FINAL REPORT
STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. CUY-14-0693
CULVERT NO. CUY-CR00240-00.610-0693
CUY-14-6.93
CUYAHOGA COUNTY, OHIO
PID#: 104132

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NEAS PROJECT 18-0023

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1. INTRODUCTION

1.1. General

National Engineering and Architectural Services Inc. (NEAS) presents our Structure Foundation Exploration Report for the planned replacement of existing Bridge CUY-14-0693 and Culvert over Mill Creek (CUY-CR00240-00.610) as part of the Ohio Department of Transportation (ODOT) bridge replacement and roadway realignment project CUY-14-6.93 (PID 104132). The existing bridge to be replaced carries Broadway Avenue (Ave) / State Route 14 (SR-14) over Chaincraft Road (Rd), Norfolk Southern Railway (Rwy) and Wheeling & Lake Erie Rwy within the City of Garfield Heights, Cuyahoga County, Ohio. The existing culvert carries a gravel access road and to some extent County Road (CR) 24 / Henry Street (St) over Mill Creek. As part of the referenced project, it is our understanding that ODOT is planning to: 1) replace the existing continuous reinforced concrete beam bridge (CUY-14-0693) with a new shortened structure on a new alignment; 2) remove the existing continuous reinforced concrete beam and steel stringer bridge (CUY-CR24-0062) carrying CR-24 / Henry St over the existing culvert CUY-CR00240-00.610; and, 3) replace a segment of existing cast-in-place 4-sided box culvert directing Mill Creek under the existing bridge CUY-CR24-0062 and Chaincraft Rd. This report presents a summary of the encountered surficial and subsurface conditions and our recommendations for bridge and culvert foundation design and construction in accordance with the Load and Resistance Factor Design (LRFD) method as set forth in AASHTO's Publication *LRFD Bridge Design Specifications, 8th Edition* (BDS) (AASHTO, 2017) and *ODOT's 2020 LRFD Bridge Design Manual* (BDM) (ODOT, 2021).

The exploration for the referenced bridge removal and replacement was conducted in general accordance with Barr Engineering, Inc. DBA National Engineering and Architectural Services Inc.'s (NEAS) proposal to AECOM, dated June 7, 2021 and with the provisions of ODOT's *Specifications for Geotechnical Explorations* (SGE) (ODOT, 2021).

The scope of work performed by NEAS as part of the referenced project included: a review of published geotechnical information; performing 22 total test borings (8 utilized within this report as part of the referenced structure foundation exploration); laboratory testing of soil samples in accordance with the SGE; performing geotechnical engineering analysis to assess foundation design and construction considerations; and development of this summary report.

1.2. Proposed Construction

The existing CUY-14-0693 bridge consists of a multi-span structure originally built in 1929. The existing bridge is comprised of continuous reinforced concrete beam spans of 24-ft with cantilevers of 6-ft and steel stringer spans either 20-ft or 47-ft. The existing structure is approximately 1,375 ft in length with an approximate roadway width between 52 and 64 ft (curb to curb) with 5 ft sidewalks on either side of the roadway. The structure carries two lanes of traffic in both the northbound (NB) and southbound (SB) directions as well as a left-hand turn lane at the Henry St intersection. The traffic lanes are atop a reinforced concrete deck supported by stub abutments and various pier types on either shallow spread footings or driven 16-inch diameter octagonal precast reinforced concrete piles.

It is our understanding that ODOT plans to replace the existing bridge (CUY-14-0693) with a widened structure on a new alignment. Furthermore, the existing bridge will be shortened with the elimination of the portion of the bridge located south of Chaincraft Rd. This portion of the existing bridge is planned to be

replaced with both newly placed embankment fill and mechanically stabilized earth (MSE) retaining walls that will support this segment of SR-14. In addition to the newly placed fill and MSE walls, 170 ft of the existing culvert over Mill Creek (CUY-CR00240-00.610) directly underlying the area of the proposed bridge removal is planned to be partially removed and replaced. The existing 22-ft by 7-ft cast-in-place (CIP) reinforced concrete box culvert is planned to be replaced by a pre-cast reinforced concrete box culvert of matching dimensions and will bear directly on the soils encountered at the site.

The remaining portion of the bridge north of Chaincraft Rd is to be realigned immediately north of the existing structure. The realigned bridge is proposed to consist of a 3-span steel plate girder superstructure atop wall type abutments and wall type piers. The proposed substructures will likely be supported by a deep foundation system consisting of driven CIP reinforced concrete pipe piles.

2. GEOLOGY AND OBSERVATIONS OF THE PROJECT

2.1. Geology and Physiography

The project site is located within the Galion Glaciated Low Plateau (ODGS, 1998). This area is characterized as rolling upland mantled with thin to thick drift and is transitional between the gently rolling Till Plain and the hilly Glaciated Allegheny Plateau with the overall area ranging in elevation from 800 ft to 1400 ft, with moderate relief (100 ft). The geology is described as medium- to low-lime Wisconsinan-age till over Mississippian-age shales and sandstone.

The geology at the bridge site is mapped as up to 70 ft of Wisconsinan-age sand and gravel thinning to an average thickness of 40 ft near the eastern end of the bridge site, all over Mississippian-age sandstone and shale bedrock (ODGS, 2002). The sand and gravel soils mapped at the bridge site are generally described as interbedded, well to moderately sorted sand and gravel commonly containing thin, discontinuous layers of silt and clay. The sand and gravel are characterized as finely stratified to massive, may be cross-bedded and locally may contain organics.

Bedrock underlying the bridge site has been mapped as Berea Sandstone and Bedford Shale, undivided, based on the Geologic Units Map of Ohio (USGS & ODGS, 2006). The sandstone at the site is described as brown, weathering light brown to reddish brown, thin to thick bedded with planar to lenticular bedding. The shale at the site is described as gray to brown in color, locally reddish brown, thin to medium bedded with planar to lenticular bedding as well. Based on the ODNR bedrock topography map of Ohio, bedrock elevation at the bridge site can be expected at approximate elevation 800 ft above mean sea level (amsl), putting bedrock at a depth between 15 ft and 25 ft below ground surface (bgs).

The soils directly underlying the bridge site have been mapped (Web Soil Survey) by the Natural Resources Conservation Service as being a combination of Urban land and Loudonville-Urban land complex. Urban land is land that has been altered or obscured by urban work and structures. Soils within these areas can be non-native human-transported material, human-altered material, or minimally altered or intact native soils. Urban land soils are not rated for local roads. The Loudonville series is described as moderately deep, well drained soils with moderate permeability formed in loamy till and underlain by sandstone or siltstone. Soils in the Loudonville series classify as both cohesive and non-cohesive A-4 soils and cohesive A-6 and A-7 soils according to the AASHTO method of soil classification (USDA, 2015).

2.2. Hydrology/Hydrogeology

Groundwater elevations at the bridge site are anticipated to be near elevations consistent with that of the immediately adjacent Mill Creek (between approximate elevations 805 and 807 ft amsl) as it is the most dominant hydraulic influence in the vicinity of the bridge site. The water level of Mill Creek may be representative of the local groundwater table although perched groundwater systems may exist with the presence of fine-grained soils making it difficult for groundwater to permeate to the natural phreatic surface.

Areas in the eastern portion of the project area adjacent to the proposed Pier 2 and forward abutment is located within a 1% Annual Chance Flood Hazard area. Based on available mapping by the Federal Emergency Management Agency's (FEMA) National Flood Hazard mapping program (FEMA, 2016) the 1% Annual Chance Flood elevation is about 822 to 823 ft amsl within the flood hazard area.

2.3. Mining and Oil/Gas Production

No abandoned mines are noted on ODNR's Abandoned Underground Mine Locator within the immediate vicinity of the bridge site (ODNR [1], 2016).

No oil or gas wells are noted on ODNR's Ohio Oil & Gas Locator within the immediate vicinity of the bridge site (ODNR [2], 2016).

2.4. Historical Records and Previous Phases of Project Exploration

The following plans were available for review and evaluation for this report:

- Bridge Foundation Investigation sheets and boring logs as part of ODOT bridge rehabilitation project CUY-14-06.99 Broadway Avenue Bridge No. 123, prepared by the Mason, Sandefur & de Verteuil, Inc., dated August 23, 1983;

Historical soil borings associated with the above referenced plans were reviewed, however, were not utilized for our analysis, and therefore, are not referenced or presented within this report or structure foundation exploration sheets.

2.5. Site Reconnaissance

A field reconnaissance visit for the proposed CUY-14-0693 bridge and CUY-CR002-00.610 culvert was conducted on August 9, 2021, during which site conditions were noted and photographed. During our field reconnaissance, no geohazards were observed within the immediate vicinity of the proposed bridge or culvert sites. Land use of the area surrounding the proposed site can be described as a mix of parks, industrial properties, and railroad right-of-way.

The existing bridge carrying SR-14 over Chaincraft Rd, Norfolk Southern Rwy and Wheeling & Lake Erie Rwy consists of a multi-span, reinforced concrete and steel beam bridge. At the existing bridge abutment locations, SR-14 is supported on an embankment constructed about 18 to 22 ft above the surrounding area. Existing embankment slopes at each abutment appeared to be approximately 2 Horizontal to 1 Vertical (2H:1V) with no signs of instability observed during our site visit. In general, the bridge substructures appeared to be in good condition with no apparent signs of distress due to geotechnical concerns noted during our field reconnaissance visit.

The site of the proposed rear abutment, located between Chaincraft Rd and the existing bridge structure, was observed to be a relatively flat grassy area with overhead utilities (Photograph 1), while the locations of the proposed bridge piers and forward abutment were observed to be in heavily vegetated areas and located within close proximity to the Norfolk Southern Rwy and Wheeling & Lake Erie Rwy (Photograph 2). The forward pier and forward abutment are proposed within existing railroad right-of-way. With respect to drainage, the site of the proposed bridge appeared to be well drained, with no signs of ponding or drainage issues observed during our field visit.

The site of the proposed culvert replacement was observed to be a relatively flat area consisting of a gravel access road connecting Garfield Parkway and Chaincraft Rd. No apparent signs of geotechnical related distress were noted in the vicinity of the culvert location during our field reconnaissance visit. The culvert location also appeared to be well drained, with no signs of ponding or drainage issues observed during our visit.

Photograph 1: Proposed rear abutment location

Photograph 2: Proposed forward pier location

3. GEOTECHNICAL EXPLORATION

3.1. Field Exploration Program

The exploration for the proposed bridge and culvert replacements was conducted by NEAS between August 6, 2021 and August 31, 2021 included 8 borings drilled to depths between 45.0 and 59.7 ft bgs. The boring locations were selected by NEAS in general accordance with the guidelines contained in the SGE with the intent to evaluate subsurface soil and groundwater conditions. Borings were typically located near the proposed substructure locations and at the proposed culvert replacement location, in areas that were not restricted by maintenance of traffic, underground utilities or dictated by terrain (i.e. steep embankment slopes). Due to railroad right-of-way constraints borings could not be performed at the forward pier location. Each as-drilled project boring location and corresponding ground surface elevation was surveyed in the field by NEAS following completion. Each individual project boring log (included within Appendix B) includes the recorded boring latitude and longitude location (based on the surveyed Ohio State Plane North, NAD83, location) and the corresponding ground surface elevation. A summary of the referenced bridge borings including depth, location and elevation is presented in Table 1 below, while the boring locations are depicted on the Boring Location Plan provided within Appendix A.

Table 1: Project Boring Summary

Boring Number	Latitude	Longitude	Elevation (NAVD 88) (ft)	Depth (ft)	Structure
B-006-0-21	41.431548	-81.601193	812.9	49.4	CUY-14-0693 Rear Abutment
B-007-0-21	41.431220	-81.600616	815.2	50.0	CUY-14-0693 Rear Abutment
B-008-0-21	41.431475	-81.600782	815.0	52.0	CUY-14-0693 Pier 1
B-009-0-21	41.431188	-81.600404	814.9	49.8	CUY-14-0693 Pier 1 & 2
B-010-0-21	41.431345	-81.599251	821.6	50.0	CUY-14-0693 Forward Abutment & Pier 2
B-011-0-21	41.431112	-81.598998	823.5	59.7	CUY-14-0693 Forward Abutment
B-020-0-21	41.430969	-81.600935	816.2	45.0	Culvert CUY-CR00240-00.610
B-021-0-21	41.4308650	-81.600658	816.6	48.8	Culvert CUY-CR00240-00.610

Notes:
1. As-drilled boring location and corresponding ground surface elevation was surveyed in the field by NEAS Inc.

Borings were drilled using CME 55, CME 75 or CME 55X truck or track mounted drilling rig utilizing 3.25-inch diameter hollow stem augers. In general, soil samples were recovered at intervals of 2.5-ft to depths between 25 and 35 ft bgs and at 5.0-ft intervals thereafter using a split spoon sampler (AASHTO T-206 “Standard Method for Penetration Test and Split Barrel Sampling of Soils.”). The soil samples obtained from the exploration program were visually observed in the field by the NEAS field representative and preserved for review by a Geologist and possible laboratory testing. Standard penetration tests (SPT) were conducted using CME auto hammers that had been calibrated to be between 68.4% and 89% efficient as indicated on the boring logs.

Field /boring logs were prepared by drilling personnel, and included lithological description, SPT results recorded as blows per 6-inch increment of penetration and estimated unconfined shear strength values on specimens exhibiting cohesion (using a hand-penetrometer). Groundwater level observations were recorded both during and after the completion of drilling. These groundwater level observations are included on the individual boring logs. After completing the borings, the boreholes were backfilled with either auger

cuttings, bentonite chips, or a combination of these materials, and patched with cold patch asphalt and/or quickset concrete where necessary and appropriate.

3.2. Laboratory Testing Program

The laboratory testing program for the proposed bridge structure foundation exploration consisted of classification testing and moisture content determinations. Data from the laboratory-testing program were incorporated onto the boring logs (Appendix B). Soil samples are retained at the laboratory for 60 days following report submittal, after which time they will be discarded.

3.2.1. Classification Testing

Representative soil samples were selected for index properties (Atterberg Limits) and gradation testing for classification purposes on approximately 28% of the samples. At each boring location, samples were selected for testing with the intent of identification and classification of all significant soil units. Soils not selected for testing were compared to laboratory tested samples/strata and classified visually. Moisture content testing was conducted on all samples. The laboratory testing was performed in general accordance with applicable AASHTO specifications.

A final classification of the soil strata was made in accordance with AASHTO M-145 “Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes,” as modified by ODOT “Classification of Soils” once laboratory test results became available. The results of the soil classification are presented on the boring logs provided in Appendix B.

3.2.2. Standard Penetration Test Results

Standard Penetration Tests (SPT) and split-barrel (commonly known as split-spoon) sampling of soils were performed at varying intervals (i.e., 2.5-ft or 5.0-ft intervals) in the project borings performed. To account for the high efficiency (automatic) hammers used during SPT sampling, field SPT N-values were converted based on the calibrated efficiency (energy ratio) of the specific drill rig's hammer. Field N-values were converted to an equivalent rod energy of 60% (N_{60}) for use in analysis or for correlation purposes. The resulting N_{60} values are presented on the boring logs provided in Appendix B.

3.2.3. Unconfined Compressive Strength of Cohesive Soil Test Results

Unconfined compressive strength testing was performed in accordance with AASHTO T-208 "Standard Method of Test for Unconfined Compressive Strength of Cohesive Soil" on one (1) relatively undisturbed (Shelby Tube), cohesive samples obtained during the exploration programs. The sample was obtained from boring B-021-0-21 at depths between 7.6 and 8.1 ft bgs (between elevations 808.5 and 809.0 ft amsl). The tested sample classified as Silt and Clay (A-6a). A summary of the Unconfined Compressive Strength of Cohesive Soil test is shown in Table 2 below, while the laboratory testing reports are included within Appendix B.

Table 2: Unconfined Compressive Strength of Cohesive Soil Test Results

Boring Number	Depth of Specimen Tested (ft bgs)	Classification	Estimated Elevation (ft amsl)	Wet Density (psf)	Unconfined Compressive Strength (psf)	Undrained Shear Strength (psf)	Strain at Failure (%)
B-021-0-21	7.6 - 8.1	A-6a	809.0 - 808.5	136.6	582	291	3.5

3.2.4. Direct Shear Testing

Direct Shear Testing was conducted in accordance with AASHTO T-236 "Standard Method of Test for Direct Shear Test of Soils under Consolidated Drained Conditions" on one (1) relatively undisturbed samples obtained during the exploration program. The sample tested were obtained from boring B-021-0-21 at depths between 8.8 and 9.3 ft bgs (between elevations 807.3 and 807.8 ft amsl). The soils from this sample classified as Coarse and Fine Sand (A-3a). The Direct Shear Test results are shown in Table 3 below. The lab testing report is provided in Appendix B.

Table 3: Direct Shear Test Results

Boring Number	Depth of Sample (ft)	Classification	Average Wet Density [1] (pcf)	Average Void Ratio [1]	Cohesion - Effective (psf)	Angle of Friction - Effective (°)
B-021-0-21	8.8 - 9.3	A-3a	121.1	0.743	29	33.1

Notes:
1. Indicated average values were collected prior to Direct Shear testing (i.e., initial readings).

4. GEOTECHNICAL FINDINGS

The subsurface conditions encountered during NEAS's explorations are described in the following subsections and on each boring log presented in Appendix B. The boring logs represent NEAS's interpretation of the subsurface conditions encountered at each boring location based on our site observations, field logs, visual review of the soil samples by NEAS's geologist, and laboratory test results. The lines designating the interfaces between various soil strata on the boring logs represent the approximate interface location; the actual transition between strata may be gradual and indistinct. The subsurface soil and groundwater characterizations included herein, including summary test data, are based on the subsurface findings from the geotechnical explorations performed by NEAS as part of the referenced project, and consideration of the geological history of the site.

4.1. Subsurface Conditions

The subsurface profile at the bridge site is relatively uniform and consistent with the geological model for the project. The subsurface profile generally consists of an upper stratum of highly variable fill/possible fill soils ranging from coarse-grained, non-cohesive material to fine-grained, cohesive material atop natural sand and gravel soils. The natural sand and gravel soils encountered underlying the fill/possible fill soils can be described as medium dense to very dense non-cohesive, granular material. Bedrock was not encountered within depths of the borings performed at the bridge site.

4.1.1. Overburden Soil

At the proposed bridge site, two different materials were encountered within the borings performed. Those materials consisted of: 1) highly variable "man-made" fill/possible fill soils; and, 2) naturally deposited sand and gravel soils. These materials and the general profile are further described below.

Fill soils or possible fill soils were encountered in each of the borings performed at the bridge site extending to depths ranging from 4.5 ft to 12 ft bgs (elevations 819.0 to 803.4 ft amsl). Based on laboratory testing results and a visual review of the samples obtained, the fill/possible fill at the site is generally comprised of non-cohesive, coarse- and fine-grained materials that are classified on the boring logs as either Gravel and Stone Fragments with Sand (A-1-b), Coarse and Fine Sand (A-3a) or non-cohesive Sandy Silt (A-4a). The

exception being the upper stratum encountered in boring B-010-0-21 in which the material consisted of fine-grained cohesive soil which was classified as Silt and Clay (A-6a), Silty Clay (A-6b) and Clay (A-7-6). With respect to the soil strength of the non-cohesive fill/possible fill soils encountered, these soils can be described as having a relative compactness of very loose to medium dense correlating to converted SPT-N (N_{60}) values between 0 and 27 blows per foot (bpf). The natural moisture content of the non-cohesive soils ranged from 12 to 29 percent. With respect to the soil strength of the fine-grained cohesive fill/possible fill, these soils can be described as having a consistency of medium stiff to very stiff correlating to N_{60} values between 5 and 8 bpf and unconfined compressive strengths (estimated by means of hand penetrometer) between 0.75 and 2.75 tons per square foot (tsf). Natural moisture contents of the cohesive fill ranged from 18 to 25 percent. Based on Atterberg Limits tests performed on representative samples of the cohesive material, the liquid and plastic limits ranged from 30 to 48 percent and from 18 to 23 percent, respectively.

Naturally deposited sand and gravel soils were encountered underlying the fill/possible fill soils in each of the borings performed at the bridge site and extended to borehole termination depths ranging from 49.4 to 59.7 ft bgs (elevations 771.6 to 763.0 ft amsl). The natural sand and gravel encountered at the site is generally comprised of non-cohesive, coarse-grained material that are classified on the boring logs as Gravel and/or Stone Fragments (A-1-a), Gravel and Stone Fragments with Sand (A-1-b), Gravel and Stone Fragments with Sand and Silt (A-2-4) and Coarse and Fine Sand (A-3a). The relative compactness of the natural sand and gravels encountered can generally be described as medium dense to very dense correlating to N_{60} values between 20 bpf and SPT-N refusal (i.e., less than 6 inches of penetration over 50 blows). Natural moisture contents of these soils ranged from 3 to 21 percent.

4.1.2. Groundwater

Groundwater measurements were taken during the drilling procedures and immediately following the completion of the boring performed. Groundwater was observed in 6 of the 8 borings performed at the bridge site at depths ranging from 7.0 to 13.2 ft bgs (elevations 809.6 to 803.4 ft amsl). Groundwater was not encountered within borings B-011-0-21 or B-021-0-21 performed as part of the referenced structure foundation exploration. It should be noted that groundwater is affected by many hydrologic characteristics in the area and may vary from those measured at the time of the exploration. The specific groundwater readings are included on the boring logs (Appendix B).

5. ANALYSIS AND RECOMMENDATIONS

5.1. Bridge Foundation Analysis and Recommendations

We understand that the existing multi-span bridge structures carrying SR-14 over Chaincraft Rd, Norfolk Southern Rwy and Wheeling & Lake Erie Rwy in Cuyahoga County, Ohio is proposed to be replaced. It is anticipated that each of the proposed substructures will be supported by the natural subsurface material through the use of a deep foundation system. Therefore; a deep pile foundation system consisting of cast-in-place (CIP) pipe piles was evaluated for the support of the proposed substructures. The summary and results of our evaluations as well as recommended "estimated" and "order" pile lengths are presented in subsequent sections.

5.1.1. Soil Profile for Analysis

For analysis purposes, each substructure location (boring log) was reviewed and a generalized material profile was developed for analysis. Utilizing the generalized soil profile, engineering properties for each

soil strata were estimated based on the field (i.e., SPT N_{60} Values, hand penetrometer values, etc.) and laboratory (i.e., Atterberg Limits, grain size, etc.) test results using correlations provided in published engineering manuals, research reports and guidance documents. The developed soil profile and estimated engineering soil properties for use in analysis (with sited correlation/reference material) are summarized within Tables 4 through 9 below. Settlement parameters (with sited correlation/reference material) developed for use in settlement analysis at each abutment location are presented in Tables 10 and 11 below.

Table 4: Soil Profile and Estimated Engineering Properties - At Boring B-006-0-21

Bridge CUY-14-0693: Rear Abutment, B-006-0-21					
Soil Description	**Unit Weight[1] (pcf)**	**Undrained Shear Strength[2] (psf)**	**Effective Cohesion[3] (psf)**	**Effective Friction Angle[3] (degrees)**	**Setup Factor (f_{su})**
Coarse and Fine Sand Depth (812.9 ft - 803.4 ft)	112	-	-	33	1.0
Gravel with Sand Depth (803.4 ft - 798.4 ft)	140	-	-	45	1.0
Coarse and Fine Sand Depth (798.4 ft - 795.9 ft)	130	-	-	38	1.0
Gravel with Sand Depth (795.9 ft - 790.9 ft)	132	-	-	42	1.0
Coarse and Fine Sand Depth (790.9 ft - 788.4 ft)	135	-	-	40	1.0
Gravel with Sand Depth (788.4 ft - 779.6 ft)	140	-	-	45	1.0
Gravel Depth (779.6 ft - 763.5 ft)	140	-	-	44	1.0

Notes:
1. *Values interpreted from Geotechnical Bulletin 7 Table 1.*
2. *Values calculated from Terzaghi and Peck (1967) if $N1_{60}$ <52, else Stroud and Butler (1975) was used.*
3. *Values interpreted from Geotechnical Bulletin 7 Table 2 for cohesive soils and LRFD BDS Table 10.4.6.2.4-1 and ODOT GDM Table 400-3 for granular soils.*

Table 5: Soil Profile and Estimated Engineering Properties - At Boring B-007-0-21

Bridge CUY-14-0693: Rear Abutment, B-007-0-21					
Soil Description	**Unit Weight[1] (pcf)**	**Undrained Shear Strength[2] (psf)**	**Effective Cohesion[3] (psf)**	**Effective Friction Angle[3] (degrees)**	**Setup Factor (f_{su})**
Gravel with Sand Depth (815.2 ft - 806.2 ft)	108	-	-	31	1.0
Gravel with Sand Depth (806.2 ft - 786.9 ft)	140	-	-	45	1.0
Gravel Depth (786.9 ft - 781.9 ft)	140	-	-	45	1.0
Gravel with Sand Depth (781.9 ft - 765.2 ft)	140	-	-	45	1.0

ɔs:
1. *Values interpreted from Geotechnical Bulletin 7 Table 1.*
2. *Values calculated from Terzaghi and Peck (1967) if $N1_{60}$ <52, else Stroud and Butler (1975) was used.*
3. *Values interpreted from Geotechnical Bulletin 7 Table 2 for cohesive soils and LRFD BDS Table 10.4.6.2.4-1 and ODOT GDM Table 400-3 for granular soils.*

Table 6: Soil Profile and Estimated Engineering Properties - At Boring B-008-0-21

Bridge CUY-14-0693: Pier 1, B-008-0-21					
Soil Description	**Unit Weight[1] (pcf)**	**Undrained Shear Strength[2] (psf)**	**Effective Cohesion[3] (psf)**	**Effective Friction Angle[3] (degrees)**	**Setup Factor (f_{su})**
Sandy Silt Depth (815 ft - 810.5 ft)	128	-	-	37	1.2
Coarse and Fine Sand Depth (810.5 ft - 805.5 ft)	122	-	-	33	1.0
Coarse and Fine Sand Depth (805.5 ft - 798 ft)	130	-	-	40	1.0
Gravel with Sand Depth (798 ft - 763 ft)	140	-	-	43	1.0

ılues interpreted from Geotechnical Bulletin 7 Table 1.
ılues calculated from Terzaghi and Peck (1967) if $N1_{60}$ <52, else Stroud and Butler (1975) was used.
ılues interpreted from Geotechnical Bulletin 7 Table 2 for cohesive soils and LRFD BDS Table 10.4.6.2.4-1 and ODOT GDM Table 400-3 for granular soils.

Table 7: Soil Profile and Estimated Engineering Properties - At Boring B-009-0-21

Bridge CUY-14-0693: Pier 1 & Pier 2, B-009-0-21					
Soil Description	**Unit Weight[1] (pcf)**	**Undrained Shear Strength[2] (psf)**	**Effective Cohesion[3] (psf)**	**Effective Friction Angle[3] (degrees)**	**Setup Factor (f_{su})**
Gravel with Sand Depth (814.9 ft - 811.1 ft)	110	-	-	35	1.0
Sandy Silt Depth (811.1 ft - 805.4 ft)	110	-	-	29	1.2
Gravel with Sand Depth (805.4 ft - 792.9 ft)	132	-	-	42	1.0
Gravel Depth (792.9 ft - 782.9 ft)	132	-	-	43	1.0
Gravel with Sand Depth (782.9 ft - 776.6 ft)	135	-	-	42	1.0
Gravel with Sand and Silt Depth (776.6 ft - 771.6 ft)	140	-	-	42	1.2
Gravel Depth (771.6 ft - 765.1 ft)	140	-	-	45	1.0

otes:
1. *Values interpreted from Geotechnical Bulletin 7 Table 1.*
2. *Values calculated from Terzaghi and Peck (1967) if $N1_{60}$<52, else Stroud and Butler (1975) was used.*
3. *Values interpreted from Geotechnical Bulletin 7 Table 2 for cohesive soils and LRFD BDS Table 10.4.6.2.4-1 and ODOT GDM Table 400-3 for granular soils.*

Table 8: Soil Profile and Estimated Engineering Properties - At Boring B-010-0-21

Bridge CUY-14-0693: Forward Abutment & Pier 2, B-010-0-21					
Soil Description	**Unit Weight[1] (pcf)**	**Undrained Shear Strength[2] (psf)**	**Effective Cohesion[3] (psf)**	**Effective Friction Angle[3] (degrees)**	**Setup Factor (f_{su})**
Silty Clay Depth (821.6 ft - 817.1 ft)	108	1000	100	22	1.75
Clay Depth (817.1 ft - 814.6 ft)	108	850	100	21	2.0
Silt and Clay Depth (814.6 ft - 809.6 ft)	105	750	75	21	1.5
Gravel Depth (809.6 ft - 802.1 ft)	130	-	-	42	1.0
Coarse and Fine Sand Depth (802.1 ft - 799.6 ft)	135	-	-	41	1.0
Gravel with Sand Depth (799.6 ft - 771.6 ft)	135	-	-	42	1.0

otes:
1. *Values interpreted from Geotechnical Bulletin 7 Table 1.*
2. *Values calculated from Terzaghi and Peck (1967) if $N1_{60}$<52, else Stroud and Butler (1975) was used.*
3. *Values interpreted from Geotechnical Bulletin 7 Table 2 for cohesive soils and LRFD BDS Table 10.4.6.2.4-1 and ODOT GDM Table 400-3 for granular soils.*

Table 9: Soil Profile and Estimated Engineering Properties - At Boring B-011-0-21

Bridge CUY-14-0693: Forward Abutment, B-011-0-21					
Soil Description	**Unit Weight[1] (pcf)**	**Undrained Shear Strength[2] (psf)**	**Effective Cohesion[3] (psf)**	**Effective Friction Angle[3] (degrees)**	**Setup Factor (f_{su})**
Sandy Silt Depth (823.5 ft - 819 ft)	100	-	-	23	1.2
Gravel with Sand Depth (819 ft - 814 ft)	128	-	-	39	1.0
Gravel with Sand Depth (814 ft - 763.5 ft)	140	-	-	44	1.0

Notes:
1. *Values interpreted from Geotechnical Bulletin 7 Table 1.*
2. *Values calculated from Terzaghi and Peck (1967) if $N1_{60}$<52, else Stroud and Butler (1975) was used.*
3. *Values interpreted from Geotechnical Bulletin 7 Table 2 for cohesive soils and LRFD BDS Table 10.4.6.2.4-1 and ODOT GDM Table 400-3 for granular soils.*

Table 10: Settlement Parameters for Analysis – Rear Abutment

Rear Abutment: Settlement Analysis, B-005-0-21 and B-006-0-21								
Soil Description	Unit Weight (pcf)	Elastic Modulus[1] (psf)	Poissons Ratio[1], v	Void Ratio e_o	Compression Index[2], C_c	Recompression Index[3], C_r	OCR[4]	Coeff. of Consol.[5], C_v
Non-cohesive Elevation (812.9 ft - 803.4 ft)	110	43000	0.20	-	-	-	-	-
Non-cohesive Elevation (803.4 ft - 789.1 ft)	135	562000	0.40	-	-	-	-	-
Cohesive[6] Elevation (789.1 ft - 785.3 ft)	122	2000000	0.50	0.816	0.169	0.042	5.0	0.16
Non-cohesive Elevation (785.3 ft - 763.5 ft)	135	562000	0.40	-	-	-	-	

Notes:
1. *Values interpreted from 2017 AASHTO LRFD BDS Table C10.4.6.3-1*
2. *Values calculated from Kulhawy and Mayne, 1990, Equation 6-6.*
3. *Values calculated from Kulhawy and Mayne, 1990, Equation 6-9.*
4. *Values interpreted from Mayne and Kemper, 1988, Figure 7.*
5. *Values interpreted from FHWA GEC No. 5, Boeckmann, et al., 2016, Figure 6-37.*
6. *Based on soils encoutnered in boring B-005-0-21.*

Table 11: Settlement Parameters for Analysis – Forward Abutment

Forward Abutment: Settlement Analysis, B-010-0-21								
Soil Description	Unit Weight (pcf)	Elastic Modulus[1] (psf)	Poissons Ratio[1], v	Void Ratio e_o	Compression Index[2], C_c	Recompression Index[3], C_r	OCR[4]	Coeff. of Consol.[5], C_v
Non-cohesive Elevation (821.6 ft - 812.6 ft)	120	106000	0.25	-	-	-	-	-
Cohesive[6] Elevation (812.6 ft - 809.6 ft)	118	586000	0.50	0.816	0.17	0.042	5.0	0.16
Non-cohesive Elevation (809.6 ft - 771.6 ft)	135	990000	0.40	-	-	-	-	-

Notes:
1. *Values interpreted from 2017 AASHTO LRFD BDS Table C10.4.6.3-1*
2. *Values calculated from Kulhawy and Mayne, 1990, Equation 6-6.*
3. *Values calculated from Kulhawy and Mayne, 1990, Equation 6-9.*
4. *Values interpreted from Mayne and Kemper, 1988, Figure 7.*
5. *Values interpreted from FHWA GEC No. 5, Boeckmann, et al., 2016, Figure 6-37.*
6. *Based on laboratory test results from borings B-016-0-21.*

It should be noted that, though boring B-016-0-21 was not drilled as part of the structure foundation exploration for the proposed bridge replacement and was not drilled in the immediate vicinity of the proposed bridge foundations, cohesive soils similar in nature to those encountered within forward abutment bridge boring B-010-0-21 were also encountered in boring B-016-0-21. Therefore, for settlement analysis purposes it was assumed that: 1) the cohesive soils encountered at the B-016-0-21 may be representative of the soils encountered at the forward abutment location; and, 2) the consolidation parameters obtained via laboratory consolidation testing performed for boring B-016-0-21 could be utilized in our analysis for the referenced cohesive soils as indicated in Table 11. The boring log and laboratory testing report for boring B-016-0-21 is included with the structure foundation exploration logs in Appendix B.

5.1.2. Deep Foundation Analysis

Based on the determined soil profile and our estimated engineering soil properties, a pile analysis was performed using the computer program *Driven* to determine the estimated geotechnical pile length at each substructure (*Driven* results included within Appendix C). For the purposes of this report and our analysis, the term 'geotechnical pile length' has been assumed to represent the length of pile from bottom of pile cap (assumed pile cap bearing elevation) to the depth at which the required Ultimate Bearing Value (UBV) is obtained. For our analysis it is assumed that the proposed pile cap elevations will match the Bridge No. CUY-14-0693 alternative 2B schematic plan and profile provided by AECOM dated December 20, 2020. Preliminary pile loads for each substructure were provided by AECOM on October 28, 2021.

The UBV is determined in accordance with Section 305.3.2 of the ODOT BDM in which the total factored load for the highest loaded pile at each substructure is divided by the appropriate driven pile resistance factor. It is recommended that the piles for the referenced project be installed according to ODOT's Construction and Material Specifications (CMS) 507 and CMS 523, and therefore, a driven pile resistance factor of 0.7 should be used.

The estimated nominal skin friction (Rs), pile tip bearing values (Rp) and required geotechnical pile length of 16-inch diameter CIP piles driven to the respective UBV per substructure location are given in Table 12 below (*Driven* results included within Appendix C).

Table 12: Deep Foundation Analysis Summary

Pile Type	Geotechnical Pile Length[1] (ft)	Ultimate Side Resistance[2] (kips)	Ultimate Point Resistance[2] (kips)	Ultimate Bearing Value[2] (kips)
CUY-14-0693 Rear Abutment, B-006-0-21 & B-007-0-21				
16-inch CIP	15.4 / 8.2	57.5 / 21.5	356.8 / 392.8	414.3
CUY-14-0693 Pier 1, B-008-0-21 & B-009-0-21				
16-inch CIP	14.0 / 15.7	42.8 / 58.1	371.5 / 356.2	414.3
CUY-14-0693 Pier 2, B-009-0-21 & B-010-0-21				
16-inch CIP	14.2 / 15.4	43.8 / 69.6	370.5 / 344.7	414.3
CUY-14-0693 Forward Abutment, B-010-0-21 & B-011-0-21				
16-inch CIP	16.4 / 6.7	78.8 / 18.1	335.5 / 396.2	414.3

Notes:
1. *The estimted length of pile from bottom of pile cap to the depth which the required UBV is obtained.*
2. *The referenced resistance factor has NOT been applied to values calculated.*
3. *The UBV per ODOT BDM Section C305.3.2.*

In accordance with AASHTO LRFD Article 10.7.1.2, CIP piles should have a minimum spacing of 30 inches or 2.5 times the diameter of the pile. This spacing is to minimize group effects for axially loaded piles. The distance from the side of any pile to the nearest edge of the pile cap shall not be less than 9 inches. The top of piles shall project at least 12 inches into the pile cap after all damaged pile material has been removed.

5.1.3. Pile Drivability

NEAS's pile drivability evaluation estimated a Delmag D19-42 diesel hammer to determine if the pile type or size being considered would be overstressed (i.e., compressive stresses experienced by pile during driving are greater than 90% of the yield strength of the steel) at any time during pile installation. The results of the evaluation indicated that the 16-inch diameter CIP pile size would not be overstressed during the pile installation process assuming: 1) a minimum wall thickness calculated in accordance with Section 507.03 "Cast-in-Place Reinforced Concrete Piles" of ODOT's CMS; 2) the use of ASTM A 252 Grade 3 steel piles; and, 3) our developed model used in the computer program *GRLWEAP* developed by GRL Engineers, Inc. Based on the assumed UBVs (Table 10) and commonly available pipe pile wall thicknesses, the minimum wall thickness was assumed to be 0.46 inches for a 16-inch diameter CIP pile at the proposed substructures. GRLWEAP results for each substructure location can be found in Appendix D.

It should be noted that the driving resistance of CIP piles through soils encountered at the bridge site is expected to be high. Drivability is difficult to assess quantitatively as the field test results (i.e., SPT N_{60} values, pocket penetrometer values, etc.) tend to be very high. Furthermore, pile drivability is highly reliant upon the specific equipment used in construction; therefore, it is recommended that the contractor provide

an analysis to demonstrate that the equipment and pile combination planned for use is capable of obtaining the UBV without over-stressing the piles.

5.1.4. Pile Foundation Recommendations

We recommend that a driven pile foundation be used for support for the proposed bridge. New 16-inch diameter CIP piles are recommended to be installed in accordance with Sections 507 and 523 of ODOT's CMS and driven to the Ultimate Bearing Values (UBVs) indicated in Table 12 of this report. When new piles are installed in accordance with referenced construction specifications, 16-inch diameter CIP piles driven to the indicated UBVs at the proposed substructure locations may be used to support a total factored load (single pile) of 290 kips.

Proposed pile lengths based on: 1) our Deep Foundation Analysis (presented in Section 5.2.1); and, 2) the "Estimated Length" and "Order Length" definitions and formulas presented in Section 303.4.2 "Pile Foundations" of the ODOT BDM, are presented in Table 13 below.

Table 13: Driven Pile Lengths

Pile Type	Bottom of Pile Cap Elevation (ft amsl)	Geotechnical Pile Length (ft)	Geotechnical Pile Tip Elevation (ft amsl)	Estimated Pile Length[(1)] (ft)	Order Length[(1)] (ft)
CUY-14-0693 Rear Abutment, B-006-0-21 & B-007-0-21					
16-inch CIP	808.5	15.4 / 8.2	793.1 / 800.3	20 / 15	25 / 20
CUY-14-0693 Pier 1, B-008-0-21 & B-009-0-21					
16-inch CIP	811.0	14.0 / 15.7	797.0 / 795.3	20	25
CUY-14-0693 Pier 2, B-009-0-21 & B-010-0-21					
16-inch CIP	815.0	14.2 / 15.4	800.8 / 799.6	20	25
CUY-14-0693 Forward Abutment, B-010-0-21 & B-011-0-21					
16-inch CIP	816.0	16.4 / 6.7	799.6 / 809.3	20 / 10	25 / 15

Notes:
1. Based on definitions and formulas presented in Section 305.3.5.2 of the 2020 BDM.

Additionally, it should be noted that because the borings performed at the bridge site encountered very dense sands and gravel and possible cobbles and/or boulders, we do recommend that piles driven for the project be driven with pile points per ODOT's BDM Section 305.3.5.6. Pile points will assist in penetrating or displacing boulders and cobbles and/or driving through dense granular materials encountered on the site.

5.2. Settlement Analysis

In order to estimate the maximum total and differential settlement that could result within the subsurface soils supporting the proposed SR-14 embankment soils adjacent to the proposed rear and forward abutments, NEAS reviewed: 1) the Stage 2 Plan Set for the CUY-14-6.93 project, prepared by AECOM dated January 16, 2023; 2) Service Limit State loading conditions; and, 3) the generalized subsurface profile and Settlement Parameters for Analysis provided in Section 5.1.1. of this report. Utilizing this information and the software entitled *FoSSA 2.0* by ADAMA Engineering, Inc., a settlement model was developed and analyzed to for both elastic (immediate) and consolidation (long term) settlement. Outputs of our *FoSSA 2.0* settlement analysis are included within Appendix E.

Based on our analyses, the estimated maximum total settlement associated with the loads induced by the proposed new embankment is about 5.6 inches and 2.5 inches at the proposed rear and forward abutment, respectively. This settlement will begin as the embankment load is applied and will dissipate with time. However, the amount of settlement and the time required for the settlement to occur is mostly dependent

on the thickness of the underlying compressible soil, the uniformity and properties of these layers (i.e., compaction, material type, compressibility, etc.), and the proposed embankment fill height/surcharge load. Due to: 1) the predominant presence of granular material within the soil profile at the site; and, 2) the consolidation properties and thickness of the cohesive soil layers encountered, this settlement magnitude is not anticipated to be a concern as the majority of the total settlement (5.3 inches and 2.2 inches at the rear and forward abutment, respectively) is expected to be elastic (immediate) and take place during construction. With respect to potential downdrag loading on the proposed pile foundations, it is not anticipated that downdrag loading will be an issue as the threshold of more than 0.4 inches of long-term (consolidation) settlement is not anticipated to be reached within soils below proposed abutment substructures.

5.3. Culvert Foundation Analysis and Recommendations

It is our understanding that a 170-ft segment of the existing culvert CUY-CR00240-00.610 over Mill Creek is planned to be replaced. Based on the culvert detail plan sheet provided by AECOM on December 7, 2021, the existing 7-ft by 22-ft CIP concrete culvert will be replaced by a precast concrete box culvert of matching dimensions that will bear directly on the natural subsurface material. For this purpose, a shallow foundation analysis was performed for the proposed replacement culvert. For analysis purposes, it is assumed that: 1) the culvert invert (flow line) elevation at the west end of the replacement segment is approximately 806.1 ft amsl while the culvert invert (flow line) elevation at the east end is approximately 807.1 ft amsl; 2) the groundwater elevation is above the bearing elevation; 3) the culvert will be supported on the natural sand and gravel soils; 4) the dimensions of the replacement segment of the culvert which match the dimensions of the existing culvert; and, 5) appropriate erosion control measures will be implemented to prevent scour of the soil. A summary and results of our evaluation of the proposed culvert replacement are presented in subsequent sections.

5.3.1. Soil Profile for Analysis

For analysis purposes, each culvert boring log was reviewed, and a generalized material profile was developed for analysis. Utilizing the generalized soil profile, engineering properties for each soil strata were estimated based on the field (i.e., SPT N_{60} Values, hand penetrometer values, etc.) and laboratory (i.e., Atterberg Limits, grain size, etc.) test results using correlations provided in published engineering manuals, research reports and guidance documents. The developed soil profile and estimated engineering soil properties for use in analysis (with sited correlation/reference material) are summarized within Tables 14 and 15 below. Settlement parameters (with sited correlation/reference material) developed for use in settlement analysis at each culvert boring location are presented in Tables 16 and 17 below

Table 14: Soil Profile and Estimated Engineering Properties - At Boring B-020-0-21

Culvert CUY-CR00240-00.610: West End, B-020-0-21				
Soil Description	**Unit Weight[1] (pcf)**	**Undrained Shear Strength[2] (psf)**	**Effective Cohesion[3] (psf)**	**Effective Friction Angle[3] (degrees)**
Gravel with Sand and Silt Depth (816.2 ft - 811.7 ft)	128	-	-	40
Coarse and Fine Sand Depth (811.7 ft - 806.7 ft)	108	-	-	30
Gravel Depth (806.7 ft - 801.7 ft)	125	-	-	35
Gravel with Sand Depth (801.7 ft - 771.2 ft)	135	-	-	43

Notes:
1. *Values interpreted from Geotechnical Bulletin 7 Table 1.*
2. *Values calculated from Terzaghi and Peck (1967) if $N1_{60}$<52, else Stroud and Butler (1975) was used.*
3. *Values interpreted from Geotechnical Bulletin 7 Table 2 for cohesive soils and Kulhawy & Mayne (1990) for granular soils.*

Table 15: Soil Profile and Estimated Engineering Properties - At Boring B-021-0-21

Culvert CUY-CR00240-00.610: East End, B-021-0-21				
Soil Description	**Unit Weight[1] (pcf)**	**Undrained Shear Strength[2] (psf)**	**Effective Cohesion[3] (psf)**	**Effective Friction Angle[3] (degrees)**
Sandy Silt Depth (816.6 ft - 808.2 ft)	110	-	-	29
Coarse and Fine Sand Depth (808.2 ft - 807.2 ft)	133	-	-	33
Clay Depth (807.2 ft - 804.8 ft)	135	5500	400	26
Gravel with Sand Depth (804.8 ft - 767.8 ft)	140	-	-	43

s:
1. *Values interpreted from Geotechnical Bulletin 7 Table 1.*
2. *Values calculated from Terzaghi and Peck (1967) if $N1_{60}$<52, else Stroud and Butler (1975) was used.*
3. *Values interpreted from Geotechnical Bulletin 7 Table 2 for cohesive soils and Kulhawy & Mayne (1990) for granular soils.*

Table 16: Settlement Parameters for Analysis - At Boring B-020-0-21

Culvert under Henry St: Settlement Analysis, B-020-0-21								
Soil Description	**Unit Weight (pcf)**	**Elastic Modulus[1] (psf)**	**Poissons Ratio[1], v**	**Void Ratio e_o**	**Compression Index[2], C_c**	**Recompression Index[3], C_r**	**OCR[4]**	**Coeff. of Consol.[5], C_v**
Non-cohesive Elevation (816.2 ft - 806.7 ft)	110	81000	0.20	-	-	-	-	-
Non-cohesive Elevation (806.7 ft - 768.0 ft)	140	4000000	0.40	-	-	-	-	-

Notes:
1. *Values interpreted from 2017 AASHTO LRFD BDS Table C10.4.6.3-1*
2. *Values calculated from Kulhawy and Mayne, 1990, Equation 6-6.*
3. *Values calculated from Kulhawy and Mayne, 1990, Equation 6-9.*
4. *Values interpreted from Mayne and Kemper, 1988, Figure 7.*
5. *Values interpreted from FHWA GEC No. 5, Boeckmann, et al., 2016, Figure 6-37.*

Table 17: Settlement Parameters for Analysis - At Boring B-021-0-21

Culvert under Henry St: Settlement Analysis, B-021-0-21								
Soil Description	**Unit Weight (pcf)**	**Elastic Modulus[1] (psf)**	**Poissons Ratio[1], v**	**Void Ratio e_o**	**Compression Index[2], C_c**	**Recompression Index[3], C_r**	**OCR[4]**	**Coeff. of Consol.[5], C_v**
Non-cohesive Elevation (816.6 ft - 809.6 ft)	110	81000	0.20	-	-	-	-	-
Cohesive Elevation (809.6 ft - 804.8 ft)	125	2000000	0.50	0.719	0.15	0.030	20.0	0.25
Non-cohesive Elevation (804.8 ft - 768.0 ft)	140	4000000	0.40	-	-	-	-	-

Notes:
1. *Values interpreted from 2017 AASHTO LRFD BDS Table C10.4.6.3-1*
2. *Values calculated from Kulhawy and Mayne, 1990, Equation 6-6.*
3. *Values calculated from Kulhawy and Mayne, 1990, Equation 6-9.*
4. *Values interpreted from Mayne and Kemper, 1988, Figure 7.*
5. *Values interpreted from FHWA GEC No. 5, Boeckmann, et al., 2016, Figure 6-37.*

5.3.2. Bearing Resistance

A shallow foundation bearing analysis was performed at the culvert location in accordance with the LRFD BDS, Section 10.6.3.1.2a, utilizing the engineering soil properties presented in Tables 14 and 15 of this report. Based on the Culvert detail provided by AECOM on December 7, 2021. The proposed replacement segment of culvert was assumed to act as a rectangular spread footing bearing approximately 2-ft below the proposed invert elevations (without the consideration of scour). Based on the assumed invert elevations of 806.1 ft amsl 807.1 ft amsl at the west end and east end of the replacement segment, respectively, the bottom of the proposed culvert segment is estimated to bear at elevations of approximately 804.1 ft amsl and 805.1 ft amsl at the west end and east end, respectively. At the estimated bearing elevations, it is anticipated that the footings will bear on a mixture of sand and gravel. Recommended nominal and factored bearing

resistances for the proposed culvert segment are presented in Table 18 below. Bearing resistance calculation are provided within Appendix F.

Table 18: Bearing Resistance Summary

Culvert Structure	Nominal Bearing Resistance (ksf) Drained / Undrained	LRFD Resistance Factor[1]	Factored Bearing Resistance (ksf) Drained / Undrained
Culvert CUY-CR00240-00.610	31.4 / 29.8	0.55	17.3 / 16.4
Notes: *1. Per LRDF Bridge Design Table 11.5.7-1.*			

5.3.3. Settlement Analysis

In order to estimate the maximum total and differential settlement that could result within the subsurface soils supporting the proposed culvert CUY-CR00240-00.610 over Mill Creek is planned to be replaced, NEAS reviewed: 1) the culvert detail plan sheet provided by AECOM on December 7, 2021; 2) Service Limit State loading conditions; and, 3) the generalized subsurface profile for Analysis provided in Section 5.2.1. of this report. Utilizing this information and the software entitled *FoSSA 2.0* by ADAMA Engineering, Inc., a settlement model was developed and analyzed to for both elastic (immediate) and consolidation (long term) settlement. Settlement along the proposed culvert section to be replaced was evaluated. Outputs of our *FoSSA 2.0* settlement analysis for culvert CUY-CR00240-00.610 is included within Appendix G.

Based on our analyses, the estimated maximum total settlement below the proposed culvert replacement section was calculated to be less than 1-inch. The majority of the settlement is associated with the loads induced by the proposed new embankment above the culvert. This settlement will begin as the embankment load is applied and will dissipate with time. However, the amount of settlement and the time required for the settlement to occur is mostly dependent on the thickness of the underlying compressible soil, the uniformity and properties of these layers (i.e., compaction, material type, compressibility, etc.), and the proposed embankment fill height/surcharge load. Due to the presence of granular material within the upper portion of the soil profile below the proposed culvert, the calculated settlement magnitude is not anticipated to be a concern as the majority of the total settlement is expected to be elastic (immediate) and take place during construction.

6. QUALIFICATIONS

This investigation was performed in accordance with accepted geotechnical engineering practice for the purpose of characterizing the subsurface conditions at the site of the proposed replacement of Bridge CUY-14-0693 over Chaincraft Road, Norfolk Southern Railway and Wheeling & Lake Erie Railway as well as Culvert CUY-CR00240-00.610 over Mill Creek. This report has been prepared for AECOM, ODOT and their design consultants to be used solely in evaluating the soils underlying the bridge site and presenting geotechnical engineering recommendations specific to this project. The assessment of general site environmental conditions or the presence of pollutants in the soil, rock and groundwater of the site was beyond the scope of this geotechnical exploration. Our recommendations are based on the results of our field explorations, laboratory tests result from representative soil samples, and geotechnical engineering analyses. The results of the field explorations and laboratory tests, which form the basis of our recommendations, are presented in the appendices as noted. This report does not reflect any variations that may occur between the borings or elsewhere on the site, or variations whose nature and extent may not become evident until a later stage of construction. In the event that any changes in the nature, design or location of the proposed bridge and culvert replacement is made, the conclusions and recommendations

contained in this report should not be considered valid until they are reviewed and have been modified or verified in writing by a geotechnical engineer.

It has been a pleasure to be of service to AECOM in performing this geotechnical exploration for the CUY-14-6.93 project. Please call if there are any questions, or if we can be of further service.

Respectfully Submitted,

National Engineering and Architectural Services Inc.

Brendan P. Andrews, P.E.
Project Geotechnical Engineer

Kevin C. Arens, P.E.
Geotechnical Engineer

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APPENDIX A

BORING LOCATION PLAN

LEGEND

PROJECT BORING LOCATION

BORING LOCATION PLAN

CUY-14-6.93

1 / 1

DRAWN KCA

CHECKED BPA

HORIZONTAL SCALE IN FEET

0 15 30 60

N

P:\18-0023 (CUY-14-6.93 PID 104132)\104132\geotechnical\bridges\CUY-14-0693 (Chaincraft Rd-NSRwy-WLERwy)\Boring Plan\CUY-14-6.93_BoringLocationPlan.dgn Sheet1 11/19/2021 2:33:19 PM karens

APPENDIX B

BORING LOGS AND LABORATORY TESTING RESULTS

PROJECT: CUY-14-6.93	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 75T	STATION / OFFSET: 372+69, 18' RT.	EXPLORATION ID B-005-0-21
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: NEAS / J. HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-14	
PID: 104132 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 5/1/19	ELEVATION: 813.6 (MSL) EOB: 44.8 ft.	PAGE 1 OF 2
START: 8/3/21 END: 8/4/21	SAMPLING METHOD: SPT / ST	ENERGY RATIO (%): 89	LAT / LONG: 41.431413, -81.601611	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, SS-1 CONTAINS A 1.5" LIMESTONE FRAGMENT, DAMP	813.6		5 6 5	16	44	SS-1	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
					75	ST-2	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
VERY LOOSE TO MEDIUM DENSE, BROWN, **GRAVEL WITH SAND AND SILT**, LITTLE CLAY, DAMP TO MOIST	806.6		1 4 4	12	100	SS-3	-	29	13	28	19	11	NP	NP	NP	12	A-2-4 (0)	
		W 803.1	1 1 2	4	17	SS-4	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
MEDIUM DENSE TO DENSE, GRAY, **FINE SAND**, "AND" COARSE SAND, TRACE SILT, TRACE GRAVEL, TRACE CLAY, MOIST TO WET	801.6		6 13 14	40	67	SS-5	-	-	-	-	-	-	-	-	-	17	A-3 (V)	
			3 4 7	16	100	SS-6	-	3	43	44	8	2	NP	NP	NP	21	A-3 (0)	
@17.5'; ENCOUNTERED HEAVE. PULLED AUGERS AND REDRILLED WITH A SLURRY MIX TO COMBAT HEAVE.	794.1		14 12 13	37	100	SS-7	-	-	-	-	-	-	-	-	-	12	A-3 (V)	
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, MOIST	789.1		5 15 17	47	56	SS-8	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
			7 16 20	53	100	SS-9	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
STIFF, GRAY, **SANDY SILT**, "AND" CLAY, TRACE GRAVEL, CONTAINS A 2.0" SILT SEAM, MOIST	785.3		13 14 8	33	39	SS-10	1.75	8	6	12	38	36	26	17	9	21	A-4a (8)	
VERY DENSE, GRAY, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST																		

PID: 104132	SFN:	PROJECT: CUY-14-6.93	STATION / OFFSET: 372+69, 18' RT.	START: 8/3/21	END: 8/4/21	PG 2 OF 2	B-005-0-21

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
VERY DENSE, GRAY, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST *(continued)* @30.0' TO 44.8'; DIFFICULT DRILLING DUE TO COBBLES AND/OR BOULDERS	783.6	31	11 23 25	71	100	SS-11	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
		32																
		33																
		34																
		35	22 34 42	113	100	SS-12	-	34	34	16	12	4	NP	NP	NP	9	A-1-b (0)	
		36																
		37																
		38																
		39																
		40	12 16 25	61	100	SS-13	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
	771.3	41																
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, STONE FRAGMENTS ARE LIMESTONE. POSSIBLE LIMESTONE COBBLE, MOIST		42																
		43																
	768.8	44 EOB	33 47 50/4"	-	44	SS-14	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	

NOTES: GROUNDWATER ENCOUNTERED AT 10.5' DURING DRILLING. HOLE DID NOT CAVE. ENCOUNTERED HEAVE AT 17.5'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 75 GAL. BENTONITE GROUT; POURED 2 BAGS HOLE PLUG

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 2/20/24 09:28 - X:\ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\1ARCHIVE BY YEAR\2021 ARCHIVE\CUY-14-6.93\GINT FILES\CUY-14

PROJECT: CUY-14-6.93	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 75T	STATION / OFFSET: 372+57, 41' LT.	EXPLORATION ID B-006-0-21
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / J. HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-14	
PID: 104132 SFN: 1081085	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 5/1/19	ELEVATION: 812.9 (MSL) EOB: 49.4 ft.	PAGE 1 OF 2
START: 8/9/21 END: 8/9/21	SAMPLING METHOD: SPT	ENERGY RATIO (%): 89	LAT / LONG: 41.431548, -81.601193	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
LOOSE TO MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, SOME SILT, LITTLE GRAVEL, TRACE CLAY, CONTAINS ROOTS, MOIST TO WET	812.9																	
		1																
		2																
		3	3 5 3	12	22	SS-1	-	-	-	-	-	-	-	-	-	14	A-3a (V)	
		4																
		5																
		6	1 2 2	6	44	SS-2	-	-	-	-	-	-	-	-	-	19	A-3a (V)	
	805.9	7																
MEDIUM DENSE TO VERY DENSE, BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS 1.5" STONE FRAGMENTS, WET TO MOIST		8	1 4 5	13	39	SS-3	-	44	14	24	16	2	NP	NP	NP	14	A-1-b (0)	
		9																
	W 802.9	10																
@10.0' TO 49.4'; ENCOUNTERED COBBLES DURING DRILLING		11	6 16 35	76	100	SS-4	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
		12																
		13	8 34 15	73	100	SS-5	-	21	45	17	14	3	NP	NP	NP	11	A-1-b (0)	
	798.4	14																
DENSE, GRAY, **COARSE AND FINE SAND**, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, WET		15																
		16	19 10 14	36	50	SS-6	-	-	-	-	-	-	-	-	-	18	A-3a (V)	
	795.9	17																
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, WET TO MOIST		18	12 17 16	49	78	SS-7	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
		19																
		20	7 16 22	56	100	SS-8	-	30	38	20	9	3	NP	NP	NP	11	A-1-b (0)	
	790.9	21																
VERY DENSE, GRAY, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE SILT, TRACE CLAY, MOIST		22																
		23	9 17 20	55	89	SS-9	-	-	-	-	-	-	-	-	-	13	A-3a (V)	
	788.4	24																
		25																
		26	33 50	-	83	SS-10	-	58	14	10	15	3	NP	NP	NP	10	A-1-b (0)	
		27																
		28																
		29																

PID: 104132	SFN:	PROJECT: CUY-14-6.93	STATION / OFFSET: 372+57, 41' LT.	START: 8/9/21	END: 8/9/21	PG 2 OF 2	B-006-0-21

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
@10.0' TO 49.4'; ENCOUNTERED COBBLES DURING DRILLING *(continued)*	782.9																	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST		31	2 8 50/3"	-	80	SS-11	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST *(continued)*	779.6	32 33 34																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS**, SOME TO "AND" SAND, LITTLE SILT, TRACE CLAY, DAMP TO MOIST		35 36	10 22 28	74	100	SS-12	-	51	23	13	11	2	NP	NP	NP	9	A-1-a (0)	
		37 38 39																
		40 41	18 23 31	80	89	SS-13	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
		42 43 44																
		45 46	17 26 27	79	89	SS-14	-	-	-	-	-	-	-	-	-	12	A-1-a (V)	
		47 48																
	763.5	EOB 49	38 50/5"	-	82	SS-15	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	

NOTES: GROUNDWATER ENCOUNTERED AT 10.0' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 3 BAGS HOLE PLUG; SHOVELED SOIL CUTTINGS

PROJECT: CUY-14-6.93	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 75T	STATION / OFFSET: 374+39, 46' RT.	EXPLORATION ID B-007-0-21
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / J. HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-14	
PID: 104132 SFN: 1081085	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 5/1/19	ELEVATION: 815.2 (MSL) EOB: 50.0 ft.	PAGE 1 OF 2
START: 8/10/21 END: 8/10/21	SAMPLING METHOD: SPT / ST	ENERGY RATIO (%): 89	LAT / LONG: 41.431220, -81.600616	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
VERY LOOSE, BROWN AND GRAY BECOMING GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE TO LITTLE SILT, TRACE CLAY, WET TO DAMP	815.2																	
		3	4 1 2	4	17	SS-1	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
		6	1 1 1	3	28	SS-2	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
		8			83	ST-3	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
@9.0'; BECOMES VERY DENSE. DIFFICULT DRILLING DUE TO COBBLES AND/OR BOULDERS	W 805.7	10	8 21 29	74	33	SS-4	-	37	23	23	13	4	NP	NP	NP	16	A-1-b (0)	
		13	6 25 33	86	67	SS-5	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		16	27 24 29	79	100	SS-6	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
		18	20 21 26	70	100	SS-7	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
		21	15 17 22	58	39	SS-8	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
		23	18 24 25	73	44	SS-9	-	32	41	15	8	4	NP	NP	NP	10	A-1-b (0)	
		26	13 27 31	86	100	SS-10	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
	786.9	29																

PID: 104132	SFN:	PROJECT: CUY-14-6.93	STATION / OFFSET: 374+39, 46' RT.	START: 8/10/21	END: 8/10/21	PG 2 OF 2	B-007-0-21

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
@9.0'; BECOMES VERY DENSE. DIFFICULT DRILLING DUE TO COBBLES AND/OR BOULDERS *(continued)*	785.2																	
VERY DENSE, GRAY AND DARK GRAY, **STONE FRAGMENTS**, LITTLE SAND, TRACE SILT, TRACE CLAY, STONE FRAGMENTS ARE LIMESTONE, POSSIBLE LIMESTONE COBBLE/BOULDER, MOIST *(continued)*	781.9	31	21 50	-	31	SS-11	-	-	-	-	-	-	-	-	-	13	A-1-a (V)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP TO MOIST		32 33 34 35	24 25 50	111	78	SS-12	-	35	37	15	9	4	NP	NP	NP	9	A-1-b (0)	
		36 37 38 39 40	30 32 37	102	100	SS-13	-	29	38	17	10	6	NP	NP	NP	11	A-1-b (0)	
		41 42 43 44 45	26 29 35	95	83	SS-14	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	765.2	46 47 48 49 EOB 50	21 32 35	99	100	SS-15	-	31	36	20	10	3	NP	NP	NP	9	A-1-b (0)	

NOTES: GROUNDWATER ENCOUNTERED AT 9.5' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 3 BAGS BENTONITE CHIPS; SHOVELED SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 2/20/24 09:28 - X:\ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\1ARCHIVE BY YEAR\2021 ARCHIVE\CUY-14-6.93\GINT FILES\CUY-14

PROJECT: CUY-14-6.93	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 75T	STATION / OFFSET: 373+83, 41' LT.	EXPLORATION ID B-008-0-21	
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / J. HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-14		
PID: 104132 SFN: 1081085	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 5/1/19	ELEVATION: 815.0 (MSL) EOB: 52.0 ft.	PAGE 1 OF 2	
START: 8/18/21 END: 8/19/21	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 89	LAT / LONG: 41.431475, -81.600782		

MATERIAL DESCRIPTION AND NOTES	ELEV. 815.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
MEDIUM DENSE, GRAYISH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, MOIST			20 13 5	27	33	SS-1	-	5	13	39	32	11	NP	NP	NP	16	A-4a (2)	
	810.5																	
LOOSE TO DENSE, GRAYISH BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, MOIST TO WET		W 808.0	7 3 4	10	22	SS-2	-	-	-	-	-	-	-	-	-	18	A-3a (V)	
			2 6 5	16	39	SS-3	-	-	-	-	-	-	-	-	-	24	A-3a (V)	
			7 11 17	42	44	SS-4	-	-	-	-	-	-	-	-	-	14	A-3a (V)	
			10 13 14	40	50	SS-5	-	7	29	48	12	4	NP	NP	NP	17	A-3a (0)	
			9 14 20	50	72	SS-6	-	-	-	-	-	-	-	-	-	13	A-3a (V)	
	798.0																	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, MOIST TO WET @17.0' TO 52.0'; ENCOUNTERED COBBLES AND/OR BOULDERS DURING DRILLING			10 20 21	61	33	SS-7	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
			12 20 21	61	33	SS-8	-	44	21	22	10	3	NP	NP	NP	10	A-1-b (0)	
			11 17 19	53	28	SS-9	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
			12 22 25	70	22	SS-10	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
			11 29 33	92	44	SS-11	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	

PID: 104132	SFN:	PROJECT: CUY-14-6.93	STATION / OFFSET: 373+83, 41' LT.	START: 8/18/21	END: 8/19/21	PG 2 OF 2	B-008-0-21

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, MOIST TO WET *(continued)*	785.0	31	20 29 32	90	50	SS-12	-	47	20	23	8	2	NP	NP	NP	10	A-1b (0)	
		32																
		33	19 25 50/3"	-	40	SS-13	-	-	-	-	-	-	-	-	-	9	A-1b (V)	
		34																
		35																
		36	32 26 30	83	56	SS-14	-	-	-	-	-	-	-	-	-	11	A-1b (V)	
		37																
		38																
		39																
		40	35 50/2"	-	50	SS-15	-	-	-	-	-	-	-	-	-	15	A-1b (V)	
		41																
@42.0' - 52.0'; CORED THROUGH GRANITE AND SILTSTONE COBBLES AND BOULDERS		42																
		43																
		44																
		45																
		46																
		47			-	NQ2-1	-	-	-	-	-	-	-	-	-	-		
		48																
		49																
		50																
		51																
	763.0	EOB 52																

NOTES: GROUNDWATER ENCOUNTERED AT 7.0' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 10 GAL. BENTONITE GROUT; POURED 3 BAGS HOLE PLUG; SHOVELED SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 2/20/24 09:29 - X:\ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\1ARCHIVE BY YEAR\2021 ARCHIVE\CUY-14-6.93\GINT FILES\CUY-14

PROJECT: CUY-14-6.93	DRILLING FIRM / OPERATOR: NEAS / JL	DRILL RIG: CME 55T	STATION / OFFSET: 374+98, 51' RT.	EXPLORATION ID B-009-0-21
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / JL	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-14	
PID: 104132 SFN: 1081085	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/5/19	ELEVATION: 814.9 (MSL) EOB: 49.8 ft.	PAGE 1 OF 2
START: 8/19/21 END: 8/20/21	SAMPLING METHOD: SPT	ENERGY RATIO (%): 68.4	LAT / LONG: 41.431188, -81.600404	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
LOOSE, BLACK, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, STONE FRAGMENTS ARE WEAK BLACK SHALE, CONTAINS SLAG, WET	814.9																	
	811.1	3	4 4 3	8	67	SS-1	-	-	-	-	-	-	-	-	-	20	A-1-b (V)	
VERY LOOSE TO MEDIUM DENSE, GRAY AND BROWN WITH TRACE BLACK STREAKS, **SANDY SILT**, TRACE CLAY, TRACE GRAVEL, SLIGHTLY ORGANIC, SS-3 CONTAINS A 1.5" SANDSTONE FRAGMENT, WET		6	0 0 1	1	100	SS-2	-	2	5	49	34	10	NP	NP	NP	29	A-4a (2)	
	805.4	8	1 5 5	11	72	SS-3	-	-	-	-	-	-	-	-	-	28	A-4a (V)	
DENSE TO VERY DENSE, BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE TO LITTLE SILT, TRACE CLAY, WET TO DAMP **@9.5' TO 49.8'; ENCOUNTERED COBBLES AND/OR BOULDERS DURING DRILLING**	W 804.9	11	2 23 18	47	28	SS-4	-	-	-	-	-	-	-	-	-	21	A-1-b (V)	
		13	9 16 31	54	100	SS-5	-	48	33	9	6	4	NP	NP	NP	12	A-1-b (0)	
		16	8 16 34	57	39	SS-6	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		18	9 19 19	43	39	SS-7	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
	792.9	21	13 21 21	48	28	SS-8	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
		23	10 16 20	41	28	SS-9	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
		26	12 20 23	49	28	SS-10	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	
		28	11 26 30	64	33	SS-11	-	60	28	8	3	1	NP	NP	NP	9	A-1-a (0)	

PID: 104132	SFN:	PROJECT: CUY-14-6.93	STATION / OFFSET: 374+98, 51' RT.	START: 8/19/21	END: 8/20/21	PG 2 OF 2	B-009-0-21

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
@9.5' TO 49.8'; ENCOUNTERED COBBLES AND/OR BOULDERS DURING DRILLING *(continued)*	784.9																	
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS**, SOME TO "AND" SAND, TRACE SILT, TRACE CLAY, DAMP TO MOIST	782.9	31	16 27 29	64	44	SS-12	-	-	-	-	-	-	-	-	-	12	A-1-a (V)	
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS**, SOME TO "AND" SAND, TRACE SILT, TRACE CLAY, DAMP TO MOIST *(continued)*		32																
		33	17 22 31	60	39	SS-13	-	49	30	14	6	1	NP	NP	NP	9	A-1-b (0)	
		34																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, MOIST		35	25 27 31	66	50	SS-14	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
	776.6	36																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, DAMP		37																
		38																
		39																
		40	29 32 35	76	28	SS-15	-	35	19	11	26	9	NP	NP	NP	14	A-2-4 (0)	
	771.6	41																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS**, TRACE SAND, TRACE SILT, TRACE CLAY, DAMP		42																
		43																
		44																
		45	19 34 50/2"	-	21	SS-16	-	-	-	-	-	-	-	-	-	5	A-1-a (V)	
		46																
		47																
		48																
	765.1	49	24 38 50/3"	-	27	SS-17	-	-	-	-	-	-	-	-	-	3	A-1-a (V)	
		EOB																

NOTES: GROUNDWATER ENCOUNTERED AT 10.0' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 3 BAGS HOLE PLUG; SHOVELED SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 2/20/24 09:29 - X:\ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\1ARCHIVE BY YEAR\2021 ARCHIVE\CUY-14-6.93\GINT FILES\CUY-14

PROJECT: CUY-14-6.93	DRILLING FIRM / OPERATOR: NEAS / JL	DRILL RIG: CME 55T	STATION / OFFSET: 378+05, 45' LT.	EXPLORATION ID B-010-0-21
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / JL	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-14	
PID: 104132 SFN: 1081085	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/5/19	ELEVATION: 821.6 (MSL) EOB: 50.0 ft.	PAGE 1 OF 2
START: 8/24/21 END: 8/24/21	SAMPLING METHOD: SPT	ENERGY RATIO (%): 68.4	LAT / LONG: 41.431345, -81.599251	

MATERIAL DESCRIPTION AND NOTES	ELEV. 821.6	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
5.0" LIMESTONE #57 GRAVEL (DRILLERS DESCRIPTION)	821.2																	
VERY STIFF, BROWN, **SILTY CLAY**, SOME SAND, SOME GRAVEL, CONTAINS BRICK FRAGMENTS, DAMP **(FILL)**	817.1		7 3 4	8	44	SS-1	2.25	25	14	13	18	30	39	21	18	18	A-6b (5)	
VERY STIFF, BROWN, **CLAY**, SOME SILT, LITTLE SAND, TRACE GRAVEL, MOIST	814.6		3 3 3	7	50	SS-2	2.75	10	9	5	22	54	48	23	25	25	A-7-6 (16)	
MEDIUM STIFF TO VERY STIFF, BROWN AND GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, CONTAINS IRON STAINING, MOIST	809.6		0 2 2	5	78	SS-3	0.75	6	7	28	39	20	30	18	12	24	A-6a (6)	
			0 2 4	7	72	SS-4	2.25	-	-	-	-	-	-	-	-	25	A-6a (V)	
DENSE TO VERY DENSE, BROWN AND GRAY, **GRAVEL**, SOME SAND, LITTLE SILT, TRACE CLAY, MOIST TO WET		W 808.4	5 13 15	32	67	SS-5	-	-	-	-	-	-	-	-	-	17	A-1-a (V)	
			8 15 18	38	56	SS-6	-	55	19	11	12	3	NP	NP	NP	10	A-1-a (0)	
	802.1		9 21 26	54	61	SS-7	-	-	-	-	-	-	-	-	-	14	A-1-a (V)	
VERY DENSE, BROWN AND GRAY, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE SILT, TRACE CLAY, MOIST	799.6		19 25 27	59	56	SS-8	-	-	-	-	-	-	-	-	-	14	A-3a (V)	
DENSE TO VERY DENSE, BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE TO LITTLE SILT, TRACE CLAY, DAMP TO WET			21 20 23	49	44	SS-9	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
			22 24 27	58	28	SS-10	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	

PID: 104132	SFN:	PROJECT: CUY-14-6.93	STATION / OFFSET: 378+05, 45' LT.	START: 8/24/21	END: 8/24/21	PG 2 OF 2	B-010-0-21

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
DENSE TO VERY DENSE, BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE TO LITTLE SILT, TRACE CLAY, DAMP TO WET *(continued)*		31	10 22 25	54	33	SS-11	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
		32																
		33																
		34																
		35	15 28 33	70	39	SS-12	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
		36																
		37																
		38																
		39																
		40	15 26 32	66	72	SS-13	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		41																
		42																
		43																
		44																
		45	29 31 36	76	94	SS-14	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		46																
		47																
		48																
		49	35 20 31	58	56	SS-15	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
	771.6	EOB 50																

NOTES: GROUNDWATER ENCOUNTERED AT 13.2' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 2/20/24 09:29 - X:\ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\1ARCHIVE BY YEAR\2021 ARCHIVE\CUY-14-6.93\GINT FILES\CUY-14

PROJECT: CUY-14-6.93	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET: 378+84, 31' RT.	EXPLORATION ID B-011-0-21
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / J. HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-14	
PID: 104132 SFN: 1081085	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/5/19	ELEVATION: 823.5 (MSL) EOB: 59.7 ft.	PAGE 1 OF 2
START: 8/30/21 END: 8/30/21	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.9	LAT / LONG: 41.431112, -81.598998	

MATERIAL DESCRIPTION AND NOTES	ELEV. 823.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
VERY LOOSE, WHITE, **SANDY SILT**, TRACE CLAY, TRACE GRAVEL, **UNTESTABLE MATERIAL. RESEMBLES LIME**, MOIST **(FILL)**		1																
		2																
		3	0 0 0	0	100	SS-1	-	-	-	-	-	-	-	-	-	-	A-4a (V)	
	819.0	4																
MEDIUM DENSE TO DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE TO LITTLE SILT, TRACE CLAY, DAMP TO MOIST		5																
		6	3 7 8	20	28	SS-2	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
		7																
		8	5 10 12	30	22	SS-3	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		9																
		10	8 17 18	48	39	SS-4	-	18	33	31	14	4	NP	NP	NP	11	A-1-b (0)	
		11																
@12.5'; BECOMES VERY DENSE. DIFFICULT DRILLING DUE TO COBBLES AND/OR BOULDERS		12																
		13	8 20 28	66	22	SS-5	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
		14																
		15	7 13 29	57	39	SS-6	-	44	27	11	13	5	NP	NP	NP	11	A-1-b (0)	
		16																
		17																
		18	20 29 33	85	28	SS-7	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		19																
		20	14 30 50/2"	-	64	SS-8	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
		21																
		22																
		23	15 37 49	117	22	SS-9	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		24																
@25.0'; SS-10 CONTAINS NO RECOVERY		25	35 47 50/2"	-	0	SS-10	-	-	-	-	-	-	-	-	-	-		
		26																
		27																
		28																
		29																

PID: 104132	SFN:	PROJECT: CUY-14-6.93	STATION / OFFSET: 378+84, 31' RT.	START: 8/30/21	END: 8/30/21	PG 2 OF 2	B-011-0-21

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
MEDIUM DENSE TO DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE TO LITTLE SILT, TRACE CLAY, DAMP TO MOIST *(continued)*	793.5	31	43 50/5"	-	45	SS-11	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
		35	30 39 44	113	22	SS-12	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		40	40 50/4"	-	30	SS-13	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
		45	35 42 50/2"	-	21	SS-14	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
		50	20 37 44	111	44	SS-15	-	48	29	12	8	3	NP	NP	NP	9	A-1-b (0)	
		55	33 50/4"	-	70	SS-16	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
	763.8	EOB 59	32 39 50/2"	-	29	SS-17	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE. RAN A SLURRY MIX AT 10.0' TO COMBAT HEAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 100 GAL. BENTONITE GROUT; POURED 1 BAG HOLE PLUG; SHOVELED SOIL CUTTINGS

PROJECT: CUY-14-6.93	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 75T	STATION / OFFSET: 382+01, 13' LT.	EXPLORATION ID B-016-0-21
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: NEAS / J. HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-14	
PID: 104132 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 5/1/19	ELEVATION: 831.0 (MSL) EOB: 35.0 ft.	PAGE 1 OF 2
START: 8/11/21 END: 8/11/21	SAMPLING METHOD: SPT / ST	ENERGY RATIO (%): 89	LAT / LONG: 41.430972, -81.597870	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
DENSE, BLACK AND BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, SLIGHTLY ORGANIC, MOIST	831.0	1	6 14 11	37	83	SS-1	-	42	20	16	16	6	NP	NP	NP	11	A-1-b (0)	
	829.5																	
MEDIUM STIFF TO VERY STIFF, BROWN AND GRAY, **CLAY**, LITTLE TO "AND" SILT, TRACE TO LITTLE SAND, TRACE GRAVEL, CONTAINS IRON STAINING, MOIST TO DAMP		2	2 3 4	10	100	SS-2	2.75	5	8	7	37	43	49	22	27	24	A-7-6 (17)	
		3 4	1 2 3	7	56	SS-3	2.00	-	-	-	-	-	-	-	-	28	A-7-6 (V)	
		5	1 2 1	4	100	SS-4	0.75	3	2	2	21	72	52	24	28	29	A-7-6 (18)	
		6 7	1 1 2	4	100	SS-5	1.00	-	-	-	-	-	-	-	-	31	A-7-6 (V)	
@7.8' TO 8.3'; Qu = 1409 PSF @ 13.5%		8 9			77	ST-6	3.50	0	1	1	17	81	54	24	30	32	A-7-6 (19)	
		10	2 2 1	4	100	SS-7	2.00	-	-	-	-	-	-	-	-	27	A-7-6 (V)	
		11 12																
	816.5	13 14	3 5 6	16	100	SS-8	2.75	-	-	-	-	-	-	-	-	22	A-7-6 (V)	
MEDIUM DENSE, BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, CONTAINS IRON STAINING, DAMP		15	5 7 7	21	89	SS-9	-	51	18	10	13	8	26	18	8	11	A-2-4 (0)	
	814.0	16 17																
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS**, "AND" SAND, TRACE SILT, TRACE CLAY, DAMP TO MOIST		18	6 13 17	45	72	SS-10	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	
		19 20	5 19 21	59	83	SS-11	-	50	31	11	7	1	NP	NP	NP	9	A-1-a (0)	
		21 22 23 24																
		25	22 39 43	122	100	SS-12	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	
		26 27 28 29																

PID: 104132	SFN:	PROJECT: CUY-14-6.93	STATION / OFFSET: 382+01, 13' LT.	START: 8/11/21	END: 8/11/21	PG 2 OF 2	B-016-0-21

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS**, "AND" SAND, TRACE SILT, TRACE CLAY, DAMP TO MOIST *(continued)*	801.0	31	17 29 29	86	89	SS-13	-	-	-	-	-	-	-	-	-	7	A-1-a (V)	
		32																
		33																
		34	20 27 33	89	44	SS-14	-	-	-	-	-	-	-	-	-	7	A-1-a (V)	
	796.0	EOB 35																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE. RAN A SLURRY MIX AS CIRCULATING FLUID.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 2 BAGS BENTONITE CHIPS; SHOVELED SOIL CUTTINGS

National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614.892.0162

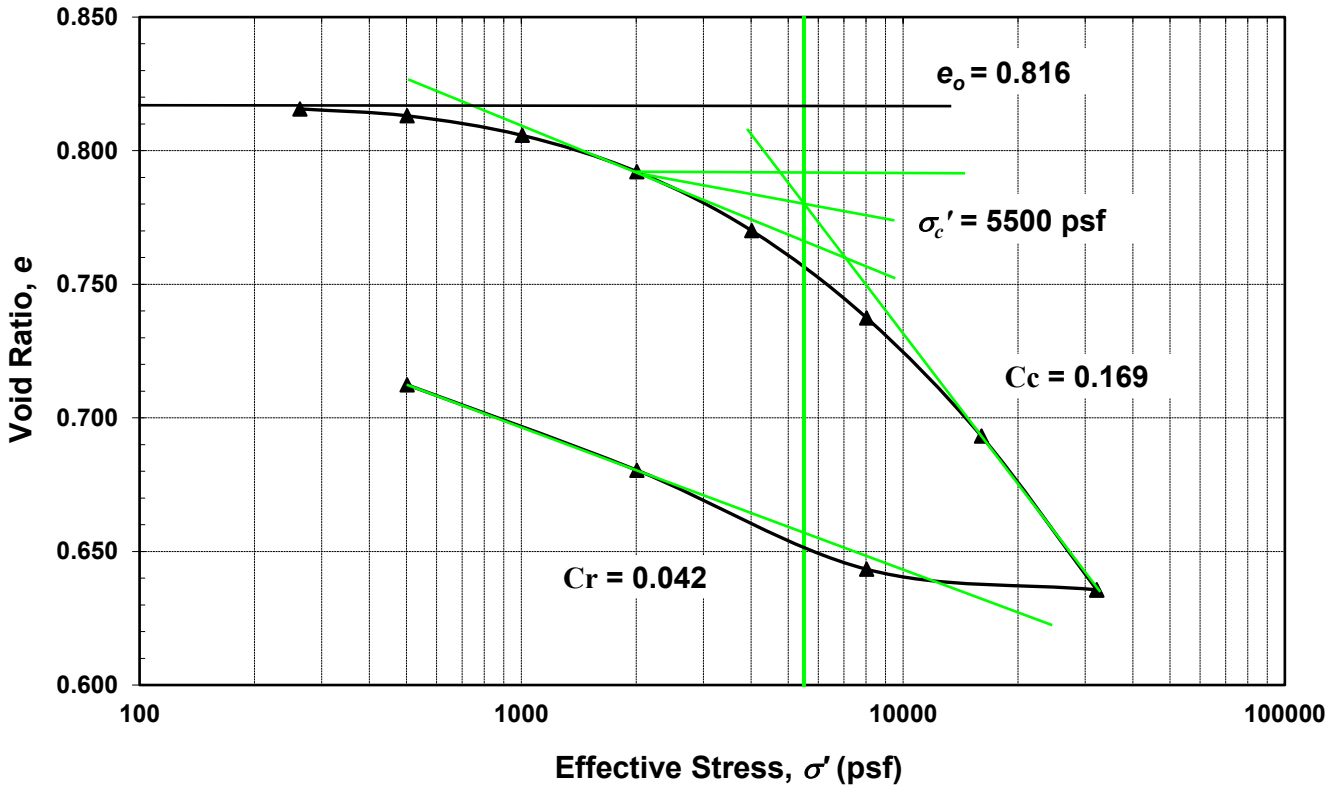
Consolidation Test

Project Name: CUY-14-6.93 | Prepared by: LR
Source: B-016-0-21 ST-6 (8.9'-9.0') | Checked by: ZM
Description: Medium stiff, grayish brown, CLAY, little silt, trace sand, trace gravel, moist. Please note that a 200g seating load was required to prevent swelling. | Date: 10/13/2021
Test Specification: ASTM D 2435
Initial Void Ratio: 0.816 | Initial Bulk Unit Weight (lb/ft^3): 122
In-situ Vertical Effective Stress (psf): 1100 | Dry Unit Weight (lb/ft^3): 93

Compression and Swelling Index

Compression Index (Cc): 0.169 | Preconsolidation Pressure (σ_c') (psf): **5500**
Recompression Index (Cr): 0.042 | Over-Consolidation Ratio (OCR): **5.00**

Consolidation Curve



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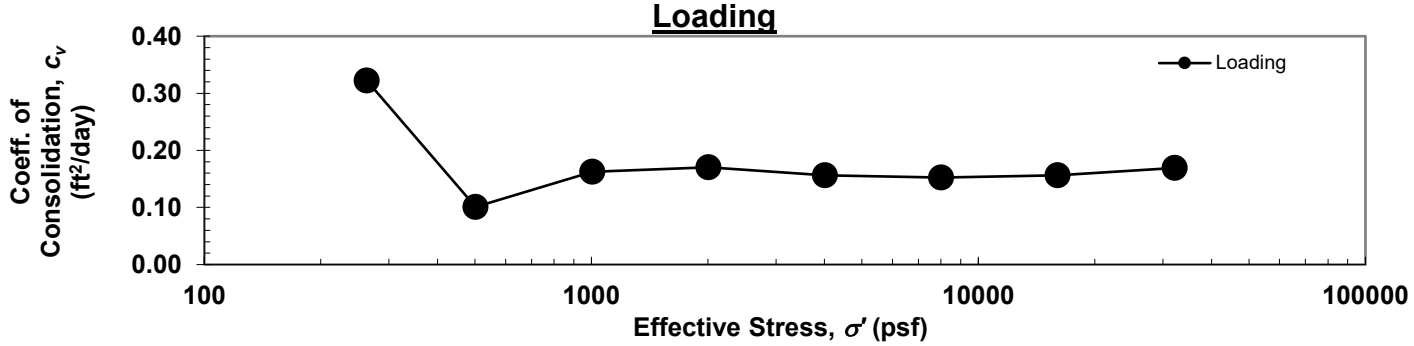


PROJECT: CUY-14-6.93	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 75T	STATION / OFFSET: 373+66, 148' RT.	EXPLORATION ID B-020-0-21
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: NEAS / J. HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-14	
PID: 104132 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 5/1/19	ELEVATION: 816.2 (MSL) EOB: 45.0 ft.	PAGE 1 OF 2
START: 8/6/21 END: 8/6/21	SAMPLING METHOD: SPT	ENERGY RATIO (%): 89	LAT / LONG: 41.430969, -81.600935	

MATERIAL DESCRIPTION AND NOTES	ELEV. 816.2	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
MEDIUM DENSE, BROWN AND GRAY, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, DAMP			6 10 9	28	50	SS-1	-	33	25	16	18	8	NP	NP	NP	7	A-2-4 (0)	
	811.7																	
VERY LOOSE TO LOOSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE GRAVEL, TRACE CLAY, CONTAINS INTERBEDDED 1.0" SILTY CLAY SEAMS, WET			3 2 2	6	100	SS-2	-	-	-	-	-	-	-	-	-	16	A-3a (V)	
	806.7		2 2 1	4	89	SS-3	-	11	25	35	19	10	NP	NP	NP	18	A-3a (0)	
MEDIUM DENSE, BROWN, **STONE FRAGMENTS**, SOME SAND, LITTLE SILT, TRACE CLAY, MOIST TO WET @10.0' - 45.0'; ENCOUNTERED COBBLES DURING DRILLING		W 806.2	2 6 8	21	28	SS-4	-	-	-	-	-	-	-	-	-	12	A-1-a (V)	
	801.7		5 7 8	22	56	SS-5	-	59	14	12	12	3	NP	NP	NP	14	A-1-a (0)	
MEDIUM DENSE TO VERY DENSE, GRAY, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, WET TO MOIST			13 12 7	28	100	SS-6	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
			9 18 21	58	100	SS-7	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
			12 18 19	55	33	SS-8	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
			14 18 22	59	33	SS-9	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
			16 18 22	59	50	SS-10	-	36	36	15	10	3	NP	NP	NP	11	A-1-b (0)	
			18 21 22	64	28	SS-11	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	

PID: 104132	SFN:	PROJECT: CUY-14-6.93	STATION / OFFSET: 373+66, 148' RT.	START: 8/6/21	END: 8/6/21	PG 2 OF 2	B-020-0-21

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
MEDIUM DENSE TO VERY DENSE, GRAY, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, WET TO MOIST *(continued)*	786.2	31	16 22 31	79	44	SS-12	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		32																
		33	17 20 29	73	61	SS-13	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		34																
		35																
		36	13 19 24	64	28	SS-14	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
		37																
		38																
		39																
		40																
		41	9 21 22	64	33	SS-15	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
		42																
		43																
	771.2	44	25 28 39	99	100	SS-16	-	47	30	11	8	4	NP	NP	NP	9	A-1-b (0)	
		EOB 45																

NOTES: GROUNDWATER ENCOUNTERED AT 10.0' DURING DRILLING. HOLE DID NOT CAVE. RAN A SLURRY MIX AS CIRCULATING FLUID.

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

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 2/20/24 09:29 - X:\ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\1ARCHIVE BY YEAR\2021 ARCHIVE\CUY-14-6.93\GINT FILES\CUY-14

PROJECT: CUY-14-6.93	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET: 374+43, 176' RT.	EXPLORATION ID B-021-0-21
TYPE: CULVERT	SAMPLING FIRM / LOGGER: NEAS / J. HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-14	
PID: 104132 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/5/19	ELEVATION: 816.6 (MSL) EOB: 48.8 ft.	PAGE 1 OF 2
START: 8/31/21 END: 8/31/21	SAMPLING METHOD: SPT / ST	ENERGY RATIO (%): 81.9	LAT / LONG: 41.430865, -81.600658	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
VERY STIFF, BROWN, **SANDY SILT**, LITTLE GRAVEL, LITTLE CLAY, CONTAINS IRON STAINING, DAMP TO MOIST	816.6																	
		1																
		2																
		3	7 4 4	11	100	SS-1	2.50	19	18	19	29	15	22	15	7	11	A-4a (2)	
		4																
		5	3 2 2	5	100	SS-2	3.00	-	-	-	-	-	-	-	-	19	A-4a (V)	
	809.6	6																
SOFT TO STIFF, BROWN, **SILT AND CLAY**, SOME SAND, SOME GRAVEL, DAMP	808.2	7																
@7.6' TO 8.1'; Qu = 582 PSF @ 3.5% @8.2'; CONTAINS A 3.0" BLACK ORGANIC SEAM CONTAINING WOOD FRAGMENTS	807.2	8			100	ST-3	1.25	23	18	16	22	21	28	17	11	15	A-6a (2)	
BROWNISH GRAY WITH TRACE BLACK STREAKS, **COARSE AND FINE SAND**, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, SLIGHTLY ORGANIC, WET	804.8	9																
		10	5 15 17	44	100	SS-4	0.25	-	-	-	-	-	-	-	-	29	A-7-6 (V)	
SOFT, DARK GRAY, **CLAY**, SOME SILT, LITTLE SAND, TRACE GRAVEL, CONTAINS IRON STAINING, MOIST		11																
		12																
		13	6 18 31	67	100	SS-5	-	39	24	15	16	6	NP	NP	NP	9	A-1-b (0)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE TO LITTLE SILT, TRACE CLAY, DAMP TO WET		14																
@11.8' TO 48.8'; ENCOUNTERED COBBLES AND/OR BOULDERS DURING DRILLING		15																
		16	9 15 32	64	39	SS-6	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		17																
		18	25 36 34	96	44	SS-7	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		19																
		20																
		21	7 28 41	94	56	SS-8	-	41	28	16	12	3	NP	NP	NP	10	A-1-b (0)	
		22																
		23	10 31 50/3"	-	20	SS-9	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		24																
		25	40 50/4"	-	40	SS-10	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
		26																
		27																
		28	35 49 50/2"	-	29	SS-11	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
		29																

PID: 104132	SFN:	PROJECT: CUY-14-6.93	STATION / OFFSET: 374+43, 176' RT.	START: 8/31/21	END: 8/31/21	PG 2 OF 2	B-021-0-21

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE TO LITTLE SILT, TRACE CLAY, DAMP TO WET *(continued)*	786.6	31	36 50	-	25	SS-12	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		33	33 40 50/2"	-	21	SS-13	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		35	37 50/3"	-	22	SS-14	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
		40	29 38 42	109	28	SS-15	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		45	39 50/4"	-	20	SS-16	-	-	-	-	-	-	-	-	-	17	A-1-b (V)	
	769.3																	
VERY DENSE, GRAY, **STONE FRAGMENTS**, TRACE SAND, TRACE SILT, TRACE CLAY, DAMP	767.8	EOB	50/4"	-	50	SS-17	-	-	-	-	-	-	-	-	-	4	A-1-a (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE. RAN A SLURRY MIX AT 10.0' TO COMBAT HEAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 1 BAG BENTONITE CHIPS; PUMPED 100 GAL. BENTONITE GROUT; SHOVELED SOIL CUTTINGS

National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Cohesive Soil (ASTM D2166)

(Project: CUY-14-6.93, Boring Location: B-021-0-21, ST-3, Depth: 7.6 - 8.1ft)

Tested Date: 9/14/2021

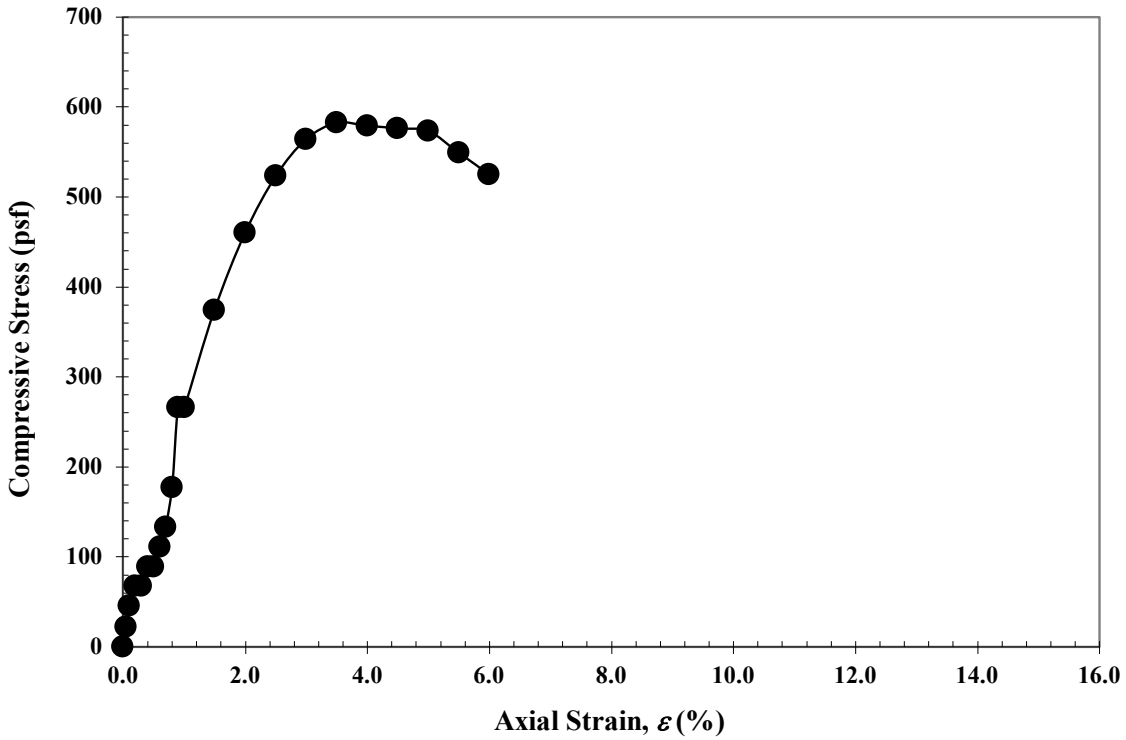
Specimen Properties

Average Dia., D_{avg} (in):	2.86
Average Height, H_{avg} (in):	5.72
Area, A (in^2):	6.44
Volume, V (in^3):	36.84
Wet Mass of Specimen (lb):	2.9
Moisture Content (%):	16.3
Dry Mass of Specimen (lb):	2.5
Wet Unit Weight, γ (lb/ft^3):	136.6
Dry Unit Weight, γ_d (lb/ft^3):	117.5

Final Specimen Figure

Results

Unconfined Compressive Strength (psf):	**582**
Strain (%):	**3.5**



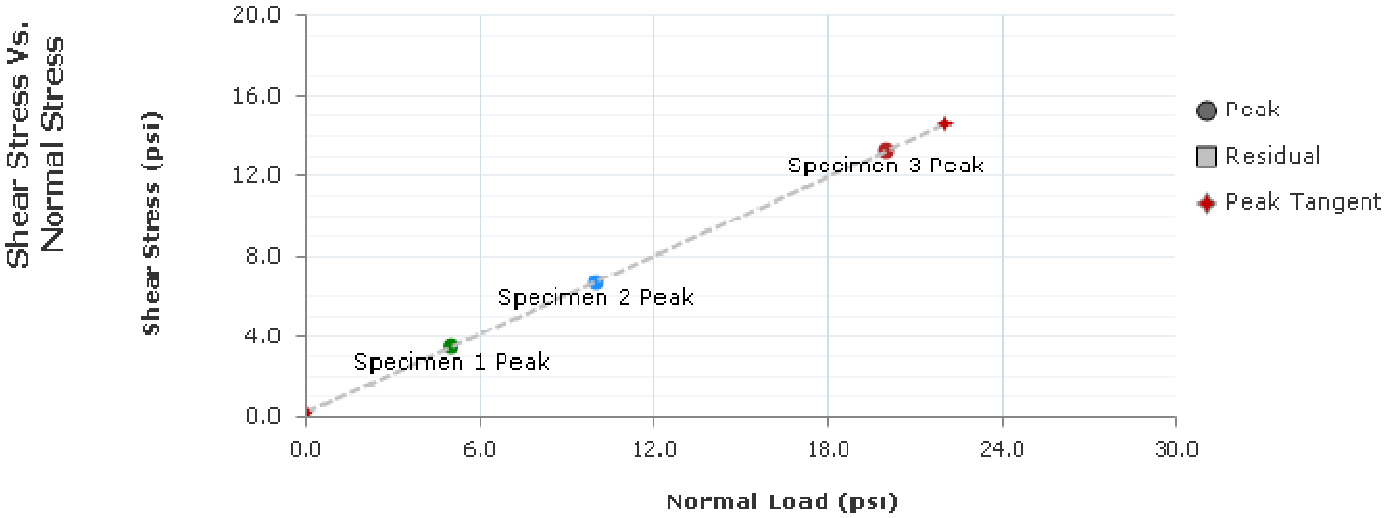
Notes: Soft, brown and gray, SILT AND CLAY, some sand, some gravel, damp.

National Engineering & Architectural Services Inc.

Direct Shear Test

T236

Project: CUY-14-6.93
Project Number: 104132
Location: B-021-0-21 ST-3
Client Name: AECOM



C (psi): 0.2
Phi (°): 33.1

Residual C (psi): NA
Residual Phi (°): NA

	Specimen Number							
Initial	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture (%):	26.1	24.1	29.7					
Dry Density (pcf):	96.4	98.5	92.2					
Void Ratio:	0.729	0.692	0.807					
Saturation (%):	95.5	93.2	98.1					
Diameter (in):	2.4973	2.4973	2.4973					
Height (in):	1.0060	1.0000	1.0018					
Final	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture (%):	28.7	24.9	30.6					
Dry Density (pcf):	96.8	99.3	92.6					
Void Ratio:	0.723	0.678	0.801					
Saturation (%):	106.0	97.9	102.1					
Height (in):	1.0008	1.0000	1.0018					
Normal Stress (psi):	5.0	10.0	20.0					
Peak Shear Stress (psi):	3.5	6.7	13.3					
Residual Stress (psi):	NA	NA	NA					
Horizontal Deformation (%):	5.2	4.8	5.4					
Rate (in/min):	0.014869	0.007800	0.030816					

National Engineering & Architectural Services Inc.

Direct Shear Test

T236

Project: CUY-14-6.93
Project Number: 104132
Sampling Date: 9/30/2021
Sample Number: ST-3
Sample Depth: 7.5-9.5 ft
Location: B-021-0-21 ST-3
Client Name: AECOM
Remarks:

Information Parameters	Specimen Number							
	1	2	3	4	5	6	7	8
Liquid Limit:	0	0	0					
Plastic Limit:	0	0	0					
Specific Gravity:	2.67	2.67	2.67					
Specific Gravity Method:	ASSUMED	ASSUMED	ASSUMED					
Initial Parameters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Test Temperature (°C):	22.2	22.2	22.2					
Sample Shape:	ROUND	ROUND	ROUND					
Height (in):	1.0060	1.0000	1.0018					
Diameter (in):	2.4973	2.4973	2.4973					
Area (in²):	4.898	4.898	4.898					
Volume (in³):	4.9277	4.8983	4.9073					
Moisture (%):	26.1	24.1	29.7					
Dry Density (pcf):	96.4	98.5	92.2					
Wet Density (pcf):	121.5	122.3	119.6					
Saturation (%):	95.5	93.2	98.1					
Void Ratio:	0.729	0.692	0.807					
Porosity (%):	42.2	40.9	44.7					
Consolidation Parameters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Initial Reference Height (in):	1.0060	1.0000	1.0018					
Final Reference Height (in):	1.0008	1.0000	1.0018					
Height (in):	1.0008	1.0000	1.0018					
Final Parameters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%)	28.7	24.9	30.6					
Dry Density (pcf):	96.8	99.3	92.6					
Wet Density (pcf):	124.5	124.0	120.9					
Saturation (%):	106.0	97.9	102.1					
Void Ratio:	0.723	0.678	0.801					
Porosity (%):	42.0	40.4	44.5					

National Engineering & Architectural Services Inc.

Direct Shear Test

T236

Specimen 1

Test Description:	Direct Shear		
Other Associated Tests:			
Device Details:	HM-5760		
Test Specification:	Undisturbed		
Test Time:	10/1/2021		
Technician:	LR	Sampling Method:	Shelby Tube
Specimen Code:	8.8'-8.9'	Specimen Lab #:	1
Specimen Description:	Brownish gray, COARSE AND FINE SAND, little silt, trace clay, trace gravel, wet.		
Specific Gravity:	2.67		
Plastic Limit:	0	Liquid Limit:	0
Test Remarks:			

Specimen 2

Test Description:	Direct Shear		
Other Associated Tests:			
Device Details:	HM-5760		
Test Specification:	Undisturbed		
Test Time:	10/5/2021		
Technician:	LR	Sampling Method:	Shelby Tube
Specimen Code:	9.0'-9.1'	Specimen Lab #:	2
Specimen Description:	Brownish gray, COARSE AND FINE SAND, little silt, trace clay, trace gravel, wet.		
Specific Gravity:	2.67		
Plastic Limit:	0	Liquid Limit:	0
Test Remarks:			

National Engineering & Architectural Services Inc.

Direct Shear Test

T236

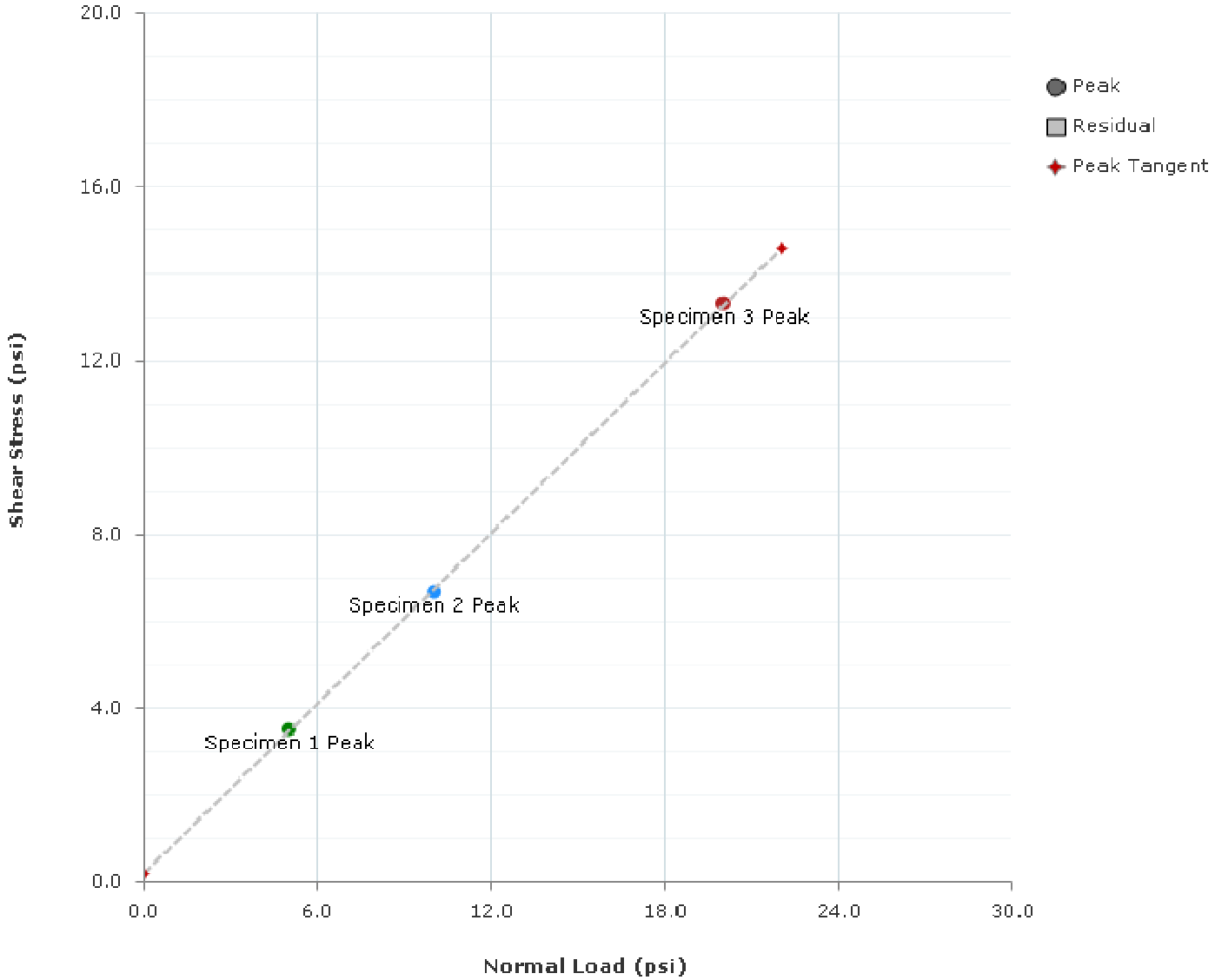
Specimen 3

Test Description:	Direct Shear		
Other Associated Tests:			
Device Details:	HM-5760		
Test Specification:	Undisturbed		
Test Time:	10/6/2021		
Technician:	LR	Sampling Method:	Shelby Tube
Specimen Code:	9.2'-9.3'	Specimen Lab #:	3
Specimen Description:	Brownish gray, COARSE AND FINE SAND, some clay, little silt, trace gravel, wet.		
Specific Gravity:	2.67		
Plastic Limit:	0	Liquid Limit:	0
Test Remarks:	Specimen contains an 1/8" clay seam.		

National Engineering & Architectural Services Inc.

Direct Shear Test - Shear Stress Vs. Normal Stress

T236

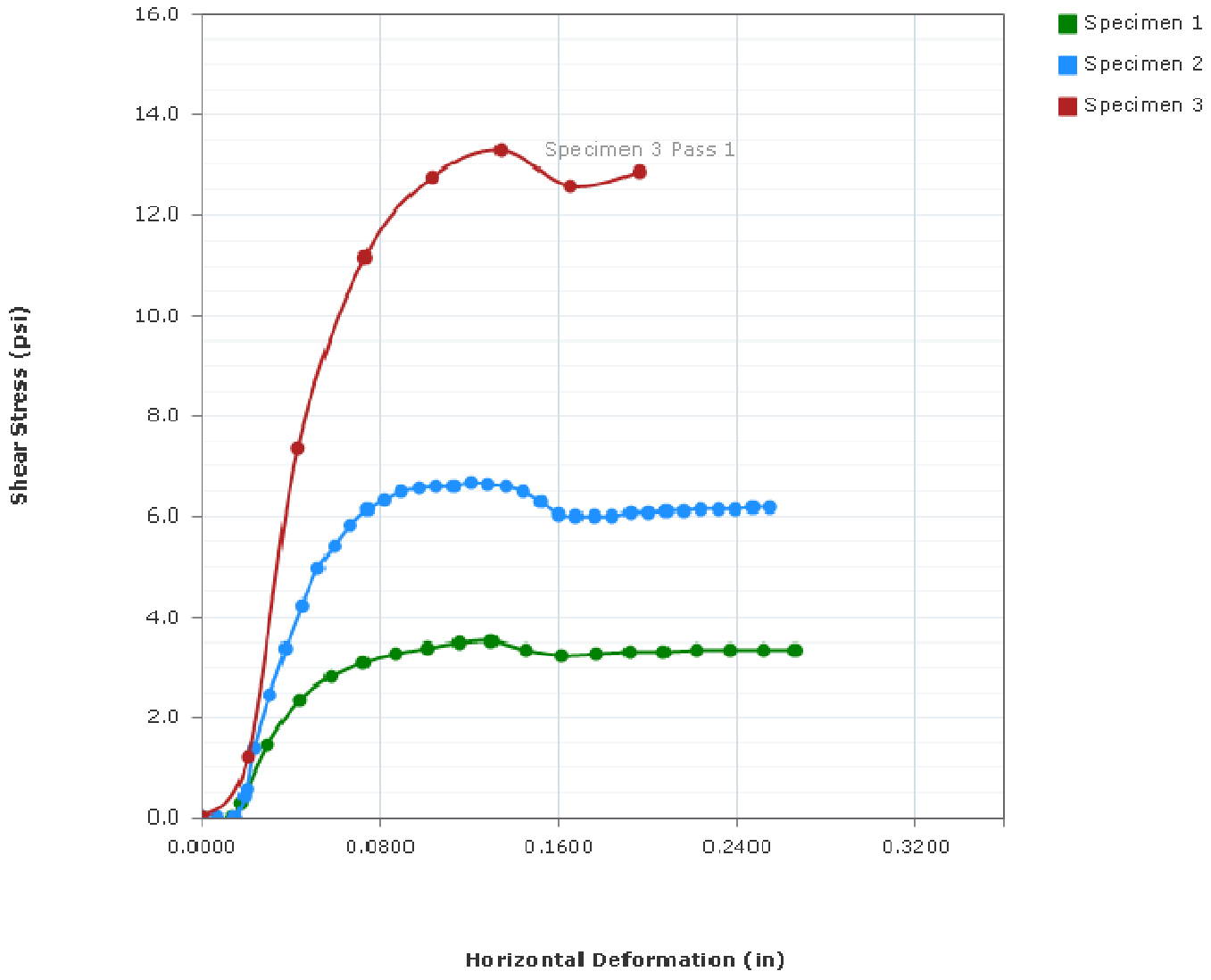


Tangent Results	C (psi)	Phi (°)
Peak Tangent:	0.2	33.1
Residual Tangent:	NA	NA

National Engineering & Architectural Services Inc.

Graph - Stress Deformation

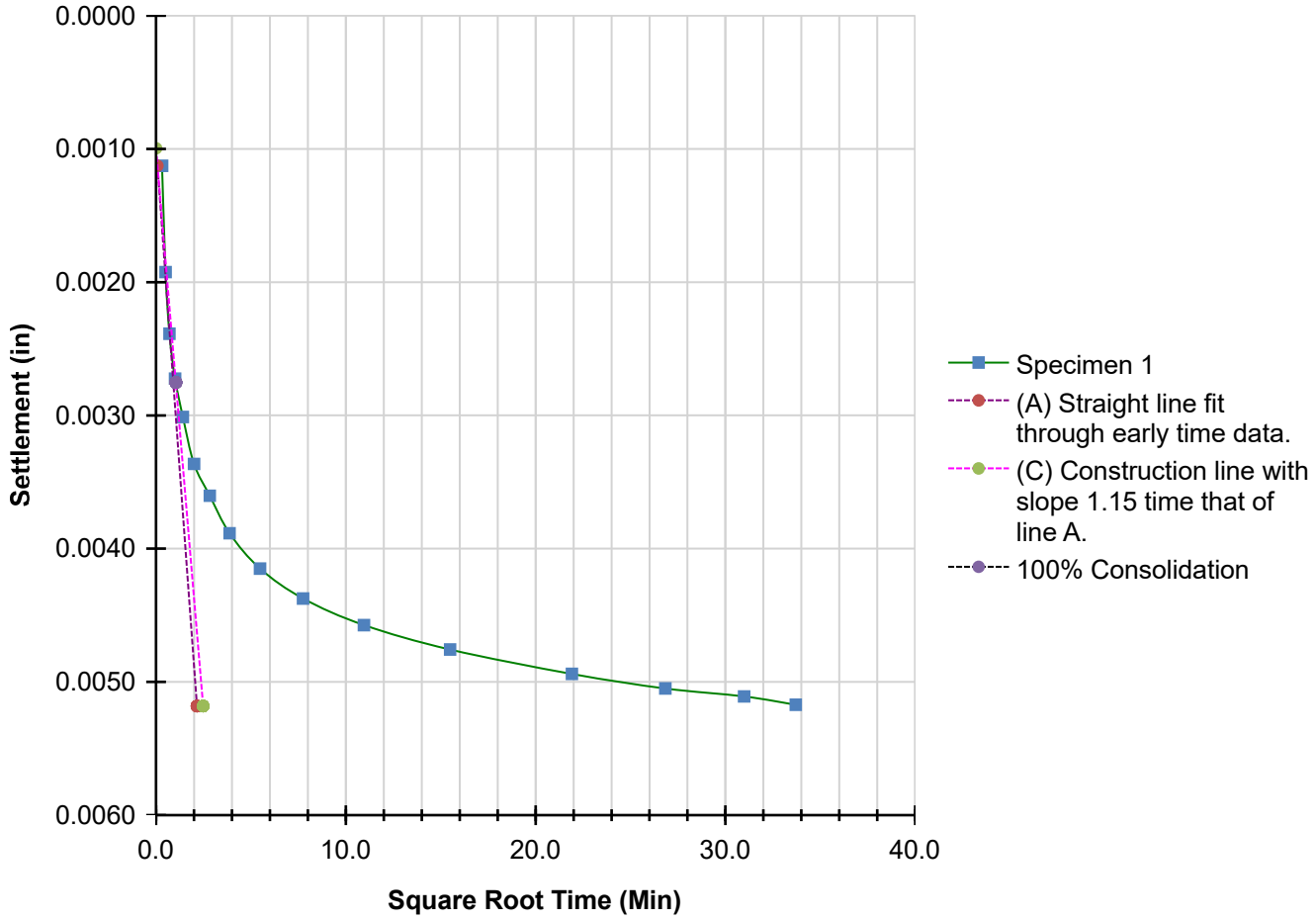
T236



National Engineering & Architectural Services Inc.

Square Root Time - Specimen 1 - Sequence 1 - 5.0 (psi)

T236

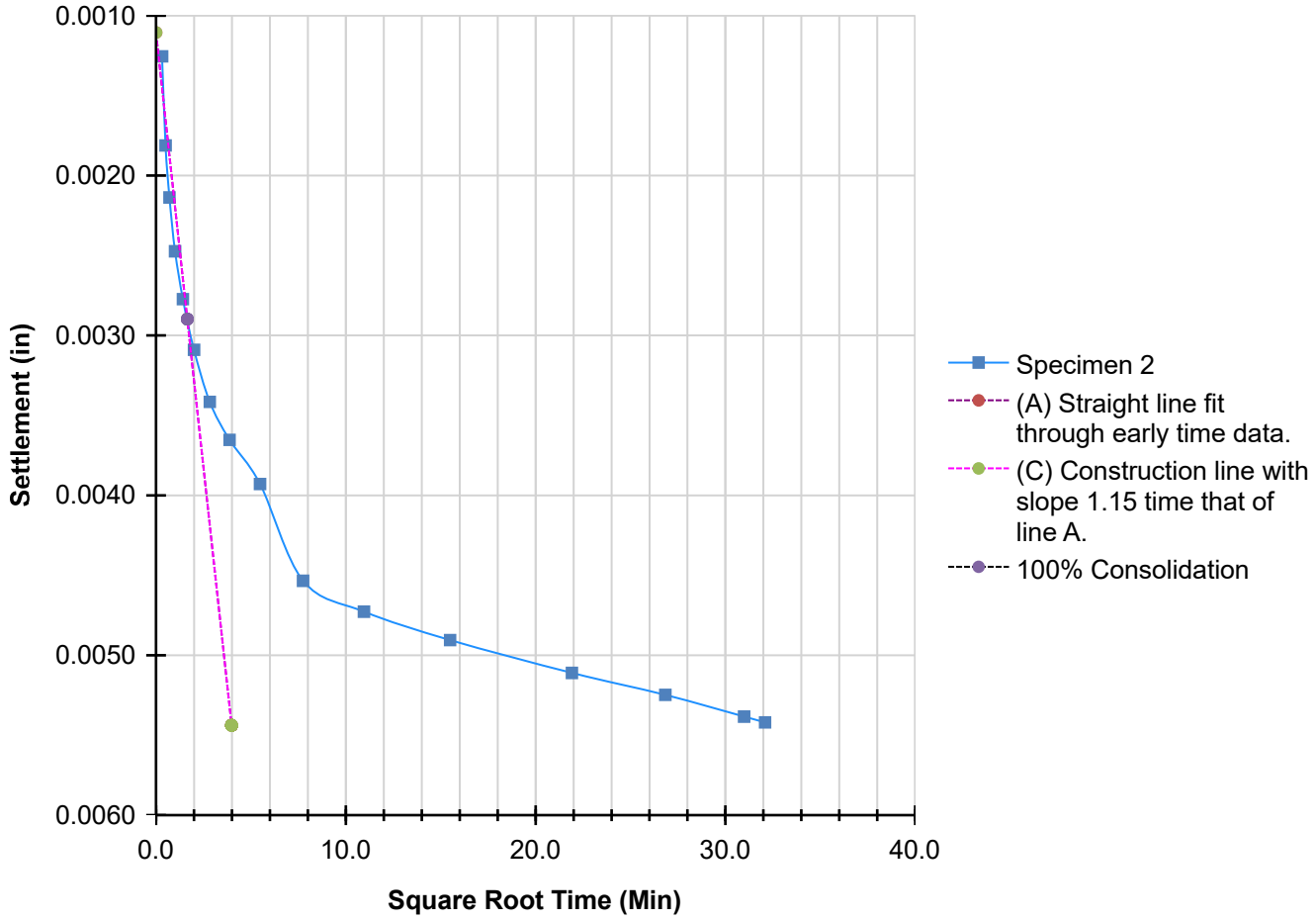


Tangent Construction Results	
T90 (Min):	1.084
T50 (Min):	0.269
Cv (in²/Min):	0.75279

National Engineering & Architectural Services Inc.

Square Root Time - Specimen 2 - Sequence 1 - 10.0 (psi)

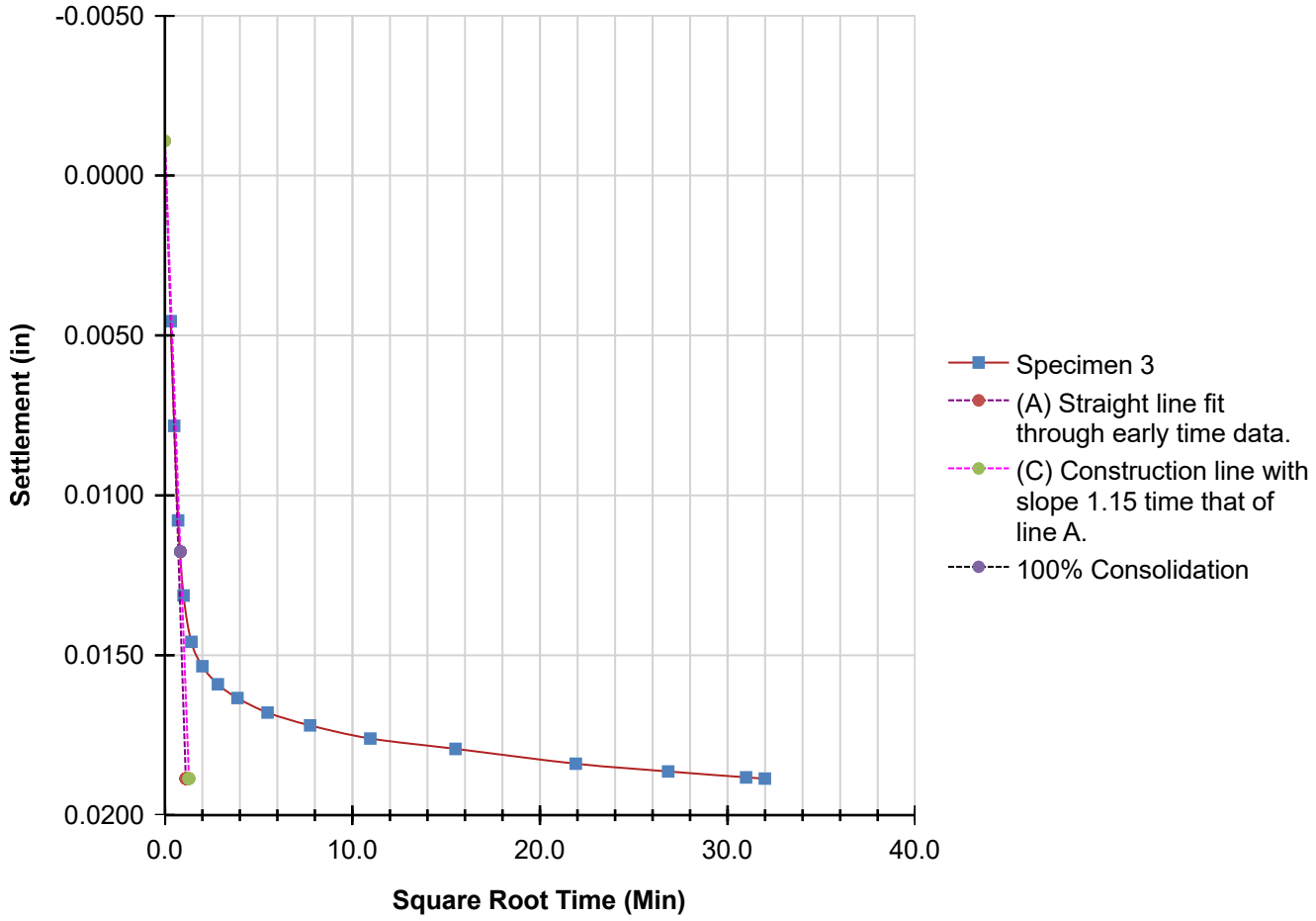
T236



Tangent Construction Results	
T90 (Min):	2.707
T50 (Min):	0.466
Cv (in²/Min):	0.42770

Square Root Time - Specimen 3 - Sequence 1 - 20.0 (psi)

T236



Tangent Construction Results	
T90 (Min):	0.687
T50 (Min):	0.159
Cv (in²/Min):	1.10169

APPENDIX C

DRIVEN ANALYSIS

REAR ABUTMENT

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: C:\DOCUME~1\XPMUSER\DESKTOP\CUY-14~1\UPDATED\RA1.DVN
Project Name: CUY-14-6.93, PID 104132 Project Date: 02/20/2024
Project Client: AECOM
Computed By: KCA
Project Manager: BPA

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 0.00 ft
Diameter of Pile: 16.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	5.60 ft
	- Driving/Restrike	5.60 ft
	- Ultimate:	5.60 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesionless	5.10 ft	0.00%	112.00 pcf	33.0/33.0	Nordlund
2	Cohesionless	5.00 ft	0.00%	140.00 pcf	45.0/45.0	Nordlund
3	Cohesionless	2.50 ft	0.00%	130.00 pcf	38.0/38.0	Nordlund
4	Cohesionless	5.00 ft	0.00%	132.00 pcf	42.0/42.0	Nordlund
5	Cohesionless	2.50 ft	0.00%	135.00 pcf	40.0/40.0	Nordlund
6	Cohesionless	8.80 ft	0.00%	140.00 pcf	45.0/45.0	Nordlund
7	Cohesionless	16.10 ft	0.00%	140.00 pcf	44.0/44.0	Nordlund

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.56 psf	24.17	N/A	0.00 Kips
5.09 ft	Cohesionless	285.04 psf	24.17	N/A	3.45 Kips
5.11 ft	Cohesionless	571.90 psf	32.96	N/A	3.49 Kips
5.59 ft	Cohesionless	605.50 psf	32.96	N/A	5.11 Kips
5.61 ft	Cohesionless	641.59 psf	32.96	N/A	5.18 Kips
10.09 ft	Cohesionless	815.41 psf	32.96	N/A	25.51 Kips
10.11 ft	Cohesionless	990.74 psf	27.83	N/A	25.61 Kips
12.59 ft	Cohesionless	1074.56 psf	27.83	N/A	37.20 Kips
12.61 ft	Cohesionless	1159.75 psf	30.76	N/A	37.31 Kips
17.59 ft	Cohesionless	1333.05 psf	30.76	N/A	73.55 Kips
17.61 ft	Cohesionless	1507.76 psf	29.30	N/A	73.72 Kips
20.09 ft	Cohesionless	1597.79 psf	29.30	N/A	94.93 Kips
20.11 ft	Cohesionless	1689.29 psf	32.96	N/A	95.12 Kips
28.89 ft	Cohesionless	2029.95 psf	32.96	N/A	194.28 Kips
28.91 ft	Cohesionless	2372.17 psf	32.23	N/A	194.55 Kips
37.91 ft	Cohesionless	2721.37 psf	32.23	N/A	330.06 Kips
44.99 ft	Cohesionless	2996.07 psf	32.23	N/A	461.11 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.12 psf	47.20	69.81 Kips	0.05 Kips
5.09 ft	Cohesionless	570.08 psf	47.20	69.81 Kips	24.26 Kips
5.11 ft	Cohesionless	572.60 psf	475.00	1029.88 Kips	303.81 Kips
5.59 ft	Cohesionless	639.80 psf	475.00	1029.88 Kips	339.46 Kips
5.61 ft	Cohesionless	641.98 psf	475.00	1029.88 Kips	340.62 Kips
10.09 ft	Cohesionless	989.62 psf	475.00	1029.88 Kips	525.07 Kips
10.11 ft	Cohesionless	991.08 psf	110.40	375.04 Kips	110.30 Kips
12.59 ft	Cohesionless	1158.72 psf	110.40	375.04 Kips	128.96 Kips
12.61 ft	Cohesionless	1160.10 psf	244.00	827.37 Kips	305.91 Kips
17.59 ft	Cohesionless	1506.70 psf	244.00	827.37 Kips	397.31 Kips
17.61 ft	Cohesionless	1508.13 psf	160.00	583.08 Kips	252.69 Kips
20.09 ft	Cohesionless	1688.17 psf	160.00	583.08 Kips	282.86 Kips
20.11 ft	Cohesionless	1689.68 psf	475.00	1029.88 Kips	896.51 Kips
28.89 ft	Cohesionless	2371.00 psf	475.00	1029.88 Kips	1029.88 Kips
28.91 ft	Cohesionless	2372.56 psf	391.00	1029.88 Kips	1025.85 Kips
37.91 ft	Cohesionless	3070.96 psf	391.00	1029.88 Kips	1029.88 Kips
44.99 ft	Cohesionless	3620.36 psf	391.00	1029.88 Kips	1029.88 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.05 Kips	0.05 Kips
5.09 ft	3.45 Kips	24.26 Kips	27.70 Kips
5.11 ft	3.49 Kips	303.81 Kips	307.30 Kips
5.59 ft	5.11 Kips	339.46 Kips	344.58 Kips
5.61 ft	5.18 Kips	340.62 Kips	345.80 Kips
10.09 ft	25.51 Kips	525.07 Kips	550.59 Kips
10.11 ft	25.61 Kips	110.30 Kips	135.91 Kips
12.59 ft	37.20 Kips	128.96 Kips	166.15 Kips
12.61 ft	37.31 Kips	305.91 Kips	343.22 Kips
17.59 ft	73.55 Kips	397.31 Kips	470.86 Kips
17.61 ft	73.72 Kips	252.69 Kips	326.40 Kips
20.09 ft	94.93 Kips	282.86 Kips	377.79 Kips
20.11 ft	95.12 Kips	896.51 Kips	991.62 Kips
28.89 ft	194.28 Kips	1029.88 Kips	1224.17 Kips
28.91 ft	194.55 Kips	1025.85 Kips	1220.40 Kips
37.91 ft	330.06 Kips	1029.88 Kips	1359.95 Kips
44.99 ft	461.11 Kips	1029.88 Kips	1490.99 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.56 psf	24.17	N/A	0.00 Kips
5.09 ft	Cohesionless	285.04 psf	24.17	N/A	3.45 Kips
5.11 ft	Cohesionless	571.90 psf	32.96	N/A	3.49 Kips
5.59 ft	Cohesionless	605.50 psf	32.96	N/A	5.11 Kips
5.61 ft	Cohesionless	641.59 psf	32.96	N/A	5.18 Kips
10.09 ft	Cohesionless	815.41 psf	32.96	N/A	25.51 Kips
10.11 ft	Cohesionless	990.74 psf	27.83	N/A	25.61 Kips
12.59 ft	Cohesionless	1074.56 psf	27.83	N/A	37.20 Kips
12.61 ft	Cohesionless	1159.75 psf	30.76	N/A	37.31 Kips
17.59 ft	Cohesionless	1333.05 psf	30.76	N/A	73.55 Kips
17.61 ft	Cohesionless	1507.76 psf	29.30	N/A	73.72 Kips
20.09 ft	Cohesionless	1597.79 psf	29.30	N/A	94.93 Kips
20.11 ft	Cohesionless	1689.29 psf	32.96	N/A	95.12 Kips
28.89 ft	Cohesionless	2029.95 psf	32.96	N/A	194.28 Kips
28.91 ft	Cohesionless	2372.17 psf	32.23	N/A	194.55 Kips
37.91 ft	Cohesionless	2721.37 psf	32.23	N/A	330.06 Kips
44.99 ft	Cohesionless	2996.07 psf	32.23	N/A	461.11 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.12 psf	47.20	69.81 Kips	0.05 Kips
5.09 ft	Cohesionless	570.08 psf	47.20	69.81 Kips	24.26 Kips
5.11 ft	Cohesionless	572.60 psf	475.00	1029.88 Kips	303.81 Kips
5.59 ft	Cohesionless	639.80 psf	475.00	1029.88 Kips	339.46 Kips
5.61 ft	Cohesionless	641.98 psf	475.00	1029.88 Kips	340.62 Kips
10.09 ft	Cohesionless	989.62 psf	475.00	1029.88 Kips	525.07 Kips
10.11 ft	Cohesionless	991.08 psf	110.40	375.04 Kips	110.30 Kips
12.59 ft	Cohesionless	1158.72 psf	110.40	375.04 Kips	128.96 Kips
12.61 ft	Cohesionless	1160.10 psf	244.00	827.37 Kips	305.91 Kips
17.59 ft	Cohesionless	1506.70 psf	244.00	827.37 Kips	397.31 Kips
17.61 ft	Cohesionless	1508.13 psf	160.00	583.08 Kips	252.69 Kips
20.09 ft	Cohesionless	1688.17 psf	160.00	583.08 Kips	282.86 Kips
20.11 ft	Cohesionless	1689.68 psf	475.00	1029.88 Kips	896.51 Kips
28.89 ft	Cohesionless	2371.00 psf	475.00	1029.88 Kips	1029.88 Kips
28.91 ft	Cohesionless	2372.56 psf	391.00	1029.88 Kips	1025.85 Kips
37.91 ft	Cohesionless	3070.96 psf	391.00	1029.88 Kips	1029.88 Kips
44.99 ft	Cohesionless	3620.36 psf	391.00	1029.88 Kips	1029.88 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.05 Kips	0.05 Kips
5.09 ft	3.45 Kips	24.26 Kips	27.70 Kips
5.11 ft	3.49 Kips	303.81 Kips	307.30 Kips
5.59 ft	5.11 Kips	339.46 Kips	344.58 Kips
5.61 ft	5.18 Kips	340.62 Kips	345.80 Kips
10.09 ft	25.51 Kips	525.07 Kips	550.59 Kips
10.11 ft	25.61 Kips	110.30 Kips	135.91 Kips
12.59 ft	37.20 Kips	128.96 Kips	166.15 Kips
12.61 ft	37.31 Kips	305.91 Kips	343.22 Kips
17.59 ft	73.55 Kips	397.31 Kips	470.86 Kips
17.61 ft	73.72 Kips	252.69 Kips	326.40 Kips
20.09 ft	94.93 Kips	282.86 Kips	377.79 Kips
20.11 ft	95.12 Kips	896.51 Kips	991.62 Kips
28.89 ft	194.28 Kips	1029.88 Kips	1224.17 Kips
28.91 ft	194.55 Kips	1025.85 Kips	1220.40 Kips
37.91 ft	330.06 Kips	1029.88 Kips	1359.95 Kips
44.99 ft	461.11 Kips	1029.88 Kips	1490.99 Kips

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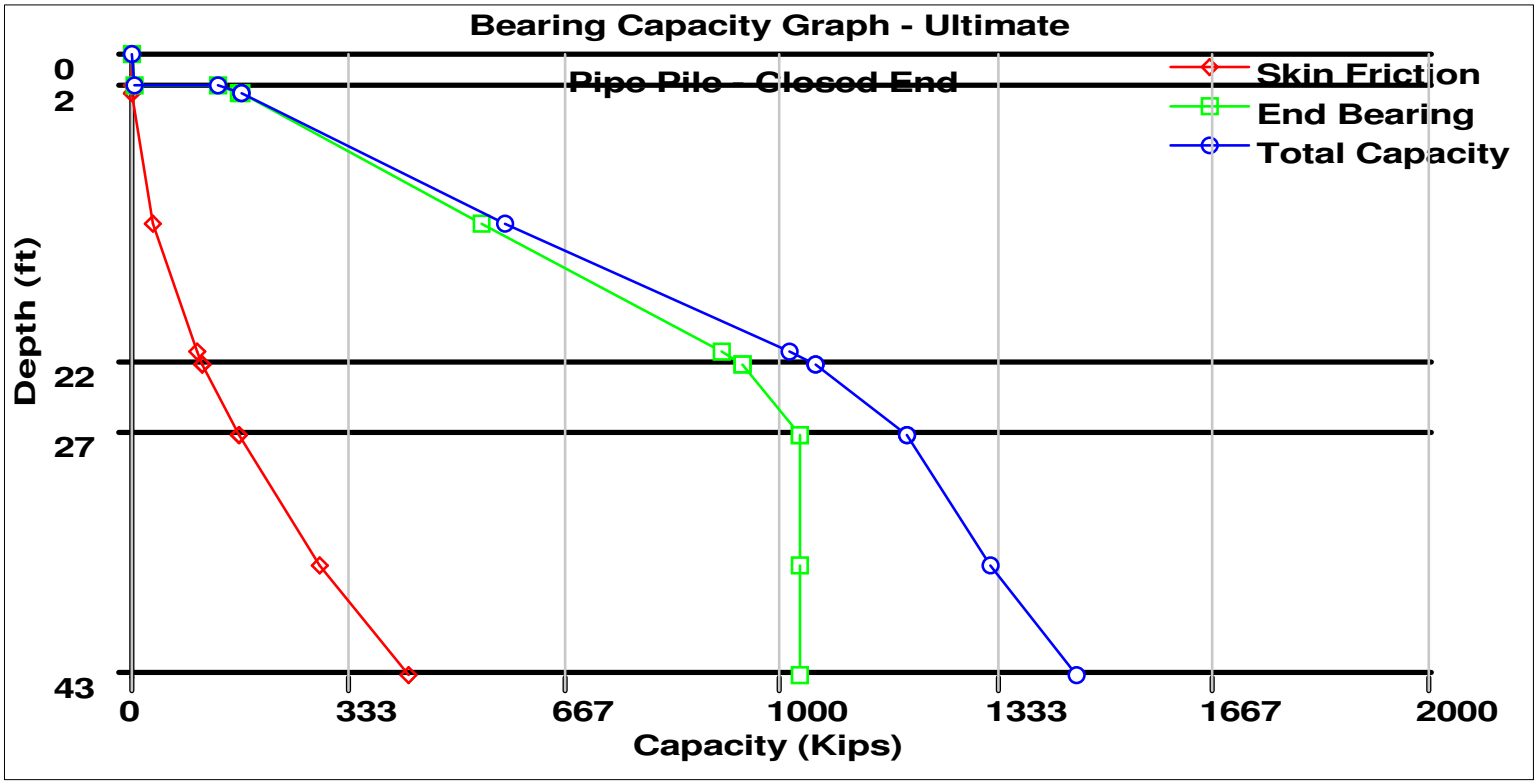

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: C:\DOCUME~1\XPMUSER\DESKTOP\CUY-14~1\UPDATED\RA2.DVN
Project Name: CUY-14-6.93, PID 104132 Project Date: 02/20/2024
Project Client: AECOM
Computed By: KCA
Project Manager: BPA

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 0.00 ft
Diameter of Pile: 16.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	2.80 ft
	- Driving/Restrike	2.80 ft
	- Ultimate:	2.80 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesionless	2.30 ft	0.00%	108.00 pcf	31.0/31.0	Nordlund
2	Cohesionless	19.30 ft	0.00%	140.00 pcf	45.0/45.0	Nordlund
3	Cohesionless	5.00 ft	0.00%	140.00 pcf	45.0/45.0	Nordlund
4	Cohesionless	16.70 ft	0.00%	140.00 pcf	45.0/45.0	Nordlund

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.54 psf	22.70	N/A	0.00 Kips
2.29 ft	Cohesionless	123.66 psf	22.70	N/A	0.54 Kips
2.31 ft	Cohesionless	249.10 psf	32.96	N/A	0.56 Kips
2.79 ft	Cohesionless	282.70 psf	32.96	N/A	1.32 Kips
2.81 ft	Cohesionless	318.79 psf	32.96	N/A	1.35 Kips
11.81 ft	Cohesionless	667.99 psf	32.96	N/A	34.81 Kips
20.81 ft	Cohesionless	1017.19 psf	32.96	N/A	103.25 Kips
21.59 ft	Cohesionless	1047.45 psf	32.96	N/A	110.82 Kips
21.61 ft	Cohesionless	1777.67 psf	32.96	N/A	111.02 Kips
26.59 ft	Cohesionless	1970.89 psf	32.96	N/A	165.63 Kips
26.61 ft	Cohesionless	2165.67 psf	32.96	N/A	165.87 Kips
35.61 ft	Cohesionless	2514.87 psf	32.96	N/A	291.81 Kips
43.29 ft	Cohesionless	2812.85 psf	32.96	N/A	426.92 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.08 psf	35.20	28.85 Kips	0.03 Kips
2.29 ft	Cohesionless	247.32 psf	35.20	28.85 Kips	7.33 Kips
2.31 ft	Cohesionless	249.80 psf	475.00	1029.88 Kips	132.54 Kips
2.79 ft	Cohesionless	317.00 psf	475.00	1029.88 Kips	168.19 Kips
2.81 ft	Cohesionless	319.18 psf	475.00	1029.88 Kips	169.35 Kips
11.81 ft	Cohesionless	1017.58 psf	475.00	1029.88 Kips	539.91 Kips
20.81 ft	Cohesionless	1715.98 psf	475.00	1029.88 Kips	910.46 Kips
21.59 ft	Cohesionless	1776.50 psf	475.00	1029.88 Kips	942.58 Kips
21.61 ft	Cohesionless	1778.06 psf	475.00	1029.88 Kips	943.40 Kips
26.59 ft	Cohesionless	2164.50 psf	475.00	1029.88 Kips	1029.88 Kips
26.61 ft	Cohesionless	2166.06 psf	475.00	1029.88 Kips	1029.88 Kips
35.61 ft	Cohesionless	2864.46 psf	475.00	1029.88 Kips	1029.88 Kips
43.29 ft	Cohesionless	3460.42 psf	475.00	1029.88 Kips	1029.88 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.03 Kips	0.03 Kips
2.29 ft	0.54 Kips	7.33 Kips	7.87 Kips
2.31 ft	0.56 Kips	132.54 Kips	133.10 Kips
2.79 ft	1.32 Kips	168.19 Kips	169.51 Kips
2.81 ft	1.35 Kips	169.35 Kips	170.70 Kips
11.81 ft	34.81 Kips	539.91 Kips	574.72 Kips
20.81 ft	103.25 Kips	910.46 Kips	1013.71 Kips
21.59 ft	110.82 Kips	942.58 Kips	1053.40 Kips
21.61 ft	111.02 Kips	943.40 Kips	1054.42 Kips
26.59 ft	165.63 Kips	1029.88 Kips	1195.52 Kips
26.61 ft	165.87 Kips	1029.88 Kips	1195.76 Kips
35.61 ft	291.81 Kips	1029.88 Kips	1321.69 Kips
43.29 ft	426.92 Kips	1029.88 Kips	1456.80 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.54 psf	22.70	N/A	0.00 Kips
2.29 ft	Cohesionless	123.66 psf	22.70	N/A	0.54 Kips
2.31 ft	Cohesionless	249.10 psf	32.96	N/A	0.56 Kips
2.79 ft	Cohesionless	282.70 psf	32.96	N/A	1.32 Kips
2.81 ft	Cohesionless	318.79 psf	32.96	N/A	1.35 Kips
11.81 ft	Cohesionless	667.99 psf	32.96	N/A	34.81 Kips
20.81 ft	Cohesionless	1017.19 psf	32.96	N/A	103.25 Kips
21.59 ft	Cohesionless	1047.45 psf	32.96	N/A	110.82 Kips
21.61 ft	Cohesionless	1777.67 psf	32.96	N/A	111.02 Kips
26.59 ft	Cohesionless	1970.89 psf	32.96	N/A	165.63 Kips
26.61 ft	Cohesionless	2165.67 psf	32.96	N/A	165.87 Kips
35.61 ft	Cohesionless	2514.87 psf	32.96	N/A	291.81 Kips
43.29 ft	Cohesionless	2812.85 psf	32.96	N/A	426.92 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.08 psf	35.20	28.85 Kips	0.03 Kips
2.29 ft	Cohesionless	247.32 psf	35.20	28.85 Kips	7.33 Kips
2.31 ft	Cohesionless	249.80 psf	475.00	1029.88 Kips	132.54 Kips
2.79 ft	Cohesionless	317.00 psf	475.00	1029.88 Kips	168.19 Kips
2.81 ft	Cohesionless	319.18 psf	475.00	1029.88 Kips	169.35 Kips
11.81 ft	Cohesionless	1017.58 psf	475.00	1029.88 Kips	539.91 Kips
20.81 ft	Cohesionless	1715.98 psf	475.00	1029.88 Kips	910.46 Kips
21.59 ft	Cohesionless	1776.50 psf	475.00	1029.88 Kips	942.58 Kips
21.61 ft	Cohesionless	1778.06 psf	475.00	1029.88 Kips	943.40 Kips
26.59 ft	Cohesionless	2164.50 psf	475.00	1029.88 Kips	1029.88 Kips
26.61 ft	Cohesionless	2166.06 psf	475.00	1029.88 Kips	1029.88 Kips
35.61 ft	Cohesionless	2864.46 psf	475.00	1029.88 Kips	1029.88 Kips
43.29 ft	Cohesionless	3460.42 psf	475.00	1029.88 Kips	1029.88 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.03 Kips	0.03 Kips
2.29 ft	0.54 Kips	7.33 Kips	7.87 Kips
2.31 ft	0.56 Kips	132.54 Kips	133.10 Kips
2.79 ft	1.32 Kips	168.19 Kips	169.51 Kips
2.81 ft	1.35 Kips	169.35 Kips	170.70 Kips
11.81 ft	34.81 Kips	539.91 Kips	574.72 Kips
20.81 ft	103.25 Kips	910.46 Kips	1013.71 Kips
21.59 ft	110.82 Kips	942.58 Kips	1053.40 Kips
21.61 ft	111.02 Kips	943.40 Kips	1054.42 Kips
26.59 ft	165.63 Kips	1029.88 Kips	1195.52 Kips
26.61 ft	165.87 Kips	1029.88 Kips	1195.76 Kips
35.61 ft	291.81 Kips	1029.88 Kips	1321.69 Kips
43.29 ft	426.92 Kips	1029.88 Kips	1456.80 Kips

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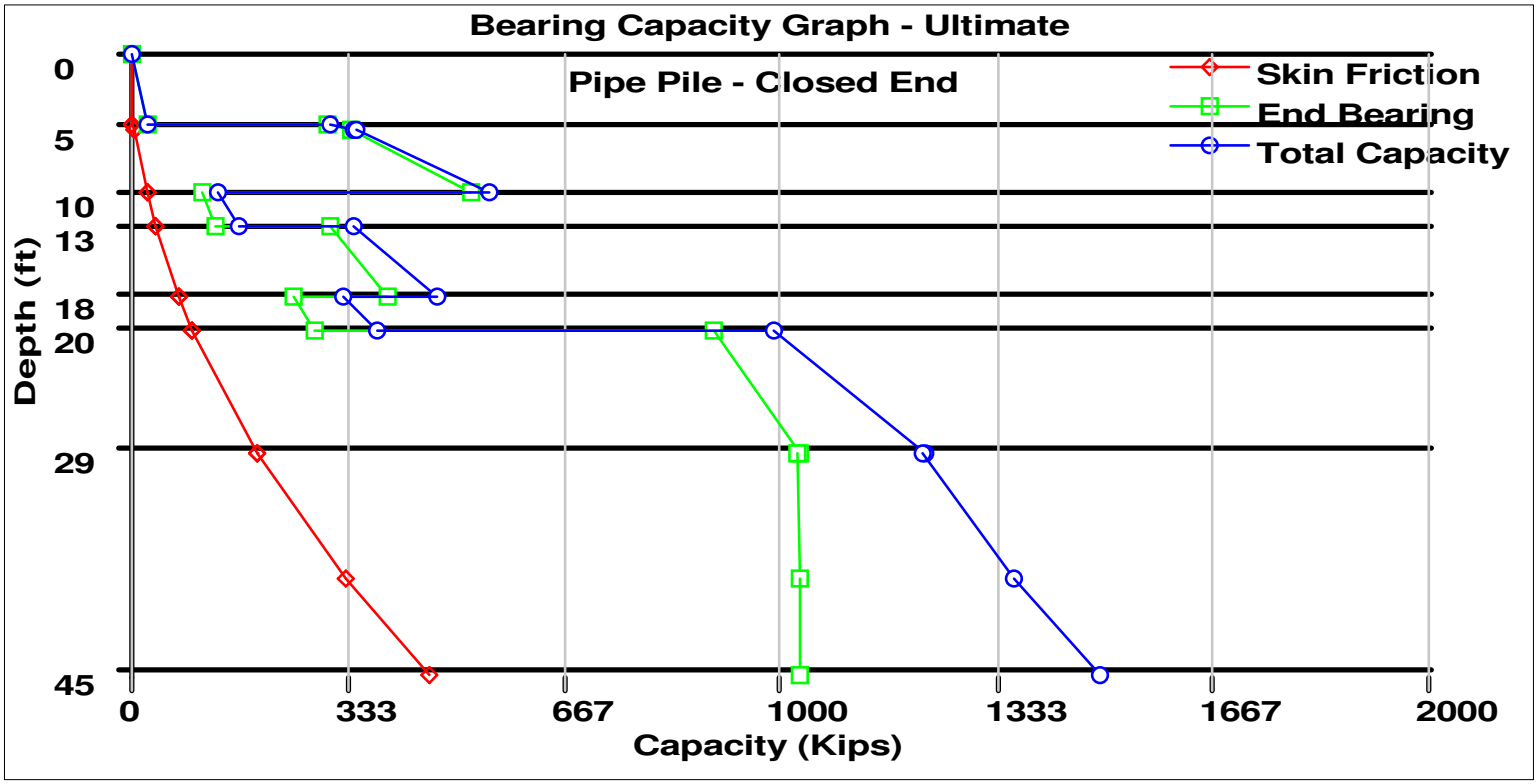

PIER 1

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: C:\DOCUME~1\XPMUSER\DESKTOP\CUY-14~1\UPDATED\P1-1.DVN
Project Name: CUY-14-6.93, PID 104132 Project Date: 10/25/2021
Project Client: AECOM
Computed By: KCA
Project Manager: BPA

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 0.00 ft
Diameter of Pile: 16.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	3.00 ft
	- Driving/Restrike	3.00 ft
	- Ultimate:	3.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesionless	0.50 ft	17.00%	128.00 pcf	37.0/37.0	Nordlund
2	Cohesionless	5.00 ft	0.00%	122.00 pcf	33.0/33.0	Nordlund
3	Cohesionless	7.50 ft	0.00%	130.00 pcf	40.0/40.0	Nordlund
4	Cohesionless	35.00 ft	0.00%	140.00 pcf	43.0/43.0	Nordlund

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.64 psf	27.10	N/A	0.00 Kips
0.49 ft	Cohesionless	31.36 psf	27.10	N/A	0.05 Kips
0.51 ft	Cohesionless	64.61 psf	24.17	N/A	0.05 Kips
2.99 ft	Cohesionless	215.89 psf	24.17	N/A	1.33 Kips
3.01 ft	Cohesionless	369.30 psf	24.17	N/A	1.35 Kips
5.49 ft	Cohesionless	443.20 psf	24.17	N/A	3.96 Kips
5.51 ft	Cohesionless	518.34 psf	29.30	N/A	4.00 Kips
12.99 ft	Cohesionless	771.16 psf	29.30	N/A	34.89 Kips
13.01 ft	Cohesionless	1025.39 psf	31.49	N/A	35.00 Kips
22.01 ft	Cohesionless	1374.59 psf	31.49	N/A	103.03 Kips
31.01 ft	Cohesionless	1723.79 psf	31.49	N/A	205.61 Kips
40.01 ft	Cohesionless	2072.99 psf	31.49	N/A	342.74 Kips
47.99 ft	Cohesionless	2382.61 psf	31.49	N/A	493.23 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.28 psf	91.20	287.69 Kips	0.12 Kips
0.49 ft	Cohesionless	62.72 psf	91.20	287.69 Kips	5.65 Kips
0.51 ft	Cohesionless	65.22 psf	47.20	69.81 Kips	2.77 Kips
2.99 ft	Cohesionless	367.78 psf	47.20	69.81 Kips	15.65 Kips
3.01 ft	Cohesionless	369.60 psf	47.20	69.81 Kips	15.73 Kips
5.49 ft	Cohesionless	517.40 psf	47.20	69.81 Kips	22.01 Kips
5.51 ft	Cohesionless	518.68 psf	160.00	583.08 Kips	86.90 Kips
12.99 ft	Cohesionless	1024.32 psf	160.00	583.08 Kips	171.63 Kips
13.01 ft	Cohesionless	1025.78 psf	307.00	946.11 Kips	344.73 Kips
22.01 ft	Cohesionless	1724.18 psf	307.00	946.11 Kips	579.43 Kips
31.01 ft	Cohesionless	2422.58 psf	307.00	946.11 Kips	814.14 Kips
40.01 ft	Cohesionless	3120.98 psf	307.00	946.11 Kips	946.11 Kips
47.99 ft	Cohesionless	3740.22 psf	307.00	946.11 Kips	946.11 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.12 Kips	0.12 Kips
0.49 ft	0.05 Kips	5.65 Kips	5.70 Kips
0.51 ft	0.05 Kips	2.77 Kips	2.83 Kips
2.99 ft	1.33 Kips	15.65 Kips	16.98 Kips
3.01 ft	1.35 Kips	15.73 Kips	17.07 Kips
5.49 ft	3.96 Kips	22.01 Kips	25.97 Kips
5.51 ft	4.00 Kips	86.90 Kips	90.90 Kips
12.99 ft	34.89 Kips	171.63 Kips	206.52 Kips
13.01 ft	35.00 Kips	344.73 Kips	379.73 Kips
22.01 ft	103.03 Kips	579.43 Kips	682.46 Kips
31.01 ft	205.61 Kips	814.14 Kips	1019.75 Kips
40.01 ft	342.74 Kips	946.11 Kips	1288.85 Kips
47.99 ft	493.23 Kips	946.11 Kips	1439.34 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.64 psf	27.10	N/A	0.00 Kips
0.49 ft	Cohesionless	31.36 psf	27.10	N/A	0.06 Kips
0.51 ft	Cohesionless	64.61 psf	24.17	N/A	0.06 Kips
2.99 ft	Cohesionless	215.89 psf	24.17	N/A	1.34 Kips
3.01 ft	Cohesionless	369.30 psf	24.17	N/A	1.36 Kips
5.49 ft	Cohesionless	443.20 psf	24.17	N/A	3.97 Kips
5.51 ft	Cohesionless	518.34 psf	29.30	N/A	4.01 Kips
12.99 ft	Cohesionless	771.16 psf	29.30	N/A	34.90 Kips
13.01 ft	Cohesionless	1025.39 psf	31.49	N/A	35.01 Kips
22.01 ft	Cohesionless	1374.59 psf	31.49	N/A	103.04 Kips
31.01 ft	Cohesionless	1723.79 psf	31.49	N/A	205.62 Kips
40.01 ft	Cohesionless	2072.99 psf	31.49	N/A	342.75 Kips
47.99 ft	Cohesionless	2382.61 psf	31.49	N/A	493.24 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.28 psf	91.20	287.69 Kips	0.12 Kips
0.49 ft	Cohesionless	62.72 psf	91.20	287.69 Kips	5.65 Kips
0.51 ft	Cohesionless	65.22 psf	47.20	69.81 Kips	2.77 Kips
2.99 ft	Cohesionless	367.78 psf	47.20	69.81 Kips	15.65 Kips
3.01 ft	Cohesionless	369.60 psf	47.20	69.81 Kips	15.73 Kips
5.49 ft	Cohesionless	517.40 psf	47.20	69.81 Kips	22.01 Kips
5.51 ft	Cohesionless	518.68 psf	160.00	583.08 Kips	86.90 Kips
12.99 ft	Cohesionless	1024.32 psf	160.00	583.08 Kips	171.63 Kips
13.01 ft	Cohesionless	1025.78 psf	307.00	946.11 Kips	344.73 Kips
22.01 ft	Cohesionless	1724.18 psf	307.00	946.11 Kips	579.43 Kips
31.01 ft	Cohesionless	2422.58 psf	307.00	946.11 Kips	814.14 Kips
40.01 ft	Cohesionless	3120.98 psf	307.00	946.11 Kips	946.11 Kips
47.99 ft	Cohesionless	3740.22 psf	307.00	946.11 Kips	946.11 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.12 Kips	0.12 Kips
0.49 ft	0.06 Kips	5.65 Kips	5.71 Kips
0.51 ft	0.06 Kips	2.77 Kips	2.84 Kips
2.99 ft	1.34 Kips	15.65 Kips	16.99 Kips
3.01 ft	1.36 Kips	15.73 Kips	17.08 Kips
5.49 ft	3.97 Kips	22.01 Kips	25.98 Kips
5.51 ft	4.01 Kips	86.90 Kips	90.91 Kips
12.99 ft	34.90 Kips	171.63 Kips	206.53 Kips
13.01 ft	35.01 Kips	344.73 Kips	379.74 Kips
22.01 ft	103.04 Kips	579.43 Kips	682.47 Kips
31.01 ft	205.62 Kips	814.14 Kips	1019.76 Kips
40.01 ft	342.75 Kips	946.11 Kips	1288.86 Kips
47.99 ft	493.24 Kips	946.11 Kips	1439.35 Kips

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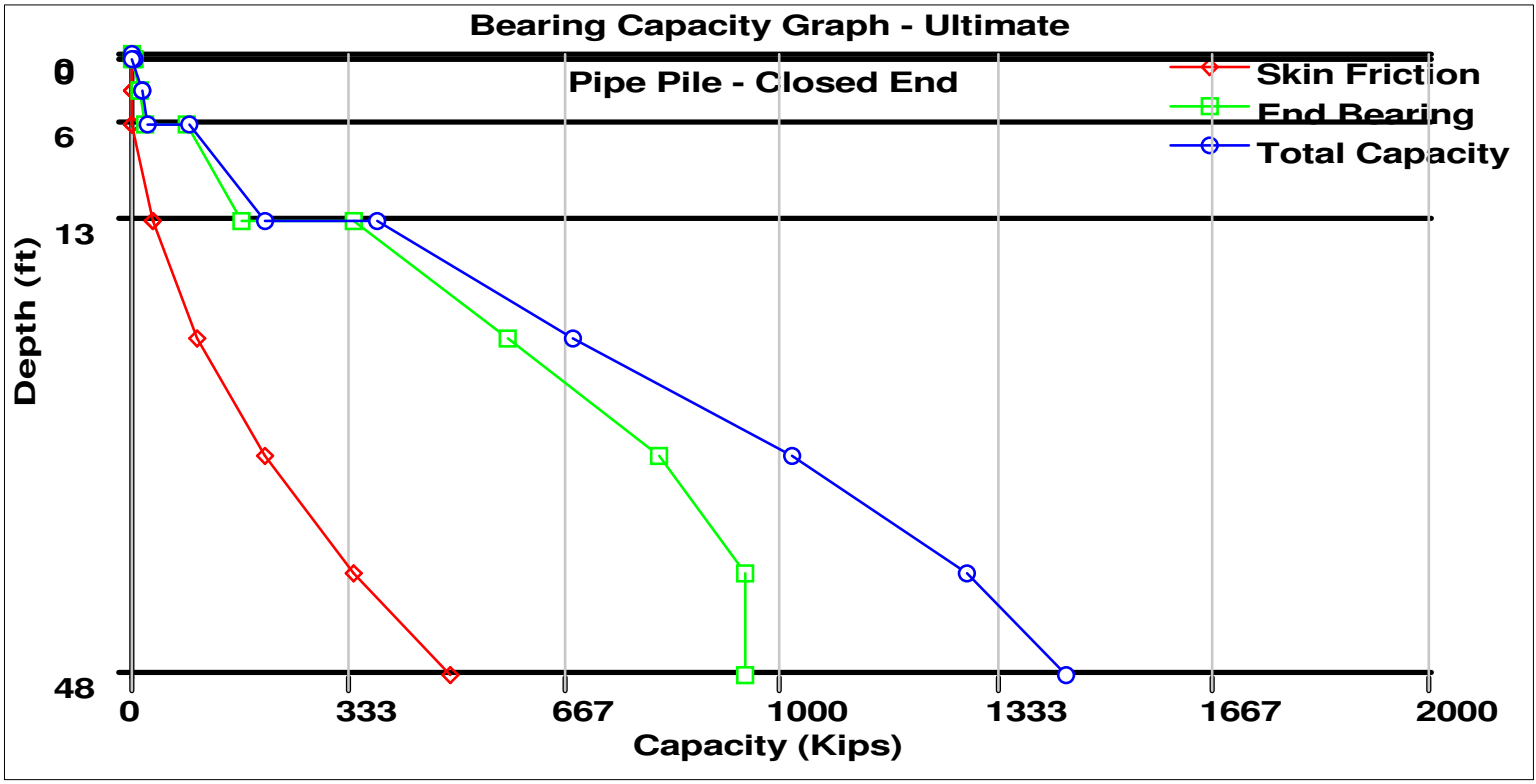

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: C:\DOCUME~1\XPMUSER\DESKTOP\CUY-14~1\UPDATED\P1-2.DVN
Project Name: CUY-14-6.93, PID 104132 Project Date: 02/20/2024
Project Client: AECOM
Computed By: KCA
Project Manager: BPA

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 0.00 ft
Diameter of Pile: 16.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	6.10 ft
	- Driving/Restrike	6.10 ft
	- Ultimate:	6.10 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesionless	5.60 ft	17.00%	110.00 pcf	29.0/29.0	Nordlund
2	Cohesionless	12.50 ft	0.00%	132.00 pcf	42.0/42.0	Nordlund
3	Cohesionless	10.00 ft	0.00%	132.00 pcf	43.0/43.0	Nordlund
4	Cohesionless	6.30 ft	0.00%	135.00 pcf	42.0/42.0	Nordlund
5	Cohesionless	5.00 ft	17.00%	140.00 pcf	42.0/42.0	Nordlund
6	Cohesionless	6.50 ft	0.00%	140.00 pcf	45.0/45.0	Nordlund

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.55 psf	21.24	N/A	0.00 Kips
5.59 ft	Cohesionless	307.45 psf	21.24	N/A	2.21 Kips
5.61 ft	Cohesionless	616.66 psf	30.76	N/A	2.25 Kips
6.09 ft	Cohesionless	648.34 psf	30.76	N/A	3.95 Kips
6.11 ft	Cohesionless	682.35 psf	30.76	N/A	4.03 Kips
15.11 ft	Cohesionless	995.55 psf	30.76	N/A	52.95 Kips
18.09 ft	Cohesionless	1099.25 psf	30.76	N/A	75.93 Kips
18.11 ft	Cohesionless	1517.55 psf	31.49	N/A	76.09 Kips
27.11 ft	Cohesionless	1830.75 psf	31.49	N/A	166.69 Kips
28.09 ft	Cohesionless	1864.85 psf	31.49	N/A	178.42 Kips
28.11 ft	Cohesionless	2213.56 psf	30.76	N/A	178.66 Kips
34.39 ft	Cohesionless	2441.53 psf	30.76	N/A	262.36 Kips
34.41 ft	Cohesionless	2670.97 psf	30.76	N/A	262.60 Kips
39.39 ft	Cohesionless	2864.19 psf	30.76	N/A	327.23 Kips
39.41 ft	Cohesionless	3058.97 psf	32.96	N/A	327.57 Kips
45.89 ft	Cohesionless	3310.39 psf	32.96	N/A	446.92 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.10 psf	26.40	18.60 Kips	0.02 Kips
5.59 ft	Cohesionless	614.90 psf	26.40	18.60 Kips	12.65 Kips
5.61 ft	Cohesionless	617.32 psf	244.00	827.37 Kips	162.78 Kips
6.09 ft	Cohesionless	680.68 psf	244.00	827.37 Kips	179.49 Kips
6.11 ft	Cohesionless	682.70 psf	244.00	827.37 Kips	180.02 Kips
15.11 ft	Cohesionless	1309.10 psf	244.00	827.37 Kips	345.20 Kips
18.09 ft	Cohesionless	1516.50 psf	244.00	827.37 Kips	399.89 Kips
18.11 ft	Cohesionless	1517.90 psf	307.00	946.11 Kips	510.11 Kips
27.11 ft	Cohesionless	2144.30 psf	307.00	946.11 Kips	720.62 Kips
28.09 ft	Cohesionless	2212.50 psf	307.00	946.11 Kips	743.54 Kips
28.11 ft	Cohesionless	2213.93 psf	244.00	827.37 Kips	583.80 Kips
34.39 ft	Cohesionless	2669.85 psf	244.00	827.37 Kips	704.02 Kips
34.41 ft	Cohesionless	2671.36 psf	244.00	827.37 Kips	704.42 Kips
39.39 ft	Cohesionless	3057.80 psf	244.00	827.37 Kips	806.32 Kips
39.41 ft	Cohesionless	3059.36 psf	475.00	1029.88 Kips	1029.88 Kips
45.89 ft	Cohesionless	3562.20 psf	475.00	1029.88 Kips	1029.88 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.02 Kips	0.02 Kips
5.59 ft	2.21 Kips	12.65 Kips	14.86 Kips
5.61 ft	2.25 Kips	162.78 Kips	165.03 Kips
6.09 ft	3.95 Kips	179.49 Kips	183.44 Kips
6.11 ft	4.03 Kips	180.02 Kips	184.05 Kips
15.11 ft	52.95 Kips	345.20 Kips	398.15 Kips
18.09 ft	75.93 Kips	399.89 Kips	475.82 Kips
18.11 ft	76.09 Kips	510.11 Kips	586.20 Kips
27.11 ft	166.69 Kips	720.62 Kips	887.30 Kips
28.09 ft	178.42 Kips	743.54 Kips	921.96 Kips
28.11 ft	178.66 Kips	583.80 Kips	762.46 Kips
34.39 ft	262.36 Kips	704.02 Kips	966.38 Kips
34.41 ft	262.60 Kips	704.42 Kips	967.02 Kips
39.39 ft	327.23 Kips	806.32 Kips	1133.55 Kips
39.41 ft	327.57 Kips	1029.88 Kips	1357.45 Kips
45.89 ft	446.92 Kips	1029.88 Kips	1476.80 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.55 psf	21.24	N/A	0.00 Kips
5.59 ft	Cohesionless	307.45 psf	21.24	N/A	2.66 Kips
5.61 ft	Cohesionless	616.66 psf	30.76	N/A	2.70 Kips
6.09 ft	Cohesionless	648.34 psf	30.76	N/A	4.40 Kips
6.11 ft	Cohesionless	682.35 psf	30.76	N/A	4.48 Kips
15.11 ft	Cohesionless	995.55 psf	30.76	N/A	53.40 Kips
18.09 ft	Cohesionless	1099.25 psf	30.76	N/A	76.38 Kips
18.11 ft	Cohesionless	1517.55 psf	31.49	N/A	76.54 Kips
27.11 ft	Cohesionless	1830.75 psf	31.49	N/A	167.14 Kips
28.09 ft	Cohesionless	1864.85 psf	31.49	N/A	178.87 Kips
28.11 ft	Cohesionless	2213.56 psf	30.76	N/A	179.12 Kips
34.39 ft	Cohesionless	2441.53 psf	30.76	N/A	262.81 Kips
34.41 ft	Cohesionless	2670.97 psf	30.76	N/A	263.11 Kips
39.39 ft	Cohesionless	2864.19 psf	30.76	N/A	340.97 Kips
39.41 ft	Cohesionless	3058.97 psf	32.96	N/A	341.31 Kips
45.89 ft	Cohesionless	3310.39 psf	32.96	N/A	460.65 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.10 psf	26.40	18.60 Kips	0.02 Kips
5.59 ft	Cohesionless	614.90 psf	26.40	18.60 Kips	12.65 Kips
5.61 ft	Cohesionless	617.32 psf	244.00	827.37 Kips	162.78 Kips
6.09 ft	Cohesionless	680.68 psf	244.00	827.37 Kips	179.49 Kips
6.11 ft	Cohesionless	682.70 psf	244.00	827.37 Kips	180.02 Kips
15.11 ft	Cohesionless	1309.10 psf	244.00	827.37 Kips	345.20 Kips
18.09 ft	Cohesionless	1516.50 psf	244.00	827.37 Kips	399.89 Kips
18.11 ft	Cohesionless	1517.90 psf	307.00	946.11 Kips	510.11 Kips
27.11 ft	Cohesionless	2144.30 psf	307.00	946.11 Kips	720.62 Kips
28.09 ft	Cohesionless	2212.50 psf	307.00	946.11 Kips	743.54 Kips
28.11 ft	Cohesionless	2213.93 psf	244.00	827.37 Kips	583.80 Kips
34.39 ft	Cohesionless	2669.85 psf	244.00	827.37 Kips	704.02 Kips
34.41 ft	Cohesionless	2671.36 psf	244.00	827.37 Kips	704.42 Kips
39.39 ft	Cohesionless	3057.80 psf	244.00	827.37 Kips	806.32 Kips
39.41 ft	Cohesionless	3059.36 psf	475.00	1029.88 Kips	1029.88 Kips
45.89 ft	Cohesionless	3562.20 psf	475.00	1029.88 Kips	1029.88 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.02 Kips	0.02 Kips
5.59 ft	2.66 Kips	12.65 Kips	15.31 Kips
5.61 ft	2.70 Kips	162.78 Kips	165.49 Kips
6.09 ft	4.40 Kips	179.49 Kips	183.89 Kips
6.11 ft	4.48 Kips	180.02 Kips	184.50 Kips
15.11 ft	53.40 Kips	345.20 Kips	398.60 Kips
18.09 ft	76.38 Kips	399.89 Kips	476.27 Kips
18.11 ft	76.54 Kips	510.11 Kips	586.65 Kips
27.11 ft	167.14 Kips	720.62 Kips	887.76 Kips
28.09 ft	178.87 Kips	743.54 Kips	922.41 Kips
28.11 ft	179.12 Kips	583.80 Kips	762.91 Kips
34.39 ft	262.81 Kips	704.02 Kips	966.84 Kips
34.41 ft	263.11 Kips	704.42 Kips	967.52 Kips
39.39 ft	340.97 Kips	806.32 Kips	1147.29 Kips
39.41 ft	341.31 Kips	1029.88 Kips	1371.19 Kips
45.89 ft	460.65 Kips	1029.88 Kips	1490.54 Kips

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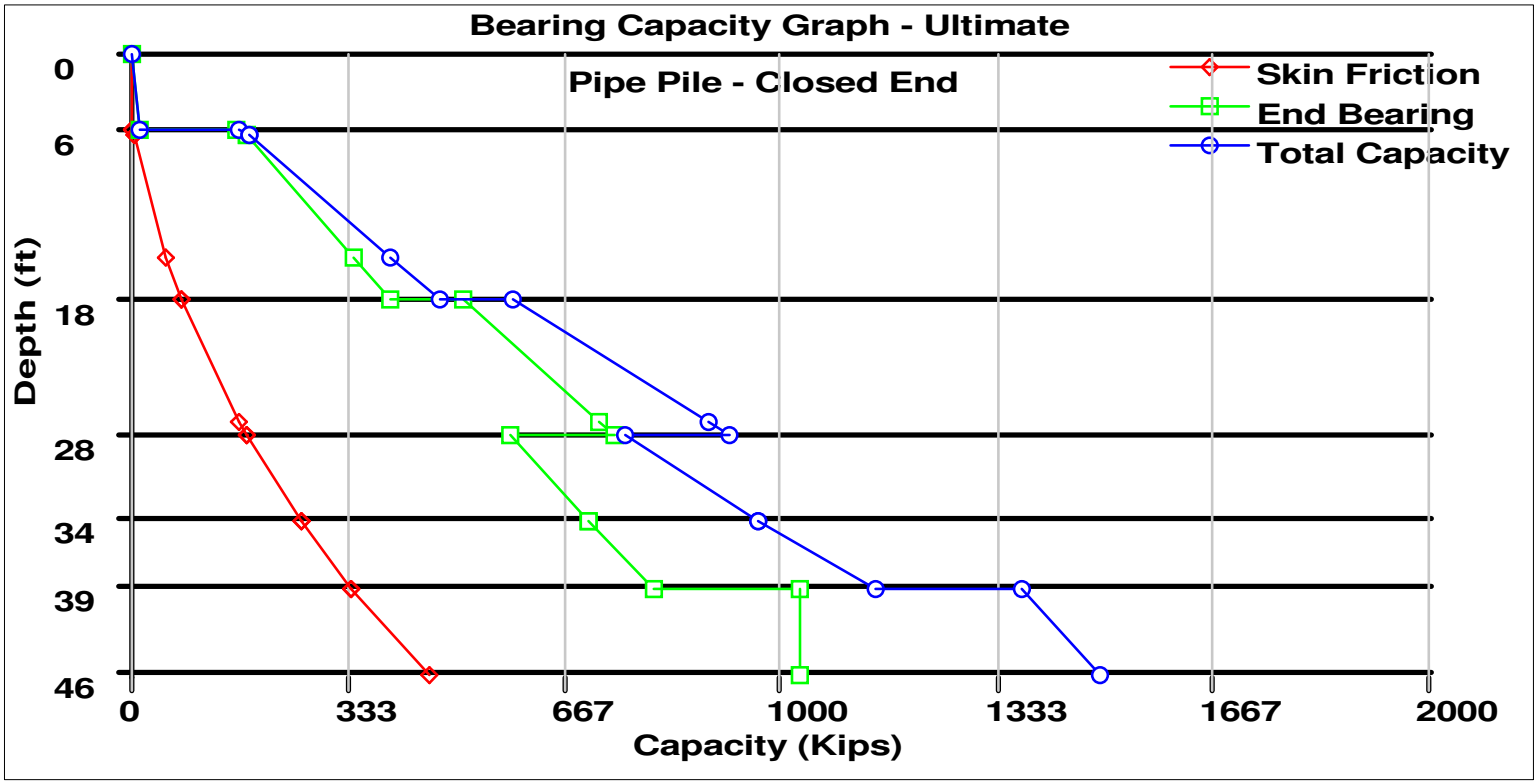

PIER 2

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: C:\DOCUME~1\XPMUSER\DESKTOP\CUY-14~1\UPDATED\P2-1.DVN
Project Name: CUY-14-6.93, PID 104132 Project Date: 01/24/2023
Project Client: AECOM
Computed By: KCA
Project Manager: BPA

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 0.00 ft
Diameter of Pile: 16.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	10.10 ft
	- Driving/Restrike	10.10 ft
	- Ultimate:	10.10 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesionless	3.90 ft	0.00%	110.00 pcf	35.0/35.0	Nordlund
2	Cohesionless	5.70 ft	17.00%	110.00 pcf	29.0/29.0	Nordlund
3	Cohesionless	12.50 ft	0.00%	132.00 pcf	42.0/42.0	Nordlund
4	Cohesionless	10.00 ft	0.00%	132.00 pcf	43.0/43.0	Nordlund
5	Cohesionless	6.30 ft	0.00%	135.00 pcf	42.0/42.0	Nordlund
6	Cohesionless	5.00 ft	17.00%	140.00 pcf	42.0/42.0	Nordlund
7	Cohesionless	6.50 ft	0.00%	140.00 pcf	45.0/45.0	Nordlund

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.55 psf	25.63	N/A	0.00 Kips
3.89 ft	Cohesionless	213.95 psf	25.63	N/A	2.39 Kips
3.91 ft	Cohesionless	429.55 psf	21.24	N/A	2.40 Kips
9.59 ft	Cohesionless	741.95 psf	21.24	N/A	7.82 Kips
9.61 ft	Cohesionless	1056.66 psf	30.76	N/A	7.90 Kips
10.09 ft	Cohesionless	1088.34 psf	30.76	N/A	10.75 Kips
10.11 ft	Cohesionless	1122.35 psf	30.76	N/A	10.87 Kips
19.11 ft	Cohesionless	1435.55 psf	30.76	N/A	81.41 Kips
22.09 ft	Cohesionless	1539.25 psf	30.76	N/A	111.54 Kips
22.11 ft	Cohesionless	1957.55 psf	31.49	N/A	111.76 Kips
31.11 ft	Cohesionless	2270.75 psf	31.49	N/A	224.12 Kips
32.09 ft	Cohesionless	2304.85 psf	31.49	N/A	238.22 Kips
32.11 ft	Cohesionless	2653.56 psf	30.76	N/A	238.52 Kips
38.39 ft	Cohesionless	2881.53 psf	30.76	N/A	337.30 Kips
38.41 ft	Cohesionless	3110.97 psf	30.76	N/A	337.58 Kips
43.39 ft	Cohesionless	3304.19 psf	30.76	N/A	412.13 Kips
43.41 ft	Cohesionless	3498.97 psf	32.96	N/A	412.52 Kips
49.89 ft	Cohesionless	3750.39 psf	32.96	N/A	547.73 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.10 psf	64.00	150.24 Kips	0.07 Kips
3.89 ft	Cohesionless	427.90 psf	64.00	150.24 Kips	26.00 Kips
3.91 ft	Cohesionless	430.10 psf	26.40	18.60 Kips	8.85 Kips
9.59 ft	Cohesionless	1054.90 psf	26.40	18.60 Kips	18.60 Kips
9.61 ft	Cohesionless	1057.32 psf	244.00	827.37 Kips	278.81 Kips
10.09 ft	Cohesionless	1120.68 psf	244.00	827.37 Kips	295.51 Kips
10.11 ft	Cohesionless	1122.70 psf	244.00	827.37 Kips	296.05 Kips
19.11 ft	Cohesionless	1749.10 psf	244.00	827.37 Kips	461.22 Kips
22.09 ft	Cohesionless	1956.50 psf	244.00	827.37 Kips	515.92 Kips
22.11 ft	Cohesionless	1957.90 psf	307.00	946.11 Kips	657.98 Kips
31.11 ft	Cohesionless	2584.30 psf	307.00	946.11 Kips	868.49 Kips
32.09 ft	Cohesionless	2652.50 psf	307.00	946.11 Kips	891.41 Kips
32.11 ft	Cohesionless	2653.93 psf	244.00	827.37 Kips	699.82 Kips
38.39 ft	Cohesionless	3109.85 psf	244.00	827.37 Kips	820.05 Kips
38.41 ft	Cohesionless	3111.36 psf	244.00	827.37 Kips	820.44 Kips
43.39 ft	Cohesionless	3497.80 psf	244.00	827.37 Kips	827.37 Kips
43.41 ft	Cohesionless	3499.36 psf	475.00	1029.88 Kips	1029.88 Kips
49.89 ft	Cohesionless	4002.20 psf	475.00	1029.88 Kips	1029.88 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.07 Kips	0.07 Kips
3.89 ft	2.39 Kips	26.00 Kips	28.39 Kips
3.91 ft	2.40 Kips	8.85 Kips	11.25 Kips
9.59 ft	7.82 Kips	18.60 Kips	26.42 Kips
9.61 ft	7.90 Kips	278.81 Kips	286.70 Kips
10.09 ft	10.75 Kips	295.51 Kips	306.26 Kips
10.11 ft	10.87 Kips	296.05 Kips	306.92 Kips
19.11 ft	81.41 Kips	461.22 Kips	542.63 Kips
22.09 ft	111.54 Kips	515.92 Kips	627.46 Kips
22.11 ft	111.76 Kips	657.98 Kips	769.73 Kips
31.11 ft	224.12 Kips	868.49 Kips	1092.61 Kips
32.09 ft	238.22 Kips	891.41 Kips	1129.63 Kips
32.11 ft	238.52 Kips	699.82 Kips	938.34 Kips
38.39 ft	337.30 Kips	820.05 Kips	1157.34 Kips
38.41 ft	337.58 Kips	820.44 Kips	1158.02 Kips
43.39 ft	412.13 Kips	827.37 Kips	1239.50 Kips
43.41 ft	412.52 Kips	1029.88 Kips	1442.40 Kips
49.89 ft	547.73 Kips	1029.88 Kips	1577.61 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.55 psf	25.63	N/A	0.00 Kips
3.89 ft	Cohesionless	213.95 psf	25.63	N/A	2.39 Kips
3.91 ft	Cohesionless	429.55 psf	21.24	N/A	2.41 Kips
9.59 ft	Cohesionless	741.95 psf	21.24	N/A	8.94 Kips
9.61 ft	Cohesionless	1056.66 psf	30.76	N/A	9.01 Kips
10.09 ft	Cohesionless	1088.34 psf	30.76	N/A	11.86 Kips
10.11 ft	Cohesionless	1122.35 psf	30.76	N/A	11.99 Kips
19.11 ft	Cohesionless	1435.55 psf	30.76	N/A	82.52 Kips
22.09 ft	Cohesionless	1539.25 psf	30.76	N/A	112.66 Kips
22.11 ft	Cohesionless	1957.55 psf	31.49	N/A	112.87 Kips
31.11 ft	Cohesionless	2270.75 psf	31.49	N/A	225.23 Kips
32.09 ft	Cohesionless	2304.85 psf	31.49	N/A	239.34 Kips
32.11 ft	Cohesionless	2653.56 psf	30.76	N/A	239.63 Kips
38.39 ft	Cohesionless	2881.53 psf	30.76	N/A	338.41 Kips
38.41 ft	Cohesionless	3110.97 psf	30.76	N/A	338.75 Kips
43.39 ft	Cohesionless	3304.19 psf	30.76	N/A	428.57 Kips
43.41 ft	Cohesionless	3498.97 psf	32.96	N/A	428.96 Kips
49.89 ft	Cohesionless	3750.39 psf	32.96	N/A	564.17 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.10 psf	64.00	150.24 Kips	0.07 Kips
3.89 ft	Cohesionless	427.90 psf	64.00	150.24 Kips	26.00 Kips
3.91 ft	Cohesionless	430.10 psf	26.40	18.60 Kips	8.85 Kips
9.59 ft	Cohesionless	1054.90 psf	26.40	18.60 Kips	18.60 Kips
9.61 ft	Cohesionless	1057.32 psf	244.00	827.37 Kips	278.81 Kips
10.09 ft	Cohesionless	1120.68 psf	244.00	827.37 Kips	295.51 Kips
10.11 ft	Cohesionless	1122.70 psf	244.00	827.37 Kips	296.05 Kips
19.11 ft	Cohesionless	1749.10 psf	244.00	827.37 Kips	461.22 Kips
22.09 ft	Cohesionless	1956.50 psf	244.00	827.37 Kips	515.92 Kips
22.11 ft	Cohesionless	1957.90 psf	307.00	946.11 Kips	657.98 Kips
31.11 ft	Cohesionless	2584.30 psf	307.00	946.11 Kips	868.49 Kips
32.09 ft	Cohesionless	2652.50 psf	307.00	946.11 Kips	891.41 Kips
32.11 ft	Cohesionless	2653.93 psf	244.00	827.37 Kips	699.82 Kips
38.39 ft	Cohesionless	3109.85 psf	244.00	827.37 Kips	820.05 Kips
38.41 ft	Cohesionless	3111.36 psf	244.00	827.37 Kips	820.44 Kips
43.39 ft	Cohesionless	3497.80 psf	244.00	827.37 Kips	827.37 Kips
43.41 ft	Cohesionless	3499.36 psf	475.00	1029.88 Kips	1029.88 Kips
49.89 ft	Cohesionless	4002.20 psf	475.00	1029.88 Kips	1029.88 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.07 Kips	0.07 Kips
3.89 ft	2.39 Kips	26.00 Kips	28.39 Kips
3.91 ft	2.41 Kips	8.85 Kips	11.25 Kips
9.59 ft	8.94 Kips	18.60 Kips	27.53 Kips
9.61 ft	9.01 Kips	278.81 Kips	287.82 Kips
10.09 ft	11.86 Kips	295.51 Kips	307.38 Kips
10.11 ft	11.99 Kips	296.05 Kips	308.03 Kips
19.11 ft	82.52 Kips	461.22 Kips	543.74 Kips
22.09 ft	112.66 Kips	515.92 Kips	628.57 Kips
22.11 ft	112.87 Kips	657.98 Kips	770.85 Kips
31.11 ft	225.23 Kips	868.49 Kips	1093.72 Kips
32.09 ft	239.34 Kips	891.41 Kips	1130.75 Kips
32.11 ft	239.63 Kips	699.82 Kips	939.45 Kips
38.39 ft	338.41 Kips	820.05 Kips	1158.45 Kips
38.41 ft	338.75 Kips	820.44 Kips	1159.19 Kips
43.39 ft	428.57 Kips	827.37 Kips	1255.94 Kips
43.41 ft	428.96 Kips	1029.88 Kips	1458.84 Kips
49.89 ft	564.17 Kips	1029.88 Kips	1594.05 Kips

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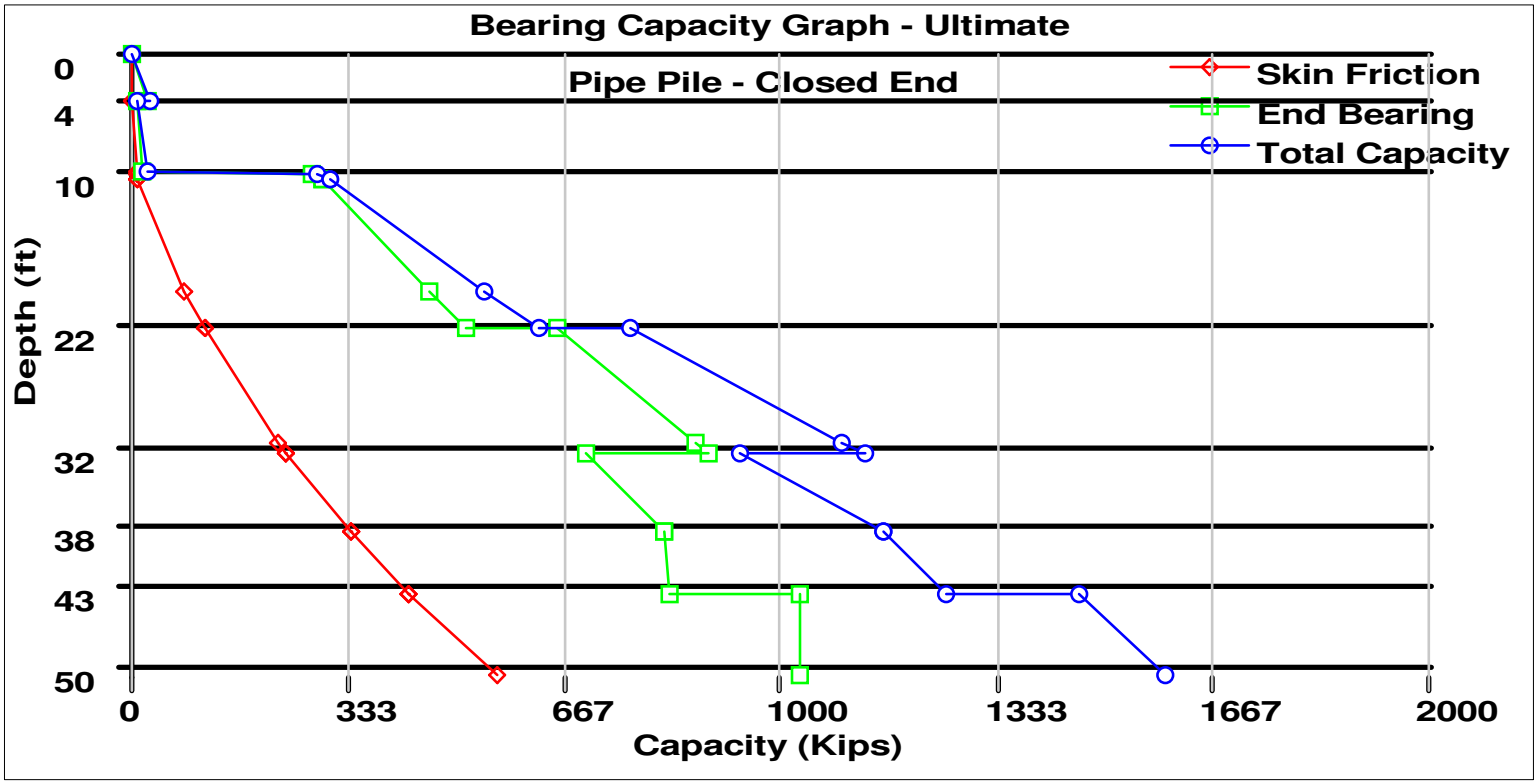

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: C:\DOCUME~1\XPMUSER\DESKTOP\CUY-14~1\UPDATED\P2-2.DVN
Project Name: CUY-14-6.93, PID 104132 Project Date: 01/24/2023
Project Client: AECOM
Computed By: KCA
Project Manager: BPA

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 0.00 ft
Diameter of Pile: 16.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	6.60 ft
	- Driving/Restrike	6.60 ft
	- Ultimate:	6.60 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	0.40 ft	50.00%	108.00 pcf	850.00 psf	T-80 Same
2	Cohesive	5.00 ft	33.00%	105.00 pcf	750.00 psf	T-80 Same
3	Cohesionless	7.50 ft	0.00%	130.00 pcf	42.0/42.0	Nordlund
4	Cohesionless	2.50 ft	0.00%	135.00 pcf	41.0/41.0	Nordlund
5	Cohesionless	28.00 ft	0.00%	135.00 pcf	42.0/42.0	Nordlund

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	802.64 psf	0.02 Kips
0.39 ft	Cohesive	N/A	N/A	802.64 psf	0.66 Kips
0.41 ft	Cohesive	N/A	N/A	715.25 psf	0.70 Kips
5.39 ft	Cohesive	N/A	N/A	715.25 psf	10.69 Kips
5.41 ft	Cohesionless	568.85 psf	30.76	N/A	10.76 Kips
6.59 ft	Cohesionless	645.55 psf	30.76	N/A	14.92 Kips
6.61 ft	Cohesionless	724.54 psf	30.76	N/A	15.00 Kips
12.89 ft	Cohesionless	936.80 psf	30.76	N/A	47.12 Kips
12.91 ft	Cohesionless	1150.44 psf	30.03	N/A	47.24 Kips
15.39 ft	Cohesionless	1240.47 psf	30.03	N/A	63.88 Kips
15.41 ft	Cohesionless	1331.94 psf	30.76	N/A	64.03 Kips
24.41 ft	Cohesionless	1658.64 psf	30.76	N/A	145.52 Kips
33.41 ft	Cohesionless	1985.34 psf	30.76	N/A	259.11 Kips
42.41 ft	Cohesionless	2312.04 psf	30.76	N/A	404.80 Kips
43.39 ft	Cohesionless	2347.62 psf	30.76	N/A	422.60 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	10.68 Kips
0.39 ft	Cohesive	N/A	N/A	N/A	10.68 Kips
0.41 ft	Cohesive	N/A	N/A	N/A	9.42 Kips
5.39 ft	Cohesive	N/A	N/A	N/A	9.42 Kips
5.41 ft	Cohesionless	569.50 psf	244.00	827.37 Kips	150.17 Kips
6.59 ft	Cohesionless	722.90 psf	244.00	827.37 Kips	190.62 Kips
6.61 ft	Cohesionless	724.88 psf	244.00	827.37 Kips	191.14 Kips
12.89 ft	Cohesionless	1149.40 psf	244.00	827.37 Kips	303.09 Kips
12.91 ft	Cohesionless	1150.81 psf	202.00	703.05 Kips	247.33 Kips
15.39 ft	Cohesionless	1330.85 psf	202.00	703.05 Kips	286.02 Kips
15.41 ft	Cohesionless	1332.31 psf	244.00	827.37 Kips	351.32 Kips
24.41 ft	Cohesionless	1985.71 psf	244.00	827.37 Kips	523.62 Kips
33.41 ft	Cohesionless	2639.11 psf	244.00	827.37 Kips	695.91 Kips
42.41 ft	Cohesionless	3292.51 psf	244.00	827.37 Kips	827.37 Kips
43.39 ft	Cohesionless	3363.65 psf	244.00	827.37 Kips	827.37 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.02 Kips	10.68 Kips	10.70 Kips
0.39 ft	0.66 Kips	10.68 Kips	11.34 Kips
0.41 ft	0.70 Kips	9.42 Kips	10.12 Kips
5.39 ft	10.69 Kips	9.42 Kips	20.12 Kips
5.41 ft	10.76 Kips	150.17 Kips	160.93 Kips
6.59 ft	14.92 Kips	190.62 Kips	205.54 Kips
6.61 ft	15.00 Kips	191.14 Kips	206.14 Kips
12.89 ft	47.12 Kips	303.09 Kips	350.21 Kips
12.91 ft	47.24 Kips	247.33 Kips	294.57 Kips
15.39 ft	63.88 Kips	286.02 Kips	349.91 Kips
15.41 ft	64.03 Kips	351.32 Kips	415.35 Kips
24.41 ft	145.52 Kips	523.62 Kips	669.14 Kips
33.41 ft	259.11 Kips	695.91 Kips	955.03 Kips
42.41 ft	404.80 Kips	827.37 Kips	1232.17 Kips
43.39 ft	422.60 Kips	827.37 Kips	1249.97 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	802.64 psf	0.03 Kips
0.39 ft	Cohesive	N/A	N/A	802.64 psf	1.31 Kips
0.41 ft	Cohesive	N/A	N/A	715.25 psf	1.37 Kips
5.39 ft	Cohesive	N/A	N/A	715.25 psf	16.30 Kips
5.41 ft	Cohesionless	568.85 psf	30.76	N/A	16.36 Kips
6.59 ft	Cohesionless	645.55 psf	30.76	N/A	20.52 Kips
6.61 ft	Cohesionless	724.54 psf	30.76	N/A	20.60 Kips
12.89 ft	Cohesionless	936.80 psf	30.76	N/A	52.72 Kips
12.91 ft	Cohesionless	1150.44 psf	30.03	N/A	52.84 Kips
15.39 ft	Cohesionless	1240.47 psf	30.03	N/A	69.48 Kips
15.41 ft	Cohesionless	1331.94 psf	30.76	N/A	69.63 Kips
24.41 ft	Cohesionless	1658.64 psf	30.76	N/A	151.12 Kips
33.41 ft	Cohesionless	1985.34 psf	30.76	N/A	264.71 Kips
42.41 ft	Cohesionless	2312.04 psf	30.76	N/A	410.40 Kips
43.39 ft	Cohesionless	2347.62 psf	30.76	N/A	428.20 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	10.68 Kips
0.39 ft	Cohesive	N/A	N/A	N/A	10.68 Kips
0.41 ft	Cohesive	N/A	N/A	N/A	9.42 Kips
5.39 ft	Cohesive	N/A	N/A	N/A	9.42 Kips
5.41 ft	Cohesionless	569.50 psf	244.00	827.37 Kips	150.17 Kips
6.59 ft	Cohesionless	722.90 psf	244.00	827.37 Kips	190.62 Kips
6.61 ft	Cohesionless	724.88 psf	244.00	827.37 Kips	191.14 Kips
12.89 ft	Cohesionless	1149.40 psf	244.00	827.37 Kips	303.09 Kips
12.91 ft	Cohesionless	1150.81 psf	202.00	703.05 Kips	247.33 Kips
15.39 ft	Cohesionless	1330.85 psf	202.00	703.05 Kips	286.02 Kips
15.41 ft	Cohesionless	1332.31 psf	244.00	827.37 Kips	351.32 Kips
24.41 ft	Cohesionless	1985.71 psf	244.00	827.37 Kips	523.62 Kips
33.41 ft	Cohesionless	2639.11 psf	244.00	827.37 Kips	695.91 Kips
42.41 ft	Cohesionless	3292.51 psf	244.00	827.37 Kips	827.37 Kips
43.39 ft	Cohesionless	3363.65 psf	244.00	827.37 Kips	827.37 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.03 Kips	10.68 Kips	10.72 Kips
0.39 ft	1.31 Kips	10.68 Kips	11.99 Kips
0.41 ft	1.37 Kips	9.42 Kips	10.80 Kips
5.39 ft	16.30 Kips	9.42 Kips	25.72 Kips
5.41 ft	16.36 Kips	150.17 Kips	166.53 Kips
6.59 ft	20.52 Kips	190.62 Kips	211.14 Kips
6.61 ft	20.60 Kips	191.14 Kips	211.74 Kips
12.89 ft	52.72 Kips	303.09 Kips	355.81 Kips
12.91 ft	52.84 Kips	247.33 Kips	300.17 Kips
15.39 ft	69.48 Kips	286.02 Kips	355.51 Kips
15.41 ft	69.63 Kips	351.32 Kips	420.95 Kips
24.41 ft	151.12 Kips	523.62 Kips	674.74 Kips
33.41 ft	264.71 Kips	695.91 Kips	960.63 Kips
42.41 ft	410.40 Kips	827.37 Kips	1237.77 Kips
43.39 ft	428.20 Kips	827.37 Kips	1255.57 Kips

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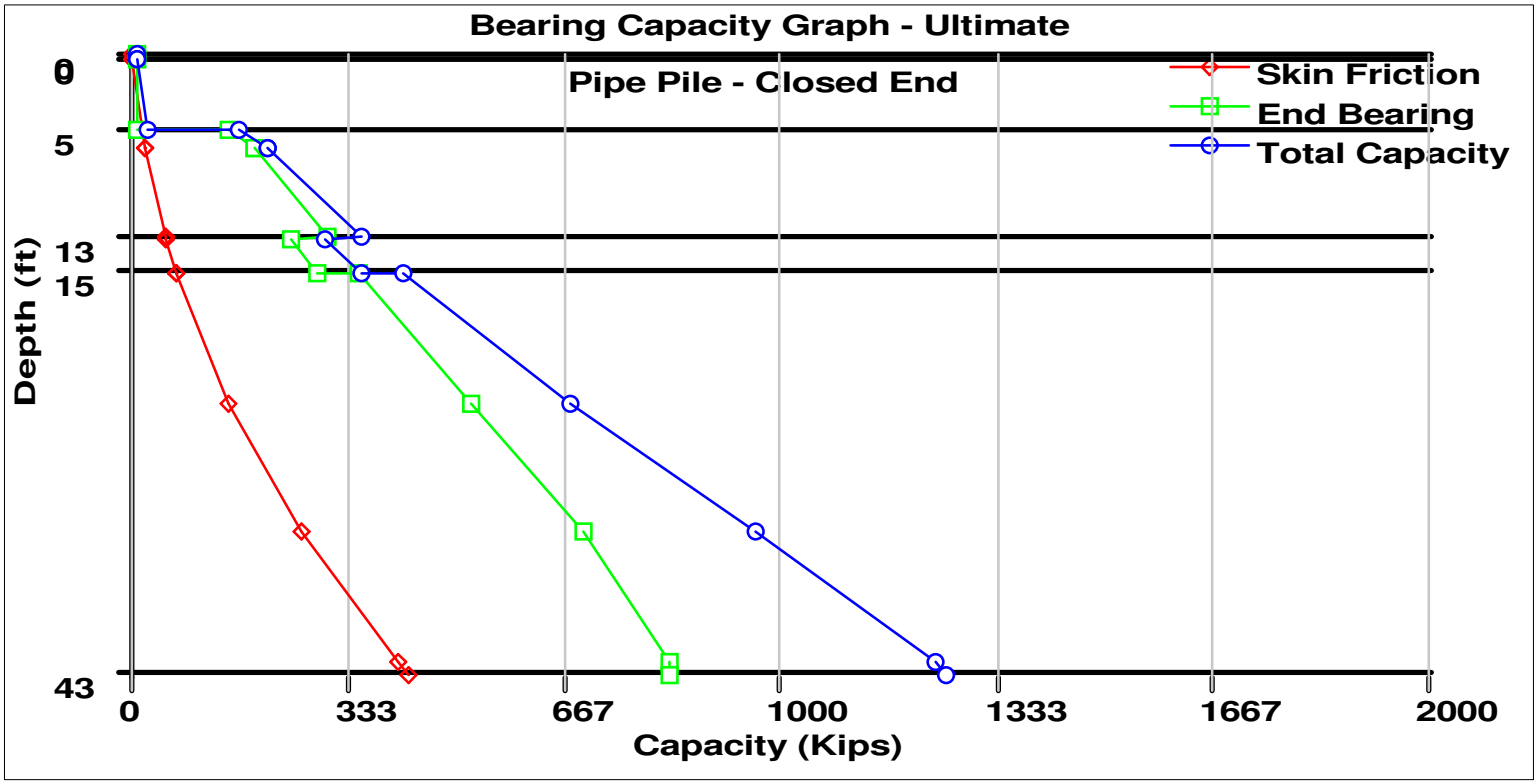

FORWARD ABUTMENT

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: C:\DOCUME~1\XPMUSER\DESKTOP\CUY-14~1\UPDATED\FA1.DVN
Project Name: CUY-14-6.93, PID 104132 Project Date: 01/24/2023
Project Client: AECOM
Computed By: KCA
Project Manager: BPA

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 0.00 ft
Diameter of Pile: 16.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	7.60 ft
	- Driving/Restrike	7.60 ft
	- Ultimate:	7.60 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	1.40 ft	50.00%	108.00 pcf	850.00 psf	T-80 Same
2	Cohesive	5.00 ft	33.00%	105.00 pcf	750.00 psf	T-80 Same
3	Cohesionless	7.50 ft	0.00%	130.00 pcf	42.0/42.0	Nordlund
4	Cohesionless	2.50 ft	0.00%	135.00 pcf	41.0/41.0	Nordlund
5	Cohesionless	28.00 ft	0.00%	135.00 pcf	42.0/42.0	Nordlund

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	802.64 psf	0.02 Kips
1.39 ft	Cohesive	N/A	N/A	802.64 psf	2.34 Kips
1.41 ft	Cohesive	N/A	N/A	715.25 psf	2.38 Kips
6.39 ft	Cohesive	N/A	N/A	715.25 psf	12.38 Kips
6.41 ft	Cohesionless	676.85 psf	30.76	N/A	12.44 Kips
7.59 ft	Cohesionless	753.55 psf	30.76	N/A	17.30 Kips
7.61 ft	Cohesionless	832.54 psf	30.76	N/A	17.39 Kips
13.89 ft	Cohesionless	1044.80 psf	30.76	N/A	53.21 Kips
13.91 ft	Cohesionless	1258.44 psf	30.03	N/A	53.35 Kips
16.39 ft	Cohesionless	1348.47 psf	30.03	N/A	71.44 Kips
16.41 ft	Cohesionless	1439.94 psf	30.76	N/A	71.60 Kips
25.41 ft	Cohesionless	1766.64 psf	30.76	N/A	158.40 Kips
34.41 ft	Cohesionless	2093.34 psf	30.76	N/A	277.29 Kips
43.41 ft	Cohesionless	2420.04 psf	30.76	N/A	428.28 Kips
44.39 ft	Cohesionless	2455.62 psf	30.76	N/A	446.66 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	10.68 Kips
1.39 ft	Cohesive	N/A	N/A	N/A	10.68 Kips
1.41 ft	Cohesive	N/A	N/A	N/A	9.42 Kips
6.39 ft	Cohesive	N/A	N/A	N/A	9.42 Kips
6.41 ft	Cohesionless	677.50 psf	244.00	827.37 Kips	178.65 Kips
7.59 ft	Cohesionless	830.90 psf	244.00	827.37 Kips	219.10 Kips
7.61 ft	Cohesionless	832.88 psf	244.00	827.37 Kips	219.62 Kips
13.89 ft	Cohesionless	1257.40 psf	244.00	827.37 Kips	331.57 Kips
13.91 ft	Cohesionless	1258.81 psf	202.00	703.05 Kips	270.54 Kips
16.39 ft	Cohesionless	1438.85 psf	202.00	703.05 Kips	309.24 Kips
16.41 ft	Cohesionless	1440.31 psf	244.00	827.37 Kips	379.80 Kips
25.41 ft	Cohesionless	2093.71 psf	244.00	827.37 Kips	552.09 Kips
34.41 ft	Cohesionless	2747.11 psf	244.00	827.37 Kips	724.39 Kips
43.41 ft	Cohesionless	3400.51 psf	244.00	827.37 Kips	827.37 Kips
44.39 ft	Cohesionless	3471.65 psf	244.00	827.37 Kips	827.37 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.02 Kips	10.68 Kips	10.70 Kips
1.39 ft	2.34 Kips	10.68 Kips	13.02 Kips
1.41 ft	2.38 Kips	9.42 Kips	11.80 Kips
6.39 ft	12.38 Kips	9.42 Kips	21.80 Kips
6.41 ft	12.44 Kips	178.65 Kips	191.09 Kips
7.59 ft	17.30 Kips	219.10 Kips	236.40 Kips
7.61 ft	17.39 Kips	219.62 Kips	237.01 Kips
13.89 ft	53.21 Kips	331.57 Kips	384.78 Kips
13.91 ft	53.35 Kips	270.54 Kips	323.89 Kips
16.39 ft	71.44 Kips	309.24 Kips	380.68 Kips
16.41 ft	71.60 Kips	379.80 Kips	451.39 Kips
25.41 ft	158.40 Kips	552.09 Kips	710.49 Kips
34.41 ft	277.29 Kips	724.39 Kips	1001.68 Kips
43.41 ft	428.28 Kips	827.37 Kips	1255.65 Kips
44.39 ft	446.66 Kips	827.37 Kips	1274.03 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	802.64 psf	0.03 Kips
1.39 ft	Cohesive	N/A	N/A	802.64 psf	4.67 Kips
1.41 ft	Cohesive	N/A	N/A	715.25 psf	4.74 Kips
6.39 ft	Cohesive	N/A	N/A	715.25 psf	19.66 Kips
6.41 ft	Cohesionless	676.85 psf	30.76	N/A	19.72 Kips
7.59 ft	Cohesionless	753.55 psf	30.76	N/A	24.58 Kips
7.61 ft	Cohesionless	832.54 psf	30.76	N/A	24.67 Kips
13.89 ft	Cohesionless	1044.80 psf	30.76	N/A	60.50 Kips
13.91 ft	Cohesionless	1258.44 psf	30.03	N/A	60.63 Kips
16.39 ft	Cohesionless	1348.47 psf	30.03	N/A	78.72 Kips
16.41 ft	Cohesionless	1439.94 psf	30.76	N/A	78.88 Kips
25.41 ft	Cohesionless	1766.64 psf	30.76	N/A	165.68 Kips
34.41 ft	Cohesionless	2093.34 psf	30.76	N/A	284.57 Kips
43.41 ft	Cohesionless	2420.04 psf	30.76	N/A	435.56 Kips
44.39 ft	Cohesionless	2455.62 psf	30.76	N/A	453.94 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	10.68 Kips
1.39 ft	Cohesive	N/A	N/A	N/A	10.68 Kips
1.41 ft	Cohesive	N/A	N/A	N/A	9.42 Kips
6.39 ft	Cohesive	N/A	N/A	N/A	9.42 Kips
6.41 ft	Cohesionless	677.50 psf	244.00	827.37 Kips	178.65 Kips
7.59 ft	Cohesionless	830.90 psf	244.00	827.37 Kips	219.10 Kips
7.61 ft	Cohesionless	832.88 psf	244.00	827.37 Kips	219.62 Kips
13.89 ft	Cohesionless	1257.40 psf	244.00	827.37 Kips	331.57 Kips
13.91 ft	Cohesionless	1258.81 psf	202.00	703.05 Kips	270.54 Kips
16.39 ft	Cohesionless	1438.85 psf	202.00	703.05 Kips	309.24 Kips
16.41 ft	Cohesionless	1440.31 psf	244.00	827.37 Kips	379.80 Kips
25.41 ft	Cohesionless	2093.71 psf	244.00	827.37 Kips	552.09 Kips
34.41 ft	Cohesionless	2747.11 psf	244.00	827.37 Kips	724.39 Kips
43.41 ft	Cohesionless	3400.51 psf	244.00	827.37 Kips	827.37 Kips
44.39 ft	Cohesionless	3471.65 psf	244.00	827.37 Kips	827.37 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.03 Kips	10.68 Kips	10.72 Kips
1.39 ft	4.67 Kips	10.68 Kips	15.35 Kips
1.41 ft	4.74 Kips	9.42 Kips	14.16 Kips
6.39 ft	19.66 Kips	9.42 Kips	29.08 Kips
6.41 ft	19.72 Kips	178.65 Kips	198.38 Kips
7.59 ft	24.58 Kips	219.10 Kips	243.68 Kips
7.61 ft	24.67 Kips	219.62 Kips	244.30 Kips
13.89 ft	60.50 Kips	331.57 Kips	392.06 Kips
13.91 ft	60.63 Kips	270.54 Kips	331.17 Kips
16.39 ft	78.72 Kips	309.24 Kips	387.96 Kips
16.41 ft	78.88 Kips	379.80 Kips	458.68 Kips
25.41 ft	165.68 Kips	552.09 Kips	717.77 Kips
34.41 ft	284.57 Kips	724.39 Kips	1008.96 Kips
43.41 ft	435.56 Kips	827.37 Kips	1262.93 Kips
44.39 ft	453.94 Kips	827.37 Kips	1281.31 Kips

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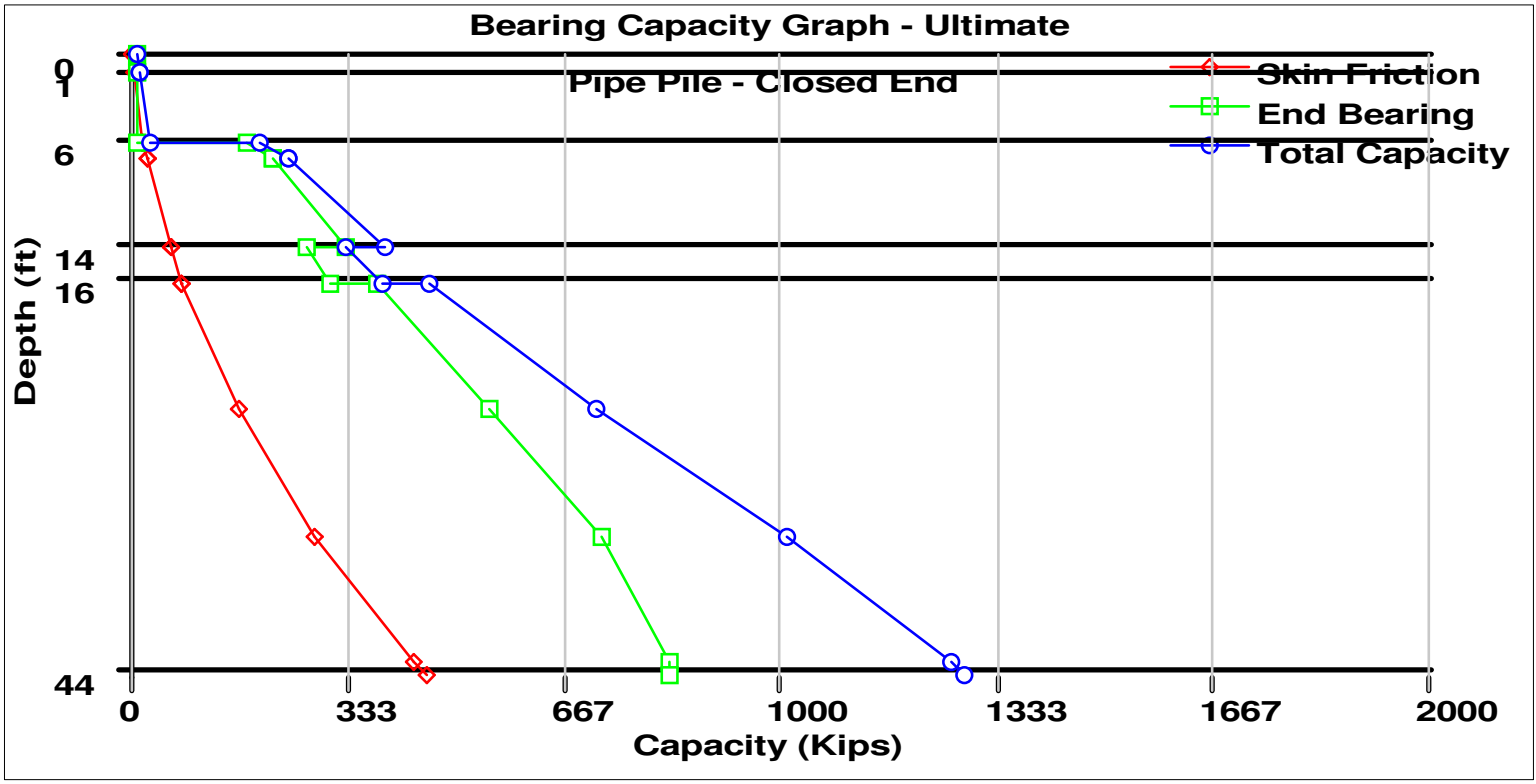


DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: C:\DOCUME~1\XPMUSER\DESKTOP\CUY-14~1\UPDATED\FA2.DVN
Project Name: CUY-14-6.93, PID 104132 Project Date: 01/24/2023
Project Client: AECOM
Computed By: KCA
Project Manager: BPA

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 0.00 ft
Diameter of Pile: 16.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	7.60 ft
	- Driving/Restrike	7.60 ft
	- Ultimate:	7.60 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesionless	2.00 ft	0.00%	128.00 pcf	39.0/39.0	Nordlund
2	Cohesionless	50.50 ft	0.00%	140.00 pcf	44.0/44.0	Nordlund

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.64 psf	28.56	N/A	0.00 Kips
1.99 ft	Cohesionless	127.36 psf	28.56	N/A	1.23 Kips
2.01 ft	Cohesionless	256.70 psf	32.23	N/A	1.25 Kips
7.59 ft	Cohesionless	647.30 psf	32.23	N/A	21.26 Kips
7.61 ft	Cohesionless	1040.39 psf	32.23	N/A	21.37 Kips
16.61 ft	Cohesionless	1389.59 psf	32.23	N/A	90.58 Kips
25.61 ft	Cohesionless	1738.79 psf	32.23	N/A	194.56 Kips
34.61 ft	Cohesionless	2087.99 psf	32.23	N/A	333.31 Kips
43.61 ft	Cohesionless	2437.19 psf	32.23	N/A	506.84 Kips
52.49 ft	Cohesionless	2781.73 psf	32.23	N/A	712.13 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.28 psf	135.20	472.94 Kips	0.18 Kips
1.99 ft	Cohesionless	254.72 psf	135.20	472.94 Kips	35.39 Kips
2.01 ft	Cohesionless	257.40 psf	391.00	1029.88 Kips	111.30 Kips
7.59 ft	Cohesionless	1038.60 psf	391.00	1029.88 Kips	449.07 Kips
7.61 ft	Cohesionless	1040.78 psf	391.00	1029.88 Kips	450.01 Kips
16.61 ft	Cohesionless	1739.18 psf	391.00	1029.88 Kips	751.99 Kips
25.61 ft	Cohesionless	2437.58 psf	391.00	1029.88 Kips	1029.88 Kips
34.61 ft	Cohesionless	3135.98 psf	391.00	1029.88 Kips	1029.88 Kips
43.61 ft	Cohesionless	3834.38 psf	391.00	1029.88 Kips	1029.88 Kips
52.49 ft	Cohesionless	4523.46 psf	391.00	1029.88 Kips	1029.88 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.18 Kips	0.18 Kips
1.99 ft	1.23 Kips	35.39 Kips	36.62 Kips
2.01 ft	1.25 Kips	111.30 Kips	112.55 Kips
7.59 ft	21.26 Kips	449.07 Kips	470.33 Kips
7.61 ft	21.37 Kips	450.01 Kips	471.39 Kips
16.61 ft	90.58 Kips	751.99 Kips	842.57 Kips
25.61 ft	194.56 Kips	1029.88 Kips	1224.44 Kips
34.61 ft	333.31 Kips	1029.88 Kips	1363.19 Kips
43.61 ft	506.84 Kips	1029.88 Kips	1536.72 Kips
52.49 ft	712.13 Kips	1029.88 Kips	1742.01 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.64 psf	28.56	N/A	0.00 Kips
1.99 ft	Cohesionless	127.36 psf	28.56	N/A	1.23 Kips
2.01 ft	Cohesionless	256.70 psf	32.23	N/A	1.25 Kips
7.59 ft	Cohesionless	647.30 psf	32.23	N/A	21.26 Kips
7.61 ft	Cohesionless	1040.39 psf	32.23	N/A	21.37 Kips
16.61 ft	Cohesionless	1389.59 psf	32.23	N/A	90.58 Kips
25.61 ft	Cohesionless	1738.79 psf	32.23	N/A	194.56 Kips
34.61 ft	Cohesionless	2087.99 psf	32.23	N/A	333.31 Kips
43.61 ft	Cohesionless	2437.19 psf	32.23	N/A	506.84 Kips
52.49 ft	Cohesionless	2781.73 psf	32.23	N/A	712.13 Kips

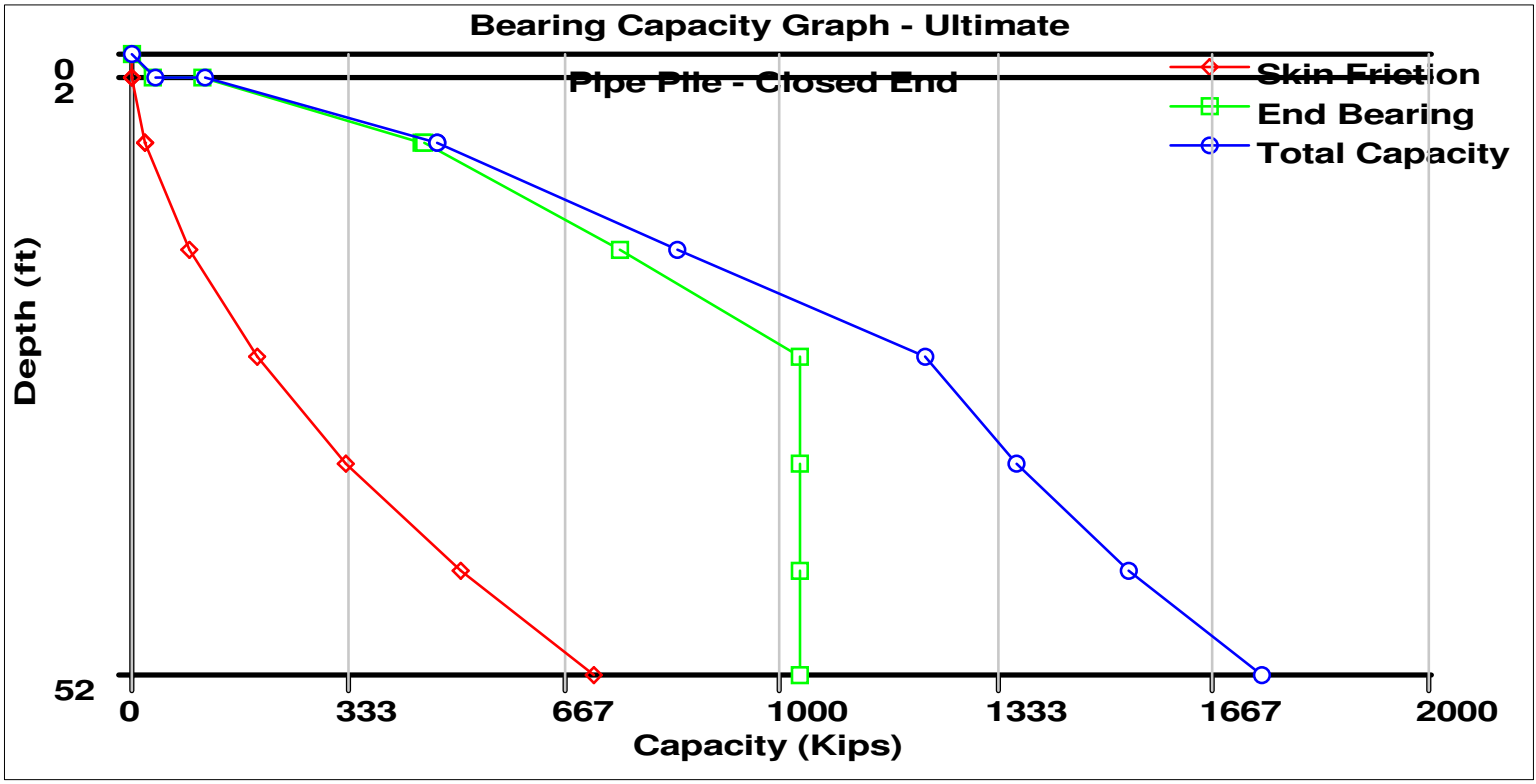
ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.28 psf	135.20	472.94 Kips	0.18 Kips
1.99 ft	Cohesionless	254.72 psf	135.20	472.94 Kips	35.39 Kips
2.01 ft	Cohesionless	257.40 psf	391.00	1029.88 Kips	111.30 Kips
7.59 ft	Cohesionless	1038.60 psf	391.00	1029.88 Kips	449.07 Kips
7.61 ft	Cohesionless	1040.78 psf	391.00	1029.88 Kips	450.01 Kips
16.61 ft	Cohesionless	1739.18 psf	391.00	1029.88 Kips	751.99 Kips
25.61 ft	Cohesionless	2437.58 psf	391.00	1029.88 Kips	1029.88 Kips
34.61 ft	Cohesionless	3135.98 psf	391.00	1029.88 Kips	1029.88 Kips
43.61 ft	Cohesionless	3834.38 psf	391.00	1029.88 Kips	1029.88 Kips
52.49 ft	Cohesionless	4523.46 psf	391.00	1029.88 Kips	1029.88 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.18 Kips	0.18 Kips
1.99 ft	1.23 Kips	35.39 Kips	36.62 Kips
2.01 ft	1.25 Kips	111.30 Kips	112.55 Kips
7.59 ft	21.26 Kips	449.07 Kips	470.33 Kips
7.61 ft	21.37 Kips	450.01 Kips	471.39 Kips
16.61 ft	90.58 Kips	751.99 Kips	842.57 Kips
25.61 ft	194.56 Kips	1029.88 Kips	1224.44 Kips
34.61 ft	333.31 Kips	1029.88 Kips	1363.19 Kips
43.61 ft	506.84 Kips	1029.88 Kips	1536.72 Kips
52.49 ft	712.13 Kips	1029.88 Kips	1742.01 Kips

Filename: C:\DOCUME~1\XPMUSER\DESKTOP\CUY-14~1\UPDATED\FA2.DVN



APPENDIX D

DRIVABILITY ANALYSIS

REAR ABUTMENT

Gain/Loss 3 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.8	29.4	1.8	27.6	2.3	11.627	-0.252	4.83	24.2
11.6	58.6	14.0	44.6	5.0	14.094	-0.041	5.54	21.3
11.6	571.9	14.1	557.7	190.5	39.408	-2.401	10.81	22.0
14.1	689.8	30.0	659.8	405.5	42.016	-2.936	11.19	22.8
16.6	810.4	48.5	761.9	1569.9	43.117	-3.551	11.56	23.5
16.6	208.9	48.8	160.1	25.4	19.887	-1.478	7.65	17.4
17.9	226.1	56.7	169.4	28.0	20.738	-1.669	7.78	17.3
19.1	243.7	65.0	178.7	30.8	21.552	-1.754	7.91	17.4
19.1	489.4	65.3	424.0	124.3	34.470	-4.669	9.96	20.2
21.6	557.8	88.3	469.5	175.3	35.333	-5.518	10.28	20.8
24.1	628.6	113.6	515.0	264.6	35.619	-6.164	10.51	21.3
24.1	441.7	114.0	327.7	88.2	29.879	-5.484	9.44	19.0
25.4	469.9	127.2	342.7	103.7	30.308	-6.086	9.64	19.5
26.6	498.6	140.9	357.7	121.7	30.691	-6.630	9.80	19.8
26.6	1171.3	141.4	1029.9	9999.0	39.619	-6.115	11.21	22.6
31.0	1227.5	197.6	1029.9	9999.0	37.120	-7.308	11.05	22.1
35.4	1292.0	262.2	1029.9	9999.0	34.389	-7.518	10.81	21.5
35.4	1292.7	262.8	1029.9	9999.0	34.373	-7.521	10.81	21.5
43.4	1431.5	401.6	1029.9	9999.0	30.148	-6.201	10.58	20.4
51.5	1598.7	568.8	1029.9	9999.0	28.574	-3.774	10.30	18.8

Refusal occurred; no driving time output possible

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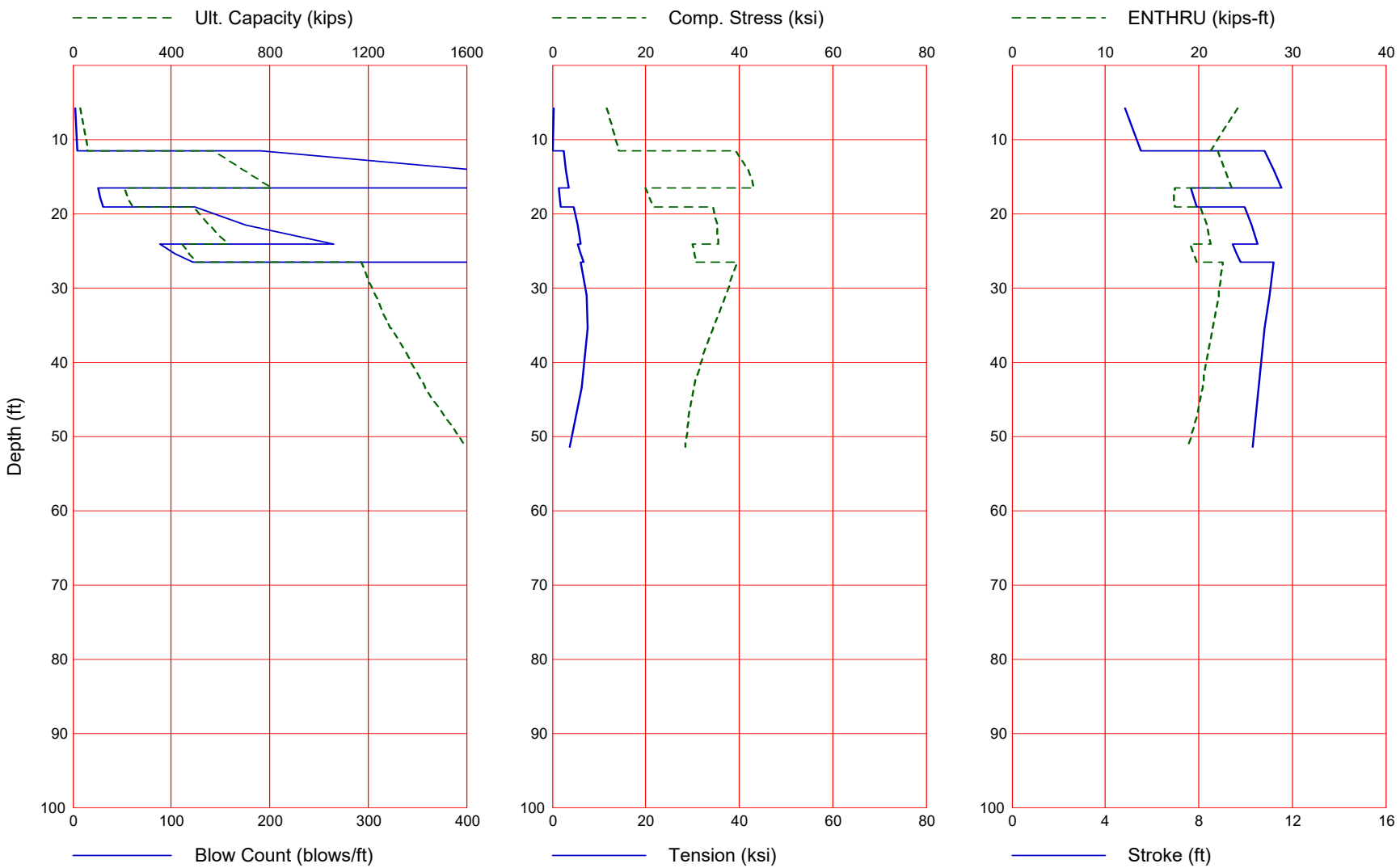
CUY-14-6.93, PID 104132 : 00/00/0000 : K

Jan 25 2023
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 1.000 / 1.000



GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

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 building and other factors.

Input File: C:\USERS\KARENS\DESKTOP\GRL FILES\RA16IN1.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

CUY-14-6.93, PID 104132 : 00/00/0000 : K

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	144.000	16.000	Unknown

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
2.500	22.450	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
51.480	22.46	30000.0	492.000	4.190	0	0.850	0.010

FFatigue	F0	0-Bottom
0	0.000	0.000

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.0020	0.0020	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1600.00	1440.00	1295.00	1165.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1600.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Research Toe Plug: Res-int, Q-int, D-int, Res-plug, Q-plug, D-plug

0.000	0.000	0.000	0.000	0.000	0.000

Research Toe Plug: RD plug toe: m, d

0.000	0.000

Research Toe Plug: New Toe Plug Model is NOT applied

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimL	TSf0
0.01	0.00	0.00	0.10	0.20	0.05	0.15	1.00	6.00	1.000
4.49	0.00	0.00	0.10	0.20	0.05	0.15	1.00	6.00	1.000
4.50	0.29	21.44	0.10	0.20	0.05	0.15	1.00	6.00	1.000
7.59	0.48	36.17	0.10	0.20	0.05	0.15	1.00	6.00	1.000
7.61	0.48	36.24	0.10	0.20	0.05	0.15	1.00	6.00	1.000
11.59	0.60	44.64	0.10	0.20	0.05	0.15	1.00	6.00	1.000
11.61	1.39	557.31	0.10	0.13	0.05	0.15	1.00	6.00	1.000
16.59	1.91	762.35	0.10	0.13	0.05	0.15	1.00	6.00	1.000
16.61	1.49	160.07	0.10	0.15	0.05	0.15	1.00	6.00	1.000
19.09	1.67	178.73	0.10	0.15	0.05	0.15	1.00	6.00	1.000

19.11	2.09	423.83	0.10	0.13	0.05	0.15	1.00	6.00	1.000
24.09	2.55	515.23	0.10	0.13	0.05	0.15	1.00	6.00	1.000
24.11	2.50	327.62	0.10	0.13	0.05	0.15	1.00	6.00	1.000
26.59	2.73	357.79	0.10	0.13	0.05	0.15	1.00	6.00	1.000
26.61	2.84	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000
35.39	3.74	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000
35.41	3.72	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000
44.41	4.65	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000
51.48	5.37	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000

Gain/Loss factors: shaft and toe

1.00000	1.00000	1.00000	1.00000	1.00000
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
5.80	0.00	0.00	0.000	0.0	0.000	0.000	0.000
11.58	0.00	0.00	0.000	0.0	0.000	0.000	0.000
11.62	0.00	0.00	0.000	0.0	0.000	0.000	0.000
14.10	0.00	0.00	0.000	0.0	0.000	0.000	0.000
16.58	0.00	0.00	0.000	0.0	0.000	0.000	0.000
16.62	0.00	0.00	0.000	0.0	0.000	0.000	0.000
17.85	0.00	0.00	0.000	0.0	0.000	0.000	0.000
19.08	0.00	0.00	0.000	0.0	0.000	0.000	0.000
19.12	0.00	0.00	0.000	0.0	0.000	0.000	0.000
21.60	0.00	0.00	0.000	0.0	0.000	0.000	0.000
24.08	0.00	0.00	0.000	0.0	0.000	0.000	0.000
24.12	0.00	0.00	0.000	0.0	0.000	0.000	0.000
25.35	0.00	0.00	0.000	0.0	0.000	0.000	0.000
26.58	0.00	0.00	0.000	0.0	0.000	0.000	0.000
26.62	0.00	0.00	0.000	0.0	0.000	0.000	0.000
31.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
35.38	0.00	0.00	0.000	0.0	0.000	0.000	0.000
35.42	0.00	0.00	0.000	0.0	0.000	0.000	0.000
43.43	0.00	0.00	0.000	0.0	0.000	0.000	0.000
51.48	0.00	0.00	0.000	0.0	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

CUY-14-6.93, PID 104132 : 00/00/0000 : K

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.6	1.000	0.0000	
3	0.800	140046.6	1.000	0.0000	
4	0.800	140046.6	1.000	0.0000	
5	0.800	140046.6	1.000	0.0000	

Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	2.500	5949.2	0.800	0.0100	5.8
Combined Pile Top		16360.7			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1600.00	Actual Pressure	(psi)	1600.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	22.45	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	5949.2	Stiffness	(kips/in)	0.0

Depth	(ft)	5.8	Standard Soil Setup
Shaft Gain/Loss Factor		1.000	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	144.000	Pile Type		Unknown
Pile Size	(inch)	16.000			

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model Total Capacity Rut (kips) 29.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	1.8	0.050	0.100	51.48	4.2	22.5
Toe						27.6	0.150	0.199			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile		Pile Segments: Automatic	
No. of Slacks/Splices	0	Pile Damping (%)	1
		Pile Damping Fact.(k/ft/s)	0.802
Driveability Analysis			
Soil Damping Option	Smith		
Max No Analysis Iterations	0	Time Increment/Critical	160
Output Time Interval	1	Analysis Time-Input (ms)	0
Output Level: Normal			
Gravity Mass, Pile, Hammer:	32.170	32.170	32.170
Output Segment Generation: Automatic			

Depth ft	Stroke ft	Pressure Ratio	Efficy
5.80	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
29.4	2.3	4.83	4.81	-0.25	2	9	11.63	1	4	24.2	54.0
29.4	2.3	4.83	4.81	-0.25	2	9	11.63	1	4	24.2	54.0
29.4	2.3	4.83	4.81	-0.25	2	9	11.63	1	4	24.2	54.0
29.4	2.3	4.83	4.81	-0.25	2	9	11.63	1	4	24.2	54.0
29.4	2.3	4.83	4.81	-0.25	2	9	11.63	1	4	24.2	54.0

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National Engineering & Architectural Ser GRLWEAP Version 2010

Depth (ft)	11.6	Standard Soil Setup	
Shaft Gain/Loss Factor	1.000	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in2)	144.000	Pile Type	Unknown
Pile Size (inch)	16.000		

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c

ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model — Total Capacity Rut (kips) 58.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	0.3	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	5.9	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	7.9	0.050	0.100	51.48	4.2	22.5
Toe						44.6	0.150	0.199			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
11.58	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
58.6	5.0	5.54	5.53	-0.04	2	10	14.09	1	3	21.3	50.3
58.6	5.0	5.54	5.53	-0.04	2	10	14.09	1	3	21.3	50.3
58.6	5.0	5.54	5.53	-0.04	2	10	14.09	1	3	21.3	50.3
58.6	5.0	5.54	5.53	-0.04	2	10	14.09	1	3	21.3	50.3
58.6	5.0	5.54	5.53	-0.04	2	10	14.09	1	3	21.3	50.3

CUY-14-6.93, PID 104132 : 00/00/0000 : K 01/25/2023
National Engineering & Architectural Ser GRLWEAP Version 2010

Depth (ft) 11.6 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model					Total Capacity Rut (kips)					571.9
No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	0.3	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	5.9	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	7.9	0.050	0.100	51.48	4.2	22.5
Toe						557.7	0.150	0.133			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
11.62	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
571.9	190.5	10.81	10.78	-2.40	13	19	39.41	15	6	22.0	36.1
571.9	190.5	10.81	10.78	-2.40	13	19	39.41	15	6	22.0	36.1
571.9	190.5	10.81	10.78	-2.40	13	19	39.41	15	6	22.0	36.1
571.9	190.5	10.81	10.78	-2.40	13	19	39.41	15	6	22.0	36.1
571.9	190.5	10.81	10.78	-2.40	13	19	39.41	15	6	22.0	36.1

CUY-14-6.93, PID 104132 : 00/00/0000 : K 01/25/2023
National Engineering & Architectural Ser GRLWEAP Version 2010

Depth (ft) 14.1 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model					Total Capacity Rut (kips)				689.8	
No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
11	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	37.75	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	4.3	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	7.5	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	18.2	0.050	0.100	51.48	4.2	22.5
Toe						659.8	0.150	0.133			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
14.10	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
689.8	405.5	11.19	11.26	-2.94	13	19	42.02	15	6	22.8	35.4
689.8	405.5	11.19	11.26	-2.94	13	19	42.02	15	6	22.8	35.4
689.8	405.5	11.19	11.26	-2.94	13	19	42.02	15	6	22.8	35.4
689.8	405.5	11.19	11.26	-2.94	13	19	42.02	15	6	22.8	35.4
689.8	405.5	11.19	11.26	-2.94	13	19	42.02	15	6	22.8	35.4

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Depth (ft) 16.6 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model					Total Capacity Rut (kips)				810.4	
No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2

1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
11	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	37.75	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	2.6	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	7.0	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	14.0	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	24.9	0.050	0.100	51.48	4.2	22.5
Toe						761.9	0.150	0.133			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
16.58	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
810.4	1569.9	11.56	11.59	-3.55	13	19	43.12	15	6	23.5	34.9
810.4	1569.9	11.56	11.59	-3.55	13	19	43.12	15	6	23.5	34.9
810.4	1569.9	11.56	11.59	-3.55	13	19	43.12	15	6	23.5	34.9
810.4	1569.9	11.56	11.59	-3.55	13	19	43.12	15	6	23.5	34.9
810.4	1569.9	11.56	11.59	-3.55	13	19	43.12	15	6	23.5	34.9

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Depth (ft) 16.6 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model Total Capacity Rut (kips) 208.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5

11	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	37.75	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	2.6	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	7.0	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	14.2	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	24.9	0.050	0.100	51.48	4.2	22.5
Toe						160.1	0.150	0.148			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
16.62	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
208.9	25.4	7.65	7.63	-1.48	12	29	19.89	13	6	17.4	42.7
208.9	25.4	7.65	7.63	-1.48	12	29	19.89	13	6	17.4	42.7
208.9	25.4	7.65	7.63	-1.48	12	29	19.89	13	6	17.4	42.7
208.9	25.4	7.65	7.63	-1.48	12	29	19.89	13	6	17.4	42.7
208.9	25.4	7.65	7.63	-1.48	12	29	19.89	13	6	17.4	42.7

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Depth (ft) 17.9 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model Total Capacity Rut (kips) 226.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
10	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	34.32	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	4.9	0.050	0.100	41.18	4.2	22.5

13	0.263	16361	0.000	0.000	1.00	7.6	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	19.7	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	24.5	0.050	0.100	51.48	4.2	22.5
Toe						169.4	0.150	0.148			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
17.85	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
226.1	28.0	7.78	7.76	-1.67	12	29	20.74	13	6	17.3	42.4
226.1	28.0	7.78	7.76	-1.67	12	29	20.74	13	6	17.3	42.4
226.1	28.0	7.78	7.76	-1.67	12	29	20.74	13	6	17.3	42.4
226.1	28.0	7.78	7.76	-1.67	12	29	20.74	13	6	17.3	42.4
226.1	28.0	7.78	7.76	-1.67	12	29	20.74	13	6	17.3	42.4

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Depth (ft) 19.1 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model Total Capacity Rut (kips) 243.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
10	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	34.32	4.2	22.5
11	0.263	16361	0.000	0.000	1.00	1.1	0.050	0.100	37.75	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	6.4	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	10.2	0.050	0.100	44.62	4.2	22.5

14	0.263	16361	0.000	0.000	1.00	23.5	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	23.8	0.050	0.100	51.48	4.2	22.5
Toe						178.7	0.150	0.148			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
19.08	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
243.7	30.8	7.91	7.89	-1.75	12	27	21.55	13	6	17.4	42.0
243.7	30.8	7.91	7.89	-1.75	12	27	21.55	13	6	17.4	42.0
243.7	30.8	7.91	7.89	-1.75	12	27	21.55	13	6	17.4	42.0
243.7	30.8	7.91	7.89	-1.75	12	27	21.55	13	6	17.4	42.0
243.7	30.8	7.91	7.89	-1.75	12	27	21.55	13	6	17.4	42.0

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Depth (ft) 19.1 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model Total Capacity Rut (kips) 489.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
10	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	34.32	4.2	22.5
11	0.263	16361	0.000	0.000	1.00	1.2	0.050	0.100	37.75	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	6.4	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	10.4	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	23.6	0.050	0.100	48.05	4.2	22.5

15	0.263	16361	0.000	0.000	1.00	23.8	0.050	0.100	51.48	4.2	22.5
Toe						424.0	0.150	0.134			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
19.12	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
489.4	124.3	9.96	9.92	-4.67	11	19	34.47	14	6	20.2	37.5
489.4	124.3	9.96	9.92	-4.67	11	19	34.47	14	6	20.2	37.5
489.4	124.3	9.96	9.92	-4.67	11	19	34.47	14	6	20.2	37.5
489.4	124.3	9.96	9.92	-4.67	11	19	34.47	14	6	20.2	37.5
489.4	124.3	9.96	9.92	-4.67	11	19	34.47	14	6	20.2	37.5

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Depth (ft) 21.6 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model Total Capacity Rut (kips) 557.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
9	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	30.89	4.2	22.5
11	0.263	16361	0.000	0.000	1.00	5.6	0.050	0.100	37.75	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	7.7	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	21.2	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	24.3	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	29.5	0.050	0.100	51.48	4.2	22.5

Toe 469.5 0.150 0.134

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
21.60	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
557.8	175.3	10.28	10.23	-5.52	11	19	35.33	14	6	20.8	37.0
557.8	175.3	10.28	10.23	-5.52	11	19	35.33	14	6	20.8	37.0
557.8	175.3	10.28	10.23	-5.52	11	19	35.33	14	6	20.8	37.0
557.8	175.3	10.28	10.23	-5.52	11	19	35.33	14	6	20.8	37.0
557.8	175.3	10.28	10.23	-5.52	11	19	35.33	14	6	20.8	37.0

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Depth (ft) 24.1 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L ft	b Top in2	Area ksi	E-Mod lb/ft3	Spec Wt ft	Perim	C Index ft/s	Wave Sp k/ft/s	EA/c
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1	
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1	

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model Total Capacity Rut (kips) 628.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
8	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	27.46	4.2	22.5
10	0.263	16361	0.000	0.000	1.00	3.7	0.050	0.100	34.32	4.2	22.5
11	0.263	16361	0.000	0.000	1.00	7.3	0.050	0.100	37.75	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	16.8	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	24.7	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	26.7	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	34.4	0.050	0.100	51.48	4.2	22.5

Toe 515.0 0.150 0.134

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.08	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
628.6	264.6	10.51	10.47	-6.16	10	18	35.62	14	6	21.3	36.6
628.6	264.6	10.51	10.47	-6.16	10	18	35.62	14	6	21.3	36.6
628.6	264.6	10.51	10.47	-6.16	10	18	35.62	14	6	21.3	36.6
628.6	264.6	10.51	10.47	-6.16	10	18	35.62	14	6	21.3	36.6
628.6	264.6	10.51	10.47	-6.16	10	18	35.62	14	6	21.3	36.6

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Depth (ft) 24.1 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L ft	b Top in2	Area ksi	E-Mod lb/ft3	Spec Wt ft	Perim	C Index ft/s	Wave Sp k/ft/s	EA/c
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1	
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1	

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model Total Capacity Rut (kips) 441.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
8	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	27.46	4.2	22.5
10	0.263	16361	0.000	0.000	1.00	3.8	0.050	0.100	34.32	4.2	22.5
11	0.263	16361	0.000	0.000	1.00	7.3	0.050	0.100	37.75	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	17.0	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	24.7	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	26.8	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	34.4	0.050	0.100	51.48	4.2	22.5

Toe 327.7 0.150 0.134

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.12	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
441.7	88.2	9.44	9.44	-5.48	10	19	29.88	13	6	19.0	38.5
441.7	88.2	9.44	9.44	-5.48	10	19	29.88	13	6	19.0	38.5
441.7	88.2	9.44	9.44	-5.48	10	19	29.88	13	6	19.0	38.5
441.7	88.2	9.44	9.44	-5.48	10	19	29.88	13	6	19.0	38.5
441.7	88.2	9.44	9.44	-5.48	10	19	29.88	13	6	19.0	38.5

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Depth (ft) 25.4 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L ft	b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model Total Capacity Rut (kips) 469.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
8	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	27.46	4.2	22.5
9	0.263	16361	0.000	0.000	1.00	0.3	0.050	0.100	30.89	4.2	22.5
10	0.263	16361	0.000	0.000	1.00	5.9	0.050	0.100	34.32	4.2	22.5
11	0.263	16361	0.000	0.000	1.00	7.9	0.050	0.100	37.75	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	22.6	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	24.2	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	30.5	0.050	0.100	48.05	4.2	22.5

15	0.263	16361	0.000	0.000	1.00	35.8	0.050	0.100	51.48	4.2	22.5
Toe						342.7	0.150	0.134			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
25.35	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
469.9	103.7	9.64	9.62	-6.09	10	19	30.31	13	6	19.5	38.1
469.9	103.7	9.64	9.62	-6.09	10	19	30.31	13	6	19.5	38.1
469.9	103.7	9.64	9.62	-6.09	10	19	30.31	13	6	19.5	38.1
469.9	103.7	9.64	9.62	-6.09	10	19	30.31	13	6	19.5	38.1
469.9	103.7	9.64	9.62	-6.09	10	19	30.31	13	6	19.5	38.1

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Depth (ft) 26.6 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model Total Capacity Rut (kips) 498.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
8	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	27.46	4.2	22.5
9	0.263	16361	0.000	0.000	1.00	2.1	0.050	0.100	30.89	4.2	22.5
10	0.263	16361	0.000	0.000	1.00	6.8	0.050	0.100	34.32	4.2	22.5
11	0.263	16361	0.000	0.000	1.00	12.8	0.050	0.100	37.75	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	24.4	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	24.5	0.050	0.100	44.62	4.2	22.5

14	0.263	16361	0.000	0.000	1.00	33.1	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	37.1	0.050	0.100	51.48	4.2	22.5
Toe						357.7	0.150	0.134			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
26.58	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
498.6	121.7	9.80	9.76	-6.63	9	19	30.69	14	6	19.8	37.9
498.6	121.7	9.80	9.76	-6.63	9	19	30.69	14	6	19.8	37.9
498.6	121.7	9.80	9.76	-6.63	9	19	30.69	14	6	19.8	37.9
498.6	121.7	9.80	9.76	-6.63	9	19	30.69	14	6	19.8	37.9
498.6	121.7	9.80	9.76	-6.63	9	19	30.69	14	6	19.8	37.9

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Depth (ft) 26.6 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model Total Capacity Rut (kips) 1171.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
8	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	27.46	4.2	22.5
9	0.263	16361	0.000	0.000	1.00	2.1	0.050	0.100	30.89	4.2	22.5
10	0.263	16361	0.000	0.000	1.00	6.8	0.050	0.100	34.32	4.2	22.5
11	0.263	16361	0.000	0.000	1.00	13.0	0.050	0.100	37.75	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	24.5	0.050	0.100	41.18	4.2	22.5

13	0.263	16361	0.000	0.000	1.00	24.6	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	33.2	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	37.2	0.050	0.100	51.48	4.2	22.5
Toe						1029.9	0.150	0.133			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
26.62	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1171.3	9999.0	11.21	11.32	-6.12	11	18	39.62	14	6	22.6	35.3
1171.3	9999.0	11.21	11.32	-6.12	11	18	39.62	14	6	22.6	35.3
1171.3	9999.0	11.21	11.32	-6.12	11	18	39.62	14	6	22.6	35.3
1171.3	9999.0	11.21	11.32	-6.12	11	18	39.62	14	6	22.6	35.3
1171.3	9999.0	11.21	11.32	-6.12	11	18	39.62	14	6	22.6	35.3

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Depth (ft) 31.0 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model — Total Capacity Rut (kips) 1227.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
6	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	20.59	4.2	22.5
8	0.263	16361	0.000	0.000	1.00	3.8	0.050	0.100	27.46	4.2	22.5
9	0.263	16361	0.000	0.000	1.00	7.4	0.050	0.100	30.89	4.2	22.5
10	0.263	16361	0.000	0.000	1.00	17.1	0.050	0.100	34.32	4.2	22.5

11	0.263	16361	0.000	0.000	1.00	24.7	0.050	0.100	37.75	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	26.8	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	34.4	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	38.7	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	44.8	0.050	0.100	51.48	4.2	22.5
Toe						1029.9	0.150	0.133			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
31.00	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1227.5	9999.0	11.05	11.12	-7.31	10	18	37.12	13	6	22.1	35.6
1227.5	9999.0	11.05	11.12	-7.31	10	18	37.12	13	6	22.1	35.6
1227.5	9999.0	11.05	11.12	-7.31	10	18	37.12	13	6	22.1	35.6
1227.5	9999.0	11.05	11.12	-7.31	10	18	37.12	13	6	22.1	35.6
1227.5	9999.0	11.05	11.12	-7.31	10	18	37.12	13	6	22.1	35.6

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Depth (ft) 35.4 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model Total Capacity Rut (kips) 1292.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
5	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	17.16	4.2	22.5
7	0.263	16361	0.000	0.000	1.00	5.7	0.050	0.100	24.02	4.2	22.5

8	0.263	16361	0.000	0.000	1.00	7.8	0.050	0.100	27.46	4.2	22.5
9	0.263	16361	0.000	0.000	1.00	21.4	0.050	0.100	30.89	4.2	22.5
10	0.263	16361	0.000	0.000	1.00	24.3	0.050	0.100	34.32	4.2	22.5
11	0.263	16361	0.000	0.000	1.00	29.7	0.050	0.100	37.75	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	35.5	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	40.5	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	46.2	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	51.3	0.050	0.100	51.48	4.2	22.5
Toe						1029.9	0.150	0.133			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
35.38	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1292.0	9999.0	10.81	10.90	-7.52	7	17	34.39	13	6	21.5	36.0
1292.0	9999.0	10.81	10.90	-7.52	7	17	34.39	13	6	21.5	36.0
1292.0	9999.0	10.81	10.90	-7.52	7	17	34.39	13	6	21.5	36.0
1292.0	9999.0	10.81	10.90	-7.52	7	17	34.39	13	6	21.5	36.0
1292.0	9999.0	10.81	10.90	-7.52	7	17	34.39	13	6	21.5	36.0

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Depth (ft) 35.4 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L ft	b Top in2	Area ksi	E-Mod lb/ft3	Spec Wt ft	Perim	C Index ft/s	Wave Sp k/ft/s	EA/c
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1	
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1	

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model Total Capacity Rut (kips) 1292.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5

2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
5	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	17.16	4.2	22.5
6	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	20.59	4.2	22.5
7	0.263	16361	0.000	0.000	1.00	5.7	0.050	0.100	24.02	4.2	22.5
8	0.263	16361	0.000	0.000	1.00	7.8	0.050	0.100	27.46	4.2	22.5
9	0.263	16361	0.000	0.000	1.00	21.6	0.050	0.100	30.89	4.2	22.5
10	0.263	16361	0.000	0.000	1.00	24.3	0.050	0.100	34.32	4.2	22.5
11	0.263	16361	0.000	0.000	1.00	29.8	0.050	0.100	37.75	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	35.5	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	40.5	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	46.2	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	51.3	0.050	0.100	51.48	4.2	22.5
Toe						1029.9	0.150	0.133			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
35.42	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1292.7	9999.0	10.81	10.90	-7.52	7	17	34.37	13	6	21.5	36.0
1292.7	9999.0	10.81	10.90	-7.52	7	17	34.37	13	6	21.5	36.0
1292.7	9999.0	10.81	10.90	-7.52	7	17	34.37	13	6	21.5	36.0
1292.7	9999.0	10.81	10.90	-7.52	7	17	34.37	13	6	21.5	36.0
1292.7	9999.0	10.81	10.90	-7.52	7	17	34.37	13	6	21.5	36.0

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Depth (ft) 43.4 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model Total Capacity Rut (kips) 1431.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	0.0	0.000	0.100	6.86	4.2	22.5
3	0.263	16361	0.000	0.000	1.00	0.0	0.050	0.100	10.30	4.2	22.5
4	0.263	16361	0.000	0.000	1.00	1.6	0.050	0.100	13.73	4.2	22.5
5	0.263	16361	0.000	0.000	1.00	6.6	0.050	0.100	17.16	4.2	22.5
6	0.263	16361	0.000	0.000	1.00	11.5	0.050	0.100	20.59	4.2	22.5
7	0.263	16361	0.000	0.000	1.00	24.0	0.050	0.100	24.02	4.2	22.5
8	0.263	16361	0.000	0.000	1.00	24.2	0.050	0.100	27.46	4.2	22.5
9	0.263	16361	0.000	0.000	1.00	32.7	0.050	0.100	30.89	4.2	22.5
10	0.263	16361	0.000	0.000	1.00	36.8	0.050	0.100	34.32	4.2	22.5
11	0.263	16361	0.000	0.000	1.00	42.7	0.050	0.100	37.75	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	47.9	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	52.9	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	57.8	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	62.8	0.050	0.100	51.48	4.2	22.5
Toe						1029.9	0.150	0.133			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
43.43	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1431.5	9999.0	10.58	10.54	-6.20	7	16	30.15	6	8	20.4	36.5
1431.5	9999.0	10.58	10.54	-6.20	7	16	30.15	6	8	20.4	36.5
1431.5	9999.0	10.58	10.54	-6.20	7	16	30.15	6	8	20.4	36.5
1431.5	9999.0	10.58	10.54	-6.20	7	16	30.15	6	8	20.4	36.5
1431.5	9999.0	10.58	10.54	-6.20	7	16	30.15	6	8	20.4	36.5

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Depth (ft) 51.5 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c

ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.5	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.126

Pile and Soil Model — Total Capacity Rut (kips) 1598.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16361	0.010	0.000	0.85	0.0	0.050	0.100	3.43	4.2	22.5
2	0.263	16361	0.000	0.000	1.00	3.6	0.050	0.100	6.86	4.2	22.5
3	0.263	16361	0.000	0.000	1.00	7.3	0.050	0.100	10.30	4.2	22.5
4	0.263	16361	0.000	0.000	1.00	16.6	0.050	0.100	13.73	4.2	22.5
5	0.263	16361	0.000	0.000	1.00	24.7	0.050	0.100	17.16	4.2	22.5
6	0.263	16361	0.000	0.000	1.00	26.5	0.050	0.100	20.59	4.2	22.5
7	0.263	16361	0.000	0.000	1.00	34.3	0.050	0.100	24.02	4.2	22.5
8	0.263	16361	0.000	0.000	1.00	38.5	0.050	0.100	27.46	4.2	22.5
9	0.263	16361	0.000	0.000	1.00	44.6	0.050	0.100	30.89	4.2	22.5
10	0.263	16361	0.000	0.000	1.00	49.7	0.050	0.100	34.32	4.2	22.5
11	0.263	16361	0.000	0.000	1.00	54.6	0.050	0.100	37.75	4.2	22.5
12	0.263	16361	0.000	0.000	1.00	59.5	0.050	0.100	41.18	4.2	22.5
13	0.263	16361	0.000	0.000	1.00	64.6	0.050	0.100	44.62	4.2	22.5
14	0.263	16361	0.000	0.000	1.00	69.6	0.050	0.100	48.05	4.2	22.5
15	0.263	16361	0.000	0.000	1.00	74.7	0.050	0.100	51.48	4.2	22.5
Toe						1029.9	0.150	0.133			

3.950 kips total unreduced pile weight (g= 32.17 ft/s2)
3.950 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
51.48	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1598.7	9999.0	10.30	10.22	-3.77	5	14	28.57	4	8	18.8	37.0
1598.7	9999.0	10.30	10.22	-3.77	5	14	28.57	4	8	18.8	37.0
1598.7	9999.0	10.30	10.22	-3.77	5	14	28.57	4	8	18.8	37.0
1598.7	9999.0	10.30	10.22	-3.77	5	14	28.57	4	8	18.8	37.0
1598.7	9999.0	10.30	10.22	-3.77	5	14	28.57	4	8	18.8	37.0

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 1.000 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.8	29.4	1.8	27.6	2.3	11.627	-0.252	4.83	24.2
11.6	58.6	14.0	44.6	5.0	14.094	-0.041	5.54	21.3
11.6	571.9	14.1	557.7	190.5	39.408	-2.401	10.81	22.0
14.1	689.8	30.0	659.8	405.5	42.016	-2.936	11.19	22.8
16.6	810.4	48.5	761.9	1569.9	43.117	-3.551	11.56	23.5
16.6	208.9	48.8	160.1	25.4	19.887	-1.478	7.65	17.4
17.9	226.1	56.7	169.4	28.0	20.738	-1.669	7.78	17.3
19.1	243.7	65.0	178.7	30.8	21.552	-1.754	7.91	17.4
19.1	489.4	65.3	424.0	124.3	34.470	-4.669	9.96	20.2
21.6	557.8	88.3	469.5	175.3	35.333	-5.518	10.28	20.8
24.1	628.6	113.6	515.0	264.6	35.619	-6.164	10.51	21.3
24.1	441.7	114.0	327.7	88.2	29.879	-5.484	9.44	19.0
25.4	469.9	127.2	342.7	103.7	30.308	-6.086	9.64	19.5
26.6	498.6	140.9	357.7	121.7	30.691	-6.630	9.80	19.8
26.6	1171.3	141.4	1029.9	9999.0	39.619	-6.115	11.21	22.6
31.0	1227.5	197.6	1029.9	9999.0	37.120	-7.308	11.05	22.1
35.4	1292.0	262.2	1029.9	9999.0	34.389	-7.518	10.81	21.5
35.4	1292.7	262.8	1029.9	9999.0	34.373	-7.521	10.81	21.5
43.4	1431.5	401.6	1029.9	9999.0	30.148	-6.201	10.58	20.4
51.5	1598.7	568.8	1029.9	9999.0	28.574	-3.774	10.30	18.8

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 1.000 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.8	29.4	1.8	27.6	2.3	11.627	-0.252	4.83	24.2
11.6	58.6	14.0	44.6	5.0	14.094	-0.041	5.54	21.3
11.6	571.9	14.1	557.7	190.5	39.408	-2.401	10.81	22.0
14.1	689.8	30.0	659.8	405.5	42.016	-2.936	11.19	22.8
16.6	810.4	48.5	761.9	1569.9	43.117	-3.551	11.56	23.5
16.6	208.9	48.8	160.1	25.4	19.887	-1.478	7.65	17.4
17.9	226.1	56.7	169.4	28.0	20.738	-1.669	7.78	17.3
19.1	243.7	65.0	178.7	30.8	21.552	-1.754	7.91	17.4
19.1	489.4	65.3	424.0	124.3	34.470	-4.669	9.96	20.2
21.6	557.8	88.3	469.5	175.3	35.333	-5.518	10.28	20.8
24.1	628.6	113.6	515.0	264.6	35.619	-6.164	10.51	21.3
24.1	441.7	114.0	327.7	88.2	29.879	-5.484	9.44	19.0
25.4	469.9	127.2	342.7	103.7	30.308	-6.086	9.64	19.5
26.6	498.6	140.9	357.7	121.7	30.691	-6.630	9.80	19.8
26.6	1171.3	141.4	1029.9	9999.0	39.619	-6.115	11.21	22.6
31.0	1227.5	197.6	1029.9	9999.0	37.120	-7.308	11.05	22.1
35.4	1292.0	262.2	1029.9	9999.0	34.389	-7.518	10.81	21.5
35.4	1292.7	262.8	1029.9	9999.0	34.373	-7.521	10.81	21.5
43.4	1431.5	401.6	1029.9	9999.0	30.148	-6.201	10.58	20.4
51.5	1598.7	568.8	1029.9	9999.0	28.574	-3.774	10.30	18.8

Refusal occurred; no driving time output possible

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 1.000 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.8	29.4	1.8	27.6	2.3	11.627	-0.252	4.83	24.2
11.6	58.6	14.0	44.6	5.0	14.094	-0.041	5.54	21.3
11.6	571.9	14.1	557.7	190.5	39.408	-2.401	10.81	22.0
14.1	689.8	30.0	659.8	405.5	42.016	-2.936	11.19	22.8
16.6	810.4	48.5	761.9	1569.9	43.117	-3.551	11.56	23.5
16.6	208.9	48.8	160.1	25.4	19.887	-1.478	7.65	17.4
17.9	226.1	56.7	169.4	28.0	20.738	-1.669	7.78	17.3
19.1	243.7	65.0	178.7	30.8	21.552	-1.754	7.91	17.4
19.1	489.4	65.3	424.0	124.3	34.470	-4.669	9.96	20.2
21.6	557.8	88.3	469.5	175.3	35.333	-5.518	10.28	20.8
24.1	628.6	113.6	515.0	264.6	35.619	-6.164	10.51	21.3
24.1	441.7	114.0	327.7	88.2	29.879	-5.484	9.44	19.0
25.4	469.9	127.2	342.7	103.7	30.308	-6.086	9.64	19.5
26.6	498.6	140.9	357.7	121.7	30.691	-6.630	9.80	19.8
26.6	1171.3	141.4	1029.9	9999.0	39.619	-6.115	11.21	22.6
31.0	1227.5	197.6	1029.9	9999.0	37.120	-7.308	11.05	22.1
35.4	1292.0	262.2	1029.9	9999.0	34.389	-7.518	10.81	21.5
35.4	1292.7	262.8	1029.9	9999.0	34.373	-7.521	10.81	21.5
43.4	1431.5	401.6	1029.9	9999.0	30.148	-6.201	10.58	20.4
51.5	1598.7	568.8	1029.9	9999.0	28.574	-3.774	10.30	18.8

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 1.000 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.8	29.4	1.8	27.6	2.3	11.627	-0.252	4.83	24.2
11.6	58.6	14.0	44.6	5.0	14.094	-0.041	5.54	21.3
11.6	571.9	14.1	557.7	190.5	39.408	-2.401	10.81	22.0
14.1	689.8	30.0	659.8	405.5	42.016	-2.936	11.19	22.8
16.6	810.4	48.5	761.9	1569.9	43.117	-3.551	11.56	23.5
16.6	208.9	48.8	160.1	25.4	19.887	-1.478	7.65	17.4
17.9	226.1	56.7	169.4	28.0	20.738	-1.669	7.78	17.3
19.1	243.7	65.0	178.7	30.8	21.552	-1.754	7.91	17.4
19.1	489.4	65.3	424.0	124.3	34.470	-4.669	9.96	20.2
21.6	557.8	88.3	469.5	175.3	35.333	-5.518	10.28	20.8
24.1	628.6	113.6	515.0	264.6	35.619	-6.164	10.51	21.3
24.1	441.7	114.0	327.7	88.2	29.879	-5.484	9.44	19.0
25.4	469.9	127.2	342.7	103.7	30.308	-6.086	9.64	19.5
26.6	498.6	140.9	357.7	121.7	30.691	-6.630	9.80	19.8

26.6	1171.3	141.4	1029.9	9999.0	39.619	-6.115	11.21	22.6
31.0	1227.5	197.6	1029.9	9999.0	37.120	-7.308	11.05	22.1
35.4	1292.0	262.2	1029.9	9999.0	34.389	-7.518	10.81	21.5
35.4	1292.7	262.8	1029.9	9999.0	34.373	-7.521	10.81	21.5
43.4	1431.5	401.6	1029.9	9999.0	30.148	-6.201	10.58	20.4
51.5	1598.7	568.8	1029.9	9999.0	28.574	-3.774	10.30	18.8

Refusal occurred; no driving time output possible

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 1.000 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.8	29.4	1.8	27.6	2.3	11.627	-0.252	4.83	24.2
11.6	58.6	14.0	44.6	5.0	14.094	-0.041	5.54	21.3
11.6	571.9	14.1	557.7	190.5	39.408	-2.401	10.81	22.0
14.1	689.8	30.0	659.8	405.5	42.016	-2.936	11.19	22.8
16.6	810.4	48.5	761.9	1569.9	43.117	-3.551	11.56	23.5
16.6	208.9	48.8	160.1	25.4	19.887	-1.478	7.65	17.4
17.9	226.1	56.7	169.4	28.0	20.738	-1.669	7.78	17.3
19.1	243.7	65.0	178.7	30.8	21.552	-1.754	7.91	17.4
19.1	489.4	65.3	424.0	124.3	34.470	-4.669	9.96	20.2
21.6	557.8	88.3	469.5	175.3	35.333	-5.518	10.28	20.8
24.1	628.6	113.6	515.0	264.6	35.619	-6.164	10.51	21.3
24.1	441.7	114.0	327.7	88.2	29.879	-5.484	9.44	19.0
25.4	469.9	127.2	342.7	103.7	30.308	-6.086	9.64	19.5
26.6	498.6	140.9	357.7	121.7	30.691	-6.630	9.80	19.8
26.6	1171.3	141.4	1029.9	9999.0	39.619	-6.115	11.21	22.6
31.0	1227.5	197.6	1029.9	9999.0	37.120	-7.308	11.05	22.1
35.4	1292.0	262.2	1029.9	9999.0	34.389	-7.518	10.81	21.5
35.4	1292.7	262.8	1029.9	9999.0	34.373	-7.521	10.81	21.5
43.4	1431.5	401.6	1029.9	9999.0	30.148	-6.201	10.58	20.4
51.5	1598.7	568.8	1029.9	9999.0	28.574	-3.774	10.30	18.8

Refusal occurred; no driving time output possible

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Table of Depths Analyzed with Driving System Modifiers

Depth	Temp. Length	Wait Time	Equivalent Pressure Stroke	Ratio	Efficy.	Stiffn. Factor	Cushion CoR
ft	ft	hr	ft				
5.80	51.48	0.00	10.81	1.00	0.80	1.00	1.00

11.58	51.48	0.00	10.81	1.00	0.80	1.00	1.00
11.62	51.48	0.00	10.81	1.00	0.80	1.00	1.00
14.10	51.48	0.00	10.81	1.00	0.80	1.00	1.00
16.58	51.48	0.00	10.81	1.00	0.80	1.00	1.00
16.62	51.48	0.00	10.81	1.00	0.80	1.00	1.00
17.85	51.48	0.00	10.81	1.00	0.80	1.00	1.00
19.08	51.48	0.00	10.81	1.00	0.80	1.00	1.00
19.12	51.48	0.00	10.81	1.00	0.80	1.00	1.00
21.60	51.48	0.00	10.81	1.00	0.80	1.00	1.00
24.08	51.48	0.00	10.81	1.00	0.80	1.00	1.00
24.12	51.48	0.00	10.81	1.00	0.80	1.00	1.00
25.35	51.48	0.00	10.81	1.00	0.80	1.00	1.00
26.58	51.48	0.00	10.81	1.00	0.80	1.00	1.00
26.62	51.48	0.00	10.81	1.00	0.80	1.00	1.00
31.00	51.48	0.00	10.81	1.00	0.80	1.00	1.00
35.38	51.48	0.00	10.81	1.00	0.80	1.00	1.00
35.42	51.48	0.00	10.81	1.00	0.80	1.00	1.00
43.43	51.48	0.00	10.81	1.00	0.80	1.00	1.00
51.48	51.48	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

Depth	Shaft Res.	End Bearing	Shaft Quake	Toe Quake	Shaft Damping	Toe Damping	Soil Setup	Limit Distance	Setup Time
ft	k/ft2	kips	inch	inch	s/ft	s/ft	Normlzd	ft	hrs
0.01	0.00	0.00	0.100	0.199	0.050	0.150	1.000	6.000	1.000
4.49	0.00	0.00	0.100	0.199	0.050	0.150	1.000	6.000	1.000
4.50	0.29	21.44	0.100	0.199	0.050	0.150	1.000	6.000	1.000
7.59	0.48	36.17	0.100	0.199	0.050	0.150	1.000	6.000	1.000
7.61	0.48	36.24	0.100	0.199	0.050	0.150	1.000	6.000	1.000
11.59	0.60	44.64	0.100	0.199	0.050	0.150	1.000	6.000	1.000
11.61	1.39	557.31	0.100	0.133	0.050	0.150	1.000	6.000	1.000
16.59	1.91	762.35	0.100	0.133	0.050	0.150	1.000	6.000	1.000
16.61	1.49	160.07	0.100	0.148	0.050	0.150	1.000	6.000	1.000
19.09	1.67	178.73	0.100	0.148	0.050	0.150	1.000	6.000	1.000
19.11	2.09	423.83	0.100	0.134	0.050	0.150	1.000	6.000	1.000
24.09	2.55	515.23	0.100	0.134	0.050	0.150	1.000	6.000	1.000
24.11	2.50	327.62	0.100	0.134	0.050	0.150	1.000	6.000	1.000
26.59	2.73	357.79	0.100	0.134	0.050	0.150	1.000	6.000	1.000
26.61	2.84	1029.88	0.100	0.133	0.050	0.150	1.000	6.000	1.000
35.39	3.74	1029.88	0.100	0.133	0.050	0.150	1.000	6.000	1.000
35.41	3.72	1029.88	0.100	0.133	0.050	0.150	1.000	6.000	1.000
44.41	4.65	1029.88	0.100	0.133	0.050	0.150	1.000	6.000	1.000
51.48	5.37	1029.88	0.100	0.133	0.050	0.150	1.000	6.000	1.000

Gain/Loss 3 at Shaft and Toe 1.000 / 1.000

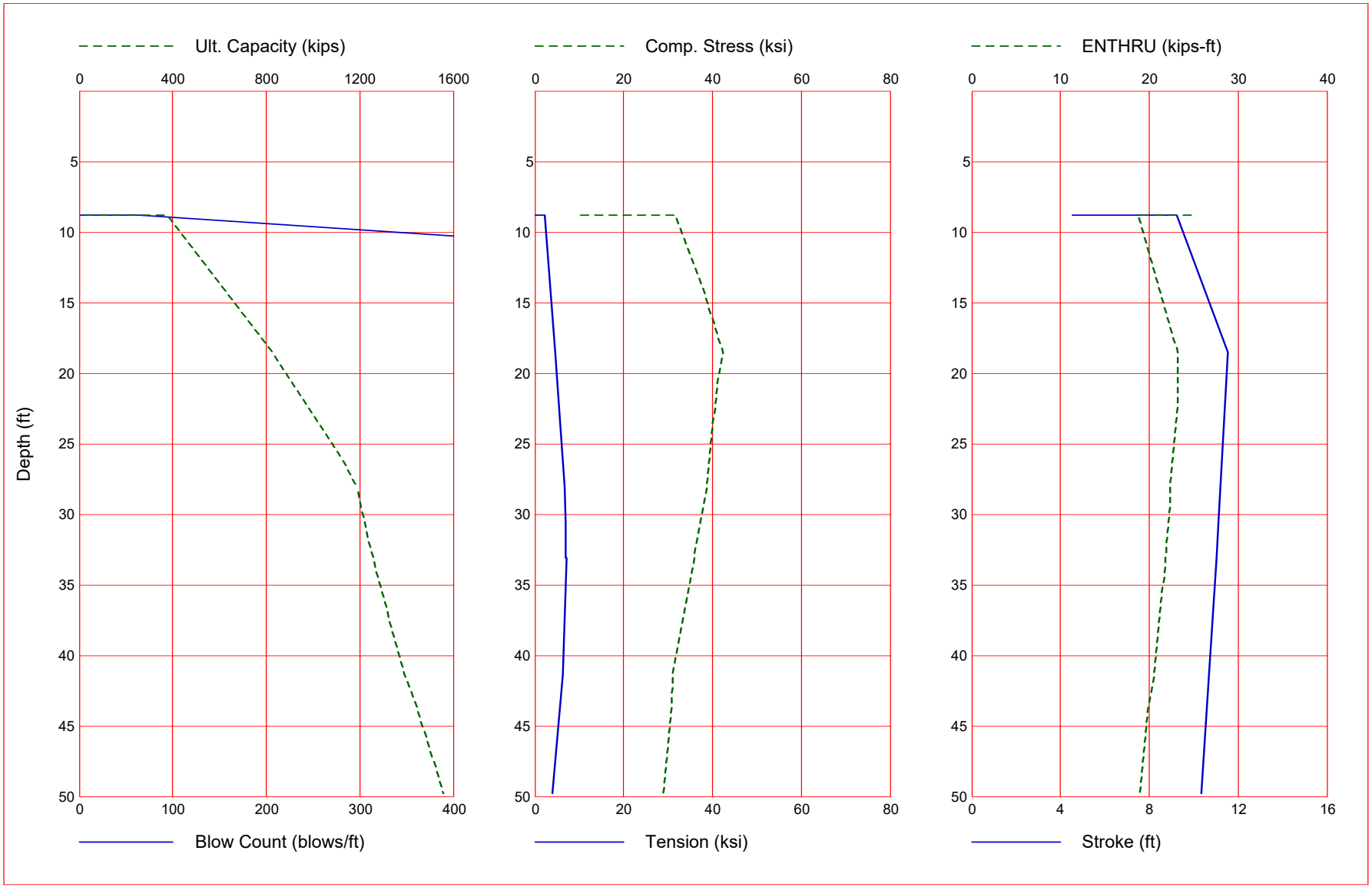
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
8.8	25.7	4.9	20.7	1.9	10.243	-0.056	4.55	24.7
8.8	377.7	5.0	372.7	64.0	31.624	-2.136	9.25	18.7
18.5	825.9	62.7	763.2	2270.4	42.351	-4.557	11.52	23.2
28.1	1190.3	160.4	1029.9	9999.0	38.751	-6.637	11.21	22.3
28.1	1190.8	160.9	1029.9	9999.0	38.729	-6.640	11.21	22.3
30.6	1222.4	192.6	1029.9	9999.0	37.318	-6.955	11.11	22.1
33.1	1256.8	226.9	1029.9	9999.0	35.867	-7.034	11.02	21.8
33.1	1257.4	227.5	1029.9	9999.0	35.845	-7.051	11.01	21.8
41.4	1392.0	362.1	1029.9	9999.0	31.004	-6.277	10.67	20.5
49.8	1557.2	527.4	1029.9	9999.0	28.810	-3.979	10.33	18.9

Refusal occurred; no driving time output possible

National Engineering & Architectural Ser
CUY-14-6.93, PID 104132 : 00/00/0000 : K

Jan 25 2023
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 1.000 / 1.000



GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

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 building and other factors.

Input File: C:\USERS\KARENS\DESKTOP\GRL FILES\RA16IN2.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

CUY-14-6.93, PID 104132 : 00/00/0000 : K

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	144.000	16.000	Unknown

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
2.500	22.450	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
49.780	22.46	30000.0	492.000	4.190	0	0.850	0.010

FFatigue	F0	0-Bottom
0	0.000	0.000

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.0020	0.0020	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1600.00	1440.00	1295.00	1165.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1600.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Research Toe Plug: Res-int, Q-int, D-int, Res-plug, Q-plug, D-plug

0.000	0.000	0.000	0.000	0.000	0.000

Research Toe Plug: RD plug toe: m, d

0.000	0.000

Research Toe Plug: New Toe Plug Model is NOT applied

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimL	TSf0
0.01	0.00	0.00	0.10	0.27	0.05	0.15	1.00	6.00	1.000
4.49	0.00	0.00	0.10	0.27	0.05	0.15	1.00	6.00	1.000
4.50	0.22	14.40	0.10	0.27	0.05	0.15	1.00	6.00	1.000
4.79	0.23	15.33	0.10	0.27	0.05	0.15	1.00	6.00	1.000
4.81	0.24	15.37	0.10	0.27	0.05	0.15	1.00	6.00	1.000
8.79	0.32	20.75	0.10	0.27	0.05	0.15	1.00	6.00	1.000
8.81	0.93	372.24	0.10	0.13	0.05	0.15	1.00	6.00	1.000
17.81	1.86	742.80	0.10	0.13	0.05	0.15	1.00	6.00	1.000
26.81	2.79	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000
28.09	2.92	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000

28.11	2.92	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000
33.09	3.43	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000
33.11	3.44	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000
42.11	4.36	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000
49.78	5.15	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000

Gain/Loss factors: shaft and toe

1.00000	1.00000	1.00000	1.00000	1.00000
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
8.78	0.00	0.00	0.000	0.0	0.000	0.000	0.000
8.82	0.00	0.00	0.000	0.0	0.000	0.000	0.000
18.45	0.00	0.00	0.000	0.0	0.000	0.000	0.000
28.08	0.00	0.00	0.000	0.0	0.000	0.000	0.000
28.12	0.00	0.00	0.000	0.0	0.000	0.000	0.000
30.60	0.00	0.00	0.000	0.0	0.000	0.000	0.000
33.08	0.00	0.00	0.000	0.0	0.000	0.000	0.000
33.12	0.00	0.00	0.000	0.0	0.000	0.000	0.000
41.43	0.00	0.00	0.000	0.0	0.000	0.000	0.000
49.78	0.00	0.00	0.000	0.0	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

CUY-14-6.93, PID 104132 : 00/00/0000 : K

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.6	1.000	0.0000	
3	0.800	140046.6	1.000	0.0000	
4	0.800	140046.6	1.000	0.0000	
5	0.800	140046.6	1.000	0.0000	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	2.500	5949.2	0.800	0.0100	5.8
Combined Pile Top		16919.4			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800

Maximum Pressure	(psi)	1600.00	Actual Pressure	(psi)	1600.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	22.45	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	5949.2	Stiffness	(kips/in)	0.0

Depth	(ft)	8.8	Standard Soil Setup		
Shaft Gain/Loss Factor		1.000	Toe Gain/Loss Factor		1.000

PILE PROFILE:

Toe Area	(in2)	144.000	Pile Type		Unknown
Pile Size	(inch)	16.000			

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
	ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	49.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 5.924

Pile and Soil Model — Total Capacity Rut (kips) 25.7

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	0.255	16919	0.010	0.000	0.85	0.0	0.000	0.100	3.32	4.2	22.5
2	0.255	16919	0.000	0.000	1.00	0.0	0.000	0.100	6.64	4.2	22.5
13	0.255	16919	0.000	0.000	1.00	0.0	0.050	0.100	43.14	4.2	22.5
14	0.255	16919	0.000	0.000	1.00	1.0	0.050	0.100	46.46	4.2	22.5
15	0.255	16919	0.000	0.000	1.00	4.0	0.050	0.100	49.78	4.2	22.5
Toe						20.7	0.150	0.267			

3.820 kips total unreduced pile weight (g= 32.17 ft/s2)
3.820 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile
No. of Slacks/Splices 0
Pile Segments: Automatic
Pile Damping (%) 1
Pile Damping Fact.(k/ft/s) 0.802

Driveability Analysis
Soil Damping Option Smith
Max No Analysis Iterations 0
Time Increment/Critical 160
Output Time Interval 1
Analysis Time-Input (ms) 0
Output Level: Normal
Gravity Mass, Pile, Hammer: 32.170 32.170 32.170
Output Segment Generation: Automatic

Depth ft	Stroke ft	Pressure Ratio	Efficy
8.78	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
25.7	1.9	4.55	4.59	-0.06	2	10	10.24	1	4	24.7	55.4
25.7	1.9	4.55	4.59	-0.06	2	10	10.24	1	4	24.7	55.4
25.7	1.9	4.55	4.59	-0.06	2	10	10.24	1	4	24.7	55.4
25.7	1.9	4.55	4.59	-0.06	2	10	10.24	1	4	24.7	55.4
25.7	1.9	4.55	4.59	-0.06	2	10	10.24	1	4	24.7	55.4

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National Engineering & Architectural Ser GRLWEAP Version 2010

Depth (ft) 8.8
Standard Soil Setup
Shaft Gain/Loss Factor 1.000
Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000
Pile Type Unknown
Pile Size (inch) 16.000

L ft	b Top in2	Area ksi	E-Mod lb/ft3	Spec Wt ft	Perim	C Index ft/s	Wave Sp k/ft/s	EA/c
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1	
49.8	22.46	30000.	492.0	4.2	0	16807.	40.1	

Wave Travel Time 2L/c (ms) 5.924

Pile and Soil Model
Total Capacity Rut (kips) 377.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.255	16919	0.010	0.000	0.85	0.0	0.000	0.100	3.32	4.2	22.5
2	0.255	16919	0.000	0.000	1.00	0.0	0.000	0.100	6.64	4.2	22.5
13	0.255	16919	0.000	0.000	1.00	0.0	0.050	0.100	43.14	4.2	22.5
14	0.255	16919	0.000	0.000	1.00	1.0	0.050	0.100	46.46	4.2	22.5

15	0.255	16919	0.000	0.000	1.00	4.0	0.050	0.100	49.78	4.2	22.5
Toe						372.7	0.150	0.133			

3.820 kips total unreduced pile weight (g= 32.17 ft/s2)
3.820 kips total reduced pile weight (g= 32.17 ft/s2)

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
8.82	10.81	1.00	0.800

Rut	Bl Ct	Stroke (ft)		Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt
kips	b/ft	down	up	ksi			ksi			kip-ft	b/min
377.7	64.0	9.25	9.27	-2.14	8	19	31.62	14	6	18.7	38.9
377.7	64.0	9.25	9.27	-2.14	8	19	31.62	14	6	18.7	38.9
377.7	64.0	9.25	9.27	-2.14	8	19	31.62	14	6	18.7	38.9
377.7	64.0	9.25	9.27	-2.14	8	19	31.62	14	6	18.7	38.9
377.7	64.0	9.25	9.27	-2.14	8	19	31.62	14	6	18.7	38.9

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National Engineering & Architectural Ser GRLWEAP Version 2010

Depth (ft) 18.5 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
	ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	49.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 5.924

Pile and Soil Model Total Capacity Rut (kips) 825.9

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	0.255	16919	0.010	0.000	0.85	0.0	0.000	0.100	3.32	4.2	22.5
2	0.255	16919	0.000	0.000	1.00	0.0	0.000	0.100	6.64	4.2	22.5
10	0.255	16919	0.000	0.000	1.00	0.0	0.050	0.100	33.19	4.2	22.5
11	0.255	16919	0.000	0.000	1.00	0.7	0.050	0.100	36.51	4.2	22.5
12	0.255	16919	0.000	0.000	1.00	3.9	0.050	0.100	39.82	4.2	22.5
13	0.255	16919	0.000	0.000	1.00	14.1	0.050	0.100	43.14	4.2	22.5
14	0.255	16919	0.000	0.000	1.00	19.6	0.050	0.100	46.46	4.2	22.5
15	0.255	16919	0.000	0.000	1.00	24.4	0.050	0.100	49.78	4.2	22.5

Toe 763.2 0.150 0.133

3.820 kips total unreduced pile weight (g= 32.17 ft/s2)
3.820 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
18.45	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
825.9	2270.4	11.52	11.55	-4.56	13	18	42.35	15	6	23.2	34.9
825.9	2270.4	11.52	11.55	-4.56	13	18	42.35	15	6	23.2	34.9
825.9	2270.4	11.52	11.55	-4.56	13	18	42.35	15	6	23.2	34.9
825.9	2270.4	11.52	11.55	-4.56	13	18	42.35	15	6	23.2	34.9
825.9	2270.4	11.52	11.55	-4.56	13	18	42.35	15	6	23.2	34.9

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National Engineering & Architectural Ser GRLWEAP Version 2010

Depth (ft) 28.1 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L ft	b Top in2	Area ksi	E-Mod lb/ft3	Spec Wt ft	Perim	C Index ft/s	Wave Sp k/ft/s	EA/c
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1	
49.8	22.46	30000.	492.0	4.2	0	16807.	40.1	

Wave Travel Time 2L/c (ms) 5.924

Pile and Soil Model — Total Capacity Rut (kips) 1190.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.255	16919	0.010	0.000	0.85	0.0	0.000	0.100	3.32	4.2	22.5
2	0.255	16919	0.000	0.000	1.00	0.0	0.000	0.100	6.64	4.2	22.5
7	0.255	16919	0.000	0.000	1.00	0.0	0.050	0.100	23.23	4.2	22.5
8	0.255	16919	0.000	0.000	1.00	0.3	0.050	0.100	26.55	4.2	22.5
9	0.255	16919	0.000	0.000	1.00	3.8	0.050	0.100	29.87	4.2	22.5
10	0.255	16919	0.000	0.000	1.00	12.9	0.050	0.100	33.19	4.2	22.5
11	0.255	16919	0.000	0.000	1.00	19.2	0.050	0.100	36.51	4.2	22.5
12	0.255	16919	0.000	0.000	1.00	23.9	0.050	0.100	39.82	4.2	22.5
13	0.255	16919	0.000	0.000	1.00	28.7	0.050	0.100	43.14	4.2	22.5

14	0.255	16919	0.000	0.000	1.00	33.4	0.050	0.100	46.46	4.2	22.5
15	0.255	16919	0.000	0.000	1.00	38.2	0.050	0.100	49.78	4.2	22.5
Toe						1029.9	0.150	0.133			

3.820 kips total unreduced pile weight (g= 32.17 ft/s2)
3.820 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
28.08	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1190.3	9999.0	11.21	11.32	-6.64	11	18	38.75	14	6	22.3	35.3
1190.3	9999.0	11.21	11.32	-6.64	11	18	38.75	14	6	22.3	35.3
1190.3	9999.0	11.21	11.32	-6.64	11	18	38.75	14	6	22.3	35.3
1190.3	9999.0	11.21	11.32	-6.64	11	18	38.75	14	6	22.3	35.3
1190.3	9999.0	11.21	11.32	-6.64	11	18	38.75	14	6	22.3	35.3

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Depth (ft) 28.1 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
49.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 5.924

Pile and Soil Model Total Capacity Rut (kips) 1190.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.255	16919	0.010	0.000	0.85	0.0	0.000	0.100	3.32	4.2	22.5
2	0.255	16919	0.000	0.000	1.00	0.0	0.000	0.100	6.64	4.2	22.5
7	0.255	16919	0.000	0.000	1.00	0.0	0.050	0.100	23.23	4.2	22.5
8	0.255	16919	0.000	0.000	1.00	0.4	0.050	0.100	26.55	4.2	22.5
9	0.255	16919	0.000	0.000	1.00	3.8	0.050	0.100	29.87	4.2	22.5
10	0.255	16919	0.000	0.000	1.00	13.0	0.050	0.100	33.19	4.2	22.5
11	0.255	16919	0.000	0.000	1.00	19.2	0.050	0.100	36.51	4.2	22.5

12	0.255	16919	0.000	0.000	1.00	24.0	0.050	0.100	39.82	4.2	22.5
13	0.255	16919	0.000	0.000	1.00	28.7	0.050	0.100	43.14	4.2	22.5
14	0.255	16919	0.000	0.000	1.00	33.5	0.050	0.100	46.46	4.2	22.5
15	0.255	16919	0.000	0.000	1.00	38.3	0.050	0.100	49.78	4.2	22.5
Toe						1029.9	0.150	0.133			

3.820 kips total unreduced pile weight (g= 32.17 ft/s2)
3.820 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
28.12	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1190.8	9999.0	11.21	11.32	-6.64	11	18	38.73	14	6	22.3	35.3
1190.8	9999.0	11.21	11.32	-6.64	11	18	38.73	14	6	22.3	35.3
1190.8	9999.0	11.21	11.32	-6.64	11	18	38.73	14	6	22.3	35.3
1190.8	9999.0	11.21	11.32	-6.64	11	18	38.73	14	6	22.3	35.3
1190.8	9999.0	11.21	11.32	-6.64	11	18	38.73	14	6	22.3	35.3

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Depth (ft) 30.6 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L ft	b Top in2	Area ksi	E-Mod lb/ft3	Spec Wt ft	Perim	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1	
49.8	22.46	30000.	492.0	4.2	0	16807.	40.1	

Wave Travel Time 2L/c (ms) 5.924

Pile and Soil Model Total Capacity Rut (kips) 1222.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.255	16919	0.010	0.000	0.85	0.0	0.000	0.100	3.32	4.2	22.5
2	0.255	16919	0.000	0.000	1.00	0.0	0.000	0.100	6.64	4.2	22.5
6	0.255	16919	0.000	0.000	1.00	0.0	0.050	0.100	19.91	4.2	22.5
8	0.255	16919	0.000	0.000	1.00	3.1	0.050	0.100	26.55	4.2	22.5
9	0.255	16919	0.000	0.000	1.00	10.0	0.050	0.100	29.87	4.2	22.5

10	0.255	16919	0.000	0.000	1.00	18.0	0.050	0.100	33.19	4.2	22.5
11	0.255	16919	0.000	0.000	1.00	22.8	0.050	0.100	36.51	4.2	22.5
12	0.255	16919	0.000	0.000	1.00	27.5	0.050	0.100	39.82	4.2	22.5
13	0.255	16919	0.000	0.000	1.00	32.3	0.050	0.100	43.14	4.2	22.5
14	0.255	16919	0.000	0.000	1.00	37.1	0.050	0.100	46.46	4.2	22.5
15	0.255	16919	0.000	0.000	1.00	41.8	0.050	0.100	49.78	4.2	22.5
Toe						1029.9	0.150	0.133			

3.820 kips total unreduced pile weight (g= 32.17 ft/s2)
3.820 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
30.60	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1222.4	9999.0	11.11	11.20	-6.95	10	17	37.32	13	6	22.1	35.5
1222.4	9999.0	11.11	11.20	-6.95	10	17	37.32	13	6	22.1	35.5
1222.4	9999.0	11.11	11.20	-6.95	10	17	37.32	13	6	22.1	35.5
1222.4	9999.0	11.11	11.20	-6.95	10	17	37.32	13	6	22.1	35.5
1222.4	9999.0	11.11	11.20	-6.95	10	17	37.32	13	6	22.1	35.5

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Depth (ft) 33.1 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L ft	b Top in2	Area ksi	E-Mod lb/ft3	Spec Wt ft	Perim	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1	
49.8	22.46	30000.	492.0	4.2	0	16807.	40.1	

Wave Travel Time 2L/c (ms) 5.924

Pile and Soil Model Total Capacity Rut (kips) 1256.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.255	16919	0.010	0.000	0.85	0.0	0.000	0.100	3.32	4.2	22.5
2	0.255	16919	0.000	0.000	1.00	0.0	0.000	0.100	6.64	4.2	22.5
6	0.255	16919	0.000	0.000	1.00	0.0	0.050	0.100	19.91	4.2	22.5

7	0.255	16919	0.000	0.000	1.00	2.1	0.050	0.100	23.23	4.2	22.5
8	0.255	16919	0.000	0.000	1.00	7.1	0.050	0.100	26.55	4.2	22.5
9	0.255	16919	0.000	0.000	1.00	16.8	0.050	0.100	29.87	4.2	22.5
10	0.255	16919	0.000	0.000	1.00	21.6	0.050	0.100	33.19	4.2	22.5
11	0.255	16919	0.000	0.000	1.00	26.3	0.050	0.100	36.51	4.2	22.5
12	0.255	16919	0.000	0.000	1.00	31.1	0.050	0.100	39.82	4.2	22.5
13	0.255	16919	0.000	0.000	1.00	35.8	0.050	0.100	43.14	4.2	22.5
14	0.255	16919	0.000	0.000	1.00	40.6	0.050	0.100	46.46	4.2	22.5
15	0.255	16919	0.000	0.000	1.00	45.4	0.050	0.100	49.78	4.2	22.5
Toe						1029.9	0.150	0.133			

3.820 kips total unreduced pile weight (g= 32.17 ft/s2)
3.820 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
33.08	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1256.8	9999.0	11.02	11.06	-7.03	7	16	35.87	13	6	21.8	35.7
1256.8	9999.0	11.02	11.06	-7.03	7	16	35.87	13	6	21.8	35.7
1256.8	9999.0	11.02	11.06	-7.03	7	16	35.87	13	6	21.8	35.7
1256.8	9999.0	11.02	11.06	-7.03	7	16	35.87	13	6	21.8	35.7
1256.8	9999.0	11.02	11.06	-7.03	7	16	35.87	13	6	21.8	35.7

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Depth (ft) 33.1 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
49.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 5.924

Pile and Soil Model Total Capacity Rut (kips) 1257.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2

1	0.255	16919	0.010	0.000	0.85	0.0	0.000	0.100	3.32	4.2	22.5
2	0.255	16919	0.000	0.000	1.00	0.0	0.000	0.100	6.64	4.2	22.5
6	0.255	16919	0.000	0.000	1.00	0.0	0.050	0.100	19.91	4.2	22.5
7	0.255	16919	0.000	0.000	1.00	2.2	0.050	0.100	23.23	4.2	22.5
8	0.255	16919	0.000	0.000	1.00	7.3	0.050	0.100	26.55	4.2	22.5
9	0.255	16919	0.000	0.000	1.00	16.9	0.050	0.100	29.87	4.2	22.5
10	0.255	16919	0.000	0.000	1.00	21.6	0.050	0.100	33.19	4.2	22.5
11	0.255	16919	0.000	0.000	1.00	26.4	0.050	0.100	36.51	4.2	22.5
12	0.255	16919	0.000	0.000	1.00	31.1	0.050	0.100	39.82	4.2	22.5
13	0.255	16919	0.000	0.000	1.00	35.9	0.050	0.100	43.14	4.2	22.5
14	0.255	16919	0.000	0.000	1.00	40.7	0.050	0.100	46.46	4.2	22.5
15	0.255	16919	0.000	0.000	1.00	45.4	0.050	0.100	49.78	4.2	22.5
Toe						1029.9	0.150	0.133			

3.820 kips total unreduced pile weight (g= 32.17 ft/s2)
3.820 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
33.12	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1257.4	9999.0	11.01	11.06	-7.05	7	16	35.84	13	6	21.8	35.7
1257.4	9999.0	11.01	11.06	-7.05	7	16	35.84	13	6	21.8	35.7
1257.4	9999.0	11.01	11.06	-7.05	7	16	35.84	13	6	21.8	35.7
1257.4	9999.0	11.01	11.06	-7.05	7	16	35.84	13	6	21.8	35.7
1257.4	9999.0	11.01	11.06	-7.05	7	16	35.84	13	6	21.8	35.7

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Depth (ft) 41.4 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
49.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 5.924

Pile and Soil Model Total Capacity Rut (kips) 1392.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.255	16919	0.010	0.000	0.85	0.0	0.000	0.100	3.32	4.2	22.5
2	0.255	16919	0.000	0.000	1.00	0.0	0.000	0.100	6.64	4.2	22.5
3	0.255	16919	0.000	0.000	1.00	0.0	0.050	0.100	9.96	4.2	22.5
4	0.255	16919	0.000	0.000	1.00	0.4	0.050	0.100	13.27	4.2	22.5
5	0.255	16919	0.000	0.000	1.00	3.8	0.050	0.100	16.59	4.2	22.5
6	0.255	16919	0.000	0.000	1.00	13.2	0.050	0.100	19.91	4.2	22.5
7	0.255	16919	0.000	0.000	1.00	19.3	0.050	0.100	23.23	4.2	22.5
8	0.255	16919	0.000	0.000	1.00	24.0	0.050	0.100	26.55	4.2	22.5
9	0.255	16919	0.000	0.000	1.00	28.8	0.050	0.100	29.87	4.2	22.5
10	0.255	16919	0.000	0.000	1.00	33.5	0.050	0.100	33.19	4.2	22.5
11	0.255	16919	0.000	0.000	1.00	38.3	0.050	0.100	36.51	4.2	22.5
12	0.255	16919	0.000	0.000	1.00	43.1	0.050	0.100	39.82	4.2	22.5
13	0.255	16919	0.000	0.000	1.00	47.8	0.050	0.100	43.14	4.2	22.5
14	0.255	16919	0.000	0.000	1.00	52.6	0.050	0.100	46.46	4.2	22.5
15	0.255	16919	0.000	0.000	1.00	57.3	0.050	0.100	49.78	4.2	22.5
Toe						1029.9	0.150	0.133			

3.820 kips total unreduced pile weight (g= 32.17 ft/s2)
3.820 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
41.43	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1392.0	9999.0	10.67	10.64	-6.28	8	16	31.00	12	6	20.5	36.3
1392.0	9999.0	10.67	10.64	-6.28	8	16	31.00	12	6	20.5	36.3
1392.0	9999.0	10.67	10.64	-6.28	8	16	31.00	12	6	20.5	36.3
1392.0	9999.0	10.67	10.64	-6.28	8	16	31.00	12	6	20.5	36.3
1392.0	9999.0	10.67	10.64	-6.28	8	16	31.00	12	6	20.5	36.3

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Depth (ft) 49.8 Standard Soil Setup
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c

ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
49.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 5.924

Pile and Soil Model — Total Capacity Rut (kips) 1557.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.255	16919	0.010	0.000	0.85	0.0	0.050	0.100	3.32	4.2	22.5
2	0.255	16919	0.000	0.000	1.00	2.3	0.050	0.100	6.64	4.2	22.5
3	0.255	16919	0.000	0.000	1.00	7.5	0.050	0.100	9.96	4.2	22.5
4	0.255	16919	0.000	0.000	1.00	17.0	0.050	0.100	13.27	4.2	22.5
5	0.255	16919	0.000	0.000	1.00	21.7	0.050	0.100	16.59	4.2	22.5
6	0.255	16919	0.000	0.000	1.00	26.5	0.050	0.100	19.91	4.2	22.5
7	0.255	16919	0.000	0.000	1.00	31.2	0.050	0.100	23.23	4.2	22.5
8	0.255	16919	0.000	0.000	1.00	36.0	0.050	0.100	26.55	4.2	22.5
9	0.255	16919	0.000	0.000	1.00	40.8	0.050	0.100	29.87	4.2	22.5
10	0.255	16919	0.000	0.000	1.00	45.5	0.050	0.100	33.19	4.2	22.5
11	0.255	16919	0.000	0.000	1.00	50.3	0.050	0.100	36.51	4.2	22.5
12	0.255	16919	0.000	0.000	1.00	55.0	0.050	0.100	39.82	4.2	22.5
13	0.255	16919	0.000	0.000	1.00	59.8	0.050	0.100	43.14	4.2	22.5
14	0.255	16919	0.000	0.000	1.00	64.5	0.050	0.100	46.46	4.2	22.5
15	0.255	16919	0.000	0.000	1.00	69.3	0.050	0.100	49.78	4.2	22.5
Toe						1029.9	0.150	0.133			

3.820 kips total unreduced pile weight (g= 32.17 ft/s2)
3.820 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
49.78	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1557.2	9999.0	10.33	10.25	-3.98	6	14	28.81	4	7	18.9	37.0
1557.2	9999.0	10.33	10.25	-3.98	6	14	28.81	4	7	18.9	37.0
1557.2	9999.0	10.33	10.25	-3.98	6	14	28.81	4	7	18.9	37.0
1557.2	9999.0	10.33	10.25	-3.98	6	14	28.81	4	7	18.9	37.0
1557.2	9999.0	10.33	10.25	-3.98	6	14	28.81	4	7	18.9	37.0

CUY-14-6.93, PID 104132 : 00/00/0000 : K 01/25/2023
National Engineering & Architectural Ser GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 1.000 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
8.8	25.7	4.9	20.7	1.9	10.243	-0.056	4.55	24.7
8.8	377.7	5.0	372.7	64.0	31.624	-2.136	9.25	18.7
18.5	825.9	62.7	763.2	2270.4	42.351	-4.557	11.52	23.2
28.1	1190.3	160.4	1029.9	9999.0	38.751	-6.637	11.21	22.3
28.1	1190.8	160.9	1029.9	9999.0	38.729	-6.640	11.21	22.3
30.6	1222.4	192.6	1029.9	9999.0	37.318	-6.955	11.11	22.1
33.1	1256.8	226.9	1029.9	9999.0	35.867	-7.034	11.02	21.8
33.1	1257.4	227.5	1029.9	9999.0	35.845	-7.051	11.01	21.8
41.4	1392.0	362.1	1029.9	9999.0	31.004	-6.277	10.67	20.5
49.8	1557.2	527.4	1029.9	9999.0	28.810	-3.979	10.33	18.9

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 1.000 1.000

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28.1	1190.8	160.9	1029.9	9999.0	38.729	-6.640	11.21	22.3
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33.1	1256.8	226.9	1029.9	9999.0	35.867	-7.034	11.02	21.8
33.1	1257.4	227.5	1029.9	9999.0	35.845	-7.051	11.01	21.8
41.4	1392.0	362.1	1029.9	9999.0	31.004	-6.277	10.67	20.5
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Refusal occurred; no driving time output possible

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National Engineering & Architectural Ser GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

Depth	Temp. Length	Wait Time	Equivalent Pressure Stroke	Ratio	Efficy.	Stiffn. Factor	Cushion CoR
ft	ft	hr	ft				
8.78	49.78	0.00	10.81	1.00	0.80	1.00	1.00

8.82	49.78	0.00	10.81	1.00	0.80	1.00	1.00
18.45	49.78	0.00	10.81	1.00	0.80	1.00	1.00
28.08	49.78	0.00	10.81	1.00	0.80	1.00	1.00
28.12	49.78	0.00	10.81	1.00	0.80	1.00	1.00
30.60	49.78	0.00	10.81	1.00	0.80	1.00	1.00
33.08	49.78	0.00	10.81	1.00	0.80	1.00	1.00
33.12	49.78	0.00	10.81	1.00	0.80	1.00	1.00
41.43	49.78	0.00	10.81	1.00	0.80	1.00	1.00
49.78	49.78	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	0.00	0.00	0.100	0.267	0.050	0.150	1.000	6.000	1.000
4.49	0.00	0.00	0.100	0.267	0.050	0.150	1.000	6.000	1.000
4.50	0.22	14.40	0.100	0.267	0.050	0.150	1.000	6.000	1.000
4.79	0.23	15.33	0.100	0.267	0.050	0.150	1.000	6.000	1.000
4.81	0.24	15.37	0.100	0.267	0.050	0.150	1.000	6.000	1.000
8.79	0.32	20.75	0.100	0.267	0.050	0.150	1.000	6.000	1.000
8.81	0.93	372.24	0.100	0.133	0.050	0.150	1.000	6.000	1.000
17.81	1.86	742.80	0.100	0.133	0.050	0.150	1.000	6.000	1.000
26.81	2.79	1029.88	0.100	0.133	0.050	0.150	1.000	6.000	1.000
28.09	2.92	1029.88	0.100	0.133	0.050	0.150	1.000	6.000	1.000
28.11	2.92	1029.88	0.100	0.133	0.050	0.150	1.000	6.000	1.000
33.09	3.43	1029.88	0.100	0.133	0.050	0.150	1.000	6.000	1.000
33.11	3.44	1029.88	0.100	0.133	0.050	0.150	1.000	6.000	1.000
42.11	4.36	1029.88	0.100	0.133	0.050	0.150	1.000	6.000	1.000
49.78	5.15	1029.88	0.100	0.133	0.050	0.150	1.000	6.000	1.000

PIER 1

Gain/Loss 3 at Shaft and Toe 0.830 / 1.000

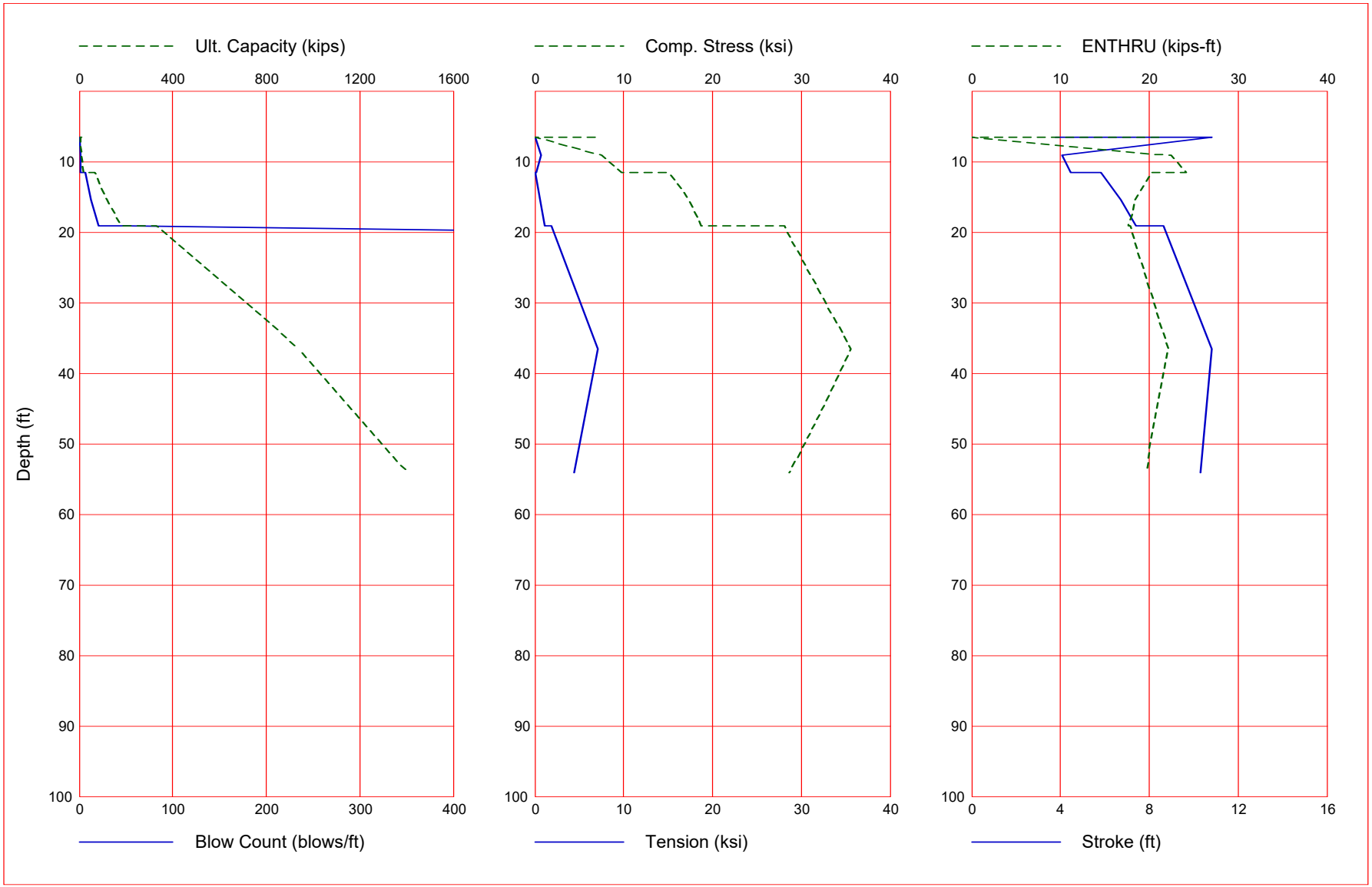
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
6.6	8.2	0.2	8.0	1.2	6.787	-0.125	3.79	21.1
6.6	4.1	0.2	3.9	0.0	0.000	0.000	10.81	0.0
9.1	11.4	1.2	10.2	1.4	7.497	-0.679	4.07	22.5
11.6	19.5	3.0	16.4	1.7	9.748	-0.183	4.46	24.2
11.6	68.3	3.1	65.2	6.5	15.095	-0.027	5.84	20.2
15.4	120.8	13.4	107.4	13.1	17.299	-0.605	6.73	18.4
19.1	178.4	28.7	149.7	21.1	18.766	-1.095	7.40	17.6
19.1	330.1	28.9	301.2	50.8	28.142	-1.827	8.63	17.9
36.6	936.6	180.0	756.5	9999.0	35.528	-7.073	10.81	22.1
54.1	1407.9	461.8	946.1	9999.0	28.684	-4.415	10.30	19.8

Refusal occurred; no driving time output possible

National Engineering & Architectural Ser
CUY-14-6.93, PID 104132 : 10/25/2021 : K

Jan 25 2023
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 0.830 / 1.000



GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

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 building and other factors.

Input File: C:\USERS\KARENS\DESKTOP\GRL FILES\P116IN1.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

CUY-14-6.93, PID 104132 : 10/25/2021 : K

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	144.000	16.000	Unknown

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
2.500	22.450	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
54.070	22.46	30000.0	492.000	4.190	0	0.850	0.010

FFatigue	F0	0-Bottom
0	0.000	0.000

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.0020	0.0020	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1600.00	1440.00	1295.00	1165.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1600.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Research Toe Plug: Res-int, Q-int, D-int, Res-plug, Q-plug, D-plug

0.000	0.000	0.000	0.000	0.000	0.000

Research Toe Plug: RD plug toe: m, d

0.000	0.000

Research Toe Plug: New Toe Plug Model is NOT applied

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimL	TSf0
0.01	0.00	0.00	0.10	0.14	0.10	0.15	1.21	6.00	24.000
4.99	0.00	0.00	0.10	0.14	0.10	0.15	1.21	6.00	24.000
5.00	0.00	-1.37	0.10	0.14	0.10	0.15	1.21	6.00	24.000
6.59	0.08	8.03	0.10	0.14	0.10	0.15	1.21	6.00	24.000
6.61	0.05	3.84	0.10	0.19	0.05	0.15	1.00	6.00	1.000
11.59	0.22	16.47	0.10	0.19	0.05	0.15	1.00	6.00	1.000
11.61	0.50	65.08	0.10	0.14	0.05	0.15	1.00	6.00	1.000
19.09	1.14	149.81	0.10	0.14	0.05	0.15	1.00	6.00	1.000
19.11	1.17	300.96	0.10	0.13	0.05	0.15	1.00	6.00	1.000
28.11	2.09	535.66	0.10	0.13	0.05	0.15	1.00	6.00	1.000

37.11	3.01	770.37	0.10	0.13	0.05	0.15	1.00	6.00	1.000
46.11	3.92	946.11	0.10	0.13	0.05	0.15	1.00	6.00	1.000
54.07	4.74	946.11	0.10	0.13	0.05	0.15	1.00	6.00	1.000

Gain/Loss factors: shaft and toe

0.79600	0.81300	0.83000	0.84700	0.86400
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
6.58	0.00	0.00	0.000	0.0	0.000	0.000	0.000
6.62	0.00	0.00	0.000	0.0	0.000	0.000	0.000
9.10	0.00	0.00	0.000	0.0	0.000	0.000	0.000
11.58	0.00	0.00	0.000	0.0	0.000	0.000	0.000
11.62	0.00	0.00	0.000	0.0	0.000	0.000	0.000
15.35	0.00	0.00	0.000	0.0	0.000	0.000	0.000
19.08	0.00	0.00	0.000	0.0	0.000	0.000	0.000
19.12	0.00	0.00	0.000	0.0	0.000	0.000	0.000
36.58	0.00	0.00	0.000	0.0	0.000	0.000	0.000
54.07	0.00	0.00	0.000	0.0	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

CUY-14-6.93, PID 104132 : 10/25/2021 : K

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.6	1.000	0.0000	
3	0.800	140046.6	1.000	0.0000	
4	0.800	140046.6	1.000	0.0000	
5	0.800	140046.6	1.000	0.0000	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	2.500	5949.2	0.800	0.0100	5.8
Combined Pile Top		16615.5			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight (kips)	4.00	Ram Length (inch)	129.10
Maximum Stroke (ft)	11.86		
Rated Stroke (ft)	10.81	Efficiency	0.800
Maximum Pressure (psi)	1600.00	Actual Pressure (psi)	1600.00
Compression Exponent	1.350	Expansion Exponent	1.250

Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	22.45	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	5949.2	Stiffness	(kips/in)	0.0

Depth	(ft)	6.6	Standard Soil Setup		
Shaft Gain/Loss Factor		0.796	Toe Gain/Loss Factor		1.000

PILE PROFILE:					
Toe Area	(in2)	144.000	Pile Type		Unknown
Pile Size	(inch)	16.000			

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
	ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	54.1	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.434

Pile and Soil Model — Total Capacity Rut (kips): 8.2

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	0.259	16615	0.010	0.000	0.85	0.0	0.000	0.100	3.38	4.2	22.5
2	0.259	16615	0.000	0.000	1.00	0.0	0.000	0.100	6.76	4.2	22.5
15	0.259	16615	0.000	0.000	1.00	0.0	0.100	0.100	50.69	4.2	22.5
16	0.259	16616	0.000	0.000	1.00	0.2	0.100	0.100	54.07	4.2	22.5
Toe						8.0	0.150	0.143			

4.149 kips total unreduced pile weight (g= 32.17 ft/s2)
4.149 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:					
Uniform pile			Pile Segments: Automatic		
No. of Slacks/Splices		0	Pile Damping	(%)	1
			Pile Damping Fact.(k/ft/s)		0.802

Driveability Analysis
Soil Damping Option Smith
Max No Analysis Iterations 0 Time Increment/Critical 160
Output Time Interval 1 Analysis Time-Input (ms) 0
Output Level: Normal
Gravity Mass, Pile, Hammer: 32.170 32.170 32.170
Output Segment Generation: Automatic

Depth ft	Stroke ft	Pressure Ratio	Efficy
6.58	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
8.2	1.2	3.79	3.80	-0.11	8	12	6.78	1	7	21.1	60.7
8.2	1.2	3.79	3.81	-0.12	8	12	6.78	1	7	21.1	60.7
8.2	1.2	3.79	3.81	-0.13	8	12	6.79	1	7	21.1	60.7
8.2	1.2	3.79	3.81	-0.13	8	12	6.79	1	7	21.1	60.7
8.2	1.2	3.79	3.81	-0.13	8	12	6.79	1	7	21.1	60.7

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Depth (ft) 6.6 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
54.1	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.434

Pile and Soil Model Total Capacity Rut (kips) 4.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.259	16615	0.010	0.000	0.85	0.0	0.000	0.100	3.38	4.2	22.5
2	0.259	16615	0.000	0.000	1.00	0.0	0.000	0.100	6.76	4.2	22.5
15	0.259	16615	0.000	0.000	1.00	0.0	0.100	0.100	50.69	4.2	22.5
16	0.259	16616	0.000	0.000	1.00	0.2	0.099	0.100	54.07	4.2	22.5
Toe						3.9	0.150	0.192			

4.149 kips total unreduced pile weight (g= 32.17 ft/s2)

4.149 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
6.62	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.4 4.1
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.4 4.1
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.4 4.1
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.4 4.1
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.4 4.1
Hammer+Pile Weight > Rult: Pile Runs

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
4.1	0.0	10.81	0.00	0.00	1	0	0.00	1	7	0.0	78.4
4.1	0.0	10.81	0.00	0.00	1	0	0.00	1	7	0.0	78.4
4.1	0.0	10.81	0.00	0.00	1	0	0.00	1	7	0.0	78.4
4.1	0.0	10.81	0.00	0.00	1	0	0.00	1	7	0.0	78.4
4.1	0.0	10.81	0.00	0.00	1	0	0.00	1	7	0.0	78.4

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Depth (ft) 9.1 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s

0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
54.1	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.434

Pile and Soil Model — Total Capacity Rut (kips) 11.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.259	16615	0.010	0.000	0.85	0.0	0.000	0.100	3.38	4.2	22.5
2	0.259	16615	0.000	0.000	1.00	0.0	0.000	0.100	6.76	4.2	22.5
14	0.259	16615	0.000	0.000	1.00	0.0	0.100	0.100	47.31	4.2	22.5
15	0.259	16615	0.000	0.000	1.00	0.0	0.100	0.100	50.69	4.2	22.5
16	0.259	16616	0.000	0.000	1.00	1.2	0.059	0.100	54.07	4.2	22.5
Toe						10.2	0.150	0.192			

4.149 kips total unreduced pile weight (g= 32.17 ft/s2)
4.149 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
9.10	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
11.4	1.4	4.07	4.07	-0.68	7	11	7.50	1	6	22.5	58.7
11.4	1.4	4.07	4.07	-0.68	7	11	7.50	1	6	22.5	58.7
11.4	1.4	4.07	4.07	-0.68	7	11	7.50	1	6	22.5	58.7
11.4	1.4	4.07	4.07	-0.67	7	11	7.48	1	6	22.5	58.7
11.4	1.4	4.07	4.07	-0.68	7	11	7.49	1	6	22.5	58.7

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Depth (ft) 11.6 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
54.1	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.434

Pile and Soil Model — Total Capacity Rut (kips) 19.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.259	16615	0.010	0.000	0.85	0.0	0.000	0.100	3.38	4.2	22.5
2	0.259	16615	0.000	0.000	1.00	0.0	0.000	0.100	6.76	4.2	22.5
13	0.259	16615	0.000	0.000	1.00	0.0	0.100	0.100	43.93	4.2	22.5
15	0.259	16615	0.000	0.000	1.00	0.7	0.067	0.100	50.69	4.2	22.5
16	0.259	16616	0.000	0.000	1.00	2.3	0.050	0.100	54.07	4.2	22.5
Toe						16.4	0.150	0.192			

4.149 kips total unreduced pile weight (g= 32.17 ft/s2)
4.149 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
11.58	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
19.5	1.7	4.46	4.48	-0.18	3	36	9.75	1	3	24.2	56.1
19.5	1.7	4.46	4.48	-0.18	3	36	9.75	1	3	24.2	56.1
19.5	1.7	4.46	4.48	-0.18	3	36	9.75	1	3	24.2	56.1
19.5	1.7	4.46	4.48	-0.18	3	36	9.75	1	3	24.2	56.1
19.5	1.7	4.46	4.48	-0.18	3	36	9.75	1	3	24.2	56.1

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Depth (ft) 11.6 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L ft	b Top in2	Area ksi	E-Mod lb/ft3	Spec Wt ft	Perim	C Index ft/s	Wave Sp k/ft/s	EA/c
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1	
54.1	22.46	30000.	492.0	4.2	0	16807.	40.1	

Wave Travel Time 2L/c (ms) 6.434

Pile and Soil Model — Total Capacity Rut (kips) 68.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2

1	0.259	16615	0.010	0.000	0.85	0.0	0.000	0.100	3.38	4.2	22.5
2	0.259	16615	0.000	0.000	1.00	0.0	0.000	0.100	6.76	4.2	22.5
13	0.259	16615	0.000	0.000	1.00	0.0	0.100	0.100	43.93	4.2	22.5
15	0.259	16615	0.000	0.000	1.00	0.8	0.067	0.100	50.69	4.2	22.5
16	0.259	16616	0.000	0.000	1.00	2.3	0.050	0.100	54.07	4.2	22.5
Toe						65.2	0.150	0.137			

4.149 kips total unreduced pile weight (g= 32.17 ft/s2)
4.149 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
11.62	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
68.3	6.5	5.84	5.89	-0.03	2	10	15.09	8	5	20.1	48.8
68.3	6.5	5.84	5.89	-0.03	2	10	15.09	8	5	20.2	48.8
68.3	6.5	5.84	5.89	-0.03	2	10	15.09	8	5	20.2	48.8
68.3	6.5	5.84	5.89	-0.03	2	10	15.09	8	5	20.1	48.8
68.3	6.5	5.84	5.89	-0.02	2	10	15.07	8	5	20.1	48.8

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Depth (ft) 15.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
54.1	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.434

Pile and Soil Model Total Capacity Rut (kips) 120.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.259	16615	0.010	0.000	0.85	0.0	0.000	0.100	3.38	4.2	22.5
2	0.259	16615	0.000	0.000	1.00	0.0	0.000	0.100	6.76	4.2	22.5
12	0.259	16615	0.000	0.000	1.00	0.0	0.100	0.100	40.55	4.2	22.5
13	0.259	16615	0.000	0.000	1.00	0.0	0.100	0.100	43.93	4.2	22.5

14	0.259	16615	0.000	0.000	1.00	0.9	0.064	0.100	47.31	4.2	22.5
15	0.259	16615	0.000	0.000	1.00	2.9	0.050	0.100	50.69	4.2	22.5
16	0.259	16616	0.000	0.000	1.00	9.5	0.050	0.100	54.07	4.2	22.5
Toe						107.4	0.150	0.137			

4.149 kips total unreduced pile weight (g= 32.17 ft/s2)
4.149 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
15.35	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
120.8	13.1	6.73	6.75	-0.61	13	44	17.30	9	5	18.4	45.5
120.8	13.1	6.73	6.75	-0.61	13	44	17.27	9	5	18.3	45.5
120.8	13.1	6.73	6.75	-0.61	13	44	17.30	9	5	18.4	45.5
120.8	13.1	6.73	6.75	-0.61	13	44	17.30	9	5	18.4	45.5
120.9	13.1	6.73	6.75	-0.61	13	44	17.30	9	5	18.4	45.5

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Depth (ft) 19.1 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
54.1	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.434

Pile and Soil Model Total Capacity Rut (kips) 178.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.259	16615	0.010	0.000	0.85	0.0	0.000	0.100	3.38	4.2	22.5
2	0.259	16615	0.000	0.000	1.00	0.0	0.000	0.100	6.76	4.2	22.5
11	0.259	16615	0.000	0.000	1.00	0.0	0.100	0.100	37.17	4.2	22.5
12	0.259	16615	0.000	0.000	1.00	0.0	0.100	0.100	40.55	4.2	22.5
13	0.259	16615	0.000	0.000	1.00	1.1	0.061	0.100	43.93	4.2	22.5
14	0.259	16615	0.000	0.000	1.00	3.5	0.050	0.100	47.31	4.2	22.5

15	0.259	16615	0.000	0.000	1.00	10.0	0.050	0.100	50.69	4.2	22.5
16	0.259	16616	0.000	0.000	1.00	14.1	0.050	0.100	54.07	4.2	22.5
Toe						149.7	0.150	0.137			

4.149 kips total unreduced pile weight (g= 32.17 ft/s2)
4.149 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
19.08	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
178.4	21.1	7.40	7.36	-1.10	14	36	18.77	9	5	17.6	43.5
178.4	21.2	7.40	7.37	-1.09	14	36	18.75	9	5	17.5	43.5
178.4	21.1	7.40	7.36	-1.10	14	36	18.77	9	5	17.6	43.5
178.4	21.2	7.40	7.37	-1.09	14	36	18.75	9	5	17.5	43.5
178.4	21.1	7.40	7.36	-1.10	14	36	18.78	9	5	17.6	43.5

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Depth (ft) 19.1 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
54.1	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.434

Pile and Soil Model Total Capacity Rut (kips) 330.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.259	16615	0.010	0.000	0.85	0.0	0.000	0.100	3.38	4.2	22.5
2	0.259	16615	0.000	0.000	1.00	0.0	0.000	0.100	6.76	4.2	22.5
11	0.259	16615	0.000	0.000	1.00	0.0	0.100	0.100	37.17	4.2	22.5
12	0.259	16615	0.000	0.000	1.00	0.0	0.100	0.100	40.55	4.2	22.5
13	0.259	16615	0.000	0.000	1.00	1.1	0.060	0.100	43.93	4.2	22.5
14	0.259	16615	0.000	0.000	1.00	3.6	0.050	0.100	47.31	4.2	22.5
15	0.259	16615	0.000	0.000	1.00	10.0	0.050	0.100	50.69	4.2	22.5

16	0.259	16616	0.000	0.000	1.00	14.2	0.050	0.100	54.07	4.2	22.5
Toe						301.2	0.150	0.133			

4.149 kips total unreduced pile weight (g= 32.17 ft/s2)
4.149 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
19.12	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
330.1	50.9	8.63	8.71	-1.82	8	21	28.16	15	6	17.9	40.1
330.1	50.8	8.63	8.71	-1.83	8	21	28.14	15	6	17.9	40.1
330.1	50.8	8.63	8.71	-1.83	8	21	28.14	15	6	17.9	40.1
330.1	50.8	8.63	8.71	-1.83	8	21	28.14	15	6	17.9	40.1
330.1	50.9	8.63	8.71	-1.83	8	21	28.14	15	6	17.9	40.1

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Depth (ft) 36.6 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
54.1	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.434

Pile and Soil Model Total Capacity Rut (kips) 936.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.259	16615	0.010	0.000	0.85	0.0	0.000	0.100	3.38	4.2	22.5
2	0.259	16615	0.000	0.000	1.00	0.0	0.000	0.100	6.76	4.2	22.5
6	0.259	16615	0.000	0.000	1.00	0.0	0.100	0.100	20.28	4.2	22.5
7	0.259	16615	0.000	0.000	1.00	0.1	0.100	0.100	23.66	4.2	22.5
8	0.259	16615	0.000	0.000	1.00	1.3	0.055	0.100	27.04	4.2	22.5
9	0.259	16615	0.000	0.000	1.00	4.7	0.050	0.100	30.41	4.2	22.5
10	0.259	16616	0.000	0.000	1.00	10.7	0.050	0.100	33.79	4.2	22.5
11	0.259	16615	0.000	0.000	1.00	14.9	0.050	0.100	37.17	4.2	22.5

12	0.259	16615	0.000	0.000	1.00	19.9	0.050	0.100	40.55	4.2	22.5
13	0.259	16615	0.000	0.000	1.00	24.8	0.050	0.100	43.93	4.2	22.5
14	0.259	16615	0.000	0.000	1.00	29.7	0.050	0.100	47.31	4.2	22.5
15	0.259	16615	0.000	0.000	1.00	34.5	0.050	0.100	50.69	4.2	22.5
16	0.259	16616	0.000	0.000	1.00	39.4	0.050	0.100	54.07	4.2	22.5
Toe						756.5	0.150	0.133			

4.149 kips total unreduced pile weight (g= 32.17 ft/s2)
4.149 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
36.58	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
936.5	9999.0	10.81	10.81	-7.07	10	19	35.53	15	6	22.1	36.1
936.6	9999.0	10.81	10.81	-7.07	10	19	35.53	15	6	22.1	36.1
936.6	9999.0	10.81	10.81	-7.07	10	19	35.53	15	6	22.1	36.1
936.6	9999.0	10.81	10.81	-7.07	10	19	35.53	15	6	22.1	36.1
936.6	9999.0	10.81	10.81	-7.07	10	19	35.53	15	6	22.1	36.1

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Depth (ft) 54.1 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
54.1	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.434

Pile and Soil Model Total Capacity Rut (kips) 1407.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.259	16615	0.010	0.000	0.85	0.0	0.100	0.100	3.38	4.2	22.5
2	0.259	16615	0.000	0.000	1.00	0.3	0.094	0.100	6.76	4.2	22.5
3	0.259	16616	0.000	0.000	1.00	1.6	0.050	0.100	10.14	4.2	22.5
4	0.259	16615	0.000	0.000	1.00	5.8	0.050	0.100	13.52	4.2	22.5

5	0.259	16615	0.000	0.000	1.00	11.4	0.050	0.100	16.90	4.2	22.5
6	0.259	16615	0.000	0.000	1.00	15.8	0.050	0.100	20.28	4.2	22.5
7	0.259	16615	0.000	0.000	1.00	20.8	0.050	0.100	23.66	4.2	22.5
8	0.259	16615	0.000	0.000	1.00	25.6	0.050	0.100	27.04	4.2	22.5
9	0.259	16615	0.000	0.000	1.00	30.5	0.050	0.100	30.41	4.2	22.5
10	0.259	16616	0.000	0.000	1.00	35.4	0.050	0.100	33.79	4.2	22.5
11	0.259	16615	0.000	0.000	1.00	40.2	0.050	0.100	37.17	4.2	22.5
12	0.259	16615	0.000	0.000	1.00	45.1	0.050	0.100	40.55	4.2	22.5
13	0.259	16615	0.000	0.000	1.00	50.0	0.050	0.100	43.93	4.2	22.5
14	0.259	16615	0.000	0.000	1.00	54.9	0.050	0.100	47.31	4.2	22.5
15	0.259	16615	0.000	0.000	1.00	59.7	0.050	0.100	50.69	4.2	22.5
16	0.259	16616	0.000	0.000	1.00	64.6	0.050	0.100	54.07	4.2	22.5
Toe						946.1	0.150	0.133			

4.149 kips total unreduced pile weight (g= 32.17 ft/s2)
4.149 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
54.07	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1407.9	9999.0	10.30	10.22	-4.42	7	16	28.68	5	8	19.8	37.0
1407.9	9999.0	10.30	10.22	-4.40	7	16	28.68	5	8	19.7	37.0
1407.9	9999.0	10.30	10.22	-4.42	7	16	28.68	5	8	19.8	37.0
1407.9	9999.0	10.30	10.22	-4.41	7	16	28.68	5	8	19.8	37.0
1407.9	9999.0	10.30	10.22	-4.42	7	16	28.68	5	8	19.8	37.0

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SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.796 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
6.6	8.2	0.2	8.0	1.2	6.776	-0.111	3.79	21.1
6.6	4.1	0.2	3.9	0.0	0.000	0.000	10.81	0.0
9.1	11.4	1.2	10.2	1.4	7.501	-0.682	4.07	22.5
11.6	19.5	3.0	16.4	1.7	9.750	-0.183	4.46	24.2
11.6	68.3	3.1	65.2	6.5	15.088	-0.027	5.84	20.1
15.4	120.8	13.4	107.4	13.1	17.298	-0.605	6.73	18.4
19.1	178.4	28.7	149.7	21.1	18.773	-1.096	7.40	17.6
19.1	330.1	28.9	301.2	50.9	28.158	-1.824	8.63	17.9
36.6	936.5	180.0	756.5	9999.0	35.528	-7.074	10.81	22.1

54.1	1407.9	461.8	946.1	9999.0	28.683	-4.417	10.30	19.8

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.813 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
6.6	8.2	0.2	8.0	1.2	6.781	-0.121	3.79	21.1
6.6	4.1	0.2	3.9	0.0	0.000	0.000	10.81	0.0
9.1	11.4	1.2	10.2	1.4	7.504	-0.683	4.07	22.5
11.6	19.5	3.0	16.4	1.7	9.750	-0.183	4.46	24.2
11.6	68.3	3.1	65.2	6.5	15.094	-0.028	5.84	20.2
15.4	120.8	13.4	107.4	13.1	17.267	-0.609	6.73	18.3
19.1	178.4	28.7	149.7	21.2	18.749	-1.093	7.40	17.5
19.1	330.1	28.9	301.2	50.8	28.140	-1.827	8.63	17.9
36.6	936.6	180.0	756.5	9999.0	35.528	-7.074	10.81	22.1
54.1	1407.9	461.8	946.1	9999.0	28.680	-4.405	10.30	19.7

Refusal occurred; no driving time output possible

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.830 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
6.6	8.2	0.2	8.0	1.2	6.787	-0.125	3.79	21.1
6.6	4.1	0.2	3.9	0.0	0.000	0.000	10.81	0.0
9.1	11.4	1.2	10.2	1.4	7.497	-0.679	4.07	22.5
11.6	19.5	3.0	16.4	1.7	9.748	-0.183	4.46	24.2
11.6	68.3	3.1	65.2	6.5	15.095	-0.027	5.84	20.2
15.4	120.8	13.4	107.4	13.1	17.299	-0.605	6.73	18.4
19.1	178.4	28.7	149.7	21.1	18.766	-1.095	7.40	17.6
19.1	330.1	28.9	301.2	50.8	28.142	-1.827	8.63	17.9
36.6	936.6	180.0	756.5	9999.0	35.528	-7.073	10.81	22.1
54.1	1407.9	461.8	946.1	9999.0	28.684	-4.415	10.30	19.8

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.847 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
6.6	8.2	0.2	8.0	1.2	6.788	-0.131	3.79	21.1
6.6	4.1	0.2	3.9	0.0	0.000	0.000	10.81	0.0
9.1	11.4	1.2	10.2	1.4	7.482	-0.673	4.07	22.5
11.6	19.5	3.1	16.4	1.7	9.752	-0.181	4.46	24.2
11.6	68.3	3.1	65.2	6.5	15.088	-0.028	5.84	20.1
15.4	120.8	13.4	107.4	13.1	17.299	-0.606	6.73	18.4

19.1	178.4	28.7	149.7	21.2	18.748	-1.093	7.40	17.5
19.1	330.1	28.9	301.2	50.8	28.142	-1.828	8.63	17.9
36.6	936.6	180.0	756.5	9999.0	35.527	-7.073	10.81	22.1
54.1	1407.9	461.8	946.1	9999.0	28.683	-4.414	10.30	19.8

Refusal occurred; no driving time output possible

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.864 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
6.6	8.2	0.2	8.0	1.2	6.793	-0.134	3.79	21.1
6.6	4.1	0.2	3.9	0.0	0.000	0.000	10.81	0.0
9.1	11.4	1.2	10.2	1.4	7.492	-0.676	4.07	22.5
11.6	19.5	3.1	16.4	1.7	9.753	-0.181	4.46	24.2
11.6	68.3	3.1	65.2	6.5	15.067	-0.021	5.84	20.1
15.4	120.9	13.4	107.4	13.1	17.300	-0.606	6.73	18.4
19.1	178.4	28.7	149.7	21.1	18.776	-1.096	7.40	17.6
19.1	330.1	28.9	301.2	50.9	28.138	-1.827	8.63	17.9
36.6	936.6	180.0	756.5	9999.0	35.527	-7.073	10.81	22.1
54.1	1407.9	461.8	946.1	9999.0	28.680	-4.416	10.30	19.8

Refusal occurred; no driving time output possible

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Table of Depths Analyzed with Driving System Modifiers

Depth	Temp. Length	Wait Time	Equivalent Pressure Stroke	Ratio	Efficy.	Stiffn. Factor	Cushion CoR
ft	ft	hr	ft				
6.58	54.07	0.00	10.81	1.00	0.80	1.00	1.00
6.62	54.07	0.00	10.81	1.00	0.80	1.00	1.00
9.10	54.07	0.00	10.81	1.00	0.80	1.00	1.00
11.58	54.07	0.00	10.81	1.00	0.80	1.00	1.00
11.62	54.07	0.00	10.81	1.00	0.80	1.00	1.00
15.35	54.07	0.00	10.81	1.00	0.80	1.00	1.00
19.08	54.07	0.00	10.81	1.00	0.80	1.00	1.00
19.12	54.07	0.00	10.81	1.00	0.80	1.00	1.00
36.58	54.07	0.00	10.81	1.00	0.80	1.00	1.00
54.07	54.07	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	0.00	0.00	0.100	0.143	0.100	0.150	1.000	6.000	24.000
4.99	0.00	0.00	0.100	0.143	0.100	0.150	1.000	6.000	24.000
5.00	0.00	-1.37	0.100	0.143	0.100	0.150	1.000	6.000	24.000
6.59	0.08	8.03	0.100	0.143	0.100	0.150	1.000	6.000	24.000
6.61	0.05	3.84	0.100	0.192	0.050	0.150	0.000	6.000	1.000
11.59	0.22	16.47	0.100	0.192	0.050	0.150	0.000	6.000	1.000
11.61	0.50	65.08	0.100	0.137	0.050	0.150	0.000	6.000	1.000
19.09	1.14	149.81	0.100	0.137	0.050	0.150	0.000	6.000	1.000
19.11	1.17	300.96	0.100	0.133	0.050	0.150	0.000	6.000	1.000
28.11	2.09	535.66	0.100	0.133	0.050	0.150	0.000	6.000	1.000
37.11	3.01	770.37	0.100	0.133	0.050	0.150	0.000	6.000	1.000
46.11	3.92	946.11	0.100	0.133	0.050	0.150	0.000	6.000	1.000
54.07	4.74	946.11	0.100	0.133	0.050	0.150	0.000	6.000	1.000

Gain/Loss 3 at Shaft and Toe 0.830 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
6.0	44.9	4.9	40.0	3.8	13.107	-0.094	5.27	22.4
6.0	18.6	4.9	13.6	1.6	9.018	-0.131	4.34	23.9
8.9	24.9	7.8	17.1	1.9	10.342	-0.140	4.57	24.8
11.7	29.8	11.2	18.6	2.2	11.189	-0.280	4.76	24.4
11.7	277.0	11.3	265.7	39.1	25.702	-1.162	8.32	17.6
18.0	433.0	53.0	380.0	87.6	32.637	-3.759	9.53	19.3
24.2	603.8	109.4	494.4	231.4	35.197	-5.984	10.40	21.1
24.2	740.8	109.8	631.0	782.3	37.422	-5.574	10.81	22.0
29.2	913.4	166.0	747.5	9999.0	36.026	-7.133	10.81	21.9
34.2	1095.6	231.6	864.0	9999.0	34.221	-7.447	10.81	21.7
34.2	910.8	232.2	678.7	9999.0	33.272	-7.842	10.81	21.8
37.3	1016.7	278.1	738.6	9999.0	31.849	-7.798	10.65	21.3
40.5	1126.4	327.9	798.5	9999.0	30.547	-7.332	10.58	20.8
40.5	1127.6	328.5	799.1	9999.0	30.538	-7.330	10.58	20.8
43.0	1176.9	363.7	813.2	9999.0	29.525	-6.250	10.49	20.4
45.5	1228.3	401.0	827.3	9999.0	28.981	-5.144	10.41	20.0
45.5	1431.5	401.7	1029.9	9999.0	29.417	-5.452	10.47	20.1
48.7	1494.8	465.0	1029.9	9999.0	28.870	-4.416	10.33	19.4
52.0	1563.5	533.6	1029.9	9999.0	28.228	-3.586	10.25	18.9

Refusal occurred; no driving time output possible

National Engineering & Architectural Ser
CUY-14-6.93, PID 104132 : 00/00/0000 : K

Jan 25 2023
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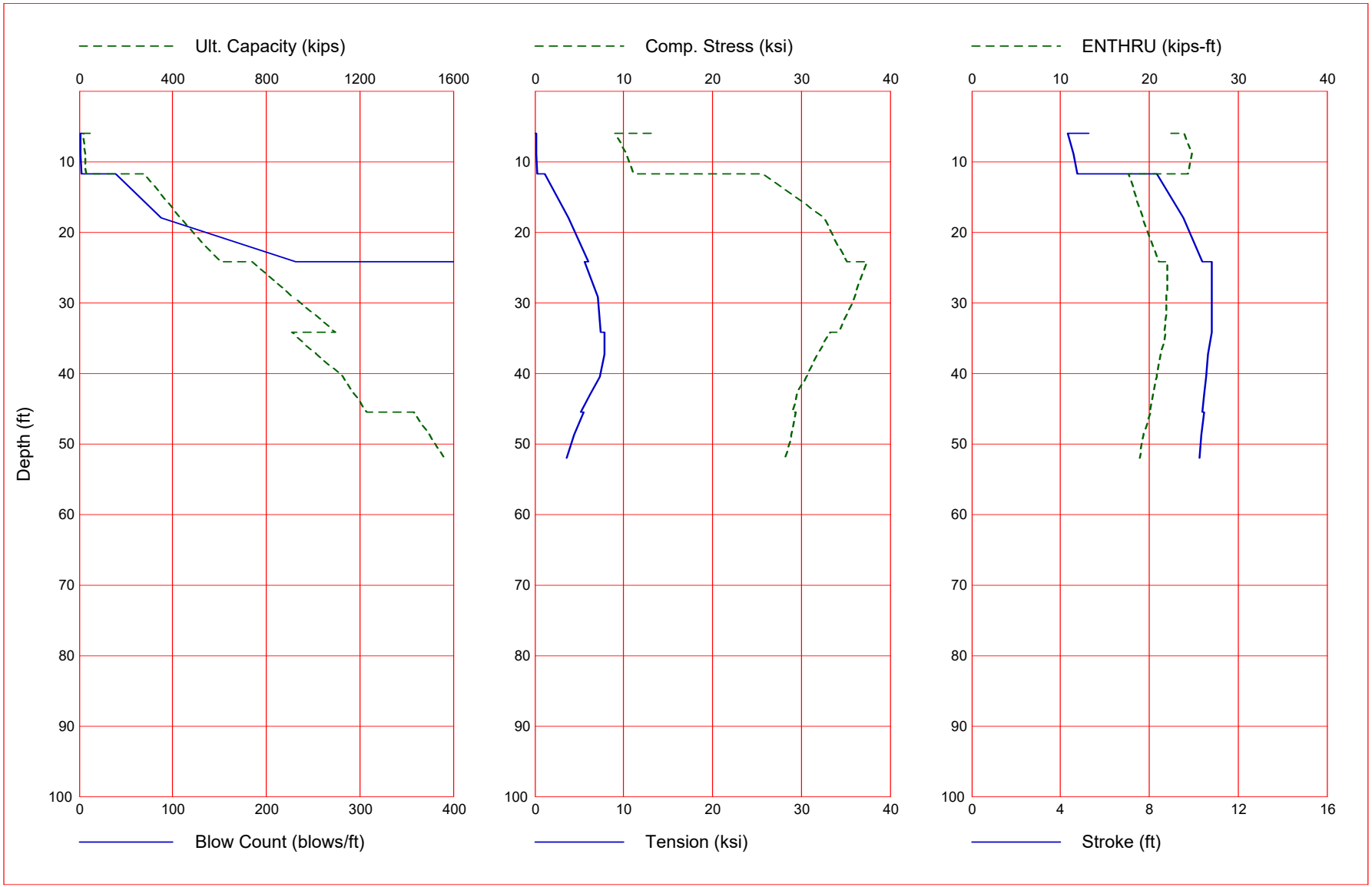
Gain/Loss 3 at Shaft and Toe 0.830 / 1.000



GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

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 building and other factors.

Input File: C:\USERS\KARENS\DESKTOP\GRL FILES\P116IN2.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

CUY-14-6.93, PID 104132 : 00/00/0000 : K

OUT	OSG	HAM	STR	FUL	PEL	N SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	144.000	16.000	Unknown

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
2.500	22.450	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
51.980	22.46	30000.0	492.000	4.190	0	0.850	0.010

FFatigue	F0	0-Bottom
0	0.000	0.000

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.0020	0.0020	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1600.00	1440.00	1295.00	1165.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1600.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Research Toe Plug: Res-int, Q-int, D-int, Res-plug, Q-plug, D-plug

0.000	0.000	0.000	0.000	0.000	0.000

Research Toe Plug: RD plug toe: m, d

0.000	0.000

Research Toe Plug: New Toe Plug Model is NOT applied

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimL	TSf0
0.01	0.00	0.00	0.10	0.20	0.05	0.15	1.00	6.00	1.000
2.19	0.00	0.00	0.10	0.20	0.05	0.15	1.00	6.00	1.000
2.20	0.17	14.71	0.10	0.20	0.05	0.15	1.00	6.00	1.000
5.99	0.45	40.04	0.10	0.20	0.05	0.15	1.00	6.00	1.000
6.01	0.24	13.60	0.10	0.24	0.10	0.15	1.21	6.00	24.000
7.19	0.29	16.27	0.10	0.24	0.10	0.15	1.21	6.00	24.000
7.21	0.29	16.30	0.10	0.24	0.10	0.15	1.21	6.00	24.000
11.69	0.37	18.60	0.10	0.24	0.10	0.15	1.21	6.00	24.000
11.71	1.31	265.51	0.10	0.13	0.05	0.15	1.00	6.00	1.000
20.71	2.13	430.69	0.10	0.13	0.05	0.15	1.00	6.00	1.000

24.19	2.44	494.56	0.10	0.13	0.05	0.15	1.00	6.00	1.000
24.21	2.46	630.76	0.10	0.14	0.05	0.15	1.00	6.00	1.000
33.21	3.29	841.27	0.10	0.14	0.05	0.15	1.00	6.00	1.000
34.19	3.38	864.19	0.10	0.14	0.05	0.15	1.00	6.00	1.000
34.21	3.35	678.46	0.10	0.13	0.05	0.15	1.00	6.00	1.000
40.49	3.95	798.69	0.10	0.13	0.05	0.15	1.00	6.00	1.000
40.51	3.95	799.08	0.10	0.13	0.10	0.15	1.21	6.00	24.000
45.49	4.45	827.37	0.10	0.13	0.10	0.15	1.21	6.00	24.000
45.51	4.54	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000
51.98	5.21	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000

Gain/Loss factors: shaft and toe

0.79600	0.81300	0.83000	0.84700	0.86400
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
5.98	0.00	0.00	0.000	0.0	0.000	0.000	0.000
6.02	0.00	0.00	0.000	0.0	0.000	0.000	0.000
8.85	0.00	0.00	0.000	0.0	0.000	0.000	0.000
11.68	0.00	0.00	0.000	0.0	0.000	0.000	0.000
11.72	0.00	0.00	0.000	0.0	0.000	0.000	0.000
17.95	0.00	0.00	0.000	0.0	0.000	0.000	0.000
24.18	0.00	0.00	0.000	0.0	0.000	0.000	0.000
24.22	0.00	0.00	0.000	0.0	0.000	0.000	0.000
29.20	0.00	0.00	0.000	0.0	0.000	0.000	0.000
34.18	0.00	0.00	0.000	0.0	0.000	0.000	0.000
34.22	0.00	0.00	0.000	0.0	0.000	0.000	0.000
37.35	0.00	0.00	0.000	0.0	0.000	0.000	0.000
40.48	0.00	0.00	0.000	0.0	0.000	0.000	0.000
40.52	0.00	0.00	0.000	0.0	0.000	0.000	0.000
43.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
45.48	0.00	0.00	0.000	0.0	0.000	0.000	0.000
45.52	0.00	0.00	0.000	0.0	0.000	0.000	0.000
48.73	0.00	0.00	0.000	0.0	0.000	0.000	0.000
51.98	0.00	0.00	0.000	0.0	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

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Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.6	1.000	0.0000	
3	0.800	140046.6	1.000	0.0000	
4	0.800	140046.6	1.000	0.0000	
5	0.800	140046.6	1.000	0.0000	

Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	2.500	5949.2	0.800	0.0100	5.8
Combined Pile Top		17283.6			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1600.00	Actual Pressure	(psi)	1600.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	22.45	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	5949.2	Stiffness	(kips/in)	0.0

Depth	(ft)	6.0	Standard Soil Setup		
Shaft Gain/Loss Factor		0.796	Toe Gain/Loss Factor		1.000

PILE PROFILE:

Toe Area	(in2)	144.000	Pile Type		Unknown
Pile Size	(inch)	16.000			

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model Total Capacity Rut (kips) 44.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	0.4	0.050	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	4.5	0.050	0.100	51.98	4.2	22.5
Toe						40.0	0.150	0.203			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile		Pile Segments: Automatic	
No. of Slacks/Splices	0	Pile Damping (%)	1
		Pile Damping Fact.(k/ft/s)	0.802
Driveability Analysis			
Soil Damping Option	Smith		
Max No Analysis Iterations	0	Time Increment/Critical	160
Output Time Interval	1	Analysis Time-Input (ms)	0
Output Level: Normal			
Gravity Mass, Pile, Hammer:	32.170	32.170	32.170
Output Segment Generation: Automatic			

Depth ft	Stroke ft	Pressure Ratio	Efficy
5.98	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
44.9	3.8	5.27	5.25	-0.09	2	9	13.11	1	4	22.4	51.7
44.9	3.8	5.27	5.25	-0.09	2	9	13.11	1	4	22.4	51.7
44.9	3.8	5.27	5.25	-0.09	2	9	13.11	1	4	22.4	51.7
44.9	3.8	5.27	5.25	-0.09	2	9	13.11	1	4	22.4	51.7
44.9	3.8	5.27	5.25	-0.09	2	9	13.11	1	4	22.4	51.7

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Depth (ft)	6.0	Standard Soil Setup	
Shaft Gain/Loss Factor	0.796	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in2)	144.000	Pile Type	Unknown
Pile Size (inch)	16.000		

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c

ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model — Total Capacity Rut (kips) 18.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	0.5	0.050	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	4.5	0.050	0.100	51.98	4.2	22.5
Toe						13.6	0.150	0.241			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
6.02	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
18.6	1.6	4.34	4.35	-0.13	2	20	9.02	1	3	23.9	56.8
18.6	1.6	4.34	4.35	-0.13	2	20	9.01	1	3	23.9	56.8
18.6	1.6	4.34	4.35	-0.13	2	20	9.02	1	3	23.9	56.8
18.6	1.6	4.34	4.35	-0.13	2	20	9.02	1	3	23.9	56.8
18.6	1.6	4.34	4.35	-0.13	2	20	9.02	1	3	23.9	56.8

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Depth (ft) 8.9 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model Total Capacity Rut (kips) 24.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
14	0.249	17284	0.000	0.000	1.00	0.1	0.050	0.100	45.48	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	4.1	0.050	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	3.5	0.091	0.100	51.98	4.2	22.5
Toe						17.1	0.150	0.241			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
8.85	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
24.8	1.9	4.56	4.60	-0.14	2	9	10.32	1	4	24.8	55.4
24.9	1.9	4.56	4.60	-0.14	2	9	10.36	1	4	24.8	55.4
24.9	1.9	4.57	4.60	-0.14	2	9	10.34	1	4	24.8	55.4
25.0	1.9	4.57	4.61	-0.14	2	9	10.35	1	4	24.8	55.4
25.1	1.9	4.57	4.61	-0.14	2	9	10.37	1	4	24.8	55.4

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Depth (ft) 11.7 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L ft	b Top in2	Area ksi	E-Mod lb/ft3	Spec Wt ft	Perim	C Index ft/s	Wave Sp k/ft/s	EA/c
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1	
52.0	22.46	30000.	492.0	4.2	0	16807.	40.1	

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model Total Capacity Rut (kips) 29.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2

1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
13	0.249	17284	0.000	0.000	1.00	0.0	0.050	0.100	42.23	4.2	22.5
14	0.249	17284	0.000	0.000	1.00	3.5	0.050	0.100	45.48	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	3.8	0.083	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	3.7	0.100	0.100	51.98	4.2	22.5
Toe						18.6	0.150	0.241			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
11.68	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
29.6	2.2	4.75	4.74	-0.27	2	9	11.16	1	4	24.5	54.4
29.7	2.2	4.75	4.74	-0.28	2	9	11.19	1	4	24.5	54.4
29.8	2.2	4.76	4.74	-0.28	2	9	11.19	1	4	24.4	54.4
29.9	2.2	4.77	4.75	-0.28	2	9	11.23	1	4	24.4	54.3
30.1	2.2	4.77	4.75	-0.29	2	9	11.27	1	4	24.4	54.3

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Depth (ft) 11.7 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model Total Capacity Rut (kips) 276.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
13	0.249	17284	0.000	0.000	1.00	0.0	0.050	0.100	42.23	4.2	22.5

14	0.249	17284	0.000	0.000	1.00	3.5	0.050	0.100	45.48	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	3.7	0.084	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	3.8	0.099	0.100	51.98	4.2	22.5
Toe						265.7	0.150	0.134			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
11.72	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
276.8	39.0	8.32	8.31	-1.16	8	23	25.69	15	6	17.6	41.0
276.9	39.1	8.32	8.31	-1.16	8	23	25.71	14	6	17.6	41.0
277.0	39.1	8.32	8.31	-1.16	8	23	25.70	15	6	17.6	41.0
277.2	39.1	8.32	8.32	-1.17	8	23	25.72	14	6	17.5	41.0
277.3	39.2	8.32	8.32	-1.17	8	23	25.72	14	6	17.5	41.0

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Depth (ft) 18.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model — Total Capacity Rut (kips) 432.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
11	0.249	17284	0.000	0.000	1.00	0.0	0.050	0.100	35.74	4.2	22.5
12	0.249	17284	0.000	0.000	1.00	3.1	0.050	0.100	38.99	4.2	22.5
13	0.249	17284	0.000	0.000	1.00	3.9	0.080	0.100	42.23	4.2	22.5
14	0.249	17284	0.000	0.000	1.00	3.7	0.100	0.100	45.48	4.2	22.5

15	0.249	17284	0.000	0.000	1.00	18.5	0.051	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	23.6	0.050	0.100	51.98	4.2	22.5
Toe						380.0	0.150	0.134			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
17.95	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
432.8	87.4	9.52	9.51	-3.75	12	20	32.64	15	6	19.3	38.4
432.9	87.5	9.52	9.51	-3.75	12	20	32.64	15	6	19.3	38.4
433.0	87.6	9.53	9.51	-3.76	12	20	32.64	15	6	19.3	38.4
433.2	87.7	9.53	9.51	-3.76	12	20	32.63	15	6	19.3	38.4
433.3	87.8	9.53	9.52	-3.77	12	20	32.62	15	6	19.3	38.3

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Depth (ft) 24.2 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model Total Capacity Rut (kips) 603.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
9	0.249	17284	0.000	0.000	1.00	0.0	0.050	0.100	29.24	4.2	22.5
10	0.249	17284	0.000	0.000	1.00	2.7	0.050	0.100	32.49	4.2	22.5
11	0.249	17284	0.000	0.000	1.00	4.0	0.075	0.100	35.74	4.2	22.5
12	0.249	17284	0.000	0.000	1.00	3.6	0.100	0.100	38.99	4.2	22.5
13	0.249	17284	0.000	0.000	1.00	17.1	0.052	0.100	42.23	4.2	22.5

14	0.249	17284	0.000	0.000	1.00	23.2	0.050	0.100	45.48	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	27.2	0.050	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	31.2	0.050	0.100	51.98	4.2	22.5
Toe						494.4	0.150	0.134			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.18	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
603.5	230.9	10.40	10.35	-5.97	11	19	35.22	15	6	21.1	36.8
603.6	231.2	10.40	10.35	-5.98	11	19	35.20	15	6	21.1	36.8
603.8	231.4	10.40	10.35	-5.98	11	19	35.20	15	6	21.1	36.8
603.9	230.1	10.40	10.35	-5.98	11	19	35.22	15	6	21.2	36.8
604.0	231.9	10.40	10.35	-5.99	11	19	35.18	15	6	21.1	36.8

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Depth (ft) 24.2 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model — Total Capacity Rut (kips) 740.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
9	0.249	17284	0.000	0.000	1.00	0.0	0.050	0.100	29.24	4.2	22.5
10	0.249	17284	0.000	0.000	1.00	2.8	0.050	0.100	32.49	4.2	22.5
11	0.249	17284	0.000	0.000	1.00	4.0	0.076	0.100	35.74	4.2	22.5
12	0.249	17284	0.000	0.000	1.00	3.6	0.100	0.100	38.99	4.2	22.5

13	0.249	17284	0.000	0.000	1.00	17.3	0.052	0.100	42.23	4.2	22.5
14	0.249	17284	0.000	0.000	1.00	23.3	0.050	0.100	45.48	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	27.3	0.050	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	31.3	0.050	0.100	51.98	4.2	22.5
Toe						631.0	0.150	0.136			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.22	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
740.5	779.0	10.81	10.87	-5.56	11	18	37.44	16	6	22.0	36.0
740.7	780.7	10.81	10.87	-5.57	11	18	37.43	16	6	22.0	36.0
740.8	782.3	10.81	10.87	-5.57	11	18	37.42	16	6	22.0	36.0
740.9	784.0	10.81	10.87	-5.58	11	18	37.41	16	6	22.0	36.0
741.1	785.8	10.81	10.87	-5.59	11	18	37.40	16	6	22.0	36.0

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Depth (ft) 29.2 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L ft	b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0		22.46	30000.	492.0	4.2	0	16807.	40.1
52.0		22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model Total Capacity Rut (kips) 913.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
8	0.249	17284	0.000	0.000	1.00	0.9	0.050	0.100	25.99	4.2	22.5
9	0.249	17284	0.000	0.000	1.00	4.4	0.055	0.100	29.24	4.2	22.5
10	0.249	17284	0.000	0.000	1.00	3.3	0.100	0.100	32.49	4.2	22.5

11	0.249	17284	0.000	0.000	1.00	9.6	0.065	0.100	35.74	4.2	22.5
12	0.249	17284	0.000	0.000	1.00	21.4	0.050	0.100	38.99	4.2	22.5
13	0.249	17284	0.000	0.000	1.00	25.4	0.050	0.100	42.23	4.2	22.5
14	0.249	17284	0.000	0.000	1.00	29.4	0.050	0.100	45.48	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	33.6	0.050	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	37.7	0.050	0.100	51.98	4.2	22.5
Toe						747.5	0.150	0.136			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
29.20	10.81	1.00	0.800

Rut	Bl Ct	Stroke (ft)		Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt
kips	b/ft	down	up	ksi			ksi			kip-ft	b/min
913.2	9999.0	10.81	10.92	-7.13	11	18	36.04	14	6	21.9	36.0
913.3	9999.0	10.81	10.91	-7.13	11	18	36.03	14	6	21.9	36.0
913.4	9999.0	10.81	10.91	-7.13	11	18	36.03	14	6	21.9	36.0
913.6	9999.0	10.81	10.91	-7.13	11	18	36.02	14	6	21.9	36.0
913.7	9999.0	10.81	10.91	-7.13	11	18	36.01	14	6	21.9	36.0

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Depth (ft) 34.2 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
	ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model Total Capacity Rut (kips) 1095.3

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
6	0.249	17284	0.000	0.000	1.00	0.0	0.050	0.100	19.49	4.2	22.5

7	0.249	17284	0.000	0.000	1.00	3.1	0.050	0.100	22.74	4.2	22.5
8	0.249	17284	0.000	0.000	1.00	3.9	0.079	0.100	25.99	4.2	22.5
9	0.249	17284	0.000	0.000	1.00	3.7	0.100	0.100	29.24	4.2	22.5
10	0.249	17284	0.000	0.000	1.00	18.4	0.051	0.100	32.49	4.2	22.5
11	0.249	17284	0.000	0.000	1.00	23.5	0.050	0.100	35.74	4.2	22.5
12	0.249	17284	0.000	0.000	1.00	27.5	0.050	0.100	38.99	4.2	22.5
13	0.249	17284	0.000	0.000	1.00	31.6	0.050	0.100	42.23	4.2	22.5
14	0.249	17284	0.000	0.000	1.00	35.8	0.050	0.100	45.48	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	39.9	0.050	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	43.9	0.050	0.100	51.98	4.2	22.5
Toe						864.0	0.150	0.136			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
34.18	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1095.3	9999.0	10.81	10.83	-7.46	10	18	34.24	14	6	21.7	36.0
1095.4	9999.0	10.81	10.83	-7.45	10	18	34.23	14	6	21.7	36.0
1095.6	9999.0	10.81	10.83	-7.45	10	18	34.22	14	6	21.7	36.0
1095.7	9999.0	10.81	10.83	-7.44	10	18	34.21	14	6	21.7	36.0
1095.8	9999.0	10.81	10.83	-7.43	10	18	34.20	14	6	21.7	36.0

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Depth (ft) 34.2 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model Total Capacity Rut (kips) 910.6

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area

	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
6	0.249	17284	0.000	0.000	1.00	0.0	0.050	0.100	19.49	4.2	22.5
7	0.249	17284	0.000	0.000	1.00	3.2	0.050	0.100	22.74	4.2	22.5
8	0.249	17284	0.000	0.000	1.00	3.9	0.080	0.100	25.99	4.2	22.5
9	0.249	17284	0.000	0.000	1.00	3.7	0.100	0.100	29.24	4.2	22.5
10	0.249	17284	0.000	0.000	1.00	18.6	0.051	0.100	32.49	4.2	22.5
11	0.249	17284	0.000	0.000	1.00	23.6	0.050	0.100	35.74	4.2	22.5
12	0.249	17284	0.000	0.000	1.00	27.6	0.050	0.100	38.99	4.2	22.5
13	0.249	17284	0.000	0.000	1.00	31.6	0.050	0.100	42.23	4.2	22.5
14	0.249	17284	0.000	0.000	1.00	35.9	0.050	0.100	45.48	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	39.9	0.050	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	44.0	0.050	0.100	51.98	4.2	22.5
Toe						678.7	0.150	0.133			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
34.22	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
910.6	9999.0	10.81	10.71	-7.85	10	18	33.29	14	6	21.8	36.1
910.7	9999.0	10.81	10.71	-7.85	10	18	33.28	14	6	21.8	36.1
910.8	9999.0	10.81	10.71	-7.84	10	18	33.27	14	6	21.8	36.1
910.9	9999.0	10.81	10.71	-7.83	10	18	33.26	14	6	21.8	36.1
911.1	9999.0	10.81	10.71	-7.83	10	18	33.25	14	6	21.8	36.1

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Depth (ft) 37.3 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

No.	Pile and Soil Model Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Total Capacity Rut (kips) 1016.4 Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
5	0.249	17284	0.000	0.000	1.00	0.0	0.050	0.100	16.24	4.2	22.5
6	0.249	17284	0.000	0.000	1.00	3.0	0.050	0.100	19.49	4.2	22.5
7	0.249	17284	0.000	0.000	1.00	3.9	0.078	0.100	22.74	4.2	22.5
8	0.249	17284	0.000	0.000	1.00	3.7	0.100	0.100	25.99	4.2	22.5
9	0.249	17284	0.000	0.000	1.00	18.0	0.052	0.100	29.24	4.2	22.5
10	0.249	17284	0.000	0.000	1.00	23.4	0.050	0.100	32.49	4.2	22.5
11	0.249	17284	0.000	0.000	1.00	27.5	0.050	0.100	35.74	4.2	22.5
12	0.249	17284	0.000	0.000	1.00	31.5	0.050	0.100	38.99	4.2	22.5
13	0.249	17284	0.000	0.000	1.00	35.7	0.050	0.100	42.23	4.2	22.5
14	0.249	17284	0.000	0.000	1.00	39.8	0.050	0.100	45.48	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	43.8	0.050	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	47.6	0.050	0.100	51.98	4.2	22.5
Toe						738.6	0.150	0.133			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
37.35	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1016.4	9999.0	10.65	10.62	-7.80	9	17	31.87	13	6	21.3	36.3
1016.5	9999.0	10.65	10.62	-7.80	9	17	31.86	13	6	21.3	36.4
1016.7	9999.0	10.65	10.62	-7.80	9	17	31.85	13	6	21.3	36.4
1016.8	9999.0	10.65	10.62	-7.77	9	17	31.81	13	6	21.2	36.4
1016.9	9999.0	10.65	10.62	-7.77	9	17	31.81	13	6	21.2	36.4

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Depth (ft) 40.5 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model — Total Capacity Rut (kips) 1126.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
4	0.249	17284	0.000	0.000	1.00	0.0	0.050	0.100	12.99	4.2	22.5
5	0.249	17284	0.000	0.000	1.00	2.8	0.050	0.100	16.24	4.2	22.5
6	0.249	17284	0.000	0.000	1.00	4.0	0.076	0.100	19.49	4.2	22.5
7	0.249	17284	0.000	0.000	1.00	3.6	0.100	0.100	22.74	4.2	22.5
8	0.249	17284	0.000	0.000	1.00	17.4	0.052	0.100	25.99	4.2	22.5
9	0.249	17284	0.000	0.000	1.00	23.3	0.050	0.100	29.24	4.2	22.5
10	0.249	17284	0.000	0.000	1.00	27.3	0.050	0.100	32.49	4.2	22.5
11	0.249	17284	0.000	0.000	1.00	31.3	0.050	0.100	35.74	4.2	22.5
12	0.249	17284	0.000	0.000	1.00	35.6	0.050	0.100	38.99	4.2	22.5
13	0.249	17284	0.000	0.000	1.00	39.6	0.050	0.100	42.23	4.2	22.5
14	0.249	17284	0.000	0.000	1.00	43.7	0.050	0.100	45.48	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	47.5	0.050	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	51.6	0.050	0.100	51.98	4.2	22.5
Toe						798.5	0.150	0.133			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
40.48	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1126.1	9999.0	10.58	10.54	-7.36	8	17	30.59	13	6	20.9	36.5
1126.3	9999.0	10.58	10.54	-7.35	8	17	30.58	13	6	20.9	36.5
1126.4	9999.0	10.58	10.53	-7.33	8	17	30.55	13	6	20.8	36.5
1126.5	9999.0	10.57	10.53	-7.33	8	17	30.54	13	6	20.9	36.5
1126.7	9999.0	10.57	10.53	-7.32	8	17	30.53	13	6	20.9	36.5

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Depth (ft) 40.5 Standard Soil Setup

Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model Total Capacity Rut (kips) 1127.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
4	0.249	17284	0.000	0.000	1.00	0.0	0.050	0.100	12.99	4.2	22.5
5	0.249	17284	0.000	0.000	1.00	2.9	0.050	0.100	16.24	4.2	22.5
6	0.249	17284	0.000	0.000	1.00	4.0	0.077	0.100	19.49	4.2	22.5
7	0.249	17284	0.000	0.000	1.00	3.6	0.100	0.100	22.74	4.2	22.5
8	0.249	17284	0.000	0.000	1.00	17.6	0.052	0.100	25.99	4.2	22.5
9	0.249	17284	0.000	0.000	1.00	23.3	0.050	0.100	29.24	4.2	22.5
10	0.249	17284	0.000	0.000	1.00	27.4	0.050	0.100	32.49	4.2	22.5
11	0.249	17284	0.000	0.000	1.00	31.4	0.050	0.100	35.74	4.2	22.5
12	0.249	17284	0.000	0.000	1.00	35.6	0.050	0.100	38.99	4.2	22.5
13	0.249	17284	0.000	0.000	1.00	39.7	0.050	0.100	42.23	4.2	22.5
14	0.249	17284	0.000	0.000	1.00	43.7	0.050	0.100	45.48	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	47.5	0.050	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	51.6	0.050	0.100	51.98	4.2	22.5
Toe						799.1	0.150	0.133			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
40.52	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1127.4	9999.0	10.58	10.53	-7.35	8	17	30.55	13	6	20.8	36.5
1127.5	9999.0	10.58	10.53	-7.34	8	17	30.55	13	6	20.8	36.5
1127.6	9999.0	10.58	10.53	-7.33	8	17	30.54	13	6	20.8	36.5
1127.8	9999.0	10.58	10.53	-7.32	8	17	30.53	13	6	20.8	36.5

Depth (ft) 43.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model Total Capacity Rut (kips) 1175.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
3	0.249	17284	0.000	0.000	1.00	0.0	0.050	0.100	9.75	4.2	22.5
4	0.249	17284	0.000	0.000	1.00	1.8	0.050	0.100	12.99	4.2	22.5
5	0.249	17284	0.000	0.000	1.00	4.3	0.066	0.100	16.24	4.2	22.5
6	0.249	17284	0.000	0.000	1.00	3.5	0.100	0.100	19.49	4.2	22.5
7	0.249	17284	0.000	0.000	1.00	13.6	0.057	0.100	22.74	4.2	22.5
8	0.249	17284	0.000	0.000	1.00	22.4	0.050	0.100	25.99	4.2	22.5
9	0.249	17284	0.000	0.000	1.00	26.4	0.050	0.100	29.24	4.2	22.5
10	0.249	17284	0.000	0.000	1.00	30.4	0.050	0.100	32.49	4.2	22.5
11	0.249	17284	0.000	0.000	1.00	34.6	0.050	0.100	35.74	4.2	22.5
12	0.249	17284	0.000	0.000	1.00	38.7	0.050	0.100	38.99	4.2	22.5
13	0.249	17284	0.000	0.000	1.00	42.8	0.050	0.100	42.23	4.2	22.5
14	0.249	17284	0.000	0.000	1.00	46.6	0.050	0.100	45.48	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	50.7	0.050	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	46.2	0.089	0.100	51.98	4.2	22.5
Toe						813.2	0.150	0.133			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
43.00	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1175.2	9999.0	10.49	10.44	-6.27	8	17	29.54	7	8	20.5	36.6
1176.0	9999.0	10.49	10.44	-6.26	8	17	29.53	7	8	20.4	36.7
1176.9	9999.0	10.49	10.43	-6.25	8	17	29.53	7	8	20.4	36.7
1177.7	9999.0	10.49	10.43	-6.23	8	17	29.52	7	8	20.4	36.7
1178.6	9999.0	10.49	10.43	-6.24	8	17	29.53	7	8	20.5	36.7

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Depth (ft) 45.5 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model Total Capacity Rut (kips) 1225.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.000	0.100	6.50	4.2	22.5
3	0.249	17284	0.000	0.000	1.00	0.9	0.050	0.100	9.75	4.2	22.5
4	0.249	17284	0.000	0.000	1.00	4.4	0.056	0.100	12.99	4.2	22.5
5	0.249	17284	0.000	0.000	1.00	3.3	0.100	0.100	16.24	4.2	22.5
6	0.249	17284	0.000	0.000	1.00	9.7	0.064	0.100	19.49	4.2	22.5
7	0.249	17284	0.000	0.000	1.00	21.4	0.050	0.100	22.74	4.2	22.5
8	0.249	17284	0.000	0.000	1.00	25.5	0.050	0.100	25.99	4.2	22.5
9	0.249	17284	0.000	0.000	1.00	29.5	0.050	0.100	29.24	4.2	22.5
10	0.249	17284	0.000	0.000	1.00	33.6	0.050	0.100	32.49	4.2	22.5
11	0.249	17284	0.000	0.000	1.00	37.8	0.050	0.100	35.74	4.2	22.5
12	0.249	17284	0.000	0.000	1.00	41.8	0.050	0.100	38.99	4.2	22.5
13	0.249	17284	0.000	0.000	1.00	45.7	0.050	0.100	42.23	4.2	22.5
14	0.249	17284	0.000	0.000	1.00	49.7	0.050	0.100	45.48	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	47.9	0.077	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	46.5	0.100	0.100	51.98	4.2	22.5
Toe						827.3	0.150	0.133			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
45.48	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1225.0	9999.0	10.41	10.34	-5.15	7	16	28.98	6	8	20.0	36.8
1226.7	9999.0	10.41	10.35	-5.15	7	16	28.98	6	8	20.0	36.8
1228.3	9999.0	10.41	10.35	-5.14	7	16	28.98	6	8	20.0	36.8
1229.9	9999.0	10.41	10.35	-5.14	7	16	28.98	6	8	20.0	36.8
1231.5	9999.0	10.41	10.34	-5.14	7	16	28.98	6	8	20.0	36.8

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Depth (ft) 45.5 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model Total Capacity Rut (kips) 1428.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.0	0.050	0.100	6.50	4.2	22.5
3	0.249	17284	0.000	0.000	1.00	0.9	0.050	0.100	9.75	4.2	22.5
4	0.249	17284	0.000	0.000	1.00	4.4	0.056	0.100	12.99	4.2	22.5
5	0.249	17284	0.000	0.000	1.00	3.3	0.100	0.100	16.24	4.2	22.5
6	0.249	17284	0.000	0.000	1.00	9.9	0.064	0.100	19.49	4.2	22.5
7	0.249	17284	0.000	0.000	1.00	21.5	0.050	0.100	22.74	4.2	22.5
8	0.249	17284	0.000	0.000	1.00	25.5	0.050	0.100	25.99	4.2	22.5
9	0.249	17284	0.000	0.000	1.00	29.5	0.050	0.100	29.24	4.2	22.5
10	0.249	17284	0.000	0.000	1.00	33.7	0.050	0.100	32.49	4.2	22.5
11	0.249	17284	0.000	0.000	1.00	37.8	0.050	0.100	35.74	4.2	22.5
12	0.249	17284	0.000	0.000	1.00	41.8	0.050	0.100	38.99	4.2	22.5
13	0.249	17284	0.000	0.000	1.00	45.7	0.050	0.100	42.23	4.2	22.5
14	0.249	17284	0.000	0.000	1.00	49.7	0.050	0.100	45.48	4.2	22.5

15	0.249	17284	0.000	0.000	1.00	47.9	0.078	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	46.6	0.100	0.100	51.98	4.2	22.5
Toe						1029.9	0.150	0.133			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
45.52	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1428.3	9999.0	10.47	10.41	-5.46	7	16	29.42	6	8	20.1	36.7
1429.9	9999.0	10.47	10.41	-5.46	7	16	29.41	6	8	20.1	36.7
1431.5	9999.0	10.47	10.41	-5.45	7	16	29.42	6	8	20.1	36.7
1433.2	9999.0	10.47	10.41	-5.45	7	16	29.42	6	8	20.1	36.7
1434.8	9999.0	10.47	10.41	-5.44	7	16	29.41	6	8	20.1	36.7

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Depth (ft) 48.7 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
52.0	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model Total Capacity Rut (kips) 1491.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.249	17284	0.010	0.000	0.85	0.0	0.000	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	0.9	0.050	0.100	6.50	4.2	22.5
3	0.249	17284	0.000	0.000	1.00	4.4	0.056	0.100	9.75	4.2	22.5
4	0.249	17284	0.000	0.000	1.00	3.3	0.100	0.100	12.99	4.2	22.5
5	0.249	17284	0.000	0.000	1.00	9.7	0.064	0.100	16.24	4.2	22.5
6	0.249	17284	0.000	0.000	1.00	21.4	0.050	0.100	19.49	4.2	22.5
7	0.249	17284	0.000	0.000	1.00	25.5	0.050	0.100	22.74	4.2	22.5

8	0.249	17284	0.000	0.000	1.00	29.5	0.050	0.100	25.99	4.2	22.5
9	0.249	17284	0.000	0.000	1.00	33.6	0.050	0.100	29.24	4.2	22.5
10	0.249	17284	0.000	0.000	1.00	37.8	0.050	0.100	32.49	4.2	22.5
11	0.249	17284	0.000	0.000	1.00	41.8	0.050	0.100	35.74	4.2	22.5
12	0.249	17284	0.000	0.000	1.00	45.7	0.050	0.100	38.99	4.2	22.5
13	0.249	17284	0.000	0.000	1.00	49.7	0.050	0.100	42.23	4.2	22.5
14	0.249	17284	0.000	0.000	1.00	47.9	0.077	0.100	45.48	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	46.5	0.100	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	64.0	0.050	0.100	51.98	4.2	22.5
Toe						1029.9	0.150	0.133			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
48.73	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1491.6	9999.0	10.33	10.26	-4.42	6	15	28.86	5	8	19.4	37.0
1493.2	9999.0	10.33	10.26	-4.42	6	15	28.87	5	8	19.4	37.0
1494.8	9999.0	10.33	10.26	-4.42	6	15	28.87	5	8	19.4	37.0
1496.5	9999.0	10.33	10.26	-4.42	6	15	28.87	5	8	19.4	37.0
1498.1	9999.0	10.33	10.26	-4.43	6	15	28.88	5	8	19.4	37.0

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Depth (ft) 52.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L ft	b Top in2	Area ksi	E-Mod lb/ft3	Spec Wt ft	Perim	C Index ft/s	Wave Sp k/ft/s	EA/c
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1	
52.0	22.46	30000.	492.0	4.2	0	16807.	40.1	

Wave Travel Time 2L/c (ms) 6.186

Pile and Soil Model Total Capacity Rut (kips) 1560.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2

1	0.249	17284	0.010	0.000	0.85	0.9	0.050	0.100	3.25	4.2	22.5
2	0.249	17284	0.000	0.000	1.00	4.4	0.056	0.100	6.50	4.2	22.5
3	0.249	17284	0.000	0.000	1.00	3.3	0.100	0.100	9.75	4.2	22.5
4	0.249	17284	0.000	0.000	1.00	9.7	0.064	0.100	12.99	4.2	22.5
5	0.249	17284	0.000	0.000	1.00	21.4	0.050	0.100	16.24	4.2	22.5
6	0.249	17284	0.000	0.000	1.00	25.5	0.050	0.100	19.49	4.2	22.5
7	0.249	17284	0.000	0.000	1.00	29.5	0.050	0.100	22.74	4.2	22.5
8	0.249	17284	0.000	0.000	1.00	33.6	0.050	0.100	25.99	4.2	22.5
9	0.249	17284	0.000	0.000	1.00	37.8	0.050	0.100	29.24	4.2	22.5
10	0.249	17284	0.000	0.000	1.00	41.8	0.050	0.100	32.49	4.2	22.5
11	0.249	17284	0.000	0.000	1.00	45.7	0.050	0.100	35.74	4.2	22.5
12	0.249	17284	0.000	0.000	1.00	49.7	0.050	0.100	38.99	4.2	22.5
13	0.249	17284	0.000	0.000	1.00	47.9	0.077	0.100	42.23	4.2	22.5
14	0.249	17284	0.000	0.000	1.00	46.5	0.100	0.100	45.48	4.2	22.5
15	0.249	17284	0.000	0.000	1.00	64.0	0.050	0.100	48.73	4.2	22.5
16	0.249	17284	0.000	0.000	1.00	68.6	0.050	0.100	51.98	4.2	22.5
Toe						1029.9	0.150	0.133			

3.989 kips total unreduced pile weight (g= 32.17 ft/s2)
3.989 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
51.98	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1560.2	9999.0	10.25	10.17	-3.59	5	14	28.21	5	8	18.8	37.1
1561.8	9999.0	10.25	10.18	-3.59	5	14	28.22	5	8	18.8	37.1
1563.5	9999.0	10.25	10.18	-3.59	5	14	28.23	5	8	18.9	37.1
1565.1	9999.0	10.26	10.18	-3.59	5	14	28.23	5	8	18.8	37.1
1566.7	9999.0	10.26	10.18	-3.58	5	14	28.23	5	8	18.8	37.1

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National Engineering & Architectural Ser GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.796 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
6.0	44.9	4.9	40.0	3.8	13.107	-0.094	5.27	22.4
6.0	18.6	4.9	13.6	1.6	9.016	-0.131	4.34	23.9
8.9	24.8	7.7	17.1	1.9	10.323	-0.137	4.56	24.8
11.7	29.6	11.0	18.6	2.2	11.161	-0.271	4.75	24.5
11.7	276.8	11.1	265.7	39.0	25.693	-1.159	8.32	17.6

18.0	432.8	52.7	380.0	87.4	32.643	-3.745	9.52	19.3
24.2	603.5	109.1	494.4	230.9	35.215	-5.973	10.40	21.1
24.2	740.5	109.5	631.0	779.0	37.440	-5.560	10.81	22.0
29.2	913.2	165.7	747.5	9999.0	36.044	-7.134	10.81	21.9
34.2	1095.3	231.3	864.0	9999.0	34.240	-7.460	10.81	21.7
34.2	910.6	231.9	678.7	9999.0	33.290	-7.854	10.81	21.8
37.3	1016.4	277.8	738.6	9999.0	31.868	-7.804	10.65	21.3
40.5	1126.1	327.6	798.5	9999.0	30.587	-7.362	10.58	20.9
40.5	1127.4	328.2	799.1	9999.0	30.552	-7.345	10.58	20.8
43.0	1175.2	361.9	813.2	9999.0	29.543	-6.269	10.49	20.5
45.5	1225.0	397.7	827.3	9999.0	28.978	-5.154	10.41	20.0
45.5	1428.3	398.4	1029.9	9999.0	29.418	-5.457	10.47	20.1
48.7	1491.6	461.7	1029.9	9999.0	28.865	-4.420	10.33	19.4
52.0	1560.2	530.3	1029.9	9999.0	28.212	-3.592	10.25	18.8

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.813 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
6.0	44.9	4.9	40.0	3.8	13.107	-0.094	5.27	22.4
6.0	18.6	4.9	13.6	1.6	9.014	-0.132	4.34	23.9
8.9	24.9	7.7	17.1	1.9	10.358	-0.142	4.56	24.8
11.7	29.7	11.1	18.6	2.2	11.187	-0.280	4.75	24.5
11.7	276.9	11.2	265.7	39.1	25.707	-1.163	8.32	17.6
18.0	432.9	52.9	380.0	87.5	32.639	-3.752	9.52	19.3
24.2	603.6	109.3	494.4	231.2	35.204	-5.978	10.40	21.1
24.2	740.7	109.7	631.0	780.7	37.430	-5.567	10.81	22.0
29.2	913.3	165.8	747.5	9999.0	36.034	-7.133	10.81	21.9
34.2	1095.4	231.5	864.0	9999.0	34.226	-7.452	10.81	21.7
34.2	910.7	232.0	678.7	9999.0	33.282	-7.847	10.81	21.8
37.3	1016.5	278.0	738.6	9999.0	31.855	-7.804	10.65	21.3
40.5	1126.3	327.8	798.5	9999.0	30.580	-7.354	10.58	20.9
40.5	1127.5	328.4	799.1	9999.0	30.545	-7.336	10.58	20.8
43.0	1176.0	362.8	813.2	9999.0	29.533	-6.255	10.49	20.4
45.5	1226.7	399.3	827.3	9999.0	28.979	-5.145	10.41	20.0
45.5	1429.9	400.0	1029.9	9999.0	29.415	-5.458	10.47	20.1
48.7	1493.2	463.3	1029.9	9999.0	28.868	-4.417	10.33	19.4
52.0	1561.8	532.0	1029.9	9999.0	28.218	-3.593	10.25	18.8

Refusal occurred; no driving time output possible

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.830 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft

6.0	44.9	4.9	40.0	3.8	13.107	-0.094	5.27	22.4
6.0	18.6	4.9	13.6	1.6	9.018	-0.131	4.34	23.9
8.9	24.9	7.8	17.1	1.9	10.342	-0.140	4.57	24.8
11.7	29.8	11.2	18.6	2.2	11.189	-0.280	4.76	24.4
11.7	277.0	11.3	265.7	39.1	25.702	-1.162	8.32	17.6
18.0	433.0	53.0	380.0	87.6	32.637	-3.759	9.53	19.3
24.2	603.8	109.4	494.4	231.4	35.197	-5.984	10.40	21.1
24.2	740.8	109.8	631.0	782.3	37.422	-5.574	10.81	22.0
29.2	913.4	166.0	747.5	9999.0	36.026	-7.133	10.81	21.9
34.2	1095.6	231.6	864.0	9999.0	34.221	-7.447	10.81	21.7
34.2	910.8	232.2	678.7	9999.0	33.272	-7.842	10.81	21.8
37.3	1016.7	278.1	738.6	9999.0	31.849	-7.798	10.65	21.3
40.5	1126.4	327.9	798.5	9999.0	30.547	-7.332	10.58	20.8
40.5	1127.6	328.5	799.1	9999.0	30.538	-7.330	10.58	20.8
43.0	1176.9	363.7	813.2	9999.0	29.525	-6.250	10.49	20.4
45.5	1228.3	401.0	827.3	9999.0	28.981	-5.144	10.41	20.0
45.5	1431.5	401.7	1029.9	9999.0	29.417	-5.452	10.47	20.1
48.7	1494.8	465.0	1029.9	9999.0	28.870	-4.416	10.33	19.4
52.0	1563.5	533.6	1029.9	9999.0	28.228	-3.586	10.25	18.9

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.847 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
6.0	44.9	4.9	40.0	3.8	13.107	-0.094	5.27	22.4
6.0	18.6	4.9	13.6	1.6	9.023	-0.127	4.34	23.9
8.9	25.0	7.9	17.1	1.9	10.345	-0.140	4.57	24.8
11.7	29.9	11.3	18.6	2.2	11.233	-0.280	4.77	24.4
11.7	277.2	11.5	265.7	39.1	25.717	-1.165	8.32	17.5
18.0	433.2	53.1	380.0	87.7	32.627	-3.764	9.53	19.3
24.2	603.9	109.5	494.4	230.1	35.223	-5.982	10.40	21.2
24.2	740.9	109.9	631.0	784.0	37.413	-5.582	10.81	22.0
29.2	913.6	166.1	747.5	9999.0	36.016	-7.131	10.81	21.9
34.2	1095.7	231.7	864.0	9999.0	34.208	-7.439	10.81	21.7
34.2	910.9	232.3	678.7	9999.0	33.264	-7.834	10.81	21.8
37.3	1016.8	278.2	738.6	9999.0	31.813	-7.771	10.65	21.2
40.5	1126.5	328.0	798.5	9999.0	30.541	-7.332	10.57	20.9
40.5	1127.8	328.6	799.1	9999.0	30.531	-7.321	10.58	20.8
43.0	1177.7	364.5	813.2	9999.0	29.520	-6.235	10.49	20.4
45.5	1229.9	402.6	827.3	9999.0	28.984	-5.137	10.41	20.0
45.5	1433.2	403.3	1029.9	9999.0	29.416	-5.446	10.47	20.1
48.7	1496.5	466.6	1029.9	9999.0	28.871	-4.417	10.33	19.4
52.0	1565.1	535.2	1029.9	9999.0	28.225	-3.592	10.26	18.8

Refusal occurred; no driving time output possible

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.864 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
6.0	44.9	4.9	40.0	3.8	13.107	-0.094	5.27	22.4
6.0	18.6	4.9	13.6	1.6	9.020	-0.131	4.34	23.9
8.9	25.1	7.9	17.1	1.9	10.367	-0.145	4.57	24.8
11.7	30.1	11.5	18.6	2.2	11.267	-0.286	4.77	24.4
11.7	277.3	11.6	265.7	39.2	25.720	-1.167	8.32	17.5
18.0	433.3	53.3	380.0	87.8	32.618	-3.769	9.53	19.3
24.2	604.0	109.6	494.4	231.9	35.178	-5.991	10.40	21.1
24.2	741.1	110.1	631.0	785.8	37.403	-5.588	10.81	22.0
29.2	913.7	166.2	747.5	9999.0	36.008	-7.130	10.81	21.9
34.2	1095.8	231.9	864.0	9999.0	34.202	-7.433	10.81	21.7
34.2	911.1	232.4	678.7	9999.0	33.254	-7.829	10.81	21.8
37.3	1016.9	278.4	738.6	9999.0	31.807	-7.767	10.65	21.2
40.5	1126.7	328.2	798.5	9999.0	30.535	-7.324	10.57	20.9
40.5	1127.9	328.8	799.1	9999.0	30.495	-7.306	10.57	20.8
43.0	1178.6	365.4	813.2	9999.0	29.525	-6.243	10.49	20.5
45.5	1231.5	404.2	827.3	9999.0	28.984	-5.136	10.41	20.0
45.5	1434.8	404.9	1029.9	9999.0	29.415	-5.443	10.47	20.1
48.7	1498.1	468.2	1029.9	9999.0	28.879	-4.426	10.33	19.4
52.0	1566.7	536.8	1029.9	9999.0	28.235	-3.584	10.26	18.8

Refusal occurred; no driving time output possible

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Pressure Stroke ft	Ratio	Efficy.	Stiffn. Factor	Cushion CoR
5.98	51.98	0.00	10.81	1.00	0.80	1.00	1.00
6.02	51.98	0.00	10.81	1.00	0.80	1.00	1.00
8.85	51.98	0.00	10.81	1.00	0.80	1.00	1.00
11.68	51.98	0.00	10.81	1.00	0.80	1.00	1.00
11.72	51.98	0.00	10.81	1.00	0.80	1.00	1.00
17.95	51.98	0.00	10.81	1.00	0.80	1.00	1.00
24.18	51.98	0.00	10.81	1.00	0.80	1.00	1.00
24.22	51.98	0.00	10.81	1.00	0.80	1.00	1.00
29.20	51.98	0.00	10.81	1.00	0.80	1.00	1.00
34.18	51.98	0.00	10.81	1.00	0.80	1.00	1.00
34.22	51.98	0.00	10.81	1.00	0.80	1.00	1.00
37.35	51.98	0.00	10.81	1.00	0.80	1.00	1.00
40.48	51.98	0.00	10.81	1.00	0.80	1.00	1.00
40.52	51.98	0.00	10.81	1.00	0.80	1.00	1.00

43.00	51.98	0.00	10.81	1.00	0.80	1.00	1.00
45.48	51.98	0.00	10.81	1.00	0.80	1.00	1.00
45.52	51.98	0.00	10.81	1.00	0.80	1.00	1.00
48.73	51.98	0.00	10.81	1.00	0.80	1.00	1.00
51.98	51.98	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	0.00	0.00	0.100	0.203	0.050	0.150	0.000	6.000	1.000
2.19	0.00	0.00	0.100	0.203	0.050	0.150	0.000	6.000	1.000
2.20	0.17	14.71	0.100	0.203	0.050	0.150	0.000	6.000	1.000
5.99	0.45	40.04	0.100	0.203	0.050	0.150	0.000	6.000	1.000
6.01	0.24	13.60	0.100	0.241	0.100	0.150	1.000	6.000	24.000
7.19	0.29	16.27	0.100	0.241	0.100	0.150	1.000	6.000	24.000
7.21	0.29	16.30	0.100	0.241	0.100	0.150	1.000	6.000	24.000
11.69	0.37	18.60	0.100	0.241	0.100	0.150	1.000	6.000	24.000
11.71	1.31	265.51	0.100	0.134	0.050	0.150	0.000	6.000	1.000
20.71	2.13	430.69	0.100	0.134	0.050	0.150	0.000	6.000	1.000
24.19	2.44	494.56	0.100	0.134	0.050	0.150	0.000	6.000	1.000
24.21	2.46	630.76	0.100	0.136	0.050	0.150	0.000	6.000	1.000
33.21	3.29	841.27	0.100	0.136	0.050	0.150	0.000	6.000	1.000
34.19	3.38	864.19	0.100	0.136	0.050	0.150	0.000	6.000	1.000
34.21	3.35	678.46	0.100	0.133	0.050	0.150	0.000	6.000	1.000
40.49	3.95	798.69	0.100	0.133	0.050	0.150	0.000	6.000	1.000
40.51	3.95	799.08	0.100	0.133	0.100	0.150	1.000	6.000	24.000
45.49	4.45	827.37	0.100	0.133	0.100	0.150	1.000	6.000	24.000
45.51	4.54	1029.88	0.100	0.133	0.050	0.150	0.000	6.000	1.000
51.98	5.21	1029.88	0.100	0.133	0.050	0.150	0.000	6.000	1.000

PIER 2

Gain/Loss 3 at Shaft and Toe 0.830 / 1.000

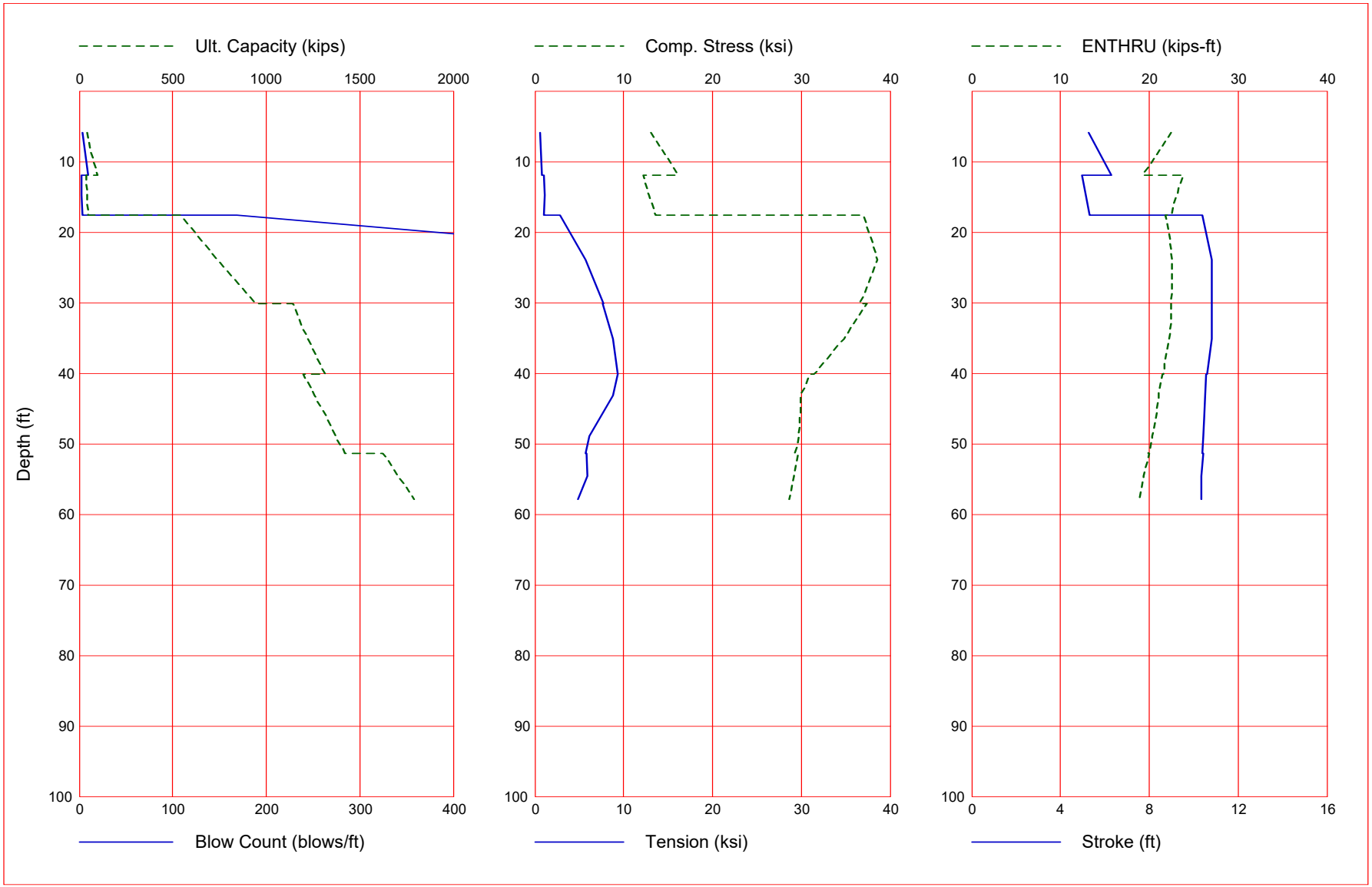
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.9	40.6	0.8	39.8	3.4	13.046	-0.611	5.25	22.5
11.9	96.9	17.5	79.4	9.7	16.067	-0.818	6.29	19.2
11.9	36.2	17.6	18.6	2.5	12.163	-1.043	4.97	23.8
14.8	41.6	23.0	18.6	2.9	12.825	-1.098	5.13	23.1
17.6	48.0	29.4	18.6	3.5	13.591	-1.066	5.30	22.4
17.6	540.9	29.7	511.2	169.0	36.910	-2.814	10.40	21.8
23.9	737.4	104.0	633.4	723.2	38.594	-5.732	10.81	22.6
30.1	940.8	193.1	747.8	9999.0	36.543	-7.695	10.81	22.4
30.1	1139.8	193.7	946.1	9999.0	37.429	-7.630	10.81	22.4
35.1	1222.3	276.2	946.1	9999.0	34.791	-8.801	10.81	22.2
40.1	1314.2	368.1	946.1	9999.0	31.434	-9.379	10.62	21.6
40.1	1196.3	368.9	827.4	9999.0	30.958	-9.354	10.58	21.5
43.2	1258.6	431.2	827.4	9999.0	29.964	-8.762	10.53	21.1
46.4	1324.8	497.5	827.4	9999.0	29.827	-7.288	10.48	20.7
46.4	1325.6	498.3	827.4	9999.0	29.825	-7.279	10.48	20.7
48.9	1371.6	544.2	827.4	9999.0	29.662	-6.156	10.44	20.3
51.4	1419.7	592.3	827.4	9999.0	29.312	-5.701	10.40	19.9
51.4	1623.1	593.2	1029.9	9999.0	29.647	-5.839	10.42	20.0
54.6	1703.5	673.7	1029.9	9999.0	29.180	-5.961	10.36	19.4
57.9	1789.5	759.7	1029.9	9999.0	28.655	-4.894	10.36	18.9

Refusal occurred; no driving time output possible

National Engineering & Architectural Ser
CUY-14-6.93, PID 104132 : 01/24/2023 : K

Jan 25 2023
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 0.830 / 1.000



GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

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 building and other factors.

Input File: C:\USERS\KARENS\DESKTOP\GRL FILES\P216IN1.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

CUY-14-6.93, PID 104132 : 01/24/2023 : K

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	144.000	16.000	Unknown

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
2.500	22.450	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
57.880	22.46	30000.0	492.000	4.190	0	0.850	0.010

FFatigue	F0	0-Bottom
0	0.000	0.000

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.0020	0.0020	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1600.00	1440.00	1295.00	1165.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1600.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Research Toe Plug: Res-int, Q-int, D-int, Res-plug, Q-plug, D-plug

0.000	0.000	0.000	0.000	0.000	0.000

Research Toe Plug: RD plug toe: m, d

0.000	0.000

Research Toe Plug: New Toe Plug Model is NOT applied

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimL	TSf0
0.01	0.00	0.00	0.10	0.20	0.05	0.15	1.00	6.00	1.000
5.49	0.00	0.00	0.10	0.20	0.05	0.15	1.00	6.00	1.000
5.50	0.41	36.76	0.10	0.20	0.05	0.15	1.00	6.00	1.000
9.01	0.68	60.22	0.10	0.20	0.05	0.15	1.00	6.00	1.000
11.89	0.90	79.47	0.10	0.20	0.05	0.15	1.00	6.00	1.000
11.91	0.48	18.60	0.10	0.24	0.10	0.15	1.21	6.00	24.000
17.59	0.71	18.60	0.10	0.24	0.10	0.15	1.21	6.00	24.000
17.61	2.52	510.86	0.10	0.13	0.05	0.15	1.00	6.00	1.000
18.09	2.61	527.56	0.10	0.13	0.05	0.15	1.00	6.00	1.000
18.11	2.61	528.10	0.10	0.13	0.05	0.15	1.00	6.00	1.000

27.11	3.43	693.27	0.10	0.13	0.05	0.15	1.00	6.00	1.000
30.09	3.70	747.96	0.10	0.13	0.05	0.15	1.00	6.00	1.000
30.11	3.72	946.11	0.10	0.14	0.05	0.15	1.00	6.00	1.000
39.11	4.55	946.11	0.10	0.14	0.05	0.15	1.00	6.00	1.000
40.09	4.64	946.11	0.10	0.14	0.05	0.15	1.00	6.00	1.000
40.11	4.61	827.37	0.10	0.13	0.05	0.15	1.00	6.00	1.000
46.39	5.20	827.37	0.10	0.13	0.05	0.15	1.00	6.00	1.000
46.41	5.20	827.37	0.10	0.13	0.10	0.15	1.21	6.00	24.000
51.39	5.70	827.37	0.10	0.13	0.10	0.15	1.21	6.00	24.000
51.41	5.82	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000
57.88	6.48	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000

Gain/Loss factors: shaft and toe

0.79600	0.81300	0.83000	0.84700	0.86400
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
5.95	0.00	0.00	0.000	0.0	0.000	0.000	0.000
11.88	0.00	0.00	0.000	0.0	0.000	0.000	0.000
11.92	0.00	0.00	0.000	0.0	0.000	0.000	0.000
14.75	0.00	0.00	0.000	0.0	0.000	0.000	0.000
17.58	0.00	0.00	0.000	0.0	0.000	0.000	0.000
17.62	0.00	0.00	0.000	0.0	0.000	0.000	0.000
23.85	0.00	0.00	0.000	0.0	0.000	0.000	0.000
30.08	0.00	0.00	0.000	0.0	0.000	0.000	0.000
30.12	0.00	0.00	0.000	0.0	0.000	0.000	0.000
35.10	0.00	0.00	0.000	0.0	0.000	0.000	0.000
40.08	0.00	0.00	0.000	0.0	0.000	0.000	0.000
40.12	0.00	0.00	0.000	0.0	0.000	0.000	0.000
43.25	0.00	0.00	0.000	0.0	0.000	0.000	0.000
46.38	0.00	0.00	0.000	0.0	0.000	0.000	0.000
46.42	0.00	0.00	0.000	0.0	0.000	0.000	0.000
48.90	0.00	0.00	0.000	0.0	0.000	0.000	0.000
51.38	0.00	0.00	0.000	0.0	0.000	0.000	0.000
51.42	0.00	0.00	0.000	0.0	0.000	0.000	0.000
54.63	0.00	0.00	0.000	0.0	0.000	0.000	0.000
57.88	0.00	0.00	0.000	0.0	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

CUY-14-6.93, PID 104132 : 01/24/2023 : K

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.6	1.000	0.0000	
3	0.800	140046.6	1.000	0.0000	

4	0.800	140046.6	1.000	0.0000	
5	0.800	140046.6	1.000	0.0000	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	2.500	5949.2	0.800	0.0100	5.8
Combined Pile Top		16491.9			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1600.00	Actual Pressure	(psi)	1600.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	22.45	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	5949.2	Stiffness	(kips/in)	0.0

Depth	(ft)	5.9	Standard Soil Setup		
Shaft Gain/Loss Factor		0.796	Toe Gain/Loss Factor		1.000

PILE PROFILE:

Toe Area	(in2)	144.000	Pile Type		Unknown
Pile Size	(inch)	16.000			

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model						Total Capacity Rut (kips)					40.6
No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	0.8	0.050	0.100	57.88	4.2	22.5
Toe						39.8	0.150	0.203			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile		Pile Segments: Automatic	
No. of Slacks/Splices	0	Pile Damping (%)	1
		Pile Damping Fact.(k/ft/s)	0.802
Driveability Analysis			
Soil Damping Option	Smith		
Max No Analysis Iterations	0	Time Increment/Critical	160
Output Time Interval	1	Analysis Time-Input (ms)	0
Output Level: Normal			
Gravity Mass, Pile, Hammer:	32.170	32.170	32.170
Output Segment Generation: Automatic			

Depth ft	Stroke ft	Pressure Ratio	Efficy
5.95	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
40.6	3.4	5.25	5.24	-0.61	3	9	13.05	1	4	22.5	51.8
40.6	3.4	5.25	5.24	-0.61	3	9	13.05	1	4	22.5	51.8
40.6	3.4	5.25	5.24	-0.61	3	9	13.05	1	4	22.5	51.8
40.6	3.4	5.25	5.24	-0.61	3	9	13.05	1	4	22.5	51.8
40.6	3.4	5.25	5.24	-0.61	3	9	13.05	1	4	22.5	51.8

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Depth (ft)	11.9	Standard Soil Setup	
Shaft Gain/Loss Factor	0.796	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in2)	144.000	Pile Type	Unknown
Pile Size (inch)	16.000		

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model — Total Capacity Rut (kips) 96.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	47.67	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	6.6	0.050	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	10.9	0.050	0.100	57.88	4.2	22.5
Toe						79.4	0.150	0.203			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
11.88	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
96.9	9.7	6.29	6.31	-0.82	16	49	16.07	9	5	19.2	47.0
96.9	9.7	6.29	6.31	-0.82	16	49	16.07	9	5	19.2	47.0
96.9	9.7	6.29	6.31	-0.82	16	49	16.07	9	5	19.2	47.0
96.9	9.7	6.29	6.31	-0.82	16	49	16.07	9	5	19.2	47.0
96.9	9.7	6.29	6.31	-0.82	16	49	16.07	9	5	19.2	47.0

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National Engineering & Architectural Ser GRLWEAP Version 2010

Depth (ft) 11.9 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1

57.9	22.46	30000.	492.0	4.2	0	16807.	40.1	

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model — Total Capacity Rut (kips) 36.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	47.67	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	6.7	0.050	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	10.9	0.050	0.100	57.88	4.2	22.5
Toe						18.6	0.150	0.241			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
11.92	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
36.2	2.5	4.97	4.96	-1.04	3	9	12.15	1	4	23.8	53.3
36.2	2.5	4.97	4.96	-1.03	3	9	12.17	1	4	23.8	53.3
36.2	2.5	4.97	4.96	-1.04	3	9	12.16	1	4	23.8	53.3
36.2	2.5	4.97	4.96	-1.03	3	9	12.16	1	4	23.8	53.3
36.2	2.5	4.97	4.96	-1.04	3	9	12.19	1	4	23.8	53.3

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Depth (ft) 14.8 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model					Total Capacity Rut (kips)				41.3	
No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5
13	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	44.26	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	5.2	0.050	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	10.4	0.050	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	7.2	0.088	0.100	57.88	4.2	22.5
Toe						18.6	0.150	0.241			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
14.75	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
41.3	2.9	5.12	5.10	-1.10	3	9	12.81	1	4	23.1	52.5
41.4	2.9	5.13	5.10	-1.10	3	9	12.83	1	4	23.1	52.4
41.6	2.9	5.13	5.11	-1.10	3	9	12.82	1	4	23.1	52.5
41.7	2.9	5.13	5.11	-1.09	3	9	12.86	1	4	23.1	52.4
41.8	2.9	5.13	5.11	-1.09	3	9	12.86	1	4	23.1	52.4

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Depth (ft) 17.6 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model					Total Capacity Rut (kips)				47.5	
No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2

1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5
12	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	40.86	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	3.8	0.050	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	9.7	0.050	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	8.1	0.078	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	7.3	0.100	0.100	57.88	4.2	22.5
Toe						18.6	0.150	0.241			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
17.58	10.81	1.00	0.800

Rut	Bl Ct	Stroke (ft)		Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt
kips	b/ft	down	up	ksi			ksi			kip-ft	b/min
47.5	3.5	5.28	5.26	-1.07	3	9	13.54	1	4	22.4	51.6
47.8	3.5	5.29	5.27	-1.06	3	9	13.53	1	3	22.3	51.6
48.0	3.5	5.30	5.27	-1.07	3	9	13.59	1	4	22.4	51.6
48.3	3.5	5.30	5.28	-1.05	3	9	13.59	1	4	22.3	51.5
48.5	3.5	5.31	5.28	-1.05	3	9	13.59	1	3	22.3	51.5

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Depth (ft) 17.6 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model Total Capacity Rut (kips) 540.4

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5

12	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	40.86	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	3.9	0.050	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	9.8	0.050	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	8.0	0.078	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	7.5	0.099	0.100	57.88	4.2	22.5
Toe						511.2	0.150	0.134			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
17.62	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
540.4	169.0	10.41	10.36	-2.79	14	19	36.90	16	7	21.7	36.7
540.6	169.1	10.41	10.36	-2.81	14	19	36.91	16	7	21.8	36.7
540.9	169.0	10.40	10.36	-2.81	14	19	36.91	16	7	21.8	36.7
541.1	170.2	10.40	10.36	-2.83	14	19	36.88	16	7	21.7	36.7
541.4	170.1	10.40	10.36	-2.84	14	19	36.89	16	7	21.7	36.8

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Depth (ft) 23.9 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model Total Capacity Rut (kips) 736.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5
10	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	34.05	4.2	22.5
12	0.261	16492	0.000	0.000	1.00	2.6	0.050	0.100	40.86	4.2	22.5

13	0.261	16492	0.000	0.000	1.00	9.2	0.050	0.100	44.26	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	8.8	0.070	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	7.1	0.100	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	33.4	0.053	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	42.5	0.050	0.100	57.88	4.2	22.5
Toe						633.4	0.150	0.134			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
23.85	10.81	1.00	0.800

Rut	Bl Ct	Stroke (ft)		Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt
kips	b/ft	down	up	ksi			ksi			kip-ft	b/min
736.9	718.5	10.81	10.80	-5.71	13	19	38.62	16	7	22.6	36.0
737.2	720.6	10.81	10.80	-5.72	13	19	38.61	16	7	22.6	36.0
737.4	723.2	10.81	10.80	-5.73	13	19	38.59	16	7	22.6	36.0
737.7	725.2	10.81	10.80	-5.74	13	19	38.58	16	7	22.6	36.0
737.9	727.8	10.81	10.80	-5.75	13	19	38.57	16	7	22.6	36.0

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Depth (ft) 30.1 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
	ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model Total Capacity Rut (kips) 940.4

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5
9	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	30.64	4.2	22.5
10	0.261	16492	0.000	0.000	1.00	1.4	0.050	0.100	34.05	4.2	22.5

11	0.261	16492	0.000	0.000	1.00	8.5	0.050	0.100	37.45	4.2	22.5
12	0.261	16492	0.000	0.000	1.00	9.6	0.062	0.100	40.86	4.2	22.5
13	0.261	16492	0.000	0.000	1.00	6.8	0.100	0.100	44.26	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	27.9	0.056	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	41.7	0.050	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	46.1	0.050	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	50.5	0.050	0.100	57.88	4.2	22.5
Toe						747.8	0.150	0.134			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
30.08	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
940.4	9999.0	10.81	10.81	-7.71	14	19	36.57	15	7	22.4	36.0
940.6	9999.0	10.81	10.81	-7.70	14	19	36.56	15	7	22.4	36.0
940.8	9999.0	10.81	10.81	-7.70	14	19	36.54	15	7	22.4	36.0
941.1	9999.0	10.81	10.81	-7.69	14	19	36.53	15	7	22.4	36.1
941.3	9999.0	10.81	10.81	-7.69	14	19	36.51	15	7	22.4	36.1

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Depth (ft) 30.1 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model Total Capacity Rut (kips) 1139.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5

9	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	30.64	4.2	22.5
10	0.261	16492	0.000	0.000	1.00	1.5	0.050	0.100	34.05	4.2	22.5
11	0.261	16492	0.000	0.000	1.00	8.6	0.050	0.100	37.45	4.2	22.5
12	0.261	16492	0.000	0.000	1.00	9.6	0.063	0.100	40.86	4.2	22.5
13	0.261	16492	0.000	0.000	1.00	6.8	0.100	0.100	44.26	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	28.3	0.056	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	41.8	0.050	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	46.2	0.050	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	50.6	0.050	0.100	57.88	4.2	22.5
Toe						946.1	0.150	0.136			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
30.12	10.81	1.00	0.800

Rut	Bl Ct	Stroke (ft)		Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt
kips	b/ft	down	up	ksi			ksi			kip-ft	b/min
1139.3	9999.0	10.81	10.91	-7.64	14	19	37.46	15	6	22.4	36.0
1139.6	9999.0	10.81	10.91	-7.63	14	19	37.45	15	6	22.4	36.0
1139.8	9999.0	10.81	10.91	-7.63	14	19	37.43	15	6	22.4	36.0
1140.0	9999.0	10.81	10.91	-7.62	14	19	37.42	15	6	22.4	36.0
1140.3	9999.0	10.81	10.91	-7.62	14	19	37.40	15	6	22.4	36.0

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Depth (ft) 35.1 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
	ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model Total Capacity Rut (kips) 1221.8

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2

1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5
7	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	23.83	4.2	22.5
9	0.261	16492	0.000	0.000	1.00	5.0	0.050	0.100	30.64	4.2	22.5
10	0.261	16492	0.000	0.000	1.00	10.3	0.050	0.100	34.05	4.2	22.5
11	0.261	16492	0.000	0.000	1.00	7.3	0.087	0.100	37.45	4.2	22.5
12	0.261	16492	0.000	0.000	1.00	11.5	0.081	0.100	40.86	4.2	22.5
13	0.261	16492	0.000	0.000	1.00	39.4	0.050	0.100	44.26	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	43.8	0.050	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	48.2	0.050	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	52.8	0.050	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	57.4	0.050	0.100	57.88	4.2	22.5
Toe						946.1	0.150	0.136			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
35.10	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1221.8	9999.0	10.81	10.76	-8.79	9	18	34.82	14	6	22.2	36.1
1222.0	9999.0	10.81	10.76	-8.80	9	18	34.81	14	6	22.2	36.1
1222.3	9999.0	10.81	10.75	-8.80	9	18	34.79	14	6	22.2	36.1
1222.5	9999.0	10.81	10.75	-8.81	9	18	34.77	14	6	22.2	36.1
1222.8	9999.0	10.81	10.75	-8.81	9	18	34.76	14	6	22.2	36.1

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Depth (ft) 40.1 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model Total Capacity Rut (kips) 1313.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5
6	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	20.43	4.2	22.5
7	0.261	16492	0.000	0.000	1.00	1.0	0.050	0.100	23.83	4.2	22.5
8	0.261	16492	0.000	0.000	1.00	8.3	0.050	0.100	27.24	4.2	22.5
9	0.261	16492	0.000	0.000	1.00	9.9	0.060	0.100	30.64	4.2	22.5
10	0.261	16492	0.000	0.000	1.00	6.7	0.100	0.100	34.05	4.2	22.5
11	0.261	16492	0.000	0.000	1.00	25.9	0.057	0.100	37.45	4.2	22.5
12	0.261	16492	0.000	0.000	1.00	41.4	0.050	0.100	40.86	4.2	22.5
13	0.261	16492	0.000	0.000	1.00	45.8	0.050	0.100	44.26	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	50.2	0.050	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	55.0	0.050	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	59.5	0.050	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	63.9	0.050	0.100	57.88	4.2	22.5
Toe						946.1	0.150	0.136			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
40.08	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1313.7	9999.0	10.62	10.58	-9.37	9	18	31.46	14	6	21.6	36.4
1314.0	9999.0	10.62	10.58	-9.37	9	18	31.45	14	6	21.6	36.4
1314.2	9999.0	10.62	10.58	-9.38	9	18	31.43	14	6	21.6	36.4
1314.5	9999.0	10.61	10.58	-9.38	9	18	31.42	14	6	21.5	36.4
1314.7	9999.0	10.61	10.58	-9.38	9	18	31.41	14	6	21.5	36.4

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Depth (ft) 40.1 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s

0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model — Total Capacity Rut (kips) 1195.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5
6	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	20.43	4.2	22.5
7	0.261	16492	0.000	0.000	1.00	1.1	0.050	0.100	23.83	4.2	22.5
8	0.261	16492	0.000	0.000	1.00	8.4	0.050	0.100	27.24	4.2	22.5
9	0.261	16492	0.000	0.000	1.00	9.8	0.060	0.100	30.64	4.2	22.5
10	0.261	16492	0.000	0.000	1.00	6.7	0.100	0.100	34.05	4.2	22.5
11	0.261	16492	0.000	0.000	1.00	26.3	0.057	0.100	37.45	4.2	22.5
12	0.261	16492	0.000	0.000	1.00	41.5	0.050	0.100	40.86	4.2	22.5
13	0.261	16492	0.000	0.000	1.00	45.9	0.050	0.100	44.26	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	50.3	0.050	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	55.1	0.050	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	59.5	0.050	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	63.9	0.050	0.100	57.88	4.2	22.5
Toe						827.4	0.150	0.133			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
40.12	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1195.8	9999.0	10.58	10.54	-9.35	9	18	30.99	14	6	21.5	36.5
1196.0	9999.0	10.58	10.54	-9.35	9	18	30.97	14	6	21.5	36.5
1196.3	9999.0	10.58	10.54	-9.35	9	18	30.96	14	6	21.5	36.5
1196.5	9999.0	10.58	10.54	-9.36	9	18	30.94	14	6	21.5	36.5
1196.8	9999.0	10.58	10.54	-9.36	9	18	30.93	14	6	21.5	36.5

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Depth (ft) 43.2 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model — Total Capacity Rut (kips) 1258.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5
5	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	17.02	4.2	22.5
6	0.261	16492	0.000	0.000	1.00	0.5	0.050	0.100	20.43	4.2	22.5
7	0.261	16492	0.000	0.000	1.00	8.1	0.050	0.100	23.83	4.2	22.5
8	0.261	16492	0.000	0.000	1.00	10.2	0.057	0.100	27.24	4.2	22.5
9	0.261	16492	0.000	0.000	1.00	6.6	0.100	0.100	30.64	4.2	22.5
10	0.261	16492	0.000	0.000	1.00	23.7	0.059	0.100	34.05	4.2	22.5
11	0.261	16492	0.000	0.000	1.00	41.1	0.050	0.100	37.45	4.2	22.5
12	0.261	16492	0.000	0.000	1.00	45.5	0.050	0.100	40.86	4.2	22.5
13	0.261	16492	0.000	0.000	1.00	49.9	0.050	0.100	44.26	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	54.7	0.050	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	59.2	0.050	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	63.6	0.050	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	67.7	0.050	0.100	57.88	4.2	22.5
Toe						827.4	0.150	0.133			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
43.25	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1258.1	9999.0	10.53	10.48	-8.78	10	18	29.97	7	8	21.1	36.6
1258.4	9999.0	10.53	10.48	-8.77	10	18	29.96	7	8	21.1	36.6
1258.6	9999.0	10.53	10.48	-8.76	10	18	29.96	7	8	21.1	36.6
1258.9	9999.0	10.53	10.48	-8.75	10	18	29.96	7	8	21.1	36.6
1259.1	9999.0	10.53	10.48	-8.74	10	18	29.96	7	8	21.1	36.6

Depth (ft) 46.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model — Total Capacity Rut (kips) 1324.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5
4	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	13.62	4.2	22.5
5	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	17.02	4.2	22.5
6	0.261	16492	0.000	0.000	1.00	7.8	0.050	0.100	20.43	4.2	22.5
7	0.261	16492	0.000	0.000	1.00	10.5	0.054	0.100	23.83	4.2	22.5
8	0.261	16492	0.000	0.000	1.00	6.5	0.100	0.100	27.24	4.2	22.5
9	0.261	16492	0.000	0.000	1.00	21.2	0.062	0.100	30.64	4.2	22.5
10	0.261	16492	0.000	0.000	1.00	40.8	0.050	0.100	34.05	4.2	22.5
11	0.261	16492	0.000	0.000	1.00	45.2	0.050	0.100	37.45	4.2	22.5
12	0.261	16492	0.000	0.000	1.00	49.6	0.050	0.100	40.86	4.2	22.5
13	0.261	16492	0.000	0.000	1.00	54.3	0.050	0.100	44.26	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	58.8	0.050	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	63.2	0.050	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	67.3	0.050	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	71.9	0.050	0.100	57.88	4.2	22.5
Toe						827.4	0.150	0.133			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
46.38	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min

1324.3	9999.0	10.48	10.43	-7.31	9	17	29.84	6	8	20.7	36.7
1324.6	9999.0	10.48	10.43	-7.30	9	17	29.83	6	8	20.7	36.7
1324.8	9999.0	10.48	10.43	-7.29	9	17	29.83	6	8	20.7	36.7
1325.1	9999.0	10.48	10.43	-7.27	9	17	29.83	6	8	20.7	36.7
1325.3	9999.0	10.48	10.43	-7.26	9	17	29.82	6	8	20.7	36.7

Depth (ft) 46.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model — Total Capacity Rut (kips) 1325.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5
4	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	13.62	4.2	22.5
5	0.261	16492	0.000	0.000	1.00	0.1	0.050	0.100	17.02	4.2	22.5
6	0.261	16492	0.000	0.000	1.00	7.8	0.050	0.100	20.43	4.2	22.5
7	0.261	16492	0.000	0.000	1.00	10.4	0.055	0.100	23.83	4.2	22.5
8	0.261	16492	0.000	0.000	1.00	6.5	0.100	0.100	27.24	4.2	22.5
9	0.261	16492	0.000	0.000	1.00	21.5	0.062	0.100	30.64	4.2	22.5
10	0.261	16492	0.000	0.000	1.00	40.8	0.050	0.100	34.05	4.2	22.5
11	0.261	16492	0.000	0.000	1.00	45.2	0.050	0.100	37.45	4.2	22.5
12	0.261	16492	0.000	0.000	1.00	49.6	0.050	0.100	40.86	4.2	22.5
13	0.261	16492	0.000	0.000	1.00	54.3	0.050	0.100	44.26	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	58.8	0.050	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	63.3	0.050	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	67.4	0.050	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	71.8	0.050	0.100	57.88	4.2	22.5
Toe						827.4	0.150	0.133			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1325.1	9999.0	10.48	10.43	-7.31	9	17	29.83	6	8	20.7	36.7
1325.4	9999.0	10.48	10.43	-7.29	9	17	29.83	6	8	20.7	36.7
1325.6	9999.0	10.48	10.43	-7.28	9	17	29.83	6	8	20.7	36.7
1325.9	9999.0	10.48	10.43	-7.26	9	17	29.82	6	8	20.7	36.7
1326.1	9999.0	10.48	10.43	-7.24	9	17	29.82	6	8	20.7	36.7

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Depth (ft) 48.9 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L ft	b Top in2	Area ksi	E-Mod lb/ft3	Spec Wt ft	Perim	C Index ft/s	Wave Sp k/ft/s	EA/c
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1	
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1	

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model Total Capacity Rut (kips) 1369.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.000	0.100	6.81	4.2	22.5
3	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	10.21	4.2	22.5
5	0.261	16492	0.000	0.000	1.00	5.4	0.050	0.100	17.02	4.2	22.5
6	0.261	16492	0.000	0.000	1.00	10.5	0.050	0.100	20.43	4.2	22.5
7	0.261	16492	0.000	0.000	1.00	7.0	0.090	0.100	23.83	4.2	22.5
8	0.261	16492	0.000	0.000	1.00	13.1	0.076	0.100	27.24	4.2	22.5
9	0.261	16492	0.000	0.000	1.00	39.6	0.050	0.100	30.64	4.2	22.5
10	0.261	16492	0.000	0.000	1.00	44.0	0.050	0.100	34.05	4.2	22.5
11	0.261	16492	0.000	0.000	1.00	48.4	0.050	0.100	37.45	4.2	22.5
12	0.261	16492	0.000	0.000	1.00	53.0	0.050	0.100	40.86	4.2	22.5
13	0.261	16492	0.000	0.000	1.00	57.6	0.050	0.100	44.26	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	62.1	0.050	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	66.3	0.050	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	70.7	0.050	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	64.0	0.087	0.100	57.88	4.2	22.5
Toe						827.4	0.150	0.133			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
48.90	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1369.2	9999.0	10.44	10.38	-6.19	9	17	29.66	6	8	20.3	36.7
1370.4	9999.0	10.44	10.38	-6.18	9	17	29.66	6	8	20.3	36.7
1371.6	9999.0	10.44	10.38	-6.16	9	17	29.66	6	8	20.3	36.7
1372.8	9999.0	10.44	10.38	-6.15	9	17	29.65	6	8	20.3	36.7
1374.0	9999.0	10.44	10.38	-6.12	9	17	29.66	6	8	20.3	36.7

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Depth (ft) 51.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L ft	b Top in2	Area ksi	E-Mod lb/ft3	Spec Wt ft	Perim	C Index ft/s	Wave Sp k/ft/s	EA/c
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1	
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1	

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model Total Capacity Rut (kips) 1415.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	6.81	4.2	22.5
4	0.261	16492	0.000	0.000	1.00	3.2	0.050	0.100	13.62	4.2	22.5
5	0.261	16492	0.000	0.000	1.00	9.5	0.050	0.100	17.02	4.2	22.5
6	0.261	16492	0.000	0.000	1.00	8.4	0.074	0.100	20.43	4.2	22.5
7	0.261	16492	0.000	0.000	1.00	7.2	0.100	0.100	23.83	4.2	22.5
8	0.261	16492	0.000	0.000	1.00	36.2	0.051	0.100	27.24	4.2	22.5
9	0.261	16492	0.000	0.000	1.00	42.8	0.050	0.100	30.64	4.2	22.5
10	0.261	16492	0.000	0.000	1.00	47.2	0.050	0.100	34.05	4.2	22.5
11	0.261	16492	0.000	0.000	1.00	51.7	0.050	0.100	37.45	4.2	22.5

12	0.261	16492	0.000	0.000	1.00	56.4	0.050	0.100	40.86	4.2	22.5
13	0.261	16492	0.000	0.000	1.00	60.9	0.050	0.100	44.26	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	65.2	0.050	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	69.4	0.050	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	66.9	0.074	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	62.8	0.100	0.100	57.88	4.2	22.5
Toe						827.4	0.150	0.133			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
51.38	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1415.3	9999.0	10.40	10.34	-5.72	8	16	29.31	6	8	19.9	36.8
1417.5	9999.0	10.40	10.34	-5.73	8	16	29.31	6	8	19.9	36.8
1419.7	9999.0	10.40	10.34	-5.70	8	16	29.31	6	8	19.9	36.8
1421.9	9999.0	10.40	10.34	-5.68	8	16	29.31	6	8	19.9	36.8
1424.0	9999.0	10.40	10.34	-5.68	8	16	29.32	6	8	19.9	36.8

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Depth (ft) 51.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model Total Capacity Rut (kips) 1618.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.000	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	6.81	4.2	22.5
4	0.261	16492	0.000	0.000	1.00	3.3	0.050	0.100	13.62	4.2	22.5

5	0.261	16492	0.000	0.000	1.00	9.5	0.050	0.100	17.02	4.2	22.5
6	0.261	16492	0.000	0.000	1.00	8.4	0.075	0.100	20.43	4.2	22.5
7	0.261	16492	0.000	0.000	1.00	7.2	0.100	0.100	23.83	4.2	22.5
8	0.261	16492	0.000	0.000	1.00	36.5	0.051	0.100	27.24	4.2	22.5
9	0.261	16492	0.000	0.000	1.00	42.9	0.050	0.100	30.64	4.2	22.5
10	0.261	16492	0.000	0.000	1.00	47.3	0.050	0.100	34.05	4.2	22.5
11	0.261	16492	0.000	0.000	1.00	51.8	0.050	0.100	37.45	4.2	22.5
12	0.261	16492	0.000	0.000	1.00	56.5	0.050	0.100	40.86	4.2	22.5
13	0.261	16492	0.000	0.000	1.00	60.9	0.050	0.100	44.26	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	65.2	0.050	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	69.5	0.050	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	66.8	0.074	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	63.0	0.100	0.100	57.88	4.2	22.5
Toe						1029.9	0.150	0.133			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
51.42	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1618.7	9999.0	10.42	10.37	-5.83	8	16	29.64	6	8	20.0	36.8
1620.9	9999.0	10.42	10.37	-5.83	8	16	29.65	6	8	20.0	36.8
1623.1	9999.0	10.42	10.37	-5.84	8	16	29.65	6	8	20.0	36.8
1625.3	9999.0	10.42	10.37	-5.81	8	16	29.65	6	8	20.0	36.8
1627.5	9999.0	10.42	10.37	-5.82	8	16	29.65	6	8	20.0	36.8

CUY-14-6.93, PID 104132 : 01/24/2023 : K 01/25/2023
National Engineering & Architectural Ser GRLWEAP Version 2010

Depth (ft) 54.6 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model						Total Capacity Rut (kips)			1699.2		
No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.050	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	0.0	0.050	0.100	6.81	4.2	22.5
3	0.261	16492	0.000	0.000	1.00	2.9	0.050	0.100	10.21	4.2	22.5
4	0.261	16492	0.000	0.000	1.00	9.3	0.050	0.100	13.62	4.2	22.5
5	0.261	16492	0.000	0.000	1.00	8.6	0.072	0.100	17.02	4.2	22.5
6	0.261	16492	0.000	0.000	1.00	7.1	0.100	0.100	20.43	4.2	22.5
7	0.261	16492	0.000	0.000	1.00	34.7	0.052	0.100	23.83	4.2	22.5
8	0.261	16492	0.000	0.000	1.00	42.6	0.050	0.100	27.24	4.2	22.5
9	0.261	16492	0.000	0.000	1.00	47.0	0.050	0.100	30.64	4.2	22.5
10	0.261	16492	0.000	0.000	1.00	51.5	0.050	0.100	34.05	4.2	22.5
11	0.261	16492	0.000	0.000	1.00	56.2	0.050	0.100	37.45	4.2	22.5
12	0.261	16492	0.000	0.000	1.00	60.7	0.050	0.100	40.86	4.2	22.5
13	0.261	16492	0.000	0.000	1.00	65.0	0.050	0.100	44.26	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	69.2	0.050	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	67.4	0.071	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	62.6	0.100	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	84.3	0.052	0.100	57.88	4.2	22.5
Toe						1029.9	0.150	0.133			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
54.63	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1699.2	9999.0	10.36	10.29	-5.98	7	15	29.18	6	8	19.4	36.9
1701.4	9999.0	10.36	10.29	-5.97	7	15	29.18	6	8	19.4	36.9
1703.5	9999.0	10.36	10.29	-5.96	7	15	29.18	6	8	19.4	36.9
1705.7	9999.0	10.36	10.29	-5.95	7	15	29.18	6	8	19.3	36.9
1707.9	9999.0	10.36	10.29	-5.94	7	15	29.18	6	8	19.3	36.9

CUY-14-6.93, PID 104132 : 01/24/2023 : K 01/25/2023
National Engineering & Architectural Ser GRLWEAP Version 2010

Depth (ft) 57.9 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown

Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
57.9	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.888

Pile and Soil Model — Total Capacity Rut (kips) 1785.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.261	16492	0.010	0.000	0.85	0.0	0.050	0.100	3.40	4.2	22.5
2	0.261	16492	0.000	0.000	1.00	2.6	0.050	0.100	6.81	4.2	22.5
3	0.261	16492	0.000	0.000	1.00	9.1	0.050	0.100	10.21	4.2	22.5
4	0.261	16492	0.000	0.000	1.00	8.9	0.069	0.100	13.62	4.2	22.5
5	0.261	16492	0.000	0.000	1.00	7.1	0.100	0.100	17.02	4.2	22.5
6	0.261	16492	0.000	0.000	1.00	33.2	0.053	0.100	20.43	4.2	22.5
7	0.261	16492	0.000	0.000	1.00	42.4	0.050	0.100	23.83	4.2	22.5
8	0.261	16492	0.000	0.000	1.00	46.8	0.050	0.100	27.24	4.2	22.5
9	0.261	16492	0.000	0.000	1.00	51.3	0.050	0.100	30.64	4.2	22.5
10	0.261	16492	0.000	0.000	1.00	56.0	0.050	0.100	34.05	4.2	22.5
11	0.261	16492	0.000	0.000	1.00	60.5	0.050	0.100	37.45	4.2	22.5
12	0.261	16492	0.000	0.000	1.00	64.8	0.050	0.100	40.86	4.2	22.5
13	0.261	16492	0.000	0.000	1.00	69.0	0.050	0.100	44.26	4.2	22.5
14	0.261	16492	0.000	0.000	1.00	67.9	0.069	0.100	47.67	4.2	22.5
15	0.261	16492	0.000	0.000	1.00	62.5	0.100	0.100	51.07	4.2	22.5
16	0.261	16492	0.000	0.000	1.00	83.2	0.055	0.100	54.48	4.2	22.5
17	0.261	16492	0.000	0.000	1.00	90.0	0.050	0.100	57.88	4.2	22.5
Toe						1029.9	0.150	0.133			

4.442 kips total unreduced pile weight (g= 32.17 ft/s2)
4.442 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
57.88	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1785.2	9999.0	10.36	10.30	-4.92	6	15	28.67	6	8	18.9	36.9
1787.4	9999.0	10.36	10.30	-4.91	6	15	28.66	6	8	18.9	36.9
1789.5	9999.0	10.36	10.30	-4.89	6	15	28.65	6	8	18.9	36.9
1791.7	9999.0	10.36	10.30	-4.88	6	15	28.65	6	8	18.9	36.9
1793.9	9999.0	10.36	10.30	-4.87	6	15	28.64	6	8	18.9	36.9

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.796 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.9	40.6	0.8	39.8	3.4	13.046	-0.611	5.25	22.5
11.9	96.9	17.5	79.4	9.7	16.067	-0.818	6.29	19.2
11.9	36.2	17.6	18.6	2.5	12.153	-1.039	4.97	23.8
14.8	41.3	22.7	18.6	2.9	12.806	-1.102	5.12	23.1
17.6	47.5	28.9	18.6	3.5	13.540	-1.067	5.28	22.4
17.6	540.4	29.2	511.2	169.0	36.898	-2.793	10.41	21.7
23.9	736.9	103.5	633.4	718.5	38.619	-5.710	10.81	22.6
30.1	940.4	192.6	747.8	9999.0	36.572	-7.705	10.81	22.4
30.1	1139.3	193.2	946.1	9999.0	37.459	-7.639	10.81	22.4
35.1	1221.8	275.7	946.1	9999.0	34.818	-8.790	10.81	22.2
40.1	1313.7	367.6	946.1	9999.0	31.464	-9.371	10.62	21.6
40.1	1195.8	368.4	827.4	9999.0	30.985	-9.350	10.58	21.5
43.2	1258.1	430.8	827.4	9999.0	29.971	-8.784	10.53	21.1
46.4	1324.3	497.0	827.4	9999.0	29.836	-7.314	10.48	20.7
46.4	1325.1	497.8	827.4	9999.0	29.833	-7.307	10.48	20.7
48.9	1369.2	541.8	827.4	9999.0	29.661	-6.189	10.44	20.3
51.4	1415.3	588.0	827.4	9999.0	29.306	-5.723	10.40	19.9
51.4	1618.7	588.8	1029.9	9999.0	29.641	-5.834	10.42	20.0
54.6	1699.2	669.3	1029.9	9999.0	29.181	-5.981	10.36	19.4
57.9	1785.2	755.3	1029.9	9999.0	28.665	-4.917	10.36	18.9

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.813 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.9	40.6	0.8	39.8	3.4	13.046	-0.611	5.25	22.5
11.9	96.9	17.5	79.4	9.7	16.067	-0.818	6.29	19.2
11.9	36.2	17.6	18.6	2.5	12.166	-1.031	4.97	23.8
14.8	41.4	22.8	18.6	2.9	12.833	-1.102	5.13	23.1
17.6	47.8	29.2	18.6	3.5	13.533	-1.062	5.29	22.3
17.6	540.6	29.4	511.2	169.1	36.911	-2.807	10.41	21.8
23.9	737.2	103.7	633.4	720.6	38.608	-5.720	10.81	22.6
30.1	940.6	192.8	747.8	9999.0	36.557	-7.700	10.81	22.4
30.1	1139.6	193.4	946.1	9999.0	37.448	-7.633	10.81	22.4
35.1	1222.0	275.9	946.1	9999.0	34.805	-8.796	10.81	22.2
40.1	1314.0	367.9	946.1	9999.0	31.450	-9.374	10.62	21.6
40.1	1196.0	368.6	827.4	9999.0	30.972	-9.352	10.58	21.5
43.2	1258.4	431.0	827.4	9999.0	29.965	-8.774	10.53	21.1
46.4	1324.6	497.2	827.4	9999.0	29.832	-7.299	10.48	20.7
46.4	1325.4	498.0	827.4	9999.0	29.833	-7.289	10.48	20.7
48.9	1370.4	543.0	827.4	9999.0	29.656	-6.179	10.44	20.3

51.4	1417.5	590.1	827.4	9999.0	29.315	-5.727	10.40	19.9
51.4	1620.9	591.0	1029.9	9999.0	29.647	-5.827	10.42	20.0
54.6	1701.4	671.5	1029.9	9999.0	29.180	-5.971	10.36	19.4
57.9	1787.4	757.5	1029.9	9999.0	28.661	-4.908	10.36	18.9

Refusal occurred; no driving time output possible

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.830 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.9	40.6	0.8	39.8	3.4	13.046	-0.611	5.25	22.5
11.9	96.9	17.5	79.4	9.7	16.067	-0.818	6.29	19.2
11.9	36.2	17.6	18.6	2.5	12.163	-1.043	4.97	23.8
14.8	41.6	23.0	18.6	2.9	12.825	-1.098	5.13	23.1
17.6	48.0	29.4	18.6	3.5	13.591	-1.066	5.30	22.4
17.6	540.9	29.7	511.2	169.0	36.910	-2.814	10.40	21.8
23.9	737.4	104.0	633.4	723.2	38.594	-5.732	10.81	22.6
30.1	940.8	193.1	747.8	9999.0	36.543	-7.695	10.81	22.4
30.1	1139.8	193.7	946.1	9999.0	37.429	-7.630	10.81	22.4
35.1	1222.3	276.2	946.1	9999.0	34.791	-8.801	10.81	22.2
40.1	1314.2	368.1	946.1	9999.0	31.434	-9.379	10.62	21.6
40.1	1196.3	368.9	827.4	9999.0	30.958	-9.354	10.58	21.5
43.2	1258.6	431.2	827.4	9999.0	29.964	-8.762	10.53	21.1
46.4	1324.8	497.5	827.4	9999.0	29.827	-7.288	10.48	20.7
46.4	1325.6	498.3	827.4	9999.0	29.825	-7.279	10.48	20.7
48.9	1371.6	544.2	827.4	9999.0	29.662	-6.156	10.44	20.3
51.4	1419.7	592.3	827.4	9999.0	29.312	-5.701	10.40	19.9
51.4	1623.1	593.2	1029.9	9999.0	29.647	-5.839	10.42	20.0
54.6	1703.5	673.7	1029.9	9999.0	29.180	-5.961	10.36	19.4
57.9	1789.5	759.7	1029.9	9999.0	28.655	-4.894	10.36	18.9

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.847 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.9	40.6	0.8	39.8	3.4	13.046	-0.611	5.25	22.5
11.9	96.9	17.5	79.4	9.7	16.067	-0.818	6.29	19.2
11.9	36.2	17.6	18.6	2.5	12.165	-1.033	4.97	23.8
14.8	41.7	23.1	18.6	2.9	12.860	-1.094	5.13	23.1
17.6	48.3	29.7	18.6	3.5	13.595	-1.054	5.30	22.3
17.6	541.1	29.9	511.2	170.2	36.882	-2.834	10.40	21.7
23.9	737.7	104.2	633.4	725.2	38.583	-5.743	10.81	22.6
30.1	941.1	193.3	747.8	9999.0	36.527	-7.690	10.81	22.4
30.1	1140.0	193.9	946.1	9999.0	37.418	-7.625	10.81	22.4

35.1	1222.5	276.4	946.1	9999.0	34.775	-8.805	10.81	22.2
40.1	1314.5	368.4	946.1	9999.0	31.420	-9.380	10.61	21.5
40.1	1196.5	369.1	827.4	9999.0	30.940	-9.360	10.58	21.5
43.2	1258.9	431.5	827.4	9999.0	29.957	-8.754	10.53	21.1
46.4	1325.1	497.7	827.4	9999.0	29.825	-7.270	10.48	20.7
46.4	1325.9	498.5	827.4	9999.0	29.825	-7.262	10.48	20.7
48.9	1372.8	545.4	827.4	9999.0	29.653	-6.146	10.44	20.3
51.4	1421.9	594.5	827.4	9999.0	29.307	-5.682	10.40	19.9
51.4	1625.3	595.4	1029.9	9999.0	29.649	-5.805	10.42	20.0
54.6	1705.7	675.9	1029.9	9999.0	29.179	-5.951	10.36	19.3
57.9	1791.7	761.9	1029.9	9999.0	28.648	-4.881	10.36	18.9

Refusal occurred; no driving time output possible

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.864 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.9	40.6	0.8	39.8	3.4	13.046	-0.611	5.25	22.5
11.9	96.9	17.5	79.4	9.7	16.067	-0.818	6.29	19.2
11.9	36.2	17.6	18.6	2.5	12.186	-1.039	4.97	23.8
14.8	41.8	23.2	18.6	2.9	12.864	-1.090	5.13	23.1
17.6	48.5	29.9	18.6	3.5	13.586	-1.048	5.31	22.3
17.6	541.4	30.2	511.2	170.1	36.894	-2.843	10.40	21.7
23.9	737.9	104.5	633.4	727.8	38.569	-5.754	10.81	22.6
30.1	941.3	193.6	747.8	9999.0	36.513	-7.686	10.81	22.4
30.1	1140.3	194.2	946.1	9999.0	37.398	-7.621	10.81	22.4
35.1	1222.8	276.6	946.1	9999.0	34.762	-8.811	10.81	22.2
40.1	1314.7	368.6	946.1	9999.0	31.407	-9.382	10.61	21.5
40.1	1196.8	369.4	827.4	9999.0	30.928	-9.357	10.58	21.5
43.2	1259.1	431.7	827.4	9999.0	29.956	-8.742	10.53	21.1
46.4	1325.3	498.0	827.4	9999.0	29.823	-7.257	10.48	20.7
46.4	1326.1	498.8	827.4	9999.0	29.824	-7.242	10.48	20.7
48.9	1374.0	546.6	827.4	9999.0	29.660	-6.120	10.44	20.3
51.4	1424.0	596.7	827.4	9999.0	29.316	-5.681	10.40	19.9
51.4	1627.5	597.6	1029.9	9999.0	29.649	-5.818	10.42	20.0
54.6	1707.9	678.0	1029.9	9999.0	29.179	-5.941	10.36	19.3
57.9	1793.9	764.0	1029.9	9999.0	28.643	-4.868	10.36	18.9

Refusal occurred; no driving time output possible

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Stroke ft	Pressure Ratio	Efficy.	Stiffn. Factor	Cushion CoR
5.95	57.88	0.00	10.81	1.00	0.80	1.00	1.00
11.88	57.88	0.00	10.81	1.00	0.80	1.00	1.00
11.92	57.88	0.00	10.81	1.00	0.80	1.00	1.00
14.75	57.88	0.00	10.81	1.00	0.80	1.00	1.00
17.58	57.88	0.00	10.81	1.00	0.80	1.00	1.00
17.62	57.88	0.00	10.81	1.00	0.80	1.00	1.00
23.85	57.88	0.00	10.81	1.00	0.80	1.00	1.00
30.08	57.88	0.00	10.81	1.00	0.80	1.00	1.00
30.12	57.88	0.00	10.81	1.00	0.80	1.00	1.00
35.10	57.88	0.00	10.81	1.00	0.80	1.00	1.00
40.08	57.88	0.00	10.81	1.00	0.80	1.00	1.00
40.12	57.88	0.00	10.81	1.00	0.80	1.00	1.00
43.25	57.88	0.00	10.81	1.00	0.80	1.00	1.00
46.38	57.88	0.00	10.81	1.00	0.80	1.00	1.00
46.42	57.88	0.00	10.81	1.00	0.80	1.00	1.00
48.90	57.88	0.00	10.81	1.00	0.80	1.00	1.00
51.38	57.88	0.00	10.81	1.00	0.80	1.00	1.00
51.42	57.88	0.00	10.81	1.00	0.80	1.00	1.00
54.63	57.88	0.00	10.81	1.00	0.80	1.00	1.00
57.88	57.88	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	0.00	0.00	0.100	0.203	0.050	0.150	0.000	6.000	1.000
5.49	0.00	0.00	0.100	0.203	0.050	0.150	0.000	6.000	1.000
5.50	0.41	36.76	0.100	0.203	0.050	0.150	0.000	6.000	1.000
9.01	0.68	60.22	0.100	0.203	0.050	0.150	0.000	6.000	1.000
11.89	0.90	79.47	0.100	0.203	0.050	0.150	0.000	6.000	1.000
11.91	0.48	18.60	0.100	0.241	0.100	0.150	1.000	6.000	24.000
17.59	0.71	18.60	0.100	0.241	0.100	0.150	1.000	6.000	24.000
17.61	2.52	510.86	0.100	0.134	0.050	0.150	0.000	6.000	1.000
18.09	2.61	527.56	0.100	0.134	0.050	0.150	0.000	6.000	1.000
18.11	2.61	528.10	0.100	0.134	0.050	0.150	0.000	6.000	1.000
27.11	3.43	693.27	0.100	0.134	0.050	0.150	0.000	6.000	1.000
30.09	3.70	747.96	0.100	0.134	0.050	0.150	0.000	6.000	1.000
30.11	3.72	946.11	0.100	0.136	0.050	0.150	0.000	6.000	1.000
39.11	4.55	946.11	0.100	0.136	0.050	0.150	0.000	6.000	1.000
40.09	4.64	946.11	0.100	0.136	0.050	0.150	0.000	6.000	1.000
40.11	4.61	827.37	0.100	0.133	0.050	0.150	0.000	6.000	1.000
46.39	5.20	827.37	0.100	0.133	0.050	0.150	0.000	6.000	1.000
46.41	5.20	827.37	0.100	0.133	0.100	0.150	1.000	6.000	24.000
51.39	5.70	827.37	0.100	0.133	0.100	0.150	1.000	6.000	24.000
51.41	5.82	1029.88	0.100	0.133	0.050	0.150	0.000	6.000	1.000

57.88	6.48	1029.88	0.100	0.133	0.050	0.150	0.000	6.000	1.000

Gain/Loss 3 at Shaft and Toe 0.500 / 1.000

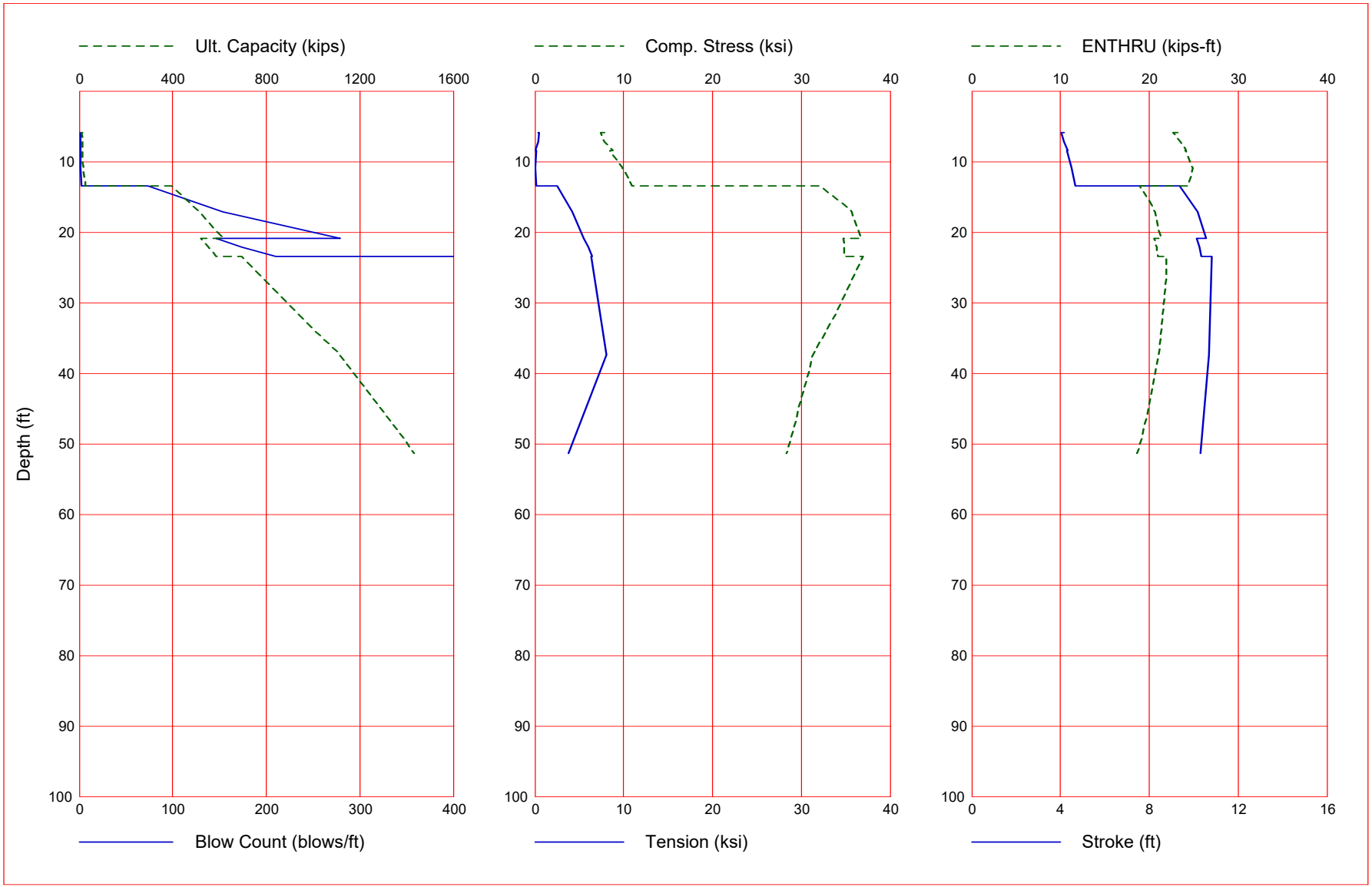
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.9	13.4	0.8	12.6	1.5	7.875	-0.413	4.16	23.2
5.9	11.6	0.9	10.7	1.4	7.429	-0.530	4.04	22.7
7.2	13.7	3.0	10.7	1.5	7.847	-0.353	4.16	23.5
8.4	15.7	5.1	10.7	1.6	8.777	-0.100	4.31	24.2
8.4	14.6	5.1	9.4	1.5	8.470	-0.178	4.28	24.0
10.9	19.5	10.1	9.4	1.8	9.881	-0.063	4.48	24.9
13.4	24.5	15.1	9.4	2.1	10.907	-0.168	4.67	24.4
13.4	393.6	15.3	378.3	73.5	32.066	-2.472	9.36	18.9
17.1	512.6	48.3	464.2	153.0	35.636	-4.230	10.18	20.6
20.9	617.5	86.7	530.7	279.2	36.737	-5.475	10.56	21.4
20.9	520.4	87.2	433.2	146.8	34.736	-5.540	10.13	20.5
22.1	553.2	100.9	452.4	174.0	34.869	-6.032	10.25	20.8
23.4	586.7	115.2	471.6	210.5	34.871	-6.405	10.36	21.0
23.4	695.0	115.7	579.3	466.5	36.945	-6.368	10.81	21.9
37.4	1115.1	321.7	793.4	9999.0	31.319	-8.077	10.69	21.1
51.4	1433.4	606.0	827.4	9999.0	28.347	-3.781	10.30	18.6

Refusal occurred; no driving time output possible

National Engineering & Architectural Ser
CUY-14-6.93, PID 104132 : 01/24/2023 : K

Jan 25 2023
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 0.500 / 1.000



GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

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 building and other factors.

Input File: C:\USERS\KARENS\DESKTOP\GRL FILES\P216IN2.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

CUY-14-6.93, PID 104132 : 01/24/2023 : K

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	144.000	16.000	Unknown

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
2.500	22.450	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
51.380	22.46	30000.0	492.000	4.190	0	0.850	0.010

FFatigue	F0	0-Bottom
0	0.000	0.000

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.0020	0.0020	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1600.00	1440.00	1295.00	1165.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1600.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Research Toe Plug: Res-int, Q-int, D-int, Res-plug, Q-plug, D-plug

0.000	0.000	0.000	0.000	0.000	0.000

Research Toe Plug: RD plug toe: m, d

0.000	0.000

Research Toe Plug: New Toe Plug Model is NOT applied

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimL	TSf0
0.01	0.00	0.00	0.10	0.19	0.20	0.15	1.75	6.00	168.000
5.49	0.00	0.00	0.10	0.19	0.20	0.15	1.75	6.00	168.000
5.50	0.92	12.57	0.10	0.19	0.20	0.15	1.75	6.00	168.000
5.89	0.92	12.57	0.10	0.19	0.20	0.15	1.75	6.00	168.000
5.91	0.80	10.68	0.10	0.20	0.20	0.15	2.00	6.00	168.000
8.39	0.80	10.68	0.10	0.20	0.20	0.15	2.00	6.00	168.000
8.41	0.71	9.42	0.10	0.20	0.15	0.15	1.49	6.00	168.000
13.39	0.71	9.42	0.10	0.20	0.15	0.15	1.49	6.00	168.000
13.41	1.87	378.00	0.10	0.14	0.05	0.15	1.00	6.00	1.000
14.59	2.07	418.45	0.10	0.14	0.05	0.15	1.00	6.00	1.000

14.61	2.07	418.97	0.10	0.14	0.05	0.15	1.00	6.00	1.000
20.89	2.62	530.92	0.10	0.14	0.05	0.15	1.00	6.00	1.000
20.91	2.60	433.02	0.10	0.13	0.05	0.15	1.00	6.00	1.000
23.39	2.83	471.71	0.10	0.13	0.05	0.15	1.00	6.00	1.000
23.41	2.86	579.15	0.10	0.14	0.05	0.15	1.00	6.00	1.000
32.41	3.71	751.45	0.10	0.14	0.05	0.15	1.00	6.00	1.000
41.41	4.57	827.37	0.10	0.14	0.05	0.15	1.00	6.00	1.000
50.41	5.42	827.37	0.10	0.14	0.05	0.15	1.00	6.00	1.000
51.38	5.51	827.37	0.10	0.14	0.05	0.15	1.00	6.00	1.000

Gain/Loss factors: shaft and toe

0.40000	0.45000	0.50000	0.55000	0.60000
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
5.88	0.00	0.00	0.000	0.0	0.000	0.000	0.000
5.92	0.00	0.00	0.000	0.0	0.000	0.000	0.000
7.15	0.00	0.00	0.000	0.0	0.000	0.000	0.000
8.38	0.00	0.00	0.000	0.0	0.000	0.000	0.000
8.42	0.00	0.00	0.000	0.0	0.000	0.000	0.000
10.90	0.00	0.00	0.000	0.0	0.000	0.000	0.000
13.38	0.00	0.00	0.000	0.0	0.000	0.000	0.000
13.42	0.00	0.00	0.000	0.0	0.000	0.000	0.000
17.15	0.00	0.00	0.000	0.0	0.000	0.000	0.000
20.88	0.00	0.00	0.000	0.0	0.000	0.000	0.000
20.92	0.00	0.00	0.000	0.0	0.000	0.000	0.000
22.15	0.00	0.00	0.000	0.0	0.000	0.000	0.000
23.38	0.00	0.00	0.000	0.0	0.000	0.000	0.000
23.42	0.00	0.00	0.000	0.0	0.000	0.000	0.000
37.38	0.00	0.00	0.000	0.0	0.000	0.000	0.000
51.38	0.00	0.00	0.000	0.0	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

CUY-14-6.93, PID 104132 : 01/24/2023 : K

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.6	1.000	0.0000	
3	0.800	140046.6	1.000	0.0000	
4	0.800	140046.6	1.000	0.0000	
5	0.800	140046.6	1.000	0.0000	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	2.500	5949.2	0.800	0.0100	5.8
Combined Pile Top		16392.6			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1600.00	Actual Pressure	(psi)	1600.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	22.45	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	5949.2	Stiffness	(kips/in)	0.0

Depth	(ft)	5.9	Standard Soil Setup
Shaft Gain/Loss Factor		0.400	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	144.000	Pile Type		Unknown
Pile Size	(inch)	16.000			

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.4	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model — Total Capacity Rut (kips) 13.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16393	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5

2	0.263	16393	0.000	0.000	1.00	0.0	0.000	0.100	6.85	4.2	22.5
14	0.263	16393	0.000	0.000	1.00	0.0	0.200	0.100	47.95	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	0.7	0.200	0.100	51.38	4.2	22.5
Toe						12.6	0.150	0.190			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile		Pile Segments: Automatic	
No. of Slacks/Splices	0	Pile Damping (%)	1
		Pile Damping Fact.(k/ft/s)	0.802

Driveability Analysis

Soil Damping Option	Smith		
Max No Analysis Iterations	0	Time Increment/Critical	160
Output Time Interval	1	Analysis Time-Input (ms)	0

Output Level: Normal

Gravity Mass, Pile, Hammer:	32.170	32.170	32.170

Output Segment Generation: Automatic

Depth ft	Stroke ft	Pressure Ratio	Efficy
5.88	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
13.3	1.5	4.16	4.17	-0.43	5	11	7.87	1	5	23.2	58.1
13.4	1.5	4.16	4.17	-0.42	5	11	7.88	1	5	23.2	58.0
13.4	1.5	4.16	4.18	-0.41	5	11	7.87	1	5	23.2	58.0
13.5	1.5	4.16	4.18	-0.41	5	11	7.88	1	5	23.2	58.0
13.5	1.5	4.16	4.19	-0.41	5	11	7.89	1	5	23.2	58.0

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National Engineering & Architectural Ser GRLWEAP Version 2010

Depth (ft)	5.9	Standard Soil Setup	
Shaft Gain/Loss Factor	0.400	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in2)	144.000	Pile Type	Unknown
Pile Size (inch)	16.000		

L ft	b Top in2	Area ksi	E-Mod lb/ft3	Spec Wt ft	Perim	C Index ft/s	Wave Sp k/ft/s	EA/c
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1	
51.4	22.46	30000.	492.0	4.2	0	16807.	40.1	

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model						Total Capacity Rut (kips)					11.5
No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16393	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16393	0.000	0.000	1.00	0.0	0.000	0.100	6.85	4.2	22.5
14	0.263	16393	0.000	0.000	1.00	0.0	0.200	0.100	47.95	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	0.8	0.200	0.100	51.38	4.2	22.5
Toe						10.7	0.150	0.196			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
5.92	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
11.5	1.4	4.03	4.05	-0.55	7	11	7.43	1	6	22.6	58.9
11.5	1.4	4.03	4.05	-0.54	7	11	7.43	1	6	22.7	58.9
11.6	1.4	4.04	4.06	-0.53	7	11	7.43	1	6	22.7	58.8
11.7	1.4	4.04	4.07	-0.52	7	11	7.43	1	6	22.8	58.8
11.7	1.4	4.05	4.07	-0.52	7	11	7.45	1	6	22.8	58.8

CUY-14-6.93, PID 104132 : 01/24/2023 : K 01/25/2023
National Engineering & Architectural Ser GRLWEAP Version 2010

Depth (ft) 7.2 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	51.4	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model						Total Capacity Rut (kips)					13.1
No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2

1	0.263	16393	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16393	0.000	0.000	1.00	0.0	0.000	0.100	6.85	4.2	22.5
13	0.263	16393	0.000	0.000	1.00	0.0	0.200	0.100	44.53	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	2.4	0.200	0.100	51.38	4.2	22.5
Toe						10.7	0.150	0.196			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
7.15	10.81	1.00	0.800

Rut	Bl Ct	Stroke (ft)		Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt
kips	b/ft	down	up	ksi			ksi			kip-ft	b/min
13.1	1.5	4.16	4.16	-0.43	6	11	7.81	1	5	23.3	58.1
13.4	1.5	4.16	4.18	-0.41	5	11	7.86	1	5	23.4	58.0
13.7	1.5	4.16	4.20	-0.35	5	11	7.85	1	3	23.5	58.0
14.0	1.5	4.22	4.21	-0.30	5	11	8.16	1	3	23.6	57.7
14.2	1.5	4.25	4.22	-0.23	5	11	8.30	1	3	23.7	57.6

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Depth (ft) 8.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
	ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	51.4	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model Total Capacity Rut (kips) 14.8

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	0.263	16393	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16393	0.000	0.000	1.00	0.0	0.000	0.100	6.85	4.2	22.5
13	0.263	16393	0.000	0.000	1.00	0.0	0.200	0.100	44.53	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	4.1	0.200	0.100	51.38	4.2	22.5
Toe						10.7	0.150	0.196			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
8.38	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
14.8	1.5	4.29	4.25	-0.17	4	10	8.56	1	3	23.9	57.3
15.3	1.6	4.28	4.29	-0.14	4	10	8.62	1	3	24.0	57.2
15.7	1.6	4.31	4.32	-0.10	3	10	8.78	1	3	24.2	57.1
16.2	1.6	4.33	4.35	-0.10	3	10	8.93	1	3	24.3	56.9
16.7	1.6	4.36	4.38	-0.09	3	10	9.09	1	3	24.4	56.8

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Depth (ft) 8.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.4	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model Total Capacity Rut (kips) 13.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16393	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16393	0.000	0.000	1.00	0.0	0.000	0.100	6.85	4.2	22.5
13	0.263	16393	0.000	0.000	1.00	0.0	0.200	0.100	44.53	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	4.2	0.200	0.100	51.38	4.2	22.5
Toe						9.4	0.150	0.203			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
8.42	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
13.6	1.5	4.16	4.20	-0.38	5	11	7.86	1	5	23.7	58.0
14.1	1.5	4.24	4.22	-0.27	5	11	8.23	1	3	23.8	57.6
14.6	1.5	4.28	4.24	-0.18	4	10	8.47	1	3	24.0	57.4
15.0	1.6	4.27	4.28	-0.16	4	10	8.55	1	3	24.1	57.3
15.5	1.6	4.30	4.32	-0.11	4	10	8.69	1	3	24.3	57.1

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Depth (ft) 10.9 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.4	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model Total Capacity Rut (kips) 18.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16393	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16393	0.000	0.000	1.00	0.0	0.000	0.100	6.85	4.2	22.5
12	0.263	16393	0.000	0.000	1.00	0.0	0.200	0.100	41.10	4.2	22.5
14	0.263	16393	0.000	0.000	1.00	2.9	0.200	0.100	47.95	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	5.8	0.165	0.100	51.38	4.2	22.5
Toe						9.4	0.150	0.203			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
10.90	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
18.1	1.7	4.41	4.43	-0.06	2	10	9.45	1	3	24.6	56.4
18.8	1.7	4.44	4.47	-0.06	2	10	9.65	1	3	24.8	56.2
19.5	1.8	4.48	4.51	-0.06	2	10	9.88	1	3	24.9	56.0
20.3	1.8	4.51	4.54	-0.06	2	10	10.06	1	3	24.8	55.8
21.0	1.8	4.54	4.57	-0.06	2	10	10.27	1	3	24.8	55.6

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Depth (ft) 13.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	51.4	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model Total Capacity Rut (kips) 22.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16393	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16393	0.000	0.000	1.00	0.0	0.000	0.100	6.85	4.2	22.5
12	0.263	16393	0.000	0.000	1.00	0.0	0.200	0.100	41.10	4.2	22.5
13	0.263	16393	0.000	0.000	1.00	1.6	0.200	0.100	44.53	4.2	22.5
14	0.263	16393	0.000	0.000	1.00	5.3	0.179	0.100	47.95	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	6.2	0.150	0.100	51.38	4.2	22.5
Toe						9.4	0.150	0.203			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
13.38	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
22.6	1.9	4.59	4.63	-0.11	2	9	10.52	1	4	24.7	55.2
23.5	2.0	4.63	4.67	-0.15	2	9	10.75	1	4	24.6	55.0
24.5	2.1	4.67	4.71	-0.17	2	9	10.91	1	4	24.4	54.8
25.5	2.1	4.75	4.74	-0.24	2	9	11.23	1	4	24.4	54.5
26.5	2.2	4.79	4.77	-0.24	2	9	11.38	1	4	24.3	54.2

Depth (ft) 13.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.4	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model Total Capacity Rut (kips) 391.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16393	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16393	0.000	0.000	1.00	0.0	0.000	0.100	6.85	4.2	22.5
12	0.263	16393	0.000	0.000	1.00	0.0	0.200	0.100	41.10	4.2	22.5
13	0.263	16393	0.000	0.000	1.00	1.7	0.200	0.100	44.53	4.2	22.5
14	0.263	16393	0.000	0.000	1.00	5.3	0.178	0.100	47.95	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	6.3	0.149	0.100	51.38	4.2	22.5
Toe						378.3	0.150	0.142			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
13.42	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
391.7	72.4	9.35	9.35	-2.38	8	19	32.05	14	6	18.9	38.7

392.6	72.7	9.36	9.35	-2.42	8	19	32.09	14	6	18.9	38.7
393.6	73.5	9.36	9.36	-2.47	8	19	32.07	14	6	18.9	38.7
394.6	73.9	9.37	9.38	-2.52	8	19	32.10	14	6	18.9	38.6
395.6	74.8	9.36	9.38	-2.56	8	19	32.09	14	6	18.9	38.6

Depth (ft) 17.1 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.4	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model Total Capacity Rut (kips) 510.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16393	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16393	0.000	0.000	1.00	0.0	0.000	0.100	6.85	4.2	22.5
10	0.263	16393	0.000	0.000	1.00	0.0	0.200	0.100	34.25	4.2	22.5
12	0.263	16393	0.000	0.000	1.00	2.1	0.200	0.100	41.10	4.2	22.5
13	0.263	16393	0.000	0.000	1.00	5.5	0.174	0.100	44.53	4.2	22.5
14	0.263	16393	0.000	0.000	1.00	8.2	0.128	0.100	47.95	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	30.6	0.050	0.100	51.38	4.2	22.5
Toe						464.2	0.150	0.142			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
17.15	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
510.6	150.9	10.18	10.13	-4.13	11	19	35.73	14	6	20.6	37.2
511.6	152.0	10.18	10.13	-4.18	11	19	35.68	14	6	20.6	37.2
512.6	153.0	10.18	10.13	-4.23	11	19	35.64	14	6	20.6	37.2

513.6	154.2	10.18	10.12	-4.28	11	19	35.57	14	6	20.6	37.2
514.5	155.3	10.18	10.13	-4.33	11	19	35.53	14	6	20.6	37.2

Depth (ft) 20.9 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.4	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model Total Capacity Rut (kips) 615.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16393	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16393	0.000	0.000	1.00	0.0	0.000	0.100	6.85	4.2	22.5
9	0.263	16393	0.000	0.000	1.00	0.0	0.200	0.100	30.83	4.2	22.5
11	0.263	16393	0.000	0.000	1.00	2.5	0.200	0.100	37.68	4.2	22.5
12	0.263	16393	0.000	0.000	1.00	5.6	0.169	0.100	41.10	4.2	22.5
13	0.263	16393	0.000	0.000	1.00	10.1	0.113	0.100	44.53	4.2	22.5
14	0.263	16393	0.000	0.000	1.00	31.1	0.050	0.100	47.95	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	35.5	0.050	0.100	51.38	4.2	22.5
Toe						530.7	0.150	0.142			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
20.88	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
615.5	272.9	10.55	10.52	-5.36	11	18	36.91	14	6	21.4	36.5
616.5	276.2	10.56	10.53	-5.42	11	18	36.82	14	6	21.4	36.5
617.5	279.2	10.56	10.52	-5.48	11	18	36.74	14	6	21.4	36.5
618.5	280.1	10.56	10.52	-5.52	11	18	36.69	14	6	21.4	36.5

619.4	285.2	10.56	10.52	-5.58	11	18	36.57	14	6	21.4	36.5

Depth (ft) 20.9 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	51.4	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model Total Capacity Rut (kips) 518.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16393	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16393	0.000	0.000	1.00	0.0	0.000	0.100	6.85	4.2	22.5
9	0.263	16393	0.000	0.000	1.00	0.0	0.200	0.100	30.83	4.2	22.5
11	0.263	16393	0.000	0.000	1.00	2.5	0.200	0.100	37.68	4.2	22.5
12	0.263	16393	0.000	0.000	1.00	5.6	0.169	0.100	41.10	4.2	22.5
13	0.263	16393	0.000	0.000	1.00	10.4	0.111	0.100	44.53	4.2	22.5
14	0.263	16393	0.000	0.000	1.00	31.1	0.050	0.100	47.95	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	35.5	0.050	0.100	51.38	4.2	22.5
Toe						433.2	0.150	0.133			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
20.92	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
518.4	145.5	10.12	10.06	-5.47	11	19	34.85	14	6	20.5	37.3
519.4	145.6	10.12	10.06	-5.51	11	19	34.81	14	6	20.5	37.3
520.4	146.8	10.13	10.06	-5.54	11	19	34.74	14	6	20.5	37.3
521.3	148.0	10.13	10.07	-5.57	11	19	34.66	14	6	20.5	37.3
522.3	149.2	10.13	10.06	-5.60	11	19	34.59	14	6	20.5	37.3

Depth (ft) 22.1 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.4	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model — Total Capacity Rut (kips) 551.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16393	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16393	0.000	0.000	1.00	0.0	0.000	0.100	6.85	4.2	22.5
9	0.263	16393	0.000	0.000	1.00	0.0	0.200	0.100	30.83	4.2	22.5
11	0.263	16393	0.000	0.000	1.00	4.2	0.199	0.100	37.68	4.2	22.5
12	0.263	16393	0.000	0.000	1.00	6.2	0.150	0.100	41.10	4.2	22.5
13	0.263	16393	0.000	0.000	1.00	18.8	0.072	0.100	44.53	4.2	22.5
14	0.263	16393	0.000	0.000	1.00	32.7	0.050	0.100	47.95	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	37.0	0.050	0.100	51.38	4.2	22.5
Toe						452.4	0.150	0.133			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
22.15	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
551.3	172.2	10.25	10.20	-5.97	11	19	34.99	14	6	20.7	37.0
552.3	172.5	10.25	10.19	-6.00	11	19	34.95	14	6	20.8	37.0
553.2	174.0	10.25	10.19	-6.03	11	19	34.87	14	6	20.8	37.0
554.2	176.8	10.25	10.20	-6.06	11	19	34.75	14	6	20.7	37.0
555.2	177.3	10.25	10.20	-6.09	11	19	34.71	14	6	20.8	37.0

Depth (ft) 23.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.4	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model Total Capacity Rut (kips) 584.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16393	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16393	0.000	0.000	1.00	0.0	0.000	0.100	6.85	4.2	22.5
9	0.263	16393	0.000	0.000	1.00	0.0	0.200	0.100	30.83	4.2	22.5
10	0.263	16393	0.000	0.000	1.00	1.2	0.200	0.100	34.25	4.2	22.5
11	0.263	16393	0.000	0.000	1.00	5.2	0.183	0.100	37.68	4.2	22.5
12	0.263	16393	0.000	0.000	1.00	6.2	0.150	0.100	41.10	4.2	22.5
13	0.263	16393	0.000	0.000	1.00	27.8	0.053	0.100	44.53	4.2	22.5
14	0.263	16393	0.000	0.000	1.00	34.3	0.050	0.100	47.95	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	38.5	0.050	0.100	51.38	4.2	22.5
Toe						471.6	0.150	0.133			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
23.38	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
584.8	206.2	10.36	10.31	-6.36	11	19	35.04	14	6	21.0	36.8
585.8	208.3	10.36	10.31	-6.38	11	19	34.96	14	6	21.0	36.8
586.7	210.5	10.36	10.31	-6.40	11	19	34.87	14	6	21.0	36.8
587.7	212.6	10.36	10.31	-6.43	11	19	34.78	14	6	21.0	36.8
588.7	214.8	10.36	10.31	-6.45	11	19	34.70	14	6	21.0	36.8

Depth (ft) 23.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.4	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model — Total Capacity Rut (kips) 693.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16393	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16393	0.000	0.000	1.00	0.0	0.000	0.100	6.85	4.2	22.5
9	0.263	16393	0.000	0.000	1.00	0.0	0.200	0.100	30.83	4.2	22.5
10	0.263	16393	0.000	0.000	1.00	1.3	0.200	0.100	34.25	4.2	22.5
11	0.263	16393	0.000	0.000	1.00	5.2	0.182	0.100	37.68	4.2	22.5
12	0.263	16393	0.000	0.000	1.00	6.2	0.150	0.100	41.10	4.2	22.5
13	0.263	16393	0.000	0.000	1.00	28.1	0.053	0.100	44.53	4.2	22.5
14	0.263	16393	0.000	0.000	1.00	34.3	0.050	0.100	47.95	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	38.5	0.050	0.100	51.38	4.2	22.5
Toe						579.3	0.150	0.135			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
23.42	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
693.0	451.4	10.81	10.78	-6.27	11	18	37.13	14	6	21.9	36.1
694.0	458.9	10.81	10.77	-6.32	11	18	37.04	14	6	21.9	36.1
695.0	466.5	10.81	10.77	-6.37	11	18	36.95	14	6	21.9	36.1
696.0	474.2	10.81	10.77	-6.42	11	18	36.85	14	6	21.9	36.1
697.0	482.1	10.81	10.77	-6.46	11	18	36.76	14	6	21.9	36.1

Depth (ft) 37.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.4	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model — Total Capacity Rut (kips) 1113.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16393	0.010	0.000	0.85	0.0	0.000	0.100	3.43	4.2	22.5
2	0.263	16393	0.000	0.000	1.00	0.0	0.000	0.100	6.85	4.2	22.5
5	0.263	16393	0.000	0.000	1.00	0.0	0.200	0.100	17.13	4.2	22.5
6	0.263	16393	0.000	0.000	1.00	1.6	0.200	0.100	20.55	4.2	22.5
7	0.263	16393	0.000	0.000	1.00	5.3	0.178	0.100	23.98	4.2	22.5
8	0.263	16393	0.000	0.000	1.00	6.2	0.150	0.100	27.40	4.2	22.5
9	0.263	16393	0.000	0.000	1.00	30.1	0.050	0.100	30.83	4.2	22.5
10	0.263	16393	0.000	0.000	1.00	34.7	0.050	0.100	34.25	4.2	22.5
11	0.263	16393	0.000	0.000	1.00	38.8	0.050	0.100	37.68	4.2	22.5
12	0.263	16393	0.000	0.000	1.00	43.8	0.050	0.100	41.10	4.2	22.5
13	0.263	16393	0.000	0.000	1.00	48.4	0.050	0.100	44.53	4.2	22.5
14	0.263	16393	0.000	0.000	1.00	53.1	0.050	0.100	47.95	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	57.7	0.050	0.100	51.38	4.2	22.5
Toe						793.4	0.150	0.135			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
37.38	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1113.1	9999.0	10.81	10.72	-8.22	9	17	31.69	12	6	21.3	36.1
1114.1	9999.0	10.70	10.68	-8.12	9	17	31.40	12	6	21.1	36.3

1115.1	9999.0	10.69	10.67	-8.08	9	17	31.32	12	6	21.1	36.3
1116.1	9999.0	10.69	10.66	-8.00	9	17	31.21	12	6	21.0	36.3
1117.1	9999.0	10.68	10.65	-7.92	9	17	31.10	12	6	21.0	36.3

Depth (ft) 51.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
51.4	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.114

Pile and Soil Model Total Capacity Rut (kips) 1431.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.263	16393	0.010	0.000	0.85	0.0	0.200	0.100	3.43	4.2	22.5
2	0.263	16393	0.000	0.000	1.00	2.0	0.200	0.100	6.85	4.2	22.5
3	0.263	16393	0.000	0.000	1.00	5.5	0.174	0.100	10.28	4.2	22.5
4	0.263	16393	0.000	0.000	1.00	8.0	0.130	0.100	13.70	4.2	22.5
5	0.263	16393	0.000	0.000	1.00	30.6	0.050	0.100	17.13	4.2	22.5
6	0.263	16393	0.000	0.000	1.00	35.1	0.050	0.100	20.55	4.2	22.5
7	0.263	16393	0.000	0.000	1.00	39.3	0.050	0.100	23.98	4.2	22.5
8	0.263	16393	0.000	0.000	1.00	44.2	0.050	0.100	27.40	4.2	22.5
9	0.263	16393	0.000	0.000	1.00	48.8	0.050	0.100	30.83	4.2	22.5
10	0.263	16393	0.000	0.000	1.00	53.5	0.050	0.100	34.25	4.2	22.5
11	0.263	16393	0.000	0.000	1.00	58.1	0.050	0.100	37.68	4.2	22.5
12	0.263	16393	0.000	0.000	1.00	62.8	0.050	0.100	41.10	4.2	22.5
13	0.263	16393	0.000	0.000	1.00	67.4	0.050	0.100	44.53	4.2	22.5
14	0.263	16393	0.000	0.000	1.00	72.1	0.050	0.100	47.95	4.2	22.5
15	0.263	16393	0.000	0.000	1.00	76.7	0.050	0.100	51.38	4.2	22.5
Toe						827.4	0.150	0.135			

3.943 kips total unreduced pile weight (g= 32.17 ft/s2)
3.943 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
51.38	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1431.4	9999.0	10.31	10.24	-3.98	5	14	28.53	5	7	18.6	37.0
1432.4	9999.0	10.31	10.24	-3.87	5	14	28.45	5	7	18.6	37.0
1433.4	9999.0	10.30	10.22	-3.78	5	14	28.35	5	7	18.6	37.0
1434.3	9999.0	10.28	10.21	-3.68	5	14	28.25	5	7	18.5	37.0
1435.3	9999.0	10.28	10.21	-3.58	5	14	28.17	5	7	18.5	37.1

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.400 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.9	13.3	0.7	12.6	1.5	7.873	-0.431	4.16	23.2
5.9	11.5	0.8	10.7	1.4	7.427	-0.547	4.03	22.6
7.2	13.1	2.4	10.7	1.5	7.814	-0.430	4.16	23.3
8.4	14.8	4.1	10.7	1.5	8.565	-0.168	4.29	23.9
8.4	13.6	4.2	9.4	1.5	7.861	-0.377	4.16	23.7
10.9	18.1	8.6	9.4	1.7	9.446	-0.062	4.41	24.6
13.4	22.6	13.1	9.4	1.9	10.523	-0.110	4.59	24.7
13.4	391.7	13.3	378.3	72.4	32.048	-2.381	9.35	18.9
17.1	510.6	46.4	464.2	150.9	35.728	-4.129	10.18	20.6
20.9	615.5	84.8	530.7	272.9	36.910	-5.360	10.55	21.4
20.9	518.4	85.2	433.2	145.5	34.852	-5.474	10.12	20.5
22.1	551.3	98.9	452.4	172.2	34.993	-5.970	10.25	20.7
23.4	584.8	113.2	471.6	206.2	35.040	-6.360	10.36	21.0
23.4	693.0	113.7	579.3	451.4	37.129	-6.267	10.81	21.9
37.4	1113.1	319.8	793.4	9999.0	31.687	-8.216	10.81	21.3
51.4	1431.4	604.0	827.4	9999.0	28.526	-3.979	10.31	18.6

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.450 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.9	13.4	0.8	12.6	1.5	7.876	-0.424	4.16	23.2
5.9	11.5	0.9	10.7	1.4	7.432	-0.541	4.03	22.7
7.2	13.4	2.7	10.7	1.5	7.862	-0.409	4.16	23.4
8.4	15.3	4.6	10.7	1.6	8.618	-0.137	4.28	24.0
8.4	14.1	4.6	9.4	1.5	8.229	-0.272	4.24	23.8
10.9	18.8	9.4	9.4	1.7	9.651	-0.064	4.44	24.8
13.4	23.5	14.1	9.4	2.0	10.748	-0.149	4.63	24.6
13.4	392.6	14.3	378.3	72.7	32.087	-2.423	9.36	18.9
17.1	511.6	47.3	464.2	152.0	35.681	-4.178	10.18	20.6
20.9	616.5	85.8	530.7	276.2	36.820	-5.419	10.56	21.4

20.9	519.4	86.2	433.2	145.6	34.812	-5.511	10.12	20.5
22.1	552.3	99.9	452.4	172.5	34.947	-6.002	10.25	20.8
23.4	585.8	114.2	471.6	208.3	34.956	-6.383	10.36	21.0
23.4	694.0	114.7	579.3	458.9	37.037	-6.319	10.81	21.9
37.4	1114.1	320.7	793.4	9999.0	31.402	-8.119	10.70	21.1
51.4	1432.4	605.0	827.4	9999.0	28.446	-3.871	10.31	18.6

Refusal occurred; no driving time output possible

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.500 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.9	13.4	0.8	12.6	1.5	7.875	-0.413	4.16	23.2
5.9	11.6	0.9	10.7	1.4	7.429	-0.530	4.04	22.7
7.2	13.7	3.0	10.7	1.5	7.847	-0.353	4.16	23.5
8.4	15.7	5.1	10.7	1.6	8.777	-0.100	4.31	24.2
8.4	14.6	5.1	9.4	1.5	8.470	-0.178	4.28	24.0
10.9	19.5	10.1	9.4	1.8	9.881	-0.063	4.48	24.9
13.4	24.5	15.1	9.4	2.1	10.907	-0.168	4.67	24.4
13.4	393.6	15.3	378.3	73.5	32.066	-2.472	9.36	18.9
17.1	512.6	48.3	464.2	153.0	35.636	-4.230	10.18	20.6
20.9	617.5	86.7	530.7	279.2	36.737	-5.475	10.56	21.4
20.9	520.4	87.2	433.2	146.8	34.736	-5.540	10.13	20.5
22.1	553.2	100.9	452.4	174.0	34.869	-6.032	10.25	20.8
23.4	586.7	115.2	471.6	210.5	34.871	-6.405	10.36	21.0
23.4	695.0	115.7	579.3	466.5	36.945	-6.368	10.81	21.9
37.4	1115.1	321.7	793.4	9999.0	31.319	-8.077	10.69	21.1
51.4	1433.4	606.0	827.4	9999.0	28.347	-3.781	10.30	18.6

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.550 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.9	13.5	0.9	12.6	1.5	7.878	-0.408	4.16	23.2
5.9	11.7	1.0	10.7	1.4	7.433	-0.522	4.04	22.8
7.2	14.0	3.3	10.7	1.5	8.155	-0.304	4.22	23.6
8.4	16.2	5.5	10.7	1.6	8.934	-0.102	4.33	24.3
8.4	15.0	5.6	9.4	1.6	8.548	-0.165	4.27	24.1
10.9	20.3	10.9	9.4	1.8	10.058	-0.062	4.51	24.8
13.4	25.5	16.1	9.4	2.1	11.227	-0.236	4.75	24.4
13.4	394.6	16.3	378.3	73.9	32.098	-2.516	9.37	18.9
17.1	513.6	49.3	464.2	154.2	35.570	-4.276	10.18	20.6
20.9	618.5	87.7	530.7	280.1	36.690	-5.518	10.56	21.4
20.9	521.3	88.2	433.2	148.0	34.658	-5.570	10.13	20.5

22.1	554.2	101.9	452.4	176.8	34.753	-6.059	10.25	20.7
23.4	587.7	116.2	471.6	212.6	34.783	-6.426	10.36	21.0
23.4	696.0	116.6	579.3	474.2	36.854	-6.416	10.81	21.9
37.4	1116.1	322.7	793.4	9999.0	31.208	-7.999	10.69	21.0
51.4	1434.3	607.0	827.4	9999.0	28.250	-3.680	10.28	18.5

Refusal occurred; no driving time output possible

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.600 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.9	13.5	1.0	12.6	1.5	7.888	-0.412	4.16	23.2
5.9	11.7	1.1	10.7	1.4	7.448	-0.518	4.05	22.8
7.2	14.2	3.6	10.7	1.5	8.296	-0.235	4.25	23.7
8.4	16.7	6.0	10.7	1.6	9.094	-0.088	4.36	24.4
8.4	15.5	6.1	9.4	1.6	8.695	-0.113	4.30	24.3
10.9	21.0	11.6	9.4	1.8	10.272	-0.056	4.54	24.8
13.4	26.5	17.1	9.4	2.2	11.377	-0.242	4.79	24.3
13.4	395.6	17.2	378.3	74.8	32.087	-2.562	9.36	18.9
17.1	514.5	50.3	464.2	155.3	35.530	-4.327	10.18	20.6
20.9	619.4	88.7	530.7	285.2	36.566	-5.579	10.56	21.4
20.9	522.3	89.1	433.2	149.2	34.586	-5.600	10.13	20.5
22.1	555.2	102.9	452.4	177.3	34.707	-6.091	10.25	20.8
23.4	588.7	117.1	471.6	214.8	34.695	-6.448	10.36	21.0
23.4	697.0	117.6	579.3	482.1	36.764	-6.463	10.81	21.9
37.4	1117.1	323.7	793.4	9999.0	31.096	-7.925	10.68	21.0
51.4	1435.3	608.0	827.4	9999.0	28.170	-3.584	10.28	18.5

Refusal occurred; no driving time output possible

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Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Pressure Stroke ft	Ratio	Efficy.	Stiffn. Factor	Cushion CoR
5.88	51.38	0.00	10.81	1.00	0.80	1.00	1.00
5.92	51.38	0.00	10.81	1.00	0.80	1.00	1.00
7.15	51.38	0.00	10.81	1.00	0.80	1.00	1.00
8.38	51.38	0.00	10.81	1.00	0.80	1.00	1.00
8.42	51.38	0.00	10.81	1.00	0.80	1.00	1.00
10.90	51.38	0.00	10.81	1.00	0.80	1.00	1.00

13.38	51.38	0.00	10.81	1.00	0.80	1.00	1.00
13.42	51.38	0.00	10.81	1.00	0.80	1.00	1.00
17.15	51.38	0.00	10.81	1.00	0.80	1.00	1.00
20.88	51.38	0.00	10.81	1.00	0.80	1.00	1.00
20.92	51.38	0.00	10.81	1.00	0.80	1.00	1.00
22.15	51.38	0.00	10.81	1.00	0.80	1.00	1.00
23.38	51.38	0.00	10.81	1.00	0.80	1.00	1.00
23.42	51.38	0.00	10.81	1.00	0.80	1.00	1.00
37.38	51.38	0.00	10.81	1.00	0.80	1.00	1.00
51.38	51.38	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

Depth	Shaft Res.	End Bearing	Shaft Quake	Toe Quake	Shaft Damping	Toe Damping	Soil Setup	Limit Distance	Setup Time
ft	k/ft2	kips	inch	inch	s/ft	s/ft	Normlzd	ft	hrs
0.01	0.00	0.00	0.100	0.190	0.200	0.150	0.860	6.000	168.000
5.49	0.00	0.00	0.100	0.190	0.200	0.150	0.860	6.000	168.000
5.50	0.92	12.57	0.100	0.190	0.200	0.150	0.860	6.000	168.000
5.89	0.92	12.57	0.100	0.190	0.200	0.150	0.860	6.000	168.000
5.91	0.80	10.68	0.100	0.196	0.200	0.150	1.000	6.000	168.000
8.39	0.80	10.68	0.100	0.196	0.200	0.150	1.000	6.000	168.000
8.41	0.71	9.42	0.100	0.203	0.150	0.150	0.660	6.000	168.000
13.39	0.71	9.42	0.100	0.203	0.150	0.150	0.660	6.000	168.000
13.41	1.87	378.00	0.100	0.142	0.050	0.150	0.000	6.000	1.000
14.59	2.07	418.45	0.100	0.142	0.050	0.150	0.000	6.000	1.000
14.61	2.07	418.97	0.100	0.142	0.050	0.150	0.000	6.000	1.000
20.89	2.62	530.92	0.100	0.142	0.050	0.150	0.000	6.000	1.000
20.91	2.60	433.02	0.100	0.133	0.050	0.150	0.000	6.000	1.000
23.39	2.83	471.71	0.100	0.133	0.050	0.150	0.000	6.000	1.000
23.41	2.86	579.15	0.100	0.135	0.050	0.150	0.000	6.000	1.000
32.41	3.71	751.45	0.100	0.135	0.050	0.150	0.000	6.000	1.000
41.41	4.57	827.37	0.100	0.135	0.050	0.150	0.000	6.000	1.000
50.41	5.42	827.37	0.100	0.135	0.050	0.150	0.000	6.000	1.000
51.38	5.51	827.37	0.100	0.135	0.050	0.150	0.000	6.000	1.000

FORWARD ABUTMENT

Gain/Loss 3 at Shaft and Toe 0.500 / 1.000

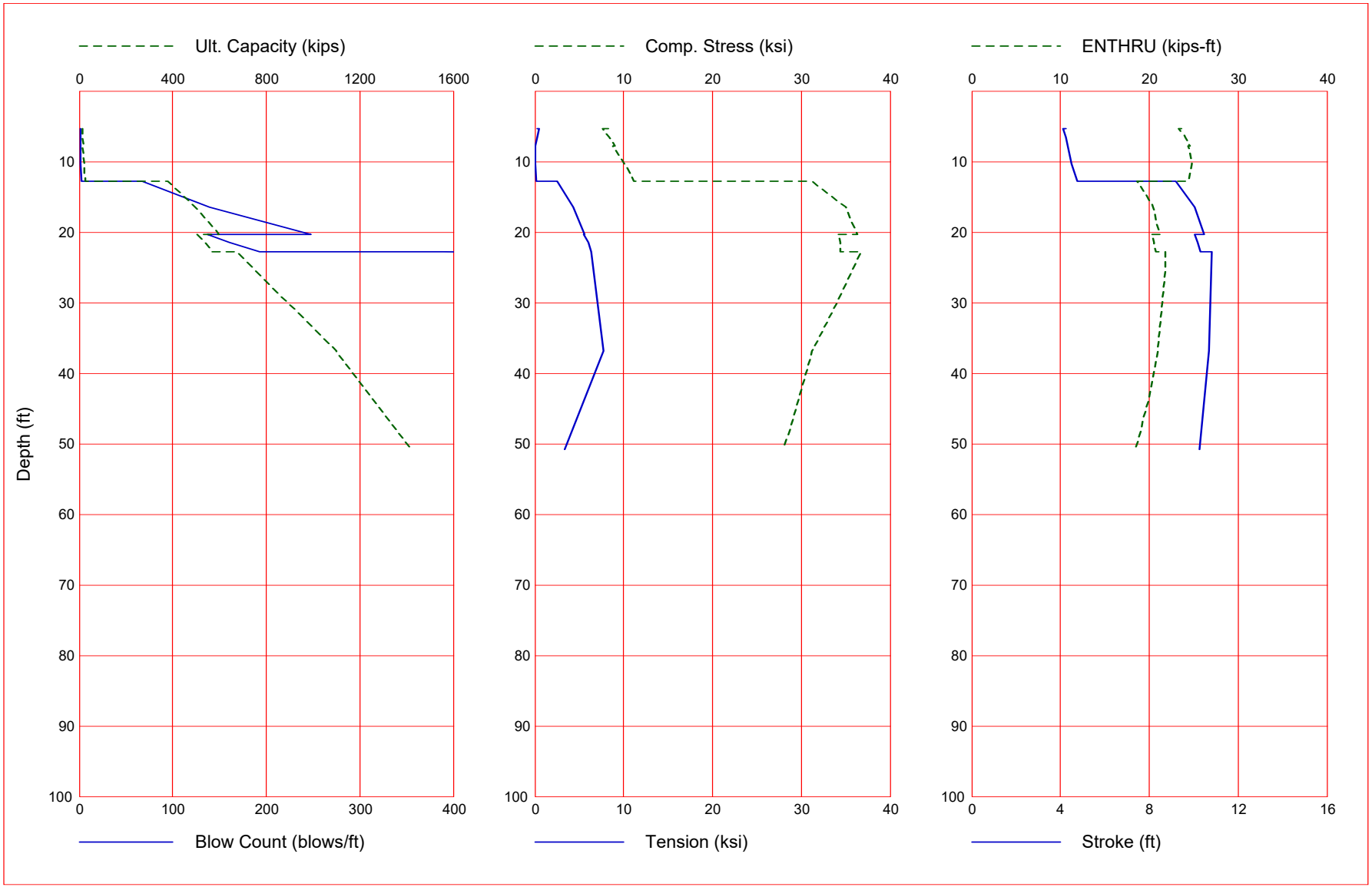
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.3	14.3	1.7	12.6	1.5	8.255	-0.276	4.23	23.6
5.3	12.5	1.8	10.7	1.4	7.575	-0.459	4.10	23.3
6.6	14.6	3.9	10.7	1.5	8.410	-0.226	4.26	24.0
7.8	16.6	5.9	10.7	1.6	9.024	-0.091	4.35	24.6
7.8	15.4	6.0	9.4	1.6	8.792	-0.100	4.33	24.4
10.3	20.4	11.0	9.4	1.8	10.074	-0.050	4.52	24.8
12.8	25.4	16.0	9.4	2.1	11.167	-0.188	4.74	24.4
12.8	377.4	16.2	361.3	67.3	31.151	-2.485	9.19	18.6
16.5	495.0	47.9	447.2	139.1	34.991	-4.365	10.06	20.4
20.3	598.6	85.0	513.7	247.5	36.288	-5.594	10.48	21.2
20.3	504.7	85.4	419.2	137.0	34.105	-5.501	10.04	20.2
21.5	537.1	98.7	438.4	160.7	34.370	-5.984	10.18	20.5
22.8	570.2	112.6	457.6	192.8	34.426	-6.335	10.30	20.7
22.8	675.3	113.0	562.3	389.8	36.700	-6.332	10.81	21.8
36.8	1099.9	314.1	785.7	9999.0	31.253	-7.711	10.68	21.0
50.8	1420.8	593.4	827.4	9999.0	27.986	-3.398	10.26	18.4

Refusal occurred; no driving time output possible

National Engineering & Architectural Ser
CUY-14-6.93, PID 104132 : 01/24/2023 : K

Jan 25 2023
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 0.500 / 1.000



GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

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 building and other factors.

Input File: C:\USERS\KARENS\DESKTOP\GRL FILES\FA16IN1.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

CUY-14-6.93, PID 104132 : 01/24/2023 : K

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	144.000	16.000	Unknown

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
2.500	22.450	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
50.780	22.46	30000.0	492.000	4.190	0	0.850	0.010

FFatigue	F0	0-Bottom
0	0.000	0.000

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.0020	0.0020	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1600.00	1440.00	1295.00	1165.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1600.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Research Toe Plug: Res-int, Q-int, D-int, Res-plug, Q-plug, D-plug

0.000	0.000	0.000	0.000	0.000	0.000

Research Toe Plug: RD plug toe: m, d

0.000	0.000

Research Toe Plug: New Toe Plug Model is NOT applied

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimL	TSf0
0.01	0.00	0.00	0.10	0.19	0.20	0.15	1.75	6.00	168.000
4.49	0.00	0.00	0.10	0.19	0.20	0.15	1.75	6.00	168.000
4.50	0.92	12.57	0.10	0.19	0.20	0.15	1.75	6.00	168.000
5.29	0.92	12.57	0.10	0.19	0.20	0.15	1.75	6.00	168.000
5.31	0.80	10.68	0.10	0.20	0.20	0.15	2.00	6.00	168.000
7.79	0.80	10.68	0.10	0.20	0.20	0.15	2.00	6.00	168.000
7.81	0.71	9.42	0.10	0.20	0.15	0.15	1.49	6.00	168.000
12.79	0.71	9.42	0.10	0.20	0.15	0.15	1.49	6.00	168.000
12.81	1.78	360.92	0.10	0.14	0.05	0.15	1.00	6.00	1.000
13.99	1.98	401.37	0.10	0.14	0.05	0.15	1.00	6.00	1.000

14.01	1.99	401.89	0.10	0.14	0.05	0.15	1.00	6.00	1.000
20.29	2.54	513.83	0.10	0.14	0.05	0.15	1.00	6.00	1.000
20.31	2.52	419.09	0.10	0.13	0.05	0.15	1.00	6.00	1.000
22.79	2.75	457.79	0.10	0.13	0.05	0.15	1.00	6.00	1.000
22.81	2.78	562.06	0.10	0.14	0.05	0.15	1.00	6.00	1.000
31.81	3.63	734.36	0.10	0.14	0.05	0.15	1.00	6.00	1.000
40.81	4.48	827.37	0.10	0.14	0.05	0.15	1.00	6.00	1.000
49.81	5.33	827.37	0.10	0.14	0.05	0.15	1.00	6.00	1.000
50.78	5.42	827.37	0.10	0.14	0.05	0.15	1.00	6.00	1.000

Gain/Loss factors: shaft and toe

0.40000	0.45000	0.50000	0.55000	0.60000
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
5.28	0.00	0.00	0.000	0.0	0.000	0.000	0.000
5.32	0.00	0.00	0.000	0.0	0.000	0.000	0.000
6.55	0.00	0.00	0.000	0.0	0.000	0.000	0.000
7.78	0.00	0.00	0.000	0.0	0.000	0.000	0.000
7.82	0.00	0.00	0.000	0.0	0.000	0.000	0.000
10.30	0.00	0.00	0.000	0.0	0.000	0.000	0.000
12.78	0.00	0.00	0.000	0.0	0.000	0.000	0.000
12.82	0.00	0.00	0.000	0.0	0.000	0.000	0.000
16.55	0.00	0.00	0.000	0.0	0.000	0.000	0.000
20.28	0.00	0.00	0.000	0.0	0.000	0.000	0.000
20.32	0.00	0.00	0.000	0.0	0.000	0.000	0.000
21.55	0.00	0.00	0.000	0.0	0.000	0.000	0.000
22.78	0.00	0.00	0.000	0.0	0.000	0.000	0.000
22.82	0.00	0.00	0.000	0.0	0.000	0.000	0.000
36.78	0.00	0.00	0.000	0.0	0.000	0.000	0.000
50.78	0.00	0.00	0.000	0.0	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

CUY-14-6.93, PID 104132 : 01/24/2023 : K

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.6	1.000	0.0000	
3	0.800	140046.6	1.000	0.0000	
4	0.800	140046.6	1.000	0.0000	
5	0.800	140046.6	1.000	0.0000	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	2.500	5949.2	0.800	0.0100	5.8
Combined Pile Top		16586.3			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1600.00	Actual Pressure	(psi)	1600.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	22.45	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	5949.2	Stiffness	(kips/in)	0.0

Depth	(ft)	5.3	Standard Soil Setup
Shaft Gain/Loss Factor		0.400	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	144.000	Pile Type		Unknown
Pile Size	(inch)	16.000			

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model — Total Capacity Rut (kips) 14.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.260	16586	0.010	0.000	0.85	0.0	0.000	0.100	3.39	4.2	22.5

2	0.260	16586	0.000	0.000	1.00	0.0	0.000	0.100	6.77	4.2	22.5
14	0.260	16586	0.000	0.000	1.00	0.0	0.200	0.100	47.39	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	1.5	0.200	0.100	50.78	4.2	22.5
Toe						12.6	0.150	0.190			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile		Pile Segments: Automatic	
No. of Slacks/Splices	0	Pile Damping (%)	1
		Pile Damping Fact.(k/ft/s)	0.802
Driveability Analysis			
Soil Damping Option	Smith		
Max No Analysis Iterations	0	Time Increment/Critical	160
Output Time Interval	1	Analysis Time-Input (ms)	0
Output Level: Normal			
Gravity Mass, Pile, Hammer:	32.170	32.170	32.170
Output Segment Generation: Automatic			

Depth ft	Stroke ft	Pressure Ratio	Efficy
5.28	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
14.0	1.5	4.16	4.20	-0.36	5	11	7.95	1	3	23.5	57.9
14.2	1.5	4.22	4.20	-0.28	5	10	8.18	1	3	23.6	57.7
14.3	1.5	4.23	4.21	-0.28	5	10	8.26	1	3	23.6	57.7
14.4	1.5	4.24	4.22	-0.26	5	10	8.31	1	3	23.7	57.6
14.6	1.5	4.25	4.23	-0.21	4	10	8.38	1	3	23.7	57.6

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Depth (ft)	5.3	Standard Soil Setup	
Shaft Gain/Loss Factor	0.400	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in2)	144.000	Pile Type	Unknown
Pile Size (inch)	16.000		

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model					Total Capacity Rut (kips)			12.2		
No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.260	16586	0.010	0.000	0.85	0.0	0.000	0.100	3.39	4.2	22.5
2	0.260	16586	0.000	0.000	1.00	0.0	0.000	0.100	6.77	4.2	22.5
14	0.260	16586	0.000	0.000	1.00	0.0	0.200	0.100	47.39	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	1.5	0.200	0.100	50.78	4.2	22.5
Toe						10.7	0.150	0.196			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
5.32	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
12.2	1.4	4.08	4.10	-0.47	7	11	7.51	1	6	23.2	58.6
12.4	1.4	4.09	4.10	-0.49	6	11	7.60	1	6	23.2	58.5
12.5	1.4	4.10	4.11	-0.46	6	11	7.58	1	6	23.3	58.5
12.6	1.4	4.10	4.12	-0.47	6	11	7.64	1	6	23.3	58.4
12.8	1.4	4.11	4.13	-0.45	6	11	7.64	1	6	23.4	58.4

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Depth (ft) 6.6 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model					Total Capacity Rut (kips)			13.9		
No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2

1	0.260	16586	0.010	0.000	0.85	0.0	0.000	0.100	3.39	4.2	22.5
2	0.260	16586	0.000	0.000	1.00	0.0	0.000	0.100	6.77	4.2	22.5
14	0.260	16586	0.000	0.000	1.00	0.0	0.200	0.100	47.39	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	3.2	0.200	0.100	50.78	4.2	22.5
Toe						10.7	0.150	0.196			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
6.55	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
13.9	1.5	4.16	4.20	-0.35	5	11	7.89	1	3	23.8	57.9
14.2	1.5	4.23	4.21	-0.27	5	11	8.23	1	3	23.9	57.7
14.6	1.5	4.26	4.23	-0.23	4	10	8.41	1	3	24.0	57.5
14.9	1.5	4.29	4.26	-0.16	4	10	8.55	1	3	24.1	57.4
15.2	1.6	4.31	4.27	-0.11	3	10	8.72	1	3	24.2	57.2

Depth (ft) 7.8 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model Total Capacity Rut (kips) 15.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.260	16586	0.010	0.000	0.85	0.0	0.000	0.100	3.39	4.2	22.5
2	0.260	16586	0.000	0.000	1.00	0.0	0.000	0.100	6.77	4.2	22.5
13	0.260	16586	0.000	0.000	1.00	0.0	0.200	0.100	44.01	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	4.8	0.200	0.100	50.78	4.2	22.5
Toe						10.7	0.150	0.196			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
7.78	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
15.5	1.6	4.28	4.30	-0.12	4	10	8.66	1	3	24.3	57.2
16.1	1.6	4.32	4.33	-0.09	3	10	8.85	1	3	24.5	57.0
16.6	1.6	4.35	4.36	-0.09	3	10	9.02	1	3	24.6	56.8
17.2	1.7	4.37	4.39	-0.07	3	10	9.20	1	3	24.7	56.7
17.7	1.7	4.40	4.43	-0.06	2	10	9.38	1	3	24.8	56.5

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Depth (ft) 7.8 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model Total Capacity Rut (kips) 14.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.260	16586	0.010	0.000	0.85	0.0	0.000	0.100	3.39	4.2	22.5
2	0.260	16586	0.000	0.000	1.00	0.0	0.000	0.100	6.77	4.2	22.5
13	0.260	16586	0.000	0.000	1.00	0.0	0.200	0.100	44.01	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	4.9	0.200	0.100	50.78	4.2	22.5
Toe						9.4	0.150	0.203			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
7.82	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
14.3	1.5	4.25	4.22	-0.25	5	10	8.32	1	3	24.1	57.6
14.9	1.5	4.29	4.26	-0.17	4	10	8.59	1	3	24.3	57.3
15.4	1.6	4.33	4.29	-0.10	3	10	8.79	1	3	24.4	57.1
16.0	1.6	4.32	4.34	-0.10	3	10	8.81	1	3	24.6	57.0
16.6	1.6	4.35	4.37	-0.07	3	10	9.03	1	3	24.7	56.9

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Depth (ft) 10.3 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model Total Capacity Rut (kips) 18.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.260	16586	0.010	0.000	0.85	0.0	0.000	0.100	3.39	4.2	22.5
2	0.260	16586	0.000	0.000	1.00	0.0	0.000	0.100	6.77	4.2	22.5
12	0.260	16586	0.000	0.000	1.00	0.0	0.200	0.100	40.62	4.2	22.5
14	0.260	16586	0.000	0.000	1.00	3.7	0.200	0.100	47.39	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	5.7	0.164	0.100	50.78	4.2	22.5
Toe						9.4	0.150	0.203			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
10.30	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
18.8	1.7	4.44	4.46	-0.06	2	10	9.64	1	3	24.9	56.2
19.6	1.8	4.48	4.50	-0.06	2	10	9.86	1	3	24.9	56.0
20.4	1.8	4.52	4.54	-0.05	2	10	10.07	1	3	24.8	55.8
21.2	1.9	4.54	4.57	-0.05	2	10	10.25	1	3	24.7	55.5
22.0	1.9	4.58	4.61	-0.06	2	10	10.43	1	4	24.6	55.3

Depth (ft) 12.8 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model Total Capacity Rut (kips) 23.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.260	16586	0.010	0.000	0.85	0.0	0.000	0.100	3.39	4.2	22.5
2	0.260	16586	0.000	0.000	1.00	0.0	0.000	0.100	6.77	4.2	22.5
12	0.260	16586	0.000	0.000	1.00	0.0	0.200	0.100	40.62	4.2	22.5
13	0.260	16586	0.000	0.000	1.00	2.5	0.200	0.100	44.01	4.2	22.5
14	0.260	16586	0.000	0.000	1.00	5.3	0.178	0.100	47.39	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	6.1	0.150	0.100	50.78	4.2	22.5
Toe						9.4	0.150	0.203			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
12.78	10.81	1.00	0.800

Rut	Bl Ct	Stroke (ft)		Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt
kips	b/ft	down	up	ksi			ksi			kip-ft	b/min
23.3	2.0	4.62	4.65	-0.10	2	9	10.67	1	4	24.6	55.1
24.3	2.0	4.66	4.69	-0.13	2	9	10.88	1	4	24.4	54.9
25.4	2.1	4.74	4.73	-0.19	2	9	11.17	1	4	24.4	54.5
26.4	2.2	4.78	4.77	-0.20	2	9	11.36	1	4	24.3	54.3
27.5	2.3	4.82	4.81	-0.21	2	9	11.53	1	4	24.2	54.0

Depth (ft) 12.8 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
	ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model Total Capacity Rut (kips) 375.3

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	0.260	16586	0.010	0.000	0.85	0.0	0.000	0.100	3.39	4.2	22.5
2	0.260	16586	0.000	0.000	1.00	0.0	0.000	0.100	6.77	4.2	22.5
12	0.260	16586	0.000	0.000	1.00	0.0	0.200	0.100	40.62	4.2	22.5
13	0.260	16586	0.000	0.000	1.00	2.5	0.200	0.100	44.01	4.2	22.5
14	0.260	16586	0.000	0.000	1.00	5.3	0.177	0.100	47.39	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	6.2	0.149	0.100	50.78	4.2	22.5
Toe						361.3	0.150	0.142			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
12.82	10.81	1.00	0.800

Rut	Bl Ct	Stroke (ft)		Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt
kips	b/ft	down	up	ksi			ksi			kip-ft	b/min
375.3	66.2	9.18	9.20	-2.39	9	19	31.15	14	6	18.6	39.0

376.4	67.0	9.18	9.21	-2.44	9	19	31.14	14	6	18.6	39.0
377.4	67.3	9.19	9.21	-2.48	9	19	31.15	14	6	18.6	39.0
378.5	67.7	9.20	9.21	-2.53	9	19	31.20	14	6	18.6	39.0
379.5	68.1	9.21	9.23	-2.58	9	19	31.21	14	6	18.6	39.0

Depth (ft) 16.5 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model Total Capacity Rut (kips) 492.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.260	16586	0.010	0.000	0.85	0.0	0.000	0.100	3.39	4.2	22.5
2	0.260	16586	0.000	0.000	1.00	0.0	0.000	0.100	6.77	4.2	22.5
11	0.260	16586	0.000	0.000	1.00	0.0	0.200	0.100	37.24	4.2	22.5
12	0.260	16586	0.000	0.000	1.00	3.0	0.200	0.100	40.62	4.2	22.5
13	0.260	16586	0.000	0.000	1.00	5.5	0.172	0.100	44.01	4.2	22.5
14	0.260	16586	0.000	0.000	1.00	8.2	0.127	0.100	47.39	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	29.1	0.050	0.100	50.78	4.2	22.5
Toe						447.2	0.150	0.142			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
16.55	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
492.9	137.3	10.06	10.02	-4.27	11	19	35.05	14	6	20.3	37.4
494.0	137.6	10.06	10.02	-4.32	11	19	35.04	14	6	20.4	37.4
495.0	139.1	10.06	10.02	-4.36	11	19	34.99	14	6	20.4	37.4

496.1	140.6	10.07	10.02	-4.41	11	19	34.93	14	6	20.4	37.4
497.1	142.1	10.07	10.03	-4.45	11	19	34.88	14	6	20.4	37.4

Depth (ft) 20.3 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model — Total Capacity Rut (kips) 596.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.260	16586	0.010	0.000	0.85	0.0	0.000	0.100	3.39	4.2	22.5
2	0.260	16586	0.000	0.000	1.00	0.0	0.000	0.100	6.77	4.2	22.5
10	0.260	16586	0.000	0.000	1.00	0.0	0.200	0.100	33.85	4.2	22.5
11	0.260	16586	0.000	0.000	1.00	3.4	0.200	0.100	37.24	4.2	22.5
12	0.260	16586	0.000	0.000	1.00	5.6	0.167	0.100	40.62	4.2	22.5
13	0.260	16586	0.000	0.000	1.00	10.3	0.110	0.100	44.01	4.2	22.5
14	0.260	16586	0.000	0.000	1.00	29.6	0.050	0.100	47.39	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	33.9	0.050	0.100	50.78	4.2	22.5
Toe						513.7	0.150	0.142			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
20.28	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
596.5	242.3	10.48	10.44	-5.50	11	19	36.47	14	6	21.2	36.6
597.6	244.8	10.48	10.44	-5.55	11	19	36.38	14	6	21.2	36.6
598.6	247.5	10.48	10.44	-5.59	11	19	36.29	14	6	21.2	36.6
599.7	250.3	10.48	10.44	-5.64	11	19	36.20	14	6	21.2	36.6

600.7	253.0	10.48	10.44	-5.69	11	19	36.11	14	6	21.2	36.6

Depth (ft) 20.3 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L	b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
	0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
	50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model Total Capacity Rut (kips) 502.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.260	16586	0.010	0.000	0.85	0.0	0.000	0.100	3.39	4.2	22.5
2	0.260	16586	0.000	0.000	1.00	0.0	0.000	0.100	6.77	4.2	22.5
9	0.260	16586	0.000	0.000	1.00	0.0	0.200	0.100	30.47	4.2	22.5
11	0.260	16586	0.000	0.000	1.00	3.5	0.200	0.100	37.24	4.2	22.5
12	0.260	16586	0.000	0.000	1.00	5.7	0.166	0.100	40.62	4.2	22.5
13	0.260	16586	0.000	0.000	1.00	10.6	0.108	0.100	44.01	4.2	22.5
14	0.260	16586	0.000	0.000	1.00	29.7	0.050	0.100	47.39	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	33.9	0.050	0.100	50.78	4.2	22.5
Toe						419.2	0.150	0.133			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
20.32	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
502.6	134.7	10.03	9.97	-5.45	11	19	34.26	14	6	20.2	37.4
503.6	135.8	10.03	9.97	-5.48	11	19	34.19	14	6	20.2	37.4
504.7	137.0	10.04	9.98	-5.50	11	19	34.11	14	6	20.2	37.4
505.7	138.1	10.03	9.98	-5.53	11	19	34.03	14	6	20.2	37.4
506.8	139.3	10.03	9.98	-5.56	11	19	33.95	14	6	20.2	37.4

Depth (ft) 21.5 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model — Total Capacity Rut (kips) 535.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.260	16586	0.010	0.000	0.85	0.0	0.000	0.100	3.39	4.2	22.5
2	0.260	16586	0.000	0.000	1.00	0.0	0.000	0.100	6.77	4.2	22.5
9	0.260	16586	0.000	0.000	1.00	0.0	0.200	0.100	30.47	4.2	22.5
10	0.260	16586	0.000	0.000	1.00	0.2	0.200	0.100	33.85	4.2	22.5
11	0.260	16586	0.000	0.000	1.00	5.0	0.197	0.100	37.24	4.2	22.5
12	0.260	16586	0.000	0.000	1.00	6.1	0.150	0.100	40.62	4.2	22.5
13	0.260	16586	0.000	0.000	1.00	18.6	0.071	0.100	44.01	4.2	22.5
14	0.260	16586	0.000	0.000	1.00	31.2	0.050	0.100	47.39	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	35.4	0.050	0.100	50.78	4.2	22.5
Toe						438.4	0.150	0.133			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
21.55	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
535.0	157.7	10.18	10.11	-5.94	11	19	34.54	14	6	20.5	37.2
536.1	159.1	10.18	10.11	-5.96	11	19	34.45	14	6	20.5	37.2
537.1	160.7	10.18	10.12	-5.98	11	19	34.37	14	6	20.5	37.2
538.2	162.0	10.18	10.12	-6.01	11	19	34.28	14	6	20.5	37.2
539.2	163.6	10.18	10.12	-6.03	11	19	34.20	14	6	20.5	37.2

Depth (ft) 22.8 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model — Total Capacity Rut (kips) 568.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.260	16586	0.010	0.000	0.85	0.0	0.000	0.100	3.39	4.2	22.5
2	0.260	16586	0.000	0.000	1.00	0.0	0.000	0.100	6.77	4.2	22.5
9	0.260	16586	0.000	0.000	1.00	0.0	0.200	0.100	30.47	4.2	22.5
10	0.260	16586	0.000	0.000	1.00	2.3	0.200	0.100	33.85	4.2	22.5
11	0.260	16586	0.000	0.000	1.00	5.2	0.180	0.100	37.24	4.2	22.5
12	0.260	16586	0.000	0.000	1.00	6.1	0.150	0.100	40.62	4.2	22.5
13	0.260	16586	0.000	0.000	1.00	27.2	0.052	0.100	44.01	4.2	22.5
14	0.260	16586	0.000	0.000	1.00	32.8	0.050	0.100	47.39	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	36.8	0.050	0.100	50.78	4.2	22.5
Toe						457.6	0.150	0.133			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
22.78	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
568.1	188.7	10.29	10.24	-6.29	10	19	34.61	14	6	20.7	37.0
569.1	190.7	10.29	10.24	-6.31	10	18	34.52	14	6	20.7	37.0
570.2	192.8	10.30	10.25	-6.34	10	18	34.43	14	6	20.7	37.0
571.2	194.8	10.30	10.25	-6.36	10	18	34.34	14	6	20.7	37.0
572.3	197.0	10.30	10.25	-6.39	10	18	34.24	14	6	20.7	37.0

Depth (ft)	22.8	Standard Soil Setup	
Shaft Gain/Loss Factor	0.400	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in2)	144.000	Pile Type	Unknown
Pile Size (inch)	16.000		

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model — Total Capacity Rut (kips) 673.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.260	16586	0.010	0.000	0.85	0.0	0.000	0.100	3.39	4.2	22.5
2	0.260	16586	0.000	0.000	1.00	0.0	0.000	0.100	6.77	4.2	22.5
9	0.260	16586	0.000	0.000	1.00	0.0	0.200	0.100	30.47	4.2	22.5
10	0.260	16586	0.000	0.000	1.00	2.3	0.200	0.100	33.85	4.2	22.5
11	0.260	16586	0.000	0.000	1.00	5.2	0.180	0.100	37.24	4.2	22.5
12	0.260	16586	0.000	0.000	1.00	6.1	0.150	0.100	40.62	4.2	22.5
13	0.260	16586	0.000	0.000	1.00	27.5	0.052	0.100	44.01	4.2	22.5
14	0.260	16586	0.000	0.000	1.00	32.8	0.050	0.100	47.39	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	36.9	0.050	0.100	50.78	4.2	22.5
Toe						562.3	0.150	0.135			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
22.82	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
673.2	377.7	10.81	10.72	-6.25	11	18	36.90	14	6	21.8	36.1
674.2	383.6	10.81	10.72	-6.29	11	18	36.80	14	6	21.8	36.1
675.3	389.8	10.81	10.72	-6.33	11	18	36.70	14	6	21.8	36.1
676.3	396.0	10.81	10.72	-6.37	11	18	36.60	14	6	21.8	36.1
677.4	402.4	10.81	10.71	-6.40	11	18	36.50	14	6	21.8	36.1

Depth (ft)	36.8	Standard Soil Setup	
Shaft Gain/Loss Factor	0.400	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in2)	144.000	Pile Type	Unknown
Pile Size (inch)	16.000		

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model — Total Capacity Rut (kips) 1097.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.260	16586	0.010	0.000	0.85	0.0	0.000	0.100	3.39	4.2	22.5
2	0.260	16586	0.000	0.000	1.00	0.0	0.000	0.100	6.77	4.2	22.5
5	0.260	16586	0.000	0.000	1.00	0.0	0.200	0.100	16.93	4.2	22.5
6	0.260	16586	0.000	0.000	1.00	2.9	0.200	0.100	20.31	4.2	22.5
7	0.260	16586	0.000	0.000	1.00	5.4	0.173	0.100	23.70	4.2	22.5
8	0.260	16586	0.000	0.000	1.00	7.7	0.131	0.100	27.08	4.2	22.5
9	0.260	16586	0.000	0.000	1.00	29.0	0.050	0.100	30.47	4.2	22.5
10	0.260	16586	0.000	0.000	1.00	33.4	0.050	0.100	33.85	4.2	22.5
11	0.260	16586	0.000	0.000	1.00	37.4	0.050	0.100	37.24	4.2	22.5
12	0.260	16586	0.000	0.000	1.00	42.2	0.050	0.100	40.62	4.2	22.5
13	0.260	16586	0.000	0.000	1.00	46.8	0.050	0.100	44.01	4.2	22.5
14	0.260	16586	0.000	0.000	1.00	51.3	0.050	0.100	47.39	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	55.9	0.050	0.100	50.78	4.2	22.5
Toe						785.7	0.150	0.135			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
36.78	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1097.8	9999.0	10.70	10.68	-7.87	9	17	31.49	12	6	21.1	36.3

1098.8	9999.0	10.69	10.67	-7.79	9	17	31.37	12	6	21.0	36.3
1099.9	9999.0	10.68	10.65	-7.71	9	17	31.25	12	6	21.0	36.3
1100.9	9999.0	10.67	10.65	-7.66	9	17	31.17	12	6	21.0	36.3
1102.0	9999.0	10.66	10.63	-7.57	9	17	31.05	12	6	20.9	36.3

Depth (ft) 50.8 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	30000.	492.0	4.2	0	16807.	40.1
50.8	22.46	30000.	492.0	4.2	0	16807.	40.1

Wave Travel Time 2L/c (ms) 6.043

Pile and Soil Model — Total Capacity Rut (kips) 1418.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.260	16586	0.010	0.000	0.85	0.0	0.200	0.100	3.39	4.2	22.5
2	0.260	16586	0.000	0.000	1.00	3.5	0.200	0.100	6.77	4.2	22.5
3	0.260	16586	0.000	0.000	1.00	5.6	0.166	0.100	10.16	4.2	22.5
4	0.260	16586	0.000	0.000	1.00	10.5	0.108	0.100	13.54	4.2	22.5
5	0.260	16586	0.000	0.000	1.00	29.7	0.050	0.100	16.93	4.2	22.5
6	0.260	16586	0.000	0.000	1.00	33.9	0.050	0.100	20.31	4.2	22.5
7	0.260	16586	0.000	0.000	1.00	38.1	0.050	0.100	23.70	4.2	22.5
8	0.260	16586	0.000	0.000	1.00	42.9	0.050	0.100	27.08	4.2	22.5
9	0.260	16586	0.000	0.000	1.00	47.4	0.050	0.100	30.47	4.2	22.5
10	0.260	16586	0.000	0.000	1.00	51.9	0.050	0.100	33.85	4.2	22.5
11	0.260	16586	0.000	0.000	1.00	56.5	0.050	0.100	37.24	4.2	22.5
12	0.260	16586	0.000	0.000	1.00	61.0	0.050	0.100	40.62	4.2	22.5
13	0.260	16586	0.000	0.000	1.00	65.6	0.050	0.100	44.01	4.2	22.5
14	0.260	16586	0.000	0.000	1.00	70.1	0.050	0.100	47.39	4.2	22.5
15	0.260	16586	0.000	0.000	1.00	74.7	0.050	0.100	50.78	4.2	22.5
Toe						827.4	0.150	0.135			

3.897 kips total unreduced pile weight (g= 32.17 ft/s2)
3.897 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
50.78	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1418.7	9999.0	10.28	10.21	-3.60	5	14	28.18	5	7	18.5	37.1
1419.8	9999.0	10.27	10.20	-3.49	5	14	28.09	5	7	18.5	37.1
1420.8	9999.0	10.26	10.19	-3.40	5	14	27.99	5	7	18.4	37.1
1421.9	9999.0	10.26	10.19	-3.30	5	14	27.90	5	7	18.4	37.1
1422.9	9999.0	10.25	10.18	-3.20	5	14	27.81	5	7	18.4	37.1

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SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.400 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.3	14.0	1.5	12.6	1.5	7.951	-0.356	4.16	23.5
5.3	12.2	1.5	10.7	1.4	7.512	-0.470	4.08	23.2
6.6	13.9	3.2	10.7	1.5	7.886	-0.349	4.16	23.8
7.8	15.5	4.8	10.7	1.6	8.664	-0.124	4.28	24.3
7.8	14.3	4.9	9.4	1.5	8.317	-0.252	4.25	24.1
10.3	18.8	9.4	9.4	1.7	9.642	-0.059	4.44	24.9
12.8	23.3	13.9	9.4	2.0	10.666	-0.102	4.62	24.6
12.8	375.3	14.1	361.3	66.2	31.152	-2.392	9.18	18.6
16.5	492.9	45.8	447.2	137.3	35.053	-4.275	10.06	20.3
20.3	596.5	82.9	513.7	242.3	36.472	-5.503	10.48	21.2
20.3	502.6	83.3	419.2	134.7	34.265	-5.448	10.03	20.2
21.5	535.0	96.6	438.4	157.7	34.540	-5.938	10.18	20.5
22.8	568.1	110.5	457.6	188.7	34.612	-6.287	10.29	20.7
22.8	673.2	110.9	562.3	377.7	36.900	-6.254	10.81	21.8
36.8	1097.8	312.0	785.7	9999.0	31.488	-7.866	10.70	21.1
50.8	1418.7	591.3	827.4	9999.0	28.177	-3.597	10.28	18.5

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.450 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.3	14.2	1.6	12.6	1.5	8.179	-0.281	4.22	23.6
5.3	12.4	1.7	10.7	1.4	7.596	-0.492	4.09	23.2
6.6	14.2	3.5	10.7	1.5	8.230	-0.269	4.23	23.9
7.8	16.1	5.4	10.7	1.6	8.854	-0.089	4.32	24.5
7.8	14.9	5.5	9.4	1.5	8.587	-0.172	4.29	24.3
10.3	19.6	10.2	9.4	1.8	9.855	-0.059	4.48	24.9
12.8	24.3	14.9	9.4	2.0	10.882	-0.130	4.66	24.4
12.8	376.4	15.1	361.3	67.0	31.136	-2.438	9.18	18.6
16.5	494.0	46.8	447.2	137.6	35.042	-4.322	10.06	20.4

20.3	597.6	83.9	513.7	244.8	36.379	-5.547	10.48	21.2
20.3	503.6	84.4	419.2	135.8	34.187	-5.475	10.03	20.2
21.5	536.1	97.6	438.4	159.1	34.449	-5.960	10.18	20.5
22.8	569.1	111.5	457.6	190.7	34.520	-6.311	10.29	20.7
22.8	674.2	112.0	562.3	383.6	36.800	-6.295	10.81	21.8
36.8	1098.8	313.1	785.7	9999.0	31.372	-7.792	10.69	21.0
50.8	1419.8	592.4	827.4	9999.0	28.090	-3.493	10.27	18.5

Refusal occurred; no driving time output possible

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.500 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.3	14.3	1.7	12.6	1.5	8.255	-0.276	4.23	23.6
5.3	12.5	1.8	10.7	1.4	7.575	-0.459	4.10	23.3
6.6	14.6	3.9	10.7	1.5	8.410	-0.226	4.26	24.0
7.8	16.6	5.9	10.7	1.6	9.024	-0.091	4.35	24.6
7.8	15.4	6.0	9.4	1.6	8.792	-0.100	4.33	24.4
10.3	20.4	11.0	9.4	1.8	10.074	-0.050	4.52	24.8
12.8	25.4	16.0	9.4	2.1	11.167	-0.188	4.74	24.4
12.8	377.4	16.2	361.3	67.3	31.151	-2.485	9.19	18.6
16.5	495.0	47.9	447.2	139.1	34.991	-4.365	10.06	20.4
20.3	598.6	85.0	513.7	247.5	36.288	-5.594	10.48	21.2
20.3	504.7	85.4	419.2	137.0	34.105	-5.501	10.04	20.2
21.5	537.1	98.7	438.4	160.7	34.370	-5.984	10.18	20.5
22.8	570.2	112.6	457.6	192.8	34.426	-6.335	10.30	20.7
22.8	675.3	113.0	562.3	389.8	36.700	-6.332	10.81	21.8
36.8	1099.9	314.1	785.7	9999.0	31.253	-7.711	10.68	21.0
50.8	1420.8	593.4	827.4	9999.0	27.986	-3.398	10.26	18.4

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.550 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.3	14.4	1.9	12.6	1.5	8.306	-0.264	4.24	23.7
5.3	12.6	1.9	10.7	1.4	7.644	-0.474	4.10	23.3
6.6	14.9	4.2	10.7	1.5	8.545	-0.157	4.29	24.1
7.8	17.2	6.5	10.7	1.7	9.204	-0.071	4.37	24.7
7.8	16.0	6.6	9.4	1.6	8.809	-0.097	4.32	24.6
10.3	21.2	11.8	9.4	1.9	10.250	-0.053	4.54	24.7
12.8	26.4	17.0	9.4	2.2	11.363	-0.198	4.78	24.3
12.8	378.5	17.2	361.3	67.7	31.201	-2.532	9.20	18.6
16.5	496.1	48.9	447.2	140.6	34.935	-4.406	10.07	20.4
20.3	599.7	86.0	513.7	250.3	36.197	-5.643	10.48	21.2

20.3	505.7	86.5	419.2	138.1	34.029	-5.529	10.03	20.2
21.5	538.2	99.7	438.4	162.0	34.279	-6.007	10.18	20.5
22.8	571.2	113.6	457.6	194.8	34.338	-6.362	10.30	20.7
22.8	676.3	114.1	562.3	396.0	36.600	-6.366	10.81	21.8
36.8	1100.9	315.2	785.7	9999.0	31.167	-7.658	10.67	21.0
50.8	1421.9	594.5	827.4	9999.0	27.897	-3.298	10.26	18.4

Refusal occurred; no driving time output possible

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.600 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.3	14.6	2.0	12.6	1.5	8.378	-0.206	4.25	23.7
5.3	12.8	2.1	10.7	1.4	7.639	-0.448	4.11	23.4
6.6	15.2	4.6	10.7	1.6	8.722	-0.112	4.31	24.2
7.8	17.7	7.0	10.7	1.7	9.377	-0.056	4.40	24.8
7.8	16.6	7.1	9.4	1.6	9.031	-0.069	4.35	24.7
10.3	22.0	12.6	9.4	1.9	10.430	-0.059	4.58	24.6
12.8	27.5	18.1	9.4	2.3	11.534	-0.210	4.82	24.2
12.8	379.5	18.3	361.3	68.1	31.214	-2.577	9.21	18.6
16.5	497.1	50.0	447.2	142.1	34.883	-4.447	10.07	20.4
20.3	600.7	87.1	513.7	253.0	36.108	-5.691	10.48	21.2
20.3	506.8	87.5	419.2	139.3	33.953	-5.555	10.03	20.2
21.5	539.2	100.8	438.4	163.6	34.197	-6.028	10.18	20.5
22.8	572.3	114.7	457.6	197.0	34.243	-6.391	10.30	20.7
22.8	677.4	115.1	562.3	402.4	36.501	-6.399	10.81	21.8
36.8	1102.0	316.2	785.7	9999.0	31.052	-7.575	10.66	20.9
50.8	1422.9	595.5	827.4	9999.0	27.810	-3.197	10.25	18.4

Refusal occurred; no driving time output possible

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Table of Depths Analyzed with Driving System Modifiers

Depth	Temp. Length	Wait Time	Equivalent Pressure Stroke	Ratio	Efficy.	Stiffn. Factor	Cushion CoR
ft	ft	hr	ft				
5.28	50.78	0.00	10.81	1.00	0.80	1.00	1.00
5.32	50.78	0.00	10.81	1.00	0.80	1.00	1.00
6.55	50.78	0.00	10.81	1.00	0.80	1.00	1.00
7.78	50.78	0.00	10.81	1.00	0.80	1.00	1.00
7.82	50.78	0.00	10.81	1.00	0.80	1.00	1.00

10.30	50.78	0.00	10.81	1.00	0.80	1.00	1.00
12.78	50.78	0.00	10.81	1.00	0.80	1.00	1.00
12.82	50.78	0.00	10.81	1.00	0.80	1.00	1.00
16.55	50.78	0.00	10.81	1.00	0.80	1.00	1.00
20.28	50.78	0.00	10.81	1.00	0.80	1.00	1.00
20.32	50.78	0.00	10.81	1.00	0.80	1.00	1.00
21.55	50.78	0.00	10.81	1.00	0.80	1.00	1.00
22.78	50.78	0.00	10.81	1.00	0.80	1.00	1.00
22.82	50.78	0.00	10.81	1.00	0.80	1.00	1.00
36.78	50.78	0.00	10.81	1.00	0.80	1.00	1.00
50.78	50.78	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

Depth	Shaft Res.	End Bearing	Shaft Quake	Toe Quake	Shaft Damping	Toe Damping	Soil Setup	Limit Distance	Setup Time
ft	k/ft2	kips	inch	inch	s/ft	s/ft	Normlzd	ft	hrs
0.01	0.00	0.00	0.100	0.190	0.200	0.150	0.860	6.000	168.000
4.49	0.00	0.00	0.100	0.190	0.200	0.150	0.860	6.000	168.000
4.50	0.92	12.57	0.100	0.190	0.200	0.150	0.860	6.000	168.000
5.29	0.92	12.57	0.100	0.190	0.200	0.150	0.860	6.000	168.000
5.31	0.80	10.68	0.100	0.196	0.200	0.150	1.000	6.000	168.000
7.79	0.80	10.68	0.100	0.196	0.200	0.150	1.000	6.000	168.000
7.81	0.71	9.42	0.100	0.203	0.150	0.150	0.660	6.000	168.000
12.79	0.71	9.42	0.100	0.203	0.150	0.150	0.660	6.000	168.000
12.81	1.78	360.92	0.100	0.142	0.050	0.150	0.000	6.000	1.000
13.99	1.98	401.37	0.100	0.142	0.050	0.150	0.000	6.000	1.000
14.01	1.99	401.89	0.100	0.142	0.050	0.150	0.000	6.000	1.000
20.29	2.54	513.83	0.100	0.142	0.050	0.150	0.000	6.000	1.000
20.31	2.52	419.09	0.100	0.133	0.050	0.150	0.000	6.000	1.000
22.79	2.75	457.79	0.100	0.133	0.050	0.150	0.000	6.000	1.000
22.81	2.78	562.06	0.100	0.135	0.050	0.150	0.000	6.000	1.000
31.81	3.63	734.36	0.100	0.135	0.050	0.150	0.000	6.000	1.000
40.81	4.48	827.37	0.100	0.135	0.050	0.150	0.000	6.000	1.000
49.81	5.33	827.37	0.100	0.135	0.050	0.150	0.000	6.000	1.000
50.78	5.42	827.37	0.100	0.135	0.050	0.150	0.000	6.000	1.000

Gain/Loss 3 at Shaft and Toe 0.830 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
3.4	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.4	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.9	95.6	3.9	91.7	10.0	16.164	-0.334	6.36	19.1
8.4	149.5	13.7	135.8	17.1	17.889	-0.688	7.13	18.1
8.4	438.9	13.9	424.9	95.5	34.252	-2.089	9.85	20.7
33.6	1360.6	330.7	1029.9	9999.0	32.135	-9.743	10.65	22.0
58.9	1956.8	926.9	1029.9	9999.0	28.107	-2.454	10.31	18.2

Refusal occurred; no driving time output possible

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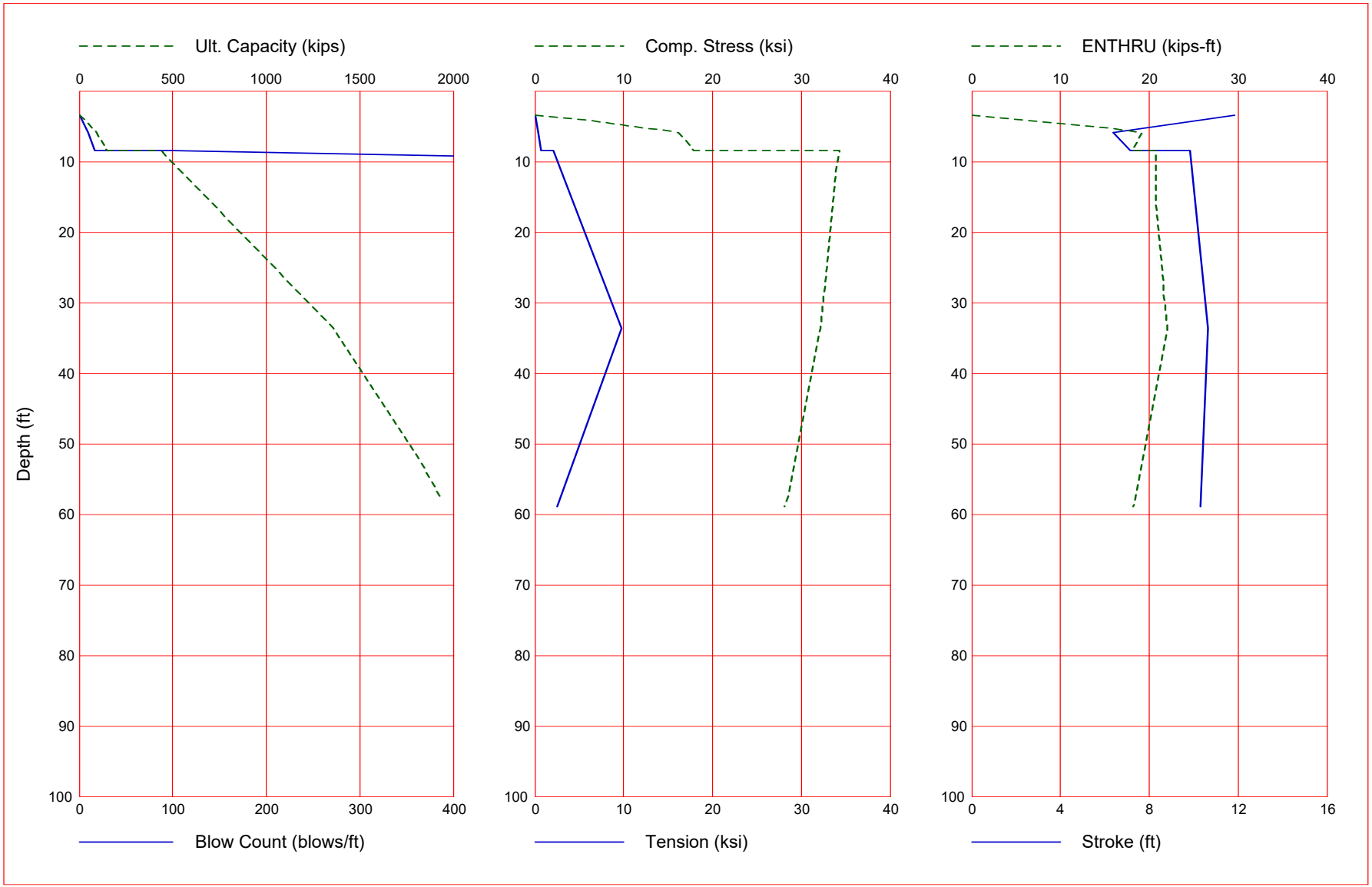
Jan 25 2023
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 0.830 / 1.000



GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

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 building and other factors.

Input File: C:\USERS\KARENS\DESKTOP\GRL FILES\FA16IN2.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

CUY-14-6.93, PID 104132 : 01/24/2023 : K

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	144.000	16.000	Unknown

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
2.500	22.450	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
58.880	22.46	29000.0	492.000	4.190	0	0.850	0.010

FFatigue	F0	0-Bottom
0	0.000	0.000

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.0020	0.0020	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1600.00	1440.00	1295.00	1165.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1600.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Research Toe Plug: Res-int, Q-int, D-int, Res-plug, Q-plug, D-plug

0.000	0.000	0.000	0.000	0.000	0.000

Research Toe Plug: RD plug toe: m, d

0.000	0.000

Research Toe Plug: New Toe Plug Model is NOT applied

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimL	TSf0
0.01	0.00	0.00	0.10	0.27	0.10	0.15	1.21	6.00	24.000
3.39	0.00	0.00	0.10	0.27	0.10	0.15	1.21	6.00	24.000
3.41	0.00	0.00	0.10	0.16	0.05	0.15	1.00	6.00	1.000
4.49	0.00	0.00	0.10	0.16	0.05	0.15	1.00	6.00	1.000
4.50	0.56	66.80	0.10	0.16	0.05	0.15	1.00	6.00	1.000
8.39	1.13	135.98	0.10	0.16	0.05	0.15	1.00	6.00	1.000
8.41	1.30	424.34	0.10	0.13	0.05	0.15	1.00	6.00	1.000
13.99	2.33	762.12	0.10	0.13	0.05	0.15	1.00	6.00	1.000
14.01	2.33	763.06	0.10	0.13	0.05	0.15	1.00	6.00	1.000
23.01	3.25	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000

32.01	4.18	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000
41.01	5.10	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000
50.01	6.02	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000
58.88	6.93	1029.88	0.10	0.13	0.05	0.15	1.00	6.00	1.000

Gain/Loss factors: shaft and toe

0.79600	0.81300	0.83000	0.84700	0.86400
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
3.38	0.00	0.00	0.000	0.0	0.000	0.000	0.000
3.42	0.00	0.00	0.000	0.0	0.000	0.000	0.000
5.90	0.00	0.00	0.000	0.0	0.000	0.000	0.000
8.38	0.00	0.00	0.000	0.0	0.000	0.000	0.000
8.42	0.00	0.00	0.000	0.0	0.000	0.000	0.000
33.63	0.00	0.00	0.000	0.0	0.000	0.000	0.000
58.88	0.00	0.00	0.000	0.0	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

CUY-14-6.93, PID 104132 : 01/24/2023 : K

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.6	1.000	0.0000	
3	0.800	140046.6	1.000	0.0000	
4	0.800	140046.6	1.000	0.0000	
5	0.800	140046.6	1.000	0.0000	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	2.500	5949.2	0.800	0.0100	5.8
Combined Pile Top		16593.2			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1600.00	Actual Pressure	(psi)	1600.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	22.45	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	5949.2	Stiffness	(kips/in)	0.0

Depth	(ft)	3.4	Standard Soil Setup		
Shaft Gain/Loss Factor		0.796	Toe Gain/Loss Factor		1.000

PILE PROFILE:

Toe Area	(in2)	144.000	Pile Type		Unknown
Pile Size	(inch)	16.000			

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
	ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
	0.0	22.46	29000.	492.0	4.2	0	16524.	39.4
	58.9	22.46	29000.	492.0	4.2	0	16524.	39.4

Wave Travel Time 2L/c (ms) 7.126

Pile and Soil Model — Total Capacity Rut (kips) 0.0

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	0.251	16593	0.010	0.000	0.85	0.0	0.000	0.100	3.27	4.2	22.5
2	0.251	16593	0.000	0.000	1.00	0.0	0.000	0.100	6.54	4.2	22.5
17	0.251	16593	0.000	0.000	1.00	0.0	0.100	0.100	55.61	4.2	22.5
18	0.251	16593	0.000	0.000	1.00	0.0	0.100	0.100	58.88	4.2	22.5
Toe						0.0	0.150	0.267			

4.518 kips total unreduced pile weight (g= 32.17 ft/s2)
4.518 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile			Pile Segments: Automatic	
No. of Slacks/Splices		0	Pile Damping	(%) 1
			Pile Damping Fact.(k/ft/s)	0.788

Driveability Analysis
Soil Damping Option Smith

Max No Analysis Iterations 0 Time Increment/Critical 160
Output Time Interval 1 Analysis Time-Input (ms) 0
Output Level: Normal
Gravity Mass, Pile, Hammer: 32.170 32.170 32.170
Output Segment Generation: Automatic

Depth ft	Stroke ft	Pressure Ratio	Efficy
3.38	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min

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Depth (ft) 3.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	29000.	492.0	4.2	0	16524.	39.4
58.9	22.46	29000.	492.0	4.2	0	16524.	39.4

Wave Travel Time 2L/c (ms) 7.126

Pile and Soil Model					Total Capacity Rut (kips)					0.0
No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.251	16593	0.010	0.000	0.85	0.0	0.000	0.100	3.27	4.2	22.5
2	0.251	16593	0.000	0.000	1.00	0.0	0.000	0.100	6.54	4.2	22.5
17	0.251	16593	0.000	0.000	1.00	0.0	0.100	0.100	55.61	4.2	22.5
18	0.251	16593	0.000	0.000	1.00	0.0	0.050	0.100	58.88	4.2	22.5
Toe						0.0	0.150	0.156			

4.518 kips total unreduced pile weight (g= 32.17 ft/s2)
4.518 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
3.42	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min

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Depth (ft) 5.9 Standard Soil Setup

Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	29000.	492.0	4.2	0	16524.	39.4
58.9	22.46	29000.	492.0	4.2	0	16524.	39.4

Wave Travel Time 2L/c (ms) 7.126

Pile and Soil Model Total Capacity Rut (kips) 95.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.251	16593	0.010	0.000	0.85	0.0	0.000	0.100	3.27	4.2	22.5
2	0.251	16593	0.000	0.000	1.00	0.0	0.000	0.100	6.54	4.2	22.5
17	0.251	16593	0.000	0.000	1.00	0.0	0.100	0.100	55.61	4.2	22.5
18	0.251	16593	0.000	0.000	1.00	3.9	0.050	0.100	58.88	4.2	22.5
Toe						91.7	0.150	0.156			

4.518 kips total unreduced pile weight (g= 32.17 ft/s2)
4.518 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
5.90	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
95.6	10.0	6.36	6.38	-0.33	13	46	16.16	10	5	19.1	46.7
95.6	10.0	6.36	6.38	-0.33	13	46	16.16	10	5	19.1	46.7
95.6	10.0	6.36	6.38	-0.33	13	46	16.16	10	5	19.1	46.7
95.6	10.0	6.36	6.38	-0.33	13	46	16.16	10	5	19.1	46.7
95.6	10.0	6.36	6.38	-0.33	13	46	16.16	10	5	19.1	46.7

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Depth (ft) 8.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	29000.	492.0	4.2	0	16524.	39.4
58.9	22.46	29000.	492.0	4.2	0	16524.	39.4

Wave Travel Time 2L/c (ms) 7.126

Pile and Soil Model — Total Capacity Rut (kips) 149.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.251	16593	0.010	0.000	0.85	0.0	0.000	0.100	3.27	4.2	22.5
2	0.251	16593	0.000	0.000	1.00	0.0	0.000	0.100	6.54	4.2	22.5
16	0.251	16593	0.000	0.000	1.00	0.0	0.100	0.100	52.34	4.2	22.5
17	0.251	16593	0.000	0.000	1.00	1.5	0.050	0.100	55.61	4.2	22.5
18	0.251	16593	0.000	0.000	1.00	12.2	0.050	0.100	58.88	4.2	22.5
Toe						135.8	0.150	0.156			

4.518 kips total unreduced pile weight (g= 32.17 ft/s2)
4.518 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
8.38	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
149.5	17.1	7.13	7.08	-0.69	17	41	17.89	10	5	18.1	44.3
149.5	17.1	7.13	7.08	-0.69	17	41	17.89	10	5	18.1	44.3
149.5	17.1	7.13	7.08	-0.69	17	41	17.89	10	5	18.1	44.3
149.5	17.1	7.13	7.08	-0.69	17	41	17.89	10	5	18.1	44.3
149.5	17.1	7.13	7.08	-0.69	17	41	17.89	10	5	18.1	44.3

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Depth (ft) 8.4 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	29000.	492.0	4.2	0	16524.	39.4

58.9	22.46	29000.	492.0	4.2	0	16524.	39.4	

Wave Travel Time 2L/c (ms) 7.126

Pile and Soil Model — Total Capacity Rut (kips) 438.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.251	16593	0.010	0.000	0.85	0.0	0.000	0.100	3.27	4.2	22.5
2	0.251	16593	0.000	0.000	1.00	0.0	0.000	0.100	6.54	4.2	22.5
16	0.251	16593	0.000	0.000	1.00	0.0	0.100	0.100	52.34	4.2	22.5
17	0.251	16593	0.000	0.000	1.00	1.7	0.050	0.100	55.61	4.2	22.5
18	0.251	16593	0.000	0.000	1.00	12.3	0.050	0.100	58.88	4.2	22.5
Toe						424.9	0.150	0.133			

4.518 kips total unreduced pile weight (g= 32.17 ft/s2)
4.518 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
8.42	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
438.9	95.5	9.85	9.80	-2.09	6	21	34.25	17	7	20.7	37.7
438.9	95.5	9.85	9.80	-2.09	6	21	34.25	17	7	20.7	37.7
438.9	95.5	9.85	9.80	-2.09	6	21	34.25	17	7	20.7	37.7
438.9	95.5	9.85	9.80	-2.09	6	21	34.25	17	7	20.7	37.7
438.9	95.5	9.85	9.80	-2.09	6	21	34.25	17	7	20.7	37.7

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Depth (ft) 33.6 Standard Soil Setup
Shaft Gain/Loss Factor 0.796 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	29000.	492.0	4.2	0	16524.	39.4
58.9	22.46	29000.	492.0	4.2	0	16524.	39.4

Wave Travel Time 2L/c (ms) 7.126

Pile and Soil Model						Total Capacity Rut (kips)			1360.6		
No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.251	16593	0.010	0.000	0.85	0.0	0.000	0.100	3.27	4.2	22.5
2	0.251	16593	0.000	0.000	1.00	0.0	0.000	0.100	6.54	4.2	22.5
8	0.251	16593	0.000	0.000	1.00	0.0	0.100	0.100	26.17	4.2	22.5
9	0.251	16593	0.000	0.000	1.00	0.0	0.050	0.100	29.44	4.2	22.5
10	0.251	16593	0.000	0.000	1.00	9.6	0.050	0.100	32.71	4.2	22.5
11	0.251	16593	0.000	0.000	1.00	18.9	0.050	0.100	35.98	4.2	22.5
12	0.251	16593	0.000	0.000	1.00	27.8	0.050	0.100	39.25	4.2	22.5
13	0.251	16593	0.000	0.000	1.00	34.2	0.050	0.100	42.52	4.2	22.5
14	0.251	16593	0.000	0.000	1.00	38.8	0.050	0.100	45.80	4.2	22.5
15	0.251	16593	0.000	0.000	1.00	43.4	0.050	0.100	49.07	4.2	22.5
16	0.251	16593	0.000	0.000	1.00	48.0	0.050	0.100	52.34	4.2	22.5
17	0.251	16593	0.000	0.000	1.00	52.6	0.050	0.100	55.61	4.2	22.5
18	0.251	16593	0.000	0.000	1.00	57.2	0.050	0.100	58.88	4.2	22.5
Toe						1029.9	0.150	0.133			

4.518 kips total unreduced pile weight (g= 32.17 ft/s2)
4.518 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
33.63	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1360.6	9999.0	10.65	10.62	-9.74	10	18	32.14	15	7	22.0	36.3
1360.6	9999.0	10.65	10.62	-9.74	10	18	32.14	15	7	22.0	36.3
1360.6	9999.0	10.65	10.62	-9.74	10	18	32.14	15	7	22.0	36.3
1360.6	9999.0	10.65	10.62	-9.74	10	18	32.14	15	7	22.0	36.3
1360.6	9999.0	10.65	10.62	-9.74	10	18	32.14	15	7	22.0	36.3

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Depth (ft)	58.9	Standard Soil Setup	
Shaft Gain/Loss Factor	0.796	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in2)	144.000	Pile Type	Unknown
Pile Size (inch)	16.000		

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	22.46	29000.	492.0	4.2	0	16524.	39.4

58.9	22.46	29000.	492.0	4.2	0	16524.	39.4

Wave Travel Time 2L/c (ms) 7.126

Pile and Soil Model					Total Capacity Rut (kips)			1956.8		
No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.251	16593	0.010	0.000	0.85	0.0	0.100	0.100	3.27	4.2	22.5
2	0.251	16593	0.000	0.000	1.00	6.1	0.050	0.100	6.54	4.2	22.5
3	0.251	16593	0.000	0.000	1.00	16.2	0.050	0.100	9.81	4.2	22.5
4	0.251	16593	0.000	0.000	1.00	25.5	0.050	0.100	13.08	4.2	22.5
5	0.251	16593	0.000	0.000	1.00	32.8	0.050	0.100	16.36	4.2	22.5
6	0.251	16593	0.000	0.000	1.00	37.5	0.050	0.100	19.63	4.2	22.5
7	0.251	16593	0.000	0.000	1.00	42.1	0.050	0.100	22.90	4.2	22.5
8	0.251	16593	0.000	0.000	1.00	46.7	0.050	0.100	26.17	4.2	22.5
9	0.251	16593	0.000	0.000	1.00	51.3	0.050	0.100	29.44	4.2	22.5
10	0.251	16593	0.000	0.000	1.00	55.9	0.050	0.100	32.71	4.2	22.5
11	0.251	16593	0.000	0.000	1.00	60.5	0.050	0.100	35.98	4.2	22.5
12	0.251	16593	0.000	0.000	1.00	65.1	0.050	0.100	39.25	4.2	22.5
13	0.251	16593	0.000	0.000	1.00	69.7	0.050	0.100	42.52	4.2	22.5
14	0.251	16593	0.000	0.000	1.00	74.3	0.050	0.100	45.80	4.2	22.5
15	0.251	16593	0.000	0.000	1.00	78.9	0.050	0.100	49.07	4.2	22.5
16	0.251	16593	0.000	0.000	1.00	83.5	0.050	0.100	52.34	4.2	22.5
17	0.251	16593	0.000	0.000	1.00	88.1	0.050	0.100	55.61	4.2	22.5
18	0.251	16593	0.000	0.000	1.00	92.7	0.050	0.100	58.88	4.2	22.5
Toe						1029.9	0.150	0.133			

4.518 kips total unreduced pile weight (g= 32.17 ft/s2)
4.518 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
58.88	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1956.8	9999.0	10.31	10.24	-2.45	4	15	28.11	4	4	18.2	37.0
1956.8	9999.0	10.31	10.24	-2.45	4	15	28.11	4	4	18.2	37.0
1956.8	9999.0	10.31	10.24	-2.45	4	15	28.11	4	4	18.2	37.0
1956.8	9999.0	10.31	10.24	-2.45	4	15	28.11	4	4	18.2	37.0
1956.8	9999.0	10.31	10.24	-2.45	4	15	28.11	4	4	18.2	37.0

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SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.796 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
3.4	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
3.4	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
5.9	95.6	3.9	91.7	10.0	16.164	-0.334	6.36	19.1
8.4	149.5	13.7	135.8	17.1	17.889	-0.688	7.13	18.1
8.4	438.9	13.9	424.9	95.5	34.252	-2.089	9.85	20.7
33.6	1360.6	330.7	1029.9	9999.0	32.135	-9.743	10.65	22.0
58.9	1956.8	926.9	1029.9	9999.0	28.107	-2.454	10.31	18.2

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.813 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
3.4	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.4	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.9	95.6	3.9	91.7	10.0	16.164	-0.334	6.36	19.1
8.4	149.5	13.7	135.8	17.1	17.889	-0.688	7.13	18.1
8.4	438.9	13.9	424.9	95.5	34.252	-2.089	9.85	20.7
33.6	1360.6	330.7	1029.9	9999.0	32.135	-9.743	10.65	22.0
58.9	1956.8	926.9	1029.9	9999.0	28.107	-2.454	10.31	18.2

Refusal occurred; no driving time output possible

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.830 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
3.4	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.4	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.9	95.6	3.9	91.7	10.0	16.164	-0.334	6.36	19.1
8.4	149.5	13.7	135.8	17.1	17.889	-0.688	7.13	18.1
8.4	438.9	13.9	424.9	95.5	34.252	-2.089	9.85	20.7
33.6	1360.6	330.7	1029.9	9999.0	32.135	-9.743	10.65	22.0
58.9	1956.8	926.9	1029.9	9999.0	28.107	-2.454	10.31	18.2

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.847 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
3.4	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.4	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0

5.9	95.6	3.9	91.7	10.0	16.164	-0.334	6.36	19.1
8.4	149.5	13.7	135.8	17.1	17.889	-0.688	7.13	18.1
8.4	438.9	13.9	424.9	95.5	34.252	-2.089	9.85	20.7
33.6	1360.6	330.7	1029.9	9999.0	32.135	-9.743	10.65	22.0
58.9	1956.8	926.9	1029.9	9999.0	28.107	-2.454	10.31	18.2

Refusal occurred; no driving time output possible

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.864 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
3.4	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.4	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.9	95.6	3.9	91.7	10.0	16.164	-0.334	6.36	19.1
8.4	149.5	13.7	135.8	17.1	17.889	-0.688	7.13	18.1
8.4	438.9	13.9	424.9	95.5	34.252	-2.089	9.85	20.7
33.6	1360.6	330.7	1029.9	9999.0	32.135	-9.743	10.65	22.0
58.9	1956.8	926.9	1029.9	9999.0	28.107	-2.454	10.31	18.2

Refusal occurred; no driving time output possible

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Table of Depths Analyzed with Driving System Modifiers

Depth	Temp. Length	Wait Time	Equivalent Pressure Stroke	Ratio	Efficy.	Stiffn. Factor	Cushion CoR
ft	ft	hr	ft				
3.38	58.88	0.00	10.81	1.00	0.80	1.00	1.00
3.42	58.88	0.00	10.81	1.00	0.80	1.00	1.00
5.90	58.88	0.00	10.81	1.00	0.80	1.00	1.00
8.38	58.88	0.00	10.81	1.00	0.80	1.00	1.00
8.42	58.88	0.00	10.81	1.00	0.80	1.00	1.00
33.63	58.88	0.00	10.81	1.00	0.80	1.00	1.00
58.88	58.88	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

Depth	Shaft Res.	End Bearing	Shaft Quake	Toe Quake	Shaft Damping	Toe Damping	Soil Setup	Limit Distance	Setup Time
ft	k/ft2	kips	inch	inch	s/ft	s/ft	Normlzd	ft	hrs
0.01	0.00	0.00	0.100	0.267	0.100	0.150	1.000	6.000	24.000
3.39	0.00	0.00	0.100	0.267	0.100	0.150	1.000	6.000	24.000

3.41	0.00	0.00	0.100	0.156	0.050	0.150	0.000	6.000	1.000
4.49	0.00	0.00	0.100	0.156	0.050	0.150	0.000	6.000	1.000
4.50	0.56	66.80	0.100	0.156	0.050	0.150	0.000	6.000	1.000
8.39	1.13	135.98	0.100	0.156	0.050	0.150	0.000	6.000	1.000
8.41	1.30	424.34	0.100	0.133	0.050	0.150	0.000	6.000	1.000
13.99	2.33	762.12	0.100	0.133	0.050	0.150	0.000	6.000	1.000
14.01	2.33	763.06	0.100	0.133	0.050	0.150	0.000	6.000	1.000
23.01	3.25	1029.88	0.100	0.133	0.050	0.150	0.000	6.000	1.000
32.01	4.18	1029.88	0.100	0.133	0.050	0.150	0.000	6.000	1.000
41.01	5.10	1029.88	0.100	0.133	0.050	0.150	0.000	6.000	1.000
50.01	6.02	1029.88	0.100	0.133	0.050	0.150	0.000	6.000	1.000
58.88	6.93	1029.88	0.100	0.133	0.050	0.150	0.000	6.000	1.000

APPENDIX E

BRIDGE SETTLEMENT ANALYSIS

REAR ABUTMENT

CUY-14-6.93

Report created by FoSSA(2.0): Copyright (c) 2003-2012, ADAMA Engineering, Inc.

PROJECT IDENTIFICATION

Title:	CUY-14-6.93
Project Number:	PID 104132 -
Client:	AECOM
Designer:	KCA
Station Number:	

Description:

Settlement analysis for Rear Abutment

Company's information:

Name: NEAS Inc.
Street: 2800 Corporate Exchange Drive
Suite 240
Columbus, OH 43231
Telephone #: 614-714-0299
Fax #:
E-Mail:

Original file path and name: C:\Users\karens\Desktop\RA FoSSA2.2ST
Original date and time of creating this file: Thu Dec 16 16:17:56 2021

GEOMETRY: Analysis of a 2D geometry

Version 2.0 FoSSA Version 2.0
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Version 2.0 FoSSA Version 2.0

INPUT DATA – FOUNDATION LAYERS – 5 layers

	Wet Unit Weight, γ [lb/ft³]	**Poisson's Ratio μ**	**Description of Soil**
1	110.00	0.40	Soil Type 1
2	110.00	0.20	Soil Type 2
3	135.00	0.40	Soil Type 3
4	122.00	0.50	Soil Type 4
5	135.00	0.40	Soil Type 3

INPUT DATA – EMBANKMENT LAYERS -- 1 layers

	Wet Unit Weight, γ [lb/ft³]	**Description of Soil**
1	120.00	Proposed Embankment and MSE Wall Fill

INPUT DATA OF WATER

Point #	**Coordinates (X, Z) :** (X) [ft.]	(Z) [ft.]
1	0.00	803.10
2	500.00	803.10

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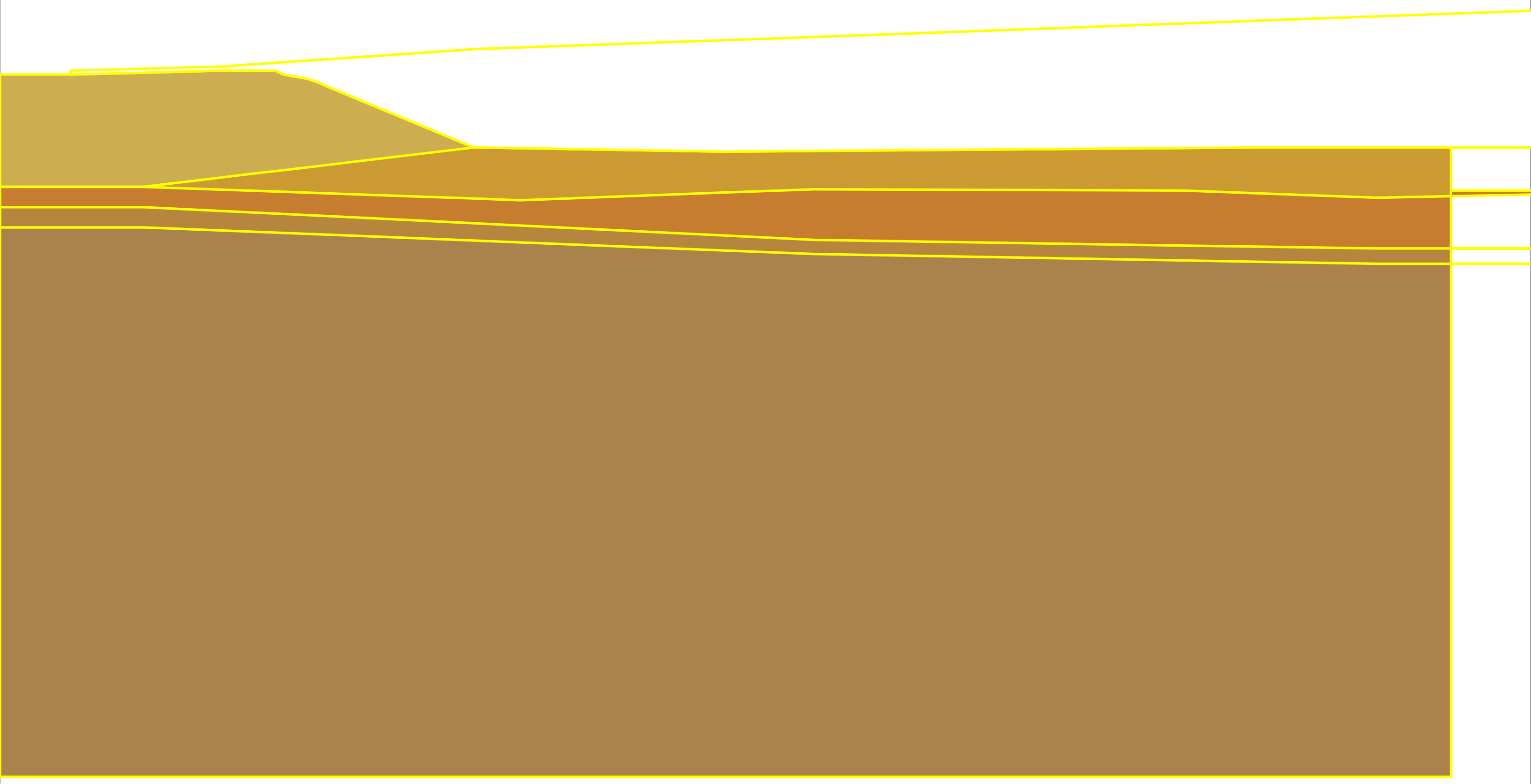
DRAWING OF SPECIFIED GEOMETRY



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INPUT DATA FOR CONSOLIDATION –– $\alpha = 1/2$

Layer #	Underging Consolidation [Yes/No]	OCR = Pc / Po	Cc	Cr	e0	Cv [ft ²/day]	Drains at :
1	Yes	8.00	0.150	0.030	0.792	0.8100	Top & Bot.
2	No	N/A	N/A	N/A	N/A	N/A	N/A
3	No	N/A	N/A	N/A	N/A	N/A	N/A
4	Yes	5.00	0.169	0.042	0.816	0.1600	Top & Bot.
5	No	N/A	N/A	N/A	N/A	N/A	N/A

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IMMEDIATE SETTLEMENT, Si

Node #	Settlement along section: X [ft.]	Y [ft.]	Layer (k)	Young's Modulus, E [lb/ft ²]	Poisson's Ratio, μ	Settlement of each layer, Si(k) [ft.]	Initial Z [ft.]	Final Z * [ft.]	Total Settlement Sum of Si(k), [ft.]
1	450.00	0.00	1	824000	0.4000	0.0000	814.01	813.57	0.44
			2	43000	0.2000	0.4088			
			3	562000	0.4000	0.0216			
			4	2000000	0.5000	0.0007			
			5	562000	0.4000	0.0086			
2	452.00	0.00	1	824000	0.4000	0.0000	814.01	813.63	0.38
			2	43000	0.2000	0.3512			
			3	562000	0.4000	0.0181			
			4	2000000	0.5000	0.0006			
			5	562000	0.4000	0.0077			
3	454.00	0.00	1	824000	0.4000	0.0000	814.01	813.69	0.32
			2	43000	0.2000	0.2951			
			3	562000	0.4000	0.0149			
			4	2000000	0.5000	0.0004			
			5	562000	0.4000	0.0068			
4	456.00	0.00	1	824000	0.4000	0.0000	814.01	813.75	0.26
			2	43000	0.2000	0.2444			
			3	562000	0.4000	0.0116			
			4	2000000	0.5000	0.0002			
			5	562000	0.4000	0.0059			
5	458.00	0.00	1	824000	0.4000	0.0000	814.01	813.80	0.21
			2	43000	0.2000	0.1977			
			3	562000	0.4000	0.0086			
			4	2000000	0.5000	0.0000			
			5	562000	0.4000	0.0050			
6	460.00	0.00	1	824000	0.4000	0.0000	814.01	813.84	0.17
			2	43000	0.2000	0.1574			
			3	562000	0.4000	0.0057			
			4	2000000	0.5000	-0.0001			
			5	562000	0.4000	0.0041			
7	462.00	0.00	1	824000	0.4000	0.0000	814.01	813.88	0.13
			2	43000	0.2000	0.1209			
			3	562000	0.4000	0.0031			
			4	2000000	0.5000	-0.0003			
			5	562000	0.4000	0.0033			
8	464.00	0.00	1	824000	0.4000	0.0000	814.01	813.92	0.09
			2	43000	0.2000	0.0908			
			3	562000	0.4000	0.0007			
			4	2000000	0.5000	-0.0005			
			5	562000	0.4000	0.0025			
9	466.00	0.00	1	824000	0.4000	0.0000	814.01	813.94	0.07
			2	43000	0.2000	0.0659			
			3	562000	0.4000	-0.0014			
			4	2000000	0.5000	-0.0006			
			5	562000	0.4000	0.0018			
10	468.00	0.00	1	824000	0.4000	0.0000	814.01	813.97	0.04
			2	43000	0.2000	0.0450			
			3	562000	0.4000	-0.0033			
			4	2000000	0.5000	-0.0007			
			5	562000	0.4000	0.0011			

*Note: Final Z is calculated assuming only 'Immediate Settlement' exists.

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Version 2.0 FoSSA Version 2.0

IMMEDIATE SETTLEMENT, Si

Node #	Settlement along section: X [ft.]	Y [ft.]	Layer (k)	Young's Modulus, E [lb/ft ²]	Poisson's Ratio, μ	Settlement of each layer, Si(k) [ft.]	Initial Z [ft.]	Final Z * [ft.]	Total Settlement Sum of Si(k), [ft.]
11	470.00	0.00	1	824000	0.4000	0.0000	814.01	813.99	0.02
			2	43000	0.2000	0.0282			
			3	562000	0.4000	-0.0049			
			4	2000000	0.5000	-0.0008			
			5	562000	0.4000	0.0005			
12	472.00	0.00	1	824000	0.4000	0.0000	814.01	814.00	0.01
			2	43000	0.2000	0.0143			
			3	562000	0.4000	-0.0063			
			4	2000000	0.5000	-0.0009			
			5	562000	0.4000	-0.0001			
13	474.00	0.00	1	824000	0.4000	0.0000	814.01	814.02	-0.01
			2	43000	0.2000	0.0033			
			3	562000	0.4000	-0.0075			
			4	2000000	0.5000	-0.0010			
			5	562000	0.4000	-0.0006			
14	476.00	0.00	1	824000	0.4000	0.0000	814.01	814.03	-0.02
			2	43000	0.2000	-0.0055			
			3	562000	0.4000	-0.0086			
			4	2000000	0.5000	-0.0011			
			5	562000	0.4000	-0.0012			
15	478.00	0.00	1	824000	0.4000	0.0000	814.01	814.03	-0.02
			2	43000	0.2000	-0.0125			
			3	562000	0.4000	-0.0094			
			4	2000000	0.5000	-0.0011			
			5	562000	0.4000	-0.0016			
16	480.00	0.00	1	824000	0.4000	0.0000	814.01	814.04	-0.03
			2	43000	0.2000	-0.0181			
			3	562000	0.4000	-0.0101			
			4	2000000	0.5000	-0.0012			
			5	562000	0.4000	-0.0020			
17	482.00	0.00	1	824000	0.4000	0.0000	814.01	814.05	-0.04
			2	43000	0.2000	-0.0224			
			3	562000	0.4000	-0.0107			
			4	2000000	0.5000	-0.0012			
			5	562000	0.4000	-0.0024			
18	484.00	0.00	1	824000	0.4000	0.0000	814.01	814.05	-0.04
			2	43000	0.2000	-0.0255			
			3	562000	0.4000	-0.0111			
			4	2000000	0.5000	-0.0013			
			5	562000	0.4000	-0.0027			
19	486.00	0.00	1	824000	0.4000	0.0000	814.01	814.05	-0.04
			2	43000	0.2000	-0.0282			
			3	562000	0.4000	-0.0114			
			4	2000000	0.5000	-0.0013			
			5	562000	0.4000	-0.0030			
20	488.00	0.00	1	824000	0.4000	0.0000	814.01	814.06	-0.05
			2	43000	0.2000	-0.0302			
			3	562000	0.4000	-0.0117			
			4	2000000	0.5000	-0.0013			
			5	562000	0.4000	-0.0032			

*Note: Final Z is calculated assuming only 'Immediate Settlement' exists.

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IMMEDIATE SETTLEMENT, Si

Node #	Settlement along section: X [ft.]	Y [ft.]	Layer (k)	Young's Modulus, E [lb/ft ²]	Poisson's Ratio, μ	Settlement of each layer, Si(k) [ft.]	Initial Z [ft.]	Final Z * [ft.]	Total Settlement Sum of Si(k), [ft.]
21	490.00	0.00	1	824000	0.4000	0.0000	814.01	814.06	-0.05
			2	43000	0.2000	-0.0316			
			3	562000	0.4000	-0.0119			
			4	2000000	0.5000	-0.0014			
			5	562000	0.4000	-0.0034			
22	492.00	0.00	1	824000	0.4000	0.0000	814.01	814.06	-0.05
			2	43000	0.2000	-0.0324			
			3	562000	0.4000	-0.0120			
			4	2000000	0.5000	-0.0014			
			5	562000	0.4000	-0.0036			
23	494.00	0.00	1	824000	0.4000	0.0000	814.01	814.06	-0.05
			2	43000	0.2000	-0.0332			
			3	562000	0.4000	-0.0121			
			4	2000000	0.5000	-0.0014			
			5	562000	0.4000	-0.0038			
24	496.00	0.00	1	824000	0.4000	0.0000	814.01	814.06	-0.05
			2	43000	0.2000	-0.0335			
			3	562000	0.4000	-0.0121			
			4	2000000	0.5000	-0.0014			
			5	562000	0.4000	-0.0039			
25	498.00	0.00	1	824000	0.4000	0.0000	814.01	814.06	-0.05
			2	43000	0.2000	-0.0336			
			3	562000	0.4000	-0.0120			
			4	2000000	0.5000	-0.0014			
			5	562000	0.4000	-0.0040			
26	500.00	0.00	1	824000	0.4000	0.0000	814.01	814.06	-0.05
			2	43000	0.2000	-0.0337			
			3	562000	0.4000	-0.0120			
			4	2000000	0.5000	-0.0014			
			5	562000	0.4000	-0.0041			

*Note: Final Z is calculated assuming only 'Immediate Settlement' exists.

ULTIMATE SETTLEMENT, Sc

Node #	X [ft.]	Y [ft.]	Original Z [ft.]	Settlement Sc [ft.]	Final Z * [ft.]
1	450.00	0.00	814.01	0.03	813.98
2	452.00	0.00	814.01	0.02	813.99
3	454.00	0.00	814.01	0.02	813.99
4	456.00	0.00	814.01	0.02	813.99
5	458.00	0.00	814.01	0.02	813.99
6	460.00	0.00	814.01	0.02	813.99
7	462.00	0.00	814.01	0.02	813.99
8	464.00	0.00	814.01	0.02	813.99
9	466.00	0.00	814.01	0.02	813.99
10	468.00	0.00	814.01	0.02	813.99
11	470.00	0.00	814.01	0.02	813.99
12	472.00	0.00	814.01	0.01	814.00
13	474.00	0.00	814.01	0.01	814.00
14	476.00	0.00	814.01	0.01	814.00
15	478.00	0.00	814.01	0.01	814.00
16	480.00	0.00	814.01	0.01	814.00
17	482.00	0.00	814.01	0.01	814.00
18	484.00	0.00	814.01	0.01	814.00
19	486.00	0.00	814.01	0.01	814.00
20	488.00	0.00	814.01	0.01	814.00
21	490.00	0.00	814.01	0.01	814.00
22	492.00	0.00	814.01	0.01	814.00
23	494.00	0.00	814.01	0.01	814.00
24	496.00	0.00	814.01	0.01	814.00
25	498.00	0.00	814.01	0.01	814.00

*Note: Final Z is calculated assuming only 'Ultimate Settlement' exists.

ULTIMATE SETTLEMENT, Sc

Node #	X [ft.]	Y [ft.]	Original Z [ft.]	Settlement Sc [ft.]	Final Z * [ft.]
26	500.00	0.00	814.01	0.01	814.00

*Note: Final Z is calculated assuming only 'Ultimate Settlement' exists.

TABULATED GEOMETRY: INPUT OF FOUNDATION SOILS

Found. Soil #	Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]	D E S C R I P T I O N
1	1	0.00	832.00	Soil Type 1
	2	37.00	833.00	
	3	50.50	833.00	
	4	52.50	832.00	
	5	58.40	831.00	
	6	61.30	830.00	
	7	63.50	829.00	
	8	99.50	814.01	
	9	161.60	813.01	
	10	293.50	814.01	
	11	450.00	814.01	
	12	500.00	814.01	
2	1	0.00	804.31	Soil Type 2
	2	18.00	804.31	
	3	99.50	814.00	
	4	161.60	813.00	
	5	293.50	814.00	
	6	450.00	814.00	
	7	500.00	814.00	
3	1	0.00	804.30	Soil Type 3
	2	18.00	804.30	
	3	110.90	801.00	
	4	183.50	803.70	
	5	274.40	803.40	
	6	322.40	801.60	
	7	408.50	803.40	
	8	450.00	803.40	
	9	500.00	803.40	
4	1	0.00	799.30	Soil Type 4
	2	18.00	799.30	
	3	183.50	791.20	
	4	322.40	789.10	
	5	450.00	789.10	
	6	500.00	789.10	
5	1	0.00	794.30	Soil Type 3
	2	18.00	794.30	
	3	183.50	787.70	
	4	322.40	785.30	
	5	450.00	785.30	
	6	500.00	785.30	

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Version 2.0 FoSSA Version 2.0

TABULATED GEOMETRY: INPUT OF EMBANKMENT SOILS

Embank. Soil #		Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]	D E S C R I P T I O N
1	X1 = 0.00 [ft]	1	0.00	833.00	Proposed Embankment and MSE Wall Fill
	X2 = 450.01 [ft]	2	37.00	834.00	
		3	100.00	838.30	
		4	200.00	841.90	
		5	300.00	845.60	
		6	400.00	849.20	
		7	450.00	851.00	
		8	450.01	814.01	

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FORWARD ABUTMENT

CUY-14-6.93

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PROJECT IDENTIFICATION

Title: CUY-14-6.93
Project Number: PID 104132 -
Client: AECOM
Designer: KCA
Station Number:

Description:

Settlement analysis for RW-E, RW-G, Temp RW-I

Company's information:

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Original file path and name: C:\Users\karens\Desktop\FA FoSSA2.2ST
Original date and time of creating this file: Thu Dec 16 16:17:56 2021

GEOMETRY: Analysis of a 2D geometry

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INPUT DATA – FOUNDATION LAYERS – 4 layers

	Wet Unit Weight, γ [lb/ft³]	Poisson's Ratio μ	Description of Soil
1	118.00	0.40	Soil Type 1
2	120.00	0.25	Soil Type 2
3	118.00	0.50	Soil Type 1
4	135.00	0.40	Soil Type 3

INPUT DATA – EMBANKMENT LAYERS -- 1 layers

	Wet Unit Weight, γ [lb/ft³]	Description of Soil
1	120.00	Proposed Embankment and MSE Wall Fill

INPUT DATA OF WATER

Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]
1	0.00	816.50
2	600.00	816.50

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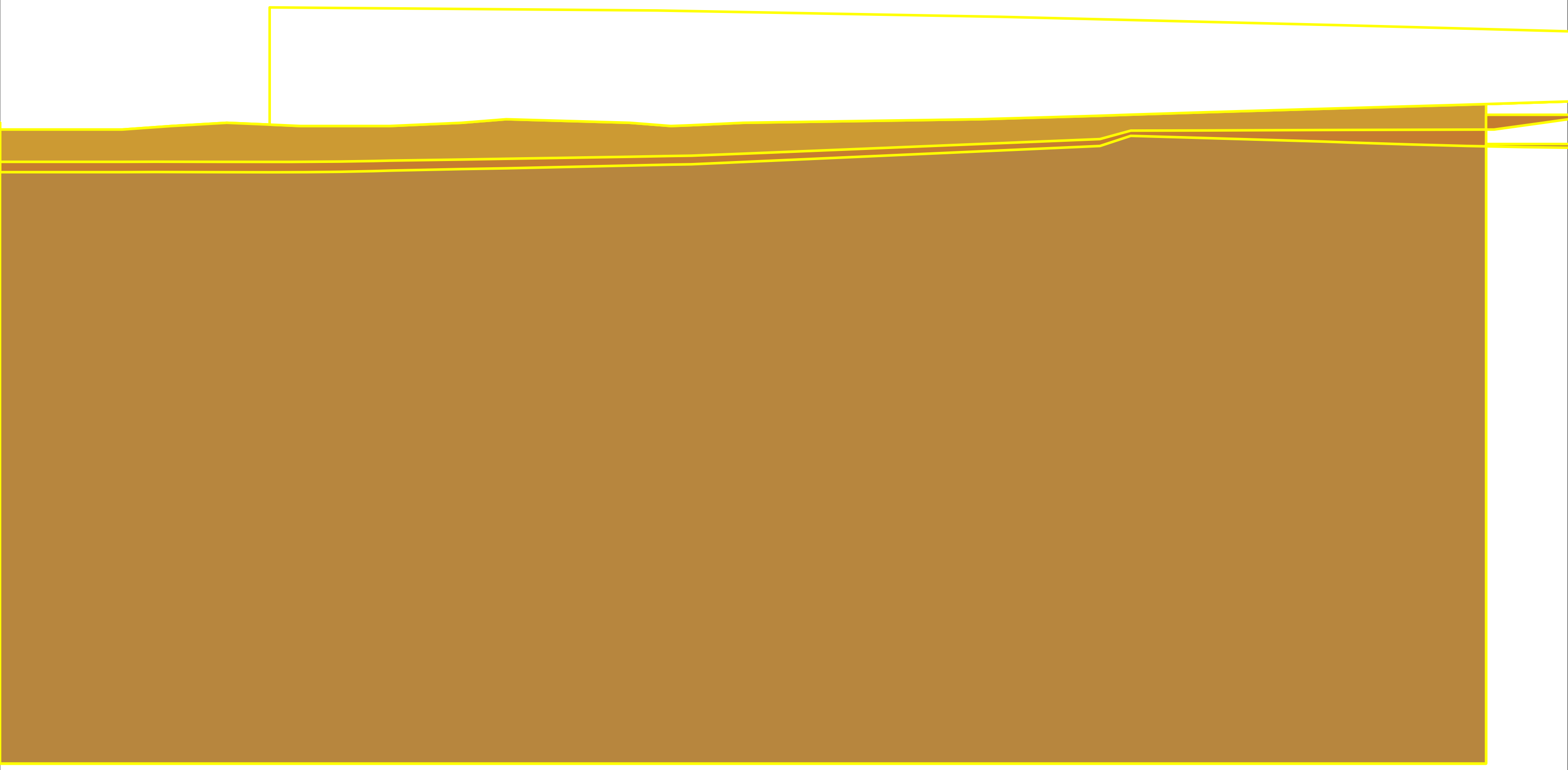
DRAWING OF SPECIFIED GEOMETRY



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INPUT DATA FOR CONSOLIDATION -- $\alpha = 1/2$

Layer #	Underging Consolidation [Yes/No]	OCR = Pc / Po	Cc	Cr	e0	Cv [ft ²/day]	Drains at :
1	Yes	5.00	0.169	0.042	0.816	0.1600	Top & Bot.
2	No	N/A	N/A	N/A	N/A	N/A	N/A
3	Yes	5.00	0.169	0.042	0.816	0.1600	Top & Bot.
4	No	N/A	N/A	N/A	N/A	N/A	N/A

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IMMEDIATE SETTLEMENT, Si

Node #	Settlement along section: X [ft.]	Y [ft.]	Layer (k)	Young's Modulus, E [lb/ft ²]	Poisson's Ratio, μ	Settlement of each layer, Si(k) [ft.]	Initial Z [ft.]	Final Z * [ft.]	Total Settlement Sum of Si(k), [ft.]
1	37.00	0.00	1	586000	0.4000	0.0000	822.01	822.03	-0.02
			2	106000	0.2500	-0.0034			
			3	586000	0.5000	-0.0015			
			4	990000	0.4000	-0.0201			
2	39.00	0.00	1	586000	0.4000	0.0000	822.01	822.04	-0.03
			2	106000	0.2500	-0.0036			
			3	586000	0.5000	-0.0016			
			4	990000	0.4000	-0.0201			
3	41.00	0.00	1	586000	0.4000	0.0000	822.01	822.04	-0.03
			2	106000	0.2500	-0.0039			
			3	586000	0.5000	-0.0017			
			4	990000	0.4000	-0.0201			
4	43.00	0.00	1	586000	0.4000	0.0000	822.01	822.04	-0.03
			2	106000	0.2500	-0.0042			
			3	586000	0.5000	-0.0018			
			4	990000	0.4000	-0.0200			
5	45.00	0.00	1	586000	0.4000	0.0000	822.08	822.11	-0.03
			2	106000	0.2500	-0.0044			
			3	586000	0.5000	-0.0019			
			4	990000	0.4000	-0.0198			
6	47.00	0.00	1	586000	0.4000	0.0000	822.22	822.24	-0.03
			2	106000	0.2500	-0.0050			
			3	586000	0.5000	-0.0020			
			4	990000	0.4000	-0.0196			
7	49.00	0.00	1	586000	0.4000	0.0000	822.35	822.38	-0.03
			2	106000	0.2500	-0.0052			
			3	586000	0.5000	-0.0022			
			4	990000	0.4000	-0.0193			
8	51.00	0.00	1	586000	0.4000	0.0000	822.49	822.52	-0.03
			2	106000	0.2500	-0.0059			
			3	586000	0.5000	-0.0023			
			4	990000	0.4000	-0.0189			
9	53.00	0.00	1	586000	0.4000	0.0000	822.63	822.66	-0.03
			2	106000	0.2500	-0.0061			
			3	586000	0.5000	-0.0024			
			4	990000	0.4000	-0.0184			
10	55.00	0.00	1	586000	0.4000	0.0000	822.77	822.80	-0.03
			2	106000	0.2500	-0.0065			
			3	586000	0.5000	-0.0026			
			4	990000	0.4000	-0.0177			
11	57.00	0.00	1	586000	0.4000	0.0000	822.91	822.93	-0.03
			2	106000	0.2500	-0.0073			
			3	586000	0.5000	-0.0027			
			4	990000	0.4000	-0.0169			
12	59.00	0.00	1	586000	0.4000	0.0000	823.04	823.07	-0.03
			2	106000	0.2500	-0.0077			
			3	586000	0.5000	-0.0029			
			4	990000	0.4000	-0.0159			

*Note: Final Z is calculated assuming only 'Immediate Settlement' exists.

IMMEDIATE SETTLEMENT, Si

Node #	Settlement along section: X [ft.]	Y [ft.]	Layer (k)	Young's Modulus, E [lb/ft ²]	Poisson's Ratio, μ	Settlement of each layer, Si(k) [ft.]	Initial Z [ft.]	Final Z * [ft.]	Total Settlement Sum of Si(k), [ft.]
13	61.00	0.00	1	586000	0.4000	0.0000	823.17	823.19	-0.03
			2	106000	0.2500	-0.0088			
			3	586000	0.5000	-0.0031			
			4	990000	0.4000	-0.0147			
14	63.00	0.00	1	586000	0.4000	0.0000	823.29	823.32	-0.03
			2	106000	0.2500	-0.0093			
			3	586000	0.5000	-0.0033			
			4	990000	0.4000	-0.0132			
15	65.00	0.00	1	586000	0.4000	0.0000	823.42	823.44	-0.02
			2	106000	0.2500	-0.0099			
			3	586000	0.5000	-0.0035			
			4	990000	0.4000	-0.0115			
16	67.00	0.00	1	586000	0.4000	0.0000	823.54	823.57	-0.02
			2	106000	0.2500	-0.0113			
			3	586000	0.5000	-0.0037			
			4	990000	0.4000	-0.0095			
17	69.00	0.00	1	586000	0.4000	0.0000	823.67	823.69	-0.02
			2	106000	0.2500	-0.0120			
			3	586000	0.5000	-0.0040			
			4	990000	0.4000	-0.0071			
18	71.00	0.00	1	586000	0.4000	0.0000	823.79	823.81	-0.02
			2	106000	0.2500	-0.0134			
			3	586000	0.5000	-0.0042			
			4	990000	0.4000	-0.0043			
19	73.00	0.00	1	586000	0.4000	0.0000	823.92	823.94	-0.02
			2	106000	0.2500	-0.0140			
			3	586000	0.5000	-0.0043			
			4	990000	0.4000	-0.0011			
20	75.00	0.00	1	586000	0.4000	0.0000	823.99	824.00	-0.02
			2	106000	0.2500	-0.0145			
			3	586000	0.5000	-0.0044			
			4	990000	0.4000	0.0027			
21	77.00	0.00	1	586000	0.4000	0.0000	823.89	823.91	-0.01
			2	106000	0.2500	-0.0145			
			3	586000	0.5000	-0.0043			
			4	990000	0.4000	0.0070			
22	79.00	0.00	1	586000	0.4000	0.0000	823.80	823.81	-0.00
			2	106000	0.2500	-0.0126			
			3	586000	0.5000	-0.0040			
			4	990000	0.4000	0.0119			
23	81.00	0.00	1	586000	0.4000	0.0000	823.71	823.70	0.01
			2	106000	0.2500	-0.0073			
			3	586000	0.5000	-0.0034			
			4	990000	0.4000	0.0175			
24	83.00	0.00	1	586000	0.4000	0.0000	823.62	823.59	0.03
			2	106000	0.2500	0.0060			
			3	586000	0.5000	-0.0023			
			4	990000	0.4000	0.0237			

*Note: Final Z is calculated assuming only 'Immediate Settlement' exists.

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IMMEDIATE SETTLEMENT, Si

Node #	Settlement along section: X [ft.]	Y [ft.]	Layer (k)	Young's Modulus, E [lb/ft ²]	Poisson's Ratio, μ	Settlement of each layer, Si(k) [ft.]	Initial Z [ft.]	Final Z * [ft.]	Total Settlement Sum of Si(k), [ft.]
25	85.00	0.00	1	586000	0.4000	0.0000	823.52	823.46	0.07
			2	106000	0.2500	0.0371			
			3	586000	0.5000	-0.0008			
			4	990000	0.4000	0.0303			
26	87.00	0.00	1	586000	0.4000	0.0000	823.43	823.25	0.18
			2	106000	0.2500	0.1375			
			3	586000	0.5000	0.0010			
			4	990000	0.4000	0.0372			

*Note: Final Z is calculated assuming only 'Immediate Settlement' exists.

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ULTIMATE SETTLEMENT, Sc

Node #	X [ft.]	Y [ft.]	Original Z [ft.]	Settlement Sc [ft.]	Final Z * [ft.]
1	37.00	0.00	822.01	0.00	822.01
2	39.00	0.00	822.01	0.00	822.01
3	41.00	0.00	822.01	0.00	822.01
4	43.00	0.00	822.01	0.00	822.01
5	45.00	0.00	822.08	0.00	822.08
6	47.00	0.00	822.22	0.00	822.22
7	49.00	0.00	822.35	0.00	822.35
8	51.00	0.00	822.49	0.00	822.49
9	53.00	0.00	822.63	0.00	822.63
10	55.00	0.00	822.77	0.00	822.77
11	57.00	0.00	822.91	0.00	822.91
12	59.00	0.00	823.04	0.00	823.04
13	61.00	0.00	823.17	0.00	823.16
14	63.00	0.00	823.29	0.00	823.29
15	65.00	0.00	823.42	0.00	823.41
16	67.00	0.00	823.54	0.00	823.54
17	69.00	0.00	823.67	0.00	823.66
18	71.00	0.00	823.79	0.00	823.79
19	73.00	0.00	823.92	0.01	823.91
20	75.00	0.00	823.99	0.01	823.98
21	77.00	0.00	823.89	0.01	823.88
22	79.00	0.00	823.80	0.01	823.79
23	81.00	0.00	823.71	0.02	823.69
24	83.00	0.00	823.62	0.02	823.59
25	85.00	0.00	823.52	0.03	823.50

*Note: Final Z is calculated assuming only 'Ultimate Settlement' exists.

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ULTIMATE SETTLEMENT, Sc

Node #	X [ft.]	Y [ft.]	Original Z [ft.]	Settlement Sc [ft.]	Final Z * [ft.]
26	87.00	0.00	823.43	0.03	823.40

*Note: Final Z is calculated assuming only 'Ultimate Settlement' exists.

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TABULATED GEOMETRY: INPUT OF FOUNDATION SOILS

Found. Soil #	Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]	DESCRIPTION
1	1	0.00	821.01	Soil Type 1
	2	5.00	822.01	
	3	44.00	822.01	
	4	58.50	823.01	
	5	74.50	824.01	
	6	86.99	823.43	
	7	96.00	823.01	
	8	122.00	823.01	
	9	143.00	824.01	
	10	156.00	825.01	
	11	192.00	824.01	
	12	204.00	823.01	
	13	225.00	824.01	
	14	294.00	825.01	
	15	328.00	826.01	
	16	358.00	827.01	
	17	394.00	828.01	
	18	429.00	829.01	
	19	458.00	830.01	
	20	490.00	831.01	
	21	510.00	832.01	
	22	518.00	833.01	
	23	523.00	834.01	
	24	528.00	835.01	
	25	533.00	836.01	
	26	538.00	837.01	
	27	543.00	838.01	
	28	546.00	839.01	
	29	548.00	840.01	
	30	550.50	841.01	
	31	552.50	842.01	
	32	554.50	843.01	
	33	557.00	844.01	
	34	559.50	845.01	
	35	562.50	846.01	
	36	565.50	847.01	
	37	578.00	848.01	
	38	593.00	847.01	
	39	600.00	846.81	

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TABULATED GEOMETRY: INPUT OF FOUNDATION SOILS

Found. Soil #	Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]	DESCRIPTION
2	1	0.00	821.01	Soil Type 2
	2	5.00	822.01	
	3	44.00	822.01	
	4	58.50	823.01	
	5	74.50	824.01	
	6	96.00	823.01	
	7	122.00	823.01	
	8	143.00	824.01	
	9	156.00	825.01	
	10	192.00	824.01	
	11	204.00	823.01	
	12	225.00	824.01	
	13	294.00	825.01	
	14	328.00	826.01	
	15	358.00	827.01	
	16	394.00	828.01	
	17	429.00	829.01	
	18	458.00	830.01	
	19	490.00	831.01	
	20	510.00	832.01	
	21	518.00	833.01	
	22	522.50	833.80	
	23	600.00	833.80	
3	1	0.00	812.60	Soil Type 1
	2	102.20	812.60	
	3	209.90	814.40	
	4	329.10	819.20	
	5	338.10	821.70	
	6	444.00	822.00	
	7	497.70	829.50	
	8	600.00	826.30	
4	1	0.00	809.60	Soil Type 3
	2	102.20	809.60	
	3	209.90	811.90	
	4	329.10	817.20	
	5	338.10	820.20	
	6	444.00	817.00	
	7	497.70	816.50	
	8	600.00	817.80	

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TABULATED GEOMETRY: INPUT OF EMBANKMENT SOILS

Embank. Soil #		Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]	DESCRIPTION
1	X1 = 86.99 [ft]	1	86.99	823.43	Proposed Embankment and MSE Wall Fill
	X2 = 593.00 [ft]	2	87.00	857.60	
		3	200.00	856.70	
		4	300.00	854.90	
		5	400.00	852.40	
		6	500.00	849.70	
		7	593.00	847.00	

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APPENDIX F

CULVERT BEARING RESISTANCE ANALYSIS

Objective: **To evaluate the bearing resistance of shallow foundation on level soil.**
Method: **In accordance with ODOT Bridge Design Manual, 2017 [Sect. 204.6.2.2] LRFD Bridge Design Specifications, 7th Ed., 2017, [Sect. 11.6.1, Sect. 11.6.2, and Sect. 11.6.3].**

Givens:

Soil Design Parameters (Average Below Footing):

Drained Conditions (Effective Stress):

$\phi'_{fd} := 26\ deg$ — Effective angle of internal friction

$\gamma_{fd} := 135\ \frac{lbf}{ft^3}$ — Unit weight

$c'_{fd} := 400\ \frac{lbf}{ft^2}$ — Effective Cohesion

Undrained Conditions (Total Stress):

$\phi_{fdu} := 0\ deg$ — Angle of internal friction (Same as Drained Conditions if Sand)

$Su_{fdu} := 5500\ \frac{lbf}{ft^2}$ — Undrained Shear Strength

Footing Geometry:

$D_f := 10.5\ ft$ — Footing cover at Toe
Note: Unless on rock, top of footing should be at least 1-ft from soil surface and bottom of footing at least 5-ft from nearest soil surface per BDM 202.2.3.1a

$B := 26\ ft$ — Footing base width

$B' := 26\ ft$ — Footing effective base width

$L' := 170\ ft$ — Footing effective length (assumed to equal actual length)

$d_w := 10\ ft$ — Depth of groundwater below ground surface

Compute Bearing Resistance:

Drained Conditions (Effective Stress):

$$N_q := \text{if}\left(\phi'_{fd} > 0\,,\, e^{\pi \cdot \tan(\phi'_{fd})} \cdot \tan\left(45\ \textit{deg} + \frac{\phi'_{fd}}{2}\right)^2\,,\, 1.0\right) \qquad N_q = 11.85$$

$$N_c := \text{if}\left(\phi'_{fd} > 0\,,\, \frac{N_q - 1}{\tan(\phi'_{fd})}\,,\, 5.14\right) \qquad N_c = 22.25$$

$$N_\gamma := 2 \cdot (N_q + 1) \cdot \tan(\phi'_{fd}) \qquad N_\gamma = 12.5$$

Compute shape correction factors per **LRFD [Table 10.6.3.1.2a-3]**:

$$s_c := \text{if}\left(\phi'_{fd} > 0\,,\, 1 + \left(\frac{B'}{L'}\right) \cdot \left(\frac{N_q}{N_c}\right)\,,\, 1 + \left(\frac{B'}{5 \cdot L'}\right)\right) \qquad s_c = 1.081$$

$$s_q := \text{if}\left(\phi'_{fd} > 0\,,\, 1 + \left(\frac{B'}{L'} \cdot \tan(\phi'_{fd})\right)\,,\, 1\right) \qquad s_q = 1.075$$

$$s_\gamma := \text{if}\left(\phi'_{fd} > 0\,,\, 1 - 0.4 \cdot \left(\frac{B'}{L'}\right)\,,\, 1\right) \qquad s_\gamma = 0.939$$

Compute groundwater depth correction factors per **LRFD [Table 10.6.3.1.2a-2]**:

$$C_{wq} := \text{if}\left(d_w \geq D_f\,,\, 1.0\,,\, 0.5\right) \qquad C_{wq} = 0.5$$

$$C_{w\gamma} := \text{if}\left(d_w \geq (1.5 \cdot B) + D_f\,,\, 1.0\,,\, 0.5\right) \qquad C_{w\gamma} = 0.5$$

Depth Correction Factor per **Hanson (1970):**

$$d_q := \text{if}\left(\frac{D_f}{B'} \leq 1\,,\, 1 + 2 \cdot \tan(\phi'_{fd}) \cdot (1 - \sin(\phi'_{fd}))^2 \cdot \frac{D_f}{B'}\,,\, 1 + 2 \cdot \tan(\phi'_{fd}) \cdot (1 - \sin(\phi'_{fd}))^2 \cdot \text{atan}\left(\frac{D_f}{B'}\right)\right)$$

$$d_q = 1.1$$

Compute modified bearing capacity factors **LRFD [Equation 10.6.3.1.2a-2 to 10.6.3.1.2a-4]:**

$$N_{cm} := N_c \cdot s_c \qquad N_{cm} = 24.067$$

$$N_{qm} := N_q \cdot s_q \cdot d_q \qquad N_{qm} = 14.321$$

$$N_{\gamma m} := N_\gamma \cdot s_\gamma \qquad N_{\gamma m} = 11.772$$

Compute nominal bearing resistance, **LRFD [Eq 10.6.3.1.2a-1]:**

$$q_{nd} := c'_{fd} \cdot N_{cm} + \gamma_{fd} \cdot D_f \cdot N_{qm} \cdot d_q \cdot C_{wq} + 0.5 \cdot \gamma_{fd} \cdot B' \cdot N_{\gamma m} \cdot C_{w\gamma} \qquad q_{nd} = 31368.2\ \frac{\textit{lbf}}{\textit{ft}^2}$$

Compute factored bearing resistance, **LRFD [Eq 10.6.3.1.1]:**

$\phi_b := 0.55$ Bearing resistance factor **LRFD Table 11.5.7-1.**

$q_{Rd} := \phi_b \cdot q_{nd}$ $q_{Rd} = 17.3\ \textit{ksf}$ Factored bearing resistance Drained Conditions

Undrained Conditions (Effective Stress):

$N_q := \text{if}\left(\phi_{fdu} > 0\,,\, e^{\pi \cdot \tan(\phi_{fdu})} \cdot \tan\left(45\ \textit{deg} + \frac{\phi_{fdu}}{2}\right)^2\,,\, 1.0\right)$ $N_q = 1$

$N_c := \text{if}\left(\phi_{fdu} > 0\,,\, \frac{N_q - 1}{\tan(\phi_{fdu})}\,,\, 5.14\right)$ $N_c = 5.14$

$N_\gamma := 2 \cdot (N_q + 1) \cdot \tan(\phi_{fdu})$ $N_\gamma = 0$

Compute shape correction factors per **LRFD [Table 10.6.3.1.2a-3]**:

$s_c := \text{if}\left(\phi_{fdu} > 0\,,\, 1 + \left(\frac{B'}{L'}\right) \cdot \left(\frac{N_q}{N_c}\right)\,,\, 1 + \left(\frac{B'}{5 \cdot L'}\right)\right)$ $s_c = 1.031$

$s_q := \text{if}\left(\phi_{fdu} > 0\,,\, 1 + \left(\frac{B'}{L'} \cdot \tan(\phi_{fdu})\right)\,,\, 1\right)$ $s_q = 1$

$s_\gamma := \text{if}\left(\phi_{fdu} > 0\,,\, 1 - 0.4 \cdot \left(\frac{B'}{L'}\right)\,,\, 1\right)$ $s_\gamma = 1$

Depth Correction Factor per **Hanson (1970):**

$d_q := \text{if}\left(\frac{D_f}{B'} \le 1\,,\, 1 + 2 \cdot \tan(\phi_{fdu}) \cdot (1 - \sin(\phi_{fdu}))^2 \cdot \frac{D_f}{B'}\,,\, 1 + 2 \cdot \tan(\phi_{fdu}) \cdot (1 - \sin(\phi_{fdu}))^2 \cdot \text{atan}\left(\frac{D_f}{B'}\right)\right)$

$d_q = 1$

Compute modified bearing capacity factors **LRFD [Equation 10.6.3.1.2a-2 to 10.6.3.1.2a-4]:**

$N_{cm} := N_c \cdot s_c$ $N_{cm} = 5.297$

$N_{qm} := N_q \cdot s_q \cdot d_q$ $N_{qm} = 1$

$N_{\gamma m} := N_\gamma \cdot s_\gamma$ $N_{\gamma m} = 0$

Compute nominal bearing resistance, **LRFD [Eq 10.6.3.1.2a-1:**

$q_{nu} := Su_{fdu} \cdot N_{cm} + \gamma_{fd} \cdot D_f \cdot N_{qm} \cdot d_q \cdot C_{wq} + 0.5 \cdot \gamma_{fd} \cdot B' \cdot N_{\gamma m} \cdot C_{w\gamma}$ $q_{nu} = 29843.5\ \frac{\textit{lbf}}{\textit{ft}^2}$

Compute factored bearing resistance, **LRFD [Eq 10.6.3.1.1]:**

$\phi_b := 0.55$ Bearing resistance factor **LRFD Table 11.5.7-1.**

$q_{Ru} := \phi_b \cdot q_{nu}$ $q_{Ru} = 16.4\ \textit{ksf}$ Factored bearing resistance Undrained Conditions

Factored Bearing Resistance Drained vs. Undrained Conditions:

Drained Conditions: $q_{Rd} = 17.3\ \textit{ksf}$

Undrained Conditions: $q_{Ru} = 16.4\ \textit{ksf}$

Objective: **To evaluate the bearing resistance of shallow foundation on level soil.**
Method: **In accordance with ODOT Bridge Design Manual, 2017 [Sect. 204.6.2.2] LRFD Bridge Design Specifications, 7th Ed., 2017, [Sect. 11.6.1, Sect. 11.6.2, and Sect. 11.6.3].**

Givens:

Soil Design Parameters (Average Below Footing):

Drained Conditions (Effective Stress):

$\phi'_{fd} := 35\ deg$ — Effective angle of internal friction

$\gamma_{fd} := 125\ \frac{lbf}{ft^3}$ — Unit weight

$c'_{fd} := 0\ \frac{lbf}{ft^2}$ — Effective Cohesion

Undrained Conditions (Total Stress):

$\phi_{fdu} := 35\ deg$ — Angle of internal friction (Same as Drained Conditions if Sand)

$Su_{fdu} := 0\ \frac{lbf}{ft^2}$ — Undrained Shear Strength

Footing Geometry:

$D_f := 10.5\ ft$ — Footing cover at Toe
Note: Unless on rock, top of footing should be at least 1-ft from soil surface and bottom of footing at least 5-ft from nearest soil surface per BDM 202.2.3.1a

$B := 26\ ft$ — Footing base width

$B' := 26\ ft$ — Footing effective base width

$L' := 170\ ft$ — Footing effective length (assumed to equal actual length)

$d_w := 10\ ft$ — Depth of groundwater below ground surface

Compute Bearing Resistance:

Drained Conditions (Effective Stress):

$$N_q := \text{if}\left(\phi'_{fd} > 0\,,\, e^{\pi \cdot \tan(\phi'_{fd})} \cdot \tan\left(45\ \textit{deg} + \frac{\phi'_{fd}}{2}\right)^2\,,\, 1.0\right) \qquad N_q = 33.3$$

$$N_c := \text{if}\left(\phi'_{fd} > 0\,,\, \frac{N_q - 1}{\tan(\phi'_{fd})}\,,\, 5.14\right) \qquad N_c = 46.12$$

$$N_\gamma := 2 \cdot (N_q + 1) \cdot \tan(\phi'_{fd}) \qquad N_\gamma = 48$$

Compute shape correction factors per **LRFD [Table 10.6.3.1.2a-3]**:

$$s_c := \text{if}\left(\phi'_{fd} > 0\,,\, 1 + \left(\frac{B'}{L'}\right) \cdot \left(\frac{N_q}{N_c}\right)\,,\, 1 + \left(\frac{B'}{5 \cdot L'}\right)\right) \qquad s_c = 1.11$$

$$s_q := \text{if}\left(\phi'_{fd} > 0\,,\, 1 + \left(\frac{B'}{L'} \cdot \tan(\phi'_{fd})\right)\,,\, 1\right) \qquad s_q = 1.107$$

$$s_\gamma := \text{if}\left(\phi'_{fd} > 0\,,\, 1 - 0.4 \cdot \left(\frac{B'}{L'}\right)\,,\, 1\right) \qquad s_\gamma = 0.939$$

Compute groundwater depth correction factors per **LRFD [Table 10.6.3.1.2a-2]**:

$$C_{wq} := \text{if}\left(d_w \geq D_f\,,\, 1.0\,,\, 0.5\right) \qquad C_{wq} = 0.5$$

$$C_{w\gamma} := \text{if}\left(d_w \geq (1.5 \cdot B) + D_f\,,\, 1.0\,,\, 0.5\right) \qquad C_{w\gamma} = 0.5$$

Depth Correction Factor per **Hanson (1970):**

$$d_q := \text{if}\left(\frac{D_f}{B'} \leq 1\,,\, 1 + 2 \cdot \tan(\phi'_{fd}) \cdot (1 - \sin(\phi'_{fd}))^2 \cdot \frac{D_f}{B'}\,,\, 1 + 2 \cdot \tan(\phi'_{fd}) \cdot (1 - \sin(\phi'_{fd}))^2 \cdot \text{atan}\left(\frac{D_f}{B'}\right)\right)$$

$$d_q = 1.1$$

Compute modified bearing capacity factors **LRFD [Equation 10.6.3.1.2a-2 to 10.6.3.1.2a-4]:**

$$N_{cm} := N_c \cdot s_c \qquad N_{cm} = 51.216$$

$$N_{qm} := N_q \cdot s_q \cdot d_q \qquad N_{qm} = 40.653$$

$$N_{\gamma m} := N_\gamma \cdot s_\gamma \qquad N_{\gamma m} = 45.091$$

Compute nominal bearing resistance, **LRFD [Eq 10.6.3.1.2a-1]:**

$$q_{nd} := c'_{fd} \cdot N_{cm} + \gamma_{fd} \cdot D_f \cdot N_{qm} \cdot d_q \cdot C_{wq} + 0.5 \cdot \gamma_{fd} \cdot B' \cdot N_{\gamma m} \cdot C_{w\gamma} \qquad q_{nd} = 66057.9\ \frac{\textit{lbf}}{\textit{ft}^2}$$

Compute factored bearing resistance, **LRFD [Eq 10.6.3.1.1]:**

$\phi_b := 0.55$ Bearing resistance factor **LRFD Table 11.5.7-1.**

$q_{Rd} := \phi_b \cdot q_{nd}$ $\quad q_{Rd} = 36.3\ \textit{ksf}$ Factored bearing resistance Drained Conditions

Undrained Conditions (Effective Stress):

$$N_q := \text{if}\left(\phi_{fdu} > 0\,,\, e^{\pi \cdot \tan(\phi_{fdu})} \cdot \tan\left(45\ \textit{deg} + \frac{\phi_{fdu}}{2}\right)^2\,,\, 1.0\right) \qquad N_q = 33.3$$

$$N_c := \text{if}\left(\phi_{fdu} > 0\,,\, \frac{N_q - 1}{\tan(\phi_{fdu})}\,,\, 5.14\right) \qquad N_c = 46.12$$

$$N_\gamma := 2 \cdot (N_q + 1) \cdot \tan(\phi_{fdu}) \qquad N_\gamma = 48$$

Compute shape correction factors per **LRFD [Table 10.6.3.1.2a-3]**:

$$s_c := \text{if}\left(\phi_{fdu} > 0\,,\, 1 + \left(\frac{B'}{L'}\right) \cdot \left(\frac{N_q}{N_c}\right)\,,\, 1 + \left(\frac{B'}{5 \cdot L'}\right)\right) \qquad s_c = 1.11$$

$$s_q := \text{if}\left(\phi_{fdu} > 0\,,\, 1 + \left(\frac{B'}{L'} \cdot \tan(\phi_{fdu})\right)\,,\, 1\right) \qquad s_q = 1.107$$

$$s_\gamma := \text{if}\left(\phi_{fdu} > 0\,,\, 1 - 0.4 \cdot \left(\frac{B'}{L'}\right)\,,\, 1\right) \qquad s_\gamma = 0.939$$

Depth Correction Factor per **Hanson (1970):**

$$d_q := \text{if}\left(\frac{D_f}{B'} \le 1\,,\, 1 + 2 \cdot \tan(\phi_{fdu}) \cdot (1 - \sin(\phi_{fdu}))^2 \cdot \frac{D_f}{B'}\,,\, 1 + 2 \cdot \tan(\phi_{fdu}) \cdot (1 - \sin(\phi_{fdu}))^2 \cdot \text{atan}\left(\frac{D_f}{B'}\right)\right)$$

$$d_q = 1.1$$

Compute modified bearing capacity factors **LRFD [Equation 10.6.3.1.2a-2 to 10.6.3.1.2a-4]:**

$$N_{cm} := N_c \cdot s_c \qquad N_{cm} = 51.216$$

$$N_{qm} := N_q \cdot s_q \cdot d_q \qquad N_{qm} = 40.653$$

$$N_{\gamma m} := N_\gamma \cdot s_\gamma \qquad N_{\gamma m} = 45.091$$

Compute nominal bearing resistance, **LRFD [Eq 10.6.3.1.2a-1:**

$$q_{nu} := Su_{fdu} \cdot N_{cm} + \gamma_{fd} \cdot D_f \cdot N_{qm} \cdot d_q \cdot C_{wq} + 0.5 \cdot \gamma_{fd} \cdot B' \cdot N_{\gamma m} \cdot C_{w\gamma} \qquad q_{nu} = 66057.9\ \frac{\textit{lbf}}{\textit{ft}^2}$$

Compute factored bearing resistance, **LRFD [Eq 10.6.3.1.1]:**

$\phi_b := 0.55$ Bearing resistance factor **LRFD Table 11.5.7-1.**

$q_{Ru} := \phi_b \cdot q_{nu}$ $q_{Ru} = 36.3\ \textit{ksf}$ Factored bearing resistance Undrained Conditions

Factored Bearing Resistance Drained vs. Undrained Conditions:

Drained Conditions: $q_{Rd} = 36.3\ \textit{ksf}$

Undrained Conditions: $q_{Ru} = 36.3\ \textit{ksf}$

APPENDIX G

CULVERT SETTLEMENT ANALYSIS

PROJECT IDENTIFICATION

Title:
Project Number: -
Client:
Designer:
Station Number:

Description:

Company's information:

Name:
Street:
,
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Users\k ..... ects\CUY-14-6.93\FOSSA_CulvertSettlement011323.2ST
Original date and time of creating this file:

GEOMETRY: Analysis of a 2D geometry

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INPUT DATA – FOUNDATION LAYERS – 4 layers

	Wet Unit Weight, γ [lb/ft³]	**Poisson's Ratio μ**	**Description of Soil**
1	110.00	0.20	Layer 1
2	125.00	0.50	Layer 2
3	140.00	0.40	Layer 3
4	150.00	0.20	Termination Layer

INPUT DATA – EMBANKMENT LAYERS -- 1 layers

	Wet Unit Weight, γ [lb/ft³]	**Description of Soil**
1	120.00	Proposed Embankment

INPUT DATA OF WATER

Point #	**Coordinates (X, Z) :**	
	(X) [ft.]	**(Z) [ft.]**
1	-150.00	806.20
2	150.00	806.20

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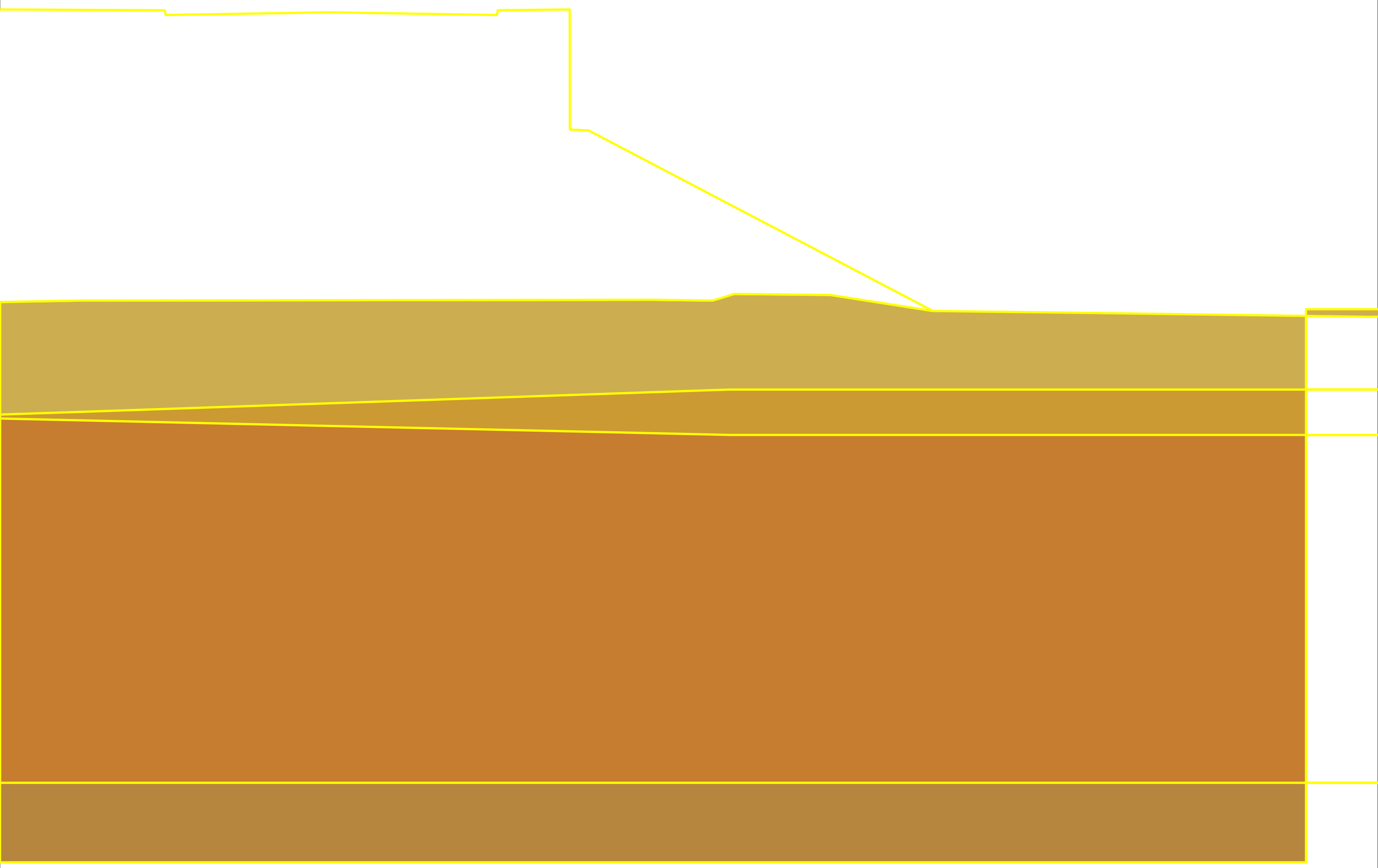
DRAWING OF SPECIFIED GEOMETRY



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INPUT DATA FOR CONSOLIDATION –– $\alpha = 1/2$

Layer #	Underging Consolidation [Yes/No]	OCR = Pc / Po	Cc	Cr	e0	Cv [ft ²/day]	Drains at :
1	No	N/A	N/A	N/A	N/A	N/A	N/A
2	Yes	20.00	0.150	0.030	0.719	0.2500	Top & Bot.
3	No	N/A	N/A	N/A	N/A	N/A	N/A
4	No	N/A	N/A	N/A	N/A	N/A	N/A

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IMMEDIATE SETTLEMENT, Si

Node #	Settlement along section: X [ft.]	Y [ft.]	Layer (k)	Young's Modulus, E [lb/ft ²]	Poisson's Ratio, μ	Settlement of each layer, Si(k) [ft.]	Initial Z [ft.]	Final Z * [ft.]	Total Settlement Sum of Si(k), [ft.]
1	-100.00	0.00	1	81000	0.2000	-0.0041	818.83	818.83	-0.01
			2	2000000	0.5000	0.0000			
			3	4000000	0.4000	-0.0010			
			4	1000000000(	0.2000	0.0000			
2	-95.00	0.00	1	81000	0.2000	0.0116	818.48	818.47	0.01
			2	2000000	0.5000	0.0000			
			3	4000000	0.4000	-0.0001			
			4	1000000000(	0.2000	0.0000			
3	-90.00	0.00	1	81000	0.2000	0.0448	818.18	818.13	0.05
			2	2000000	0.5000	0.0000			
			3	4000000	0.4000	0.0011			
			4	1000000000(	0.2000	0.0000			
4	-85.00	0.00	1	81000	0.2000	0.0804	817.91	817.82	0.08
			2	2000000	0.5000	0.0000			
			3	4000000	0.4000	0.0025			
			4	1000000000(	0.2000	0.0000			
5	-80.00	0.00	1	81000	0.2000	0.1131	818.00	817.88	0.12
			2	2000000	0.5000	0.0000			
			3	4000000	0.4000	0.0041			
			4	1000000000(	0.2000	0.0000			
6	-75.00	0.00	1	81000	0.2000	0.1453	818.09	817.94	0.15
			2	2000000	0.5000	0.0000			
			3	4000000	0.4000	0.0057			
			4	1000000000(	0.2000	0.0000			
7	-70.00	0.00	1	81000	0.2000	0.1823	818.19	818.00	0.19
			2	2000000	0.5000	0.0000			
			3	4000000	0.4000	0.0074			
			4	1000000000(	0.2000	0.0000			
8	-65.00	0.00	1	81000	0.2000	0.2150	818.28	818.06	0.22
			2	2000000	0.5000	0.0000			
			3	4000000	0.4000	0.0091			
			4	1000000000(	0.2000	0.0000			
9	-60.00	0.00	1	81000	0.2000	0.2478	818.38	818.12	0.26
			2	2000000	0.5000	0.0000			
			3	4000000	0.4000	0.0108			
			4	1000000000(	0.2000	0.0000			
10	-55.00	0.00	1	81000	0.2000	0.2805	818.47	818.18	0.29
			2	2000000	0.5000	0.0000			
			3	4000000	0.4000	0.0125			
			4	1000000000(	0.2000	0.0000			
11	-50.00	0.00	1	81000	0.2000	0.3209	818.56	818.23	0.33
			2	2000000	0.5000	0.0000			
			3	4000000	0.4000	0.0141			
			4	1000000000(	0.2000	0.0000			
12	-45.00	0.00	1	81000	0.2000	0.3558	818.66	818.29	0.37
			2	2000000	0.5000	0.0000			
			3	4000000	0.4000	0.0156			
			4	1000000000(	0.2000	0.0000			

*Note: Final Z is calculated assuming only 'Immediate Settlement' exists.

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IMMEDIATE SETTLEMENT, Si

Node #	Settlement along section: X [ft.]	Y [ft.]	Layer (k)	Young's Modulus, E [lb/ft ²]	Poisson's Ratio, μ	Settlement of each layer, Si(k) [ft.]	Initial Z [ft.]	Final Z * [ft.]	Total Settlement Sum of Si(k), [ft.]
13	-40.00	0.00	1	81000	0.2000	0.3887	818.75	818.35	0.41
			2	2000000	0.5000	0.0000			
			3	4000000	0.4000	0.0169			
			4	1000000000	0.2000	0.0000			
14	-35.00	0.00	1	81000	0.2000	0.4165	818.84	818.41	0.43
			2	2000000	0.5000	0.0004			
			3	4000000	0.4000	0.0179			
			4	1000000000	0.2000	0.0000			
15	-30.00	0.00	1	81000	0.2000	0.4220	818.94	818.50	0.44
			2	2000000	0.5000	0.0006			
			3	4000000	0.4000	0.0186			
			4	1000000000	0.2000	0.0000			
16	-25.00	0.00	1	81000	0.2000	0.4094	819.00	818.57	0.43
			2	2000000	0.5000	0.0006			
			3	4000000	0.4000	0.0189			
			4	1000000000	0.2000	0.0000			
17	-20.00	0.00	1	81000	0.2000	0.4078	819.01	818.58	0.43
			2	2000000	0.5000	0.0007			
			3	4000000	0.4000	0.0192			
			4	1000000000	0.2000	0.0000			
18	-15.00	0.00	1	81000	0.2000	0.3913	819.02	818.61	0.41
			2	2000000	0.5000	0.0008			
			3	4000000	0.4000	0.0193			
			4	1000000000	0.2000	0.0000			
19	-10.00	0.00	1	81000	0.2000	0.3913	819.03	818.62	0.41
			2	2000000	0.5000	0.0009			
			3	4000000	0.4000	0.0191			
			4	1000000000	0.2000	0.0000			
20	-5.00	0.00	1	81000	0.2000	0.3809	819.04	818.63	0.40
			2	2000000	0.5000	0.0011			
			3	4000000	0.4000	0.0190			
			4	1000000000	0.2000	0.0000			
21	0.00	0.00	1	81000	0.2000	0.3821	819.04	818.64	0.40
			2	2000000	0.5000	0.0013			
			3	4000000	0.4000	0.0188			
			4	1000000000	0.2000	0.0000			
22	5.00	0.00	1	81000	0.2000	0.3705	819.05	818.66	0.39
			2	2000000	0.5000	0.0015			
			3	4000000	0.4000	0.0183			
			4	1000000000	0.2000	0.0000			
23	10.00	0.00	1	81000	0.2000	0.3704	819.06	818.67	0.39
			2	2000000	0.5000	0.0017			
			3	4000000	0.4000	0.0176			
			4	1000000000	0.2000	0.0000			
24	15.00	0.00	1	81000	0.2000	0.3590	819.07	818.69	0.38
			2	2000000	0.5000	0.0017			
			3	4000000	0.4000	0.0166			
			4	1000000000	0.2000	0.0000			

*Note: Final Z is calculated assuming only 'Immediate Settlement' exists.

IMMEDIATE SETTLEMENT, Si

Node #	Settlement along section: X [ft.]	Y [ft.]	Layer (k)	Young's Modulus, E [lb/ft ²]	Poisson's Ratio, μ	Settlement of each layer, Si(k) [ft.]	Initial Z [ft.]	Final Z * [ft.]	Total Settlement Sum of Si(k), [ft.]
25	20.00	0.00	1	81000	0.2000	0.3590	819.08	818.70	0.38
			2	2000000	0.5000	0.0018			
			3	4000000	0.4000	0.0150			
			4	1000000000	0.2000	0.0000			
26	25.00	0.00	1	81000	0.2000	0.3002	819.08	818.77	0.31
			2	2000000	0.5000	0.0015			
			3	4000000	0.4000	0.0130			
			4	1000000000	0.2000	0.0000			
27	30.00	0.00	1	81000	0.2000	0.1919	819.09	818.89	0.20
			2	2000000	0.5000	0.0008			
			3	4000000	0.4000	0.0107			
			4	1000000000	0.2000	0.0000			
28	35.00	0.00	1	81000	0.2000	0.1511	819.09	818.93	0.16
			2	2000000	0.5000	0.0004			
			3	4000000	0.4000	0.0083			
			4	1000000000	0.2000	0.0000			
29	40.00	0.00	1	81000	0.2000	0.1168	819.01	818.88	0.12
			2	2000000	0.5000	0.0000			
			3	4000000	0.4000	0.0062			
			4	1000000000	0.2000	0.0000			
30	45.00	0.00	1	81000	0.2000	0.0890	819.68	819.59	0.09
			2	2000000	0.5000	-0.0003			
			3	4000000	0.4000	0.0042			
			4	1000000000	0.2000	0.0000			
31	50.00	0.00	1	81000	0.2000	0.0591	819.63	819.57	0.06
			2	2000000	0.5000	-0.0005			
			3	4000000	0.4000	0.0025			
			4	1000000000	0.2000	0.0000			
32	55.00	0.00	1	81000	0.2000	0.0320	819.27	819.24	0.03
			2	2000000	0.5000	-0.0007			
			3	4000000	0.4000	0.0011			
			4	1000000000	0.2000	0.0000			
33	60.00	0.00	1	81000	0.2000	0.0104	818.49	818.48	0.01
			2	2000000	0.5000	-0.0009			
			3	4000000	0.4000	-0.0001			
			4	1000000000	0.2000	0.0000			
34	65.00	0.00	1	81000	0.2000	-0.0027	817.89	817.89	-0.00
			2	2000000	0.5000	-0.0009			
			3	4000000	0.4000	-0.0010			
			4	1000000000	0.2000	0.0000			
35	70.00	0.00	1	81000	0.2000	-0.0036	817.82	817.83	-0.01
			2	2000000	0.5000	-0.0009			
			3	4000000	0.4000	-0.0015			
			4	1000000000	0.2000	0.0000			

*Note: Final Z is calculated assuming only 'Immediate Settlement' exists.

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ULTIMATE SETTLEMENT, Sc

Node #	X [ft.]	Y [ft.]	Original Z [ft.]	Settlement Sc [ft.]	Final Z * [ft.]
1	-100.00	0.00	818.83	0.00	818.83
2	-95.00	0.00	818.48	0.00	818.48
3	-90.00	0.00	818.18	0.00	818.18
4	-85.00	0.00	817.91	0.00	817.91
5	-80.00	0.00	818.00	0.00	818.00
6	-75.00	0.00	818.09	0.00	818.09
7	-70.00	0.00	818.19	0.00	818.19
8	-65.00	0.00	818.28	0.00	818.28
9	-60.00	0.00	818.38	0.00	818.38
10	-55.00	0.00	818.47	0.00	818.47
11	-50.00	0.00	818.56	0.00	818.56
12	-45.00	0.00	818.66	0.00	818.66
13	-40.00	0.00	818.75	0.00	818.75
14	-35.00	0.00	818.84	0.00	818.84
15	-30.00	0.00	818.94	0.01	818.93
16	-25.00	0.00	819.00	0.01	818.99
17	-20.00	0.00	819.01	0.01	819.00
18	-15.00	0.00	819.02	0.02	819.00
19	-10.00	0.00	819.03	0.02	819.01
20	-5.00	0.00	819.04	0.02	819.01
21	0.00	0.00	819.04	0.02	819.02
22	5.00	0.00	819.05	0.03	819.03
23	10.00	0.00	819.06	0.03	819.03
24	15.00	0.00	819.07	0.03	819.04
25	20.00	0.00	819.08	0.03	819.04

*Note: Final Z is calculated assuming only 'Ultimate Settlement' exists.

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ULTIMATE SETTLEMENT, Sc

Node #	X [ft.]	Y [ft.]	Original Z [ft.]	Settlement Sc [ft.]	Final Z * [ft.]
26	25.00	0.00	819.08	0.03	819.05
27	30.00	0.00	819.09	0.03	819.06
28	35.00	0.00	819.09	0.03	819.06
29	40.00	0.00	819.01	0.03	818.98
30	45.00	0.00	819.68	0.02	819.66
31	50.00	0.00	819.63	0.02	819.61
32	55.00	0.00	819.27	0.01	819.26
33	60.00	0.00	818.49	0.01	818.49
34	65.00	0.00	817.89	0.00	817.88
35	70.00	0.00	817.82	0.00	817.82

*Note: Final Z is calculated assuming only 'Ultimate Settlement' exists.

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TABULATED GEOMETRY: INPUT OF FOUNDATION SOILS

Found. Soil #	Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]	DESCRIPTION
1	1	-150.00	820.40	Layer 1
	2	-140.00	820.40	
	3	-106.50	819.30	
	4	-96.90	818.60	
	5	-85.40	817.90	
	6	-26.70	819.00	
	7	34.20	819.10	
	8	40.50	819.00	
	9	42.80	819.70	
	10	52.90	819.60	
	11	63.80	817.90	
	12	80.00	817.70	
	13	110.00	817.30	
	14	150.00	818.10	
2	1	-150.00	806.70	Layer 2
	2	-42.10	806.70	
	3	42.30	809.60	
	4	150.00	809.60	
3	1	-150.00	806.69	Layer 3
	2	-42.10	806.69	
	3	42.30	804.80	
	4	150.00	804.80	
4	1	-150.00	768.00	Termination Layer
	2	150.00	768.00	

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TABULATED GEOMETRY: INPUT OF EMBANKMENT SOILS

Embank. Soil #		Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]	DESCRIPTION
1	X1 = -96.90 [ft]	1	-96.90	818.60	Proposed Embankment
	X2 = 63.80 [ft]	2	-34.70	849.80	
		3	-17.40	849.70	
		4	-17.30	849.20	
		5	0.00	849.50	
		6	17.70	849.20	
		7	17.80	849.70	
		8	25.40	849.80	
		9	25.41	837.10	
		10	27.40	837.00	
		11	63.80	817.90	

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