



ATLAS

## BRIDGE FOUNDATION INVESTIGATION (LRFD)

Rockbridge Road over Lake Capri  
Rockdale County, Georgia

Revision No. 1

July 23, 2021

### PREPARED BY:

Atlas Technical Consultants, LLC  
2450 Commerce Avenue  
Suite 100  
Duluth, Georgia 30096

Atlas Project No. 20-ROCK-20514

Bridge Foundation Investigation (LRFD)  
 Rockbridge Road over Lake Capri, Rockdale County  
 Revision No. 1  
 July 23, 2021

**Bridge Foundation Investigation (LRFD)**  
**Rockbridge Road over Lake Capri**  
**Rockdale County**  
**Revision No. 1**  
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**LOCATION (See Map)** Rockbridge Road over Lake Capri

**GENERAL INFORMATION**

**GEOLOGIC FORMATION** Granitic Gneiss undifferentiated (Precambrian-Paleozoic)  
 Formation of the Georgia Piedmont Region.

**SUBSURFACE FEATURES** The subsurface soils consist of loose to medium dense silty sand over very hard biotite gneiss. Groundwater was encountered between elevations 721' and 723' and hard rock/dense soil was encountered from elevations 704' to 710'. For additional information see the boring layout and boring logs.

**SITE CLASSIFICATION** We recommend a site class of D per AASHTO LRFD 3.10.3.1.

**1.0 -- FOUNDATION RECOMMENDATIONS**

<b>Bents</b>	<b>Drilled Shaft</b>	<b>Spread Footing</b>	<b>Pile Footing (Type)</b>	<b>Pile Bent (Type)</b>
1 and 2	-	-	-	H-Pile

**1.1 -- Pile Properties**

<b>Pile Type</b>	<b>Pile Size (in)</b>	<b>Nominal Compression Stress (ksi)</b>	<b>Nominal Tension Stress (ksi)</b>	<b>Maximum Factored Structural Resistance (kips)</b>
HP (50 ksi)	12 x 53	45.0	45.0	384
HP (36 ksi)	14 x 73	32.4	32.4	385

**1.2 -- DESIGN LOADS**

<b>Bents</b>	<b>Maximum Factored Strength Limit State Load (kips)</b>	<b>Maximum Factored Service Limit State Load (kips)</b>	<b>Factored Extreme Event I Limit State Load (kips)</b>
1 and 2	225	161	-

## 2.0 -- FOUNDATION LOADS

### 2.1 -- PILE FOUNDATION LOADS

Bents	Pile Type	Size (in)	Down Drag (kips)	Scour (Kips)	Driving Resistance * (kips)
1 and 2	H-Pile	12 x 53 (Option 1)	-	-	346
1 and 2	H-Pile	14 x 73 (Option 2)	-	-	346

### 3.0 -- FOUNDATION ELEVATIONS

Bents	Minimum Tip (ft)	Estimated Tip (ft)
1 (HP 12x53)	708	707
1 (HP 14x73)	708	708
2 (HP 12x53)	704	702
2 (HP 14x73)	704	703

### 4.0 -- GENERAL NOTES

**Elevations** All elevations are based on a bench mark elevation of 728.79' at top of the hydrant across from Lake Capri Drive, Station 58+85, 19.17' Lt.

**Waiting Period** None required.

**Theoretical Scour** Appears feasible for the material encountered.

### 4.1 -- PILE FOUNDATION NOTES

**PDO** Driving resistance after minimum tip elevations are achieved in conjunction with GDOT Standard Specification 520.3.05.D.2 and Special Provision 523 Dynamic Pile Testing. Perform one PDA test at Bent 1 Left and Bent 2 Right, alternately, perform one PDA at Bent 2 Left and one at Bent 2 Right.

**\* Nominal Bearing Resistance of Single Pile** Driving resistance is based on the following field verification method and resistance factor  $\phi_{dyn}$  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

**Piles Driven to Hard Rock** The nominal resistance of piles driven to point bearing on hard rock where pile penetration into the rock formation is minimal is controlled by the structural limit state. The Nominal Driving Resistance should not exceed the Factored Structural Resistance. Dynamic pile measurements should be used to monitor for pile damage.

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**Drivability** A drivability analysis has been completed on the above mentioned piles to their respective estimated tips with a diesel hammer ICE 30-S, the driving stresses are within the allowable limits.

**Points** Pile points are recommended for each pile to be driven at Bents 1 and 2 to insure adequate penetration into very dense weathered rock.

## 5.0 – QA / QC

**Prepared By:** Yong Shao, PhD, PE  
(GA PE Registration No.: 26340)

**Signature:** \_\_\_\_\_



## **APPENDICES**

- A. Special provisions**
- B. Boring locations and logs**
- C. Drilling Calibration Report**
- D. Laboratory tests on soils**
- E. Seismic site class determination**
- F. Foundation design data**
- G. Pile capacity calculations with APILE**
- H. Drivability analysis with GRL-WEAP**

## **Appendix A - Special provisions**

- SP 523 Dynamic Pile Testing

**DEPARTMENT OF TRANSPORTATION  
STATE OF GEORGIA**

**SPECIAL PROVISION**

**Rockbridge Road over Lake Capri, Rockdale 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:

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

where;

$\sigma_{dr}$  = 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**

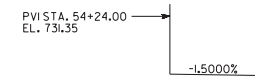
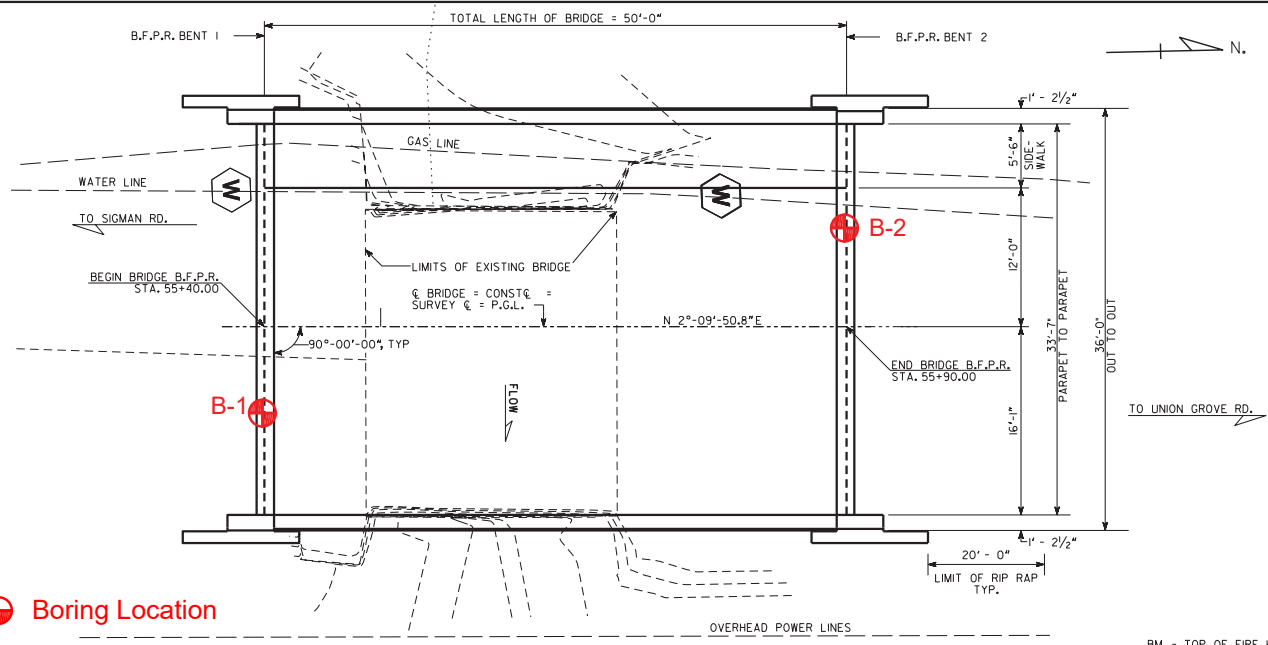
The Dynamic Pile Test completed and accepted will be paid for at the Contract unit Price. This payment will be full compensation for all costs of complying with this specification, including incidentals, additional work, and any delays incurred in conjunction therewith.

Payment will be made under:

Item No. 523. Dynamic Pile Test \_\_\_\_\_ Per Each



## **Appendix B - Boring locations and logs**



PROPOSED GRADE DATA

DESIGN DATA

SPECIFICATIONS ----- AASHTO LRFD 8TH EDITION, 2017  
 DESIGN VEHICLE ----- HL-93  
 FUTURE PAVING ALLOWANCE ----- 30 LBS PER SQ FT

BRIDGE CONSIST OF

1- 50'-0" PSC 24" CORED SLAB SPANS ----- SPECIAL DESIGN  
 2 - PILE END BENTS ----- SPECIAL DESIGN  
 24" TYPE I RIPRAP

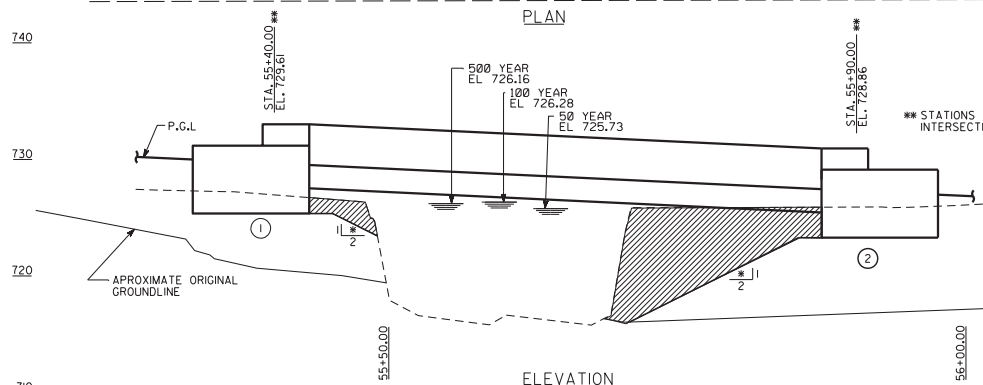
TRAFFIC DATA

TRAFFIC ----- ADT = 2,212 (2021)  
 DESIGN SPEED ----- ADT = 2,970 (2041)  
 24 HR TRUCKS ----- 35 MPH  
 ----- 5%

DRAINAGE DATA

FLOOD FREQUENCY	TOTAL DISCHARGE	MEAN VELOCITY THRU BRIDGE	AREA OF OPENING UNDER FLOODSTAGE	BACKWATER
50 YEAR	1400 CFS	5.13 FPS	273 SQ FT	0.92
100 YEAR	1640 CFS	5.56 FPS	295 SQ FT	0.98
500 YEAR	2230 CFS	5.38 FPS	395 SQ FT	2.28

Boring Location



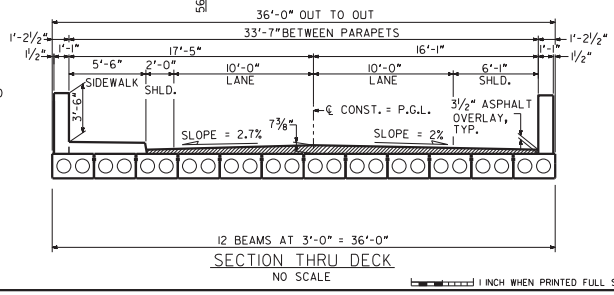
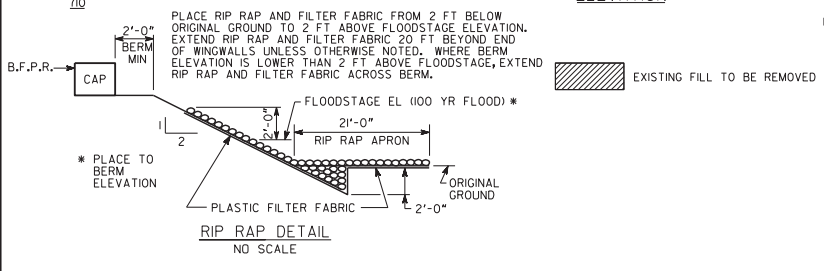
BM - TOP OF FIRE HYDRANT, ACROSS FROM LAKE CAPRI DRIVE, STA. 58+85, L.T. ELEV. = 728.73

\*\* STATIONS AND ELEVATIONS ARE ALONG PROFILE GRADE LINE AT THE INTERSECTION OF PROFILE GRADE LINE AND B.F.P.R. OR BENTS.

NOTE: THE 500 YEAR SCOUR IN THE CHANNEL IS 23.2 FT

NOTES:

- \* SLOPE NORMAL TO END BENT.
- ALL BENTS ARE PARALLEL.
- END BENT PILES NOT SHOWN.
- REMOVE EXISTING BRIDGE. REMOVE EXISTING SUBSTRUCTURE PER THE SPECIFICATIONS.
- MINIMUM BOTTOM OF BEAM ELEVATION FOR PROPOSED BRIDGE SHALL BE NO LOWER THAN ELEVATION 726.23
- CR 439 (ROCKBRIDGE ROAD) WILL BE CLOSED TO TRAFFIC DURING THE PROPOSED CONSTRUCTION. TRAFFIC WILL BE MAINTAINED ON AN OFF-SITE DETOUR.



BRIDGE NO. 1



PRELIMINARY PLAN AND ELEVATION  
 CR 439 (ROCKBRIDGE ROAD)  
 OVER LAKE CAPRI  
 ROCKDALE COUNTY 20-ROCK-20514






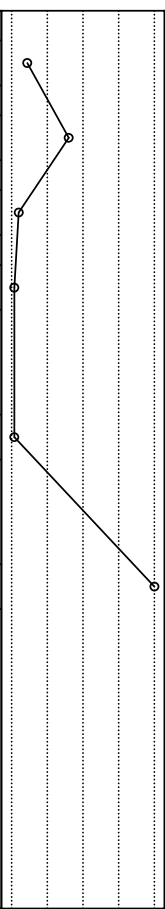











SCALE: 1" = 10'-0" (UNLESS OTHERWISE NOTED) MAY 2021

DRAWING NO. 35-0001	DESIGNED JEM	CHECKED RMD	REVIEWED -
BRIDGE SHEET 1 OF 1	DRAWN JEM	DESIGN GROUP -	APPROVED RMD

DATE	REVISIONS

# B-1: Station 55+40, 5ft Rt (Bent 1)

Rockbridge Road Bridge Replacement Over Lake Capri Rockdale County, Georgia	DATE COMPLETED : 5/11/2021	SURFACE ELE. : 728'
	DRILL RIG : B-45 (SN20110005)	DEPTH OF BORING : 30'
Atlas Proj. No.: 20-ROCK-20514	DRILLING METHOD : HSA / Auto Hammer	DEPTH TO WATER : 5'
	DRILLER : South Bros. Drilling Inc.	LOGGED BY : M. Khan
	ENERGY EFFICIENCY: 95%	BTM OF CAP ELE. : 725'+/-

Depth in Feet	Surf. Elev. 728	USCS	GRAPHIC	Sample Condition	Sampler Type	Blow count	SPT-N60 Value	N60 Value Graph	Sampler Type	Sample	Moist, %	Water Level
				 Remoulded  Undisturbed  Lost  Rock Core	SS Split Spoon ST Shelby Tube PS Piston Sampler DC Diamond Core Bar.							
DESCRIPTION												
0 - 728												
2 - 726		SM		Tan/grey/brown medium dense to dense, SILTY SAND, highly organics	SS Split Spoon	2-3-4	11		SS			
4 - 724					SS Split Spoon	7-17-8	40		SS			
6 - 722		SP		Gray/dark brown, loose to very loose, SAND, some organics	SS Split Spoon	1-2-1	5		SS			
8 - 720					SS Split Spoon	1-0-1	2		SS			
10 - 718					SS Split Spoon							
12 - 716												
14 - 714		SP		Grey/dark brown, very loose, SAND with some CLAY, wet	SS Split Spoon	1-0-1	2	SS				
16 - 712												
18 - 710				No recovery, very dense		50/4"	50/4"		SS			
20 - 708		QU		Auger refused at depth of 20' Start rock coring at 20'  @ Depth 20'-25' REC= 83% RQD= 77%  @ Depth 25'-30' REC= 88% RQD= 91%	DC Diamond Core Bar.				DC			
22 - 706									DC			
24 - 704												
26 - 702												
28 - 700												
30 - 698				Coring terminated at depth of 30' B.G.S.								
32 - 696												
34 - 694												
36 - 692												
38 - 690												
40 -												

BTM of Cap →

Min. Tip →

05-22-2021 Q:\Rockdale County\20-ROCK-20514 Rockbridge Rd over Lake Capri\BFI\Borings\B-1.bor

NOTE: SPT-N values have been corrected with 95% ER





2 ↓

1 ↓

2 ↑

1 ↑



**B-2: Station 55+90, 5ft Lt (Bent 2)**

Rockbridge Road Bridge Replacement  
 Over Lake Capri  
 Rockdale County, Georgia

DATE COMPLETED : 5/11/2021  
 DRILL RIG : B-45 (SN 20110005)  
 DRILLING METHOD : HSA / Auto Hammer  
 DRILLER : South Bros. Drilling Inc.  
 ENERGY EFFICIENCY: 95%

SURFACE ELE. : 727'  
 DEPTH OF BORING : 35'  
 DEPTH TO WATER : 6'  
 LOGGED BY : M. Khan  
 BTM OF CAP ELE. : 723'+/-

Atlas Proj. No.: 20-ROCK-20514

Depth in Feet	Surf. Elev. 727	USCS	GRAPHIC	Sample Condition	Sampler Type	Blow count	SPT-N60 Value	N60 Value Graph	Sampler Type	Sample	Moist, %	Water Level		
				Remoulded Undisturbed Lost Rock Core	SS Split Spoon ST Shelby Tube PS Piston Sampler DC Diamond Core Bar.									
DESCRIPTION														
0	726	SM		Grey/tan, medium dense to loose, SILTY SAND, organic stained		2-5-5	16		SS					
2	724					2-2-1	5						SS	
4	722					2-1-1	3						SS	
6	720	SM		Grey/dark brown, loose, SILTY SAND, with wood piece		2-2-2	6	SS						
8	718					2-2-2	6						SS	
10	716	ML		Grey, firm, SILTY SAND, organic stained		1-1-2	5	SS						
12	714					1-1-2	5						SS	
14	712	SP		Grey, medium dense SAND, with wood piece, wet		13-10-8	29	SS						
16	710					13-10-8	29						SS	
18	708	SP		Grey/tan, very dense, SAND, wet		10-14-50/1"	50/1"	SS						
20	706					10-14-50/1"	50/1"						SS	
22	704	QU		Auger refused at depth of 25' Start rock coring at 25'				DC						
24	702													
26	700	QU		@ depth 25'-30' REC= 100% RQD= 100%				DC						
28	698													
30	696	QU		@ depth 30'-35' REC= 70% RQD= 98%				DC						
32	694													
34	692	Coring terminated at depth of 35'												
36	690													
38	688													
40	688													

BTM Cap

Min Tip

NOTE: SPT-N values have been corrected with 95% ER



## **Appendix C - Drilling Calibration Report**



April 27, 2021

140 Johnson Hale Rd  
Muscle Shoals, AL 35661

Attention: Mr. Tony South

Subject: Drill Rig SPT Energy Calibrations  
Muscle Shoals, Alabama  
Building & Earth Project No: HV210045

Dear Mr. South:

Building & Earth Sciences, Inc. has completed the authorized Standard Penetration Test (SPT) energy measurements for the following drill rigs:

Tested Drill Rigs
B-45 Track Rig
B-45-HD Truck Rig
D-50 Track Rig
CME 450 Track Rig

**Table 1: Tested Drill Rigs**

The purpose in collecting the SPT energy measurements was to compute the energy transfer efficiency for the SPT hammer. To meet this objective, a Pile Driving Analyzer (PDA) was used to acquire and process the dynamic test data.

Using an instrumented AW-J rod, energy measurements were made at various sample depths. Dynamic measurements were obtained for sample depths between 28.5 and 45 feet. Each sample depth consisted of energy measurements over 18 inches of driving.



An 8G model Pile Driving Analyzer was used to take measurements of strain and acceleration. The strain and acceleration signals were conditioned and converted to force and velocities by the PDA. The PDA interprets the measured dynamic data according to the Case Method equations. Force and velocity records from the PDA were also viewed graphically on an LCD screen to evaluate data quality. All force and velocity records were also digitally stored for subsequent analysis.

The maximum energy transferred to the rod (EMX) was calculated by integrating both the force and velocity records over time as follows:

$$EMX = \int F(t)V(t)dt$$

Where: F(t) = the force at time t  
 V(t) = the velocity at time t

The energy transfer ratio or efficiency is computed from dividing EMX by the theoretical SPT hammer energy of 350 lb-ft (computed from the product of the hammer weight, assumed to be 140 lbs, and the fall height, assumed to be 2.5 ft). The SPT N values can then be corrected for a nominal 60% transfer efficiency,  $N_{60}$ , as follows:

$$N_{60} = (e_m / 60) N_m$$

Where:  $e_m$  = the measured transfer ratio (ETR)  
 $N_m$  = the measured SPT "N" value

Tables below present a summary of the project and average transferred energy and the energy transfer ratio for the tested drill rig. Included in the tables below are also average SPT blow counts for each analyzed depth, N-values, number of blows analyzed, average hammer operational rate (BPM), average measured energy (EFV), and energy transfer ratio (ETR).

Project Information						
Test No.	Drill Rig Model No.	Drill Rig Serial No.	Operator	Drill Rod Type	Test Date	Project Site
1	B-45 Track Rig	20110005	Jerry Adams	AW-J	4/23/2021	South Bros. Shop
2	B-45-HD Truck Rig	2013016	Jerry Adams	AW-J	4/23/2021	South Bros. Shop
3	D-50 Track Rig	143	Jerry Adams	AW-J	4/20/2021	South Bros. Shop
4	CME 450 Track Rig	280184	Jerry Adams	AW-J	4/20/2021	South Bros. Shop

**Table 2: Project Information**

B-45 Track Rig						
Depth	SPT Blow Counts	N-Value	No. Blows Analyzed	Average Hammer Operating Rate (BPM)	Average Measured Energy (lb-ft) (EFV)	Energy Transfer Ratio (%) (ETR)
28.5 – 30	4-7-4	11	11	36.5	335.6	95.9
33.5 – 35	5-4-9	13	13	31.6	326.5	93.3
38.5 – 40	8-5-5	10	10	37.9	334.9	95.7
<b>Overall Average:</b>				<b>35.3</b>	<b>332.3</b>	<b>95.0</b>
B-45-HD Truck Rig						
Depth	SPT Blow Counts	N-Value	No. Blows Analyzed	Average Hammer Operating Rate (BPM)	Average Measured Energy (lb-ft) (EFV)	Energy Transfer Ratio (%) (ETR)
28.5 – 30	15-19-18	37	37	29.7	314.2	89.8
33.5 – 35	6-9-11	20	20	39.3	335.4	95.8
38.5 – 40	4-13-12	25	25	33.5	337.8	96.5
<b>Overall Average:</b>				<b>34.2</b>	<b>329.1</b>	<b>94.0</b>
D-50 Track Rig						
Depth	SPT Blow Counts	N-Value	No. Blows Analyzed	Average Hammer Operating Rate (BPM)	Average Measured Energy (lb-ft) (EFV)	Energy Transfer Ratio (%) (ETR)
33.5 – 35	12-9-13	22	22	33.5	226.9	64.8
38.5 – 40	20-18-15	33	33	35.9	215.5	61.6
33.5 – 40	10-16-10	26	26	34.6	211.2	60.3
<b>Overall Average:</b>				<b>34.7</b>	<b>217.9</b>	<b>62.2</b>
CME 450 Track Rig						
Depth	SPT Blow Counts	N-Value	No. Blows Analyzed	Average Hammer Operating Rate (BPM)	Average Measured Energy (lb-ft) (EFV)	Energy Transfer Ratio (%) (ETR)
33.5 – 35	10-10-6	16	16	34.0	320.1	91.4
38.5 – 40	13-11-7	18	18	33.5	293.1	83.7
43.5 – 45	3-9-4	13	13	35.0	296.7	84.8
<b>Overall Average:</b>				<b>34.2</b>	<b>303.3</b>	<b>86.6</b>

**Table 3: Energy Measurements**

Field recorded data for each analysis is attached.

We appreciate the opportunity to provide calibration report for you. If you have any questions regarding the information in this report or need any additional information, please call us.

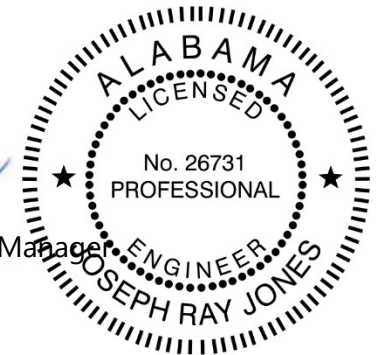
Respectfully Submitted,  
**BUILDING & EARTH SCIENCES, INC.**



Srdj Boskovic, P.E.  
Huntsville Branch Manager



Joey Jones, P.E.  
Birmingham Branch Manager



## **Appendix D - Laboratory tests on soils**



2450 Commerce Avenue  
 Suite 100  
 Duluth, Georgia 30096  
 Tel: 770-2635945  
 Fax: 770-263-0166

## Soil Classification

Project Name:	Rockbridge road Bridge Replacement			PI No.:	
Sample Location:	Station 55+40, Bent 1			Sample Depth:	2.5'-5'
Date Sampled:	5/11/2021	Sampled By:	Khan	Sample Number:	B-1
Date Tested:	5/21/2021	Tested By:	Jay	Atlas Project Number:	20-ROCK-20514
Sample Description:	Tan/Grey/Brwon silty Sand				

### Sieve Analysis

US Sieve Size	Sieve Opening		% Passing
	(inch)	(mm)	
3 Inch	3.0000	76.2	
1.5 Inch	1.5000	38.1	
1 Inch	1.0000	25.4	
No.4	1.8701	4.75	100.0
No.10	0.7874	2.00	97.2
No.20	0.3346	0.85	83.9
No.40	0.1673	0.425	64.0
No.60	0.0984	0.25	49.7
No.100	0.0591	0.15	49.5
No.200	0.0295	0.075	31.3
% Clay	0.0079	0.02	30.3

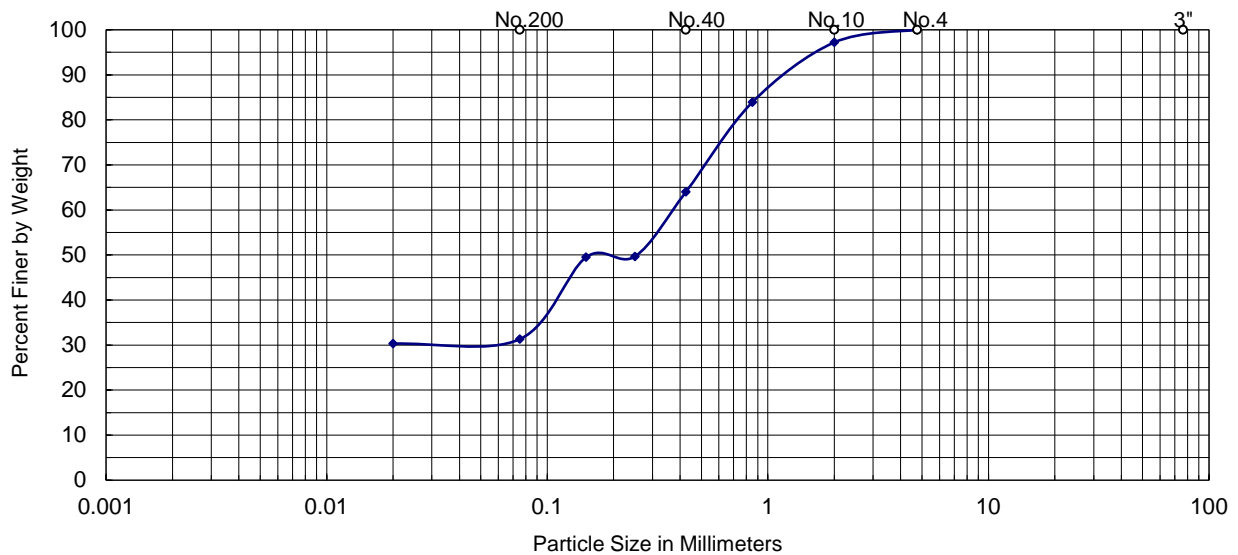
### Atterberg Limits

Liquid limit (LL)	
Plastic Limit (PL)	
Plasticity Index (PI)	

D <sub>10</sub> (mm) =	0.0000
D <sub>30</sub> (mm) =	0.0000
D <sub>75</sub> (mm) =	0.623
Coefficient of Uniformity, C <sub>u</sub> =	1000.00
Coefficient of curvature, C <sub>c</sub> =	1000.00

Organic Content, %	0
Maximum Dry Density, pcf	
Volume Change, %	

**Grain size distribution**



### Soil Classification

AASHTO	
USCS	SM - Silty sand
GDOT	



2450 Commerce Avenue  
 Suite 100  
 Duluth, Georgia 30096  
 Tel: 770-2635945  
 Fax: 770-263-0166

## Soil Classification

Project Name:	Rockbridge road Bridge Replacement			PI No.:	
Sample Location:	Station 55+40, Bent 1			Sample Depth:	5'-7.5'
Date Sampled:	5/11/2021	Sampled By:	Khan	Sample Number:	B-1
Date Tested:	5/21/2021	Tested By:	Jay	Atlas Project Number:	20-ROCK-20514
Sample Description:	Grey/Dark Brown Silty Sand				

### Sieve Analysis

US Sieve Size	Sieve Opening		% Passing
	(inch)	(mm)	
3 Inch	3.0000	76.2	
1.5 Inch	1.5000	38.1	
1 Inch	1.0000	25.4	
No.4	1.8701	4.75	100.0
No.10	0.7874	2.00	95.5
No.20	0.3346	0.85	75.0
No.40	0.1673	0.425	55.8
No.60	0.0984	0.25	44.5
No.100	0.0591	0.15	35.2
No.200	0.0295	0.075	27.4
% Clay	0.0079	0.02	26.7

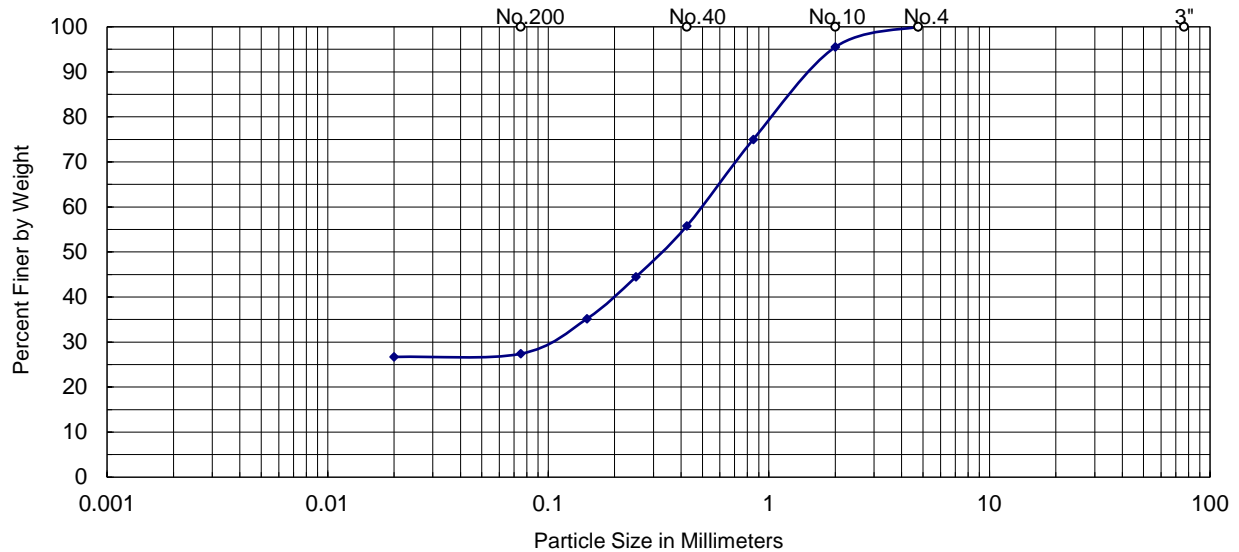
### Atterberg Limits

Liquid limit (LL)	
Plastic Limit (PL)	
Plasticity Index (PI)	

D <sub>10</sub> (mm) =	0.0000
D <sub>30</sub> (mm) =	0.0000
D <sub>75</sub> (mm) =	0.850
Coefficient of Uniformity, C <sub>u</sub> =	1000.00
Coefficient of curvature, C <sub>c</sub> =	1000.00

Organic Content, %	0
Maximum Dry Density, pcf	
Volume Change, %	

**Grain size distribution**



### Soil Classification

AASHTO	
USCS	SM - Silty sand
GDOT	



2450 Commerce Avenue  
 Suite 100  
 Duluth, Georgia 30096  
 Tel: 770-2635945  
 Fax: 770-263-0166

## Soil Classification

Project Name:	Rockbridge road Bridge Replacement			PI No.:	
Sample Location:	Station 55+40, Bent 1			Sample Depth:	7.5'-10'
Date Sampled:	5/11/2021	Sampled By:	Khan	Sample Number:	B-1
Date Tested:	5/21/2021	Tested By:	Jay	Atlas Project Number:	20-ROCK-20514
Sample Description:	Grey/Brown Silty sand				

### Sieve Analysis

US Sieve Size	Sieve Opening		% Passing
	(inch)	(mm)	
3 Inch	3.0000	76.2	
1.5 Inch	1.5000	38.1	
1 Inch	1.0000	25.4	
No.4	1.8701	4.75	100.0
No.10	0.7874	2.00	96.6
No.20	0.3346	0.85	81.5
No.40	0.1673	0.425	59.2
No.60	0.0984	0.25	43.9
No.100	0.0591	0.15	31.6
No.200	0.0295	0.075	23.1
% Clay	0.0079	0.02	22.6

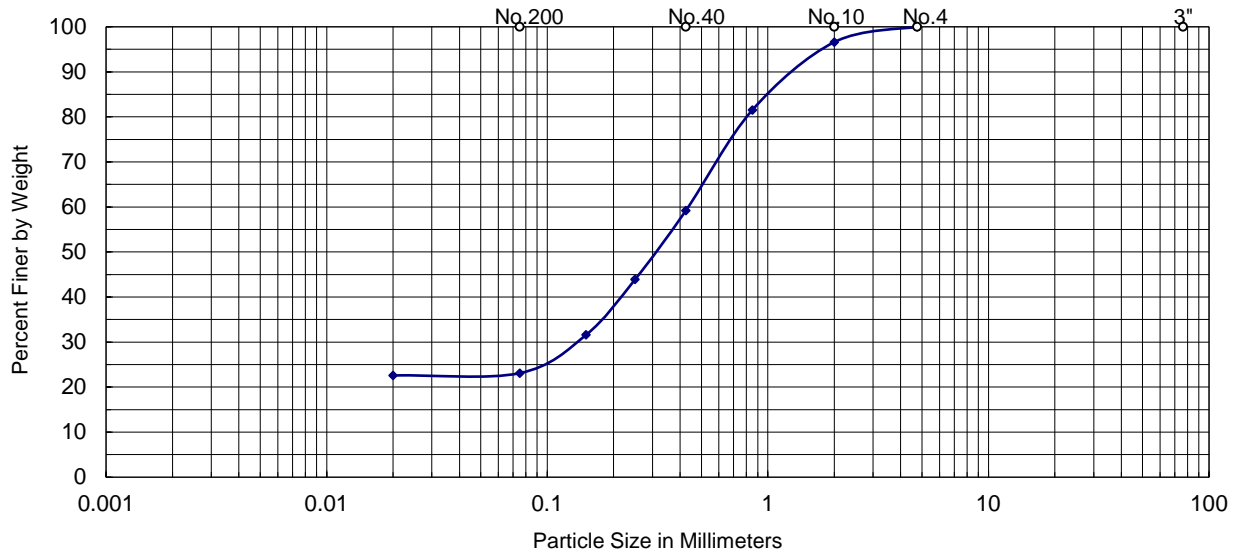
### Atterberg Limits

Liquid limit (LL)	
Plastic Limit (PL)	
Plasticity Index (PI)	

D <sub>10</sub> (mm) =	0.0000
D <sub>30</sub> (mm) =	0.0000
D <sub>75</sub> (mm) =	0.695
Coefficient of Uniformity, C <sub>u</sub> =	1000.00
Coefficient of curvature, C <sub>c</sub> =	1000.00

Organic Content, %	0
Maximum Dry Density, pcf	
Volume Change, %	

**Grain size distribution**



### Soil Classification

AASHTO	
USCS	SM - Silty sand
GDOT	



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 Suite 100  
 Duluth, Georgia 30096  
 Tel: 770-2635945  
 Fax: 770-263-0166

## Soil Classification

Project Name:	Rockbridge road Bridge Replacement			PI No.:	
Sample Location:	Station 55+90, Bent 2			Sample Depth:	5'-7.5'
Date Sampled:	5/11/2021	Sampled By:	Khan	Sample Number:	B-2
Date Tested:	5/21/2021	Tested By:	Jay	Atlas Project Number:	20-ROCK-20514
Sample Description:	Grey/Tan silty sand				

### Sieve Analysis

US Sieve Size	Sieve Opening		% Passing
	(inch)	(mm)	
3 Inch	3.0000	76.2	
1.5 Inch	1.5000	38.1	
1 Inch	1.0000	25.4	
No.4	1.8701	4.75	100.0
No.10	0.7874	2.00	98.7
No.20	0.3346	0.85	87.4
No.40	0.1673	0.425	69.7
No.60	0.0984	0.25	56.6
No.100	0.0591	0.15	45.4
No.200	0.0295	0.075	37.1
% Clay	0.0079	0.02	36.6

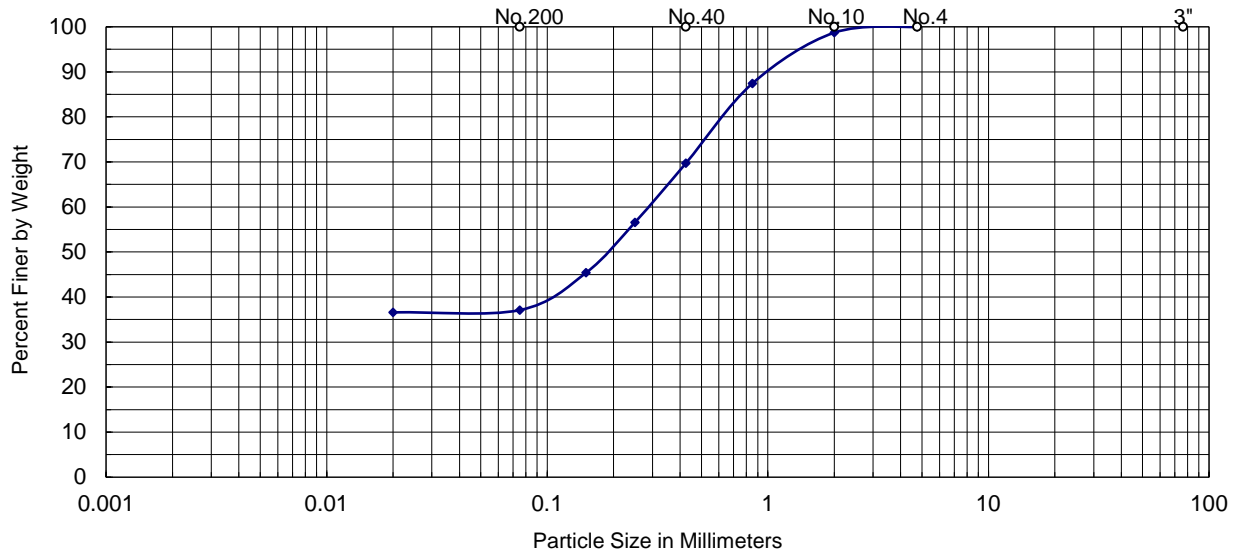
### Atterberg Limits

Liquid limit (LL)	
Plastic Limit (PL)	
Plasticity Index (PI)	

D <sub>10</sub> (mm) =	0.0000
D <sub>30</sub> (mm) =	0.0000
D <sub>75</sub> (mm) =	0.523
Coefficient of Uniformity, C <sub>u</sub> =	1000.00
Coefficient of curvature, C <sub>c</sub> =	1000.00

Organic Content, %	0
Maximum Dry Density, pcf	
Volume Change, %	

**Grain size distribution**



### Soil Classification

AASHTO	
USCS	SM - Silty sand
GDOT	





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 Suite 100  
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## Soil Classification

Project Name:	Rockbridge road Bridge Replacement			PI No.:	
Sample Location:	Station 55+90, Bent 2			Sample Depth:	13.5'-15'
Date Sampled:	5/11/2021	Sampled By:	Khan	Sample Number:	B-2
Date Tested:	5/21/2021	Tested By:	Jay	Atlas Project Number:	20-ROCK-20514
Sample Description:	Grey Sandy silt				

### Sieve Analysis

US Sieve Size	Sieve Opening		% Passing
	(inch)	(mm)	
3 Inch	3.0000	76.2	
1.5 Inch	1.5000	38.1	
1 Inch	1.0000	25.4	
No.4	1.8701	4.75	100.0
No.10	0.7874	2.00	99.8
No.20	0.3346	0.85	97.7
No.40	0.1673	0.425	93.4
No.60	0.0984	0.25	88.7
No.100	0.0591	0.15	78.0
No.200	0.0295	0.075	56.9
% Clay	0.0079	0.02	54.4

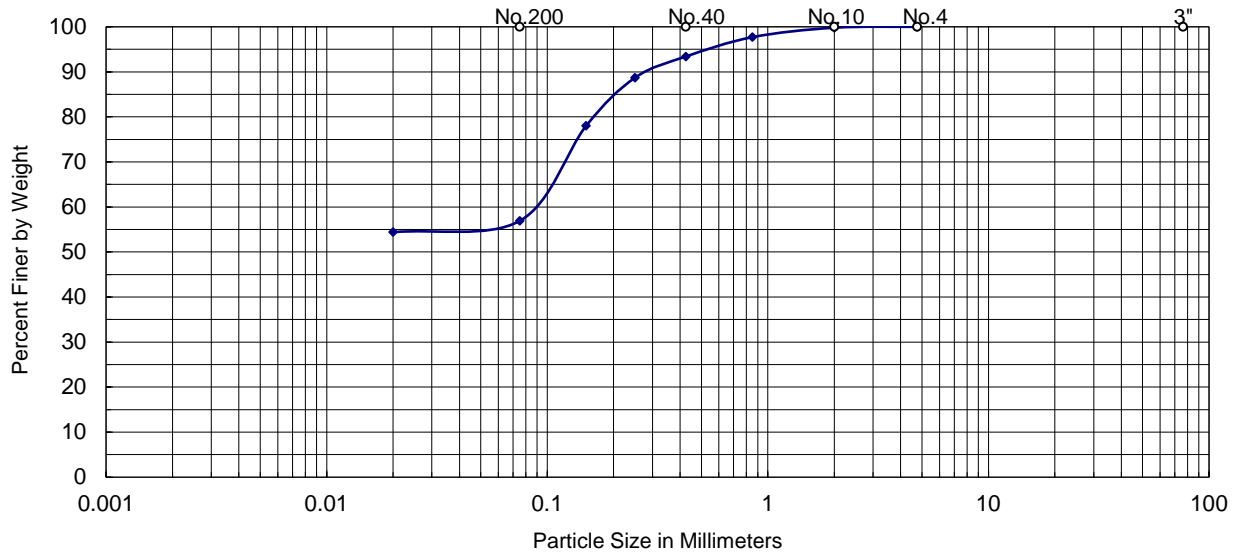
### Atterberg Limits

Liquid limit (LL)	
Plastic Limit (PL)	
Plasticity Index (PI)	

D <sub>10</sub> (mm) =	0.0000
D <sub>30</sub> (mm) =	0.0000
D <sub>75</sub> (mm) =	0.136
Coefficient of Uniformity, C <sub>u</sub> =	1000.00
Coefficient of curvature, C <sub>c</sub> =	1000.00

Organic Content, %	0
Maximum Dry Density, pcf	
Volume Change, %	

**Grain size distribution**



### Soil Classification

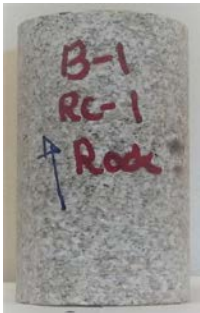
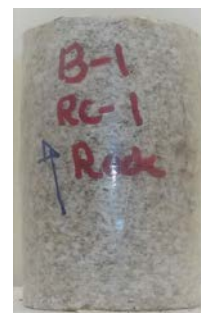
AASHTO	
USCS	ML - Sandy silt
GDOT	



**UNCONFINED COMPRESSIVE STRENGTH OF ROCK CORE SPECIMENS**  
( ASTM D 7012 Method C )

PROJECT DATA			
<b>Project:</b>	Rockbridge road over Lake Capri	<b>Page</b>	1 of 1
<b>Project #:</b>	20-ROCK-20514	<b>PI. No.:</b>	
<b>Client:</b>	Rockdale County	<b>Field Report #</b>	
<b>Sampled By:</b>	M Khan	<b>Tested By:</b>	Jay
<b>Date Sampled:</b>	5/11/2021	<b>Date of Test:</b>	6/8/2021
<b>Location of Core:</b>	Bent # 1		

ROCK CORE DATA			
<b>Station:</b>	55+40	<b>Drill Rig:</b>	B-45 (SN20110005)
<b>Depth of Core</b>	20'-25'	<b>Drilling Method:</b>	HAS/Auto/Hammer
<b>Avg.Length of Core:</b>	3.780 inch	<b>Driller:</b>	South Bros. Drilling
<b>Weight of Core:</b>	0.951 Lb		
<b>Volume of Core</b>	0.006 Cu.Ft		
<b>Unit Weight of Core:</b>	159.999 Lb/ Cu.Ft		
<b>Cross sectional area:</b>	0.019 Sq.Ft		

UNCONFINED COMPRESSIVE STRENGTH LAB TEST RESULTS								
Rock Core No.	Age (days)	Date tested	Diameter (inch)	Area (Sq. in)	Maximum Load (lbs)	Strength (psi)	Picture before Break	Picture after Break
B-1, RC-1	28	6/8/2021	1.860	2.72	15,762	5800		

**Notes:**

Reviewed by: \_\_\_\_\_

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Updated 6/5/2019

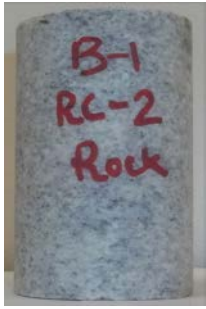
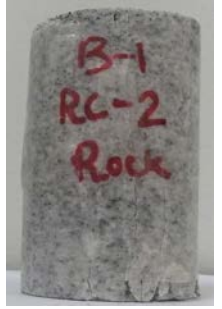
B-1, RC-1



**UNCONFINED COMPRESSIVE STRENGTH OF ROCK CORE SPECIMENS**  
( ASTM D 7012 Method C )

PROJECT DATA			
<b>Project:</b>	Rockbridge road over Lake Capri	<b>Page</b>	1 of 1
<b>Project #:</b>	20-ROCK-20514	<b>PI. No.:</b>	
<b>Client:</b>	Rockdale County	<b>Field Report #</b>	
<b>Sampled By:</b>	M Khan	<b>Tested By:</b>	Jay
<b>Date Sampled:</b>	5/11/2021	<b>Date of Test:</b>	6/8/2021
<b>Location of Core:</b>	Bent # 1		

ROCK CORE DATA			
<b>Station:</b>	55+40	<b>Drill Rig:</b>	B-45 (SN20110005)
<b>Depth of Core</b>	25'-30'	<b>Drilling Method:</b>	HAS/Auto/Hammer
<b>Avg.Length of Core:</b>	3.790 inch	<b>Driller:</b>	South Bros. Drilling
<b>Weight of Core:</b>	0.955 Lb		
<b>Volume of Core</b>	0.006 Cu.Ft		
<b>Unit Weight of Core:</b>	160.248 Lb/ Cu.Ft		
<b>Cross sectional area:</b>	0.019 Sq.Ft		

UNCONFINED COMPRESSIVE STRENGTH LAB TEST RESULTS								
Rock Core No.	Age (days)	Date tested	Diameter (inch)	Area (Sq. in)	Maximum Load (lbs)	Strength (psi)	Picture before Break	Picture after Break
B-1, RC-2	28	6/8/2021	1.860	2.72	39,442	14520		

**Notes:**

Reviewed by: \_\_\_\_\_

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B-1, RC-2


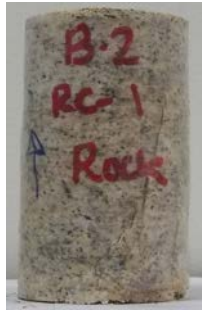
Updated 6/5/2019



**UNCONFINED COMPRESSIVE STRENGTH OF ROCK CORE SPECIMENS**  
( ASTM D 7012 Method C )

PROJECT DATA			
<b>Project:</b>	Rockbridge road over Lake Capri	<b>Page</b>	1 of 1
<b>Project #:</b>	20-ROCK-20514	<b>Pl. No.:</b>	
<b>Client:</b>	Rockdale County	<b>Field Report #</b>	
<b>Sampled By:</b>	M Khan	<b>Tested By:</b>	Jay
<b>Date Sampled:</b>	5/11/2021	<b>Date of Test:</b>	6/7/2021
<b>Location of Core:</b>	Bent # 2		

ROCK CORE DATA			
<b>Station:</b>	55+90	<b>Drill Rig:</b>	B-45 (SN20110005)
<b>Depth of Core</b>	25'-30'	<b>Drilling Method:</b>	HAS/Auto/Hammer
<b>Avg.Length of Core:</b>	3.790 inch	<b>Driller:</b>	South Bros. Drilling
<b>Weight of Core:</b>	0.967 Lb		
<b>Volume of Core</b>	0.006 Cu.Ft		
<b>Unit Weight of Core:</b>	162.261 Lb/ Cu.Ft		
<b>Cross sectional area:</b>	0.019 Sq.Ft		

UNCONFINED COMPRESSIVE STRENGTH LAB TEST RESULTS								
Rock Core No.	Age (days)	Date tested	Diameter (inch)	Area (Sq. in)	Maximum Load (lbs)	Strength (psi)	Picture before Break	Picture after Break
B-2, RC-1	27	6/7/2021	1.860	2.72	29,094	10710		

**Notes:**

Reviewed by: \_\_\_\_\_

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Updated 6/5/2019

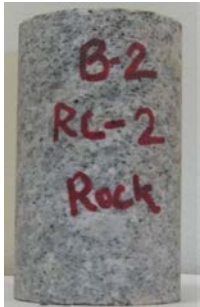
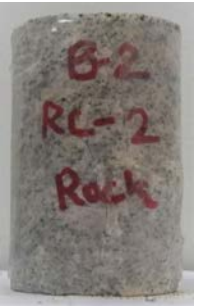
B-2, RC-1



**UNCONFINED COMPRESSIVE STRENGTH OF ROCK CORE SPECIMENS**  
( ASTM D 7012 Method C )

PROJECT DATA			
<b>Project:</b>	Rockbridge road over Lake Capri	<b>Page</b>	1 of 1
<b>Project #:</b>	20-ROCK-20514	<b>PI. No.:</b>	
<b>Client:</b>	Rockdale County	<b>Field Report #</b>	
<b>Sampled By:</b>	M Khan	<b>Tested By:</b>	Jay
<b>Date Sampled:</b>	5/11/2021	<b>Date of Test:</b>	6/8/2021
<b>Location of Core:</b>	Bent # 2		

ROCK CORE DATA			
<b>Station:</b>	55+90	<b>Drill Rig:</b>	B-45 (SN20110005)
<b>Depth of Core</b>	30'-35'	<b>Drilling Method:</b>	HAS/Auto/Hammer
<b>Avg.Length of Core:</b>	3.710 inch	<b>Driller:</b>	South Bros. Drilling
<b>Weight of Core:</b>	0.947 Lb		
<b>Volume of Core</b>	0.006 Cu.Ft		
<b>Unit Weight of Core:</b>	162.332 Lb/ Cu.Ft		
<b>Cross sectional area:</b>	0.019 Sq.Ft		

UNCONFINED COMPRESSIVE STRENGTH LAB TEST RESULTS								
Rock Core No.	Age (days)	Date tested	Diameter (inch)	Area (Sq. in)	Maximum Load (lbs)	Strength (psi)	Picture before Break	Picture after Break
B-2, RC-2	28	6/8/2021	1.860	2.72	39,810	14650		

**Notes:**

Reviewed by: \_\_\_\_\_

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Updated 6/5/2019

B-2, RC-2

## **Appendix E - Seismic site class determination**

## Seismic Site Class Calculations

Project: Rockbridge Road over Lake Capri  
 GDOT PI No. N/A  
 Atlas Proj. No. 20-ROCK-20514

**Table 3.10.3.1-1—Site Class Definitions**

Site Class	Soil Type and Profile
A	Hard rock with measured shear wave velocity, $\bar{v}_s > 5,000$ ft/s
B	Rock with $2,500$ ft/sec $< \bar{v}_s < 5,000$ ft/s
C	Very dense soil and soil rock with $1,200$ ft/sec $< \bar{v}_s < 2,500$ ft/s, or with either $\bar{N} > 50$ blows/ft, or $\bar{s}_u > 2.0$ ksf
D	Stiff soil with $600$ ft/s $< \bar{v}_s < 1,200$ ft/s, or with either $15 < \bar{N} < 50$ blows/ft, or $1.0 < \bar{s}_u < 2.0$ ksf
E	Soil profile with $\bar{v}_s < 600$ ft/s or with either $\bar{N} < 15$ blows/ft or $\bar{s}_u < 1.0$ ksf, or any profile with more than $10.0$ ft of soft clay defined as soil with $PI > 20$ , $w > 40$ percent and $\bar{s}_u < 0.5$ ksf
F	Soils requiring site-specific evaluations, such as: <ul style="list-style-type: none"> <li>• Peats or highly organic clays (<math>H &gt; 10.0</math> ft of peat or highly organic clay where <math>H</math> = thickness of soil)</li> <li>• Very high plasticity clays (<math>H &gt; 25.0</math> ft with <math>PI &gt; 75</math>)</li> <li>• Very thick soft/medium stiff clays (<math>H &gt; 120</math> ft)</li> </ul>

Boring B-1 (Hammer Efficiency = 95%)			
Sample Number	Layer Thickness, $d_i$ (ft)	$N_{60}$	$d_i/N_{60}$
1	2.5	11	0.18
2	2.5	40	0.17
3	2.5	5	0.15
4	2.5	2	0.15
5	5	2	0.24
6	5	100	0.24
7	5	100	0.45
8	5	100	0.36
9	5	100	0.33
10	5	100	0.63
11	5	100	0.09
12	5	100	0.05
13	5	100	0.05
14	5	100	0.05
15	5	100	0.05
16	5	100	0.05
17	5	100	0.05
18	5	100	0.05
19	5	100	0.05
20	5	100	0.05
21	5	100	0.05
22	5	100	0.05
$\sum d_i =$	100	$\sum d_i/N_{60} =$	3.53

Average N= 28.3  
 Site Class = D

Boring B-2 (Hammer Efficiency = 95%)			
Sample Number	Layer Thickness, $d_i$ (ft)	$N_{60}$	$d_i/N_{60}$
1	2.5	16	0.16
2	2.5	5	0.50
3	2.5	3	0.83
4	2.5	6	0.42
5	5	5	1.00
6	5	29	0.17
7	5	100	0.05
8	5	100	0.05
9	5	100	0.05
10	5	100	0.05
11	5	100	0.05
12	5	100	0.05
13	5	100	0.05
14	5	100	0.05
15	5	100	0.05
16	5	100	0.05
17	5	100	0.05
18	5	100	0.05
19	5	100	0.05
20	5	100	0.05
21	5	100	0.05
22	5	100	0.05
$\sum d_i =$	100	$\sum d_i/N_{60} =$	3.88

Average N= 25.8  
 Site Class = D

## **Appendix F - Foundation design data**





DESIGNER: ATLAS  
 DATE: May 24, 2021  
 PI NUMBER: 20-ROCK-20514  
 PROJECT: CR 439 Rockbridge Road Over Lake Capri  
 FROM: Jaime Mandujano, EIT, Bridge Engineer, Atlas Technical Consultants, LLC  
 TO: Yong Shao, Ph.D. PE, Atlas Technical Consultants, LLC

**SUBJECT: BRIDGE FOUNDATION DESIGN DATA (LRFD)**

The following design information has been calculated for the below listed structures. Please use the provided values to complete the Bridge Foundation Investigation report for this project.

Bent(s):	DESIGN LOADS:		Pile Size:	DRIVABILITY:		PILE DESIGN LOAD:
	Maximum Factored Load (kips)	Service Load (kips)		Stress limits = $\sigma_d$		(Structural Capacity)
				Comp. (ksi)	Tens. (ksi)	$P_R$ (kips)
<b>1 and 2</b>	225	161	HP 14x73 Or HP 12x53	32.4 Or 45.0	32.4 Or 45.0	385 Or 384

If you have any questions please contact Jaime Mandujano of Atlas Technical Consultants at 770-263-5945 (ex.312) or [Jaime.Mandujano@oneatlas.com](mailto:Jaime.Mandujano@oneatlas.com)

## **Appendix G - Pile capacity calculations with APILE**

=====

APILE for Windows, Version 2015.7.5

Serial Number : 139694124

A Program for Analyzing the Axial Capacity  
and Short-term Settlement of Driven Piles  
under Axial Loading.  
(c) Copyright ENSOFT, Inc., 1987-2015  
All Rights Reserved

=====

This program is licensed to :

Moreland Altobelli Associates  
Duluth, GA

Path to file locations : Q:\Rockdale County\20-ROCK-20514 Rockbridge Rd over Lake Capri\BFI\Apile\  
Name of input data file : Bent1.ap7d  
Name of output file : Bent1.ap7o  
Name of plot output file : Bent1.ap7p

-----  
Time and Date of Analysis  
-----

Date: July 09, 2021 Time: 13:09:06

1

\*\*\*\*\*  
\* INPUT INFORMATION \*  
\*\*\*\*\*

Rockbridge Road - Bent 1 HP12x53

DESIGNER : YCS

JOB NUMBER : 20-ROCK-20514

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)  
- API RP 2A (American Petroleum Institute)

TYPE OF LOADING :  
- COMPRESSION

PILE TYPE :

H-Pile/Steel Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI  
 - CROSS SECTION AREA = 141.89 IN2

NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL = 18.00 FT.  
 - PILE STICKUP LENGTH, PSL = 0.00 FT.  
 - ZERO FRICTION LENGTH, ZFL = 0.00 FT.  
 - PERIMETER OF PILE = 47.65 IN.  
 - TIP AREA OF PILE = 141.89 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	42.60	0.00	0.00
13.00	SAND	0.00	42.60	0.00	0.00
13.00	SAND	0.00	62.60	40.00	0.00
15.00	SAND	0.00	62.60	40.00	0.00
15.00	SAND	0.00	62.60	45.00	0.00
25.00	SAND	0.00	62.60	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	2.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	2.00	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	1.000	1.000
13.00	1.000	1.000
13.00	1.000	1.000
15.00	1.000	1.000
15.00	1.000	1.000
25.00	1.000	1.000

DEPTH	PLASTIC INDEX PI	YIELD STRESS RATIO	Qc FROM CPT

FT.	%		KSF
0.00	0.00	2.00	0.000E+00
13.00	0.00	2.00	0.000E+00
13.00	0.00	0.00	0.000E+00
15.00	0.00	0.00	0.000E+00
15.00	0.00	0.00	0.000E+00
25.00	0.00	0.00	0.000E+00

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 \* COMPUTATION RESULT \*  
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 \* FED. HWY. METHOD \*  
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	PILE PENETRATION	TOTAL SKIN FRICTION	END BEARING	ULTIMATE CAPACITY
	FT.	KIP	KIP	KIP
Bottom of Pile Cap →	0.00	0.0	0.5	0.5
ELE. 725'	1.00	0.1	1.0	1.1
	2.00	0.2	2.1	2.3
	3.00	0.5	3.1	3.7
	4.00	1.0	4.1	5.1
	5.00	1.5	5.2	6.7
	6.00	2.1	6.2	8.3
	7.00	2.9	7.2	10.1
	8.00	3.8	8.1	11.9
	9.00	4.8	9.1	13.9
	10.00	5.9	10.1	16.0
	11.00	7.1	11.0	18.1
	12.00	8.5	25.1	33.5
	13.00	9.9	42.3	52.2
	14.00	12.9	103.9	116.9
	15.00	17.7	174.9	192.6
	16.00	23.2	238.3	261.5
	17.00	29.5	301.1	330.6
ELE. 707' →	18.00	36.3	324.6	360.8

Rndr = 346kips

\*\*\*\*\*  
 \* API RP-2A (1994) \*  
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PILE PENETRATION	TOTAL SKIN FRICTION	END BEARING	ULTIMATE CAPACITY
FT.	KIP	KIP	KIP
0.00	0.0	0.0	0.0
1.00	0.0	0.0	0.0
2.00	0.0	0.0	0.0
3.00	0.0	0.0	0.0
4.00	0.0	0.0	0.0
5.00	0.0	0.0	0.0
6.00	0.0	0.0	0.0
7.00	0.0	0.0	0.0
8.00	0.0	0.0	0.0
9.00	0.0	0.0	0.0
10.00	0.0	0.0	0.0
11.00	0.0	0.0	0.0
12.00	0.0	0.0	0.0
13.00	0.0	0.0	0.0
14.00	0.0	0.0	0.0
15.00	0.0	0.0	0.0

16.00	0.0	0.0	0.0
17.00	0.0	0.0	0.0
18.00	0.0	0.0	0.0

NOTES:

- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN  
 IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION  
 OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

\*\*\*\*\*  
 \* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT \*  
 \* CURVES FOR AXIAL LOADING \*  
 \*\*\*\*\*

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00	0.0000E+00	0.0000E+00
			0.3154E-01	0.1000E-01
			0.6308E-01	0.2000E-01
			0.1262E+00	0.4000E-01
			0.1892E+00	0.6000E-01
			0.2523E+00	0.8000E-01
			0.2839E+00	0.9000E-01
			0.3154E+00	0.1000E+00
			0.3154E+00	0.5000E+00
			0.3154E+00	0.2000E+01
2	10	0.6525E+01	0.0000E+00	0.0000E+00
			0.1445E+00	0.1000E-01
			0.2890E+00	0.2000E-01
			0.5781E+00	0.4000E-01
			0.8671E+00	0.6000E-01
			0.1156E+01	0.8000E-01
			0.1301E+01	0.9000E-01
			0.1445E+01	0.1000E+00
			0.1445E+01	0.5000E+00
			0.1445E+01	0.2000E+01
3	10	0.1296E+02	0.0000E+00	0.0000E+00
			0.3915E+00	0.1000E-01
			0.7831E+00	0.2000E-01
			0.1566E+01	0.4000E-01
			0.2349E+01	0.6000E-01
			0.3132E+01	0.8000E-01
			0.3524E+01	0.9000E-01
			0.3915E+01	0.1000E+00
			0.3915E+01	0.5000E+00
			0.3915E+01	0.2000E+01
4	10	0.1300E+02	0.0000E+00	0.0000E+00
			0.6834E+00	0.1000E-01
			0.1367E+01	0.2000E-01
			0.2734E+01	0.4000E-01
			0.4101E+01	0.6000E-01
			0.5468E+01	0.8000E-01
			0.6151E+01	0.9000E-01
			0.6834E+01	0.1000E+00
			0.6834E+01	0.5000E+00
			0.6834E+01	0.2000E+01
5	10	0.1403E+02	0.0000E+00	0.0000E+00
			0.9006E+00	0.1000E-01
			0.1801E+01	0.2000E-01

			0.3602E+01	0.4000E-01
			0.5403E+01	0.6000E-01
			0.7204E+01	0.8000E-01
			0.8105E+01	0.9000E-01
			0.9006E+01	0.1000E+00
			0.9006E+01	0.5000E+00
			0.9006E+01	0.2000E+01
6	10	0.1496E+02	0.0000E+00	0.0000E+00
			0.9006E+00	0.1000E-01
			0.1801E+01	0.2000E-01
			0.3602E+01	0.4000E-01
			0.5403E+01	0.6000E-01
			0.7204E+01	0.8000E-01
			0.8105E+01	0.9000E-01
			0.9006E+01	0.1000E+00
			0.9006E+01	0.5000E+00
			0.9006E+01	0.2000E+01
7	10	0.1500E+02	0.0000E+00	0.0000E+00
			0.1029E+01	0.1000E-01
			0.2059E+01	0.2000E-01
			0.4118E+01	0.4000E-01
			0.6177E+01	0.6000E-01
			0.8236E+01	0.8000E-01
			0.9265E+01	0.9000E-01
			0.1029E+02	0.1000E+00
			0.1029E+02	0.5000E+00
			0.1029E+02	0.2000E+01
8	10	0.2003E+02	0.0000E+00	0.0000E+00
			0.1184E+01	0.1000E-01
			0.2367E+01	0.2000E-01
			0.4734E+01	0.4000E-01
			0.7101E+01	0.6000E-01
			0.9468E+01	0.8000E-01
			0.1065E+02	0.9000E-01
			0.1184E+02	0.1000E+00
			0.1184E+02	0.5000E+00
			0.1184E+02	0.2000E+01
9	10	0.2496E+02	0.0000E+00	0.0000E+00
			0.1184E+01	0.1000E-01
			0.2367E+01	0.2000E-01
			0.4734E+01	0.4000E-01
			0.7101E+01	0.6000E-01
			0.9468E+01	0.8000E-01
			0.1065E+02	0.9000E-01
			0.1184E+02	0.1000E+00
			0.1184E+02	0.5000E+00
			0.1184E+02	0.2000E+01

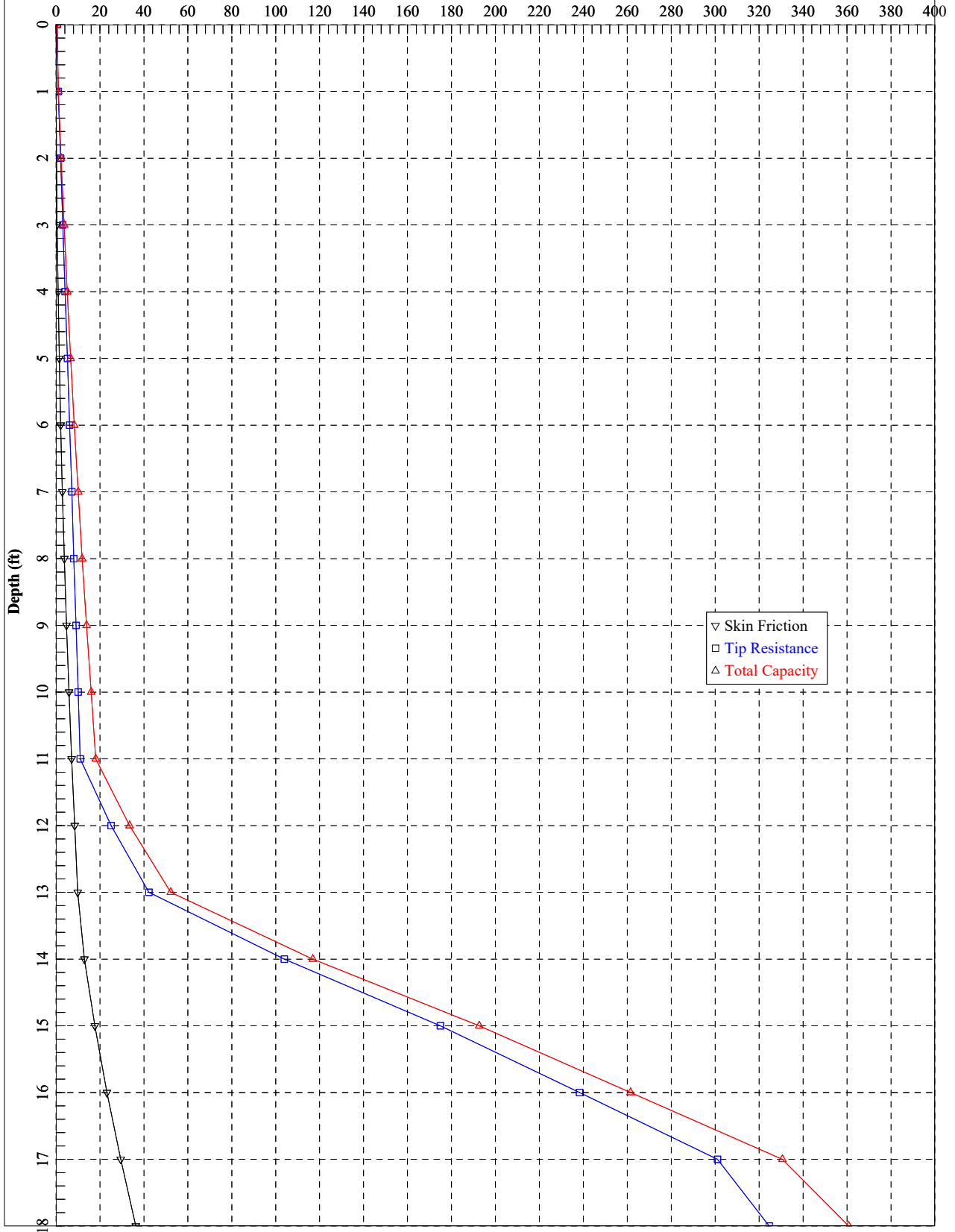
TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.2028E+02	0.7584E-02
0.4057E+02	0.1517E-01
0.8114E+02	0.3033E-01
0.1623E+03	0.1972E+00
0.2434E+03	0.6370E+00
0.2921E+03	0.1107E+01
0.3246E+03	0.1517E+01
0.3246E+03	0.2275E+01
0.3246E+03	0.3033E+01

LOAD VERSUS SETTLEMENT CURVE  
\*\*\*\*\*

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.3097E+00	0.1157E-03	0.2675E+00	0.1000E-03
0.3097E+01	0.1157E-02	0.2675E+01	0.1000E-02
0.1548E+02	0.5784E-02	0.1337E+02	0.5000E-02
0.3097E+02	0.1157E-01	0.2675E+02	0.1000E-01
0.1116E+03	0.5558E-01	0.9070E+02	0.5000E-01
0.1558E+03	0.1076E+00	0.1150E+03	0.1000E+00
0.2589E+03	0.5130E+00	0.2181E+03	0.5000E+00
0.3218E+03	0.1016E+01	0.2810E+03	0.1000E+01
0.3653E+03	0.2019E+01	0.3246E+03	0.2000E+01



**Bent 1 HP 12x53**  
**Axial Capacity (kips)**



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APILE for Windows, Version 2015.7.5

Serial Number : 139694124

A Program for Analyzing the Axial Capacity  
and Short-term Settlement of Driven Piles  
under Axial Loading.  
(c) Copyright ENSOFT, Inc., 1987-2015  
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This program is licensed to :

Moreland Altobelli Associates  
Duluth, GA

Path to file locations : Q:\Rockdale County\20-ROCK-20514 Rockbridge Rd over Lake Capri\BFI\Apile\  
Name of input data file : Bent2.ap7d  
Name of output file : Bent2.ap7o  
Name of plot output file : Bent2.ap7p

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Time and Date of Analysis  
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Date: July 09, 2021 Time: 13:38:33

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\* INPUT INFORMATION \*  
\*\*\*\*\*

Rockbridge Road - Bent 2 HP12x53

DESIGNER : YCS

JOB NUMBER : 20-ROCK-20514

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)  
- API RP 2A (American Petroleum Institute)

TYPE OF LOADING :  
- COMPRESSION

PILE TYPE :

H-Pile/Steel Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI  
 - CROSS SECTION AREA = 141.89 IN2

NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL = 22.00 FT.  
 - PILE STICKUP LENGTH, PSL = 0.00 FT.  
 - ZERO FRICTION LENGTH, ZFL = 0.00 FT.  
 - PERIMETER OF PILE = 47.65 IN.  
 - TIP AREA OF PILE = 141.89 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	42.60	0.00	0.00
13.00	SAND	0.00	42.60	0.00	0.00
13.00	SAND	0.00	52.60	34.00	0.00
18.00	SAND	0.00	52.60	34.00	0.00
18.00	SAND	0.00	62.60	40.00	0.00
20.00	SAND	0.00	62.60	40.00	0.00
20.00	SAND	0.00	62.60	45.00	0.00
30.00	SAND	0.00	62.60	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	5.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	5.00	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	1.000	1.000
13.00	1.000	1.000
13.00	1.000	1.000
18.00	1.000	1.000
18.00	1.000	1.000
20.00	1.000	1.000
20.00	1.000	1.000
30.00	1.000	1.000

DEPTH FT.	PLASTIC INDEX PI %	YIELD STRESS RATIO	Qc FROM CPT KSF
0.00	0.00	5.00	0.000E+00
13.00	0.00	5.00	0.000E+00
13.00	0.00	0.00	0.000E+00
18.00	0.00	0.00	0.000E+00
18.00	0.00	0.00	0.000E+00
20.00	0.00	0.00	0.000E+00
20.00	0.00	0.00	0.000E+00
30.00	0.00	0.00	0.000E+00

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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	0.8	0.8
	1.00	0.1	1.7	1.8
	2.00	0.3	3.5	3.8
	3.00	0.7	5.2	6.0
	4.00	1.3	6.9	8.2
	5.00	2.0	8.5	10.5
	6.00	2.9	10.1	13.0
	7.00	3.9	11.7	15.6
	8.00	5.1	13.2	18.2
	9.00	6.4	14.6	21.0
	10.00	7.8	16.1	23.9
	11.00	9.5	17.4	26.9
	12.00	11.2	18.9	30.1
	13.00	13.1	20.4	33.5
	14.00	15.1	22.1	37.2
	15.00	17.3	23.9	41.3
	16.00	19.7	25.8	45.6
	17.00	22.3	44.1	66.5
	18.00	25.1	65.7	90.8
	19.00	29.8	147.5	177.3
	20.00	36.5	239.7	276.2
	21.00	44.1	320.8	364.9
	22.00	52.5	399.6	452.0

Bottom of Pile Cap → ELE. 723'

ELE. 702 → Rndr = 346 kips

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 \* API RP-2A (1994) \*  
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PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.0	0.0
1.00	0.0	0.0	0.0
2.00	0.0	0.0	0.0
3.00	0.0	0.0	0.0

4.00	0.0	0.0	0.0
5.00	0.0	0.0	0.0
6.00	0.0	0.0	0.0
7.00	0.0	0.0	0.0
8.00	0.0	0.0	0.0
9.00	0.0	0.0	0.0
10.00	0.0	0.0	0.0
11.00	0.0	0.0	0.0
12.00	0.0	0.0	0.0
13.00	0.0	0.0	0.0
14.00	0.0	0.0	0.0
15.00	0.0	0.0	0.0
16.00	0.0	0.0	0.0
17.00	0.0	0.0	0.0
18.00	0.0	0.0	0.0
19.00	0.0	0.0	0.0
20.00	0.0	0.0	0.0
21.00	0.0	0.0	0.0
22.00	0.0	0.0	0.0

NOTES:

- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN  
IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION  
OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

\*\*\*\*\*  
\* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT \*  
\* CURVES FOR AXIAL LOADING \*  
\*\*\*\*\*

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00	0.0000E+00	0.0000E+00
			0.4265E-01	0.1000E-01
			0.8531E-01	0.2000E-01
			0.1706E+00	0.4000E-01
			0.2559E+00	0.6000E-01
			0.3412E+00	0.8000E-01
			0.3839E+00	0.9000E-01
			0.4265E+00	0.1000E+00
			0.4265E+00	0.5000E+00
			0.4265E+00	0.2000E+01
2	10	0.6525E+01	0.0000E+00	0.0000E+00
			0.1916E+00	0.1000E-01
			0.3833E+00	0.2000E-01
			0.7666E+00	0.4000E-01
			0.1150E+01	0.6000E-01
			0.1533E+01	0.8000E-01
			0.1725E+01	0.9000E-01
			0.1916E+01	0.1000E+00
			0.1916E+01	0.5000E+00
			0.1916E+01	0.2000E+01
3	10	0.1296E+02	0.0000E+00	0.0000E+00
			0.3428E+00	0.1000E-01
			0.6856E+00	0.2000E-01
			0.1371E+01	0.4000E-01
			0.2057E+01	0.6000E-01
			0.2742E+01	0.8000E-01
			0.3085E+01	0.9000E-01
			0.3428E+01	0.1000E+00
			0.3428E+01	0.5000E+00

4	10	0.1300E+02	0.3428E+01	0.2000E+01
			0.0000E+00	0.0000E+00
			0.3723E+00	0.1000E-01
			0.7447E+00	0.2000E-01
			0.1489E+01	0.4000E-01
			0.2234E+01	0.6000E-01
			0.2979E+01	0.8000E-01
			0.3351E+01	0.9000E-01
			0.3723E+01	0.1000E+00
			0.3723E+01	0.5000E+00
5	10	0.1553E+02	0.3723E+01	0.2000E+01
			0.0000E+00	0.0000E+00
			0.4366E+00	0.1000E-01
			0.8731E+00	0.2000E-01
			0.1746E+01	0.4000E-01
			0.2619E+01	0.6000E-01
			0.3492E+01	0.8000E-01
			0.3929E+01	0.9000E-01
			0.4366E+01	0.1000E+00
			0.4366E+01	0.5000E+00
6	10	0.1796E+02	0.4366E+01	0.2000E+01
			0.0000E+00	0.0000E+00
			0.6519E+00	0.1000E-01
			0.1304E+01	0.2000E-01
			0.2608E+01	0.4000E-01
			0.3911E+01	0.6000E-01
			0.5215E+01	0.8000E-01
			0.5867E+01	0.9000E-01
			0.6519E+01	0.1000E+00
			0.6519E+01	0.5000E+00
7	10	0.1800E+02	0.6519E+01	0.2000E+01
			0.0000E+00	0.0000E+00
			0.9979E+00	0.1000E-01
			0.1996E+01	0.2000E-01
			0.3992E+01	0.4000E-01
			0.5987E+01	0.6000E-01
			0.7983E+01	0.8000E-01
			0.8981E+01	0.9000E-01
			0.9979E+01	0.1000E+00
			0.9979E+01	0.5000E+00
8	10	0.1903E+02	0.9979E+01	0.2000E+01
			0.0000E+00	0.0000E+00
			0.1249E+01	0.1000E-01
			0.2497E+01	0.2000E-01
			0.4994E+01	0.4000E-01
			0.7492E+01	0.6000E-01
			0.9989E+01	0.8000E-01
			0.1124E+02	0.9000E-01
			0.1249E+02	0.1000E+00
			0.1249E+02	0.5000E+00
9	10	0.1996E+02	0.1249E+02	0.2000E+01
			0.0000E+00	0.0000E+00
			0.1249E+01	0.1000E-01
			0.2497E+01	0.2000E-01
			0.4994E+01	0.4000E-01
			0.7492E+01	0.6000E-01
			0.9989E+01	0.8000E-01
			0.1124E+02	0.9000E-01
			0.1249E+02	0.1000E+00
			0.1249E+02	0.5000E+00
10	10	0.2000E+02	0.1249E+02	0.2000E+01
			0.0000E+00	0.0000E+00

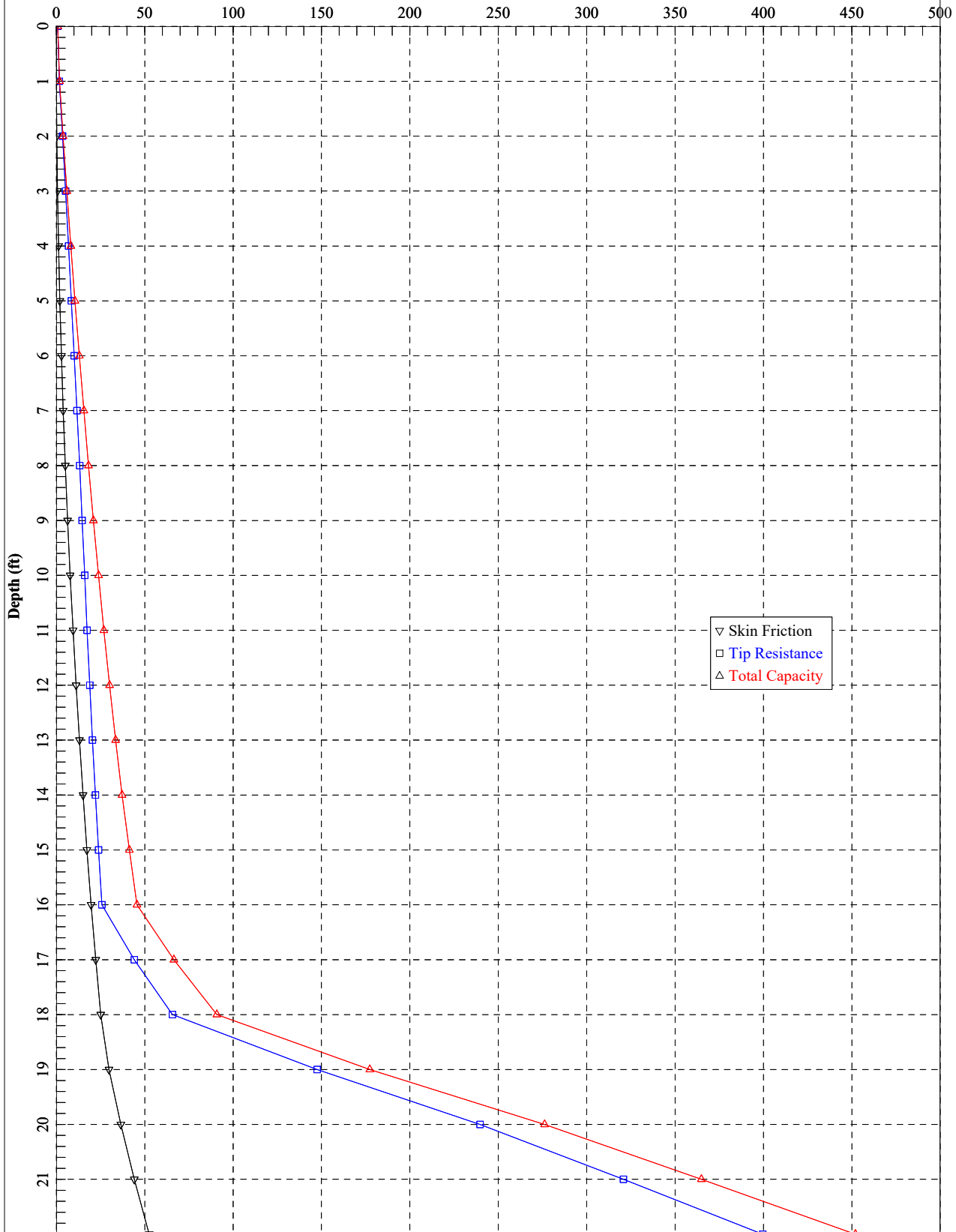
			0.1394E+01	0.1000E-01
			0.2788E+01	0.2000E-01
			0.5575E+01	0.4000E-01
			0.8363E+01	0.6000E-01
			0.1115E+02	0.8000E-01
			0.1254E+02	0.9000E-01
			0.1394E+02	0.1000E+00
			0.1394E+02	0.5000E+00
			0.1394E+02	0.2000E+01
11	10	0.2503E+02		
			0.0000E+00	0.0000E+00
			0.1467E+01	0.1000E-01
			0.2935E+01	0.2000E-01
			0.5870E+01	0.4000E-01
			0.8804E+01	0.6000E-01
			0.1174E+02	0.8000E-01
			0.1321E+02	0.9000E-01
			0.1467E+02	0.1000E+00
			0.1467E+02	0.5000E+00
			0.1467E+02	0.2000E+01
12	10	0.2996E+02		
			0.0000E+00	0.0000E+00
			0.1467E+01	0.1000E-01
			0.2935E+01	0.2000E-01
			0.5870E+01	0.4000E-01
			0.8804E+01	0.6000E-01
			0.1174E+02	0.8000E-01
			0.1321E+02	0.9000E-01
			0.1467E+02	0.1000E+00
			0.1467E+02	0.5000E+00
			0.1467E+02	0.2000E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.2497E+02	0.7584E-02
0.4995E+02	0.1517E-01
0.9990E+02	0.3033E-01
0.1998E+03	0.1972E+00
0.2997E+03	0.6370E+00
0.3596E+03	0.1107E+01
0.3996E+03	0.1517E+01
0.3996E+03	0.2275E+01
0.3996E+03	0.3033E+01

LOAD VERSUS SETTLEMENT CURVE  
\*\*\*\*\*

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.3896E+00	0.1239E-03	0.3293E+00	0.1000E-03
0.3896E+01	0.1239E-02	0.3293E+01	0.1000E-02
0.1948E+02	0.6195E-02	0.1647E+02	0.5000E-02
0.3896E+02	0.1239E-01	0.3293E+02	0.1000E-01
0.1414E+03	0.5854E-01	0.1117E+03	0.5000E-01
0.1986E+03	0.1118E+00	0.1416E+03	0.1000E+00
0.3256E+03	0.5199E+00	0.2686E+03	0.5000E+00
0.4030E+03	0.1025E+01	0.3460E+03	0.1000E+01
0.4566E+03	0.2028E+01	0.3996E+03	0.2000E+01

**Bent 2 HP 12x53  
Axial Capacity (kips)**





=====

APILE for Windows, Version 2015.7.5

Serial Number : 139694124

A Program for Analyzing the Axial Capacity  
and Short-term Settlement of Driven Piles  
under Axial Loading.  
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This program is licensed to :

Moreland Altobelli Associates  
Duluth, GA

Path to file locations : Q:\Rockdale County\20-ROCK-20514 Rockbridge Rd over Lake Capri\BFI\Apile\  
Name of input data file : Bent1\_14x73.ap7d  
Name of output file : Bent1\_14x73.ap7o  
Name of plot output file : Bent1\_14x73.ap7p

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Time and Date of Analysis  
-----

Date: July 09, 2021 Time: 13:45:03

1

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\* INPUT INFORMATION \*  
\*\*\*\*\*

Rockbridge Road - Bent 1 HP14x73

DESIGNER : YCS

JOB NUMBER : 20-ROCK-20514

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)  
- API RP 2A (American Petroleum Institute)

TYPE OF LOADING :  
- COMPRESSION

PILE TYPE :

H-Pile/Steel Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI  
 - CROSS SECTION AREA = 198.50 IN2

NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL = 18.00 FT.  
 - PILE STICKUP LENGTH, PSL = 0.00 FT.  
 - ZERO FRICTION LENGTH, ZFL = 0.00 FT.  
 - PERIMETER OF PILE = 56.40 IN.  
 - TIP AREA OF PILE = 198.50 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	42.60	0.00	0.00
13.00	SAND	0.00	42.60	0.00	0.00
13.00	SAND	0.00	62.60	40.00	0.00
15.00	SAND	0.00	62.60	40.00	0.00
15.00	SAND	0.00	62.60	45.00	0.00
25.00	SAND	0.00	62.60	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	2.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	2.00	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	1.000	1.000
13.00	1.000	1.000
13.00	1.000	1.000
15.00	1.000	1.000
15.00	1.000	1.000
25.00	1.000	1.000

DEPTH	PLASTIC INDEX PI	YIELD STRESS RATIO	Qc FROM CPT

FT.	%		KSF
0.00	0.00	2.00	0.000E+00
13.00	0.00	2.00	0.000E+00
13.00	0.00	0.00	0.000E+00
15.00	0.00	0.00	0.000E+00
15.00	0.00	0.00	0.000E+00
25.00	0.00	0.00	0.000E+00

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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
Bottom of Pile Cap →	0.00	0.0	0.8	0.8
ELE. 725'	1.00	0.1	1.6	1.6
	2.00	0.3	2.8	3.1
	3.00	0.7	4.4	5.0
	4.00	1.2	5.8	6.9
	5.00	1.8	7.2	9.0
	6.00	2.6	8.6	11.2
	7.00	3.5	10.0	13.5
	8.00	4.6	11.4	15.9
	9.00	5.8	12.7	18.5
	10.00	7.1	14.1	21.2
	11.00	8.6	19.5	28.1
	12.00	10.2	38.7	48.9
	13.00	11.9	73.3	85.2
	14.00	15.6	154.5	170.1
	15.00	21.4	242.6	264.1
ELE. 709' →	16.00	28.1	324.9	353.0
	17.00	35.7	408.2	443.9
	18.00	43.9	454.0	498.0

Rndr = 346 kips

\*\*\*\*\*  
 \* API RP-2A (1994) \*  
 \*\*\*\*\*

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.0	0.0
1.00	0.0	0.0	0.0
2.00	0.0	0.0	0.0
3.00	0.0	0.0	0.0
4.00	0.0	0.0	0.0
5.00	0.0	0.0	0.0
6.00	0.0	0.0	0.0
7.00	0.0	0.0	0.0
8.00	0.0	0.0	0.0
9.00	0.0	0.0	0.0
10.00	0.0	0.0	0.0
11.00	0.0	0.0	0.0
12.00	0.0	0.0	0.0
13.00	0.0	0.0	0.0
14.00	0.0	0.0	0.0
15.00	0.0	0.0	0.0

16.00	0.0	0.0	0.0
17.00	0.0	0.0	0.0
18.00	0.0	0.0	0.0

NOTES:

- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN  
 IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION  
 OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

\*\*\*\*\*  
 \* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT \*  
 \* CURVES FOR AXIAL LOADING \*  
 \*\*\*\*\*

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00	0.0000E+00	0.0000E+00
			0.3210E-01	0.1000E-01
			0.6420E-01	0.2000E-01
			0.1284E+00	0.4000E-01
			0.1926E+00	0.6000E-01
			0.2568E+00	0.8000E-01
			0.2889E+00	0.9000E-01
			0.3210E+00	0.1000E+00
			0.3210E+00	0.5000E+00
			0.3210E+00	0.2000E+01
2	10	0.6525E+01	0.0000E+00	0.0000E+00
			0.1470E+00	0.1000E-01
			0.2941E+00	0.2000E-01
			0.5882E+00	0.4000E-01
			0.8823E+00	0.6000E-01
			0.1176E+01	0.8000E-01
			0.1323E+01	0.9000E-01
			0.1470E+01	0.1000E+00
			0.1470E+01	0.5000E+00
			0.1470E+01	0.2000E+01
3	10	0.1296E+02	0.0000E+00	0.0000E+00
			0.3999E+00	0.1000E-01
			0.7999E+00	0.2000E-01
			0.1600E+01	0.4000E-01
			0.2400E+01	0.6000E-01
			0.3200E+01	0.8000E-01
			0.3599E+01	0.9000E-01
			0.3999E+01	0.1000E+00
			0.3999E+01	0.5000E+00
			0.3999E+01	0.2000E+01
4	10	0.1300E+02	0.0000E+00	0.0000E+00
			0.7003E+00	0.1000E-01
			0.1401E+01	0.2000E-01
			0.2801E+01	0.4000E-01
			0.4202E+01	0.6000E-01
			0.5602E+01	0.8000E-01
			0.6303E+01	0.9000E-01
			0.7003E+01	0.1000E+00
			0.7003E+01	0.5000E+00
			0.7003E+01	0.2000E+01
5	10	0.1403E+02	0.0000E+00	0.0000E+00
			0.9235E+00	0.1000E-01
			0.1847E+01	0.2000E-01

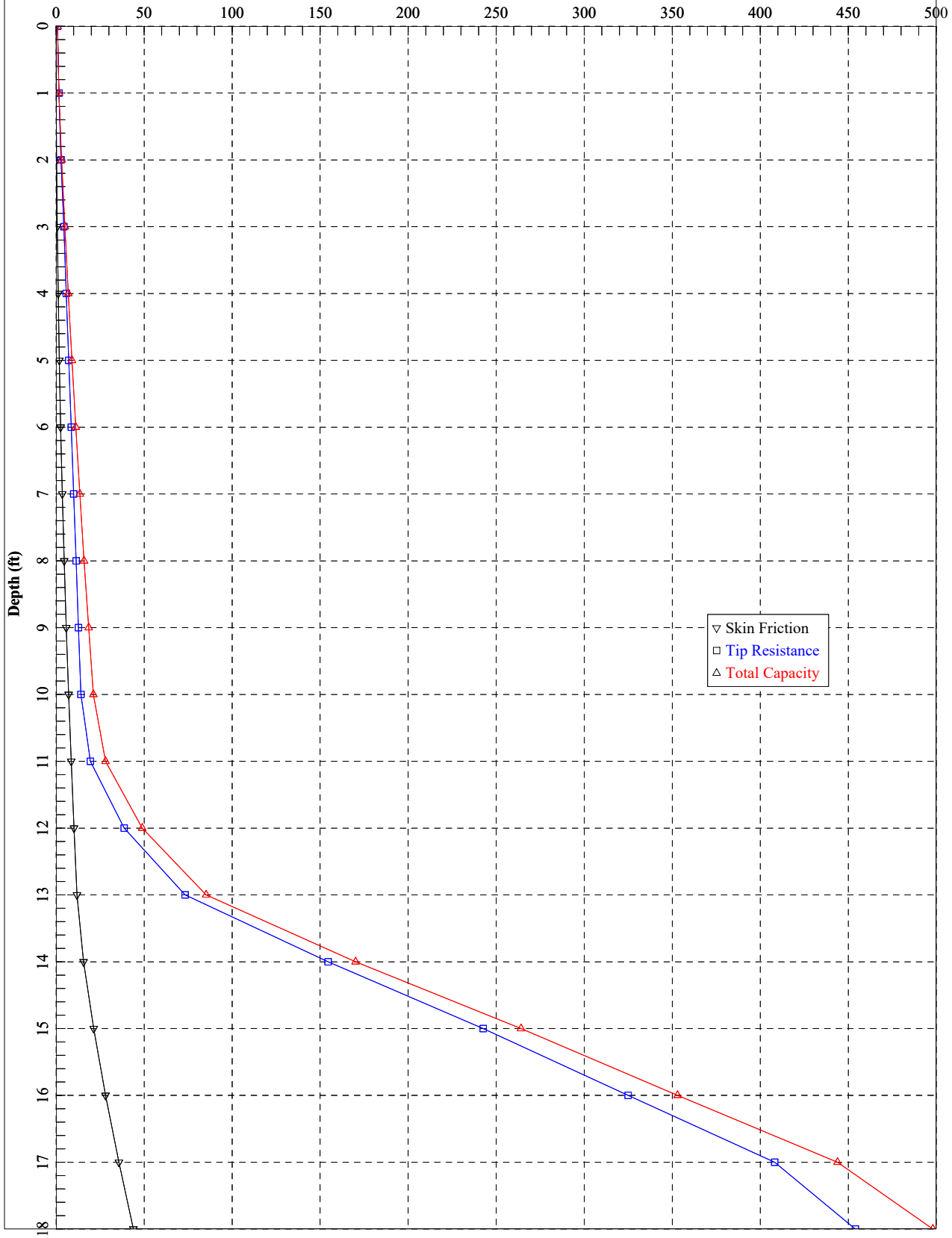
			0.3694E+01	0.4000E-01
			0.5541E+01	0.6000E-01
			0.7388E+01	0.8000E-01
			0.8311E+01	0.9000E-01
			0.9235E+01	0.1000E+00
			0.9235E+01	0.5000E+00
			0.9235E+01	0.2000E+01
6	10	0.1496E+02	0.0000E+00	0.0000E+00
			0.9235E+00	0.1000E-01
			0.1847E+01	0.2000E-01
			0.3694E+01	0.4000E-01
			0.5541E+01	0.6000E-01
			0.7388E+01	0.8000E-01
			0.8311E+01	0.9000E-01
			0.9235E+01	0.1000E+00
			0.9235E+01	0.5000E+00
			0.9235E+01	0.2000E+01
7	10	0.1500E+02	0.0000E+00	0.0000E+00
			0.1056E+01	0.1000E-01
			0.2111E+01	0.2000E-01
			0.4223E+01	0.4000E-01
			0.6334E+01	0.6000E-01
			0.8445E+01	0.8000E-01
			0.9501E+01	0.9000E-01
			0.1056E+02	0.1000E+00
			0.1056E+02	0.5000E+00
			0.1056E+02	0.2000E+01
8	10	0.2003E+02	0.0000E+00	0.0000E+00
			0.1214E+01	0.1000E-01
			0.2427E+01	0.2000E-01
			0.4855E+01	0.4000E-01
			0.7282E+01	0.6000E-01
			0.9709E+01	0.8000E-01
			0.1092E+02	0.9000E-01
			0.1214E+02	0.1000E+00
			0.1214E+02	0.5000E+00
			0.1214E+02	0.2000E+01
9	10	0.2496E+02	0.0000E+00	0.0000E+00
			0.1214E+01	0.1000E-01
			0.2427E+01	0.2000E-01
			0.4855E+01	0.4000E-01
			0.7282E+01	0.6000E-01
			0.9709E+01	0.8000E-01
			0.1092E+02	0.9000E-01
			0.1214E+02	0.1000E+00
			0.1214E+02	0.5000E+00
			0.1214E+02	0.2000E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.2838E+02	0.8976E-02
0.5676E+02	0.1795E-01
0.1135E+03	0.3591E-01
0.2270E+03	0.2334E+00
0.3405E+03	0.7540E+00
0.4086E+03	0.1311E+01
0.4540E+03	0.1795E+01
0.4540E+03	0.2693E+01
0.4540E+03	0.3591E+01

LOAD VERSUS SETTLEMENT CURVE  
\*\*\*\*\*

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.3670E+00	0.1133E-03	0.3161E+00	0.1000E-03
0.3670E+01	0.1133E-02	0.3161E+01	0.1000E-02
0.1835E+02	0.5664E-02	0.1581E+02	0.5000E-02
0.3670E+02	0.1133E-01	0.3161E+02	0.1000E-01
0.1469E+03	0.5527E-01	0.1216E+03	0.5000E-01
0.1998E+03	0.1070E+00	0.1504E+03	0.1000E+00
0.3346E+03	0.5121E+00	0.2852E+03	0.5000E+00
0.4200E+03	0.1015E+01	0.3706E+03	0.1000E+01
0.5034E+03	0.2018E+01	0.4540E+03	0.2000E+01

Bent 1 HP 14x73  
Axial Capacity (kips)



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APILE for Windows, Version 2015.7.5

Serial Number : 139694124

A Program for Analyzing the Axial Capacity  
and Short-term Settlement of Driven Piles  
under Axial Loading.  
(c) Copyright ENSOFT, Inc., 1987-2015  
All Rights Reserved

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This program is licensed to :

Moreland Altobelli Associates  
Duluth, GA

Path to file locations : Q:\Rockdale County\20-ROCK-20514 Rockbridge Rd over Lake Capri\BFI\Apile\  
Name of input data file : Bent2\_14x73.ap7d  
Name of output file : Bent2\_14x73.ap7o  
Name of plot output file : Bent2\_14x73.ap7p

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Time and Date of Analysis  
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Date: July 09, 2021 Time: 13:41:39

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\* INPUT INFORMATION \*  
\*\*\*\*\*

Rockbridge Road - Bent 2 HP14x73

DESIGNER : YCS

JOB NUMBER : 20-ROCK-20514

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)  
- API RP 2A (American Petroleum Institute)

TYPE OF LOADING :  
- COMPRESSION

PILE TYPE :

H-Pile/Steel Pile



DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI  
 - CROSS SECTION AREA = 198.50 IN2

NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL = 22.00 FT.  
 - PILE STICKUP LENGTH, PSL = 0.00 FT.  
 - ZERO FRICTION LENGTH, ZFL = 0.00 FT.  
 - PERIMETER OF PILE = 56.40 IN.  
 - TIP AREA OF PILE = 198.50 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	42.60	0.00	0.00
13.00	SAND	0.00	42.60	0.00	0.00
13.00	SAND	0.00	52.60	34.00	0.00
18.00	SAND	0.00	52.60	34.00	0.00
18.00	SAND	0.00	62.60	40.00	0.00
20.00	SAND	0.00	62.60	40.00	0.00
20.00	SAND	0.00	62.60	45.00	0.00
30.00	SAND	0.00	62.60	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	5.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	5.00	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	1.000	1.000
13.00	1.000	1.000
13.00	1.000	1.000
18.00	1.000	1.000
18.00	1.000	1.000
20.00	1.000	1.000
20.00	1.000	1.000
30.00	1.000	1.000

DEPTH FT.	PLASTIC INDEX PI %	YIELD STRESS RATIO	Qc FROM CPT KSF
0.00	0.00	5.00	0.000E+00
13.00	0.00	5.00	0.000E+00
13.00	0.00	0.00	0.000E+00
18.00	0.00	0.00	0.000E+00
18.00	0.00	0.00	0.000E+00
20.00	0.00	0.00	0.000E+00
20.00	0.00	0.00	0.000E+00
30.00	0.00	0.00	0.000E+00

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

Bottom of Pile Cap →  
 ELE. 723'

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	1.4	1.4
1.00	0.1	2.6	2.7
2.00	0.4	4.6	5.0
3.00	0.9	7.3	8.2
4.00	1.6	9.6	11.2
5.00	2.4	11.9	14.3
6.00	3.5	14.1	17.6
7.00	4.7	16.3	21.0
8.00	6.1	18.4	24.5
9.00	7.7	20.5	28.2
10.00	9.5	22.5	31.9
11.00	11.4	24.4	35.8
12.00	13.5	26.4	39.9
13.00	15.8	28.6	44.4
14.00	18.2	31.0	49.2
15.00	20.9	33.5	54.4
16.00	23.8	41.3	65.1
17.00	26.9	66.1	93.0
18.00	30.3	111.1	141.4
19.00	36.0	218.3	254.3
20.00	44.1	332.2	376.3
21.00	53.3	436.5	489.8
22.00	63.5	540.8	604.3

ELE, 703' →

Rndr = 346 kips

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 \* API RP-2A (1994) \*  
 \*\*\*\*\*

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.0	0.0
1.00	0.0	0.0	0.0
2.00	0.0	0.0	0.0
3.00	0.0	0.0	0.0

4.00	0.0	0.0	0.0
5.00	0.0	0.0	0.0
6.00	0.0	0.0	0.0
7.00	0.0	0.0	0.0
8.00	0.0	0.0	0.0
9.00	0.0	0.0	0.0
10.00	0.0	0.0	0.0
11.00	0.0	0.0	0.0
12.00	0.0	0.0	0.0
13.00	0.0	0.0	0.0
14.00	0.0	0.0	0.0
15.00	0.0	0.0	0.0
16.00	0.0	0.0	0.0
17.00	0.0	0.0	0.0
18.00	0.0	0.0	0.0
19.00	0.0	0.0	0.0
20.00	0.0	0.0	0.0
21.00	0.0	0.0	0.0
22.00	0.0	0.0	0.0

NOTES:

- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN  
IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION  
OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

\*\*\*\*\*  
\* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT \*  
\* CURVES FOR AXIAL LOADING \*  
\*\*\*\*\*

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00	0.0000E+00	0.0000E+00
			0.4351E-01	0.1000E-01
			0.8702E-01	0.2000E-01
			0.1740E+00	0.4000E-01
			0.2610E+00	0.6000E-01
			0.3481E+00	0.8000E-01
			0.3916E+00	0.9000E-01
			0.4351E+00	0.1000E+00
			0.4351E+00	0.5000E+00
			0.4351E+00	0.2000E+01
2	10	0.6525E+01	0.0000E+00	0.0000E+00
			0.1954E+00	0.1000E-01
			0.3909E+00	0.2000E-01
			0.7817E+00	0.4000E-01
			0.1173E+01	0.6000E-01
			0.1563E+01	0.8000E-01
			0.1759E+01	0.9000E-01
			0.1954E+01	0.1000E+00
			0.1954E+01	0.5000E+00
			0.1954E+01	0.2000E+01
3	10	0.1296E+02	0.0000E+00	0.0000E+00
			0.3495E+00	0.1000E-01
			0.6990E+00	0.2000E-01
			0.1398E+01	0.4000E-01
			0.2097E+01	0.6000E-01
			0.2796E+01	0.8000E-01
			0.3145E+01	0.9000E-01
			0.3495E+01	0.1000E+00
			0.3495E+01	0.5000E+00

4	10	0.1300E+02	0.3495E+01	0.2000E+01
			0.0000E+00	0.0000E+00
			0.3796E+00	0.1000E-01
			0.7592E+00	0.2000E-01
			0.1518E+01	0.4000E-01
			0.2277E+01	0.6000E-01
			0.3037E+01	0.8000E-01
			0.3416E+01	0.9000E-01
			0.3796E+01	0.1000E+00
			0.3796E+01	0.5000E+00
5	10	0.1553E+02	0.3796E+01	0.2000E+01
			0.0000E+00	0.0000E+00
			0.4450E+00	0.1000E-01
			0.8901E+00	0.2000E-01
			0.1780E+01	0.4000E-01
			0.2670E+01	0.6000E-01
			0.3560E+01	0.8000E-01
			0.4005E+01	0.9000E-01
			0.4450E+01	0.1000E+00
			0.4450E+01	0.5000E+00
6	10	0.1796E+02	0.4450E+01	0.2000E+01
			0.0000E+00	0.0000E+00
			0.6663E+00	0.1000E-01
			0.1333E+01	0.2000E-01
			0.2665E+01	0.4000E-01
			0.3998E+01	0.6000E-01
			0.5330E+01	0.8000E-01
			0.5996E+01	0.9000E-01
			0.6663E+01	0.1000E+00
			0.6663E+01	0.5000E+00
7	10	0.1800E+02	0.6663E+01	0.2000E+01
			0.0000E+00	0.0000E+00
			0.1023E+01	0.1000E-01
			0.2045E+01	0.2000E-01
			0.4090E+01	0.4000E-01
			0.6135E+01	0.6000E-01
			0.8180E+01	0.8000E-01
			0.9203E+01	0.9000E-01
			0.1023E+02	0.1000E+00
			0.1023E+02	0.5000E+00
8	10	0.1903E+02	0.1023E+02	0.2000E+01
			0.0000E+00	0.0000E+00
			0.1280E+01	0.1000E-01
			0.2561E+01	0.2000E-01
			0.5122E+01	0.4000E-01
			0.7682E+01	0.6000E-01
			0.1024E+02	0.8000E-01
			0.1152E+02	0.9000E-01
			0.1280E+02	0.1000E+00
			0.1280E+02	0.5000E+00
9	10	0.1996E+02	0.1280E+02	0.2000E+01
			0.0000E+00	0.0000E+00
			0.1280E+01	0.1000E-01
			0.2561E+01	0.2000E-01
			0.5122E+01	0.4000E-01
			0.7682E+01	0.6000E-01
			0.1024E+02	0.8000E-01
			0.1152E+02	0.9000E-01
			0.1280E+02	0.1000E+00
			0.1280E+02	0.5000E+00
10	10	0.2000E+02	0.1280E+02	0.2000E+01
			0.0000E+00	0.0000E+00

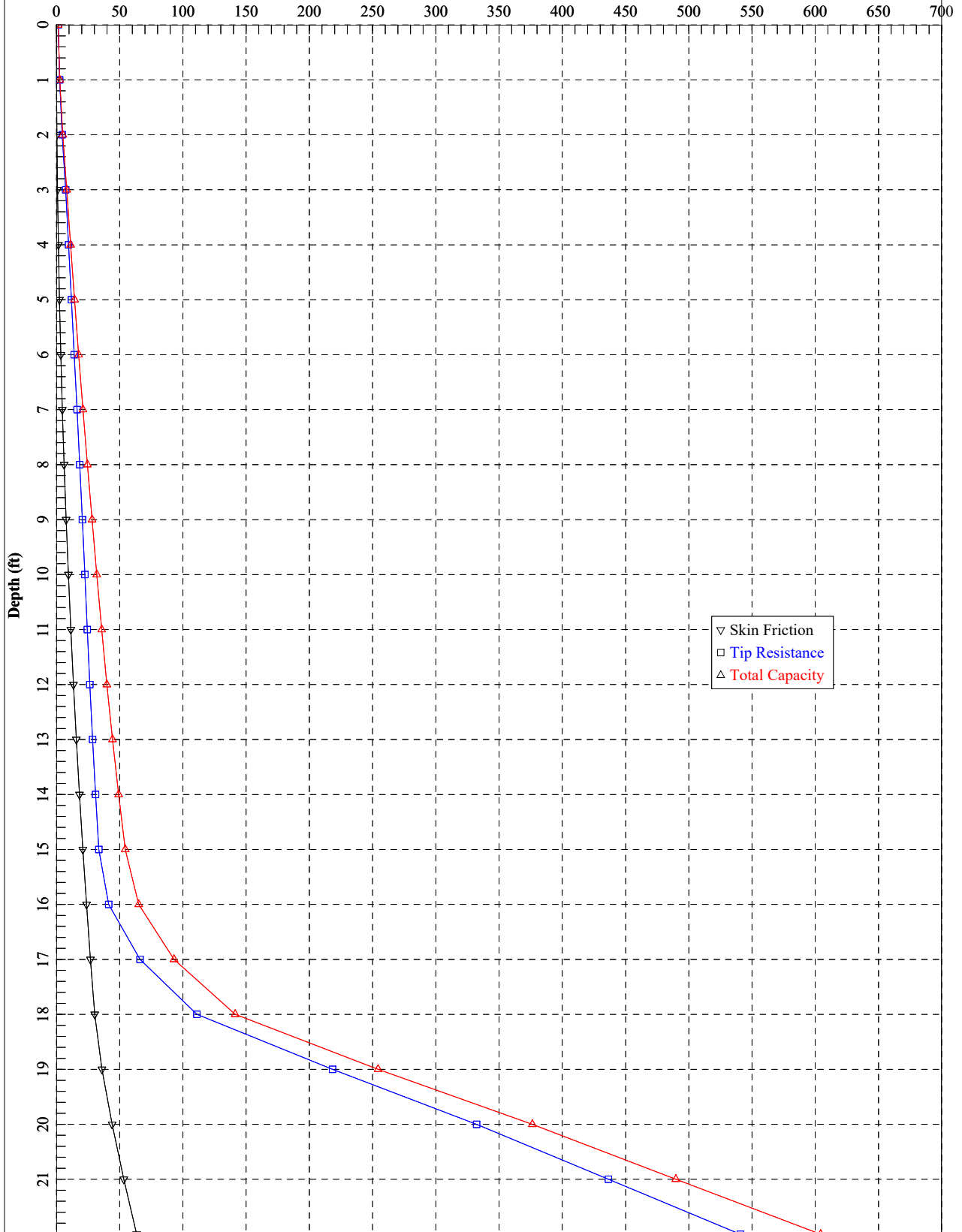
			0.1429E+01	0.1000E-01
			0.2859E+01	0.2000E-01
			0.5717E+01	0.4000E-01
			0.8576E+01	0.6000E-01
			0.1143E+02	0.8000E-01
			0.1286E+02	0.9000E-01
			0.1429E+02	0.1000E+00
			0.1429E+02	0.5000E+00
			0.1429E+02	0.2000E+01
11	10	0.2503E+02	0.0000E+00	0.0000E+00
			0.1505E+01	0.1000E-01
			0.3010E+01	0.2000E-01
			0.6019E+01	0.4000E-01
			0.9029E+01	0.6000E-01
			0.1204E+02	0.8000E-01
			0.1354E+02	0.9000E-01
			0.1505E+02	0.1000E+00
			0.1505E+02	0.5000E+00
			0.1505E+02	0.2000E+01
12	10	0.2996E+02	0.0000E+00	0.0000E+00
			0.1505E+01	0.1000E-01
			0.3010E+01	0.2000E-01
			0.6019E+01	0.4000E-01
			0.9029E+01	0.6000E-01
			0.1204E+02	0.8000E-01
			0.1354E+02	0.9000E-01
			0.1505E+02	0.1000E+00
			0.1505E+02	0.5000E+00
			0.1505E+02	0.2000E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.3380E+02	0.8976E-02
0.6760E+02	0.1795E-01
0.1352E+03	0.3591E-01
0.2704E+03	0.2334E+00
0.4056E+03	0.7540E+00
0.4867E+03	0.1311E+01
0.5408E+03	0.1795E+01
0.5408E+03	0.2693E+01
0.5408E+03	0.3591E+01

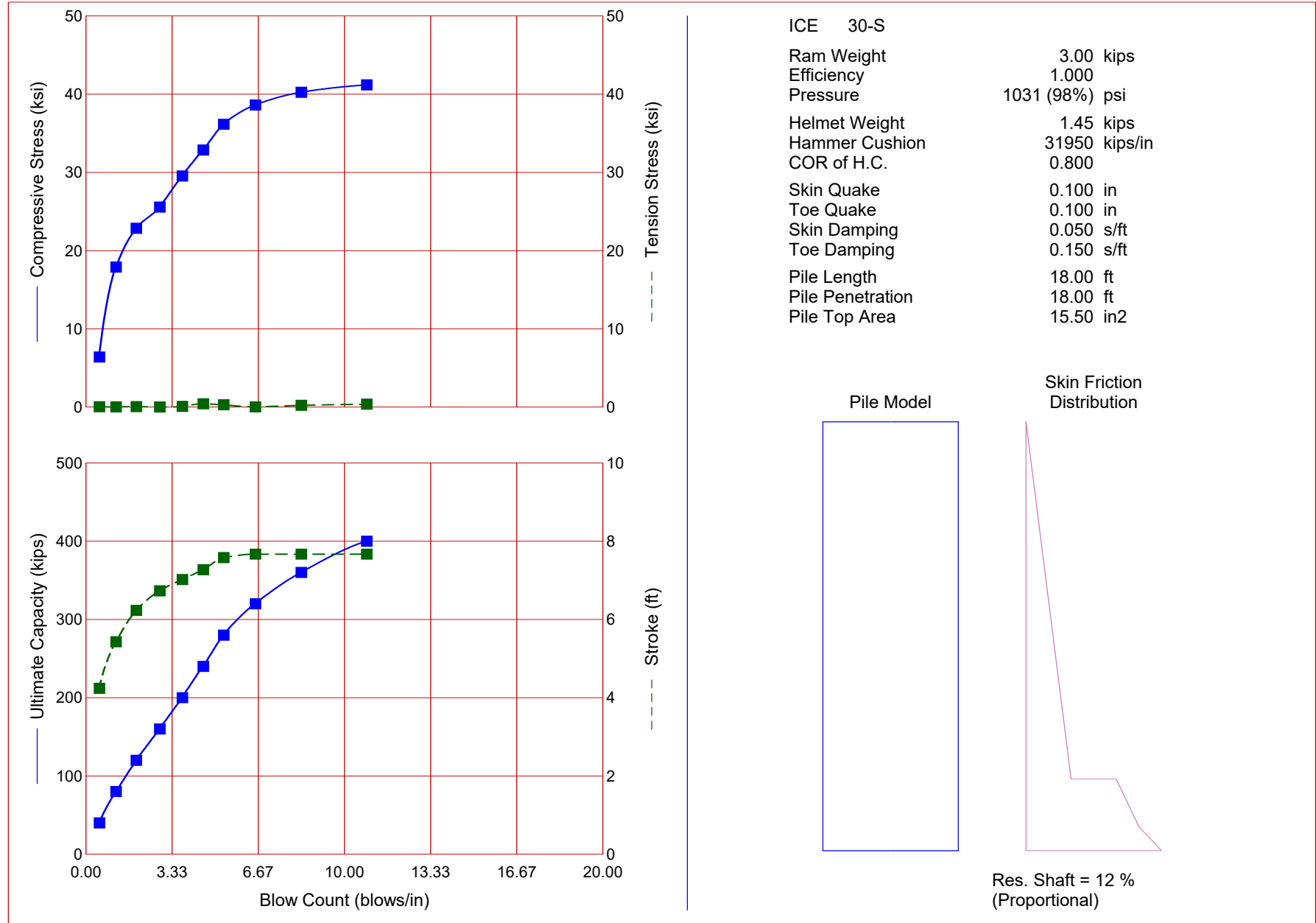
LOAD VERSUS SETTLEMENT CURVE  
\*\*\*\*\*

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.4488E+00	0.1197E-03	0.3766E+00	0.1000E-03
0.4488E+01	0.1197E-02	0.3766E+01	0.1000E-02
0.2244E+02	0.5983E-02	0.1883E+02	0.5000E-02
0.4488E+02	0.1197E-01	0.3766E+02	0.1000E-01
0.1807E+03	0.5783E-01	0.1449E+03	0.5000E-01
0.2481E+03	0.1105E+00	0.1791E+03	0.1000E+00
0.4087E+03	0.5179E+00	0.3396E+03	0.5000E+00
0.5105E+03	0.1023E+01	0.4415E+03	0.1000E+01
0.6098E+03	0.2027E+01	0.5408E+03	0.2000E+01

**Bent 2 HP 14x73  
Axial Capacity (kips)**



## **Appendix H - Drivability analysis with GRL-WEAP**



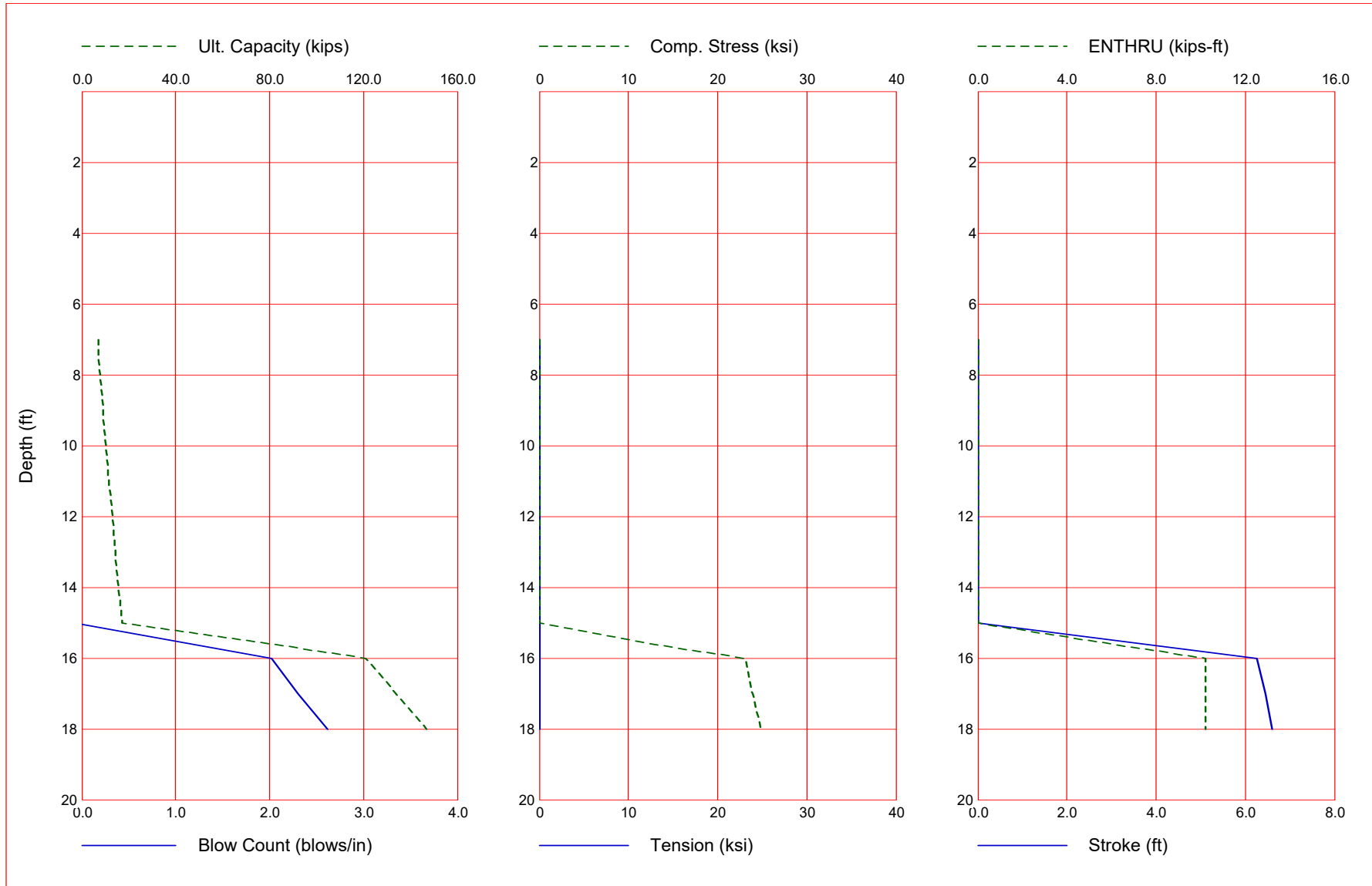


Moreland Altobelli Associates Inc.  
ROCK 20514 Bent 1 12x53

09-Jul-2021  
GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count blows/in	Stroke ft	Energy kips-ft
40.0	6.40	0.05	0.5	4.24	9.99
80.0	17.89	0.03	1.2	5.43	10.22
120.0	22.85	0.07	1.9	6.23	10.26
160.0	25.56	0.02	2.9	6.73	10.25
200.0	29.53	0.09	3.7	7.02	10.25
240.0	32.85	0.42	4.5	7.27	10.46
280.0	36.14	0.30	5.3	7.58	10.94
320.0	38.60	0.04	6.6	7.67	10.94
360.0	40.23	0.23	8.3	7.67	10.72
400.0	41.19	0.38	10.9	7.67	10.42

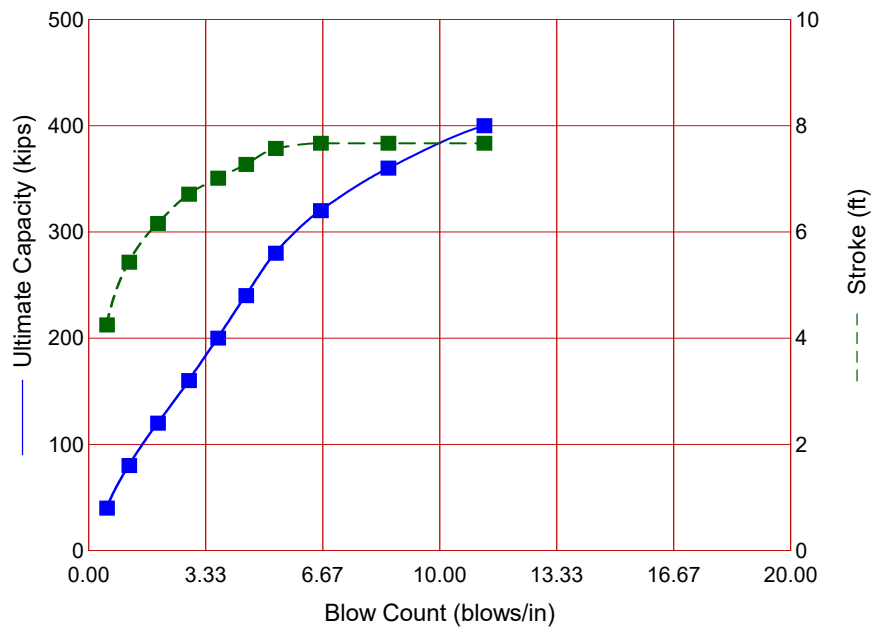
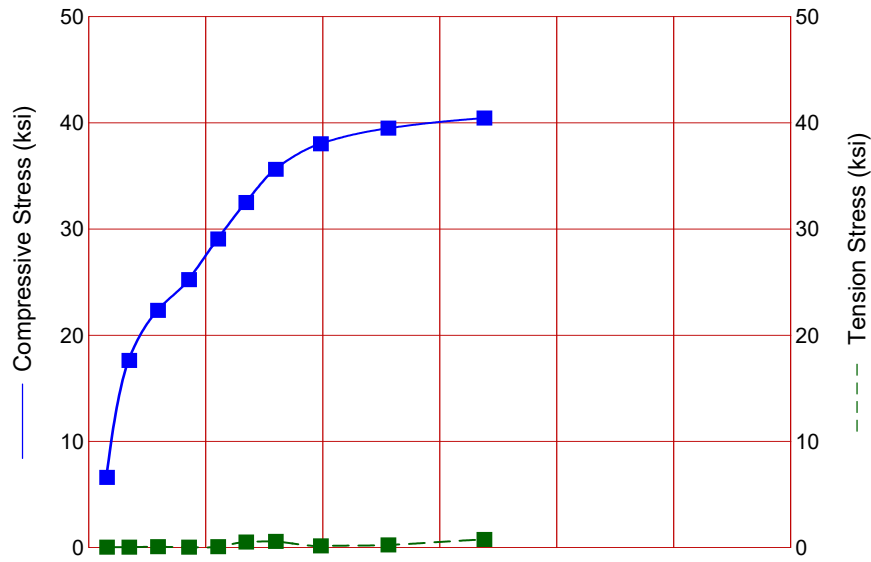
Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

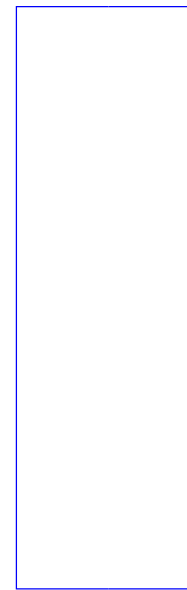
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/in	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
Bottom of Cap ELE. 725'								
1.0	0.9	0.0	0.9	0.0	0.000	0.000	7.67	0.0
2.0	1.8	0.1	1.7	0.0	0.000	0.000	7.67	0.0
3.0	2.7	0.2	2.6	0.0	0.000	0.000	7.67	0.0
4.0	3.7	0.3	3.4	-0.1	0.000	0.000	0.00	0.0
5.0	4.7	0.5	4.3	-0.1	0.000	0.000	0.00	0.0
6.0	5.8	0.7	5.1	-0.1	0.000	0.000	0.00	0.0
7.0	6.9	0.9	6.0	-0.1	0.000	0.000	0.00	0.0
8.0	8.0	1.2	6.8	-0.1	0.000	0.000	0.00	0.0
9.0	9.2	1.5	7.7	-0.1	0.000	0.000	0.00	0.0
10.0	10.4	1.9	8.5	-0.1	0.000	0.000	0.00	0.0
11.0	11.7	2.3	9.4	-0.1	0.000	0.000	0.00	0.0
12.0	13.0	2.7	10.2	-0.1	0.000	0.000	0.00	0.0
13.0	14.3	3.2	11.1	-0.1	0.000	0.000	0.00	0.0
14.0	15.7	3.7	11.9	-0.1	0.000	0.000	0.00	0.0
15.0	17.1	4.3	12.8	-0.1	0.000	0.000	0.00	0.0
16.0	120.9	5.9	115.0	2.0	23.074	-0.070	6.27	10.2
17.0	133.9	7.6	126.3	2.3	23.990	-0.062	6.45	10.2
18.0	147.0	9.5	137.5	2.6	24.949	-0.043	6.61	10.2

Total Continuous Driving Time 1.00 minutes; Total Number of Blows 68 (starting at penetration 1.0 ft)

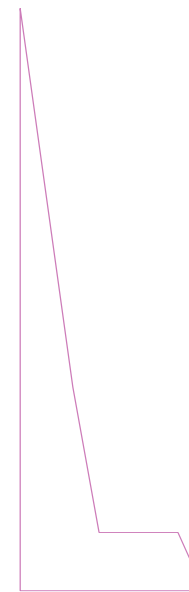


ICE 30-S  
 Ram Weight 3.00 kips  
 Efficiency 1.000  
 Pressure 1031 (98%) psi  
 Helmet Weight 1.45 kips  
 Hammer Cushion 31950 kips/in  
 COR of H.C. 0.800  
 Skin Quake 0.100 in  
 Toe Quake 0.100 in  
 Skin Damping 0.050 s/ft  
 Toe Damping 0.150 s/ft  
 Pile Length 20.00 ft  
 Pile Penetration 20.00 ft  
 Pile Top Area 15.50 in<sup>2</sup>

Pile Model



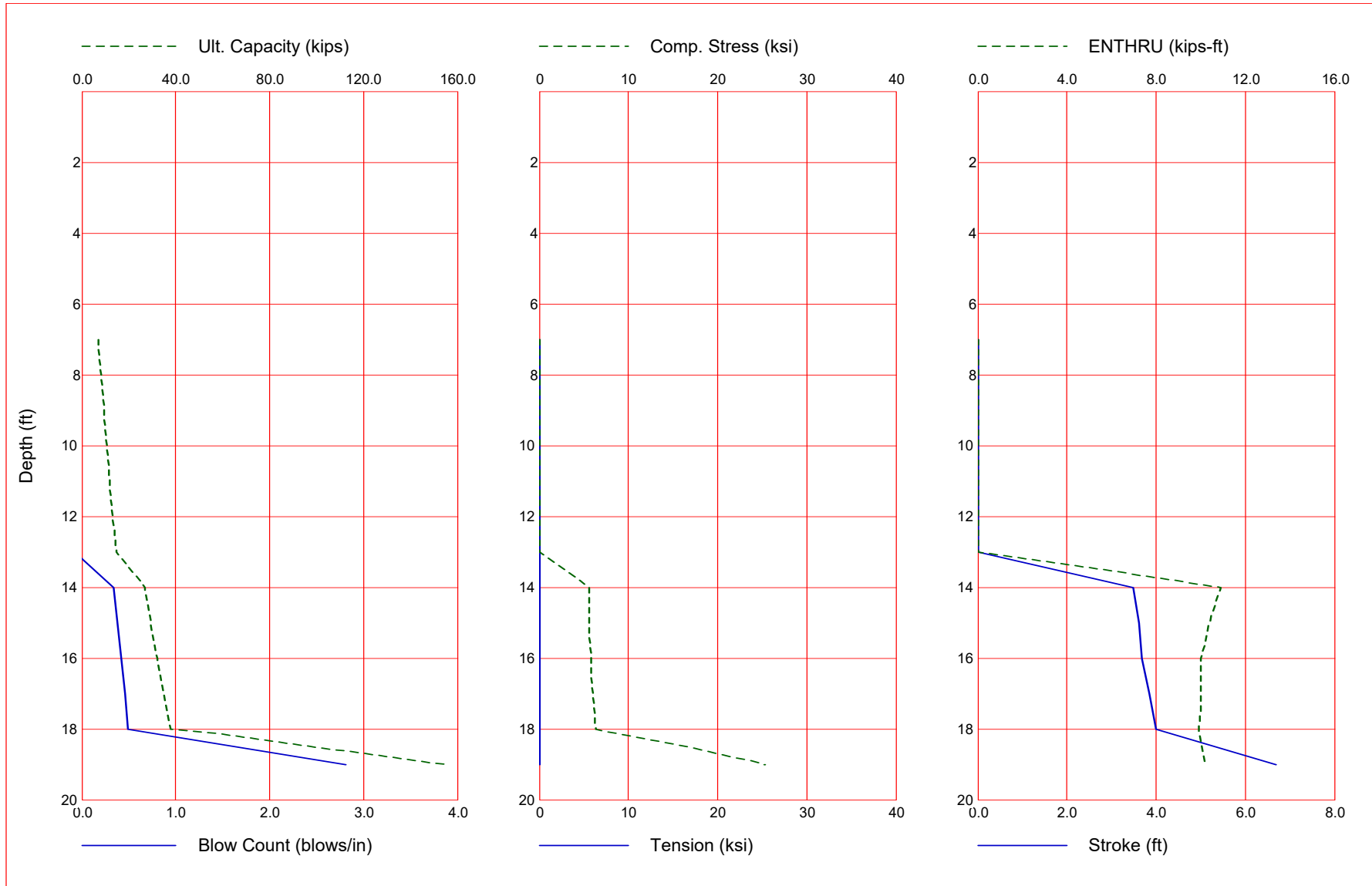
Skin Friction Distribution



Res. Shaft = 12 %  
 (Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count blows/in	Stroke ft	Energy kips-ft
40.0	6.61	0.05	0.5	4.25	9.94
80.0	17.63	0.05	1.2	5.43	10.19
120.0	22.34	0.09	2.0	6.16	10.11
160.0	25.23	0.05	2.9	6.71	10.22
200.0	29.05	0.09	3.7	7.01	10.36
240.0	32.48	0.53	4.5	7.27	10.65
280.0	35.61	0.58	5.3	7.57	11.06
320.0	38.02	0.17	6.6	7.67	11.10
360.0	39.48	0.26	8.5	7.67	10.87
400.0	40.44	0.77	11.3	7.67	10.63

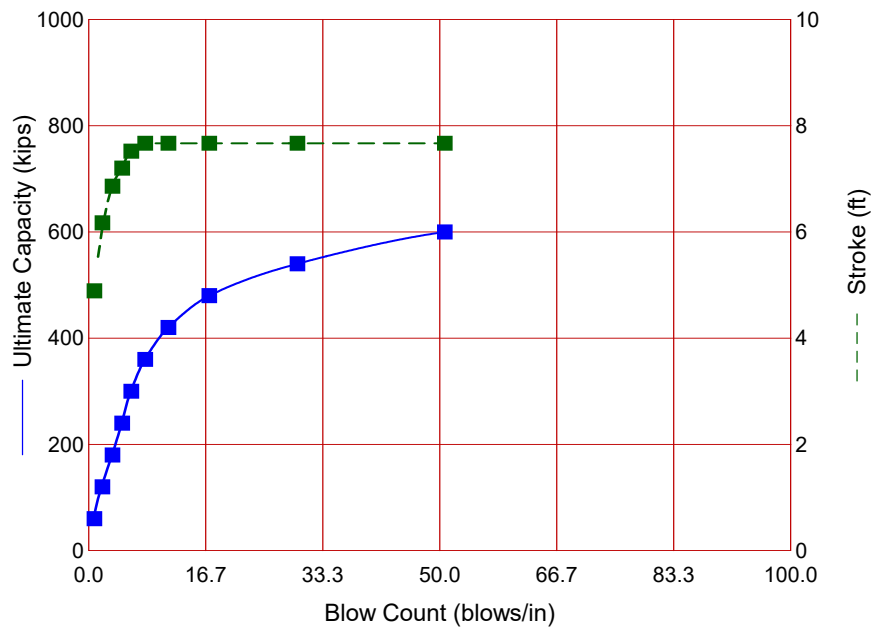
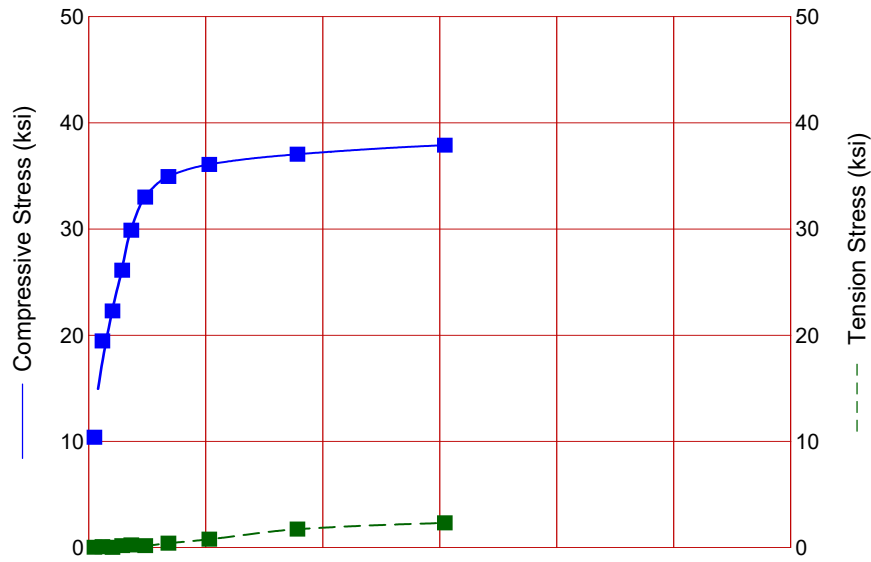
Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

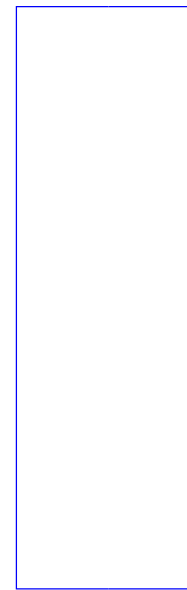
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/in	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
Bottom of Cap ELE. 723' →								
1.0	0.9	0.0	0.9	0.0	0.000	0.000	7.67	0.0
2.0	1.8	0.1	1.7	0.0	0.000	0.000	7.67	0.0
3.0	2.8	0.2	2.6	0.0	0.000	0.000	7.67	0.0
4.0	3.8	0.3	3.5	-0.1	0.000	0.000	0.00	0.0
5.0	4.9	0.5	4.4	-0.1	0.000	0.000	0.00	0.0
6.0	6.0	0.7	5.2	-0.1	0.000	0.000	0.00	0.0
7.0	7.1	1.0	6.1	-0.1	0.000	0.000	0.00	0.0
8.0	8.3	1.3	7.0	-0.1	0.000	0.000	0.00	0.0
9.0	9.5	1.6	7.9	-0.1	0.000	0.000	0.00	0.0
10.0	10.7	2.0	8.7	-0.1	0.000	0.000	0.00	0.0
11.0	12.0	2.4	9.6	-0.1	0.000	0.000	0.00	0.0
12.0	13.3	2.8	10.5	-0.1	0.000	0.000	0.00	0.0
13.0	14.7	3.3	11.4	-0.1	0.000	0.000	0.00	0.0
14.0	26.8	4.0	22.8	0.3	5.639	0.000	3.49	10.9
15.0	29.4	4.8	24.7	0.4	5.594	0.000	3.61	10.4
16.0	32.2	5.6	26.6	0.4	5.782	0.000	3.69	10.0
17.0	35.0	6.4	28.5	0.5	6.046	0.000	3.85	10.0
18.0	37.8	7.4	30.4	0.5	6.297	0.000	4.01	9.9
19.0	155.4	9.4	146.0	2.8	25.376	-0.058	6.69	10.2
20.0	168.8	11.5	157.3	3.1	26.880	-0.009	6.83	10.3

Total Continuous Driving Time 2.00 minutes; Total Number of Blows 77 (starting at penetration 1.0 ft)

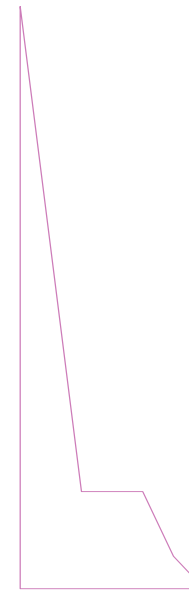


ICE 30-S  
 Ram Weight 3.00 kips  
 Efficiency 1.000  
 Pressure 1031 (98%) psi  
 Helmet Weight 1.45 kips  
 Hammer Cushion 31950 kips/in  
 COR of H.C. 0.800  
 Skin Quake 0.100 in  
 Toe Quake 0.100 in  
 Skin Damping 0.050 s/ft  
 Toe Damping 0.150 s/ft  
 Pile Length 18.00 ft  
 Pile Penetration 18.00 ft  
 Pile Top Area 21.40 in<sup>2</sup>

Pile Model



Skin Friction Distribution

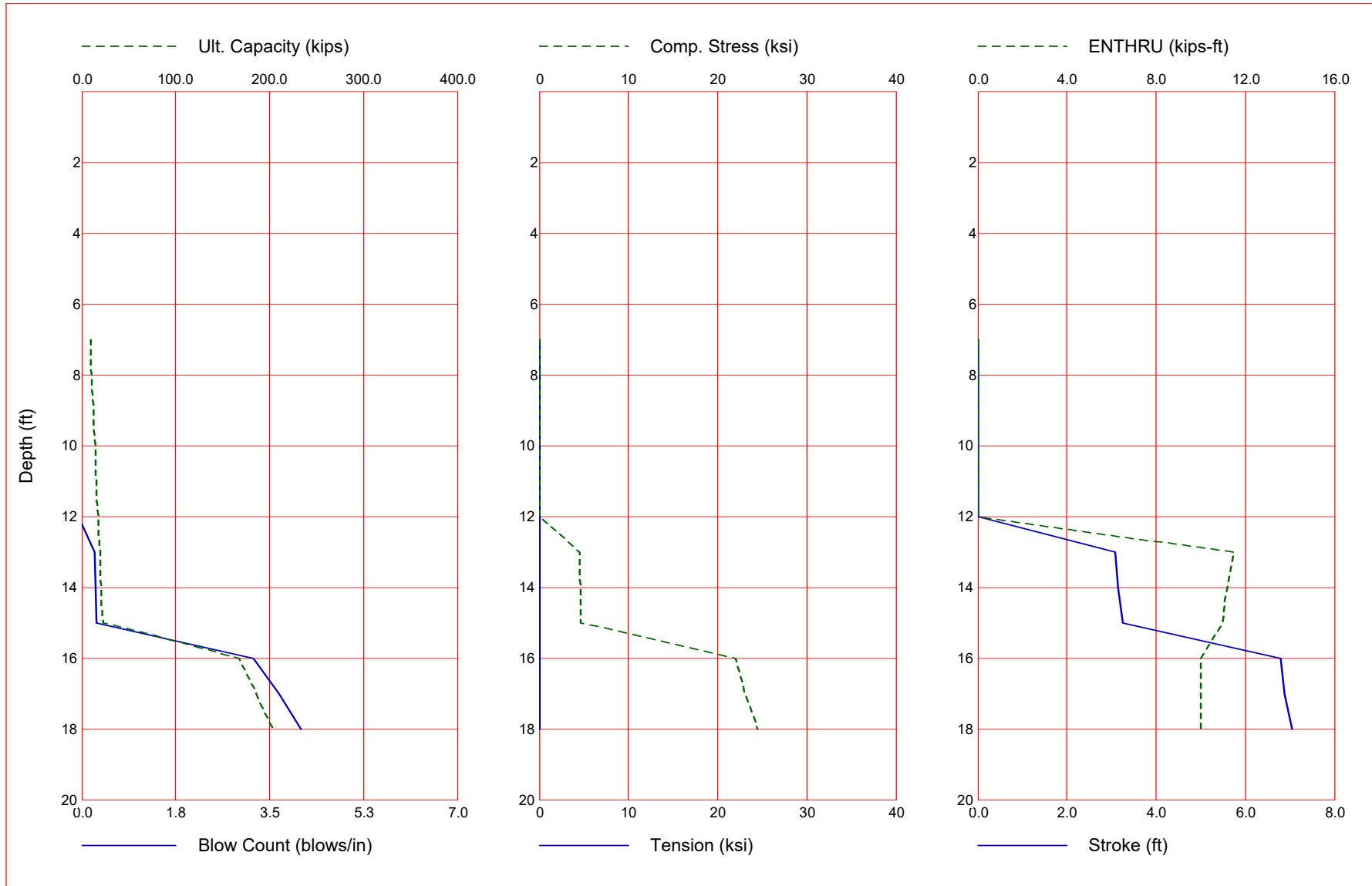


Res. Shaft = 12 %  
 (Proportional)



Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count blows/in	Stroke ft	Energy kips-ft
60.0	10.40	0.04	0.8	4.89	9.87
120.0	19.46	0.09	2.0	6.17	10.10
180.0	22.29	0.03	3.4	6.86	10.08
240.0	26.11	0.19	4.8	7.20	10.15
300.0	29.89	0.26	6.1	7.52	10.52
360.0	33.00	0.19	8.0	7.67	10.50
420.0	34.94	0.42	11.4	7.67	10.17
480.0	36.08	0.79	17.2	7.67	10.11
540.0	37.04	1.74	29.8	7.67	10.12
600.0	37.89	2.33	50.7	7.67	10.20

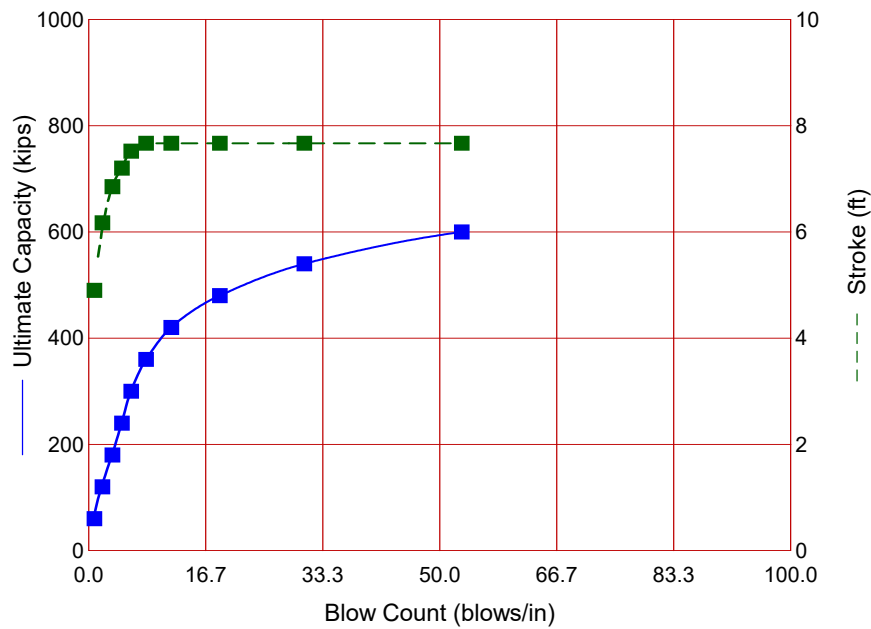
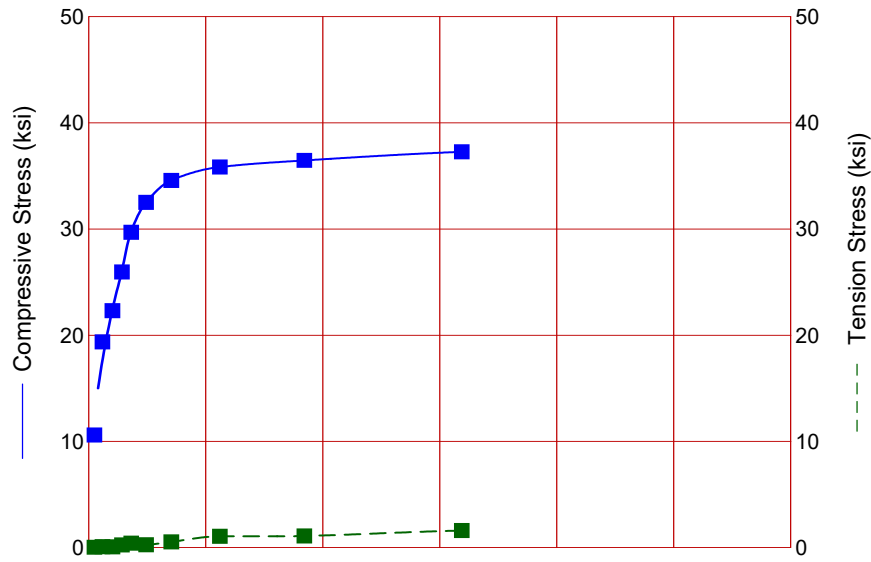
Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

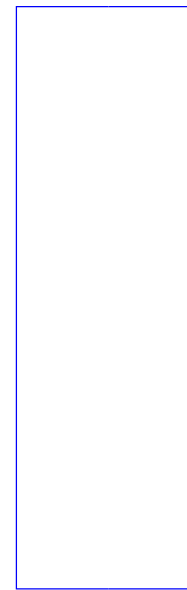
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/in	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
Bottom of Cap → ELE. 725'								
1.0	1.2	0.0	1.2	0.0	0.000	0.000	7.67	0.0
2.0	2.5	0.1	2.4	0.0	0.000	0.000	7.67	0.0
3.0	3.8	0.2	3.6	-0.1	0.000	0.000	0.00	0.0
4.0	5.1	0.4	4.8	-0.1	0.000	0.000	0.00	0.0
5.0	6.5	0.6	6.0	-0.1	0.000	0.000	0.00	0.0
6.0	8.0	0.8	7.2	-0.1	0.000	0.000	0.00	0.0
7.0	9.5	1.1	8.3	-0.1	0.000	0.000	0.00	0.0
8.0	11.0	1.4	9.5	-0.1	0.000	0.000	0.00	0.0
9.0	12.6	1.8	10.7	-0.1	0.000	0.000	0.00	0.0
10.0	14.2	2.3	11.9	-0.1	0.000	0.000	0.00	0.0
11.0	15.8	2.7	13.1	-0.1	0.000	0.000	0.00	0.0
12.0	17.6	3.3	14.3	-0.1	0.000	0.000	0.00	0.0
13.0	19.3	3.8	15.5	0.2	4.523	0.000	3.09	11.5
14.0	21.1	4.4	16.7	0.3	4.639	0.000	3.15	11.2
15.0	23.0	5.1	17.9	0.3	4.604	0.000	3.26	11.0
16.0	167.9	6.9	160.9	3.2	22.054	-0.034	6.79	10.0
17.0	185.7	9.0	176.7	3.7	23.112	-0.022	6.89	10.0
18.0	203.6	11.2	192.4	4.1	24.484	-0.057	7.04	10.1

Total Continuous Driving Time 3.00 minutes; Total Number of Blows 116 (starting at penetration 1.0 ft)

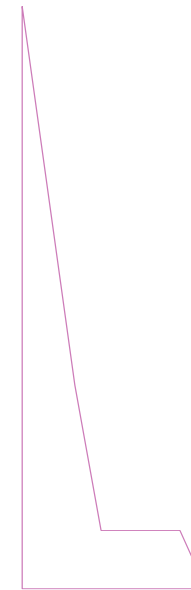


ICE 30-S  
 Ram Weight 3.00 kips  
 Efficiency 1.000  
 Pressure 1031 (98%) psi  
 Helmet Weight 1.45 kips  
 Hammer Cushion 31950 kips/in  
 COR of H.C. 0.800  
 Skin Quake 0.100 in  
 Toe Quake 0.100 in  
 Skin Damping 0.050 s/ft  
 Toe Damping 0.150 s/ft  
 Pile Length 20.00 ft  
 Pile Penetration 20.00 ft  
 Pile Top Area 21.40 in<sup>2</sup>

Pile Model



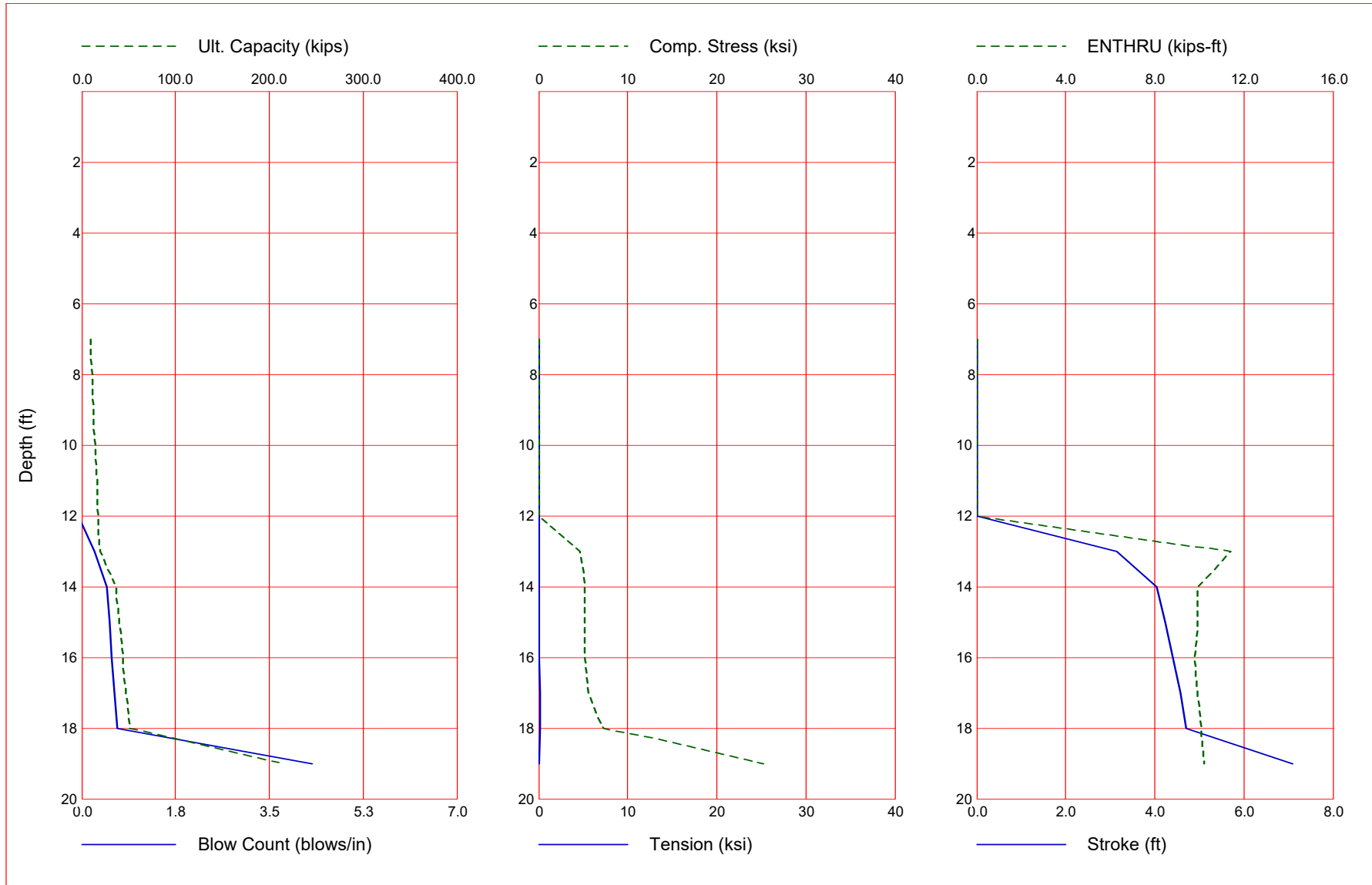
Skin Friction Distribution



Res. Shaft = 12 %  
 (Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count blows/in	Stroke ft	Energy kips-ft
60.0	10.61	0.04	0.8	4.90	9.90
120.0	19.37	0.09	2.0	6.17	10.12
180.0	22.31	0.07	3.4	6.85	10.14
240.0	25.95	0.26	4.7	7.20	10.29
300.0	29.69	0.42	6.0	7.52	10.67
360.0	32.50	0.28	8.2	7.67	10.62
420.0	34.57	0.55	11.8	7.67	10.45
480.0	35.83	1.08	18.7	7.67	10.45
540.0	36.45	1.11	30.7	7.67	10.40
600.0	37.26	1.62	53.1	7.67	10.49

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/in	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
Bottom of Cap ELE. 723'								
1.0	1.2	0.0	1.2	0.0	0.000	0.000	7.67	0.0
2.0	2.5	0.1	2.4	0.0	0.000	0.000	7.67	0.0
3.0	3.9	0.2	3.7	-0.1	0.000	0.000	0.00	0.0
4.0	5.3	0.4	4.9	-0.1	0.000	0.000	0.00	0.0
5.0	6.7	0.6	6.1	-0.1	0.000	0.000	0.00	0.0
6.0	8.2	0.8	7.3	-0.1	0.000	0.000	0.00	0.0
7.0	9.7	1.1	8.6	-0.1	0.000	0.000	0.00	0.0
8.0	11.3	1.5	9.8	-0.1	0.000	0.000	0.00	0.0
9.0	12.9	1.9	11.0	-0.1	0.000	0.000	0.00	0.0
10.0	14.6	2.3	12.2	-0.1	0.000	0.000	0.00	0.0
11.0	16.3	2.8	13.5	-0.1	0.000	0.000	0.00	0.0
12.0	18.0	3.3	14.7	-0.1	0.000	0.000	0.00	0.0
13.0	19.8	3.9	15.9	0.2	4.619	0.000	3.14	11.4
14.0	36.6	4.7	31.9	0.5	5.184	0.000	4.05	9.9
15.0	40.2	5.6	34.5	0.5	5.167	0.000	4.24	9.9
16.0	43.8	6.6	37.2	0.6	5.208	-0.069	4.41	9.8
17.0	47.5	7.6	39.9	0.6	5.585	-0.152	4.58	9.9
18.0	51.3	8.7	42.6	0.7	7.285	-0.164	4.70	10.1
19.0	215.4	11.1	204.3	4.3	25.256	-0.090	7.10	10.2
20.0	233.7	13.7	220.0	4.7	26.408	-0.175	7.19	10.2

Total Continuous Driving Time 2.00 minutes; Total Number of Blows 116 (starting at penetration 1.0 ft)