

**MOT-835-2.57 BRIDGE REPLACEMENT
PID 116922
MONTGOMERY COUNTY, OHIO**

**STRUCTURE FOUNDATION
EXPLORATION REPORT**

Prepared For:
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Prepared By:
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Rii Project No. W-23-155

September 2025



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September 17, 2025

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**Re: Structure Foundation Exploration Report
MOT-835-2.57
PID 116922
Montgomery County, Ohio
Rii Project No. W-23-155**

Ms. Boehm:

Resource International, Inc. (Rii) is pleased to submit this revised draft structure foundation exploration report for the above referenced project. Engineering logs have been prepared and are attached to this report along with the results of laboratory testing. This revised report includes geotechnical recommendations for the design and construction of the proposed replacement of the existing bridge carrying State Route 835 over Little Beaver Creek in Kettering, Montgomery County, Ohio. This revised report supersedes our previous submittal.

We sincerely appreciate the opportunity to be of service to you on this project. If you have any questions regarding the structure foundation exploration or this report, please contact us.

Sincerely,

RESOURCE INTERNATIONAL, INC.

Abed Al-Kalabani, E.I.
Staff Engineer

Daniel E. Karch, P.E.
Project Manager – Geotechnical Services

Enclosure: Structure Foundation Exploration Report

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EXECUTIVE SUMMARY

Resource International, Inc. (Rii) has completed a structure foundation exploration performed for the design and construction of the proposed replacement of the existing bridge (MOT-835-2.57) carrying SR 835 over Little Beaver Creek approximately 0.15 miles west of County Line Road in Kettering, Montgomery County, Ohio.

Based on the available plan information, Rii understands the current bridge is to be replaced with a three-span structure with either concrete or steel beams. The proposed structure will roughly maintain the existing horizontal and vertical alignment. The length of the proposed bridge is 204.11 feet with a total out-to-out width of 96.96 feet and a skew of 15 degrees.

The investigation was carried out in two phases: the initial investigation, with a previously-submitted report dated August 13, 2024, and this final investigation. This report includes the results from both phases of the field and laboratory testing. The initial field exploration consisted of four (4) borings for scour analyses only. Rii utilized historic borings to prepare a preliminary evaluation of the bridge foundation elements. The results of the foundation analyses indicated that depths of the historic borings, upon which the analyses were based, were insufficient to provide the required geotechnical resistance per pile. Therefore, deeper borings to supplement the historic boring data was needed confirm the required pile design lengths and tip elevations.

Exploration and Findings

On January 4, 2024, a total of four (4) borings, designated as B-001-0-24 through B-004-0-24, were performed for the initial investigation of the project. The borings were performed for scour considerations for the proposed bridge replacement and were advanced to depths ranging from 6.0 to 11.8 feet below the existing grade. Subsequently, between November 4 and December 13, 2024, four (4) additional structure borings, designated as B-001-1-24 through B-004-1-24, were drilled for the final investigation and were advanced to depths ranging from 109.2 to 110.0 feet below the existing ground surface.

Borings B-001-0-24 and B-004-0-24 were drilled through the existing roadway surface of SR 835 and encountered 15.5 and 15.0 inches of asphalt, respectively. No aggregate base was encountered below the borings or the pavement cores. Borings B-002-0-24 and B-003-0-24 were drilled on the creek slopes near each existing pier, and no measurable surface material was encountered. Similarly, for the final investigation borings, Borings B-001-1-24 and B-004-1-24 were drilled through the existing roadway surface of SR 835 and encountered 18.0 and 12.0 inches of asphalt, respectively, overlying 6 inches of aggregate base. Borings B-002-1-24 and B-003-1-24 were drilled on the creek slopes near each existing pier, and encountered 12.0 and 3.0 inches of topsoil at the ground surface, as identified by the presence of vegetation and organic matter.



Below the asphalt in boring B-004-0-24, existing fill was encountered to a depth of 5.8 feet below the existing ground surface. The fill was described as sandy silt (ODOT A-4a) and contained traces of brick fragments. Underlying the fill and the surficial materials, natural cohesive and granular soils were encountered to the termination depths of the borings. The cohesive soils were described as sandy silt, silt and clay, silty clay, and clay (ODOT A-4a, A-6a, A-6b, A-7-6). The granular soils were described as gravel, gravel with sand, gravel with sand, silt, and clay, and silt (ODOT A-1-a, A-1-b, A-2-6, A-4b).

During drilling groundwater was encountered in borings B-002-0-24 and B-003-0-24 at depths of 3.5 and 2.0 feet below the existing ground surface, respectively. Groundwater measured upon completion of drilling at depths of 3.0 and 2.5 feet below the existing ground surface, respectively. In the final investigation, Groundwater was encountered during drilling in borings B-001-1-24, B-001-1-24 and B-003-1-24 at depths of 8.5, 3.5 and 3.0 feet below the existing ground surface, respectively. Groundwater could not be measured upon completion of drilling due to addition of mud to boreholes.

Records of four (4) historic borings, designated as B-012-0-84 through B-015-0-84, were obtained from the ODOT Transportation Information Mapping System (TIMS) and were utilized in the foundation analysis.

Historic borings B-012-0-84 and B-013-0-84 encountered 0.7 to 1.0 feet of topsoil at the ground surface. Typical surface materials were not encountered at the ground surface of borings B-014-0-84 and B-015-0-84.

Underlying the fill material and surface materials, natural cohesive and granular soils were encountered to the termination depths of the borings. The cohesive soils were described as silt, silt with fine sand, and silt and clay. HP values were not reported on the historic boring logs.

Groundwater was encountered in the historic borings at depths ranging from 4.0 to 6.0 feet below the existing ground surface. Groundwater measured upon completion of drilling in the historic borings at depths ranging from 3.0 to 6.5 feet below the existing ground surface.

Analyses and Recommendations

Data obtained from the current and historic geotechnical explorations have been used to determine the foundation support capabilities and the settlement potential for the soil encountered at the site. These parameters have been used to provide guidelines for the design of foundation systems for the subject bridge.



Driven Pile Recommendations

Driven Pile Recommendations – Closed End CIP Piles

Substructure Reference	Bottom of Footing ¹ (feet)	Pile Size / Type ²	Min. Req. Pile Wall Thickness (inch)	Pile Elevation (feet)		Est. Pile Length ⁴ (feet)	Scour Friction Loss (kips/pile)	Required UBV ⁵ (kips/pile)	ϕ_{dyn} ⁶
				Top ³	Tip				
Rear Abutment (B-001-1-24)	873.29	12" CIP	0.25	875.29	793.29	85.0	N/A	265.7	0.7
		14" CIP	0.25	875.29	811.50	65.0	N/A	265.7	
		16" CIP	0.25	875.29	820.29	55.0	N/A	265.7	
Pier 1 (B-002-1-24)	866.80	14" CIP	0.28	868.80	806.80	65.0	0.25	245.95	
		16" CIP	0.25	868.80	816.60	55.0	0.30	246.0	
Pier 2 (B-003-1-24)	866.20	14" CIP	0.25	868.20	811.20	60.0	0.13	245.83	
		16" CIP	0.28	868.20	820.00	50.0	0.20	245.90	
Forward Abutment (B-004-1-24)	872.38	12" CIP	0.25	874.38	791.90	85.0	N/A	265.7	
		14" CIP	0.25	874.38	803.20	75.0	N/A	265.7	
		16" CIP	0.25	874.38	813.00	65.0	N/A	265.7	

1. Bottom of footing elevation determined from design plans provided by Korda.
2. Minimum of Grade 3 steel. Detailed pile thickness and steel grade will be provided with geotechnical report.
3. The top of pile elevation corresponds to the pile cutoff elevation, which is considered to be 2.0-foot above the bottom of footing elevation.
4. Per Section 305.3.5.2 of the 2023 ODOT BDM, the estimated pile length was determined as the pile cutoff elevation (top) minus the pile tip elevation, rounded up to the nearest 5.0 feet. Order (furnished) length for each pile should be calculated by adding 5 feet on estimated pile length.
5. UBV is the required resistance that an individual pile is expected to provide based on the structural loading and accounting for the applicable geotechnical resistance factor. Values are determined based on the design maximum factored structural loads provided by Korda and scour friction, as per Section 606.2 of the ODOT BDM.
6. The resistance factor listed assumes dynamic testing of the pile elements per Section 305.7.1 of the 2023 ODOT BDM.

Drilled Shaft Recommendations

If drilled shafts are selected for foundation support, it is recommended that they be designed using the axial design parameters provided in the following tables.



Drilled Shaft Recommendations (Rear Abutment)

Substructure Unit	Elevation ¹ (feet)	Shaft Length (feet)	Soil Type	Nominal Resistance (ksf)		Resistance Factor	
				End	Side	End	Side
Rear Abutment (B-001-1-24)	873.9-872.7	0.0-1.2	A-6b	10	0.89	0.40	0.45
	872.7-864.7	1.2-9.2	A-6a	18	1.10	0.40	0.45
	864.7-854.7	9.2-19.2	A-1-b	51	1.12	0.50	0.55
	854.7-847.7	19.2-26.2	A-4b	50	2.12	0.50	0.55
	847.7-841.7	26.2-32.2	A-4b	27	1.80	0.50	0.55
	841.7-826.7	32.2-47.2	A-6b	14	0.89	0.40	0.45
	826.7-821.7	47.2-52.2	A-4b	33	2.52	0.50	0.55
	821.7-811.7	52.2-62.2	A-4b	28	2.09	0.50	0.55
	811.7-801.7	62.2-72.2	A-6a	28	1.71	0.40	0.45
	801.7-791.7	72.2-82.2	A-4b	38	3.06	0.50	0.55
	791.7-782.7	82.2-91.2	A-4b	60	5.21	0.50	0.55
	782.7-777.7	91.2-96.2	A-4b	60	4.56	0.50	0.55
777.7-772.7	96.2-101.2	A-4b	28	2.94	0.50	0.55	

1. Top of shaft elevation based on structure information provided by Korda.

Drilled Shaft Recommendations (Pier 1)

Substructure Unit	Elevation ¹ (feet)	Shaft Length (feet)	Soil Type	Nominal Resistance (ksf)		Resistance Factor	
				End	Side	End	Side
B-002-1-24 (Pier 1)	866.8-863.5	0.0-3.3	A-1-b	33	0.41	0.50	0.55
	863.5-858.5	3.3-8.3	A-4a	31	1.87	0.40	0.45
	858.5-851.0	8.3-15.8	A-1-b	54	1.07	0.50	0.55
	851.0-845.5	15.8-21.3	A-6a	36	2.04	0.40	0.45
	845.5-834.5	21.3-32.3	A-6b	32	1.91	0.40	0.45
	834.5-829.5	32.3-37.3	A-4b	24	1.96	0.50	0.55
	829.5-819.5	37.3-47.3	A-4b	37	2.56	0.50	0.55
	819.5-799.5	47.3-67.3	A-6a	28	1.71	0.40	0.45
	799.5-794.5	67.3-72.3	A-6a	18	1.10	0.40	0.45
	794.5-784.5	72.3-82.3	A-4b	27	2.59	0.50	0.55
	784.5-774.5	82.3-92.3	A-4b	36	3.27	0.50	0.55
	774.5-766.5	92.3-100.3	A-4b	57	4.27	0.50	0.55
	766.5-761.5	100.3-105.3	A-4b	60	4.86	0.50	0.55

1. Top of shaft elevation based on structure information provided by Korda.



Drilled Shaft Recommendations (Pier 2)

Substructure Unit	Elevation ¹ (feet)	Shaft Length (feet)	Soil Type	Nominal Resistance (ksf)		Resistance Factor	
				End	Side	End	Side
B-003-1-24 (Pier 2)	866.2-856.8	0.0-9.4	A-1-a	36	0.70	0.50	0.55
	856.8-847.3	9.4-18.9	A-1-a	32	0.85	0.50	0.55
	847.3-840.3	18.9-25.9	A-1-a	51	1.68	0.50	0.55
	840.3-835.3	25.9-30.9	A-6a	39	2.15	0.40	0.45
	835.3-822.3	30.9-43.9	A-6a	45	2.32	0.40	0.45
	822.3-810.3	43.9-55.9	A-6a	42	2.26	0.40	0.45
	810.3-800.3	55.9-65.9	A-6a	47	2.37	0.40	0.45
	800.3-790.3	65.9-75.9	A-4b	33	2.74	0.50	0.55
	790.3-780.3	75.9-85.9	A-4b	60	4.39	0.50	0.55
	780.3-775.3	85.9-90.9	A-4b	26	2.80	0.50	0.55
	775.3-770.3	90.9-95.9	A-6a	27	1.65	0.40	0.45
	770.3-762.3	95.9-103.9	A-6a	27	1.65	0.40	0.45

1. Top of shaft elevation based on structure information provided by Korda.

Drilled Shaft Recommendations (Forward Abutment)

Substructure Unit	Elevation ¹ (feet)	Shaft Length (feet)	Soil Type	Nominal Resistance (ksf)		Resistance Factor	
				End	Side	End	Side
Forward Abutment (B-004-1-24)	872.4-861.5	0.0-10.9	A-1-b	44	0.93	0.50	0.55
	861.5-859.0	10.9-13.4	A-1-a	0	0.00	0.50	0.55
	859.0-855.0	13.4-17.4	A-1-a	52	1.47	0.50	0.55
	855.0-851.0	17.4-21.4	A-4a	60	2.28	0.50	0.55
	851.0-846.0	21.4-26.4	A-4b	51	2.67	0.50	0.55
	846.0-836.0	26.4-36.4	A-4b	49	2.70	0.50	0.55
	836.0-831.0	36.4-41.4	A-6a	16	1.03	0.40	0.45
	831.0-811.0	41.4-61.4	A-6a	27	1.65	0.40	0.45
	811.0-796.0	61.4-76.4	A-6b	22	1.37	0.40	0.45
	796.0-791.0	76.4-81.4	A-4b	20	2.33	0.50	0.55
	791.0-786.0	81.4-86.4	A-4b	60	5.00	0.50	0.55
	786.0-772.0	86.4-100.4	A-6a	16	1.03	0.40	0.45

1. Top of shaft elevation based on structure information provided by Korda.



Soil borings performed for the proposed bridge replacement encountered granular and cohesive soils consisting of gravel, gravel with sand, gravel with sand, silt, and clay, sandy silt, silt, silt and clay, and silty clay (ODOT A-1-a, A-1-b, A-2-6, A-4a, A-4b, A-6a, A-6b) at or near the existing creek bed elevations. Classification tests were performed on the soil samples recovered from near the creek bed elevations for the scour considerations. A summary of soil parameters for scour analysis are tabulated below.

Parameters for Scour Analysis

Boring Number	Sample	Elevation, (feet)	Soil Type	D ₅₀ (mm)	Critical Shear Stress τ_c , (psf)	D _{50, equiv.} (mm)	Erosion Category (EC)
B-001-0-24	SS-3	879.2-877.7	A-2-6	0.5140	0.1500	0.5140	1.85
	SS-4	877.7-876.2	A-2-6	0.7880	0.1318	0.7880	2.08
	SS-5	876.2-874.7	A-6b	0.0770	0.4556	21.8154	3.78
	SS-6	874.7-873.2	A-6a	0.0500	0.2605	12.4740	3.26
B-002-0-24	SS-1 & 2S-1A	871.5-869.5	A-1-b	1.1320	0.0236	1.1320	2.26
	SS-2 & 2S-2A	869.5-867.5	A-1-a	8.6030	0.1797	8.6030	3.32
	SS-3	867.5-866	A-1-a	2.0730	0.0433	2.0730	2.58
	SS-4	866-864.5	A-1-a	2.2830	0.0477	2.2830	2.63
B-003-0-24	SS-1	873-871.5	A-4b	0.0320	0.0138	0.6628	2.21
	SS-2	871.5-870	A-1-b	3.5730	0.0746	3.5730	2.86
	SS-3	870-868.5	A-1-a	7.9330	0.1657	7.9330	3.28
	SS-4	868.5-867	A-1-a	11.0120	0.2300	11.0120	3.45
B-004-0-24	SS-4A	877.2-876.2	A-1-b	0.5850	0.0122	0.5850	1.92
	SS-4B	876.2-875.7	A-4a	0.2290	0.0333	1.5963	2.21
	SS-5	875.7-874.2	A-6a	0.3890	0.3675	17.5967	3.17
	SS-6	874.2-872.7	A-2-6	0.4630	0.0869	0.4630	1.80
	SS-7 & 2S-7A	872.7-870.7	A-4a	0.0920	0.0745	3.5689	2.21

Please note that this executive summary does not contain all the information presented in the report. The unabridged subsurface exploration report should be read in its entirety to obtain a more complete understanding of the information presented.



1.0 INTRODUCTION

This report is a presentation of the structure foundation exploration performed for the design and construction of the proposed replacement of the existing bridge (MOT-835-2.57) carrying SR 835 over Little Beaver Creek approximately 0.15 miles west of County Line Road in Kettering, Montgomery County, Ohio.

Based on the available plan information, Rii understands the current bridge is to be replaced with a three-span structure with composite prestressed concrete box beams with integral abutments and cap and column piers on cast-in-place concrete pile foundations. The proposed structure will roughly maintain the existing horizontal and vertical alignment. The length of the proposed bridge is 204.11 feet with a total out-to-out width of 96.96 feet and a skew of 15 degrees.

The investigation was carried out in two phases: the initial investigation, with a previously-submitted report dated August 13, 2024, and this final investigation. This report includes the results from both phases of the field and laboratory testing. The initial field exploration consisted of four (4) borings for scour analyses only. Rii utilized historic borings to prepare a preliminary evaluation of the bridge foundation elements. The results of the foundation analyses indicated that depths of the historic borings, upon which the analyses were based, were insufficient to provide the required geotechnical resistance per pile. Therefore, deeper borings to supplement the historic boring data was needed confirm the required pile design lengths and tip elevations.

2.0 GEOLOGY AND OBSERVATIONS OF THE PROJECT

2.1 Site Geology

Physiographically, this site lies within the Southern Ohio Loamy Till Plain Region. This region is characterized by relatively flat-lying silty loam till ground moraine, interspersed with end and recessional moraines, outwash and alluvial deposits. Ground moraines are deposited during the retreat of a glacier, resulting in an undifferentiated mixture of clay, silt, sand and gravel. End moraines are normally associated with ice melting that is neither advancing nor retreating for a period of time. Recessional moraines are deposited when the ice sheet is retreating. Both end and recessional moraines are commonly associated with boulder belts. Outwash deposits consist of undifferentiated sand and gravel deposited by meltwater in front of glacial ice, and often occurs as valley terraces or low plains. Alluvium and alluvial terrace deposits range from silty clay to cobble sized deposits, usually deposited in present and former floodplain areas.

Based on bedrock geology and topography maps of the area from the Ohio Department of Natural Resources (ODNR), the bedrock at the project site consists of the Ordovician-aged Grant Lake Formation. This unit is comprised of gray to bluish gray interbedded shale and limestone. The unit features deposition of multiple sedimentary cycles of shale and limestone displaying planar to irregular bedding, and limestone and shale exhibiting



wavy to nodular bedding, and ranges between 60 to 130 feet thick. According to ODNR bedrock topography mapping, the bedrock surface in the vicinity of the site is at an approximate elevation of 580 feet, which is approximately 300 feet below the existing surface grade.

2.2 Existing Conditions

The site of the proposed structure replacement is located along SR 835 approximately 0.15 miles west of County Line Road in Kettering, Montgomery County, Ohio. Rii understands the existing bridge is a three-span structure approximately 193 feet long with center-to-center bearings of 64 feet at each span. The existing structure consists of a precast box beam system with abutments supported on 12-inch diameter CIP concrete piles and piers supported on conventional continuous shallow spread footings. In the vicinity of the project area, the existing roadway is a four-lane, bidirectional, asphalt surfaced roadway with an approximate width of 36.0 feet that is aligned east to west. Within the project limits, the roadway traverses primarily along commercial properties.

3.0 EXPLORATION

On January 4, 2024, a total of four (4) borings, designated as B-001-0-24 through B-004-0-24, were performed for the initial investigation of the project. The borings were performed for scour considerations for the proposed bridge replacement and were advanced to depths ranging from 6.0 to 11.8 feet below the existing grade. Records of four (4) historic borings, designated as B-012-0-84 through B-015-0-84, were obtained from the ODOT Transportation Information Mapping System (TIMS) and were utilized in the foundation analysis. Subsequently, between November 4 and December 13, 2024, four (4) additional structure borings, designated as B-001-1-24 through B-004-1-24, were drilled for the final investigation and were advanced to depths ranging from 109.2 to 110.0 feet below the existing ground surface.

The soil borings were performed at the locations shown on the boring plan provided in Appendix I of this report. A summary of soil borings information is provided in Table 1.

Table 1. Test Boring Summary

Boring Number	Station ¹	Offset ¹	Latitude	Longitude	Ground Elevation ¹ (feet)	Boring Depth (feet)
B-001-0-24	134+83	30' RT	39.717205	-84.108170	883.0	11.8
B-002-0-24	135+96	54' LT	39.717410	-84.107744	872.0	7.0
B-003-0-24	136+29	5' RT	39.717116	-84.107658	872.9	6.0
B-004-0-24	137+55	30' LT	39.717307	-84.107189	882.4	11.3
B-012-0-84 ²	135+28	45' LT	39.717400	-84.107987	882.2	40.0



Boring Number	Station ¹	Offset ¹	Latitude	Longitude	Ground Elevation ¹ (feet)	Boring Depth (feet)
B-013-0-84 ²	135+75	44' RT	39.717145	-84.107847	870.7	40.0
B-014-0-84 ²	136+66	44' LT	39.717365	-84.107499	871.2	40.0
B-015-0-84 ²	137+15	43' RT	39.717118	-84.107352	882.4	40.0
B-001-1-24	134+91	25' RT	39.717220	-84.108139	882.7	109.2
B-002-1-24	136+08	55' LT	39.717411	-84.107702	871.5	110.0
B-003-1-24	136+35	49' RT	39.717121	-84.107637	872.3	110.0
B-004-1-24	137+48	31' LT	39.717313	-84.107214	882.1	109.2

1. Station, offset and ground surface elevations were interpolated from basemaps provided by Korda.
2. Historic boring station, offset, and ground surface elevations obtained from ODOT Transportation Information Mapping System (TIMS).

The boring locations were determined and located in the field by Rii personnel. Rii utilized a handheld GPS unit to obtain geographic latitude and longitude coordinates of the boring locations. Ground surface elevations, stations, offsets, were interpolated from basemapping provided by Korda.

The borings performed for the initial and final investigations were drilled using either a Diedrich D-50 or Mobile-57 rotary drilling machine, utilizing 4.5-inch outside diameter continuous flight augers to advance the holes. Standard penetration testing (SPT) and split spoon sampling were performed at 1.5-foot intervals to depths of 6.0 to 11.8 feet below the existing ground surface for scour considerations, or at 2.5-foot increments to a depth of 25.0 to 30.0 feet and at 5.0-foot increments thereafter to the boring termination depth for the structure borings.

The SPT, per the American Society for Testing and Materials (ASTM) designation D1586, is conducted using a 140-pound hammer falling 30.0 inches to drive a 2.0-inch outside diameter split spoon sampler 18.0 inches. A calibrated automatic drop hammer was utilized to generate consistent energy transfer to the sampler. Driving resistance is recorded on the boring logs in terms of blows per 6.0-inch interval of the driving distance. The second and third intervals are added to obtain the number of blows per foot (N). Standard penetration blow counts aid in determining soil properties applicable in foundation design. Measured blow count (N) values are corrected to an equivalent (60%) energy ratio, N_{60} , by the following equation. Both values are represented on boring logs in Appendix III.



$$N_{60} = N^*(ER/60)$$

Where:

N = measured N value

ER = drill rod energy ratio, expressed as a percent, for the system used

The Diedrich D-50 drill rig was utilized for the initial investigation and both the Diedrich D-50 and Mobile B-57 drill rigs were utilized for the final investigation. The hammer for the Diedrich D-50 drill rig was calibrated on March 21, 2022 and the hammer for the Mobile B-57 drill rig was calibrated on August 21, 2023, and had drill rod energy ratios of 86.4 and 80.4 percent for the Diedrich D-50 and Mobile B-57, respectively.

At the completion of drilling in borings, borings B-001-0-24 and B-004-0-24 were backfilled with a mixture of soil cuttings and bentonite chips in accordance with ODOT Specifications for Geotechnical Explorations (SGE) policy for sealing boreholes. The pavement surface at boring locations B-001-0-24 and B-004-0-24 were patched with an equivalent thickness of cold patch asphalt. Further, structure borings B-001-1-24 and B-004-1-24 were backfilled with cement-bentonite grout upon completion, and were patched with an equivalent thickness of quick set concrete.

In general, for instances of no recovery from standard split spoon sampling, a 2.5-inch outside diameter split spoon sampler was driven the full length of the standard split spoon interval plus an additional 6.0 inches to obtain a representative sample. These samples are designated with a "2S" preceding the sample number on the boring logs. Only the final 6.0 inches of sample were retained for classification.

Hand penetrometer readings, which provide a rough estimate of the unconfined compressive strength of the cohesive soils, were reported on the boring logs in units of tons per square foot (tsf) and were utilized to classify the consistency of the cohesive soil in each layer. An indirect estimate of the unconfined compressive strength of the cohesive split spoon sample can also be made from a correlation with the blow counts (N_{60}). Please note that split spoon samples are considered to be disturbed and the laboratory determination of their shear strengths may vary from undisturbed conditions.

During drilling, Rii personnel prepared field logs detailing the encountered subsurface conditions. Soil samples obtained from the drilling operation were preserved and sealed in glass jars and delivered to the soil laboratory. In the laboratory, the soil samples were visually classified and select samples were tested, as noted in Table 2.



Table 2. Laboratory Test Schedule

Laboratory Test	Test Designation	Number of Tests Performed
Natural Moisture Content	ASTM D 2216	134
Plastic and Liquid Limits	AASHTO T89, T90	15
Gradation – Sieve/Hydrometer	AASHTO T88	36
Gradation – Sieve Only	AASHTO T88	2

The tests performed are necessary to classify the existing soil according to the Ohio Department of Transportation (ODOT) classification system and to estimate engineering properties of importance for foundation design and construction recommendations. Results of the laboratory testing are presented on the boring logs in Appendix III.

4.0 FINDINGS

Interpreted engineering logs have been prepared based on the field logs, visual examination of samples and laboratory test results. Classification follows the version of the ODOT SGE at the time the exploration borings were performed. The following is a summary of what was found in the test borings and what is represented on the boring logs. A description of the soil terms used throughout this report is presented in Appendix II.

4.1 Initial Investigation Borings

4.1.1 Surface Materials

Borings B-001-0-24 and B-004-0-24 were drilled through the existing roadway surface of SR 835 and encountered 15.5 and 15.0 inches of asphalt, respectively. No aggregate base was encountered below the borings or the pavement cores. Borings B-002-0-24 and B-003-0-24 were drilled on the creek slopes near each existing pier, and no measurable surface material was encountered.

4.1.2 Subsurface Soils

Below the asphalt in boring B-004-0-24, existing fill was encountered to a depth of 5.8 feet below the existing ground surface. The fill was described as sandy silt (ODOT A-4a) and contained traces of brick fragments.

Underlying the fill in boring B-004-0-24, the asphalt in B-001-0-24, and from the ground surface in the remaining borings, natural cohesive and granular soils were encountered



to the termination depths of the borings. The cohesive soils were described as sandy silt, silt and clay, silty clay, and clay (ODOT A-4a, A-6a, A-6b, A-7-6). The shear strength and consistency of cohesive soils are primarily derived from the hand penetrometer values (HP). The HP values ranged from stiff ($1.0 < HP \leq 2.0$ tsf) to very stiff ($2.0 < HP \leq 4.0$ tsf). The unconfined compressive strength of the cohesive soil samples tested, obtained from the hand penetrometer, ranged from 1.25 tsf to 3.25 tsf (limit of the instrument). The N_{60} values recorded within these natural cohesive soils ranged from 13 to 30 blows per foot (bpf).

The granular soils were described as gravel, gravel with sand, gravel with sand, silt, and clay, and silt (ODOT A-1-a, A-1-b, A-2-6, A-4b). The relative density of granular soils is primarily derived from SPT blow counts (N_{60}). Based on the SPT blow counts obtained, the relative density of the granular soils encountered ranged from medium dense ($10 \leq N_{60} \leq 30$ bpf) to dense ($30 \leq N_{60} \leq 50$ bpf). SPT blow counts (N_{60}) of the granular deposits ranged from 17 bpf to 39 bpf.

Moisture contents of the natural cohesive soil samples tested ranged from 9 to 38 percent. The moisture contents of the natural cohesive soil samples tested for plasticity index ranged from 6 percent below to 1 percent above their corresponding plastic limits. In general, the soils exhibited natural moisture contents ranging from moderately below to near their estimated optimum moisture levels.

4.1.3 Bedrock

Bedrock was not encountered in the borings performed for this investigation.

4.1.4 Groundwater

Groundwater was encountered in the borings as shown in Table 3 below.

Table 3. Groundwater Levels – Initial Investigation Borings

Boring Number	Ground Elevation (feet)	During Drilling		Upon Completion	
		Depth (feet)	Elevation (feet)	Depth (feet)	Elevation (feet)
B-002-0-24	871.5	3.5	868.0	2.0	869.5
B-003-0-24	873.0	3.0	870.0	2.5	870.5

During drilling groundwater was encountered in borings B-002-0-24 and B-003-0-24 at depths of 3.5 and 2.0 feet below the existing ground surface, respectively. Groundwater measured upon completion of drilling at depths of 3.0 and 2.5 feet below the existing ground surface, respectively.



Please note that short-term water level readings are not necessarily an accurate indication of the actual groundwater level. In addition, groundwater levels or the presence of groundwater are considered to be dependent on seasonal fluctuations in precipitation.

4.2 Final Investigation Borings

4.2.1 Surface Materials

Borings B-001-1-24 and B-004-1-24 were drilled through the existing roadway surface of SR 835 and encountered 18.0 and 12.0 inches of asphalt, respectively, overlying 6 inches of aggregate base. Borings B-002-1-24 and B-003-1-24 were drilled on the creek slopes near each existing pier and encountered 12.0 and 3.0 inches of topsoil at the ground surface, as identified by the presence of vegetation and organic matter.

4.2.2 Subsurface Soils

Underlying the surficial materials, natural cohesive and granular soils were encountered to the termination depths of the borings. The cohesive soils were described as sandy silt, silt and clay, and silty clay (ODOT A-4a, A-6a, A-6b). The shear strength and consistency of cohesive soils are primarily derived from the hand penetrometer values (HP). The HP values ranged from medium stiff ($0.5 < \text{HP} \leq 1.0$ tsf) to hard ($\text{HP} > 4.0$ tsf). The unconfined compressive strength of the cohesive soil samples tested, obtained from the hand penetrometer, ranged from 0.75 tsf to 4.5 tsf (limit of the instrument). The N_{60} values recorded within the natural cohesive soils ranged from 8 to 53 blows per foot (bpf).

The granular soils were described as gravel, gravel with sand, gravel with sand, silt, and clay, as well as silt (ODOT A-1-a, A-1-b, A-2-6, A-4b). The relative density of granular soils is primarily derived from SPT blow counts (N_{60}). Based on the SPT blow counts obtained, the relative density of the granular soils encountered ranged from very loose ($N_{60} \leq 4$ bpf) to very dense ($N_{60} > 50$ bpf). SPT blow counts (N_{60}) of the granular deposits ranged from 0 bpf to 112 bpf.

Moisture contents of the natural cohesive soil samples tested ranged from 4 to 26 percent. The moisture contents of the natural cohesive soil samples tested for plasticity index ranged from values similar to 8 percent above their corresponding plastic limits. In general, the soils exhibited natural moisture contents ranging from moderately below to significantly above their estimated optimum moisture levels.

4.2.3 Bedrock

Bedrock was not encountered in the borings performed for this investigation.

4.2.4 Groundwater

Groundwater was encountered in the borings as shown in Table 4 below.

Table 4. Groundwater Levels – Final Investigation Borings

Boring Number	Ground Elevation (feet)	During Drilling	
		Depth (feet)	Elevation (feet)
B-001-1-24	882.7	8.5	874.2
B-002-1-24	871.5	3.5	868.0
B-003-1-24	872.3	3.0	869.3

Groundwater was encountered during drilling in borings B-001-1-24, B-001-1-24 and B-003-1-24 at depths of 8.5, 3.5 and 3.0 feet below the existing ground surface, respectively. Groundwater could not be measured upon completion of drilling due to addition of drilling mud to boreholes.

Please note that short-term water level readings are not necessarily an accurate indication of the actual groundwater level. In addition, groundwater levels or the presence of groundwater are considered to be dependent on seasonal fluctuations in precipitation.

A more comprehensive description of what was encountered during the drilling process may be found on the boring logs in Appendix III.

4.3 Historic Borings

4.3.1 Surface Materials

Historic borings B-012-0-84 and B-013-0-84 encountered 0.7 to 1.0 feet of topsoil at the ground surface. Typical surface materials were not encountered at the ground surface of borings B-014-0-84 and B-015-0-84.

4.3.2 Subsurface Soils

Historic borings B-014-0-84 and B-015-0-84 encountered existing fill to a depth of 4.0 feet each below the ground surface. The fill was described as silt and silt and clay (ODOT A-4b, A-6a) with traces of organics, wood, asphalt, and cobbles.

Underlying the fill material and surface materials, natural cohesive and granular soils were encountered to the termination depths of the borings. The cohesive soils were described as silt, silt with fine sand, and silt and clay. HP values were not reported on the historic boring logs. The N values recorded within these natural cohesive soils ranged from 5 to 79 bpf.



The granular soils were described as sand and gravel and sand. Blow counts (N) of the granular soil deposits ranged from 21 to 105 bpf.

4.3.3 Bedrock

Bedrock was not encountered in the borings performed for this investigation.

4.3.4 Groundwater

Groundwater was encountered in the historic borings as shown in Table 5 below.

Table 5. Groundwater Levels – Historic Borings

Boring Number	Ground Elevation (feet)	During Drilling		Upon Completion	
		Depth (feet)	Elevation (feet)	Depth (feet)	Elevation (feet)
B-012-0-84	877.9	6.0	871.9	6.5	871.4
B-013-0-84	877.5	4.0	873.5	4.0	873.5
B-014-0-84	877.2	4.0	873.2	3.0	874.2
B-015-0-84	877.3	4.0	873.3	3.5	873.8

Groundwater was encountered in the historic borings at depths ranging from 4.0 to 6.0 feet below the existing ground surface. Groundwater measured upon completion of drilling in the historic borings at depths ranging from 3.0 to 6.5 feet below the existing ground surface.

5.0 ANALYSES AND RECOMMENDATIONS

Data obtained from the current and historic geotechnical explorations have been used to determine the foundation support capabilities and the settlement potential for the soil encountered at the site. These parameters have been used to provide guidelines for the design of foundation systems for the subject bridge which are discussed in the following paragraphs.

Design details of the proposed structure were provided by Korda and are summarized in Table 6. Based on the information provided, it is understood that the proposed bridge will be a three-span composite prestressed box beam superstructure with reinforced concrete piers and capped pile abutments. The length of the proposed bridge, measured between center to center of the bearings, will be 200.1 feet.



Table 6. Bridge Design Details

Substructure Unit (Boring)	Bottom of Footing Elevation (feet) ¹	Maximum Factored Design Load (kips) ¹	Scour Elevation ¹ (feet)
Rear Abutment (B-001-1-24)	873.29	186.0	NA
Pier 1 (B-002-1-24)	866.80	172.0	865.18
Pier 2 (B-003-1-24)	866.20	172.0	864.99
Forward Abutment (B-004-1-24)	872.38	186.0	NA

1. Bottom of footing elevation, structural loading, and scour depth information provided by Korda.

5.1 Driven Pile Recommendations

Given the subsurface conditions encountered, Rii recommends that closed end steel CIP pipe piles (ODOT Item 507.06) driven to the depth of the ultimate bearing value (UBV) be employed for foundation support. The geotechnical resistance recommendations for CIP pipe piles are provided in Table 7.



Table 7. Driven Pile Recommendations – Closed End CIP Piles

Substructure Reference	Bottom of Footing ¹ (feet)	Pile Size / Type ²	Min. Req. Pile Wall Thickness (inch)	Pile Elevation (feet)		Est. Pile Length ⁴ (feet)	Scour Friction Loss (kips/pile)	Required UBV ⁵ (kips/pile)	ϕ_{dyn} ⁶
				Top ³	Tip				
Rear Abutment (B-001-1-24)	873.29	12" CIP	0.25	875.29	793.29	85.0	N/A	265.7	0.7
		14" CIP	0.25	875.29	811.50	65.0	N/A	265.7	
		16" CIP	0.25	875.29	820.29	55.0	N/A	265.7	
Pier 1 (B-002-1-24)	866.80	14" CIP	0.28	868.80	806.80	65.0	0.25	245.72	
		16" CIP	0.25	868.80	816.60	55.0	0.30	245.72	
Pier 2 (B-003-1-24)	866.20	14" CIP	0.25	868.20	811.20	60.0	0.13	245.72	
		16" CIP	0.28	868.20	820.00	50.0	0.20	245.72	
Forward Abutment (B-004-1-24)	872.38	12" CIP	0.25	874.38	791.90	85.0	N/A	265.7	
		14" CIP	0.25	874.38	803.20	75.0	N/A	265.7	
		16" CIP	0.25	874.38	813.00	65.0	N/A	265.7	

1. Bottom of footing elevation determined from design plans provided by Korda.
2. Minimum of Grade 3 steel. Detailed pile thickness and steel grade will be provided with geotechnical report.
3. The top of pile elevation corresponds to the pile cutoff elevation, which is considered to be 2.0-foot above the bottom of footing elevation.
4. Per Section 305.3.5.2 of the 2023 ODOT BDM, the estimated pile length was determined as the pile cutoff elevation (top) minus the pile tip elevation, rounded up to the nearest 5.0 feet. Order (furnished) length for each pile should be calculated by adding 5 feet on estimated pile length.
5. UBV is the required resistance that an individual pile is expected to provide based on the structural loading and accounting for the applicable geotechnical resistance factor. Values are determined based on the design maximum factored structural loads provided by Korda and scour friction, as per Section 606.2 of the ODOT BDM.
6. The resistance factor listed assumes dynamic testing of the pile elements per Section 305.7.1 of the 2023 ODOT BDM.

The factored structural axial resistances listed in Table 7 consider an axially loaded pile with negligible moment, no appreciable loss of section due to deterioration throughout the life of the structure. The piles were analyzed using the APILE software program. The ultimate bearing values listed in Table 7 were calculated in accordance with Section 305.3.2 and 305.3.4 of the ODOT BDM and Section 1304.1 of the ODOT GDM.

Please note that, UBV is the ultimate resistance achieved by the pile in the long-term after pile set-up has occurred. Pile restrrike testing should be performed to verify that the pile has achieved UBV as recommended in Table 7. The wait period of 14 days is recommended for the pile restrrike.

It should be noted that the pile lengths and ultimate bearing values presented in are estimates using empirical equations based on the derived characteristics of the soils



encountered in the subject current and historic borings drilled. The actual pile capacities should be verified using static or dynamic pile load testing as detailed in Sections 305.7.1 of the ODOT BDM. Dynamic pile load testing should be performed in accordance with ASTM D4945.

5.1.1 Drivability

Drivability analyses were performed in accordance with Section 10.7.8 of the 2020 AASHTO LRFD BDS using the GRLWEAP software program, and the results are provided in Appendix VI. In the drivability analysis, a **Delmag 19-42** hammer with a rated energy of approximately 44,000 ft-lbs was used in conjunction with the CIP pipe pile sections. Based on the results of this analysis, driving stresses induced on the CIP-piles **would not exceed** 90 percent of the yield stress of the steel ($f_y = 45$ ksi, $0.9f_y = 40.5$ ksi) if driven to the elevations provided in Table 7. Care should be taken during pile driving operations to ensure that the driving stresses induced on the pile elements do not exceed the maximum allowable value of 90 percent of the yield stress of the steel, subsequently damaging the pile elements. Pile driving should be terminated upon achieving the required 100 blows from the pile hammer with an foot or less of penetration to reduce the possibility of damaging the pile element.

5.1.2 Driven Pile Considerations

Proper pile installation is as important as pile design in order to obtain a cost effective and safe product. Driven piles must be installed to develop adequate soil resistance without structural damage. Because piles cannot be visually inspected after installation, direct quality control of the finished product is impossible. Consequently, substantial control must be exercised over peripheral operations leading to the pile placement within the foundation. It is essential that installation be considered during the design stage to ensure that piles shown on the plans can be installed. Construction monitoring should be employed in (1) pile materials, (2) installation equipment, and (3) the estimation of the static load capacity.

It is recommended that the contractor submit a wave equation analysis (bearing graph) of their pile driving equipment, or the necessary pile driving and equipment data to perform the wave equation analysis, for hammer approval. A constant capacity wave equation analysis (inspector's chart) should also be performed to assist field personnel during inspection in accordance with the ODOT BDM

5.2 Drilled Shaft Recommendations

If drilled shafts are selected for foundation support, it is recommended that they be designed using the axial design parameters provided in Table 8 through Table 11.

Table 8. Drilled Shaft Recommendations (Rear Abutment)

Substructure Unit	Elevation ¹ (feet)	Shaft Length (feet)	Soil Type	Nominal Resistance (ksf)		Resistance Factor	
				End	Side	End	Side
Rear Abutment (B-001-1-24)	873.9-872.7	0.0-1.2	A-6b	10	0.89	0.40	0.45
	872.7-864.7	1.2-9.2	A-6a	18	1.10	0.40	0.45
	864.7-854.7	9.2-19.2	A-1-b	51	1.12	0.50	0.55
	854.7-847.7	19.2-26.2	A-4b	50	2.12	0.50	0.55
	847.7-841.7	26.2-32.2	A-4b	27	1.80	0.50	0.55
	841.7-826.7	32.2-47.2	A-6b	14	0.89	0.40	0.45
	826.7-821.7	47.2-52.2	A-4b	33	2.52	0.50	0.55
	821.7-811.7	52.2-62.2	A-4b	28	2.09	0.50	0.55
	811.7-801.7	62.2-72.2	A-6a	28	1.71	0.40	0.45
	801.7-791.7	72.2-82.2	A-4b	38	3.06	0.50	0.55
	791.7-782.7	82.2-91.2	A-4b	60	5.21	0.50	0.55
	782.7-777.7	91.2-96.2	A-4b	60	4.56	0.50	0.55
777.7-772.7	96.2-101.2	A-4b	28	2.94	0.50	0.55	

1. Top of shaft elevation based on structure information provided by Korda.

Table 9. Drilled Shaft Recommendations (Pier 1)

Substructure Unit	Elevation ¹ (feet)	Shaft Length (feet)	Soil Type	Nominal Resistance (ksf)		Resistance Factor	
				End	Side	End	Side
B-002-1-24 (Pier 1)	866.8-863.5	0.0-3.3	A-1-b	33	0.41	0.50	0.55
	863.5-858.5	3.3-8.3	A-4a	31	1.87	0.40	0.45
	858.5-851.0	8.3-15.8	A-1-b	54	1.07	0.50	0.55
	851.0-845.5	15.8-21.3	A-6a	36	2.04	0.40	0.45
	845.5-834.5	21.3-32.3	A-6b	32	1.91	0.40	0.45
	834.5-829.5	32.3-37.3	A-4b	24	1.96	0.50	0.55
	829.5-819.5	37.3-47.3	A-4b	37	2.56	0.50	0.55
	819.5-799.5	47.3-67.3	A-6a	28	1.71	0.40	0.45
	799.5-794.5	67.3-72.3	A-6a	18	1.10	0.40	0.45
	794.5-784.5	72.3-82.3	A-4b	27	2.59	0.50	0.55
	784.5-774.5	82.3-92.3	A-4b	36	3.27	0.50	0.55
	774.5-766.5	92.3-100.3	A-4b	57	4.27	0.50	0.55
	766.5-761.5	100.3-105.3	A-4b	60	4.86	0.50	0.55

1. Top of shaft elevation based on structure information provided by Korda.



Table 10. Drilled Shaft Recommendations (Pier 2)

Substructure Unit	Elevation ¹ (feet)	Shaft Length (feet)	Soil Type	Nominal Resistance (ksf)		Resistance Factor	
				End	Side	End	Side
B-003-1-24 (Pier 2)	866.2-856.8	0.0-9.4	A-1-a	36	0.70	0.50	0.55
	856.8-847.3	9.4-18.9	A-1-a	32	0.85	0.50	0.55
	847.3-840.3	18.9-25.9	A-1-a	51	1.68	0.50	0.55
	840.3-835.3	25.9-30.9	A-6a	39	2.15	0.40	0.45
	835.3-822.3	30.9-43.9	A-6a	45	2.32	0.40	0.45
	822.3-810.3	43.9-55.9	A-6a	42	2.26	0.40	0.45
	810.3-800.3	55.9-65.9	A-6a	47	2.37	0.40	0.45
	800.3-790.3	65.9-75.9	A-4b	33	2.74	0.50	0.55
	790.3-780.3	75.9-85.9	A-4b	60	4.39	0.50	0.55
	780.3-775.3	85.9-90.9	A-4b	26	2.80	0.50	0.55
	775.3-770.3	90.9-95.9	A-6a	27	1.65	0.40	0.45
	770.3-762.3	95.9-103.9	A-6a	27	1.65	0.40	0.45

1. Top of shaft elevation based on structure information provided by Korda.

Table 11. Drilled Shaft Recommendations (Forward Abutment)

Substructure Unit	Elevation ¹ (feet)	Shaft Length (feet)	Soil Type	Nominal Resistance (ksf)		Resistance Factor	
				End	Side	End	Side
Forward Abutment (B-004-1-24)	872.4-861.5	0.0-10.9	A-1-b	44	0.93	0.50	0.55
	861.5-859.0	10.9-13.4	A-1-a	0	0.00	0.50	0.55
	859.0-855.0	13.4-17.4	A-1-a	52	1.47	0.50	0.55
	855.0-851.0	17.4-21.4	A-4a	60	2.28	0.50	0.55
	851.0-846.0	21.4-26.4	A-4b	51	2.67	0.50	0.55
	846.0-836.0	26.4-36.4	A-4b	49	2.70	0.50	0.55
	836.0-831.0	36.4-41.4	A-6a	16	1.03	0.40	0.45
	831.0-811.0	41.4-61.4	A-6a	27	1.65	0.40	0.45
	811.0-796.0	61.4-76.4	A-6b	22	1.37	0.40	0.45
	796.0-791.0	76.4-81.4	A-4b	20	2.33	0.50	0.55
	791.0-786.0	81.4-86.4	A-4b	60	5.00	0.50	0.55
	786.0-772.0	86.4-100.4	A-6a	16	1.03	0.40	0.45

1. Top of shaft elevation based on structure information provided by Korda.



Per Section 10.8.3.5.3 of the AASHTO LRFD BDS, where drilled shafts are extended to end bear in a strong soil layer overlying a weaker soil layer, the end bearing resistance shall be reduced if the tip elevation is within 1.5 times the diameter of the drilled shaft above the top of the weaker soil layer. A weighted average that varies linearly from the full end bearing resistance in the overlying strong soil layer at a distance of 1.5 times the diameter of the drilled shaft above the top of the weak soil layer to the end bearing resistance of the weak soil layer at the top of the weak soil layer should be used to determine the end bearing resistance utilized in the design. Therefore, the end bearing resistance utilized in the design will need to be adjusted accordingly if the tip elevation of the drilled shafts will be within 1.5 times the diameter of the drilled shaft above the underlying weaker soil layer.

Based on the estimated settlement noted above, it is anticipated that 100 percent of the side friction resistance will be mobilized and approximately 70 percent of the end bearing resistance will be mobilized based on the displacement of the shaft. Therefore, the nominal end bearing resistance noted in the table above should be reduced to 70 percent of the values provided for the respective tip elevation in the determination of the design shaft resistance.

5.2.1 Drilled Shaft Group Efficiency

The axial capacity of drilled shaft groups may be less than the sum of the individual shaft capacities within a group of shafts. For soil profiles that consist of cohesive and granular soils, the allowable bearing capacity shall be taken as the lesser of:

- the sum of the individual capacity of each shaft within the group multiplied by a group efficiency factor (defined below), or
- the total resistance of an equivalent pier consisting of the shafts and the block of soil within the area bounded by the shafts.

The individual capacity of each drilled shaft shall be reduced by applying an efficiency factor, η , as recommended below:

- $\eta = 0.65$ for a center-to-center spacing of 2.5 diameters,
- $\eta = 1.0$ for a center-to-center spacing of 4.0 diameters or greater,
- For intermediate spacing, the value of η may be determined by linear interpolation.

Please note that the efficiency factor should be applied to the total individual shaft capacity (including both end bearing and side friction along the shaft length) for evaluation of the sum of the individual capacity of each shaft within the group, and should not be applied when evaluating the equivalent pier approach. It is not recommended to space the drilled shafts less than 2.5 diameters center-to-center.



5.2.2 Drilled Shaft Considerations

The minimum requirements for proper inspection of drilled shaft construction are as follows:

- A qualified inspector should record the material types being removed from the hole as excavation proceeds.
- When the bearing material has been encountered and identified and/or the design tip elevation has been reached, the shaft walls and base should be observed for anomalies, unexpected soft soil conditions, obstructions or caving.
- Concrete placed freefall should not be allowed to hit the sidewalls of the excavation or the rebar cage and should not pass through any water.
- Structural stability of the rebar cage should be maintained during the concrete pour to prevent buckling.
- The volume of concrete should be checked to ensure voids did not result during extraction of the casing (if utilized).
- The placement of all concrete for the drilled shafts shall follow the American Concrete Institute's Design and Construction of Drilled Piers (ACI 336.3R-93).
- If concrete is placed by tremie method, it must be done so with an adequate head to displace water or slurry if groundwater has entered the caisson (all tremie procedures shall follow applicable ACI specifications).
- Pulling casing with insufficient concrete inside should be restricted.
- The bottom of drilled shaft excavation should be clean and free of loose material. Any loose material observed should be removed using a clean-out bucket (muck bucket).

The use of casing for drilled shafts is recommended under any of the following conditions:

- Caving material is encountered at any time during the drilling of the shaft.
- Groundwater is encountered at any time during the drilling of the shaft, or groundwater seepage occurs in the drilled shaft.
- Down hole inspection is planned (casing is required for this instance).

In addition, it is recommended that if casing is used, it be pulled immediately after the concrete is placed, allowing for reuse of the casing and eliminating reduction of side resistance (between soil and concrete).



It is anticipated that conventional drilled shaft equipment (with a standard soil bit) will be able to penetrate the soils. However, it is the responsibility of the contractor to determine the most effective excavation procedures.

5.2.3 Lateral Design

If lateral loads or moments are expected to be applied on the foundation elements, they should be analyzed to verify the pile has enough lateral and bending resistance against these loads. A boring-by-boring tabulation of parameters that should be used for lateral loading design is provided in Appendix IV. In order to evaluate the lateral capacity, it is recommended that a derivation of COM624, such as LPILE, be utilized to determine the proper embedment depth required to resist the lateral load for a given end condition and deflection. Table 12 lists the eleven different soil types internal to the LPILE program. These strata were utilized to define the soil strata in the soil profile for each boring provided in Appendix V.

Table 12. Subsurface Strata Description

Strata	Description
1	Soft Clay
2	Stiff Clay with Water
3	Stiff Clay without Free Water
4	Sand (Reese)
5	User Defined
6	Vuggy Limestone (Strong Rock)
7	Silt (with cohesion and internal friction angle)
8	API Sand
9	Weak Rock
10	Liquefiable Sand (Rollins)
11	Stiff Clay without free water with a specified initial K (Brown)

5.3 Scour Data

Soil borings performed for the proposed bridge replacement encountered granular and cohesive soils consisting of gravel, gravel with sand, gravel with sand, silt, and clay, sandy silt, silt, silt and clay, and silty clay (ODOT A-1-a, A-1-b, A-2-6, A-4a, A-4b, A-6a, A-6b) at or near the existing creek bed elevations. Classification tests were performed on the soil samples recovered from near the creek bed elevations for the scour considerations. A summary of soil parameters for scour analysis are tabulated in Table 13.



Table 13. Parameters for Scour Analysis

Boring Number	Sample	Elevation, (feet)	Soil Type	D ₅₀ (mm)	Critical Shear Stress τ_c , (psf)	D _{50, equiv.} (mm)	Erosion Category (EC)
B-001-0-24	SS-3	879.2-877.7	A-2-6	0.5140	0.1500	0.5140	1.85
	SS-4	877.7-876.2	A-2-6	0.7880	0.1318	0.7880	2.08
	SS-5	876.2-874.7	A-6b	0.0770	0.4556	21.8154	3.78
	SS-6	874.7-873.2	A-6a	0.0500	0.2605	12.4740	3.26
B-002-0-24	SS-1 & 2S-1A	871.5-869.5	A-1-b	1.1320	0.0236	1.1320	2.26
	SS-2 & 2S-2A	869.5-867.5	A-1-a	8.6030	0.1797	8.6030	3.32
	SS-3	867.5-866	A-1-a	2.0730	0.0433	2.0730	2.58
	SS-4	866-864.5	A-1-a	2.2830	0.0477	2.2830	2.63
B-003-0-24	SS-1	873-871.5	A-4b	0.0320	0.0138	0.6628	2.21
	SS-2	871.5-870	A-1-b	3.5730	0.0746	3.5730	2.86
	SS-3	870-868.5	A-1-a	7.9330	0.1657	7.9330	3.28
	SS-4	868.5-867	A-1-a	11.0120	0.2300	11.0120	3.45
B-004-0-24	SS-4A	877.2-876.2	A-1-b	0.5850	0.0122	0.5850	1.92
	SS-4B	876.2-875.7	A-4a	0.2290	0.0333	1.5963	2.21
	SS-5	875.7-874.2	A-6a	0.3890	0.3675	17.5967	3.17
	SS-6	874.2-872.7	A-2-6	0.4630	0.0869	0.4630	1.80
	SS-7 & 2S-7A	872.7-870.7	A-4a	0.0920	0.0745	3.5689	2.21

5.4 Lateral Earth Pressure

For the soil types encountered in the borings, the “in-situ” unit weight (γ), cohesion (c), effective angle of friction (ϕ'), and lateral earth pressure coefficients for at-rest conditions (k_o), active conditions (k_a), and passive conditions (k_p) have been estimated and are provided in Table 14 and Table 15.



Table 14. Estimated Undrained (Short-term) Soil Parameters for Design

Soil Type	γ (pcf) ¹	c (psf)	ϕ	k_a	k_o	k_p
Medium Stiff to Stiff Cohesive Soil	115	1,000	0°	N/A	N/A	N/A
Very Stiff to Hard Cohesive Soil	120	2,500	0°	N/A	N/A	N/A
Very Loose to Loose Granular Soil	120	0	28°	0.36	0.53	2.77
Medium Dense to Very Dense Granular Soil	125	0	32°	0.31	0.47	3.25
Compacted Cohesive Engineered Fill	120	2,000	0°	N/A	N/A	N/A
Compacted Granular Engineered Fill	130	0	32°	0.31	0.47	3.25

1. When below groundwater table, use effective unit weight, $\gamma' = \gamma - 62.4$ pcf and add hydrostatic water pressure.

Table 15. Estimated Drained (Long-term) Soil Parameters for Design

Soil Type	γ (pcf) ¹	c' (psf)	ϕ'	k_a	k_o	k_p
Medium Stiff to Stiff Cohesive Soil	115	0	25°	0.41	0.58	2.46
Very Stiff to Hard Cohesive Soil	120	0	27°	0.38	0.55	2.66
Very Loose to Loose Granular Soil	120	0	28°	0.36	0.53	2.77
Medium Dense to Very Dense Granular Soil	125	0	32°	0.31	0.47	3.25
Compacted Cohesive Engineered Fill	120	0	28°	0.36	0.53	2.77
Compacted Granular Engineered Fill	130	0	32°	0.31	0.47	3.25

1. When below groundwater table, use effective unit weight, $\gamma' = \gamma - 62.4$ pcf and add hydrostatic water pressure.

These parameters are considered appropriate for the design of all subsurface structures and any excavation support systems. Subsurface structures (where the top of the structure is restrained from movement) should be designed based on at-rest conditions (k_o). For proposed temporary retaining structures (where the top of the structure is allowed to move), earth pressure distributions should be based on active (k_a) and passive (k_p) conditions.

These recommendations do not take into consideration the effect of any surcharge loading or a sloped ground surface (a flat surface is assumed). Earth pressures on excavation support systems will be dependent on the type of sheeting and method of bracing or anchorage. Surcharge loads, such as that imposed by traffic loading, will create additional lateral loading on the subsurface structures and excavation support systems. The resulting lateral earth pressure should be evaluated based on active (k_a) and at-rest (k_o) conditions and the anticipated magnitude of the loading.

Where necessary, temporary retaining structures, such as sheet pile system, should be designed using the undrained soil parameters provided in Table 14, and the design

should follow all applicable guidelines for the type of retaining structure utilized. Permanent retaining and subsurface structures should be designed using the drained soil parameters provided in Table 15. Regardless of whether the retaining structure is temporary or permanent, the effective unit weight ($\gamma' = \gamma - 62.4$ pcf) plus the hydrostatic water pressure ($\gamma_w * h_w$, where h_w is the height of water behind the wall above the base of the wall) should be utilized below the design groundwater level. The lateral earth pressure coefficients should only be applied to the horizontal pressure resulting from the effective overburden pressure, and should not be applied to the hydrostatic water pressure.

5.5 Construction Considerations

All site work shall conform to local codes and to the latest ODOT Construction and Materials Specifications (CMS), including that all excavation and embankment preparation and construction should follow ODOT Item 200 (Earthwork).

5.5.1 Excavation Considerations

All excavations should be shored / braced or laid back at a safe angle in accordance with Occupational Safety and Health Administration (OSHA) guidelines. During excavation, if slopes cannot be laid back to OSHA Standards due to adjacent structures or other obstructions, temporary shoring may be required. The following table should be utilized as a general guide for implementing OSHA guidelines when estimating excavation back slopes at the various boring locations. Actual excavation back slopes must be field verified by qualified personnel at the time of excavation in strict accordance with OSHA guidelines.

Table 16. Excavation Back Slopes

Soil	Maximum Back Slope	Notes
Soft to Medium Stiff Cohesive	1.5 : 1.0	Above Ground Water Table and No Seepage
Stiff Cohesive	1.0 : 1.0	Above Ground Water Table and No Seepage
Very Stiff to Hard Cohesive	0.75 : 1.0	Above Ground Water Table and No Seepage
All Granular & Cohesive Soil Below Ground Water Table or with Seepage	1.5 : 1.0	None

5.5.2 Groundwater Considerations

Groundwater should be anticipated at or near the elevations as indicated in Table 3. Groundwater should be anticipated within the upper cohesive and granular soils at the normal pool elevation and above the normal pool elevation during and after storm events. Additionally, groundwater conditions affecting construction may be encountered within the trapped/perched zones. These trapped/perched zones are generally the layer(s) of granular soils that are isolated within the fine-grained soil layers and may not be identified



in boring logs. If excavation encounter such layers, temporary dewatering may be accomplished by placing localized sumps and pumps within and beyond the excavation. Seepage rates from these layers are difficult to predict and flow rate could be significant.

Groundwater, wherever encountered, proper groundwater control measures should be implemented to prevent disturbance to excavation bottoms consisting of cohesive soil, and to prevent the possible development of a quick or “boiling” condition if soft/loose silts and/or fine sands are encountered. It is preferable that the groundwater level, if encountered, be maintained at least 36.0 inches below the deepest excavation. Note that determining and maintaining actual groundwater levels during construction is the responsibility of the contractor.

6.0 LIMITATIONS OF STUDY

The above recommendations are predicated upon construction inspection by a qualified soil technician under the direct supervision of a professional geotechnical engineer. Adequate testing and inspection during construction are considered necessary to assure an adequate foundation system and are part of these recommendations.

The recommendations for this project were developed utilizing subsurface information obtained from the test borings that were made at the proposed site for the current investigation. Resource International is not responsible for the data, conclusions, opinions or recommendations made by others during previous investigations at this site. At this time we would like to point out that soil borings only depict the subsurface conditions at the specific locations and time at which they were made. The conditions at other locations on the site may differ from those occurring at the boring locations.

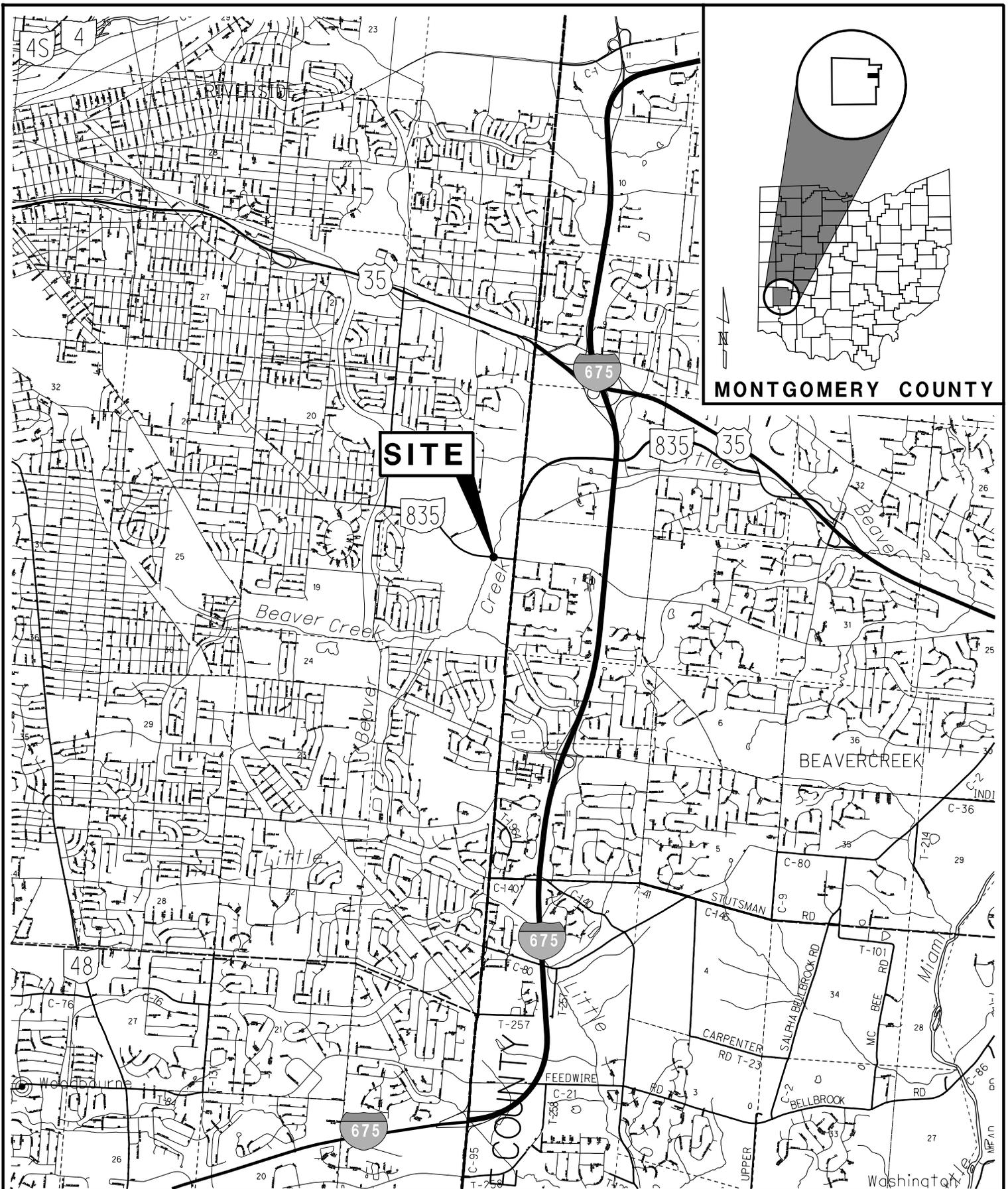
The conclusions and recommendations herein have been based upon the available soil and bedrock information and the design details furnished by a representative of the owner of the proposed project. Any revision in the plans for the proposed construction from those anticipated in this report should be brought to the attention of the geotechnical engineer to determine whether any changes in the foundation or earthwork recommendations are necessary. If deviations from the noted subsurface conditions are encountered during construction, they should also be brought to the attention of the geotechnical engineer.

The scope of our services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater or surface water within or beyond the site studied. Any statements in this report or on the test boring logs regarding odors, staining of soils or other unusual conditions observed are strictly for the information of our client.

Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. Resource International is not responsible for the conclusions, opinions or recommendations made by others based upon the data included.



APPENDIX I
BORING PLAN



MONTGOMERY COUNTY

SITE

VICINITY MAP
MOT-SR 835-2.57
BRIDGE REPLACEMENT
MONTGOMERY COUNTY, OHIO

RII PROJECT NO.
W-23-155

SCALE: 1"=5000'

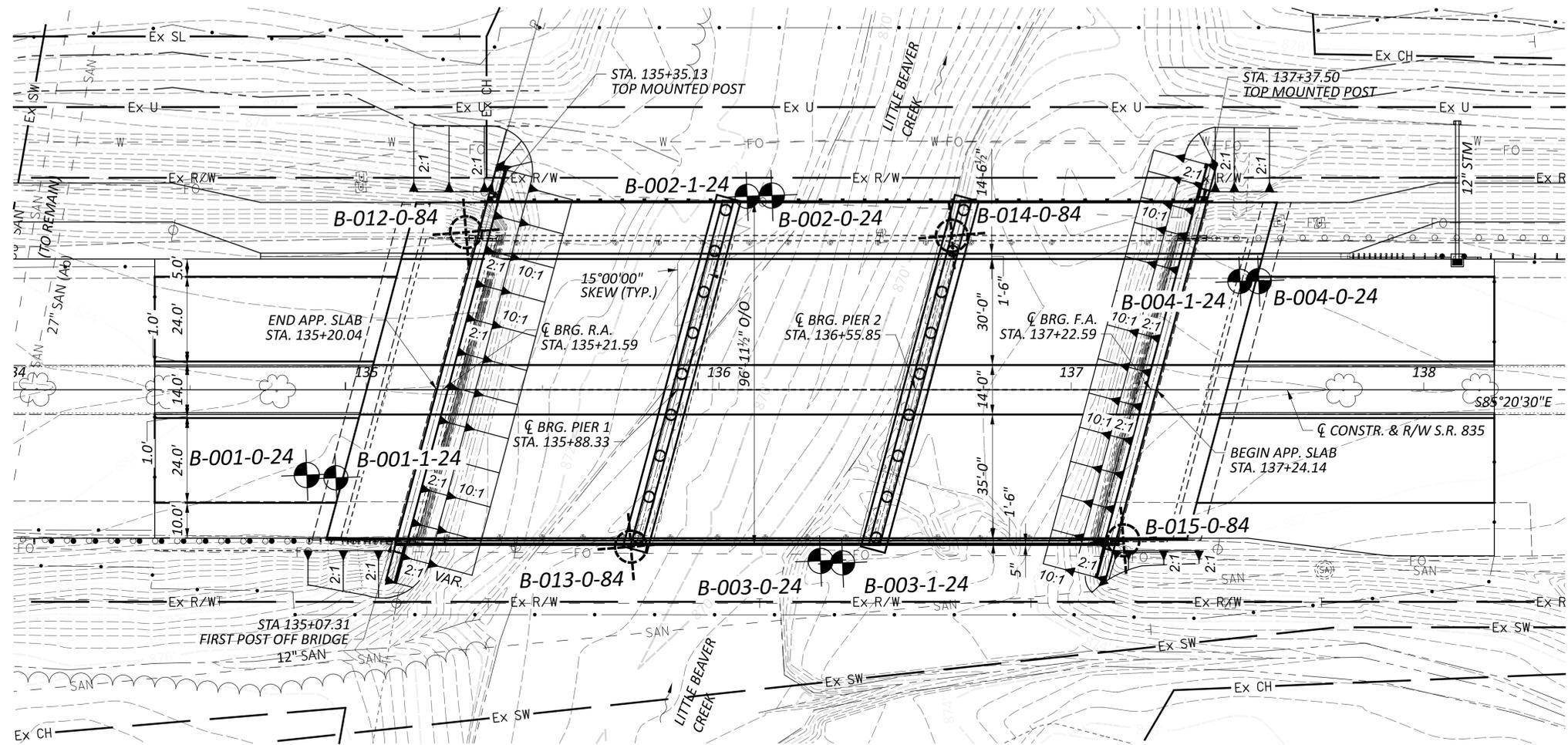


DRAWN
JAS

REVIEWED
DEK

DATE
3/1/2024





BORING PLAN

MOT-835-2.57 BRIDGE REPLACEMENT

MONTGOMERY COUNTY, OHIO

RII PROJECT NO.
W-23-155

SCALE: 1" = 40'
0 20 40



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2/01/2024



APPENDIX II

DESCRIPTION OF SOIL TERMS



CLASSIFICATION OF SOILS

Ohio Department of Transportation

(The classification of a soil is found by proceeding from top to bottom of the chart. The first classification that the test data fits is the correct classification.)

SYMBOL	DESCRIPTION	Classification		LL _O /LL × 100*	% Pass #40	% Pass #200	Liquid Limit (LL)	Plastic Index (PI)	Group Index Max.	REMARKS
		AASHTO	OHIO							
	Gravel and/or Stone Fragments	A-1-a			30 Max.	15 Max.		6 Max.	0	Min. of 50% combined gravel, cobble and boulder sizes
	Gravel and/or Stone Fragments with Sand	A-1-b			50 Max.	25 Max.		6 Max.	0	
	Fine Sand	A-3			51 Min.	10 Max.	NON-PLASTIC		0	
	Coarse and Fine Sand	--	A-3a			35 Max.		6 Max.	0	Min. of 50% combined coarse and fine sand sizes
	Gravel and/or Stone Fragments with Sand and Silt	A-2-4				35 Max.	40 Max.	10 Max.	0	
		A-2-5			41 Min.					
	Gravel and/or Stone Fragments with Sand, Silt and Clay	A-2-6				35 Max.	40 Max.	11 Min.	4	
		A-2-7			41 Min.					
	Sandy Silt	A-4	A-4a	76 Min.		36 Min.	40 Max.	10 Max.	8	Less than 50% silt sizes
	Silt	A-4	A-4b	76 Min.		50 Min.	40 Max.	10 Max.	8	50% or more silt sizes
	Elastic Silt and Clay	A-5		76 Min.		36 Min.	41 Min.	10 Max.	12	
	Silt and Clay	A-6	A-6a	76 Min.		36 Min.	40 Max.	11 - 15	10	
	Silty Clay	A-6	A-6b	76 Min.		36 Min.	40 Max.	16 Min.	16	
	Elastic Clay	A-7-5		76 Min.		36 Min.	41 Min.	≤ LL-30	20	
	Clay	A-7-6		76 Min.		36 Min.	41 Min.	> LL-30	20	
	Organic Silt	A-8	A-8a	75 Max.		36 Min.				W/o organics would classify as A-4a or A-4b
	Organic Clay	A-8	A-8b	75 Max.		36 Min.				W/o organics would classify as A-5, A-6a, A-6b, A-7-5 or A-7-6
MATERIAL CLASSIFIED BY VISUAL INSPECTION										
	Sod and Topsoil		Uncontrolled Fill (Describe)		Bouldery Zone		Peat			
	Pavement or Base									

* Only perform the oven-dried liquid limit test and this calculation if organic material is present in the sample.

DESCRIPTION OF SOIL TERMS

The following terminology was used to describe soils throughout this report and is generally adapted from ASTM 2487/2488 and ODOT Specifications for Geotechnical Explorations.

Granular Soils – ODOT A-1, A-2, A-3, A-4 (non-plastic)

The relative compactness of granular soils is described as:

<u>Description</u>	<u>Blows per foot – SPT (N₆₀)</u>		
Very Loose	Below		5
Loose	5	-	10
Medium Dense	11	-	30
Dense	31	-	50
Very Dense	Over		50

Cohesive Soils – ODOT A-4, A-5, A-6, A-7, A-8

The relative consistency of cohesive soils is described as:

<u>Description</u>	<u>Unconfined Compression (tsf)</u>		
Very Soft	Less than		0.25
Soft	0.25	-	0.5
Medium Stiff	0.5	-	1.0
Stiff	1.0	-	2.0
Very Stiff	2.0	-	4.0
Hard	Over		4.0

Gradation - The following size-related denominations are used to describe soils:

<u>Soil Fraction</u>	<u>Size</u>
Boulders	Larger than 12"
Cobbles	12" to 3"
Gravel coarse	3" to ¾"
fine	¾" to 2.0 mm (¾" to #10 Sieve)
Sand coarse	2.0 mm to 0.42 mm (#10 to #40 Sieve)
fine	0.42 mm to 0.074 mm (#40 to #200 Sieve)
Silt	0.074 mm to 0.005 mm (#200 to 0.005 mm)
Clay	Smaller than 0.005 mm

Modifiers of Components - The following modifiers indicate the range of percentages of the minor soil components:

<u>Term</u>	<u>Range</u>		
Trace	0%	-	10%
Little	10%	-	20%
Some	20%	-	35%
And	35%	-	50%

Moisture Table - The following moisture-related denominations are used to describe cohesive soils:

<u>Term</u>	<u>Range - ODOT</u>
Dry	Well below Plastic Limit
Damp	Below Plastic Limit
Moist	Above PL to 3% below LL
Wet	3% below LL to above LL

Organic Content – The following terms are used to describe organic soils:

<u>Term</u>	<u>Organic Content (%)</u>
Slightly organic	2-4
Moderately organic	4-10
Highly organic	>10

Bedrock – The following terms are used to describe the relative strength of bedrock:

<u>Description</u>	<u>Field Parameter</u>
Very Weak	Can be carved with knife and scratched by fingernail. Pieces 1 in. thick can be broken by finger pressure.
Weak	Can be grooved or gouged with knife readily. Small, thin pieces can be broken by finger pressure.
Slightly Strong	Can be grooved or gouged 0.05 in deep with knife. 1 in. size pieces from hard blows of geologist hammer.
Moderately Strong	Can be scratched with knife or pick. 1/4 in. size grooves or gouges from blows of geologist hammer.
Strong	Can be scratched with knife or pick with difficulty. Hard hammer blows to detach hand specimen.
Very Strong	Cannot be scratched by knife or pick. Hard repeated blows of geologist hammer to detach hand specimen.
Extremely Strong	Cannot be scratched by knife or pick. Hard repeated blows of geologist hammer to chip hand specimen.

APPENDIX III

BORING LOGS:

B-001-0-24 TO B-004-0-24

B-001-1-24 TO B-004-1-24

B-012-0-84 TO B-015-0-84

BORING LOGS

Definitions of Abbreviations

AS	=	Auger sample
GI	=	Group index as determined from the Ohio Department of Transportation classification system
HP	=	Unconfined compressive strength as determined by a hand penetrometer (tons per square foot)
LL _o	=	Oven-dried liquid limit as determined by ASTM D4318. Per ASTM D2487, if LL _o /LL is less than 75 percent, soil is classified as "organic".
LOI	=	Percent organic content (by weight) as determined by ASTM D2974 (loss on ignition test)
PID	=	Photo-ionization detector reading (parts per million)
QR	=	Unconfined compressive strength of intact rock core sample as determined by ASTM D2938 (pounds per square inch)
QU	=	Unconfined compressive strength of soil sample as determined by ASTM D2166 (pounds per square foot)
RC	=	Rock core sample
REC	=	Ratio of total length of recovered soil or rock to the total sample length, expressed as a percentage
RQD	=	Rock quality designation – estimate of the degree of jointing or fracture in a rock mass, expressed as a percentage:

$$\frac{\sum \text{segments equal to or longer than 4.0 inches}}{\text{core run length}} \times 100$$

S	=	Sulfate content (parts per million)
SPT	=	Standard penetration test blow counts, per ASTM D1586. Driving resistance recorded in terms of blows per 6-inch interval while letting a 140-pound hammer free fall 30 inches to drive a 2-inch outer diameter (O.D.) split spoon sampler a total of 18 inches. The second and third intervals are added to obtain the number of blows per foot (N _m).
N ₆₀	=	Measured blow counts corrected to an equivalent (60 percent) energy ratio (ER) by the following equation: N ₆₀ = N _m *(ER/60)
SS	=	Split spoon sample
2S	=	For instances of no recovery from standard SS interval, a 2.5 inch O.D. split spoon is driven the full length of the standard SS interval plus an additional 6.0 inches to obtain a representative sample. Only the final 6.0 inches of sample is retained. Blow counts from 2S sampling are not correlated with N ₆₀ values.
3S	=	Same as 2S, but using a 3.0 inch O.D. split spoon sampler.
TR	=	Top of rock
W	=	Initial water level measured during drilling
▽	=	Water level measured at completion of drilling

Classification Test Data

Gradation (as defined on Description of Soil Terms):

GR	=	% Gravel
SA	=	% Sand
SI	=	% Silt
CL	=	% Clay

Atterberg Limits:

LL	=	Liquid limit
PL	=	Plastic limit
PI	=	Plasticity Index
WC	=	Water content (%)

	PROJECT: MOT-835-2.57	DRILLING FIRM / OPERATOR: RII / TG	DRILL RIG: DIEDRICH D-50 (# 313)	STATION / OFFSET: 134+83 / 30' RT.	EXPLORATION ID B-001-0-24
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / BG	HAMMER: AUTOMATIC	ALIGNMENT: CL SR 835	
	PID: 116922 SFN: NA	DRILLING METHOD: 4.5" CFA	CALIBRATION DATE: 3/21/22	ELEVATION: 883.0 (MSL) EOB: 11.8 ft.	PAGE 1 OF 1
	START: 1/4/24 END: 1/4/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 86.4	LAT / LONG: 39.717205, -84.108170	

MATERIAL DESCRIPTION AND NOTES	ELEV. 883.0	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			ODOT CLASS (GI)	BACK FILL	
								GR	CS	FS	SI	CL	LL	PL	PI			WC
1.3' - ASPHALT (15.5")	881.7	1																
VERY STIFF, BROWN SILT AND CLAY , LITTLE GRAVEL AND SAND, MOIST.	880.2	2	4	3	13	78	SS-1	3.00	-	-	-	-	-	-	-	-	13	A-6a (V)
DENSE TO MEDIUM DENSE, BROWN GRAVEL WITH SAND, SILT, AND CLAY , DAMP.		3	13	15	33	39	SS-2	-	-	-	-	-	-	-	-	-	9	A-2-6 (V)
		4	8	12	36	100	SS-3	-	26	27	15	18	14	25	14	11	9	A-2-6 (0)
		5	13	8	36	100	SS-3	-	26	27	15	18	14	25	14	11	9	A-2-6 (0)
	875.7	6	13	8	17	56	SS-4	-	39	18	13	18	12	-	-	-	9	A-2-6 (V)
STIFF, BROWN SILTY CLAY , LITTLE FINE TO COARSE SAND, LITTLE GRAVEL, DAMP TO MOIST.	874.2	7	11	9	30	100	SS-5	1.25	17	17	16	25	25	36	15	21	16	A-6b (7)
VERY STIFF, BROWN SILT AND CLAY , "AND" COARSE TO FINE SAND, TRACE TO LITTLE FINE GRAVEL, MOIST.	872.7	8	6	6	20	78	SS-6	2.50	9	13	22	35	21	28	15	13	16	A-6a (5)
VERY STIFF, BROWN TO GRAY CLAY , SOME SILT, TRACE SAND, VERY MOIST.	871.2	9	5	8	22	89	SS-7	2.25	-	-	-	-	-	-	-	-	38	A-7-6 (V)
		10	8	6	20	78	SS-6	2.50	9	13	22	35	21	28	15	13	16	A-6a (5)
		11	5	8	22	89	SS-7	2.25	-	-	-	-	-	-	-	-	38	A-7-6 (V)
		EOB	7	8	22	89	SS-7	2.25	-	-	-	-	-	-	-	-	38	A-7-6 (V)

000-23 RII STA ODOT BORING LOG (8.5X11) - OH DOT.GDT - 9/17/25 14:57 - C:\USERS\KAYLEEWIDESTOP\W-23-155.GPJ

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING
 ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 12.5 LBS. BENTONITE CHIPS AND SOIL CUTTINGS. PAVEMENT PATCHED WITH COLD PATCH ASPHALT .

	PROJECT: MOT-835-2.57	DRILLING FIRM / OPERATOR: RII / TG	DRILL RIG: DIEDRICH D-50 (# 313)	STATION / OFFSET: 135+96 / 54' LT.	EXPLORATION ID B-002-0-24
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / BG	HAMMER: AUTOMATIC	ALIGNMENT: CL SR 835	
	PID: 116922 SFN: NA	DRILLING METHOD: 4.5" CFA	CALIBRATION DATE: 3/21/22	ELEVATION: 872.0 (MSL) EOB: 7.0 ft.	PAGE 1 OF 1
	START: 1/4/24 END: 1/4/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 86.4	LAT / LONG: 39.717410, -84.107744	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	BACK FILL
								GR	CS	FS	SI	CL	LL	PL	PI			
MEDIUM DENSE, BROWN TO GRAY GRAVEL WITH SAND, LITTLE SILT, TRACE CLAY, MOIST.	872.0		6															
		1	8	27	0	SS-1	-	-	-	-	-	-	-	-	-	-		
	870.0	2	9	-	100	2S-1A	-	42	23	16	14	5	NP	NP	NP	8	A-1-b (0)	
MEDIUM DENSE TO DENSE, BROWN GRAVEL, SOME SAND, TRACE SILT, TRACE CLAY, WET.		3	7	22	0	SS-2	-	-	-	-	-	-	-	-	-	-		
		4	10	-	50	2S-2A	-	67	15	8	-	10	-	-	-	11	A-1-a (V)	
		5	7	11	36	64	SS-3	-	50	25	12	9	4	NP	NP	NP	11	A-1-a (0)
		6	15	14	39	100	SS-4	-	52	26	11	8	3	NP	NP	NP	9	A-1-a (0)
	865.0	7	14	13														

000-23 RII STA ODOT BORING LOG (8.5X11) - OH DOT.GDT - 9/17/25 14:57 - C:\USERS\KAYLEE\DESKTOP\W-23-155.GPJ

NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 3.5' AND UPON COMPLETION @2.0'
 ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 12.5 LBS. BENTONITE CHIPS AND SOIL CUTTINGS .

	PROJECT: MOT-835-2.57	DRILLING FIRM / OPERATOR: RII / TG	DRILL RIG: DIEDRICH D-50 (# 313)	STATION / OFFSET: 136+29 / 5' RT.	EXPLORATION ID B-003-0-24
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / BG	HAMMER: AUTOMATIC	ALIGNMENT: CL SR 835	
	PID: 116922 SFN: NA	DRILLING METHOD: 4.5" CFA	CALIBRATION DATE: 3/21/22	ELEVATION: 872.9 (MSL) EOB: 6.0 ft.	PAGE 1 OF 1
	START: 1/4/24 END: 1/4/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 86.4	LAT / LONG: 39.717116, -84.107658	

MATERIAL DESCRIPTION AND NOTES	ELEV. 872.9	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	BACK FILL
								GR	CS	FS	SI	CL	LL	PL	PI			
MEDIUM DENSE, DARK BROWN SILT, SOME COARSE TO FINE SAND, LITTLE CLAY, TRACE FINE GRAVEL, WET. -TRACE ORGANICS IN SS-1	871.4	1	1 3	13	50	SS-1	-	7	7	16	55	15	NP	NP	NP	37	A-4b (7)	<< < > >>
MEDIUM DENSE, DARK BROWN GRAVEL WITH SAND, LITTLE SILT, MOIST. -TRACE ORGANICS IN SS-2	869.9	2 3	2 4	17	50	SS-2	-	55	10	10	19	6	-	-	-	11	A-1-b (V)	<< < > >>
MEDIUM DENSE, BROWN TO GRAY GRAVEL, SOME TO LITTLE COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, WET.	866.9	4 5	3 8	22	33	SS-3	-	64	17	9	7	3	-	-	-	15	A-1-a (V)	<< < > >>
	866.9	6	11 8	22	75	SS-4	-	72	10	8	8	2	NP	NP	NP	13	A-1-a (0)	<< < > >>
		EOB																

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NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 3.0' AND UPON COMPLETION @2.5'
 ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 12.5 LBS. BENTONITE CHIPS AND SOIL CUTTINGS .

	PROJECT: MOT-835-2.57	DRILLING FIRM / OPERATOR: RII / TG	DRILL RIG: DIETRICH D-50 (# 313)	STATION / OFFSET: 137+55 / 30' LT.	EXPLORATION ID B-004-0-24
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / BG	HAMMER: AUTOMATIC	ALIGNMENT: CL SR 835	
	PID: 116922 SFN: NA	DRILLING METHOD: 4.5" CFA	CALIBRATION DATE: 3/21/22	ELEVATION: 882.4 (MSL) EOB: 11.3 ft.	PAGE 1 OF 1
	START: 1/4/24 END: 1/4/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 86.4	LAT / LONG: 39.717307, -84.107189	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTH	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	BACK FILL
								GR	CS	FS	SI	CL	LL	PL	PI			
1.3' - ASPHALT (15.0")	882.4																	
FILL: VERY STIFF, BROWN SANDY SILT, LITTLE FINE GRAVEL, LITTLE CLAY, MOIST.	881.1	1	5															
		2	7	20	83	SS-1	3.25	-	-	-	-	-	-	-	20	A-4a (V)		
		3	6															
-TRACE BRICKS IN SS-2		4	5	17	61	SS-2	3.75	-	-	-	-	-	-	-	18	A-4a (V)		
	877.6				100	ST-3	2.00	-	-	-	-	-	-	-	11	A-4a (V)		
MEDIUM DENSE, BROWN GRAVEL WITH SAND, LITTLE SILT, TRACE CLAY, MOIST.	876.6	5	7			SS-4A	-	26	31	18	17	8	NP	NP	NP	8	A-1-b (0)	
MEDIUM DENSE, BLACK SANDY SILT, SOME FINE GRAVEL, LITTLE CLAY, MOIST.	876.1	6	6			SS-4B	-	24	19	20	26	11	NP	NP	NP	14	A-4a (0)	
-TRACE ORGANICS IN SS-4B		7	4	24	44	SS-5	3.50	23	26	13	26	12	27	15	12	9	A-6a (1)	
VERY STIFF, BROWN SILT AND CLAY, AND COARSE TO FINE SAND, SOME FINE GRAVEL, DAMP.	874.6	8	8															
		9	8	22	78	SS-6	-	25	26	15	23	11	29	16	13	14	A-2-6 (1)	
MEDIUM DENSE, BLACK TO BROWN GRAVEL WITH SAND, SILT, AND CLAY, MOIST.	871.9	10	5															
-TRACE ASPHALT IN SS-4B - SS-7B		11	7	23	0	SS-7	-	-	-	-	-	-	-	-	-	-		
STIFF, BLACK SANDY SILT, LITTLE FINE GRAVEL, TRACE CLAY, MOIST.	871.1	EOB	10	-	83	2S-7A	1.50	13	14	26	38	9	NP	NP	NP	12	A-4a (V)	

000-23 RII STA ODOT BORING LOG (8.5X11) - OH DOT.GDT - 9/17/25 14:57 - C:\USERS\KAYLE\DESKTOP\PIW-23-155.GPJ

NOTES: GROUNDWATER NOT ENCOUNTERED ABOVE THE DEPTH WHERE MUD WAS ADDED TO BOREHOLE. GROUNDWATER WAS NOT RECORDED AFTER MUD WAS ADDED TO BOREHOLE.
 ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 12.5 LBS. BENTONITE CHIPS AND SOIL CUTTINGS. PAVEMENT PATCHED WITH COLD PATCH ASPHALT .

	PROJECT: MOT-835-2.57	DRILLING FIRM / OPERATOR: RII / SB	DRILL RIG: MOBLE B57 (2015023)	STATION / OFFSET: 134+91 / 25' RT.	EXPLORATION ID B-001-1-24
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / DB	HAMMER: AUTOMATIC	ALIGNMENT: CL SR 835	
	PID: 116922 SFN: NA	DRILLING METHOD: 4.5" CFA	CALIBRATION DATE: 8/21/23	ELEVATION: 882.7 (MSL) EOB: 109.2 ft.	PAGE 1 OF 4
	START: 11/6/24 END: 11/8/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.4	LAT / LONG: 39.717220, -84.108139	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG				HOLE SEALED		
								GR	CS	FS	SI	CL	LL	PL	PI	WC		ODOT CLASS (GI)	
1.5' - ASPHALT (18.0")	882.7																		
0.5' - AGGREGATE BASE (6.0")	881.2	1																	
VERY STIFF, BROWN SILT AND CLAY , LITTLE FINE GRAVEL, TRACE COARSE TO FINE SAND, MOIST.	880.7	2	5	4	13	83	SS-1	3.75	-	-	-	-	-	-	-	-	-	18	A-6a (V)
		3		6															
		4	6	6	16	78	SS-2	2.50	-	-	-	-	-	-	-	-	-	15	A-6a (V)
		5																	
		6	13	6	12	39	SS-3	-	-	-	-	-	-	-	-	-	-	13	A-6a (V)
		7																	
STIFF TO VERY STIFF, BROWN SILTY CLAY , TRACE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST. -SWITCHED TO MUD ROTARY DRILLING @ 10.0'	874.7	8																	
		9	5	4	11	100	SS-4	-	-	-	-	-	-	-	-	-	-	23	A-6b (V)
	872.2	10																	
MEDIUM DENSE, BROWN TO BLACK TO RED GRAVEL , LITTLE COARSE TO FINE SAND, TRACE SILT, WET.	869.7	11	1	6	16	44	SS-5	-	-	-	-	-	-	-	-	-	-	16	A-1-a (V)
		12																	
VERY STIFF, BROWN SILTY CLAY , TRACE FINE GRAVEL, TRACE COARSE TO FINE SAND, MOIST.	864.7	13																	
		14	2	3	16	33	SS-6	3.50	-	-	-	-	-	-	-	-	-	12	A-6a (V)
		15																	
		16	4	5	16	67	SS-7	3.50	-	-	-	-	-	-	-	-	-	11	A-6a (V)
	864.7	17																	
DENSE, LIGHT BROWN TO BROWN GRAVEL WITH SAND , LITTLE SILT, TRACE CLAY, MOIST.		18																	
		19	5	14	46	61	SS-8	-	-	-	-	-	-	-	-	-	-	13	A-1-b (V)
		20																	
		21																	
		22	7	16	42	44	SS-9	-	46	22	11	16	5	-	-	-	-	14	A-1-b (V)
		23																	
		24	6	17	47	39	SS-10	-	-	-	-	-	-	-	-	-	-	11	A-1-b (V)
		25																	
		26																	
		27	7	16	38	50	SS-11	-	-	-	-	-	-	-	-	-	-	10	A-1-b (V)
	854.7	28																	
MEDIUM DENSE TO DENSE, GRAY SILT , SOME FINE SAND, TRACE CLAY, MOIST TO WET.		29	10	14	42	50	SS-12	-	-	-	-	-	-	-	-	-	-	21	A-4b (V)

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MATERIAL DESCRIPTION AND NOTES	ELEV. 820.6	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED			
								GR	CS	FS	SI	CL	LL	PL	PI						
MEDIUM DENSE, GRAY SILT, SOME FINE SAND, TRACE CLAY, MOIST. (continued)	+++++	63	10	21	92	SS-19	-	-	-	-	-	-	-	-	21	A-4b (V)	[Pattern]				
		64	9															7			
		65																			
		66																			
		67																			
		68	6	28	89	SS-20	-	-	-	-	-	-	-	-	-	18		A-4b (V)	[Pattern]		
		69	8																	13	
		70																			
		71																			
		72																			
VERY STIFF, GRAY SILT AND CLAY, TRACE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST.	[Pattern]	811.7																			
		73	5	32	100	SS-21	3.50	-	-	-	-	-	-	-	-	18	A-6a (V)	[Pattern]			
		74	9																	15	
		75																			
		76																			
		77																			
		78	4	19	100	SS-22	2.50	-	-	-	-	-	-	-	-	20	A-6a (V)		[Pattern]		
		79	6																	8	
		80																			
		81																			
82																					
MEDIUM DENSE TO VERY DENSE, GRAY SILT, TRACE CLAY, TRACE COARSE TO FINE SAND, WET.	+++++	801.7																			
		83	8	21	100	SS-23	-	-	-	-	-	-	-	-	26	A-4b (V)	[Pattern]				
		84	8															8			
		85																			
		86																			
		87																			
		88	18	43	100	SS-24	-	-	-	-	-	-	-	-	-	21		A-4b (V)	[Pattern]		
		89	19																	13	
		90																			
		91																			
92																					
93	14	56	78	SS-25	-	-	-	-	-	-	-	-	-	24	A-4b (V)	[Pattern]					
94	20																22				

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MATERIAL DESCRIPTION AND NOTES	ELEV. 788.4	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI			
MEDIUM DENSE TO VERY DENSE, GRAY SILT, TRACE CLAY, TRACE COARSE TO FINE SAND, WET. (continued)		95																
		96																
		97																
		98		25														
		99		36 27	84	100	SS-26	-	0	0	1	90	9	NP	NP	NP	25	A-4b (8)
		100																
		101																
		102																
		103		9														
		104		14 27	55	100	SS-27	-	-	-	-	-	-	-	-	-	24	A-4b (V)
	105																	
	106																	
	107																	
	108		5															
	109		9	24	100	SS-28	-	-	-	-	-	-	-	-	-	22	A-4b (V)	
	773.5	EOB																

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NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 8.5' BUT COULD NOT BE DETERMINED UPON COMPLETION DUE TO ADDITION OF MUD TO BOREHOLE.
 ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LB. CEMENT / 50 LB. BENTONITE POWDER / 80 GAL WATER. PAVEMENT PATCHED WITH CONCRETE.

	PROJECT: MOT-835-2.57	DRILLING FIRM / OPERATOR: RII / IS	DRILL RIG: DIEDRICH D-50 (# 313)	STATION / OFFSET: 136+08 / 55' LT.	EXPLORATION ID B-002-1-24
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / DB	HAMMER: AUTOMATIC	ALIGNMENT: CL SR 835	
	PID: 116922 SFN: NA	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/21/22	ELEVATION: 871.5 (MSL) EOB: 110.0 ft.	PAGE 1 OF 4
	START: 12/13/24 END: 12/13/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 86.4	LAT / LONG: 39.717411, -84.107702	

MATERIAL DESCRIPTION AND NOTES	ELEV. 871.5	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG				HOLE SEALED		
								GR	CS	FS	SI	CL	LL	PL	PI	WC		ODOT CLASS (GI)	
1.0' - TOPSOIL (12.0")	870.5	1	5																
DENSE, GRAYISH BROWN GRAVEL WITH SAND , TRACE SILT, WET.	868.0	2	9 6	22	72	SS-1A	-	-	-	-	-	-	-	-	-	16	A-1-b (V)		
		3																	
		4	11 10 13	33	61	SS-2	-	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
HARD, BROWNISH GRAY SANDY SILT , SOME CLAY, LITTLE FINE GRAVEL, MOIST.	863.5	5																	
		6	11 20 18	55	50	SS-3	-	-	-	-	-	-	-	-	-	10	A-1-b (V)		
		7																	
DENSE TO VERY DENSE, BROWN GRAVEL WITH SAND , TRACE SILT, TRACE CLAY, WET.	858.5	8																	
		9	6 7 9	23	56	SS-4	4.50	13	14	22	30	21	14	6	8	9	A-4a (3)		
		10																	
-2.0' HEAVING SANDS @ 16.0'; WATER ADDED TO BOREHOLE	851.0	11	5 6 17	33	67	SS-5	4.50	-	-	-	-	-	-	-	-	10	A-4a (V)		
		12																	
		13																	
HARD, BROWNISH GRAY SILT AND CLAY , TRACE COARSE TO FINE SAND, DAMP TO MOIST.	845.5	14	9 13 23	52	56	SS-6	-	-	-	-	-	-	-	-	-	12	A-1-b (V)		
		15																	
		16	14 18 17	50	100	SS-7	-	48	22	19	8	3	NP	NP	NP	11	A-1-b (0)		
VERY STIFF TO HARD, BROWNISH GRAY SILTY CLAY , LITTLE COARSE TO FINE SAND, LITTLE GRAVEL, MOIST.	845.5	17																	
		18	10 11 13	35	56	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-b (V)		
		19																	
-SWITCHED TO MUD ROTARY DRILLING @ 28.5'	845.5	20																	
		21	7 9 25	49	67	SS-9	-	0	1	1	46	52	31	16	15	18	A-6a (10)		
		22																	
	845.5	23																	
		24	10 12 11	33	17	SS-10	-	-	-	-	-	-	-	-	-	14	A-6a (V)		
		25	14	-	100	2S-10A	-	-	-	-	-	-	-	-	-	10	A-6a (V)		
	845.5	26																	
		27	10 13 12	36	39	SS-11	4.50	-	-	-	-	-	-	-	-	13	A-6b (V)		
		28																	
	845.5	29	5 9 10	27	42	SS-12	3.50	12	4	6	35	43	31	15	16	18	A-6b (10)		
		30																	

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MATERIAL DESCRIPTION AND NOTES	ELEV. 841.5	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI			
VERY STIFF TO HARD, BROWNISH GRAY SILTY CLAY , LITTLE COARSE TO FINE SAND, LITTLE GRAVEL, MOIST. <i>(continued)</i>	841.5	31																
		32																
		33																
		34	3	5	26	0	SS-13	-	-	-	-	-	-	-	-	-	-	
MEDIUM DENSE TO DENSE, BROWNISH GRAY SILT , SOME CLAY, TRACE SAND, MOIST.	834.5	35	14	13	-	100	2S-13A	-	-	-	-	-	-	-	-	-	18	A-6b (V)
		36																
		37																
		38																
		39	9	6	20	67	SS-14	-	-	-	-	-	-	-	-	-	19	A-4b (V)
		40		8														
		41																
		42																
		43																
		44	10	11	35	78	SS-15	-	0	0	0	78	22	NP	NP	NP	22	A-4b (8)
STIFF TO VERY STIFF, BROWNISH GRAY SILT AND CLAY , TRACE COARSE AND FINE SAND, TRACE FINE GRAVEL, MOIST.	819.8	45																
		46																
		47																
		48																
		49	8	9	27	78	SS-16	-	-	-	-	-	-	-	-	-	20	A-4b (V)
		50		10														
		51																
52																		
53																		
54	5	6	20	94	SS-17	2.50	-	-	-	-	-	-	-	-	-	18	A-6a (V)	
55		8																
56																		
57																		
58																		
59	6	9	30	44	SS-18	2.50	-	-	-	-	-	-	-	-	-	26	A-6a (V)	
60		12																
61																		

000-23 RII STA. ODOT BORING LOG (8.5X11) - OH DOT.GDT - 9/17/25 14:33 - C:\USERS\KAYLEE\DESKTOP\PIW-23-155.GPJ

MATERIAL DESCRIPTION AND NOTES	ELEV. 809.4	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI			
STIFF TO VERY STIFF, BROWNISH GRAY SILT AND CLAY, TRACE COARSE AND FINE SAND, TRACE FINE GRAVEL, MOIST. (continued)		63																
		64	7	24	100	SS-19	3.00	1	1	1	48	49	31	16	15	20	A-6a (10)	
		65																
		66																
		67																
		68																
MEDIUM DENSE TO VERY DENSE, BROWNISH GRAY SILT, SOME TO LITTLE CLAY, TRACE COARSE TO FINE SAND, MOIST TO WET.		69	6	27	100	SS-20	2.50	-	-	-	-	-	-	-	-	22	A-6a (V)	
		70	8	11														
		71																
		72																
		73																
		74	6	23	100	SS-21	1.50	-	-	-	-	-	-	-	-	22	A-6a (V)	
		75	7	9														
		76																
		77																
		78																
		79	10	29	100	SS-22	-	-	-	-	-	-	-	-	-	24	A-4b (V)	
		80	8	12														
	81																	
	82																	
	83																	
	84	5	17	100	SS-23	-	-	-	-	-	-	-	-	-	19	A-4b (V)		
	85	5	7															
	86																	
	87																	
	88																	
	89	7	30	100	SS-24	-	1	3	6	68	22	NP	NP	NP	23	A-4b (8)		
	90	8	13															
	91																	
	92																	
	93																	
	94		16															

000-23 RII STA ODOT BORING LOG (8.5X11) - OH DOT.GDT - 9/17/25 14:33 - C:\USERS\KAYLEEW\Desktop\PIW-23-155.GPJ

000-23 RII STA. ODOT BORING LOG (8.5X11) - OH DOT.GDT - 9/17/25 14:33 - C:\USERS\KAYLEE\DESKTOP\PIW-23-155.GPJ

PID: 116922 | SFN: NA | PROJECT: MOT-835-2.57 | STATION / OFFSET: 13608, 55' LT. | START: 12/13/24 | END: 12/13/24 | PG 4 OF 4 | B-002-1-24

MATERIAL DESCRIPTION AND NOTES	ELEV. 777.2	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED	
								GR	CS	FS	SI	CL	LL	PL	PI				
MEDIUM DENSE TO VERY DENSE, BROWNISH GRAY SILT, SOME TO LITTLE CLAY, TRACE COARSE TO FINE SAND, MOIST TO WET. (continued)		95	18 16	49	100	SS-25	-	-	-	-	-	-	-	-	-	24	A-4b (V)		
		96																	
		97																	
		98																	
		99		14 26 35	88	61	SS-26	-	-	-	-	-	-	-	-	24	A-4b (V)		
		100																	
		101																	
		102																	
		103																	
		104		13 16 16	46	61	SS-27	-	0	0	0	82	18	NP	NP	NP	26		A-4b (8)
		105																	
	106																		
	107																		
	108																		
	109		15 21 24	65	56	SS-28	-	-	-	-	-	-	-	-	-	23	A-4b (V)		
	761.5	EOB																	

NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 3.5' BUT COULD NOT BE DETERMINED UPON COMPLETION DUE TO ADDITION OF MUD TO BOREHOLE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH BENTONITE CHIPS. PUMPED WITH 94LBS. OF CEMENT/ 25LBS. BENTONITE POWDER/ 40 GAL. WATER.

	PROJECT: MOT-835-2.57	DRILLING FIRM / OPERATOR: RII / IS	DRILL RIG: DIEDRICH D-50 (# 313)	STATION / OFFSET: 136+35 / 49' RT.	EXPLORATION ID B-003-1-24
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / DB	HAMMER: AUTOMATIC	ALIGNMENT: CL SR 835	
	PID: 116922 SFN: NA	DRILLING METHOD: 4.5" CFA	CALIBRATION DATE: 3/21/22	ELEVATION: 872.3 (MSL) EOB: 110.0 ft.	PAGE 1 OF 4
	START: 12/9/24 END: 12/13/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 86.4	LAT / LONG: 39.717121, -84.107637	

MATERIAL DESCRIPTION AND NOTES	ELEV. 872.3	DEPTH	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG				HOLE SEALED		
								GR	CS	FS	SI	CL	LL	PL	PI	WC		ODOT CLASS (GI)	
0.3' - TOPSOIL (3.0") DENSE, BROWN GRAVEL WITH SAND, SILT, AND CLAY, MOIST. -COBBLE ENCOUNTERED @ 3.0'	872.0	1																	
		2	7																
		3	8	36	17	SS-1	-	-	-	-	-	-	-	-	-	-	4	A-2-6 (V)	
	868.8	4	14	-	100	2S-1A	-	-	-	-	-	-	-	-	-	-	12	A-2-6 (V)	
MEDIUM DENSE, BROWN SANDY SILT, TRACE FINE GRAVEL, MOIST. -SWITCHED TO MUD ROTARY @ 5.0'	866.8	5	7	9	23	67	SS-2	-	-	-	-	-	-	-	-	-	19	A-4a (V)	
	866.8	6	18	28	50	112	83	SS-3	-	-	-	-	-	-	-	-	8	A-1-a (V)	
MEDIUM DENSE TO VERY DENSE, BROWN GRAVEL, SOME FINE TO COARSE SAND, TRACE SILT, TRACE CLAY, MOIST.		7	13	32	17	71	61	SS-4	-	62	20	8	7	3	NP	NP	NP	8	A-1-a (0)
		8																	
		9	7	8	23	44	SS-5	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	
		10																	
		11	8	13	12	36	0	SS-6	-	-	-	-	-	-	-	-	-	-	-
	856.6	12	14	-	100	2S-6A	-	-	-	-	-	-	-	-	-	-	12	A-1-a (V)	
HARD, BROWN SILT AND CLAY, LITTLE COARSE TO FINE SAND, LITTLE FINE GRAVEL, MOIST.		13																	
		14	11	6	19	39	SS-7	4.50	-	-	-	-	-	-	-	-	10	A-6a (V)	
	854.3	15																	
DENSE TO VERY DENSE, BROWNISH GRAY GRAVEL, SOME FINE TO COARSE SAND, TRACE SILT, TRACE CLAY, MOIST.		16	8	11	9	29	44	SS-8	-	-	-	-	-	-	-	-	11	A-1-a (V)	
		17																	
		18	7	10	9	27	39	SS-9	-	61	22	10	5	2	NP	NP	NP	10	A-1-a (0)
		19																	
		20	5	10	14	35	50	SS-10	-	-	-	-	-	-	-	-	13	A-1-a (V)	
		21																	
		22	8	12	15	39	53	SS-11	-	-	-	-	-	-	-	-	13	A-1-a (V)	
		23																	
		24	9	14	19	48	61	SS-12	-	-	-	-	-	-	-	-	14	A-1-a (V)	
		25																	

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MATERIAL DESCRIPTION AND NOTES	ELEV. 842.3	DEPTHS	SPT/RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI			
VERY STIFF TO HARD, BROWN SILT AND CLAY, TRACE COARSE TO FINE SAND, TRACE FINE GRAVEL, DAMP TO MOIST.	840.6	31																
		32																
		33																
		34		11 10 14	35	39	SS-13	2.75	-	-	-	-	-	-	-	19	A-6a (V)	
		35																
		36																
		37																
		38																
		39		11 15 22	53	72	SS-14	4.50	4	3	6	48	39	29	15	14	17	A-6a (10)
		40																
		41																
		42																
		43																
		44		9 12 15	39	100	SS-15	4.50	-	-	-	-	-	-	-	19	A-6a (V)	
		45																
	46																	
	47																	
	48																	
	49		10 13 16	42	100	SS-16	4.50	-	-	-	-	-	-	-	17	A-6a (V)		
	50																	
	51																	
	52																	
	53																	
	54		6 11 16	39	100	SS-17	4.50	-	-	-	-	-	-	-	18	A-6a (V)		
	55																	
	56																	
	57																	
	58																	
	59		6 10 16	37	100	SS-18	4.50	3	2	5	45	45	30	16	14	16	A-6a (10)	
	60																	
	61																	

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MATERIAL DESCRIPTION AND NOTES	ELEV. 778.0	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED		
								GR	CS	FS	SI	CL	LL	PL	PI					
MEDIUM DENSE TO VERY DENSE, BROWNISH GRAY SILT, SOME CLAY, TRACE COARSE TO FINE SAND, MOIST. (continued)	775.6	95	7 8	22	100	SS-25	-	-	-	-	-	-	-	-	-	-	24	A-4b (V)		
STIFF TO VERY STIFF, BROWNISH GRAY SILT AND CLAY, TRACE COARSE TO FINE SAND, MOIST.		96																		
	762.3	97																		
		98																		
		99	16 15 21	52	100	SS-26	1.50	-	-	-	-	-	-	-	-	-	22	A-6a (V)		
		100																		
		101																		
		102																		
		103																		
		104	8 9 13	32	100	SS-27	2.50	0	0	1	58	41	25	14	11	21	A-6a (8)			
		105																		
		106																		
		107																		
		108																		
		109	6 7 10	24	100	SS-28	2.00	-	-	-	-	-	-	-	-	-	24	A-6a (V)		
		110																		

EOB

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NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 3.0' BUT COULD NOT BE DETERMINED UPON COMPLETION DUE TO ADDITION OF MUD TO BOREHOLE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LB. CEMENT / 50 LB. BENTONITE POWDER / 80 GAL WATER. PAVEMENT PATCHED WITH CONCRETE.

	PROJECT: MOT-835-2.57	DRILLING FIRM / OPERATOR: RII / SB/IS	DRILL RIG: MOBLE B57 (2015023)	STATION / OFFSET: 137+48 / 31' LT.	EXPLORATION ID B-004-1-24
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / DB	HAMMER: AUTOMATIC	ALIGNMENT: CL SR 835	
	PID: 116922 SFN: NA	DRILLING METHOD: 4.5" CFA	CALIBRATION DATE: 8/21/23	ELEVATION: 882.1 (MSL) EOB: 109.2 ft.	PAGE 1 OF 4
	START: 11/4/24 END: 11/6/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.4	LAT / LONG: 39.717313, -84.107214	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTH	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED	
								GR	CS	FS	SI	CL	LL	PL	PI				
1.0' - ASPHALT (12.0")	881.1	1																	
AGGREGATE BASE (6.0")	880.6	2	4	6	17	72	SS-1	4.5+	-	-	-	-	-	-	-	-	15	A-6a (V)	
STIFF TO HARD, BROWN TO DARK BROWN SILT AND CLAY , LITTLE COARSE FINE SAND, LITTLE FINE GRAVEL, MOIST.	880.6	3		7															
		4	2	5	19	83	SS-2	1.50	-	-	-	-	-	-	-	-	15	A-6a (V)	
		5		9															
		6	7	9	29	100	SS-3	1.25	-	-	-	-	-	-	-	-	13	A-6a (V)	
MEDIUM DENSE TO DENSE, LIGHT BROWN GRAVEL WITH SAND , LITTLE SILT, TRACE CLAY, WET. -MUD ROTARY DRILLING STARTED @ 11.5'	872.1	7		13															
		8																	
		9	3	2	8	28	SS-4	1.00	-	-	-	-	-	-	-	-	17	A-6a (V)	
		10	10		-	100	2S-4A	-	-	-	-	-	-	-	-	-	17	A-4a (V)	
		11																	
		12	7	15	44	50	SS-5	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		13		18															
		14	6	15	39	44	SS-6	-	31	30	23	11	5	NP	NP	NP	14	A-1-b (0)	
		15		14															
		16	2	10	32	22	SS-7	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
17		14																	
18	13		-	0	2S-7A	-	-	-	-	-	-	-	-	-	-	-	-		
19	8	10	36	44	SS-8	-	-	-	-	-	-	-	-	-	10	A-1-b (V)			
20		17																	
VERY LOOSE, BROWN TO LIGHT BROWN GRAVEL , TRACE COARSE TO FINE SAND, TRACE SILT, WET.	861.6	21																	
		22	1	0	0	0	SS-9	-	-	-	-	-	-	-	-	-	-	-	
		23	3		-	100	SS-9A	-	90	8	1	-	-	-	-	-	15	A-1-a (V)	
		24	3	14	44	50	SS-10	-	-	-	-	-	-	-	-	-	14	A-1-a (V)	
25		19																	
26																			
27																			
28																			
VERY DENSE, BROWN SANDY SILT , WET.	854.1	29	10	18	51	67	SS-11	-	-	-	-	-	-	-	-	-	25	A-4a (V)	
				20															

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MATERIAL DESCRIPTION AND NOTES	ELEV. 852.1	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI			
VERY DENSE, BROWN SANDY SILT , WET. (continued)	851.1	31																
DENSE, LIGHT BROWN SILT , SOME FINE SAND, MOIST.		32																
		33	16	43	67	SS-12	-	-	-	-	-	-	-	-	20	A-4b (V)		
		34	14 18															
		35																
		36																
		37																
		38	8	34	72	SS-13	-	-	-	-	-	-	-	-	21	A-4b (V)		
		39	10 15															
		40																
		41																
		42																
		43	11	48	78	SS-14	-	-	-	-	-	-	-	-	21	A-4b (V)		
	44	17 19																
	45																	
	836.1																	
VERY STIFF, LIGHT BROWN SILTY CLAY , TRACE FINE SAND, MOIST.	836.1	46																
		47																
		48	3	15	100	SS-15	3.00	-	-	-	-	-	-	-	20	A-6a (V)		
		49	5 6															
		50																
		51																
		52																
		53	3	27	83	SS-16	3.25	-	-	-	-	-	-	-	20	A-6a (V)		
		54	7 13															
		55																
	56																	
	57																	
	58	5	23	89	SS-17	3.50	-	-	-	-	-	-	-	19	A-6a (V)			
	59	8 9																
	60																	
	61																	

000-23 RII STA ODOT BORING LOG (8.5X11) - OH DOT.GDT - 9/17/25 14:33 - C:\USERS\KAYLEE\DESKTOP\PIW-23-155.GPJ

000-23 RII STA. ODOT BORING LOG (8.5X11) - OH DOT.GDT - 9/17/25 14:33 - C:\USERS\KAYLEE\DESKTOP\PIW-23-155.GPJ

PID: 116922		SFN: NA		PROJECT: MOT-835-2.57		STATION / OFFSET: 13748, 31' LT.		START: 11/4/24		END: 11/6/24		PG 3 OF 4		B-004-1-24								
MATERIAL DESCRIPTION AND NOTES			ELEV. 820.0	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED		
										GR	CS	FS	SI	CL	LL	PL	PI					
VERY STIFF, LIGHT BROWN SILTY CLAY, TRACE FINE SAND, MOIST. (continued)			811.1	63	4	21	100	SS-18	3.00	-	-	-	-	-	-	-	-	20	A-6a (V)			
				64	7															9		
				65																		
				66																		
STIFF TO VERY STIFF, BROWN SILTY CLAY, LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST.			796.1	67																		
				68	4	27	100	SS-19	3.50	-	-	-	-	-	-	-	-	-	18	A-6a (V)		
				69	9																11	
				70																		
MEDIUM DENSE TO VERY DENSE, LIGHT BROWN SANDY SILT, TRACE CLAY, MOIST.			796.1	71																		
				72																		
				73	3	24	100	SS-20	2.75	2	4	6	40	48	31	15	16	19	A-6b (10)			
				74	8															10		
75																						
76																						
MEDIUM DENSE TO VERY DENSE, LIGHT BROWN SANDY SILT, TRACE CLAY, MOIST.			796.1	77																		
				78	3	17	100	SS-21	1.75	-	-	-	-	-	-	-	-	22	A-6b (V)			
				79	6															7		
				80																		
81																						
MEDIUM DENSE TO VERY DENSE, LIGHT BROWN SANDY SILT, TRACE CLAY, MOIST.			796.1	82																		
				83	6	34	100	SS-22	3.50	-	-	-	-	-	-	-	-	22	A-6b (V)			
				84	13															12		
				85																		
MEDIUM DENSE TO VERY DENSE, LIGHT BROWN SANDY SILT, TRACE CLAY, MOIST.			796.1	86																		
				87																		
				88	6	17	100	SS-23	-	-	-	-	-	-	-	-	-	22	A-4b (V)			
				89	6															7		
90																						
MEDIUM DENSE TO VERY DENSE, LIGHT BROWN SANDY SILT, TRACE CLAY, MOIST.			796.1	91																		
				92																		
				93	10	71	78	SS-24	-	-	-	-	-	-	-	-	25	A-4b (V)				
				94	26														27			

MATERIAL DESCRIPTION AND NOTES	ELEV. 787.8	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI			
MEDIUM DENSE TO VERY DENSE, LIGHT BROWN SANDY SILT, TRACE CLAY, MOIST. (continued)	786.1	95																
		96																
MEDIUM STIFF TO STIFF, LIGHT BROWN SILT AND CLAY, MOIST.	772.9	97																
		98	8	8	21	72	SS-25	1.25	-	-	-	-	-	-	-	-	23	A-6a (V)
		99																
		100																
		101																
		102																
		103	5	5	19	83	SS-26	1.75	-	-	-	-	-	-	-	-	20	A-6a (V)
		104																
		105																
		106																
		107																
		108	0	3	11	100	SS-27	0.75	-	-	-	-	-	-	-	-	26	A-6a (V)
		109		5														
		EOB																

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NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING.
 ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LB. CEMENT / 50 LB. BENTONITE POWDER / 80 GAL WATER. PAVEMENT PATCHED WITH CONCRETE.

	PROJECT: MOT-835-2.57	DRILLING FIRM / OPERATOR: RII / KB	DRILL RIG: DRILL RIG	STATION / OFFSET: 135+28 / 45' LT.	EXPLORATION ID B-012-0-84
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / DD	HAMMER: AUTOMATIC	ALIGNMENT: CL SR 835	
	PID: 116922 SFN: NA	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 7/18/84	ELEVATION: 882.2 (MSL) EOB: 40.0 ft.	PAGE
	START: 7/18/24 END: 7/18/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 100	LAT / LONG: 39.717399, -84.107987	1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV. 882.2	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG				ODOT CLASS (GI)	BACK FILL	
								GR	CS	FS	SI	CL	LL	PL	PI	WC			
1.0' - Topsoil	881.2	1	6																
		2	3	8	100	SS-1	-	-	-	-	-	-	-	-	-	-	-	-	A-4b (V)
		3																	
		4	10																
		5	8	21	100	SS-2	-	-	-	-	-	-	-	-	-	-	-	-	A-4b (V)
		6																	
	875.2	7	14			SS-3A	-	-	-	-	-	-	-	-	-	-	-	-	A-4b (V)
		8	11	32	100	SS-3B	-	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)
		9																	
	872.7	10	9			SS-4A	-	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)
		11	17	53	100	SS-4B	-	-	-	-	-	-	-	-	-	-	-	-	A-4a (V)
		12																	
	870.2	13	13			SS-5A	-	-	-	-	-	-	-	-	-	-	-	-	A-4a (V)
		14	11	42	100	SS-5B	-	-	-	-	-	-	-	-	-	-	-	-	A-4b (V)
		15																	
	867.7	16	20			SS-6A	-	-	-	-	-	-	-	-	-	-	-	-	A-4b (V)
		17	38	95	100	SS-6B	-	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)
		18																	
		19	17																
		20	31	89	100	SS-7	-	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)
		21																	
		22																	
		23																	
		24	13																
		25	32	101	100	SS-9	-	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)
		26																	
		27																	
		28																	
	852.7	29	40																
		30	33	102	100	SS-10	-	-	-	-	-	-	-	-	-	-	-	-	A-4b (V)

000-23 RII STA ODOT BORING LOG (8.5X11) - OH DOT.GDT - 9/17/25 14:33 - C:\USERS\KAYLEE\DESKTOP\W-23-155.GPJ

MATERIAL DESCRIPTION AND NOTES	ELEV. 852.2	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	BACK FILL
								GR	CS	FS	SI	CL	LL	PL	PI			
			35															<>
		31																<>
		32																<>
		33																<>
		34	25															<>
		35	30 28	87	100	SS-11	-	-	-	-	-	-	-	-	-	-	-	A-4b (V)
		36																<>
		37																<>
		38																<>
		39	41 37 42	119	100	SS-12	-	-	-	-	-	-	-	-	-	-	-	A-4b (V)
	842.2	EOB	40															<>

000-23 RII STA ODOT BORING LOG (8.5X11) - OH DOT.GDT - 9/17/25 14:33 - C:\USERS\KAYLEE\DESKTOP\PIW-23-155.GPJ

NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 6.0' AND UPON COMPLETION @ 6.5'
 ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

	PROJECT: MOT-835-2.57	DRILLING FIRM / OPERATOR: RII / DH	DRILL RIG: DRILL RIG	STATION / OFFSET: 135+75 / 44' RT.	EXPLORATION ID B-013-0-84
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / DH	HAMMER: AUTOMATIC	ALIGNMENT: CL SR 835	
	PID: 116922 SFN: NA	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 7/18/84	ELEVATION: 870.7 (MSL) EOB: 40.0 ft.	PAGE
	START: 7/18/24 END: 7/18/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 100	LAT / LONG: 39.717145, -84.107847	1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV. 870.7	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG				ODOT CLASS (GI)	BACK FILL
								GR	CS	FS	SI	CL	LL	PL	PI	WC		
0.7' - TOPSOIL	870.0																	
	868.2	1	4	18	100	SS-1	-	-	-	-	-	-	-	-	-	-	-	A-4b (V)
		2	5	7														
		3																
	866.7	4	15	57	100	SS-2	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)
		5	16	22														
		6	17															
		7	17	60	100	SS-3	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)
		8																
		9	20	95	100	SS-4	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)
		10	29	34														
		11	29															
		12	37	117	100	SS-5	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)
		13	41															
		14	17	80	100	SS-6	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)
		15	23	30														
	854.2	16	13	39	100	SS-7	-	-	-	-	-	-	-	-	-	-	-	A-2-4 (V)
		17	13	13														
	852.2	18																
		19	17	47	100	SS-8	-	-	-	-	-	-	-	-	-	-	-	A-4b (V)
		20	12	19														
		21																
		22																
	847.2	23																
		24	52	-	100	SS-9	-	-	-	-	-	-	-	-	-	-	-	A-3a (V)
		25	53															
		26																
		27																
		28																
		29	16	60	100	SS-10	-	-	-	-	-	-	-	-	-	-	-	A-3a (V)
			17	23														

000-23 RII STA ODOT BORING LOG (8.5X11) - OH DOT.GDT - 9/17/25 14:33 - C:\USERS\KAYLEE\DESKTOP\W-23-155.GPJ

	PROJECT: MOT-835-2.57	DRILLING FIRM / OPERATOR: RII / DH	DRILL RIG: DRILL RIG	STATION / OFFSET: 136+66 / 44' LT.	EXPLORATION ID B-014-0-84
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / DH	HAMMER: AUTOMATIC	ALIGNMENT: CL SR 835	
	PID: 116922 SFN: NA	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 7/18/84	ELEVATION: 871.2 (MSL) EOB: 40.0 ft.	PAGE 1 OF 2
	START: 7/18/24 END: 7/18/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 100	LAT / LONG: 39.717365, -84.107499	

MATERIAL DESCRIPTION AND NOTES	ELEV. 871.2	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG				ODOT CLASS (GI)	BACK FILL
								GR	CS	FS	SI	CL	LL	PL	PI	WC		
FILL	871.2	1	30															
		2	33 51	126	100	SS-1	-	-	-	-	-	-	-	-	-	-	-	A-6a (V)
	867.2	3																
	867.2	4	16 8	24	100	SS-2A	-	-	-	-	-	-	-	-	-	-	-	A-6a (V)
	864.2	5		8		SS-2B	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)
		6	4															
	864.2	7	7 12	29	100	SS-3A	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)
		8																
	864.2	9	35 22 29	77	100	SS-4	-	-	-	-	-	-	-	-	-	-	-	A-2-4 (V)
		10																
	864.2	11	11 15 20	53	100	SS-5	-	-	-	-	-	-	-	-	-	-	-	A-2-4 (V)
		12																
	864.2	14	15 25 34	89	100	SS-6	-	-	-	-	-	-	-	-	-	-	-	A-2-4 (V)
		15																
	864.2	16	15 25 30	83	100	SS-7	-	-	-	-	-	-	-	-	-	-	-	A-2-4 (V)
		17																
	864.2	18																
		19	15 25 30	83	100	SS-8	-	-	-	-	-	-	-	-	-	-	-	A-2-4 (V)
	864.2	20																
		21																
	864.2	22																
		23																
	864.2	24	15 22 30	78	100	SS-9	-	-	-	-	-	-	-	-	-	-	-	A-2-4 (V)
		25																
	864.2	26																
		27																
	864.2	28																
		29	20 22 25	71	100	SS-10	-	-	-	-	-	-	-	-	-	-	-	A-4a (V)

000-23 RII STA ODOT BORING LOG (8.5X11) - OH DOT.GDT - 9/17/25 14:33 - C:\USERS\KAYLEE\DESKTOP\W-23-155.GPJ

	PROJECT: MOT-835-2.57	DRILLING FIRM / OPERATOR: RII / DH	DRILL RIG: DRILL RIG	STATION / OFFSET: 137+15 / 43' RT.	EXPLORATION ID B-015-0-84
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / DH	HAMMER: AUTOMATIC	ALIGNMENT: CL SR 835	
	PID: 116922 SFN: NA	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 7/18/84	ELEVATION: 882.4 (MSL) EOB: 40.0 ft.	PAGE 1 OF 2
	START: 7/18/24 END: 7/18/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 100	LAT / LONG: 39.717118, -84.107352	

MATERIAL DESCRIPTION AND NOTES	ELEV. 882.4	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG				ODOT CLASS (GI)	BACK FILL	
								GR	CS	FS	SI	CL	LL	PL	PI	WC			
FILL	882.4	1	5																
		2	5 6	17	100	SS-1	-	-	-	-	-	-	-	-	-	-	-	A-4b (V)	
	878.4	3																	
		4	7 4	17	100	SS-2A SS-2B	-	-	-	-	-	-	-	-	-	-	-	A-4b (V) A-4b (V)	
	876.4	5																	
		6			100	SS	-	-	-	-	-	-	-	-	-	-	-		
		7	15																
		8	9 8	26	100	SS-3	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
		9	8 12 20	48	100	SS-4	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
		10																	
		11	6																
		12	4 12	24	100	SS-5	-	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)
		13																	
		14	15 18 23	62	100	SS-6	-	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)
15																			
16	15																		
17	12 20	48	100	SS-7	-	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)		
18																			
19	16 26 34	90	100	SS-8	-	-	-	-	-	-	-	-	-	-	-	-	A-1-b (V)		
20																			
21																			
22																			
23																			
	858.9	24	6 12 14	39	100	SS-9	-	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
		25																	
26																			
27																			
28																			
29			9 14 16	45	100	SS-10	-	-	-	-	-	-	-	-	-	-	-	A-6a (V)	

000-23 RII STA ODOT BORING LOG (8.5X11) - OH DOT.GDT - 9/17/25 14:33 - C:\USERS\KAYLEE\DESKTOP\W-23-155.GPJ

MATERIAL DESCRIPTION AND NOTES	ELEV. 852.4	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	BACK FILL
								GR	CS	FS	SI	CL	LL	PL	PI			
		31																
		32																
		33																
		34	12 17 22	59	100	SS-11	-	-	-	-	-	-	-	-	-	-	-	A-6a (V)
		35																
	845.4	36																
		37																
		38																
		39	14 26 22	72	100	SS-12	-	-	-	-	-	-	-	-	-	-	-	A-4a (V)
	842.4	40																

EOB

000-23 RII STA ODOT BORING LOG (8.5X11) - OH DOT.GDT - 9/17/25 14:33 - C:\USERS\KAYLEE\DESKTOP\PIW-23-155.GPJ

NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 4.0' AND UPON COMPLETION @ 3.5'
 ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

LOG OF BORING NO. 12

SOIL STUDY FOR MOT/GRE RESEARCH BOULEVARD,
KETTERING & BEAVERCREEK, OHIO (ACCORDING TO ODOT SPECIFICATIONS)

BORING LOCATION: Sta. 48+34.2'; 44.6' Lt.

DATE STARTED: 7/18/84

SURFACE ELEVATION: 877.9'

DATE COMPLETED: 7/18/84

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
877.9 0.0'	Topsoil				
1.0'	Soft brown silt, some sand, trace of clay - damp	1A	1.0-2.5	6- 3- 2	5
5'	(Becomes stiff at 4.0')	2A	4.0-5.5	10- 8- 6	14
7.0'	Medium dense gray sand and gravel, trace of silt - wet	3A	6.5-8.0	14-11-10 ²¹	21
867.9 10' 9.5'	Hard gray silt and fine sand, trace of gravel - moist	4A	9.0-10.5	9-17-18	35
11.0'	Very stiff gray silt, some clay, some sand, trace of gravel - moist	5A	11.5-13.0	13-11-17	28
15' 14.5'	Very dense gray sand and gravel, trace of silt - wet	6A	14.0-15.5	20-38-25	63
7A		7A	16.5-18.0	17-31-28	59
20' 19.5'	Very dense brown sand and gravel, trace of silt - wet	8A	19.0-20.5	39-37-40	77
9A		9A	24.0-25.5	13-32-35	67
30' 29.5'	Hard gray silt and fine sand, trace of clay - damp (Continued on next page)	10A	29.0-30.5	40-33-35	68

METHOD: HOLLOW STEM AUGER
TECHNICIAN: KB-DD
JOB NO.: 28129 (bw)

WATER OBSERVATIONS
INITIAL DEPTH: 6.0'
COMPLETION DEPTH: 6.5'
DEPTH AFTER: _____ HRS. _____

TYPE SAMPLER:
 A. SPLIT SPOON
 B.
 C. SHELBY TUBE

LOG OF BORING NO. 12 (Second page)
 SOIL STUDY FOR MOT/GRE RESEARCH BOULEVARD,
 KETTERING & BEAVERCREEK, OHIO (ACCORDING TO ODOT SPECIFICATIONS)

BORING LOCATION: Sta. 48+34.2'; 44.6' Lt. **DATE STARTED:** 7/18/84
SURFACE ELEVATION: 877.9' **DATE COMPLETED:** 7/18/84

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS / FT. OR CORE REC.
30'	(Continued)				
35'		11A	34.0-35.5	25-30-28	58
40'		12A	38.5-40.0	41-37-42	79
45'	Bottom of boring at 40.0'				
50'					
55'					
60'					

METHOD: HOLLOW STEM AUGER TECHNICIAN: KB-DD JOB NO.: 28129 (bw)	WATER OBSERVATIONS INITIAL DEPTH: <u>6.0'</u> COMPLETION DEPTH: <u>6.5'</u> DEPTH AFTER: _____ HRS. _____	TYPE SAMPLER: <input checked="" type="checkbox"/> A. SPLIT SPOON <input type="checkbox"/> B. <input type="checkbox"/> C. SHELBY TUBE
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BOWSER - MORNER

LOG OF BORING NO. 13
 SOIL STUDY FOR MOT/GRE RESEARCH BOULEVARD,
 KETTERING & BEAVERCREEK, OHIO (ACCORDING TO ODOT SPECIFICATIONS)

BORING LOCATION: Sta. 48+81.0'; 44.4' Rt. **DATE STARTED:** 7/18/84
SURFACE ELEVATION: 877.5' **DATE COMPLETED:** 7/18/84

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS / FT. OR CORE REC.
0.0' - 0.7'	Topsoil				
0.7' - 2.5'	Stiff dark brown silt, some clay, some sand, trace of gravel, trace of organic material - moist	1A	1.0-2.5	4- 5- 7	12
2.5' - 5'	Dense brown sand and gravel, trace of silt, trace of cobbles - wet	2A	3.5-5.0	15-16-22	38
5' - 6.0'		3A	6.0-7.5	17-17-23	40
6.0' - 8.5'	(Becomes very dense at 9.0')	4A	8.5-10.0	20-29-34	63
8.5' - 11.0'		5A	11.0-12.5	29-37-41	78
11.0' - 13.5'		6A	13.5-15.0	17-23-30	53
13.5' - 16.0'		1C	16.0-16.5		0"
16.0' - 16.5'	Medium dense gray sand, some silt, trace of gravel, trace of cobbles - wet	7A	16.5-18.0	13-13-13	26
16.5' - 18.5'					
18.5' - 20'	Hard gray silt, some clay, some sand, trace of gravel, trace of cobbles - wet	8A	18.5-20.0	17-12-19	31
20' - 23.5'	(With 1' to 3' sand and gravel seams at 19.0')				
23.5' - 25'	Very dense gray sand, some gravel, trace of cobbles - wet	9A	23.5-24.5	52-53	105
25' - 30'	(Becomes dense at 29.0') (Continued on next page)	10A	28.5-30.0	16-17-23	40

METHOD: HOLLOW STEM AUGER	WATER OBSERVATIONS	TYPE SAMPLER:
TECHNICIAN: DH	INITIAL DEPTH: <u>4.0'</u> (heavy)	<input checked="" type="checkbox"/> A. SPLIT SPOON
JOB NO.: 28129 (bw)	COMPLETION DEPTH: <u>4.0'</u>	<input type="checkbox"/> B.
	DEPTH AFTER: _____ HRS. _____	<input checked="" type="checkbox"/> C. SHELBY TUBE

BOWSER - MORNER

LOG OF BORING NO. 13 (Second page)
 SOIL STUDY FOR MOT/GRE RESEARCH BOULEVARD,
 KETTERING & BEAVERCREEK, OHIO (ACCORDING TO ODOT SPECIFICATIONS)

BORING LOCATION: Sta. 48+81.0'; 44.4' Rt. **DATE STARTED:** 7/18/84
SURFACE ELEVATION: 877.5' **DATE COMPLETED:** 7/18/84

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'	(Continued)				
35'	(With 1' to 2' gray silt lenses at 34.0')	11A	33.5-35.0	15-16-30 37	46
40'	(Becomes very dense at 39.0') Bottom of boring at 40.0'	12A	38.5-40.0	23-25-28	53
45'					
50'					
55'					
60'					

METHOD: HOLLOW STEM AUGER	WATER OBSERVATIONS	TYPE SAMPLER:
TECHNICIAN: DH	INITIAL DEPTH: <u>4.0'</u> (heavy)	<u>X</u> A. SPLIT SPOON
JOB NO.: 28129 (bw)	COMPLETION DEPTH: <u>4.0'</u>	___ B.
	DEPTH AFTER: _____ HRS. _____	<u>X</u> C. SHELBY TUBE

BOWSER - MORNER

LOG OF BORING NO. 14
 SOIL STUDY FOR MOT/GRE RESEARCH BOULEVARD,
 KETTERING & BEAVERCREEK, OHIO (ACCORDING TO ODOT SPECIFICATIONS)

BORING LOCATION: Sta. 49+72'; 43.6' Lt.

DATE STARTED: 7/18/84

SURFACE ELEVATION: 877.2'

DATE COMPLETED: 7/18/84

877
872
71
70
69
68
67

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS / FT. OR CORE REC.
0.0'	(FILL) Hard brown silt and clay, some sand, trace of organic material, trace of cobbles, trace of asphalt, trace of wood - damp	1A	1.0-2.5	30-33-51	84
4.0'	(ORIGINAL) Medium dense brown sand and gravel, some cobbles, trace of organic material - wet	2A	3.5-5.0	16- 8- 8	16
7.0'	Medium dense brown sand and gravel, trace of cobbles, trace of silt - wet	3A	6.0-7.5	4- 7-12	19
10'	(Becomes very dense at 9.0')	4A	8.5-10.0	35-22-29	51
	(Becomes dense at 11.5')	5A	11.0-12.5	11-15-20	35
15'	(Becomes very dense at 14.0')	6A	13.5-15.0	15-25-34	59
		7A	16.0-17.5	15-25-30	55
20'	(Becomes dense at 18.5')	8A	18.5-20.0	17-17-18	35
25'	(Becomes very dense at 24.0')	9A	23.5-25.0	15-22-30	52
28.5'	Dense gray sand and silt, trace of gravel - wet	10A	28.5-30.0	20-22-25	47
30'	(Continued on next page)				

METHOD: HOLLOW STEM AUGER	WATER OBSERVATIONS	TYPE SAMPLER:
TECHNICIAN: DH	INITIAL DEPTH: <u>4.0'</u> (heavy)	<input checked="" type="checkbox"/> A. SPLIT SPOON
JOB NO.: 28129 (bw)	COMPLETION DEPTH: <u>3.0'</u>	<input type="checkbox"/> B.
	DEPTH AFTER: _____ HRS. _____	<input type="checkbox"/> C. SHELBY TUBE

BOWSER - MORNER

LOG OF BORING NO. 14 (Second page)
 SOIL STUDY FOR MOT/GRE RESEARCH BOULEVARD,
 KETTERING & BEAVERCREEK, OHIO (ACCORDING TO ODOT SPECIFICATIONS)

BORING LOCATION: Sta. 49+72'; 43.6' Lt. **DATE STARTED:** 7/18/84
SURFACE ELEVATION: 877.2' **DATE COMPLETED:** 7/18/84

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 8" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'	(Continued)				
35'		11A	33.5-35.0	14-22-23	45
37.0'	Hard gray silt and fine sand, some clay - moist	12A	38.5-40.0	10-14-22	36
40'	Bottom of boring at 40.0'				
45'					
50'					
55'					
60'					

METHOD: HOLLOW STEM AUGER TECHNICIAN: DH JOB NO.: 28129 (bw)	WATER OBSERVATIONS INITIAL DEPTH: <u>4.0'</u> (heavy) COMPLETION DEPTH: <u>3.0'</u> DEPTH AFTER: _____ HRS. _____	TYPE SAMPLER: <input checked="" type="checkbox"/> A. SPLIT SPOON <input type="checkbox"/> B. <input type="checkbox"/> C. SHELBY TUBE
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BOWSER - MORNER

LOG OF BORING NO. 15
SOIL STUDY FOR MOT/GRE RESEARCH BOULEVARD,
KETTERING & BEAVERCREEK, OHIO (ACCORDING TO ODOT SPECIFICATIONS)

BORING LOCATION: Sta. 50+20.7'; 42.6' Rt. **DATE STARTED:** 7/18/84
SURFACE ELEVATION: 877.3' **DATE COMPLETED:** 7/18/84

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 8" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
877.3 0.0'	(FILL) Stiff brown silt, some clay, some sand, trace of gravel, trace of asphalt, trace of cobbles - moist	1A	1.0-2.5	5- 5- 6	11
4.0'	(ORIGINAL) Stiff brown silt, some clay, some sand, trace of roots, trace of gravel - wet	2A	3.5-5.0	7- 7- 4	11
5' 6.0'	Medium dense brown sand and gravel, trace of silt, trace of cobbles	1C	6.0-7.0		6"
868.3 367.3 10'	- wet (Becomes dense at 9.0')	3A 4A	7.0-8.5 8.5-10.0	15- 9- 8 8-12-20	17 32
15'	(Becomes medium dense at 11.5') (Becomes dense at 14.0')	5A 6A	11.0-12.5 13.5-15.0	6- 4-12 15-18-23	16 41
20'	(With 6" gray silt lenses at 16.5') (Becomes very dense at 18.5')	7A 8A	16.0-17.5 18.5-20.0	15-12-20 16-26-34	32 60
23.5'	Very stiff gray silt and clay, some sand, trace of gravel, trace of cobbles - moist (With 1' to 3' gray wet sand seams from 24.0')	9A	23.5-25.0	6-12-14	26
25' 30'	(Continued on next page)	10A	28.5-30.0	9-14-16	30

METHOD: HOLLOW STEM AUGER	WATER OBSERVATIONS	TYPE SAMPLER:
TECHNICIAN: DH	INITIAL DEPTH: <u>4.0'</u> (heavy)	<input checked="" type="checkbox"/> A. SPLIT SPOON
JOB NO.: 28129 (bw)	COMPLETION DEPTH: <u>3.5'</u>	<input type="checkbox"/> B.
	DEPTH AFTER: _____ HRS. _____	<input checked="" type="checkbox"/> C. SHELBY TUBE

BOWSER - MORNER

LOG OF BORING NO. 15 (Second page)
 SOIL STUDY FOR MOT/GRE RESEARCH BOULEVARD,
 KETTERING & BEAVERCREEK, OHIO (ACCORDING TO ODOT SPECIFICATIONS)

BORING LOCATION: Sta. 50+20.7'; 42.6' Rt. **DATE STARTED:** 7/18/84
SURFACE ELEVATION: 877.3' **DATE COMPLETED:** 7/18/84

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS / FT. OR CORE REC.
30'	(Continued)				
35'	(Becomes hard at 34.0')	12A	33.5-35.0	12-17-22	39
37.0'	Hard gray silt and fine sand, some clay - moist	13A	38.5-40.0	14-26-22	48
40'	Bottom of boring at 40.0'				
45'					
50'					
55'					
60'					

METHOD: HOLLOW STEM AUGER	WATER OBSERVATIONS	TYPE SAMPLER:
TECHNICIAN: DH	INITIAL DEPTH: <u>4.0'</u> (heavy)	<input checked="" type="checkbox"/> A. SPLIT SPOON
JOB NO.: 28129 (bw)	COMPLETION DEPTH: <u>3.5'</u>	<input type="checkbox"/> B.
	DEPTH AFTER: _____ HRS. _____	<input checked="" type="checkbox"/> C. SHELBY TUBE

BOWSER - MORNER

APPENDIX IV

PAVEMENT CORE DATA SHEETS



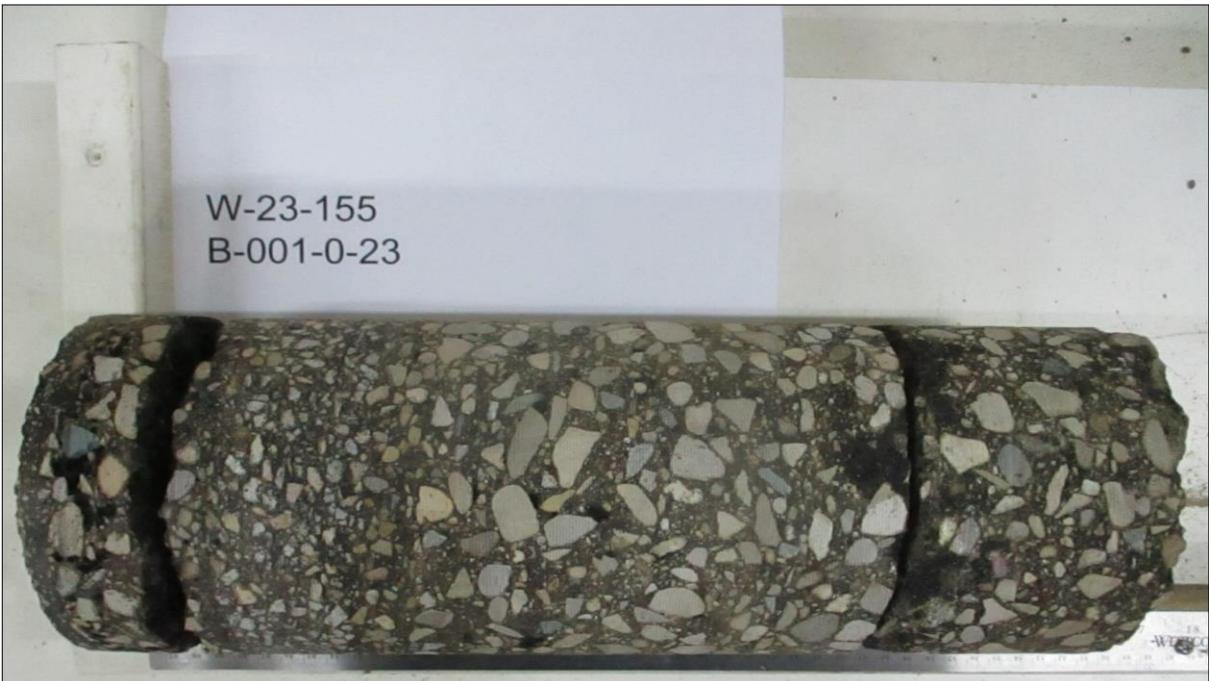
6350 Presidential Gateway
 Columbus, Ohio 43231
 Telephone: (614) 823-4949
 Fax Number: (614) 823-4990

Pavement Core Data Summary

PROJECT	MOT-835-2.57 Bridge Replacement
LOCATION	Montgomery County, Ohio
JOB No.	W-23-155
BORING/CORE No.	B-001-0-24
DATE CORE OBTAINED	1/4/2024
CORE OBTAINED BY	TG & BG

Core Composition										Comments/Remarks
Core Number	Layer Thickness (in.)	Pavement Layer Number	Asphalt			Concrete	Aggregate/Granular Base	Other		
			Surface Binder	Intermediate Binder	Base Binder					
B-001-0-24	0.25	8	✓							- Layer 8 is a sand mix.
	1.25	7		✓						- Layer 7 has voids.
	0.75	6	✓							- The core separated between layers 6 & 7.
	1.25	5	✓							- Layer 3 has some voids.
	1.25	4	✓							
	1.75	3		✓						
	4.75	2		✓						
	4.25	1		✓						

Total Pavement Thickness = 15.50 in. Total Asphalt Thickness = 15.50 in. Total Concrete Thickness = 0.00 in. Total Base Thickness = 0.00 in.





6350 Presidential Gateway
 Columbus, Ohio 43231
 Telephone: (614) 823-4949
 Fax Number: (614) 823-4990

Pavement Core Data Summary

PROJECT	MOT-835-2.57 Bridge Replacement
LOCATION	Montgomery County, Ohio
JOB No.	W-23-155
BORING/CORE No.	B-004-0-24
DATE CORE OBTAINED	1/4/2024
CORE OBTAINED BY	TG & BG

Core Composition										Comments/Remarks
Core Number	Layer Thickness (in.)	Pavement Layer Number	Asphalt			Concrete	Aggregate/Granular Base	Other		
			Surface Binder	Intermediate Binder	Base Binder					
B-004-0-24	0.25	7	✓							<ul style="list-style-type: none"> - Layer 7 is a sand mix. - Layers 3 - 6 have some voids. - The core separated between layers 1 & 2. - Layer 1 is deteriorating.
	1.25	6		✓						
	1.75	5	✓							
	1.25	4	✓							
	2.75	3		✓						
	4.25	2		✓						
	3.50	1		✓						

Total Pavement Thickness = 15.00 in. Total Asphalt Thickness = 15.00 in. Total Concrete Thickness = 0.00 in. Total Base Thickness = 0.00 in.



APPENDIX V

LATERAL DESIGN PARAMETERS

Soil Parameters for Lateral Load Analysis
MOT-835-2.57 Bridge Replacement; PID 116922
Geauga County, Ohio
Rii Project Number: W-23-155

Substructure Unit (Boring)	Elevation (feet)	Soil Class.	Soil Type	Strata	N ₆₀	N1 ₆₀	γ (pcf)	γ' (pcf)	Strength Parameter	k (soil) k _{rm} (rock)	ε ₅₀ (soil) E _r (rock)	RQD (rock)
B-001-1-24 (Rear Abutment)	883.5 to 873.5	A-6a	C	3	13	18	125	125	Su = 1,625 psf	540 pci	0.0068	-
	873.5 to 865.5	A-6a	C	2	16	18	125	62.6	Su = 2,000 psf	665 pci	0.0063	-
	865.5 to 855.5	A-1-b	G	4	43	43	130	67.6	φ = 38°	165 pci	-	-
	855.5 to 848.5	A-4b	G	4	42	39	130	67.6	φ = 33°	75 pci	-	-
	848.5 to 842.5	A-4b	G	4	23	20	125	62.6	φ = 30°	35 pci	-	-
	842.5 to 832.5	A-6b	C	2	13	11	125	62.6	Su = 1,625 psf	540 pci	0.0068	-
	832.5 to 822.5	A-4b	G	4	28	21	130	67.6	φ = 31°	50 pci	-	-
	822.5 to 812.5	A-4b	G	4	24	17	125	62.6	φ = 30°	35 pci	-	-
	812.5 to 802.5	A-6a	C	2	25	17	125	62.6	Su = 3,125 psf	1,040 pci	0.0050	-
	802.5 to 792.5	A-4b	G	4	32	20	130	67.6	φ = 30°	35 pci	-	-
	792.5 to 783.5	A-4b	G	4	70	42	135	72.6	φ = 34°	90 pci	-	-
	783.5 to 778.5	A-4b	G	4	55	31	135	72.6	φ = 32°	60 pci	-	-
778.5 to 773.5	A-4b	G	4	24	13	125	62.6	φ = 29°	30 pci	-	-	
B-002-1-24 (Pier 1)	871.5 to 863.5	A-1-b	G	4	28	41	130	67.6	φ = 38°	165 pci	-	-
	863.5 to 858.5	A-4a	C	2	28	35	125	62.6	Su = 3,500 psf	1,165 pci	0.0048	-
	858.5 to 851.0	A-1-b	G	4	45	51	130	67.6	φ = 39°	190 pci	-	-
	851.0 to 845.5	A-6a	C	2	40	42	130	67.6	Su = 4,000 psf	1,335 pci	0.0047	-
	845.5 to 834.5	A-6b	C	2	29	28	125	62.6	Su = 3,625 psf	1,210 pci	0.0048	-
	834.5 to 829.5	A-4b	G	4	20	18	125	62.6	φ = 30°	35 pci	-	-
	829.5 to 819.5	A-4b	G	4	31	26	130	67.6	φ = 32°	60 pci	-	-
	819.5 to 799.5	A-6a	C	2	25	19	125	62.6	Su = 3,125 psf	1,040 pci	0.0050	-
	799.5 to 794.5	A-6a	C	2	23	16	125	62.6	Su = 2,000 psf	665 pci	0.0063	-
	794.5 to 784.5	A-4b	G	4	23	15	125	62.6	φ = 29°	30 pci	-	-
	784.5 to 774.5	A-4b	G	4	30	19	130	67.6	φ = 30°	35 pci	-	-
	774.5 to 766.5	A-4b	G	4	48	28	135	72.6	φ = 32°	60 pci	-	-
766.5 to 761.5	A-4b	G	4	65	37	135	72.6	φ = 33°	75 pci	-	-	

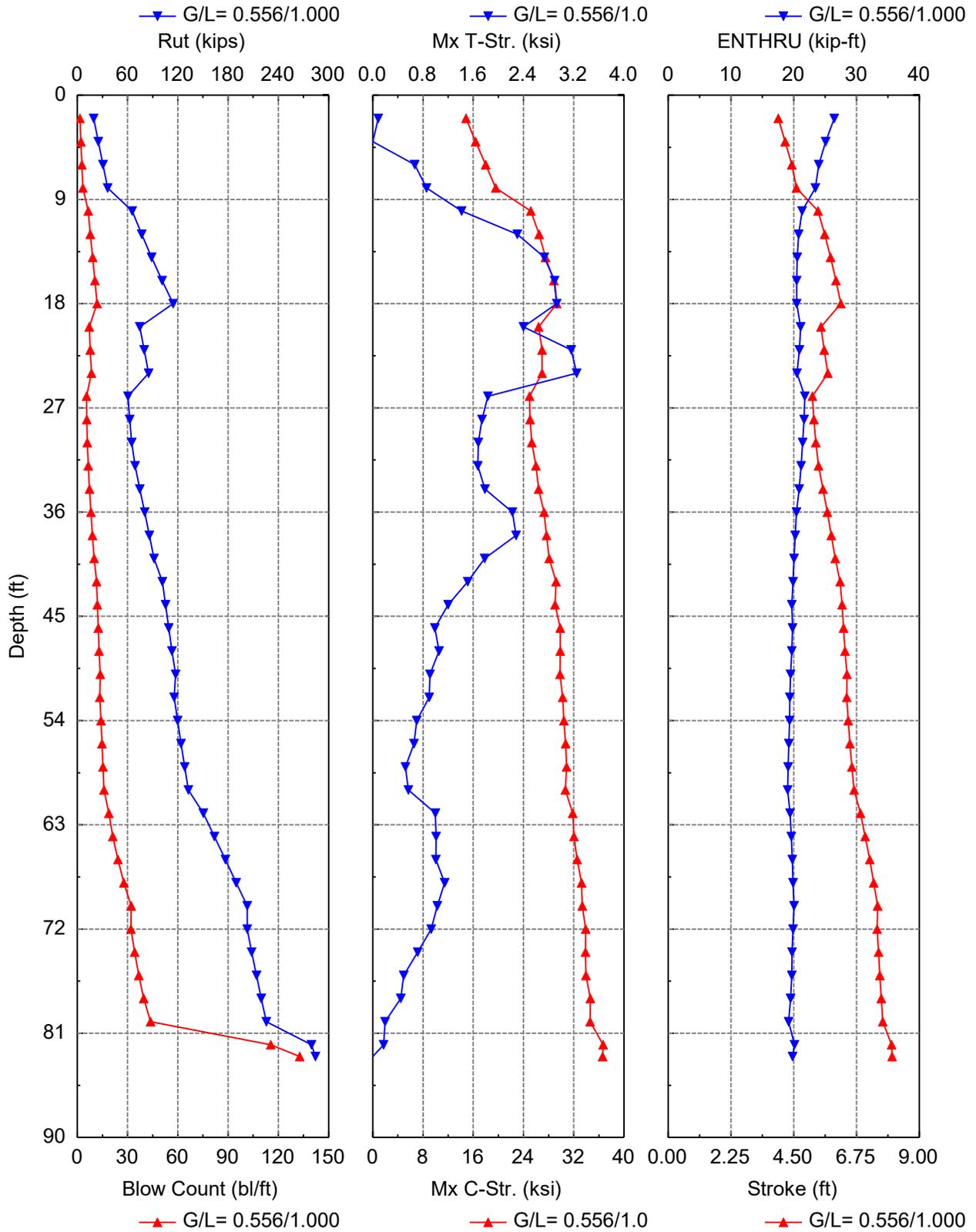
Soil Parameters for Lateral Load Analysis
MOT-835-2.57 Bridge Replacement; PID 116922
Geauga County, Ohio
Rii Project Number: W-23-155

Substructure Unit (Boring)	Elevation (feet)	Soil Class.	Soil Type	Strata	N ₆₀	N ₁₆₀	γ (pcf)	γ' (pcf)	Strength Parameter	k (soil) k _{rm} (rock)	ε ₅₀ (soil) E _r (rock)	RQD (rock)
B-003-1-24 (Pier 2)	873.0 to 867.5	A-2-6	G	4	23	37	125	125	φ = 35°	185 pci	-	-
	867.5 to 857.5	A-1-a	G	4	30	38	130	67.6	φ = 38°	165 pci	-	-
	857.5 to 848.0	A-1-a	G	4	27	29	130	67.6	φ = 37°	145 pci	-	-
	848.0 to 841.0	A-1-a	G	4	43	42	130	67.6	φ = 39°	190 pci	-	-
	841.0 to 836.0	A-6a	C	2	35	33	125	62.6	Su = 4,375 psf	1,460 pci	0.0045	-
	836.0 to 823.0	A-6a	C	2	40	34	130	67.6	Su = 5,000 psf	1,665 pci	0.0043	-
	823.0 to 811.0	A-6a	C	2	38	30	125	62.6	Su = 4,750 psf	1,585 pci	0.0044	-
	811.0 to 801.0	A-6a	C	2	42	30	130	67.6	Su = 5,250 psf	1,750 pci	0.0043	-
	801.0 to 791.0	A-4b	G	4	28	19	130	67.6	φ = 30°	35 pci	-	-
	791.0 to 781.0	A-4b	G	4	63	40	135	72.6	φ = 34°	90 pci	-	-
	781.0 to 776.0	A-4b	G	4	22	13	125	62.6	φ = 29°	30 pci	-	-
	776.0 to 771.0	A-6a	C	2	52	31	130	67.6	Su = 3,000 psf	1,000 pci	0.0050	-
771.0 to 763.0	A-6a	C	2	24	14	125	62.6	Su = 3,000 psf	1,000 pci	0.0050	-	
B-004-1-24 (Forward Abutment)	882.0 to 872.5	A-6a	C	3	18	25	125	125	Su = 2,250 psf	750 pci	0.0060	-
	872.5 to 861.5	A-1-b	G	4	37	39	130	67.6	φ = 37°	145 pci	-	-
	861.5 to 859.0	A-1-a	G	4	0	0	115	52.6	φ = 28°	20 pci	-	-
	859.0 to 855.0	A-1-a	G	4	44	42	130	67.6	φ = 39°	190 pci	-	-
	855.0 to 851.0	A-4a	G	4	51	47	135	72.6	φ = 34°	90 pci	-	-
	851.0 to 846.0	A-4b	G	4	43	38	130	67.6	φ = 33°	75 pci	-	-
	846.0 to 836.0	A-4b	G	4	41	34	130	67.6	φ = 33°	75 pci	-	-
	836.0 to 831.0	A-6a	C	2	15	12	125	62.6	Su = 1,875 psf	625 pci	0.0065	-
	831.0 to 811.0	A-6a	C	2	24	17	125	62.6	Su = 3,000 psf	1,000 pci	0.0050	-
	811.0 to 796.0	A-6b	C	2	20	13	125	62.6	Su = 2,500 psf	835 pci	0.0057	-
	796.0 to 791.0	A-4b	G	4	17	10	125	62.6	φ = 27°	15 pci	-	-
	791.0 to 786.0	A-4b	G	4	71	42	135	72.6	φ = 34°	90 pci	-	-
786.0 to 772.0	A-6a	C	2	15	8	125	62.6	Su = 1,875 psf	625 pci	0.0065	-	

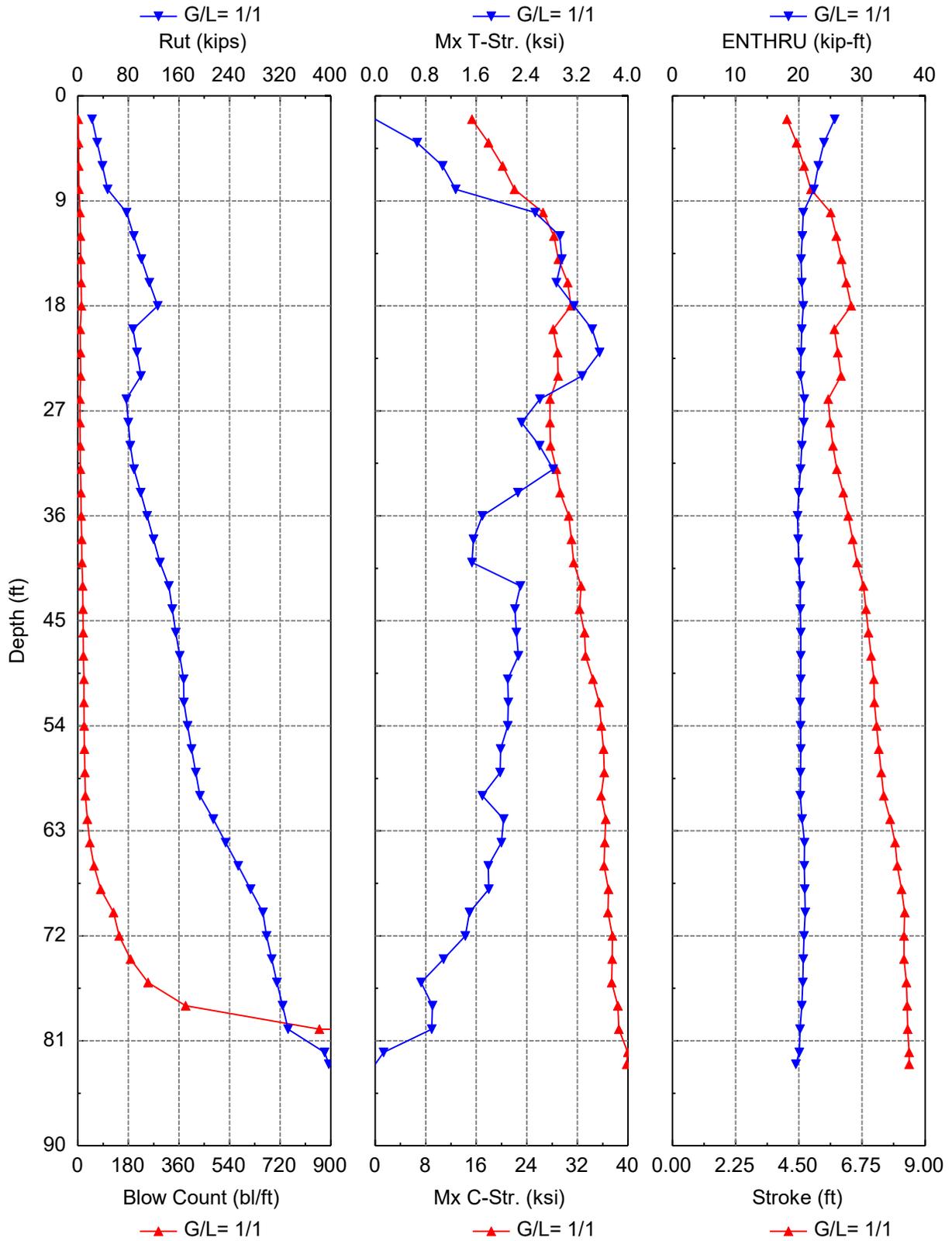
APPENDIX VI

**GRLWEAP DRIVABILITY & APILE
ANLAYSIS OUTPUTS**

Driveability Analysis Summary



Driveability Analysis Summary



Gain/Loss Factor at Shaft/Toe = 0.556/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow bl/ft	CtMx ksi	C-StrMx ksi	T-Str. ft	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	19.6	5.5	14.1	1.6	14.845	0.087	3.94	26.4	D 19-42	
4.0	25.2	11.0	14.1	2.1	16.368	0.000	4.19	25.1	D 19-42	
6.0	30.7	16.6	14.1	2.7	17.960	0.668	4.42	24.0	D 19-42	
8.0	36.3	22.1	14.1	3.3	19.572	0.858	4.60	23.4	D 19-42	
10.0	65.4	25.5	39.9	6.5	25.150	1.415	5.37	21.3	D 19-42	
12.0	76.8	28.4	48.5	7.8	26.474	2.300	5.60	20.8	D 19-42	
14.0	88.8	31.8	57.0	9.2	27.484	2.730	5.82	20.5	D 19-42	
16.0	101.3	35.8	65.5	10.5	28.831	2.893	6.01	20.4	D 19-42	
18.0	114.3	40.3	74.1	11.9	29.311	2.931	6.18	20.5	D 19-42	
20.0	74.6	43.2	31.5	7.1	26.418	2.400	5.48	21.1	D 19-42	
22.0	79.8	45.3	34.5	7.7	26.955	3.160	5.59	20.9	D 19-42	
24.0	85.1	47.7	37.4	8.5	26.970	3.245	5.72	20.5	D 19-42	
26.0	60.7	50.2	10.5	5.5	24.983	1.831	5.17	21.8	D 19-42	
28.0	62.7	52.3	10.5	5.7	25.042	1.738	5.22	21.6	D 19-42	
30.0	64.9	54.5	10.5	6.0	25.300	1.680	5.29	21.4	D 19-42	
32.0	69.0	57.5	11.5	6.5	25.985	1.673	5.39	21.2	D 19-42	
34.0	74.7	63.2	11.5	7.3	26.401	1.786	5.54	20.9	D 19-42	
36.0	80.3	68.8	11.5	8.2	27.273	2.223	5.70	20.4	D 19-42	
38.0	86.0	74.5	11.5	9.0	27.642	2.283	5.84	20.2	D 19-42	
40.0	91.7	80.2	11.5	10.1	28.094	1.781	5.98	20.0	D 19-42	
42.0	101.7	85.4	16.3	11.5	29.164	1.512	6.15	19.9	D 19-42	
44.0	105.3	89.0	16.3	12.0	29.041	1.202	6.23	19.7	D 19-42	
46.0	109.1	92.8	16.3	12.5	29.833	0.989	6.28	19.8	D 19-42	
48.0	113.1	96.8	16.3	13.0	29.854	1.054	6.33	19.7	D 19-42	
50.0	117.2	101.0	16.3	13.7	29.791	0.912	6.40	19.5	D 19-42	
52.0	115.7	105.2	10.5	13.5	30.248	0.900	6.39	19.4	D 19-42	
54.0	119.7	109.2	10.5	14.1	30.431	0.699	6.45	19.3	D 19-42	
56.0	123.8	113.4	10.5	14.7	30.716	0.658	6.51	19.2	D 19-42	
58.0	128.2	117.7	10.5	15.4	30.844	0.519	6.58	19.1	D 19-42	
60.0	132.6	122.1	10.5	16.0	30.647	0.567	6.66	19.0	D 19-42	
62.0	150.5	128.4	22.1	18.8	31.848	0.997	6.89	19.4	D 19-42	
64.0	163.6	141.5	22.1	21.2	32.023	1.008	7.05	19.6	D 19-42	
66.0	176.7	154.6	22.1	24.3	32.537	1.004	7.22	19.8	D 19-42	
68.0	189.8	167.7	22.1	27.8	33.233	1.144	7.36	19.9	D 19-42	
70.0	202.9	180.8	22.1	32.2	33.363	1.029	7.50	20.0	D 19-42	
72.0	202.8	192.3	10.5	32.1	33.901	0.931	7.49	19.9	D 19-42	
74.0	208.3	197.8	10.5	34.2	33.887	0.717	7.54	19.7	D 19-42	
76.0	213.9	203.4	10.5	36.7	33.930	0.495	7.58	19.7	D 19-42	

MOT-835-2.57 Bridge Replacement + Rear Abt RESOURCE INTERNATIONAL INC

78.0	219.7	209.2	10.5	39.6	34.654	0.447	7.63	19.5	D 19-42
80.0	225.7	215.2	10.5	43.7	34.616	0.198	7.69	19.2	D 19-42
82.0	279.7	221.9	57.8	115.5	36.696	0.175	8.01	20.1	D 19-42
83.0	284.4	226.5	57.8	132.8	36.589	0.000	8.02	19.8	D 19-42

Total driving time: 32 minutes; Total Number of Blows: 1406 (starting at penetration 2.0 ft)

Gain/Loss Factor at Shaft/Toe = 1.000/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow bl/ft	CtMx ksi	C-StrMx ksi	T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	22.4	8.2	14.1	1.8	15.302	0.000	4.07	25.7	D 19-42	
4.0	30.7	16.6	14.1	2.7	17.939	0.666	4.42	24.0	D 19-42	
6.0	39.0	24.9	14.1	3.6	20.164	1.066	4.68	23.1	D 19-42	
8.0	47.3	33.2	14.1	4.5	22.035	1.275	4.93	22.4	D 19-42	
10.0	77.3	37.4	39.9	8.0	26.567	2.531	5.63	20.7	D 19-42	
12.0	88.7	40.3	48.5	9.3	28.289	2.921	5.83	20.5	D 19-42	
14.0	100.7	43.7	57.0	10.6	28.974	2.952	6.02	20.3	D 19-42	
16.0	113.2	47.7	65.5	11.9	30.474	2.869	6.19	20.4	D 19-42	
18.0	126.2	52.2	74.1	13.2	30.985	3.143	6.36	20.7	D 19-42	
20.0	87.2	55.8	31.5	8.7	28.159	3.432	5.76	20.5	D 19-42	
22.0	93.5	59.0	34.5	9.6	28.871	3.550	5.89	20.4	D 19-42	
24.0	100.0	62.6	37.4	10.4	28.931	3.275	6.00	20.3	D 19-42	
26.0	76.8	66.3	10.5	7.4	27.651	2.606	5.55	20.9	D 19-42	
28.0	79.9	69.4	10.5	7.7	27.657	2.318	5.62	20.8	D 19-42	
30.0	83.2	72.8	10.5	8.2	27.747	2.600	5.71	20.5	D 19-42	
32.0	89.1	77.6	11.5	9.1	28.682	2.817	5.85	20.3	D 19-42	
34.0	99.3	87.8	11.5	10.8	29.253	2.257	6.08	20.0	D 19-42	
36.0	109.5	98.0	11.5	12.3	30.637	1.694	6.26	19.8	D 19-42	
38.0	119.7	108.2	11.5	13.6	31.054	1.555	6.41	19.9	D 19-42	
40.0	129.9	118.4	11.5	15.1	31.405	1.532	6.57	20.0	D 19-42	
42.0	143.9	127.7	16.3	17.2	32.597	2.299	6.80	20.2	D 19-42	
44.0	149.4	133.1	16.3	18.1	32.335	2.211	6.89	20.2	D 19-42	
46.0	155.1	138.8	16.3	19.1	33.133	2.235	6.98	20.3	D 19-42	
48.0	161.0	144.8	16.3	20.2	33.279	2.265	7.07	20.3	D 19-42	
50.0	167.3	151.0	16.3	21.4	34.445	2.097	7.17	20.3	D 19-42	
52.0	167.8	157.3	10.5	21.5	35.447	2.107	7.18	20.2	D 19-42	
54.0	173.8	163.4	10.5	22.6	35.788	2.097	7.27	20.3	D 19-42	
56.0	180.1	169.6	10.5	23.9	36.127	1.986	7.35	20.3	D 19-42	
58.0	186.5	176.1	10.5	25.5	36.265	1.976	7.43	20.3	D 19-42	
60.0	193.2	182.7	10.5	27.3	35.739	1.696	7.52	20.2	D 19-42	
62.0	214.3	192.2	22.1	34.3	36.483	2.031	7.75	20.5	D 19-42	

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64.0	233.9	211.8	22.1	43.1	36.315	1.997	7.92	20.9	D 19-42
66.0	253.5	231.4	22.1	58.0	36.211	1.790	8.00	20.8	D 19-42
68.0	273.2	251.1	22.1	81.7	36.920	1.799	8.15	20.9	D 19-42
70.0	292.8	270.7	22.1	127.3	36.844	1.494	8.27	21.0	D 19-42
72.0	298.5	288.0	10.5	147.3	37.545	1.426	8.24	20.8	D 19-42
74.0	306.7	296.2	10.5	187.6	37.509	1.085	8.24	20.7	D 19-42
76.0	315.2	304.7	10.5	250.5	37.416	0.727	8.32	20.6	D 19-42
78.0	323.9	313.4	10.5	383.4	38.390	0.909	8.36	20.4	D 19-42
80.0	332.8	322.3	10.5	859.8	38.542	0.896	8.37	20.2	D 19-42
82.0	390.2	332.4	57.8	9999.0	39.954	0.134	8.42	20.1	D 19-42
83.0	397.2	339.3	57.8	9999.0	39.812	0.000	8.42	19.5	D 19-42

Refusal occurred; no driving time output possible.

GRLWEAP: Wave Equation Analysis of Pile Foundations

MOT-835-2.57 Bridge Replacement + Rear Abt
RESOURCE INTERNATIONAL INC

1/29/2025
GRLWEAP 14.1.20.1

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity-blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They **MUST** be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors.

SOIL PROFILE

Depth ft	Soil Type -	Spec. Wt lb/ft ³	Su ksf	Phi °	Unit Rs ksf	Unit Rt ksf
0.0	Clay	125.0	1.6	0.0	1.28	14.62
0.6	Clay	125.0	1.6	0.0	1.28	14.62
0.6	Clay	125.0	2.0	0.0	1.32	18.00
8.6	Clay	125.0	2.0	0.0	1.32	18.00
8.6	Sand	130.0	0.0	38.0	0.35	43.24
18.6	Sand	130.0	0.0	38.0	0.79	97.54
18.6	Sand	130.0	0.0	33.0	0.46	37.21
25.6	Sand	130.0	0.0	33.0	0.64	50.11
25.6	Sand	125.0	0.0	30.0	0.47	13.32
31.6	Sand	125.0	0.0	30.0	0.57	13.32
31.6	Clay	125.0	1.6	0.0	1.62	14.62
41.6	Clay	125.0	1.6	0.0	1.62	14.62
41.6	Sand	130.0	0.0	31.0	0.84	20.71
51.6	Sand	130.0	0.0	31.0	1.05	20.71
51.6	Sand	125.0	0.0	30.0	0.93	13.32
61.6	Sand	125.0	0.0	30.0	1.11	13.32
61.6	Clay	125.0	3.1	0.0	3.12	28.12
71.6	Clay	125.0	3.1	0.0	3.12	28.12
71.6	Sand	130.0	0.0	30.0	1.28	13.32
81.6	Sand	130.0	0.0	30.0	1.47	13.32
81.6	Sand	130.0	0.0	34.0	2.19	73.64
90.6	Sand	130.0	0.0	34.0	2.44	73.64
90.6	Sand	135.0	0.0	32.0	2.03	33.09
95.6	Sand	135.0	0.0	32.0	2.16	33.09
95.6	Sand	125.0	0.0	29.0	1.62	13.32
100.6	Sand	125.0	0.0	29.0	1.70	13.32

PILE INPUT

Uniform Pile		Pile Type:	Closed-End Pipe
Pile Length: (ft)	85.000	Pile Penetration: (ft)	83.000
Pile Size: (ft)	1.00	Toe Area: (in ²)	113.10

Pile Profile

Lb Top ft	X-Area in ²	E-Modulus ksi	Spec. Wt lb/ft ³	Perim. ft	Crit. Index -
0.0	9.2	30,000.0	492.0	3.1	0
85.0	9.2	30,000.0	492.0	3.1	0

HAMMER INPUT

ID	41	Made By:	DELMAG
Model	D 19-42	Type:	OED

Hammer Data

ID	Ram Wt	Ram L.	Ram Ar.	Rtd. Stk	Effic.	Rtd. Energy
-	kips	in	in ²	ft	-	kip-ft
41	4.000	129.1	124.7	10.8	0.80	43.2

DRIVE SYSTEM FOR DELMAG D 19-42-OED

Type	X-Area	E-Modulus	Thickness	COR	Round-out	Stiffness
-	in ²	ksi	in	-	in	kips/in
Hammer C.	227.000	530.000	2.000	0.800	0.120	60155.555
Helmet Wt.	1.900	kips				

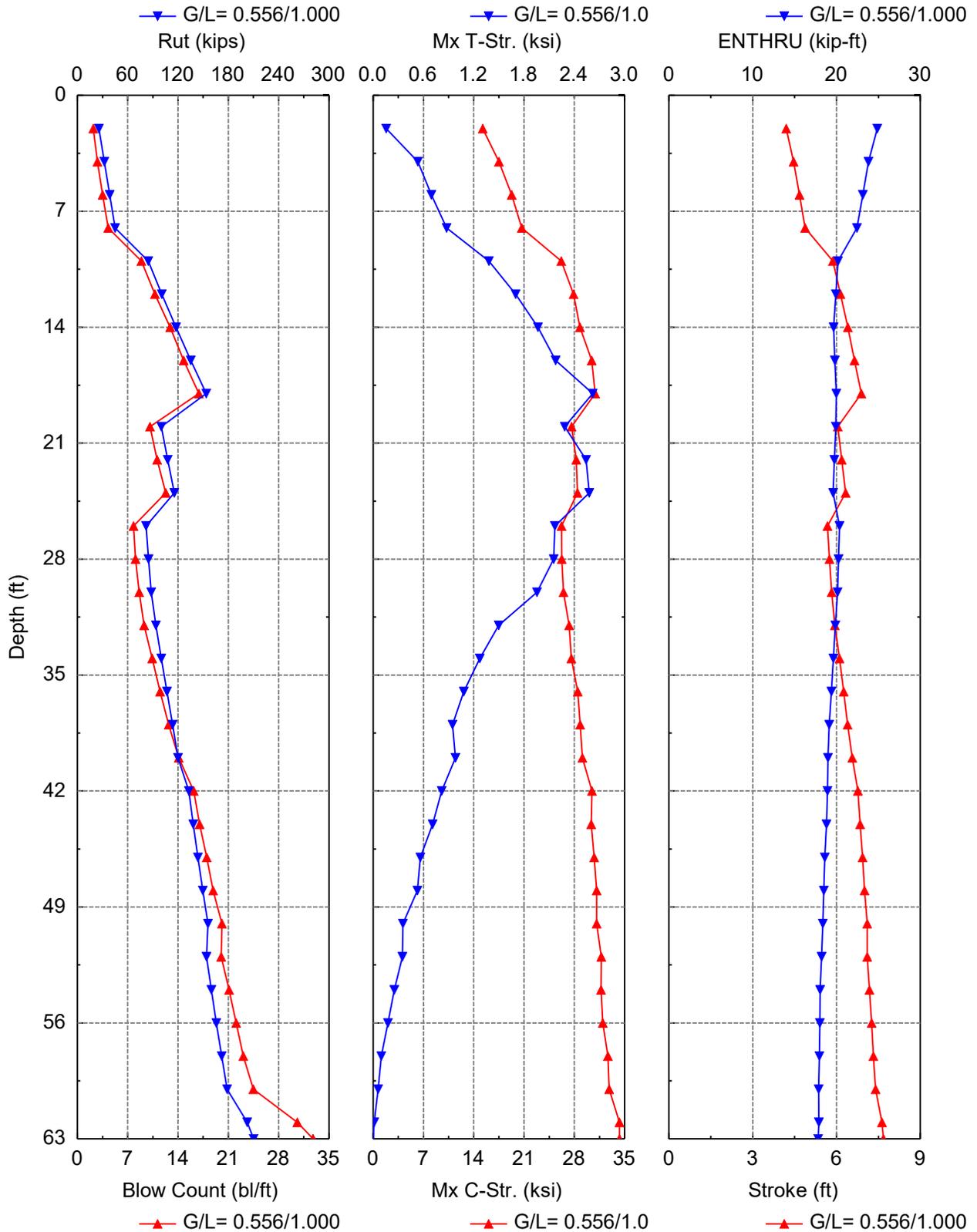
SOIL RESISTANCE DISTRIBUTION

Depth	Unit Rs	Unit Rt	Qs	Qt	Js	Jt	Set. F.	Limit D.	Set. T.	EB Area
ft	ksf	ksf	in	in	s/ft	s/ft	-	ft	Hours	in ²
0.0	1.3	14.6	0.10	0.13	0.15	0.15	1.5	6.0	168.0	113.1
0.6	1.3	14.6	0.10	0.13	0.15	0.15	1.5	6.0	168.0	113.1
0.6	1.3	18.0	0.10	0.12	0.15	0.15	1.5	6.0	1.0	113.1
2.6	1.3	18.0	0.10	0.12	0.15	0.15	1.5	6.0	1.0	113.1
4.6	1.3	18.0	0.10	0.12	0.15	0.15	1.5	6.0	1.0	113.1
6.6	1.3	18.0	0.10	0.12	0.15	0.15	1.5	6.0	1.0	113.1
8.6	1.3	18.0	0.10	0.12	0.15	0.15	1.5	6.0	1.0	113.1
8.6	0.4	43.2	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
10.3	0.4	52.3	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
11.9	0.5	61.3	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
13.6	0.6	70.4	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
15.3	0.6	79.4	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
16.9	0.7	88.5	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
18.6	0.8	97.5	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
18.6	0.5	37.2	0.10	0.11	0.15	0.15	1.5	6.0	24.0	113.1
20.4	0.5	40.8	0.10	0.11	0.15	0.15	1.5	6.0	24.0	113.1
22.1	0.5	44.1	0.10	0.11	0.15	0.15	1.5	6.0	24.0	113.1
23.9	0.6	47.3	0.10	0.11	0.15	0.15	1.5	6.0	24.0	113.1
25.6	0.6	50.1	0.10	0.11	0.15	0.15	1.5	6.0	24.0	113.1
25.6	0.5	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
27.6	0.5	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
29.6	0.5	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
31.6	0.6	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1

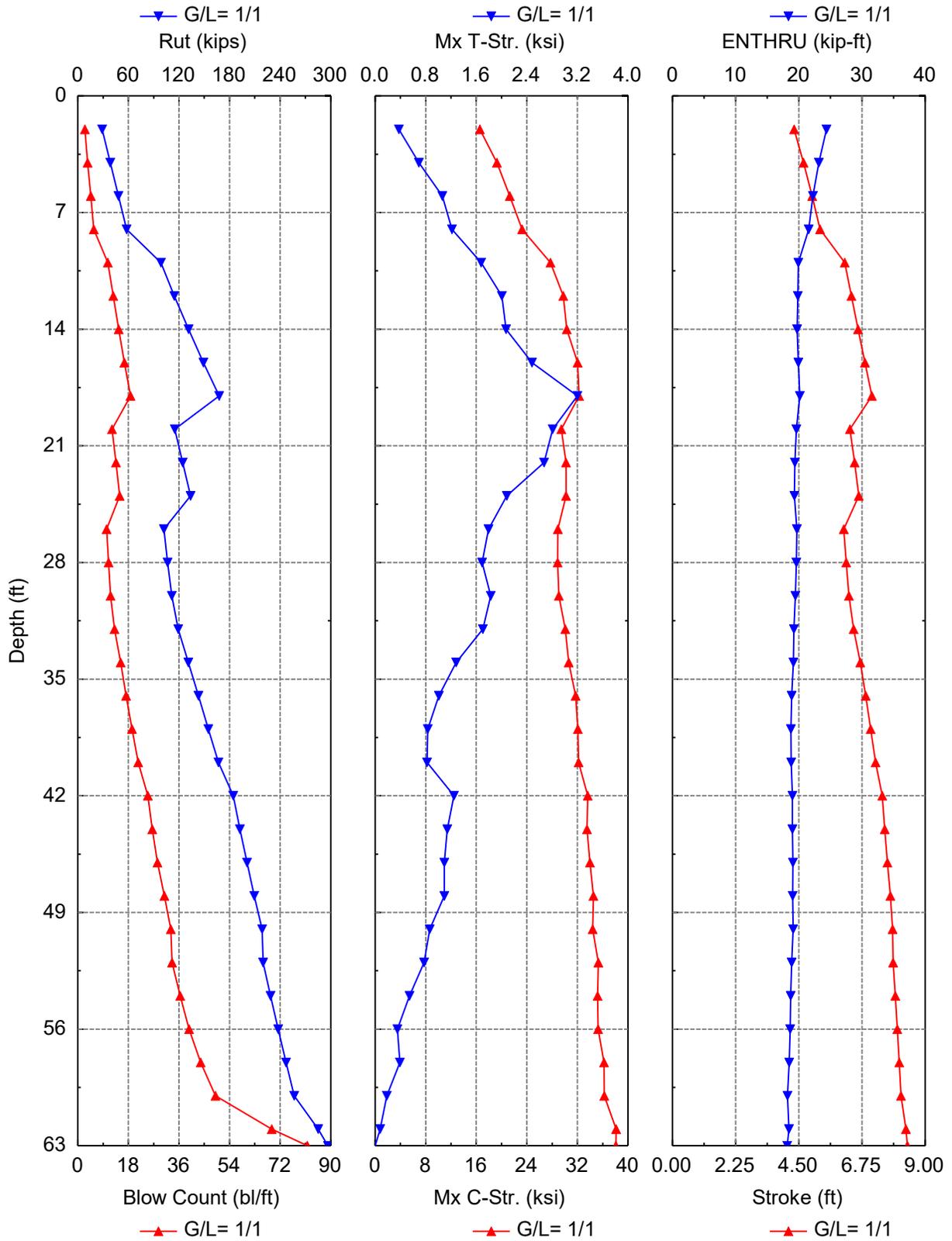
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31.6	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	113.1
33.3	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	113.1
34.9	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	113.1
36.6	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	113.1
38.3	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	113.1
39.9	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	113.1
41.6	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	113.1
41.6	0.8	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	113.1
43.3	0.9	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	113.1
44.9	0.9	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	113.1
46.6	0.9	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	113.1
48.3	1.0	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	113.1
49.9	1.0	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	113.1
51.6	1.0	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	113.1
51.6	0.9	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
53.3	1.0	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
54.9	1.0	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
56.6	1.0	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
58.3	1.0	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
59.9	1.1	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
61.6	1.1	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
61.6	3.1	28.1	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
63.3	3.1	28.1	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
64.9	3.1	28.1	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
66.6	3.1	28.1	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
68.3	3.1	28.1	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
69.9	3.1	28.1	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
71.6	3.1	28.1	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
71.6	1.3	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
73.3	1.3	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
74.9	1.3	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
76.6	1.4	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
78.3	1.4	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
79.9	1.4	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
81.6	1.5	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	113.1
81.6	2.2	73.6	0.10	0.11	0.15	0.15	1.5	6.0	24.0	113.1
83.0	2.2	73.6	0.10	0.11	0.15	0.15	1.5	6.0	24.0	113.1

Driveability Analysis Summary



Driveability Analysis Summary



Gain/Loss Factor at Shaft/Toe = 0.556/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow bl/ft	CtMx ksi	C-StrMx ksi	T-Str. ft	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	25.6	6.4	19.2	2.2	15.257	0.156	4.20	24.9	D 19-42	
4.0	32.1	12.9	19.2	2.8	17.488	0.533	4.46	23.8	D 19-42	
6.0	38.6	19.4	19.2	3.5	19.293	0.695	4.67	23.1	D 19-42	
8.0	45.1	25.8	19.2	4.3	20.674	0.877	4.87	22.4	D 19-42	
10.0	84.7	30.3	54.4	8.9	26.179	1.381	5.87	20.2	D 19-42	
12.0	100.7	34.7	66.0	10.8	27.902	1.700	6.14	19.9	D 19-42	
14.0	117.5	40.0	77.6	12.9	28.768	1.967	6.40	19.6	D 19-42	
16.0	135.2	46.0	89.2	14.8	30.424	2.176	6.64	19.8	D 19-42	
18.0	153.8	53.0	100.8	16.9	30.883	2.620	6.89	20.0	D 19-42	
20.0	100.2	57.3	42.9	10.1	27.629	2.285	6.04	19.9	D 19-42	
22.0	107.8	60.5	47.3	11.1	28.276	2.541	6.18	19.7	D 19-42	
24.0	115.6	64.1	51.5	12.3	28.436	2.577	6.33	19.6	D 19-42	
26.0	81.9	67.7	14.2	7.8	26.220	2.167	5.68	20.3	D 19-42	
28.0	84.9	70.7	14.2	8.1	26.235	2.153	5.74	20.2	D 19-42	
30.0	88.1	73.9	14.2	8.6	26.492	1.953	5.82	20.1	D 19-42	
32.0	93.6	78.0	15.6	9.3	27.274	1.499	5.94	19.9	D 19-42	
34.0	100.2	84.6	15.6	10.4	27.575	1.272	6.10	19.6	D 19-42	
36.0	106.8	91.2	15.6	11.5	28.472	1.081	6.25	19.4	D 19-42	
38.0	113.4	97.8	15.6	12.7	28.810	0.946	6.40	19.1	D 19-42	
40.0	120.1	104.4	15.6	14.1	29.112	0.982	6.56	19.0	D 19-42	
42.0	132.9	110.7	22.1	16.2	30.451	0.818	6.76	18.9	D 19-42	
44.0	138.2	116.0	22.1	17.0	30.340	0.709	6.85	18.8	D 19-42	
46.0	143.7	121.6	22.1	18.0	30.753	0.564	6.93	18.6	D 19-42	
48.0	149.5	127.4	22.1	18.9	31.116	0.528	7.01	18.5	D 19-42	
50.0	155.6	133.5	22.1	20.1	31.109	0.355	7.10	18.4	D 19-42	
52.0	153.9	139.7	14.2	20.0	31.737	0.351	7.10	18.2	D 19-42	
54.0	159.7	145.5	14.2	21.1	31.717	0.252	7.18	18.0	D 19-42	
56.0	165.8	151.5	14.2	22.1	31.943	0.177	7.25	18.0	D 19-42	
58.0	172.0	157.8	14.2	23.1	32.665	0.097	7.32	18.0	D 19-42	
60.0	178.5	164.3	14.2	24.5	32.836	0.059	7.40	17.9	D 19-42	
62.0	202.7	172.6	30.1	30.6	34.290	0.014	7.63	17.9	D 19-42	
63.0	210.3	180.3	30.1	32.8	34.283	0.000	7.68	17.8	D 19-42	

Total driving time: 19 minutes; Total Number of Blows: 848 (starting at penetration 2.0 ft)

Gain/Loss Factor at Shaft/Toe = 1.000/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow bl/ft	CtMx ksi	C-StrMx ksi	T-Str. ft	Stroke ft	ENTHRU kip-ft	Hammer -
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MOT-835-2.57 Bridge Replacement + Rear Abt RESOURCE INTERNATIONAL INC

2.0	28.9	9.6	19.2	2.5	16.580	0.375	4.33	24.4	D 19-42
4.0	38.6	19.3	19.2	3.5	19.266	0.693	4.67	23.2	D 19-42
6.0	48.3	29.0	19.2	4.6	21.301	1.065	4.97	22.2	D 19-42
8.0	58.0	38.7	19.2	5.7	23.240	1.217	5.25	21.5	D 19-42
10.0	98.6	44.2	54.4	10.7	27.750	1.675	6.13	19.9	D 19-42
12.0	114.6	48.6	66.0	12.6	29.775	2.005	6.37	19.8	D 19-42
14.0	131.4	53.9	77.6	14.6	30.329	2.070	6.61	19.7	D 19-42
16.0	149.1	59.9	89.2	16.6	32.024	2.481	6.85	19.9	D 19-42
18.0	167.7	66.9	100.8	18.8	32.263	3.200	7.10	20.1	D 19-42
20.0	115.1	72.2	42.9	12.2	29.462	2.808	6.32	19.6	D 19-42
22.0	124.4	77.1	47.3	13.6	30.186	2.674	6.48	19.4	D 19-42
24.0	133.9	82.4	51.5	14.9	30.190	2.083	6.63	19.3	D 19-42
26.0	102.1	87.8	14.2	10.3	28.912	1.793	6.10	19.7	D 19-42
28.0	106.6	92.3	14.2	11.0	28.864	1.691	6.19	19.6	D 19-42
30.0	111.4	97.1	14.2	11.7	29.063	1.830	6.28	19.4	D 19-42
32.0	119.2	103.6	15.6	13.1	30.096	1.706	6.45	19.2	D 19-42
34.0	131.1	115.5	15.6	15.3	30.621	1.281	6.69	19.1	D 19-42
36.0	143.1	127.4	15.6	17.2	31.708	1.011	6.88	18.8	D 19-42
38.0	155.0	139.3	15.6	19.3	32.087	0.833	7.05	18.7	D 19-42
40.0	166.9	151.2	15.6	21.5	32.182	0.822	7.23	18.8	D 19-42
42.0	184.5	162.3	22.1	24.9	33.631	1.246	7.47	19.0	D 19-42
44.0	192.4	170.3	22.1	26.5	33.530	1.143	7.56	19.0	D 19-42
46.0	200.7	178.6	22.1	28.4	33.967	1.096	7.65	19.0	D 19-42
48.0	209.5	187.3	22.1	30.8	34.546	1.093	7.76	19.0	D 19-42
50.0	218.6	196.4	22.1	33.1	34.401	0.865	7.84	19.1	D 19-42
52.0	219.9	205.7	14.2	33.5	35.322	0.773	7.86	18.9	D 19-42
54.0	228.7	214.4	14.2	36.4	35.207	0.546	7.93	18.7	D 19-42
56.0	237.7	223.5	14.2	39.6	35.267	0.355	8.00	18.6	D 19-42
58.0	247.1	232.9	14.2	43.7	36.218	0.393	8.07	18.5	D 19-42
60.0	256.8	242.6	14.2	49.0	36.231	0.186	8.13	18.2	D 19-42
62.0	285.2	255.2	30.1	69.0	38.123	0.079	8.31	18.4	D 19-42
63.0	296.7	266.6	30.1	81.7	38.093	0.000	8.36	18.2	D 19-42

Total driving time: 31 minutes; Total Number of Blows: 1333 (starting at penetration 2.0 ft)

GRLWEAP: Wave Equation Analysis of Pile Foundations

MOT-835-2.57 Bridge Replacement + Rear Abt
RESOURCE INTERNATIONAL INC

1/29/2025
GRLWEAP 14.1.20.1

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity-blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They **MUST** be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors.

SOIL PROFILE

Depth ft	Soil Type -	Spec. Wt lb/ft ³	Su ksf	Phi °	Unit Rs ksf	Unit Rt ksf
0.0	Clay	125.0	1.6	0.0	1.28	14.62
0.6	Clay	125.0	1.6	0.0	1.28	14.62
0.6	Clay	125.0	2.0	0.0	1.32	18.00
8.6	Clay	125.0	2.0	0.0	1.32	18.00
8.6	Sand	130.0	0.0	38.0	0.35	43.24
18.6	Sand	130.0	0.0	38.0	0.79	97.54
18.6	Sand	130.0	0.0	33.0	0.46	37.21
25.6	Sand	130.0	0.0	33.0	0.64	50.11
25.6	Sand	125.0	0.0	30.0	0.47	13.32
31.6	Sand	125.0	0.0	30.0	0.57	13.32
31.6	Clay	125.0	1.6	0.0	1.62	14.62
41.6	Clay	125.0	1.6	0.0	1.62	14.62
41.6	Sand	130.0	0.0	31.0	0.84	20.71
51.6	Sand	130.0	0.0	31.0	1.05	20.71
51.6	Sand	125.0	0.0	30.0	0.93	13.32
61.6	Sand	125.0	0.0	30.0	1.11	13.32
61.6	Clay	125.0	3.1	0.0	3.12	28.12
71.6	Clay	125.0	3.1	0.0	3.12	28.12
71.6	Sand	130.0	0.0	30.0	1.28	13.32
81.6	Sand	130.0	0.0	30.0	1.47	13.32
81.6	Sand	130.0	0.0	34.0	2.19	73.64
90.6	Sand	130.0	0.0	34.0	2.44	73.64
90.6	Sand	135.0	0.0	32.0	2.03	33.09
95.6	Sand	135.0	0.0	32.0	2.16	33.09
95.6	Sand	125.0	0.0	29.0	1.62	13.32
100.6	Sand	125.0	0.0	29.0	1.70	13.32

PILE INPUT

Uniform Pile		Pile Type:	Closed-End Pipe
Pile Length: (ft)	65.000	Pile Penetration: (ft)	63.000
Pile Size: (ft)	1.17	Toe Area: (in ²)	153.94

Pile Profile

Lb Top ft	X-Area in ²	E-Modulus ksi	Spec. Wt lb/ft ³	Perim. ft	Crit. Index -
0.0	10.8	30,000.0	492.0	3.7	0
65.0	10.8	30,000.0	492.0	3.7	0

HAMMER INPUT

ID	41	Made By:	DELMAG
Model	D 19-42	Type:	OED

Hammer Data

ID	Ram Wt	Ram L.	Ram Ar.	Rtd. Stk	Effic.	Rtd. Energy
-	kips	in	in ²	ft	-	kip-ft
41	4.000	129.1	124.7	10.8	0.80	43.2

DRIVE SYSTEM FOR DELMAG D 19-42-OED

Type	X-Area	E-Modulus	Thickness	COR	Round-out	Stiffness
-	in ²	ksi	in	-	in	kips/in
Hammer C.	227.000	530.000	2.000	0.800	0.120	60155.555
Helmet Wt.	1.900	kips				

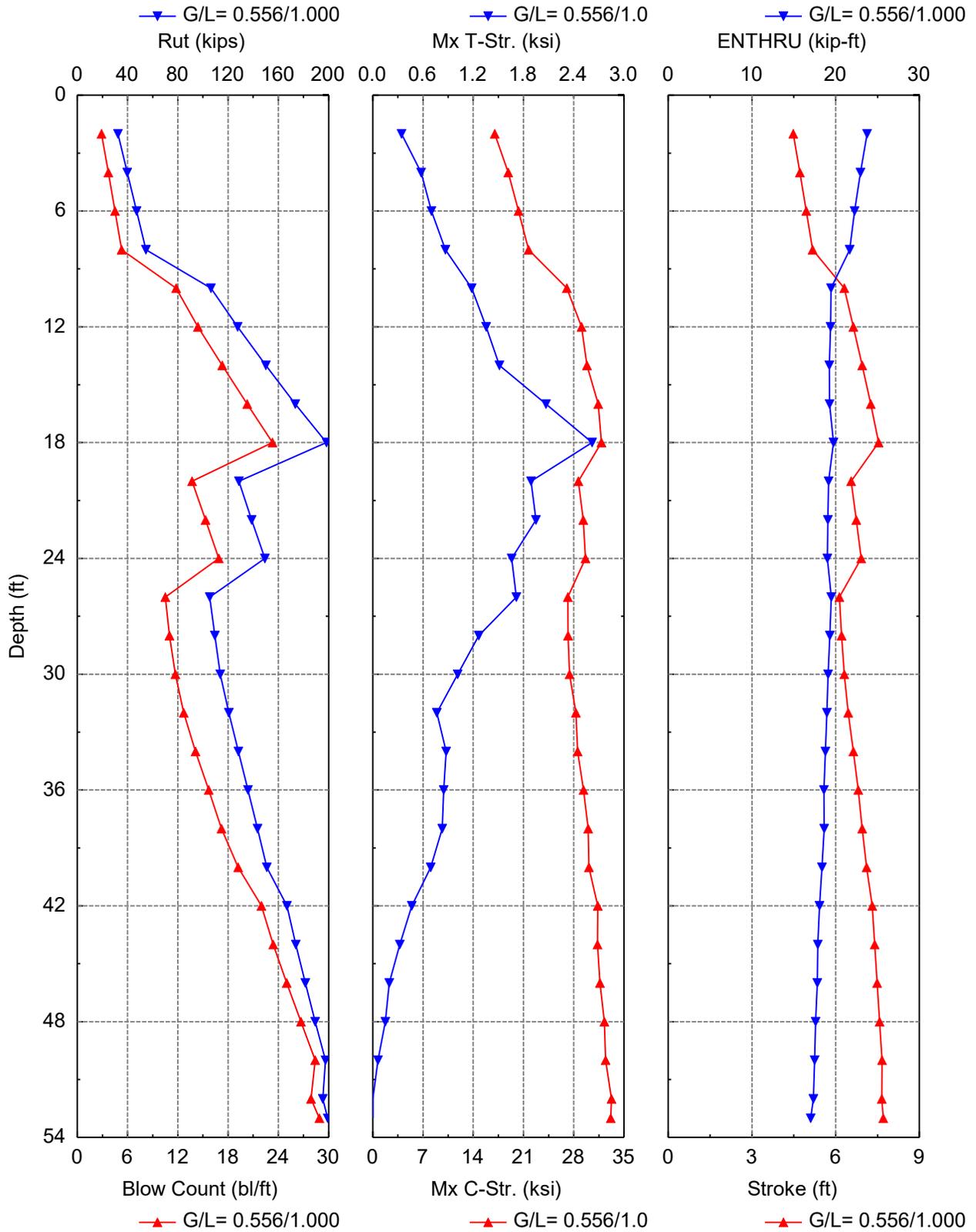
SOIL RESISTANCE DISTRIBUTION

Depth	Unit Rs	Unit Rt	Qs	Qt	Js	Jt	Set. F.	Limit D.	Set. T.	EB Area
ft	ksf	ksf	in	in	s/ft	s/ft	-	ft	Hours	in ²
0.0	1.3	14.6	0.10	0.13	0.15	0.15	1.5	6.0	168.0	153.9
0.6	1.3	14.6	0.10	0.13	0.15	0.15	1.5	6.0	168.0	153.9
0.6	1.3	18.0	0.10	0.12	0.15	0.15	1.5	6.0	1.0	153.9
2.6	1.3	18.0	0.10	0.12	0.15	0.15	1.5	6.0	1.0	153.9
4.6	1.3	18.0	0.10	0.12	0.15	0.15	1.5	6.0	1.0	153.9
6.6	1.3	18.0	0.10	0.12	0.15	0.15	1.5	6.0	1.0	153.9
8.6	1.3	18.0	0.10	0.12	0.15	0.15	1.5	6.0	1.0	153.9
8.6	0.5	43.2	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
10.3	0.6	52.3	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
11.9	0.7	61.3	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
13.6	0.7	70.4	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
15.3	0.8	79.4	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
16.9	0.9	88.5	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
18.6	1.0	97.5	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
18.6	0.6	37.2	0.10	0.11	0.15	0.15	1.5	6.0	24.0	153.9
20.4	0.6	40.8	0.10	0.11	0.15	0.15	1.5	6.0	24.0	153.9
22.1	0.7	44.5	0.10	0.11	0.15	0.15	1.5	6.0	24.0	153.9
23.9	0.8	48.0	0.10	0.11	0.15	0.15	1.5	6.0	24.0	153.9
25.6	0.8	50.1	0.10	0.11	0.15	0.15	1.5	6.0	24.0	153.9
25.6	0.6	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	153.9
27.6	0.6	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	153.9
29.6	0.7	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	153.9
31.6	0.7	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	153.9

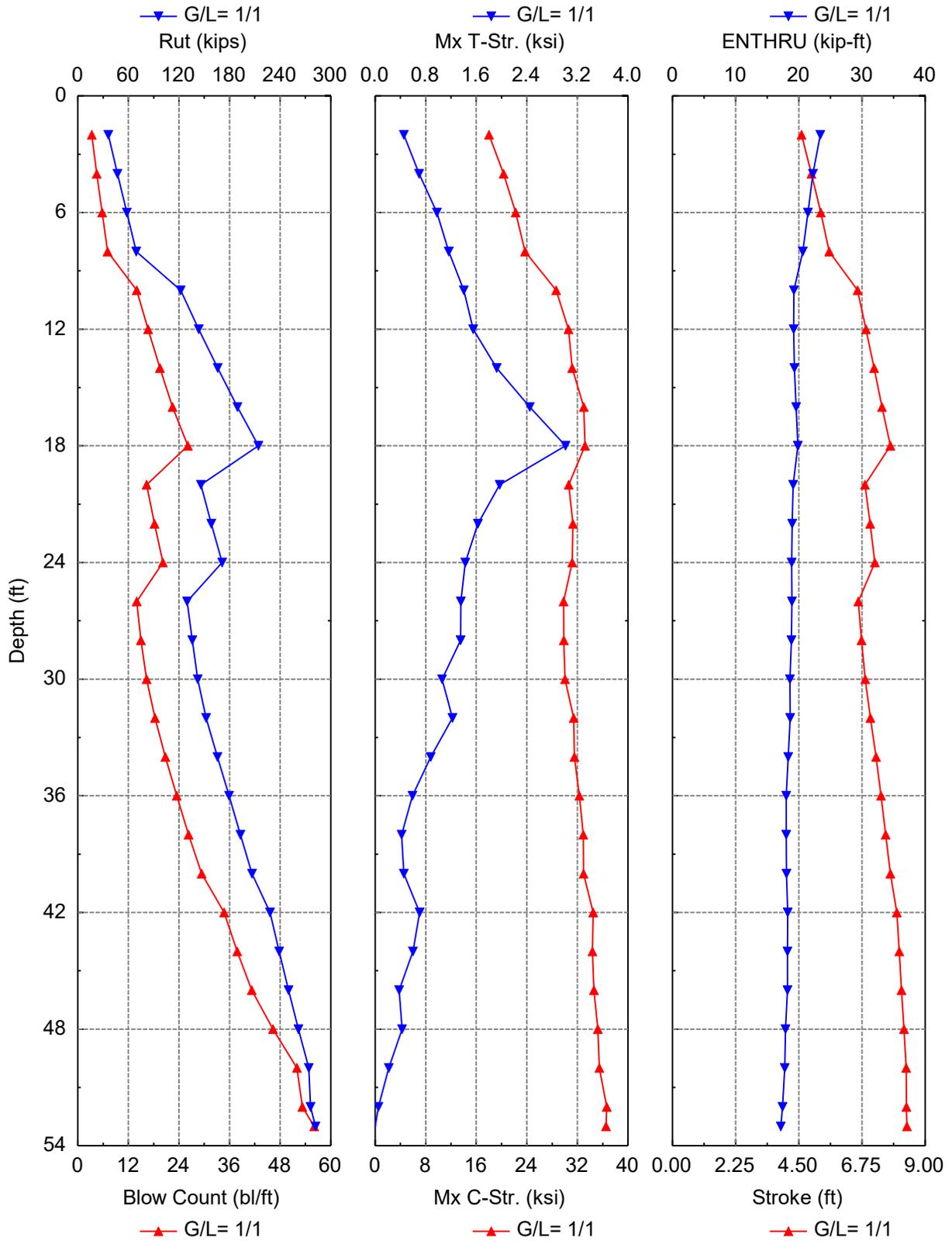
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31.6	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	153.9
33.3	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	153.9
34.9	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	153.9
36.6	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	153.9
38.3	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	153.9
39.9	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	153.9
41.6	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	153.9
41.6	1.0	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	153.9
43.3	1.1	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	153.9
44.9	1.1	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	153.9
46.6	1.2	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	153.9
48.3	1.2	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	153.9
49.9	1.3	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	153.9
51.6	1.3	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	153.9
51.6	1.2	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	153.9
53.3	1.2	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	153.9
54.9	1.2	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	153.9
56.6	1.3	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	153.9
58.3	1.3	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	153.9
59.9	1.3	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	153.9
61.6	1.4	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	153.9
61.6	3.1	28.1	0.10	0.11	0.15	0.15	1.5	6.0	168.0	153.9
63.0	3.1	28.1	0.10	0.11	0.15	0.15	1.5	6.0	168.0	153.9

Driveability Analysis Summary



Driveability Analysis Summary



Gain/Loss Factor at Shaft/Toe = 0.556/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow CtMx bl/ft	C-StrMx ksi	T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	32.5	7.3	25.1	2.9	16.981	0.344	4.48	23.8	D 19-42
4.0	39.9	14.7	25.1	3.7	18.857	0.577	4.72	23.0	D 19-42
6.0	47.3	22.1	25.1	4.5	20.323	0.702	4.95	22.3	D 19-42
8.0	54.7	29.5	25.1	5.3	21.713	0.868	5.18	21.7	D 19-42
10.0	106.3	35.3	71.0	11.8	27.029	1.182	6.31	19.4	D 19-42
12.0	127.6	41.4	86.2	14.4	29.078	1.355	6.64	19.4	D 19-42
14.0	150.0	48.7	101.3	17.3	29.853	1.513	6.95	19.2	D 19-42
16.0	173.6	57.1	116.5	20.3	31.410	2.068	7.26	19.3	D 19-42
18.0	198.4	66.8	131.6	23.3	31.847	2.619	7.54	19.7	D 19-42
20.0	128.7	72.7	56.0	13.7	28.627	1.889	6.56	19.2	D 19-42
22.0	138.9	77.1	61.8	15.3	29.329	1.949	6.74	19.1	D 19-42
24.0	149.3	81.9	67.4	16.9	29.619	1.659	6.91	19.0	D 19-42
26.0	105.4	86.8	18.6	10.5	27.181	1.713	6.13	19.5	D 19-42
28.0	109.4	90.8	18.6	11.0	27.224	1.265	6.21	19.3	D 19-42
30.0	113.7	95.1	18.6	11.7	27.416	1.014	6.30	19.1	D 19-42
32.0	120.7	100.3	20.4	12.7	28.298	0.766	6.45	19.0	D 19-42
34.0	128.2	107.8	20.4	14.1	28.524	0.875	6.63	18.8	D 19-42
36.0	135.8	115.4	20.4	15.7	29.374	0.848	6.81	18.6	D 19-42
38.0	143.4	122.9	20.4	17.2	30.008	0.830	6.95	18.6	D 19-42
40.0	150.9	130.5	20.4	19.2	30.124	0.692	7.11	18.4	D 19-42
42.0	166.9	137.9	28.9	22.0	31.328	0.467	7.31	18.1	D 19-42
44.0	174.0	145.1	28.9	23.4	31.322	0.324	7.40	17.9	D 19-42
46.0	181.5	152.5	28.9	25.0	31.641	0.199	7.48	17.8	D 19-42
48.0	189.3	160.4	28.9	26.7	32.278	0.149	7.57	17.6	D 19-42
50.0	197.4	168.5	28.9	28.4	32.434	0.064	7.66	17.5	D 19-42
52.0	195.4	176.8	18.6	27.9	33.257	0.000	7.65	17.3	D 19-42
53.0	199.3	180.7	18.6	28.9	33.158	0.000	7.70	17.0	D 19-42

Total driving time: 19 minutes; Total Number of Blows: 827 (starting at penetration 2.0 ft)

Gain/Loss Factor at Shaft/Toe = 1.000/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow CtMx bl/ft	C-StrMx ksi	T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	36.1	11.0	25.1	3.3	18.006	0.453	4.60	23.4	D 19-42
4.0	47.2	22.1	25.1	4.5	20.300	0.698	4.95	22.2	D 19-42
6.0	58.3	33.2	25.1	5.8	22.212	0.979	5.28	21.4	D 19-42
8.0	69.4	44.3	25.1	7.1	23.727	1.165	5.58	20.6	D 19-42
10.0	122.2	51.2	71.0	14.0	28.641	1.402	6.58	19.2	D 19-42

MOT-835-2.57 Bridge Replacement + Rear Abt RESOURCE INTERNATIONAL INC

12.0	143.4	57.3	86.2	16.7	30.577	1.550	6.89	19.2	D 19-42
14.0	165.9	64.5	101.3	19.5	31.159	1.923	7.17	19.3	D 19-42
16.0	189.5	73.0	116.5	22.5	32.995	2.445	7.46	19.5	D 19-42
18.0	214.3	82.6	131.6	26.1	33.188	3.013	7.75	19.8	D 19-42
20.0	146.0	90.0	56.0	16.3	30.608	1.970	6.85	19.1	D 19-42
22.0	158.3	96.5	61.8	18.2	31.280	1.628	7.03	18.9	D 19-42
24.0	171.1	103.7	67.4	20.2	31.169	1.425	7.21	18.8	D 19-42
26.0	129.7	111.1	18.6	14.0	29.789	1.355	6.61	18.9	D 19-42
28.0	135.7	117.1	18.6	15.0	29.865	1.352	6.73	18.8	D 19-42
30.0	142.2	123.6	18.6	16.3	30.053	1.061	6.86	18.6	D 19-42
32.0	152.2	131.8	20.4	18.3	31.408	1.225	7.05	18.6	D 19-42
34.0	165.8	145.4	20.4	20.8	31.515	0.881	7.25	18.3	D 19-42
36.0	179.4	159.0	20.4	23.5	32.315	0.591	7.43	18.0	D 19-42
38.0	193.0	172.6	20.4	26.3	32.926	0.419	7.59	18.0	D 19-42
40.0	206.6	186.2	20.4	29.4	32.964	0.455	7.76	18.0	D 19-42
42.0	228.1	199.2	28.9	34.7	34.491	0.706	7.98	18.2	D 19-42
44.0	238.8	209.9	28.9	37.8	34.388	0.598	8.07	18.2	D 19-42
46.0	250.0	221.1	28.9	41.3	34.609	0.381	8.16	18.2	D 19-42
48.0	261.7	232.8	28.9	46.3	35.244	0.428	8.24	17.9	D 19-42
50.0	274.0	245.1	28.9	52.0	35.454	0.215	8.32	17.8	D 19-42
52.0	276.1	257.5	18.6	53.3	36.651	0.053	8.33	17.4	D 19-42
53.0	281.9	263.3	18.6	56.1	36.506	0.000	8.35	17.1	D 19-42

Total driving time: 28 minutes; Total Number of Blows: 1204 (starting at penetration 2.0 ft)

GRLWEAP: Wave Equation Analysis of Pile Foundations

MOT-835-2.57 Bridge Replacement + Rear Abt
RESOURCE INTERNATIONAL INC

1/29/2025
GRLWEAP 14.1.20.1

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity-blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They **MUST** be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors.

SOIL PROFILE

Depth ft	Soil Type -	Spec. Wt lb/ft ³	Su ksf	Phi °	Unit Rs ksf	Unit Rt ksf
0.0	Clay	125.0	1.6	0.0	1.28	14.62
0.6	Clay	125.0	1.6	0.0	1.28	14.62
0.6	Clay	125.0	2.0	0.0	1.32	18.00
8.6	Clay	125.0	2.0	0.0	1.32	18.00
8.6	Sand	130.0	0.0	38.0	0.35	43.24
18.6	Sand	130.0	0.0	38.0	0.79	97.54
18.6	Sand	130.0	0.0	33.0	0.46	37.21
25.6	Sand	130.0	0.0	33.0	0.64	50.11
25.6	Sand	125.0	0.0	30.0	0.47	13.32
31.6	Sand	125.0	0.0	30.0	0.57	13.32
31.6	Clay	125.0	1.6	0.0	1.62	14.62
41.6	Clay	125.0	1.6	0.0	1.62	14.62
41.6	Sand	130.0	0.0	31.0	0.84	20.71
51.6	Sand	130.0	0.0	31.0	1.05	20.71
51.6	Sand	125.0	0.0	30.0	0.93	13.32
61.6	Sand	125.0	0.0	30.0	1.11	13.32
61.6	Clay	125.0	3.1	0.0	3.12	28.12
71.6	Clay	125.0	3.1	0.0	3.12	28.12
71.6	Sand	130.0	0.0	30.0	1.28	13.32
81.6	Sand	130.0	0.0	30.0	1.47	13.32
81.6	Sand	130.0	0.0	34.0	2.19	73.64
90.6	Sand	130.0	0.0	34.0	2.44	73.64
90.6	Sand	135.0	0.0	32.0	2.03	33.09
95.6	Sand	135.0	0.0	32.0	2.16	33.09
95.6	Sand	125.0	0.0	29.0	1.62	13.32
100.6	Sand	125.0	0.0	29.0	1.70	13.32

PILE INPUT

Uniform Pile		Pile Type:	Closed-End Pipe
Pile Length: (ft)	55.000	Pile Penetration: (ft)	53.000
Pile Size: (ft)	1.33	Toe Area: (in ²)	201.06

Pile Profile

Lb Top ft	X-Area in ²	E-Modulus ksi	Spec. Wt lb/ft ³	Perim. ft	Crit. Index -
0.0	12.4	30,000.0	492.0	4.2	0
55.0	12.4	30,000.0	492.0	4.2	0

HAMMER INPUT

ID	41	Made By:	DELMAG
Model	D 19-42	Type:	OED

Hammer Data

ID	Ram Wt	Ram L.	Ram Ar.	Rtd. Stk	Effic.	Rtd. Energy
-	kips	in	in ²	ft	-	kip-ft
41	4.000	129.1	124.7	10.8	0.80	43.2

DRIVE SYSTEM FOR DELMAG D 19-42-OED

Type	X-Area	E-Modulus	Thickness	COR	Round-out	Stiffness
-	in ²	ksi	in	-	in	kips/in
Hammer C.	227.000	530.000	2.000	0.800	0.120	60155.555
Helmet Wt.	1.900	kips				

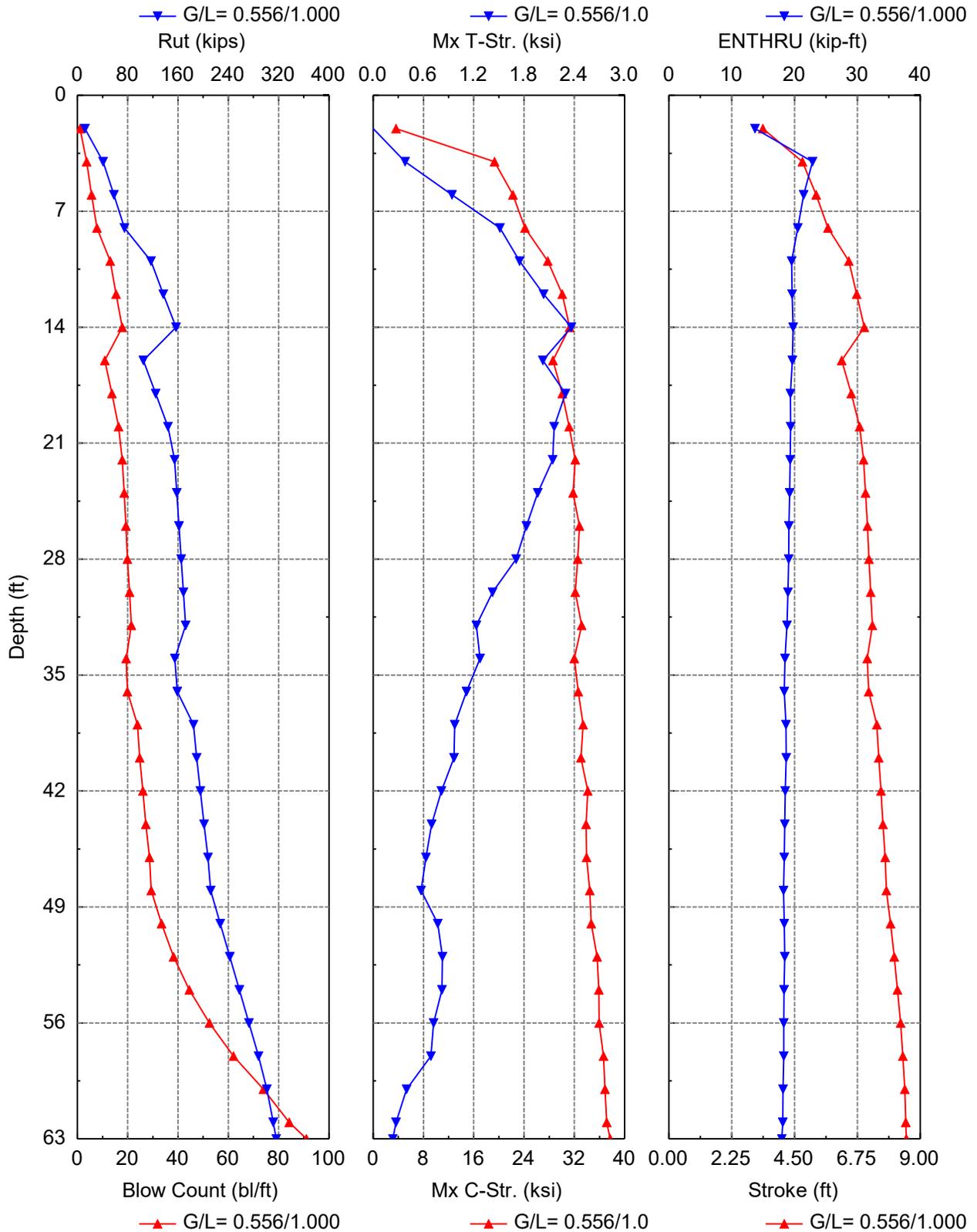
SOIL RESISTANCE DISTRIBUTION

Depth	Unit Rs	Unit Rt	Qs	Qt	Js	Jt	Set. F.	Limit D.	Set. T.	EB Area
ft	ksf	ksf	in	in	s/ft	s/ft	-	ft	Hours	in ²
0.0	1.3	14.6	0.10	0.13	0.15	0.15	1.5	6.0	168.0	201.1
0.6	1.3	14.6	0.10	0.13	0.15	0.15	1.5	6.0	168.0	201.1
0.6	1.3	18.0	0.10	0.12	0.15	0.15	1.5	6.0	1.0	201.1
2.6	1.3	18.0	0.10	0.12	0.15	0.15	1.5	6.0	1.0	201.1
4.6	1.3	18.0	0.10	0.12	0.15	0.15	1.5	6.0	1.0	201.1
6.6	1.3	18.0	0.10	0.12	0.15	0.15	1.5	6.0	1.0	201.1
8.6	1.3	18.0	0.10	0.12	0.15	0.15	1.5	6.0	1.0	201.1
8.6	0.6	43.2	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
10.3	0.7	52.3	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
11.9	0.8	61.3	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
13.6	0.9	70.4	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
15.3	1.0	79.4	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
16.9	1.1	88.5	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
18.6	1.3	97.5	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
18.6	0.7	37.2	0.10	0.11	0.15	0.15	1.5	6.0	24.0	201.1
20.4	0.8	40.8	0.10	0.11	0.15	0.15	1.5	6.0	24.0	201.1
22.1	0.8	44.5	0.10	0.11	0.15	0.15	1.5	6.0	24.0	201.1
23.9	0.9	48.1	0.10	0.11	0.15	0.15	1.5	6.0	24.0	201.1
25.6	1.0	50.1	0.10	0.11	0.15	0.15	1.5	6.0	24.0	201.1
25.6	0.7	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	201.1
27.6	0.7	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	201.1
29.6	0.8	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	201.1
31.6	0.8	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	201.1

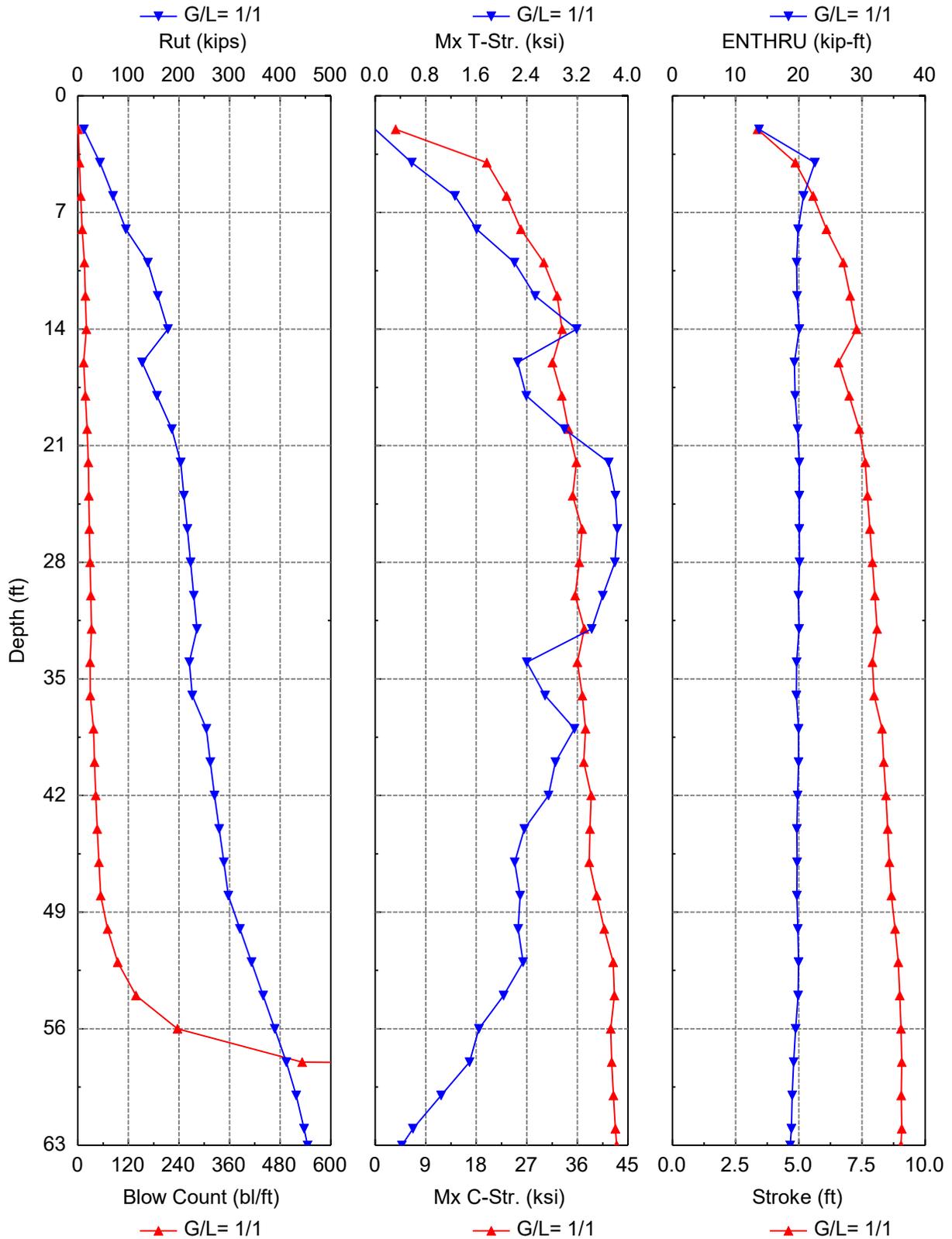
MOT-835-2.57 Bridge Replacement + Rear Abt RESOURCE INTERNATIONAL INC

31.6	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	201.1
33.3	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	201.1
34.9	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	201.1
36.6	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	201.1
38.3	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	201.1
39.9	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	201.1
41.6	1.6	14.6	0.10	0.13	0.20	0.15	1.8	6.0	168.0	201.1
41.6	1.2	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	201.1
43.3	1.3	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	201.1
44.9	1.3	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	201.1
46.6	1.4	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	201.1
48.3	1.4	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	201.1
49.9	1.5	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	201.1
51.6	1.5	20.7	0.10	0.13	0.15	0.15	1.5	6.0	24.0	201.1
51.6	1.4	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	201.1
53.0	1.4	13.3	0.10	0.14	0.15	0.15	1.5	6.0	24.0	201.1

Driveability Analysis Summary



Driveability Analysis Summary



Gain/Loss Factor at Shaft/Toe = 0.556/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow bl/ft	CtMx ksi	C-StrMx ksi	T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	12.0	0.4	11.6	1.1	3.658	0.000	3.37	13.7	D 19-42	
4.0	40.8	7.1	33.7	3.7	19.309	0.383	4.77	22.8	D 19-42	
6.0	57.9	24.2	33.7	5.6	22.213	0.940	5.27	21.5	D 19-42	
8.0	75.0	41.3	33.7	7.8	24.141	1.511	5.70	20.5	D 19-42	
10.0	117.1	47.4	69.6	13.1	27.791	1.746	6.44	19.5	D 19-42	
12.0	136.5	52.4	84.1	15.4	30.079	2.034	6.72	19.6	D 19-42	
14.0	156.9	58.4	98.6	17.8	31.265	2.364	6.99	19.7	D 19-42	
16.0	104.9	66.5	38.5	10.9	28.607	2.024	6.18	19.6	D 19-42	
18.0	124.5	86.0	38.5	13.7	30.062	2.294	6.53	19.3	D 19-42	
20.0	144.0	105.5	38.5	16.4	31.167	2.160	6.82	19.4	D 19-42	
22.0	154.4	119.5	34.9	17.8	32.142	2.142	6.97	19.3	D 19-42	
24.0	157.9	123.0	34.9	18.6	31.799	1.962	7.04	19.2	D 19-42	
26.0	161.5	126.6	34.9	19.3	32.833	1.827	7.10	19.1	D 19-42	
28.0	165.0	130.1	34.9	19.9	32.532	1.707	7.16	19.0	D 19-42	
30.0	168.5	133.7	34.9	20.8	32.167	1.425	7.23	19.0	D 19-42	
32.0	172.1	137.2	34.9	21.5	33.154	1.230	7.28	18.8	D 19-42	
34.0	155.1	140.8	14.2	19.4	31.986	1.274	7.10	18.5	D 19-42	
36.0	158.9	144.7	14.2	19.9	32.635	1.115	7.16	18.3	D 19-42	
38.0	184.5	149.1	35.4	23.9	33.417	0.975	7.45	18.6	D 19-42	
40.0	189.8	154.5	35.4	24.8	33.039	0.966	7.51	18.7	D 19-42	
42.0	195.5	160.1	35.4	26.0	34.136	0.814	7.59	18.5	D 19-42	
44.0	201.4	166.1	35.4	27.2	33.866	0.699	7.66	18.4	D 19-42	
46.0	207.7	172.3	35.4	28.7	33.964	0.630	7.74	18.4	D 19-42	
48.0	211.9	181.8	30.1	29.4	34.461	0.571	7.78	18.2	D 19-42	
50.0	227.2	197.1	30.1	33.5	34.700	0.773	7.93	18.4	D 19-42	
52.0	242.4	212.4	30.1	38.2	35.627	0.826	8.07	18.4	D 19-42	
54.0	257.7	227.7	30.1	44.5	35.913	0.820	8.18	18.3	D 19-42	
56.0	273.0	242.9	30.1	52.5	35.937	0.722	8.29	18.3	D 19-42	
58.0	288.3	258.2	30.1	62.1	36.636	0.688	8.38	18.3	D 19-42	
60.0	301.4	271.3	30.1	74.0	36.882	0.400	8.44	18.2	D 19-42	
62.0	311.5	281.5	30.1	84.2	37.156	0.274	8.48	18.1	D 19-42	
63.0	316.1	286.0	30.1	91.1	37.707	0.234	8.49	18.0	D 19-42	

Total driving time: 38 minutes; Total Number of Blows: 1625 (starting at penetration 2.0 ft)

Gain/Loss Factor at Shaft/Toe = 1.000/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow bl/ft	CtMx ksi	C-StrMx ksi	T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
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2.0	12.0	0.4	11.6	1.1	3.658	0.000	3.37	13.7	D 19-42
4.0	43.8	10.1	33.7	4.0	19.870	0.580	4.86	22.5	D 19-42
6.0	69.5	35.8	33.7	7.0	23.383	1.263	5.57	20.7	D 19-42
8.0	95.1	61.4	33.7	10.3	25.931	1.605	6.09	19.9	D 19-42
10.0	138.4	68.8	69.6	15.7	30.008	2.204	6.76	19.6	D 19-42
12.0	157.9	73.8	84.1	18.1	32.383	2.533	7.03	19.7	D 19-42
14.0	178.3	79.7	98.6	20.6	33.254	3.186	7.28	20.1	D 19-42
16.0	127.3	88.8	38.5	14.0	31.539	2.255	6.57	19.3	D 19-42
18.0	156.6	118.1	38.5	17.9	33.208	2.390	6.99	19.4	D 19-42
20.0	185.9	147.5	38.5	22.0	34.412	2.994	7.39	19.8	D 19-42
22.0	203.6	168.7	34.9	24.9	35.800	3.696	7.62	20.1	D 19-42
24.0	210.0	175.1	34.9	26.2	35.139	3.802	7.71	20.1	D 19-42
26.0	216.4	181.5	34.9	27.6	36.832	3.833	7.81	20.1	D 19-42
28.0	222.8	187.9	34.9	29.1	36.337	3.795	7.90	20.1	D 19-42
30.0	229.1	194.3	34.9	31.1	35.612	3.602	8.00	19.9	D 19-42
32.0	235.5	200.6	34.9	32.5	37.202	3.428	8.09	20.0	D 19-42
34.0	220.5	206.2	14.2	28.9	35.995	2.398	7.91	19.7	D 19-42
36.0	226.2	212.0	14.2	30.0	36.870	2.689	7.98	19.6	D 19-42
38.0	254.0	218.6	35.4	37.2	37.464	3.154	8.28	20.0	D 19-42
40.0	262.1	226.7	35.4	39.5	37.118	2.852	8.36	20.0	D 19-42
42.0	270.5	235.2	35.4	42.6	38.452	2.741	8.44	19.8	D 19-42
44.0	279.4	244.1	35.4	46.2	38.236	2.359	8.51	19.7	D 19-42
46.0	288.8	253.4	35.4	50.1	38.094	2.208	8.58	19.7	D 19-42
48.0	297.8	267.7	30.1	54.5	39.413	2.292	8.66	19.7	D 19-42
50.0	320.7	290.6	30.1	70.7	40.784	2.260	8.81	19.8	D 19-42
52.0	343.6	313.6	30.1	95.0	42.372	2.340	8.93	20.0	D 19-42
54.0	366.5	336.5	30.1	138.0	42.565	2.032	8.99	19.9	D 19-42
56.0	389.4	359.4	30.1	236.3	41.907	1.642	9.03	19.5	D 19-42
58.0	412.3	382.3	30.1	532.5	42.117	1.494	9.06	19.2	D 19-42
60.0	432.0	402.0	30.1	9999.0	42.392	1.044	9.05	18.9	D 19-42
62.0	447.2	417.2	30.1	9999.0	42.779	0.600	9.06	18.8	D 19-42
63.0	454.1	424.0	30.1	9999.0	42.987	0.425	9.04	18.6	D 19-42

Refusal occurred; no driving time output possible.

GRLWEAP: Wave Equation Analysis of Pile Foundations

MOT-835-2.57 Bridge Replacement + Pier 1
RESOURCE INTERNATIONAL INC

1/24/2025
GRLWEAP 14.1.20.1

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity-blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They **MUST** be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors.

SOIL PROFILE

Depth ft	Soil Type -	Spec. Wt lb/ft ³	Su ksf	Phi °	Unit Rs ksf	Unit Rt ksf
0.0	Gravel	130.0	0.0	38.0	0.00	0.00
3.3	Gravel	130.0	0.0	38.0	0.19	17.92
3.3	Clay	125.0	3.5	0.0	3.50	31.50
8.3	Clay	125.0	3.5	0.0	3.50	31.50
8.3	Gravel	130.0	0.0	39.0	0.51	53.64
15.8	Gravel	130.0	0.0	39.0	0.99	104.37
15.8	Clay	130.0	4.0	0.0	4.00	36.00
21.3	Clay	130.0	4.0	0.0	4.00	36.00
21.3	Clay	125.0	3.6	0.0	0.87	32.62
32.3	Clay	125.0	3.6	0.0	0.87	32.62
32.3	Sand	125.0	0.0	30.0	0.73	13.32
37.3	Sand	125.0	0.0	30.0	0.84	13.32
37.3	Sand	130.0	0.0	32.0	1.05	33.09
47.3	Sand	130.0	0.0	32.0	1.34	33.09
47.3	Clay	125.0	3.1	0.0	2.86	28.12
67.3	Clay	125.0	3.1	0.0	2.86	28.12
67.3	Clay	125.0	2.0	0.0	1.32	18.00
72.3	Clay	125.0	2.0	0.0	1.32	18.00
72.3	Sand	125.0	0.0	29.0	1.49	13.32
82.3	Sand	125.0	0.0	29.0	1.69	13.32
82.3	Sand	130.0	0.0	30.0	1.83	13.32
92.3	Sand	130.0	0.0	30.0	2.06	13.32
92.3	Sand	135.0	0.0	32.0	2.59	33.09
100.3	Sand	135.0	0.0	32.0	2.84	33.09
100.3	Sand	135.0	0.0	33.0	3.14	50.11
105.3	Sand	135.0	0.0	33.0	3.31	50.11

PILE INPUT

Uniform Pile		Pile Type:	Closed-End Pipe
Pile Length: (ft)	65.000	Pile Penetration: (ft)	63.000
Pile Size: (ft)	1.17	Toe Area: (in ²)	153.94

Pile Profile

Lb Top ft	X-Area in ²	E-Modulus ksi	Spec. Wt lb/ft ³	Perim. ft	Crit. Index -
0.0	12.1	30,000.0	492.0	3.7	0
65.0	12.1	30,000.0	492.0	3.7	0

HAMMER INPUT

ID	41	Made By:	DELMAG
Model	D 19-42	Type:	OED

Hammer Data

ID	Ram Wt	Ram L.	Ram Ar.	Rtd. Stk	Effic.	Rtd. Energy
-	kips	in	in ²	ft	-	kip-ft
41	4.000	129.1	124.7	10.8	0.80	43.2

DRIVE SYSTEM FOR DELMAG D 19-42-OED

Type	X-Area	E-Modulus	Thickness	COR	Round-out	Stiffness
-	in ²	ksi	in	-	in	kips/in
Hammer C.	227.000	530.000	2.000	0.800	0.120	60155.555
Helmet Wt.	1.900	kips				

SOIL RESISTANCE DISTRIBUTION

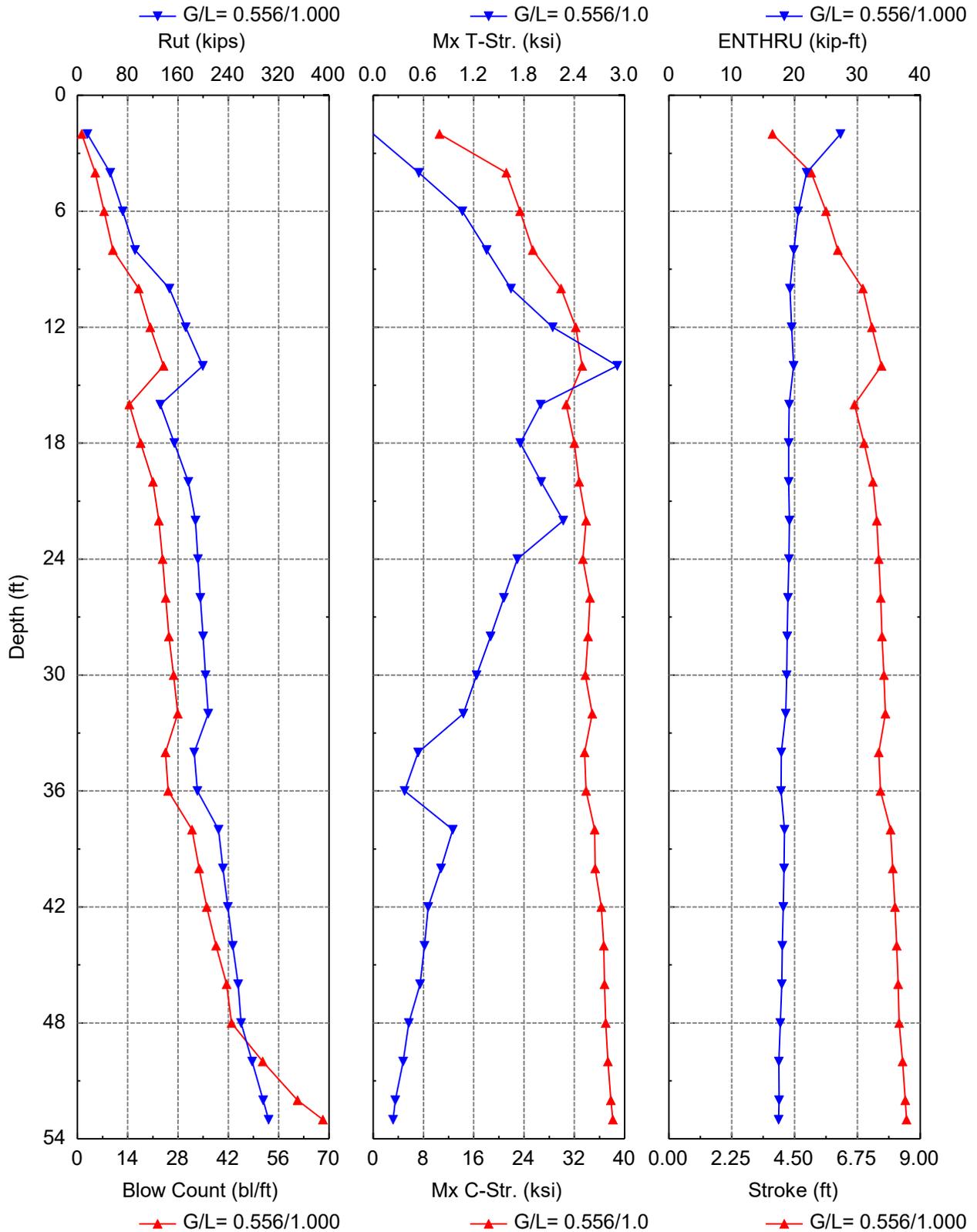
Depth	Unit Rs	Unit Rt	Qs	Qt	Js	Jt	Set. F.	Limit D.	Set. T.	EB Area
ft	ksf	ksf	in	in	s/ft	s/ft	-	ft	Hours	in ²
0.0	0.0	0.0	0.10	0.13	0.05	0.15	1.0	6.0	1.0	153.9
1.7	0.1	9.0	0.10	0.13	0.05	0.15	1.0	6.0	1.0	153.9
3.3	0.2	17.9	0.10	0.13	0.05	0.15	1.0	6.0	1.0	153.9
3.3	3.5	31.5	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
5.0	3.5	31.5	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
6.6	3.5	31.5	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
8.3	3.5	31.5	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
8.3	0.5	53.6	0.10	0.12	0.05	0.15	1.0	6.0	1.0	153.9
10.2	0.6	66.3	0.10	0.12	0.05	0.15	1.0	6.0	1.0	153.9
12.1	0.7	79.0	0.10	0.12	0.05	0.15	1.0	6.0	1.0	153.9
13.9	0.9	91.7	0.10	0.12	0.05	0.15	1.0	6.0	1.0	153.9
15.8	1.0	104.4	0.10	0.12	0.05	0.15	1.0	6.0	1.0	153.9
15.8	4.0	36.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
17.6	4.0	36.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
19.5	4.0	36.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
21.3	4.0	36.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
21.3	0.9	32.6	0.10	0.12	0.20	0.15	1.8	6.0	168.0	153.9
23.1	0.9	32.6	0.10	0.12	0.20	0.15	1.8	6.0	168.0	153.9
25.0	0.9	32.6	0.10	0.12	0.20	0.15	1.8	6.0	168.0	153.9
26.8	0.9	32.6	0.10	0.12	0.20	0.15	1.8	6.0	168.0	153.9
28.6	0.9	32.6	0.10	0.12	0.20	0.15	1.8	6.0	168.0	153.9
30.5	0.9	32.6	0.10	0.12	0.20	0.15	1.8	6.0	168.0	153.9
32.3	0.9	32.6	0.10	0.12	0.20	0.15	1.8	6.0	168.0	153.9

MOT-835-2.57 Bridge Replacement + Pier 1

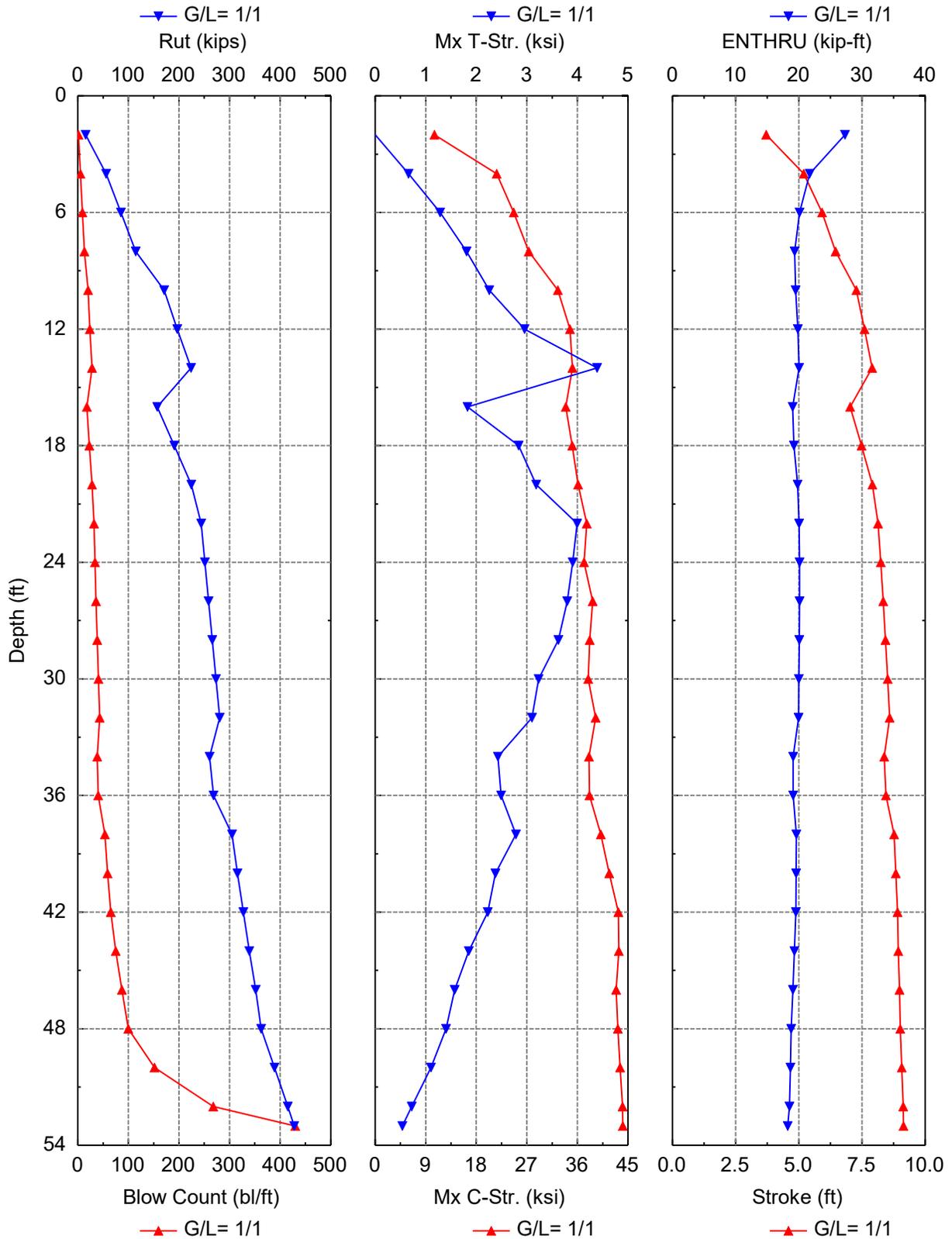
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32.3	0.7	13.3	0.10	0.16	0.15	0.15	1.5	6.0	24.0	153.9
34.0	0.8	13.3	0.10	0.16	0.15	0.15	1.5	6.0	24.0	153.9
35.6	0.8	13.3	0.10	0.16	0.15	0.15	1.5	6.0	24.0	153.9
37.3	0.8	13.3	0.10	0.16	0.15	0.15	1.5	6.0	24.0	153.9
37.3	1.0	33.1	0.10	0.15	0.15	0.15	1.5	6.0	24.0	153.9
39.0	1.1	33.1	0.10	0.15	0.15	0.15	1.5	6.0	24.0	153.9
40.6	1.1	33.1	0.10	0.15	0.15	0.15	1.5	6.0	24.0	153.9
42.3	1.2	33.1	0.10	0.15	0.15	0.15	1.5	6.0	24.0	153.9
44.0	1.2	33.1	0.10	0.15	0.15	0.15	1.5	6.0	24.0	153.9
45.6	1.3	33.1	0.10	0.15	0.15	0.15	1.5	6.0	24.0	153.9
47.3	1.3	33.1	0.10	0.15	0.15	0.15	1.5	6.0	24.0	153.9
47.3	2.9	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	153.9
49.0	2.9	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	153.9
50.6	2.9	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	153.9
52.3	2.9	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	153.9
54.0	2.9	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	153.9
55.6	2.9	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	153.9
57.3	2.9	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	153.9
59.0	2.9	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	153.9
60.6	2.9	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	153.9
62.3	2.9	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	153.9
63.0	2.9	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	153.9

Driveability Analysis Summary



Driveability Analysis Summary



Gain/Loss Factor at Shaft/Toe = 0.556/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow bl/ft	CtMx ksi	C-StrMx ksi	T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	15.8	0.6	15.2	1.2	10.550	0.000	3.71	27.3	D 19-42	
4.0	52.4	8.4	44.0	5.0	21.184	0.545	5.10	21.9	D 19-42	
6.0	72.0	28.0	44.0	7.4	23.365	1.065	5.62	20.6	D 19-42	
8.0	91.5	47.5	44.0	9.9	25.387	1.353	6.04	19.9	D 19-42	
10.0	146.3	55.4	90.9	17.1	29.871	1.645	6.94	19.2	D 19-42	
12.0	172.2	62.3	109.8	20.3	32.214	2.141	7.27	19.5	D 19-42	
14.0	199.4	70.6	128.7	24.0	33.250	2.911	7.61	19.8	D 19-42	
16.0	131.7	81.4	50.3	14.5	30.720	1.999	6.64	19.1	D 19-42	
18.0	154.1	103.8	50.3	17.6	32.002	1.754	6.99	19.0	D 19-42	
20.0	176.4	126.1	50.3	21.0	32.779	2.004	7.30	19.1	D 19-42	
22.0	187.6	142.1	45.6	22.7	33.882	2.268	7.44	19.2	D 19-42	
24.0	191.7	146.1	45.6	23.7	33.363	1.721	7.51	19.1	D 19-42	
26.0	195.7	150.2	45.6	24.6	34.497	1.558	7.58	18.9	D 19-42	
28.0	199.8	154.2	45.6	25.5	34.167	1.400	7.62	18.8	D 19-42	
30.0	203.8	158.3	45.6	26.8	33.740	1.233	7.69	18.7	D 19-42	
32.0	207.9	162.3	45.6	27.9	34.848	1.076	7.75	18.6	D 19-42	
34.0	185.7	167.1	18.6	24.5	33.641	0.536	7.51	17.9	D 19-42	
36.0	190.8	172.2	18.6	25.3	33.863	0.375	7.58	17.8	D 19-42	
38.0	224.4	178.1	46.2	31.9	35.227	0.949	7.93	18.4	D 19-42	
40.0	231.6	185.4	46.2	33.9	35.303	0.808	8.01	18.3	D 19-42	
42.0	239.2	193.0	46.2	36.0	36.274	0.658	8.09	18.2	D 19-42	
44.0	247.3	201.1	46.2	38.6	36.672	0.612	8.15	18.0	D 19-42	
46.0	255.7	209.5	46.2	41.5	36.812	0.561	8.21	17.9	D 19-42	
48.0	260.5	221.3	39.3	42.9	37.000	0.427	8.24	17.7	D 19-42	
50.0	278.0	238.7	39.3	51.6	37.343	0.360	8.36	17.5	D 19-42	
52.0	295.4	256.2	39.3	61.3	37.826	0.266	8.46	17.5	D 19-42	
53.0	304.2	264.9	39.3	68.3	38.122	0.239	8.51	17.4	D 19-42	

Total driving time: 32 minutes; Total Number of Blows: 1356 (starting at penetration 2.0 ft)

Gain/Loss Factor at Shaft/Toe = 1.000/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow bl/ft	CtMx ksi	C-StrMx ksi	T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	15.8	0.6	15.2	1.2	10.550	0.000	3.71	27.3	D 19-42	
4.0	55.8	11.9	44.0	5.4	21.634	0.660	5.19	21.7	D 19-42	
6.0	85.2	41.2	44.0	9.0	24.650	1.285	5.91	20.1	D 19-42	
8.0	114.5	70.5	44.0	13.0	27.342	1.809	6.45	19.3	D 19-42	
10.0	170.7	79.8	90.9	20.3	32.515	2.258	7.27	19.5	D 19-42	

12.0	196.6	86.8	109.8	23.7	34.673	2.955	7.59	19.9	D 19-42
14.0	223.8	95.1	128.7	28.0	35.133	4.392	7.89	20.0	D 19-42
16.0	157.3	107.0	50.3	18.0	33.909	1.827	7.03	19.0	D 19-42
18.0	190.8	140.5	50.3	22.9	35.062	2.836	7.48	19.2	D 19-42
20.0	224.3	174.0	50.3	28.3	36.136	3.186	7.90	19.8	D 19-42
22.0	243.9	198.4	45.6	32.3	37.655	3.992	8.13	20.0	D 19-42
24.0	251.2	205.6	45.6	34.2	37.187	3.906	8.23	20.1	D 19-42
26.0	258.5	212.9	45.6	36.2	38.707	3.799	8.34	20.1	D 19-42
28.0	265.8	220.2	45.6	38.5	38.188	3.624	8.42	20.1	D 19-42
30.0	273.1	227.5	45.6	41.0	37.927	3.231	8.51	20.0	D 19-42
32.0	280.3	234.8	45.6	43.5	39.260	3.100	8.59	20.0	D 19-42
34.0	260.7	242.1	18.6	38.4	38.055	2.427	8.37	19.1	D 19-42
36.0	268.4	249.8	18.6	40.2	38.142	2.489	8.44	19.1	D 19-42
38.0	304.9	258.7	46.2	53.6	40.168	2.785	8.77	19.6	D 19-42
40.0	315.8	269.6	46.2	58.9	41.668	2.379	8.83	19.6	D 19-42
42.0	327.3	281.1	46.2	65.4	43.263	2.228	8.90	19.5	D 19-42
44.0	339.3	293.1	46.2	75.1	43.384	1.854	8.94	19.3	D 19-42
46.0	351.9	305.7	46.2	87.4	42.879	1.573	8.98	19.0	D 19-42
48.0	362.7	323.4	39.3	100.0	43.214	1.405	9.01	18.8	D 19-42
50.0	388.9	349.6	39.3	151.8	43.579	1.106	9.06	18.7	D 19-42
52.0	415.0	375.8	39.3	267.7	44.043	0.726	9.12	18.5	D 19-42
53.0	428.1	388.9	39.3	429.7	44.078	0.541	9.14	18.2	D 19-42

Total driving time: 68 minutes; Total Number of Blows: 2747 (starting at penetration 2.0 ft)

GRLWEAP: Wave Equation Analysis of Pile Foundations

MOT-835-2.57 Bridge Replacement + Pier 1
RESOURCE INTERNATIONAL INC

1/24/2025
GRLWEAP 14.1.20.1

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity-blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They **MUST** be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors.

SOIL PROFILE

Depth ft	Soil Type -	Spec. Wt lb/ft ³	Su ksf	Phi °	Unit Rs ksf	Unit Rt ksf
0.0	Gravel	130.0	0.0	38.0	0.00	0.00
3.3	Gravel	130.0	0.0	38.0	0.19	17.92
3.3	Clay	125.0	3.5	0.0	3.50	31.50
8.3	Clay	125.0	3.5	0.0	3.50	31.50
8.3	Gravel	130.0	0.0	39.0	0.51	53.64
15.8	Gravel	130.0	0.0	39.0	0.99	104.37
15.8	Clay	130.0	4.0	0.0	4.00	36.00
21.3	Clay	130.0	4.0	0.0	4.00	36.00
21.3	Clay	125.0	3.6	0.0	0.87	32.62
32.3	Clay	125.0	3.6	0.0	0.87	32.62
32.3	Sand	125.0	0.0	30.0	0.73	13.32
37.3	Sand	125.0	0.0	30.0	0.84	13.32
37.3	Sand	130.0	0.0	32.0	1.05	33.09
47.3	Sand	130.0	0.0	32.0	1.34	33.09
47.3	Clay	125.0	3.1	0.0	2.86	28.12
67.3	Clay	125.0	3.1	0.0	2.86	28.12
67.3	Clay	125.0	2.0	0.0	1.32	18.00
72.3	Clay	125.0	2.0	0.0	1.32	18.00
72.3	Sand	125.0	0.0	29.0	1.49	13.32
82.3	Sand	125.0	0.0	29.0	1.69	13.32
82.3	Sand	130.0	0.0	30.0	1.83	13.32
92.3	Sand	130.0	0.0	30.0	2.06	13.32
92.3	Sand	135.0	0.0	32.0	2.59	33.09
100.3	Sand	135.0	0.0	32.0	2.84	33.09
100.3	Sand	135.0	0.0	33.0	3.14	50.11
105.3	Sand	135.0	0.0	33.0	3.31	50.11

PILE INPUT

Uniform Pile		Pile Type:	Closed-End Pipe
Pile Length: (ft)	55.000	Pile Penetration: (ft)	53.000
Pile Size: (ft)	1.33	Toe Area: (in ²)	201.06

Pile Profile

Lb Top ft	X-Area in ²	E-Modulus ksi	Spec. Wt lb/ft ³	Perim. ft	Crit. Index -
0.0	12.4	30,000.0	492.0	4.2	0
55.0	12.4	30,000.0	492.0	4.2	0

HAMMER INPUT

ID	41	Made By:	DELMAG
Model	D 19-42	Type:	OED

Hammer Data

ID	Ram Wt	Ram L.	Ram Ar.	Rtd. Stk	Effic.	Rtd. Energy
-	kips	in	in ²	ft	-	kip-ft
41	4.000	129.1	124.7	10.8	0.80	43.2

DRIVE SYSTEM FOR DELMAG D 19-42-OED

Type	X-Area	E-Modulus	Thickness	COR	Round-out	Stiffness
-	in ²	ksi	in	-	in	kips/in
Hammer C.	227.000	530.000	2.000	0.800	0.120	60155.555
Helmet Wt.	1.900	kips				

SOIL RESISTANCE DISTRIBUTION

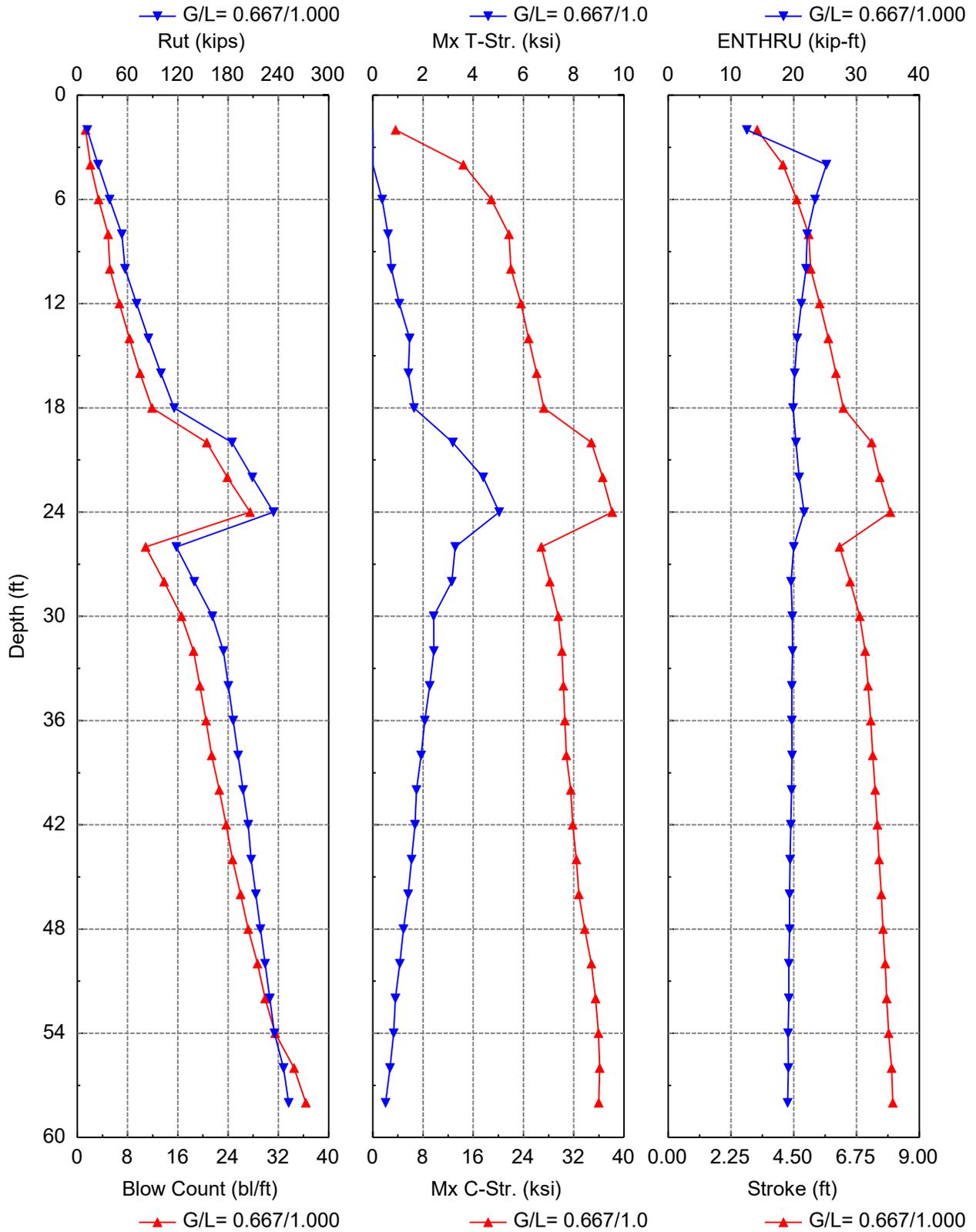
Depth	Unit Rs	Unit Rt	Qs	Qt	Js	Jt	Set. F.	Limit D.	Set. T.	EB Area
ft	ksf	ksf	in	in	s/ft	s/ft	-	ft	Hours	in ²
0.0	0.0	0.0	0.10	0.13	0.05	0.15	1.0	6.0	1.0	201.1
1.7	0.1	9.0	0.10	0.13	0.05	0.15	1.0	6.0	1.0	201.1
3.3	0.2	17.9	0.10	0.13	0.05	0.15	1.0	6.0	1.0	201.1
3.3	3.5	31.5	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
5.0	3.5	31.5	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
6.6	3.5	31.5	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
8.3	3.5	31.5	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
8.3	0.6	53.6	0.10	0.12	0.05	0.15	1.0	6.0	1.0	201.1
10.2	0.8	66.3	0.10	0.12	0.05	0.15	1.0	6.0	1.0	201.1
12.1	0.9	79.0	0.10	0.12	0.05	0.15	1.0	6.0	1.0	201.1
13.9	1.1	91.7	0.10	0.12	0.05	0.15	1.0	6.0	1.0	201.1
15.8	1.2	104.4	0.10	0.12	0.05	0.15	1.0	6.0	1.0	201.1
15.8	4.0	36.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
17.6	4.0	36.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
19.5	4.0	36.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
21.3	4.0	36.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
21.3	0.9	32.6	0.10	0.12	0.20	0.15	1.8	6.0	168.0	201.1
23.1	0.9	32.6	0.10	0.12	0.20	0.15	1.8	6.0	168.0	201.1
25.0	0.9	32.6	0.10	0.12	0.20	0.15	1.8	6.0	168.0	201.1
26.8	0.9	32.6	0.10	0.12	0.20	0.15	1.8	6.0	168.0	201.1
28.6	0.9	32.6	0.10	0.12	0.20	0.15	1.8	6.0	168.0	201.1
30.5	0.9	32.6	0.10	0.12	0.20	0.15	1.8	6.0	168.0	201.1
32.3	0.9	32.6	0.10	0.12	0.20	0.15	1.8	6.0	168.0	201.1

MOT-835-2.57 Bridge Replacement + Pier 1

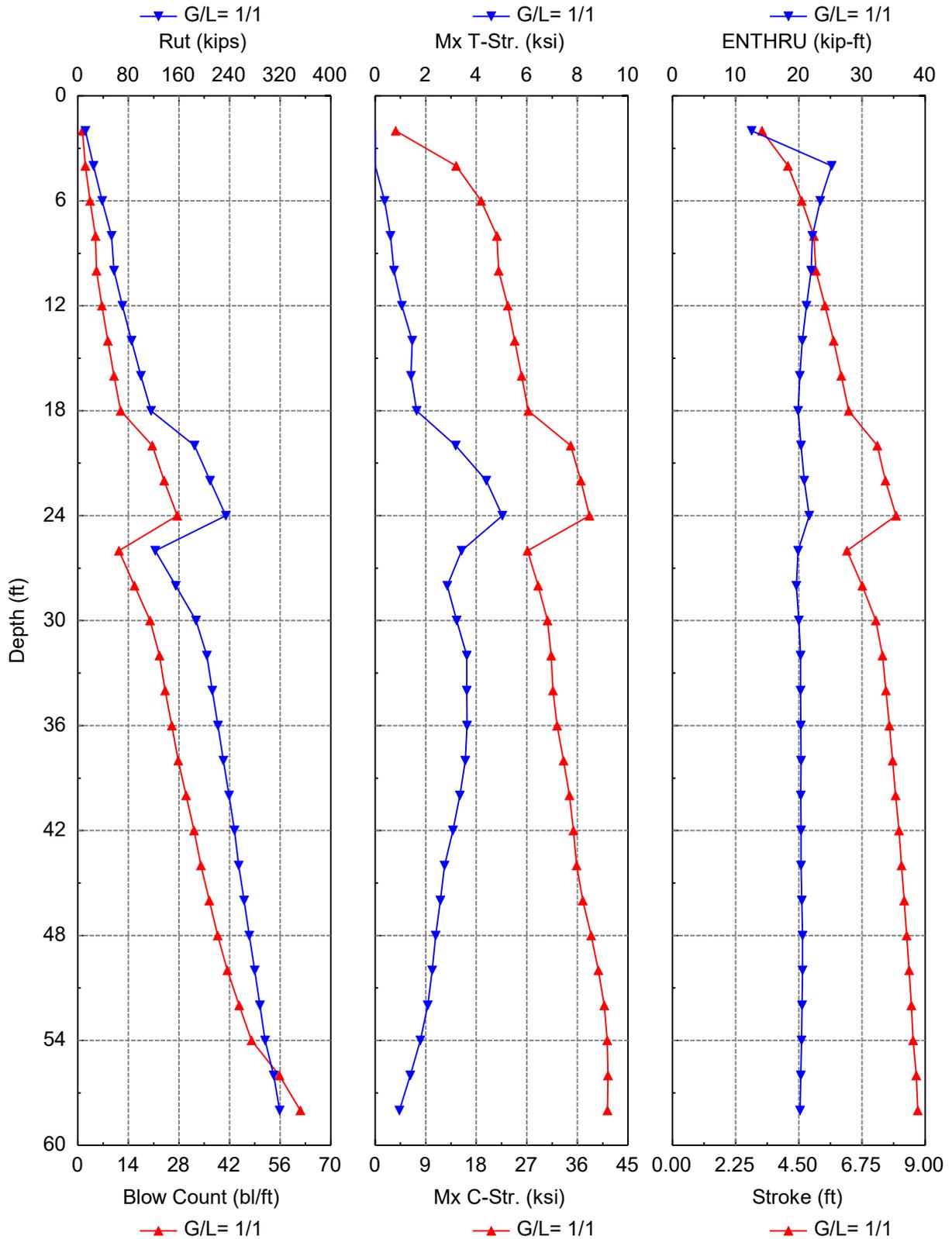
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32.3	0.9	13.3	0.10	0.16	0.15	0.15	1.5	6.0	24.0	201.1
34.0	0.9	13.3	0.10	0.16	0.15	0.15	1.5	6.0	24.0	201.1
35.6	0.9	13.3	0.10	0.16	0.15	0.15	1.5	6.0	24.0	201.1
37.3	1.0	13.3	0.10	0.16	0.15	0.15	1.5	6.0	24.0	201.1
37.3	1.2	33.1	0.10	0.15	0.15	0.15	1.5	6.0	24.0	201.1
39.0	1.3	33.1	0.10	0.15	0.15	0.15	1.5	6.0	24.0	201.1
40.6	1.4	33.1	0.10	0.15	0.15	0.15	1.5	6.0	24.0	201.1
42.3	1.4	33.1	0.10	0.15	0.15	0.15	1.5	6.0	24.0	201.1
44.0	1.5	33.1	0.10	0.15	0.15	0.15	1.5	6.0	24.0	201.1
45.6	1.5	33.1	0.10	0.15	0.15	0.15	1.5	6.0	24.0	201.1
47.3	1.6	33.1	0.10	0.15	0.15	0.15	1.5	6.0	24.0	201.1
47.3	3.1	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	201.1
49.0	3.1	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	201.1
50.6	3.1	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	201.1
52.3	3.1	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	201.1
53.0	3.1	28.1	0.10	0.13	0.15	0.15	1.5	6.0	168.0	201.1

Driveability Analysis Summary



Driveability Analysis Summary



Gain/Loss Factor at Shaft/Toe = 0.667/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow CtMx bl/ft	C-StrMx ksi	T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	12.0	0.4	11.6	1.3	3.641	0.000	3.19	12.5	D 19-42
4.0	24.9	1.7	23.2	2.1	14.404	0.000	4.11	25.2	D 19-42
6.0	38.6	3.8	34.8	3.4	18.876	0.378	4.60	23.4	D 19-42
8.0	53.2	6.8	46.4	4.9	21.684	0.612	5.03	22.2	D 19-42
10.0	57.2	10.3	46.9	5.2	21.986	0.747	5.11	22.0	D 19-42
12.0	70.7	14.4	56.2	6.7	23.601	1.062	5.43	21.2	D 19-42
14.0	84.9	19.3	65.6	8.3	24.828	1.470	5.74	20.5	D 19-42
16.0	99.9	25.0	75.0	10.0	26.086	1.416	6.01	20.2	D 19-42
18.0	115.7	31.4	84.3	11.9	27.233	1.645	6.27	19.9	D 19-42
20.0	184.7	40.1	144.6	20.6	34.808	3.185	7.29	20.3	D 19-42
22.0	209.1	50.0	159.1	23.9	36.617	4.398	7.58	20.8	D 19-42
24.0	234.3	60.8	173.5	27.5	38.137	5.033	7.96	21.6	D 19-42
26.0	118.4	76.3	42.1	10.9	26.851	3.284	6.14	20.0	D 19-42
28.0	139.8	97.7	42.1	13.8	28.188	3.148	6.52	19.5	D 19-42
30.0	161.1	119.1	42.1	16.6	29.534	2.424	6.86	19.7	D 19-42
32.0	174.6	126.5	48.1	18.5	30.107	2.439	7.06	19.8	D 19-42
34.0	180.4	132.3	48.1	19.5	30.363	2.268	7.16	19.7	D 19-42
36.0	186.3	138.2	48.1	20.5	30.589	2.077	7.25	19.7	D 19-42
38.0	192.2	144.1	48.1	21.4	30.817	1.930	7.33	19.7	D 19-42
40.0	198.0	149.9	48.1	22.6	31.539	1.745	7.42	19.7	D 19-42
42.0	203.9	155.8	48.1	23.7	31.840	1.678	7.50	19.5	D 19-42
44.0	207.6	161.9	45.7	24.7	32.426	1.547	7.55	19.4	D 19-42
46.0	213.2	167.5	45.7	26.0	32.798	1.410	7.63	19.3	D 19-42
48.0	218.7	173.0	45.7	27.2	33.757	1.219	7.70	19.3	D 19-42
50.0	224.3	178.6	45.7	28.7	34.795	1.077	7.77	19.2	D 19-42
52.0	229.9	184.2	45.7	29.9	35.473	0.898	7.83	19.2	D 19-42
54.0	235.5	189.8	45.7	31.5	35.945	0.830	7.90	19.1	D 19-42
56.0	246.2	195.6	50.5	34.5	36.148	0.689	8.00	19.1	D 19-42
58.0	252.3	201.8	50.5	36.4	35.972	0.515	8.05	19.0	D 19-42

Total driving time: 24 minutes; Total Number of Blows: 1026 (starting at penetration 2.0 ft)

Gain/Loss Factor at Shaft/Toe = 1.000/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow CtMx bl/ft	C-StrMx ksi	T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	12.0	0.4	11.6	1.3	3.641	0.000	3.19	12.5	D 19-42
4.0	24.9	1.7	23.2	2.1	14.404	0.000	4.11	25.2	D 19-42
6.0	38.6	3.8	34.8	3.4	18.876	0.378	4.60	23.4	D 19-42

8.0	53.2	6.8	46.4	4.9	21.684	0.612	5.03	22.2	D 19-42
10.0	57.2	10.3	46.9	5.2	21.986	0.747	5.11	22.0	D 19-42
12.0	70.7	14.4	56.2	6.7	23.601	1.062	5.43	21.2	D 19-42
14.0	84.9	19.3	65.6	8.3	24.828	1.470	5.74	20.5	D 19-42
16.0	99.9	25.0	75.0	10.0	26.086	1.416	6.01	20.2	D 19-42
18.0	115.7	31.4	84.3	11.9	27.233	1.645	6.27	19.9	D 19-42
20.0	184.7	40.1	144.6	20.6	34.808	3.185	7.29	20.3	D 19-42
22.0	209.1	50.0	159.1	23.9	36.617	4.398	7.58	20.8	D 19-42
24.0	234.3	60.8	173.5	27.5	38.137	5.033	7.96	21.6	D 19-42
26.0	122.7	80.6	42.1	11.4	27.113	3.416	6.21	19.9	D 19-42
28.0	154.7	112.6	42.1	15.7	29.012	2.852	6.75	19.6	D 19-42
30.0	186.8	144.7	42.1	20.0	30.661	3.223	7.24	20.0	D 19-42
32.0	203.9	155.8	48.1	22.6	31.344	3.629	7.47	20.3	D 19-42
34.0	212.7	164.6	48.1	24.2	31.651	3.621	7.60	20.3	D 19-42
36.0	221.5	173.4	48.1	26.0	32.412	3.632	7.72	20.3	D 19-42
38.0	230.3	182.2	48.1	27.8	33.521	3.565	7.84	20.3	D 19-42
40.0	239.1	191.0	48.1	30.0	34.596	3.356	7.95	20.3	D 19-42
42.0	248.0	199.9	48.1	32.2	35.275	3.077	8.06	20.3	D 19-42
44.0	254.7	209.0	45.7	34.1	35.856	2.746	8.15	20.4	D 19-42
46.0	263.0	217.3	45.7	36.4	36.950	2.581	8.25	20.5	D 19-42
48.0	271.4	225.7	45.7	38.7	38.464	2.399	8.34	20.6	D 19-42
50.0	279.8	234.1	45.7	41.4	39.746	2.257	8.43	20.6	D 19-42
52.0	288.1	242.4	45.7	44.7	40.797	2.087	8.50	20.5	D 19-42
54.0	296.5	250.8	45.7	48.1	41.327	1.790	8.57	20.4	D 19-42
56.0	310.1	259.6	50.5	55.8	41.433	1.387	8.68	20.3	D 19-42
58.0	319.3	268.8	50.5	61.6	41.342	0.961	8.73	20.2	D 19-42

Total driving time: 32 minutes; Total Number of Blows: 1330 (starting at penetration 2.0 ft)

GRLWEAP: Wave Equation Analysis of Pile Foundations

MOT-835-2.57 Bridge Replacement + Pier 2

1/24/2025

RESOURCE INTERNATIONAL INC

GRLWEAP 14.1.20.1

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity-blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They **MUST** be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors.

SOIL PROFILE

Depth ft	Soil Type -	Spec. Wt lb/ft ³	Su ksf	Phi °	Unit Rs ksf	Unit Rt ksf
0.0	Gravel	130.0	0.0	38.0	0.00	0.00
8.7	Gravel	130.0	0.0	38.0	0.50	47.24
8.7	Gravel	130.0	0.0	37.0	0.45	38.13
18.2	Gravel	130.0	0.0	37.0	0.93	79.77
18.2	Gravel	130.0	0.0	39.0	1.17	123.10
25.2	Gravel	130.0	0.0	39.0	1.62	170.45
25.2	Clay	125.0	4.4	0.0	4.37	39.37
30.2	Clay	125.0	4.4	0.0	4.37	39.37
30.2	Clay	130.0	5.0	0.0	1.21	45.00
43.2	Clay	130.0	5.0	0.0	1.21	45.00
43.2	Clay	125.0	4.7	0.0	1.14	42.75
55.2	Clay	125.0	4.7	0.0	1.14	42.75
55.2	Clay	130.0	5.2	0.0	1.26	47.25
65.2	Clay	130.0	5.2	0.0	1.26	47.25
65.2	Sand	130.0	0.0	30.0	1.49	13.32
75.2	Sand	130.0	0.0	30.0	1.73	13.32
75.2	Sand	135.0	0.0	34.0	2.63	73.64
85.2	Sand	135.0	0.0	34.0	3.01	73.64
85.2	Sand	125.0	0.0	29.0	1.83	13.32
90.2	Sand	125.0	0.0	29.0	1.93	13.32
90.2	Clay	130.0	3.0	0.0	3.00	27.00
95.2	Clay	130.0	3.0	0.0	3.00	27.00
95.2	Clay	125.0	3.0	33.0	0.90	27.00
103.2	Clay	125.0	3.0	33.0	0.90	27.00

PILE INPUT

Uniform Pile		Pile Type:	Closed-End Pipe
Pile Length: (ft)	60.000	Pile Penetration: (ft)	58.000
Pile Size: (ft)	1.17	Toe Area: (in ²)	153.94

Pile Profile

Lb Top ft	X-Area in ²	E-Modulus ksi	Spec. Wt lb/ft ³	Perim. ft	Crit. Index -
0.0	10.8	30,000.0	492.0	3.7	0
60.0	10.8	30,000.0	492.0	3.7	0

HAMMER INPUT

ID	41	Made By:	DELMAG
1/24/2025	6/8		GRLWEAP 14.1.20.1

Model	D 19-42	Type:	OED
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Hammer Data

ID	Ram Wt	Ram L.	Ram Ar.	Rtd. Stk	Effic.	Rtd. Energy
-	kips	in	in ²	ft	-	kip-ft
41	4.000	129.1	124.7	10.8	0.80	43.2

DRIVE SYSTEM FOR DELMAG D 19-42-OED

Type	X-Area	E-Modulus	Thickness	COR	Round-out	Stiffness
-	in ²	ksi	in	-	in	kips/in
Hammer C.	227.000	530.000	2.000	0.800	0.120	60155.550
Helmet Wt.	1.900	kips				

SOIL RESISTANCE DISTRIBUTION

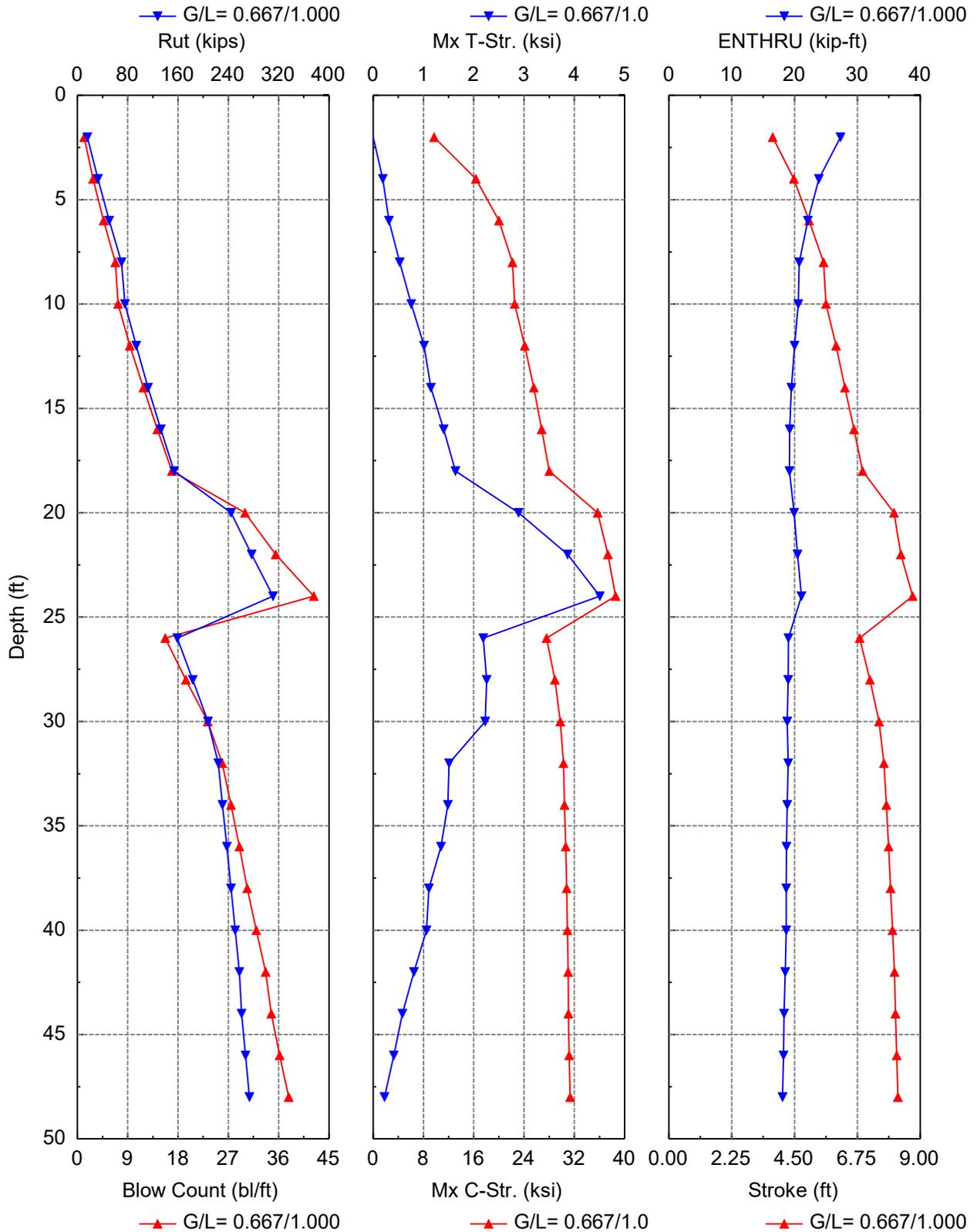
Depth	Unit Rs	Unit Rt	Qs	Qt	Js	Jt	Set. F.	Limit D.	Set. T.	EB Area
ft	ksf	ksf	in	in	s/ft	s/ft	-	ft	Hours	in ²
0.0	0.0	0.0	0.10	0.13	0.05	0.15	1.0	6.0	1.0	153.9
1.7	0.1	9.4	0.10	0.13	0.05	0.15	1.0	6.0	1.0	153.9
3.5	0.2	18.9	0.10	0.13	0.05	0.15	1.0	6.0	1.0	153.9
5.2	0.3	28.3	0.10	0.13	0.05	0.15	1.0	6.0	1.0	153.9
7.0	0.4	37.8	0.10	0.13	0.05	0.15	1.0	6.0	1.0	153.9
8.7	0.5	47.2	0.10	0.13	0.05	0.15	1.0	6.0	1.0	153.9
8.7	0.4	38.1	0.10	0.14	0.05	0.15	1.0	6.0	1.0	153.9
10.6	0.5	46.5	0.10	0.14	0.05	0.15	1.0	6.0	1.0	153.9
12.5	0.6	54.8	0.10	0.14	0.05	0.15	1.0	6.0	1.0	153.9
14.4	0.7	63.1	0.10	0.14	0.05	0.15	1.0	6.0	1.0	153.9
16.3	0.8	71.4	0.10	0.14	0.05	0.15	1.0	6.0	1.0	153.9
18.2	0.9	79.8	0.10	0.14	0.05	0.15	1.0	6.0	1.0	153.9
18.2	1.2	123.1	0.10	0.13	0.05	0.15	1.0	6.0	1.0	153.9
20.0	1.3	134.9	0.10	0.13	0.05	0.15	1.0	6.0	1.0	153.9
21.7	1.4	146.8	0.10	0.13	0.05	0.15	1.0	6.0	1.0	153.9
23.5	1.5	158.6	0.10	0.13	0.05	0.15	1.0	6.0	1.0	153.9
25.2	1.6	170.4	0.10	0.13	0.05	0.15	1.0	6.0	1.0	153.9
25.2	4.4	39.4	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
26.9	4.4	39.4	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
28.5	4.4	39.4	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
30.2	4.4	39.4	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
30.2	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
32.1	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
33.9	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
35.8	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9

MOT-835-2.57 Bridge Replacement + Pier 2

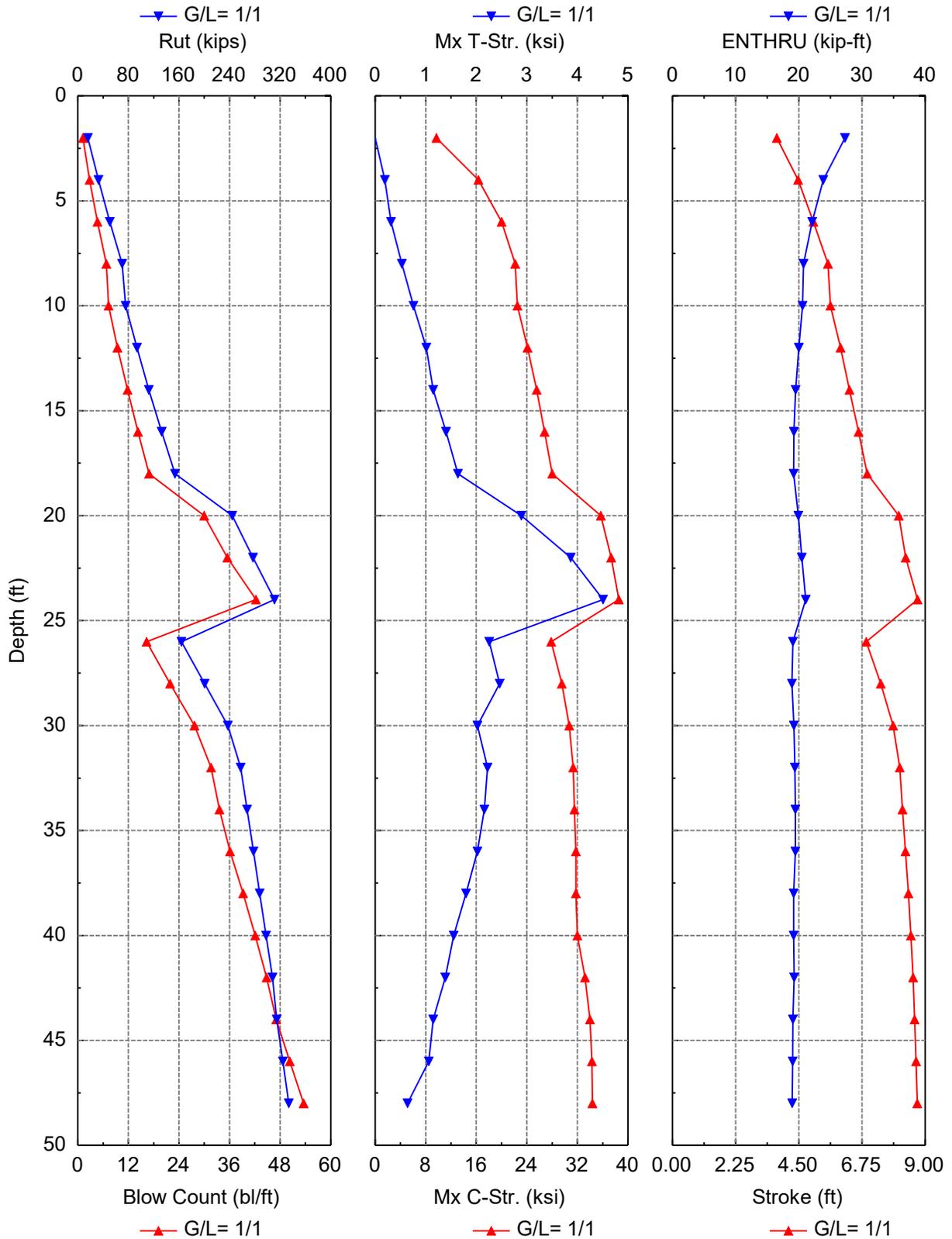
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37.6	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
39.5	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
41.3	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
43.2	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
43.2	1.1	42.7	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
44.9	1.1	42.7	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
46.6	1.1	42.7	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
48.3	1.1	42.7	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
50.1	1.1	42.7	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
51.8	1.1	42.7	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
53.5	1.1	42.7	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
55.2	1.1	42.7	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
55.2	1.3	47.2	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
56.9	1.3	47.2	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
58.0	1.3	47.2	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9

Driveability Analysis Summary



Driveability Analysis Summary



Gain/Loss Factor at Shaft/Toe = 0.667/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow bl/ft	CtMx ksi	C-StrMx ksi	T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	15.8	0.6	15.2	1.2	9.710	0.000	3.72	27.3	D 19-42	
4.0	32.7	2.4	30.3	2.8	16.325	0.194	4.47	23.9	D 19-42	
6.0	50.8	5.3	45.5	4.7	20.017	0.314	5.02	22.1	D 19-42	
8.0	70.1	9.4	60.7	6.8	22.149	0.529	5.53	20.7	D 19-42	
10.0	75.5	14.3	61.2	7.3	22.519	0.759	5.62	20.6	D 19-42	
12.0	93.5	20.0	73.4	9.4	24.121	1.010	5.98	20.0	D 19-42	
14.0	112.5	26.8	85.7	11.8	25.538	1.147	6.30	19.5	D 19-42	
16.0	132.5	34.6	97.9	14.3	26.804	1.400	6.63	19.2	D 19-42	
18.0	153.6	43.4	110.2	16.9	28.028	1.635	6.93	19.2	D 19-42	
20.0	244.5	55.6	188.9	30.0	35.685	2.891	8.05	19.9	D 19-42	
22.0	277.2	69.4	207.8	35.5	37.325	3.865	8.30	20.5	D 19-42	
24.0	311.2	84.5	226.7	42.3	38.561	4.505	8.72	21.1	D 19-42	
26.0	159.0	104.0	55.0	15.7	27.580	2.189	6.83	19.0	D 19-42	
28.0	183.4	128.4	55.0	19.4	28.902	2.257	7.19	19.0	D 19-42	
30.0	207.8	152.8	55.0	23.3	29.755	2.226	7.52	18.8	D 19-42	
32.0	224.2	161.3	62.8	25.9	30.289	1.508	7.69	19.0	D 19-42	
34.0	230.9	168.0	62.8	27.5	30.450	1.484	7.79	18.8	D 19-42	
36.0	237.6	174.7	62.8	29.0	30.611	1.351	7.86	18.7	D 19-42	
38.0	244.3	181.4	62.8	30.4	30.782	1.108	7.94	18.7	D 19-42	
40.0	251.0	188.1	62.8	32.0	30.883	1.062	8.00	18.7	D 19-42	
42.0	257.7	194.8	62.8	33.7	30.999	0.814	8.07	18.5	D 19-42	
44.0	261.1	201.4	59.7	34.7	31.043	0.585	8.11	18.3	D 19-42	
46.0	267.5	207.8	59.7	36.2	31.156	0.410	8.15	18.2	D 19-42	
48.0	273.8	214.1	59.7	37.8	31.330	0.228	8.20	18.1	D 19-42	

Total driving time: 24 minutes; Total Number of Blows: 1018 (starting at penetration 2.0 ft)

Gain/Loss Factor at Shaft/Toe = 1.000/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow bl/ft	CtMx ksi	C-StrMx ksi	T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	15.8	0.6	15.2	1.2	9.710	0.000	3.72	27.3	D 19-42	
4.0	32.7	2.4	30.3	2.8	16.325	0.194	4.47	23.9	D 19-42	
6.0	50.8	5.3	45.5	4.7	20.017	0.314	5.02	22.1	D 19-42	
8.0	70.1	9.4	60.7	6.8	22.149	0.529	5.53	20.7	D 19-42	
10.0	75.5	14.3	61.2	7.3	22.519	0.759	5.62	20.6	D 19-42	
12.0	93.5	20.0	73.4	9.4	24.121	1.010	5.98	20.0	D 19-42	
14.0	112.5	26.8	85.7	11.8	25.538	1.147	6.30	19.5	D 19-42	
16.0	132.5	34.6	97.9	14.3	26.804	1.400	6.63	19.2	D 19-42	

18.0	153.6	43.4	110.2	16.9	28.028	1.635	6.93	19.2	D 19-42
20.0	244.5	55.6	188.9	30.0	35.685	2.891	8.05	19.9	D 19-42
22.0	277.2	69.4	207.8	35.5	37.325	3.865	8.30	20.5	D 19-42
24.0	311.2	84.5	226.7	42.3	38.561	4.505	8.72	21.1	D 19-42
26.0	163.8	108.9	55.0	16.3	27.841	2.258	6.89	19.0	D 19-42
28.0	200.5	145.5	55.0	21.9	29.524	2.464	7.41	18.9	D 19-42
30.0	237.1	182.2	55.0	27.7	30.703	2.021	7.85	19.2	D 19-42
32.0	257.7	194.9	62.8	31.6	31.336	2.221	8.09	19.4	D 19-42
34.0	267.8	204.9	62.8	33.6	31.540	2.159	8.19	19.5	D 19-42
36.0	277.8	215.0	62.8	36.1	31.752	2.022	8.29	19.4	D 19-42
38.0	287.9	225.0	62.8	39.2	31.765	1.798	8.40	19.2	D 19-42
40.0	297.9	235.1	62.8	42.1	32.006	1.554	8.49	19.2	D 19-42
42.0	308.0	245.1	62.8	44.8	33.195	1.390	8.57	19.2	D 19-42
44.0	314.7	255.0	59.7	47.1	33.985	1.149	8.62	19.1	D 19-42
46.0	324.2	264.5	59.7	50.3	34.292	1.063	8.67	19.0	D 19-42
48.0	333.8	274.1	59.7	53.6	34.357	0.642	8.71	18.9	D 19-42

Total driving time: 29 minutes; Total Number of Blows: 1199 (starting at penetration 2.0 ft)

GRLWEAP: Wave Equation Analysis of Pile Foundations

MOT-835-2.57 Bridge Replacement + Pier 2

1/24/2025

RESOURCE INTERNATIONAL INC

GRLWEAP 14.1.20.1

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity-blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They **MUST** be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors.

SOIL PROFILE

Depth ft	Soil Type -	Spec. Wt lb/ft ³	Su ksf	Phi °	Unit Rs ksf	Unit Rt ksf
0.0	Gravel	130.0	0.0	38.0	0.00	0.00
8.7	Gravel	130.0	0.0	38.0	0.50	47.24
8.7	Gravel	130.0	0.0	37.0	0.45	38.13
18.2	Gravel	130.0	0.0	37.0	0.93	79.77
18.2	Gravel	130.0	0.0	39.0	1.17	123.10
25.2	Gravel	130.0	0.0	39.0	1.62	170.45
25.2	Clay	125.0	4.4	0.0	4.37	39.37
30.2	Clay	125.0	4.4	0.0	4.37	39.37
30.2	Clay	130.0	5.0	0.0	1.21	45.00
43.2	Clay	130.0	5.0	0.0	1.21	45.00
43.2	Clay	125.0	4.7	0.0	1.14	42.75
55.2	Clay	125.0	4.7	0.0	1.14	42.75
55.2	Clay	130.0	5.2	0.0	1.26	47.25
65.2	Clay	130.0	5.2	0.0	1.26	47.25
65.2	Sand	130.0	0.0	30.0	1.49	13.32
75.2	Sand	130.0	0.0	30.0	1.73	13.32
75.2	Sand	135.0	0.0	34.0	2.63	73.64
85.2	Sand	135.0	0.0	34.0	3.01	73.64
85.2	Sand	125.0	0.0	29.0	1.83	13.32
90.2	Sand	125.0	0.0	29.0	1.93	13.32
90.2	Clay	130.0	3.0	0.0	3.00	27.00
95.2	Clay	130.0	3.0	0.0	3.00	27.00
95.2	Clay	125.0	3.0	33.0	0.90	27.00
103.2	Clay	125.0	3.0	33.0	0.90	27.00

PILE INPUT

Uniform Pile		Pile Type:	Closed-End Pipe
Pile Length: (ft)	50.000	Pile Penetration: (ft)	48.000
Pile Size: (ft)	1.33	Toe Area: (in ²)	201.06

Pile Profile

Lb Top ft	X-Area in ²	E-Modulus ksi	Spec. Wt lb/ft ³	Perim. ft	Crit. Index -
0.0	13.8	30,000.0	492.0	4.2	0
50.0	13.8	30,000.0	492.0	4.2	0

HAMMER INPUT

ID	41	Made By:	DELMAG
1/24/2025	6/8		GRLWEAP 14.1.20.1

Model	D 19-42	Type:	OED
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Hammer Data

ID	Ram Wt	Ram L.	Ram Ar.	Rtd. Stk	Effic.	Rtd. Energy
-	kips	in	in ²	ft	-	kip-ft
41	4.000	129.1	124.7	10.8	0.80	43.2

DRIVE SYSTEM FOR DELMAG D 19-42-OED

Type	X-Area	E-Modulus	Thickness	COR	Round-out	Stiffness
-	in ²	ksi	in	-	in	kips/in
Hammer C.	227.000	530.000	2.000	0.800	0.120	60155.555
Helmet Wt.	1.900	kips				

SOIL RESISTANCE DISTRIBUTION

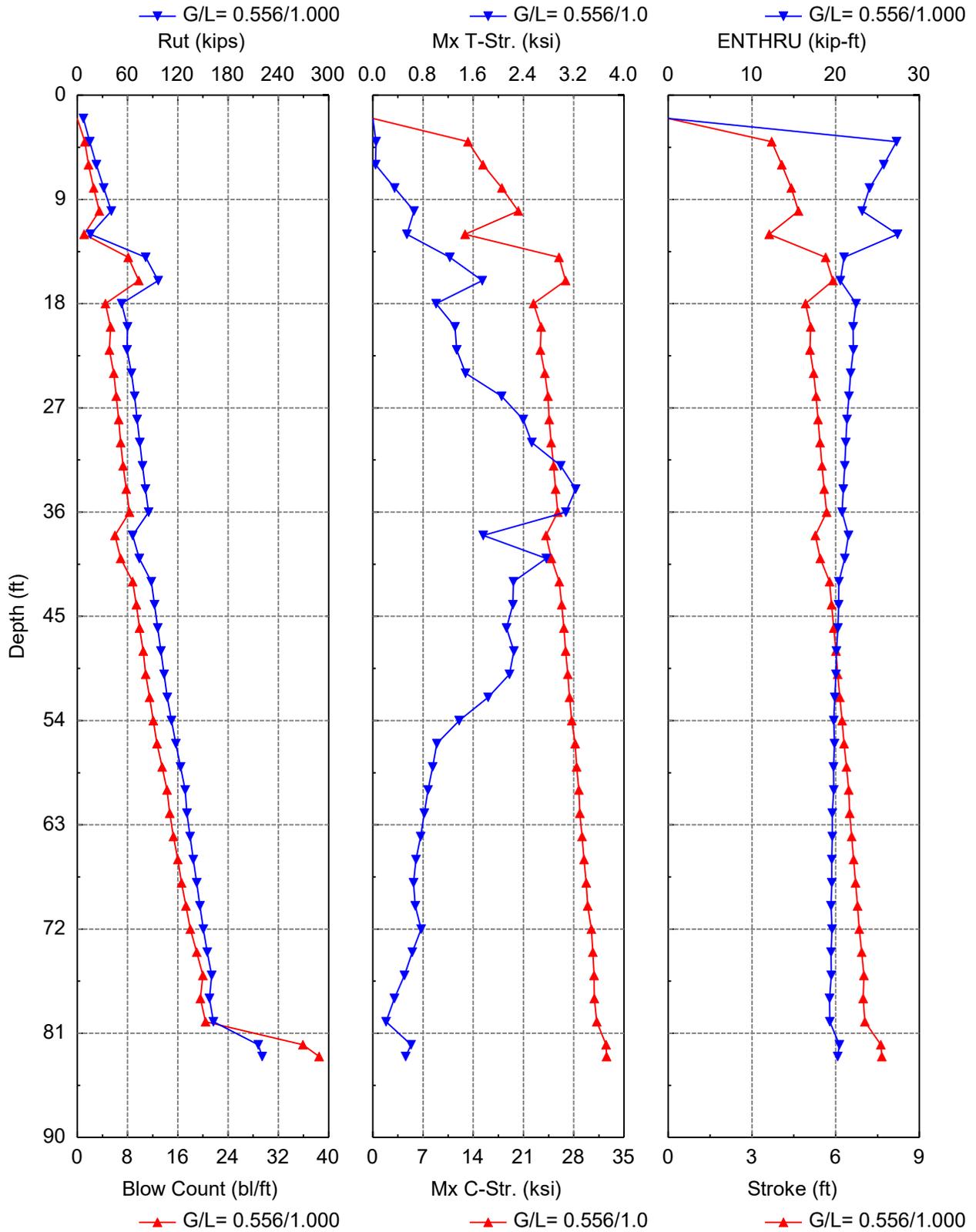
Depth	Unit Rs	Unit Rt	Qs	Qt	Js	Jt	Set. F.	Limit D.	Set. T.	EB Area
ft	ksf	ksf	in	in	s/ft	s/ft	-	ft	Hours	in ²
0.0	0.0	0.0	0.10	0.13	0.05	0.15	1.0	6.0	1.0	201.1
1.7	0.1	9.4	0.10	0.13	0.05	0.15	1.0	6.0	1.0	201.1
3.5	0.2	18.9	0.10	0.13	0.05	0.15	1.0	6.0	1.0	201.1
5.2	0.4	28.3	0.10	0.13	0.05	0.15	1.0	6.0	1.0	201.1
7.0	0.5	37.8	0.10	0.13	0.05	0.15	1.0	6.0	1.0	201.1
8.7	0.6	47.2	0.10	0.13	0.05	0.15	1.0	6.0	1.0	201.1
8.7	0.5	38.1	0.10	0.14	0.05	0.15	1.0	6.0	1.0	201.1
10.6	0.7	46.5	0.10	0.14	0.05	0.15	1.0	6.0	1.0	201.1
12.5	0.8	54.8	0.10	0.14	0.05	0.15	1.0	6.0	1.0	201.1
14.4	0.9	63.1	0.10	0.14	0.05	0.15	1.0	6.0	1.0	201.1
16.3	1.0	71.4	0.10	0.14	0.05	0.15	1.0	6.0	1.0	201.1
18.2	1.1	79.8	0.10	0.14	0.05	0.15	1.0	6.0	1.0	201.1
18.2	1.4	123.1	0.10	0.13	0.05	0.15	1.0	6.0	1.0	201.1
20.0	1.6	134.9	0.10	0.13	0.05	0.15	1.0	6.0	1.0	201.1
21.7	1.7	146.8	0.10	0.13	0.05	0.15	1.0	6.0	1.0	201.1
23.5	1.8	158.6	0.10	0.13	0.05	0.15	1.0	6.0	1.0	201.1
25.2	2.0	170.4	0.10	0.13	0.05	0.15	1.0	6.0	1.0	201.1
25.2	4.4	39.4	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
26.9	4.4	39.4	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
28.5	4.4	39.4	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
30.2	4.4	39.4	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
30.2	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
32.1	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
33.9	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
35.8	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1

MOT-835-2.57 Bridge Replacement + Pier 2

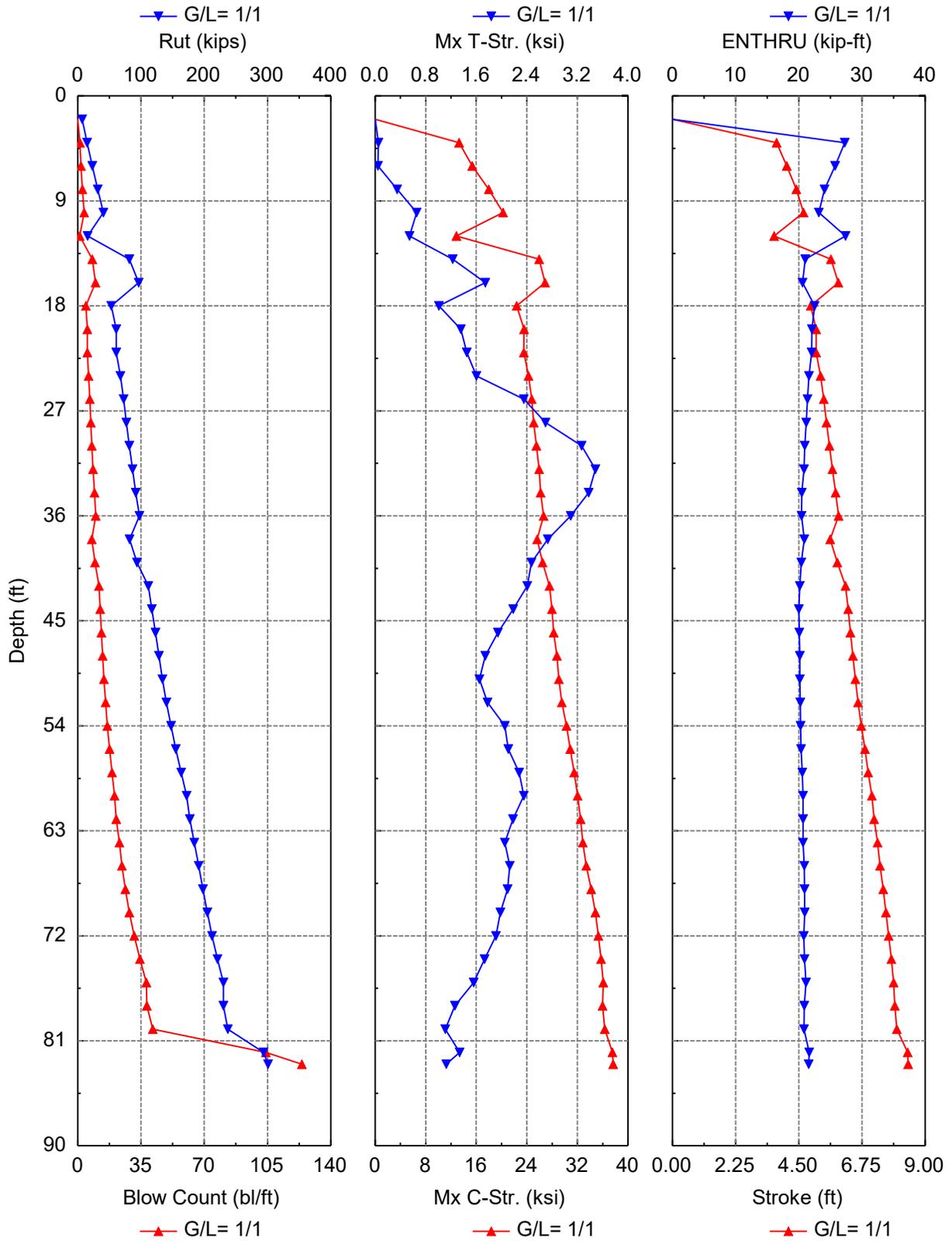
RESOURCE INTERNATIONAL INC

37.6	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
39.5	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
41.3	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
43.2	1.2	45.0	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
43.2	1.1	42.7	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
44.9	1.1	42.7	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
46.6	1.1	42.7	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
48.0	1.1	42.7	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1

Driveability Analysis Summary



Driveability Analysis Summary



Gain/Loss Factor at Shaft/Toe = 0.556/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow Ct bl/ft	Mx C-Str ksi	Mx T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	7.1	0.2	6.9	0.0	0.000	0.000	0.00	0.0	D 19-42
4.0	14.8	1.0	13.8	1.2	13.282	0.053	3.70	27.3	D 19-42
6.0	22.9	2.2	20.7	1.8	15.355	0.043	4.07	25.7	D 19-42
8.0	31.5	4.0	27.5	2.6	17.979	0.350	4.41	24.0	D 19-42
10.0	40.6	6.2	34.4	3.5	20.257	0.658	4.67	23.2	D 19-42
12.0	15.7	8.0	7.7	1.1	12.874	0.546	3.62	27.4	D 19-42
14.0	81.5	10.1	71.4	8.1	25.933	1.229	5.64	21.0	D 19-42
16.0	96.5	14.5	82.0	9.8	26.867	1.745	5.90	20.6	D 19-42
18.0	53.1	18.7	34.4	4.5	22.376	1.008	4.92	22.4	D 19-42
20.0	59.9	21.4	38.5	5.3	23.457	1.310	5.10	22.1	D 19-42
22.0	59.3	24.2	35.1	5.1	23.339	1.338	5.08	22.1	D 19-42
24.0	64.6	26.6	38.0	5.8	23.962	1.477	5.21	21.8	D 19-42
26.0	68.6	29.3	39.3	6.2	24.398	2.052	5.30	21.6	D 19-42
28.0	71.5	32.1	39.4	6.6	24.562	2.395	5.37	21.4	D 19-42
30.0	74.6	35.2	39.4	6.9	24.858	2.532	5.44	21.2	D 19-42
32.0	77.9	38.5	39.4	7.3	25.179	2.991	5.51	21.1	D 19-42
34.0	81.4	42.0	39.4	7.8	25.461	3.229	5.59	20.9	D 19-42
36.0	85.1	45.8	39.4	8.3	25.786	3.074	5.67	20.8	D 19-42
38.0	66.1	52.8	13.3	6.0	24.129	1.758	5.27	21.5	D 19-42
40.0	73.9	60.7	13.3	6.9	24.888	2.763	5.45	21.1	D 19-42
42.0	88.5	67.3	21.2	8.8	25.986	2.240	5.78	20.4	D 19-42
44.0	92.2	71.0	21.2	9.4	26.303	2.232	5.85	20.3	D 19-42
46.0	96.0	74.8	21.2	9.9	26.613	2.128	5.93	20.3	D 19-42
48.0	99.7	78.5	21.2	10.5	26.880	2.247	6.01	20.1	D 19-42
50.0	103.5	82.3	21.2	10.9	27.178	2.176	6.07	20.0	D 19-42
52.0	107.5	86.3	21.2	11.5	27.401	1.838	6.15	19.9	D 19-42
54.0	112.4	91.2	21.2	12.1	27.708	1.376	6.23	19.8	D 19-42
56.0	117.6	96.4	21.2	12.7	28.187	1.021	6.30	19.9	D 19-42
58.0	123.1	101.9	21.2	13.5	28.416	0.956	6.39	19.7	D 19-42
60.0	128.9	107.7	21.2	14.3	28.709	0.881	6.46	19.8	D 19-42
62.0	130.9	113.2	17.7	14.7	28.845	0.820	6.50	19.6	D 19-42
64.0	134.7	117.0	17.7	15.3	29.154	0.763	6.57	19.6	D 19-42
66.0	138.6	120.9	17.7	16.0	29.443	0.689	6.64	19.5	D 19-42
68.0	142.4	124.8	17.7	16.6	29.732	0.648	6.71	19.5	D 19-42
70.0	146.3	128.6	17.7	17.3	29.928	0.676	6.78	19.4	D 19-42
72.0	150.4	132.7	17.7	18.0	30.439	0.773	6.84	19.6	D 19-42
74.0	155.2	137.5	17.7	19.0	30.652	0.632	6.93	19.4	D 19-42
76.0	160.3	142.6	17.7	20.0	30.820	0.505	7.01	19.5	D 19-42

MOT-835-2.57 Bridge Replacement + Forward Abutment RESOURCE INTERNATIONAL INC

78.0	157.8	147.3	10.5	19.6	30.852	0.343	6.99	19.3	D 19-42
80.0	162.5	152.1	10.5	20.4	31.205	0.214	7.04	19.3	D 19-42
82.0	216.0	158.2	57.8	35.9	32.507	0.609	7.62	20.4	D 19-42
83.0	220.6	162.8	57.8	38.5	32.579	0.525	7.65	20.2	D 19-42

Total driving time: 18 minutes; Total Number of Blows: 863 (starting at penetration 2.0 ft)

Gain/Loss Factor at Shaft/Toe = 1.000/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow Ct bl/ft	Mx C-Str ksi	Mx T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	7.1	0.2	6.9	0.0	0.000	0.000	0.00	0.0	D 19-42
4.0	14.8	1.0	13.8	1.2	13.282	0.053	3.70	27.3	D 19-42
6.0	22.9	2.2	20.7	1.8	15.355	0.043	4.07	25.7	D 19-42
8.0	31.5	4.0	27.5	2.6	17.979	0.350	4.41	24.0	D 19-42
10.0	40.6	6.2	34.4	3.5	20.257	0.658	4.67	23.2	D 19-42
12.0	15.7	8.0	7.7	1.1	12.874	0.546	3.62	27.4	D 19-42
14.0	81.5	10.1	71.4	8.1	25.933	1.229	5.64	21.0	D 19-42
16.0	96.5	14.5	82.0	9.8	26.867	1.745	5.90	20.6	D 19-42
18.0	53.2	18.8	34.4	4.5	22.401	1.007	4.92	22.5	D 19-42
20.0	60.6	22.1	38.5	5.3	23.547	1.355	5.11	22.0	D 19-42
22.0	60.7	25.6	35.1	5.3	23.535	1.452	5.11	22.0	D 19-42
24.0	67.3	29.3	38.0	6.0	24.247	1.602	5.27	21.6	D 19-42
26.0	72.6	33.3	39.3	6.6	24.767	2.353	5.38	21.4	D 19-42
28.0	76.9	37.6	39.4	7.2	25.099	2.697	5.48	21.2	D 19-42
30.0	81.6	42.2	39.4	7.8	25.530	3.264	5.59	20.9	D 19-42
32.0	86.5	47.1	39.4	8.4	25.930	3.483	5.69	20.8	D 19-42
34.0	91.8	52.4	39.4	9.2	26.192	3.379	5.81	20.5	D 19-42
36.0	97.4	58.0	39.4	9.9	26.639	3.092	5.91	20.4	D 19-42
38.0	81.8	68.6	13.3	7.8	25.630	2.730	5.61	20.9	D 19-42
40.0	93.6	80.4	13.3	9.5	26.478	2.474	5.87	20.4	D 19-42
42.0	111.5	90.3	21.2	11.7	27.595	2.407	6.16	20.1	D 19-42
44.0	117.1	95.9	21.2	12.4	27.961	2.185	6.26	20.0	D 19-42
46.0	122.8	101.6	21.2	13.1	28.258	1.941	6.34	20.1	D 19-42
48.0	128.4	107.2	21.2	13.8	28.770	1.742	6.42	20.2	D 19-42
50.0	134.0	112.8	21.2	14.5	29.054	1.649	6.51	20.2	D 19-42
52.0	140.0	118.8	21.2	15.4	29.534	1.777	6.60	20.2	D 19-42
54.0	147.3	126.1	21.2	16.4	30.256	2.050	6.72	20.3	D 19-42
56.0	155.1	133.9	21.2	17.6	30.864	2.105	6.85	20.3	D 19-42
58.0	163.4	142.2	21.2	18.9	31.470	2.277	6.97	20.5	D 19-42
60.0	172.2	151.0	21.2	20.4	32.017	2.353	7.09	20.6	D 19-42
62.0	177.2	159.5	17.7	21.3	32.491	2.180	7.18	20.7	D 19-42

64.0	184.1	166.4	17.7	23.0	32.852	2.050	7.30	20.6	D 19-42
66.0	191.1	173.4	17.7	24.5	33.416	2.129	7.39	20.9	D 19-42
68.0	198.0	180.3	17.7	26.4	34.165	2.094	7.50	20.9	D 19-42
70.0	205.0	187.3	17.7	28.5	34.854	1.980	7.60	20.9	D 19-42
72.0	212.3	194.6	17.7	31.2	35.314	1.910	7.70	20.8	D 19-42
74.0	221.0	203.3	17.7	34.4	35.735	1.733	7.79	20.9	D 19-42
76.0	230.1	212.4	17.7	38.0	36.107	1.558	7.87	21.1	D 19-42
78.0	230.3	219.9	10.5	38.2	35.979	1.262	7.92	20.9	D 19-42
80.0	237.4	226.9	10.5	41.5	36.314	1.110	7.98	20.8	D 19-42
82.0	294.0	236.1	57.8	104.1	37.532	1.337	8.37	21.6	D 19-42
83.0	300.9	243.0	57.8	124.0	37.668	1.126	8.39	21.6	D 19-42

Total driving time: 31 minutes; Total Number of Blows: 1371 (starting at penetration 2.0 ft)

GRLWEAP: Wave Equation Analysis of Pile Foundations

MOT-835-2.57 Bridge Replacement + Forward Abutment
RESOURCE INTERNATIONAL INC

1/24/2025
GRLWEAP 14.1.20.1

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

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SOIL PROFILE

Depth ft	Soil Type -	Spec. Wt lb/ft ³	Su ksf	Phi °	Unit Rs ksf	Unit Rt ksf
0.0	Gravel	130.0	0.0	37.0	0.00	0.00
10.9	Gravel	130.0	0.0	37.0	0.43	47.77
10.9	Gravel	115.0	0.0	28.0	0.18	9.09
13.4	Gravel	115.0	0.0	28.0	0.21	10.71
13.4	Gravel	130.0	0.0	39.0	0.62	86.88
17.4	Gravel	130.0	0.0	39.0	0.82	113.94
17.4	Sand	135.0	0.0	34.0	0.47	42.15
21.4	Sand	135.0	0.0	34.0	0.59	52.70
21.4	Sand	130.0	0.0	33.0	0.54	43.55
26.4	Sand	130.0	0.0	33.0	0.67	50.11
26.4	Sand	130.0	0.0	33.0	0.67	50.11
36.4	Sand	130.0	0.0	33.0	0.93	50.11
36.4	Clay	125.0	1.9	0.0	1.87	16.87
41.4	Clay	125.0	1.9	0.0	1.87	16.87
41.4	Clay	125.0	3.0	0.0	1.09	27.00
61.4	Clay	125.0	3.0	0.0	1.09	27.00
61.4	Clay	125.0	2.5	0.0	1.21	22.50
76.4	Clay	125.0	2.5	0.0	1.21	22.50
76.4	Sand	125.0	0.0	27.0	1.09	13.32
81.4	Sand	125.0	0.0	27.0	1.16	13.32
81.4	Sand	130.0	0.0	34.0	2.17	73.64
86.4	Sand	130.0	0.0	34.0	2.31	73.64
86.4	Clay	125.0	1.9	0.0	1.87	16.87
100.4	Clay	125.0	1.9	0.0	1.87	16.87

PILE INPUT

Uniform Pile		Pile Type:	Closed-End Pipe
Pile Length: (ft)	85.000	Pile Penetration: (ft)	83.000
Pile Size: (ft)	1.00	Toe Area: (in ²)	113.10

Pile Profile

Lb Top ft	X-Area in ²	E-Modulus ksi	Spec. Wt lb/ft ³	Perim. ft	Crit. Index -
0.0	9.2	30,000.0	492.0	3.1	0
85.0	9.2	30,000.0	492.0	3.1	0

HAMMER INPUT

ID	41	Made By:	DELMAG
1/24/2025	7/9		GRLWEAP 14.1.20.1

Model D 19-42 Type: OED

Hammer Data

ID	Ram Wt	Ram L.	Ram Ar.	Rtd. Stk	Effic.	Rtd. Energy
-	kips	in	in ²	ft	-	kip-ft
41	4.000	129.1	124.7	10.8	0.80	43.2

DRIVE SYSTEM FOR DELMAG D 19-42-OED

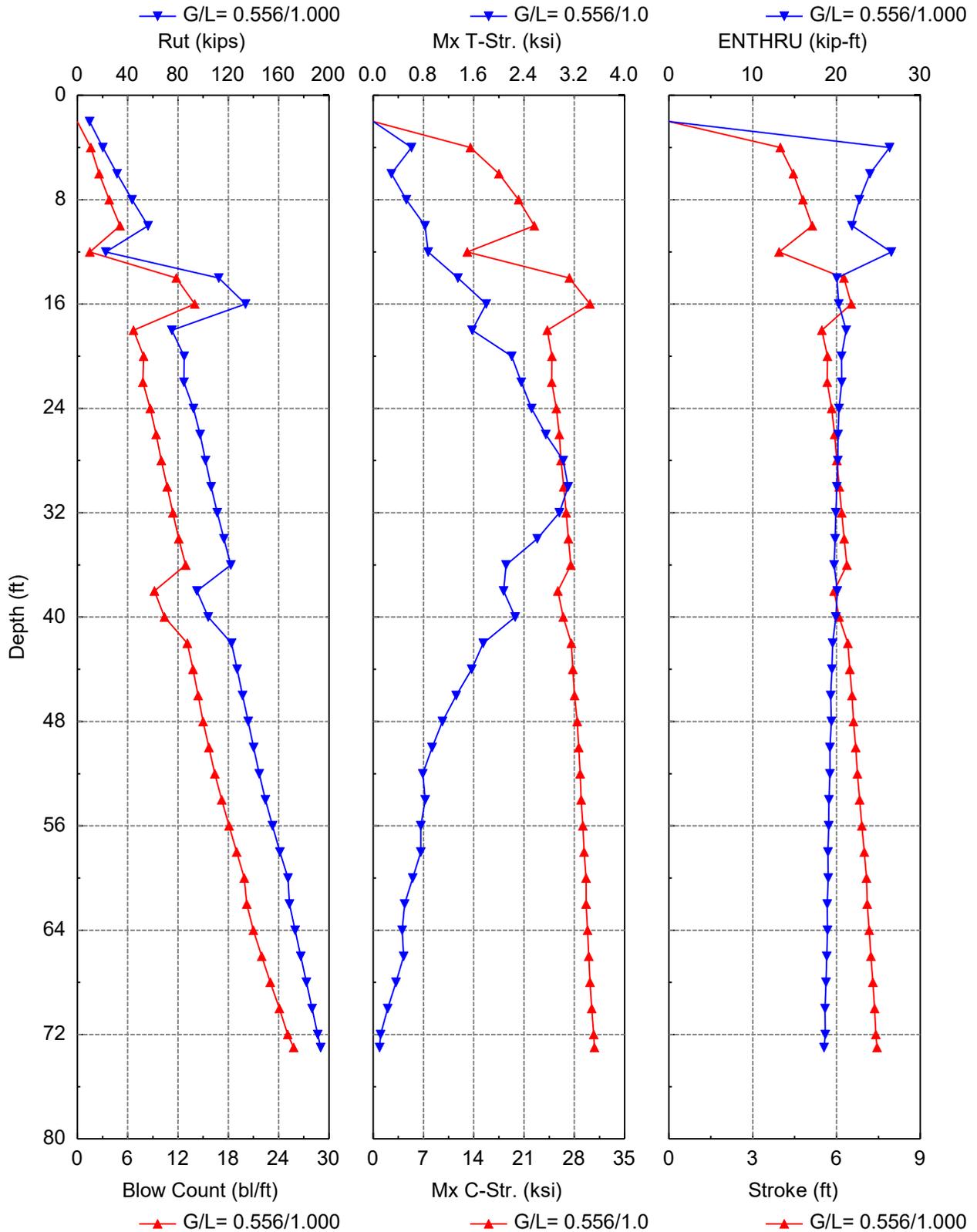
Type	X-Area	E-Modulus	Thickness	COR	Round-out	Stiffness
-	in ²	ksi	in	-	in	kips/in
Hammer C.	227.000	530.000	2.000	0.800	0.120	60155.555
Helmet Wt.	1.900	kips				

SOIL RESISTANCE DISTRIBUTION

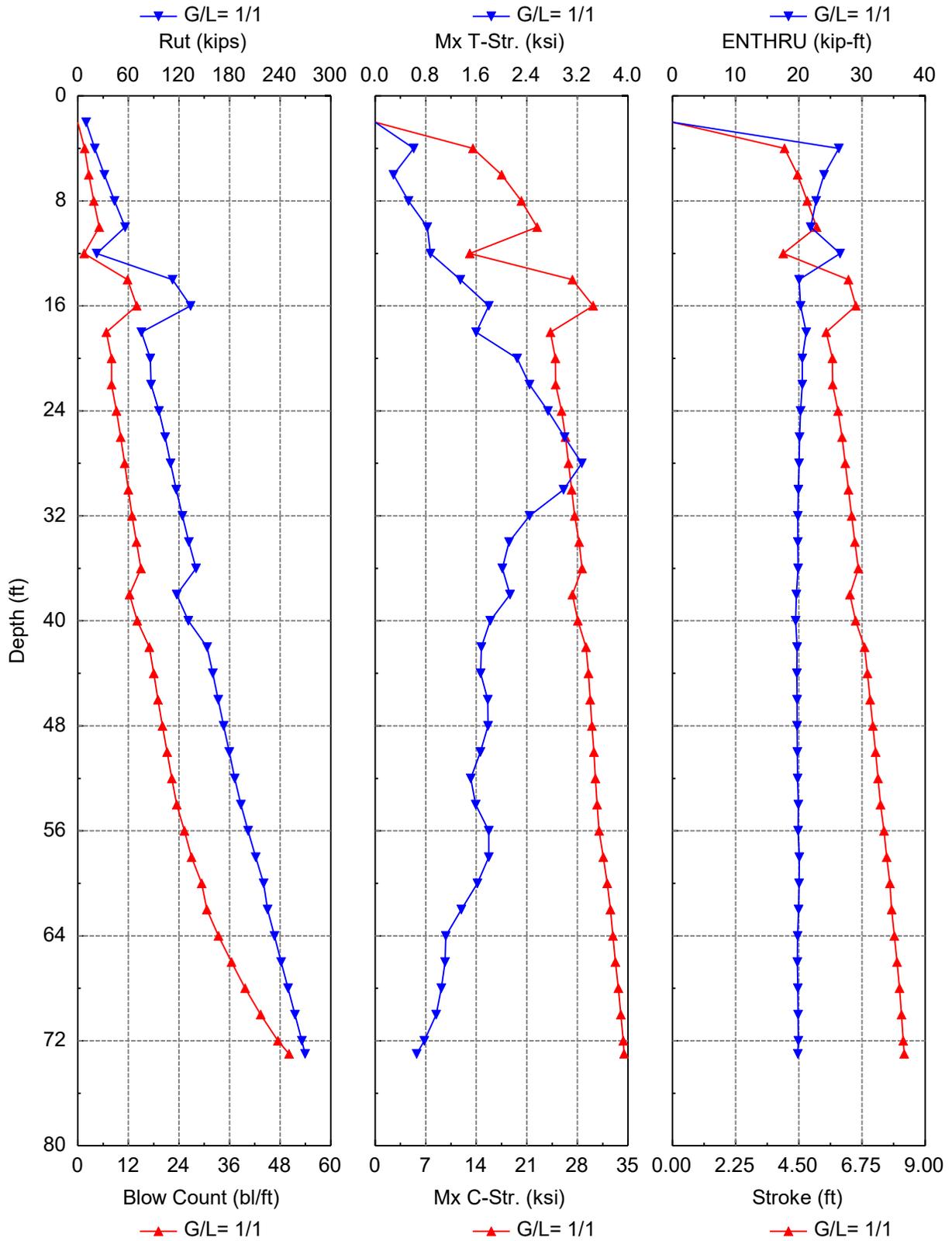
Depth	Unit Rs	Unit Rt	Qs	Qt	Js	Jt	Set. F.	Limit D.	Set. T.	EB Area
ft	ksf	ksf	in	in	s/ft	s/ft	-	ft	Hours	in ²
0.0	0.0	0.0	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
1.8	0.1	8.0	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
3.6	0.1	15.9	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
5.4	0.2	23.9	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
7.3	0.3	31.8	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
9.1	0.4	39.8	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
10.9	0.4	47.8	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
10.9	0.2	9.1	0.10	0.20	0.05	0.15	1.0	6.0	1.0	113.1
12.2	0.2	9.9	0.10	0.20	0.05	0.15	1.0	6.0	1.0	113.1
13.4	0.2	10.7	0.10	0.20	0.05	0.15	1.0	6.0	1.0	113.1
13.4	0.6	86.9	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
15.4	0.7	100.4	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
17.4	0.8	113.9	0.10	0.11	0.05	0.15	1.0	6.0	1.0	113.1
17.4	0.5	42.1	0.10	0.11	0.10	0.15	1.2	6.0	168.0	113.1
19.4	0.5	47.5	0.10	0.11	0.10	0.15	1.2	6.0	168.0	113.1
21.4	0.6	52.7	0.10	0.11	0.10	0.15	1.2	6.0	168.0	113.1
21.4	0.5	43.5	0.10	0.11	0.15	0.15	1.5	6.0	24.0	113.1
23.1	0.6	46.7	0.10	0.11	0.15	0.15	1.5	6.0	24.0	113.1
24.7	0.6	49.7	0.10	0.11	0.15	0.15	1.5	6.0	24.0	113.1
26.4	0.7	50.1	0.10	0.11	0.15	0.15	1.5	6.0	24.0	113.1
26.4	0.7	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	113.1
28.1	0.7	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	113.1
29.7	0.8	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	113.1
31.4	0.8	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	113.1
33.1	0.8	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	113.1

34.7	0.9	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	113.1
36.4	0.9	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	113.1
36.4	1.9	16.9	0.10	0.12	0.15	0.15	1.5	6.0	168.0	113.1
38.1	1.9	16.9	0.10	0.12	0.15	0.15	1.5	6.0	168.0	113.1
39.7	1.9	16.9	0.10	0.12	0.15	0.15	1.5	6.0	168.0	113.1
41.4	1.9	16.9	0.10	0.12	0.15	0.15	1.5	6.0	168.0	113.1
41.4	1.1	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
43.1	1.1	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
44.7	1.1	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
46.4	1.1	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
48.1	1.1	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
49.7	1.1	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
51.4	1.1	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
53.1	1.1	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
54.7	1.1	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
56.4	1.1	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
58.1	1.1	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
59.7	1.1	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
61.4	1.1	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	113.1
61.4	1.2	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	113.1
63.1	1.2	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	113.1
64.7	1.2	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	113.1
66.4	1.2	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	113.1
68.1	1.2	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	113.1
69.7	1.2	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	113.1
71.4	1.2	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	113.1
73.1	1.2	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	113.1
74.7	1.2	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	113.1
76.4	1.2	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	113.1
76.4	1.1	13.3	0.10	0.17	0.15	0.15	1.5	6.0	24.0	113.1
78.1	1.1	13.3	0.10	0.17	0.15	0.15	1.5	6.0	24.0	113.1
79.7	1.1	13.3	0.10	0.17	0.15	0.15	1.5	6.0	24.0	113.1
81.4	1.2	13.3	0.10	0.17	0.15	0.15	1.5	6.0	24.0	113.1
81.4	2.2	73.6	0.10	0.11	0.15	0.15	1.5	6.0	24.0	113.1
83.0	2.2	73.6	0.10	0.11	0.15	0.15	1.5	6.0	24.0	113.1

Driveability Analysis Summary



Driveability Analysis Summary



Gain/Loss Factor at Shaft/Toe = 0.556/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow Ct bl/ft	Mx C-Str ksi	Mx T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	9.7	0.4	9.4	0.0	0.000	0.000	0.00	0.0	D 19-42
4.0	20.2	1.5	18.7	1.6	13.557	0.611	3.99	26.3	D 19-42
6.0	31.5	3.4	28.1	2.6	17.505	0.292	4.45	24.0	D 19-42
8.0	43.5	6.0	37.5	3.8	20.245	0.529	4.80	22.7	D 19-42
10.0	56.3	9.4	46.9	5.1	22.418	0.826	5.13	21.8	D 19-42
12.0	22.6	12.1	10.5	1.5	13.095	0.876	3.95	26.5	D 19-42
14.0	112.4	15.2	97.2	11.8	27.303	1.347	6.26	20.0	D 19-42
16.0	133.7	22.0	111.7	14.0	30.174	1.796	6.53	20.3	D 19-42
18.0	75.2	28.4	46.8	6.7	24.245	1.575	5.47	21.1	D 19-42
20.0	85.0	32.4	52.5	7.9	24.869	2.203	5.68	20.6	D 19-42
22.0	84.7	36.6	48.1	7.8	24.847	2.354	5.66	20.6	D 19-42
24.0	92.4	40.2	52.2	8.7	25.495	2.518	5.83	20.3	D 19-42
26.0	97.7	44.1	53.6	9.4	25.926	2.746	5.93	20.2	D 19-42
28.0	101.9	48.3	53.6	10.0	26.164	3.022	6.01	20.1	D 19-42
30.0	106.4	52.9	53.6	10.7	26.514	3.102	6.10	20.0	D 19-42
32.0	111.3	57.7	53.6	11.4	26.856	2.961	6.19	19.9	D 19-42
34.0	116.5	62.9	53.6	12.1	27.181	2.609	6.27	19.8	D 19-42
36.0	122.0	68.4	53.6	12.9	27.507	2.114	6.37	19.7	D 19-42
38.0	94.9	76.9	18.0	9.2	25.709	2.074	5.91	20.1	D 19-42
40.0	104.1	86.1	18.0	10.4	26.466	2.257	6.09	19.9	D 19-42
42.0	122.7	93.8	28.9	13.1	27.570	1.749	6.40	19.5	D 19-42
44.0	127.0	98.2	28.9	13.8	27.796	1.567	6.47	19.4	D 19-42
46.0	131.4	102.5	28.9	14.4	28.041	1.320	6.55	19.3	D 19-42
48.0	135.8	106.9	28.9	15.0	28.392	1.102	6.61	19.4	D 19-42
50.0	140.2	111.3	28.9	15.7	28.623	0.940	6.69	19.2	D 19-42
52.0	144.5	115.7	28.9	16.4	28.804	0.792	6.75	19.2	D 19-42
54.0	149.4	120.5	28.9	17.2	28.962	0.829	6.82	19.1	D 19-42
56.0	155.1	126.2	28.9	18.1	29.204	0.761	6.90	19.1	D 19-42
58.0	161.1	132.2	28.9	19.0	29.369	0.760	6.99	19.0	D 19-42
60.0	167.4	138.6	28.9	19.9	29.623	0.628	7.07	19.0	D 19-42
62.0	168.6	144.6	24.1	20.2	29.649	0.501	7.10	18.9	D 19-42
64.0	173.1	149.1	24.1	21.0	29.849	0.463	7.16	18.9	D 19-42
66.0	177.6	153.6	24.1	22.0	29.996	0.487	7.23	18.8	D 19-42
68.0	182.1	158.1	24.1	23.0	30.195	0.364	7.30	18.8	D 19-42
70.0	186.6	162.6	24.1	24.1	30.429	0.233	7.36	18.6	D 19-42
72.0	191.1	167.1	24.1	25.1	30.692	0.117	7.41	18.7	D 19-42
73.0	193.4	169.3	24.1	25.8	30.805	0.103	7.45	18.5	D 19-42

Total driving time: 20 minutes; Total Number of Blows: 911 (starting at penetration 2.0 ft)

Gain/Loss Factor at Shaft/Toe = 1.000/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow Ct bl/ft	Mx C-Str ksi	Mx T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	9.7	0.4	9.4	0.0	0.000	0.000	0.00	0.0	D 19-42
4.0	20.2	1.5	18.7	1.6	13.557	0.611	3.99	26.3	D 19-42
6.0	31.5	3.4	28.1	2.6	17.505	0.292	4.45	24.0	D 19-42
8.0	43.5	6.0	37.5	3.8	20.245	0.529	4.80	22.7	D 19-42
10.0	56.3	9.4	46.9	5.1	22.418	0.826	5.13	21.8	D 19-42
12.0	22.6	12.1	10.5	1.5	13.095	0.876	3.95	26.5	D 19-42
14.0	112.4	15.2	97.2	11.8	27.303	1.347	6.26	20.0	D 19-42
16.0	133.7	22.0	111.7	14.0	30.174	1.796	6.53	20.3	D 19-42
18.0	75.4	28.6	46.8	6.8	24.279	1.598	5.47	21.2	D 19-42
20.0	86.0	33.5	52.5	8.0	24.950	2.245	5.70	20.5	D 19-42
22.0	86.9	38.7	48.1	8.0	24.994	2.443	5.70	20.5	D 19-42
24.0	96.3	44.1	52.2	9.2	25.803	2.733	5.89	20.3	D 19-42
26.0	103.6	50.0	53.6	10.2	26.358	2.996	6.03	20.1	D 19-42
28.0	109.9	56.4	53.6	11.1	26.764	3.269	6.15	20.0	D 19-42
30.0	116.8	63.2	53.6	12.0	27.225	2.981	6.26	19.9	D 19-42
32.0	124.1	70.5	53.6	12.9	27.626	2.443	6.38	19.8	D 19-42
34.0	131.8	78.3	53.6	13.9	28.226	2.118	6.49	19.8	D 19-42
36.0	140.1	86.5	53.6	15.0	28.641	2.014	6.62	19.9	D 19-42
38.0	117.3	99.2	18.0	12.3	27.307	2.134	6.31	19.6	D 19-42
40.0	131.0	113.0	18.0	14.1	28.049	1.820	6.52	19.5	D 19-42
42.0	153.4	124.6	28.9	17.0	29.189	1.681	6.84	19.7	D 19-42
44.0	160.0	131.1	28.9	18.0	29.523	1.669	6.94	19.7	D 19-42
46.0	166.6	137.7	28.9	19.0	29.776	1.780	7.04	19.7	D 19-42
48.0	173.1	144.3	28.9	20.1	30.001	1.787	7.13	19.7	D 19-42
50.0	179.7	150.8	28.9	21.2	30.282	1.664	7.23	19.8	D 19-42
52.0	186.3	157.4	28.9	22.3	30.496	1.512	7.32	19.8	D 19-42
54.0	193.6	164.7	28.9	23.5	30.733	1.590	7.40	19.9	D 19-42
56.0	202.1	173.2	28.9	25.3	31.018	1.797	7.53	19.9	D 19-42
58.0	211.1	182.2	28.9	27.0	31.597	1.798	7.62	20.1	D 19-42
60.0	220.6	191.7	28.9	29.4	32.137	1.617	7.74	20.0	D 19-42
62.0	225.2	201.1	24.1	30.6	32.560	1.366	7.80	19.9	D 19-42
64.0	233.3	209.2	24.1	33.4	32.925	1.117	7.90	19.8	D 19-42
66.0	241.4	217.3	24.1	36.5	33.247	1.108	8.00	19.7	D 19-42
68.0	249.5	225.4	24.1	39.7	33.674	1.047	8.08	19.8	D 19-42
70.0	257.6	233.6	24.1	43.4	33.995	0.968	8.15	19.9	D 19-42
72.0	265.7	241.7	24.1	47.5	34.351	0.777	8.21	19.9	D 19-42

73.0 269.8 245.7 24.1 50.1 34.451 0.657 8.25 19.8 D 19-42

Total driving time: 29 minutes; Total Number of Blows: 1256 (starting at penetration 2.0 ft)

GRLWEAP: Wave Equation Analysis of Pile Foundations

MOT-835-2.57 Bridge Replacement + Forward Abutment
RESOURCE INTERNATIONAL INC

1/24/2025
GRLWEAP 14.1.20.1

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity-blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They **MUST** be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors.

SOIL PROFILE

Depth ft	Soil Type -	Spec. Wt lb/ft ³	Su ksf	Phi °	Unit Rs ksf	Unit Rt ksf
0.0	Gravel	130.0	0.0	37.0	0.00	0.00
10.9	Gravel	130.0	0.0	37.0	0.43	47.77
10.9	Gravel	115.0	0.0	28.0	0.18	9.09
13.4	Gravel	115.0	0.0	28.0	0.21	10.71
13.4	Gravel	130.0	0.0	39.0	0.62	86.88
17.4	Gravel	130.0	0.0	39.0	0.82	113.94
17.4	Sand	135.0	0.0	34.0	0.47	42.15
21.4	Sand	135.0	0.0	34.0	0.59	52.70
21.4	Sand	130.0	0.0	33.0	0.54	43.55
26.4	Sand	130.0	0.0	33.0	0.67	50.11
26.4	Sand	130.0	0.0	33.0	0.67	50.11
36.4	Sand	130.0	0.0	33.0	0.93	50.11
36.4	Clay	125.0	1.9	0.0	1.87	16.87
41.4	Clay	125.0	1.9	0.0	1.87	16.87
41.4	Clay	125.0	3.0	0.0	1.09	27.00
61.4	Clay	125.0	3.0	0.0	1.09	27.00
61.4	Clay	125.0	2.5	0.0	1.21	22.50
76.4	Clay	125.0	2.5	0.0	1.21	22.50
76.4	Sand	125.0	0.0	27.0	1.09	13.32
81.4	Sand	125.0	0.0	27.0	1.16	13.32
81.4	Sand	130.0	0.0	34.0	2.17	73.64
86.4	Sand	130.0	0.0	34.0	2.31	73.64
86.4	Clay	125.0	1.9	0.0	1.87	16.87
100.4	Clay	125.0	1.9	0.0	1.87	16.87

PILE INPUT

Uniform Pile		Pile Type:	Closed-End Pipe
Pile Length: (ft)	75.000	Pile Penetration: (ft)	73.000
Pile Size: (ft)	1.17	Toe Area: (in ²)	153.94

Pile Profile

Lb Top ft	X-Area in ²	E-Modulus ksi	Spec. Wt lb/ft ³	Perim. ft	Crit. Index -
0.0	10.8	30,000.0	492.0	3.7	0
75.0	10.8	30,000.0	492.0	3.7	0

HAMMER INPUT

ID	41	Made By:	DELMAG
1/24/2025	7/9		GRLWEAP 14.1.20.1

Model D 19-42 Type: OED

Hammer Data

ID	Ram Wt	Ram L.	Ram Ar.	Rtd. Stk	Effic.	Rtd. Energy
-	kips	in	in ²	ft	-	kip-ft
41	4.000	129.1	124.7	10.8	0.80	43.2

DRIVE SYSTEM FOR DELMAG D 19-42-OED

Type	X-Area	E-Modulus	Thickness	COR	Round-out	Stiffness
-	in ²	ksi	in	-	in	kips/in
Hammer C.	227.000	530.000	2.000	0.800	0.120	60155.550
Helmet Wt.	1.900	kips				

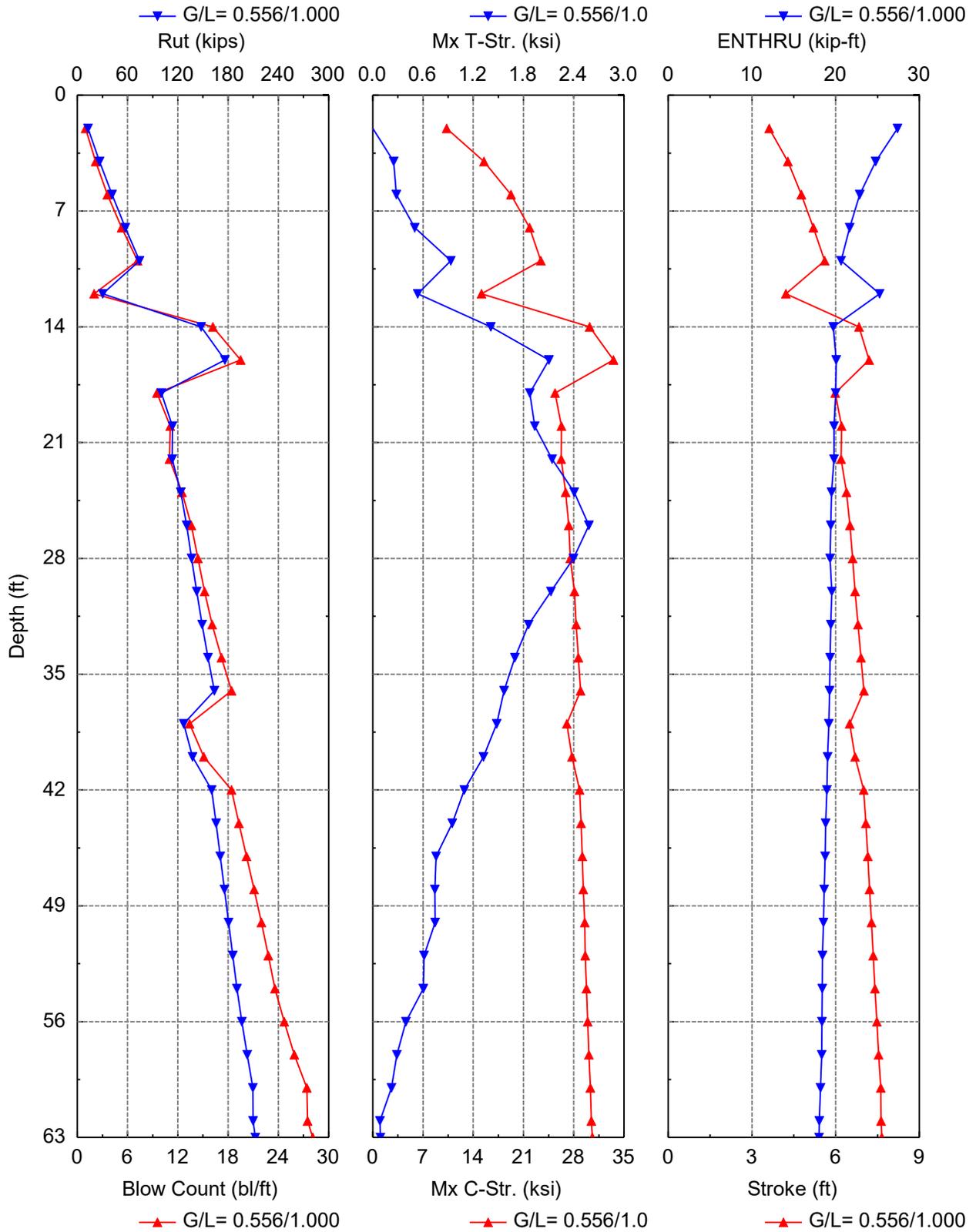
SOIL RESISTANCE DISTRIBUTION

Depth	Unit Rs	Unit Rt	Qs	Qt	Js	Jt	Set. F.	Limit D.	Set. T.	EB Area
ft	ksf	ksf	in	in	s/ft	s/ft	-	ft	Hours	in ²
0.0	0.0	0.0	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
1.8	0.1	8.0	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
3.6	0.2	15.9	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
5.4	0.3	23.9	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
7.3	0.4	31.8	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
9.1	0.5	39.8	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
10.9	0.6	47.8	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
10.9	0.2	9.1	0.10	0.20	0.05	0.15	1.0	6.0	1.0	153.9
12.2	0.2	9.9	0.10	0.20	0.05	0.15	1.0	6.0	1.0	153.9
13.4	0.3	10.7	0.10	0.20	0.05	0.15	1.0	6.0	1.0	153.9
13.4	0.8	86.9	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
15.4	1.0	100.4	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
17.4	1.1	113.9	0.10	0.11	0.05	0.15	1.0	6.0	1.0	153.9
17.4	0.6	42.1	0.10	0.11	0.10	0.15	1.2	6.0	168.0	153.9
19.4	0.7	47.5	0.10	0.11	0.10	0.15	1.2	6.0	168.0	153.9
21.4	0.8	52.9	0.10	0.11	0.10	0.15	1.2	6.0	168.0	153.9
21.4	0.7	43.8	0.10	0.11	0.15	0.15	1.5	6.0	24.0	153.9
23.1	0.7	47.2	0.10	0.11	0.15	0.15	1.5	6.0	24.0	153.9
24.7	0.8	50.1	0.10	0.11	0.15	0.15	1.5	6.0	24.0	153.9
26.4	0.8	50.1	0.10	0.11	0.15	0.15	1.5	6.0	24.0	153.9
26.4	0.8	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	153.9
28.1	0.9	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	153.9
29.7	1.0	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	153.9
31.4	1.0	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	153.9
33.1	1.1	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	153.9

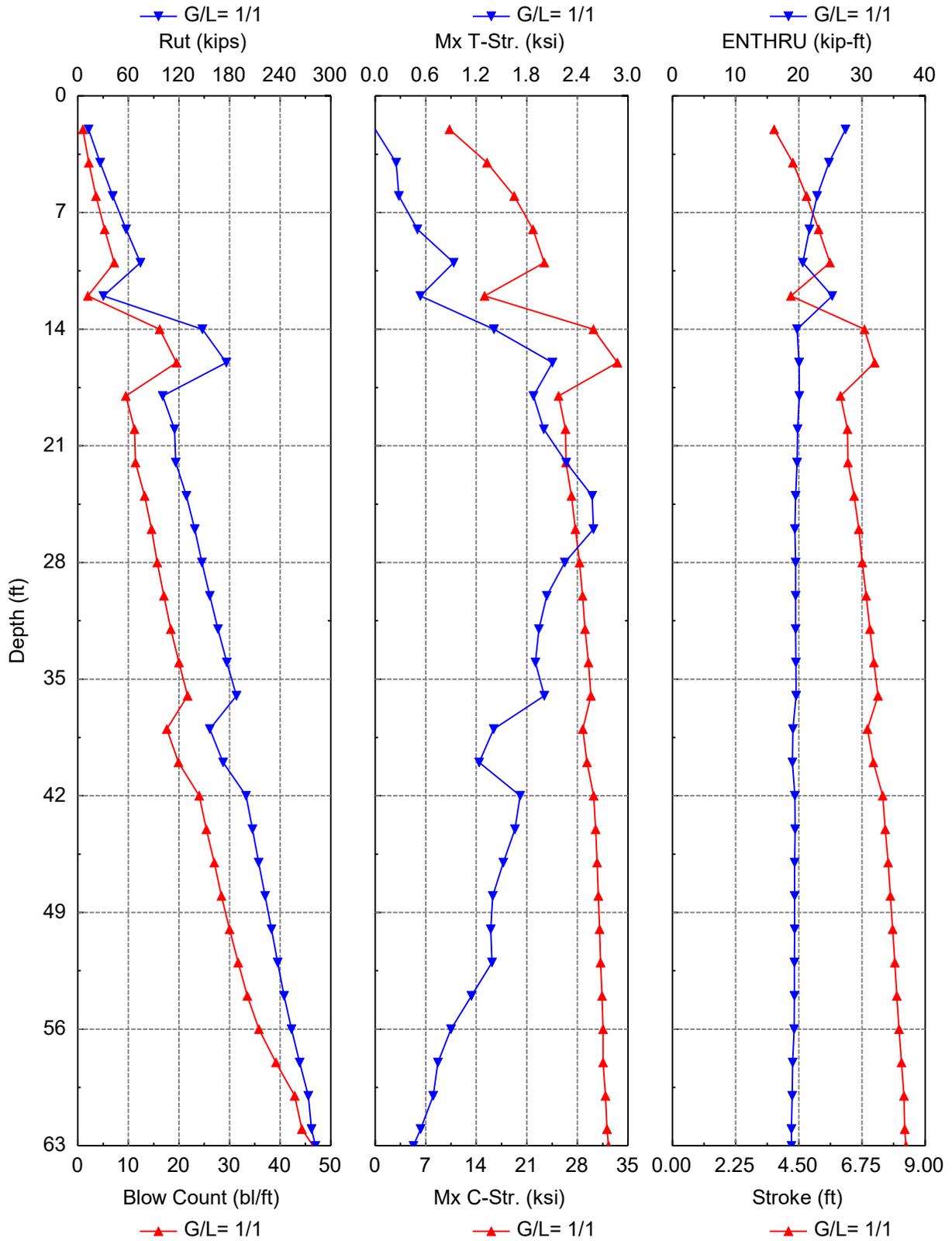
MOT-835-2.57 Bridge Replacement + Forward Abutment RESOURCE INTERNATIONAL INC

34.7	1.1	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	153.9
36.4	1.2	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	153.9
36.4	1.9	16.9	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
38.1	1.9	16.9	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
39.7	1.9	16.9	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
41.4	1.9	16.9	0.10	0.12	0.15	0.15	1.5	6.0	168.0	153.9
41.4	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	153.9
43.1	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	153.9
44.7	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	153.9
46.4	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	153.9
48.1	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	153.9
49.7	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	153.9
51.4	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	153.9
53.1	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	153.9
54.7	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	153.9
56.4	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	153.9
58.1	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	153.9
59.7	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	153.9
61.4	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	153.9
61.4	1.1	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	153.9
63.1	1.1	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	153.9
64.7	1.1	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	153.9
66.4	1.1	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	153.9
68.1	1.1	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	153.9
69.7	1.1	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	153.9
71.4	1.1	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	153.9
73.0	1.1	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	153.9

Driveability Analysis Summary



Driveability Analysis Summary



Gain/Loss Factor at Shaft/Toe = 0.556/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow Ct bl/ft	Mx C-Str ksi	Mx T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
2.0	12.8	0.5	12.2	1.0	10.310	0.000	3.62	27.4	D 19-42
4.0	26.6	2.1	24.5	2.2	15.495	0.251	4.29	24.8	D 19-42
6.0	41.4	4.7	36.7	3.6	19.249	0.281	4.77	22.9	D 19-42
8.0	57.3	8.3	49.0	5.3	21.851	0.503	5.20	21.7	D 19-42
10.0	74.2	13.0	61.2	7.2	23.432	0.934	5.61	20.6	D 19-42
12.0	30.3	16.7	13.7	2.0	15.141	0.537	4.22	25.2	D 19-42
14.0	147.9	20.9	127.0	16.2	30.200	1.409	6.83	19.7	D 19-42
16.0	176.3	30.4	145.9	19.5	33.519	2.105	7.19	20.0	D 19-42
18.0	100.4	39.3	61.1	9.5	25.410	1.877	5.98	20.0	D 19-42
20.0	113.4	44.8	68.6	11.1	26.294	1.932	6.21	19.8	D 19-42
22.0	113.3	50.4	62.9	11.0	26.253	2.140	6.20	19.8	D 19-42
24.0	123.5	55.3	68.2	12.5	26.876	2.405	6.38	19.5	D 19-42
26.0	130.6	60.6	70.0	13.6	27.304	2.580	6.51	19.4	D 19-42
28.0	136.3	66.4	70.0	14.4	27.527	2.395	6.61	19.3	D 19-42
30.0	142.5	72.5	70.0	15.2	28.104	2.127	6.69	19.5	D 19-42
32.0	149.1	79.1	70.0	16.1	28.352	1.860	6.80	19.4	D 19-42
34.0	156.1	86.2	70.0	17.2	28.658	1.698	6.90	19.3	D 19-42
36.0	163.6	93.6	70.0	18.4	28.945	1.569	7.01	19.3	D 19-42
38.0	127.1	103.6	23.6	13.4	27.046	1.479	6.50	19.2	D 19-42
40.0	137.6	114.0	23.6	15.1	27.745	1.322	6.69	19.0	D 19-42
42.0	160.6	122.9	37.7	18.4	28.817	1.094	7.00	19.0	D 19-42
44.0	165.6	127.9	37.7	19.3	29.015	0.949	7.08	18.8	D 19-42
46.0	170.6	132.9	37.7	20.2	29.205	0.758	7.15	18.7	D 19-42
48.0	175.6	137.9	37.7	21.1	29.322	0.742	7.22	18.6	D 19-42
50.0	180.6	142.9	37.7	22.0	29.532	0.744	7.28	18.5	D 19-42
52.0	185.6	147.9	37.7	22.8	29.614	0.612	7.35	18.4	D 19-42
54.0	190.6	152.9	37.7	23.6	29.774	0.603	7.41	18.4	D 19-42
56.0	196.3	158.6	37.7	24.7	29.953	0.396	7.47	18.4	D 19-42
58.0	202.8	165.1	37.7	25.9	30.105	0.288	7.54	18.3	D 19-42
60.0	209.7	172.0	37.7	27.4	30.330	0.223	7.62	18.2	D 19-42
62.0	209.9	178.5	31.4	27.5	30.456	0.086	7.63	18.0	D 19-42
63.0	212.5	181.1	31.4	28.1	30.578	0.093	7.65	18.0	D 19-42

Total driving time: 21 minutes; Total Number of Blows: 953 (starting at penetration 2.0 ft)

Gain/Loss Factor at Shaft/Toe = 1.000/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow Ct bl/ft	Mx C-Str ksi	Mx T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
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2.0	12.8	0.5	12.2	1.0	10.310	0.000	3.62	27.4	D 19-42
4.0	26.6	2.1	24.5	2.2	15.495	0.251	4.29	24.8	D 19-42
6.0	41.4	4.7	36.7	3.6	19.249	0.281	4.77	22.9	D 19-42
8.0	57.3	8.3	49.0	5.3	21.851	0.503	5.20	21.7	D 19-42
10.0	74.2	13.0	61.2	7.2	23.432	0.934	5.61	20.6	D 19-42
12.0	30.3	16.7	13.7	2.0	15.141	0.537	4.22	25.2	D 19-42
14.0	147.9	20.9	127.0	16.2	30.200	1.409	6.83	19.7	D 19-42
16.0	176.3	30.4	145.9	19.5	33.519	2.105	7.19	20.0	D 19-42
18.0	100.7	39.6	61.1	9.5	25.414	1.877	5.99	20.1	D 19-42
20.0	114.8	46.2	68.6	11.2	26.366	2.000	6.23	19.8	D 19-42
22.0	116.2	53.4	62.9	11.4	26.407	2.266	6.24	19.7	D 19-42
24.0	128.9	60.7	68.2	13.2	27.189	2.575	6.47	19.5	D 19-42
26.0	138.6	68.6	70.0	14.6	27.721	2.589	6.63	19.4	D 19-42
28.0	147.2	77.3	70.0	15.7	28.287	2.250	6.76	19.5	D 19-42
30.0	156.5	86.5	70.0	17.0	28.728	2.038	6.89	19.5	D 19-42
32.0	166.4	96.4	70.0	18.4	29.070	1.943	7.03	19.5	D 19-42
34.0	177.0	107.0	70.0	20.0	29.536	1.902	7.17	19.5	D 19-42
36.0	188.1	118.2	70.0	21.7	29.880	2.007	7.32	19.6	D 19-42
38.0	156.6	133.1	23.6	17.6	28.734	1.407	6.94	19.0	D 19-42
40.0	172.3	148.8	23.6	19.9	29.327	1.233	7.15	19.0	D 19-42
42.0	199.7	162.0	37.7	24.0	30.262	1.721	7.48	19.4	D 19-42
44.0	207.2	169.5	37.7	25.4	30.539	1.658	7.57	19.4	D 19-42
46.0	214.7	177.0	37.7	27.0	30.725	1.522	7.68	19.3	D 19-42
48.0	222.2	184.5	37.7	28.4	30.901	1.396	7.76	19.3	D 19-42
50.0	229.7	192.0	37.7	30.0	31.079	1.372	7.84	19.3	D 19-42
52.0	237.2	199.5	37.7	31.7	31.216	1.386	7.91	19.3	D 19-42
54.0	244.7	207.0	37.7	33.5	31.407	1.144	7.98	19.3	D 19-42
56.0	253.4	215.7	37.7	35.8	31.564	0.900	8.06	19.3	D 19-42
58.0	263.1	225.4	37.7	39.2	31.548	0.745	8.15	19.0	D 19-42
60.0	273.4	235.7	37.7	42.9	31.881	0.689	8.24	19.0	D 19-42
62.0	277.3	245.9	31.4	44.3	32.102	0.540	8.27	18.8	D 19-42
63.0	282.0	250.6	31.4	46.5	32.285	0.455	8.31	18.8	D 19-42

Total driving time: 28 minutes; Total Number of Blows: 1219 (starting at penetration 2.0 ft)

GRLWEAP: Wave Equation Analysis of Pile Foundations

MOT-835-2.57 Bridge Replacement + Forward Abutment
RESOURCE INTERNATIONAL INC

1/24/2025
GRLWEAP 14.1.20.1

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity-blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They **MUST** be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors.

SOIL PROFILE

Depth ft	Soil Type -	Spec. Wt lb/ft ³	Su ksf	Phi °	Unit Rs ksf	Unit Rt ksf
0.0	Gravel	130.0	0.0	37.0	0.00	0.00
10.9	Gravel	130.0	0.0	37.0	0.43	47.77
10.9	Gravel	115.0	0.0	28.0	0.18	9.09
13.4	Gravel	115.0	0.0	28.0	0.21	10.71
13.4	Gravel	130.0	0.0	39.0	0.62	86.88
17.4	Gravel	130.0	0.0	39.0	0.82	113.94
17.4	Sand	135.0	0.0	34.0	0.47	42.15
21.4	Sand	135.0	0.0	34.0	0.59	52.70
21.4	Sand	130.0	0.0	33.0	0.54	43.55
26.4	Sand	130.0	0.0	33.0	0.67	50.11
26.4	Sand	130.0	0.0	33.0	0.67	50.11
36.4	Sand	130.0	0.0	33.0	0.93	50.11
36.4	Clay	125.0	1.9	0.0	1.87	16.87
41.4	Clay	125.0	1.9	0.0	1.87	16.87
41.4	Clay	125.0	3.0	0.0	1.09	27.00
61.4	Clay	125.0	3.0	0.0	1.09	27.00
61.4	Clay	125.0	2.5	0.0	1.21	22.50
76.4	Clay	125.0	2.5	0.0	1.21	22.50
76.4	Sand	125.0	0.0	27.0	1.09	13.32
81.4	Sand	125.0	0.0	27.0	1.16	13.32
81.4	Sand	130.0	0.0	34.0	2.17	73.64
86.4	Sand	130.0	0.0	34.0	2.31	73.64
86.4	Clay	125.0	1.9	0.0	1.87	16.87
100.4	Clay	125.0	1.9	0.0	1.87	16.87

PILE INPUT

Uniform Pile		Pile Type:	Closed-End Pipe
Pile Length: (ft)	65.000	Pile Penetration: (ft)	63.000
Pile Size: (ft)	1.33	Toe Area: (in ²)	201.06

Pile Profile

Lb Top ft	X-Area in ²	E-Modulus ksi	Spec. Wt lb/ft ³	Perim. ft	Crit. Index -
0.0	12.4	30,000.0	492.0	4.2	0
65.0	12.4	30,000.0	492.0	4.2	0

HAMMER INPUT

ID	41	Made By:	DELMAG
1/24/2025	6/8		GRLWEAP 14.1.20.1

Model D 19-42 Type: OED

Hammer Data

ID	Ram Wt	Ram L.	Ram Ar.	Rtd. Stk	Effic.	Rtd. Energy
-	kips	in	in ²	ft	-	kip-ft
41	4.000	129.1	124.7	10.8	0.80	43.2

DRIVE SYSTEM FOR DELMAG D 19-42-OED

Type	X-Area	E-Modulus	Thickness	COR	Round-out	Stiffness
-	in ²	ksi	in	-	in	kips/in
Hammer C.	227.000	530.000	2.000	0.800	0.120	60155.555
Helmet Wt.	1.900	kips				

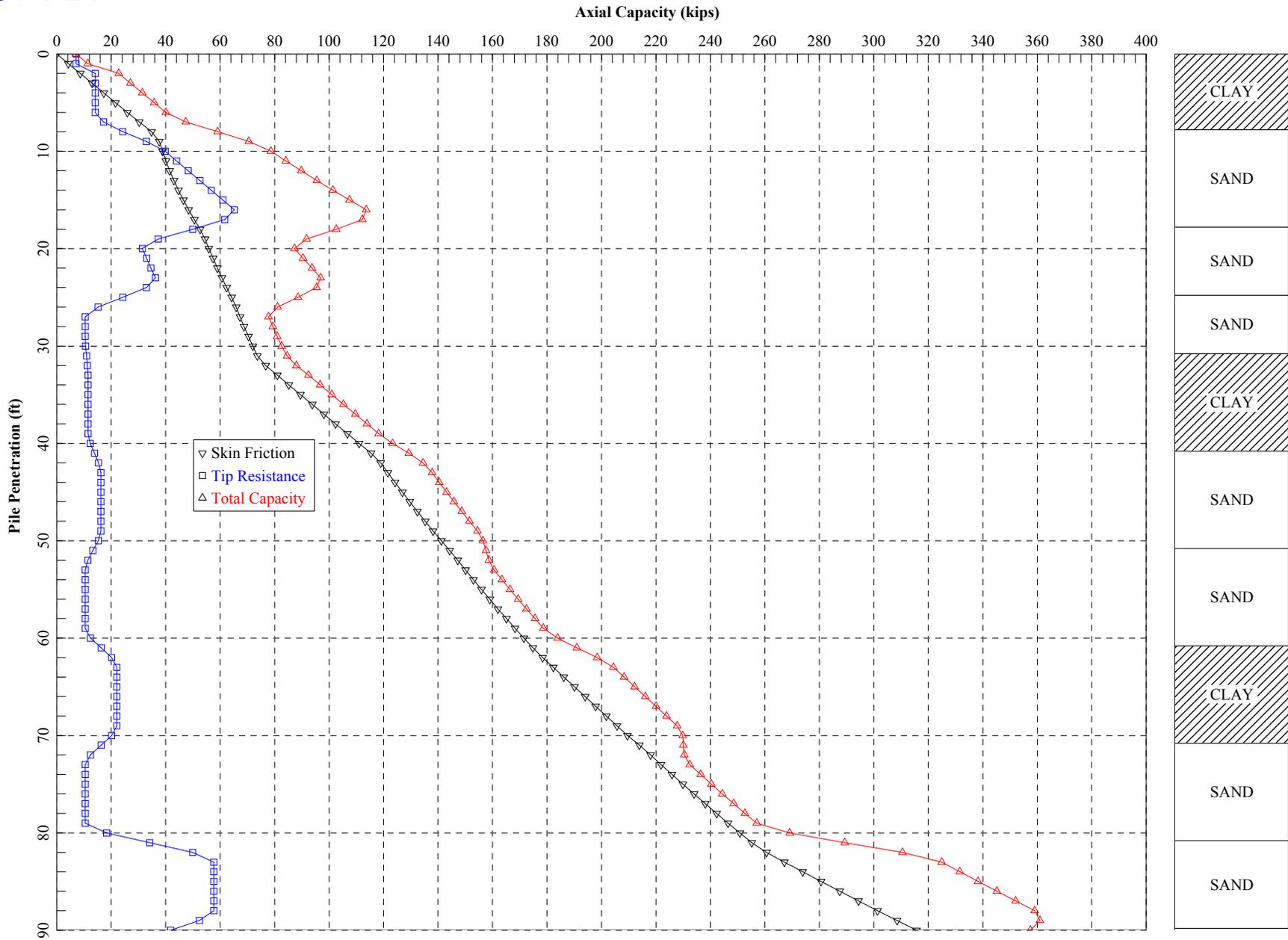
SOIL RESISTANCE DISTRIBUTION

Depth	Unit Rs	Unit Rt	Qs	Qt	Js	Jt	Set. F.	Limit D.	Set. T.	EB Area
ft	ksf	ksf	in	in	s/ft	s/ft	-	ft	Hours	in ²
0.0	0.0	0.0	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
1.8	0.1	8.0	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
3.6	0.2	15.9	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
5.4	0.3	23.9	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
7.3	0.5	31.8	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
9.1	0.6	39.8	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
10.9	0.7	47.8	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
10.9	0.3	9.1	0.10	0.20	0.05	0.15	1.0	6.0	1.0	201.1
12.2	0.3	9.9	0.10	0.20	0.05	0.15	1.0	6.0	1.0	201.1
13.4	0.3	10.7	0.10	0.20	0.05	0.15	1.0	6.0	1.0	201.1
13.4	1.0	86.9	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
15.4	1.2	100.4	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
17.4	1.3	113.9	0.10	0.11	0.05	0.15	1.0	6.0	1.0	201.1
17.4	0.7	42.1	0.10	0.11	0.10	0.15	1.2	6.0	168.0	201.1
19.4	0.8	47.5	0.10	0.11	0.10	0.15	1.2	6.0	168.0	201.1
21.4	0.9	52.9	0.10	0.11	0.10	0.15	1.2	6.0	168.0	201.1
21.4	0.8	43.8	0.10	0.11	0.15	0.15	1.5	6.0	24.0	201.1
23.1	0.9	47.2	0.10	0.11	0.15	0.15	1.5	6.0	24.0	201.1
24.7	0.9	50.1	0.10	0.11	0.15	0.15	1.5	6.0	24.0	201.1
26.4	1.0	50.1	0.10	0.11	0.15	0.15	1.5	6.0	24.0	201.1
26.4	1.0	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	201.1
28.1	1.1	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	201.1
29.7	1.1	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	201.1
31.4	1.2	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	201.1
33.1	1.3	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	201.1

MOT-835-2.57 Bridge Replacement + Forward Abutment RESOURCE INTERNATIONAL INC

34.7	1.3	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	201.1
36.4	1.4	50.1	0.10	0.12	0.15	0.15	1.5	6.0	24.0	201.1
36.4	1.9	16.9	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
38.1	1.9	16.9	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
39.7	1.9	16.9	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
41.4	1.9	16.9	0.10	0.12	0.15	0.15	1.5	6.0	168.0	201.1
41.4	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	201.1
43.1	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	201.1
44.7	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	201.1
46.4	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	201.1
48.1	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	201.1
49.7	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	201.1
51.4	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	201.1
53.1	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	201.1
54.7	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	201.1
56.4	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	201.1
58.1	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	201.1
59.7	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	201.1
61.4	1.0	27.0	0.10	0.11	0.15	0.15	1.5	6.0	168.0	201.1
61.4	1.1	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	201.1
63.0	1.1	22.5	0.10	0.11	0.20	0.15	1.8	6.0	168.0	201.1

12-Inch Dia. Closed End CIP Piles - UBV Rear Abutment B-001-1-24



**12-Inch Dia. Closed End CIP Piles - UBV
Rear Abutment
B-001-1-24**

B-001-1-24 UBV.ap9o

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APILE for Windows, Version 2019.9.12

Serial Number : 136090498

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 :

Resource International, Inc.
Columbus, OH

Path to file locations : C:\Users\legacy\Desktop\1.3.2025\12 In Abt (only
Abt)\B-001-1-24\
Name of input data file : B-001-1-24 UBV.ap9d
Name of output file : B-001-1-24 UBV.ap9o
Name of plot output file : B-001-1-24 UBV.ap9p

Time and Date of Analysis

Date: January 07, 2025 Time: 09:21:54

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* INPUT INFORMATION *

B-001-1-24 (Rear Abutment)

DESIGNER : AG/DEK

JOB NUMBER : W-23-155 (MOT-835-2.57)

METHOD FOR UNIT LOAD TRANSFERS :

- FHWA (Federal Highway Administration)
Unfactored Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

TYPE OF LOADING :

- COMPRESSION

PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
 - Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
 - CROSS SECTION AREA = 113.05 IN²

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 12.00 IN.
 - INTERNAL DIAMETER, ID = 0.25 IN.
 - TOTAL PILE LENGTH, TL = 90.00 FT.
 - BATTER ANGLE = 0.00 DEG
 - PILE STICKUP LENGTH, PSL = 0.00 FT.
 - ZERO FRICTION LENGTH, ZFL = 0.00 FT.
 - INCREMENT OF PILE LENGTH
 USED IN COMPUTATION = 1.00 FT.
 - LENGTH OF ENHANCED
 END SECTION = 90.00 FT.
 - INTERNAL DIAMETER OF
 ENHANCED END SECTION = 0.25 IN.

PLUGGED/UNPLUGGED CONDITIONS :

Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	CLAY	0.80*	62.60	0.00	4.80**
7.80	CLAY	0.80*	62.60	0.00	4.80**
7.80	SAND	0.80*	67.60	38.00	110.40**
17.80	SAND	0.80*	67.60	38.00	110.40**
17.80	SAND	0.80*	67.60	33.00	47.20**
24.80	SAND	0.80*	67.60	33.00	47.20**
24.80	SAND	0.80*	62.60	30.00	30.00**
30.80	SAND	0.80*	62.60	30.00	30.00**
30.80	CLAY	0.80*	62.60	0.00	4.80**
40.80	CLAY	0.80*	62.60	0.00	4.80**
40.80	SAND	0.80*	67.60	31.00	35.20**
50.80	SAND	0.80*	67.60	31.00	35.20**
50.80	SAND	0.80*	62.60	30.00	30.00**
60.80	SAND	0.80*	62.60	30.00	30.00**
60.80	CLAY	0.80*	62.60	0.00	4.80**
70.80	CLAY	0.80*	62.60	0.00	4.80**
70.80	SAND	0.80*	67.60	30.00	30.00**
80.80	SAND	0.80*	67.60	30.00	30.00**
80.80	SAND	0.80*	72.60	34.00	55.60**
89.80	SAND	0.80*	72.60	34.00	55.60**
89.80	SAND	0.80*	72.60	32.00	40.40**

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70.80	1.000	1.000
70.80	1.000	1.000
80.80	1.000	1.000
80.80	1.000	1.000
89.80	1.000	1.000
89.80	1.000	1.000
94.80	1.000	1.000
94.80	1.000	1.000
99.80	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.120 *	0.90 **
7.80	0.120 *	0.90 **
7.80	0.120 *	0.00
17.80	0.120 *	0.00
17.80	0.120 *	0.00
24.80	0.120 *	0.00
24.80	0.120 *	0.00
30.80	0.120 *	0.00
30.80	0.120 *	0.90 **
40.80	0.120 *	0.90 **
40.80	0.120 *	0.00
50.80	0.120 *	0.00
50.80	0.120 *	0.00
60.80	0.120 *	0.00
60.80	0.120 *	0.90 **
70.80	0.120 *	0.90 **
70.80	0.120 *	0.00
80.80	0.120 *	0.00
80.80	0.120 *	0.00
89.80	0.120 *	0.00
89.80	0.120 *	0.00
94.80	0.120 *	0.00
94.80	0.120 *	0.00
99.80	0.120 *	0.00

* DEFAULT VALUE = 0.01 D
 ** DEFAULT VALUE = 0.9

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 * COMPUTATION RESULT *

 * FED. HWY. METHOD *

PILE PENETRATION FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	7.1	7.1
1.00	4.3	7.1	11.4
2.00	8.6	14.1	22.8
3.00	13.0	14.1	27.1

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4.00	17.3	14.1	31.4
5.00	21.6	14.1	35.8
6.00	25.9	14.1	40.1
7.00	30.3	17.2	47.4
8.00	34.8	24.3	59.1
9.00	37.6	32.9	70.5
10.00	38.8	39.8	78.6
11.00	40.1	44.0	84.1
12.00	41.5	48.3	89.8
13.00	43.0	52.5	95.5
14.00	44.7	56.7	101.4
15.00	46.5	61.0	107.5
16.00	48.4	65.2	113.6
17.00	50.5	61.7	112.2
18.00	52.6	49.9	102.6
19.00	54.5	37.3	91.7
20.00	55.9	31.4	87.3
21.00	57.4	33.0	90.4
22.00	59.0	34.6	93.7
23.00	60.7	36.2	96.9
24.00	62.4	32.9	95.4
25.00	64.2	24.3	88.6
26.00	65.9	15.2	81.1
27.00	67.3	10.5	77.8
28.00	68.8	10.5	79.3
29.00	70.4	10.5	80.9
30.00	72.0	10.6	82.6
31.00	73.7	11.0	84.6
32.00	76.7	11.3	88.0
33.00	81.0	11.5	92.4
34.00	85.2	11.5	96.7
35.00	89.5	11.5	101.0
36.00	93.8	11.5	105.3
37.00	98.1	11.5	109.6
38.00	102.4	11.5	113.9
39.00	106.7	11.5	118.2
40.00	111.0	12.3	123.3
41.00	115.4	13.9	129.3
42.00	119.0	15.4	134.5
43.00	121.6	16.2	137.8
44.00	124.2	16.2	140.4
45.00	126.9	16.2	143.1
46.00	129.6	16.2	145.8
47.00	132.4	16.2	148.7
48.00	135.3	16.2	151.5
49.00	138.2	16.2	154.5
50.00	141.2	15.3	156.5
51.00	144.3	13.3	157.6
52.00	147.2	11.4	158.7
53.00	150.1	10.5	160.6
54.00	153.0	10.5	163.5
55.00	156.0	10.5	166.4
56.00	159.0	10.5	169.4
57.00	162.0	10.5	172.5
58.00	165.1	10.5	175.6
59.00	168.3	10.5	178.7
60.00	171.5	12.4	183.9
61.00	174.8	16.3	191.0
62.00	178.4	20.2	198.5
63.00	182.3	22.1	204.4
64.00	186.2	22.1	208.3
65.00	190.1	22.1	212.2
66.00	194.0	22.1	216.1

**12-Inch Dia. Closed End CIP Piles - UBV
Rear Abutment
B-001-1-24**

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67.00	197.9	22.1	220.0
68.00	201.8	22.1	223.9
69.00	205.7	22.1	227.8
70.00	209.6	20.2	229.8
71.00	213.9	16.3	230.1
72.00	218.0	12.4	230.4
73.00	221.9	10.5	232.4
74.00	225.9	10.5	236.4
75.00	229.9	10.5	240.4
76.00	234.0	10.5	244.4
77.00	238.1	10.5	248.6
78.00	242.3	10.5	252.7
79.00	246.5	10.5	257.0
80.00	250.8	18.3	269.1
81.00	255.2	34.1	289.3
82.00	260.6	49.9	310.5
83.00	267.2	57.7	324.9
84.00	273.9	57.7	331.6
85.00	280.6	57.7	338.3
86.00	287.5	57.7	345.2
87.00	294.4	57.7	352.1
88.00	301.4	57.7	359.1
89.00	308.5	52.4	361.0
90.00	315.7	41.8	357.5

NOTES:

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

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

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.4167E-01	0.0000E+00	0.0000E+00
			0.2867E+01	0.1920E-01
			0.4778E+01	0.3720E-01
			0.7167E+01	0.6840E-01
			0.8600E+01	0.9600E-01
			0.9556E+01	0.1200E+00
			0.8600E+01	0.2400E+00
			0.8600E+01	0.3600E+00
			0.8600E+01	0.6000E+00
			0.8600E+01	0.2400E+01
2	10	0.3900E+01	0.0000E+00	0.0000E+00
			0.2867E+01	0.1920E-01
			0.4778E+01	0.3720E-01
			0.7167E+01	0.6840E-01
			0.8600E+01	0.9600E-01
			0.9556E+01	0.1200E+00
			0.8600E+01	0.2400E+00
			0.8600E+01	0.3600E+00
			0.8600E+01	0.6000E+00
			0.8600E+01	0.6000E+00

Max. Factored Designed Load per Pile = 186.0kips
Required Nominal Resistance per Pile = (186/0.7) kips = 265.7 kips

Pile length = 80+ 2.0 (estimated embedment in pile cap) = 82.0 feet
Estimated Pile Length to Rounded Up to Nearest 5 feet = 85.0 feet
Pile Order Length = 90 feet

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3	10	0.7758E+01	0.8600E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.3041E+01	0.1920E-01
			0.5068E+01	0.3720E-01
			0.7602E+01	0.6840E-01
			0.9122E+01	0.9600E-01
			0.1014E+02	0.1200E+00
			0.9122E+01	0.2400E+00
			0.9122E+01	0.3600E+00
			0.9122E+01	0.6000E+00
4	10	0.7842E+01	0.9122E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.3060E+01	0.1920E-01
			0.5100E+01	0.3720E-01
			0.7650E+01	0.6840E-01
			0.9180E+01	0.9600E-01
			0.1020E+02	0.1200E+00
			0.1020E+02	0.2400E+00
			0.1020E+02	0.3600E+00
			0.1020E+02	0.6000E+00
5	10	0.1280E+02	0.1020E+02	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1046E+01	0.1920E-01
			0.1744E+01	0.3720E-01
			0.2615E+01	0.6840E-01
			0.3138E+01	0.9600E-01
			0.3487E+01	0.1200E+00
			0.3487E+01	0.2400E+00
			0.3487E+01	0.3600E+00
			0.3487E+01	0.6000E+00
6	10	0.1776E+02	0.3487E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1471E+01	0.1920E-01
			0.2452E+01	0.3720E-01
			0.3678E+01	0.6840E-01
			0.4413E+01	0.9600E-01
			0.4903E+01	0.1200E+00
			0.4903E+01	0.2400E+00
			0.4903E+01	0.3600E+00
			0.4903E+01	0.6000E+00
7	10	0.1784E+02	0.4903E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1478E+01	0.1920E-01
			0.2464E+01	0.3720E-01
			0.3695E+01	0.6840E-01
			0.4434E+01	0.9600E-01
			0.4927E+01	0.1200E+00
			0.4927E+01	0.2400E+00
			0.4927E+01	0.3600E+00
			0.4927E+01	0.6000E+00
8	10	0.2130E+02	0.4927E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1045E+01	0.1920E-01
			0.1742E+01	0.3720E-01
			0.2613E+01	0.6840E-01
			0.3136E+01	0.9600E-01
			0.3484E+01	0.1200E+00

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			0.3484E+01	0.2400E+00
			0.3484E+01	0.3600E+00
			0.3484E+01	0.6000E+00
9	10	0.2476E+02	0.3484E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1220E+01	0.1920E-01
			0.2033E+01	0.3720E-01
			0.3050E+01	0.6840E-01
			0.3659E+01	0.9600E-01
			0.4066E+01	0.1200E+00
			0.4066E+01	0.2400E+00
			0.4066E+01	0.3600E+00
			0.4066E+01	0.6000E+00
10	10	0.2484E+02	0.4066E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1224E+01	0.1920E-01
			0.2040E+01	0.3720E-01
			0.3060E+01	0.6840E-01
			0.3672E+01	0.9600E-01
			0.4080E+01	0.1200E+00
			0.4080E+01	0.2400E+00
			0.4080E+01	0.3600E+00
			0.4080E+01	0.6000E+00
11	10	0.2780E+02	0.4080E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1008E+01	0.1920E-01
			0.1680E+01	0.3720E-01
			0.2520E+01	0.6840E-01
			0.3024E+01	0.9600E-01
			0.3359E+01	0.1200E+00
			0.3359E+01	0.2400E+00
			0.3359E+01	0.3600E+00
			0.3359E+01	0.6000E+00
12	10	0.3076E+02	0.3359E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1110E+01	0.1920E-01
			0.1850E+01	0.3720E-01
			0.2775E+01	0.6840E-01
			0.3330E+01	0.9600E-01
			0.3700E+01	0.1200E+00
			0.3700E+01	0.2400E+00
			0.3700E+01	0.3600E+00
			0.3700E+01	0.6000E+00
13	10	0.3084E+02	0.3700E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1113E+01	0.1920E-01
			0.1855E+01	0.3720E-01
			0.2782E+01	0.6840E-01
			0.3339E+01	0.9600E-01
			0.3710E+01	0.1200E+00
			0.3339E+01	0.2400E+00
			0.3339E+01	0.3600E+00
			0.3339E+01	0.6000E+00
14	10	0.3580E+02	0.3339E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.2847E+01	0.1920E-01
			0.4745E+01	0.3720E-01

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			0.7117E+01	0.6840E-01
			0.8540E+01	0.9600E-01
			0.9489E+01	0.1200E+00
			0.8540E+01	0.2400E+00
			0.8540E+01	0.3600E+00
			0.8540E+01	0.6000E+00
			0.8540E+01	0.2400E+01
15	10	0.4076E+02		
			0.0000E+00	0.0000E+00
			0.3002E+01	0.1920E-01
			0.5003E+01	0.3720E-01
			0.7505E+01	0.6840E-01
			0.9005E+01	0.9600E-01
			0.1001E+02	0.1200E+00
			0.9005E+01	0.2400E+00
			0.9005E+01	0.3600E+00
			0.9005E+01	0.6000E+00
			0.9005E+01	0.2400E+01
16	10	0.4084E+02		
			0.0000E+00	0.0000E+00
			0.3019E+01	0.1920E-01
			0.5031E+01	0.3720E-01
			0.7547E+01	0.6840E-01
			0.9057E+01	0.9600E-01
			0.1006E+02	0.1200E+00
			0.1006E+02	0.2400E+00
			0.1006E+02	0.3600E+00
			0.1006E+02	0.6000E+00
			0.1006E+02	0.2400E+01
17	10	0.4580E+02		
			0.0000E+00	0.0000E+00
			0.1833E+01	0.1920E-01
			0.3056E+01	0.3720E-01
			0.4583E+01	0.6840E-01
			0.5500E+01	0.9600E-01
			0.6111E+01	0.1200E+00
			0.6111E+01	0.2400E+00
			0.6111E+01	0.3600E+00
			0.6111E+01	0.6000E+00
			0.6111E+01	0.2400E+01
18	10	0.5076E+02		
			0.0000E+00	0.0000E+00
			0.2040E+01	0.1920E-01
			0.3400E+01	0.3720E-01
			0.5100E+01	0.6840E-01
			0.6120E+01	0.9600E-01
			0.6800E+01	0.1200E+00
			0.6800E+01	0.2400E+00
			0.6800E+01	0.3600E+00
			0.6800E+01	0.6000E+00
			0.6800E+01	0.2400E+01
19	10	0.5084E+02		
			0.0000E+00	0.0000E+00
			0.2043E+01	0.1920E-01
			0.3406E+01	0.3720E-01
			0.5108E+01	0.6840E-01
			0.6130E+01	0.9600E-01
			0.6811E+01	0.1200E+00
			0.6811E+01	0.2400E+00
			0.6811E+01	0.3600E+00
			0.6811E+01	0.6000E+00
			0.6811E+01	0.2400E+01
20	10	0.5580E+02		

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			0.0000E+00	0.0000E+00
			0.2003E+01	0.1920E-01
			0.3339E+01	0.3720E-01
			0.5008E+01	0.6840E-01
			0.6010E+01	0.9600E-01
			0.6678E+01	0.1200E+00
			0.6678E+01	0.2400E+00
			0.6678E+01	0.3600E+00
			0.6678E+01	0.6000E+00
			0.6678E+01	0.2400E+01
21	10	0.6076E+02		
			0.0000E+00	0.0000E+00
			0.2175E+01	0.1920E-01
			0.3624E+01	0.3720E-01
			0.5437E+01	0.6840E-01
			0.6524E+01	0.9600E-01
			0.7249E+01	0.1200E+00
			0.7249E+01	0.2400E+00
			0.7249E+01	0.3600E+00
			0.7249E+01	0.6000E+00
			0.7249E+01	0.2400E+01
22	10	0.6084E+02		
			0.0000E+00	0.0000E+00
			0.2178E+01	0.1920E-01
			0.3629E+01	0.3720E-01
			0.5444E+01	0.6840E-01
			0.6533E+01	0.9600E-01
			0.7258E+01	0.1200E+00
			0.6533E+01	0.2400E+00
			0.6533E+01	0.3600E+00
			0.6533E+01	0.6000E+00
			0.6533E+01	0.2400E+01
23	10	0.6580E+02		
			0.0000E+00	0.0000E+00
			0.2593E+01	0.1920E-01
			0.4321E+01	0.3720E-01
			0.6482E+01	0.6840E-01
			0.7779E+01	0.9600E-01
			0.8643E+01	0.1200E+00
			0.7779E+01	0.2400E+00
			0.7779E+01	0.3600E+00
			0.7779E+01	0.6000E+00
			0.7779E+01	0.2400E+01
24	10	0.7076E+02		
			0.0000E+00	0.0000E+00
			0.2897E+01	0.1920E-01
			0.4829E+01	0.3720E-01
			0.7243E+01	0.6840E-01
			0.8692E+01	0.9600E-01
			0.9658E+01	0.1200E+00
			0.8692E+01	0.2400E+00
			0.8692E+01	0.3600E+00
			0.8692E+01	0.6000E+00
			0.8692E+01	0.2400E+01
25	10	0.7084E+02		
			0.0000E+00	0.0000E+00
			0.2931E+01	0.1920E-01
			0.4885E+01	0.3720E-01
			0.7327E+01	0.6840E-01
			0.8792E+01	0.9600E-01
			0.9769E+01	0.1200E+00
			0.9769E+01	0.2400E+00
			0.9769E+01	0.3600E+00

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26	10	0.7580E+02	0.9769E+01	0.6000E+00
			0.9769E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.2708E+01	0.1920E-01
			0.4513E+01	0.3720E-01
			0.6770E+01	0.6840E-01
			0.8123E+01	0.9600E-01
			0.9026E+01	0.1200E+00
			0.9026E+01	0.2400E+00
			0.9026E+01	0.3600E+00
27	10	0.8076E+02	0.9026E+01	0.6000E+00
			0.9026E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.2893E+01	0.1920E-01
			0.4821E+01	0.3720E-01
			0.7232E+01	0.6840E-01
			0.8679E+01	0.9600E-01
			0.9643E+01	0.1200E+00
			0.9643E+01	0.2400E+00
			0.9643E+01	0.3600E+00
28	10	0.8084E+02	0.9643E+01	0.6000E+00
			0.9643E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.2896E+01	0.1920E-01
			0.4827E+01	0.3720E-01
			0.7240E+01	0.6840E-01
			0.8688E+01	0.9600E-01
			0.9653E+01	0.1200E+00
			0.9653E+01	0.2400E+00
			0.9653E+01	0.3600E+00
29	10	0.8530E+02	0.9653E+01	0.6000E+00
			0.9653E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.4527E+01	0.1920E-01
			0.7545E+01	0.3720E-01
			0.1132E+02	0.6840E-01
			0.1358E+02	0.9600E-01
			0.1509E+02	0.1200E+00
			0.1509E+02	0.2400E+00
			0.1509E+02	0.3600E+00
30	10	0.8976E+02	0.1509E+02	0.6000E+00
			0.1509E+02	0.2400E+01
			0.0000E+00	0.0000E+00
			0.4790E+01	0.1920E-01
			0.7984E+01	0.3720E-01
			0.1198E+02	0.6840E-01
			0.1437E+02	0.9600E-01
			0.1597E+02	0.1200E+00
			0.1597E+02	0.2400E+00
			0.1597E+02	0.3600E+00
31	10	0.8984E+02	0.1597E+02	0.6000E+00
			0.1597E+02	0.2400E+01
			0.0000E+00	0.0000E+00
			0.4795E+01	0.1920E-01
			0.7992E+01	0.3720E-01
			0.1199E+02	0.6840E-01
			0.1439E+02	0.9600E-01

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			0.1598E+02	0.1200E+00
			0.1598E+02	0.2400E+00
			0.1598E+02	0.3600E+00
			0.1598E+02	0.6000E+00
			0.1598E+02	0.2400E+01
32	10	0.9230E+02	0.0000E+00	0.0000E+00
			0.4804E+01	0.1920E-01
			0.8007E+01	0.3720E-01
			0.1201E+02	0.6840E-01
			0.1441E+02	0.9600E-01
			0.1601E+02	0.1200E+00
			0.1601E+02	0.2400E+00
			0.1601E+02	0.3600E+00
			0.1601E+02	0.6000E+00
			0.1601E+02	0.2400E+01
33	10	0.9476E+02	0.0000E+00	0.0000E+00
			0.4804E+01	0.1920E-01
			0.8007E+01	0.3720E-01
			0.1201E+02	0.6840E-01
			0.1441E+02	0.9600E-01
			0.1601E+02	0.1200E+00
			0.1601E+02	0.2400E+00
			0.1601E+02	0.3600E+00
			0.1601E+02	0.6000E+00
			0.1601E+02	0.2400E+01
34	10	0.9484E+02	0.0000E+00	0.0000E+00
			0.4804E+01	0.1920E-01
			0.8007E+01	0.3720E-01
			0.1201E+02	0.6840E-01
			0.1441E+02	0.9600E-01
			0.1601E+02	0.1200E+00
			0.1601E+02	0.2400E+00
			0.1601E+02	0.3600E+00
			0.1601E+02	0.6000E+00
			0.1601E+02	0.2400E+01
35	10	0.9730E+02	0.0000E+00	0.0000E+00
			0.4804E+01	0.1920E-01
			0.8007E+01	0.3720E-01
			0.1201E+02	0.6840E-01
			0.1441E+02	0.9600E-01
			0.1601E+02	0.1200E+00
			0.1601E+02	0.2400E+00
			0.1601E+02	0.3600E+00
			0.1601E+02	0.6000E+00
			0.1601E+02	0.2400E+01
36	10	0.9976E+02	0.0000E+00	0.0000E+00
			0.4804E+01	0.1920E-01
			0.8007E+01	0.3720E-01
			0.1201E+02	0.6840E-01
			0.1441E+02	0.9600E-01
			0.1601E+02	0.1200E+00
			0.1601E+02	0.2400E+00
			0.1601E+02	0.3600E+00
			0.1601E+02	0.6000E+00
			0.1601E+02	0.2400E+01

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TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.2614E+01	0.6000E-02
0.5229E+01	0.1200E-01
0.1046E+02	0.2400E-01
0.2092E+02	0.1560E+00
0.3137E+02	0.5040E+00
0.3765E+02	0.8760E+00
0.4183E+02	0.1200E+01
0.4183E+02	0.1800E+01
0.4183E+02	0.2400E+01

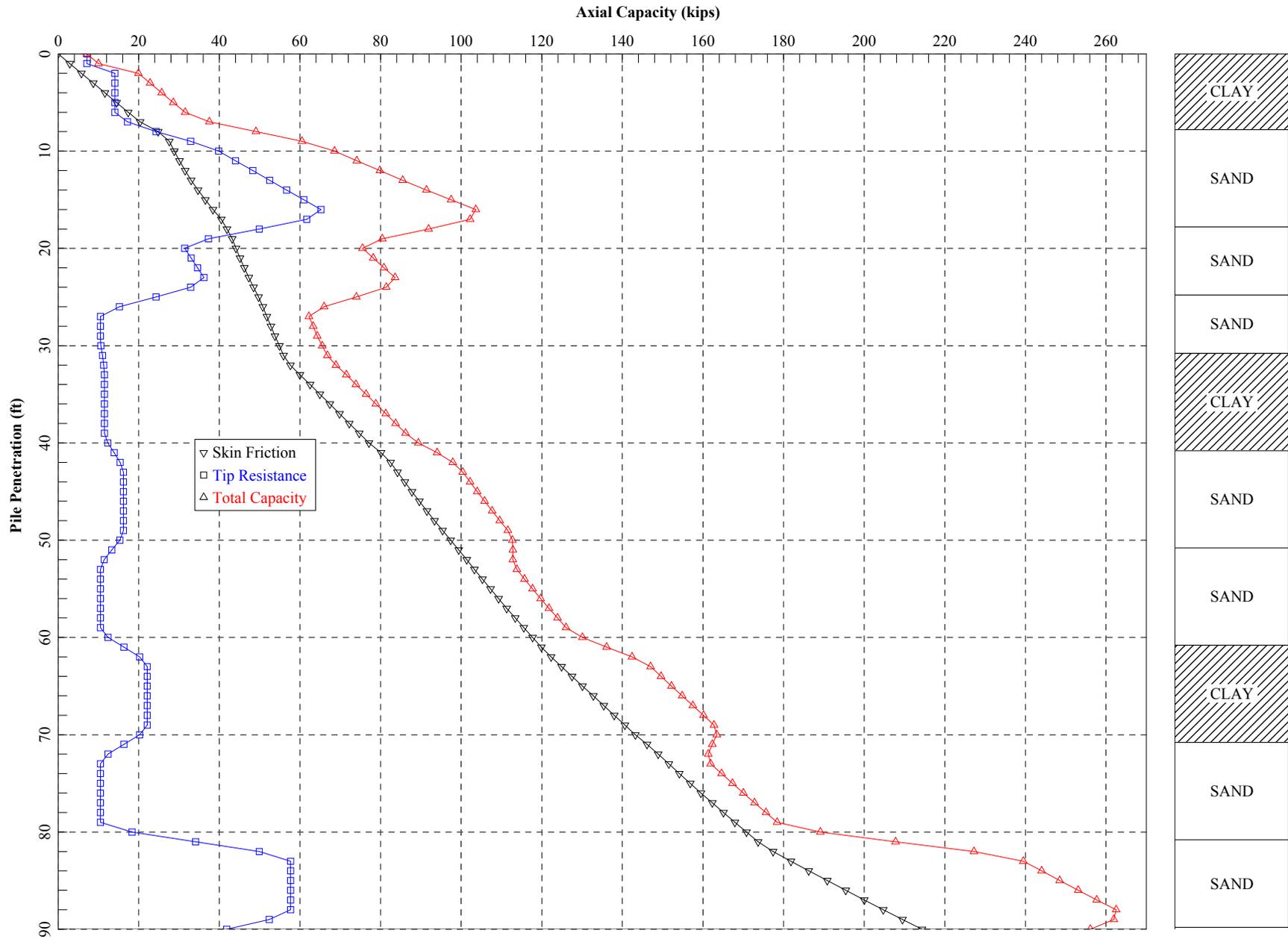
LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.7193E+00	0.2244E-03	0.4357E-01	0.1000E-03
0.7193E+01	0.2244E-02	0.4357E+00	0.1000E-02
0.3596E+02	0.1122E-01	0.2179E+01	0.5000E-02
0.7163E+02	0.2243E-01	0.4357E+01	0.1000E-01
0.1311E+03	0.4366E-01	0.8715E+01	0.2000E-01
0.2332E+03	0.9314E-01	0.1252E+02	0.5000E-01
0.2959E+03	0.1361E+00	0.1489E+02	0.8000E-01
0.3198E+03	0.1621E+00	0.1648E+02	0.1000E+00
0.3282E+03	0.2659E+00	0.2224E+02	0.2000E+00
0.3358E+03	0.5686E+00	0.3125E+02	0.5000E+00
0.3409E+03	0.8703E+00	0.3637E+02	0.8000E+00
0.3438E+03	0.1071E+01	0.3925E+02	0.1000E+01
0.3464E+03	0.2072E+01	0.4183E+02	0.2000E+01

12-Inch Dia. Closed End CIP Piles - EOID

Rear Abutment

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**12-Inch Dia. Closed End CIP Piles - EOID
Rear Abutment
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APILE for Windows, Version 2019.9.12

Serial Number : 136090498

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

Abt)\B-001-1-24\
Path to file locations : C:\Users\legacy\Desktop\1.3.2025\12 In Abt (only
Name of input data file : B-001-1-24 EOID.ap9d
Name of output file : B-001-1-24 EOID.ap9o
Name of plot output file : B-001-1-24 EOID.ap9p

Time and Date of Analysis

Date: January 07, 2025 Time: 09:24:22

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* INPUT INFORMATION *

B-001-1-24 (Rear Abutment) - EOID

DESIGNER : AG/DEK

JOB NUMBER : W-23-155 (MOT-835-2.57)

METHOD FOR UNIT LOAD TRANSFERS :

- FHWA (Federal Highway Administration)
Unfactored Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

TYPE OF LOADING :

- COMPRESSION

PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
 - Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
 - CROSS SECTION AREA = 113.05 IN²

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 12.00 IN.
 - INTERNAL DIAMETER, ID = 0.25 IN.
 - TOTAL PILE LENGTH, TL = 90.00 FT.
 - BATTER ANGLE = 0.00 DEG
 - PILE STICKUP LENGTH, PSL = 0.00 FT.
 - ZERO FRICTION LENGTH, ZFL = 0.00 FT.
 - INCREMENT OF PILE LENGTH
 USED IN COMPUTATION = 1.00 FT.
 - LENGTH OF ENHANCED
 END SECTION = 90.00 FT.
 - INTERNAL DIAMETER OF
 ENHANCED END SECTION = 0.25 IN.

PLUGGED/UNPLUGGED CONDITIONS :
 Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	CLAY	0.80*	62.60	0.00	4.80**
7.80	CLAY	0.80*	62.60	0.00	4.80**
7.80	SAND	0.80*	67.60	38.00	110.40**
17.80	SAND	0.80*	67.60	38.00	110.40**
17.80	SAND	0.80*	67.60	33.00	47.20**
24.80	SAND	0.80*	67.60	33.00	47.20**
24.80	SAND	0.80*	62.60	30.00	30.00**
30.80	SAND	0.80*	62.60	30.00	30.00**
30.80	CLAY	0.80*	62.60	0.00	4.80**
40.80	CLAY	0.80*	62.60	0.00	4.80**
40.80	SAND	0.80*	67.60	31.00	35.20**
50.80	SAND	0.80*	67.60	31.00	35.20**
50.80	SAND	0.80*	62.60	30.00	30.00**
60.80	SAND	0.80*	62.60	30.00	30.00**
60.80	CLAY	0.80*	62.60	0.00	4.80**
70.80	CLAY	0.80*	62.60	0.00	4.80**
70.80	SAND	0.80*	67.60	30.00	30.00**
80.80	SAND	0.80*	67.60	30.00	30.00**
80.80	SAND	0.80*	72.60	34.00	55.60**
89.80	SAND	0.80*	72.60	34.00	55.60**
89.80	SAND	0.80*	72.60	32.00	40.40**

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70.80	0.670	1.000
70.80	0.670	1.000
80.80	0.670	1.000
80.80	0.670	1.000
89.80	0.670	1.000
89.80	0.670	1.000
94.80	0.670	1.000
94.80	0.670	1.000
99.80	0.670	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.120 *	0.90 **
7.80	0.120 *	0.90 **
7.80	0.120 *	0.00
17.80	0.120 *	0.00
17.80	0.120 *	0.00
24.80	0.120 *	0.00
24.80	0.120 *	0.00
30.80	0.120 *	0.00
30.80	0.120 *	0.90 **
40.80	0.120 *	0.90 **
40.80	0.120 *	0.00
50.80	0.120 *	0.00
50.80	0.120 *	0.00
60.80	0.120 *	0.00
60.80	0.120 *	0.90 **
70.80	0.120 *	0.90 **
70.80	0.120 *	0.00
80.80	0.120 *	0.00
80.80	0.120 *	0.00
89.80	0.120 *	0.00
89.80	0.120 *	0.00
94.80	0.120 *	0.00
94.80	0.120 *	0.00
99.80	0.120 *	0.00

* DEFAULT VALUE = 0.01 D
 ** DEFAULT VALUE = 0.9

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 * COMPUTATION RESULT *

 * FED. HWY. METHOD *

PILE PENETRATION FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	7.1	7.1
1.00	2.9	7.1	10.0
2.00	5.8	14.1	19.9
3.00	8.7	14.1	22.8

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4.00	11.6	14.1	25.7
5.00	14.5	14.1	28.6
6.00	17.4	14.1	31.5
7.00	20.3	17.2	37.5
8.00	24.8	24.3	49.1
9.00	27.6	32.9	60.5
10.00	28.8	39.8	68.6
11.00	30.1	44.0	74.1
12.00	31.5	48.3	79.8
13.00	33.0	52.5	85.5
14.00	34.7	56.7	91.4
15.00	36.5	61.0	97.5
16.00	38.4	65.2	103.6
17.00	40.5	61.7	102.2
18.00	41.9	49.9	91.9
19.00	43.2	37.3	80.4
20.00	44.1	31.4	75.5
21.00	45.1	33.0	78.2
22.00	46.2	34.6	80.8
23.00	47.3	36.2	83.6
24.00	48.5	32.9	81.4
25.00	49.7	24.3	74.0
26.00	50.8	15.2	66.0
27.00	51.8	10.5	62.2
28.00	52.8	10.5	63.3
29.00	53.8	10.5	64.3
30.00	54.9	10.6	65.5
31.00	55.9	11.0	66.8
32.00	57.6	11.3	68.9
33.00	60.0	11.5	71.5
34.00	62.5	11.5	73.9
35.00	64.9	11.5	76.4
36.00	67.4	11.5	78.8
37.00	69.8	11.5	81.3
38.00	72.2	11.5	83.7
39.00	74.7	11.5	86.2
40.00	77.1	12.3	89.4
41.00	80.1	13.9	94.0
42.00	82.5	15.4	97.9
43.00	84.2	16.2	100.4
44.00	86.0	16.2	102.2
45.00	87.8	16.2	104.0
46.00	89.6	16.2	105.8
47.00	91.5	16.2	107.7
48.00	93.4	16.2	109.6
49.00	95.4	16.2	111.6
50.00	97.4	15.3	112.7
51.00	99.4	13.3	112.8
52.00	101.4	11.4	112.8
53.00	103.3	10.5	113.8
54.00	105.3	10.5	115.7
55.00	107.3	10.5	117.7
56.00	109.3	10.5	119.7
57.00	111.3	10.5	121.8
58.00	113.4	10.5	123.9
59.00	115.5	10.5	126.0
60.00	117.7	12.4	130.1
61.00	119.9	16.3	136.1
62.00	122.3	20.2	142.4
63.00	124.9	22.1	147.0
64.00	127.5	22.1	149.6
65.00	130.1	22.1	152.2
66.00	132.8	22.1	154.8

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67.00	135.4	22.1	157.5
68.00	138.0	22.1	160.1
69.00	140.6	22.1	162.7
70.00	143.2	20.2	163.4
71.00	146.1	16.3	162.3
72.00	148.9	12.4	161.3
73.00	151.5	10.5	161.9
74.00	154.1	10.5	164.6
75.00	156.8	10.5	167.3
76.00	159.5	10.5	170.0
77.00	162.3	10.5	172.8
78.00	165.1	10.5	175.6
79.00	167.9	10.5	178.4
80.00	170.8	18.3	189.1
81.00	173.7	34.1	207.8
82.00	177.4	49.9	227.2
83.00	181.8	57.7	239.5
84.00	186.2	57.7	244.0
85.00	190.8	57.7	248.5
86.00	195.4	57.7	253.1
87.00	200.0	57.7	257.7
88.00	204.7	57.7	262.5
89.00	209.5	52.4	261.9
90.00	214.3	41.8	256.1

NOTES:

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

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

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.4167E-01	0.0000E+00	0.0000E+00
			0.2867E+01	0.1920E-01
			0.4778E+01	0.3720E-01
			0.7167E+01	0.6840E-01
			0.8600E+01	0.9600E-01
			0.9556E+01	0.1200E+00
			0.8600E+01	0.2400E+00
			0.8600E+01	0.3600E+00
			0.8600E+01	0.6000E+00
			0.8600E+01	0.2400E+01
2	10	0.3900E+01	0.0000E+00	0.0000E+00
			0.2867E+01	0.1920E-01
			0.4778E+01	0.3720E-01
			0.7167E+01	0.6840E-01
			0.8600E+01	0.9600E-01
			0.9556E+01	0.1200E+00
			0.8600E+01	0.2400E+00
			0.8600E+01	0.3600E+00
			0.8600E+01	0.6000E+00
			0.8600E+01	0.6000E+00

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3	10	0.7758E+01	0.8600E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.3041E+01	0.1920E-01
			0.5068E+01	0.3720E-01
			0.7602E+01	0.6840E-01
			0.9122E+01	0.9600E-01
			0.1014E+02	0.1200E+00
			0.9122E+01	0.2400E+00
			0.9122E+01	0.3600E+00
			0.9122E+01	0.6000E+00
			0.9122E+01	0.2400E+01
4	10	0.7842E+01		
			0.0000E+00	0.0000E+00
			0.3060E+01	0.1920E-01
			0.5100E+01	0.3720E-01
			0.7650E+01	0.6840E-01
			0.9180E+01	0.9600E-01
			0.1020E+02	0.1200E+00
			0.1020E+02	0.2400E+00
			0.1020E+02	0.3600E+00
			0.1020E+02	0.6000E+00
			0.1020E+02	0.2400E+01
5	10	0.1280E+02		
			0.0000E+00	0.0000E+00
			0.1046E+01	0.1920E-01
			0.1744E+01	0.3720E-01
			0.2615E+01	0.6840E-01
			0.3138E+01	0.9600E-01
			0.3487E+01	0.1200E+00
			0.3487E+01	0.2400E+00
			0.3487E+01	0.3600E+00
			0.3487E+01	0.6000E+00
			0.3487E+01	0.2400E+01
6	10	0.1776E+02		
			0.0000E+00	0.0000E+00
			0.1471E+01	0.1920E-01
			0.2452E+01	0.3720E-01
			0.3678E+01	0.6840E-01
			0.4413E+01	0.9600E-01
			0.4903E+01	0.1200E+00
			0.4903E+01	0.2400E+00
			0.4903E+01	0.3600E+00
			0.4903E+01	0.6000E+00
			0.4903E+01	0.2400E+01
7	10	0.1784E+02		
			0.0000E+00	0.0000E+00
			0.1478E+01	0.1920E-01
			0.2464E+01	0.3720E-01
			0.3695E+01	0.6840E-01
			0.4434E+01	0.9600E-01
			0.4927E+01	0.1200E+00
			0.4927E+01	0.2400E+00
			0.4927E+01	0.3600E+00
			0.4927E+01	0.6000E+00
			0.4927E+01	0.2400E+01
8	10	0.2130E+02		
			0.0000E+00	0.0000E+00
			0.1045E+01	0.1920E-01
			0.1742E+01	0.3720E-01
			0.2613E+01	0.6840E-01
			0.3136E+01	0.9600E-01
			0.3484E+01	0.1200E+00

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			0.3484E+01	0.2400E+00
			0.3484E+01	0.3600E+00
			0.3484E+01	0.6000E+00
9	10	0.2476E+02	0.3484E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1220E+01	0.1920E-01
			0.2033E+01	0.3720E-01
			0.3050E+01	0.6840E-01
			0.3659E+01	0.9600E-01
			0.4066E+01	0.1200E+00
			0.4066E+01	0.2400E+00
			0.4066E+01	0.3600E+00
			0.4066E+01	0.6000E+00
10	10	0.2484E+02	0.4066E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1224E+01	0.1920E-01
			0.2040E+01	0.3720E-01
			0.3060E+01	0.6840E-01
			0.3672E+01	0.9600E-01
			0.4080E+01	0.1200E+00
			0.4080E+01	0.2400E+00
			0.4080E+01	0.3600E+00
			0.4080E+01	0.6000E+00
11	10	0.2780E+02	0.4080E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1008E+01	0.1920E-01
			0.1680E+01	0.3720E-01
			0.2520E+01	0.6840E-01
			0.3024E+01	0.9600E-01
			0.3359E+01	0.1200E+00
			0.3359E+01	0.2400E+00
			0.3359E+01	0.3600E+00
			0.3359E+01	0.6000E+00
12	10	0.3076E+02	0.3359E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1110E+01	0.1920E-01
			0.1850E+01	0.3720E-01
			0.2775E+01	0.6840E-01
			0.3330E+01	0.9600E-01
			0.3700E+01	0.1200E+00
			0.3700E+01	0.2400E+00
			0.3700E+01	0.3600E+00
			0.3700E+01	0.6000E+00
13	10	0.3084E+02	0.3700E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1113E+01	0.1920E-01
			0.1855E+01	0.3720E-01
			0.2782E+01	0.6840E-01
			0.3339E+01	0.9600E-01
			0.3710E+01	0.1200E+00
			0.3339E+01	0.2400E+00
			0.3339E+01	0.3600E+00
			0.3339E+01	0.6000E+00
14	10	0.3580E+02	0.3339E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.2847E+01	0.1920E-01
			0.4745E+01	0.3720E-01

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			0.7117E+01	0.6840E-01
			0.8540E+01	0.9600E-01
			0.9489E+01	0.1200E+00
			0.8540E+01	0.2400E+00
			0.8540E+01	0.3600E+00
			0.8540E+01	0.6000E+00
			0.8540E+01	0.2400E+01
15	10	0.4076E+02		
			0.0000E+00	0.0000E+00
			0.3002E+01	0.1920E-01
			0.5003E+01	0.3720E-01
			0.7505E+01	0.6840E-01
			0.9005E+01	0.9600E-01
			0.1001E+02	0.1200E+00
			0.9005E+01	0.2400E+00
			0.9005E+01	0.3600E+00
			0.9005E+01	0.6000E+00
			0.9005E+01	0.2400E+01
16	10	0.4084E+02		
			0.0000E+00	0.0000E+00
			0.3019E+01	0.1920E-01
			0.5031E+01	0.3720E-01
			0.7547E+01	0.6840E-01
			0.9057E+01	0.9600E-01
			0.1006E+02	0.1200E+00
			0.1006E+02	0.2400E+00
			0.1006E+02	0.3600E+00
			0.1006E+02	0.6000E+00
			0.1006E+02	0.2400E+01
17	10	0.4580E+02		
			0.0000E+00	0.0000E+00
			0.1833E+01	0.1920E-01
			0.3056E+01	0.3720E-01
			0.4583E+01	0.6840E-01
			0.5500E+01	0.9600E-01
			0.6111E+01	0.1200E+00
			0.6111E+01	0.2400E+00
			0.6111E+01	0.3600E+00
			0.6111E+01	0.6000E+00
			0.6111E+01	0.2400E+01
18	10	0.5076E+02		
			0.0000E+00	0.0000E+00
			0.2040E+01	0.1920E-01
			0.3400E+01	0.3720E-01
			0.5100E+01	0.6840E-01
			0.6120E+01	0.9600E-01
			0.6800E+01	0.1200E+00
			0.6800E+01	0.2400E+00
			0.6800E+01	0.3600E+00
			0.6800E+01	0.6000E+00
			0.6800E+01	0.2400E+01
19	10	0.5084E+02		
			0.0000E+00	0.0000E+00
			0.2043E+01	0.1920E-01
			0.3406E+01	0.3720E-01
			0.5108E+01	0.6840E-01
			0.6130E+01	0.9600E-01
			0.6811E+01	0.1200E+00
			0.6811E+01	0.2400E+00
			0.6811E+01	0.3600E+00
			0.6811E+01	0.6000E+00
			0.6811E+01	0.2400E+01
20	10	0.5580E+02		

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			0.0000E+00	0.0000E+00
			0.2003E+01	0.1920E-01
			0.3339E+01	0.3720E-01
			0.5008E+01	0.6840E-01
			0.6010E+01	0.9600E-01
			0.6678E+01	0.1200E+00
			0.6678E+01	0.2400E+00
			0.6678E+01	0.3600E+00
			0.6678E+01	0.6000E+00
			0.6678E+01	0.2400E+01
21	10	0.6076E+02		
			0.0000E+00	0.0000E+00
			0.2175E+01	0.1920E-01
			0.3624E+01	0.3720E-01
			0.5437E+01	0.6840E-01
			0.6524E+01	0.9600E-01
			0.7249E+01	0.1200E+00
			0.7249E+01	0.2400E+00
			0.7249E+01	0.3600E+00
			0.7249E+01	0.6000E+00
			0.7249E+01	0.2400E+01
22	10	0.6084E+02		
			0.0000E+00	0.0000E+00
			0.2178E+01	0.1920E-01
			0.3629E+01	0.3720E-01
			0.5444E+01	0.6840E-01
			0.6533E+01	0.9600E-01
			0.7258E+01	0.1200E+00
			0.6533E+01	0.2400E+00
			0.6533E+01	0.3600E+00
			0.6533E+01	0.6000E+00
			0.6533E+01	0.2400E+01
23	10	0.6580E+02		
			0.0000E+00	0.0000E+00
			0.2593E+01	0.1920E-01
			0.4321E+01	0.3720E-01
			0.6482E+01	0.6840E-01
			0.7779E+01	0.9600E-01
			0.8643E+01	0.1200E+00
			0.7779E+01	0.2400E+00
			0.7779E+01	0.3600E+00
			0.7779E+01	0.6000E+00
			0.7779E+01	0.2400E+01
24	10	0.7076E+02		
			0.0000E+00	0.0000E+00
			0.2897E+01	0.1920E-01
			0.4829E+01	0.3720E-01
			0.7243E+01	0.6840E-01
			0.8692E+01	0.9600E-01
			0.9658E+01	0.1200E+00
			0.8692E+01	0.2400E+00
			0.8692E+01	0.3600E+00
			0.8692E+01	0.6000E+00
			0.8692E+01	0.2400E+01
25	10	0.7084E+02		
			0.0000E+00	0.0000E+00
			0.2931E+01	0.1920E-01
			0.4885E+01	0.3720E-01
			0.7327E+01	0.6840E-01
			0.8792E+01	0.9600E-01
			0.9769E+01	0.1200E+00
			0.9769E+01	0.2400E+00
			0.9769E+01	0.3600E+00

			B-001-1-24 EOID.ap9o	
26	10	0.7580E+02	0.9769E+01	0.6000E+00
			0.9769E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.2708E+01	0.1920E-01
			0.4513E+01	0.3720E-01
			0.6770E+01	0.6840E-01
			0.8123E+01	0.9600E-01
			0.9026E+01	0.1200E+00
			0.9026E+01	0.2400E+00
			0.9026E+01	0.3600E+00
27	10	0.8076E+02	0.9026E+01	0.6000E+00
			0.9026E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.2893E+01	0.1920E-01
			0.4821E+01	0.3720E-01
			0.7232E+01	0.6840E-01
			0.8679E+01	0.9600E-01
			0.9643E+01	0.1200E+00
			0.9643E+01	0.2400E+00
			0.9643E+01	0.3600E+00
28	10	0.8084E+02	0.9643E+01	0.6000E+00
			0.9643E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.2896E+01	0.1920E-01
			0.4827E+01	0.3720E-01
			0.7240E+01	0.6840E-01
			0.8688E+01	0.9600E-01
			0.9653E+01	0.1200E+00
			0.9653E+01	0.2400E+00
			0.9653E+01	0.3600E+00
29	10	0.8530E+02	0.9653E+01	0.6000E+00
			0.9653E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.4527E+01	0.1920E-01
			0.7545E+01	0.3720E-01
			0.1132E+02	0.6840E-01
			0.1358E+02	0.9600E-01
			0.1509E+02	0.1200E+00
			0.1509E+02	0.2400E+00
			0.1509E+02	0.3600E+00
30	10	0.8976E+02	0.1509E+02	0.6000E+00
			0.1509E+02	0.2400E+01
			0.0000E+00	0.0000E+00
			0.4790E+01	0.1920E-01
			0.7984E+01	0.3720E-01
			0.1198E+02	0.6840E-01
			0.1437E+02	0.9600E-01
			0.1597E+02	0.1200E+00
			0.1597E+02	0.2400E+00
			0.1597E+02	0.3600E+00
31	10	0.8984E+02	0.1597E+02	0.6000E+00
			0.1597E+02	0.2400E+01
			0.0000E+00	0.0000E+00
			0.4795E+01	0.1920E-01
			0.7992E+01	0.3720E-01
			0.1199E+02	0.6840E-01
			0.1439E+02	0.9600E-01

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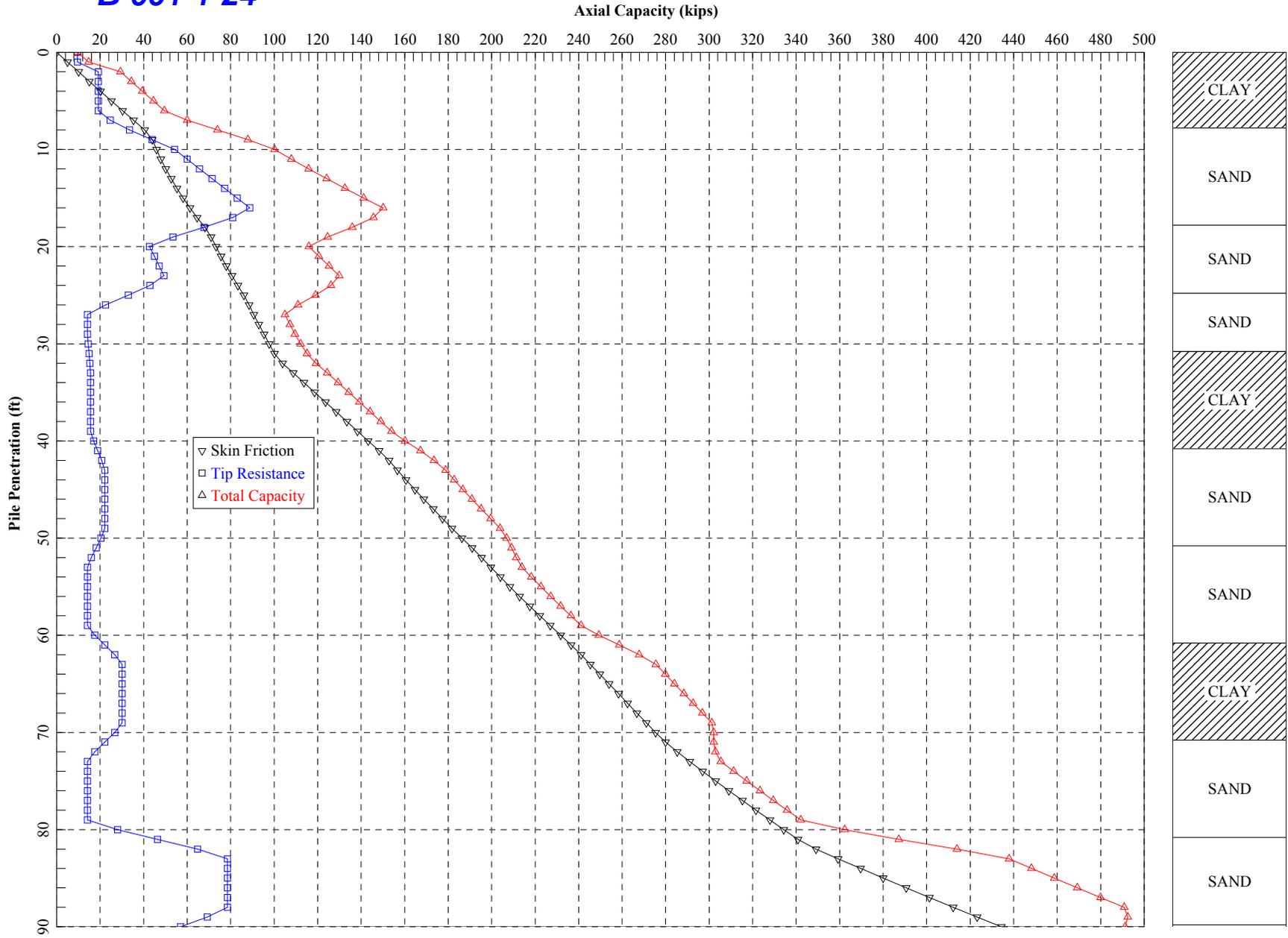
			0.1598E+02	0.1200E+00
			0.1598E+02	0.2400E+00
			0.1598E+02	0.3600E+00
			0.1598E+02	0.6000E+00
			0.1598E+02	0.2400E+01
32	10	0.9230E+02	0.0000E+00	0.0000E+00
			0.4804E+01	0.1920E-01
			0.8007E+01	0.3720E-01
			0.1201E+02	0.6840E-01
			0.1441E+02	0.9600E-01
			0.1601E+02	0.1200E+00
			0.1601E+02	0.2400E+00
			0.1601E+02	0.3600E+00
			0.1601E+02	0.6000E+00
			0.1601E+02	0.2400E+01
33	10	0.9476E+02	0.0000E+00	0.0000E+00
			0.4804E+01	0.1920E-01
			0.8007E+01	0.3720E-01
			0.1201E+02	0.6840E-01
			0.1441E+02	0.9600E-01
			0.1601E+02	0.1200E+00
			0.1601E+02	0.2400E+00
			0.1601E+02	0.3600E+00
			0.1601E+02	0.6000E+00
			0.1601E+02	0.2400E+01
34	10	0.9484E+02	0.0000E+00	0.0000E+00
			0.4804E+01	0.1920E-01
			0.8007E+01	0.3720E-01
			0.1201E+02	0.6840E-01
			0.1441E+02	0.9600E-01
			0.1601E+02	0.1200E+00
			0.1601E+02	0.2400E+00
			0.1601E+02	0.3600E+00
			0.1601E+02	0.6000E+00
			0.1601E+02	0.2400E+01
35	10	0.9730E+02	0.0000E+00	0.0000E+00
			0.4804E+01	0.1920E-01
			0.8007E+01	0.3720E-01
			0.1201E+02	0.6840E-01
			0.1441E+02	0.9600E-01
			0.1601E+02	0.1200E+00
			0.1601E+02	0.2400E+00
			0.1601E+02	0.3600E+00
			0.1601E+02	0.6000E+00
			0.1601E+02	0.2400E+01
36	10	0.9976E+02	0.0000E+00	0.0000E+00
			0.4804E+01	0.1920E-01
			0.8007E+01	0.3720E-01
			0.1201E+02	0.6840E-01
			0.1441E+02	0.9600E-01
			0.1601E+02	0.1200E+00
			0.1601E+02	0.2400E+00
			0.1601E+02	0.3600E+00
			0.1601E+02	0.6000E+00
			0.1601E+02	0.2400E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.2614E+01	0.6000E-02
0.5229E+01	0.1200E-01
0.1046E+02	0.2400E-01
0.2092E+02	0.1560E+00
0.3137E+02	0.5040E+00
0.3765E+02	0.8760E+00
0.4183E+02	0.1200E+01
0.4183E+02	0.1800E+01
0.4183E+02	0.2400E+01

LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.7193E+00	0.2244E-03	0.4357E-01	0.1000E-03
0.7193E+01	0.2244E-02	0.4357E+00	0.1000E-02
0.3596E+02	0.1122E-01	0.2179E+01	0.5000E-02
0.7163E+02	0.2243E-01	0.4357E+01	0.1000E-01
0.1311E+03	0.4366E-01	0.8715E+01	0.2000E-01
0.2332E+03	0.9314E-01	0.1252E+02	0.5000E-01
0.2959E+03	0.1361E+00	0.1489E+02	0.8000E-01
0.3198E+03	0.1621E+00	0.1648E+02	0.1000E+00
0.3282E+03	0.2659E+00	0.2224E+02	0.2000E+00
0.3358E+03	0.5686E+00	0.3125E+02	0.5000E+00
0.3409E+03	0.8703E+00	0.3637E+02	0.8000E+00
0.3438E+03	0.1071E+01	0.3925E+02	0.1000E+01
0.3464E+03	0.2072E+01	0.4183E+02	0.2000E+01

14-Inch Dia. Closed End CIP Piles - UBV Rear Abutment B-001-1-24



**14-Inch Dia. Closed End CIP Piles - UBV
Rear Abutment
B-001-1-24**

B-001-1-24 - 14 Inch UBV.ap9o

APILE for Windows, Version 2019.9.12

Serial Number : 136090498

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 :

Resource International, Inc.
Columbus, OH

Path to file locations : C:\Users\legacy\Desktop\1.3.2025\14-inch\
Name of input data file : B-001-1-24 - 14 Inch UBV.ap9d
Name of output file : B-001-1-24 - 14 Inch UBV.ap9o
Name of plot output file : B-001-1-24 - 14 Inch UBV.ap9p

Time and Date of Analysis

Date: January 07, 2025 Time: 09:39:53

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* INPUT INFORMATION *

B-001-1-24 (Rear Abutment) - 14 -Inch CIP

DESIGNER : AG/DEK

JOB NUMBER : W-23-155 (MOT-835-2.57)

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

B-001-1-24 - 14 Inch UBV.ap9o

PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 153.89 IN²

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 14.00 IN.
- INTERNAL DIAMETER, ID = 0.25 IN.
- TOTAL PILE LENGTH, TL = 90.00 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH
USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED
END SECTION = 90.00 FT.
- INTERNAL DIAMETER OF
ENHANCED END SECTION = 0.25 IN.

PLUGGED/UNPLUGGED CONDITIONS :

Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	CLAY	0.80*	62.60	0.00	4.80**
7.80	CLAY	0.80*	62.60	0.00	4.80**
7.80	SAND	0.80*	67.60	38.00	110.40**
17.80	SAND	0.80*	67.60	38.00	110.40**
17.80	SAND	0.80*	67.60	33.00	47.20**
24.80	SAND	0.80*	67.60	33.00	47.20**
24.80	SAND	0.80*	62.60	30.00	30.00**
30.80	SAND	0.80*	62.60	30.00	30.00**
30.80	CLAY	0.80*	62.60	0.00	4.80**
40.80	CLAY	0.80*	62.60	0.00	4.80**
40.80	SAND	0.80*	67.60	31.00	35.20**
50.80	SAND	0.80*	67.60	31.00	35.20**
50.80	SAND	0.80*	62.60	30.00	30.00**
60.80	SAND	0.80*	62.60	30.00	30.00**
60.80	CLAY	0.80*	62.60	0.00	4.80**
70.80	CLAY	0.80*	62.60	0.00	4.80**
70.80	SAND	0.80*	67.60	30.00	30.00**
80.80	SAND	0.80*	67.60	30.00	30.00**
80.80	SAND	0.80*	72.60	34.00	55.60**
89.80	SAND	0.80*	72.60	34.00	55.60**
89.80	SAND	0.80*	72.60	32.00	40.40**
94.80	SAND	0.80*	72.60	32.00	40.40**

B-001-1-24 - 14 Inch UBV.ap9o

70.80	1.000	1.000
80.80	1.000	1.000
80.80	1.000	1.000
89.80	1.000	1.000
89.80	1.000	1.000
94.80	1.000	1.000
94.80	1.000	1.000
99.80	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.140 *	0.90 **
7.80	0.140 *	0.90 **
7.80	0.140 *	0.00
17.80	0.140 *	0.00
17.80	0.140 *	0.00
24.80	0.140 *	0.00
24.80	0.140 *	0.00
30.80	0.140 *	0.00
30.80	0.140 *	0.90 **
40.80	0.140 *	0.90 **
40.80	0.140 *	0.00
50.80	0.140 *	0.00
50.80	0.140 *	0.00
60.80	0.140 *	0.00
60.80	0.140 *	0.90 **
70.80	0.140 *	0.90 **
70.80	0.140 *	0.00
80.80	0.140 *	0.00
80.80	0.140 *	0.00
89.80	0.140 *	0.00
89.80	0.140 *	0.00
94.80	0.140 *	0.00
94.80	0.140 *	0.00
99.80	0.140 *	0.00

* DEFAULT VALUE = 0.01 D
 ** DEFAULT VALUE = 0.9

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 * COMPUTATION RESULT *

 * FED. HWY. METHOD *

PILE PENETRATION FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	9.6	9.6
1.00	5.0	9.6	14.7
2.00	10.1	19.2	29.3
3.00	15.1	19.2	34.4
4.00	20.2	19.2	39.4

14-Inch Dia. Closed End CIP Piles - UBV
Rear Abutment
B-001-1-24

B-001-1-24 - 14 Inch UBV.ap9o

5.00	25.2	19.2	44.5
6.00	30.3	19.2	49.5
7.00	35.3	24.7	60.0
8.00	40.5	33.5	74.0
9.00	44.0	43.9	87.9
10.00	45.9	54.2	100.1
11.00	47.9	60.0	107.9
12.00	50.2	65.7	115.9
13.00	52.7	71.5	124.1
14.00	55.3	77.2	132.6
15.00	58.2	83.0	141.2
16.00	61.3	88.8	150.1
17.00	64.6	81.0	145.6
18.00	68.2	67.7	135.9
19.00	71.0	53.5	124.6
20.00	73.3	42.7	116.0
21.00	75.6	44.9	120.5
22.00	78.0	47.1	125.2
23.00	80.6	49.3	129.9
24.00	83.3	42.9	126.1
25.00	86.1	33.0	119.0
26.00	88.5	22.5	111.0
27.00	90.7	14.2	105.0
28.00	93.0	14.2	107.2
29.00	95.3	14.2	109.5
30.00	97.7	14.5	112.2
31.00	100.2	14.9	115.1
32.00	103.9	15.3	119.2
33.00	108.8	15.6	124.4
34.00	113.7	15.6	129.4
35.00	118.6	15.6	134.3
36.00	123.6	15.6	139.2
37.00	128.5	15.6	144.1
38.00	133.4	15.6	149.0
39.00	138.3	15.6	153.9
40.00	143.2	17.0	160.2
41.00	148.3	18.9	167.2
42.00	152.8	20.7	173.5
43.00	156.7	22.1	178.8
44.00	160.6	22.1	182.7
45.00	164.7	22.1	186.8
46.00	168.8	22.1	190.9
47.00	173.1	22.1	195.2
48.00	177.4	22.1	199.5
49.00	181.8	22.1	203.9
50.00	186.3	20.4	206.8
51.00	191.0	18.2	209.1
52.00	195.4	15.9	211.3
53.00	199.7	14.2	213.9
54.00	204.0	14.2	218.2
55.00	208.4	14.2	222.7
56.00	212.9	14.2	227.1
57.00	217.5	14.2	231.7
58.00	222.1	14.2	236.4
59.00	226.9	14.2	241.1
60.00	231.7	17.6	249.3
61.00	236.5	22.2	258.7
62.00	241.1	26.7	267.8
63.00	245.4	30.1	275.5
64.00	249.7	30.1	279.8
65.00	254.0	30.1	284.0
66.00	258.3	30.1	288.3
67.00	262.5	30.1	292.6

Max. Factored Designed Load per Pile = 186.0kips
 Required Nominal Resistance per Pile = (186/0.7) kips = 265.7 kips

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Pile length = 61.8+ 2.0 (estimated embedment in pile cap) = 63.8 feet
 Estimated Pile Length to Rounded Up to Nearest 5 feet = 65.0 feet
 Pile Order Length = 70 feet

B-001-1-24 - 14 Inch UBV.ap9o

68.00	266.8	30.1	296.9
69.00	271.1	30.1	301.2
70.00	275.4	26.7	302.1
71.00	280.0	22.2	302.1
72.00	285.3	17.6	302.9
73.00	291.1	14.2	305.4
74.00	297.0	14.2	311.3
75.00	303.0	14.2	317.3
76.00	309.1	14.2	323.4
77.00	315.3	14.2	329.5
78.00	321.5	14.2	335.8
79.00	327.9	14.2	342.1
80.00	334.3	28.0	362.3
81.00	340.8	46.4	387.2
82.00	349.1	64.8	413.9
83.00	359.3	78.6	437.9
84.00	369.6	78.6	448.2
85.00	380.0	78.6	458.6
86.00	390.6	78.6	469.2
87.00	401.3	78.6	479.9
88.00	412.2	78.6	490.8
89.00	423.2	69.3	492.5
90.00	434.3	56.9	491.3

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	0.4167E-01	0.0000E+00	0.0000E+00
			0.2867E+01	0.2240E-01
			0.4778E+01	0.4340E-01
			0.7167E+01	0.7980E-01
			0.8600E+01	0.1120E+00
			0.9556E+01	0.1400E+00
			0.8600E+01	0.2800E+00
			0.8600E+01	0.4200E+00
			0.8600E+01	0.7000E+00
			0.8600E+01	0.2800E+01
2	10	0.3900E+01	0.0000E+00	0.0000E+00
			0.2867E+01	0.2240E-01
			0.4778E+01	0.4340E-01
			0.7167E+01	0.7980E-01
			0.8600E+01	0.1120E+00
			0.9556E+01	0.1400E+00
			0.8600E+01	0.2800E+00
			0.8600E+01	0.4200E+00
			0.8600E+01	0.7000E+00
			0.8600E+01	0.2800E+01

3	10	B-001-1-24 - 14 Inch UBV.ap9o 0.7758E+01	0.0000E+00 0.2984E+01 0.4973E+01 0.7460E+01 0.8952E+01 0.9947E+01 0.8952E+01 0.8952E+01 0.8952E+01 0.8952E+01	0.0000E+00 0.2240E-01 0.4340E-01 0.7980E-01 0.1120E+00 0.1400E+00 0.2800E+00 0.4200E+00 0.7000E+00 0.2800E+01
4	10	0.7842E+01	0.0000E+00 0.2997E+01 0.4995E+01 0.7492E+01 0.8991E+01 0.9990E+01 0.9990E+01 0.9990E+01 0.9990E+01 0.9990E+01	0.0000E+00 0.2240E-01 0.4340E-01 0.7980E-01 0.1120E+00 0.1400E+00 0.2800E+00 0.4200E+00 0.7000E+00 0.2800E+01
5	10	0.1280E+02	0.0000E+00 0.1442E+01 0.2404E+01 0.3606E+01 0.4327E+01 0.4807E+01 0.4807E+01 0.4807E+01 0.4807E+01 0.4807E+01	0.0000E+00 0.2240E-01 0.4340E-01 0.7980E-01 0.1120E+00 0.1400E+00 0.2800E+00 0.4200E+00 0.7000E+00 0.2800E+01
6	10	0.1776E+02	0.0000E+00 0.2028E+01 0.3380E+01 0.5070E+01 0.6084E+01 0.6760E+01 0.6760E+01 0.6760E+01 0.6760E+01 0.6760E+01	0.0000E+00 0.2240E-01 0.4340E-01 0.7980E-01 0.1120E+00 0.1400E+00 0.2800E+00 0.4200E+00 0.7000E+00 0.2800E+01
7	10	0.1784E+02	0.0000E+00 0.2038E+01 0.3396E+01 0.5095E+01 0.6113E+01 0.6793E+01 0.6793E+01 0.6793E+01 0.6793E+01 0.6793E+01	0.0000E+00 0.2240E-01 0.4340E-01 0.7980E-01 0.1120E+00 0.1400E+00 0.2800E+00 0.4200E+00 0.7000E+00 0.2800E+01
8	10	0.2130E+02	0.0000E+00 0.1375E+01 0.2292E+01 0.3438E+01 0.4126E+01 0.4584E+01 0.4584E+01	0.0000E+00 0.2240E-01 0.4340E-01 0.7980E-01 0.1120E+00 0.1400E+00 0.2800E+00

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			0.4584E+01	0.4200E+00
			0.4584E+01	0.7000E+00
9	10	0.2476E+02	0.4584E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.1605E+01	0.2240E-01
			0.2675E+01	0.4340E-01
			0.4012E+01	0.7980E-01
			0.4815E+01	0.1120E+00
			0.5350E+01	0.1400E+00
			0.5350E+01	0.2800E+00
			0.5350E+01	0.4200E+00
			0.5350E+01	0.7000E+00
10	10	0.2484E+02	0.5350E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.1610E+01	0.2240E-01
			0.2684E+01	0.4340E-01
			0.4026E+01	0.7980E-01
			0.4831E+01	0.1120E+00
			0.5368E+01	0.1400E+00
			0.5368E+01	0.2800E+00
			0.5368E+01	0.4200E+00
			0.5368E+01	0.7000E+00
11	10	0.2780E+02	0.5368E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.1291E+01	0.2240E-01
			0.2152E+01	0.4340E-01
			0.3228E+01	0.7980E-01
			0.3874E+01	0.1120E+00
			0.4304E+01	0.1400E+00
			0.4304E+01	0.2800E+00
			0.4304E+01	0.4200E+00
			0.4304E+01	0.7000E+00
12	10	0.3076E+02	0.4304E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.1422E+01	0.2240E-01
			0.2370E+01	0.4340E-01
			0.3556E+01	0.7980E-01
			0.4267E+01	0.1120E+00
			0.4741E+01	0.1400E+00
			0.4741E+01	0.2800E+00
			0.4741E+01	0.4200E+00
			0.4741E+01	0.7000E+00
13	10	0.3084E+02	0.4741E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.1426E+01	0.2240E-01
			0.2377E+01	0.4340E-01
			0.3565E+01	0.7980E-01
			0.4278E+01	0.1120E+00
			0.4753E+01	0.1400E+00
			0.4278E+01	0.2800E+00
			0.4278E+01	0.4200E+00
			0.4278E+01	0.7000E+00
14	10	0.3580E+02	0.4278E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2795E+01	0.2240E-01
			0.4658E+01	0.4340E-01
			0.6987E+01	0.7980E-01

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			0.8384E+01	0.1120E+00
			0.9316E+01	0.1400E+00
			0.8384E+01	0.2800E+00
			0.8384E+01	0.4200E+00
			0.8384E+01	0.7000E+00
			0.8384E+01	0.2800E+01
15	10	0.4076E+02	0.0000E+00	0.0000E+00
			0.2928E+01	0.2240E-01
			0.4879E+01	0.4340E-01
			0.7319E+01	0.7980E-01
			0.8783E+01	0.1120E+00
			0.9759E+01	0.1400E+00
			0.8783E+01	0.2800E+00
			0.8783E+01	0.4200E+00
			0.8783E+01	0.7000E+00
			0.8783E+01	0.2800E+01
16	10	0.4084E+02	0.0000E+00	0.0000E+00
			0.2942E+01	0.2240E-01
			0.4904E+01	0.4340E-01
			0.7356E+01	0.7980E-01
			0.8827E+01	0.1120E+00
			0.9808E+01	0.1400E+00
			0.9808E+01	0.2800E+00
			0.9808E+01	0.4200E+00
			0.9808E+01	0.7000E+00
			0.9808E+01	0.2800E+01
17	10	0.4580E+02	0.0000E+00	0.0000E+00
			0.2372E+01	0.2240E-01
			0.3953E+01	0.4340E-01
			0.5929E+01	0.7980E-01
			0.7115E+01	0.1120E+00
			0.7906E+01	0.1400E+00
			0.7906E+01	0.2800E+00
			0.7906E+01	0.4200E+00
			0.7906E+01	0.7000E+00
			0.7906E+01	0.2800E+01
18	10	0.5076E+02	0.0000E+00	0.0000E+00
			0.2639E+01	0.2240E-01
			0.4398E+01	0.4340E-01
			0.6597E+01	0.7980E-01
			0.7917E+01	0.1120E+00
			0.8796E+01	0.1400E+00
			0.8796E+01	0.2800E+00
			0.8796E+01	0.4200E+00
			0.8796E+01	0.7000E+00
			0.8796E+01	0.2800E+01
19	10	0.5084E+02	0.0000E+00	0.0000E+00
			0.2643E+01	0.2240E-01
			0.4406E+01	0.4340E-01
			0.6608E+01	0.7980E-01
			0.7930E+01	0.1120E+00
			0.8811E+01	0.1400E+00
			0.8811E+01	0.2800E+00
			0.8811E+01	0.4200E+00
			0.8811E+01	0.7000E+00
			0.8811E+01	0.2800E+01
20	10	0.5580E+02	0.0000E+00	0.0000E+00

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			0.2567E+01	0.2240E-01
			0.4278E+01	0.4340E-01
			0.6416E+01	0.7980E-01
			0.7700E+01	0.1120E+00
			0.8555E+01	0.1400E+00
			0.8555E+01	0.2800E+00
			0.8555E+01	0.4200E+00
			0.8555E+01	0.7000E+00
			0.8555E+01	0.2800E+01
21	10	0.6076E+02		
			0.0000E+00	0.0000E+00
			0.2786E+01	0.2240E-01
			0.4644E+01	0.4340E-01
			0.6965E+01	0.7980E-01
			0.8358E+01	0.1120E+00
			0.9287E+01	0.1400E+00
			0.9287E+01	0.2800E+00
			0.9287E+01	0.4200E+00
			0.9287E+01	0.7000E+00
			0.9287E+01	0.2800E+01
22	10	0.6084E+02		
			0.0000E+00	0.0000E+00
			0.2790E+01	0.2240E-01
			0.4650E+01	0.4340E-01
			0.6975E+01	0.7980E-01
			0.8369E+01	0.1120E+00
			0.9299E+01	0.1400E+00
			0.8369E+01	0.2800E+00
			0.8369E+01	0.4200E+00
			0.8369E+01	0.7000E+00
			0.8369E+01	0.2800E+01
23	10	0.6580E+02		
			0.0000E+00	0.0000E+00
			0.2433E+01	0.2240E-01
			0.4056E+01	0.4340E-01
			0.6084E+01	0.7980E-01
			0.7300E+01	0.1120E+00
			0.8111E+01	0.1400E+00
			0.7300E+01	0.2800E+00
			0.7300E+01	0.4200E+00
			0.7300E+01	0.7000E+00
			0.7300E+01	0.2800E+01
24	10	0.7076E+02		
			0.0000E+00	0.0000E+00
			0.2694E+01	0.2240E-01
			0.4491E+01	0.4340E-01
			0.6736E+01	0.7980E-01
			0.8083E+01	0.1120E+00
			0.8981E+01	0.1400E+00
			0.8083E+01	0.2800E+00
			0.8083E+01	0.4200E+00
			0.8083E+01	0.7000E+00
			0.8083E+01	0.2800E+01
25	10	0.7084E+02		
			0.0000E+00	0.0000E+00
			0.2723E+01	0.2240E-01
			0.4538E+01	0.4340E-01
			0.6808E+01	0.7980E-01
			0.8169E+01	0.1120E+00
			0.9077E+01	0.1400E+00
			0.9077E+01	0.2800E+00
			0.9077E+01	0.4200E+00
			0.9077E+01	0.7000E+00

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26	10	0.7580E+02	0.9077E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.3469E+01	0.2240E-01
			0.5782E+01	0.4340E-01
			0.8673E+01	0.7980E-01
			0.1041E+02	0.1120E+00
			0.1156E+02	0.1400E+00
			0.1156E+02	0.2800E+00
			0.1156E+02	0.4200E+00
			0.1156E+02	0.7000E+00
			0.1156E+02	0.2800E+01
27	10	0.8076E+02		
			0.0000E+00	0.0000E+00
			0.3706E+01	0.2240E-01
			0.6177E+01	0.4340E-01
			0.9266E+01	0.7980E-01
			0.1112E+02	0.1120E+00
			0.1235E+02	0.1400E+00
			0.1235E+02	0.2800E+00
			0.1235E+02	0.4200E+00
			0.1235E+02	0.7000E+00
			0.1235E+02	0.2800E+01
28	10	0.8084E+02		
			0.0000E+00	0.0000E+00
			0.3710E+01	0.2240E-01
			0.6184E+01	0.4340E-01
			0.9276E+01	0.7980E-01
			0.1113E+02	0.1120E+00
			0.1237E+02	0.1400E+00
			0.1237E+02	0.2800E+00
			0.1237E+02	0.4200E+00
			0.1237E+02	0.7000E+00
			0.1237E+02	0.2800E+01
29	10	0.8530E+02		
			0.0000E+00	0.0000E+00
			0.6002E+01	0.2240E-01
			0.1000E+02	0.4340E-01
			0.1500E+02	0.7980E-01
			0.1801E+02	0.1120E+00
			0.2001E+02	0.1400E+00
			0.2001E+02	0.2800E+00
			0.2001E+02	0.4200E+00
			0.2001E+02	0.7000E+00
			0.2001E+02	0.2800E+01
30	10	0.8976E+02		
			0.0000E+00	0.0000E+00
			0.6351E+01	0.2240E-01
			0.1058E+02	0.4340E-01
			0.1588E+02	0.7980E-01
			0.1905E+02	0.1120E+00
			0.2117E+02	0.1400E+00
			0.2117E+02	0.2800E+00
			0.2117E+02	0.4200E+00
			0.2117E+02	0.7000E+00
			0.2117E+02	0.2800E+01
31	10	0.8984E+02		
			0.0000E+00	0.0000E+00
			0.6357E+01	0.2240E-01
			0.1060E+02	0.4340E-01
			0.1589E+02	0.7980E-01
			0.1907E+02	0.1120E+00
			0.2119E+02	0.1400E+00

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			0.2119E+02	0.2800E+00
			0.2119E+02	0.4200E+00
			0.2119E+02	0.7000E+00
			0.2119E+02	0.2800E+01
32	10	0.9230E+02	0.0000E+00	0.0000E+00
			0.6370E+01	0.2240E-01
			0.1062E+02	0.4340E-01
			0.1592E+02	0.7980E-01
			0.1911E+02	0.1120E+00
			0.2123E+02	0.1400E+00
			0.2123E+02	0.2800E+00
			0.2123E+02	0.4200E+00
			0.2123E+02	0.7000E+00
			0.2123E+02	0.2800E+01
33	10	0.9476E+02	0.0000E+00	0.0000E+00
			0.6370E+01	0.2240E-01
			0.1062E+02	0.4340E-01
			0.1592E+02	0.7980E-01
			0.1911E+02	0.1120E+00
			0.2123E+02	0.1400E+00
			0.2123E+02	0.2800E+00
			0.2123E+02	0.4200E+00
			0.2123E+02	0.7000E+00
			0.2123E+02	0.2800E+01
34	10	0.9484E+02	0.0000E+00	0.0000E+00
			0.6370E+01	0.2240E-01
			0.1062E+02	0.4340E-01
			0.1592E+02	0.7980E-01
			0.1911E+02	0.1120E+00
			0.2123E+02	0.1400E+00
			0.2123E+02	0.2800E+00
			0.2123E+02	0.4200E+00
			0.2123E+02	0.7000E+00
			0.2123E+02	0.2800E+01
35	10	0.9730E+02	0.0000E+00	0.0000E+00
			0.6370E+01	0.2240E-01
			0.1062E+02	0.4340E-01
			0.1592E+02	0.7980E-01
			0.1911E+02	0.1120E+00
			0.2123E+02	0.1400E+00
			0.2123E+02	0.2800E+00
			0.2123E+02	0.4200E+00
			0.2123E+02	0.7000E+00
			0.2123E+02	0.2800E+01
36	10	0.9976E+02	0.0000E+00	0.0000E+00
			0.6370E+01	0.2240E-01
			0.1062E+02	0.4340E-01
			0.1592E+02	0.7980E-01
			0.1911E+02	0.1120E+00
			0.2123E+02	0.1400E+00
			0.2123E+02	0.2800E+00
			0.2123E+02	0.4200E+00
			0.2123E+02	0.7000E+00
			0.2123E+02	0.2800E+01

TIP LOAD

TIP MOVEMENT

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IN.

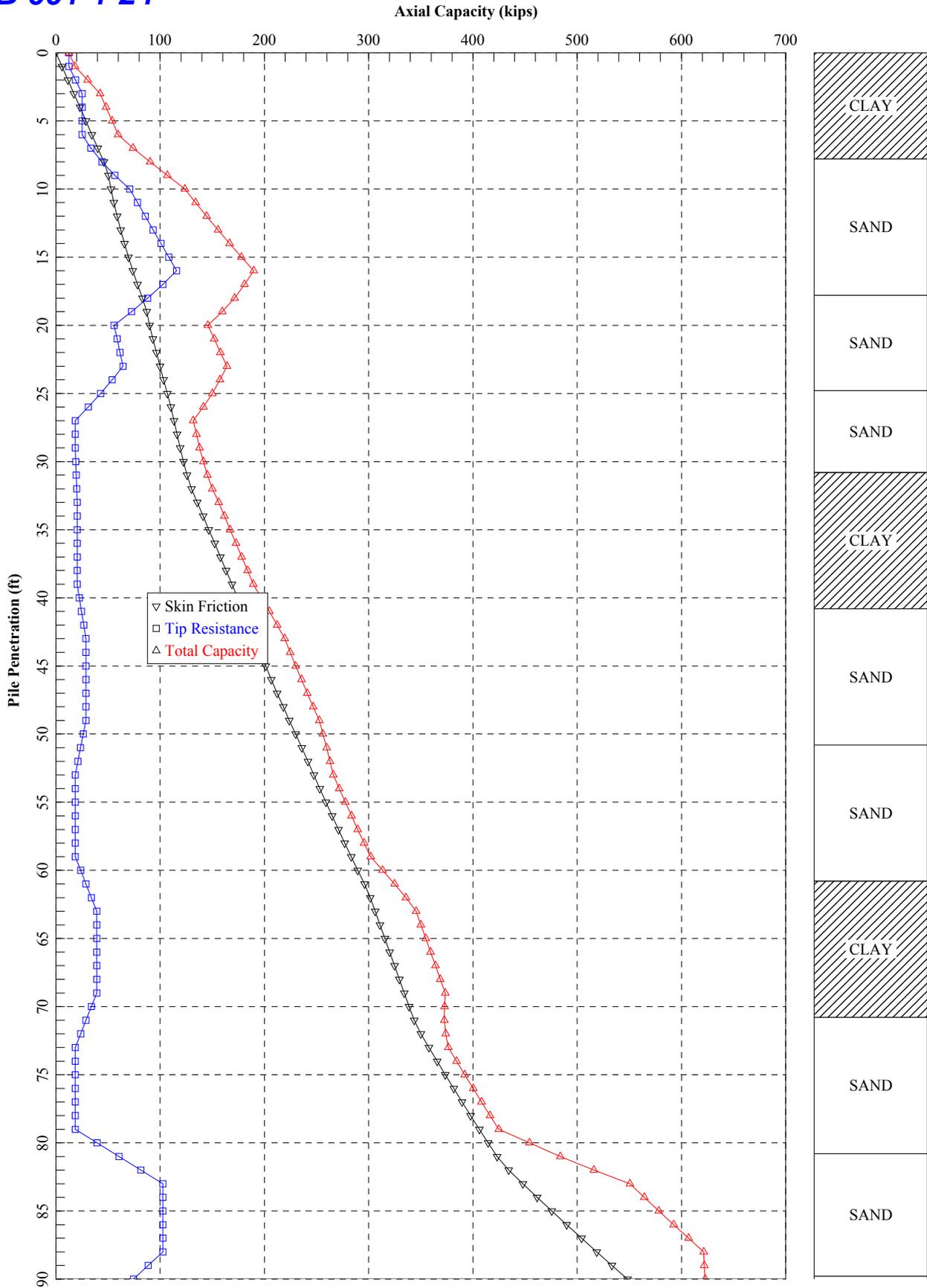
KIP

0.0000E+00	0.0000E+00
0.3558E+01	0.7000E-02
0.7117E+01	0.1400E-01
0.1423E+02	0.2800E-01
0.2847E+02	0.1820E+00
0.4270E+02	0.5880E+00
0.5124E+02	0.1022E+01
0.5694E+02	0.1400E+01
0.5694E+02	0.2100E+01
0.5694E+02	0.2800E+01

LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.8144E+00	0.2080E-03	0.5084E-01	0.1000E-03
0.8144E+01	0.2080E-02	0.5084E+00	0.1000E-02
0.4072E+02	0.1040E-01	0.2542E+01	0.5000E-02
0.8146E+02	0.2080E-01	0.5084E+01	0.1000E-01
0.1553E+03	0.4121E-01	0.1017E+02	0.2000E-01
0.2881E+03	0.9027E-01	0.1627E+02	0.5000E-01
0.3764E+03	0.1335E+00	0.1904E+02	0.8000E-01
0.4156E+03	0.1597E+00	0.2089E+02	0.1000E+00
0.4548E+03	0.2684E+00	0.2910E+02	0.2000E+00
0.4611E+03	0.5704E+00	0.3962E+02	0.5000E+00
0.4683E+03	0.8722E+00	0.4687E+02	0.8000E+00
0.4723E+03	0.1073E+01	0.5081E+02	0.1000E+01
0.4784E+03	0.2075E+01	0.5694E+02	0.2000E+01

16-Inch Dia. Closed End CIP Piles - UBV Rear Abutment B-001-1-24



**16-Inch Dia. Closed End CIP Piles - UBV
Rear Abutment
B-001-1-24**

B-001-1-24 - 16 Inch UBV.ap9o

APILE for Windows, Version 2019.9.12

Serial Number : 136090498

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 :

Resource International, Inc.
Columbus, OH

Path to file locations : C:\Users\legacy\Desktop\1.3.2025\16-inch\
Name of input data file : B-001-1-24 - 16 Inch UBV.ap9d
Name of output file : B-001-1-24 - 16 Inch UBV.ap9o
Name of plot output file : B-001-1-24 - 16 Inch UBV.ap9p

Time and Date of Analysis

Date: January 07, 2025 Time: 09:52:06

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* INPUT INFORMATION *

B-001-1-24 (Rear Abutment) - 16 -Inch CIP

DESIGNER : AG/DEK

JOB NUMBER : W-23-155 (MOT-835-2.57)

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

B-001-1-24 - 16 Inch UBV.ap9o

PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 201.01 IN²

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 16.00 IN.
- INTERNAL DIAMETER, ID = 0.25 IN.
- TOTAL PILE LENGTH, TL = 90.00 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH
USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED
END SECTION = 90.00 FT.
- INTERNAL DIAMETER OF
ENHANCED END SECTION = 0.25 IN.

PLUGGED/UNPLUGGED CONDITIONS :

Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	CLAY	0.80*	62.60	0.00	4.80**
7.80	CLAY	0.80*	62.60	0.00	4.80**
7.80	SAND	0.80*	67.60	38.00	110.40**
17.80	SAND	0.80*	67.60	38.00	110.40**
17.80	SAND	0.80*	67.60	33.00	47.20**
24.80	SAND	0.80*	67.60	33.00	47.20**
24.80	SAND	0.80*	62.60	30.00	30.00**
30.80	SAND	0.80*	62.60	30.00	30.00**
30.80	CLAY	0.80*	62.60	0.00	4.80**
40.80	CLAY	0.80*	62.60	0.00	4.80**
40.80	SAND	0.80*	67.60	31.00	35.20**
50.80	SAND	0.80*	67.60	31.00	35.20**
50.80	SAND	0.80*	62.60	30.00	30.00**
60.80	SAND	0.80*	62.60	30.00	30.00**
60.80	CLAY	0.80*	62.60	0.00	4.80**
70.80	CLAY	0.80*	62.60	0.00	4.80**
70.80	SAND	0.80*	67.60	30.00	30.00**
80.80	SAND	0.80*	67.60	30.00	30.00**
80.80	SAND	0.80*	72.60	34.00	55.60**
89.80	SAND	0.80*	72.60	34.00	55.60**
89.80	SAND	0.80*	72.60	32.00	40.40**
94.80	SAND	0.80*	72.60	32.00	40.40**

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70.80	1.000	1.000
80.80	1.000	1.000
80.80	1.000	1.000
89.80	1.000	1.000
89.80	1.000	1.000
94.80	1.000	1.000
94.80	1.000	1.000
99.80	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.160 *	0.90 **
7.80	0.160 *	0.90 **
7.80	0.160 *	0.00
17.80	0.160 *	0.00
17.80	0.160 *	0.00
24.80	0.160 *	0.00
24.80	0.160 *	0.00
30.80	0.160 *	0.00
30.80	0.160 *	0.90 **
40.80	0.160 *	0.90 **
40.80	0.160 *	0.00
50.80	0.160 *	0.00
50.80	0.160 *	0.00
60.80	0.160 *	0.00
60.80	0.160 *	0.90 **
70.80	0.160 *	0.90 **
70.80	0.160 *	0.00
80.80	0.160 *	0.00
80.80	0.160 *	0.00
89.80	0.160 *	0.00
89.80	0.160 *	0.00
94.80	0.160 *	0.00
94.80	0.160 *	0.00
99.80	0.160 *	0.00

* DEFAULT VALUE = 0.01 D
 ** DEFAULT VALUE = 0.9

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 * COMPUTATION RESULT *

 * FED. HWY. METHOD *

PILE PENETRATION FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	12.6	12.6
1.00	5.8	12.6	18.3
2.00	11.5	18.8	30.4
3.00	17.3	25.1	42.4
4.00	23.1	25.1	48.2

16-Inch Dia. Closed End CIP Piles - UBV

Rear Abutment

B-001-1-24

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5.00	28.8	25.1	54.0
6.00	34.6	25.1	59.7
7.00	40.3	33.7	74.1
8.00	46.2	44.2	90.4
9.00	50.4	56.5	106.9
10.00	52.9	70.8	123.7
11.00	55.7	78.3	134.0
12.00	58.8	85.8	144.6
13.00	62.1	93.4	155.5
14.00	65.8	100.9	166.7
15.00	69.7	108.4	178.1
16.00	73.9	115.9	189.8
17.00	78.4	102.6	181.0
18.00	83.2	88.2	171.4
19.00	87.1	72.6	159.7
20.00	90.0	55.8	145.8
21.00	93.1	58.7	151.8
22.00	96.4	61.6	157.9
23.00	99.8	64.4	164.2
24.00	103.3	54.0	157.3
25.00	107.0	42.9	150.0
26.00	110.4	31.1	141.4
27.00	113.2	18.6	131.8
28.00	116.2	18.6	134.8
29.00	119.2	18.6	137.8
30.00	122.4	19.1	141.5
31.00	125.7	19.5	145.2
32.00	130.1	20.0	150.1
33.00	135.6	20.4	156.1
34.00	141.2	20.4	161.6
35.00	146.7	20.4	167.1
36.00	152.3	20.4	172.7
37.00	157.8	20.4	178.2
38.00	163.3	20.4	183.8
39.00	168.9	20.4	189.3
40.00	174.4	22.5	197.0
41.00	180.1	24.6	204.8
42.00	185.6	26.7	212.3
43.00	190.7	28.9	219.5
44.00	195.9	28.9	224.8
45.00	201.3	28.9	230.1
46.00	206.7	28.9	235.6
47.00	212.3	28.9	241.2
48.00	218.1	28.9	246.9
49.00	223.9	28.9	252.8
50.00	229.9	26.3	256.2
51.00	236.0	23.7	259.7
52.00	241.9	21.2	263.0
53.00	247.5	18.6	266.1
54.00	253.2	18.6	271.8
55.00	259.0	18.6	277.6
56.00	264.9	18.6	283.5
57.00	271.0	18.6	289.6
58.00	277.1	18.6	295.7
59.00	283.3	18.6	301.9
60.00	289.6	23.8	313.4
61.00	296.1	28.9	325.0
62.00	301.6	34.1	335.7
63.00	306.3	39.3	345.6
64.00	310.9	39.3	350.2
65.00	315.6	39.3	354.9
66.00	320.2	39.3	359.5
67.00	324.9	39.3	364.2

Max. Factored Designed Load per Pile = 186.0kips
Required Nominal Resistance per Pile = (186/0.7) kips = 265.7 kips

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Pile length = 53+ 2.0 (estimated embedment in pile cap) = 55 feet
Estimated Pile Length to Rounded Up to Nearest 5 feet = 60.0 feet
Pile Order Length = 65 feet

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68.00	329.5	39.3	368.8
69.00	334.2	39.3	373.5
70.00	338.8	34.1	372.9
71.00	343.8	28.9	372.7
72.00	350.2	23.8	374.0
73.00	357.9	18.6	376.5
74.00	365.7	18.6	384.3
75.00	373.6	18.6	392.2
76.00	381.6	18.6	400.2
77.00	389.7	18.6	408.3
78.00	397.9	18.6	416.5
79.00	406.3	18.6	424.9
80.00	414.7	39.6	454.4
81.00	423.3	60.6	483.9
82.00	434.4	81.6	516.0
83.00	448.0	102.7	550.6
84.00	461.7	102.7	564.4
85.00	475.7	102.7	578.4
86.00	489.9	102.7	592.5
87.00	504.2	102.7	606.9
88.00	518.7	102.7	621.4
89.00	533.4	88.5	621.9
90.00	548.3	74.4	622.7

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	0.4167E-01	0.0000E+00	0.0000E+00
			0.2867E+01	0.2560E-01
			0.4778E+01	0.4960E-01
			0.7167E+01	0.9120E-01
			0.8600E+01	0.1280E+00
			0.9556E+01	0.1600E+00
			0.8600E+01	0.3200E+00
			0.8600E+01	0.4800E+00
			0.8600E+01	0.8000E+00
			0.8600E+01	0.3200E+01
2	10	0.3900E+01	0.0000E+00	0.0000E+00
			0.2867E+01	0.2560E-01
			0.4778E+01	0.4960E-01
			0.7167E+01	0.9120E-01
			0.8600E+01	0.1280E+00
			0.9556E+01	0.1600E+00
			0.8600E+01	0.3200E+00
			0.8600E+01	0.4800E+00
			0.8600E+01	0.8000E+00
			0.8600E+01	0.3200E+01

3	10	B-001-1-24 - 16 Inch UBV.ap9o 0.7758E+01	0.0000E+00 0.2941E+01 0.4902E+01 0.7354E+01 0.8824E+01 0.9805E+01 0.8824E+01 0.8824E+01 0.8824E+01 0.8824E+01	0.0000E+00 0.2560E-01 0.4960E-01 0.9120E-01 0.1280E+00 0.1600E+00 0.3200E+00 0.4800E+00 0.8000E+00 0.3200E+01
4	10	0.7842E+01	0.0000E+00 0.2950E+01 0.4916E+01 0.7374E+01 0.8849E+01 0.9832E+01 0.9832E+01 0.9832E+01 0.9832E+01 0.9832E+01	0.0000E+00 0.2560E-01 0.4960E-01 0.9120E-01 0.1280E+00 0.1600E+00 0.3200E+00 0.4800E+00 0.8000E+00 0.3200E+01
5	10	0.1280E+02	0.0000E+00 0.1714E+01 0.2857E+01 0.4285E+01 0.5142E+01 0.5713E+01 0.5713E+01 0.5713E+01 0.5713E+01 0.5713E+01	0.0000E+00 0.2560E-01 0.4960E-01 0.9120E-01 0.1280E+00 0.1600E+00 0.3200E+00 0.4800E+00 0.8000E+00 0.3200E+01
6	10	0.1776E+02	0.0000E+00 0.2410E+01 0.4017E+01 0.6025E+01 0.7230E+01 0.8034E+01 0.8034E+01 0.8034E+01 0.8034E+01 0.8034E+01	0.0000E+00 0.2560E-01 0.4960E-01 0.9120E-01 0.1280E+00 0.1600E+00 0.3200E+00 0.4800E+00 0.8000E+00 0.3200E+01
7	10	0.1784E+02	0.0000E+00 0.2422E+01 0.4036E+01 0.6054E+01 0.7265E+01 0.8073E+01 0.8073E+01 0.8073E+01 0.8073E+01 0.8073E+01	0.0000E+00 0.2560E-01 0.4960E-01 0.9120E-01 0.1280E+00 0.1600E+00 0.3200E+00 0.4800E+00 0.8000E+00 0.3200E+01
8	10	0.2130E+02	0.0000E+00 0.1603E+01 0.2671E+01 0.4007E+01 0.4809E+01 0.5343E+01 0.5343E+01	0.0000E+00 0.2560E-01 0.4960E-01 0.9120E-01 0.1280E+00 0.1600E+00 0.3200E+00

B-001-1-24 - 16 Inch UBV.ap9o

			0.5343E+01	0.4800E+00
			0.5343E+01	0.8000E+00
9	10	0.2476E+02	0.5343E+01	0.3200E+01
			0.0000E+00	0.0000E+00
			0.1871E+01	0.2560E-01
			0.3118E+01	0.4960E-01
			0.4676E+01	0.9120E-01
			0.5612E+01	0.1280E+00
			0.6235E+01	0.1600E+00
			0.6235E+01	0.3200E+00
			0.6235E+01	0.4800E+00
			0.6235E+01	0.8000E+00
10	10	0.2484E+02	0.6235E+01	0.3200E+01
			0.0000E+00	0.0000E+00
			0.1877E+01	0.2560E-01
			0.3128E+01	0.4960E-01
			0.4692E+01	0.9120E-01
			0.5631E+01	0.1280E+00
			0.6257E+01	0.1600E+00
			0.6257E+01	0.3200E+00
			0.6257E+01	0.4800E+00
			0.6257E+01	0.8000E+00
11	10	0.2780E+02	0.6257E+01	0.3200E+01
			0.0000E+00	0.0000E+00
			0.1488E+01	0.2560E-01
			0.2481E+01	0.4960E-01
			0.3721E+01	0.9120E-01
			0.4465E+01	0.1280E+00
			0.4961E+01	0.1600E+00
			0.4961E+01	0.3200E+00
			0.4961E+01	0.4800E+00
			0.4961E+01	0.8000E+00
12	10	0.3076E+02	0.4961E+01	0.3200E+01
			0.0000E+00	0.0000E+00
			0.1639E+01	0.2560E-01
			0.2732E+01	0.4960E-01
			0.4098E+01	0.9120E-01
			0.4918E+01	0.1280E+00
			0.5465E+01	0.1600E+00
			0.5465E+01	0.3200E+00
			0.5465E+01	0.4800E+00
			0.5465E+01	0.8000E+00
13	10	0.3084E+02	0.5465E+01	0.3200E+01
			0.0000E+00	0.0000E+00
			0.1644E+01	0.2560E-01
			0.2739E+01	0.4960E-01
			0.4109E+01	0.9120E-01
			0.4931E+01	0.1280E+00
			0.5479E+01	0.1600E+00
			0.4931E+01	0.3200E+00
			0.4931E+01	0.4800E+00
			0.4931E+01	0.8000E+00
14	10	0.3580E+02	0.4931E+01	0.3200E+01
			0.0000E+00	0.0000E+00
			0.2756E+01	0.2560E-01
			0.4593E+01	0.4960E-01
			0.6889E+01	0.9120E-01

B-001-1-24 - 16 Inch UBV.ap9o

			0.8267E+01	0.1280E+00
			0.9186E+01	0.1600E+00
			0.8267E+01	0.3200E+00
			0.8267E+01	0.4800E+00
			0.8267E+01	0.8000E+00
			0.8267E+01	0.3200E+01
15	10	0.4076E+02	0.0000E+00	0.0000E+00
			0.2872E+01	0.2560E-01
			0.4787E+01	0.4960E-01
			0.7180E+01	0.9120E-01
			0.8616E+01	0.1280E+00
			0.9573E+01	0.1600E+00
			0.8616E+01	0.3200E+00
			0.8616E+01	0.4800E+00
			0.8616E+01	0.8000E+00
			0.8616E+01	0.3200E+01
16	10	0.4084E+02	0.0000E+00	0.0000E+00
			0.2885E+01	0.2560E-01
			0.4808E+01	0.4960E-01
			0.7212E+01	0.9120E-01
			0.8654E+01	0.1280E+00
			0.9616E+01	0.1600E+00
			0.9616E+01	0.3200E+00
			0.9616E+01	0.4800E+00
			0.9616E+01	0.8000E+00
			0.9616E+01	0.3200E+01
17	10	0.4580E+02	0.0000E+00	0.0000E+00
			0.2744E+01	0.2560E-01
			0.4574E+01	0.4960E-01
			0.6860E+01	0.9120E-01
			0.8232E+01	0.1280E+00
			0.9147E+01	0.1600E+00
			0.9147E+01	0.3200E+00
			0.9147E+01	0.4800E+00
			0.9147E+01	0.8000E+00
			0.9147E+01	0.3200E+01
18	10	0.5076E+02	0.0000E+00	0.0000E+00
			0.3053E+01	0.2560E-01
			0.5089E+01	0.4960E-01
			0.7633E+01	0.9120E-01
			0.9160E+01	0.1280E+00
			0.1018E+02	0.1600E+00
			0.1018E+02	0.3200E+00
			0.1018E+02	0.4800E+00
			0.1018E+02	0.8000E+00
			0.1018E+02	0.3200E+01
19	10	0.5084E+02	0.0000E+00	0.0000E+00
			0.3058E+01	0.2560E-01
			0.5097E+01	0.4960E-01
			0.7646E+01	0.9120E-01
			0.9175E+01	0.1280E+00
			0.1019E+02	0.1600E+00
			0.1019E+02	0.3200E+00
			0.1019E+02	0.4800E+00
			0.1019E+02	0.8000E+00
			0.1019E+02	0.3200E+01
20	10	0.5580E+02	0.0000E+00	0.0000E+00

B-001-1-24 - 16 Inch UBV.ap9o

			0.2958E+01	0.2560E-01
			0.4931E+01	0.4960E-01
			0.7396E+01	0.9120E-01
			0.8875E+01	0.1280E+00
			0.9861E+01	0.1600E+00
			0.9861E+01	0.3200E+00
			0.9861E+01	0.4800E+00
			0.9861E+01	0.8000E+00
			0.9861E+01	0.3200E+01
21	10	0.6076E+02		
			0.0000E+00	0.0000E+00
			0.3211E+01	0.2560E-01
			0.5352E+01	0.4960E-01
			0.8029E+01	0.9120E-01
			0.9634E+01	0.1280E+00
			0.1070E+02	0.1600E+00
			0.1070E+02	0.3200E+00
			0.1070E+02	0.4800E+00
			0.1070E+02	0.8000E+00
			0.1070E+02	0.3200E+01
22	10	0.6084E+02		
			0.0000E+00	0.0000E+00
			0.3216E+01	0.2560E-01
			0.5360E+01	0.4960E-01
			0.8039E+01	0.9120E-01
			0.9647E+01	0.1280E+00
			0.1072E+02	0.1600E+00
			0.9647E+01	0.3200E+00
			0.9647E+01	0.4800E+00
			0.9647E+01	0.8000E+00
			0.9647E+01	0.3200E+01
23	10	0.6580E+02		
			0.0000E+00	0.0000E+00
			0.2314E+01	0.2560E-01
			0.3856E+01	0.4960E-01
			0.5785E+01	0.9120E-01
			0.6942E+01	0.1280E+00
			0.7713E+01	0.1600E+00
			0.6942E+01	0.3200E+00
			0.6942E+01	0.4800E+00
			0.6942E+01	0.8000E+00
			0.6942E+01	0.3200E+01
24	10	0.7076E+02		
			0.0000E+00	0.0000E+00
			0.2542E+01	0.2560E-01
			0.4237E+01	0.4960E-01
			0.6355E+01	0.9120E-01
			0.7627E+01	0.1280E+00
			0.8474E+01	0.1600E+00
			0.7627E+01	0.3200E+00
			0.7627E+01	0.4800E+00
			0.7627E+01	0.8000E+00
			0.7627E+01	0.3200E+01
25	10	0.7084E+02		
			0.0000E+00	0.0000E+00
			0.2567E+01	0.2560E-01
			0.4279E+01	0.4960E-01
			0.6418E+01	0.9120E-01
			0.7702E+01	0.1280E+00
			0.8558E+01	0.1600E+00
			0.8558E+01	0.3200E+00
			0.8558E+01	0.4800E+00
			0.8558E+01	0.8000E+00

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26	10	0.7580E+02	0.8558E+01	0.3200E+01
			0.0000E+00	0.0000E+00
			0.3999E+01	0.2560E-01
			0.6665E+01	0.4960E-01
			0.9997E+01	0.9120E-01
			0.1200E+02	0.1280E+00
			0.1333E+02	0.1600E+00
			0.1333E+02	0.3200E+00
			0.1333E+02	0.4800E+00
			0.1333E+02	0.8000E+00
			0.1333E+02	0.3200E+01
27	10	0.8076E+02		
			0.0000E+00	0.0000E+00
			0.4272E+01	0.2560E-01
			0.7120E+01	0.4960E-01
			0.1068E+02	0.9120E-01
			0.1282E+02	0.1280E+00
			0.1424E+02	0.1600E+00
			0.1424E+02	0.3200E+00
			0.1424E+02	0.4800E+00
			0.1424E+02	0.8000E+00
			0.1424E+02	0.3200E+01
28	10	0.8084E+02		
			0.0000E+00	0.0000E+00
			0.4277E+01	0.2560E-01
			0.7128E+01	0.4960E-01
			0.1069E+02	0.9120E-01
			0.1283E+02	0.1280E+00
			0.1426E+02	0.1600E+00
			0.1426E+02	0.3200E+00
			0.1426E+02	0.4800E+00
			0.1426E+02	0.8000E+00
			0.1426E+02	0.3200E+01
29	10	0.8530E+02		
			0.0000E+00	0.0000E+00
			0.7020E+01	0.2560E-01
			0.1170E+02	0.4960E-01
			0.1755E+02	0.9120E-01
			0.2106E+02	0.1280E+00
			0.2340E+02	0.1600E+00
			0.2340E+02	0.3200E+00
			0.2340E+02	0.4800E+00
			0.2340E+02	0.8000E+00
			0.2340E+02	0.3200E+01
30	10	0.8976E+02		
			0.0000E+00	0.0000E+00
			0.7429E+01	0.2560E-01
			0.1238E+02	0.4960E-01
			0.1857E+02	0.9120E-01
			0.2229E+02	0.1280E+00
			0.2476E+02	0.1600E+00
			0.2476E+02	0.3200E+00
			0.2476E+02	0.4800E+00
			0.2476E+02	0.8000E+00
			0.2476E+02	0.3200E+01
31	10	0.8984E+02		
			0.0000E+00	0.0000E+00
			0.7436E+01	0.2560E-01
			0.1239E+02	0.4960E-01
			0.1859E+02	0.9120E-01
			0.2231E+02	0.1280E+00
			0.2479E+02	0.1600E+00

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			0.2479E+02	0.3200E+00
			0.2479E+02	0.4800E+00
			0.2479E+02	0.8000E+00
			0.2479E+02	0.3200E+01
32	10	0.9230E+02		
			0.0000E+00	0.0000E+00
			0.7451E+01	0.2560E-01
			0.1242E+02	0.4960E-01
			0.1863E+02	0.9120E-01
			0.2235E+02	0.1280E+00
			0.2484E+02	0.1600E+00
			0.2484E+02	0.3200E+00
			0.2484E+02	0.4800E+00
			0.2484E+02	0.8000E+00
			0.2484E+02	0.3200E+01
33	10	0.9476E+02		
			0.0000E+00	0.0000E+00
			0.7451E+01	0.2560E-01
			0.1242E+02	0.4960E-01
			0.1863E+02	0.9120E-01
			0.2235E+02	0.1280E+00
			0.2484E+02	0.1600E+00
			0.2484E+02	0.3200E+00
			0.2484E+02	0.4800E+00
			0.2484E+02	0.8000E+00
			0.2484E+02	0.3200E+01
34	10	0.9484E+02		
			0.0000E+00	0.0000E+00
			0.7451E+01	0.2560E-01
			0.1242E+02	0.4960E-01
			0.1863E+02	0.9120E-01
			0.2235E+02	0.1280E+00
			0.2484E+02	0.1600E+00
			0.2484E+02	0.3200E+00
			0.2484E+02	0.4800E+00
			0.2484E+02	0.8000E+00
			0.2484E+02	0.3200E+01
35	10	0.9730E+02		
			0.0000E+00	0.0000E+00
			0.7451E+01	0.2560E-01
			0.1242E+02	0.4960E-01
			0.1863E+02	0.9120E-01
			0.2235E+02	0.1280E+00
			0.2484E+02	0.1600E+00
			0.2484E+02	0.3200E+00
			0.2484E+02	0.4800E+00
			0.2484E+02	0.8000E+00
			0.2484E+02	0.3200E+01
36	10	0.9976E+02		
			0.0000E+00	0.0000E+00
			0.7451E+01	0.2560E-01
			0.1242E+02	0.4960E-01
			0.1863E+02	0.9120E-01
			0.2235E+02	0.1280E+00
			0.2484E+02	0.1600E+00
			0.2484E+02	0.3200E+00
			0.2484E+02	0.4800E+00
			0.2484E+02	0.8000E+00
			0.2484E+02	0.3200E+01

TIP LOAD

TIP MOVEMENT

B-001-1-24 - 16 Inch UBV.ap9o
IN.

KIP

0.0000E+00	0.0000E+00
0.4648E+01	0.8000E-02
0.9296E+01	0.1600E-01
0.1859E+02	0.3200E-01
0.3718E+02	0.2080E+00
0.5577E+02	0.6720E+00
0.6693E+02	0.1168E+01
0.7436E+02	0.1600E+01
0.7436E+02	0.2400E+01
0.7436E+02	0.3200E+01

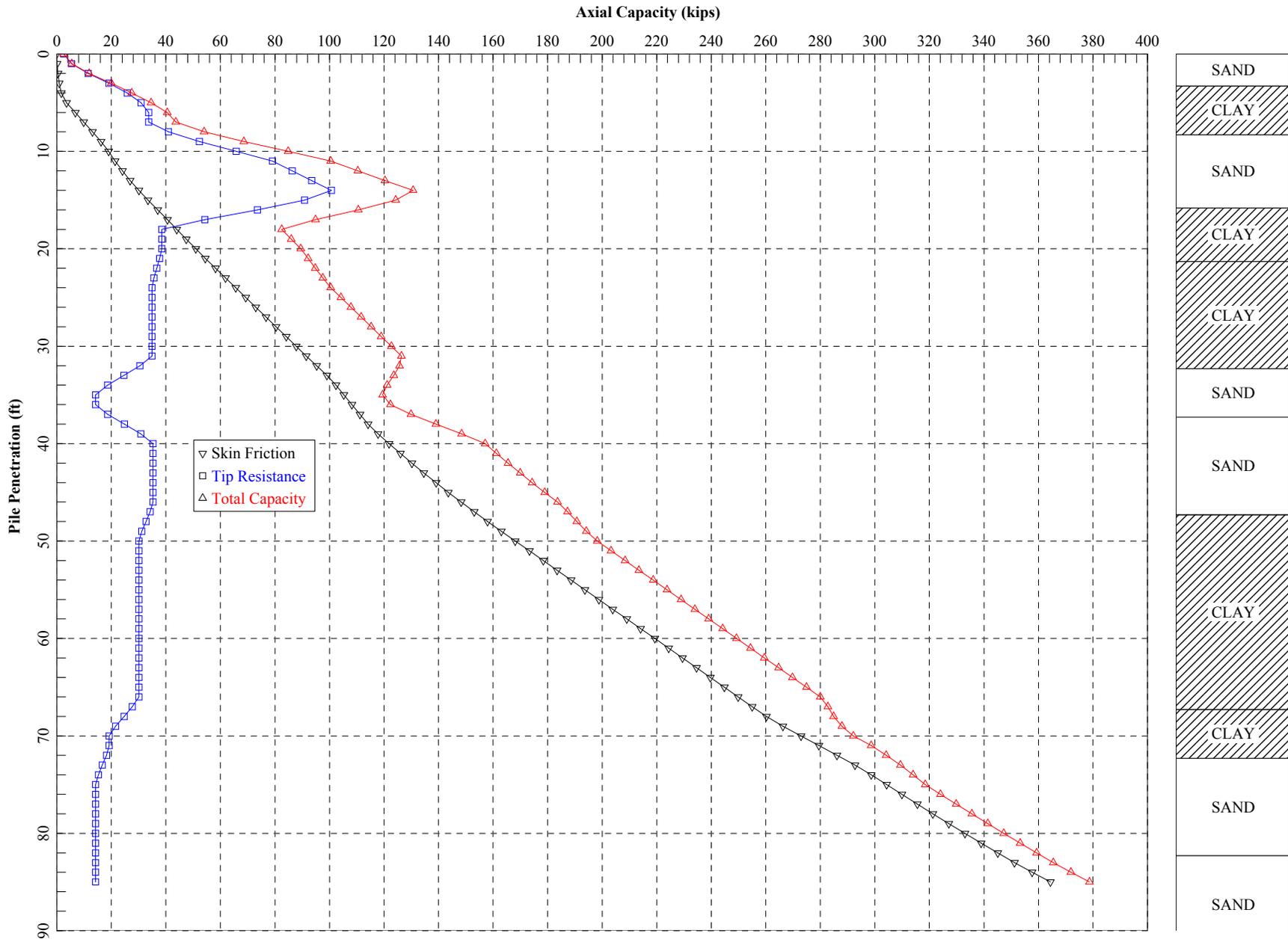
LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.8684E+00	0.1911E-03	0.5810E-01	0.1000E-03
0.8684E+01	0.1911E-02	0.5810E+00	0.1000E-02
0.4342E+02	0.9556E-02	0.2905E+01	0.5000E-02
0.8684E+02	0.1911E-01	0.5810E+01	0.1000E-01
0.1700E+03	0.3813E-01	0.1162E+02	0.2000E-01
0.3311E+03	0.8627E-01	0.2049E+02	0.5000E-01
0.4369E+03	0.1282E+00	0.2366E+02	0.8000E-01
0.4908E+03	0.1545E+00	0.2577E+02	0.1000E+00
0.5780E+03	0.2671E+00	0.3634E+02	0.2000E+00
0.5826E+03	0.5688E+00	0.4888E+02	0.5000E+00
0.5924E+03	0.8706E+00	0.5865E+02	0.8000E+00
0.5969E+03	0.1071E+01	0.6315E+02	0.1000E+01
0.6081E+03	0.2074E+01	0.7436E+02	0.2000E+01

14-Inch Dia. Closed End CIP Piles - UBV

Pier 1

B-002-1-24



**14-Inch Dia. Closed End CIP Piles - UBV
Pier 1
B-002-1-24**

B-002-1-24 UBV.ap9o

APILE for Windows, Version 2019.9.12

Serial Number : 136090498

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 :

Resource International, Inc.
Columbus, OH

Path to file locations :
C:\Users\legacy\Desktop\1.3.2025\14-inch\Piers\B-002-1-24\
Name of input data file : B-002-1-24 UBV.ap9d
Name of output file : B-002-1-24 UBV.ap9o
Name of plot output file : B-002-1-24 UBV.ap9p

Time and Date of Analysis

Date: January 07, 2025 Time: 09:44:10

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* INPUT INFORMATION *

B-002-1-23 (Pier 1) - 14 Inch CIP

DESIGNER : AG/DEK

JOB NUMBER : W-23-155 (MOT-835-2.57)

METHOD FOR UNIT LOAD TRANSFERS :

- FHWA (Federal Highway Administration)
Unfactored Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

TYPE OF LOADING :

- COMPRESSION

PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
 - Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
 - CROSS SECTION AREA = 153.89 IN²

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 14.00 IN.
 - INTERNAL DIAMETER, ID = 0.25 IN.
 - TOTAL PILE LENGTH, TL = 85.00 FT.
 - BATTER ANGLE = 0.00 DEG
 - PILE STICKUP LENGTH, PSL = 0.00 FT.
 - ZERO FRICTION LENGTH, ZFL = 0.00 FT.
 - INCREMENT OF PILE LENGTH
 USED IN COMPUTATION = 1.00 FT.
 - LENGTH OF ENHANCED
 END SECTION = 85.00 FT.
 - INTERNAL DIAMETER OF
 ENHANCED END SECTION = 0.25 IN.

PLUGGED/UNPLUGGED CONDITIONS :
 Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	SAND	0.80*	67.60	38.00	110.40**
3.30	SAND	0.80*	67.60	38.00	110.40**
3.30	CLAY	0.80*	67.60	0.00	4.80**
8.30	CLAY	0.80*	67.60	0.00	4.80**
8.30	SAND	0.80*	67.60	39.00	135.20**
15.80	SAND	0.80*	67.60	39.00	135.20**
15.80	CLAY	0.80*	67.60	0.00	4.80**
21.30	CLAY	0.80*	67.60	0.00	4.80**
21.30	CLAY	0.80*	62.60	0.00	4.80**
32.30	CLAY	0.80*	62.60	0.00	4.80**
32.30	SAND	0.80*	62.60	30.00	30.00**
37.30	SAND	0.80*	62.60	30.00	30.00**
37.30	SAND	0.80*	67.60	32.00	40.40**
47.30	SAND	0.80*	67.60	32.00	40.40**
47.30	CLAY	0.80*	62.60	0.00	4.80**
67.30	CLAY	0.80*	62.60	0.00	4.80**
67.30	CLAY	0.80*	62.60	0.00	4.80**
72.30	CLAY	0.80*	62.60	0.00	4.80**
72.30	SAND	0.80*	62.60	29.00	26.40**
82.30	SAND	0.80*	62.60	29.00	26.40**
82.30	SAND	0.80*	67.60	30.00	30.00**

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67.30	1.000	1.000
67.30	1.000	1.000
72.30	1.000	1.000
72.30	1.000	1.000
82.30	1.000	1.000
82.30	1.000	1.000
92.30	1.000	1.000
92.30	1.000	1.000
100.30	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.140 *	0.00
3.30	0.140 *	0.00
3.30	0.140 *	0.90 **
8.30	0.140 *	0.90 **
8.30	0.140 *	0.00
15.80	0.140 *	0.00
15.80	0.140 *	0.90 **
21.30	0.140 *	0.90 **
21.30	0.140 *	0.90 **
32.30	0.140 *	0.90 **
32.30	0.140 *	0.00
37.30	0.140 *	0.00
37.30	0.140 *	0.00
47.30	0.140 *	0.00
47.30	0.140 *	0.90 **
67.30	0.140 *	0.90 **
67.30	0.140 *	0.90 **
72.30	0.140 *	0.90 **
72.30	0.140 *	0.00
82.30	0.140 *	0.00
82.30	0.140 *	0.00
92.30	0.140 *	0.00
92.30	0.140 *	0.00
100.30	0.140 *	0.00

* DEFAULT VALUE = 0.01 D
 ** DEFAULT VALUE = 0.9

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 * COMPUTATION RESULT *

Q100, Low Scour Elev = 865.18 ft, (1.6 feet
 below bottom of pile cap)
 Side Friction Loss Due to Scour = 0.25 kips

 * FED. HWY. METHOD *

PILE PENETRATION FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	2.5	2.5
1.00	0.1	5.4	5.5
2.00	0.4	11.5	11.9
3.00	0.9	19.1	20.0

14-Inch Dia. Closed End CIP Piles - UBV

Pier 1

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4.00	1.7	25.8	27.5
5.00	3.6	30.9	34.6
6.00	6.8	33.7	40.5
7.00	9.9	33.7	43.6
8.00	13.1	40.9	54.0
9.00	16.2	52.3	68.6
10.00	19.0	65.8	84.8
11.00	21.4	79.1	100.5
12.00	24.1	86.3	110.4
13.00	26.9	93.5	120.4
14.00	30.1	100.7	130.7
15.00	33.4	90.9	124.3
16.00	37.0	73.6	110.6
17.00	40.6	54.3	94.9
18.00	44.0	38.5	82.5
19.00	47.5	38.5	86.0
20.00	51.0	38.5	89.5
21.00	54.5	37.7	92.2
22.00	58.2	36.7	94.8
23.00	61.9	35.6	97.6
24.00	65.6	34.9	100.5
25.00	69.3	34.9	104.2
26.00	73.0	34.9	107.9
27.00	76.7	34.9	111.6
28.00	80.4	34.9	115.3
29.00	84.1	34.9	119.0
30.00	87.8	34.9	122.7
31.00	91.5	34.9	126.4
32.00	95.3	30.5	125.7
33.00	99.1	24.6	123.6
34.00	102.4	18.7	121.1
35.00	105.3	14.2	119.5
36.00	108.2	14.2	122.4
37.00	111.2	18.7	129.9
38.00	114.2	24.8	139.0
39.00	117.8	30.8	148.5
40.00	121.8	35.3	157.1
41.00	126.0	35.3	161.2
42.00	130.2	35.3	165.5
43.00	134.6	35.3	169.9
44.00	139.1	35.3	174.3
45.00	143.6	35.3	178.9
46.00	148.3	35.3	183.6
47.00	153.1	34.2	187.3
48.00	158.0	32.7	190.7
49.00	163.0	31.2	194.2
50.00	168.1	30.1	198.2
51.00	173.3	30.1	203.3
52.00	178.4	30.1	208.4
53.00	183.5	30.1	213.5
54.00	188.6	30.1	218.7
55.00	193.7	30.1	223.8
56.00	198.8	30.1	228.9
57.00	203.9	30.1	234.0
58.00	209.0	30.1	239.1
59.00	214.1	30.1	244.2
60.00	219.3	30.1	249.3
61.00	224.4	30.1	254.4
62.00	229.5	30.1	259.5
63.00	234.6	30.1	264.7
64.00	239.7	30.1	269.8
65.00	244.8	30.1	274.9
66.00	249.9	30.1	280.0

Max. Factored Designed Load per Pile = 172.0 kips
Required Nominal Resistance per Pile = $(172/0.7)$ kips = 245.7 kips
Required Nominal Driving Resistance = $(172/0.7)+scour\ loss\ (0.25)= 245.96$ kips

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Pile length = 60 + 2.0 (estimated embedment in pile cap) = 62.0 feet
Estimated Pile Length to Rounded Up to Nearest 5 feet = 65.0 feet
Order Length = 70 feet

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67.00	255.0	27.7	282.8
68.00	260.3	24.7	284.9
69.00	266.3	21.6	287.9
70.00	272.9	19.2	292.1
71.00	279.5	19.2	298.7
72.00	286.1	18.2	304.2
73.00	292.7	16.7	309.4
74.00	298.7	15.3	314.0
75.00	304.3	14.2	318.5
76.00	309.9	14.2	324.1
77.00	315.6	14.2	329.8
78.00	321.3	14.2	335.6
79.00	327.1	14.2	341.4
80.00	333.1	14.2	347.3
81.00	339.0	14.2	353.3
82.00	345.1	14.2	359.3
83.00	351.2	14.2	365.4
84.00	357.7	14.2	371.9
85.00	364.4	14.2	378.7

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	0.4167E-01	0.0000E+00	0.0000E+00
			0.4922E-02	0.2240E-01
			0.8204E-02	0.4340E-01
			0.1231E-01	0.7980E-01
			0.1477E-01	0.1120E+00
			0.1641E-01	0.1400E+00
			0.1641E-01	0.2800E+00
			0.1641E-01	0.4200E+00
			0.1641E-01	0.7000E+00
			0.1641E-01	0.2800E+01
2	10	0.1650E+01	0.0000E+00	0.0000E+00
			0.1949E+00	0.2240E-01
			0.3249E+00	0.4340E-01
			0.4873E+00	0.7980E-01
			0.5848E+00	0.1120E+00
			0.6497E+00	0.1400E+00
			0.6497E+00	0.2800E+00
			0.6497E+00	0.4200E+00
			0.6497E+00	0.7000E+00
			0.6497E+00	0.2800E+01
3	10	0.3258E+01	0.0000E+00	0.0000E+00
			0.3849E+00	0.2240E-01
			0.6415E+00	0.4340E-01

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			0.9623E+00	0.7980E-01
			0.1155E+01	0.1120E+00
			0.1283E+01	0.1400E+00
			0.1283E+01	0.2800E+00
			0.1283E+01	0.4200E+00
			0.1283E+01	0.7000E+00
			0.1283E+01	0.2800E+01
4	10	0.3342E+01		
			0.0000E+00	0.0000E+00
			0.3948E+00	0.2240E-01
			0.6579E+00	0.4340E-01
			0.9869E+00	0.7980E-01
			0.1184E+01	0.1120E+00
			0.1316E+01	0.1400E+00
			0.1184E+01	0.2800E+00
			0.1184E+01	0.4200E+00
			0.1184E+01	0.7000E+00
			0.1184E+01	0.2800E+01
5	10	0.5800E+01		
			0.0000E+00	0.0000E+00
			0.1786E+01	0.2240E-01
			0.2977E+01	0.4340E-01
			0.4466E+01	0.7980E-01
			0.5359E+01	0.1120E+00
			0.5955E+01	0.1400E+00
			0.5359E+01	0.2800E+00
			0.5359E+01	0.4200E+00
			0.5359E+01	0.7000E+00
			0.5359E+01	0.2800E+01
6	10	0.8258E+01		
			0.0000E+00	0.0000E+00
			0.1793E+01	0.2240E-01
			0.2988E+01	0.4340E-01
			0.4482E+01	0.7980E-01
			0.5379E+01	0.1120E+00
			0.5976E+01	0.1400E+00
			0.5379E+01	0.2800E+00
			0.5379E+01	0.4200E+00
			0.5379E+01	0.7000E+00
			0.5379E+01	0.2800E+01
7	10	0.8342E+01		
			0.0000E+00	0.0000E+00
			0.1795E+01	0.2240E-01
			0.2992E+01	0.4340E-01
			0.4487E+01	0.7980E-01
			0.5385E+01	0.1120E+00
			0.5983E+01	0.1400E+00
			0.5983E+01	0.2800E+00
			0.5983E+01	0.4200E+00
			0.5983E+01	0.7000E+00
			0.5983E+01	0.2800E+01
8	10	0.1205E+02		
			0.0000E+00	0.0000E+00
			0.1579E+01	0.2240E-01
			0.2631E+01	0.4340E-01
			0.3947E+01	0.7980E-01
			0.4736E+01	0.1120E+00
			0.5263E+01	0.1400E+00
			0.5263E+01	0.2800E+00
			0.5263E+01	0.4200E+00
			0.5263E+01	0.7000E+00
			0.5263E+01	0.2800E+01
9	10	0.1576E+02		

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			0.0000E+00	0.0000E+00
			0.2065E+01	0.2240E-01
			0.3441E+01	0.4340E-01
			0.5162E+01	0.7980E-01
			0.6194E+01	0.1120E+00
			0.6882E+01	0.1400E+00
			0.6882E+01	0.2800E+00
			0.6882E+01	0.4200E+00
			0.6882E+01	0.7000E+00
10	10	0.1584E+02	0.6882E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2076E+01	0.2240E-01
			0.3459E+01	0.4340E-01
			0.5189E+01	0.7980E-01
			0.6227E+01	0.1120E+00
			0.6919E+01	0.1400E+00
			0.6227E+01	0.2800E+00
			0.6227E+01	0.4200E+00
			0.6227E+01	0.7000E+00
11	10	0.1855E+02	0.6227E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.1983E+01	0.2240E-01
			0.3306E+01	0.4340E-01
			0.4958E+01	0.7980E-01
			0.5950E+01	0.1120E+00
			0.6611E+01	0.1400E+00
			0.5950E+01	0.2800E+00
			0.5950E+01	0.4200E+00
			0.5950E+01	0.7000E+00
12	10	0.2126E+02	0.5950E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2030E+01	0.2240E-01
			0.3383E+01	0.4340E-01
			0.5075E+01	0.7980E-01
			0.6090E+01	0.1120E+00
			0.6766E+01	0.1400E+00
			0.6090E+01	0.2800E+00
			0.6090E+01	0.4200E+00
			0.6090E+01	0.7000E+00
13	10	0.2134E+02	0.6090E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2045E+01	0.2240E-01
			0.3408E+01	0.4340E-01
			0.5112E+01	0.7980E-01
			0.6135E+01	0.1120E+00
			0.6816E+01	0.1400E+00
			0.6135E+01	0.2800E+00
			0.6135E+01	0.4200E+00
			0.6135E+01	0.7000E+00
14	10	0.2680E+02	0.6135E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2105E+01	0.2240E-01
			0.3509E+01	0.4340E-01
			0.5264E+01	0.7980E-01
			0.6316E+01	0.1120E+00
			0.7018E+01	0.1400E+00
			0.6316E+01	0.2800E+00
			0.6316E+01	0.4200E+00

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15	10	0.3226E+02	0.6316E+01	0.7000E+00
			0.6316E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2141E+01	0.2240E-01
			0.3568E+01	0.4340E-01
			0.5352E+01	0.7980E-01
			0.6422E+01	0.1120E+00
			0.7136E+01	0.1400E+00
			0.6422E+01	0.2800E+00
			0.6422E+01	0.4200E+00
16	10	0.3234E+02	0.6422E+01	0.7000E+00
			0.6422E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2152E+01	0.2240E-01
			0.3587E+01	0.4340E-01
			0.5380E+01	0.7980E-01
			0.6456E+01	0.1120E+00
			0.7174E+01	0.1400E+00
			0.7174E+01	0.2800E+00
			0.7174E+01	0.4200E+00
17	10	0.3480E+02	0.7174E+01	0.7000E+00
			0.7174E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.1619E+01	0.2240E-01
			0.2698E+01	0.4340E-01
			0.4047E+01	0.7980E-01
			0.4857E+01	0.1120E+00
			0.5396E+01	0.1400E+00
			0.5396E+01	0.2800E+00
			0.5396E+01	0.4200E+00
18	10	0.3726E+02	0.5396E+01	0.7000E+00
			0.5396E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.1728E+01	0.2240E-01
			0.2880E+01	0.4340E-01
			0.4319E+01	0.7980E-01
			0.5183E+01	0.1120E+00
			0.5759E+01	0.1400E+00
			0.5759E+01	0.2800E+00
			0.5759E+01	0.4200E+00
19	10	0.3734E+02	0.5759E+01	0.7000E+00
			0.5759E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.1731E+01	0.2240E-01
			0.2886E+01	0.4340E-01
			0.4329E+01	0.7980E-01
			0.5194E+01	0.1120E+00
			0.5772E+01	0.1400E+00
			0.5772E+01	0.2800E+00
			0.5772E+01	0.4200E+00
20	10	0.4230E+02	0.5772E+01	0.7000E+00
			0.5772E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2470E+01	0.2240E-01
			0.4117E+01	0.4340E-01
			0.6175E+01	0.7980E-01
			0.7410E+01	0.1120E+00

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			0.8234E+01	0.1400E+00
			0.8234E+01	0.2800E+00
			0.8234E+01	0.4200E+00
			0.8234E+01	0.7000E+00
			0.8234E+01	0.2800E+01
21	10	0.4726E+02	0.0000E+00	0.0000E+00
			0.2768E+01	0.2240E-01
			0.4613E+01	0.4340E-01
			0.6920E+01	0.7980E-01
			0.8304E+01	0.1120E+00
			0.9227E+01	0.1400E+00
			0.9227E+01	0.2800E+00
			0.9227E+01	0.4200E+00
			0.9227E+01	0.7000E+00
			0.9227E+01	0.2800E+01
22	10	0.4734E+02	0.0000E+00	0.0000E+00
			0.2773E+01	0.2240E-01
			0.4622E+01	0.4340E-01
			0.6932E+01	0.7980E-01
			0.8319E+01	0.1120E+00
			0.9243E+01	0.1400E+00
			0.8319E+01	0.2800E+00
			0.8319E+01	0.4200E+00
			0.8319E+01	0.7000E+00
			0.8319E+01	0.2800E+01
23	10	0.5730E+02	0.0000E+00	0.0000E+00
			0.2905E+01	0.2240E-01
			0.4841E+01	0.4340E-01
			0.7262E+01	0.7980E-01
			0.8715E+01	0.1120E+00
			0.9683E+01	0.1400E+00
			0.8715E+01	0.2800E+00
			0.8715E+01	0.4200E+00
			0.8715E+01	0.7000E+00
			0.8715E+01	0.2800E+01
24	10	0.6726E+02	0.0000E+00	0.0000E+00
			0.2949E+01	0.2240E-01
			0.4916E+01	0.4340E-01
			0.7373E+01	0.7980E-01
			0.8848E+01	0.1120E+00
			0.9831E+01	0.1400E+00
			0.8848E+01	0.2800E+00
			0.8848E+01	0.4200E+00
			0.8848E+01	0.7000E+00
			0.8848E+01	0.2800E+01
25	10	0.6734E+02	0.0000E+00	0.0000E+00
			0.2964E+01	0.2240E-01
			0.4939E+01	0.4340E-01
			0.7409E+01	0.7980E-01
			0.8891E+01	0.1120E+00
			0.9879E+01	0.1400E+00
			0.8891E+01	0.2800E+00
			0.8891E+01	0.4200E+00
			0.8891E+01	0.7000E+00
			0.8891E+01	0.2800E+01
26	10	0.6980E+02	0.0000E+00	0.0000E+00
			0.3746E+01	0.2240E-01

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			0.6243E+01	0.4340E-01
			0.9364E+01	0.7980E-01
			0.1124E+02	0.1120E+00
			0.1249E+02	0.1400E+00
			0.1124E+02	0.2800E+00
			0.1124E+02	0.4200E+00
			0.1124E+02	0.7000E+00
			0.1124E+02	0.2800E+01
27	10	0.7226E+02		
			0.0000E+00	0.0000E+00
			0.3747E+01	0.2240E-01
			0.6245E+01	0.4340E-01
			0.9367E+01	0.7980E-01
			0.1124E+02	0.1120E+00
			0.1249E+02	0.1400E+00
			0.1124E+02	0.2800E+00
			0.1124E+02	0.4200E+00
			0.1124E+02	0.7000E+00
			0.1124E+02	0.2800E+01
28	10	0.7234E+02		
			0.0000E+00	0.0000E+00
			0.3747E+01	0.2240E-01
			0.6245E+01	0.4340E-01
			0.9368E+01	0.7980E-01
			0.1124E+02	0.1120E+00
			0.1249E+02	0.1400E+00
			0.1249E+02	0.2800E+00
			0.1249E+02	0.4200E+00
			0.1249E+02	0.7000E+00
			0.1249E+02	0.2800E+01
29	10	0.7730E+02		
			0.0000E+00	0.0000E+00
			0.3266E+01	0.2240E-01
			0.5443E+01	0.4340E-01
			0.8165E+01	0.7980E-01
			0.9798E+01	0.1120E+00
			0.1089E+02	0.1400E+00
			0.1089E+02	0.2800E+00
			0.1089E+02	0.4200E+00
			0.1089E+02	0.7000E+00
			0.1089E+02	0.2800E+01
30	10	0.8226E+02		
			0.0000E+00	0.0000E+00
			0.3469E+01	0.2240E-01
			0.5781E+01	0.4340E-01
			0.8672E+01	0.7980E-01
			0.1041E+02	0.1120E+00
			0.1156E+02	0.1400E+00
			0.1156E+02	0.2800E+00
			0.1156E+02	0.4200E+00
			0.1156E+02	0.7000E+00
			0.1156E+02	0.2800E+01
31	10	0.8234E+02		
			0.0000E+00	0.0000E+00
			0.3472E+01	0.2240E-01
			0.5787E+01	0.4340E-01
			0.8681E+01	0.7980E-01
			0.1042E+02	0.1120E+00
			0.1157E+02	0.1400E+00
			0.1157E+02	0.2800E+00
			0.1157E+02	0.4200E+00
			0.1157E+02	0.7000E+00
			0.1157E+02	0.2800E+01

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32	10	0.8730E+02	0.0000E+00	0.0000E+00
			0.3884E+01	0.2240E-01
			0.6474E+01	0.4340E-01
			0.9711E+01	0.7980E-01
			0.1165E+02	0.1120E+00
			0.1295E+02	0.1400E+00
			0.1295E+02	0.2800E+00
			0.1295E+02	0.4200E+00
			0.1295E+02	0.7000E+00
			0.1295E+02	0.2800E+01
33	10	0.9226E+02	0.0000E+00	0.0000E+00
			0.3884E+01	0.2240E-01
			0.6474E+01	0.4340E-01
			0.9711E+01	0.7980E-01
			0.1165E+02	0.1120E+00
			0.1295E+02	0.1400E+00
			0.1295E+02	0.2800E+00
			0.1295E+02	0.4200E+00
			0.1295E+02	0.7000E+00
			0.1295E+02	0.2800E+01
34	10	0.9234E+02	0.0000E+00	0.0000E+00
			0.3884E+01	0.2240E-01
			0.6474E+01	0.4340E-01
			0.9711E+01	0.7980E-01
			0.1165E+02	0.1120E+00
			0.1295E+02	0.1400E+00
			0.1295E+02	0.2800E+00
			0.1295E+02	0.4200E+00
			0.1295E+02	0.7000E+00
			0.1295E+02	0.2800E+01
35	10	0.9630E+02	0.0000E+00	0.0000E+00
			0.3884E+01	0.2240E-01
			0.6474E+01	0.4340E-01
			0.9711E+01	0.7980E-01
			0.1165E+02	0.1120E+00
			0.1295E+02	0.1400E+00
			0.1295E+02	0.2800E+00
			0.1295E+02	0.4200E+00
			0.1295E+02	0.7000E+00
			0.1295E+02	0.2800E+01
36	10	0.1003E+03	0.0000E+00	0.0000E+00
			0.3884E+01	0.2240E-01
			0.6474E+01	0.4340E-01
			0.9711E+01	0.7980E-01
			0.1165E+02	0.1120E+00
			0.1295E+02	0.1400E+00
			0.1295E+02	0.2800E+00
			0.1295E+02	0.4200E+00
			0.1295E+02	0.7000E+00
			0.1295E+02	0.2800E+01

TIP LOAD
KIP

0.0000E+00
0.8900E+00

TIP MOVEMENT
IN.

0.0000E+00
0.7000E-02

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0.1780E+01
0.3560E+01
0.7120E+01
0.1068E+02
0.1282E+02
0.1424E+02
0.1424E+02
0.1424E+02

0.1400E-01
0.2800E-01
0.1820E+00
0.5880E+00
0.1022E+01
0.1400E+01
0.2100E+01
0.2800E+01

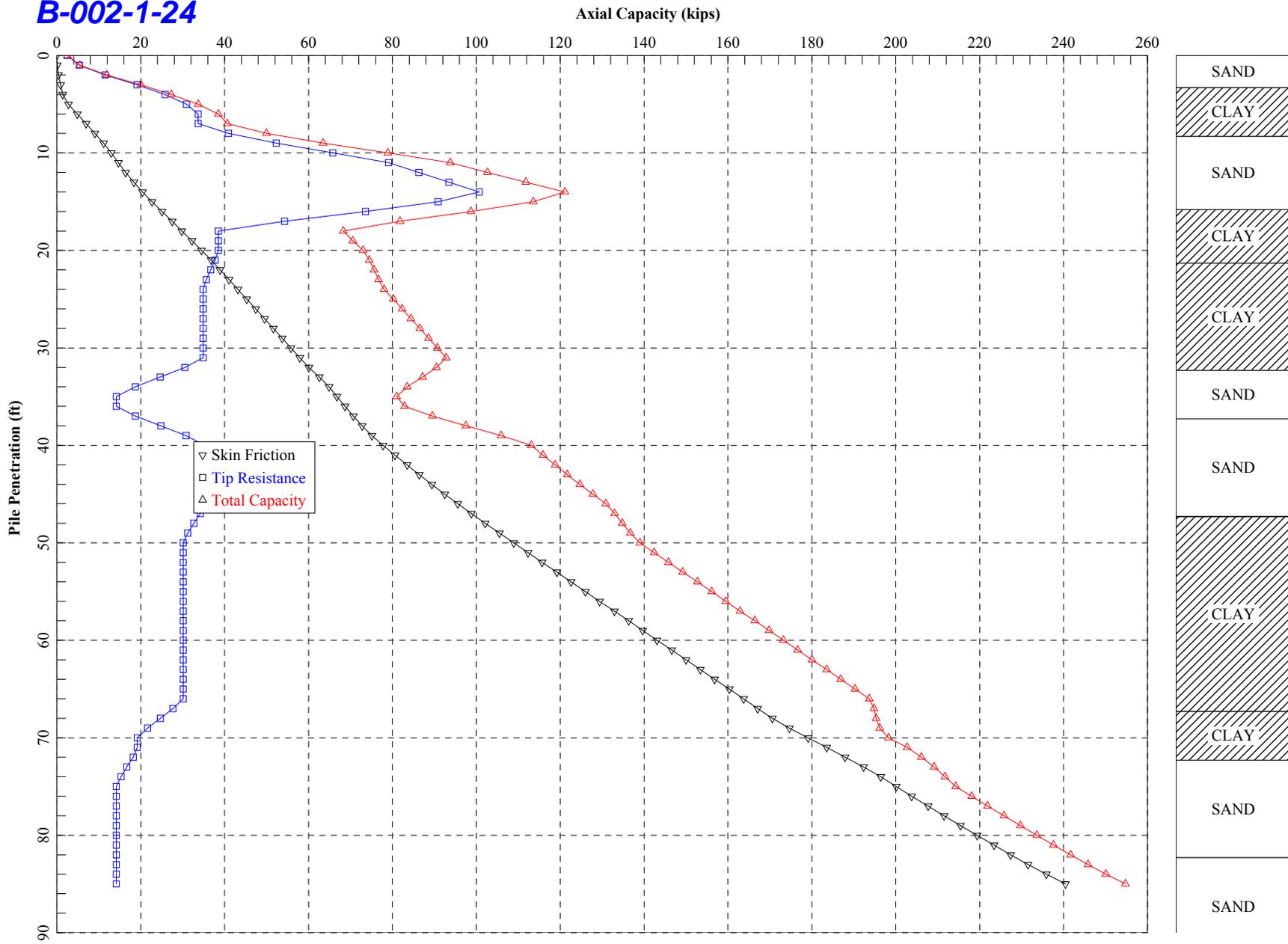
LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.5941E+00	0.1754E-03	0.1271E-01	0.1000E-03
0.5941E+01	0.1754E-02	0.1271E+00	0.1000E-02
0.2971E+02	0.8771E-02	0.6357E+00	0.5000E-02
0.5941E+02	0.1754E-01	0.1271E+01	0.1000E-01
0.1158E+03	0.3492E-01	0.2543E+01	0.2000E-01
0.2219E+03	0.7907E-01	0.4068E+01	0.5000E-01
0.2959E+03	0.1192E+00	0.4762E+01	0.8000E-01
0.3306E+03	0.1439E+00	0.5224E+01	0.1000E+00
0.3605E+03	0.2494E+00	0.7277E+01	0.2000E+00
0.3534E+03	0.5487E+00	0.9908E+01	0.5000E+00
0.3552E+03	0.8491E+00	0.1172E+02	0.8000E+00
0.3562E+03	0.1049E+01	0.1271E+02	0.1000E+01
0.3577E+03	0.2050E+01	0.1424E+02	0.2000E+01

14-Inch Dia. Closed End CIP Piles - EOID

Pier 1

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14-Inch Dia. Closed End CIP Piles - EOID

Pier 1

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APILE for Windows, Version 2019.9.12

Serial Number : 136090498

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 :

Resource International, Inc.
Columbus, OH

Path to file locations :
C:\Users\legacy\Desktop\1.3.2025\14-inch\Piers\B-002-1-24\
Name of input data file : B-002-1-24 EOID.ap9d
Name of output file : B-002-1-24 EOID.ap9o
Name of plot output file : B-002-1-24 EOID.ap9p

Time and Date of Analysis

Date: January 07, 2025 Time: 09:45:09

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* INPUT INFORMATION *

B-002-1-24 (Pier 1) - 14 Inch CIP

DESIGNER : AG/DEK

JOB NUMBER : W-23-155 (MOT-835-2.57)

METHOD FOR UNIT LOAD TRANSFERS :

- FHWA (Federal Highway Administration)
Unfactored Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

TYPE OF LOADING :

- COMPRESSION

PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
 - Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
 - CROSS SECTION AREA = 153.89 IN²

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 14.00 IN.
 - INTERNAL DIAMETER, ID = 0.25 IN.
 - TOTAL PILE LENGTH, TL = 85.00 FT.
 - BATTER ANGLE = 0.00 DEG
 - PILE STICKUP LENGTH, PSL = 0.00 FT.
 - ZERO FRICTION LENGTH, ZFL = 0.00 FT.
 - INCREMENT OF PILE LENGTH
 USED IN COMPUTATION = 1.00 FT.
 - LENGTH OF ENHANCED
 END SECTION = 85.00 FT.
 - INTERNAL DIAMETER OF
 ENHANCED END SECTION = 0.25 IN.

PLUGGED/UNPLUGGED CONDITIONS :
 Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	SAND	0.80*	67.60	38.00	110.40**
3.30	SAND	0.80*	67.60	38.00	110.40**
3.30	CLAY	0.80*	67.60	0.00	4.80**
8.30	CLAY	0.80*	67.60	0.00	4.80**
8.30	SAND	0.80*	67.60	39.00	135.20**
15.80	SAND	0.80*	67.60	39.00	135.20**
15.80	CLAY	0.80*	67.60	0.00	4.80**
21.30	CLAY	0.80*	67.60	0.00	4.80**
21.30	CLAY	0.80*	62.60	0.00	4.80**
32.30	CLAY	0.80*	62.60	0.00	4.80**
32.30	SAND	0.80*	62.60	30.00	30.00**
37.30	SAND	0.80*	62.60	30.00	30.00**
37.30	SAND	0.80*	67.60	32.00	40.40**
47.30	SAND	0.80*	67.60	32.00	40.40**
47.30	CLAY	0.80*	62.60	0.00	4.80**
67.30	CLAY	0.80*	62.60	0.00	4.80**
67.30	CLAY	0.80*	62.60	0.00	4.80**
72.30	CLAY	0.80*	62.60	0.00	4.80**
72.30	SAND	0.80*	62.60	29.00	26.40**
82.30	SAND	0.80*	62.60	29.00	26.40**
82.30	SAND	0.80*	67.60	30.00	30.00**

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67.30	0.670	1.000
67.30	0.670	1.000
72.30	0.670	1.000
72.30	0.670	1.000
82.30	0.670	1.000
82.30	0.670	1.000
92.30	0.670	1.000
92.30	0.670	1.000
100.30	0.670	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.140 *	0.00
3.30	0.140 *	0.00
3.30	0.140 *	0.90 **
8.30	0.140 *	0.90 **
8.30	0.140 *	0.00
15.80	0.140 *	0.00
15.80	0.140 *	0.90 **
21.30	0.140 *	0.90 **
21.30	0.140 *	0.90 **
32.30	0.140 *	0.90 **
32.30	0.140 *	0.00
37.30	0.140 *	0.00
37.30	0.140 *	0.00
47.30	0.140 *	0.00
47.30	0.140 *	0.90 **
67.30	0.140 *	0.90 **
67.30	0.140 *	0.90 **
72.30	0.140 *	0.90 **
72.30	0.140 *	0.00
82.30	0.140 *	0.00
82.30	0.140 *	0.00
92.30	0.140 *	0.00
92.30	0.140 *	0.00
100.30	0.140 *	0.00

* DEFAULT VALUE = 0.01 D
 ** DEFAULT VALUE = 0.9

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 * COMPUTATION RESULT *

 * FED. HWY. METHOD *

PILE PENETRATION FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	2.5	2.5
1.00	0.1	5.4	5.5
2.00	0.4	11.5	11.9
3.00	0.9	19.1	20.0

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4.00	1.4	25.8	27.3
5.00	2.8	30.9	33.7
6.00	4.9	33.7	38.5
7.00	7.0	33.7	40.6
8.00	9.1	40.9	50.0
9.00	11.2	52.3	63.5
10.00	13.0	65.8	78.9
11.00	14.7	79.1	93.8
12.00	16.4	86.3	102.7
13.00	18.4	93.5	111.8
14.00	20.4	100.7	121.1
15.00	22.7	90.9	113.6
16.00	25.1	73.6	98.7
17.00	27.5	54.3	81.8
18.00	29.8	38.5	68.3
19.00	32.2	38.5	70.6
20.00	34.5	38.5	73.0
21.00	36.8	37.7	74.5
22.00	38.9	36.7	75.6
23.00	41.1	35.6	76.7
24.00	43.2	34.9	78.0
25.00	45.3	34.9	80.2
26.00	47.4	34.9	82.3
27.00	49.5	34.9	84.4
28.00	51.6	34.9	86.5
29.00	53.7	34.9	88.6
30.00	55.8	34.9	90.7
31.00	57.9	34.9	92.8
32.00	60.1	30.5	90.5
33.00	62.6	24.6	87.2
34.00	64.9	18.7	83.5
35.00	66.8	14.2	81.0
36.00	68.7	14.2	82.9
37.00	70.7	18.7	89.5
38.00	72.8	24.8	97.5
39.00	75.1	30.8	105.9
40.00	77.8	35.3	113.1
41.00	80.6	35.3	115.9
42.00	83.5	35.3	118.8
43.00	86.4	35.3	121.7
44.00	89.4	35.3	124.7
45.00	92.5	35.3	127.8
46.00	95.6	35.3	130.9
47.00	98.8	34.2	133.0
48.00	102.1	32.7	134.8
49.00	105.5	31.2	136.7
50.00	108.9	30.1	139.0
51.00	112.3	30.1	142.4
52.00	115.7	30.1	145.8
53.00	119.2	30.1	149.2
54.00	122.6	30.1	152.7
55.00	126.0	30.1	156.1
56.00	129.4	30.1	159.5
57.00	132.9	30.1	162.9
58.00	136.3	30.1	166.4
59.00	139.7	30.1	169.8
60.00	143.1	30.1	173.2
61.00	146.6	30.1	176.6
62.00	150.0	30.1	180.0
63.00	153.4	30.1	183.5
64.00	156.8	30.1	186.9
65.00	160.3	30.1	190.3
66.00	163.7	30.1	193.7

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67.00	167.1	27.7	194.8
68.00	170.6	24.7	195.3
69.00	174.6	21.6	196.2
70.00	179.1	19.2	198.3
71.00	183.5	19.2	202.7
72.00	187.9	18.2	206.1
73.00	192.3	16.7	209.1
74.00	196.4	15.3	211.7
75.00	200.1	14.2	214.3
76.00	203.8	14.2	218.1
77.00	207.7	14.2	221.9
78.00	211.5	14.2	225.8
79.00	215.4	14.2	229.7
80.00	219.4	14.2	233.6
81.00	223.4	14.2	237.6
82.00	227.4	14.2	241.7
83.00	231.5	14.2	245.8
84.00	235.9	14.2	250.1
85.00	240.4	14.2	254.7

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	0.4167E-01	0.0000E+00	0.0000E+00
			0.4922E-02	0.2240E-01
			0.8204E-02	0.4340E-01
			0.1231E-01	0.7980E-01
			0.1477E-01	0.1120E+00
			0.1641E-01	0.1400E+00
			0.1641E-01	0.2800E+00
			0.1641E-01	0.4200E+00
			0.1641E-01	0.7000E+00
			0.1641E-01	0.2800E+01
2	10	0.1650E+01	0.0000E+00	0.0000E+00
			0.1949E+00	0.2240E-01
			0.3249E+00	0.4340E-01
			0.4873E+00	0.7980E-01
			0.5848E+00	0.1120E+00
			0.6497E+00	0.1400E+00
			0.6497E+00	0.2800E+00
			0.6497E+00	0.4200E+00
			0.6497E+00	0.7000E+00
			0.6497E+00	0.2800E+01
3	10	0.3258E+01	0.0000E+00	0.0000E+00
			0.3849E+00	0.2240E-01
			0.6415E+00	0.4340E-01

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			0.9623E+00	0.7980E-01
			0.1155E+01	0.1120E+00
			0.1283E+01	0.1400E+00
			0.1283E+01	0.2800E+00
			0.1283E+01	0.4200E+00
			0.1283E+01	0.7000E+00
			0.1283E+01	0.2800E+01
4	10	0.3342E+01		
			0.0000E+00	0.0000E+00
			0.3948E+00	0.2240E-01
			0.6579E+00	0.4340E-01
			0.9869E+00	0.7980E-01
			0.1184E+01	0.1120E+00
			0.1316E+01	0.1400E+00
			0.1184E+01	0.2800E+00
			0.1184E+01	0.4200E+00
			0.1184E+01	0.7000E+00
			0.1184E+01	0.2800E+01
5	10	0.5800E+01		
			0.0000E+00	0.0000E+00
			0.1786E+01	0.2240E-01
			0.2977E+01	0.4340E-01
			0.4466E+01	0.7980E-01
			0.5359E+01	0.1120E+00
			0.5955E+01	0.1400E+00
			0.5359E+01	0.2800E+00
			0.5359E+01	0.4200E+00
			0.5359E+01	0.7000E+00
			0.5359E+01	0.2800E+01
6	10	0.8258E+01		
			0.0000E+00	0.0000E+00
			0.1793E+01	0.2240E-01
			0.2988E+01	0.4340E-01
			0.4482E+01	0.7980E-01
			0.5379E+01	0.1120E+00
			0.5976E+01	0.1400E+00
			0.5379E+01	0.2800E+00
			0.5379E+01	0.4200E+00
			0.5379E+01	0.7000E+00
			0.5379E+01	0.2800E+01
7	10	0.8342E+01		
			0.0000E+00	0.0000E+00
			0.1795E+01	0.2240E-01
			0.2992E+01	0.4340E-01
			0.4487E+01	0.7980E-01
			0.5385E+01	0.1120E+00
			0.5983E+01	0.1400E+00
			0.5983E+01	0.2800E+00
			0.5983E+01	0.4200E+00
			0.5983E+01	0.7000E+00
			0.5983E+01	0.2800E+01
8	10	0.1205E+02		
			0.0000E+00	0.0000E+00
			0.1579E+01	0.2240E-01
			0.2631E+01	0.4340E-01
			0.3947E+01	0.7980E-01
			0.4736E+01	0.1120E+00
			0.5263E+01	0.1400E+00
			0.5263E+01	0.2800E+00
			0.5263E+01	0.4200E+00
			0.5263E+01	0.7000E+00
			0.5263E+01	0.2800E+01
9	10	0.1576E+02		

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			0.0000E+00	0.0000E+00
			0.2065E+01	0.2240E-01
			0.3441E+01	0.4340E-01
			0.5162E+01	0.7980E-01
			0.6194E+01	0.1120E+00
			0.6882E+01	0.1400E+00
			0.6882E+01	0.2800E+00
			0.6882E+01	0.4200E+00
			0.6882E+01	0.7000E+00
			0.6882E+01	0.2800E+01
10	10	0.1584E+02		
			0.0000E+00	0.0000E+00
			0.2076E+01	0.2240E-01
			0.3459E+01	0.4340E-01
			0.5189E+01	0.7980E-01
			0.6227E+01	0.1120E+00
			0.6919E+01	0.1400E+00
			0.6227E+01	0.2800E+00
			0.6227E+01	0.4200E+00
			0.6227E+01	0.7000E+00
			0.6227E+01	0.2800E+01
11	10	0.1855E+02		
			0.0000E+00	0.0000E+00
			0.1983E+01	0.2240E-01
			0.3306E+01	0.4340E-01
			0.4958E+01	0.7980E-01
			0.5950E+01	0.1120E+00
			0.6611E+01	0.1400E+00
			0.5950E+01	0.2800E+00
			0.5950E+01	0.4200E+00
			0.5950E+01	0.7000E+00
			0.5950E+01	0.2800E+01
12	10	0.2126E+02		
			0.0000E+00	0.0000E+00
			0.2030E+01	0.2240E-01
			0.3383E+01	0.4340E-01
			0.5075E+01	0.7980E-01
			0.6090E+01	0.1120E+00
			0.6766E+01	0.1400E+00
			0.6090E+01	0.2800E+00
			0.6090E+01	0.4200E+00
			0.6090E+01	0.7000E+00
			0.6090E+01	0.2800E+01
13	10	0.2134E+02		
			0.0000E+00	0.0000E+00
			0.2045E+01	0.2240E-01
			0.3408E+01	0.4340E-01
			0.5112E+01	0.7980E-01
			0.6135E+01	0.1120E+00
			0.6816E+01	0.1400E+00
			0.6135E+01	0.2800E+00
			0.6135E+01	0.4200E+00
			0.6135E+01	0.7000E+00
			0.6135E+01	0.2800E+01
14	10	0.2680E+02		
			0.0000E+00	0.0000E+00
			0.2105E+01	0.2240E-01
			0.3509E+01	0.4340E-01
			0.5264E+01	0.7980E-01
			0.6316E+01	0.1120E+00
			0.7018E+01	0.1400E+00
			0.6316E+01	0.2800E+00
			0.6316E+01	0.4200E+00

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15	10	0.3226E+02	0.6316E+01	0.7000E+00
			0.6316E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2141E+01	0.2240E-01
			0.3568E+01	0.4340E-01
			0.5352E+01	0.7980E-01
			0.6422E+01	0.1120E+00
			0.7136E+01	0.1400E+00
			0.6422E+01	0.2800E+00
			0.6422E+01	0.4200E+00
16	10	0.3234E+02	0.6422E+01	0.7000E+00
			0.6422E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2152E+01	0.2240E-01
			0.3587E+01	0.4340E-01
			0.5380E+01	0.7980E-01
			0.6456E+01	0.1120E+00
			0.7174E+01	0.1400E+00
			0.7174E+01	0.2800E+00
			0.7174E+01	0.4200E+00
17	10	0.3480E+02	0.7174E+01	0.7000E+00
			0.7174E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.1619E+01	0.2240E-01
			0.2698E+01	0.4340E-01
			0.4047E+01	0.7980E-01
			0.4857E+01	0.1120E+00
			0.5396E+01	0.1400E+00
			0.5396E+01	0.2800E+00
			0.5396E+01	0.4200E+00
18	10	0.3726E+02	0.5396E+01	0.7000E+00
			0.5396E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.1728E+01	0.2240E-01
			0.2880E+01	0.4340E-01
			0.4319E+01	0.7980E-01
			0.5183E+01	0.1120E+00
			0.5759E+01	0.1400E+00
			0.5759E+01	0.2800E+00
			0.5759E+01	0.4200E+00
19	10	0.3734E+02	0.5759E+01	0.7000E+00
			0.5759E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.1731E+01	0.2240E-01
			0.2886E+01	0.4340E-01
			0.4329E+01	0.7980E-01
			0.5194E+01	0.1120E+00
			0.5772E+01	0.1400E+00
			0.5772E+01	0.2800E+00
			0.5772E+01	0.4200E+00
20	10	0.4230E+02	0.5772E+01	0.7000E+00
			0.5772E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2470E+01	0.2240E-01
			0.4117E+01	0.4340E-01
			0.6175E+01	0.7980E-01
			0.7410E+01	0.1120E+00

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			0.8234E+01	0.1400E+00
			0.8234E+01	0.2800E+00
			0.8234E+01	0.4200E+00
			0.8234E+01	0.7000E+00
			0.8234E+01	0.2800E+01
21	10	0.4726E+02	0.0000E+00	0.0000E+00
			0.2768E+01	0.2240E-01
			0.4613E+01	0.4340E-01
			0.6920E+01	0.7980E-01
			0.8304E+01	0.1120E+00
			0.9227E+01	0.1400E+00
			0.9227E+01	0.2800E+00
			0.9227E+01	0.4200E+00
			0.9227E+01	0.7000E+00
			0.9227E+01	0.2800E+01
22	10	0.4734E+02	0.0000E+00	0.0000E+00
			0.2773E+01	0.2240E-01
			0.4622E+01	0.4340E-01
			0.6932E+01	0.7980E-01
			0.8319E+01	0.1120E+00
			0.9243E+01	0.1400E+00
			0.8319E+01	0.2800E+00
			0.8319E+01	0.4200E+00
			0.8319E+01	0.7000E+00
			0.8319E+01	0.2800E+01
23	10	0.5730E+02	0.0000E+00	0.0000E+00
			0.2905E+01	0.2240E-01
			0.4841E+01	0.4340E-01
			0.7262E+01	0.7980E-01
			0.8715E+01	0.1120E+00
			0.9683E+01	0.1400E+00
			0.8715E+01	0.2800E+00
			0.8715E+01	0.4200E+00
			0.8715E+01	0.7000E+00
			0.8715E+01	0.2800E+01
24	10	0.6726E+02	0.0000E+00	0.0000E+00
			0.2949E+01	0.2240E-01
			0.4916E+01	0.4340E-01
			0.7373E+01	0.7980E-01
			0.8848E+01	0.1120E+00
			0.9831E+01	0.1400E+00
			0.8848E+01	0.2800E+00
			0.8848E+01	0.4200E+00
			0.8848E+01	0.7000E+00
			0.8848E+01	0.2800E+01
25	10	0.6734E+02	0.0000E+00	0.0000E+00
			0.2964E+01	0.2240E-01
			0.4939E+01	0.4340E-01
			0.7409E+01	0.7980E-01
			0.8891E+01	0.1120E+00
			0.9879E+01	0.1400E+00
			0.8891E+01	0.2800E+00
			0.8891E+01	0.4200E+00
			0.8891E+01	0.7000E+00
			0.8891E+01	0.2800E+01
26	10	0.6980E+02	0.0000E+00	0.0000E+00
			0.3746E+01	0.2240E-01

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			0.6243E+01	0.4340E-01
			0.9364E+01	0.7980E-01
			0.1124E+02	0.1120E+00
			0.1249E+02	0.1400E+00
			0.1124E+02	0.2800E+00
			0.1124E+02	0.4200E+00
			0.1124E+02	0.7000E+00
			0.1124E+02	0.2800E+01
27	10	0.7226E+02		
			0.0000E+00	0.0000E+00
			0.3747E+01	0.2240E-01
			0.6245E+01	0.4340E-01
			0.9367E+01	0.7980E-01
			0.1124E+02	0.1120E+00
			0.1249E+02	0.1400E+00
			0.1124E+02	0.2800E+00
			0.1124E+02	0.4200E+00
			0.1124E+02	0.7000E+00
			0.1124E+02	0.2800E+01
28	10	0.7234E+02		
			0.0000E+00	0.0000E+00
			0.3747E+01	0.2240E-01
			0.6245E+01	0.4340E-01
			0.9368E+01	0.7980E-01
			0.1124E+02	0.1120E+00
			0.1249E+02	0.1400E+00
			0.1249E+02	0.2800E+00
			0.1249E+02	0.4200E+00
			0.1249E+02	0.7000E+00
			0.1249E+02	0.2800E+01
29	10	0.7730E+02		
			0.0000E+00	0.0000E+00
			0.3266E+01	0.2240E-01
			0.5443E+01	0.4340E-01
			0.8165E+01	0.7980E-01
			0.9798E+01	0.1120E+00
			0.1089E+02	0.1400E+00
			0.1089E+02	0.2800E+00
			0.1089E+02	0.4200E+00
			0.1089E+02	0.7000E+00
			0.1089E+02	0.2800E+01
30	10	0.8226E+02		
			0.0000E+00	0.0000E+00
			0.3469E+01	0.2240E-01
			0.5781E+01	0.4340E-01
			0.8672E+01	0.7980E-01
			0.1041E+02	0.1120E+00
			0.1156E+02	0.1400E+00
			0.1156E+02	0.2800E+00
			0.1156E+02	0.4200E+00
			0.1156E+02	0.7000E+00
			0.1156E+02	0.2800E+01
31	10	0.8234E+02		
			0.0000E+00	0.0000E+00
			0.3472E+01	0.2240E-01
			0.5787E+01	0.4340E-01
			0.8681E+01	0.7980E-01
			0.1042E+02	0.1120E+00
			0.1157E+02	0.1400E+00
			0.1157E+02	0.2800E+00
			0.1157E+02	0.4200E+00
			0.1157E+02	0.7000E+00
			0.1157E+02	0.2800E+01

		B-002-1-24 EOID.ap9o		
32	10	0.8730E+02	0.0000E+00	0.0000E+00
			0.3884E+01	0.2240E-01
			0.6474E+01	0.4340E-01
			0.9711E+01	0.7980E-01
			0.1165E+02	0.1120E+00
			0.1295E+02	0.1400E+00
			0.1295E+02	0.2800E+00
			0.1295E+02	0.4200E+00
			0.1295E+02	0.7000E+00
			0.1295E+02	0.2800E+01
33	10	0.9226E+02	0.0000E+00	0.0000E+00
			0.3884E+01	0.2240E-01
			0.6474E+01	0.4340E-01
			0.9711E+01	0.7980E-01
			0.1165E+02	0.1120E+00
			0.1295E+02	0.1400E+00
			0.1295E+02	0.2800E+00
			0.1295E+02	0.4200E+00
			0.1295E+02	0.7000E+00
			0.1295E+02	0.2800E+01
34	10	0.9234E+02	0.0000E+00	0.0000E+00
			0.3884E+01	0.2240E-01
			0.6474E+01	0.4340E-01
			0.9711E+01	0.7980E-01
			0.1165E+02	0.1120E+00
			0.1295E+02	0.1400E+00
			0.1295E+02	0.2800E+00
			0.1295E+02	0.4200E+00
			0.1295E+02	0.7000E+00
			0.1295E+02	0.2800E+01
35	10	0.9630E+02	0.0000E+00	0.0000E+00
			0.3884E+01	0.2240E-01
			0.6474E+01	0.4340E-01
			0.9711E+01	0.7980E-01
			0.1165E+02	0.1120E+00
			0.1295E+02	0.1400E+00
			0.1295E+02	0.2800E+00
			0.1295E+02	0.4200E+00
			0.1295E+02	0.7000E+00
			0.1295E+02	0.2800E+01
36	10	0.1003E+03	0.0000E+00	0.0000E+00
			0.3884E+01	0.2240E-01
			0.6474E+01	0.4340E-01
			0.9711E+01	0.7980E-01
			0.1165E+02	0.1120E+00
			0.1295E+02	0.1400E+00
			0.1295E+02	0.2800E+00
			0.1295E+02	0.4200E+00
			0.1295E+02	0.7000E+00
			0.1295E+02	0.2800E+01

TIP LOAD
KIP

0.0000E+00
0.8900E+00

TIP MOVEMENT
IN.

0.0000E+00
0.7000E-02

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0.1780E+01
0.3560E+01
0.7120E+01
0.1068E+02
0.1282E+02
0.1424E+02
0.1424E+02
0.1424E+02

0.1400E-01
0.2800E-01
0.1820E+00
0.5880E+00
0.1022E+01
0.1400E+01
0.2100E+01
0.2800E+01

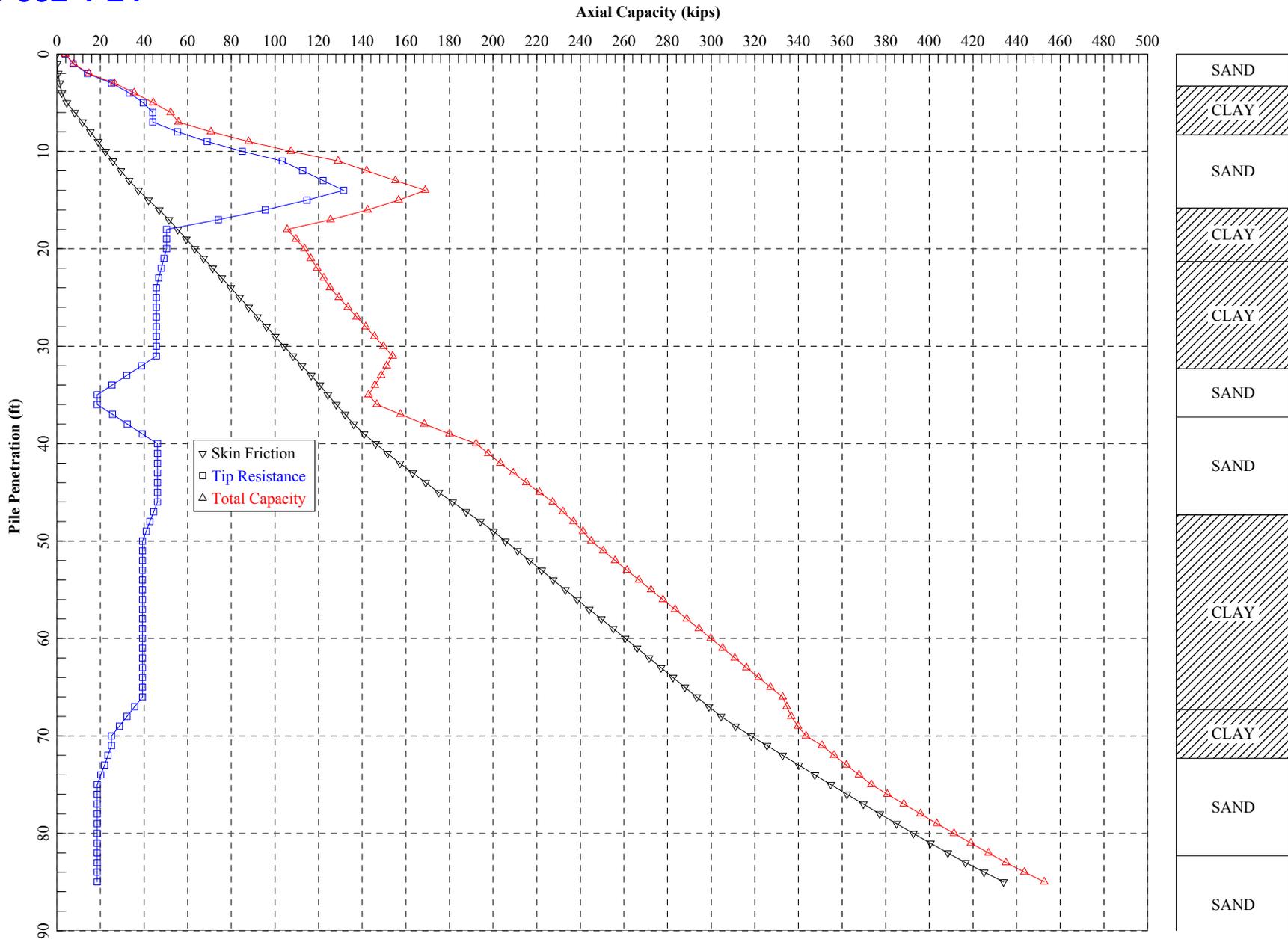
LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.5941E+00	0.1754E-03	0.1271E-01	0.1000E-03
0.5941E+01	0.1754E-02	0.1271E+00	0.1000E-02
0.2971E+02	0.8771E-02	0.6357E+00	0.5000E-02
0.5941E+02	0.1754E-01	0.1271E+01	0.1000E-01
0.1158E+03	0.3492E-01	0.2543E+01	0.2000E-01
0.2219E+03	0.7907E-01	0.4068E+01	0.5000E-01
0.2959E+03	0.1192E+00	0.4762E+01	0.8000E-01
0.3306E+03	0.1439E+00	0.5224E+01	0.1000E+00
0.3605E+03	0.2494E+00	0.7277E+01	0.2000E+00
0.3534E+03	0.5487E+00	0.9908E+01	0.5000E+00
0.3552E+03	0.8491E+00	0.1172E+02	0.8000E+00
0.3562E+03	0.1049E+01	0.1271E+02	0.1000E+01
0.3577E+03	0.2050E+01	0.1424E+02	0.2000E+01

16-Inch Dia. Closed End CIP Piles - UBV

Pier 1

B-002-1-24



**16-Inch Dia. Closed End CIP Piles - UBV
Pier 1
B-002-1-24**

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APILE for Windows, Version 2019.9.12

Serial Number : 136090498

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 :

Resource International, Inc.
Columbus, OH

Path to file locations : C:\Users\legacy\Desktop\1.3.2025\16-inch\
Name of input data file : B-002-1-24 - 16 Inch UBV.ap9d
Name of output file : B-002-1-24 - 16 Inch UBV.ap9o
Name of plot output file : B-002-1-24 - 16 Inch UBV.ap9p

Time and Date of Analysis

Date: January 07, 2025 Time: 09:54:07

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* INPUT INFORMATION *

B-002-1-24 (Pier 1) - 16 Inch CIP

DESIGNER : AG/DEK

JOB NUMBER : W-23-155 (MOT-835-2.57)

METHOD FOR UNIT LOAD TRANSFERS :

- FHWA (Federal Highway Administration)
Unfactored Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

TYPE OF LOADING :

- COMPRESSION

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PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 201.01 IN²

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 16.00 IN.
- INTERNAL DIAMETER, ID = 0.25 IN.
- TOTAL PILE LENGTH, TL = 85.00 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH
USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED
END SECTION = 85.00 FT.
- INTERNAL DIAMETER OF
ENHANCED END SECTION = 0.25 IN.

PLUGGED/UNPLUGGED CONDITIONS :

Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	SAND	0.80*	67.60	38.00	110.40**
3.30	SAND	0.80*	67.60	38.00	110.40**
3.30	CLAY	0.80*	67.60	0.00	4.80**
8.30	CLAY	0.80*	67.60	0.00	4.80**
8.30	SAND	0.80*	67.60	39.00	135.20**
15.80	SAND	0.80*	67.60	39.00	135.20**
15.80	CLAY	0.80*	67.60	0.00	4.80**
21.30	CLAY	0.80*	67.60	0.00	4.80**
21.30	CLAY	0.80*	62.60	0.00	4.80**
32.30	CLAY	0.80*	62.60	0.00	4.80**
32.30	SAND	0.80*	62.60	30.00	30.00**
37.30	SAND	0.80*	62.60	30.00	30.00**
37.30	SAND	0.80*	67.60	32.00	40.40**
47.30	SAND	0.80*	67.60	32.00	40.40**
47.30	CLAY	0.80*	62.60	0.00	4.80**
67.30	CLAY	0.80*	62.60	0.00	4.80**
67.30	CLAY	0.80*	62.60	0.00	4.80**
72.30	CLAY	0.80*	62.60	0.00	4.80**
72.30	SAND	0.80*	62.60	29.00	26.40**
82.30	SAND	0.80*	62.60	29.00	26.40**
82.30	SAND	0.80*	67.60	30.00	30.00**
92.30	SAND	0.80*	67.60	30.00	30.00**

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92.30	SAND	0.80*	72.60	32.00	40.40**
100.30	SAND	0.80*	72.60	32.00	40.40**

* VALUE ASSUMED BY THE PROGRAM

** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

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*	3.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.50	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*	4.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	4.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.62	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.62	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*	3.12	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.12	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	2.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	2.00	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	1.000	1.000
3.30	1.000	1.000
3.30	1.000	1.000
8.30	1.000	1.000
8.30	1.000	1.000
15.80	1.000	1.000
15.80	1.000	1.000
21.30	1.000	1.000
21.30	1.000	1.000
32.30	1.000	1.000
32.30	1.000	1.000
37.30	1.000	1.000
37.30	1.000	1.000
47.30	1.000	1.000
47.30	1.000	1.000
67.30	1.000	1.000

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67.30	1.000	1.000
72.30	1.000	1.000
72.30	1.000	1.000
82.30	1.000	1.000
82.30	1.000	1.000
92.30	1.000	1.000
92.30	1.000	1.000
100.30	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.160 *	0.00
3.30	0.160 *	0.00
3.30	0.160 *	0.90 **
8.30	0.160 *	0.90 **
8.30	0.160 *	0.00
15.80	0.160 *	0.00
15.80	0.160 *	0.90 **
21.30	0.160 *	0.90 **
21.30	0.160 *	0.90 **
32.30	0.160 *	0.90 **
32.30	0.160 *	0.00
37.30	0.160 *	0.00
37.30	0.160 *	0.00
47.30	0.160 *	0.00
47.30	0.160 *	0.90 **
67.30	0.160 *	0.90 **
67.30	0.160 *	0.90 **
72.30	0.160 *	0.90 **
72.30	0.160 *	0.00
82.30	0.160 *	0.00
82.30	0.160 *	0.00
92.30	0.160 *	0.00
92.30	0.160 *	0.00
100.30	0.160 *	0.00

* DEFAULT VALUE = 0.01 D
 ** DEFAULT VALUE = 0.9

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 * COMPUTATION RESULT *

Q100, Low Scour Elev = 865.18 ft, (1.6 feet
 below bottom of pile cap)
 Side Friction Loss Due to Scour = 0.3 kips

 * FED. HWY. METHOD *

PILE PENETRATION FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	3.8	3.8
1.00	0.1	7.5	7.7
2.00	0.6	14.1	14.7
3.00	1.3	25.1	26.4
4.00	2.3	33.3	35.5

16-Inch Dia. Closed End CIP Piles - UBV

Pier 1

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5.00	4.6	39.6	44.2
6.00	8.2	44.0	52.2
7.00	11.8	44.0	55.8
8.00	15.4	55.3	70.7
9.00	19.0	69.0	87.9
10.00	22.4	85.0	107.3
11.00	25.7	103.3	129.0
12.00	29.3	112.7	142.0
13.00	33.2	122.1	155.3
14.00	37.4	131.5	168.9
15.00	42.0	114.7	156.7
16.00	46.9	95.6	142.5
17.00	51.4	74.1	125.5
18.00	55.4	50.3	105.6
19.00	59.4	50.3	109.6
20.00	63.3	50.3	113.6
21.00	67.3	49.1	116.4
22.00	71.5	47.9	119.4
23.00	75.6	46.7	122.4
24.00	79.7	45.6	125.3
25.00	83.8	45.6	129.3
26.00	87.9	45.6	133.4
27.00	92.0	45.6	137.5
28.00	96.1	45.6	141.6
29.00	100.1	45.6	145.7
30.00	104.2	45.6	149.8
31.00	108.3	45.6	153.9
32.00	112.4	38.8	151.2
33.00	116.6	32.1	148.7
34.00	120.6	25.3	145.9
35.00	124.3	18.6	142.9
36.00	128.1	18.6	146.7
37.00	132.1	25.5	157.5
38.00	136.1	32.3	168.4
39.00	140.8	39.2	180.0
40.00	146.2	46.1	192.2
41.00	151.7	46.1	197.8
42.00	157.3	46.1	203.4
43.00	163.1	46.1	209.2
44.00	169.1	46.1	215.1
45.00	175.1	46.1	221.2
46.00	181.4	46.1	227.4
47.00	187.7	44.4	232.1
48.00	194.2	42.7	236.9
49.00	200.2	41.0	241.2
50.00	205.7	39.3	245.0
51.00	211.2	39.3	250.5
52.00	216.7	39.3	256.0
53.00	222.2	39.3	261.4
54.00	227.6	39.3	266.9
55.00	233.1	39.3	272.4
56.00	238.6	39.3	277.9
57.00	244.1	39.3	283.4
58.00	249.6	39.3	288.8
59.00	255.1	39.3	294.3
60.00	260.5	39.3	299.8
61.00	266.0	39.3	305.3
62.00	271.5	39.3	310.8
63.00	277.0	39.3	316.2
64.00	282.5	39.3	321.7
65.00	287.9	39.3	327.2
66.00	293.4	39.3	332.7
67.00	298.9	35.7	334.6

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Max. Factored Designed Load per Pile = 172.0 kips

Required Nominal Resistance per Pile = $(172/0.7)$ kips = 245.7 kips

Required Nominal Driving Resistance = $(172/0.7) + \text{scour loss } (0.3) = 246.0$ kips

Pile length = 50.2 + 2.0 (estimated embedment in pile cap) = 52.2 feet

Estimated Pile Length to Rounded Up to Nearest 5 feet = 55.0 feet

Order Length = 60 feet

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68.00	304.5	32.2	336.7
69.00	311.1	28.7	339.7
70.00	318.3	25.1	343.4
71.00	325.5	25.1	350.7
72.00	332.8	23.5	356.3
73.00	340.1	21.9	362.0
74.00	347.5	20.2	367.8
75.00	354.8	18.6	373.4
76.00	362.2	18.6	380.8
77.00	369.7	18.6	388.3
78.00	377.3	18.6	395.9
79.00	384.9	18.6	403.5
80.00	392.7	18.6	411.3
81.00	400.5	18.6	419.1
82.00	408.5	18.6	427.1
83.00	416.5	18.6	435.1
84.00	425.0	18.6	443.6
85.00	434.0	18.6	452.6

NOTES:

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

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

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.4167E-01	0.0000E+00	0.0000E+00
			0.5850E-02	0.2560E-01
			0.9749E-02	0.4960E-01
			0.1462E-01	0.9120E-01
			0.1755E-01	0.1280E+00
			0.1950E-01	0.1600E+00
			0.1950E-01	0.3200E+00
			0.1950E-01	0.4800E+00
			0.1950E-01	0.8000E+00
			0.1950E-01	0.3200E+01
2	10	0.1650E+01	0.0000E+00	0.0000E+00
			0.2316E+00	0.2560E-01
			0.3861E+00	0.4960E-01
			0.5791E+00	0.9120E-01
			0.6949E+00	0.1280E+00
			0.7722E+00	0.1600E+00
			0.7722E+00	0.3200E+00
			0.7722E+00	0.4800E+00
			0.7722E+00	0.8000E+00
			0.7722E+00	0.3200E+01
3	10	0.3258E+01	0.0000E+00	0.0000E+00
			0.4574E+00	0.2560E-01
			0.7624E+00	0.4960E-01
			0.1144E+01	0.9120E-01

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4	10	0.3342E+01	0.1372E+01	0.1280E+00
			0.1525E+01	0.1600E+00
			0.1525E+01	0.3200E+00
			0.1525E+01	0.4800E+00
			0.1525E+01	0.8000E+00
			0.1525E+01	0.3200E+01
			0.0000E+00	0.0000E+00
			0.4691E+00	0.2560E-01
			0.7819E+00	0.4960E-01
			0.1173E+01	0.9120E-01
5	10	0.5800E+01	0.1407E+01	0.1280E+00
			0.1564E+01	0.1600E+00
			0.1407E+01	0.3200E+00
			0.1407E+01	0.4800E+00
			0.1407E+01	0.8000E+00
			0.1407E+01	0.3200E+01
			0.0000E+00	0.0000E+00
			0.1786E+01	0.2560E-01
			0.2977E+01	0.4960E-01
			0.4466E+01	0.9120E-01
6	10	0.8258E+01	0.5359E+01	0.1280E+00
			0.5955E+01	0.1600E+00
			0.5359E+01	0.3200E+00
			0.5359E+01	0.4800E+00
			0.5359E+01	0.8000E+00
			0.5359E+01	0.3200E+01
			0.0000E+00	0.0000E+00
			0.1786E+01	0.2560E-01
			0.2977E+01	0.4960E-01
			0.4466E+01	0.9120E-01
7	10	0.8342E+01	0.5359E+01	0.1280E+00
			0.5955E+01	0.1600E+00
			0.5359E+01	0.3200E+00
			0.5359E+01	0.4800E+00
			0.5359E+01	0.8000E+00
			0.5359E+01	0.3200E+01
			0.0000E+00	0.0000E+00
			0.1786E+01	0.2560E-01
			0.2977E+01	0.4960E-01
			0.4466E+01	0.9120E-01
8	10	0.1205E+02	0.5359E+01	0.1280E+00
			0.5955E+01	0.1600E+00
			0.5955E+01	0.3200E+00
			0.5955E+01	0.4800E+00
			0.5955E+01	0.8000E+00
			0.5955E+01	0.3200E+01
			0.0000E+00	0.0000E+00
			0.1884E+01	0.2560E-01
			0.3140E+01	0.4960E-01
			0.4710E+01	0.9120E-01
9	10	0.1576E+02	0.5652E+01	0.1280E+00
			0.6280E+01	0.1600E+00
			0.6280E+01	0.3200E+00
			0.6280E+01	0.4800E+00
			0.6280E+01	0.8000E+00
			0.6280E+01	0.3200E+01
			0.0000E+00	0.0000E+00
			0.1884E+01	0.2560E-01
			0.3140E+01	0.4960E-01
			0.4710E+01	0.9120E-01

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			0.2464E+01	0.2560E-01
			0.4107E+01	0.4960E-01
			0.6160E+01	0.9120E-01
			0.7392E+01	0.1280E+00
			0.8213E+01	0.1600E+00
			0.8213E+01	0.3200E+00
			0.8213E+01	0.4800E+00
			0.8213E+01	0.8000E+00
			0.8213E+01	0.3200E+01
10	10	0.1584E+02		
			0.0000E+00	0.0000E+00
			0.2477E+01	0.2560E-01
			0.4128E+01	0.4960E-01
			0.6192E+01	0.9120E-01
			0.7431E+01	0.1280E+00
			0.8257E+01	0.1600E+00
			0.7431E+01	0.3200E+00
			0.7431E+01	0.4800E+00
			0.7431E+01	0.8000E+00
			0.7431E+01	0.3200E+01
11	10	0.1855E+02		
			0.0000E+00	0.0000E+00
			0.1983E+01	0.2560E-01
			0.3306E+01	0.4960E-01
			0.4958E+01	0.9120E-01
			0.5950E+01	0.1280E+00
			0.6611E+01	0.1600E+00
			0.5950E+01	0.3200E+00
			0.5950E+01	0.4800E+00
			0.5950E+01	0.8000E+00
			0.5950E+01	0.3200E+01
12	10	0.2126E+02		
			0.0000E+00	0.0000E+00
			0.2017E+01	0.2560E-01
			0.3362E+01	0.4960E-01
			0.5043E+01	0.9120E-01
			0.6052E+01	0.1280E+00
			0.6724E+01	0.1600E+00
			0.6052E+01	0.3200E+00
			0.6052E+01	0.4800E+00
			0.6052E+01	0.8000E+00
			0.6052E+01	0.3200E+01
13	10	0.2134E+02		
			0.0000E+00	0.0000E+00
			0.2028E+01	0.2560E-01
			0.3380E+01	0.4960E-01
			0.5070E+01	0.9120E-01
			0.6084E+01	0.1280E+00
			0.6760E+01	0.1600E+00
			0.6084E+01	0.3200E+00
			0.6084E+01	0.4800E+00
			0.6084E+01	0.8000E+00
			0.6084E+01	0.3200E+01
14	10	0.2680E+02		
			0.0000E+00	0.0000E+00
			0.2032E+01	0.2560E-01
			0.3387E+01	0.4960E-01
			0.5080E+01	0.9120E-01
			0.6096E+01	0.1280E+00
			0.6774E+01	0.1600E+00
			0.6096E+01	0.3200E+00
			0.6096E+01	0.4800E+00
			0.6096E+01	0.8000E+00

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15	10	0.3226E+02	0.6096E+01	0.3200E+01
			0.0000E+00	0.0000E+00
			0.2063E+01	0.2560E-01
			0.3438E+01	0.4960E-01
			0.5157E+01	0.9120E-01
			0.6189E+01	0.1280E+00
			0.6876E+01	0.1600E+00
			0.6189E+01	0.3200E+00
			0.6189E+01	0.4800E+00
			0.6189E+01	0.8000E+00
			0.6189E+01	0.3200E+01
16	10	0.3234E+02		
			0.0000E+00	0.0000E+00
			0.2073E+01	0.2560E-01
			0.3455E+01	0.4960E-01
			0.5182E+01	0.9120E-01
			0.6219E+01	0.1280E+00
			0.6910E+01	0.1600E+00
			0.6910E+01	0.3200E+00
			0.6910E+01	0.4800E+00
			0.6910E+01	0.8000E+00
			0.6910E+01	0.3200E+01
17	10	0.3480E+02		
			0.0000E+00	0.0000E+00
			0.1866E+01	0.2560E-01
			0.3110E+01	0.4960E-01
			0.4665E+01	0.9120E-01
			0.5598E+01	0.1280E+00
			0.6220E+01	0.1600E+00
			0.6220E+01	0.3200E+00
			0.6220E+01	0.4800E+00
			0.6220E+01	0.8000E+00
			0.6220E+01	0.3200E+01
18	10	0.3726E+02		
			0.0000E+00	0.0000E+00
			0.1992E+01	0.2560E-01
			0.3319E+01	0.4960E-01
			0.4979E+01	0.9120E-01
			0.5975E+01	0.1280E+00
			0.6638E+01	0.1600E+00
			0.6638E+01	0.3200E+00
			0.6638E+01	0.4800E+00
			0.6638E+01	0.8000E+00
			0.6638E+01	0.3200E+01
19	10	0.3734E+02		
			0.0000E+00	0.0000E+00
			0.1996E+01	0.2560E-01
			0.3326E+01	0.4960E-01
			0.4989E+01	0.9120E-01
			0.5987E+01	0.1280E+00
			0.6653E+01	0.1600E+00
			0.6653E+01	0.3200E+00
			0.6653E+01	0.4800E+00
			0.6653E+01	0.8000E+00
			0.6653E+01	0.3200E+01
20	10	0.4230E+02		
			0.0000E+00	0.0000E+00
			0.2868E+01	0.2560E-01
			0.4781E+01	0.4960E-01
			0.7171E+01	0.9120E-01
			0.8605E+01	0.1280E+00
			0.9561E+01	0.1600E+00

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			0.9561E+01	0.3200E+00
			0.9561E+01	0.4800E+00
			0.9561E+01	0.8000E+00
			0.9561E+01	0.3200E+01
21	10	0.4726E+02	0.0000E+00	0.0000E+00
			0.3214E+01	0.2560E-01
			0.5357E+01	0.4960E-01
			0.8036E+01	0.9120E-01
			0.9643E+01	0.1280E+00
			0.1071E+02	0.1600E+00
			0.1071E+02	0.3200E+00
			0.1071E+02	0.4800E+00
			0.1071E+02	0.8000E+00
			0.1071E+02	0.3200E+01
22	10	0.4734E+02	0.0000E+00	0.0000E+00
			0.3220E+01	0.2560E-01
			0.5367E+01	0.4960E-01
			0.8050E+01	0.9120E-01
			0.9660E+01	0.1280E+00
			0.1073E+02	0.1600E+00
			0.9660E+01	0.3200E+00
			0.9660E+01	0.4800E+00
			0.9660E+01	0.8000E+00
			0.9660E+01	0.3200E+01
23	10	0.5730E+02	0.0000E+00	0.0000E+00
			0.2726E+01	0.2560E-01
			0.4544E+01	0.4960E-01
			0.6816E+01	0.9120E-01
			0.8179E+01	0.1280E+00
			0.9088E+01	0.1600E+00
			0.8179E+01	0.3200E+00
			0.8179E+01	0.4800E+00
			0.8179E+01	0.8000E+00
			0.8179E+01	0.3200E+01
24	10	0.6726E+02	0.0000E+00	0.0000E+00
			0.2765E+01	0.2560E-01
			0.4609E+01	0.4960E-01
			0.6913E+01	0.9120E-01
			0.8296E+01	0.1280E+00
			0.9218E+01	0.1600E+00
			0.8296E+01	0.3200E+00
			0.8296E+01	0.4800E+00
			0.8296E+01	0.8000E+00
			0.8296E+01	0.3200E+01
25	10	0.6734E+02	0.0000E+00	0.0000E+00
			0.2778E+01	0.2560E-01
			0.4630E+01	0.4960E-01
			0.6945E+01	0.9120E-01
			0.8333E+01	0.1280E+00
			0.9259E+01	0.1600E+00
			0.8333E+01	0.3200E+00
			0.8333E+01	0.4800E+00
			0.8333E+01	0.8000E+00
			0.8333E+01	0.3200E+01
26	10	0.6980E+02	0.0000E+00	0.0000E+00
			0.3599E+01	0.2560E-01
			0.5998E+01	0.4960E-01

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			0.8998E+01	0.9120E-01
			0.1080E+02	0.1280E+00
			0.1200E+02	0.1600E+00
			0.1080E+02	0.3200E+00
			0.1080E+02	0.4800E+00
			0.1080E+02	0.8000E+00
			0.1080E+02	0.3200E+01
27	10	0.7226E+02		
			0.0000E+00	0.0000E+00
			0.3638E+01	0.2560E-01
			0.6063E+01	0.4960E-01
			0.9095E+01	0.9120E-01
			0.1091E+02	0.1280E+00
			0.1213E+02	0.1600E+00
			0.1091E+02	0.3200E+00
			0.1091E+02	0.4800E+00
			0.1091E+02	0.8000E+00
			0.1091E+02	0.3200E+01
28	10	0.7234E+02		
			0.0000E+00	0.0000E+00
			0.3651E+01	0.2560E-01
			0.6084E+01	0.4960E-01
			0.9127E+01	0.9120E-01
			0.1095E+02	0.1280E+00
			0.1217E+02	0.1600E+00
			0.1217E+02	0.3200E+00
			0.1217E+02	0.4800E+00
			0.1217E+02	0.8000E+00
			0.1217E+02	0.3200E+01
29	10	0.7730E+02		
			0.0000E+00	0.0000E+00
			0.3756E+01	0.2560E-01
			0.6260E+01	0.4960E-01
			0.9390E+01	0.9120E-01
			0.1127E+02	0.1280E+00
			0.1252E+02	0.1600E+00
			0.1252E+02	0.3200E+00
			0.1252E+02	0.4800E+00
			0.1252E+02	0.8000E+00
			0.1252E+02	0.3200E+01
30	10	0.8226E+02		
			0.0000E+00	0.0000E+00
			0.3989E+01	0.2560E-01
			0.6649E+01	0.4960E-01
			0.9973E+01	0.9120E-01
			0.1197E+02	0.1280E+00
			0.1330E+02	0.1600E+00
			0.1330E+02	0.3200E+00
			0.1330E+02	0.4800E+00
			0.1330E+02	0.8000E+00
			0.1330E+02	0.3200E+01
31	10	0.8234E+02		
			0.0000E+00	0.0000E+00
			0.3993E+01	0.2560E-01
			0.6655E+01	0.4960E-01
			0.9983E+01	0.9120E-01
			0.1198E+02	0.1280E+00
			0.1331E+02	0.1600E+00
			0.1331E+02	0.3200E+00
			0.1331E+02	0.4800E+00
			0.1331E+02	0.8000E+00
			0.1331E+02	0.3200E+01
32	10	0.8730E+02		

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			0.0000E+00	0.0000E+00
			0.4477E+01	0.2560E-01
			0.7462E+01	0.4960E-01
			0.1119E+02	0.9120E-01
			0.1343E+02	0.1280E+00
			0.1492E+02	0.1600E+00
			0.1492E+02	0.3200E+00
			0.1492E+02	0.4800E+00
			0.1492E+02	0.8000E+00
			0.1492E+02	0.3200E+01
33	10	0.9226E+02		
			0.0000E+00	0.0000E+00
			0.4477E+01	0.2560E-01
			0.7462E+01	0.4960E-01
			0.1119E+02	0.9120E-01
			0.1343E+02	0.1280E+00
			0.1492E+02	0.1600E+00
			0.1492E+02	0.3200E+00
			0.1492E+02	0.4800E+00
			0.1492E+02	0.8000E+00
			0.1492E+02	0.3200E+01
34	10	0.9234E+02		
			0.0000E+00	0.0000E+00
			0.4477E+01	0.2560E-01
			0.7462E+01	0.4960E-01
			0.1119E+02	0.9120E-01
			0.1343E+02	0.1280E+00
			0.1492E+02	0.1600E+00
			0.1492E+02	0.3200E+00
			0.1492E+02	0.4800E+00
			0.1492E+02	0.8000E+00
			0.1492E+02	0.3200E+01
35	10	0.9630E+02		
			0.0000E+00	0.0000E+00
			0.4477E+01	0.2560E-01
			0.7462E+01	0.4960E-01
			0.1119E+02	0.9120E-01
			0.1343E+02	0.1280E+00
			0.1492E+02	0.1600E+00
			0.1492E+02	0.3200E+00
			0.1492E+02	0.4800E+00
			0.1492E+02	0.8000E+00
			0.1492E+02	0.3200E+01
36	10	0.1003E+03		
			0.0000E+00	0.0000E+00
			0.4477E+01	0.2560E-01
			0.7462E+01	0.4960E-01
			0.1119E+02	0.9120E-01
			0.1343E+02	0.1280E+00
			0.1492E+02	0.1600E+00
			0.1492E+02	0.3200E+00
			0.1492E+02	0.4800E+00
			0.1492E+02	0.8000E+00
			0.1492E+02	0.3200E+01

TIP LOAD
KIP

TIP MOVEMENT
IN.

0.0000E+00
0.1162E+01
0.2325E+01

0.0000E+00
0.8000E-02
0.1600E-01

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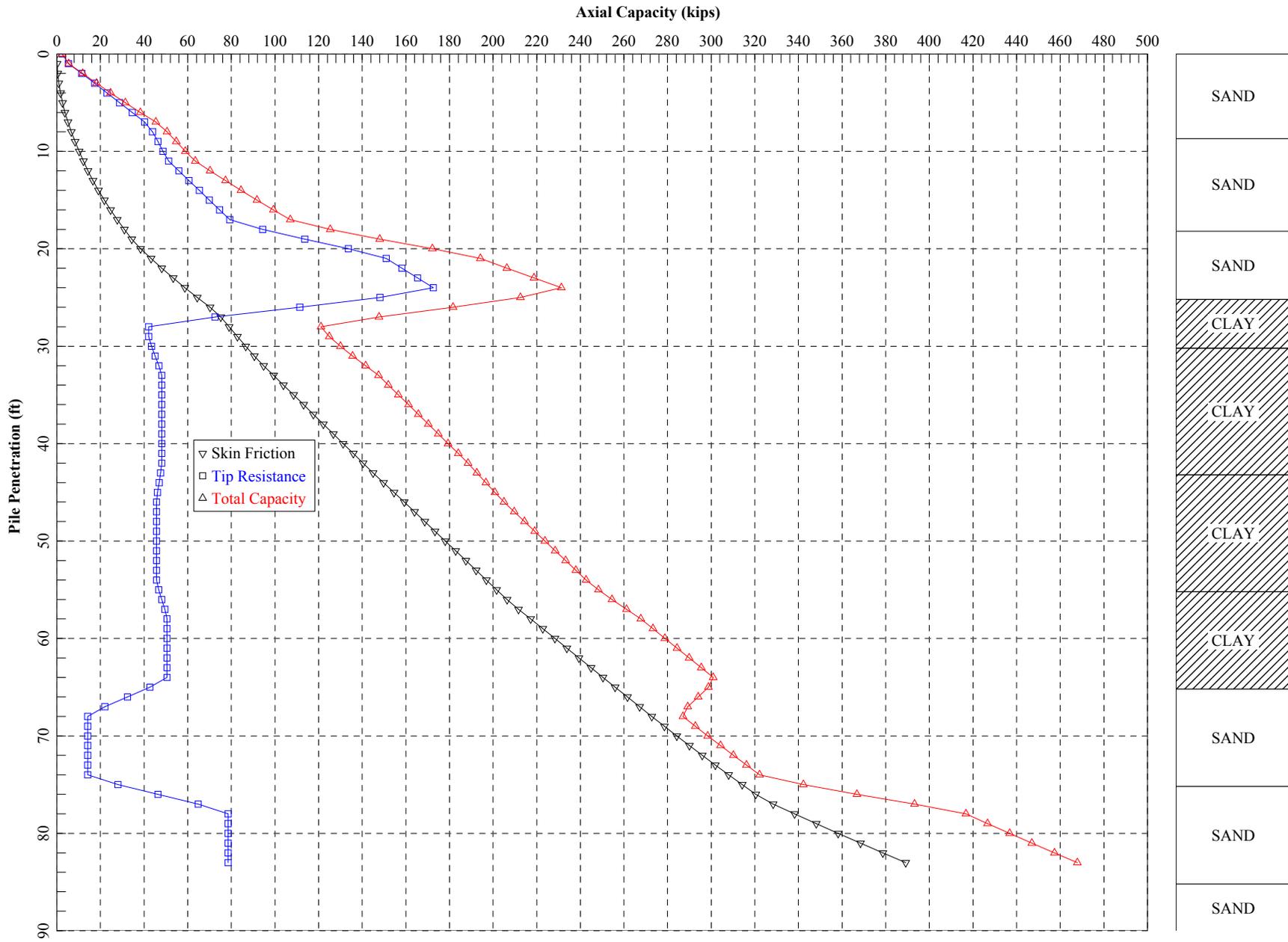
0.4650E+01
0.9299E+01
0.1395E+02
0.1674E+02
0.1860E+02
0.1860E+02
0.1860E+02

0.3200E-01
0.2080E+00
0.6720E+00
0.1168E+01
0.1600E+01
0.2400E+01
0.3200E+01

LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.6015E+00	0.1594E-03	0.1453E-01	0.1000E-03
0.6015E+01	0.1594E-02	0.1453E+00	0.1000E-02
0.3008E+02	0.7969E-02	0.7265E+00	0.5000E-02
0.6015E+02	0.1594E-01	0.1453E+01	0.1000E-01
0.1196E+03	0.3186E-01	0.2906E+01	0.2000E-01
0.2401E+03	0.7432E-01	0.5125E+01	0.5000E-01
0.3227E+03	0.1128E+00	0.5918E+01	0.8000E-01
0.3650E+03	0.1373E+00	0.6446E+01	0.1000E+00
0.4352E+03	0.2456E+00	0.9088E+01	0.2000E+00
0.4230E+03	0.5447E+00	0.1223E+02	0.5000E+00
0.4255E+03	0.8451E+00	0.1467E+02	0.8000E+00
0.4266E+03	0.1045E+01	0.1579E+02	0.1000E+01
0.4294E+03	0.2046E+01	0.1860E+02	0.2000E+01

**14-Inch Dia. Closed End CIP Piles - UBV
Pier 2
B-003-1-24**



**14-Inch Dia. Closed End CIP Piles - UBV
Pier 2
B-003-1-24**

B-003-1-24 UBV.ap9o

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APILE for Windows, Version 2019.9.12

Serial Number : 136090498

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 :

Resource International, Inc.
Columbus, OH

Path to file locations :
C:\Users\legacy\Desktop\1.3.2025\14-inch\Piers\B-003-1-24\
Name of input data file : B-003-1-24 UBV.ap9d
Name of output file : B-003-1-24 UBV.ap9o
Name of plot output file : B-003-1-24 UBV.ap9p

Time and Date of Analysis

Date: January 07, 2025 Time: 09:46:57

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* INPUT INFORMATION *

B-003-1-24 (Pier 2) - 14 Inch CIP

DESIGNER : AG/DEK

JOB NUMBER : W-23-155 (MOT-835-2.57)

METHOD FOR UNIT LOAD TRANSFERS :

- FHWA (Federal Highway Administration)
Unfactored Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

TYPE OF LOADING :

- COMPRESSION

PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
 - Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
 - CROSS SECTION AREA = 153.89 IN²

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 14.00 IN.
 - INTERNAL DIAMETER, ID = 0.25 IN.
 - TOTAL PILE LENGTH, TL = 83.00 FT.
 - BATTER ANGLE = 0.00 DEG
 - PILE STICKUP LENGTH, PSL = 0.00 FT.
 - ZERO FRICTION LENGTH, ZFL = 0.00 FT.
 - INCREMENT OF PILE LENGTH
 USED IN COMPUTATION = 1.00 FT.
 - LENGTH OF ENHANCED
 END SECTION = 83.00 FT.
 - INTERNAL DIAMETER OF
 ENHANCED END SECTION = 0.25 IN.

PLUGGED/UNPLUGGED CONDITIONS :
 Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	SAND	0.80*	67.60	38.00	110.40**
8.70	SAND	0.80*	67.60	38.00	110.40**
8.70	SAND	0.80*	67.60	37.00	91.20**
18.20	SAND	0.80*	67.60	37.00	91.20**
18.20	SAND	0.80*	67.60	39.00	135.20**
25.20	SAND	0.80*	67.60	39.00	135.20**
25.20	CLAY	0.80*	62.60	0.00	4.80**
30.20	CLAY	0.80*	62.60	0.00	4.80**
30.20	CLAY	0.80*	67.60	0.00	4.80**
43.20	CLAY	0.80*	67.60	0.00	4.80**
43.20	CLAY	0.80*	62.60	0.00	4.80**
55.20	CLAY	0.80*	62.60	0.00	4.80**
55.20	CLAY	0.80*	67.60	0.00	4.80**
65.20	CLAY	0.80*	67.60	0.00	4.80**
65.20	SAND	0.80*	67.60	30.00	30.00**
75.20	SAND	0.80*	67.60	30.00	30.00**
75.20	SAND	0.80*	72.60	34.00	55.60**
85.20	SAND	0.80*	72.60	34.00	55.60**
85.20	SAND	0.80*	62.60	29.00	26.40**
90.20	SAND	0.80*	62.60	29.00	26.40**

* VALUE ASSUMED BY THE PROGRAM

** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

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*	4.38	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	4.38	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	4.75	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	4.75	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.25	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.25	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	1.000	1.000
8.70	1.000	1.000
8.70	1.000	1.000
18.20	1.000	1.000
18.20	1.000	1.000
25.20	1.000	1.000
25.20	1.000	1.000
30.20	1.000	1.000
30.20	1.000	1.000
43.20	1.000	1.000
43.20	1.000	1.000
55.20	1.000	1.000
55.20	1.000	1.000
65.20	1.000	1.000
65.20	1.000	1.000
75.20	1.000	1.000
75.20	1.000	1.000
85.20	1.000	1.000
85.20	1.000	1.000
90.20	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.140 *	0.00
8.70	0.140 *	0.00
8.70	0.140 *	0.00
18.20	0.140 *	0.00
18.20	0.140 *	0.00
25.20	0.140 *	0.00
25.20	0.140 *	0.90 **
30.20	0.140 *	0.90 **
30.20	0.140 *	0.90 **
43.20	0.140 *	0.90 **
43.20	0.140 *	0.90 **
55.20	0.140 *	0.90 **
55.20	0.140 *	0.90 **
65.20	0.140 *	0.90 **
65.20	0.140 *	0.00
75.20	0.140 *	0.00
75.20	0.140 *	0.00
85.20	0.140 *	0.00
85.20	0.140 *	0.00
90.20	0.140 *	0.00

* DEFAULT VALUE = 0.01 D
 ** DEFAULT VALUE = 0.9

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 * COMPUTATION RESULT *

Q100, Low Scour Elev = 864.99 ft, (1.2 feet
 below bottom of pile cap)
 Side Friction Loss Due to Scour = 0.13 kips

 * FED. HWY. METHOD *

PILE PENETRATION FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	2.5	2.5
1.00	0.1	5.4	5.5
2.00	0.4	11.5	11.9
3.00	0.9	17.3	18.2
4.00	1.7	23.0	24.7
5.00	2.6	28.8	31.4
6.00	3.7	34.6	38.3
7.00	5.1	40.3	45.4
8.00	6.7	43.9	50.5
9.00	8.4	46.4	54.8
10.00	10.3	48.7	58.9
11.00	12.2	51.3	63.5
12.00	14.3	56.0	70.3
13.00	16.6	60.6	77.3
14.00	19.1	65.3	84.4
15.00	21.8	69.9	91.8
16.00	24.7	74.6	99.3
17.00	27.7	79.3	107.0
18.00	31.0	94.4	125.4
19.00	34.4	113.7	148.1

14-Inch Dia. Closed End CIP Piles - UBV

Pier 2

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20.00	38.4	133.7	172.2
21.00	43.2	151.0	194.2
22.00	48.1	158.2	206.3
23.00	53.3	165.4	218.7
24.00	58.7	172.6	231.3
25.00	64.4	148.2	212.5
26.00	70.3	111.4	181.6
27.00	75.2	72.6	147.7
28.00	79.0	42.1	121.1
29.00	82.8	42.1	124.9
30.00	86.6	43.4	130.0
31.00	90.5	45.1	135.6
32.00	94.8	46.8	141.6
33.00	99.4	48.1	147.5
34.00	103.9	48.1	152.0
35.00	108.5	48.1	156.6
36.00	113.1	48.1	161.2
37.00	117.6	48.1	165.7
38.00	122.2	48.1	170.3
39.00	126.8	48.1	174.9
40.00	131.3	48.1	179.4
41.00	135.9	48.1	184.0
42.00	140.4	48.1	188.5
43.00	145.0	47.6	192.6
44.00	149.8	46.9	196.7
45.00	154.6	46.2	200.8
46.00	159.3	45.7	205.0
47.00	164.0	45.7	209.7
48.00	168.7	45.7	214.4
49.00	173.4	45.7	219.1
50.00	178.1	45.7	223.8
51.00	182.8	45.7	228.5
52.00	187.5	45.7	233.2
53.00	192.2	45.7	237.9
54.00	196.9	45.7	242.6
55.00	201.6	46.7	248.3
56.00	206.4	48.1	254.5
57.00	211.7	49.5	261.2
58.00	217.2	50.5	267.7
59.00	222.8	50.5	273.3
60.00	228.3	50.5	278.8
61.00	233.8	50.5	284.3
62.00	239.4	50.5	289.9
63.00	244.9	50.5	295.4
64.00	250.4	50.5	300.9
65.00	255.9	42.7	298.7
66.00	261.6	32.4	294.0
67.00	267.2	22.0	289.2
68.00	272.8	14.2	287.0
69.00	278.5	14.2	292.7
70.00	284.2	14.2	298.4
71.00	290.0	14.2	304.3
72.00	295.9	14.2	310.2
73.00	301.9	14.2	316.2
74.00	308.0	14.2	322.2
75.00	314.2	28.0	342.2
76.00	320.4	46.4	366.8
77.00	328.4	64.8	393.2
78.00	338.2	78.6	416.8
79.00	348.1	78.6	426.7
80.00	358.2	78.6	436.8
81.00	368.4	78.6	447.0
82.00	378.7	78.6	457.3

Max. Factored Designed Load per Pile = 172.0 kips
Required Nominal Resistance per Pile = (172/0.7) kips = 245.7 kips
Required Nominal Driving Resistance = (172/0.7)+scour loss (0.13)= 245.83 kips

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Pile length = 55+ 2.0 (estimated embedment in pile cap) = 57 feet
Estimated Pile Length to Rounded Up to Nearest 5 feet = 60.0 feet
Order Length = 65 feet

83.00 389.2 B-003-1-24 UBv.ap9o 78.6 467.8

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	0.4167E-01	0.0000E+00	0.0000E+00
			0.4922E-02	0.2240E-01
			0.8204E-02	0.4340E-01
			0.1231E-01	0.7980E-01
			0.1477E-01	0.1120E+00
			0.1641E-01	0.1400E+00
			0.1641E-01	0.2800E+00
			0.1641E-01	0.4200E+00
			0.1641E-01	0.7000E+00
			0.1641E-01	0.2800E+01
2	10	0.4350E+01	0.0000E+00	0.0000E+00
			0.5139E+00	0.2240E-01
			0.8565E+00	0.4340E-01
			0.1285E+01	0.7980E-01
			0.1542E+01	0.1120E+00
			0.1713E+01	0.1400E+00
			0.1713E+01	0.2800E+00
			0.1713E+01	0.4200E+00
			0.1713E+01	0.7000E+00
			0.1713E+01	0.2800E+01
3	10	0.8658E+01	0.0000E+00	0.0000E+00
			0.1023E+01	0.2240E-01
			0.1705E+01	0.4340E-01
			0.2557E+01	0.7980E-01
			0.3069E+01	0.1120E+00
			0.3409E+01	0.1400E+00
			0.3409E+01	0.2800E+00
			0.3409E+01	0.4200E+00
			0.3409E+01	0.7000E+00
			0.3409E+01	0.2800E+01
4	10	0.8742E+01	0.0000E+00	0.0000E+00
			0.1033E+01	0.2240E-01
			0.1721E+01	0.4340E-01
			0.2582E+01	0.7980E-01
			0.3098E+01	0.1120E+00
			0.3442E+01	0.1400E+00
			0.3442E+01	0.2800E+00
			0.3442E+01	0.4200E+00
			0.3442E+01	0.7000E+00
			0.3442E+01	0.2800E+01

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5	10	0.1345E+02	0.0000E+00	0.0000E+00
			0.1412E+01	0.2240E-01
			0.2354E+01	0.4340E-01
			0.3531E+01	0.7980E-01
			0.4237E+01	0.1120E+00
			0.4708E+01	0.1400E+00
			0.4708E+01	0.2800E+00
			0.4708E+01	0.4200E+00
			0.4708E+01	0.7000E+00
			0.4708E+01	0.2800E+01
6	10	0.1816E+02	0.0000E+00	0.0000E+00
			0.1907E+01	0.2240E-01
			0.3178E+01	0.4340E-01
			0.4767E+01	0.7980E-01
			0.5721E+01	0.1120E+00
			0.6356E+01	0.1400E+00
			0.6356E+01	0.2800E+00
			0.6356E+01	0.4200E+00
			0.6356E+01	0.7000E+00
			0.6356E+01	0.2800E+01
7	10	0.1824E+02	0.0000E+00	0.0000E+00
			0.1916E+01	0.2240E-01
			0.3193E+01	0.4340E-01
			0.4789E+01	0.7980E-01
			0.5747E+01	0.1120E+00
			0.6385E+01	0.1400E+00
			0.6385E+01	0.2800E+00
			0.6385E+01	0.4200E+00
			0.6385E+01	0.7000E+00
			0.6385E+01	0.2800E+01
8	10	0.2170E+02	0.0000E+00	0.0000E+00
			0.2843E+01	0.2240E-01
			0.4739E+01	0.4340E-01
			0.7108E+01	0.7980E-01
			0.8529E+01	0.1120E+00
			0.9477E+01	0.1400E+00
			0.9477E+01	0.2800E+00
			0.9477E+01	0.4200E+00
			0.9477E+01	0.7000E+00
			0.9477E+01	0.2800E+01
9	10	0.2516E+02	0.0000E+00	0.0000E+00
			0.3296E+01	0.2240E-01
			0.5494E+01	0.4340E-01
			0.8241E+01	0.7980E-01
			0.9889E+01	0.1120E+00
			0.1099E+02	0.1400E+00
			0.1099E+02	0.2800E+00
			0.1099E+02	0.4200E+00
			0.1099E+02	0.7000E+00
			0.1099E+02	0.2800E+01
10	10	0.2524E+02	0.0000E+00	0.0000E+00
			0.3307E+01	0.2240E-01
			0.5512E+01	0.4340E-01
			0.8268E+01	0.7980E-01
			0.9922E+01	0.1120E+00
			0.1102E+02	0.1400E+00
			0.9922E+01	0.2800E+00

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			0.9922E+01	0.4200E+00
			0.9922E+01	0.7000E+00
			0.9922E+01	0.2800E+01
11	10	0.2770E+02		
			0.0000E+00	0.0000E+00
			0.2169E+01	0.2240E-01
			0.3615E+01	0.4340E-01
			0.5423E+01	0.7980E-01
			0.6508E+01	0.1120E+00
			0.7231E+01	0.1400E+00
			0.6508E+01	0.2800E+00
			0.6508E+01	0.4200E+00
			0.6508E+01	0.7000E+00
			0.6508E+01	0.2800E+01
12	10	0.3016E+02		
			0.0000E+00	0.0000E+00
			0.2186E+01	0.2240E-01
			0.3644E+01	0.4340E-01
			0.5466E+01	0.7980E-01
			0.6559E+01	0.1120E+00
			0.7287E+01	0.1400E+00
			0.6559E+01	0.2800E+00
			0.6559E+01	0.4200E+00
			0.6559E+01	0.7000E+00
			0.6559E+01	0.2800E+01
13	10	0.3024E+02		
			0.0000E+00	0.0000E+00
			0.2195E+01	0.2240E-01
			0.3659E+01	0.4340E-01
			0.5488E+01	0.7980E-01
			0.6586E+01	0.1120E+00
			0.7317E+01	0.1400E+00
			0.6586E+01	0.2800E+00
			0.6586E+01	0.4200E+00
			0.6586E+01	0.7000E+00
			0.6586E+01	0.2800E+01
14	10	0.3670E+02		
			0.0000E+00	0.0000E+00
			0.2594E+01	0.2240E-01
			0.4324E+01	0.4340E-01
			0.6485E+01	0.7980E-01
			0.7782E+01	0.1120E+00
			0.8647E+01	0.1400E+00
			0.7782E+01	0.2800E+00
			0.7782E+01	0.4200E+00
			0.7782E+01	0.7000E+00
			0.7782E+01	0.2800E+01
15	10	0.4316E+02		
			0.0000E+00	0.0000E+00
			0.2629E+01	0.2240E-01
			0.4381E+01	0.4340E-01
			0.6572E+01	0.7980E-01
			0.7886E+01	0.1120E+00
			0.8762E+01	0.1400E+00
			0.7886E+01	0.2800E+00
			0.7886E+01	0.4200E+00
			0.7886E+01	0.7000E+00
			0.7886E+01	0.2800E+01
16	10	0.4324E+02		
			0.0000E+00	0.0000E+00
			0.2647E+01	0.2240E-01
			0.4411E+01	0.4340E-01
			0.6617E+01	0.7980E-01

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			0.7940E+01	0.1120E+00
			0.8823E+01	0.1400E+00
			0.7940E+01	0.2800E+00
			0.7940E+01	0.4200E+00
			0.7940E+01	0.7000E+00
			0.7940E+01	0.2800E+01
17	10	0.4920E+02		
			0.0000E+00	0.0000E+00
			0.2671E+01	0.2240E-01
			0.4452E+01	0.4340E-01
			0.6679E+01	0.7980E-01
			0.8014E+01	0.1120E+00
			0.8905E+01	0.1400E+00
			0.8014E+01	0.2800E+00
			0.8014E+01	0.4200E+00
			0.8014E+01	0.7000E+00
			0.8014E+01	0.2800E+01
18	10	0.5516E+02		
			0.0000E+00	0.0000E+00
			0.2699E+01	0.2240E-01
			0.4498E+01	0.4340E-01
			0.6747E+01	0.7980E-01
			0.8096E+01	0.1120E+00
			0.8996E+01	0.1400E+00
			0.8096E+01	0.2800E+00
			0.8096E+01	0.4200E+00
			0.8096E+01	0.7000E+00
			0.8096E+01	0.2800E+01
19	10	0.5524E+02		
			0.0000E+00	0.0000E+00
			0.2713E+01	0.2240E-01
			0.4522E+01	0.4340E-01
			0.6783E+01	0.7980E-01
			0.8139E+01	0.1120E+00
			0.9044E+01	0.1400E+00
			0.8139E+01	0.2800E+00
			0.8139E+01	0.4200E+00
			0.8139E+01	0.7000E+00
			0.8139E+01	0.2800E+01
20	10	0.6020E+02		
			0.0000E+00	0.0000E+00
			0.3143E+01	0.2240E-01
			0.5239E+01	0.4340E-01
			0.7858E+01	0.7980E-01
			0.9430E+01	0.1120E+00
			0.1048E+02	0.1400E+00
			0.9430E+01	0.2800E+00
			0.9430E+01	0.4200E+00
			0.9430E+01	0.7000E+00
			0.9430E+01	0.2800E+01
21	10	0.6516E+02		
			0.0000E+00	0.0000E+00
			0.3163E+01	0.2240E-01
			0.5272E+01	0.4340E-01
			0.7908E+01	0.7980E-01
			0.9490E+01	0.1120E+00
			0.1054E+02	0.1400E+00
			0.9490E+01	0.2800E+00
			0.9490E+01	0.4200E+00
			0.9490E+01	0.7000E+00
			0.9490E+01	0.2800E+01
22	10	0.6524E+02		
			0.0000E+00	0.0000E+00

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			0.3174E+01	0.2240E-01
			0.5290E+01	0.4340E-01
			0.7935E+01	0.7980E-01
			0.9522E+01	0.1120E+00
			0.1058E+02	0.1400E+00
			0.1058E+02	0.2800E+00
			0.1058E+02	0.4200E+00
			0.1058E+02	0.7000E+00
23	10	0.7020E+02	0.1058E+02	0.2800E+01
			0.0000E+00	0.0000E+00
			0.3297E+01	0.2240E-01
			0.5495E+01	0.4340E-01
			0.8242E+01	0.7980E-01
			0.9891E+01	0.1120E+00
			0.1099E+02	0.1400E+00
			0.1099E+02	0.2800E+00
			0.1099E+02	0.4200E+00
			0.1099E+02	0.7000E+00
24	10	0.7516E+02	0.1099E+02	0.2800E+01
			0.0000E+00	0.0000E+00
			0.3534E+01	0.2240E-01
			0.5890E+01	0.4340E-01
			0.8835E+01	0.7980E-01
			0.1060E+02	0.1120E+00
			0.1178E+02	0.1400E+00
			0.1178E+02	0.2800E+00
			0.1178E+02	0.4200E+00
			0.1178E+02	0.7000E+00
25	10	0.7524E+02	0.1178E+02	0.2800E+01
			0.0000E+00	0.0000E+00
			0.3538E+01	0.2240E-01
			0.5897E+01	0.4340E-01
			0.8845E+01	0.7980E-01
			0.1061E+02	0.1120E+00
			0.1179E+02	0.1400E+00
			0.1179E+02	0.2800E+00
			0.1179E+02	0.4200E+00
			0.1179E+02	0.7000E+00
26	10	0.8020E+02	0.1179E+02	0.2800E+01
			0.0000E+00	0.0000E+00
			0.5775E+01	0.2240E-01
			0.9626E+01	0.4340E-01
			0.1444E+02	0.7980E-01
			0.1733E+02	0.1120E+00
			0.1925E+02	0.1400E+00
			0.1925E+02	0.2800E+00
			0.1925E+02	0.4200E+00
			0.1925E+02	0.7000E+00
27	10	0.8516E+02	0.1925E+02	0.2800E+01
			0.0000E+00	0.0000E+00
			0.5994E+01	0.2240E-01
			0.9991E+01	0.4340E-01
			0.1499E+02	0.7980E-01
			0.1798E+02	0.1120E+00
			0.1998E+02	0.1400E+00
			0.1998E+02	0.2800E+00
			0.1998E+02	0.4200E+00
			0.1998E+02	0.7000E+00

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28	10	0.8524E+02	0.1998E+02	0.2800E+01
			0.0000E+00	0.0000E+00
			0.5994E+01	0.2240E-01
			0.9991E+01	0.4340E-01
			0.1499E+02	0.7980E-01
			0.1798E+02	0.1120E+00
			0.1998E+02	0.1400E+00
			0.1998E+02	0.2800E+00
			0.1998E+02	0.4200E+00
			0.1998E+02	0.7000E+00
			0.1998E+02	0.2800E+01
29	10	0.8770E+02		
			0.0000E+00	0.0000E+00
			0.5994E+01	0.2240E-01
			0.9991E+01	0.4340E-01
			0.1499E+02	0.7980E-01
			0.1798E+02	0.1120E+00
			0.1998E+02	0.1400E+00
			0.1998E+02	0.2800E+00
			0.1998E+02	0.4200E+00
			0.1998E+02	0.7000E+00
			0.1998E+02	0.2800E+01
30	10	0.9016E+02		
			0.0000E+00	0.0000E+00
			0.5994E+01	0.2240E-01
			0.9991E+01	0.4340E-01
			0.1499E+02	0.7980E-01
			0.1798E+02	0.1120E+00
			0.1998E+02	0.1400E+00
			0.1998E+02	0.2800E+00
			0.1998E+02	0.4200E+00
			0.1998E+02	0.7000E+00
			0.1998E+02	0.2800E+01

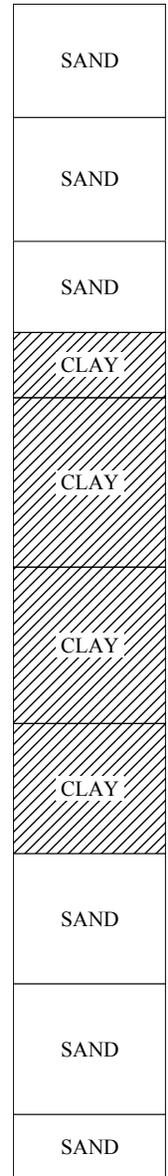
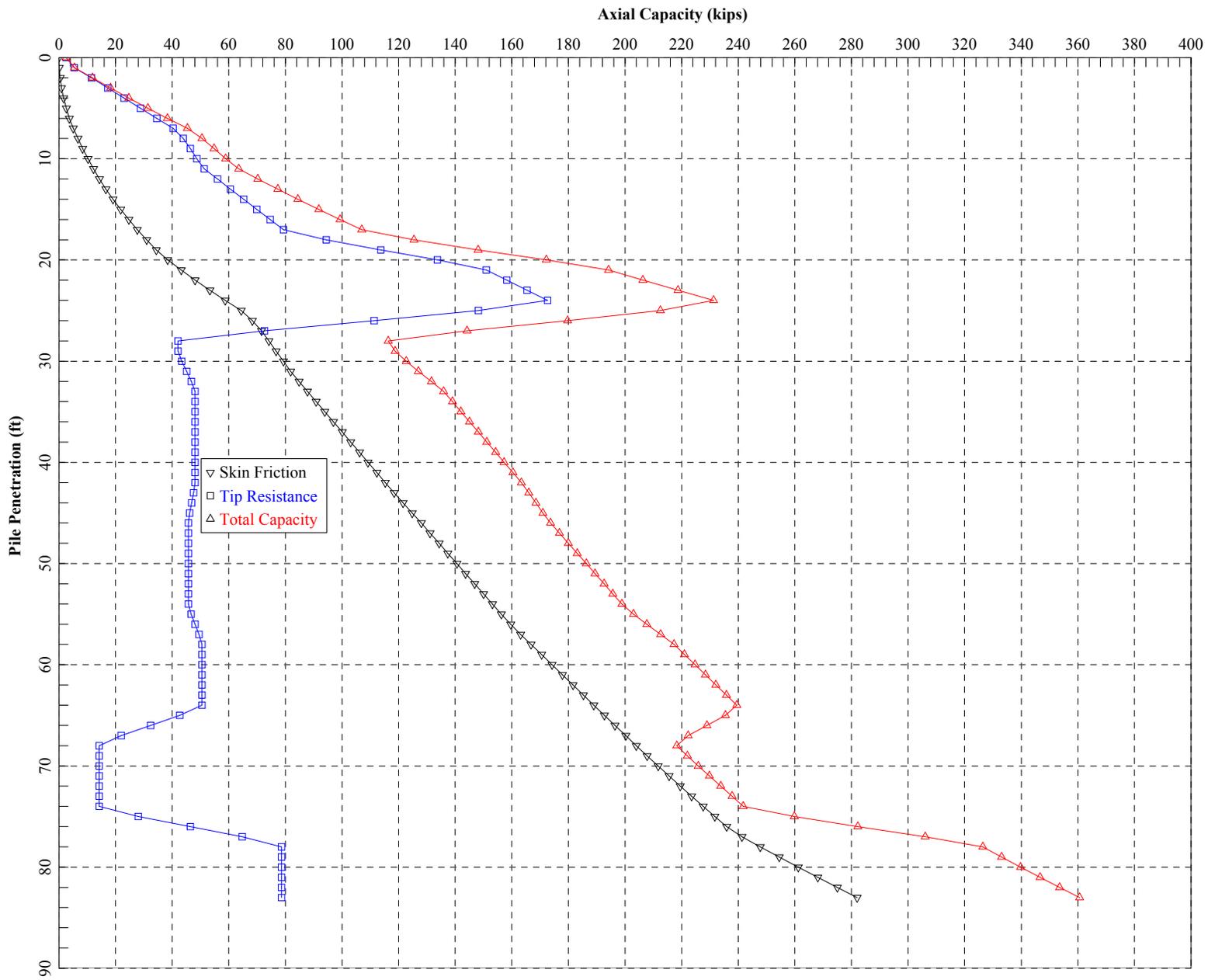
TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.4912E+01	0.7000E-02
0.9824E+01	0.1400E-01
0.1965E+02	0.2800E-01
0.3930E+02	0.1820E+00
0.5895E+02	0.5880E+00
0.7073E+02	0.1022E+01
0.7859E+02	0.1400E+01
0.7859E+02	0.2100E+01
0.7859E+02	0.2800E+01

LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.7202E+00	0.1980E-03	0.7017E-01	0.1000E-03
0.7202E+01	0.1980E-02	0.7017E+00	0.1000E-02
0.3601E+02	0.9898E-02	0.3509E+01	0.5000E-02

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0.7202E+02	0.1980E-01	0.7017E+01	0.1000E-01
0.1393E+03	0.3928E-01	0.1403E+02	0.2000E-01
0.2598E+03	0.8627E-01	0.2246E+02	0.5000E-01
0.3409E+03	0.1279E+00	0.2628E+02	0.8000E-01
0.3796E+03	0.1535E+00	0.2883E+02	0.1000E+00
0.4187E+03	0.2612E+00	0.4017E+02	0.2000E+00
0.4247E+03	0.5633E+00	0.5469E+02	0.5000E+00
0.4347E+03	0.8656E+00	0.6470E+02	0.8000E+00
0.4401E+03	0.1067E+01	0.7014E+02	0.1000E+01
0.4486E+03	0.2069E+01	0.7859E+02	0.2000E+01



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APILE for Windows, Version 2019.9.12

Serial Number : 136090498

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 :

Resource International, Inc.
Columbus, OH

Path to file locations :
C:\Users\legacy\Desktop\1.3.2025\14-inch\Piers\B-003-1-24\
Name of input data file : B-003-1-24 EOID.ap9d
Name of output file : B-003-1-24 EOID.ap9o
Name of plot output file : B-003-1-24 EOID.ap9p

Time and Date of Analysis

Date: January 07, 2025 Time: 09:48:22

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* INPUT INFORMATION *

B-003-1-24 (Pier 2) -14 Inch

DESIGNER : AG/DEK

JOB NUMBER : W-23-155 (MOT-835-2.57)

METHOD FOR UNIT LOAD TRANSFERS :

- FHWA (Federal Highway Administration)
Unfactored Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

TYPE OF LOADING :

- COMPRESSION

PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
 - Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
 - CROSS SECTION AREA = 153.89 IN²

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 14.00 IN.
 - INTERNAL DIAMETER, ID = 0.25 IN.
 - TOTAL PILE LENGTH, TL = 83.00 FT.
 - BATTER ANGLE = 0.00 DEG
 - PILE STICKUP LENGTH, PSL = 0.00 FT.
 - ZERO FRICTION LENGTH, ZFL = 0.00 FT.
 - INCREMENT OF PILE LENGTH
 USED IN COMPUTATION = 1.00 FT.
 - LENGTH OF ENHANCED
 END SECTION = 83.00 FT.
 - INTERNAL DIAMETER OF
 ENHANCED END SECTION = 0.25 IN.

PLUGGED/UNPLUGGED CONDITIONS :
 Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	SAND	0.80*	67.60	38.00	110.40**
8.70	SAND	0.80*	67.60	38.00	110.40**
8.70	SAND	0.80*	67.60	37.00	91.20**
18.20	SAND	0.80*	67.60	37.00	91.20**
18.20	SAND	0.80*	67.60	39.00	135.20**
25.20	SAND	0.80*	67.60	39.00	135.20**
25.20	CLAY	0.80*	62.60	0.00	4.80**
30.20	CLAY	0.80*	62.60	0.00	4.80**
30.20	CLAY	0.80*	67.60	0.00	4.80**
43.20	CLAY	0.80*	67.60	0.00	4.80**
43.20	CLAY	0.80*	62.60	0.00	4.80**
55.20	CLAY	0.80*	62.60	0.00	4.80**
55.20	CLAY	0.80*	67.60	0.00	4.80**
65.20	CLAY	0.80*	67.60	0.00	4.80**
65.20	SAND	0.80*	67.60	30.00	30.00**
75.20	SAND	0.80*	67.60	30.00	30.00**
75.20	SAND	0.80*	72.60	34.00	55.60**
85.20	SAND	0.80*	72.60	34.00	55.60**
85.20	SAND	0.80*	62.60	29.00	26.40**
90.20	SAND	0.80*	62.60	29.00	26.40**

* VALUE ASSUMED BY THE PROGRAM

** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

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*	4.38	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	4.38	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	4.75	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	4.75	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.25	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.25	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	1.000	1.000
8.70	1.000	1.000
8.70	1.000	1.000
18.20	1.000	1.000
18.20	1.000	1.000
25.20	1.000	1.000
25.20	0.670	1.000
30.20	0.670	1.000
30.20	0.670	1.000
43.20	0.670	1.000
43.20	0.670	1.000
55.20	0.670	1.000
55.20	0.670	1.000
65.20	0.670	1.000
65.20	0.670	1.000
75.20	0.670	1.000
75.20	0.670	1.000
85.20	0.670	1.000
85.20	0.670	1.000
90.20	0.670	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.140 *	0.00
8.70	0.140 *	0.00
8.70	0.140 *	0.00
18.20	0.140 *	0.00
18.20	0.140 *	0.00
25.20	0.140 *	0.00
25.20	0.140 *	0.90 **
30.20	0.140 *	0.90 **
30.20	0.140 *	0.90 **
43.20	0.140 *	0.90 **
43.20	0.140 *	0.90 **
55.20	0.140 *	0.90 **
55.20	0.140 *	0.90 **
65.20	0.140 *	0.90 **
65.20	0.140 *	0.00
75.20	0.140 *	0.00
75.20	0.140 *	0.00
85.20	0.140 *	0.00
85.20	0.140 *	0.00
90.20	0.140 *	0.00

* DEFAULT VALUE = 0.01 D
 ** DEFAULT VALUE = 0.9

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 * COMPUTATION RESULT *

 * FED. HWY. METHOD *

PILE PENETRATION FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	2.5	2.5
1.00	0.1	5.4	5.5
2.00	0.4	11.5	11.9
3.00	0.9	17.3	18.2
4.00	1.7	23.0	24.7
5.00	2.6	28.8	31.4
6.00	3.7	34.6	38.3
7.00	5.1	40.3	45.4
8.00	6.7	43.9	50.5
9.00	8.4	46.4	54.8
10.00	10.3	48.7	58.9
11.00	12.2	51.3	63.5
12.00	14.3	56.0	70.3
13.00	16.6	60.6	77.3
14.00	19.1	65.3	84.4
15.00	21.8	69.9	91.8
16.00	24.7	74.6	99.3
17.00	27.7	79.3	107.0
18.00	31.0	94.4	125.4
19.00	34.4	113.7	148.1

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20.00	38.4	133.7	172.2
21.00	43.2	151.0	194.2
22.00	48.1	158.2	206.3
23.00	53.3	165.4	218.7
24.00	58.7	172.6	231.3
25.00	64.4	148.2	212.5
26.00	68.3	111.4	179.7
27.00	71.6	72.6	144.2
28.00	74.2	42.1	116.3
29.00	76.7	42.1	118.8
30.00	79.3	43.4	122.7
31.00	81.9	45.1	127.0
32.00	84.8	46.8	131.6
33.00	87.8	48.1	135.9
34.00	90.9	48.1	139.0
35.00	93.9	48.1	142.0
36.00	97.0	48.1	145.1
37.00	100.1	48.1	148.2
38.00	103.1	48.1	151.2
39.00	106.2	48.1	154.3
40.00	109.2	48.1	157.3
41.00	112.3	48.1	160.4
42.00	115.3	48.1	163.4
43.00	118.4	47.6	166.0
44.00	121.6	46.9	168.5
45.00	124.8	46.2	171.0
46.00	128.0	45.7	173.7
47.00	131.1	45.7	176.8
48.00	134.3	45.7	180.0
49.00	137.4	45.7	183.1
50.00	140.6	45.7	186.3
51.00	143.7	45.7	189.4
52.00	146.9	45.7	192.6
53.00	150.0	45.7	195.7
54.00	153.2	45.7	198.9
55.00	156.3	46.7	203.0
56.00	159.6	48.1	207.7
57.00	163.1	49.5	212.6
58.00	166.8	50.5	217.3
59.00	170.5	50.5	221.0
60.00	174.2	50.5	224.7
61.00	177.9	50.5	228.4
62.00	181.6	50.5	232.1
63.00	185.3	50.5	235.8
64.00	189.0	50.5	239.5
65.00	192.7	42.7	235.5
66.00	196.5	32.4	228.9
67.00	200.3	22.0	222.3
68.00	204.0	14.2	218.3
69.00	207.8	14.2	222.0
70.00	211.7	14.2	225.9
71.00	215.6	14.2	229.8
72.00	219.5	14.2	233.8
73.00	223.5	14.2	237.8
74.00	227.6	14.2	241.8
75.00	231.7	28.0	259.8
76.00	235.9	46.4	282.3
77.00	241.3	64.8	306.1
78.00	247.8	78.6	326.4
79.00	254.5	78.6	333.1
80.00	261.2	78.6	339.8
81.00	268.1	78.6	346.7
82.00	275.0	78.6	353.6

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 282.0 78.6 360.6

NOTES:

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

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

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.4167E-01	0.0000E+00	0.0000E+00
			0.4922E-02	0.2240E-01
			0.8204E-02	0.4340E-01
			0.1231E-01	0.7980E-01
			0.1477E-01	0.1120E+00
			0.1641E-01	0.1400E+00
			0.1641E-01	0.2800E+00
			0.1641E-01	0.4200E+00
			0.1641E-01	0.7000E+00
			0.1641E-01	0.2800E+01
2	10	0.4350E+01	0.0000E+00	0.0000E+00
			0.5139E+00	0.2240E-01
			0.8565E+00	0.4340E-01
			0.1285E+01	0.7980E-01
			0.1542E+01	0.1120E+00
			0.1713E+01	0.1400E+00
			0.1713E+01	0.2800E+00
			0.1713E+01	0.4200E+00
			0.1713E+01	0.7000E+00
			0.1713E+01	0.2800E+01
3	10	0.8658E+01	0.0000E+00	0.0000E+00
			0.1023E+01	0.2240E-01
			0.1705E+01	0.4340E-01
			0.2557E+01	0.7980E-01
			0.3069E+01	0.1120E+00
			0.3409E+01	0.1400E+00
			0.3409E+01	0.2800E+00
			0.3409E+01	0.4200E+00
			0.3409E+01	0.7000E+00
			0.3409E+01	0.2800E+01
4	10	0.8742E+01	0.0000E+00	0.0000E+00
			0.1033E+01	0.2240E-01
			0.1721E+01	0.4340E-01
			0.2582E+01	0.7980E-01
			0.3098E+01	0.1120E+00
			0.3442E+01	0.1400E+00
			0.3442E+01	0.2800E+00
			0.3442E+01	0.4200E+00
			0.3442E+01	0.7000E+00
			0.3442E+01	0.2800E+01

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5	10	0.1345E+02	0.0000E+00	0.0000E+00
			0.1412E+01	0.2240E-01
			0.2354E+01	0.4340E-01
			0.3531E+01	0.7980E-01
			0.4237E+01	0.1120E+00
			0.4708E+01	0.1400E+00
			0.4708E+01	0.2800E+00
			0.4708E+01	0.4200E+00
			0.4708E+01	0.7000E+00
			0.4708E+01	0.2800E+01
6	10	0.1816E+02	0.0000E+00	0.0000E+00
			0.1907E+01	0.2240E-01
			0.3178E+01	0.4340E-01
			0.4767E+01	0.7980E-01
			0.5721E+01	0.1120E+00
			0.6356E+01	0.1400E+00
			0.6356E+01	0.2800E+00
			0.6356E+01	0.4200E+00
			0.6356E+01	0.7000E+00
			0.6356E+01	0.2800E+01
7	10	0.1824E+02	0.0000E+00	0.0000E+00
			0.1916E+01	0.2240E-01
			0.3193E+01	0.4340E-01
			0.4789E+01	0.7980E-01
			0.5747E+01	0.1120E+00
			0.6385E+01	0.1400E+00
			0.6385E+01	0.2800E+00
			0.6385E+01	0.4200E+00
			0.6385E+01	0.7000E+00
			0.6385E+01	0.2800E+01
8	10	0.2170E+02	0.0000E+00	0.0000E+00
			0.2843E+01	0.2240E-01
			0.4739E+01	0.4340E-01
			0.7108E+01	0.7980E-01
			0.8529E+01	0.1120E+00
			0.9477E+01	0.1400E+00
			0.9477E+01	0.2800E+00
			0.9477E+01	0.4200E+00
			0.9477E+01	0.7000E+00
			0.9477E+01	0.2800E+01
9	10	0.2516E+02	0.0000E+00	0.0000E+00
			0.3296E+01	0.2240E-01
			0.5494E+01	0.4340E-01
			0.8241E+01	0.7980E-01
			0.9889E+01	0.1120E+00
			0.1099E+02	0.1400E+00
			0.1099E+02	0.2800E+00
			0.1099E+02	0.4200E+00
			0.1099E+02	0.7000E+00
			0.1099E+02	0.2800E+01
10	10	0.2524E+02	0.0000E+00	0.0000E+00
			0.3307E+01	0.2240E-01
			0.5512E+01	0.4340E-01
			0.8268E+01	0.7980E-01
			0.9922E+01	0.1120E+00
			0.1102E+02	0.1400E+00
			0.9922E+01	0.2800E+00

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			0.9922E+01	0.4200E+00
			0.9922E+01	0.7000E+00
11	10	0.2770E+02	0.9922E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2169E+01	0.2240E-01
			0.3615E+01	0.4340E-01
			0.5423E+01	0.7980E-01
			0.6508E+01	0.1120E+00
			0.7231E+01	0.1400E+00
			0.6508E+01	0.2800E+00
			0.6508E+01	0.4200E+00
			0.6508E+01	0.7000E+00
12	10	0.3016E+02	0.6508E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2186E+01	0.2240E-01
			0.3644E+01	0.4340E-01
			0.5466E+01	0.7980E-01
			0.6559E+01	0.1120E+00
			0.7287E+01	0.1400E+00
			0.6559E+01	0.2800E+00
			0.6559E+01	0.4200E+00
			0.6559E+01	0.7000E+00
13	10	0.3024E+02	0.6559E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2195E+01	0.2240E-01
			0.3659E+01	0.4340E-01
			0.5488E+01	0.7980E-01
			0.6586E+01	0.1120E+00
			0.7317E+01	0.1400E+00
			0.6586E+01	0.2800E+00
			0.6586E+01	0.4200E+00
			0.6586E+01	0.7000E+00
14	10	0.3670E+02	0.6586E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2594E+01	0.2240E-01
			0.4324E+01	0.4340E-01
			0.6485E+01	0.7980E-01
			0.7782E+01	0.1120E+00
			0.8647E+01	0.1400E+00
			0.7782E+01	0.2800E+00
			0.7782E+01	0.4200E+00
			0.7782E+01	0.7000E+00
15	10	0.4316E+02	0.7782E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2629E+01	0.2240E-01
			0.4381E+01	0.4340E-01
			0.6572E+01	0.7980E-01
			0.7886E+01	0.1120E+00
			0.8762E+01	0.1400E+00
			0.7886E+01	0.2800E+00
			0.7886E+01	0.4200E+00
			0.7886E+01	0.7000E+00
16	10	0.4324E+02	0.7886E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2647E+01	0.2240E-01
			0.4411E+01	0.4340E-01
			0.6617E+01	0.7980E-01

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			0.7940E+01	0.1120E+00
			0.8823E+01	0.1400E+00
			0.7940E+01	0.2800E+00
			0.7940E+01	0.4200E+00
			0.7940E+01	0.7000E+00
			0.7940E+01	0.2800E+01
17	10	0.4920E+02		
			0.0000E+00	0.0000E+00
			0.2671E+01	0.2240E-01
			0.4452E+01	0.4340E-01
			0.6679E+01	0.7980E-01
			0.8014E+01	0.1120E+00
			0.8905E+01	0.1400E+00
			0.8014E+01	0.2800E+00
			0.8014E+01	0.4200E+00
			0.8014E+01	0.7000E+00
			0.8014E+01	0.2800E+01
18	10	0.5516E+02		
			0.0000E+00	0.0000E+00
			0.2699E+01	0.2240E-01
			0.4498E+01	0.4340E-01
			0.6747E+01	0.7980E-01
			0.8096E+01	0.1120E+00
			0.8996E+01	0.1400E+00
			0.8096E+01	0.2800E+00
			0.8096E+01	0.4200E+00
			0.8096E+01	0.7000E+00
			0.8096E+01	0.2800E+01
19	10	0.5524E+02		
			0.0000E+00	0.0000E+00
			0.2713E+01	0.2240E-01
			0.4522E+01	0.4340E-01
			0.6783E+01	0.7980E-01
			0.8139E+01	0.1120E+00
			0.9044E+01	0.1400E+00
			0.8139E+01	0.2800E+00
			0.8139E+01	0.4200E+00
			0.8139E+01	0.7000E+00
			0.8139E+01	0.2800E+01
20	10	0.6020E+02		
			0.0000E+00	0.0000E+00
			0.3143E+01	0.2240E-01
			0.5239E+01	0.4340E-01
			0.7858E+01	0.7980E-01
			0.9430E+01	0.1120E+00
			0.1048E+02	0.1400E+00
			0.9430E+01	0.2800E+00
			0.9430E+01	0.4200E+00
			0.9430E+01	0.7000E+00
			0.9430E+01	0.2800E+01
21	10	0.6516E+02		
			0.0000E+00	0.0000E+00
			0.3163E+01	0.2240E-01
			0.5272E+01	0.4340E-01
			0.7908E+01	0.7980E-01
			0.9490E+01	0.1120E+00
			0.1054E+02	0.1400E+00
			0.9490E+01	0.2800E+00
			0.9490E+01	0.4200E+00
			0.9490E+01	0.7000E+00
			0.9490E+01	0.2800E+01
22	10	0.6524E+02		
			0.0000E+00	0.0000E+00

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			0.3174E+01	0.2240E-01
			0.5290E+01	0.4340E-01
			0.7935E+01	0.7980E-01
			0.9522E+01	0.1120E+00
			0.1058E+02	0.1400E+00
			0.1058E+02	0.2800E+00
			0.1058E+02	0.4200E+00
			0.1058E+02	0.7000E+00
23	10	0.7020E+02	0.1058E+02	0.2800E+01
			0.0000E+00	0.0000E+00
			0.3297E+01	0.2240E-01
			0.5495E+01	0.4340E-01
			0.8242E+01	0.7980E-01
			0.9891E+01	0.1120E+00
			0.1099E+02	0.1400E+00
			0.1099E+02	0.2800E+00
			0.1099E+02	0.4200E+00
			0.1099E+02	0.7000E+00
24	10	0.7516E+02	0.1099E+02	0.2800E+01
			0.0000E+00	0.0000E+00
			0.3534E+01	0.2240E-01
			0.5890E+01	0.4340E-01
			0.8835E+01	0.7980E-01
			0.1060E+02	0.1120E+00
			0.1178E+02	0.1400E+00
			0.1178E+02	0.2800E+00
			0.1178E+02	0.4200E+00
			0.1178E+02	0.7000E+00
25	10	0.7524E+02	0.1178E+02	0.2800E+01
			0.0000E+00	0.0000E+00
			0.3538E+01	0.2240E-01
			0.5897E+01	0.4340E-01
			0.8845E+01	0.7980E-01
			0.1061E+02	0.1120E+00
			0.1179E+02	0.1400E+00
			0.1179E+02	0.2800E+00
			0.1179E+02	0.4200E+00
			0.1179E+02	0.7000E+00
26	10	0.8020E+02	0.1179E+02	0.2800E+01
			0.0000E+00	0.0000E+00
			0.5775E+01	0.2240E-01
			0.9626E+01	0.4340E-01
			0.1444E+02	0.7980E-01
			0.1733E+02	0.1120E+00
			0.1925E+02	0.1400E+00
			0.1925E+02	0.2800E+00
			0.1925E+02	0.4200E+00
			0.1925E+02	0.7000E+00
27	10	0.8516E+02	0.1925E+02	0.2800E+01
			0.0000E+00	0.0000E+00
			0.5994E+01	0.2240E-01
			0.9991E+01	0.4340E-01
			0.1499E+02	0.7980E-01
			0.1798E+02	0.1120E+00
			0.1998E+02	0.1400E+00
			0.1998E+02	0.2800E+00
			0.1998E+02	0.4200E+00
			0.1998E+02	0.7000E+00

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28	10	0.8524E+02	0.1998E+02	0.2800E+01
			0.0000E+00	0.0000E+00
			0.5994E+01	0.2240E-01
			0.9991E+01	0.4340E-01
			0.1499E+02	0.7980E-01
			0.1798E+02	0.1120E+00
			0.1998E+02	0.1400E+00
			0.1998E+02	0.2800E+00
			0.1998E+02	0.4200E+00
			0.1998E+02	0.7000E+00
			0.1998E+02	0.2800E+01
29	10	0.8770E+02		
			0.0000E+00	0.0000E+00
			0.5994E+01	0.2240E-01
			0.9991E+01	0.4340E-01
			0.1499E+02	0.7980E-01
			0.1798E+02	0.1120E+00
			0.1998E+02	0.1400E+00
			0.1998E+02	0.2800E+00
			0.1998E+02	0.4200E+00
			0.1998E+02	0.7000E+00
			0.1998E+02	0.2800E+01
30	10	0.9016E+02		
			0.0000E+00	0.0000E+00
			0.5994E+01	0.2240E-01
			0.9991E+01	0.4340E-01
			0.1499E+02	0.7980E-01
			0.1798E+02	0.1120E+00
			0.1998E+02	0.1400E+00
			0.1998E+02	0.2800E+00
			0.1998E+02	0.4200E+00
			0.1998E+02	0.7000E+00
			0.1998E+02	0.2800E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.4912E+01	0.7000E-02
0.9824E+01	0.1400E-01
0.1965E+02	0.2800E-01
0.3930E+02	0.1820E+00
0.5895E+02	0.5880E+00
0.7073E+02	0.1022E+01
0.7859E+02	0.1400E+01
0.7859E+02	0.2100E+01
0.7859E+02	0.2800E+01

LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.7202E+00	0.1980E-03	0.7017E-01	0.1000E-03
0.7202E+01	0.1980E-02	0.7017E+00	0.1000E-02
0.3601E+02	0.9898E-02	0.3509E+01	0.5000E-02

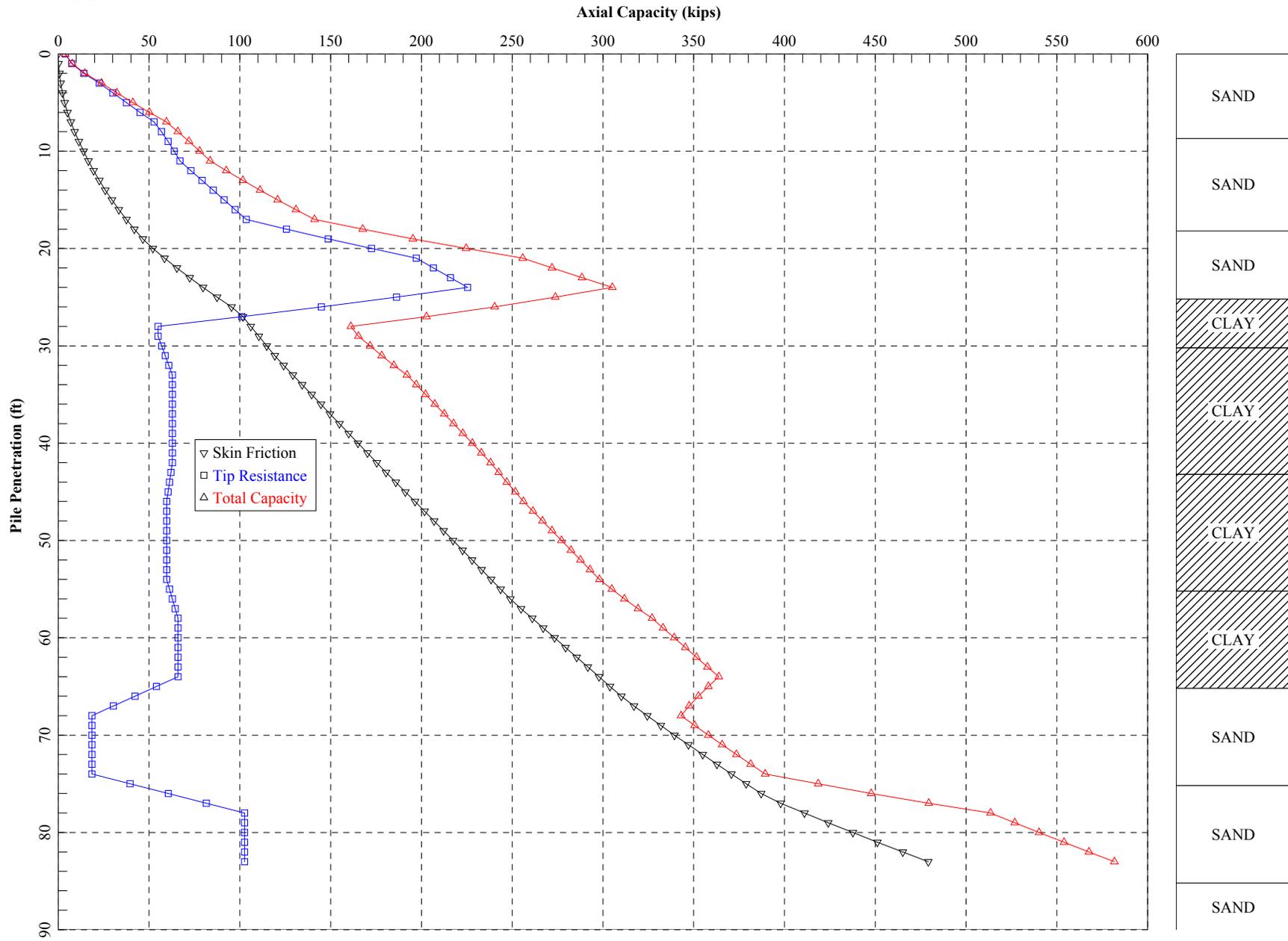
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0.7202E+02	0.1980E-01	0.7017E+01	0.1000E-01
0.1393E+03	0.3928E-01	0.1403E+02	0.2000E-01
0.2598E+03	0.8627E-01	0.2246E+02	0.5000E-01
0.3409E+03	0.1279E+00	0.2628E+02	0.8000E-01
0.3796E+03	0.1535E+00	0.2883E+02	0.1000E+00
0.4187E+03	0.2612E+00	0.4017E+02	0.2000E+00
0.4247E+03	0.5633E+00	0.5469E+02	0.5000E+00
0.4347E+03	0.8656E+00	0.6470E+02	0.8000E+00
0.4401E+03	0.1067E+01	0.7014E+02	0.1000E+01
0.4486E+03	0.2069E+01	0.7859E+02	0.2000E+01

16-Inch Dia. Closed End CIP Piles - UBV

Pier 2

B-003-1-24



**16-Inch Dia. Closed End CIP Piles - UBV
Pier 2
B-003-1-24**

B-003-1-24 - 16 Inch UBV.ap9o

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APILE for Windows, Version 2019.9.12

Serial Number : 136090498

A Program for Analyzing the Axial Capacity
and Short-term Settlement of Driven Piles
under Axial Loading.
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Resource International, Inc.
Columbus, OH

Path to file locations : C:\Users\legacy\Desktop\1.3.2025\16-inch\
Name of input data file : B-003-1-24 - 16 Inch UBV.ap9d
Name of output file : B-003-1-24 - 16 Inch UBV.ap9o
Name of plot output file : B-003-1-24 - 16 Inch UBV.ap9p

Time and Date of Analysis

Date: January 07, 2025 Time: 09:55:58

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* INPUT INFORMATION *

B-003-1-24 (Pier 2) -16 Inch

DESIGNER : AG/DEK

JOB NUMBER : W-23-155 (MOT-835-2.57)

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

B-003-1-24 - 16 Inch UBV.ap9o

PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 201.01 IN²

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 16.00 IN.
- INTERNAL DIAMETER, ID = 0.25 IN.
- TOTAL PILE LENGTH, TL = 83.00 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH
USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED
END SECTION = 83.00 FT.
- INTERNAL DIAMETER OF
ENHANCED END SECTION = 0.25 IN.

PLUGGED/UNPLUGGED CONDITIONS :

Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	SAND	0.80*	67.60	38.00	110.40**
8.70	SAND	0.80*	67.60	38.00	110.40**
8.70	SAND	0.80*	67.60	37.00	91.20**
18.20	SAND	0.80*	67.60	37.00	91.20**
18.20	SAND	0.80*	67.60	39.00	135.20**
25.20	SAND	0.80*	67.60	39.00	135.20**
25.20	CLAY	0.80*	62.60	0.00	4.80**
30.20	CLAY	0.80*	62.60	0.00	4.80**
30.20	CLAY	0.80*	67.60	0.00	4.80**
43.20	CLAY	0.80*	67.60	0.00	4.80**
43.20	CLAY	0.80*	62.60	0.00	4.80**
55.20	CLAY	0.80*	62.60	0.00	4.80**
55.20	CLAY	0.80*	67.60	0.00	4.80**
65.20	CLAY	0.80*	67.60	0.00	4.80**
65.20	SAND	0.80*	67.60	30.00	30.00**
75.20	SAND	0.80*	67.60	30.00	30.00**
75.20	SAND	0.80*	72.60	34.00	55.60**
85.20	SAND	0.80*	72.60	34.00	55.60**
85.20	SAND	0.80*	62.60	29.00	26.40**
90.20	SAND	0.80*	62.60	29.00	26.40**

* VALUE ASSUMED BY THE PROGRAM

** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

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*	4.38	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	4.38	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	4.75	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	4.75	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.25	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.25	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	1.000	1.000
8.70	1.000	1.000
8.70	1.000	1.000
18.20	1.000	1.000
18.20	1.000	1.000
25.20	1.000	1.000
25.20	1.000	1.000
30.20	1.000	1.000
30.20	1.000	1.000
43.20	1.000	1.000
43.20	1.000	1.000
55.20	1.000	1.000
55.20	1.000	1.000
65.20	1.000	1.000
65.20	1.000	1.000
75.20	1.000	1.000
75.20	1.000	1.000
85.20	1.000	1.000
85.20	1.000	1.000
90.20	1.000	1.000

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DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.160 *	0.00
8.70	0.160 *	0.00
8.70	0.160 *	0.00
18.20	0.160 *	0.00
18.20	0.160 *	0.00
25.20	0.160 *	0.00
25.20	0.160 *	0.90 **
30.20	0.160 *	0.90 **
30.20	0.160 *	0.90 **
43.20	0.160 *	0.90 **
43.20	0.160 *	0.90 **
55.20	0.160 *	0.90 **
55.20	0.160 *	0.90 **
65.20	0.160 *	0.90 **
65.20	0.160 *	0.00
75.20	0.160 *	0.00
75.20	0.160 *	0.00
85.20	0.160 *	0.00
85.20	0.160 *	0.00
90.20	0.160 *	0.00

* DEFAULT VALUE = 0.01 D

** DEFAULT VALUE = 0.9

Q100, Low Scour Elev = 864.99 ft, (1.2 feet
below bottom of pile cap)
Side Friction Loss Due to Scour = 0.2 kips

1

* COMPUTATION RESULT *

* FED. HWY. METHOD *

PILE PENETRATION FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	3.8	3.8
1.00	0.1	7.5	7.7
2.00	0.6	14.1	14.7
3.00	1.3	22.6	23.8
4.00	2.3	30.1	32.4
5.00	3.5	37.6	41.1
6.00	5.1	45.1	50.2
7.00	6.9	52.7	59.6
8.00	9.0	56.8	65.8
9.00	11.4	60.5	72.0
10.00	14.0	63.9	77.9
11.00	16.6	67.0	83.6
12.00	19.5	73.1	92.5
13.00	22.6	79.2	101.7
14.00	25.9	85.3	111.2
15.00	29.6	91.4	120.9
16.00	33.4	97.4	130.9
17.00	37.6	103.5	141.1
18.00	41.9	125.7	167.7
19.00	46.6	148.7	195.3
20.00	52.1	172.6	224.7

16-Inch Dia. Closed End CIP Piles - UBV

Pier 2

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B-003-1-24 - 16 Inch UBV.ap9o			
21.00	58.5	197.2	255.8
22.00	65.3	206.6	271.9
23.00	72.4	216.0	288.4
24.00	79.7	225.4	305.2
25.00	87.5	186.3	273.8
26.00	95.5	144.9	240.4
27.00	101.7	101.1	202.8
28.00	106.1	55.0	161.1
29.00	110.5	55.0	165.4
30.00	114.8	56.9	171.8
31.00	119.3	58.9	178.2
32.00	124.1	60.9	184.9
33.00	129.2	62.8	192.0
34.00	134.3	62.8	197.2
35.00	139.5	62.8	202.3
36.00	144.6	62.8	207.4
37.00	149.7	62.8	212.6
38.00	154.9	62.8	217.7
39.00	160.0	62.8	222.8
40.00	165.1	62.8	228.0
41.00	170.3	62.8	233.1
42.00	175.4	62.8	238.2
43.00	180.5	62.0	242.6
44.00	185.9	61.3	247.1
45.00	191.2	60.5	251.7
46.00	196.5	59.7	256.2
47.00	201.7	59.7	261.4
48.00	207.0	59.7	266.7
49.00	212.2	59.7	271.9
50.00	217.5	59.7	277.1
51.00	222.7	59.7	282.4
52.00	227.9	59.7	287.6
53.00	233.2	59.7	292.9
54.00	238.4	59.7	298.1
55.00	243.7	61.3	304.9
56.00	249.0	62.8	311.9
57.00	254.9	64.4	319.3
58.00	261.0	66.0	327.0
59.00	267.1	66.0	333.1
60.00	273.3	66.0	339.2
61.00	279.4	66.0	345.4
62.00	285.5	66.0	351.5
63.00	291.7	66.0	357.6
64.00	297.8	66.0	363.8
65.00	303.9	54.1	358.0
66.00	310.2	42.3	352.5
67.00	317.1	30.4	347.5
68.00	324.4	18.6	343.0
69.00	331.9	18.6	350.5
70.00	339.4	18.6	358.0
71.00	347.1	18.6	365.7
72.00	354.9	18.6	373.5
73.00	362.8	18.6	381.4
74.00	370.8	18.6	389.4
75.00	378.9	39.6	418.5
76.00	387.1	60.6	447.8
77.00	397.8	81.6	479.4
78.00	410.9	102.7	513.5
79.00	424.1	102.7	526.8
80.00	437.6	102.7	540.2
81.00	451.2	102.7	553.9
82.00	465.1	102.7	567.7
83.00	479.1	102.7	581.7

Max. Factored Designed Load per Pile = 172.0 kips

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Required Nominal Resistance per Pile = $(172/0.7)$ kips = 245.7 kips

Required Nominal Driving Resistance = $(172/0.7) + \text{scour loss } (0.2) = 245.9$ kips

Pile length = $44.2 + 2.0$ (estimated embedment in pile cap) = 46.2 feet

Estimated Pile Length to Rounded Up to Nearest 5 feet = 50.0 feet

Order Length = 55 feet

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	0.4167E-01	0.0000E+00	0.0000E+00
			0.5850E-02	0.2560E-01
			0.9749E-02	0.4960E-01
			0.1462E-01	0.9120E-01
			0.1755E-01	0.1280E+00
			0.1950E-01	0.1600E+00
			0.1950E-01	0.3200E+00
			0.1950E-01	0.4800E+00
			0.1950E-01	0.8000E+00
			0.1950E-01	0.3200E+01
2	10	0.4350E+01	0.0000E+00	0.0000E+00
			0.6107E+00	0.2560E-01
			0.1018E+01	0.4960E-01
			0.1527E+01	0.9120E-01
			0.1832E+01	0.1280E+00
			0.2036E+01	0.1600E+00
			0.2036E+01	0.3200E+00
			0.2036E+01	0.4800E+00
			0.2036E+01	0.8000E+00
			0.2036E+01	0.3200E+01
3	10	0.8658E+01	0.0000E+00	0.0000E+00
			0.1216E+01	0.2560E-01
			0.2026E+01	0.4960E-01
			0.3039E+01	0.9120E-01
			0.3647E+01	0.1280E+00
			0.4052E+01	0.1600E+00
			0.4052E+01	0.3200E+00
			0.4052E+01	0.4800E+00
			0.4052E+01	0.8000E+00
			0.4052E+01	0.3200E+01
4	10	0.8742E+01	0.0000E+00	0.0000E+00
			0.1227E+01	0.2560E-01
			0.2045E+01	0.4960E-01
			0.3068E+01	0.9120E-01
			0.3682E+01	0.1280E+00
			0.4091E+01	0.1600E+00
			0.4091E+01	0.3200E+00
			0.4091E+01	0.4800E+00
			0.4091E+01	0.8000E+00
			0.4091E+01	0.3200E+01
5	10	0.1345E+02	0.0000E+00	0.0000E+00
			0.1227E+01	0.2560E-01
			0.2045E+01	0.4960E-01
			0.3068E+01	0.9120E-01
			0.3682E+01	0.1280E+00
			0.4091E+01	0.1600E+00
			0.4091E+01	0.3200E+00
			0.4091E+01	0.4800E+00
			0.4091E+01	0.8000E+00
			0.4091E+01	0.3200E+01

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			0.0000E+00	0.0000E+00
			0.1672E+01	0.2560E-01
			0.2786E+01	0.4960E-01
			0.4180E+01	0.9120E-01
			0.5016E+01	0.1280E+00
			0.5573E+01	0.1600E+00
			0.5573E+01	0.3200E+00
			0.5573E+01	0.4800E+00
			0.5573E+01	0.8000E+00
			0.5573E+01	0.3200E+01
6	10	0.1816E+02		
			0.0000E+00	0.0000E+00
			0.2257E+01	0.2560E-01
			0.3762E+01	0.4960E-01
			0.5643E+01	0.9120E-01
			0.6771E+01	0.1280E+00
			0.7524E+01	0.1600E+00
			0.7524E+01	0.3200E+00
			0.7524E+01	0.4800E+00
			0.7524E+01	0.8000E+00
			0.7524E+01	0.3200E+01
7	10	0.1824E+02		
			0.0000E+00	0.0000E+00
			0.2267E+01	0.2560E-01
			0.3779E+01	0.4960E-01
			0.5669E+01	0.9120E-01
			0.6802E+01	0.1280E+00
			0.7558E+01	0.1600E+00
			0.7558E+01	0.3200E+00
			0.7558E+01	0.4800E+00
			0.7558E+01	0.8000E+00
			0.7558E+01	0.3200E+01
8	10	0.2170E+02		
			0.0000E+00	0.0000E+00
			0.3393E+01	0.2560E-01
			0.5655E+01	0.4960E-01
			0.8483E+01	0.9120E-01
			0.1018E+02	0.1280E+00
			0.1131E+02	0.1600E+00
			0.1131E+02	0.3200E+00
			0.1131E+02	0.4800E+00
			0.1131E+02	0.8000E+00
			0.1131E+02	0.3200E+01
9	10	0.2516E+02		
			0.0000E+00	0.0000E+00
			0.3934E+01	0.2560E-01
			0.6556E+01	0.4960E-01
			0.9834E+01	0.9120E-01
			0.1180E+02	0.1280E+00
			0.1311E+02	0.1600E+00
			0.1311E+02	0.3200E+00
			0.1311E+02	0.4800E+00
			0.1311E+02	0.8000E+00
			0.1311E+02	0.3200E+01
10	10	0.2524E+02		
			0.0000E+00	0.0000E+00
			0.3947E+01	0.2560E-01
			0.6578E+01	0.4960E-01
			0.9867E+01	0.9120E-01
			0.1184E+02	0.1280E+00
			0.1316E+02	0.1600E+00
			0.1184E+02	0.3200E+00
			0.1184E+02	0.4800E+00

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			0.1184E+02	0.8000E+00
			0.1184E+02	0.3200E+01
11	10	0.2770E+02	0.0000E+00	0.0000E+00
			0.2169E+01	0.2560E-01
			0.3615E+01	0.4960E-01
			0.5423E+01	0.9120E-01
			0.6508E+01	0.1280E+00
			0.7231E+01	0.1600E+00
			0.6508E+01	0.3200E+00
			0.6508E+01	0.4800E+00
			0.6508E+01	0.8000E+00
			0.6508E+01	0.3200E+01
12	10	0.3016E+02	0.0000E+00	0.0000E+00
			0.2180E+01	0.2560E-01
			0.3634E+01	0.4960E-01
			0.5451E+01	0.9120E-01
			0.6541E+01	0.1280E+00
			0.7267E+01	0.1600E+00
			0.6541E+01	0.3200E+00
			0.6541E+01	0.4800E+00
			0.6541E+01	0.8000E+00
			0.6541E+01	0.3200E+01
13	10	0.3024E+02	0.0000E+00	0.0000E+00
			0.2186E+01	0.2560E-01
			0.3643E+01	0.4960E-01
			0.5465E+01	0.9120E-01
			0.6558E+01	0.1280E+00
			0.7287E+01	0.1600E+00
			0.6558E+01	0.3200E+00
			0.6558E+01	0.4800E+00
			0.6558E+01	0.8000E+00
			0.6558E+01	0.3200E+01
14	10	0.3670E+02	0.0000E+00	0.0000E+00
			0.2553E+01	0.2560E-01
			0.4255E+01	0.4960E-01
			0.6383E+01	0.9120E-01
			0.7660E+01	0.1280E+00
			0.8511E+01	0.1600E+00
			0.7660E+01	0.3200E+00
			0.7660E+01	0.4800E+00
			0.7660E+01	0.8000E+00
			0.7660E+01	0.3200E+01
15	10	0.4316E+02	0.0000E+00	0.0000E+00
			0.2583E+01	0.2560E-01
			0.4306E+01	0.4960E-01
			0.6459E+01	0.9120E-01
			0.7750E+01	0.1280E+00
			0.8612E+01	0.1600E+00
			0.7750E+01	0.3200E+00
			0.7750E+01	0.4800E+00
			0.7750E+01	0.8000E+00
			0.7750E+01	0.3200E+01
16	10	0.4324E+02	0.0000E+00	0.0000E+00
			0.2599E+01	0.2560E-01
			0.4332E+01	0.4960E-01
			0.6498E+01	0.9120E-01
			0.7798E+01	0.1280E+00

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			0.8665E+01	0.1600E+00
			0.7798E+01	0.3200E+00
			0.7798E+01	0.4800E+00
			0.7798E+01	0.8000E+00
			0.7798E+01	0.3200E+01
17	10	0.4920E+02	0.0000E+00	0.0000E+00
			0.2607E+01	0.2560E-01
			0.4345E+01	0.4960E-01
			0.6517E+01	0.9120E-01
			0.7820E+01	0.1280E+00
			0.8689E+01	0.1600E+00
			0.7820E+01	0.3200E+00
			0.7820E+01	0.4800E+00
			0.7820E+01	0.8000E+00
			0.7820E+01	0.3200E+01
18	10	0.5516E+02	0.0000E+00	0.0000E+00
			0.2631E+01	0.2560E-01
			0.4384E+01	0.4960E-01
			0.6577E+01	0.9120E-01
			0.7892E+01	0.1280E+00
			0.8769E+01	0.1600E+00
			0.7892E+01	0.3200E+00
			0.7892E+01	0.4800E+00
			0.7892E+01	0.8000E+00
			0.7892E+01	0.3200E+01
19	10	0.5524E+02	0.0000E+00	0.0000E+00
			0.2643E+01	0.2560E-01
			0.4405E+01	0.4960E-01
			0.6608E+01	0.9120E-01
			0.7930E+01	0.1280E+00
			0.8811E+01	0.1600E+00
			0.7930E+01	0.3200E+00
			0.7930E+01	0.4800E+00
			0.7930E+01	0.8000E+00
			0.7930E+01	0.3200E+01
20	10	0.6020E+02	0.0000E+00	0.0000E+00
			0.3048E+01	0.2560E-01
			0.5080E+01	0.4960E-01
			0.7620E+01	0.9120E-01
			0.9144E+01	0.1280E+00
			0.1016E+02	0.1600E+00
			0.9144E+01	0.3200E+00
			0.9144E+01	0.4800E+00
			0.9144E+01	0.8000E+00
			0.9144E+01	0.3200E+01
21	10	0.6516E+02	0.0000E+00	0.0000E+00
			0.3074E+01	0.2560E-01
			0.5124E+01	0.4960E-01
			0.7686E+01	0.9120E-01
			0.9223E+01	0.1280E+00
			0.1025E+02	0.1600E+00
			0.9223E+01	0.3200E+00
			0.9223E+01	0.4800E+00
			0.9223E+01	0.8000E+00
			0.9223E+01	0.3200E+01
22	10	0.6524E+02	0.0000E+00	0.0000E+00
			0.3088E+01	0.2560E-01

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			0.5147E+01	0.4960E-01
			0.7721E+01	0.9120E-01
			0.9265E+01	0.1280E+00
			0.1029E+02	0.1600E+00
			0.1029E+02	0.3200E+00
			0.1029E+02	0.4800E+00
			0.1029E+02	0.8000E+00
			0.1029E+02	0.3200E+01
23	10	0.7020E+02		
			0.0000E+00	0.0000E+00
			0.3800E+01	0.2560E-01
			0.6334E+01	0.4960E-01
			0.9501E+01	0.9120E-01
			0.1140E+02	0.1280E+00
			0.1267E+02	0.1600E+00
			0.1267E+02	0.3200E+00
			0.1267E+02	0.4800E+00
			0.1267E+02	0.8000E+00
			0.1267E+02	0.3200E+01
24	10	0.7516E+02		
			0.0000E+00	0.0000E+00
			0.4074E+01	0.2560E-01
			0.6789E+01	0.4960E-01
			0.1018E+02	0.9120E-01
			0.1222E+02	0.1280E+00
			0.1358E+02	0.1600E+00
			0.1358E+02	0.3200E+00
			0.1358E+02	0.4800E+00
			0.1358E+02	0.8000E+00
			0.1358E+02	0.3200E+01
25	10	0.7524E+02		
			0.0000E+00	0.0000E+00
			0.4078E+01	0.2560E-01
			0.6797E+01	0.4960E-01
			0.1020E+02	0.9120E-01
			0.1223E+02	0.1280E+00
			0.1359E+02	0.1600E+00
			0.1359E+02	0.3200E+00
			0.1359E+02	0.4800E+00
			0.1359E+02	0.8000E+00
			0.1359E+02	0.3200E+01
26	10	0.8020E+02		
			0.0000E+00	0.0000E+00
			0.6755E+01	0.2560E-01
			0.1126E+02	0.4960E-01
			0.1689E+02	0.9120E-01
			0.2027E+02	0.1280E+00
			0.2252E+02	0.1600E+00
			0.2252E+02	0.3200E+00
			0.2252E+02	0.4800E+00
			0.2252E+02	0.8000E+00
			0.2252E+02	0.3200E+01
27	10	0.8516E+02		
			0.0000E+00	0.0000E+00
			0.7012E+01	0.2560E-01
			0.1169E+02	0.4960E-01
			0.1753E+02	0.9120E-01
			0.2103E+02	0.1280E+00
			0.2337E+02	0.1600E+00
			0.2337E+02	0.3200E+00
			0.2337E+02	0.4800E+00
			0.2337E+02	0.8000E+00
			0.2337E+02	0.3200E+01

Station	Depth (ft)	Load (kip)	Settlement (in)	Settlement (in)
28	10	0.8524E+02	0.0000E+00	0.0000E+00
			0.7012E+01	0.2560E-01
			0.1169E+02	0.4960E-01
			0.1753E+02	0.9120E-01
			0.2103E+02	0.1280E+00
			0.2337E+02	0.1600E+00
			0.2337E+02	0.3200E+00
			0.2337E+02	0.4800E+00
			0.2337E+02	0.8000E+00
			0.2337E+02	0.3200E+01
29	10	0.8770E+02	0.0000E+00	0.0000E+00
			0.7012E+01	0.2560E-01
			0.1169E+02	0.4960E-01
			0.1753E+02	0.9120E-01
			0.2103E+02	0.1280E+00
			0.2337E+02	0.1600E+00
			0.2337E+02	0.3200E+00
			0.2337E+02	0.4800E+00
			0.2337E+02	0.8000E+00
			0.2337E+02	0.3200E+01
30	10	0.9016E+02	0.0000E+00	0.0000E+00
			0.7012E+01	0.2560E-01
			0.1169E+02	0.4960E-01
			0.1753E+02	0.9120E-01
			0.2103E+02	0.1280E+00
			0.2337E+02	0.1600E+00
			0.2337E+02	0.3200E+00
			0.2337E+02	0.4800E+00
			0.2337E+02	0.8000E+00
			0.2337E+02	0.3200E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.6416E+01	0.8000E-02
0.1283E+02	0.1600E-01
0.2566E+02	0.3200E-01
0.5133E+02	0.2080E+00
0.7699E+02	0.6720E+00
0.9239E+02	0.1168E+01
0.1027E+03	0.1600E+01
0.1027E+03	0.2400E+01
0.1027E+03	0.3200E+01

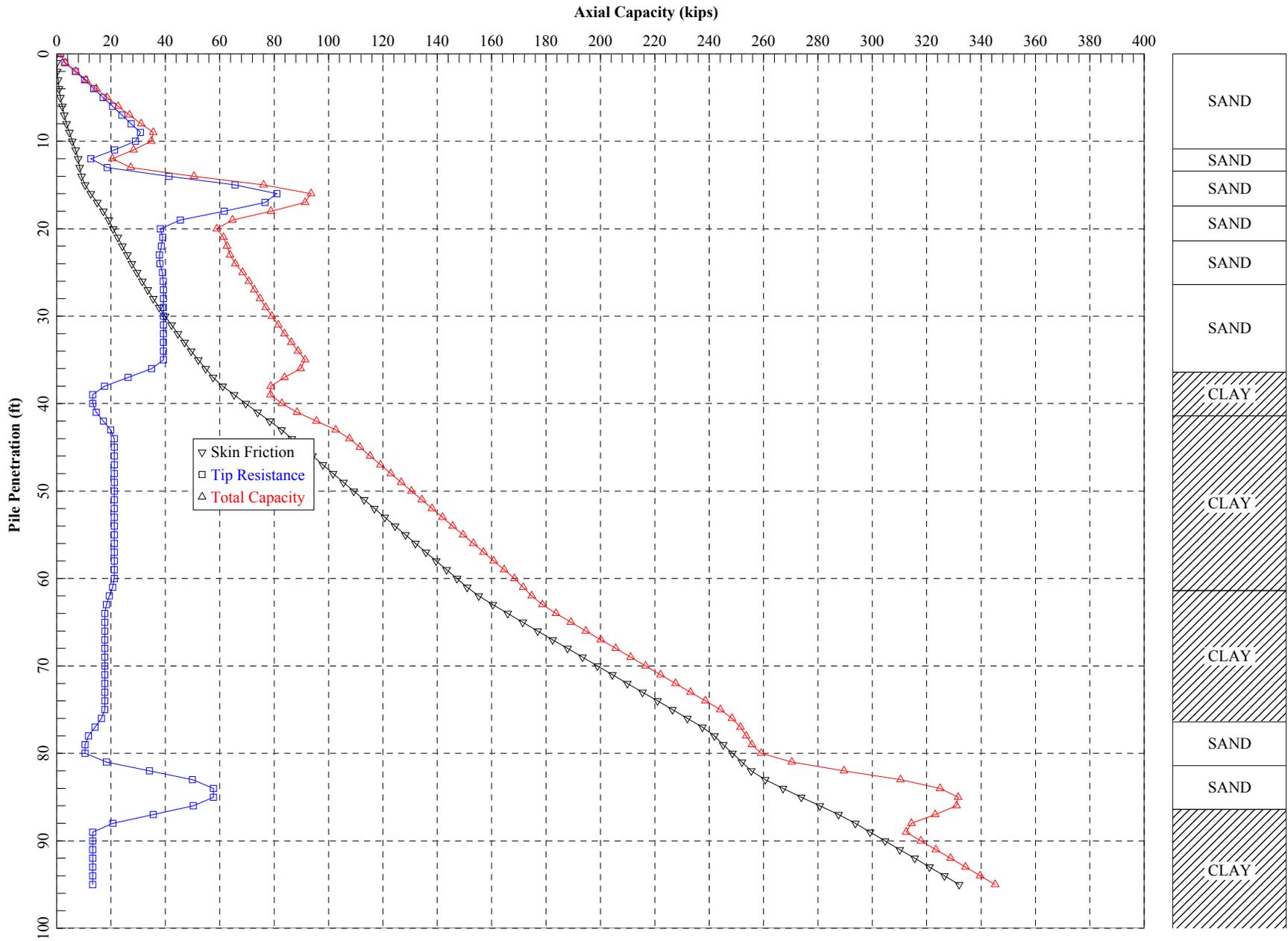
LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.7591E+00	0.1802E-03	0.8020E-01	0.1000E-03
0.7591E+01	0.1802E-02	0.8020E+00	0.1000E-02
0.3796E+02	0.9008E-02	0.4010E+01	0.5000E-02
0.7591E+02	0.1802E-01	0.8020E+01	0.1000E-01

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0.1501E+03	0.3597E-01	0.1604E+02	0.2000E-01
0.2934E+03	0.8173E-01	0.2829E+02	0.5000E-01
0.3876E+03	0.1219E+00	0.3266E+02	0.8000E-01
0.4363E+03	0.1473E+00	0.3558E+02	0.1000E+00
0.5214E+03	0.2584E+00	0.5016E+02	0.2000E+00
0.5249E+03	0.5600E+00	0.6748E+02	0.5000E+00
0.5384E+03	0.8623E+00	0.8096E+02	0.8000E+00
0.5446E+03	0.1063E+01	0.8717E+02	0.1000E+01
0.5601E+03	0.2066E+01	0.1027E+03	0.2000E+01

12-Inch Dia. Closed End CIP Piles - UBV Forward Abutment B-004-1-24



**12-Inch Dia. Closed End CIP Piles - UBV
Forward Abutment
B-004-1-24**

B-004-1-24 UBV.ap9o

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APILE for Windows, Version 2019.9.12

Serial Number : 136090498

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 :

Resource International, Inc.
Columbus, OH

Abt)\B-004-1-24\
Path to file locations : C:\Users\legacy\Desktop\1.3.2025\12 In Abt (only
Name of input data file : B-004-1-24 UBV.ap9d
Name of output file : B-004-1-24 UBV.ap9o
Name of plot output file : B-004-1-24 UBV.ap9p

Time and Date of Analysis

Date: January 07, 2025 Time: 09:26:28

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* INPUT INFORMATION *

B-004-1-24 (Forward Abutment)

DESIGNER : AG/DEK

JOB NUMBER : W-23-155 (MOT-835-2.57)

METHOD FOR UNIT LOAD TRANSFERS :

- FHWA (Federal Highway Administration)
Unfactored Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

TYPE OF LOADING :

- COMPRESSION

PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
 - Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
 - CROSS SECTION AREA = 113.05 IN²

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 12.00 IN.
 - INTERNAL DIAMETER, ID = 0.25 IN.
 - TOTAL PILE LENGTH, TL = 95.00 FT.
 - BATTER ANGLE = 0.00 DEG
 - PILE STICKUP LENGTH, PSL = 0.00 FT.
 - ZERO FRICTION LENGTH, ZFL = 0.00 FT.
 - INCREMENT OF PILE LENGTH
 USED IN COMPUTATION = 1.00 FT.
 - LENGTH OF ENHANCED
 END SECTION = 95.00 FT.
 - INTERNAL DIAMETER OF
 ENHANCED END SECTION = 0.25 IN.

PLUGGED/UNPLUGGED CONDITIONS :
 Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	SAND	0.80*	67.60	37.00	91.20**
10.90	SAND	0.80*	67.60	37.00	91.20**
10.90	SAND	0.80*	52.60	28.00	22.80**
13.40	SAND	0.80*	52.60	28.00	22.80**
13.40	SAND	0.80*	67.60	39.00	135.20**
17.40	SAND	0.80*	67.60	39.00	135.20**
17.40	SAND	0.80*	72.60	34.00	55.60**
21.40	SAND	0.80*	72.60	34.00	55.60**
21.40	SAND	0.80*	67.60	33.00	47.20**
26.40	SAND	0.80*	67.60	33.00	47.20**
26.40	SAND	0.80*	67.60	33.00	47.20**
36.40	SAND	0.80*	67.60	33.00	47.20**
36.40	CLAY	0.80*	62.60	0.00	4.80**
41.40	CLAY	0.80*	62.60	0.00	4.80**
41.40	CLAY	0.80*	62.60	0.00	4.80**
61.40	CLAY	0.80*	62.60	0.00	4.80**
61.40	CLAY	0.80*	62.60	0.00	4.80**
76.40	CLAY	0.80*	62.60	0.00	4.80**
76.40	SAND	0.80*	62.60	27.00	19.80**
81.40	SAND	0.80*	62.60	27.00	19.80**
81.40	SAND	0.80*	72.60	34.00	55.60**

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61.40	1.000	1.000
61.40	1.000	1.000
76.40	1.000	1.000
76.40	1.000	1.000
81.40	1.000	1.000
81.40	1.000	1.000
86.40	1.000	1.000
86.40	1.000	1.000
100.40	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.120 *	0.00
10.90	0.120 *	0.00
10.90	0.120 *	0.00
13.40	0.120 *	0.00
13.40	0.120 *	0.00
17.40	0.120 *	0.00
17.40	0.120 *	0.00
21.40	0.120 *	0.00
21.40	0.120 *	0.00
26.40	0.120 *	0.00
26.40	0.120 *	0.00
36.40	0.120 *	0.00
36.40	0.120 *	0.90 **
41.40	0.120 *	0.90 **
41.40	0.120 *	0.90 **
61.40	0.120 *	0.90 **
61.40	0.120 *	0.90 **
76.40	0.120 *	0.90 **
76.40	0.120 *	0.00
81.40	0.120 *	0.00
81.40	0.120 *	0.00
86.40	0.120 *	0.00
86.40	0.120 *	0.90 **
100.40	0.120 *	0.90 **

* DEFAULT VALUE = 0.01 D
 ** DEFAULT VALUE = 0.9

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 * COMPUTATION RESULT *

 * FED. HWY. METHOD *

PILE PENETRATION FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	1.3	1.3
1.00	0.1	3.0	3.1
2.00	0.2	6.9	7.1
3.00	0.5	10.3	10.8

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4.00	0.9	13.7	14.6
5.00	1.4	17.1	18.6
6.00	2.1	20.6	22.6
7.00	2.8	24.0	26.8
8.00	3.7	27.4	31.1
9.00	4.7	30.8	35.5
10.00	5.8	29.0	34.8
11.00	7.0	21.3	28.3
12.00	7.9	12.6	20.5
13.00	8.5	18.6	27.2
14.00	9.2	41.3	50.5
15.00	10.5	65.6	76.1
16.00	12.6	81.0	93.6
17.00	14.9	76.6	91.4
18.00	17.2	61.6	78.8
19.00	19.2	45.5	64.7
20.00	20.8	38.1	58.9
21.00	22.5	39.0	61.4
22.00	24.2	38.5	62.7
23.00	26.0	37.8	63.8
24.00	27.7	38.0	65.7
25.00	29.6	38.9	68.4
26.00	31.5	39.2	70.7
27.00	33.5	39.3	72.7
28.00	35.5	39.3	74.8
29.00	37.7	39.3	76.9
30.00	39.9	39.3	79.2
31.00	42.2	39.3	81.5
32.00	44.6	39.3	83.8
33.00	47.0	39.3	86.3
34.00	49.5	39.3	88.8
35.00	52.1	39.3	91.4
36.00	54.8	34.9	89.7
37.00	57.5	26.3	83.8
38.00	61.1	17.6	78.7
39.00	65.3	13.3	78.6
40.00	69.6	13.3	82.8
41.00	73.9	14.6	88.4
42.00	78.4	17.2	95.6
43.00	82.7	19.9	102.6
44.00	86.5	21.2	107.7
45.00	90.3	21.2	111.5
46.00	94.1	21.2	115.3
47.00	97.9	21.2	119.1
48.00	101.7	21.2	122.9
49.00	105.5	21.2	126.7
50.00	109.3	21.2	130.5
51.00	113.1	21.2	134.3
52.00	116.9	21.2	138.1
53.00	120.7	21.2	141.9
54.00	124.5	21.2	145.7
55.00	128.3	21.2	149.5
56.00	132.0	21.2	153.3
57.00	135.8	21.2	157.0
58.00	139.6	21.2	160.8
59.00	143.4	21.2	164.6
60.00	147.2	21.2	168.4
61.00	151.0	20.6	171.6
62.00	155.3	19.4	174.7
63.00	160.4	18.3	178.7
64.00	165.9	17.7	183.6
65.00	171.4	17.7	189.1
66.00	176.9	17.7	194.6

**12-Inch Dia. Closed End CIP Piles - UBV
Forward Abutment
B-004-1-24**

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67.00	182.4	17.7	200.1
68.00	187.9	17.7	205.6
69.00	193.4	17.7	211.1
70.00	198.9	17.7	216.6
71.00	204.4	17.7	222.1
72.00	209.9	17.7	227.6
73.00	215.5	17.7	233.1
74.00	221.0	17.7	238.6
75.00	226.5	17.7	244.1
76.00	232.0	16.5	248.4
77.00	237.5	14.1	251.5
78.00	241.9	11.7	253.6
79.00	245.2	10.5	255.7
80.00	248.6	10.5	259.1
81.00	252.1	18.3	270.4
82.00	255.5	34.1	289.6
83.00	260.6	49.9	310.4
84.00	267.2	57.7	324.9
85.00	273.9	57.7	331.6
86.00	280.7	50.3	331.0
87.00	287.6	35.5	323.1
88.00	293.8	20.7	314.4
89.00	299.2	13.3	312.5
90.00	304.7	13.3	317.9
91.00	310.1	13.3	323.4
92.00	315.6	13.3	328.8
93.00	321.0	13.3	334.3
94.00	326.5	13.3	339.7
95.00	331.9	13.3	345.2

NOTES:

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

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

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.4167E-01	0.0000E+00	0.0000E+00
			0.3204E-02	0.1920E-01
			0.5340E-02	0.3720E-01
			0.8009E-02	0.6840E-01
			0.9611E-02	0.9600E-01
			0.1068E-01	0.1200E+00
			0.1068E-01	0.2400E+00
			0.1068E-01	0.3600E+00
			0.1068E-01	0.6000E+00
			0.1068E-01	0.2400E+01
2	10	0.5450E+01	0.0000E+00	0.0000E+00
			0.4191E+00	0.1920E-01
			0.6984E+00	0.3720E-01
			0.1048E+01	0.6840E-01

Max. Factored Designed Load per Pile = 186.0kips
Required Nominal Resistance per Pile = (186/0.7) kips = 265.7 kips

Pile length = 80.5+ 2.0 (estimated embedment in pile cap) = 82.5 feet
Estimated Pile Length to Rounded Up to Nearest 5 feet = 85.0 feet
Pile Order Length = 90 feet

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			0.1257E+01	0.9600E-01
			0.1397E+01	0.1200E+00
			0.1397E+01	0.2400E+00
			0.1397E+01	0.3600E+00
			0.1397E+01	0.6000E+00
			0.1397E+01	0.2400E+01
3	10	0.1086E+02		
			0.0000E+00	0.0000E+00
			0.8349E+00	0.1920E-01
			0.1392E+01	0.3720E-01
			0.2087E+01	0.6840E-01
			0.2505E+01	0.9600E-01
			0.2783E+01	0.1200E+00
			0.2783E+01	0.2400E+00
			0.2783E+01	0.3600E+00
			0.2783E+01	0.6000E+00
			0.2783E+01	0.2400E+01
4	10	0.1094E+02		
			0.0000E+00	0.0000E+00
			0.8413E+00	0.1920E-01
			0.1402E+01	0.3720E-01
			0.2103E+01	0.6840E-01
			0.2524E+01	0.9600E-01
			0.2804E+01	0.1200E+00
			0.2804E+01	0.2400E+00
			0.2804E+01	0.3600E+00
			0.2804E+01	0.6000E+00
			0.2804E+01	0.2400E+01
5	10	0.1215E+02		
			0.0000E+00	0.0000E+00
			0.3817E+00	0.1920E-01
			0.6362E+00	0.3720E-01
			0.9544E+00	0.6840E-01
			0.1145E+01	0.9600E-01
			0.1272E+01	0.1200E+00
			0.1272E+01	0.2400E+00
			0.1272E+01	0.3600E+00
			0.1272E+01	0.6000E+00
			0.1272E+01	0.2400E+01
6	10	0.1336E+02		
			0.0000E+00	0.0000E+00
			0.4119E+00	0.1920E-01
			0.6865E+00	0.3720E-01
			0.1030E+01	0.6840E-01
			0.1236E+01	0.9600E-01
			0.1373E+01	0.1200E+00
			0.1373E+01	0.2400E+00
			0.1373E+01	0.3600E+00
			0.1373E+01	0.6000E+00
			0.1373E+01	0.2400E+01
7	10	0.1344E+02		
			0.0000E+00	0.0000E+00
			0.4140E+00	0.1920E-01
			0.6900E+00	0.3720E-01
			0.1035E+01	0.6840E-01
			0.1242E+01	0.9600E-01
			0.1380E+01	0.1200E+00
			0.1380E+01	0.2400E+00
			0.1380E+01	0.3600E+00
			0.1380E+01	0.6000E+00
			0.1380E+01	0.2400E+01
8	10	0.1540E+02		
			0.0000E+00	0.0000E+00

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			0.1388E+01	0.1920E-01
			0.2313E+01	0.3720E-01
			0.3470E+01	0.6840E-01
			0.4164E+01	0.9600E-01
			0.4627E+01	0.1200E+00
			0.4627E+01	0.2400E+00
			0.4627E+01	0.3600E+00
			0.4627E+01	0.6000E+00
			0.4627E+01	0.2400E+01
9	10	0.1736E+02		
			0.0000E+00	0.0000E+00
			0.1572E+01	0.1920E-01
			0.2621E+01	0.3720E-01
			0.3931E+01	0.6840E-01
			0.4717E+01	0.9600E-01
			0.5242E+01	0.1200E+00
			0.5242E+01	0.2400E+00
			0.5242E+01	0.3600E+00
			0.5242E+01	0.6000E+00
			0.5242E+01	0.2400E+01
10	10	0.1744E+02		
			0.0000E+00	0.0000E+00
			0.1580E+01	0.1920E-01
			0.2634E+01	0.3720E-01
			0.3951E+01	0.6840E-01
			0.4741E+01	0.9600E-01
			0.5268E+01	0.1200E+00
			0.5268E+01	0.2400E+00
			0.5268E+01	0.3600E+00
			0.5268E+01	0.6000E+00
			0.5268E+01	0.2400E+01
11	10	0.1940E+02		
			0.0000E+00	0.0000E+00
			0.1035E+01	0.1920E-01
			0.1726E+01	0.3720E-01
			0.2589E+01	0.6840E-01
			0.3106E+01	0.9600E-01
			0.3451E+01	0.1200E+00
			0.3451E+01	0.2400E+00
			0.3451E+01	0.3600E+00
			0.3451E+01	0.6000E+00
			0.3451E+01	0.2400E+01
12	10	0.2136E+02		
			0.0000E+00	0.0000E+00
			0.1151E+01	0.1920E-01
			0.1918E+01	0.3720E-01
			0.2878E+01	0.6840E-01
			0.3453E+01	0.9600E-01
			0.3837E+01	0.1200E+00
			0.3837E+01	0.2400E+00
			0.3837E+01	0.3600E+00
			0.3837E+01	0.6000E+00
			0.3837E+01	0.2400E+01
13	10	0.2144E+02		
			0.0000E+00	0.0000E+00
			0.1156E+01	0.1920E-01
			0.1927E+01	0.3720E-01
			0.2890E+01	0.6840E-01
			0.3468E+01	0.9600E-01
			0.3853E+01	0.1200E+00
			0.3853E+01	0.2400E+00
			0.3853E+01	0.3600E+00
			0.3853E+01	0.6000E+00

			B-004-1-24 UBV.ap9o	
14	10	0.2390E+02	0.3853E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1188E+01	0.1920E-01
			0.1980E+01	0.3720E-01
			0.2969E+01	0.6840E-01
			0.3563E+01	0.9600E-01
			0.3959E+01	0.1200E+00
			0.3959E+01	0.2400E+00
			0.3959E+01	0.3600E+00
			0.3959E+01	0.6000E+00
			0.3959E+01	0.2400E+01
15	10	0.2636E+02	0.0000E+00	0.0000E+00
			0.1312E+01	0.1920E-01
			0.2186E+01	0.3720E-01
			0.3279E+01	0.6840E-01
			0.3935E+01	0.9600E-01
			0.4373E+01	0.1200E+00
			0.4373E+01	0.2400E+00
			0.4373E+01	0.3600E+00
			0.4373E+01	0.6000E+00
			0.4373E+01	0.2400E+01
16	10	0.2644E+02	0.0000E+00	0.0000E+00
			0.1316E+01	0.1920E-01
			0.2193E+01	0.3720E-01
			0.3290E+01	0.6840E-01
			0.3948E+01	0.9600E-01
			0.4387E+01	0.1200E+00
			0.4387E+01	0.2400E+00
			0.4387E+01	0.3600E+00
			0.4387E+01	0.6000E+00
			0.4387E+01	0.2400E+01
17	10	0.3140E+02	0.0000E+00	0.0000E+00
			0.1566E+01	0.1920E-01
			0.2610E+01	0.3720E-01
			0.3916E+01	0.6840E-01
			0.4699E+01	0.9600E-01
			0.5221E+01	0.1200E+00
			0.5221E+01	0.2400E+00
			0.5221E+01	0.3600E+00
			0.5221E+01	0.6000E+00
			0.5221E+01	0.2400E+01
18	10	0.3636E+02	0.0000E+00	0.0000E+00
			0.1817E+01	0.1920E-01
			0.3028E+01	0.3720E-01
			0.4541E+01	0.6840E-01
			0.5450E+01	0.9600E-01
			0.6055E+01	0.1200E+00
			0.6055E+01	0.2400E+00
			0.6055E+01	0.3600E+00
			0.6055E+01	0.6000E+00
			0.6055E+01	0.2400E+01
19	10	0.3644E+02	0.0000E+00	0.0000E+00
			0.1821E+01	0.1920E-01
			0.3035E+01	0.3720E-01
			0.4552E+01	0.6840E-01
			0.5462E+01	0.9600E-01
			0.6069E+01	0.1200E+00

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			0.5462E+01	0.2400E+00
			0.5462E+01	0.3600E+00
			0.5462E+01	0.6000E+00
			0.5462E+01	0.2400E+01
20	10	0.3890E+02	0.0000E+00	0.0000E+00
			0.2825E+01	0.1920E-01
			0.4709E+01	0.3720E-01
			0.7063E+01	0.6840E-01
			0.8476E+01	0.9600E-01
			0.9417E+01	0.1200E+00
			0.8476E+01	0.2400E+00
			0.8476E+01	0.3600E+00
			0.8476E+01	0.6000E+00
			0.8476E+01	0.2400E+01
21	10	0.4136E+02	0.0000E+00	0.0000E+00
			0.2966E+01	0.1920E-01
			0.4944E+01	0.3720E-01
			0.7416E+01	0.6840E-01
			0.8899E+01	0.9600E-01
			0.9888E+01	0.1200E+00
			0.8899E+01	0.2400E+00
			0.8899E+01	0.3600E+00
			0.8899E+01	0.6000E+00
			0.8899E+01	0.2400E+01
22	10	0.4144E+02	0.0000E+00	0.0000E+00
			0.2999E+01	0.1920E-01
			0.4999E+01	0.3720E-01
			0.7498E+01	0.6840E-01
			0.8998E+01	0.9600E-01
			0.9997E+01	0.1200E+00
			0.8998E+01	0.2400E+00
			0.8998E+01	0.3600E+00
			0.8998E+01	0.6000E+00
			0.8998E+01	0.2400E+01
23	10	0.5140E+02	0.0000E+00	0.0000E+00
			0.2516E+01	0.1920E-01
			0.4193E+01	0.3720E-01
			0.6289E+01	0.6840E-01
			0.7547E+01	0.9600E-01
			0.8385E+01	0.1200E+00
			0.7547E+01	0.2400E+00
			0.7547E+01	0.3600E+00
			0.7547E+01	0.6000E+00
			0.7547E+01	0.2400E+01
24	10	0.6136E+02	0.0000E+00	0.0000E+00
			0.2738E+01	0.1920E-01
			0.4564E+01	0.3720E-01
			0.6846E+01	0.6840E-01
			0.8215E+01	0.9600E-01
			0.9128E+01	0.1200E+00
			0.8215E+01	0.2400E+00
			0.8215E+01	0.3600E+00
			0.8215E+01	0.6000E+00
			0.8215E+01	0.2400E+01
25	10	0.6144E+02	0.0000E+00	0.0000E+00
			0.2790E+01	0.1920E-01
			0.4650E+01	0.3720E-01

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			0.6976E+01	0.6840E-01
			0.8371E+01	0.9600E-01
			0.9301E+01	0.1200E+00
			0.8371E+01	0.2400E+00
			0.8371E+01	0.3600E+00
			0.8371E+01	0.6000E+00
			0.8371E+01	0.2400E+01
26	10	0.6890E+02		
			0.0000E+00	0.0000E+00
			0.3651E+01	0.1920E-01
			0.6085E+01	0.3720E-01
			0.9128E+01	0.6840E-01
			0.1095E+02	0.9600E-01
			0.1217E+02	0.1200E+00
			0.1095E+02	0.2400E+00
			0.1095E+02	0.3600E+00
			0.1095E+02	0.6000E+00
			0.1095E+02	0.2400E+01
27	10	0.7636E+02		
			0.0000E+00	0.0000E+00
			0.3651E+01	0.1920E-01
			0.6085E+01	0.3720E-01
			0.9128E+01	0.6840E-01
			0.1095E+02	0.9600E-01
			0.1217E+02	0.1200E+00
			0.1095E+02	0.2400E+00
			0.1095E+02	0.3600E+00
			0.1095E+02	0.6000E+00
			0.1095E+02	0.2400E+01
28	10	0.7644E+02		
			0.0000E+00	0.0000E+00
			0.3651E+01	0.1920E-01
			0.6085E+01	0.3720E-01
			0.9128E+01	0.6840E-01
			0.1095E+02	0.9600E-01
			0.1217E+02	0.1200E+00
			0.1217E+02	0.2400E+00
			0.1217E+02	0.3600E+00
			0.1217E+02	0.6000E+00
			0.1217E+02	0.2400E+01
29	10	0.7890E+02		
			0.0000E+00	0.0000E+00
			0.2231E+01	0.1920E-01
			0.3718E+01	0.3720E-01
			0.5576E+01	0.6840E-01
			0.6692E+01	0.9600E-01
			0.7435E+01	0.1200E+00
			0.7435E+01	0.2400E+00
			0.7435E+01	0.3600E+00
			0.7435E+01	0.6000E+00
			0.7435E+01	0.2400E+01
30	10	0.8136E+02		
			0.0000E+00	0.0000E+00
			0.2298E+01	0.1920E-01
			0.3830E+01	0.3720E-01
			0.5745E+01	0.6840E-01
			0.6894E+01	0.9600E-01
			0.7660E+01	0.1200E+00
			0.7660E+01	0.2400E+00
			0.7660E+01	0.3600E+00
			0.7660E+01	0.6000E+00
			0.7660E+01	0.2400E+01
31	10	0.8144E+02		

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			0.0000E+00	0.0000E+00
			0.2300E+01	0.1920E-01
			0.3834E+01	0.3720E-01
			0.5750E+01	0.6840E-01
			0.6901E+01	0.9600E-01
			0.7667E+01	0.1200E+00
			0.7667E+01	0.2400E+00
			0.7667E+01	0.3600E+00
			0.7667E+01	0.6000E+00
			0.7667E+01	0.2400E+01
32	10	0.8390E+02		
			0.0000E+00	0.0000E+00
			0.4416E+01	0.1920E-01
			0.7360E+01	0.3720E-01
			0.1104E+02	0.6840E-01
			0.1325E+02	0.9600E-01
			0.1472E+02	0.1200E+00
			0.1472E+02	0.2400E+00
			0.1472E+02	0.3600E+00
			0.1472E+02	0.6000E+00
			0.1472E+02	0.2400E+01
33	10	0.8636E+02		
			0.0000E+00	0.0000E+00
			0.4561E+01	0.1920E-01
			0.7602E+01	0.3720E-01
			0.1140E+02	0.6840E-01
			0.1368E+02	0.9600E-01
			0.1520E+02	0.1200E+00
			0.1520E+02	0.2400E+00
			0.1520E+02	0.3600E+00
			0.1520E+02	0.6000E+00
			0.1520E+02	0.2400E+01
34	10	0.8644E+02		
			0.0000E+00	0.0000E+00
			0.4566E+01	0.1920E-01
			0.7610E+01	0.3720E-01
			0.1141E+02	0.6840E-01
			0.1370E+02	0.9600E-01
			0.1522E+02	0.1200E+00
			0.1370E+02	0.2400E+00
			0.1370E+02	0.3600E+00
			0.1370E+02	0.6000E+00
			0.1370E+02	0.2400E+01
35	10	0.9340E+02		
			0.0000E+00	0.0000E+00
			0.3613E+01	0.1920E-01
			0.6022E+01	0.3720E-01
			0.9033E+01	0.6840E-01
			0.1084E+02	0.9600E-01
			0.1204E+02	0.1200E+00
			0.1084E+02	0.2400E+00
			0.1084E+02	0.3600E+00
			0.1084E+02	0.6000E+00
			0.1084E+02	0.2400E+01
36	10	0.1004E+03		
			0.0000E+00	0.0000E+00
			0.3613E+01	0.1920E-01
			0.6022E+01	0.3720E-01
			0.9033E+01	0.6840E-01
			0.1084E+02	0.9600E-01
			0.1204E+02	0.1200E+00
			0.1084E+02	0.2400E+00
			0.1084E+02	0.3600E+00

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0.1084E+02
0.1084E+02

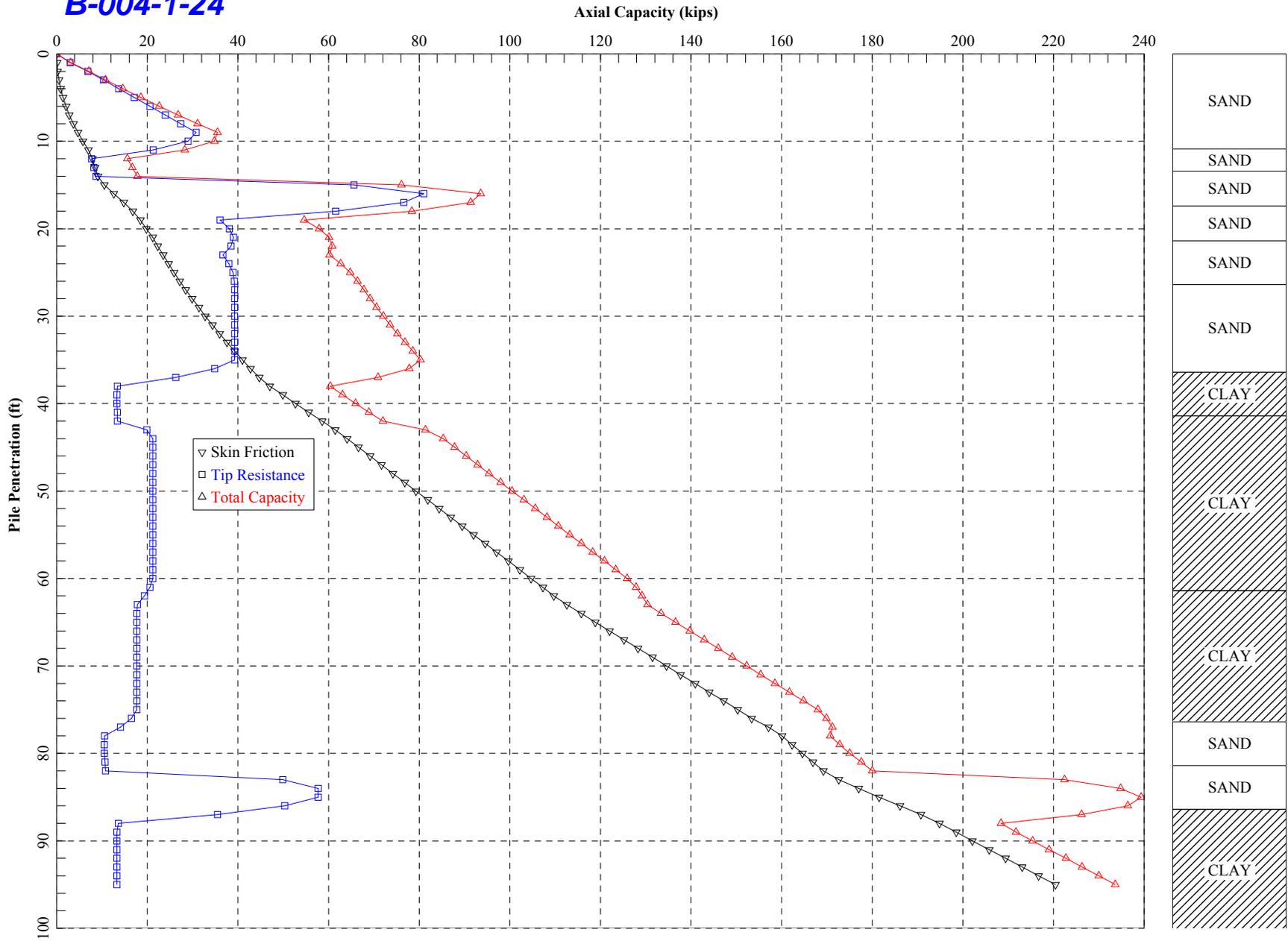
0.6000E+00
0.2400E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.8283E+00	0.6000E-02
0.1657E+01	0.1200E-01
0.3313E+01	0.2400E-01
0.6627E+01	0.1560E+00
0.9940E+01	0.5040E+00
0.1193E+02	0.8760E+00
0.1325E+02	0.1200E+01
0.1325E+02	0.1800E+01
0.1325E+02	0.2400E+01

LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.6789E+00	0.2392E-03	0.1381E-01	0.1000E-03
0.6789E+01	0.2392E-02	0.1381E+00	0.1000E-02
0.3394E+02	0.1196E-01	0.6903E+00	0.5000E-02
0.6782E+02	0.2393E-01	0.1381E+01	0.1000E-01
0.1255E+03	0.4641E-01	0.2761E+01	0.2000E-01
0.2301E+03	0.9930E-01	0.3966E+01	0.5000E-01
0.2966E+03	0.1445E+00	0.4719E+01	0.8000E-01
0.3238E+03	0.1715E+00	0.5221E+01	0.1000E+00
0.3217E+03	0.2719E+00	0.7046E+01	0.2000E+00
0.3192E+03	0.5715E+00	0.9902E+01	0.5000E+00
0.3208E+03	0.8721E+00	0.1152E+02	0.8000E+00
0.3217E+03	0.1072E+01	0.1244E+02	0.1000E+01
0.3225E+03	0.2073E+01	0.1325E+02	0.2000E+01

12-Inch Dia. Closed End CIP Piles - EOID Forward Abutment B-004-1-24



**12-Inch Dia. Closed End CIP Piles - EOID
Forward Abutment
B-004-1-24**

B-004-1-24 EOID.ap9o

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APILE for Windows, Version 2019.9.12

Serial Number : 136090498

A Program for Analyzing the Axial Capacity
and Short-term Settlement of Driven Piles
under Axial Loading.
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Abt)\B-004-1-24\
Path to file locations : C:\Users\legacy\Desktop\1.3.2025\12 In Abt (only
Name of input data file : B-004-1-24 EOID.ap9d
Name of output file : B-004-1-24 EOID.ap9o
Name of plot output file : B-004-1-24 EOID.ap9p

Time and Date of Analysis

Date: January 07, 2025 Time: 09:35:35

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* INPUT INFORMATION *

B-004-1-24 (Forward Abutment)

DESIGNER : AG/DEK

JOB NUMBER : W-23-155 (MOT-835-2.57)

METHOD FOR UNIT LOAD TRANSFERS :

- FHWA (Federal Highway Administration)
Unfactored Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

TYPE OF LOADING :

- COMPRESSION

PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
 - Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
 - CROSS SECTION AREA = 113.05 IN²

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 12.00 IN.
 - INTERNAL DIAMETER, ID = 0.25 IN.
 - TOTAL PILE LENGTH, TL = 95.00 FT.
 - BATTER ANGLE = 0.00 DEG
 - PILE STICKUP LENGTH, PSL = 0.00 FT.
 - ZERO FRICTION LENGTH, ZFL = 0.00 FT.
 - INCREMENT OF PILE LENGTH
 USED IN COMPUTATION = 1.00 FT.
 - LENGTH OF ENHANCED
 END SECTION = 95.00 FT.
 - INTERNAL DIAMETER OF
 ENHANCED END SECTION = 0.25 IN.

PLUGGED/UNPLUGGED CONDITIONS :
 Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	SAND	0.80*	67.60	37.00	91.20**
10.90	SAND	0.80*	67.60	37.00	91.20**
10.90	SAND	0.80*	52.60	28.00	22.80**
13.40	SAND	0.80*	52.60	28.00	22.80**
13.40	SAND	0.80*	67.60	39.00	135.20**
17.40	SAND	0.80*	67.60	39.00	135.20**
17.40	SAND	0.80*	72.60	34.00	55.60**
21.40	SAND	0.80*	72.60	34.00	55.60**
21.40	SAND	0.80*	67.60	33.00	47.20**
26.40	SAND	0.80*	67.60	33.00	47.20**
26.40	SAND	0.80*	67.60	33.00	47.20**
36.40	SAND	0.80*	67.60	33.00	47.20**
36.40	CLAY	0.80*	62.60	0.00	4.80**
41.40	CLAY	0.80*	62.60	0.00	4.80**
41.40	CLAY	0.80*	62.60	0.00	4.80**
61.40	CLAY	0.80*	62.60	0.00	4.80**
61.40	CLAY	0.80*	62.60	0.00	4.80**
76.40	CLAY	0.80*	62.60	0.00	4.80**
76.40	SAND	0.80*	62.60	27.00	19.80**
81.40	SAND	0.80*	62.60	27.00	19.80**
81.40	SAND	0.80*	72.60	34.00	55.60**

61.40	0.670	1.000
61.40	0.570	1.000
76.40	0.570	1.000
76.40	0.670	1.000
81.40	0.670	1.000
81.40	0.670	1.000
86.40	0.670	1.000
86.40	0.670	1.000
100.40	0.670	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.120 *	0.00
10.90	0.120 *	0.00
10.90	0.120 *	0.00
13.40	0.120 *	0.00
13.40	0.120 *	0.00
17.40	0.120 *	0.00
17.40	0.120 *	0.00
21.40	0.120 *	0.00
21.40	0.120 *	0.00
26.40	0.120 *	0.00
26.40	0.120 *	0.00
36.40	0.120 *	0.00
36.40	0.120 *	0.90 **
41.40	0.120 *	0.90 **
41.40	0.120 *	0.90 **
61.40	0.120 *	0.90 **
61.40	0.120 *	0.90 **
76.40	0.120 *	0.90 **
76.40	0.120 *	0.00
81.40	0.120 *	0.00
81.40	0.120 *	0.00
86.40	0.120 *	0.00
86.40	0.120 *	0.90 **
100.40	0.120 *	0.90 **

* DEFAULT VALUE = 0.01 D
 ** DEFAULT VALUE = 0.9

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 * COMPUTATION RESULT *

 * FED. HWY. METHOD *

PILE PENETRATION FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	1.3	1.3
1.00	0.1	3.0	3.1
2.00	0.2	6.9	7.1
3.00	0.5	10.3	10.8

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4.00	0.9	13.7	14.6
5.00	1.4	17.1	18.6
6.00	2.1	20.6	22.6
7.00	2.8	24.0	26.8
8.00	3.7	27.4	31.1
9.00	4.7	30.8	35.5
10.00	5.8	29.0	34.8
11.00	7.0	21.3	28.3
12.00	7.9	12.6	20.5
13.00	8.5	18.6	27.2
14.00	9.2	41.3	50.5
15.00	10.5	65.6	76.1
16.00	12.6	81.0	93.6
17.00	14.9	76.6	91.4
18.00	16.8	61.6	78.4
19.00	18.5	45.5	64.0
20.00	19.8	38.1	57.9
21.00	21.2	39.0	60.1
22.00	22.3	38.5	60.8
23.00	23.5	37.8	61.3
24.00	24.7	38.0	62.7
25.00	25.9	38.9	64.8
26.00	27.2	39.2	66.4
27.00	28.5	39.3	67.8
28.00	29.9	39.3	69.2
29.00	31.4	39.3	70.6
30.00	32.8	39.3	72.1
31.00	34.4	39.3	73.7
32.00	36.0	39.3	75.2
33.00	37.6	39.3	76.9
34.00	39.3	39.3	78.6
35.00	41.0	39.3	80.3
36.00	42.8	34.9	77.8
37.00	44.7	26.3	70.9
38.00	47.0	17.6	64.6
39.00	49.9	13.3	63.1
40.00	52.7	13.3	66.0
41.00	55.6	14.6	70.2
42.00	58.7	17.2	75.9
43.00	61.5	19.9	81.4
44.00	64.1	21.2	85.3
45.00	66.6	21.2	87.8
46.00	69.2	21.2	90.4
47.00	71.7	21.2	92.9
48.00	74.3	21.2	95.5
49.00	76.8	21.2	98.0
50.00	79.3	21.2	100.5
51.00	81.9	21.2	103.1
52.00	84.4	21.2	105.6
53.00	87.0	21.2	108.2
54.00	89.5	21.2	110.7
55.00	92.0	21.2	113.3
56.00	94.6	21.2	115.8
57.00	97.1	21.2	118.3
58.00	99.7	21.2	120.9
59.00	102.2	21.2	123.4
60.00	104.8	21.2	126.0
61.00	107.3	20.6	127.9
62.00	109.7	19.4	129.2
63.00	112.6	18.3	130.9
64.00	115.8	17.7	133.5
65.00	118.9	17.7	136.6
66.00	122.1	17.7	139.7

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67.00	125.2	17.7	142.9
68.00	128.3	17.7	146.0
69.00	131.5	17.7	149.1
70.00	134.6	17.7	152.3
71.00	137.8	17.7	155.4
72.00	140.9	17.7	158.6
73.00	144.0	17.7	161.7
74.00	147.2	17.7	164.8
75.00	150.3	17.7	168.0
76.00	153.4	16.5	169.9
77.00	157.1	14.1	171.2
78.00	160.1	11.7	171.8
79.00	162.3	10.5	172.8
80.00	164.6	10.5	175.1
81.00	166.9	18.3	185.2
82.00	169.2	34.1	203.3
83.00	172.6	49.9	222.5
84.00	177.0	57.7	234.8
85.00	181.5	57.7	239.3
86.00	186.1	50.3	236.4
87.00	190.7	35.5	226.2
88.00	194.9	20.7	215.5
89.00	198.5	13.3	211.8
90.00	202.2	13.3	215.4
91.00	205.8	13.3	219.1
92.00	209.5	13.3	222.7
93.00	213.1	13.3	226.4
94.00	216.8	13.3	230.0
95.00	220.4	13.3	233.7

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	0.4167E-01	0.0000E+00	0.0000E+00
			0.3204E-02	0.1920E-01
			0.5340E-02	0.3720E-01
			0.8009E-02	0.6840E-01
			0.9611E-02	0.9600E-01
			0.1068E-01	0.1200E+00
			0.1068E-01	0.2400E+00
			0.1068E-01	0.3600E+00
			0.1068E-01	0.6000E+00
			0.1068E-01	0.2400E+01
2	10	0.5450E+01	0.0000E+00	0.0000E+00
			0.4191E+00	0.1920E-01
			0.6984E+00	0.3720E-01
			0.1048E+01	0.6840E-01

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			0.1257E+01	0.9600E-01
			0.1397E+01	0.1200E+00
			0.1397E+01	0.2400E+00
			0.1397E+01	0.3600E+00
			0.1397E+01	0.6000E+00
			0.1397E+01	0.2400E+01
3	10	0.1086E+02		
			0.0000E+00	0.0000E+00
			0.8349E+00	0.1920E-01
			0.1392E+01	0.3720E-01
			0.2087E+01	0.6840E-01
			0.2505E+01	0.9600E-01
			0.2783E+01	0.1200E+00
			0.2783E+01	0.2400E+00
			0.2783E+01	0.3600E+00
			0.2783E+01	0.6000E+00
			0.2783E+01	0.2400E+01
4	10	0.1094E+02		
			0.0000E+00	0.0000E+00
			0.8413E+00	0.1920E-01
			0.1402E+01	0.3720E-01
			0.2103E+01	0.6840E-01
			0.2524E+01	0.9600E-01
			0.2804E+01	0.1200E+00
			0.2804E+01	0.2400E+00
			0.2804E+01	0.3600E+00
			0.2804E+01	0.6000E+00
			0.2804E+01	0.2400E+01
5	10	0.1215E+02		
			0.0000E+00	0.0000E+00
			0.3817E+00	0.1920E-01
			0.6362E+00	0.3720E-01
			0.9544E+00	0.6840E-01
			0.1145E+01	0.9600E-01
			0.1272E+01	0.1200E+00
			0.1272E+01	0.2400E+00
			0.1272E+01	0.3600E+00
			0.1272E+01	0.6000E+00
			0.1272E+01	0.2400E+01
6	10	0.1336E+02		
			0.0000E+00	0.0000E+00
			0.4119E+00	0.1920E-01
			0.6865E+00	0.3720E-01
			0.1030E+01	0.6840E-01
			0.1236E+01	0.9600E-01
			0.1373E+01	0.1200E+00
			0.1373E+01	0.2400E+00
			0.1373E+01	0.3600E+00
			0.1373E+01	0.6000E+00
			0.1373E+01	0.2400E+01
7	10	0.1344E+02		
			0.0000E+00	0.0000E+00
			0.4140E+00	0.1920E-01
			0.6900E+00	0.3720E-01
			0.1035E+01	0.6840E-01
			0.1242E+01	0.9600E-01
			0.1380E+01	0.1200E+00
			0.1380E+01	0.2400E+00
			0.1380E+01	0.3600E+00
			0.1380E+01	0.6000E+00
			0.1380E+01	0.2400E+01
8	10	0.1540E+02		
			0.0000E+00	0.0000E+00

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			0.1388E+01	0.1920E-01
			0.2313E+01	0.3720E-01
			0.3470E+01	0.6840E-01
			0.4164E+01	0.9600E-01
			0.4627E+01	0.1200E+00
			0.4627E+01	0.2400E+00
			0.4627E+01	0.3600E+00
			0.4627E+01	0.6000E+00
			0.4627E+01	0.2400E+01
9	10	0.1736E+02		
			0.0000E+00	0.0000E+00
			0.1572E+01	0.1920E-01
			0.2621E+01	0.3720E-01
			0.3931E+01	0.6840E-01
			0.4717E+01	0.9600E-01
			0.5242E+01	0.1200E+00
			0.5242E+01	0.2400E+00
			0.5242E+01	0.3600E+00
			0.5242E+01	0.6000E+00
			0.5242E+01	0.2400E+01
10	10	0.1744E+02		
			0.0000E+00	0.0000E+00
			0.1580E+01	0.1920E-01
			0.2634E+01	0.3720E-01
			0.3951E+01	0.6840E-01
			0.4741E+01	0.9600E-01
			0.5268E+01	0.1200E+00
			0.5268E+01	0.2400E+00
			0.5268E+01	0.3600E+00
			0.5268E+01	0.6000E+00
			0.5268E+01	0.2400E+01
11	10	0.1940E+02		
			0.0000E+00	0.0000E+00
			0.1035E+01	0.1920E-01
			0.1726E+01	0.3720E-01
			0.2589E+01	0.6840E-01
			0.3106E+01	0.9600E-01
			0.3451E+01	0.1200E+00
			0.3451E+01	0.2400E+00
			0.3451E+01	0.3600E+00
			0.3451E+01	0.6000E+00
			0.3451E+01	0.2400E+01
12	10	0.2136E+02		
			0.0000E+00	0.0000E+00
			0.1151E+01	0.1920E-01
			0.1918E+01	0.3720E-01
			0.2878E+01	0.6840E-01
			0.3453E+01	0.9600E-01
			0.3837E+01	0.1200E+00
			0.3837E+01	0.2400E+00
			0.3837E+01	0.3600E+00
			0.3837E+01	0.6000E+00
			0.3837E+01	0.2400E+01
13	10	0.2144E+02		
			0.0000E+00	0.0000E+00
			0.1156E+01	0.1920E-01
			0.1927E+01	0.3720E-01
			0.2890E+01	0.6840E-01
			0.3468E+01	0.9600E-01
			0.3853E+01	0.1200E+00
			0.3853E+01	0.2400E+00
			0.3853E+01	0.3600E+00
			0.3853E+01	0.6000E+00

			B-004-1-24 EOID.ap9o	
14	10	0.2390E+02	0.3853E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.1188E+01	0.1920E-01
			0.1980E+01	0.3720E-01
			0.2969E+01	0.6840E-01
			0.3563E+01	0.9600E-01
			0.3959E+01	0.1200E+00
			0.3959E+01	0.2400E+00
			0.3959E+01	0.3600E+00
			0.3959E+01	0.6000E+00
			0.3959E+01	0.2400E+01
15	10	0.2636E+02	0.0000E+00	0.0000E+00
			0.1312E+01	0.1920E-01
			0.2186E+01	0.3720E-01
			0.3279E+01	0.6840E-01
			0.3935E+01	0.9600E-01
			0.4373E+01	0.1200E+00
			0.4373E+01	0.2400E+00
			0.4373E+01	0.3600E+00
			0.4373E+01	0.6000E+00
			0.4373E+01	0.2400E+01
16	10	0.2644E+02	0.0000E+00	0.0000E+00
			0.1316E+01	0.1920E-01
			0.2193E+01	0.3720E-01
			0.3290E+01	0.6840E-01
			0.3948E+01	0.9600E-01
			0.4387E+01	0.1200E+00
			0.4387E+01	0.2400E+00
			0.4387E+01	0.3600E+00
			0.4387E+01	0.6000E+00
			0.4387E+01	0.2400E+01
17	10	0.3140E+02	0.0000E+00	0.0000E+00
			0.1566E+01	0.1920E-01
			0.2610E+01	0.3720E-01
			0.3916E+01	0.6840E-01
			0.4699E+01	0.9600E-01
			0.5221E+01	0.1200E+00
			0.5221E+01	0.2400E+00
			0.5221E+01	0.3600E+00
			0.5221E+01	0.6000E+00
			0.5221E+01	0.2400E+01
18	10	0.3636E+02	0.0000E+00	0.0000E+00
			0.1817E+01	0.1920E-01
			0.3028E+01	0.3720E-01
			0.4541E+01	0.6840E-01
			0.5450E+01	0.9600E-01
			0.6055E+01	0.1200E+00
			0.6055E+01	0.2400E+00
			0.6055E+01	0.3600E+00
			0.6055E+01	0.6000E+00
			0.6055E+01	0.2400E+01
19	10	0.3644E+02	0.0000E+00	0.0000E+00
			0.1821E+01	0.1920E-01
			0.3035E+01	0.3720E-01
			0.4552E+01	0.6840E-01
			0.5462E+01	0.9600E-01
			0.6069E+01	0.1200E+00

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			0.5462E+01	0.2400E+00
			0.5462E+01	0.3600E+00
			0.5462E+01	0.6000E+00
20	10	0.3890E+02	0.5462E+01	0.2400E+01
			0.0000E+00	0.0000E+00
			0.2825E+01	0.1920E-01
			0.4709E+01	0.3720E-01
			0.7063E+01	0.6840E-01
			0.8476E+01	0.9600E-01
			0.9417E+01	0.1200E+00
			0.8476E+01	0.2400E+00
			0.8476E+01	0.3600E+00
			0.8476E+01	0.6000E+00
			0.8476E+01	0.2400E+01
21	10	0.4136E+02		
			0.0000E+00	0.0000E+00
			0.2966E+01	0.1920E-01
			0.4944E+01	0.3720E-01
			0.7416E+01	0.6840E-01
			0.8899E+01	0.9600E-01
			0.9888E+01	0.1200E+00
			0.8899E+01	0.2400E+00
			0.8899E+01	0.3600E+00
			0.8899E+01	0.6000E+00
			0.8899E+01	0.2400E+01
22	10	0.4144E+02		
			0.0000E+00	0.0000E+00
			0.2999E+01	0.1920E-01
			0.4999E+01	0.3720E-01
			0.7498E+01	0.6840E-01
			0.8998E+01	0.9600E-01
			0.9997E+01	0.1200E+00
			0.8998E+01	0.2400E+00
			0.8998E+01	0.3600E+00
			0.8998E+01	0.6000E+00
			0.8998E+01	0.2400E+01
23	10	0.5140E+02		
			0.0000E+00	0.0000E+00
			0.2516E+01	0.1920E-01
			0.4193E+01	0.3720E-01
			0.6289E+01	0.6840E-01
			0.7547E+01	0.9600E-01
			0.8385E+01	0.1200E+00
			0.7547E+01	0.2400E+00
			0.7547E+01	0.3600E+00
			0.7547E+01	0.6000E+00
			0.7547E+01	0.2400E+01
24	10	0.6136E+02		
			0.0000E+00	0.0000E+00
			0.2738E+01	0.1920E-01
			0.4564E+01	0.3720E-01
			0.6846E+01	0.6840E-01
			0.8215E+01	0.9600E-01
			0.9128E+01	0.1200E+00
			0.8215E+01	0.2400E+00
			0.8215E+01	0.3600E+00
			0.8215E+01	0.6000E+00
			0.8215E+01	0.2400E+01
25	10	0.6144E+02		
			0.0000E+00	0.0000E+00
			0.2790E+01	0.1920E-01
			0.4650E+01	0.3720E-01

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			0.6976E+01	0.6840E-01
			0.8371E+01	0.9600E-01
			0.9301E+01	0.1200E+00
			0.8371E+01	0.2400E+00
			0.8371E+01	0.3600E+00
			0.8371E+01	0.6000E+00
			0.8371E+01	0.2400E+01
26	10	0.6890E+02		
			0.0000E+00	0.0000E+00
			0.3651E+01	0.1920E-01
			0.6085E+01	0.3720E-01
			0.9128E+01	0.6840E-01
			0.1095E+02	0.9600E-01
			0.1217E+02	0.1200E+00
			0.1095E+02	0.2400E+00
			0.1095E+02	0.3600E+00
			0.1095E+02	0.6000E+00
			0.1095E+02	0.2400E+01
27	10	0.7636E+02		
			0.0000E+00	0.0000E+00
			0.3651E+01	0.1920E-01
			0.6085E+01	0.3720E-01
			0.9128E+01	0.6840E-01
			0.1095E+02	0.9600E-01
			0.1217E+02	0.1200E+00
			0.1095E+02	0.2400E+00
			0.1095E+02	0.3600E+00
			0.1095E+02	0.6000E+00
			0.1095E+02	0.2400E+01
28	10	0.7644E+02		
			0.0000E+00	0.0000E+00
			0.3651E+01	0.1920E-01
			0.6085E+01	0.3720E-01
			0.9128E+01	0.6840E-01
			0.1095E+02	0.9600E-01
			0.1217E+02	0.1200E+00
			0.1217E+02	0.2400E+00
			0.1217E+02	0.3600E+00
			0.1217E+02	0.6000E+00
			0.1217E+02	0.2400E+01
29	10	0.7890E+02		
			0.0000E+00	0.0000E+00
			0.2231E+01	0.1920E-01
			0.3718E+01	0.3720E-01
			0.5576E+01	0.6840E-01
			0.6692E+01	0.9600E-01
			0.7435E+01	0.1200E+00
			0.7435E+01	0.2400E+00
			0.7435E+01	0.3600E+00
			0.7435E+01	0.6000E+00
			0.7435E+01	0.2400E+01
30	10	0.8136E+02		
			0.0000E+00	0.0000E+00
			0.2298E+01	0.1920E-01
			0.3830E+01	0.3720E-01
			0.5745E+01	0.6840E-01
			0.6894E+01	0.9600E-01
			0.7660E+01	0.1200E+00
			0.7660E+01	0.2400E+00
			0.7660E+01	0.3600E+00
			0.7660E+01	0.6000E+00
			0.7660E+01	0.2400E+01
31	10	0.8144E+02		

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			0.0000E+00	0.0000E+00
			0.2300E+01	0.1920E-01
			0.3834E+01	0.3720E-01
			0.5750E+01	0.6840E-01
			0.6901E+01	0.9600E-01
			0.7667E+01	0.1200E+00
			0.7667E+01	0.2400E+00
			0.7667E+01	0.3600E+00
			0.7667E+01	0.6000E+00
			0.7667E+01	0.2400E+01
32	10	0.8390E+02		
			0.0000E+00	0.0000E+00
			0.4416E+01	0.1920E-01
			0.7360E+01	0.3720E-01
			0.1104E+02	0.6840E-01
			0.1325E+02	0.9600E-01
			0.1472E+02	0.1200E+00
			0.1472E+02	0.2400E+00
			0.1472E+02	0.3600E+00
			0.1472E+02	0.6000E+00
			0.1472E+02	0.2400E+01
33	10	0.8636E+02		
			0.0000E+00	0.0000E+00
			0.4561E+01	0.1920E-01
			0.7602E+01	0.3720E-01
			0.1140E+02	0.6840E-01
			0.1368E+02	0.9600E-01
			0.1520E+02	0.1200E+00
			0.1520E+02	0.2400E+00
			0.1520E+02	0.3600E+00
			0.1520E+02	0.6000E+00
			0.1520E+02	0.2400E+01
34	10	0.8644E+02		
			0.0000E+00	0.0000E+00
			0.4566E+01	0.1920E-01
			0.7610E+01	0.3720E-01
			0.1141E+02	0.6840E-01
			0.1370E+02	0.9600E-01
			0.1522E+02	0.1200E+00
			0.1370E+02	0.2400E+00
			0.1370E+02	0.3600E+00
			0.1370E+02	0.6000E+00
			0.1370E+02	0.2400E+01
35	10	0.9340E+02		
			0.0000E+00	0.0000E+00
			0.3613E+01	0.1920E-01
			0.6022E+01	0.3720E-01
			0.9033E+01	0.6840E-01
			0.1084E+02	0.9600E-01
			0.1204E+02	0.1200E+00
			0.1084E+02	0.2400E+00
			0.1084E+02	0.3600E+00
			0.1084E+02	0.6000E+00
			0.1084E+02	0.2400E+01
36	10	0.1004E+03		
			0.0000E+00	0.0000E+00
			0.3613E+01	0.1920E-01
			0.6022E+01	0.3720E-01
			0.9033E+01	0.6840E-01
			0.1084E+02	0.9600E-01
			0.1204E+02	0.1200E+00
			0.1084E+02	0.2400E+00
			0.1084E+02	0.3600E+00

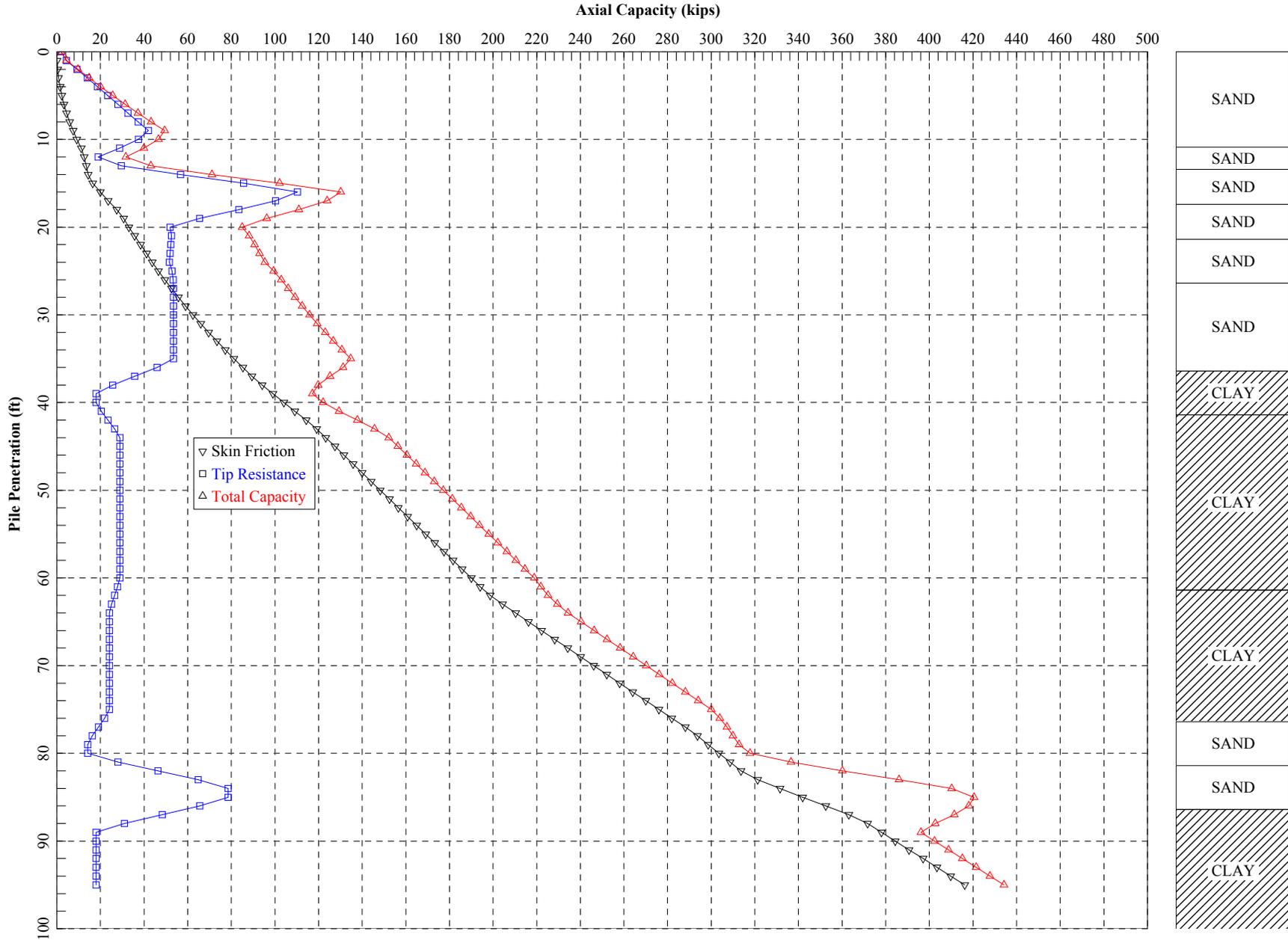
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0.1084E+02 0.6000E+00
0.1084E+02 0.2400E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.8283E+00	0.6000E-02
0.1657E+01	0.1200E-01
0.3313E+01	0.2400E-01
0.6627E+01	0.1560E+00
0.9940E+01	0.5040E+00
0.1193E+02	0.8760E+00
0.1325E+02	0.1200E+01
0.1325E+02	0.1800E+01
0.1325E+02	0.2400E+01

LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.6789E+00	0.2392E-03	0.1381E-01	0.1000E-03
0.6789E+01	0.2392E-02	0.1381E+00	0.1000E-02
0.3394E+02	0.1196E-01	0.6903E+00	0.5000E-02
0.6782E+02	0.2393E-01	0.1381E+01	0.1000E-01
0.1255E+03	0.4641E-01	0.2761E+01	0.2000E-01
0.2301E+03	0.9930E-01	0.3966E+01	0.5000E-01
0.2966E+03	0.1445E+00	0.4719E+01	0.8000E-01
0.3238E+03	0.1715E+00	0.5221E+01	0.1000E+00
0.3217E+03	0.2719E+00	0.7046E+01	0.2000E+00
0.3192E+03	0.5715E+00	0.9902E+01	0.5000E+00
0.3208E+03	0.8721E+00	0.1152E+02	0.8000E+00
0.3217E+03	0.1072E+01	0.1244E+02	0.1000E+01
0.3225E+03	0.2073E+01	0.1325E+02	0.2000E+01

14-Inch Dia. Closed End CIP Piles - UBV Forward Abutment B-004-1-24



APILE for Windows, Version 2019.9.12

Serial Number : 136090498

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 :

Resource International, Inc.
Columbus, OH

Path to file locations : C:\Users\legacy\Desktop\1.3.2025\14-inch\
Name of input data file : B-004-1-24 - 14 Inch UBV.ap9d
Name of output file : B-004-1-24 - 14 Inch UBV.ap9o
Name of plot output file : B-004-1-24 - 14 Inch UBV.ap9p

Time and Date of Analysis

Date: January 07, 2025 Time: 09:41:41

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* INPUT INFORMATION *

B-004-1-24 (Forward Abutment) - 14 Inch CIP

DESIGNER : AG/DEK

JOB NUMBER : W-23-155 (MOT-835-2.57)

METHOD FOR UNIT LOAD TRANSFERS :

- FHWA (Federal Highway Administration)
Unfactored Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

TYPE OF LOADING :

- COMPRESSION

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PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 153.89 IN²

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 14.00 IN.
- INTERNAL DIAMETER, ID = 0.25 IN.
- TOTAL PILE LENGTH, TL = 95.00 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH
USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED
END SECTION = 95.00 FT.
- INTERNAL DIAMETER OF
ENHANCED END SECTION = 0.25 IN.

PLUGGED/UNPLUGGED CONDITIONS :

Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	SAND	0.80*	67.60	37.00	91.20**
10.90	SAND	0.80*	67.60	37.00	91.20**
10.90	SAND	0.80*	52.60	28.00	22.80**
13.40	SAND	0.80*	52.60	28.00	22.80**
13.40	SAND	0.80*	67.60	39.00	135.20**
17.40	SAND	0.80*	67.60	39.00	135.20**
17.40	SAND	0.80*	72.60	34.00	55.60**
21.40	SAND	0.80*	72.60	34.00	55.60**
21.40	SAND	0.80*	67.60	33.00	47.20**
26.40	SAND	0.80*	67.60	33.00	47.20**
26.40	SAND	0.80*	67.60	33.00	47.20**
36.40	SAND	0.80*	67.60	33.00	47.20**
36.40	CLAY	0.80*	62.60	0.00	4.80**
41.40	CLAY	0.80*	62.60	0.00	4.80**
41.40	CLAY	0.80*	62.60	0.00	4.80**
61.40	CLAY	0.80*	62.60	0.00	4.80**
61.40	CLAY	0.80*	62.60	0.00	4.80**
76.40	CLAY	0.80*	62.60	0.00	4.80**
76.40	SAND	0.80*	62.60	27.00	19.80**
81.40	SAND	0.80*	62.60	27.00	19.80**
81.40	SAND	0.80*	72.60	34.00	55.60**
86.40	SAND	0.80*	72.60	34.00	55.60**

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86.40	CLAY	0.80*	62.60	0.00	4.80**
100.40	CLAY	0.80*	62.60	0.00	4.80**

* VALUE ASSUMED BY THE PROGRAM

** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

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
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.88	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.88	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	2.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	2.50	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*	1.88	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.88	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
10.90	1.000	1.000
10.90	1.000	1.000
13.40	1.000	1.000
13.40	1.000	1.000
17.40	1.000	1.000
17.40	1.000	1.000
21.40	1.000	1.000
21.40	1.000	1.000
26.40	1.000	1.000
26.40	1.000	1.000
36.40	1.000	1.000
36.40	1.000	1.000
41.40	1.000	1.000
41.40	1.000	1.000
61.40	1.000	1.000

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61.40	1.000	1.000
76.40	1.000	1.000
76.40	1.000	1.000
81.40	1.000	1.000
81.40	1.000	1.000
86.40	1.000	1.000
86.40	1.000	1.000
100.40	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.140 *	0.00
10.90	0.140 *	0.00
10.90	0.140 *	0.00
13.40	0.140 *	0.00
13.40	0.140 *	0.00
17.40	0.140 *	0.00
17.40	0.140 *	0.00
21.40	0.140 *	0.00
21.40	0.140 *	0.00
26.40	0.140 *	0.00
26.40	0.140 *	0.00
36.40	0.140 *	0.00
36.40	0.140 *	0.90 **
41.40	0.140 *	0.90 **
41.40	0.140 *	0.90 **
61.40	0.140 *	0.90 **
61.40	0.140 *	0.90 **
76.40	0.140 *	0.90 **
76.40	0.140 *	0.00
81.40	0.140 *	0.00
81.40	0.140 *	0.00
86.40	0.140 *	0.00
86.40	0.140 *	0.90 **
100.40	0.140 *	0.90 **

* DEFAULT VALUE = 0.01 D
 ** DEFAULT VALUE = 0.9

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 * COMPUTATION RESULT *

 * FED. HWY. METHOD *

PILE PENETRATION FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	2.0	2.0
1.00	0.1	4.4	4.5
2.00	0.4	9.3	9.7
3.00	0.8	14.0	14.8
4.00	1.5	18.7	20.1

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5.00	2.3	23.3	25.6
6.00	3.3	28.0	31.3
7.00	4.5	32.6	37.2
8.00	5.9	37.3	43.2
9.00	7.5	42.0	49.4
10.00	9.2	37.4	46.6
11.00	11.2	28.8	39.9
12.00	12.6	19.0	31.6
13.00	13.5	29.6	43.1
14.00	14.4	56.7	71.1
15.00	16.5	85.6	102.1
16.00	20.0	110.3	130.2
17.00	23.6	100.3	123.9
18.00	27.5	83.5	111.0
19.00	30.7	65.5	96.2
20.00	33.1	51.9	85.0
21.00	35.7	52.6	88.2
22.00	38.4	52.3	90.7
23.00	41.1	51.9	92.9
24.00	43.8	51.6	95.4
25.00	46.6	52.8	99.4
26.00	49.5	53.3	102.9
27.00	52.6	53.5	106.0
28.00	55.8	53.5	109.2
29.00	59.0	53.5	112.5
30.00	62.4	53.5	115.9
31.00	66.0	53.5	119.4
32.00	69.6	53.5	123.1
33.00	73.4	53.5	126.8
34.00	77.2	53.5	130.7
35.00	81.2	53.5	134.7
36.00	85.3	45.9	131.2
37.00	89.5	35.7	125.3
38.00	94.2	25.6	119.8
39.00	99.1	18.0	117.2
40.00	104.1	18.0	122.1
41.00	109.1	20.4	129.4
42.00	114.3	23.5	137.8
43.00	119.1	26.5	145.7
44.00	123.3	28.9	152.2
45.00	127.5	28.9	156.3
46.00	131.6	28.9	160.5
47.00	135.8	28.9	164.7
48.00	140.0	28.9	168.8
49.00	144.1	28.9	173.0
50.00	148.3	28.9	177.2
51.00	152.5	28.9	181.3
52.00	156.6	28.9	185.5
53.00	160.8	28.9	189.7
54.00	165.0	28.9	193.8
55.00	169.1	28.9	198.0
56.00	173.3	28.9	202.2
57.00	177.5	28.9	206.3
58.00	181.6	28.9	210.5
59.00	185.8	28.9	214.6
60.00	190.0	28.9	218.8
61.00	194.1	27.8	221.9
62.00	198.7	26.5	225.2
63.00	204.3	25.1	229.4
64.00	210.3	24.1	234.3
65.00	216.2	24.1	240.3
66.00	222.2	24.1	246.3
67.00	228.2	24.1	252.2

**14-Inch Dia. Closed End CIP Piles - UBV
Forward Abutment
B-004-1-24**

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68.00	234.2	24.1	258.2
69.00	240.1	24.1	264.2
70.00	246.1	24.1	270.2
71.00	252.1	24.1	276.1
72.00	258.0	24.1	282.1
73.00	264.0	24.1	288.1
74.00	270.0	24.1	294.0
75.00	276.0	24.1	300.0
76.00	281.9	21.9	303.9
77.00	288.1	19.1	307.2
78.00	293.7	16.3	310.0
79.00	298.6	14.2	312.8
80.00	303.5	14.2	317.8
81.00	308.6	28.0	336.6
82.00	313.7	46.4	360.1
83.00	321.3	64.8	386.1
84.00	331.6	78.6	410.2
85.00	341.9	78.6	420.5
86.00	352.5	65.6	418.1
87.00	363.1	48.3	411.4
88.00	371.7	31.0	402.7
89.00	378.0	18.0	396.1
90.00	384.4	18.0	402.4
91.00	390.7	18.0	408.8
92.00	397.1	18.0	415.1
93.00	403.4	18.0	421.5
94.00	409.8	18.0	427.8
95.00	416.2	18.0	434.2

NOTES:

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

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

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.4167E-01	0.0000E+00	0.0000E+00
			0.4375E-02	0.2240E-01
			0.7292E-02	0.4340E-01
			0.1094E-01	0.7980E-01
			0.1313E-01	0.1120E+00
			0.1458E-01	0.1400E+00
			0.1458E-01	0.2800E+00
			0.1458E-01	0.4200E+00
			0.1458E-01	0.7000E+00
			0.1458E-01	0.2800E+01
2	10	0.5450E+01	0.0000E+00	0.0000E+00
			0.5723E+00	0.2240E-01
			0.9539E+00	0.4340E-01
			0.1431E+01	0.7980E-01
			0.1717E+01	0.1120E+00

Max. Factored Designed Load per Pile = 186.0kips
Required Nominal Resistance per Pile = (186/0.7) kips = 265.7 kips

Pile length = 69.25+ 2.0 (estimated embedment in pile cap) = 71.25 feet
Estimated Pile Length to Rounded Up to Nearest 5 feet = 75.0 feet
Pile Order Length = 80 feet

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			0.1908E+01	0.1400E+00
			0.1908E+01	0.2800E+00
			0.1908E+01	0.4200E+00
			0.1908E+01	0.7000E+00
			0.1908E+01	0.2800E+01
3	10	0.1086E+02	0.0000E+00	0.0000E+00
			0.1140E+01	0.2240E-01
			0.1900E+01	0.4340E-01
			0.2851E+01	0.7980E-01
			0.3421E+01	0.1120E+00
			0.3801E+01	0.1400E+00
			0.3801E+01	0.2800E+00
			0.3801E+01	0.4200E+00
			0.3801E+01	0.7000E+00
			0.3801E+01	0.2800E+01
4	10	0.1094E+02	0.0000E+00	0.0000E+00
			0.1149E+01	0.2240E-01
			0.1915E+01	0.4340E-01
			0.2873E+01	0.7980E-01
			0.3447E+01	0.1120E+00
			0.3830E+01	0.1400E+00
			0.3830E+01	0.2800E+00
			0.3830E+01	0.4200E+00
			0.3830E+01	0.7000E+00
			0.3830E+01	0.2800E+01
5	10	0.1215E+02	0.0000E+00	0.0000E+00
			0.4831E+00	0.2240E-01
			0.8052E+00	0.4340E-01
			0.1208E+01	0.7980E-01
			0.1449E+01	0.1120E+00
			0.1610E+01	0.1400E+00
			0.1610E+01	0.2800E+00
			0.1610E+01	0.4200E+00
			0.1610E+01	0.7000E+00
			0.1610E+01	0.2800E+01
6	10	0.1336E+02	0.0000E+00	0.0000E+00
			0.5213E+00	0.2240E-01
			0.8688E+00	0.4340E-01
			0.1303E+01	0.7980E-01
			0.1564E+01	0.1120E+00
			0.1738E+01	0.1400E+00
			0.1738E+01	0.2800E+00
			0.1738E+01	0.4200E+00
			0.1738E+01	0.7000E+00
			0.1738E+01	0.2800E+01
7	10	0.1344E+02	0.0000E+00	0.0000E+00
			0.5239E+00	0.2240E-01
			0.8732E+00	0.4340E-01
			0.1310E+01	0.7980E-01
			0.1572E+01	0.1120E+00
			0.1746E+01	0.1400E+00
			0.1746E+01	0.2800E+00
			0.1746E+01	0.4200E+00
			0.1746E+01	0.7000E+00
			0.1746E+01	0.2800E+01
8	10	0.1540E+02	0.0000E+00	0.0000E+00
			0.1930E+01	0.2240E-01

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			0.3217E+01	0.4340E-01
			0.4826E+01	0.7980E-01
			0.5791E+01	0.1120E+00
			0.6435E+01	0.1400E+00
			0.6435E+01	0.2800E+00
			0.6435E+01	0.4200E+00
			0.6435E+01	0.7000E+00
			0.6435E+01	0.2800E+01
9	10	0.1736E+02		
			0.0000E+00	0.0000E+00
			0.2187E+01	0.2240E-01
			0.3645E+01	0.4340E-01
			0.5468E+01	0.7980E-01
			0.6561E+01	0.1120E+00
			0.7290E+01	0.1400E+00
			0.7290E+01	0.2800E+00
			0.7290E+01	0.4200E+00
			0.7290E+01	0.7000E+00
			0.7290E+01	0.2800E+01
10	10	0.1744E+02		
			0.0000E+00	0.0000E+00
			0.2198E+01	0.2240E-01
			0.3663E+01	0.4340E-01
			0.5495E+01	0.7980E-01
			0.6594E+01	0.1120E+00
			0.7327E+01	0.1400E+00
			0.7327E+01	0.2800E+00
			0.7327E+01	0.4200E+00
			0.7327E+01	0.7000E+00
			0.7327E+01	0.2800E+01
11	10	0.1940E+02		
			0.0000E+00	0.0000E+00
			0.1373E+01	0.2240E-01
			0.2288E+01	0.4340E-01
			0.3432E+01	0.7980E-01
			0.4118E+01	0.1120E+00
			0.4576E+01	0.1400E+00
			0.4576E+01	0.2800E+00
			0.4576E+01	0.4200E+00
			0.4576E+01	0.7000E+00
			0.4576E+01	0.2800E+01
12	10	0.2136E+02		
			0.0000E+00	0.0000E+00
			0.1526E+01	0.2240E-01
			0.2543E+01	0.4340E-01
			0.3815E+01	0.7980E-01
			0.4578E+01	0.1120E+00
			0.5087E+01	0.1400E+00
			0.5087E+01	0.2800E+00
			0.5087E+01	0.4200E+00
			0.5087E+01	0.7000E+00
			0.5087E+01	0.2800E+01
13	10	0.2144E+02		
			0.0000E+00	0.0000E+00
			0.1533E+01	0.2240E-01
			0.2554E+01	0.4340E-01
			0.3831E+01	0.7980E-01
			0.4598E+01	0.1120E+00
			0.5108E+01	0.1400E+00
			0.5108E+01	0.2800E+00
			0.5108E+01	0.4200E+00
			0.5108E+01	0.7000E+00
			0.5108E+01	0.2800E+01

14	10	B-004-1-24 - 14 Inch UBV.ap9o 0.2390E+02	0.0000E+00 0.1563E+01 0.2604E+01 0.3907E+01 0.4688E+01 0.5209E+01 0.5209E+01 0.5209E+01 0.5209E+01 0.5209E+01	0.0000E+00 0.2240E-01 0.4340E-01 0.7980E-01 0.1120E+00 0.1400E+00 0.2800E+00 0.4200E+00 0.7000E+00 0.2800E+01
15	10	0.2636E+02	0.0000E+00 0.1726E+01 0.2877E+01 0.4315E+01 0.5178E+01 0.5753E+01 0.5753E+01 0.5753E+01 0.5753E+01 0.5753E+01	0.0000E+00 0.2240E-01 0.4340E-01 0.7980E-01 0.1120E+00 0.1400E+00 0.2800E+00 0.4200E+00 0.7000E+00 0.2800E+01
16	10	0.2644E+02	0.0000E+00 0.1731E+01 0.2886E+01 0.4329E+01 0.5194E+01 0.5772E+01 0.5772E+01 0.5772E+01 0.5772E+01 0.5772E+01	0.0000E+00 0.2240E-01 0.4340E-01 0.7980E-01 0.1120E+00 0.1400E+00 0.2800E+00 0.4200E+00 0.7000E+00 0.2800E+01
17	10	0.3140E+02	0.0000E+00 0.2061E+01 0.3435E+01 0.5152E+01 0.6182E+01 0.6869E+01 0.6869E+01 0.6869E+01 0.6869E+01 0.6869E+01	0.0000E+00 0.2240E-01 0.4340E-01 0.7980E-01 0.1120E+00 0.1400E+00 0.2800E+00 0.4200E+00 0.7000E+00 0.2800E+01
18	10	0.3636E+02	0.0000E+00 0.2390E+01 0.3983E+01 0.5975E+01 0.7170E+01 0.7967E+01 0.7967E+01 0.7967E+01 0.7967E+01 0.7967E+01	0.0000E+00 0.2240E-01 0.4340E-01 0.7980E-01 0.1120E+00 0.1400E+00 0.2800E+00 0.4200E+00 0.7000E+00 0.2800E+01
19	10	0.3644E+02	0.0000E+00 0.2396E+01 0.3993E+01 0.5989E+01 0.7187E+01 0.7985E+01 0.7187E+01	0.0000E+00 0.2240E-01 0.4340E-01 0.7980E-01 0.1120E+00 0.1400E+00 0.2800E+00

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			0.7187E+01	0.4200E+00
			0.7187E+01	0.7000E+00
20	10	0.3890E+02	0.7187E+01	0.2800E+01
			0.0000E+00	0.0000E+00
			0.2825E+01	0.2240E-01
			0.4709E+01	0.4340E-01
			0.7063E+01	0.7980E-01
			0.8476E+01	0.1120E+00
			0.9417E+01	0.1400E+00
			0.8476E+01	0.2800E+00
			0.8476E+01	0.4200E+00
			0.8476E+01	0.7000E+00
			0.8476E+01	0.2800E+01
21	10	0.4136E+02		
			0.0000E+00	0.0000E+00
			0.2933E+01	0.2240E-01
			0.4888E+01	0.4340E-01
			0.7332E+01	0.7980E-01
			0.8798E+01	0.1120E+00
			0.9776E+01	0.1400E+00
			0.8798E+01	0.2800E+00
			0.8798E+01	0.4200E+00
			0.8798E+01	0.7000E+00
			0.8798E+01	0.2800E+01
22	10	0.4144E+02		
			0.0000E+00	0.0000E+00
			0.2958E+01	0.2240E-01
			0.4930E+01	0.4340E-01
			0.7394E+01	0.7980E-01
			0.8873E+01	0.1120E+00
			0.9859E+01	0.1400E+00
			0.8873E+01	0.2800E+00
			0.8873E+01	0.4200E+00
			0.8873E+01	0.7000E+00
			0.8873E+01	0.2800E+01
23	10	0.5140E+02		
			0.0000E+00	0.0000E+00
			0.2368E+01	0.2240E-01
			0.3946E+01	0.4340E-01
			0.5919E+01	0.7980E-01
			0.7103E+01	0.1120E+00
			0.7892E+01	0.1400E+00
			0.7103E+01	0.2800E+00
			0.7103E+01	0.4200E+00
			0.7103E+01	0.7000E+00
			0.7103E+01	0.2800E+01
24	10	0.6136E+02		
			0.0000E+00	0.0000E+00
			0.2559E+01	0.2240E-01
			0.4264E+01	0.4340E-01
			0.6396E+01	0.7980E-01
			0.7676E+01	0.1120E+00
			0.8529E+01	0.1400E+00
			0.7676E+01	0.2800E+00
			0.7676E+01	0.4200E+00
			0.7676E+01	0.7000E+00
			0.7676E+01	0.2800E+01
25	10	0.6144E+02		
			0.0000E+00	0.0000E+00
			0.2603E+01	0.2240E-01
			0.4338E+01	0.4340E-01
			0.6507E+01	0.7980E-01

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			0.7809E+01	0.1120E+00
			0.8677E+01	0.1400E+00
			0.7809E+01	0.2800E+00
			0.7809E+01	0.4200E+00
			0.7809E+01	0.7000E+00
			0.7809E+01	0.2800E+01
26	10	0.6890E+02		
			0.0000E+00	0.0000E+00
			0.3395E+01	0.2240E-01
			0.5658E+01	0.4340E-01
			0.8488E+01	0.7980E-01
			0.1019E+02	0.1120E+00
			0.1132E+02	0.1400E+00
			0.1019E+02	0.2800E+00
			0.1019E+02	0.4200E+00
			0.1019E+02	0.7000E+00
			0.1019E+02	0.2800E+01
27	10	0.7636E+02		
			0.0000E+00	0.0000E+00
			0.3464E+01	0.2240E-01
			0.5773E+01	0.4340E-01
			0.8660E+01	0.7980E-01
			0.1039E+02	0.1120E+00
			0.1155E+02	0.1400E+00
			0.1039E+02	0.2800E+00
			0.1039E+02	0.4200E+00
			0.1039E+02	0.7000E+00
			0.1039E+02	0.2800E+01
28	10	0.7644E+02		
			0.0000E+00	0.0000E+00
			0.3480E+01	0.2240E-01
			0.5800E+01	0.4340E-01
			0.8700E+01	0.7980E-01
			0.1044E+02	0.1120E+00
			0.1160E+02	0.1400E+00
			0.1160E+02	0.2800E+00
			0.1160E+02	0.4200E+00
			0.1160E+02	0.7000E+00
			0.1160E+02	0.2800E+01
29	10	0.7890E+02		
			0.0000E+00	0.0000E+00
			0.2804E+01	0.2240E-01
			0.4673E+01	0.4340E-01
			0.7009E+01	0.7980E-01
			0.8411E+01	0.1120E+00
			0.9346E+01	0.1400E+00
			0.9346E+01	0.2800E+00
			0.9346E+01	0.4200E+00
			0.9346E+01	0.7000E+00
			0.9346E+01	0.2800E+01
30	10	0.8136E+02		
			0.0000E+00	0.0000E+00
			0.2888E+01	0.2240E-01
			0.4814E+01	0.4340E-01
			0.7221E+01	0.7980E-01
			0.8665E+01	0.1120E+00
			0.9628E+01	0.1400E+00
			0.9628E+01	0.2800E+00
			0.9628E+01	0.4200E+00
			0.9628E+01	0.7000E+00
			0.9628E+01	0.2800E+01
31	10	0.8144E+02		
			0.0000E+00	0.0000E+00

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			0.2891E+01	0.2240E-01
			0.4819E+01	0.4340E-01
			0.7228E+01	0.7980E-01
			0.8674E+01	0.1120E+00
			0.9638E+01	0.1400E+00
			0.9638E+01	0.2800E+00
			0.9638E+01	0.4200E+00
			0.9638E+01	0.7000E+00
			0.9638E+01	0.2800E+01
32	10	0.8390E+02		
			0.0000E+00	0.0000E+00
			0.5855E+01	0.2240E-01
			0.9758E+01	0.4340E-01
			0.1464E+02	0.7980E-01
			0.1756E+02	0.1120E+00
			0.1952E+02	0.1400E+00
			0.1952E+02	0.2800E+00
			0.1952E+02	0.4200E+00
			0.1952E+02	0.7000E+00
			0.1952E+02	0.2800E+01
33	10	0.8636E+02		
			0.0000E+00	0.0000E+00
			0.6047E+01	0.2240E-01
			0.1008E+02	0.4340E-01
			0.1512E+02	0.7980E-01
			0.1814E+02	0.1120E+00
			0.2016E+02	0.1400E+00
			0.2016E+02	0.2800E+00
			0.2016E+02	0.4200E+00
			0.2016E+02	0.7000E+00
			0.2016E+02	0.2800E+01
34	10	0.8644E+02		
			0.0000E+00	0.0000E+00
			0.6054E+01	0.2240E-01
			0.1009E+02	0.4340E-01
			0.1513E+02	0.7980E-01
			0.1816E+02	0.1120E+00
			0.2018E+02	0.1400E+00
			0.1816E+02	0.2800E+00
			0.1816E+02	0.4200E+00
			0.1816E+02	0.7000E+00
			0.1816E+02	0.2800E+01
35	10	0.9340E+02		
			0.0000E+00	0.0000E+00
			0.3613E+01	0.2240E-01
			0.6022E+01	0.4340E-01
			0.9033E+01	0.7980E-01
			0.1084E+02	0.1120E+00
			0.1204E+02	0.1400E+00
			0.1084E+02	0.2800E+00
			0.1084E+02	0.4200E+00
			0.1084E+02	0.7000E+00
			0.1084E+02	0.2800E+01
36	10	0.1004E+03		
			0.0000E+00	0.0000E+00
			0.3613E+01	0.2240E-01
			0.6022E+01	0.4340E-01
			0.9033E+01	0.7980E-01
			0.1084E+02	0.1120E+00
			0.1204E+02	0.1400E+00
			0.1084E+02	0.2800E+00
			0.1084E+02	0.4200E+00
			0.1084E+02	0.7000E+00

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0.1084E+02

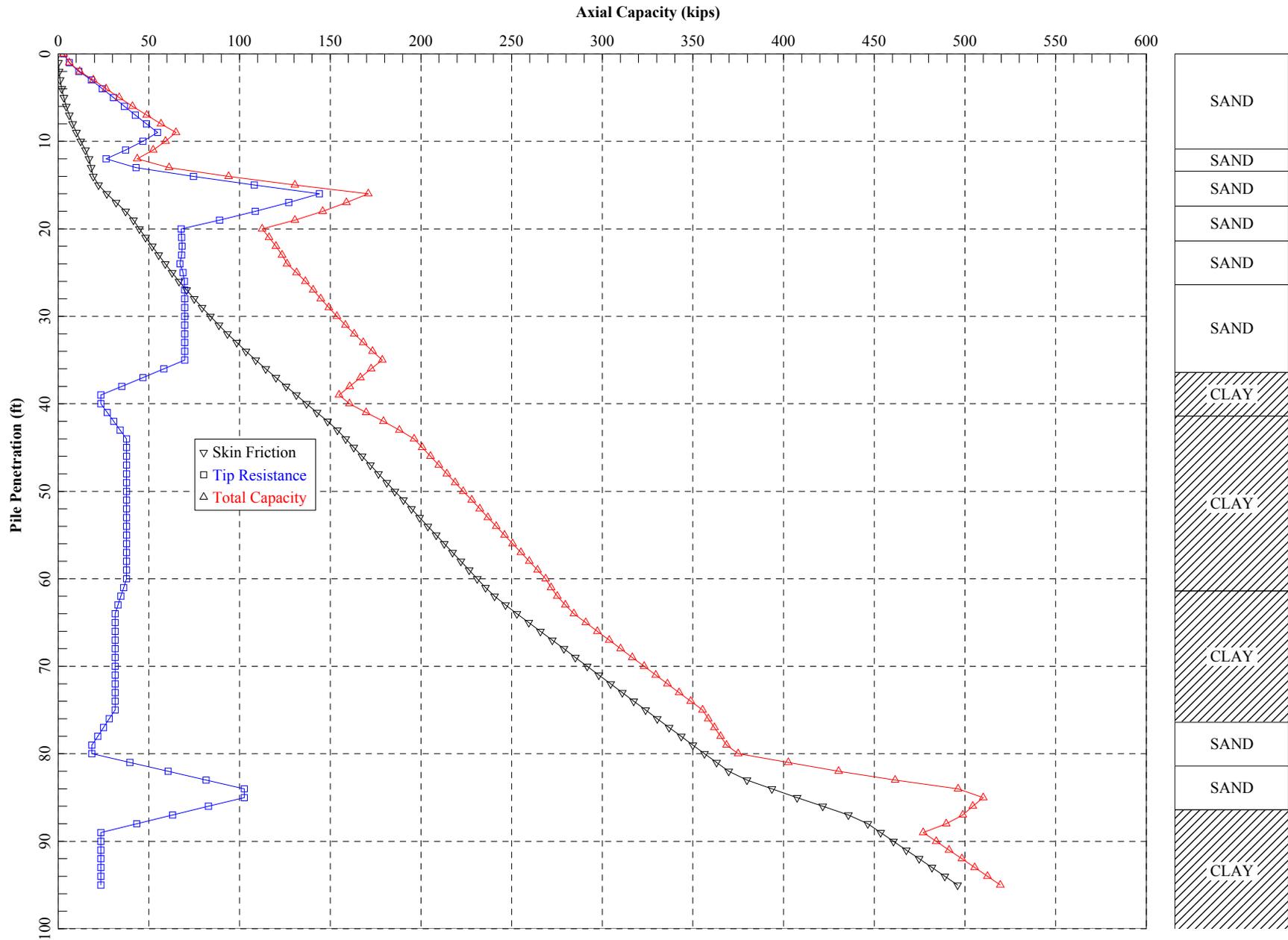
0.2800E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.1127E+01	0.7000E-02
0.2255E+01	0.1400E-01
0.4510E+01	0.2800E-01
0.9020E+01	0.1820E+00
0.1353E+02	0.5880E+00
0.1624E+02	0.1022E+01
0.1804E+02	0.1400E+01
0.1804E+02	0.2100E+01
0.1804E+02	0.2800E+01

LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.7039E+00	0.2052E-03	0.1611E-01	0.1000E-03
0.7039E+01	0.2052E-02	0.1611E+00	0.1000E-02
0.3519E+02	0.1026E-01	0.8053E+00	0.5000E-02
0.7039E+02	0.2052E-01	0.1611E+01	0.1000E-01
0.1360E+03	0.4069E-01	0.3221E+01	0.2000E-01
0.2584E+03	0.9003E-01	0.5154E+01	0.5000E-01
0.3424E+03	0.1337E+00	0.6033E+01	0.8000E-01
0.3812E+03	0.1601E+00	0.6618E+01	0.1000E+00
0.4124E+03	0.2666E+00	0.9220E+01	0.2000E+00
0.4031E+03	0.5652E+00	0.1255E+02	0.5000E+00
0.4054E+03	0.8657E+00	0.1485E+02	0.8000E+00
0.4067E+03	0.1066E+01	0.1610E+02	0.1000E+01
0.4086E+03	0.2067E+01	0.1804E+02	0.2000E+01

16-Inch Dia. Closed End CIP Piles - UBV Forward Abutment B-004-1-24



APILE for Windows, Version 2019.9.12

Serial Number : 136090498

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 :

Resource International, Inc.
Columbus, OH

Path to file locations : C:\Users\legacy\Desktop\1.3.2025\16-inch\
Name of input data file : B-004-1-24 - 16 Inch UBV.ap9d
Name of output file : B-004-1-24 - 16 Inch UBV.ap9o
Name of plot output file : B-004-1-24 - 16 Inch UBV.ap9p

Time and Date of Analysis

Date: January 07, 2025 Time: 09:57:03

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* INPUT INFORMATION *

B-004-1-24 (Forward Abutment) - 16 Inch CIP

DESIGNER : AG/DEK

JOB NUMBER : W-23-155 (MOT-835-2.57)

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

B-004-1-24 - 16 Inch UBV.ap9o

PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 201.01 IN²

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 16.00 IN.
- INTERNAL DIAMETER, ID = 0.25 IN.
- TOTAL PILE LENGTH, TL = 95.00 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH
USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED
END SECTION = 95.00 FT.
- INTERNAL DIAMETER OF
ENHANCED END SECTION = 0.25 IN.

PLUGGED/UNPLUGGED CONDITIONS :

Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	SAND	0.80*	67.60	37.00	91.20**
10.90	SAND	0.80*	67.60	37.00	91.20**
10.90	SAND	0.80*	52.60	28.00	22.80**
13.40	SAND	0.80*	52.60	28.00	22.80**
13.40	SAND	0.80*	67.60	39.00	135.20**
17.40	SAND	0.80*	67.60	39.00	135.20**
17.40	SAND	0.80*	72.60	34.00	55.60**
21.40	SAND	0.80*	72.60	34.00	55.60**
21.40	SAND	0.80*	67.60	33.00	47.20**
26.40	SAND	0.80*	67.60	33.00	47.20**
26.40	SAND	0.80*	67.60	33.00	47.20**
36.40	SAND	0.80*	67.60	33.00	47.20**
36.40	CLAY	0.80*	62.60	0.00	4.80**
41.40	CLAY	0.80*	62.60	0.00	4.80**
41.40	CLAY	0.80*	62.60	0.00	4.80**
61.40	CLAY	0.80*	62.60	0.00	4.80**
61.40	CLAY	0.80*	62.60	0.00	4.80**
76.40	CLAY	0.80*	62.60	0.00	4.80**
76.40	SAND	0.80*	62.60	27.00	19.80**
81.40	SAND	0.80*	62.60	27.00	19.80**
81.40	SAND	0.80*	72.60	34.00	55.60**
86.40	SAND	0.80*	72.60	34.00	55.60**

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61.40	1.000	1.000
76.40	1.000	1.000
76.40	1.000	1.000
81.40	1.000	1.000
81.40	1.000	1.000
86.40	1.000	1.000
86.40	1.000	1.000
100.40	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.160 *	0.00
10.90	0.160 *	0.00
10.90	0.160 *	0.00
13.40	0.160 *	0.00
13.40	0.160 *	0.00
17.40	0.160 *	0.00
17.40	0.160 *	0.00
21.40	0.160 *	0.00
21.40	0.160 *	0.00
26.40	0.160 *	0.00
26.40	0.160 *	0.00
36.40	0.160 *	0.00
36.40	0.160 *	0.90 **
41.40	0.160 *	0.90 **
41.40	0.160 *	0.90 **
61.40	0.160 *	0.90 **
61.40	0.160 *	0.90 **
76.40	0.160 *	0.90 **
76.40	0.160 *	0.00
81.40	0.160 *	0.00
81.40	0.160 *	0.00
86.40	0.160 *	0.00
86.40	0.160 *	0.90 **
100.40	0.160 *	0.90 **

* DEFAULT VALUE = 0.01 D

** DEFAULT VALUE = 0.9

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 * COMPUTATION RESULT *

 * FED. HWY. METHOD *

PILE PENETRATION FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	3.0	3.0
1.00	0.1	6.1	6.2
2.00	0.5	11.4	11.9
3.00	1.1	18.3	19.4
4.00	2.0	24.4	26.4

16-Inch Dia. Closed End CIP Piles - UBV
Forward Abutment
B-004-1-24

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5.00	3.1	30.5	33.6
6.00	4.5	36.5	41.0
7.00	6.1	42.6	48.8
8.00	8.0	48.7	56.7
9.00	10.1	54.8	64.9
10.00	12.5	46.7	59.2
11.00	15.1	37.2	52.4
12.00	17.0	26.5	43.6
13.00	18.2	43.0	61.2
14.00	19.4	74.6	94.0
15.00	22.3	108.2	130.5
16.00	26.9	144.0	171.0
17.00	31.9	127.1	159.0
18.00	37.2	108.7	145.9
19.00	41.5	89.0	130.5
20.00	44.8	67.8	112.5
21.00	48.2	68.1	116.3
22.00	51.8	68.3	120.1
23.00	55.4	68.1	123.5
24.00	59.0	67.2	126.2
25.00	62.8	68.8	131.5
26.00	66.7	69.6	136.3
27.00	70.8	69.8	140.6
28.00	75.0	69.8	144.8
29.00	79.4	69.8	149.2
30.00	83.9	69.8	153.7
31.00	88.6	69.8	158.4
32.00	93.4	69.8	163.2
33.00	98.4	69.8	168.2
34.00	103.6	69.8	173.4
35.00	108.9	69.8	178.7
36.00	114.4	58.3	172.6
37.00	120.0	46.7	166.7
38.00	125.7	35.1	160.8
39.00	131.3	23.6	154.9
40.00	137.0	23.6	160.6
41.00	142.7	27.1	169.8
42.00	148.6	30.6	179.3
43.00	154.0	34.2	188.1
44.00	158.5	37.7	196.2
45.00	163.0	37.7	200.7
46.00	167.6	37.7	205.3
47.00	172.1	37.7	209.8
48.00	176.6	37.7	214.3
49.00	181.2	37.7	218.9
50.00	185.7	37.7	223.4
51.00	190.3	37.7	228.0
52.00	194.8	37.7	232.5
53.00	199.3	37.7	237.0
54.00	203.9	37.7	241.6
55.00	208.4	37.7	246.1
56.00	212.9	37.7	250.6
57.00	217.5	37.7	255.2
58.00	222.0	37.7	259.7
59.00	226.6	37.7	264.3
60.00	231.1	37.7	268.8
61.00	235.6	36.1	271.8
62.00	240.6	34.6	275.2
63.00	246.6	33.0	279.6
64.00	253.0	31.4	284.4
65.00	259.5	31.4	290.9
66.00	265.9	31.4	297.3
67.00	272.4	31.4	303.8

Max. Factored Designed Load per Pile = 186.0kips
 Required Nominal Resistance per Pile = (186/0.7) kips = 265.7 kips

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Pile length = 59.4+ 2.0 (estimated embedment in pile cap) = 61.4 feet
 Estimated Pile Length to Rounded Up to Nearest 5 feet = 65.0 feet
 Pile Order Length = 70 feet

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68.00	278.8	31.4	310.2
69.00	285.2	31.4	316.6
70.00	291.7	31.4	323.1
71.00	298.1	31.4	329.5
72.00	304.6	31.4	336.0
73.00	311.0	31.4	342.4
74.00	317.4	31.4	348.8
75.00	323.9	31.4	355.3
76.00	330.3	28.2	358.5
77.00	336.9	25.0	361.9
78.00	343.5	21.8	365.3
79.00	349.9	18.6	368.5
80.00	356.4	18.6	375.0
81.00	363.0	39.6	402.6
82.00	369.7	60.6	430.3
83.00	379.8	81.6	461.5
84.00	393.5	102.7	496.2
85.00	407.4	102.7	510.0
86.00	421.5	82.9	504.3
87.00	435.7	63.1	498.8
88.00	446.4	43.3	489.7
89.00	453.5	23.6	477.0
90.00	460.6	23.6	484.1
91.00	467.6	23.6	491.2
92.00	474.7	23.6	498.3
93.00	481.8	23.6	505.4
94.00	488.9	23.6	512.4
95.00	495.9	23.6	519.5

NOTES:

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

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

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.4167E-01	0.0000E+00	0.0000E+00
			0.5179E-02	0.2560E-01
			0.8632E-02	0.4960E-01
			0.1295E-01	0.9120E-01
			0.1554E-01	0.1280E+00
			0.1726E-01	0.1600E+00
			0.1726E-01	0.3200E+00
			0.1726E-01	0.4800E+00
			0.1726E-01	0.8000E+00
			0.1726E-01	0.3200E+01
2	10	0.5450E+01	0.0000E+00	0.0000E+00
			0.6774E+00	0.2560E-01
			0.1129E+01	0.4960E-01
			0.1694E+01	0.9120E-01
			0.2032E+01	0.1280E+00

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			0.2258E+01	0.1600E+00
			0.2258E+01	0.3200E+00
			0.2258E+01	0.4800E+00
			0.2258E+01	0.8000E+00
			0.2258E+01	0.3200E+01
3	10	0.1086E+02	0.0000E+00	0.0000E+00
			0.1350E+01	0.2560E-01
			0.2249E+01	0.4960E-01
			0.3374E+01	0.9120E-01
			0.4049E+01	0.1280E+00
			0.4499E+01	0.1600E+00
			0.4499E+01	0.3200E+00
			0.4499E+01	0.4800E+00
			0.4499E+01	0.8000E+00
			0.4499E+01	0.3200E+01
4	10	0.1094E+02	0.0000E+00	0.0000E+00
			0.1360E+01	0.2560E-01
			0.2267E+01	0.4960E-01
			0.3400E+01	0.9120E-01
			0.4080E+01	0.1280E+00
			0.4533E+01	0.1600E+00
			0.4533E+01	0.3200E+00
			0.4533E+01	0.4800E+00
			0.4533E+01	0.8000E+00
			0.4533E+01	0.3200E+01
5	10	0.1215E+02	0.0000E+00	0.0000E+00
			0.5543E+00	0.2560E-01
			0.9238E+00	0.4960E-01
			0.1386E+01	0.9120E-01
			0.1663E+01	0.1280E+00
			0.1848E+01	0.1600E+00
			0.1848E+01	0.3200E+00
			0.1848E+01	0.4800E+00
			0.1848E+01	0.8000E+00
			0.1848E+01	0.3200E+01
6	10	0.1336E+02	0.0000E+00	0.0000E+00
			0.5981E+00	0.2560E-01
			0.9969E+00	0.4960E-01
			0.1495E+01	0.9120E-01
			0.1794E+01	0.1280E+00
			0.1994E+01	0.1600E+00
			0.1994E+01	0.3200E+00
			0.1994E+01	0.4800E+00
			0.1994E+01	0.8000E+00
			0.1994E+01	0.3200E+01
7	10	0.1344E+02	0.0000E+00	0.0000E+00
			0.6011E+00	0.2560E-01
			0.1002E+01	0.4960E-01
			0.1503E+01	0.9120E-01
			0.1803E+01	0.1280E+00
			0.2004E+01	0.1600E+00
			0.2004E+01	0.3200E+00
			0.2004E+01	0.4800E+00
			0.2004E+01	0.8000E+00
			0.2004E+01	0.3200E+01
8	10	0.1540E+02	0.0000E+00	0.0000E+00
			0.2304E+01	0.2560E-01

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			0.3840E+01	0.4960E-01
			0.5760E+01	0.9120E-01
			0.6912E+01	0.1280E+00
			0.7680E+01	0.1600E+00
			0.7680E+01	0.3200E+00
			0.7680E+01	0.4800E+00
			0.7680E+01	0.8000E+00
			0.7680E+01	0.3200E+01
9	10	0.1736E+02		
			0.0000E+00	0.0000E+00
			0.2610E+01	0.2560E-01
			0.4350E+01	0.4960E-01
			0.6525E+01	0.9120E-01
			0.7830E+01	0.1280E+00
			0.8700E+01	0.1600E+00
			0.8700E+01	0.3200E+00
			0.8700E+01	0.4800E+00
			0.8700E+01	0.8000E+00
			0.8700E+01	0.3200E+01
10	10	0.1744E+02		
			0.0000E+00	0.0000E+00
			0.2623E+01	0.2560E-01
			0.4372E+01	0.4960E-01
			0.6558E+01	0.9120E-01
			0.7869E+01	0.1280E+00
			0.8744E+01	0.1600E+00
			0.8744E+01	0.3200E+00
			0.8744E+01	0.4800E+00
			0.8744E+01	0.8000E+00
			0.8744E+01	0.3200E+01
11	10	0.1940E+02		
			0.0000E+00	0.0000E+00
			0.1606E+01	0.2560E-01
			0.2676E+01	0.4960E-01
			0.4014E+01	0.9120E-01
			0.4817E+01	0.1280E+00
			0.5352E+01	0.1600E+00
			0.5352E+01	0.3200E+00
			0.5352E+01	0.4800E+00
			0.5352E+01	0.8000E+00
			0.5352E+01	0.3200E+01
12	10	0.2136E+02		
			0.0000E+00	0.0000E+00
			0.1785E+01	0.2560E-01
			0.2975E+01	0.4960E-01
			0.4462E+01	0.9120E-01
			0.5355E+01	0.1280E+00
			0.5950E+01	0.1600E+00
			0.5950E+01	0.3200E+00
			0.5950E+01	0.4800E+00
			0.5950E+01	0.8000E+00
			0.5950E+01	0.3200E+01
13	10	0.2144E+02		
			0.0000E+00	0.0000E+00
			0.1793E+01	0.2560E-01
			0.2988E+01	0.4960E-01
			0.4481E+01	0.9120E-01
			0.5378E+01	0.1280E+00
			0.5975E+01	0.1600E+00
			0.5975E+01	0.3200E+00
			0.5975E+01	0.4800E+00
			0.5975E+01	0.8000E+00
			0.5975E+01	0.3200E+01

14	10	B-004-1-24 - 16 Inch UBV.ap9o 0.2390E+02	0.0000E+00 0.1821E+01 0.3035E+01 0.4553E+01 0.5464E+01 0.6071E+01 0.6071E+01 0.6071E+01 0.6071E+01 0.6071E+01	0.0000E+00 0.2560E-01 0.4960E-01 0.9120E-01 0.1280E+00 0.1600E+00 0.3200E+00 0.4800E+00 0.8000E+00 0.3200E+01
15	10	0.2636E+02	0.0000E+00 0.2012E+01 0.3353E+01 0.5029E+01 0.6035E+01 0.6705E+01 0.6705E+01 0.6705E+01 0.6705E+01 0.6705E+01	0.0000E+00 0.2560E-01 0.4960E-01 0.9120E-01 0.1280E+00 0.1600E+00 0.3200E+00 0.4800E+00 0.8000E+00 0.3200E+01
16	10	0.2644E+02	0.0000E+00 0.2018E+01 0.3363E+01 0.5045E+01 0.6054E+01 0.6727E+01 0.6727E+01 0.6727E+01 0.6727E+01 0.6727E+01	0.0000E+00 0.2560E-01 0.4960E-01 0.9120E-01 0.1280E+00 0.1600E+00 0.3200E+00 0.4800E+00 0.8000E+00 0.3200E+01
17	10	0.3140E+02	0.0000E+00 0.2402E+01 0.4003E+01 0.6005E+01 0.7205E+01 0.8006E+01 0.8006E+01 0.8006E+01 0.8006E+01 0.8006E+01	0.0000E+00 0.2560E-01 0.4960E-01 0.9120E-01 0.1280E+00 0.1600E+00 0.3200E+00 0.4800E+00 0.8000E+00 0.3200E+01
18	10	0.3636E+02	0.0000E+00 0.2786E+01 0.4643E+01 0.6964E+01 0.8357E+01 0.9285E+01 0.9285E+01 0.9285E+01 0.9285E+01 0.9285E+01	0.0000E+00 0.2560E-01 0.4960E-01 0.9120E-01 0.1280E+00 0.1600E+00 0.3200E+00 0.4800E+00 0.8000E+00 0.3200E+01
19	10	0.3644E+02	0.0000E+00 0.2792E+01 0.4653E+01 0.6980E+01 0.8376E+01 0.9307E+01 0.8376E+01	0.0000E+00 0.2560E-01 0.4960E-01 0.9120E-01 0.1280E+00 0.1600E+00 0.3200E+00

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			0.8376E+01	0.4800E+00
			0.8376E+01	0.8000E+00
20	10	0.3890E+02	0.8376E+01	0.3200E+01
			0.0000E+00	0.0000E+00
			0.2825E+01	0.2560E-01
			0.4709E+01	0.4960E-01
			0.7063E+01	0.9120E-01
			0.8476E+01	0.1280E+00
			0.9417E+01	0.1600E+00
			0.8476E+01	0.3200E+00
			0.8476E+01	0.4800E+00
			0.8476E+01	0.8000E+00
			0.8476E+01	0.3200E+01
21	10	0.4136E+02		
			0.0000E+00	0.0000E+00
			0.2908E+01	0.2560E-01
			0.4846E+01	0.4960E-01
			0.7269E+01	0.9120E-01
			0.8723E+01	0.1280E+00
			0.9692E+01	0.1600E+00
			0.8723E+01	0.3200E+00
			0.8723E+01	0.4800E+00
			0.8723E+01	0.8000E+00
			0.8723E+01	0.3200E+01
22	10	0.4144E+02		
			0.0000E+00	0.0000E+00
			0.2927E+01	0.2560E-01
			0.4878E+01	0.4960E-01
			0.7317E+01	0.9120E-01
			0.8780E+01	0.1280E+00
			0.9756E+01	0.1600E+00
			0.8780E+01	0.3200E+00
			0.8780E+01	0.4800E+00
			0.8780E+01	0.8000E+00
			0.8780E+01	0.3200E+01
23	10	0.5140E+02		
			0.0000E+00	0.0000E+00
			0.2257E+01	0.2560E-01
			0.3761E+01	0.4960E-01
			0.5641E+01	0.9120E-01
			0.6770E+01	0.1280E+00
			0.7522E+01	0.1600E+00
			0.6770E+01	0.3200E+00
			0.6770E+01	0.4800E+00
			0.6770E+01	0.8000E+00
			0.6770E+01	0.3200E+01
24	10	0.6136E+02		
			0.0000E+00	0.0000E+00
			0.2424E+01	0.2560E-01
			0.4039E+01	0.4960E-01
			0.6059E+01	0.9120E-01
			0.7271E+01	0.1280E+00
			0.8079E+01	0.1600E+00
			0.7271E+01	0.3200E+00
			0.7271E+01	0.4800E+00
			0.7271E+01	0.8000E+00
			0.7271E+01	0.3200E+01
25	10	0.6144E+02		
			0.0000E+00	0.0000E+00
			0.2463E+01	0.2560E-01
			0.4104E+01	0.4960E-01
			0.6156E+01	0.9120E-01

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			0.7388E+01	0.1280E+00
			0.8208E+01	0.1600E+00
			0.7388E+01	0.3200E+00
			0.7388E+01	0.4800E+00
			0.7388E+01	0.8000E+00
			0.7388E+01	0.3200E+01
26	10	0.6890E+02	0.0000E+00	0.0000E+00
			0.3203E+01	0.2560E-01
			0.5339E+01	0.4960E-01
			0.8008E+01	0.9120E-01
			0.9609E+01	0.1280E+00
			0.1068E+02	0.1600E+00
			0.9609E+01	0.3200E+00
			0.9609E+01	0.4800E+00
			0.9609E+01	0.8000E+00
			0.9609E+01	0.3200E+01
27	10	0.7636E+02	0.0000E+00	0.0000E+00
			0.3263E+01	0.2560E-01
			0.5439E+01	0.4960E-01
			0.8158E+01	0.9120E-01
			0.9790E+01	0.1280E+00
			0.1088E+02	0.1600E+00
			0.9790E+01	0.3200E+00
			0.9790E+01	0.4800E+00
			0.9790E+01	0.8000E+00
			0.9790E+01	0.3200E+01
28	10	0.7644E+02	0.0000E+00	0.0000E+00
			0.3277E+01	0.2560E-01
			0.5462E+01	0.4960E-01
			0.8193E+01	0.9120E-01
			0.9832E+01	0.1280E+00
			0.1092E+02	0.1600E+00
			0.1092E+02	0.3200E+00
			0.1092E+02	0.4800E+00
			0.1092E+02	0.8000E+00
			0.1092E+02	0.3200E+01
29	10	0.7890E+02	0.0000E+00	0.0000E+00
			0.3209E+01	0.2560E-01
			0.5349E+01	0.4960E-01
			0.8023E+01	0.9120E-01
			0.9628E+01	0.1280E+00
			0.1070E+02	0.1600E+00
			0.1070E+02	0.3200E+00
			0.1070E+02	0.4800E+00
			0.1070E+02	0.8000E+00
			0.1070E+02	0.3200E+01
30	10	0.8136E+02	0.0000E+00	0.0000E+00
			0.3306E+01	0.2560E-01
			0.5510E+01	0.4960E-01
			0.8266E+01	0.9120E-01
			0.9919E+01	0.1280E+00
			0.1102E+02	0.1600E+00
			0.1102E+02	0.3200E+00
			0.1102E+02	0.4800E+00
			0.1102E+02	0.8000E+00
			0.1102E+02	0.3200E+01
31	10	0.8144E+02	0.0000E+00	0.0000E+00

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			0.3310E+01	0.2560E-01
			0.5516E+01	0.4960E-01
			0.8274E+01	0.9120E-01
			0.9929E+01	0.1280E+00
			0.1103E+02	0.1600E+00
			0.1103E+02	0.3200E+00
			0.1103E+02	0.4800E+00
			0.1103E+02	0.8000E+00
			0.1103E+02	0.3200E+01
32	10	0.8390E+02		
			0.0000E+00	0.0000E+00
			0.6848E+01	0.2560E-01
			0.1141E+02	0.4960E-01
			0.1712E+02	0.9120E-01
			0.2054E+02	0.1280E+00
			0.2283E+02	0.1600E+00
			0.2283E+02	0.3200E+00
			0.2283E+02	0.4800E+00
			0.2283E+02	0.8000E+00
			0.2283E+02	0.3200E+01
33	10	0.8636E+02		
			0.0000E+00	0.0000E+00
			0.7073E+01	0.2560E-01
			0.1179E+02	0.4960E-01
			0.1768E+02	0.9120E-01
			0.2122E+02	0.1280E+00
			0.2358E+02	0.1600E+00
			0.2358E+02	0.3200E+00
			0.2358E+02	0.4800E+00
			0.2358E+02	0.8000E+00
			0.2358E+02	0.3200E+01
34	10	0.8644E+02		
			0.0000E+00	0.0000E+00
			0.7081E+01	0.2560E-01
			0.1180E+02	0.4960E-01
			0.1770E+02	0.9120E-01
			0.2124E+02	0.1280E+00
			0.2360E+02	0.1600E+00
			0.2124E+02	0.3200E+00
			0.2124E+02	0.4800E+00
			0.2124E+02	0.8000E+00
			0.2124E+02	0.3200E+01
35	10	0.9340E+02		
			0.0000E+00	0.0000E+00
			0.3520E+01	0.2560E-01
			0.5867E+01	0.4960E-01
			0.8800E+01	0.9120E-01
			0.1056E+02	0.1280E+00
			0.1173E+02	0.1600E+00
			0.1056E+02	0.3200E+00
			0.1056E+02	0.4800E+00
			0.1056E+02	0.8000E+00
			0.1056E+02	0.3200E+01
36	10	0.1004E+03		
			0.0000E+00	0.0000E+00
			0.3520E+01	0.2560E-01
			0.5867E+01	0.4960E-01
			0.8800E+01	0.9120E-01
			0.1056E+02	0.1280E+00
			0.1173E+02	0.1600E+00
			0.1056E+02	0.3200E+00
			0.1056E+02	0.4800E+00
			0.1056E+02	0.8000E+00

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0.1056E+02

0.3200E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.1473E+01	0.8000E-02
0.2945E+01	0.1600E-01
0.5890E+01	0.3200E-01
0.1178E+02	0.2080E+00
0.1767E+02	0.6720E+00
0.2121E+02	0.1168E+01
0.2356E+02	0.1600E+01
0.2356E+02	0.2400E+01
0.2356E+02	0.3200E+01

LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.7109E+00	0.1814E-03	0.1841E-01	0.1000E-03
0.7109E+01	0.1814E-02	0.1841E+00	0.1000E-02
0.3555E+02	0.9069E-02	0.9204E+00	0.5000E-02
0.7109E+02	0.1814E-01	0.1841E+01	0.1000E-01
0.1405E+03	0.3621E-01	0.3682E+01	0.2000E-01
0.2796E+03	0.8299E-01	0.6493E+01	0.5000E-01
0.3740E+03	0.1243E+00	0.7497E+01	0.8000E-01
0.4223E+03	0.1503E+00	0.8166E+01	0.1000E+00
0.4986E+03	0.2609E+00	0.1151E+02	0.2000E+00
0.4830E+03	0.5590E+00	0.1549E+02	0.5000E+00
0.4861E+03	0.8597E+00	0.1858E+02	0.8000E+00
0.4876E+03	0.1060E+01	0.2001E+02	0.1000E+01
0.4911E+03	0.2061E+01	0.2356E+02	0.2000E+01