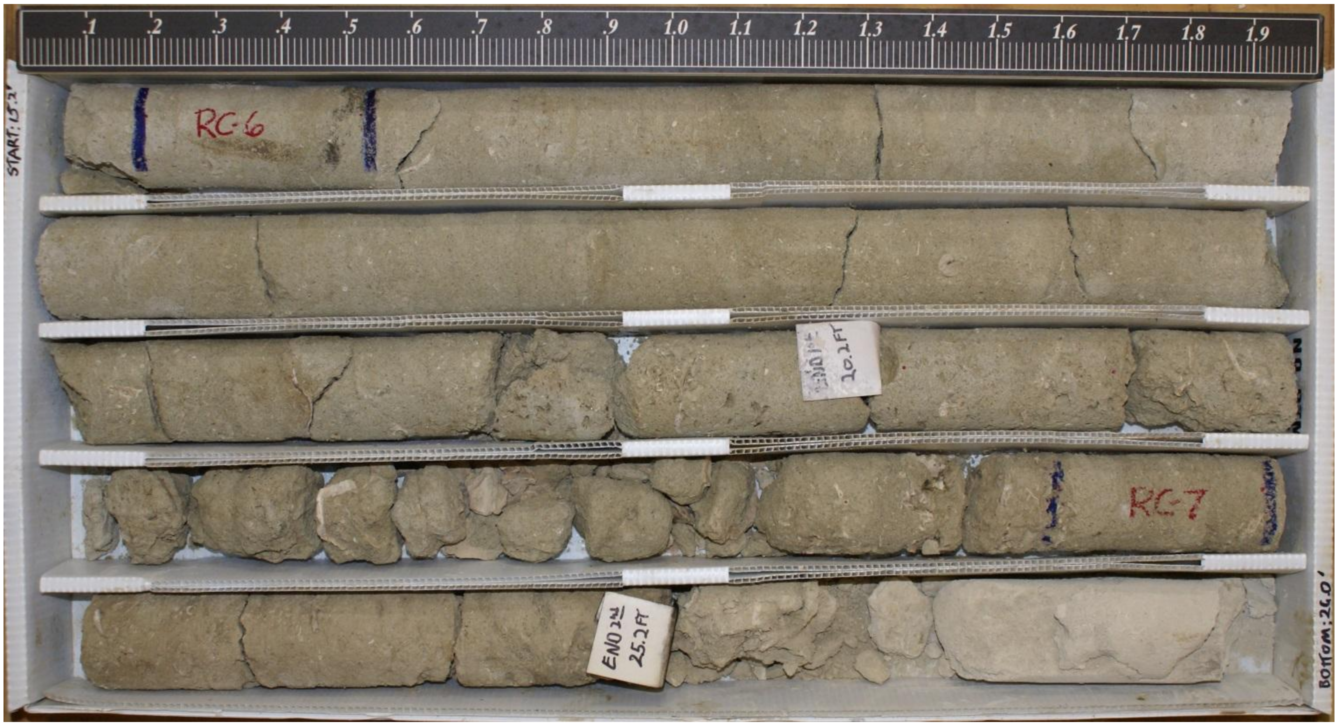
Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
		sandstone, fossiliferous (frags. & trc. mega shells). med. strong 25.6'-26.5'; 27+ 0° B, T-MW, No, Pl-Ir, SR								
52.8		Boring Terminated @ 35.2' (Elev. 85.0). Bridge deck to mudline 12.4'.								
47.8										
42.8										
37.8										
32.8										
27.8										
22.8										
17.8										
12.8										

LEGEND

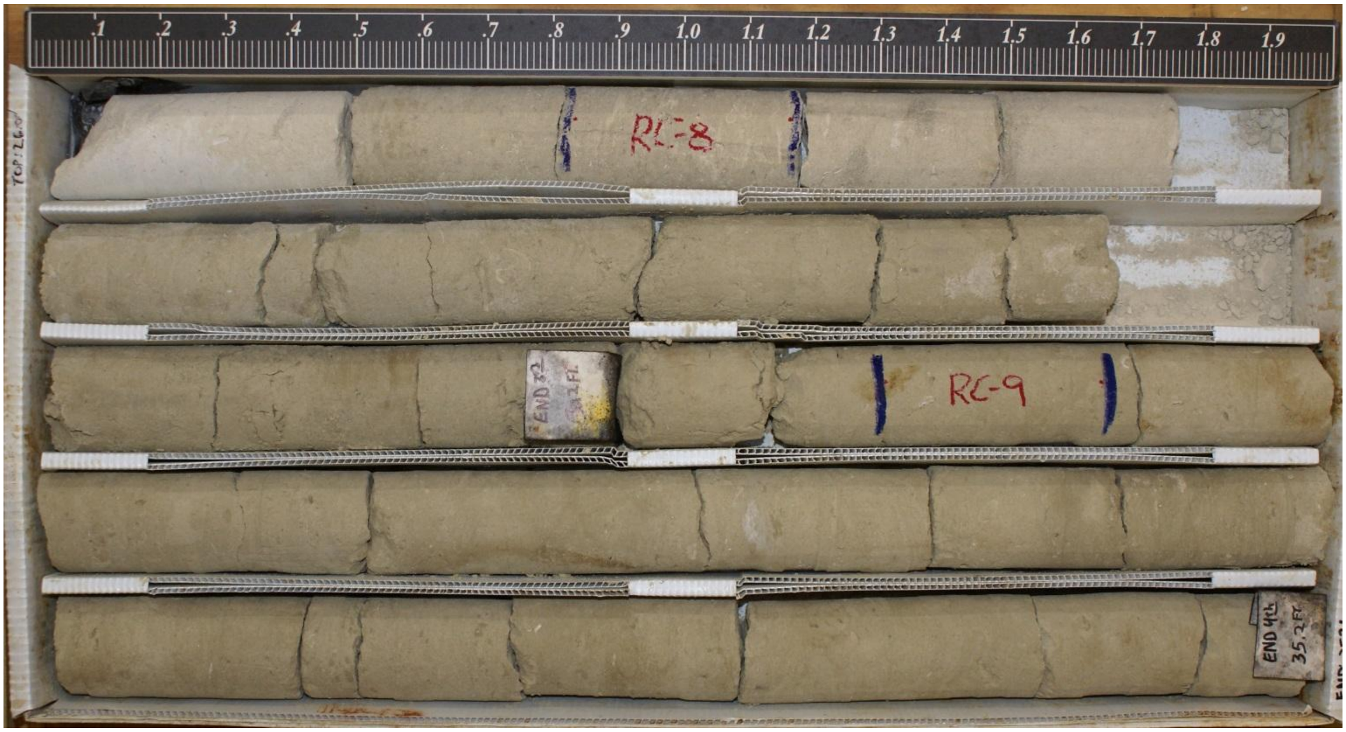
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

CORE PHOTOGRAPHIC RECORD

Bridge Replacement over Four Hole Swamp



B6 – Box 1 of 2



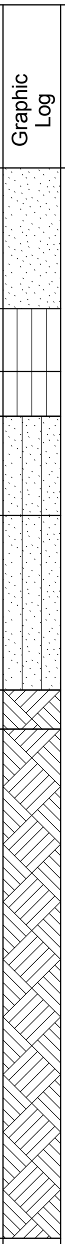
B6 – Box 2 of 2

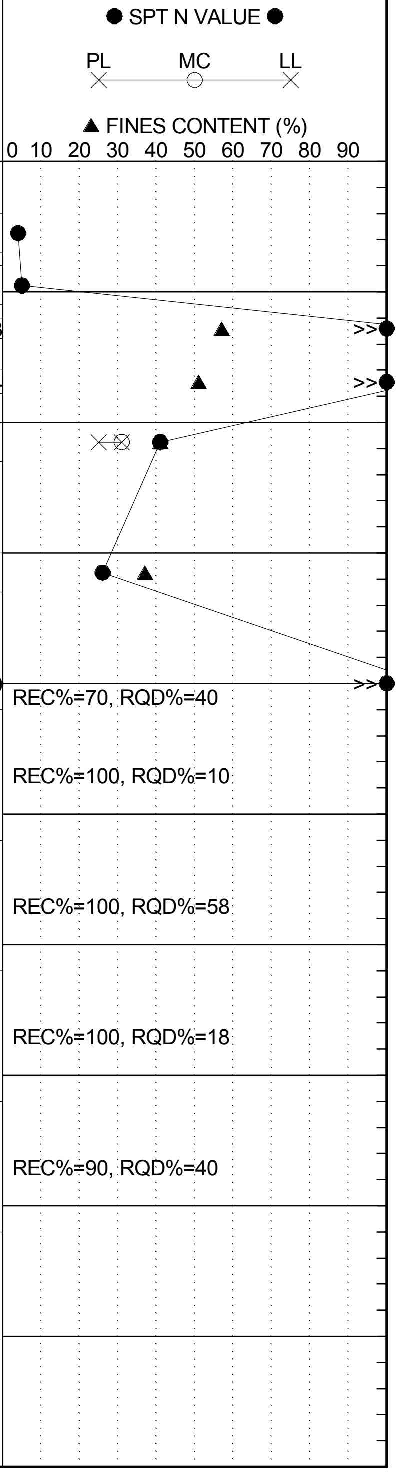
SCDOT Soil Test Boring Log

File No.: 38.040308 **Project No. (PIN):** BR38(019) **County:** Orangeburg **Eng./Geo.:** R. DeLost
Site Description: Bridge Replacement over Four Hole Swamp **Route:** US 301
Boring No.: B-7 **Boring Location:** 5951+86 **Offset:** 8' Lt. **Alignment:** US 301
Elev.: 105.0 ft **Latitude:** 33.45744 **Longitude:** 80.6481 **Date Started:** 4/12/2014
Total Depth: 41 ft **Soil Depth:** 20 ft **Core Depth:** 21 ft **Date Completed:** 4/12/2014
Bore Hole Diameter (in): 4 **Sampler Configuration** **Liner Required:** Y [✓ N] **Liner Used:** Y [✓ N]
Drill Machine: CME 45C **Drill Method:** RW/RC/DC **Hammer Type:** Automatic **Energy Ratio:** 79%
Core Size: NQ2 **Driller:** M. Morgan **Groundwater:** **TOB** NA **24HR** NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION
	0.0	Mudline
		Alluvium:
		Very loose to loose, wet, dark gray, gray & tan, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP/A-1-b).
100.0	5.4	Santee Formation:
	7.8	Hard, moist, green & gray, strongly reactive, mod. to strongly cemented, f. to med. grain, sandy SILT (ML/A-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=56.5
95.0	9.5	
	13.3	Hard, moist, green & gray, strongly reactive, mod. cemented areas, f. grain, sandy SILT (ML/A-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=50.7
90.0		
85.0	20.0	Dense, moist, green & gray, strongly reactive, mod. cemented areas, f. grain, silty SAND (SM/A-4). LL=31, PL=25, PI=6, NMC=30.9, %#200=40.6
	21.5	
80.0		Medium dense, moist, green & gray, strongly reactive, mod. cemented, f. grain, siilty SAND (SM/A-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=36.6
75.0		Casing Refusal @ 20.0'. Begin coring in Calcareous Sandstone. Tan-gray, v.f. to scat. med. grain, thinly bedded, quartz-calcite-phosphate, mod. weathered w/ highly weathered seam, weak, mod. hardness w/low hardness seam, VC discontinuity spacing, fossiliferous (frags.). med. strong 20.0'-20.4' & 21.1'-21.5'; 2 0° B, N-MW, No, Pl, SR
70.0		
65.0	41.0	Calcarenite: Tan-lt. gray, scat. lt. olive green tint, v.f. to f. grain, thinly to thickly bedded, calcite-quartz, mod. to highly weathered, v. weak to weak, friable to low hardness, VC discontinuity spacing, fossiliferous (frags. & trc. mega shells). 45 0° B, VN-N, No, Pl-Ir, SR; 1 25° J, VN, No, Pl, S; interpreted core loss 40.5'-41.0'
60.0		

Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	
2.0	SS-1	1	0	4	4	
4.0	SS-2	9	3	2	5	
6.0	SS-3	8	50/0.3		50/0.3	
8.0	SS-4	6	50/0.4		50/0.4	
10.0	SS-5	32	17	24	41	
15.0	SS-6	22	13	13	26	
20.0	SS-7	50/0.0			50/0.0	
20.0	NQ-1					REC%=70, RQD%=40
21.0	NQ-2					REC%=100, RQD%=10
26.0	NQ-3					REC%=100, RQD%=58
31.0	NQ-4					REC%=100, RQD%=18
36.0	NQ-5					REC%=90, RQD%=40





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LEGEND

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
AWG - Rock Core, 1-1/8"
NQ - Rock Core, 1-7/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-7	**Boring Location:**	5951+86	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	105.0 ft	**Latitude:**	33.45744	**Longitude:**	80.6481	**Date Started:**	4/12/2014
Total Depth:	41 ft	**Soil Depth:**	20 ft	**Core Depth:**	21 ft	**Date Completed:**	4/12/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

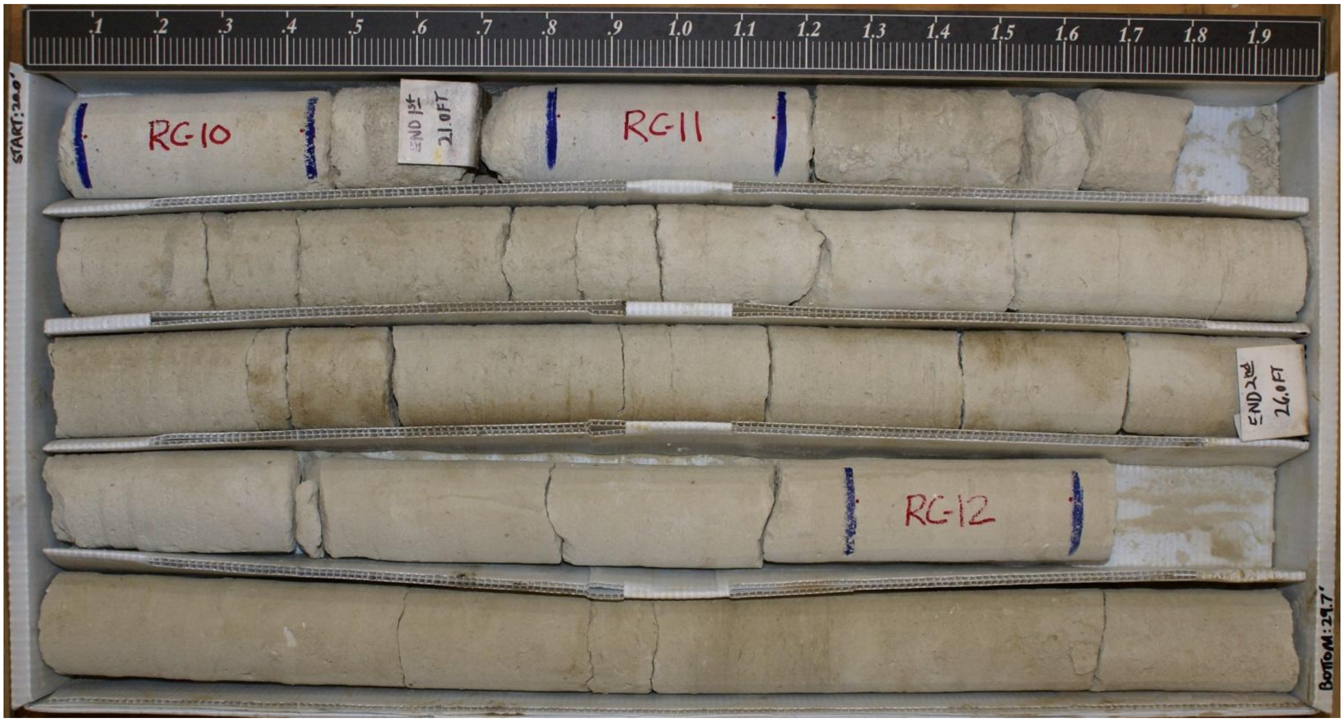
Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
		Boring Terminated @ 41.0' (Elev. 79.1). Bridge deck to mudline 15.1'.								
50.0										
45.0										
40.0										
35.0										
30.0										
25.0										
20.0										
15.0										
10.0										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

CORE PHOTOGRAPHIC RECORD

Bridge Replacement over Four Hole Swamp

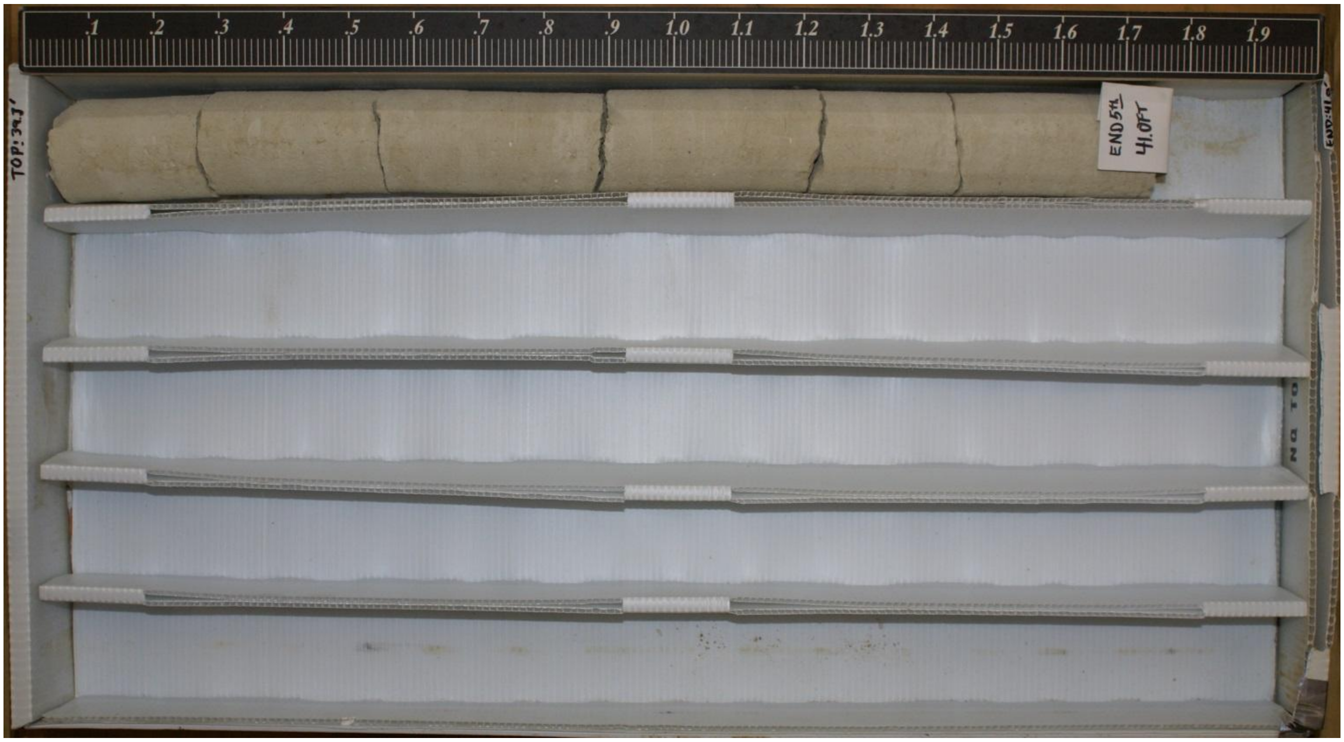


B7 – Box 1 of 3

B7 – Box 2 of 3

CORE PHOTOGRAPHIC RECORD

Bridge Replacement over Four Hole Swamp

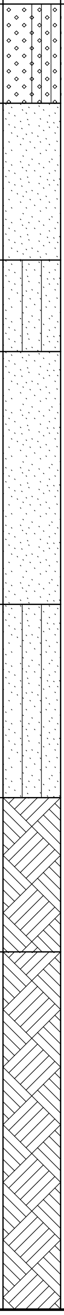


B7 – Box 3 of 3

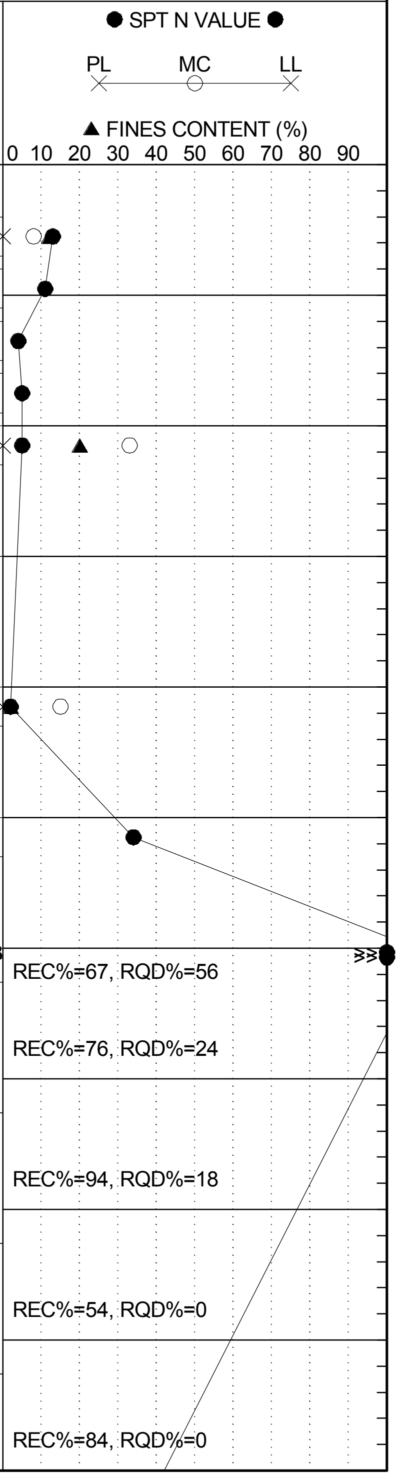
SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-8	**Boring Location:**	5952+17	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	120.0 ft	**Latitude:**	33.45747	**Longitude:**	80.64821	**Date Started:**	4/8/2014
Total Depth:	101.4 ft	**Soil Depth:**	80.5 ft	**Core Depth:**	20.9 ft	**Date Completed:**	4/9/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	TOB 12 ft.	**24HR**	10.4 ft.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION
	0.0	Roadway Embankment: Medium dense, dry to moist, tan, brown & gray, sub-angular, non-reactive, f. to cse. grain, well-graded SAND with silt (SW-SM/A-2-4). LL=NP, PL=NP, PI=NP, NMC=8.3, %#200=11.9
	3.8	
115.0		
	9.8	Alluvium: Very loose to medium dense, dry to moist, tan, brown & gray, sub-angular, non to weakly reactive, f. to cse. grain, poorly graded SAND (SP/A-1-b).
110.0		
	13.3	Loose, moist to wet, dark gray, sub-angular, non-reactive, f. grain, silty SAND (SM/A-2-4). LL=NP, PL=NP, PI=NP, NMC=33.4, %#200=20.1
105.0		
100.0		Very loose, moist to wet, dark gray, sub-angular, non-reactive, f. grain, poorly graded SAND (SP/A-1-b). LL=NP, PL=NP, PI=NP, NMC=15.0, %#200=1.8
	23.0	Santee Formation: Dense to very dense, moist, gray & green, sub-angular, strongly reactive, mod. to strongly cemented, f. to med. grain, silty SAND (SM/A-4).
95.0		
90.0	30.4	Casing Refusal @ 30.4'. Begin coring in Calcareous Sandstone. Tan-lt. gray, lt. green-tan, trcs. black-dk. brown, f. to med. grain w/scat. cse. frags., thinly to thickly bedded, quartz-calcite-phosphate, mod. to highly weathered, v. weak to weak, friable in parts-seams mod. hardness, VC discontinuity spacing, seams calcarenite, fossiliferous (frags. & mega shells), vugular texture in parts. med. strong 30.4'-30.9' & 35.2'-36.3'; 21 0° B, T-MW, No, Ir, SR
85.0		
	36.3	Calcarenite: Tan-gray, lt. olive green, v.f. to f. grain, thinly to thickly bedded, calcite-quartz, mod. to highly weathered, v. weak to weak, friable w/seams low hardness, VC discontinuity spacing, widely scat. pods
80.0		
75.0		



Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	
2.0	SS-1	4	7	6	13	
4.0	SS-2	3	6	5	11	
6.0	SS-3	1	2	2	4	
8.0	SS-4	2	2	3	5	
10.0	SS-5	1	3	2	5	
15.0	SS-6					
20.0	SS-7	1	1	1	2	
25.0	SS-8	46	14	20	34	
30.0	SS-9	50/0.3			50/0.3	
30.3	SS-10	50/0.1			50/0.1	
30.4	NQ-1					REC%=67, RQD%=56
31.3	NQ-2					REC%=76, RQD%=24
36.3	NQ-3					REC%=94, RQD%=18
41.3	NQ-4					REC%=54, RQD%=0
46.3	NQ-5					REC%=84, RQD%=0



LEGEND

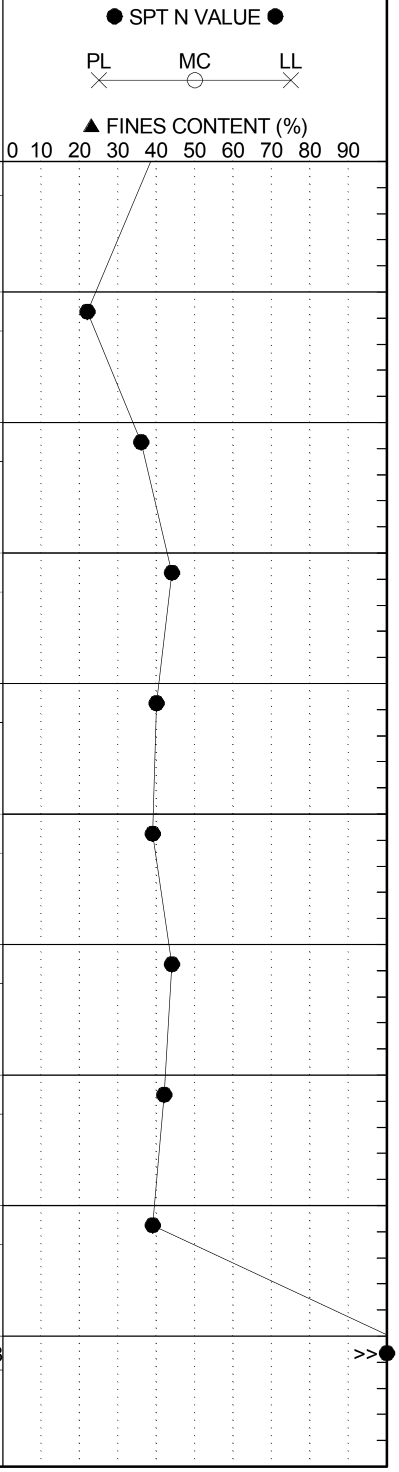
Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-8	**Boring Location:**	5952+17	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	120.0 ft	**Latitude:**	33.45747	**Longitude:**	80.64821	**Date Started:**	4/8/2014
Total Depth:	101.4 ft	**Soil Depth:**	80.5 ft	**Core Depth:**	20.9 ft	**Date Completed:**	4/9/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 12 ft.	**24HR**	10.4 ft.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	51.3	of calcareous sandstone, fossiliferous (frags. & trc. mega shells). 116+ 0° B, T-MW, No, Pl-Ir, SR; med. strong 51.1'-51.3'							
65.0		End Coring @ 51.3'. Return to Casing and Sample. Medium dense to dense, moist, green & gray, strongly reactive, weakly cemented, f. grain, silty SAND (SM/A-4).		55.0	SS-11	7	8	14	22
60.0				60.0	SS-12	10	14	22	36
55.0				65.0	SS-13	11	16	28	44
50.0				70.0	SS-14	10	15	25	40
45.0				75.0	SS-15	12	17	22	39
40.0				80.0	SS-16	15	20	24	44
35.0				85.0	SS-17	14	18	24	42
	88.0	Congaree Formation: Dense, wet, dark green & gray, sub-angular, weakly reactive, f. to cse. grain, poorly graded SAND with silt (SP-SM/A-1-b).							
30.0				90.0	SS-18	12	20	19	39
25.0	95.0	Very dense, wet, dark gray, sub-angular, non-reactive, med. to cse. grain, well-graded SAND with silt (SW-SM/A-1-b).		95.0	SS-19	23	38	50/0.3	88/0.8
				100.0					



LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-8	**Boring Location:**	5952+17	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	120.0 ft	**Latitude:**	33.45747	**Longitude:**	80.64821	**Date Started:**	4/8/2014
Total Depth:	101.4 ft	**Soil Depth:**	80.5 ft	**Core Depth:**	20.9 ft	**Date Completed:**	4/9/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 12 ft.	**24HR**	10.4 ft.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	101.4		▨		SS-20	25	31	50/0.4	81/0.9	>>●
		No Casing Refusal & Boring Terminated @ 101.4' (Elev. 18.6). Could not obtain sample at 15.0' due to bore backfilling w/wash rotary, switched to mud rotary drilling. Bulk Sample #2 taken at 1' to 5' deep as per boring plan.								
15.0										
10.0										
5.0										
0.0										
-5.0										
-10.0										
-15.0										
-20.0										
-25.0										

LEGEND

SAMPLER TYPE

SS - Split Spoon	NQ - Rock Core, 1-7/8"
ST - Shelby Tube	CU - Cuttings
AWG - Rock Core, 1-1/8"	CT - Continuous Tube

DRILLING METHOD

HSA - Hollow Stem Auger	RW - Rotary Wash
CFA - Continuous Flight Augers	RC - Rock Core
DC - Driving Casing	

CORE PHOTOGRAPHIC RECORD

Bridge Replacement over Four Hole Swamp

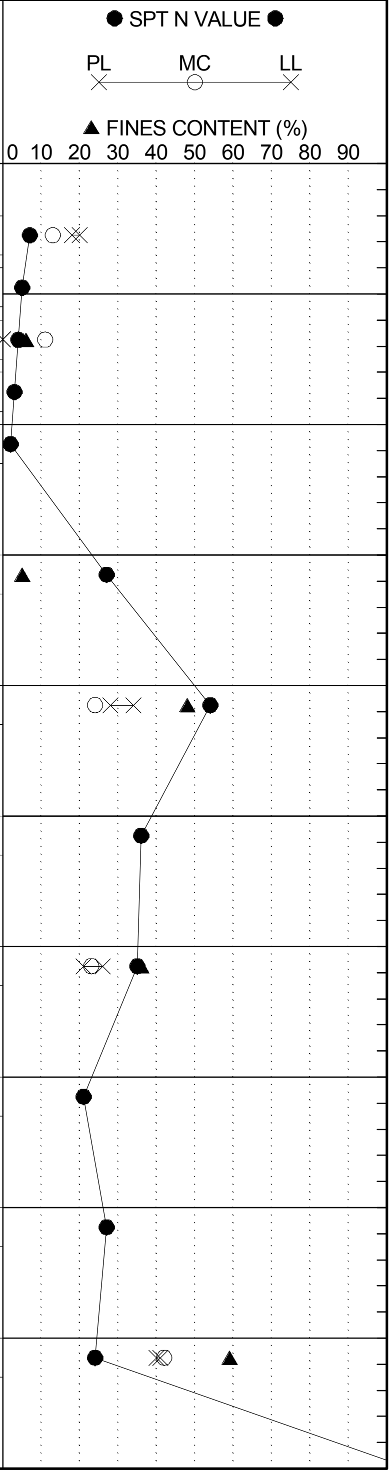
B8 – Box 1 of 2

B8 – Box 2 of 2

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-9	**Boring Location:**	5952+28	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	120.0 ft	**Latitude:**	33.45742	**Longitude:**	80.64824	**Date Started:**	4/11/2014
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/11/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 5.9 ft.	**24HR**	12.6 ft.

Elevation (ft)	Depth (ft) 0.0	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		Roadway Embankment:						
			2.0					
		Loose, wet, tan, red & gray, sub-angular, non-reactive, f. to cse. grain, silty SAND (SM/A-2-4).		SS-1	4	3	4	7
	4.0		4.0					
115.0		LL=20, PL=18, PI=2, NMC=13.3, %#200=18.9		SS-2	2	2	3	5
	5.8 ▽		6.0					
				SS-3	2	2	2	4
	7.8		8.0					
		Alluvium:		SS-4	1	1	2	3
	9.8	Loose, wet, gray & tan, sub-angular, non-reactive, f. to cse. grain, well-graded SAND (SW/A-1-b).	10.0					
110.0				SS-5	0	0	2	2
	▼ 13.3	Very loose, wet, gray & tan, sub-angular, non-reactive, f. to cse. grain, poorly graded SAND with silt (SP-SM/A-3).						
105.0		LL=NP, PL=NP, PI=NP, NMC=10.5, %#200=5.6	15.0	SS-6	13	13	14	27
	18.5	Very loose, wet, gray & tan, sub-angular, non-reactive, f. to cse. grain, well-graded SAND (SW/A-1-b).						
100.0			20.0	SS-7	1	33	21	54
		Very loose, wet, gray & tan, sub-angular, non-reactive, f. to cse. grain, silty SAND (SM/A-2-4).						
	23.3							
95.0		Medium dense, wet, gray & tan, sub-angular, non-reactive, f. to cse. grain, well-graded SAND (SW/A-1-b).	25.0	SS-8	31	15	20	36
		LL=NA, PL=NA, PI=NA, NMC=NA, %#200=4.6						
90.0			30.0	SS-9	24	14	21	35
		Santee Formation:						
	33.3	Very dense, moist, green & gray, strongly reactive, f. grain, silty SAND (SM/A-4).						
85.0		LL=34, PL=28, PI=6, NMC=24.1, %#200=48.4	35.0	SS-10	12	8	13	21
		Dense, moist, green & gray, strongly reactive, f. grain, silty, clayey SAND (SC-SM/A-4).						
80.0		LL=26, PL=21, PI=5, NMC=23.3, %#200=35.7	40.0	SS-11	9	16	11	27
		Very stiff to hard, moist, green, gray & tan, strongly reactive, strongly cemented areas, f. to med. grain, sandy SILT (ML/A-5).						
75.0		LL=41, PL=40, PI=1, NMC=41.7, %#200=59.4	45.0	SS-12	7	10	14	24
			50.0					



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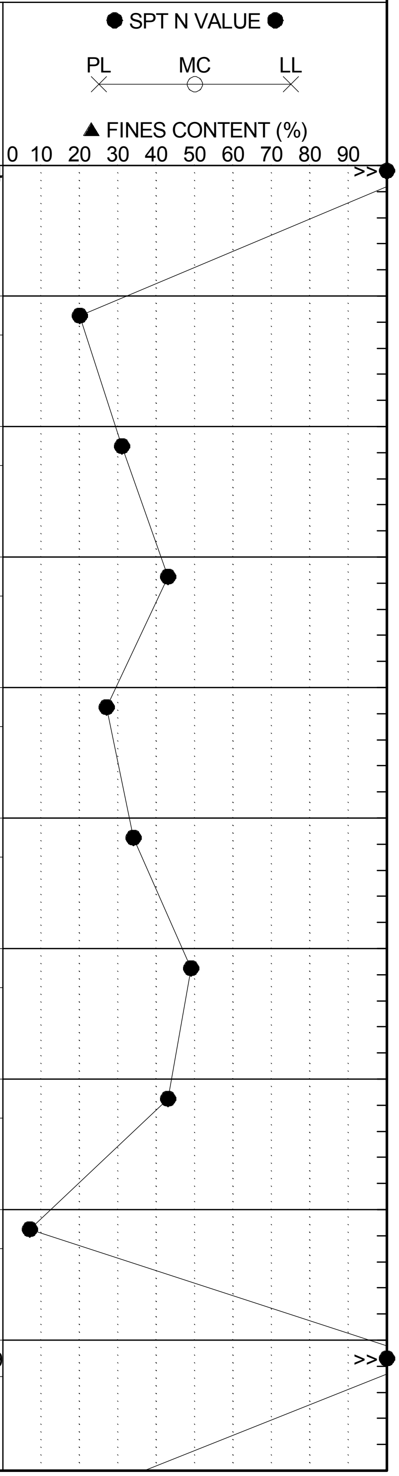
LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-9	**Boring Location:**	5952+28	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	120.0 ft	**Latitude:**	33.45742	**Longitude:**	80.64824	**Date Started:**	4/11/2014
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/11/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**	**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]	
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 5.9 ft.	**24HR**	12.6 ft.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
				SS-13	50/0.4			50/0.4
65.0			55.0	SS-14	6	8	12	20
60.0			60.0	SS-15	9	13	18	31
55.0			65.0	SS-16	15	14	29	43
50.0			70.0	SS-17	10	12	15	27
45.0			75.0	SS-18	8	14	20	34
40.0			80.0	SS-19	10	19	30	49
35.0			85.0	SS-20	8	20	23	43
	88.0	Congaree Formation: Loose, wet, dark green & gray, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND with silt (SP-SM/A-1-b).						
30.0			90.0	SS-21	4	4	3	7
	93.3	Very dense, dry, gray, non-reactive, weakly to mod. cemented, f. grain, silty SAND (SM/A-4).						
25.0			95.0	SS-22	22	35	50/0.4	85/0.9
	97.0	Medium dense, gray, sub-angular, non-reactive, med. to cse. grain, well-graded, SAND with silt (SW-SM/A-1-b).						
			100.0					



LEGEND

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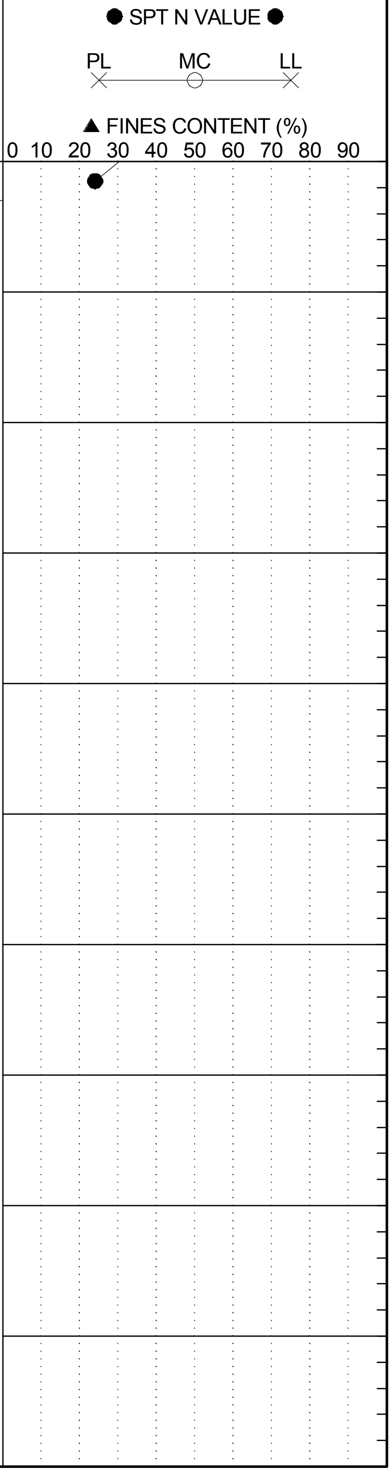
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-9	**Boring Location:**	5952+28	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	120.0 ft	**Latitude:**	33.45742	**Longitude:**	80.64824	**Date Started:**	4/11/2014
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/11/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 5.9 ft.	**24HR**	12.6 ft.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	101.5		▨		SS-23	2	6	18	24
		No Casing Refusal & Boring Terminated @ 101.5' (Elev. 18.5). No sample obtained at 35.0', drove rock fragment in front of spoon.							
15.0									
10.0									
5.0									
0.0									
-5.0									
-10.0									
-15.0									
-20.0									
-25.0									



LEGEND

SAMPLER TYPE

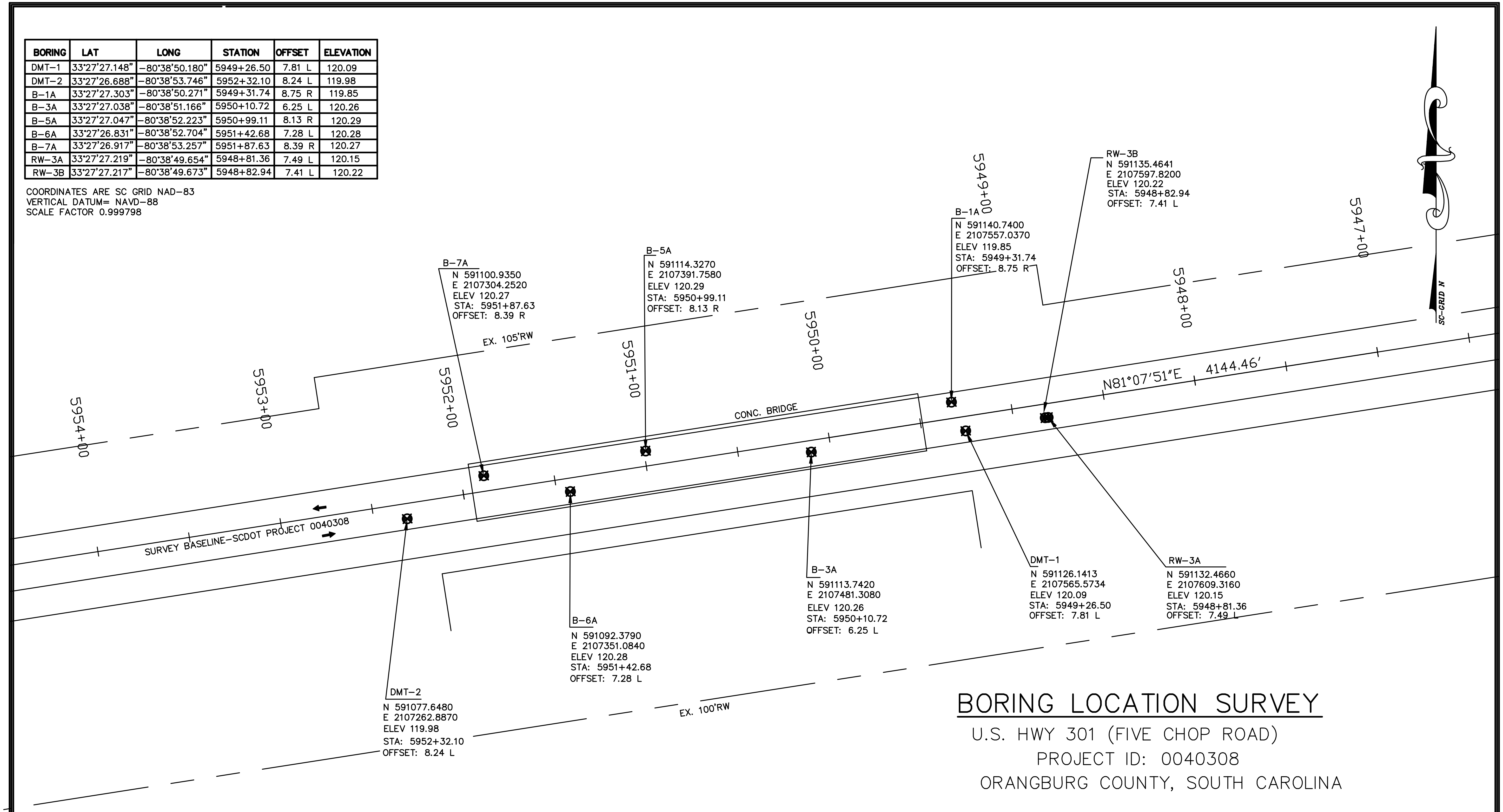
SS - Split Spoon
ST - Shelby Tube
AWG - Rock Core, 1-1/8"
NQ - Rock Core, 1-7/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD

HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

BORING	LAT	LONG	STATION	OFFSET	ELEVATION
DMT–1	33°27'27.148"	–80°38'50.180"	5949+26.50	7.81 L	120.09
DMT–2	33°27'26.688"	–80°38'53.746"	5952+32.10	8.24 L	119.98
B–1A	33°27'27.303"	–80°38'50.271"	5949+31.74	8.75 R	119.85
B–3A	33°27'27.038"	–80°38'51.166"	5950+10.72	6.25 L	120.26
B–5A	33°27'27.047"	–80°38'52.223"	5950+99.11	8.13 R	120.29
B–6A	33°27'26.831"	–80°38'52.704"	5951+42.68	7.28 L	120.28
B–7A	33°27'26.917"	–80°38'53.257"	5951+87.63	8.39 R	120.27
RW–3A	33°27'27.219"	–80°38'49.654"	5948+81.36	7.49 L	120.15
RW–3B	33°27'27.217"	–80°38'49.673"	5948+82.94	7.41 L	120.22

COORDINATES ARE SC GRID NAD–83
VERTICAL DATUM= NAVD–88
SCALE FACTOR 0.999798



BORING LOCATION SURVEY

U.S. HWY 301 (FIVE CHOP ROAD)
PROJECT ID: 0040308
ORANGBURG COUNTY, SOUTH CAROLINA

I HEREBY STATE THAT TO THE BEST OF MY PROFESSIONAL KNOWLEDGE, INFORMATION AND BELIEF, THE SURVEY SHOWN HEREON WAS MADE IN ACCORDANCE WITH THE REQUIREMENTS OF THE STANDARD OF PRACTICE MANUAL FOR SURVEYING IN SOUTH CAROLINA, AND MEETS OR EXCEEDS THE REQUIREMENTS FOR A CLASS " " SURVEY AS SPECIFIED THEREIN, ALSO THERE ARE NO ENCROACHMENTS, PROJECTIONS, OR SETBACKS AFFECTING THE PROPERTY OTHER THAN THOSE SHOWN.

PROPERTY NOT TO BE IN A FLOOD ZONE. UNLESS NOTED HEREON THIS MAP DOES NOT ADDRESS ENVIRONMENTAL CONCERNS OR SUBSURFACE INVESTIGATION.

FILE#

NESBITT SURVEYING CO., INC.
4340 ALLIGATOR ROAD
U.S. HIGHWAY 76 & ALLIGATOR ROAD
TIMMONSVILLE, S.C. 29161
PHONE (843) 346–3302
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email davidn@nesbittsurveying.com

DAVID A. NESBITT RLS NO 7623

No. C01197

DATE: DECEMBER 18, 2014
JOB NO: 14670
REVISED 2–5–15 TO SHOW BORING RW3A & RW3B
ROUTE NO.. US 301
SCDOT #: 0040308
SCALE 1" =50 FT
0 25 50 100
GRAPHIC SCALE

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-1A	**Boring Location:**	5949+31.74	**Offset:**	8.75 R	**Alignment:**	Proposed
Elev.:	119.9 ft	**Latitude:**	33.4575	**Longitude:**	-80.6472	**Date Started:**	12/4/2014
Total Depth:	120 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/4/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.7 ft	**24HR**	6 ft

Elevation (ft): 114.9, 109.9, 104.9, 99.9, 94.9, 89.9, 84.9, 79.9, 74.9, 69.9

Depth (ft): 0.0, 0.7, 2.7, 9.7, 12.0, 16.5, 21.5, 36.5, 41.5, 46.5

MATERIAL DESCRIPTION

Asphalt at 0 to 8 inches

FILL - Dense, moist, brown, red with gray, fine to medium grained, Clayey SAND (SC)

FILL - Medium dense to very loose, moist, tan, fine to medium grained, poorly graded SAND (SP), slightly micaceous

ALLUVIAL - Soft, wet, gray, Lean CLAY with sand (CL), slightly micaceous

SS-5: MC=24.5%, LL=34, PL=14, PI=20, FC=73%

Loose, wet, gray, fine to medium grained Clayey SAND (SC), slightly micaceous

SS-6: MC=20.5%, LL=25, PL=13, PI=12, FC=42.3%

COASTAL PLAIN DEPOSIT - Medium dense, wet, gray, medium grained, poorly graded SAND (SP), slightly micaceous

(low recovery)

Dense to very dense, wet, green gray, fine to medium grained, Silty SAND (SM), slightly micaceous

(contains sand with strong cementation)

(contains trace shell fragments)

Very stiff, wet, green gray, Sandy SILT (ML), slightly micaceous

(contains sand with strong cementation)

(conains trace shell fragments)

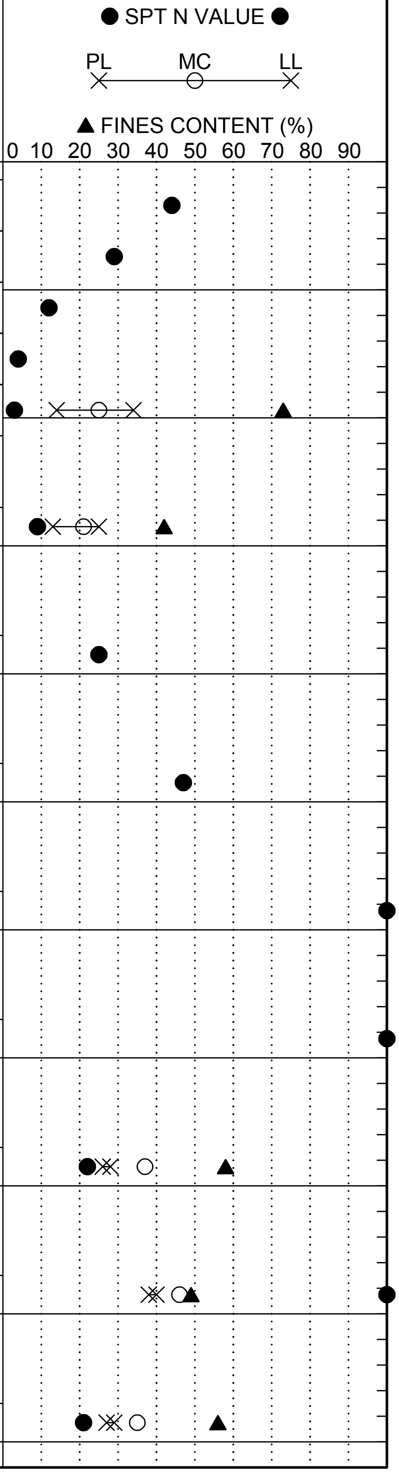
SS-11: MC=37%, LL=28, PL=26, PI=2, FC=57.7%

Very dense, wet, green gray, fine to coarse grained, Silty SAND (SM), slightly micaceous

(contains sand with strong cementation)

(contains trace shell fragments)

Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
0.7	SS-1	16	17	27	44
2.7	SS-2	15	15	14	29
4.7	SS-3	7	6	6	12
6.7	SS-4	3	2	2	4
8.7	SS-5	1	1	2	3
13.5	SS-6	2	4	5	9
18.5	SS-7	7	16	9	25
23.5	SS-8	14	16	31	47
28.5	SS-9	50/5"			100
33.5	SS-10	7	50/4"		100
38.5	SS-11	7	9	13	22
43.5	SS-12	11	14	50/5"	100
48.5	SS-13	11	10	11	21



LEGEND

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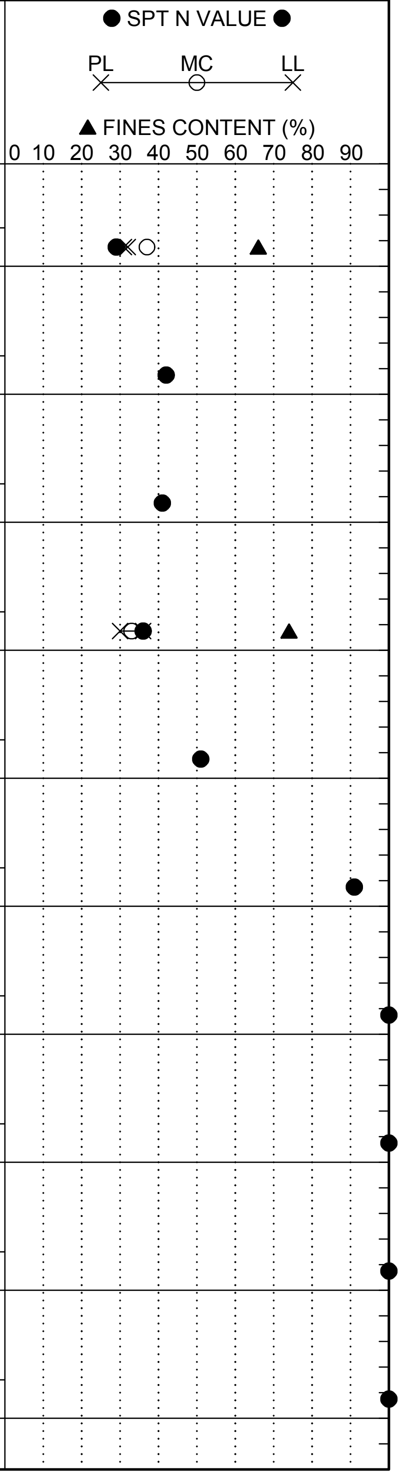
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-1A	**Boring Location:**	5949+31.74	**Offset:**	8.75 R	**Alignment:**	Proposed
Elev.:	119.9 ft	**Latitude:**	33.4575	**Longitude:**	-80.6472	**Date Started:**	12/4/2014
Total Depth:	120 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/4/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.7 ft	**24HR**	6 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		SS-12: MC=46%, LL=40, PL=38, PI=2, FC=49.3%						
64.9		Very stiff to hard, wet, green gray, Sandy SILT (ML), slightly micaceous (contains lenses of sand with strong cementation) (contains trace shell fragments) SS-13: MC=35.3%, LL=29, PL=27, PI=2, FC=56% SS-14: MC=36.7%, LL=32, PL=31, PI=1, FC=66.3%	53.5	SS-14	7	13	16	29
59.9			58.5	SS-15	10	18	24	42
54.9			63.5	SS-16	15	18	23	41
	66.5	Hard to very hard, wet, green gray, SILT with sand (ML), slightly micaceous (contains sands with strong cementation) (contains trace shell fragments) SS-17: MC=32.7%, LL=36, PL=30, PI=6, FC=73.7%	68.5	SS-17	14	15	21	36
49.9			73.5	SS-18	19	22	29	51
44.9								
	76.5	Very dense, wet, green gray, fine to medium grained, Silty SAND (SM), slightly micaceous (contains sands with strong cementation) (contains trace shell fragments)	78.5	SS-19	40	41	50	91
39.9			83.5	SS-20	30	50/3"		100
34.9								
	86.5	Very dense, wet, dark green, fine to medium grained, Silty SAND (SM), slightly micaceous	88.5	SS-21	17	32	50/5"	100
29.9								
	91.5	Very dense, wet, gray, fine to coarse grained, well graded SAND with silt (SW-SM)	93.5	SS-22	34	49	50/4"	100
24.9			98.5	SS-23	37	50/5.5"		100
19.9								



LEGEND

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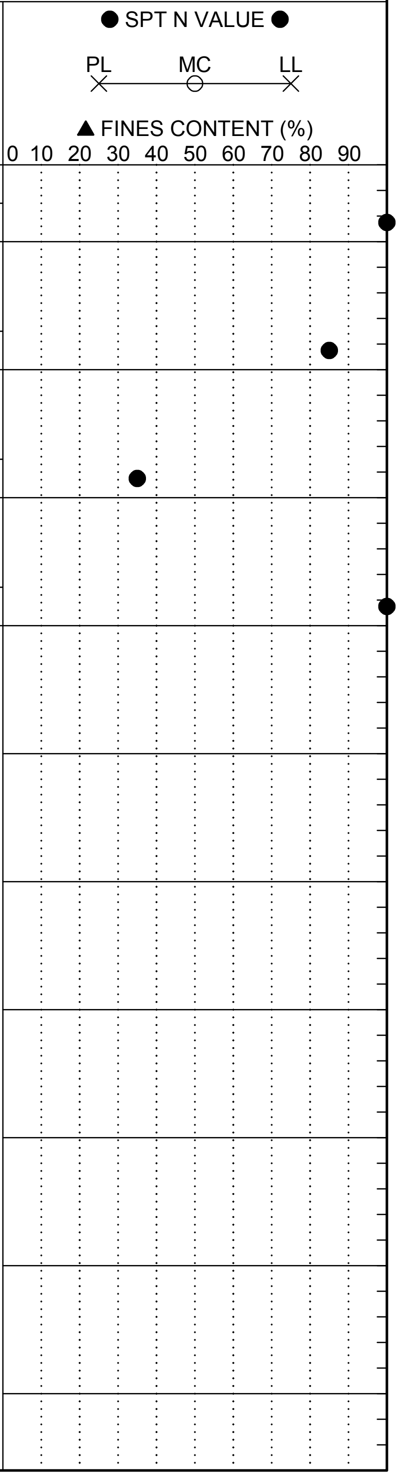
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-1A	**Boring Location:**	5949+31.74	**Offset:**	8.75 R	**Alignment:**	Proposed
Elev.:	119.9 ft	**Latitude:**	33.4575	**Longitude:**	-80.6472	**Date Started:**	12/4/2014
Total Depth:	120 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/4/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.7 ft	**24HR**	6 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
			103.5	SS-24	29	45	50/5"	100
14.9								
			108.5	SS-25	37	37	48	85
9.9								
	111.5	Hard, wet, black, Sandy Lean CLAY (CL), micaceous						
			113.5	SS-26	12	17	18	35
4.9								
	116.5	Ver dense, wet, dark gray, fine to medium grained, poorly graded SAND with silt (SP-SM), micaceous						
			118.5	SS-27	30	32	50/5"	100
-0.2	120.0	(contains cemented sands with strong cementation)						
		Boring Terminated at 120 Feet						
-5.2		Groundwater Encountered at 9.7 Feet at Time of Boring and 6 Feet 48 Hours After Boring						
-10.2								
-15.2								
-20.2								
-25.2								
-30.2								



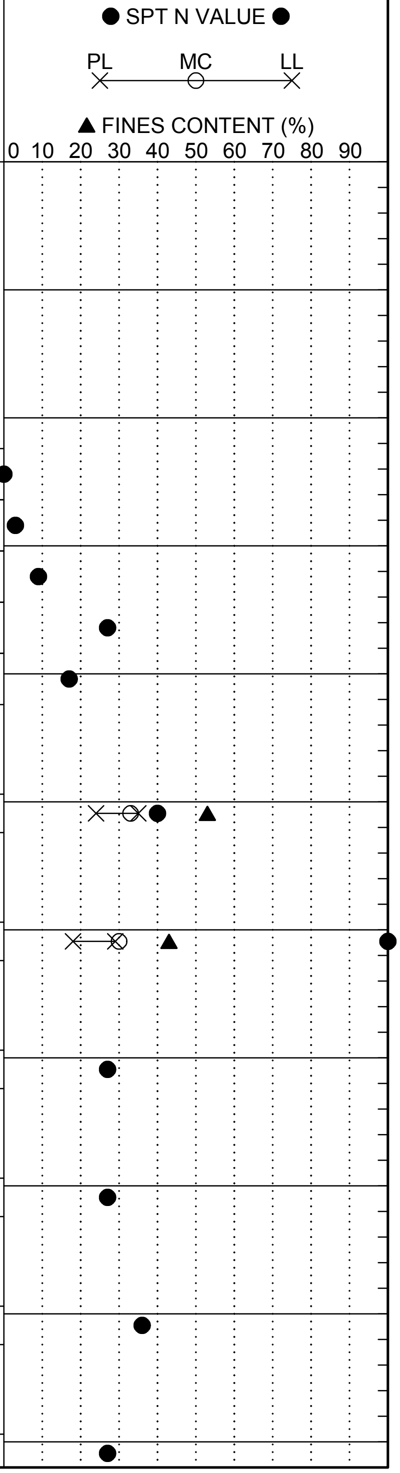
LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-3A	**Boring Location:**	5950+10.72	**Offset:**	6.25 L	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6475	**Date Started:**	12/8/2014
Total Depth:	131.2 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/8/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.5 ft	**24HR**	

Elevation (ft)	Depth (ft) 0.0	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	1.5	Asphalt at 0 to 3" / Sand-Stone Stabilized Subbase at 3" to 1' / Reinforced Concrete at 1' to 1.5'							
		Air							
115.3									
	9.5 ▽								
110.3		Water							
	11.2	ALLUVIAL - Very soft to soft, wet, dark gray, Lean CLAY with sand (CL)		11.2	SS-1	WOR/24"			0
		(contains trace roots)		13.2	SS-2	1	1	2	3
105.3	14.7	Loose, wet, gray and white, medium to coarse grained, poorly graded SAND (SP)		15.2	SS-3	4	4	5	9
	17.2	COASTAL PLAIN DEPOSIT - Medium dense, wet, gray and white, medium to coarse grained, poorly graded SAND (SP)		17.2	SS-4	13	13	14	27
100.3				19.2	SS-5	7	8	9	17
	23.5	Hard, wet, green gray, Sandy SILT (ML), slightly micaceous (contains sand with strong cementation) (contains shell fragments)							
95.3				24.7	SS-6	7	18	22	40
	28.5	SS-6: MC=33.3%, LL=35, PL=24, PI=11, FC=53.1%							
90.3		Very dense, wet, green gray, fine to medium grained, Clayey SAND (SC), slightly micaceous		29.7	SS-7	11	14	50/2"	100
	33.5	(contains sand with strong cementation) (contains shell fragments)							
85.3		SS-7: MC=29.6%, LL=29, PL=18, PI=11, FC=42.8%		34.7	SS-8	7	10	17	27
80.3		Very stiff to very hard, wet, green gray, Sandy SILT (ML), slightly micaceous		39.7	SS-9	8	12	15	27
75.3		(contains lenses of sand with strong cementation) (contains shell fragments)		44.7	SS-10	10	17	19	36
		SS-12: MC=43.6%, LL=35, PL=29, PI=6, FC=63.3%							
70.3		SS-14: MC=39.6%, LL=41, PL=33, PI=8,		49.7	SS-11	10	12	15	27



LEGEND *Continued Next Page*

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

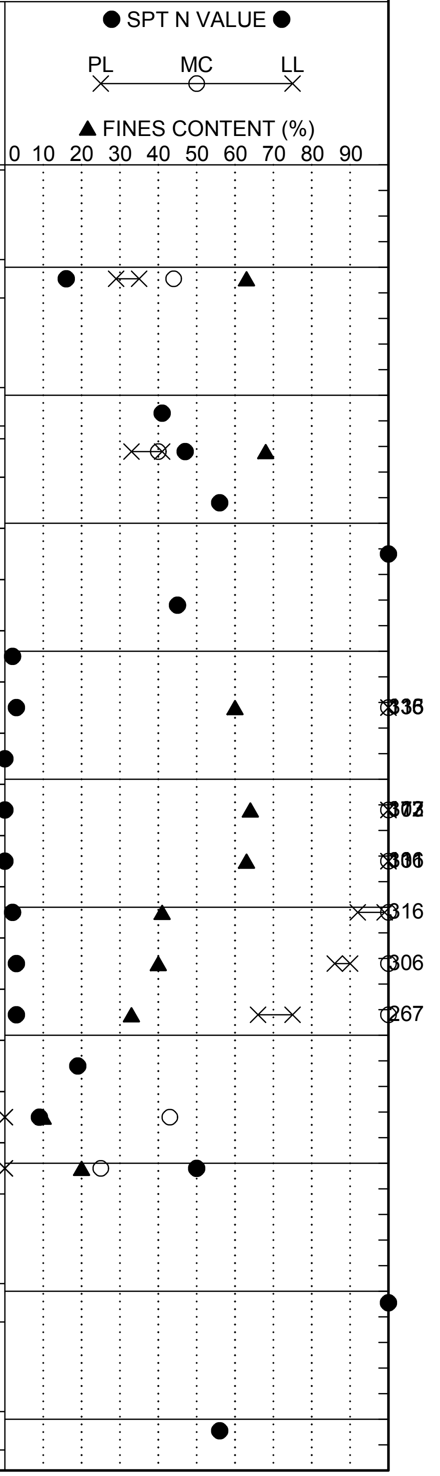
SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-3A	**Boring Location:**	5950+10.72	**Offset:**	6.25 L	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6475	**Date Started:**	12/8/2014
Total Depth:	131.2 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/8/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.5 ft	**24HR**	

Elevation (ft)
65.3
60.3
55.3
50.3
45.3
40.3
35.3
30.3
25.3
20.3

Depth (ft)	MATERIAL DESCRIPTION
	FC=68.3%
68.8	Very soft to soft, wet, dark green, Sandy Elastic SILT (MH), slightly micaceous SS-19: MC=316.1%, LL=135, PL=133, PI=2, FC=60.1% SS-21: MC=376.9%, LL=113, PL=102, PI=11, FC=64% SS-22: MC=336.3%, LL=111, PL=101, PI=10, FC=62.8%
79.2	Very soft to soft, wet, dark green, fine to medium grained, Silty SAND (SM), slightly micaceous SS-23: MC=316.1%, LL=99, PL=92, PI=7, FC=41% SS-24: MC=305.5%, LL=90, PL=86, PI=4, FC=39.7% SS-25: MC=266.5%, LL=75, PL=66, PI=9, FC=32.8%
85.2	
89.2	Medium dense to loose, wet, dark green, fine to coarse grained, well graded SAND with silt (SW-SM), slightly micaceous SS-27: MC=42.6%, LL=NP, PL=NP, PI=NP, FC=10.4% SS-28: MC=25%, LL=NP, PL=NP, PI=NP, FC=19.9%
93.0	Dense, wet, dark green, fine to coarse grained, Silty SAND (SM), slightly micaceous

Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
54.7	SS-12	6	6	10	16
59.7	SS-13	13	21	20	41
61.2	SS-14	11	19	28	47
63.2	SS-15	15	24	32	56
65.2	SS-16	15	19	50/5.5"	100
67.2	SS-17	21	24	21	45
69.2	SS-18	1	1	1	2
71.2	SS-19	4	2	1	3
73.2	SS-20	WOR/24"			0
75.2	SS-21	WOR/18"	WOH		0
77.2	SS-22	WOR	WOH/12"		0
79.2	SS-23	WOR	WOH	2	2
81.2	SS-24	WOH	1	2	3
83.2	SS-25	WOH	2	1	3
85.2	SS-26	4	6	13	19
87.2	SS-27	WOH	1	8	9
89.2	SS-28	14	22	28	50
94.7	SS-29	25	50/3"		100
99.7	SS-30	23	28	28	56



LEGEND

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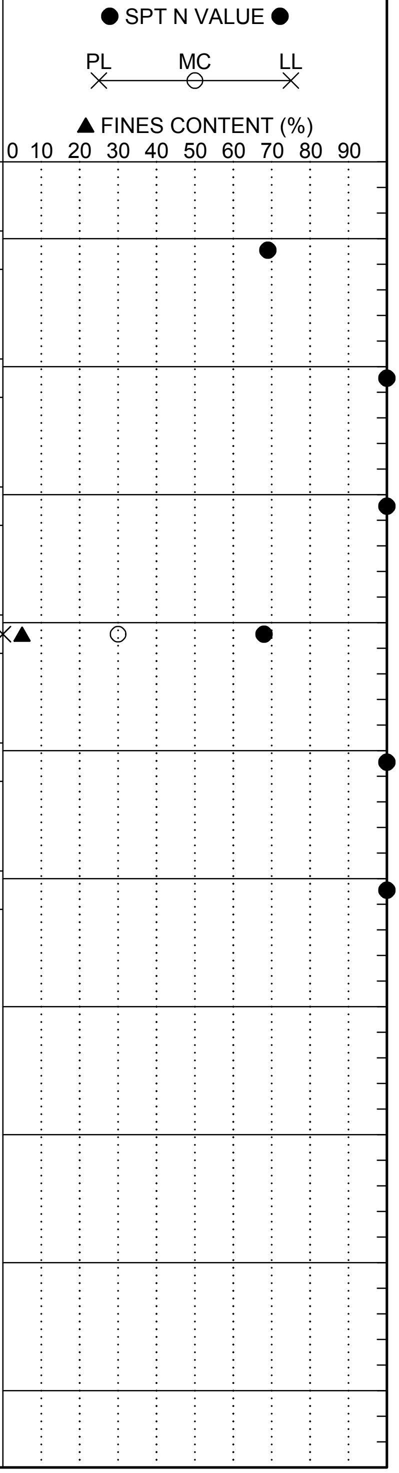
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-3A	**Boring Location:**	5950+10.72	**Offset:**	6.25 L	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6475	**Date Started:**	12/8/2014
Total Depth:	131.2 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/8/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.5 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		Very dense, wet, gray, medium to coarse grained, well graded SAND with silt (SW-SM), slightly micaceous		104.7					
15.3					SS-31	23	29	40	69
				109.7					
10.3					SS-32	34	50/5"		100
	113.0	Very hard, wet, dark gray and black, Sandy Lean CLAY (CL), micaceous		114.7					
5.3					SS-32	13	33	50/5"	100
	118.0	Very dense, wet, dark gray, fine to medium grained, poorly graded SAND with silt (SP-SM), micaceous SS-34: MC=30.3%, LL=NP, PL=NP, PI=NP, FC=5%		119.7					
0.3					SS-34	13	29	39	68
	124.5	Very hard, wet, black, Sandy Elastic SILT (MH), micaceous		124.7					
-4.7					SS-35	50/0"			100
				129.7					
-9.7					SS-36	42	50/4.5"		100
	131.2	Boring Terminated at 131.2' Groundwater Encountered at 9.5' at Time of Boring							
-14.7									
-19.7									
-24.7									
-29.7									



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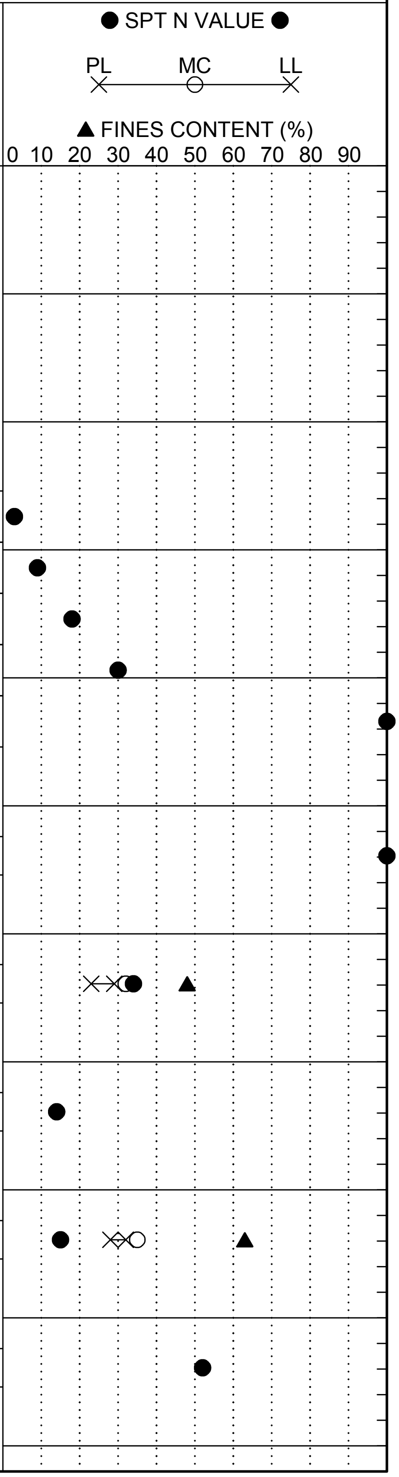
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-5A	**Boring Location:**	5950+99.11	**Offset:**	8.13 R	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6478	**Date Started:**	12/5/2014
Total Depth:	132.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/4/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.7 ft	**24HR**	

Elevation (ft)	Depth (ft) 0.0	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	1.5	Asphalt at 0 to 3 " / Stabilized Sand-Stone Subgrade at 3" to 11" / Concrete at 11" to 1.5'						
		Air						
115.3								
110.3	9.7 ▽	Water						
	12.7		12.7					
		ALLUVIAL - Wood / Roots, no soil recovery in split spoon		SS-1	2	1	2	3
105.3	14.7	Loose to medium dense, wet, gray, fine to coarse grained, Silty SAND (SM)	14.7	SS-2	4	5	4	9
		contains trace roots	16.7	SS-3	5	6	12	18
100.3	18.7	COASTAL PLAIN DEPOSITS - Medium dense to dense, wet, gray, medium to coarse grained, poorly graded SAND (SP)	18.7	SS-4	15	14	16	30
	21.7	contains trace roots	20.7	SS-5	7	4	50/5"	100
95.3		Very dense to dense, wet, green gray, fine grained, Silty SAND (SM), slightly micaceous	26.2	SS-6	19	50/2.5"		100
		(contains seams of cemented sands with strong cementation)						
90.3		SS-7: MC=31.8%, LL=29, PL=23, PI=6, FC=47.9%	31.2	SS-7	13	12	22	34
85.3	34.2	(low recovery)	36.2	SS-8	8	7	7	14
		Very stiff to very hard, wet, green gray, Sandy SILT (ML), slightly micaceous						
80.3		(contains small amounts of moderate to highly cemented sands)	41.2	SS-9	8	7	8	15
		SS-9: MC=35.3%, LL=32, PL=28, PI=4, FC=63.4%						
75.3		SS-11: MC=36.8%, LL=28, PL=25, PI=3, FC=52.3%	46.2	SS-10	9	17	35	52
		SS-13: MC=34.9%, LL=35, PL=30, PI=5, FC=66.3%						
70.3		SS-16: MC=35.3%, LL=34, PL=28, PI=6,						



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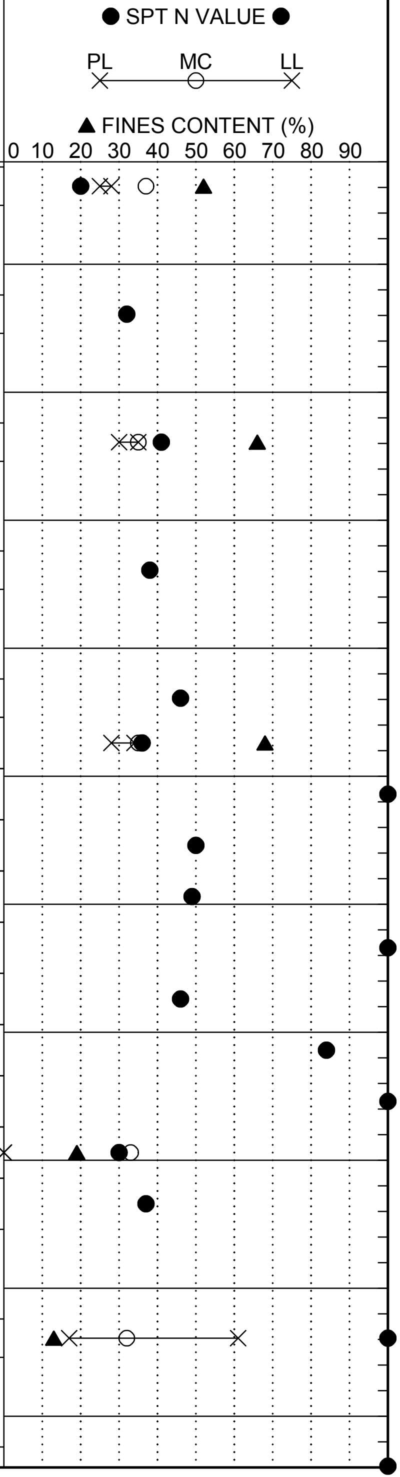
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-5A	**Boring Location:**	5950+99.11	**Offset:**	8.13 R	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6478	**Date Started:**	12/5/2014
Total Depth:	132.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/4/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.7 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		FC=67.6%		51.2	SS-11	8	9	11	20
65.3									
				56.2	SS-12	11	14	18	32
60.3									
				61.2	SS-13	14	15	26	41
55.3									
				66.2	SS-14	8	16	22	38
50.3									
				71.2	SS-15	15	18	28	46
				72.7	SS-16	13	17	19	36
45.3				74.7	SS-17	14	50/4.5"		100
				76.7	SS-18	15	22	28	50
40.3				78.7	SS-19	18	23	26	49
				80.7	SS-20	50/4"			100
				82.7	SS-21	15	20	23	46
35.3				84.7	SS-22	26	41	43	84
				86.7	SS-23	33	50/5"		100
30.3	88.7	Dense, wet, dark green, fine to medium grained, Silty SAND (SM), slightly micaceous SS-24: MC=32.8%, LL=NP, PL=NP, PI=NP, FC=19.2%		88.7	SS-24	8	12	18	30
				90.7	SS-25	7	17	20	37
25.3	94.5	Very dense, wet, gray, fine to coarse grained, Clayey SAND (SC), micaceous SS-26: MC=32.4%, LL=61, PL=17, PI=44, FC=13.2%		92.7					
				96.2	SS-26	26	43	50/4"	100
20.3				101.2					



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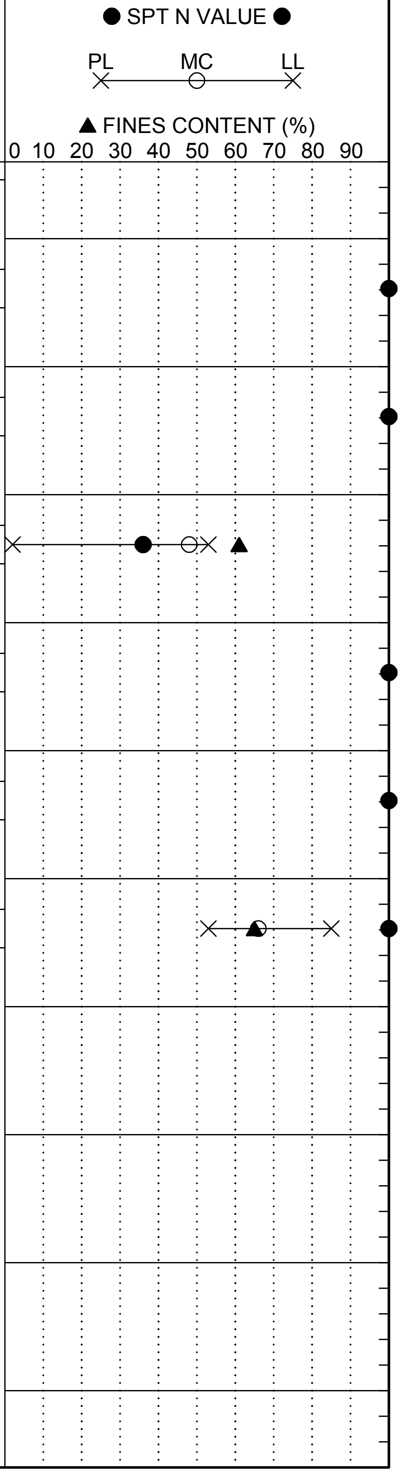
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-5A	**Boring Location:**	5950+99.11	**Offset:**	8.13 R	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6478	**Date Started:**	12/5/2014
Total Depth:	132.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/4/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.7 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
					SS-27	28	48	50/5"	100
15.3									
				106.2	SS-28	29	33	50/4.5"	100
10.3									
				111.2	SS-29	26	31	50/5"	100
5.3	114.5	Hard, wet, black, Sandy Fat CLAY (CH), micaceous SS-30: MC=48.2%, LL=53, PL=20, PI=33, FC=61%							
				116.2	SS-30	13	17	19	36
0.3	119.5	Very dense, wet, dark gray, fine to medium grained, Silty SAND (SM), micaceous (dense material from 123.7' - 125.7' caused slow drilling)							
				121.2	SS-31	21	50/4.5"		100
-4.7									
				126.2	SS-32	22	41	50/3"	100
-9.7	129.5	Very hard, wet, black, Sandy Elastic SILT (MH), slightly micaceous SS-33: MC=66%, LL=85, PL=53, PI=32, FC=65%							
				131.2	SS-33	15	50/5.5"		100
-14.7	132.7	Boring Terminated at 132.7' Groundwater Encountered at 9.7' at Time of Boring							
-19.7									
-24.7									
-29.7									



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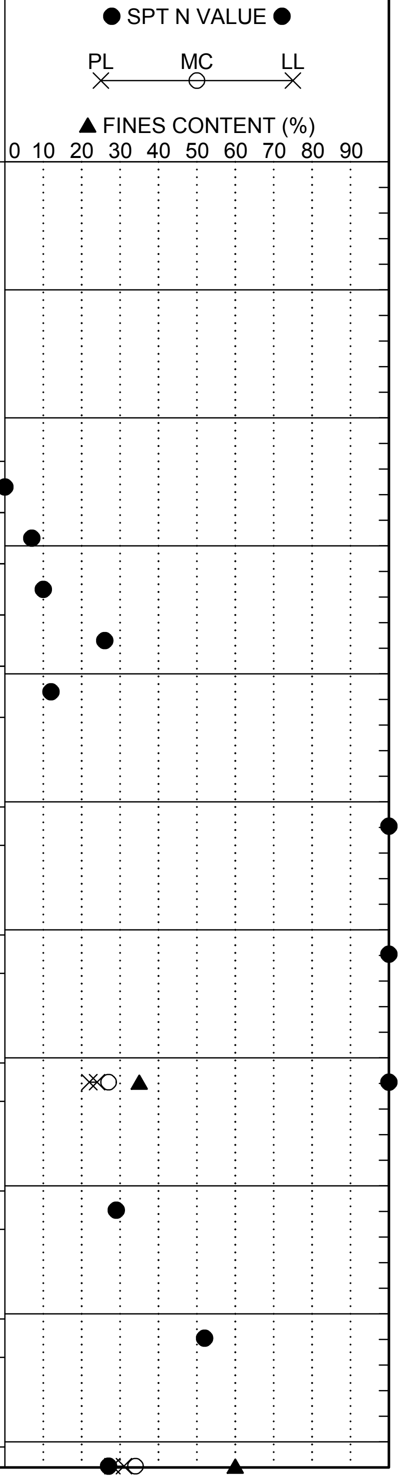
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-6A	**Boring Location:**	5951+42.68	**Offset:**	7.28 L	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6478	**Date Started:**	12/7/2014
Total Depth:	131.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/7/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.6 ft	**24HR**	

Elevation (ft)	Depth (ft) 0.0	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	1.6	Asphalt at 0 to 4" / Sand-Stone Stabilized Subgrade at 4" to 1.1' / Reinforced Concrete at 1.1' to 1.6'							
		Air							
115.3									
	9.6 ▽	Water							
110.3									
	11.7	ALLUVIAL - Very soft, wet, brown, Sandy SILT (ML)		11.7	SS-1	WOH/18"3			0
	13.7	contains wood		13.7	SS-2	3	3	4	7
105.3		Loose to medium dense, wet, light gray and white, medium to coarse grained, poorly graded SAND (SP)		15.7	SS-3	3	4	6	10
		(dark gray and white color at 17.1')		17.7	SS-4	10	14	12	26
	19.7			19.7	SS-5	6	6	6	12
100.3		COASTAL PLAIN DEPOSIT - Medium dense, wet, dark gray, fine to medium grained, poorly graded SAND with silt (SP-SM)							
	23.5	Very dense, wet, green gray, fine grained, Slty SAND (SM), slightly micaceous (contains sands with strong cementation) (contains shell fragments) SS-8: MC=27.4%, LL=24, PL=22, PI=2, FC=34.6%							
95.3				25.2	SS-6	17	12	50/2"	100
90.3				30.2	SS-7	18	24	50/4"	100
85.3				35.2	SS-8	13	50/3"		100
	39.0	Very stiff to very hard, wet, green gray, Sandy SILT (ML), slightly micaceous (contains lenses of cemented sands with moderate to strong cementation) (contains small shell fragments) SS-11: MC=34.1%, LL=31, PL=28, PI=3, FC=59.9% SS-12: MC=39.9%, LL=32, PL=31, PI=1, FC=68.2%							
80.3				40.2	SS-9	13	13	16	29
75.3				45.2	SS-10	12	17	35	52
70.3				50.2					



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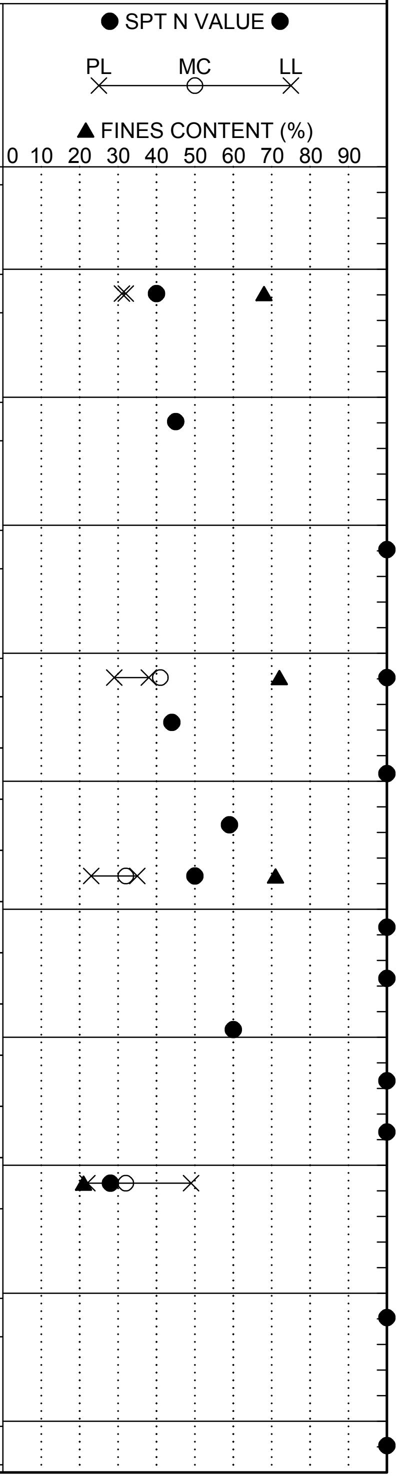
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-6A	**Boring Location:**	5951+42.68	**Offset:**	7.28 L	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6478	**Date Started:**	12/7/2014
Total Depth:	131.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/7/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.6 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
					SS-11	10	13	14	27
65.3				55.2	SS-12	10	16	24	40
60.3				60.2	SS-13	12	17	28	45
55.3				65.2	SS-14	28	43	50/3"	100
	68.2	Hard to very hard, wet, green gray, SILT with sand (ML), slightly micaceous (contains lenses of cemented sands with moderate to strong cementation) (contains small shell fragments) SS-15: MC=41.2%, LL=38, PL=29, PI=9, FC=72.2% SS-19: MC=32%, LL=35, PL=23, PI=12, FC=70.9%							
50.3				70.2	SS-15	14	32	50/5"	100
				71.7	SS-16	15	19	25	44
45.3				73.7	SS-17	19	28	50/5.5"	100
				75.7	SS-18	23	24	35	59
				77.7	SS-19	18	22	28	50
40.3				79.7	SS-20	16	25	50/4"	100
				81.7	SS-21	26	33	50/5.5"	100
35.3				83.7	SS-22	19	28	32	60
				85.7	SS-23	27	50/5"		100
				87.7	SS-24	27	50/5.5"		100
30.3	89.7	Medium dense, wet, dark green, fine to medium grained, Clayey SAND (SC), slightly micaceous SS-25: MC=31.5%, LL=49, PL=22, PI=27, FC=21.2%		89.7	SS-25	10	14	14	28
	93.5	Very dense, wet, gray and black, fine to medium grained, poorly graded SAND with silt (SP-SM), micaceous (contains 2" - 5" black silt seams) SS-28: MC=29.1%, LL=NP, PL=NP, PI=NP,		91.7					
25.3				95.2	SS-26	45	50/4"		100
20.3				100.2	SS-27	31	50/5.5"		100



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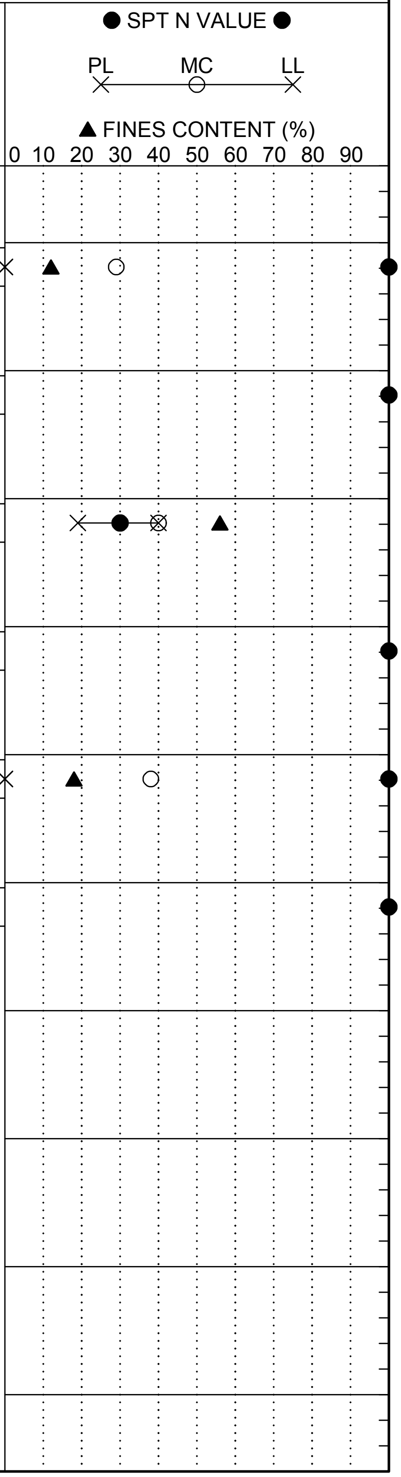
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-6A	**Boring Location:**	5951+42.68	**Offset:**	7.28 L	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6478	**Date Started:**	12/7/2014
Total Depth:	131.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/7/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.6 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		FC=11.5%						
15.3			105.2	SS-28	50/5.5"			100
10.3			110.2	SS-29	30	40	50/5"	100
	113.5	Hard, wet, black, Sandy Lean CLAY (CL), micaceous SS-30, MC=40.1%, LL=40, PL=19, PI=21, FC=56%						
5.3			115.2	SS-30	11	14	16	30
	118.5	Very dense, wet, dark gray, fine to medium grained, Silty SAND (SM), micaceous SS-32: MC=38%, LL=NP, PL=NP, PI=NP, FC=17.8%						
0.3			120.2	SS-31	37	40	50/4"	100
-4.7			125.2	SS-32	50/2"			100
	127.0	Very hard, wet, black, Sandy Elastic SILT (MH), micaceous						
-9.7			130.2	SS-33	16	23	50/5"	100
	131.7	Boring Terminated at 131.7' Groundwater Encountered at 9.6' at Time of Boring						
-14.7								
-19.7								
-24.7								
-29.7								



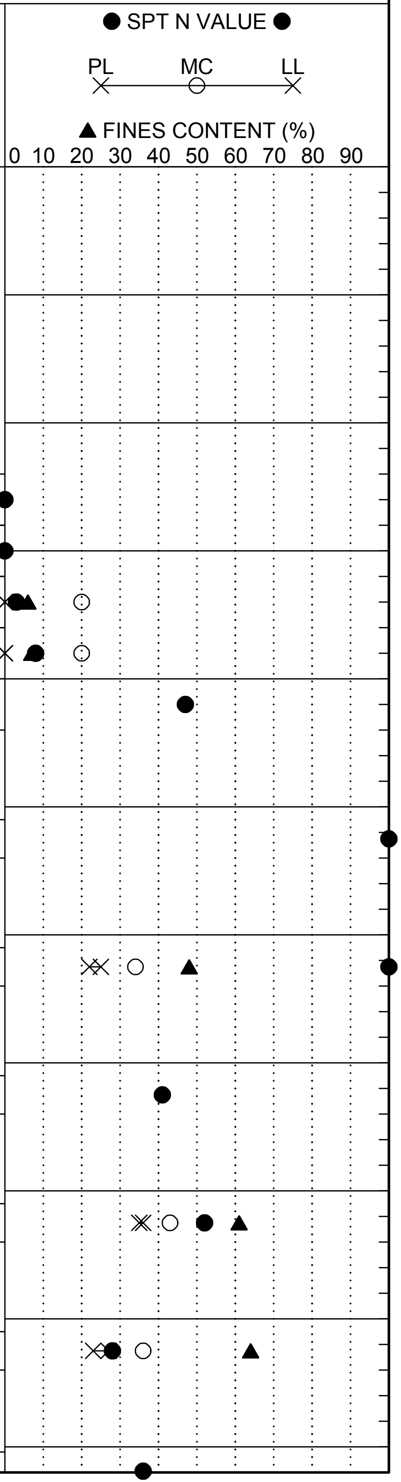
LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-7A	**Boring Location:**	5951+87.63	**Offset:**	8.39 R	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6481	**Date Started:**	12/6/2014
Total Depth:	132 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/6/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.5 ft	**24HR**	

Elevation (ft)	Depth (ft) 0.0	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	2.1	Asphalt at 0 to 5.5" / Sand-Stone Stabilized Subbase at 5.5" to 1.5' / Reinforced Concrete at 1.5' to 2.1'						
		Air						
115.3								
	9.5 ▽	Water						
110.3								
	12.0	ALLUVIAL - Very soft, wet, brown, Sandy SILT (ML) (contains trace roots)	12.0	SS-1	WOR/24"			0
			14.0	SS-2	WOR/24"			0
105.3	16.0	Very loose to loose, wet, gray, medium to coarse grained, poorly graded SAND with silt (SP-SM) SS-3: MC=20.3%, LL=NP, PL=NP, PI=NP, FC=5.9% SS-4: MC=19.9%, LL=NP, PL=NP, PI=NP, FC=7.4%	16.0	SS-3	WOR/WOH-3			3
			18.0	SS-4	4	4	4	8
100.3	20.0	COASTAL PLAIN DEPOSIT - Dense to very dense, wet, green gray, fine grained, Silty SAND (SM), slightly micaceous (contains sands with strong cementation) (contains trace shell fragments) SS-7: MC=33.6%, LL=25, PL=22, PI=3, FC=47.8%	20.0	SS-5	1	23	24	47
95.3			25.5	SS-6	32	31	50/4.5"	100
90.3			30.5	SS-7	16	19	50/2"	100
	33.5	Very stiff to hard, wet, green gray, Sandy SILT (ML), slightly micaceous (contains cemented sands with moderate to high cementation) SS-9: MC=42.8%, LL=36, PL=35, PI=1, FC=61.1% SS-10: MC=36.2%, LL=27, PL=23, PI=4, FC=64%						
85.3			35.5	SS-8	15	16	25	41
80.3			40.5	SS-9	15	18	34	52
75.3			45.5	SS-10	10	12	16	28
70.3			50.2					



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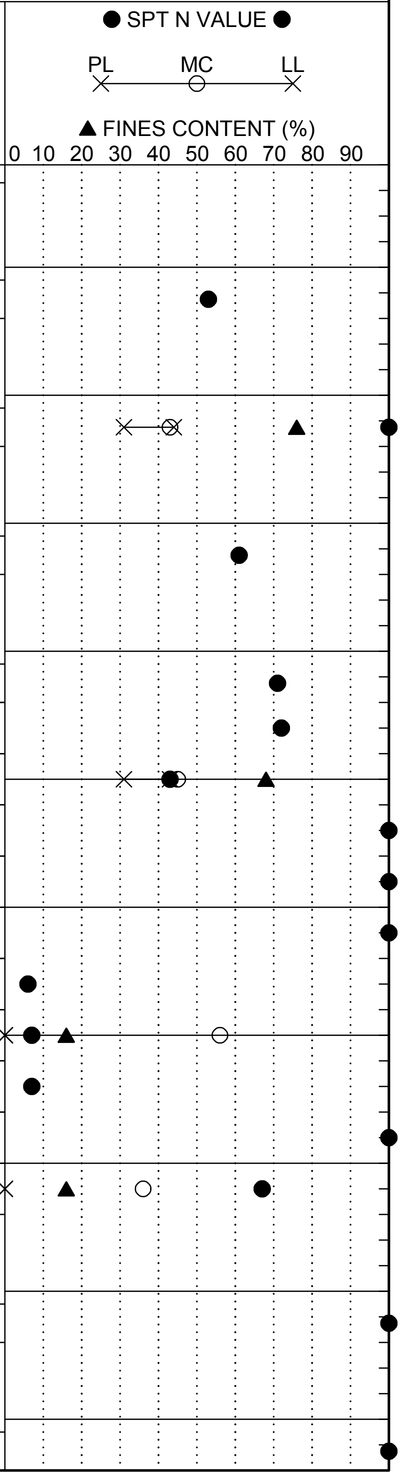
LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-7A	**Boring Location:**	5951+87.63	**Offset:**	8.39 R	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6481	**Date Started:**	12/6/2014
Total Depth:	132 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/6/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.5 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
				SS-11	9	15	21	36
65.3			55.5	SS-12	15	20	33	53
	58.5	Very hard, wet, green gray, SILT with sand (ML), slightly micaceous (contains cemented sands with moderate to high cementation) SS-13: MC=43.3%, LL=44, PL=31, PI=13, FC=76%						
60.3			60.5	SS-13	12	30	50/4"	100
55.3			65.5	SS-14	13	21	41	61
50.3			70.5	SS-15	16	21	50	71
			72.0	SS-16	16	25	47	72
45.3	74.0	Hard to very hard, wet, green gray, Sandy SILT (ML), slightly micaceous (contains cemented sands with moderate to high cementation) SS-17: MC=44.7%, LL=43, PL=31, PI=12, FC=68%	74.0	SS-17	12	14	29	43
			76.0	SS-18	17	33	50/5.5"	100
40.3			78.0	SS-19	31	36	50/4.5"	100
			80.0	SS-20	40	50/4"		100
	82.0	Loose, wet, dark green, fine grained, Silty SAND (SM), slightly micaceous SS-22: MC=55.9%, LL=NP, PL=NP, PI=NP, FC=16.1%	82.0	SS-21	2	4	2	6
35.3			84.0	SS-22	2	3	4	7
			86.0	SS-23	2	3	4	7
			88.0	SS-24	13	38	50/4"	100
30.3	89.1	Very dense, wet, gray, fine to coarse grained, Silty SAND (SM), micaceous SS-25: MC=36.1%, LL=NP, PL=NP, PI=NP, FC=16.4%	90.0	SS-25	22	30	37	67
25.3			95.5	SS-26	19	46	50/3"	100
20.3			100.5	SS-27	40	50/5.5"		100
	102.0							



LEGEND

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SAMPLER TYPE

SS - Split Spoon
ST - Shelby Tube
AWG - Rock Core, 1-1/8"
NQ - Rock Core, 1-7/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD

HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-7A	**Boring Location:**	5951+87.63	**Offset:**	8.39 R	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6481	**Date Started:**	12/6/2014
Total Depth:	132 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/6/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.5 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
		Very dense, wet, black, fine to medium grained, poorly graded SAND with silt (SP-SM), micaceous								
15.3		SS-28: MC=26.7%, LL=NP, PL=NP, PI=NP, FC=8.5%		105.5	SS-28	19	33	50/3"	100	
	106.5	Very hard, wet, black, Sandy Lean CLAY (CL), micaceous								
10.3				110.5	SS-29	15	50/5"		100	
	113.5	Very dense, wet, dark gray, fine to medium grained, Silty SAND (SM), micaceous								
5.3				115.5	SS-30	15	40	50/4.5"	100	
0.3				120.5	SS-31	15	42	50/5"	100	
	124.5	Very hard, wet, black, Sandy Elastic SILT (MH), micaceous								
-4.7				125.5	SS-32	16	30	50/3"	100	
-9.7				130.5	SS-33	50/5"			100	
	132.0	Boring Terminated at 132' Groundwater Encountered at 9.5' at Time of Boring								
-14.7										
-19.7										
-24.7										
-29.7										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

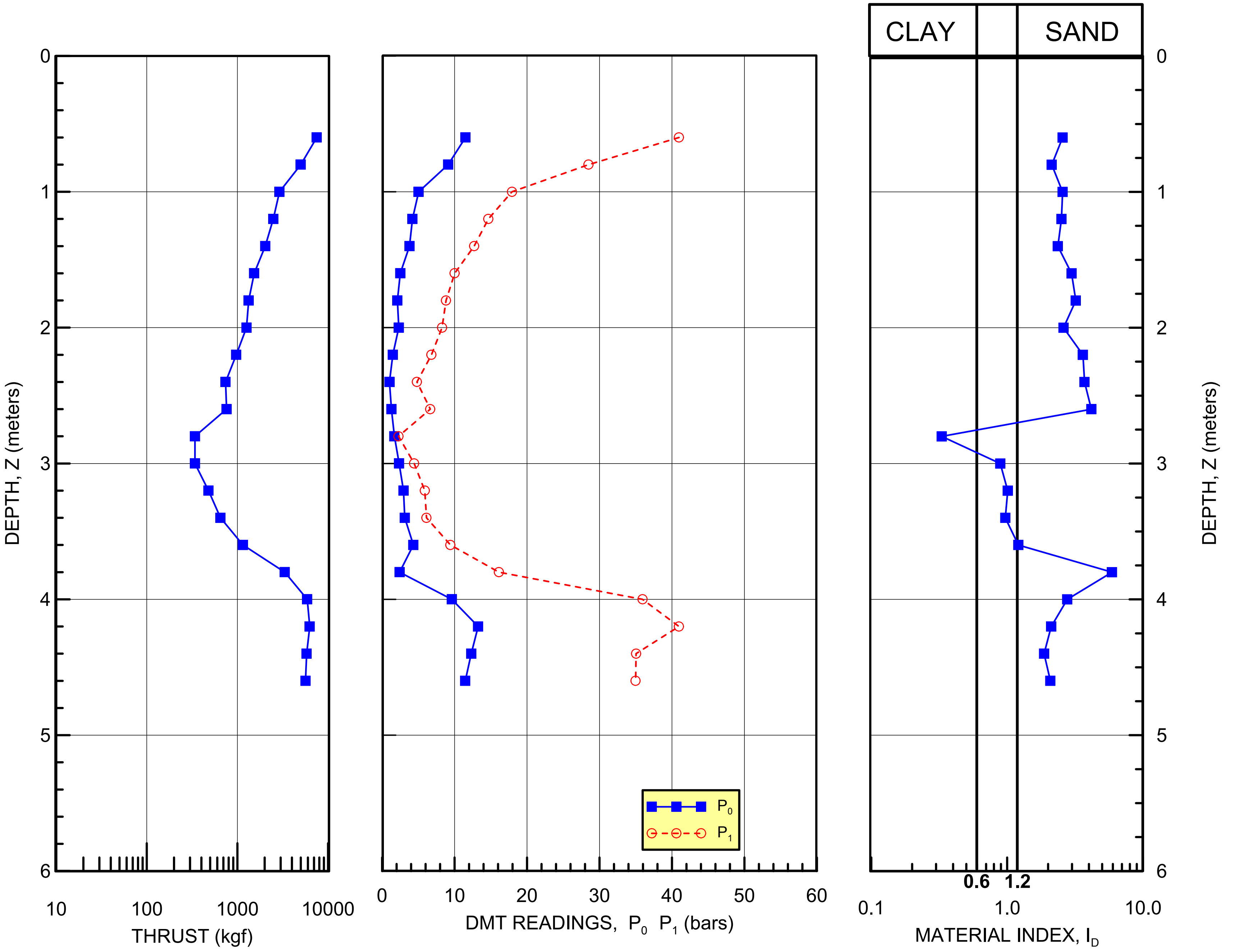
PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC

DILATOMETER RESULTS

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14

SOUNDING
DMT-1

Ground Surface Elev.: ~37.3 m
Water Depth: ~2.9 m



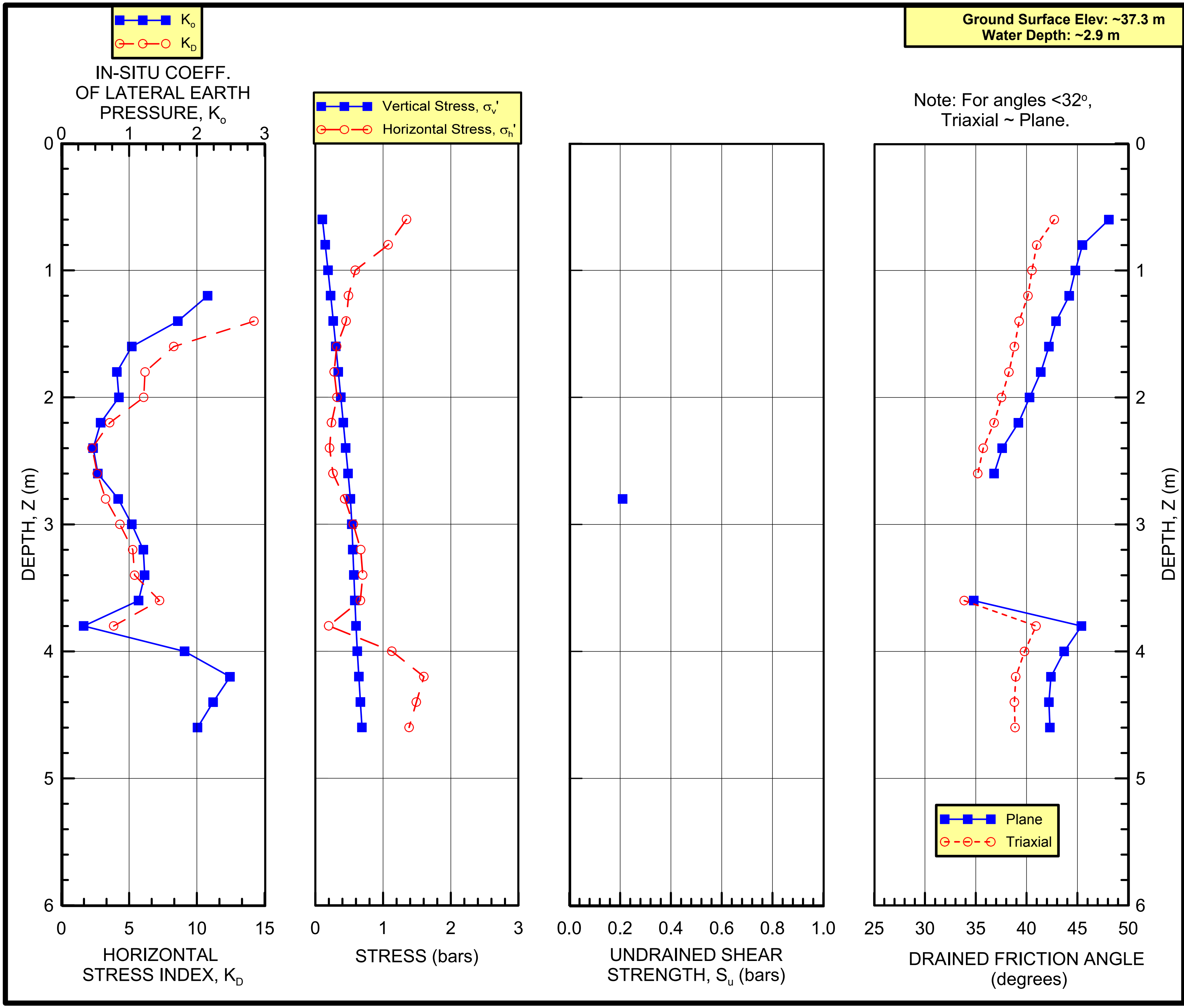
INTERPRETED DMT STRENGTH PARAMETERS

PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14

SOUNDING
DMT-1

Ground Surface Elev: ~37.3 m
Water Depth: ~2.9 m



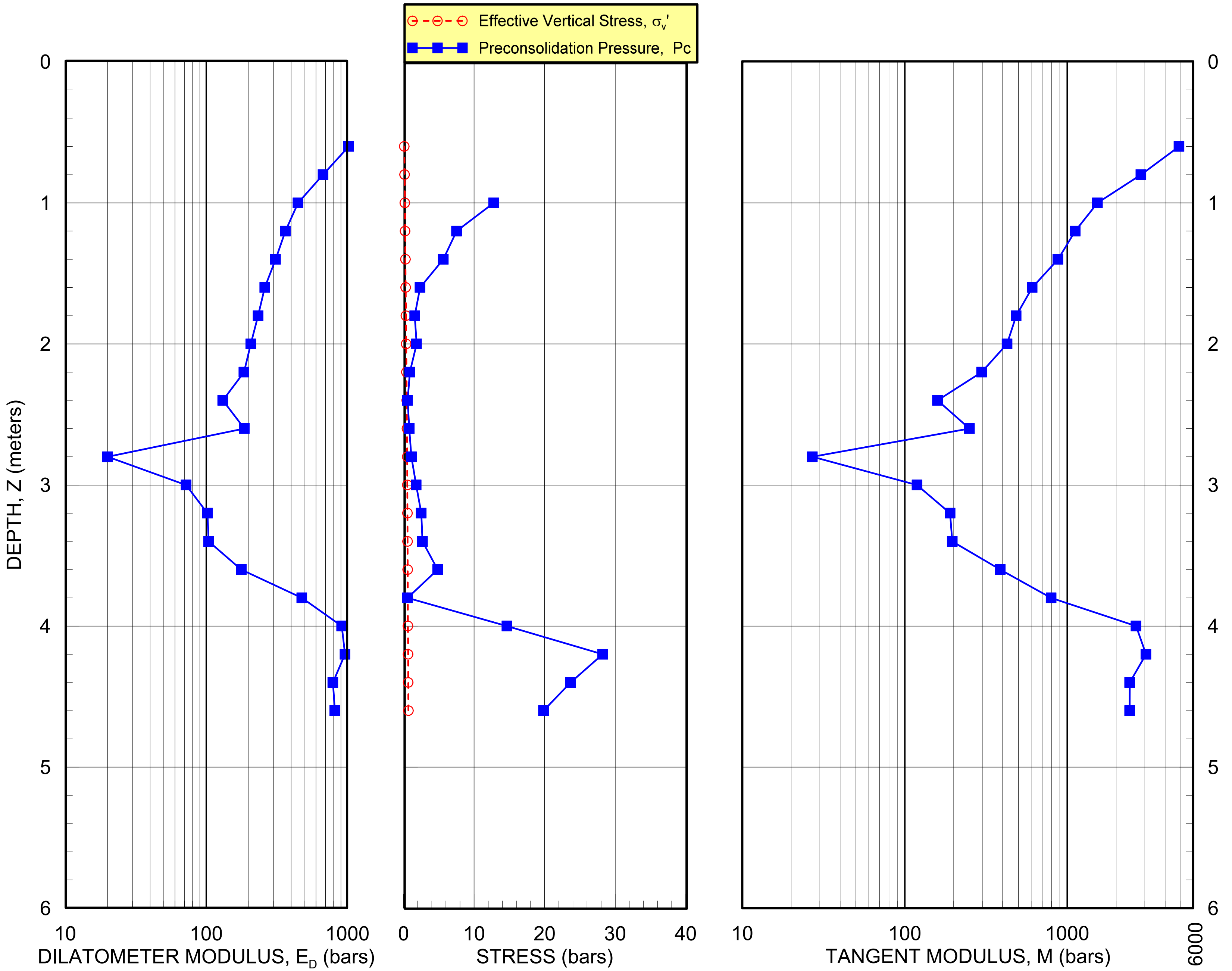
PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC

INTERPRETED DMT DEFORMATION PARAMETERS

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14

SOUNDING
DMT-1

Ground Surface Elev.: ~37.3 m
Water Depth: ~2.9 m



Pile Width/Diameter = 14 inches 36 cm

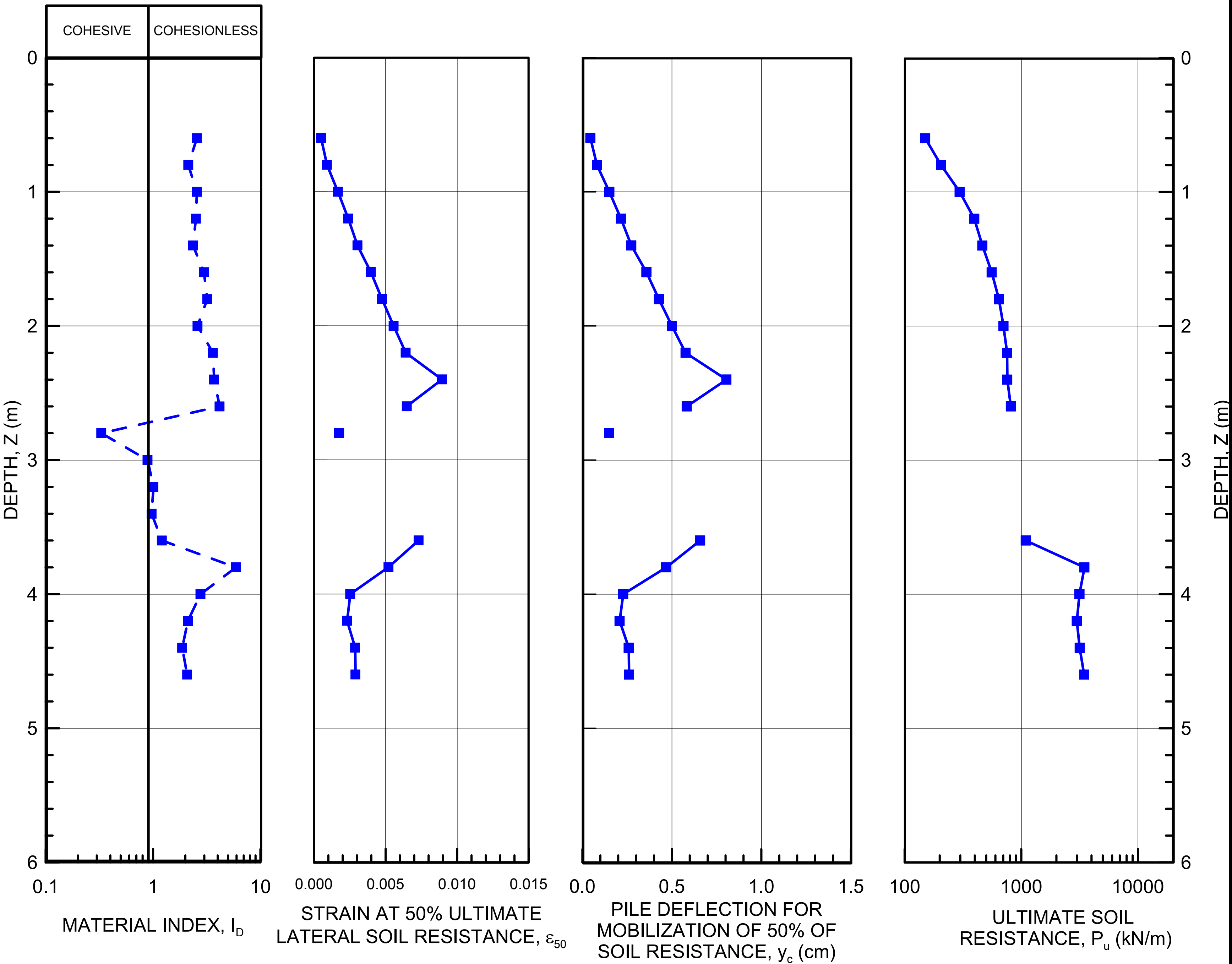
Ground Surface Elev: ~37.3 m
Water Depth: ~2.9 m

PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC

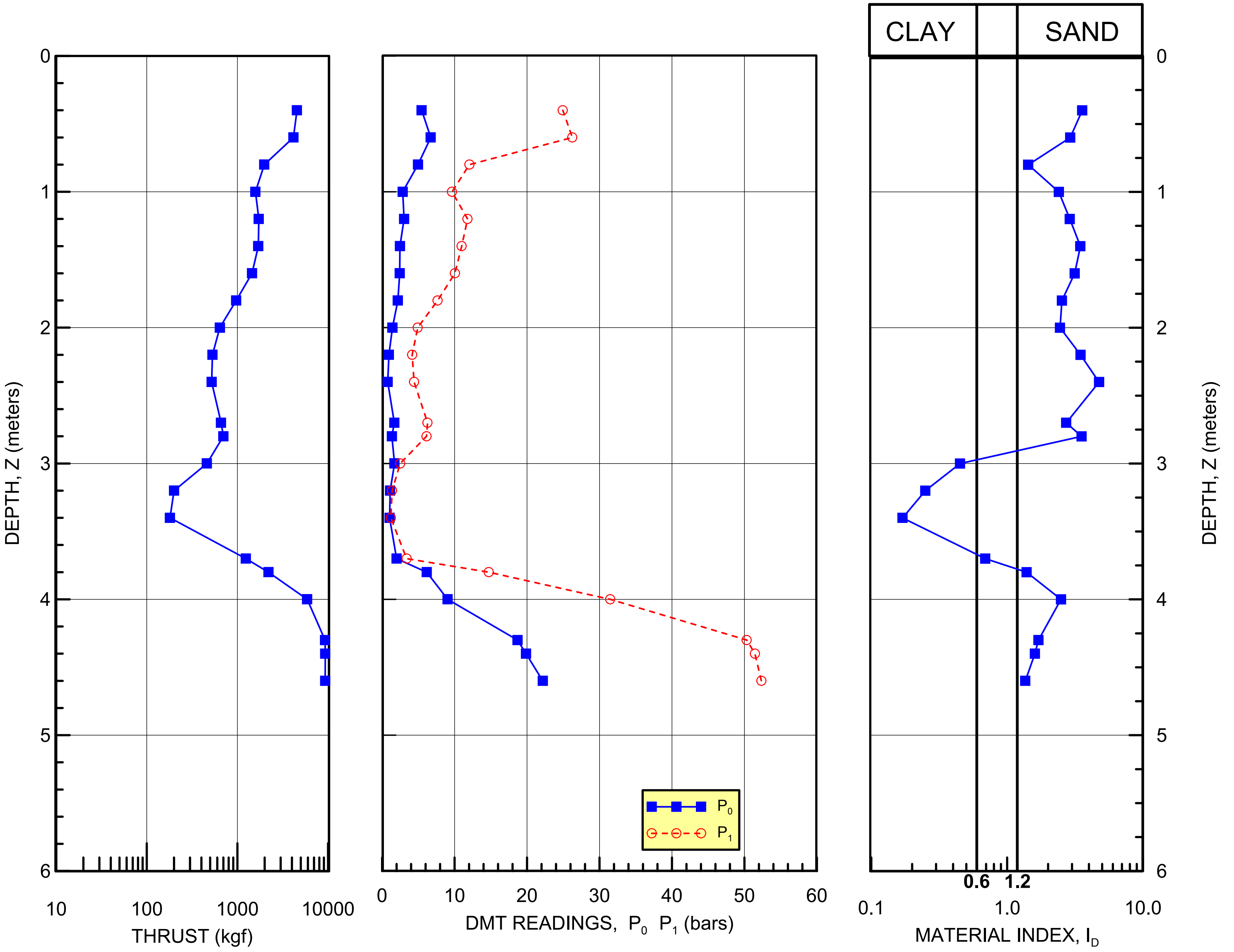
INTERPRETED P-y PARAMETERS FOR LATERAL LOAD ANALYSES

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14

SOUNDING
DMT-1



Ground Surface Elev.: ~37.4 m
Water Depth: ~3.7 m



DILATOMETER RESULTS

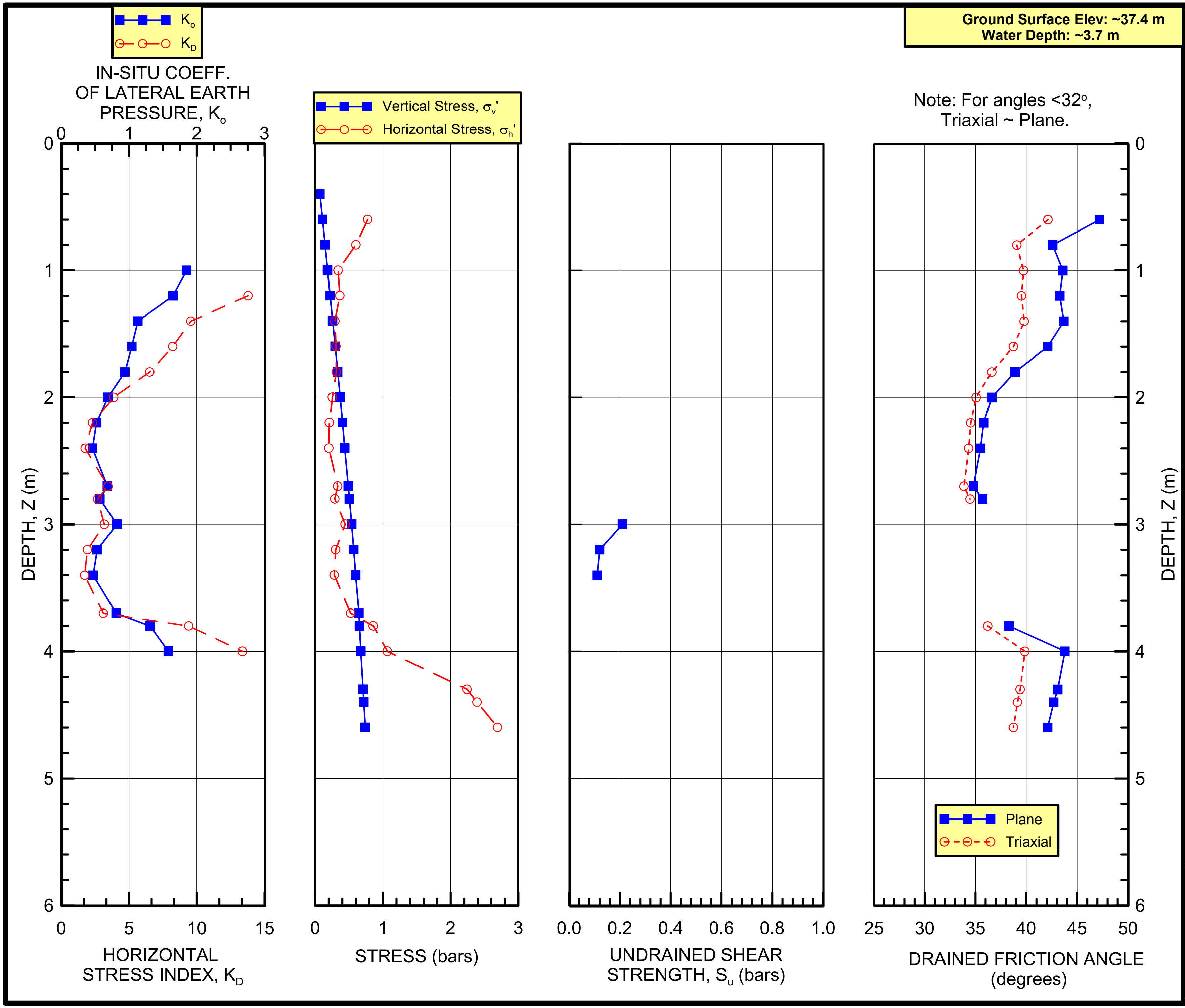
PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14

SOUNDING

DMT-2

Ground Surface Elev: ~37.4 m
Water Depth: ~3.7 m



PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC

INTERPRETED DMT STRENGTH PARAMETERS

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14

SOUNDING
DMT-2

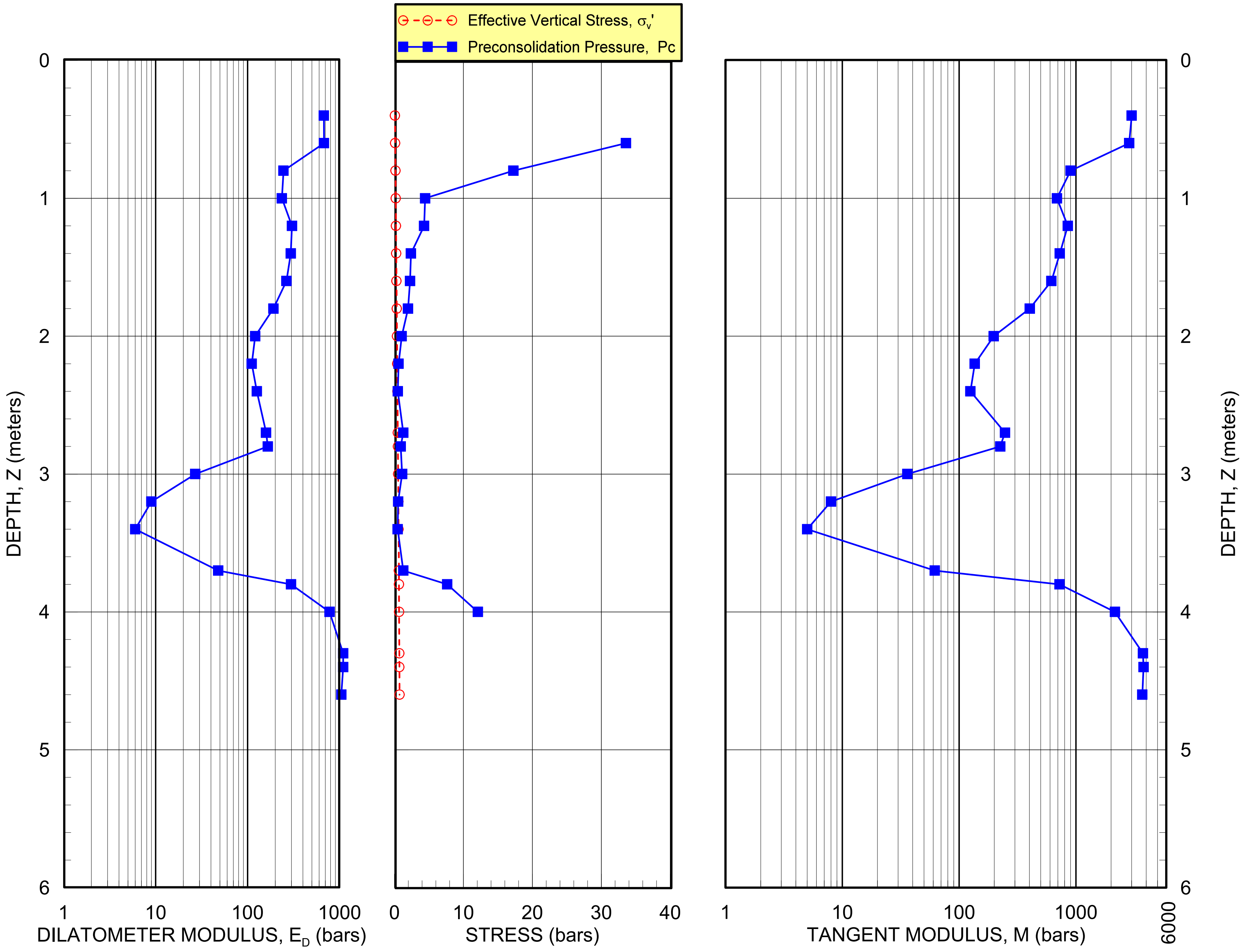
PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC

INTERPRETED DMT DEFORMATION PARAMETERS

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14

SOUNDING
DMT-2

Ground Surface Elev.: ~37.4 m
Water Depth: ~3.7 m



PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC

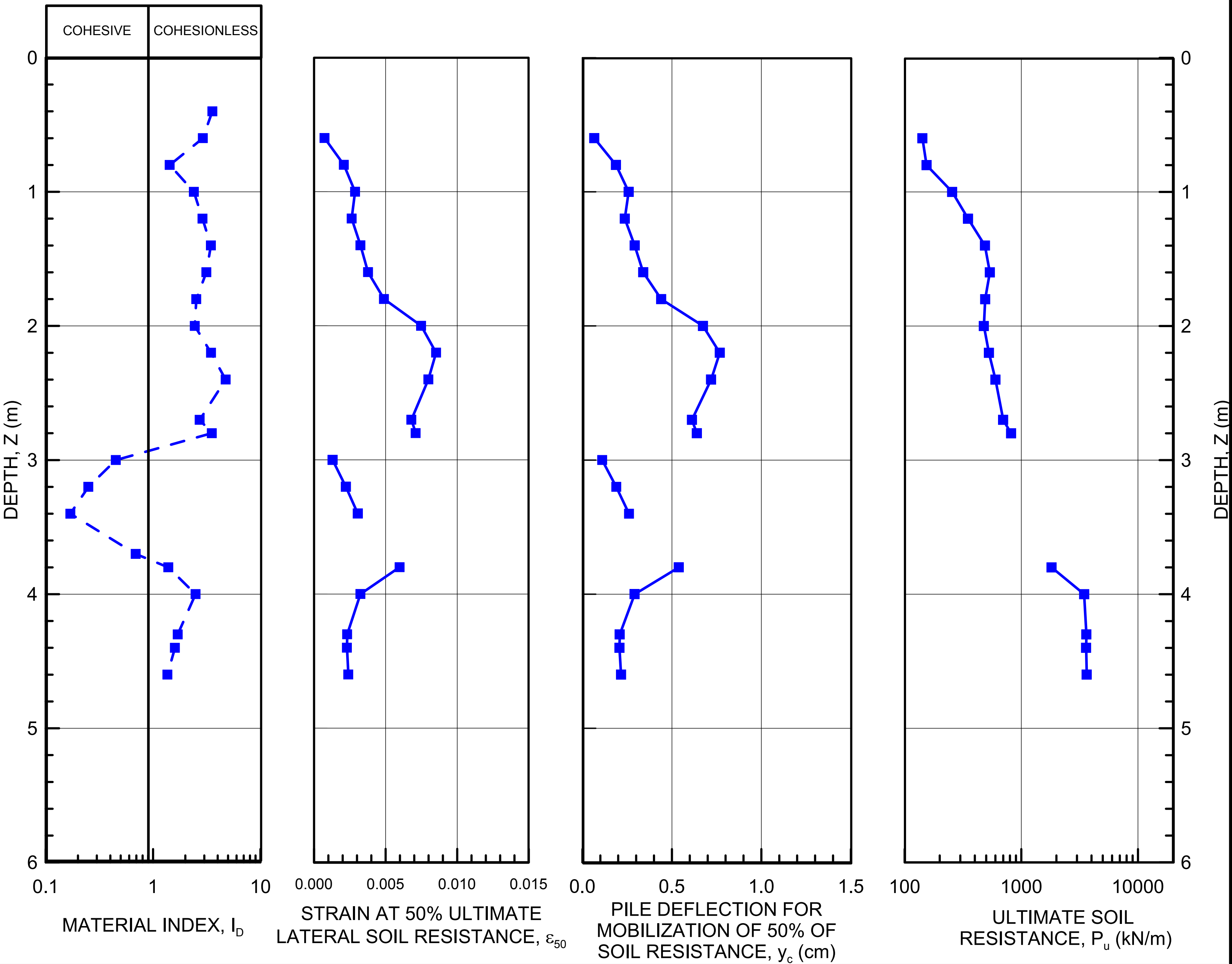
INTERPRETED P-y PARAMETERS FOR LATERAL LOAD ANALYSES

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14

SOUNDING
DMT-2

Pile Width/Diameter = 14 inches 36 cm

Ground Surface Elev: ~37.4 m
Water Depth: ~3.7 m



Appendix III

Summary of Lab Data

ICA Engineering

Project Name : Bridge Replacement over Four Hole Swamp

Location : Orangeburg County, South Carolina
Job Number : 11200-10

Soil Classifications Summary

				Grain Size Data					Hydrometer Test Data							Atterberg			Classification		Direct Shear		Rock Core
Soil No.	Boring No.	Sample No.	Depth (ft)	Natural Moisture (%)	%< #4 Sieve	%< #10 Sieve	%< #40 Sieve	%< #200 Sieve	%< #1 Hyd. Rd.	%< #2 Hyd. Rd.	%< #3 Hyd. Rd.	%< #4 Hyd. Rd.	%< #5 Hyd. Rd.	%< #6 Hyd. Rd.	%< #7 Hyd. Rd.	LL	PL	PI	ASTM	AASHTO	Phi Angle	Cohesion (psi)	Unconfined Compressive Stength (psi)
1	B-1	SS-1	2-3.5	11.7	99.7	97.7	60.1	16.2								NP	NP	NP	SM	A-2-4 (0)			
2	B-1	SS-4	8-9.5	17.5	99.6	97.8	79.3	32.3								25	17	8	SC	A-2-4 (0)			
3	B-1	SS-6	16-17.5	13.1	100	98.5	41.9	4.4								NP	NP	NP	SP	A-1-b (0)			
4	B-1	SS-7	21-22.5	38.1	100	99.4	80.9	28.5								37	31	6	SM	A-2-4 (0)			
5	B-1	SS-9	31-32.5	23.5	93.7	83.9	59.5	24.5								NP	NP	NP	SM	A-2-4 (0)			
6	B-1	SS-11	41-42.5	44.9	100	100	83.7	44								NP	NP	NP	SM	A-4 (0)			
7	B-1	SS-13	51-52.5	33.9	98.3	92.9	87.5	55.3								NP	NP	NP	ML	A-4 (0)			
8	B-2	SS-4	8-9.5	N/A	99	96.1	37.4	14.2	11.2	10.2	9.1	8.2	5.3	4.1	2.7	NA	NA	NA	SM	A-1-b (0)			
9	B-2	SS-5	10-11.3	N/A	100	100	95.2	55.1	46.3	42.4	38.2	33.2	29.2	17	8.6	NA	NA	NA	ML	A-4 (0)			
10	B-2	SS-6	15-16.5	24.6	100	100	76.7	46.7	41.8	40.7	32.8	28.8	23.9	15	7.1	35	23	12	SC	A-6 (3)			
11	B-2	SS-8	25-26.5	34.4	100	100	87.1	39.2								31	30	1	SM	A-4 (0)			
12	B-2	SS-10	35-36.5	N/A	100	99.9	82.4	43.8								NA	NA	NA	SM	A-4 (0)			
13	B-2	SS-11	40-41.5	38.1	100	99.2	87	47.1								NP	NP	NP	SM	A-4 (0)			
14	B-2	SS-15	60-61.5	33.8	100	99.6	81.9	48.7								40	35	5	SM	A-4 (1)			
15	B-2	SS-17	70-71.5	37.6	100	99.7	64.2	23								NP	NP	NP	SM	A-2-4 (0)			
16	B-2	SS-18	75-76.5	35.1	95.8	84.3	42	7.9								NP	NP	NP	SP-SM	A-1-b (0)			
17	B-3	SS-2	4-5.5	4.5	98.6	74.9	8	0.5								NP	NP	NP	SP	A-1-b (0)			
18	B-3	SS-5	10-11.5	30.2	99.5	97	85.2	51.9	44.9	40.1	38.1	32.2	27.5	15.6	8.3	36	29	7	ML	A-4 (2)			
19	B-3	SS-6	15-16.5	N/A	100	99.7	93.1	55.2	49.2	44.2	41.2	34.4	25.5	15.5	6	NA	NA	NA	ML	A-4 (0)			
20	B-3	SS-8	25-26.5	37.9	100	100	84.5	43.6								36	33	3	SM	A-4 (0)			
21	B-3	SS-10	35-36.5	46.7	100	99.4	82.5	47.3								NP	NP	NP	SM	A-4 (0)			
22	B-3	SS-15	60-61.5	35.9	99.8	93.5	63.7	28								NP	NP	NP	SM	A-2-4 (0)			
23	B-3	SS-19	80-81.5	19.7	100	95.5	17.1	5.7								NP	NP	NP	SW-SM	A-1-b (0)			
24	B-3	SS-23	100-101.5	38.9	100	97.7	82.9	42.6								NP	NP	NP	SM	A-5 (0)			
25	B-4	SS-3	6-7.5	17.2	92.3	83.5	7.2	0.1								NP	NP	NP	SP	A-1-b (0)			
26	B-4	SS-5	10.0-11.5	N/A	98.9	96.3	87.1	50.2	43.5	39.7	36	33.1	27.1	16.7	9.4	NA	NA	NA	ML	A-4(0)			
27	B-4	SS-6	15-16.5	34.8	100	100	92	52.4	45	41	37	32.9	28.8	17	9.2	35	27	8	ML	A-4 (2)			
28	B-4	SS-7	20-21.5	N/A	85	80	61.7	32.8	29.5	27.9	23.2	20.1	16	8.1	3	NA	NA	NA	SM	A-2-4 (0)			
29	B-4	SS-8	25-26.5	33.2	100	99.8	88	49.8								NP	NP	NP	SM	A-4 (0)			
30	B-4	SS-10	35-36.5	43.4	98.2	91.7	80	49.4								NP	NP	NP	SM	A-4 (0)			
31	B-4	SS-13	50-51.5	36.0	100	100	83.6	42.6								37	34	3	SM	A-4 (0)			
32	B-4	SS-16	65-66.5	33.4	100	99.3	82.6	33.5								36	33	3	SM	A-2-4 (0)			
33	B-4	SS-19	80-81.5	22.7	100	99.9	68.1	27.3								33	30	3	SM	A-2-4 (0)			
34	B-5	SS-2	4-5.5	16.8	96.9	85.4	29.2	3.8								NP	NP	NP	SW	A-1-b (0)			
35	B-5	SS-3	6-7.5	N/A	100	99.9	96.1	59.9	52.8	47.9	44.1	40.2	33.4	20.5	10.6	NA	NA	NA	ML	A-4 (0)			
36	B-5	SS-4	8-9.5	N/A	95.7	93.4	82.4	47.8	39.4	35.8	31.2	27.5	20	12.2	7	NA	NA	NA	SM	A-4 (0)			
37	B-5	SS-6	32.4-33.9	36.4	100	99.8	83.6	41.2								NP	NP	NP	SM	A-4 (0)			
38	B-5	SS-9	45-46.5	37.0	100	99.9	82.9	52.3								45	33	12	ML	A-7-5 (5)			
39	B-5	SS-11	55-56.5	39.6	100	100	84.1	50.1								43	40	3	ML	A-5 (1)			
40	B-5	SS-13	65-66.5	45.4	99.7	85.2	23.5	2.6								NP	NP	NP	SW	A-1-b (0)			
41	B-6	SS-2	4-5.5	12.7	100	88.2	11.9	1.6								NA	NA	NA	SP	A-1-b (0)			
42	B-6	SS-3	6-7.5	14.0	100	97.8	43.7	4								NP	NP	NP	SP	A-1-b (0)			
43	B-6	SS-4	8-9.5	17.0	96.7	92.2	37.7	2.1								NP	NP	NP	SP	A-1-b (0)			
44	B-6	SS-5	10-11.5	N/A	99.6	99.2	86.4	8.8	4.8	4.8	3.9	3.8	3.8	3.6	2.9	NA	NA	NA	SP-SM	A-2-4 (0)			
45	B-7	SS-3	6-7.5	N/A	100	99.9	93.1	56.5	46.8	44.9	39.9	35.1	27.3	17.7	8.8	NA	NA	NA	ML	A-4 (0)			
46	B-7	SS-4	8-9.5	N/A	100	100	93	50.7	42.2	40	36.8	34.6	28	17.2	9.9	NA	NA	NA	ML	A-4 (0)			
47	B-7	SS-5	10-11.5	30.9	99.8	97.5	86.9	40.6								31	25	6	SM	A-4 (0)			
48	B-7	SS-6	15-16.5	N/A	98	93	87.1	64.2	30.4	29.5	26.9	22.7	17.6	9.3	4.2	NA	NA	NA	SM	A-4 (0)			
49	B-8	SS-1	2-3.5	8.3	99.8	97.4	54.2	11.9								NP	NP	NP	SW-SM	A-2-4 (0)			
50	B-8	SS-5	10-11.5	33.4	100	98.9	90.2	20.1								NP	NP	NP	SM	A-2-4 (0)			
51	B-8	SS-7	20-21.5	15.0	100	95.2	16.9	1.8								NP	NP	NP	SP	A-1-b (0)			
52	B-9	SS-1	2-3.5	13.3	96.6	93.5	57.7	18.9								20	18	2	SM	A-2-4 (0)			
53	B-9	SS-3	6-7.5	10.5	100	98.1	51.9	5.6								NP	NP	NP	SP-SM	A-3 (0)			
54	B-9	SS-6	15-16.5	N/A	100	98.2	38.7	4.6								NA	NA	NA	SW	A-1-b (0)			
55	B-9	SS-7	20-21.5	24.1	94.6	88.7	78.8	48.4								34	28	6	SM	A-4 (1)			
56	B-9	SS-9	30-31.5	23.3	93.7	87.3	66.8	35.7								26	21	5	SC-SM	A-4 (0)			
57	B-9	SS-12	45-46.5	41.7	97.8	92.5	83.5	59.4								41	40	1	ML	A-5 (1)			
58	RW-1	SS-1	2-3.5	12.7	100	98.7	64.6	29.5								33	19	14	SC	A-2-6 (1)			
59	RW-1	SS-2	4-5.5	11.0	100	98.7	58.9	12.8								NP	NP	NP	SM	A-2-4 (0)			
60	RW-1	SS-5	9.9-11.4	18.0	99.2	98.3	84.4	43.4								23	16	7	SC-SM	A-4 (0)			
61	RW-1	SS-6	14.9-16.4	16.8	100	98.7	39.3	4.3								NP	NP	NP	SP	A-1-b (0)			
62	RW-1	SS-7	19.9-21.4	26.4	99.6	97.8	92	52.9								37	31	6	ML	A-4 (2)			
63	RW-2	SS-1	2-3.5	14.0	97.3	93.7	49.5	15.4								18	17	1	SM	A-1-b (0)			
64	RW-2	SS-2	4-5.5	8.5	98.8	97.2	38.7	7.3								NP	NP	NP	SW-SM	A-1-b (0)			
65	RW-2	SS-4	8-9.5	18.9	98	95.7	71.2	35								21	19	2	SM	A-2-4 (0)			

Project Name : Bridge Replacement over Four Hole Swamp
Location : Orangeburg County, South Carolina
Job Number : 11200-10

Soil Classifications Summary

				Grain Size Data					Hydrometer Test Data							Atterberg			Classification		Direct Shear		Rock Core
Soil No.	**Boring No.**	**Sample No.**	**Depth (ft)**	**Natural Moisture (%)**	**%< #4 Sieve**	**%< #10 Sieve**	**%< #40 Sieve**	**%< #200 Sieve**	**%< #1 Hyd. Rd.**	**%< #2 Hyd. Rd.**	**%< #3 Hyd. Rd.**	**%< #4 Hyd. Rd.**	**%< #5 Hyd. Rd.**	**%< #6 Hyd. Rd.**	**%< #7 Hyd. Rd.**	**LL**	**PL**	**PI**	**ASTM**	**AASHTO**	**Phi Angle**	**Cohesion (psi)**	**Unconfined Compressive Stength (psi)**
66	RW-2	SS-6	15-16.5	25.7	100	99.9	57.3	2.5								NP	NP	NP	SP	A-3 (0)			
67	RW-2	SS-7	20-21.5	30.6	99.2	96.8	89.9	51.1								39	31	8	ML	A-4 (2)			
68	RW-3	SS-2	4-5.5	12.0	100	99.3	58.2	10.3								NP	NP	NP	SP-SM	A-2-4 (0)			
69	RW-3	SS-5	10-11.5	28.0	99.6	99	95.8	60.8								25	16	9	CL	A-4 (3)			
70	RW-3	SS-7	20-21.5	28.4	99.6	97.1	91.6	51.4								38	31	7	ML	A-4 (2)			
71	RW-4	SS-1	2-3.5	18.3	97.3	94.9	64.8	20.2								20	16	4	SM	A-2-4 (0)			
72	RW-4	SS-3	6-7.5	10.6	100	95.9	17.2	4.1								NP	NP	NP	SW	A-1-b (0)			
73	RW-4	SS-6	14.9-16.4	N/A	100	96.7	73.2	21.3								NA	NA	NA	SM	A-2-4 (0)			
74	RW-4	SS-7	19.9-21.4	32.2	96.2	91	80.4	49.3								34	28	6	SM	A-4 (1)			
75	RW-5	SS-1	2-3.5	6.7	100	96.2	89	11.3								NP	NP	NP	SW-SM	A-2-4 (0)			
76	RW-5	SS-3	6-7.5	11.7	100	98	55.2	11.5								NP	NP	NP	SW-SM	A-2-4 (0)			
77	RW-5	SS-5	9.9-11.4	60.2	100	94.8	87.4	41								NP	NP	NP	SM	A-4 (0)			
78	RW-5	SS-7	19.9-21.4	31.3	100	99.5	94.8	59.9								38	30	8	ML	A-4 (4)			
79	RW-6	SS-1	2-3.5	14.4	96.8	95.2	61.8	16								NP	NP	NP	SM	A-2-4 (0)			
80	RW-6	SS-5	10-11.5	21.3	99.9	97.8	78.3	25.1								NP	NP	NP	SM	A-2-4 (0)			
81	RW-7	SS-1	2-3.5	11.3	92.5	88.4	45.6	13.7								NP	NP	NP	SM	A-1-b (0)			
82	RW-7	SS-3	6-7.5	15.1	96.1	90.7	43.1	7.3								NP	NP	NP	SP-SM	A-1-b (0)			
83	RW-7	SS-6	15-16.5	25.1	99.9	97.9	81.5	12								NP	NP	NP	SW-SM	A-2-4 (0)			
84	B-1	Bulk-1	0-5	N/A	99.3	95.3	45.1	15.5								NP	NP	NP	SM	A-1-b (0)	35.96	0.83	
85	B-8	Bulk-2	0-5	N/A	96.9	92.9	62.6	17								NP	NP	NP	SM	A-1-b (0)	30.62	0.32	
	RC-1	B-5	10.6-11																				665
	RC-2	B-5	12.3-12.6																				1007
	RC-3	B-5	19.5-19.9																				1722
	RC-4	B-5	24.6-24.9																				299
	RC-5	B-5	26.5-26.8																				116
	RC-6	B-6	15.3-15.7																				297
	RC-7	B-6	23.9-24.3																				275
	RC-8	B-6	26.7-27.1																				459
	RC-9	B-6	30.6-31.0																				295
	RC-10	B-7	20.0-20.4																				4688
	RC-11	B-7	21.1-21.5																				4251
	RC-12	B-7	27.3-27.6																				435
	RC-13	B-7	31.5-31.9																				314
	RC-14	B-7	37-37.4																				643
	RC-15	B-8	30.5-30.8																				452
	RC-16	B-8	34.5-34.9																				261
	RC-17	B-8	39-39.4																				203

PSI **Professional Service Industries, Inc.**

Project Name: Bridge Replacement over Four Hole Swamp
Location : Orangeburg County

Soil Classification Summary

			Grain Size Data				Hydrometer Test Data							Atterberg			Classification	
Boring No.	Sample No.	Depth (ft)	Natural Moisture (%)	% Gravel	% Sand	% Silt Clay	% Passing 32.9 µm	% Passing 21.1 µm	% Passing 12.4 µm	% Passing 8.9 µm	% Passing 6.4 µm	% Passing 3.2 µm	% Passing 1.3 µm	LL	PL	PI	ASTM	AASHTO
B-1A	SS-5	8.7	24.5		27.0	73.0								34	14	20	CL	
B-1A	SS-6	13.5	20.5		57.7	42.3								25	13	12	SC	
B-1A	SS-11	38.5	37		42.3	57.7								28	26	2	ML	
B-1A	SS-12	43.5	46.0	8.3	42.4	49.3								40	38	2	SM	
B-1A	SS-13	48.5	35.3		44.0	56.0								29	27	2	ML	
B-1A	SS-14	53.5	36.7		33.7	66.3								32	31	1	ML	
B-1A	SS-17	68.5	32.7		26.3	73.7								36	30	6	ML	
B-3A	SS-6	24.7	33.3		46.9	53.1								35	24	11	ML	
B-3A	SS-7	31.2	29.6	1.0	56.2	42.8								29	18	11	SC	
B-3A	SS-12	54.7	43.6		36.7	63.3								35	29	6	ML	
B-3A	SS-14	61.7	39.6	3.3	28.4	68.3								41	33	8	ML	
B-3A	SS-19	71.2	316.1		39.9	60.1								135	133	2	MH	
B-3A	SS-21	75.2	376.9		35.7	64.3	44.7	40.6	34.4	30.0	25.9	19.7	9.7	113	102	11	MH	
B-3A	SS-22	77.2	336.3		37.2	62.8								111	101	10	MH	
B-3A	SS-23	79.2	316.1		59.0	41.0	24.5	22.4	18.3	16.0	13.7	9.3	3.5	99	92	7	SM	
B-3A	SS-24	81.2	305.5		60.3	39.7								90	86	4	SM	
B-3A	SS-25	83.2	266.5		67.2	32.8								75	66	9	SM	
B-3A	SS-27	87.2	42.6	0.6	89.0	10.4								NP	NP	NP	SW-SM	
B-3A	SS-28	89.2	25.0	3.2	76.9	19.9								NP	NP	NP	SM	
B-3A	SS-34	120.7	30.3		95.0	5.0								NP	NP	NP	SP-SM	
B-5A	SS-7	31.2	31.8	0.5	51.6	47.9								29	33	6	SM	
B-5A	SS-9	41.2	35.3		36.6	63.4								32	28	4	ML	
B-5A	SS-11	51.2	36.8		47.7	52.3								28	25	3	ML	
B-5A	SS-13	61.2	34.9	2.1	31.6	66.3								35	30	5	ML	
B-5A	SS-16	72.7	35.3	0.1	32.3	67.6								34	28	6	ML	
B-5A	SS-24	88.7	32.8	0.3	80.5	19.2								NP	NP	NP	SM	
B-5A	SS-26	96.2	32.4	1.2	85.6	13.2								61	17	44	SC	
B-5A	SS-30	116.2	48.2		38.9	61.1	31.5	25.2	18.7	15.4	13.8	8.9	7.6	53	20	33	CH	
B-5A	SS-33	132.7	66.0		35.0	65.1	46.4	40.7	38.6	35.0	33.2	27.5	15.7	85	53	32	MH	
B-6A	SS-8	35.2	27.4	17.8	47.6	34.6								24	22	2	SM	
B-6A	SS-11	50.2	34.1		40.1	59.9								31	28	3	ML	

PSI Professional Service Industries, Inc.

Project Name: Bridge Replacement over Four Hole Swamp
Location : Orangeburg County

Soil Classification Summary

			Grain Size Data				Hydrometer Test Data							Atterberg			Classification	
Boring No.	**Sample No.**	**Depth (ft)**	**Natural Moisture (%)**	**% Gravel**	**% Sand**	**% Silt Clay**	**% Passing 32.9 µm**	**% Passing 21.1 µm**	**% Passing 12.4 µm**	**% Passing 8.9 µm**	**% Passing 6.4 µm**	**% Passing 3.2 µm**	**% Passing 1.3 µm**	**LL**	**PL**	**PI**	**ASTM**	**AASHTO**
B-6A	SS-12	55.2	39.9		31.8	68.2								32	31	1	ML	
B-6A	SS-15	70.2	41.2		27.8	72.2								38	29	9	ML	
B-6A	SS-19	77.7	32.0		29.1	70.9								35	23	12	ML	
B-6A	SS-25	89.7	31.5	0.2	78.6	21.2								49	22	27	SC	
B-6A	SS-28	105.2	29.1		88.5	11.5								NP	NP	NP	SP-SM	
B-6A	SS-30	115.2	40.1		43.6	56.4	26.7	20.7	14.8	12.8	11.0	7.0	4.6	40	19	21	CL	
B-6A	SS-32	125.2	38.0	6.5	75.7	17.8								NP	NP	NP	SM	
B-7A	SS-3	16.0	20.3		94.1	5.9								NP	NP	NP	SP-SM	
B-7A	SS-4	18.0	19.9	0.7	91.9	7.4								NP	NP	NP	SP-SM	
B-7A	SS-7	30.5	33.6	3.3	48.9	47.8								25	22	3	SM	
B-7A	SS-9	40.5	42.8	0.7	38.2	61.1								36	35	1	ML	
B-7A	SS-10	45.5	36.2		36.1	63.9	32.7	30.8	25.2	23.4	17.8	10.3	4.5	27	23	4	ML	
B-7A	SS-13	60.5	43.3		23.9	76.2	47.4	41.7	35.9	30.5	23.2	10.3	4.5	44	31	13	ML	
B-7A	SS-17	74.0	44.7		31.7	68.3	44.5	39.0	31.5	28.0	20.9	9.9	6.2	43	31	12	ML	
B-7A	SS-22	84.0	55.9	1.1	82.8	16.1								NP	NP	NP	SM	
B-7A	SS-25	90.0	36.1	0.8	82.8	16.4								NP	NP	NP	SM	
B-7A	SS-28	105.5	26.7		91.5	8.5								NP	NP	NP	SP-SM	

PSI **Professional Service Industries, Inc.**

Project Name: Bridge Replacement over Four Hole Swamp
Location : Orangeburg County

Boring No.	RW-3A		Grain Size Data							Hydrometer Test Data								
Sample No.	Depth (ft)	Natural Moisture (%)	% < #4	% < #10	%< #20	%< #40	%< #60	%< #140	%< #200	0.0332 mm	0.0213 mm	0.0125 mm	0.0089 mm	.0064 mm	.0046 mm	.0032 mm	.0014 mm	.0010 mm
ST-1	9.00' - 11.00'	30.8	100.0	96.7	94.8	92.5	90.1	67.3	63.1	56.2	51.5	46.8	42.1	37.4	32.7	25.7	11.6	6.9

Atterberg			Classification		Direct Shear	
LL	PL	PI	ASTM	AASHTO	Effective Phi Angle	Cohesion (TSF)
35	15	20	CL	A-6(10)	28.9	0.162

PSI Professional Service Industries, Inc.

Project Name: Bridge Replacement over Four Hole Swamp
Location : Orangeburg County

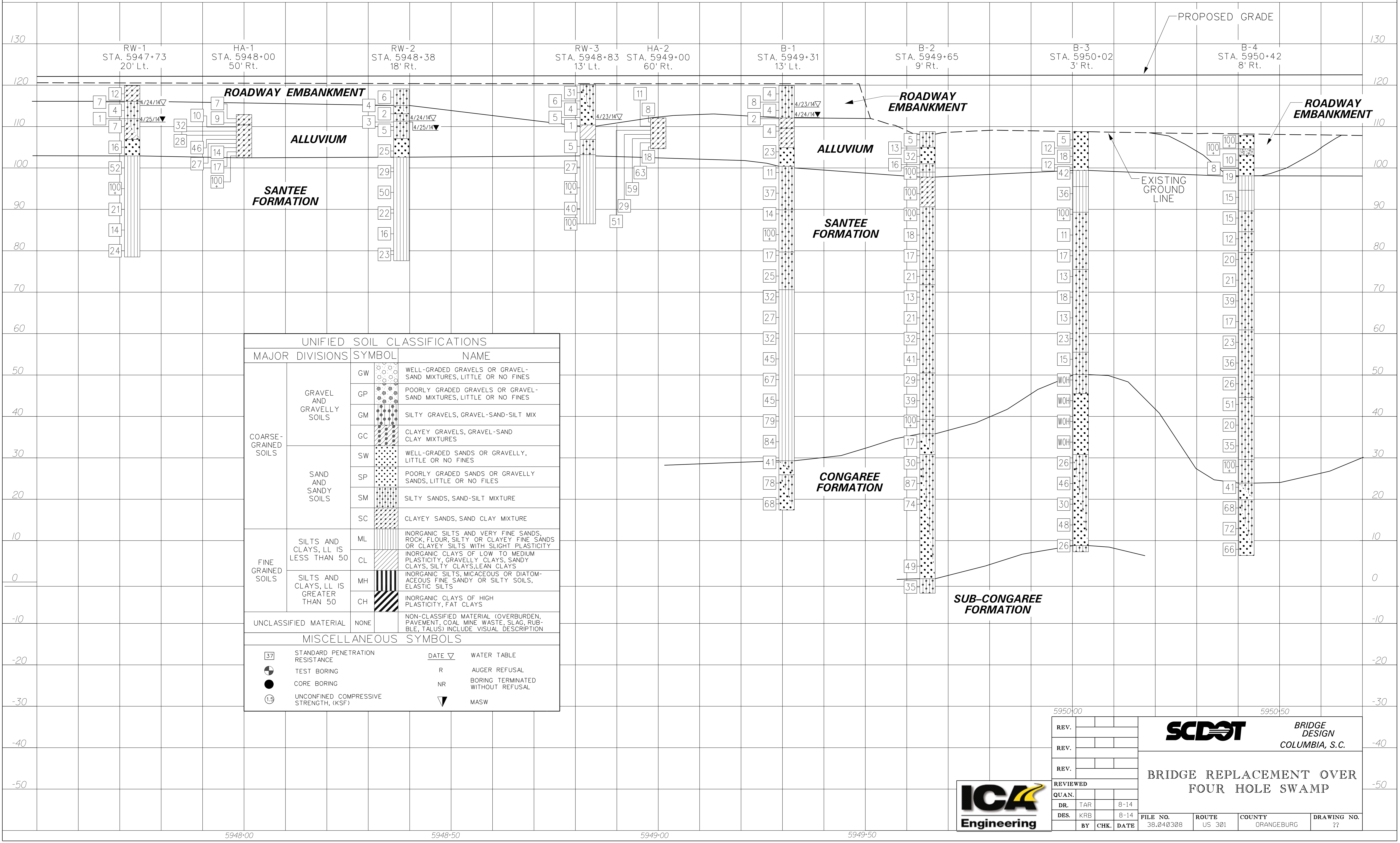
SUMMARY OF LABORATORY CORROSION SERIES TEST RESULTS				
Sample	**pH**	**Resistivity (ρ,Ω*cm)**	**Chloride Content (ppm)**	**Sulfate Content (ppm)**
B-1A SS-7	3.9	2600	*	*
B-1A Composite (SS-9/SS-10)	7.7	1500	5	555
B-3A Composite (SS-3/SS-4)	7.5	7600	2	111
B-5A SS-9	7.6	1800	4	396

***Insufficieint Sample**

Appendix IV

Subsurface Profile

PIN	SHEET NO.	TOTAL SHEETS
40308 BR01	??	??



UNIFIED SOIL CLASSIFICATIONS

MAJOR DIVISIONS		SYMBOL		NAME
COARSE-GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GP		POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIX
		GC		CLAYEY GRAVELS, GRAVEL-SAND CLAY MIXTURES
	SAND AND SANDY SOILS	SW		WELL-GRADED SANDS OR GRAVELLY, LITTLE OR NO FINES
		SP		POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FILES
		SM		SILTY SANDS, SAND-SILT MIXTURE
		SC		CLAYEY SANDS, SAND CLAY MIXTURE
FINE GRAINED SOILS	SILTS AND CLAYS, LL IS LESS THAN 50	ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK, FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
		CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
	SILTS AND CLAYS, LL IS GREATER THAN 50	MH		INORGANIC SILTS, MICACEOUS OR DIATOM-ACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
		CH	▨	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
UNCLASSIFIED MATERIAL		NONE		NON-CLASSIFIED MATERIAL (OVERBURDEN, PAVEMENT, COAL MINE WASTE, SLAG, RUBBLE, TALUS) INCLUDE VISUAL DESCRIPTION

MISCELLANEOUS SYMBOLS

37	STANDARD PENETRATION RESISTANCE	DATE ▽	WATER TABLE
◕	TEST BORING	R	AUGER REFUSAL
●	CORE BORING	NR	BORING TERMINATED WITHOUT REFUSAL
(1.5)	UNCONFINED COMPRESSIVE STRENGTH, (KSF)	▼	MASW

ICA Engineering

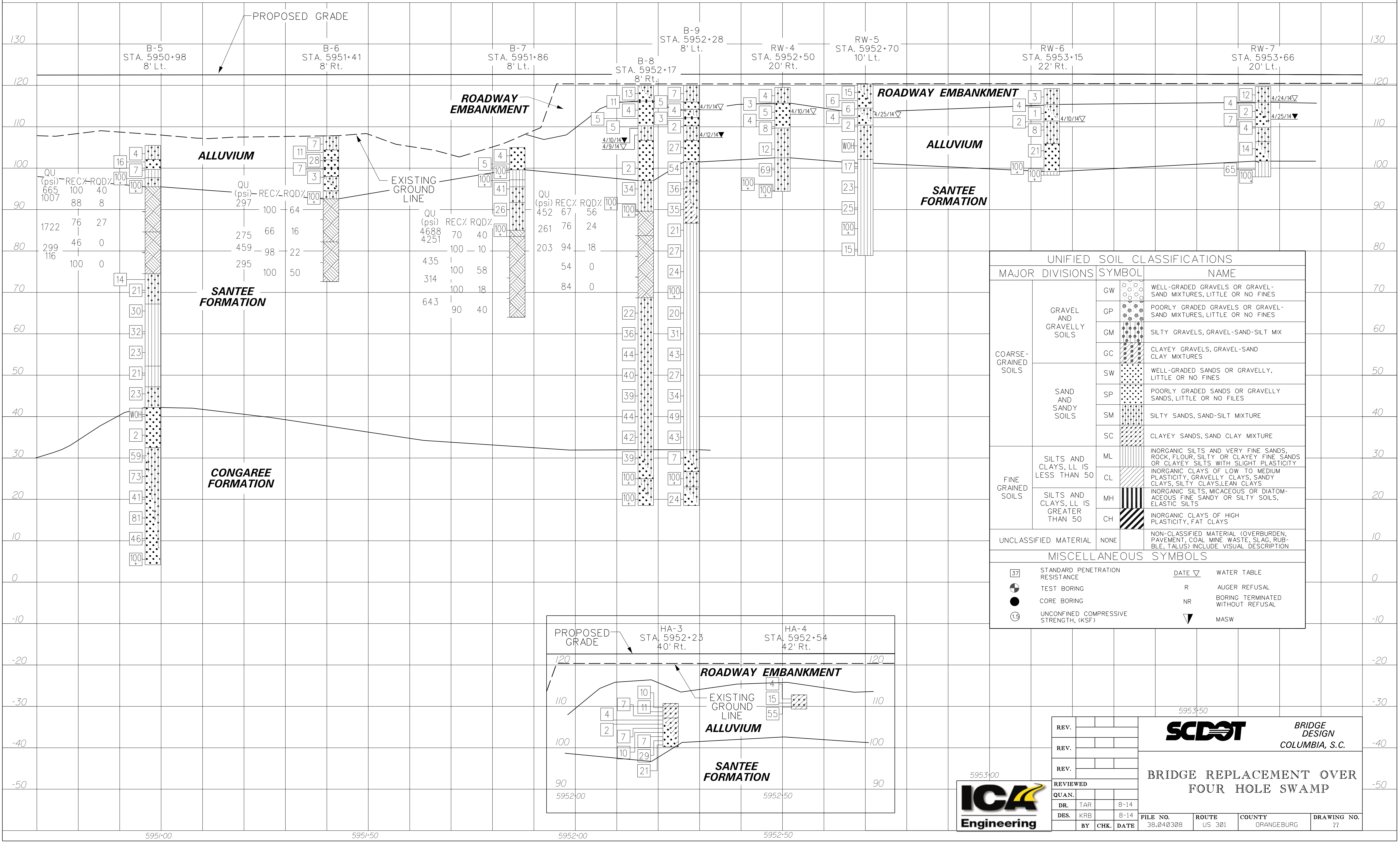
REV.			
REV.			
REV.			
REVIEWED			
QUAN.			
DR.	TAR		8-14
DES.	KRB		8-14
	BY	CHK.	DATE

SCDOT
BRIDGE DESIGN
COLUMBIA, S.C.

BRIDGE REPLACEMENT OVER
FOUR HOLE SWAMP

FILE NO.	ROUTE	COUNTY	DRAWING NO.
38.040308	US 301	ORANGEBURG	??

PIN	SHEET NO.	TOTAL SHEETS
40308 BR01	??	??



UNIFIED SOIL CLASSIFICATIONS				
MAJOR DIVISIONS		SYMBOL		NAME
COARSE-GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GP		POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIX
		GC		CLAYEY GRAVELS, GRAVEL-SAND CLAY MIXTURES
	SAND AND SANDY SOILS	SW		WELL-GRADED SANDS OR GRAVELLY, LITTLE OR NO FINES
		SP		POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FILES
		SM		SILTY SANDS, SAND-SILT MIXTURE
		SC		CLAYEY SANDS, SAND CLAY MIXTURE
FINE GRAINED SOILS	SILTS AND CLAYS, LL IS LESS THAN 50	ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK, FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
		CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS,LEAN CLAYS
	SILTS AND CLAYS, LL IS GREATER THAN 50	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
		CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
UNCLASSIFIED MATERIAL		NONE		NON-CLASSIFIED MATERIAL (OVERBURDEN, PAVEMENT, COAL MINE WASTE, SLAG, RUBBLE, TALUS) INCLUDE VISUAL DESCRIPTION

MISCELLANEOUS SYMBOLS

37	STANDARD PENETRATION RESISTANCE	DATE ▽	WATER TABLE
◑	TEST BORING	R	AUGER REFUSAL
●	CORE BORING	NR	BORING TERMINATED WITHOUT REFUSAL
(1.5)	UNCONFINED COMPRESSIVE STRENGTH, (KSF)	▼	MASW

REV.			
REV.			
REV.			
REVIEWED			
QUAN.			
DR.	TAR		8-14
DES.	KRB		8-14
	BY	CHK.	DATE

ICA Engineering

SCDOT
BRIDGE DESIGN
COLUMBIA, S.C.

BRIDGE REPLACEMENT OVER FOUR HOLE SWAMP

FILE NO.	ROUTE	COUNTY	DRAWING NO.
38.040308	US 301	ORANGEBURG	??

G:\11200\10\Dwgs\Plan Sheet 1.dgn
$TIME$
1/27/2015

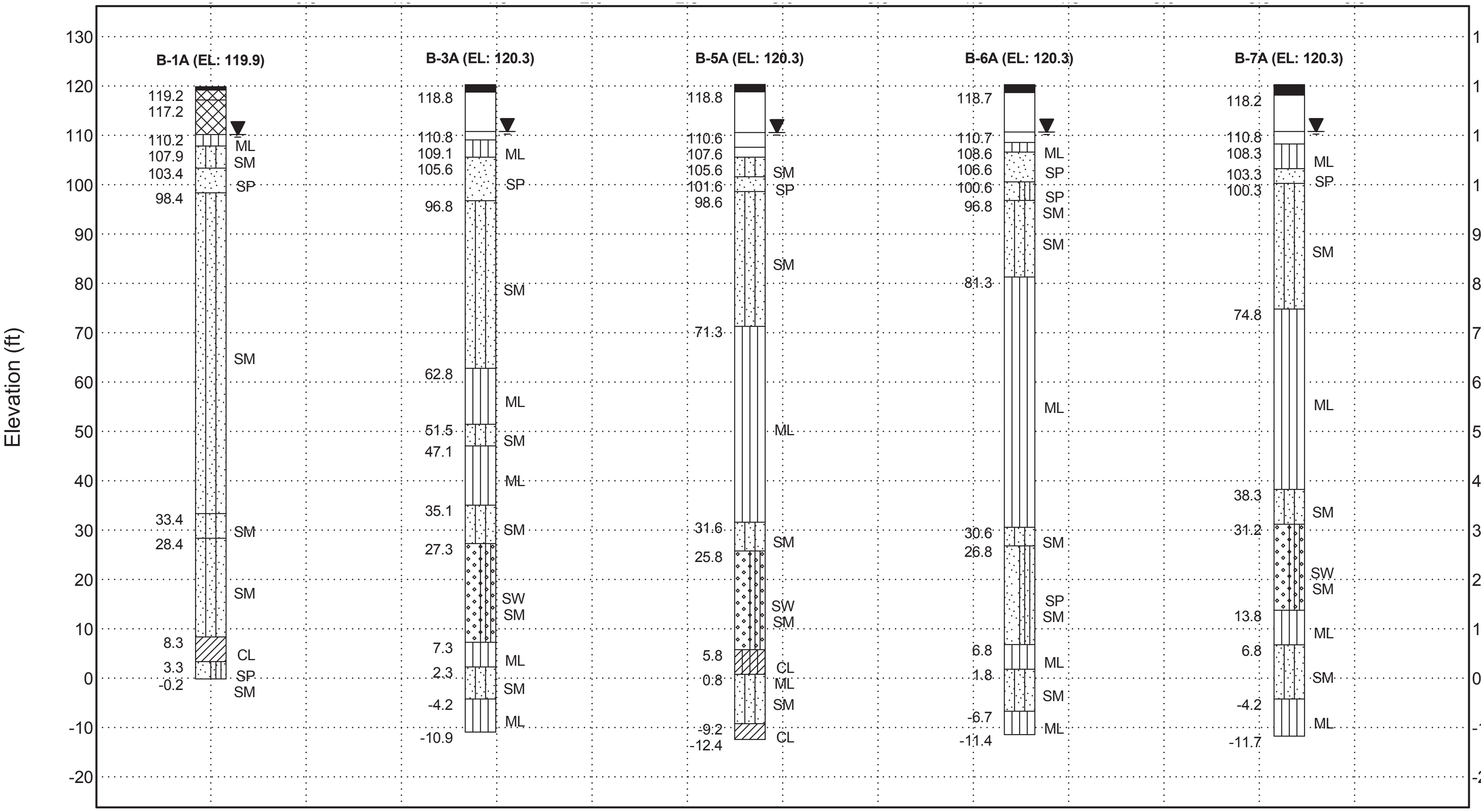
SUBSURFACE DIAGRAM

psi Information To Build On
Engineering • Consulting • Testing

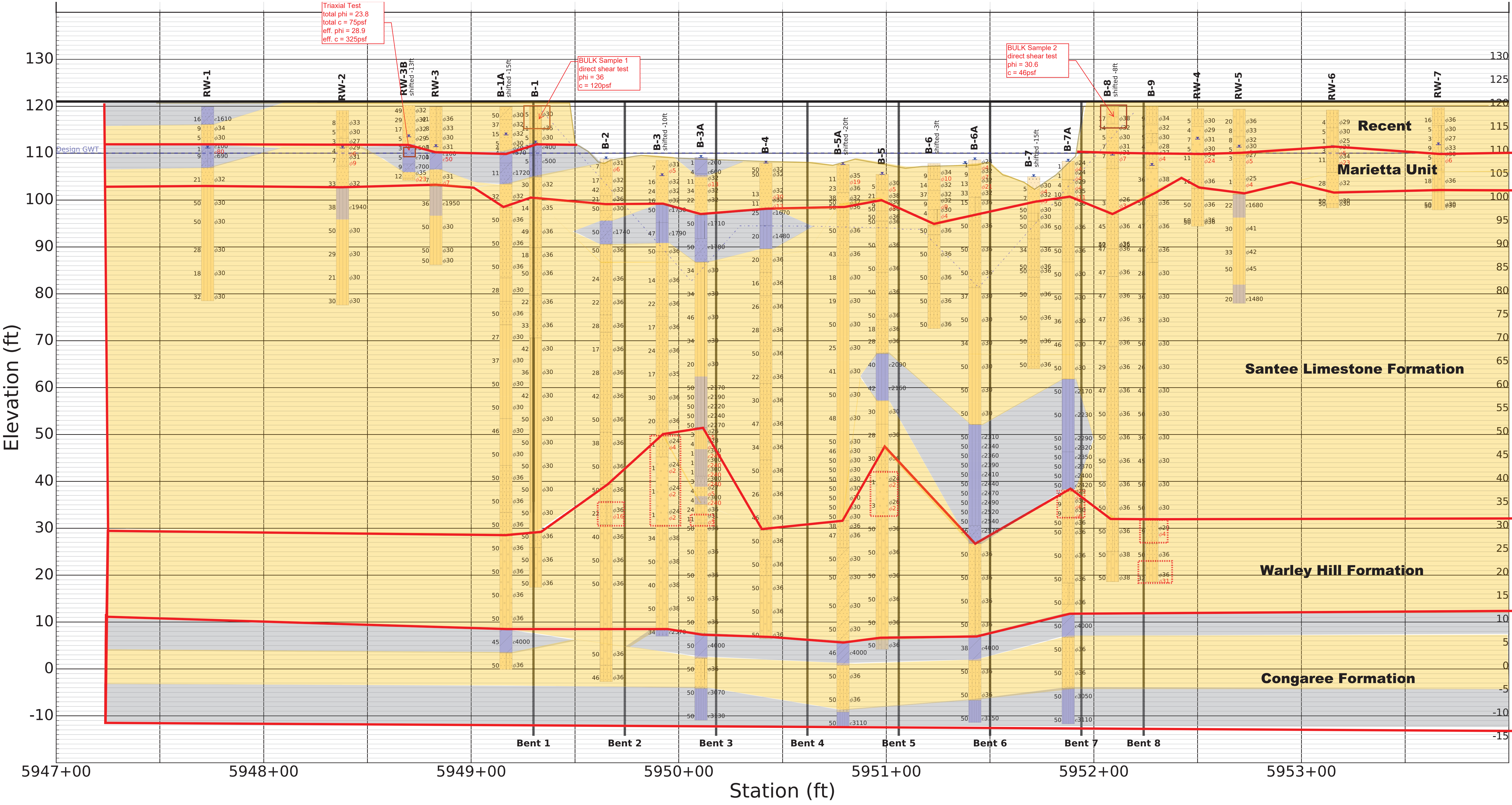
PROJECT NAME: Bridge Replacement Over Four Hole Swamp

PROJECT NUMBER: 0040308 **PROJECT LOCATION:** Orangeburg

■ Asphalt
▩ Fill Material
▥ Silt (ML)
▦ Silty Sand (SM)
⬚ Poorly-graded Sand (SP)
▨ Lean Clay (CL)

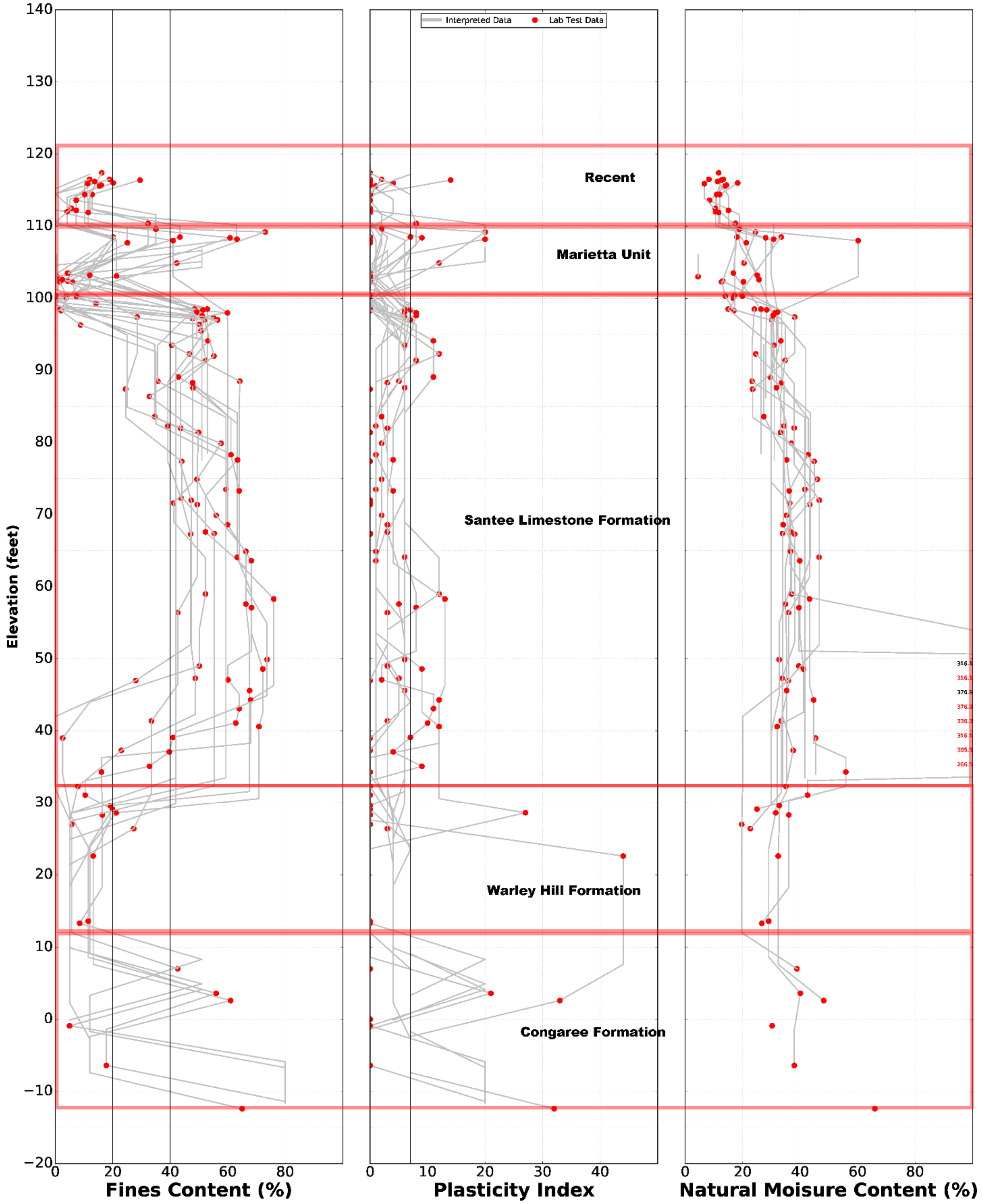


STRATIGRAPHY & GW - A SIZE - PSIHOUSTON.GDT - 1/9/15 11:22 - P:\511-PROJECTS\0-2014\0451 COLUMBIA JOBS\0451644\286-1179 LOGS.GPJ



US 301 RBO Four Hole Swamp Subsurface Profile

2016-03-16
GeoStellar Engineering, LLC



Index Properties – Laboratory Data

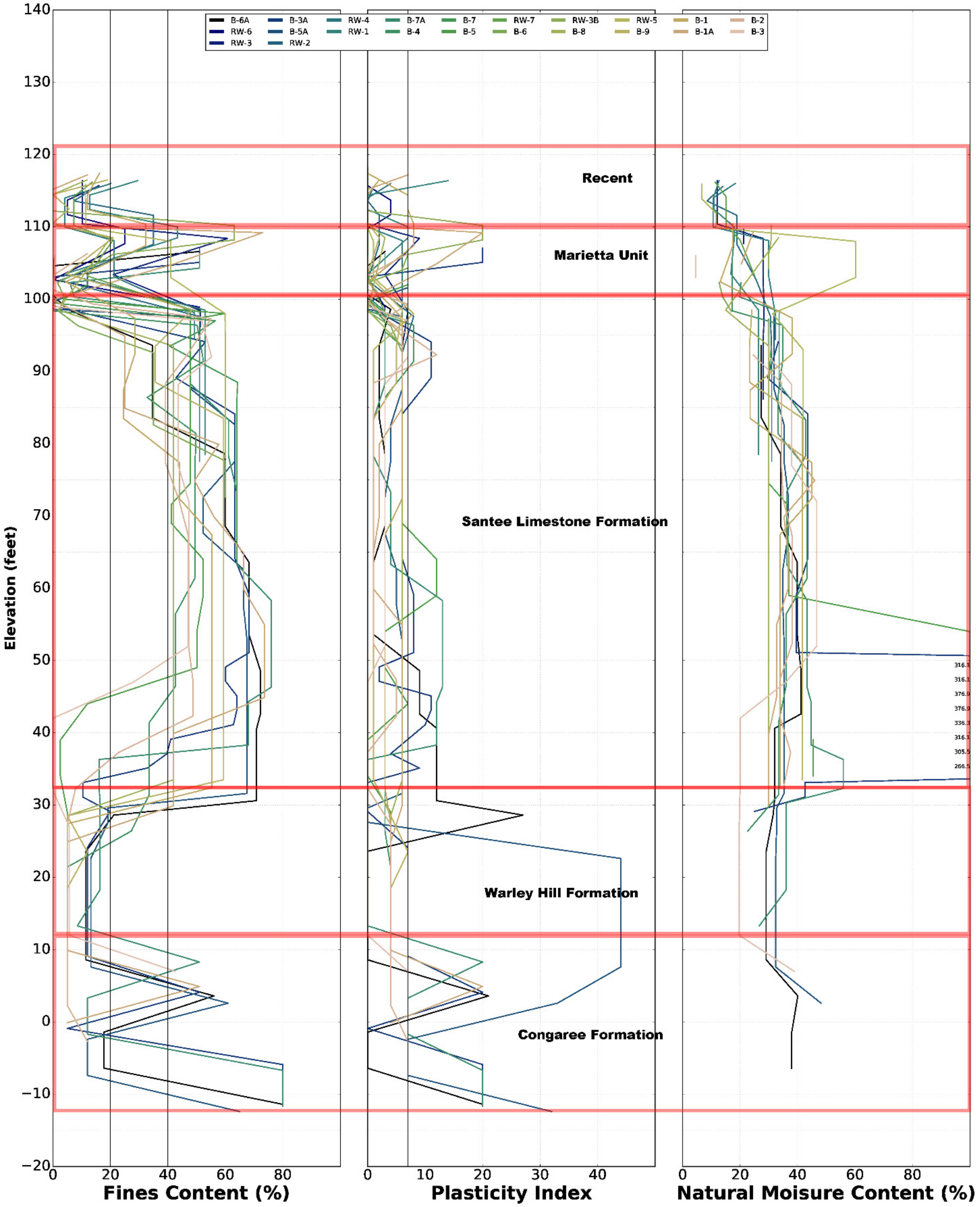
US 301 RBO Four Hole Swamp

Orangeburg County, South Carolina

GeoStellar Engineering, LLC

Figure 4

P:\41503-0002-0001\RBO Four Hole Swamp\Index Properties – Laboratory Data.pptx



Index Properties – Interpretation

US 301 RBO Four Hole Swamp

Orangeburg County, South Carolina

GeoStellar Engineering, LLC

Figure 5

P:\41503-0002-0001\RBO Four Hole Swamp\Index Properties – Laboratory Interpretation.pptx

Appendix V

Soil Strength Parameters

South Carolina
Department of Transportation

PROJECT ID	0040308
DATE	03/16/15
COMPUTED BY	RSG
CHECKED BY	SMS

PROJECT NAME: US 301 RBO Four Hole Swamp

CALCULATION: Soil Strength Parameters

PROBLEM: Determine the proper soil strength parameters to utilize in embankment and foundation design.

PROJECT INFORMATION

Project Type: Bridge Replacement
Existing Alignment: 2-lane paved road of variable shoulder widths
Proposed Alignment: 2-lane paved road of variable shoulder widths
Proposed Bridge Dimensions: 47.25 x 294 feet
Stations: 5941+40 to 5960+00, (Bridge 5949+30.00 to 5952+24.00)
End Bent Pile Type: HP 14x73 steel H-Piles
Interior Bent Pile Type: 48-inch steel pipe piles with 1.5 inch wall thickness
Grades: Bridge grades will be raised approximately 2 feet
End Slopes: 2:1
Side Slopes: Right 4:1, Left 2:1
Added Fill: Not expected to exceed 2.5 feet at the shoulder breaks
Travel ways: 12 feet wide
Medians: NA
Project Features: It is our understanding that the proposed bridge will be constructed on the existing alignment and traffic of the existing bridge will be shifted to share the northbound lanes during construction of the proposed bridge.

GIVEN/ASSUMPTIONS

- Based on soil properties, soil strata layers only have friction angles or cohesion, unless a triaxial test is available and then the c and the phi from this test is used.
- Field-tests conducted are SPT and DMT.
- Field Sampling consisted of split spoon, bulk and UD.
- Lab testing consists of classification series, hydrometer analysis, direct shear, corrosion series, and Standard Proctor.
- Liquefiable soils were determined from SSL_Idriss and Boulanger-07302012 spreadsheet for the SPT's.
- Settlement due to liquefaction was determined from the Idriss and Boulanger spreadsheet.
- SEE: M=7.3, PGA=0.43; FEE: M=7.3, PGA=0.20
- Parameters were limited if necessary by maximum values outlined in the SCDOT GDM.
- Others listed as used.

METHODOLOGY

SPTs

We evaluated Strength Parameters using the SSL_Idriss and Boulanger Spreadsheet (SSL). We derived input for this spreadsheet based on the soil lithology and blow counts presented on the boring logs. In turn, the spreadsheet calculated the liquefiable layers and the strength parameters for both the static and seismic conditions.

CPTs

There were no CPTs performed for this project.

DMTs

DMT's were not used in the determination of soil strength parameters at this site. However, the P_1 values on the DMT logs were compared to soil strength parameters determined with the SSL spreadsheet as a check to ensure agreement.

RESULTS and DISCUSSION

The results of the subsurface investigation indicated that the entire bridge site could be divided into five general geologic layers. The five soil layers consist of Recent Fill Embankment, Marietta Unit, Santee Limestone Formation, Warley Hill Formation and Congaree formation.

SPT CORRECTIONS, SOIL SHEAR STRENGTH, AND SEISMIC HAZARD EVLAUATION

The SPT testing results were first corrected and then correlated to static soil shear strengths. Seismic soil shear strengths were evaluated by first screening for soils susceptible to soil shear strength loss (SSL) and then evaluating if soil SSL could be triggered by the SEE design events. If soil SSL was not triggered by the SEE design event, it was assumed that the FEE design event would also not trigger soil SSL. Seismic soil shear strengths were determined based on correlations with SPT results after evaluating if the soils are subject to cyclic softening, full cyclic liquefaction, or limited cyclic liquefaction.

SPT CORRECTIONS

The SPT penetration field results, N_{Meas}, were corrected for energy losses in order to obtain N_{60} and N^*_{60}. The energy corrected N^*_{60} blow counts were then normalized to a reference overburden pressure of 1 tsf (1atm) to obtain a normalized $N^*_{1,60}$. The SPT N_{60} and $N^*_{1,60}$ were used to evaluate the static soil shear strengths. The energy corrections and overburden corrections used are in accordance with the 2010 SCDOT GDM, Section 7.8.1.1 and Section 13.11.1. The SPT $N^*_{1,60}$ values were also corrected for fines content to equivalent clean sand SPT $N^*_{1,60,CS}$ blow counts that were used to evaluate soil shear strength loss (SSL). The fines content correction used was in accordance with the 2010 SCDOT GDM, Table 13-7.

STATIC SOIL SHEAR STRENGTH

The SPT N_{60} blow counts were used to obtain total soil shear strength (cohesion, c) for cohesive soils and SPT $N^*_{1,60}$ was used to obtain effective shear strength (internal friction angle, ϕ') for cohesionless soils based on correlations obtained from the 2010 SCDOT GDM, Sections 7.10 and 7.11. Effective (drained) soil shear strengths of clay-like soils typically used in long-term drained analyses were computed by observing the soil behavior trends. Laboratory index testing from the subsurface investigations were used to plot fines content (FC), plasticity index (PI) and natural moisture content (NMC) versus elevation. The trends observed were used to interpret subsurface soil behavior for soils that did not have any index testing performed. The interpreted results were then applied to all borings and used to develop a Subsurface Soil Profile of Sand-Like and Clay-Like soils.

An internal angle of friction was assigned for sand-like soils (typically: $FC \leq 20\%$ or $PI < 7$) and a cohesion was assigned for clay-like soils (typically: $FC > 20\%$ and $PI \geq 7$) by using the appropriate SCDOT correlations. The computed shear strength parameters (internal angle of friction or cohesion) were further evaluated and limited to the maximum allowable total and effective soil shear strength in accordance with 2010 SCDOT GDM, Tables 7-15 and 7-16, respectively, unless laboratory shear strength data was available. The majority of the SPT blow counts, $N_{*\ 1,\ 60}$ for cohesionless soils substantially exceeded a corrected blow count of 16.6 blows/foot which corresponds to an effective internal angle of friction, ϕ', of 36^o and consequently may be a lower bound value that has been limited to the maximum allowable internal angle of friction (typically 36^o). The corrected SPT blow counts, N^*_{60}, $N^*_{1,\ 60}$, $N^*_{1,\ 60,\ CS}$ and soil shear strength correlations for SPT soil borings are included in the attachments.

SEISMIC SOIL SHEAR STRENGTH

Siesmic soil shear strength parameters of the subsurface soils were evaluated by first screening the SPT soil borings to determine if the soils encountered are susceptible to soil shear strength loss (SSL). Soils identified as susceptible to soil SSL were then evaluated to determine if the seismic demand (SEE) was capable of triggering soil SSL.

Soil borings were screened for soil SSL susceptibility based on classification of the soils as either No Strength Loss (NSL) or Possible Strength Loss (PSL). PSL soils were further classified as either Sand-Like, NS Clay-Like soils or HS Clay-Like soils. The soil SSL screening for Sand-Like, NS Clay-Like soils and HS Clay-Like soils was based on fines content corrected SPT blow counts, $N^*_{1,60,CS}$, USCS soil classification, and depth to ground water table in accordance with the GDM Subsection 13.6.

Sand-Like, NS Clay-Like and HS Clay-Like soils were then evaluated to determine if the seismic demand (SEE) would trigger soil SSL. Soil SSL triggering was evaluated using seismic design parameters from the ADRS Three-Point Method and the SSL triggering method for level ground sites in accordance with GDM Subsection 13.7. Sand-like soils were assigned liquefaction resistance age correction factors (K_{DR}) based on the Shear Wave Velocity Evaluation. Sand-Like soils that indicate triggering of soil SSL will undergo full or limited cyclic liquefaction and NS/HS Clay-Like soils that indicate triggering of soil SSL will undergo cyclic softening. The SSL screening, triggering, and seismic soil shear strengths for the borings listed below are provided in the attachments.

PROJECT ID	0040308
DATE	03/16/15
COMPUTED BY	RSG
CHECKED BY	SMS

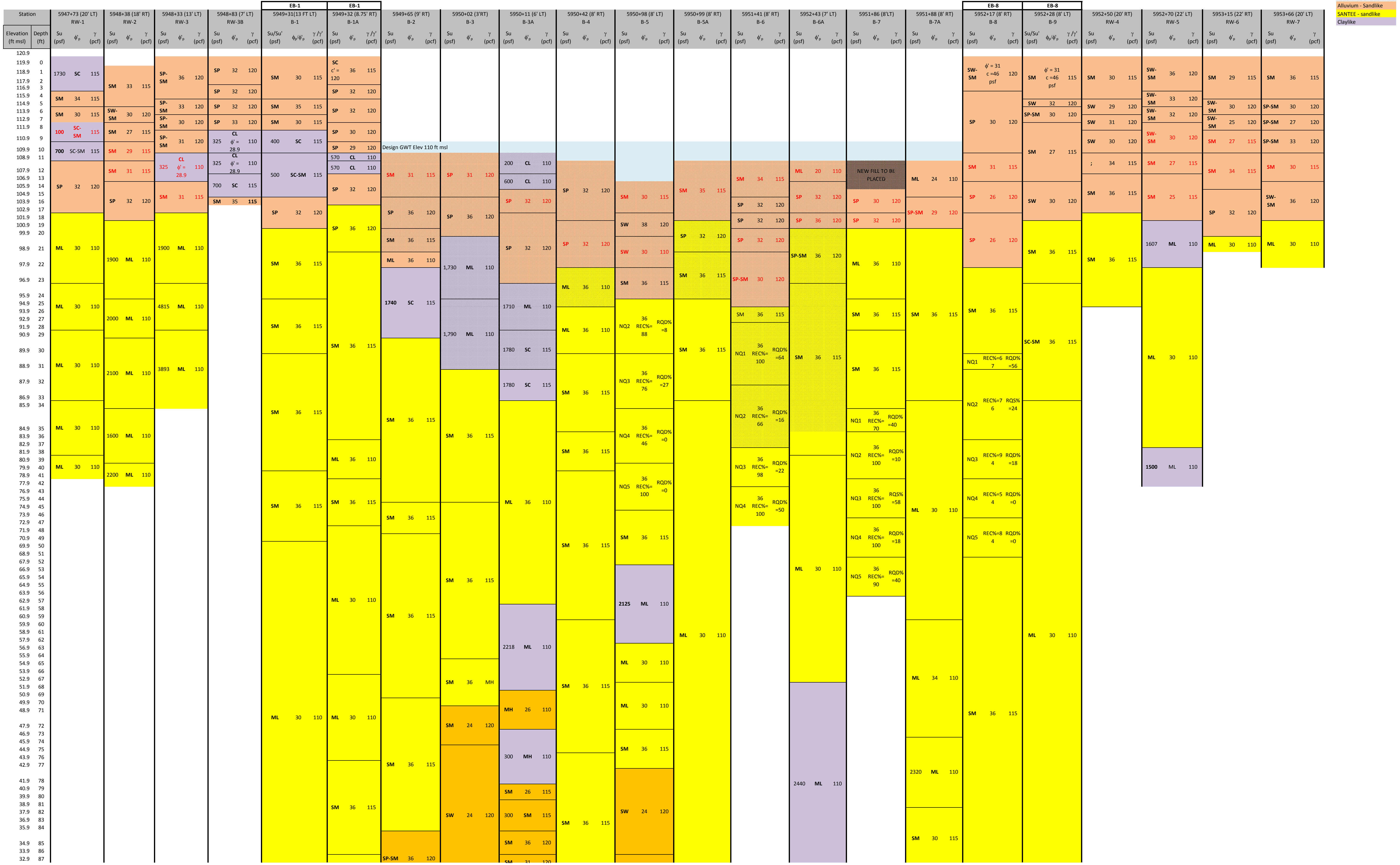
SEISMIC HAZARD EVALUATION

Seismic settlements were evaluated using the procedures outlined by Idriss and Boulanger in the 2008 EERI Monograph MNO-12, “Soil Liquefaction during Earthquakes” and Chapter 13 – “Geotechnical Seismic Hazards” of the 2010 GDM. The results of the seismic settlement evaluation are provided in the attachments.

ATTACHMENTS

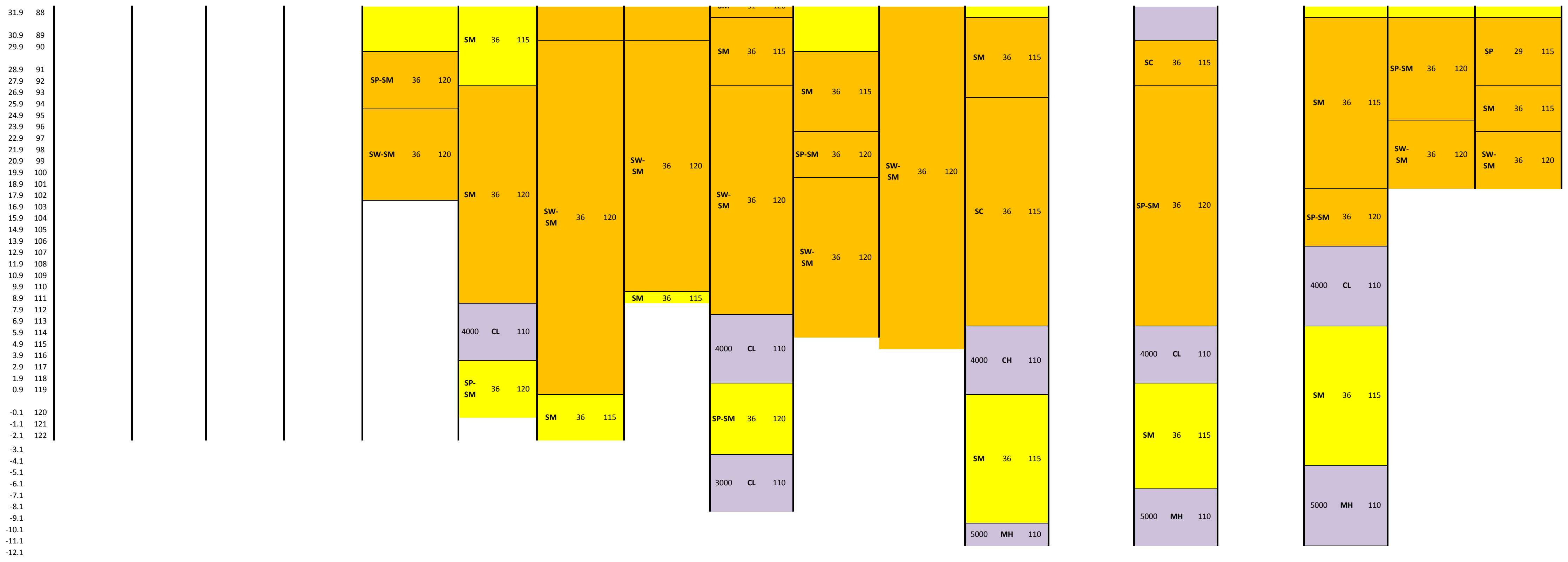
Strength Parameters for Service Limit State and Extreme Event I (SEE)
RW-1_SPT-SSL_Idriss and Boulanger-07302012
RW-2_SPT-SSL_Idriss and Boulanger-07302012
RW-3_SPT-SSL_Idriss and Boulanger-07302012
RW-3B_SPT-SSL_Idriss and Boulanger-07302012
B-1_SPT-SSL_Idriss and Boulanger-07302012
B-1A_SPT-SSL_Idriss and Boulanger-07302012
B-2_SPT-SSL_Idriss and Boulanger-07302012
B-3_SPT-SSL_Idriss and Boulanger-07302012
B-3A_SPT-SSL_Idriss and Boulanger-07302012
B-4_SPT-SSL_Idriss and Boulanger-07302012
B-5_SPT-SSL_Idriss and Boulanger-07302012
B-5A_SPT-SSL_Idriss and Boulanger-07302012
B-6_SPT-SSL_Idriss and Boulanger-07302012
B-6A_SPT-SSL_Idriss and Boulanger-07302012
B-7_SPT-SSL_Idriss and Boulanger-07302012
B-7A_SPT-SSL_Idriss and Boulanger-07302012
B-8_SPT-SSL_Idriss and Boulanger-07302012
B-9_SPT-SSL_Idriss and Boulanger-07302012
RW-4_SPT-SSL_Idriss and Boulanger-07302012
RW-5_SPT-SSL_Idriss and Boulanger-07302012
RW-6_SPT-SSL_Idriss and Boulanger-07302012
RW-7_SPT-SSL_Idriss and Boulanger-07302012

Orangeburg, US 301 Design Soil Parameters SLS



Scour zone
Alluvium - Sandlike
SANTEE - sandlike
Claylike

						EB-1	EB-1											EB-8	EB-8				
Station		5947+73 (20' LT) RW-1	5948+38 (18' RT) RW-2	5948+33 (13' LT) RW-3	5948+83 (7' LT) RW-3B	5949+31(13 FT LT) B-1	5949+32 (8.75' RT) B-1A	5949+65 (9' RT) B-2	5950+02 (3'RT) B-3	5950+11 (6' LT) B-3A	5950+42 (8' RT) B-4	5950+98 (8' LT) B-5	5950+99 (8' RT) B-5A	5951+41 (8' RT) B-6	5952+43 (7' LT) B-6A	5951+86 (8'LT) B-7	5951+88 (8' RT) B-7A	5952+17 (8' RT) B-8	5952+28 (8' LT) B-9	5952+50 (20' RT) RW-4	5952+70 (22' LT) RW-5	5953+15 (22' RT) RW-6	5953+66 (20' LT) RW-7
Elevation (ft msl)	Depth (ft)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)	Su/Su' (psf) ϕ_p/ϕ'_p γ /γ' (pcf)	Su (psf) ϕ'_p γ /γ' (pcf)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)	Su/Su' (psf) ϕ_p/ϕ'_p γ /γ' (pcf)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)	Su (psf) ϕ'_p γ (pcf)
120.9																							
119.9	0																						
118.9	1	1730 SC 115			SP 32 120		SC c' = 120 36 115											SW-SM ϕ' = 31 c =46 psf 120			SW-SM 36 120		
117.9	2			SP-SM 36 120		SM 30 115													SM ϕ' = 31 c =46 psf 115	SM 30 115		SM 29 115	SM 36 115
116.9	3		SM 33 115		SP 32 120		SP 32 120																
115.9	4	SM 34 115																			SW-SM 33 120		
114.9	5			SP-SM 33 120	SP 32 120	SM 35 115													SW 32 120	SW 29 120		SW-SM 30 120	SP-SM 30 120
113.9	6	SM 30 115	SW-SM 30 120				SP 32 120												SP-SM 30 120		SW-SM 32 120		
112.9	7			SP-SM 30 120	SP 33 120	SM 30 115												SP 30 120		SW 31 120		SW-SM 25 120	SP-SM 27 120
111.9	8	100 SC-SM 115	SM 27 115				SP 30 120																
110.9	9			SP-SM 31 120	325 CL ϕ' = 28.9 110	400 SC 115														SW 30 120	SW-SM 30 120	SM 27 115	SP-SM 33 120
109.9	10	700 SC-SM 115	SM 29 115				SP 29 120	Design GWT Elev 110 ft msl											SM 27 115				
108.9	11				325 CL ϕ' = 28.9 110		570 CL 110			200 CL 110										; 34 115	SM 27 115		
107.9	12		SM 31 115	325 CL ϕ' = 28.9 110			570 CL 110								ML 20 110	NEW FILL TO BE PLACED		SM 31 115				SM 34 115	SM 30 115
106.9	13					500 SC-SM 115		SM 31 115	SP 31 120	600 CL 110				SM 34 115			ML 24 110						
105.9	14	SP 32 120			700 SC 115		SP 32 120																
104.9	15			SM 31 115							SP 32 120	SM 30 115	SM 35 115		SP 32 120			SP 26 120		SM 36 115	SM 25 115		
103.9	16		SP 32 120		SM 35 115					SP 32 120				SP 32 120		SP 30 120			SW 30 120				SW-SM 36 120
102.9	17					SP 32 120		SP 36 120									SP-SM 29 120					SP 32 120	
101.9	18								SP 36 120					SP 32 120	SP 36 120	SP 32 120							
100.9	19						SP 36 120					SW 38 120											
99.9	20							SM 36 115					SP 32 120	SP 32 120				SP 26 120					
98.9	21	ML 30 110		1900 ML 110						SP 32 120	SP 32 120	SW 30 110			SP-SM 36 120				SM 36 115		1607 ML 110	ML 30 110	ML 30 110
97.9	22		1900 ML 110			SM 36 115		ML 36 110	1,730 ML 110							ML 36 110				SM 36 115			
96.9	23										ML 36 110	SM 36 115	SM 36 115	SP-SM 30 120									
95.9	24																						
94.9	25	ML 30 110		4815 ML 110				1740 SC 115		1710 ML 110													
93.9	26													SM 36 115		SM 36 115	SM 36 115	SM 36 115					
92.9	27		2000 ML 110																				
91.9	28					SM 36 115					ML 36 110	NQ2 36 REC%= 88 RQD% =8											
90.9	29								1,790 ML 110										SC-SM 36 115				
89.9	30						SM 36 115			1780 SC 115			SM 36 115	NQ1 36 REC%= 100 RQD% =64	SM 36 115						ML 30 110		
88.9	31	ML 30 110	2100 ML 110	3893 ML 110												SM 36 115		NQ1 REC%=67 RQD% =56					
87.9	32									1780 SC 115		NQ3 36 REC%= 76 RQD% =27											
86.9	33										SM 36 115												
85.9	34					SM 36 115								NQ2 36 REC%= 66 RQD% =16				NQ2 REC%=76 RQS% =24					
84.9	35	ML 30 110						SM 36 115								NQ1 36 REC%= 70 RQD% =40							
83.9	36		1600 ML 110						SM 36 115			NQ4 36 REC%= 46 RQD% =0											
82.9	37																						
81.9	38										SM 36 115					NQ2 36 REC%= 100 RQD% =10							
80.9	39						ML 36 110											NQ3 REC%=94 RQD% =18					
79.9	40	ML 30 110												NQ3 36 REC%= 98 RQD% =22							1500 ML 110		
78.9	41		2200 ML 110																				
77.9	42											NQ5 36 REC%= 100 RQD% =0											
76.9	43																						
75.9	44						SM 36 115			ML 36 110						NQ3 36 REC%= 100 RQS% =58		NQ4 REC%=54 RQD% =0					
74.9	45					SM 36 115								NQ4 36 REC%= 100 RQD% =50			ML 30 110						
73.9	46							SM 36 115															
72.9	47																						
71.9	48																						
70.9	49											SM 36 115				NQ4 36 REC%= 100 RQD% =18		NQ5 REC%=84 RQD% =0					
69.9	50										SM 36 115												
68.9	51																						
67.9	52																						
66.9	53														ML 30 110								
65.9	54								SM 36 115							NQ5 36 REC%= 90 RQD% =40							
64.9	55																						
63.9	56																						
62.9	57						ML 30 110					2125 ML 110											
61.9	58																						
60.9	59							SM 36 115															
59.9	60																						
58.9	61												ML 30 110						ML 30 110				
57.9	62																						
56.9	63									2218 ML 110													
55.9	64																						
54.9	65											ML 30 110											
53.9	66																						
52.9	67								SM 36 MH								ML 34 110						
51.9	68										SM 36 115												
50.9	69																						
49.9	70											ML 30 110											
48.9	71					ML 30 110	ML 30 110			MH 26 110								SM 36 115					
47.9	72								SM 24 120														
46.9	73																						
45.9	74																						
44.9	75											SM 36 115											
43.9	76									300 MH 110													
42.9	77							SM 36 115									2320 ML 110						
41.9	78														2440 ML 110								
40.9	79									SM 26 115													
39.9	80																						
38.9	81						SM 36 115																
37.9	82								SW 24 120	300 SM 115		SW 24 120											
36.9	83										SM 36 115												
35.9	84																						
34.9	85									SM 36 120							SM 30 115						
33.9	86																						
32.9	87							SP-SM 36 120		SM 31 120													


31.9 88
30.9 89
29.9 90
28.9 91
27.9 92
26.9 93
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24.9 95
23.9 96
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17.9 102
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15.9 104
14.9 105
13.9 106
12.9 107
11.9 108
10.9 109
9.9 110
8.9 111
7.9 112
6.9 113
5.9 114
4.9 115
3.9 116
2.9 117
1.9 118
0.9 119
-0.1 120
-1.1 121
-2.1 122
-3.1
-4.1
-5.1
-6.1
-7.1
-8.1
-9.1
-10.1
-11.1
-12.1
SP-SM 36 120
SW-SM 36 120
SM 36 115
SM 36 120
4000 CL 110
SP-SM 36 120
SW-SM 36 120
SM 36 115
SW-SM 36 120
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SP-SM 36 120
SW-SM 36 120
SW-SM 36 120
SM 36 115
SC 36 115
4000 CH 110
SM 36 115
5000 MH 110
SC 36 115
SP-SM 36 120
4000 CL 110
SM 36 115
5000 MH 110
SM 36 115
SP-SM 36 120
4000 CL 110
SM 36 115
5000 MH 110
SP-SM 36 120
SW-SM 36 120
SP 29 115
SM 36 115
SW-SM 36 120

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	9/9/2014
Project:	Bridge Replacement over Four Hole Swamp						
Location:	RW-1			**Station:**	5947+73.00	**Finished Embankment Height (ft)^1 =**	0

^{1}Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC = II

ROC = II

Seismic Data:

Site Class =	D					
Design Earthquake:	SEE	FEE				
S_{D1} =	0.490	0.180	g			
k_{max} = PGA =	0.430	0.200	g			
$\beta = S_{D1}/PGA$ =	1.140	0.900		β = Ground Motion Index:		$0.50 \leq \beta \leq 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:		$1+0.01h_{slope}[(0.5\beta)-1] \leq 1.0$: for $h_{slope} \leq 20ft$ $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:		$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake		M_w & R = Deaggregation Analysis
R =	63.3	64.1	km	R = Site-to-Source Distance		
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity		$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output		
ε =	0.000	0.000		ε = Near-fault directivity correction:		$R < 20$ km; $\varepsilon = 0.015(R-20)$
D_{a5-95}	30.12	30.07	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration:	Use Eq. 12-48	$R \geq 20$ km; $\varepsilon = 0$

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	Bridge Replacement over Four Hole Swamp			**Longitude:**	80.6470	**Date:**	9/9/2014
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	RW-1	**Station:**	5947+73.00

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.4
R (km) = 63.3
D_{a5-95} (sec) = 30.12

Boring Number = RW-1
Boring Station = 5947+73.00
Boring Offset = 20' Lt
Ground Elevation at Boring (ft msl) = 119.9
Water Table Depth (Dw) (ft) = 8.8
Water Table Elevation (msl ft) = 111.1

Hammer Type = Automatic
Energy Ratio = 79.0
Energy Correction (C_E) = 1.32
Borehole Diameter (in) = 4
Borehole Correction (CB) = 1.00

No. of Soil Layers = 5 each
No. of Split Spoon Samples = 11 each
Total Profile Thickness = 41.4 feet

Sampler Configuration:
Liner Required = N
Liner Used = N

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	119.9													
1	3.5	116.4	24.9	SM/SC/SC-SM	PSL	NS Clay-Like	0.07	0.90	No Strength Loss			1729.50			
2	5.5	114.4	14.6	SM/SC/SC-SM	NSL-S				No Liquefaction		33.7				
3	7.5	112.4	9.0	SM/SC/SC-SM	NSL-S				No Liquefaction		30.0				
4	9.9	110.0	7.0	SM/SC/SC-SM	PSL	NS Clay-Like	3.73	0.90	Strength Loss			80.00			
5	11.4	108.5	16.2	SM/SC/SC-SM	PSL	NS Clay-Like	0.60	0.90	No Strength Loss			700.00			
6	16.4	103.5	23.0	SP/SW	NSL-S				No Liquefaction		32.0				
7	21.4	98.5	46.0	ML	NSL-S				No Liquefaction		30.0				
8	25.4	94.5	46.0	ML	NSL-S				No Liquefaction		30.0				
9	31.4	88.5	32.7	ML	NSL-S				No Liquefaction		30.0				
10	36.4	83.5	23.8	ML	NSL-S				No Liquefaction		30.0				
11	41.4	78.5	36.9	ML	NSL-S				No Liquefaction		30.0				

0.00	0.00
LDI Total (feet)	**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.:	**40308**	**File No.:**	**38.040308**	**Latitude:**	**33.4570**	**Designer:**	**R. Gardner - Midlands RPG**
Project:	**Bridge Replacement over Four Hole Swamp**			**Longitude:**	**80.6470**	**Date:**	**9/9/2014**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**	**RW-1**	**Station:**	**5947+73.00**

Boring Number = **RW-1**
Boring Station = **5947+73.00**
Boring Offset = **20' Lt**
Ground Elevation at Boring (ft msl) = **119.9**
Water Table Depth (Dw) (ft) = **8.8**
Water Table Elevation (msl ft) = **111.1**

Design EQ = **SEE**
Site Class = **D**
PGA (g) = **0.43**
M_W = **7.37**
R (km) = **63.3**
D_{a5-95} (sec) = **30.12**

No. of Soil Layers = **5** **each**
No. of Split Spoon Samples = **11** **each**
Total Profile Thickness = **41** **feet**

SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**N_{Meas}**	**C_E**	**C_B**	**C_R**	**C_S**	**σ'_{vo} (psf)**	**C_N**	**Fines Content (FC)**	**$\Delta N^*_{1,60}$**	**N^*_{60}**	**$N^*_{1,60}$**	**$N^*_{1,60,CS}$**	**Soil Layer No.**	**Soil Type (USCS)**
	0	119.9														
1	3.5	116.4	12.0	1.32	1.00	0.73	1.00	402.5	1.70	29.5	5.3	11.5	19.6	24.9	1	SM/SC/SC-SM
2	5.5	114.4	7.0	1.32	1.00	0.78	1.00	632.5	1.70	12.8	2.4	7.2	12.2	14.6	2	SM/SC/SC-SM
3	7.5	112.4	4.0	1.32	1.00	0.82	1.00	862.5	1.52	12.8	2.4	4.3	6.5	9.0	2	SM/SC/SC-SM
4	9.9	110.0	1.0	1.32	1.00	0.86	1.00	1,069.9	1.37	43.4	5.5	1.1	1.5	7.0	3	SM/SC/SC-SM
5	11.4	108.5	7.0	1.32	1.00	0.88	1.00	1,140.8	1.32	43.4	5.5	8.1	10.7	16.2	3	SM/SC/SC-SM
6	16.4	103.5	16.0	1.32	1.00	0.93	1.00	1,434.8	1.18	4.3	0.0	19.5	23.0	23.0	4	SP/SW
7	21.4	98.5	50.0	1.32	1.00	0.96	1.00	1,672.8	1.00	52.9	5.5	63.0	63.0	46.0	5	ML
8	25.4	94.5	50.0	1.32	1.00	0.97	1.00	1,863.2	1.00	52.9	5.5	64.0	64.0	46.0	5	ML
9	31.4	88.5	21.0	1.32	1.00	0.99	1.00	2,148.8	1.00	52.9	5.5	27.2	27.2	32.7	5	ML
10	36.4	83.5	14.0	1.32	1.00	0.99	1.00	2,386.8	1.00	52.9	5.5	18.3	18.3	23.8	5	ML
11	41.4	78.5	24.0	1.32	1.00	1.00	1.00	2,624.8	1.00	52.9	5.5	31.4	31.4	36.9	5	ML

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = RW-1
Boring Station = 5947+73.00
Boring Offset = 20' Lt
Ground Elevation at Boring (ft msl) = 119.9
Water Table Depth (Dw) (ft) = 8.8
Water Table Elevation (msl ft) = 111.1

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.3
D_{a5-95} (sec) = 30.12

No. of Soil Layers = 5 each
No. of Split Spoon Samples = 11 each
Total Profile Thickness = 41 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	119.9																	
1	3.5	116.4	12.0	11.5	19.6	24.9	1	SM/SC/SC-SM	NS Clay-Like	No Strength Loss		29.5					1730		1730
2	5.5	114.4	7.0	7.2	12.2	14.6	2	SM/SC/SC-SM		No Liquefaction		12.8				34		34	
3	7.5	112.4	4.0	4.3	6.5	9.0	2	SM/SC/SC-SM		No Liquefaction		12.8				30		30	
4	9.9	110.0	1.0	1.1	1.5	7.0	3	SM/SC/SC-SM	NS Clay-Like	Strength Loss		43.4					100		80
5	11.4	108.5	7.0	8.1	10.7	16.2	3	SM/SC/SC-SM	NS Clay-Like	No Strength Loss		43.4					700		700
6	16.4	103.5	16.0	19.5	23.0	23.0	4	SP/SW		No Liquefaction		4.3				32		32	
7	21.4	98.5	50.0	63.0	63.0	46.0	5	ML		No Liquefaction		52.9				30		30	
8	25.4	94.5	50.0	64.0	64.0	46.0	5	ML		No Liquefaction		52.9				30		30	
9	31.4	88.5	21.0	27.2	27.2	32.7	5	ML		No Liquefaction		52.9				30		30	
10	36.4	83.5	14.0	18.3	18.3	23.8	5	ML		No Liquefaction		52.9				30		30	
11	41.4	78.5	24.0	31.4	31.4	36.9	5	ML		No Liquefaction		52.9				30		30	

^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	10/8/2014
Project:	Bridge Replacement over Four Hole Swamp						
Location:	RW-2			**Station:**	5948+38.00	**Finished Embankment Height (ft)[1] =**	0

[1] Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D					
Design Earthquake:	**SEE**	**FEE**				
S_{D1} =	0.490	0.180	g			
k_{max} = PGA =	0.430	0.200	g			
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index:		0.50 ≤ β ≤ 1.5
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:		$1+0.01h_{slope}[(0.5\beta)-1]\leq1.0$: for $h_{slope}\leq20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:		$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake		M_w & R = Deaggregation Analysis
R =	63.3	64.1	km	R = Site-to-Source Distance		
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity		$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output		
ε =	0.000	0.000		ε = Near-fault directivity correction:		R < 20 km; ε = 0.015(R-20)
D_{a5-95}	30.12	30.07	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration:	Use Eq. 12-48	R ≥ 20 km; ε = 0

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	Bridge Replacement over Four Hole Swamp			**Longitude:**	80.6470	**Date:**	10/8/2014
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	RW-2	**Station:**	5948+38.00

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.4
R (km) = 63.3
$D_{a5\text{-}95}$ (sec) = 30.12

Boring Number = RW-2
Boring Station = 5948+38.00
Boring Offset = 18' Rt
Ground Elevation at Boring (ft msl) = 119.1
Water Table Depth (Dw) (ft) = 8.0
Water Table Elevation (msl ft) = 111.1

Hammer Type = Automatic
Energy Ratio = 79.0
Energy Correction (C_E) = 1.32
Borehole Diameter (in) = 4
Borehole Correction (CB) = 1.00

No. of Soil Layers = 6 each
No. of Split Spoon Samples = 11 each
Total Profile Thickness = 41.5 feet

Sampler Configuration:
Liner Required = N
Liner Used = N

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Seismic Analysis Summary		Geotechnical Seismic Hazards Summary		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	119.1													
1	3.5	115.6	13.2	SM/SC/SC-SM	NSL-S				No Liquefaction		33.0				
2	5.5	113.6	7.1	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		30.0				
3	7.5	111.6	5.3	SM/SC/SC-SM	NSL-S				No Liquefaction		27.0				
4	9.5	109.6	10.2	SM/SC/SC-SM	SSL	Sand-Like	1.44	0.90	Full Liquefaction	0.7 - 1.0	5.8		0.92	0.92	0.88
5	11.5	107.6	13.2	SM/SC/SC-SM	SSL	Sand-Like	1.32	0.90	Full Liquefaction	0.7 - 1.0	8.7		0.66	1.59	0.75
6	16.5	102.6	36.5	SP/SW	NSL-S				No Liquefaction		32.0				
7	21.5	97.6	42.1	ML	PSL	NS Clay-Like	0.40	0.90	No Strength Loss			1900.00			
8	26.5	92.6	46.0	ML	PSL	NS Clay-Like	0.47	0.90	No Strength Loss			2000.00			
9	31.5	87.6	34.1	ML	PSL	NS Clay-Like	0.53	0.90	No Strength Loss			2100.00			
10	36.5	82.6	26.4	ML	PSL	NS Clay-Like	0.80	0.90	No Strength Loss			1600.00			
11	41.5	77.6	35.6	ML	PSL	NS Clay-Like	0.66	0.90	No Strength Loss			2200.00			

1.59
LDI Total (feet)

1.64
S Total (inches)

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^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.: 40308
File No.: 38.040308
Latitude: 33.4570
Designer: R. Gardner - Midlands RPG
Project: Bridge Replacement over Four Hole Swamp
Longitude: 80.6470
Date: 10/8/2014
Route: US 301
County: 38 - Orangeburg
Location: RW-2
Station: 5948+38.00

Boring Number = RW-2
Boring Station = 5948+38.00
Boring Offset = 18' Rt
Ground Elevation at Boring (ft msl) = 119.1
Water Table Depth (Dw) (ft) = 8
Water Table Elevation (msl ft) = 111.1

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.3
D_{a5-95} (sec) = 30.12

No. of Soil Layers = 6 each
No. of Split Spoon Samples = 11 each
Total Profile Thickness = 42 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.1														
1	3.5	115.6	6.0	1.32	1.00	0.73	1.00	400.0	1.70	15.4	3.4	5.8	9.8	13.2	1	SM/SC/SC-SM
2	5.5	113.6	4.0	1.32	1.00	0.78	1.00	642.5	1.70	7.3	0.2	4.1	7.0	7.1	2	SW-SM/SW-SC/SP-SM/SP-SC
3	7.5	111.6	2.0	1.32	1.00	0.82	1.00	872.5	1.51	12.0	2.1	2.1	3.3	5.3	3	SM/SC/SC-SM
4	9.5	109.6	3.0	1.32	1.00	0.85	1.00	1,008.9	1.41	35.0	5.5	3.4	4.7	10.2	4	SM/SC/SC-SM
5	11.5	107.6	5.0	1.32	1.00	0.88	1.00	1,111.6	1.34	35.0	5.5	5.8	7.7	13.2	4	SM/SC/SC-SM
6	16.5	102.6	25.0	1.32	1.00	0.93	1.00	1,399.6	1.20	2.5	0.0	30.5	36.5	36.5	5	SP/SW
7	21.5	97.6	29.0	1.32	1.00	0.96	1.00	1,637.6	1.00	51.1	5.5	36.6	36.6	42.1	6	ML
8	26.5	92.6	50.0	1.32	1.00	0.98	1.00	1,875.6	1.00	51.1	5.5	64.2	64.2	46.0	6	ML
9	31.5	87.6	22.0	1.32	1.00	0.99	1.00	2,113.6	1.00	51.1	5.5	28.6	28.6	34.1	6	ML
10	36.5	82.6	16.0	1.32	1.00	0.99	1.00	2,351.6	1.00	51.1	5.5	20.9	20.9	26.4	6	ML
11	41.5	77.6	23.0	1.32	1.00	1.00	1.00	2,589.6	1.00	51.1	5.5	30.1	30.1	35.6	6	ML

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = RW-2
Boring Station = 5948+38.00
Boring Offset = 18' Rt
Ground Elevation at Boring (ft msl) = 119.1
Water Table Depth (Dw) (ft) = 8
Water Table Elevation (msl ft) = 111.1

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.3
$D_{a5\text{-}95}$ (sec) = 30.12

No. of Soil Layers = 6 each
No. of Split Spoon Samples = 11 each
Total Profile Thickness = 42 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \le \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	119.1																	
1	3.5	115.6	6.0	5.8	9.8	13.2	1	SM/SC/SC-SM		No Liquefaction		15.4				33		33	
2	5.5	113.6	4.0	4.1	7.0	7.1	2	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		7.3				30		30	
3	7.5	111.6	2.0	2.1	3.3	5.3	3	SM/SC/SC-SM		No Liquefaction		12.0				27		27	
4	9.5	109.6	3.0	3.4	4.7	10.2	4	SM/SC/SC-SM	Sand-Like	Full Liquefaction	27.0	35.0				29		6	
5	11.5	107.6	5.0	5.8	7.7	13.2	4	SM/SC/SC-SM	Sand-Like	Full Liquefaction	35.4	35.0				31		9	
6	16.5	102.6	25.0	30.5	36.5	36.5	5	SP/SW		No Liquefaction		2.5				32		32	
7	21.5	97.6	29.0	36.6	36.6	42.1	6	ML	NS Clay-Like	No Strength Loss		51.1					1900		1900
8	26.5	92.6	50.0	64.2	64.2	46.0	6	ML	NS Clay-Like	No Strength Loss		51.1					2000		2000
9	31.5	87.6	22.0	28.6	28.6	34.1	6	ML	NS Clay-Like	No Strength Loss		51.1					2100		2100
10	36.5	82.6	16.0	20.9	20.9	26.4	6	ML	NS Clay-Like	No Strength Loss		51.1					1600		1600
11	41.5	77.6	23.0	30.1	30.1	35.6	6	ML	NS Clay-Like	No Strength Loss		51.1					2200		2200

^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	10/8/2014
Project:	Bridge Replacement over Four Hole Swamp						
Location:	RW-3			**Station:**	5948+83.00	**Finished Embankment Height (ft)[1] =**	0

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D					
Design Earthquake:	SEE	FEE				
S_{D1} =	0.490	0.180	g			
k_{max} = PGA =	0.430	0.200	g			
$\beta = S_{D1}$/PGA =	1.140	0.900		β = Ground Motion Index:		$0.50 \leq \beta \leq 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:		$1+0.01h_{slope}[(0.5\beta)-1]\leq1.0$: for $h_{slope}\leq20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:		$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake		M_w & R = Deaggregation Analysis
R =	63.3	64.1	km	R = Site-to-Source Distance		
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity		$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output		
ε =	0.000	0.000		ε = Near-fault directivity correction:		R < 20 km; ε = 0.015(R-20)
D_{a5-95}	30.12	30.07	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration:	Use Eq. 12-48	R ≥ 20 km; ε = 0

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	Bridge Replacement over Four Hole Swamp			**Longitude:**	80.6470	**Date:**	10/8/2014
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	RW-3	**Station:**	5948+83.00

Design EQ = SEE

Site Class = D

PGA (g) = 0.43

M_W = 7.4

R (km) = 63.3

D_{a5-95} (sec) = 30.12

Boring Number = RW-3

Boring Station = 5948+83.00

Boring Offset = 19' Lt

Ground Elevation at Boring (ft msl) = 119.9

Water Table Depth (Dw) (ft) = 9.9

Water Table Elevation (msl ft) = 110.0

Hammer Type = Automatic

Energy Ratio = 79.0

Energy Correction (C_E) = 1.32

Borehole Diameter (in) = 4

Borehole Correction (CB) = 1.00

No. of Soil Layers = 4 each

No. of Split Spoon Samples = 10 each

Total Profile Thickness = 33.7 feet

Sampler Configuration:

Liner Required = N

Liner Used = N

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Seismic Analysis Summary		Geotechnical Seismic Hazards Summary		
SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	$N^*_{1,60,CS}$	Soil Type (USCS)	SSL Potential	Sand-like or Clay-like	$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}	φ_{SL}	(D/C)SL ≤ φSL	R_u	φ' (degrees)	τ (psf)	ΔLDI_i (feet)	$\sum \Delta LDI_i$ (feet)	ΔS_i (inches)
	0	119.9													
1	3.5	116.4	46.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
2	5.5	114.4	11.7	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		33.0				
3	7.5	112.4	7.7	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		30.0				
4	9.5	110.4	8.7	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		31.0				
5	11.5	108.4	6.7	CL	PSL	HS Clay-Like	4.46	0.90	Strength Loss			50.00			
6	16.5	103.4	9.1	SM/SC/SC-SM	SSL	Sand-Like	1.80	0.90	Full Liquefaction	0.7 - 1.0	5.1		2.50	2.50	2.37
7	21.5	98.4	39.5	ML	PSL	NS Clay-Like	0.41	0.90	No Strength Loss			1900.00			
8	26.5	93.4	46.0	ML	PSL	NS Clay-Like	0.20	0.90	No Strength Loss			4815.12			
9	31.5	88.4	46.0	ML	PSL	NS Clay-Like	0.30	0.90	No Strength Loss			3893.22			
10	33.7	86.2	46.0	ML	PSL	NS Clay-Like	0.25	0.90	No Strength Loss			4881.69			
													2.50		**2.37**
													LDI Total (feet)		**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.: 40308 **File No.:** 38.040308 **Latitude:** 33.4570 **Designer:** R. Gardner - Midlands RPG
Project: Bridge Replacement over Four Hole Swamp **Longitude:** 80.6470 **Date:** 10/8/2014
Route: US 301 **County:** 38 - Orangeburg **Location:** RW-3 **Station:** 5948+83.00

Boring Number = RW-3
Boring Station = 5948+83.00
Boring Offset = 19' Lt
Ground Elevation at Boring (ft msl) = 119.9
Water Table Depth (Dw) (ft) = 9.9
Water Table Elevation (msl ft) = 110

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.3
$D_{a5\text{-}95}$ (sec) = 30.12

No. of Soil Layers = 4 **each**
No. of Split Spoon Samples = 10 **each**
Total Profile Thickness = 34 **feet**

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.9														
1	3.5	116.4	31.0	1.32	1.00	0.73	1.00	420.0	1.70	5.0	0.0	29.8	50.6	46.0	1	SW-SM/SW-SC/SP-SM/SP-SC
2	5.5	114.4	6.0	1.32	1.00	0.78	1.00	660.0	1.70	10.3	1.3	6.1	10.4	11.7	1	SW-SM/SW-SC/SP-SM/SP-SC
3	7.5	112.4	4.0	1.32	1.00	0.82	1.00	900.0	1.49	10.3	1.3	4.3	6.4	7.7	1	SW-SM/SW-SC/SP-SM/SP-SC
4	9.5	110.4	5.0	1.32	1.00	0.85	1.00	1,143.0	1.32	10.3	1.3	5.6	7.4	8.7	1	SW-SM/SW-SC/SP-SM/SP-SC
5	11.5	108.4	1.0	1.32	1.00	0.88	1.00	1,254.2	1.00	60.8	5.5	1.2	1.2	6.7	2	CL
6	16.5	103.4	5.0	1.32	1.00	0.93	1.00	1,519.7	1.15	12.0	2.1	6.1	7.0	9.1	3	SM/SC/SC-SM
7	21.5	98.4	27.0	1.32	1.00	0.96	1.00	1,757.7	1.00	51.4	5.5	34.0	34.0	39.5	4	ML
8	26.5	93.4	50.0	1.32	1.00	0.98	1.00	1,995.7	1.00	51.4	5.5	64.2	64.2	46.0	4	ML
9	31.5	88.4	40.0	1.32	1.00	0.99	1.00	2,233.7	1.00	51.4	5.5	51.9	51.9	46.0	4	ML
10	33.7	86.2	50.0	1.32	1.00	0.99	1.00	2,338.4	1.00	51.4	5.5	65.1	65.1	46.0	4	ML

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = RW-3
Boring Station = 5948+83.00
Boring Offset = 19' Lt
Ground Elevation at Boring (ft msl) = 119.9
Water Table Depth (Dw) (ft) = 9.9
Water Table Elevation (msl ft) = 110

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.3
D_{a5-95} (sec) = 30.12

No. of Soil Layers = 4 each
No. of Split Spoon Samples = 10 each
Total Profile Thickness = 34 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \le \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	119.9																	
1	3.5	116.4	31.0	29.8	50.6	46.0	1	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
2	5.5	114.4	6.0	6.1	10.4	11.7	1	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		10.3				33		33	
3	7.5	112.4	4.0	4.3	6.4	7.7	1	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		10.3				30		30	
4	9.5	110.4	5.0	5.6	7.4	8.7	1	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		10.3				31		31	
5	11.5	108.4	1.0	1.2	1.2	6.7	2	CL	HS Clay-Like	Strength Loss		60.8					100		50
6	16.5	103.4	5.0	6.1	7.0	9.1	3	SM/SC/SC-SM	Sand-Like	Full Liquefaction	36.4	12.0				31		5	
7	21.5	98.4	27.0	34.0	34.0	39.5	4	ML	NS Clay-Like	No Strength Loss		51.4					1900		1900
8	26.5	93.4	50.0	64.2	64.2	46.0	4	ML	NS Clay-Like	No Strength Loss		51.4				30	4815		4815
9	31.5	88.4	40.0	51.9	51.9	46.0	4	ML	NS Clay-Like	No Strength Loss		51.4				30	3893		3893
10	33.7	86.2	50.0	65.1	65.1	46.0	4	ML	NS Clay-Like	No Strength Loss		51.4				30	4882		4882

[D] Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	2/25/2015
Project:	Bridge Replacement over Four Hole Swamp						
Location:				**Station:**	5948+82.94	**Finished Embankment Height (ft)[1] =**	0

[1] Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D				
Design Earthquake:	SEE	FEE			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index:	0.50 ≤ β ≤ 1.5
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1]\leq 1.0$: for $h_{slope}\leq 20ft$ $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.3	64.1	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; ε = 0.015(R-20)
D_{a5-95}	30.12	30.07	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; ε = 0

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	Bridge Replacement over Four Hole Swamp			**Longitude:**	80.6470	**Date:**	2/25/2015
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	0	**Station:**	5948+82.94

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.4
R (km) = 63.3
D_{a5-95} (sec) = 30.12

Boring Number = RW-B
Boring Station = 5948+82.94
Boring Offset = 7' Lt
Ground Elevation at Boring (ft msl) = 120.2
Water Table Depth (Dw) (ft) = 6.7
Water Table Elevation (msl ft) = 113.5

Hammer Type = Safety
Energy Ratio = 91.3
Energy Correction (C_E) = 1.52
Borehole Diameter (in) = 4
Borehole Correction (CB) = 1.00

No. of Soil Layers = 4 each
No. of Split Spoon Samples = 8 each
Total Profile Thickness = 16 feet

Sampler Configuration:
Liner Required = N
Liner Used = N

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Seismic Analysis Summary		Geotechnical Seismic Hazards Summary		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	120.2													
1	2	118.2	46.0	SP/SW	NSL-S				No Liquefaction		32.0				
2	4	116.2	36.5	SP/SW	NSL-S				No Liquefaction		32.0				
3	6	114.2	22.0	SP/SW	NSL-S				No Liquefaction		32.0				
4	8	112.2	11.3	SP/SW	NSL-S				No Liquefaction		33.2				
5	10	110.2	8.1	CL	PSL	HS Clay-Like	0.77	0.90	No Strength Loss			500.00			
6	12	108.2	9.5	CL	PSL	HS Clay-Like	0.65	0.90	No Strength Loss			700.00			
7	14	106.2	12.8	SM/SC/SC-SM	NSL-C				No Strength Loss			700.00			
8	16	104.2	16.1	SM/SC/SC-SM	NSL-S				No Liquefaction		34.7				
													0.00		**0.00**
													LDI Total (feet)		**S Total (inches)**

[D] Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.: 40308
File No.: 38.040308
Latitude: 33.4570
Designer: R. Gardner - Midlands RPG
Project: Bridge Replacement over Four Hole Swamp
Longitude: 80.6470
Date: 2/25/2015
Route: US 301
County: 38 - Orangeburg
Location: 0
Station: 5948+82.94

Boring Number = RW-B
Boring Station = 5948+82.94
Boring Offset = 7' Lt
Ground Elevation at Boring (ft msl) = 120.2
Water Table Depth (Dw) (ft) = 6.7
Water Table Elevation (msl ft) = 113.5

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.3
D_{a5-95} (sec) = 30.12

No. of Soil Layers = 4 each
No. of Split Spoon Samples = 8 each
Total Profile Thickness = 16 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	120.2														
1	2	118.2	32.0	1.52	1.00	0.69	1.00	240.0	1.70	0.0	0.0	33.6	57.1	46.0	1	SP/SW
2	4	116.2	19.0	1.52	1.00	0.74	1.00	480.0	1.70	0.0	0.0	21.5	36.5	36.5	1	SP/SW
3	6	114.2	11.0	1.52	1.00	0.79	1.00	720.0	1.67	0.0	0.0	13.2	22.0	22.0	1	SP/SW
4	8	112.2	6.0	1.52	1.00	0.83	1.00	887.9	1.50	0.0	0.0	7.5	11.3	11.3	1	SP/SW
5	10	110.2	2.0	1.52	1.00	0.86	1.00	983.1	1.00	63.1	5.5	2.6	2.6	8.1	2	CL
6	12	108.2	3.0	1.52	1.00	0.88	1.00	1,075.8	1.00	63.1	5.5	4.0	4.0	9.5	2	CL
7	14	106.2	6.0	1.52	1.00	0.91	1.00	1,181.0	1.30	12.0	2.1	8.3	10.8	12.8	3	SM/SC/SC-SM
8	16	104.2	8.0	1.52	1.00	0.92	1.00	1,286.2	1.25	12.0	2.1	11.2	14.0	16.1	4	SM/SC/SC-SM

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = RW-B
Boring Station = 5948+82.94
Boring Offset = 7' Lt
Ground Elevation at Boring (ft msl) = 120.2
Water Table Depth (Dw) (ft) = 6.7
Water Table Elevation (msl ft) = 113.5

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.3
D_{a5-95} (sec) = 30.12

No. of Soil Layers = 4 each
No. of Split Spoon Samples = 8 each
Total Profile Thickness = 16 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \le \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	120.2																	
1	2	118.2	32.0	33.6	57.1	46.0	1	SP/SW		No Liquefaction		0.0				32		32	
2	4	116.2	19.0	21.5	36.5	36.5	1	SP/SW		No Liquefaction		0.0				32		32	
3	6	114.2	11.0	13.2	22.0	22.0	1	SP/SW		No Liquefaction		0.0				32		32	
4	8	112.2	6.0	7.5	11.3	11.3	1	SP/SW		No Liquefaction		0.0				33		33	
5	10	110.2	2.0	2.6	2.6	8.1	2	CL	HS Clay-Like	No Strength Loss		63.1	0.001	42.3	0.3		500		500
6	12	108.2	3.0	4.0	4.0	9.5	2	CL	HS Clay-Like	No Strength Loss		63.1					700		700
7	14	106.2	6.0	8.3	10.8	12.8	3	SM/SC/SC-SM		No Strength Loss		12.0					700		700
8	16	104.2	8.0	11.2	14.0	16.1	4	SM/SC/SC-SM		No Liquefaction		12.0				35		35	

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^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	9/23/2014
Project:	RBO Four Hole Swamp						
Location:	EB1 B-1			**Station:**	5949+31	**Finished Embankment Height (ft)[1] =**	0

[1] Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D					
Design Earthquake:	SEE	FEE				
S_{D1} =	0.490	0.180	g			
k_{max} = PGA =	0.430	0.200	g			
$\beta = S_{D1}$/PGA =	1.140	0.900		β = Ground Motion Index:		$0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:		$1+0.01h_{slope}[(0.5\beta)-1]\le1.0$: for $h_{slope}\le20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:		$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake		M_w & R = Deaggregation Analysis
R =	63.5	64.2	km	R = Site-to-Source Distance		
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity		$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output		
ε =	0.000	0.000		ε = Near-fault directivity correction:		R < 20 km; $\varepsilon = 0.015(R-20)$
D_{a5-95}	30.15	30.09	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration:	Use Eq. 12-48	R ≥ 20 km; $\varepsilon = 0$

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	**40308**	**File No.:**	**38.040308**	**Latitude:**	**33.4570**	**Designer:**	**R. Gardner - Midlands RPG**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**80.6470**	**Date:**	**9/23/2014**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**	**EB1 B-1**	**Station:**	**5949+31**

Design EQ = SEE

Site Class = D

PGA (g) = 0.43

M_W = 7.4

R (km) = 63.5

D_{a5-95} (sec) = 30.15

Boring Number = B-1

Boring Station = 5949+31.00

Boring Offset = 13 ft LT

Ground Elevation at Boring (ft msl) = 119.9

Water Table Depth (Dw) (ft) = 7.7

Water Table Elevation (msl ft) = 112.2

Hammer Type = Automatic

Energy Ratio = 79.0

Energy Correction (C_E) = 1.32

Borehole Diameter (in) = 4

Borehole Correction (CB) = 1.00

No. of Soil Layers = 10 **each**

No. of Split Spoon Samples = 23 **each**

Total Profile Thickness = 102.5 **feet**

Sampler Configuration:

Liner Required = N

Liner Used = N

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Seismic Analysis Summary		Geotechnical Seismic Hazards Summary		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	119.9													
1	2.5	117.4	9.9	SM/SC/SC-SM	NSL-S				No Liquefaction		29.8				
2	5.5	114.4	17.5	SM/SC/SC-SM	NSL-S				No Liquefaction		34.6				
3	7.5	112.4	10.2	SM/SC/SC-SM	NSL-S				No Liquefaction		30.0				
4	9.5	110.4	8.6	SM/SC/SC-SM	NSL-C				No Strength Loss			400.00			
5	12.5	107.4	11.7	SM/SC/SC-SM	NSL-C				No Strength Loss			500.00			
6	17.5	102.4	33.6	SP/SW	NSL-S				No Liquefaction		32.0				
7	22.5	97.4	20.5	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
8	27.5	92.4	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
9	32.5	87.4	22.3	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
10	36.4	83.5	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
11	42.5	77.4	24.5	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
12	47.5	72.4	32.3	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
13	52.5	67.4	46.0	ML	NSL-S				No Liquefaction		30.0				
14	57.5	62.4	41.0	ML	NSL-S				No Liquefaction		30.0				
15	62.5	57.4	46.0	ML	NSL-S				No Liquefaction		30.0				
16	67.5	52.4	46.0	ML	NSL-S				No Liquefaction		30.0				
17	72.5	47.4	46.0	ML	NSL-S				No Liquefaction		30.0				
18	77.5	42.4	46.0	ML	NSL-S				No Liquefaction		30.0				
19	82.5	37.4	46.0	ML	NSL-S				No Liquefaction		30.0				
20	87.5	32.4	46.0	ML	NSL-S				No Liquefaction		30.0				
21	92.5	27.4	33.6	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		30.0				
22	67.5	52.4	46.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
23	102.5	17.4	38.8	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
													0.00		**0.00**
													LDI Total (feet)		**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.:	**40308**	**File No.:**	**38.040308**	**Latitude:**	**33.4570**	**Designer:**	**R. Gardner - Midlands RPG**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**80.6470**	**Date:**	**9/23/2014**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**	**EB1 B-1**	**Station:**	**5949+31**

Boring Number =	**B-1**	**Design EQ =**	**SEE**	**No. of Soil Layers =**	**10**	**each**
Boring Station =	**5949+31.00**	**Site Class =**	**D**	**No. of Split Spoon Samples =**	**23**	**each**
Boring Offset =	**13 ft LT**	**PGA (g) =**	**0.43**	**Total Profile Thickness =**	**103**	**feet**
Ground Elevation at Boring (ft msl) =	**119.9**	**M_W =**	**7.37**			
Water Table Depth (Dw) (ft) =	**7.7**	**R (km) =**	**63.5**			
Water Table Elevation (msl ft) =	**112.2**	**D_{a5-95} (sec) =**	**30.15**			

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.9														
1	2.5	117.4	4.0	1.32	1.00	0.70	1.00	287.5	1.70	16.2	3.6	3.7	6.3	9.9	1	SM/SC/SC-SM
2	5.5	114.4	8.0	1.32	1.00	0.78	1.00	632.5	1.70	16.2	3.6	8.2	13.9	17.5	1	SM/SC/SC-SM
3	7.5	112.4	4.0	1.32	1.00	0.82	1.00	862.5	1.52	16.2	3.6	4.3	6.5	10.2	1	SM/SC/SC-SM
4	9.5	110.4	2.0	1.32	1.00	0.85	1.00	980.2	1.43	32.3	5.4	2.2	3.2	8.6	2	SM/SC/SC-SM
5	12.5	107.4	4.0	1.32	1.00	0.89	1.00	1,125.5	1.33	32.3	5.4	4.7	6.2	11.7	3	SM/SC/SC-SM
6	17.5	102.4	23.0	1.32	1.00	0.93	1.00	1,423.5	1.19	4.4	0.0	28.3	33.6	33.6	4	SP/SW
7	22.5	97.4	11.0	1.32	1.00	0.96	1.00	1,686.5	1.09	28.5	5.3	13.9	15.2	20.5	5	SM/SC/SC-SM
8	27.5	92.4	37.0	1.32	1.00	0.98	1.00	1,949.5	1.01	28.5	5.3	47.6	48.2	46.0	5	SM/SC/SC-SM
9	32.5	87.4	14.0	1.32	1.00	0.99	1.00	2,212.5	0.95	24.5	5.0	18.2	17.3	22.3	6	SM/SC/SC-SM
10	36.4	83.5	50.0	1.32	1.00	0.99	1.00	2,417.6	0.91	24.5	5.0	65.3	59.4	46.0	6	SM/SC/SC-SM
11	42.5	77.4	17.0	1.32	1.00	1.00	1.00	2,738.5	0.85	44.0	5.5	22.3	19.0	24.5	7	SM/SC/SC-SM
12	47.5	72.4	25.0	1.32	1.00	1.00	1.00	3,010.5	0.82	44.0	5.5	32.8	26.8	32.3	7	SM/SC/SC-SM
13	52.5	67.4	32.0	1.32	1.00	1.00	1.00	3,248.5	1.00	55.3	5.5	42.1	42.1	46.0	8	ML
14	57.5	62.4	27.0	1.32	1.00	1.00	1.00	3,486.5	1.00	55.3	5.5	35.5	35.5	41.0	8	ML
15	62.5	57.4	32.0	1.32	1.00	1.00	1.00	3,724.5	1.00	55.3	5.5	42.1	42.1	46.0	8	ML
16	67.5	52.4	45.0	1.32	1.00	1.00	1.00	3,962.5	1.00	55.3	5.5	59.2	59.2	46.0	8	ML
17	72.5	47.4	67.0	1.32	1.00	1.00	1.00	4,200.5	1.00	55.3	5.5	88.2	88.2	46.0	8	ML
18	77.5	42.4	45.0	1.32	1.00	1.00	1.00	4,438.5	1.00	55.3	5.5	59.2	59.2	46.0	8	ML
19	82.5	37.4	50.0	1.32	1.00	1.00	1.00	4,676.5	1.00	55.3	5.5	65.8	65.8	46.0	8	ML
20	87.5	32.4	50.0	1.32	1.00	1.00	1.00	4,883.5	1.00	55.3	5.5	65.8	65.8	46.0	8	ML
21	92.5	27.4	41.0	1.32	1.00	1.00	1.00	5,171.5	0.62	5.0	0.0	54.0	33.6	33.6	9	SW-SM/SW-SC/SP-SM/SP-SC
22	67.5	52.4	50.0	1.32	1.00	1.00	1.00	3,962.5	0.71	5.0	0.0	65.8	46.8	46.0	10	SW-SM/SW-SC/SP-SM/SP-SC
23	102.5	17.4	50.0	1.32	1.00	1.00	1.00	5,747.5	0.59	5.0	0.0	65.8	38.8	38.8	10	SW-SM/SW-SC/SP-SM/SP-SC

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = B-1
Boring Station = 5949+31.00
Boring Offset = 13 ft LT
Ground Elevation at Boring (ft msl) = 119.9
Water Table Depth (Dw) (ft) = 7.7
Water Table Elevation (msl ft) = 112.2

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 10 **each**
No. of Split Spoon Samples = 23 **each**
Total Profile Thickness = 103 **feet**

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \le \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	119.9																	
1	2.5	117.4	4.0	3.7	6.3	9.9	1	SM/SC/SC-SM		No Liquefaction		16.2				30		30	
2	5.5	114.4	8.0	8.2	13.9	17.5	1	SM/SC/SC-SM		No Liquefaction		16.2				35		35	
3	7.5	112.4	4.0	4.3	6.5	10.2	1	SM/SC/SC-SM		No Liquefaction		16.2				30		30	
4	9.5	110.4	2.0	2.2	3.2	8.6	2	SM/SC/SC-SM		No Strength Loss		32.3					400		400
5	12.5	107.4	4.0	4.7	6.2	11.7	3	SM/SC/SC-SM		No Strength Loss		32.3					500		500
6	17.5	102.4	23.0	28.3	33.6	33.6	4	SP/SW		No Liquefaction		4.4				32		32	
7	22.5	97.4	11.0	13.9	15.2	20.5	5	SM/SC/SC-SM		No Liquefaction		28.5				36		36	
8	27.5	92.4	37.0	47.6	48.2	46.0	5	SM/SC/SC-SM		No Liquefaction		28.5				36		36	
9	32.5	87.4	14.0	18.2	17.3	22.3	6	SM/SC/SC-SM		No Liquefaction		24.5				36		36	
10	36.4	83.5	50.0	65.3	59.4	46.0	6	SM/SC/SC-SM		No Liquefaction		24.5				36		36	
11	42.5	77.4	17.0	22.3	19.0	24.5	7	SM/SC/SC-SM		No Liquefaction		44.0				36		36	
12	47.5	72.4	25.0	32.8	26.8	32.3	7	SM/SC/SC-SM		No Liquefaction		44.0				36		36	
13	52.5	67.4	32.0	42.1	42.1	46.0	8	ML		No Liquefaction		55.3				30		30	
14	57.5	62.4	27.0	35.5	35.5	41.0	8	ML		No Liquefaction		55.3				30		30	
15	62.5	57.4	32.0	42.1	42.1	46.0	8	ML		No Liquefaction		55.3				30		30	
16	67.5	52.4	45.0	59.2	59.2	46.0	8	ML		No Liquefaction		55.3				30		30	
17	72.5	47.4	67.0	88.2	88.2	46.0	8	ML		No Liquefaction		55.3				30		30	
18	77.5	42.4	45.0	59.2	59.2	46.0	8	ML		No Liquefaction		55.3				30		30	
19	82.5	37.4	50.0	65.8	65.8	46.0	8	ML		No Liquefaction		55.3				30		30	
20	87.5	32.4	50.0	65.8	65.8	46.0	8	ML		No Liquefaction		55.3				30		30	
21	92.5	27.4	41.0	54.0	33.6	33.6	9	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				30		30	
22	67.5	52.4	50.0	65.8	46.8	46.0	10	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
23	102.5	17.4	50.0	65.8	38.8	38.8	10	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	

^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	1/21/2015
Project:	RBO Four Hole Swamp						
Location:	EB1 B-1A			**Station:**	5949+31.75	**Finished Embankment Height (ft)^1 =**	0

^{1}**Embankment height measured from natural ground surface**

Bridge & Roadway Information:

OC = II

ROC = II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
$\beta = S_{D1}/PGA$ =	1.140	0.900		β = Ground Motion Index:	$0.50 \leq \beta \leq 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1]\leq 1.0$: for $h_{slope}\leq 20ft$ $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.5	64.2	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; $\varepsilon = 0.015(R-20)$
D_{a5-95}	30.15	30.09	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; $\varepsilon = 0$

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	RBO Four Hole Swamp			**Longitude:**	80.6470	**Date:**	1/21/2015
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	EB1 B-1A	**Station:**	5949+31.75

Design EQ =	SEE	**Boring Number =**	B-1A	**Hammer Type =**	Safety
Site Class =	D	**Boring Station =**	5949+31.75	**Energy Ratio =**	76.4
PGA (g) =	0.43	**Boring Offset =**	8.75 ft RT	**Energy Correction (C_E) =**	1.27
M_W =	7.4	**Ground Elevation at Boring (ft msl) =**	119.9		
R (km) =	63.5	**Water Table Depth (Dw) (ft) =**	6.0	**Borehole Diameter (in) =**	4
$D_{a5\text{-}95}$ (sec) =	30.15	**Water Table Elevation (msl ft) =**	113.9	**Borehole Correction (CB) =**	1.00
		No. of Soil Layers =	15 each	**Sampler Configuration:**	
		No. of Split Spoon Samples =	28 each	**Liner Required =**	N
		Total Profile Thickness =	120 feet	**Liner Used =**	N

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	119.9													
1	2.7	117.2	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		30.0				
2	4.7	115.2	46.0	SP/SW	NSL-S				No Liquefaction		32.0				
3	6.7	113.2	20.0	SP/SW	NSL-S				No Liquefaction		32.0				
4	8.7	111.2	6.5	SP/SW	NSL-S				No Liquefaction		30.0				
5	9.7	110.2	10.3	SP/SW	NSL-S				No Liquefaction		28.6				
6	10.7	109.2	8.8	CL	NSL-C				No Strength Loss			570.00			
7	15	104.9	15.7	SM/SC/SC-SM	NSL-S				No Liquefaction		32.0				
8	20	99.9	40.7	SP/SW	NSL-S				No Liquefaction		36.0				
9	25	94.9	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
10	30	89.9	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
11	35	84.9	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
12	40	79.9	33.4	ML	NSL-S				No Liquefaction		36.0				
13	45	74.9	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
14	50	69.9	32.2	ML	NSL-S				No Liquefaction		30.0				
15	55	64.9	42.4	ML	NSL-S				No Liquefaction		30.0				
16	60	59.9	46.0	ML	NSL-S				No Liquefaction		30.0				
17	65	54.9	46.0	ML	NSL-S				No Liquefaction		30.0				
18	70	49.9	46.0	ML	NSL-S				No Liquefaction		30.0				
19	75	44.9	46.0	ML	NSL-S				No Liquefaction		30.0				
20	80	39.9	44.7	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
21	85	34.9	43.5	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
22	90	29.9	42.4	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
23	95	24.9	39.3	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
24	100	19.9	38.2	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
25	105	14.9	37.3	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
26	110	9.9	46.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
27	115	4.9	46.0	CL	NSL-C				No Strength Loss			4000.00			
28	120	-0.1	34.9	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
													0.00		0.00
													LDI Total (feet)		**S Total (inches)**

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^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	RBO Four Hole Swamp			**Longitude:**	80.6470	**Date:**	1/21/2015
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	EB1 B-1A	**Station:**	5949+31.75

Boring Number = B-1A
Boring Station = 5949+31.75
Boring Offset = 8.75 ft RT
Ground Elevation at Boring (ft msl) = 119.9
Water Table Depth (Dw) (ft) = 6
Water Table Elevation (msl ft) = 113.9

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 15 each
No. of Split Spoon Samples = 28 each
Total Profile Thickness = 120 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.9														
1	2.7	117.2	44.0	1.27	1.00	0.71	1.00	310.5	1.70	12.0	2.1	39.7	67.5	46.0	1	SM/SC/SC-SM
2	4.7	115.2	29.0	1.27	1.00	0.76	1.00	550.5	1.70	0.0	0.0	28.0	47.6	46.0	2	SP/SW
3	6.7	113.2	12.0	1.27	1.00	0.80	1.00	746.8	1.64	0.0	0.0	12.2	20.0	20.0	2	SP/SW
4	8.7	111.2	4.0	1.27	1.00	0.84	1.00	862.0	1.52	0.0	0.0	4.3	6.5	6.5	2	SP/SW
5	9.7	110.2	3.0	1.27	1.00	0.85	1.00	919.6	1.47	73.0	5.5	3.3	4.8	10.3	2	SP/SW
6	10.7	109.2	3.0	1.27	1.00	0.87	1.00	960.7	1.00	42.3	5.5	3.3	3.3	8.8	3	CL
7	15	104.9	9.0	1.27	1.00	0.91	1.00	1,179.4	1.30	12.0	2.1	10.5	13.7	15.7	4	SM/SC/SC-SM
8	20	99.9	25.0	1.27	1.00	0.95	1.00	1,474.9	1.16	57.7	5.5	30.2	35.2	40.7	5	SP/SW
9	25	94.9	47.0	1.27	1.00	0.97	1.00	1,737.9	1.07	57.7	5.5	58.1	62.3	46.0	6	SM/SC/SC-SM
10	30	89.9	50.0	1.27	1.00	0.98	1.00	2,000.9	1.00	57.7	5.5	62.6	62.6	46.0	6	SM/SC/SC-SM
11	35	84.9	50.0	1.27	1.00	0.99	1.00	2,271.4	0.94	57.7	5.5	63.0	59.2	46.0	6	SM/SC/SC-SM
12	40	79.9	22.0	1.27	1.00	0.99	1.00	2,501.9	1.00	49.3	5.5	27.9	27.9	33.4	7	ML
13	45	74.9	50.0	1.27	1.00	1.00	1.00	2,772.4	0.85	56.0	5.5	63.5	53.9	46.0	8	SM/SC/SC-SM
14	50	69.9	21.0	1.27	1.00	1.00	1.00	3,010.4	1.00	66.3	5.5	26.7	26.7	32.2	9	ML
15	55	64.9	29.0	1.27	1.00	1.00	1.00	3,248.4	1.00	73.7	5.5	36.9	36.9	42.4	9	ML
16	60	59.9	42.0	1.27	1.00	1.00	1.00	3,486.4	1.00	73.7	5.5	53.4	53.4	46.0	9	ML
17	65	54.9	41.0	1.27	1.00	1.00	1.00	3,724.4	1.00	73.7	5.5	52.2	52.2	46.0	9	ML
18	70	49.9	36.0	1.27	1.00	1.00	1.00	3,962.4	1.00	51.0	5.5	45.8	45.8	46.0	10	ML
19	75	44.9	51.0	1.27	1.00	1.00	1.00	4,192.9	1.00	51.0	5.5	64.9	64.9	46.0	10	ML
20	80	39.9	50.0	1.27	1.00	1.00	1.00	4,455.9	0.67	12.0	2.1	63.7	42.7	44.7	11	SM/SC/SC-SM
21	85	34.9	50.0	1.27	1.00	1.00	1.00	4,718.9	0.65	12.0	2.1	63.7	41.4	43.5	11	SM/SC/SC-SM
22	90	29.9	50.0	1.27	1.00	1.00	1.00	4,974.4	0.63	12.0	2.1	63.7	40.4	42.4	12	SM/SC/SC-SM
23	95	24.9	50.0	1.27	1.00	1.00	1.00	5,262.4	0.62	5.0	0.0	63.7	39.2	39.3	13	SW-SM/SW-SC/SP-SM/SP-SC
24	100	19.9	50.0	1.27	1.00	1.00	1.00	5,550.4	0.60	5.0	0.0	63.7	38.2	38.2	13	SW-SM/SW-SC/SP-SM/SP-SC
25	105	14.9	50.0	1.27	1.00	1.00	1.00	5,838.4	0.59	5.0	0.0	63.7	37.3	37.3	13	SW-SM/SW-SC/SP-SM/SP-SC
26	110	9.9	85.0	1.27	1.00	1.00	1.00	6,141.4	0.57	5.0	0.0	108.2	61.8	46.0	13	SW-SM/SW-SC/SP-SM/SP-SC
27	115	4.9	35.0	1.27	1.00	1.00	1.00	6,364.4	1.00	51.0	5.5	44.6	44.6	46.0	14	CL
28	120	-0.1	50.0	1.27	1.00	1.00	1.00	6,652.4	0.55	5.0	0.0	63.7	34.9	34.9	15	SW-SM/SW-SC/SP-SM/SP-SC

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = B-1A
Boring Station = 5949+31.75
Boring Offset = 8.75 ft RT
Ground Elevation at Boring (ft msl) = 119.9
Water Table Depth (Dw) (ft) = 6
Water Table Elevation (msl ft) = 113.9

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 15 each
No. of Split Spoon Samples = 28 each
Total Profile Thickness = 120 feet

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	119.9																	
1	2.7	117.2	44.0	39.7	67.5	46.0	1	SM/SC/SC-SM		No Liquefaction		12.0				30		30	
2	4.7	115.2	29.0	28.0	47.6	46.0	2	SP/SW		No Liquefaction		0.0				32		32	
3	6.7	113.2	12.0	12.2	20.0	20.0	2	SP/SW		No Liquefaction		0.0				32		32	
4	8.7	111.2	4.0	4.3	6.5	6.5	2	SP/SW		No Liquefaction		0.0				30		30	
5	9.7	110.2	3.0	3.3	4.8	10.3	2	SP/SW		No Liquefaction		73.0				29		29	
6	10.7	109.2	3.0	3.3	3.3	8.8	3	CL		No Strength Loss		42.3					570		570
7	15	104.9	9.0	10.5	13.7	15.7	4	SM/SC/SC-SM		No Liquefaction		12.0				32		32	
8	20	99.9	25.0	30.2	35.2	40.7	5	SP/SW		No Liquefaction		57.7				36		36	
9	25	94.9	47.0	58.1	62.3	46.0	6	SM/SC/SC-SM		No Liquefaction		57.7				36		36	
10	30	89.9	50.0	62.6	62.6	46.0	6	SM/SC/SC-SM		No Liquefaction		57.7				36		36	
11	35	84.9	50.0	63.0	59.2	46.0	6	SM/SC/SC-SM		No Liquefaction		57.7				36		36	
12	40	79.9	22.0	27.9	27.9	33.4	7	ML		No Liquefaction		49.3				36		36	
13	45	74.9	50.0	63.5	53.9	46.0	8	SM/SC/SC-SM		No Liquefaction		56.0				36		36	
14	50	69.9	21.0	26.7	26.7	32.2	9	ML		No Liquefaction		66.3				30		30	
15	55	64.9	29.0	36.9	36.9	42.4	9	ML		No Liquefaction		73.7				30		30	
16	60	59.9	42.0	53.4	53.4	46.0	9	ML		No Liquefaction		73.7				30		30	
17	65	54.9	41.0	52.2	52.2	46.0	9	ML		No Liquefaction		73.7				30		30	
18	70	49.9	36.0	45.8	45.8	46.0	10	ML		No Liquefaction		51.0				30		30	
19	75	44.9	51.0	64.9	64.9	46.0	10	ML		No Liquefaction		51.0				30		30	
20	80	39.9	50.0	63.7	42.7	44.7	11	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
21	85	34.9	50.0	63.7	41.4	43.5	11	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
22	90	29.9	50.0	63.7	40.4	42.4	12	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
23	95	24.9	50.0	63.7	39.2	39.3	13	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
24	100	19.9	50.0	63.7	38.2	38.2	13	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
25	105	14.9	50.0	63.7	37.3	37.3	13	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
26	110	9.9	85.0	108.2	61.8	46.0	13	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
27	115	4.9	35.0	44.6	44.6	46.0	14	CL		No Strength Loss		51.0					4000		4000
28	120	-0.1	50.0	63.7	34.9	34.9	15	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	

[D] Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	9/29/2014
Project:	RBO Four Hole Swamp						
Location:	B-2			**Station:**	5949+65	**Finished Embankment Height (ft)[1] =**	0

[1] Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
$\beta = S_{D1}$/PGA =	1.140	0.900		β = Ground Motion Index:	$0.50 \leq \beta \leq 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1]\leq 1.0$: for $h_{slope} \leq 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.5	64.2	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; $\varepsilon = 0.015(R-20)$
D_{a5-95}	30.15	30.09	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; $\varepsilon = 0$

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	RBO Four Hole Swamp			**Longitude:**	80.6470	**Date:**	9/29/2014
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	B-2	**Station:**	5949+65

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.4
R (km) = 63.5
D_{a5-95} (sec) = 30.15

Boring Number = B-2
Boring Station = 5949+65.00
Boring Offset = 9 ft RT
Ground Elevation at Boring (ft msl) = 108.8
Water Table Depth (Dw) (ft) = 0.0
Water Table Elevation (msl ft) = 108.8

Hammer Type = Automatic
Energy Ratio = 79.0
Energy Correction (C_E) = 1.32
Borehole Diameter (in) = 4
Borehole Correction (CB) = 1.00

No. of Soil Layers = 13 each
No. of Split Spoon Samples = 23 each
Total Profile Thickness = 111.5 feet

Sampler Configuration:
Liner Required = N
Liner Used = N

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	108.8													
1	2.5	106.3	9.9	SM/SC/SC-SM	SSL	Sand-Like	2.93	0.90	Full Liquefaction	0.7 - 1.0	5.6		1.19	1.19	1.12
2	5.5	103.3	22.6	SP/SW	NSL-S				No Liquefaction		32.0				
3	7.5	101.3	46.0	SP/SW	NSL-S				No Liquefaction		32.0				
4	9.5	99.3	33.4	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
5	11.5	97.3	46.0	ML	NSL-S				No Liquefaction		36.0				
6	16.5	92.3	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
7	20.4	88.4	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
8	26.5	82.3	33.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
9	31.5	77.3	29.6	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
10	36.5	72.3	33.4	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
11	41.5	67.3	21.8	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
12	46.5	62.3	30.4	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
13	51.5	57.3	41.6	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
14	56.5	52.3	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
15	61.5	47.3	35.4	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
16	66.5	42.3	44.2	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
17	71.5	37.3	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
18	76.5	32.3	16.1	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		16.0				
19	81.5	27.3	26.8	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
20	86.5	22.3	43.3	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
21	91.5	17.3	42.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
22	106.5	2.3	37.9	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
23	111.5	-2.7	28.6	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
													1.19		**1.12**
													LDI Total (feet)		**S Total (inches)**

[D] Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	RBO Four Hole Swamp			**Longitude:**	80.6470	**Date:**	9/29/2014
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	B-2	**Station:**	5949+65

Boring Number = B-2
Boring Station = 5949+65.00
Boring Offset = 9 ft RT
Ground Elevation at Boring (ft msl) = 108.8
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 108.8

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 13 **each**
No. of Split Spoon Samples = 23 **each**
Total Profile Thickness = 112 **feet**

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	108.8														
1	2.5	106.3	5.0	1.32	1.00	0.70	1.00	125.0	1.70	12.0	2.1	4.6	7.9	9.9	1	SM/SC/SC-SM
2	5.5	103.3	13.0	1.32	1.00	0.78	1.00	297.8	1.70	0.0	0.0	13.3	22.6	22.6	2	SP/SW
3	7.5	101.3	32.0	1.32	1.00	0.82	1.00	414.5	1.70	0.0	0.0	34.4	58.5	46.0	2	SP/SW
4	9.5	99.3	16.0	1.32	1.00	0.85	1.00	521.2	1.70	14.2	3.0	17.9	30.4	33.4	3	SM/SC/SC-SM
5	11.5	97.3	50.0	1.32	1.00	0.88	1.00	618.9	1.00	55.1	5.5	57.8	57.8	46.0	4	ML
6	16.5	92.3	50.0	1.32	1.00	0.93	1.00	881.9	1.51	46.7	5.5	61.1	91.9	46.0	5	SM/SC/SC-SM
7	20.4	88.4	50.0	1.32	1.00	0.95	1.00	1,087.0	1.36	39.2	5.5	62.7	85.0	46.0	6	SM/SC/SC-SM
8	26.5	82.3	18.0	1.32	1.00	0.98	1.00	1,407.9	1.19	39.2	5.5	23.1	27.5	33.0	6	SM/SC/SC-SM
9	31.5	77.3	17.0	1.32	1.00	0.99	1.00	1,670.9	1.09	39.2	5.5	22.1	24.1	29.6	6	SM/SC/SC-SM
10	36.5	72.3	21.0	1.32	1.00	0.99	1.00	1,933.9	1.02	43.8	5.5	27.4	27.9	33.4	7	SM/SC/SC-SM
11	41.5	67.3	13.0	1.32	1.00	1.00	1.00	2,196.9	0.95	47.1	5.5	17.0	16.3	21.8	8	SM/SC/SC-SM
12	46.5	62.3	21.0	1.32	1.00	1.00	1.00	2,459.9	0.90	47.1	5.5	27.6	24.9	30.4	8	SM/SC/SC-SM
13	51.5	57.3	32.0	1.32	1.00	1.00	1.00	2,722.9	0.86	47.1	5.5	42.1	36.1	41.6	8	SM/SC/SC-SM
14	56.5	52.3	41.0	1.32	1.00	1.00	1.00	2,985.9	0.82	47.1	5.5	53.9	44.1	46.0	8	SM/SC/SC-SM
15	61.5	47.3	29.0	1.32	1.00	1.00	1.00	3,248.9	0.78	48.7	5.5	38.2	29.9	35.4	9	SM/SC/SC-SM
16	66.5	42.3	39.0	1.32	1.00	1.00	1.00	3,511.9	0.75	48.7	5.5	51.3	38.7	44.2	9	SM/SC/SC-SM
17	71.5	37.3	50.0	1.32	1.00	1.00	1.00	3,767.4	0.73	23.0	4.9	65.8	48.0	46.0	10	SM/SC/SC-SM
18	76.5	32.3	17.0	1.32	1.00	1.00	1.00	4,055.4	0.70	7.9	0.3	22.4	15.7	16.1	11	SW-SM/SW-SC/SP-SM/SP-SC
19	81.5	27.3	30.0	1.32	1.00	1.00	1.00	4,343.4	0.68	5.0	0.0	39.5	26.8	26.8	12	SW-SM/SW-SC/SP-SM/SP-SC
20	86.5	22.3	50.0	1.32	1.00	1.00	1.00	4,631.4	0.66	5.0	0.0	65.8	43.3	43.3	12	SW-SM/SW-SC/SP-SM/SP-SC
21	91.5	17.3	50.0	1.32	1.00	1.00	1.00	4,919.4	0.64	5.0	0.0	65.8	42.0	42.0	12	SW-SM/SW-SC/SP-SM/SP-SC
22	106.5	2.3	49.0	1.32	1.00	1.00	1.00	5,790.9	0.59	5.0	0.0	64.5	37.9	37.9	12	SW-SM/SW-SC/SP-SM/SP-SC
23	111.5	-2.7	35.0	1.32	1.00	1.00	1.00	6,053.9	0.57	12.0	2.1	46.1	26.5	28.6	13	SM/SC/SC-SM

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = B-2
Boring Station = 5949+65.00
Boring Offset = 9 ft RT
Ground Elevation at Boring (ft msl) = 108.8
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 108.8

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 13 each
No. of Split Spoon Samples = 23 each
Total Profile Thickness = 112 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	108.8																	
1	2.5	106.3	5.0	4.6	7.9	9.9	1	SM/SC/SC-SM	Sand-Like	Full Liquefaction	31.7	12.0				31		6	
2	5.5	103.3	13.0	13.3	22.6	22.6	2	SP/SW		No Liquefaction		0.0				32		32	
3	7.5	101.3	32.0	34.4	58.5	46.0	2	SP/SW		No Liquefaction		0.0				32		32	
4	9.5	99.3	16.0	17.9	30.4	33.4	3	SM/SC/SC-SM		No Liquefaction		14.2				36		36	
5	11.5	97.3	50.0	57.8	57.8	46.0	4	ML		No Liquefaction		55.1				36		36	
6	16.5	92.3	50.0	61.1	91.9	46.0	5	SM/SC/SC-SM		No Liquefaction		46.7				36		36	
7	20.4	88.4	50.0	62.7	85.0	46.0	6	SM/SC/SC-SM		No Liquefaction		39.2				36		36	
8	26.5	82.3	18.0	23.1	27.5	33.0	6	SM/SC/SC-SM		No Liquefaction		39.2				36		36	
9	31.5	77.3	17.0	22.1	24.1	29.6	6	SM/SC/SC-SM		No Liquefaction		39.2				36		36	
10	36.5	72.3	21.0	27.4	27.9	33.4	7	SM/SC/SC-SM		No Liquefaction		43.8				36		36	
11	41.5	67.3	13.0	17.0	16.3	21.8	8	SM/SC/SC-SM		No Liquefaction		47.1				36		36	
12	46.5	62.3	21.0	27.6	24.9	30.4	8	SM/SC/SC-SM		No Liquefaction		47.1				36		36	
13	51.5	57.3	32.0	42.1	36.1	41.6	8	SM/SC/SC-SM		No Liquefaction		47.1				36		36	
14	56.5	52.3	41.0	53.9	44.1	46.0	8	SM/SC/SC-SM		No Liquefaction		47.1				36		36	
15	61.5	47.3	29.0	38.2	29.9	35.4	9	SM/SC/SC-SM		No Liquefaction		48.7				36		36	
16	66.5	42.3	39.0	51.3	38.7	44.2	9	SM/SC/SC-SM		No Liquefaction		48.7				36		36	
17	71.5	37.3	50.0	65.8	48.0	46.0	10	SM/SC/SC-SM		No Liquefaction		23.0				36		36	
18	76.5	32.3	17.0	22.4	15.7	16.1	11	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		7.9				36		16	
19	81.5	27.3	30.0	39.5	26.8	26.8	12	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
20	86.5	22.3	50.0	65.8	43.3	43.3	12	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
21	91.5	17.3	50.0	65.8	42.0	42.0	12	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
22	106.5	2.3	49.0	64.5	37.9	37.9	12	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
23	111.5	-2.7	35.0	46.1	26.5	28.6	13	SM/SC/SC-SM		No Liquefaction		12.0				36		36	

^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	9/30/2014
Project:	RBO Four Hole Swamp						
Location:	B-3			**Station:**	5950+02	**Finished Embankment Height (ft)[1] =**	

[1] Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
$\beta = S_{D1}/PGA$ =	1.140	0.900		β = Ground Motion Index:	$0.50 \leq \beta \leq 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1]\leq1.0$: for $h_{slope}\leq20ft$ $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.5	64.2	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; $\varepsilon = 0.015(R-20)$
D_{a5-95}	30.15	30.09	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; $\varepsilon = 0$

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	**40308**	**File No.:**	**38.040308**	**Latitude:**	**33.4570**	**Designer:**	**R. Gardner - Midlands RPG**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**80.6470**	**Date:**	**9/30/2014**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**	**B-3**	**Station:**	**5950+02**

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.4
R (km) = 63.5
D_{a5-95} (sec) = 30.15

Boring Number = B-3
Boring Station = 5950+02.00
Boring Offset = 3 ft RT
Ground Elevation at Boring (ft msl) = 108.5
Water Table Depth (Dw) (ft) = 0.0
Water Table Elevation (msl ft) = 108.5

Hammer Type = Automatic
Energy Ratio = 79.0
Energy Correction (C_E) = 1.32
Borehole Diameter (in) = 4
Borehole Correction (CB) = 1.00

No. of Soil Layers = 10 each
No. of Split Spoon Samples = 23 each
Total Profile Thickness = 101.5 feet

Sampler Configuration:
Liner Required = N
Liner Used = N

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	108.5													
1	2.5	106.0	7.9	SP/SW	SSL	Sand-Like	3.08	0.90	Full Liquefaction	0.7 - 1.0	4.6		1.25	1.25	1.28
2	5.5	103.0	20.9	SP/SW	NSL-S				No Liquefaction		32.0				
3	7.5	101.0	32.9	SP/SW	NSL-S				No Liquefaction		32.0				
4	9.5	99.0	22.8	SP/SW	NSL-S				No Liquefaction		32.0				
5	11.5	97.0	46.0	ML	NSL-S				No Liquefaction		36.0				
6	16.5	92.0	46.0	ML	NSL-S				No Liquefaction		36.0				
7	20.3	88.2	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
8	26.5	82.0	22.4	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
9	31.5	77.0	29.8	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
10	36.5	72.0	22.8	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
11	41.5	67.0	28.1	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
12	46.5	62.0	20.9	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
13	51.5	57.0	31.5	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
14	56.5	52.0	21.7	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
15	61.5	47.0	6.3	SM/SC/SC-SM	NSL-S				No Liquefaction		24.0				
16	66.5	42.0	1.0	SP/SW	NSL-S				No Liquefaction		23.9				
17	71.5	37.0	1.0	SP/SW	NSL-S				No Liquefaction		23.8				
18	76.5	32.0	0.9	SP/SW	NSL-S				No Liquefaction		23.8				
19	81.5	27.0	23.2	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		38.0				
20	86.5	22.0	39.7	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		38.0				
21	91.5	17.0	25.1	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		38.0				
22	96.5	12.0	39.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		38.0				
23	101.5	7.0	26.1	SM/SC/SC-SM	NSL-S				No Liquefaction		37.8				
													1.25		**1.28**
													LDI Total (feet)		**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.: 40308
File No.: 38.040308
Latitude: 33.4570
Longitude: 80.6470
Designer: R. Gardner - Midlands RPG
Project: RBO Four Hole Swamp
Date: 9/30/2014
Route: US 301
County: 38 - Orangeburg
Location: B-3
Station: 5950+02

Boring Number = B-3
Boring Station = 5950+02.00
Boring Offset = 3 ft RT
Ground Elevation at Boring (ft msl) = 108.5
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 108.5

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 10 each
No. of Split Spoon Samples = 23 each
Total Profile Thickness = 102 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	108.5														
1	2.5	106.0	5.0	1.32	1.00	0.70	1.00	144.0	1.70	0.5	0.0	4.6	7.9	7.9	1	SP/SW
2	5.5	103.0	12.0	1.32	1.00	0.78	1.00	316.8	1.70	0.5	0.0	12.3	20.9	20.9	1	SP/SW
3	7.5	101.0	18.0	1.32	1.00	0.82	1.00	432.0	1.70	0.5	0.0	19.3	32.9	32.9	1	SP/SW
4	9.5	99.0	12.0	1.32	1.00	0.85	1.00	546.2	1.70	0.5	0.0	13.4	22.8	22.8	1	SP/SW
5	11.5	97.0	42.0	1.32	1.00	0.88	1.00	641.4	1.00	51.9	5.5	48.5	48.5	46.0	2	ML
6	16.5	92.0	36.0	1.32	1.00	0.93	1.00	864.4	1.00	55.2	5.5	44.0	44.0	46.0	3	ML
7	20.3	88.2	50.0	1.32	1.00	0.95	1.00	1,064.3	1.37	43.6	5.5	62.6	85.9	46.0	4	SM/SC/SC-SM
8	26.5	82.0	11.0	1.32	1.00	0.98	1.00	1,390.4	1.20	43.6	5.5	14.1	16.9	22.4	4	SM/SC/SC-SM
9	31.5	77.0	17.0	1.32	1.00	0.99	1.00	1,653.4	1.10	43.6	5.5	22.1	24.3	29.8	4	SM/SC/SC-SM
10	36.5	72.0	13.0	1.32	1.00	0.99	1.00	1,916.4	1.02	47.3	5.5	17.0	17.3	22.8	5	SM/SC/SC-SM
11	41.5	67.0	18.0	1.32	1.00	1.00	1.00	2,179.4	0.96	47.3	5.5	23.6	22.6	28.1	5	SM/SC/SC-SM
12	46.5	62.0	13.0	1.32	1.00	1.00	1.00	2,442.4	0.90	47.3	5.5	17.1	15.4	20.9	5	SM/SC/SC-SM
13	51.5	57.0	23.0	1.32	1.00	1.00	1.00	2,705.4	0.86	47.3	5.5	30.2	26.0	31.5	5	SM/SC/SC-SM
14	56.5	52.0	15.0	1.32	1.00	1.00	1.00	2,968.4	0.82	47.3	5.5	19.7	16.2	21.7	6	SM/SC/SC-SM
15	61.5	47.0	1.0	1.32	1.00	1.00	1.00	3,222.4	0.79	28.0	5.3	1.3	1.0	6.3	7	SM/SC/SC-SM
16	66.5	42.0	1.0	1.32	1.00	1.00	1.00	3,510.4	0.75	0.0	0.0	1.3	1.0	1.0	8	SP/SW
17	71.5	37.0	1.0	1.32	1.00	1.00	1.00	3,798.4	0.73	0.0	0.0	1.3	1.0	1.0	8	SP/SW
18	76.5	32.0	1.0	1.32	1.00	1.00	1.00	4,086.4	0.70	0.0	0.0	1.3	0.9	0.9	8	SP/SW
19	81.5	27.0	26.0	1.32	1.00	1.00	1.00	4,374.4	0.68	5.7	0.0	34.2	23.1	23.2	9	SW-SM/SW-SC/SP-SM/SP-SC
20	86.5	22.0	46.0	1.32	1.00	1.00	1.00	4,662.4	0.65	5.0	0.0	60.6	39.7	39.7	9	SW-SM/SW-SC/SP-SM/SP-SC
21	91.5	17.0	30.0	1.32	1.00	1.00	1.00	4,950.4	0.64	5.0	0.0	39.5	25.1	25.1	9	SW-SM/SW-SC/SP-SM/SP-SC
22	96.5	12.0	48.0	1.32	1.00	1.00	1.00	5,255.9	0.62	5.0	0.0	63.2	39.0	39.0	9	SW-SM/SW-SC/SP-SM/SP-SC
23	101.5	7.0	26.0	1.32	1.00	1.00	1.00	5,518.9	0.60	42.6	5.5	34.2	20.6	26.1	10	SM/SC/SC-SM

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = B-3
Boring Station = 5950+02.00
Boring Offset = 3 ft RT
Ground Elevation at Boring (ft msl) = 108.5
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 108.5

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
$D_{a5\text{-}95}$ (sec) = 30.15

No. of Soil Layers = 10 each
No. of Split Spoon Samples = 23 each
Total Profile Thickness = 102 feet

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	108.5																	
1	2.5	106.0	5.0	4.6	7.9	7.9	1	SP/SW	Sand-Like	Full Liquefaction	31.7	0.5				31		5	
2	5.5	103.0	12.0	12.3	20.9	20.9	1	SP/SW		No Liquefaction		0.5				32		32	
3	7.5	101.0	18.0	19.3	32.9	32.9	1	SP/SW		No Liquefaction		0.5				32		32	
4	9.5	99.0	12.0	13.4	22.8	22.8	1	SP/SW		No Liquefaction		0.5				32		32	
5	11.5	97.0	42.0	48.5	48.5	46.0	2	ML		No Liquefaction		51.9				36		36	
6	16.5	92.0	36.0	44.0	44.0	46.0	3	ML		No Liquefaction		55.2				36		36	
7	20.3	88.2	50.0	62.6	85.9	46.0	4	SM/SC/SC-SM		No Liquefaction		43.6				36		36	
8	26.5	82.0	11.0	14.1	16.9	22.4	4	SM/SC/SC-SM		No Liquefaction		43.6				36		36	
9	31.5	77.0	17.0	22.1	24.3	29.8	4	SM/SC/SC-SM		No Liquefaction		43.6				36		36	
10	36.5	72.0	13.0	17.0	17.3	22.8	5	SM/SC/SC-SM		No Liquefaction		47.3				36		36	
11	41.5	67.0	18.0	23.6	22.6	28.1	5	SM/SC/SC-SM		No Liquefaction		47.3				36		36	
12	46.5	62.0	13.0	17.1	15.4	20.9	5	SM/SC/SC-SM		No Liquefaction		47.3				36		36	
13	51.5	57.0	23.0	30.2	26.0	31.5	5	SM/SC/SC-SM		No Liquefaction		47.3				36		36	
14	56.5	52.0	15.0	19.7	16.2	21.7	6	SM/SC/SC-SM		No Liquefaction		47.3				36		36	
15	61.5	47.0	1.0	1.3	1.0	6.3	7	SM/SC/SC-SM		No Liquefaction		28.0				24		24	
16	66.5	42.0	1.0	1.3	1.0	1.0	8	SP/SW		No Liquefaction		0.0				24		24	
17	71.5	37.0	1.0	1.3	1.0	1.0	8	SP/SW		No Liquefaction		0.0				24		24	
18	76.5	32.0	1.0	1.3	0.9	0.9	8	SP/SW		No Liquefaction		0.0				24		24	
19	81.5	27.0	26.0	34.2	23.1	23.2	9	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.7				38		38	
20	86.5	22.0	46.0	60.6	39.7	39.7	9	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				38		38	
21	91.5	17.0	30.0	39.5	25.1	25.1	9	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				38		38	
22	96.5	12.0	48.0	63.2	39.0	39.0	9	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				38		38	
23	101.5	7.0	26.0	34.2	20.6	26.1	10	SM/SC/SC-SM		No Liquefaction		42.6				38		38	

[D] Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	1/21/2015
Project:	RBO Four Hole Swamp						
Location:	B-3A			**Station:**	5950+10.72	**Finished Embankment Height (ft)[1] =**	0

[1] Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
$\beta = S_{D1}/PGA$ =	1.140	0.900		β = Ground Motion Index:	$0.50 \leq \beta \leq 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1]\leq 1.0$: for $h_{slope}\leq 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.5	64.2	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; $\varepsilon = 0.015(R-20)$
D_{a5-95}	30.15	30.09	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; $\varepsilon = 0$

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	**40308**	**File No.:**	**38.040308**	**Latitude:**	**33.4570**	**Designer:**	**R. Gardner - Midlands RPG**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**80.6470**	**Date:**	**1/21/2015**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**	**B-3A**	**Station:**	**5950+10.72**

Design EQ =	**SEE**	**Boring Number =**	**B-3A**	**Hammer Type =**	**Safety**
Site Class =	**D**	**Boring Station =**	**5950+10.72**	**Energy Ratio =**	**76.4**
PGA (g) =	**0.43**	**Boring Offset =**	**6.25 LT**	**Energy Correction (C_E) =**	1.27
M_W =	**7.4**	**Ground Elevation at Boring (ft msl) =**	**109.1**		
R (km) =	**63.5**	**Water Table Depth (Dw) (ft) =**	**0.0**	**Borehole Diameter (in) =**	**4**
D_{a5-95} (sec) =	**30.15**	**Water Table Elevation (msl ft) =**	**109.1**	**Borehole Correction (CB) =**	1.00

No. of Soil Layers =	**14**	**each**	**Sampler Configuration:**	
No. of Split Spoon Samples =	**36**	**each**	**Liner Required =**	**N**
Total Profile Thickness =	**120**	**feet**	**Liner Used =**	**N**

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	109.1													
1	2	107.1	6.4	CL	PSL	HS Clay-Like	0.35	0.90	No Strength Loss			200.00			
2	4	105.1	8.3	CL	PSL	HS Clay-Like	0.23	0.90	No Strength Loss			600.00			
3	6	103.1	15.3	SP/SW	SSL	Sand-Like	3.38	0.90	Full Liquefaction	0.7 - 1.0	13.2		0.53	0.53	0.68
4	8	101.1	46.0	SP/SW	NSL-S				No Liquefaction		32.0				
5	10	99.1	31.5	SP/SW	NSL-S				No Liquefaction		32.0				
6	15	94.1	46.0	ML	PSL	HS Clay-Like	0.31	0.90	No Strength Loss			1710.00			
7	20	89.1	46.0	SM/SC/SC-SM	PSL	HS Clay-Like	0.39	0.90	No Strength Loss			1780.00			
8	25	84.1	38.9	ML	NSL-S				No Liquefaction		36.0				
9	30	79.1	39.3	ML	NSL-S				No Liquefaction		36.0				
10	35	74.1	46.0	ML	NSL-S				No Liquefaction		36.0				
11	40	69.1	39.7	ML	NSL-S				No Liquefaction		36.0				
12	45	64.1	25.8	ML	NSL-S				No Liquefaction		36.0				
13	50	59.1	46.0	ML	NSL-C				No Strength Loss			2170.00			
14	52	57.1	46.0	ML	NSL-C				No Strength Loss			2190.00			
15	54	55.1	46.0	ML	NSL-C				No Strength Loss			2220.00			
16	56	53.1	46.0	ML	NSL-C				No Strength Loss			2240.00			
17	58	51.1	46.0	ML	NSL-C				No Strength Loss			2270.00			
18	60	49.1	8.0	MH	NSL-S				No Liquefaction		5.0				
19	62	47.1	9.3	MH	NSL-S				No Liquefaction		5.0				
20	64	45.1	6.8	MH	PSL	HS Clay-Like	6.31	0.90	Strength Loss			150.00			
21	66	43.1	6.8	MH	PSL	HS Clay-Like	6.44	0.90	Strength Loss			240.00			
22	68	41.1	6.8	MH	PSL	HS Clay-Like	6.57	0.90	Strength Loss			240.00			
23	70	39.1	7.4	SM/SC/SC-SM	PSL	HS Clay-Like	6.71	0.90	Strength Loss			240.00			
24	72	37.1	8.4	SM/SC/SC-SM	NSL-S				No Liquefaction		5.0				
25	74	35.1	8.3	SM/SC/SC-SM	PSL	HS Clay-Like	6.99	0.90	Strength Loss			240.00			
26	76	33.1	17.6	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
27	78	31.1	9.5	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		5.0				
28	80	29.1	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
29	85	24.1	43.5	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
30	90	19.1	46.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
31	95	14.1	46.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
32	100	9.1	39.6	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
33	105	4.1	46.0	CL	NSL-C				No Strength Loss			4000.00			
34	110	-0.9	46.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
35	115	-5.9	46.0	MH	NSL-C				No Strength Loss			3000.00			
36	120	-10.9	46.0	MH	NSL-C				No Strength Loss			3000.00			
													0.53		**0.68**
													LDI Total (feet)		**S Total (inches)**

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^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.: 40308
File No.: 38.040308
Latitude: 33.4570
Designer: R. Gardner - Midlands RPG
Project: RBO Four Hole Swamp
Longitude: 80.6470
Date: 1/21/2015
Route: US 301
County: 38 - Orangeburg
Location: B-3A
Station: 5950+10.72

Boring Number = B-3A
Boring Station = 5950+10.72
Boring Offset = 6.25 LT
Ground Elevation at Boring (ft msl) = 109.1
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 109.1

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 14 **each**
No. of Split Spoon Samples = 36 **each**
Total Profile Thickness = 120 **feet**

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	109.1														
1	2	107.1	1.0	1.27	1.00	0.69	1.00	95.2	1.00	51.0	5.5	0.9	0.9	6.4	1	CL
2	4	105.1	3.0	1.27	1.00	0.74	1.00	195.4	1.00	51.0	5.5	2.8	2.8	8.3	1	CL
3	6	103.1	9.0	1.27	1.00	0.79	1.00	310.6	1.70	0.0	0.0	9.0	15.3	15.3	2	SP/SW
4	8	101.1	27.0	1.27	1.00	0.83	1.00	425.8	1.70	0.0	0.0	28.4	48.2	46.0	3	SP/SW
5	10	99.1	17.0	1.27	1.00	0.86	1.00	564.0	1.70	0.0	0.0	18.6	31.5	31.5	3	SP/SW
6	15	94.1	40.0	1.27	1.00	0.91	1.00	790.5	1.00	53.1	5.5	46.6	46.6	46.0	4	ML
7	20	89.1	50.0	1.27	1.00	0.95	1.00	1,065.0	1.37	42.8	5.5	60.5	82.9	46.0	5	SM/SC/SC-SM
8	25	84.1	27.0	1.27	1.00	0.97	1.00	1,303.0	1.00	51.0	5.5	33.4	33.4	38.9	6	ML
9	30	79.1	27.0	1.27	1.00	0.98	1.00	1,541.0	1.00	51.0	5.5	33.8	33.8	39.3	6	ML
10	35	74.1	36.0	1.27	1.00	0.99	1.00	1,779.0	1.00	51.0	5.5	45.4	45.4	46.0	6	ML
11	40	69.1	27.0	1.27	1.00	0.99	1.00	2,017.0	1.00	51.0	5.5	34.2	34.2	39.7	6	ML
12	45	64.1	16.0	1.27	1.00	1.00	1.00	2,255.0	1.00	63.3	5.5	20.3	20.3	25.8	6	ML
13	50	59.1	41.0	1.27	1.00	1.00	1.00	2,493.0	1.00	51.0	5.5	52.1	52.1	46.0	6	ML
14	52	57.1	47.0	1.27	1.00	1.00	1.00	2,588.2	1.00	68.3	5.5	59.8	59.8	46.0	6	ML
15	54	55.1	56.0	1.27	1.00	1.00	1.00	2,683.4	1.00	51.0	5.5	71.2	71.2	46.0	6	ML
16	56	53.1	50.0	1.27	1.00	1.00	1.00	2,778.6	1.00	51.0	5.5	63.6	63.6	46.0	6	ML
17	58	51.1	45.0	1.27	1.00	1.00	1.00	2,873.8	1.00	51.0	5.5	57.3	57.3	46.0	6	ML
18	60	49.1	2.0	1.27	1.00	1.00	1.00	2,969.0	1.00	60.1	5.5	2.5	2.5	8.0	7	MH
19	62	47.1	3.0	1.27	1.00	1.00	1.00	3,064.2	1.00	60.1	5.5	3.8	3.8	9.3	7	MH
20	64	45.1	1.0	1.27	1.00	1.00	1.00	3,159.4	1.00	64.0	5.5	1.3	1.3	6.8	7	MH
21	66	43.1	1.0	1.27	1.00	1.00	1.00	3,254.6	1.00	64.0	5.5	1.3	1.3	6.8	7	MH
22	68	41.1	1.0	1.27	1.00	1.00	1.00	3,349.8	1.00	62.8	5.5	1.3	1.3	6.8	7	MH
23	70	39.1	2.0	1.27	1.00	1.00	1.00	3,455.0	0.76	41.0	5.5	2.5	1.9	7.4	8	SM/SC/SC-SM
24	72	37.1	3.0	1.27	1.00	1.00	1.00	3,560.2	0.75	39.7	5.5	3.8	2.9	8.4	8	SM/SC/SC-SM
25	74	35.1	3.0	1.27	1.00	1.00	1.00	3,665.4	0.74	32.8	5.5	3.8	2.8	8.3	8	SM/SC/SC-SM
26	76	33.1	19.0	1.27	1.00	1.00	1.00	3,780.6	0.73	5.0	0.0	24.2	17.6	17.6	9	SW-SM/SW-SC/SP-SM/SP-SC
27	78	31.1	9.0	1.27	1.00	1.00	1.00	3,895.8	0.72	10.4	1.3	11.5	8.2	9.5	9	SW-SM/SW-SC/SP-SM/SP-SC
28	80	29.1	50.0	1.27	1.00	1.00	1.00	3,992.0	0.71	19.9	4.5	63.7	45.1	46.0	10	SM/SC/SC-SM
29	85	24.1	50.0	1.27	1.00	1.00	1.00	4,280.0	0.68	5.0	0.0	63.7	43.5	43.5	11	SW-SM/SW-SC/SP-SM/SP-SC
30	90	19.1	56.0	1.27	1.00	1.00	1.00	4,568.0	0.66	5.0	0.0	71.3	47.2	46.0	11	SW-SM/SW-SC/SP-SM/SP-SC
31	95	14.1	69.0	1.27	1.00	1.00	1.00	4,856.0	0.64	5.0	0.0	87.9	56.4	46.0	11	SW-SM/SW-SC/SP-SM/SP-SC
32	100	9.1	50.0	1.27	1.00	1.00	1.00	5,162.0	0.62	5.0	0.0	63.7	39.6	39.6	11	SW-SM/SW-SC/SP-SM/SP-SC
33	105	4.1	50.0	1.27	1.00	1.00	1.00	5,382.0	1.00	51.0	5.5	63.7	63.7	46.0	12	CL
34	110	-0.9	68.0	1.27	1.00	1.00	1.00	5,703.0	0.59	5.0	0.0	86.6	51.3	46.0	13	SW-SM/SW-SC/SP-SM/SP-SC
35	115	-5.9	50.0	1.27	1.00	1.00	1.00	5,941.0	1.00	80.0	5.5	63.7	63.7	46.0	14	MH
36	120	-10.9	50.0	1.27	1.00	1.00	1.00	6,179.0	1.00	80.0	5.5	63.7	63.7	46.0	14	MH

[D] Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = B-3A
Boring Station = 5950+10.72
Boring Offset = 6.25 LT
Ground Elevation at Boring (ft msl) = 109.1
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 109.1

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 14 each
No. of Split Spoon Samples = 36 each
Total Profile Thickness = 120 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	109.1																	
1	2	107.1	1.0	0.9	0.9	6.4	1	CL	HS Clay-Like	No Strength Loss		51.0					200		200
2	4	105.1	3.0	2.8	2.8	8.3	1	CL	HS Clay-Like	No Strength Loss		51.0					600		600
3	6	103.1	9.0	9.0	15.3	15.3	2	SP/SW	Sand-Like	Full Liquefaction	44.3	0.0				32		13	
4	8	101.1	27.0	28.4	48.2	46.0	3	SP/SW		No Liquefaction		0.0				32		32	
5	10	99.1	17.0	18.6	31.5	31.5	3	SP/SW		No Liquefaction		0.0				32		32	
6	15	94.1	40.0	46.6	46.6	46.0	4	ML	HS Clay-Like	No Strength Loss		53.1					1710		1710
7	20	89.1	50.0	60.5	82.9	46.0	5	SM/SC/SC-SM	HS Clay-Like	No Strength Loss		42.8					1780		1780
8	25	84.1	27.0	33.4	33.4	38.9	6	ML		No Liquefaction		51.0				36		36	
9	30	79.1	27.0	33.8	33.8	39.3	6	ML		No Liquefaction		51.0				36		36	
10	35	74.1	36.0	45.4	45.4	46.0	6	ML		No Liquefaction		51.0				36		36	
11	40	69.1	27.0	34.2	34.2	39.7	6	ML		No Liquefaction		51.0				36		36	
12	45	64.1	16.0	20.3	20.3	25.8	6	ML		No Liquefaction		63.3				36		36	
13	50	59.1	41.0	52.1	52.1	46.0	6	ML		No Strength Loss		51.0					2170		2170
14	52	57.1	47.0	59.8	59.8	46.0	6	ML		No Strength Loss		68.3					2190		2190
15	54	55.1	56.0	71.2	71.2	46.0	6	ML		No Strength Loss		51.0					2220		2220
16	56	53.1	50.0	63.6	63.6	46.0	6	ML		No Strength Loss		51.0					2240		2240
17	58	51.1	45.0	57.3	57.3	46.0	6	ML		No Strength Loss		51.0					2270		2270
18	60	49.1	2.0	2.5	2.5	8.0	7	MH		No Liquefaction		60.1				26		5	
19	62	47.1	3.0	3.8	3.8	9.3	7	MH		No Liquefaction		60.1				28		5	
20	64	45.1	1.0	1.3	1.3	6.8	7	MH	HS Clay-Like	Strength Loss		64.0					300		150
21	66	43.1	1.0	1.3	1.3	6.8	7	MH	HS Clay-Like	Strength Loss		64.0	0.004	83.4	1.8		300		240
22	68	41.1	1.0	1.3	1.3	6.8	7	MH	HS Clay-Like	Strength Loss		62.8					300		240
23	70	39.1	2.0	2.5	1.9	7.4	8	SM/SC/SC-SM	HS Clay-Like	Strength Loss		41.0	0.004	83.4	1.8		300		240
24	72	37.1	3.0	3.8	2.9	8.4	8	SM/SC/SC-SM		No Liquefaction		39.7				27		5	
25	74	35.1	3.0	3.8	2.8	8.3	8	SM/SC/SC-SM	HS Clay-Like	Strength Loss		32.8					300		240
26	76	33.1	19.0	24.2	17.6	17.6	9	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
27	78	31.1	9.0	11.5	8.2	9.5	9	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		10.4				31		5	
28	80	29.1	50.0	63.7	45.1	46.0	10	SM/SC/SC-SM		No Liquefaction		19.9				36		36	
29	85	24.1	50.0	63.7	43.5	43.5	11	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
30	90	19.1	56.0	71.3	47.2	46.0	11	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
31	95	14.1	69.0	87.9	56.4	46.0	11	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
32	100	9.1	50.0	63.7	39.6	39.6	11	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
33	105	4.1	50.0	63.7	63.7	46.0	12	CL		No Strength Loss		51.0					4000		4000
34	110	-0.9	68.0	86.6	51.3	46.0	13	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0	0.107	1.7	0.9	36		36	
35	115	-5.9	50.0	63.7	63.7	46.0	14	MH		No Strength Loss		80.0					3000		3000
36	120	-10.9	50.0	63.7	63.7	46.0	14	MH		No Strength Loss		80.0					3000		3000

^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	9/30/2014
Project:	RBO Four Hole Swamp						
Location:	B-4			**Station:**	5950+42.00	**Finished Embankment Height (ft)[1] =**	

[1] Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index:	0.50 ≤ β ≤ 1.5
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1]\le1.0$: for $h_{slope}\le20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.5	64.2	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; ε = 0.015(R-20)
D_{a5-95}	30.15	30.09	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; ε = 0

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	File No.:	38.040308	Latitude:	33.4570	Designer:	R. Gardner - Midlands RPG
Project:	RBO Four Hole Swamp			Longitude:	80.6470	Date:	9/30/2014
Route:	US 301	County:	38 - Orangeburg	Location:	B-4	Station:	5950+42.00

Design EQ =	SEE	Boring Number =	B-4	Hammer Type =	Automatic
Site Class =	D	Boring Station =	5950+42.00	Energy Ratio =	79.0
PGA (g) =	0.43	Boring Offset =	8 ft RT	Energy Correction (C_E) =	1.32
M_W =	7.4	Ground Elevation at Boring (ft msl) =	107.9		
R (km) =	63.5	Water Table Depth (Dw) (ft) =	0.0	Borehole Diameter (in) =	4
$D_{a5\text{-}95}$ (sec) =	30.15	Water Table Elevation (msl ft) =	107.9	Borehole Correction (CB) =	1.00

No. of Soil Layers = 11 each

No. of Split Spoon Samples = 23 each

Total Profile Thickness = 101.5 feet

Sampler Configuration:

Liner Required = N

Liner Used = N

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Seismic Analysis Summary		Geotechnical Seismic Hazards Summary		
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	$N^*_{1,60,CS}$	Soil Type (USCS)	SSL Potential	Sand-like or Clay-like	$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}	φ_{SL}	(D/C)SL ≤ φSL	R_u	φ' (degrees)	τ (psf)	ΔLDI_i (feet)	$\sum \Delta LDI_i$ (feet)	ΔS_i (inches)
	0	107.9													
1	2.3	105.6	46.0	SP/SW	NSL-S				No Liquefaction		32.0				
2	3.3	104.6	46.0	SP/SW	NSL-S				No Liquefaction		32.0				
3	7.5	100.4	18.3	SP/SW	SSL	Sand-Like	1.69	0.90	Full Liquefaction	0.7 - 1.0	30.4		0.81	0.81	1.25
4	9.5	98.4	15.2	SP/SW	SSL	Sand-Like	1.98	0.90	Full Liquefaction	0.7 - 1.0	12.9		0.54	1.35	0.68
5	11.5	96.4	27.5	ML	NSL-S				No Liquefaction		36.0				
6	16.5	91.4	23.8	ML	NSL-S				No Liquefaction		36.0				
7	21.5	86.4	30.5	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
8	26.5	81.4	23.9	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
9	31.5	76.4	34.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
10	36.5	71.4	33.4	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
11	41.5	66.4	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
12	46.5	61.4	25.7	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
13	51.5	56.4	31.4	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
14	56.5	51.4	44.3	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
15	61.5	46.4	32.4	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
16	66.5	41.4	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
17	71.5	36.4	24.7	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
18	76.5	31.4	37.9	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
19	81.5	26.4	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
20	86.5	21.4	35.7	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
21	91.5	16.4	46.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
22	96.5	11.4	46.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
23	101.5	6.4	46.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
													1.35		1.93
													LDI Total (feet)		S Total (inches)

[D] Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.: 40308
File No.: 38.040308
Latitude: 33.4570
Designer: R. Gardner - Midlands RPG
Project: RBO Four Hole Swamp
Longitude: 80.6470
Date: 9/30/2014
Route: US 301
County: 38 - Orangeburg
Location: B-4
Station: 5950+42.00

Boring Number = B-4
Boring Station = 5950+42.00
Boring Offset = 8 ft RT
Ground Elevation at Boring (ft msl) = 107.9
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 107.9

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 11 **each**
No. of Split Spoon Samples = 23 **each**
Total Profile Thickness = 102 **feet**

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	107.9														
1	2.3	105.6	50.0	1.32	1.00	0.70	1.00	132.5	1.70	0.1	0.0	46.0	78.1	46.0	1	SP/SW
2	3.3	104.6	50.0	1.32	1.00	0.72	1.00	190.1	1.70	0.1	0.0	47.7	81.1	46.0	1	SP/SW
3	7.5	100.4	10.0	1.32	1.00	0.82	1.00	432.0	1.70	0.1	0.0	10.7	18.3	18.3	1	SP/SW
4	9.5	98.4	8.0	1.32	1.00	0.85	1.00	550.2	1.70	0.1	0.0	9.0	15.2	15.2	1	SP/SW
5	11.5	96.4	19.0	1.32	1.00	0.88	1.00	645.4	1.00	50.2	5.5	22.0	22.0	27.5	2	ML
6	16.5	91.4	15.0	1.32	1.00	0.93	1.00	874.4	1.00	52.4	5.5	18.3	18.3	23.8	3	ML
7	21.5	86.4	15.0	1.32	1.00	0.96	1.00	1,137.4	1.33	32.8	5.5	18.9	25.1	30.5	4	SM/SC/SC-SM
8	26.5	81.4	12.0	1.32	1.00	0.98	1.00	1,400.4	1.20	49.8	5.5	15.4	18.4	23.9	5	SM/SC/SC-SM
9	31.5	76.4	20.0	1.32	1.00	0.99	1.00	1,663.4	1.10	49.4	5.5	26.0	28.5	34.0	6	SM/SC/SC-SM
10	36.5	71.4	21.0	1.32	1.00	0.99	1.00	1,926.4	1.02	49.4	5.5	27.4	27.9	33.4	6	SM/SC/SC-SM
11	41.5	66.4	39.0	1.32	1.00	1.00	1.00	2,189.4	0.96	49.4	5.5	51.1	48.8	46.0	6	SM/SC/SC-SM
12	46.5	61.4	17.0	1.32	1.00	1.00	1.00	2,452.4	0.90	49.4	5.5	22.3	20.2	25.7	6	SM/SC/SC-SM
13	51.5	56.4	23.0	1.32	1.00	1.00	1.00	2,715.4	0.86	42.6	5.5	30.2	25.9	31.4	7	SM/SC/SC-SM
14	56.5	51.4	36.0	1.32	1.00	1.00	1.00	2,978.4	0.82	42.6	5.5	47.4	38.8	44.3	7	SM/SC/SC-SM
15	61.5	46.4	26.0	1.32	1.00	1.00	1.00	3,241.4	0.79	42.6	5.5	34.2	26.9	32.4	7	SM/SC/SC-SM
16	66.5	41.4	51.0	1.32	1.00	1.00	1.00	3,504.4	0.76	33.5	5.5	67.1	50.7	46.0	8	SM/SC/SC-SM
17	71.5	36.4	20.0	1.32	1.00	1.00	1.00	3,767.4	0.73	33.5	5.5	26.3	19.2	24.7	8	SM/SC/SC-SM
18	76.5	31.4	35.0	1.32	1.00	1.00	1.00	4,030.4	0.70	33.5	5.5	46.1	32.5	37.9	8	SM/SC/SC-SM
19	81.5	26.4	50.0	1.32	1.00	1.00	1.00	4,280.9	0.68	27.3	5.2	65.8	45.0	46.0	9	SM/SC/SC-SM
20	86.5	21.4	41.0	1.32	1.00	1.00	1.00	4,568.9	0.66	5.0	0.0	54.0	35.7	35.7	10	SW-SM/SW-SC/SP-SM/SP-SC
21	91.5	16.4	68.0	1.32	1.00	1.00	1.00	4,856.9	0.64	5.0	0.0	89.5	57.5	46.0	11	SW-SM/SW-SC/SP-SM/SP-SC
22	96.5	11.4	72.0	1.32	1.00	1.00	1.00	5,144.9	0.62	5.0	0.0	94.8	59.1	46.0	11	SW-SM/SW-SC/SP-SM/SP-SC
23	101.5	6.4	66.0	1.32	1.00	1.00	1.00	5,432.9	0.61	5.0	0.0	86.9	52.7	46.0	11	SW-SM/SW-SC/SP-SM/SP-SC

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = B-4
Boring Station = 5950+42.00
Boring Offset = 8 ft RT
Ground Elevation at Boring (ft msl) = 107.9
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 107.9

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 11 **each**
No. of Split Spoon Samples = 23 **each**
Total Profile Thickness = 102 **feet**

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \le \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	107.9																	
1	2.3	105.6	50.0	46.0	78.1	46.0	1	SP/SW		No Liquefaction		0.1				32		32	
2	3.3	104.6	50.0	47.7	81.1	46.0	1	SP/SW		No Liquefaction		0.1				32		32	
3	7.5	100.4	10.0	10.7	18.3	18.3	1	SP/SW	Sand-Like	Full Liquefaction	48.3	0.1				32		30	
4	9.5	98.4	8.0	9.0	15.2	15.2	1	SP/SW	Sand-Like	Full Liquefaction	44.1	0.1				32		13	
5	11.5	96.4	19.0	22.0	22.0	27.5	2	ML		No Liquefaction		50.2				36		36	
6	16.5	91.4	15.0	18.3	18.3	23.8	3	ML		No Liquefaction		52.4				36		36	
7	21.5	86.4	15.0	18.9	25.1	30.5	4	SM/SC/SC-SM		No Liquefaction		32.8				36		36	
8	26.5	81.4	12.0	15.4	18.4	23.9	5	SM/SC/SC-SM		No Liquefaction		49.8				36		36	
9	31.5	76.4	20.0	26.0	28.5	34.0	6	SM/SC/SC-SM		No Liquefaction		49.4				36		36	
10	36.5	71.4	21.0	27.4	27.9	33.4	6	SM/SC/SC-SM		No Liquefaction		49.4				36		36	
11	41.5	66.4	39.0	51.1	48.8	46.0	6	SM/SC/SC-SM		No Liquefaction		49.4				36		36	
12	46.5	61.4	17.0	22.3	20.2	25.7	6	SM/SC/SC-SM		No Liquefaction		49.4				36		36	
13	51.5	56.4	23.0	30.2	25.9	31.4	7	SM/SC/SC-SM		No Liquefaction		42.6				36		36	
14	56.5	51.4	36.0	47.4	38.8	44.3	7	SM/SC/SC-SM		No Liquefaction		42.6				36		36	
15	61.5	46.4	26.0	34.2	26.9	32.4	7	SM/SC/SC-SM		No Liquefaction		42.6				36		36	
16	66.5	41.4	51.0	67.1	50.7	46.0	8	SM/SC/SC-SM		No Liquefaction		33.5				36		36	
17	71.5	36.4	20.0	26.3	19.2	24.7	8	SM/SC/SC-SM		No Liquefaction		33.5				36		36	
18	76.5	31.4	35.0	46.1	32.5	37.9	8	SM/SC/SC-SM		No Liquefaction		33.5				36		36	
19	81.5	26.4	50.0	65.8	45.0	46.0	9	SM/SC/SC-SM		No Liquefaction		27.3				36		36	
20	86.5	21.4	41.0	54.0	35.7	35.7	10	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
21	91.5	16.4	68.0	89.5	57.5	46.0	11	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
22	96.5	11.4	72.0	94.8	59.1	46.0	11	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
23	101.5	6.4	66.0	86.9	52.7	46.0	11	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	

^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	9/30/2014
Project:	RBO Four Hole Swamp						
Location:	B-5			**Station:**	5950+98.00	**Finished Embankment Height (ft)^1 =**	

^{1}**Embankment height measured from natural ground surface**

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
$\beta = S_{D1}/PGA$ =	1.140	0.900		β = Ground Motion Index:	$0.50 \leq \beta \leq 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1]\leq1.0$: for $h_{slope}\leq20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.5	64.2	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; $\varepsilon = 0.015(R-20)$
D_{a5-95}	30.15	30.09	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; $\varepsilon = 0$

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	RBO Four Hole Swamp			**Longitude:**	80.6470	**Date:**	9/30/2014
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	B-5	**Station:**	5950+98.00

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.4
R (km) = 63.5
D_{a5-95} (sec) = 30.15

Boring Number = B-5
Boring Station = 5950+98.00
Boring Offset = 8 ft LT
Ground Elevation at Boring (ft msl) = 105.5
Water Table Depth (Dw) (ft) = 0.0
Water Table Elevation (msl ft) = 105.5

Hammer Type = Automatic
Energy Ratio = 79.0
Energy Correction (C_E) = 1.32
Borehole Diameter (in) = 4
Borehole Correction (CB) = 1.00

No. of Soil Layers = 12 each
No. of Split Spoon Samples = 25 each
Total Profile Thickness = 101.3 feet

Sampler Configuration:
Liner Required = N
Liner Used = N

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Soil Shear Strength for Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	105.5													
1	3.5	102.0	8.6	SM/SC/SC-SM	SSL	Sand-Like	3.08	0.90	Full Liquefaction	0.7 - 1.0	4.9		1.75	1.75	1.71
2	5.5	100.0	27.8	SP/SW	NSL-S				No Liquefaction		38.0				
3	7.5	98.0	13.0	ML	SSL	Sand-Like	1.79	0.90	Full Liquefaction	0.7 - 1.0	8.3		0.68	2.43	0.76
4	8.3	97.2	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
5	10	95.5	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
6	11	94.5	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
7	16	89.5	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
8	21	84.5	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
9	26	79.5	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
10	31	74.5	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
11	33.9	71.6	24.8	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
12	36.5	69.0	33.4	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
13	41.5	64.0	44.8	ML	PSL	NS Clay-Like	0.69	0.90	No Strength Loss			2090.00			
14	46.5	59.0	46.0	ML	PSL	NS Clay-Like	0.74	0.90	No Strength Loss			2160.00			
15	51.5	54.0	35.7	ML	NSL-S				No Liquefaction		30.0				
16	56.5	49.0	33.1	ML	NSL-S				No Liquefaction		30.0				
17	61.5	44.0	26.3	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
18	66.5	39.0	1.0	SP/SW	NSL-S				No Liquefaction		2.0				
19	71.5	34.0	1.9	SP/SW	NSL-S				No Liquefaction		2.0				
20	76.5	29.0	46.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
21	81.5	24.0	46.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
22	86.5	19.0	35.7	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
23	91.5	14.0	46.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
24	96.5	9.0	37.8	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
25	101.3	4.2	40.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
													2.43		**2.47**
													LDI Total (feet)		**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.: 40308 **File No.:** 38.040308 **Latitude:** 33.4570 **Designer:** R. Gardner - Midlands RPG
Project: RBO Four Hole Swamp **Longitude:** 80.6470 **Date:** 9/30/2014
Route: US 301 **County:** 38 - Orangeburg **Location:** B-5 **Station:** 5950+98.00

Boring Number = B-5
Boring Station = 5950+98.00
Boring Offset = 8 ft LT
Ground Elevation at Boring (ft msl) = 105.5
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 105.5

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
$D_{a5\text{-}95}$ (sec) = 30.15

No. of Soil Layers = 12 each
No. of Split Spoon Samples = 25 each
Total Profile Thickness = 101 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	105.5														
1	3.5	102.0	4.0	1.32	1.00	0.73	1.00	184.6	1.70	12.0	2.1	3.8	6.5	8.6	1	SM/SC/SC-SM
2	5.5	100.0	16.0	1.32	1.00	0.78	1.00	302.8	1.70	3.8	0.0	16.4	27.8	27.8	2	SP/SW
3	7.5	98.0	7.0	1.32	1.00	0.82	1.00	396.5	1.00	59.9	5.5	7.5	7.5	13.0	3	ML
4	8.3	97.2	50.0	1.32	1.00	0.83	1.00	438.6	1.70	47.8	5.5	54.7	92.9	46.0	4	SM/SC/SC-SM
5	10	95.5	50.0	1.32	1.00	0.86	1.00	528.0	1.70	12.0	2.1	56.4	95.9	46.0	5	SM/SC/SC-SM
6	11	94.5	50.0	1.32	1.00	0.87	1.00	580.6	1.70	12.0	2.1	57.3	97.5	46.0	5	SM/SC/SC-SM
7	16	89.5	50.0	1.32	1.00	0.92	1.00	843.6	1.54	12.0	2.1	60.8	93.6	46.0	5	SM/SC/SC-SM
8	21	84.5	50.0	1.32	1.00	0.96	1.00	1,106.6	1.34	12.0	2.1	62.9	84.5	46.0	5	SM/SC/SC-SM
9	26	79.5	50.0	1.32	1.00	0.97	1.00	1,369.6	1.21	12.0	2.1	64.1	77.5	46.0	6	SM/SC/SC-SM
10	31	74.5	50.0	1.32	1.00	0.98	1.00	1,632.6	1.11	12.0	2.1	64.8	71.8	46.0	6	SM/SC/SC-SM
11	33.9	71.6	14.0	1.32	1.00	0.99	1.00	1,785.1	1.06	41.2	5.5	18.2	19.3	24.8	7	SM/SC/SC-SM
12	36.5	69.0	21.0	1.32	1.00	0.99	1.00	1,930.9	1.02	41.2	5.5	27.4	27.9	33.4	7	SM/SC/SC-SM
13	41.5	64.0	30.0	1.32	1.00	1.00	1.00	2,168.9	1.00	52.3	5.5	39.3	39.3	44.8	8	ML
14	46.5	59.0	32.0	1.32	1.00	1.00	1.00	2,406.9	1.00	52.3	5.5	42.0	42.0	46.0	8	ML
15	51.5	54.0	23.0	1.32	1.00	1.00	1.00	2,644.9	1.00	50.1	5.5	30.2	30.2	35.7	8	ML
16	56.5	49.0	21.0	1.32	1.00	1.00	1.00	2,873.9	1.00	50.1	5.5	27.6	27.6	33.1	9	ML
17	61.5	44.0	23.0	1.32	1.00	1.00	1.00	3,127.9	0.80	12.0	2.1	30.3	24.2	26.3	10	SM/SC/SC-SM
18	66.5	39.0	1.0	1.32	1.00	1.00	1.00	3,415.9	0.77	2.6	0.0	1.3	1.0	1.0	11	SP/SW
19	71.5	34.0	2.0	1.32	1.00	1.00	1.00	3,703.9	0.73	2.6	0.0	2.6	1.9	1.9	11	SP/SW
20	76.5	29.0	59.0	1.32	1.00	1.00	1.00	3,991.9	0.71	5.0	0.0	77.7	55.0	46.0	12	SW-SM/SW-SC/SP-SM/SP-SC
21	81.5	24.0	73.0	1.32	1.00	1.00	1.00	4,279.9	0.68	5.0	0.0	96.1	65.7	46.0	12	SW-SM/SW-SC/SP-SM/SP-SC
22	86.5	19.0	41.0	1.32	1.00	1.00	1.00	4,567.9	0.66	5.0	0.0	54.0	35.7	35.7	12	SW-SM/SW-SC/SP-SM/SP-SC
23	91.5	14.0	81.0	1.32	1.00	1.00	1.00	4,855.9	0.64	5.0	0.0	106.6	68.4	46.0	12	SW-SM/SW-SC/SP-SM/SP-SC
24	96.5	9.0	46.0	1.32	1.00	1.00	1.00	5,143.9	0.62	5.0	0.0	60.6	37.8	37.8	12	SW-SM/SW-SC/SP-SM/SP-SC
25	101.3	4.2	50.0	1.32	1.00	1.00	1.00	5,420.4	0.61	5.0	0.0	65.8	40.0	40.0	12	SW-SM/SW-SC/SP-SM/SP-SC

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = B-5
Boring Station = 5950+98.00
Boring Offset = 8 ft LT
Ground Elevation at Boring (ft msl) = 105.5
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 105.5

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 12 **each**
No. of Split Spoon Samples = 25 **each**
Total Profile Thickness = 101 **feet**

SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**N_{Meas}**	**N^*_{60}**	**$N^*_{1,60}$**	**$N^*_{1,60,CS}$**	**Soil Layer No.**	**Soil Type (USCS)**	**Screening Sand-Like or Clay-Like**	**Triggering $(D/C)_{SL} \leq \varphi_{SL}$**	**D_R (%)**	**Fines Content (%)**	**D_{10} (%)**	**C_u**	**C_c**	**Static Shear Strengths**		**Seismic Shear Strengths**	
																ϕ' (degrees)	**τ = c (psf)**	**ϕ' (degrees)**	**τ = c (psf)**
	0	105.5																	
1	3.5	102.0	4.0	3.8	6.5	8.6	1	SM/SC/SC-SM	Sand-Like	Full Liquefaction	28.9	12.0				30		5	
2	5.5	100.0	16.0	16.4	27.8	27.8	2	SP/SW		No Liquefaction		3.8				38		38	
3	7.5	98.0	7.0	7.5	7.5	13.0	3	ML	Sand-Like	Full Liquefaction	40.4	59.9				30		8	
4	8.3	97.2	50.0	54.7	92.9	46.0	4	SM/SC/SC-SM		No Liquefaction		47.8				36		36	
5	10	95.5	50.0	56.4	95.9	46.0	5	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
6	11	94.5	50.0	57.3	97.5	46.0	5	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
7	16	89.5	50.0	60.8	93.6	46.0	5	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
8	21	84.5	50.0	62.9	84.5	46.0	5	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
9	26	79.5	50.0	64.1	77.5	46.0	6	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
10	31	74.5	50.0	64.8	71.8	46.0	6	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
11	33.9	71.6	14.0	18.2	19.3	24.8	7	SM/SC/SC-SM		No Liquefaction		41.2				36		36	
12	36.5	69.0	21.0	27.4	27.9	33.4	7	SM/SC/SC-SM		No Liquefaction		41.2				36		36	
13	41.5	64.0	30.0	39.3	39.3	44.8	8	ML	NS Clay-Like	No Strength Loss		52.3					2090		2090
14	46.5	59.0	32.0	42.0	42.0	46.0	8	ML	NS Clay-Like	No Strength Loss		52.3					2160		2160
15	51.5	54.0	23.0	30.2	30.2	35.7	8	ML		No Liquefaction		50.1				30		30	
16	56.5	49.0	21.0	27.6	27.6	33.1	9	ML		No Liquefaction		50.1				30		30	
17	61.5	44.0	23.0	30.3	24.2	26.3	10	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
18	66.5	39.0	1.0	1.3	1.0	1.0	11	SP/SW		No Liquefaction		2.6				24		2	
19	71.5	34.0	2.0	2.6	1.9	1.9	11	SP/SW		No Liquefaction		2.6				25		2	
20	76.5	29.0	59.0	77.7	55.0	46.0	12	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
21	81.5	24.0	73.0	96.1	65.7	46.0	12	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
22	86.5	19.0	41.0	54.0	35.7	35.7	12	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
23	91.5	14.0	81.0	106.6	68.4	46.0	12	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
24	96.5	9.0	46.0	60.6	37.8	37.8	12	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
25	101.3	4.2	50.0	65.8	40.0	40.0	12	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	

^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	2/18/2015
Project:	RBO Four Hole Swamp						
Location:	B-5A			**Station:**	5950+99.11	**Finished Embankment Height (ft)[1] =**	

[1] **Embankment height measured from natural ground surface**

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
$\beta = S_{D1}$/PGA =	1.140	0.900		β = Ground Motion Index:	$0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1]\le1.0$: for $h_{slope}\le20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.5	64.2	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; $\varepsilon = 0.015(R-20)$
D_{a5-95}	30.15	30.09	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; $\varepsilon = 0$

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	RBO Four Hole Swamp			**Longitude:**	80.6470	**Date:**	2/18/2015
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	B-5A	**Station:**	5950+99.11

Design EQ =	SEE	**Boring Number =**	B-5A	**Hammer Type =**	Safety
Site Class =	D	**Boring Station =**	5950+99.11	**Energy Ratio =**	76.4
PGA (g) =	0.43	**Boring Offset =**	8.13 ft RT	**Energy Correction (C_E) =**	1.27
M_W =	7.4	**Ground Elevation at Boring (ft msl) =**	107.6		
R (km) =	63.5	**Water Table Depth (Dw) (ft) =**	0.0	**Borehole Diameter (in) =**	4
D_{a5-95} (sec) =	30.15	**Water Table Elevation (msl ft) =**	107.6	**Borehole Correction (CB) =**	1.00

No. of Soil Layers =	9	each	**Sampler Configuration:**	
No. of Split Spoon Samples =	33	each	**Liner Required =**	N
Total Profile Thickness =	120	feet	**Liner Used =**	N

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	107.6													
1	4	103.6	16.5	SM/SC/SC-SM	SSL	Sand-Like	1.97	0.90	Full Liquefaction	0.7 - 1.0	18.1		0.93	0.93	1.28
2	6	101.6	32.7	SM/SC/SC-SM	NSL-S				No Liquefaction		35.0				
3	8	99.6	46.0	SP/SW	NSL-S				No Liquefaction		36.0				
4	9	98.6	46.0	SP/SW	NSL-S				No Liquefaction		32.0				
5	10	97.6	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		32.0				
6	15	92.6	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
7	20	87.6	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
8	25	82.6	22.8	ML	NSL-S				No Liquefaction		30.0				
9	30	77.6	24.3	ML	NSL-S				No Liquefaction		30.0				
10	35	72.6	46.0	ML	NSL-S				No Liquefaction		30.0				
11	40	67.6	30.8	ML	NSL-S				No Liquefaction		30.0				
12	45	62.6	46.0	ML	NSL-S				No Liquefaction		30.0				
13	50	57.6	46.0	ML	NSL-S				No Liquefaction		30.0				
14	55	52.6	46.0	ML	NSL-S				No Liquefaction		30.0				
15	60	47.6	46.0	ML	NSL-S				No Liquefaction		30.0				
16	62	45.6	46.0	ML	NSL-S				No Liquefaction		30.0				
17	64	43.6	46.0	ML	NSL-S				No Liquefaction		30.0				
18	66	41.6	46.0	ML	NSL-S				No Liquefaction		30.0				
19	68	39.6	46.0	ML	NSL-S				No Liquefaction		30.0				
20	70	37.6	46.0	ML	NSL-S				No Liquefaction		30.0				
21	72	35.6	46.0	ML	NSL-S				No Liquefaction		30.0				
22	74	33.6	46.0	ML	NSL-S				No Liquefaction		30.0				
23	76	31.6	46.0	ML	NSL-S				No Liquefaction		30.0				
24	78	29.6	31.9	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
25	80	27.6	37.9	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
26	85	22.6	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
27	88.9	18.7	45.4	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
28	95	12.6	43.9	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
29	100	7.6	42.8	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
30	105	2.6	46.0	CH	PSL	HS Clay-Like	0.87	0.90	No Strength Loss			4000.00			
31	110	-2.4	40.5	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
32	115	-7.4	39.5	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
33	120	-12.4	46.0	MH	PSL	NS Clay-Like	0.83	0.90	No Strength Loss			5000.00			

0.93	**1.28**
LDI Total (feet)	**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.:	**40308**	**File No.:**	**38.040308**	**Latitude:**	**33.4570**	**Designer:**	**R. Gardner - Midlands RPG**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**80.6470**	**Date:**	**2/18/2015**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**	**B-5A**	**Station:**	**5950+99.11**

Boring Number =	**B-5A**	**Design EQ =**	**SEE**	**No. of Soil Layers =**	**9**	**each**
Boring Station =	**5950+99.11**	**Site Class =**	**D**	**No. of Split Spoon Samples =**	**33**	**each**
Boring Offset =	**8.13 ft RT**	**PGA (g) =**	**0.43**	**Total Profile Thickness =**	**120**	**feet**
Ground Elevation at Boring (ft msl) =	**107.6**	**M_W =**	**7.37**			
Water Table Depth (Dw) (ft) =	**0**	**R (km) =**	**63.5**			
Water Table Elevation (msl ft) =	**107.6**	**$D_{a5\text{-}95}$ (sec) =**	**30.15**			

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	107.6														
1	4	103.6	9.0	1.27	1.00	0.74	1.00	210.4	1.70	12.0	2.1	8.5	14.5	16.5	1	SM/SC/SC-SM
2	6	101.6	18.0	1.27	1.00	0.79	1.00	315.6	1.70	12.0	2.1	18.0	30.7	32.7	1	SM/SC/SC-SM
3	8	99.6	30.0	1.27	1.00	0.83	1.00	430.8	1.70	0.0	0.0	31.5	53.6	46.0	2	SP/SW
4	9	98.6	50.0	1.27	1.00	0.84	1.00	488.4	1.70	0.0	0.0	53.6	91.1	46.0	2	SP/SW
5	10	97.6	50.0	1.27	1.00	0.86	1.00	541.0	1.70	12.0	2.1	54.6	92.8	46.0	3	SM/SC/SC-SM
6	15	92.6	50.0	1.27	1.00	0.91	1.00	804.0	1.58	47.9	5.5	58.2	91.9	46.0	3	SM/SC/SC-SM
7	20	87.6	34.0	1.27	1.00	0.95	1.00	1,074.5	1.36	47.9	5.5	41.1	56.1	46.0	3	SM/SC/SC-SM
8	25	82.6	14.0	1.27	1.00	0.97	1.00	1,312.5	1.00	63.4	5.5	17.3	17.3	22.8	4	ML
9	30	77.6	15.0	1.27	1.00	0.98	1.00	1,550.5	1.00	63.4	5.5	18.8	18.8	24.3	4	ML
10	35	72.6	52.0	1.27	1.00	0.99	1.00	1,788.5	1.00	52.3	5.5	65.6	65.6	46.0	4	ML
11	40	67.6	20.0	1.27	1.00	0.99	1.00	2,026.5	1.00	52.3	5.5	25.3	25.3	30.8	4	ML
12	45	62.6	32.0	1.27	1.00	1.00	1.00	2,264.5	1.00	66.3	5.5	40.6	40.6	46.0	4	ML
13	50	57.6	41.0	1.27	1.00	1.00	1.00	2,502.5	1.00	66.3	5.5	52.1	52.1	46.0	4	ML
14	55	52.6	38.0	1.27	1.00	1.00	1.00	2,740.5	1.00	67.6	5.5	48.3	48.3	46.0	4	ML
15	60	47.6	46.0	1.27	1.00	1.00	1.00	2,978.5	1.00	67.6	5.5	58.5	58.5	46.0	4	ML
16	62	45.6	36.0	1.27	1.00	1.00	1.00	3,073.7	1.00	67.6	5.5	45.8	45.8	46.0	4	ML
17	64	43.6	50.0	1.27	1.00	1.00	1.00	3,168.9	1.00	67.6	5.5	63.6	63.6	46.0	4	ML
18	66	41.6	50.0	1.27	1.00	1.00	1.00	3,264.1	1.00	67.6	5.5	63.6	63.6	46.0	4	ML
19	68	39.6	49.0	1.27	1.00	1.00	1.00	3,359.3	1.00	67.6	5.5	62.4	62.4	46.0	4	ML
20	70	37.6	50.0	1.27	1.00	1.00	1.00	3,454.5	1.00	67.6	5.5	63.7	63.7	46.0	4	ML
21	72	35.6	46.0	1.27	1.00	1.00	1.00	3,549.7	1.00	67.6	5.5	58.6	58.6	46.0	4	ML
22	74	33.6	84.0	1.27	1.00	1.00	1.00	3,644.9	1.00	67.6	5.5	106.9	106.9	46.0	4	ML
23	76	31.6	50.0	1.27	1.00	1.00	1.00	3,740.1	1.00	67.6	5.5	63.7	63.7	46.0	4	ML
24	78	29.6	30.0	1.27	1.00	1.00	1.00	3,845.3	0.72	19.2	4.3	38.2	27.5	31.9	5	SM/SC/SC-SM
25	80	27.6	37.0	1.27	1.00	1.00	1.00	3,950.5	0.71	19.2	4.3	47.1	33.5	37.9	5	SM/SC/SC-SM
26	85	22.6	50.0	1.27	1.00	1.00	1.00	4,213.5	0.69	13.2	2.6	63.7	43.9	46.0	6	SM/SC/SC-SM
27	88.9	18.7	50.0	1.27	1.00	1.00	1.00	4,418.6	0.67	13.2	2.6	63.7	42.8	45.4	6	SM/SC/SC-SM
28	95	12.6	50.0	1.27	1.00	1.00	1.00	4,739.5	0.65	13.2	2.6	63.7	41.4	43.9	6	SM/SC/SC-SM
29	100	7.6	50.0	1.27	1.00	1.00	1.00	5,011.5	0.63	13.2	2.6	63.7	40.2	42.8	6	SM/SC/SC-SM
30	105	2.6	36.0	1.27	1.00	1.00	1.00	5,240.5	1.00	61.0	5.5	45.8	45.8	46.0	7	CH
31	110	-2.4	50.0	1.27	1.00	1.00	1.00	5,503.5	0.60	12.0	2.1	63.7	38.4	40.5	8	SM/SC/SC-SM
32	115	-7.4	50.0	1.27	1.00	1.00	1.00	5,775.5	0.59	12.0	2.1	63.7	37.5	39.5	8	SM/SC/SC-SM
33	120	-12.4	50.0	1.27	1.00	1.00	1.00	6,013.5	1.00	65.0	5.5	63.7	63.7	46.0	9	MH

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = B-5A
Boring Station = 5950+99.11
Boring Offset = 8.13 ft RT
Ground Elevation at Boring (ft msl) = 107.6
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 107.6

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 9 **each**
No. of Split Spoon Samples = 33 **each**
Total Profile Thickness = 120 **feet**

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \le \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	107.6																	
1	4	103.6	9.0	8.5	14.5	16.5	1	SM/SC/SC-SM	Sand-Like	Full Liquefaction	43.0	12.0				35		18	
2	6	101.6	18.0	18.0	30.7	32.7	1	SM/SC/SC-SM		No Liquefaction		12.0				35		35	
3	8	99.6	30.0	31.5	53.6	46.0	2	SP/SW		No Liquefaction		0.0				36		36	
4	9	98.6	50.0	53.6	91.1	46.0	2	SP/SW		No Liquefaction		0.0				32		32	
5	10	97.6	50.0	54.6	92.8	46.0	3	SM/SC/SC-SM		No Liquefaction		12.0				32		32	
6	15	92.6	50.0	58.2	91.9	46.0	3	SM/SC/SC-SM		No Liquefaction		47.9				36		36	
7	20	87.6	34.0	41.1	56.1	46.0	3	SM/SC/SC-SM		No Liquefaction		47.9				36		36	
8	25	82.6	14.0	17.3	17.3	22.8	4	ML		No Liquefaction		63.4				30		30	
9	30	77.6	15.0	18.8	18.8	24.3	4	ML		No Liquefaction		63.4				30		30	
10	35	72.6	52.0	65.6	65.6	46.0	4	ML		No Liquefaction		52.3				30		30	
11	40	67.6	20.0	25.3	25.3	30.8	4	ML		No Liquefaction		52.3				30		30	
12	45	62.6	32.0	40.6	40.6	46.0	4	ML		No Liquefaction		66.3				30		30	
13	50	57.6	41.0	52.1	52.1	46.0	4	ML		No Liquefaction		66.3				30		30	
14	55	52.6	38.0	48.3	48.3	46.0	4	ML		No Liquefaction		67.6				30		30	
15	60	47.6	46.0	58.5	58.5	46.0	4	ML		No Liquefaction		67.6				30		30	
16	62	45.6	36.0	45.8	45.8	46.0	4	ML		No Liquefaction		67.6				30		30	
17	64	43.6	50.0	63.6	63.6	46.0	4	ML		No Liquefaction		67.6				30		30	
18	66	41.6	50.0	63.6	63.6	46.0	4	ML		No Liquefaction		67.6				30		30	
19	68	39.6	49.0	62.4	62.4	46.0	4	ML		No Liquefaction		67.6				30		30	
20	70	37.6	50.0	63.7	63.7	46.0	4	ML		No Liquefaction		67.6				30		30	
21	72	35.6	46.0	58.6	58.6	46.0	4	ML		No Liquefaction		67.6				30		30	
22	74	33.6	84.0	106.9	106.9	46.0	4	ML		No Liquefaction		67.6				30		30	
23	76	31.6	50.0	63.7	63.7	46.0	4	ML		No Liquefaction		67.6				30		30	
24	78	29.6	30.0	38.2	27.5	31.9	5	SM/SC/SC-SM		No Liquefaction		19.2				36		36	
25	80	27.6	37.0	47.1	33.5	37.9	5	SM/SC/SC-SM		No Liquefaction		19.2				36		36	
26	85	22.6	50.0	63.7	43.9	46.0	6	SM/SC/SC-SM		No Liquefaction		13.2				36		36	
27	88.9	18.7	50.0	63.7	42.8	45.4	6	SM/SC/SC-SM		No Liquefaction		13.2				36		36	
28	95	12.6	50.0	63.7	41.4	43.9	6	SM/SC/SC-SM		No Liquefaction		13.2				36		36	
29	100	7.6	50.0	63.7	40.2	42.8	6	SM/SC/SC-SM		No Liquefaction		13.2				36		36	
30	105	2.6	36.0	45.8	45.8	46.0	7	CH	HS Clay-Like	No Strength Loss		61.0	0.004	18.7	3.3		4000		4000
31	110	-2.4	50.0	63.7	38.4	40.5	8	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
32	115	-7.4	50.0	63.7	37.5	39.5	8	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
33	120	-12.4	50.0	63.7	63.7	46.0	9	MH	NS Clay-Like	No Strength Loss		65.0					5000		5000

^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	10/1/2014
Project:	RBO Four Hole Swamp						
Location:	B-6			**Station:**	5951+41.00	**Finished Embankment Height (ft)[1] =**	

[1] Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
$\beta = S_{D1}/PGA$ =	1.140	0.900		β = Ground Motion Index:	$0.50 \leq \beta \leq 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1]\leq 1.0$: for $h_{slope} \leq 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.5	64.2	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; ε = 0.015(R-20)
D_{a5-95}	30.15	30.09	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; ε = 0

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	RBO Four Hole Swamp			**Longitude:**	80.6470	**Date:**	10/1/2014
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	B-6	**Station:**	5951+41.00

Design EQ =	SEE	**Boring Number =**	B-6	**Hammer Type =**	Automatic
Site Class =	D	**Boring Station =**	5951+41.00	**Energy Ratio =**	79.0
PGA (g) =	0.43	**Boring Offset =**	8 ft RT	**Energy Correction (C_E) =**	1.32
M_W =	7.4	**Ground Elevation at Boring (ft msl) =**	107.8		
R (km) =	63.5	**Water Table Depth (Dw) (ft) =**	0.0	**Borehole Diameter (in) =**	4
D_{a5-95} (sec) =	30.15	**Water Table Elevation (msl ft) =**	107.8	**Borehole Correction (CB) =**	1.00

No. of Soil Layers =	8	each	**Sampler Configuration:**	
No. of Split Spoon Samples =	10	each	**Liner Required =**	N
Total Profile Thickness =	35.2	feet	**Liner Used =**	N

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Seismic Analysis Summary		Geotechnical Seismic Hazards Summary		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	107.8													
1	3.5	104.3	13.5	SM/SC/SC-SM	NSL-S				No Liquefaction		9.0				
2	5.5	102.3	19.1	SP/SW	NSL-S				No Liquefaction		32.0				
3	7.5	100.3	46.0	SP/SW	NSL-S				No Liquefaction		32.0				
4	9.5	98.3	13.3	SP/SW	NSL-S				No Liquefaction		9.0				
5	11.5	96.3	6.5	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		4.0				
6	15.2	92.6	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
7	20.2	87.6	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
8	25.2	82.6	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
9	30.2	77.6	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
10	35.2	72.6	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
													0.00		0.00
													LDI Total (feet)		**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	RBO Four Hole Swamp			**Longitude:**	80.6470	**Date:**	10/1/2014
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	B-6	**Station:**	5951+41.00

Boring Number =	B-6	**Design EQ =**	SEE	**No. of Soil Layers =**	8	each
Boring Station =	5951+41.00	**Site Class =**	D	**No. of Split Spoon Samples =**	10	each
Boring Offset =	8 ft RT	**PGA (g) =**	0.43	**Total Profile Thickness =**	35	feet
Ground Elevation at Boring (ft msl) =	107.8	**M_W =**	7.37			
Water Table Depth (Dw) (ft) =	0	**R (km) =**	63.5			
Water Table Elevation (msl ft) =	107.8	**D_{a5-95} (sec) =**	30.15			

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	107.8														
1	3.5	104.3	7.0	1.32	1.00	0.73	1.00	184.6	1.70	12.0	2.1	6.7	11.4	13.5	1	SM/SC/SC-SM
2	5.5	102.3	11.0	1.32	1.00	0.78	1.00	299.8	1.70	1.6	0.0	11.2	19.1	19.1	2	SP/SW
3	7.5	100.3	28.0	1.32	1.00	0.82	1.00	415.0	1.70	43.7	5.5	30.1	51.2	46.0	3	SP/SW
4	9.5	98.3	7.0	1.32	1.00	0.85	1.00	530.2	1.70	2.1	0.0	7.8	13.3	13.3	4	SP/SW
5	11.5	96.3	3.0	1.32	1.00	0.88	1.00	654.4	1.70	8.8	0.6	3.5	5.9	6.5	5	SW-SM/SW-SC/SP-SM/SP-SC
6	15.2	92.6	50.0	1.32	1.00	0.92	1.00	849.0	1.53	12.0	2.1	60.3	92.6	46.0	6	SM/SC/SC-SM
7	20.2	87.6	50.0	1.32	1.00	0.95	1.00	1,112.0	1.34	34.6	5.5	62.6	84.0	46.0	7	SM/SC/SC-SM
8	25.2	82.6	50.0	1.32	1.00	0.97	1.00	1,375.0	1.21	34.6	5.5	64.0	77.1	46.0	7	SM/SC/SC-SM
9	30.2	77.6	50.0	1.32	1.00	0.98	1.00	1,638.0	1.10	59.9	5.5	64.7	71.5	46.0	8	SM/SC/SC-SM
10	35.2	72.6	50.0	1.32	1.00	0.99	1.00	1,901.0	1.03	68.2	5.5	65.2	66.9	46.0	8	SM/SC/SC-SM

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = B-6
Boring Station = 5951+41.00
Boring Offset = 8 ft RT
Ground Elevation at Boring (ft msl) = 107.8
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 107.8

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 8 each
No. of Split Spoon Samples = 10 each
Total Profile Thickness = 35 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	107.8																	
1	3.5	104.3	7.0	6.7	11.4	13.5	1	SM/SC/SC-SM		No Liquefaction		12.0				34		9	
2	5.5	102.3	11.0	11.2	19.1	19.1	2	SP/SW		No Liquefaction		1.6				32		32	
3	7.5	100.3	28.0	30.1	51.2	46.0	3	SP/SW		No Liquefaction		43.7				32		32	
4	9.5	98.3	7.0	7.8	13.3	13.3	4	SP/SW		No Liquefaction		2.1				32		9	
5	11.5	96.3	3.0	3.5	5.9	6.5	5	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		8.8				30		4	
6	15.2	92.6	50.0	60.3	92.6	46.0	6	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
7	20.2	87.6	50.0	62.6	84.0	46.0	7	SM/SC/SC-SM		No Liquefaction		34.6				36		36	
8	25.2	82.6	50.0	64.0	77.1	46.0	7	SM/SC/SC-SM		No Liquefaction		34.6				36		36	
9	30.2	77.6	50.0	64.7	71.5	46.0	8	SM/SC/SC-SM		No Liquefaction		59.9				36		36	
10	35.2	72.6	50.0	65.2	66.9	46.0	8	SM/SC/SC-SM		No Liquefaction		68.2				36		36	

^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	2/18/2015
Project:	RBO Four Hole Swamp						
Location:	B-6A			**Station:**	5951+42.68	**Finished Embankment Height (ft)[1] =**	

[1]**Embankment height measured from natural ground surface**

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
$\beta = S_{D1}/PGA$ =	1.140	0.900		β = Ground Motion Index:	$0.50 \leq \beta \leq 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1] \leq 1.0$: for $h_{slope} \leq 20ft$ $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.5	64.2	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; $\varepsilon = 0.015(R-20)$
D_{a5-95}	30.15	30.09	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; $\varepsilon = 0$

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	RBO Four Hole Swamp			**Longitude:**	80.6470	**Date:**	2/18/2015
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	B-6A	**Station:**	5951+42.68

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.4
R (km) = 63.5
D_{a5-95} (sec) = 30.15

Boring Number = B-6A
Boring Station = 5951+42.68
Boring Offset = 7.28 ft LT
Ground Elevation at Boring (ft msl) = 108.6
Water Table Depth (Dw) (ft) = 0.0
Water Table Elevation (msl ft) = 108.6

Hammer Type = Safety
Energy Ratio = 76.4
Energy Correction (C_E) = 1.27
Borehole Diameter (in) = 4
Borehole Correction (CB) = 1.00

No. of Soil Layers = 11 each
No. of Split Spoon Samples = 33 each
Total Profile Thickness = 120 feet

Sampler Configuration:
Liner Required = N
Liner Used = N

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Seismic Analysis Summary		Geotechnical Seismic Hazards Summary		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	108.6													
1	2	106.6	5.5	ML	NSL-S				No Liquefaction		4.0				
2	4	104.6	11.2	SP/SW	NSL-S				No Liquefaction		7.0				
3	6	102.6	17.0	SP/SW	NSL-S				No Liquefaction		21.0				
4	8	100.6	46.0	SP/SW	NSL-S				No Liquefaction		32.0				
5	10	98.6	22.3	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
6	15	93.6	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
7	20	88.6	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
8	25	83.6	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
9	30	78.6	41.8	ML	NSL-S				No Liquefaction		30.0				
10	35	73.6	46.0	ML	NSL-S				No Liquefaction		30.0				
11	40	68.6	39.7	ML	NSL-S				No Liquefaction		30.0				
12	45	63.6	46.0	ML	NSL-S				No Liquefaction		30.0				
13	50	58.6	46.0	ML	NSL-S				No Liquefaction		30.0				
14	55	53.6	46.0	ML	NSL-S				No Liquefaction		30.0				
15	60	48.6	46.0	ML	NSL-C				No Strength Loss			2310.00			
16	62	46.6	46.0	ML	NSL-C				No Strength Loss			2340.00			
17	64	44.6	46.0	ML	NSL-C				No Strength Loss			2360.00			
18	66	42.6	46.0	ML	NSL-C				No Strength Loss			2390.00			
19	68	40.6	46.0	ML	NSL-C				No Strength Loss			2410.00			
20	70	38.6	46.0	ML	NSL-C				No Strength Loss			2440.00			
21	72	36.6	46.0	ML	NSL-C				No Strength Loss			2470.00			
22	74	34.6	46.0	ML	NSL-C				No Strength Loss			2490.00			
23	76	32.6	46.0	ML	NSL-C				No Strength Loss			2520.00			
24	78	30.6	46.0	ML	NSL-C				No Strength Loss			2540.00			
25	80	28.6	29.9	SM/SC/SC-SM	NSL-C				No Strength Loss			2570.00			
26	85	23.6	45.4	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
27	90	18.6	44.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
28	95	13.6	42.7	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
29	100	8.6	41.5	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
30	105	3.6	43.7	CL	NSL-C				No Strength Loss			4000.00			
31	110	-1.4	41.9	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
32	115	-6.4	41.1	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
33	120	-11.4	46.0	MH	NSL-C				No Strength Loss			5000.00			
													0.00		**0.00**
													LDI Total (feet)		**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.: 40308 **File No.:** 38.040308 **Latitude:** 33.4570 **Designer:** R. Gardner - Midlands RPG
Project: RBO Four Hole Swamp **Longitude:** 80.6470 **Date:** 2/18/2015
Route: US 301 **County:** 38 - Orangeburg **Location:** B-6A **Station:** 5951+42.68

Boring Number = B-6A
Boring Station = 5951+42.68
Boring Offset = 7.28 ft LT
Ground Elevation at Boring (ft msl) = 108.6
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 108.6

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 11 each
No. of Split Spoon Samples = 33 each
Total Profile Thickness = 120 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	108.6														
1	2	106.6	0.0	1.27	1.00	0.69	1.00	95.2	1.00	51.0	5.5	0.0	0.0	5.5	1	ML
2	4	104.6	7.0	1.27	1.00	0.74	1.00	210.4	1.70	0.0	0.0	6.6	11.2	11.2	2	SP/SW
3	6	102.6	10.0	1.27	1.00	0.79	1.00	325.6	1.70	0.0	0.0	10.0	17.0	17.0	2	SP/SW
4	8	100.6	26.0	1.27	1.00	0.83	1.00	440.8	1.70	0.0	0.0	27.3	46.4	46.0	2	SP/SW
5	10	98.6	12.0	1.27	1.00	0.86	1.00	565.0	1.70	5.0	0.0	13.1	22.3	22.3	3	SW-SM/SW-SC/SP-SM/SP-SC
6	15	93.6	50.0	1.27	1.00	0.91	1.00	828.0	1.55	34.6	5.5	58.2	90.5	46.0	4	SM/SC/SC-SM
7	20	88.6	50.0	1.27	1.00	0.95	1.00	1,091.0	1.35	34.6	5.5	60.5	81.9	46.0	4	SM/SC/SC-SM
8	25	83.6	50.0	1.27	1.00	0.97	1.00	1,365.5	1.21	34.6	5.5	61.8	74.8	46.0	4	SM/SC/SC-SM
9	30	78.6	29.0	1.27	1.00	0.98	1.00	1,603.5	1.00	59.9	5.5	36.3	36.3	41.8	5	ML
10	35	73.6	52.0	1.27	1.00	0.99	1.00	1,841.5	1.00	59.9	5.5	65.6	65.6	46.0	5	ML
11	40	68.6	27.0	1.27	1.00	0.99	1.00	2,079.5	1.00	59.9	5.5	34.2	34.2	39.7	5	ML
12	45	63.6	40.0	1.27	1.00	1.00	1.00	2,317.5	1.00	68.2	5.5	50.8	50.8	46.0	5	ML
13	50	58.6	45.0	1.27	1.00	1.00	1.00	2,555.5	1.00	68.2	5.5	57.2	57.2	46.0	5	ML
14	55	53.6	50.0	1.27	1.00	1.00	1.00	2,793.5	1.00	68.2	5.5	63.6	63.6	46.0	5	ML
15	60	48.6	50.0	1.27	1.00	1.00	1.00	3,031.5	1.00	72.2	5.5	63.6	63.6	46.0	6	ML
16	62	46.6	44.0	1.27	1.00	1.00	1.00	3,126.7	1.00	72.2	5.5	56.0	56.0	46.0	6	ML
17	64	44.6	50.0	1.27	1.00	1.00	1.00	3,221.9	1.00	72.2	5.5	63.6	63.6	46.0	6	ML
18	66	42.6	59.0	1.27	1.00	1.00	1.00	3,317.1	1.00	72.2	5.5	75.1	75.1	46.0	6	ML
19	68	40.6	50.0	1.27	1.00	1.00	1.00	3,412.3	1.00	70.9	5.5	63.7	63.7	46.0	6	ML
20	70	38.6	50.0	1.27	1.00	1.00	1.00	3,507.5	1.00	70.9	5.5	63.7	63.7	46.0	6	ML
21	72	36.6	50.0	1.27	1.00	1.00	1.00	3,602.7	1.00	70.9	5.5	63.7	63.7	46.0	6	ML
22	74	34.6	60.0	1.27	1.00	1.00	1.00	3,697.9	1.00	70.9	5.5	76.4	76.4	46.0	6	ML
23	76	32.6	50.0	1.27	1.00	1.00	1.00	3,793.1	1.00	70.9	5.5	63.7	63.7	46.0	6	ML
24	78	30.6	50.0	1.27	1.00	1.00	1.00	3,888.3	1.00	70.9	5.5	63.7	63.7	46.0	6	ML
25	80	28.6	28.0	1.27	1.00	1.00	1.00	3,984.5	0.71	21.2	4.7	35.7	25.3	29.9	7	SM/SC/SC-SM
26	85	23.6	50.0	1.27	1.00	1.00	1.00	4,272.5	0.68	11.5	1.8	63.7	43.6	45.4	8	SW-SM/SW-SC/SP-SM/SP-SC
27	90	18.6	50.0	1.27	1.00	1.00	1.00	4,560.5	0.66	11.5	1.8	63.7	42.2	44.0	8	SW-SM/SW-SC/SP-SM/SP-SC
28	95	13.6	50.0	1.27	1.00	1.00	1.00	4,848.5	0.64	11.5	1.8	63.7	40.9	42.7	8	SW-SM/SW-SC/SP-SM/SP-SC
29	100	8.6	50.0	1.27	1.00	1.00	1.00	5,154.5	0.62	11.5	1.8	63.7	39.7	41.5	8	SW-SM/SW-SC/SP-SM/SP-SC
30	105	3.6	30.0	1.27	1.00	1.00	1.00	5,383.5	1.00	56.0	5.5	38.2	38.2	43.7	9	CL
31	110	-1.4	50.0	1.27	1.00	1.00	1.00	5,646.5	0.60	17.8	4.0	63.7	37.9	41.9	10	SM/SC/SC-SM
32	115	-6.4	50.0	1.27	1.00	1.00	1.00	5,911.0	0.58	17.8	4.0	63.7	37.0	41.1	10	SM/SC/SC-SM
33	120	-11.4	50.0	1.27	1.00	1.00	1.00	6,149.0	1.00	80.0	5.5	63.7	63.7	46.0	11	MH

[D] Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = B-6A
Boring Station = 5951+42.68
Boring Offset = 7.28 ft LT
Ground Elevation at Boring (ft msl) = 108.6
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 108.6

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
$D_{a5\text{-}95}$ (sec) = 30.15

No. of Soil Layers = 11 **each**
No. of Split Spoon Samples = 33 **each**
Total Profile Thickness = 120 **feet**

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	108.6																	
1	2	106.6	0.0	0.0	0.0	5.5	1	ML		No Liquefaction		51.0				20		4	
2	4	104.6	7.0	6.6	11.2	11.2	2	SP/SW		No Liquefaction		0.0				32		7	
3	6	102.6	10.0	10.0	17.0	17.0	2	SP/SW		No Liquefaction		0.0				32		21	
4	8	100.6	26.0	27.3	46.4	46.0	2	SP/SW		No Liquefaction		0.0				32		32	
5	10	98.6	12.0	13.1	22.3	22.3	3	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
6	15	93.6	50.0	58.2	90.5	46.0	4	SM/SC/SC-SM		No Liquefaction		34.6				36		36	
7	20	88.6	50.0	60.5	81.9	46.0	4	SM/SC/SC-SM		No Liquefaction		34.6				36		36	
8	25	83.6	50.0	61.8	74.8	46.0	4	SM/SC/SC-SM		No Liquefaction		34.6				36		36	
9	30	78.6	29.0	36.3	36.3	41.8	5	ML		No Liquefaction		59.9				30		30	
10	35	73.6	52.0	65.6	65.6	46.0	5	ML		No Liquefaction		59.9				30		30	
11	40	68.6	27.0	34.2	34.2	39.7	5	ML		No Liquefaction		59.9				30		30	
12	45	63.6	40.0	50.8	50.8	46.0	5	ML		No Liquefaction		68.2				30		30	
13	50	58.6	45.0	57.2	57.2	46.0	5	ML		No Liquefaction		68.2				30		30	
14	55	53.6	50.0	63.6	63.6	46.0	5	ML		No Liquefaction		68.2				30		30	
15	60	48.6	50.0	63.6	63.6	46.0	6	ML		No Strength Loss		72.2					2310		2310
16	62	46.6	44.0	56.0	56.0	46.0	6	ML		No Strength Loss		72.2					2340		2340
17	64	44.6	50.0	63.6	63.6	46.0	6	ML		No Strength Loss		72.2					2360		2360
18	66	42.6	59.0	75.1	75.1	46.0	6	ML		No Strength Loss		72.2					2390		2390
19	68	40.6	50.0	63.7	63.7	46.0	6	ML		No Strength Loss		70.9					2410		2410
20	70	38.6	50.0	63.7	63.7	46.0	6	ML		No Strength Loss		70.9					2440		2440
21	72	36.6	50.0	63.7	63.7	46.0	6	ML		No Strength Loss		70.9					2470		2470
22	74	34.6	60.0	76.4	76.4	46.0	6	ML		No Strength Loss		70.9					2490		2490
23	76	32.6	50.0	63.7	63.7	46.0	6	ML		No Strength Loss		70.9					2520		2520
24	78	30.6	50.0	63.7	63.7	46.0	6	ML		No Strength Loss		70.9					2540		2540
25	80	28.6	28.0	35.7	25.3	29.9	7	SM/SC/SC-SM		No Strength Loss		21.2					2570		2570
26	85	23.6	50.0	63.7	43.6	45.4	8	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		11.5				36		36	
27	90	18.6	50.0	63.7	42.2	44.0	8	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		11.5				36		36	
28	95	13.6	50.0	63.7	40.9	42.7	8	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		11.5				36		36	
29	100	8.6	50.0	63.7	39.7	41.5	8	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		11.5				36		36	
30	105	3.6	30.0	38.2	38.2	43.7	9	CL		No Strength Loss		56.0	0.006	15.2	3.1		4000		4000
31	110	-1.4	50.0	63.7	37.9	41.9	10	SM/SC/SC-SM		No Liquefaction		17.8				36		36	
32	115	-6.4	50.0	63.7	37.0	41.1	10	SM/SC/SC-SM		No Liquefaction		17.8				36		36	
33	120	-11.4	50.0	63.7	63.7	46.0	11	MH		No Strength Loss		80.0					5000		5000

[D] Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	10/1/2014
Project:	RBO Four Hole Swamp						
Location:	B-7			**Station:**	5951+86.00	**Finished Embankment Height (ft)[1] =**	

[1] Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D		
Design Earthquake:	**SEE**	**FEE**	
S_{D1} =	0.490	0.180	g
k_{max} = PGA =	0.430	0.200	g
$\beta = S_{D1}/PGA$ =	1.140	0.900	
α_w =	1.000	1.000	
$k_h = k_{avg}$ =	0.430	0.200	g
M_w =	7.37	7.36	
R =	63.5	64.2	km
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec
Z_{HR} =	494.50	494.50	meters
ε =	0.000	0.000	
D_{a5-95}	30.15	30.09	sec

β = Ground Motion Index: $0.50 \leq \beta \leq 1.5$

α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1]\leq 1.0$: for $h_{slope}\leq 20$ft $\alpha_w = 1.0$

k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$

M_w = Moment Magnitude of Design Earthquake M_w & R = Deaggregation Analysis

R = Site-to-Source Distance

$\bar{V}_s$ = Average Shear Wave Velocity $\bar{V}_s$ from Three-Point Method Excel Spreadsheet

Z_{HR} = Depth from ground surface to hard rock $V_s > 5{,}000$ ft/sec; from SCENARIO_PC 2006 output

ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20)

D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48 R ≥ 20 km; ε = 0

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	RBO Four Hole Swamp			**Longitude:**	80.6470	**Date:**	10/1/2014
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	B-7	**Station:**	5951+86.00

Design EQ =	SEE	**Boring Number =**	B-7	**Hammer Type =**	Automatic
Site Class =	D	**Boring Station =**	5951+86.00	**Energy Ratio =**	79.0
PGA (g) =	0.43	**Boring Offset =**	8 ft LT	**Energy Correction (C_E) =**	1.32
M_W =	7.4	**Ground Elevation at Boring (ft msl) =**	105.0		
R (km) =	63.5	**Water Table Depth (Dw) (ft) =**	0.0	**Borehole Diameter (in) =**	4
D_{a5-95} (sec) =	30.15	**Water Table Elevation (msl ft) =**	105.0	**Borehole Correction (CB) =**	1.00

No. of Soil Layers = 7 each

No. of Split Spoon Samples = 12 each

Total Profile Thickness = 41 feet

Sampler Configuration:

Liner Required = N

Liner Used = N

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	105.0													
1	3.5	101.5	6.5	SP/SW	SSL	Sand-Like	3.35	0.90	Full Liquefaction	0.7 - 1.0	4.0		1.75	1.75	1.96
2	5.5	99.5	8.7	SP/SW	SSL	Sand-Like	2.91	0.90	Full Liquefaction	0.7 - 1.0	4.9		1.00	2.75	0.97
3	6.3	98.7	46.0	ML	NSL-S				No Liquefaction		36.0				
4	8.4	96.6	46.0	ML	NSL-S				No Liquefaction		36.0				
5	11.5	93.5	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
6	16.5	88.5	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
7	20.1	84.9	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
8	21	84.0	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
9	26	79.0	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
10	31	74.0	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
11	36	69.0	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
12	41	64.0	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
													2.75		**2.93**
													LDI Total (feet)		**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.:	**40308**	**File No.:**	**38.040308**	**Latitude:**	**33.4570**	**Designer:**	**R. Gardner - Midlands RPG**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**80.6470**	**Date:**	**10/1/2014**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**	**B-7**	**Station:**	**5951+86.00**

Boring Number = B-7
Boring Station = 5951+86.00
Boring Offset = 8 ft LT
Ground Elevation at Boring (ft msl) = 105
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 105

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
$D_{a5\text{-}95}$ (sec) = 30.15

No. of Soil Layers = 7 each
No. of Split Spoon Samples = 12 each
Total Profile Thickness = 41 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	105.0														
1	3.5	101.5	4.0	1.32	1.00	0.73	1.00	201.6	1.70	0.0	0.0	3.8	6.5	6.5	1	SP/SW
2	5.5	99.5	5.0	1.32	1.00	0.78	1.00	315.8	1.70	0.0	0.0	5.1	8.7	8.7	1	SP/SW
3	6.3	98.7	50.0	1.32	1.00	0.79	1.00	353.9	1.00	56.5	5.5	52.2	52.2	46.0	2	ML
4	8.4	96.6	50.0	1.32	1.00	0.83	1.00	448.3	1.00	50.7	5.5	54.8	54.8	46.0	3	ML
5	11.5	93.5	41.0	1.32	1.00	0.88	1.00	611.4	1.70	40.6	5.5	47.4	80.5	46.0	4	SM/SC/SC-SM
6	16.5	88.5	26.0	1.32	1.00	0.93	1.00	874.4	1.51	64.2	5.5	31.7	48.0	46.0	5	SM/SC/SC-SM
7	20.1	84.9	50.0	1.32	1.00	0.95	1.00	1,063.8	1.37	61.1	5.5	62.6	85.8	46.0	6	SM/SC/SC-SM
8	21	84.0	50.0	1.32	1.00	0.96	1.00	1,111.1	1.34	61.1	5.5	62.9	84.4	46.0	6	SM/SC/SC-SM
9	26	79.0	50.0	1.32	1.00	0.97	1.00	1,374.1	1.21	64.0	5.5	64.1	77.3	46.0	7	SM/SC/SC-SM
10	31	74.0	50.0	1.32	1.00	0.98	1.00	1,637.1	1.11	64.0	5.5	64.8	71.7	46.0	7	SM/SC/SC-SM
11	36	69.0	50.0	1.32	1.00	0.99	1.00	1,900.1	1.03	64.0	5.5	65.3	66.9	46.0	7	SM/SC/SC-SM
12	41	64.0	50.0	1.32	1.00	0.99	1.00	2,163.1	0.96	64.0	5.5	65.5	63.0	46.0	7	SM/SC/SC-SM

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = B-7
Boring Station = 5951+86.00
Boring Offset = 8 ft LT
Ground Elevation at Boring (ft msl) = 105
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 105

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
$D_{a5\text{-}95}$ (sec) = 30.15

No. of Soil Layers = 7 each
No. of Split Spoon Samples = 12 each
Total Profile Thickness = 41 feet

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	105.0																	
1	3.5	101.5	4.0	3.8	6.5	6.5	1	SP/SW	Sand-Like	Full Liquefaction	28.9	0.0				30		4	
2	5.5	99.5	5.0	5.1	8.7	8.7	1	SP/SW	Sand-Like	Full Liquefaction	33.3	0.0				32		5	
3	6.3	98.7	50.0	52.2	52.2	46.0	2	ML		No Liquefaction		56.5				36		36	
4	8.4	96.6	50.0	54.8	54.8	46.0	3	ML		No Liquefaction		50.7				36		36	
5	11.5	93.5	41.0	47.4	80.5	46.0	4	SM/SC/SC-SM		No Liquefaction		40.6				36		36	
6	16.5	88.5	26.0	31.7	48.0	46.0	5	SM/SC/SC-SM		No Liquefaction		64.2				36		36	
7	20.1	84.9	50.0	62.6	85.8	46.0	6	SM/SC/SC-SM		No Liquefaction		61.1				36		36	
8	21	84.0	50.0	62.9	84.4	46.0	6	SM/SC/SC-SM		No Liquefaction		61.1				36		36	
9	26	79.0	50.0	64.1	77.3	46.0	7	SM/SC/SC-SM		No Liquefaction		64.0				36		36	
10	31	74.0	50.0	64.8	71.7	46.0	7	SM/SC/SC-SM		No Liquefaction		64.0				36		36	
11	36	69.0	50.0	65.3	66.9	46.0	7	SM/SC/SC-SM		No Liquefaction		64.0				36		36	
12	41	64.0	50.0	65.5	63.0	46.0	7	SM/SC/SC-SM		No Liquefaction		64.0				36		36	

[D] Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	2/18/2015
Project:	RBO Four Hole Swamp						
Location:	B-7A			**Station:**	5951+87.63	**Finished Embankment Height (ft)[1] =**	

[1] Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC = II

ROC = II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
$\beta = S_{D1}/PGA$ =	1.140	0.900		β = Ground Motion Index:	$0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1]\le1.0$: for $h_{slope}\le20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.5	64.2	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; ε = 0.015(R-20)
D_{a5-95}	30.15	30.09	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; ε = 0

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	RBO Four Hole Swamp			**Longitude:**	80.6470	**Date:**	2/18/2015
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	B-7A	**Station:**	5951+87.63

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.4
R (km) = 63.5
D_{a5-95} (sec) = 30.15

Boring Number = B-7A
Boring Station = 5951+87.63
Boring Offset = 8.39 ft RT
Ground Elevation at Boring (ft msl) = 108.3
Water Table Depth (Dw) (ft) = 0.0
Water Table Elevation (msl ft) = 108.3

Hammer Type = Safety
Energy Ratio = 76.4
Energy Correction (C_E) = 1.27
Borehole Diameter (in) = 4
Borehole Correction (CB) = 1.00

No. of Soil Layers = 12 **each**
No. of Split Spoon Samples = 33 **each**
Total Profile Thickness = 120 **feet**

Sampler Configuration:
Liner Required = N
Liner Used = N

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Seismic Analysis Summary		Geotechnical Seismic Hazards Summary		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	108.3													
1	2	106.3	5.5	ML	NSL-S				No Liquefaction		24.0				
2	4	104.3	5.5	ML	NSL-S				No Liquefaction		24.0				
3	6	102.3	5.1	SW-SM/SW-SC/SP-SM/SP-SC	SSL	Sand-Like	3.89	0.90	Full Liquefaction	0.7 - 1.0	3.5		1.00	1.00	1.25
4	8	100.3	14.5	SW-SM/SW-SC/SP-SM/SP-SC	SSL	Sand-Like	2.18	0.90	Full Liquefaction	0.7 - 1.0	11.0		0.58	1.58	0.71
5	10	98.3	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
6	15	93.3	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
7	20	88.3	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
8	25	83.3	46.0	ML	NSL-S				No Liquefaction		30.0				
9	30	78.3	46.0	ML	NSL-S				No Liquefaction		30.0				
10	35	73.3	40.8	ML	NSL-S				No Liquefaction		30.0				
11	40	68.3	46.0	ML	NSL-S				No Liquefaction		30.0				
12	45	63.3	46.0	ML	NSL-S				No Liquefaction		30.0				
13	50	58.3	46.0	ML	PSL	HS Clay-Like	0.77	0.90	No Strength Loss			2170.00			
14	55	53.3	46.0	ML	PSL	HS Clay-Like	0.82	0.90	No Strength Loss			2230.00			
15	60	48.3	46.0	ML	PSL	HS Clay-Like	0.87	0.90	No Strength Loss			2290.00			
16	62	46.3	46.0	ML	PSL	HS Clay-Like	0.89	0.90	No Strength Loss			2320.00			
17	64	44.3	46.0	ML	PSL	HS Clay-Like	0.90	0.90	Strength Loss			1175.00			
18	66	42.3	46.0	ML	PSL	HS Clay-Like	0.92	0.90	Strength Loss			1185.00			
19	68	40.3	46.0	ML	PSL	HS Clay-Like	0.94	0.90	Strength Loss			1200.00			
20	70	38.3	46.0	ML	PSL	HS Clay-Like	0.95	0.90	Strength Loss			1210.00			
21	72	36.3	9.3	SM/SC/SC-SM	NSL-S				No Liquefaction		5.0				
22	74	34.3	10.2	SM/SC/SC-SM	NSL-S				No Liquefaction		6.0				
23	76	32.3	10.1	SM/SC/SC-SM	NSL-S				No Liquefaction		6.0				
24	78	30.3	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
25	80	28.3	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
26	85	23.3	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
27	90	18.3	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
28	95	13.3	41.7	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
29	100	8.3	46.0	CL	PSL	HS Clay-Like	0.83	0.90	No Strength Loss			4000.00			
30	105	3.3	41.3	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
31	110	-1.7	40.3	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
32	115	-6.7	46.0	MH	PSL	HS Clay-Like	0.78	0.90	No Strength Loss			5000.00			
33	120	-11.7	46.0	MH	PSL	HS Clay-Like	0.83	0.90	No Strength Loss			5000.00			
													1.58		**1.95**
													LDI Total (feet)		**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	RBO Four Hole Swamp			**Longitude:**	80.6470	**Date:**	2/18/2015
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	B-7A	**Station:**	5951+87.63

Boring Number =	B-7A	**Design EQ =**	SEE	**No. of Soil Layers =**	12	each
Boring Station =	5951+87.63	**Site Class =**	D	**No. of Split Spoon Samples =**	33	each
Boring Offset =	8.39 ft RT	**PGA (g) =**	0.43	**Total Profile Thickness =**	120	feet
Ground Elevation at Boring (ft msl) =	108.3	**M_W =**	7.37			
Water Table Depth (Dw) (ft) =	0	**R (km) =**	63.5			
Water Table Elevation (msl ft) =	108.3	**D_{a5-95} (sec) =**	30.15			

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	108.3														
1	2	106.3	0.0	1.27	1.00	0.69	1.00	95.2	1.00	51.0	5.5	0.0	0.0	5.5	1	ML
2	4	104.3	0.0	1.27	1.00	0.74	1.00	190.4	1.00	51.0	5.5	0.0	0.0	5.5	1	ML
3	6	102.3	3.0	1.27	1.00	0.79	1.00	305.6	1.70	5.9	0.0	3.0	5.1	5.1	2	SW-SM/SW-SC/SP-SM/SP-SC
4	8	100.3	8.0	1.27	1.00	0.83	1.00	420.8	1.70	7.4	0.2	8.4	14.3	14.5	2	SW-SM/SW-SC/SP-SM/SP-SC
5	10	98.3	47.0	1.27	1.00	0.86	1.00	526.0	1.70	47.8	5.5	51.3	87.2	46.0	3	SM/SC/SC-SM
6	15	93.3	50.0	1.27	1.00	0.91	1.00	789.0	1.59	47.8	5.5	58.2	92.7	46.0	3	SM/SC/SC-SM
7	20	88.3	50.0	1.27	1.00	0.95	1.00	1,059.5	1.37	47.8	5.5	60.5	83.1	46.0	3	SM/SC/SC-SM
8	25	83.3	41.0	1.27	1.00	0.97	1.00	1,297.5	1.00	61.1	5.5	50.7	50.7	46.0	4	ML
9	30	78.3	52.0	1.27	1.00	0.98	1.00	1,535.5	1.00	61.1	5.5	65.1	65.1	46.0	4	ML
10	35	73.3	28.0	1.27	1.00	0.99	1.00	1,773.5	1.00	64.0	5.5	35.3	35.3	40.8	4	ML
11	40	68.3	36.0	1.27	1.00	0.99	1.00	2,011.5	1.00	64.0	5.5	45.6	45.6	46.0	4	ML
12	45	63.3	53.0	1.27	1.00	1.00	1.00	2,249.5	1.00	64.0	5.5	67.3	67.3	46.0	4	ML
13	50	58.3	50.0	1.27	1.00	1.00	1.00	2,487.5	1.00	76.0	5.5	63.5	63.5	46.0	5	ML
14	55	53.3	50.0	1.27	1.00	1.00	1.00	2,725.5	1.00	76.0	5.5	63.6	63.6	46.0	5	ML
15	60	48.3	50.0	1.27	1.00	1.00	1.00	2,963.5	1.00	76.0	5.5	63.6	63.6	46.0	5	ML
16	62	46.3	50.0	1.27	1.00	1.00	1.00	3,058.7	1.00	76.0	5.5	63.6	63.6	46.0	5	ML
17	64	44.3	43.0	1.27	1.00	1.00	1.00	3,153.9	1.00	68.0	5.5	54.7	54.7	46.0	6	ML
18	66	42.3	50.0	1.27	1.00	1.00	1.00	3,249.1	1.00	68.0	5.5	63.6	63.6	46.0	6	ML
19	68	40.3	50.0	1.27	1.00	1.00	1.00	3,344.3	1.00	68.0	5.5	63.7	63.7	46.0	6	ML
20	70	38.3	50.0	1.27	1.00	1.00	1.00	3,439.5	1.00	68.0	5.5	63.7	63.7	46.0	6	ML
21	72	36.3	6.0	1.27	1.00	1.00	1.00	3,544.7	0.75	16.1	3.6	7.6	5.7	9.3	7	SM/SC/SC-SM
22	74	34.3	7.0	1.27	1.00	1.00	1.00	3,649.9	0.74	16.1	3.6	8.9	6.6	10.2	7	SM/SC/SC-SM
23	76	32.3	7.0	1.27	1.00	1.00	1.00	3,755.1	0.73	16.1	3.6	8.9	6.5	10.1	7	SM/SC/SC-SM
24	78	30.3	50.0	1.27	1.00	1.00	1.00	3,860.3	0.72	16.4	3.7	63.7	45.8	46.0	8	SM/SC/SC-SM
25	80	28.3	50.0	1.27	1.00	1.00	1.00	3,965.5	0.71	16.4	3.7	63.7	45.2	46.0	8	SM/SC/SC-SM
26	85	23.3	50.0	1.27	1.00	1.00	1.00	4,228.5	0.69	16.4	3.7	63.7	43.8	46.0	8	SM/SC/SC-SM
27	90	18.3	50.0	1.27	1.00	1.00	1.00	4,491.5	0.67	16.4	3.7	63.7	42.5	46.0	8	SM/SC/SC-SM
28	95	13.3	50.0	1.27	1.00	1.00	1.00	4,774.5	0.65	8.5	0.5	63.7	41.2	41.7	9	SW-SM/SW-SC/SP-SM/SP-SC
29	100	8.3	50.0	1.27	1.00	1.00	1.00	5,005.0	1.00	51.0	5.5	63.7	63.7	46.0	10	CL
30	105	3.3	50.0	1.27	1.00	1.00	1.00	5,268.0	0.62	12.0	2.1	63.7	39.2	41.3	11	SM/SC/SC-SM
31	110	-1.7	50.0	1.27	1.00	1.00	1.00	5,543.5	0.60	12.0	2.1	63.7	38.2	40.3	11	SM/SC/SC-SM
32	115	-6.7	50.0	1.27	1.00	1.00	1.00	5,781.5	1.00	80.0	5.5	63.7	63.7	46.0	12	MH
33	120	-11.7	50.0	1.27	1.00	1.00	1.00	6,019.5	1.00	80.0	5.5	63.7	63.7	46.0	12	MH

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = B-7A
Boring Station = 5951+87.63
Boring Offset = 8.39 ft RT
Ground Elevation at Boring (ft msl) = 108.3
Water Table Depth (Dw) (ft) = 0
Water Table Elevation (msl ft) = 108.3

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 12 **each**
No. of Split Spoon Samples = 33 **each**
Total Profile Thickness = 120 **feet**

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \le \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																φ' (degrees)	τ = c (psf)	φ' (degrees)	τ = c (psf)
	0	108.3																	
1	2	106.3	0.0	0.0	0.0	5.5	1	ML		No Liquefaction		51.0				24		24	
2	4	104.3	0.0	0.0	0.0	5.5	1	ML		No Liquefaction		51.0				24		24	
3	6	102.3	3.0	3.0	5.1	5.1	2	SW-SM/SW-SC/SP-SM/SP-SC	Sand-Like	Full Liquefaction	25.6	5.9	0.119	7.4	1.5	29		3	
4	8	100.3	8.0	8.4	14.3	14.5	2	SW-SM/SW-SC/SP-SM/SP-SC	Sand-Like	Full Liquefaction	42.7	7.4	0.096	7.8	2.1	35		11	
5	10	98.3	47.0	51.3	87.2	46.0	3	SM/SC/SC-SM		No Liquefaction		47.8				36		36	
6	15	93.3	50.0	58.2	92.7	46.0	3	SM/SC/SC-SM		No Liquefaction		47.8				36		36	
7	20	88.3	50.0	60.5	83.1	46.0	3	SM/SC/SC-SM		No Liquefaction		47.8				36		36	
8	25	83.3	41.0	50.7	50.7	46.0	4	ML		No Liquefaction		61.1				30		30	
9	30	78.3	52.0	65.1	65.1	46.0	4	ML		No Liquefaction		61.1				30		30	
10	35	73.3	28.0	35.3	35.3	40.8	4	ML		No Liquefaction		64.0	0.003	21.3	1.9	30		30	
11	40	68.3	36.0	45.6	45.6	46.0	4	ML		No Liquefaction		64.0				30		30	
12	45	63.3	53.0	67.3	67.3	46.0	4	ML		No Liquefaction		64.0				30		30	
13	50	58.3	50.0	63.5	63.5	46.0	5	ML	HS Clay-Like	No Strength Loss		76.0	0.003	14.7	0.5		2170		2170
14	55	53.3	50.0	63.6	63.6	46.0	5	ML	HS Clay-Like	No Strength Loss		76.0					2230		2230
15	60	48.3	50.0	63.6	63.6	46.0	5	ML	HS Clay-Like	No Strength Loss		76.0					2290		2290
16	62	46.3	50.0	63.6	63.6	46.0	5	ML	HS Clay-Like	No Strength Loss		76.0					2320		2320
17	64	44.3	43.0	54.7	54.7	46.0	6	ML	HS Clay-Like	Strength Loss		68.0	0.003	17.1	0.7		2350		1175
18	66	42.3	50.0	63.6	63.6	46.0	6	ML	HS Clay-Like	Strength Loss		68.0					2370		1185
19	68	40.3	50.0	63.7	63.7	46.0	6	ML	HS Clay-Like	Strength Loss		68.0					2400		1200
20	70	38.3	50.0	63.7	63.7	46.0	6	ML	HS Clay-Like	Strength Loss		68.0					2420		1210
21	72	36.3	6.0	7.6	5.7	9.3	7	SM/SC/SC-SM		No Liquefaction		16.1				29		5	
22	74	34.3	7.0	8.9	6.6	10.2	7	SM/SC/SC-SM		No Liquefaction		16.1				30		6	
23	76	32.3	7.0	8.9	6.5	10.1	7	SM/SC/SC-SM		No Liquefaction		16.1				30		6	
24	78	30.3	50.0	63.7	45.8	46.0	8	SM/SC/SC-SM		No Liquefaction		16.4				36		36	
25	80	28.3	50.0	63.7	45.2	46.0	8	SM/SC/SC-SM		No Liquefaction		16.4				36		36	
26	85	23.3	50.0	63.7	43.8	46.0	8	SM/SC/SC-SM		No Liquefaction		16.4				36		36	
27	90	18.3	50.0	63.7	42.5	46.0	8	SM/SC/SC-SM		No Liquefaction		16.4				36		36	
28	95	13.3	50.0	63.7	41.2	41.7	9	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		8.5	0.093	5.3	1.6	36		36	
29	100	8.3	50.0	63.7	63.7	46.0	10	CL	HS Clay-Like	No Strength Loss		51.0					4000		4000
30	105	3.3	50.0	63.7	39.2	41.3	11	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
31	110	-1.7	50.0	63.7	38.2	40.3	11	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
32	115	-6.7	50.0	63.7	63.7	46.0	12	MH	HS Clay-Like	No Strength Loss		80.0					5000		5000
33	120	-11.7	50.0	63.7	63.7	46.0	12	MH	HS Clay-Like	No Strength Loss		80.0					5000		5000

^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	10/1/2014
Project:	RBO Four Hole Swamp						
Location:	B-8			**Station:**	5952+17.00	**Finished Embankment Height (ft)[1] =**	

[1] **Embankment height measured from natural ground surface**

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
$\beta = S_{D1}/PGA$ =	1.140	0.900		β = Ground Motion Index:	$0.50 \leq \beta \leq 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1] \leq 1.0$: for $h_{slope} \leq 20ft$ $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.5	64.2	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; $\varepsilon = 0.015(R-20)$
D_{a5-95}	30.15	30.09	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; $\varepsilon = 0$

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	RBO Four Hole Swamp			**Longitude:**	80.6470	**Date:**	10/1/2014
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	B-8	**Station:**	5952+17.00

Design EQ =	SEE	**Boring Number =**	B-8	**Hammer Type =**	Automatic
Site Class =	D	**Boring Station =**	5952+17.00	**Energy Ratio =**	79.0
PGA (g) =	0.43	**Boring Offset =**	8 ft RT	**Energy Correction (C_E) =**	1.32
M_W =	7.4	**Ground Elevation at Boring (ft msl) =**	120.0		
R (km) =	63.5	**Water Table Depth (Dw) (ft) =**	10.0	**Borehole Diameter (in) =**	4
D_{a5-95} (sec) =	30.15	**Water Table Elevation (msl ft) =**	110.0	**Borehole Correction (CB) =**	1.00
		No. of Soil Layers =	10 each	**Sampler Configuration:**	
		No. of Split Spoon Samples =	24 each	**Liner Required =**	N
		Total Profile Thickness =	101.4 feet	**Liner Used =**	N

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Seismic Analysis Summary		Geotechnical Seismic Hazards Summary		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	120.0													
1	3.5	116.5	23.3	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		38.1				
2	5.5	114.5	19.1	SP/SW	NSL-S				No Liquefaction		32.0				
3	7.5	112.5	6.4	SP/SW	NSL-S				No Liquefaction		29.9				
4	9.5	110.5	7.4	SP/SW	NSL-S				No Liquefaction		30.7				
5	11.5	108.5	11.7	SM/SC/SC-SM	SSL	Sand-Like	1.30	0.90	Full Liquefaction	0.7 - 1.0	7.0		0.78	0.78	0.81
6	15.1	104.9	2.8	SP/SW	SSL	Sand-Like	2.61	0.90	Full Liquefaction	0.7 - 1.0	3.0		1.80	2.58	2.79
7	21.5	98.5	2.6	SP/SW	SSL	Sand-Like	2.98	0.90	Full Liquefaction	0.7 - 1.0	2.6		3.20	5.78	5.07
8	26.5	93.5	44.5	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
9	30.3	89.7	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
10	30.4	89.6	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
11	31.3	88.7	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
12	36.3	83.7	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
13	41.3	78.7	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
14	46.3	73.7	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
15	51.3	68.7	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
16	56.5	63.5	23.4	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
17	61.5	58.5	35.8	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
18	66.5	53.5	41.9	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
19	71.5	48.5	37.2	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
20	76.5	43.5	35.4	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
21	81.5	38.5	38.7	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
22	86.5	33.5	36.2	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
23	91.5	28.5	30.8	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
24	96.5	23.5	38.5	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				

5.78	8.68
LDI Total (feet)	**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.:	**40308**	**File No.:**	**38.040308**	**Latitude:**	**33.4570**	**Designer:**	**R. Gardner - Midlands RPG**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**80.6470**	**Date:**	**10/1/2014**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**	**B-8**	**Station:**	**5952+17.00**

Boring Number =	**B-8**	**Design EQ =**	**SEE**	**No. of Soil Layers =**	**10**	**each**
Boring Station =	**5952+17.00**	**Site Class =**	**D**	**No. of Split Spoon Samples =**	**24**	**each**
Boring Offset =	**8 ft RT**	**PGA (g) =**	**0.43**	**Total Profile Thickness =**	**101**	**feet**
Ground Elevation at Boring (ft msl) =	**120**	**M_W =**	**7.37**			
Water Table Depth (Dw) (ft) =	**10**	**R (km) =**	**63.5**			
Water Table Elevation (msl ft) =	**110**	**D_{a5-95} (sec) =**	**30.15**			

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	120.0														
1	3.5	116.5	13.0	1.32	1.00	0.73	1.00	420.0	1.70	11.9	2.0	12.5	21.2	23.3	1	SW-SM/SW-SC/SP-SM/SP-SC
2	5.5	114.5	11.0	1.32	1.00	0.78	1.00	660.0	1.70	0.0	0.0	11.2	19.1	19.1	2	SP/SW
3	7.5	112.5	4.0	1.32	1.00	0.82	1.00	900.0	1.49	0.0	0.0	4.3	6.4	6.4	2	SP/SW
4	9.5	110.5	5.0	1.32	1.00	0.85	1.00	1,141.5	1.32	0.0	0.0	5.6	7.4	7.4	2	SP/SW
5	11.5	108.5	5.0	1.32	1.00	0.88	1.00	1,268.9	1.26	20.1	4.5	5.8	7.3	11.7	3	SM/SC/SC-SM
6	15.1	104.9	2.0	1.32	1.00	0.92	1.00	1,476.3	1.16	0.0	0.0	2.4	2.8	2.8	4	SP/SW
7	21.5	98.5	2.0	1.32	1.00	0.96	1.00	1,852.4	1.04	1.8	0.0	2.5	2.6	2.6	4	SP/SW
8	26.5	93.5	34.0	1.32	1.00	0.98	1.00	2,115.4	0.97	12.0	2.1	43.7	42.4	44.5	5	SM/SC/SC-SM
9	30.3	89.7	50.0	1.32	1.00	0.98	1.00	2,315.3	0.93	59.4	5.5	64.8	60.2	46.0	5	SM/SC/SC-SM
10	30.4	89.6	50.0	1.32	1.00	0.98	1.00	2,320.5	0.93	59.4	5.5	64.8	60.1	46.0	6	SM/SC/SC-SM
11	31.3	88.7	50.0	1.32	1.00	0.99	1.00	2,367.9	0.92	59.4	5.5	64.9	59.6	46.0	6	SM/SC/SC-SM
12	36.3	83.7	50.0	1.32	1.00	0.99	1.00	2,630.9	0.87	59.4	5.5	65.3	56.9	46.0	6	SM/SC/SC-SM
13	41.3	78.7	50.0	1.32	1.00	1.00	1.00	2,893.9	0.83	59.4	5.5	65.5	54.5	46.0	6	SM/SC/SC-SM
14	46.3	73.7	50.0	1.32	1.00	1.00	1.00	3,156.9	0.80	59.4	5.5	65.6	52.3	46.0	7	SM/SC/SC-SM
15	51.3	68.7	50.0	1.32	1.00	1.00	1.00	3,419.9	0.76	59.4	5.5	65.7	50.3	46.0	7	SM/SC/SC-SM
16	56.5	63.5	22.0	1.32	1.00	1.00	1.00	3,693.4	0.74	12.0	2.1	28.9	21.3	23.4	8	SM/SC/SC-SM
17	61.5	58.5	36.0	1.32	1.00	1.00	1.00	3,956.4	0.71	12.0	2.1	47.4	33.7	35.8	8	SM/SC/SC-SM
18	66.5	53.5	44.0	1.32	1.00	1.00	1.00	4,219.4	0.69	12.0	2.1	57.9	39.9	41.9	8	SM/SC/SC-SM
19	71.5	48.5	40.0	1.32	1.00	1.00	1.00	4,482.4	0.67	12.0	2.1	52.7	35.2	37.2	8	SM/SC/SC-SM
20	76.5	43.5	39.0	1.32	1.00	1.00	1.00	4,745.4	0.65	12.0	2.1	51.3	33.3	35.4	8	SM/SC/SC-SM
21	81.5	38.5	44.0	1.32	1.00	1.00	1.00	5,008.4	0.63	12.0	2.1	57.9	36.6	38.7	8	SM/SC/SC-SM
22	86.5	33.5	42.0	1.32	1.00	1.00	1.00	5,263.9	0.62	12.0	2.1	55.3	34.1	36.2	8	SM/SC/SC-SM
23	91.5	28.5	39.0	1.32	1.00	1.00	1.00	5,551.9	0.60	5.0	0.0	51.3	30.8	30.8	9	SW-SM/SW-SC/SP-SM/SP-SC
24	96.5	23.5	50.0	1.32	1.00	1.00	1.00	5,839.9	0.59	5.0	0.0	65.8	38.5	38.5	10	SW-SM/SW-SC/SP-SM/SP-SC
															10	SW-SM/SW-SC/SP-SM/SP-SC

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = B-8
Boring Station = 5952+17.00
Boring Offset = 8 ft RT
Ground Elevation at Boring (ft msl) = 120
Water Table Depth (Dw) (ft) = 10
Water Table Elevation (msl ft) = 110

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 10 **each**
No. of Split Spoon Samples = 24 **each**
Total Profile Thickness = 101 **feet**

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \le \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																φ' (degrees)	τ = c (psf)	φ' (degrees)	τ = c (psf)
	0	120.0																	
1	3.5	116.5	13.0	12.5	21.2	23.3	1	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		11.9				38		38	
2	5.5	114.5	11.0	11.2	19.1	19.1	2	SP/SW		No Liquefaction		0.0				32		32	
3	7.5	112.5	4.0	4.3	6.4	6.4	2	SP/SW		No Liquefaction		0.0				30		30	
4	9.5	110.5	5.0	5.6	7.4	7.4	2	SP/SW		No Liquefaction		0.0				31		31	
5	11.5	108.5	5.0	5.8	7.3	11.7	3	SM/SC/SC-SM	Sand-Like	Full Liquefaction	35.4	20.1				31		7	
6	15.1	104.9	2.0	2.4	2.8	2.8	4	SP/SW	Sand-Like	Full Liquefaction	22.9	0.0				26		3	
7	21.5	98.5	2.0	2.5	2.6	2.6	4	SP/SW	Sand-Like	Full Liquefaction	23.4	1.8				26		3	
8	26.5	93.5	34.0	43.7	42.4	44.5	5	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
9	30.3	89.7	50.0	64.8	60.2	46.0	5	SM/SC/SC-SM		No Liquefaction		59.4				36		36	
10	30.4	89.6	50.0	64.8	60.1	46.0	6	SM/SC/SC-SM		No Liquefaction		59.4				36		36	
11	31.3	88.7	50.0	64.9	59.6	46.0	6	SM/SC/SC-SM		No Liquefaction		59.4				36		36	
12	36.3	83.7	50.0	65.3	56.9	46.0	6	SM/SC/SC-SM		No Liquefaction		59.4				36		36	
13	41.3	78.7	50.0	65.5	54.5	46.0	6	SM/SC/SC-SM		No Liquefaction		59.4				36		36	
14	46.3	73.7	50.0	65.6	52.3	46.0	7	SM/SC/SC-SM		No Liquefaction		59.4				36		36	
15	51.3	68.7	50.0	65.7	50.3	46.0	7	SM/SC/SC-SM		No Liquefaction		59.4				36		36	
16	56.5	63.5	22.0	28.9	21.3	23.4	8	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
17	61.5	58.5	36.0	47.4	33.7	35.8	8	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
18	66.5	53.5	44.0	57.9	39.9	41.9	8	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
19	71.5	48.5	40.0	52.7	35.2	37.2	8	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
20	76.5	43.5	39.0	51.3	33.3	35.4	8	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
21	81.5	38.5	44.0	57.9	36.6	38.7	8	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
22	86.5	33.5	42.0	55.3	34.1	36.2	8	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
23	91.5	28.5	39.0	51.3	30.8	30.8	9	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
24	96.5	23.5	50.0	65.8	38.5	38.5	10	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	
							10	SW-SM/SW-SC/SP-SM/SP-SC											

^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	10/1/2014
Project:	RBO Four Hole Swamp						
Location:	B-9			**Station:**	5952+28.00	**Finished Embankment Height (ft)[1] =**	

[1] **Embankment height measured from natural ground surface**

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index:	$0.50 \leq \beta \leq 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1]\leq 1.0$: for $h_{slope} \leq 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.5	64.2	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock $V_s > 5{,}000$ ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; ε = 0.015(R-20)
$D_{a5\text{-}95}$	30.15	30.09	sec	$D_{a5\text{-}95}$ = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; ε = 0

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	RBO Four Hole Swamp			**Longitude:**	80.6470	**Date:**	10/1/2014
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	B-9	**Station:**	5952+28.00

Design EQ =	SEE	**Boring Number =**	B-9	**Hammer Type =**	Automatic
Site Class =	D	**Boring Station =**	5952+28.00	**Energy Ratio =**	79.0
PGA (g) =	0.43	**Boring Offset =**	8 ft LT	**Energy Correction (C_E) =**	1.32
M_W =	7.4	**Ground Elevation at Boring (ft msl) =**	120.0		
R (km) =	63.5	**Water Table Depth (Dw) (ft) =**	12.6	**Borehole Diameter (in) =**	4
D_{a5-95} (sec) =	30.15	**Water Table Elevation (msl ft) =**	107.4	**Borehole Correction (CB) =**	1.00

No. of Soil Layers =	12	each	**Sampler Configuration:**	
No. of Split Spoon Samples =	23	each	**Liner Required =**	N
Total Profile Thickness =	101.5	feet	**Liner Used =**	N

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Seismic Analysis Summary		Geotechnical Seismic Hazards Summary		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	120.0													
1	3.5	116.5	15.7	SM/SC/SC-SM	NSL-S				No Liquefaction		34.0				
2	5.5	114.5	8.7	SP/SW	NSL-S				No Liquefaction		32.0				
3	7.5	112.5	6.5	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		30.0				
4	9.5	110.5	4.5	SP/SW	NSL-S				No Liquefaction		28.3				
5	11.5	108.5	4.9	SM/SC/SC-SM	NSL-S				No Liquefaction		26.6				
6	16.5	103.5	35.7	SP/SW	NSL-S				No Liquefaction		36.0				
7	21.5	98.5	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
8	26.5	93.5	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
9	31.5	88.5	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
10	36.5	83.5	32.9	ML	NSL-S				No Liquefaction		30.0				
11	41.5	78.5	40.9	ML	NSL-S				No Liquefaction		30.0				
12	46.5	73.5	37.0	ML	NSL-S				No Liquefaction		30.0				
13	51.5	68.5	46.0	ML	NSL-S				No Liquefaction		30.0				
14	56.5	63.5	31.8	ML	NSL-S				No Liquefaction		30.0				
15	61.5	58.5	46.0	ML	NSL-S				No Liquefaction		30.0				
16	66.5	53.5	46.0	ML	NSL-S				No Liquefaction		30.0				
17	71.5	48.5	41.0	ML	NSL-S				No Liquefaction		30.0				
18	76.5	43.5	46.0	ML	NSL-S				No Liquefaction		30.0				
19	81.5	38.5	46.0	ML	NSL-S				No Liquefaction		30.0				
20	86.5	33.5	46.0	ML	NSL-S				No Liquefaction		30.0				
21	91.5	28.5	5.6	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		29.0				
22	96.5	23.5	41.2	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
23	101.5	18.5	18.3	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				

0.00	0.00
LDI Total (feet)	**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.:	**40308**	**File No.:**	**38.040308**	**Latitude:**	**33.4570**	**Designer:**	**R. Gardner - Midlands RPG**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**80.6470**	**Date:**	**10/1/2014**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**	**B-9**	**Station:**	**5952+28.00**

Boring Number =	**B-9**	**Design EQ =**	**SEE**	**No. of Soil Layers =**	**12**	**each**
Boring Station =	**5952+28.00**	**Site Class =**	**D**	**No. of Split Spoon Samples =**	**23**	**each**
Boring Offset =	**8 ft LT**	**PGA (g) =**	**0.43**	**Total Profile Thickness =**	**102**	**feet**
Ground Elevation at Boring (ft msl) =	**120**	**M_W =**	**7.37**			
Water Table Depth (Dw) (ft) =	**12.6**	**R (km) =**	**63.5**			
Water Table Elevation (msl ft) =	**107.4**	**D_{a5-95} (sec) =**	**30.15**			

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	120.0														
1	3.5	116.5	7.0	1.32	1.00	0.73	1.00	400.0	1.70	18.9	4.3	6.7	11.4	15.7	1	SM/SC/SC-SM
2	5.5	114.5	5.0	1.32	1.00	0.78	1.00	640.0	1.70	0.0	0.0	5.1	8.7	8.7	2	SP/SW
3	7.5	112.5	4.0	1.32	1.00	0.82	1.00	880.0	1.51	5.6	0.0	4.3	6.5	6.5	3	SW-SM/SW-SC/SP-SM/SP-SC
4	9.5	110.5	3.0	1.32	1.00	0.85	1.00	1,121.5	1.34	0.0	0.0	3.4	4.5	4.5	4	SP/SW
5	11.5	108.5	2.0	1.32	1.00	0.88	1.00	1,342.5	1.22	12.0	2.1	2.3	2.8	4.9	5	SM/SC/SC-SM
6	16.5	103.5	27.0	1.32	1.00	0.93	1.00	1,709.1	1.08	4.6	0.0	33.0	35.7	35.7	6	SP/SW
7	21.5	98.5	54.0	1.32	1.00	0.96	1.00	1,972.1	1.01	48.4	5.5	68.1	68.6	46.0	7	SM/SC/SC-SM
8	26.5	93.5	36.0	1.32	1.00	0.98	1.00	2,235.1	0.95	35.7	5.5	46.2	43.7	46.0	8	SM/SC/SC-SM
9	31.5	88.5	35.0	1.32	1.00	0.99	1.00	2,507.1	0.89	35.7	5.5	45.4	40.6	46.0	8	SM/SC/SC-SM
10	36.5	83.5	21.0	1.32	1.00	0.99	1.00	2,745.1	1.00	59.4	5.5	27.4	27.4	32.9	9	ML
11	41.5	78.5	27.0	1.32	1.00	1.00	1.00	2,983.1	1.00	59.4	5.5	35.4	35.4	40.9	9	ML
12	46.5	73.5	24.0	1.32	1.00	1.00	1.00	3,221.1	1.00	59.4	5.5	31.5	31.5	37.0	9	ML
13	51.5	68.5	50.0	1.32	1.00	1.00	1.00	3,459.1	1.00	59.4	5.5	65.7	65.7	46.0	9	ML
14	56.5	63.5	20.0	1.32	1.00	1.00	1.00	3,697.1	1.00	59.4	5.5	26.3	26.3	31.8	9	ML
15	61.5	58.5	31.0	1.32	1.00	1.00	1.00	3,935.1	1.00	59.4	5.5	40.8	40.8	46.0	9	ML
16	66.5	53.5	43.0	1.32	1.00	1.00	1.00	4,173.1	1.00	59.4	5.5	56.6	56.6	46.0	9	ML
17	71.5	48.5	27.0	1.32	1.00	1.00	1.00	4,411.1	1.00	59.4	5.5	35.5	35.5	41.0	9	ML
18	76.5	43.5	34.0	1.32	1.00	1.00	1.00	4,649.1	1.00	59.4	5.5	44.8	44.8	46.0	9	ML
19	81.5	38.5	49.0	1.32	1.00	1.00	1.00	4,887.1	1.00	59.4	5.5	64.5	64.5	46.0	9	ML
20	86.5	33.5	43.0	1.32	1.00	1.00	1.00	5,110.1	1.00	59.4	5.5	56.6	56.6	46.0	9	ML
21	91.5	28.5	7.0	1.32	1.00	1.00	1.00	5,407.1	0.61	5.0	0.0	9.2	5.6	5.6	10	SW-SM/SW-SC/SP-SM/SP-SC
22	96.5	23.5	50.0	1.32	1.00	1.00	1.00	5,667.6	0.59	12.0	2.1	65.8	39.1	41.2	11	SM/SC/SC-SM
23	101.5	18.5	24.0	1.32	1.00	1.00	1.00	5,955.6	0.58	5.0	0.0	31.6	18.3	18.3	12	SW-SM/SW-SC/SP-SM/SP-SC

[D] Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = B-9
Boring Station = 5952+28.00
Boring Offset = 8 ft LT
Ground Elevation at Boring (ft msl) = 120
Water Table Depth (Dw) (ft) = 12.6
Water Table Elevation (msl ft) = 107.4

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.5
D_{a5-95} (sec) = 30.15

No. of Soil Layers = 12 each
No. of Split Spoon Samples = 23 each
Total Profile Thickness = 102 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \le \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	120.0																	
1	3.5	116.5	7.0	6.7	11.4	15.7	1	SM/SC/SC-SM		No Liquefaction		18.9				34		34	
2	5.5	114.5	5.0	5.1	8.7	8.7	2	SP/SW		No Liquefaction		0.0				32		32	
3	7.5	112.5	4.0	4.3	6.5	6.5	3	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.6				30		30	
4	9.5	110.5	3.0	3.4	4.5	4.5	4	SP/SW		No Liquefaction		0.0				28		28	
5	11.5	108.5	2.0	2.3	2.8	4.9	5	SM/SC/SC-SM		No Liquefaction		12.0				27		27	
6	16.5	103.5	27.0	33.0	35.7	35.7	6	SP/SW		No Liquefaction		4.6				36		36	
7	21.5	98.5	54.0	68.1	68.6	46.0	7	SM/SC/SC-SM		No Liquefaction		48.4				36		36	
8	26.5	93.5	36.0	46.2	43.7	46.0	8	SM/SC/SC-SM		No Liquefaction		35.7				36		36	
9	31.5	88.5	35.0	45.4	40.6	46.0	8	SM/SC/SC-SM		No Liquefaction		35.7				36		36	
10	36.5	83.5	21.0	27.4	27.4	32.9	9	ML		No Liquefaction		59.4				30		30	
11	41.5	78.5	27.0	35.4	35.4	40.9	9	ML		No Liquefaction		59.4				30		30	
12	46.5	73.5	24.0	31.5	31.5	37.0	9	ML		No Liquefaction		59.4				30		30	
13	51.5	68.5	50.0	65.7	65.7	46.0	9	ML		No Liquefaction		59.4				30		30	
14	56.5	63.5	20.0	26.3	26.3	31.8	9	ML		No Liquefaction		59.4				30		30	
15	61.5	58.5	31.0	40.8	40.8	46.0	9	ML		No Liquefaction		59.4				30		30	
16	66.5	53.5	43.0	56.6	56.6	46.0	9	ML		No Liquefaction		59.4				30		30	
17	71.5	48.5	27.0	35.5	35.5	41.0	9	ML		No Liquefaction		59.4				30		30	
18	76.5	43.5	34.0	44.8	44.8	46.0	9	ML		No Liquefaction		59.4				30		30	
19	81.5	38.5	49.0	64.5	64.5	46.0	9	ML		No Liquefaction		59.4				30		30	
20	86.5	33.5	43.0	56.6	56.6	46.0	9	ML		No Liquefaction		59.4				30		30	
21	91.5	28.5	7.0	9.2	5.6	5.6	10	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				29		29	
22	96.5	23.5	50.0	65.8	39.1	41.2	11	SM/SC/SC-SM		No Liquefaction		12.0				36		36	
23	101.5	18.5	24.0	31.6	18.3	18.3	12	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				36		36	

^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	10/16/2014
Project:	Bridge Replacement over Four Hole Swamp						
Location:	RW-4			**Station:**	5952+50.00	**Finished Embankment Height (ft)[1] =**	0

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
$\beta = S_{D1}$/PGA =	1.140	0.900		β = Ground Motion Index:	$0.50 \leq \beta \leq 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1]\leq1.0$: for $h_{slope}\leq20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.3	64.1	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; $\varepsilon = 0.015(R-20)$
$D_{a5\text{-}95}$	30.12	30.07	sec	$D_{a5\text{-}95}$ = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; $\varepsilon = 0$

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	Bridge Replacement over Four Hole Swamp			**Longitude:**	80.6470	**Date:**	10/16/2014
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	RW-4	**Station:**	5952+50.00

Design EQ =	SEE	**Boring Number =**	RW-4	**Hammer Type =**	Automatic
Site Class =	D	**Boring Station =**	5952+50.00	**Energy Ratio =**	79.0
PGA (g) =	0.43	**Boring Offset =**	20' Rt	**Energy Correction (C_E) =**	1.32
M_W =	7.4	**Ground Elevation at Boring (ft msl) =**	119.5		
R (km) =	63.3	**Water Table Depth (Dw) (ft) =**	6.5	**Borehole Diameter (in) =**	4
D_{a5-95} (sec) =	30.12	**Water Table Elevation (msl ft) =**	113.0	**Borehole Correction (CB) =**	1.00

No. of Soil Layers =	4	each	**Sampler Configuration:**	
No. of Split Spoon Samples =	9	each	**Liner Required =**	N
Total Profile Thickness =	25.1	feet	**Liner Used =**	N

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	119.5													
1	3.5	116.0	11.0	SM/SC/SC-SM	NSL-S				No Liquefaction		30.0				
2	5.5	114.0	5.2	SP/SW	NSL-S				No Liquefaction		29.0				
3	7.5	112.0	8.4	SP/SW	NSL-S				No Liquefaction		31.4				
4	9.5	110.0	6.5	SP/SW	NSL-S				No Liquefaction		30.0				
5	11.4	108.1	17.5	SM/SC/SC-SM	NSL-S				No Liquefaction		34.1				
6	16.4	103.1	22.8	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
7	21.4	98.1	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
8	24.7	94.8	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
9	25.1	94.4	46.0	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				

0.00	**0.00**
LDI Total (feet)	**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.:	**40308**	**File No.:**	**38.040308**	**Latitude:**	**33.4570**	**Designer:**	**R. Gardner - Midlands RPG**
Project:	**Bridge Replacement over Four Hole Swamp**			**Longitude:**	**80.6470**	**Date:**	**10/16/2014**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**	**RW-4**	**Station:**	**5952+50.00**

Boring Number = RW-4
Boring Station = 5952+50.00
Boring Offset = 20' Rt
Ground Elevation at Boring (ft msl) = 119.5
Water Table Depth (Dw) (ft) = 6.5
Water Table Elevation (msl ft) = 113

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.3
D_{a5-95} (sec) = 30.12

No. of Soil Layers = 4 **each**
No. of Split Spoon Samples = 9 **each**
Total Profile Thickness = 25 **feet**

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.5														
1	3.5	116.0	4.0	1.32	1.00	0.73	1.00	401.0	1.70	20.2	4.5	3.8	6.5	11.0	1	SM/SC/SC-SM
2	5.5	114.0	3.0	1.32	1.00	0.78	1.00	641.0	1.70	4.1	0.0	3.1	5.2	5.2	2	SP/SW
3	7.5	112.0	5.0	1.32	1.00	0.82	1.00	818.6	1.56	4.1	0.0	5.4	8.4	8.4	2	SP/SW
4	9.5	110.0	4.0	1.32	1.00	0.85	1.00	935.3	1.46	4.1	0.0	4.5	6.5	6.5	2	SP/SW
5	11.4	108.1	8.0	1.32	1.00	0.88	1.00	1,035.2	1.39	21.3	4.7	9.2	12.8	17.5	3	SM/SC/SC-SM
6	16.4	103.1	12.0	1.32	1.00	0.93	1.00	1,298.2	1.24	21.3	4.7	14.6	18.2	22.8	3	SM/SC/SC-SM
7	21.4	98.1	50.0	1.32	1.00	0.96	1.00	1,561.2	1.13	49.3	5.5	63.0	71.3	46.0	4	SM/SC/SC-SM
8	24.7	94.8	50.0	1.32	1.00	0.97	1.00	1,734.8	1.07	49.3	5.5	63.8	68.6	46.0	4	SM/SC/SC-SM
9	25.1	94.4	50.0	1.32	1.00	0.97	1.00	1,755.9	1.07	49.3	5.5	63.9	68.2	46.0	4	SM/SC/SC-SM

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = RW-4
Boring Station = 5952+50.00
Boring Offset = 20' Rt
Ground Elevation at Boring (ft msl) = 119.5
Water Table Depth (Dw) (ft) = 6.5
Water Table Elevation (msl ft) = 113

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.3
D_{a5-95} (sec) = 30.12

No. of Soil Layers = 4 each
No. of Split Spoon Samples = 9 each
Total Profile Thickness = 25 feet

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	119.5																	
1	3.5	116.0	4.0	3.8	6.5	11.0	1	SM/SC/SC-SM		No Liquefaction		20.2				30		30	
2	5.5	114.0	3.0	3.1	5.2	5.2	2	SP/SW		No Liquefaction		4.1				29		29	
3	7.5	112.0	5.0	5.4	8.4	8.4	2	SP/SW		No Liquefaction		4.1				31		31	
4	9.5	110.0	4.0	4.5	6.5	6.5	2	SP/SW		No Liquefaction		4.1				30		30	
5	11.4	108.1	8.0	9.2	12.8	17.5	3	SM/SC/SC-SM		No Liquefaction		21.3				34		34	
6	16.4	103.1	12.0	14.6	18.2	22.8	3	SM/SC/SC-SM		No Liquefaction		21.3				36		36	
7	21.4	98.1	50.0	63.0	71.3	46.0	4	SM/SC/SC-SM		No Liquefaction		49.3				36		36	
8	24.7	94.8	50.0	63.8	68.6	46.0	4	SM/SC/SC-SM		No Liquefaction		49.3				36		36	
9	25.1	94.4	50.0	63.9	68.2	46.0	4	SM/SC/SC-SM		No Liquefaction		49.3				36		36	

[D] Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	10/16/2014
Project:	Bridge Replacement over Four Hole Swamp						
Location:	RW-5			**Station:**	5952+70.00	**Finished Embankment Height (ft)[1] =**	0

[1] Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index:	0.50 ≤ β ≤ 1.5
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1]\leq 1.0$: for $h_{slope} \leq 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.3	64.1	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; ε = 0.015(R-20)
D_{a5-95}	30.12	30.07	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; ε = 0

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	Bridge Replacement over Four Hole Swamp			**Longitude:**	80.6470	**Date:**	10/16/2014
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	RW-5	**Station:**	5952+70.00

Design EQ =	SEE	**Boring Number =**	RW-5	**Hammer Type =**	Automatic
Site Class =	D	**Boring Station =**	5952+70.00	**Energy Ratio =**	79.0
PGA (g) =	0.43	**Boring Offset =**	22' Lt	**Energy Correction (C_E) =**	1.32
M_W =	7.4	**Ground Elevation at Boring (ft msl) =**	119.4		
R (km) =	63.3	**Water Table Depth (Dw) (ft) =**	8.1	**Borehole Diameter (in) =**	4
D_{a5-95} (sec) =	30.12	**Water Table Elevation (msl ft) =**	111.3	**Borehole Correction (CB) =**	1.00

No. of Soil Layers =	4	each	**Sampler Configuration:**	
No. of Split Spoon Samples =	11	each	**Liner Required =**	N
Total Profile Thickness =	41.4	feet	**Liner Used =**	N

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	119.4													
1	3.5	115.9	26.3	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
2	5.5	113.9	12.2	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		32.7				
3	7.5	111.9	11.5	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		32.2				
4	9.5	109.9	8.0	SW-SM/SW-SC/SP-SM/SP-SC	SSL	Sand-Like	2.61	0.90	Full Liquefaction	0.7 - 1.0	4.6		1.00	1.00	1.01
5	11.4	108.0	8.5	SM/SC/SC-SM	SSL	Sand-Like	1.73	0.90	Full Liquefaction	0.7 - 1.0	4.9		0.95	1.95	0.93
6	16.4	103.0	5.5	SM/SC/SC-SM	SSL	Sand-Like	2.43	0.90	Full Liquefaction	0.7 - 1.0	3.6		2.50	4.45	3.03
7	21.4	98.0	26.9	ML	NSL-C				No Strength Loss			1606.52			
8	26.4	93.0	35.0	ML	NSL-S				No Liquefaction		30.0				
9	31.4	88.0	37.9	ML	NSL-S				No Liquefaction		30.0				
10	35	84.4	46.0	ML	NSL-S				No Liquefaction		30.0				
11	41.4	78.0	25.2	ML	NSL-C				No Strength Loss			1500.00			

4.45	**4.97**
LDI Total (feet)	**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.:	**40308**	**File No.:**	**38.040308**	**Latitude:**	**33.4570**	**Designer:**	**R. Gardner - Midlands RPG**
Project:	**Bridge Replacement over Four Hole Swamp**			**Longitude:**	**80.6470**	**Date:**	**10/16/2014**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**	**RW-5**	**Station:**	**5952+70.00**

Boring Number = **RW-5**
Boring Station = **5952+70.00**
Boring Offset = **22' Lt**
Ground Elevation at Boring (ft msl) = **119.4**
Water Table Depth (Dw) (ft) = **8.1**
Water Table Elevation (msl ft) = **111.3**

Design EQ = **SEE**
Site Class = **D**
PGA (g) = **0.43**
M_W = **7.37**
R (km) = **63.3**
D_{a5-95} (sec) = **30.12**

No. of Soil Layers = **4** **each**
No. of Split Spoon Samples = **11** **each**
Total Profile Thickness = **41** **feet**

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.4														
1	3.5	115.9	15.0	1.32	1.00	0.73	1.00	420.0	1.70	11.3	1.8	14.4	24.5	26.3	1	SW-SM/SW-SC/SP-SM/SP-SC
2	5.5	113.9	6.0	1.32	1.00	0.78	1.00	660.0	1.70	11.3	1.8	6.1	10.4	12.2	1	SW-SM/SW-SC/SP-SM/SP-SC
3	7.5	111.9	6.0	1.32	1.00	0.82	1.00	900.0	1.49	11.5	1.8	6.4	9.6	11.5	2	SW-SM/SW-SC/SP-SM/SP-SC
4	9.5	109.9	4.0	1.32	1.00	0.85	1.00	1,054.6	1.38	11.5	1.8	4.5	6.2	8.0	2	SW-SM/SW-SC/SP-SM/SP-SC
5	11.4	108.0	2.0	1.32	1.00	0.88	1.00	1,154.6	1.32	41.0	5.5	2.3	3.0	8.5	3	SM/SC/SC-SM
6	16.4	103.0	0.0	1.32	1.00	0.93	1.00	1,426.6	1.18	41.0	5.5	0.0	0.0	5.5	3	SM/SC/SC-SM
7	21.4	98.0	17.0	1.32	1.00	0.96	1.00	1,664.6	1.00	59.9	5.5	21.4	21.4	26.9	4	ML
8	26.4	93.0	23.0	1.32	1.00	0.97	1.00	1,902.6	1.00	59.9	5.5	29.5	29.5	35.0	4	ML
9	31.4	88.0	25.0	1.32	1.00	0.99	1.00	2,140.6	1.00	59.9	5.5	32.4	32.4	37.9	4	ML
10	35	84.4	50.0	1.32	1.00	0.99	1.00	2,311.9	1.00	59.9	5.5	65.2	65.2	46.0	4	ML
11	41.4	78.0	15.0	1.32	1.00	1.00	1.00	2,616.6	1.00	59.9	5.5	19.7	19.7	25.2	4	ML

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = RW-5
Boring Station = 5952+70.00
Boring Offset = 22' Lt
Ground Elevation at Boring (ft msl) = 119.4
Water Table Depth (Dw) (ft) = 8.1
Water Table Elevation (msl ft) = 111.3

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.3
$D_{a5\text{-}95}$ (sec) = 30.12

No. of Soil Layers = 4 each
No. of Split Spoon Samples = 11 each
Total Profile Thickness = 41 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic S Strengt
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)
	0	119.4																
1	3.5	115.9	15.0	14.4	24.5	26.3	1	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		11.3				36		36
2	5.5	113.9	6.0	6.1	10.4	12.2	1	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		11.3				33		33
3	7.5	111.9	6.0	6.4	9.6	11.5	2	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		11.5				32		32
4	9.5	109.9	4.0	4.5	6.2	8.0	2	SW-SM/SW-SC/SP-SM/SP-SC	Sand-Like	Full Liquefaction	31.2	11.5				30		5
5	11.4	108.0	2.0	2.3	3.0	8.5	3	SM/SC/SC-SM	Sand-Like	Full Liquefaction	22.4	41.0				27		5
6	16.4	103.0	0.0	0.0	0.0	5.5	3	SM/SC/SC-SM	Sand-Like	Full Liquefaction	0.0	41.0				25		4
7	21.4	98.0	17.0	21.4	21.4	26.9	4	ML		No Strength Loss		59.9					1607	
8	26.4	93.0	23.0	29.5	29.5	35.0	4	ML		No Liquefaction		59.9				30		30
9	31.4	88.0	25.0	32.4	32.4	37.9	4	ML		No Liquefaction		59.9				30		30
10	35	84.4	50.0	65.2	65.2	46.0	4	ML		No Liquefaction		59.9				30		30
11	41.4	78.0	15.0	19.7	19.7	25.2	4	ML		No Strength Loss		59.9					1500	

^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	10/16/2014
Project:	Bridge Replacement over Four Hole Swamp						
Location:	RW-6			**Station:**	5953+15.00	**Finished Embankment Height (ft)^1 =**	0

^{1}**Embankment height measured from natural ground surface**

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index:	0.50 ≤ β ≤ 1.5
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1]\leq1.0$: for $h_{slope}\leq20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.3	64.1	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; ε = 0.015(R-20)
D_{a5-95}	30.12	30.07	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; ε = 0

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	Bridge Replacement over Four Hole Swamp			**Longitude:**	80.6470	**Date:**	10/16/2014
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	RW-6	**Station:**	5953+15.00

Design EQ =	SEE	**Boring Number =**	RW-6	**Hammer Type =**	Automatic
Site Class =	D	**Boring Station =**	5953+15.00	**Energy Ratio =**	79.0
PGA (g) =	0.43	**Boring Offset =**	22' Rt	**Energy Correction (C_E) =**	1.32
M_W =	7.4	**Ground Elevation at Boring (ft msl) =**	119.2		
R (km) =	63.3	**Water Table Depth (Dw) (ft) =**	8.0	**Borehole Diameter (in) =**	4
D_{a5-95} (sec) =	30.12	**Water Table Elevation (msl ft) =**	111.2	**Borehole Correction (CB) =**	1.00

No. of Soil Layers =	5	each	**Sampler Configuration:**	
No. of Split Spoon Samples =	8	each	**Liner Required =**	N
Total Profile Thickness =	20.9	feet	**Liner Used =**	N

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	119.2													
1	3.5	115.7	8.5	SM/SC/SC-SM	NSL-S				No Liquefaction		28.7				
2	5.5	113.7	7.0	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		30.3				
3	7.5	111.7	1.6	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		25.0				
4	9.5	109.7	8.2	SM/SC/SC-SM	SSL	Sand-Like	1.63	0.90	Full Liquefaction	0.7 - 1.0	4.7		1.00	1.00	1.00
5	11.5	107.7	17.5	SM/SC/SC-SM	SSL	Sand-Like	1.04	0.90	Full Liquefaction	0.7 - 1.0	23.7		0.08	1.08	0.32
6	16.5	102.7	30.2	SP/SW	NSL-S				No Liquefaction		32.0				
7	20.3	98.9	46.0	ML	NSL-S				No Liquefaction		30.0				
8	20.9	98.3	46.0	ML	NSL-S				No Liquefaction		30.0				
													1.08 **LDI Total (feet)**		**1.32** **S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.: 40308
File No.: 38.040308
Latitude: 33.4570
Designer: R. Gardner - Midlands RPG
Project: Bridge Replacement over Four Hole Swamp
Longitude: 80.6470
Date: 10/16/2014
Route: US 301
County: 38 - Orangeburg
Location: RW-6
Station: 5953+15.00

Boring Number = RW-6
Boring Station = 5953+15.00
Boring Offset = 22' Rt
Ground Elevation at Boring (ft msl) = 119.2
Water Table Depth (Dw) (ft) = 8
Water Table Elevation (msl ft) = 111.2

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.3
D_{a5-95} (sec) = 30.12

No. of Soil Layers = 5 each
No. of Split Spoon Samples = 8 each
Total Profile Thickness = 21 feet

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.2														
1	3.5	115.7	3.0	1.32	1.00	0.73	1.00	401.0	1.70	16.0	3.6	2.9	4.9	8.5	1	SM/SC/SC-SM
2	5.5	113.7	4.0	1.32	1.00	0.78	1.00	641.0	1.70	5.0	0.0	4.1	7.0	7.0	2	SW-SM/SW-SC/SP-SM/SP-SC
3	7.5	111.7	1.0	1.32	1.00	0.82	1.00	882.5	1.51	5.0	0.0	1.1	1.6	1.6	2	SW-SM/SW-SC/SP-SM/SP-SC
4	9.5	109.7	2.0	1.32	1.00	0.85	1.00	1,018.9	1.40	25.1	5.1	2.2	3.1	8.2	3	SM/SC/SC-SM
5	11.5	107.7	8.0	1.32	1.00	0.88	1.00	1,115.1	1.34	25.1	5.1	9.2	12.4	17.5	3	SM/SC/SC-SM
6	16.5	102.7	21.0	1.32	1.00	0.93	1.00	1,438.1	1.18	0.0	0.0	25.6	30.2	30.2	4	SP/SW
7	20.3	98.9	50.0	1.32	1.00	0.95	1.00	1,619.0	1.00	51.0	5.5	62.6	62.6	46.0	5	ML
8	20.9	98.3	50.0	1.32	1.00	0.95	1.00	1,647.5	1.00	51.0	5.5	62.8	62.8	46.0	5	ML

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number = RW-6
Boring Station = 5953+15.00
Boring Offset = 22' Rt
Ground Elevation at Boring (ft msl) = 119.2
Water Table Depth (Dw) (ft) = 8
Water Table Elevation (msl ft) = 111.2

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.3
D_{a5-95} (sec) = 30.12

No. of Soil Layers = 5 **each**
No. of Split Spoon Samples = 8 **each**
Total Profile Thickness = 21 **feet**

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	D_{10} (%)	C_u	C_c	Static Shear Strengths		Seismic Shear Strengths	
																ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)
	0	119.2																	
1	3.5	115.7	3.0	2.9	4.9	8.5	1	SM/SC/SC-SM		No Liquefaction		16.0				29		29	
2	5.5	113.7	4.0	4.1	7.0	7.0	2	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				30		30	
3	7.5	111.7	1.0	1.1	1.6	1.6	2	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		5.0				25		25	
4	9.5	109.7	2.0	2.2	3.1	8.2	3	SM/SC/SC-SM	Sand-Like	Full Liquefaction	22.1	25.1				27		5	
5	11.5	107.7	8.0	9.2	12.4	17.5	3	SM/SC/SC-SM	Sand-Like	Full Liquefaction	44.8	25.1				34		24	
6	16.5	102.7	21.0	25.6	30.2	30.2	4	SP/SW		No Liquefaction		0.0				32		32	
7	20.3	98.9	50.0	62.6	62.6	46.0	5	ML		No Liquefaction		51.0				30		30	
8	20.9	98.3	50.0	62.8	62.8	46.0	5	ML		No Liquefaction		51.0				30		30	

^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	80.6470	**Date:**	10/16/2014
Project:	Bridge Replacement over Four Hole Swamp						
Location:	RW-7			**Station:**	5953+66.00	**Finished Embankment Height (ft)[1] =**	0

[1] Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC = II

ROC = II

Seismic Data:

Site Class =	D				
Design Earthquake:	**SEE**	**FEE**			
S_{D1} =	0.490	0.180	g		
k_{max} = PGA =	0.430	0.200	g		
$\beta = S_{D1}/PGA$ =	1.140	0.900		β = Ground Motion Index:	$0.50 \leq \beta \leq 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1]\leq1.0$: for $h_{slope}\leq20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis
R =	63.3	64.1	km	R = Site-to-Source Distance	
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	494.50	494.50	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output	
ε =	0.000	0.000		ε = Near-fault directivity correction:	R < 20 km; $\varepsilon = 0.015(R-20)$
D_{a5-95}	30.12	30.07	sec	D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48	R ≥ 20 km; ε = 0

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - SCDOT v1.2 - 07302012

PIN No.:	40308	**File No.:**	38.040308	**Latitude:**	33.4570	**Designer:**	R. Gardner - Midlands RPG
Project:	Bridge Replacement over Four Hole Swamp			**Longitude:**	80.6470	**Date:**	10/16/2014
Route:	US 301	**County:**	38 - Orangeburg	**Location:**	RW-7	**Station:**	5953+66.00

Design EQ =	SEE	**Boring Number =**	RW-7	**Hammer Type =**	Automatic
Site Class =	D	**Boring Station =**	5953+66.00	**Energy Ratio =**	79.0
PGA (g) =	0.43	**Boring Offset =**	20' Lt	**Energy Correction (C_E) =**	1.32
M_W =	7.4	**Ground Elevation at Boring (ft msl) =**	119.7		
R (km) =	63.3	**Water Table Depth (Dw) (ft) =**	7.9	**Borehole Diameter (in) =**	4
D_{a5-95} (sec) =	30.12	**Water Table Elevation (msl ft) =**	111.8	**Borehole Correction (CB) =**	1.00

No. of Soil Layers =	5	each	**Sampler Configuration:**	
No. of Split Spoon Samples =	8	each	**Liner Required =**	N
Total Profile Thickness =	21.8	feet	**Liner Used =**	N

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Seismic Analysis Summary		Geotechnical Seismic Hazards Summary		
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**
	0	119.7													
1	3.5	116.2	22.4	SM/SC/SC-SM	NSL-S				No Liquefaction		36.0				
2	5.5	114.2	7.1	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		30.3				
3	7.5	112.2	3.4	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		27.1				
4	9.5	110.2	11.1	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		33.0				
5	11.5	108.2	8.3	SM/SC/SC-SM	SSL	Sand-Like	1.78	0.90	Full Liquefaction	0.7 - 1.0	4.7		1.00	1.00	1.00
6	16.5	103.2	22.3	SW-SM/SW-SC/SP-SM/SP-SC	NSL-S				No Liquefaction		36.0				
7	21.5	98.2	46.0	ML	NSL-S				No Liquefaction		30.0				
8	21.8	97.9	46.0	ML	NSL-S				No Liquefaction		30.0				
													1.00		**1.00**
													LDI Total (feet)		**S Total (inches)**

[D] Depth at bottom of Split-Spoon Sampler.

SPT Correction Summary

PIN No.: 40308
File No.: 38.040308
Latitude: 33.4570
Designer: R. Gardner - Midlands RPG
Project: Bridge Replacement over Four Hole Swamp
Longitude: 80.6470
Date: 10/16/2014
Route: US 301
County: 38 - Orangeburg
Location: RW-7
Station: 5953+66.00

Boring Number = RW-7
Boring Station = 5953+66.00
Boring Offset = 20' Lt
Ground Elevation at Boring (ft msl) = 119.7
Water Table Depth (Dw) (ft) = 7.9
Water Table Elevation (msl ft) = 111.8

Design EQ = SEE
Site Class = D
PGA (g) = 0.43
M_W = 7.37
R (km) = 63.3
$D_{a5\text{-}95}$ (sec) = 30.12

No. of Soil Layers = 5 **each**
No. of Split Spoon Samples = 8 **each**
Total Profile Thickness = 22 **feet**

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.7														
1	3.5	116.2	12.0	1.32	1.00	0.73	1.00	401.0	1.70	13.7	2.8	11.5	19.6	22.4	1	SM/SC/SC-SM
2	5.5	114.2	4.0	1.32	1.00	0.78	1.00	641.0	1.70	7.3	0.2	4.1	7.0	7.1	2	SW-SM/SW-SC/SP-SM/SP-SC
3	7.5	112.2	2.0	1.32	1.00	0.82	1.00	881.0	1.51	7.3	0.2	2.1	3.2	3.4	2	SW-SM/SW-SC/SP-SM/SP-SC
4	9.5	110.2	7.0	1.32	1.00	0.85	1.00	1,022.7	1.40	7.3	0.2	7.8	11.0	11.1	2	SW-SM/SW-SC/SP-SM/SP-SC
5	11.5	108.2	4.0	1.32	1.00	0.88	1.00	1,118.9	1.34	12.0	2.1	4.6	6.2	8.3	3	SM/SC/SC-SM
6	16.5	103.2	14.0	1.32	1.00	0.93	1.00	1,421.9	1.19	12.0	2.1	17.1	20.3	22.3	4	SW-SM/SW-SC/SP-SM/SP-SC
7	21.5	98.2	50.0	1.32	1.00	0.96	1.00	1,659.9	1.00	51.0	5.5	63.0	63.0	46.0	5	ML
8	21.8	97.9	50.0	1.32	1.00	0.96	1.00	1,674.1	1.00	51.0	5.5	63.1	63.1	46.0	5	ML

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

Boring Number =	**RW-7**	**Design EQ =**	**SEE**	**No. of Soil Layers =**	**5**	**each**
Boring Station =	**5953+66.00**	**Site Class =**	**D**	**No. of Split Spoon Samples =**	**8**	**each**
Boring Offset =	**20' Lt**	**PGA (g) =**	**0.43**	**Total Profile Thickness =**	**22**	**feet**
Ground Elevation at Boring (ft msl) =	**119.7**	**M_W =**	**7.37**			
Water Table Depth (Dw) (ft) =	**7.9**	**R (km) =**	**63.3**			
Water Table Elevation (msl ft) =	**111.8**	**D_{a5-95} (sec) =**	**30.12**			

SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**N_{Meas}**	**N^*_{60}**	**$N^*_{1,60}$**	**$N^*_{1,60,CS}$**	**Soil Layer No.**	**Soil Type (USCS)**	**Screening Sand-Like or Clay-Like**	**Triggering $(D/C)_{SL} \leq \varphi_{SL}$**	**D_R (%)**	**Fines Content (%)**	**D_{10} (%)**	**C_u**	**C_c**	**Static Shear Strengths**		**Seismic S Strengt**
																ϕ' (degrees)	**τ = c (psf)**	**ϕ' (degrees)**
	0	119.7																
1	3.5	116.2	12.0	11.5	19.6	22.4	1	SM/SC/SC-SM		No Liquefaction		13.7				36		36
2	5.5	114.2	4.0	4.1	7.0	7.1	2	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		7.3				30		30
3	7.5	112.2	2.0	2.1	3.2	3.4	2	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		7.3				27		27
4	9.5	110.2	7.0	7.8	11.0	11.1	2	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		7.3				33		33
5	11.5	108.2	4.0	4.6	6.2	8.3	3	SM/SC/SC-SM	Sand-Like	Full Liquefaction	31.7	12.0				30		5
6	16.5	103.2	14.0	17.1	20.3	22.3	4	SW-SM/SW-SC/SP-SM/SP-SC		No Liquefaction		12.0				36		36
7	21.5	98.2	50.0	63.0	63.0	46.0	5	ML		No Liquefaction		51.0				30		30
8	21.8	97.9	50.0	63.1	63.1	46.0	5	ML		No Liquefaction		51.0				30		30

^{D}Depth at bottom of Split-Spoon Sampler.

Appendix VI

Three-Point ADRS Curves

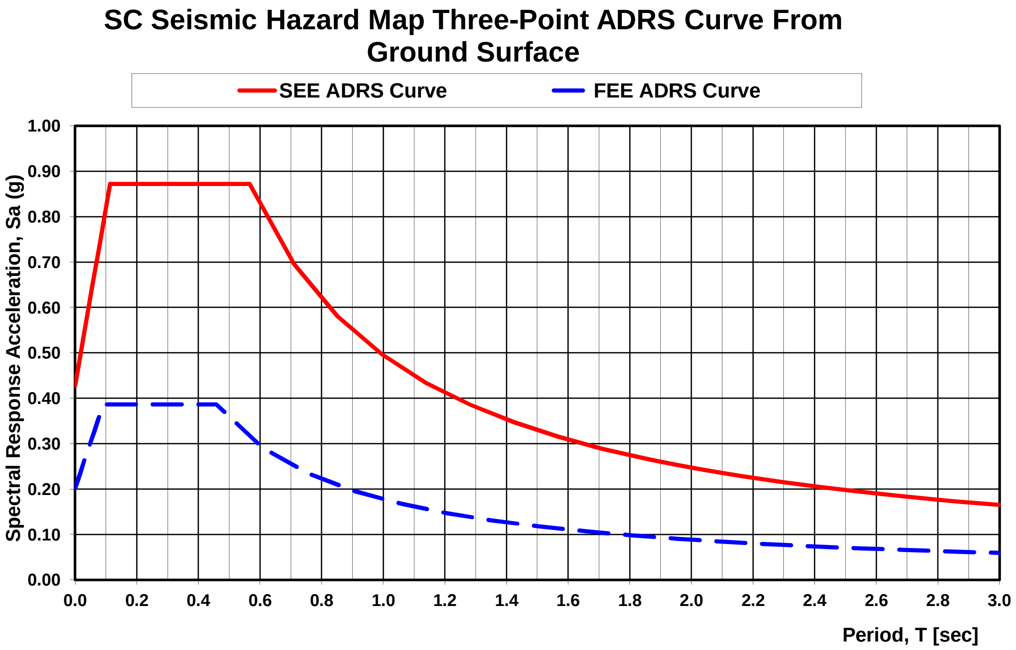
MASW/MAM Profile

SC Seismic Hazard Map
Three-Point ADRS Curves

PIN No.	**40308**	**File No:**	**38.040308**	**Latitude:**	**33.457**
Route:	**US 301**	**County:**	**Orangeburg**	**Longitude:**	**80.6470**
Project:	**RBO Four Hole Swamp**				

Designer:	**M. Jackson - Midlands RPG**
Date:	**9/4/2014**

Design EQ	PGA	S_{DS}	S_{D1}	M_W	R (km)	Geologic Condition	Site Class	Damping
FEE	0.20	0.39	0.18	7.36	64.1	Geologically Realistic (Q = 100)	D	5%
SEE	0.43	0.87	0.49	7.37	63.3	Geologically Realistic (Q = 100)	D	

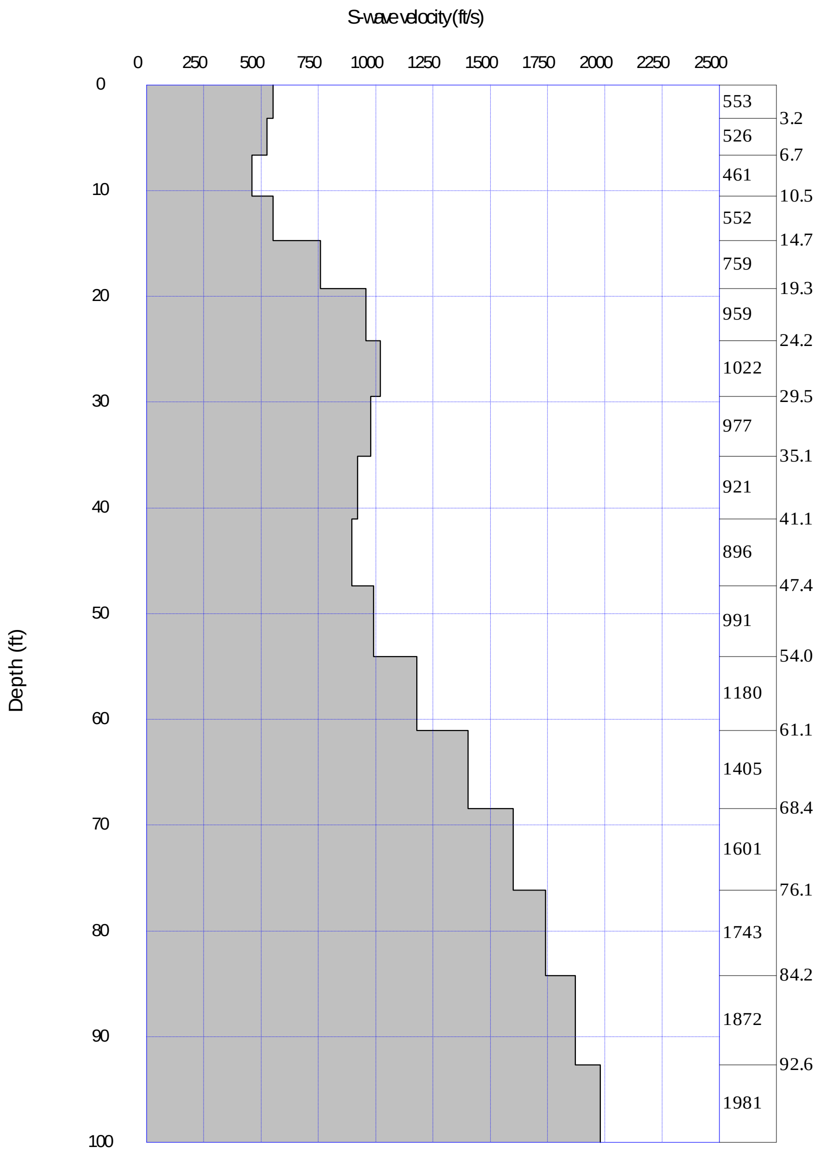


FEE ADRS Curve
Three-Point Method

	T	S_a
	0.00	0.20
	0.02	0.23
	0.03	0.26
	0.05	0.29
	0.06	0.32
	0.08	0.36
To	0.09	0.39
	0.12	0.39
	0.15	0.39
	0.18	0.39
	0.21	0.39
	0.24	0.39
	0.28	0.39
	0.31	0.39
	0.34	0.39
	0.37	0.39
	0.40	0.39
	0.43	0.39
Ts	0.46	0.39
	0.61	0.29
	0.76	0.23
	0.91	0.20
	1.06	0.17
	1.21	0.15
	1.36	0.13
	1.51	0.12
	1.65	0.11
	1.80	0.10
	1.95	0.09
	2.10	0.08
	2.25	0.08
	2.40	0.07
	2.55	0.07
	2.70	0.07
	2.85	0.06
	3.00	0.06

SEE ADRS Curve
Three-Point Method

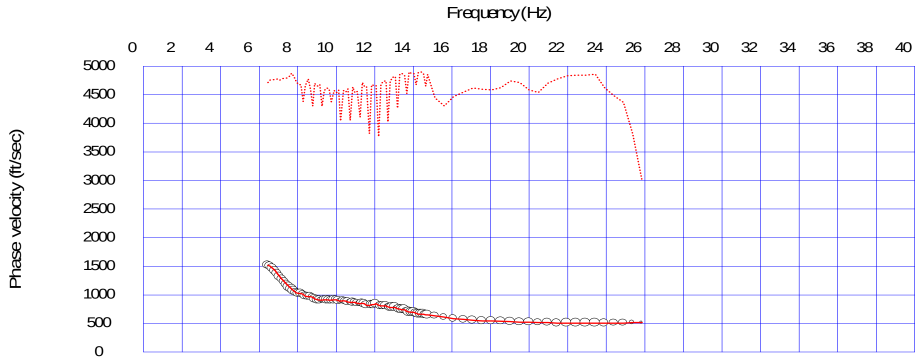
	T	Sa
	0.00	0.43
	0.02	0.50
	0.04	0.58
	0.06	0.65
	0.08	0.72
	0.09	0.80
To	0.11	0.87
	0.15	0.87
	0.19	0.87
	0.23	0.87
	0.26	0.87
	0.30	0.87
	0.34	0.87
	0.38	0.87
	0.42	0.87
	0.45	0.87
	0.49	0.87
	0.53	0.87
Ts	0.57	0.87
	0.71	0.70
	0.85	0.58
	1.00	0.50
	1.14	0.43
	1.28	0.39
	1.43	0.35
	1.57	0.32
	1.71	0.29
	1.85	0.27
	2.00	0.25
	2.14	0.23
	2.28	0.22
	2.43	0.20
	2.57	0.19
	2.71	0.18
	2.86	0.17
	3.00	0.16



S-wave velocity model (inverted): EN145045 Active and Passive Combined.rst

Average Vs 100ft = 1005.4 ft/sec

Testing Results	
Depth(ft)	S-wave velocity(ft/s)
0.0	553.1
3.2	526.7
6.7	461.6
10.5	552.7
14.7	759.5
19.3	959.8
24.2	1022.2
29.5	977.8
35.1	921.2
41.1	896.1
47.4	991.6
54.0	1180.6
61.1	1405.0
68.4	1601.4
76.1	1743.3
84.2	1872.3
92.6	1981.6



Dispersion curve : EN145045 Active and Passive Combined.rst

Project Mgr:	BTS
Prepared by:	BTS
Checked by:	BTS
Approved by:	BTS

Project No.	EN145045
Scale:	NA
Date:	4/18/2014

Terracon

1450 FIFTH STREET WEST
NORTH CHARLESTON, SC
PH: (843) 884-1234
Fax. (843) 884-9234

GEOPHYSICAL TESTING RESULTS
MASW SHEAR WAVE VELOCITY

XXXXX
Orangeburg County, South Carolina

TEST N0

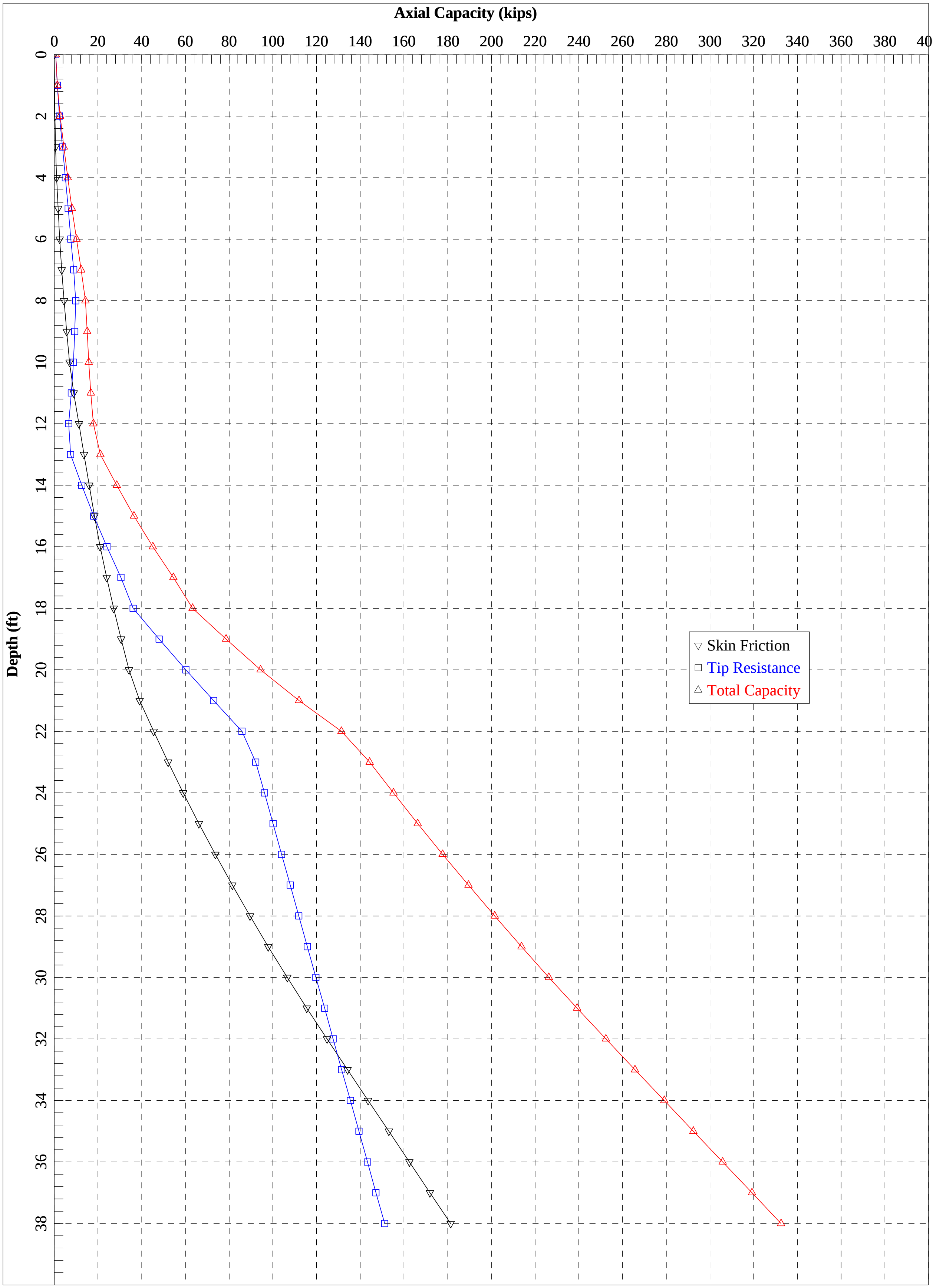
X

Appendix VII

APile Results

End Bents

End Bents


Axial Capacity (kips)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
▽ Skin Friction
□ Tip Resistance
△ Total Capacity

```
     ==========================================================================

                       APILE for Windows, Version 2015.7.2

                        Serial Number :  239146456

                        A Program for Analyzing the Axial Capacity
                        and Short-term Settlement of Driven Piles
                                  under Axial Loading.
                      (c) Copyright ENSOFT, Inc., 1987-2015
                            All Rights Reserved

     ==========================================================================


     This program is licensed to :

     SCDOT
     Columbia, SC

     Path to file locations      :
P:\Orangeburg\40308_us301\Geotechnical\5_Design\2_Final\6_EndBents\APile\
     Name of input data file     : EndBents.ap7d
     Name of output file         : EndBents.ap7o
     Name of plot output file    : EndBents.ap7p

     --------------------------------------------------------------------------
                          Time and Date of Analysis
     --------------------------------------------------------------------------

               Date:  March 24, 2016     Time:  15:14:04



1
          *********************
          * INPUT INFORMATION *
          *********************



          US 301 over Four Hole Swamp EB

          DESIGNER   : RSG

          JOB NUMBER : 0040308


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Unfactored Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION
```

```
PILE TYPE :

H-Pile/Steel Pile


DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY     = 0.290E+08 PSI
- CROSS SECTION AREA        =    199.92 IN2


NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL     =     38.00 FT.
- PILE STICKUP LENGTH, PSL  =      0.00 FT.
- ZERO FRICTION LENGTH, ZFL =      0.00 FT.
- PERIMETER OF PILE         =     56.60 IN.
- TIP AREA OF PILE          =    199.92 IN2
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION       =      1.00 FT.



SOIL INFORMATIONS :



                  LATERAL    EFFECTIVE    FRICTION   BEARING
          SOIL    EARTH      UNIT         ANGLE      CAPACITY
 DEPTH    TYPE    PRESSURE   WEIGHT       DEGREES    FACTOR
  FT.                        LB/CF
   0.00   SAND      0.00        52.60        30.00      0.00
  10.00   SAND      0.00        52.60        30.00      0.00
  10.00   CLAY      0.00        52.60         0.00      0.00
  15.00   CLAY      0.00        52.60         0.00      0.00
  15.00   SAND      0.00        57.60        32.00      0.00
  20.00   SAND      0.00        57.60        32.00      0.00
  20.00   SAND      0.00        52.60        36.00      0.00
  88.00   SAND      0.00        52.60        36.00      0.00
  88.00   SAND      0.00        57.60        30.00      0.00
 108.00   SAND      0.00        57.60        30.00      0.00
 108.00   SAND      0.00        52.26        36.00      0.00
 200.00   SAND      0.00        52.60        36.00      0.00



MAXIMUM   MAXIMUM   UNDISTURB  REMOLDED
UNIT      UNIT      SHEAR      SHEAR     BLOW   UNIT SKIN  UNIT END
FRICTION  BEARING   STRENGTH   STRENGTH  COUNT  FRICTION   BEARING
  KSF       KSF        KSF       KSF               KSF       KSF
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.50      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.50      0.00   0.00       0.00      0.00
0.20E+01  0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.20E+01  0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
```

```
         * MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
           WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
           PLAN TO LIMIT THE COMPUTED DATA.



                LRFD FACTOR  LRFD FACTOR
                 ON UNIT      ON UNIT
          DEPTH    FRICTION     BEARING
           FT.
            0.00    1.000       1.000
           10.00    1.000       1.000
           10.00    1.000       1.000
           15.00    1.000       1.000
           15.00    1.000       1.000
           20.00    1.000       1.000
           20.00    1.000       1.000
           88.00    1.000       1.000
           88.00    1.000       1.000
          108.00    1.000       1.000
          108.00    1.000       1.000
          200.00    1.000       1.000



1
         **********************
         * COMPUTATION RESULT *
         **********************



                           **********************
                           *  FED. HWY. METHOD  *
                           **********************

            PILE       TOTAL SKIN       END       ULTIMATE
         PENETRATION   FRICTION       BEARING     CAPACITY
             FT.          KIP           KIP          KIP
             0.00           0.0            0.7          0.7
             1.00           0.1            1.4          1.4
             2.00           0.3            2.4          2.7
             3.00           0.6            3.8          4.4
             4.00           1.1            5.1          6.2
             5.00           1.8            6.4          8.1
             6.00           2.5            7.6         10.2
             7.00           3.4            8.9         12.3
             8.00           4.5            9.8         14.3
             9.00           5.7            9.4         15.1
            10.00           7.0            8.8         15.8
            11.00           8.9            7.8         16.7
            12.00          11.3            6.6         17.9
            13.00          13.6            7.5         21.1
            14.00          16.0           12.6         28.6
            15.00          18.4           18.1         36.5
            16.00          21.0           24.1         45.1
            17.00          24.0           30.5         54.5
            18.00          27.2           36.1         63.3
            19.00          30.6           48.0         78.6
            20.00          34.2           60.2         94.4
            21.00          39.1           72.9        112.0
            22.00          45.5           85.9        131.4
```

```
     23.00          52.1          92.2         144.3
     24.00          59.0          96.2         155.2
     25.00          66.2         100.1         166.3
     26.00          73.7         104.0         177.7
     27.00          81.5         108.0         189.5
     28.00          89.6         111.9         201.5
     29.00          97.9         115.8         213.8
     30.00         106.6         119.7         226.3
     31.00         115.5         123.7         239.2
     32.00         124.8         127.6         252.4
     33.00         134.2         131.5         265.7
     34.00         143.6         135.5         279.1
     35.00         153.1         139.4         292.4
     36.00         162.5         143.3         305.8
     37.00         171.9         147.2         319.2
     38.00         181.4         151.2         332.5


    NOTES:
    - AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
      IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
      OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.



        *************************************************
        * COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
        * CURVES FOR AXIAL LOADING                      *
        *************************************************


T-Z CURVE   NO. OF   DEPTH TO CURVE   LOAD TRANSFER   PILE MOVEMENT
   NO.      POINTS        FT.              PSI             IN.

    1         10      0.0000E+00
                                       0.0000E+00      0.0000E+00
                                       0.3109E-01      0.1000E-01
                                       0.6218E-01      0.2000E-01
                                       0.1244E+00      0.4000E-01
                                       0.1866E+00      0.6000E-01
                                       0.2487E+00      0.8000E-01
                                       0.2798E+00      0.9000E-01
                                       0.3109E+00      0.1000E+00
                                       0.3109E+00      0.5000E+00
                                       0.3109E+00      0.2000E+01
    2         10      0.5025E+01
                                       0.0000E+00      0.0000E+00
                                       0.1244E+00      0.1000E-01
                                       0.2487E+00      0.2000E-01
                                       0.4975E+00      0.4000E-01
                                       0.7462E+00      0.6000E-01
                                       0.9950E+00      0.8000E-01
                                       0.1119E+01      0.9000E-01
                                       0.1244E+01      0.1000E+00
                                       0.1244E+01      0.5000E+00
                                       0.1244E+01      0.2000E+01
    3         10      0.9958E+01
                                       0.0000E+00      0.0000E+00
                                       0.2371E+00      0.1000E-01
                                       0.4742E+00      0.2000E-01
                                       0.9483E+00      0.4000E-01
                                       0.1423E+01      0.6000E-01
                                       0.1897E+01      0.8000E-01
```

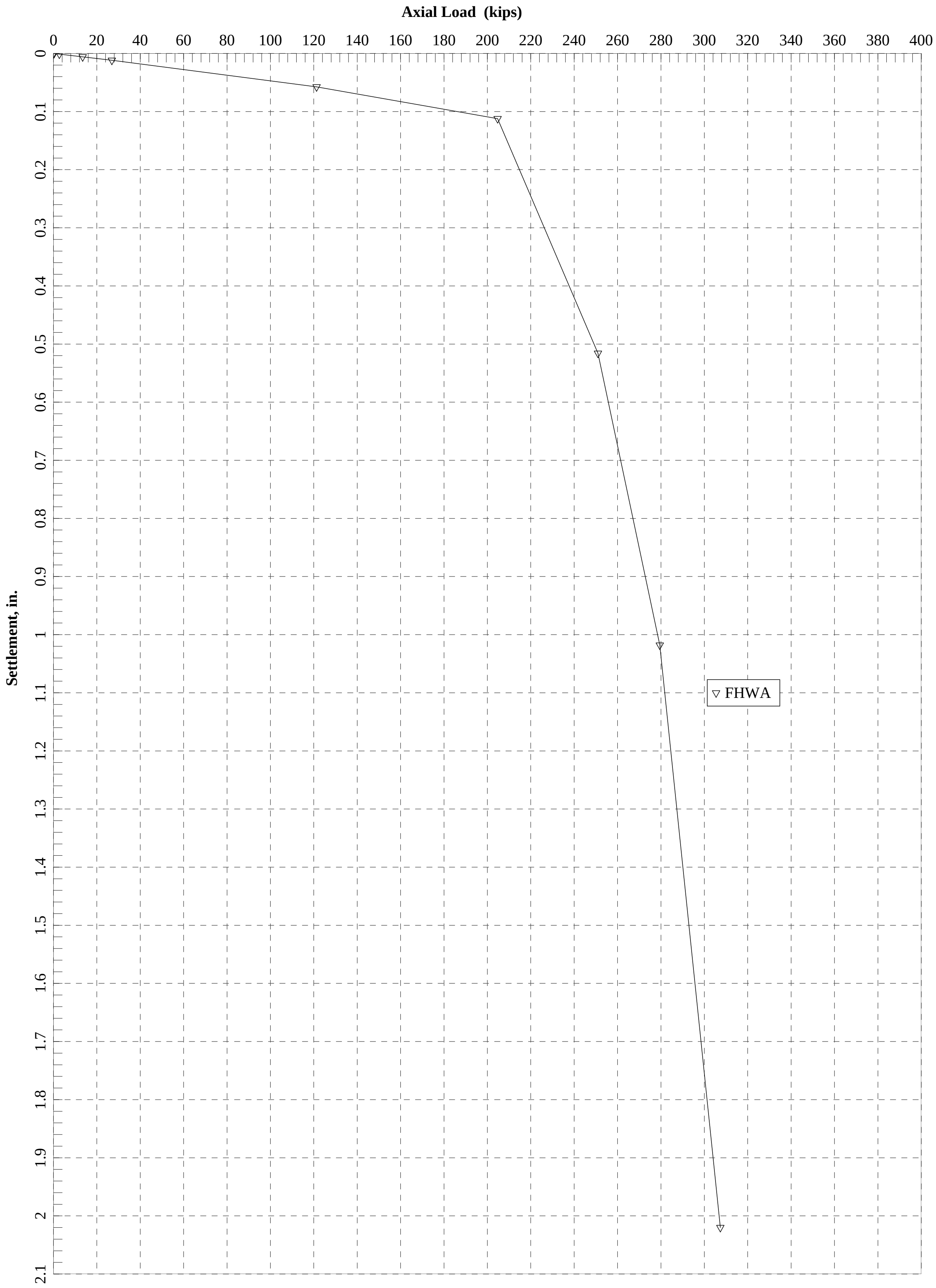
```
                                  0.2134E+01      0.9000E-01
                                  0.2371E+01      0.1000E+00
                                  0.2371E+01      0.5000E+00
                                  0.2371E+01      0.2000E+01
4         10       0.1000E+02
                                  0.0000E+00      0.0000E+00
                                  0.9367E+00      0.2883E-01
                                  0.1561E+01      0.5585E-01
                                  0.2342E+01      0.1027E+00
                                  0.2810E+01      0.1441E+00
                                  0.3122E+01      0.1802E+00
                                  0.2810E+01      0.3603E+00
                                  0.2810E+01      0.5405E+00
                                  0.2810E+01      0.9008E+00
                                  0.2810E+01      0.3603E+01
5         10       0.1253E+02
                                  0.0000E+00      0.0000E+00
                                  0.1042E+01      0.2883E-01
                                  0.1736E+01      0.5585E-01
                                  0.2604E+01      0.1027E+00
                                  0.3125E+01      0.1441E+00
                                  0.3472E+01      0.1802E+00
                                  0.3125E+01      0.3603E+00
                                  0.3125E+01      0.5405E+00
                                  0.3125E+01      0.9008E+00
                                  0.3125E+01      0.3603E+01
6         10       0.1496E+02
                                  0.0000E+00      0.0000E+00
                                  0.1102E+01      0.2883E-01
                                  0.1837E+01      0.5585E-01
                                  0.2755E+01      0.1027E+00
                                  0.3306E+01      0.1441E+00
                                  0.3674E+01      0.1802E+00
                                  0.3306E+01      0.3603E+00
                                  0.3306E+01      0.5405E+00
                                  0.3306E+01      0.9008E+00
                                  0.3306E+01      0.3603E+01
7         10       0.1500E+02
                                  0.0000E+00      0.0000E+00
                                  0.4149E+00      0.1000E-01
                                  0.8299E+00      0.2000E-01
                                  0.1660E+01      0.4000E-01
                                  0.2490E+01      0.6000E-01
                                  0.3320E+01      0.8000E-01
                                  0.3734E+01      0.9000E-01
                                  0.4149E+01      0.1000E+00
                                  0.4149E+01      0.5000E+00
                                  0.4149E+01      0.2000E+01
8         10       0.1753E+02
                                  0.0000E+00      0.0000E+00
                                  0.4860E+00      0.1000E-01
                                  0.9721E+00      0.2000E-01
                                  0.1944E+01      0.4000E-01
                                  0.2916E+01      0.6000E-01
                                  0.3888E+01      0.8000E-01
                                  0.4374E+01      0.9000E-01
                                  0.4860E+01      0.1000E+00
                                  0.4860E+01      0.5000E+00
                                  0.4860E+01      0.2000E+01
9         10       0.1996E+02
                                  0.0000E+00      0.0000E+00
                                  0.6290E+00      0.1000E-01
                                  0.1258E+01      0.2000E-01
```

```
                                0.2516E+01      0.4000E-01
                                0.3774E+01      0.6000E-01
                                0.5032E+01      0.8000E-01
                                0.5661E+01      0.9000E-01
                                0.6290E+01      0.1000E+00
                                0.6290E+01      0.5000E+00
                                0.6290E+01      0.2000E+01
  10        10      0.2000E+02
                                0.0000E+00      0.0000E+00
                                0.8309E+00      0.1000E-01
                                0.1662E+01      0.2000E-01
                                0.3324E+01      0.4000E-01
                                0.4986E+01      0.6000E-01
                                0.6647E+01      0.8000E-01
                                0.7478E+01      0.9000E-01
                                0.8309E+01      0.1000E+00
                                0.8309E+01      0.5000E+00
                                0.8309E+01      0.2000E+01
  11        10      0.5403E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
  12        10      0.8796E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
  13        10      0.8800E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
  14        10      0.9803E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
  15        10      0.1080E+03
```

```
                                 0.0000E+00      0.0000E+00
                                 0.1389E+01      0.1000E-01
                                 0.2778E+01      0.2000E-01
                                 0.5556E+01      0.4000E-01
                                 0.8333E+01      0.6000E-01
                                 0.1111E+02      0.8000E-01
                                 0.1250E+02      0.9000E-01
                                 0.1389E+02      0.1000E+00
                                 0.1389E+02      0.5000E+00
                                 0.1389E+02      0.2000E+01
   16         10      0.1080E+03
                                 0.0000E+00      0.0000E+00
                                 0.1389E+01      0.1000E-01
                                 0.2778E+01      0.2000E-01
                                 0.5556E+01      0.4000E-01
                                 0.8333E+01      0.6000E-01
                                 0.1111E+02      0.8000E-01
                                 0.1250E+02      0.9000E-01
                                 0.1389E+02      0.1000E+00
                                 0.1389E+02      0.5000E+00
                                 0.1389E+02      0.2000E+01
   17         10      0.1540E+03
                                 0.0000E+00      0.0000E+00
                                 0.1389E+01      0.1000E-01
                                 0.2778E+01      0.2000E-01
                                 0.5556E+01      0.4000E-01
                                 0.8333E+01      0.6000E-01
                                 0.1111E+02      0.8000E-01
                                 0.1250E+02      0.9000E-01
                                 0.1389E+02      0.1000E+00
                                 0.1389E+02      0.5000E+00
                                 0.1389E+02      0.2000E+01
   18         10      0.2000E+03
                                 0.0000E+00      0.0000E+00
                                 0.1389E+01      0.1000E-01
                                 0.2778E+01      0.2000E-01
                                 0.5556E+01      0.4000E-01
                                 0.8333E+01      0.6000E-01
                                 0.1111E+02      0.8000E-01
                                 0.1250E+02      0.9000E-01
                                 0.1389E+02      0.1000E+00
                                 0.1389E+02      0.5000E+00
                                 0.1389E+02      0.2000E+01


TIP   LOAD        TIP MOVEMENT
    KIP               IN.

0.0000E+00         0.0000E+00
0.9448E+01         0.9008E-02
0.1890E+02         0.1802E-01
0.3779E+02         0.3603E-01
0.7558E+02         0.2342E+00
0.1134E+03         0.7567E+00
0.1361E+03         0.1315E+01
0.1512E+03         0.1802E+01
0.1512E+03         0.2702E+01
0.1512E+03         0.3603E+01


              LOAD VERSUS SETTLEMENT CURVE
```

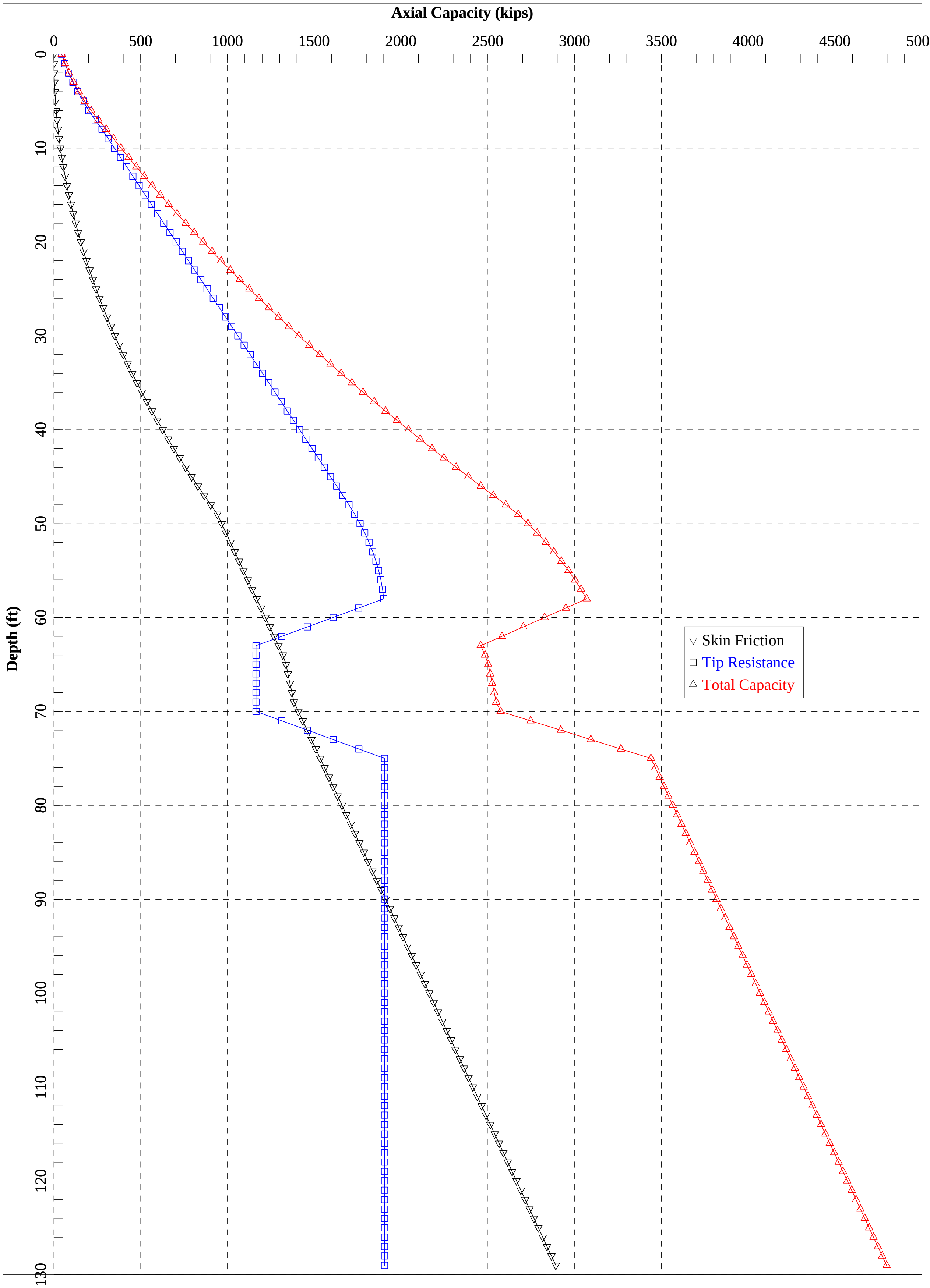
```
                         ****************************



  TOP  LOAD     TOP MOVEMENT       TIP  LOAD      TIP MOVEMENT
     KIP             IN.              KIP             IN.
 0.2692E+00      0.1168E-03      0.1049E+00      0.1000E-03
 0.2692E+01      0.1168E-02      0.1049E+01      0.1000E-02
 0.1346E+02      0.5842E-02      0.5244E+01      0.5000E-02
 0.2692E+02      0.1168E-01      0.1049E+02      0.1000E-01
 0.1213E+03      0.5744E-01      0.4046E+02      0.5000E-01
 0.2047E+03      0.1122E+00      0.4999E+02      0.1000E+00
 0.2510E+03      0.5158E+00      0.9481E+02      0.5000E+00
 0.2795E+03      0.1018E+01      0.1233E+03      0.1000E+01
 0.3074E+03      0.2020E+01      0.1512E+03      0.2000E+01
```

End Bents


Axial Load (kips)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
Settlement, in.
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
2.1
▽ FHWA

Interior Bents

IB-2 Plugged Condition



```
     =========================================================================

                      APILE for Windows, Version 2015.7.2

                       Serial Number :  239146456

                       A Program for Analyzing the Axial Capacity
                       and Short-term Settlement of Driven Piles
                                 under Axial Loading.
                     (c) Copyright ENSOFT, Inc., 1987-2015
                           All Rights Reserved

     =========================================================================


     This program is licensed to :

     SCDOT
     Columbia, SC

     Path to file locations       :
P:\Orangeburg\40308_us301\Geotechnical\5_Design\2_Final\7_InteriorBents\APile\Without
Overburden\
     Name of input data file     : B-2.ap7d
     Name of output file         : B-2.ap7o
     Name of plot output file    : B-2.ap7p

     -------------------------------------------------------------------------
                          Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  April 14, 2016     Time:  14:07:32



1
          *********************
          * INPUT INFORMATION *
          *********************



          US 301 over Four Hole Swamp IB-2

          DESIGNER   : RSG

          JOB NUMBER : 0040308


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Reduced Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION
```

```
PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Open-Ended Pile


DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY     = 0.290E+08 PSI
- CROSS SECTION AREA        =    219.13 IN2


CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD      =     48.00 IN.
- INTERNAL DIAMETER, ID     =     45.00 IN.
- TOTAL PILE LENGTH, TL     =    150.00 FT.
- PILE STICKUP LENGTH, PSL  =     21.00 FT.
- ZERO FRICTION LENGTH, ZFL =      0.00 FT.
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION       =      1.00 FT.
- LENGTH OF ENHANCED
  END SECTION               =    150.00 FT.
- INTERNAL DIAMETER OF
  ENHANCED END SECTION      =     45.00 IN.


PLUGGED/UNPLUGGED CONDITIONS :
Plugged for open-ended pile



SOIL INFORMATIONS :



                  LATERAL    EFFECTIVE    FRICTION   BEARING
          SOIL    EARTH      UNIT         ANGLE      CAPACITY
 DEPTH    TYPE    PRESSURE   WEIGHT       DEGREES    FACTOR
  FT.                        LB/CF
   0.00   SAND      0.00        47.60        36.00      0.00
   1.20   SAND      0.00        47.60        36.00      0.00
   1.20   SAND      0.00        52.60        36.00      0.00
   8.40   SAND      0.00        52.60        36.00      0.00
   8.40   SAND      0.00        52.60        36.00      0.00
  23.50   SAND      0.00        52.60        36.00      0.00
  23.50   SAND      0.00        52.60        36.00      0.00
  27.20   SAND      0.00        52.60        36.00      0.00
  27.20   SAND      0.00        52.60        36.00      0.00
  48.50   SAND      0.00        52.60        36.00      0.00
  48.50   SAND      0.00        52.60        36.00      0.00
  59.70   SAND      0.00        52.60        36.00      0.00
  59.70   SAND      0.00        52.60        36.00      0.00
  63.20   SAND      0.00        52.60        36.00      0.00
  63.20   SAND      0.00        21.00        20.00      0.00
  68.20   SAND      0.00        21.00        20.00      0.00
  68.20   SAND      0.00        52.60        36.00      0.00
  98.20   SAND      0.00        52.60        36.00      0.00
  98.20   SAND      0.00        52.60        36.00      0.00
 150.00   SAND      0.00        52.60        36.00      0.00
```

```
MAXIMUM   MAXIMUM   UNDISTURB  REMOLDED
UNIT      UNIT      SHEAR      SHEAR     BLOW   UNIT SKIN  UNIT END
FRICTION  BEARING   STRENGTH   STRENGTH  COUNT  FRICTION   BEARING
  KSF       KSF        KSF       KSF               KSF       KSF
0.10E+08* 0.10E-03        0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E-03        0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.20E+01  0.33E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.33E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.46E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.46E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.15E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.15E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.49E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.49E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.26E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.26E+03        0.00      0.00   0.00       0.00      0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
  PLAN TO LIMIT THE COMPUTED DATA.



         LRFD FACTOR  LRFD FACTOR
          ON UNIT      ON UNIT
 DEPTH    FRICTION     BEARING
  FT.
   0.00    1.000       1.000
   1.20    1.000       1.000
   1.20    1.000       1.000
   8.40    1.000       1.000
   8.40    1.000       1.000
  23.50    1.000       1.000
  23.50    1.000       1.000
  27.20    1.000       1.000
  27.20    1.000       1.000
  48.50    1.000       1.000
  48.50    1.000       1.000
  59.70    1.000       1.000
  59.70    1.000       1.000
  63.20    1.000       1.000
  63.20    1.000       1.000
  68.20    1.000       1.000
  68.20    1.000       1.000
  98.20    1.000       1.000
  98.20    1.000       1.000
 150.00    1.000       1.000


1
          **********************
          * COMPUTATION RESULT *
```

```
**********************



                  **********************
                  *  FED. HWY. METHOD  *
                  **********************

   PILE       TOTAL SKIN       END       ULTIMATE
PENETRATION   FRICTION       BEARING     CAPACITY
    FT.          KIP           KIP          KIP
    0.00           0.0          45.2         45.2
    1.00           0.4          63.9         64.2
    2.00           1.4          85.5         87.0
    3.00           3.3         110.2        113.4
    4.00           5.9         137.7        143.6
    5.00           9.3         168.3        177.6
    6.00          13.5         201.8        215.3
    7.00          18.5         238.3        256.8
    8.00          24.3         277.7        302.0
    9.00          30.8         313.3        344.1
   10.00          38.2         348.9        387.1
   11.00          46.3         384.4        430.8
   12.00          55.3         420.0        475.3
   13.00          65.0         455.6        520.6
   14.00          75.5         491.1        566.7
   15.00          86.9         526.7        613.5
   16.00          99.0         562.2        661.2
   17.00         111.9         597.8        709.7
   18.00         125.5         633.4        758.9
   19.00         140.0         668.9        809.0
   20.00         155.3         704.5        859.8
   21.00         171.3         740.1        911.4
   22.00         188.2         775.6        963.8
   23.00         205.8         811.2       1017.0
   24.00         224.3         846.8       1071.0
   25.00         243.5         882.3       1125.8
   26.00         263.5         917.9       1181.4
   27.00         284.3         953.4       1237.8
   28.00         305.9         989.0       1294.9
   29.00         328.3        1024.6       1352.9
   30.00         351.5        1060.1       1411.6
   31.00         375.4        1095.7       1471.1
   32.00         400.2        1131.3       1531.5
   33.00         425.7        1166.8       1592.6
   34.00         452.1        1202.4       1654.5
   35.00         479.2        1237.9       1717.2
   36.00         507.1        1273.5       1780.6
   37.00         535.8        1309.1       1844.9
   38.00         565.3        1344.6       1910.0
   39.00         595.6        1380.2       1975.8
   40.00         626.7        1415.8       2042.5
   41.00         658.6        1451.3       2109.9
   42.00         691.3        1486.9       2178.2
   43.00         724.7        1522.5       2247.2
   44.00         759.0        1558.0       2317.0
   45.00         794.0        1593.6       2387.6
   46.00         829.8        1629.1       2459.0
   47.00         866.4        1664.7       2531.2
   48.00         903.9        1699.9       2603.8
   49.00         942.1        1733.3       2675.3
   50.00         967.2        1763.7       2730.9
   51.00         992.3        1791.1       2783.4
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  52.00        1017.5        1815.6        2833.0
  53.00        1042.6        1837.1        2879.7
  54.00        1067.7        1855.6        2923.4
  55.00        1092.9        1871.2        2964.1
  56.00        1118.0        1883.9        3001.8
  57.00        1143.1        1893.5        3036.6
  58.00        1168.3        1900.2        3068.5
  59.00        1193.4        1755.7        2949.1
  60.00        1218.5        1608.7        2827.2
  61.00        1243.7        1460.7        2704.3
  62.00        1268.8        1312.6        2581.4
  63.00        1293.9        1164.7        2458.6
  64.00        1319.0        1164.7        2483.8
  65.00        1337.3        1164.7        2502.0
  66.00        1348.7        1164.7        2513.4
  67.00        1360.2        1164.7        2524.9
  68.00        1371.7        1164.7        2536.4
  69.00        1383.3        1164.7        2548.1
  70.00        1408.5        1164.7        2573.2
  71.00        1433.6        1312.9        2746.5
  72.00        1458.7        1461.0        2919.8
  73.00        1483.9        1609.1        3093.0
  74.00        1509.0        1757.1        3266.1
  75.00        1534.1        1905.1        3439.2
  76.00        1559.3        1905.1        3464.3
  77.00        1584.4        1905.1        3489.5
  78.00        1609.5        1905.1        3514.6
  79.00        1634.7        1905.1        3539.7
  80.00        1659.8        1905.1        3564.9
  81.00        1684.9        1905.1        3590.0
  82.00        1710.1        1905.1        3615.1
  83.00        1735.2        1905.1        3640.3
  84.00        1760.3        1905.1        3665.4
  85.00        1785.5        1905.1        3690.5
  86.00        1810.6        1905.1        3715.7
  87.00        1835.7        1905.1        3740.8
  88.00        1860.9        1905.1        3765.9
  89.00        1886.0        1905.1        3791.1
  90.00        1911.1        1905.1        3816.2
  91.00        1936.3        1905.1        3841.3
  92.00        1961.4        1905.1        3866.5
  93.00        1986.5        1905.1        3891.6
  94.00        2011.7        1905.1        3916.7
  95.00        2036.8        1905.1        3941.9
  96.00        2061.9        1905.1        3967.0
  97.00        2087.1        1905.1        3992.1
  98.00        2112.2        1905.1        4017.3
  99.00        2137.3        1905.1        4042.4
 100.00        2162.5        1905.1        4067.5
 101.00        2187.6        1905.1        4092.7
 102.00        2212.7        1905.1        4117.8
 103.00        2237.9        1905.1        4142.9
 104.00        2263.0        1905.1        4168.1
 105.00        2288.1        1905.1        4193.2
 106.00        2313.3        1905.1        4218.3
 107.00        2338.4        1905.1        4243.5
 108.00        2363.5        1905.1        4268.6
 109.00        2388.7        1905.1        4293.7
 110.00        2413.8        1905.1        4318.8
 111.00        2438.9        1905.1        4344.0
 112.00        2464.1        1905.1        4369.1
 113.00        2489.2        1905.1        4394.2
 114.00        2514.3        1905.1        4419.4
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    115.00        2539.5        1905.1       4444.5
    116.00        2564.6        1905.1       4469.6
    117.00        2589.7        1905.1       4494.8
    118.00        2614.9        1905.1       4519.9
    119.00        2640.0        1905.1       4545.0
    120.00        2665.1        1905.1       4570.2
    121.00        2690.2        1905.1       4595.3
    122.00        2715.4        1905.1       4620.4
    123.00        2740.5        1905.1       4645.6
    124.00        2765.6        1905.1       4670.7
    125.00        2790.8        1905.1       4695.8
    126.00        2815.9        1905.1       4721.0
    127.00        2841.0        1905.1       4746.1
    128.00        2866.2        1905.1       4771.2
    129.00        2891.3        1905.1       4796.4

    NOTES:
    - AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
      IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
      OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.



        *************************************************
        * COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
        * CURVES FOR AXIAL LOADING                      *
        *************************************************


T-Z CURVE   NO. OF   DEPTH TO CURVE   LOAD TRANSFER   PILE MOVEMENT
   NO.      POINTS        FT.              PSI              IN.

    1         10      0.0000E+00
                                        0.0000E+00      0.0000E+00
                                        0.5932E-01      0.1000E-01
                                        0.1186E+00      0.2000E-01
                                        0.2373E+00      0.4000E-01
                                        0.3559E+00      0.6000E-01
                                        0.4745E+00      0.8000E-01
                                        0.5338E+00      0.9000E-01
                                        0.5932E+00      0.1000E+00
                                        0.5932E+00      0.5000E+00
                                        0.5932E+00      0.2000E+01
    2         10      0.6250E+00
                                        0.0000E+00      0.0000E+00
                                        0.5932E-01      0.1000E-01
                                        0.1186E+00      0.2000E-01
                                        0.2373E+00      0.4000E-01
                                        0.3559E+00      0.6000E-01
                                        0.4745E+00      0.8000E-01
                                        0.5338E+00      0.9000E-01
                                        0.5932E+00      0.1000E+00
                                        0.5932E+00      0.5000E+00
                                        0.5932E+00      0.2000E+01
    3         10      0.1158E+01
                                        0.0000E+00      0.0000E+00
                                        0.8013E-01      0.1000E-01
                                        0.1603E+00      0.2000E-01
                                        0.3205E+00      0.4000E-01
                                        0.4808E+00      0.6000E-01
                                        0.6410E+00      0.8000E-01
                                        0.7211E+00      0.9000E-01
```

```
                                    0.8013E+00      0.1000E+00
                                    0.8013E+00      0.5000E+00
                                    0.8013E+00      0.2000E+01
4          10       0.1200E+01
                                    0.0000E+00      0.0000E+00
                                    0.8013E-01      0.1000E-01
                                    0.1603E+00      0.2000E-01
                                    0.3205E+00      0.4000E-01
                                    0.4808E+00      0.6000E-01
                                    0.6410E+00      0.8000E-01
                                    0.7211E+00      0.9000E-01
                                    0.8013E+00      0.1000E+00
                                    0.8013E+00      0.5000E+00
                                    0.8013E+00      0.2000E+01
5          10       0.4825E+01
                                    0.0000E+00      0.0000E+00
                                    0.2102E+00      0.1000E-01
                                    0.4204E+00      0.2000E-01
                                    0.8407E+00      0.4000E-01
                                    0.1261E+01      0.6000E-01
                                    0.1681E+01      0.8000E-01
                                    0.1892E+01      0.9000E-01
                                    0.2102E+01      0.1000E+00
                                    0.2102E+01      0.5000E+00
                                    0.2102E+01      0.2000E+01
6          10       0.8358E+01
                                    0.0000E+00      0.0000E+00
                                    0.3850E+00      0.1000E-01
                                    0.7699E+00      0.2000E-01
                                    0.1540E+01      0.4000E-01
                                    0.2310E+01      0.6000E-01
                                    0.3080E+01      0.8000E-01
                                    0.3465E+01      0.9000E-01
                                    0.3850E+01      0.1000E+00
                                    0.3850E+01      0.5000E+00
                                    0.3850E+01      0.2000E+01
7          10       0.8400E+01
                                    0.0000E+00      0.0000E+00
                                    0.3850E+00      0.1000E-01
                                    0.7699E+00      0.2000E-01
                                    0.1540E+01      0.4000E-01
                                    0.2310E+01      0.6000E-01
                                    0.3080E+01      0.8000E-01
                                    0.3465E+01      0.9000E-01
                                    0.3850E+01      0.1000E+00
                                    0.3850E+01      0.5000E+00
                                    0.3850E+01      0.2000E+01
8          10       0.1598E+02
                                    0.0000E+00      0.0000E+00
                                    0.6909E+00      0.1000E-01
                                    0.1382E+01      0.2000E-01
                                    0.2763E+01      0.4000E-01
                                    0.4145E+01      0.6000E-01
                                    0.5527E+01      0.8000E-01
                                    0.6218E+01      0.9000E-01
                                    0.6909E+01      0.1000E+00
                                    0.6909E+01      0.5000E+00
                                    0.6909E+01      0.2000E+01
9          10       0.2346E+02
                                    0.0000E+00      0.0000E+00
                                    0.1040E+01      0.1000E-01
                                    0.2081E+01      0.2000E-01
                                    0.4162E+01      0.4000E-01
```

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                                    0.6243E+01      0.6000E-01
                                    0.8323E+01      0.8000E-01
                                    0.9364E+01      0.9000E-01
                                    0.1040E+02      0.1000E+00
                                    0.1040E+02      0.5000E+00
                                    0.1040E+02      0.2000E+01
10         10      0.2350E+02
                                    0.0000E+00      0.0000E+00
                                    0.1040E+01      0.1000E-01
                                    0.2081E+01      0.2000E-01
                                    0.4162E+01      0.4000E-01
                                    0.6243E+01      0.6000E-01
                                    0.8323E+01      0.8000E-01
                                    0.9364E+01      0.9000E-01
                                    0.1040E+02      0.1000E+00
                                    0.1040E+02      0.5000E+00
                                    0.1040E+02      0.2000E+01
11         10      0.2538E+02
                                    0.0000E+00      0.0000E+00
                                    0.1128E+01      0.1000E-01
                                    0.2256E+01      0.2000E-01
                                    0.4511E+01      0.4000E-01
                                    0.6767E+01      0.6000E-01
                                    0.9023E+01      0.8000E-01
                                    0.1015E+02      0.9000E-01
                                    0.1128E+02      0.1000E+00
                                    0.1128E+02      0.5000E+00
                                    0.1128E+02      0.2000E+01
12         10      0.2716E+02
                                    0.0000E+00      0.0000E+00
                                    0.1215E+01      0.1000E-01
                                    0.2430E+01      0.2000E-01
                                    0.4861E+01      0.4000E-01
                                    0.7291E+01      0.6000E-01
                                    0.9722E+01      0.8000E-01
                                    0.1094E+02      0.9000E-01
                                    0.1215E+02      0.1000E+00
                                    0.1215E+02      0.5000E+00
                                    0.1215E+02      0.2000E+01
13         10      0.2720E+02
                                    0.0000E+00      0.0000E+00
                                    0.1215E+01      0.1000E-01
                                    0.2430E+01      0.2000E-01
                                    0.4861E+01      0.4000E-01
                                    0.7291E+01      0.6000E-01
                                    0.9722E+01      0.8000E-01
                                    0.1094E+02      0.9000E-01
                                    0.1215E+02      0.1000E+00
                                    0.1215E+02      0.5000E+00
                                    0.1215E+02      0.2000E+01
14         10      0.3788E+02
                                    0.0000E+00      0.0000E+00
                                    0.1652E+01      0.1000E-01
                                    0.3304E+01      0.2000E-01
                                    0.6609E+01      0.4000E-01
                                    0.9913E+01      0.6000E-01
                                    0.1322E+02      0.8000E-01
                                    0.1487E+02      0.9000E-01
                                    0.1652E+02      0.1000E+00
                                    0.1652E+02      0.5000E+00
                                    0.1652E+02      0.2000E+01
15         10      0.4846E+02
                                    0.0000E+00      0.0000E+00
```

```
                                 0.1750E+01       0.1000E-01
                                 0.3500E+01       0.2000E-01
                                 0.7000E+01       0.4000E-01
                                 0.1050E+02       0.6000E-01
                                 0.1400E+02       0.8000E-01
                                 0.1575E+02       0.9000E-01
                                 0.1750E+02       0.1000E+00
                                 0.1750E+02       0.5000E+00
                                 0.1750E+02       0.2000E+01
16          10      0.4850E+02
                                 0.0000E+00       0.0000E+00
                                 0.1750E+01       0.1000E-01
                                 0.3500E+01       0.2000E-01
                                 0.7000E+01       0.4000E-01
                                 0.1050E+02       0.6000E-01
                                 0.1400E+02       0.8000E-01
                                 0.1575E+02       0.9000E-01
                                 0.1750E+02       0.1000E+00
                                 0.1750E+02       0.5000E+00
                                 0.1750E+02       0.2000E+01
17          10      0.5413E+02
                                 0.0000E+00       0.0000E+00
                                 0.1389E+01       0.1000E-01
                                 0.2778E+01       0.2000E-01
                                 0.5556E+01       0.4000E-01
                                 0.8333E+01       0.6000E-01
                                 0.1111E+02       0.8000E-01
                                 0.1250E+02       0.9000E-01
                                 0.1389E+02       0.1000E+00
                                 0.1389E+02       0.5000E+00
                                 0.1389E+02       0.2000E+01
18          10      0.5966E+02
                                 0.0000E+00       0.0000E+00
                                 0.1389E+01       0.1000E-01
                                 0.2778E+01       0.2000E-01
                                 0.5556E+01       0.4000E-01
                                 0.8333E+01       0.6000E-01
                                 0.1111E+02       0.8000E-01
                                 0.1250E+02       0.9000E-01
                                 0.1389E+02       0.1000E+00
                                 0.1389E+02       0.5000E+00
                                 0.1389E+02       0.2000E+01
19          10      0.5970E+02
                                 0.0000E+00       0.0000E+00
                                 0.1389E+01       0.1000E-01
                                 0.2778E+01       0.2000E-01
                                 0.5556E+01       0.4000E-01
                                 0.8333E+01       0.6000E-01
                                 0.1111E+02       0.8000E-01
                                 0.1250E+02       0.9000E-01
                                 0.1389E+02       0.1000E+00
                                 0.1389E+02       0.5000E+00
                                 0.1389E+02       0.2000E+01
20          10      0.6148E+02
                                 0.0000E+00       0.0000E+00
                                 0.1389E+01       0.1000E-01
                                 0.2778E+01       0.2000E-01
                                 0.5556E+01       0.4000E-01
                                 0.8333E+01       0.6000E-01
                                 0.1111E+02       0.8000E-01
                                 0.1250E+02       0.9000E-01
                                 0.1389E+02       0.1000E+00
                                 0.1389E+02       0.5000E+00
```

```
                                        0.1389E+02       0.2000E+01
 21          10        0.6316E+02
                                        0.0000E+00       0.0000E+00
                                        0.1199E+01       0.1000E-01
                                        0.2397E+01       0.2000E-01
                                        0.4795E+01       0.4000E-01
                                        0.7192E+01       0.6000E-01
                                        0.9590E+01       0.8000E-01
                                        0.1079E+02       0.9000E-01
                                        0.1199E+02       0.1000E+00
                                        0.1199E+02       0.5000E+00
                                        0.1199E+02       0.2000E+01
 22          10        0.6320E+02
                                        0.0000E+00       0.0000E+00
                                        0.1199E+01       0.1000E-01
                                        0.2397E+01       0.2000E-01
                                        0.4795E+01       0.4000E-01
                                        0.7192E+01       0.6000E-01
                                        0.9590E+01       0.8000E-01
                                        0.1079E+02       0.9000E-01
                                        0.1199E+02       0.1000E+00
                                        0.1199E+02       0.5000E+00
                                        0.1199E+02       0.2000E+01
 23          10        0.6573E+02
                                        0.0000E+00       0.0000E+00
                                        0.6322E+00       0.1000E-01
                                        0.1264E+01       0.2000E-01
                                        0.2529E+01       0.4000E-01
                                        0.3793E+01       0.6000E-01
                                        0.5058E+01       0.8000E-01
                                        0.5690E+01       0.9000E-01
                                        0.6322E+01       0.1000E+00
                                        0.6322E+01       0.5000E+00
                                        0.6322E+01       0.2000E+01
 24          10        0.6816E+02
                                        0.0000E+00       0.0000E+00
                                        0.1015E+01       0.1000E-01
                                        0.2031E+01       0.2000E-01
                                        0.4062E+01       0.4000E-01
                                        0.6093E+01       0.6000E-01
                                        0.8124E+01       0.8000E-01
                                        0.9139E+01       0.9000E-01
                                        0.1015E+02       0.1000E+00
                                        0.1015E+02       0.5000E+00
                                        0.1015E+02       0.2000E+01
 25          10        0.6820E+02
                                        0.0000E+00       0.0000E+00
                                        0.1015E+01       0.1000E-01
                                        0.2031E+01       0.2000E-01
                                        0.4062E+01       0.4000E-01
                                        0.6093E+01       0.6000E-01
                                        0.8124E+01       0.8000E-01
                                        0.9139E+01       0.9000E-01
                                        0.1015E+02       0.1000E+00
                                        0.1015E+02       0.5000E+00
                                        0.1015E+02       0.2000E+01
 26          10        0.8323E+02
                                        0.0000E+00       0.0000E+00
                                        0.1389E+01       0.1000E-01
                                        0.2778E+01       0.2000E-01
                                        0.5556E+01       0.4000E-01
                                        0.8333E+01       0.6000E-01
                                        0.1111E+02       0.8000E-01
```

```
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
   27          10      0.9816E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
   28          10      0.9820E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
   29          10      0.1241E+03
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
   30          10      0.1500E+03
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01


 TIP   LOAD        TIP MOVEMENT
     KIP               IN.

 0.0000E+00         0.0000E+00
 0.1191E+03         0.2400E-01
 0.2381E+03         0.4800E-01
 0.4763E+03         0.9600E-01
 0.9525E+03         0.6240E+00
 0.1429E+04         0.2016E+01
 0.1715E+04         0.3504E+01
 0.1905E+04         0.4800E+01
 0.1905E+04         0.7200E+01
```

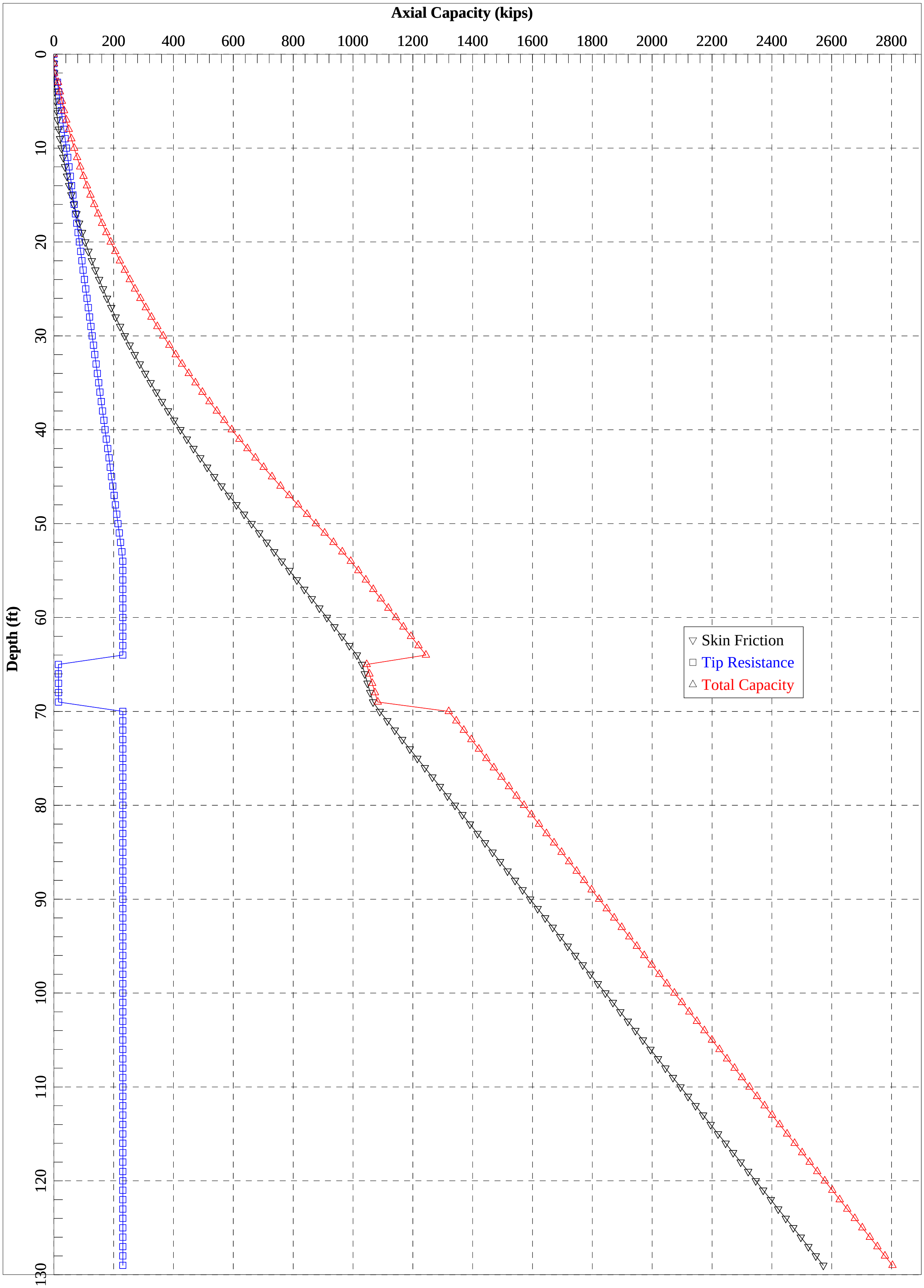
```
  0.1905E+04         0.9600E+01


                LOAD VERSUS SETTLEMENT CURVE
                ****************************



  TOP  LOAD     TOP MOVEMENT       TIP  LOAD      TIP MOVEMENT
     KIP             IN.              KIP              IN.
 0.9759E+01      0.1487E-02      0.4961E+00      0.1000E-03
 0.9765E+02      0.1487E-01      0.4961E+01      0.1000E-02
 0.4942E+03      0.7502E-01      0.2481E+02      0.5000E-02
 0.9906E+03      0.1504E+00      0.4961E+02      0.1000E-01
 0.2750E+04      0.5285E+00      0.2481E+03      0.5000E-01
 0.3323E+04      0.7303E+00      0.4799E+03      0.1000E+00
 0.3684E+04      0.1233E+01      0.8407E+03      0.5000E+00
 0.3924E+04      0.1801E+01      0.1081E+04      0.1000E+01
 0.4266E+04      0.2898E+01      0.1423E+04      0.2000E+01
```

IB -2 Unplugged Condition



```
     =========================================================================

                      APILE for Windows, Version 2015.7.2

                       Serial Number :  239146456

                       A Program for Analyzing the Axial Capacity
                       and Short-term Settlement of Driven Piles
                                 under Axial Loading.
                     (c) Copyright ENSOFT, Inc., 1987-2015
                           All Rights Reserved

     =========================================================================


     This program is licensed to :

     SCDOT
     Columbia, SC

     Path to file locations      :
P:\Orangeburg\40308_us301\Geotechnical\5_Design\2_Final\7_InteriorBents\APile\Without
Overburden\
     Name of input data file     : B-2.ap7d
     Name of output file         : B-2.ap7o
     Name of plot output file    : B-2.ap7p

     -------------------------------------------------------------------------
                          Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  April 14, 2016     Time:  14:08:43



1
          *********************
          * INPUT INFORMATION *
          *********************



          US 301 over Four Hole Swamp IB-2

          DESIGNER   : RSG

          JOB NUMBER : 0040308


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Reduced Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION
```

```
PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Open-Ended Pile


DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY     = 0.290E+08 PSI
- CROSS SECTION AREA        =    219.13 IN2


CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD      =     48.00 IN.
- INTERNAL DIAMETER, ID     =     45.00 IN.
- TOTAL PILE LENGTH, TL     =    150.00 FT.
- PILE STICKUP LENGTH, PSL  =     21.00 FT.
- ZERO FRICTION LENGTH, ZFL =      0.00 FT.
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION       =      1.00 FT.
- LENGTH OF ENHANCED
  END SECTION               =    150.00 FT.
- INTERNAL DIAMETER OF
  ENHANCED END SECTION      =     45.00 IN.


PLUGGED/UNPLUGGED CONDITIONS :
Unplugged for open-ended pile



SOIL INFORMATIONS :



                  LATERAL    EFFECTIVE    FRICTION   BEARING
          SOIL    EARTH      UNIT         ANGLE      CAPACITY
 DEPTH    TYPE    PRESSURE   WEIGHT       DEGREES    FACTOR
  FT.                        LB/CF
   0.00   SAND      0.00        47.60        36.00      0.00
   1.20   SAND      0.00        47.60        36.00      0.00
   1.20   SAND      0.00        52.60        36.00      0.00
   8.40   SAND      0.00        52.60        36.00      0.00
   8.40   SAND      0.00        52.60        36.00      0.00
  23.50   SAND      0.00        52.60        36.00      0.00
  23.50   SAND      0.00        52.60        36.00      0.00
  27.20   SAND      0.00        52.60        36.00      0.00
  27.20   SAND      0.00        52.60        36.00      0.00
  48.50   SAND      0.00        52.60        36.00      0.00
  48.50   SAND      0.00        52.60        36.00      0.00
  59.70   SAND      0.00        52.60        36.00      0.00
  59.70   SAND      0.00        52.60        36.00      0.00
  63.20   SAND      0.00        52.60        36.00      0.00
  63.20   SAND      0.00        21.00        20.00      0.00
  68.20   SAND      0.00        21.00        20.00      0.00
  68.20   SAND      0.00        52.60        36.00      0.00
  98.20   SAND      0.00        52.60        36.00      0.00
  98.20   SAND      0.00        52.60        36.00      0.00
 150.00   SAND      0.00        52.60        36.00      0.00
```

```
MAXIMUM   MAXIMUM   UNDISTURB  REMOLDED
UNIT      UNIT      SHEAR      SHEAR     BLOW   UNIT SKIN  UNIT END
FRICTION  BEARING   STRENGTH   STRENGTH  COUNT  FRICTION   BEARING
  KSF       KSF        KSF       KSF               KSF       KSF
0.10E+08* 0.10E-03        0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E-03        0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.20E+01  0.33E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.33E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.46E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.46E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.15E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.15E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.49E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.49E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.26E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.26E+03        0.00      0.00   0.00       0.00      0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
  PLAN TO LIMIT THE COMPUTED DATA.



         LRFD FACTOR  LRFD FACTOR
          ON UNIT      ON UNIT
 DEPTH    FRICTION     BEARING
  FT.
   0.00    1.000       1.000
   1.20    1.000       1.000
   1.20    1.000       1.000
   8.40    1.000       1.000
   8.40    1.000       1.000
  23.50    1.000       1.000
  23.50    1.000       1.000
  27.20    1.000       1.000
  27.20    1.000       1.000
  48.50    1.000       1.000
  48.50    1.000       1.000
  59.70    1.000       1.000
  59.70    1.000       1.000
  63.20    1.000       1.000
  63.20    1.000       1.000
  68.20    1.000       1.000
  68.20    1.000       1.000
  98.20    1.000       1.000
  98.20    1.000       1.000
 150.00    1.000       1.000


1
          **********************
          * COMPUTATION RESULT *
```

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**********************



                  **********************
                  *  FED. HWY. METHOD  *
                  **********************

   PILE        TOTAL SKIN       END       ULTIMATE
PENETRATION    FRICTION       BEARING     CAPACITY
    FT.          KIP            KIP         KIP
    0.00          0.0            0.0*        0.0
    1.00          0.2            0.0*        0.2
    2.00          1.0            0.0*        1.0
    3.00          2.2           12.1*       14.3
    4.00          4.0           16.4*       20.4
    5.00          6.3           20.7*       27.0
    6.00          9.1           25.0*       34.1
    7.00         12.5           29.3*       41.8
    8.00         16.4           33.6*       50.0
    9.00         20.8           37.9*       58.8
   10.00         25.8           42.2*       68.0
   11.00         31.3           46.6*       77.8
   12.00         37.3           50.9*       88.2
   13.00         43.9           55.2*       99.1
   14.00         51.0           59.5*      110.5
   15.00         58.7           63.8*      122.4
   16.00         66.8           68.1*      134.9
   17.00         75.5           72.4*      147.9
   18.00         84.8           76.7*      161.5
   19.00         94.6           81.0*      175.6
   20.00        104.9           85.3*      190.2
   21.00        115.7           89.6*      205.3
   22.00        127.1           93.9*      221.0
   23.00        139.0           98.2*      237.2
   24.00        151.5          102.5*      254.0
   25.00        164.5          106.8*      271.3
   26.00        178.0          111.1*      289.1
   27.00        192.0          115.5*      307.5
   28.00        206.6          119.8*      326.4
   29.00        221.7          124.1*      345.8
   30.00        237.4          128.4*      365.7
   31.00        253.6          132.7*      386.2
   32.00        270.3          137.0*      407.3
   33.00        287.5          141.3*      428.8
   34.00        305.3          145.6*      450.9
   35.00        323.6          149.9*      473.6
   36.00        342.5          154.2*      496.7
   37.00        361.9          158.5*      520.4
   38.00        381.8          162.8*      544.6
   39.00        402.3          167.1*      569.4
   40.00        423.3          171.4*      594.7
   41.00        444.8          175.7*      620.5
   42.00        466.9          180.1*      646.9
   43.00        489.5          184.4*      673.8
   44.00        512.6          188.7*      701.2
   45.00        536.2          193.0*      729.2
   46.00        560.4          197.3*      757.7
   47.00        585.2          201.6*      786.8
   48.00        610.4          205.9*      816.3
   49.00        636.2          210.2*      846.4
   50.00        661.4          214.5*      875.9
   51.00        686.5          218.8*      905.3
```

```
    52.00            711.6          223.1*        934.8
    53.00            736.8          227.4*        964.2
    54.00            761.9          230.7*        992.6
    55.00            787.0          230.7*       1017.7
    56.00            812.2          230.7*       1042.9
    57.00            837.3          230.7*       1068.0
    58.00            862.4          230.7*       1093.1
    59.00            887.6          230.7*       1118.3
    60.00            912.7          230.7*       1143.4
    61.00            937.8          230.7*       1168.5
    62.00            963.0          230.7*       1193.7
    63.00            988.1          230.7*       1218.8
    64.00           1013.2          230.7*       1243.9
    65.00           1030.3           15.4*       1045.7
    66.00           1039.4           15.5*       1054.9
    67.00           1048.5           15.6*       1064.1
    68.00           1057.7           15.7*       1073.4
    69.00           1067.0           15.8*       1082.7
    70.00           1089.5          230.7*       1320.1
    71.00           1114.6          230.7*       1345.3
    72.00           1139.7          230.7*       1370.4
    73.00           1164.8          230.7*       1395.5
    74.00           1190.0          230.7*       1420.7
    75.00           1215.1          230.7*       1445.8
    76.00           1240.2          230.7*       1470.9
    77.00           1265.4          230.7*       1496.1
    78.00           1290.5          230.7*       1521.2
    79.00           1315.6          230.7*       1546.3
    80.00           1340.8          230.7*       1571.5
    81.00           1365.9          230.7*       1596.6
    82.00           1391.0          230.7*       1621.7
    83.00           1416.2          230.7*       1646.9
    84.00           1441.3          230.7*       1672.0
    85.00           1466.4          230.7*       1697.1
    86.00           1491.6          230.7*       1722.3
    87.00           1516.7          230.7*       1747.4
    88.00           1541.8          230.7*       1772.5
    89.00           1567.0          230.7*       1797.7
    90.00           1592.1          230.7*       1822.8
    91.00           1617.2          230.7*       1847.9
    92.00           1642.4          230.7*       1873.1
    93.00           1667.5          230.7*       1898.2
    94.00           1692.6          230.7*       1923.3
    95.00           1717.8          230.7*       1948.5
    96.00           1742.9          230.7*       1973.6
    97.00           1768.0          230.7*       1998.7
    98.00           1793.2          230.7*       2023.9
    99.00           1818.3          230.7*       2049.0
   100.00           1843.4          230.7*       2074.1
   101.00           1868.6          230.7*       2099.3
   102.00           1893.7          230.7*       2124.4
   103.00           1918.8          230.7*       2149.5
   104.00           1944.0          230.7*       2174.7
   105.00           1969.1          230.7*       2199.8
   106.00           1994.2          230.7*       2224.9
   107.00           2019.4          230.7*       2250.1
   108.00           2044.5          230.7*       2275.2
   109.00           2069.6          230.7*       2300.3
   110.00           2094.8          230.7*       2325.5
   111.00           2119.9          230.7*       2350.6
   112.00           2145.0          230.7*       2375.7
   113.00           2170.2          230.7*       2400.8
   114.00           2195.3          230.7*       2426.0
```

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   115.00        2220.4        230.7*      2451.1
   116.00        2245.6        230.7*      2476.2
   117.00        2270.7        230.7*      2501.4
   118.00        2295.8        230.7*      2526.5
   119.00        2321.0        230.7*      2551.6
   120.00        2346.1        230.7*      2576.8
   121.00        2371.2        230.7*      2601.9
   122.00        2396.4        230.7*      2627.0
   123.00        2421.5        230.7*      2652.2
   124.00        2446.6        230.7*      2677.3
   125.00        2471.8        230.7*      2702.4
   126.00        2496.9        230.7*      2727.6
   127.00        2522.0        230.7*      2752.7
   128.00        2547.1        230.7*      2777.8
   129.00        2572.3        230.7*      2803.0


   NOTES:
   - AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
     IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
     OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.



       *************************************************
       * COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
       * CURVES FOR AXIAL LOADING                      *
       *************************************************


 T-Z CURVE   NO. OF   DEPTH TO CURVE   LOAD TRANSFER   PILE MOVEMENT
    NO.      POINTS        FT.              PSI             IN.

     1         10      0.0000E+00
                                        0.0000E+00      0.0000E+00
                                        0.4006E-01      0.1000E-01
                                        0.8012E-01      0.2000E-01
                                        0.1602E+00      0.4000E-01
                                        0.2404E+00      0.6000E-01
                                        0.3205E+00      0.8000E-01
                                        0.3605E+00      0.9000E-01
                                        0.4006E+00      0.1000E+00
                                        0.4006E+00      0.5000E+00
                                        0.4006E+00      0.2000E+01
     2         10      0.6250E+00
                                        0.0000E+00      0.0000E+00
                                        0.4006E-01      0.1000E-01
                                        0.8012E-01      0.2000E-01
                                        0.1602E+00      0.4000E-01
                                        0.2404E+00      0.6000E-01
                                        0.3205E+00      0.8000E-01
                                        0.3605E+00      0.9000E-01
                                        0.4006E+00      0.1000E+00
                                        0.4006E+00      0.5000E+00
                                        0.4006E+00      0.2000E+01
     3         10      0.1158E+01
                                        0.0000E+00      0.0000E+00
                                        0.5411E-01      0.1000E-01
                                        0.1082E+00      0.2000E-01
                                        0.2165E+00      0.4000E-01
                                        0.3247E+00      0.6000E-01
                                        0.4329E+00      0.8000E-01
                                        0.4870E+00      0.9000E-01
```

```
                                     0.5411E+00      0.1000E+00
                                     0.5411E+00      0.5000E+00
                                     0.5411E+00      0.2000E+01
    4         10       0.1200E+01
                                     0.0000E+00      0.0000E+00
                                     0.5411E-01      0.1000E-01
                                     0.1082E+00      0.2000E-01
                                     0.2165E+00      0.4000E-01
                                     0.3247E+00      0.6000E-01
                                     0.4329E+00      0.8000E-01
                                     0.4870E+00      0.9000E-01
                                     0.5411E+00      0.1000E+00
                                     0.5411E+00      0.5000E+00
                                     0.5411E+00      0.2000E+01
    5         10       0.4825E+01
                                     0.0000E+00      0.0000E+00
                                     0.1419E+00      0.1000E-01
                                     0.2839E+00      0.2000E-01
                                     0.5678E+00      0.4000E-01
                                     0.8517E+00      0.6000E-01
                                     0.1136E+01      0.8000E-01
                                     0.1278E+01      0.9000E-01
                                     0.1419E+01      0.1000E+00
                                     0.1419E+01      0.5000E+00
                                     0.1419E+01      0.2000E+01
    6         10       0.8358E+01
                                     0.0000E+00      0.0000E+00
                                     0.2600E+00      0.1000E-01
                                     0.5200E+00      0.2000E-01
                                     0.1040E+01      0.4000E-01
                                     0.1560E+01      0.6000E-01
                                     0.2080E+01      0.8000E-01
                                     0.2340E+01      0.9000E-01
                                     0.2600E+01      0.1000E+00
                                     0.2600E+01      0.5000E+00
                                     0.2600E+01      0.2000E+01
    7         10       0.8400E+01
                                     0.0000E+00      0.0000E+00
                                     0.2600E+00      0.1000E-01
                                     0.5200E+00      0.2000E-01
                                     0.1040E+01      0.4000E-01
                                     0.1560E+01      0.6000E-01
                                     0.2080E+01      0.8000E-01
                                     0.2340E+01      0.9000E-01
                                     0.2600E+01      0.1000E+00
                                     0.2600E+01      0.5000E+00
                                     0.2600E+01      0.2000E+01
    8         10       0.1598E+02
                                     0.0000E+00      0.0000E+00
                                     0.4666E+00      0.1000E-01
                                     0.9332E+00      0.2000E-01
                                     0.1866E+01      0.4000E-01
                                     0.2799E+01      0.6000E-01
                                     0.3733E+01      0.8000E-01
                                     0.4199E+01      0.9000E-01
                                     0.4666E+01      0.1000E+00
                                     0.4666E+01      0.5000E+00
                                     0.4666E+01      0.2000E+01
    9         10       0.2346E+02
                                     0.0000E+00      0.0000E+00
                                     0.7027E+00      0.1000E-01
                                     0.1405E+01      0.2000E-01
                                     0.2811E+01      0.4000E-01
```

```
                                   0.4216E+01      0.6000E-01
                                   0.5621E+01      0.8000E-01
                                   0.6324E+01      0.9000E-01
                                   0.7027E+01      0.1000E+00
                                   0.7027E+01      0.5000E+00
                                   0.7027E+01      0.2000E+01
10          10       0.2350E+02
                                   0.0000E+00      0.0000E+00
                                   0.7027E+00      0.1000E-01
                                   0.1405E+01      0.2000E-01
                                   0.2811E+01      0.4000E-01
                                   0.4216E+01      0.6000E-01
                                   0.5621E+01      0.8000E-01
                                   0.6324E+01      0.9000E-01
                                   0.7027E+01      0.1000E+00
                                   0.7027E+01      0.5000E+00
                                   0.7027E+01      0.2000E+01
11          10       0.2538E+02
                                   0.0000E+00      0.0000E+00
                                   0.7617E+00      0.1000E-01
                                   0.1523E+01      0.2000E-01
                                   0.3047E+01      0.4000E-01
                                   0.4570E+01      0.6000E-01
                                   0.6094E+01      0.8000E-01
                                   0.6855E+01      0.9000E-01
                                   0.7617E+01      0.1000E+00
                                   0.7617E+01      0.5000E+00
                                   0.7617E+01      0.2000E+01
12          10       0.2716E+02
                                   0.0000E+00      0.0000E+00
                                   0.8207E+00      0.1000E-01
                                   0.1641E+01      0.2000E-01
                                   0.3283E+01      0.4000E-01
                                   0.4924E+01      0.6000E-01
                                   0.6566E+01      0.8000E-01
                                   0.7387E+01      0.9000E-01
                                   0.8207E+01      0.1000E+00
                                   0.8207E+01      0.5000E+00
                                   0.8207E+01      0.2000E+01
13          10       0.2720E+02
                                   0.0000E+00      0.0000E+00
                                   0.8207E+00      0.1000E-01
                                   0.1641E+01      0.2000E-01
                                   0.3283E+01      0.4000E-01
                                   0.4924E+01      0.6000E-01
                                   0.6566E+01      0.8000E-01
                                   0.7387E+01      0.9000E-01
                                   0.8207E+01      0.1000E+00
                                   0.8207E+01      0.5000E+00
                                   0.8207E+01      0.2000E+01
14          10       0.3788E+02
                                   0.0000E+00      0.0000E+00
                                   0.1116E+01      0.1000E-01
                                   0.2232E+01      0.2000E-01
                                   0.4463E+01      0.4000E-01
                                   0.6695E+01      0.6000E-01
                                   0.8927E+01      0.8000E-01
                                   0.1004E+02      0.9000E-01
                                   0.1116E+02      0.1000E+00
                                   0.1116E+02      0.5000E+00
                                   0.1116E+02      0.2000E+01
15          10       0.4846E+02
                                   0.0000E+00      0.0000E+00
```

```
                                    0.1407E+01      0.1000E-01
                                    0.2815E+01      0.2000E-01
                                    0.5629E+01      0.4000E-01
                                    0.8444E+01      0.6000E-01
                                    0.1126E+02      0.8000E-01
                                    0.1267E+02      0.9000E-01
                                    0.1407E+02      0.1000E+00
                                    0.1407E+02      0.5000E+00
                                    0.1407E+02      0.2000E+01
16         10      0.4850E+02
                                    0.0000E+00      0.0000E+00
                                    0.1407E+01      0.1000E-01
                                    0.2815E+01      0.2000E-01
                                    0.5629E+01      0.4000E-01
                                    0.8444E+01      0.6000E-01
                                    0.1126E+02      0.8000E-01
                                    0.1267E+02      0.9000E-01
                                    0.1407E+02      0.1000E+00
                                    0.1407E+02      0.5000E+00
                                    0.1407E+02      0.2000E+01
17         10      0.5413E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
18         10      0.5966E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
19         10      0.5970E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
20         10      0.6148E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
```

```
                                    0.1389E+02      0.2000E+01
21         10      0.6316E+02
                                    0.0000E+00      0.0000E+00
                                    0.1167E+01      0.1000E-01
                                    0.2333E+01      0.2000E-01
                                    0.4667E+01      0.4000E-01
                                    0.7000E+01      0.6000E-01
                                    0.9334E+01      0.8000E-01
                                    0.1050E+02      0.9000E-01
                                    0.1167E+02      0.1000E+00
                                    0.1167E+02      0.5000E+00
                                    0.1167E+02      0.2000E+01
22         10      0.6320E+02
                                    0.0000E+00      0.0000E+00
                                    0.1167E+01      0.1000E-01
                                    0.2333E+01      0.2000E-01
                                    0.4667E+01      0.4000E-01
                                    0.7000E+01      0.6000E-01
                                    0.9334E+01      0.8000E-01
                                    0.1050E+02      0.9000E-01
                                    0.1167E+02      0.1000E+00
                                    0.1167E+02      0.5000E+00
                                    0.1167E+02      0.2000E+01
23         10      0.6573E+02
                                    0.0000E+00      0.0000E+00
                                    0.5033E+00      0.1000E-01
                                    0.1007E+01      0.2000E-01
                                    0.2013E+01      0.4000E-01
                                    0.3020E+01      0.6000E-01
                                    0.4026E+01      0.8000E-01
                                    0.4529E+01      0.9000E-01
                                    0.5033E+01      0.1000E+00
                                    0.5033E+01      0.5000E+00
                                    0.5033E+01      0.2000E+01
24         10      0.6816E+02
                                    0.0000E+00      0.0000E+00
                                    0.8766E+00      0.1000E-01
                                    0.1753E+01      0.2000E-01
                                    0.3506E+01      0.4000E-01
                                    0.5259E+01      0.6000E-01
                                    0.7012E+01      0.8000E-01
                                    0.7889E+01      0.9000E-01
                                    0.8766E+01      0.1000E+00
                                    0.8766E+01      0.5000E+00
                                    0.8766E+01      0.2000E+01
25         10      0.6820E+02
                                    0.0000E+00      0.0000E+00
                                    0.8766E+00      0.1000E-01
                                    0.1753E+01      0.2000E-01
                                    0.3506E+01      0.4000E-01
                                    0.5259E+01      0.6000E-01
                                    0.7012E+01      0.8000E-01
                                    0.7889E+01      0.9000E-01
                                    0.8766E+01      0.1000E+00
                                    0.8766E+01      0.5000E+00
                                    0.8766E+01      0.2000E+01
26         10      0.8323E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
```

```
                                     0.1250E+02      0.9000E-01
                                     0.1389E+02      0.1000E+00
                                     0.1389E+02      0.5000E+00
                                     0.1389E+02      0.2000E+01
   27         10      0.9816E+02
                                     0.0000E+00      0.0000E+00
                                     0.1389E+01      0.1000E-01
                                     0.2778E+01      0.2000E-01
                                     0.5556E+01      0.4000E-01
                                     0.8333E+01      0.6000E-01
                                     0.1111E+02      0.8000E-01
                                     0.1250E+02      0.9000E-01
                                     0.1389E+02      0.1000E+00
                                     0.1389E+02      0.5000E+00
                                     0.1389E+02      0.2000E+01
   28         10      0.9820E+02
                                     0.0000E+00      0.0000E+00
                                     0.1389E+01      0.1000E-01
                                     0.2778E+01      0.2000E-01
                                     0.5556E+01      0.4000E-01
                                     0.8333E+01      0.6000E-01
                                     0.1111E+02      0.8000E-01
                                     0.1250E+02      0.9000E-01
                                     0.1389E+02      0.1000E+00
                                     0.1389E+02      0.5000E+00
                                     0.1389E+02      0.2000E+01
   29         10      0.1241E+03
                                     0.0000E+00      0.0000E+00
                                     0.1389E+01      0.1000E-01
                                     0.2778E+01      0.2000E-01
                                     0.5556E+01      0.4000E-01
                                     0.8333E+01      0.6000E-01
                                     0.1111E+02      0.8000E-01
                                     0.1250E+02      0.9000E-01
                                     0.1389E+02      0.1000E+00
                                     0.1389E+02      0.5000E+00
                                     0.1389E+02      0.2000E+01
   30         10      0.1500E+03
                                     0.0000E+00      0.0000E+00
                                     0.1389E+01      0.1000E-01
                                     0.2778E+01      0.2000E-01
                                     0.5556E+01      0.4000E-01
                                     0.8333E+01      0.6000E-01
                                     0.1111E+02      0.8000E-01
                                     0.1250E+02      0.9000E-01
                                     0.1389E+02      0.1000E+00
                                     0.1389E+02      0.5000E+00
                                     0.1389E+02      0.2000E+01


TIP   LOAD        TIP MOVEMENT
    KIP               IN.

0.0000E+00         0.0000E+00
0.1442E+02         0.2400E-01
0.2884E+02         0.4800E-01
0.5767E+02         0.9600E-01
0.1153E+03         0.6240E+00
0.1730E+03         0.2016E+01
0.2076E+03         0.3504E+01
0.2307E+03         0.4800E+01
0.2307E+03         0.7200E+01
```

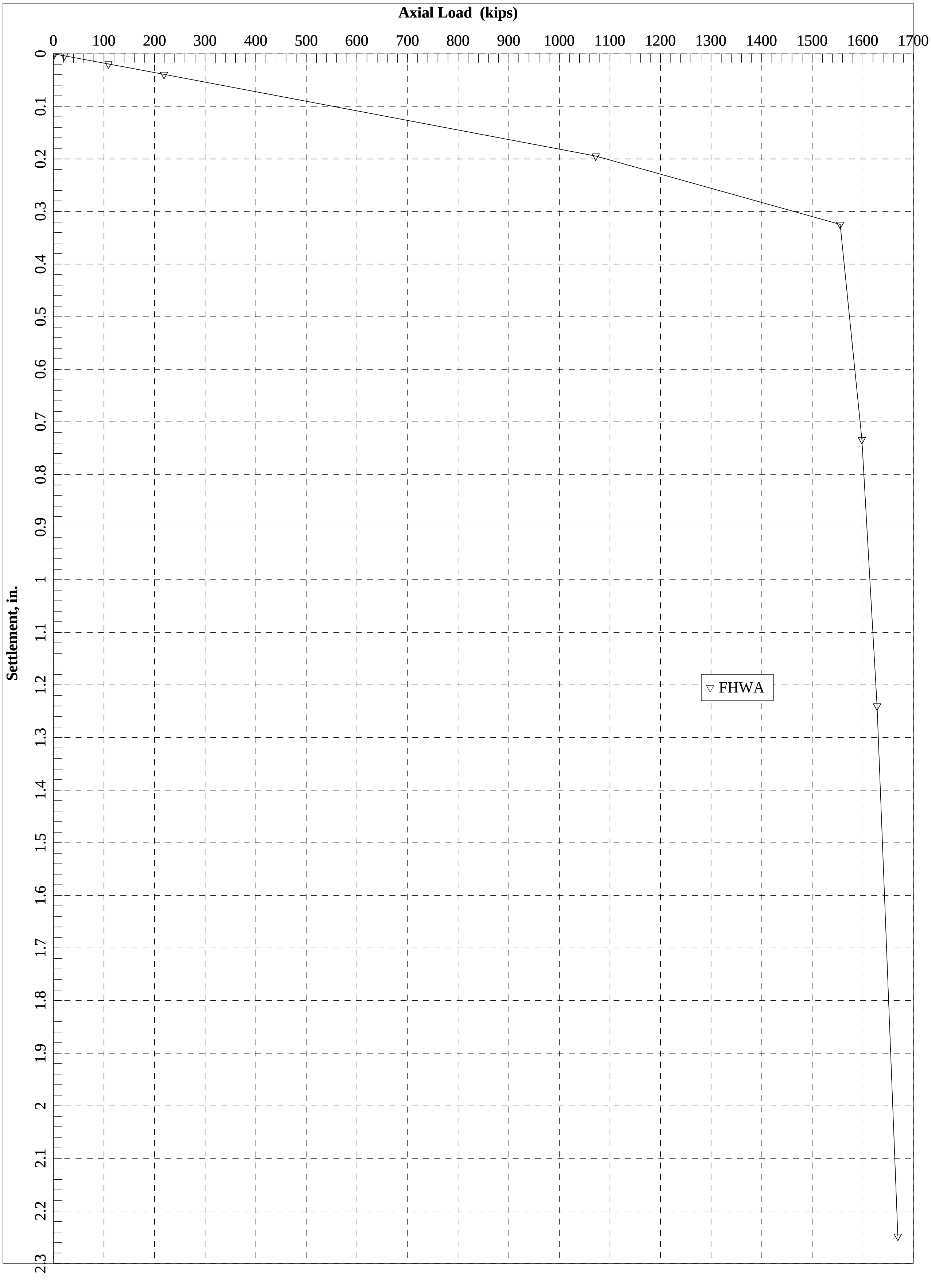
```
  0.2307E+03         0.9600E+01


                LOAD VERSUS SETTLEMENT CURVE
                ****************************

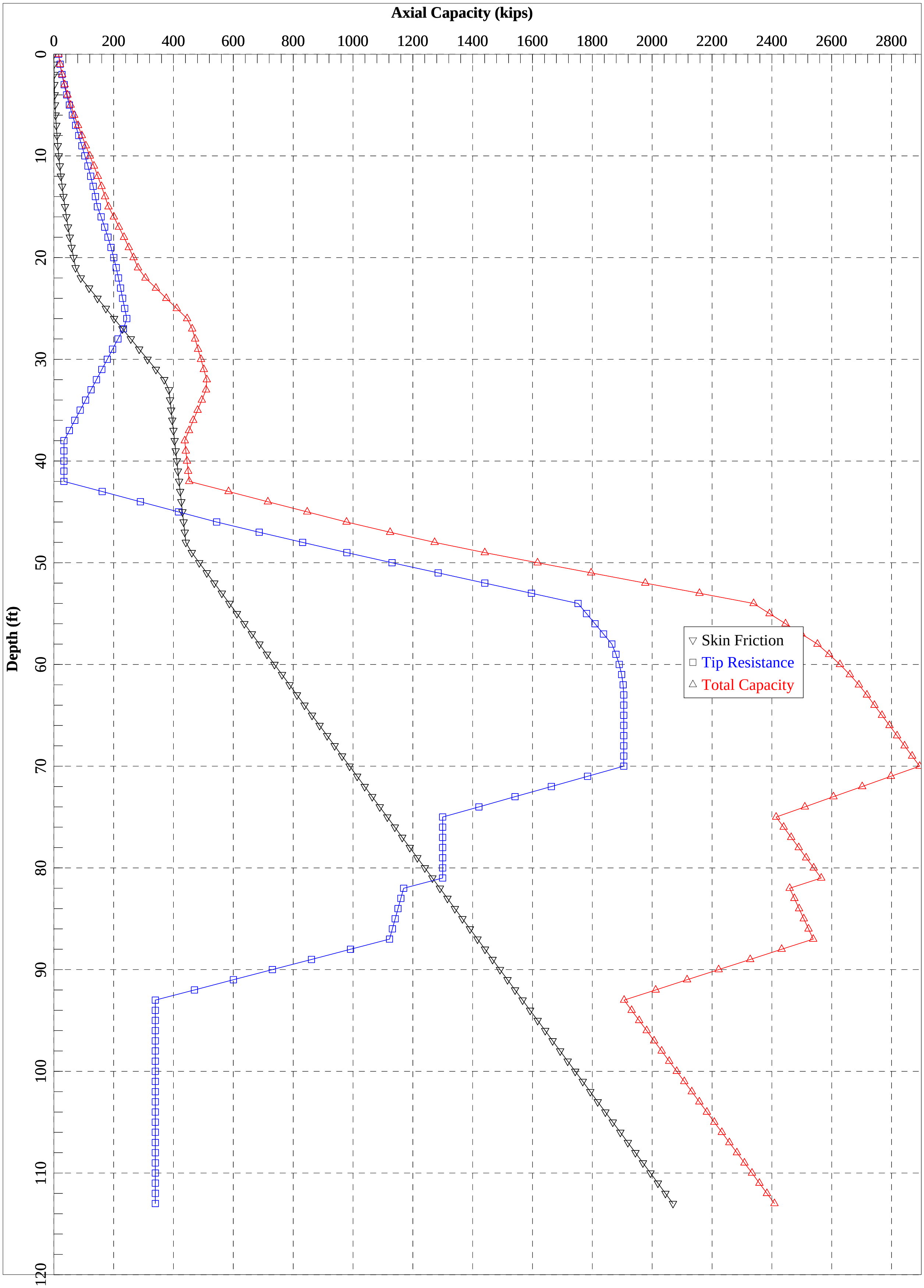


  TOP  LOAD      TOP MOVEMENT        TIP  LOAD      TIP MOVEMENT
     KIP              IN.                KIP              IN.
 0.5722E+01      0.9563E-03      0.6008E-01      0.1000E-03
 0.5722E+02      0.9563E-02      0.6008E+00      0.1000E-02
 0.2886E+03      0.4808E-01      0.3004E+01      0.5000E-02
 0.5790E+03      0.9645E-01      0.6008E+01      0.1000E-01
 0.2067E+04      0.4009E+00      0.3004E+02      0.5000E-01
 0.2584E+04      0.5771E+00      0.5811E+02      0.1000E+00
 0.2627E+04      0.9894E+00      0.1018E+03      0.5000E+00
 0.2657E+04      0.1498E+01      0.1309E+03      0.1000E+01
 0.2698E+04      0.2509E+01      0.1724E+03      0.2000E+01
```

IB -2 Settlement



IB-3 Plugged Condition



```
     ==========================================================================

                       APILE for Windows, Version 2015.7.2

                        Serial Number :  239146456

                        A Program for Analyzing the Axial Capacity
                        and Short-term Settlement of Driven Piles
                                  under Axial Loading.
                      (c) Copyright ENSOFT, Inc., 1987-2015
                            All Rights Reserved

     ==========================================================================


     This program is licensed to :

     SCDOT
     Columbia, SC

     Path to file locations      :
P:\Orangeburg\40308_us301\Geotechnical\5_Design\2_Final\7_InteriorBents\APile\Without
Overburden\
     Name of input data file     : B-3A.ap7d
     Name of output file         : B-3A.ap7o
     Name of plot output file    : B-3A.ap7p

     --------------------------------------------------------------------------
                          Time and Date of Analysis
     --------------------------------------------------------------------------

               Date:  April 14, 2016     Time:  13:29:01



1
          *********************
          * INPUT INFORMATION *
          *********************



          US 301 over Four Hole Swamp, Orangeburg Co. IB-3

          DESIGNER   : RSG

          JOB NUMBER : 0040308


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Unfactored Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION
```

```
PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Open-Ended Pile


DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY     = 0.290E+08 PSI
- CROSS SECTION AREA        =    219.13 IN2


CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD      =     48.00 IN.
- INTERNAL DIAMETER, ID     =     45.00 IN.
- TOTAL PILE LENGTH, TL     =    150.00 FT.
- PILE STICKUP LENGTH, PSL  =     37.00 FT.
- ZERO FRICTION LENGTH, ZFL =     26.00 FT.
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION       =      1.00 FT.
- LENGTH OF ENHANCED
  END SECTION               =    150.00 FT.
- INTERNAL DIAMETER OF
  ENHANCED END SECTION      =     45.00 IN.


PLUGGED/UNPLUGGED CONDITIONS :
Plugged for open-ended pile



SOIL INFORMATIONS :



                  LATERAL    EFFECTIVE    FRICTION   BEARING
         SOIL     EARTH      UNIT         ANGLE      CAPACITY
 DEPTH   TYPE     PRESSURE   WEIGHT       DEGREES    FACTOR
  FT.                        LB/CF
   0.00  SAND       0.00        47.60        30.00      0.00
  20.20  SAND       0.00        47.60        30.00      0.00
  20.20  CLAY       0.00        47.60         0.00      0.00
  31.20  CLAY       0.00        47.60         0.00      0.00
  31.20  CLAY       0.00        47.60         0.00      0.00
  41.30  CLAY       0.00        47.60         0.00      0.00
  41.30  CLAY       0.00        52.60         0.00      0.00
  47.60  CLAY       0.00        52.60         0.00      0.00
  47.60  SAND       0.00        57.60        36.00      0.00
  51.60  SAND       0.00        57.60        36.00      0.00
  51.60  SAND       0.00        52.60        36.00      0.00
  55.40  SAND       0.00        52.60        36.00      0.00
  55.40  SAND       0.00        57.60        36.00      0.00
  75.40  SAND       0.00        57.60        36.00      0.00
  75.40  CLAY       0.00        47.60         0.00      0.00
  80.40  CLAY       0.00        47.60         0.00      0.00
  80.40  SAND       0.00        57.60        36.00      0.00
  86.90  SAND       0.00        57.60        36.00      0.00
  86.90  CLAY       0.00        47.60         0.00      0.00
 150.00  CLAY       0.00        47.60         0.00      0.00
```

```
          MAXIMUM   MAXIMUM   UNDISTURB  REMOLDED
          UNIT      UNIT      SHEAR      SHEAR     BLOW   UNIT SKIN  UNIT END
          FRICTION  BEARING   STRENGTH   STRENGTH  COUNT  FRICTION   BEARING
            KSF       KSF        KSF       KSF                 KSF       KSF
          0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
          0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
          0.10E+08* 0.10E+08*       2.22      1.11   0.00       0.00      0.00
          0.10E+08* 0.10E+08*       2.22      1.11   0.00       0.00      0.00
          0.10E+08* 0.10E+08*       0.30      0.15   0.00       0.00      0.00
          0.10E+08* 0.10E+08*       0.30      0.15   0.00       0.00      0.00
          0.20E+01  0.25E+02        0.30      0.15   0.00       0.00      0.00
          0.20E+01  0.25E+02        0.30      0.15   0.00       0.00      0.00
          0.20E+01  0.12E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.12E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.43E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.43E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.32E+03        4.00      2.00   0.00       0.00      0.00
          0.20E+01  0.32E+03        4.00      2.00   0.00       0.00      0.00
          0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.32E+03        3.00      1.50   0.00       0.00      0.00
          0.20E+01  0.32E+03        3.00      1.50   0.00       0.00      0.00

          * MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
            WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
            PLAN TO LIMIT THE COMPUTED DATA.



                   LRFD FACTOR  LRFD FACTOR
                    ON UNIT      ON UNIT
           DEPTH    FRICTION     BEARING
            FT.
             0.00    1.000       1.000
            20.20    1.000       1.000
            20.20    1.000       1.000
            31.20    1.000       1.000
            31.20    1.000       1.000
            41.30    1.000       1.000
            41.30    1.000       1.000
            47.60    1.000       1.000
            47.60    1.000       1.000
            51.60    1.000       1.000
            51.60    1.000       1.000
            55.40    1.000       1.000
            55.40    1.000       1.000
            75.40    1.000       1.000
            75.40    1.000       1.000
            80.40    1.000       1.000
            80.40    1.000       1.000
            86.90    1.000       1.000
            86.90    1.000       1.000
           150.00    1.000       1.000


1
          **********************
          * COMPUTATION RESULT *
```

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**********************



                  **********************
                  *  FED. HWY. METHOD  *
                  **********************

   PILE       TOTAL SKIN       END       ULTIMATE
PENETRATION   FRICTION       BEARING     CAPACITY
    FT.          KIP           KIP          KIP
    0.00           0.0          15.6         15.6
    1.00           0.0          20.8         20.8
    2.00           0.0          27.3         27.3
    3.00           0.0          34.7         34.7
    4.00           0.0          42.9         42.9
    5.00           0.0          52.0         52.0
    6.00           0.0          62.0         62.0
    7.00           0.0          72.9         72.9
    8.00           0.0          83.3         83.3
    9.00           0.0          93.7         93.7
   10.00           0.0         104.1        104.1
   11.00           0.0         114.1        114.1
   12.00           0.0         123.3        123.3
   13.00           0.0         131.6        131.6
   14.00           0.0         139.0        139.0
   15.00           0.0         145.6        145.6
   16.00           0.0         158.3        158.3
   17.00           0.0         170.1        170.1
   18.00           0.0         181.0        181.0
   19.00           0.0         191.1        191.1
   20.00           0.0         200.2        200.2
   21.00           0.0         208.6        208.6
   22.00           0.0         216.0        216.0
   23.00           0.0         223.0        223.0
   24.00           0.0         230.0        230.0
   25.00           0.0         236.9        236.9
   26.00          13.9         243.9        257.8
   27.00          41.8         232.8        274.6
   28.00          69.7         214.7        284.4
   29.00          97.6         196.6        294.2
   30.00         125.4         178.5        304.0
   31.00         153.3         160.5        313.8
   32.00         181.2         142.4        323.6
   33.00         197.0         124.3        321.3
   34.00         200.8         106.2        307.0
   35.00         204.5          88.2        292.7
   36.00         208.3          70.1        278.4
   37.00         212.1          52.0        264.1
   38.00         215.8          33.9        249.8
   39.00         219.6          33.9        253.5
   40.00         223.4          33.9        257.3
   41.00         227.1          33.9        261.1
   42.00         230.9          33.9        264.8
   43.00         234.7         161.6        396.2
   44.00         238.5         289.2        527.7
   45.00         242.2         416.9        659.1
   46.00         246.0         544.5        790.5
   47.00         249.8         686.6        936.4
   48.00         253.5         831.6       1085.1
   49.00         273.3         979.6       1252.8
   50.00         298.4        1130.5       1428.9
   51.00         323.5        1284.6       1608.1
```

```
  52.00          348.7         1440.4        1789.0
  53.00          373.8         1596.3        1970.1
  54.00          398.9         1752.2        2151.2
  55.00          424.1         1780.5        2204.6
  56.00          449.2         1808.8        2258.0
  57.00          474.3         1837.1        2311.4
  58.00          499.5         1865.4        2364.8
  59.00          524.6         1879.2        2403.8
  60.00          549.7         1890.1        2439.8
  61.00          574.8         1898.1        2472.9
  62.00          600.0         1903.1        2503.0
  63.00          625.1         1904.9        2530.0
  64.00          650.2         1905.1        2555.3
  65.00          675.4         1905.1        2580.4
  66.00          700.5         1905.1        2605.6
  67.00          725.6         1905.1        2630.7
  68.00          750.8         1905.1        2655.8
  69.00          775.9         1905.1        2681.0
  70.00          801.0         1905.1        2706.1
  71.00          826.2         1784.0        2610.2
  72.00          851.3         1662.9        2514.3
  73.00          876.4         1541.9        2418.3
  74.00          901.6         1420.8        2322.4
  75.00          926.7         1299.8        2226.5
  76.00          951.8         1299.8        2251.6
  77.00          977.0         1299.8        2276.8
  78.00         1002.1         1299.8        2301.9
  79.00         1027.2         1299.8        2327.0
  80.00         1052.4         1299.8        2352.2
  81.00         1077.5         1299.8        2377.3
  82.00         1102.6         1169.3        2271.9
  83.00         1127.8         1159.9        2287.6
  84.00         1152.9         1150.5        2303.4
  85.00         1178.0         1141.0        2319.1
  86.00         1203.2         1131.6        2334.8
  87.00         1228.3         1122.2        2350.5
  88.00         1253.4          991.7        2245.1
  89.00         1278.6          861.2        2139.8
  90.00         1303.7          730.7        2034.4
  91.00         1328.8          600.3        1929.1
  92.00         1354.0          469.8        1823.7
  93.00         1379.1          339.3        1718.4
  94.00         1404.2          339.3        1743.5
  95.00         1429.4          339.3        1768.7
  96.00         1454.5          339.3        1793.8
  97.00         1479.6          339.3        1818.9
  98.00         1504.8          339.3        1844.1
  99.00         1529.9          339.3        1869.2
 100.00         1555.0          339.3        1894.3
 101.00         1580.2          339.3        1919.4
 102.00         1605.3          339.3        1944.6
 103.00         1630.4          339.3        1969.7
 104.00         1655.6          339.3        1994.8
 105.00         1680.7          339.3        2020.0
 106.00         1705.8          339.3        2045.1
 107.00         1731.0          339.3        2070.2
 108.00         1756.1          339.3        2095.4
 109.00         1781.2          339.3        2120.5
 110.00         1806.4          339.3        2145.6
 111.00         1831.5          339.3        2170.8
 112.00         1856.6          339.3        2195.9
 113.00         1881.8          339.3        2221.0
```

```
NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.



    ************************************************
    * COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
    * CURVES FOR AXIAL LOADING                      *
    ************************************************


T-Z CURVE   NO. OF   DEPTH TO CURVE   LOAD TRANSFER   PILE MOVEMENT
   NO.      POINTS        FT.              PSI             IN.

    1         10      0.0000E+00
                                       0.0000E+00      0.0000E+00
                                       0.0000E+00      0.1000E-01
                                       0.0000E+00      0.2000E-01
                                       0.0000E+00      0.4000E-01
                                       0.0000E+00      0.6000E-01
                                       0.0000E+00      0.8000E-01
                                       0.0000E+00      0.9000E-01
                                       0.0000E+00      0.1000E+00
                                       0.0000E+00      0.5000E+00
                                       0.0000E+00      0.2000E+01
    2         10      0.1013E+02
                                       0.0000E+00      0.0000E+00
                                       0.0000E+00      0.1000E-01
                                       0.0000E+00      0.2000E-01
                                       0.0000E+00      0.4000E-01
                                       0.0000E+00      0.6000E-01
                                       0.0000E+00      0.8000E-01
                                       0.0000E+00      0.9000E-01
                                       0.0000E+00      0.1000E+00
                                       0.0000E+00      0.5000E+00
                                       0.0000E+00      0.2000E+01
    3         10      0.2016E+02
                                       0.0000E+00      0.0000E+00
                                       0.0000E+00      0.1000E-01
                                       0.0000E+00      0.2000E-01
                                       0.0000E+00      0.4000E-01
                                       0.0000E+00      0.6000E-01
                                       0.0000E+00      0.8000E-01
                                       0.0000E+00      0.9000E-01
                                       0.0000E+00      0.1000E+00
                                       0.0000E+00      0.5000E+00
                                       0.0000E+00      0.2000E+01
    4         10      0.2020E+02
                                       0.0000E+00      0.0000E+00
                                       0.0000E+00      0.7680E-01
                                       0.0000E+00      0.1488E+00
                                       0.0000E+00      0.2736E+00
                                       0.0000E+00      0.3840E+00
                                       0.0000E+00      0.4800E+00
                                       0.0000E+00      0.9600E+00
                                       0.0000E+00      0.1440E+01
                                       0.0000E+00      0.2400E+01
                                       0.0000E+00      0.9600E+01
    5         10      0.2573E+02
                                       0.0000E+00      0.0000E+00
```

```
                                  0.4621E+01      0.7680E-01
                                  0.7701E+01      0.1488E+00
                                  0.1155E+02      0.2736E+00
                                  0.1386E+02      0.3840E+00
                                  0.1540E+02      0.4800E+00
                                  0.1386E+02      0.9600E+00
                                  0.1386E+02      0.1440E+01
                                  0.1386E+02      0.2400E+01
                                  0.1386E+02      0.9600E+01
     6          10      0.3116E+02
                                  0.0000E+00      0.0000E+00
                                  0.3622E+01      0.7680E-01
                                  0.6036E+01      0.1488E+00
                                  0.9055E+01      0.2736E+00
                                  0.1087E+02      0.3840E+00
                                  0.1207E+02      0.4800E+00
                                  0.1087E+02      0.9600E+00
                                  0.1087E+02      0.1440E+01
                                  0.1087E+02      0.2400E+01
                                  0.1087E+02      0.9600E+01
     7          10      0.3120E+02
                                  0.0000E+00      0.0000E+00
                                  0.3622E+01      0.7680E-01
                                  0.6036E+01      0.1488E+00
                                  0.9055E+01      0.2736E+00
                                  0.1087E+02      0.3840E+00
                                  0.1207E+02      0.4800E+00
                                  0.1087E+02      0.9600E+00
                                  0.1087E+02      0.1440E+01
                                  0.1087E+02      0.2400E+01
                                  0.1087E+02      0.9600E+01
     8          10      0.3628E+02
                                  0.0000E+00      0.0000E+00
                                  0.6250E+00      0.7680E-01
                                  0.1042E+01      0.1488E+00
                                  0.1562E+01      0.2736E+00
                                  0.1875E+01      0.3840E+00
                                  0.2083E+01      0.4800E+00
                                  0.1875E+01      0.9600E+00
                                  0.1875E+01      0.1440E+01
                                  0.1875E+01      0.2400E+01
                                  0.1875E+01      0.9600E+01
     9          10      0.4126E+02
                                  0.0000E+00      0.0000E+00
                                  0.6250E+00      0.7680E-01
                                  0.1042E+01      0.1488E+00
                                  0.1562E+01      0.2736E+00
                                  0.1875E+01      0.3840E+00
                                  0.2083E+01      0.4800E+00
                                  0.1875E+01      0.9600E+00
                                  0.1875E+01      0.1440E+01
                                  0.1875E+01      0.2400E+01
                                  0.1875E+01      0.9600E+01
    10          10      0.4130E+02
                                  0.0000E+00      0.0000E+00
                                  0.6250E+00      0.7680E-01
                                  0.1042E+01      0.1488E+00
                                  0.1562E+01      0.2736E+00
                                  0.1875E+01      0.3840E+00
                                  0.2083E+01      0.4800E+00
                                  0.1875E+01      0.9600E+00
                                  0.1875E+01      0.1440E+01
                                  0.1875E+01      0.2400E+01
```

```
                                        0.1875E+01      0.9600E+01
   11           10       0.4448E+02
                                        0.0000E+00      0.0000E+00
                                        0.6250E+00      0.7680E-01
                                        0.1042E+01      0.1488E+00
                                        0.1562E+01      0.2736E+00
                                        0.1875E+01      0.3840E+00
                                        0.2083E+01      0.4800E+00
                                        0.1875E+01      0.9600E+00
                                        0.1875E+01      0.1440E+01
                                        0.1875E+01      0.2400E+01
                                        0.1875E+01      0.9600E+01
   12           10       0.4756E+02
                                        0.0000E+00      0.0000E+00
                                        0.1947E+01      0.7680E-01
                                        0.3245E+01      0.1488E+00
                                        0.4867E+01      0.2736E+00
                                        0.5841E+01      0.3840E+00
                                        0.6490E+01      0.4800E+00
                                        0.5841E+01      0.9600E+00
                                        0.5841E+01      0.1440E+01
                                        0.5841E+01      0.2400E+01
                                        0.5841E+01      0.9600E+01
   13           10       0.4760E+02
                                        0.0000E+00      0.0000E+00
                                        0.6490E+00      0.1000E-01
                                        0.1298E+01      0.2000E-01
                                        0.2596E+01      0.4000E-01
                                        0.3894E+01      0.6000E-01
                                        0.5192E+01      0.8000E-01
                                        0.5841E+01      0.9000E-01
                                        0.6490E+01      0.1000E+00
                                        0.6490E+01      0.5000E+00
                                        0.6490E+01      0.2000E+01
   14           10       0.4963E+02
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
   15           10       0.5156E+02
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
   16           10       0.5160E+02
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
```

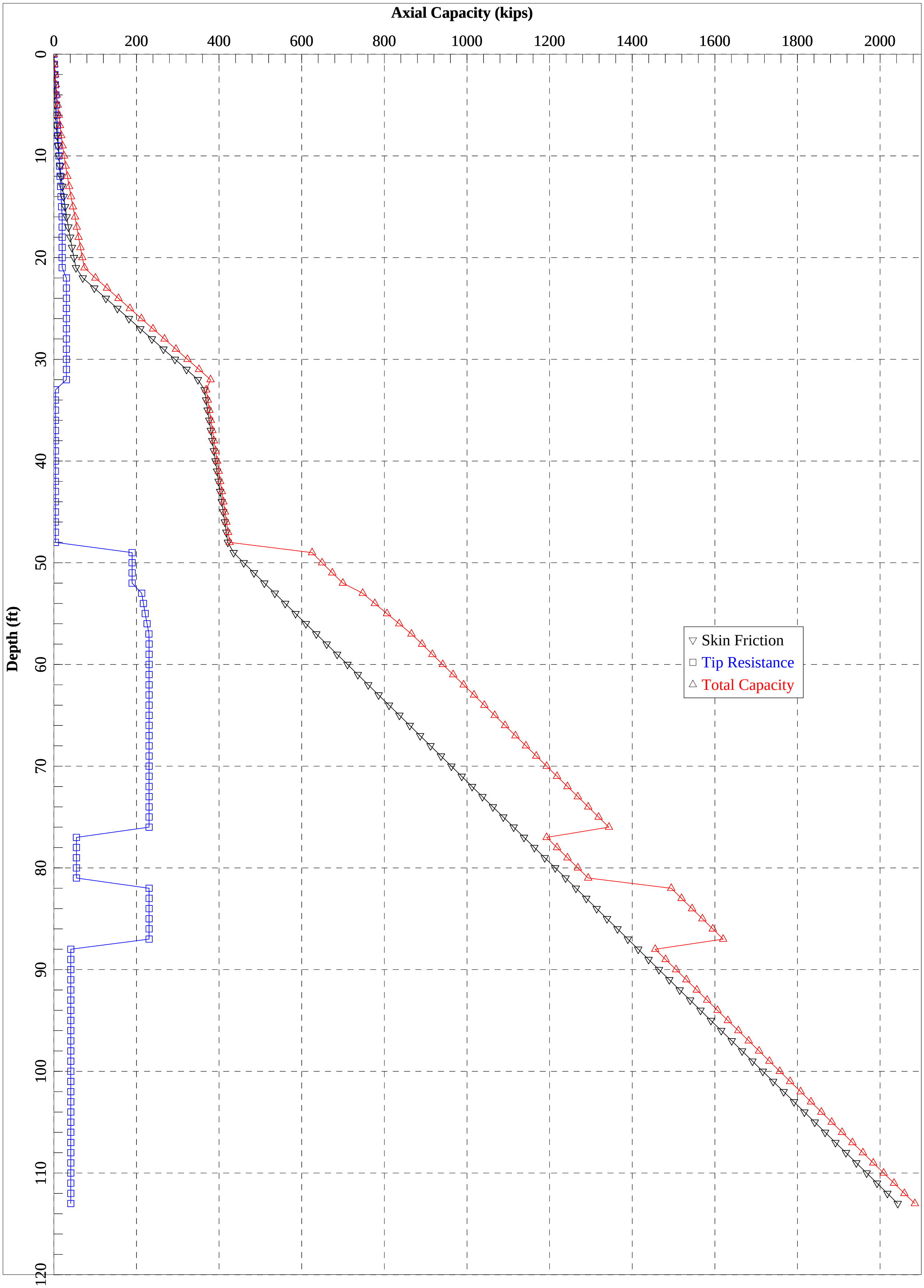
```
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
17         10      0.5353E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
18         10      0.5536E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
19         10      0.5540E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
20         10      0.6543E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
21         10      0.7536E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
22         10      0.7540E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
```

```
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
23         10      0.7793E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
24         10      0.8036E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
25         10      0.8040E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
26         10      0.8368E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
27         10      0.8686E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
28         10      0.8690E+02
```

```
                                        0.0000E+00      0.0000E+00
                                        0.4167E+01      0.7680E-01
                                        0.6944E+01      0.1488E+00
                                        0.1042E+02      0.2736E+00
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01
    29         10      0.1185E+03
                                        0.0000E+00      0.0000E+00
                                        0.4167E+01      0.7680E-01
                                        0.6944E+01      0.1488E+00
                                        0.1042E+02      0.2736E+00
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01
    30         10      0.1500E+03
                                        0.0000E+00      0.0000E+00
                                        0.4167E+01      0.7680E-01
                                        0.6944E+01      0.1488E+00
                                        0.1042E+02      0.2736E+00
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01


 TIP   LOAD        TIP MOVEMENT
     KIP               IN.

 0.0000E+00         0.0000E+00
 0.2121E+02         0.2400E-01
 0.4241E+02         0.4800E-01
 0.8482E+02         0.9600E-01
 0.1696E+03         0.6240E+00
 0.2545E+03         0.2016E+01
 0.3054E+03         0.3504E+01
 0.3393E+03         0.4800E+01
 0.3393E+03         0.7200E+01
 0.3393E+03         0.9600E+01


               LOAD VERSUS SETTLEMENT CURVE
               ****************************


 TOP  LOAD     TOP MOVEMENT       TIP  LOAD      TIP MOVEMENT
    KIP             IN.              KIP             IN.
0.1869E+01      0.4660E-03      0.8836E-01      0.1000E-03
0.1869E+02      0.4660E-02      0.8836E+00      0.1000E-02
0.9357E+02      0.2332E-01      0.4418E+01      0.5000E-02
0.1880E+03      0.4678E-01      0.8836E+01      0.1000E-01
0.9278E+03      0.2326E+00      0.4418E+02      0.5000E-01
```

```
0.1433E+04      0.3890E+00      0.8547E+02      0.1000E+00
0.2093E+04      0.9437E+00      0.1497E+03      0.5000E+00
0.2043E+04      0.1435E+01      0.1926E+03      0.1000E+01
0.2104E+04      0.2452E+01      0.2535E+03      0.2000E+01
```

IB-3 Unplugged Condition



```
===========================================================================

                 APILE for Windows, Version 2015.7.2

                  Serial Number :  239146456

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                (c) Copyright ENSOFT, Inc., 1987-2015
                      All Rights Reserved

===========================================================================


     This program is licensed to :

     SCDOT
     Columbia, SC

     Path to file locations      :
P:\Orangeburg\40308_us301\Geotechnical\5_Design\2_Final\7_InteriorBents\APile\Without
Overburden\
     Name of input data file     : B-3A.ap7d
     Name of output file         : B-3A.ap7o
     Name of plot output file    : B-3A.ap7p

     ---------------------------------------------------------------------------
                           Time and Date of Analysis
     ---------------------------------------------------------------------------

               Date:  April 14, 2016     Time:  14:17:55



1
          *********************
          * INPUT INFORMATION *
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          US 301 over Four Hole Swamp, Orangeburg Co. IB-3

          DESIGNER   : RSG

          JOB NUMBER : 0040308


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Unfactored Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION
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PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Open-Ended Pile


DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY     = 0.290E+08 PSI
- CROSS SECTION AREA        =    219.13 IN2


CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD      =     48.00 IN.
- INTERNAL DIAMETER, ID     =     45.00 IN.
- TOTAL PILE LENGTH, TL     =    150.00 FT.
- PILE STICKUP LENGTH, PSL  =     37.00 FT.
- ZERO FRICTION LENGTH, ZFL =      0.00 FT.
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION       =      1.00 FT.
- LENGTH OF ENHANCED
  END SECTION               =    150.00 FT.
- INTERNAL DIAMETER OF
  ENHANCED END SECTION      =     45.00 IN.


PLUGGED/UNPLUGGED CONDITIONS :
Unplugged for open-ended pile



SOIL INFORMATIONS :



                  LATERAL    EFFECTIVE    FRICTION   BEARING
          SOIL    EARTH      UNIT         ANGLE      CAPACITY
 DEPTH    TYPE    PRESSURE   WEIGHT       DEGREES    FACTOR
  FT.                        LB/CF
   0.00   SAND      0.00       47.60        30.00      0.00
  20.20   SAND      0.00       47.60        30.00      0.00
  20.20   CLAY      0.00       47.60         0.00      0.00
  31.20   CLAY      0.00       47.60         0.00      0.00
  31.20   CLAY      0.00       47.60         0.00      0.00
  41.30   CLAY      0.00       47.60         0.00      0.00
  41.30   CLAY      0.00       52.60         0.00      0.00
  47.60   CLAY      0.00       52.60         0.00      0.00
  47.60   SAND      0.00       57.60        36.00      0.00
  51.60   SAND      0.00       57.60        36.00      0.00
  51.60   SAND      0.00       52.60        36.00      0.00
  55.40   SAND      0.00       52.60        36.00      0.00
  55.40   SAND      0.00       57.60        36.00      0.00
  75.40   SAND      0.00       57.60        36.00      0.00
  75.40   CLAY      0.00       47.60         0.00      0.00
  80.40   CLAY      0.00       47.60         0.00      0.00
  80.40   SAND      0.00       57.60        36.00      0.00
  86.90   SAND      0.00       57.60        36.00      0.00
  86.90   CLAY      0.00       47.60         0.00      0.00
 150.00   CLAY      0.00       47.60         0.00      0.00
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MAXIMUM   MAXIMUM   UNDISTURB  REMOLDED
UNIT      UNIT      SHEAR      SHEAR     BLOW   UNIT SKIN  UNIT END
FRICTION  BEARING   STRENGTH   STRENGTH  COUNT  FRICTION   BEARING
  KSF       KSF        KSF       KSF                 KSF       KSF
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       2.22      1.11   0.00       0.00      0.00
0.10E+08* 0.10E+08*       2.22      1.11   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.30      0.15   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.30      0.15   0.00       0.00      0.00
0.20E+01  0.25E+02        0.30      0.15   0.00       0.00      0.00
0.20E+01  0.25E+02        0.30      0.15   0.00       0.00      0.00
0.20E+01  0.12E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.12E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.43E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.43E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        4.00      2.00   0.00       0.00      0.00
0.20E+01  0.32E+03        4.00      2.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        3.00      1.50   0.00       0.00      0.00
0.20E+01  0.32E+03        3.00      1.50   0.00       0.00      0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
  PLAN TO LIMIT THE COMPUTED DATA.



         LRFD FACTOR  LRFD FACTOR
          ON UNIT      ON UNIT
 DEPTH    FRICTION     BEARING
  FT.
   0.00    1.000       1.000
  20.20    1.000       1.000
  20.20    1.000       1.000
  31.20    1.000       1.000
  31.20    1.000       1.000
  41.30    1.000       1.000
  41.30    1.000       1.000
  47.60    1.000       1.000
  47.60    1.000       1.000
  51.60    1.000       1.000
  51.60    1.000       1.000
  55.40    1.000       1.000
  55.40    1.000       1.000
  75.40    1.000       1.000
  75.40    1.000       1.000
  80.40    1.000       1.000
  80.40    1.000       1.000
  86.90    1.000       1.000
  86.90    1.000       1.000
 150.00    1.000       1.000


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          * COMPUTATION RESULT *
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                     *  FED. HWY. METHOD  *
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   PILE       TOTAL SKIN       END       ULTIMATE
PENETRATION   FRICTION       BEARING     CAPACITY
    FT.         KIP            KIP         KIP
    0.00           0.0           0.0*        0.0
    1.00           0.1           1.3*        1.4
    2.00           0.5           2.5*        3.0
    3.00           1.1           3.8*        4.9
    4.00           2.0           5.0*        7.0
    5.00           3.0           6.3*        9.3
    6.00           4.4           7.6*       11.9
    7.00           6.0           8.8*       14.8
    8.00           7.8          10.1*       17.9
    9.00           9.9          11.3*       21.2
   10.00          12.2          12.6*       24.8
   11.00          14.7          13.9*       28.6
   12.00          17.6          15.1*       32.7
   13.00          20.6          16.4*       37.0
   14.00          23.9          17.6*       41.5
   15.00          27.4          18.9*       46.3
   16.00          31.2          20.2*       51.4
   17.00          35.2          20.3*       55.5
   18.00          39.5          20.3*       59.8
   19.00          44.0          20.3*       64.3
   20.00          48.8          20.3*       69.0
   21.00          53.7          20.3*       74.0
   22.00          70.2          30.4*      100.6
   23.00          98.1          30.4*      128.5
   24.00         126.0          30.4*      156.4
   25.00         153.9          30.4*      184.2
   26.00         181.7          30.4*      212.1
   27.00         209.6          30.4*      240.0
   28.00         237.5          30.4*      267.9
   29.00         265.3          30.4*      295.7
   30.00         293.2          30.4*      323.6
   31.00         321.1          30.4*      351.5
   32.00         349.0          30.4*      379.3
   33.00         364.8           4.1*      368.9
   34.00         368.6           4.1*      372.7
   35.00         372.3           4.1*      376.4
   36.00         376.1           4.1*      380.2
   37.00         379.9           4.1*      384.0
   38.00         383.6           4.1*      387.7
   39.00         387.4           4.1*      391.5
   40.00         391.2           4.1*      395.3
   41.00         394.9           4.1*      399.1
   42.00         398.7           4.1*      402.8
   43.00         402.5           4.1*      406.6
   44.00         406.3           4.1*      410.4
   45.00         410.0           4.1*      414.1
   46.00         413.8           4.1*      417.9
   47.00         417.6           4.1*      421.7
   48.00         421.3           4.1*      425.4
   49.00         435.3         189.6*      624.9
   50.00         459.6         189.6*      649.3
   51.00         484.6         189.6*      674.2
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    52.00          509.7         189.6*        699.4
    53.00          534.9         212.7*        747.6
    54.00          560.0         217.0*        777.0
    55.00          585.1         221.3*        806.4
    56.00          610.3         225.6*        835.9
    57.00          635.4         230.3*        865.7
    58.00          660.5         230.7*        891.2
    59.00          685.7         230.7*        916.4
    60.00          710.8         230.7*        941.5
    61.00          735.9         230.7*        966.6
    62.00          761.1         230.7*        991.8
    63.00          786.2         230.7*       1016.9
    64.00          811.3         230.7*       1042.0
    65.00          836.5         230.7*       1067.2
    66.00          861.6         230.7*       1092.3
    67.00          886.7         230.7*       1117.4
    68.00          911.9         230.7*       1142.6
    69.00          937.0         230.7*       1167.7
    70.00          962.1         230.7*       1192.8
    71.00          987.3         230.7*       1218.0
    72.00         1012.4         230.7*       1243.1
    73.00         1037.5         230.7*       1268.2
    74.00         1062.7         230.7*       1293.4
    75.00         1087.8         230.7*       1318.5
    76.00         1112.9         230.7*       1343.6
    77.00         1138.1          54.8*       1192.8
    78.00         1163.2          54.8*       1218.0
    79.00         1188.3          54.8*       1243.1
    80.00         1213.5          54.8*       1268.2
    81.00         1238.6          54.8*       1293.4
    82.00         1263.7         230.7*       1494.4
    83.00         1288.9         230.7*       1519.5
    84.00         1314.0         230.7*       1544.7
    85.00         1339.1         230.7*       1569.8
    86.00         1364.3         230.7*       1594.9
    87.00         1389.4         230.7*       1620.1
    88.00         1414.5          41.1*       1455.6
    89.00         1439.7          41.1*       1480.7
    90.00         1464.8          41.1*       1505.9
    91.00         1489.9          41.1*       1531.0
    92.00         1515.0          41.1*       1556.1
    93.00         1540.2          41.1*       1581.3
    94.00         1565.3          41.1*       1606.4
    95.00         1590.4          41.1*       1631.5
    96.00         1615.6          41.1*       1656.7
    97.00         1640.7          41.1*       1681.8
    98.00         1665.8          41.1*       1706.9
    99.00         1691.0          41.1*       1732.1
   100.00         1716.1          41.1*       1757.2
   101.00         1741.2          41.1*       1782.3
   102.00         1766.4          41.1*       1807.5
   103.00         1791.5          41.1*       1832.6
   104.00         1816.6          41.1*       1857.7
   105.00         1841.8          41.1*       1882.9
   106.00         1866.9          41.1*       1908.0
   107.00         1892.0          41.1*       1933.1
   108.00         1917.2          41.1*       1958.3
   109.00         1942.3          41.1*       1983.4
   110.00         1967.4          41.1*       2008.5
   111.00         1992.6          41.1*       2033.7
   112.00         2017.7          41.1*       2058.8
   113.00         2042.8          41.1*       2083.9
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NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.



     *************************************************
     * COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
     * CURVES FOR AXIAL LOADING                      *
     *************************************************


T-Z CURVE   NO. OF   DEPTH TO CURVE   LOAD TRANSFER   PILE MOVEMENT
   NO.      POINTS        FT.              PSI             IN.

    1         10      0.0000E+00
                                     0.0000E+00      0.0000E+00
                                     0.2021E-01      0.1000E-01
                                     0.4041E-01      0.2000E-01
                                     0.8082E-01      0.4000E-01
                                     0.1212E+00      0.6000E-01
                                     0.1616E+00      0.8000E-01
                                     0.1819E+00      0.9000E-01
                                     0.2021E+00      0.1000E+00
                                     0.2021E+00      0.5000E+00
                                     0.2021E+00      0.2000E+01
    2         10      0.1013E+02
                                     0.0000E+00      0.0000E+00
                                     0.1482E+00      0.1000E-01
                                     0.2964E+00      0.2000E-01
                                     0.5927E+00      0.4000E-01
                                     0.8891E+00      0.6000E-01
                                     0.1185E+01      0.8000E-01
                                     0.1334E+01      0.9000E-01
                                     0.1482E+01      0.1000E+00
                                     0.1482E+01      0.5000E+00
                                     0.1482E+01      0.2000E+01
    3         10      0.2016E+02
                                     0.0000E+00      0.0000E+00
                                     0.5939E+00      0.1000E-01
                                     0.1188E+01      0.2000E-01
                                     0.2375E+01      0.4000E-01
                                     0.3563E+01      0.6000E-01
                                     0.4751E+01      0.8000E-01
                                     0.5345E+01      0.9000E-01
                                     0.5939E+01      0.1000E+00
                                     0.5939E+01      0.5000E+00
                                     0.5939E+01      0.2000E+01
    4         10      0.2020E+02
                                     0.0000E+00      0.0000E+00
                                     0.1782E+01      0.7680E-01
                                     0.2969E+01      0.1488E+00
                                     0.4454E+01      0.2736E+00
                                     0.5345E+01      0.3840E+00
                                     0.5939E+01      0.4800E+00
                                     0.5345E+01      0.9600E+00
                                     0.5345E+01      0.1440E+01
                                     0.5345E+01      0.2400E+01
                                     0.5345E+01      0.9600E+01
    5         10      0.2573E+02
                                     0.0000E+00      0.0000E+00
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                                    0.4621E+01      0.7680E-01
                                    0.7701E+01      0.1488E+00
                                    0.1155E+02      0.2736E+00
                                    0.1386E+02      0.3840E+00
                                    0.1540E+02      0.4800E+00
                                    0.1386E+02      0.9600E+00
                                    0.1386E+02      0.1440E+01
                                    0.1386E+02      0.2400E+01
                                    0.1386E+02      0.9600E+01
 6         10      0.3116E+02
                                    0.0000E+00      0.0000E+00
                                    0.3622E+01      0.7680E-01
                                    0.6036E+01      0.1488E+00
                                    0.9055E+01      0.2736E+00
                                    0.1087E+02      0.3840E+00
                                    0.1207E+02      0.4800E+00
                                    0.1087E+02      0.9600E+00
                                    0.1087E+02      0.1440E+01
                                    0.1087E+02      0.2400E+01
                                    0.1087E+02      0.9600E+01
 7         10      0.3120E+02
                                    0.0000E+00      0.0000E+00
                                    0.3622E+01      0.7680E-01
                                    0.6036E+01      0.1488E+00
                                    0.9055E+01      0.2736E+00
                                    0.1087E+02      0.3840E+00
                                    0.1207E+02      0.4800E+00
                                    0.1087E+02      0.9600E+00
                                    0.1087E+02      0.1440E+01
                                    0.1087E+02      0.2400E+01
                                    0.1087E+02      0.9600E+01
 8         10      0.3628E+02
                                    0.0000E+00      0.0000E+00
                                    0.6250E+00      0.7680E-01
                                    0.1042E+01      0.1488E+00
                                    0.1562E+01      0.2736E+00
                                    0.1875E+01      0.3840E+00
                                    0.2083E+01      0.4800E+00
                                    0.1875E+01      0.9600E+00
                                    0.1875E+01      0.1440E+01
                                    0.1875E+01      0.2400E+01
                                    0.1875E+01      0.9600E+01
 9         10      0.4126E+02
                                    0.0000E+00      0.0000E+00
                                    0.6250E+00      0.7680E-01
                                    0.1042E+01      0.1488E+00
                                    0.1562E+01      0.2736E+00
                                    0.1875E+01      0.3840E+00
                                    0.2083E+01      0.4800E+00
                                    0.1875E+01      0.9600E+00
                                    0.1875E+01      0.1440E+01
                                    0.1875E+01      0.2400E+01
                                    0.1875E+01      0.9600E+01
10         10      0.4130E+02
                                    0.0000E+00      0.0000E+00
                                    0.6250E+00      0.7680E-01
                                    0.1042E+01      0.1488E+00
                                    0.1562E+01      0.2736E+00
                                    0.1875E+01      0.3840E+00
                                    0.2083E+01      0.4800E+00
                                    0.1875E+01      0.9600E+00
                                    0.1875E+01      0.1440E+01
                                    0.1875E+01      0.2400E+01
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                                         0.1875E+01      0.9600E+01
  11          10       0.4448E+02
                                         0.0000E+00      0.0000E+00
                                         0.6250E+00      0.7680E-01
                                         0.1042E+01      0.1488E+00
                                         0.1562E+01      0.2736E+00
                                         0.1875E+01      0.3840E+00
                                         0.2083E+01      0.4800E+00
                                         0.1875E+01      0.9600E+00
                                         0.1875E+01      0.1440E+01
                                         0.1875E+01      0.2400E+01
                                         0.1875E+01      0.9600E+01
  12          10       0.4756E+02
                                         0.0000E+00      0.0000E+00
                                         0.1467E+01      0.7680E-01
                                         0.2445E+01      0.1488E+00
                                         0.3668E+01      0.2736E+00
                                         0.4401E+01      0.3840E+00
                                         0.4890E+01      0.4800E+00
                                         0.4401E+01      0.9600E+00
                                         0.4401E+01      0.1440E+01
                                         0.4401E+01      0.2400E+01
                                         0.4401E+01      0.9600E+01
  13          10       0.4760E+02
                                         0.0000E+00      0.0000E+00
                                         0.4890E+00      0.1000E-01
                                         0.9780E+00      0.2000E-01
                                         0.1956E+01      0.4000E-01
                                         0.2934E+01      0.6000E-01
                                         0.3912E+01      0.8000E-01
                                         0.4401E+01      0.9000E-01
                                         0.4890E+01      0.1000E+00
                                         0.4890E+01      0.5000E+00
                                         0.4890E+01      0.2000E+01
  14          10       0.4963E+02
                                         0.0000E+00      0.0000E+00
                                         0.1363E+01      0.1000E-01
                                         0.2727E+01      0.2000E-01
                                         0.5454E+01      0.4000E-01
                                         0.8180E+01      0.6000E-01
                                         0.1091E+02      0.8000E-01
                                         0.1227E+02      0.9000E-01
                                         0.1363E+02      0.1000E+00
                                         0.1363E+02      0.5000E+00
                                         0.1363E+02      0.2000E+01
  15          10       0.5156E+02
                                         0.0000E+00      0.0000E+00
                                         0.1389E+01      0.1000E-01
                                         0.2778E+01      0.2000E-01
                                         0.5556E+01      0.4000E-01
                                         0.8333E+01      0.6000E-01
                                         0.1111E+02      0.8000E-01
                                         0.1250E+02      0.9000E-01
                                         0.1389E+02      0.1000E+00
                                         0.1389E+02      0.5000E+00
                                         0.1389E+02      0.2000E+01
  16          10       0.5160E+02
                                         0.0000E+00      0.0000E+00
                                         0.1389E+01      0.1000E-01
                                         0.2778E+01      0.2000E-01
                                         0.5556E+01      0.4000E-01
                                         0.8333E+01      0.6000E-01
                                         0.1111E+02      0.8000E-01
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                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
17         10      0.5353E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
18         10      0.5536E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
19         10      0.5540E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
20         10      0.6543E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
21         10      0.7536E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
22         10      0.7540E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
```
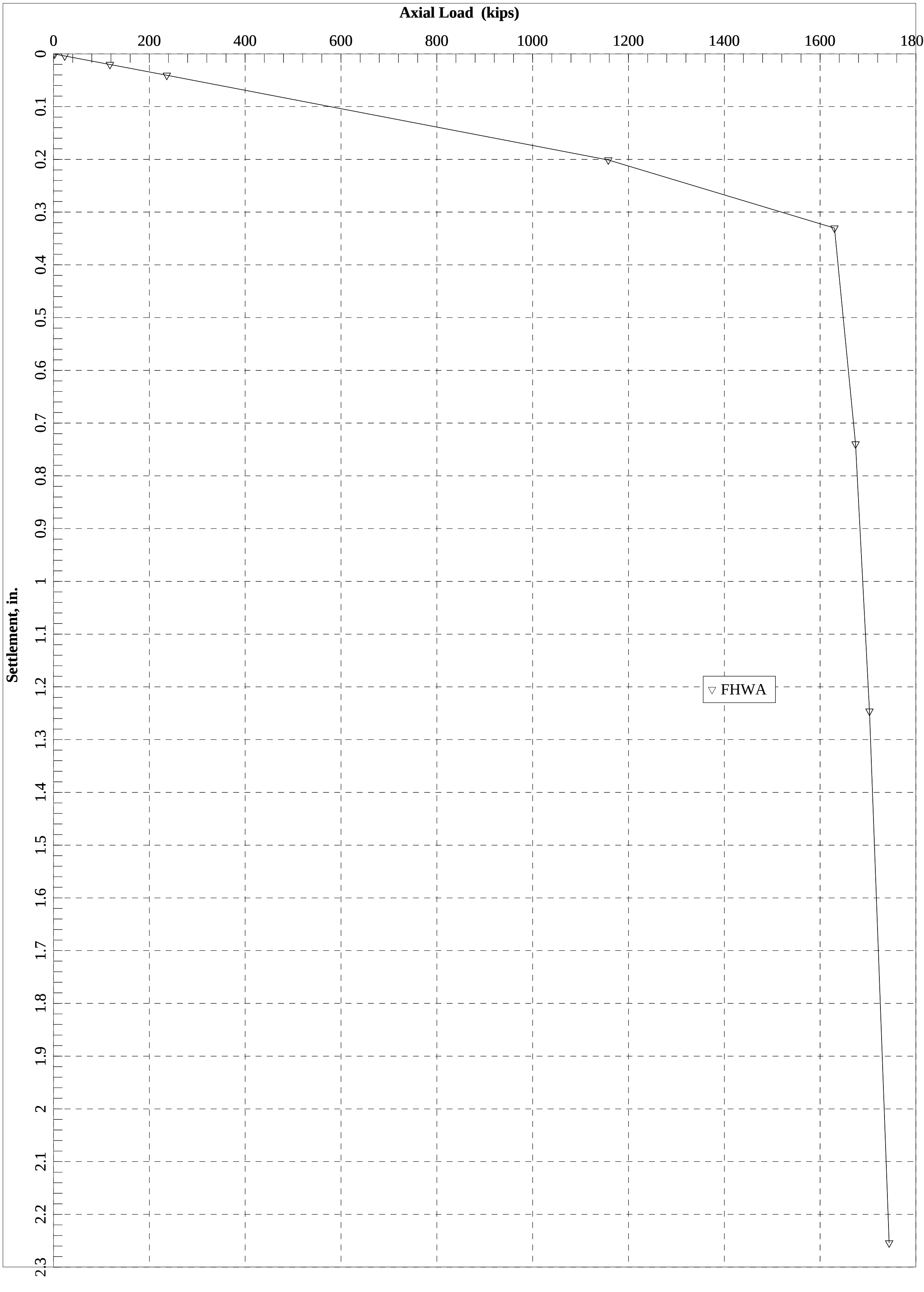

```
                                    0.1042E+02       0.2736E+00
                                    0.1250E+02       0.3840E+00
                                    0.1389E+02       0.4800E+00
                                    0.1250E+02       0.9600E+00
                                    0.1250E+02       0.1440E+01
                                    0.1250E+02       0.2400E+01
                                    0.1250E+02       0.9600E+01
23          10       0.7793E+02
                                    0.0000E+00       0.0000E+00
                                    0.4167E+01       0.7680E-01
                                    0.6944E+01       0.1488E+00
                                    0.1042E+02       0.2736E+00
                                    0.1250E+02       0.3840E+00
                                    0.1389E+02       0.4800E+00
                                    0.1250E+02       0.9600E+00
                                    0.1250E+02       0.1440E+01
                                    0.1250E+02       0.2400E+01
                                    0.1250E+02       0.9600E+01
24          10       0.8036E+02
                                    0.0000E+00       0.0000E+00
                                    0.4167E+01       0.7680E-01
                                    0.6944E+01       0.1488E+00
                                    0.1042E+02       0.2736E+00
                                    0.1250E+02       0.3840E+00
                                    0.1389E+02       0.4800E+00
                                    0.1250E+02       0.9600E+00
                                    0.1250E+02       0.1440E+01
                                    0.1250E+02       0.2400E+01
                                    0.1250E+02       0.9600E+01
25          10       0.8040E+02
                                    0.0000E+00       0.0000E+00
                                    0.1389E+01       0.1000E-01
                                    0.2778E+01       0.2000E-01
                                    0.5556E+01       0.4000E-01
                                    0.8333E+01       0.6000E-01
                                    0.1111E+02       0.8000E-01
                                    0.1250E+02       0.9000E-01
                                    0.1389E+02       0.1000E+00
                                    0.1389E+02       0.5000E+00
                                    0.1389E+02       0.2000E+01
26          10       0.8368E+02
                                    0.0000E+00       0.0000E+00
                                    0.1389E+01       0.1000E-01
                                    0.2778E+01       0.2000E-01
                                    0.5556E+01       0.4000E-01
                                    0.8333E+01       0.6000E-01
                                    0.1111E+02       0.8000E-01
                                    0.1250E+02       0.9000E-01
                                    0.1389E+02       0.1000E+00
                                    0.1389E+02       0.5000E+00
                                    0.1389E+02       0.2000E+01
27          10       0.8686E+02
                                    0.0000E+00       0.0000E+00
                                    0.1389E+01       0.1000E-01
                                    0.2778E+01       0.2000E-01
                                    0.5556E+01       0.4000E-01
                                    0.8333E+01       0.6000E-01
                                    0.1111E+02       0.8000E-01
                                    0.1250E+02       0.9000E-01
                                    0.1389E+02       0.1000E+00
                                    0.1389E+02       0.5000E+00
                                    0.1389E+02       0.2000E+01
28          10       0.8690E+02
```

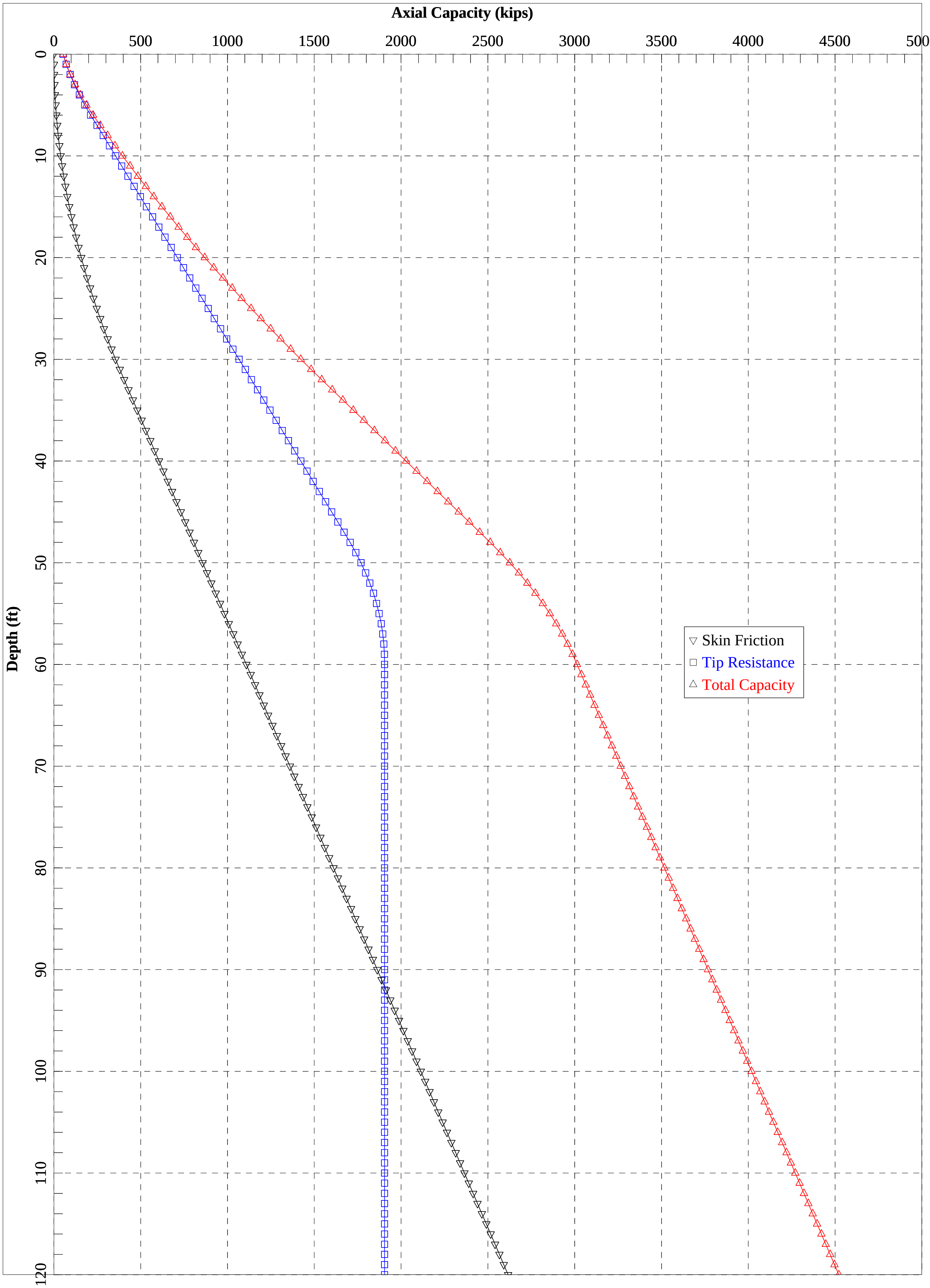
```
                                                  0.0000E+00      0.0000E+00
                                                  0.4167E+01      0.7680E-01
                                                  0.6944E+01      0.1488E+00
                                                  0.1042E+02      0.2736E+00
                                                  0.1250E+02      0.3840E+00
                                                  0.1389E+02      0.4800E+00
                                                  0.1250E+02      0.9600E+00
                                                  0.1250E+02      0.1440E+01
                                                  0.1250E+02      0.2400E+01
                                                  0.1250E+02      0.9600E+01
   29          10      0.1185E+03
                                                  0.0000E+00      0.0000E+00
                                                  0.4167E+01      0.7680E-01
                                                  0.6944E+01      0.1488E+00
                                                  0.1042E+02      0.2736E+00
                                                  0.1250E+02      0.3840E+00
                                                  0.1389E+02      0.4800E+00
                                                  0.1250E+02      0.9600E+00
                                                  0.1250E+02      0.1440E+01
                                                  0.1250E+02      0.2400E+01
                                                  0.1250E+02      0.9600E+01
   30          10      0.1500E+03
                                                  0.0000E+00      0.0000E+00
                                                  0.4167E+01      0.7680E-01
                                                  0.6944E+01      0.1488E+00
                                                  0.1042E+02      0.2736E+00
                                                  0.1250E+02      0.3840E+00
                                                  0.1389E+02      0.4800E+00
                                                  0.1250E+02      0.9600E+00
                                                  0.1250E+02      0.1440E+01
                                                  0.1250E+02      0.2400E+01
                                                  0.1250E+02      0.9600E+01


  TIP   LOAD        TIP MOVEMENT
      KIP               IN.

  0.0000E+00         0.0000E+00
  0.2568E+01         0.2400E-01
  0.5136E+01         0.4800E-01
  0.1027E+02         0.9600E-01
  0.2054E+02         0.6240E+00
  0.3081E+02         0.2016E+01
  0.3698E+02         0.3504E+01
  0.4109E+02         0.4800E+01
  0.4109E+02         0.7200E+01
  0.4109E+02         0.9600E+01


                    LOAD VERSUS SETTLEMENT CURVE
                    ****************************


  TOP  LOAD      TOP MOVEMENT       TIP  LOAD      TIP MOVEMENT
     KIP             IN.              KIP              IN.
 0.1922E+01      0.4487E-03      0.1070E-01      0.1000E-03
 0.1922E+02      0.4487E-02      0.1070E+00      0.1000E-02
 0.9625E+02      0.2245E-01      0.5350E+00      0.5000E-02
 0.1933E+03      0.4503E-01      0.1070E+01      0.1000E-01
 0.9309E+03      0.2217E+00      0.5350E+01      0.5000E-01
```

```
 0.1437E+04      0.3743E+00      0.1035E+02      0.1000E+00
 0.2067E+04      0.9167E+00      0.1813E+02      0.5000E+00
 0.1975E+04      0.1397E+01      0.2332E+02      0.1000E+01
 0.1983E+04      0.2399E+01      0.3070E+02      0.2000E+01
```

IB-3 Settlement



IB-4 Plugged Condition



```
     =========================================================================

                      APILE for Windows, Version 2015.7.2

                       Serial Number :  239146456

                       A Program for Analyzing the Axial Capacity
                       and Short-term Settlement of Driven Piles
                                 under Axial Loading.
                     (c) Copyright ENSOFT, Inc., 1987-2015
                           All Rights Reserved

     =========================================================================


     This program is licensed to :

     SCDOT
     Columbia, SC

     Path to file locations      :
P:\Orangeburg\40308_us301\Geotechnical\5_Design\2_Final\7_InteriorBents\APile\Without
Overburden\
     Name of input data file     : B-4.ap7d
     Name of output file         : B-4.ap7o
     Name of plot output file    : B-4.ap7p

     -------------------------------------------------------------------------
                          Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  April 14, 2016     Time:  14:22:21



1
          *********************
          * INPUT INFORMATION *
          *********************



          US 301 over Four Hole Swamp, Orangeburg County  IB-4

          DESIGNER   : RSG

          JOB NUMBER : 0040308


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Reduced Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION
```

```
PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Open-Ended Pile


DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY     = 0.290E+08 PSI
- CROSS SECTION AREA        =    219.13 IN2


CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD      =     48.00 IN.
- INTERNAL DIAMETER, ID     =     45.00 IN.
- TOTAL PILE LENGTH, TL     =    150.00 FT.
- PILE STICKUP LENGTH, PSL  =     30.00 FT.
- ZERO FRICTION LENGTH, ZFL =      0.00 FT.
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION       =      1.00 FT.
- LENGTH OF ENHANCED
  END SECTION               =    150.00 FT.
- INTERNAL DIAMETER OF
  ENHANCED END SECTION      =     45.00 IN.


PLUGGED/UNPLUGGED CONDITIONS :
Plugged for open-ended pile



SOIL INFORMATIONS :



                  LATERAL    EFFECTIVE    FRICTION   BEARING
          SOIL    EARTH      UNIT         ANGLE      CAPACITY
 DEPTH    TYPE    PRESSURE   WEIGHT       DEGREES    FACTOR
  FT.                        LB/CF
   0.00   SAND      0.00        52.60        36.00      0.00
   5.00   SAND      0.00        52.60        36.00      0.00
   5.00   SAND      0.00        52.60        36.00      0.00
  10.00   SAND      0.00        52.60        36.00      0.00
  10.00   SAND      0.00        52.60        36.00      0.00
  28.70   SAND      0.00        52.60        36.00      0.00
  28.70   SAND      0.00        52.60        36.00      0.00
  45.00   SAND      0.00        52.60        36.00      0.00
  45.00   SAND      0.00        52.60        36.00      0.00
  60.00   SAND      0.00        52.60        36.00      0.00
  60.00   SAND      0.00        52.60        36.00      0.00
  65.70   SAND      0.00        52.60        36.00      0.00
  65.70   SAND      0.00        57.60        36.00      0.00
  69.70   SAND      0.00        57.60        36.00      0.00
  69.70   SAND      0.00        57.60        36.00      0.00
 150.00   SAND      0.00        57.60        36.00      0.00


MAXIMUM   MAXIMUM   UNDISTURB  REMOLDED
UNIT      UNIT      SHEAR      SHEAR     BLOW   UNIT SKIN  UNIT END
```

```
FRICTION  BEARING   STRENGTH   STRENGTH  COUNT  FRICTION   BEARING
  KSF       KSF        KSF       KSF                KSF       KSF
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.20E+01  0.29E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.29E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.42E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.42E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.33E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.33E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.53E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.53E+03        0.00      0.00   0.00       0.00      0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
  PLAN TO LIMIT THE COMPUTED DATA.


         LRFD FACTOR  LRFD FACTOR
          ON UNIT      ON UNIT
 DEPTH    FRICTION     BEARING
  FT.
   0.00    1.000       1.000
   5.00    1.000       1.000
   5.00    1.000       1.000
  10.00    1.000       1.000
  10.00    1.000       1.000
  28.70    1.000       1.000
  28.70    1.000       1.000
  45.00    1.000       1.000
  45.00    1.000       1.000
  60.00    1.000       1.000
  60.00    1.000       1.000
  65.70    1.000       1.000
  65.70    1.000       1.000
  69.70    1.000       1.000
  69.70    1.000       1.000
 150.00    1.000       1.000


1
**********************
* COMPUTATION RESULT *
**********************


                  **********************
                  *  FED. HWY. METHOD  *
                  **********************

   PILE       TOTAL SKIN      END       ULTIMATE
PENETRATION   FRICTION      BEARING     CAPACITY
    FT.          KIP          KIP          KIP
    0.00           0.0         53.3         53.3
```

1.00	0.4	71.1	71.5
2.00	1.6	93.4	94.9
3.00	3.6	118.5	122.1
4.00	6.3	146.7	153.0
5.00	9.9	177.8	187.7
6.00	14.2	211.9	226.1
7.00	19.4	248.9	268.3
8.00	25.3	284.5	309.8
9.00	32.0	320.1	352.1
10.00	39.5	355.6	395.2
11.00	47.8	391.2	439.0
12.00	56.9	426.8	483.7
13.00	66.8	462.3	529.1
14.00	77.5	497.9	575.4
15.00	89.0	533.4	622.4
16.00	101.2	569.0	670.2
17.00	114.3	604.6	718.8
18.00	128.1	640.1	768.2
19.00	142.7	675.7	818.4
20.00	158.1	711.3	869.4
21.00	174.4	746.8	921.2
22.00	191.4	782.4	973.7
23.00	209.1	818.0	1027.1
24.00	227.7	853.5	1081.2
25.00	247.1	889.1	1136.2
26.00	267.3	924.6	1191.9
27.00	288.2	960.2	1248.4
28.00	310.0	995.8	1305.7
29.00	332.5	1031.3	1363.8
30.00	355.8	1066.9	1422.7
31.00	379.9	1102.5	1482.4
32.00	404.9	1138.0	1542.9
33.00	430.0	1173.6	1603.6
34.00	455.1	1209.1	1664.3
35.00	480.3	1244.7	1725.0
36.00	505.4	1280.3	1785.7
37.00	530.5	1315.8	1846.4
38.00	555.7	1351.4	1907.0
39.00	580.8	1387.0	1967.7
40.00	605.9	1422.5	2028.4
41.00	631.0	1458.1	2089.1
42.00	656.2	1493.6	2149.8
43.00	681.3	1529.2	2210.5
44.00	706.4	1564.8	2271.2
45.00	731.6	1600.3	2331.9
46.00	756.7	1635.9	2392.6
47.00	781.8	1671.5	2453.3
48.00	807.0	1706.4	2513.4
49.00	832.1	1739.2	2571.3
50.00	857.2	1769.0	2626.3
51.00	882.4	1795.9	2678.3
52.00	907.5	1819.8	2727.3
53.00	932.6	1840.8	2773.4
54.00	957.8	1858.7	2816.5
55.00	982.9	1873.8	2856.7
56.00	1008.0	1885.8	2893.9
57.00	1033.2	1894.9	2928.1
58.00	1058.3	1901.1	2959.4
59.00	1083.4	1904.2	2987.7
60.00	1108.6	1905.1	3013.6
61.00	1133.7	1905.1	3038.8
62.00	1158.8	1905.1	3063.9
63.00	1184.0	1905.1	3089.0

```
  64.00         1209.1         1905.1        3114.2
  65.00         1234.2         1905.1        3139.3
  66.00         1259.4         1905.1        3164.4
  67.00         1284.5         1905.1        3189.6
  68.00         1309.6         1905.1        3214.7
  69.00         1334.8         1905.1        3239.8
  70.00         1359.9         1905.1        3265.0
  71.00         1385.0         1905.1        3290.1
  72.00         1410.2         1905.1        3315.2
  73.00         1435.3         1905.1        3340.4
  74.00         1460.4         1905.1        3365.5
  75.00         1485.6         1905.1        3390.6
  76.00         1510.7         1905.1        3415.8
  77.00         1535.8         1905.1        3440.9
  78.00         1561.0         1905.1        3466.0
  79.00         1586.1         1905.1        3491.2
  80.00         1611.2         1905.1        3516.3
  81.00         1636.4         1905.1        3541.4
  82.00         1661.5         1905.1        3566.6
  83.00         1686.6         1905.1        3591.7
  84.00         1711.8         1905.1        3616.8
  85.00         1736.9         1905.1        3641.9
  86.00         1762.0         1905.1        3667.1
  87.00         1787.2         1905.1        3692.2
  88.00         1812.3         1905.1        3717.3
  89.00         1837.4         1905.1        3742.5
  90.00         1862.6         1905.1        3767.6
  91.00         1887.7         1905.1        3792.7
  92.00         1912.8         1905.1        3817.9
  93.00         1938.0         1905.1        3843.0
  94.00         1963.1         1905.1        3868.1
  95.00         1988.2         1905.1        3893.3
  96.00         2013.3         1905.1        3918.4
  97.00         2038.5         1905.1        3943.5
  98.00         2063.6         1905.1        3968.7
  99.00         2088.7         1905.1        3993.8
 100.00         2113.9         1905.1        4018.9
 101.00         2139.0         1905.1        4044.1
 102.00         2164.1         1905.1        4069.2
 103.00         2189.3         1905.1        4094.3
 104.00         2214.4         1905.1        4119.5
 105.00         2239.5         1905.1        4144.6
 106.00         2264.7         1905.1        4169.7
 107.00         2289.8         1905.1        4194.9
 108.00         2314.9         1905.1        4220.0
 109.00         2340.1         1905.1        4245.1
 110.00         2365.2         1905.1        4270.3
 111.00         2390.3         1905.1        4295.4
 112.00         2415.5         1905.1        4320.5
 113.00         2440.6         1905.1        4345.7
 114.00         2465.7         1905.1        4370.8
 115.00         2490.9         1905.1        4395.9
 116.00         2516.0         1905.1        4421.1
 117.00         2541.1         1905.1        4446.2
 118.00         2566.3         1905.1        4471.3
 119.00         2591.4         1905.1        4496.5
 120.00         2616.5         1905.1        4521.6


 NOTES:
 - AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
   IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
   OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.
```

```
          ***********************************************
          * COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
          * CURVES FOR AXIAL LOADING                      *
          ***********************************************


 T-Z CURVE   NO. OF   DEPTH TO CURVE   LOAD TRANSFER   PILE MOVEMENT
    NO.      POINTS        FT.              PSI              IN.

     1         10      0.0000E+00
                                        0.0000E+00      0.0000E+00
                                        0.6555E-01      0.1000E-01
                                        0.1311E+00      0.2000E-01
                                        0.2622E+00      0.4000E-01
                                        0.3933E+00      0.6000E-01
                                        0.5244E+00      0.8000E-01
                                        0.5899E+00      0.9000E-01
                                        0.6555E+00      0.1000E+00
                                        0.6555E+00      0.5000E+00
                                        0.6555E+00      0.2000E+01
     2         10      0.2525E+01
                                        0.0000E+00      0.0000E+00
                                        0.1311E+00      0.1000E-01
                                        0.2622E+00      0.2000E-01
                                        0.5244E+00      0.4000E-01
                                        0.7866E+00      0.6000E-01
                                        0.1049E+01      0.8000E-01
                                        0.1180E+01      0.9000E-01
                                        0.1311E+01      0.1000E+00
                                        0.1311E+01      0.5000E+00
                                        0.1311E+01      0.2000E+01
     3         10      0.4958E+01
                                        0.0000E+00      0.0000E+00
                                        0.2185E+00      0.1000E-01
                                        0.4370E+00      0.2000E-01
                                        0.8739E+00      0.4000E-01
                                        0.1311E+01      0.6000E-01
                                        0.1748E+01      0.8000E-01
                                        0.1966E+01      0.9000E-01
                                        0.2185E+01      0.1000E+00
                                        0.2185E+01      0.5000E+00
                                        0.2185E+01      0.2000E+01
     4         10      0.5000E+01
                                        0.0000E+00      0.0000E+00
                                        0.2622E+00      0.1000E-01
                                        0.5244E+00      0.2000E-01
                                        0.1049E+01      0.4000E-01
                                        0.1573E+01      0.6000E-01
                                        0.2097E+01      0.8000E-01
                                        0.2360E+01      0.9000E-01
                                        0.2622E+01      0.1000E+00
                                        0.2622E+01      0.5000E+00
                                        0.2622E+01      0.2000E+01
     5         10      0.7525E+01
                                        0.0000E+00      0.0000E+00
                                        0.3496E+00      0.1000E-01
                                        0.6992E+00      0.2000E-01
                                        0.1398E+01      0.4000E-01
                                        0.2097E+01      0.6000E-01
                                        0.2797E+01      0.8000E-01
```

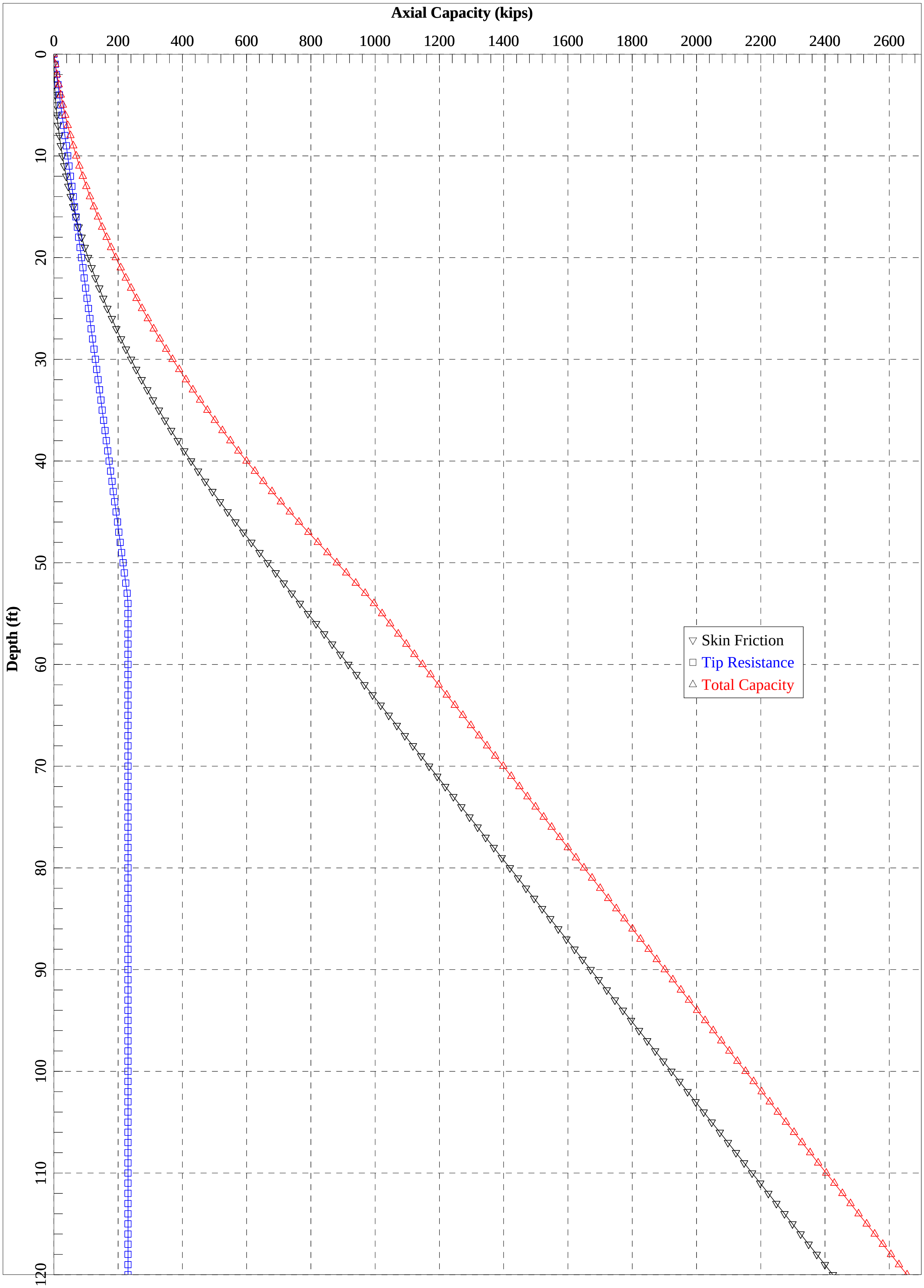
```
                                    0.3146E+01      0.9000E-01
                                    0.3496E+01      0.1000E+00
                                    0.3496E+01      0.5000E+00
                                    0.3496E+01      0.2000E+01
 6         10      0.9958E+01
                                    0.0000E+00      0.0000E+00
                                    0.4370E+00      0.1000E-01
                                    0.8739E+00      0.2000E-01
                                    0.1748E+01      0.4000E-01
                                    0.2622E+01      0.6000E-01
                                    0.3496E+01      0.8000E-01
                                    0.3933E+01      0.9000E-01
                                    0.4370E+01      0.1000E+00
                                    0.4370E+01      0.5000E+00
                                    0.4370E+01      0.2000E+01
 7         10      0.1000E+02
                                    0.0000E+00      0.0000E+00
                                    0.4807E+00      0.1000E-01
                                    0.9613E+00      0.2000E-01
                                    0.1923E+01      0.4000E-01
                                    0.2884E+01      0.6000E-01
                                    0.3845E+01      0.8000E-01
                                    0.4326E+01      0.9000E-01
                                    0.4807E+01      0.1000E+00
                                    0.4807E+01      0.5000E+00
                                    0.4807E+01      0.2000E+01
 8         10      0.1938E+02
                                    0.0000E+00      0.0000E+00
                                    0.8739E+00      0.1000E-01
                                    0.1748E+01      0.2000E-01
                                    0.3496E+01      0.4000E-01
                                    0.5244E+01      0.6000E-01
                                    0.6992E+01      0.8000E-01
                                    0.7866E+01      0.9000E-01
                                    0.8739E+01      0.1000E+00
                                    0.8739E+01      0.5000E+00
                                    0.8739E+01      0.2000E+01
 9         10      0.2866E+02
                                    0.0000E+00      0.0000E+00
                                    0.1267E+01      0.1000E-01
                                    0.2534E+01      0.2000E-01
                                    0.5069E+01      0.4000E-01
                                    0.7603E+01      0.6000E-01
                                    0.1014E+02      0.8000E-01
                                    0.1141E+02      0.9000E-01
                                    0.1267E+02      0.1000E+00
                                    0.1267E+02      0.5000E+00
                                    0.1267E+02      0.2000E+01
10         10      0.2870E+02
                                    0.0000E+00      0.0000E+00
                                    0.1267E+01      0.1000E-01
                                    0.2534E+01      0.2000E-01
                                    0.5069E+01      0.4000E-01
                                    0.7603E+01      0.6000E-01
                                    0.1014E+02      0.8000E-01
                                    0.1141E+02      0.9000E-01
                                    0.1267E+02      0.1000E+00
                                    0.1267E+02      0.5000E+00
                                    0.1267E+02      0.2000E+01
11         10      0.3688E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
```

```
                                 0.5556E+01      0.4000E-01
                                 0.8333E+01      0.6000E-01
                                 0.1111E+02      0.8000E-01
                                 0.1250E+02      0.9000E-01
                                 0.1389E+02      0.1000E+00
                                 0.1389E+02      0.5000E+00
                                 0.1389E+02      0.2000E+01
12          10       0.4496E+02
                                 0.0000E+00      0.0000E+00
                                 0.1389E+01      0.1000E-01
                                 0.2778E+01      0.2000E-01
                                 0.5556E+01      0.4000E-01
                                 0.8333E+01      0.6000E-01
                                 0.1111E+02      0.8000E-01
                                 0.1250E+02      0.9000E-01
                                 0.1389E+02      0.1000E+00
                                 0.1389E+02      0.5000E+00
                                 0.1389E+02      0.2000E+01
13          10       0.4500E+02
                                 0.0000E+00      0.0000E+00
                                 0.1389E+01      0.1000E-01
                                 0.2778E+01      0.2000E-01
                                 0.5556E+01      0.4000E-01
                                 0.8333E+01      0.6000E-01
                                 0.1111E+02      0.8000E-01
                                 0.1250E+02      0.9000E-01
                                 0.1389E+02      0.1000E+00
                                 0.1389E+02      0.5000E+00
                                 0.1389E+02      0.2000E+01
14          10       0.5253E+02
                                 0.0000E+00      0.0000E+00
                                 0.1389E+01      0.1000E-01
                                 0.2778E+01      0.2000E-01
                                 0.5556E+01      0.4000E-01
                                 0.8333E+01      0.6000E-01
                                 0.1111E+02      0.8000E-01
                                 0.1250E+02      0.9000E-01
                                 0.1389E+02      0.1000E+00
                                 0.1389E+02      0.5000E+00
                                 0.1389E+02      0.2000E+01
15          10       0.5996E+02
                                 0.0000E+00      0.0000E+00
                                 0.1389E+01      0.1000E-01
                                 0.2778E+01      0.2000E-01
                                 0.5556E+01      0.4000E-01
                                 0.8333E+01      0.6000E-01
                                 0.1111E+02      0.8000E-01
                                 0.1250E+02      0.9000E-01
                                 0.1389E+02      0.1000E+00
                                 0.1389E+02      0.5000E+00
                                 0.1389E+02      0.2000E+01
16          10       0.6000E+02
                                 0.0000E+00      0.0000E+00
                                 0.1389E+01      0.1000E-01
                                 0.2778E+01      0.2000E-01
                                 0.5556E+01      0.4000E-01
                                 0.8333E+01      0.6000E-01
                                 0.1111E+02      0.8000E-01
                                 0.1250E+02      0.9000E-01
                                 0.1389E+02      0.1000E+00
                                 0.1389E+02      0.5000E+00
                                 0.1389E+02      0.2000E+01
17          10       0.6288E+02
```

```
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
 18          10        0.6566E+02
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
 19          10        0.6570E+02
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
 20          10        0.6773E+02
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
 21          10        0.6966E+02
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
 22          10        0.6970E+02
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
```

```
                                          0.1389E+02      0.5000E+00
                                          0.1389E+02      0.2000E+01
   23         10      0.1099E+03
                                          0.0000E+00      0.0000E+00
                                          0.1389E+01      0.1000E-01
                                          0.2778E+01      0.2000E-01
                                          0.5556E+01      0.4000E-01
                                          0.8333E+01      0.6000E-01
                                          0.1111E+02      0.8000E-01
                                          0.1250E+02      0.9000E-01
                                          0.1389E+02      0.1000E+00
                                          0.1389E+02      0.5000E+00
                                          0.1389E+02      0.2000E+01
   24         10      0.1500E+03
                                          0.0000E+00      0.0000E+00
                                          0.1389E+01      0.1000E-01
                                          0.2778E+01      0.2000E-01
                                          0.5556E+01      0.4000E-01
                                          0.8333E+01      0.6000E-01
                                          0.1111E+02      0.8000E-01
                                          0.1250E+02      0.9000E-01
                                          0.1389E+02      0.1000E+00
                                          0.1389E+02      0.5000E+00
                                          0.1389E+02      0.2000E+01


 TIP   LOAD         TIP MOVEMENT
     KIP                IN.

 0.0000E+00          0.0000E+00
 0.1191E+03          0.2400E-01
 0.2381E+03          0.4800E-01
 0.4763E+03          0.9600E-01
 0.9525E+03          0.6240E+00
 0.1429E+04          0.2016E+01
 0.1715E+04          0.3504E+01
 0.1905E+04          0.4800E+01
 0.1905E+04          0.7200E+01
 0.1905E+04          0.9600E+01


               LOAD VERSUS SETTLEMENT CURVE
               ****************************


 TOP  LOAD     TOP MOVEMENT       TIP  LOAD      TIP MOVEMENT
    KIP            IN.               KIP             IN.
0.8017E+01      0.1366E-02      0.4961E+00      0.1000E-03
0.8017E+02      0.1366E-01      0.4961E+01      0.1000E-02
0.4060E+03      0.6895E-01      0.2481E+02      0.5000E-02
0.8145E+03      0.1383E+00      0.4961E+02      0.1000E-01
0.2533E+04      0.5166E+00      0.2481E+03      0.5000E-01
0.3106E+04      0.7185E+00      0.4799E+03      0.1000E+00
0.3467E+04      0.1221E+01      0.8407E+03      0.5000E+00
0.3707E+04      0.1789E+01      0.1081E+04      0.1000E+01
0.4049E+04      0.2886E+01      0.1423E+04      0.2000E+01
```

IB-4 Unplugged Condition



```
     =========================================================================

                      APILE for Windows, Version 2015.7.2

                       Serial Number :  239146456

                       A Program for Analyzing the Axial Capacity
                       and Short-term Settlement of Driven Piles
                                 under Axial Loading.
                     (c) Copyright ENSOFT, Inc., 1987-2015
                           All Rights Reserved

     =========================================================================


     This program is licensed to :

     SCDOT
     Columbia, SC

     Path to file locations      :
P:\Orangeburg\40308_us301\Geotechnical\5_Design\2_Final\7_InteriorBents\APile\Without
Overburden\
     Name of input data file     : B-4.ap7d
     Name of output file         : B-4.ap7o
     Name of plot output file    : B-4.ap7p

     -------------------------------------------------------------------------
                          Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  April 14, 2016     Time:  14:21:20



1
          *********************
          * INPUT INFORMATION *
          *********************



          US 301 over Four Hole Swamp, Orangeburg County  IB-4

          DESIGNER   : RSG

          JOB NUMBER : 0040308


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Reduced Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION
```

```
PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Open-Ended Pile


DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY     = 0.290E+08 PSI
- CROSS SECTION AREA        =    219.13 IN2


CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD      =     48.00 IN.
- INTERNAL DIAMETER, ID     =     45.00 IN.
- TOTAL PILE LENGTH, TL     =    150.00 FT.
- PILE STICKUP LENGTH, PSL  =     30.00 FT.
- ZERO FRICTION LENGTH, ZFL =      0.00 FT.
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION       =      1.00 FT.
- LENGTH OF ENHANCED
  END SECTION               =    150.00 FT.
- INTERNAL DIAMETER OF
  ENHANCED END SECTION      =     45.00 IN.


PLUGGED/UNPLUGGED CONDITIONS :
Unplugged for open-ended pile



SOIL INFORMATIONS :



                  LATERAL    EFFECTIVE    FRICTION   BEARING
          SOIL    EARTH      UNIT         ANGLE      CAPACITY
 DEPTH    TYPE    PRESSURE   WEIGHT       DEGREES    FACTOR
  FT.                        LB/CF
   0.00   SAND      0.00        52.60        36.00      0.00
   5.00   SAND      0.00        52.60        36.00      0.00
   5.00   SAND      0.00        52.60        36.00      0.00
  10.00   SAND      0.00        52.60        36.00      0.00
  10.00   SAND      0.00        52.60        36.00      0.00
  28.70   SAND      0.00        52.60        36.00      0.00
  28.70   SAND      0.00        52.60        36.00      0.00
  45.00   SAND      0.00        52.60        36.00      0.00
  45.00   SAND      0.00        52.60        36.00      0.00
  60.00   SAND      0.00        52.60        36.00      0.00
  60.00   SAND      0.00        52.60        36.00      0.00
  65.70   SAND      0.00        52.60        36.00      0.00
  65.70   SAND      0.00        57.60        36.00      0.00
  69.70   SAND      0.00        57.60        36.00      0.00
  69.70   SAND      0.00        57.60        36.00      0.00
 150.00   SAND      0.00        57.60        36.00      0.00


MAXIMUM   MAXIMUM   UNDISTURB  REMOLDED
UNIT      UNIT      SHEAR      SHEAR     BLOW   UNIT SKIN  UNIT END
```

```
FRICTION  BEARING   STRENGTH   STRENGTH  COUNT  FRICTION   BEARING
  KSF       KSF        KSF        KSF                KSF       KSF
0.10E+08* 0.10E+08*       0.00       0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00       0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00       0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00       0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00       0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00       0.00   0.00       0.00      0.00
0.20E+01  0.29E+03        0.00       0.00   0.00       0.00      0.00
0.20E+01  0.29E+03        0.00       0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00       0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00       0.00   0.00       0.00      0.00
0.20E+01  0.42E+03        0.00       0.00   0.00       0.00      0.00
0.20E+01  0.42E+03        0.00       0.00   0.00       0.00      0.00
0.20E+01  0.33E+03        0.00       0.00   0.00       0.00      0.00
0.20E+01  0.33E+03        0.00       0.00   0.00       0.00      0.00
0.20E+01  0.53E+03        0.00       0.00   0.00       0.00      0.00
0.20E+01  0.53E+03        0.00       0.00   0.00       0.00      0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
  PLAN TO LIMIT THE COMPUTED DATA.



         LRFD FACTOR  LRFD FACTOR
          ON UNIT      ON UNIT
 DEPTH    FRICTION     BEARING
  FT.
   0.00    1.000       1.000
   5.00    1.000       1.000
   5.00    1.000       1.000
  10.00    1.000       1.000
  10.00    1.000       1.000
  28.70    1.000       1.000
  28.70    1.000       1.000
  45.00    1.000       1.000
  45.00    1.000       1.000
  60.00    1.000       1.000
  60.00    1.000       1.000
  65.70    1.000       1.000
  65.70    1.000       1.000
  69.70    1.000       1.000
  69.70    1.000       1.000
 150.00    1.000       1.000



1
          **********************
          * COMPUTATION RESULT *
          **********************



                            **********************
                            *  FED. HWY. METHOD  *
                            **********************

   PILE       TOTAL SKIN      END       ULTIMATE
PENETRATION   FRICTION      BEARING    CAPACITY
    FT.          KIP          KIP         KIP
    0.00           0.0          0.0*        0.0
```

```
 1.00           0.3           4.3*          4.6
 2.00           1.1           8.6*          9.7
 3.00           2.4          12.9*         15.3
 4.00           4.3          17.2*         21.5
 5.00           6.7          21.5*         28.2
 6.00           9.6          25.8*         35.5
 7.00          13.1          30.1*         43.2
 8.00          17.1          34.5*         51.5
 9.00          21.6          38.8*         60.4
10.00          26.7          43.1*         69.8
11.00          32.3          47.4*         79.7
12.00          38.5          51.7*         90.1
13.00          45.1          56.0*        101.1
14.00          52.3          60.3*        112.6
15.00          60.1          64.6*        124.7
16.00          68.4          68.9*        137.3
17.00          77.2          73.2*        150.4
18.00          86.5          77.5*        164.0
19.00          96.4          81.8*        178.2
20.00         106.8          86.1*        192.9
21.00         117.8          90.4*        208.2
22.00         129.2          94.7*        224.0
23.00         141.3          99.0*        240.3
24.00         153.8         103.4*        257.2
25.00         166.9         107.7*        274.5
26.00         180.5         112.0*        292.5
27.00         194.7         116.3*        310.9
28.00         209.3         120.6*        329.9
29.00         224.6         124.9*        349.5
30.00         240.3         129.2*        369.5
31.00         256.6         133.5*        390.1
32.00         273.4         137.8*        411.2
33.00         290.8         142.1*        432.9
34.00         308.7         146.4*        455.1
35.00         327.1         150.7*        477.8
36.00         346.1         155.0*        501.1
37.00         365.5         159.3*        524.9
38.00         385.6         163.6*        549.2
39.00         406.1         168.0*        574.1
40.00         427.2         172.3*        599.5
41.00         448.9         176.6*        625.4
42.00         471.0         180.9*        651.9
43.00         493.7         185.2*        678.9
44.00         516.9         189.5*        706.4
45.00         540.7         193.8*        734.5
46.00         565.0         198.1*        763.1
47.00         589.8         202.4*        792.2
48.00         615.0         206.7*        821.7
49.00         640.1         211.0*        851.1
50.00         665.2         215.3*        880.6
51.00         690.4         219.6*        910.0
52.00         715.5         223.9*        939.4
53.00         740.6         228.2*        968.9
54.00         765.8         230.7*        996.5
55.00         790.9         230.7*       1021.6
56.00         816.0         230.7*       1046.7
57.00         841.2         230.7*       1071.9
58.00         866.3         230.7*       1097.0
59.00         891.4         230.7*       1122.1
60.00         916.6         230.7*       1147.3
61.00         941.7         230.7*       1172.4
62.00         966.8         230.7*       1197.5
63.00         992.0         230.7*       1222.7
```

```
 64.00        1017.1         230.7*      1247.8
 65.00        1042.2         230.7*      1272.9
 66.00        1067.4         230.7*      1298.1
 67.00        1092.5         230.7*      1323.2
 68.00        1117.6         230.7*      1348.3
 69.00        1142.8         230.7*      1373.5
 70.00        1167.9         230.7*      1398.6
 71.00        1193.0         230.7*      1423.7
 72.00        1218.2         230.7*      1448.9
 73.00        1243.3         230.7*      1474.0
 74.00        1268.4         230.7*      1499.1
 75.00        1293.6         230.7*      1524.3
 76.00        1318.7         230.7*      1549.4
 77.00        1343.8         230.7*      1574.5
 78.00        1369.0         230.7*      1599.7
 79.00        1394.1         230.7*      1624.8
 80.00        1419.2         230.7*      1649.9
 81.00        1444.4         230.7*      1675.0
 82.00        1469.5         230.7*      1700.2
 83.00        1494.6         230.7*      1725.3
 84.00        1519.8         230.7*      1750.4
 85.00        1544.9         230.7*      1775.6
 86.00        1570.0         230.7*      1800.7
 87.00        1595.2         230.7*      1825.8
 88.00        1620.3         230.7*      1851.0
 89.00        1645.4         230.7*      1876.1
 90.00        1670.6         230.7*      1901.2
 91.00        1695.7         230.7*      1926.4
 92.00        1720.8         230.7*      1951.5
 93.00        1746.0         230.7*      1976.6
 94.00        1771.1         230.7*      2001.8
 95.00        1796.2         230.7*      2026.9
 96.00        1821.3         230.7*      2052.0
 97.00        1846.5         230.7*      2077.2
 98.00        1871.6         230.7*      2102.3
 99.00        1896.7         230.7*      2127.4
100.00        1921.9         230.7*      2152.6
101.00        1947.0         230.7*      2177.7
102.00        1972.1         230.7*      2202.8
103.00        1997.3         230.7*      2228.0
104.00        2022.4         230.7*      2253.1
105.00        2047.5         230.7*      2278.2
106.00        2072.7         230.7*      2303.4
107.00        2097.8         230.7*      2328.5
108.00        2122.9         230.7*      2353.6
109.00        2148.1         230.7*      2378.8
110.00        2173.2         230.7*      2403.9
111.00        2198.3         230.7*      2429.0
112.00        2223.5         230.7*      2454.2
113.00        2248.6         230.7*      2479.3
114.00        2273.7         230.7*      2504.4
115.00        2298.9         230.7*      2529.6
116.00        2324.0         230.7*      2554.7
117.00        2349.1         230.7*      2579.8
118.00        2374.3         230.7*      2605.0
119.00        2399.4         230.7*      2630.1
120.00        2424.5         230.7*      2655.2


NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.
```

```
     ************************************************
     * COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
     * CURVES FOR AXIAL LOADING                      *
     ************************************************


T-Z CURVE   NO. OF   DEPTH TO CURVE   LOAD TRANSFER   PILE MOVEMENT
   NO.      POINTS        FT.              PSI             IN.

    1         10      0.0000E+00
                                        0.0000E+00      0.0000E+00
                                        0.4427E-01      0.1000E-01
                                        0.8854E-01      0.2000E-01
                                        0.1771E+00      0.4000E-01
                                        0.2656E+00      0.6000E-01
                                        0.3541E+00      0.8000E-01
                                        0.3984E+00      0.9000E-01
                                        0.4427E+00      0.1000E+00
                                        0.4427E+00      0.5000E+00
                                        0.4427E+00      0.2000E+01
    2         10      0.2525E+01
                                        0.0000E+00      0.0000E+00
                                        0.8854E-01      0.1000E-01
                                        0.1771E+00      0.2000E-01
                                        0.3541E+00      0.4000E-01
                                        0.5312E+00      0.6000E-01
                                        0.7083E+00      0.8000E-01
                                        0.7968E+00      0.9000E-01
                                        0.8854E+00      0.1000E+00
                                        0.8854E+00      0.5000E+00
                                        0.8854E+00      0.2000E+01
    3         10      0.4958E+01
                                        0.0000E+00      0.0000E+00
                                        0.1476E+00      0.1000E-01
                                        0.2951E+00      0.2000E-01
                                        0.5902E+00      0.4000E-01
                                        0.8854E+00      0.6000E-01
                                        0.1180E+01      0.8000E-01
                                        0.1328E+01      0.9000E-01
                                        0.1476E+01      0.1000E+00
                                        0.1476E+01      0.5000E+00
                                        0.1476E+01      0.2000E+01
    4         10      0.5000E+01
                                        0.0000E+00      0.0000E+00
                                        0.1771E+00      0.1000E-01
                                        0.3541E+00      0.2000E-01
                                        0.7083E+00      0.4000E-01
                                        0.1062E+01      0.6000E-01
                                        0.1417E+01      0.8000E-01
                                        0.1594E+01      0.9000E-01
                                        0.1771E+01      0.1000E+00
                                        0.1771E+01      0.5000E+00
                                        0.1771E+01      0.2000E+01
    5         10      0.7525E+01
                                        0.0000E+00      0.0000E+00
                                        0.2361E+00      0.1000E-01
                                        0.4722E+00      0.2000E-01
                                        0.9444E+00      0.4000E-01
                                        0.1417E+01      0.6000E-01
                                        0.1889E+01      0.8000E-01
```

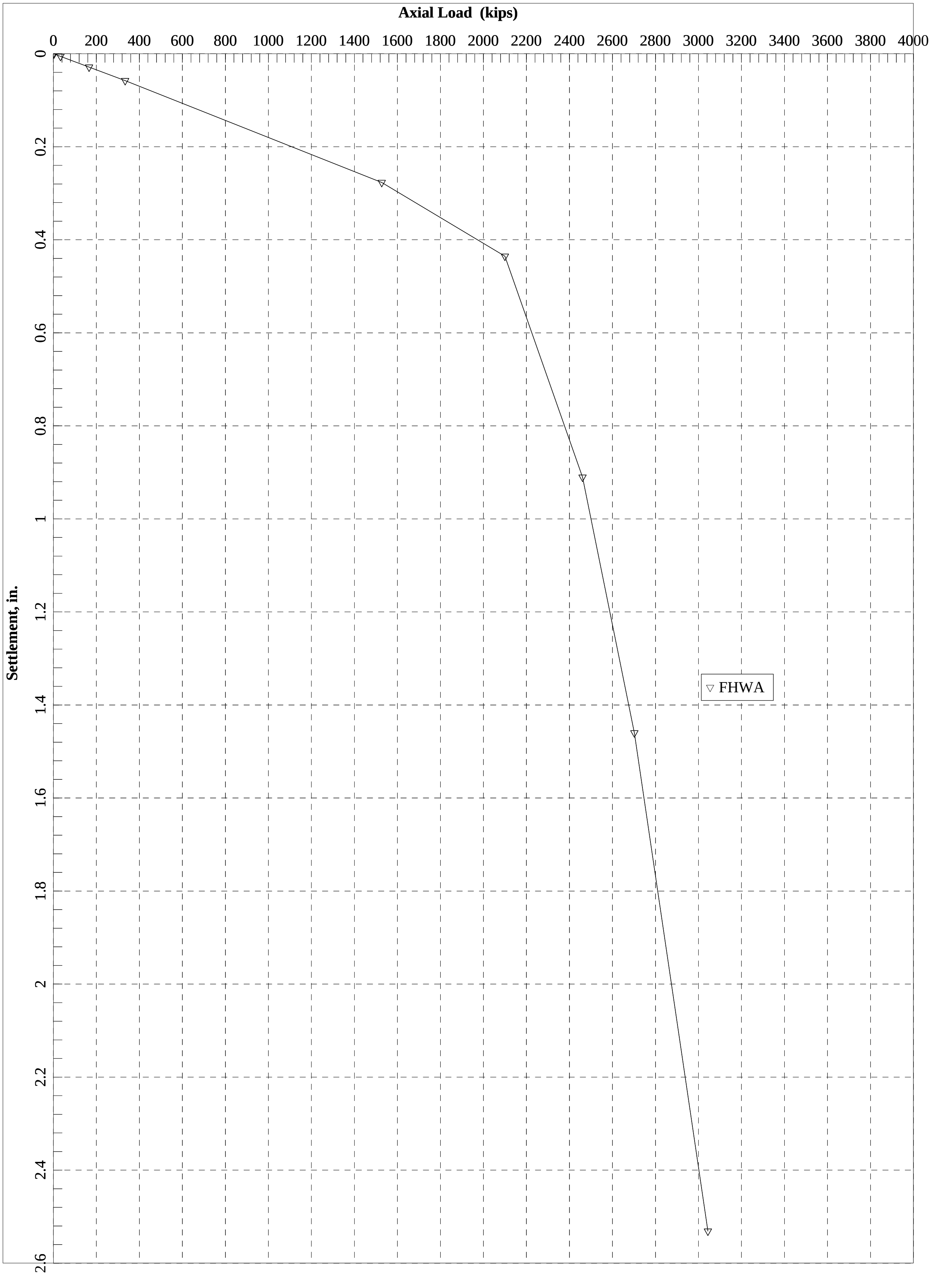
```
                                    0.2125E+01      0.9000E-01
                                    0.2361E+01      0.1000E+00
                                    0.2361E+01      0.5000E+00
                                    0.2361E+01      0.2000E+01
  6        10      0.9958E+01
                                    0.0000E+00      0.0000E+00
                                    0.2951E+00      0.1000E-01
                                    0.5902E+00      0.2000E-01
                                    0.1180E+01      0.4000E-01
                                    0.1771E+01      0.6000E-01
                                    0.2361E+01      0.8000E-01
                                    0.2656E+01      0.9000E-01
                                    0.2951E+01      0.1000E+00
                                    0.2951E+01      0.5000E+00
                                    0.2951E+01      0.2000E+01
  7        10      0.1000E+02
                                    0.0000E+00      0.0000E+00
                                    0.3246E+00      0.1000E-01
                                    0.6493E+00      0.2000E-01
                                    0.1299E+01      0.4000E-01
                                    0.1948E+01      0.6000E-01
                                    0.2597E+01      0.8000E-01
                                    0.2922E+01      0.9000E-01
                                    0.3246E+01      0.1000E+00
                                    0.3246E+01      0.5000E+00
                                    0.3246E+01      0.2000E+01
  8        10      0.1938E+02
                                    0.0000E+00      0.0000E+00
                                    0.5902E+00      0.1000E-01
                                    0.1180E+01      0.2000E-01
                                    0.2361E+01      0.4000E-01
                                    0.3541E+01      0.6000E-01
                                    0.4722E+01      0.8000E-01
                                    0.5312E+01      0.9000E-01
                                    0.5902E+01      0.1000E+00
                                    0.5902E+01      0.5000E+00
                                    0.5902E+01      0.2000E+01
  9        10      0.2866E+02
                                    0.0000E+00      0.0000E+00
                                    0.8558E+00      0.1000E-01
                                    0.1712E+01      0.2000E-01
                                    0.3423E+01      0.4000E-01
                                    0.5135E+01      0.6000E-01
                                    0.6847E+01      0.8000E-01
                                    0.7703E+01      0.9000E-01
                                    0.8558E+01      0.1000E+00
                                    0.8558E+01      0.5000E+00
                                    0.8558E+01      0.2000E+01
 10        10      0.2870E+02
                                    0.0000E+00      0.0000E+00
                                    0.8558E+00      0.1000E-01
                                    0.1712E+01      0.2000E-01
                                    0.3423E+01      0.4000E-01
                                    0.5135E+01      0.6000E-01
                                    0.6847E+01      0.8000E-01
                                    0.7703E+01      0.9000E-01
                                    0.8558E+01      0.1000E+00
                                    0.8558E+01      0.5000E+00
                                    0.8558E+01      0.2000E+01
 11        10      0.3688E+02
                                    0.0000E+00      0.0000E+00
                                    0.1092E+01      0.1000E-01
                                    0.2184E+01      0.2000E-01
```

```
                                    0.4368E+01       0.4000E-01
                                    0.6552E+01       0.6000E-01
                                    0.8736E+01       0.8000E-01
                                    0.9828E+01       0.9000E-01
                                    0.1092E+02       0.1000E+00
                                    0.1092E+02       0.5000E+00
                                    0.1092E+02       0.2000E+01
12          10       0.4496E+02
                                    0.0000E+00       0.0000E+00
                                    0.1328E+01       0.1000E-01
                                    0.2656E+01       0.2000E-01
                                    0.5312E+01       0.4000E-01
                                    0.7968E+01       0.6000E-01
                                    0.1062E+02       0.8000E-01
                                    0.1195E+02       0.9000E-01
                                    0.1328E+02       0.1000E+00
                                    0.1328E+02       0.5000E+00
                                    0.1328E+02       0.2000E+01
13          10       0.4500E+02
                                    0.0000E+00       0.0000E+00
                                    0.1358E+01       0.1000E-01
                                    0.2715E+01       0.2000E-01
                                    0.5430E+01       0.4000E-01
                                    0.8145E+01       0.6000E-01
                                    0.1086E+02       0.8000E-01
                                    0.1222E+02       0.9000E-01
                                    0.1358E+02       0.1000E+00
                                    0.1358E+02       0.5000E+00
                                    0.1358E+02       0.2000E+01
14          10       0.5253E+02
                                    0.0000E+00       0.0000E+00
                                    0.1389E+01       0.1000E-01
                                    0.2778E+01       0.2000E-01
                                    0.5556E+01       0.4000E-01
                                    0.8333E+01       0.6000E-01
                                    0.1111E+02       0.8000E-01
                                    0.1250E+02       0.9000E-01
                                    0.1389E+02       0.1000E+00
                                    0.1389E+02       0.5000E+00
                                    0.1389E+02       0.2000E+01
15          10       0.5996E+02
                                    0.0000E+00       0.0000E+00
                                    0.1389E+01       0.1000E-01
                                    0.2778E+01       0.2000E-01
                                    0.5556E+01       0.4000E-01
                                    0.8333E+01       0.6000E-01
                                    0.1111E+02       0.8000E-01
                                    0.1250E+02       0.9000E-01
                                    0.1389E+02       0.1000E+00
                                    0.1389E+02       0.5000E+00
                                    0.1389E+02       0.2000E+01
16          10       0.6000E+02
                                    0.0000E+00       0.0000E+00
                                    0.1389E+01       0.1000E-01
                                    0.2778E+01       0.2000E-01
                                    0.5556E+01       0.4000E-01
                                    0.8333E+01       0.6000E-01
                                    0.1111E+02       0.8000E-01
                                    0.1250E+02       0.9000E-01
                                    0.1389E+02       0.1000E+00
                                    0.1389E+02       0.5000E+00
                                    0.1389E+02       0.2000E+01
17          10       0.6288E+02
```

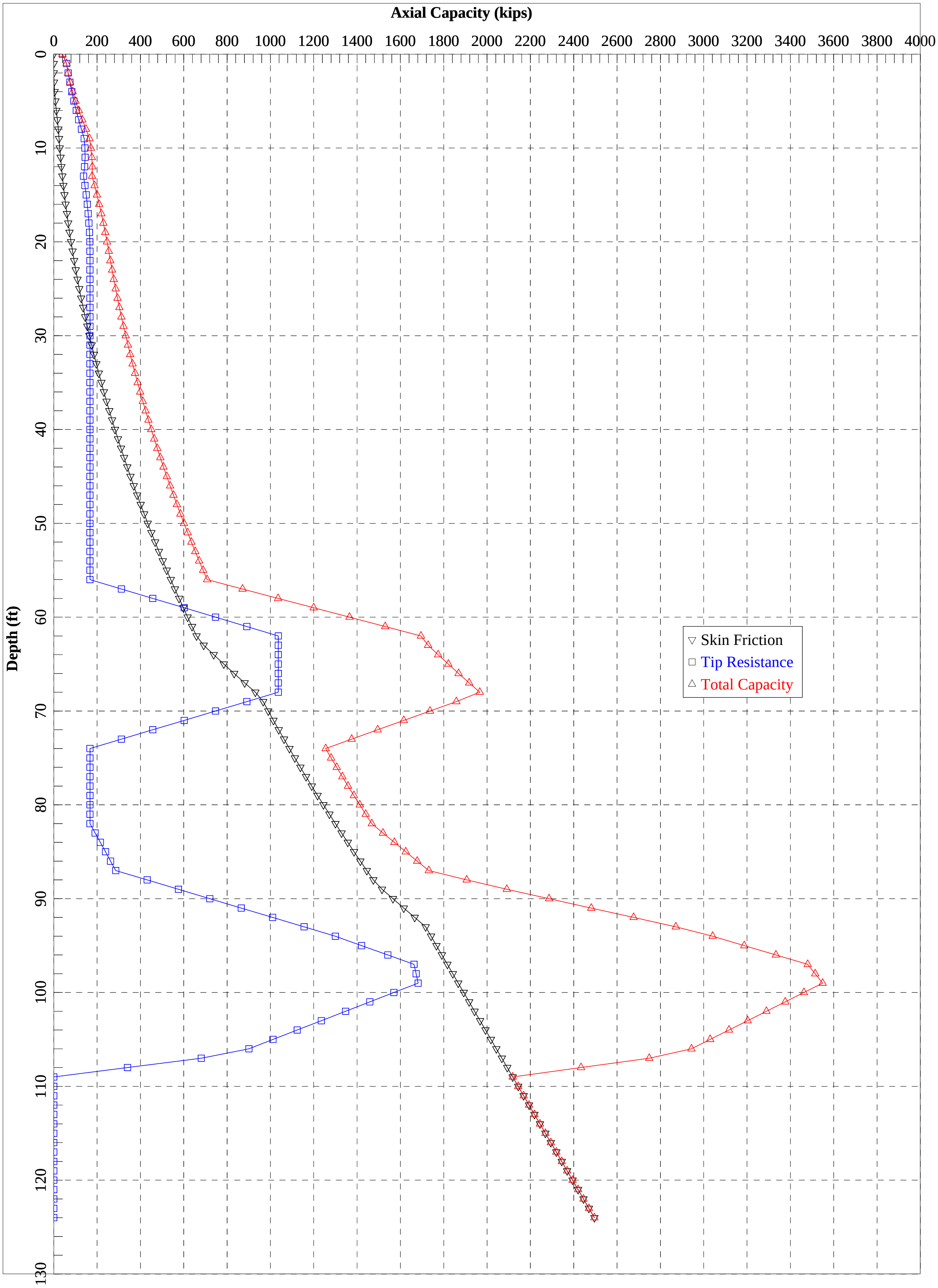
```
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
18         10      0.6566E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
19         10      0.6570E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
20         10      0.6773E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
21         10      0.6966E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
22         10      0.6970E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
```

```
                                         0.1389E+02      0.5000E+00
                                         0.1389E+02      0.2000E+01
    23          10      0.1099E+03
                                         0.0000E+00      0.0000E+00
                                         0.1389E+01      0.1000E-01
                                         0.2778E+01      0.2000E-01
                                         0.5556E+01      0.4000E-01
                                         0.8333E+01      0.6000E-01
                                         0.1111E+02      0.8000E-01
                                         0.1250E+02      0.9000E-01
                                         0.1389E+02      0.1000E+00
                                         0.1389E+02      0.5000E+00
                                         0.1389E+02      0.2000E+01
    24          10      0.1500E+03
                                         0.0000E+00      0.0000E+00
                                         0.1389E+01      0.1000E-01
                                         0.2778E+01      0.2000E-01
                                         0.5556E+01      0.4000E-01
                                         0.8333E+01      0.6000E-01
                                         0.1111E+02      0.8000E-01
                                         0.1250E+02      0.9000E-01
                                         0.1389E+02      0.1000E+00
                                         0.1389E+02      0.5000E+00
                                         0.1389E+02      0.2000E+01


   TIP   LOAD        TIP MOVEMENT
       KIP               IN.

   0.0000E+00         0.0000E+00
   0.1442E+02         0.2400E-01
   0.2884E+02         0.4800E-01
   0.5767E+02         0.9600E-01
   0.1153E+03         0.6240E+00
   0.1730E+03         0.2016E+01
   0.2076E+03         0.3504E+01
   0.2307E+03         0.4800E+01
   0.2307E+03         0.7200E+01
   0.2307E+03         0.9600E+01


                 LOAD VERSUS SETTLEMENT CURVE
                 ****************************



   TOP  LOAD     TOP MOVEMENT       TIP  LOAD      TIP MOVEMENT
      KIP             IN.              KIP             IN.
  0.5057E+01      0.9239E-03      0.6008E-01      0.1000E-03
  0.5057E+02      0.9239E-02      0.6008E+00      0.1000E-02
  0.2552E+03      0.4649E-01      0.3004E+01      0.5000E-02
  0.5119E+03      0.9323E-01      0.6008E+01      0.1000E-01
  0.1974E+04      0.4021E+00      0.3004E+02      0.5000E-01
  0.2493E+04      0.5789E+00      0.5811E+02      0.1000E+00
  0.2537E+04      0.9912E+00      0.1018E+03      0.5000E+00
  0.2566E+04      0.1499E+01      0.1309E+03      0.1000E+01
  0.2608E+04      0.2511E+01      0.1724E+03      0.2000E+01
```

IB-4 Settlement



IB-5 Plugged Condition



```
==========================================================================

                 APILE for Windows, Version 2015.7.2

                  Serial Number :  239146456

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                (c) Copyright ENSOFT, Inc., 1987-2015
                      All Rights Reserved

==========================================================================


This program is licensed to :

SCDOT
Columbia, SC

Path to file locations      :
P:\Orangeburg\40308_us301\Geotechnical\5_Design\2_Final\7_InteriorBents\APile\Without
Overburden\
Name of input data file     : B-5A.ap7d
Name of output file         : B-5A.ap7o
Name of plot output file    : B-5A.ap7p

--------------------------------------------------------------------------
                     Time and Date of Analysis
--------------------------------------------------------------------------

          Date:  April 14, 2016     Time:  14:27:21



1
     *********************
     * INPUT INFORMATION *
     *********************



     US 301 over Four Hole Swamp IB-5

     DESIGNER   : RSG

     JOB NUMBER : 0040308


     METHOD FOR UNIT LOAD TRANSFERS :

     - FHWA (Federal Highway Administration)
       Reduced Unit Side Friction and Unit Side Resistance are used.



     COMPUTATION METHOD(S) FOR PILE CAPACITY :

     - FHWA (Federal Highway Administration)


     TYPE OF LOADING :
     - COMPRESSION
```

```
PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Open-Ended Pile


DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY     = 0.290E+08 PSI
- CROSS SECTION AREA        =    219.13 IN2


CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD      =     48.00 IN.
- INTERNAL DIAMETER, ID     =     45.00 IN.
- TOTAL PILE LENGTH, TL     =    150.00 FT.
- PILE STICKUP LENGTH, PSL  =     26.00 FT.
- ZERO FRICTION LENGTH, ZFL =      3.00 FT.
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION       =      1.00 FT.
- LENGTH OF ENHANCED
  END SECTION               =    150.00 FT.
- INTERNAL DIAMETER OF
  ENHANCED END SECTION      =     45.00 IN.


PLUGGED/UNPLUGGED CONDITIONS :
Plugged for open-ended pile



SOIL INFORMATIONS :



                  LATERAL    EFFECTIVE    FRICTION   BEARING
         SOIL     EARTH      UNIT         ANGLE      CAPACITY
 DEPTH   TYPE     PRESSURE   WEIGHT       DEGREES    FACTOR
  FT.                        LB/CF
   0.00  SAND       0.00        52.60        36.00      0.00
   2.80  SAND       0.00        52.60        36.00      0.00
   2.80  SAND       0.00        52.60        36.00      0.00
   7.00  SAND       0.00        52.60        36.00      0.00
   7.00  SAND       0.00        47.60        30.00      0.00
  61.50  SAND       0.00        47.60        30.00      0.00
  61.50  SAND       0.00        52.60        36.00      0.00
  67.30  SAND       0.00        52.60        36.00      0.00
  67.30  SAND       0.00        52.60        30.00      0.00
  87.30  SAND       0.00        52.60        30.00      0.00
  87.30  CLAY       0.00        47.60         0.00      0.00
  92.30  CLAY       0.00        47.60         0.00      0.00
  92.30  SAND       0.00        52.60        36.00      0.00
 102.30  SAND       0.00        52.60        36.00      0.00
 102.30  CLAY       0.00        47.60         0.00      0.00
 150.00  CLAY       0.00        47.60         0.00      0.00


MAXIMUM   MAXIMUM   UNDISTURB  REMOLDED
UNIT      UNIT      SHEAR      SHEAR     BLOW   UNIT SKIN  UNIT END
```

```
FRICTION  BEARING   STRENGTH   STRENGTH  COUNT  FRICTION   BEARING
  KSF       KSF        KSF       KSF              KSF       KSF
0.10E+08* 0.10E-03        0.00       0.00   0.00       0.00      0.00
0.10E+08* 0.10E-03        0.00       0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00       0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00       0.00   0.00       0.00      0.00
0.10E+08* 0.44E+03        0.00       0.00   0.00       0.00      0.00
0.10E+08* 0.44E+03        0.00       0.00   0.00       0.00      0.00
0.10E+08* 0.29E+03        0.00       0.00   0.00       0.00      0.00
0.10E+08* 0.29E+03        0.00       0.00   0.00       0.00      0.00
0.10E+08* 0.41E+03        0.00       0.00   0.00       0.00      0.00
0.10E+08* 0.41E+03        0.00       0.00   0.00       0.00      0.00
0.10E+08* 0.10E-03        4.00       2.00   0.00       0.00      0.00
0.10E+08* 0.10E-03        4.00       2.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00       0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00       0.00   0.00       0.00      0.00
0.20E+01  0.10E-03        5.00       2.50   0.00       0.00      0.00
0.20E+01  0.10E-03        5.00       2.50   0.00       0.00      0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
  PLAN TO LIMIT THE COMPUTED DATA.


         LRFD FACTOR  LRFD FACTOR
          ON UNIT      ON UNIT
 DEPTH    FRICTION     BEARING
  FT.
   0.00    1.000       1.000
   2.80    1.000       1.000
   2.80    1.000       1.000
   7.00    1.000       1.000
   7.00    1.000       1.000
  61.50    1.000       1.000
  61.50    1.000       1.000
  67.30    1.000       1.000
  67.30    1.000       1.000
  87.30    1.000       1.000
  87.30    1.000       1.000
  92.30    1.000       1.000
  92.30    1.000       1.000
 102.30    1.000       1.000
 102.30    1.000       1.000
 150.00    1.000       1.000



1
**********************
* COMPUTATION RESULT *
**********************


                  **********************
                  *  FED. HWY. METHOD  *
                  **********************

   PILE       TOTAL SKIN       END       ULTIMATE
PENETRATION   FRICTION       BEARING     CAPACITY
    FT.          KIP           KIP          KIP
    0.00            0.0          40.0         40.0
```

```
   1.00          0.0        59.3        59.3
   2.00          0.0        66.4        66.4
   3.00          1.2        74.4        75.6
   4.00          4.0        83.3        87.3
   5.00          7.5        93.0       100.6
   6.00         11.9       103.7       115.5
   7.00         17.0       115.1       132.1
   8.00         21.2       127.5       148.7
   9.00         24.3       140.7       165.0
  10.00         27.6       144.1       171.8
  11.00         31.4       144.7       176.1
  12.00         35.4       142.4       177.8
  13.00         39.8       137.1       176.8
  14.00         44.5       143.9       188.4
  15.00         49.5       149.8       199.3
  16.00         54.9       154.9       209.8
  17.00         60.6       159.1       219.7
  18.00         66.6       162.4       229.0
  19.00         72.9       164.9       237.8
  20.00         79.6       166.5       246.1
  21.00         86.7       167.2       253.9
  22.00         94.0       167.4       261.4
  23.00        101.7       167.4       269.1
  24.00        109.7       167.4       277.1
  25.00        118.0       167.4       285.4
  26.00        126.7       167.4       294.1
  27.00        135.7       167.4       303.1
  28.00        145.0       167.4       312.4
  29.00        154.7       167.4       322.1
  30.00        164.7       167.4       332.0
  31.00        175.0       167.4       342.4
  32.00        185.6       167.4       353.0
  33.00        196.6       167.4       364.0
  34.00        207.9       167.4       375.3
  35.00        219.6       167.4       387.0
  36.00        231.5       167.4       398.9
  37.00        243.8       167.4       411.2
  38.00        256.5       167.4       423.9
  39.00        269.4       167.4       436.8
  40.00        282.7       167.4       450.1
  41.00        296.4       167.4       463.7
  42.00        310.3       167.4       477.7
  43.00        324.6       167.4       492.0
  44.00        339.2       167.4       506.6
  45.00        354.2       167.4       521.5
  46.00        369.4       167.4       536.8
  47.00        385.0       167.4       552.4
  48.00        401.0       167.4       568.4
  49.00        417.3       167.4       584.6
  50.00        433.8       167.4       601.2
  51.00        450.8       167.4       618.2
  52.00        468.0       167.4       635.4
  53.00        485.6       167.4       653.0
  54.00        503.5       167.4       670.9
  55.00        521.8       167.4       689.2
  56.00        540.4       167.4       707.8
  57.00        559.3       312.2       871.5
  58.00        578.5       457.0      1035.5
  59.00        598.1       601.8      1199.9
  60.00        618.0       746.6      1364.6
  61.00        638.2       891.4      1529.7
  62.00        658.8      1036.2      1695.0
  63.00        692.0      1036.2      1728.2
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  64.00         738.1        1036.2        1774.3
  65.00         784.9        1036.2        1821.2
  66.00         832.6        1036.2        1868.8
  67.00         881.1        1036.2        1917.3
  68.00         930.3        1036.2        1966.5
  69.00         966.8         891.4        1858.2
  70.00         990.2         746.6        1736.8
  71.00        1014.1         601.8        1615.9
  72.00        1038.3         457.0        1495.2
  73.00        1062.8         312.2        1375.0
  74.00        1087.7         167.4        1255.1
  75.00        1113.0         167.4        1280.4
  76.00        1138.7         167.4        1306.1
  77.00        1164.7         167.4        1332.1
  78.00        1191.1         167.4        1358.5
  79.00        1217.9         167.4        1385.2
  80.00        1245.0         167.4        1412.4
  81.00        1272.5         167.4        1439.8
  82.00        1300.3         167.4        1467.7
  83.00        1328.5         191.1        1519.6
  84.00        1357.1         214.9        1572.0
  85.00        1386.0         238.6        1624.7
  86.00        1415.3         262.4        1677.7
  87.00        1445.0         286.1        1731.2
  88.00        1475.1         430.9        1906.0
  89.00        1515.3         575.7        2091.0
  90.00        1565.6         720.6        2286.1
  91.00        1615.8         865.4        2481.2
  92.00        1666.1        1010.2        2676.3
  93.00        1716.4        1155.0        2871.3
  94.00        1741.5        1299.8        3041.3
  95.00        1766.6        1420.8        3187.5
  96.00        1791.8        1541.9        3333.6
  97.00        1816.9        1662.9        3479.8
  98.00        1842.0        1672.4        3514.4
  99.00        1867.2        1681.8        3549.0
 100.00        1892.3        1570.2        3462.5
 101.00        1917.4        1458.5        3376.0
 102.00        1942.6        1346.9        3289.5
 103.00        1967.7        1235.3        3203.0
 104.00        1992.8        1123.6        3116.5
 105.00        2018.0        1012.0        3030.0
 106.00        2043.1         900.4        2943.5
 107.00        2068.2         680.7        2748.9
 108.00        2093.3         340.3        2433.7
 109.00        2118.5           0.0        2118.5
 110.00        2143.6           0.0        2143.6
 111.00        2168.7           0.0        2168.7
 112.00        2193.9           0.0        2193.9
 113.00        2219.0           0.0        2219.0
 114.00        2244.1           0.0        2244.1
 115.00        2269.3           0.0        2269.3
 116.00        2294.4           0.0        2294.4
 117.00        2319.5           0.0        2319.5
 118.00        2344.7           0.0        2344.7
 119.00        2369.8           0.0        2369.8
 120.00        2394.9           0.0        2394.9
 121.00        2420.1           0.0        2420.1
 122.00        2445.2           0.0        2445.2
 123.00        2470.3           0.0        2470.3
 124.00        2495.5           0.0        2495.5
```

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NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.



    *************************************************
    * COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
    * CURVES FOR AXIAL LOADING                      *
    *************************************************


T-Z CURVE   NO. OF   DEPTH TO CURVE   LOAD TRANSFER   PILE MOVEMENT
   NO.      POINTS        FT.               PSI             IN.

    1         10      0.0000E+00
                                       0.0000E+00      0.0000E+00
                                       0.0000E+00      0.1000E-01
                                       0.0000E+00      0.2000E-01
                                       0.0000E+00      0.4000E-01
                                       0.0000E+00      0.6000E-01
                                       0.0000E+00      0.8000E-01
                                       0.0000E+00      0.9000E-01
                                       0.0000E+00      0.1000E+00
                                       0.0000E+00      0.5000E+00
                                       0.0000E+00      0.2000E+01
    2         10      0.1425E+01
                                       0.0000E+00      0.0000E+00
                                       0.6555E-01      0.1000E-01
                                       0.1311E+00      0.2000E-01
                                       0.2622E+00      0.4000E-01
                                       0.3933E+00      0.6000E-01
                                       0.5244E+00      0.8000E-01
                                       0.5899E+00      0.9000E-01
                                       0.6555E+00      0.1000E+00
                                       0.6555E+00      0.5000E+00
                                       0.6555E+00      0.2000E+01
    3         10      0.2758E+01
                                       0.0000E+00      0.0000E+00
                                       0.1529E+00      0.1000E-01
                                       0.3059E+00      0.2000E-01
                                       0.6118E+00      0.4000E-01
                                       0.9176E+00      0.6000E-01
                                       0.1224E+01      0.8000E-01
                                       0.1376E+01      0.9000E-01
                                       0.1529E+01      0.1000E+00
                                       0.1529E+01      0.5000E+00
                                       0.1529E+01      0.2000E+01
    4         10      0.2800E+01
                                       0.0000E+00      0.0000E+00
                                       0.1529E+00      0.1000E-01
                                       0.3059E+00      0.2000E-01
                                       0.6118E+00      0.4000E-01
                                       0.9176E+00      0.6000E-01
                                       0.1224E+01      0.8000E-01
                                       0.1376E+01      0.9000E-01
                                       0.1529E+01      0.1000E+00
                                       0.1529E+01      0.5000E+00
                                       0.1529E+01      0.2000E+01
    5         10      0.4925E+01
                                       0.0000E+00      0.0000E+00
                                       0.2185E+00      0.1000E-01
```

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                                 0.4370E+00      0.2000E-01
                                 0.8739E+00      0.4000E-01
                                 0.1311E+01      0.6000E-01
                                 0.1748E+01      0.8000E-01
                                 0.1966E+01      0.9000E-01
                                 0.2185E+01      0.1000E+00
                                 0.2185E+01      0.5000E+00
                                 0.2185E+01      0.2000E+01
    6         10      0.6958E+01
                                 0.0000E+00      0.0000E+00
                                 0.2584E+00      0.1000E-01
                                 0.5167E+00      0.2000E-01
                                 0.1033E+01      0.4000E-01
                                 0.1550E+01      0.6000E-01
                                 0.2067E+01      0.8000E-01
                                 0.2325E+01      0.9000E-01
                                 0.2584E+01      0.1000E+00
                                 0.2584E+01      0.5000E+00
                                 0.2584E+01      0.2000E+01
    7         10      0.7000E+01
                                 0.0000E+00      0.0000E+00
                                 0.2007E+00      0.1000E-01
                                 0.4013E+00      0.2000E-01
                                 0.8026E+00      0.4000E-01
                                 0.1204E+01      0.6000E-01
                                 0.1605E+01      0.8000E-01
                                 0.1806E+01      0.9000E-01
                                 0.2007E+01      0.1000E+00
                                 0.2007E+01      0.5000E+00
                                 0.2007E+01      0.2000E+01
    8         10      0.3428E+02
                                 0.0000E+00      0.0000E+00
                                 0.6525E+00      0.1000E-01
                                 0.1305E+01      0.2000E-01
                                 0.2610E+01      0.4000E-01
                                 0.3915E+01      0.6000E-01
                                 0.5220E+01      0.8000E-01
                                 0.5872E+01      0.9000E-01
                                 0.6525E+01      0.1000E+00
                                 0.6525E+01      0.5000E+00
                                 0.6525E+01      0.2000E+01
    9         10      0.6146E+02
                                 0.0000E+00      0.0000E+00
                                 0.1486E+01      0.1000E-01
                                 0.2971E+01      0.2000E-01
                                 0.5943E+01      0.4000E-01
                                 0.8914E+01      0.6000E-01
                                 0.1189E+02      0.8000E-01
                                 0.1337E+02      0.9000E-01
                                 0.1486E+02      0.1000E+00
                                 0.1486E+02      0.5000E+00
                                 0.1486E+02      0.2000E+01
   10         10      0.6150E+02
                                 0.0000E+00      0.0000E+00
                                 0.1486E+01      0.1000E-01
                                 0.2971E+01      0.2000E-01
                                 0.5943E+01      0.4000E-01
                                 0.8914E+01      0.6000E-01
                                 0.1189E+02      0.8000E-01
                                 0.1337E+02      0.9000E-01
                                 0.1486E+02      0.1000E+00
                                 0.1486E+02      0.5000E+00
                                 0.1486E+02      0.2000E+01
```
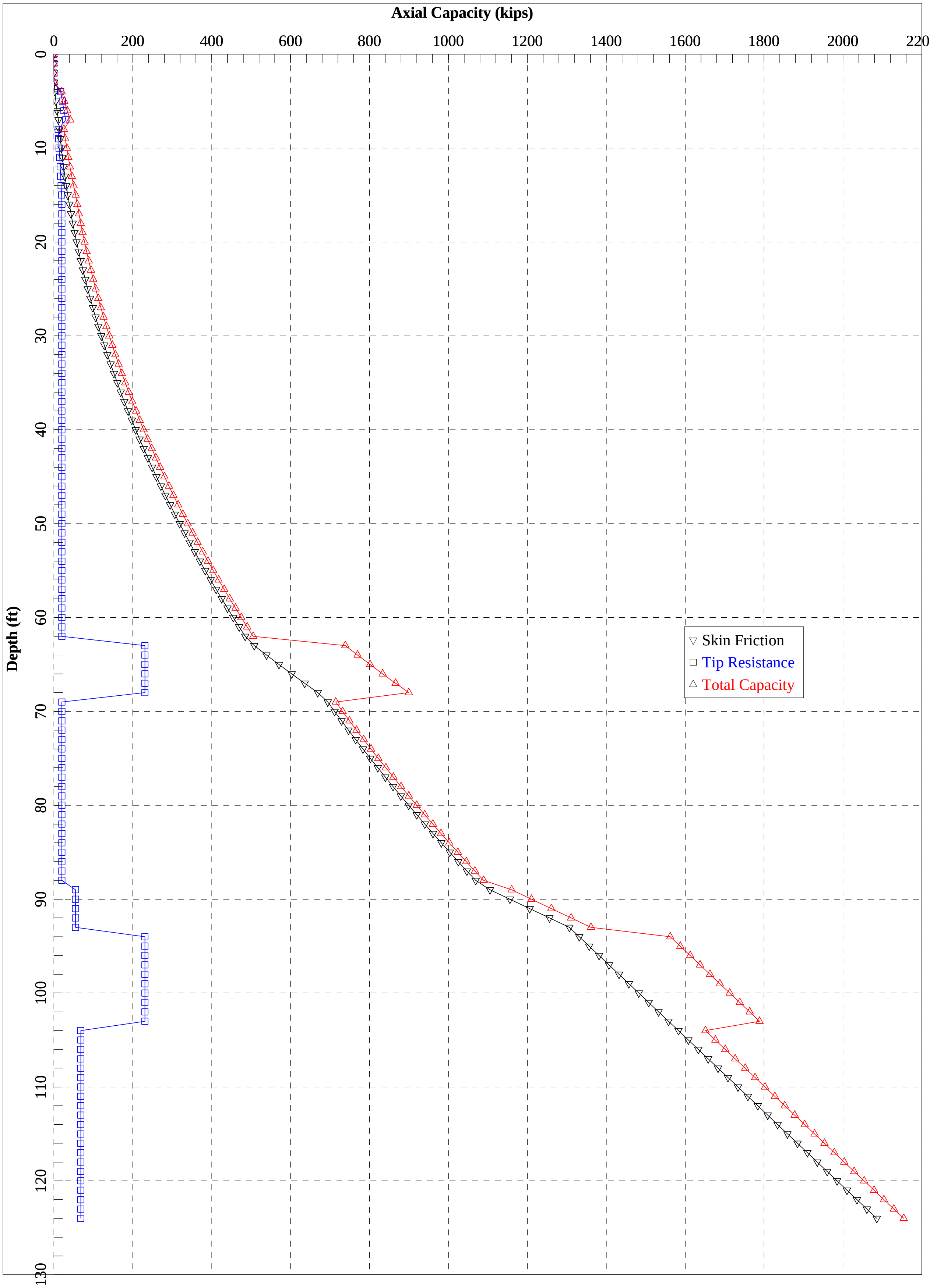

```
11          10       0.6443E+02
                                    0.0000E+00      0.0000E+00
                                    0.2612E+01      0.1000E-01
                                    0.5224E+01      0.2000E-01
                                    0.1045E+02      0.4000E-01
                                    0.1567E+02      0.6000E-01
                                    0.2090E+02      0.8000E-01
                                    0.2351E+02      0.9000E-01
                                    0.2612E+02      0.1000E+00
                                    0.2612E+02      0.5000E+00
                                    0.2612E+02      0.2000E+01
12          10       0.6726E+02
                                    0.0000E+00      0.0000E+00
                                    0.2368E+01      0.1000E-01
                                    0.4736E+01      0.2000E-01
                                    0.9472E+01      0.4000E-01
                                    0.1421E+02      0.6000E-01
                                    0.1894E+02      0.8000E-01
                                    0.2131E+02      0.9000E-01
                                    0.2368E+02      0.1000E+00
                                    0.2368E+02      0.5000E+00
                                    0.2368E+02      0.2000E+01
13          10       0.6730E+02
                                    0.0000E+00      0.0000E+00
                                    0.2368E+01      0.1000E-01
                                    0.4736E+01      0.2000E-01
                                    0.9472E+01      0.4000E-01
                                    0.1421E+02      0.6000E-01
                                    0.1894E+02      0.8000E-01
                                    0.2131E+02      0.9000E-01
                                    0.2368E+02      0.1000E+00
                                    0.2368E+02      0.5000E+00
                                    0.2368E+02      0.2000E+01
14          10       0.7733E+02
                                    0.0000E+00      0.0000E+00
                                    0.1468E+01      0.1000E-01
                                    0.2937E+01      0.2000E-01
                                    0.5873E+01      0.4000E-01
                                    0.8810E+01      0.6000E-01
                                    0.1175E+02      0.8000E-01
                                    0.1321E+02      0.9000E-01
                                    0.1468E+02      0.1000E+00
                                    0.1468E+02      0.5000E+00
                                    0.1468E+02      0.2000E+01
15          10       0.8726E+02
                                    0.0000E+00      0.0000E+00
                                    0.1942E+01      0.1000E-01
                                    0.3884E+01      0.2000E-01
                                    0.7768E+01      0.4000E-01
                                    0.1165E+02      0.6000E-01
                                    0.1554E+02      0.8000E-01
                                    0.1748E+02      0.9000E-01
                                    0.1942E+02      0.1000E+00
                                    0.1942E+02      0.5000E+00
                                    0.1942E+02      0.2000E+01
16          10       0.8730E+02
                                    0.0000E+00      0.0000E+00
                                    0.5826E+01      0.7680E-01
                                    0.9710E+01      0.1488E+00
                                    0.1456E+02      0.2736E+00
                                    0.1748E+02      0.3840E+00
                                    0.1942E+02      0.4800E+00
                                    0.1748E+02      0.9600E+00
```

```
                                    0.1748E+02      0.1440E+01
                                    0.1748E+02      0.2400E+01
                                    0.1748E+02      0.9600E+01
17         10      0.8983E+02
                                    0.0000E+00      0.0000E+00
                                    0.8333E+01      0.7680E-01
                                    0.1389E+02      0.1488E+00
                                    0.2083E+02      0.2736E+00
                                    0.2500E+02      0.3840E+00
                                    0.2778E+02      0.4800E+00
                                    0.2500E+02      0.9600E+00
                                    0.2500E+02      0.1440E+01
                                    0.2500E+02      0.2400E+01
                                    0.2500E+02      0.9600E+01
18         10      0.9226E+02
                                    0.0000E+00      0.0000E+00
                                    0.6250E+01      0.7680E-01
                                    0.1042E+02      0.1488E+00
                                    0.1562E+02      0.2736E+00
                                    0.1875E+02      0.3840E+00
                                    0.2083E+02      0.4800E+00
                                    0.1875E+02      0.9600E+00
                                    0.1875E+02      0.1440E+01
                                    0.1875E+02      0.2400E+01
                                    0.1875E+02      0.9600E+01
19         10      0.9230E+02
                                    0.0000E+00      0.0000E+00
                                    0.2083E+01      0.1000E-01
                                    0.4167E+01      0.2000E-01
                                    0.8333E+01      0.4000E-01
                                    0.1250E+02      0.6000E-01
                                    0.1667E+02      0.8000E-01
                                    0.1875E+02      0.9000E-01
                                    0.2083E+02      0.1000E+00
                                    0.2083E+02      0.5000E+00
                                    0.2083E+02      0.2000E+01
20         10      0.9733E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
21         10      0.1023E+03
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
22         10      0.1023E+03
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
```

```
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01
    23         10      0.1262E+03
                                        0.0000E+00      0.0000E+00
                                        0.4167E+01      0.7680E-01
                                        0.6944E+01      0.1488E+00
                                        0.1042E+02      0.2736E+00
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01
    24         10      0.1500E+03
                                        0.0000E+00      0.0000E+00
                                        0.4167E+01      0.7680E-01
                                        0.6944E+01      0.1488E+00
                                        0.1042E+02      0.2736E+00
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01


 TIP   LOAD         TIP MOVEMENT
     KIP                IN.

 0.0000E+00          0.0000E+00
 0.7854E-04          0.2400E-01
 0.1571E-03          0.4800E-01
 0.3142E-03          0.9600E-01
 0.6283E-03          0.6240E+00
 0.9425E-03          0.2016E+01
 0.1131E-02          0.3504E+01
 0.1257E-02          0.4800E+01
 0.1257E-02          0.7200E+01
 0.1257E-02          0.9600E+01


               LOAD VERSUS SETTLEMENT CURVE
               ****************************



 TOP  LOAD     TOP MOVEMENT       TIP  LOAD      TIP MOVEMENT
    KIP             IN.              KIP            IN.
0.3848E+01      0.7124E-03      0.3272E-06      0.1000E-03
0.3848E+02      0.7124E-02      0.3272E-05      0.1000E-02
0.1937E+03      0.3578E-01      0.1636E-04      0.5000E-02
0.3888E+03      0.7176E-01      0.3272E-04      0.1000E-01
0.1670E+04      0.3330E+00      0.1636E-03      0.5000E-01
0.2201E+04      0.4972E+00      0.3165E-03      0.1000E+00
0.2691E+04      0.1019E+01      0.5545E-03      0.5000E+00
0.2617E+04      0.1501E+01      0.7132E-03      0.1000E+01
0.2617E+04      0.2501E+01      0.9389E-03      0.2000E+01
```

IB-5 Unplugged Condition



```
==========================================================================

                 APILE for Windows, Version 2015.7.2

                  Serial Number :  239146456

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                (c) Copyright ENSOFT, Inc., 1987-2015
                      All Rights Reserved

==========================================================================


     This program is licensed to :

     SCDOT
     Columbia, SC

     Path to file locations      :
P:\Orangeburg\40308_us301\Geotechnical\5_Design\2_Final\7_InteriorBents\APile\Without
Overburden\
     Name of input data file     : B-5A.ap7d
     Name of output file         : B-5A.ap7o
     Name of plot output file    : B-5A.ap7p

     --------------------------------------------------------------------------
                         Time and Date of Analysis
     --------------------------------------------------------------------------

               Date:  April 14, 2016     Time:  14:25:31



1
          *********************
          * INPUT INFORMATION *
          *********************



          US 301 over Four Hole Swamp IB-5

          DESIGNER   : RSG

          JOB NUMBER : 0040308


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Reduced Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION
```

```
PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Open-Ended Pile


DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY     = 0.290E+08 PSI
- CROSS SECTION AREA        =    219.13 IN2


CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD      =     48.00 IN.
- INTERNAL DIAMETER, ID     =     45.00 IN.
- TOTAL PILE LENGTH, TL     =    150.00 FT.
- PILE STICKUP LENGTH, PSL  =     26.00 FT.
- ZERO FRICTION LENGTH, ZFL =      3.00 FT.
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION       =      1.00 FT.
- LENGTH OF ENHANCED
  END SECTION               =    150.00 FT.
- INTERNAL DIAMETER OF
  ENHANCED END SECTION      =     45.00 IN.


PLUGGED/UNPLUGGED CONDITIONS :
Unplugged for open-ended pile



SOIL INFORMATIONS :



                  LATERAL    EFFECTIVE    FRICTION   BEARING
          SOIL    EARTH      UNIT         ANGLE      CAPACITY
 DEPTH    TYPE    PRESSURE   WEIGHT       DEGREES    FACTOR
  FT.                        LB/CF
   0.00   SAND      0.00        52.60        36.00      0.00
   2.80   SAND      0.00        52.60        36.00      0.00
   2.80   SAND      0.00        52.60        36.00      0.00
   7.00   SAND      0.00        52.60        36.00      0.00
   7.00   SAND      0.00        47.60        30.00      0.00
  61.50   SAND      0.00        47.60        30.00      0.00
  61.50   SAND      0.00        52.60        36.00      0.00
  67.30   SAND      0.00        52.60        36.00      0.00
  67.30   SAND      0.00        52.60        30.00      0.00
  87.30   SAND      0.00        52.60        30.00      0.00
  87.30   CLAY      0.00        47.60         0.00      0.00
  92.30   CLAY      0.00        47.60         0.00      0.00
  92.30   SAND      0.00        52.60        36.00      0.00
 102.30   SAND      0.00        52.60        36.00      0.00
 102.30   CLAY      0.00        47.60         0.00      0.00
 150.00   CLAY      0.00        47.60         0.00      0.00


MAXIMUM   MAXIMUM   UNDISTURB  REMOLDED
UNIT      UNIT      SHEAR      SHEAR     BLOW   UNIT SKIN  UNIT END
```

```
FRICTION  BEARING   STRENGTH   STRENGTH  COUNT  FRICTION   BEARING
  KSF       KSF        KSF       KSF               KSF       KSF
0.10E+08* 0.10E-03        0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E-03        0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.44E+03        0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.44E+03        0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.29E+03        0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.29E+03        0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.41E+03        0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.41E+03        0.00      0.00   0.00       0.00      0.00
0.10E+08* 0.10E-03        4.00      2.00   0.00       0.00      0.00
0.10E+08* 0.10E-03        4.00      2.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.32E+03        0.00      0.00   0.00       0.00      0.00
0.20E+01  0.10E-03        5.00      2.50   0.00       0.00      0.00
0.20E+01  0.10E-03        5.00      2.50   0.00       0.00      0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
  PLAN TO LIMIT THE COMPUTED DATA.



         LRFD FACTOR  LRFD FACTOR
          ON UNIT      ON UNIT
 DEPTH    FRICTION     BEARING
  FT.
   0.00    1.000       1.000
   2.80    1.000       1.000
   2.80    1.000       1.000
   7.00    1.000       1.000
   7.00    1.000       1.000
  61.50    1.000       1.000
  61.50    1.000       1.000
  67.30    1.000       1.000
  67.30    1.000       1.000
  87.30    1.000       1.000
  87.30    1.000       1.000
  92.30    1.000       1.000
  92.30    1.000       1.000
 102.30    1.000       1.000
 102.30    1.000       1.000
 150.00    1.000       1.000



1
**********************
* COMPUTATION RESULT *
**********************


                  **********************
                  *  FED. HWY. METHOD  *
                  **********************

   PILE       TOTAL SKIN       END       ULTIMATE
PENETRATION   FRICTION      BEARING     CAPACITY
    FT.          KIP           KIP          KIP
    0.00           0.0           0.0*         0.0
```

```
  1.00          0.0          0.0*         0.0
  2.00          0.0          0.0*         0.0
  3.00          0.8          0.0*         0.8
  4.00          2.7         17.2*        19.9
  5.00          5.1         21.5*        26.6
  6.00          8.0         25.8*        33.8
  7.00         11.5         30.1*        41.6
  8.00         14.4         11.0*        25.4
  9.00         16.7         12.3*        28.9
 10.00         19.2         13.5*        32.7
 11.00         21.9         14.8*        36.7
 12.00         24.9         16.1*        40.9
 13.00         28.1         17.3*        45.4
 14.00         31.6         18.6*        50.2
 15.00         35.3         19.8*        55.1
 16.00         39.3         20.3*        59.5
 17.00         43.5         20.3*        63.7
 18.00         47.9         20.3*        68.2
 19.00         52.6         20.3*        72.9
 20.00         57.5         20.3*        77.8
 21.00         62.7         20.3*        83.0
 22.00         68.1         20.3*        88.4
 23.00         73.8         20.3*        94.0
 24.00         79.7         20.3*       100.0
 25.00         85.8         20.3*       106.1
 26.00         92.2         20.3*       112.5
 27.00         98.9         20.3*       119.1
 28.00        105.8         20.3*       126.0
 29.00        112.9         20.3*       133.1
 30.00        120.3         20.3*       140.5
 31.00        127.9         20.3*       148.1
 32.00        135.7         20.3*       156.0
 33.00        143.8         20.3*       164.1
 34.00        152.2         20.3*       172.4
 35.00        160.8         20.3*       181.0
 36.00        169.6         20.3*       189.9
 37.00        178.7         20.3*       198.9
 38.00        188.0         20.3*       208.3
 39.00        197.6         20.3*       217.8
 40.00        207.4         20.3*       227.6
 41.00        217.4         20.3*       237.7
 42.00        227.7         20.3*       248.0
 43.00        238.2         20.3*       258.5
 44.00        249.0         20.3*       269.3
 45.00        260.1         20.3*       280.3
 46.00        271.3         20.3*       291.6
 47.00        282.8         20.3*       303.1
 48.00        294.6         20.3*       314.9
 49.00        306.6         20.3*       326.9
 50.00        318.8         20.3*       339.1
 51.00        331.3         20.3*       351.6
 52.00        344.1         20.3*       364.3
 53.00        357.0         20.3*       377.3
 54.00        370.3         20.3*       390.5
 55.00        383.7         20.3*       404.0
 56.00        397.4         20.3*       417.7
 57.00        411.4         20.3*       431.7
 58.00        425.6         20.3*       445.9
 59.00        440.0         20.3*       460.3
 60.00        454.7         20.3*       475.0
 61.00        469.6         20.3*       489.9
 62.00        484.8         20.3*       505.1
 63.00        507.9        230.7*       738.6
```

```
     64.00          539.0         230.7*        769.7
     65.00          570.6         230.7*        801.3
     66.00          602.8         230.7*        833.5
     67.00          635.6         230.7*        866.2
     68.00          668.8         230.7*        899.5
     69.00          694.2          20.3*        714.4
     70.00          711.5          20.3*        731.7
     71.00          729.1          20.3*        749.3
     72.00          746.9          20.3*        767.2
     73.00          765.0          20.3*        785.3
     74.00          783.4          20.3*        803.7
     75.00          802.1          20.3*        822.3
     76.00          821.0          20.3*        841.3
     77.00          840.2          20.3*        860.5
     78.00          859.7          20.3*        879.9
     79.00          879.4          20.3*        899.7
     80.00          899.4          20.3*        919.7
     81.00          919.7          20.3*        940.0
     82.00          940.2          20.3*        960.5
     83.00          961.0          20.3*        981.3
     84.00          982.1          20.3*       1002.4
     85.00         1003.5          20.3*       1023.8
     86.00         1025.1          20.3*       1045.4
     87.00         1047.0          20.3*       1067.3
     88.00         1069.2          20.3*       1089.4
     89.00         1105.4          54.8*       1160.2
     90.00         1155.7          54.8*       1210.5
     91.00         1206.0          54.8*       1260.8
     92.00         1256.2          54.8*       1311.0
     93.00         1306.5          54.8*       1361.3
     94.00         1331.6         230.7*       1562.3
     95.00         1356.8         230.7*       1587.5
     96.00         1381.9         230.7*       1612.6
     97.00         1407.0         230.7*       1637.7
     98.00         1432.2         230.7*       1662.9
     99.00         1457.3         230.7*       1688.0
    100.00         1482.4         230.7*       1713.1
    101.00         1507.6         230.7*       1738.3
    102.00         1532.7         230.7*       1763.4
    103.00         1557.8         230.7*       1788.5
    104.00         1583.0          68.5*       1651.4
    105.00         1608.1          68.5*       1676.6
    106.00         1633.2          68.5*       1701.7
    107.00         1658.4          68.5*       1726.8
    108.00         1683.5          68.5*       1752.0
    109.00         1708.6          68.5*       1777.1
    110.00         1733.8          68.5*       1802.2
    111.00         1758.9          68.5*       1827.4
    112.00         1784.0          68.5*       1852.5
    113.00         1809.2          68.5*       1877.6
    114.00         1834.3          68.5*       1902.8
    115.00         1859.4          68.5*       1927.9
    116.00         1884.6          68.5*       1953.0
    117.00         1909.7          68.5*       1978.2
    118.00         1934.8          68.5*       2003.3
    119.00         1960.0          68.5*       2028.4
    120.00         1985.1          68.5*       2053.6
    121.00         2010.2          68.5*       2078.7
    122.00         2035.4          68.5*       2103.8
    123.00         2060.5          68.5*       2129.0
    124.00         2085.6          68.5*       2154.1
```

```
NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.



      *************************************************
      * COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
      * CURVES FOR AXIAL LOADING                      *
      *************************************************


T-Z CURVE   NO. OF   DEPTH TO CURVE   LOAD TRANSFER   PILE MOVEMENT
   NO.      POINTS         FT.              PSI             IN.

    1         10      0.0000E+00
                                     0.0000E+00      0.0000E+00
                                     0.0000E+00      0.1000E-01
                                     0.0000E+00      0.2000E-01
                                     0.0000E+00      0.4000E-01
                                     0.0000E+00      0.6000E-01
                                     0.0000E+00      0.8000E-01
                                     0.0000E+00      0.9000E-01
                                     0.0000E+00      0.1000E+00
                                     0.0000E+00      0.5000E+00
                                     0.0000E+00      0.2000E+01
    2         10      0.1425E+01
                                     0.0000E+00      0.0000E+00
                                     0.4427E-01      0.1000E-01
                                     0.8854E-01      0.2000E-01
                                     0.1771E+00      0.4000E-01
                                     0.2656E+00      0.6000E-01
                                     0.3541E+00      0.8000E-01
                                     0.3984E+00      0.9000E-01
                                     0.4427E+00      0.1000E+00
                                     0.4427E+00      0.5000E+00
                                     0.4427E+00      0.2000E+01
    3         10      0.2758E+01
                                     0.0000E+00      0.0000E+00
                                     0.1033E+00      0.1000E-01
                                     0.2066E+00      0.2000E-01
                                     0.4132E+00      0.4000E-01
                                     0.6198E+00      0.6000E-01
                                     0.8263E+00      0.8000E-01
                                     0.9296E+00      0.9000E-01
                                     0.1033E+01      0.1000E+00
                                     0.1033E+01      0.5000E+00
                                     0.1033E+01      0.2000E+01
    4         10      0.2800E+01
                                     0.0000E+00      0.0000E+00
                                     0.1033E+00      0.1000E-01
                                     0.2066E+00      0.2000E-01
                                     0.4132E+00      0.4000E-01
                                     0.6198E+00      0.6000E-01
                                     0.8263E+00      0.8000E-01
                                     0.9296E+00      0.9000E-01
                                     0.1033E+01      0.1000E+00
                                     0.1033E+01      0.5000E+00
                                     0.1033E+01      0.2000E+01
    5         10      0.4925E+01
                                     0.0000E+00      0.0000E+00
                                     0.1476E+00      0.1000E-01
```

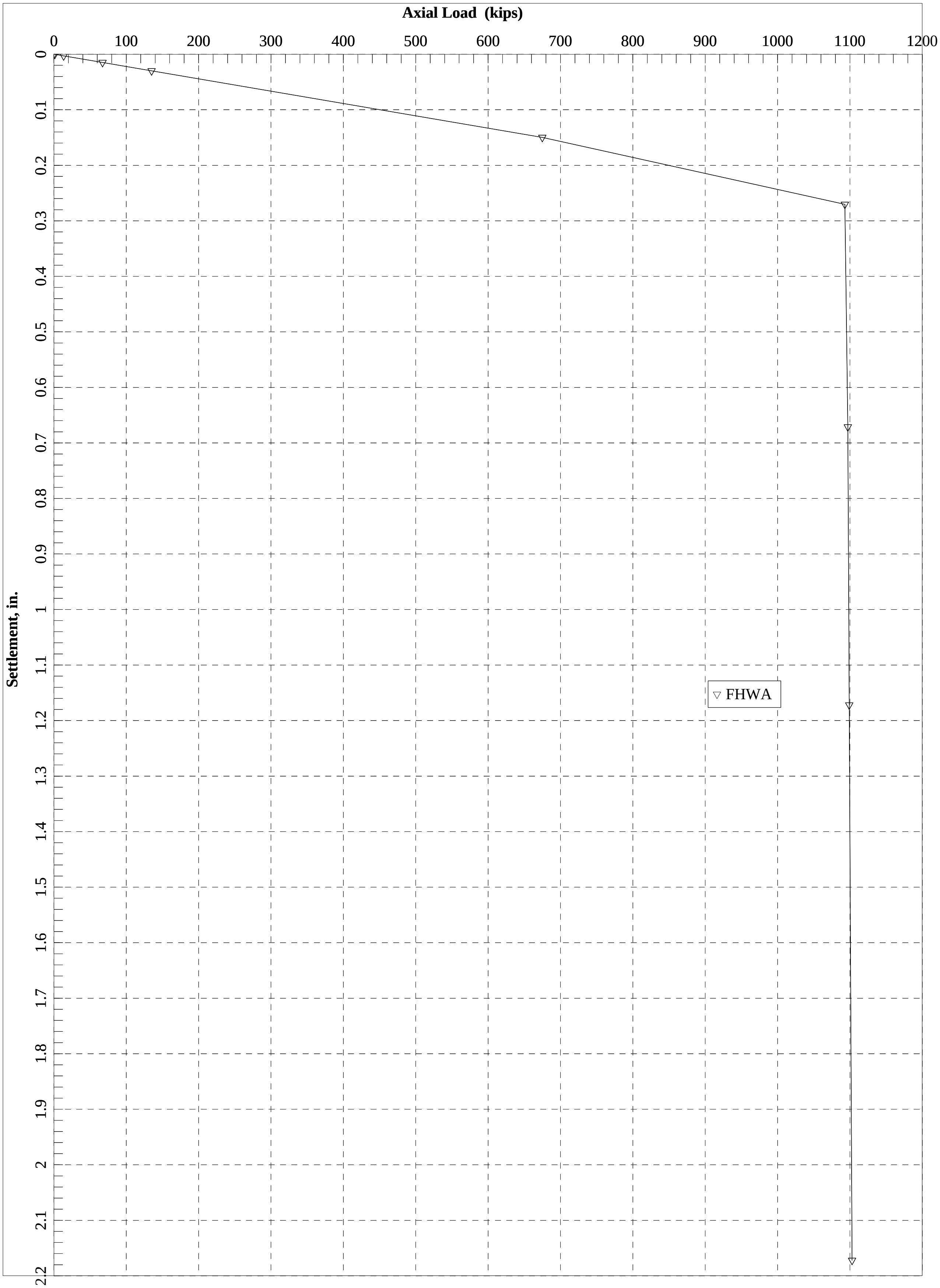
```
                                    0.2951E+00      0.2000E-01
                                    0.5902E+00      0.4000E-01
                                    0.8854E+00      0.6000E-01
                                    0.1180E+01      0.8000E-01
                                    0.1328E+01      0.9000E-01
                                    0.1476E+01      0.1000E+00
                                    0.1476E+01      0.5000E+00
                                    0.1476E+01      0.2000E+01
 6         10      0.6958E+01
                                    0.0000E+00      0.0000E+00
                                    0.1770E+00      0.1000E-01
                                    0.3540E+00      0.2000E-01
                                    0.7079E+00      0.4000E-01
                                    0.1062E+01      0.6000E-01
                                    0.1416E+01      0.8000E-01
                                    0.1593E+01      0.9000E-01
                                    0.1770E+01      0.1000E+00
                                    0.1770E+01      0.5000E+00
                                    0.1770E+01      0.2000E+01
 7         10      0.7000E+01
                                    0.0000E+00      0.0000E+00
                                    0.1433E+00      0.1000E-01
                                    0.2865E+00      0.2000E-01
                                    0.5731E+00      0.4000E-01
                                    0.8596E+00      0.6000E-01
                                    0.1146E+01      0.8000E-01
                                    0.1289E+01      0.9000E-01
                                    0.1433E+01      0.1000E+00
                                    0.1433E+01      0.5000E+00
                                    0.1433E+01      0.2000E+01
 8         10      0.3428E+02
                                    0.0000E+00      0.0000E+00
                                    0.4814E+00      0.1000E-01
                                    0.9628E+00      0.2000E-01
                                    0.1926E+01      0.4000E-01
                                    0.2888E+01      0.6000E-01
                                    0.3851E+01      0.8000E-01
                                    0.4332E+01      0.9000E-01
                                    0.4814E+01      0.1000E+00
                                    0.4814E+01      0.5000E+00
                                    0.4814E+01      0.2000E+01
 9         10      0.6146E+02
                                    0.0000E+00      0.0000E+00
                                    0.1057E+01      0.1000E-01
                                    0.2113E+01      0.2000E-01
                                    0.4227E+01      0.4000E-01
                                    0.6340E+01      0.6000E-01
                                    0.8454E+01      0.8000E-01
                                    0.9510E+01      0.9000E-01
                                    0.1057E+02      0.1000E+00
                                    0.1057E+02      0.5000E+00
                                    0.1057E+02      0.2000E+01
10         10      0.6150E+02
                                    0.0000E+00      0.0000E+00
                                    0.1057E+01      0.1000E-01
                                    0.2113E+01      0.2000E-01
                                    0.4227E+01      0.4000E-01
                                    0.6340E+01      0.6000E-01
                                    0.8454E+01      0.8000E-01
                                    0.9510E+01      0.9000E-01
                                    0.1057E+02      0.1000E+00
                                    0.1057E+02      0.5000E+00
                                    0.1057E+02      0.2000E+01
```

```
11         10      0.6443E+02
                                     0.0000E+00      0.0000E+00
                                     0.1764E+01      0.1000E-01
                                     0.3528E+01      0.2000E-01
                                     0.7056E+01      0.4000E-01
                                     0.1058E+02      0.6000E-01
                                     0.1411E+02      0.8000E-01
                                     0.1588E+02      0.9000E-01
                                     0.1764E+02      0.1000E+00
                                     0.1764E+02      0.5000E+00
                                     0.1764E+02      0.2000E+01
12         10      0.6726E+02
                                     0.0000E+00      0.0000E+00
                                     0.1619E+01      0.1000E-01
                                     0.3239E+01      0.2000E-01
                                     0.6477E+01      0.4000E-01
                                     0.9716E+01      0.6000E-01
                                     0.1295E+02      0.8000E-01
                                     0.1457E+02      0.9000E-01
                                     0.1619E+02      0.1000E+00
                                     0.1619E+02      0.5000E+00
                                     0.1619E+02      0.2000E+01
13         10      0.6730E+02
                                     0.0000E+00      0.0000E+00
                                     0.1619E+01      0.1000E-01
                                     0.3239E+01      0.2000E-01
                                     0.6477E+01      0.4000E-01
                                     0.9716E+01      0.6000E-01
                                     0.1295E+02      0.8000E-01
                                     0.1457E+02      0.9000E-01
                                     0.1619E+02      0.1000E+00
                                     0.1619E+02      0.5000E+00
                                     0.1619E+02      0.2000E+01
14         10      0.7733E+02
                                     0.0000E+00      0.0000E+00
                                     0.1083E+01      0.1000E-01
                                     0.2167E+01      0.2000E-01
                                     0.4333E+01      0.4000E-01
                                     0.6500E+01      0.6000E-01
                                     0.8666E+01      0.8000E-01
                                     0.9749E+01      0.9000E-01
                                     0.1083E+02      0.1000E+00
                                     0.1083E+02      0.5000E+00
                                     0.1083E+02      0.2000E+01
15         10      0.8726E+02
                                     0.0000E+00      0.0000E+00
                                     0.1615E+01      0.1000E-01
                                     0.3230E+01      0.2000E-01
                                     0.6459E+01      0.4000E-01
                                     0.9689E+01      0.6000E-01
                                     0.1292E+02      0.8000E-01
                                     0.1453E+02      0.9000E-01
                                     0.1615E+02      0.1000E+00
                                     0.1615E+02      0.5000E+00
                                     0.1615E+02      0.2000E+01
16         10      0.8730E+02
                                     0.0000E+00      0.0000E+00
                                     0.4844E+01      0.7680E-01
                                     0.8074E+01      0.1488E+00
                                     0.1211E+02      0.2736E+00
                                     0.1453E+02      0.3840E+00
                                     0.1615E+02      0.4800E+00
                                     0.1453E+02      0.9600E+00
```

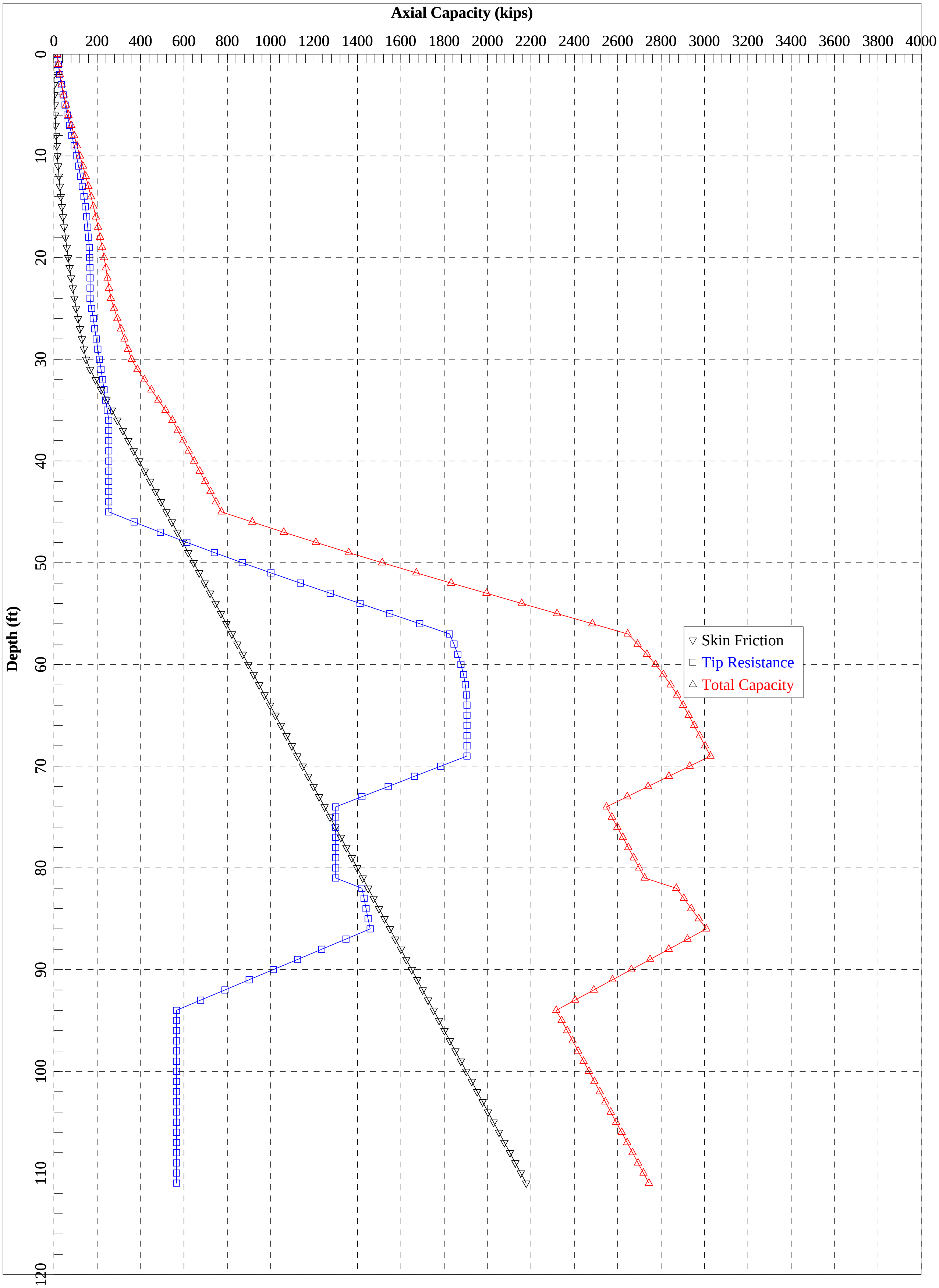
```
                                     0.1453E+02      0.1440E+01
                                     0.1453E+02      0.2400E+01
                                     0.1453E+02      0.9600E+01
 17          10       0.8983E+02
                                     0.0000E+00      0.0000E+00
                                     0.8333E+01      0.7680E-01
                                     0.1389E+02      0.1488E+00
                                     0.2083E+02      0.2736E+00
                                     0.2500E+02      0.3840E+00
                                     0.2778E+02      0.4800E+00
                                     0.2500E+02      0.9600E+00
                                     0.2500E+02      0.1440E+01
                                     0.2500E+02      0.2400E+01
                                     0.2500E+02      0.9600E+01
 18          10       0.9226E+02
                                     0.0000E+00      0.0000E+00
                                     0.6250E+01      0.7680E-01
                                     0.1042E+02      0.1488E+00
                                     0.1562E+02      0.2736E+00
                                     0.1875E+02      0.3840E+00
                                     0.2083E+02      0.4800E+00
                                     0.1875E+02      0.9600E+00
                                     0.1875E+02      0.1440E+01
                                     0.1875E+02      0.2400E+01
                                     0.1875E+02      0.9600E+01
 19          10       0.9230E+02
                                     0.0000E+00      0.0000E+00
                                     0.2083E+01      0.1000E-01
                                     0.4167E+01      0.2000E-01
                                     0.8333E+01      0.4000E-01
                                     0.1250E+02      0.6000E-01
                                     0.1667E+02      0.8000E-01
                                     0.1875E+02      0.9000E-01
                                     0.2083E+02      0.1000E+00
                                     0.2083E+02      0.5000E+00
                                     0.2083E+02      0.2000E+01
 20          10       0.9733E+02
                                     0.0000E+00      0.0000E+00
                                     0.1389E+01      0.1000E-01
                                     0.2778E+01      0.2000E-01
                                     0.5556E+01      0.4000E-01
                                     0.8333E+01      0.6000E-01
                                     0.1111E+02      0.8000E-01
                                     0.1250E+02      0.9000E-01
                                     0.1389E+02      0.1000E+00
                                     0.1389E+02      0.5000E+00
                                     0.1389E+02      0.2000E+01
 21          10       0.1023E+03
                                     0.0000E+00      0.0000E+00
                                     0.1389E+01      0.1000E-01
                                     0.2778E+01      0.2000E-01
                                     0.5556E+01      0.4000E-01
                                     0.8333E+01      0.6000E-01
                                     0.1111E+02      0.8000E-01
                                     0.1250E+02      0.9000E-01
                                     0.1389E+02      0.1000E+00
                                     0.1389E+02      0.5000E+00
                                     0.1389E+02      0.2000E+01
 22          10       0.1023E+03
                                     0.0000E+00      0.0000E+00
                                     0.4167E+01      0.7680E-01
                                     0.6944E+01      0.1488E+00
                                     0.1042E+02      0.2736E+00
```

```
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01
    23         10      0.1262E+03
                                        0.0000E+00      0.0000E+00
                                        0.4167E+01      0.7680E-01
                                        0.6944E+01      0.1488E+00
                                        0.1042E+02      0.2736E+00
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01
    24         10      0.1500E+03
                                        0.0000E+00      0.0000E+00
                                        0.4167E+01      0.7680E-01
                                        0.6944E+01      0.1488E+00
                                        0.1042E+02      0.2736E+00
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01


 TIP   LOAD        TIP MOVEMENT
     KIP               IN.

 0.0000E+00         0.0000E+00
 0.4280E+01         0.2400E-01
 0.8560E+01         0.4800E-01
 0.1712E+02         0.9600E-01
 0.3424E+02         0.6240E+00
 0.5136E+02         0.2016E+01
 0.6163E+02         0.3504E+01
 0.6848E+02         0.4800E+01
 0.6848E+02         0.7200E+01
 0.6848E+02         0.9600E+01


               LOAD VERSUS SETTLEMENT CURVE
               ****************************


 TOP  LOAD     TOP MOVEMENT       TIP  LOAD      TIP MOVEMENT
    KIP             IN.              KIP            IN.
0.2835E+01      0.5752E-03      0.1783E-01      0.1000E-03
0.2835E+02      0.5752E-02      0.1783E+00      0.1000E-02
0.1423E+03      0.2882E-01      0.8916E+00      0.5000E-02
0.2856E+03      0.5781E-01      0.1783E+01      0.1000E-01
0.1294E+04      0.2768E+00      0.8916E+01      0.5000E-01
0.1766E+04      0.4303E+00      0.1725E+02      0.1000E+00
0.2261E+04      0.9545E+00      0.3022E+02      0.5000E+00
0.2196E+04      0.1439E+01      0.3886E+02      0.1000E+01
0.2209E+04      0.2442E+01      0.5116E+02      0.2000E+01
```

IB-5 Settlement



IB-6 Plugged Condition



```
     =========================================================================

                      APILE for Windows, Version 2015.7.2

                       Serial Number :  239146456

                       A Program for Analyzing the Axial Capacity
                       and Short-term Settlement of Driven Piles
                                 under Axial Loading.
                     (c) Copyright ENSOFT, Inc., 1987-2015
                           All Rights Reserved

     =========================================================================


     This program is licensed to :

     SCDOT
     Columbia, SC

     Path to file locations       :
P:\Orangeburg\40308_us301\Geotechnical\5_Design\2_Final\7_InteriorBents\APile\Without
Overburden\
     Name of input data file      : B-6A.ap7d
     Name of output file          : B-6A.ap7o
     Name of plot output file     : B-6A.ap7p

     -------------------------------------------------------------------------
                          Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  April 14, 2016     Time:  14:30:04



1
          *********************
          * INPUT INFORMATION *
          *********************



          US 301 over Four Hole Swamp, Orangburg County  IB-6

          DESIGNER   : RSG

          JOB NUMBER : 0040308


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Reduced Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION
```

```
PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Open-Ended Pile


DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY     = 0.290E+08 PSI
- CROSS SECTION AREA        =    219.13 IN2


CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD      =     48.00 IN.
- INTERNAL DIAMETER, ID     =     45.00 IN.
- TOTAL PILE LENGTH, TL     =    150.00 FT.
- PILE STICKUP LENGTH, PSL  =     39.00 FT.
- ZERO FRICTION LENGTH, ZFL =      0.00 FT.
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION       =      1.00 FT.
- LENGTH OF ENHANCED
  END SECTION               =    150.00 FT.
- INTERNAL DIAMETER OF
  ENHANCED END SECTION      =     45.00 IN.


PLUGGED/UNPLUGGED CONDITIONS :
Plugged for open-ended pile



SOIL INFORMATIONS :



                  LATERAL    EFFECTIVE    FRICTION   BEARING
          SOIL    EARTH      UNIT         ANGLE      CAPACITY
 DEPTH    TYPE    PRESSURE   WEIGHT       DEGREES    FACTOR
  FT.                        LB/CF
   0.00   SAND      0.00        47.60        30.00      0.00
  29.20   SAND      0.00        47.60        30.00      0.00
  29.20   CLAY      0.00        47.60         0.00      0.00
  50.70   CLAY      0.00        47.60         0.00      0.00
  50.70   SAND      0.00        52.60        36.00      0.00
  54.50   SAND      0.00        52.60        36.00      0.00
  54.50   SAND      0.00        57.60        36.00      0.00
  74.50   SAND      0.00        57.60        36.00      0.00
  74.50   CLAY      0.00        47.60         0.00      0.00
  79.50   CLAY      0.00        47.60         0.00      0.00
  79.50   SAND      0.00        52.60        36.00      0.00
  88.00   SAND      0.00        52.60        36.00      0.00
  88.00   CLAY      0.00        47.60         0.00      0.00
 150.00   CLAY      0.00        47.60         0.00      0.00


MAXIMUM   MAXIMUM   UNDISTURB  REMOLDED
UNIT      UNIT      SHEAR      SHEAR     BLOW   UNIT SKIN  UNIT END
FRICTION  BEARING   STRENGTH   STRENGTH  COUNT  FRICTION   BEARING
  KSF       KSF        KSF       KSF                KSF       KSF
```

```
0.20E+01  0.47E+03        0.00      0.00   0.00        0.00      0.00
0.20E+01  0.47E+03        0.00      0.00   0.00        0.00      0.00
0.20E+01  0.48E+03        2.24      1.12   0.00        0.00      0.00
0.20E+01  0.48E+03        2.24      1.12   0.00        0.00      0.00
0.20E+01  0.24E+03        0.00      0.00   0.00        0.00      0.00
0.20E+01  0.24E+03        0.00      0.00   0.00        0.00      0.00
0.20E+01  0.40E+03        0.00      0.00   0.00        0.00      0.00
0.20E+01  0.40E+03        0.00      0.00   0.00        0.00      0.00
0.20E+01  0.23E+03        4.00      2.00   0.00        0.00      0.00
0.20E+01  0.23E+03        4.00      2.00   0.00        0.00      0.00
0.20E+01  0.36E+03        0.00      0.00   0.00        0.00      0.00
0.20E+01  0.36E+03        0.00      0.00   0.00        0.00      0.00
0.20E+01  0.35E+03        5.00      2.50   0.00        0.00      0.00
0.20E+01  0.35E+03        5.00      2.50   0.00        0.00      0.00


         LRFD FACTOR  LRFD FACTOR
          ON UNIT      ON UNIT
 DEPTH    FRICTION     BEARING
  FT.
   0.00    1.000        1.000
  29.20    1.000        1.000
  29.20    1.000        1.000
  50.70    1.000        1.000
  50.70    1.000        1.000
  54.50    1.000        1.000
  54.50    1.000        1.000
  74.50    1.000        1.000
  74.50    1.000        1.000
  79.50    1.000        1.000
  79.50    1.000        1.000
  88.00    1.000        1.000
  88.00    1.000        1.000
 150.00    1.000        1.000


1
          **********************
          * COMPUTATION RESULT *
          **********************


                              **********************
                              *  FED. HWY. METHOD  *
                              **********************

   PILE        TOTAL SKIN       END       ULTIMATE
PENETRATION    FRICTION       BEARING     CAPACITY
    FT.           KIP           KIP          KIP
    0.00            0.0          15.6         15.6
    1.00            0.2          20.8         21.0
    2.00            0.7          27.3         28.0
    3.00            1.5          34.7         36.2
    4.00            2.6          42.9         45.6
    5.00            4.1          52.0         56.2
    6.00            5.9          62.0         68.0
    7.00            8.1          72.9         81.0
    8.00           10.6          83.3         93.8
    9.00           13.4          93.7        107.1
   10.00           16.5         104.1        120.6
```

```
11.00          20.0         114.1        134.1
12.00          23.8         123.3        147.1
13.00          27.9         131.6        159.5
14.00          32.4         139.0        171.4
15.00          37.2         145.6        182.8
16.00          42.3         151.3        193.6
17.00          47.7         156.1        203.9
18.00          53.5         160.1        213.6
19.00          59.6         163.2        222.9
20.00          66.1         165.5        231.6
21.00          72.9         166.8        239.7
22.00          80.0         167.3        247.3
23.00          87.4         167.4        254.8
24.00          95.2         167.4        262.5
25.00         103.3         174.5        277.8
26.00         111.7         181.7        293.4
27.00         120.4         188.9        309.3
28.00         129.5         196.0        325.6
29.00         138.9         203.2        342.1
30.00         148.7         210.4        359.0
31.00         167.7         217.5        385.2
32.00         192.8         224.7        417.5
33.00         218.0         231.8        449.8
34.00         243.1         239.0        482.1
35.00         268.2         246.2        514.4
36.00         293.4         253.3        546.7
37.00         318.5         253.3        571.8
38.00         343.6         253.3        597.0
39.00         368.8         253.3        622.1
40.00         393.9         253.3        647.2
41.00         419.0         253.3        672.4
42.00         444.2         253.3        697.5
43.00         469.3         253.3        722.6
44.00         494.4         253.3        747.8
45.00         519.6         253.3        772.9
46.00         544.7         370.5        915.2
47.00         569.8         490.6       1060.4
48.00         595.0         613.7       1208.6
49.00         620.1         739.7       1359.8
50.00         645.2         868.8       1514.1
51.00         670.4        1001.2       1671.6
52.00         695.5        1136.9       1832.4
53.00         720.6        1274.3       1994.9
54.00         745.8        1412.0       2157.7
55.00         770.9        1549.6       2320.5
56.00         796.0        1687.2       2483.3
57.00         821.2        1824.9       2646.1
58.00         846.3        1845.4       2691.7
59.00         871.4        1862.9       2734.3
60.00         896.6        1877.5       2774.1
61.00         921.7        1889.1       2810.8
62.00         946.8        1897.6       2844.4
63.00         972.0        1902.9       2874.8
64.00         997.1        1904.9       2902.0
65.00        1022.2        1905.1       2927.3
66.00        1047.4        1905.1       2952.4
67.00        1072.5        1905.1       2977.6
68.00        1097.6        1905.1       3002.7
69.00        1122.8        1905.1       3027.8
70.00        1147.9        1784.0       2931.9
71.00        1173.0        1662.9       2836.0
72.00        1198.2        1541.9       2740.0
73.00        1223.3        1420.8       2644.1
```

```
     74.00         1248.4        1299.8        2548.2
     75.00         1273.6        1299.8        2573.3
     76.00         1298.7        1299.8        2598.5
     77.00         1323.8        1299.8        2623.6
     78.00         1349.0        1299.8        2648.7
     79.00         1374.1        1299.8        2673.9
     80.00         1399.2        1299.8        2699.0
     81.00         1424.3        1299.8        2724.1
     82.00         1449.5        1420.8        2870.3
     83.00         1474.6        1430.3        2904.9
     84.00         1499.7        1439.7        2939.4
     85.00         1524.9        1449.1        2974.0
     86.00         1550.0        1458.5        3008.5
     87.00         1575.1        1346.9        2922.0
     88.00         1600.3        1235.3        2835.6
     89.00         1625.4        1123.6        2749.1
     90.00         1650.5        1012.0        2662.6
     91.00         1675.7         900.4        2576.1
     92.00         1700.8         788.7        2489.6
     93.00         1725.9         677.1        2403.1
     94.00         1751.1         565.5        2316.6
     95.00         1776.2         565.5        2341.7
     96.00         1801.3         565.5        2366.8
     97.00         1826.5         565.5        2392.0
     98.00         1851.6         565.5        2417.1
     99.00         1876.7         565.5        2442.2
    100.00         1901.9         565.5        2467.4
    101.00         1927.0         565.5        2492.5
    102.00         1952.1         565.5        2517.6
    103.00         1977.3         565.5        2542.8
    104.00         2002.4         565.5        2567.9
    105.00         2027.5         565.5        2593.0
    106.00         2052.7         565.5        2618.2
    107.00         2077.8         565.5        2643.3
    108.00         2102.9         565.5        2668.4
    109.00         2128.1         565.5        2693.6
    110.00         2153.2         565.5        2718.7
    111.00         2178.3         565.5        2743.8


    NOTES:
    - AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
      IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
      OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.




        *************************************************
        * COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
        * CURVES FOR AXIAL LOADING                      *
        *************************************************


T-Z CURVE   NO. OF   DEPTH TO CURVE   LOAD TRANSFER   PILE MOVEMENT
   NO.      POINTS        FT.              PSI             IN.

    1         10      0.0000E+00
                                        0.0000E+00      0.0000E+00
                                        0.2739E-01      0.1000E-01
                                        0.5478E-01      0.2000E-01
                                        0.1096E+00      0.4000E-01
                                        0.1643E+00      0.6000E-01
                                        0.2191E+00      0.8000E-01
```

```
                                   0.2465E+00      0.9000E-01
                                   0.2739E+00      0.1000E+00
                                   0.2739E+00      0.5000E+00
                                   0.2739E+00      0.2000E+01
2         10      0.1463E+02
                                   0.0000E+00      0.0000E+00
                                   0.2739E+00      0.1000E-01
                                   0.5478E+00      0.2000E-01
                                   0.1096E+01      0.4000E-01
                                   0.1643E+01      0.6000E-01
                                   0.2191E+01      0.8000E-01
                                   0.2465E+01      0.9000E-01
                                   0.2739E+01      0.1000E+00
                                   0.2739E+01      0.5000E+00
                                   0.2739E+01      0.2000E+01
3         10      0.2916E+02
                                   0.0000E+00      0.0000E+00
                                   0.7951E+00      0.1000E-01
                                   0.1590E+01      0.2000E-01
                                   0.3181E+01      0.4000E-01
                                   0.4771E+01      0.6000E-01
                                   0.6361E+01      0.8000E-01
                                   0.7156E+01      0.9000E-01
                                   0.7951E+01      0.1000E+00
                                   0.7951E+01      0.5000E+00
                                   0.7951E+01      0.2000E+01
4         10      0.2920E+02
                                   0.0000E+00      0.0000E+00
                                   0.2385E+01      0.7680E-01
                                   0.3976E+01      0.1488E+00
                                   0.5964E+01      0.2736E+00
                                   0.7156E+01      0.3840E+00
                                   0.7951E+01      0.4800E+00
                                   0.7156E+01      0.9600E+00
                                   0.7156E+01      0.1440E+01
                                   0.7156E+01      0.2400E+01
                                   0.7156E+01      0.9600E+01
5         10      0.3998E+02
                                   0.0000E+00      0.0000E+00
                                   0.4167E+01      0.7680E-01
                                   0.6944E+01      0.1488E+00
                                   0.1042E+02      0.2736E+00
                                   0.1250E+02      0.3840E+00
                                   0.1389E+02      0.4800E+00
                                   0.1250E+02      0.9600E+00
                                   0.1250E+02      0.1440E+01
                                   0.1250E+02      0.2400E+01
                                   0.1250E+02      0.9600E+01
6         10      0.5066E+02
                                   0.0000E+00      0.0000E+00
                                   0.4167E+01      0.7680E-01
                                   0.6944E+01      0.1488E+00
                                   0.1042E+02      0.2736E+00
                                   0.1250E+02      0.3840E+00
                                   0.1389E+02      0.4800E+00
                                   0.1250E+02      0.9600E+00
                                   0.1250E+02      0.1440E+01
                                   0.1250E+02      0.2400E+01
                                   0.1250E+02      0.9600E+01
7         10      0.5070E+02
                                   0.0000E+00      0.0000E+00
                                   0.1389E+01      0.1000E-01
                                   0.2778E+01      0.2000E-01
```

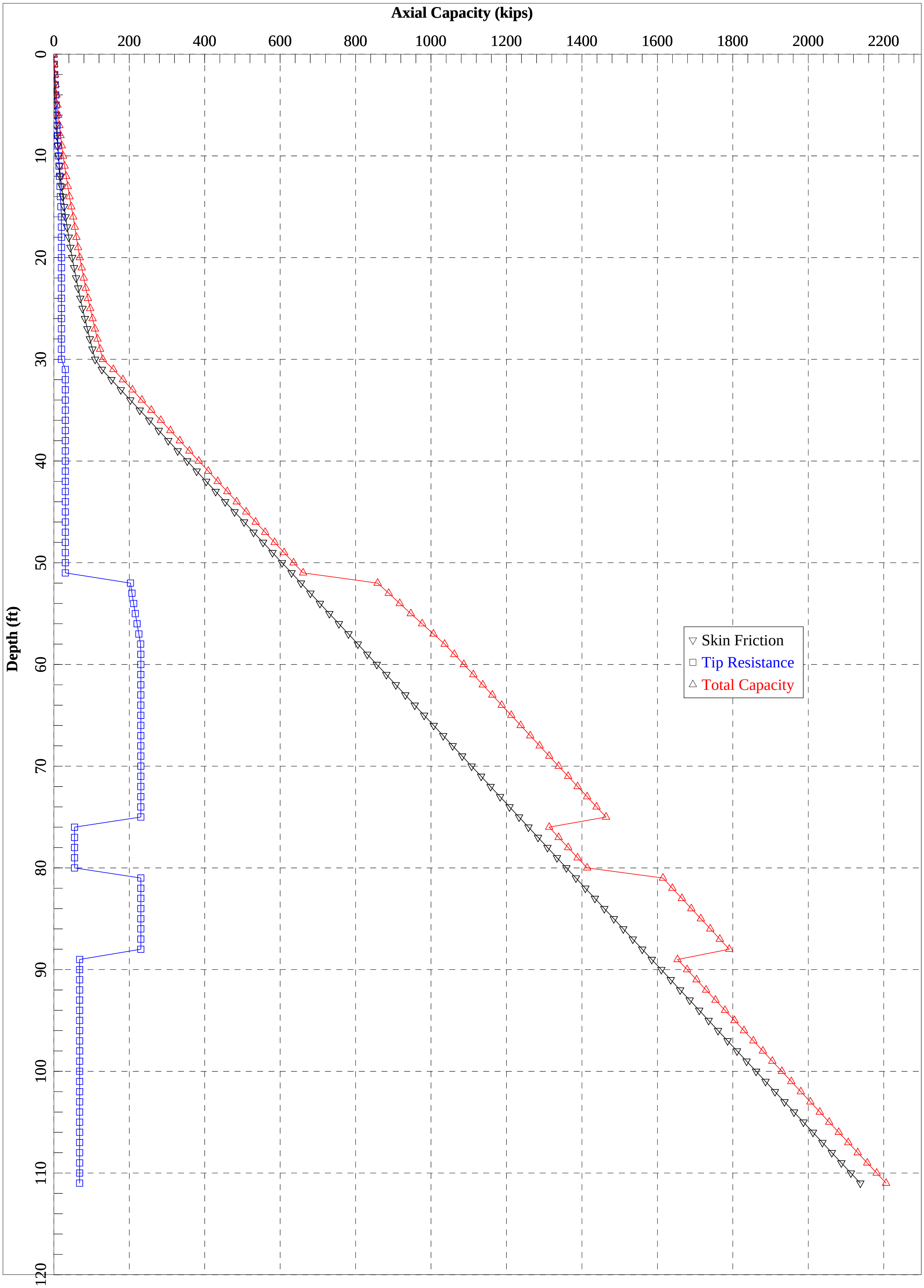
```
                              0.5556E+01       0.4000E-01
                              0.8333E+01       0.6000E-01
                              0.1111E+02       0.8000E-01
                              0.1250E+02       0.9000E-01
                              0.1389E+02       0.1000E+00
                              0.1389E+02       0.5000E+00
                              0.1389E+02       0.2000E+01
 8          10       0.5263E+02
                              0.0000E+00       0.0000E+00
                              0.1389E+01       0.1000E-01
                              0.2778E+01       0.2000E-01
                              0.5556E+01       0.4000E-01
                              0.8333E+01       0.6000E-01
                              0.1111E+02       0.8000E-01
                              0.1250E+02       0.9000E-01
                              0.1389E+02       0.1000E+00
                              0.1389E+02       0.5000E+00
                              0.1389E+02       0.2000E+01
 9          10       0.5446E+02
                              0.0000E+00       0.0000E+00
                              0.1389E+01       0.1000E-01
                              0.2778E+01       0.2000E-01
                              0.5556E+01       0.4000E-01
                              0.8333E+01       0.6000E-01
                              0.1111E+02       0.8000E-01
                              0.1250E+02       0.9000E-01
                              0.1389E+02       0.1000E+00
                              0.1389E+02       0.5000E+00
                              0.1389E+02       0.2000E+01
10          10       0.5450E+02
                              0.0000E+00       0.0000E+00
                              0.1389E+01       0.1000E-01
                              0.2778E+01       0.2000E-01
                              0.5556E+01       0.4000E-01
                              0.8333E+01       0.6000E-01
                              0.1111E+02       0.8000E-01
                              0.1250E+02       0.9000E-01
                              0.1389E+02       0.1000E+00
                              0.1389E+02       0.5000E+00
                              0.1389E+02       0.2000E+01
11          10       0.6453E+02
                              0.0000E+00       0.0000E+00
                              0.1389E+01       0.1000E-01
                              0.2778E+01       0.2000E-01
                              0.5556E+01       0.4000E-01
                              0.8333E+01       0.6000E-01
                              0.1111E+02       0.8000E-01
                              0.1250E+02       0.9000E-01
                              0.1389E+02       0.1000E+00
                              0.1389E+02       0.5000E+00
                              0.1389E+02       0.2000E+01
12          10       0.7446E+02
                              0.0000E+00       0.0000E+00
                              0.1389E+01       0.1000E-01
                              0.2778E+01       0.2000E-01
                              0.5556E+01       0.4000E-01
                              0.8333E+01       0.6000E-01
                              0.1111E+02       0.8000E-01
                              0.1250E+02       0.9000E-01
                              0.1389E+02       0.1000E+00
                              0.1389E+02       0.5000E+00
                              0.1389E+02       0.2000E+01
13          10       0.7450E+02
```

```
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
14         10      0.7703E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
15         10      0.7946E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
16         10      0.7950E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
17         10      0.8378E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
18         10      0.8796E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
```

```
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
    19         10      0.8800E+02
                                        0.0000E+00      0.0000E+00
                                        0.4167E+01      0.7680E-01
                                        0.6944E+01      0.1488E+00
                                        0.1042E+02      0.2736E+00
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01
    20         10      0.1190E+03
                                        0.0000E+00      0.0000E+00
                                        0.4167E+01      0.7680E-01
                                        0.6944E+01      0.1488E+00
                                        0.1042E+02      0.2736E+00
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01
    21         10      0.1500E+03
                                        0.0000E+00      0.0000E+00
                                        0.4167E+01      0.7680E-01
                                        0.6944E+01      0.1488E+00
                                        0.1042E+02      0.2736E+00
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01


 TIP   LOAD        TIP MOVEMENT
     KIP               IN.

 0.0000E+00         0.0000E+00
 0.3534E+02         0.2400E-01
 0.7069E+02         0.4800E-01
 0.1414E+03         0.9600E-01
 0.2827E+03         0.6240E+00
 0.4241E+03         0.2016E+01
 0.5089E+03         0.3504E+01
 0.5655E+03         0.4800E+01
 0.5655E+03         0.7200E+01
 0.5655E+03         0.9600E+01


               LOAD VERSUS SETTLEMENT CURVE
               ****************************



 TOP  LOAD     TOP MOVEMENT       TIP  LOAD      TIP MOVEMENT
    KIP             IN.              KIP             IN.
0.2490E+01      0.5600E-03      0.1473E+00      0.1000E-03
0.2490E+02      0.5600E-02      0.1473E+01      0.1000E-02
```

```
0.1250E+03       0.2806E-01       0.7363E+01       0.5000E-02
0.2510E+03       0.5630E-01       0.1473E+02       0.1000E-01
0.1163E+04       0.2713E+00       0.7363E+02       0.5000E-01
0.1707E+04       0.4399E+00       0.1424E+03       0.1000E+00
0.2407E+04       0.1003E+01       0.2495E+03       0.5000E+00
0.2385E+04       0.1502E+01       0.3209E+03       0.1000E+01
0.2486E+04       0.2531E+01       0.4225E+03       0.2000E+01
```

IB-6 Unplugged Condition



```
     =========================================================================

                      APILE for Windows, Version 2015.7.2

                       Serial Number :  239146456

                       A Program for Analyzing the Axial Capacity
                       and Short-term Settlement of Driven Piles
                                 under Axial Loading.
                     (c) Copyright ENSOFT, Inc., 1987-2015
                           All Rights Reserved

     =========================================================================


     This program is licensed to :

     SCDOT
     Columbia, SC

     Path to file locations      :
P:\Orangeburg\40308_us301\Geotechnical\5_Design\2_Final\7_InteriorBents\APile\Without
Overburden\
     Name of input data file     : B-6A.ap7d
     Name of output file         : B-6A.ap7o
     Name of plot output file    : B-6A.ap7p

     -------------------------------------------------------------------------
                          Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  April 14, 2016     Time:  14:29:11



1
          *********************
          * INPUT INFORMATION *
          *********************



          US 301 over Four Hole Swamp, Orangburg County  IB-6

          DESIGNER   : RSG

          JOB NUMBER : 0040308


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Reduced Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION
```

```
PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Open-Ended Pile


DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY     = 0.290E+08 PSI
- CROSS SECTION AREA        =    219.13 IN2


CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD      =     48.00 IN.
- INTERNAL DIAMETER, ID     =     45.00 IN.
- TOTAL PILE LENGTH, TL     =    150.00 FT.
- PILE STICKUP LENGTH, PSL  =     39.00 FT.
- ZERO FRICTION LENGTH, ZFL =      0.00 FT.
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION       =      1.00 FT.
- LENGTH OF ENHANCED
  END SECTION               =    150.00 FT.
- INTERNAL DIAMETER OF
  ENHANCED END SECTION      =     45.00 IN.


PLUGGED/UNPLUGGED CONDITIONS :
Unplugged for open-ended pile



SOIL INFORMATIONS :



                 LATERAL    EFFECTIVE    FRICTION   BEARING
          SOIL   EARTH      UNIT         ANGLE      CAPACITY
 DEPTH    TYPE   PRESSURE   WEIGHT       DEGREES    FACTOR
  FT.                       LB/CF
   0.00   SAND     0.00        47.60        30.00      0.00
  29.20   SAND     0.00        47.60        30.00      0.00
  29.20   CLAY     0.00        47.60         0.00      0.00
  50.70   CLAY     0.00        47.60         0.00      0.00
  50.70   SAND     0.00        52.60        36.00      0.00
  54.50   SAND     0.00        52.60        36.00      0.00
  54.50   SAND     0.00        57.60        36.00      0.00
  74.50   SAND     0.00        57.60        36.00      0.00
  74.50   CLAY     0.00        47.60         0.00      0.00
  79.50   CLAY     0.00        47.60         0.00      0.00
  79.50   SAND     0.00        52.60        36.00      0.00
  88.00   SAND     0.00        52.60        36.00      0.00
  88.00   CLAY     0.00        47.60         0.00      0.00
 150.00   CLAY     0.00        47.60         0.00      0.00


MAXIMUM   MAXIMUM   UNDISTURB  REMOLDED
UNIT      UNIT      SHEAR      SHEAR     BLOW   UNIT SKIN  UNIT END
FRICTION  BEARING   STRENGTH   STRENGTH  COUNT  FRICTION   BEARING
  KSF       KSF        KSF       KSF               KSF       KSF
```

```
          0.20E+01  0.47E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.47E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.48E+03        2.24      1.12   0.00       0.00      0.00
          0.20E+01  0.48E+03        2.24      1.12   0.00       0.00      0.00
          0.20E+01  0.24E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.24E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.40E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.40E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.23E+03        4.00      2.00   0.00       0.00      0.00
          0.20E+01  0.23E+03        4.00      2.00   0.00       0.00      0.00
          0.20E+01  0.36E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.36E+03        0.00      0.00   0.00       0.00      0.00
          0.20E+01  0.35E+03        5.00      2.50   0.00       0.00      0.00
          0.20E+01  0.35E+03        5.00      2.50   0.00       0.00      0.00


                   LRFD FACTOR  LRFD FACTOR
                    ON UNIT      ON UNIT
           DEPTH    FRICTION     BEARING
            FT.
             0.00    1.000       1.000
            29.20    1.000       1.000
            29.20    1.000       1.000
            50.70    1.000       1.000
            50.70    1.000       1.000
            54.50    1.000       1.000
            54.50    1.000       1.000
            74.50    1.000       1.000
            74.50    1.000       1.000
            79.50    1.000       1.000
            79.50    1.000       1.000
            88.00    1.000       1.000
            88.00    1.000       1.000
           150.00    1.000       1.000


1
          **********************
          * COMPUTATION RESULT *
          **********************


                            **********************
                            *  FED. HWY. METHOD  *
                            **********************

             PILE       TOTAL SKIN       END       ULTIMATE
          PENETRATION   FRICTION       BEARING     CAPACITY
              FT.          KIP           KIP          KIP
              0.00           0.0           0.0*          0.0
              1.00           0.1           1.3*          1.4
              2.00           0.5           2.5*          3.0
              3.00           1.1           3.8*          4.9
              4.00           2.0           5.0*          7.0
              5.00           3.0           6.3*          9.3
              6.00           4.4           7.6*         11.9
              7.00           6.0           8.8*         14.8
              8.00           7.8          10.1*         17.9
              9.00           9.9          11.3*         21.2
             10.00          12.2          12.6*         24.8
```

```
11.00          14.7          13.9*        28.6
12.00          17.6          15.1*        32.7
13.00          20.6          16.4*        37.0
14.00          23.9          17.6*        41.5
15.00          27.4          18.9*        46.3
16.00          31.2          20.2*        51.4
17.00          35.2          20.3*        55.5
18.00          39.5          20.3*        59.8
19.00          44.0          20.3*        64.3
20.00          48.8          20.3*        69.0
21.00          53.7          20.3*        74.0
22.00          59.0          20.3*        79.3
23.00          64.5          20.3*        84.7
24.00          70.2          20.3*        90.5
25.00          76.2          20.3*        96.4
26.00          82.4          20.3*       102.7
27.00          88.9          20.3*       109.1
28.00          95.6          20.3*       115.8
29.00         102.5          20.3*       122.8
30.00         109.7          20.3*       130.0
31.00         127.4          30.7*       158.1
32.00         152.6          30.7*       183.2
33.00         177.7          30.7*       208.4
34.00         202.8          30.7*       233.5
35.00         228.0          30.7*       258.6
36.00         253.1          30.7*       283.8
37.00         278.2          30.7*       308.9
38.00         303.4          30.7*       334.0
39.00         328.5          30.7*       359.2
40.00         353.6          30.7*       384.3
41.00         378.7          30.7*       409.4
42.00         403.9          30.7*       434.6
43.00         429.0          30.7*       459.7
44.00         454.1          30.7*       484.8
45.00         479.3          30.7*       510.0
46.00         504.4          30.7*       535.1
47.00         529.5          30.7*       560.2
48.00         554.7          30.7*       585.4
49.00         579.8          30.7*       610.5
50.00         604.9          30.7*       635.6
51.00         630.1          30.7*       660.8
52.00         655.2         203.1*       858.3
53.00         680.3         207.4*       887.7
54.00         705.5         211.7*       917.1
55.00         730.6         216.0*       946.6
56.00         755.7         220.7*       976.4
57.00         780.9         225.4*      1006.3
58.00         806.0         230.1*      1036.1
59.00         831.1         230.7*      1061.8
60.00         856.3         230.7*      1087.0
61.00         881.4         230.7*      1112.1
62.00         906.5         230.7*      1137.2
63.00         931.7         230.7*      1162.4
64.00         956.8         230.7*      1187.5
65.00         981.9         230.7*      1212.6
66.00        1007.1         230.7*      1237.8
67.00        1032.2         230.7*      1262.9
68.00        1057.3         230.7*      1288.0
69.00        1082.5         230.7*      1313.2
70.00        1107.6         230.7*      1338.3
71.00        1132.7         230.7*      1363.4
72.00        1157.9         230.7*      1388.6
73.00        1183.0         230.7*      1413.7
```

```
     74.00         1208.1         230.7*     1438.8
     75.00         1233.3         230.7*     1464.0
     76.00         1258.4          54.8*     1313.2
     77.00         1283.5          54.8*     1338.3
     78.00         1308.7          54.8*     1363.4
     79.00         1333.8          54.8*     1388.6
     80.00         1358.9          54.8*     1413.7
     81.00         1384.1         230.7*     1614.7
     82.00         1409.2         230.7*     1639.9
     83.00         1434.3         230.7*     1665.0
     84.00         1459.5         230.7*     1690.1
     85.00         1484.6         230.7*     1715.3
     86.00         1509.7         230.7*     1740.4
     87.00         1534.9         230.7*     1765.5
     88.00         1560.0         230.7*     1790.7
     89.00         1585.1          68.5*     1653.6
     90.00         1610.3          68.5*     1678.7
     91.00         1635.4          68.5*     1703.9
     92.00         1660.5          68.5*     1729.0
     93.00         1685.7          68.5*     1754.1
     94.00         1710.8          68.5*     1779.3
     95.00         1735.9          68.5*     1804.4
     96.00         1761.0          68.5*     1829.5
     97.00         1786.2          68.5*     1854.7
     98.00         1811.3          68.5*     1879.8
     99.00         1836.4          68.5*     1904.9
    100.00         1861.6          68.5*     1930.1
    101.00         1886.7          68.5*     1955.2
    102.00         1911.8          68.5*     1980.3
    103.00         1937.0          68.5*     2005.5
    104.00         1962.1          68.5*     2030.6
    105.00         1987.2          68.5*     2055.7
    106.00         2012.4          68.5*     2080.9
    107.00         2037.5          68.5*     2106.0
    108.00         2062.6          68.5*     2131.1
    109.00         2087.8          68.5*     2156.3
    110.00         2112.9          68.5*     2181.4
    111.00         2138.0          68.5*     2206.5


    NOTES:
    - AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
      IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
      OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.



        *************************************************
        * COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
        * CURVES FOR AXIAL LOADING                      *
        *************************************************


T-Z CURVE   NO. OF   DEPTH TO CURVE   LOAD TRANSFER   PILE MOVEMENT
   NO.      POINTS        FT.              PSI             IN.

    1         10      0.0000E+00
                                       0.0000E+00      0.0000E+00
                                       0.2021E-01      0.1000E-01
                                       0.4041E-01      0.2000E-01
                                       0.8082E-01      0.4000E-01
                                       0.1212E+00      0.6000E-01
                                       0.1616E+00      0.8000E-01
```

```
                                   0.1819E+00      0.9000E-01
                                   0.2021E+00      0.1000E+00
                                   0.2021E+00      0.5000E+00
                                   0.2021E+00      0.2000E+01
2         10      0.1463E+02
                                   0.0000E+00      0.0000E+00
                                   0.2021E+00      0.1000E-01
                                   0.4041E+00      0.2000E-01
                                   0.8082E+00      0.4000E-01
                                   0.1212E+01      0.6000E-01
                                   0.1616E+01      0.8000E-01
                                   0.1819E+01      0.9000E-01
                                   0.2021E+01      0.1000E+00
                                   0.2021E+01      0.5000E+00
                                   0.2021E+01      0.2000E+01
3         10      0.2916E+02
                                   0.0000E+00      0.0000E+00
                                   0.6886E+00      0.1000E-01
                                   0.1377E+01      0.2000E-01
                                   0.2754E+01      0.4000E-01
                                   0.4132E+01      0.6000E-01
                                   0.5509E+01      0.8000E-01
                                   0.6197E+01      0.9000E-01
                                   0.6886E+01      0.1000E+00
                                   0.6886E+01      0.5000E+00
                                   0.6886E+01      0.2000E+01
4         10      0.2920E+02
                                   0.0000E+00      0.0000E+00
                                   0.2066E+01      0.7680E-01
                                   0.3443E+01      0.1488E+00
                                   0.5165E+01      0.2736E+00
                                   0.6197E+01      0.3840E+00
                                   0.6886E+01      0.4800E+00
                                   0.6197E+01      0.9600E+00
                                   0.6197E+01      0.1440E+01
                                   0.6197E+01      0.2400E+01
                                   0.6197E+01      0.9600E+01
5         10      0.3998E+02
                                   0.0000E+00      0.0000E+00
                                   0.4167E+01      0.7680E-01
                                   0.6944E+01      0.1488E+00
                                   0.1042E+02      0.2736E+00
                                   0.1250E+02      0.3840E+00
                                   0.1389E+02      0.4800E+00
                                   0.1250E+02      0.9600E+00
                                   0.1250E+02      0.1440E+01
                                   0.1250E+02      0.2400E+01
                                   0.1250E+02      0.9600E+01
6         10      0.5066E+02
                                   0.0000E+00      0.0000E+00
                                   0.4167E+01      0.7680E-01
                                   0.6944E+01      0.1488E+00
                                   0.1042E+02      0.2736E+00
                                   0.1250E+02      0.3840E+00
                                   0.1389E+02      0.4800E+00
                                   0.1250E+02      0.9600E+00
                                   0.1250E+02      0.1440E+01
                                   0.1250E+02      0.2400E+01
                                   0.1250E+02      0.9600E+01
7         10      0.5070E+02
                                   0.0000E+00      0.0000E+00
                                   0.1389E+01      0.1000E-01
                                   0.2778E+01      0.2000E-01
```

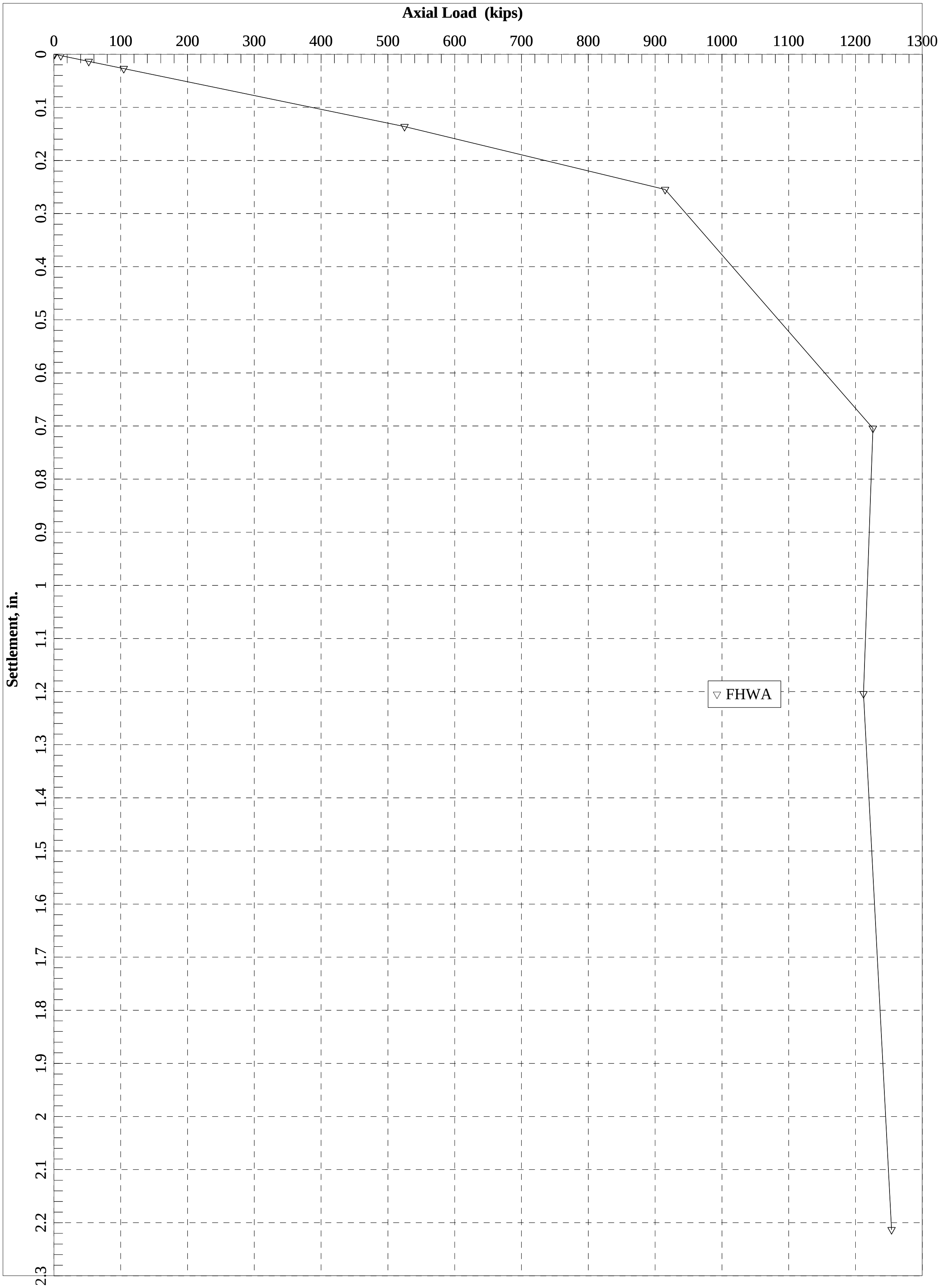
```
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
 8         10      0.5263E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
 9         10      0.5446E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
10         10      0.5450E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
11         10      0.6453E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
12         10      0.7446E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
13         10      0.7450E+02
```

```
                                        0.0000E+00      0.0000E+00
                                        0.4167E+01      0.7680E-01
                                        0.6944E+01      0.1488E+00
                                        0.1042E+02      0.2736E+00
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01
14          10      0.7703E+02
                                        0.0000E+00      0.0000E+00
                                        0.4167E+01      0.7680E-01
                                        0.6944E+01      0.1488E+00
                                        0.1042E+02      0.2736E+00
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01
15          10      0.7946E+02
                                        0.0000E+00      0.0000E+00
                                        0.4167E+01      0.7680E-01
                                        0.6944E+01      0.1488E+00
                                        0.1042E+02      0.2736E+00
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01
16          10      0.7950E+02
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
17          10      0.8378E+02
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
18          10      0.8796E+02
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
```

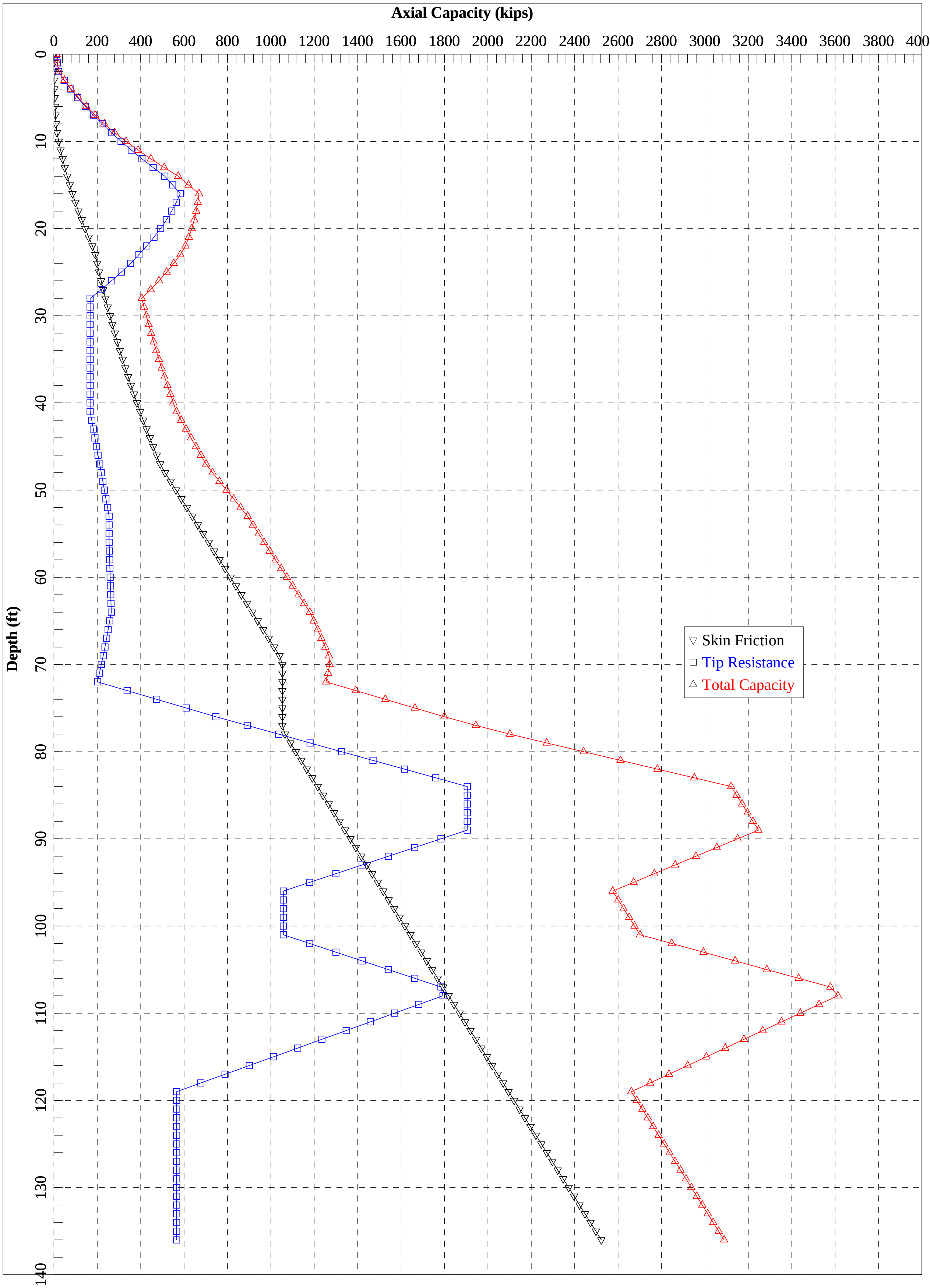
```
                                      0.1389E+02      0.5000E+00
                                      0.1389E+02      0.2000E+01
   19          10      0.8800E+02
                                      0.0000E+00      0.0000E+00
                                      0.4167E+01      0.7680E-01
                                      0.6944E+01      0.1488E+00
                                      0.1042E+02      0.2736E+00
                                      0.1250E+02      0.3840E+00
                                      0.1389E+02      0.4800E+00
                                      0.1250E+02      0.9600E+00
                                      0.1250E+02      0.1440E+01
                                      0.1250E+02      0.2400E+01
                                      0.1250E+02      0.9600E+01
   20          10      0.1190E+03
                                      0.0000E+00      0.0000E+00
                                      0.4167E+01      0.7680E-01
                                      0.6944E+01      0.1488E+00
                                      0.1042E+02      0.2736E+00
                                      0.1250E+02      0.3840E+00
                                      0.1389E+02      0.4800E+00
                                      0.1250E+02      0.9600E+00
                                      0.1250E+02      0.1440E+01
                                      0.1250E+02      0.2400E+01
                                      0.1250E+02      0.9600E+01
   21          10      0.1500E+03
                                      0.0000E+00      0.0000E+00
                                      0.4167E+01      0.7680E-01
                                      0.6944E+01      0.1488E+00
                                      0.1042E+02      0.2736E+00
                                      0.1250E+02      0.3840E+00
                                      0.1389E+02      0.4800E+00
                                      0.1250E+02      0.9600E+00
                                      0.1250E+02      0.1440E+01
                                      0.1250E+02      0.2400E+01
                                      0.1250E+02      0.9600E+01


 TIP   LOAD        TIP MOVEMENT
     KIP               IN.

 0.0000E+00         0.0000E+00
 0.4280E+01         0.2400E-01
 0.8560E+01         0.4800E-01
 0.1712E+02         0.9600E-01
 0.3424E+02         0.6240E+00
 0.5136E+02         0.2016E+01
 0.6163E+02         0.3504E+01
 0.6848E+02         0.4800E+01
 0.6848E+02         0.7200E+01
 0.6848E+02         0.9600E+01


                 LOAD VERSUS SETTLEMENT CURVE
                 ****************************



 TOP  LOAD     TOP MOVEMENT       TIP  LOAD      TIP MOVEMENT
    KIP            IN.               KIP             IN.
0.2057E+01      0.4789E-03      0.1783E-01      0.1000E-03
0.2057E+02      0.4789E-02      0.1783E+00      0.1000E-02
```

```
0.1031E+03      0.2397E-01      0.8916E+00      0.5000E-02
0.2071E+03      0.4810E-01      0.1783E+01      0.1000E-01
0.9909E+03      0.2356E+00      0.8916E+01      0.5000E-01
0.1519E+04      0.3958E+00      0.1725E+02      0.1000E+00
0.2147E+04      0.9363E+00      0.3022E+02      0.5000E+00
0.2059E+04      0.1417E+01      0.3886E+02      0.1000E+01
0.2071E+04      0.2421E+01      0.5116E+02      0.2000E+01
```

IB-6 Settlement



IB-7 Plugged Condition



```
     =========================================================================

                      APILE for Windows, Version 2015.7.2

                       Serial Number :  239146456

                       A Program for Analyzing the Axial Capacity
                       and Short-term Settlement of Driven Piles
                                 under Axial Loading.
                     (c) Copyright ENSOFT, Inc., 1987-2015
                           All Rights Reserved

     =========================================================================


     This program is licensed to :

     SCDOT
     Columbia, SC

     Path to file locations      :
P:\Orangeburg\40308_us301\Geotechnical\5_Design\2_Final\7_InteriorBents\APile\Without
Overburden(Capacity)\
     Name of input data file     : B-7A.ap7d
     Name of output file         : B-7A.ap7o
     Name of plot output file    : B-7A.ap7p

     -------------------------------------------------------------------------
                          Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  April 27, 2016     Time:  10:19:44



1
          *********************
          * INPUT INFORMATION *
          *********************



          US 301 over Four Hole Swamp, Orangeburg County  IB-7

          DESIGNER   : RSG

          JOB NUMBER : 0040308


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Reduced Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION
```

```
PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Open-Ended Pile


DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY     = 0.290E+08 PSI
- CROSS SECTION AREA        =    219.13 IN2


CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD      =     48.00 IN.
- INTERNAL DIAMETER, ID     =     45.00 IN.
- TOTAL PILE LENGTH, TL     =    150.00 FT.
- PILE STICKUP LENGTH, PSL  =     14.00 FT.
- ZERO FRICTION LENGTH, ZFL =      0.00 FT.
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION       =      1.00 FT.
- LENGTH OF ENHANCED
  END SECTION               =    150.00 FT.
- INTERNAL DIAMETER OF
  ENHANCED END SECTION      =     45.00 IN.


PLUGGED/UNPLUGGED CONDITIONS :
Plugged for open-ended pile



SOIL INFORMATIONS :



                  LATERAL    EFFECTIVE    FRICTION   BEARING
         SOIL     EARTH      UNIT         ANGLE      CAPACITY
 DEPTH   TYPE     PRESSURE   WEIGHT       DEGREES    FACTOR
  FT.                        LB/CF
   0.00  CLAY       0.00        47.60         0.00       0.00
   2.00  CLAY       0.00        47.60         0.00       0.00
   2.00  SAND       0.00        57.60        28.00       0.00
   8.00  SAND       0.00        57.60        28.00       0.00
   8.00  SAND       0.00        52.60        36.00       0.00
  21.50  SAND       0.00        52.60        36.00       0.00
  21.50  SAND       0.00        47.60        30.00       0.00
  46.50  SAND       0.00        47.60        30.00       0.00
  46.50  CLAY       0.00        47.60         0.00       0.00
  62.00  CLAY       0.00        47.60         0.00       0.00
  62.00  CLAY       0.00        47.60         0.00       0.00
  70.00  CLAY       0.00        47.60         0.00       0.00
  70.00  SAND       0.00        52.60        29.00       0.00
  77.10  SAND       0.00        52.60        29.00       0.00
  77.10  SAND       0.00        52.60        36.00       0.00
  90.00  SAND       0.00        52.60        36.00       0.00
  90.00  SAND       0.00        57.60        36.00       0.00
  94.50  SAND       0.00        57.60        36.00       0.00
  94.50  CLAY       0.00        47.60         0.00       0.00
 101.50  CLAY       0.00        47.60         0.00       0.00
 101.50  SAND       0.00        52.60        36.00       0.00
```

```
 112.50   SAND      0.00        52.60        36.00      0.00
 112.50   CLAY      0.00        47.60         0.00      0.00
 150.00   CLAY      0.00        47.60         0.00      0.00
```

```
MAXIMUM   MAXIMUM   UNDISTURB  REMOLDED
UNIT      UNIT      SHEAR      SHEAR     BLOW   UNIT SKIN  UNIT END
FRICTION  BEARING   STRENGTH   STRENGTH  COUNT  FRICTION   BEARING
  KSF       KSF        KSF       KSF               KSF       KSF
0.10E+08* 0.10E+08*       0.10      0.05   0.00        0.00      0.00
0.10E+08* 0.10E+08*       0.10      0.05   0.00        0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00        0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00        0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00        0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00        0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00        0.00      0.00
0.10E+08* 0.10E+08*       0.00      0.00   0.00        0.00      0.00
0.20E+01  0.52E+03        2.25      1.13   0.00        0.00      0.00
0.20E+01  0.52E+03        2.25      1.13   0.00        0.00      0.00
0.20E+01  0.46E+03        2.39      1.19   0.00        0.00      0.00
0.20E+01  0.46E+03        2.39      1.19   0.00        0.00      0.00
0.10E-03  0.60E+02        0.00      0.00   0.00        0.00      0.00
0.10E-03  0.60E+02        0.00      0.00   0.00        0.00      0.00
0.20E+01  0.43E+03        0.00      0.00   0.00        0.00      0.00
0.20E+01  0.43E+03        0.00      0.00   0.00        0.00      0.00
0.20E+01  0.40E+03        0.00      0.00   0.00        0.00      0.00
0.20E+01  0.40E+03        0.00      0.00   0.00        0.00      0.00
0.20E+01  0.10E+08*       4.00      2.00   0.00        0.00      0.00
0.20E+01  0.10E+08*       4.00      2.00   0.00        0.00      0.00
0.20E+01  0.37E+03        0.00      0.00   0.00        0.00      0.00
0.20E+01  0.37E+03        0.00      0.00   0.00        0.00      0.00
0.20E+01  0.10E+08*       5.00      2.50   0.00        0.00      0.00
0.20E+01  0.10E+08*       5.00      2.50   0.00        0.00      0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
  PLAN TO LIMIT THE COMPUTED DATA.
```

```
         LRFD FACTOR  LRFD FACTOR
          ON UNIT      ON UNIT
 DEPTH    FRICTION     BEARING
  FT.
   0.00    1.000       1.000
   2.00    1.000       1.000
   2.00    1.000       1.000
   8.00    1.000       1.000
   8.00    1.000       1.000
  21.50    1.000       1.000
  21.50    1.000       1.000
  46.50    1.000       1.000
  46.50    1.000       1.000
  62.00    1.000       1.000
  62.00    1.000       1.000
  70.00    1.000       1.000
  70.00    1.000       1.000
  77.10    1.000       1.000
  77.10    1.000       1.000
  90.00    1.000       1.000
  90.00    1.000       1.000
  94.50    1.000       1.000
```

```
            94.50    1.000       1.000
           101.50    1.000       1.000
           101.50    1.000       1.000
           112.50    1.000       1.000
           112.50    1.000       1.000
           150.00    1.000       1.000



1
          **********************
          * COMPUTATION RESULT *
          **********************



                            **********************
                            *  FED. HWY. METHOD  *
                            **********************

             PILE       TOTAL SKIN       END       ULTIMATE
          PENETRATION   FRICTION       BEARING     CAPACITY
              FT.          KIP           KIP          KIP
              0.00           0.0          12.7         12.7
              1.00           0.0          16.2         16.2
              2.00           0.4          21.5         21.9
              3.00           1.3          47.8         49.1
              4.00           2.3          77.1         79.4
              5.00           3.7         109.4        113.0
              6.00           5.4         144.6        150.0
              7.00           7.4         182.7        190.2
              8.00           9.8         222.9        232.7
              9.00          14.7         265.4        280.2
             10.00          22.6         310.2        332.7
             11.00          31.2         357.2        388.3
             12.00          40.6         406.3        446.9
             13.00          50.7         457.8        508.5
             14.00          61.7         511.4        573.1
             15.00          73.5         547.0        620.4
             16.00          86.0         582.5        668.6
             17.00          99.4         564.2        663.6
             18.00         113.5         543.0        656.5
             19.00         128.5         518.8        647.2
             20.00         144.2         491.6        635.7
             21.00         160.7         461.4        622.1
             22.00         178.0         428.3        606.3
             23.00         191.1         392.2        583.3
             24.00         199.7         353.2        552.9
             25.00         208.7         311.2        519.9
             26.00         218.1         266.2        484.3
             27.00         227.7         218.3        446.0
             28.00         237.7         167.4        405.1
             29.00         248.0         167.4        415.4
             30.00         258.7         167.4        426.1
             31.00         269.7         167.4        437.1
             32.00         281.0         167.4        448.4
             33.00         292.6         167.4        460.0
             34.00         304.6         167.4        472.0
             35.00         316.9         167.4        484.3
             36.00         329.5         167.4        496.9
             37.00         342.5         167.4        509.9
             38.00         355.8         167.4        523.2
             39.00         369.4         167.4        536.8
```

40.00	383.4	167.4	550.7
41.00	397.6	167.4	565.0
42.00	412.3	174.7	586.9
43.00	427.2	181.9	609.1
44.00	442.5	189.2	631.7
45.00	458.1	196.5	654.6
46.00	474.0	203.8	677.8
47.00	490.3	211.0	701.3
48.00	512.6	218.3	731.0
49.00	537.8	225.6	763.4
50.00	562.9	232.9	795.8
51.00	588.0	240.1	828.2
52.00	613.2	247.4	860.6
53.00	638.3	254.7	893.0
54.00	663.4	254.7	918.1
55.00	688.6	254.7	943.3
56.00	713.7	254.7	968.4
57.00	738.8	256.0	994.8
58.00	764.0	257.2	1021.2
59.00	789.1	258.5	1047.6
60.00	814.2	259.7	1074.0
61.00	839.4	261.0	1100.4
62.00	864.5	262.3	1126.8
63.00	889.6	263.5	1153.2
64.00	914.8	264.8	1179.6
65.00	939.9	257.5	1197.4
66.00	965.0	250.2	1215.3
67.00	990.2	243.0	1233.1
68.00	1015.3	235.7	1251.0
69.00	1040.4	227.2	1267.6
70.00	1053.0	218.6	1271.6
71.00	1053.0	210.1	1263.1
72.00	1053.0	201.5	1254.5
73.00	1053.0	337.8	1390.8
74.00	1053.0	474.1	1527.1
75.00	1053.0	610.3	1663.3
76.00	1053.0	746.6	1799.6
77.00	1053.0	891.4	1944.4
78.00	1065.3	1036.2	2101.5
79.00	1090.4	1181.0	2271.4
80.00	1115.5	1325.8	2441.4
81.00	1140.7	1470.6	2611.3
82.00	1165.8	1615.4	2781.3
83.00	1190.9	1760.3	2951.2
84.00	1216.1	1905.1	3121.1
85.00	1241.2	1905.1	3146.3
86.00	1266.3	1905.1	3171.4
87.00	1291.5	1905.1	3196.5
88.00	1316.6	1905.1	3221.7
89.00	1341.7	1905.1	3246.8
90.00	1366.9	1784.0	3150.9
91.00	1392.0	1662.9	3055.0
92.00	1417.1	1541.9	2959.0
93.00	1442.3	1420.8	2863.1
94.00	1467.4	1299.8	2767.2
95.00	1492.5	1178.7	2671.3
96.00	1517.7	1057.7	2575.3
97.00	1542.8	1057.7	2600.5
98.00	1567.9	1057.7	2625.6
99.00	1593.1	1057.7	2650.7
100.00	1618.2	1057.7	2675.9
101.00	1643.3	1057.7	2701.0
102.00	1668.5	1178.7	2847.2

```
    103.00        1693.6        1299.8       2993.4
    104.00        1718.7        1420.8       3139.6
    105.00        1743.9        1541.9       3285.8
    106.00        1769.0        1662.9       3431.9
    107.00        1794.1        1784.0       3578.1
    108.00        1819.3        1793.4       3612.7
    109.00        1844.4        1681.8       3526.2
    110.00        1869.5        1570.2       3439.7
    111.00        1894.7        1458.5       3353.2
    112.00        1919.8        1346.9       3266.7
    113.00        1944.9        1235.3       3180.2
    114.00        1970.1        1123.6       3093.7
    115.00        1995.2        1012.0       3007.2
    116.00        2020.3         900.4       2920.7
    117.00        2045.5         788.7       2834.2
    118.00        2070.6         677.1       2747.7
    119.00        2095.7         565.5       2661.2
    120.00        2120.9         565.5       2686.3
    121.00        2146.0         565.5       2711.5
    122.00        2171.1         565.5       2736.6
    123.00        2196.3         565.5       2761.7
    124.00        2221.4         565.5       2786.9
    125.00        2246.5         565.5       2812.0
    126.00        2271.7         565.5       2837.1
    127.00        2296.8         565.5       2862.3
    128.00        2321.9         565.5       2887.4
    129.00        2347.1         565.5       2912.5
    130.00        2372.2         565.5       2937.7
    131.00        2397.3         565.5       2962.8
    132.00        2422.5         565.5       2987.9
    133.00        2447.6         565.5       3013.1
    134.00        2472.7         565.5       3038.2
    135.00        2497.8         565.5       3063.3
    136.00        2523.0         565.5       3088.5


    NOTES:
    - AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
      IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
      OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.


        *************************************************
        * COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
        * CURVES FOR AXIAL LOADING                      *
        *************************************************


T-Z CURVE   NO. OF   DEPTH TO CURVE   LOAD TRANSFER   PILE MOVEMENT
   NO.      POINTS        FT.              PSI             IN.

    1         10      0.0000E+00
                                       0.0000E+00      0.0000E+00
                                       0.6915E-01      0.7680E-01
                                       0.1152E+00      0.1488E+00
                                       0.1729E+00      0.2736E+00
                                       0.2074E+00      0.3840E+00
                                       0.2305E+00      0.4800E+00
                                       0.2074E+00      0.9600E+00
                                       0.2074E+00      0.1440E+01
                                       0.2074E+00      0.2400E+01
                                       0.2074E+00      0.9600E+01
```

```
2         10      0.1025E+01
                                   0.0000E+00      0.0000E+00
                                   0.1417E+00      0.7680E-01
                                   0.2361E+00      0.1488E+00
                                   0.3542E+00      0.2736E+00
                                   0.4250E+00      0.3840E+00
                                   0.4723E+00      0.4800E+00
                                   0.4250E+00      0.9600E+00
                                   0.4250E+00      0.1440E+01
                                   0.4250E+00      0.2400E+01
                                   0.4250E+00      0.9600E+01
3         10      0.1958E+01
                                   0.0000E+00      0.0000E+00
                                   0.1417E+00      0.7680E-01
                                   0.2361E+00      0.1488E+00
                                   0.3542E+00      0.2736E+00
                                   0.4250E+00      0.3840E+00
                                   0.4723E+00      0.4800E+00
                                   0.4250E+00      0.9600E+00
                                   0.4250E+00      0.1440E+01
                                   0.4250E+00      0.2400E+01
                                   0.4250E+00      0.9600E+01
4         10      0.2000E+01
                                   0.0000E+00      0.0000E+00
                                   0.5235E-01      0.1000E-01
                                   0.1047E+00      0.2000E-01
                                   0.2094E+00      0.4000E-01
                                   0.3141E+00      0.6000E-01
                                   0.4188E+00      0.8000E-01
                                   0.4711E+00      0.9000E-01
                                   0.5235E+00      0.1000E+00
                                   0.5235E+00      0.5000E+00
                                   0.5235E+00      0.2000E+01
5         10      0.5025E+01
                                   0.0000E+00      0.0000E+00
                                   0.1030E+00      0.1000E-01
                                   0.2061E+00      0.2000E-01
                                   0.4122E+00      0.4000E-01
                                   0.6183E+00      0.6000E-01
                                   0.8244E+00      0.8000E-01
                                   0.9274E+00      0.9000E-01
                                   0.1030E+01      0.1000E+00
                                   0.1030E+01      0.5000E+00
                                   0.1030E+01      0.2000E+01
6         10      0.7958E+01
                                   0.0000E+00      0.0000E+00
                                   0.2025E+00      0.1000E-01
                                   0.4051E+00      0.2000E-01
                                   0.8102E+00      0.4000E-01
                                   0.1215E+01      0.6000E-01
                                   0.1620E+01      0.8000E-01
                                   0.1823E+01      0.9000E-01
                                   0.2025E+01      0.1000E+00
                                   0.2025E+01      0.5000E+00
                                   0.2025E+01      0.2000E+01
7         10      0.8000E+01
                                   0.0000E+00      0.0000E+00
                                   0.3532E+00      0.1000E-01
                                   0.7064E+00      0.2000E-01
                                   0.1413E+01      0.4000E-01
                                   0.2119E+01      0.6000E-01
                                   0.2826E+01      0.8000E-01
                                   0.3179E+01      0.9000E-01
```

```
                                    0.3532E+01      0.1000E+00
                                    0.3532E+01      0.5000E+00
                                    0.3532E+01      0.2000E+01
 8         10      0.1478E+02
                                    0.0000E+00      0.0000E+00
                                    0.6721E+00      0.1000E-01
                                    0.1344E+01      0.2000E-01
                                    0.2688E+01      0.4000E-01
                                    0.4032E+01      0.6000E-01
                                    0.5377E+01      0.8000E-01
                                    0.6049E+01      0.9000E-01
                                    0.6721E+01      0.1000E+00
                                    0.6721E+01      0.5000E+00
                                    0.6721E+01      0.2000E+01
 9         10      0.2146E+02
                                    0.0000E+00      0.0000E+00
                                    0.8400E+00      0.1000E-01
                                    0.1680E+01      0.2000E-01
                                    0.3360E+01      0.4000E-01
                                    0.5040E+01      0.6000E-01
                                    0.6720E+01      0.8000E-01
                                    0.7560E+01      0.9000E-01
                                    0.8400E+01      0.1000E+00
                                    0.8400E+01      0.5000E+00
                                    0.8400E+01      0.2000E+01
10         10      0.2150E+02
                                    0.0000E+00      0.0000E+00
                                    0.8400E+00      0.1000E-01
                                    0.1680E+01      0.2000E-01
                                    0.3360E+01      0.4000E-01
                                    0.5040E+01      0.6000E-01
                                    0.6720E+01      0.8000E-01
                                    0.7560E+01      0.9000E-01
                                    0.8400E+01      0.1000E+00
                                    0.8400E+01      0.5000E+00
                                    0.8400E+01      0.2000E+01
11         10      0.3403E+02
                                    0.0000E+00      0.0000E+00
                                    0.6889E+00      0.1000E-01
                                    0.1378E+01      0.2000E-01
                                    0.2756E+01      0.4000E-01
                                    0.4134E+01      0.6000E-01
                                    0.5511E+01      0.8000E-01
                                    0.6200E+01      0.9000E-01
                                    0.6889E+01      0.1000E+00
                                    0.6889E+01      0.5000E+00
                                    0.6889E+01      0.2000E+01
12         10      0.4646E+02
                                    0.0000E+00      0.0000E+00
                                    0.1067E+01      0.1000E-01
                                    0.2135E+01      0.2000E-01
                                    0.4270E+01      0.4000E-01
                                    0.6405E+01      0.6000E-01
                                    0.8539E+01      0.8000E-01
                                    0.9607E+01      0.9000E-01
                                    0.1067E+02      0.1000E+00
                                    0.1067E+02      0.5000E+00
                                    0.1067E+02      0.2000E+01
13         10      0.4650E+02
                                    0.0000E+00      0.0000E+00
                                    0.3202E+01      0.7680E-01
                                    0.5337E+01      0.1488E+00
                                    0.8006E+01      0.2736E+00
```

```
                                    0.9607E+01      0.3840E+00
                                    0.1067E+02      0.4800E+00
                                    0.9607E+01      0.9600E+00
                                    0.9607E+01      0.1440E+01
                                    0.9607E+01      0.2400E+01
                                    0.9607E+01      0.9600E+01
14         10      0.5428E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
15         10      0.6196E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
16         10      0.6200E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
17         10      0.6603E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
18         10      0.6996E+02
                                    0.0000E+00      0.0000E+00
                                    0.1042E+01      0.7680E-01
                                    0.1736E+01      0.1488E+00
                                    0.2605E+01      0.2736E+00
                                    0.3125E+01      0.3840E+00
                                    0.3473E+01      0.4800E+00
                                    0.3125E+01      0.9600E+00
                                    0.3125E+01      0.1440E+01
                                    0.3125E+01      0.2400E+01
                                    0.3125E+01      0.9600E+01
19         10      0.7000E+02
                                    0.0000E+00      0.0000E+00
```

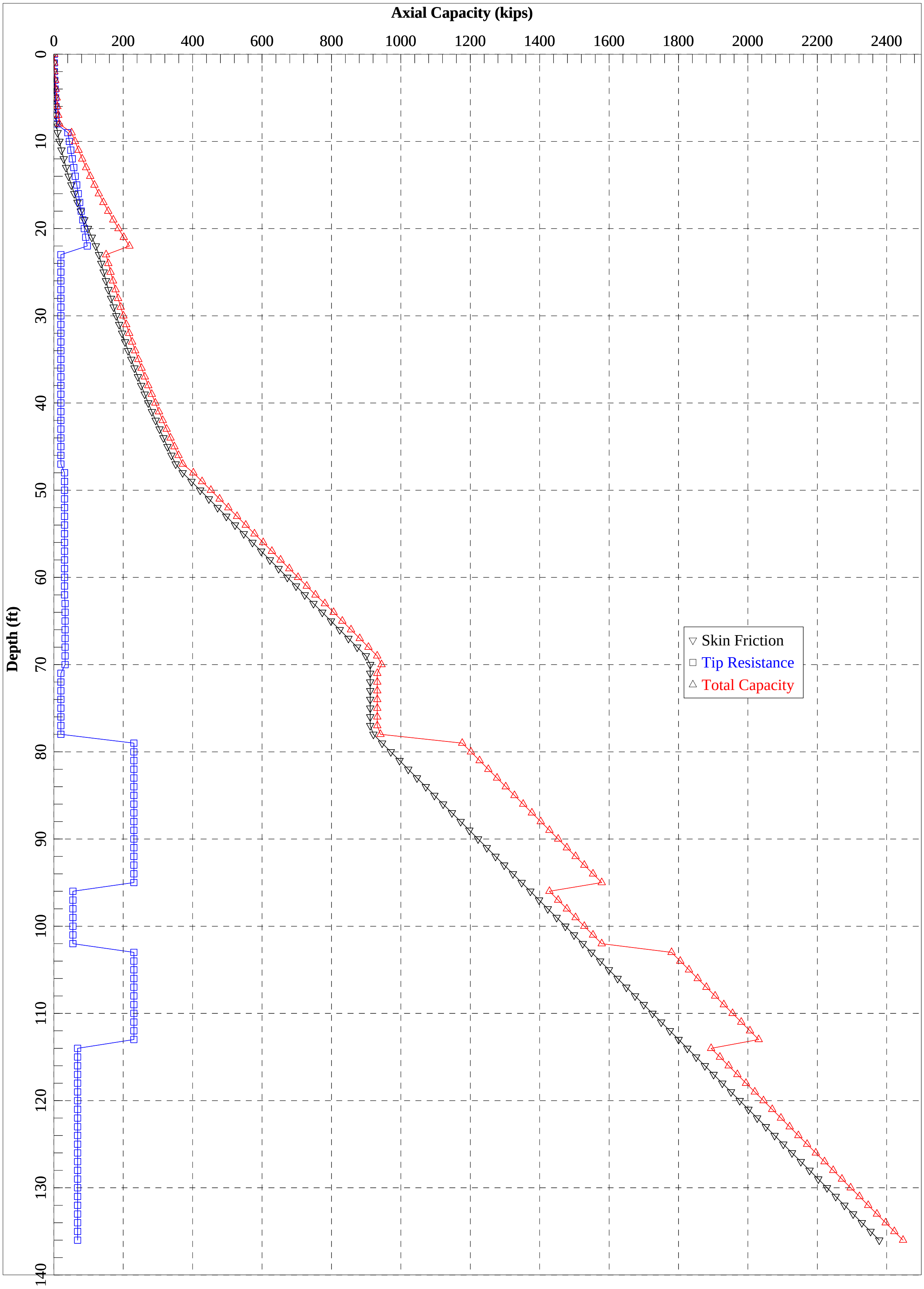
```
                                    0.6944E-04      0.1000E-01
                                    0.1389E-03      0.2000E-01
                                    0.2778E-03      0.4000E-01
                                    0.4167E-03      0.6000E-01
                                    0.5556E-03      0.8000E-01
                                    0.6250E-03      0.9000E-01
                                    0.6944E-03      0.1000E+00
                                    0.6944E-03      0.5000E+00
                                    0.6944E-03      0.2000E+01
20         10      0.7358E+02
                                    0.0000E+00      0.0000E+00
                                    0.6944E-04      0.1000E-01
                                    0.1389E-03      0.2000E-01
                                    0.2778E-03      0.4000E-01
                                    0.4167E-03      0.6000E-01
                                    0.5556E-03      0.8000E-01
                                    0.6250E-03      0.9000E-01
                                    0.6944E-03      0.1000E+00
                                    0.6944E-03      0.5000E+00
                                    0.6944E-03      0.2000E+01
21         10      0.7706E+02
                                    0.0000E+00      0.0000E+00
                                    0.1034E+01      0.1000E-01
                                    0.2067E+01      0.2000E-01
                                    0.4135E+01      0.4000E-01
                                    0.6202E+01      0.6000E-01
                                    0.8269E+01      0.8000E-01
                                    0.9303E+01      0.9000E-01
                                    0.1034E+02      0.1000E+00
                                    0.1034E+02      0.5000E+00
                                    0.1034E+02      0.2000E+01
22         10      0.7710E+02
                                    0.0000E+00      0.0000E+00
                                    0.1034E+01      0.1000E-01
                                    0.2067E+01      0.2000E-01
                                    0.4135E+01      0.4000E-01
                                    0.6202E+01      0.6000E-01
                                    0.8269E+01      0.8000E-01
                                    0.9303E+01      0.9000E-01
                                    0.1034E+02      0.1000E+00
                                    0.1034E+02      0.5000E+00
                                    0.1034E+02      0.2000E+01
23         10      0.8358E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
24         10      0.8996E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
```

```
                                    0.1389E+02      0.2000E+01
25         10      0.9000E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
26         10      0.9228E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
27         10      0.9446E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
28         10      0.9450E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
29         10      0.9803E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
30         10      0.1015E+03
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
```

```
                                        0.1250E+02       0.9600E+00
                                        0.1250E+02       0.1440E+01
                                        0.1250E+02       0.2400E+01
                                        0.1250E+02       0.9600E+01
31          10       0.1015E+03
                                        0.0000E+00       0.0000E+00
                                        0.1389E+01       0.1000E-01
                                        0.2778E+01       0.2000E-01
                                        0.5556E+01       0.4000E-01
                                        0.8333E+01       0.6000E-01
                                        0.1111E+02       0.8000E-01
                                        0.1250E+02       0.9000E-01
                                        0.1389E+02       0.1000E+00
                                        0.1389E+02       0.5000E+00
                                        0.1389E+02       0.2000E+01
32          10       0.1070E+03
                                        0.0000E+00       0.0000E+00
                                        0.1389E+01       0.1000E-01
                                        0.2778E+01       0.2000E-01
                                        0.5556E+01       0.4000E-01
                                        0.8333E+01       0.6000E-01
                                        0.1111E+02       0.8000E-01
                                        0.1250E+02       0.9000E-01
                                        0.1389E+02       0.1000E+00
                                        0.1389E+02       0.5000E+00
                                        0.1389E+02       0.2000E+01
33          10       0.1125E+03
                                        0.0000E+00       0.0000E+00
                                        0.1389E+01       0.1000E-01
                                        0.2778E+01       0.2000E-01
                                        0.5556E+01       0.4000E-01
                                        0.8333E+01       0.6000E-01
                                        0.1111E+02       0.8000E-01
                                        0.1250E+02       0.9000E-01
                                        0.1389E+02       0.1000E+00
                                        0.1389E+02       0.5000E+00
                                        0.1389E+02       0.2000E+01
34          10       0.1125E+03
                                        0.0000E+00       0.0000E+00
                                        0.4167E+01       0.7680E-01
                                        0.6944E+01       0.1488E+00
                                        0.1042E+02       0.2736E+00
                                        0.1250E+02       0.3840E+00
                                        0.1389E+02       0.4800E+00
                                        0.1250E+02       0.9600E+00
                                        0.1250E+02       0.1440E+01
                                        0.1250E+02       0.2400E+01
                                        0.1250E+02       0.9600E+01
35          10       0.1313E+03
                                        0.0000E+00       0.0000E+00
                                        0.4167E+01       0.7680E-01
                                        0.6944E+01       0.1488E+00
                                        0.1042E+02       0.2736E+00
                                        0.1250E+02       0.3840E+00
                                        0.1389E+02       0.4800E+00
                                        0.1250E+02       0.9600E+00
                                        0.1250E+02       0.1440E+01
                                        0.1250E+02       0.2400E+01
                                        0.1250E+02       0.9600E+01
36          10       0.1500E+03
                                        0.0000E+00       0.0000E+00
                                        0.4167E+01       0.7680E-01
                                        0.6944E+01       0.1488E+00
```

```
                                   0.1042E+02      0.2736E+00
                                   0.1250E+02      0.3840E+00
                                   0.1389E+02      0.4800E+00
                                   0.1250E+02      0.9600E+00
                                   0.1250E+02      0.1440E+01
                                   0.1250E+02      0.2400E+01
                                   0.1250E+02      0.9600E+01


  TIP   LOAD        TIP MOVEMENT
      KIP               IN.

  0.0000E+00         0.0000E+00
  0.3534E+02         0.2400E-01
  0.7069E+02         0.4800E-01
  0.1414E+03         0.9600E-01
  0.2827E+03         0.6240E+00
  0.4241E+03         0.2016E+01
  0.5089E+03         0.3504E+01
  0.5655E+03         0.4800E+01
  0.5655E+03         0.7200E+01
  0.5655E+03         0.9600E+01


                  LOAD VERSUS SETTLEMENT CURVE
                  ****************************


  TOP  LOAD     TOP MOVEMENT       TIP  LOAD      TIP MOVEMENT
     KIP            IN.              KIP              IN.
 0.3837E+01      0.6331E-03      0.1473E+00      0.1000E-03
 0.3837E+02      0.6331E-02      0.1473E+01      0.1000E-02
 0.1927E+03      0.3171E-01      0.7363E+01      0.5000E-02
 0.3866E+03      0.6359E-01      0.1473E+02      0.1000E-01
 0.1501E+04      0.2860E+00      0.7363E+02      0.5000E-01
 0.2049E+04      0.4529E+00      0.1424E+03      0.1000E+00
 0.2787E+04      0.1021E+01      0.2495E+03      0.5000E+00
 0.2758E+04      0.1520E+01      0.3209E+03      0.1000E+01
 0.2860E+04      0.2548E+01      0.4225E+03      0.2000E+01
```

IB-7 Unplugged Condition



```
     ==========================================================================

                      APILE for Windows, Version 2015.7.2

                       Serial Number :  239146456

                       A Program for Analyzing the Axial Capacity
                       and Short-term Settlement of Driven Piles
                                 under Axial Loading.
                     (c) Copyright ENSOFT, Inc., 1987-2015
                           All Rights Reserved

     ==========================================================================


     This program is licensed to :

     SCDOT
     Columbia, SC

     Path to file locations      :
P:\Orangeburg\40308_us301\Geotechnical\5_Design\2_Final\7_InteriorBents\APile\Without
Overburden(Capacity)\
     Name of input data file     : B-7A.ap7d
     Name of output file         : B-7A.ap7o
     Name of plot output file    : B-7A.ap7p

     --------------------------------------------------------------------------
                         Time and Date of Analysis
     --------------------------------------------------------------------------

               Date:  April 27, 2016     Time:  10:29:45



1
          *********************
          * INPUT INFORMATION *
          *********************



          US 301 over Four Hole Swamp, Orangeburg County  IB-7

          DESIGNER   : RSG

          JOB NUMBER : 0040308


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Reduced Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION
```

```
PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Open-Ended Pile


DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY     = 0.290E+08 PSI
- CROSS SECTION AREA        =    219.13 IN2


CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD      =     48.00 IN.
- INTERNAL DIAMETER, ID     =     45.00 IN.
- TOTAL PILE LENGTH, TL     =    150.00 FT.
- PILE STICKUP LENGTH, PSL  =     14.00 FT.
- ZERO FRICTION LENGTH, ZFL =      0.00 FT.
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION       =      1.00 FT.
- LENGTH OF ENHANCED
  END SECTION               =    150.00 FT.
- INTERNAL DIAMETER OF
  ENHANCED END SECTION      =     45.00 IN.


PLUGGED/UNPLUGGED CONDITIONS :
Unplugged for open-ended pile



SOIL INFORMATIONS :



                  LATERAL    EFFECTIVE    FRICTION   BEARING
         SOIL     EARTH      UNIT         ANGLE      CAPACITY
 DEPTH   TYPE     PRESSURE   WEIGHT       DEGREES    FACTOR
  FT.                        LB/CF
   0.00  CLAY       0.00        47.60         0.00      0.00
   2.00  CLAY       0.00        47.60         0.00      0.00
   2.00  SAND       0.00        57.60        28.00      0.00
   8.00  SAND       0.00        57.60        28.00      0.00
   8.00  SAND       0.00        52.60        36.00      0.00
  21.50  SAND       0.00        52.60        36.00      0.00
  21.50  SAND       0.00        47.60        30.00      0.00
  46.50  SAND       0.00        47.60        30.00      0.00
  46.50  CLAY       0.00        47.60         0.00      0.00
  62.00  CLAY       0.00        47.60         0.00      0.00
  62.00  CLAY       0.00        47.60         0.00      0.00
  70.00  CLAY       0.00        47.60         0.00      0.00
  70.00  SAND       0.00        52.60        29.00      0.00
  77.10  SAND       0.00        52.60        29.00      0.00
  77.10  SAND       0.00        52.60        36.00      0.00
  90.00  SAND       0.00        52.60        36.00      0.00
  90.00  SAND       0.00        57.60        36.00      0.00
  94.50  SAND       0.00        57.60        36.00      0.00
  94.50  CLAY       0.00        47.60         0.00      0.00
 101.50  CLAY       0.00        47.60         0.00      0.00
 101.50  SAND       0.00        52.60        36.00      0.00
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 112.50   SAND      0.00        52.60        36.00      0.00
 112.50   CLAY      0.00        47.60         0.00      0.00
 150.00   CLAY      0.00        47.60         0.00      0.00


MAXIMUM   MAXIMUM   UNDISTURB  REMOLDED
UNIT      UNIT      SHEAR      SHEAR     BLOW   UNIT SKIN  UNIT END
FRICTION  BEARING   STRENGTH   STRENGTH  COUNT  FRICTION   BEARING
  KSF       KSF        KSF       KSF                KSF        KSF
0.10E+08* 0.10E+08*      0.10      0.05   0.00       0.00       0.00
0.10E+08* 0.10E+08*      0.10      0.05   0.00       0.00       0.00
0.10E+08* 0.10E+08*      0.00      0.00   0.00       0.00       0.00
0.10E+08* 0.10E+08*      0.00      0.00   0.00       0.00       0.00
0.10E+08* 0.10E+08*      0.00      0.00   0.00       0.00       0.00
0.10E+08* 0.10E+08*      0.00      0.00   0.00       0.00       0.00
0.10E+08* 0.10E+08*      0.00      0.00   0.00       0.00       0.00
0.10E+08* 0.10E+08*      0.00      0.00   0.00       0.00       0.00
0.20E+01  0.52E+03       2.25      1.13   0.00       0.00       0.00
0.20E+01  0.52E+03       2.25      1.13   0.00       0.00       0.00
0.20E+01  0.46E+03       2.39      1.19   0.00       0.00       0.00
0.20E+01  0.46E+03       2.39      1.19   0.00       0.00       0.00
0.10E-03  0.60E+02       0.00      0.00   0.00       0.00       0.00
0.10E-03  0.60E+02       0.00      0.00   0.00       0.00       0.00
0.20E+01  0.43E+03       0.00      0.00   0.00       0.00       0.00
0.20E+01  0.43E+03       0.00      0.00   0.00       0.00       0.00
0.20E+01  0.40E+03       0.00      0.00   0.00       0.00       0.00
0.20E+01  0.40E+03       0.00      0.00   0.00       0.00       0.00
0.20E+01  0.10E+08*      4.00      2.00   0.00       0.00       0.00
0.20E+01  0.10E+08*      4.00      2.00   0.00       0.00       0.00
0.20E+01  0.37E+03       0.00      0.00   0.00       0.00       0.00
0.20E+01  0.37E+03       0.00      0.00   0.00       0.00       0.00
0.20E+01  0.10E+08*      5.00      2.50   0.00       0.00       0.00
0.20E+01  0.10E+08*      5.00      2.50   0.00       0.00       0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
  PLAN TO LIMIT THE COMPUTED DATA.



         LRFD FACTOR  LRFD FACTOR
          ON UNIT      ON UNIT
 DEPTH    FRICTION     BEARING
  FT.
   0.00    1.000       1.000
   2.00    1.000       1.000
   2.00    1.000       1.000
   8.00    1.000       1.000
   8.00    1.000       1.000
  21.50    1.000       1.000
  21.50    1.000       1.000
  46.50    1.000       1.000
  46.50    1.000       1.000
  62.00    1.000       1.000
  62.00    1.000       1.000
  70.00    1.000       1.000
  70.00    1.000       1.000
  77.10    1.000       1.000
  77.10    1.000       1.000
  90.00    1.000       1.000
  90.00    1.000       1.000
  94.50    1.000       1.000
```

```
            94.50    1.000       1.000
           101.50    1.000       1.000
           101.50    1.000       1.000
           112.50    1.000       1.000
           112.50    1.000       1.000
           150.00    1.000       1.000



1
          **********************
          * COMPUTATION RESULT *
          **********************



                            **********************
                            *  FED. HWY. METHOD  *
                            **********************

             PILE       TOTAL SKIN       END       ULTIMATE
          PENETRATION   FRICTION        BEARING    CAPACITY
              FT.          KIP           KIP          KIP
              0.00           0.0           1.4*         1.4
              1.00           0.0           1.4*         1.4
              2.00           0.4           1.4*         1.8
              3.00           1.2           2.8*         4.0
              4.00           1.9           3.9*         5.9
              5.00           3.0           5.0*         8.0
              6.00           4.3           6.1*        10.3
              7.00           5.8           7.1*        12.9
              8.00           7.6           8.2*        15.8
              9.00          11.0          40.4*        51.4
             10.00          16.3          44.7*        61.0
             11.00          22.1          49.0*        71.1
             12.00          28.5          53.3*        81.8
             13.00          35.3          57.6*        93.0
             14.00          42.8          61.9*       104.7
             15.00          50.7          66.2*       116.9
             16.00          59.2          70.5*       129.7
             17.00          68.2          74.8*       143.0
             18.00          77.8          79.2*       156.9
             19.00          87.8          83.5*       171.3
             20.00          98.5          87.8*       186.2
             21.00         109.6          92.1*       201.7
             22.00         121.3          96.4*       217.7
             23.00         130.4          20.3*       150.7
             24.00         136.8          20.3*       157.1
             25.00         143.4          20.3*       163.7
             26.00         150.3          20.3*       170.6
             27.00         157.4          20.3*       177.7
             28.00         164.8          20.3*       185.1
             29.00         172.4          20.3*       192.7
             30.00         180.3          20.3*       200.5
             31.00         188.4          20.3*       208.6
             32.00         196.7          20.3*       217.0
             33.00         205.3          20.3*       225.6
             34.00         214.1          20.3*       234.4
             35.00         223.2          20.3*       243.5
             36.00         232.5          20.3*       252.8
             37.00         242.1          20.3*       262.4
             38.00         251.9          20.3*       272.2
             39.00         262.0          20.3*       282.2
```

```
 40.00         272.2          20.3*       292.5
 41.00         282.8          20.3*       303.1
 42.00         293.6          20.3*       313.8
 43.00         304.6          20.3*       324.9
 44.00         315.9          20.3*       336.1
 45.00         327.4          20.3*       347.6
 46.00         339.1          20.3*       359.4
 47.00         351.1          20.3*       371.4
 48.00         371.3          30.8*       402.2
 49.00         396.5          30.8*       427.3
 50.00         421.6          30.8*       452.5
 51.00         446.7          30.8*       477.6
 52.00         471.9          30.8*       502.7
 53.00         497.0          30.8*       527.9
 54.00         522.1          30.8*       553.0
 55.00         547.3          30.8*       578.1
 56.00         572.4          30.8*       603.2
 57.00         597.5          30.8*       628.4
 58.00         622.7          30.8*       653.5
 59.00         647.8          30.8*       678.6
 60.00         672.9          30.8*       703.8
 61.00         698.1          30.8*       728.9
 62.00         723.2          30.8*       754.0
 63.00         748.3          32.7*       781.0
 64.00         773.5          32.7*       806.1
 65.00         798.6          32.7*       831.3
 66.00         823.7          32.7*       856.4
 67.00         848.9          32.7*       881.5
 68.00         874.0          32.7*       906.7
 69.00         899.1          32.7*       931.8
 70.00         911.7          32.7*       944.4
 71.00         911.7          20.3*       932.0
 72.00         911.7          20.3*       932.0
 73.00         911.7          20.3*       932.0
 74.00         911.7          20.3*       932.0
 75.00         911.7          20.3*       932.0
 76.00         911.7          20.3*       932.0
 77.00         911.7          20.3*       932.0
 78.00         920.9          20.3*       941.1
 79.00         946.0         230.7*      1176.7
 80.00         971.1         230.7*      1201.8
 81.00         996.3         230.7*      1227.0
 82.00        1021.4         230.7*      1252.1
 83.00        1046.5         230.7*      1277.2
 84.00        1071.7         230.7*      1302.4
 85.00        1096.8         230.7*      1327.5
 86.00        1121.9         230.7*      1352.6
 87.00        1147.1         230.7*      1377.7
 88.00        1172.2         230.7*      1402.9
 89.00        1197.3         230.7*      1428.0
 90.00        1222.5         230.7*      1453.1
 91.00        1247.6         230.7*      1478.3
 92.00        1272.7         230.7*      1503.4
 93.00        1297.9         230.7*      1528.5
 94.00        1323.0         230.7*      1553.7
 95.00        1348.1         230.7*      1578.8
 96.00        1373.3          54.8*      1428.0
 97.00        1398.4          54.8*      1453.2
 98.00        1423.5          54.8*      1478.3
 99.00        1448.7          54.8*      1503.4
100.00        1473.8          54.8*      1528.6
101.00        1498.9          54.8*      1553.7
102.00        1524.0          54.8*      1578.8
```

```
    103.00        1549.2         230.7*      1779.9
    104.00        1574.3         230.7*      1805.0
    105.00        1599.4         230.7*      1830.1
    106.00        1624.6         230.7*      1855.3
    107.00        1649.7         230.7*      1880.4
    108.00        1674.8         230.7*      1905.5
    109.00        1700.0         230.7*      1930.7
    110.00        1725.1         230.7*      1955.8
    111.00        1750.2         230.7*      1980.9
    112.00        1775.4         230.7*      2006.1
    113.00        1800.5         230.7*      2031.2
    114.00        1825.6          68.5*      1894.1
    115.00        1850.8          68.5*      1919.3
    116.00        1875.9          68.5*      1944.4
    117.00        1901.0          68.5*      1969.5
    118.00        1926.2          68.5*      1994.6
    119.00        1951.3          68.5*      2019.8
    120.00        1976.4          68.5*      2044.9
    121.00        2001.6          68.5*      2070.0
    122.00        2026.7          68.5*      2095.2
    123.00        2051.8          68.5*      2120.3
    124.00        2077.0          68.5*      2145.4
    125.00        2102.1          68.5*      2170.6
    126.00        2127.2          68.5*      2195.7
    127.00        2152.4          68.5*      2220.8
    128.00        2177.5          68.5*      2246.0
    129.00        2202.6          68.5*      2271.1
    130.00        2227.8          68.5*      2296.2
    131.00        2252.9          68.5*      2321.4
    132.00        2278.0          68.5*      2346.5
    133.00        2303.2          68.5*      2371.6
    134.00        2328.3          68.5*      2396.8
    135.00        2353.4          68.5*      2421.9
    136.00        2378.6          68.5*      2447.0


    NOTES:
    - AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
      IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
      OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.



        *************************************************
        * COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
        * CURVES FOR AXIAL LOADING                      *
        *************************************************


T-Z CURVE   NO. OF   DEPTH TO CURVE   LOAD TRANSFER   PILE MOVEMENT
   NO.      POINTS         FT.              PSI             IN.

    1         10      0.0000E+00
                                       0.0000E+00      0.0000E+00
                                       0.6915E-01      0.7680E-01
                                       0.1152E+00      0.1488E+00
                                       0.1729E+00      0.2736E+00
                                       0.2074E+00      0.3840E+00
                                       0.2305E+00      0.4800E+00
                                       0.2074E+00      0.9600E+00
                                       0.2074E+00      0.1440E+01
                                       0.2074E+00      0.2400E+01
                                       0.2074E+00      0.9600E+01
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2          10        0.1025E+01
                                     0.0000E+00      0.0000E+00
                                     0.1239E+00      0.7680E-01
                                     0.2065E+00      0.1488E+00
                                     0.3098E+00      0.2736E+00
                                     0.3717E+00      0.3840E+00
                                     0.4130E+00      0.4800E+00
                                     0.3717E+00      0.9600E+00
                                     0.3717E+00      0.1440E+01
                                     0.3717E+00      0.2400E+01
                                     0.3717E+00      0.9600E+01
3          10        0.1958E+01
                                     0.0000E+00      0.0000E+00
                                     0.1239E+00      0.7680E-01
                                     0.2065E+00      0.1488E+00
                                     0.3098E+00      0.2736E+00
                                     0.3717E+00      0.3840E+00
                                     0.4130E+00      0.4800E+00
                                     0.3717E+00      0.9600E+00
                                     0.3717E+00      0.1440E+01
                                     0.3717E+00      0.2400E+01
                                     0.3717E+00      0.9600E+01
4          10        0.2000E+01
                                     0.0000E+00      0.0000E+00
                                     0.4235E-01      0.1000E-01
                                     0.8469E-01      0.2000E-01
                                     0.1694E+00      0.4000E-01
                                     0.2541E+00      0.6000E-01
                                     0.3388E+00      0.8000E-01
                                     0.3811E+00      0.9000E-01
                                     0.4235E+00      0.1000E+00
                                     0.4235E+00      0.5000E+00
                                     0.4235E+00      0.2000E+01
5          10        0.5025E+01
                                     0.0000E+00      0.0000E+00
                                     0.7779E-01      0.1000E-01
                                     0.1556E+00      0.2000E-01
                                     0.3112E+00      0.4000E-01
                                     0.4668E+00      0.6000E-01
                                     0.6223E+00      0.8000E-01
                                     0.7001E+00      0.9000E-01
                                     0.7779E+00      0.1000E+00
                                     0.7779E+00      0.5000E+00
                                     0.7779E+00      0.2000E+01
6          10        0.7958E+01
                                     0.0000E+00      0.0000E+00
                                     0.1448E+00      0.1000E-01
                                     0.2895E+00      0.2000E-01
                                     0.5790E+00      0.4000E-01
                                     0.8685E+00      0.6000E-01
                                     0.1158E+01      0.8000E-01
                                     0.1303E+01      0.9000E-01
                                     0.1448E+01      0.1000E+00
                                     0.1448E+01      0.5000E+00
                                     0.1448E+01      0.2000E+01
7          10        0.8000E+01
                                     0.0000E+00      0.0000E+00
                                     0.2413E+00      0.1000E-01
                                     0.4827E+00      0.2000E-01
                                     0.9653E+00      0.4000E-01
                                     0.1448E+01      0.6000E-01
                                     0.1931E+01      0.8000E-01
                                     0.2172E+01      0.9000E-01
```

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                                    0.2413E+01      0.1000E+00
                                    0.2413E+01      0.5000E+00
                                    0.2413E+01      0.2000E+01
  8        10      0.1478E+02
                                    0.0000E+00      0.0000E+00
                                    0.4539E+00      0.1000E-01
                                    0.9078E+00      0.2000E-01
                                    0.1816E+01      0.4000E-01
                                    0.2723E+01      0.6000E-01
                                    0.3631E+01      0.8000E-01
                                    0.4085E+01      0.9000E-01
                                    0.4539E+01      0.1000E+00
                                    0.4539E+01      0.5000E+00
                                    0.4539E+01      0.2000E+01
  9        10      0.2146E+02
                                    0.0000E+00      0.0000E+00
                                    0.5746E+00      0.1000E-01
                                    0.1149E+01      0.2000E-01
                                    0.2299E+01      0.4000E-01
                                    0.3448E+01      0.6000E-01
                                    0.4597E+01      0.8000E-01
                                    0.5172E+01      0.9000E-01
                                    0.5746E+01      0.1000E+00
                                    0.5746E+01      0.5000E+00
                                    0.5746E+01      0.2000E+01
 10        10      0.2150E+02
                                    0.0000E+00      0.0000E+00
                                    0.5746E+00      0.1000E-01
                                    0.1149E+01      0.2000E-01
                                    0.2299E+01      0.4000E-01
                                    0.3448E+01      0.6000E-01
                                    0.4597E+01      0.8000E-01
                                    0.5172E+01      0.9000E-01
                                    0.5746E+01      0.1000E+00
                                    0.5746E+01      0.5000E+00
                                    0.5746E+01      0.2000E+01
 11        10      0.3403E+02
                                    0.0000E+00      0.0000E+00
                                    0.5083E+00      0.1000E-01
                                    0.1017E+01      0.2000E-01
                                    0.2033E+01      0.4000E-01
                                    0.3050E+01      0.6000E-01
                                    0.4066E+01      0.8000E-01
                                    0.4574E+01      0.9000E-01
                                    0.5083E+01      0.1000E+00
                                    0.5083E+01      0.5000E+00
                                    0.5083E+01      0.2000E+01
 12        10      0.4646E+02
                                    0.0000E+00      0.0000E+00
                                    0.8900E+00      0.1000E-01
                                    0.1780E+01      0.2000E-01
                                    0.3560E+01      0.4000E-01
                                    0.5340E+01      0.6000E-01
                                    0.7120E+01      0.8000E-01
                                    0.8010E+01      0.9000E-01
                                    0.8900E+01      0.1000E+00
                                    0.8900E+01      0.5000E+00
                                    0.8900E+01      0.2000E+01
 13        10      0.4650E+02
                                    0.0000E+00      0.0000E+00
                                    0.2670E+01      0.7680E-01
                                    0.4450E+01      0.1488E+00
                                    0.6675E+01      0.2736E+00
```

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                                    0.8010E+01      0.3840E+00
                                    0.8900E+01      0.4800E+00
                                    0.8010E+01      0.9600E+00
                                    0.8010E+01      0.1440E+01
                                    0.8010E+01      0.2400E+01
                                    0.8010E+01      0.9600E+01
14         10      0.5428E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
15         10      0.6196E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
16         10      0.6200E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
17         10      0.6603E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
18         10      0.6996E+02
                                    0.0000E+00      0.0000E+00
                                    0.1042E+01      0.7680E-01
                                    0.1736E+01      0.1488E+00
                                    0.2605E+01      0.2736E+00
                                    0.3125E+01      0.3840E+00
                                    0.3473E+01      0.4800E+00
                                    0.3125E+01      0.9600E+00
                                    0.3125E+01      0.1440E+01
                                    0.3125E+01      0.2400E+01
                                    0.3125E+01      0.9600E+01
19         10      0.7000E+02
                                    0.0000E+00      0.0000E+00
```

```
                                    0.6944E-04      0.1000E-01
                                    0.1389E-03      0.2000E-01
                                    0.2778E-03      0.4000E-01
                                    0.4167E-03      0.6000E-01
                                    0.5556E-03      0.8000E-01
                                    0.6250E-03      0.9000E-01
                                    0.6944E-03      0.1000E+00
                                    0.6944E-03      0.5000E+00
                                    0.6944E-03      0.2000E+01
20         10      0.7358E+02
                                    0.0000E+00      0.0000E+00
                                    0.6944E-04      0.1000E-01
                                    0.1389E-03      0.2000E-01
                                    0.2778E-03      0.4000E-01
                                    0.4167E-03      0.6000E-01
                                    0.5556E-03      0.8000E-01
                                    0.6250E-03      0.9000E-01
                                    0.6944E-03      0.1000E+00
                                    0.6944E-03      0.5000E+00
                                    0.6944E-03      0.2000E+01
21         10      0.7706E+02
                                    0.0000E+00      0.0000E+00
                                    0.9474E+00      0.1000E-01
                                    0.1895E+01      0.2000E-01
                                    0.3790E+01      0.4000E-01
                                    0.5685E+01      0.6000E-01
                                    0.7579E+01      0.8000E-01
                                    0.8527E+01      0.9000E-01
                                    0.9474E+01      0.1000E+00
                                    0.9474E+01      0.5000E+00
                                    0.9474E+01      0.2000E+01
22         10      0.7710E+02
                                    0.0000E+00      0.0000E+00
                                    0.9474E+00      0.1000E-01
                                    0.1895E+01      0.2000E-01
                                    0.3790E+01      0.4000E-01
                                    0.5685E+01      0.6000E-01
                                    0.7579E+01      0.8000E-01
                                    0.8527E+01      0.9000E-01
                                    0.9474E+01      0.1000E+00
                                    0.9474E+01      0.5000E+00
                                    0.9474E+01      0.2000E+01
23         10      0.8358E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
24         10      0.8996E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
```

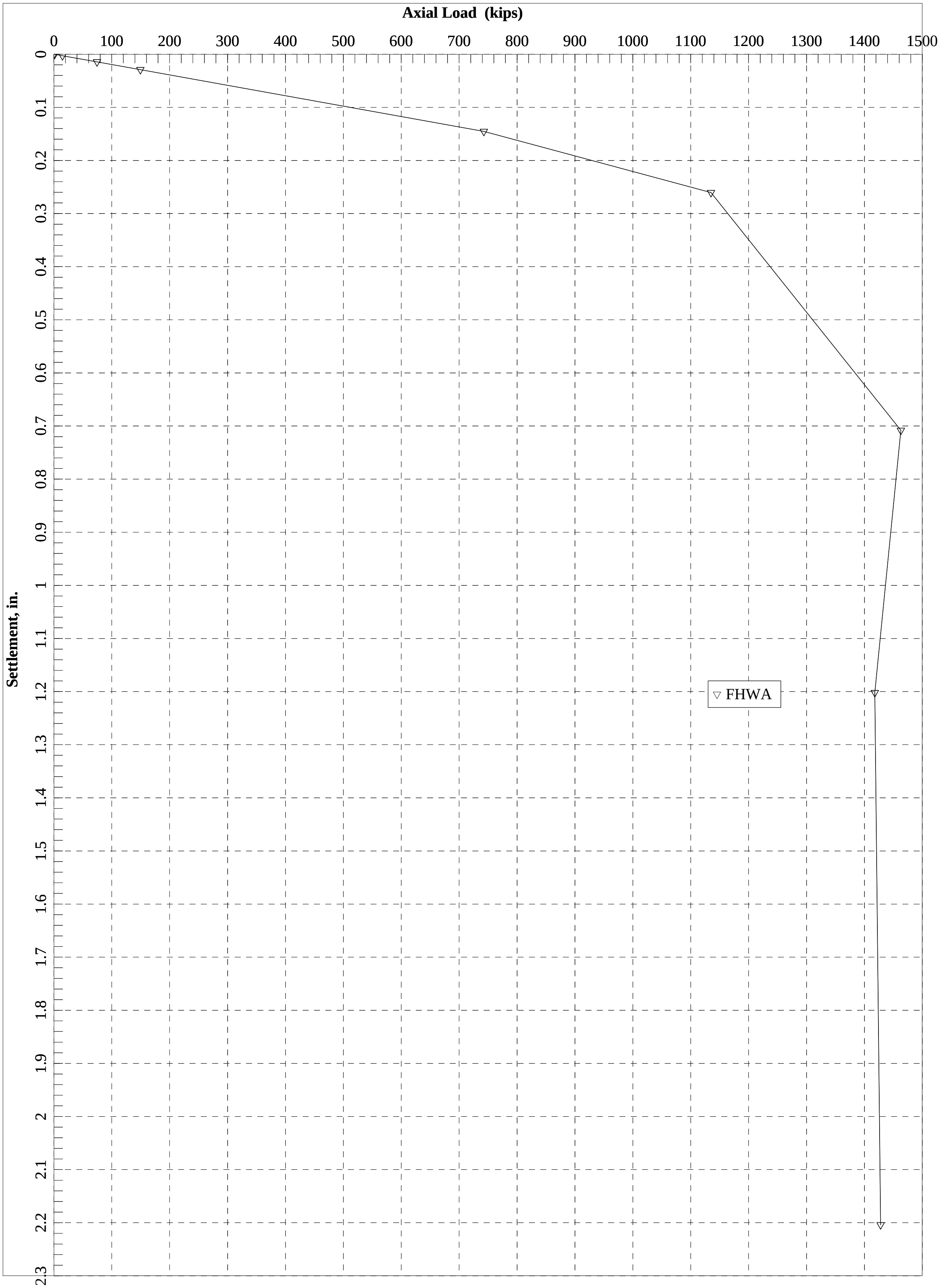
```
                                    0.1389E+02      0.2000E+01
25         10      0.9000E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
26         10      0.9228E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
27         10      0.9446E+02
                                    0.0000E+00      0.0000E+00
                                    0.1389E+01      0.1000E-01
                                    0.2778E+01      0.2000E-01
                                    0.5556E+01      0.4000E-01
                                    0.8333E+01      0.6000E-01
                                    0.1111E+02      0.8000E-01
                                    0.1250E+02      0.9000E-01
                                    0.1389E+02      0.1000E+00
                                    0.1389E+02      0.5000E+00
                                    0.1389E+02      0.2000E+01
28         10      0.9450E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
29         10      0.9803E+02
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
                                    0.1250E+02      0.9600E+00
                                    0.1250E+02      0.1440E+01
                                    0.1250E+02      0.2400E+01
                                    0.1250E+02      0.9600E+01
30         10      0.1015E+03
                                    0.0000E+00      0.0000E+00
                                    0.4167E+01      0.7680E-01
                                    0.6944E+01      0.1488E+00
                                    0.1042E+02      0.2736E+00
                                    0.1250E+02      0.3840E+00
                                    0.1389E+02      0.4800E+00
```

```
                                     0.1250E+02      0.9600E+00
                                     0.1250E+02      0.1440E+01
                                     0.1250E+02      0.2400E+01
                                     0.1250E+02      0.9600E+01
31          10       0.1015E+03
                                     0.0000E+00      0.0000E+00
                                     0.1389E+01      0.1000E-01
                                     0.2778E+01      0.2000E-01
                                     0.5556E+01      0.4000E-01
                                     0.8333E+01      0.6000E-01
                                     0.1111E+02      0.8000E-01
                                     0.1250E+02      0.9000E-01
                                     0.1389E+02      0.1000E+00
                                     0.1389E+02      0.5000E+00
                                     0.1389E+02      0.2000E+01
32          10       0.1070E+03
                                     0.0000E+00      0.0000E+00
                                     0.1389E+01      0.1000E-01
                                     0.2778E+01      0.2000E-01
                                     0.5556E+01      0.4000E-01
                                     0.8333E+01      0.6000E-01
                                     0.1111E+02      0.8000E-01
                                     0.1250E+02      0.9000E-01
                                     0.1389E+02      0.1000E+00
                                     0.1389E+02      0.5000E+00
                                     0.1389E+02      0.2000E+01
33          10       0.1125E+03
                                     0.0000E+00      0.0000E+00
                                     0.1389E+01      0.1000E-01
                                     0.2778E+01      0.2000E-01
                                     0.5556E+01      0.4000E-01
                                     0.8333E+01      0.6000E-01
                                     0.1111E+02      0.8000E-01
                                     0.1250E+02      0.9000E-01
                                     0.1389E+02      0.1000E+00
                                     0.1389E+02      0.5000E+00
                                     0.1389E+02      0.2000E+01
34          10       0.1125E+03
                                     0.0000E+00      0.0000E+00
                                     0.4167E+01      0.7680E-01
                                     0.6944E+01      0.1488E+00
                                     0.1042E+02      0.2736E+00
                                     0.1250E+02      0.3840E+00
                                     0.1389E+02      0.4800E+00
                                     0.1250E+02      0.9600E+00
                                     0.1250E+02      0.1440E+01
                                     0.1250E+02      0.2400E+01
                                     0.1250E+02      0.9600E+01
35          10       0.1313E+03
                                     0.0000E+00      0.0000E+00
                                     0.4167E+01      0.7680E-01
                                     0.6944E+01      0.1488E+00
                                     0.1042E+02      0.2736E+00
                                     0.1250E+02      0.3840E+00
                                     0.1389E+02      0.4800E+00
                                     0.1250E+02      0.9600E+00
                                     0.1250E+02      0.1440E+01
                                     0.1250E+02      0.2400E+01
                                     0.1250E+02      0.9600E+01
36          10       0.1500E+03
                                     0.0000E+00      0.0000E+00
                                     0.4167E+01      0.7680E-01
                                     0.6944E+01      0.1488E+00
```

```
                                        0.1042E+02      0.2736E+00
                                        0.1250E+02      0.3840E+00
                                        0.1389E+02      0.4800E+00
                                        0.1250E+02      0.9600E+00
                                        0.1250E+02      0.1440E+01
                                        0.1250E+02      0.2400E+01
                                        0.1250E+02      0.9600E+01


 TIP   LOAD        TIP MOVEMENT
     KIP               IN.

 0.0000E+00         0.0000E+00
 0.4280E+01         0.2400E-01
 0.8560E+01         0.4800E-01
 0.1712E+02         0.9600E-01
 0.3424E+02         0.6240E+00
 0.5136E+02         0.2016E+01
 0.6163E+02         0.3504E+01
 0.6848E+02         0.4800E+01
 0.6848E+02         0.7200E+01
 0.6848E+02         0.9600E+01


               LOAD VERSUS SETTLEMENT CURVE
               ****************************


 TOP  LOAD     TOP MOVEMENT       TIP  LOAD      TIP MOVEMENT
    KIP             IN.              KIP              IN.
0.2831E+01      0.5146E-03      0.1783E-01      0.1000E-03
0.2831E+02      0.5146E-02      0.1783E+00      0.1000E-02
0.1419E+03      0.2575E-01      0.8916E+00      0.5000E-02
0.2847E+03      0.5162E-01      0.1783E+01      0.1000E-01
0.1213E+04      0.2426E+00      0.8916E+01      0.5000E-01
0.1735E+04      0.3993E+00      0.1725E+02      0.1000E+00
0.2408E+04      0.9456E+00      0.3022E+02      0.5000E+00
0.2313E+04      0.1426E+01      0.3886E+02      0.1000E+01
0.2325E+04      0.2429E+01      0.5116E+02      0.2000E+01
```

```
      0.2344E+02      0.2736E+00
      0.2812E+02      0.3840E+00
      0.3125E+02      0.4800E+00
      0.2812E+02      0.9600E+00
      0.2812E+02      0.1440E+01
      0.2812E+02      0.2400E+01
      0.2812E+02      0.9600E+01


 TIP   LOAD        TIP MOVEMENT
     KIP               IN.

 0.0000E+00         0.0000E+00
 0.4280E+01         0.2400E-01
 0.8560E+01         0.4800E-01
 0.1712E+02         0.9600E-01
 0.3424E+02         0.6240E+00
 0.5136E+02         0.2016E+01
 0.6163E+02         0.3504E+01
 0.6848E+02         0.4800E+01
 0.6848E+02         0.7200E+01
 0.6848E+02         0.9600E+01


               LOAD VERSUS SETTLEMENT CURVE
               ****************************


 TOP  LOAD     TOP MOVEMENT       TIP  LOAD      TIP MOVEMENT
    KIP            IN.               KIP             IN.
0.4080E+01      0.7226E-03      0.1783E-01      0.1000E-03
0.4080E+02      0.7226E-02      0.1783E+00      0.1000E-02
0.2049E+03      0.3622E-01      0.8916E+00      0.5000E-02
0.4113E+03      0.7267E-01      0.1783E+01      0.1000E-01
0.1603E+04      0.3281E+00      0.8916E+01      0.5000E-01
0.2243E+04      0.5177E+00      0.1725E+02      0.1000E+00
0.3322E+04      0.1175E+01      0.3022E+02      0.5000E+00
0.3167E+04      0.1639E+01      0.3886E+02      0.1000E+01
0.3180E+04      0.2642E+01      0.5116E+02      0.2000E+01
```

IB-7 Settlement



Appendix VIII

LPile2015 Results

Bridge Load Data Sheet

PROJECT INFORMATION

File No.	0040308-B01	**PCN:**	40308
County:	ORANGEBURG	**Route:**	US 301
Description:	REPLACE BRIDGE OVER FOUR HOLE SWAMP		
Loads Provided By:	GFD/DRF	**Date Loads Provided:**	April 2, 2015

Bridge Type:	2 (3 SPAN CONTINUOUS FLAT SLAB - 44'-44'-44') and 1 (30' SINGLE SPAN FLAT SLAB)		
No. Spans /Lengths:	7 SPAN 44'-44'-44' 44'-44'-44' 30'	**Width / No. Lanes:**	44/2

Edition of AASHTO LRFD Bridge Design Specifications:	2013
Edition of SCDOT Seismic Design Specifications for Highway Bridges:	2008

Bridge Operational Classification (OC):	OC=II	**Site Class:**	D - Stiff Soil
Seismic Design Category (SDC):	C	**Scour Report Attached**	No

Proposed Foundations (foundation type, size, and number per bent)	**End Bent**	EB1 & EB8 - 6 - HP 14X73 PILES
	Interior Bent	3 - 48" COLUMNS WITH 54" DRILLED SHAFTS & 48" SOCKETS

Location/Elev. of Applied Loads:	**End Bent:**	119.822	**Int. Bent:**	120.093
Location/Elev. Est. Point of Fixity:	**End Bent:**	110.1	**Int. Bent:**	69.4

Bridge Load Data Sheet

	Limit State	Strength			Service		
	Load Cases:	**Case 1FL ($P=P_{max}$)**	**Case 2FL ($V=V_{max}$)**	**Case 3FL ($M=M_{max}$)**	**Case 1SL ($P=P_{max}$)**	**Case 2SL ($V=V_{max}$)**	**Case 3SL ($M=M_{max}$)**
End Bent - Longitudinal	**P (kips) =**	-210	-167.5	-203.1	-144.1	-116	-137.8
	V (kips) =	-10.28	11.1	-9.558	-5.877	6.882	-6.013
	M (ft-kip) =	-91.49	94.03	-103.7	-52.28	54.16	-59.65
End Bent - Transverse	**P (kips) =**	-210	-116.6	-116.6	-144.1	-90.96	-90.96
	V (kips) =	-0.1794	-2.123	-2.123	-0.12	-1.653	-1.653
	M (ft-kip) =	-0.959	-10.66	-10.66	-0.6442	-8.222	-8.222
Interior Bent - Longitudinal	**P (kips) =**	-777.5	-491.6	-777.5	-552.3	-341.5	-546.5
	V (kips) =	-19.75	21.63	-19.75	-11.28	14.48	-13.44
	M (ft-kip) =	-259.4	196.1	-259.4	-148.2	114.9	-150.5
Interior Bent - Transverse	**P (kips) =**	-777.5	-322	-322	-552.3	-310.8	-324.7
	V (kips) =	-0.5821	-10.07	-10.07	-0.3326	6.975	6.971
	M (ft-kip) =	-18.56	-332.9	-332.9	-10.61	216.8	216.9

	Limit State	Extreme Event I			Extreme Event II[a]			Extreme Event II[b]		
	Load Cases:	**Case 1EL ($P=P_{max}$)**	**Case 2EL ($V=V_{max}$)**	**Case 3EL ($M=M_{max}$)**	**Case 1EEL ($P=P_{max}$)**	**Case 2EEL ($V=V_{max}$)**	**Case 3EEL ($M=M_{max}$)**	**Case 1EEL ($P=P_{max}$)**	**Case 2EEL ($V=V_{max}$)**	**Case 3EEL ($M=M_{max}$)**
End Bent - Longitudinal	**P (kips) =**	NA	NA	NA	NA	NA	NA	NA	NA	NA
	V (kips) =	NA	NA	NA	NA	NA	NA	NA	NA	NA
	M (ft-kip) =	NA	NA	NA	NA	NA	NA	NA	NA	NA
End Bent - Transverse	**P (kips) =**	NA	NA	NA	NA	NA	NA	NA	NA	NA
	V (kips) =	NA	NA	NA	NA	NA	NA	NA	NA	NA
	M (ft-kip) =	NA	NA	NA	NA	NA	NA	NA	NA	NA
Interior Bent - Longitudinal	**P (kips) =**	NA	NA	NA	NA	NA	NA	NA	NA	NA
	V (kips) =	NA	NA	NA	NA	NA	NA	NA	NA	NA
	M (ft-kip) =	NA	NA	NA	NA	NA	NA	NA	NA	NA
Interior Bent - Transverse	**P (kips) =**	NA	NA	NA	NA	NA	NA	NA	NA	NA
	V (kips) =	NA	NA	NA	NA	NA	NA	NA	NA	NA
	M (ft-kip) =	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

P – Axial; V – Shear; M – Moment; [a] – Check Flood w/o collision loads; [b] – Collision loads w/o check flood

US 301 - FOUR HOLE SWAMP

8/26/15

Bridge Load Data Sheet

GEOTECH LOADS FOR INTERIOR BENT WITH 3-48" DIA COLUMNS OR PIPE PILES

FROM GFD & DRF

		Limit State	Strength			Service		
		Load Cases:	Case 1FL ($P=P_{max}$)	Case 2FL ($V=V_{max}$)	Case 3FL ($M=M_{max}$)	Case 1SL ($P=P_{max}$)	Case 2SL ($V=V_{max}$)	Case 3SL ($M=M_{max}$)
	End Bent - Longitudinal	P (kips) =						
		V (kips) =						
		M (ft-kip) =						
	End Bent - Transverse	P (kips) =						
		V (kips) =						
		M (ft-kip) =						
Fy	Interior Bent - Longitudinal	P (kips) =	Fy -768.4	-499.3	-768.4	Fy -551.7	-356.7	-546
Fz		V (kips) =	-20.07	Fz 21.46	-20.07	-11.47	Fz -14.43	-13.62
Mx		M (ft-kip) =	-254.1	198.7	Mx -254.1	-145.2	-116.6	Mx -147.7
Fy	Interior Bent - Transverse	P (kips) =	Fy -768.4	-345.4	-345.4	Fy -551.7	-328.6	-328.6
Fx		V (kips) =	-0.4159	Fx -8.815	-8.815	2.592	Fx -5.427	-5.427
Mz		M (ft-kip) =	-16.1	-374.0	Mz -374.0	71.79	-209.3	Mz -209.3

	Limit State	Extreme Event I			Extreme Event II[a]			Extreme Event II[b]		
	Load Cases:	Case 1EL ($P=P_{max}$)	Case 2EL ($V=V_{max}$)	Case 3EL ($M=M_{max}$)	Case 1EEL ($P=P_{max}$)	Case 2EEL ($V=V_{max}$)	Case 3EEL ($M=M_{max}$)	Case 1EEL ($P=P_{max}$)	Case 2EEL ($V=V_{max}$)	Case 3EEL ($M=M_{max}$)
End Bent - Longitudinal	P (kips) =				NA	NA	NA	NA	NA	NA
	V (kips) =				NA	NA	NA	NA	NA	NA
	M (ft-kip) =				NA	NA	NA	NA	NA	NA
End Bent - Transverse	P (kips) =				NA	NA	NA	NA	NA	NA
	V (kips) =				NA	NA	NA	NA	NA	NA
	M (ft-kip) =				NA	NA	NA	NA	NA	NA
Interior Bent - Longitudinal	P (kips) =							NA	NA	NA
	V (kips) =							NA	NA	NA
	M (ft-kip) =							NA	NA	NA
Interior Bent - Transverse	P (kips) =							NA	NA	NA
	V (kips) =							NA	NA	NA
	M (ft-kip) =							NA	NA	NA

Notes:

US301 - FOUR HOLE SWAMP

8/26/15

Bridge Load Data Sheet

GEOTECH LOADS FOR INTERIOR BENT
WITH
5 - 48" DIA COLUMNS
OR PIPE PILES

From GFD & DRF

		Limit State	Strength			Service		
		Load Cases:	Case 1FL ($P=P_{max}$)	Case 2FL ($V=V_{max}$)	Case 3FL ($M=M_{max}$)	Case 1SL ($P=P_{max}$)	Case 2SL ($V=V_{max}$)	Case 3SL ($M=M_{max}$)
	End Bent - Longitudinal	P (kips) =						
		V (kips) =						
		M (ft-kip) =						
	End Bent - Transverse	P (kips) =						
		V (kips) =						
		M (ft-kip) =						
Fy	Interior Bent - Longitudinal	P (kips) =	Fy -371.3	-346.2	-371.3	Fy -266.8	-253.4	-261.9
Fz		V (kips) =	-11.69	Fz 13.03	-11.69	7.438	Fz -8.743	-7.488
Mx		M (ft-kip) =	-165.5	113.7	Mx -165.5	64.97	-66.64	Mx -100.7
Fy	Interior Bent - Transverse	P (kips) =	Fy -371.3	-217.9	-220.3	Fy -266.8	-218.7	-222.6
Fx		V (kips) =	-0.119	Fx 7.281	-4.115	-1.637	Fx -2.107	2.994
Mz		M (ft-kip) =	-5.11	208.4	Mz -234.0	-70.73	-90.71	Mz 91.11

	Limit State	Extreme Event I			Extreme Event II^a			Extreme Event II^b		
	Load Cases:	Case 1EL ($P=P_{max}$)	Case 2EL ($V=V_{max}$)	Case 3EL ($M=M_{max}$)	Case 1EEL ($P=P_{max}$)	Case 2EEL ($V=V_{max}$)	Case 3EEL ($M=M_{max}$)	Case 1EEL ($P=P_{max}$)	Case 2EEL ($V=V_{max}$)	Case 3EEL ($M=M_{max}$)
End Bent - Longitudinal	P (kips) =				NA	NA	NA	NA	NA	NA
	V (kips) =				NA	NA	NA	NA	NA	NA
	M (ft-kip) =				NA	NA	NA	NA	NA	NA
End Bent - Transverse	P (kips) =				NA	NA	NA	NA	NA	NA
	V (kips) =				NA	NA	NA	NA	NA	NA
	M (ft-kip) =				NA	NA	NA	NA	NA	NA
Interior Bent - Longitudinal	P (kips) =							NA	NA	NA
	V (kips) =							NA	NA	NA
	M (ft-kip) =							NA	NA	NA
Interior Bent - Transverse	P (kips) =							NA	NA	NA
	V (kips) =							NA	NA	NA
	M (ft-kip) =							NA	NA	NA

Notes:

Bridge Load Data Sheet

PROJECT INFORMATION

File No.	**0040308-B01**	**PCN:**	**40308**
County:	**ORANGEBURG**	**Route:**	**US 301**

Description: **REPLACE BRIDGE OVER FOUR HOLE SWAMP**

Loads Provided By:	**GFD/DRF**	**Date Loads Provided:**	**4/2/15 & 10/20/16**

Bridge Type:	**2 (3 SPAN CONTINUOUS FLAT SLAB - 44'-44'-44') and 1 (30' SINGLE SPAN FLAT SLAB)**		
No. Spans /Lengths:	**7 SPAN 44'-44'-44' 44'-44'-44' 30'**	**Width / No. Lanes:**	**44/2**

Edition of AASHTO LRFD Bridge Design Specifications:	**2013**
Edition of SCDOT Seismic Design Specifications for Highway Bridges:	**2008**

Bridge Operational Classification (OC):	**OC=II**	**Site Class:**	**D - Stiff Soil**
Seismic Design Category (SDC):	**C**	**Scour Report Attached**	**No**

Proposed Foundations (foundation type, size, and number per bent)	**End Bent**	**EB1 & EB8 - 6 - HP 14X73 PILES**
	Interior Bent	**5 - 48" STEEL PIPE PILES**

Location/Elev. of Applied Loads:	**End Bent:**	**119.822**	**Int. Bent:**	**120.093**
Location/Elev. Est. Point of Fixity:	**End Bent:**	**110.1**	**Int. Bent:**	**69.4**

Bridge Load Data Sheet

	Limit State	**Strength**			**Service**		
	Load Cases:	**Case 1FL ($P=P_{max}$)**	**Case 2FL ($V=V_{max}$)**	**Case 3FL ($M=M_{max}$)**	**Case 1SL ($P=P_{max}$)**	**Case 2SL ($V=V_{max}$)**	**Case 3SL ($M=M_{max}$)**
End Bent - Longitudinal	**P (kips) =**	-210	-167.5	-203.1	-144.1	-116	-137.8
	V (kips) =	-10.28	11.1	-9.558	-5.877	6.882	-6.013
	M (ft-kip) =	-91.49	94.03	-103.7	-52.28	54.16	-59.65
End Bent - Transverse	**P (kips) =**	-210	-116.6	-116.6	-144.1	-90.96	-90.96
	V (kips) =	-0.1794	-2.123	-2.123	-0.12	-1.653	-1.653
	M (ft-kip) =	-0.959	-10.66	-10.66	-0.6442	-8.222	-8.222
Interior Bent - Longitudinal	**P (kips) =**	Fy -371.3	-346.2	-371.3	Fy -266.8	-253.4	-261.9
	V (kips) =	-11.69	Fx 13.03	-11.69	7.438	Fz -8.743	-7.488
	M (ft-kip) =	-165.5	113.7	Mx -165.5	64.97	-66.64	Mx -100.7
Interior Bent - Transverse	**P (kips) =**	Fy -371.3	-217.9	-220.3	Fy -266.8	-218.7	-222.6
	V (kips) =	-0.119	Fx 7.281	-4.115	-1.637	Fx -2.107	2.994
	M (ft-kip) =	-5.11	208.4	Mz -234.0	-70.73	-90.71	Mz 91.11

	Limit State	**Extreme Event I**			**Extreme Event II^a**			**Extreme Event II^b**		
	Load Cases:	**Case 1EL ($P=P_{max}$)**	**Case 2EL ($V=V_{max}$)**	**Case 3EL ($M=M_{max}$)**	**Case 1EEL ($P=P_{max}$)**	**Case 2EEL ($V=V_{max}$)**	**Case 3EEL ($M=M_{max}$)**	**Case 1EEL ($P=P_{max}$)**	**Case 2EEL ($V=V_{max}$)**	**Case 3EEL ($M=M_{max}$)**
End Bent - Longitudinal	**P (kips) =**	-157	-116	0	NA	NA	NA	NA	NA	NA
	V (kips) =	-37	-40	0	NA	NA	NA	NA	NA	NA
	M (ft-kip) =	0	0	0	NA	NA	NA	NA	NA	NA
End Bent - Transverse	**P (kips) =**	-157	-66	-157	NA	NA	NA	NA	NA	NA
	V (kips) =	-59	-60	-59	NA	NA	NA	NA	NA	NA
	M (ft-kip) =	+432	+424	+432	NA	NA	NA	NA	NA	NA
Interior Bent - Longitudinal	**P (kips) =**	-1067	-1067	0	NA	NA	NA	NA	NA	NA
	V (kips) =	-98	-98	0	NA	NA	NA	NA	NA	NA
	M (ft-kip) =	0	0	0	NA	NA	NA	NA	NA	NA
Interior Bent - Transverse	**P (kips) =**	-1067	-202	-202	NA	NA	NA	NA	NA	NA
	V (kips) =	-218	-240	-240	NA	NA	NA	NA	NA	NA
	M (ft-kip) =	+6983	+7600	+7600	NA	NA	NA	NA	NA	NA

Notes:

P – Axial; V – Shear; M – Moment; ^{a} – Check Flood w/o collision loads; ^{b} – Collision loads w/o check flood

From:	DeLaughter, George F.
To:	Gardner, Renee S.
Cc:	Stone, Sara M.; Nanney, Steve; Li, Tong
Subject:	RE: Location/Elevation of Applied Loads
Date:	Tuesday, August 02, 2016 1:29:58 PM
Attachments:	image001.png

Renee,

This is to put on record from our conversation less than two hours ago that the End Bent elevation for LPILE top of pile/column applied loads is 118.322 located at the center of the bent cap and for the Interior Bents 117.593 which is also located at the center of the bent cap.

Thanks,
George

From: Gardner, Renee S.
Sent: Tuesday, August 02, 2016 11:08 AM
To: DeLaughter, George F.
Cc: Stone, Sara M.; Nanney, Steve
Subject: Location/Elevation of Applied Loads

George,

Back in May you and I had a conversation about the location of the applied loads. The conversation focused on the interior bents. However, as I am compiling the data for your RCPier Input for the End Bents it occurs to me that I should verify the location for the End Bents too.

Your initial Load Data sheet indicates that the loads for the End Bents are at Elevation 119.822. Is this still accurate? Or do I need to change the elevation where loads are applied?

Thanks,

Renée S. Gardner, P.E.

SCDOT

South Carolina Department of Transportation
Midlands Regional Production Group
955 Park Street, Room 411
Columbia, SC 29202
Office: 803-737-3987
Fax: 803-737-1510

P-Y Modifiers (LRFD Table 10.7.2.4-1)

Per AASHTO LRFD Bridge Design Specifications, 6th Ed.

Spacing (Terms of B)	Row 1	Row 2	Row 3
3	0.80	0.40	0.30
5	1.00	0.85	0.70

End Bent (Single Row of Piles)

B (in)	14.5
Spacing (ft)	7.875
No. Piles	6
S/B	6.52

Row 1	Row 2	Row 3
1.152	1.191	1.003

Long P Modifier	1.000
Trans P Modifier	1.000

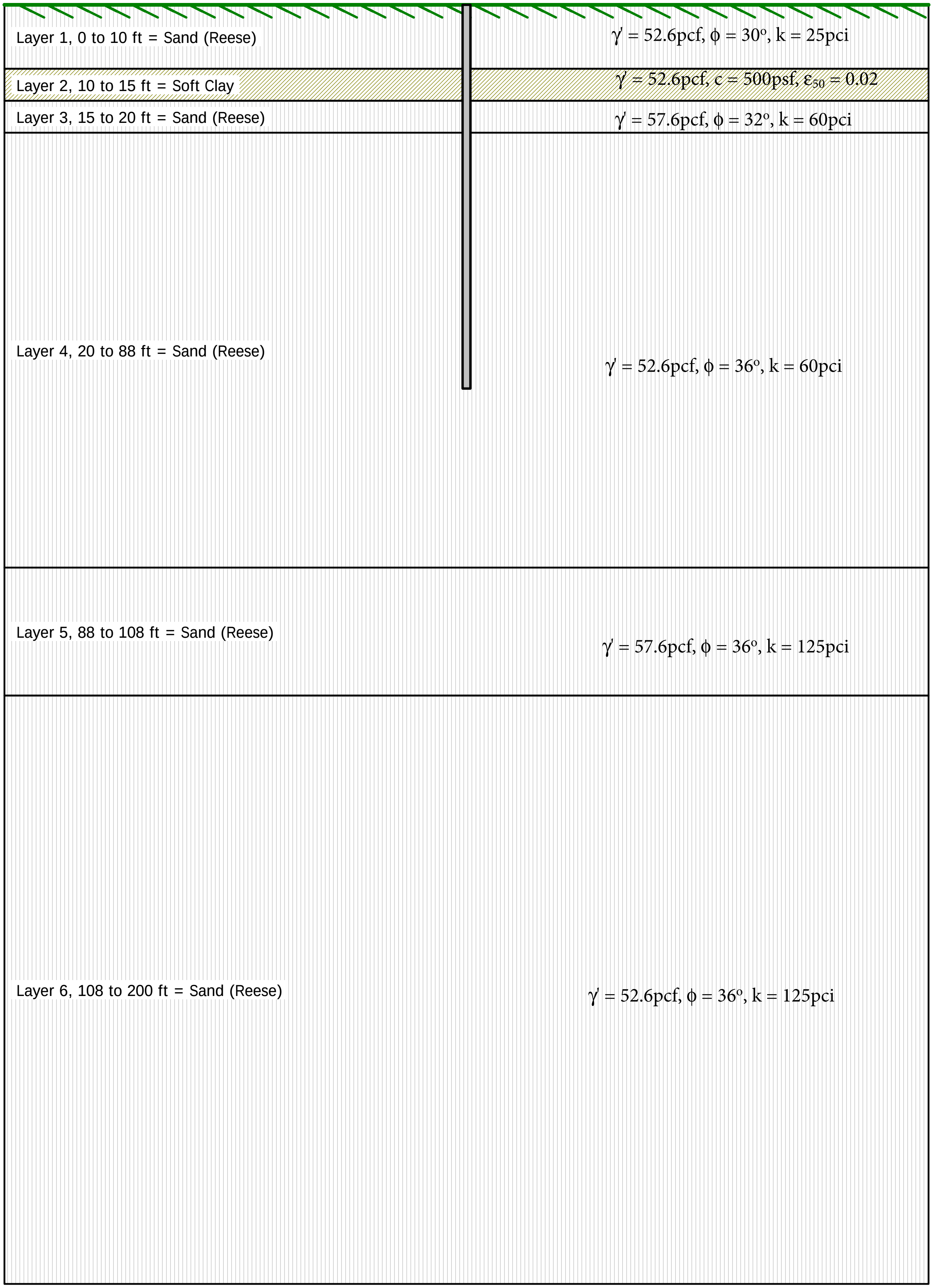
Int Bent (Single Row of Piles)

B (in)	48
Spacing (ft)	10
No. Piles	5
S/B	2.50

Row 1	Row 2	Row 3
0.750	0.288	0.200

Long P Modifier	0.750
Trans P Modifier	0.328

EndBents_Soil & Pile Profile



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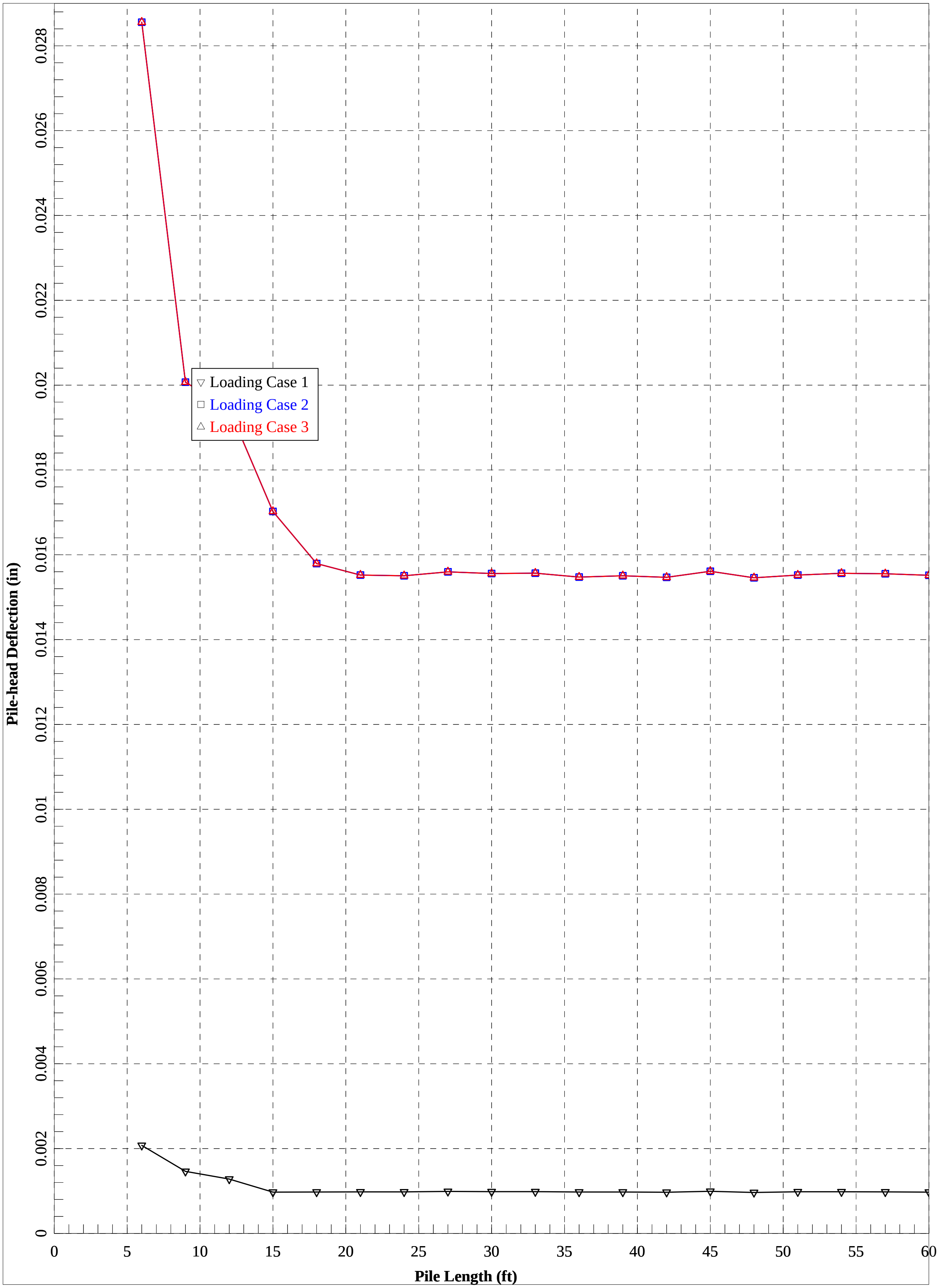
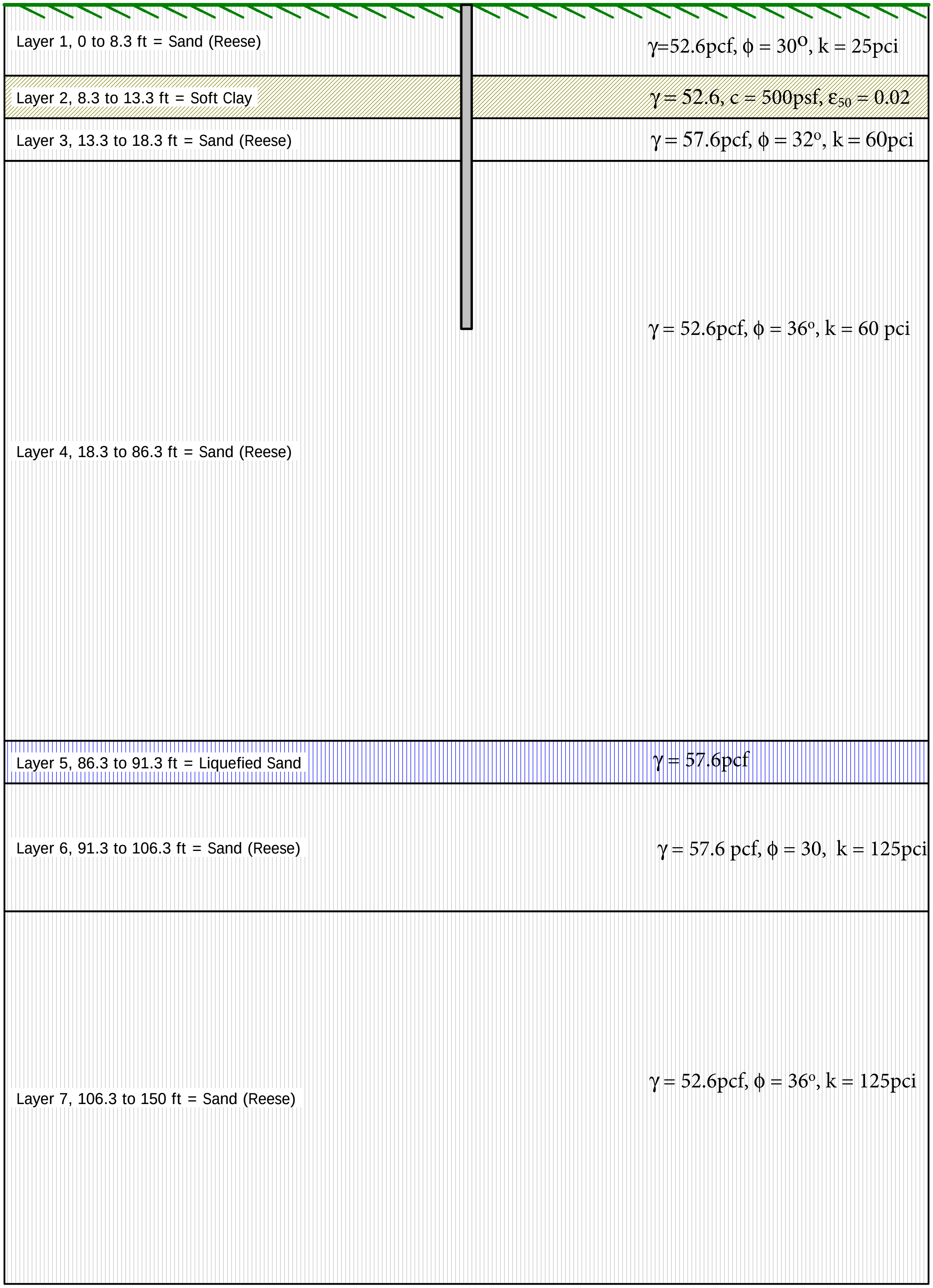
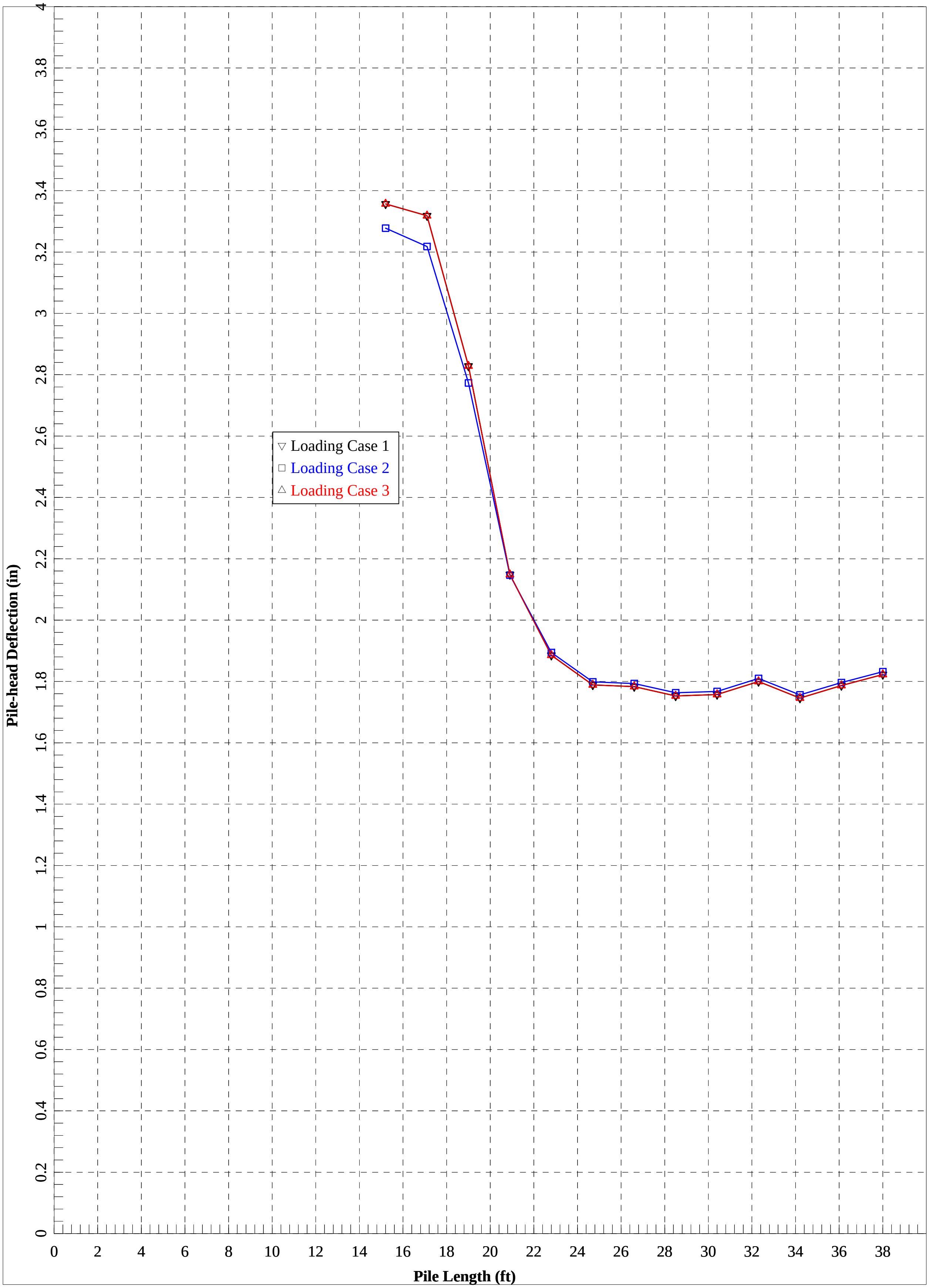
End Bents_Critical Depth_Transverse



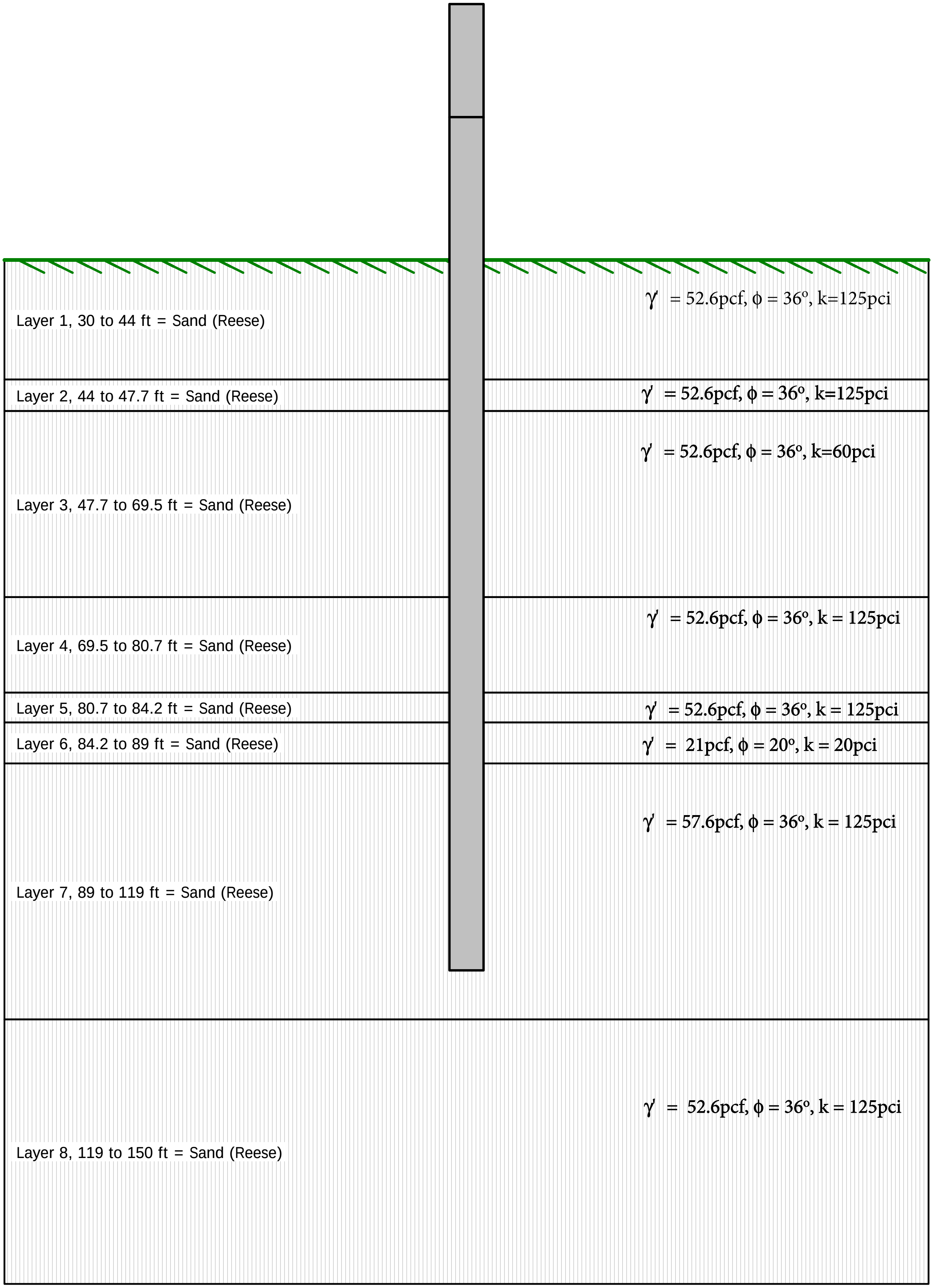
End Bents_Soil & Pile Profile
Extreme Event I Loading



End Bents_Critical Depth_Transverse
Extreme Event I Loading



IB-2_B-2_Soil & Pile Profile



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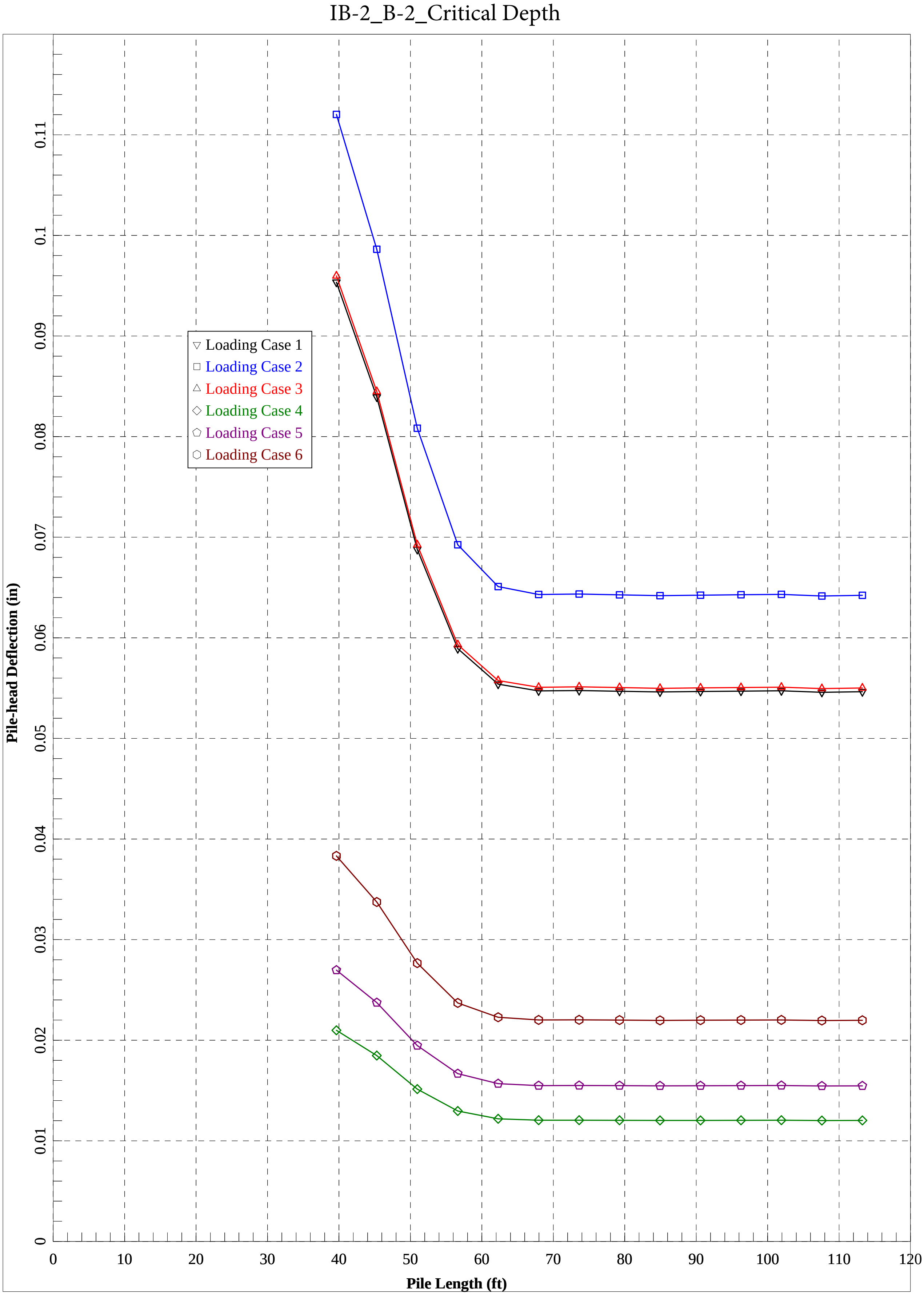
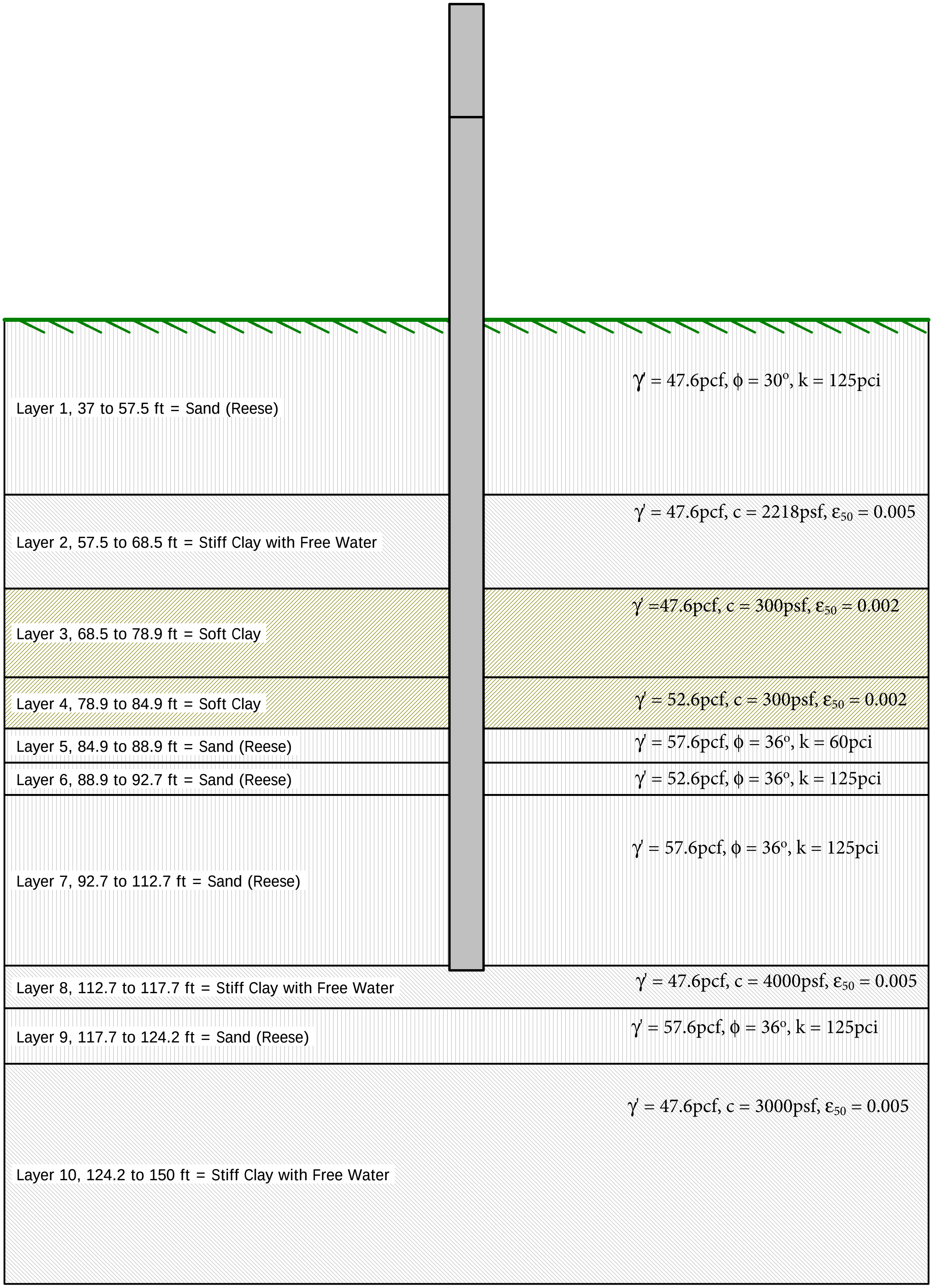

IB-2_B-2_Critical Depth
Pile-head Deflection (in)
Pile Length (ft)
▽ Loading Case 1
□ Loading Case 2
△ Loading Case 3
◇ Loading Case 4
⬠ Loading Case 5
⬡ Loading Case 6
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
0.11
0
10
20
30
40
50
60
70
80
90
100
110
120

IB-3_B-3A_Soil & Pile Profile



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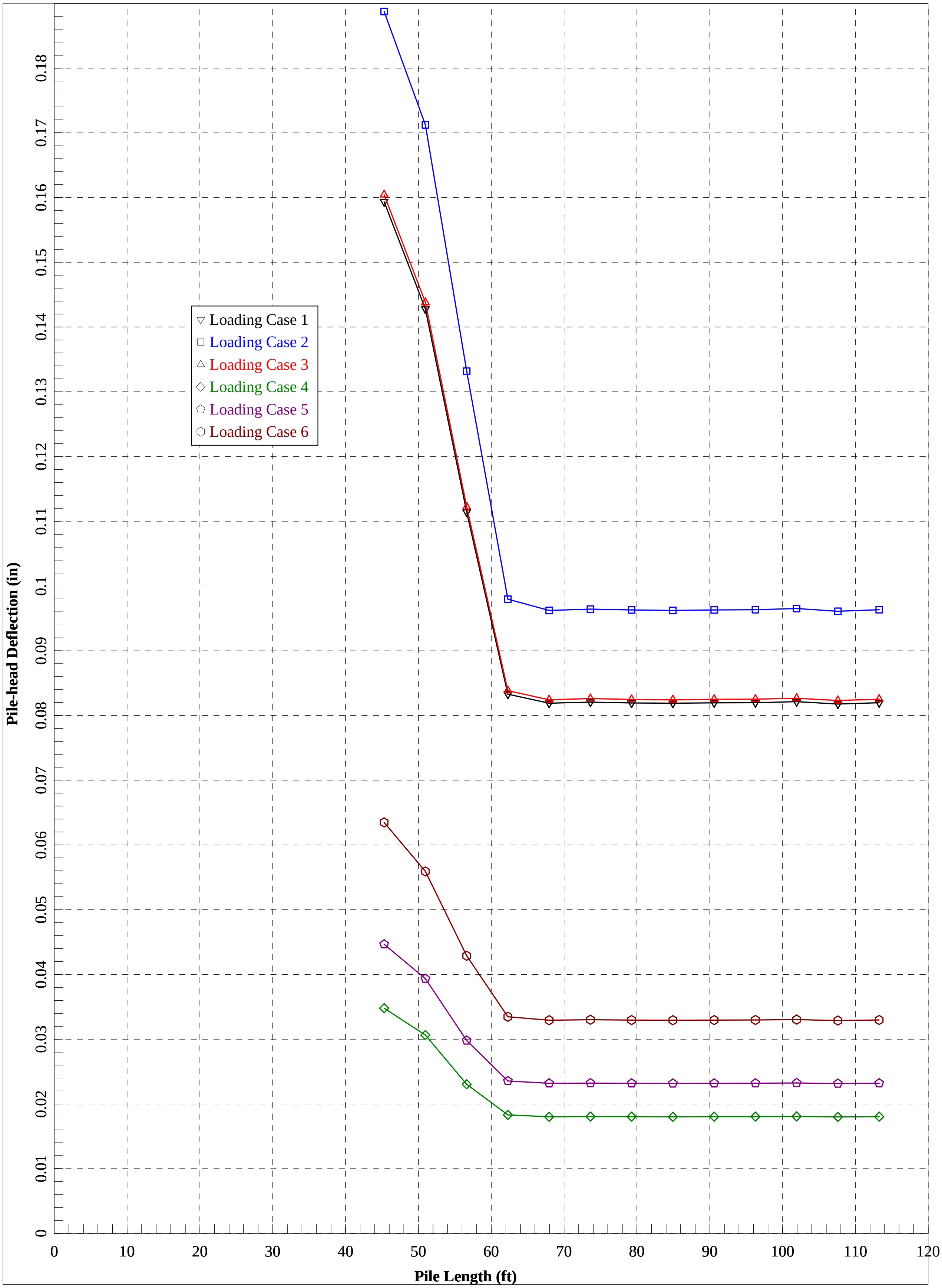
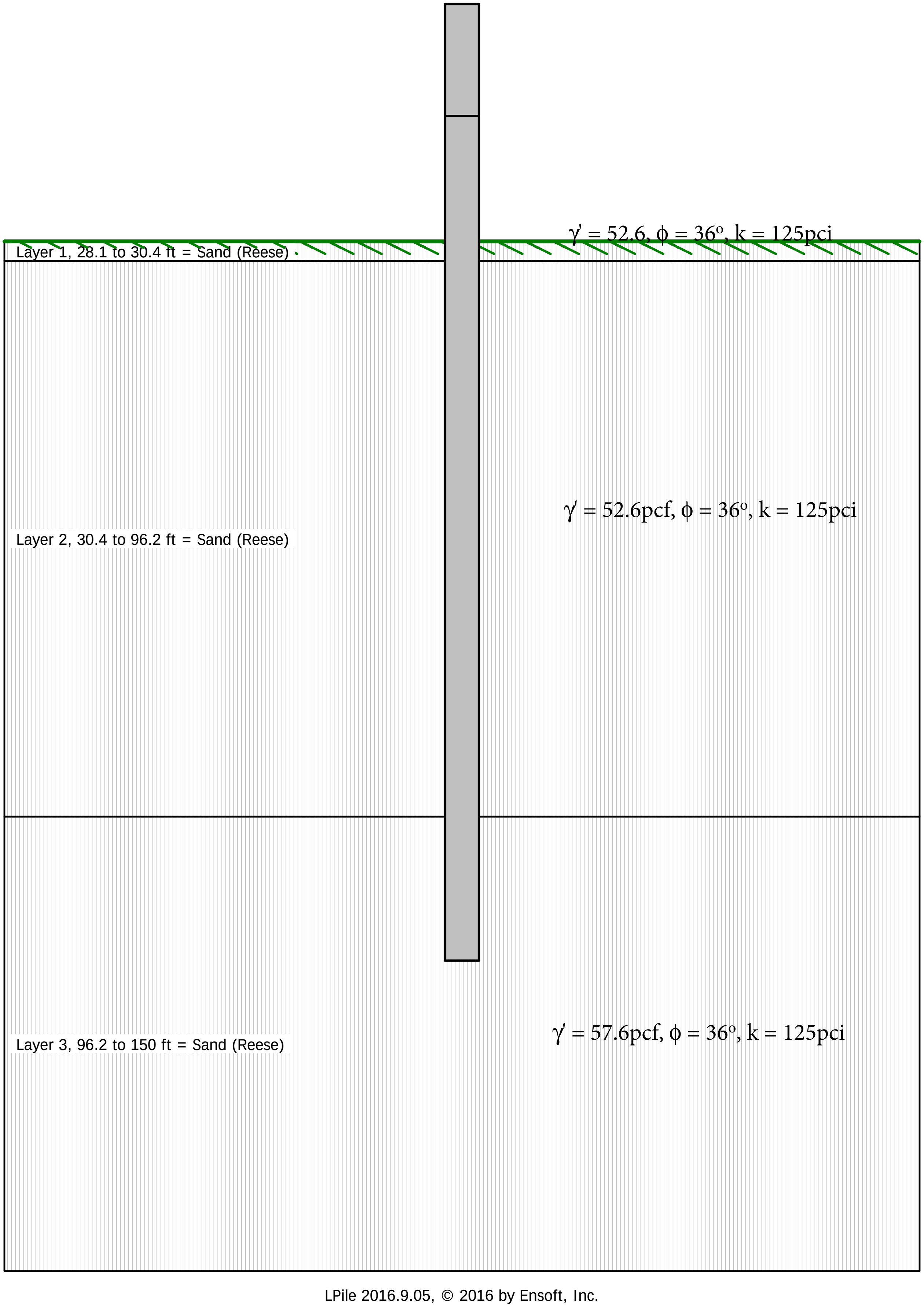
IB-3_B-3A_Critical Depth



IB-4_B-4_Soil & Pile Profile



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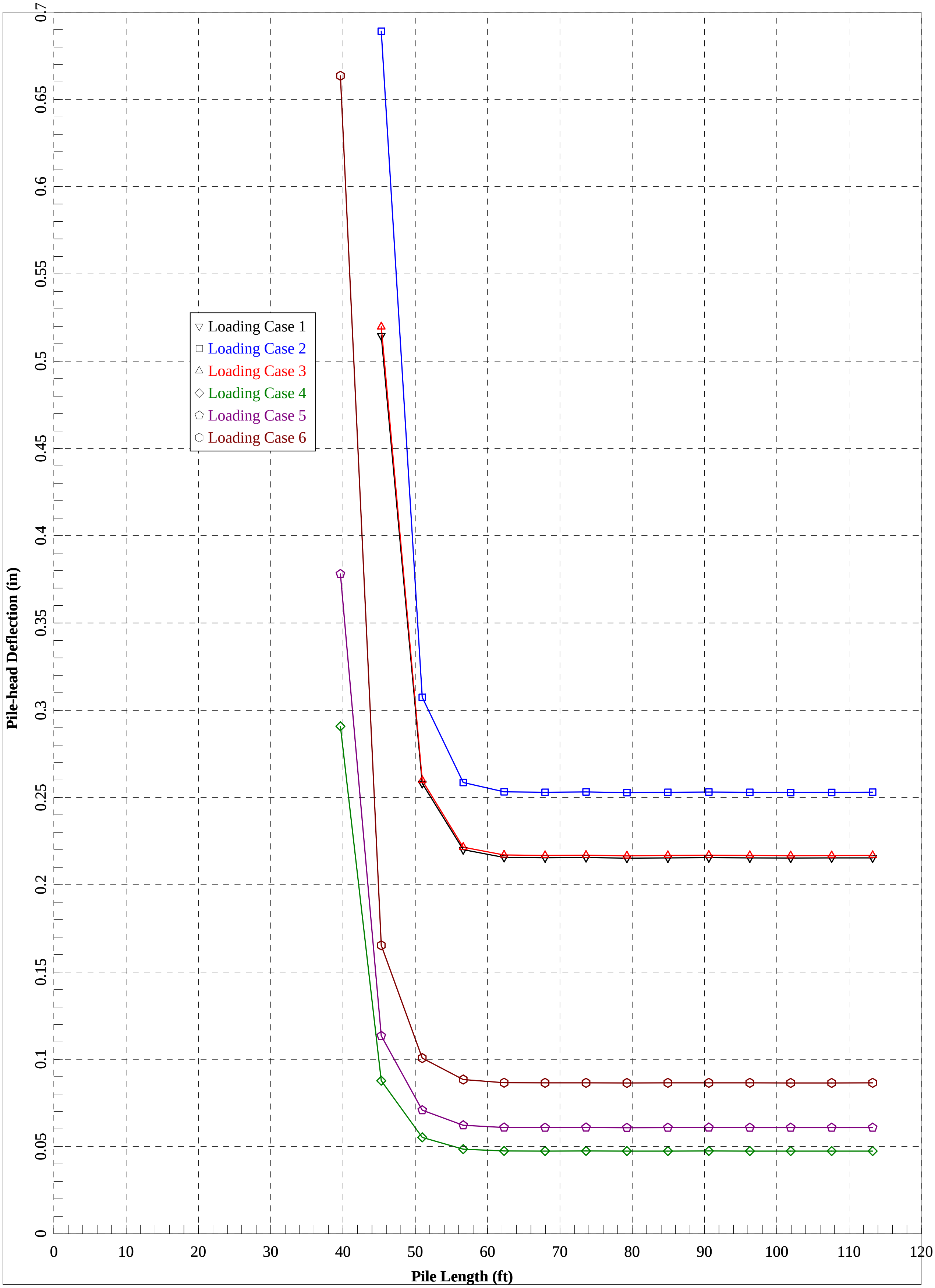
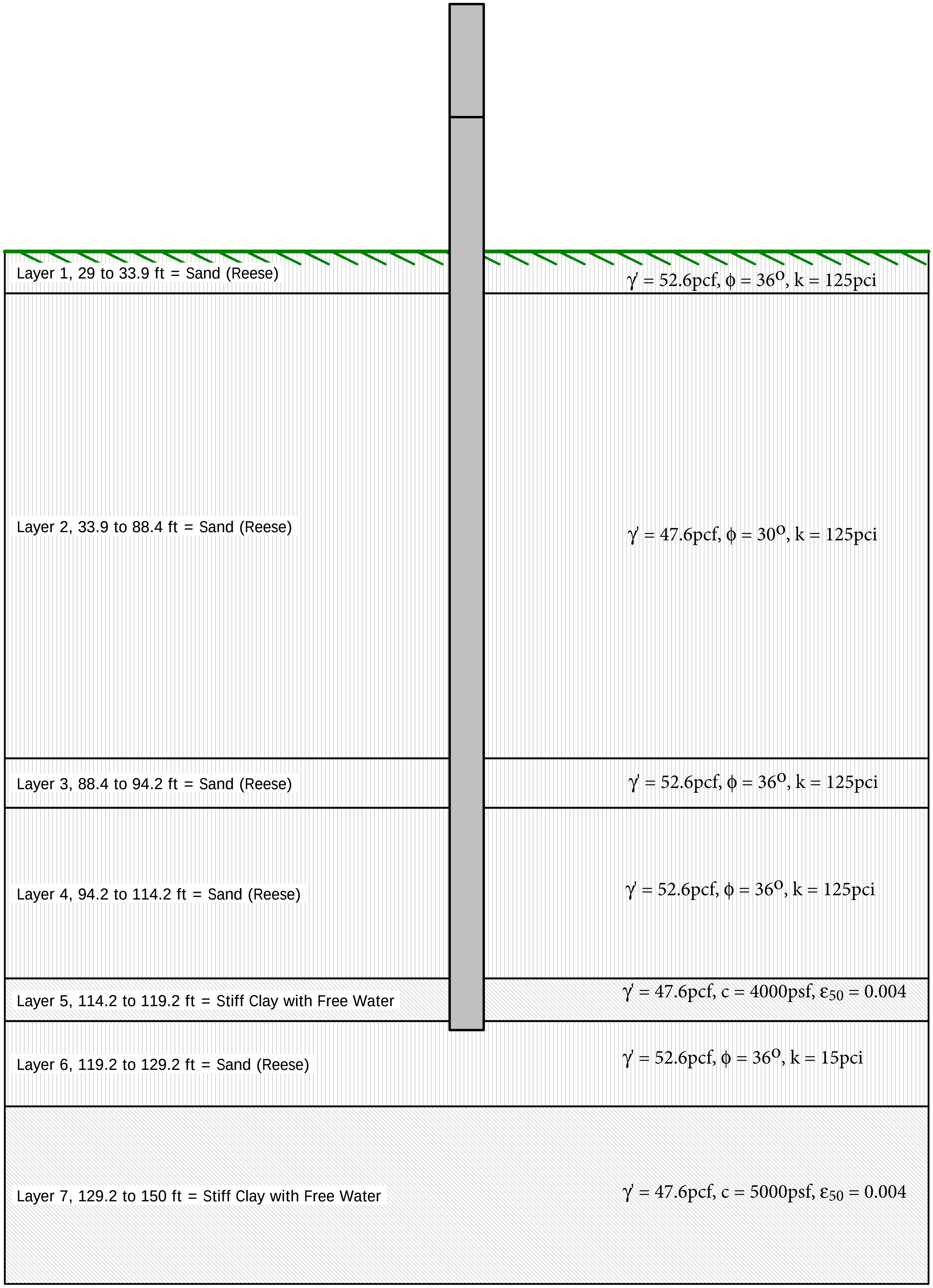
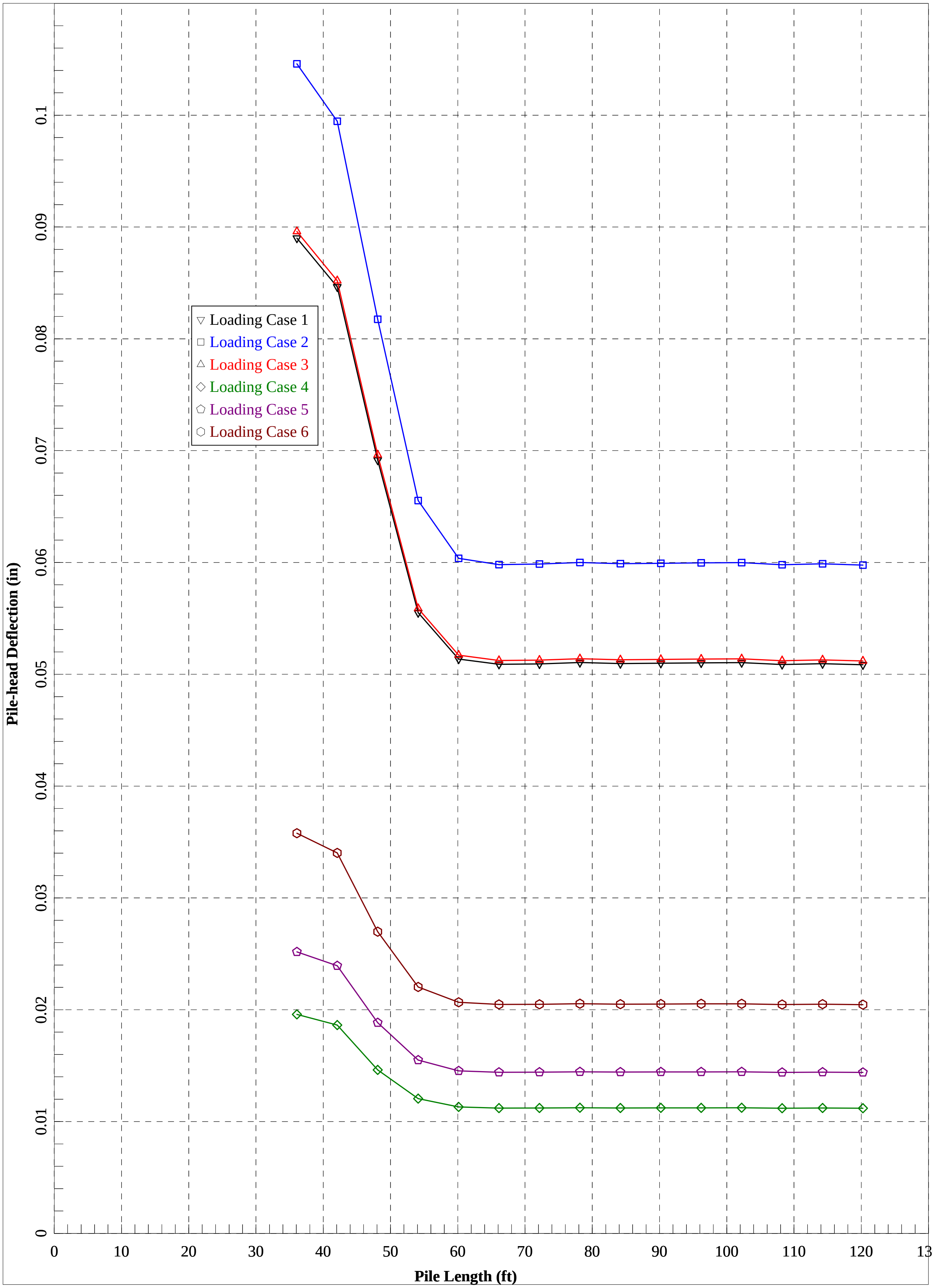
IB-4_B-4_Critical Depth



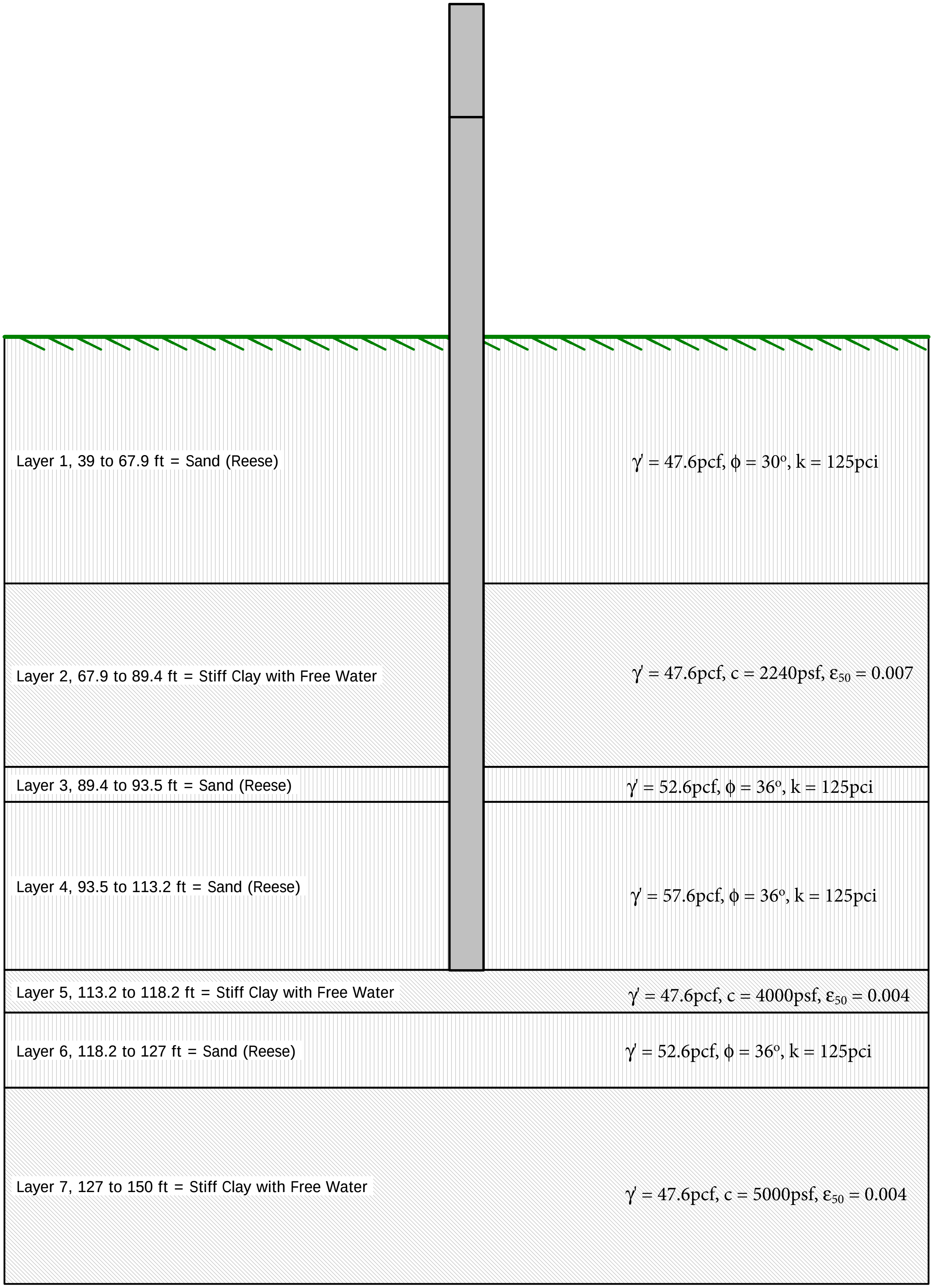
IB-5_B-5A_Soil & Pile Profile



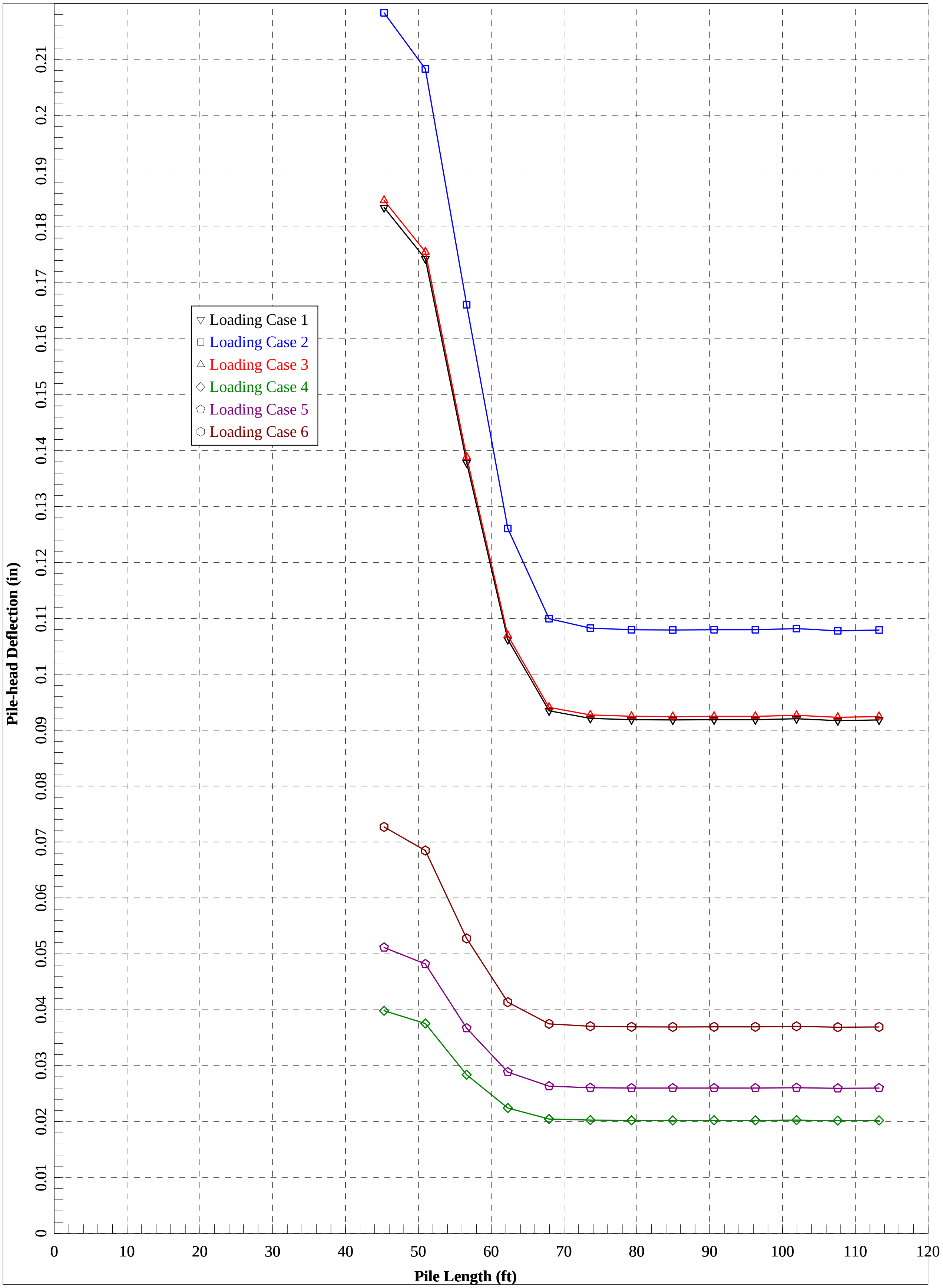
IB-5_B-5A_Critical Depth



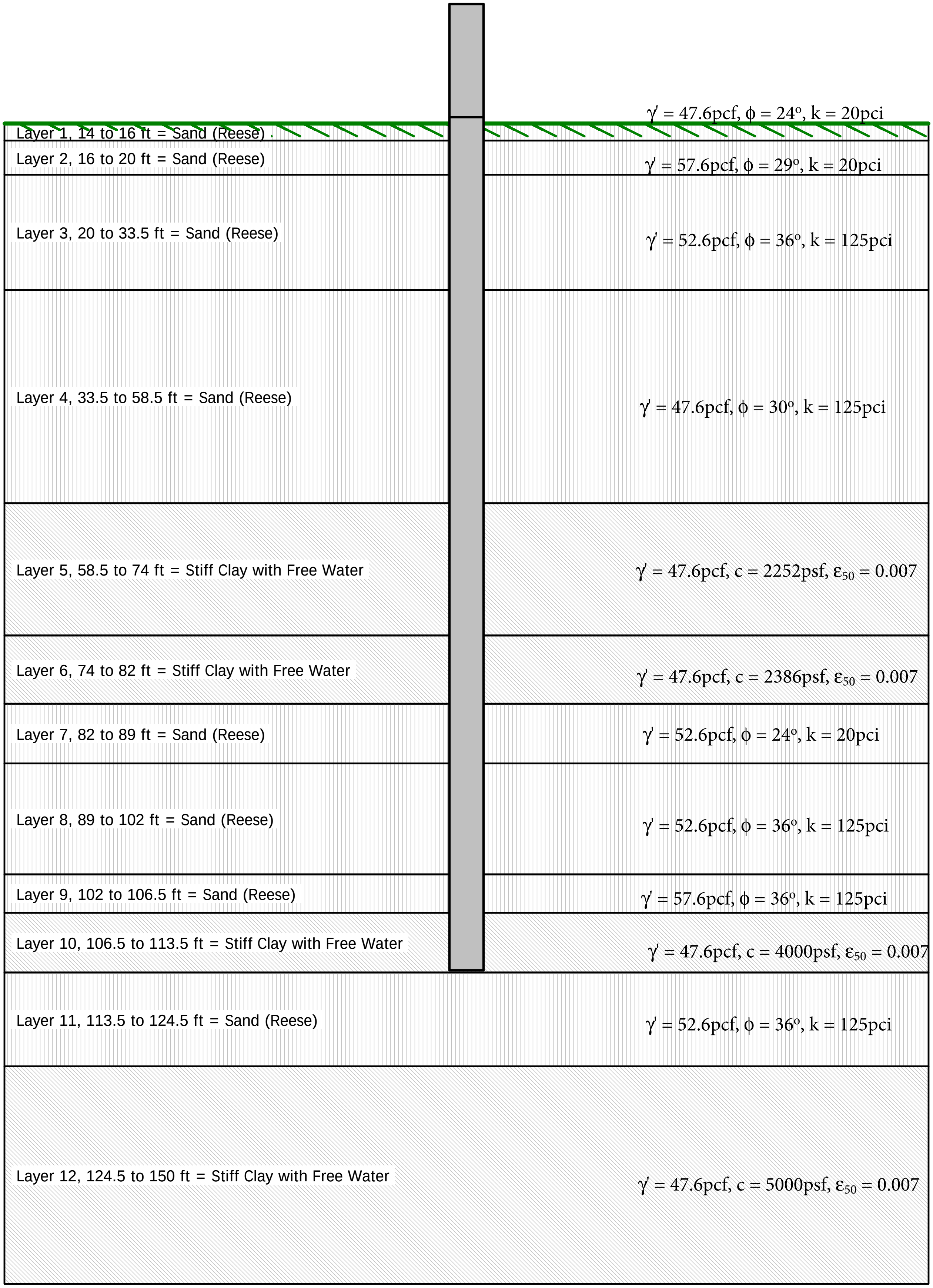
IB-6_B-6A_Soil & Pile Profile



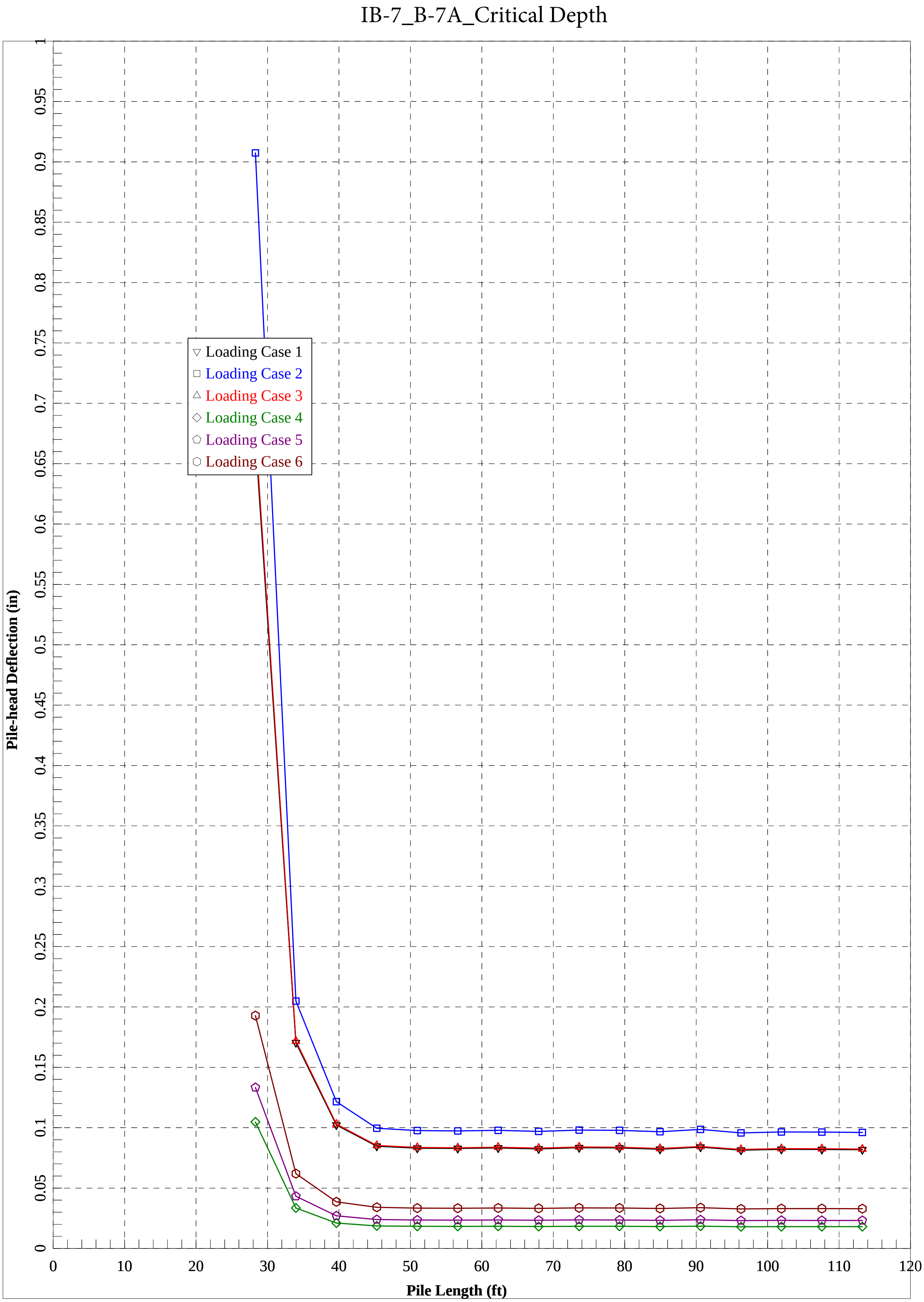
IB-6_B-6A_Critical Depth



IB-7_B-7A_Soil & Pile Profile



LPile 2016.9.05, © 2016 by Ensoft, Inc.


IB-7_B-7A_Critical Depth
Pile-head Deflection (in)
Pile Length (ft)
▽ Loading Case 1
□ Loading Case 2
△ Loading Case 3
◇ Loading Case 4
⬠ Loading Case 5
⬡ Loading Case 6
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
0
10
20
30
40
50
60
70
80
90
100
110
120

Appendix IX

Abutment Backwall Seismic Passive Pressures

Seismic Passive Pressure

(GDM Chapter 14, Section 14.9)

PIN No.: 40308
File No.: 38.0040308
Latitude: 33.4570
Designer: R. Gardner - Midlands RPG
Route: US 301
County: Orangeburg
Longitude: -80.6470
Date: 2/11/2016
Project: RBO Four Hole Swamp
Location: EB-1 Abutment (Cap)

Bridge Information:

OC =	II		
ROC =	II		
Abutment Type =	Integral		GDM Section 14.6.2

Backwall Dimensions:

Abutment Wall Height, h_{wall} =	3.0	ft	
Abutment Wall Width, b_{wall} =	49.5	ft	
Skew, α =	0.0000	degrees	
$Slope_H$ =	2	H : 1 V	Use $Slope_H$ = 99 for flat ground around bridge abutment; use $Slope_H$ = 0 for vertical walls.
Effective Wall Width, B_{eff} =	49.5	ft	

Seismic Data:

Design Earthquake:	SEE		
S_{D1} =	0.490	g	
k_{max} = PGA =	0.430	g	

Wave Scattering:

$\beta = S_{D1}/PGA$ =	1.140		β = Ground Motion Index:	$0.50 \le \beta \le 1.5$
α_w =	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{wall}[(0.5\beta)-1] \le 1.0$
$k_h = k_{avg}$ =	0.430	g	k_h = Average seismic horizontal coefficient due to wave scattering	$k_h = k_{avg} = \alpha_w k_{max}$

Soil Backfill:

Backfill Type:	c-Φ	
Friction Angle, ϕ =	36	°
Cohesion, c =	120	psf
Total Unit Weight, $\gamma_{backfill}$ =	115	pcf

Ultimate Force/Disp. per Foot of Wall Width:

K_{PE} =	6.53		Select appropriate Figure to determine K_{PE} from Figures 14-10, 14-11 or 14-12 of the GDM (2010)
Length of Passive Wedge (AE) ≈	9.8	ft	See Figure 14-9 of the GDM (2010)
$c/\gamma_{backfill}*h_{wall}$ =	0.35		If h_{wall} < 5 feet, use $K_P = K_{PE}$, see Section 14.5. K_P = 6.53
p_{wall} =	1.74	ksf	$p_{wall} = 2*c*(KPE)^{0.5}+0.5*K_{PE}*\gamma_{backfill}*h_{wall}$
y_{max}/h_{wall} =	0.10		(y_{max} / h_{wall}): Cohesionless Soils 0.05, Cohesive Soils 0.10
y_{max} =	3.60	inches	
$f_{ult} = p_{wall}*h_{wall}$ =	5.22	kip/ft	
$F_{ult} = f_{ult}*b_{wall}$ =	258.35	kips	

Average Wall Stiffness per Foot of Wall Width:

f_{avg} =	2.61	kip/ft	
K_{avg} =	30.00	kip/in/ft	K_{avg}: Cohesionless Soils = 50 k/in/ft, Cohesive/c-ϕ Soils = 25 k/in/ft
y_{avg} =	0.09	inches	

Hyperbolic force-relationship:

$f(y_i) = (y_i)/(A+B*y_i)$

A =	0.0171	$A = (y_{max})/((2*K_{avg}*y_{max})-f_{ult})$
B =	0.1869	$B = (2*(K_{avg}*y_{max}-f_{ult}))/(f_{ult}*((2*K_{avg}*y_{max})-f_{ult}))$

Total Wall Force/Stiffness per Foot of Wall Width:

$f_{max} = f_{ult}$ =	5.22	kip/ft
K_{max} =	52.78	kip/inch
K_{avg} =	30.00	kip/inch
K_{min} =	1.45	kip/inch

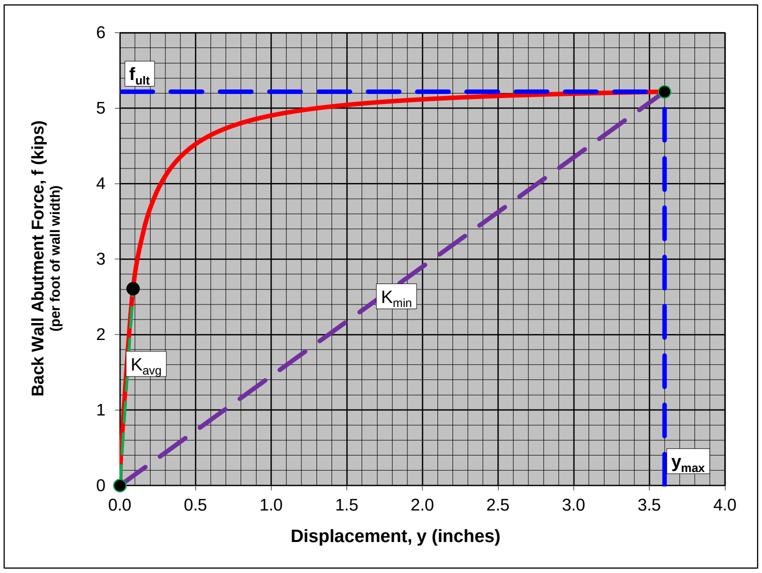
Seismic Passive Pressure

(GDM Chapter 14, Section 14.9)

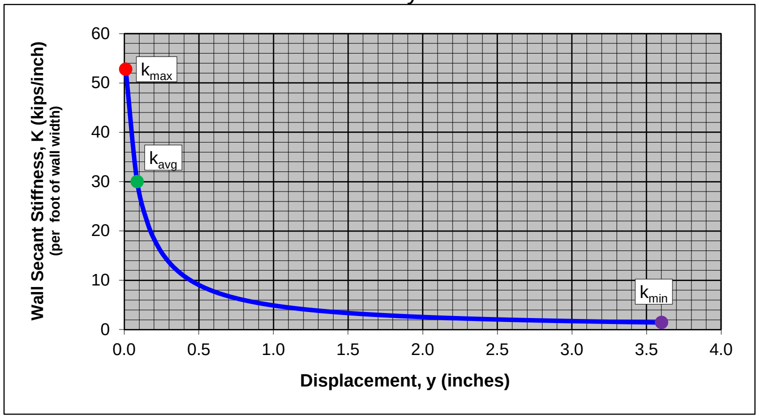
PIN No.: 40308 **File No.:** 38.0040308 **Latitude:** 33.4570 **Designer:** R. Gardner - Midlands RPG
Route: US 301 **County:** Orangeburg **Longitude:** -80.6470 **Date:** 2/11/2016
Project: RBO Four Hole Swamp
Location: EB-1 Abutment (Cap)

Per Foot of Wall Width		
y	**f**	**K**
inches	**k/ft**	**kip/inch**
0.00	0.00	0.00
0.01	0.53	52.78
0.08	2.55	30.60
0.16	3.38	21.55
0.23	3.83	16.63
0.30	4.11	13.54
0.38	4.31	11.42
0.45	4.45	9.87
0.52	4.56	8.69
0.60	4.64	7.77
0.67	4.71	7.02
0.74	4.77	6.40
0.82	4.81	5.88
0.89	4.85	5.44
0.97	4.89	5.07
1.04	4.92	4.74
1.11	4.95	4.45
1.19	4.97	4.19
1.26	4.99	3.96
1.33	5.01	3.76
1.41	5.02	3.57
1.48	5.04	3.41
1.55	5.05	3.25
1.63	5.07	3.12
1.70	5.08	2.99
1.77	5.09	2.87
1.85	5.10	2.76
1.92	5.11	2.66
1.99	5.12	2.57
2.07	5.13	2.48
2.14	5.13	2.40
2.21	5.14	2.32
2.29	5.15	2.25
2.36	5.15	2.18
2.43	5.16	2.12
2.51	5.16	2.06
2.58	5.17	2.00
2.65	5.17	1.95
2.73	5.18	1.90
2.80	5.18	1.85
2.88	5.19	1.80
2.95	5.19	1.76
3.02	5.19	1.72
3.10	5.20	1.68
3.17	5.20	1.64
3.24	5.20	1.61
3.32	5.21	1.57
3.39	5.21	1.54
3.46	5.21	1.51
3.54	5.22	1.48
3.61	5.22	1.45

$f\{y_i\} = y_i/A+By_i$



K = f / y



Seismic Passive Pressure

(GDM Chapter 14, Section 14.9)

PIN No.: 40308
File No.: 38.0040308
Latitude: 33.4570
Designer: R. Gardner - Midlands RPG
Route: US 301
County: Orangeburg
Longitude: -80.6470
Date: 2/11/2016
Project: RBO Four Hole Swamp
Location: EB-1 Wing Wall

Bridge Information:

OC =	II		
ROC =	II		
Abutment Type =	Integral		GDM Section 14.6.2

Backwall Dimensions:

Abutment Wall Height, h_{wall} =	5.0	ft	
Abutment Wall Width, b_{wall} =	8.0	ft	
Skew, α =	0.0000	degrees	
$Slope_H$ =	2	H : 1 V	Use $Slope_H$ = 99 for flat ground around bridge abutment; use $Slope_H$ = 0 for vertical walls.
Effective Wall Width, B_{eff} =	8.0	ft	

Seismic Data:

Design Earthquake:	SEE		
S_{D1} =	0.490	g	
k_{max} = PGA =	0.430	g	

Wave Scattering:

$\beta = S_{D1}/PGA$ =	1.140		β = Ground Motion Index:	$0.50 \le \beta \le 1.5$
α_w =	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{wall}[(0.5\beta)-1]\le 1.0$
$k_h = k_{avg}$ =	0.430	g	k_h = Average seismic horizontal coefficient due to wave scattering	$k_h = k_{avg} = \alpha_w k_{max}$

Soil Backfill:

Backfill Type:	c-Φ	
Friction Angle, ϕ =	36	°
Cohesion, c =	120	psf
Total Unit Weight, $\gamma_{backfill}$ =	115	pcf

Ultimate Force/Disp. per Foot of Wall Width:

K_{PE} =	5.46		Select appropriate Figure to determine K_{PE} from Figures 14-10, 14-11 or 14-12 of the GDM (2010)
Length of Passive Wedge (AE) ≈	16.3	ft	See Figure 14-9 of the GDM (2010)
$c/\gamma_{backfill}*h_{wall}$ =	0.21		If h_{wall} < 5 feet, use $K_P = K_{PE}$, see Section 14.5. K_P = 5.46
p_{wall} =	2.13	ksf	$p_{wall} = 2*c*(KPE)^{0.5}+0.5*K_{PE}*\gamma_{backfill}*h_{wall}$
y_{max}/h_{wall} =	0.10		(y_{max} / h_{wall}): Cohesionless Soils 0.05, Cohesive Soils 0.10
y_{max} =	6.00	inches	
$f_{ult} = p_{wall}*h_{wall}$ =	10.65	kip/ft	
$F_{ult} = f_{ult}*b_{wall}$ =	85.22	kips	

Average Wall Stiffness per Foot of Wall Width:

f_{avg} =	5.33	kip/ft	
K_{avg} =	30.00	kip/in/ft	K_{avg}: Cohesionless Soils = 50 k/in/ft, Cohesive/c-ϕ Soils = 25 k/in/ft
y_{avg} =	0.18	inches	

Hyperbolic force-relationship:

$f(y_i) = (y_i)/(A+B*y_i)$

A =	0.0172	$A = (y_{max})/((2*K_{avg}*y_{max})-f_{ult})$
B =	0.0910	$B = (2*(K_{avg}*y_{max}-f_{ult}))/(f_{ult}*((2*K_{avg}*y_{max})-f_{ult}))$

Total Wall Force/Stiffness per Foot of Wall Width:

$f_{max} = f_{ult}$ =	10.65	kip/ft
K_{max} =	55.29	kip/inch
K_{avg} =	30.00	kip/inch
K_{min} =	1.77	kip/inch

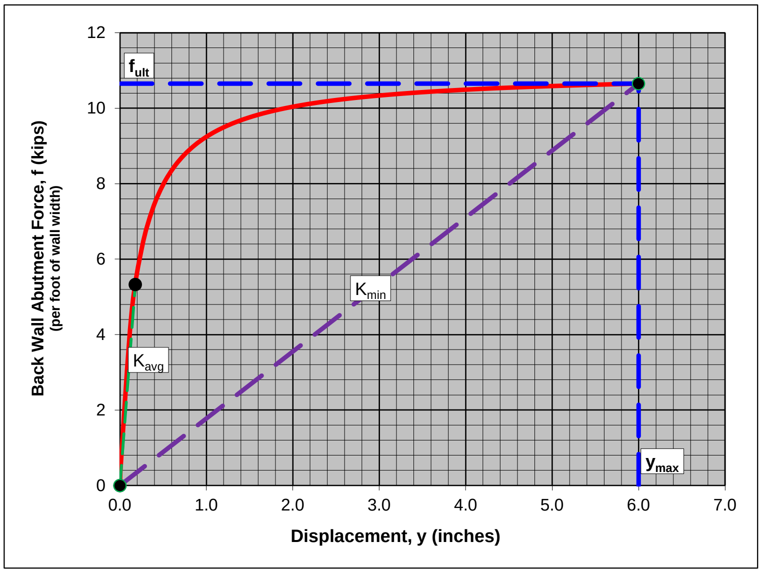
Seismic Passive Pressure

(GDM Chapter 14, Section 14.9)

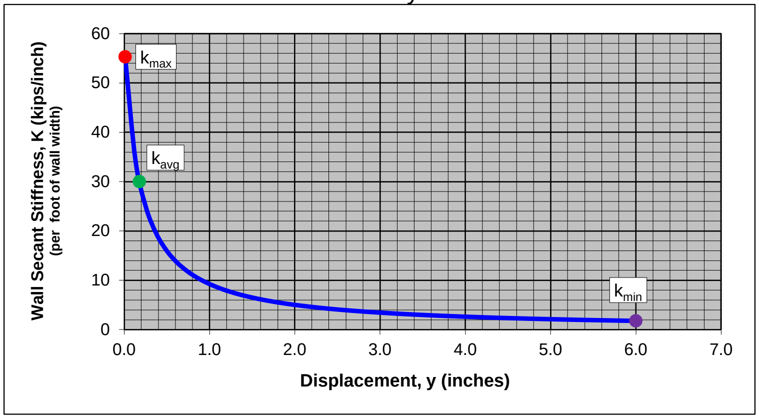
PIN No.: 40308
File No.: 38.0040308
Latitude: 33.4570
Designer: R. Gardner - Midlands RPG
Route: US 301
County: Orangeburg
Longitude: -80.6470
Date: 2/11/2016
Project: RBO Four Hole Swamp
Location: EB-1 Wing Wall

Per Foot of Wall Width		
y inches	f k/ft	K kip/inch
0.00	0.00	0.00
0.01	0.55	55.29
0.13	4.53	34.21
0.25	6.31	24.77
0.38	7.32	19.41
0.50	7.98	15.96
0.62	8.43	13.55
0.74	8.77	11.77
0.87	9.02	10.41
0.99	9.23	9.33
1.11	9.39	8.45
1.23	9.53	7.72
1.36	9.65	7.11
1.48	9.74	6.59
1.60	9.83	6.14
1.72	9.90	5.74
1.85	9.97	5.40
1.97	10.03	5.09
2.09	10.08	4.82
2.21	10.12	4.57
2.34	10.17	4.35
2.46	10.20	4.15
2.58	10.24	3.97
2.70	10.27	3.80
2.83	10.30	3.64
2.95	10.33	3.50
3.07	10.35	3.37
3.19	10.37	3.25
3.32	10.40	3.14
3.44	10.42	3.03
3.56	10.43	2.93
3.68	10.45	2.84
3.81	10.47	2.75
3.93	10.48	2.67
4.05	10.50	2.59
4.17	10.51	2.52
4.30	10.53	2.45
4.42	10.54	2.39
4.54	10.55	2.32
4.66	10.56	2.26
4.79	10.57	2.21
4.91	10.58	2.16
5.03	10.59	2.11
5.15	10.60	2.06
5.28	10.61	2.01
5.40	10.62	1.97
5.52	10.62	1.92
5.64	10.63	1.88
5.77	10.64	1.85
5.89	10.65	1.81
6.01	10.65	1.77

$f\{y_i\} = y_i/A+By_i$



K = f / y



Seismic Passive Pressure

(GDM Chapter 14, Section 14.9)

PIN No.: 40308
File No.: 38.0040308
Latitude: 33.4570
Designer: R. Gardner - Midlands RPG
Route: US 301
County: Orangeburg
Longitude: -80.6470
Date: 2/11/2016
Project: RBO Four Hole Swamp
Location: EB-8 Abutment (Cap)

Bridge Information:

OC = II
ROC = II
Abutment Type = Integral — GDM Section 14.6.2

Backwall Dimensions:

Abutment Wall Height, h_{wall} = 3.0 ft
Abutment Wall Width, b_{wall} = 49.5 ft
Skew, α = 0.0000 degrees
$Slope_H$ = 2 H : 1 V — Use $Slope_H$ = 99 for flat ground around bridge abutment; use $Slope_H$ = 0 for vertical walls.
Effective Wall Width, B_{eff} = 49.5 ft

Seismic Data:

Design Earthquake: SEE
S_{D1} = 0.490 g
k_{max} = PGA = 0.430 g

Wave Scattering:

β = S_{D1}/PGA = 1.140 — β = Ground Motion Index: — $0.50 \leq \beta \leq 1.5$
α_w = 1.000 — α_w = Wave Scattering Scaling Factor: — $1+0.01h_{wall}[(0.5\beta)-1]\leq 1.0$
$k_h = k_{avg}$ = 0.430 g — k_h = Average seismic horizontal coefficient due to wave scattering — $k_h = k_{avg} = \alpha_w k_{max}$

Soil Backfill:

Backfill Type: c-Φ
Friction Angle, ϕ = 31 °
Cohesion, c = 46 psf
Total Unit Weight, $\gamma_{backfill}$ = 120 pcf

Ultimate Force/Disp. per Foot of Wall Width:

K_{PE} = 3.92 — Select appropriate Figure to determine K_{PE} from Figures 14-10, 14-11 or 14-12 of the GDM (2010)
Length of Passive Wedge (AE) ≈ 9.8 ft — See Figure 14-9 of the GDM (2010)
$c/\gamma_{backfill}*h_{wall}$ = 0.13 — If h_{wall} < 5 feet, use $K_P = K_{PE}$, see Section 14.5. — K_P = 3.92
p_{wall} = 0.89 ksf — $p_{wall} = 2*c*(KPE)^{0.5}+0.5*K_{PE}*\gamma_{backfill}*h_{wall}$
y_{max}/h_{wall} = 0.10 — (y_{max} / h_{wall}): Cohesionless Soils 0.05, Cohesive Soils 0.10
y_{max} = 3.60 inches
$f_{ult} = p_{wall}*h_{wall}$ = 2.66 kip/ft
$F_{ult} = f_{ult}*b_{wall}$ = 131.83 kips

Average Wall Stiffness per Foot of Wall Width:

f_{avg} = 1.33 kip/ft
K_{avg} = 30.00 kip/in/ft — K_{avg}: Cohesionless Soils = 50 k/in/ft, Cohesive/c-ϕ Soils = 25 k/in/ft
y_{avg} = 0.04 inches

Hyperbolic force-relationship:

$f(y_i) = (y_i)/(A+B*y_i)$

A = 0.0169 — $A = (y_{max})/((2*K_{avg}*y_{max})-f_{ult})$
B = 0.3708 — $B = (2*(K_{avg}*y_{max}-f_{ult}))/(f_{ult}*((2*K_{avg}*y_{max})-f_{ult}))$

Total Wall Force/Stiffness per Foot of Wall Width:

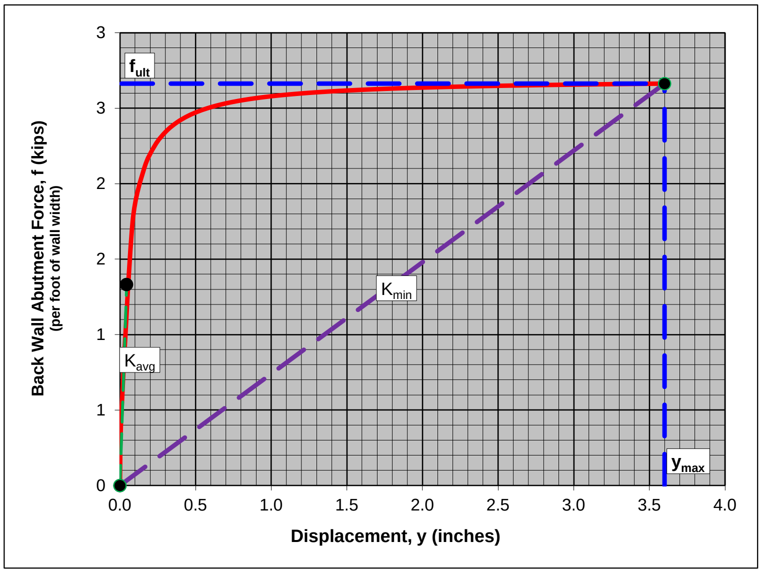
$f_{max} = f_{ult}$ = 2.66 kip/ft
K_{max} = 48.58 kip/inch
K_{avg} = 30.00 kip/inch
K_{min} = 0.74 kip/inch

Seismic Passive Pressure

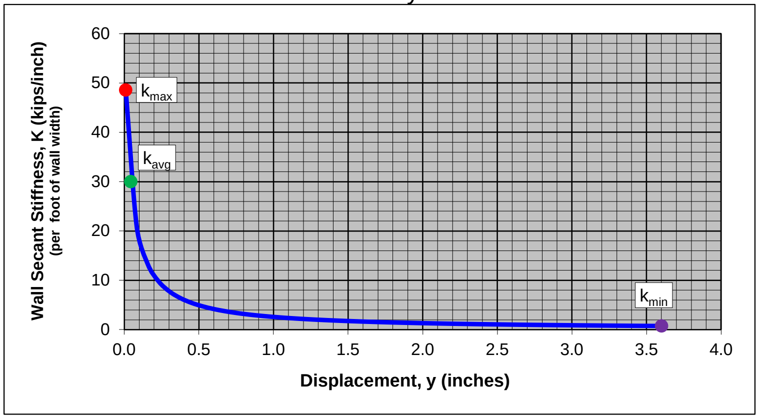
(GDM Chapter 14, Section 14.9)

PIN No.: 40308
File No.: 38.0040308
Latitude: 33.4570
Designer: R. Gardner - Midlands RPG
Route: US 301
County: Orangeburg
Longitude: -80.6470
Date: 2/11/2016
Project: RBO Four Hole Swamp
Location: EB-8 Abutment (Cap)

Per Foot of Wall Width		
y **inches**	**f** **k/ft**	**K** **kip/inch**
0.00	0.00	0.00
0.01	0.49	48.58
0.08	1.75	20.91
0.16	2.09	13.32
0.23	2.25	9.77
0.30	2.35	7.72
0.38	2.41	6.38
0.45	2.45	5.43
0.52	2.48	4.73
0.60	2.51	4.19
0.67	2.53	3.76
0.74	2.54	3.41
0.82	2.55	3.12
0.89	2.57	2.88
0.97	2.58	2.67
1.04	2.58	2.49
1.11	2.59	2.33
1.19	2.60	2.19
1.26	2.60	2.07
1.33	2.61	1.96
1.41	2.61	1.86
1.48	2.62	1.77
1.55	2.62	1.69
1.63	2.62	1.61
1.70	2.63	1.55
1.77	2.63	1.48
1.85	2.63	1.43
1.92	2.63	1.37
1.99	2.64	1.32
2.07	2.64	1.28
2.14	2.64	1.23
2.21	2.64	1.19
2.29	2.64	1.16
2.36	2.65	1.12
2.43	2.65	1.09
2.51	2.65	1.06
2.58	2.65	1.03
2.65	2.65	1.00
2.73	2.65	0.97
2.80	2.65	0.95
2.88	2.65	0.92
2.95	2.66	0.90
3.02	2.66	0.88
3.10	2.66	0.86
3.17	2.66	0.84
3.24	2.66	0.82
3.32	2.66	0.80
3.39	2.66	0.79
3.46	2.66	0.77
3.54	2.66	0.75
3.61	2.66	0.74



$f\{y_i\} = y_i/A + By_i$



K = f / y

Seismic Passive Pressure
(GDM Chapter 14, Section 14.9)

PIN No.: 40308
File No.: 38.0040308
Latitude: 33.4570
Designer: R. Gardner - Midlands RPG
Route: US 301
County: Orangeburg
Longitude: -80.6470
Date: 2/11/2016
Project: RBO Four Hole Swamp
Location: EB-8 Wing Wall

Bridge Information:

OC =	II		
ROC =	II		
Abutment Type =	Integral		GDM Section 14.6.2

Backwall Dimensions:

Abutment Wall Height, h_{wall} =	5.0	ft	
Abutment Wall Width, b_{wall} =	8.0	ft	
Skew, α =	0.0000	degrees	
$Slope_H$ =	2	H : 1 V	Use $Slope_H$ = 99 for flat ground around bridge abutment; use $Slope_H$ = 0 for vertical walls.
Effective Wall Width, B_{eff} =	8.0	ft	

Seismic Data:

Design Earthquake:	SEE	
S_{D1} =	0.490	g
k_{max} = PGA =	0.430	g

Wave Scattering:

$\beta = S_{D1}/PGA$ =	1.140		β = Ground Motion Index:	$0.50 \le \beta \le 1.5$
α_w =	1.000		α_w = Wave Scattering Scaling Factor:	$1+0.01h_{wall}[(0.5\beta)-1] \le 1.0$
$k_h = k_{avg}$ =	0.430	g	k_h = Average seismic horizontal coefficient due to wave scattering	$k_h = k_{avg} = \alpha_w k_{max}$

Soil Backfill:

Backfill Type:	c-Φ	
Friction Angle, ϕ =	31	°
Cohesion, c =	46	psf
Total Unit Weight, $\gamma_{backfill}$ =	120	pcf

Ultimate Force/Disp. per Foot of Wall Width:

K_{PE} =	3.60		Select appropriate Figure to determine K_{PE} from Figures 14-10, 14-11 or 14-12 of the GDM (2010)	
Length of Passive Wedge (AE) ≈	16.3	ft	See Figure 14-9 of the GDM (2010)	
$c/\gamma_{backfill}*h_{wall}$ =	0.08		If h_{wall} < 5 feet, use $K_P = K_{PE}$, see Section 14.5.	K_P = 3.60
p_{wall} =	1.25	ksf	$p_{wall} = 2*c*(KPE)^{0.5}+0.5*K_{PE}*\gamma_{backfill}*h_{wall}$	
y_{max}/h_{wall} =	0.10		(y_{max} / h_{wall}): Cohesionless Soils 0.05, Cohesive Soils 0.10	
y_{max} =	6.00	inches		
$f_{ult} = p_{wall}*h_{wall}$ =	6.27	kip/ft		
$F_{ult} = f_{ult}*b_{wall}$ =	50.18	kips		

Average Wall Stiffness per Foot of Wall Width:

f_{avg} =	3.14	kip/ft	
K_{avg} =	30.00	kip/in/ft	K_{avg}: Cohesionless Soils = 50 k/in/ft, Cohesive/c-ϕ Soils = 25 k/in/ft
y_{avg} =	0.10	inches	

Hyperbolic force-relationship:

$f(y_i) = (y_i)/(A+B*y_i)$

A =	0.0170	$A = (y_{max})/((2*K_{avg}*y_{max})-f_{ult})$
B =	0.1566	$B = (2*(K_{avg}*y_{max}-f_{ult}))/(f_{ult}*((2*K_{avg}*y_{max})-f_{ult}))$

Total Wall Force/Stiffness per Foot of Wall Width:

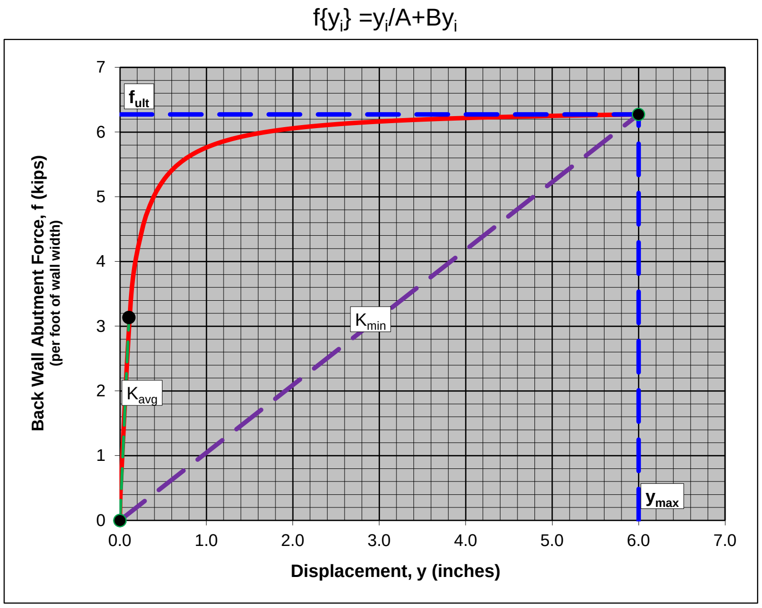
$f_{max} = f_{ult}$ =	6.27	kip/ft
K_{max} =	53.97	kip/inch
K_{avg} =	30.00	kip/inch
K_{min} =	1.04	kip/inch

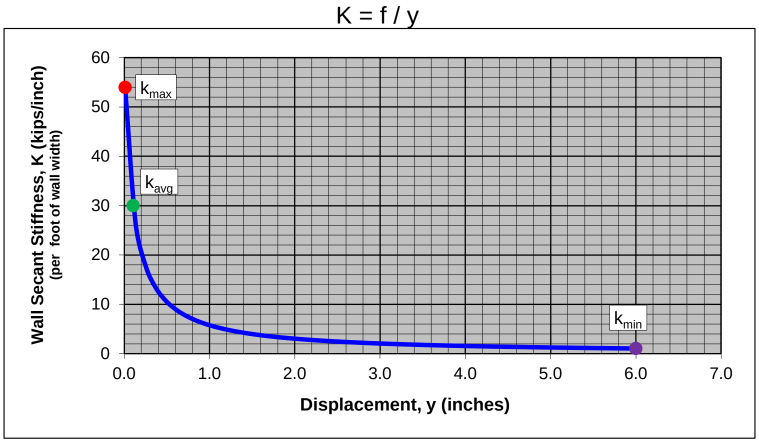
Seismic Passive Pressure

(GDM Chapter 14, Section 14.9)

PIN No.: 40308
File No.: 38.0040308
Latitude: 33.4570
Designer: R. Gardner - Midlands RPG
Route: US 301
County: Orangeburg
Longitude: -80.6470
Date: 2/11/2016
Project: RBO Four Hole Swamp
Location: EB-8 Wing Wall

Per Foot of Wall Width		
y inches	f k/ft	K kip/inch
0.00	0.00	0.00
0.01	0.54	53.97
0.13	3.51	26.52
0.25	4.48	17.58
0.38	4.96	13.15
0.50	5.25	10.50
0.62	5.44	8.74
0.74	5.58	7.49
0.87	5.68	6.55
0.99	5.76	5.82
1.11	5.82	5.23
1.23	5.87	4.76
1.36	5.91	4.36
1.48	5.95	4.02
1.60	5.98	3.73
1.72	6.01	3.48
1.85	6.03	3.27
1.97	6.05	3.07
2.09	6.07	2.90
2.21	6.09	2.75
2.34	6.10	2.61
2.46	6.12	2.49
2.58	6.13	2.37
2.70	6.14	2.27
2.83	6.15	2.18
2.95	6.16	2.09
3.07	6.17	2.01
3.19	6.18	1.93
3.32	6.18	1.86
3.44	6.19	1.80
3.56	6.20	1.74
3.68	6.20	1.68
3.81	6.21	1.63
3.93	6.21	1.58
4.05	6.22	1.54
4.17	6.22	1.49
4.30	6.23	1.45
4.42	6.23	1.41
4.54	6.24	1.37
4.66	6.24	1.34
4.79	6.24	1.30
4.91	6.25	1.27
5.03	6.25	1.24
5.15	6.25	1.21
5.28	6.26	1.19
5.40	6.26	1.16
5.52	6.26	1.13
5.64	6.27	1.11
5.77	6.27	1.09
5.89	6.27	1.07
6.01	6.27	1.04





Appendix X

Deep Foundation Settlement Analysis

South Carolina
Department of Transportation

PROJECT ID	0040308
DATE	07/13/2016
COMPUTED BY	RSG
CHECKED BY	SMS

PROJECT NAME US-301 RBO Four Hole Swamp

SUBJECT Deep Foundation Settlement Analysis

PROBLEM

Determine total settlement at each bridge bent and differential settlement between each bridge bent for both the Service and Extreme Event 1 (EE1) Limit States as outlined in the FHWA NHI -05-042, Design and Construction of Driven Pile Foundations, 2006 and SCDOT Geotechnical Design Manual (GDM) Chapter 16.3.4.

PROJECT INFORMATION

Project Type: Bridge Replacement
Existing Alignment: 2-lane paved road of variable shoulder widths
Proposed Alignment: 2-lane paved road of variable shoulder widths
Proposed Bridge Dimensions: 47.25 x 294 feet
Stations: 5941+40 to 5960+00, (Bridge 5949+30.00 to 5952+24.00)
End Bent Pile Type: HP 14x73 steel H-Piles
Interior Bent Pile Type: 48-inch steel pipe piles with 1.5 inch wall thickness
Grades: Bridge grades will be raised approximately 2 feet
End Slopes: 2:1
Side Slopes: Right 4:1, Left 2:1
Added Fill: Not expected to exceed 2.5 feet at the shoulder breaks
Travel ways: 12 feet wide
Medians: NA
Project Features: It is our understanding that the proposed bridge will be constructed on the existing alignment and traffic of the existing bridge will be shifted to share the northbound lanes during construction of the proposed bridge.

GIVEN/ASSUMPTIONS

- Bridge loads provided by SDS
- 50 KSI steel
- Santee Limestone Formation is a homogeneous sand-like material.
- Others listed as used.

METHODOLOGY

Settlement was calculated for both the Service and EEI Limit States using the equivalent method. This method determines the settlement at each bent by using a pile group instead of individual piles. The equivalent footing for this method was located at two-thirds the distance between the top of the pile (bottom of bent cap) and the steel tip elevation, and the settlement was determined at two depths below it. See the attached spreadsheets for more details about the calculations.

The differential settlement between each consecutive bent was calculated. The differential settlement for interior and end bents and both Limit States was compared to the Performance Limits outlined in tables 10-32, 10-35, and 10-36 of the GDM. EB-01 was used for the end bents (Integral/Semi-Integral), IB-01 (fixed bearing) was used for interior bents IB-2, IB-3, IB-5, and IB-6 and IB-02 (Expansion Bearing) was used for interior bents IB-4 and IB-7.

RESULTS and DISCUSSION

The summary table below shows the results that were determined from the Deep Foundation Settlement Analysis. These values were taken directly from the attached spreadsheets.

Settlement Summary Table

Differential Settlement Summary Sheet

Service Limit State

	Bent	Δ_E	S_i	S_t	Differential settlement
Semi Integral	EB-1	0.001	0.38	0.38	0.14
Fixed	IB-2	0.051	0.20	0.25	0.14
Fixed	IB-3	0.051	0.54	0.59	0.35
Expansion	IB-4	0.051	0.36	0.41	0.21
Fixed	IB-5	0.051	0.15	0.20	0.21
Fixed	IB-6	0.051	0.20	0.25	0.30
Expansion	IB-7	0.051	0.49	0.54	0.30
Semi Integral	EB-8	0.001	0.26	0.26	0.29

Extreme Event I Limit State

	Bent	Δ_E	S_i	S_t	Differential settlement
Semi Integral	EB-1	0.001	0.40	0.40	0.23
Fixed	IB-2	0.205	0.42	0.62	0.23
Fixed	IB-3	0.205	1.17	1.37	0.75
Expansion	IB-4	0.205	0.76	0.96	0.43
Fixed	IB-5	0.205	0.33	0.54	0.43
Fixed	IB-6	0.205	0.41	0.61	0.70
Expansion	IB-7	0.205	1.11	1.32	1.05
Semi Integral	EB-8	0.001	0.27	0.27	1.05

South Carolina
Department of Transportation

PROJECT ID	0040308
DATE	07/13/2016
COMPUTED BY	RSG
CHECKED BY	SMS

ATTACHMENTS

Service Limit State
- Deep Foundations Settlement Spreadsheet EB-1
- Deep Foundations Settlement Spreadsheet IB-2
- Deep Foundations Settlement Spreadsheet IB-3
- Deep Foundations Settlement Spreadsheet IB-4
- Deep Foundations Settlement Spreadsheet IB-5
- Deep Foundations Settlement Spreadsheet IB-6
- Deep Foundations Settlement Spreadsheet IB-7
- Deep Foundations Settlement Spreadsheet EB-8

EEI Limit State
- Deep Foundations Settlement Spreadsheet EB-1
- Deep Foundations Settlement Spreadsheet IB-2
- Deep Foundations Settlement Spreadsheet IB-3
- Deep Foundations Settlement Spreadsheet IB-4
- Deep Foundations Settlement Spreadsheet IB-5
- Deep Foundations Settlement Spreadsheet IB-6
- Deep Foundations Settlement Spreadsheet IB-7
- Deep Foundations Settlement Spreadsheet EB-8

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	EB-1	
Bent cap width (B)=	50	ft
Bentcap length (L)=	5	ft
Foundation type = HP 14x73	13.6	in
Number of Piles per bent	6	piles
Cross section area of pile (A) =	21.40	in^2
Service load (Q_a) =	144.1	kips
bottom of cap elevation =	115	ft. MSL
PD FG elevation =	115	ft. MSL
Tip elevation =	79.5	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t=S_i+S_c+S_s+\Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t=S_i+\Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (Service Load)=	144.1	kips
L (Pile Length) =	35.5	ft
A (Pile cross sec. area) =	21.400	ft^2
E (elastic modulus) =	4320000	ksf

Δ_E = 0.000 ft

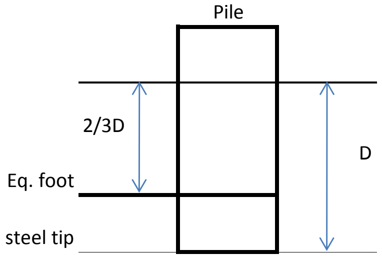
$\boxed{0.001}$ in.

Determine Equivalent Footing Location

Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)

Equivalent footing depth (2/3 pile embedment depth) =	23.67	ft
Equivalent footing Elevation =	91.33	ft. MSL
10 feet below tip	69.50	ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)



Determine S_i

Determine S_i using the following equation.

$S_i=\Sigma^n_{i=1}(1/C')H_i*\log((\sigma'_{vo}+\Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

D_1 =	5.92	ft	D_1 should equal half way between equivalent footing and tip.
D_2 =	10.92	ft	D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1= width 55.92 ft

Length 10.92 ft

$\Delta\sigma$ at D_1= 1,416 psf

$N_{measured}$ = 14 bpf   Near elevation : 90 ft MSL

Hammer Energy Ratio = 79 %

σ'_{vo} = 2,816.87 psf

$(N_1)_{60}$ = 15.53 bpf

C' (Figure 17-16, GDM) = 50

H_i (Thickness of i^{th} layer) = 5.92 ft.

σ'_{vo} (effect. Overburden at top of pile = 1416.39 psf

From Elastic settlement calculation, $\sigma'_{vo} + \Delta\sigma_{v.}$ Because there is no soil above top of pile this is just $\Delta\sigma v$.

σ'_{vo} (effect. Overburden at mid pt of layer) = 2816.87 psf

S_i at D_1 = $\boxed{0.251}$ in

Determine S_i at D_2.

Equivalent footing at D_2= Base 60.92 ft

Length 15.92 ft

$\Delta\sigma$ at D_2= 891.72 psf

$N_{measured}$ = 22 bpf   Near elevation : 79 ft MSL

Hammer Energy Ratio = 79 %

σ'_{vo} = 1,416.39 psf

$(N_1)_{60}$ = 34.42 bpf

C' (Figure 17-16, GDM) = 85

H_i (Thickness of i^{th} layer) = 10.92 ft.

σ'_{vo} (effect. Overburden at top of pile = 1,416.39 psf

σ'_{vo} (effect. Overburden at mid pt of layer) = 4,096.80 psf

S_i at D_2 = $\boxed{0.132}$ in.

$S_{i,\ total}$ = 0.383 in.

Determine S_t

$S_t=S_i+\Delta_E$

S_t= $\boxed{\mathbf{0.384}}$ in.

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	IB-2	
Bent width (B)=	50	ft
Bent length (L)=	5	ft
Foundation type =	48	in
Number of Piles per bent	5	piles
Cross section area of pile (A) =	219.13	in^2
Service load (Q_a) =	266.8	kips
bottom of cap elevation =	115	ft. MSL
Scour elevation =	89.8	ft. MSL
Tip elevation =	10	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t=S_i+S_c+S_s+\Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t=S_i+\Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (Service Load)=	266.8	kips
L (Pile Length) =	105	ft
A (Pile cross sec. area) =	1.522	ft^2
E (elastic modulus) =	4320000	ksf

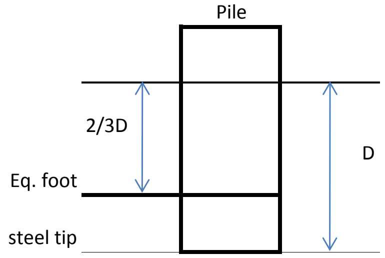
	0.004	ft
Δ_E =	0.051	in.

Determine Equivalent Footing Location

Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)

Equivalent footing depth (2/3 pile embedment depth) =	53.20	ft
Equivalent footing Elevation =	36.60	ft. MSL
10 feet below tip	0.00	ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)



Determine S_i

Determine S_i using the following equation.

$S_i=\Sigma^n_{i=1}(1/C')H_i*\log((\sigma'_{vo}+\Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

D_1 =	13.30 ft	D_1 should equal half way between equivalent footing and tip.
D_2 =	18.30 ft	D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1= width 63.30 ft

Length 18.30 ft

$\Delta\sigma$ at D_1= 1,152 psf

$N_{measured}$ = 50 bpf Near elevation : 37 ft MSL

Hammer Energy Ratio = 79 %

σ'_{vo} = 4,299.71 psf

$(N_1)_{60}$ = 44.90 bpf

C' (Figure 17-16, GDM) = 118

H_i (Thickness of i^{th} layer) = 13.30 ft.

σ'_{vo} (effect. Overburden at top of pile = 1151.60 psf

From Elastic settlement calculation, $\sigma'_{vo} + \Delta\sigma_{v.}$ Because there is no soil above top of pile this is just $\Delta\sigma v$.

σ'_{vo} (effect. Overburden at mid pt of layer) = 4299.71 psf

S_i at D_1 = $\boxed{0.139}$ in

Determine S_i at D_2.

Equivalent footing at D_2= Base 68.30 ft

Length 23.30 ft

$\Delta\sigma$ at D_2= 838.26 psf

$N_{measured}$ = 49 bpf Near elevation : 0 ft MSL

Hammer Energy Ratio = 79 %

σ'_{vo} = 1,151.60 psf

$(N_1)_{60}$ = 85.02 bpf

C' (Figure 17-16, GDM) = 208

H_i (Thickness of i^{th} layer) = 18.30 ft.

σ'_{vo} (effect. Overburden at top of pile = 1,151.60 psf

σ'_{vo} (effect. Overburden at mid pt of layer) = 6,356.37 psf

S_i at D_2 = $\boxed{0.057}$ in.

$S_{i,\ total}$ = 0.196 in.

Determine S_t

S_t=S_i+Δ_E

S_t= $\boxed{\mathbf{0.247}}$ in.

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	IB-3	
Bent width (B)=	50	ft
Bent length (L)=	5	ft
Foundation type =	48	in
Number of Piles per bent	5	piles
Cross section area of pile (A) =	219.13	in^2
Service load (Q_a) =	266.8	kips
bottom of cap elevation =	115	ft. MSL
Scour elevation =	82.7	ft. MSL
Tip elevation =	10	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t = S_i + S_c + S_s + \Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t = S_i + \Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (Service Load)=	266.8	kips
L (Pile Length) =	105	ft
A (Pile cross sec. area) =	1.522	ft^2
E (elastic modulus) =	4320000	ksf

Δ_E = 0.004 ft

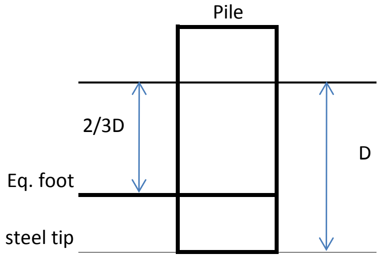
$\boxed{0.051}$ in.

Determine Equivalent Footing Location

Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)

Equivalent footing depth (2/3 pile embedment depth) =	48.47	ft
Equivalent footing Elevation =	34.23	ft. MSL
10 feet below tip	0.00	ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)



Determine S_i

Determine S_i using the following equation.

$S_i = \Sigma^n_{i=1}(1/C')H_i * \log((\sigma'_{vo} + \Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

D_1 =	12.12	ft	D_1 should equal half way between equivalent footing and tip.
D_2 =	17.12	ft	D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1= width 62.12 ft
Length 17.12 ft

$\Delta\sigma$ at D_1= 1,255 psf

$N_{measured}$ = 3 bpf Near elevation : 37 ft MSL
Hammer Energy Ratio = 79 %
σ'_{vo} = 4,122.68 psf
$(N_1)_{60}$ = 2.75 bpf
C' (Figure 17-16, GDM) = 34
H_i (Thickness of i^{th} layer) = 12.12 ft.

σ'_{vo} (effect. Overburden at top of pile = 1254.67 psf

From Elastic settlement calculation, $\sigma'_{vo} + \Delta\sigma_{v.}$ Because there is no soil above top of pile this is just $\Delta\sigma$v.

σ'_{vo} (effect. Overburden at mid pt of layer) = 4122.68 psf

S_i at D_1 = $\boxed{0.493}$ in

Determine S_i at D_2.

Equivalent footing at D_2= Base 67.12 ft
Length 22.12 ft

$\Delta\sigma$ at D_2= 898.68 psf

$N_{measured}$ = 68 bpf Near elevation : 0 ft MSL
Hammer Energy Ratio = 79 %
σ'_{vo} = 1,254.67 psf
$(N_1)_{60}$ = 113.04 bpf
C' (Figure 17-16, GDM) = 255
H_i (Thickness of i^{th} layer) = 17.12 ft.

σ'_{vo} (effect. Overburden at top of pile = 1,254.67 psf

σ'_{vo} (effect. Overburden at mid pt of layer) = 6,054.86 psf

S_i at D_2 = $\boxed{0.048}$ in.

$S_{i,\,total}$ = 0.542 in.

Determine S_t

$S_t=S_i+\Delta_E$

S_t= $\boxed{\mathbf{0.593}}$ in.

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	IB-4	
Bent width (B)=	50	ft
Bent length (L)=	5	ft
Foundation type =	48	in
Number of Piles per bent	5	piles
Cross section area of pile (A) =	219.13	in^2
Service load (Q_a) =	266.8	kips
bottom of cap elevation =	115	ft. MSL
Scour elevation =	89.6	ft. MSL
Tip elevation =	10	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t=S_i+S_c+S_s+\Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t=S_i+\Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (Service Load)=	266.8	kips
L (Pile Length) =	105	ft
A (Pile cross sec. area) =	1.522	ft^2
E (elastic modulus) =	4320000	ksf

$\Delta_E =$ 0.004 ft

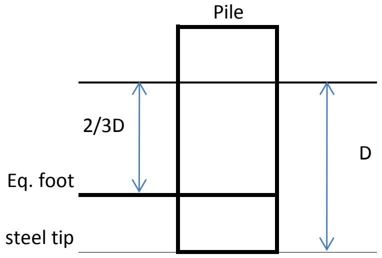
$\boxed{0.051}$ in.

Determine Equivalent Footing Location

Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)

Equivalent footing depth (2/3 pile embedment depth) =	53.07	ft
Equivalent footing Elevation =	36.53	ft. MSL
10 feet below tip	0.00	ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)



Determine S_i

Determine S_i using the following equation.

$S_i=\Sigma^n_{i=1}(1/C')H_i*\log((\sigma'_{vo}+\Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

D_1 =	13.27 ft	D_1 should equal half way between equivalent footing and tip.
D_2 =	18.27 ft	D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1= width 63.27 ft
Length 18.27 ft

$\Delta\sigma$ at D_1= 1,154 psf

$N_{measured}$ =	20	bpf	Near elevation :	37	ft MSL
Hammer Energy Ratio =	79	%			
σ'_{vo} =	4,294.53	psf			
$(N_1)_{60}$ =	17.97	bpf			
C' (Figure 17-16, GDM) =	58				
H_i (Thickness of i^{th} layer) =	13.27	ft.			
σ'_{vo} (effect. Overburden at top of pile =	1154.31	psf			
σ'_{vo} (effect. Overburden at mid pt of layer) =	4294.53	psf			

From Elastic settlement calculation, $\sigma'_{vo} + \Delta\sigma_{v.}$ Because there is no soil above top of pile this is just $\Delta\sigma v$.

S_i at D_1 = $\boxed{0.284}$ in

Determine S_i at D_2.

Equivalent footing at D_2= Base 68.27 ft
Length 23.27 ft

$\Delta\sigma$ at D_2= 839.87 psf

$N_{measured}$ =	66	bpf	Near elevation :	0	ft MSL
Hammer Energy Ratio =	79	%			
σ'_{vo} =	1,154.31	psf			
$(N_1)_{60}$ =	114.39	bpf			
C' (Figure 17-16, GDM) =	158				
H_i (Thickness of i^{th} layer) =	18.27	ft.			
σ'_{vo} (effect. Overburden at top of pile =	1,154.31	psf			
σ'_{vo} (effect. Overburden at mid pt of layer) =	6,347.68	psf			

S_i at D_2 = $\boxed{0.075}$ in.

$S_{i,\ total}$ = 0.359 in.

Determine S_t

S_t=S_i+Δ_E

S_t= $\boxed{\mathbf{0.410}}$ in.

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	IB-5	
Bent width (B)=	50	ft
Bent length (L)=	5	ft
Foundation type =	48	in
Number of Piles per bent	5	piles
Cross section area of pile (A) =	219.13	in^2
Service load (Q_a) =	266.8	kips
bottom of cap elevation =	115	ft. MSL
Scour elevation =	91	ft. MSL
Tip elevation =	10	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t=S_i+S_c+S_s+\Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t=S_i+\Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (Service Load)= 266.8 kips

L (Pile Length) = 105 ft

A (Pile cross sec. area) = 1.522 ft^2

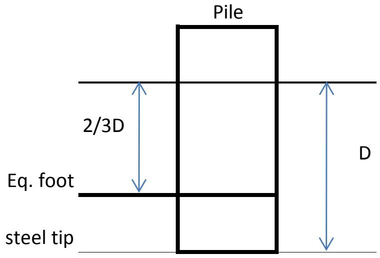
E (elastic modulus) = 4320000 ksf

Δ_E = 0.004 ft

$\boxed{0.051}$ in.

Determine Equivalent Footing Location

Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)



Equivalent footing depth (2/3 pile embedment depth) = 54.00 ft

Equivalent footing Elevation = 37.00 ft. MSL

10 feet below tip 0.00 ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)

Determine S_i

Determine S_i using the following equation.

$S_i=\Sigma^n{}_{i=1}(1/C')H_i*\log((\sigma'_{vo}+\Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

D_1 = 13.50 ft D_1 should equal half way between equivalent footing and tip.

D_2 = 18.50 ft D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1= width 63.50 ft

Length 18.50 ft

$\Delta\sigma$ at D_1= 1,136 psf

$N_{measured}$ = 84 bpf Near elevation : 37 ft MSL

Hammer Energy Ratio = 76.4 %

σ'_{vo} = 4,331.01 psf

$(N_1)_{60}$ = 72.68 bpf

C' (Figure 17-16, GDM) = 176

H_i (Thickness of i^{th} layer) = 13.50 ft.

σ'_{vo} (effect. Overburden at top of pile = 1135.56 psf

From Elastic settlement calculation, $\sigma'_{vo} + \Delta\sigma_v$. Because there is no soil above top of pile this is just $\Delta\sigma v$.

σ'_{vo} (effect. Overburden at mid pt of layer) = 4331.01 psf

S_i at D_1 = 0.093 in

Determine S_i at D_2.

Equivalent footing at D_2= Base 68.50 ft

Length 23.50 ft

$\Delta\sigma$ at D_2= 828.70 psf

$N_{measured}$ = 50 bpf Near elevation : 0 ft MSL

Hammer Energy Ratio = 76.4 %

σ'_{vo} = 1,135.56 psf

$(N_1)_{60}$ = 84.49 bpf

C' (Figure 17-16, GDM) = 200

H_i (Thickness of i^{th} layer) = 18.50 ft.

σ'_{vo} (effect. Overburden at top of pile = 1,135.56 psf

σ'_{vo} (effect. Overburden at mid pt of layer) = 6,408.71 psf

S_i at D_2 = 0.059 in.

$S_{i,\ total}$ = 0.152 in.

Determine S_t

$S_t=S_i+\Delta_E$

S_t= **0.203** in.

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	IB-6	
Bent width (B)=	50	ft
Bent length (L)=	5	ft
Foundation type =	48	in
Number of Piles per bent	5	piles
Cross section area of pile (A) =	219.13	in^2
Service load (Q_a) =	266.8	kips
bottom of cap elevation =	115	ft. MSL
Scour elevation =	81.3	ft. MSL
Tip elevation =	10	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t=S_i+S_c+S_s+\Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t=S_i+\Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (Service Load)=	266.8	kips
L (Pile Length) =	105	ft
A (Pile cross sec. area) =	1.522	ft^2
E (elastic modulus) =	4320000	ksf

Δ_E = 0.004 ft

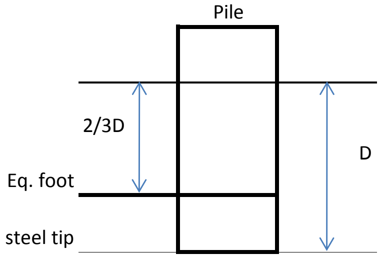
$\boxed{0.051}$ in.

Determine Equivalent Footing Location

Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)

Equivalent footing depth (2/3 pile embedment depth) =	47.53	ft
Equivalent footing Elevation =	33.77	ft. MSL
10 feet below tip	0.00	ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)



Determine S_i

Determine S_i using the following equation.

$S_i=\Sigma^n_{i=1}(1/C')H_i*\log((\sigma'_{vo}+\Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

D_1 =	11.88	ft	D_1 should equal half way between equivalent footing and tip.
D_2 =	16.88	ft	D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1= width 61.88 ft
Length 16.88 ft

$\Delta\sigma$ at D_1= 1,277 psf

$N_{measured}$ = 60 bpf Near elevation : 37 ft MSL
Hammer Energy Ratio = 76.4 %
σ'_{vo} = 4,089.59 psf
$(N_1)_{60}$ = 53.43 bpf
C' (Figure 17-16, GDM) = 125
H_i (Thickness of i^{th} layer) = 11.88 ft.

σ'_{vo} (effect. Overburden at top of pile = 1276.80 psf

From Elastic settlement calculation, $\sigma'_{vo} + \Delta\sigma_v$. Because there is no soil above top of pile this is just $\Delta\sigma v$.

σ'_{vo} (effect. Overburden at mid pt of layer) = 4089.59 psf

S_i at D_1 = 0.135 in

Determine S_i at D_2.

Equivalent footing at D_2= Base 66.88 ft
Length 21.88 ft

$\Delta\sigma$ at D_2= 911.43 psf

$N_{measured}$ = 50 bpf Near elevation : 0 ft MSL
Hammer Energy Ratio = 76.4 %
σ'_{vo} = 1,276.80 psf
$(N_1)_{60}$ = 79.68 bpf
C' (Figure 17-16, GDM) = 200
H_i (Thickness of i^{th} layer) = 16.88 ft.

σ'_{vo} (effect. Overburden at top of pile = 1,276.80 psf

σ'_{vo} (effect. Overburden at mid pt of layer) = 5,997.21 psf

S_i at D_2 = 0.062 in.

$S_{i,\ total}$ = 0.197 in.

Determine S_t

$S_t=S_i+\Delta_E$

S_t= **0.248** in.

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	IB-7	
Bent width (B)=	50	ft
Bent length (L)=	5	ft
Foundation type =	48	in
Number of Piles per bent	5	piles
Cross section area of pile (A) =	219.13	in^2
Service load (Q_a) =	266.8	kips
bottom of cap elevation =	115	ft. MSL
PD FG elevation =	106	ft. MSL
Tip elevation =	10	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t=S_i+S_c+S_s+\Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t=S_i+\Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (Service Load)=	266.8	kips
L (Pile Length) =	105	ft
A (Pile cross sec. area) =	1.522	ft^2
E (elastic modulus) =	4320000	ksf

Δ_E = 0.004 ft

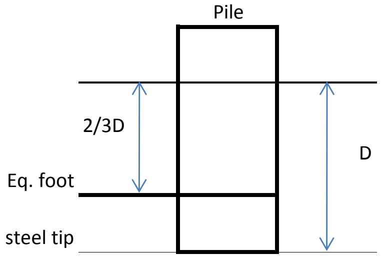
0.051 in.

Determine Equivalent Footing Location

Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)

Equivalent footing depth (2/3 pile embedment depth) =	64.00	ft
Equivalent footing Elevation =	42.00	ft. MSL
10 feet below tip	0.00	ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)



Determine S_i

Determine S_i using the following equation.

$S_i=\Sigma^n_{i=1}(1/C')H_i*\log((\sigma'_{vo}+\Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

D_1 =	16.00	ft	D_1 should equal half way between equivalent footing and tip.
D_2 =	21.00	ft	D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1= width 66.00 ft
Length 21.00 ft

Δσ at D_1= 962 psf

$N_{measured}$ = 7 bpf Near elevation : 37 ft MSL
Hammer Energy Ratio = 76.4 %
σ'$_{vo}$ = 4,749.68 psf
$(N_1)_{60}$ = 5.78 bpf
C' (Figure 17-16, GDM) = 35
H_i (Thickness of i^{th} layer) = 16.00 ft.

σ'$_{vo}$ (effect. Overburden at top of pile = 962.48 psf

From Elastic settlement calculation, σ'$_{vo}$ + Δσ$_{v.}$ Because there is no soil above top of pile this is just Δσv.

σ'$_{vo}$ (effect. Overburden at mid pt of layer) = 4749.68 psf

S_i at D_1 = 0.440 in

Determine S_i at D_2.

Equivalent footing at D_2= Base 71.00 ft
Length 26.00 ft

Δσ at D_2= 722.64 psf

$N_{measured}$ = 50 bpf Near elevation : 0 ft MSL
Hammer Energy Ratio = 76.4 %
σ'$_{vo}$ = 962.48 psf
$(N_1)_{60}$ = 91.78 bpf
C' (Figure 17-16, GDM) = 200
H_i (Thickness of i^{th} layer) = 21.00 ft.

σ'$_{vo}$ (effect. Overburden at top of pile = 962.48 psf

σ'$_{vo}$ (effect. Overburden at mid pt of layer) = 7,090.38 psf

S_i at D_2 = 0.053 in.

$S_{i,\ total}$ = 0.493 in.

Determine S_t

S_t=S_i+Δ_E

S_t= **0.544** in.

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	EB-8	
Bent cap width (B)=	50	ft
Bentcap length (L)=	5	ft
Foundation type = HP 14x73	13.6	in
Number of Piles per bent	6	piles
Cross section area of pile (A) =	21.40	in^2
Service load (Q_a) =	144.1	kips
bottom of cap elevation =	115	ft. MSL
PD FG elevation =	115	ft. MSL
Tip elevation =	79.5	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t=S_i+S_c+S_s+\Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t=S_i+\Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (Service Load)= 144.1 kips

L (Pile Length) = 35.5 ft

A (Pile cross sec. area) = 21.400 ft^2

E (elastic modulus) = 4320000 ksf

Δ_E = 0.000 ft

$\boxed{0.001}$ in.

Determine Equivalent Footing Location

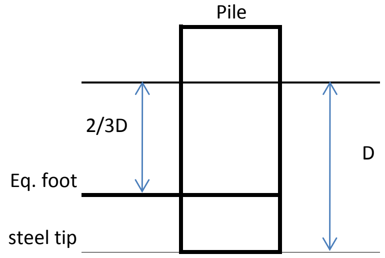
Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)

Equivalent footing depth (2/3 pile embedment depth) = 23.67 ft

Equivalent footing Elevation = 91.33 ft. MSL

10 feet below tip 69.50 ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)



Determine S_i

Determine S_i using the following equation.

$S_i=\Sigma^n{}_{i=1}(1/C')H_i*\log((\sigma'_{vo}+\Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

D_1 = 5.92 ft D_1 should equal half way between equivalent footing and tip.

D_2 = 10.92 ft D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1= width 55.92 ft

Length 10.92 ft

$\Delta\sigma$ at D_1= 1,416 psf

$N_{measured}$ = 35 bpf Near elevation : 90 ft MSL

Hammer Energy Ratio = 79 %

σ'_{vo} = 2,816.87 psf

$(N_1)_{60}$ = 38.83 bpf

C' (Figure 17-16, GDM) = 90

H_i (Thickness of i^{th} layer) = 5.92 ft.

σ'_{vo} (effect. Overburden at top of pile = 1416.39 psf

σ'_{vo} (effect. Overburden at mid pt of layer) = 2816.87 psf

S_i at D_1 = $\boxed{0.140}$ in

Determine S_i at D_2.

Equivalent footing at D_2= Base 60.92 ft

Length 15.92 ft

$\Delta\sigma$ at D_2= 891.72 psf

$N_{measured}$ = 27 bpf Near elevation : 79 ft MSL

Hammer Energy Ratio = 79 %

σ'_{vo} = 1,416.39 psf

$(N_1)_{60}$ = 42.24 bpf

C' (Figure 17-16, GDM) = 95

H_i (Thickness of i^{th} layer) = 10.92 ft.

σ'_{vo} (effect. Overburden at top of pile = 1,416.39 psf

σ'_{vo} (effect. Overburden at mid pt of layer) = 4,096.80 psf

S_i at D_2 = $\boxed{0.118}$ in.

$S_{i,\ total}$ = 0.257 in.

Determine S_t

S_t=S_i+Δ_E

S_t= $\boxed{\mathbf{0.258}}$ in.

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	EB-1	
Bent cap width (B)=	50	ft
Bentcap length (L)=	5	ft
Foundation type = HP 14x73	13.6	in
Number of Piles per bent	6	piles
Cross section area of pile (A) =	21.40	in^2
EEI load (Q_a) =	157	kips
bottom of cap elevation =	115	ft. MSL
PD FG elevation =	115	ft. MSL
Tip elevation =	79.5	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t=S_i+S_c+S_s+\Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t=S_i+\Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (EEI Load)=	157	kips
L (Pile Length) =	35.5	ft
A (Pile cross sec. area) =	21.400	ft^2
E (elastic modulus) =	4320000	ksf

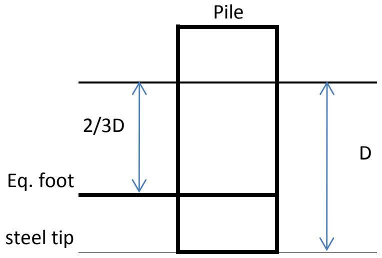
	0.000	ft
Δ_E =	0.001	in.

Determine Equivalent Footing Location

Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)

Equivalent footing depth (2/3 pile embedment depth) =	23.67	ft
Equivalent footing Elevation =	91.33	ft. MSL
10 feet below tip	69.50	ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)



Determine S_i

Determine S_i using the following equation.

$S_i=\Sigma^n_{i=1}(1/C')H_i*\log((\sigma'_{vo}+\Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

D_1 =	5.92	ft	D_1 should equal half way between equivalent footing and tip.
D_2 =	10.92	ft	D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1= width 55.92 ft

Length 10.92 ft

$\Delta\sigma$ at D_1= 1,543 psf

$N_{measured}$ = 14 bpf   Near elevation : 90 ft MSL

Hammer Energy Ratio = 79 %

σ'_{vo} = 2,943.67 psf

$(N_1)_{60}$ = 15.19 bpf

C' (Figure 17-16, GDM) = 50

H_i (Thickness of i^{th} layer) = 5.92 ft.

σ'_{vo} (effect. Overburden at top of pile = 1,543.19 psf

From Elastic settlement calculation, $\sigma'_{vo} + \Delta\sigma_{v.}$ Because there is no soil above top of pile this is jiust Δσv.

σ'_{vo} (effect. Overburden at mid pt of layer) = 2,943.67 psf

S_i at D_1 = $\boxed{0.260}$ in

Determine S_i at D_2.

Equivalent footing at D_2= Base 60.92 ft

Length 15.92 ft

$\Delta\sigma$ at D_2= 971.54 psf

$N_{measured}$ = 22 bpf   Near elevation : 79 ft MSL

Hammer Energy Ratio = 79 %

σ'_{vo} = 1,543.19 psf

$(N_1)_{60}$ = 32.98 bpf

C' (Figure 17-16, GDM) = 85

H_i (Thickness of i^{th} layer) = 10.92 ft.

σ'_{vo} (effect. Overburden at top of pile = 1,543.19 psf

From Elastic settlement calculation, $\sigma'_{vo} + \Delta\sigma_{v.}$

σ'_{vo} (effect. Overburden at mid pt of layer) = 4,223.60 psf

S_i at D_2 = $\boxed{0.139}$ in.

$S_{i,\ total}$ = 0.399 in.

Determine S_t

$S_t = S_i + \Delta_E$

S_t= $\boxed{\mathbf{0.399}}$ in.

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	IB-2	
Bent width (B)=	50	ft
Bent length (L)=	5	ft
Foundation type =	48	in
Number of Piles per bent	5	piles
Cross section area of pile (A) =	219.13	in^2
EEI load (Q_a) =	1067	kips
bottom of cap elevation =	115	ft. MSL
Scour elevation =	102	ft. MSL
Tip elevation =	10	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t=S_i+S_c+S_s+\Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t=S_i+\Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (EEI Load)=	1067	kips
L (Pile Length) =	105	ft
A (Pile cross sec. area) =	1.522	ft^2
E (elastic modulus) =	4320000	ksf

Δ_E = 0.017 ft

$\boxed{0.205}$ in.

Determine Equivalent Footing Location

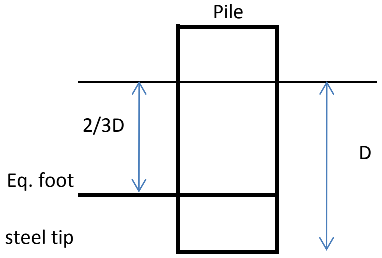
Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)

Equivalent footing depth (2/3 pile embedment depth) = 61.33 ft

Equivalent footing Elevation = 40.67 ft. MSL

10 feet below tip 0.00 ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)



Determine S_i

Determine S_i using the following equation.

$S_i=\Sigma^n_{i=1}(1/C')H_i*\log((\sigma'_{vo}+\Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

D_1 = 15.33 ft D_1 should equal half way between equivalent footing and tip.

D_2 = 20.33 ft D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1= width 65.33 ft
Length 20.33 ft

$\Delta\sigma$ at D_1= 4,016 psf

$N_{measured}$ = 50 bpf Near elevation : 37 ft MSL
Hammer Energy Ratio = 79 %
σ'_{vo} = 7,645.38 psf
$(N_1)_{60}$ = 33.67 bpf
C' (Figure 17-16, GDM) = 118
H_i (Thickness of i^{th} layer) = 15.33 ft.

σ'_{vo} (effect. Overburden at top of pile = 4015.98 psf

From Elastic settlement calculation, $\sigma'_{vo} + \Delta\sigma_{v.}$ Because there is no soil above top of pile this is just Δσv.

σ'_{vo} (effect. Overburden at mid pt of layer) = 7645.38 psf

S_i at D_1 = 0.286 in

Determine S_i at D_2.

Equivalent footing at D_2= Base 70.33 ft
Length 25.33 ft

$\Delta\sigma$ at D_2= 2,994.20 psf

$N_{measured}$ = 49 bpf Near elevation : 0 ft MSL
Hammer Energy Ratio = 79 %
σ'_{vo} = 4,015.98 psf
$(N_1)_{60}$ = 45.53 bpf
C' (Figure 17-16, GDM) = 208
H_i (Thickness of i^{th} layer) = 20.33 ft.

σ'_{vo} (effect. Overburden at top of pile = 4,015.98 psf

σ'_{vo} (effect. Overburden at mid pt of layer) = 9,915.94 psf

S_i at D_2 = 0.134 in.

$S_{i,\ total}$ = 0.420 in.

Determine S_t

$S_t=S_i+\Delta_E$

S_t= **0.625** in.

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	IB-3	
Bent width (B)=	50	ft
Bent length (L)=	5	ft
Foundation type =	48	in
Number of Piles per bent	5	piles
Cross section area of pile (A) =	219.13	in^2
EEI load (Q_a) =	1067	kips
bottom of cap elevation =	115	ft. MSL
Backfill elevation =	102	ft. MSL
Tip elevation =	10	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t = S_i + S_c + S_s + \Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t = S_i + \Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (EEI Load)= 1067 kips

L (Pile Length) = 105 ft

A (Pile cross sec. area) = 1.522 ft^2

E (elastic modulus) = 4320000 ksf

$\Delta_E =$ 0.017 ft

$\boxed{0.205}$ in.

Determine Equivalent Footing Location

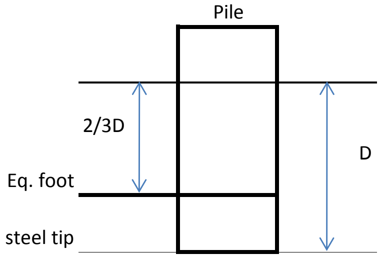
Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)

Equivalent footing depth (2/3 pile embedment depth) = 61.33 ft

Equivalent footing Elevation = 40.67 ft. MSL

10 feet below tip 0.00 ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)



Determine S_i

Determine S_i using the following equation.

$S_i = \Sigma^n_{i=1}(1/C')H_i * \log((\sigma'_{vo} + \Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

$D_1 =$ 15.33 ft D_1 should equal half way between equivalent footing and tip.

$D_2 =$ 20.33 ft D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1=	width		65.33	ft
	Length		20.33	ft

Δσ at D_1= 4,016 psf

$N_{measured}$ =	3	bpf	Near elevation :	37	ft MSL
Hammer Energy Ratio =	79	%			
σ'_{vo} =	7,645.38	psf			
$(N_1)_{60}$ =	2.02	bpf			
C' (Figure 17-16, GDM) =	34				
H_i (Thickness of i^{th} layer) =	15.33	ft.			
σ'_{vo} (effect. Overburden at top of pile =	4015.98	psf	From Elastic settlement calculation, $\sigma'_{vo} + \Delta\sigma_{v.}$ Because there is no soil above top of pile this is just Δσv.		
σ'_{vo} (effect. Overburden at mid pt of layer) =	7645.38	psf			

S_i at D_1 = $\boxed{0.992}$ in

Determine S_i at D_2.

Equivalent footing at D_2=	Base		70.33	ft
	Length		25.33	ft

Δσ at D_2= 2,994.20 psf

$N_{measured}$ =	68	bpf	Near elevation :	0	ft MSL
Hammer Energy Ratio =	79	%			
σ'_{vo} =	4,015.98	psf			
$(N_1)_{60}$ =	63.18	bpf			
C' (Figure 17-16, GDM) =	158				
H_i (Thickness of i^{th} layer) =	20.33	ft.			
σ'_{vo} (effect. Overburden at top of pile =	4,015.98	psf			
σ'_{vo} (effect. Overburden at mid pt of layer) =	9,915.94	psf			

S_i at D_2 = $\boxed{0.177}$ in.

$S_{i,\ total}$ = 1.169 in.

Determine S_t

$S_t=S_i+\Delta_E$

S_t= $\boxed{\mathbf{1.374}}$ in.

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	IB-4	
Bent width (B)=	50	ft
Bent length (L)=	5	ft
Foundation type =	48	in
Number of Piles per bent	5	piles
Cross section area of pile (A) =	219.13	in^2
EEI load (Q_a) =	1067	kips
bottom of cap elevation =	115	ft. MSL
Backfill elevation =	102	ft. MSL
Tip elevation =	10	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t=S_i+S_c+S_s+\Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t=S_i+\Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (EEI Load)= 1067 kips

L (Pile Length) = 105 ft

A (Pile cross sec. area) = 1.522 ft^2

E (elastic modulus) = 4320000 ksf

Δ_E = 0.017 ft

$\boxed{0.205}$ in.

Determine Equivalent Footing Location

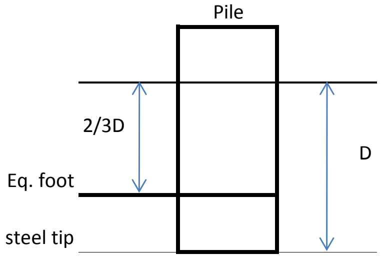
Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)

Equivalent footing depth (2/3 pile embedment depth) = 61.33 ft

Equivalent footing Elevation = 40.67 ft. MSL

10 feet below tip 0.00 ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)



Determine S_i

Determine S_i using the following equation.

$S_i=\Sigma^n_{i=1}(1/C')H_i*\log((\sigma'_{vo}+\Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

D_1 =	15.33 ft	D_1 should equal half way between equivalent footing and tip.
D_2 =	20.33 ft	D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1= width 65.33 ft
Length 20.33 ft

$\Delta\sigma$ at D_1= 4,016 psf

$N_{measured}$ =	20	bpf	Near elevation :	37	ft MSL
Hammer Energy Ratio =	79	%			
σ'_{vo} =	7,645.38	psf			
$(N_1)_{60}$ =	13.47	bpf			
C' (Figure 17-16, GDM) =	58				
H_i (Thickness of i^{th} layer) =	15.33	ft.			
σ'_{vo} (effect. Overburden at top of pile =	4015.98	psf	From Elastic settlement calculation, $\sigma'_{vo} + \Delta\sigma_{v.}$ Because there is no soil above top of pile this is just $\Delta\sigma v$.		
σ'_{vo} (effect. Overburden at mid pt of layer) =	7645.38	psf			

S_i at D_1 = $\boxed{0.582}$ in

Determine S_i at D_2.

Equivalent footing at D_2= Base 70.33 ft
Length 25.33 ft

$\Delta\sigma$ at D_2= 2,994.20 psf

$N_{measured}$ =	66	bpf	Near elevation :	0	ft MSL
Hammer Energy Ratio =	79	%			
σ'_{vo} =	4,015.98	psf			
$(N_1)_{60}$ =	61.33	bpf			
C' (Figure 17-16, GDM) =	158				
H_i (Thickness of i^{th} layer) =	20.33	ft.			
σ'_{vo} (effect. Overburden at top of pile =	4,015.98	psf			
σ'_{vo} (effect. Overburden at mid pt of layer) =	9,915.94	psf			

S_i at D_2 = $\boxed{0.177}$ in.

$S_{i,\ total}$ = 0.759 in.

Determine S_t

S_t=S_i+Δ_E

S_t= $\boxed{\mathbf{0.963}}$ in.

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	IB-5	
Bent width (B)=	50	ft
Bent length (L)=	5	ft
Foundation type =	48	in
Number of Piles per bent	5	piles
Cross section area of pile (A) =	219.13	in^2
EEI load (Q_a) =	1067	kips
bottom of cap elevation =	115	ft. MSL
Backfill elevation =	102	ft. MSL
Tip elevation =	10	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t=S_i+S_c+S_s+\Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t=S_i+\Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (EEI Load)=	1067	kips
L (Pile Length) =	105	ft
A (Pile cross sec. area) =	1.522	ft^2
E (elastic modulus) =	4320000	ksf

Δ_E = 0.017 ft

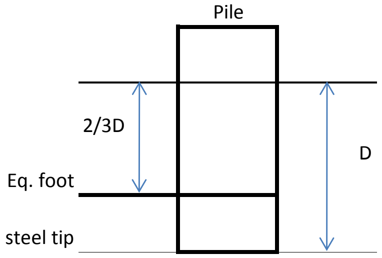
$\boxed{0.205}$ in.

Determine Equivalent Footing Location

Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)

Equivalent footing depth (2/3 pile embedment depth) =	61.33	ft
Equivalent footing Elevation =	40.67	ft. MSL
10 feet below tip	0.00	ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)



Determine S_i

Determine S_i using the following equation.

$S_i=\Sigma^n_{i=1}(1/C')H_i*\log((\sigma'_{vo}+\Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

D_1 =	15.33	ft	D_1 should equal half way between equivalent footing and tip.
D_2 =	20.33	ft	D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1= width 65.33 ft

Length 20.33 ft

$\Delta\sigma$ at D_1= 4,016 psf

$N_{measured}$ = 84 bpf

Near elevation : 37 ft MSL

Hammer Energy Ratio = 76.4 %

σ'_{vo} = 7,645.38 psf

$(N_1)_{60}$ = 54.71 bpf

C' (Figure 17-16, GDM) = 176

H_i (Thickness of i^{th} layer) = 15.33 ft.

σ'_{vo} (effect. Overburden at top of pile = 4015.98 psf

From Elastic settlement calculation, $\sigma'_{vo} + \Delta\sigma_{v.}$ Because there is no soil above top of pile this is just Δσv.

σ'_{vo} (effect. Overburden at mid pt of layer) = 7645.38 psf

S_i at D_1 = $\boxed{0.192}$ in

Determine S_i at D_2.

Equivalent footing at D_2= Base 70.33 ft

Length 25.33 ft

$\Delta\sigma$ at D_2= 2,994.20 psf

$N_{measured}$ = 50 bpf

Near elevation : 0 ft MSL

Hammer Energy Ratio = 76.4 %

σ'_{vo} = 4,015.98 psf

$(N_1)_{60}$ = 44.93 bpf

C' (Figure 17-16, GDM) = 200

H_i (Thickness of i^{th} layer) = 20.33 ft.

σ'_{vo} (effect. Overburden at top of pile = 4,015.98 psf

σ'_{vo} (effect. Overburden at mid pt of layer) = 9,915.94 psf

S_i at D_2 = $\boxed{0.140}$ in.

$S_{i,\ total}$ = 0.331 in.

Determine S_t

$S_t = S_i + \Delta_E$

S_t= $\boxed{\mathbf{0.536}}$ in.

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	IB-6	
Bent width (B)=	50	ft
Bent length (L)=	5	ft
Foundation type =	48	in
Number of Piles per bent	5	piles
Cross section area of pile (A) =	219.13	in^2
EEI load (Q_a) =	1067	kips
bottom of cap elevation =	115	ft. MSL
Backfill elevation =	102	ft. MSL
Tip elevation =	10	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t = S_i + S_c + S_s + \Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t = S_i + \Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (EEI Load)=	1067	kips
L (Pile Length) =	105	ft
A (Pile cross sec. area) =	1.522	ft^2
E (elastic modulus) =	4320000	ksf

Δ_E = 0.017 ft

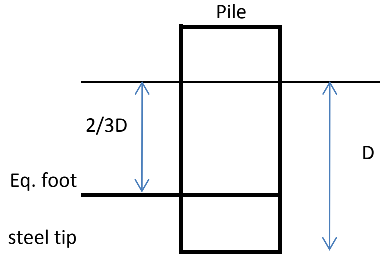
$\boxed{0.205}$ in.

Determine Equivalent Footing Location

Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)

Equivalent footing depth (2/3 pile embedment depth) =	61.33	ft
Equivalent footing Elevation =	40.67	ft. MSL
10 feet below tip	0.00	ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)



Determine S_i

Determine S_i using the following equation.

$S_i = \Sigma^n_{i=1}(1/C')H_i * \log((\sigma'_{vo} + \Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

D_1 =	15.33	ft	D_1 should equal half way between equivalent footing and tip.
D_2 =	20.33	ft	D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1= width 65.33 ft
Length 20.33 ft

Δσ at D_1= 4,016 psf

$N_{measured}$ = 60 bpf Near elevation : 37 ft MSL
Hammer Energy Ratio = 76.4 %
σ'$_{vo}$ = 7,645.38 psf
$(N_1)_{60}$ = 39.08 bpf
C' (Figure 17-16, GDM) = 125
H_i (Thickness of i^{th} layer) = 15.33 ft.

σ'$_{vo}$ (effect. Overburden at top of pile = 4015.98 psf

From Elastic settlement calculation, σ'$_{vo}$ + Δσ$_{v.}$ Because there is no soil above top of pile this is just Δσv.

σ'$_{vo}$ (effect. Overburden at mid pt of layer) = 7645.38 psf

S_i at D_1 = $\boxed{0.270}$ in

Determine S_i at D_2.

Equivalent footing at D_2= Base 70.33 ft
Length 25.33 ft

Δσ at D_2= 2,994.20 psf

$N_{measured}$ = 50 bpf Near elevation : 0 ft MSL
Hammer Energy Ratio = 76.4 %
σ'$_{vo}$ = 4,015.98 psf
$(N_1)_{60}$ = 44.93 bpf
C' (Figure 17-16, GDM) = 200
H_i (Thickness of i^{th} layer) = 20.33 ft.

σ'$_{vo}$ (effect. Overburden at top of pile = 4,015.98 psf

σ'$_{vo}$ (effect. Overburden at mid pt of layer) = 9,915.94 psf

S_i at D_2 = $\boxed{0.140}$ in.

$S_{i,\ total}$ = 0.410 in.

Determine S_t

S_t=S_i+Δ_E

S_t= $\boxed{\mathbf{0.614}}$ in.

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	IB-7	
Bent width (B)=	50	ft
Bent length (L)=	5	ft
Foundation type =	48	in
Number of Piles per bent	5	piles
Cross section area of pile (A) =	219.13	in^2
EEI load (Q_a) =	1067	kips
bottom of cap elevation =	115	ft. MSL
Backfill elevation =	106	ft. MSL
Tip elevation =	10	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t=S_i+S_c+S_s+\Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t=S_i+\Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (EEI Load)=	1067	kips
L (Pile Length) =	105	ft
A (Pile cross sec. area) =	1.522	ft^2
E (elastic modulus) =	4320000	ksf

Δ_E = 0.017 ft

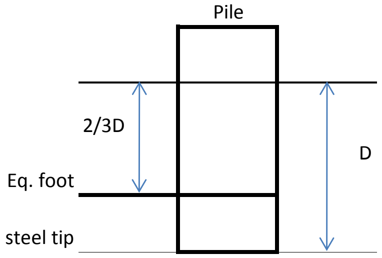
$\boxed{0.205}$ in.

Determine Equivalent Footing Location

Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)

Equivalent footing depth (2/3 pile embedment depth) =	64.00	ft
Equivalent footing Elevation =	42.00	ft. MSL
10 feet below tip	0.00	ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)



Determine S_i

Determine S_i using the following equation.

$S_i=\Sigma^n_{i=1}(1/C')H_i*\log((\sigma'_{vo}+\Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

D_1 =	16.00	ft	D_1 should equal half way between equivalent footing and tip.
D_2 =	21.00	ft	D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1= width 66.00 ft
Length 21.00 ft

$\Delta\sigma$ at D_1= 3,849 psf

$N_{measured}$ = 7 bpf Near elevation : 37 ft MSL
Hammer Energy Ratio = 76.4 %
σ'_{vo} = 7,636.41 psf
$(N_1)_{60}$ = 4.56 bpf
C' (Figure 17-16, GDM) = 35
H_i (Thickness of i^{th} layer) = 16.00 ft.

σ'_{vo} (effect. Overburden at top of pile = 3849.21 psf

From Elastic settlement calculation, $\sigma'_{vo} + \Delta\sigma_{v.}$ Because there is no soil above top of pile this is just $\Delta\sigma v$.

σ'_{vo} (effect. Overburden at mid pt of layer) = 7636.41 psf

S_i at D_1 = $\boxed{0.972}$ in

Determine S_i at D_2.

Equivalent footing at D_2= Base 71.00 ft
Length 26.00 ft

$\Delta\sigma$ at D_2= 2,890.03 psf

$N_{measured}$ = 50 bpf Near elevation : 0 ft MSL
Hammer Energy Ratio = 76.4 %
σ'_{vo} = 3,849.21 psf
$(N_1)_{60}$ = 45.89 bpf
C' (Figure 17-16, GDM) = 200
H_i (Thickness of i^{th} layer) = 21.00 ft.

σ'_{vo} (effect. Overburden at top of pile = 3,849.21 psf

σ'_{vo} (effect. Overburden at mid pt of layer) = 9,977.11 psf

S_i at D_2 = $\boxed{0.139}$ in.

$S_{i,\,total}$ = 1.112 in.

Determine S_t

$S_t=S_i+\Delta_E$

S_t= $\boxed{\mathbf{1.316}}$ in.

Determination of Bent Settlement using the Method based on SPT Test Data recommmended by Meyerhof, 1976 for Service Limit State

Assumptions:

Method Based on SPT Test Data

Refer to FHWA NHI-05-042 April 2006, p 9-125

Refer to GDM Chapter 16.3.4

Foundation Information

Bridge Bent =	EB-8	
Bent cap width (B)=	50	ft
Bentcap length (L)=	5	ft
Foundation type = HP 14x73	13.6	in
Number of Piles per bent	6	piles
Cross section area of pile (A) =	21.40	in^2
Service load (Q_a) =	157	kips
bottom of cap elevation =	115	ft. MSL
PD FG elevation =	115	ft. MSL
Tip elevation =	79	ft. MSL

ONLY ENTER VALUES IN FOR TEXT THAT IS THIS COLOR!

The equation below is for the total settlement (S_t) of a bent cap or pile group.

$S_t=S_i+S_c+S_s+\Delta_E$

S_s is general neglected for deep foundations

S_c is general neglected for foundations in cohesionless soils or overconsolidated soils (OCR ≥ 4)

This leaves the following equation: $S_t=S_i+\Delta_E$

Determine Δ_E

Determine Δ_E using the following equation: $\Delta_E = Q_a L/AE$

Q_a (EEI Load)=	157	kips
L (Pile Length) =	36	ft
A (Pile cross sec. area) =	21.400	ft^2
E (elastic modulus) =	4320000	ksf

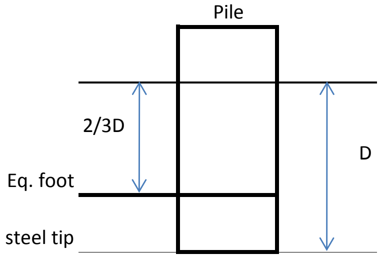
	0.000	ft
Δ_E =	0.001	in.

Determine Equivalent Footing Location

Equivalent footing should be located 2/3 of the length from the PD FG EL (bottom of cap)

Equivalent footing depth (2/3 pile embedment depth) =	24.00	ft
Equivalent footing Elevation =	91.00	ft. MSL
10 feet below tip	69.00	ft msl

Load is assumed to act at this level on Equivalent Footing (B)(z)



Determine S_i

Determine S_i using the following equation.

$S_i=\Sigma^n_{i=1}(1/C')H_i*\log((\sigma'_{vo}+\Delta\sigma'_v)/\sigma'_{vo})$

S_i will be determined at two depths below the equivalent footing depth. These depths are:

D_1 =	6.00	ft	D_1 should equal half way between equivalent footing and tip.
D_2 =	11.00	ft	D_2 should equal 10' below tip.

Determine S_i at D_1.

Equivalent footing at D_1=	width	56.00	ft			
	Length	11.00	ft			
Δσ at D_1=	1,529	psf				
$N_{measured}$ =	35	bpf		Near elevation :	90	ft MSL
Hammer Energy Ratio =	79	%				
σ'_{vo} =	2,949.42	psf				
$(N_1)_{60}$ =	37.95	bpf				
C' (Figure 17-16, GDM) =	90					
H_i (Thickness of i^{th} layer) =	6.00	ft.				
σ'_{vo} (effect. Overburden at top of pile =	1529.22	psf				
σ'_{vo} (effect. Overburden at mid pt of layer) =	2949.42	psf				
S_i at D_1 =	0.145	in				

Determine S_i at D_2.

Equivalent footing at D_2=	Base	61.00	ft			
	Length	16.00	ft			
Δσ at D_2=	965.16	psf				
$N_{measured}$ =	27	bpf		Near elevation :	79	ft MSL
Hammer Energy Ratio =	79	%				
σ'_{vo} =	1,529.22	psf				
$(N_1)_{60}$ =	40.66	bpf				
C' (Figure 17-16, GDM) =	95					
H_i (Thickness of i^{th} layer) =	11.00	ft.				
σ'_{vo} (effect. Overburden at top of pile =	1,529.22	psf				
σ'_{vo} (effect. Overburden at mid pt of layer) =	4,238.12	psf				
S_i at D_2 =	0.124	in.				
$S_{i,\ total}$ =	0.269	in.				

Determine S_t

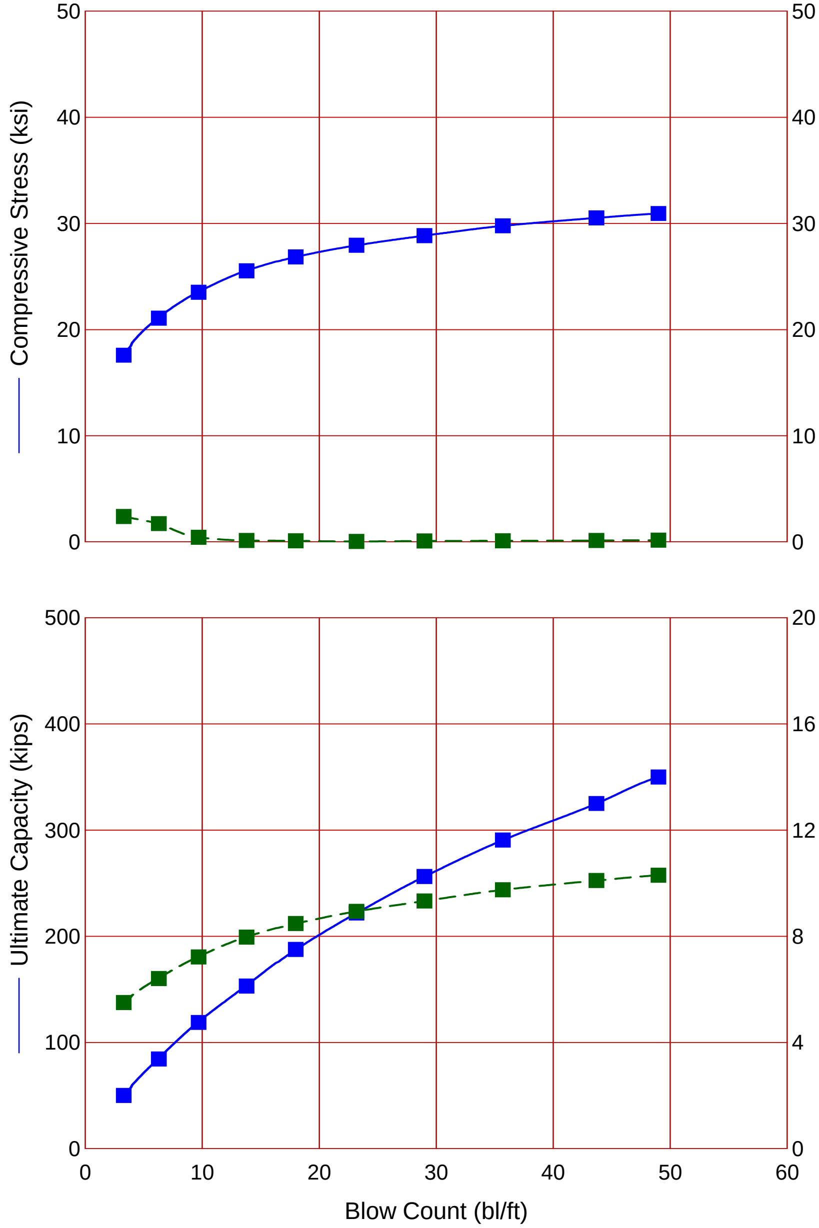
$S_t=S_i+\Delta_E$

S_t= **0.270** in.

Appendix XI

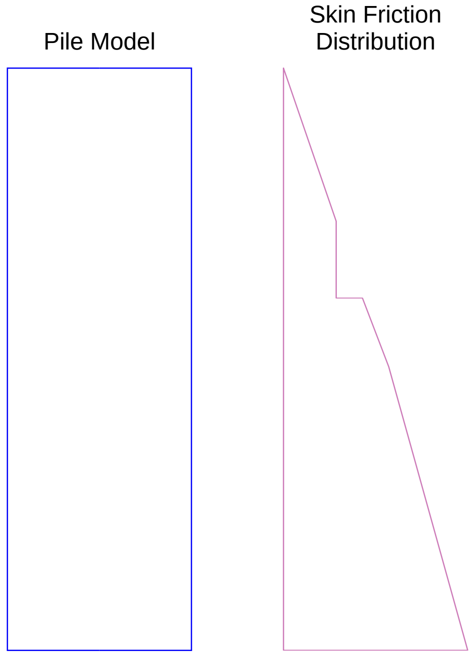
GRLWeap
Analysis

End Bents



MVE M-19

Ram Weight	4.01	kips
Efficiency	0.800	
Pressure	1640 (100%)	psi
Helmet Weight	1.39	kips
Hammer Cushion	11082	kips/in
COR of H.C.	0.800	
Skin Quake	0.100	in
Toe Quake	0.234	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	38.00	ft
Pile Penetration	38.00	ft
Pile Top Area	21.40	in2



Res. Shaft = 54 %
(Proportional)

South Carolina DOT
US 301 RBO Four Hole Swamp - EndBents

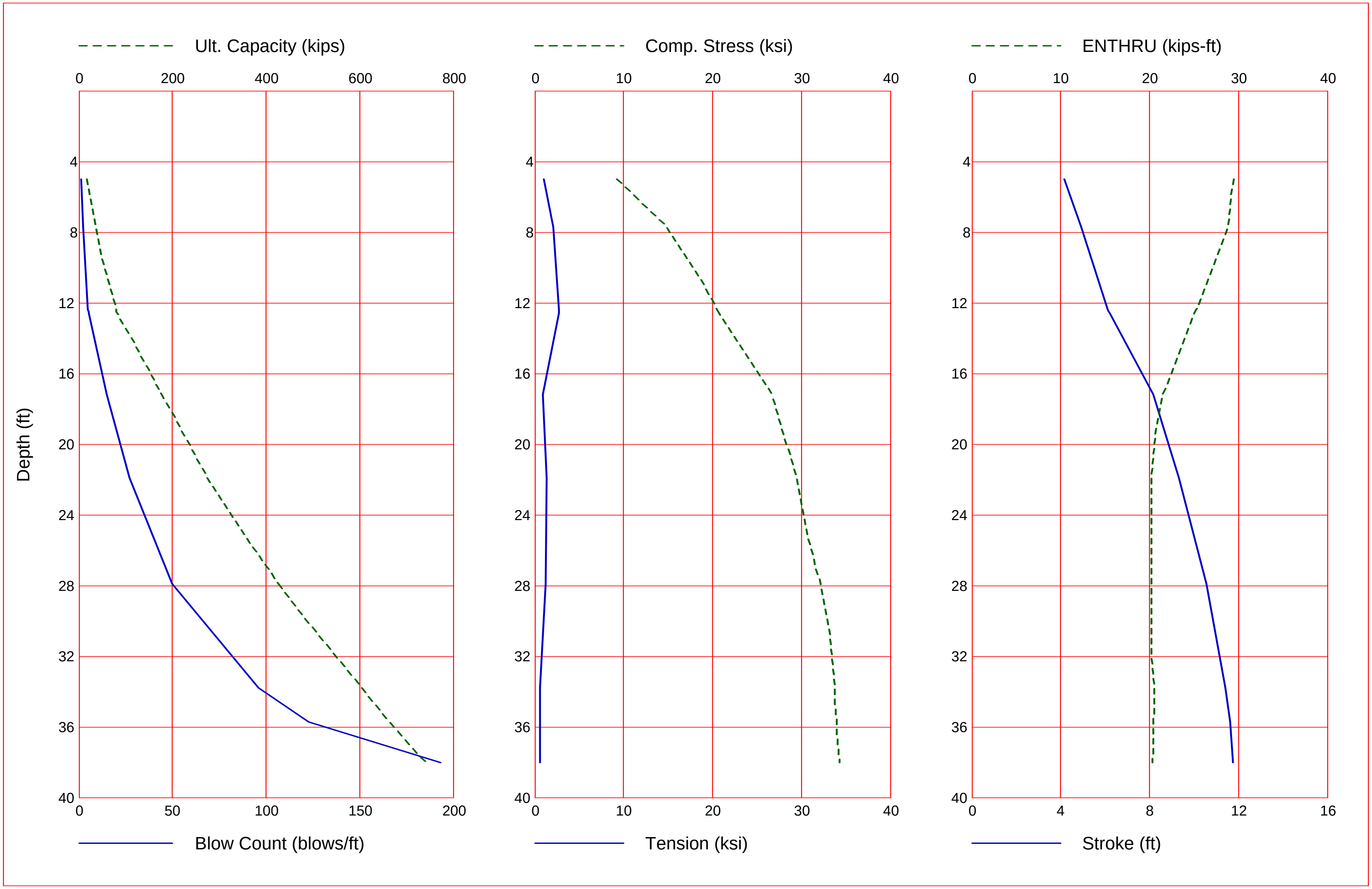
13-Apr-2016
GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
50.0	17.59	2.40	3.3	5.50	26.92
84.4	21.07	1.73	6.3	6.41	24.09
118.8	23.51	0.44	9.7	7.22	22.58
153.1	25.52	0.14	13.8	7.97	21.71
187.5	26.85	0.11	18.0	8.48	20.81
221.9	27.94	0.05	23.2	8.94	20.24
256.3	28.85	0.09	29.0	9.33	19.97
290.6	29.77	0.11	35.7	9.75	20.03
325.0	30.52	0.14	43.7	10.10	20.01
350.0	30.93	0.17	49.0	10.30	19.93

South Carolina DOT
US 301 RBO Four Hole Swamp - EndBents

Apr 13 2016
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	18.1	10.6	7.4	1.2	9.201	-1.009	4.15	29.5
7.7	36.3	24.9	11.4	2.1	14.891	-2.046	4.92	28.9
12.4	79.1	63.2	15.9	5.0	20.533	-2.742	6.14	25.2
12.5	80.6	64.6	16.0	5.1	20.670	-2.742	6.17	25.1
12.6	82.0	65.9	16.1	5.2	20.768	-2.709	6.20	25.0
17.2	177.3	124.3	52.9	15.1	26.706	-0.872	8.19	21.5
21.9	275.4	211.3	64.1	27.3	29.519	-1.380	9.31	20.2
27.9	426.0	349.0	77.0	49.8	32.202	-1.191	10.55	20.2
33.8	603.8	513.8	90.0	95.7	33.708	-0.638	11.40	20.5
35.7	662.4	568.5	93.8	123.0	34.021	-0.588	11.61	20.4
38.0	742.6	643.6	98.9	193.4	34.245	-0.591	11.76	20.3

Total Continuous Driving Time 39.00 minutes; Total Number of Blows 1405

South Carolina DOT
US 301 RBO Four Hole Swamp - EndBents

13-Apr-2016
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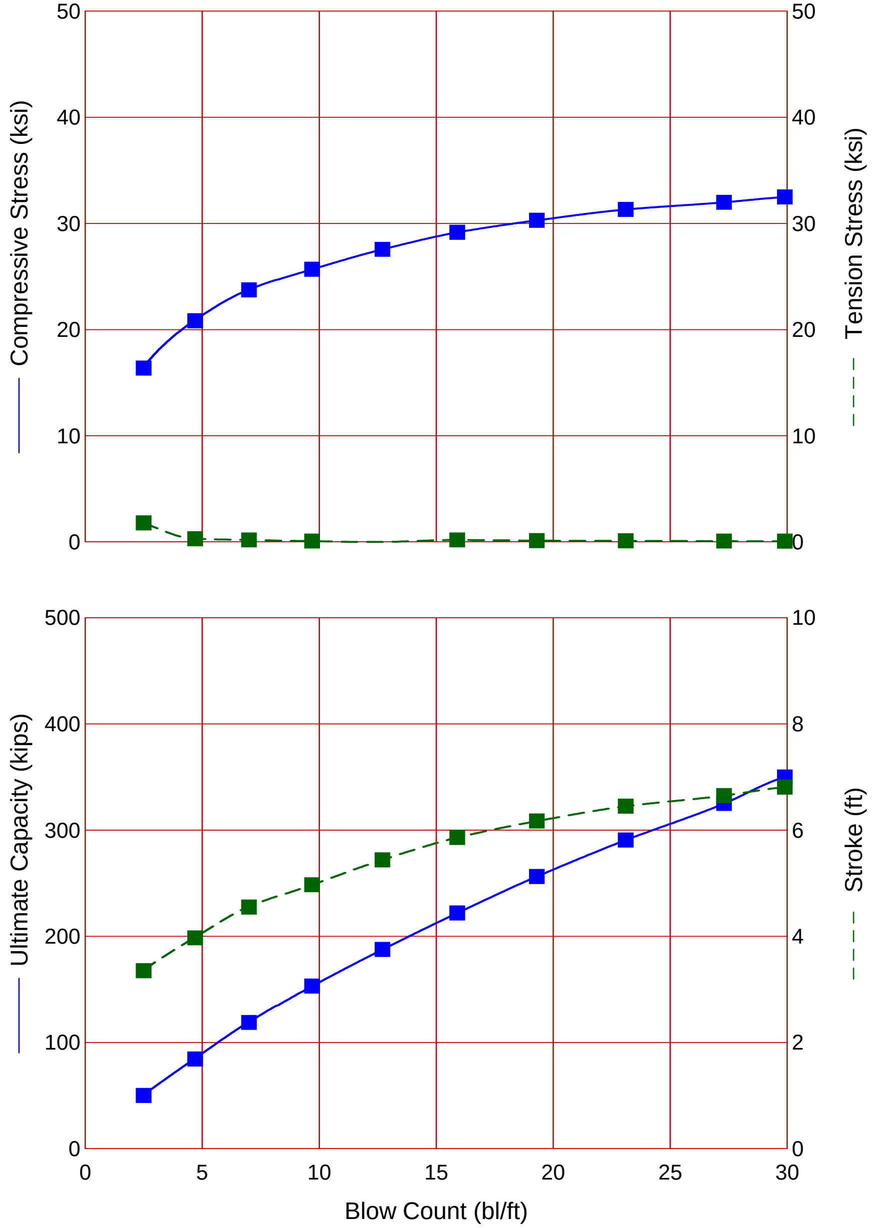
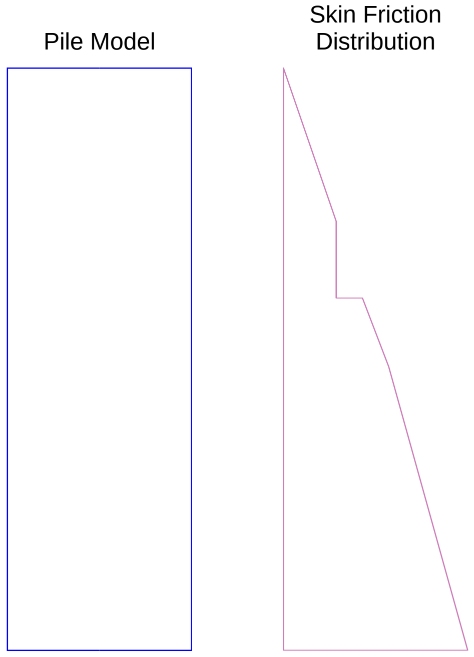


DELMAG D 30

Ram Weight	6.60	kips
Efficiency	0.800	
Pressure	1480 (100%)	psi
Helmet Weight	1.90	kips
Hammer Cushion	60155	kips/in
COR of H.C.	0.800	
Skin Quake	0.100	in
Toe Quake	0.100	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	38.00	ft
Pile Penetration	38.00	ft
Pile Top Area	21.40	in2



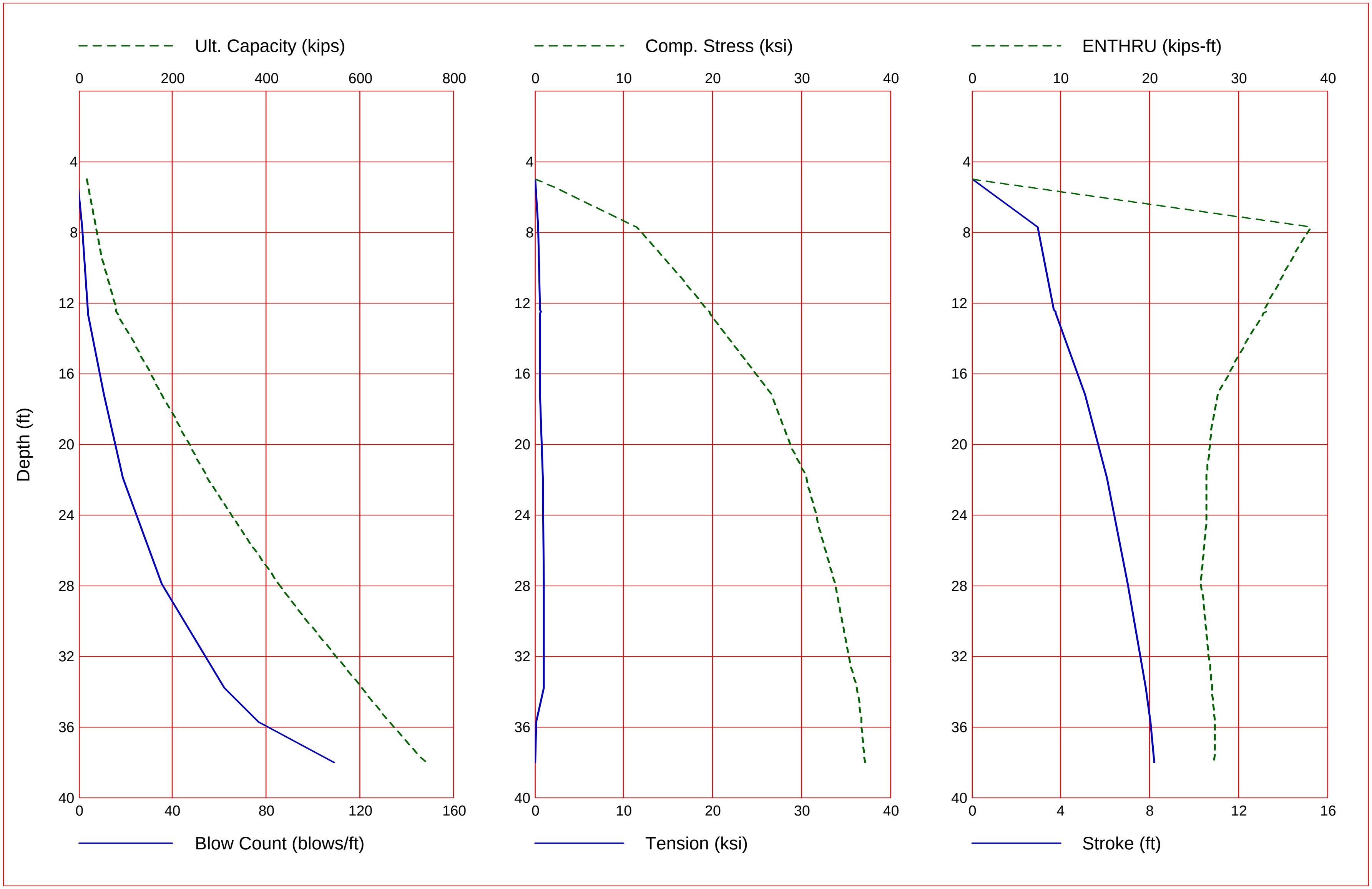
Res. Shaft = 54 %
(Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
50.0	16.38	1.79	2.5	3.35	35.28
84.4	20.84	0.30	4.7	3.97	31.52
118.8	23.74	0.19	7.0	4.55	29.61
153.1	25.68	0.08	9.7	4.97	27.89
187.5	27.56	0.00	12.7	5.44	27.06
221.9	29.16	0.19	15.9	5.86	26.50
256.3	30.29	0.13	19.3	6.17	25.94
290.6	31.31	0.10	23.1	6.45	25.63
325.0	31.99	0.08	27.3	6.65	25.10
350.0	32.48	0.07	29.9	6.81	25.28

South Carolina DOT
US 301 RBO Four Hole Swamp - EndBents

Apr 13 2016
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	18.1	10.6	7.4	-1.0	0.000	0.000	0.00	0.0
7.7	36.3	24.9	11.4	1.6	11.473	-0.370	2.96	38.1
12.4	79.1	63.2	15.9	3.8	19.312	-0.591	3.71	32.9
12.5	80.6	64.6	16.0	3.8	19.648	-0.683	3.76	33.1
12.6	82.0	65.9	16.1	3.9	19.691	-0.601	3.76	32.8
17.2	177.3	124.3	52.9	10.9	26.589	-0.563	5.10	27.7
21.9	275.4	211.3	64.1	18.8	30.583	-0.866	6.09	26.4
27.9	426.0	349.0	77.0	35.4	33.749	-0.971	7.02	25.8
33.8	603.8	513.8	90.0	62.2	36.242	-1.061	7.82	27.0
35.7	662.4	568.5	93.8	76.8	36.722	-0.149	8.03	27.4
38.0	742.6	643.6	98.9	109.1	37.124	0.000	8.22	27.3

Total Continuous Driving Time 21.00 minutes; Total Number of Blows 917

South Carolina DOT
US 301 RBO Four Hole Swamp - EndBents

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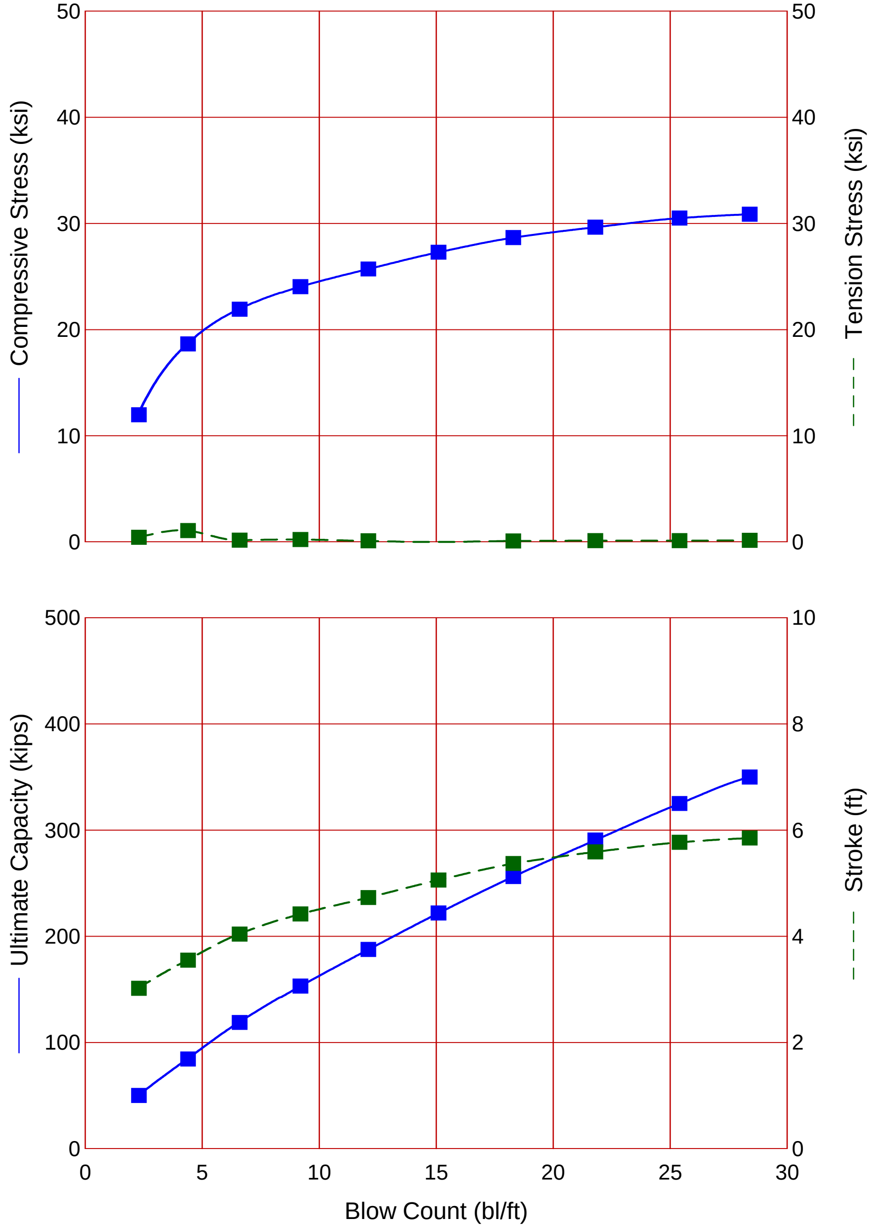
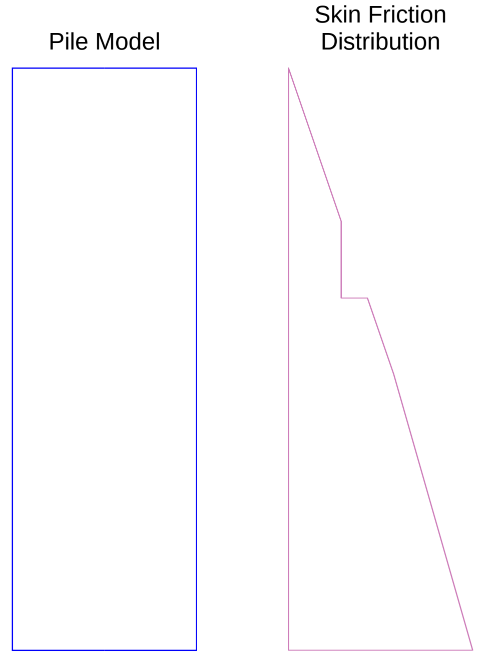


MITSUBIS MH 35

Ram Weight	7.72	kips
Efficiency	0.800	
Pressure	1050 (100%)	psi
Helmet Weight	2.44	kips
Hammer Cushion	42963	kips/in
COR of H.C.	0.920	
Skin Quake	0.100	in
Toe Quake	0.100	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	38.00	ft
Pile Penetration	38.00	ft
Pile Top Area	21.40	in2



Res. Shaft = 54 %
(Proportional)

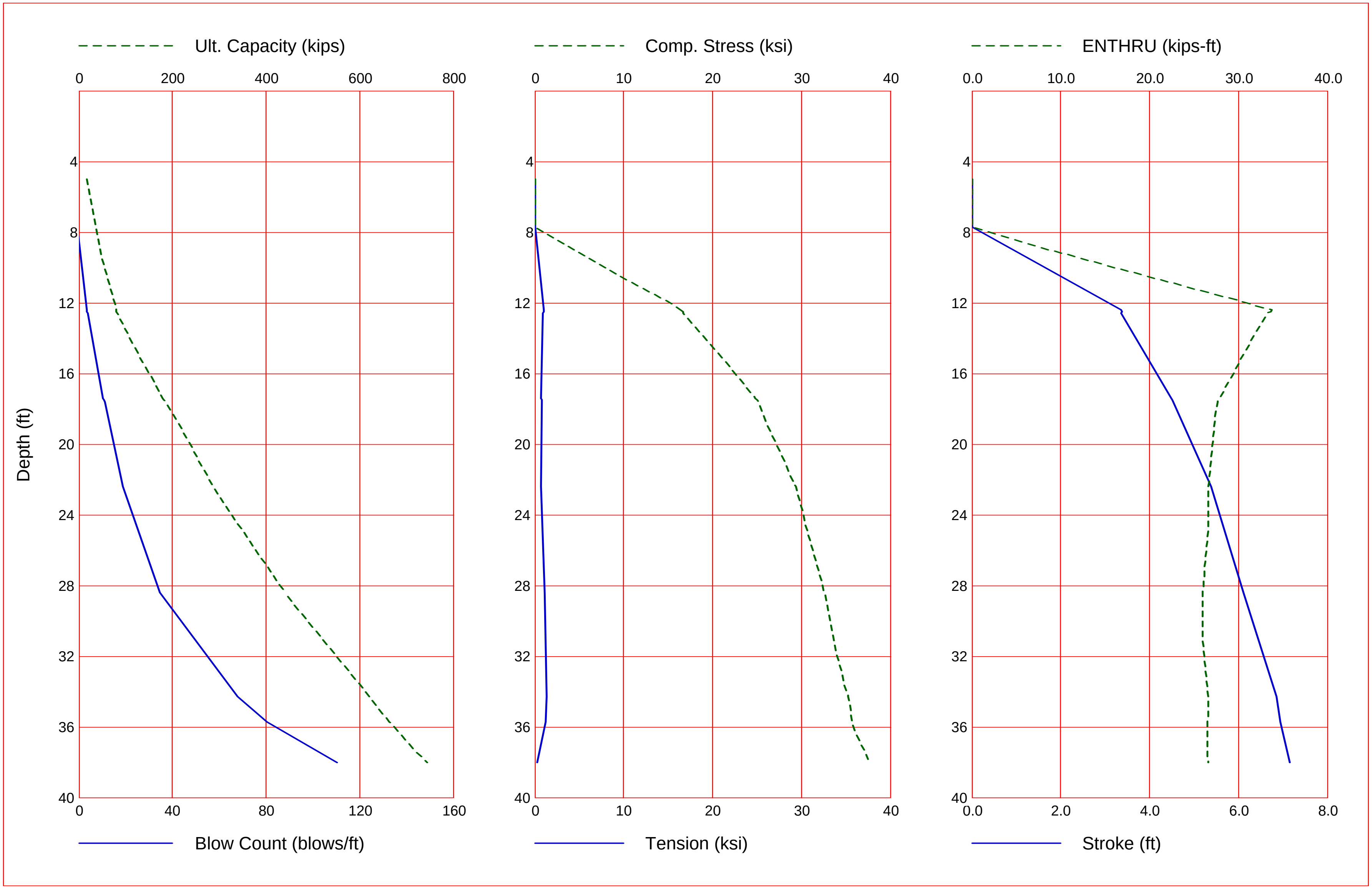
South Carolina DOT 13-Apr-2016
US 301 RBO Four Hole Swamp - EndBents GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
50.0	11.98	0.45	2.3	3.02	36.32
84.4	18.65	1.08	4.4	3.55	32.08
118.8	21.92	0.17	6.6	4.04	30.08
153.1	24.04	0.23	9.2	4.42	28.46
187.5	25.71	0.10	12.1	4.73	27.15
221.9	27.29	0.00	15.1	5.06	26.54
256.3	28.66	0.10	18.3	5.37	26.14
290.6	29.64	0.13	21.8	5.59	25.76
325.0	30.50	0.13	25.4	5.77	25.52
350.0	30.86	0.15	28.4	5.85	25.24

South Carolina DOT
US 301 RBO Four Hole Swamp - EndBents

Apr 13 2016
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

	Ultimate		End	Blow	Comp.	Tension		
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Stroke	ENTHRU
ft	kips	kips	kips	blows/ft	ksi	ksi	ft	kips-ft
5.0	18.1	10.6	7.4	-1.0	0.000	0.000	0.00	0.0
7.7	36.3	24.9	11.4	-1.0	0.000	0.000	0.00	0.0
12.4	79.1	63.2	15.9	3.5	16.457	-1.023	3.36	33.8
12.5	80.6	64.6	16.0	3.6	16.699	-1.020	3.38	33.7
12.6	82.0	65.9	16.1	3.7	16.670	-0.915	3.37	33.2
17.4	179.2	126.0	53.2	10.5	24.827	-0.745	4.49	27.9
17.5	182.2	128.6	53.6	10.7	24.994	-0.769	4.52	27.8
17.6	185.2	131.2	54.0	11.0	25.151	-0.791	4.54	27.7
22.4	287.2	221.9	65.4	19.0	29.362	-0.721	5.39	26.6
28.4	440.4	362.1	78.3	34.6	32.539	-1.085	6.12	26.0
34.3	620.7	529.5	91.2	68.0	35.250	-1.344	6.86	26.6
35.7	663.3	569.3	94.0	80.4	35.713	-1.263	6.94	26.5
38.0	743.6	644.5	99.1	110.3	37.657	-0.305	7.15	26.6

Total Continuous Driving Time 19.00 minutes; Total Number of Blows 906

South Carolina DOT
US 301 RBO Four Hole Swamp - EndBents

13-Apr-2016
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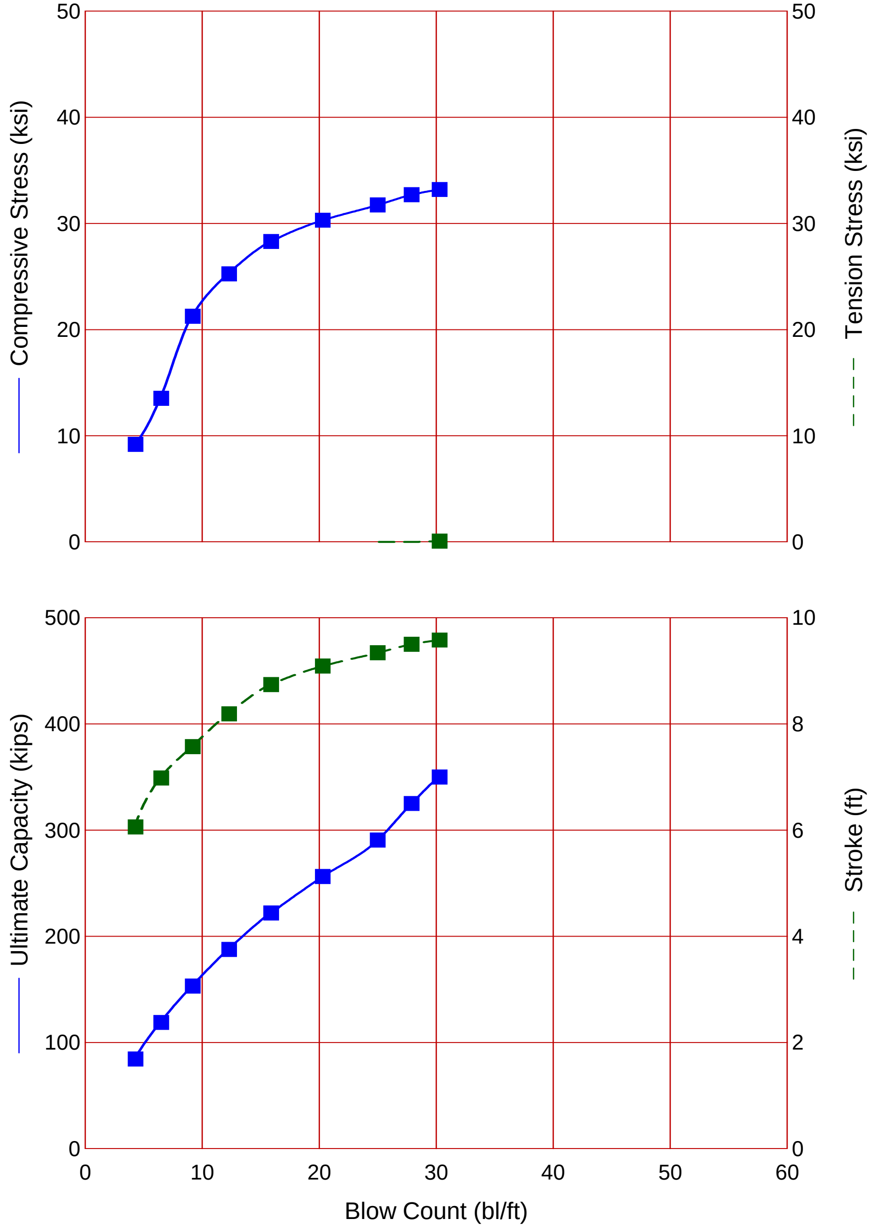
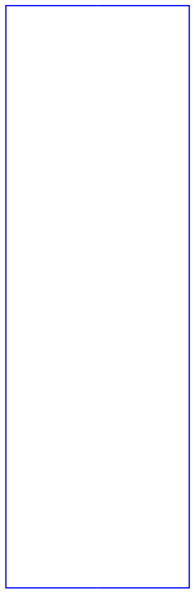


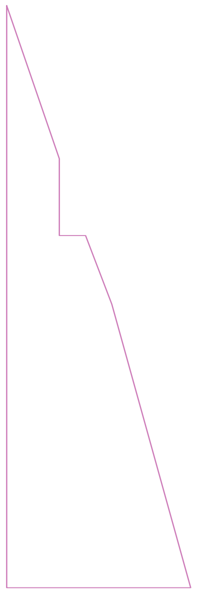
ICE 70-S

Ram Weight	7.00	kips
Efficiency	0.800	
Pressure	1029 (100%)	psi
Helmet Weight	2.09	kips
Hammer Cushion	34825	kips/in
COR of H.C.	0.920	
Skin Quake	0.100	in
Toe Quake	0.100	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	38.00	ft
Pile Penetration	38.00	ft
Pile Top Area	21.40	in2

Pile Model



Skin Friction
Distribution



Res. Shaft = 54 %
(Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
84.4	9.19	0.00	4.3	6.06	26.39
118.8	13.53	0.00	6.5	6.98	25.00
153.1	21.25	0.00	9.2	7.57	24.24
187.5	25.25	0.00	12.3	8.19	24.41
221.9	28.29	0.00	15.9	8.74	24.36
256.3	30.30	0.00	20.3	9.09	23.85
290.6	31.73	0.00	25.0	9.34	23.64
325.0	32.70	0.00	27.9	9.50	23.71
350.0	33.19	0.08	30.3	9.58	23.90

South Carolina DOT
US 301 RBO Four Hole Swamp - EndBents

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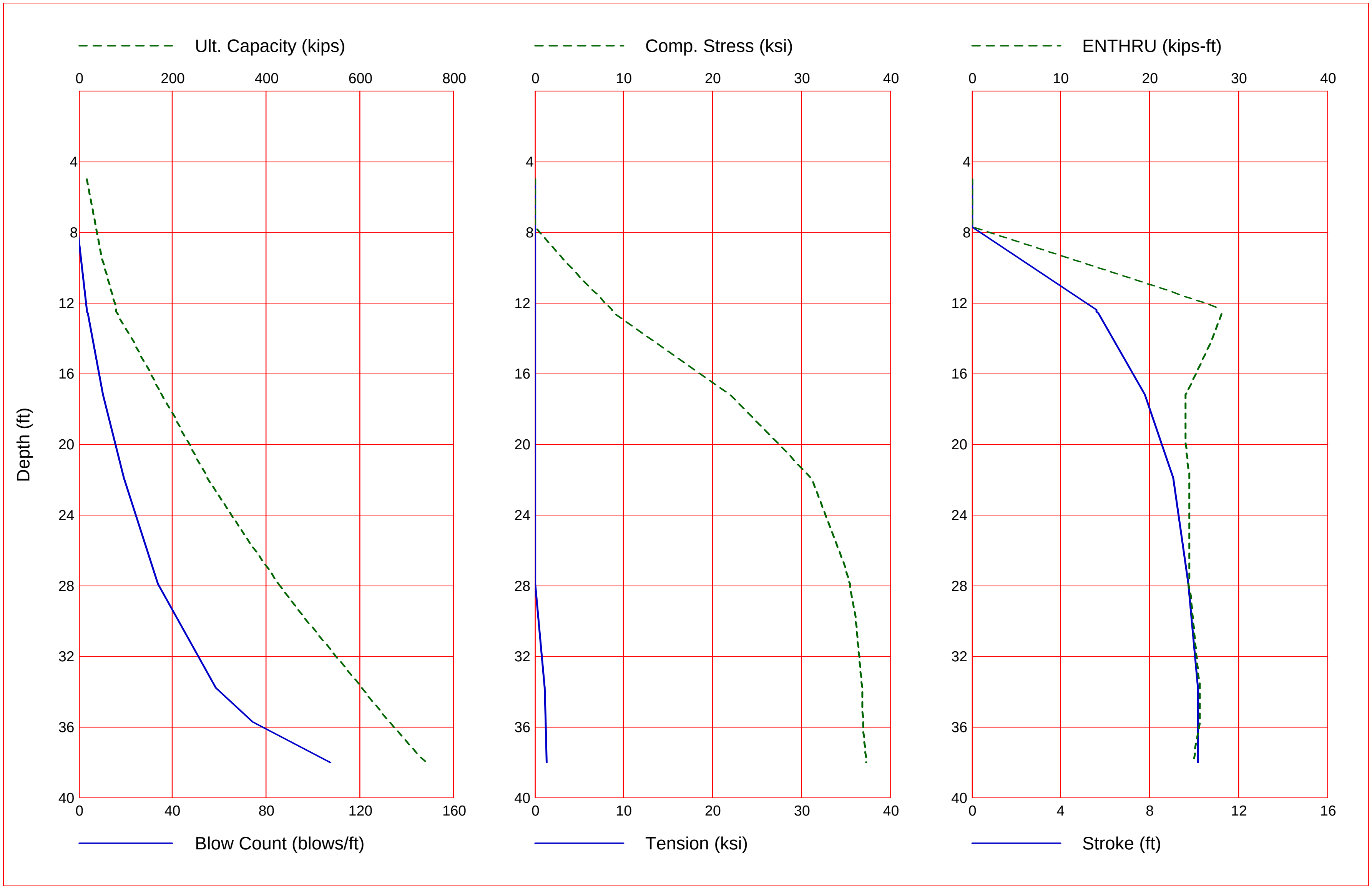
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	18.1	10.6	7.4	-1.0	0.000	0.000	0.00	0.0
7.7	36.3	24.9	11.4	-1.0	0.000	0.000	0.00	0.0
12.4	79.1	63.2	15.9	3.6	8.705	0.000	5.59	28.4
12.5	80.6	64.6	16.0	3.6	8.816	0.000	5.63	28.3
12.6	82.0	65.9	16.1	3.7	8.927	0.000	5.68	28.1
17.2	177.3	124.3	52.9	10.5	21.945	0.000	7.77	24.1
21.9	275.4	211.3	64.1	19.4	31.050	0.000	9.07	24.5
27.9	426.0	349.0	77.0	33.9	35.498	0.000	9.74	24.4
33.8	603.8	513.8	90.0	58.7	36.897	-1.127	10.16	25.6
35.7	662.4	568.5	93.8	74.4	36.933	-1.190	10.17	25.6
38.0	742.6	643.6	98.9	107.5	37.253	-1.326	10.17	25.0

Total Continuous Driving Time 23.00 minutes; Total Number of Blows 884

Interior Bents

Unplugged Conditions

South Carolina DOT
US301-RBO-Four-Hole-Swamp-IB-2

13-Apr-2016
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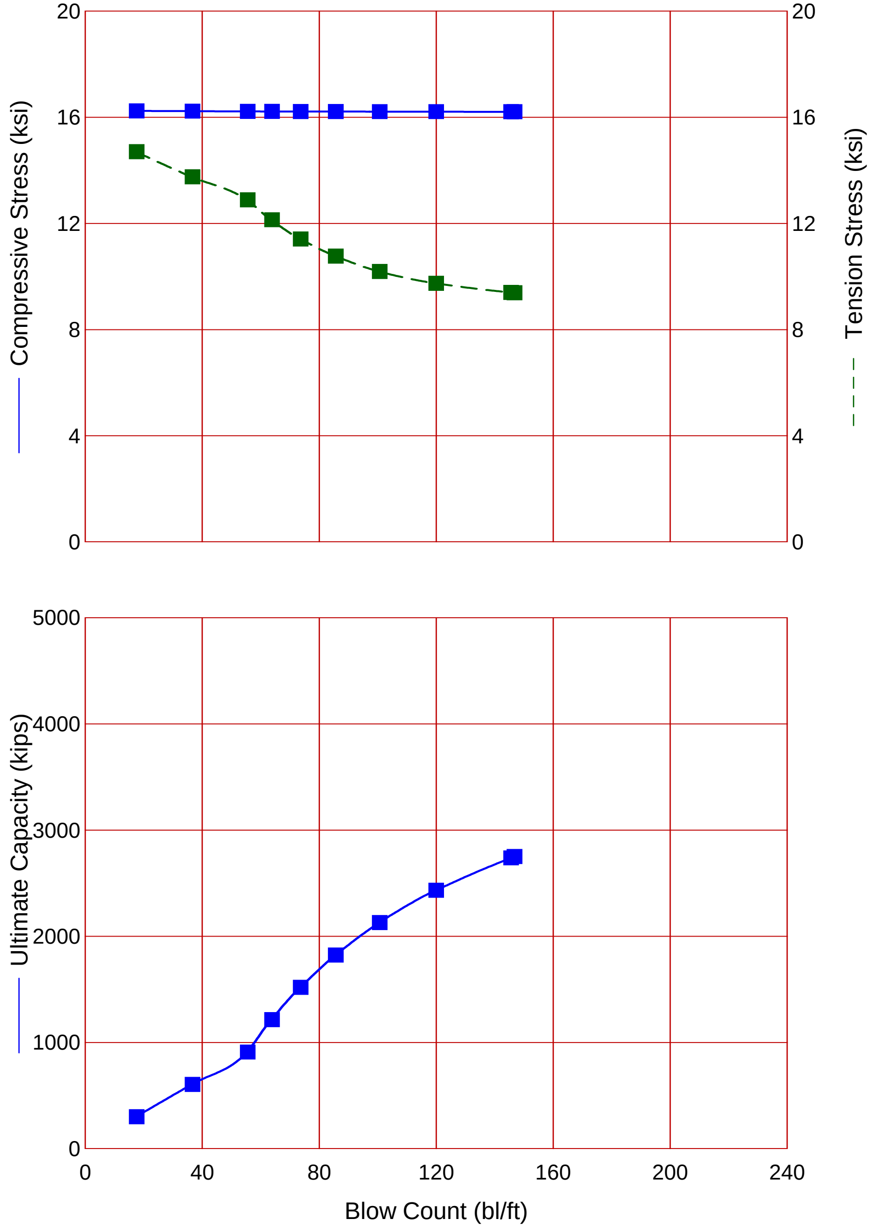
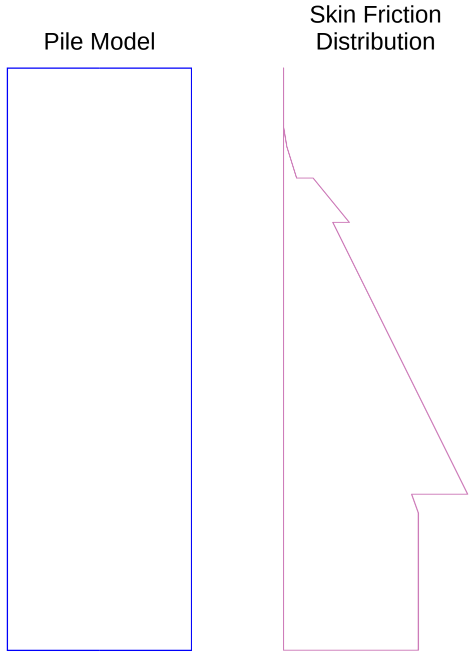


IHC S-70

Stroke	6.63	ft
Ram Weight	7.73	kips
Efficiency	0.950	
Helmet Weight	2.00	kips
COR of H.C.	0.000	
Skin Quake	0.100	in
Toe Quake	0.100	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	110.00	ft
Pile Penetration	99.00	ft
Pile Top Area	219.12	in2



Res. Shaft = 89 %
(Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
300.0	16.24	14.70	17.6	6.63	40.98
604.8	16.23	13.75	36.7	6.63	40.98
909.5	16.22	12.89	55.6	6.63	40.98
1214.3	16.22	12.14	63.9	6.63	40.98
1519.0	16.22	11.41	73.7	6.63	40.98
1823.8	16.21	10.77	85.7	6.63	40.97
2128.5	16.21	10.19	100.7	6.63	40.97
2433.3	16.21	9.74	120.0	6.63	40.97
2738.0	16.21	9.40	145.6	6.63	40.97
2750.0	16.21	9.39	146.8	6.63	40.97

South Carolina DOT
US301-RBO-Four-Hole-Swamp-IB-2

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Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.9	2.2	0.2	2.1	0.0	0.000	0.000	6.63	0.0
6.6	18.6	2.8	15.8	0.0	0.000	0.000	6.63	0.0
6.8	19.5	3.1	16.4	0.0	0.000	0.000	6.63	0.0
7.0	20.4	3.3	17.1	0.0	0.000	0.000	6.63	0.0
12.6	178.6	18.2	160.4	12.9	16.303	-13.266	6.63	41.0
14.0	210.5	25.4	185.1	14.4	16.303	-12.832	6.63	41.1
15.4	243.4	33.6	209.7	16.3	16.303	-12.406	6.63	41.0
21.0	229.3	70.1	159.3	14.8	16.303	-12.895	6.63	41.0
27.0	292.5	115.3	177.2	18.2	16.303	-12.349	6.63	41.0
33.0	366.2	171.0	195.1	23.1	16.303	-11.796	6.63	41.0
39.0	450.5	237.4	213.1	29.5	16.304	-11.278	6.63	41.0
45.0	545.4	314.4	231.0	34.3	16.304	-10.856	6.63	41.1
51.0	651.0	402.0	249.0	39.7	16.308	-10.447	6.63	41.0
57.0	767.1	500.2	266.9	46.7	16.309	-10.060	6.63	41.0
63.0	893.8	609.0	284.8	56.2	16.309	-9.705	6.63	41.0
66.7	978.2	682.2	296.0	62.1	16.303	-9.492	6.63	41.0
71.2	992.6	765.2	227.4	61.0	16.301	-10.222	6.63	41.0
75.8	1062.8	834.6	228.2	62.7	16.302	-10.283	6.63	41.0
81.8	1155.4	927.1	228.2	65.0	16.301	-10.388	6.63	41.0
87.8	1248.3	1020.0	228.2	67.4	16.286	-10.541	6.63	41.0
93.8	1341.5	1113.2	228.2	70.1	16.258	-10.761	6.63	41.0
96.2	1379.5	1151.2	228.2	71.2	16.240	-10.875	6.63	41.0
99.0	1422.9	1194.6	228.2	72.5	16.217	-10.927	6.63	41.0

Total Number of Blows: 3871

Driving Time (min):	129	96	77	64	55	48	43	38	35	32
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

South Carolina DOT
US301-RBO-Four-Hole-Swamp-IB-2

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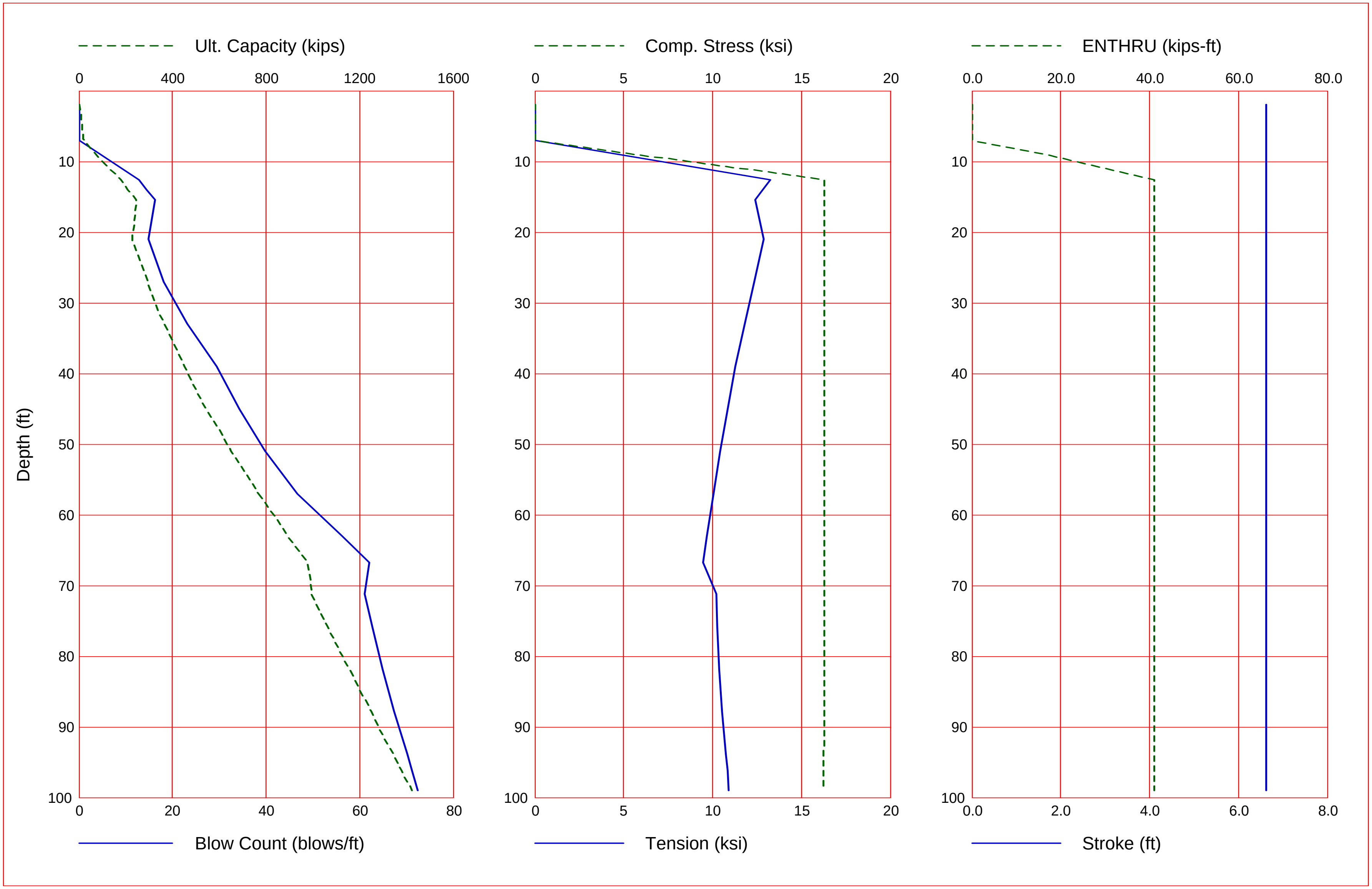
Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



South Carolina DOT
US301-RBO-Four-Hole-Swamp-IB-2

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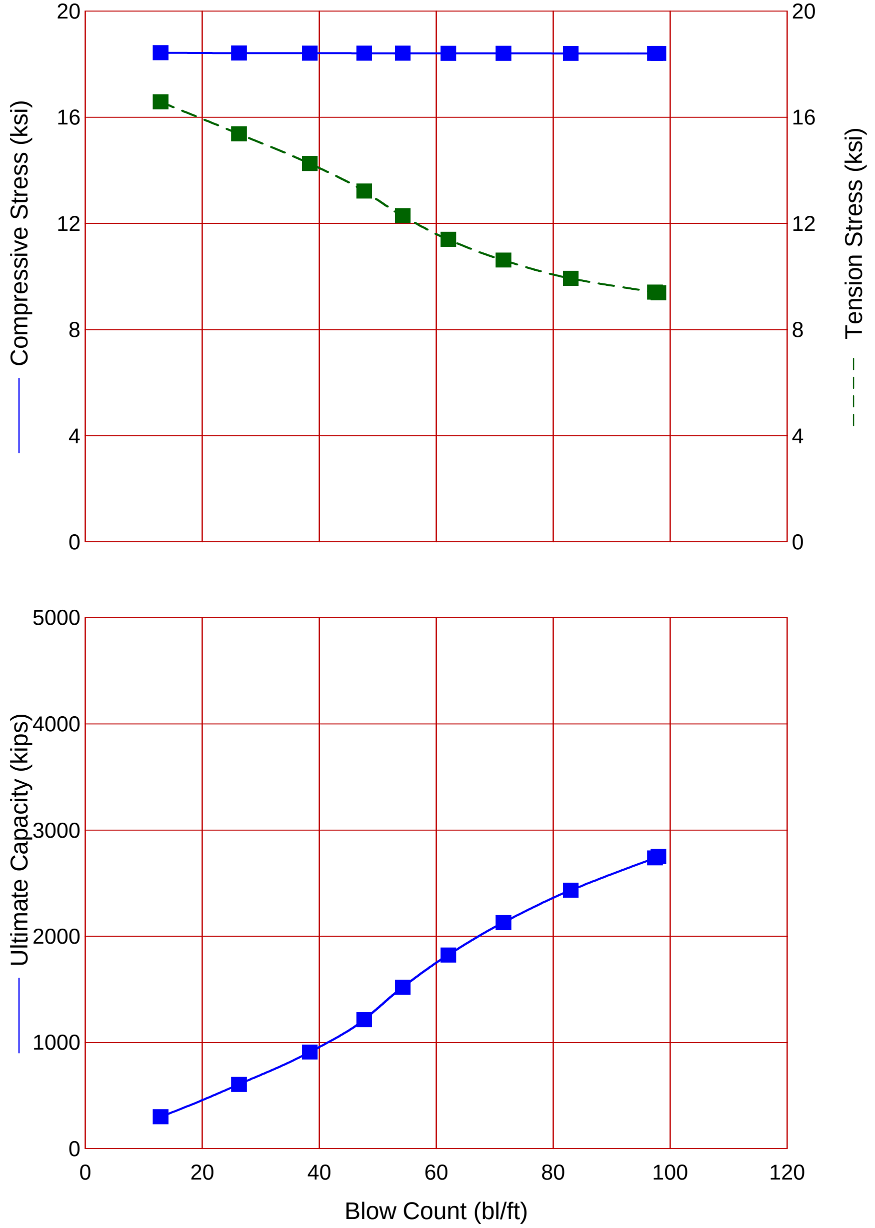
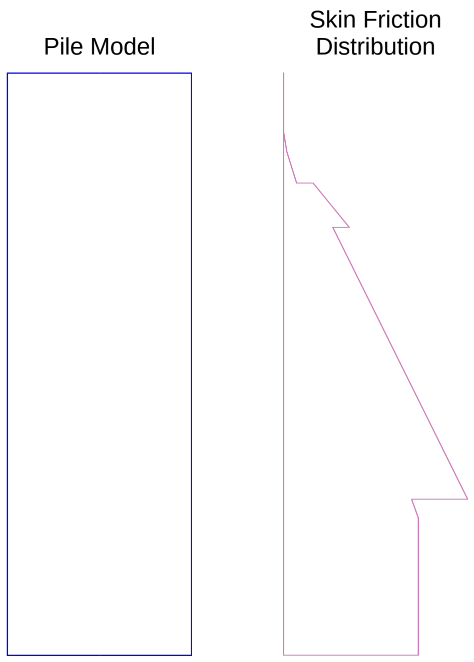


IHC S-90

Stroke	6.63	ft
Ram Weight	9.94	kips
Efficiency	0.950	
Helmet Weight	3.52	kips
COR of H.C.	0.000	
Skin Quake	0.100	in
Toe Quake	0.100	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	110.00	ft
Pile Penetration	99.00	ft
Pile Top Area	219.12	in2



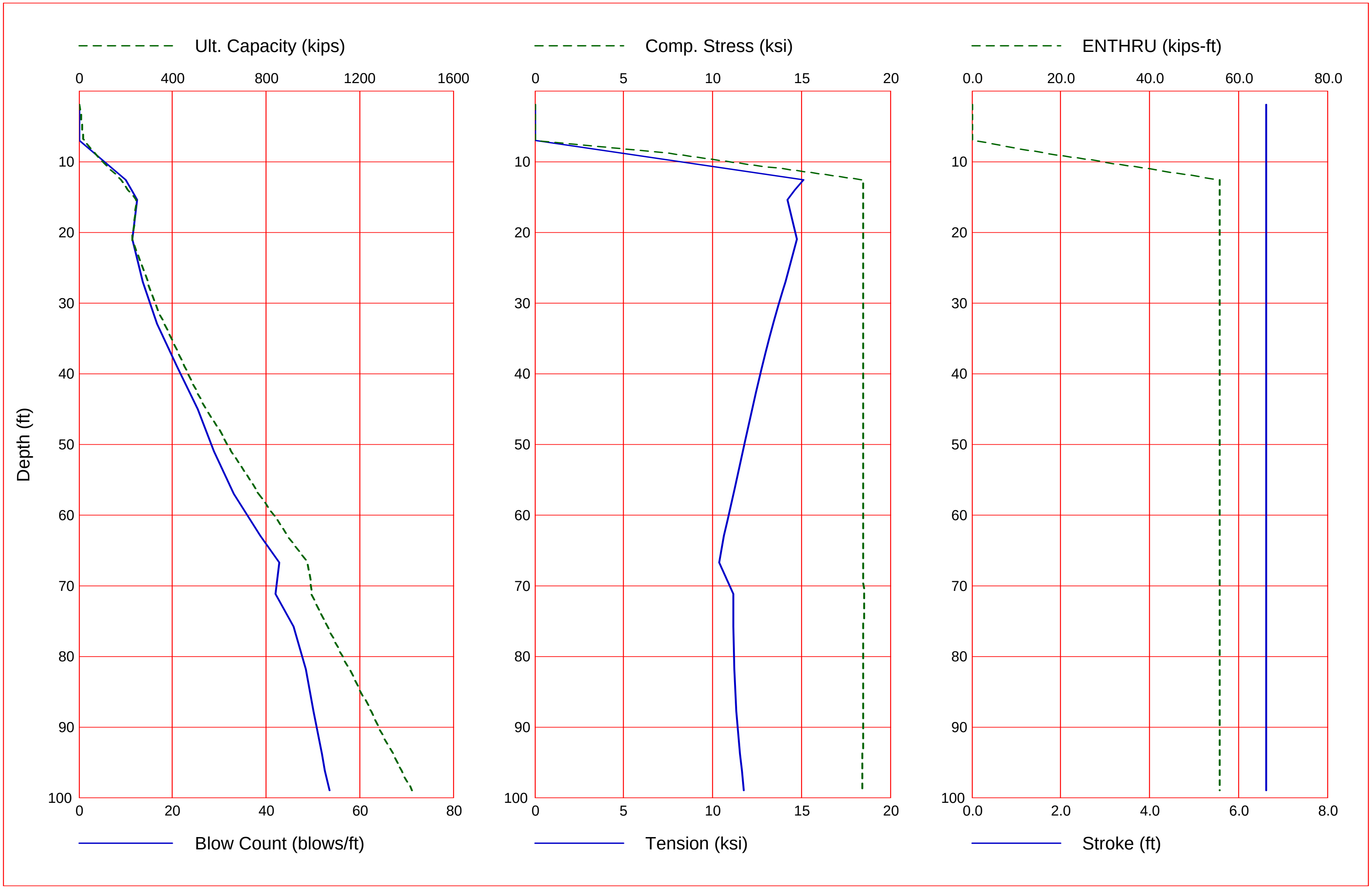
Res. Shaft = 89 %
(Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
300.0	18.43	16.58	12.9	6.63	55.81
604.8	18.42	15.38	26.3	6.63	55.69
909.5	18.41	14.26	38.4	6.63	55.69
1214.3	18.41	13.22	47.7	6.63	55.69
1519.0	18.41	12.29	54.3	6.63	55.68
1823.8	18.41	11.40	62.1	6.63	55.68
2128.5	18.41	10.62	71.5	6.63	55.67
2433.3	18.40	9.93	83.0	6.63	55.67
2738.0	18.40	9.41	97.4	6.63	55.67
2750.0	18.40	9.39	98.0	6.63	55.67

South Carolina DOT
US301-RBO-Four-Hole-Swamp-IB-2

Apr 13 2016
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



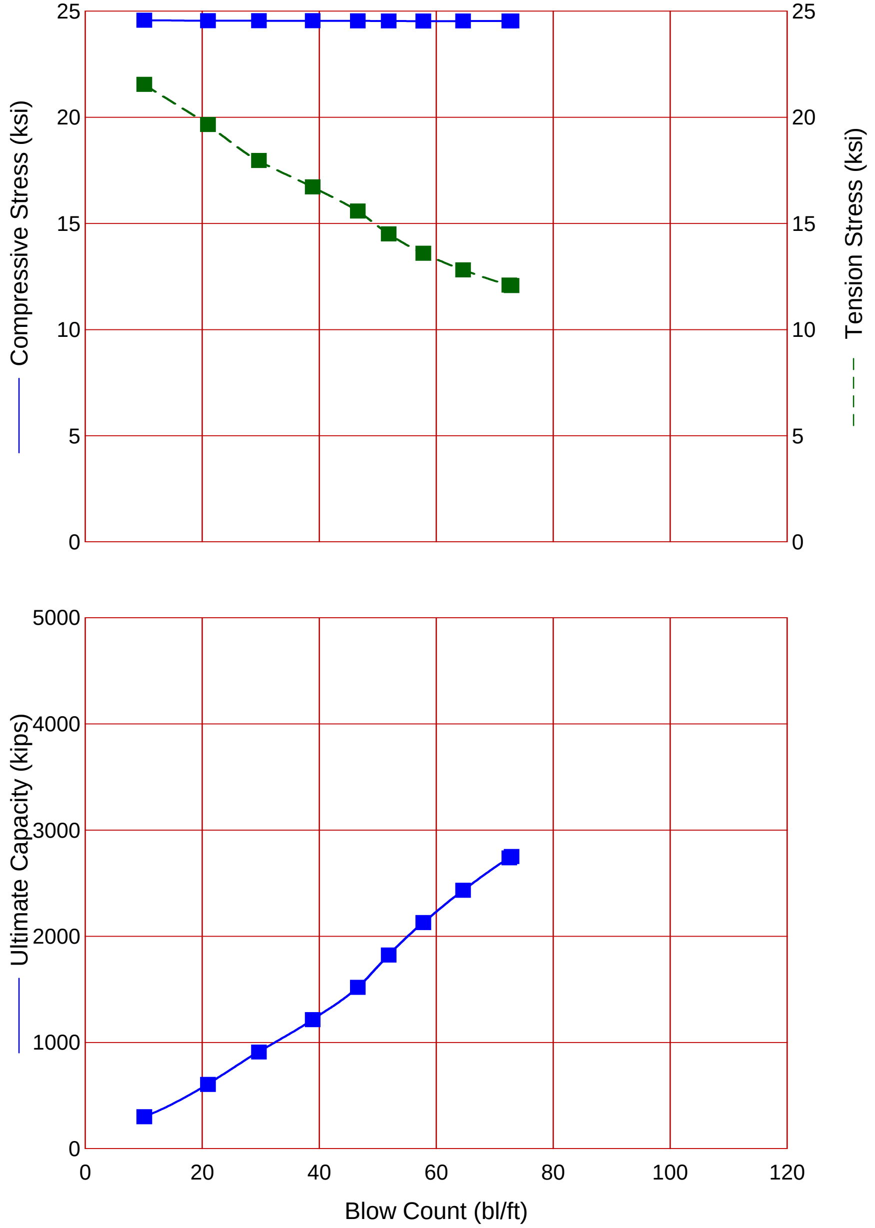
Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.9	2.2	0.2	2.1	0.0	0.000	0.000	6.63	0.0
6.6	18.6	2.8	15.8	0.0	0.000	0.000	6.63	0.0
6.8	19.5	3.1	16.4	0.0	0.000	0.000	6.63	0.0
7.0	20.4	3.3	17.1	0.0	0.000	0.000	6.63	0.0
12.6	178.6	18.2	160.4	10.0	18.499	-15.135	6.63	55.7
14.0	210.5	25.4	185.1	11.2	18.499	-14.665	6.63	55.7
15.4	243.4	33.6	209.7	12.5	18.499	-14.187	6.63	55.7
21.0	229.3	70.1	159.3	11.5	18.499	-14.733	6.63	55.7
27.0	292.5	115.3	177.2	13.7	18.500	-14.096	6.63	55.7
33.0	366.2	171.0	195.1	16.8	18.500	-13.437	6.63	55.8
39.0	450.5	237.4	213.1	21.0	18.500	-12.788	6.63	55.7
45.0	545.4	314.4	231.0	25.4	18.500	-12.222	6.63	55.8
51.0	651.0	402.0	249.0	28.8	18.504	-11.693	6.63	55.8
57.0	767.1	500.2	266.9	33.1	18.506	-11.154	6.63	55.7
63.0	893.8	609.0	284.8	38.7	18.502	-10.638	6.63	55.7
66.7	978.2	682.2	296.0	42.9	18.506	-10.352	6.63	55.7
71.2	992.6	765.2	227.4	42.1	18.510	-11.151	6.63	55.7
75.8	1062.8	834.6	228.2	45.9	18.505	-11.168	6.63	55.7
81.8	1155.4	927.1	228.2	48.5	18.470	-11.221	6.63	55.8
87.8	1248.3	1020.0	228.2	50.2	18.466	-11.343	6.63	55.7
93.8	1341.5	1113.2	228.2	51.9	18.451	-11.544	6.63	55.7
96.2	1379.5	1151.2	228.2	52.6	18.431	-11.644	6.63	55.7
99.0	1422.9	1194.6	228.2	53.5	18.411	-11.775	6.63	55.7

Total Number of Blows: 2815

Driving Time (min):	93	70	56	46	40	35	31	28	25	23
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

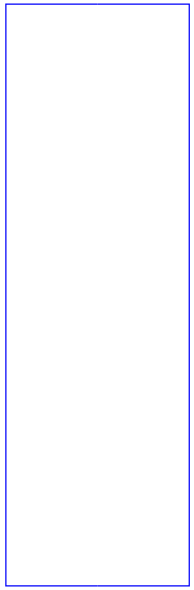
Driving Time for continuously running hammer; any wait times not included



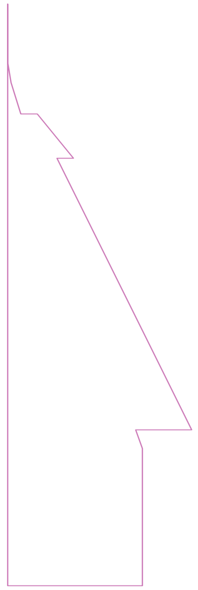
IHC S-120

Stroke	6.63	ft
Ram Weight	13.48	kips
Efficiency	0.950	
Helmet Weight	6.15	kips
COR of H.C.	0.000	
Skin Quake	0.100	in
Toe Quake	0.100	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	110.00	ft
Pile Penetration	99.00	ft
Pile Top Area	219.12	in2

Pile Model



Skin Friction
Distribution



Res. Shaft = 89 %
(Proportional)

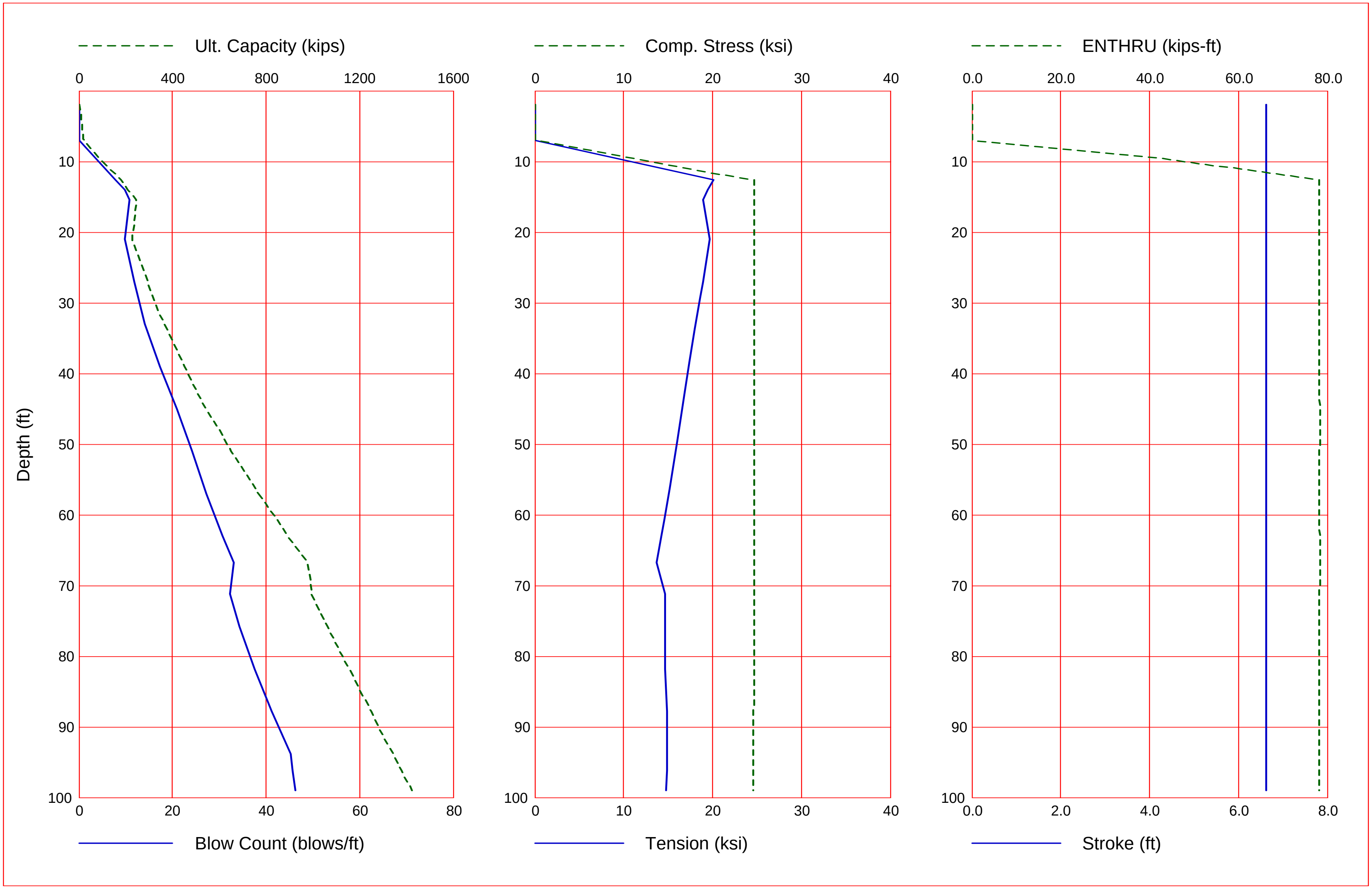
South Carolina DOT 13-Apr-2016
US301-RBO-Four-Hole-Swamp-IB-2 GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
300.0	24.57	21.55	10.1	6.63	78.17
604.8	24.55	19.66	21.0	6.63	78.15
909.5	24.54	17.96	29.7	6.63	78.13
1214.3	24.54	16.72	38.9	6.63	78.11
1519.0	24.54	15.58	46.6	6.63	78.10
1823.8	24.53	14.51	51.9	6.63	78.08
2128.5	24.53	13.60	57.8	6.63	78.06
2433.3	24.53	12.81	64.6	6.63	78.04
2738.0	24.53	12.10	72.5	6.63	78.03
2750.0	24.53	12.07	72.9	6.63	78.03

South Carolina DOT
US301-RBO-Four-Hole-Swamp-IB-2

Apr 13 2016
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



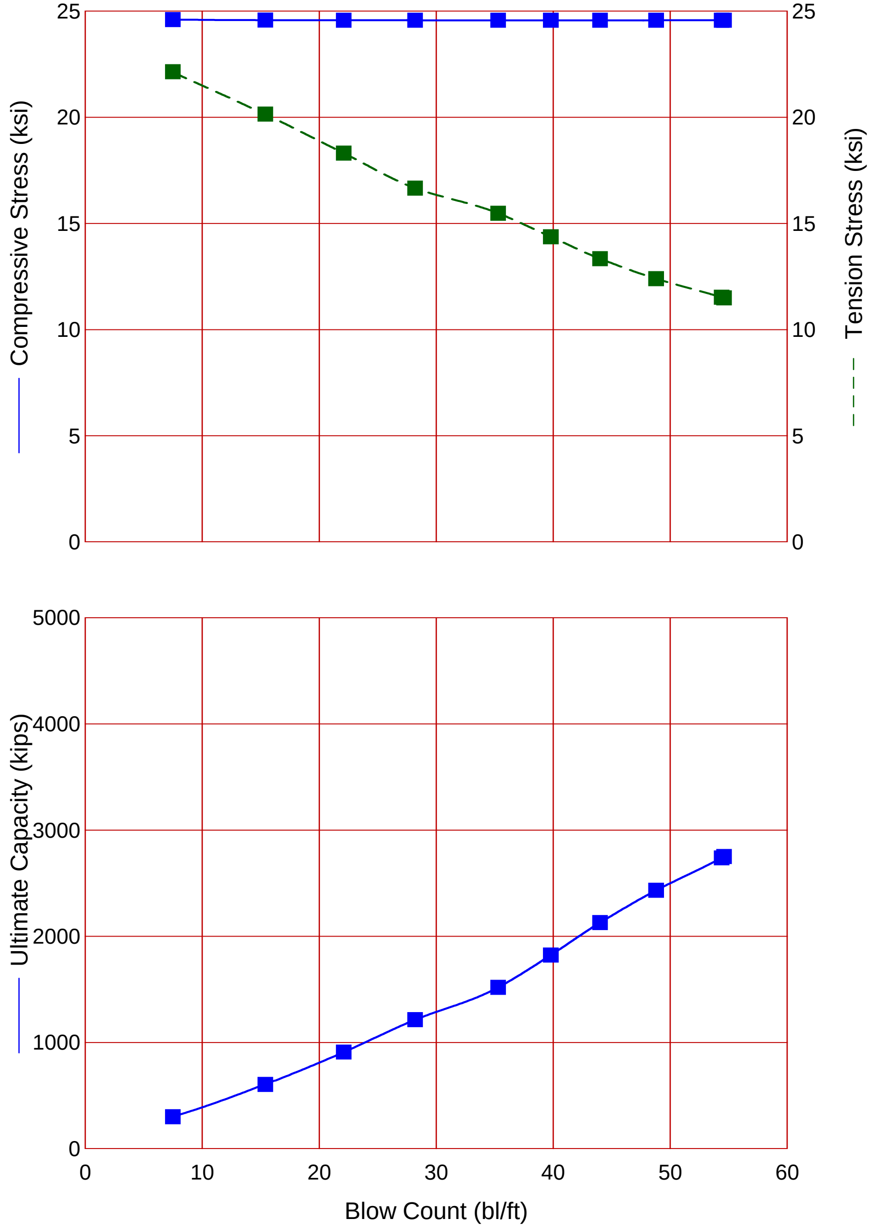
Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.9	2.2	0.2	2.1	0.0	0.000	0.000	6.63	0.0
6.6	18.6	2.8	15.8	0.0	0.000	0.000	6.63	0.0
6.8	19.5	3.1	16.4	0.0	0.000	0.000	6.63	0.0
7.0	20.4	3.3	17.1	0.0	0.000	0.000	6.63	0.0
12.6	178.6	18.2	160.4	7.8	24.663	-20.092	6.63	78.2
14.0	210.5	25.4	185.1	9.8	24.663	-19.515	6.63	78.2
15.4	243.4	33.6	209.7	10.8	24.663	-18.938	6.63	78.2
21.0	229.3	70.1	159.3	9.9	24.663	-19.644	6.63	78.2
27.0	292.5	115.3	177.2	11.8	24.663	-18.912	6.63	78.2
33.0	366.2	171.0	195.1	14.1	24.663	-18.122	6.63	78.2
39.0	450.5	237.4	213.1	17.4	24.663	-17.292	6.63	78.2
45.0	545.4	314.4	231.0	20.9	24.663	-16.561	6.63	78.4
51.0	651.0	402.0	249.0	24.3	24.663	-15.820	6.63	78.2
57.0	767.1	500.2	266.9	27.3	24.664	-15.077	6.63	78.2
63.0	893.8	609.0	284.8	30.7	24.671	-14.211	6.63	78.3
66.7	978.2	682.2	296.0	33.2	24.674	-13.657	6.63	78.3
71.2	992.6	765.2	227.4	32.3	24.674	-14.626	6.63	78.2
75.8	1062.8	834.6	228.2	34.4	24.673	-14.650	6.63	78.2
81.8	1155.4	927.1	228.2	37.5	24.655	-14.717	6.63	78.2
87.8	1248.3	1020.0	228.2	41.3	24.629	-14.835	6.63	78.2
93.8	1341.5	1113.2	228.2	45.2	24.592	-14.837	6.63	78.1
96.2	1379.5	1151.2	228.2	45.7	24.566	-14.827	6.63	78.1
99.0	1422.9	1194.6	228.2	46.3	24.538	-14.825	6.63	78.1

Total Number of Blows: 2293

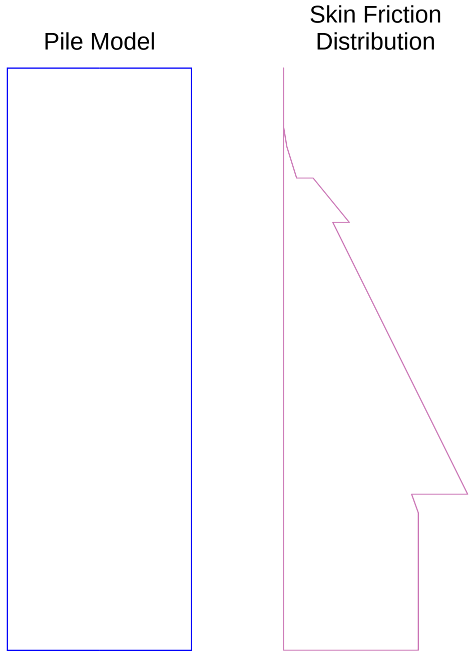
Driving Time (min):	76	57	45	38	32	28	25	22	20	19
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included



IHC S-150

Stroke	6.63	ft
Ram Weight	16.60	kips
Efficiency	0.950	
Helmet Weight	6.15	kips
COR of H.C.	0.000	
Skin Quake	0.100	in
Toe Quake	0.100	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	110.00	ft
Pile Penetration	99.00	ft
Pile Top Area	219.12	in2



Res. Shaft = 89 %
(Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
300.0	24.59	22.14	7.5	6.63	97.91
604.8	24.57	20.15	15.4	6.63	97.88
909.5	24.57	18.31	22.1	6.63	97.85
1214.3	24.57	16.66	28.2	6.63	97.82
1519.0	24.56	15.48	35.3	6.63	97.80
1823.8	24.56	14.37	39.8	6.63	97.77
2128.5	24.56	13.34	44.0	6.63	97.74
2433.3	24.57	12.40	48.8	6.63	97.72
2738.0	24.57	11.53	54.4	6.63	97.69
2750.0	24.57	11.49	54.6	6.63	97.69

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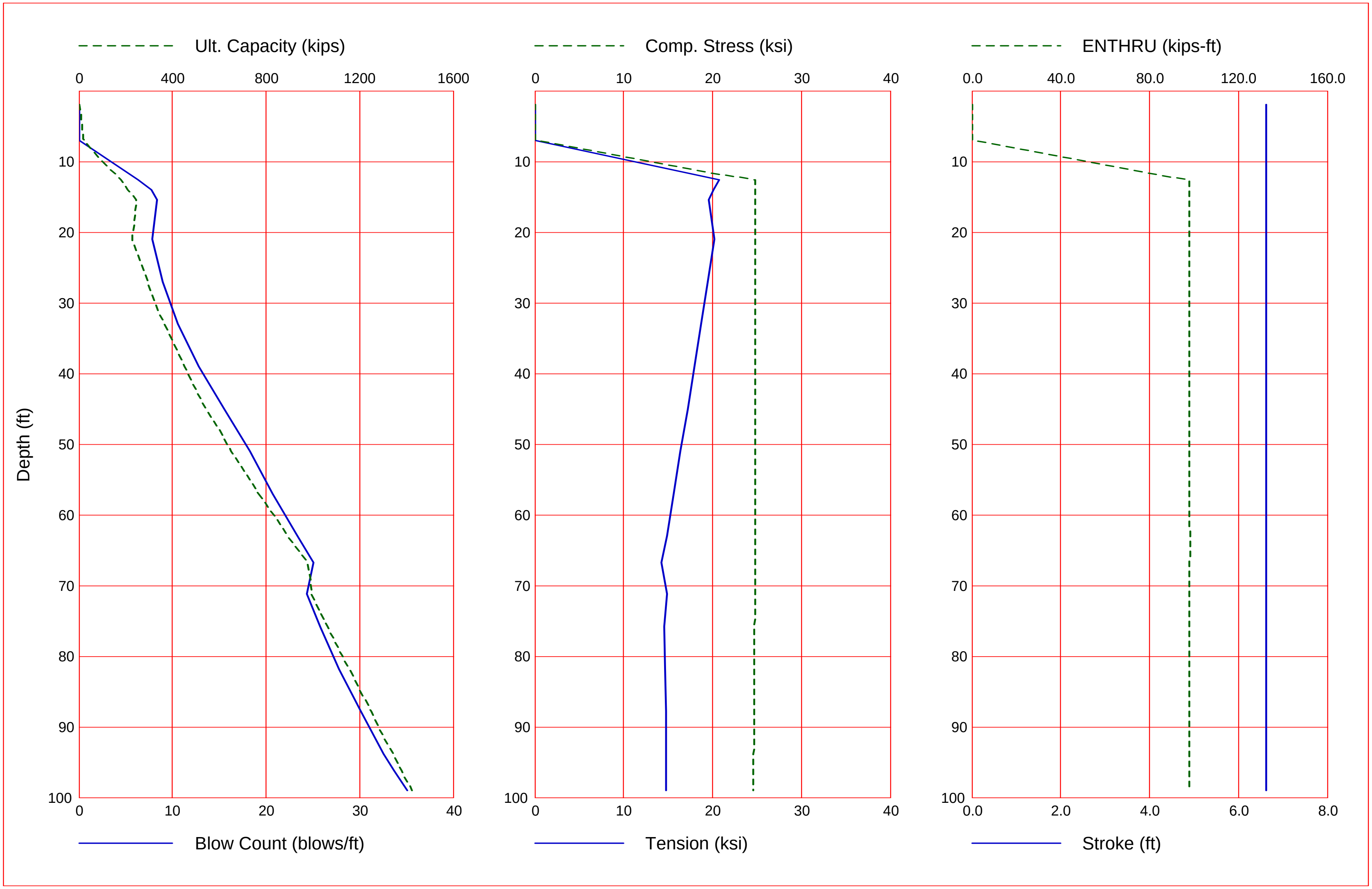
Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.9	2.2	0.2	2.1	0.0	0.000	0.000	6.63	0.0
6.6	18.6	2.8	15.8	0.0	0.000	0.000	6.63	0.0
6.8	19.5	3.1	16.4	0.0	0.000	0.000	6.63	0.0
7.0	20.4	3.3	17.1	0.0	0.000	0.000	6.63	0.0
12.6	178.6	18.2	160.4	6.3	24.806	-20.706	6.63	97.9
14.0	210.5	25.4	185.1	7.7	24.806	-20.122	6.63	97.9
15.4	243.4	33.6	209.7	8.4	24.806	-19.536	6.63	97.9
21.0	229.3	70.1	159.3	7.8	24.806	-20.248	6.63	97.9
27.0	292.5	115.3	177.2	9.0	24.814	-19.494	6.63	97.9
33.0	366.2	171.0	195.1	10.6	24.834	-18.682	6.63	97.9
39.0	450.5	237.4	213.1	12.8	24.835	-17.932	6.63	97.9
45.0	545.4	314.4	231.0	15.5	24.829	-17.181	6.63	97.9
51.0	651.0	402.0	249.0	18.3	24.818	-16.410	6.63	97.9
57.0	767.1	500.2	266.9	20.7	24.812	-15.632	6.63	97.9
63.0	893.8	609.0	284.8	23.3	24.797	-14.842	6.63	98.2
66.7	978.2	682.2	296.0	25.1	24.783	-14.213	6.63	97.9
71.2	992.6	765.2	227.4	24.4	24.756	-14.929	6.63	97.9
75.8	1062.8	834.6	228.2	25.8	24.737	-14.601	6.63	98.0
81.8	1155.4	927.1	228.2	27.8	24.697	-14.652	6.63	97.9
87.8	1248.3	1020.0	228.2	30.1	24.661	-14.767	6.63	97.9
93.8	1341.5	1113.2	228.2	32.6	24.616	-14.757	6.63	97.9
96.2	1379.5	1151.2	228.2	33.7	24.592	-14.739	6.63	97.8
99.0	1422.9	1194.6	228.2	35.1	24.564	-14.730	6.63	97.8

Total Number of Blows: 1714

Driving Time (min):	57	42	34	28	24	21	19	17	15	14
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

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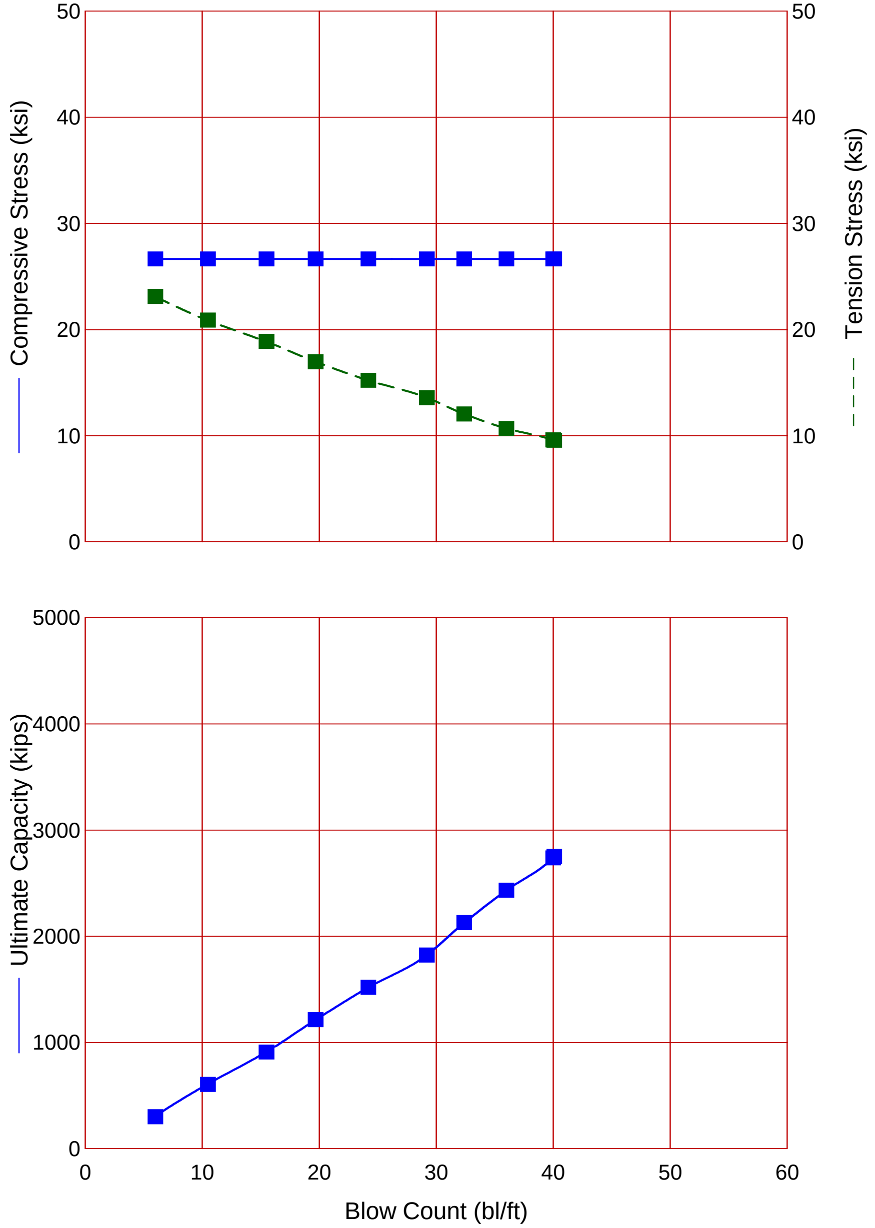
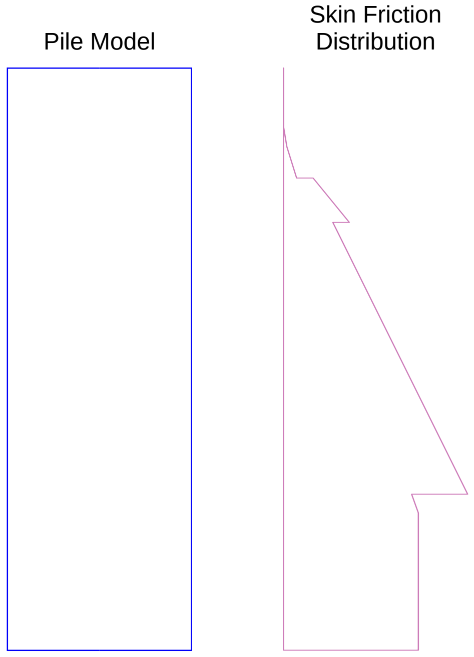


IHC S-200

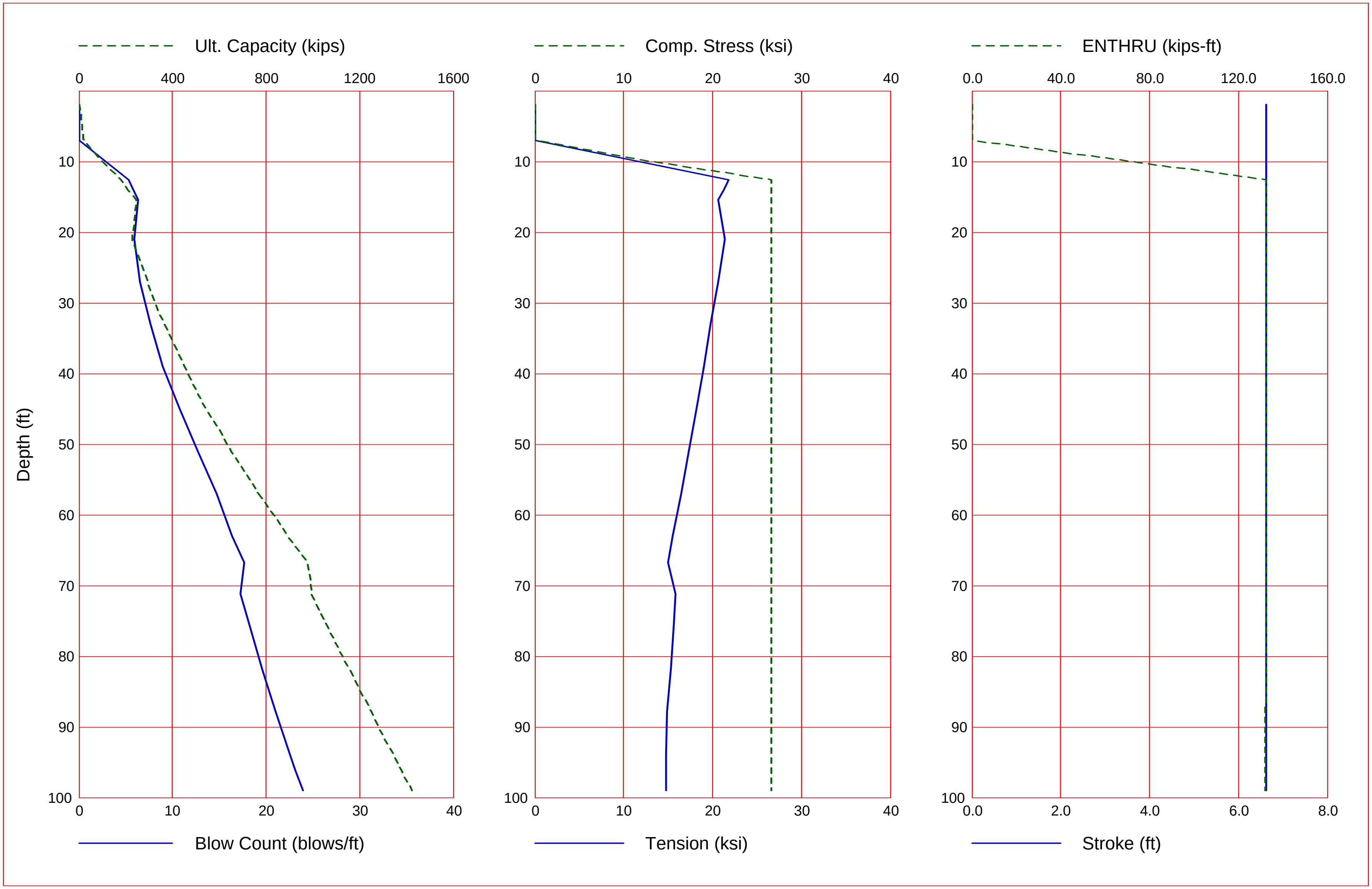
Stroke	6.62	ft
Ram Weight	22.00	kips
Efficiency	0.950	
Helmet Weight	6.15	kips
COR of H.C.	0.000	
Skin Quake	0.100	in
Toe Quake	0.100	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	110.00	ft
Pile Penetration	99.00	ft
Pile Top Area	219.12	in2



Res. Shaft = 89 %
(Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
300.0	26.66	23.12	6.0	6.62	132.25
604.8	26.66	20.90	10.5	6.62	132.19
909.5	26.66	18.88	15.5	6.62	132.14
1214.3	26.66	16.97	19.7	6.62	132.08
1519.0	26.66	15.22	24.2	6.62	132.02
1823.8	26.66	13.59	29.2	6.62	131.96
2128.5	26.66	12.05	32.4	6.62	131.90
2433.3	26.66	10.69	36.0	6.62	131.84
2738.0	26.66	9.61	40.0	6.62	131.78
2750.0	26.66	9.57	40.1	6.62	131.78

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



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Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.9	2.2	0.2	2.1	0.0	0.000	0.000	6.62	0.0
6.6	18.6	2.8	15.8	0.0	0.000	0.000	6.62	0.0
6.8	19.5	3.1	16.4	0.0	0.000	0.000	6.62	0.0
7.0	20.4	3.3	17.1	0.0	0.000	0.000	6.62	0.0
12.6	178.6	18.2	160.4	5.3	26.656	-21.847	6.62	132.3
14.0	210.5	25.4	185.1	5.8	26.656	-21.255	6.62	132.3
15.4	243.4	33.6	209.7	6.3	26.656	-20.669	6.62	132.3
21.0	229.3	70.1	159.3	5.9	26.656	-21.400	6.62	132.3
27.0	292.5	115.3	177.2	6.5	26.656	-20.632	6.62	132.3
33.0	366.2	171.0	195.1	7.6	26.656	-19.811	6.62	132.3
39.0	450.5	237.4	213.1	9.0	26.656	-19.050	6.62	132.3
45.0	545.4	314.4	231.0	10.8	26.656	-18.232	6.62	132.3
51.0	651.0	402.0	249.0	12.7	26.656	-17.347	6.62	132.3
57.0	767.1	500.2	266.9	14.7	26.656	-16.429	6.62	132.3
63.0	893.8	609.0	284.8	16.4	26.656	-15.523	6.62	132.3
66.7	978.2	682.2	296.0	17.7	26.656	-14.972	6.62	132.3
71.2	992.6	765.2	227.4	17.3	26.656	-15.832	6.62	132.3
75.8	1062.8	834.6	228.2	18.3	26.656	-15.611	6.62	132.3
81.8	1155.4	927.1	228.2	19.6	26.656	-15.266	6.62	132.3
87.8	1248.3	1020.0	228.2	21.0	26.656	-14.854	6.62	132.2
93.8	1341.5	1113.2	228.2	22.5	26.656	-14.790	6.62	132.1
96.2	1379.5	1151.2	228.2	23.1	26.656	-14.776	6.62	132.1
99.0	1422.9	1194.6	228.2	23.9	26.656	-14.775	6.62	132.1

Total Number of Blows: 1213

Driving Time (min):	40	30	24	20	17	15	13	12	11	10
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

Unplugged Conditions including 15% Resistance for Hard Layers

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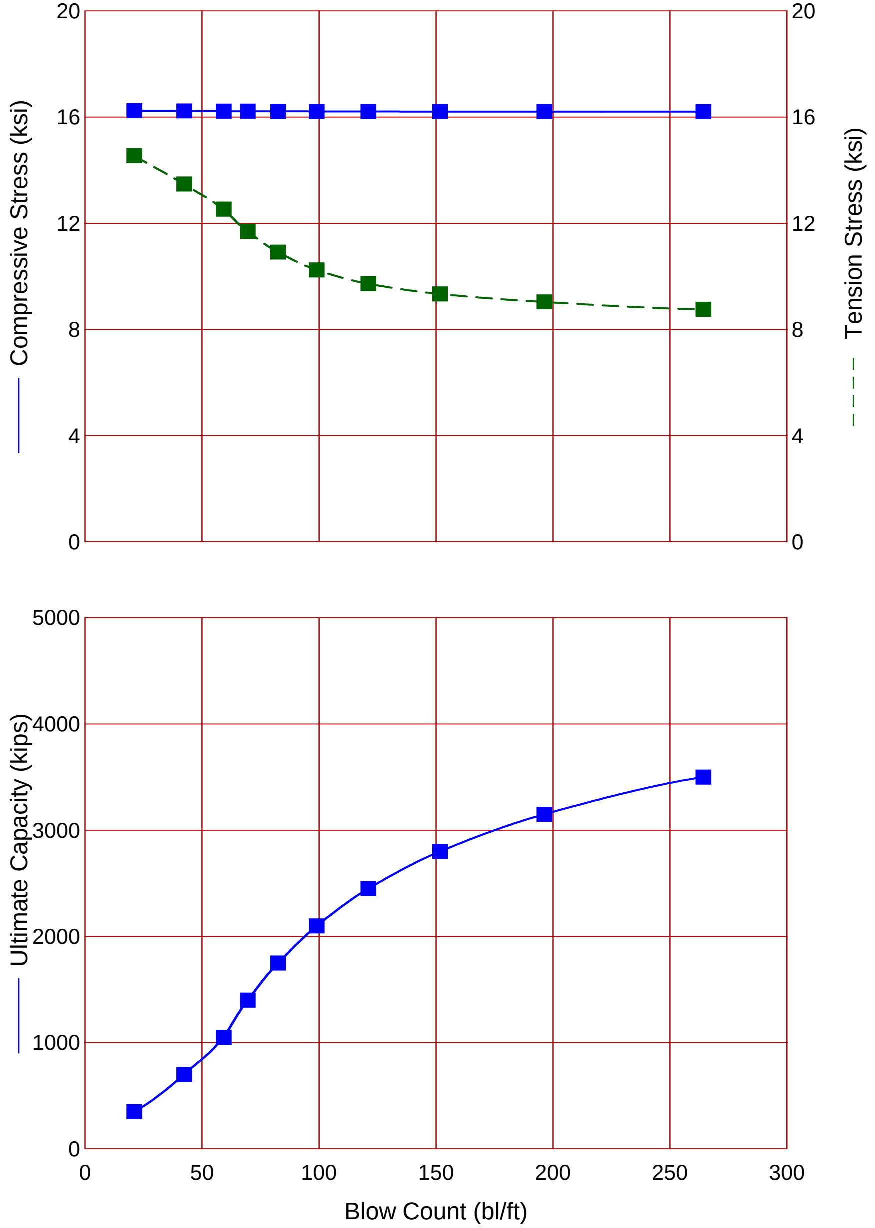
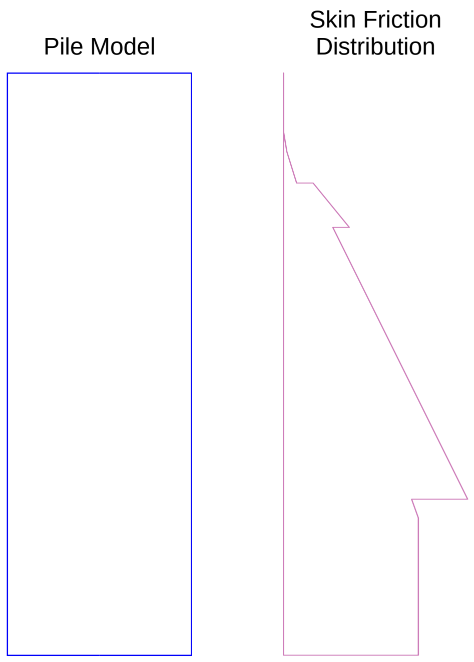


IHC S-70

Stroke	6.63	ft
Ram Weight	7.73	kips
Efficiency	0.950	
Helmet Weight	2.00	kips
COR of H.C.	0.000	
Skin Quake	0.100	in
Toe Quake	0.100	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	110.00	ft
Pile Penetration	99.00	ft
Pile Top Area	219.12	in2



Res. Shaft = 89 %
(Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
350.0	16.24	14.54	21.1	6.63	40.98
699.9	16.23	13.48	42.4	6.63	40.98
1049.8	16.22	12.53	59.3	6.63	40.98
1399.6	16.22	11.69	69.6	6.63	40.98
1749.5	16.21	10.91	82.5	6.63	40.97
2099.4	16.21	10.24	99.1	6.63	40.97
2449.3	16.21	9.72	121.1	6.63	40.97
2799.1	16.21	9.34	151.7	6.63	40.97
3149.0	16.20	9.04	196.3	6.63	40.97
3500.0	16.20	8.76	264.3	6.63	40.97

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.9	2.2	0.2	2.1	0.0	0.000	0.000	6.63	0.0
6.6	18.6	2.8	15.8	0.0	0.000	0.000	6.63	0.0
6.8	19.5	3.1	16.4	0.0	0.000	0.000	6.63	0.0
7.0	20.4	3.3	17.1	0.0	0.000	0.000	6.63	0.0
12.6	178.6	18.2	160.4	12.9	16.303	-13.266	6.63	41.0
14.0	210.5	25.4	185.1	14.4	16.303	-12.832	6.63	41.1
15.4	243.4	33.6	209.7	16.3	16.303	-12.406	6.63	41.0
21.0	229.3	70.1	159.3	14.8	16.303	-12.895	6.63	41.0
27.0	292.5	115.3	177.2	18.2	16.303	-12.349	6.63	41.0
33.0	366.2	171.0	195.1	23.1	16.303	-11.796	6.63	41.0
39.0	450.5	237.4	213.1	29.5	16.304	-11.278	6.63	41.0
45.0	545.4	314.4	231.0	34.3	16.304	-10.856	6.63	41.1
51.0	651.0	402.0	249.0	39.7	16.308	-10.447	6.63	41.0
57.0	767.1	500.2	266.9	46.7	16.309	-10.060	6.63	41.0
63.0	893.8	609.0	284.8	56.2	16.309	-9.705	6.63	41.0
66.7	978.2	682.2	296.0	62.1	16.303	-9.492	6.63	41.0
71.2	992.6	765.2	227.4	61.0	16.301	-10.222	6.63	41.0
75.8	1062.8	834.6	228.2	62.7	16.302	-10.283	6.63	41.0
81.8	1155.4	927.1	228.2	65.0	16.301	-10.388	6.63	41.0
87.8	1248.3	1020.0	228.2	67.4	16.286	-10.541	6.63	41.0
93.8	1341.5	1113.2	228.2	70.1	16.258	-10.761	6.63	41.0
96.2	1379.5	1151.2	228.2	71.2	16.240	-10.875	6.63	41.0
99.0	1422.9	1194.6	228.2	72.5	16.217	-10.927	6.63	41.0

Total Number of Blows: 3871

Driving Time (min):	129	96	77	64	55	48	43	38	35	32
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

South Carolina DOT
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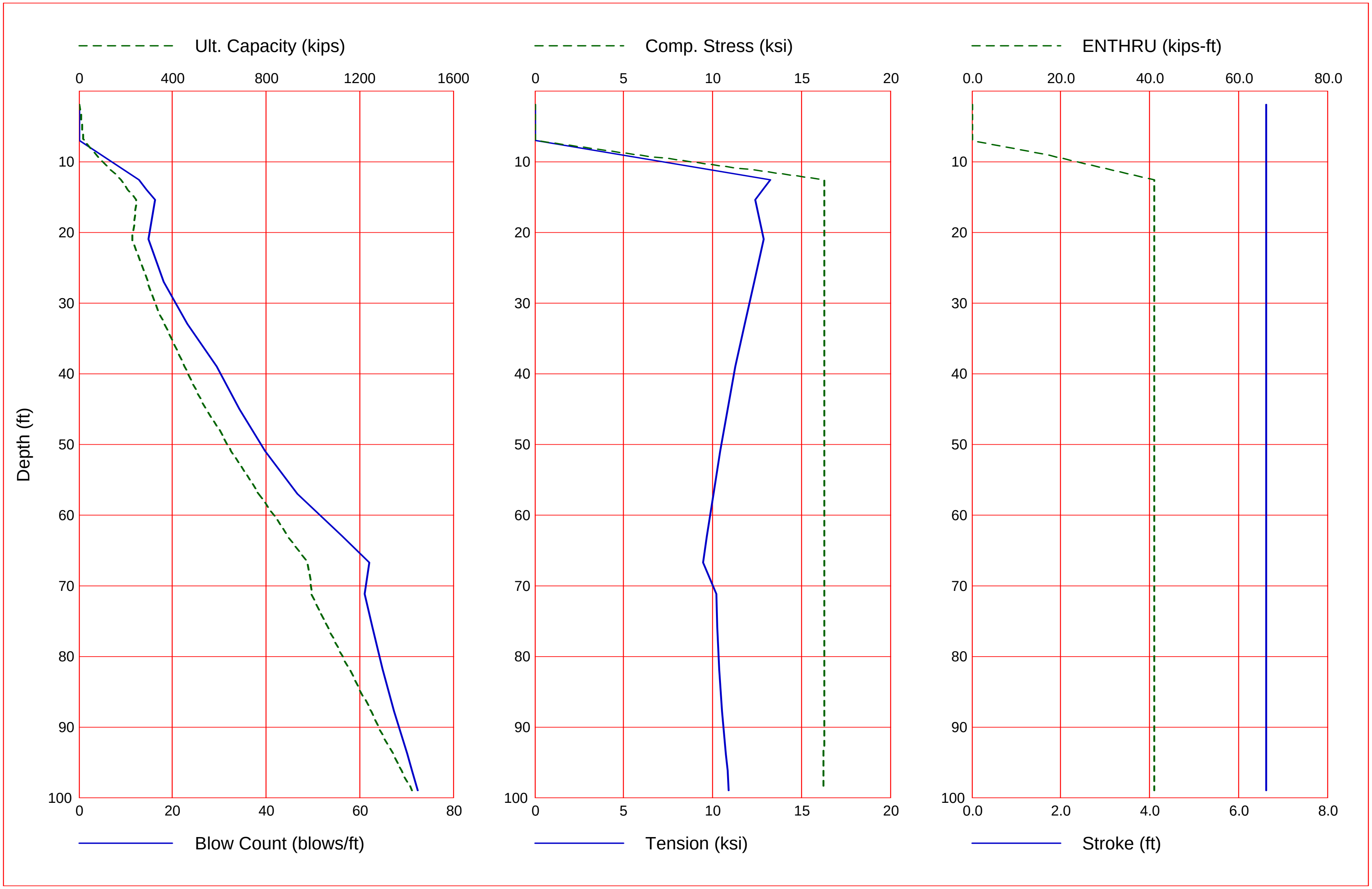
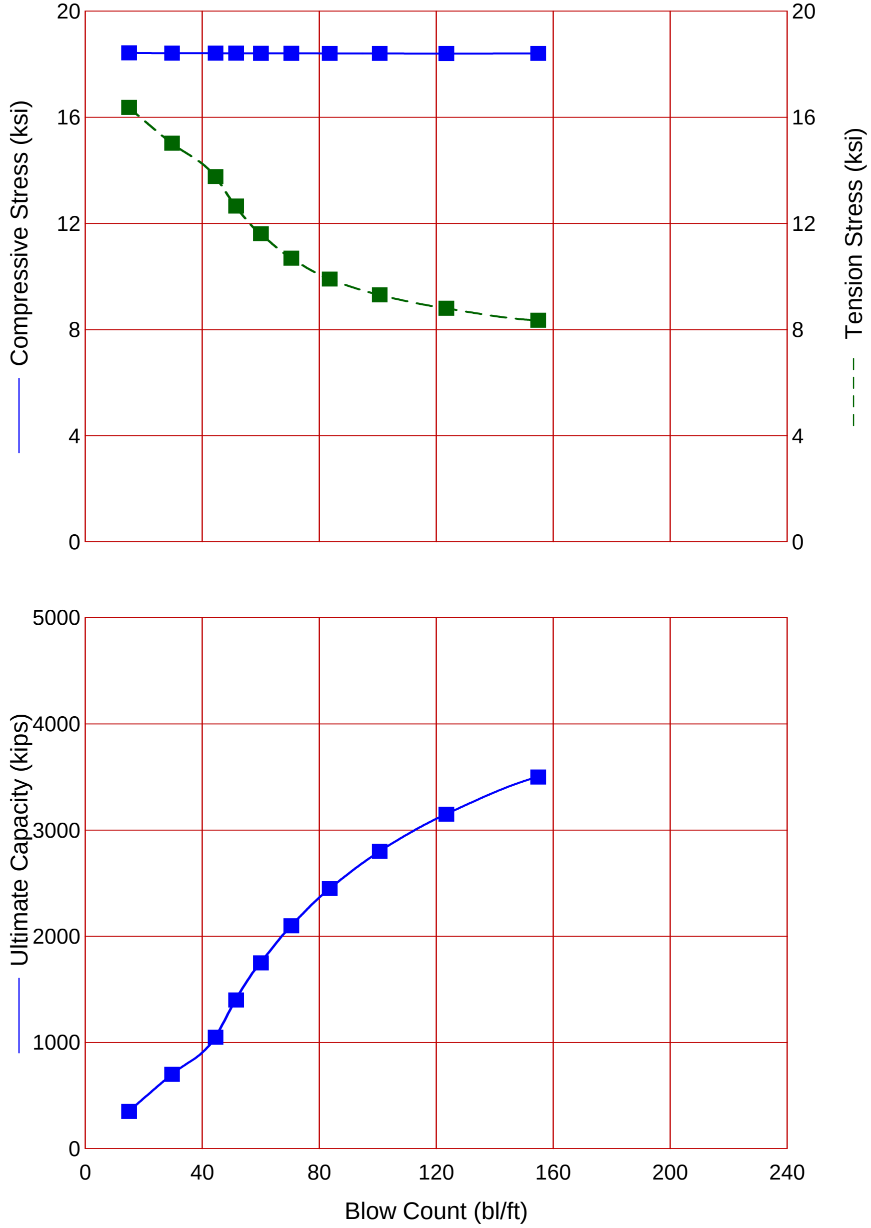
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



South Carolina DOT
US301-RBO-Four-Hole-Swamp-IB-2

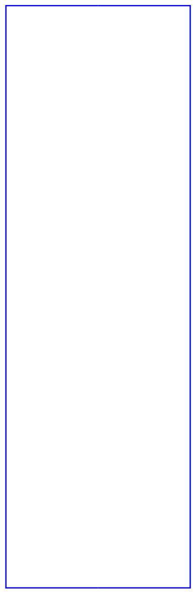
13-Apr-2016
GRLWEAP Version 2010



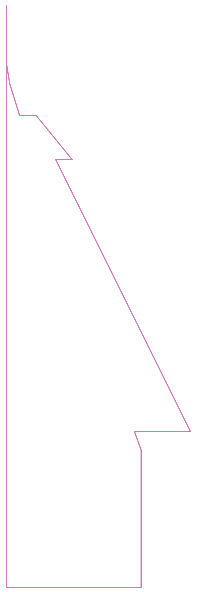
IHC S-90

Stroke	6.63	ft
Ram Weight	9.94	kips
Efficiency	0.950	
Helmet Weight	3.52	kips
COR of H.C.	0.000	
Skin Quake	0.100	in
Toe Quake	0.100	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	110.00	ft
Pile Penetration	99.00	ft
Pile Top Area	219.12	in2

Pile Model



Skin Friction Distribution



Res. Shaft = 89 %
(Proportional)

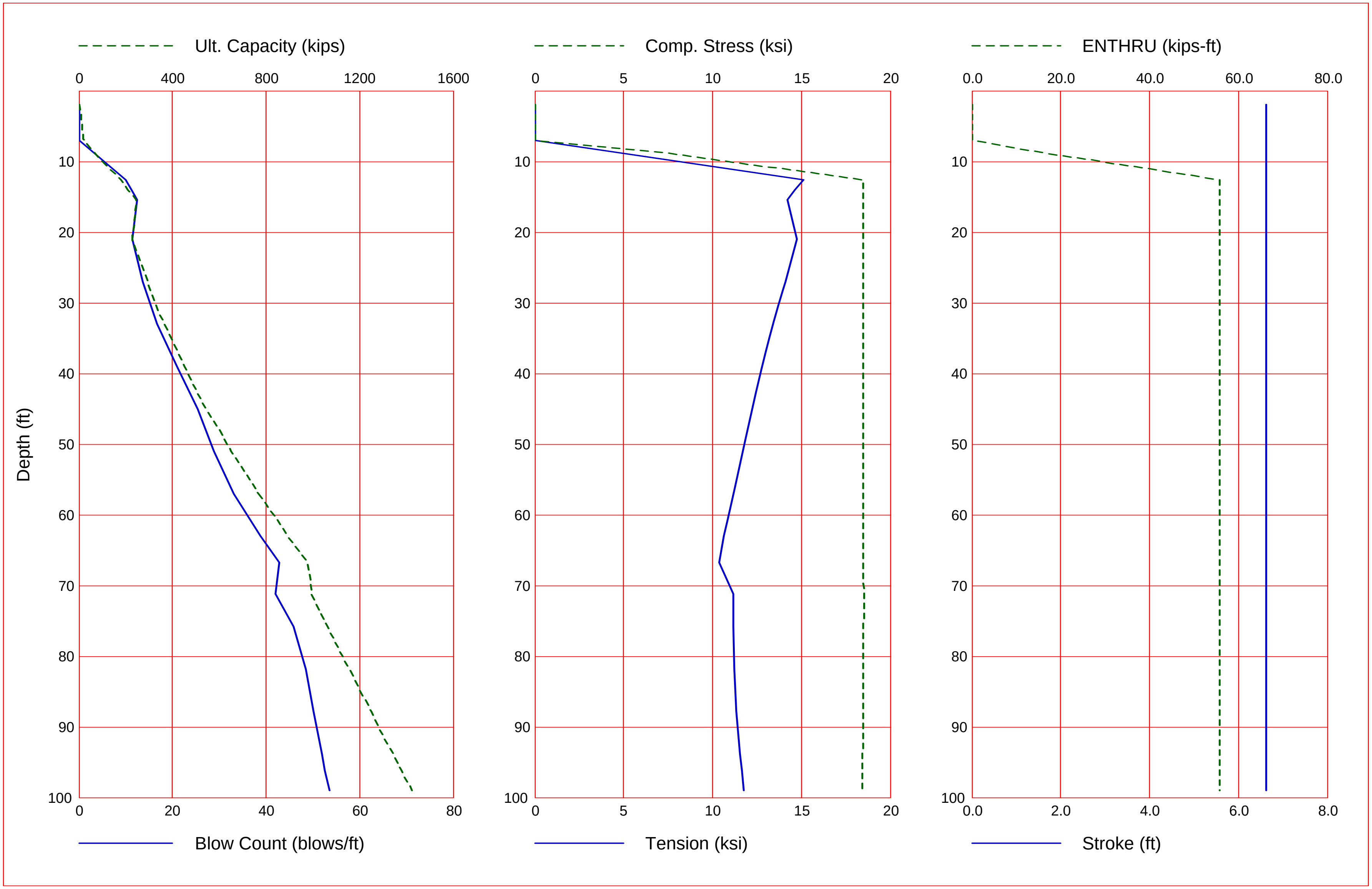
South Carolina DOT 13-Apr-2016
US301-RBO-Four-Hole-Swamp-IB-2 GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
350.0	18.42	16.37	15.0	6.63	55.70
699.9	18.41	15.02	29.7	6.63	55.69
1049.8	18.41	13.76	44.6	6.63	55.75
1399.6	18.41	12.65	51.6	6.63	55.68
1749.5	18.41	11.61	60.1	6.63	55.68
2099.4	18.41	10.69	70.5	6.63	55.68
2449.3	18.40	9.90	83.6	6.63	55.67
2799.1	18.40	9.31	100.7	6.63	55.67
3149.0	18.40	8.80	123.5	6.63	55.66
3500.0	18.40	8.35	154.9	6.63	55.66

South Carolina DOT
US301-RBO-Four-Hole-Swamp-IB-2

Apr 13 2016
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.9	2.2	0.2	2.1	0.0	0.000	0.000	6.63	0.0
6.6	18.6	2.8	15.8	0.0	0.000	0.000	6.63	0.0
6.8	19.5	3.1	16.4	0.0	0.000	0.000	6.63	0.0
7.0	20.4	3.3	17.1	0.0	0.000	0.000	6.63	0.0
12.6	178.6	18.2	160.4	10.0	18.499	-15.135	6.63	55.7
14.0	210.5	25.4	185.1	11.2	18.499	-14.665	6.63	55.7
15.4	243.4	33.6	209.7	12.5	18.499	-14.187	6.63	55.7
21.0	229.3	70.1	159.3	11.5	18.499	-14.733	6.63	55.7
27.0	292.5	115.3	177.2	13.7	18.500	-14.096	6.63	55.7
33.0	366.2	171.0	195.1	16.8	18.500	-13.437	6.63	55.8
39.0	450.5	237.4	213.1	21.0	18.500	-12.788	6.63	55.7
45.0	545.4	314.4	231.0	25.4	18.500	-12.222	6.63	55.8
51.0	651.0	402.0	249.0	28.8	18.504	-11.693	6.63	55.8
57.0	767.1	500.2	266.9	33.1	18.506	-11.154	6.63	55.7
63.0	893.8	609.0	284.8	38.7	18.502	-10.638	6.63	55.7
66.7	978.2	682.2	296.0	42.9	18.506	-10.352	6.63	55.7
71.2	992.6	765.2	227.4	42.1	18.510	-11.151	6.63	55.7
75.8	1062.8	834.6	228.2	45.9	18.505	-11.168	6.63	55.7
81.8	1155.4	927.1	228.2	48.5	18.470	-11.221	6.63	55.8
87.8	1248.3	1020.0	228.2	50.2	18.466	-11.343	6.63	55.7
93.8	1341.5	1113.2	228.2	51.9	18.451	-11.544	6.63	55.7
96.2	1379.5	1151.2	228.2	52.6	18.431	-11.644	6.63	55.7
99.0	1422.9	1194.6	228.2	53.5	18.411	-11.775	6.63	55.7

Total Number of Blows: 2815

Driving Time (min):	93	70	56	46	40	35	31	28	25	23
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

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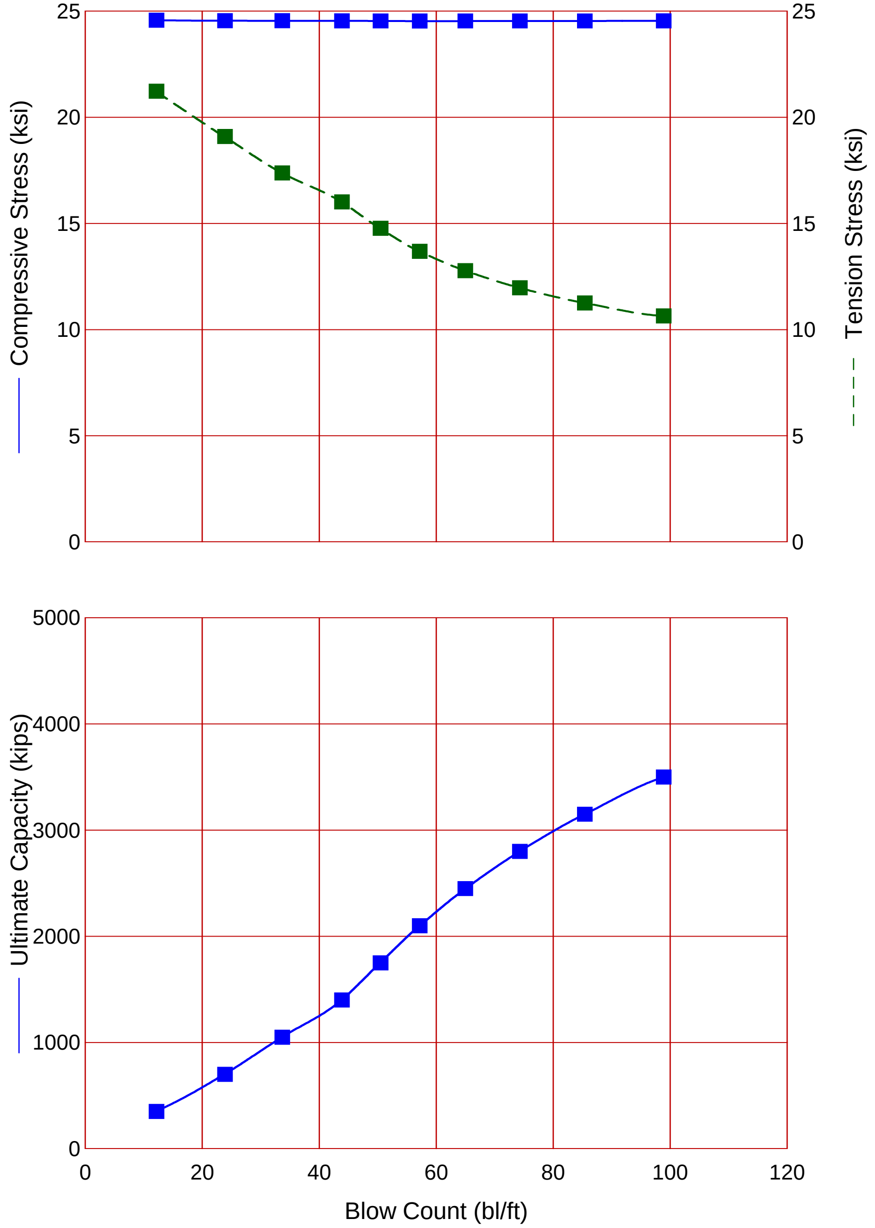
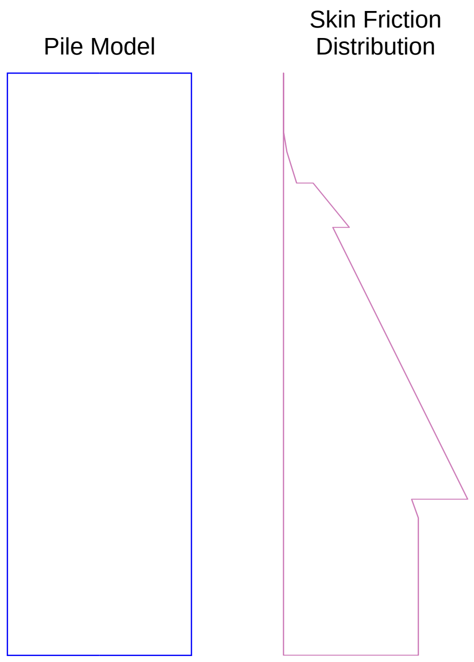


IHC S-120

Stroke	6.63	ft
Ram Weight	13.48	kips
Efficiency	0.950	
Helmet Weight	6.15	kips
COR of H.C.	0.000	
Skin Quake	0.100	in
Toe Quake	0.100	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	110.00	ft
Pile Penetration	99.00	ft
Pile Top Area	219.12	in2



Res. Shaft = 89 %
(Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
350.0	24.56	21.23	12.2	6.63	78.17
699.9	24.55	19.09	23.9	6.63	78.16
1049.8	24.54	17.38	33.7	6.63	78.12
1399.6	24.54	16.01	43.9	6.63	78.10
1749.5	24.53	14.77	50.5	6.63	78.08
2099.4	24.53	13.68	57.2	6.63	78.06
2449.3	24.53	12.77	65.0	6.63	78.04
2799.1	24.53	11.97	74.3	6.63	78.03
3149.0	24.53	11.25	85.4	6.63	78.01
3500.0	24.54	10.64	98.9	6.63	78.00

South Carolina DOT
US301-RBO-Four-Hole-Swamp-IB-2

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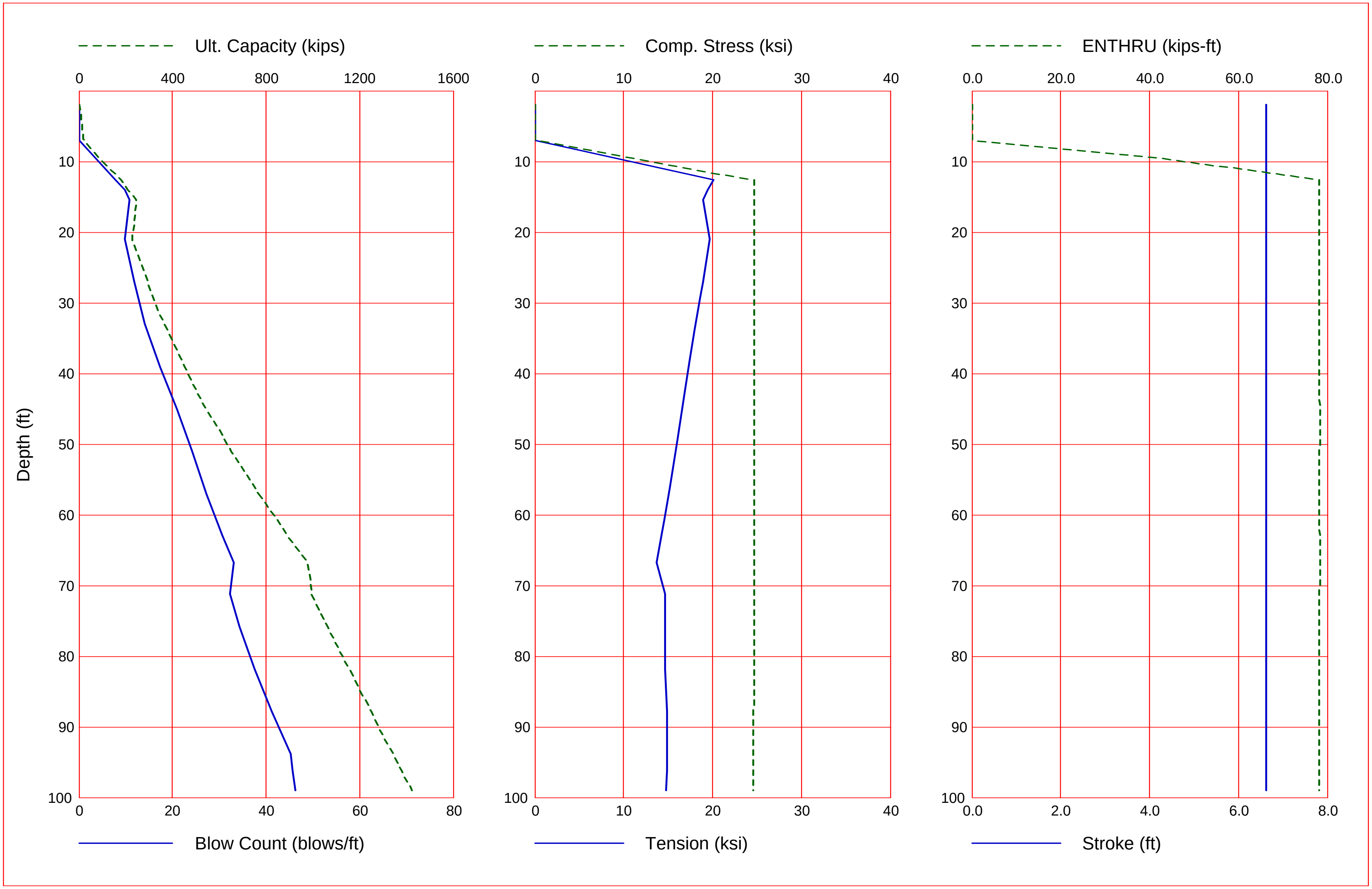
Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.9	2.2	0.2	2.1	0.0	0.000	0.000	6.63	0.0
6.6	18.6	2.8	15.8	0.0	0.000	0.000	6.63	0.0
6.8	19.5	3.1	16.4	0.0	0.000	0.000	6.63	0.0
7.0	20.4	3.3	17.1	0.0	0.000	0.000	6.63	0.0
12.6	178.6	18.2	160.4	7.8	24.663	-20.092	6.63	78.2
14.0	210.5	25.4	185.1	9.8	24.663	-19.515	6.63	78.2
15.4	243.4	33.6	209.7	10.8	24.663	-18.938	6.63	78.2
21.0	229.3	70.1	159.3	9.9	24.663	-19.644	6.63	78.2
27.0	292.5	115.3	177.2	11.8	24.663	-18.912	6.63	78.2
33.0	366.2	171.0	195.1	14.1	24.663	-18.122	6.63	78.2
39.0	450.5	237.4	213.1	17.4	24.663	-17.292	6.63	78.2
45.0	545.4	314.4	231.0	20.9	24.663	-16.561	6.63	78.4
51.0	651.0	402.0	249.0	24.3	24.663	-15.820	6.63	78.2
57.0	767.1	500.2	266.9	27.3	24.664	-15.077	6.63	78.2
63.0	893.8	609.0	284.8	30.7	24.671	-14.211	6.63	78.3
66.7	978.2	682.2	296.0	33.2	24.674	-13.657	6.63	78.3
71.2	992.6	765.2	227.4	32.3	24.674	-14.626	6.63	78.2
75.8	1062.8	834.6	228.2	34.4	24.673	-14.650	6.63	78.2
81.8	1155.4	927.1	228.2	37.5	24.655	-14.717	6.63	78.2
87.8	1248.3	1020.0	228.2	41.3	24.629	-14.835	6.63	78.2
93.8	1341.5	1113.2	228.2	45.2	24.592	-14.837	6.63	78.1
96.2	1379.5	1151.2	228.2	45.7	24.566	-14.827	6.63	78.1
99.0	1422.9	1194.6	228.2	46.3	24.538	-14.825	6.63	78.1

Total Number of Blows: 2293

Driving Time (min):	76	57	45	38	32	28	25	22	20	19
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

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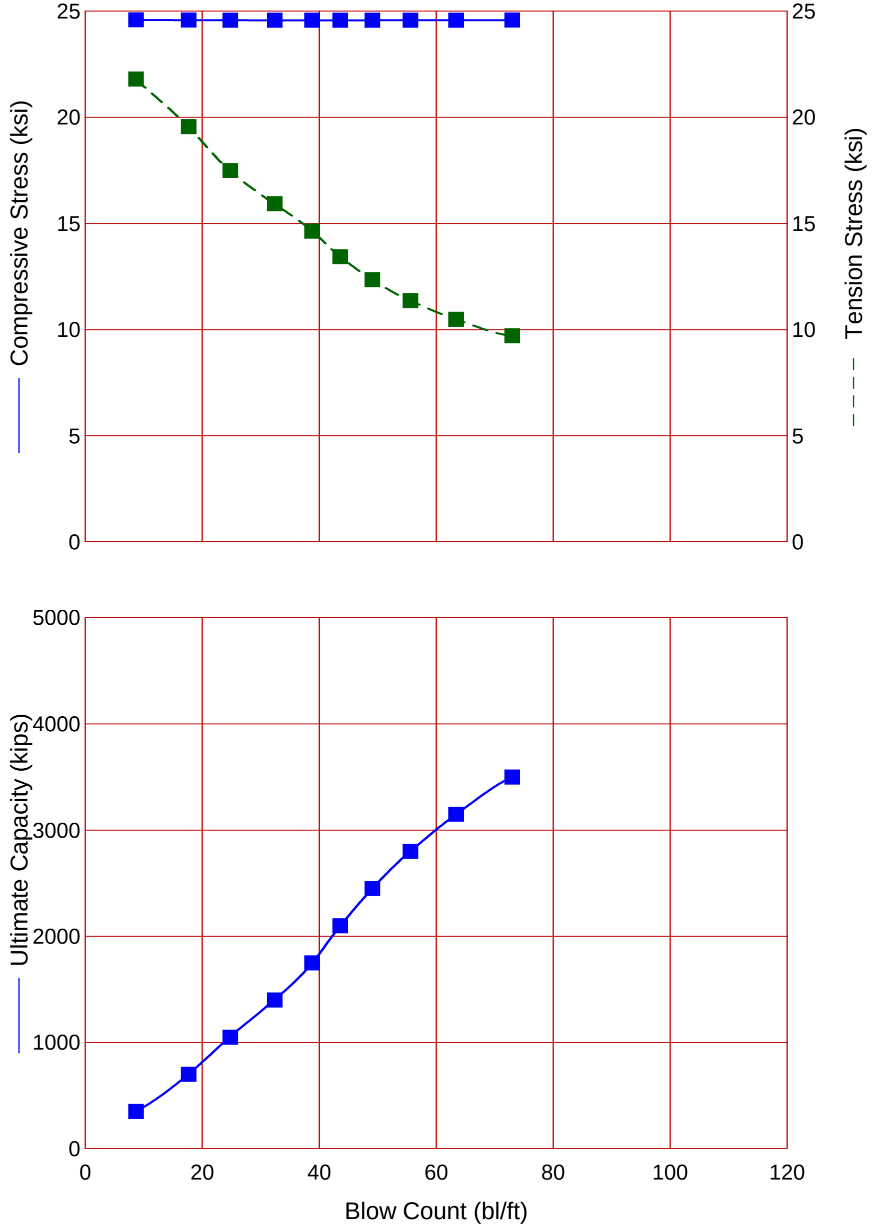
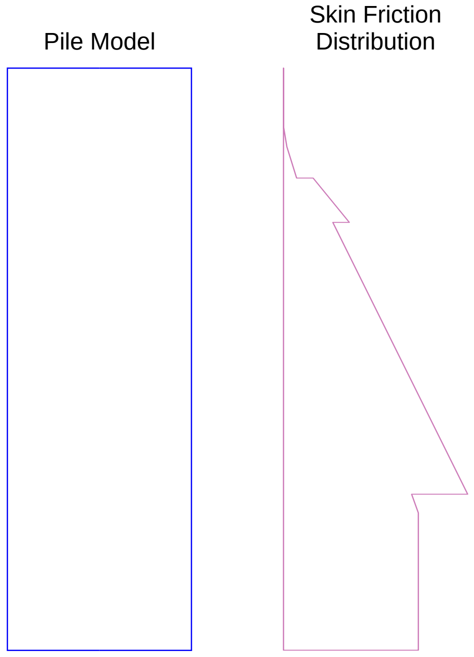


IHC S-150

Stroke	6.63	ft
Ram Weight	16.60	kips
Efficiency	0.950	
Helmet Weight	6.15	kips
COR of H.C.	0.000	
Skin Quake	0.100	in
Toe Quake	0.100	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	110.00	ft
Pile Penetration	99.00	ft
Pile Top Area	219.12	in2



Res. Shaft = 89 %
(Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
350.0	24.59	21.80	8.7	6.63	97.90
699.9	24.57	19.56	17.7	6.63	97.87
1049.8	24.57	17.49	24.8	6.63	97.84
1399.6	24.56	15.93	32.4	6.63	97.81
1749.5	24.56	14.64	38.8	6.63	97.78
2099.4	24.56	13.43	43.6	6.63	97.75
2449.3	24.57	12.35	49.1	6.63	97.72
2799.1	24.57	11.36	55.6	6.63	97.69
3149.0	24.57	10.48	63.4	6.63	97.66
3500.0	24.57	9.71	73.0	6.63	97.63

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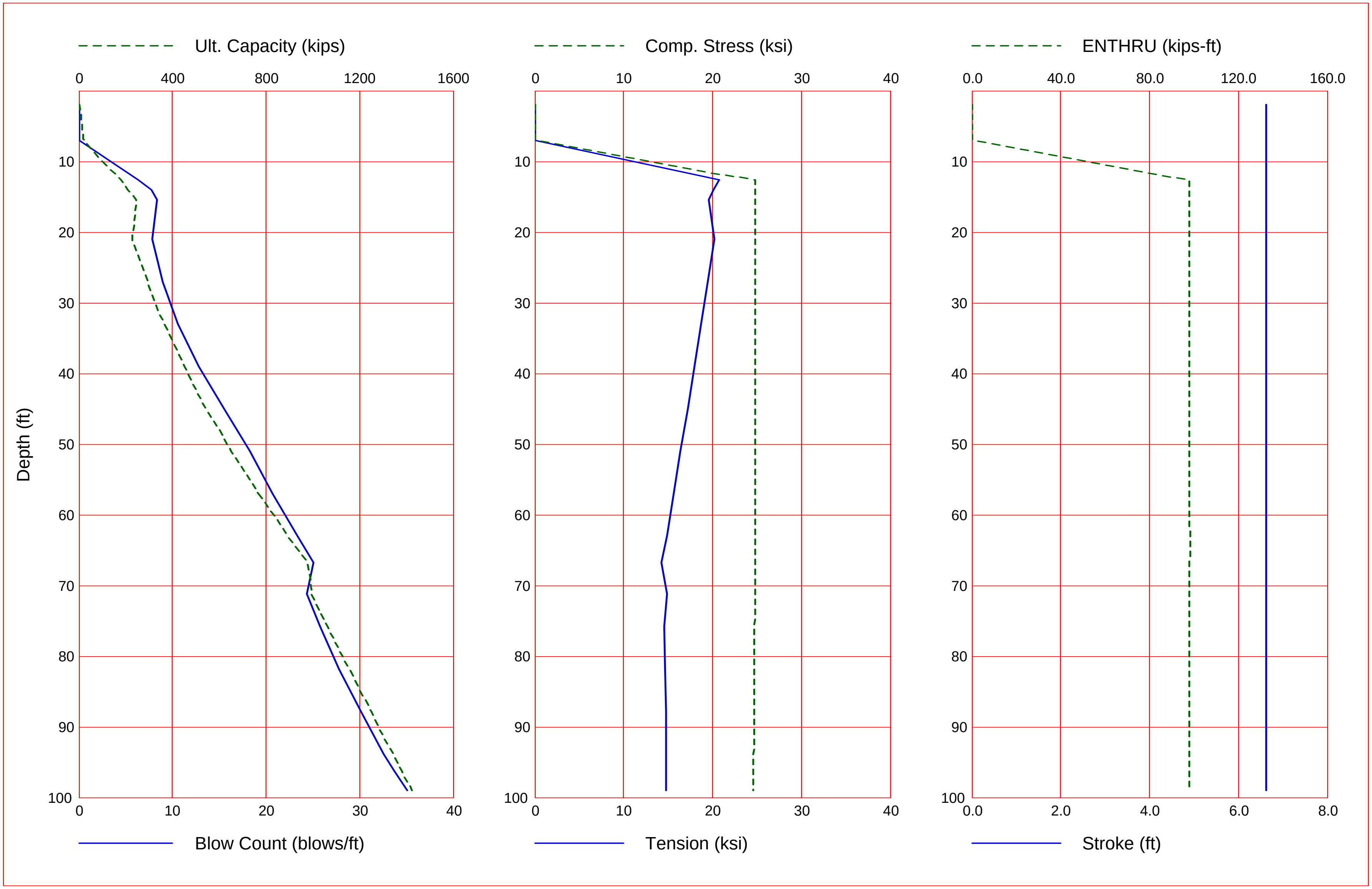
Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



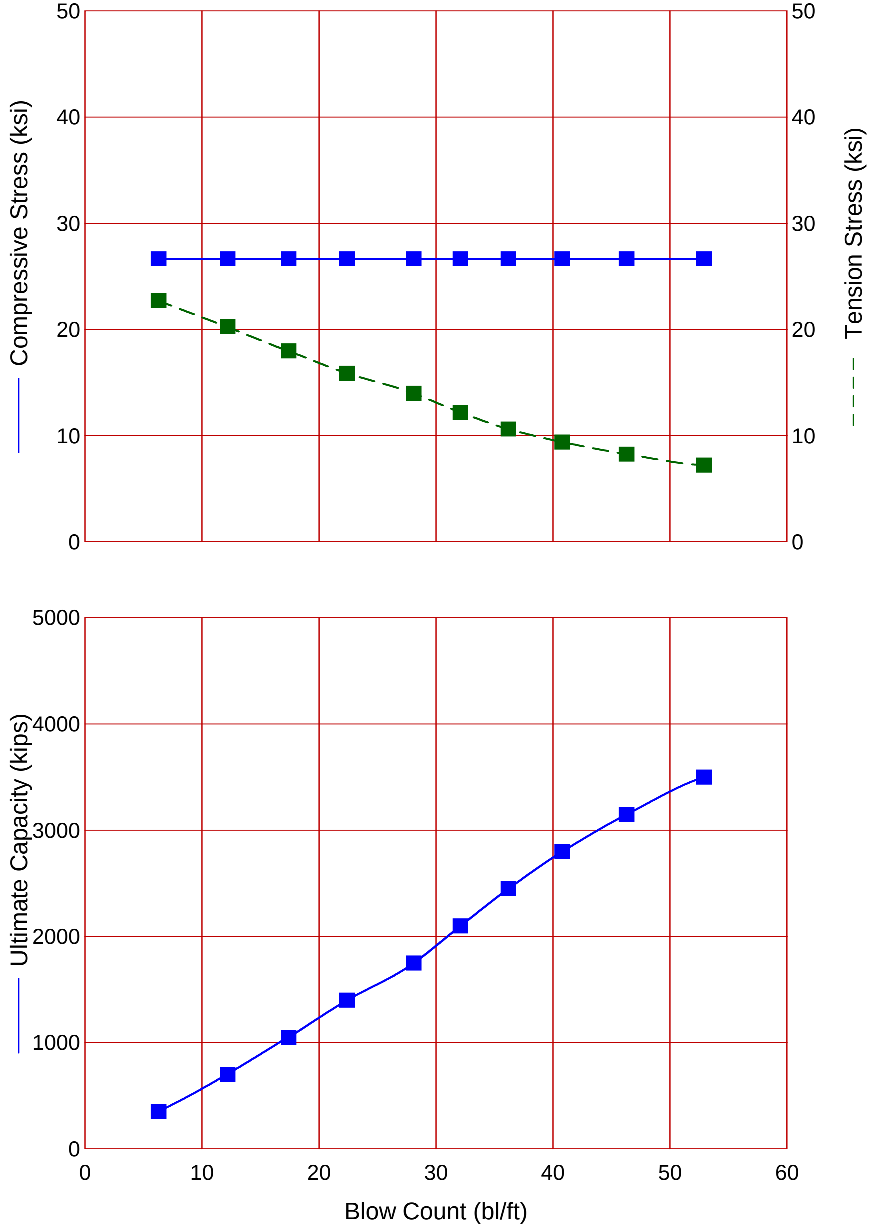
Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.9	2.2	0.2	2.1	0.0	0.000	0.000	6.63	0.0
6.6	18.6	2.8	15.8	0.0	0.000	0.000	6.63	0.0
6.8	19.5	3.1	16.4	0.0	0.000	0.000	6.63	0.0
7.0	20.4	3.3	17.1	0.0	0.000	0.000	6.63	0.0
12.6	178.6	18.2	160.4	6.3	24.806	-20.706	6.63	97.9
14.0	210.5	25.4	185.1	7.7	24.806	-20.122	6.63	97.9
15.4	243.4	33.6	209.7	8.4	24.806	-19.536	6.63	97.9
21.0	229.3	70.1	159.3	7.8	24.806	-20.248	6.63	97.9
27.0	292.5	115.3	177.2	9.0	24.814	-19.494	6.63	97.9
33.0	366.2	171.0	195.1	10.6	24.834	-18.682	6.63	97.9
39.0	450.5	237.4	213.1	12.8	24.835	-17.932	6.63	97.9
45.0	545.4	314.4	231.0	15.5	24.829	-17.181	6.63	97.9
51.0	651.0	402.0	249.0	18.3	24.818	-16.410	6.63	97.9
57.0	767.1	500.2	266.9	20.7	24.812	-15.632	6.63	97.9
63.0	893.8	609.0	284.8	23.3	24.797	-14.842	6.63	98.2
66.7	978.2	682.2	296.0	25.1	24.783	-14.213	6.63	97.9
71.2	992.6	765.2	227.4	24.4	24.756	-14.929	6.63	97.9
75.8	1062.8	834.6	228.2	25.8	24.737	-14.601	6.63	98.0
81.8	1155.4	927.1	228.2	27.8	24.697	-14.652	6.63	97.9
87.8	1248.3	1020.0	228.2	30.1	24.661	-14.767	6.63	97.9
93.8	1341.5	1113.2	228.2	32.6	24.616	-14.757	6.63	97.9
96.2	1379.5	1151.2	228.2	33.7	24.592	-14.739	6.63	97.8
99.0	1422.9	1194.6	228.2	35.1	24.564	-14.730	6.63	97.8

Total Number of Blows: 1714

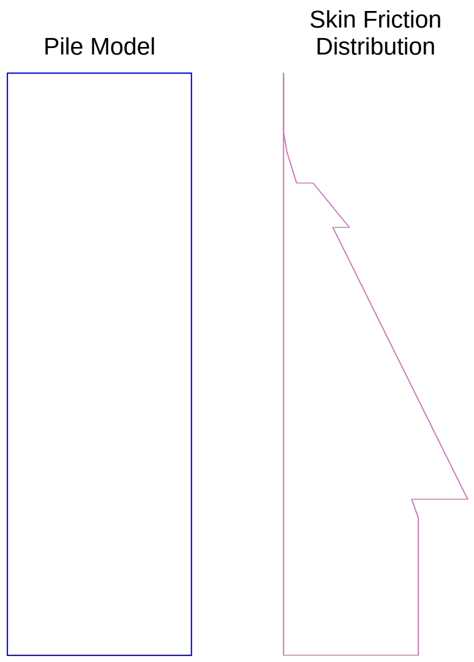
Driving Time (min):	57	42	34	28	24	21	19	17	15	14
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included



IHC S-200

Stroke	6.62	ft
Ram Weight	22.00	kips
Efficiency	0.950	
Helmet Weight	6.15	kips
COR of H.C.	0.000	
Skin Quake	0.100	in
Toe Quake	0.100	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	110.00	ft
Pile Penetration	99.00	ft
Pile Top Area	219.12	in2



Res. Shaft = 89 %
(Proportional)

South Carolina DOT
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Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
350.0	26.66	22.73	6.3	6.62	132.24
699.9	26.66	20.26	12.2	6.62	132.18
1049.8	26.66	17.99	17.4	6.62	132.11
1399.6	26.66	15.88	22.4	6.62	132.04
1749.5	26.66	13.99	28.1	6.62	131.97
2099.4	26.66	12.19	32.1	6.62	131.91
2449.3	26.66	10.63	36.2	6.62	131.84
2799.1	26.66	9.40	40.8	6.62	131.77
3149.0	26.66	8.27	46.3	6.62	131.71
3500.0	26.66	7.23	52.9	6.62	131.64

South Carolina DOT
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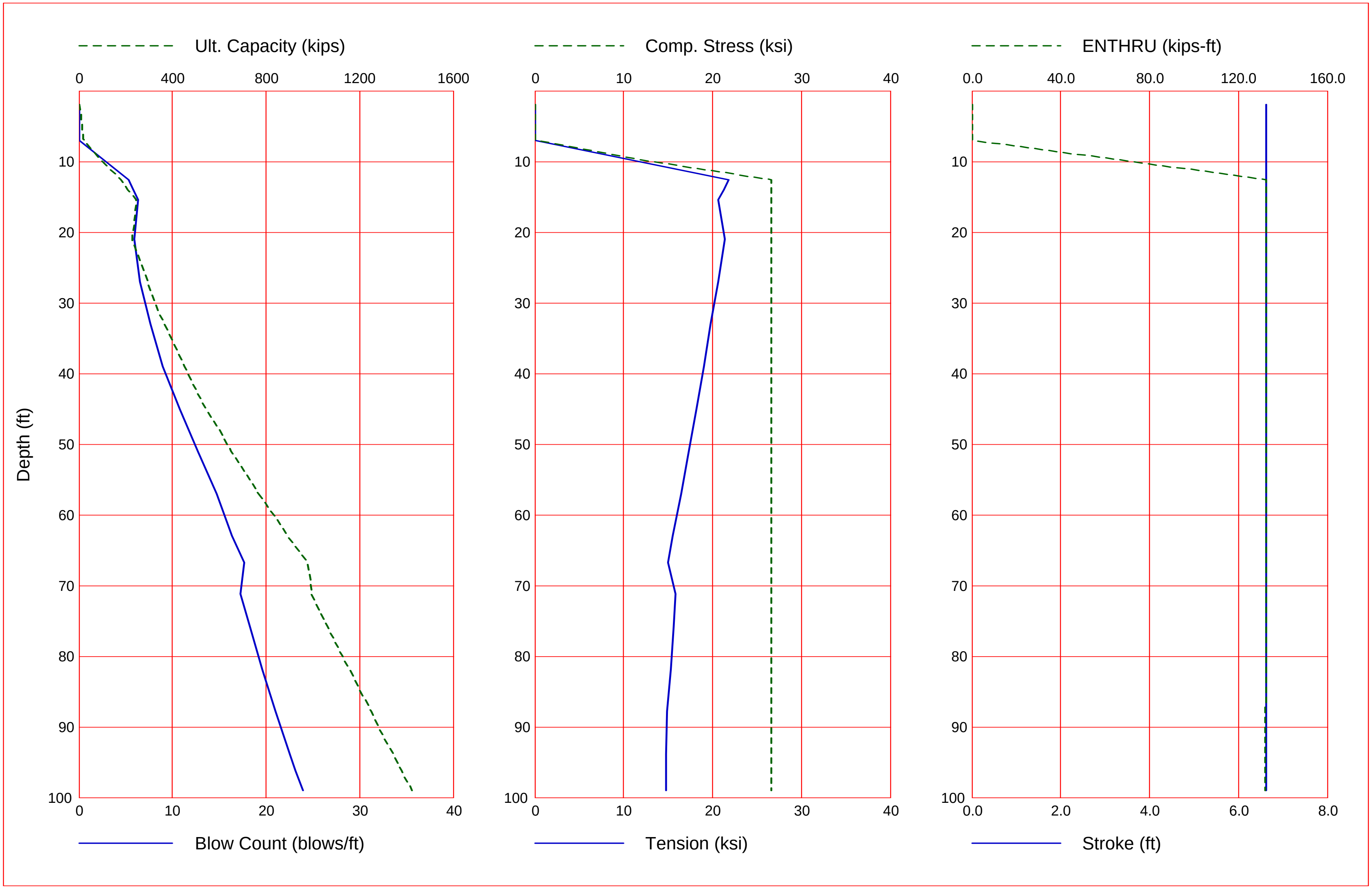
Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.9	2.2	0.2	2.1	0.0	0.000	0.000	6.62	0.0
6.6	18.6	2.8	15.8	0.0	0.000	0.000	6.62	0.0
6.8	19.5	3.1	16.4	0.0	0.000	0.000	6.62	0.0
7.0	20.4	3.3	17.1	0.0	0.000	0.000	6.62	0.0
12.6	178.6	18.2	160.4	5.3	26.656	-21.847	6.62	132.3
14.0	210.5	25.4	185.1	5.8	26.656	-21.255	6.62	132.3
15.4	243.4	33.6	209.7	6.3	26.656	-20.669	6.62	132.3
21.0	229.3	70.1	159.3	5.9	26.656	-21.400	6.62	132.3
27.0	292.5	115.3	177.2	6.5	26.656	-20.632	6.62	132.3
33.0	366.2	171.0	195.1	7.6	26.656	-19.811	6.62	132.3
39.0	450.5	237.4	213.1	9.0	26.656	-19.050	6.62	132.3
45.0	545.4	314.4	231.0	10.8	26.656	-18.232	6.62	132.3
51.0	651.0	402.0	249.0	12.7	26.656	-17.347	6.62	132.3
57.0	767.1	500.2	266.9	14.7	26.656	-16.429	6.62	132.3
63.0	893.8	609.0	284.8	16.4	26.656	-15.523	6.62	132.3
66.7	978.2	682.2	296.0	17.7	26.656	-14.972	6.62	132.3
71.2	992.6	765.2	227.4	17.3	26.656	-15.832	6.62	132.3
75.8	1062.8	834.6	228.2	18.3	26.656	-15.611	6.62	132.3
81.8	1155.4	927.1	228.2	19.6	26.656	-15.266	6.62	132.3
87.8	1248.3	1020.0	228.2	21.0	26.656	-14.854	6.62	132.2
93.8	1341.5	1113.2	228.2	22.5	26.656	-14.790	6.62	132.1
96.2	1379.5	1151.2	228.2	23.1	26.656	-14.776	6.62	132.1
99.0	1422.9	1194.6	228.2	23.9	26.656	-14.775	6.62	132.1

Total Number of Blows: 1213

Driving Time (min):	40	30	24	20	17	15	13	12	11	10
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

Plugged Conditions

South Carolina DOT
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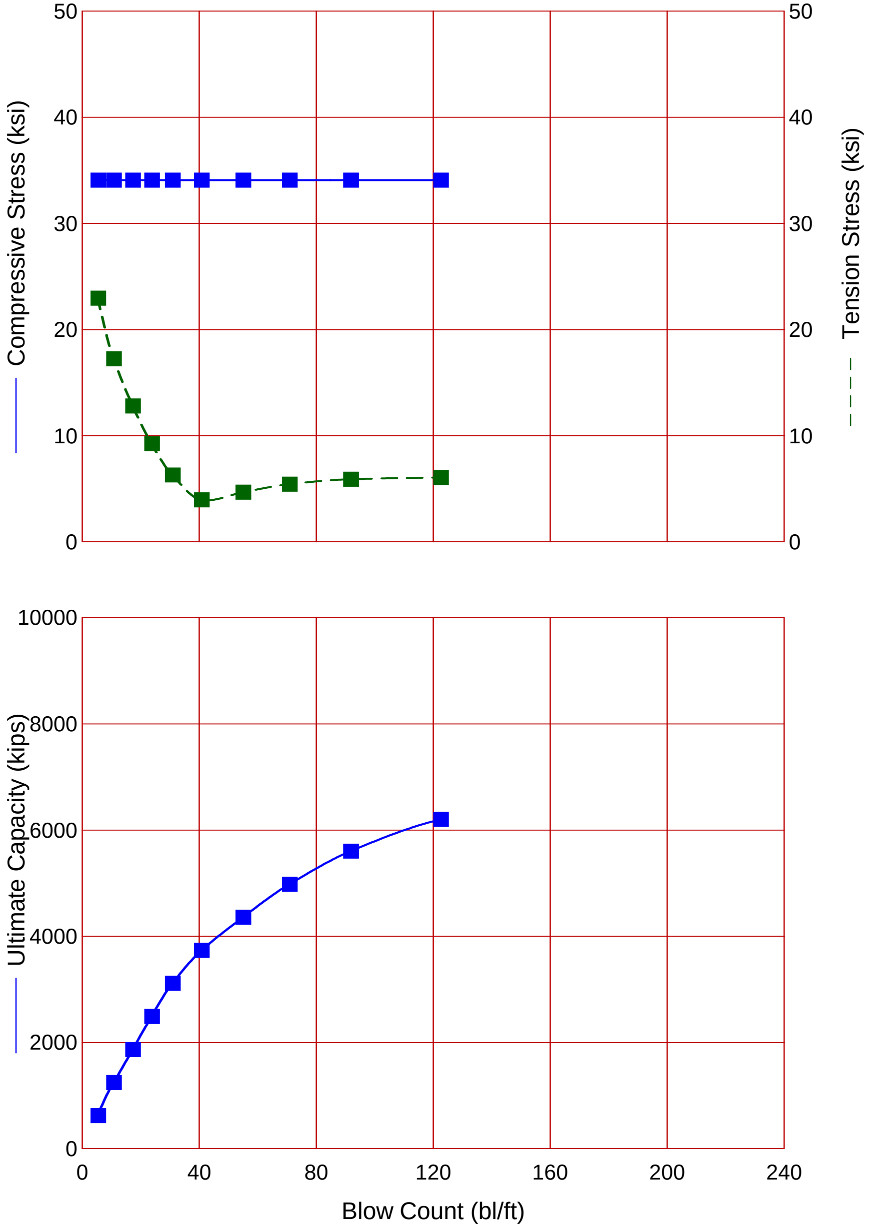
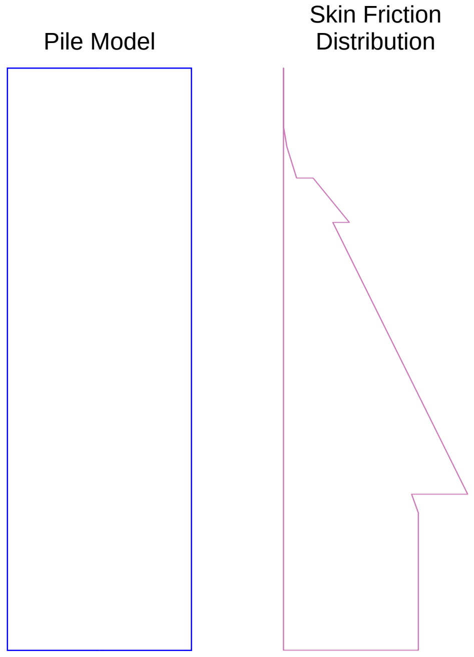


IHC S-400

Stroke	6.62	ft
Ram Weight	44.20	kips
Efficiency	0.950	
Helmet Weight	8.13	kips
COR of H.C.	0.000	
Skin Quake	0.100	in
Toe Quake	0.400	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	110.00	ft
Pile Penetration	99.00	ft
Pile Top Area	219.12	in2



Res. Shaft = 66 %
(Proportional)

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US301-RBO-Four-Hole-Swamp-IB-2 GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
622.0	34.08	22.95	5.5	6.62	267.62
1244.5	34.08	17.25	10.9	6.62	266.77
1867.0	34.08	12.81	17.4	6.62	266.00
2489.5	34.08	9.26	23.9	6.62	265.48
3112.0	34.08	6.31	31.0	6.62	265.04
3734.5	34.08	3.96	40.9	6.62	264.59
4357.0	34.08	4.68	55.1	6.62	264.11
4979.5	34.08	5.44	71.0	6.62	263.61
5602.0	34.08	5.91	91.9	6.62	263.08
6200.0	34.08	6.07	122.7	6.62	262.55

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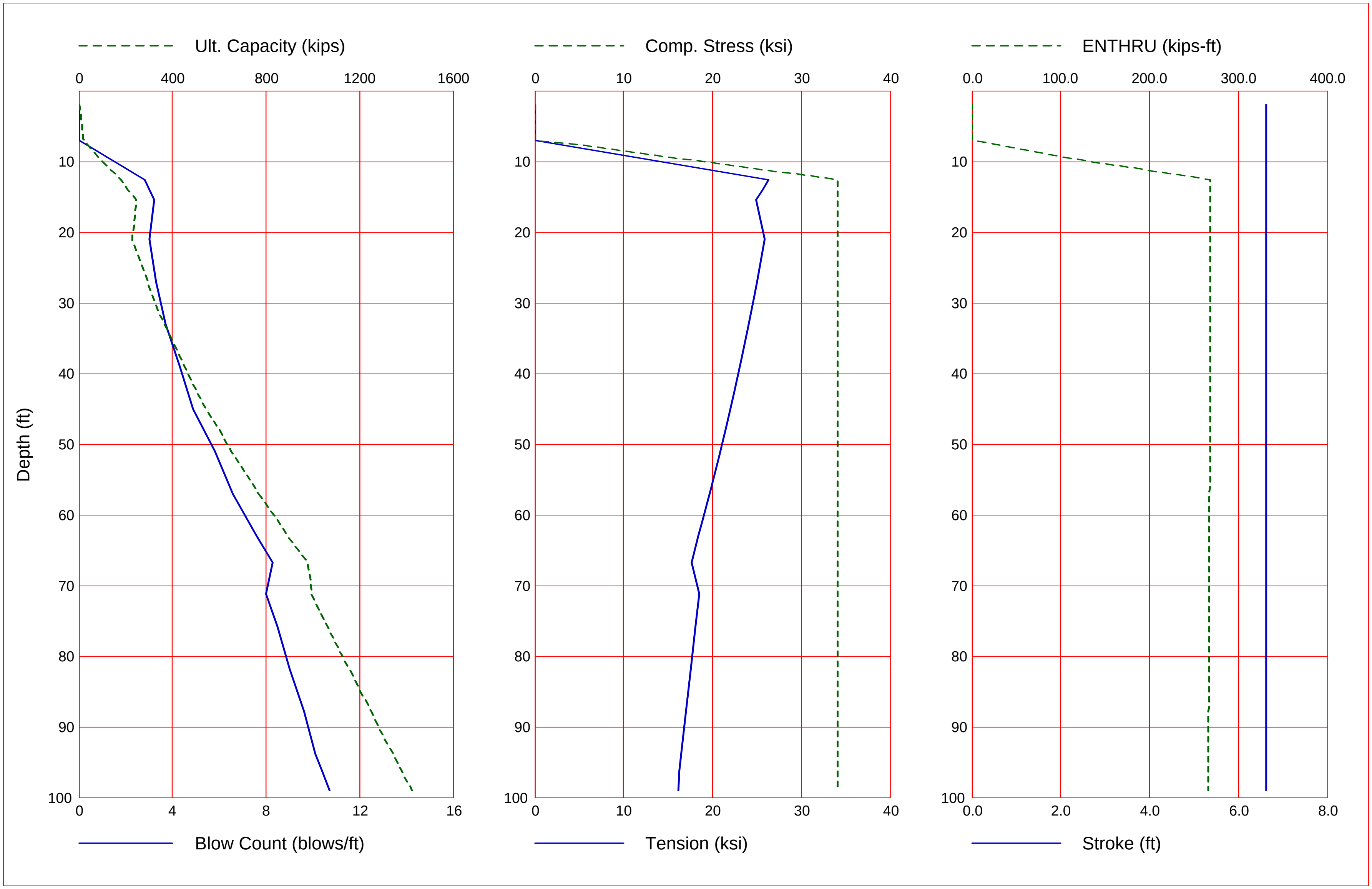
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.9	2.2	0.2	2.1	0.0	0.000	0.000	6.62	0.0
6.6	18.6	2.8	15.8	0.0	0.000	0.000	6.62	0.0
6.8	19.5	3.1	16.4	0.0	0.000	0.000	6.62	0.0
7.0	20.4	3.3	17.1	0.0	0.000	0.000	6.62	0.0
12.6	178.6	18.2	160.4	2.8	34.079	-26.302	6.62	267.9
14.0	210.5	25.4	185.1	3.0	34.079	-25.613	6.62	267.9
15.4	243.4	33.6	209.7	3.2	34.079	-24.921	6.62	267.9
21.0	229.3	70.1	159.3	3.0	34.079	-25.824	6.62	267.9
27.0	292.5	115.3	177.2	3.3	34.079	-24.974	6.62	267.9
33.0	366.2	171.0	195.1	3.7	34.079	-24.054	6.62	267.9
39.0	450.5	237.4	213.1	4.3	34.079	-23.054	6.62	267.9
45.0	545.4	314.4	231.0	4.9	34.079	-21.987	6.62	267.8
51.0	651.0	402.0	249.0	5.8	34.079	-20.863	6.62	267.8
57.0	767.1	500.2	266.9	6.6	34.079	-19.674	6.62	267.7
63.0	893.8	609.0	284.8	7.6	34.079	-18.440	6.62	267.6
66.7	978.2	682.2	296.0	8.3	34.079	-17.663	6.62	267.5
71.2	992.6	765.2	227.4	8.0	34.079	-18.524	6.62	267.3
75.8	1062.8	834.6	228.2	8.5	34.079	-18.078	6.62	267.1
81.8	1155.4	927.1	228.2	9.0	34.079	-17.513	6.62	266.8
87.8	1248.3	1020.0	228.2	9.6	34.079	-16.960	6.62	266.6
93.8	1341.5	1113.2	228.2	10.1	34.079	-16.449	6.62	266.3
96.2	1379.5	1151.2	228.2	10.4	34.079	-16.273	6.62	266.2
99.0	1422.9	1194.6	228.2	10.7	34.079	-16.129	6.62	266.1

Total Number of Blows: 563

Driving Time (min):	18	14	11	9	8	7	6	5	5	4
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

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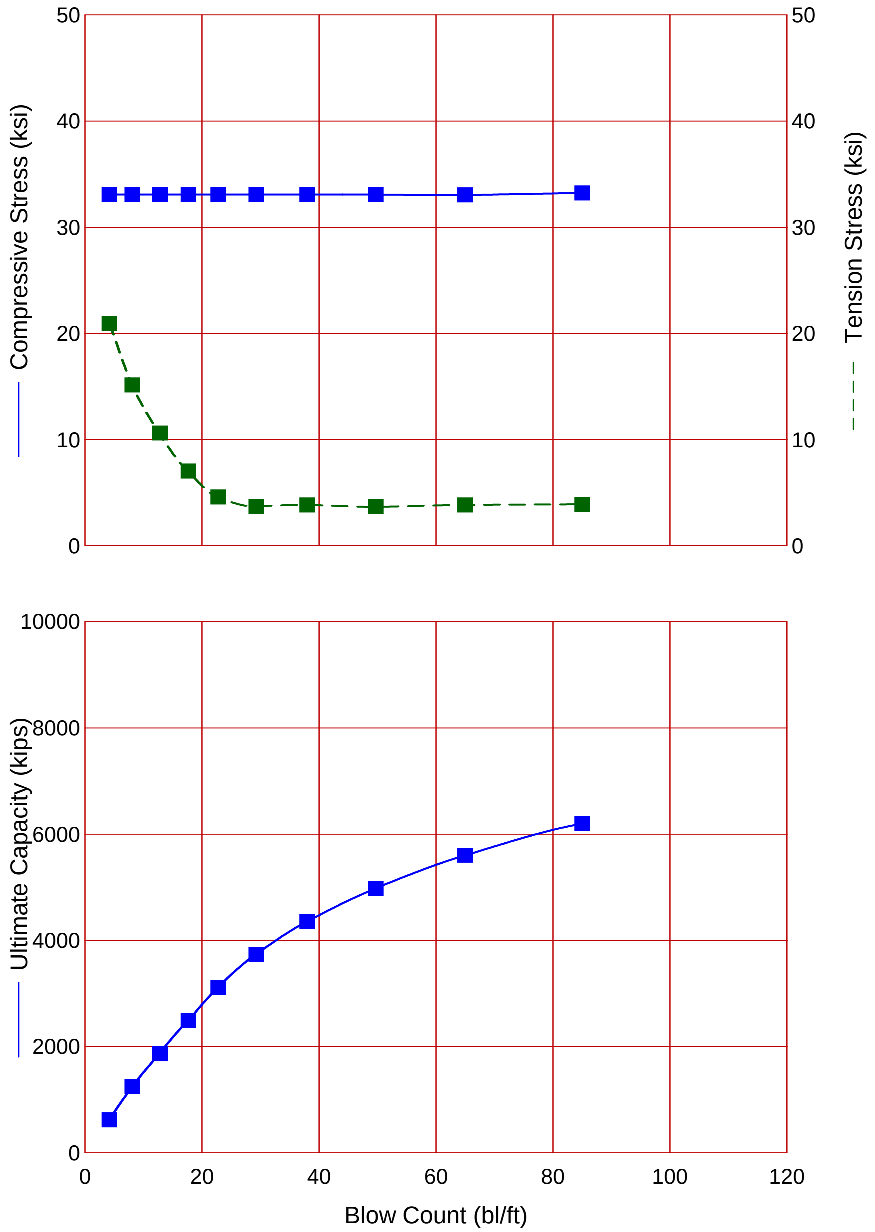
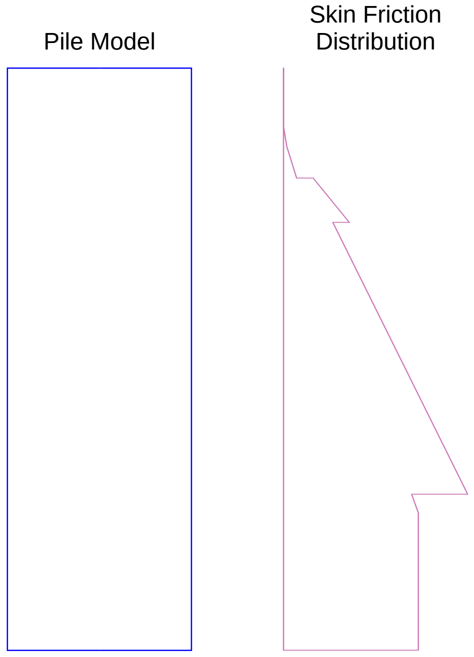


IHC S-500

Stroke	6.62	ft
Ram Weight	55.30	kips
Efficiency	0.950	
Helmet Weight	5.05	kips
COR of H.C.	0.000	
Skin Quake	0.100	in
Toe Quake	0.400	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	110.00	ft
Pile Penetration	99.00	ft
Pile Top Area	219.12	in2



Res. Shaft = 66 %
(Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
622.0	33.08	20.93	4.2	6.62	337.47
1244.5	33.08	15.15	8.1	6.62	336.85
1867.0	33.08	10.63	12.8	6.62	335.35
2489.5	33.08	7.05	17.7	6.62	334.01
3112.0	33.08	4.60	22.8	6.62	332.88
3734.5	33.08	3.73	29.3	6.62	331.65
4357.0	33.08	3.86	38.0	6.62	330.92
4979.5	33.08	3.69	49.7	6.62	330.24
5602.0	33.04	3.86	65.0	6.62	329.67
6200.0	33.22	3.92	85.0	6.62	329.02

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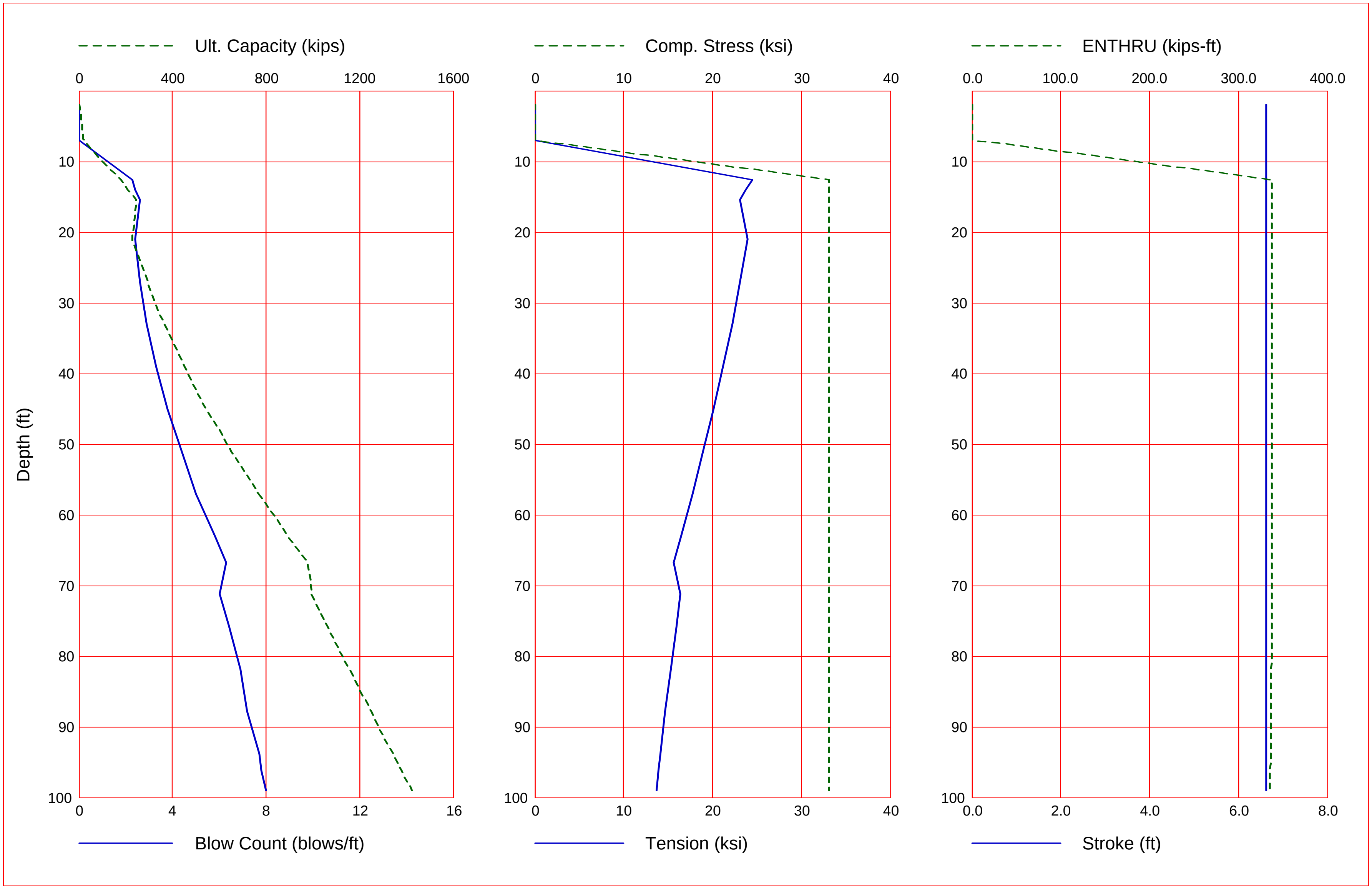
Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.9	2.2	0.2	2.1	0.0	0.000	0.000	6.62	0.0
6.6	18.6	2.8	15.8	0.0	0.000	0.000	6.62	0.0
6.8	19.5	3.1	16.4	0.0	0.000	0.000	6.62	0.0
7.0	20.4	3.3	17.1	0.0	0.000	0.000	6.62	0.0
12.6	178.6	18.2	160.4	2.3	33.079	-24.451	6.62	337.4
14.0	210.5	25.4	185.1	2.4	33.079	-23.782	6.62	337.4
15.4	243.4	33.6	209.7	2.6	33.079	-23.110	6.62	337.4
21.0	229.3	70.1	159.3	2.4	33.079	-23.971	6.62	337.4
27.0	292.5	115.3	177.2	2.6	33.079	-23.125	6.62	337.4
33.0	366.2	171.0	195.1	2.9	33.079	-22.208	6.62	337.4
39.0	450.5	237.4	213.1	3.3	33.079	-21.204	6.62	337.4
45.0	545.4	314.4	231.0	3.8	33.079	-20.126	6.62	337.4
51.0	651.0	402.0	249.0	4.4	33.079	-18.956	6.62	337.4
57.0	767.1	500.2	266.9	5.0	33.079	-17.718	6.62	337.4
63.0	893.8	609.0	284.8	5.8	33.079	-16.451	6.62	337.4
66.7	978.2	682.2	296.0	6.3	33.079	-15.650	6.62	337.4
71.2	992.6	765.2	227.4	6.0	33.079	-16.416	6.62	337.3
75.8	1062.8	834.6	228.2	6.4	33.079	-15.916	6.62	337.1
81.8	1155.4	927.1	228.2	6.9	33.079	-15.301	6.62	337.0
87.8	1248.3	1020.0	228.2	7.2	33.079	-14.700	6.62	336.5
93.8	1341.5	1113.2	228.2	7.7	33.079	-14.152	6.62	336.0
96.2	1379.5	1151.2	228.2	7.8	33.079	-13.953	6.62	335.8
99.0	1422.9	1194.6	228.2	8.0	33.079	-13.750	6.62	335.5

Total Number of Blows: 430

Driving Time (min):	14	10	8	7	6	5	4	4	3	3
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

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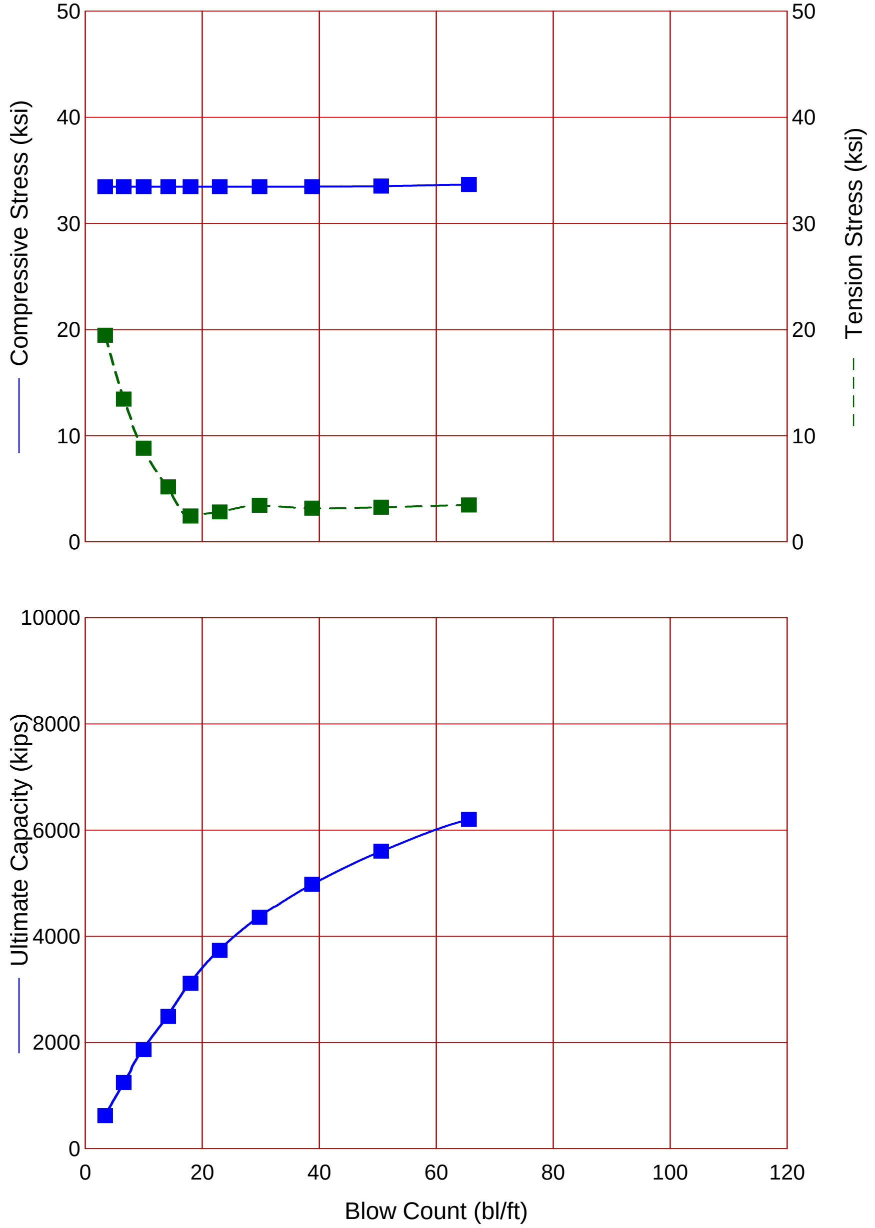
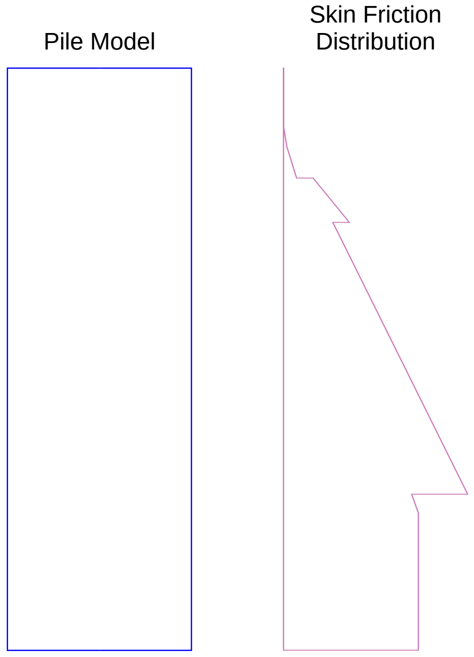


IHC S-600

Stroke	6.62	ft
Ram Weight	67.00	kips
Efficiency	0.950	
Helmet Weight	5.05	kips
COR of H.C.	0.000	
Skin Quake	0.100	in
Toe Quake	0.400	in
Skin Damping	0.050	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	110.00	ft
Pile Penetration	99.00	ft
Pile Top Area	219.12	in2



Res. Shaft = 66 %
(Proportional)

South Carolina DOT 13-Apr-2016
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Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
622.0	33.47	19.45	3.4	6.62	409.31
1244.5	33.47	13.46	6.6	6.62	409.63
1867.0	33.47	8.83	10.0	6.62	409.06
2489.5	33.47	5.19	14.2	6.62	407.57
3112.0	33.47	2.43	18.0	6.62	405.18
3734.5	33.47	2.82	23.0	6.62	402.55
4357.0	33.47	3.45	29.8	6.62	401.14
4979.5	33.47	3.17	38.8	6.62	399.62
5602.0	33.51	3.27	50.6	6.62	398.15
6200.0	33.66	3.48	65.6	6.62	396.84

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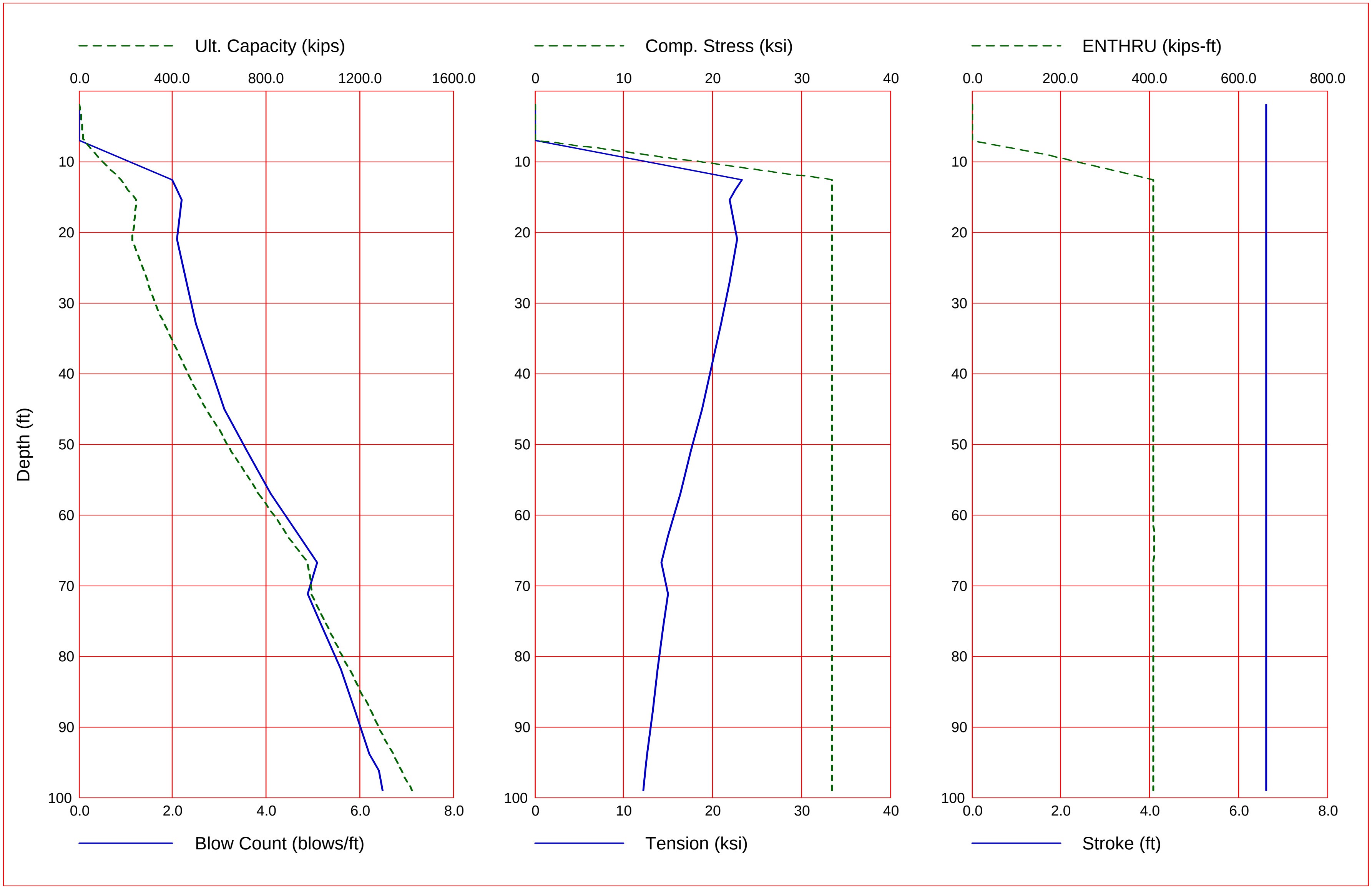
Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.9	2.2	0.2	2.1	0.0	0.000	0.000	6.62	0.0
6.6	18.6	2.8	15.8	0.0	0.000	0.000	6.62	0.0
6.8	19.5	3.1	16.4	0.0	0.000	0.000	6.62	0.0
7.0	20.4	3.3	17.1	0.0	0.000	0.000	6.62	0.0
12.6	178.6	18.2	160.4	2.0	33.465	-23.255	6.62	408.4
14.0	210.5	25.4	185.1	2.1	33.465	-22.575	6.62	408.4
15.4	243.4	33.6	209.7	2.2	33.465	-21.898	6.62	408.5
21.0	229.3	70.1	159.3	2.1	33.465	-22.762	6.62	408.4
27.0	292.5	115.3	177.2	2.3	33.465	-21.912	6.62	408.5
33.0	366.2	171.0	195.1	2.5	33.465	-20.968	6.62	408.6
39.0	450.5	237.4	213.1	2.8	33.465	-19.939	6.62	408.6
45.0	545.4	314.4	231.0	3.1	33.465	-18.801	6.62	408.7
51.0	651.0	402.0	249.0	3.6	33.465	-17.585	6.62	408.8
57.0	767.1	500.2	266.9	4.1	33.465	-16.332	6.62	409.5
63.0	893.8	609.0	284.8	4.7	33.465	-15.039	6.62	410.5
66.7	978.2	682.2	296.0	5.1	33.465	-14.221	6.62	409.3
71.2	992.6	765.2	227.4	4.9	33.465	-14.996	6.62	409.3
75.8	1062.8	834.6	228.2	5.2	33.465	-14.491	6.62	409.4
81.8	1155.4	927.1	228.2	5.6	33.465	-13.852	6.62	409.5
87.8	1248.3	1020.0	228.2	5.9	33.465	-13.235	6.62	409.5
93.8	1341.5	1113.2	228.2	6.2	33.465	-12.663	6.62	409.4
96.2	1379.5	1151.2	228.2	6.4	33.465	-12.455	6.62	409.3
99.0	1422.9	1194.6	228.2	6.5	33.465	-12.242	6.62	409.2

Total Number of Blows: 352

Driving Time (min):	11	8	7	5	5	4	3	3	3	2
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included