APPENDIX

Georgia Department of Transportation

Bridge Inspection Report

District: 4841700000 - D7 District Seven **Inspection Area:** 9 **County:** Cobb
Location ID: 067-09028M-000.04N **Over:** CSX RAILROAD (340397A)
Structure ID: 067-0161-0 **Road Name:** OLD HWY 41
Bridge Information: 6-Revised inventory or operating ratings; load limits

Georgia Department of Transportation

Evaluation

Topside Inspection Team **Inspection Type:** General **Inspection Date:** 05/15/2017
Team Leader: Lj Mergia
Assistants: Phillip Jennings

Deck

NBIS Condition 6 - Satisfactory Condition **Material:** O. Concrete

Deck Wearing Surface Type: 1. Concrete

7.0" Concrete slab.

The deck surface has up to 0.125" transverse cracking, exposed aggregate and minor pop-out spalls.
All deck joints are leaking.
Deck overhang in span 4 right side has a spall with exposed rebar due to collision damage.
Moderate abrasion throughout the deck surface.
Edge beam spall with exposed rebar at bent 3 bay 4 and bent 5 bay 4.

Superstructure

NBIS Condition 5 - Fair Condition **Material:** M. Steel **Year Painted:** 1972

Paint Type : 1- Lead Chromate Oil Alkyd System **Temperature (F):**

5-Span steel beam, (6-beams with steel diaphragms (Bolted and welded) per span).
Spans 1, 2, 4 and 5 are W21 X 55.
Span 3 has W27 X 84.

Paint is peeling and flaking off beams.
Paint has lost its effectivness with overall corrosion being more severe on beam ends and bearings.
Minor section loss on the beam ends and bearings.

Substructure

NBIS Condition 5 - Fair Condition **Material:** N. Steel-Concrete **Year Painted:** 1972

Paint Type : 6- No Paint Present

Concrete caps at both abutments founded on round steel tube piles.
Bents 2, 3, 4 and 5 have concrete caps on 6-HP12 X 53 steel piles.

Minor settlement at both abutment.
Abutment 1 has 1pile exposed and abutment 6 has 3piles exposed.
Cap at bent 5 has a 0.31" crack in the bottom, along the top and ends of the cap at piles 1 and 2.
Bent 4, right end of cap has small spall.
Steel piling in bents 2 through 5 have no paint.
All piling have minor section loss.
Bent 3 piles have section loss up to 0.125".
All steel piling needs to be cleaned and painted.

General

This Bridge:

Built in 1972, project unknown.

Forward left approach slab is undermined 1.0' high X 6' long.

Old Highway 41 (CR02896)

Hand tools used.

Repairs:
Clean and paint all steel piling and then encase in concrete.
Clean and paint superstructure.
Clean and seal all deck joints.

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Repair damage concrete where handrail posts were bolted and replace missing post.
Repair settlement at both abutments.
Repair undermined approach slab.

Conditional Situations

Confined Space: No **Traffic Control Needed:** No

Equipment Used

Access Equipment: None **Topside Boat:** None
Waders: None **Special Imaging Device:** Binoculars

Load Rating and Posting

Truck Type	Gross/H-Modified	HSModified	Tandem	3-S-2	Log	Piggy
Calculated Posting	13	13	09	21	15	00
Posting Required	Yes	Yes	Yes	No	Yes	No
Existing Posting	13	13	09	00	15	00

Item 103 Temporarily Shored : No **Posting Required:** Yes
Item 41 - Structure Open, Posted or Closed: B. Open, posting recommended

Element Data

Element	Parent Element	Measurement Unit	Env*	Quantity	State 1	State 2	State 3	State 4
12-Reinforced Concrete Deck		SQUARE FEET	2	4737	4709	20	8	
107-Steel Open Web Girder/Beam		Linear Foot	2	954	0	954		
515-Steel Protective Coating (107)	107-Steel Open Web Girder/Beam	SQUARE FEET	2	5304	0	3276	934	1094
215-Reinforced Conc Abutment		Linear Foot	2	60	40		20	
225-Steel Pile		Each	2	24	6	18		
515-Steel Protective Coating (225)	225-Steel Pile	SQUARE FEET	2	1902	331			1571
234-Reinforced Conc Pier Cap		Linear Foot	2	249	249			
301-Pourable Joint Seal		Linear Foot	2	168	0		140	28
311-Movable Bearing		Each	2	30	0	30		
515-Steel Protective Coating (311)	311-Movable Bearing	SQUARE FEET	2	60	0		60	
313-Fixed Bearing		Each	2	30	0	30		
515-Steel Protective Coating (313)	313-Fixed Bearing	SQUARE FEET	2	60	0		60	
321-Reinforced Concrete Approach Slab		SQUARE FEET	2	1788	1788			
330-Metal Bridge Railing		Linear Foot	2	318	308		10	

Env* = Environment

Defects

Element	Defect	State 2	State 3	State 4
107-Steel Open Web Girder/Beam	Corrosion	954		
12-Reinforced Concrete Deck	Delamination/Spall/Patched Area	20	8	
215-Reinforced Conc Abutment	Scour		20	
225-Steel Pile	Corrosion	18		
301-Pourable Joint Seal	Seal Adhesion		140	28
311-Movable Bearing	Corrosion	30		
313-Fixed Bearing	Corrosion	30		
330-Metal Bridge Railing	Damage		10	
515-Steel Protective Coating (107)	Effectiveness (Steel Protective Coatings)	3276	934	1094
515-Steel Protective Coating (225)	Effectiveness (Steel Protective Coatings)			1571
515-Steel Protective Coating (311)	Effectiveness (Steel Protective Coatings)		60	
515-Steel Protective Coating (313)	Effectiveness (Steel Protective Coatings)		60	

Maintenance Items

Activity	Work Quantity	Priority	Location	Inspection Date	Completion Date	Comments
815 - BRIDGE CURB/RAIL REPAIR (LINEAR FEET)		B	Bridge rail.	05/16/2017		Repair collision damage.
000 - BRIDGE PAINTING (Not performed by Highway Maintenance, used by Bridge Mntce) ()		B	All piles.	05/16/2017		Clean and paint.
000 - BRIDGE PAINTING (Not performed by Highway Maintenance, used by Bridge Mntce) ()		B	Beams and bearings.	05/15/2017		Clean and paint.
845 - OTHER BRIDGE MAINT (PERSON HOURS)		B	Abutments.	05/15/2017		Repair settlement.
800 - BRIDGE JOINT SEALING (LINEAR FEET)		B	All joints.	05/15/2017		Clean and seal.
550 - EROSION CONTROL (PERSON HOURS)		B	Forward left approach slab.	05/15/2017		Repair undermining.

No Specialized Inspection performed on this bridge.

No Other Special Inspection performed on this bridge.

No Fracture Critical Inspection performed on this bridge.

Bridge Components

Superstructure Data

Span #	Beam Type	Beam Spacing	Length	# Beams	Remarks
1	Steel	4.7	28	6	W21 X 55
2	Steel	4.7	28	6	W21 X 55
3	Steel	4.7	47	6	W27 X 84
4	Steel	4.7	28	6	W21 X 55
5	Steel	4.7	28	6	W21 X 55

Bearing Data

Span #	Rear Type Bearing	Forward Type Bearing	Remarks
1	02 - Fixed Plate	01 - Sliding Plate	Fair
2	01 - Sliding Plate	02 - Fixed Plate	Fair
3	01 - Sliding Plate	02 - Fixed Plate	Fair
4	01 - Sliding Plate	02 - Fixed Plate	Fair
5	01 - Sliding Plate	02 - Fixed Plate	Fair

This bridge has no intersected feature.

No Underwater Inspection performed on this bridge.

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Location ID: 067-09028M-000.04N **Over:** CSX RAILROAD (340397A)
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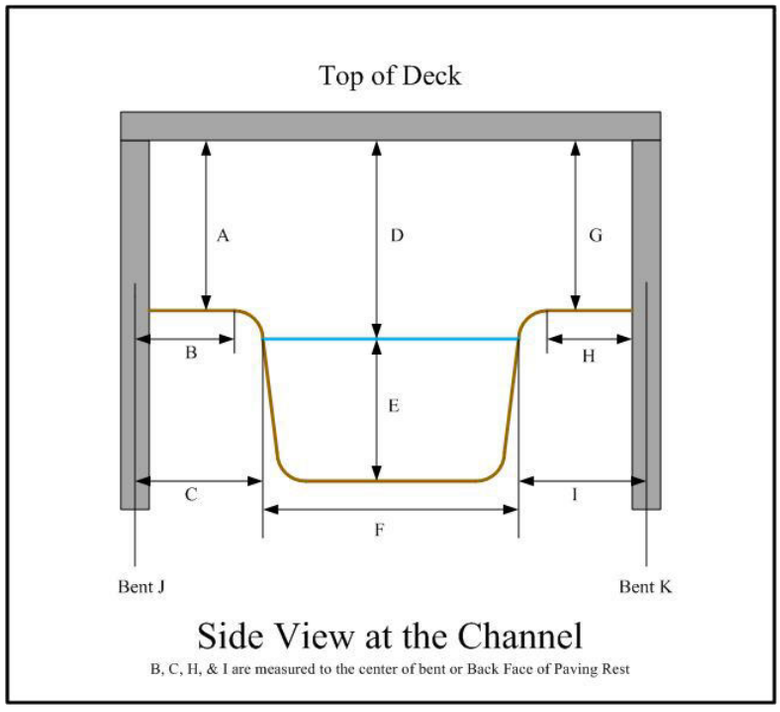
Waterway Information



A :
B :
C :
D : 00.0
E : 00.0
F :
G :
H :
I :
J :
K :

Location of Bridge Height :
Bridge Height Taken:
Scour Condition : N
Waterway Adequacy : N
Channel Protection : N

Comments :

Substructure Skew = **Channel Skew =** **Stream Angle =**

Collision Information

Beam Type :

Span # with Beam Damage :

Total # of Beams in Span :

# of Damaged Beams :

Minimum Vertical Clearance : ft - in

Actual Vertical Clearance at Point of Impact : ft - in

Posted Vertical Clearance : ft - in

Report Type :

Report Date :

Damage Location in Span :

Damage Type :

Damage Details :

Repairs Required : No **Repairs Made :** No

Repair Details :

Additional Comments :

Photographs

P5150030.JPG

Typical beam paint.

P5150024.JPG

Typical deck cracking.

P5150025.JPG

Typical joint.

P5150029.JPG

Typical pile paint.

P5150027.JPG

Span 4 looking south.

067-0161-0-2.JPG

Right side.

Photographs

067-0161-0-53.JPG

Telephone Lines = 9 @ 4.5".

P5150028.JPG

Deck over hang spall at bent 4.

2017-05-15_Roadway.JPG

Looking North.

2017-05-15_Sideview.JPG

Left side.

2017-05-15.JPG

Rear

ECS Southeast, LLP

Report of Bridge Foundation Investigation

Old Highway 41 Bridge Replacement Project

Cobb County, Georgia

Cobb County DOT P. I. No.: X2116

ECS Project Number 10:9815

February 12, 2019
Revision 2

February 12, 2019
Revision 2

Mr. Garrick Edwards, P.E.
AECOM
One Midtown Plaza
1360 Peachtree Street, NE, Suite 500
Atlanta, Georgia 30309, USA

Reference: BFI Report - Old Highway 41 Bridge Replacement Project
Old Highway 41 over CSX RR
Cobb County, Georgia
Cobb County DOT P. I. No.: X2116

ECS Project Number 10:9815

Dear Mr. Edwards:

ECS Southeast, LLC (ECS) is pleased to submit this revised Bridge Foundation Investigation (BFI) for Old Highway 41 Bridge Replacement project in Cobb County. The attached report has been revised to incorporate the comments and correspondence from the Cobb County DOT Review Engineer.

For this project we recommend the abutments be supported using 14 x 117 H-piles (50 ksi) bearing in partially weathered rock (PWR) and/or rock. Hard driving is anticipated and pile points will be required for driven piles. Pilot holes will likely be required at Bent 2 as indicated in the attached.

Thank you for the opportunity to provide geotechnical engineering services on this project. Should you have questions regarding our findings or need additional consultation, please do not hesitate to contact our office.

Sincerely,

ECS SOUTHEAST, LLP represented by:

Jay Hornsby, P.G.
Geotechnical Department Manager

Robert H. Barnes, P.E., P.G.
Principal Engineer
GA Registration No. 29715

Enclosure: BFI Data Form

Bridge Foundation Investigation (LRFD)
Old Highway 41 Bridge Replacement Project
Cobb County, Georgia
Cobb County DOT Project No.: X2116
February 12, 2019
Revision 2

LOCATION (See Map) Old Highway 41 Bridge Replacement, Old Highway 41 over CSX Railroad, Cobb County, Georgia

GENERAL INFORMATION

GEOLOGIC FORMATION The site is located in the Piedmont Region of Georgia. According to the Geology of the Greater Atlanta Region (1984), the site is underlain by the Laurel Lake Mafic Complex (llu) with bedrock consisting of undifferentiated mafic and intermediate rocks. According to the Geologic Map of Georgia (1976) the site is underlain by bedrock consisting of hornblende gneiss and amphibolite (mm3).

SUBSURFACE FEATURES The subsurface is comprised of various layers of silt, sandy, silt, and silty sand overlaying partially weathered rock, fractured rock, and bedrock. Partially weathered rock (PWR) was noted at:

Bent	Boring	Elevation
Bent 1	BB-1	1135
Bent 1	WB1-2	1140
Bent 1	WB1-3	1143
Bent 2	BB-2	1152
Bent 2	WB2-1	1146
Bent 2	WB2-2	1145

Refusal is a designation applied to any material which cannot be further penetrated by the power auger and is normally indicative of very hard or very dense material such as boulders, rock lenses, or the upper surface of bedrock.

Auger refusal was encountered at:

Bent	Boring	Elevation
Bent 1	BB-1	1131
Bent 1	WB1-2	1135
Bent 1	WB1-3	1138
Bent 2	BB-2	1150
Bent 2	WB2-1	1142
Bent 2	WB2-2	1142

Groundwater was noted in the borings at:

Bent	Boring	Elevation
Bent 1	BB-1	1138
Bent 1	WB1-2	1143

For additional information see the boring layout and boring logs.

SITE CLASSIFICATION We recommend a Seismic Site Class of D per AASHTO LRFD 3.10.3.1.

1.0 -- FOUNDATION RECOMMENDATIONS

Bents	Pile Bent (Type)
1 & 2	H-Pile (50 ksi)

1.1 -- Pile Properties

Pile Type	Pile Size (in)	Nominal Compression Stress (ksi)	Nominal Tension Stress (ksi)	Maximum Factored Structural Resistance (kips)
HP (50 ksi)	14 x 117	45.0	45.0	860

1.2 -- DESIGN LOADS

Bents	Maximum Factored Strength Limit State Load (kips)	Maximum Factored Service Limit State Load (kips)
1 & 2	432	295

2.0 -- FOUNDATION LOADS

2.1 -- PILE FOUNDATION LOADS

Bents	Pile Type	Size (in)	Down Drag (kips)***	Driving Resistance (kips)
1	H-Pile (50 ksi)	14 x 117	17	713
2	H-Pile (50 ksi)	14 x 117	--	665

3.0 -- FOUNDATION ELEVATIONS

Bent	Minimum Tip Elevation	Estimated Tip Elevation
1	1132	1126[(1)]
2	1144	1144

[(1)] Pilot holes, if used, must extend 5 feet into rock.

4.0 -- GENERAL NOTES

Elevations All elevations are based on survey control and plans provided by AECOM.

Waiting Period None required.

As Built Foundation Information The as built foundation information should be forwarded to the Cobb County DOT upon completion of the foundation system.

Special Problems Both underground and overhead utilities, including electric, natural gas, and water were noted in the proposed work area during our site visit.

4.1 -- PILE FOUNDATION NOTES

PDO Driving resistance after minimum tip elevations are achieved in conjunction with Special Provision 520 Piling for LRFD and Special Provision 523 Dynamic Pile Testing.

Perform a PDA test at each of the following locations:

Bent	Location
1	Left and Right

*** Nominal Bearing Resistance of Single Pile** Driving resistance is based on the following field verification method and resistance factor φ_{dyn} AASHTO LRFD 2014 (10.5.5.2.3-1):

Resistance Determination Method	Resistance Factor
Driving criteria established by dynamic testing of at least two piles per site condition, but no less than 2% of the production piles.	*0.65*

Downdrag* The load factor γ_p used to calculate the downdrag force per AASTHO LRFD 2010 (3.4.1-2) is 0.75.

Drivability A drivability analysis has been completed on the above mentioned piles to their respective estimated tips with a Delmag 19-42 hammer system.

Points Pile points are recommended for each pile to be driven to insure adequate penetration into very dense weathered rock.

Pilot Holes Layers of very dense PWR or rock will likely be encountered above minimum tip elevation at Bent 2 requiring pilot holes. Pilot holes should be set up for H-piles at Bent 2 to advance piles to the required depth.

In addition, pilot holes may also be required at Bent 1 when the minimum tip elevation specified cannot be attained by normal pile driving. Refer to the attached Special Provision 520 Modified Pilot holes.

Use a maximum pilot hole diameter of 24". The holes should be filled with concrete to the top of the rock after the piles are driven. When required, pilot holes should be set up to the following minimum elevations:

Bent	Elevation
1	1126
2	1144

Down-drag Protection To avoid inducing down-drag loads into the piles from potential settlement of compressible layers during construction of the MSE wall, we recommend that piles at Bent 1 be protected from down-drag by using jackets or other approved materials.

Special Problems

A. Both underground and overhead utilities, including electric, natural gas, and water were noted in the proposed work area.

B. Erratic pile lengths can be expected.

5.0 – QA / QC

This Report of Bridge Foundation Investigation has been prepared in accordance with generally accepted geotechnical engineering practice and GDOT requirements for Bridge Foundation Investigations. No warranty is expressed or implied. Furthermore, ECS assumes no liability for any third party's usage of this report and its attachments without express written consent.

The evaluations presented in this report are based on the available project information, as well as on the results of the exploration. Should a change in the project criteria be made such as the location of the new construction, ECS should be notified to evaluate the changes and make new recommendations if warranted.

ECS SOUTHEAST, LLP represented by:

Prepared By: _____
Robert H. Barnes, P.E., P.G.
GA PE Registration No. 29715

Reviewed By: _____
Jay Hornsby, P.G.

Attachments:

- Special Provision 520 Piling for LRFD
- Special Provision 520 Modified Pilot holes
- Special Provision 523 Dynamic Pile Testing
- Figure 1 – Site Vicinity Map
- Figure 2 – Boring Location Plan and Cross Section
- Reference Notes for Borings
- Boring Logs (6)
- Lab Summary Sheet
- Core Photo Logs (BB-1, BB-2, WB2-1, and WB2-2)
- Driller's Hammer Energy Rating Report (Diedrich D-50 SN# 404)
- Seismic Site Class Calculations
- Nominal Pile Driving Resistance Calculation Sheets
- APile analysis
- GRLWEAP analysis

Attachments

COBB COUNTY DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION

COBB COUNTY DOT PROJECT No. X2116, COBB COUNTY

SECTION 520—PILING

Delete Sub-Section 520.3.05.D.1 and substitute the following:

520.3.05.D.1. Determine Driving Resistance
Drive piles in one continuous operation. Determine the driving resistance of the piling based on the method specified in the plans, which will be one of the following methods (a – c):

a. Upon completion of the dynamic pile testing in accordance with Special Provision Section 523. The pile bearing will be determined by computing the penetration per blow with less than ¼-inch (6-mm) rebound averaged through 12 inches (305 mm) each of penetration. When it is considered necessary by the Engineer, the average penetration per blow may be determined by averaging the penetration per blow through the last 10 to 20 blows of the hammer. In soft material the driving resistance may be determined, at the Engineer's discretion, after delaying driving operations and performing pile re-strikes.

b. Upon completion of the loading test in accordance with Sub-Section 520.3.05.D.2.

c. Shall not be used when driving pile to hard rock. Using FHWA-modified Gates Formula as provided below:

$R_{ndr} = 1.75 (E_d)^{0.5} \log_{10} (10N_b) - 100$ (kips) U.S units

$R_{ndr} = 7 (E_d)^{0.5} \log_{10} (10N_b) - 550$ (kN) S.I. units

Where:

R_{ndr} = nominal pile driving resistance measured during pile driving

E_d = developed hammer energy. This is the kinetic energy in the ram at impact for a given blow. If ram velocity is not measured, it may be assumed equal to the potential energy of the ram at the height of the

stroke, taken as the ram weight times the actual stroke (ft-lb for U.S units, kN-m for S.I. units)

N_b = Number of hammer blows for 1.0 inch of pile permanent set (blows/in)

These resistance formulas apply only when:

- The hammer has a free fall.
- The head of the pile is not broomed, crushed, spalled, or excessively crimped.
- The penetration rate is reasonably uniform.

Determining driving resistance by formula is not a Pay Item. Provide the facilities for determining driving resistance by formula as an incidental part of the work.

Once the driving resistance has been determined by one of the methods noted above, do not continue to drive piles if the Engineer determines that the piles have reached practical refusal. Practical refusal is defined as 20 blows per inch with the hammer operating at the highest setting or setting determined by the Engineer and less than ¼-inch (6-mm) rebound per blow. The Engineer will generally make this determination within 2 inches (51 mm) of driving. However, the Engineer will not approve the continuation of driving at practical refusal for more than 12 inches (305 mm). When the required pile penetration cannot be achieved by driving without exceeding practical refusal, use other penetration aids such as jetting, spudding, predrilling or other methods approved by the Engineer.

d. **Wave Equation:** Use the Wave Equation Analysis for Piles (WEAP) program to evaluate the suitability of the proposed driving system chosen from the methods noted above (including the hammer, follower, capblock and pile cushions) as well as to estimate the driving resistance to achieve the pile bearing requirements and to evaluate pile driving stresses. Use the WEAP program to show that the hammer is capable of driving to a driving resistance equal 130% (1.3 times) the driving resistance shown in the Plans without overstressing the piling in compression or tension and without reaching practical refusal.

   Perform the WEAP analysis with personnel who are experienced in this type work, and have performed this analysis on a minimum of 15 projects. Provide a list of the qualifications and experience of the personnel to perform the WEAP analysis for this Project.

   The Engineer may modify the scour resistance shown in the plans if the dynamic pile test is used to determine the actual soil resistance through the scour zone. Also, the Engineer may make modifications in scour resistance when the Contractor proposes drilling and/or jetting to reduce the soil resistance in the scour zone.

A minimum of two weeks prior to beginning any pile driving operations, submit to the Engineer for evaluation and approval the following information on all of the proposed pile driving system(s) to be used on the Project including but not limited to:

i. Items on Pile Driving Equipment Data Sheet
ii. Other information on the driving system required by the Engineer
iii. A WEAP program output indicating the approximate depth or elevation where the pile will achieve the bearing required
iv. Valid Driving Criteria.

Valid driving criteria is defined as having the required hammer having a hammer set greater than 3 blows per inch and less than 10 blows per inch at the driving resistance for that pile.

If WEAP analyses show that the hammer(s) will overstress the pile, modify the driving system or method of operation as required to prevent overstressing the pile. Resubmit the modified pile driving system information and WEAP program output to the Engineer for re-evaluation. Do not begin pile driving operations until the Engineer has approved the qualifications of the personnel, the WEAP program output, and the pile driving system(s).

Approval of the pile driving system(s) is also based on satisfactory field trials with dynamic pile testing. Obtain approval from the Engineer for the pile driving system(s) based on satisfactory field performance.

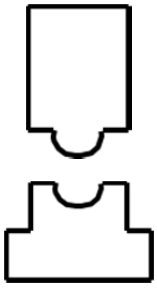
If piles require different hammer sizes, the Contractor may elect to drive with more than one size hammer or with a variable energy hammer, provided that the hammer is properly sized and cushioned, will not damage the pile, and will develop the required resistance.

For penetration of weak soils by concrete piles, use thick cushions and/or reduced stroke to control tension stresses during driving.

Pile Driving Data Form

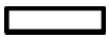
Contract ID:
PI Number:
County

Structure Name:
Structure No.:
Pile Driving Contractor:



Hammer

Manufacturer: _____ Model No. _____
Hammer Type: _____ Serial No. _____
Manufacturers Maximum Rated Energy: _____(ft-k)
Stroke at Maximum Rated Energy: _____(ft)
Range in Operating Energy: _____ to _____(ft-k)
Range in Operating Stroke: _____ to _____(ft)
Ram Weight: _____ (kips)
Modifications: _____



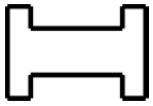
Striker Plate

Weight: _____(kips) Diameter: _____(in)
Thickness: _____(in)

Hammer Cushion

Material 1	Material 2
Name: _____	Name: _____
Area: _____(in^2)	Area: (in^2)
Thickness/Plate: _____(in)	Thickness/Plate:_____(in)
No. of Plates: _____	No. of Plates: _____

Total Thickness of Hammer Cushion: _____(in)

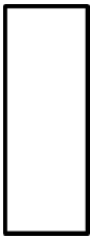


Helmet

Weight including inserts: _____(kips)

Pile Cushion

Material: _____
Area: _____(in^2) Thickness/Sheet: _____(in)
No. of Sheets: _____
Total Thickness of Pile Cushion: _____(in)



Pile

Pile Type: _____
Wall Thickness: _____(in) Taper: _____
Cross Sectional Area: ___(in^2) Weight/Meter: _____
Ordered Length: _____(ft)
Driving Resistance: _____(kips)
Description of Splice: _____
Driving Shoe/Closure Plate Description: _____

Submitted By: _____ Date: _____

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

SPECIAL PROVISION

Cobb County DOT Project No. X2116
Cobb County

SECTION 520 MODIFIED—PILING

Delete Sub-Section 520.3.05.B and substitute the following:

520.3.05.B. Drill Pilot Holes

Drill Pilot Holes only when the minimum tip elevation specified in the Plans cannot be attained by normal pile driving. Remove the driven piles that did not reach minimum tip elevations prior to drilling pilot holes and cut off any damaged sections as directed by the Engineer prior to reuse. Include the cost of pile removal and cut off in the bid price for pilot holes.

When pilot holes are required, drill them to the diameter and approximate depth specified on the Plans.

Backfill voids and holes with Class A or better concrete. Furnishing and placing backfill concrete is an incidental part of the work.

The following are not considered pilot holes:

- Holes created by spudding (punching)
- Holes dug to drive piling that is too long to fit leads
- Holes dug to replace a template (if permitted)

Where pilot holes are required in granular material and the material cannot be sealed off using "mudding" drilling methods, drill the pilot hole as follows:

1. Place a casing pipe with a large enough diameter around the boring device.
2. Hold the casing in position until the pilot hole is completed and the pile driving progresses deep enough into the hard material to keep loose material out of the pilot hole.

The use of casing is incidental to the work.

COBB COUNTY DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION

COBB COUNTY DOT PROJECT No. X2116, COBB COUNTY

SECTION 523 - DYNAMIC PILE TESTING

523.1 General Description

The work consists of performing dynamic pile testing using the Pile Driving Analyzer (PDA) to monitor the driving of piles with accelerometer and strain gauges attached to the piles. Piles to be dynamically tested will be identified in the Special Provision or on the Plans. Prior to pile driving, the Engineer will determine production or test piles to be dynamically tested. Perform the dynamic pile testing in accordance with ASTM D4945-12.

Take dynamic measurements during driving of any required piles. Drive the pile as shown in the Special Provisions or on the Plans.

523.2 Materials

Furnish measuring instruments for dynamic pile testing. Attach instruments near the top of the piles with bolts placed in drilled holes. Furnish materials, labor and equipment necessary for installation of the instruments.

523.3 Construction Requirements

Measure wave speed prior to driving piles. Wave speed measurements will not be required for Steel H piles or metal shell piles. When wave speed measurements are performed, place the piles in a horizontal position not in contact with other piles.

Perform dynamic pile testing during driving. Modify the driving to reduce the stress and/or eliminate the damage, should the recommended stress level be exceeded or if damage occurs (determined visually or as indicated by the instrumentation).

Do not exceed the following maximum driving stresses, as determined by the dynamic pile testing:

1. For Steel piles:

   0.9 Fy, where Fy = Yield strength of steel

2. For Prestressed Concrete Piles:

   Compression:

   $$\sigma_{dr} = (0.85f'_c - f_{pe})$$

   Tension in Normal Environments:

   $$\sigma_{dr} = (0.095\sqrt{f'_c} + f_{pe})$$

   Tension in Severe Corrosive Environments:

   $$\sigma_{dr} = \varphi_{da} f_{pe}$$

   where;
   σ_{dr} = maximum allowed driving stress, ksi
   f 'c= specified minimum 28-day compressive strength of concrete, ksi
   f pe= effective prestress in concrete, ksi, (after all losses) at the time of driving taken as 0.78 times the initial prestress force

Re-drive friction piles that do not obtain bearing after a freeze period of a minimum of 24 hours or for a period designated on the Plans, whichever is longer. Reset the gauges if required. Re-strike the pile with a warm hammer until a maximum penetration of 3 inches (76 mm) or 40 blows is reached, whichever occurs first. The Engineer may modify the Pile Driving Objective based on the results of the PDA work.

Provide two weeks' notice prior to the driving of designated piles and cooperate with the Engineer in connection with the performance of Dynamic Pile Testing.

Provide a complete report consisting of but not limited to PDA field monitoring data, results of CAPWAP computer analyses, and recommendations such as pile lengths, hammer fuel setting, and valid driving criteria. Valid driving criteria is defined as having the required hammer having a hammer set greater than 3 blows per inch and less than 10 blows per inch at the driving resistance for that pile. Submit the report electronically in PDF format and the electronic data files of the PDA analysis and CAPWAP to the Geotechnical Bureau and allow seven (7) calendar days for review and approval before proceeding with driving production piles.

523.4 Measurement

The Dynamic Pile Tests performed in accordance with these Specifications will be counted separately for payment. (Refer to plans summary sheet for the required amount of PDA testing.)

523.5 Payment

The Dynamic Pile Test completed and accepted will be paid for at the Contract unit Price. This payment will be full compensation for all costs of complying with this specification, including incidentals, additional work, and any delays incurred in conjunction therewith.

Payment will be made under:

Item No. 523. Dynamic Pile Test_____ . . . . . Per Each

SITE LOCATION DIAGRAM

REPORT OF GEOTECHNICAL EXPLORATION	**Project No.: 10:9815**	**Figure No.: 1**
Old Highway 41 Bridge Replacement - BFI Cobb County, Georgia	**NTS**	
Reference: Google Maps	**Date: 5/2018**	

SOIL CLASSIFICATION LEGEND

- FILL - FILL (POSS/PROB) OF ALL TYPES.
- GW - WELL GRADED GRAVEL
- GM - SILTY GRAVEL
- GP - POORLY GRADED GRAVEL
- GC - CLAYEY GRAVEL
- SW - WELL GRADED SAND
- SM - SILTY SAND
- SP - POORLY GRADED SAND
- SC - CLAYEY SAND
- ML - LOW PLASTICITY SILT
- CL - LOW PLASTICITY CLAY
- MH - HIGH PLASTICITY SILT
- CH - HIGH PLASTICITY CLAY
- OH - HIGH PLASTICITY ORGANIC SILTS AND CLAYS
- OL - LOW PLASTICITY ORGANIC SILTS AND CLAY
- PT - PEAT
- PWR - PARTIALLY WEATHERED ROCK

SURFACE MATERIALS

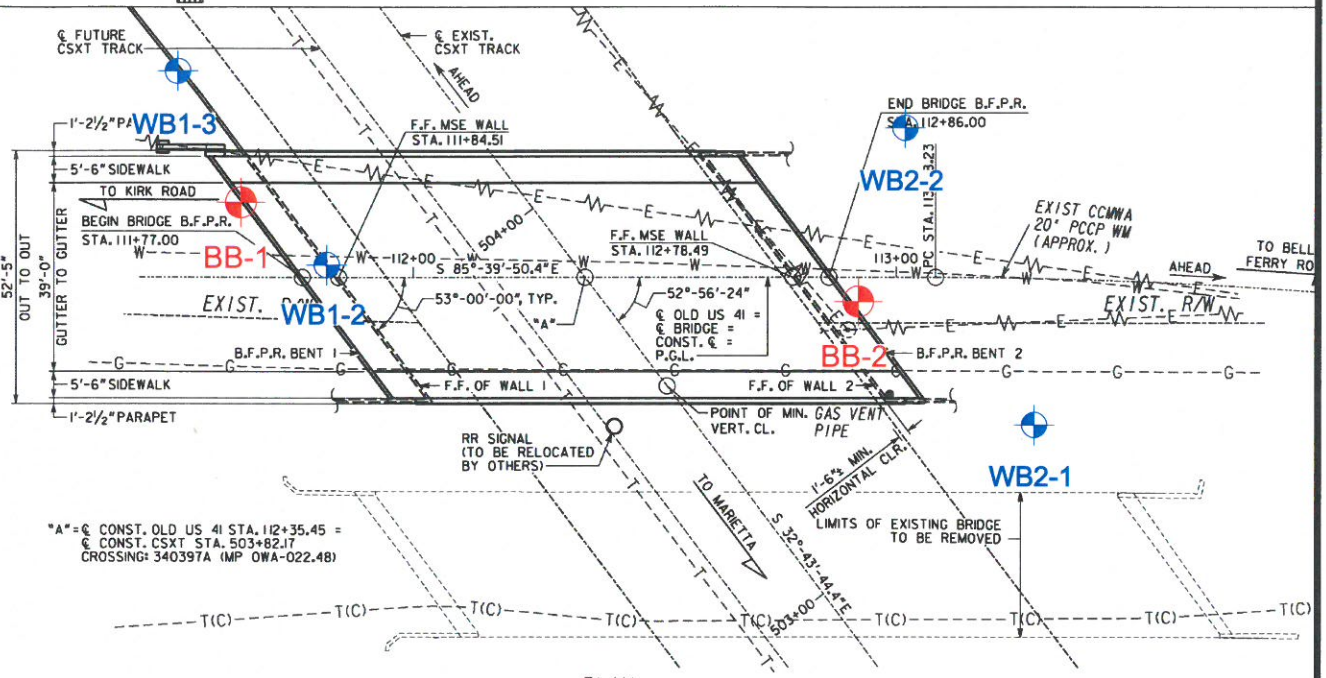
- TOPSOIL
- ASPHALT
- GRAVEL
- CONCRETE
- NR - NO RECOVERY

ROCK TYPES

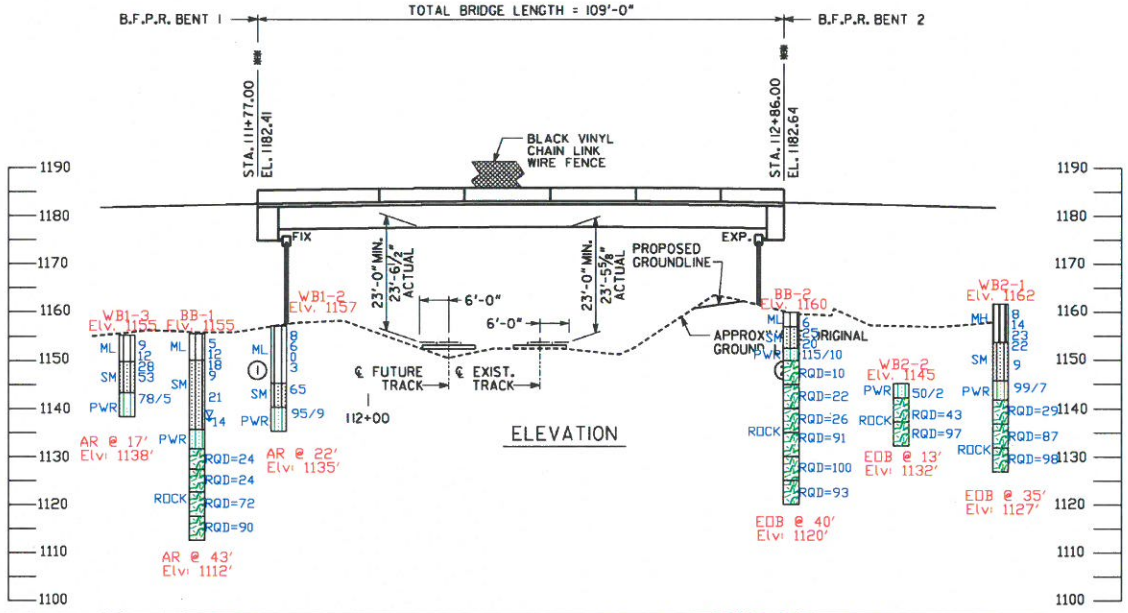
- IGNEOUS
- METAMORPHIC
- SEDIMENTARY

SYMBOL LEGEND

- WATER LEVEL
- WL BEFORE CASING REMOVAL
- WL AFTER CASING REMOVAL
- WL AFTER 24 HOURS
- APPROXIMATE BORING LOCATION
- B-X BORING DESIGNATION



PLAN



ELEVATION

LEGEND

- Approximate Bridge Boring Location
- BB-# Bridge Boring Designation
- Approximate Wall Boring Location
- WB#-# Wall Boring Designation

Note: N-values have been corrected with 87.5% ER.

Graphic Scale 1"=40'

40 20 0 10 20 30 40

JOB NO.	10:9815	REVISIONS	
SCALE	1"=40'		
DRAWN	CFS		
APPR. BY	KJH		
DATE	5/2018		

FIGURE NAME: BORING LOCATION PLAN & PROFILE

PROJECT: Old Highway 41 Bridge Replacement

REFERENCE: Preliminary Layout Old Hwy 41 Bridge Replacement over CSX Railroad

PREPARED FOR: AECOM

FIGURE NO.: 2

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]	
	ASPHALT
	CONCRETE
	GRAVEL
	TOPSOIL
	VOID
	BRICK
	AGGREGATE BASE COURSE
	FILL[3] MAN-PLACED SOILS
GW	**WELL-GRADED GRAVEL** gravel-sand mixtures, little or no fines
GP	**POORLY-GRADED GRAVEL** gravel-sand mixtures, little or no fines
GM	**SILTY GRAVEL** gravel-sand-silt mixtures
GC	**CLAYEY GRAVEL** gravel-sand-clay mixtures
SW	**WELL-GRADED SAND** gravelly sand, little or no fines
SP	**POORLY-GRADED SAND** gravelly sand, little or no fines
SM	**SILTY SAND** sand-silt mixtures
SC	**CLAYEY SAND** sand-clay mixtures
ML	**SILT** non-plastic to medium plasticity
MH	**ELASTIC SILT** high plasticity
CL	**LEAN CLAY** low to medium plasticity
CH	**FAT CLAY** high plasticity
OL	**ORGANIC SILT or CLAY** non-plastic to low plasticity
OH	**ORGANIC SILT or CLAY** high plasticity
PT	**PEAT** highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS			
SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION		
DESIGNATION		**PARTICLE SIZES**
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS		
UNCONFINED COMPRESSIVE STRENGTH, Q_P[4]	**SPT[5] (BPF)**	**CONSISTENCY[7] (COHESIVE)**
<0.25	<3	Very Soft
0.25 - <0.50	3 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

GRAVELS, SANDS & NON-COHESIVE SILTS	
SPT[5]	**DENSITY**
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
Dual Symbol *(ex: SW-SM)*	10	10
With	15 - 20	15 - 25
Adjective *(ex: "Silty")*	≥25	≥30

WATER LEVELS[6]		
	WL	Water Level (WS)(WD)
		(WS) While Sampling
		(WD) While Drilling
	SHW	Seasonal High WT
	ACR	After Casing Removal
	SWT	Stabilized Water Table
	DCI	Dry Cave-In
	WCI	Wet Cave-In

[1] Classifications and symbols per ASTM D 2488-09 (Visual-Manual Procedure) unless noted otherwise.

[2] To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.

*[3] Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-**FILL**)].*

[4] Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

[5] Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf).

[6] The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.

[7] Minor deviation from ASTM D 2488-09 Note 16.

[8] Percentages are estimated to the nearest 5% per ASTM D 2488-09.

CLIENT	JOB #	BORING #	SHEET
AECOM	10:9815	BB-1	1 OF 2

PROJECT NAME: Old Highway 41 Bridge Replacement - Bridge Bent 1

ARCHITECT-ENGINEER:

SITE LOCATION: Old Highway 41, Cobb County, GA

DOT PROJ. #: Cobb Co. DOT Project #: X2116

P.I. #:

STATION: 111+66,14'L

CALIBRATED PENETROMETER TONS/FT^2: 1 2 3 4 5+

ROCK QUALITY DESIGNATION & RECOVERY: RQD% 20% 40% 60% 80% 100% — REC.%

PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT %

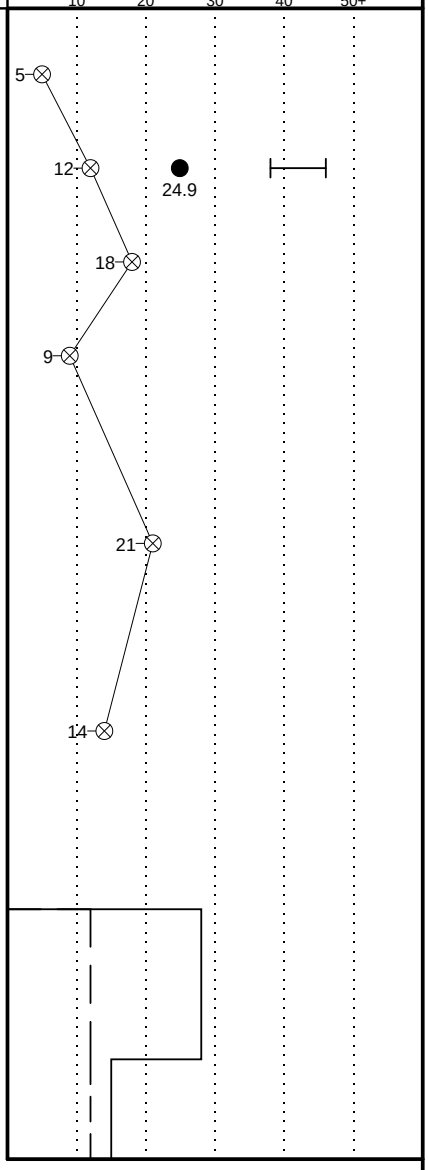
STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50+

ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION (100%)

SURFACE ELEVATION 1155

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [3"]		1155	
	S-1	SS	18	18	(ML) SILT, reddish brown, moist, firm to stiff			1 2 1
	S-2	SS	18	18				2 3 5
5							1150	
	S-3	SS	18	18	(SM) SILTY SAND, brown, moist, loose to medium dense			3 3 9
	S-4	SS	18	18				3 2 4
10							1145	
	S-5	SS	18	18				5 7 7
15						▽	1140	
	S-6	SS	18	18				1 1 8
20					(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SILTY SAND, grayish brown, wet		1135	
25	R-1	RC	48	27	HORNBLENDE GNEISS, black, white, and gray, seamy and fractured, [REC=56%,RQD= 24%]		1130	
30					HORNBLENDE GNEISS, black, white, and gray, seamy and fractured, [REC=30%,RQD= 24%]		1125	



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL 17 WS ☐ WD ☒	BORING STARTED 05/01/18	
▽ WL(BCR) ▼ WL(ACR)	BORING COMPLETED 05/01/18	CAVE IN DEPTH
▽ WL	RIG Dietrich D-50 FOREMAN John Dodd	DRILLING METHOD 2-1/4" Hollow Stem Auger

CLIENT	JOB #	BORING #	SHEET
AECOM	10:9815	BB-1	2 OF 2

PROJECT NAME: Old Highway 41 Bridge Replacement - Bridge Bent 1

ARCHITECT-ENGINEER:

SITE LOCATION: Old Highway 41, Cobb County, GA

GDOT PROJ. #: Cobb Co. DOT Project #: X2116

P.I. #:

STATION: 111+66,14'L

CALIBRATED PENETROMETER TONS/FT^2: 1 2 3 4 5+

ROCK QUALITY DESIGNATION & RECOVERY: RQD% 20% 40% 60% 80% 100% — REC.%

PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT %

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50+

ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION (100%)

SURFACE ELEVATION 1155

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	R-2	RC	60	18	HORNBLENDE GNEISS, black, white, and gray, seamy and fractured, [REC=30%,RQD= 24%]			
35	R-3	RC	60	48	HORNBLENDE GNEISS, black, white, and gray, seamy [REC=80%,RQD=47%]		1120	
40	R-4	RC	60	58	HORNBLENDE GNEISS, black, white, and gray, [REC=97%,RQD=80%]		1115	
45					END OF BORING @ 43' *Note: Blows/6" are uncorrected field measurements. N-values have been corrected with 93% ER.		1110	
50							1105	
55							1100	
60							1095	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 17 WS ☐ WD ☒	BORING STARTED 05/01/18	
WL(BCR) WL(ACR)	BORING COMPLETED 05/01/18	CAVE IN DEPTH
WL	RIG Dietrich D-50 FOREMAN John Dodd	DRILLING METHOD 2-1/4" Hollow Stem Auger

CLIENT	JOB #	BORING #	SHEET
AECOM	10:9815	BB-2	1 OF 2

PROJECT NAME: Old Highway 41 Bridge Replacement - Bridge Bent 2

ARCHITECT-ENGINEER:

SITE LOCATION: Old Highway 41, Cobb County, GA

DOT PROJ. #: Cobb Co. DOT Project #: X2116

P.I. #:

STATION: 112+92, 5'R

CALIBRATED PENETROMETER TONS/FT^2 (1 2 3 4 5+)

ROCK QUALITY DESIGNATION & RECOVERY — RQD% (20% 40% 60% 80% 100%) REC.%

PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT %

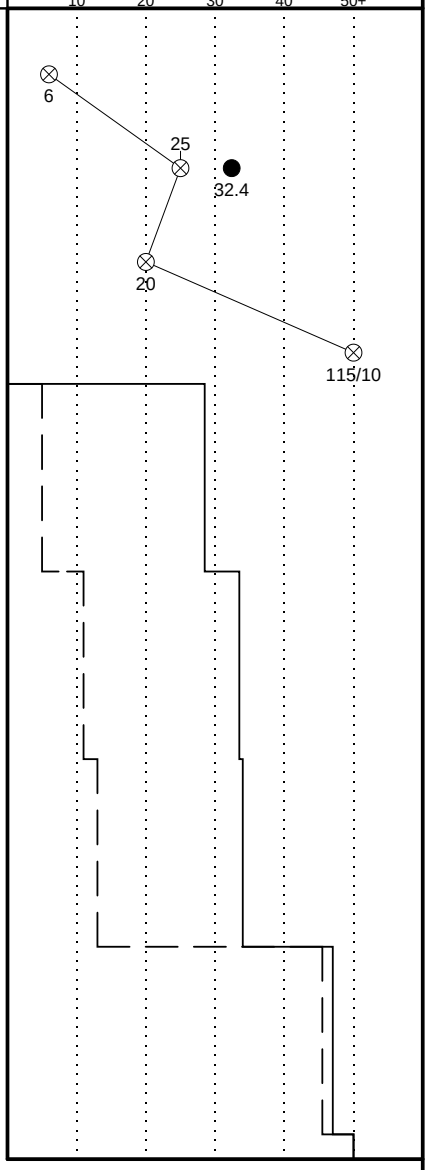
STANDARD PENETRATION BLOWS/FT (10 20 30 40 50+)

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION (100%)

SURFACE ELEVATION 1160

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [4"]		1160	
	S-1	SS	18	18	(ML) SANDY SILT, contains mica and slight roots, reddish brown, moist, firm			2 2 2
	S-2	SS	18	18	(SM) SILTY SAND, reddish brown, moist, medium dense			4 6 10
5							1155	
	S-3	SS	18	18				4 6 7
	S-4	SS	16	16	(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SILTY SAND, contains mica contains slight rock fragments, reddish brown grayish brown, moist			11 24 50/4
10							1150	
	R-1	RC	60	34	HORNBLENDE GNEISS, black, white, and gray, seaamy and fractured, [REC=57%,RQD= 10%]			
15							1145	
	R-2	RC	60	40	HORNBLENDE GNEISS, black, white, and gray, seamy and fractured, [REC=67%,RQD= 22%]			
20							1140	
	R-3	RC	60	41	HORNBLENDE GNEISS, black, white, and gray, seamy and fractured, [REC=68%,RQD= 26%]			
25							1135	
	R-4	RC	60	56.5	HORNBLENDE GNEISS, black, white, and gray, [REC=94%,RQD=91%]			
30					HORNBLENDE GNEISS, black, white, and gray, [REC=100%,RQD=100%]		1130	



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 05/02/18	
WL(BCR) WL(ACR)	BORING COMPLETED 05/02/18	CAVE IN DEPTH
WL	RIG Dietrich D-50 FOREMAN John Dodd	DRILLING METHOD 2-1/4" Hollow Stem Auger

CLIENT	JOB #	BORING #	SHEET
AECOM	10:9815	BB-2	2 OF 2

PROJECT NAME: Old Highway 41 Bridge Replacement - Bridge Bent 2

ARCHITECT-ENGINEER:

SITE LOCATION: Old Highway 41, Cobb County, GA

GDOT PROJ. #: Cobb Co. DOT Project #: X2116

P.I. #:

STATION: 112+92, 5'R

CALIBRATED PENETROMETER TONS/FT^2: 1 2 3 4 5+

ROCK QUALITY DESIGNATION & RECOVERY: RQD% 20% 40% 60% 80% 100% — REC.%

PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT %

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50+

ENGLISH UNITS

BOTTOM OF CASING ▰ LOSS OF CIRCULATION (100%)

SURFACE ELEVATION 1160

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	R-5	RC	60	60	HORNBLENDE GNEISS, black, white, and gray, [REC=100%,RQD=100%]			
35							1125	
	R-6	RC	60	60	HORNBLENDE GNEISS, black, white, and gray, [REC=100%,RQD=93%]			
40					END OF BORING @ 40'		1120	
					*Note: Blows/6" are uncorrected field measurements. N-values have been corrected with 93% ER.			
45							1115	
50							1110	
55							1105	
60							1100	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 05/02/18	
WL(BCR) WL(ACR)	BORING COMPLETED 05/02/18	CAVE IN DEPTH
WL	RIG Dietrich D-50 FOREMAN John Dodd	DRILLING METHOD 2-1/4" Hollow Stem Auger

CLIENT	JOB #	BORING #	SHEET
AECOM	10:9815	WB1-2	1 OF 1

PROJECT NAME	ARCHITECT-ENGINEER
Old Highway 41 Bridge Replacement - Wall 1	

SITE LOCATION: Old Highway 41, Cobb County, GA

DOT PROJ. #: Cobb Co. DOT Project #: X2116

P.I. #:

STATION: 111+80, 3'L

CALIBRATED PENETROMETER TONS/FT^2 (1 2 3 4 5+)

ROCK QUALITY DESIGNATION & RECOVERY — RQD% (20% 40% 60% 80% 100%) REC.%

PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT %

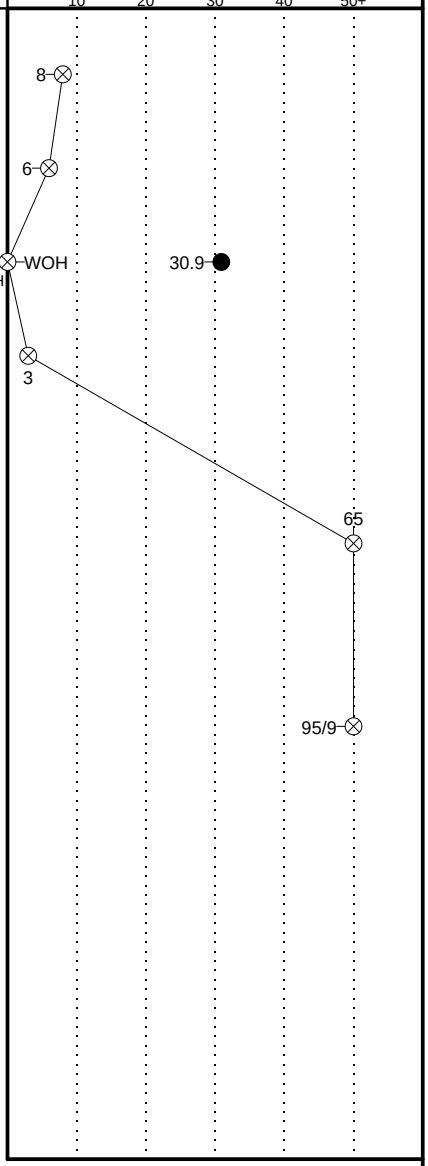
STANDARD PENETRATION BLOWS/FT (10 20 30 40 50+)

ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION (100%)

SURFACE ELEVATION 1157

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [10"]		
	S-1	SS	18	18	(ML) SANDY SILT, contains slight mica, trace roots and gravel fragments, brown, moist, very soft to firm	1155	5 3 2
	S-2	SS	18	18			2 2 2
5	S-3	SS	18	18		1150	1 WOH WOH
	S-4	SS	18	18			1 1 1
10					(SM) SILTY SAND, contains mica and rock fragments, brown, moist, very dense	1145	
	S-5	SS	18	18			11 23 19
15					(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SILTY SAND, contains mica, brown, moist	1140	
	S-6	SS	15	15			18 11 50/3
20					AUGER REFUSAL @ 22'	1135	
					*Note: Blows/6" are uncorrected field measurements. N-values have been corrected with 93% ER.		
25						1130	
30							



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 14 WS ☐ WD ☒	BORING STARTED 05/01/18	
WL(BCR) WL(ACR)	BORING COMPLETED 05/01/18	CAVE IN DEPTH
WL	RIG Dietrich D-50 FOREMAN John Dodd	DRILLING METHOD 2-1/4" Hollow Stem Auger

CLIENT	JOB #	BORING #	SHEET
AECOM	10:9815	WB1-3	1 OF 1

PROJECT NAME: Old Highway 41 Bridge Replacement - Wall 1

ARCHITECT-ENGINEER:

SITE LOCATION: Old Highway 41, Cobb County, GA

DOT PROJ. #: Cobb Co. DOT Project #: X2116

P.I. #:

STATION: 111+53,40'L

CALIBRATED PENETROMETER TONS/FT^2: 1 2 3 4 5+

ROCK QUALITY DESIGNATION & RECOVERY: RQD% 20% 40% 60% 80% 100% — REC.%

PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT %

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

SURFACE ELEVATION 1155

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0						1155	
	S-1	SS	18	18			4 3 3
	S-2	SS	18	18			5 3 5
5						1150	
	S-3	SS	18	18			7 9 9
	S-4	SS	18	18			10 14 20
10						1145	
	S-5	SS	11	11			18 50/5
15						1140	
20						1135	
25						1130	
30						1125	

Topsoil Depth [8"]

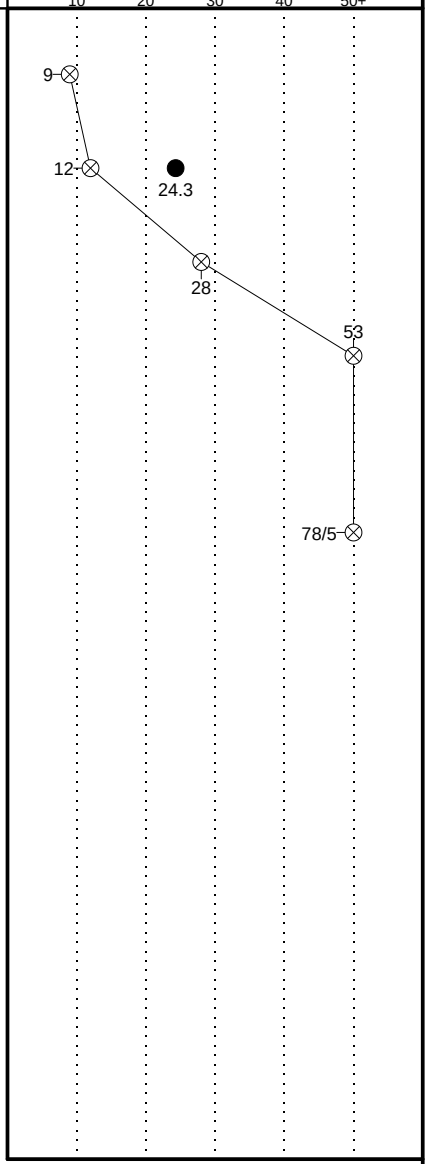
(ML) SANDY SILT, contains slight mica and rock fragments, brown to reddish brown, moist, stiff

(SM) SILTY SAND, contains mica and rock fragments, reddish brown, moist, medium dense to very dense

(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SILTY SAND, brown to gray, moist

AUGER REFUSAL @ 17'

*Note: Blows/6" are uncorrected field measurements. N-values have been corrected with 93% ER.



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 05/01/18	
WL(BCR) WL(ACR)	BORING COMPLETED 05/01/18	CAVE IN DEPTH
WL	RIG Dietrich D-50 FOREMAN John Dodd	DRILLING METHOD 2-1/4" Hollow Stem Auger

CLIENT	JOB #	BORING #	SHEET
AECOM	10:9815	WB2-1	1 OF 2

PROJECT NAME: Old Highway 41 Bridge Replacement - Wall 2

ARCHITECT-ENGINEER:

SITE LOCATION: Old Highway 41, Cobb County, GA

DOT PROJ. #: Cobb Co. DOT Project #: X2116

P.I. #:

STATION: 113+35,32'R

CALIBRATED PENETROMETER TONS/FT^2 (1 2 3 4 5+)

ROCK QUALITY DESIGNATION & RECOVERY — RQD% (20% 40% 60% 80% 100%) REC.%

PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT %

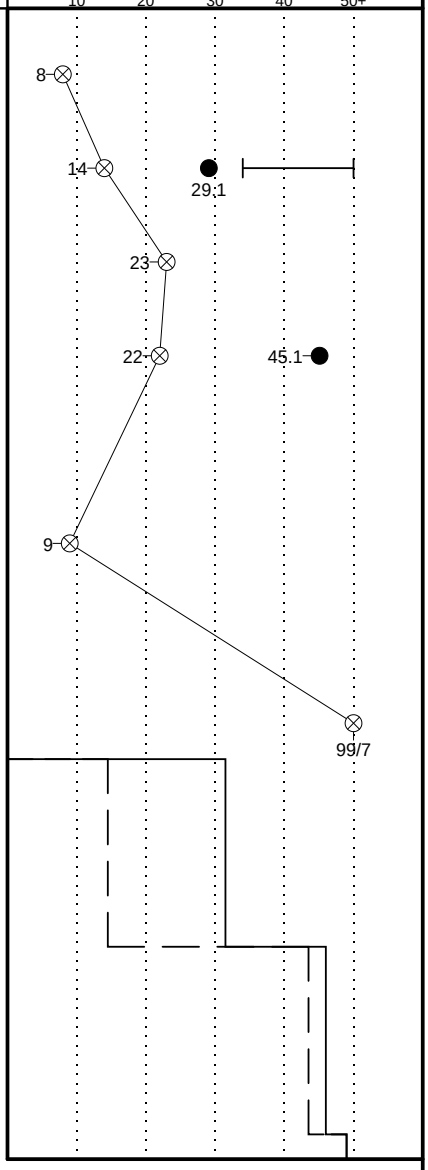
STANDARD PENETRATION BLOWS/FT (10 20 30 40 50+)

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION (100%)

SURFACE ELEVATION 1162

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [8"]			
	S-1	SS	18	18	(MH POSSIBLE FILL) SANDY ELASTIC SILT, contains mica, reddish brown, moist, firm to very stiff		1160	3 3 2
	S-2	SS	18	18				2 3 6
5								
	S-3	SS	18	18			1155	4 6 9
	S-4	SS	18	18	(SM) SILTY SAND, contains slight rock fragments, moist, loose to medium dense			9 5 9
10							1150	
	S-5	SS	18	18				3 2 4
15					(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SILTY SAND, contains mica and contains slight rock fragments, brown, moist		1145	
	S-6	SS	13	13		▽		11 14 50/1
20					HORNBLENDE GNEISS, black, white, and gray, seamy and fractured, [REC=63%,RQD= 29%]		1140	
	R-1	RC	60	38				
25					HORNBLENDE GNEISS, black, white and gray, seamy, [REC=92%,RQD=87%]		1135	
	R-2	RC	60	55.5				
30					HORNBLENDE GNEISS, black, white and gray, [REC=98%,RQD=98%]			



CONTINUED ON NEXT PAGE.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 20 WS ☐ WD ☒	BORING STARTED 05/03/18	
WL(BCR) WL(ACR)	BORING COMPLETED 05/03/18	CAVE IN DEPTH
WL	RIG Dietrich D-50 FOREMAN John Dodd	DRILLING METHOD 2-1/4" Hollow Stem Auger

CLIENT	JOB #	BORING #	SHEET
AECOM	10:9815	WB2-1	2 OF 2

PROJECT NAME: Old Highway 41 Bridge Replacement - Wall 2

ARCHITECT-ENGINEER:

SITE LOCATION: Old Highway 41, Cobb County, GA

DOT PROJ. #: Cobb Co. DOT Project #: X2116

P.I. #:

STATION: 113+35,32'R

CALIBRATED PENETROMETER TONS/FT^2: 1 2 3 4 5+

ROCK QUALITY DESIGNATION & RECOVERY: RQD% 20% 40% 60% 80% 100% — REC.%

PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT %

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50+

ENGLISH UNITS

BOTTOM OF CASING ▰ LOSS OF CIRCULATION (100%)

SURFACE ELEVATION 1162

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	R-3	RC	60	59	HORNBLENDE GNEISS, black, white and gray, [REC=98%,RQD=98%]		1130	
35					END OF BORING @ 35'			
					*Note: Blows/6" are uncorrected field measurements. N-values have been corrected with 93% ER.		1125	
40							1120	
45							1115	
50							1110	
55							1105	
60								

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 20 WS ☐ WD ☒	BORING STARTED 05/03/18	
WL(BCR) WL(ACR)	BORING COMPLETED 05/03/18	CAVE IN DEPTH
WL	RIG Dietrich D-50 FOREMAN John Dodd	DRILLING METHOD 2-1/4" Hollow Stem Auger

CLIENT	JOB #	BORING #	SHEET
AECOM	10:9815	WB2-2	1 OF 1

PROJECT NAME: Old Highway 41 Bridge Replacement - Wall 2

ARCHITECT-ENGINEER:

SITE LOCATION: Old Highway 41, Cobb County, GA

DOT PROJ. #: Cobb Co. DOT Project #: X2116

P.I. #:

STATION: 113+02,30'L

CALIBRATED PENETROMETER TONS/FT^2: 1 2 3 4 5+

ROCK QUALITY DESIGNATION & RECOVERY: RQD% 20% 40% 60% 80% 100% — REC.%

PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT %

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

SURFACE ELEVATION 1145

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	2	2		1145	78/2
							50/2
5	R-1	RC	60	52		1140	
10	R-2	RC	60	58		1135	
15						1130	
20						1125	
25						1120	
30						1115	

(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SANDY SILT, contains slight mica and gravel fragments, gray, moist

HORNBLENDE GNEISS, black, white, and gray, seamy and fractured, [REC=87%,RQD= 43%]

HORNBLENDE GNEISS, black, white, and gray, [REC=97%,RQD=97%]

END OF BORING @ 13'

*Note: Blows/6" are uncorrected field measurements. N-values have been corrected with 93% ER.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 05/03/18	
WL(BCR) WL(ACR)	BORING COMPLETED 05/03/18	CAVE IN DEPTH
WL	RIG Dietrich D-50 FOREMAN John Dodd	DRILLING METHOD 2-1/4" Hollow Stem Auger

Laboratory Testing Summary

Sample Source	Sample Number	Depth (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Percent Passing No. 200 Sieve[4]	Moisture - Density (Corr.)[5]		CBR Value[6]	Other
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
BB-1												
	S-2	3.5 - 5.0	24.9	ML	46	38	8	96.1				
BB-2												
	S-2	3.5 - 5.0	32.4	SM				33.9				
WB1-2												
	S-3	6.0 - 7.5	30.9	ML				54.1				
WB1-3												
	S-2	3.5 - 5.0	24.3	ML				59.2				
WB2-1												
	S-2	3.5 - 5.0	29.1	MH Possible Fill	50	34	16	87.6				
	S-4	8.5 - 10.0	45.1	SM				46.7				

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content (ASTM D 2974)

Project No. 10:9815

Project Name: Old Highway 41 Bridge Replacement - BFI

ECS SOUTHEAST, LLP
1281 Kennestone Circle, NE, Suite 200
Marietta, GA 30066
Phone: (770) 590-1971
Fax: (770) 590-1975

ECS Southeast, LLP
1281 Kennestone Circle
Suite 200
Marietta, GA 30066
Phone: 770-590-1971
Fax: 770-590-1975

PHOTO LOG

Project Name: Old Highway 41 Bridge Replacement	Project Number: 10:9815
Project Location: Cobb County, Georgia	Date: 05/21/2018

Photo 1: Boring BB-1 (24'-28') Recovery = 56%, RQD = 24%

Photo 2: Boring BB-1 (28'-33') Recovery = 30%, RQD = 24%

ECS Southeast, LLP
1281 Kennestone Circle
Suite 200
Marietta, GA 30066
Phone: 770-590-1971
Fax: 770-590-1975

PHOTO LOG

Project Name: Old Highway 41 Bridge Replacement	Project Number: 10:9815
Project Location: Cobb County, Georgia	Date: 05/21/2018

Photo 3: Boring BB-1 (33'-38') Recovery = 80%, RQD = 47%

Photo 4: Boring BB-1 (38'-43') Recovery = 97%, RQD = 80%

ECS Southeast, LLP
1281 Kennestone Circle
Suite 200
Marietta, GA 30066
Phone: 770-590-1971
Fax: 770-590-1975

PHOTO LOG

Project Name: Old Highway 41 Bridge Replacement	Project Number: 10:9815
Project Location: Cobb County, Georgia	Date: 05/21/2018

Photo 1: Boring BB-2 (10'-15') Recovery = 57%, RQD = 10%

Photo 2: Boring BB-2 (15'-20') Recovery = 67%, RQD = 22%

ECS Southeast, LLP
1281 Kennestone Circle
Suite 200
Marietta, GA 30066
Phone: 770-590-1971
Fax: 770-590-1975

PHOTO LOG

Project Name: Old Highway 41 Bridge Replacement	Project Number: 10:9815
Project Location: Cobb County, Georgia	Date: 05/21/2018

Photo 3: Boring BB-2 (20'-25') Recovery = 68%, RQD = 26%

Photo 4: Boring BB-2 (25'-30') Recovery = 94%, RQD = 91%

ECS Southeast, LLP
1281 Kennestone Circle
Suite 200
Marietta, GA 30066
Phone: 770-590-1971
Fax: 770-590-1975

PHOTO LOG

Project Name: Old Highway 41 Bridge Replacement	Project Number: 10:9815
Project Location: Cobb County, Georgia	Date: 05/21/2018

Photo 5: Boring BB-2 (30'-35') Recovery = 100%, RQD = 100%

Photo 6: Boring BB-2 (35'-40') Recovery = 100%, RQD = 93%

ECS Southeast, LLP
1281 Kennestone Circle
Suite 200
Marietta, GA 30066
Phone: 770-590-1971
Fax: 770-590-1975

PHOTO LOG

Project Name: Old Highway 41 Bridge Replacement	Project Number: 10:9815
Project Location: Cobb County, Georgia	Date: 05/21/2018

Photo 1: Boring WB2-1 (20'-25') Recovery = 63%, RQD = 29%

Photo 2: Boring WB2-1 (25'-30') Recovery = 92%, RQD = 87%

ECS Southeast, LLP
1281 Kennestone Circle
Suite 200
Marietta, GA 30066
Phone: 770-590-1971
Fax: 770-590-1975

PHOTO LOG

Project Name: Old Highway 41 Bridge Replacement	Project Number: 10:9815
Project Location: Cobb County, Georgia	Date: 05/21/2018

Photo 3: Boring WB2-1 (30'-35') Recovery = 98%, RQD = 98%

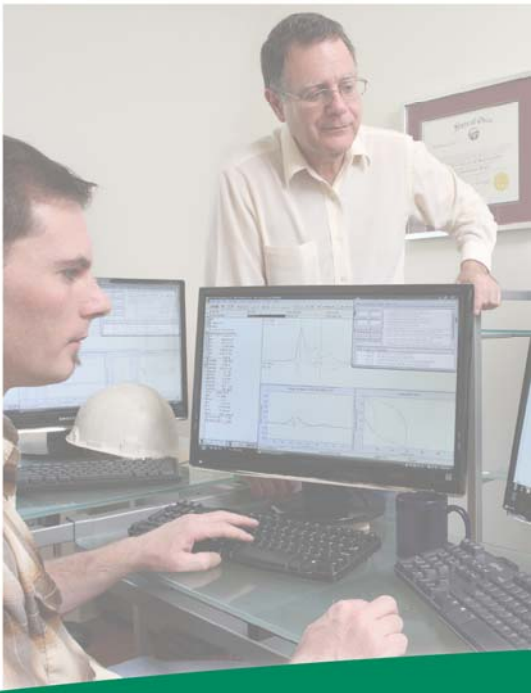
ECS Southeast, LLP
1281 Kennestone Circle
Suite 200
Marietta, GA 30066
Phone: 770-590-1971
Fax: 770-590-1975

PHOTO LOG

Project Name: Old Highway 41 Bridge Replacement	Project Number: 10:9815
Project Location: Cobb County, Georgia	Date: 05/21/2018

Photo 1: Boring WB2-2 (3'-8') Recovery = 87%, RQD = 43%

Photo 2: Boring WB2-2 (8'-13') Recovery = 97%, RQD = 97%



GRL engineers, inc.

Dynamic Measurements and Analyses

Job No. 179031-1

Report on: Standard Penetration Test Energy Measurements
Jonesboro, GA

Prepared for Big Dog Geotech

By Thomas G. Hyatt, P.E. and Joel S. Webster, E.I.

June 20, 2017

June 20, 2017

John Dodd
Big Dog Geotech
P.O. Box 928
Cumming, GA 30028

Re: Standard Penetration Test Energy Measurements
Jonesboro, GA GRL Job No. 179031-1

Dear Mr. Dodd,

This report presents results of energy measurements obtained on June 8, 2017 during Standard Penetration Tests (SPT) sampling. Two automatic hammers mounted on two separate Diedrich D-50 dill rigs that were tested generally following ASTM D4633-10 standards. All dynamic tests were performed on AWJ drill rods. GRL Engineers, Inc. obtained the dynamic measurements with an instrumented AW subsection that had AWJ adapters and a Model 8G Pile Driving Analyzer®. This report describes the testing procedures and summarizes the test results. Appendix A describes our measurement and analysis methods, Appendix B contains calibration information for the gages and equipment used, and Appendix C is a summary of the field data.

PURPOSE AND SCOPE OF WORK

At the request of Big Dog Geotech, GRL conducted SPT energy measurements in Jonesboro, GA according to ASTM D4633-10. Specifically, we recorded SPT energy measurements at five-foot sample intervals between 18.5 and 43.5 feet below the existing ground surface. SPT samples were taken every five feet from the ground surface until a boring depth of about 43.5 feet was reached. All SPT samples were driven for a total of 3 six-inch increments, or 1.5 feet.

EQUIPMENT

Drilling and SPT Hammer Equipment

Diedrich D-50 (Serial # 380)

SPT energy measurements were made on an automatic hammer mounted on a Diedrich D-50 drill rig. The drilling method used to advance the boring was hollow stem auger. Energy measurements for this drill rig were collected at a borehole located in Jonesboro, GA. SPT energy measurements were performed at 5-foot sampling intervals between 18.5 and 40.0 feet. A total of five energy measurement events were performed for this drill rig.

Diedrich D-50 (Serial # 404)

SPT energy measurements were made on an automatic hammer mounted on a Diedrich D-50 drill rig. The drilling method used to advance the boring was hollow stem auger. Energy measurements for this drill rig were collected at a borehole located in Jonesboro, GA. SPT energy measurements were performed at 5-foot sampling intervals between 18.5 and 43.5 feet. A total of six energy measurement events were performed for this drill rig. The SPT energy measurements performed from 33.5 to 40 feet did not meet the ASTM D4633-10 specifications for blow counts and were not considered in the calibration of this drill rig.

Instrumentation

A Model 8G Pile Driving Analyzer (PDA) data acquisition system (SN# 4613LE) was used to collect and process the dynamic measurements of force and velocity. The data was collected using a two foot long section of AW rod subsection (SN# 246AW) with a cross sectional area of 1.21 square inches and instrumented with two full bridge foil resistance strain gages and two piezoresistive accelerometers mounted in the midpoint location of the instrumented rod. Couplings were used to convert the threads from the AW rod subsection to the AWJ rod string.

Analog signals from the strain gages and accelerometers were conditioned, digitized, stored and processed with the PDA. The sampling frequency used during the SPT testing was 50 kHz. Selected output from the PDA for each recorded impact included the energy transfer ratio (ETR), maximum rod top velocity (VMX), maximum energy transfer (EFV), maximum rod top force (FMX), and the hammer operating rate (BPM).

MEASUREMENTS AND CALCULATIONS

FV Method (EFV)

Energy transfer to the PDA gage location, EFV, was computed by the PDA using force, F(t), and velocity, v(t), records as follows:

$$EFV = \int_a^b F(t) \cdot v(t) dt$$

The time "a" corresponds to the start of the record when the energy transfer begins, and "b" is the time at which energy transferred to the rod reaches a maximum value. The FV Method is currently recognized in ASTM D4633-10, and is the theoretically correct result; therefore, no other energy calculation methods are reported.

Corrected SPT number (N_{60})

While the primary purpose of SPT energy testing is to calculate the maximum transferred energy (ETR) of each hammer blow, the overall average EFV value can be used to calculate the corrected SPT number (N_{60}). To adjust the SPT N-values for hammer performance, the following correction as suggested by Seed for N-value adjustment to 60% transfer efficiency (e.g. 210 ft-pounds) was used:

Where:

N_{60} = Corrected N-value
E_m = overall average measured energy transfer (EFV)
N_m =number of blows for last 12 inches of sampler penetration

A general introduction to dynamic SPT testing methods is included in this report as Appendix A. References for more detailed descriptions of our testing and analysis methods are available upon request.

Any cross-sectional area difference between the GRL rod subsection and the drill rods, any loose connections or changes in area at section joints, or any cross-sectional area differences between the individual drill rod sections will result in stress wave reflections that can potentially influence the energy transfer. The EFV transferred energy calculation method, utilizing both force and velocity records, is theoretically correct and gives energy transfer results that are not adversely affected by cross-sectional area changes or loose connectors. The EFV results are included in Appendix C for all records collected and accepted after checking them for consistency.

RESULTS

Upon return to the office, the records collected by the PDA were checked for consistency and accuracy. For example, records from very weak startup or final impacts were not included in average results. Appendix C contains a representative plot of force and normalized velocity versus time, as well as tables of PDA results for all hammer blows at each dynamically monitored sampling depth. The results include the EFV (transferred energy by the FV method, as recommended by ASTM D4633-10), ETR (energy transfer efficiency for the EFV method), BPM (hammer operating rate), FMX (maximum rod top force) and VMX (maximum rod top velocity). The tables show statistical summaries for the final two 6 inch increments over which the SPT N value is calculated. At the end of each table is a statistical evaluation of these results which include the average and standard deviation.

$$N_{60} = \left(\frac{E_m}{210} \right) N_m$$

The table below and the summary tables in Appendix C summarize the average transferred energy values calculated by the EFV method. The records consist of averaged hammer blows from the last 12 inches (i.e. N value) at each dynamically monitored sampling depth. The "energy transfer ratio" (ETR) is defined as the ratio of maximum transferred energy EFV divided by the theoretical hammer potential energy of 350 ft-lbs (i.e., computed per the 140 lb SPT hammer and the standard 30 inch drop as specified by ASTM D1586-08). The average hammer operating rate is reported in blows per minute (BPM). A summary of the dynamic measurements of the energy transfer to the drill rods using the EFV equation is provided in the table below.

Drill Rig	Avg. EFV (ft-lbs)	Avg ETR (%)	Range of EFV (ft-lbs)	Range of ETR (%)
Diedrich D-50 SN 380	330	94	309 – 367	88 – 105
Diedrich D-50 SN 404	325	93	302 – 343	86 – 98

CONCLUSIONS

Based upon the dynamic test data obtained, the following conclusions are presented:

1. Loose connections in the drill string were sometimes observed in the force and velocity records. However, energy transfer values calculated using the EFV equation are not adversely affected by the connectors and therefore are considered a better indication of transferred energy.

2. Dynamic measurements of the transferred energy to the drill rods using the EFV equation ranged from 309 to 367 ft-lbs for the Diedrich D-50, SN 380 drill rig. This corresponds to a transfer efficiency ranging from 88 to 105% of the SPT hammer energy of 350 ft-lbs.

3. Dynamic measurements of the transferred energy to the drill rods using the EFV equation ranged from 302 to 343 ft-lbs for the Diedrich D-50, SN 404 drill rig. This corresponds to a transfer efficiency ranging from 86 to 98% of the SPT hammer energy of 350 ft-lbs.

4. The average transferred energy (EFV) and energy transfer ratio (ETR) for the Diedrich D-50 drill rigs tested was as follows:

   Diedrich D-50, SN 380: Average EFV = 330 ft-lbs; Average ETR = 94%

   Diedrich D-50, SN 404: Average EFV = 325 ft-lbs; Average ETR = 93%

Please review both ASTM D4633-10 and ASTM D1586-08 prior to applying these test results. The energy calibrations reported herein are valid for the same hammer/drill rig, with the same drill operator, same anvil dimensions, and same drilling methods.

We appreciate the opportunity to be of assistance to you on this project. Please contact our office should you have any questions regarding this submittal, require additional information, or if we may be of further service.

Sincerely,

GRL Engineers, Inc.

Thomas G. Hyatt, P.E.

Joel S. Webster, E.I.

TGH:JSW:dms

PROJECT NAME: Old Highway 41 Bridge Replacement

PROJECT NO.: 10:9815

N bar = **40**

Layer Top	Layer Top Elevation	Layer Bottom	N-values at Borings										N_{AVG}	D_i	D_i / N_{AV}
			BB-1												
0	1155	2.5	5										5.00	2.5	0.50
2.5		5	12										12.00	2.5	0.21
5		7.5	18										18.00	2.5	0.14
7.5		10	9										9.00	2.5	0.28
10		15	21										21.00	5	0.24
15		20	14										14.00	5	0.36
20		25	100										100.00	5	0.05
25		30	100										100.00	5	0.05
30		35	100										100.00	5	0.05
35		40	100										100.00	5	0.05
40		45	100										100.00	5	0.05
45		50	100										100.00	5	0.05
50		55	100										100.00	5	0.05
55		60	100										100.00	5	0.05
60		65	100										100.00	5	0.05
65		70	100										100.00	5	0.05
70		75	100										100.00	5	0.05
75		80	100										100.00	5	0.05
80		85	100										100.00	5	0.05
85		90	100										100.00	5	0.05
90		95	100										100.00	5	0.05
95		100	100										100.00	5	0.05
													76.32	**100**	**2.52**

N bar = **40**

SITE CLASS	SOIL PROFILE NAME	AVERAGE PROPERTIES IN TOP 100 ft, AS PER SECTION 1615.1.5		
		Soil shear wave velocity, Vs-bar, (ft/s)	Standard Penetration Resistance, N-bar	Soil Undrained Shear Strength, Su-bar , (psf)
A	Hard Rock	Vs-bar > 5,000	Not Applicable	Not Applicable
B	Rock	2,500 < Vs-bar ≤ 5,000	Not Applicable	Not Applicable
C	Very Dense Soil and Soft Rock	1,200 < Vs-bar ≤ 2,500	N-bar > 50	Su-bar ≥ 2000
D	Stiff Soil Profile	600 ≤ Vs-bar ≤ 1,200	15 ≤ N-bar ≤ 50	1,000 ≤ Su-bar ≤ 2000
E	Soft Soil Profile	Vs-bar < 600	N-bar < 15	Su-bar < 1,000
E	–	Any profile with more than 10 feet of soil having the following characteristics: 1. Plaxticity Index , PI > 20; 2. Moisture content , w ≥ 40%, and 3. Undrained shear strength, Su-bar < 500 psf		
F	–	Any profile containing soils having one or more of the following characteristics: 1. Soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils, quick and highly sensitive clays, collapsible weakly cemented soils. 2. Peats and/or highly organic clays (H > 10 ft or peat and/or highly organic caly where H = thickness of soil) 3. Very high plasticity clays (H> 25 ft with plasticity index PI > 75) 4. Very thick soft/medium stiff clays (H > 120 ft)		

PROJECT NAME: Old Highway 41 Bridge Replacement

PROJECT NO.: 10:9815

N bar = **64**

Layer Top	Layer Top Elevation	Layer Bottom	N-values at Borings										N_{AVG}	D_i	D_i / N_{AV}
			BB-2												
0	1160	2.5	6										6.00	2.5	0.42
2.5		5	25										25.00	2.5	0.10
5		7.5	20										20.00	2.5	0.13
7.5		10	100										100.00	2.5	0.03
10		15	100										100.00	5	0.05
15		20	100										100.00	5	0.05
20		25	100										100.00	5	0.05
25		30	100										100.00	5	0.05
30		35	100										100.00	5	0.05
35		40	100										100.00	5	0.05
40		45	100										100.00	5	0.05
45		50	100										100.00	5	0.05
50		55	100										100.00	5	0.05
55		60	100										100.00	5	0.05
60		65	100										100.00	5	0.05
65		70	100										100.00	5	0.05
70		75	100										100.00	5	0.05
75		80	100										100.00	5	0.05
80		85	100										100.00	5	0.05
85		90	100										100.00	5	0.05
90		95	100										100.00	5	0.05
95		100	100										100.00	5	0.05
													88.68	**100**	**1.57**

N bar = **64**

SITE CLASS	SOIL PROFILE NAME	AVERAGE PROPERTIES IN TOP 100 ft, AS PER SECTION 1615.1.5		
		Soil shear wave velocity, Vs-bar, (ft/s)	Standard Penetration Resistance, N-bar	Soil Undrained Shear Strength, Su-bar , (psf)
A	Hard Rock	Vs-bar > 5,000	Not Applicable	Not Applicable
B	Rock	2,500 < Vs-bar ≤ 5,000	Not Applicable	Not Applicable
C	Very Dense Soil and Soft Rock	1,200 < Vs-bar ≤ 2,500	N-bar > 50	Su-bar ≥ 2000
D	Stiff Soil Profile	600 ≤ Vs-bar ≤ 1,200	15 ≤ N-bar ≤ 50	1,000 ≤ Su-bar ≤ 2000
E	Soft Soil Profile	Vs-bar < 600	N-bar < 15	Su-bar < 1,000
E	–	Any profile with more than 10 feet of soil having the following characteristics: 1. Plaxticity Index , PI > 20; 2. Moisture content , w ≥ 40%, and 3. Undrained shear strength, Su-bar < 500 psf		
F	–	Any profile containing soils having one or more of the following characteristics: 1. Soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils, quick and highly sensitive clays, collapsible weakly cemented soils. 2. Peats and/or highly organic clays (H > 10 ft or peat and/or highly organic caly where H = thickness of soil) 3. Very high plasticity clays (H> 25 ft with plasticity index PI > 75) 4. Very thick soft/medium stiff clays (H > 120 ft)		

Nominal Pile Driving Resistance - C10.7.3.7

Project Name:	Old Highway 41 Bridge Replacement
Project Number:	10:9815
Project Location:	Cobb County
Boring Number:	WB1-2
Bent (EB/IB):	EB Bent 1
Pile Type:	H-Pile 14X117

Factored Load:

Nominal Pile Driving Resistance	Rndr		
Resistance Factor (10.5.5.2.3.1)	phi(dyn)	0.65	PDA
Load factor for downdrag (1.05, 3.4.1-2)	yp		
Downdrag load per pile (10.7.3.7)	DD		
Side resistance for the down drag zone (10.7.3.7)	Rsdd		
Side resistance for the scour zone (10.7.3.6)	Rsscour		

Rndr = (Factored Load/phi(dyn))+((yp*DD)/phi(dyn))+Rsdd+Rsscour

Rndr (Service Limit State)	502	Rndr(Strength Limit State)	713
phi(dyn)	0.65	phi(dyn)	0.65
yp	0.75	yp	0.75
DD	28	DD	28
Rsdd	16.3	Rsdd	16.3
Rsscour	0	Rsscour	0
Factored Load	295	Factored Load	432

Nominal Pile Driving Resistance - C10.7.3.7

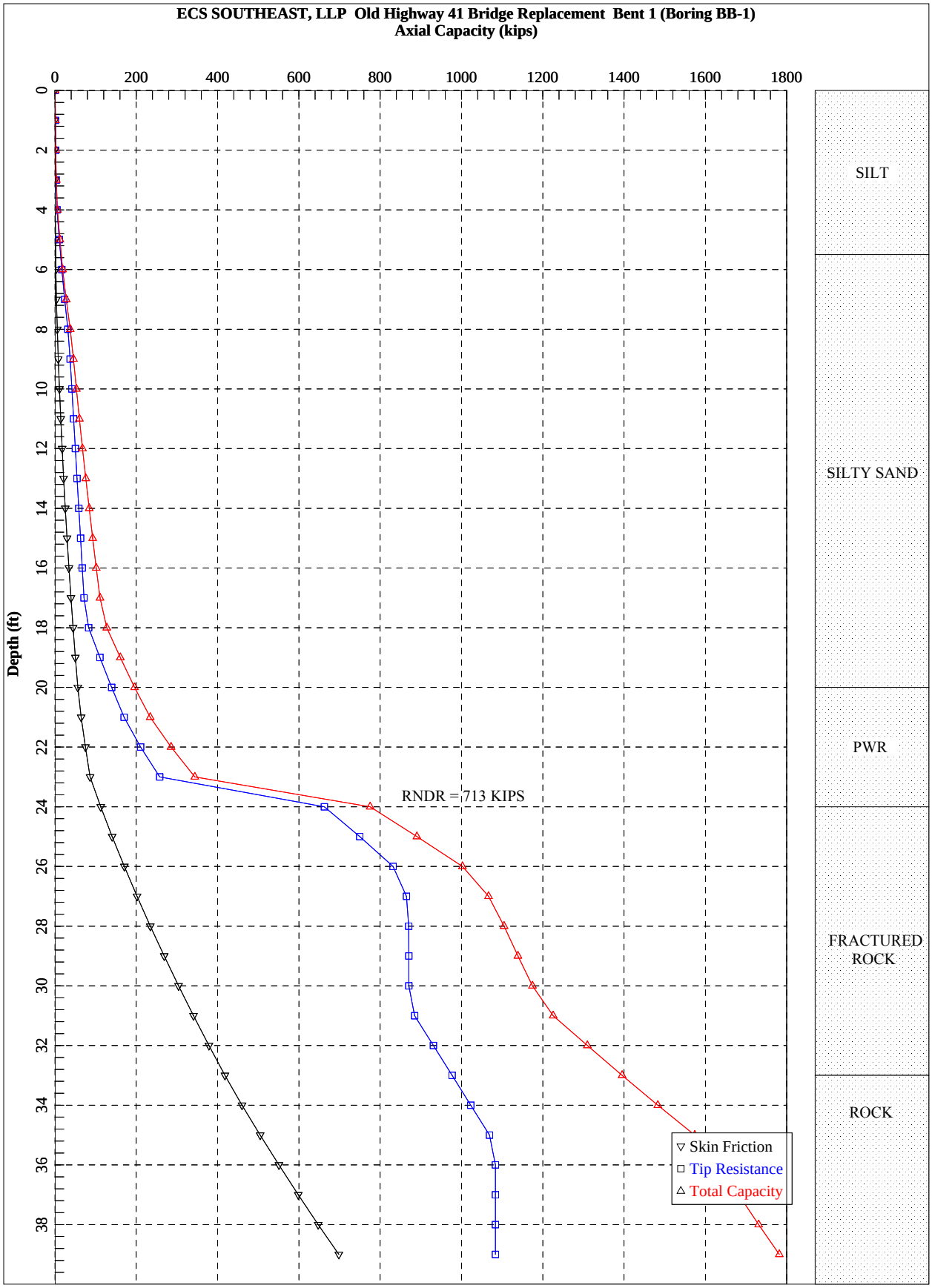
Project Name:	Old Highway 41 Bridge Replacement
Project Number:	10:9815
Project Location:	Cobb County
Boring Number:	BB-2
Bent (EB/IB):	EB Bent 2
Pile Type:	H-Pile 14X117

Factored Load:

Nominal Pile Driving Resistance	Rndr		
Resistance Factor (10.5.5.2.3.1)	phi(dyn)	0.65	PDA
Load factor for downdrag (1.05, 3.4.1-2)	yp		
Downdrag load per pile (10.7.3.7)	DD		
Side resistance for the down drag zone (10.7.3.7)	Rsdd		
Side resistance for the scour zone (10.7.3.6)	Rsscour		

Rndr = (Factored Load/phi(dyn))+((yp*DD)/phi(dyn))+Rsdd+Rsscour

Rndr (Service Limit State)	454	Rndr(Strength Limit State)	665
phi(dyn)	0.65	phi(dyn)	0.65
yp	0.75	yp	0.75
DD	0	DD	0
Rsdd	0	Rsdd	0
Rsscour	0	Rsscour	0
Factored Load	295	Factored Load	432


ECS SOUTHEAST, LLP Old Highway 41 Bridge Replacement Bent 1 (Boring BB-1)
Axial Capacity (kips)
0
200
400
600
800
1000
1200
1400
1600
1800
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
SILT
SILTY SAND
PWR
FRACTURED ROCK
ROCK
RNDR = 713 KIPS
Skin Friction
Tip Resistance
Total Capacity

APILE for Windows, Version 2015.7.4

Serial Number : 166870365

A Program for Analyzing the Axial Capacity
and Short-term Settlement of Driven Piles
under Axial Loading.

This program is licensed to :

ECS Southeast, LLC.
Marietta, GA

Path to file locations : I:\GEOTECH\REPORTS\9751-10000\9815 Old Highway 41 Bridge over CSX RR\APILE\
Name of input data file : 9815, Boring BB-1- Rev1-19.ap7d
Name of output file : 9815, Boring BB-1- Rev1-19.ap7o
Name of plot output file : 9815, Boring BB-1- Rev1-19.ap7p

Time and Date of Analysis

Date: January 10, 2019 Time: 10:34:28

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* INPUT INFORMATION *

Old Highway 41 Bridge Replacement Boring BB-1 (Bent 1)

DESIGNER : Robert Barnes

JOB NUMBER : Cobb DOT Project No.: X2116

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 = 34.40 IN2

NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL = 60.00 FT.
- PILE STICKUP LENGTH, PSL = 20.50 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- PERIMETER OF PILE = 58.19 IN.
- TIP AREA OF PILE = 211.52 IN2
- INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	115.00	28.00	0.00
5.50	SAND	0.00	115.00	28.00	0.00
5.50	SAND	0.00	120.00	36.00	0.00
20.00	SAND	0.00	120.00	36.00	0.00
20.00	SAND	0.00	130.00	40.00	0.00
24.00	SAND	0.00	130.00	40.00	0.00
24.00	SAND	0.00	140.00	42.00	0.00
33.00	SAND	0.00	140.00	42.00	0.00
33.00	SAND	0.00	150.00	45.00	0.00
50.00	SAND	0.00	150.00	45.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING 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
0.14E+02	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.14E+02	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.40E+02	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.40E+02	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.60E+02	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.60E+02	0.10E+08*	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.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	0.450	0.450
5.50	0.450	0.450
5.50	0.450	0.450
20.00	0.450	0.450
20.00	0.450	0.450
24.00	0.450	0.450
24.00	1.000	1.000
33.00	1.000	1.000
33.00	1.000	1.000
50.00	1.000	1.000

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* COMPUTATION RESULT *
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* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.5	0.5
1.00	0.1	1.0	1.1
2.00	0.2	1.8	2.0
3.00	0.5	2.8	3.3
4.00	1.0	5.0	6.0
5.00	1.5	10.7	12.2
6.00	2.2	17.0	19.1
7.00	3.5	24.0	27.6
8.00	5.8	31.8	37.6
9.00	8.3	37.3	45.6
10.00	11.1	41.6	52.7
11.00	14.2	45.9	60.1
12.00	17.7	50.1	67.8
13.00	21.4	54.4	75.8
14.00	25.5	58.7	84.2
15.00	29.8	62.9	92.8
16.00	34.5	67.2	101.7
17.00	39.4	71.5	110.9
18.00	44.7	82.9	127.6
19.00	50.3	110.6	160.9
20.00	56.2	139.6	195.8
21.00	64.4	170.0	234.4
22.00	75.1	210.6	285.8
23.00	86.4	257.6	344.0
24.00	112.7	662.8	775.5
25.00	140.7	749.7	890.5
26.00	170.7	831.7	1002.4
27.00	202.0	864.7	1066.7
28.00	234.7	870.1	1104.8

29.00	268.7	870.4	1139.1
30.00	304.1	870.4	1174.5
31.00	340.8	884.9	1225.7
32.00	378.9	930.9	1309.8
33.00	418.3	976.9	1395.2
34.00	460.2	1022.9	1483.2
35.00	504.8	1068.9	1573.7
36.00	550.9	1083.5	1634.3
37.00	598.5	1083.5	1682.0
38.00	647.7	1083.5	1731.1
39.00	698.3	1083.5	1781.8

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.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.5723E-01	0.1000E-01
			0.1145E+00	0.2000E-01
			0.2289E+00	0.4000E-01
			0.3434E+00	0.6000E-01
			0.4579E+00	0.8000E-01
			0.5151E+00	0.9000E-01
			0.5723E+00	0.1000E+00
			0.5723E+00	0.5000E+00
			0.5723E+00	0.2000E+01
2	10	0.2775E+01		
			0.0000E+00	0.0000E+00
			0.1145E+00	0.1000E-01
			0.2289E+00	0.2000E-01
			0.4579E+00	0.4000E-01
			0.6868E+00	0.6000E-01
			0.9157E+00	0.8000E-01
			0.1030E+01	0.9000E-01
			0.1145E+01	0.1000E+00
			0.1145E+01	0.5000E+00
			0.1145E+01	0.2000E+01
3	10	0.5458E+01		
			0.0000E+00	0.0000E+00
			0.3262E+00	0.1000E-01
			0.6525E+00	0.2000E-01
			0.1305E+01	0.4000E-01
			0.1957E+01	0.6000E-01
			0.2610E+01	0.8000E-01
			0.2936E+01	0.9000E-01
			0.3262E+01	0.1000E+00
			0.3262E+01	0.5000E+00
			0.3262E+01	0.2000E+01
4	10	0.5500E+01		

			0.0000E+00	0.0000E+00
			0.3262E+00	0.1000E-01
			0.6525E+00	0.2000E-01
			0.1305E+01	0.4000E-01
			0.1957E+01	0.6000E-01
			0.2610E+01	0.8000E-01
			0.2936E+01	0.9000E-01
			0.3262E+01	0.1000E+00
			0.3262E+01	0.5000E+00
			0.3262E+01	0.2000E+01
5	10	0.1278E+02		
			0.0000E+00	0.0000E+00
			0.1240E+01	0.1000E-01
			0.2479E+01	0.2000E-01
			0.4959E+01	0.4000E-01
			0.7438E+01	0.6000E-01
			0.9918E+01	0.8000E-01
			0.1116E+02	0.9000E-01
			0.1240E+02	0.1000E+00
			0.1240E+02	0.5000E+00
			0.1240E+02	0.2000E+01
6	10	0.1996E+02		
			0.0000E+00	0.0000E+00
			0.2248E+01	0.1000E-01
			0.4496E+01	0.2000E-01
			0.8991E+01	0.4000E-01
			0.1349E+02	0.6000E-01
			0.1798E+02	0.8000E-01
			0.2023E+02	0.9000E-01
			0.2248E+02	0.1000E+00
			0.2248E+02	0.5000E+00
			0.2248E+02	0.2000E+01
7	10	0.2000E+02		
			0.0000E+00	0.0000E+00
			0.3019E+01	0.1000E-01
			0.6038E+01	0.2000E-01
			0.1208E+02	0.4000E-01
			0.1811E+02	0.6000E-01
			0.2415E+02	0.8000E-01
			0.2717E+02	0.9000E-01
			0.3019E+02	0.1000E+00
			0.3019E+02	0.5000E+00
			0.3019E+02	0.2000E+01
8	10	0.2203E+02		
			0.0000E+00	0.0000E+00
			0.3673E+01	0.1000E-01
			0.7347E+01	0.2000E-01
			0.1469E+02	0.4000E-01
			0.2204E+02	0.6000E-01
			0.2939E+02	0.8000E-01
			0.3306E+02	0.9000E-01
			0.3673E+02	0.1000E+00
			0.3673E+02	0.5000E+00
			0.3673E+02	0.2000E+01
9	10	0.2396E+02		
			0.0000E+00	0.0000E+00
			0.3890E+01	0.1000E-01
			0.7780E+01	0.2000E-01
			0.1556E+02	0.4000E-01
			0.2334E+02	0.6000E-01
			0.3112E+02	0.8000E-01
			0.3501E+02	0.9000E-01
			0.3890E+02	0.1000E+00

			0.3890E+02	0.5000E+00
			0.3890E+02	0.2000E+01
10	10	0.2400E+02		
			0.0000E+00	0.0000E+00
			0.4155E+01	0.1000E-01
			0.8310E+01	0.2000E-01
			0.1662E+02	0.4000E-01
			0.2493E+02	0.6000E-01
			0.3324E+02	0.8000E-01
			0.3739E+02	0.9000E-01
			0.4155E+02	0.1000E+00
			0.4155E+02	0.5000E+00
			0.4155E+02	0.2000E+01
11	10	0.2853E+02		
			0.0000E+00	0.0000E+00
			0.4968E+01	0.1000E-01
			0.9936E+01	0.2000E-01
			0.1987E+02	0.4000E-01
			0.2981E+02	0.6000E-01
			0.3975E+02	0.8000E-01
			0.4471E+02	0.9000E-01
			0.4968E+02	0.1000E+00
			0.4968E+02	0.5000E+00
			0.4968E+02	0.2000E+01
12	10	0.3296E+02		
			0.0000E+00	0.0000E+00
			0.5827E+01	0.1000E-01
			0.1165E+02	0.2000E-01
			0.2331E+02	0.4000E-01
			0.3496E+02	0.6000E-01
			0.4662E+02	0.8000E-01
			0.5244E+02	0.9000E-01
			0.5827E+02	0.1000E+00
			0.5827E+02	0.5000E+00
			0.5827E+02	0.2000E+01
13	10	0.3300E+02		
			0.0000E+00	0.0000E+00
			0.6195E+01	0.1000E-01
			0.1239E+02	0.2000E-01
			0.2478E+02	0.4000E-01
			0.3717E+02	0.6000E-01
			0.4956E+02	0.8000E-01
			0.5576E+02	0.9000E-01
			0.6195E+02	0.1000E+00
			0.6195E+02	0.5000E+00
			0.6195E+02	0.2000E+01
14	10	0.4153E+02		
			0.0000E+00	0.0000E+00
			0.7258E+01	0.1000E-01
			0.1452E+02	0.2000E-01
			0.2903E+02	0.4000E-01
			0.4355E+02	0.6000E-01
			0.5806E+02	0.8000E-01
			0.6532E+02	0.9000E-01
			0.7258E+02	0.1000E+00
			0.7258E+02	0.5000E+00
			0.7258E+02	0.2000E+01
15	10	0.4996E+02		
			0.0000E+00	0.0000E+00
			0.7258E+01	0.1000E-01
			0.1452E+02	0.2000E-01
			0.2903E+02	0.4000E-01
			0.4355E+02	0.6000E-01

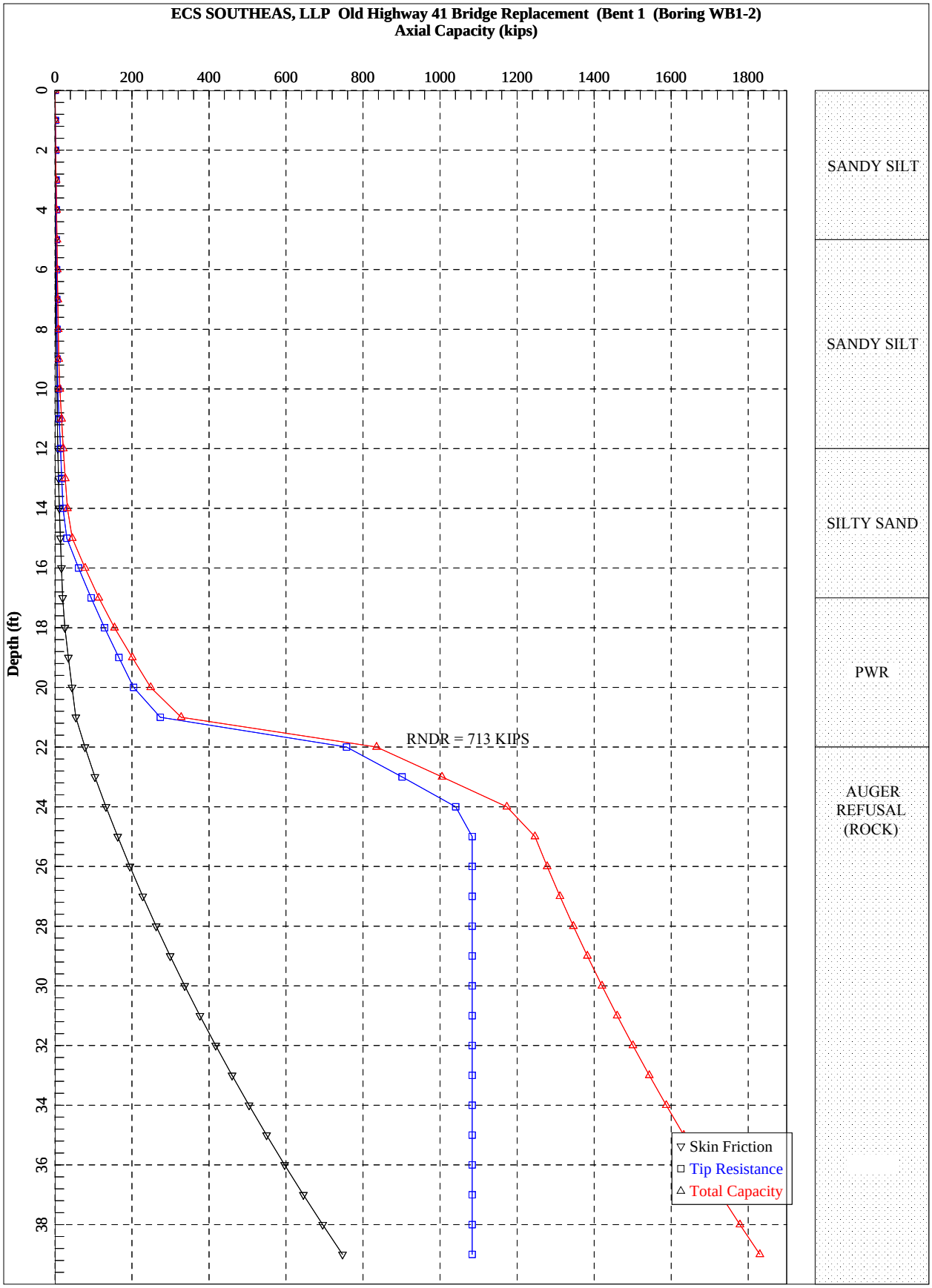
0.5806E+02	0.8000E-01
0.6532E+02	0.9000E-01
0.7258E+02	0.1000E+00
0.7258E+02	0.5000E+00
0.7258E+02	0.2000E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.6772E+02	0.9261E-02
0.1354E+03	0.1852E-01
0.2709E+03	0.3704E-01
0.5417E+03	0.2408E+00
0.8126E+03	0.7779E+00
0.9751E+03	0.1352E+01
0.1083E+04	0.1852E+01
0.1083E+04	0.2778E+01
0.1083E+04	0.3704E+01

LOAD VERSUS SETTLEMENT CURVE

****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.2916E+01	0.1779E-02	0.7312E+00	0.1000E-03
0.3015E+02	0.1828E-01	0.7312E+01	0.1000E-02
0.1534E+03	0.9295E-01	0.3656E+02	0.5000E-02
0.3068E+03	0.1859E+00	0.7312E+02	0.1000E-01
0.1009E+04	0.6696E+00	0.2881E+03	0.5000E-01
0.1198E+04	0.8513E+00	0.3546E+03	0.1000E+00
0.1516E+04	0.1481E+01	0.6724E+03	0.5000E+00
0.1719E+04	0.2127E+01	0.8754E+03	0.1000E+01
0.1927E+04	0.3277E+01	0.1083E+04	0.2000E+01


ECS SOUTHEAS, LLP Old Highway 41 Bridge Replacement (Bent 1 (Boring WB1-2)
Axial Capacity (kips)
0
200
400
600
800
1000
1200
1400
1600
1800
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
SANDY SILT
SANDY SILT
SILTY SAND
PWR
AUGER REFUSAL (ROCK)
RNDR = 713 KIPS
Skin Friction
Tip Resistance
Total Capacity

APILE for Windows, Version 2015.7.4

Serial Number : 166870365

A Program for Analyzing the Axial Capacity
and Short-term Settlement of Driven Piles
under Axial Loading.

This program is licensed to :

ECS Southeast, LLC.
Marietta, GA

Path to file locations : I:\GEOTECH\REPORTS\9751-10000\9815 Old Highway 41 Bridge over CSX RR\APILE\
Name of input data file : 9815, Boring WB1-2wDD.ap7d
Name of output file : 9815, Boring WB1-2wDD.ap7o
Name of plot output file : 9815, Boring WB1-2wDD.ap7p

Time and Date of Analysis

Date: January 11, 2019 Time: 10:36:57

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****
* INPUT INFORMATION *
****

Old Highway 41 Bridge Replacement Boring WB1-2 (Bent 1)

DESIGNER : Robert Barnes

JOB NUMBER : Cobb DOT Project No.: X2116

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 = 34.40 IN2

NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL = 60.00 FT.
- PILE STICKUP LENGTH, PSL = 20.50 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- PERIMETER OF PILE = 58.19 IN.
- TIP AREA OF PILE = 211.52 IN2
- INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	115.00	28.00	0.00
5.00	SAND	0.00	115.00	28.00	0.00
5.00	SAND	0.00	110.00	26.00	0.00
12.00	SAND	0.00	110.00	26.00	0.00
12.00	SAND	0.00	120.00	32.00	0.00
17.00	SAND	0.00	120.00	32.00	0.00
17.00	SAND	0.00	130.00	40.00	0.00
22.00	SAND	0.00	130.00	40.00	0.00
22.00	SAND	0.00	150.00	45.00	0.00
50.00	SAND	0.00	150.00	45.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING 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+02	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+02	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.60E+02	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.60E+02	0.10E+08*	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.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	0.450	0.450
5.00	0.450	0.450
5.00	0.450	0.450
12.00	0.450	0.450
12.00	0.450	0.450
17.00	0.450	0.450
17.00	0.450	0.450
22.00	0.450	0.450
22.00	1.000	1.000
50.00	1.000	1.000

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****
* COMPUTATION RESULT *
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****
* FED. HWY. METHOD *
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PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.5	0.5
1.00	0.1	1.0	1.1
2.00	0.2	1.8	2.0
3.00	0.5	2.7	3.2
4.00	1.0	3.3	4.2
5.00	1.5	3.8	5.3
6.00	2.1	4.2	6.3
7.00	2.7	4.6	7.3
8.00	3.5	5.1	8.6
9.00	4.3	5.7	10.0
10.00	5.2	7.3	12.5
11.00	6.2	10.9	17.1
12.00	7.3	14.4	21.7
13.00	9.1	17.7	26.7
14.00	11.5	20.8	32.3
15.00	14.1	30.9	45.1
16.00	16.9	61.4	78.3
17.00	19.9	94.0	113.9
18.00	25.8	128.9	154.7
19.00	34.8	166.0	200.8
20.00	44.3	204.3	248.5
21.00	54.3	273.6	327.9
22.00	77.8	757.2	835.0
23.00	103.8	901.3	1005.2
24.00	132.6	1040.6	1173.2
25.00	162.8	1083.5	1246.3
26.00	194.6	1083.5	1278.1
27.00	227.9	1083.5	1311.4
28.00	262.8	1083.5	1346.2

29.00	299.1	1083.5	1382.6
30.00	337.0	1083.5	1420.5
31.00	376.4	1083.5	1459.9
32.00	417.4	1083.5	1500.8
33.00	459.9	1083.5	1543.3
34.00	503.9	1083.5	1587.3
35.00	549.4	1083.5	1632.9
36.00	596.5	1083.5	1679.9
37.00	645.1	1083.5	1728.5
38.00	695.2	1083.5	1778.6
39.00	746.8	1083.5	1830.3

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.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.5723E-01	0.1000E-01
			0.1145E+00	0.2000E-01
			0.2289E+00	0.4000E-01
			0.3434E+00	0.6000E-01
			0.4579E+00	0.8000E-01
			0.5151E+00	0.9000E-01
			0.5723E+00	0.1000E+00
			0.5723E+00	0.5000E+00
			0.5723E+00	0.2000E+01
2	10	0.2525E+01		
			0.0000E+00	0.0000E+00
			0.1145E+00	0.1000E-01
			0.2289E+00	0.2000E-01
			0.4579E+00	0.4000E-01
			0.6868E+00	0.6000E-01
			0.9157E+00	0.8000E-01
			0.1030E+01	0.9000E-01
			0.1145E+01	0.1000E+00
			0.1145E+01	0.5000E+00
			0.1145E+01	0.2000E+01
3	10	0.4958E+01		
			0.0000E+00	0.0000E+00
			0.1803E+00	0.1000E-01
			0.3607E+00	0.2000E-01
			0.7214E+00	0.4000E-01
			0.1082E+01	0.6000E-01
			0.1443E+01	0.8000E-01
			0.1623E+01	0.9000E-01
			0.1803E+01	0.1000E+00
			0.1803E+01	0.5000E+00
			0.1803E+01	0.2000E+01
4	10	0.5000E+01		

			0.0000E+00	0.0000E+00
			0.1956E+00	0.1000E-01
			0.3912E+00	0.2000E-01
			0.7824E+00	0.4000E-01
			0.1174E+01	0.6000E-01
			0.1565E+01	0.8000E-01
			0.1760E+01	0.9000E-01
			0.1956E+01	0.1000E+00
			0.1956E+01	0.5000E+00
			0.1956E+01	0.2000E+01
5	10	0.8525E+01		
			0.0000E+00	0.0000E+00
			0.2774E+00	0.1000E-01
			0.5548E+00	0.2000E-01
			0.1110E+01	0.4000E-01
			0.1664E+01	0.6000E-01
			0.2219E+01	0.8000E-01
			0.2496E+01	0.9000E-01
			0.2774E+01	0.1000E+00
			0.2774E+01	0.5000E+00
			0.2774E+01	0.2000E+01
6	10	0.1196E+02		
			0.0000E+00	0.0000E+00
			0.4537E+00	0.1000E-01
			0.9075E+00	0.2000E-01
			0.1815E+01	0.4000E-01
			0.2722E+01	0.6000E-01
			0.3630E+01	0.8000E-01
			0.4084E+01	0.9000E-01
			0.4537E+01	0.1000E+00
			0.4537E+01	0.5000E+00
			0.4537E+01	0.2000E+01
7	10	0.1200E+02		
			0.0000E+00	0.0000E+00
			0.6638E+00	0.1000E-01
			0.1328E+01	0.2000E-01
			0.2655E+01	0.4000E-01
			0.3983E+01	0.6000E-01
			0.5310E+01	0.8000E-01
			0.5974E+01	0.9000E-01
			0.6638E+01	0.1000E+00
			0.6638E+01	0.5000E+00
			0.6638E+01	0.2000E+01
8	10	0.1453E+02		
			0.0000E+00	0.0000E+00
			0.8639E+00	0.1000E-01
			0.1728E+01	0.2000E-01
			0.3456E+01	0.4000E-01
			0.5183E+01	0.6000E-01
			0.6911E+01	0.8000E-01
			0.7775E+01	0.9000E-01
			0.8639E+01	0.1000E+00
			0.8639E+01	0.5000E+00
			0.8639E+01	0.2000E+01
9	10	0.1696E+02		
			0.0000E+00	0.0000E+00
			0.1414E+01	0.1000E-01
			0.2829E+01	0.2000E-01
			0.5657E+01	0.4000E-01
			0.8486E+01	0.6000E-01
			0.1131E+02	0.8000E-01
			0.1273E+02	0.9000E-01
			0.1414E+02	0.1000E+00

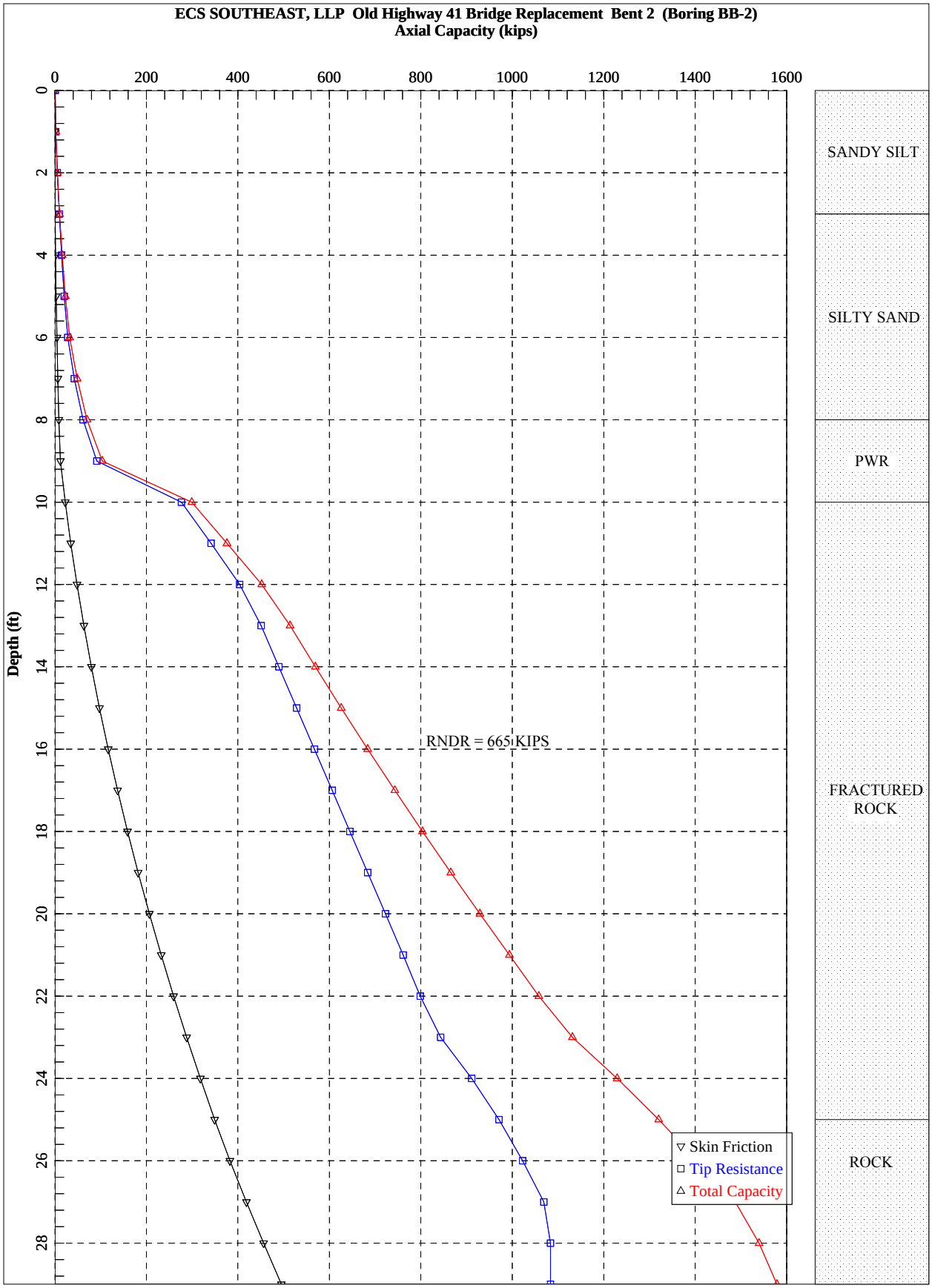
		0.1414E+02	0.5000E+00
		0.1414E+02	0.2000E+01
10	10	0.1700E+02	
		0.0000E+00	0.0000E+00
		0.2361E+01	0.1000E-01
		0.4722E+01	0.2000E-01
		0.9444E+01	0.4000E-01
		0.1417E+02	0.6000E-01
		0.1889E+02	0.8000E-01
		0.2125E+02	0.9000E-01
		0.2361E+02	0.1000E+00
		0.2361E+02	0.5000E+00
		0.2361E+02	0.2000E+01
11	10	0.1953E+02	
		0.0000E+00	0.0000E+00
		0.3108E+01	0.1000E-01
		0.6216E+01	0.2000E-01
		0.1243E+02	0.4000E-01
		0.1865E+02	0.6000E-01
		0.2486E+02	0.8000E-01
		0.2797E+02	0.9000E-01
		0.3108E+02	0.1000E+00
		0.3108E+02	0.5000E+00
		0.3108E+02	0.2000E+01
12	10	0.2196E+02	
		0.0000E+00	0.0000E+00
		0.3548E+01	0.1000E-01
		0.7097E+01	0.2000E-01
		0.1419E+02	0.4000E-01
		0.2129E+02	0.6000E-01
		0.2839E+02	0.8000E-01
		0.3193E+02	0.9000E-01
		0.3548E+02	0.1000E+00
		0.3548E+02	0.5000E+00
		0.3548E+02	0.2000E+01
13	10	0.2200E+02	
		0.0000E+00	0.0000E+00
		0.3922E+01	0.1000E-01
		0.7843E+01	0.2000E-01
		0.1569E+02	0.4000E-01
		0.2353E+02	0.6000E-01
		0.3137E+02	0.8000E-01
		0.3529E+02	0.9000E-01
		0.3922E+02	0.1000E+00
		0.3922E+02	0.5000E+00
		0.3922E+02	0.2000E+01
14	10	0.3603E+02	
		0.0000E+00	0.0000E+00
		0.7068E+01	0.1000E-01
		0.1414E+02	0.2000E-01
		0.2827E+02	0.4000E-01
		0.4241E+02	0.6000E-01
		0.5654E+02	0.8000E-01
		0.6361E+02	0.9000E-01
		0.7068E+02	0.1000E+00
		0.7068E+02	0.5000E+00
		0.7068E+02	0.2000E+01
15	10	0.4996E+02	
		0.0000E+00	0.0000E+00
		0.7396E+01	0.1000E-01
		0.1479E+02	0.2000E-01
		0.2958E+02	0.4000E-01
		0.4438E+02	0.6000E-01

0.5917E+02	0.8000E-01
0.6657E+02	0.9000E-01
0.7396E+02	0.1000E+00
0.7396E+02	0.5000E+00
0.7396E+02	0.2000E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.6772E+02	0.9261E-02
0.1354E+03	0.1852E-01
0.2709E+03	0.3704E-01
0.5417E+03	0.2408E+00
0.8126E+03	0.7779E+00
0.9751E+03	0.1352E+01
0.1083E+04	0.1852E+01
0.1083E+04	0.2778E+01
0.1083E+04	0.3704E+01

LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.2869E+01	0.1792E-02	0.7312E+00	0.1000E-03
0.2978E+02	0.1848E-01	0.7312E+01	0.1000E-02
0.1511E+03	0.9375E-01	0.3656E+02	0.5000E-02
0.3021E+03	0.1875E+00	0.7312E+02	0.1000E-01
0.1028E+04	0.6877E+00	0.2881E+03	0.5000E-01
0.1223E+04	0.8735E+00	0.3546E+03	0.1000E+00
0.1541E+04	0.1503E+01	0.6724E+03	0.5000E+00
0.1744E+04	0.2149E+01	0.8754E+03	0.1000E+01
0.1952E+04	0.3300E+01	0.1083E+04	0.2000E+01


ECS SOUTHEAST, LLP Old Highway 41 Bridge Replacement Bent 2 (Boring BB-2)
Axial Capacity (kips)
0
200
400
600
800
1000
1200
1400
1600
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
RNDR = 665 KIPS
SANDY SILT
SILTY SAND
PWR
FRACTURED ROCK
ROCK
Skin Friction
Tip Resistance
Total Capacity

APILE for Windows, Version 2015.7.4

Serial Number : 166870365

A Program for Analyzing the Axial Capacity
and Short-term Settlement of Driven Piles
under Axial Loading.

This program is licensed to :

ECS Southeast, LLC.
Marietta, GA

Path to file locations : I:\GEOTECH\REPORTS\9751-10000\9815 Old Highway 41 Bridge over CSX RR\APILE\
Name of input data file : 9815, Boring BB-2-Rev1-19.ap7d
Name of output file : 9815, Boring BB-2-Rev1-19.ap7o
Name of plot output file : 9815, Boring BB-2-Rev1-19.ap7p

Time and Date of Analysis

Date: January 10, 2019 Time: 11:07:14

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* INPUT INFORMATION *

Old Highway 41 Bridge Replacement Boring BB-2 (Bent 2)

DESIGNER : Robert Barnes

JOB NUMBER : Cobb DOT Project No.: X2116

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 = 34.40 IN2

NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL = 45.00 FT.
- PILE STICKUP LENGTH, PSL = 16.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- PERIMETER OF PILE = 58.19 IN.
- TIP AREA OF PILE = 211.52 IN2
- INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	115.00	28.00	0.00
3.00	SAND	0.00	115.00	28.00	0.00
3.00	SAND	0.00	120.00	36.00	0.00
8.00	SAND	0.00	120.00	36.00	0.00
8.00	SAND	0.00	130.00	40.00	0.00
10.00	SAND	0.00	130.00	40.00	0.00
10.00	SAND	0.00	140.00	42.00	0.00
25.00	SAND	0.00	140.00	42.00	0.00
25.00	SAND	0.00	150.00	45.00	0.00
40.00	SAND	0.00	150.00	45.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING 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
0.10E+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

* 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.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	0.450	0.450
3.00	0.450	0.450
3.00	0.450	0.450
8.00	0.450	0.450
8.00	0.450	0.450
10.00	0.450	0.450
10.00	1.000	1.000
25.00	1.000	1.000
25.00	1.000	1.000
40.00	1.000	1.000

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****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.5	0.5
1.00	0.1	1.7	1.7
2.00	0.2	5.1	5.3
3.00	0.5	9.5	10.0
4.00	1.3	14.5	15.8
5.00	2.6	20.2	22.8
6.00	4.3	28.0	32.2
7.00	6.2	42.2	48.5
8.00	8.5	61.6	70.1
9.00	11.9	91.6	103.5
10.00	22.5	276.4	299.0
11.00	34.6	341.5	376.1
12.00	48.3	403.8	452.1
13.00	63.3	450.8	514.1
14.00	79.7	489.6	569.3
15.00	97.4	528.5	625.9
16.00	116.5	567.3	683.8
17.00	137.0	606.1	743.1
18.00	158.8	645.0	803.7
19.00	181.9	683.8	865.7
20.00	206.4	722.6	929.1
21.00	232.3	761.4	993.7
22.00	259.5	798.6	1058.0
23.00	288.0	843.4	1131.4
24.00	317.9	911.4	1229.3
25.00	349.2	971.0	1320.2
26.00	382.7	1022.6	1405.4
27.00	418.7	1068.9	1487.7
28.00	456.2	1083.5	1539.6

29.00	495.2	1083.5	1578.7

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.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.5723E-01	0.1000E-01
			0.1145E+00	0.2000E-01
			0.2289E+00	0.4000E-01
			0.3434E+00	0.6000E-01
			0.4579E+00	0.8000E-01
			0.5151E+00	0.9000E-01
			0.5723E+00	0.1000E+00
			0.5723E+00	0.5000E+00
			0.5723E+00	0.2000E+01
2	10	0.1525E+01		
			0.0000E+00	0.0000E+00
			0.7631E-01	0.1000E-01
			0.1526E+00	0.2000E-01
			0.3052E+00	0.4000E-01
			0.4579E+00	0.6000E-01
			0.6105E+00	0.8000E-01
			0.6868E+00	0.9000E-01
			0.7631E+00	0.1000E+00
			0.7631E+00	0.5000E+00
			0.7631E+00	0.2000E+01
3	10	0.2958E+01		
			0.0000E+00	0.0000E+00
			0.1705E+00	0.1000E-01
			0.3410E+00	0.2000E-01
			0.6820E+00	0.4000E-01
			0.1023E+01	0.6000E-01
			0.1364E+01	0.8000E-01
			0.1535E+01	0.9000E-01
			0.1705E+01	0.1000E+00
			0.1705E+01	0.5000E+00
			0.1705E+01	0.2000E+01
4	10	0.3000E+01		
			0.0000E+00	0.0000E+00
			0.3355E+00	0.1000E-01
			0.6710E+00	0.2000E-01
			0.1342E+01	0.4000E-01
			0.2013E+01	0.6000E-01
			0.2684E+01	0.8000E-01
			0.3020E+01	0.9000E-01
			0.3355E+01	0.1000E+00
			0.3355E+01	0.5000E+00
			0.3355E+01	0.2000E+01

5	10	0.5525E+01		
			0.0000E+00	0.0000E+00
			0.5713E+00	0.1000E-01
			0.1143E+01	0.2000E-01
			0.2285E+01	0.4000E-01
			0.3428E+01	0.6000E-01
			0.4570E+01	0.8000E-01
			0.5141E+01	0.9000E-01
			0.5713E+01	0.1000E+00
			0.5713E+01	0.5000E+00
			0.5713E+01	0.2000E+01
6	10	0.7958E+01		
			0.0000E+00	0.0000E+00
			0.9077E+00	0.1000E-01
			0.1815E+01	0.2000E-01
			0.3631E+01	0.4000E-01
			0.5446E+01	0.6000E-01
			0.7261E+01	0.8000E-01
			0.8169E+01	0.9000E-01
			0.9077E+01	0.1000E+00
			0.9077E+01	0.5000E+00
			0.9077E+01	0.2000E+01
7	10	0.8000E+01		
			0.0000E+00	0.0000E+00
			0.1308E+01	0.1000E-01
			0.2616E+01	0.2000E-01
			0.5231E+01	0.4000E-01
			0.7847E+01	0.6000E-01
			0.1046E+02	0.8000E-01
			0.1177E+02	0.9000E-01
			0.1308E+02	0.1000E+00
			0.1308E+02	0.5000E+00
			0.1308E+02	0.2000E+01
8	10	0.9025E+01		
			0.0000E+00	0.0000E+00
			0.1625E+01	0.1000E-01
			0.3250E+01	0.2000E-01
			0.6500E+01	0.4000E-01
			0.9750E+01	0.6000E-01
			0.1300E+02	0.8000E-01
			0.1462E+02	0.9000E-01
			0.1625E+02	0.1000E+00
			0.1625E+02	0.5000E+00
			0.1625E+02	0.2000E+01
9	10	0.9958E+01		
			0.0000E+00	0.0000E+00
			0.1625E+01	0.1000E-01
			0.3250E+01	0.2000E-01
			0.6500E+01	0.4000E-01
			0.9750E+01	0.6000E-01
			0.1300E+02	0.8000E-01
			0.1462E+02	0.9000E-01
			0.1625E+02	0.1000E+00
			0.1625E+02	0.5000E+00
			0.1625E+02	0.2000E+01
10	10	0.1000E+02		
			0.0000E+00	0.0000E+00
			0.1845E+01	0.1000E-01
			0.3691E+01	0.2000E-01
			0.7382E+01	0.4000E-01
			0.1107E+02	0.6000E-01
			0.1476E+02	0.8000E-01
			0.1661E+02	0.9000E-01

			0.1845E+02	0.1000E+00
			0.1845E+02	0.5000E+00
			0.1845E+02	0.2000E+01
11	10	0.1753E+02		
			0.0000E+00	0.0000E+00
			0.3218E+01	0.1000E-01
			0.6435E+01	0.2000E-01
			0.1287E+02	0.4000E-01
			0.1931E+02	0.6000E-01
			0.2574E+02	0.8000E-01
			0.2896E+02	0.9000E-01
			0.3218E+02	0.1000E+00
			0.3218E+02	0.5000E+00
			0.3218E+02	0.2000E+01
12	10	0.2496E+02		
			0.0000E+00	0.0000E+00
			0.4642E+01	0.1000E-01
			0.9284E+01	0.2000E-01
			0.1857E+02	0.4000E-01
			0.2785E+02	0.6000E-01
			0.3714E+02	0.8000E-01
			0.4178E+02	0.9000E-01
			0.4642E+02	0.1000E+00
			0.4642E+02	0.5000E+00
			0.4642E+02	0.2000E+01
13	10	0.2500E+02		
			0.0000E+00	0.0000E+00
			0.4978E+01	0.1000E-01
			0.9957E+01	0.2000E-01
			0.1991E+02	0.4000E-01
			0.2987E+02	0.6000E-01
			0.3983E+02	0.8000E-01
			0.4480E+02	0.9000E-01
			0.4978E+02	0.1000E+00
			0.4978E+02	0.5000E+00
			0.4978E+02	0.2000E+01
14	10	0.3253E+02		
			0.0000E+00	0.0000E+00
			0.5587E+01	0.1000E-01
			0.1117E+02	0.2000E-01
			0.2235E+02	0.4000E-01
			0.3352E+02	0.6000E-01
			0.4470E+02	0.8000E-01
			0.5029E+02	0.9000E-01
			0.5587E+02	0.1000E+00
			0.5587E+02	0.5000E+00
			0.5587E+02	0.2000E+01
15	10	0.3996E+02		
			0.0000E+00	0.0000E+00
			0.5587E+01	0.1000E-01
			0.1117E+02	0.2000E-01
			0.2235E+02	0.4000E-01
			0.3352E+02	0.6000E-01
			0.4470E+02	0.8000E-01
			0.5029E+02	0.9000E-01
			0.5587E+02	0.1000E+00
			0.5587E+02	0.5000E+00
			0.5587E+02	0.2000E+01

TIP	LOAD	TIP MOVEMENT
	KIP	IN.

0.0000E+00	0.0000E+00
0.6772E+02	0.9261E-02
0.1354E+03	0.1852E-01
0.2709E+03	0.3704E-01
0.5417E+03	0.2408E+00
0.8126E+03	0.7779E+00
0.9751E+03	0.1352E+01
0.1083E+04	0.1852E+01
0.1083E+04	0.2778E+01
0.1083E+04	0.3704E+01

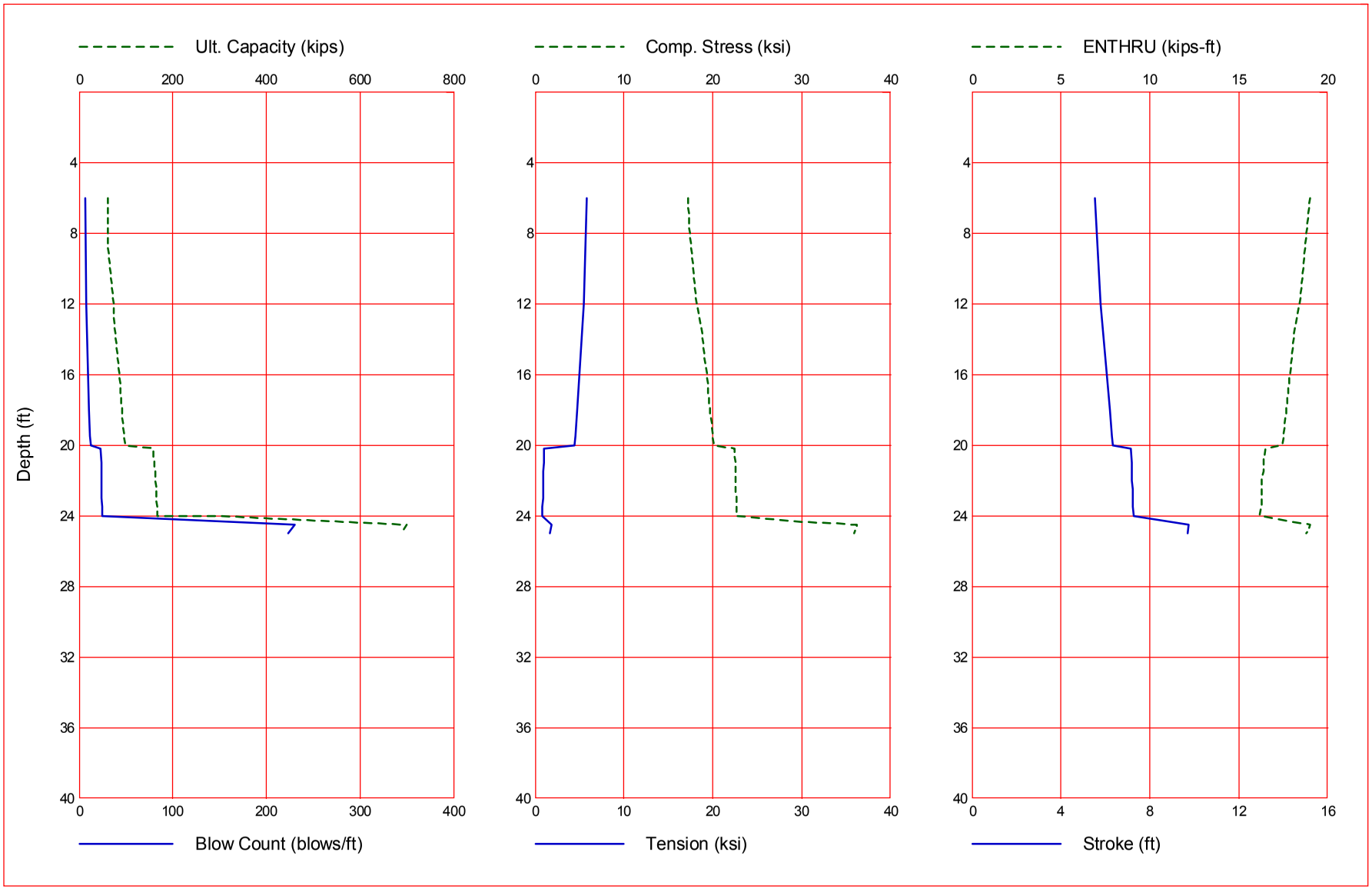
LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.1795E+01	0.9195E-03	0.7312E+00	0.1000E-03
0.1826E+02	0.9306E-02	0.7312E+01	0.1000E-02
0.9292E+02	0.4725E-01	0.3656E+02	0.5000E-02
0.1858E+03	0.9450E-01	0.7312E+02	0.1000E-01
0.7199E+03	0.3862E+00	0.2881E+03	0.5000E-01
0.8821E+03	0.5200E+00	0.3546E+03	0.1000E+00
0.1200E+04	0.1092E+01	0.6724E+03	0.5000E+00
0.1403E+04	0.1702E+01	0.8754E+03	0.1000E+01
0.1611E+04	0.2815E+01	0.1083E+04	0.2000E+01

ECS SOUTHEAST, LLP
Old Highway 41 Bridge Replacelelt BB-1

May 24 2018
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

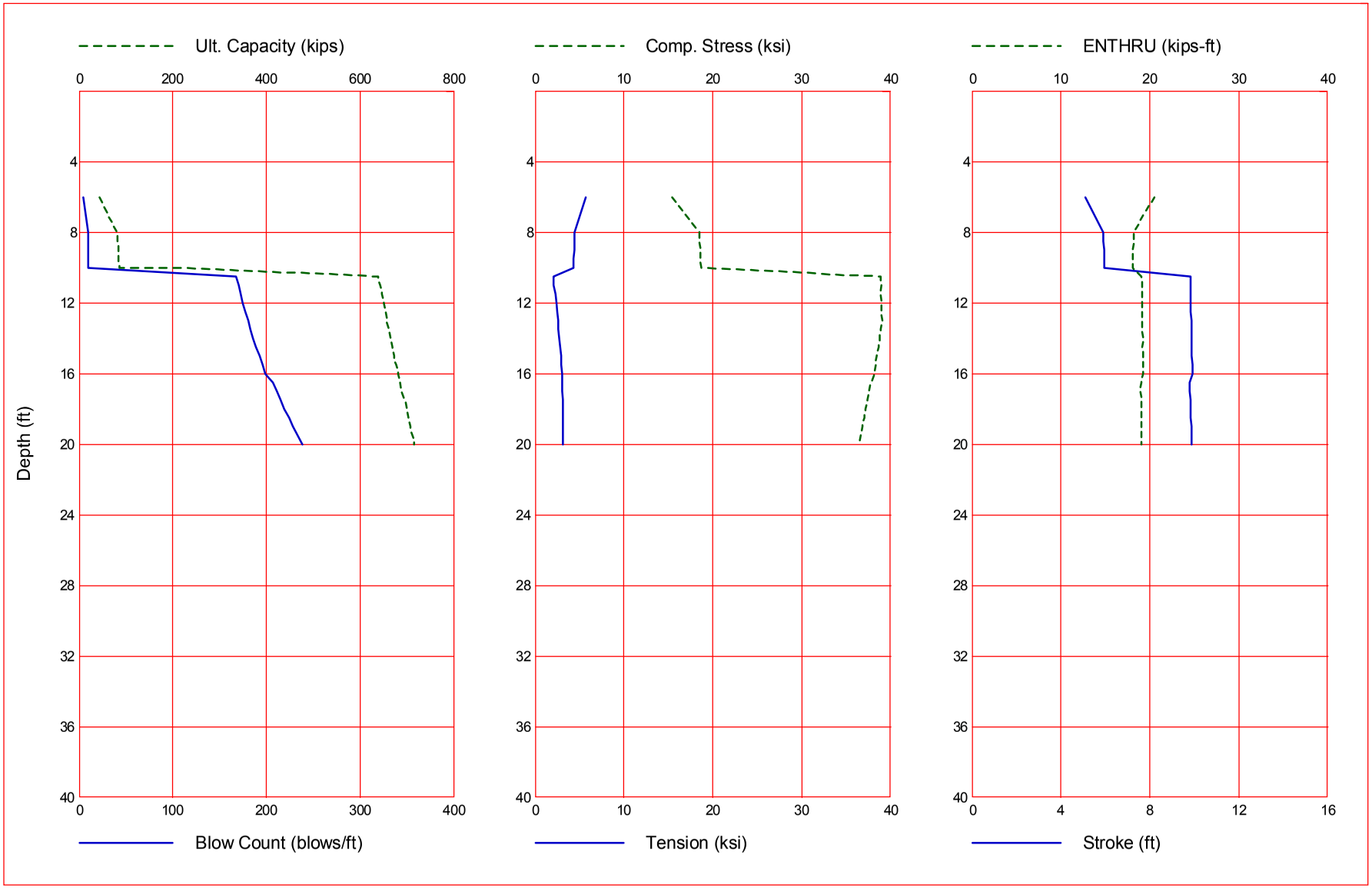
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
6.0	62.0	4.8	57.1	6.4	17.267	-5.819	5.53	19.0
12.0	73.1	15.9	57.1	8.0	18.231	-5.516	5.80	18.4
18.0	91.3	34.2	57.1	11.0	19.673	-4.789	6.20	17.7
19.5	97.0	39.8	57.1	11.9	19.996	-4.505	6.30	17.5
20.0	99.0	41.8	57.1	12.2	20.090	-4.412	6.34	17.4
20.2	159.4	42.2	117.2	23.0	22.488	-1.009	7.16	16.5
21.0	161.1	43.8	117.2	23.4	22.518	-0.963	7.18	16.4
21.5	162.1	44.9	117.2	23.6	22.547	-0.929	7.19	16.4
22.0	163.1	45.9	117.2	23.8	22.576	-0.906	7.20	16.3
22.5	164.2	47.0	117.2	24.0	22.594	-0.882	7.22	16.3
23.0	165.3	48.1	117.2	24.3	22.618	-0.855	7.23	16.3
23.5	166.4	49.1	117.2	24.5	22.652	-0.824	7.24	16.3
24.0	167.5	50.2	117.2	24.8	22.659	-0.785	7.26	16.2
24.5	699.0	52.7	646.3	230.0	36.236	-1.830	9.76	19.0
25.0	686.8	55.2	631.6	223.1	35.847	-1.628	9.69	18.8

Total Continuous Driving lime 10.00 minutes; Total Number of Blows 414

ECS SOUTHEAST, LLP
Old Highway 41 Bridge Repcelelt BB-2

May 24 2018
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 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
6.0	44.5	4.9	39.6	4.3	15.458	-5.718	5.09	20.5
8.0	82.2	8.3	73.9	9.2	18.474	-4.433	5.91	18.2
8.5	82.9	9.0	73.9	9.3	18.530	-4.404	5.92	18.2
9.0	83.6	9.7	73.9	9.4	18.585	-4.390	5.94	18.1
9.5	84.3	10.4	73.9	9.5	18.621	-4.352	5.95	18.1
10.0	85.1	11.2	73.9	9.6	18.702	-4.328	5.97	18.1
10.5	639.1	13.6	625.5	168.0	38.918	-2.068	9.82	19.0
11.0	642.8	16.1	626.7	170.4	38.935	-2.102	9.83	19.1
11.5	646.5	18.6	627.9	173.1	38.907	-2.278	9.83	19.1
12.0	650.3	21.2	629.1	175.1	38.994	-2.422	9.85	19.1
12.5	654.2	23.8	630.4	177.7	38.989	-2.508	9.85	19.1
13.0	658.0	26.4	631.6	180.4	39.058	-2.571	9.86	19.1
13.5	661.9	29.1	632.8	183.2	38.876	-2.635	9.87	19.1
14.0	665.9	31.9	634.0	185.9	38.753	-2.730	9.88	19.2
14.5	669.9	34.6	635.3	189.3	38.677	-2.875	9.89	19.1
15.0	673.9	37.4	636.5	192.5	38.436	-2.912	9.89	19.2
15.5	678.0	40.3	637.7	195.6	38.347	-2.980	9.90	19.2
16.0	682.1	43.2	638.9	199.0	38.223	-3.036	9.91	19.2
16.5	686.3	46.1	640.2	207.0	37.796	-3.039	9.81	19.0
17.0	690.5	49.1	641.4	211.5	37.577	-3.072	9.81	18.9
17.5	694.7	52.1	642.6	215.6	37.400	-3.102	9.82	19.0
18.0	699.0	55.1	643.8	219.7	37.193	-3.124	9.84	19.0
18.5	703.3	58.2	645.1	224.1	37.014	-3.121	9.85	19.0
19.0	707.6	61.4	646.3	228.4	36.850	-3.109	9.86	19.0
19.5	712.0	64.5	647.5	233.4	36.663	-3.115	9.87	19.0
20.0	716.5	67.7	648.7	238.9	36.472	-3.144	9.87	19.0

Total Continuous Driving lime 52.00 minutes; Total Number of Blows 1973