

**FRA-70-13.01
FRA-70-1301R
I-70 EB OVER SR 135
PID NO. 105430
FRANKLIN COUNTY, OHIO**

STRUCTURE FOUNDATION EXPLORATION REPORT (REV. 1)

***Prepared For:*
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Rii Project No. W-20-025

November 2021

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June 28, 2021 (Revised November 2, 2021)

Ms. Leslie Montgomery, P.E.
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**Re: Structure Foundation Exploration (Rev. 1)
FRA-70-13.01
FRA-70-1301R – I-70 EB over SR 315
PID No. 105430
Franklin County, Ohio
Rii Project No. W-20-025**

Ms. Montgomery:

Resource International, Inc. (Rii) is pleased to submit this revised subsurface exploration report for the above referenced project. Engineering logs have been prepared and are attached to this report along with the results of laboratory testing. This report includes recommendations for the design and construction of the proposed FRA-70-13.01 project in Franklin County, Ohio.

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

Sincerely,

RESOURCE INTERNATIONAL, INC.

Brian R. Trenner, P.E.
Director – Geotechnical Services

Jonathan P. Sterenberg, P.E.
Vice President – Geotechnical Services

Enclosure: Structure Foundation Exploration Report (Rev. 1)

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EXECUTIVE SUMMARY

Resource International, Inc. (Rii) has completed a structure foundation exploration for the design and construction of the proposed FRA-70-13.10 project in Franklin County, Ohio, which includes the FRA-70-1301R bridge structure over SR-315. Based on the information provided, it is understood that the existing bridge will be completely removed and replaced with a three-span structure, having a total length of approximately 513 feet and width of approximately 63.5 feet. It is also understood that the proposed project includes roadway improvements along the I-70 eastbound lanes between Souder Avenue and the proposed FRA-70-13.21R bridge structure.

Exploration and Findings

Between April 22 and 29, 2020, five (5) soil borings, designated as B-014-1-19 through B-014-5-19, were drilled along the project alignment at the locations shown on the boring plan provided in Appendix I of the full report. Borings B-014-1-19 and B-014-5-19 were advanced to completion depths ranging from 7.3 to 7.5 feet below the existing ground surface for the roadway approach work, and borings B-014-2-19 through B-014-4-19 were drilled to completion depths ranging from 49.7 to 94.6 feet below the existing ground surface for the proposed structure replacement.

In addition to the borings performed for the current exploration, borings B-015-1-13 and B-015-2-13 from the FRA-70-12.68 Phase 4R (PID No. 105523) project, and borings B-108-5-13 and B-108-6-13 from the FRA-71-14.36 Phase 6R (PID No. 105588) project were also referenced to further characterize the subsurface profile along the bridge alignment. The borings were advanced to depths ranging from 63.0 to 95.0 feet below the existing ground surface.

Borings B-014-1-19, B-014-2-19 and B-014-5-19 were drilled within the existing pavement of eastbound lanes of I-70 and encountered 4.5 to 5.5 inches of asphalt overlying 11.5 to 13.5 inches of concrete. Boring B-015-1-13 was drilled through the existing shoulder of I-70 eastbound and encountered 9.0 inches of asphalt overlying 6.0 inches of aggregate base. The remaining borings were drilled in the grass infield areas between the various roadways and interchange ramps and encountered 2.0 to 6.0 inches of topsoil at the ground surface.

Beneath the surface materials in borings B-015-1-13, B-014-2-19 and B-108-6-13 material identified as existing fill was encountered extending to depths ranging from 25.5 to 37.0 feet below the ground surface. The fill material consisted of grayish brown to gray, medium stiff to hard sandy silt and silt and clay (ODOT A-4a, A-6a) and brown, medium dense to dense gravel and gravel with sand and silt (ODOT A-1-a, A-2-4).

Underlying the surficial materials and existing fill, where encountered, natural soils were encountered consisting of both granular and cohesive material. The granular soils were generally described as brown, gray, grayish brown, dark brown and black, loose to very dense gravel, gravel with sand, gravel with sand and silt and gravel with sand, silt and clay (ODOT A-1-a, A-1-b, A-2-4, A-2-6). The cohesive soils were generally described as brown, dark brown, dark gray and gray, stiff to hard sandy silt, silt and clay, silty clay and clay (ODOT A-4a, A-6a, A-6b, A-7-6).

Analyses and Recommendations

Design details of the proposed structure were provided by ms consultants, inc. Based on the information provided, it is understood that the proposed project includes roadway reconstruction and widening along the I-70 eastbound lanes between Souder Avenue and the proposed FRA-70-1321R bridge structure. It is understood that the existing I-70 eastbound bridge will be completely removed and replaced with a three-span composite steel curved plate girder structure with stub abutments and multi-column piers on driven pile foundations, having a total length of approximately 513 feet and width of approximately 63.5 feet. The rear abutment of the proposed structure will be located in front of the existing rear abutment with an MSE wall that crosses in front of the abutment footing and wraps around to the west on the north side of I-70 eastbound. The forward abutment of the proposed structure will be located in front of the existing forward abutment and will be situated at the top of a new spill through embankment slope. A new MSE retaining wall will also be located on the south side of the spill through embankment slope at the forward abutment, which will provide grade separation for the existing pump station that is located just south of the existing bridge structure in the infield of the I-70 eastbound to SR 315 northbound ramp.

Driven Pile Recommendations

It is recommended that driven piles be utilized for foundation support at all of the substructure units for this structure. Given the depth of bedrock encountered and the required structural loading, it is recommended that steel H-piles (ODOT Item 507.06) driven to refusal on bedrock be employed for foundation support. Per Section 305.3.1.2 of the 2020 ODOT Bridge Design Manual, refusal is met during driving when the pile penetration is an inch or less after receiving at least 20 blows from the pile hammer. The following table shows the recommended pile lengths and the corresponding factored structural axial resistance ($R_{R \max}$) of steel H-piles. For H-piles driven to refusal on bedrock, no geotechnical resistance factor should be applied to the factored structural axial resistance values presented, as the values presented account for the structural resistance factor, $\phi_c = 0.50$, for H-piles subject to damage due to severe driving conditions.

Driven Pile Recommendations

Substructure Reference	Ground Elevation ¹ (feet msl)	Pile Size	Pile Elevation		Pile Length ³ (feet)	Q _p max (kips/pile)	R _R max ⁴ (kips/pile)	Sleeve / Prebore Length ^{5,6} (feet)	φ ⁷
			Top ²	Tip					
Rear Abutment (B-015-1-13)	746.7	HP 10x42 ⁸	738.0	648.4	95	269	310	12.5	N/A
		HP 12x53 ⁸	738.0	648.4	95	269	380	12.5	N/A
Pier 1 (B-014-3-19)	700.9	HP 12x53 ⁸	694.5	654.9	45	338	380	N/A	N/A
Pier 2 (B-014-4-19)	698.8	HP 12x53 ⁸	693.9	658.3	40	355	380 ⁹	N/A	N/A
		HP 14x73 ⁸	693.9	658.3	40	355	530 ⁹	N/A	N/A
Forward Abutment (B-014-7-20, B-108-6-13 & B-012-E-68) ¹⁰	715.5	HP 10x42 ⁸	729.5	651.7	80	303	310 ⁹	14.0	N/A
		HP 12x53 ⁸	729.5	651.7	80	303	380 ⁹	14.0	N/A

1. Ground elevation listed is the ground elevation at the respective boring location.
2. The top of pile elevation corresponds to the pile cutoff elevation, which is considered to be 1.0-foot above the proposed bottom of footing elevation per Section 305.3.5.1 of the 2020 ODOT BDM.
3. Per Section 305.3.5.2 of the 2020 ODOT BDM, the estimated pile length was determined as the pile cutoff elevation (top) minus the pile tip elevation, rounded up to the nearest 5.0 feet.
4. The factored structural axial resistance for H-piles is based on the structural limit state of the steel H-pile section per Section 305.3.3 of the 2020 ODOT BDM.
5. Sleeve length at the rear abutment represents the required length of pile that should be sleeved within the MSE wall backfill.
6. Per Section 305.3.5.7 of the 2020 ODOT BDM, all piles at the forward abutment should be prebored to the bottom of the new embankment elevation at each pile location in accordance with ODOT Item 507.11.
7. For H-piles driven to refusal on bedrock, no geotechnical resistance factor should be applied (N/A) to the factored structural axial resistance values presented, as the values presented account for the structural resistance factor, $\phi_c = 0.50$, for H-piles subject to damage due to severe driving conditions.
8. A steel pile point is recommended to protect the tips of the piles during pile installation.
9. This represents the structural resistance of the pile section to resist structural loading only. The pile section will also need to be checked to verify that downdrag loads can also be resisted, which is evaluated in Section 5.1.2 of the full report.
10. The soil profile from boring B-014-7-20 was used in the analysis for the forward abutment. Since the bedrock elevation was not confirmed at this boring, and given the variability in the elevation of the top of rock between borings B108-6-13 and B-012-E-68, the average top of rock elevation between these borings was used at the forward abutment.

Based on the plan information provided, approximately 30.0 feet of new embankment fill will be placed at the forward abutment to achieve the proposed roadway profile grade, which will result in approximately 14.0 feet of new fill below the bottom of footing. Therefore, per Section 305.3.5.7 of the 2020 ODOT BDM, all piles at the forward abutment should be prebored to the bottom of the new embankment elevation at each pile location in accordance with ODOT Item 507.11.

The anticipated total settlement along the facing of Retaining Wall W4 at the rear abutment is approximately 1.83 inches. Results of the settlement analysis indicate that approximately 90 percent of the primary consolidation of the cohesive layers at the rear abutment will be complete within 24 days following the placement of the surcharge load. Therefore, if the above noted waiting period is specified following completion of construction of the retaining wall at the rear abutment, downdrag forces along the piles will be eliminated.

Total settlements up to 5.73 inches should be expected due to the weight of the new embankment fill at the forward abutment. Results of the settlement analysis indicate that approximately 90 percent of the primary consolidation of the cohesive layers will be complete within 105 days following the placement of the embankment. Since this is not a practical time period to accommodate during construction, it is recommended that a shorter wait period be specified and that the piles be designed to accommodate the downdrag loading. The depth of downdrag at the forward abutment following a 30 day hold period will be 13.0 feet. Using the calculated depth of downdrag and considering an HP 10x42 and HP 12x53 pile sizes, the unfactored downdrag load at forward abutment is 63 and 77 kips/pile, respectively. The total factored load, considering both structural and downdrag loading, is 369 kips/pile for an HP 10x42 pile section and 384 kips/pile for an HP 12x53 pile section considering a load factor of 1.05 for the downdrag loading. The structural resistance for an HP 10x42 and HP 12x53 pile section is 372 and 456 kips/pile, respectively, considering a structural resistance factor of $\phi_c = 0.60$ for combined structure and downdrag loading.

The total anticipated settlement below the existing ground surface grade at Piers 2 is 2.05 inches, with an anticipated settlement below the bottom of footing elevation 1.26 inches due to the placement of the future embankment fill. Based on the results of the settlement analysis, downdrag loads will develop along the piles supporting Pier 2 following placement of the future embankment fill. Using the traditional method criterion, the depth of downdrag for 100 percent of primary consolidation is 18.0 feet below the bottom of footing elevation. Using the calculated depth of downdrag and considering an HP 12x53 and HP 14x73 pile size, the unfactored downdrag load at forward abutment is 74 and 104 kips/pile, respectively. The total factored load, considering both structural and downdrag loading, is 433 kips/pile for an HP 12x53 pile section and 464 kips/pile for an HP 14x73 pile section considering a load factor of 1.05 for the downdrag loading. The resulting structural resistance for an HP 12x53 and HP 14x73 pile section is 456 and 636 kips/pile, respectively, considering a structural resistance factor of $\phi_c = 0.60$ for combined structure and downdrag loading.

MSE Wall Recommendations

The bearing soils along the alignment of Wall W4 at the rear abutment are anticipated to consist of stiff to very stiff silt and clay and sandy silt (ODOT A-6a, A-4a), and the anticipated soils along the alignment of Wall W6 south of the rear abutment are anticipated to consist of very stiff silt and clay (ODOT A-6a) or loose to medium dense gravel, gravel with sand or gravel with sand, silt and clay (ODOT A-1-a, A-1-b, A-2-6). MSE wall foundations bearing on these soils or engineered fill, placed and compacted in accordance with ODOT Item 203, may be proportioned for a factored bearing resistance as indicated in the following table. A geotechnical resistance factor of $\phi_b=0.65$ was considered in calculating the factored bearing resistance at the strength limit state.

FRA-70-1301R (Retaining Wall W4 and W6) MSE Wall Design Parameters

Substructure Unit (Boring)	Wall Height Analyzed (feet)	Back-slope Behind Wall	Minimum Required Reinforcement Length ¹ (feet)	Bearing Resistance at Strength Limit (ksf)		Strength Limit Equivalent Bearing Pressure ³ (ksf)
				Nominal	Factored ²	
Rear Abutment / Retaining Wall W4 (B-015-1-13)	25.2	Level	20.2 (0.80H)	14.05 ⁽⁴⁾	9.13	5.64
Forward Abutment / Retaining Wall W6 (B-108-5-13, B-012-E-68)	21.4	2:1 (Broken-Back)	15.0 (0.70H)	12.05	7.83	7.70

1. The minimum reinforcement length is based on the maximum wall height analyzed. The value in parentheses represent the required reinforcement length expressed as a percentage of the wall height, H.
2. A geotechnical resistance factor of $\phi_b=0.65$ was considered in calculating the factored bearing resistance at the strength limit state.
3. The strength limit equivalent bearing pressure is the uniformly distributed pressure asserted by the wall over an effective base width based on the eccentricity of the wall system at the strength limit state.
4. The nominal bearing resistance was determined using limit equilibrium methodology, which is permitted as an alternate methodology per Section 10.6.3.1.2c of the 2020 AASHTO LRFD BDM.

Total settlements of up to 2.90 inches at the center of the reinforced soil mass and 1.80 inches at the facing of the wall are anticipated along Wall W4 at the rear abutment. Total settlements ranging from 0.39 to 1.83 inches at the center of the reinforced soil mass and 0.30 to 1.58 inches at the facing of the wall are anticipated along Wall W6 on the south side of the forward abutment. Based on the results of the analysis, 90 percent of the total settlement is anticipated to occur over a period of approximately 2 to 24 days. Based on the results of the settlement analysis, differential settlement greater than 1/100 may occur along the wall facing at Wall W6 over the short distance that the wall is brought down to existing grade.

Based on the results of the external and global stability analysis performed for Wall W4 (rear abutment) and Wall W6 (south side of the forward abutment), the recommended controlling strap length is 0.8 and 0.7 times the maximum height of the MSE wall, respectively. Global stability under drained conditions was the controlling factor in the determination of the recommended strap length at Wall W4 (rear abutment).

Pavement Subgrade Recommendations

The soils at the proposed subgrade elevation along the I-70 eastbound lanes between Souder Avenue (begin Sta. 128+26) and the proposed FRA-70-1321R bridge structure (end Sta. 147+63) consist of granular material comprised of medium dense gravel with sand (ODOT A-1-b) and natural or fill materials comprised of very stiff to hard sandy silt and silt and clay (ODOT A-4a, A-6a). It is understood that the existing and proposed roadway profiles will approximately match.

Per ODOT GB1, global stabilization recommendations are based upon the overall average site parameters, as noted in the table below.

Average Site Parameters from GB-1 Analysis

Average N_{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Design CBR
20	8	14	12	5	8

Applying the averages in the table above, GB1 recommends the following global stabilization options, which should be evaluated based upon a cost and constructability analysis:

- Option 1. Chemically stabilize the entire subgrade with 12-inches of cement, as per ODOT Item 206. For estimating purposes, utilize a cement content of 6.0 percent by weight of soil. Actual application rates shall be verified by the contractor under Item 206.06 Mixture Design for Chemically Stabilized Soils.**
- Option 2. Stone stabilize the entire subgrade via a 12-inch undercut and replacement with ODOT Item 703.16C granular material, Type B, C or D installed over ODOT Item 712.09 Geotextile Fabric, Type D as detailed in accordance with ODOT Item 204.**

Given that this section of I-70 is being reconstructed as part of a larger corridor construction project, it is recommended that global stabilization of the subgrade shall be performed regardless of the length of the project using the global chemical stabilization option (Option 1) above. This stabilization option will provide the most uniform and durable subgrade, and will match the proposed subgrade stabilization that is being utilized along the interstate sections within this corridor in the other phases of construction.

California Bearing Ratio (CBR) values for the entire project ranged from 6 to 12 with an average of 8. If it is elected to proceed with global stabilization of the entire subgrade, it is recommended that pavement design be based on the average CBR of 8 with a corresponding natural resilient modulus, M_R , of 9,600 psi. However, since the entire subgrade will receive global chemical stabilization, the resilient modulus can be increased per Section 203.4.1 of the ODOT Pavement Design Manual, which results in an increased design resilient modulus, M_{R-GCS} , of 13,056 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 182 pci and a soil support value (SSV) of 5.4.

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



1.0 INTRODUCTION

This report is a presentation of the structure foundation exploration performed for the design and construction of the proposed FRA-70-13.10 project in Franklin County, Ohio, which includes the FRA-70-1301R bridge structure over SR-315, as shown on the vicinity map and boring plan presented in Appendix I. The existing structure is a six-span bridge with a total length of approximately 535 feet and width of approximately 58 feet. Based on the information provided, it is understood that the existing bridge will be completely removed and replaced with a three-span composite steel curved plate girder structure with stub abutments and multi-column piers supported on driven pile foundations, having a total length of approximately 513 feet and width of approximately 63.5 feet. The rear abutment of the proposed structure will be located in front of the existing rear abutment with an MSE wall that crosses in front of the abutment footing and wraps around to the west on the north side of I-70 eastbound. The forward abutment of the proposed structure will be located in front of the existing forward abutment and will be situated at the top of a new spill through embankment slope. A new MSE retaining wall will also be located on the south side of the spill through embankment slope at the forward abutment, which will provide grade separation for the existing pump station that is located just south of the existing bridge structure in the infield of the I-70 eastbound to SR 315 northbound ramp. It is also understood that the proposed project includes roadway improvements along the I-70 eastbound lanes between Souder Avenue and the proposed FRA-70-1321R bridge structure.

In addition to the borings obtained as part of the current exploration, borings from the adjacent projects for FRA-70-12.68 Phase 4R (PID No. 105523) and FRA-71-14.36 Phase 6R (PID No. 105588) were utilized to in the development of the analysis and recommendations for this report. Additionally, historic borings performed in 1968 by the Department of Highways as part of the FRA-70-12.30S project were obtained from the construction documents on record.

2.0 GEOLOGY AND OBSERVATIONS OF THE PROJECT

2.1 Site Geology

Both the Illinoian and Wisconsinan glaciers advanced over two-thirds of the State of Ohio, leaving behind glacial features such as moraines, kame deposits, lacustrine deposits and outwash terraces. The glacial and non-glacial regions comprise five physiographic sections based on geological age, depositional process and geomorphic occurrence (physical features or landforms). The project area lies within the Columbus Lowland District of the Till Plains Section. This area is characterized by flat to gently rolling ground moraine deposits from the Late Wisconsinan age. The site topography exhibits moderate to high relief. The ground moraine deposits are composed primarily of silty loam till (Darby, Bellefontaine, Centerburg, Grand Lake, Arcanum, Knightstown Tills), with smaller alluvium and outwash deposits bordering the Scioto River, its tributaries and floodplain areas. A ground moraine is the sheet of debris left after the



steady retreat of glacial ice. The debris left behind ranges in composition from clay size particles to boulders (including silt, sand, and gravel). Outwash deposits consist of undifferentiated sand and gravel deposited by meltwater in front of glacial ice, and often occurs as valley terraces or low plains. Alluvium and alluvial terrace deposits range in composition from silty clay size particles to cobbles, usually deposited in present and former floodplain areas.

According to the bedrock geology and topography maps obtained from the Ohio Department of Natural Resources (ODNR), the underlying bedrock consists predominantly of the Middle to Lower Devonian-aged Columbus Limestone Formation. This formation is further subdivided into two members in the central portion of the state, known as the Delhi and Bellepoint Members. The Delhi Member consists of light gray, finely to coarsely crystalline, irregularly bedded, fossiliferous limestone. The Bellepoint Member consists of variable brown, finely crystalline, massively bedded limy dolomite. Both of these members contain chert nodules. Just east of Scioto River, the Upper Devonian Ohio Shale Formation overlies the Columbus Limestone Formation. The Ohio Shale formation consists of brownish black to greenish gray, thinly bedded, fissile, carbonaceous shale. Regionally, the bedrock surface forms a broad valley aligned roughly north-to-south beneath the Scioto River, and the site is located within this valley. According to bedrock topography mapping, the elevation of the bedrock surface within the bedrock valley is approximately 600 feet mean sea level (msl). Just east of the Scioto River, the bedrock surface forms a knoll that slopes up to the north along the alignment of SR 315. The elevation of the knoll at the proposed structure ranges from approximately 630 to 650 feet msl. Limestone bedrock was encountered at elevations ranging from 641.9 to 657.6 feet msl along the structure alignment.

2.2 Existing Conditions

The project alignment is located along the eastbound lanes of I-70 starting from Souder Avenue and ending at the proposed FRA-70-13.21R bridge structure. The existing I-70 roadway has two driving lanes in the eastbound direction, including one exit ramp to I-71 southbound, just east of Souder Avenue, and another exit ramp to SR 135 northbound at the east end of the existing structure. The existing roadway width is 58 feet. The existing bridge structure carrying I-70 eastbound lanes over SR 135 is a six span continuous steel girder structure with non-composite reinforced concrete deck with 25 foot long approach slabs. It is understood that the existing structure was constructed in 1975. The terrain along SR-315 is lowered from the surrounding terrain, and the existing areas between the roadways are generally grass covered, with some patches of dense vegetation along the slopes. The Scioto River flows along the east side of I-71 and SR 315 northbound.

3.0 EXPLORATION

Between April 22 and 29, 2020, five (5) soil borings, designated as B-014-1-19 through B-014-5-19, were drilled along the project alignment at the locations shown on the boring plan provided in Appendix I of this report and summarized in Table 1. Borings B-014-1-19 and B-014-5-19 were advanced to completion depths ranging from 7.3 to 7.5 feet below the existing ground surface for the roadway approach work, and borings B-014-2-19 through B-014-4-19 were drilled to completion depths ranging from 49.7 to 94.6 feet below the existing ground surface for the proposed structure replacement. On December 10 and 15, 2020, two additional borings, designated as B-014-6-20 and B-014-7-20, were performed in close proximity to the rear and forward abutment to obtain undisturbed samples within the cohesive soil layers present in these areas to further define the compressibility parameters of these layers. The borings were extended to a depth of 88.1 and 56.6 feet below existing grade, respectively.

Table 1. Test Boring Summary

Boring Number	Reference Alignment	Station	Offset	Latitude	Longitude	Ground Elevation (feet msl)	Boring Depth (feet)
B-014-1-19	BL Const. I-70 EB	130+97	21' Lt.	39.950225	-83.019864	736.5	7.5
B-014-2-19	BL Const. I-70 EB	135+82	16' Lt.	39.950298	-83.018137	744.5	94.6
B-014-3-19	BL Const. I-70 EB	139+05	31' Lt.	39.950416	-83.017000	700.9	54.8
B-014-4-19	BL Const. I-70 EB	140+65	29' Lt.	39.950496	-83.016450	698.8	49.7
B-014-5-19	BL Const. I-70 EB	145+09	10' Lt.	39.950903	-83.014979	736.1	7.3
B-014-6-20	BL Const. I-70 EB	136+40	12' Lt.	39.950322	-83.017927	745.4	88.1
B-014-7-20	BL Const. I-70 EB	142+46	48' Lt.	39.950764	-83.015989	715.5	56.6

The boring locations were determined and located in the field by Rii representatives. Rii utilized a handheld GPS unit to obtain northing and easting coordinates of the boring locations. Ground surface elevations at the boring locations were interpolated using topographic mapping information provided by ms consultants.

The borings were drilled using a CME 55 truck or CME 750X all-terrain vehicle (ATV) mounted rotary drilling machine, utilizing either a 3.25-inch inside diameter hollow-stem or 4.5-inch outside diameter solid flight auger to advance the holes. Standard penetration testing (SPT) and split spoon sampling were performed continuously to the boring termination depth in borings B-014-1-19 and B-014-5-19. In borings B-014-2-19 through B-014-4-19, SPT and split spoon sampling were performed at 2.5-foot increments of depth to 30.0 feet and at 5.0-foot increments thereafter to auger refusal on bedrock or boulders. In borings B-014-6-19 and B-014-7-19, SPT and split spoon

sampling were performed generally at 5.0 to 10.0-foot increments of depth to verify the material type encountered for determination of the appropriate depths to obtain undisturbed (Shelby tube) samples.

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

$$N_{60} = N \cdot (ER/60)$$

Where:

N = measured N value

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

The hammers for the CME 55 and CME 750X drill rigs used were calibrated on September 4, 2018, and have drill rod energy ratios of 91.2 and 79.5 percent, respectively.

In addition to the SPT sampling, relatively undisturbed (Shelby tube) samples were obtained for laboratory compressibility testing within the various cohesive soil layers encountered in borings B-014-6-20 and B-014-7-20. The samples were obtained by hydraulically pushing a 2.75-inch outer diameter thin-walled seamless steel (Shelby) tube into the soil at a constant rate of penetration. The recovered Shelby tube samples were cleaned of soil cuttings and preserved within the tubes by sealing the ends with wax. There were several instances where the down pressure exerted on the tubes was maximized and the tubes were crushed due to the inability to advance the tubes, which generally resulted in no or poor recovery of samples that would not be suitable for testing.

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

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

Table 2. Laboratory Test Schedule

Laboratory Test	Test Designation	Number of Tests Performed
Natural Moisture Content	ASTM D 2216	89
Plastic and Liquid Limits	AASHTO T89, T90	29
Gradation – Sieve/Hydrometer	AASHTO T88	29
Sulfate Content in Soils (Colorimetric Method)	ODOT S1122	3
One-Dimensional Consolidation	ASTM D2435	4

The tests performed are necessary to classify existing soil according to the Ohio Department of Transportation (ODOT) classification system and to estimate engineering properties of importance in determining foundation design and construction recommendations. Results of the laboratory testing are presented on the boring logs in Appendix III. A description of the soil terms used throughout this report is presented in Appendix II.

The depth to bedrock was determined by auger refusal. Auger refusal is defined as no or insignificant observable advancement of the augers with the weight of the drill rig driving the augers.

Where borings were extended into the bedrock (after encountering auger refusal), an NQ-sized double-tube diamond bit core barrel (utilizing wire line equipment) was used to core the bedrock. Coring produced 1.85 inch diameter cores, from which the type of rock and its geological characteristics were determined.

Rock cores were logged in the field and visually classified in the laboratory. They were analyzed to identify the type of rock, color, mineral content, bedding planes and other geological and mechanical features of interest in this project. The Rock Quality Designation (RQD) for each rock core run was calculated according to the following equation:

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

At the completion of drilling, the borings were backfilled with a mixture of bentonite chips and soil cuttings or sealed with a cement-bentonite grout mix, and any pavement surfaces were patched with an equivalent thickness of either cold patch asphalt or quick set concrete.

In addition to the borings performed for the current exploration, borings B-015-1-13 and B-015-2-13 from the FRA-70-12.68 Phase 4R (PID No. 105523) project, and borings B-108-5-13 and B-108-6-13 from the FRA-71-14.36 Phase 6R (PID No. 105588) project were used for determination of the subsurface profile at Piers 1 and 2 and the forward abutment. Details regarding the subsurface explorations for these borings can be found in the FRA-70-1301A (PID No. 105523) structure foundation exploration report dated January 30, 2019, and the FRA-71-1503L (PID No. 105588) structure foundation exploration report dated April 6, 2020. The borings were advanced to depths ranging from 63.0 to 95.0 feet below the existing ground surface. The boring locations are shown on the boring plan provided in Appendix I, and the boring logs are included with the remaining project borings in Appendix III.

3.1 Historic Borings

Historic borings performed in 1968 by the Department of Highways as part of the original FRA-70-12.31S project were obtained from the construction documents on record. Two (2) borings, designated as B-003-E-68 and B-012-E-68, were obtained near the abutments of the existing I-70 eastbound bridge structure over SR 315. The borings were extended to a depth of 75.0 and 60.0 feet, respectively, below the ground surface at the time the borings were obtained. Please note that the elevations provided on the historic boring logs are referenced to the North American Datum (NAD) 27. The current design survey is referenced to NAD 83. The NAD 27 datum is 0.6 feet lower than the NAD 83 datum. **Therefore, all elevations noted in this report with respect to the historic borings are adjusted to the current NAD 83 datum.** The historic boring locations are shown on the boring plan provided in Appendix I, and the historic boring logs are provided in Appendix IV.

4.0 FINDINGS

Interpreted engineering logs have been prepared based on the field logs, visual examination of samples and laboratory test results. Classification follows the respective version of the ODOT Specifications for Geotechnical Explorations (SGE) at the time the exploration borings were performed. The following is a summary of what was found in the test borings and what is represented on the boring logs.

4.1 Surface Materials

Borings B-014-1-19, B-014-2-19, B-014-5-19 and B-014-6-20 were drilled within the existing pavement of the I-70 eastbound lanes and encountered 4.5 to 5.5 inches of asphalt overlying 11.5 to 13.5 inches of concrete. Boring B-015-1-13 was drilled through the existing shoulder of I-70 eastbound and encountered 9.0 inches of asphalt overlying 6.0 inches of aggregate base. The remaining borings were drilled in the grass infield areas between the various roadways and interchange ramps and encountered 2.0 to 6.0 inches of topsoil at the ground surface.

4.2 Subsurface Soils

Beneath the surface materials in borings B-014-2-20, B-014-6-20, B-014-7-20, B-015-1-13, and B-108-6-13 material identified as existing fill was encountered extending to depths ranging from 11.5 to 37.0 feet below the ground surface. The fill material consisted of grayish brown to gray, medium stiff to hard sandy silt and silt and clay (ODOT A-4a, A-6a) and brown, medium dense to dense gravel and gravel with sand and silt (ODOT A-1-a, A-2-4).

Underlying the surficial materials and existing fill, where encountered, natural soils were encountered consisting of both granular and cohesive material. The granular soils were generally described as brown, gray, grayish brown, dark brown and black, loose to very dense gravel, gravel with sand, gravel with sand and silt and gravel with sand, silt and clay (ODOT A-1-a, A-1-b, A-2-4, A-2-6). The cohesive soils were generally described as brown, dark brown, dark gray and gray, stiff to hard sandy silt, silt and clay, silty clay and clay (ODOT A-4a, A-6a, A-6b, A-7-6).

The relative density of granular soils is primarily derived from SPT blow counts (N_{60}). Based on the SPT blow counts obtained, the granular soil encountered ranged from loose ($6 \leq N_{60} \leq 10$ blows per foot [bpf]) to very dense ($N_{60} > 50$ bpf). Overall blow counts recorded from the SPT sampling within the granular soil layers ranged from 10 bpf to split spoon sampler refusal. Split spoon sampler refusal is defined as exceeding 50 blows from the hammer with less than 6.0 inches of penetration by the split spoon sampler. The shear strength and consistency of the cohesive soils are primarily derived from the hand penetrometer values (HP). The cohesive soil encountered ranged from medium stiff ($0.5 < HP \leq 1.0$ tsf) to hard ($HP > 4.0$ tsf). The unconfined compressive strength of the cohesive soil samples tested, obtained from the hand penetrometer, ranged from 0.75 to over 4.5 tsf (limit of instrument).

Natural moisture contents of the soil samples tested ranged from 5 to 24 percent. The natural moisture content of the cohesive soil samples tested for plasticity index ranged from 8 percent below to 5 percent above their corresponding plastic limits. In general, the soil exhibited natural moisture contents considered to be significantly below to moderately above optimum moisture levels.

4.2.1 Historic Borings

The natural soils encountered in historic borings B-012-E-68 and B-003-E-68 consisted of both granular and cohesive material. The granular soils were generally described as brown and gray gravel, sandy gravel, silty sandy gravel and gravelly sandy silt (ODOT A-1-a, A-1-b, A-2-4, A-4a). The cohesive soils were generally described as brownish gray, gray gravelly sandy silt, sandy silt, silt and clay (ODOT A-4a, A-7-6). In general, the subsurface conditions encountered in the historic borings matched relatively closely with the subsurface conditions encountered in the project borings.

4.3 Bedrock

Bedrock was encountered in the project and historic borings as presented in Table 3.

Table 3. Top of Bedrock Elevations

Boring Number	Ground Surface Elevation (feet msl)	Top of Bedrock (Auger Refusal)	
		Depth (feet)	Elevation (feet msl)
B-014-1-19	736.5	N/A ¹	-
B-014-2-19	744.5	N/A ¹	-
B-014-3-19	700.9	46.0	654.9
B-014-4-19	698.8	42.0	656.7
B-014-5-19	736.1	N/A ¹	-
B-014-6-20	745.4	N/A ¹	-
B-014-7-20	715.5	56.6 ²	658.9
B-015-1-13	746.7	N/A ¹	-
B-015-2-13	700.4	58.5	641.9
B-108-5-13	700.3	54.5	645.8
B-108-6-13	714.5	57.5	657.0
B-003-E-68	718.4	70.0	648.4
B-012-E-68	704.4	58.0	646.4

1. Bedrock was not encountered in these borings.

2. Auger refusal encountered on presumed top of bedrock.

With the exception of borings B-014-1-19, B-015-1-13, B-014-2-19, B-014-5-19 and B-014-6-20, bedrock was encountered in the remaining borings at depths ranging from 42.0 to 70.0 feet below the ground surface, which corresponds to elevations ranging from 641.9 to 658.9 feet msl. For boring B-014-7-20, auger refusal was encountered at a depth of 56.6 feet below grade (El. 658.9 feet msl) on the presume top of limestone bedrock based on the bedrock elevation encountered in adjacent borings. The cored bedrock consisted of limestone in all of the borings where bedrock was encountered, which was described as brown, dark brown, gray and dark grown, slightly weathered to unweathered, slightly strong to very strong and slightly to highly fractured. Boulders and cobbles consisting of limestone, dolomite, granite and siltstone fragments was encountered in boring B-014-2-19 at a depth of 82.0 to 94.6 feet, corresponding to elevations ranging from 649.9 to 662.5 feet msl.

The percent recovery, RQD values and unconfined compressive strengths of the bedrock core runs are summarized in Table 4. The rock core runs performed within the boulder zone in boring B-019-5-19 is not included in the tabulation below.

Table 4. Rock Core Summary

Boring	Core No.	Elevation (feet msl)	Recovery (%)	RQD (%)	Unconfined Compressive Strength
B-014-3-19	NQ-1	654.9 to 649.9	93	24	N/A
	NQ-2	649.9 to 646.1	93	40	N/A
B-014-4-19	NQ-1	656.7 to 651.7	97	54	N/A
	NQ-2	651.7 to 649.1	96	89	N/A
B-015-2-13	RC-1	641.9 to 640.9	100	54	N/A
	RC-2	640.9 to 635.9	87	63	N/A
	RC-3	635.9 to 631.9	96	78	q_u @ 67.6' = 5,771 psi
B-108-5-13	RC-1	645.8 to 640.8	100	79	q_u @ 56.8' = 11,933 psi
	RC-2	640.8 to 637.3	87	79	N/A
B-108-6-13	RC-1	657.0 to 652.0	100	55	q_u @ 59.6' = 8,033 psi
	RC-2	652.0 to 647.4	90	98	N/A

It should be noted that bedrock naturally experiences mechanical breaks during the drilling and coring processes. Rii attempted to account for fresh, manmade breaks during tabulation of the RQD analysis. The quality of the cored bedrock, according to the RQD value, was very poor ($0\% < \text{RQD} \leq 25\%$) to very good ($90\% < \text{RQD} \leq 100\%$). Three (3) unconfined compression tests were performed on the recovered limestone in borings B-015-2-13, B108-5-13 and B-108-6-13, with resulting unconfined compressive strengths ranging from 5,771 to 11,993 psi.

4.4 Groundwater

Groundwater was encountered in the project borings as presented in Table 5.

Table 5. Groundwater Levels in Borings

Boring Number	Ground Elevation (feet msl)	Initial Groundwater		Upon Completion	
		Depth (feet)	Elevation (feet msl)	Depth (feet)	Elevation (feet msl)
B-014-1-19	736.5	Dry	-	Dry	-
B-014-2-19	744.5	62.0	682.5	N/A ¹	-
B-014-3-19	700.9	12.0	688.9	N/A ¹	-
B-014-4-19	698.8	8.0	690.8	N/A ¹	-
B-014-5-19	736.1	Dry	-	Dry	-
B-014-6-20	745.4	63.5	681.9	N/A ¹	-
B-014-7-20	715.5	25.0	690.5	N/A ¹	-
B-015-1-13	746.7	68.5	678.2	N/A ¹	-
B-015-2-13	700.4	11.0	689.4	N/A ¹	-
B-108-5-13	700.3	11.5	688.8	N/A ¹	-
B-108-6-13	714.5	38.5	676.0	N/A ¹	-

1. The groundwater level at completion could not be obtained due to the addition of mud or water as a drilling fluid.

Groundwater was encountered initially during drilling in all of the project structure borings at depths ranging from 8.0 to 68.5 feet below the existing ground surface, corresponding to elevations ranging from 676.0 to 690.8 feet msl. The groundwater level at the completion of drilling could not be measured in any of the borings due to the addition of mud or water to counteract heaving sands or water as a circulating fluid during the rock coring process. Borings B-014-1-19 and B-014-5-19 were observed to be dry during and at the completion of drilling. Groundwater levels were not noted in borings B-003-E-68 and B-012-E-68, which were performed during the 1968 investigation.

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

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

5.0 ANALYSES AND RECOMMENDATIONS

Data obtained from the review of existing geotechnical information have been used to determine the foundation support capabilities and the settlement potential for the soil encountered at the site. These parameters have been used to provide guidelines for the design of foundation systems for the subject bridge, as well as the construction specifications related to the placement of foundation systems and general earthwork recommendations, which are discussed in the following paragraphs.

Based on the information provided, it is understood that the proposed project includes roadway reconstruction and widening along the I-70 eastbound lanes between Souder Avenue and the proposed FRA-70-1321R bridge structure. It is understood that the existing I-70 eastbound bridge over SR 315 will be completely removed and replaced with a three-span composite steel curved plate girder structure with stub abutments and multi-column piers supported on driven pile foundations, having a total length of approximately 513 feet and width of approximately 63.5 feet. It is also understood that the proposed project includes roadway improvements along the I-70 eastbound lanes between Souder Avenue and the proposed FRA-70-1321R bridge structure.

The rear abutment of the proposed structure will be located in front of the existing rear abutment with an MSE wall (Retaining Wall W4) that crosses in front of the abutment footing and wraps around to the west on the north side of I-70 eastbound. The forward abutment of the proposed structure will be located in front of the existing forward abutment and will be situated at the top of a new spill through embankment slope. A new MSE wall (Retaining Wall W6) will also be located on the south side of the spill through embankment slope at the forward abutment, which will provide grade separation for the existing pump station that is located just south of the existing bridge structure in the infield of the I-70 eastbound to SR 315 northbound ramp.

It is further understood that Pier 2 will be designed to accommodate approximately 22.0 feet of new embankment fill, which will be placed over the proposed pier foundations as part of the future realignment and profile grade changes to SR 315 northbound.

Proposed structural data was obtained from design details provided by ms consultants, inc. and are included in Table 6.

Table 6. Structure and Bridge Design Elevations

Substructure Reference	Structure Component	Elevation ¹ (feet msl)	Design Maximum Factored Load
Rear Abutment / Retaining Wall W4 (B-014-2-19, B-014-6-20, B-015-1-13 & B-003-E-68)	Profile Grade	750.2	269 kips/pile
	Bottom of Footing	737.0	
	Bottom of Wall (Top of Leveling Pad)	725.0	
Pier 1 (B-014-3-19 & B-015-2-13)	Bottom of Footing	693.5	338 kips/pile
Pier 2 (B-014-4-19)	Bottom of Footing	692.9	300 kips/pile / 355 kips/pile ²
Forward Abutment / Retaining Wall W6 (B-014-7-20, B-108-5-13, B-108-6-13 & B-012-E-68)	Bottom of Footing	728.5	303 kips/pile

1. Proposed bottom of footing elevations and structural loading based on structure information provided by ms consultants, inc.
2. The first value represents the factored load for the proposed structure following the construction of this bridge structure. The second value represents the factored load considering 22 feet of embankment surcharge over the pier footings following construction of the future realignment and profile grade change to SR 315 northbound.

5.1 Driven Pile Recommendations

It is recommended that driven piles be utilized for foundation support at all of the substructure units for this structure. Given the depth of bedrock encountered and the anticipated structural loading on the piles, it is recommended that steel H-piles (ODOT Item 507.06) driven to refusal on bedrock be employed for foundation support. Per Section 305.3.4 of the 2020 ODOT Bridge Design Manual (BDM), refusal is met during driving when the pile penetration is an inch or less after receiving at least 20 blows from the pile hammer.

The soil profile from boring B-014-7-20 was used in the analysis for the forward abutment. Since the bedrock elevation was not confirmed at this boring, and given the variability in the elevation of the top of rock between borings B108-6-13 and B-012-E-68, the average top of rock elevation between these borings was use at the forward abutment. Table 7 shows the recommended pile lengths and the corresponding factored structural axial resistance ($R_{R \max}$) of H-piles.

Table 7. Driven Pile Recommendations

Substructure Reference	Ground Elevation ¹ (feet msl)	Pile Size	Pile Elevation		Pile Length ³ (feet)	Q _p max (kips/pile)	R _R max ⁴ (kips/pile)	Sleeve / Prebore Length ^{5,6} (feet)	φ ⁷
			Top ²	Tip					
Rear Abutment (B-015-1-13)	746.7	HP 10x42 ⁸	738.0	648.4	95	269	310	12.5	N/A
		HP 12x53 ⁸	738.0	648.4	95	269	380	12.5	N/A
Pier 1 (B-014-3-19)	700.9	HP 12x53 ⁸	694.5	654.9	45	338	380	N/A	N/A
Pier 2 (B-014-4-19)	698.8	HP 12x53 ⁸	693.9	658.3	40	355	380 ⁹	N/A	N/A
		HP 14x73 ⁸	693.9	658.3	40	355	530 ⁹	N/A	N/A
Forward Abutment (B-014-7-20, B-108-6-13 & B-012-E-68) ¹⁰	715.5	HP 10x42 ⁸	729.5	651.7	80	303	310 ⁹	14.0	N/A
		HP 12x53 ⁸	729.5	651.7	80	303	380 ⁹	14.0	N/A

1. Ground elevation listed is the ground elevation at the respective boring location.
2. The top of pile elevation corresponds to the pile cutoff elevation, which is considered to be 1.0-foot above the proposed bottom of footing elevation per Section 305.3.5.1 of the 2020 ODOT BDM.
3. Per Section 305.3.5.2 of the 2020 ODOT BDM, the estimated pile length was determined as the pile cutoff elevation (top) minus the pile tip elevation, rounded up to the nearest 5.0 feet.
4. The factored structural axial resistance for H-piles is based on the structural limit state of the steel H-pile section per Section 305.3.3 of the 2020 ODOT BDM.
5. Sleeve length at the rear abutment represents the required length of pile that should be sleeved within the MSE wall backfill.
6. Per Section 305.3.5.7 of the 2020 ODOT BDM, all piles at the forward abutment should be prebored to the bottom of the new embankment elevation at each pile location in accordance with ODOT Item 507.11.
7. For H-piles driven to refusal on bedrock, no geotechnical resistance factor should be applied (N/A) to the factored structural axial resistance values presented, as the values presented account for the structural resistance factor, $\phi_c = 0.50$, for H-piles subject to damage due to severe driving conditions.
8. A steel pile point is recommended to protect the tips of the piles during pile installation.
9. This represents the structural resistance of the pile section to resist structural loading only. The pile section will also need to be checked to verify that downdrag loads can also be resisted, which is evaluated in Section 5.1.2.
10. The soil profile from boring B-014-7-20 was used in the analysis for the forward abutment. Since the bedrock elevation was not confirmed at this boring, and given the variability in the elevation of the top of rock between borings B108-6-13 and B-012-E-68, the average top of rock elevation between these borings was used at the forward abutment.

Based on the plan information provided, approximately 30.0 feet of new embankment fill will be placed at the forward abutment to achieve the proposed roadway profile grade, which will result in approximately 14.0 feet of new fill below the bottom of footing. Therefore, per Section 305.3.5.7 of the 2020 ODOT BDM, all piles at the forward abutment should be prebored to the bottom of the new embankment elevation at each pile location in accordance with ODOT Item 507.11.

Per Section 305.3.3 of the 2020 ODOT BDM, the factored resistance of H-piles driven to refusal on bedrock is typically governed by the structural resistance of the pile element. The factored structural axial resistances listed in Table 7 consider an axially loaded pile with negligible moment, no appreciable loss of section due to deterioration throughout the life of the structure, a steel yield strength of 50 ksi, a structural resistance factor for H-piles subject to damage due to severe driving conditions (LRFD 6.5.4.2: $\phi_c = 0.50$) and a pile fully braced along its length. For piles subjected to downdrag loads, a structural resistance factor of $\phi_c = 0.60$ was considered in the calculation of the factored structural resistance of the piles. **The factored structural axial resistance should not be used for piles that are subjected to bending moments or are not supported by soil for their entire length.** It is anticipated that the H-piles will be able to be driven a short distance into the surficial bedrock (approximately 3 to 6 inches) before satisfying the driving conditions that meet the refusal criterion. Settlement is estimated to be less than 0.5 inches for H-piles driven to refusal on bedrock.

For Pier 2 and the forward abutment, it should be noted that the maximum factored structural resistance provided in Table 7 represents the structural resistance of the pile section for structural loading only. The pile section will also need to be checked to verify that downdrag loads can also be resisted, which is evaluated in Section 5.1.2.

Static or dynamic pile load testing is not required for H-piles driven to refusal on bedrock. Further installation considerations are presented in Section 5.1.3.

5.1.1 Driveability

A drivability analysis was performed in accordance with Section 10.7.8 of the 2018 AASHTO LRFD Bridge Design Specifications (BDS) using the GRLWEAP software program, and the results are provided in Appendix VIII. In the driveability analysis, a Delmag 19-42 hammer with a rated energy of approximately 43,000 ft-lbs was used in conjunction with the H-pile sections.

In accordance with the comments provided by ODOT Office of Geotechnical Engineering (OGE) on the initial draft report, for the rear abutment, driveability analysis was performed in order to account for sleeved portion of the pile length by analyzing two (2) cases: Case 1 considers zero friction within the sleeved length (such as Yellow Jacket ® option); and, Case-2 considers a sleeved length consisting of PVC filled with sand with a friction angle of 28 degrees. Additionally, for the forward abutment, while the piles will be prebored through the proposed embankment, it is understood that the driveability should consider the frictional resistance through the proposed embankment with the appropriate driving strength losses (assuming embankment fill consisting of ODOT A-6a material). For the driveability analysis, the static capacity was determined using the DrivenPiles software program manufactured by Multidimensional Software Creations. An input file for the GRLWEAP driveability analysis was generated from the DrivenPiles program. The DrivenPiles analysis outputs are provided in Appendix VII.

Based on the results of this analysis, driving stresses induced on the H-piles **would not exceed** 90 percent of the yield stress of the steel ($f_y = 50$ ksi, $0.9f_y = 45$ ksi) if driven through the overburden soils to the bedrock depths provided in Table 7. Care should be taken during pile driving operations when approaching the bedrock elevations noted above, and when extending the piles into the surficial bedrock material, to ensure that the driving stresses induced on the pile elements do not exceed the maximum allowable value of 90 percent of the yield stress of the steel, subsequently damaging the pile elements. Pile driving should be terminated upon achieving the required 20 blows from the pile hammer with an inch or less of penetration to reduce the possibility of damaging the pile element. Per Section 202.2.3.2.a of the 2019 ODOT BDM, steel pile points should be used when the piles are driven to bear on strong bedrock (limestone or dolomite).

5.1.2 Downdrag Considerations

5.1.2.1 Rear Abutment (Retaining Wall W4)

The anticipated total settlement along the facing of Retaining Wall W4 at the rear abutment is approximately 1.83 inches. Given the anticipated amount of settlement following construction of the embankment, downdrag loads may be induced on the pile elements if installed to the final tip elevation prior to placement of the embankment fill. To reduce the amount of downdrag induced on the piles, it is recommended that the piles be pre-driven into the soil only as far as necessary to remain vertical and that the retaining wall should be constructed around the piles and then allowed to sit for a specified holding period such that a percentage of the consolidation can occur prior to driving the piles to the design tip elevation and reduce the amount of downdrag on the piles.

In order to consolidate the underlying soil to the required settlement, consideration should be given to the placement of a surcharge load in order to preload the site under the full weight of the retaining wall heights (from the bottom of wall elevation to the profile grade). The surcharge should remain in place until approximately 90 percent of consolidation of the subsurface soils has occurred to prevent downdrag loads from developing along the pile elements. Results of the settlement analysis indicate that approximately 90 percent of the primary consolidation of the cohesive layers at the rear abutment will be complete within 24 days following the placement of the surcharge load. Therefore, if the above noted waiting period is specified following completion of construction of the retaining wall at the rear abutment, downdrag forces along the piles will be eliminated.

Settlement platforms should be installed once the embankment surcharge has been placed to monitor the settlement of the embankment over time. A shorter or longer hold period than specified may be required based on the settlement platform readings as directed by the geotechnical engineer. The required hold period may be considered complete when survey monitoring of the settlement platforms indicate that the above noted settlement has occurred for the hold period or until the survey shows less than $\frac{1}{8}$ -inch of total movement per week over a two week period **following placement of the final lifts of surcharge loading.**

5.1.2.2 Forward Abutment (Spill Through Slope)

As previously noted, approximately 29.5 feet of new embankment will be placed at the forward abutment to achieve the proposed profile grade. A settlement analysis was performed to determine the amount settlement that is anticipated due to the placement of the new embankment fill and to evaluate the potential for downdrag loads on the piles at the forward abutment (see Section 5.3 for additional details regarding the settlement analysis). Results of the settlement analysis indicate that total settlements up to 5.73 inches should be expected due to the weight of the new embankment fill at the forward abutment. Additionally, results of the settlement analysis indicate that approximately 90 percent of the primary consolidation of the cohesive layers will be complete within 105 days following the placement of the embankment. Since this is not a practical time period to accommodate during construction, it is recommended that a shorter wait period be specified and that the piles be designed to accommodate the downdrag loading.

Since the piles are driven to point bear on bedrock, downdrag at the forward abutment was calculated using the traditional method to determine the depth of downdrag. Per the traditional method for calculating the depth of downdrag, downdrag loads will develop along the portion of the pile above the interface where the relative soil movement from consolidation with respect to the pile is greater 0.40 inches. The magnitude of the downdrag load induced on the piles is a function of the degree of consolidation that will occur at the end of the specified hold period. The degree of consolidation represents the amount of primary consolidation that has occurred during the hold period, expressed as a percentage of the total settlement that is anticipated, and is calculated using the following equations:



$$U = \sqrt{\frac{4T_v}{\pi}} \times 100\% \text{ for } T_v \leq 0.217;$$

$$U = \left[1 + 10^{-\left(\frac{0.085+T_v}{0.933}\right)} \right] \times 100\% \text{ for } T_v > 0.217;$$

$$T_v = \frac{c_v t}{H_{dr}^2}$$

Where:

U = the degree of consolidation

T_v = time factor

c_v = coefficient of consolidation

t = hold period

H_{dr} = length of longest drainage path (half the thickness of the compressible stratum)

For time rate of consolidation calculations, the coefficient of consolidation (C_v) shown in Table 13 of Section 5.3.1 was considered for the cohesive soil layers and the granular soils were considered fully consolidated at the completion of construction of the embankment. Based on the results of the settlement analysis, the depth of downdrag at the forward abutment following a 30 day hold period will be 13.0 feet below the existing grade elevation (26.9 feet below the bottom of footing elevation).

The downdrag force induced on the piles was calculated using static analysis and is equal to the magnitude of the side resistance over the length of the pile within the downdrag zone. Using the calculated depth of downdrag and considering an HP 10x42 and HP 12x53 pile section, the unfactored downdrag load at forward abutment is 63 and 77 kips/pile, respectively. A load factor of 1.05 should be applied to the unfactored downdrag load when determining the factored downdrag load per pile at the strength limit state and should be added to the factored load per pile from the superstructure. The downdrag loads were calculated using the DrivenPiles software program, and the results are provided in Appendix VII.

The total factored load, considering both structural and downdrag loading, is 369 kips/pile for an HP 10x42 pile section and 384 kips/pile for an HP 12x53 pile section. Based on correspondence with the ODOT Office of Geotechnical Engineering (OGE), for piles subjected to downdrag loads, a structural resistance factor of $\phi_c = 0.60$ should be applied in the calculation of the factored structural resistance of the piles when considering the combined loading of the structure and downdrag loads. The resulting structural resistance for an HP 10x42 and HP 12x53 pile section is 372 and 456 kips/pile, respectively.

Settlement platforms should be installed once the embankment has been constructed to monitor the settlement of the embankment over time. A shorter or longer hold period than specified may be required based on the settlement platform readings as directed by the geotechnical engineer. The required hold period may be considered complete when survey monitoring of the settlement platforms indicate that the above noted settlement has occurred for the hold period.

5.1.2.3 Pier 2 (Future SR 315 Embankment)

As previously noted, it is understood that Pier 2 will be designed to accommodate approximately 22.0 feet of new embankment fill, which will be placed over the proposed pier foundations as part of the future realignment and profile grade changes to SR 315 northbound. The bottom of footing elevation at Pier 2 is approximately 5.5 feet below the existing ground surface grade.

Downdrag was evaluated using the traditional method to determine the depth of downdrag, as outlined in Section 5.1.2.2. The total anticipated settlement below the existing ground surface grade at Piers 2 is 2.05 inches, with an anticipated settlement below the bottom of footing elevation 1.26 inches. Based on the results of the settlement analysis, downdrag loads will develop along the piles supporting Pier 2 following placement of the future embankment fill. Using the traditional method criterion, the depth of downdrag for 100 percent of primary consolidation is 18.0 feet below the bottom of footing elevation.

Using the calculated depth of downdrag and considering an HP 12x53 and HP 14x73 pile size, the unfactored downdrag load at forward abutment is 74 and 104 kips/pile, respectively. A load factor of 1.05 should be applied to the unfactored downdrag load when determining the factored downdrag load per pile at the strength limit state and should be added to the factored load per pile from the superstructure. The downdrag load was calculated using the DrivenPiles software program, and the results are provided in Appendix VII.

The total factored load, considering both structural and downdrag loading, is 433 kips/pile for an HP 12x53 pile section and 464 kips/pile for an HP 14x73 pile section. Based on correspondence with the ODOT Office of Geotechnical Engineering (OGE), for piles subjected to downdrag loads, a structural resistance factor of $\phi_c = 0.60$ should be applied in the calculation of the factored structural resistance of the piles when considering the combined loading of the structure and downdrag loads. The resulting structural resistance for an HP 12x53 and HP 14x73 pile section is 456 and 636 kips/pile, respectively. Both pile sections will provide the required resistance considering the combined factored structure and downdrag loading at Pier 2.

5.1.3 Driven Pile Considerations

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

It is recommended that the contractor submit a wave equation analysis (bearing graph) of his driving equipment, or the necessary pile driving and equipment data to perform the wave equation analysis, for hammer approval. A constant capacity wave equation analysis (inspector's chart) should also be performed to assist field personnel during inspection in accordance with the 2020 ODOT BDM.

Based on the plan information provided, it is understood that the forward abutment of the existing structure carrying I-70 eastbound over SR 315 will be abandoned in place and removed to 1.0-foot below finished grade. This would also include the existing piles, which consist of three rows of battered piles at the front of the footing. Based on the geometry of the piles shown on the site plan, there is concern that the existing battered piles may interfere with the installation of the back row, or potentially both rows, of piles for the proposed forward abutment substructure. Careful survey of the existing and proposed piles should be performed prior to installation to minimize the risk of interfering with the existing piling during pile driving operations. If a pile does strike an existing pile during installation, a contingency plan shall be available to either withdraw the pile or abandon it and install a new pile at an offset location.

5.1.4 Lateral Design

If lateral loads or moments are expected to be applied on the foundation elements, they should be analyzed to verify the pile has enough lateral and bending resistance against these loads. A boring-by-boring tabulation of parameters that should be used for lateral loading design is provided in Appendix XI. In order to evaluate the lateral capacity, it is recommended that a derivation of COM624, such as LPILE, be utilized to determine the proper embedment depth required to resist the lateral load for a given end condition and deflection. Table 8 lists the eleven different soil types internal to the LPILE program. These strata were utilized to define the soil strata in the soil profile for each boring provided in Appendix XI.

Table 8. Subsurface Strata Description

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

5.2 MSE Wall Recommendations

It is proposed to construct MSE walls at the rear abutment (Retaining Wall W4) and south of the forward abutment (Retaining Wall W5) of the proposed bridge structure. MSE walls are constructed on earthen foundations at a minimum depth of 3.0 feet below grade, as defined by the top of the leveling pad to the ground surface located 4.0 feet from the face of the wall. Per Section 840.04.A of ODOT Supplemental Specification 840 (SS 840), the height of the MSE wall at the bridge abutment is defined as the elevation difference between the profile grade at the face of the wall and the top of the leveling pad, and where the wall does not cross in front of the abutment, the height of the wall is defined as the elevation difference between the top of coping and the top of the leveling pad. However, at the abutment, it is noted that the reinforced soil mass only extends from the foundation bearing elevation (top of leveling pad) to the bottom of footing elevation. Additionally, per Section 201.4.1.C.7 of the 2020 ODOT BDM, a minimum of one row of soil reinforcement straps should be attached to the backside of the abutment footing to resist horizontal forces from the bridge structure and lateral pressures along the back wall of the abutment footing, and prevent any load transfer from these forces to the coping and facing panels. The width of the MSE wall foundation (B) is defined by the length of the reinforced soil mass. Per the 307.4.A of the 2020 ODOT BDM and Section 840.04.A.2 of ODOT SS 840, the minimum length of the reinforced soil mass is equal to 70 percent of the height of the MSE wall or 8.0 feet whichever is greater. A non-structural bearing leveling pad consisting of a minimum of 6.0-inches of unreinforced concrete should be placed at the base of the wall facing for constructability purposes. Please note that the leveling pad is not a structural foundation.

Based upon the proposed plan information, the wall height at the rear abutment (Wall W4) is 25.2 feet from the top of the leveling pad to the proposed profile grade of the roadway. The wall height on the south side of the spill through embankment slope at the forward abutment (Wall W6) is 21.4 feet from the top of the leveling pad to the top of coping elevation, with a 2:1 graded backslope that extends up from a paved gutter to the abutment footing and roadway. For the analysis, the foundation width was set at 70 percent of the maximum wall height and the foundation width was increased, if required, until external and global stability requirements were satisfied.

Per Section 840.06.D of ODOT SS 840, the foundation subgrade should be inspected to verify that the subsurface conditions are the same as those anticipated in this report. The anticipated soils at the proposed bearing elevation along Wall W4 at the rear abutment will consist of stiff to very stiff silt and clay and sandy silt (ODOT A-6a, A-4a). The anticipated soils at the proposed bearing elevation along Wall W6 on the south side of the forward abutment will consist of very stiff silt and clay (ODOT A-6a) or loose to medium dense gravel, gravel with sand or gravel with sand, silt and clay (ODOT A-1-a, A-1-b, A-2-6). These soils in their current condition are suitable for foundation support of the proposed MSE wall structures.

Per 307.4.C of the 2020 AASHTO LRFD BDS and Section 840.06.D of ODOT SS 840, following foundation subgrade inspection and acceptance, a minimum of 12.0 inches of ODOT Item 703.16.C, Granular Material Type C, should be placed and compacted in accordance with ODOT Item 204.07.

5.2.1 Strength Parameters Utilized in External and Global Stability Analyses

The shear strength parameters utilized in the external and global stability analyses for the MSE walls at the abutments are provided in Table 9.

Table 9. Shear Strength Parameters Utilized in MSE Wall Stability Analyses

Material Type	γ (pcf)	ϕ' ⁽¹⁾ (°)	c' ⁽²⁾ (psf)	S_u ⁽³⁾ (psf)
MSE Wall Backfill (Select granular fill)	120	34	0	N/A
Item 203 Embankment Fill (Retained soil)	120	30	0 to 100	2,000
Existing Embankment Fill: Stiff to Very Stiff Sandy Silt, Silt and Clay and Silty Clay (ODOT A-4a, A-6a, A-6b)	115 to 125	26 to 29	0 to 35	1,500 to 4,000
Stiff to Hard Sandy Silt (ODOT A-4a)	115 to 130	28 to 29	0	1,875 to 3,625
Medium Dense to Dense Granular Soil (ODOT A-1-a, A-1-b, A-2-4, A-3a)	130 to 135	36 to 42	0	N/A

1. Per Figure 7-45, Section 7.6.9 of FHWA GEC 5 for cohesive soils and Table 10.4.6.2.4-1 of the 2020 AASHTO LRFS BDS for granular soils.
2. Estimated based on overconsolidated nature of soil.
3. $S_u = 125(N_{60})$, Terzaghi and Peck (1967).

Shear strength parameters for the reinforced soil backfill and retained embankment are provided in Table 307-1 of the 2020 ODOT BDM and Section 840.04.A.3 of ODOT SS 840. Per these specifications, the select granular backfill in the reinforced zone and the retained embankment must meet the shear strength requirements provided in Table 9. The shear strength parameters for the natural soils were assigned using correlations provided in FHWA Geotechnical Engineering Circular (GEC) No. 5 (FHWA-NHI-16-072) Evaluation of Soil and Rock Properties, the 2020 AASHTO LRFD BDS and based on past experience in the vicinity of the site with projects performed in similar subsurface profiles.

5.2.2 Bearing Stability

The bearing soils along the alignment of Wall W4 at the rear abutment are anticipated to consist of stiff to very stiff silt and clay and sandy silt (ODOT A-6a, A-4a), and the anticipated soils along the alignment of Wall W6 south of the rear abutment are anticipated to consist of very stiff silt and clay (ODOT A-6a) or loose to medium dense gravel, gravel with sand or gravel with sand, silt and clay (ODOT A-1-a, A-1-b, A-2-6). MSE wall foundations bearing on these soils or engineered fill, placed and compacted in accordance with ODOT Item 203, may be proportioned for a factored bearing resistance as indicated in Table 10. A geotechnical resistance factor of $\phi_b=0.65$ was considered in calculating the factored bearing resistance at the strength limit state. Given that the bearing soils consist cohesive material, the bearing resistance was evaluated under both drained and undrained conditions. The reinforcement lengths presented in the following table represent the minimum foundation widths required to satisfy external and global stability requirements, expressed as a percentage of the wall height.

Table 10. FRA-70-1301R (Retaining Wall W4 and W6) MSE Wall Design Parameters

Substructure Unit (Boring)	Wall Height Analyzed (feet)	Back-slope Behind Wall	Minimum Required Reinforcement Length ¹ (feet)	Bearing Resistance at Strength Limit (ksf)		Strength Limit Equivalent Bearing Pressure ³ (ksf)
				Nominal	Factored ²	
Rear Abutment / Retaining Wall W4 (B-015-1-13)	25.2	Level	20.2 (0.80H)	14.05 ⁽⁴⁾	9.13	5.64
Forward Abutment / Retaining Wall W6 (B-108-5-13, B-012-E-68)	21.4	2:1 (Broken-Back)	15.0 (0.70H)	12.05	7.83	7.70

1. The minimum reinforcement length is based on the maximum wall height analyzed. The value in parentheses represent the required reinforcement length expressed as a percentage of the wall height, H.
2. A geotechnical resistance factor of $\phi_b=0.65$ was considered in calculating the factored bearing resistance at the strength limit state.
3. The strength limit equivalent bearing pressure is the uniformly distributed pressure asserted by the wall over an effective base width based on the eccentricity of the wall system at the strength limit state.
4. The nominal bearing resistance was determined using limit equilibrium methodology, which is permitted as an alternate methodology per Section 10.6.3.1.2c of the 2020 AASHTO LRFD BDM.

The nominal bearing resistance at the rear abutment, which is supported at the top of a slope, was determined using limit equilibrium methodology, which is permitted as an alternate methodology per Section 10.6.3.1.2c of the 2020 AASHTO LRFD BDM. The cross section of the wall and slope were modeled within a slope stability software along with the layered soil stratigraphy, and the loading for the MSE wall was simulated along the effective footing width based on the calculated eccentricity of the wall. The bearing pressure was increased incrementally until a factor of safety of 1.00 was achieved, which represents the unfactored (nominal) bearing resistance.

Rii performed a verification of the bearing pressure exerted on the subgrade material for the specified wall heights indicated in Table 10. Based on the minimum length of reinforced soil mass presented, the factored equivalent bearing pressure exerted below the wall **will not exceed** the factored bearing resistance at the strength limit state, considering the wall will bear on the existing fill material at the rear abutment.

5.2.3 Settlement Evaluation

The compressibility parameters utilized in the settlement analyses of the proposed MSE walls are provided in Table 11.

Table 11. Compressibility Parameters Utilized in Settlement Analysis

Material Type	γ (pcf)	LL (%)	$C_c^{(1)}$	$C_r^{(2)}$	$e_o^{(3)}$	$C_v^{(4)}$ (ft ² /yr)	N_{60}	$C'^{(5)}$
Upper Cohesive Soils: Stiff to Very Stiff Sandy Silt, Silt and Clay and Silty Clay (ODOT A-4a, A-6a, A-6b)	120	26 to 37	0.080 to 0.137 ⁽⁶⁾	0.016 to 0.023 ⁽⁶⁾	0.355 to 0.698 ⁽⁶⁾	175 to 400 ⁽⁶⁾	N/A	N/A
Lower Cohesive Soils: Stiff to Hard Sandy Silt (ODOT A-4a)	115 to 125	21	0.099	0.015	0.436	400	N/A	N/A
Medium Dense to Very Dense Granular Soils (ODOT A-1-a, A-1-b, A-2-6)	125 to 135	N/A	N/A	N/A	N/A	N/A	18 to 69	70 to 357

1. Per Table 6-9, Section 6.14.1 of FHWA GEC 5.
2. Estimated at 10% of C_c per Section 8.11 of Holtz and Kovacs (1981).
3. Per Table 8-2 of Holtz and Kovacs (1981).
4. Per Figure 6-37, Section 6.14.2 of FHWA GEC 5.
5. Per Figure 10.6.2.4.2-1 of 2018 AASHTO LRFD BDS.
6. Values determined from consolidation test results on representative samples.

Results of the settlement analysis are tabulated in Table 12. Total settlements of up to 2.90 inches at the center of the reinforced soil mass and 1.80 inches at the facing of the wall are anticipated along Wall W4 at the rear abutment. Total settlements ranging from 0.39 to 1.83 inches at the center of the reinforced soil mass and 0.30 to 1.58 inches at the facing of the wall are anticipated along Wall W6 on the south side of the forward abutment. Based on the results of the analysis, 90 percent of the total settlement is anticipated to occur over a period of approximately 2 to 24 days. Please note that the consolidation settlement and time rate of consolidation are based on estimates using correlated compressibility parameters provided in Table 11 for the underlying soils. Actual settlement and time rate of consolidation should be determined by monitoring the settlement of the wall using settlement platforms.

Table 12. MSE Wall Settlement Values

Substructure Unit (Boring)	Service Limit Equivalent Bearing Pressure ¹ (ksf)	Total Settlement Values (inches)		Time to 90% Consolidation (Days)
		Center of Wall Mass	Facing of Wall	
Rear Abutment / Retaining Wall W4 (B-015-1-13)	3.98	2.90	1.83	24
Forward Abutment / Retaining Wall W6 (B-108-5-13, B-012-E-68)	0.53 to 5.14	0.39 to 1.92	0.30 to 1.58	1 to 2

1. The service limit equivalent bearing pressure is the uniformly distributed pressure asserted by the wall over an effective base width based on the eccentricity of the wall system at the service limit state.

Per Section 307.1.6 of the 2020 ODOT BDM, the maximum allowable differential settlement in the longitudinal direction (regardless of the size of panels) is one (1) percent (1/100). Based on the results of the settlement analysis, differential settlement greater than 1/100 may occur along the wall facing based on the short distance that the wall is brought down to existing grade. If either the total or differential settlement values predicted present an issue with respect to the deformation tolerances that the wall can withstand, then measures should be taken to minimize the amount of settlement that will occur. This can be achieved by preloading the site and consolidating the underlying soils prior to constructing the walls. If preloading the site is not a desired option, then consideration could be given to ground improvement through the use of stone columns.

5.2.4 Eccentricity (Overturning Stability)

The resistance of the MSE walls to overturning will be dependent on the on the location of the resultant force at the bottom of the wall due to the overturning and resisting moments acting on the wall. For MSE walls, overturning stability is determined by calculating the eccentricity of the resultant force from the midpoint of the base of the wall and comparing this value to a limiting eccentricity value. Per Section 11.10.5.5 of the 2020 AASHTO LRFD BDS, for foundations bearing on soil, the location of the resultant of the reaction forces shall be within the middle two-thirds ($\frac{2}{3}$) of the base width. Therefore, the limiting eccentricity is one-third ($\frac{1}{3}$) of the base width of the wall. Rii performed a verification of the eccentricity of the resultant force for the specified wall height indicated in Table 10. Based on the minimum length of reinforced soil mass presented in Table 10 and utilizing the soil parameters listed in Section 5.2.1 for the retained embankment material, the calculated eccentricity of the resultant force **will not exceed** the limiting eccentricity at the strength limit state.

5.2.5 Sliding Stability

The resistance of the MSE walls to sliding was evaluated per Section 11.10.5.3 of the 2020 AASHTO LRFD BDS. Given that the bearing soils along both of the walls consist of cohesive material, the sliding resistance was evaluated under both drained and undrained conditions. For drained conditions, the sliding resistance is determined by multiplying a coefficient of sliding friction “f” times the total vertical force at the base of the wall. The coefficient of sliding friction is determined based on the limiting friction angle between the foundation soil and the reinforced soil backfill. Based on the soil parameters listed in Section 5.2.1 for the foundation soil and the reinforced soil backfill, a coefficient of sliding friction of 0.53 was utilized for design. For undrained conditions, the sliding resistance is taken as the limiting value between the undrained shear strength of the bearing soil and half of the vertical stress applied by the wall multiplied by the width of the MSE wall. Based on the soil parameters listed in Section 5.2.1, the undrained shear strength of the bearing material ranges from 2.00 to 3.13 ksf.

Per Section 307.4 of the 2020 ODOT BDM, the sliding resistance was evaluated at both the top and bottom of the foundation preparation layer, which consists of 12.0 inches of ODOT Item 703.16.C, Granular Material Type C. For analysis at the top of the foundation preparation layer, the full wall height as defined in Table 10 is utilized and the material properties for the Granular Material Type C are assumed to be the same as the select granular backfill. For the analysis at the bottom of the foundation preparation layer, the full wall height as defined in Table 10 plus 1.0-foot is utilized in the analysis along with material properties for the subgrade soils as defined in the paragraph above.

A geotechnical resistance factor of $\phi_r=1.0$ was considered in calculating the factored shear resistance between the reinforced soil mass and foundation for sliding. Based on the minimum length of reinforced soil mass presented in Table 10 and utilizing the soil parameters listed in Section 5.2.1 for the retained embankment material, the resultant horizontal forces on the back of the MSE walls **will not exceed** the factored shear resistance at the strength limit state under drained or undrained conditions for either wall.

5.2.6 Overall (Global) Stability

A slope stability analysis was performed to check the global stability of walls at the rear and forward abutments. As per Section 11.6.2.3 of the 2020 AASHTO LRFD BDS, safety against soil failure shall be evaluated at the service limit state by assuming the reinforced soil mass to be a rigid body. Soil parameters utilized in external stability analyses are presented in Section 5.2.1. For the global stability condition, it was considered that the failure plane will not cross through the reinforced soil masses. The computer software program Slide 2, manufactured by Rocscience Inc., was utilized to perform the analyses.

Per Section 307.1.2 of the 2020 ODOT BDM and Section 11.6.2.3 of the 2020 AASHTO LRFD BDS, overall (global) stability for MSE walls that are integrated with or supporting structural foundations or elements is satisfied if the product of the factor of safety from the slope stability output multiplied by the resistance factor $\phi=0.65$ is greater than 1.0. Therefore, global stability is satisfied when a minimum factor of safety of 1.5 is obtained. For an MSE wall designed with the minimum strap length listed in Table 10, the resulting factor of safety under drained conditions (long-term stability) and undrained conditions (short-term stability) at Wall W4 (rear abutment) and Wall W6 (south side of forward abutment) using the Spencer's analysis method was greater than 1.5.

5.2.7 Final MSE Wall Considerations

Based on the results of the external and global stability analysis performed for Wall W4 (rear abutment) and Wall W6 (south side of the forward abutment), the recommended controlling strap length is 0.8 and 0.7 times the maximum height of the MSE wall, respectively. Global stability under drained conditions was the controlling factor in the determination of the recommended strap length at Wall W4 (rear abutment).

Calculations for external (bearing and sliding resistance and limiting eccentricity), overall (global) stability and settlement of the MSE walls are provided in Appendix IX.

5.3 Embankment Settlement Evaluation (Pier 2 and Forward Abutment)

5.3.1 Compressibility Parameters

The compressibility parameters utilized in the settlement analyses of the future embankment fill at that will be placed at Pier 2 and the proposed spill through embankment at the forward abutment are provided in Table 13.

Table 13. Compressibility Parameters Utilized in Settlement Analysis

Material Type	γ (pcf)	LL (%)	C_c ⁽¹⁾	C_r ⁽²⁾	e_o ⁽³⁾	C_v ⁽⁴⁾ (ft ² /yr)	N_{60}	C' ⁽⁵⁾
Upper Cohesive Soils: Very Stiff to Hard Silt and Clay and Clay (ODOT A-6a, A-7-6)	120 to 130	32 to 42	0.109 to 0.234 ⁽⁶⁾	0.023 to 0.029 ⁽⁶⁾	0.563 to 0.987 ⁽⁶⁾	200 to 300 ⁽⁶⁾	N/A	N/A
Lower Cohesive Soils: Hard Sandy Silt (ODOT A-4a)	125 to 135	19 to 20	0.081 to 0.090	0.012 to 0.014	0.420 to 0.436	400	N/A	N/A
Medium Dense to Very Dense Granular Soils (ODOT A-1-a, A-1-b)	125 to 140	N/A	N/A	N/A	N/A	N/A	15 to 100	66 to 355

1. Per Table 6-9, Section 6.14.1 of FHWA GEC 5.
2. Estimated at 15% of C_c per Section 8.11 of Holtz and Kovacs (1981).
3. Per Table 8-2 of Holtz and Kovacs (1981).
4. Per Figure 6-37, Section 6.14.2 of FHWA GEC 5.
5. Per Figure 10.6.2.4.2-1 of 2018 AASHTO LRFD BDS.
6. Values determined from consolidation test results on representative samples.

5.3.2 Settlement Analysis

The soil profile at pier 2 consists of a thin layer of stiff to very stiff silt and clay (ODOT A-6a) overlying granular soils comprised of medium dense to very dense gravel and gravel with sand (ODOT A-1-a, A-1-b) with isolated seams of hard sandy silt (ODOT A-4a) based on the conditions encountered in boring B-014-4-19. The soil profile at the forward abutment consists of hard silt and clay and clay (ODOT A-6a, A-7-6) overlying granular soils comprised of dense to very dense gravel and gravel with sand (ODOT A-1-a, A-1-b) with isolated seams of hard sandy silt (ODOT A-4a) based on the conditions encountered in boring B-014-7-20.

A settlement analysis was performed at each location to predict the long term consolidation settlement that will result after the embankment fill has been placed. Based on the plan and profile information provided, fill heights up to 22.0 feet for the future SR 315 embankment at Pier 2 and 29.5 feet for the forward abutment spill through embankment are anticipated. Results of the settlement analysis for each location are presented in Table 14.

Table 14. Anticipated Settlement

Substructure Unit	Boring Number	Anticipated Embankment Height (feet)	Total Settlement (in)
Pier 2	B-014-4-19	22.0	2.05
Forward Abutment	B-014-7-20	29.5	5.73

Results of the settlement analysis indicate that a total settlement of 2.05 inches should be expected due to the weight of the new embankment fill at Pier 2. Since the fill will be placed at a future date following construction of the bridge structure, time rate of settlement is not pertinent for this structure. The total settlement anticipated below the bottom of footing elevation at this substructure is anticipated to be 1.26 inches following the placement of the fill.

Results of the settlement analysis indicate that a total settlement of 5.73 inches should be expected due to the weight of the new embankment fill at the forward abutment. Based on the results of the analysis, 90 percent of the total settlement is anticipated to occur over a period of approximately 105 days, which results in a remaining settlement of 0.59 inches following this time period. Following a period of 30 days from the placement of the fill, the remaining settlement is estimated to be 1.50 inches, which is 74 percent of the total anticipated settlement. Please note that the consolidation settlement and time rate of consolidation are based on estimates using correlated compressibility parameters provided in Table 13 for the underlying soils. Actual settlement and time rate of consolidation should be determined by monitoring the settlement of the wall using settlement platforms. Results of the settlement analysis are provided in Appendix X.

5.4 Lateral Earth Pressure

For the soil types encountered in the borings, the “in-situ” unit weight (γ), cohesion (c), effective angle of friction (ϕ'), and lateral earth pressure coefficients for at-rest conditions (k_o), active conditions (k_a), and passive conditions (k_p) have been estimated and are provided in Table 15 and Table 16.

Table 15. Estimated Undrained (Short-term) Soil Parameters for Design

Soil Type	γ (pcf) ¹	c (psf)	ϕ	k_a	k_o	k_p
Soft to Stiff Cohesive Soil	115	1,000	0°	N/A	N/A	N/A
Very Stiff to Hard Cohesive Soil	125	3,000	0°	N/A	N/A	N/A
Loose Granular Soil	120	0	28°	0.32	0.53	5.07
Medium Dense to Dense Granular Soil	130	0	32°	0.27	0.47	6.82
Very Dense Granular Soil	135	0	35°	0.24	0.43	8.56
Compacted Cohesive Engineered Fill	120	2,000	0°	N/A	N/A	N/A
Compacted Granular Engineered Fill	130	0	33°	0.26	0.46	7.41

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

Table 16. Estimated Drained (Long-term) Soil Parameters for Design

Soil Type	γ (pcf) ¹	c (psf)	ϕ'	k_a	k_o	k_p
Soft to Stiff Cohesive Soil	115	0	24°	0.37	0.59	3.97
Very Stiff to Hard Cohesive Soil	125	100	28°	0.32	0.53	5.07
Loose Granular Soil	120	0	28°	0.32	0.53	5.07
Medium Dense to Dense Granular Soil	130	0	32°	0.27	0.47	6.82
Very Dense Granular Soil	135	0	35°	0.24	0.43	8.56
Compacted Cohesive Engineered Fill	120	0	28°	0.32	0.53	5.07
Compacted Granular Engineered Fill	130	0	33°	0.26	0.46	7.41

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

These parameters are considered appropriate for the design of all subsurface structures and any excavation support systems. Subsurface structures (where the top of the structure is restrained from movement) should be designed based on at-rest conditions (k_o). For proposed temporary retaining structures (where the top of the structure is allowed to move), earth pressure distributions should be based on active (k_a) and passive (k_p) conditions. Active earth pressure is developed as the structure moves away from the backfill or retained soil, while passive pressure is developed as the structure moves towards the backfill. A relatively small amount of lateral movement is needed to reach the active condition (≥ 0.1 percent of the height), whereas the movements required to engage the passive condition are approximately ten times greater than those required to develop active earth pressure. The values in this table have been estimated from correlation charts based on minimum standards specified for compacted engineered fill materials.

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

Where necessary, temporary retaining structures such as sheet pile system should be designed using the undrained soil parameters provided in Table 15, and the design should follow all applicable guidelines for the type of retaining structure utilized. Permanent retaining and subsurface structures should be designed using the drained soil parameters provided in Table 16. Regardless of whether the retaining structure is temporary or permanent, the effective unit weight ($\gamma' = \gamma - 62.4$ pcf) plus the hydrostatic water pressure ($\gamma_w * h_w$, where h_w is the height of water behind the wall above the base of the wall) should be utilized below the design groundwater level. The lateral earth pressure coefficients should only be applied to the horizontal pressure resulting from the effective overburden pressure, and should not be applied to the hydrostatic water pressure.

5.5 Pavement Subgrade Recommendations

The soils at the proposed subgrade elevation along the I-70 eastbound lanes between Souder Avenue (begin Sta. 128+26) and the proposed FRA-70-13.21R bridge structure (end Sta. 147+63) consist of granular material comprised of medium dense gravel with sand (ODOT A-1-b) and natural or fill materials comprised of very stiff to hard sandy silt and silt and clay (ODOT A-4a, A-6a). Based on the soil conditions encountered during the drilling phase and the presence of fill materials, it is estimated that the subgrade soils will require some level of stabilization under ODOT GB1. It is understood that the existing and proposed roadway profiles will approximately match.

The moisture content of cohesive soil has a significant effect on the physical properties of the material. It should be noted that the moisture contents provided on the boring logs, and utilized in this analysis, represent the conditions during the drilling phase of the project. The referenced borings for subgrade analysis were drilled on April 27, 2020. These soil conditions, especially in the surficial soils, may not coincide with the soil conditions that will be encountered during construction. Consequently, the extent/need for subgrade improvement is entirely dependent on the subgrade conditions (i.e., moisture contents) encountered at the time of construction.

5.5.1 Station by Station Stabilization Recommendations

It is understood that specific, “station by station” recommendations for subgrade stabilization under GB1 are required for anticipated stabilization quantities. Therefore, a summary of recommended excavation and replacement quantities are presented in Table 17. A complete analysis of each soil boring, looking at the proposed subgrade soils at each location, is presented in Appendix XII. Please note that the excavation and replacement depths in Table 17 are measured from the proposed subgrade elevation, which is estimated to be 1.4 to 1.5 feet on average below the proposed roadway profile grade.

Table 17. Station by Station Subgrade Stabilization Summary

From Station ¹	To Station ¹	Length (feet)	Representative Boring(s)	GB1 Subgrade Stabilization
128+26 (Begin Project)	135+78	752	B-014-1-19 & B-014-2-19	No stabilization is anticipated. Subgrade should be proof rolled per ODOT Item 204 to verify that the subgrade will not require stabilization.
142+24	147+63 (End Project)	539	B-014-5-19	No stabilization is anticipated. Subgrade should be proof rolled per ODOT Item 204 to verify that the subgrade will not require stabilization.

1. Beginning and ending station limits determined from plan information provided by ms consultants. Station limits estimated based on soil conditions encountered during the field exploration. Actual limits of stabilization may vary based on the conditions encountered during construction.

Please note that the limits and depth of stabilization provided in the table above are estimated based on the soil conditions encountered in the borings performed during the field exploration. Actual limits and depth of stabilization may differ from the recommendations provided. Per ODOT GB1 requirements, if it is elected to perform station by station stabilization, the entire subgrade should be proof rolled to identify the actual limits of unstable subgrade and depth of stabilization required. Upon completion of the stabilization, areas that required stabilization should be proof rolled to verify that stability has been achieved.

5.5.2 Global Stabilization

Based on the ODOT GB1, when approximately 30 percent or more of the subgrade requires stabilization, consideration should be given to utilizing a global stabilization option. Per ODOT GB1, global stabilization recommendations are based upon the overall average site parameters, as noted in Table 18.

Table 18. Average Site Parameters from GB-1 Analysis

Average N _{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Design CBR
20	8	14	12	5	8

Applying the averages in Table 18, GB1 recommends the following global stabilization options, which should be evaluated based upon a cost and constructability analysis:

- Option 1. Chemically stabilize the entire subgrade with 12-inches of cement, as per ODOT Item 206. For estimating purposes, utilize a cement content of 6.0 percent by weight of soil. Actual application rates shall be verified by the contractor under Item 206.06 Mixture Design for Chemically Stabilized Soils.**
- Option 2. Stone stabilize the entire subgrade via a 12-inch undercut and replacement with ODOT Item 703.16C granular material, Type B, C or D installed over ODOT Item 712.09 Geotextile Fabric, Type D as detailed in accordance with ODOT Item 204.**

Per ODOT GB1 requirements, if it is elected to perform global stabilization, the entire subgrade should be stabilized using one of the global stabilization options provided above (proof rolling of the subgrade prior to stabilization is not required). Upon completion of the stabilization, the entire subgrade should be proof rolled to verify that stability has been achieved.

Given that this section of I-70 is being reconstructed as part of a larger corridor construction project, it is recommended that global stabilization of the subgrade shall be performed regardless of the length of the project using the global chemical stabilization option (Option 1) above. This stabilization option will provide the most uniform and durable subgrade, and will match the proposed subgrade stabilization that is being utilized along the interstate sections within this corridor in the other phases of construction.

5.5.3 Subgrade Design Considerations

California Bearing Ratio (CBR) values for the entire project ranged from 6 to 12 with an average of 8. If it is elected to proceed with global stabilization of the entire subgrade, it is recommended that pavement design be based on the average CBR of 8 with a corresponding natural resilient modulus, M_R , of 9,600 psi. However, since the entire subgrade will receive global chemical stabilization, the resilient modulus can be increased per Section 203.4.1 of the ODOT Pavement Design Manual, which results in an increased design resilient modulus, M_{R-GCS} , of 13,056 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 182 pci and a soil support value (SSV) of 5.4.

Per ODOT GB1, soils with sulfate content in excess of 5,000 ppm cannot be chemically stabilized due to the potential for sulfate heave in the soil. Based on the results of the testing, the sulfate contents of the subgrade soils in range from 640 to 1,900 parts per million (ppm or mg/kg of material). Therefore, soil with a sulfate content greater than 5,000 ppm was not encountered in any of the borings.

Please note that the recommended CBR values assume that the materials utilized for the road subgrade in fill areas are equivalent to, or better than materials at the existing subgrade elevation. Sources of borrow material should be designated in advance of construction. The material should be tested in the laboratory to verify the soil exhibits a minimum design CBR value of 8.

Pavement design is dependent on the inclusion of adequate surface and subsurface drainage in order to maintain the compacted subgrade near optimum moisture conditions throughout the lifetime of the pavement. If underdrain systems are considered, they should be installed in accordance to the specifications presented in Item 204.

5.6 Construction Considerations

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

5.6.1 Excavation Considerations

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

Table 19. Excavation Back Slopes

Soil	Maximum Back Slope	Notes
Soft to Medium Stiff Cohesive	1.5 : 1.0	Above Ground Water Table and No Seepage
Stiff Cohesive	1.0 : 1.0	Above Ground Water Table and No Seepage
Very Stiff to Hard Cohesive	0.75 : 1.0	Above Ground Water Table and No Seepage
All Granular & Cohesive Soil Below Ground Water Table or with Seepage	1.5 : 1.0	None
Rock to 3.0' +/- below Auger Refusal	0.75 : 1.0	Above Ground Water Table and No Seepage
Stable Rock	Vertical	Above Ground Water Table and No Seepage

5.6.2 Groundwater Considerations

Based on the groundwater observations made during drilling, groundwater may be encountered during construction of Piers 2 and 3. Where groundwater is encountered, proper groundwater control should be employed and maintained to prevent disturbance to excavation bottoms consisting of cohesive soil, and to prevent the possible development of a quick or "boiling" condition where soft silts and/or fine sands are encountered. It is preferable that the groundwater level, if encountered, be maintained at least 36 inches below the deepest excavation. Any seepage or groundwater encountered at this site should be able to be controlled by pumping from temporary sumps. Additional measures may be required depending on seasonal fluctuations of the groundwater level. Note that determining and maintaining actual groundwater levels during construction is the responsibility of the contractor.

6.0 LIMITATIONS OF STUDY

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

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

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

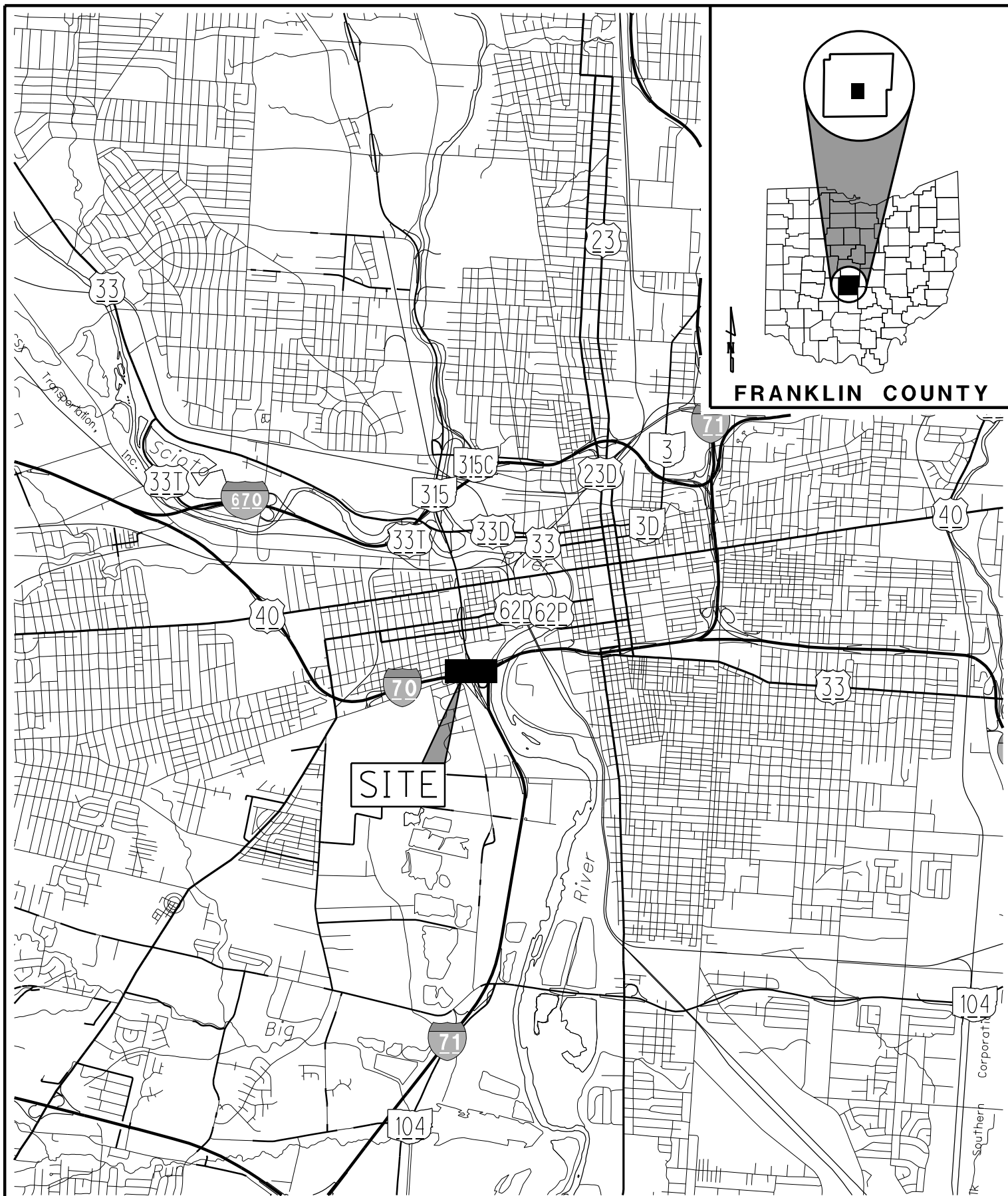
The scope of our services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater or surface water within or beyond the site studied. Any statements in this report or on the test boring logs regarding odors, staining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

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



APPENDIX I

VICINITY MAP AND BORING PLAN



VICINITY MAP
FRA-70-13.01
COLUMBUS, OHIO

RII PROJECT NO.
W-20-025

SCALE: 1"=5000'
 0 2500 5000

DRAWN
RRM
 REVIEWED
BRT
 DATE
5/13/2020



APPENDIX II

DESCRIPTION OF SOIL TERMS

DESCRIPTION OF SOIL TERMS

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

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

The relative compactness of granular soils is described as:

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

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

The relative consistency of cohesive soils is described as:

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

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

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

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

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

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

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

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

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

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





















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



CLASSIFICATION OF SOILS

Ohio Department of Transportation

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

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

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

DESCRIPTION OF ROCK TERMS

The following terminology was used to describe the rock throughout this report and is generally adapted from ASTM D5878 and the ODOT Specifications for Geotechnical Explorations.

Weathering – Describes the degree of weathering of the rock mass:

<u>Description</u>	<u>Field Parameter</u>
Unweathered	No evidence of any chemical or mechanical alteration of the rock mass. Mineral crystals have a right appearance with no discoloration. Fractures show little or not staining on surfaces.
Slightly Weathered	Slight discoloration of the rock surface with minor alterations along discontinuities. Less than 10% of the rock volume presents alteration.
Moderately Weathered	Portions of the rock mass are discolored as evident by a dull appearance. Surfaces may have a pitted appearance with weathering “halos” evident. Isolated zones of varying rock strengths due to alteration may be present. 10 to 15% of the rock volume presents alterations.
Highly Weathered	Entire rock mass appears discolored and dull. Some pockets of slightly to moderately weathered rock may be present and some areas of severely weathered materials may be present.
Severely Weathered	Majority of the rock mass reduced to a soil-like state with relic rock structure discernable. Zones of more resistant rock may be present but the material can generally be molded and crumbled by hand pressures.

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

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

Bedding Thickness – Description of bedding thickness as the average perpendicular distances between bedding surfaces:

<u>Description</u>	<u>Thickness</u>
Very Thick	Greater than 36 inches
Thick	18 to 36 inches
Medium	10 to 18 inches
Thin	2 to 10 inches
Very Thin	0.4 to 2 inches
Laminated	0.1 to 0.4 inches
Thinly Laminated	Less than 0.1 inches

Fracturing – Describes the degree and condition of fracturing (fault, joint, or shear):

Degree of Fracturing

<u>Description</u>	<u>Spacing</u>
Unfractured	Greater than 10 feet
Intact	3 to 10 feet
Slightly Fractured	1 to 3 feet
Moderately Fractured	

Aperture Width

<u>Description</u>	<u>Width</u>
Open	Greater than 0.2 inches
Narrow	0.05 to 0.2 inches
Tight	Less than 0.05 inches

Surface Roughness

<u>Description</u>	<u>Criteria</u>
Very Rough	Near vertical steps and ridges occur on surface
Slightly Rough	Asperities on the surfaces distinguishable
Slickensided	Surface has smooth, glassy finish, evidence of Striations

RQD – Rock Quality Designation (calculation shown in report) and Rock Quality (ODOT, GB 3, January 13, 2006):

<u>RQD %</u>	<u>Rock Index Property Classification (based on RQD, not slake durability index)</u>
0 – 25%	Very Poor
26 – 50%	Poor
51 – 70%	Fair
71 – 85%	Good
86 – 100%	Very Good

APPENDIX III

PROJECT BORING LOGS:

**B-014-1-19 through B014-7-20, B-015-1-13,
B-015-2-13 and B-108-5-13 and B-108-6-13**

BORING LOGS

Definitions of Abbreviations

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

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

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


Classification Test Data

Gradation (as defined on Description of Soil Terms):

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

Atterberg Limits:

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

	PROJECT: FRA-70-13.01	DRILLING FIRM / OPERATOR: RII / LH	DRILL RIG: CME 55 (386345)	STATION / OFFSET: 130+97.17 / 20.8' LT	EXPLORATION ID B-014-1-19
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / TG	HAMMER: AUTOMATIC	ALIGNMENT: BL CONST. I-70 EB	
	PID: 105430 SFN: NA	DRILLING METHOD: 4.5" CFA	CALIBRATION DATE: 9/4/18	ELEVATION: 736.5 (MSL) EOB: 7.5 ft.	PAGE 1 OF 1
	START: 4/27/20 END: 4/27/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 91.2	LAT / LONG: 39.950225, -83.019864	

MATERIAL DESCRIPTION AND NOTES	ELEV. 736.5	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
								GR	CS	FS	SI	CL	LL	PL	PI				
0.4' - ASPHALT (4.5")	736.1																		
1.0' - CONCRETE (11.5")	735.1	1																	
MEDIUM DENSE, GRAY GRAVEL WITH SAND , LITTLE SILT, TRACE CLAY, DAMP.	733.5	2	6	5	15	72	SS-1	-	39	26	12	18	5	19	14	5	8	A-1-b (0)	1900
VERY STIFF, GRAY SANDY SILT , SOME FINE GRAVEL, TRACE CLAY, DAMP.		3	10	8	30	67	SS-2	3.50	26	16	22	26	10	21	17	4	13	A-4a (0)	-
		4	14	12															
	730.5	5	14	11	35	92	SS-3	3.50	-	-	-	-	-	-	-	-	13	A-4a (V)	-
		6	8	12															
HARD, GRAY SILT AND CLAY , LITTLE COARSE TO FINE SAND, LITTLE FINE GRAVEL, DAMP.	729.0	7	12	14	39	72	SS-4	4.5+	-	-	-	-	-	-	-	-	11	A-6a (V)	-
		EOB																	

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NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS. PAVEMENT PATCHED WITH COLD PATCH ASPHALT.

	PROJECT: FRA-70-13.01	DRILLING FIRM / OPERATOR: RII / LH	DRILL RIG: CME 55 (386345)	STATION / OFFSET: 135+81.56 / 15.6' LT	EXPLORATION ID B-014-2-19
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / TG	HAMMER: AUTOMATIC	ALIGNMENT: BL CONST. I-70 EB	
	PID: 105430 SFN: NA	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 9/4/18	ELEVATION: 744.5 (MSL) EOB: 94.6 ft.	PAGE 1 OF 4
	START: 4/27/20 END: 4/29/20	SAMPLING METHOD: SPT/RC	ENERGY RATIO (%): 91.2	LAT / LONG: 39.950298, -83.018137	

MATERIAL DESCRIPTION AND NOTES	ELEV. 744.5	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI				
0.4' - ASPHALT (4.5")	744.1																		
1.1' - CONCRETE (13.5")	743.0																		
FILL: VERY STIFF TO HARD, GRAY SANDY SILT , SOME FINE GRAVEL, LITTLE CLAY, DAMP TO MOIST.	736.3	1																	
		2	8	21	50	SS-1	3.50	32	23	9	24	12	19	16	3	16	A-4a (0)	1500	
		3																	
		4	11	29	33	SS-2	3.75	-	-	-	-	-	-	-	-	11	A-4a (V)	-	
		5																	
		6	9																
		7	8	21	14	SS-3	4.50	-	-	-	-	-	-	-	-	8	A-4a (V)	-	
		8	10	-	50	SS-3A	3.00	-	-	-	-	-	-	-	-	13	A-4a (V)	-	
FILL: VERY STIFF, GRAY SILT AND CLAY , SOME COARSE TO FINE SAND, SOME FINE GRAVEL, DAMP TO MOIST.	721.5	9	8	15	69	SS-4	3.00	21	12	15	32	20	26	15	11	13	A-6a (4)	-	
		10																	
		11	3																
		12	4	15	72	SS-5	3.75	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
		13																	
		14	4	15	75	SS-6	3.50	-	-	-	-	-	-	-	-	16	A-6a (V)	-	
		15																	
		16	3																
		17	7	23	67	SS-7	3.75	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
		18																	
FILL: VERY STIFF, GRAY SANDY SILT , LITTLE CLAY, LITTLE FINE GRAVEL, DAMP TO MOIST.	716.5	19	5	27	78	SS-8	2.75	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
		20																	
		21	4																
		22	4	17	75	SS-9	3.25	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
		23																	
		24	8	33	94	SS-10	3.50	12	13	19	38	18	25	16	9	13	A-4a (4)	-	
		25																	
VERY STIFF TO HARD, GRAY SANDY SILT , LITTLE CLAY, SOME FINE GRAVEL, DAMP.	716.5	26	4																
		27	6	23	100	SS-11	4.00	-	-	-	-	-	-	-	-	18	A-4a (V)	-	
		28																	
		29	4	-	100	SS-12	4.00	-	-	-	-	-	-	-	-	9	A-4a (V)	-	

[illegible]

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PID: 105430	SFN: NA	PROJECT: FRA-70-13.01	STATION / OFFSET: 13581.56, 16' LT.					START: 4/27/20		END: 4/29/20		PG 3 OF 4		B-014-2-19						
MATERIAL DESCRIPTION AND NOTES		ELEV. 682.4	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
									GR	CS	FS	SI	CL	LL	PL	PI				
MEDIUM DENSE TO VERY DENSE, BROWN AND DARK BROWN GRAVEL WITH SAND , SOME SILT, TRACE CLAY, MOIST TO WET. <i>(continued)</i>		682.4	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></d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-WATER ADDED @ 78.3'
-HEAVING SAND @ 78.5'


AUGER REFUSAL @ 82.0'

00-2021 RII STAND ODOT LOG-SUL (8.5 X 11) - OH DOT.GDT - 6/26/21 18:12 - U:\G8\PROJECTS\2020\W-20-025.GPJ

PID: 105430	SFN: NA	PROJECT: FRA-70-13.01	STATION / OFFSET: 13581.56, 16' LT.				START: 4/27/20		END: 4/29/20		PG 4 OF 4		B-014-2-19										
MATERIAL DESCRIPTION AND NOTES			ELEV.	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED		
			650.2							GR	CS	FS	SI	CL	LL	PL	PI						
			649.9	EOB																			
NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 62.0'; CAVE-IN DEPTH @ 72.3'																							
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 94 LBS CEMENT / 50 LBS BENTONITE POWDER / 20 GAL WATER. PAVEMENT PATCHED WITH ASPHALT COLD PATCH.																							



B-014-2-19 – NQ-2 and NQ-3 – Depth from 84.6 to 94.6 feet

	PROJECT: FRA-70-13.01	DRILLING FIRM / OPERATOR: RII / SB	DRILL RIG: CME 750X (310218)	STATION / OFFSET: 139+05.23 / 30.7' LT	EXPLORATION ID B-014-3-19
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / TG	HAMMER: AUTOMATIC	ALIGNMENT: BL CONST. I-70 EB	
	PID: 105430 SFN: NA	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 9/4/18	ELEVATION: 700.9 (MSL) EOB: 54.8 ft.	PAGE 1 OF 2
	START: 4/24/20 END: 4/24/20	SAMPLING METHOD: SPT/RC	ENERGY RATIO (%): 79.5	LAT / LONG: 39.950416, -83.017000	

MATERIAL DESCRIPTION AND NOTES	ELEV. 700.9	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI				
0.4' - TOPSOIL (4.0")	700.5		5			SS-1A	-	-	-	-	-	-	-	-	-	-			
DENSE, DARK BROWN GRAVEL WITH SAND AND SILT , TRACE CLAY, MOIST.	699.4	1	11 14	33	56	SS-1B	-	73	8	5	9	5	26	19	7	9	A-2-4 (0)	-	
DENSE TO VERY DENSE, DARK BROWN TO BROWNISH GRAY GRAVEL , LITTLE FINE TO COARSE SAND, LITTLE SILT, TRACE CLAY, MOIST.		2	11 39 25	85	56	SS-2	-	-	-	-	-	-	-	-	-	5	A-1-a (V)	-	
		3																	
		4	12 14 18	42	69	SS-3	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	-	
-COBBLES @ 5.0'		5																	
		6																	
		7	24 23 30	70	72	SS-4	-	-	-	-	-	-	-	-	-	6	A-1-a (V)	-	
		8																	
		9	24 30 24	72	89	SS-5	-	66	13	6	11	4	NP	NP	NP	7	A-1-a (0)	-	
-COBBLES @ 10.0'		10																	
		11	19 14 12	34	75	SS-6	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	-	
		12																	
		13																	
		14	16 16 13	38	39	SS-7	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	-	
		15																	
-MUD ADDED @ 16.0'		16	18 17 11	37	69	SS-8	-	-	-	-	-	-	-	-	-	9	A-1-a (V)	-	
	682.9	17																	
MEDIUM DENSE, GRAY GRAVEL WITH SAND , TRACE SILT, TRACE CLAY, WET.		18																	
		19	3 5 6	15	36	SS-9	-	-	-	-	-	-	-	-	-	17	A-1-b (V)	-	
		20																	
		21	6 7 6	17	81	SS-10	-	22	51	14	10	3	NP	NP	NP	16	A-1-b (0)	-	
	677.9	22																	
STIFF, GRAY SANDY SILT , LITTLE CLAY, TRACE FINE GRAVEL, MOIST.		23																	
		24	5 15 20	46	92	SS-11	1.25	-	-	-	-	-	-	-	-	19	A-4a (V)	-	
	675.4	25																	
VERY DENSE, GRAY GRAVEL WITH SAND , TRACE SILT, TRACE CLAY, MOIST.		26																	
-HEAVING SAND @ 26.0'		27	14 25 50/5"	-	85	SS-12	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	-	
		28																	
-COBBLES @ 29.0'		29	41 22 40	82	47	SS-13	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	-	

[illegible]



B-014-3-19 – NQ-1 and NQ-2 – Depth from 46.0 to 54.8 feet



PROJECT: FRA-70-13.01
 TYPE: BRIDGE REPLACEMENT
 PID: 105430 SFN: NA
 START: 4/22/20 END: 4/22/20

DRILLING FIRM / OPERATOR: RII / SB
 SAMPLING FIRM / LOGGER: RII / TG
 DRILLING METHOD: 3.25" HSA / NQ
 SAMPLING METHOD: SPT/RC

DRILL RIG: CME 750X (310218)
 HAMMER: AUTOMATIC
 CALIBRATION DATE: 9/4/18
 ENERGY RATIO (%): 79.5

STATION / OFFSET: 140+65.30 / 28.7' LT
 ALIGNMENT: BL CONST. I-70 EB
 ELEVATION: 698.8 (MSL) EOB: 49.7 ft.
 LAT / LONG: 39.950496, -83.016450


EXPLORATION ID
B-014-4-19
 PAGE
 1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI				
0.4' - TOPSOIL (5.0")	698.4		3			SS-1A	-	-	-	-	-	-	-	-	-	-		-	
STIFF TO VERY STIFF, DARK GRAY TO DARK BROWN SILT AND CLAY , "AND" FINE GRAVEL, LITTLE FINE TO COARSE SAND, DAMP.		1	10 9	25	50	SS-1B	2.75	-	-	-	-	-	-	-	-	10	A-6a (V)	-	
-COBBLES @ 3.0'		2	9																
	695.6	3	11 17	37	50	SS-2	1.50	44	13	7	23	13	33	19	14	16	A-6a (1)	-	
MEDIUM DENSE TO VERY DENSE, BROWNISH GRAY TO GRAY GRAVEL , SOME FINE TO COARSE SAND, TRACE SILT, TRACE CLAY, MOIST TO WET.		4	8			SS-3	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	-	
		5	12 12	32	61														
		6	8																
-COBBLES @ 7.5'		7	22 8	40	44	SS-4	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	-	
		8																	
		9	10 11	30	56	SS-5	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	-	
		10	12																
		11	12																
		12	17 16	44	83	SS-6	-	64	15	6	11	4	20	18	2	8	A-1-a (0)	-	
		13																	
-COBBLES @ 14.0'		14	5 8	28	61	SS-7	-	-	-	-	-	-	-	-	-	14	A-1-a (V)	-	
		15	13																
		16	3																
		17	9 9	24	72	SS-8	-	-	-	-	-	-	-	-	-	12	A-1-a (V)	-	
		18																	
-MUD ADDED @ 20.0'		19	8 7	15	78	SS-9	-	-	-	-	-	-	-	-	-	9	A-1-a (V)	-	
-COBBLES @ 20.0'		20	4																
		21																	
		22	18 30	73	86	SS-10	-	-	-	-	-	-	-	-	-	9	A-1-a (V)	-	
		23	25																
-COBBLES @ 23.0'		24	15 29	73	81	SS-11	-	69	18	5	7	1	NP	NP	NP	9	A-1-a (0)	-	
		25	26																
	672.3	26				SS-12A	-	-	-	-	-	-	-	-	-	7	A-1-a (V)	-	
HARD, GRAY SANDY SILT , SOME FINE GRAVEL, LITTLE CLAY, DAMP.		27	22 15	34	94	SS-12B	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	-	
		28																	
		29	5 9	27	81	SS-13	4.5+	25	11	14	32	18	20	14	6	11	A-4a (3)	-	
			11																

PID: 105430		SFN: NA		PROJECT: FRA-70-13.01		STATION / OFFSET: 14065.3, 29' LT.				START: 4/22/20			END: 4/22/20			PG 2 OF 2		B-014-4-19						
MATERIAL DESCRIPTION AND NOTES				ELEV. 668.8	DEPTHS		SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG				ODOT CLASS (GI)	SO4 ppm	HOLE SEALED	
												GR	CS	FS	SI	CL	LL	PL	PI	WC				
HARD, GRAY SANDY SILT , SOME FINE GRAVEL, LITTLE CLAY, DAMP. (continued)				666.8	TR	31																		
MEDIUM DENSE, GRAY GRAVEL WITH SAND , TRACE SILT, TRACE CLAY, MOIST.				662.3		32																		
						33																		
						34	6	8	25	50	SS-14	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	-	
						35	11																	
						36																		
HARD, GRAY SANDY SILT , TRACE CLAY, TRACE FINE GRAVEL, DAMP.				658.3		37																		
						38																		
						39	50/4"	-	88	SS-15	4.5+	-	-	-	-	-	-	-	-	-	8	A-4a (V)	-	
						40																		
GRAY LIMESTONE FRAGMENTS				656.7	EOB	41																		
AUGER REFUSAL @ 42.0'						42	50/1"	-	100	SS-16	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	-		
LIMESTONE : DARK GRAY AND DARK BROWN, SLIGHTLY WEATHERED, STRONG, THICK TO VERY THICK BEDDED, CHERTY, FOSSILIFEROUS, CRYSTALLINE, INTACT, NARROW, SLIGHTLY ROUGH; RQD 71.5%, REC 96.5%. -LOST WATER RETURNED @ 44.5'						43	54		97	NQ-1											CORE			
						44																		
						45																		
						46																		
					47																			
					48																			
					49																			
				649.1																				
NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 8.0'																								
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 70 LBS CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER																								




B-014-4-19 – NQ-1 and NQ-2 – Depth from 42.0 to 49.7 feet

	PROJECT: FRA-70-13.01	DRILLING FIRM / OPERATOR: RII / LH	DRILL RIG: CME 55 (386345)	STATION / OFFSET: 145+09.20 / 10' LT	EXPLORATION ID B-014-5-19
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / TG	HAMMER: AUTOMATIC	ALIGNMENT: BL CONST. I-70 EB	
	PID: 105430 SFN: NA	DRILLING METHOD: 4.5" CFA	CALIBRATION DATE: 9/4/18	ELEVATION: 736.1 (MSL) EOB: 7.3 ft.	PAGE 1 OF 1
	START: 4/27/20 END: 4/27/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 91.2	LAT / LONG: 39.950903, -83.014979	

MATERIAL DESCRIPTION AND NOTES	ELEV. 736.1	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
								GR	CS	FS	SI	CL	LL	PL	PI				
0.5' - ASPHALT (5.5")	735.6																		
0.9' - CONCRETE (11.5")	734.7																		
VERY STIFF, BROWN SANDY SILT , LITTLE CLAY, TRACE FINE GRAVEL, DAMP.	733.9		10	27	92	SS-1A	3.25	-	-	-	-	-	-	-	-	9	A-4a (V)	640	
VERY STIFF, DARK GRAY SILT AND CLAY , "AND" FINE TO COARSE SAND, LITTLE FINE GRAVEL, DAMP.	733.1		9			SS-1B	3.50	13	21	15	33	18	36	21	15	13	A-6a (5)	-	
			11	23	72	SS-2	3.50	21	18	17	26	18	33	23	10	20	A-4a (2)	-	
			8																
			4	29	100	SS-3	3.00	-	-	-	-	-	-	-	-	21	A-4a (V)	-	
			8																
			11																
			12																
			18																
			50/4"	-	100	SS-4	4.25	-	-	-	-	-	-	-	-	14	A-4a (V)	-	
	728.8	EOB																	

00-2021 RII STAND ODOT LOG-SUL (8.5 X 11) - OH DOT.GDT - 6/26/21 18:12 - U:\G8\PROJECTS\2020\W-20-025.GPJ


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

	PROJECT: FRA-70-13.01	DRILLING FIRM / OPERATOR: RII / LH	DRILL RIG: CME 55 - 386345	STATION / OFFSET: 136+40.68 / 12.2' LT	EXPLORATION ID B-014-6-20
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / JP	HAMMER: AUTOMATIC	ALIGNMENT: BL CONST. I-70 EB	
	PID: 105430 SFN: NA	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/14/20	ELEVATION: 745.4 (MSL) EOB: 88.1 ft.	PAGE 1 OF 3
	START: 12/10/20 END: 12/10/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 84.2	LAT / LONG: 39.950299, -83.017926	

MATERIAL DESCRIPTION AND NOTES	ELEV. 745.4	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI				
0.4' - ASPHALT (4.5")	745.0																		
1.1' - CONCRETE (13.5")	743.9																		
FILL:: HARD, DARK GRAY TO GRAY SILT AND CLAY, SOME COARSE TO FINE SAND, TRACE FINE GRAVEL, DAMP.		1																	
		2																	
		3																	
		4	3																
		5	4	5	13	33	SS-1	4.5+	-	-	-	-	-	-	-	13	A-6a (V)	-	
		6																	
		7																	
		8																	
		9																	
		10																	
		11																	
		12	6																
FILL:: HARD, DARK GRAY TO GRAY SILT AND CLAY, SOME COARSE TO FINE SAND, TRACE FINE GRAVEL, DAMP.		13	6	7	18	78	SS-2	4.5+	-	-	-	-	-	-	-	14	A-6a (V)	-	
		14																	
		15				71	ST-3	4.5+	8	9	16	31	36	27	15	12	13	A-6a (7)	-
		16																	
		17																	
		18																	
		19																	
		20																	
		21																	
		22																	
		23																	
		24	12																
-COBBLES @ 25.5' VERY STIFF TO HARD, BROWN TO GRAY SILT AND CLAY, LITTLE TO SOME COARSE TO FINE SAND, TRACE TO LITTLE FINE GRAVEL, DRY TO MOIST. -ATTEMPTED SHELBY TUBE @ 26.0'. MAXED OUT DOWN PRESSURE AND CRUSHED TUBE.	719.4	25	9	9	25	83	SS-4	4.5+	-	-	-	-	-	-	-	14	A-6a (V)	-	
		26																	
		27				0	ST-5	-	-	-	-	-	-	-	-	-		-	
		28				100	ST-6	4.5+	1	5	10	45	39	34	20	14	20	A-6a (10)	-
		29																	

[illegible]

[illegible]

	PROJECT: FRA-70-13.01	DRILLING FIRM / OPERATOR: RII / SB	DRILL RIG: CME 750X - 310218	STATION / OFFSET: 142+45.72 / 49.7' LT	EXPLORATION ID B-014-7-20
	TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / KS	HAMMER: AUTOMATIC	ALIGNMENT: BL CONST. I-70 EB	
	PID: 105430 SFN: NA	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/14/20	ELEVATION: 715.5 (MSL) EOB: 56.6 ft.	PAGE 1 OF 2
	START: 12/15/20 END: 12/15/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 86.2	LAT / LONG: 39.950698, -83.015876	

MATERIAL DESCRIPTION AND NOTES	ELEV. 715.5	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
								GR	CS	FS	SI	CL	LL	PL	PI				
0.2' - TOPSOIL (2.0") FILL: HARD, GRAY SILT AND CLAY, SOME FINE TO COARSE SAND, SOME FINE GRAVEL, DAMP.	715.3	1																	
		2																	
		3																	
		4	4	22	0	SS-1	-	-	-	-	-	-	-	-	-	-		-	
-LIMESTONE FRAGMENTS PRESENT THROUGHOUT		5	5 10 15	-	67	2S-1A	4.50	26	16	14	20	24	32	21	11	14	A-6a (2)	-	
		6																	
		7	7	53	83	SS-2	4.50	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
-ATTEMPTED SHELBY TUBES @ 8.0' AND 9.0'. MAXED OUT DOWN PRESSURE AND CRUSHED TUBES.		8	9 28		0	ST-3	-	-	-	-	-	-	-	-	-	-		-	
		9			0	ST-4	-	-	-	-	-	-	-	-	-	-		-	
		10																	
	704.0	11																	
HARD, DARK GRAY CLAY, "AND" SILT, LITTLE COARSE TO FINE SAND, MOIST.		12																	
		13	6 7 9	23	44	SS-5	4.50	0	5	7	41	47	46	25	21	23	A-7-6 (14)	-	
		14																	
		15			85	ST-6	4.50	32	10	7	32	19	42	27	15	23	A-7-6 (5)	-	
		16																	
		17																	
		18																	
		19																	
		20																	
		21																	
		22																	
		23																	
		24																	
	690.5	25																	
VERY DENSE, BROWN GRAVEL WITH SAND, LITTLE SILT, TRACE CLAY, WET.		26																	
-HEAVING SANDS @ 26.5'		27	21 40 49	128	94	SS-7	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	-	
		28	50/5"	-	80	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	-	
		29																	
		30	36																

00-2021 RII STAND ODOT LOG SUL (8.5 X 11) - OH DOT.GDT - 6/26/21 18:12 - U:\G8\PROJECTS\2020\W-20-025.GPJ

PID: 105430	SFN: NA	PROJECT: FRA-70-13.01	STATION / OFFSET: 14245.72, 50' LT.					START: 12/15/20					END: 12/15/20				PG 2 OF 2		B-014-7-20		
MATERIAL DESCRIPTION AND NOTES		ELEV. 685.5	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL	
									GR	CS	FS	SI	CL	LL	PL	PI					
VERY DENSE, BROWN GRAVEL WITH SAND , LITTLE SILT, TRACE CLAY, WET. <i>(continued)</i>		683.5	31	24 23	68	83	SS-9	-	62	15	6	14	3	NP	NP	NP	9	A-1-b (0)	-		
DENSE, BROWN GRAVEL , "AND" FINE TO COARSE SAND, TRACE SILT, WET. -COBBLES @ 33.0'			32																		
			33																		
			34																		
			35	13 15 15	43	72	SS-10	-	-	-	-	-	-	-	-	9	A-1-a (V)	-			
HARD, DARK GRAY SANDY SILT , SOME FINE GRAVEL, LITTLE CLAY, DAMP. -LIMESTONE FRAGMENTS IN SS-12		673.5	36																		
			37																		
			38																		
			39	12 14 14	40	78	SS-11	-	54	30	7	9	0	NP	NP	NP	11	A-1-a (0)	-		
			40																		
DENSE TO VERY DENSE, GRAY GRAVEL , SOME FINE TO COARSE SAND, TRACE SILT, WET. -LIMESTONE FRAGMENTS PRESENT THROUGHOUT		667.5	41																		
			42																		
			43																		
			44	3 6 10	23	67	SS-12	4.50	23	17	17	31	12	19	14	5	10	A-4a (2)	-		
			45																		
-COBBLES @ 55.0'		658.9	46			0	ST-13	-	-	-	-	-	-	-	-	-	-		-		
			47																		
			48																		
			49	9 13 18	45	61	SS-14	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	-		
			50																		
AUGER REFUSAL @ 56.6'			51																		
			52																		
			53																		
			54	11 50/5"	-	55	SS-15	-	64	23	6	7	0	NP	NP	NP	9	A-1-a (0)	-		
			55																		
			56																		
			EOB	50/1"	-	100	SS-16	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	-		

NOTES: GROUNDWATER ENCOUNTERED INITIALLY @ 25.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: COMPACTED WITH THE AUGER 100 LBS BENTONITE CHIPS AND SOIL CUTTINGS.



PROJECT: FRA-70-12.68 - PHASE 4A	DRILLING FIRM / OPERATOR: RII / J.B.	DRILL RIG: MOBILE B-53 (SN 624400)	STATION / OFFSET: 5041+24.30 / 73.2' LT	EXPLOSION ID B-015-1-13
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / A.D.	HAMMER: AUTOMATIC	ALIGNMENT: BL RAMP C5	
PID: 77372 BR ID: FRA-70-1301A	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/26/13	ELEVATION: 746.7 (MSL) EOB: 95.0 ft.	PAGE 1 OF 4
START: 7/25/13 END: 7/30/13	SAMPLING METHOD: SPT	ENERGY RATIO (%): 77.7	LAT / LONG: 39.949844277, -83.017516074	

MATERIAL DESCRIPTION AND NOTES	ELEV. 746.7	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	BACK FILL
								GR	CS	FS	SI	CL	LL	PL	PI			
0.8' - ASPHALT (9.0")	745.9																	
0.5' - AGGREGATE BASE (6.0")	745.4																	
FILL: VERY STIFF, GRAYISH BROWN TO GRAY SILT AND CLAY, LITTLE TO SOME COARSE TO FINE SAND, TRACE TO LITTLE FINE GRAVEL, DAMP. -STONE FRAGMENTS PRESENT IN SS-1		1																
		2	6	13	41	67	SS-1	4.00	-	-	-	-	-	-	-	9	A-6a (V)	
		3		19														
		4	3	6	22	67	SS-2	3.50	-	-	-	-	-	-	-	13	A-6a (V)	
		5		11														
		6	3															
		7	4	7	14	83	SS-3	4.00	-	-	-	-	-	-	-	12	A-6a (V)	
		8																
		9	4	4	10	33	SS-4	3.50	13	6	14	41	26	29	16	13	A-6a (8)	
		10																
		11	4															
		12	4	7	14	67	SS-5	4.00	-	-	-	-	-	-	-	14	A-6a (V)	
		13																
		14	2	2	10	67	SS-6	4.00	-	-	-	-	-	-	-	12	A-6a (V)	
		15		6														
		16	3															
		17	13	13	34	33	SS-7	4.00	-	-	-	-	-	-	-	13	A-6a (V)	
		18																
		19	5	7	26	61	SS-8	3.25	3	8	16	46	27	27	16	11	A-6a (8)	
		20		13														
		21	3															
		22	6	9	19	78	SS-9	3.50	-	-	-	-	-	-	-	14	A-6a (V)	
		23																
		24	6	13	28	61	SS-10	4.00	-	-	-	-	-	-	-	14	A-6a (V)	
	721.2	25		9														
STIFF, GRAY SANDY SILT, SOME FINE GRAVEL, LITTLE CLAY, DAMP.		26	2															
		27	6	7	17	78	SS-11	-	23	24	16	25	12	29	19	10	A-4a (0)	
	718.7	28																
VERY DENSE, BROWN GRAVEL AND SAND, LITTLE SILT, TRACE CLAY, MOIST.		29	21	28	69	83	SS-12	-	-	-	-	-	-	-	-	7	A-1-b (V)	
			25															

[illegible]

[illegible]



PROJECT: FRA-70-12.68 - PHASE 4A
 TYPE: STRUCTURE
 PID: 77372 BR ID: FRA-70-1301A
 START: 6/27/13 END: 6/28/13

DRILLING FIRM / OPERATOR: RII / S.M.
 SAMPLING FIRM / LOGGER: RII / S.B.
 DRILLING METHOD: 3.75" HSA / RC
 SAMPLING METHOD: SPT / NQ

DRILL RIG: CME-750 (SN 98048)
 HAMMER: CME AUTOMATIC
 CALIBRATION DATE: 4/26/13
 ENERGY RATIO (%): 82.6

STATION / OFFSET: 5042+88.86 / 2.6' RT
 ALIGNMENT: BL RAMP C5
 ELEVATION: 700.4 (MSL) EOB: 68.5 ft.
 LAT / LONG: 39.950018890, -83.017141752


EXPLORATION ID
B-015-2-13
 PAGE
 1 OF 3

MATERIAL DESCRIPTION AND NOTES	ELEV. 700.4	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	BACK FILL
								GR	CS	FS	SI	CL	LL	PL	PI			
0.4' - TOPSOIL (4.0") MEDIUM DENSE TO DENSE, BROWN GRAVEL WITH SAND AND SILT , TRACE CLAY, DAMP TO MOIST. -TRACE ROOT FIBERS PRESENT IN SS-1	700.0	1	10															
		2	17 17	47	72	SS-1	-	-	-	-	-	-	-	-	-	5	A-2-4 (V)	
		3																
		4	6															
-COBBLES PRESENT @ 5.0'	694.9	5	6 6	17	56	SS-2	-	40	18	12	22	8	25	18	7	11	A-2-4 (0)	
DENSE TO VERY DENSE, GRAY GRAVEL AND SAND , LITTLE SILT, TRACE CLAY, DAMP.		6	6															
		7	18 22	55	56	SS-3	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
		8																
		9	18 19 10	40	56	SS-4	-	59	15	7	16	3	18	17	1	6	A-1-b (0)	
	689.9	10																
LOOSE TO MEDIUM DENSE, GRAY GRAVEL AND SAND , LITTLE SILT, TRACE CLAY, MOIST TO WET.		11	8															
		12	4 6	14	33	SS-5	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
		13																
		14	2 3 4	10	33	SS-6	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
		15																
		16	3															
		17	6 4	14	33	SS-7	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		18																
		19	17 12 9	29	33	SS-8	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
-HEAVING SANDS ENCOUNTERED @ 20.0'		20																
-INTRODUCED MUD @ 20.0'		21	16 13 8	29	33	SS-9	-	-	-	-	-	-	-	-	-	24	A-1-b (V)	
	677.4	22																
MEDIUM DENSE TO VERY DENSE, GRAY GRAVEL , SOME FINE TO COARSE SAND, TRACE SILT, TRACE CLAY, MOIST.		23	2															
		24	7 16	32	33	SS-10	-	-	-	-	-	-	-	-	-	13	A-1-a (V)	
		25																
		26	11 19 21	55	50	SS-11	-	72	18	4	5	1	NP	NP	NP	10	A-1-a (0)	
		27																
		28																
		29	6 6 10	22	28	SS-12	-	-	-	-	-	-	-	-	-	12	A-1-a (V)	

[illegible]



B-015-2-13 – RC-1, RC-2, and RC-3 – Depth from 58.5 to 68.5 feet

	PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: RII / T.F.	DRILL RIG: CME-750X (SN 310218)	STATION / OFFSET: 239+69.30 / 18.7' RT	EXPLORATION ID B-108-5-13
	TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / S.B.	HAMMER: CME AUTOMATIC	ALIGNMENT: BL I-71 SB	
	PID: 89464 BR ID: FRA-71-1503L	DRILLING METHOD: 4.25" HSA / HQ	CALIBRATION DATE: 4/26/13	ELEVATION: 700.3 (MSL) EOB: 63.0 ft.	
	START: 6/30/14 END: 7/1/14	SAMPLING METHOD: SPT / RC	ENERGY RATIO (%): 86.8	LAT / LONG: 39.950226, -83.016079	
					PAGE 1 OF 3

MATERIAL DESCRIPTION AND NOTES	ELEV. 700.3	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI			
0.5' - TOPSOIL (6.0")	699.8																	
MEDIUM DENSE, BROWN AND GRAY GRAVEL WITH SAND , LITTLE SILT, TRACE CLAY, DAMP.		1	3															
		2	5	25	33	SS-1	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
	697.3	3	12															
STIFF, DARK BROWN SILT AND CLAY , SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, MOIST. -ROCK FRAGMENTS AND ORGANICS PRESENT IN SS-2		4	6	12	33	SS-2	2.00	20	16	15	30	19	30	17	13	18	A-6a (4)	
	694.8	5	4															
MEDIUM DENSE, BROWN TO DARK BROWN GRAVEL WITH SAND, SILT, AND CLAY , MOIST.		6	2															
		7	5	16	0	SS-3	-	-	-	-	-	-	-	-	-	-		
		8	5															
-COBBLES PRESENT THROUGHOUT		9	3															
		10	5	20	0	SS-4	-	-	-	-	-	-	-	-	-	-		
-ROCK FRAGMENTS PRESENT IN 3S-4A		11	9															
	689.8	12	9	-	100	3S-4A	-	43	17	10	17	13	30	18	12	15	A-2-6 (0)	
MEDIUM DENSE TO DENSE, BROWN GRAVEL , SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST.		13	8															
		14	7	20	39	SS-5	-	-	-	-	-	-	-	-	-	6	A-1-a (V)	
		15	7															
-COBBLES PRESENT THROUGHOUT		16	20															
		17	20	41	33	SS-6	-	-	-	-	-	-	-	-	-	12	A-1-a (V)	
		18	8															
	682.3	19	11															
MEDIUM DENSE, BROWN GRAVEL WITH SAND , LITTLE SILT, TRACE CLAY, WET.		20	9	27	100	SS-7	-	67	17	7	6	3	NP	NP	NP	13	A-1-a (0)	
		21	10															
		22	3															
-ROCK FRAGMENTS PRESENT IN SS-9		23	5	16	100	SS-8	-	3	61	20	11	5	NP	NP	NP	24	A-1-b (0)	
		24	6															
		25	3															
	677.3	26	6	22	78	SS-9	-	-	-	-	-	-	-	-	-	23	A-1-b (V)	
		27	9															
DENSE TO VERY DENSE, GRAY TO BROWN GRAVEL , SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, DAMP TO MOIST.		28	12															
		29	13	36	67	SS-10	-	-	-	-	-	-	-	-	-	6	A-1-a (V)	
		30	11															
		31	14															
		32	15	42	89	SS-11	-	67	15	7	8	3	17	14	3	10	A-1-a (0)	
		33																
-COBBLES PRESENT THROUGHOUT		34	60/3"	-	100	SS-12	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	


[illegible]

2014 ODOT BORING LOG-RII NE BRIDGE ID - OH DOT.GDT - 7/12/19 13:01 - U:\GIS\PROJECTS\2013\W-13-072.GPJ

PID: 89464		BR ID: FRA-71-1503L		PROJECT: FRA-70-13.10 - PHASE 6A		STATION / OFFSET: 239+69.30 / 18.7 RT				START: 6/30/14		END: 7/1/14		PG 3 OF 3		B-108-5-13							
MATERIAL DESCRIPTION AND NOTES				ELEV.	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED		
				638.2							GR	CS	FS	SI	CL	LL	PL	PI					
				637.3	EOB	63																	
NOTES: GROUNDWATER ENCOUNTERED INITIALLY @ 11.5'																							
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER																							



B-108-5-13 – RC-1 and RC-2 – Depth from 54.5 to 63.0 feet

	PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: RII / R.B.	DRILL RIG: CME-750X (SN 310218)	STATION / OFFSET: 242+23.02 / 20.7' RT	EXPLORATION ID B-108-6-13
	TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / S.B.	HAMMER: CME AUTOMATIC	ALIGNMENT: BL I-71 SB	
	PID: 89464 BR ID: FRA-71-1503L	DRILLING METHOD: 4.25" HSA / NQ	CALIBRATION DATE: 4/26/13	ELEVATION: 714.5 (MSL) EOB: 67.1 ft.	PAGE 1 OF 3
	START: 7/7/14 END: 7/8/14	SAMPLING METHOD: SPT / RC	ENERGY RATIO (%): 86.8	LAT / LONG: 39.950860, -83.015750	

MATERIAL DESCRIPTION AND NOTES	ELEV. 714.5	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI			
0.2' - TOPSOIL (2.0")	714.3																	
FILL: MEDIUM DENSE TO DENSE, BROWN GRAVEL WITH SAND AND SILT, LITTLE CLAY, DAMP.		1	9															
-BRICK AND CONCRETE FRAGMENTS PRESENT THROUGHOUT		2	13	33	67	SS-1	-	-	-	-	-	-	-	-	-	7	A-2-4 (V)	
		3	10															
		4	5															
		5	6	19	72	SS-2	-	50	16	5	15	14	NP	NP	NP	6	A-2-4 (0)	
	709.0	6	7															
FILL: MEDIUM STIFF, BLACK SILT AND CLAY, SOME COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST.		7	3	7	78	SS-3	-	-	-	-	-	-	-	-	-	19	A-6a (V)	
	706.5	8	2															
		9	7	16	11	SS-4	-	-	-	-	-	-	-	-	-	5	A-1-a (V)	
FILL: MEDIUM DENSE, BROWN GRAVEL, LITTLE COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, DAMP TO MOIST.		10	4															
	704.0	11	5	-	100	3S-4A	-	-	-	-	-	-	-	-	-	9	A-1-a (V)	
FILL: MEDIUM STIFF TO STIFF, GRAY TO BROWNISH GRAY SILT AND CLAY, SOME COARSE TO FINE SAND, LITTLE TO SOME FINE GRAVEL, DAMP TO MOIST.		12	2	9	44	SS-5	1.50	22	24	11	25	18	26	15	11	12	A-6a (2)	
		13	3															
		14	4	12	33	SS-6	1.75	-	-	-	-	-	-	-	-	21	A-6a (V)	
-ASPHALT AND COAL FRAGMENTS PRESENT IN SS-6		15	3															
		16	5															
		17	1	7	94	SS-7	1.00	16	12	11	28	33	31	19	12	24	A-6a (6)	
		18	2															
		19	2	7	67	SS-8	0.75	-	-	-	-	-	-	-	-	21	A-6a (V)	
-BRICK FRAGMENTS PRESENT THROUGHOUT		20	3															
		21	1															
		22	10	46	72	SS-9	1.75	-	-	-	-	-	-	-	-	24	A-6a (V)	
		23	22															
		24	12															
		25	5	12	61	SS-10	1.50	12	16	12	30	30	31	20	11	20	A-6a (5)	
	689.0	26	3															
FILL: MEDIUM STIFF TO STIFF, BROWNISH GRAY SANDY SILT, SOME FINE GRAVEL, LITTLE CLAY, DAMP.		27	4	12	67	SS-11	1.75	-	-	-	-	-	-	-	-	15	A-4a (V)	
		28	5															
		29	4	9	44	SS-12	1.25	33	20	10	18	19	25	19	6	17	A-4a (0)	
			2															
			4															

[illegible]

2014 ODOT BORING LOG-RI NE BRIDGE ID - OH DOT GDT - 7/12/19 13:01 - U:\GIS\PROJECTS\2013\W-13-072.GPJ

PID: 89464		BR ID: FRA-71-1503L		PROJECT: FRA-70-13.10 - PHASE 6A		STATION / OFFSET: 242+23.02 / 20.7 RT				START: 7/7/14		END: 7/8/14		PG 3 OF 3		B-108-6-13					
MATERIAL DESCRIPTION AND NOTES				ELEV.	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED
				652.4							GR	CS	FS	SI	CL	LL	PL	PI			
LIMESTONE : GRAY, UNWEATHERED, VERY STRONG, VERY THICK BEDDED, CALCAREOUS, SILICEOUS, CHERTY, DOLOMITIC, PYRITIC, MODERATELY TO HIGHLY FRACTURED, OPEN APERTURES, SLIGHTLY ROUGH; RQD 73%, REC 99%. (same as above)					63 64 65 66 67	90		98	RC-2										CORE		
				647.4	EOB																
NOTES: SEEPAGE ENCOUNTERED @ 12.5'; GROUNDWATER ENCOUNTERED INITIALLY @ 38.5'																					
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER																					



B-108-6-13 – RC-1 and RC-2 – Depth from 57.5 to 67.1 feet

APPENDIX IV

HISTORIC BORING LOGS:

B-003-E-68 and B-012-E-68

LOG OF BORING

Date Started 7-15-68 Sampler Typ. SS Dia 1 3/8"
Date Completed 7-17-68 Casing Length 55' Dia 3 1/2"
Boring No. B-3 Station & Offset 494+81, 19' Lt. (First Pier)

Wt. Elev. _____
Surface Elev 719.0'

REPRODUCTION
COPY 5
MICROFILM

Elev.	Depth	Std Pen (N)	Rec ft.	Loss ft.	Description	Sample No	Physical Characteristics								SMTL Class.
							% Agg	% CS	% FS	% Silt	% Clay	LL	PI	WC	
719.0	0														
	2														
	4														
714.0	6	11/14			Brownish-Gray Sandy Gravelly Silt	1	40	9	8	18	25	28	9	22	A-4a
	8														
709.0	10	14/16			Brown Gravelly Sand (Wash Sample)	2	37	53	4	-	-	NP	NP	22	A-1-b
	12														
	14														
704.0	16	10/12			Gray Silt and Clay, Slightly Organic	3	0	5	11	36	48	44	16	22	A-7-6
	18														
699.0	20	50* (0.7')			Brown Silty Sandy Gravel	4	66	12	7	-15	-	NP	NP	14	A-1-a
	22														
	24														
694.0	26	50*/ (0.4')			Brown Silty Sandy Gravel	5	65	16	7	-12	-	NP	NP	9	A-1-a
	28														
689.0	30	50* (0.7')			Gray Gravel	6	90	6	2	-	-	NP	NP	29	A-1-a
	32														
	34														
684.0	36	9/4			Brown Gravel	7	81	7	4	-	-	NP	NP	9	A-1-a
	38														
679.0	40	11/17			Brown Silty Sandy Gravel	8	72	9	7	-12	-	NP	NP	4	A-1-a
	42														
	44														
674.0	46	27/27			Gray Sandy Gravel	9	72	14	6	-	-	NP	NP	10	A-1-a
	48														
669.0	50	12/14			Gray Silty Sand	10	12	56	19	-13	-	NP	NP	20	A-1-b
	52														
	54														
664.0	56	10/15			Brown Gravelly Sandy Silt	11	24	13	16	24	23	19	6	10	A-4a
	58														
659.0	60	15/16			Gray Gravelly Sandy Silt	12	22	16	17	24	21	20	7	10	A-4a
	62														
	64														
654.0	66	11/13			Gray Gravelly Sandy Silt	13	16	13	17	23	31	21	9	14	A-4a
	68														
649.0	70	50/*													
	72				TOP OF ROCK										
	74		4.5	0.0	Limestone, light-gray, hard, dense, crystalline, few fossils, few chert seams. No Core Loss.										
644.0															

BOTTOM OF BORING
*Refusal

LOG OF BORING

Date Started 7-11-68
 Date Completed 7-17-68
 Boring No. B-12

Sampler Type SS Dia 1 3/8"
 Casing Length 58' Dia 3 1/2"
 Station & Offset 498+62, 65' Rt. (5th Pier)

Water Elev. _____

Surface Elev. 705.0'

Elev.	Depth	Std Pen (N)	Rec ft	Loss ft	Description	Sample No.	Physical Characteristics								SMTL Class
							% Agg	% C.S.	% F.S.	% Silt	% Clay	LL	PI	WC	
705.0	0														
702.5	2														
	4				No Sample Recovered (Hole Caved in)		V	I	S	U		A	L		
700.0	6	9/9			Brown Sandy Gravel	1	51	43	3	- 3 -		NP	NP	13	A-1-a
697.5	8				No Sample Recovered (Hole Caved in)		V	I	S	U		A	L		
695.0	10	6/3			Brown Silty Sandy Gravel	2	49	27	9	-15 -		NP	NP	18	A-1-b
	12														
690.0	14														
	16	3/1			Brown Sandy Gravel	3	67	24	3	- 6 -		NP	NP	10	A-1-a
	18														
685.0	20	23/24			Brown Silty Sandy Gravel	4	68	12	8	-12 -		NP	NP	8	A-1-a
	22														
680.0	24														
	26	15/12			Brown Sandy Gravel	5	70	16	6	- 8 -		NP	NP	12	A-1-a
	28														
675.0	30														
	32	50" / (0.4')			Gray Gravel	6	90	8	1	- 1 -		NP	NP	4	A-1-a
	34														
670.0	36														
	38	50" (0.9')			Gray Silty Sandy Gravel	7	38	23	11	17	11	16	4	14	A-2-d
	40														
665.0	42	11/15			Gray Sandy Gravelly Silt	8	35	9	13	23	20	NP	NP	12	A-4a
	44														
660.0	46														
	48	50" (0.6')			Gray Gravelly Sandy Silt	9	25	17	16	19	23	19	6	15	A-4a
	50														
655.0	52	11/12			Gray Silty Sandy Gravel	10	44	11	12	15	18	-	-	10	A-2-d
	54														
650.0	56	23/27			Gray Silty Sandy Gravel	11	52	15	13	-20 -		NP	NP	10	A-1-b
647.0	58				TOP OF ROCK										
645.0	60		2.0	0.0	Limestone, light-gray, hard, dense, crystalline, few small fossils. No Core Loss.										

BOTTOM OF BORING

*Refusal

APPENDIX V

LABORATORY TESTS RESULTS



One-Dimensional Consolidation Test Report (ASTM D2435)

Project Number: W-20-025

Boring Number: B-014-6-20

Project Name: FRA-70-13.01

Sample No. / Depth: ST-3 / 10.0'

Project Location: Franklin County, Ohio

Date of Testing: 12/21/2020 to 01/02/2021

Client: ODOT

Technician: E.Mesko

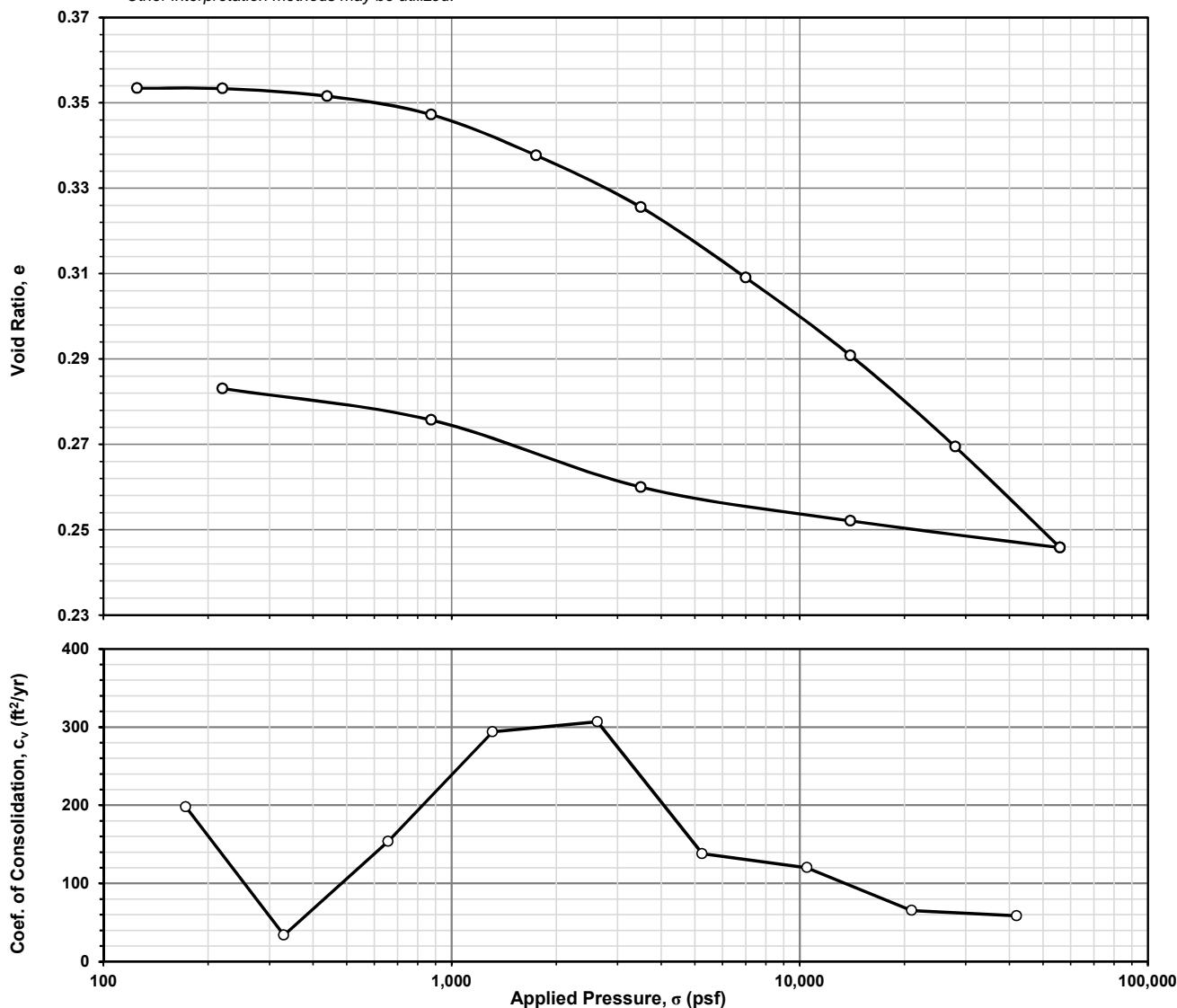
Soil Description: Gray Silt and Clay, some coarse to fine sand, trace fine gravel.
Soil Classification: ODOT A-6a (7)

Physical Characteristics

L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
27	15	12	8.0	9.0	16.0	31.0	36.0

Natural		γ_d (pcf)	γ_{sat} (pcf)	σ_{vo}' (psf)	S_G	e_o	$\sigma_p'^{-1}$ (psf)	c_c^{-1}	c_r^{-1}
S_o	w_o								
99.5%	13.6%	123.0	139.2	1,200	2.67	0.355	3,819	0.080	0.016

1. The values listed for $\sigma_p'^{-1}$, c_c and c_r are interpreted by Rii using Cassagrande and Schemertman methods.
Other interpretation methods may be utilized.



Notes: _____



One-Dimensional Consolidation Test Report (ASTM D2435)

Project Number: W-20-025

Boring Number: B-014-6-20

Project Name: FRA-70-13.01

Sample No. / Depth: ST-6 / 28.6-28.8'

Project Location: Franklin County, Ohio

Date of Testing: 12/16/2020 to 12/28/2020

Client: ODOT

Technician: C. Straub

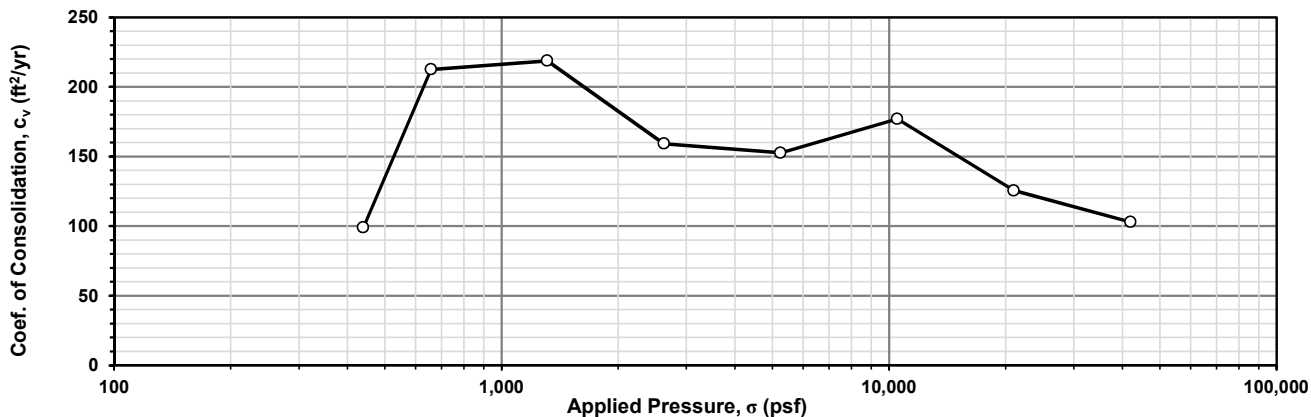
Soil Description: Brown Silt and Clay, little coarse to fine sand, trace fine gravel.
 Soil Classification: ODOT A-6a (10)

Physical Characteristics

L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
34	20	14	1.0	5.0	10.0	45.0	39.0

Natural		γ_d (pcf)	γ_{sat} (pcf)	σ_{vo}' (psf)	S_G	e_o	$\sigma_{p'}^{1/2}$ (psf)	$c_c^{1/2}$	$c_r^{1/2}$
S_o	w_o								
91.6%	19.8%	106.2	126.8	3,575	2.659	0.563	6,151	0.109	0.023

1. The values listed for $\sigma_{p'}^{1/2}$, $c_c^{1/2}$ and $c_r^{1/2}$ are interpreted by Rii using Cassagrande and Schemertman methods.
 Other interpretation methods may be utilized.



Notes: _____



One-Dimensional Consolidation Test Report (ASTM D2435)

Project Number: W-20-025

Boring Number: B-014-6-20

Project Name: FRA-70-13.01

Sample No. / Depth: ST-10 / 44.8'

Project Location: Franklin County, Ohio

Date of Testing: 12/31/2020 to 01/13/2021

Client: ms consultants, inc.

Technician: C. Straub

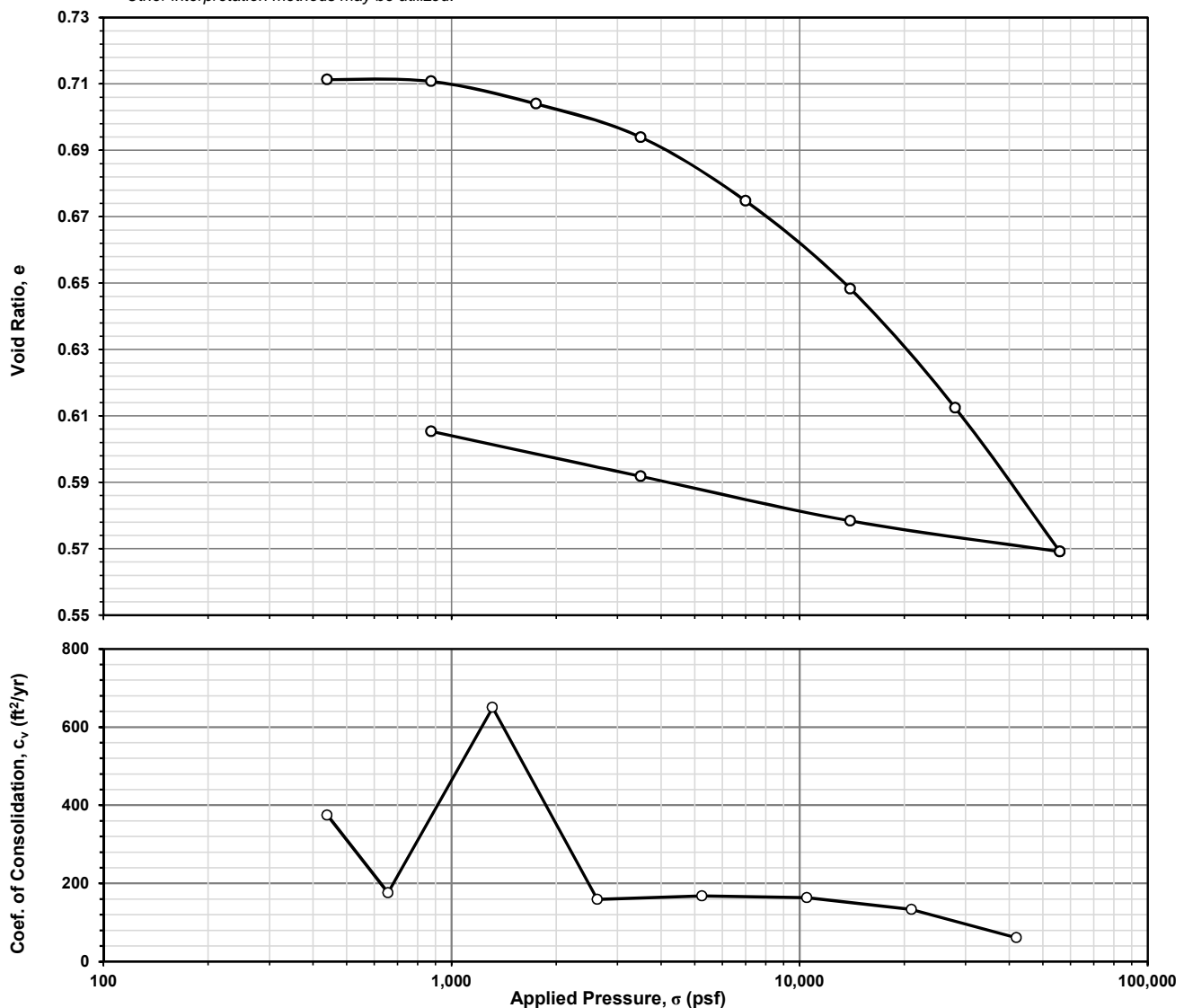
Soil Description: Gray Silt and Clay, some coarse to fine sand, little fine gravel.
Soil Classification: ODOT A-6a

Physical Characteristics

L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
34	21	13	18.9	18.1	13.9	26.8	22.3

Natural		γ_d (pcf)	γ_{sat} (pcf)	σ_{vo}' (psf)	S_G	e_o	$\sigma_p'^{-1}$ (psf)	c_c^{-1}	c_r^{-1}
S_o	w_o								
90.6%	24.4%	98.1	121.4	5,600	2.67	0.698	8,157	0.137	0.018

1. The values listed for $\sigma_p'^{-1}$, c_c and c_r are interpreted by Rii using Cassagrande and Schemertman methods.
Other interpretation methods may be utilized.



Notes: Several rocks were in test sample.



One-Dimensional Consolidation Test Report (ASTM D2435)

Project Number: W-20-025

Boring Number: B-014-7-20

Project Name: FRA-70-13.01

Sample No. / Depth: ST-6 / 14.8'

Project Location: Franklin County, Ohio

Date of Testing: 01/07/2021 to 01/20/2021

Client: ms consultants, inc.

Technician: E.Mesko

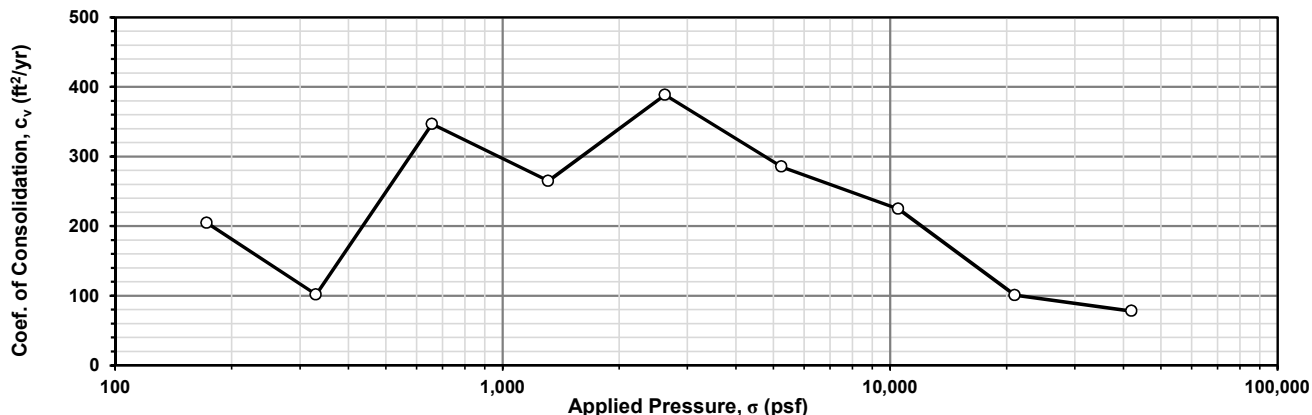
Soil Description: Dark gray CLAY, some silt, some fine gravel, little coarse to fine sand
Soil Classification: ODOT A-7-6

Physical Characteristics

L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
42	27	15	31.6	9.8	7.5	32.5	18.6

Natural		γ_d (pcf)	γ_{sat} (pcf)	σ_{vo}' (psf)	S_G	e_o	$\sigma_p'^{-1}$ (psf)	c_c^{-1}	c_r^{-1}
S_o	w_o								
68.5%	23.3%	86.0	107.2	1,702	2.737	0.987	1,710	0.234	0.029

1. The values listed for $\sigma_p'^{-1}$, c_c and c_r are interpreted by Rii using Cassagrande and Schemertman methods.
Other interpretation methods may be utilized.



Notes: Two rocks were contained within the test specimen.



RESOURCE INTERNATIONAL, INC.
Engineering Consultants

**Unconfined Compressive Strength
of Intact Rock Core Specimens (ASTM D 7012-04)**

6350 Presidential Gateway.

Columbus, OH 43231

Phone (614) 823-4949

9885 Rockside Road

Cleveland, OH 44125

Phone (216) 573-0955

4480 Lake Forest Drive

Cincinnati, Ohio 45242

Phone (513) 769-6998

Project: FRA-70-12.68

Project No.: W-13-045

Date of Testing: 7/12/2013

Test Performed by: JJH/TK

Rock Description: LIMESTONE: Light gray, slightly weathered, strong.

Boring No.: B-015-2-13

Station / Offset: 5042+88.86, 2.6' Rt.

Sample No. / Depth: RC-3 / 67.6 ft.

Moisture condition: As received

Average Length: 4.094 in

Average Diameter: 1.872 in

Length to diameter ratio: 2.187

Cross Sectional Area: 2.751 in²

Rate of Loading: 79.4 lbs/sec

Testing Time: 200 sec

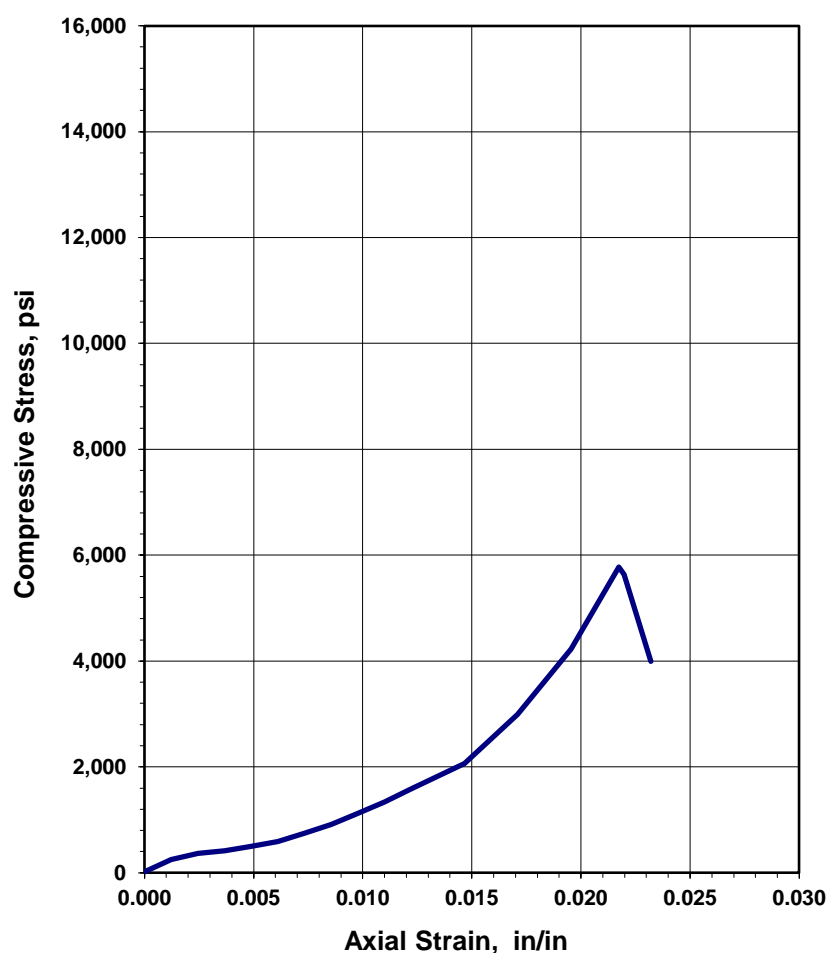
(Rate 2-15 minutes to failure)

Failure Load: 15,880 lbs

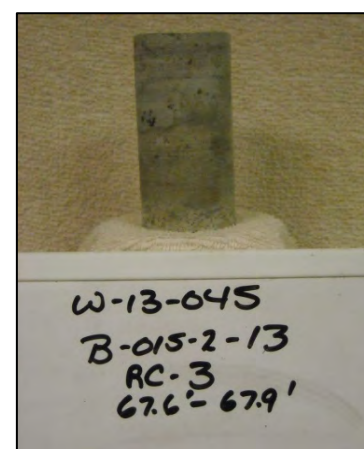
Axial Strain at Failure: 0.0217 in/in

Stress: 5,771 psi

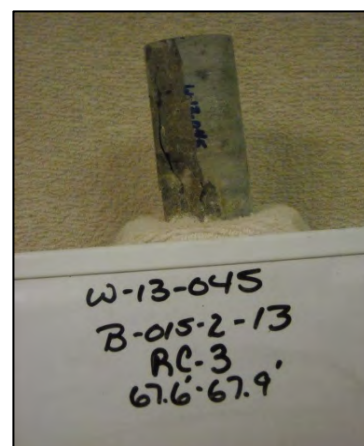
Unconfined Compression Test



Before Testing



After Failure



REMARKS: _____



RESOURCE INTERNATIONAL, INC.
Engineering Consultants

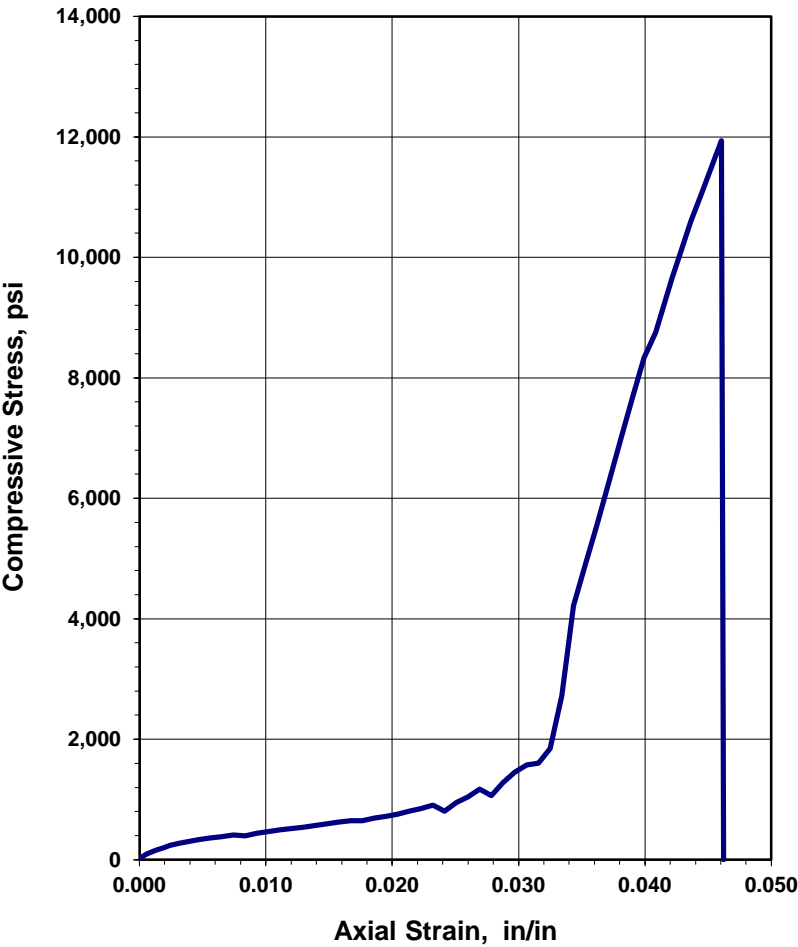
**Unconfined Compressive Strength
of Intact Rock Core Specimens (ASTM D 7012-04)**

6350 Presidential Gateway.	9885 Rockside Road	4480 Lake Forest Drive	Project: <u>FRA-70-13.10 - Project 6A</u>
Columbus, OH 43231	Cleveland, OH 44125	Cincinnati, Ohio 45242	Project No.: <u>W-13-072</u>
Phone (614) 823-4949	Phone (216) 573-0955	Phone (513) 769-6998	Date of Testing: <u>7/3/2014</u>
			Test Performed by: <u>K.R./T.K.</u>

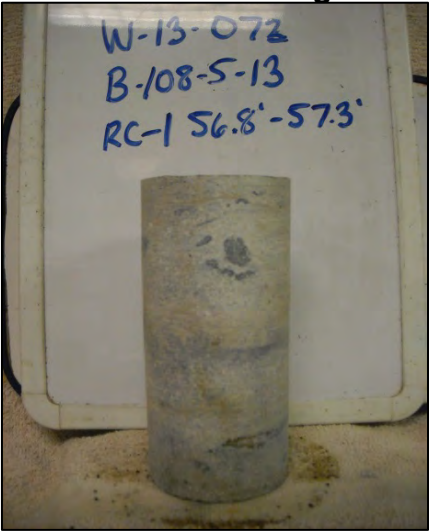
Rock Description: Dolomitic Limestone

Boring No.: <u>B-108-5-13</u>	Average Length: <u>5.386 in</u>
Station / Offset: <u>239+69.30, 18.7' Rt.</u>	Average Diameter: <u>2.408 in</u>
Sample No. / Depth: <u>RC-1 / 56.8 ft</u>	Length to diameter ratio: <u>2.237</u>
Moisture condition: <u>As received</u>	Cross Sectional Area: <u>4.552 in²</u>
Rate of Loading: <u>72.6 lbs/sec</u>	Failure Load: <u>54,340 lbs</u>
Testing Time: <u>749 sec</u>	Axial Strain at Failure: <u>0.0460 in/in</u>
(Rate 2-15 minutes to failure)	Stress: <u>11,933 psi</u>

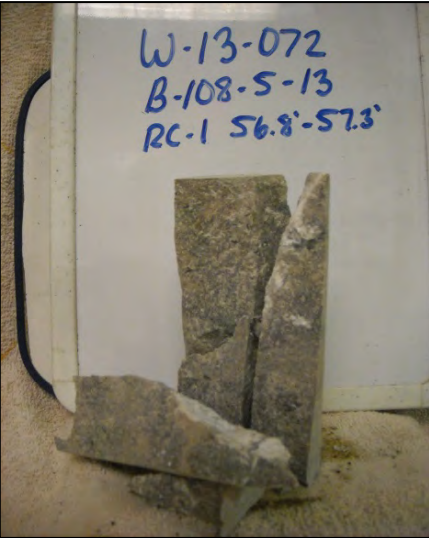
Unconfined Compression Test



Before Testing



After Failure



REMARKS: _____



RESOURCE INTERNATIONAL, INC.
Engineering Consultants

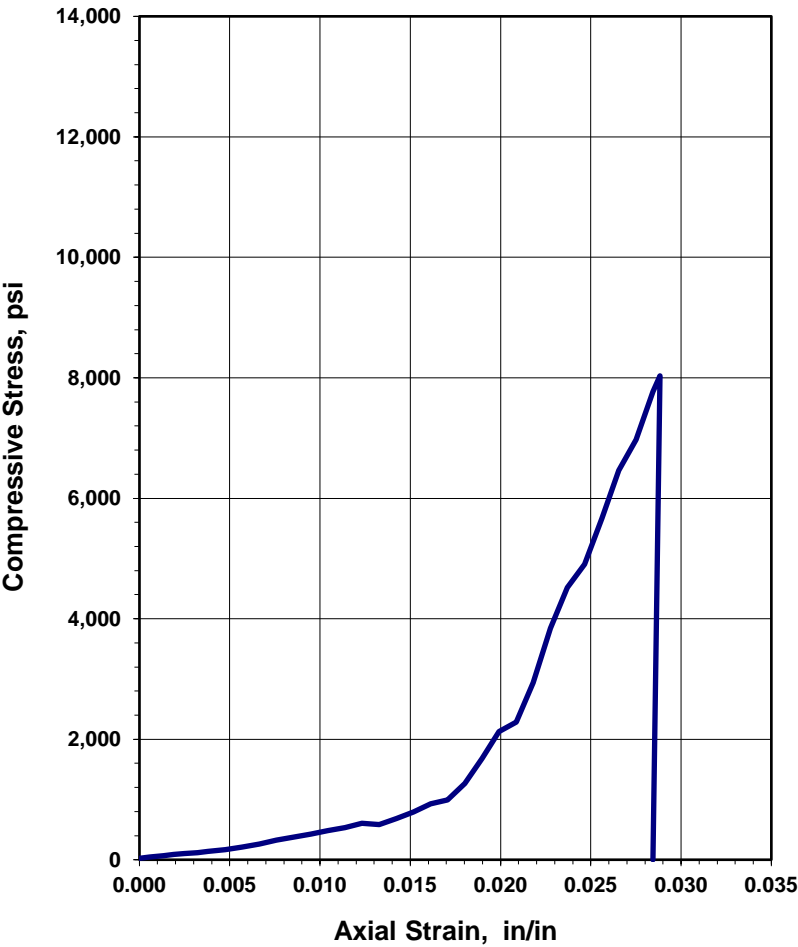
**Unconfined Compressive Strength
of Intact Rock Core Specimens (ASTM D 7012-04)**

6350 Presidential Gateway.	9885 Rockside Road	4480 Lake Forest Drive	Project: <u>FRA-70-13.10 - Project 6A</u>
Columbus, OH 43231	Cleveland, OH 44125	Cincinnati, Ohio 45242	Project No.: <u>W-13-072</u>
Phone (614) 823-4949	Phone (216) 573-0955	Phone (513) 769-6998	Date of Testing: <u>7/9/2014</u>
			Test Performed by: <u>K.R./T.K.</u>

Rock Description: Dolomitic Limestone

Boring No.: <u>B-108-6-13</u>	Average Length: <u>5.272 in</u>
Station / Offset: <u>242+23.02, 20.7' Rt.</u>	Average Diameter: <u>2.398 in</u>
Sample No. / Depth: <u>RC-1 / 59.6 ft</u>	Length to diameter ratio: <u>2.198</u>
Moisture condition: <u>As received</u>	Cross Sectional Area: <u>4.514 in²</u>
Rate of Loading: <u>63.5 lbs/sec</u>	Failure Load: <u>36,270 lbs</u>
Testing Time: <u>571 sec</u>	Axial Strain at Failure: <u>0.0288 in/in</u>
(Rate 2-15 minutes to failure)	Stress: <u>8,033 psi</u>

Unconfined Compression Test



Before Testing



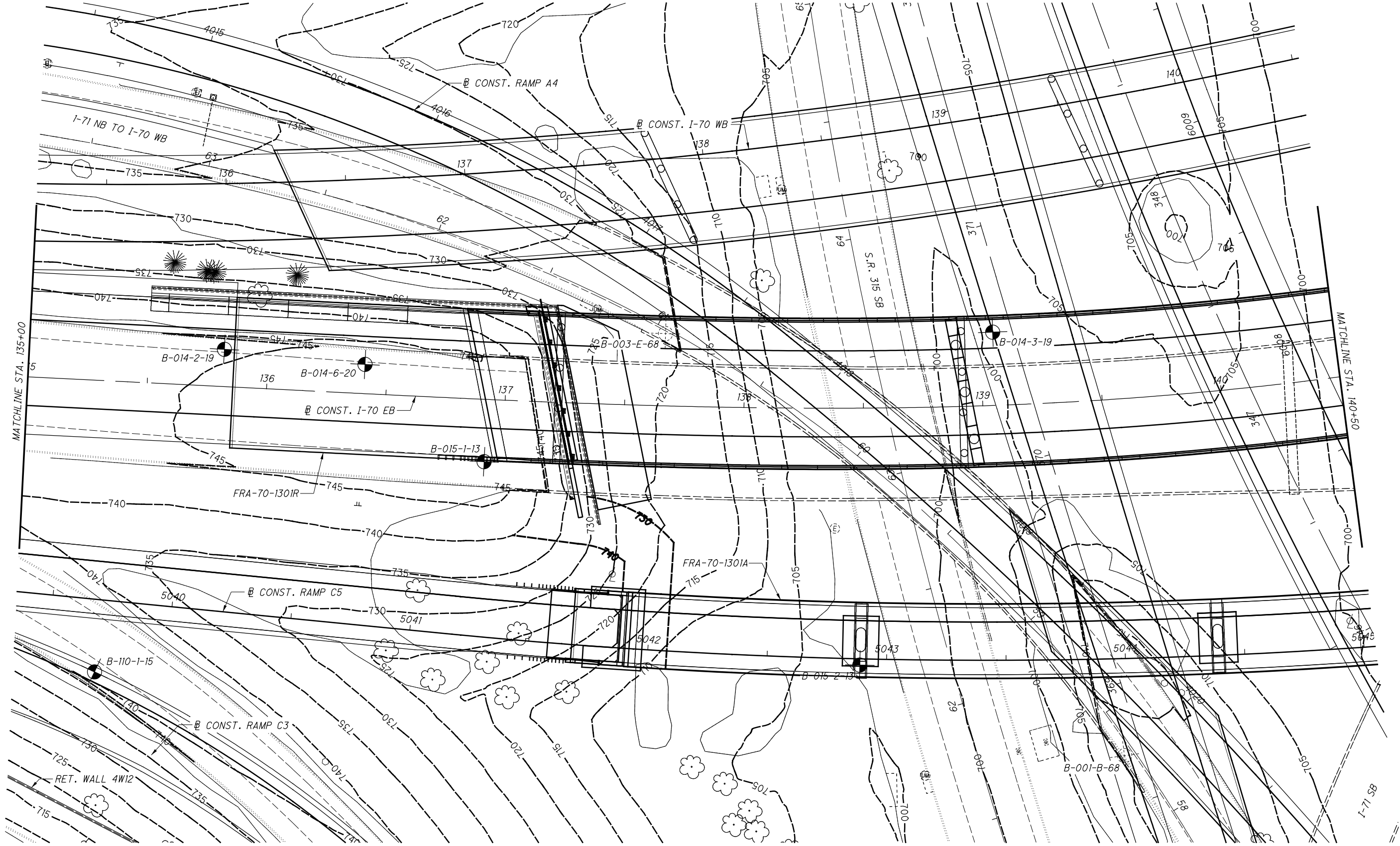
After Failure



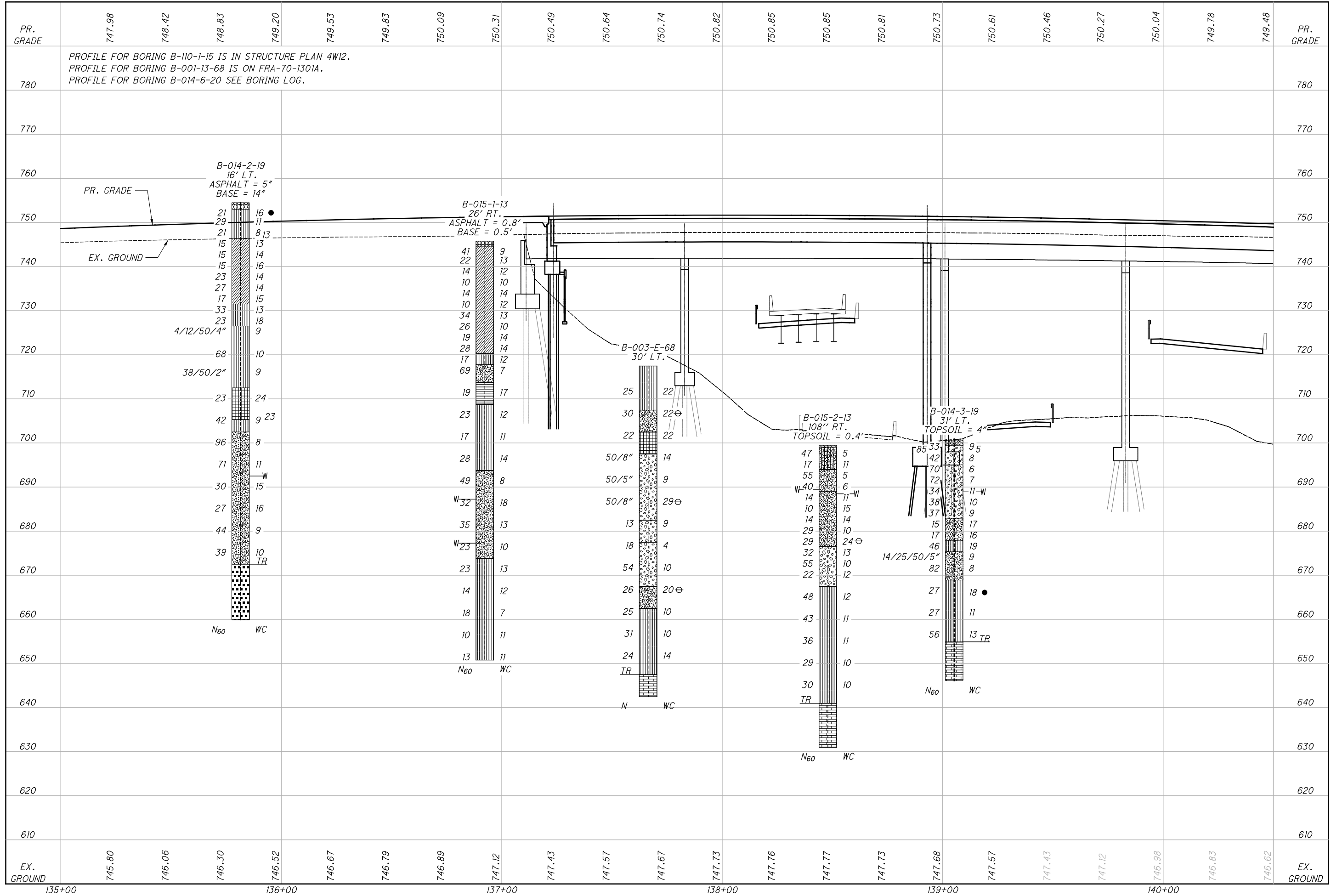
REMARKS: _____

APPENDIX VI

STRUCTURE FOUNDATION EXPLORATION SHEETS

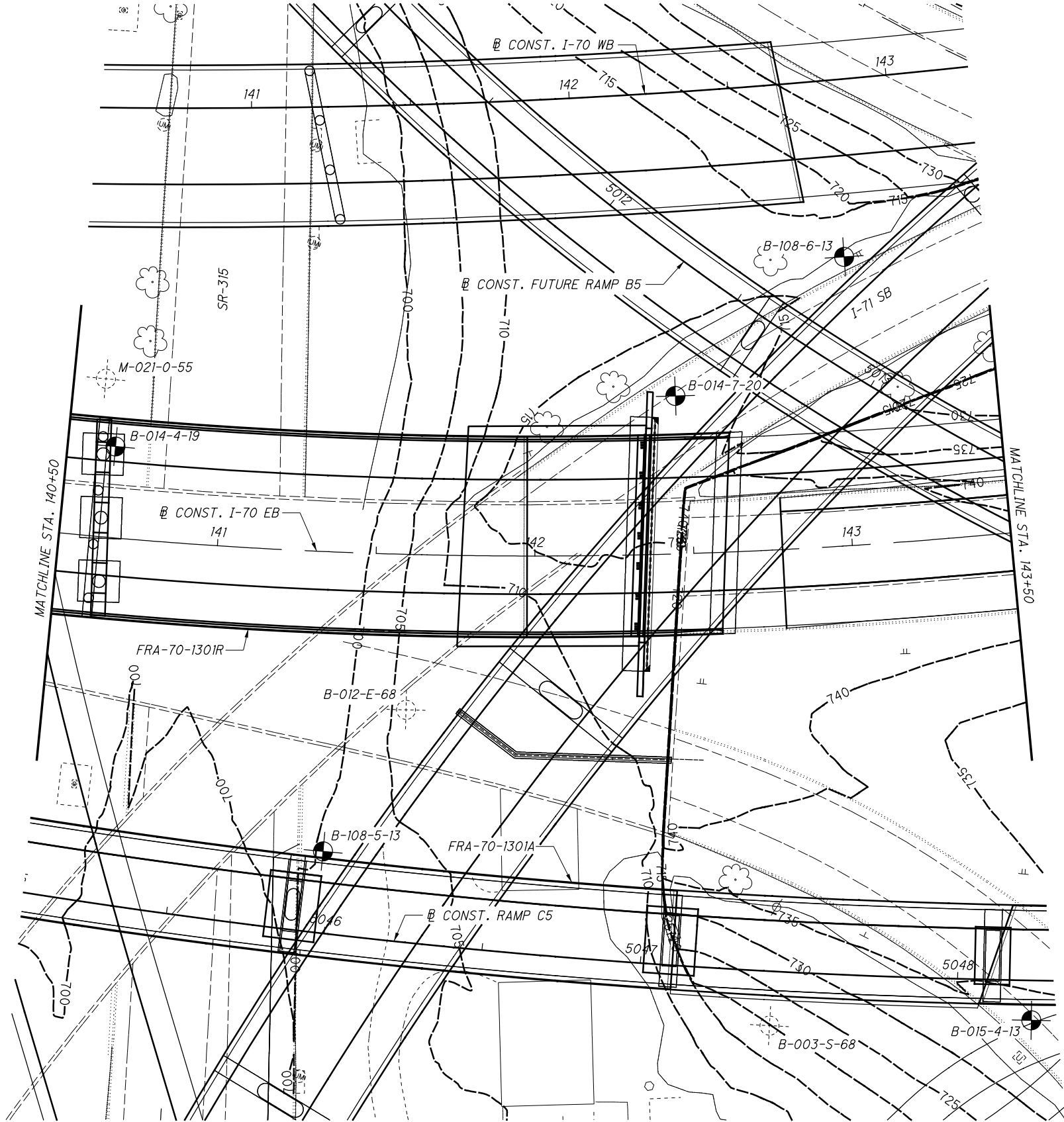


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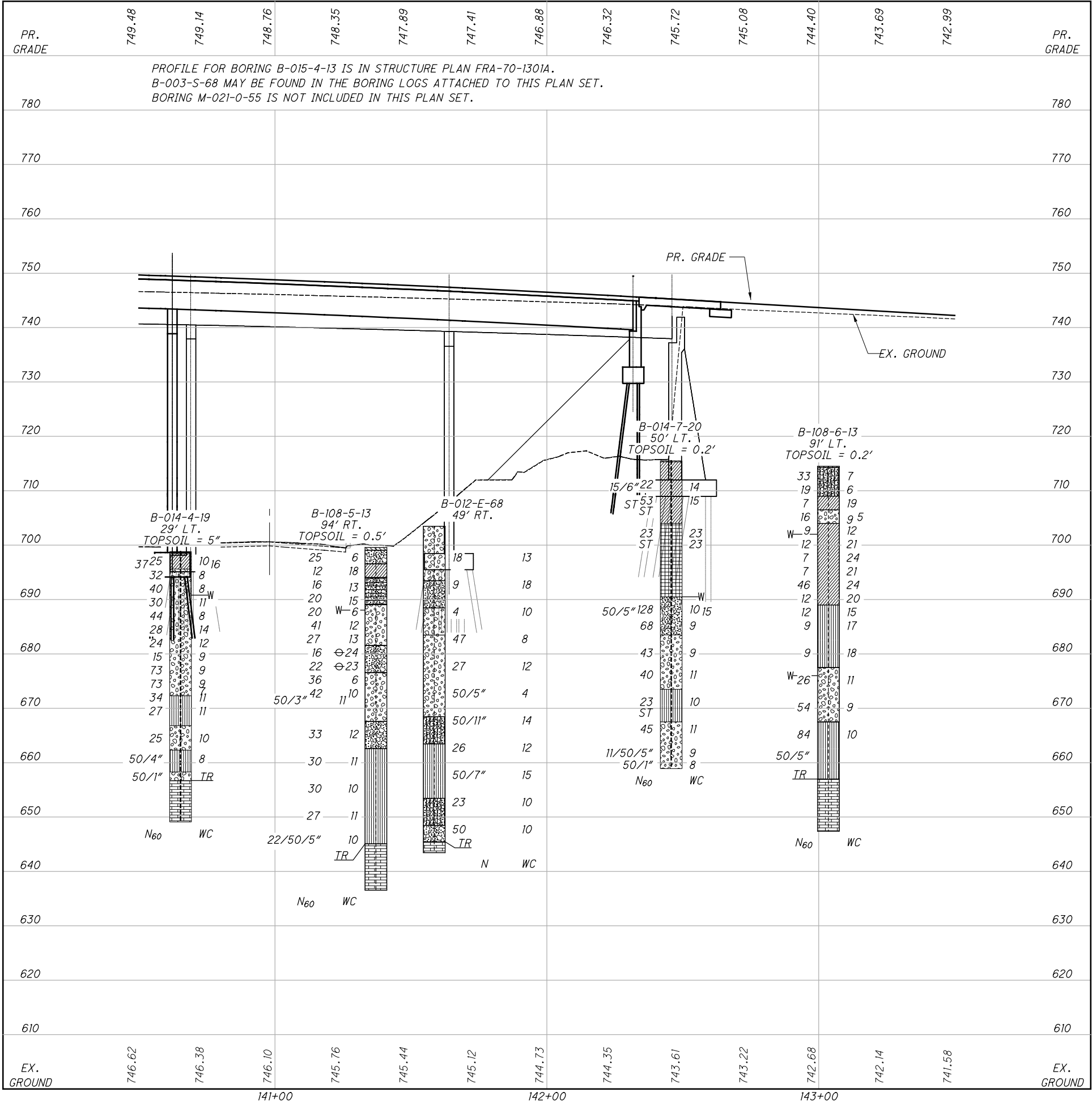


STRUCTURE FOUNDATION EXPLORATION
FRA-70-1301R I-70 EB OVER SR 315
STA. 135+00 TO STA. 140+50

FRA-70-13.01

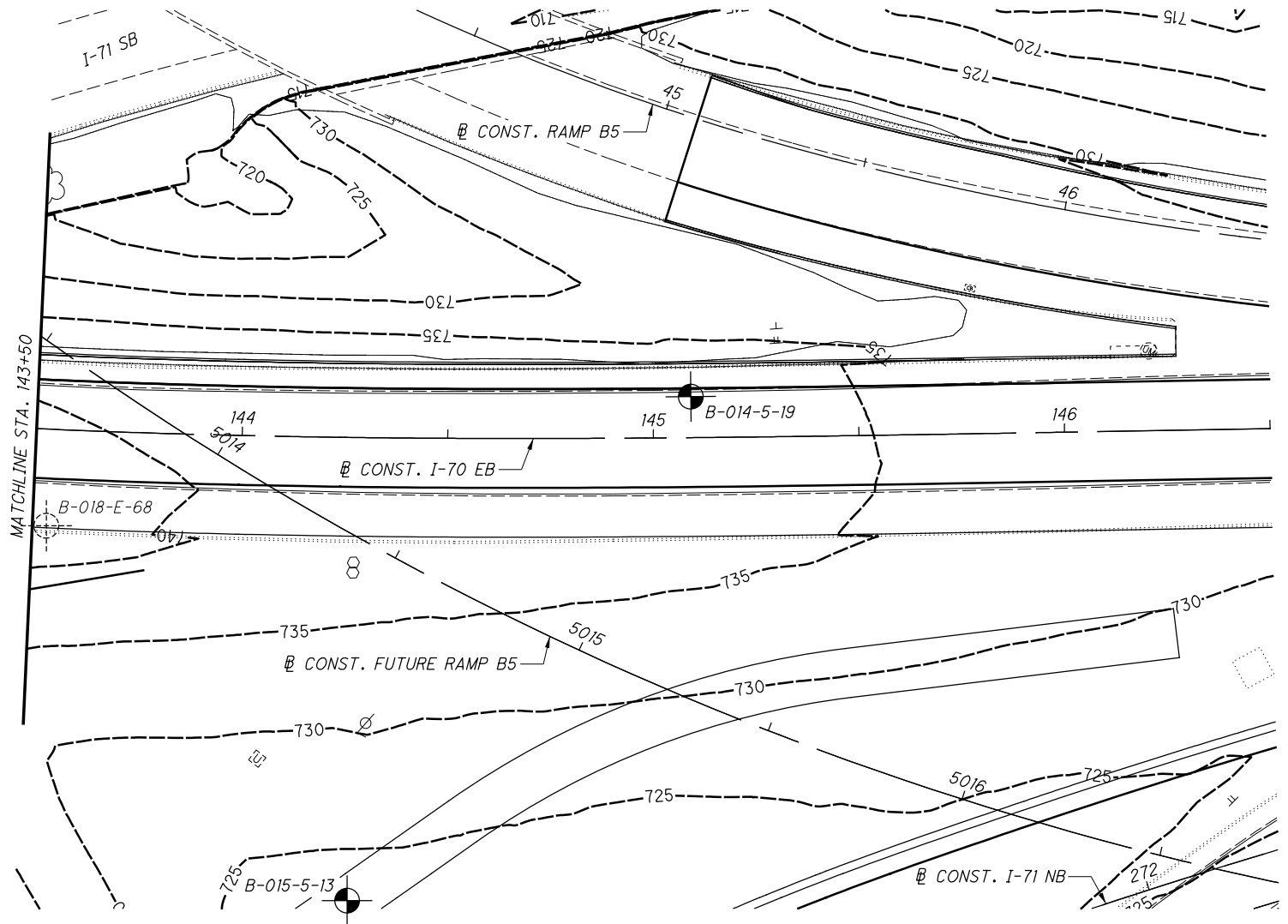


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STRUCTURE FOUNDATION EXPLORATION
FRA-70-1301R I-70 EB OVER SR 315
STA. 140+50 TO STA. 143+50

FRA-70-13.01



APPENDIX VII

DRIVEN ANALYSIS OUTPUTS

**Rear Abutment
(B-015-1-13)**

DrivenPiles - Report

General Project Information

Filename: ...3.01\Analysis\Driven Piles\Rear Abutment\FRA-70-13.01 - Rear Abutment HP 10x42-B-015-1-13.dvn
Project Name: FRA-70-13.01 Rear Abutment (B-015-1-13)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile - HP 10x42
Top of Pile: 0.00 ft
Diameter of Pile: 10.08 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling: 58.00 ft
Driving/Restrike: 58.00 ft
Nominal: 58.00 ft

Nominal Considations:

Local Scour: 0.00 ft
Long Term Scour: 0.00 ft
Soft Soil: 0.00 ft

Nominal Profile

Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesionless	12.50 ft	1.000	120.00 pcf	0.0/0.0	Nordlund
2	Cohesive	6.30 ft	1.500	120.00 pcf	3125.00 psf	T-80 Same
3	Cohesionless	4.00 ft	1.000	135.00 pcf	42.0/42.0	Nordlund
4	Cohesive	5.00 ft	1.750	120.00 pcf	2375.00 psf	T-80 Sand
5	Cohesive	15.00 ft	1.500	120.00 pcf	2875.00 psf	T-80 Same
6	Cohesionless	5.00 ft	1.000	135.00 pcf	39.0/39.0	Nordlund
7	Cohesionless	15.00 ft	1.000	130.00 pcf	36.0/36.0	Nordlund
8	Cohesive	23.00 ft	1.500	115.00 pcf	1875.00 psf	T-80 Sand

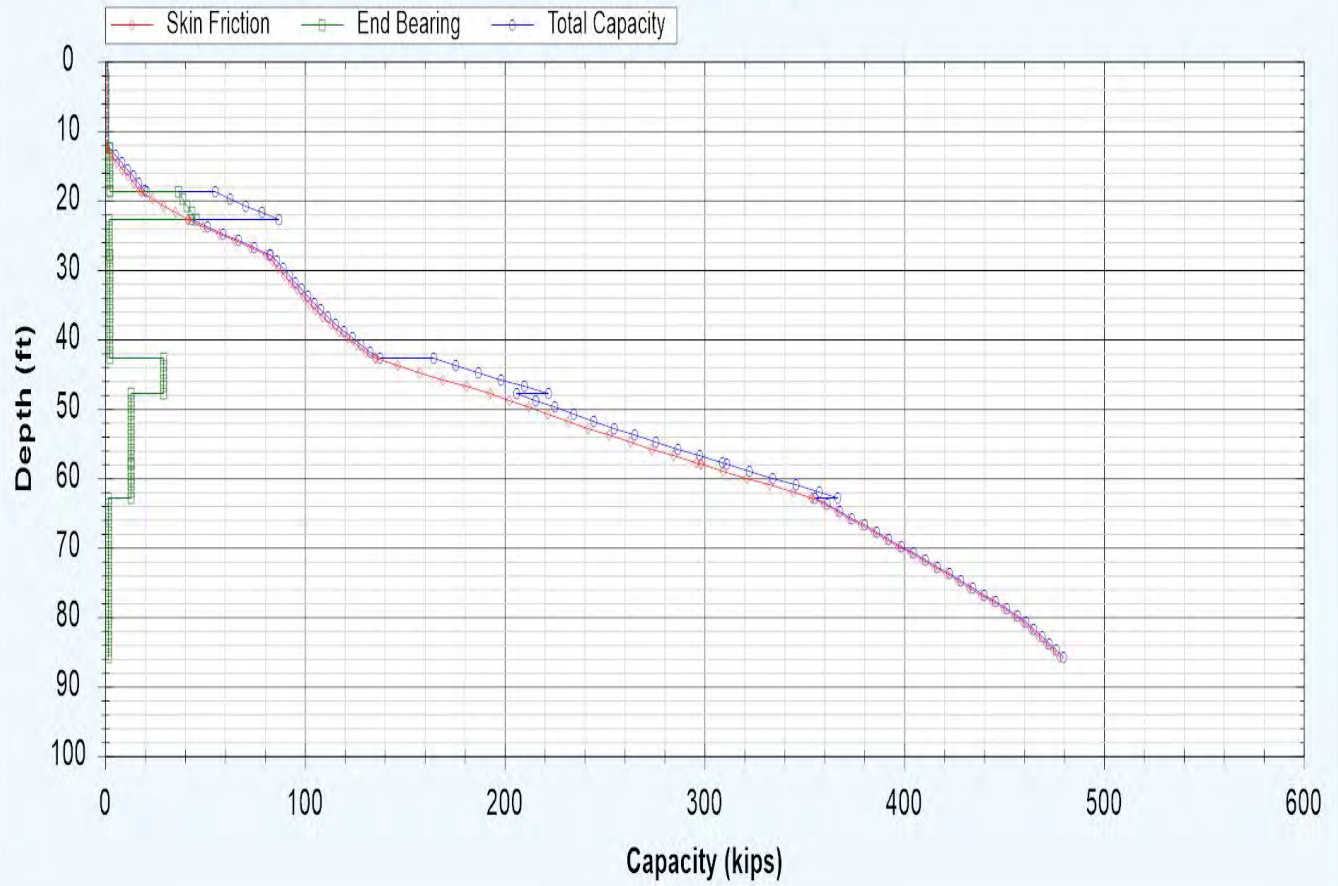
Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.02 kips	0.02 kips
2.00 ft	0.00 kips	0.04 kips	0.04 kips
3.00 ft	0.00 kips	0.05 kips	0.05 kips
4.00 ft	0.00 kips	0.07 kips	0.07 kips
5.00 ft	0.00 kips	0.09 kips	0.09 kips
6.00 ft	0.00 kips	0.11 kips	0.11 kips
7.00 ft	0.00 kips	0.13 kips	0.13 kips
8.00 ft	0.00 kips	0.14 kips	0.14 kips
9.00 ft	0.00 kips	0.16 kips	0.16 kips
10.00 ft	0.00 kips	0.18 kips	0.18 kips
11.00 ft	0.00 kips	0.20 kips	0.20 kips
12.00 ft	0.00 kips	0.22 kips	0.22 kips
12.49 ft	0.00 kips	0.23 kips	0.23 kips
12.51 ft	0.03 kips	2.42 kips	2.45 kips
13.50 ft	2.89 kips	2.42 kips	5.31 kips
14.50 ft	5.78 kips	2.42 kips	8.20 kips
15.50 ft	8.67 kips	2.42 kips	11.10 kips
16.50 ft	11.57 kips	2.42 kips	13.99 kips
17.50 ft	14.46 kips	2.42 kips	16.88 kips
18.50 ft	17.35 kips	2.42 kips	19.77 kips
18.79 ft	18.19 kips	2.42 kips	20.61 kips
18.81 ft	18.27 kips	36.71 kips	54.98 kips
19.80 ft	23.55 kips	38.88 kips	62.43 kips
20.80 ft	29.19 kips	41.08 kips	70.26 kips
21.80 ft	35.13 kips	43.27 kips	78.41 kips
22.79 ft	41.33 kips	45.45 kips	86.78 kips
22.81 ft	41.47 kips	1.84 kips	43.31 kips
23.80 ft	49.22 kips	1.84 kips	51.06 kips
24.80 ft	57.05 kips	1.84 kips	58.89 kips
25.80 ft	64.88 kips	1.84 kips	66.72 kips
26.80 ft	72.70 kips	1.84 kips	74.54 kips
27.79 ft	80.45 kips	1.84 kips	82.29 kips
27.81 ft	80.56 kips	2.23 kips	82.79 kips
28.80 ft	83.65 kips	2.23 kips	85.88 kips
29.80 ft	86.76 kips	2.23 kips	88.99 kips
30.80 ft	89.88 kips	2.23 kips	92.11 kips
31.80 ft	93.00 kips	2.23 kips	95.23 kips
32.80 ft	96.11 kips	2.23 kips	98.34 kips
33.80 ft	99.23 kips	2.23 kips	101.46 kips
34.80 ft	102.35 kips	2.23 kips	104.58 kips
35.80 ft	105.46 kips	2.23 kips	107.69 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.80 ft	109.02 kips	2.23 kips	111.25 kips
37.80 ft	113.00 kips	2.23 kips	115.23 kips
38.80 ft	117.14 kips	2.23 kips	119.37 kips
39.80 ft	121.44 kips	2.23 kips	123.67 kips
40.80 ft	125.91 kips	2.23 kips	128.14 kips
41.80 ft	130.54 kips	2.23 kips	132.77 kips
42.79 ft	135.28 kips	2.23 kips	137.51 kips
42.81 ft	135.44 kips	29.17 kips	164.60 kips
43.80 ft	146.28 kips	29.17 kips	175.45 kips
44.80 ft	157.51 kips	29.17 kips	186.68 kips
45.80 ft	169.03 kips	29.17 kips	198.20 kips
46.80 ft	180.83 kips	29.17 kips	209.99 kips
47.79 ft	192.78 kips	29.17 kips	221.95 kips
47.81 ft	193.00 kips	13.05 kips	206.05 kips
48.80 ft	202.27 kips	13.05 kips	215.32 kips
49.80 ft	211.84 kips	13.05 kips	224.90 kips
50.80 ft	221.62 kips	13.05 kips	234.67 kips
51.80 ft	231.60 kips	13.05 kips	244.65 kips
52.80 ft	241.79 kips	13.05 kips	254.84 kips
53.80 ft	252.18 kips	13.05 kips	265.23 kips
54.80 ft	262.78 kips	13.05 kips	275.83 kips
55.80 ft	273.58 kips	13.05 kips	286.63 kips
56.80 ft	284.59 kips	13.05 kips	297.64 kips
57.80 ft	295.80 kips	13.05 kips	308.85 kips
57.99 ft	297.95 kips	13.05 kips	311.01 kips
58.01 ft	298.18 kips	13.05 kips	311.24 kips
59.00 ft	309.48 kips	13.05 kips	322.53 kips
60.00 ft	320.99 kips	13.05 kips	334.05 kips
61.00 ft	332.62 kips	13.05 kips	345.67 kips
62.00 ft	344.35 kips	13.05 kips	357.40 kips
62.79 ft	353.69 kips	13.05 kips	366.74 kips
62.81 ft	353.87 kips	1.45 kips	355.32 kips
63.80 ft	359.99 kips	1.45 kips	361.44 kips
64.80 ft	366.17 kips	1.45 kips	367.62 kips
65.80 ft	372.35 kips	1.45 kips	373.80 kips
66.80 ft	378.53 kips	1.45 kips	379.98 kips
67.80 ft	384.71 kips	1.45 kips	386.16 kips
68.80 ft	390.89 kips	1.45 kips	392.34 kips
69.80 ft	397.06 kips	1.45 kips	398.52 kips
70.80 ft	403.24 kips	1.45 kips	404.70 kips
71.80 ft	409.29 kips	1.45 kips	410.75 kips
72.80 ft	415.21 kips	1.45 kips	416.67 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.80 ft	421.09 kips	1.45 kips	422.54 kips
74.80 ft	426.91 kips	1.45 kips	428.36 kips
75.80 ft	432.69 kips	1.45 kips	434.14 kips
76.80 ft	438.41 kips	1.45 kips	439.87 kips
77.80 ft	444.09 kips	1.45 kips	445.55 kips
78.80 ft	449.72 kips	1.45 kips	451.18 kips
79.80 ft	455.06 kips	1.45 kips	456.52 kips
80.80 ft	459.36 kips	1.45 kips	460.81 kips
81.80 ft	463.47 kips	1.45 kips	464.92 kips
82.80 ft	467.40 kips	1.45 kips	468.85 kips
83.80 ft	471.14 kips	1.45 kips	472.59 kips
84.80 ft	474.70 kips	1.45 kips	476.15 kips
85.79 ft	478.04 kips	1.45 kips	479.49 kips

Bearing Capacity - Restrike



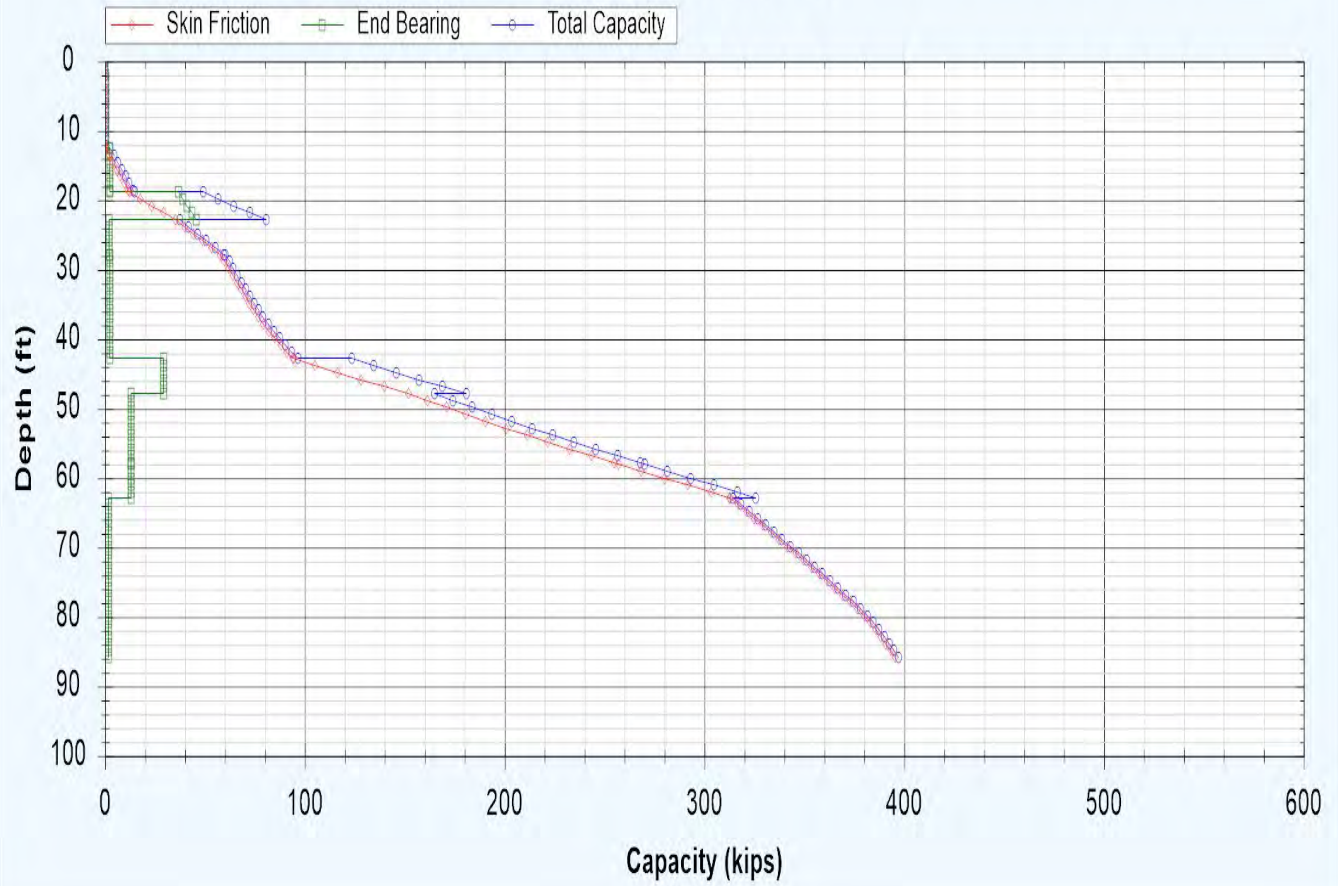
Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.02 kips	0.02 kips
2.00 ft	0.00 kips	0.04 kips	0.04 kips
3.00 ft	0.00 kips	0.05 kips	0.05 kips
4.00 ft	0.00 kips	0.07 kips	0.07 kips
5.00 ft	0.00 kips	0.09 kips	0.09 kips
6.00 ft	0.00 kips	0.11 kips	0.11 kips
7.00 ft	0.00 kips	0.13 kips	0.13 kips
8.00 ft	0.00 kips	0.14 kips	0.14 kips
9.00 ft	0.00 kips	0.16 kips	0.16 kips
10.00 ft	0.00 kips	0.18 kips	0.18 kips
11.00 ft	0.00 kips	0.20 kips	0.20 kips
12.00 ft	0.00 kips	0.22 kips	0.22 kips
12.49 ft	0.00 kips	0.23 kips	0.23 kips
12.51 ft	0.02 kips	2.42 kips	2.44 kips
13.50 ft	1.93 kips	2.42 kips	4.35 kips
14.50 ft	3.86 kips	2.42 kips	6.28 kips
15.50 ft	5.78 kips	2.42 kips	8.20 kips
16.50 ft	7.71 kips	2.42 kips	10.13 kips
17.50 ft	9.64 kips	2.42 kips	12.06 kips
18.50 ft	11.57 kips	2.42 kips	13.99 kips
18.79 ft	12.13 kips	2.42 kips	14.55 kips
18.81 ft	12.20 kips	36.71 kips	48.91 kips
19.80 ft	17.47 kips	38.88 kips	56.36 kips
20.80 ft	23.11 kips	41.08 kips	64.19 kips
21.80 ft	29.06 kips	43.27 kips	72.34 kips
22.79 ft	35.26 kips	45.45 kips	80.71 kips
22.81 ft	35.37 kips	1.84 kips	37.21 kips
23.80 ft	39.79 kips	1.84 kips	41.63 kips
24.80 ft	44.27 kips	1.84 kips	46.11 kips
25.80 ft	48.74 kips	1.84 kips	50.58 kips
26.80 ft	53.21 kips	1.84 kips	55.05 kips
27.79 ft	57.64 kips	1.84 kips	59.48 kips
27.81 ft	57.71 kips	2.23 kips	59.93 kips
28.80 ft	59.76 kips	2.23 kips	61.99 kips
29.80 ft	61.84 kips	2.23 kips	64.07 kips
30.80 ft	63.92 kips	2.23 kips	66.15 kips
31.80 ft	66.00 kips	2.23 kips	68.22 kips
32.80 ft	68.07 kips	2.23 kips	70.30 kips
33.80 ft	70.15 kips	2.23 kips	72.38 kips
34.80 ft	72.23 kips	2.23 kips	74.46 kips
35.80 ft	74.31 kips	2.23 kips	76.54 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.80 ft	76.68 kips	2.23 kips	78.91 kips
37.80 ft	79.33 kips	2.23 kips	81.56 kips
38.80 ft	82.09 kips	2.23 kips	84.32 kips
39.80 ft	84.96 kips	2.23 kips	87.19 kips
40.80 ft	87.94 kips	2.23 kips	90.17 kips
41.80 ft	91.02 kips	2.23 kips	93.25 kips
42.79 ft	94.19 kips	2.23 kips	96.41 kips
42.81 ft	94.33 kips	29.17 kips	123.49 kips
43.80 ft	105.17 kips	29.17 kips	134.34 kips
44.80 ft	116.41 kips	29.17 kips	145.57 kips
45.80 ft	127.92 kips	29.17 kips	157.09 kips
46.80 ft	139.72 kips	29.17 kips	168.88 kips
47.79 ft	151.67 kips	29.17 kips	180.84 kips
47.81 ft	151.89 kips	13.05 kips	164.94 kips
48.80 ft	161.16 kips	13.05 kips	174.21 kips
49.80 ft	170.73 kips	13.05 kips	183.79 kips
50.80 ft	180.51 kips	13.05 kips	193.56 kips
51.80 ft	190.49 kips	13.05 kips	203.55 kips
52.80 ft	200.68 kips	13.05 kips	213.73 kips
53.80 ft	211.07 kips	13.05 kips	224.12 kips
54.80 ft	221.67 kips	13.05 kips	234.72 kips
55.80 ft	232.47 kips	13.05 kips	245.52 kips
56.80 ft	243.48 kips	13.05 kips	256.53 kips
57.80 ft	254.69 kips	13.05 kips	267.75 kips
57.99 ft	256.84 kips	13.05 kips	269.90 kips
58.01 ft	257.07 kips	13.05 kips	270.13 kips
59.00 ft	268.37 kips	13.05 kips	281.42 kips
60.00 ft	279.88 kips	13.05 kips	292.94 kips
61.00 ft	291.51 kips	13.05 kips	304.56 kips
62.00 ft	303.24 kips	13.05 kips	316.29 kips
62.79 ft	312.58 kips	13.05 kips	325.63 kips
62.81 ft	312.74 kips	1.45 kips	314.19 kips
63.80 ft	316.82 kips	1.45 kips	318.27 kips
64.80 ft	320.94 kips	1.45 kips	322.39 kips
65.80 ft	325.06 kips	1.45 kips	326.51 kips
66.80 ft	329.18 kips	1.45 kips	330.63 kips
67.80 ft	333.30 kips	1.45 kips	334.75 kips
68.80 ft	337.42 kips	1.45 kips	338.87 kips
69.80 ft	341.54 kips	1.45 kips	342.99 kips
70.80 ft	345.66 kips	1.45 kips	347.11 kips
71.80 ft	349.69 kips	1.45 kips	351.14 kips
72.80 ft	353.64 kips	1.45 kips	355.09 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.80 ft	357.55 kips	1.45 kips	359.01 kips
74.80 ft	361.44 kips	1.45 kips	362.89 kips
75.80 ft	365.29 kips	1.45 kips	366.74 kips
76.80 ft	369.11 kips	1.45 kips	370.56 kips
77.80 ft	372.89 kips	1.45 kips	374.34 kips
78.80 ft	376.65 kips	1.45 kips	378.10 kips
79.80 ft	380.21 kips	1.45 kips	381.66 kips
80.80 ft	383.07 kips	1.45 kips	384.52 kips
81.80 ft	385.81 kips	1.45 kips	387.26 kips
82.80 ft	388.43 kips	1.45 kips	389.88 kips
83.80 ft	390.92 kips	1.45 kips	392.38 kips
84.80 ft	393.29 kips	1.45 kips	394.75 kips
85.79 ft	395.52 kips	1.45 kips	396.97 kips

Bearing Capacity - Driving



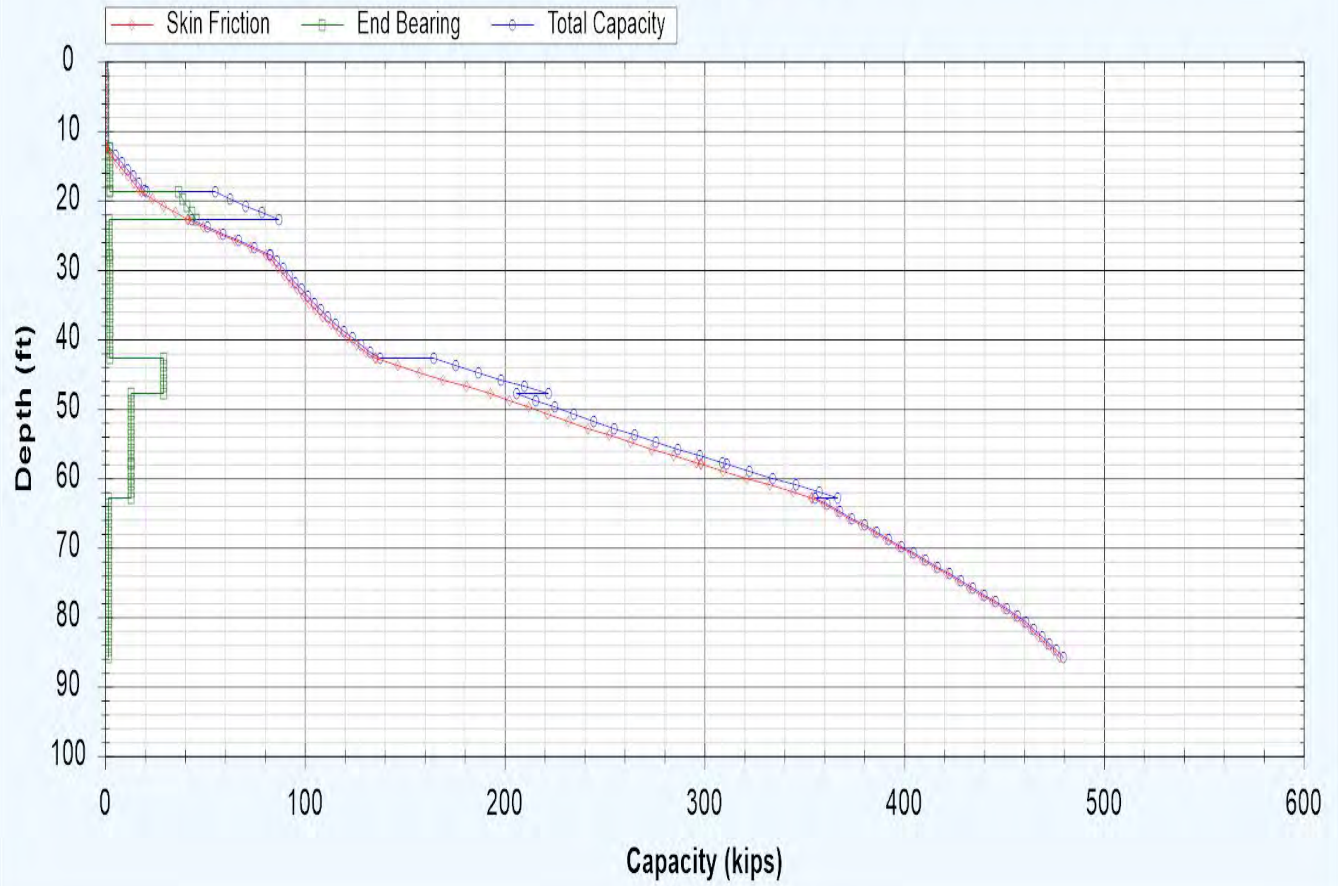
Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.02 kips	0.02 kips
2.00 ft	0.00 kips	0.04 kips	0.04 kips
3.00 ft	0.00 kips	0.05 kips	0.05 kips
4.00 ft	0.00 kips	0.07 kips	0.07 kips
5.00 ft	0.00 kips	0.09 kips	0.09 kips
6.00 ft	0.00 kips	0.11 kips	0.11 kips
7.00 ft	0.00 kips	0.13 kips	0.13 kips
8.00 ft	0.00 kips	0.14 kips	0.14 kips
9.00 ft	0.00 kips	0.16 kips	0.16 kips
10.00 ft	0.00 kips	0.18 kips	0.18 kips
11.00 ft	0.00 kips	0.20 kips	0.20 kips
12.00 ft	0.00 kips	0.22 kips	0.22 kips
12.49 ft	0.00 kips	0.23 kips	0.23 kips
12.51 ft	0.03 kips	2.42 kips	2.45 kips
13.50 ft	2.89 kips	2.42 kips	5.31 kips
14.50 ft	5.78 kips	2.42 kips	8.20 kips
15.50 ft	8.67 kips	2.42 kips	11.10 kips
16.50 ft	11.57 kips	2.42 kips	13.99 kips
17.50 ft	14.46 kips	2.42 kips	16.88 kips
18.50 ft	17.35 kips	2.42 kips	19.77 kips
18.79 ft	18.19 kips	2.42 kips	20.61 kips
18.81 ft	18.27 kips	36.71 kips	54.98 kips
19.80 ft	23.55 kips	38.88 kips	62.43 kips
20.80 ft	29.19 kips	41.08 kips	70.26 kips
21.80 ft	35.13 kips	43.27 kips	78.41 kips
22.79 ft	41.33 kips	45.45 kips	86.78 kips
22.81 ft	41.47 kips	1.84 kips	43.31 kips
23.80 ft	49.22 kips	1.84 kips	51.06 kips
24.80 ft	57.05 kips	1.84 kips	58.89 kips
25.80 ft	64.88 kips	1.84 kips	66.72 kips
26.80 ft	72.70 kips	1.84 kips	74.54 kips
27.79 ft	80.45 kips	1.84 kips	82.29 kips
27.81 ft	80.56 kips	2.23 kips	82.79 kips
28.80 ft	83.65 kips	2.23 kips	85.88 kips
29.80 ft	86.76 kips	2.23 kips	88.99 kips
30.80 ft	89.88 kips	2.23 kips	92.11 kips
31.80 ft	93.00 kips	2.23 kips	95.23 kips
32.80 ft	96.11 kips	2.23 kips	98.34 kips
33.80 ft	99.23 kips	2.23 kips	101.46 kips
34.80 ft	102.35 kips	2.23 kips	104.58 kips
35.80 ft	105.46 kips	2.23 kips	107.69 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.80 ft	109.02 kips	2.23 kips	111.25 kips
37.80 ft	113.00 kips	2.23 kips	115.23 kips
38.80 ft	117.14 kips	2.23 kips	119.37 kips
39.80 ft	121.44 kips	2.23 kips	123.67 kips
40.80 ft	125.91 kips	2.23 kips	128.14 kips
41.80 ft	130.54 kips	2.23 kips	132.77 kips
42.79 ft	135.28 kips	2.23 kips	137.51 kips
42.81 ft	135.44 kips	29.17 kips	164.60 kips
43.80 ft	146.28 kips	29.17 kips	175.45 kips
44.80 ft	157.51 kips	29.17 kips	186.68 kips
45.80 ft	169.03 kips	29.17 kips	198.20 kips
46.80 ft	180.83 kips	29.17 kips	209.99 kips
47.79 ft	192.78 kips	29.17 kips	221.95 kips
47.81 ft	193.00 kips	13.05 kips	206.05 kips
48.80 ft	202.27 kips	13.05 kips	215.32 kips
49.80 ft	211.84 kips	13.05 kips	224.90 kips
50.80 ft	221.62 kips	13.05 kips	234.67 kips
51.80 ft	231.60 kips	13.05 kips	244.65 kips
52.80 ft	241.79 kips	13.05 kips	254.84 kips
53.80 ft	252.18 kips	13.05 kips	265.23 kips
54.80 ft	262.78 kips	13.05 kips	275.83 kips
55.80 ft	273.58 kips	13.05 kips	286.63 kips
56.80 ft	284.59 kips	13.05 kips	297.64 kips
57.80 ft	295.80 kips	13.05 kips	308.85 kips
57.99 ft	297.95 kips	13.05 kips	311.01 kips
58.01 ft	298.18 kips	13.05 kips	311.24 kips
59.00 ft	309.48 kips	13.05 kips	322.53 kips
60.00 ft	320.99 kips	13.05 kips	334.05 kips
61.00 ft	332.62 kips	13.05 kips	345.67 kips
62.00 ft	344.35 kips	13.05 kips	357.40 kips
62.79 ft	353.69 kips	13.05 kips	366.74 kips
62.81 ft	353.87 kips	1.45 kips	355.32 kips
63.80 ft	359.99 kips	1.45 kips	361.44 kips
64.80 ft	366.17 kips	1.45 kips	367.62 kips
65.80 ft	372.35 kips	1.45 kips	373.80 kips
66.80 ft	378.53 kips	1.45 kips	379.98 kips
67.80 ft	384.71 kips	1.45 kips	386.16 kips
68.80 ft	390.89 kips	1.45 kips	392.34 kips
69.80 ft	397.06 kips	1.45 kips	398.52 kips
70.80 ft	403.24 kips	1.45 kips	404.70 kips
71.80 ft	409.29 kips	1.45 kips	410.75 kips
72.80 ft	415.21 kips	1.45 kips	416.67 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.80 ft	421.09 kips	1.45 kips	422.54 kips
74.80 ft	426.91 kips	1.45 kips	428.36 kips
75.80 ft	432.69 kips	1.45 kips	434.14 kips
76.80 ft	438.41 kips	1.45 kips	439.87 kips
77.80 ft	444.09 kips	1.45 kips	445.55 kips
78.80 ft	449.72 kips	1.45 kips	451.18 kips
79.80 ft	455.06 kips	1.45 kips	456.52 kips
80.80 ft	459.36 kips	1.45 kips	460.81 kips
81.80 ft	463.47 kips	1.45 kips	464.92 kips
82.80 ft	467.40 kips	1.45 kips	468.85 kips
83.80 ft	471.14 kips	1.45 kips	472.59 kips
84.80 ft	474.70 kips	1.45 kips	476.15 kips
85.79 ft	478.04 kips	1.45 kips	479.49 kips

Bearing Capacity - Nominal



DrivenPiles - Report

General Project Information

Filename: ...3.01\Analysis\Driven Piles\Rear Abutment\FRA-70-13.01 - Rear Abutment HP 10x42-B-015-1-13.dvn
Project Name: FRA-70-13.01 Rear Abutment (B-015-1-13)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile - HP 10x42
Top of Pile: 0.00 ft
Diameter of Pile: 10.08 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling: 58.00 ft
Driving/Restrike: 58.00 ft
Nominal: 58.00 ft

Nominal Considations:

Local Scour: 0.00 ft
Long Term Scour: 0.00 ft
Soft Soil: 0.00 ft

Nominal Profile

Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesionless	12.50 ft	1.000	120.00 pcf	28.0/28.0	Nordlund
2	Cohesive	6.30 ft	1.500	120.00 pcf	3125.00 psf	T-80 Same
3	Cohesionless	4.00 ft	1.000	135.00 pcf	42.0/42.0	Nordlund
4	Cohesive	5.00 ft	1.750	120.00 pcf	2375.00 psf	T-80 Sand
5	Cohesive	15.00 ft	1.500	120.00 pcf	2875.00 psf	T-80 Same
6	Cohesionless	5.00 ft	1.000	135.00 pcf	39.0/39.0	Nordlund
7	Cohesionless	15.00 ft	1.000	130.00 pcf	36.0/36.0	Nordlund
8	Cohesive	23.00 ft	1.500	115.00 pcf	1875.00 psf	T-80 Sand

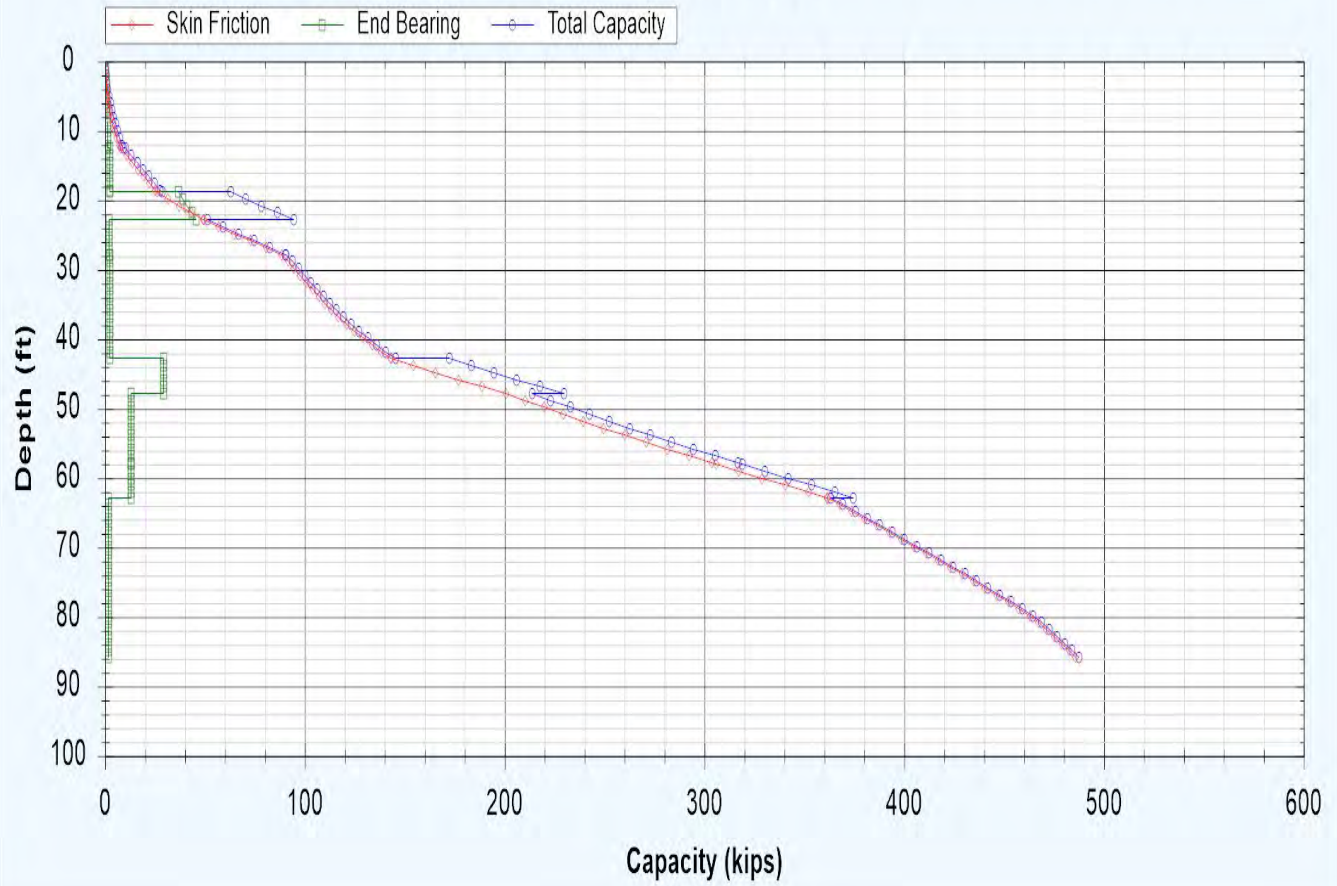
Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.05 kips	0.13 kips	0.18 kips
2.00 ft	0.20 kips	0.25 kips	0.45 kips
3.00 ft	0.45 kips	0.38 kips	0.83 kips
4.00 ft	0.80 kips	0.51 kips	1.30 kips
5.00 ft	1.24 kips	0.63 kips	1.88 kips
6.00 ft	1.79 kips	0.76 kips	2.55 kips
7.00 ft	2.44 kips	0.88 kips	3.32 kips
8.00 ft	3.18 kips	1.01 kips	4.19 kips
9.00 ft	4.03 kips	1.14 kips	5.17 kips
10.00 ft	4.98 kips	1.15 kips	6.12 kips
11.00 ft	6.02 kips	1.15 kips	7.17 kips
12.00 ft	7.16 kips	1.15 kips	8.31 kips
12.49 ft	7.76 kips	1.15 kips	8.91 kips
12.51 ft	7.80 kips	2.42 kips	10.22 kips
13.50 ft	10.67 kips	2.42 kips	13.09 kips
14.50 ft	13.56 kips	2.42 kips	15.98 kips
15.50 ft	16.45 kips	2.42 kips	18.87 kips
16.50 ft	19.34 kips	2.42 kips	21.76 kips
17.50 ft	22.23 kips	2.42 kips	24.65 kips
18.50 ft	25.12 kips	2.42 kips	27.54 kips
18.79 ft	25.96 kips	2.42 kips	28.38 kips
18.81 ft	26.04 kips	36.71 kips	62.75 kips
19.80 ft	31.32 kips	38.88 kips	70.20 kips
20.80 ft	36.96 kips	41.08 kips	78.04 kips
21.80 ft	42.91 kips	43.27 kips	86.18 kips
22.79 ft	49.10 kips	45.45 kips	94.55 kips
22.81 ft	49.24 kips	1.84 kips	51.09 kips
23.80 ft	56.99 kips	1.84 kips	58.83 kips
24.80 ft	64.82 kips	1.84 kips	66.66 kips
25.80 ft	72.65 kips	1.84 kips	74.49 kips
26.80 ft	80.48 kips	1.84 kips	82.32 kips
27.79 ft	88.23 kips	1.84 kips	90.07 kips
27.81 ft	88.34 kips	2.23 kips	90.56 kips
28.80 ft	91.42 kips	2.23 kips	93.65 kips
29.80 ft	94.54 kips	2.23 kips	96.77 kips
30.80 ft	97.65 kips	2.23 kips	99.88 kips
31.80 ft	100.77 kips	2.23 kips	103.00 kips
32.80 ft	103.89 kips	2.23 kips	106.12 kips
33.80 ft	107.00 kips	2.23 kips	109.23 kips
34.80 ft	110.12 kips	2.23 kips	112.35 kips
35.80 ft	113.24 kips	2.23 kips	115.47 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.80 ft	116.80 kips	2.23 kips	119.02 kips
37.80 ft	120.77 kips	2.23 kips	123.00 kips
38.80 ft	124.91 kips	2.23 kips	127.14 kips
39.80 ft	129.22 kips	2.23 kips	131.45 kips
40.80 ft	133.68 kips	2.23 kips	135.91 kips
41.80 ft	138.31 kips	2.23 kips	140.54 kips
42.79 ft	143.05 kips	2.23 kips	145.28 kips
42.81 ft	143.21 kips	29.17 kips	172.38 kips
43.80 ft	154.05 kips	29.17 kips	183.22 kips
44.80 ft	165.29 kips	29.17 kips	194.46 kips
45.80 ft	176.80 kips	29.17 kips	205.97 kips
46.80 ft	188.60 kips	29.17 kips	217.77 kips
47.79 ft	200.55 kips	29.17 kips	229.72 kips
47.81 ft	200.77 kips	13.05 kips	213.82 kips
48.80 ft	210.04 kips	13.05 kips	223.10 kips
49.80 ft	219.61 kips	13.05 kips	232.67 kips
50.80 ft	229.39 kips	13.05 kips	242.45 kips
51.80 ft	239.37 kips	13.05 kips	252.43 kips
52.80 ft	249.56 kips	13.05 kips	262.62 kips
53.80 ft	259.95 kips	13.05 kips	273.01 kips
54.80 ft	270.55 kips	13.05 kips	283.61 kips
55.80 ft	281.35 kips	13.05 kips	294.41 kips
56.80 ft	292.36 kips	13.05 kips	305.42 kips
57.80 ft	303.57 kips	13.05 kips	316.63 kips
57.99 ft	305.73 kips	13.05 kips	318.78 kips
58.01 ft	305.95 kips	13.05 kips	319.01 kips
59.00 ft	317.25 kips	13.05 kips	330.31 kips
60.00 ft	328.77 kips	13.05 kips	341.82 kips
61.00 ft	340.39 kips	13.05 kips	353.44 kips
62.00 ft	352.12 kips	13.05 kips	365.17 kips
62.79 ft	361.46 kips	13.05 kips	374.52 kips
62.81 ft	361.64 kips	1.45 kips	363.10 kips
63.80 ft	367.76 kips	1.45 kips	369.21 kips
64.80 ft	373.94 kips	1.45 kips	375.39 kips
65.80 ft	380.12 kips	1.45 kips	381.57 kips
66.80 ft	386.30 kips	1.45 kips	387.75 kips
67.80 ft	392.48 kips	1.45 kips	393.93 kips
68.80 ft	398.66 kips	1.45 kips	400.11 kips
69.80 ft	404.84 kips	1.45 kips	406.29 kips
70.80 ft	411.02 kips	1.45 kips	412.47 kips
71.80 ft	417.07 kips	1.45 kips	418.52 kips
72.80 ft	422.99 kips	1.45 kips	424.44 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.80 ft	428.86 kips	1.45 kips	430.31 kips
74.80 ft	434.69 kips	1.45 kips	436.14 kips
75.80 ft	440.46 kips	1.45 kips	441.91 kips
76.80 ft	446.19 kips	1.45 kips	447.64 kips
77.80 ft	451.87 kips	1.45 kips	453.32 kips
78.80 ft	457.50 kips	1.45 kips	458.95 kips
79.80 ft	462.84 kips	1.45 kips	464.29 kips
80.80 ft	467.13 kips	1.45 kips	468.59 kips
81.80 ft	471.24 kips	1.45 kips	472.70 kips
82.80 ft	475.17 kips	1.45 kips	476.62 kips
83.80 ft	478.91 kips	1.45 kips	480.37 kips
84.80 ft	482.47 kips	1.45 kips	483.92 kips
85.79 ft	485.81 kips	1.45 kips	487.26 kips

Bearing Capacity - Restrike



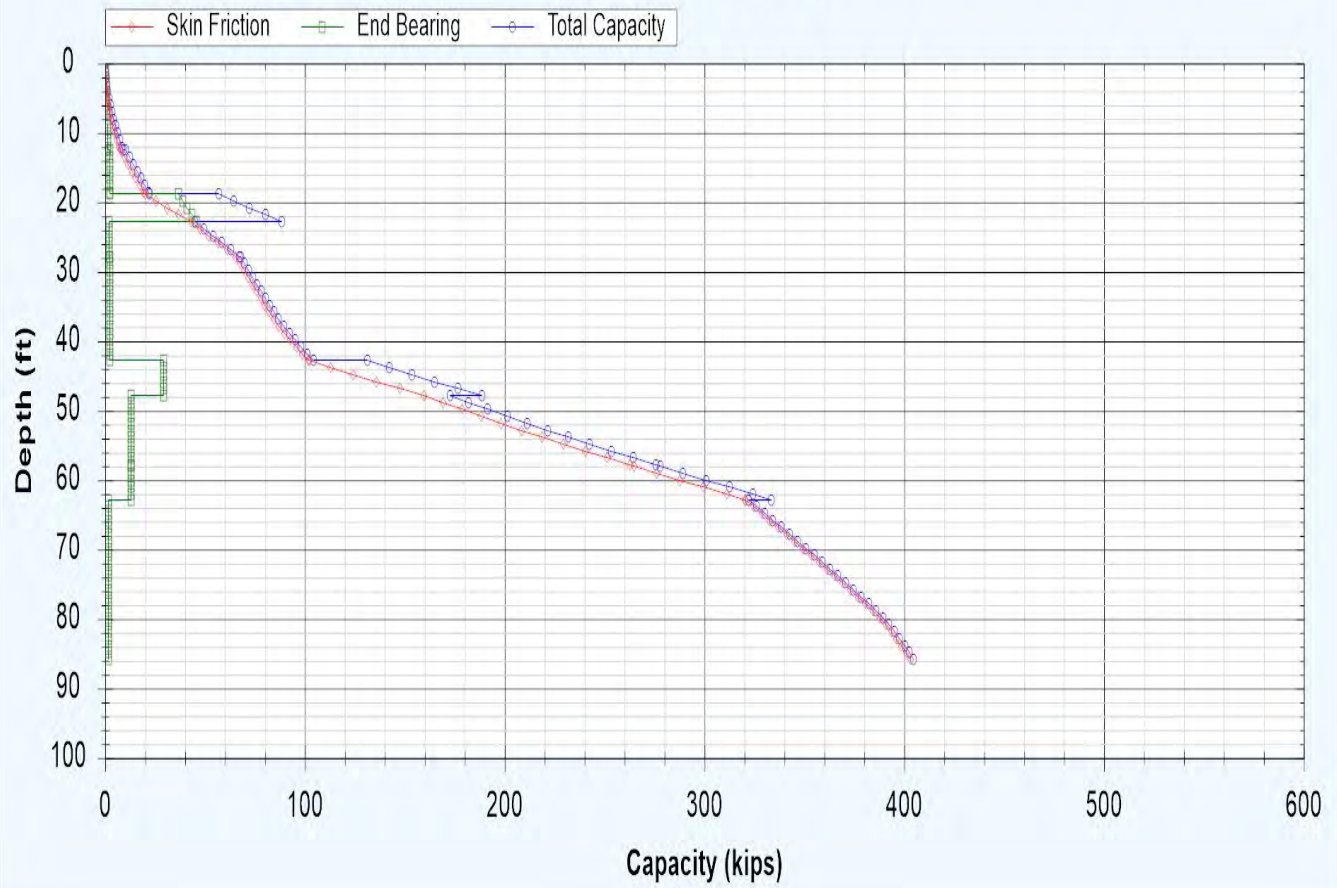
Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.05 kips	0.13 kips	0.18 kips
2.00 ft	0.20 kips	0.25 kips	0.45 kips
3.00 ft	0.45 kips	0.38 kips	0.83 kips
4.00 ft	0.80 kips	0.51 kips	1.30 kips
5.00 ft	1.24 kips	0.63 kips	1.88 kips
6.00 ft	1.79 kips	0.76 kips	2.55 kips
7.00 ft	2.44 kips	0.88 kips	3.32 kips
8.00 ft	3.18 kips	1.01 kips	4.19 kips
9.00 ft	4.03 kips	1.14 kips	5.17 kips
10.00 ft	4.98 kips	1.15 kips	6.12 kips
11.00 ft	6.02 kips	1.15 kips	7.17 kips
12.00 ft	7.16 kips	1.15 kips	8.31 kips
12.49 ft	7.76 kips	1.15 kips	8.91 kips
12.51 ft	7.79 kips	2.42 kips	10.21 kips
13.50 ft	9.70 kips	2.42 kips	12.12 kips
14.50 ft	11.63 kips	2.42 kips	14.05 kips
15.50 ft	13.56 kips	2.42 kips	15.98 kips
16.50 ft	15.48 kips	2.42 kips	17.91 kips
17.50 ft	17.41 kips	2.42 kips	19.83 kips
18.50 ft	19.34 kips	2.42 kips	21.76 kips
18.79 ft	19.90 kips	2.42 kips	22.32 kips
18.81 ft	19.97 kips	36.71 kips	56.68 kips
19.80 ft	25.25 kips	38.88 kips	64.13 kips
20.80 ft	30.89 kips	41.08 kips	71.97 kips
21.80 ft	36.84 kips	43.27 kips	80.11 kips
22.79 ft	43.03 kips	45.45 kips	88.48 kips
22.81 ft	43.14 kips	1.84 kips	44.98 kips
23.80 ft	47.57 kips	1.84 kips	49.41 kips
24.80 ft	52.04 kips	1.84 kips	53.88 kips
25.80 ft	56.51 kips	1.84 kips	58.35 kips
26.80 ft	60.99 kips	1.84 kips	62.83 kips
27.79 ft	65.41 kips	1.84 kips	67.25 kips
27.81 ft	65.48 kips	2.23 kips	67.71 kips
28.80 ft	67.54 kips	2.23 kips	69.76 kips
29.80 ft	69.61 kips	2.23 kips	71.84 kips
30.80 ft	71.69 kips	2.23 kips	73.92 kips
31.80 ft	73.77 kips	2.23 kips	76.00 kips
32.80 ft	75.85 kips	2.23 kips	78.08 kips
33.80 ft	77.93 kips	2.23 kips	80.15 kips
34.80 ft	80.00 kips	2.23 kips	82.23 kips
35.80 ft	82.08 kips	2.23 kips	84.31 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.80 ft	84.45 kips	2.23 kips	86.68 kips
37.80 ft	87.11 kips	2.23 kips	89.33 kips
38.80 ft	89.87 kips	2.23 kips	92.09 kips
39.80 ft	92.74 kips	2.23 kips	94.96 kips
40.80 ft	95.71 kips	2.23 kips	97.94 kips
41.80 ft	98.80 kips	2.23 kips	101.03 kips
42.79 ft	101.96 kips	2.23 kips	104.19 kips
42.81 ft	102.10 kips	29.17 kips	131.27 kips
43.80 ft	112.94 kips	29.17 kips	142.11 kips
44.80 ft	124.18 kips	29.17 kips	153.35 kips
45.80 ft	135.69 kips	29.17 kips	164.86 kips
46.80 ft	147.49 kips	29.17 kips	176.66 kips
47.79 ft	159.44 kips	29.17 kips	188.61 kips
47.81 ft	159.66 kips	13.05 kips	172.71 kips
48.80 ft	168.93 kips	13.05 kips	181.99 kips
49.80 ft	178.51 kips	13.05 kips	191.56 kips
50.80 ft	188.28 kips	13.05 kips	201.34 kips
51.80 ft	198.26 kips	13.05 kips	211.32 kips
52.80 ft	208.45 kips	13.05 kips	221.51 kips
53.80 ft	218.84 kips	13.05 kips	231.90 kips
54.80 ft	229.44 kips	13.05 kips	242.50 kips
55.80 ft	240.24 kips	13.05 kips	253.30 kips
56.80 ft	251.25 kips	13.05 kips	264.31 kips
57.80 ft	262.46 kips	13.05 kips	275.52 kips
57.99 ft	264.62 kips	13.05 kips	277.67 kips
58.01 ft	264.85 kips	13.05 kips	277.90 kips
59.00 ft	276.14 kips	13.05 kips	289.20 kips
60.00 ft	287.66 kips	13.05 kips	300.71 kips
61.00 ft	299.28 kips	13.05 kips	312.34 kips
62.00 ft	311.01 kips	13.05 kips	324.07 kips
62.79 ft	320.35 kips	13.05 kips	333.41 kips
62.81 ft	320.51 kips	1.45 kips	321.97 kips
63.80 ft	324.59 kips	1.45 kips	326.04 kips
64.80 ft	328.71 kips	1.45 kips	330.16 kips
65.80 ft	332.83 kips	1.45 kips	334.28 kips
66.80 ft	336.95 kips	1.45 kips	338.40 kips
67.80 ft	341.07 kips	1.45 kips	342.52 kips
68.80 ft	345.19 kips	1.45 kips	346.64 kips
69.80 ft	349.31 kips	1.45 kips	350.76 kips
70.80 ft	353.43 kips	1.45 kips	354.88 kips
71.80 ft	357.46 kips	1.45 kips	358.92 kips
72.80 ft	361.41 kips	1.45 kips	362.86 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.80 ft	365.33 kips	1.45 kips	366.78 kips
74.80 ft	369.21 kips	1.45 kips	370.66 kips
75.80 ft	373.06 kips	1.45 kips	374.51 kips
76.80 ft	376.88 kips	1.45 kips	378.33 kips
77.80 ft	380.67 kips	1.45 kips	382.12 kips
78.80 ft	384.42 kips	1.45 kips	385.87 kips
79.80 ft	387.98 kips	1.45 kips	389.43 kips
80.80 ft	390.84 kips	1.45 kips	392.30 kips
81.80 ft	393.58 kips	1.45 kips	395.04 kips
82.80 ft	396.20 kips	1.45 kips	397.65 kips
83.80 ft	398.70 kips	1.45 kips	400.15 kips
84.80 ft	401.07 kips	1.45 kips	402.52 kips
85.79 ft	403.29 kips	1.45 kips	404.75 kips

Bearing Capacity - Driving



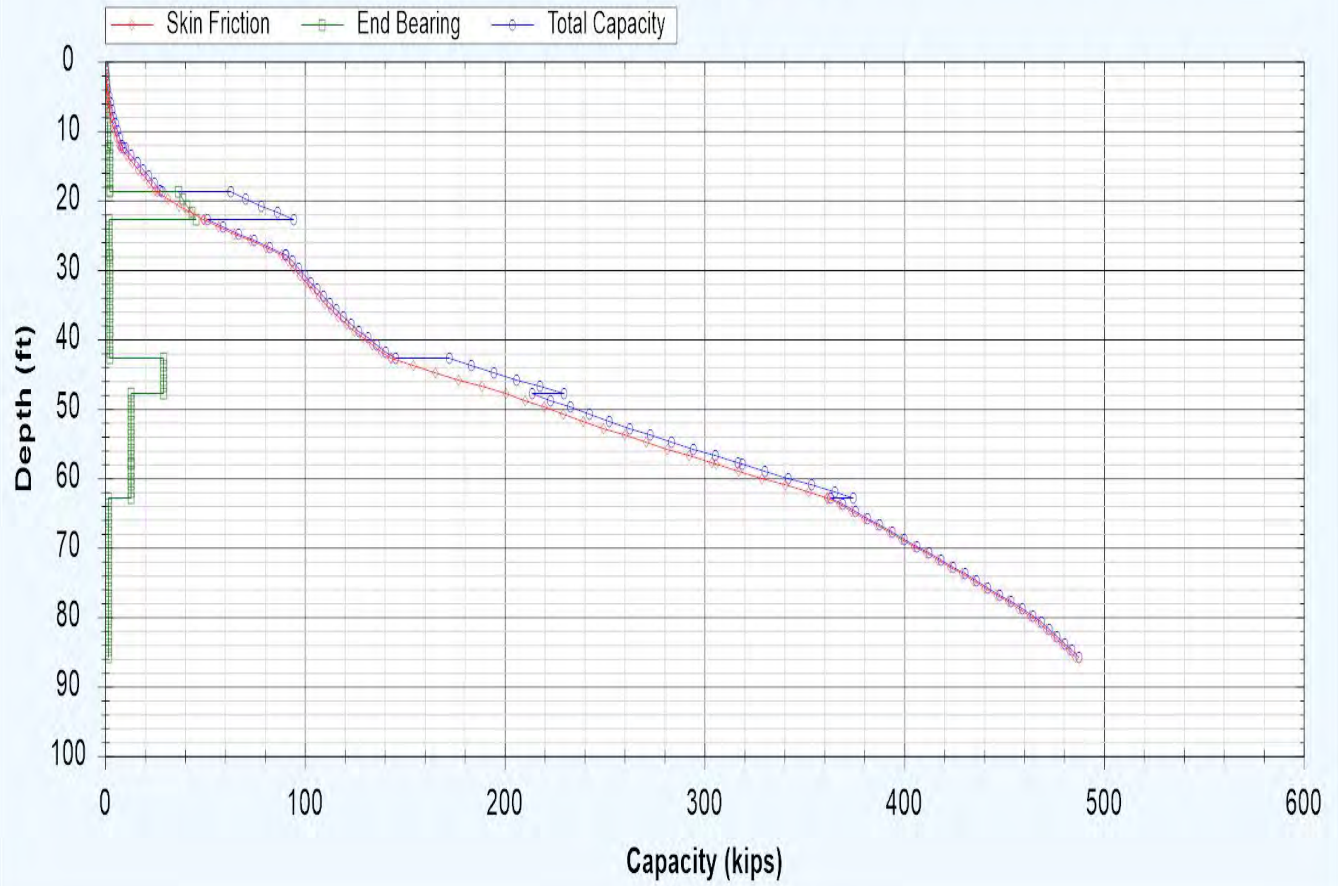
Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.05 kips	0.13 kips	0.18 kips
2.00 ft	0.20 kips	0.25 kips	0.45 kips
3.00 ft	0.45 kips	0.38 kips	0.83 kips
4.00 ft	0.80 kips	0.51 kips	1.30 kips
5.00 ft	1.24 kips	0.63 kips	1.88 kips
6.00 ft	1.79 kips	0.76 kips	2.55 kips
7.00 ft	2.44 kips	0.88 kips	3.32 kips
8.00 ft	3.18 kips	1.01 kips	4.19 kips
9.00 ft	4.03 kips	1.14 kips	5.17 kips
10.00 ft	4.98 kips	1.15 kips	6.12 kips
11.00 ft	6.02 kips	1.15 kips	7.17 kips
12.00 ft	7.16 kips	1.15 kips	8.31 kips
12.49 ft	7.76 kips	1.15 kips	8.91 kips
12.51 ft	7.80 kips	2.42 kips	10.22 kips
13.50 ft	10.67 kips	2.42 kips	13.09 kips
14.50 ft	13.56 kips	2.42 kips	15.98 kips
15.50 ft	16.45 kips	2.42 kips	18.87 kips
16.50 ft	19.34 kips	2.42 kips	21.76 kips
17.50 ft	22.23 kips	2.42 kips	24.65 kips
18.50 ft	25.12 kips	2.42 kips	27.54 kips
18.79 ft	25.96 kips	2.42 kips	28.38 kips
18.81 ft	26.04 kips	36.71 kips	62.75 kips
19.80 ft	31.32 kips	38.88 kips	70.20 kips
20.80 ft	36.96 kips	41.08 kips	78.04 kips
21.80 ft	42.91 kips	43.27 kips	86.18 kips
22.79 ft	49.10 kips	45.45 kips	94.55 kips
22.81 ft	49.24 kips	1.84 kips	51.09 kips
23.80 ft	56.99 kips	1.84 kips	58.83 kips
24.80 ft	64.82 kips	1.84 kips	66.66 kips
25.80 ft	72.65 kips	1.84 kips	74.49 kips
26.80 ft	80.48 kips	1.84 kips	82.32 kips
27.79 ft	88.23 kips	1.84 kips	90.07 kips
27.81 ft	88.34 kips	2.23 kips	90.56 kips
28.80 ft	91.42 kips	2.23 kips	93.65 kips
29.80 ft	94.54 kips	2.23 kips	96.77 kips
30.80 ft	97.65 kips	2.23 kips	99.88 kips
31.80 ft	100.77 kips	2.23 kips	103.00 kips
32.80 ft	103.89 kips	2.23 kips	106.12 kips
33.80 ft	107.00 kips	2.23 kips	109.23 kips
34.80 ft	110.12 kips	2.23 kips	112.35 kips
35.80 ft	113.24 kips	2.23 kips	115.47 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.80 ft	116.80 kips	2.23 kips	119.02 kips
37.80 ft	120.77 kips	2.23 kips	123.00 kips
38.80 ft	124.91 kips	2.23 kips	127.14 kips
39.80 ft	129.22 kips	2.23 kips	131.45 kips
40.80 ft	133.68 kips	2.23 kips	135.91 kips
41.80 ft	138.31 kips	2.23 kips	140.54 kips
42.79 ft	143.05 kips	2.23 kips	145.28 kips
42.81 ft	143.21 kips	29.17 kips	172.38 kips
43.80 ft	154.05 kips	29.17 kips	183.22 kips
44.80 ft	165.29 kips	29.17 kips	194.46 kips
45.80 ft	176.80 kips	29.17 kips	205.97 kips
46.80 ft	188.60 kips	29.17 kips	217.77 kips
47.79 ft	200.55 kips	29.17 kips	229.72 kips
47.81 ft	200.77 kips	13.05 kips	213.82 kips
48.80 ft	210.04 kips	13.05 kips	223.10 kips
49.80 ft	219.61 kips	13.05 kips	232.67 kips
50.80 ft	229.39 kips	13.05 kips	242.45 kips
51.80 ft	239.37 kips	13.05 kips	252.43 kips
52.80 ft	249.56 kips	13.05 kips	262.62 kips
53.80 ft	259.95 kips	13.05 kips	273.01 kips
54.80 ft	270.55 kips	13.05 kips	283.61 kips
55.80 ft	281.35 kips	13.05 kips	294.41 kips
56.80 ft	292.36 kips	13.05 kips	305.42 kips
57.80 ft	303.57 kips	13.05 kips	316.63 kips
57.99 ft	305.73 kips	13.05 kips	318.78 kips
58.01 ft	305.95 kips	13.05 kips	319.01 kips
59.00 ft	317.25 kips	13.05 kips	330.31 kips
60.00 ft	328.77 kips	13.05 kips	341.82 kips
61.00 ft	340.39 kips	13.05 kips	353.44 kips
62.00 ft	352.12 kips	13.05 kips	365.17 kips
62.79 ft	361.46 kips	13.05 kips	374.52 kips
62.81 ft	361.64 kips	1.45 kips	363.10 kips
63.80 ft	367.76 kips	1.45 kips	369.21 kips
64.80 ft	373.94 kips	1.45 kips	375.39 kips
65.80 ft	380.12 kips	1.45 kips	381.57 kips
66.80 ft	386.30 kips	1.45 kips	387.75 kips
67.80 ft	392.48 kips	1.45 kips	393.93 kips
68.80 ft	398.66 kips	1.45 kips	400.11 kips
69.80 ft	404.84 kips	1.45 kips	406.29 kips
70.80 ft	411.02 kips	1.45 kips	412.47 kips
71.80 ft	417.07 kips	1.45 kips	418.52 kips
72.80 ft	422.99 kips	1.45 kips	424.44 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.80 ft	428.86 kips	1.45 kips	430.31 kips
74.80 ft	434.69 kips	1.45 kips	436.14 kips
75.80 ft	440.46 kips	1.45 kips	441.91 kips
76.80 ft	446.19 kips	1.45 kips	447.64 kips
77.80 ft	451.87 kips	1.45 kips	453.32 kips
78.80 ft	457.50 kips	1.45 kips	458.95 kips
79.80 ft	462.84 kips	1.45 kips	464.29 kips
80.80 ft	467.13 kips	1.45 kips	468.59 kips
81.80 ft	471.24 kips	1.45 kips	472.70 kips
82.80 ft	475.17 kips	1.45 kips	476.62 kips
83.80 ft	478.91 kips	1.45 kips	480.37 kips
84.80 ft	482.47 kips	1.45 kips	483.92 kips
85.79 ft	485.81 kips	1.45 kips	487.26 kips

Bearing Capacity - Nominal



DrivenPiles - Report

General Project Information

Filename: ...3.01\Analysis\Driven Piles\Rear Abutment\FRA-70-13.01 - Rear Abutment HP 12x53-B-015-1-13.dvn
Project Name: FRA-70-13.01 Rear Abutment (B-015-1-13)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile - HP 12x53
Top of Pile: 0.00 ft
Diameter of Pile: 12.00 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling: 58.00 ft
Driving/Restrike: 58.00 ft
Nominal: 58.00 ft

Nominal Considations:

Local Scour: 0.00 ft
Long Term Scour: 0.00 ft
Soft Soil: 0.00 ft

Nominal Profile

Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesionless	12.50 ft	1.000	120.00 pcf	0.0/0.0	Nordlund
2	Cohesive	6.30 ft	1.500	120.00 pcf	3125.00 psf	T-80 Same
3	Cohesionless	4.00 ft	1.000	135.00 pcf	42.0/42.0	Nordlund
4	Cohesive	5.00 ft	1.750	120.00 pcf	2375.00 psf	T-80 Sand
5	Cohesive	15.00 ft	1.500	120.00 pcf	2875.00 psf	T-80 Same
6	Cohesionless	5.00 ft	1.000	135.00 pcf	39.0/39.0	Nordlund
7	Cohesionless	15.00 ft	1.000	130.00 pcf	36.0/36.0	Nordlund
8	Cohesive	23.00 ft	1.500	115.00 pcf	1875.00 psf	T-80 Sand

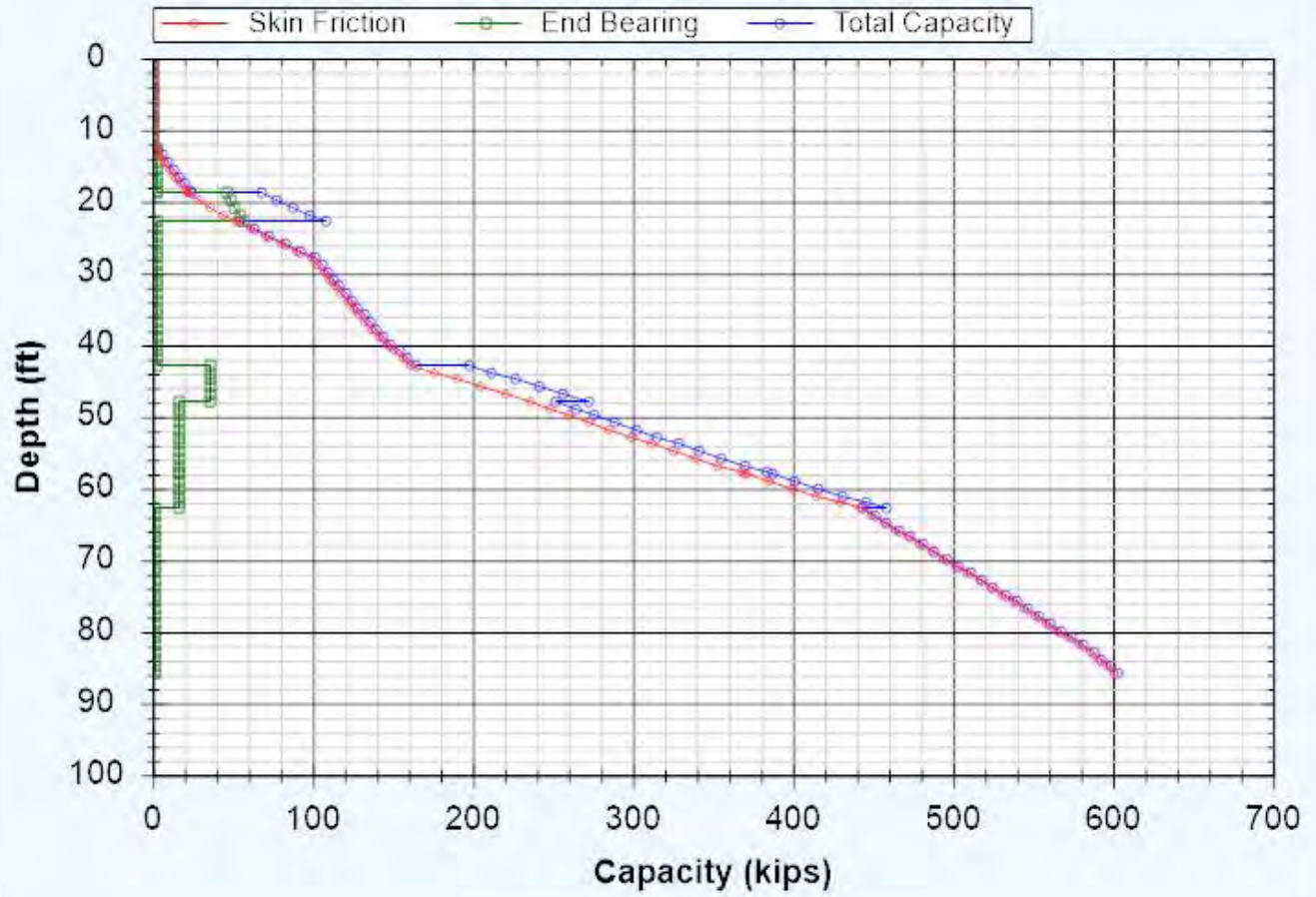
Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.02 kips	0.02 kips
2.00 ft	0.00 kips	0.05 kips	0.05 kips
3.00 ft	0.00 kips	0.07 kips	0.07 kips
4.00 ft	0.00 kips	0.09 kips	0.09 kips
5.00 ft	0.00 kips	0.11 kips	0.11 kips
6.00 ft	0.00 kips	0.14 kips	0.14 kips
7.00 ft	0.00 kips	0.16 kips	0.16 kips
8.00 ft	0.00 kips	0.18 kips	0.18 kips
9.00 ft	0.00 kips	0.20 kips	0.20 kips
10.00 ft	0.00 kips	0.23 kips	0.23 kips
11.00 ft	0.00 kips	0.25 kips	0.25 kips
12.00 ft	0.00 kips	0.27 kips	0.27 kips
12.49 ft	0.00 kips	0.28 kips	0.28 kips
12.51 ft	0.03 kips	3.03 kips	3.06 kips
13.50 ft	3.48 kips	3.03 kips	6.51 kips
14.50 ft	6.96 kips	3.03 kips	9.99 kips
15.50 ft	10.44 kips	3.03 kips	13.47 kips
16.50 ft	13.92 kips	3.03 kips	16.95 kips
17.50 ft	17.40 kips	3.03 kips	20.43 kips
18.50 ft	20.88 kips	3.03 kips	23.91 kips
18.79 ft	21.89 kips	3.03 kips	24.92 kips
18.81 ft	21.99 kips	45.89 kips	67.88 kips
19.80 ft	28.83 kips	48.60 kips	77.44 kips
20.80 ft	36.14 kips	51.35 kips	87.49 kips
21.80 ft	43.86 kips	54.09 kips	97.95 kips
22.79 ft	51.89 kips	56.81 kips	108.70 kips
22.81 ft	52.06 kips	2.30 kips	54.36 kips
23.80 ft	61.39 kips	2.30 kips	63.69 kips
24.80 ft	70.81 kips	2.30 kips	73.11 kips
25.80 ft	80.23 kips	2.30 kips	82.53 kips
26.80 ft	89.65 kips	2.30 kips	91.95 kips
27.79 ft	98.98 kips	2.30 kips	101.28 kips
27.81 ft	99.11 kips	2.79 kips	101.90 kips
28.80 ft	102.82 kips	2.79 kips	105.61 kips
29.80 ft	106.57 kips	2.79 kips	109.36 kips
30.80 ft	110.33 kips	2.79 kips	113.11 kips
31.80 ft	114.08 kips	2.79 kips	116.86 kips
32.80 ft	117.83 kips	2.79 kips	120.61 kips
33.80 ft	121.58 kips	2.79 kips	124.36 kips
34.80 ft	125.33 kips	2.79 kips	128.11 kips
35.80 ft	129.08 kips	2.79 kips	131.87 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.80 ft	132.83 kips	2.79 kips	135.62 kips
37.80 ft	136.58 kips	2.79 kips	139.37 kips
38.80 ft	141.24 kips	2.79 kips	144.02 kips
39.80 ft	146.05 kips	2.79 kips	148.84 kips
40.80 ft	151.04 kips	2.79 kips	153.82 kips
41.80 ft	156.18 kips	2.79 kips	158.97 kips
42.79 ft	161.44 kips	2.79 kips	164.22 kips
42.81 ft	161.63 kips	36.46 kips	198.09 kips
43.80 ft	175.63 kips	36.46 kips	212.09 kips
44.80 ft	190.13 kips	36.46 kips	226.59 kips
45.80 ft	205.00 kips	36.46 kips	241.46 kips
46.80 ft	220.22 kips	36.46 kips	256.68 kips
47.79 ft	235.65 kips	36.46 kips	272.11 kips
47.81 ft	235.93 kips	16.32 kips	252.25 kips
48.80 ft	247.81 kips	16.32 kips	264.13 kips
49.80 ft	260.08 kips	16.32 kips	276.40 kips
50.80 ft	272.61 kips	16.32 kips	288.92 kips
51.80 ft	285.40 kips	16.32 kips	301.71 kips
52.80 ft	298.45 kips	16.32 kips	314.77 kips
53.80 ft	311.77 kips	16.32 kips	328.08 kips
54.80 ft	325.34 kips	16.32 kips	341.66 kips
55.80 ft	339.19 kips	16.32 kips	355.50 kips
56.80 ft	353.29 kips	16.32 kips	369.61 kips
57.80 ft	367.66 kips	16.32 kips	383.98 kips
57.99 ft	370.42 kips	16.32 kips	386.74 kips
58.01 ft	370.71 kips	16.32 kips	387.03 kips
59.00 ft	385.18 kips	16.32 kips	401.50 kips
60.00 ft	399.94 kips	16.32 kips	416.26 kips
61.00 ft	414.83 kips	16.32 kips	431.15 kips
62.00 ft	429.86 kips	16.32 kips	446.18 kips
62.79 ft	441.83 kips	16.32 kips	458.15 kips
62.81 ft	442.06 kips	1.82 kips	443.88 kips
63.80 ft	449.42 kips	1.82 kips	451.24 kips
64.80 ft	456.86 kips	1.82 kips	458.68 kips
65.80 ft	464.30 kips	1.82 kips	466.12 kips
66.80 ft	471.74 kips	1.82 kips	473.55 kips
67.80 ft	479.17 kips	1.82 kips	480.99 kips
68.80 ft	486.61 kips	1.82 kips	488.43 kips
69.80 ft	494.05 kips	1.82 kips	495.87 kips
70.80 ft	501.49 kips	1.82 kips	503.30 kips
71.80 ft	508.92 kips	1.82 kips	510.74 kips
72.80 ft	516.36 kips	1.82 kips	518.18 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.80 ft	523.53 kips	1.82 kips	525.34 kips
74.80 ft	530.65 kips	1.82 kips	532.46 kips
75.80 ft	537.72 kips	1.82 kips	539.53 kips
76.80 ft	544.74 kips	1.82 kips	546.55 kips
77.80 ft	551.71 kips	1.82 kips	553.52 kips
78.80 ft	558.63 kips	1.82 kips	560.44 kips
79.80 ft	565.50 kips	1.82 kips	567.32 kips
80.80 ft	572.32 kips	1.82 kips	574.14 kips
81.80 ft	579.10 kips	1.82 kips	580.91 kips
82.80 ft	585.82 kips	1.82 kips	587.64 kips
83.80 ft	591.06 kips	1.82 kips	592.87 kips
84.80 ft	596.10 kips	1.82 kips	597.92 kips
85.79 ft	600.92 kips	1.82 kips	602.73 kips

Bearing Capacity - Restrike



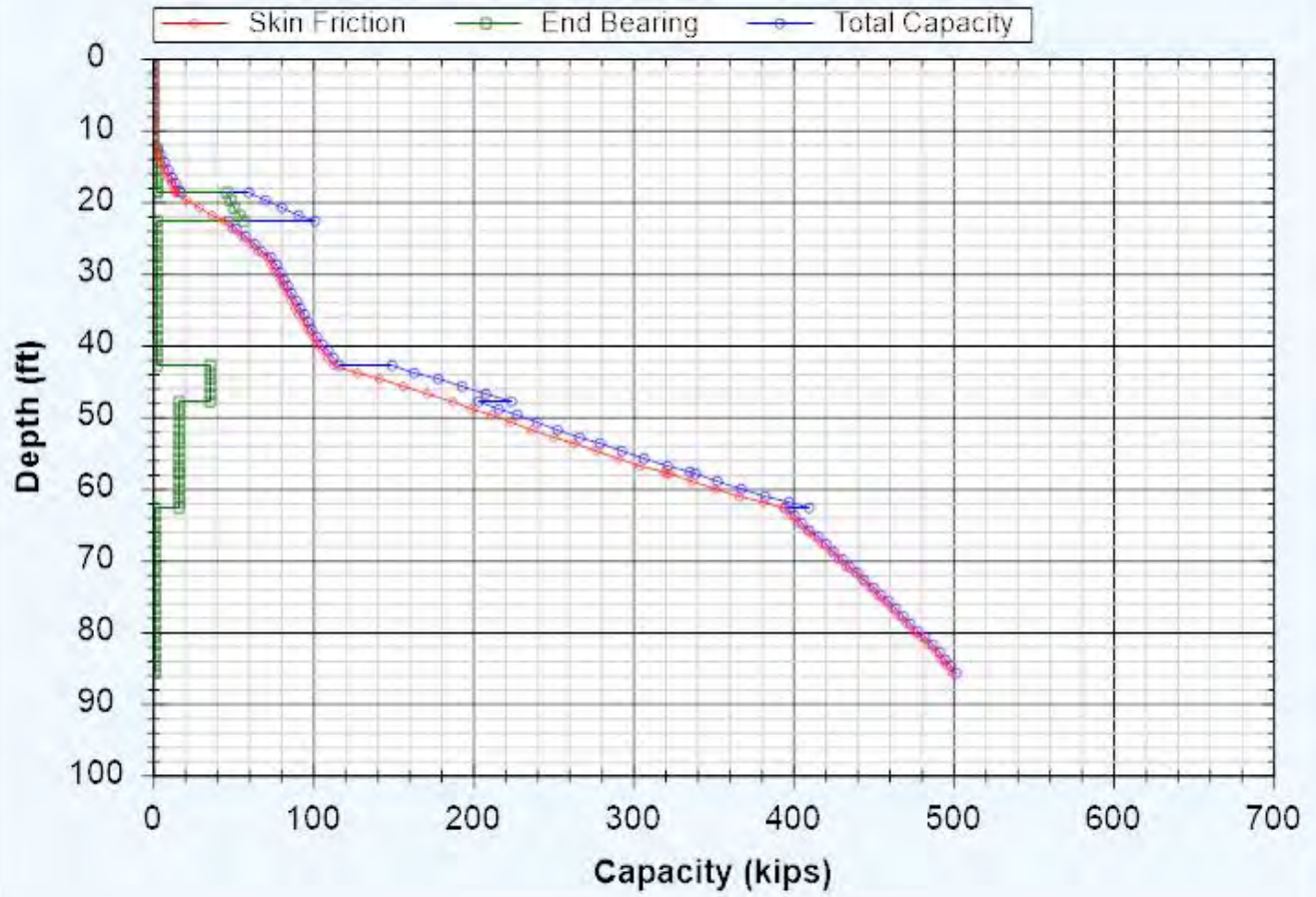
Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.02 kips	0.02 kips
2.00 ft	0.00 kips	0.05 kips	0.05 kips
3.00 ft	0.00 kips	0.07 kips	0.07 kips
4.00 ft	0.00 kips	0.09 kips	0.09 kips
5.00 ft	0.00 kips	0.11 kips	0.11 kips
6.00 ft	0.00 kips	0.14 kips	0.14 kips
7.00 ft	0.00 kips	0.16 kips	0.16 kips
8.00 ft	0.00 kips	0.18 kips	0.18 kips
9.00 ft	0.00 kips	0.20 kips	0.20 kips
10.00 ft	0.00 kips	0.23 kips	0.23 kips
11.00 ft	0.00 kips	0.25 kips	0.25 kips
12.00 ft	0.00 kips	0.27 kips	0.27 kips
12.49 ft	0.00 kips	0.28 kips	0.28 kips
12.51 ft	0.02 kips	3.03 kips	3.05 kips
13.50 ft	2.32 kips	3.03 kips	5.35 kips
14.50 ft	4.64 kips	3.03 kips	7.67 kips
15.50 ft	6.96 kips	3.03 kips	9.99 kips
16.50 ft	9.28 kips	3.03 kips	12.31 kips
17.50 ft	11.60 kips	3.03 kips	14.63 kips
18.50 ft	13.92 kips	3.03 kips	16.95 kips
18.79 ft	14.59 kips	3.03 kips	17.62 kips
18.81 ft	14.68 kips	45.89 kips	60.57 kips
19.80 ft	21.53 kips	48.60 kips	70.13 kips
20.80 ft	28.84 kips	51.35 kips	80.19 kips
21.80 ft	36.55 kips	54.09 kips	90.64 kips
22.79 ft	44.58 kips	56.81 kips	101.39 kips
22.81 ft	44.72 kips	2.30 kips	47.02 kips
23.80 ft	50.04 kips	2.30 kips	52.35 kips
24.80 ft	55.43 kips	2.30 kips	57.73 kips
25.80 ft	60.81 kips	2.30 kips	63.11 kips
26.80 ft	66.19 kips	2.30 kips	68.49 kips
27.79 ft	71.52 kips	2.30 kips	73.82 kips
27.81 ft	71.60 kips	2.79 kips	74.39 kips
28.80 ft	74.08 kips	2.79 kips	76.86 kips
29.80 ft	76.58 kips	2.79 kips	79.36 kips
30.80 ft	79.08 kips	2.79 kips	81.86 kips
31.80 ft	81.58 kips	2.79 kips	84.37 kips
32.80 ft	84.08 kips	2.79 kips	86.87 kips
33.80 ft	86.58 kips	2.79 kips	89.37 kips
34.80 ft	89.08 kips	2.79 kips	91.87 kips
35.80 ft	91.58 kips	2.79 kips	94.37 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.80 ft	94.08 kips	2.79 kips	96.87 kips
37.80 ft	96.58 kips	2.79 kips	99.37 kips
38.80 ft	99.69 kips	2.79 kips	102.47 kips
39.80 ft	102.90 kips	2.79 kips	105.68 kips
40.80 ft	106.22 kips	2.79 kips	109.01 kips
41.80 ft	109.65 kips	2.79 kips	112.44 kips
42.79 ft	113.16 kips	2.79 kips	115.94 kips
42.81 ft	113.33 kips	36.46 kips	149.79 kips
43.80 ft	127.33 kips	36.46 kips	163.79 kips
44.80 ft	141.83 kips	36.46 kips	178.29 kips
45.80 ft	156.70 kips	36.46 kips	193.15 kips
46.80 ft	171.92 kips	36.46 kips	208.38 kips
47.79 ft	187.35 kips	36.46 kips	223.81 kips
47.81 ft	187.63 kips	16.32 kips	203.95 kips
48.80 ft	199.51 kips	16.32 kips	215.83 kips
49.80 ft	211.78 kips	16.32 kips	228.09 kips
50.80 ft	224.30 kips	16.32 kips	240.62 kips
51.80 ft	237.09 kips	16.32 kips	253.41 kips
52.80 ft	250.15 kips	16.32 kips	266.47 kips
53.80 ft	263.46 kips	16.32 kips	279.78 kips
54.80 ft	277.04 kips	16.32 kips	293.36 kips
55.80 ft	290.89 kips	16.32 kips	307.20 kips
56.80 ft	304.99 kips	16.32 kips	321.31 kips
57.80 ft	319.36 kips	16.32 kips	335.68 kips
57.99 ft	322.12 kips	16.32 kips	338.44 kips
58.01 ft	322.41 kips	16.32 kips	338.73 kips
59.00 ft	336.88 kips	16.32 kips	353.20 kips
60.00 ft	351.64 kips	16.32 kips	367.96 kips
61.00 ft	366.53 kips	16.32 kips	382.85 kips
62.00 ft	381.56 kips	16.32 kips	397.88 kips
62.79 ft	393.53 kips	16.32 kips	409.85 kips
62.81 ft	393.73 kips	1.82 kips	395.55 kips
63.80 ft	398.64 kips	1.82 kips	400.46 kips
64.80 ft	403.60 kips	1.82 kips	405.42 kips
65.80 ft	408.56 kips	1.82 kips	410.38 kips
66.80 ft	413.52 kips	1.82 kips	415.34 kips
67.80 ft	418.48 kips	1.82 kips	420.29 kips
68.80 ft	423.44 kips	1.82 kips	425.25 kips
69.80 ft	428.40 kips	1.82 kips	430.21 kips
70.80 ft	433.35 kips	1.82 kips	435.17 kips
71.80 ft	438.31 kips	1.82 kips	440.13 kips
72.80 ft	443.27 kips	1.82 kips	445.09 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.80 ft	448.05 kips	1.82 kips	449.87 kips
74.80 ft	452.80 kips	1.82 kips	454.61 kips
75.80 ft	457.51 kips	1.82 kips	459.32 kips
76.80 ft	462.19 kips	1.82 kips	464.00 kips
77.80 ft	466.84 kips	1.82 kips	468.65 kips
78.80 ft	471.45 kips	1.82 kips	473.27 kips
79.80 ft	476.03 kips	1.82 kips	477.85 kips
80.80 ft	480.58 kips	1.82 kips	482.40 kips
81.80 ft	485.10 kips	1.82 kips	486.91 kips
82.80 ft	489.58 kips	1.82 kips	491.40 kips
83.80 ft	493.07 kips	1.82 kips	494.89 kips
84.80 ft	496.44 kips	1.82 kips	498.25 kips
85.79 ft	499.64 kips	1.82 kips	501.46 kips

Bearing Capacity - Driving



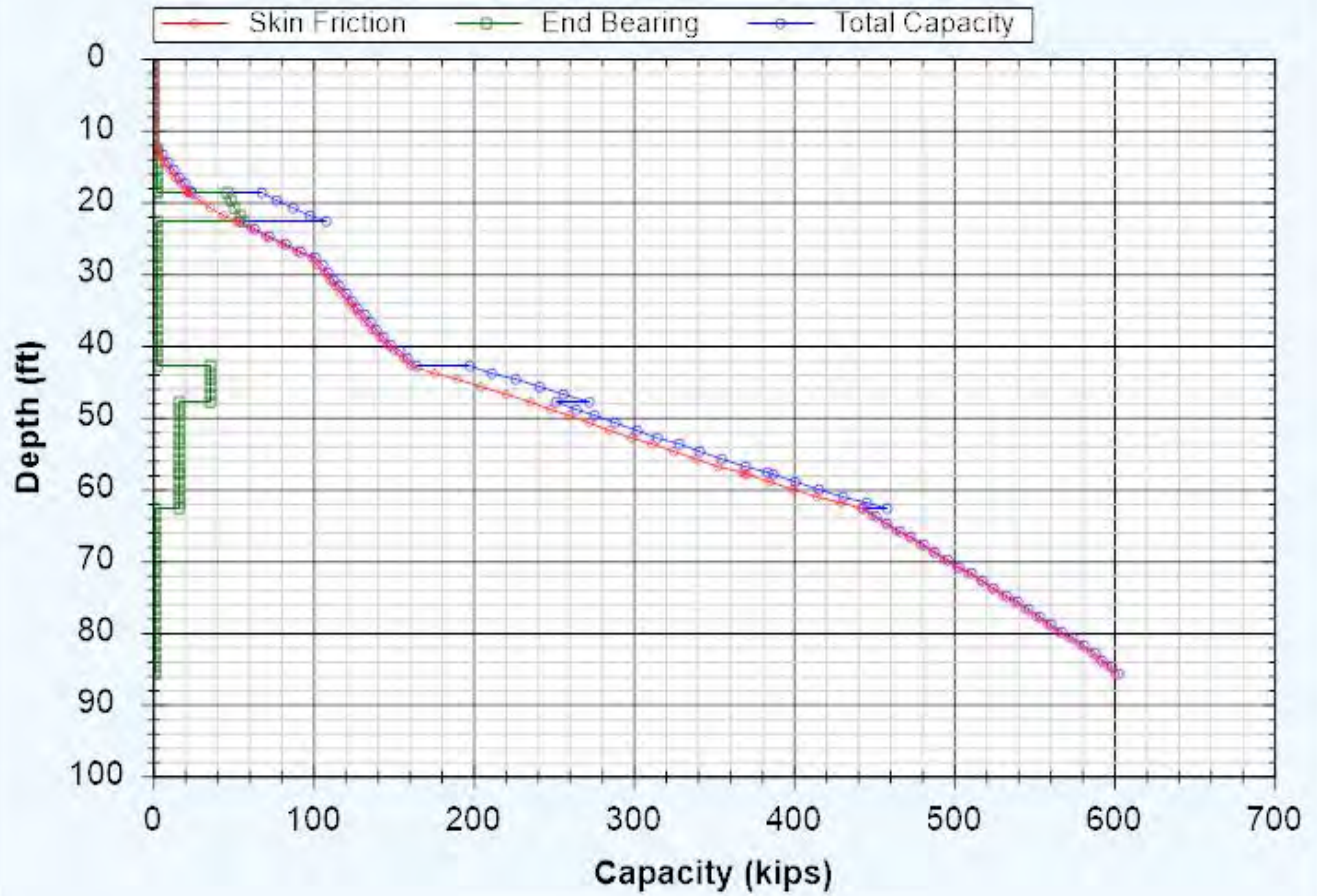
Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.02 kips	0.02 kips
2.00 ft	0.00 kips	0.05 kips	0.05 kips
3.00 ft	0.00 kips	0.07 kips	0.07 kips
4.00 ft	0.00 kips	0.09 kips	0.09 kips
5.00 ft	0.00 kips	0.11 kips	0.11 kips
6.00 ft	0.00 kips	0.14 kips	0.14 kips
7.00 ft	0.00 kips	0.16 kips	0.16 kips
8.00 ft	0.00 kips	0.18 kips	0.18 kips
9.00 ft	0.00 kips	0.20 kips	0.20 kips
10.00 ft	0.00 kips	0.23 kips	0.23 kips
11.00 ft	0.00 kips	0.25 kips	0.25 kips
12.00 ft	0.00 kips	0.27 kips	0.27 kips
12.49 ft	0.00 kips	0.28 kips	0.28 kips
12.51 ft	0.03 kips	3.03 kips	3.06 kips
13.50 ft	3.48 kips	3.03 kips	6.51 kips
14.50 ft	6.96 kips	3.03 kips	9.99 kips
15.50 ft	10.44 kips	3.03 kips	13.47 kips
16.50 ft	13.92 kips	3.03 kips	16.95 kips
17.50 ft	17.40 kips	3.03 kips	20.43 kips
18.50 ft	20.88 kips	3.03 kips	23.91 kips
18.79 ft	21.89 kips	3.03 kips	24.92 kips
18.81 ft	21.99 kips	45.89 kips	67.88 kips
19.80 ft	28.83 kips	48.60 kips	77.44 kips
20.80 ft	36.14 kips	51.35 kips	87.49 kips
21.80 ft	43.86 kips	54.09 kips	97.95 kips
22.79 ft	51.89 kips	56.81 kips	108.70 kips
22.81 ft	52.06 kips	2.30 kips	54.36 kips
23.80 ft	61.39 kips	2.30 kips	63.69 kips
24.80 ft	70.81 kips	2.30 kips	73.11 kips
25.80 ft	80.23 kips	2.30 kips	82.53 kips
26.80 ft	89.65 kips	2.30 kips	91.95 kips
27.79 ft	98.98 kips	2.30 kips	101.28 kips
27.81 ft	99.11 kips	2.79 kips	101.90 kips
28.80 ft	102.82 kips	2.79 kips	105.61 kips
29.80 ft	106.57 kips	2.79 kips	109.36 kips
30.80 ft	110.33 kips	2.79 kips	113.11 kips
31.80 ft	114.08 kips	2.79 kips	116.86 kips
32.80 ft	117.83 kips	2.79 kips	120.61 kips
33.80 ft	121.58 kips	2.79 kips	124.36 kips
34.80 ft	125.33 kips	2.79 kips	128.11 kips
35.80 ft	129.08 kips	2.79 kips	131.87 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.80 ft	132.83 kips	2.79 kips	135.62 kips
37.80 ft	136.58 kips	2.79 kips	139.37 kips
38.80 ft	141.24 kips	2.79 kips	144.02 kips
39.80 ft	146.05 kips	2.79 kips	148.84 kips
40.80 ft	151.04 kips	2.79 kips	153.82 kips
41.80 ft	156.18 kips	2.79 kips	158.97 kips
42.79 ft	161.44 kips	2.79 kips	164.22 kips
42.81 ft	161.63 kips	36.46 kips	198.09 kips
43.80 ft	175.63 kips	36.46 kips	212.09 kips
44.80 ft	190.13 kips	36.46 kips	226.59 kips
45.80 ft	205.00 kips	36.46 kips	241.46 kips
46.80 ft	220.22 kips	36.46 kips	256.68 kips
47.79 ft	235.65 kips	36.46 kips	272.11 kips
47.81 ft	235.93 kips	16.32 kips	252.25 kips
48.80 ft	247.81 kips	16.32 kips	264.13 kips
49.80 ft	260.08 kips	16.32 kips	276.40 kips
50.80 ft	272.61 kips	16.32 kips	288.92 kips
51.80 ft	285.40 kips	16.32 kips	301.71 kips
52.80 ft	298.45 kips	16.32 kips	314.77 kips
53.80 ft	311.77 kips	16.32 kips	328.08 kips
54.80 ft	325.34 kips	16.32 kips	341.66 kips
55.80 ft	339.19 kips	16.32 kips	355.50 kips
56.80 ft	353.29 kips	16.32 kips	369.61 kips
57.80 ft	367.66 kips	16.32 kips	383.98 kips
57.99 ft	370.42 kips	16.32 kips	386.74 kips
58.01 ft	370.71 kips	16.32 kips	387.03 kips
59.00 ft	385.18 kips	16.32 kips	401.50 kips
60.00 ft	399.94 kips	16.32 kips	416.26 kips
61.00 ft	414.83 kips	16.32 kips	431.15 kips
62.00 ft	429.86 kips	16.32 kips	446.18 kips
62.79 ft	441.83 kips	16.32 kips	458.15 kips
62.81 ft	442.06 kips	1.82 kips	443.88 kips
63.80 ft	449.42 kips	1.82 kips	451.24 kips
64.80 ft	456.86 kips	1.82 kips	458.68 kips
65.80 ft	464.30 kips	1.82 kips	466.12 kips
66.80 ft	471.74 kips	1.82 kips	473.55 kips
67.80 ft	479.17 kips	1.82 kips	480.99 kips
68.80 ft	486.61 kips	1.82 kips	488.43 kips
69.80 ft	494.05 kips	1.82 kips	495.87 kips
70.80 ft	501.49 kips	1.82 kips	503.30 kips
71.80 ft	508.92 kips	1.82 kips	510.74 kips
72.80 ft	516.36 kips	1.82 kips	518.18 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.80 ft	523.53 kips	1.82 kips	525.34 kips
74.80 ft	530.65 kips	1.82 kips	532.46 kips
75.80 ft	537.72 kips	1.82 kips	539.53 kips
76.80 ft	544.74 kips	1.82 kips	546.55 kips
77.80 ft	551.71 kips	1.82 kips	553.52 kips
78.80 ft	558.63 kips	1.82 kips	560.44 kips
79.80 ft	565.50 kips	1.82 kips	567.32 kips
80.80 ft	572.32 kips	1.82 kips	574.14 kips
81.80 ft	579.10 kips	1.82 kips	580.91 kips
82.80 ft	585.82 kips	1.82 kips	587.64 kips
83.80 ft	591.06 kips	1.82 kips	592.87 kips
84.80 ft	596.10 kips	1.82 kips	597.92 kips
85.79 ft	600.92 kips	1.82 kips	602.73 kips

Bearing Capacity - Nominal



DrivenPiles - Report

General Project Information

Filename: ...3.01\Analysis\Driven Piles\Rear Abutment\FRA-70-13.01 - Rear Abutment HP 12x53-B-015-1-13.dvn
Project Name: FRA-70-13.01 Rear Abutment (B-015-1-13)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile - HP 12x53
Top of Pile: 0.00 ft
Diameter of Pile: 12.00 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling: 58.00 ft
Driving/Restrike: 58.00 ft
Nominal: 58.00 ft

Nominal Considations:

Local Scour: 0.00 ft
Long Term Scour: 0.00 ft
Soft Soil: 0.00 ft

Nominal Profile

Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesionless	12.50 ft	1.000	120.00 pcf	28.0/28.0	Nordlund
2	Cohesive	6.30 ft	1.500	120.00 pcf	3125.00 psf	T-80 Same
3	Cohesionless	4.00 ft	1.000	135.00 pcf	42.0/42.0	Nordlund
4	Cohesive	5.00 ft	1.750	120.00 pcf	2375.00 psf	T-80 Sand
5	Cohesive	15.00 ft	1.500	120.00 pcf	2875.00 psf	T-80 Same
6	Cohesionless	5.00 ft	1.000	135.00 pcf	39.0/39.0	Nordlund
7	Cohesionless	15.00 ft	1.000	130.00 pcf	36.0/36.0	Nordlund
8	Cohesive	23.00 ft	1.500	115.00 pcf	1875.00 psf	T-80 Sand

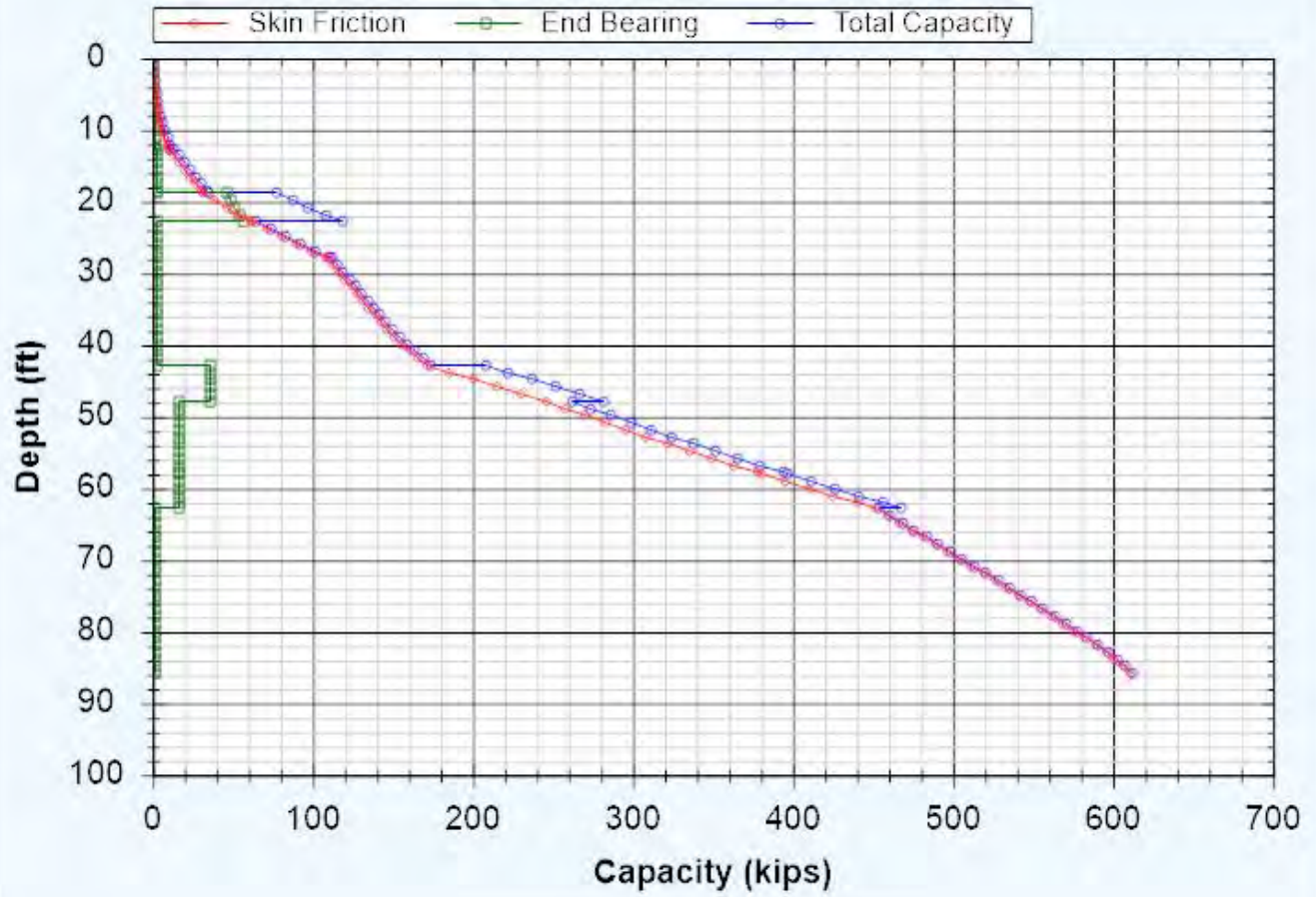
Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.06 kips	0.16 kips	0.22 kips
2.00 ft	0.25 kips	0.32 kips	0.57 kips
3.00 ft	0.57 kips	0.47 kips	1.04 kips
4.00 ft	1.00 kips	0.63 kips	1.64 kips
5.00 ft	1.57 kips	0.79 kips	2.36 kips
6.00 ft	2.26 kips	0.95 kips	3.21 kips
7.00 ft	3.08 kips	1.10 kips	4.18 kips
8.00 ft	4.02 kips	1.26 kips	5.28 kips
9.00 ft	5.09 kips	1.42 kips	6.51 kips
10.00 ft	6.28 kips	1.43 kips	7.71 kips
11.00 ft	7.60 kips	1.43 kips	9.03 kips
12.00 ft	9.04 kips	1.43 kips	10.47 kips
12.49 ft	9.79 kips	1.43 kips	11.23 kips
12.51 ft	9.85 kips	3.03 kips	12.87 kips
13.50 ft	13.29 kips	3.03 kips	16.32 kips
14.50 ft	16.77 kips	3.03 kips	19.80 kips
15.50 ft	20.25 kips	3.03 kips	23.28 kips
16.50 ft	23.73 kips	3.03 kips	26.76 kips
17.50 ft	27.21 kips	3.03 kips	30.24 kips
18.50 ft	30.69 kips	3.03 kips	33.72 kips
18.79 ft	31.70 kips	3.03 kips	34.73 kips
18.81 ft	31.80 kips	45.89 kips	77.69 kips
19.80 ft	38.64 kips	48.60 kips	87.25 kips
20.80 ft	45.95 kips	51.35 kips	97.30 kips
21.80 ft	53.67 kips	54.09 kips	107.76 kips
22.79 ft	61.70 kips	56.81 kips	118.51 kips
22.81 ft	61.87 kips	2.30 kips	64.17 kips
23.80 ft	71.20 kips	2.30 kips	73.50 kips
24.80 ft	80.62 kips	2.30 kips	82.92 kips
25.80 ft	90.04 kips	2.30 kips	92.34 kips
26.80 ft	99.46 kips	2.30 kips	101.76 kips
27.79 ft	108.79 kips	2.30 kips	111.09 kips
27.81 ft	108.92 kips	2.79 kips	111.71 kips
28.80 ft	112.63 kips	2.79 kips	115.42 kips
29.80 ft	116.39 kips	2.79 kips	119.17 kips
30.80 ft	120.14 kips	2.79 kips	122.92 kips
31.80 ft	123.89 kips	2.79 kips	126.67 kips
32.80 ft	127.64 kips	2.79 kips	130.42 kips
33.80 ft	131.39 kips	2.79 kips	134.17 kips
34.80 ft	135.14 kips	2.79 kips	137.92 kips
35.80 ft	138.89 kips	2.79 kips	141.68 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.80 ft	142.64 kips	2.79 kips	145.43 kips
37.80 ft	146.39 kips	2.79 kips	149.18 kips
38.80 ft	151.05 kips	2.79 kips	153.83 kips
39.80 ft	155.86 kips	2.79 kips	158.65 kips
40.80 ft	160.85 kips	2.79 kips	163.63 kips
41.80 ft	165.99 kips	2.79 kips	168.78 kips
42.79 ft	171.25 kips	2.79 kips	174.04 kips
42.81 ft	171.44 kips	36.46 kips	207.90 kips
43.80 ft	185.44 kips	36.46 kips	221.90 kips
44.80 ft	199.94 kips	36.46 kips	236.40 kips
45.80 ft	214.81 kips	36.46 kips	251.27 kips
46.80 ft	230.03 kips	36.46 kips	266.49 kips
47.79 ft	245.46 kips	36.46 kips	281.92 kips
47.81 ft	245.74 kips	16.32 kips	262.06 kips
48.80 ft	257.62 kips	16.32 kips	273.94 kips
49.80 ft	269.89 kips	16.32 kips	286.21 kips
50.80 ft	282.42 kips	16.32 kips	298.73 kips
51.80 ft	295.21 kips	16.32 kips	311.52 kips
52.80 ft	308.26 kips	16.32 kips	324.58 kips
53.80 ft	321.58 kips	16.32 kips	337.89 kips
54.80 ft	335.15 kips	16.32 kips	351.47 kips
55.80 ft	349.00 kips	16.32 kips	365.31 kips
56.80 ft	363.10 kips	16.32 kips	379.42 kips
57.80 ft	377.47 kips	16.32 kips	393.79 kips
57.99 ft	380.23 kips	16.32 kips	396.55 kips
58.01 ft	380.52 kips	16.32 kips	396.84 kips
59.00 ft	394.99 kips	16.32 kips	411.31 kips
60.00 ft	409.75 kips	16.32 kips	426.07 kips
61.00 ft	424.64 kips	16.32 kips	440.96 kips
62.00 ft	439.67 kips	16.32 kips	455.99 kips
62.79 ft	451.64 kips	16.32 kips	467.96 kips
62.81 ft	451.87 kips	1.82 kips	453.69 kips
63.80 ft	459.23 kips	1.82 kips	461.05 kips
64.80 ft	466.67 kips	1.82 kips	468.49 kips
65.80 ft	474.11 kips	1.82 kips	475.93 kips
66.80 ft	481.55 kips	1.82 kips	483.36 kips
67.80 ft	488.98 kips	1.82 kips	490.80 kips
68.80 ft	496.42 kips	1.82 kips	498.24 kips
69.80 ft	503.86 kips	1.82 kips	505.68 kips
70.80 ft	511.30 kips	1.82 kips	513.11 kips
71.80 ft	518.73 kips	1.82 kips	520.55 kips
72.80 ft	526.17 kips	1.82 kips	527.99 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.80 ft	533.34 kips	1.82 kips	535.16 kips
74.80 ft	540.46 kips	1.82 kips	542.27 kips
75.80 ft	547.53 kips	1.82 kips	549.34 kips
76.80 ft	554.55 kips	1.82 kips	556.36 kips
77.80 ft	561.52 kips	1.82 kips	563.33 kips
78.80 ft	568.44 kips	1.82 kips	570.25 kips
79.80 ft	575.31 kips	1.82 kips	577.13 kips
80.80 ft	582.13 kips	1.82 kips	583.95 kips
81.80 ft	588.91 kips	1.82 kips	590.72 kips
82.80 ft	595.63 kips	1.82 kips	597.45 kips
83.80 ft	600.87 kips	1.82 kips	602.68 kips
84.80 ft	605.91 kips	1.82 kips	607.73 kips
85.79 ft	610.73 kips	1.82 kips	612.54 kips

Bearing Capacity - Restrike



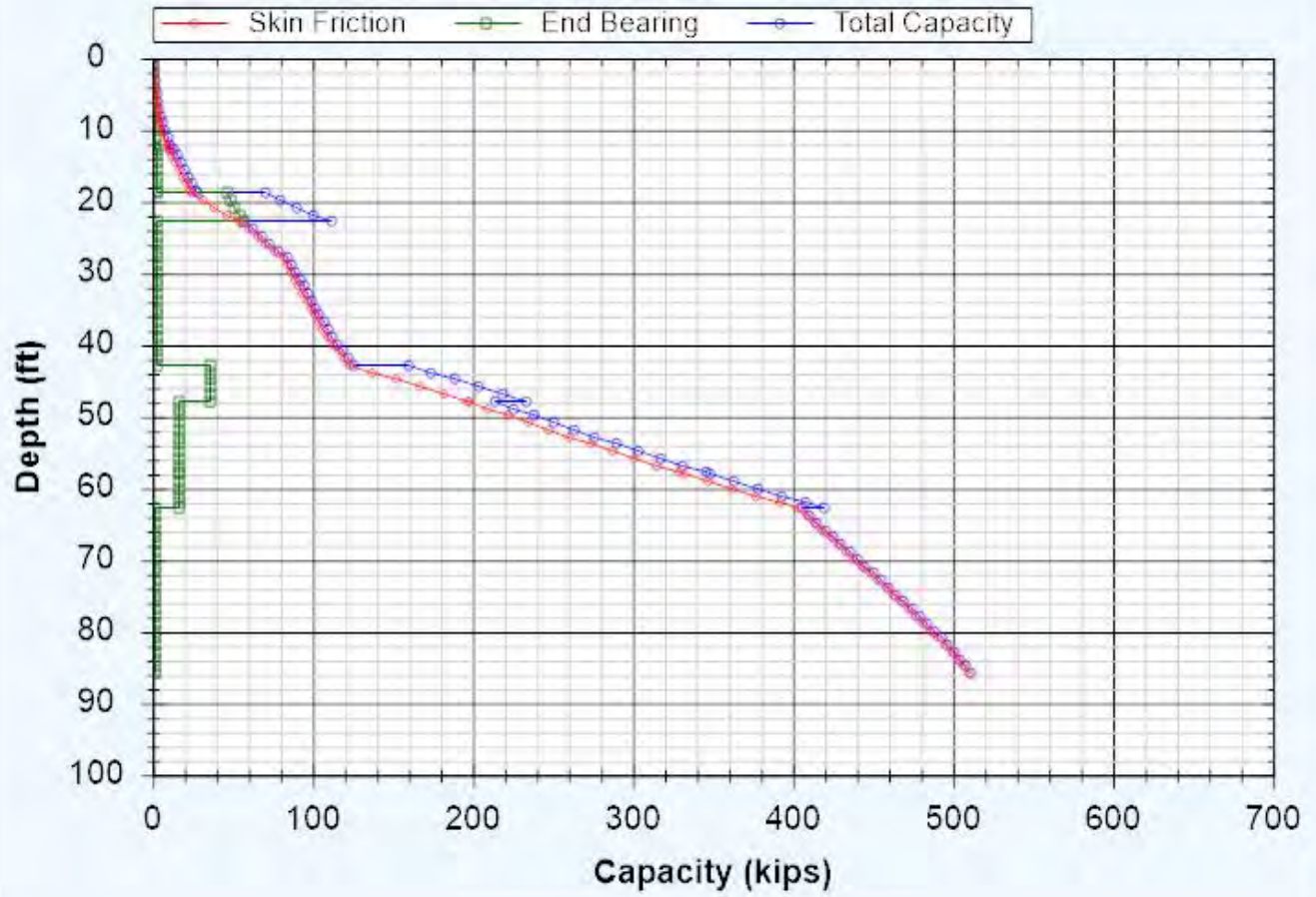
Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.06 kips	0.16 kips	0.22 kips
2.00 ft	0.25 kips	0.32 kips	0.57 kips
3.00 ft	0.57 kips	0.47 kips	1.04 kips
4.00 ft	1.00 kips	0.63 kips	1.64 kips
5.00 ft	1.57 kips	0.79 kips	2.36 kips
6.00 ft	2.26 kips	0.95 kips	3.21 kips
7.00 ft	3.08 kips	1.10 kips	4.18 kips
8.00 ft	4.02 kips	1.26 kips	5.28 kips
9.00 ft	5.09 kips	1.42 kips	6.51 kips
10.00 ft	6.28 kips	1.43 kips	7.71 kips
11.00 ft	7.60 kips	1.43 kips	9.03 kips
12.00 ft	9.04 kips	1.43 kips	10.47 kips
12.49 ft	9.79 kips	1.43 kips	11.23 kips
12.51 ft	9.83 kips	3.03 kips	12.86 kips
13.50 ft	12.13 kips	3.03 kips	15.16 kips
14.50 ft	14.45 kips	3.03 kips	17.48 kips
15.50 ft	16.77 kips	3.03 kips	19.80 kips
16.50 ft	19.09 kips	3.03 kips	22.12 kips
17.50 ft	21.41 kips	3.03 kips	24.44 kips
18.50 ft	23.73 kips	3.03 kips	26.76 kips
18.79 ft	24.40 kips	3.03 kips	27.43 kips
18.81 ft	24.49 kips	45.89 kips	70.38 kips
19.80 ft	31.34 kips	48.60 kips	79.94 kips
20.80 ft	38.65 kips	51.35 kips	90.00 kips
21.80 ft	46.36 kips	54.09 kips	100.45 kips
22.79 ft	54.39 kips	56.81 kips	111.20 kips
22.81 ft	54.53 kips	2.30 kips	56.83 kips
23.80 ft	59.85 kips	2.30 kips	62.16 kips
24.80 ft	65.24 kips	2.30 kips	67.54 kips
25.80 ft	70.62 kips	2.30 kips	72.92 kips
26.80 ft	76.00 kips	2.30 kips	78.30 kips
27.79 ft	81.33 kips	2.30 kips	83.63 kips
27.81 ft	81.41 kips	2.79 kips	84.20 kips
28.80 ft	83.89 kips	2.79 kips	86.67 kips
29.80 ft	86.39 kips	2.79 kips	89.17 kips
30.80 ft	88.89 kips	2.79 kips	91.67 kips
31.80 ft	91.39 kips	2.79 kips	94.18 kips
32.80 ft	93.89 kips	2.79 kips	96.68 kips
33.80 ft	96.39 kips	2.79 kips	99.18 kips
34.80 ft	98.89 kips	2.79 kips	101.68 kips
35.80 ft	101.39 kips	2.79 kips	104.18 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.80 ft	103.89 kips	2.79 kips	106.68 kips
37.80 ft	106.39 kips	2.79 kips	109.18 kips
38.80 ft	109.50 kips	2.79 kips	112.28 kips
39.80 ft	112.71 kips	2.79 kips	115.49 kips
40.80 ft	116.03 kips	2.79 kips	118.82 kips
41.80 ft	119.46 kips	2.79 kips	122.25 kips
42.79 ft	122.97 kips	2.79 kips	125.75 kips
42.81 ft	123.14 kips	36.46 kips	159.60 kips
43.80 ft	137.14 kips	36.46 kips	173.60 kips
44.80 ft	151.64 kips	36.46 kips	188.10 kips
45.80 ft	166.51 kips	36.46 kips	202.96 kips
46.80 ft	181.73 kips	36.46 kips	218.19 kips
47.79 ft	197.16 kips	36.46 kips	233.62 kips
47.81 ft	197.44 kips	16.32 kips	213.76 kips
48.80 ft	209.32 kips	16.32 kips	225.64 kips
49.80 ft	221.59 kips	16.32 kips	237.91 kips
50.80 ft	234.11 kips	16.32 kips	250.43 kips
51.80 ft	246.91 kips	16.32 kips	263.22 kips
52.80 ft	259.96 kips	16.32 kips	276.28 kips
53.80 ft	273.27 kips	16.32 kips	289.59 kips
54.80 ft	286.85 kips	16.32 kips	303.17 kips
55.80 ft	300.70 kips	16.32 kips	317.01 kips
56.80 ft	314.80 kips	16.32 kips	331.12 kips
57.80 ft	329.17 kips	16.32 kips	345.49 kips
57.99 ft	331.93 kips	16.32 kips	348.25 kips
58.01 ft	332.22 kips	16.32 kips	348.54 kips
59.00 ft	346.69 kips	16.32 kips	363.01 kips
60.00 ft	361.45 kips	16.32 kips	377.77 kips
61.00 ft	376.34 kips	16.32 kips	392.66 kips
62.00 ft	391.37 kips	16.32 kips	407.69 kips
62.79 ft	403.34 kips	16.32 kips	419.66 kips
62.81 ft	403.55 kips	1.82 kips	405.36 kips
63.80 ft	408.45 kips	1.82 kips	410.27 kips
64.80 ft	413.41 kips	1.82 kips	415.23 kips
65.80 ft	418.37 kips	1.82 kips	420.19 kips
66.80 ft	423.33 kips	1.82 kips	425.15 kips
67.80 ft	428.29 kips	1.82 kips	430.10 kips
68.80 ft	433.25 kips	1.82 kips	435.06 kips
69.80 ft	438.21 kips	1.82 kips	440.02 kips
70.80 ft	443.16 kips	1.82 kips	444.98 kips
71.80 ft	448.12 kips	1.82 kips	449.94 kips
72.80 ft	453.08 kips	1.82 kips	454.90 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.80 ft	457.86 kips	1.82 kips	459.68 kips
74.80 ft	462.61 kips	1.82 kips	464.42 kips
75.80 ft	467.32 kips	1.82 kips	469.13 kips
76.80 ft	472.00 kips	1.82 kips	473.81 kips
77.80 ft	476.65 kips	1.82 kips	478.46 kips
78.80 ft	481.26 kips	1.82 kips	483.08 kips
79.80 ft	485.84 kips	1.82 kips	487.66 kips
80.80 ft	490.39 kips	1.82 kips	492.21 kips
81.80 ft	494.91 kips	1.82 kips	496.72 kips
82.80 ft	499.39 kips	1.82 kips	501.21 kips
83.80 ft	502.88 kips	1.82 kips	504.70 kips
84.80 ft	506.25 kips	1.82 kips	508.06 kips
85.79 ft	509.45 kips	1.82 kips	511.27 kips

Bearing Capacity - Driving



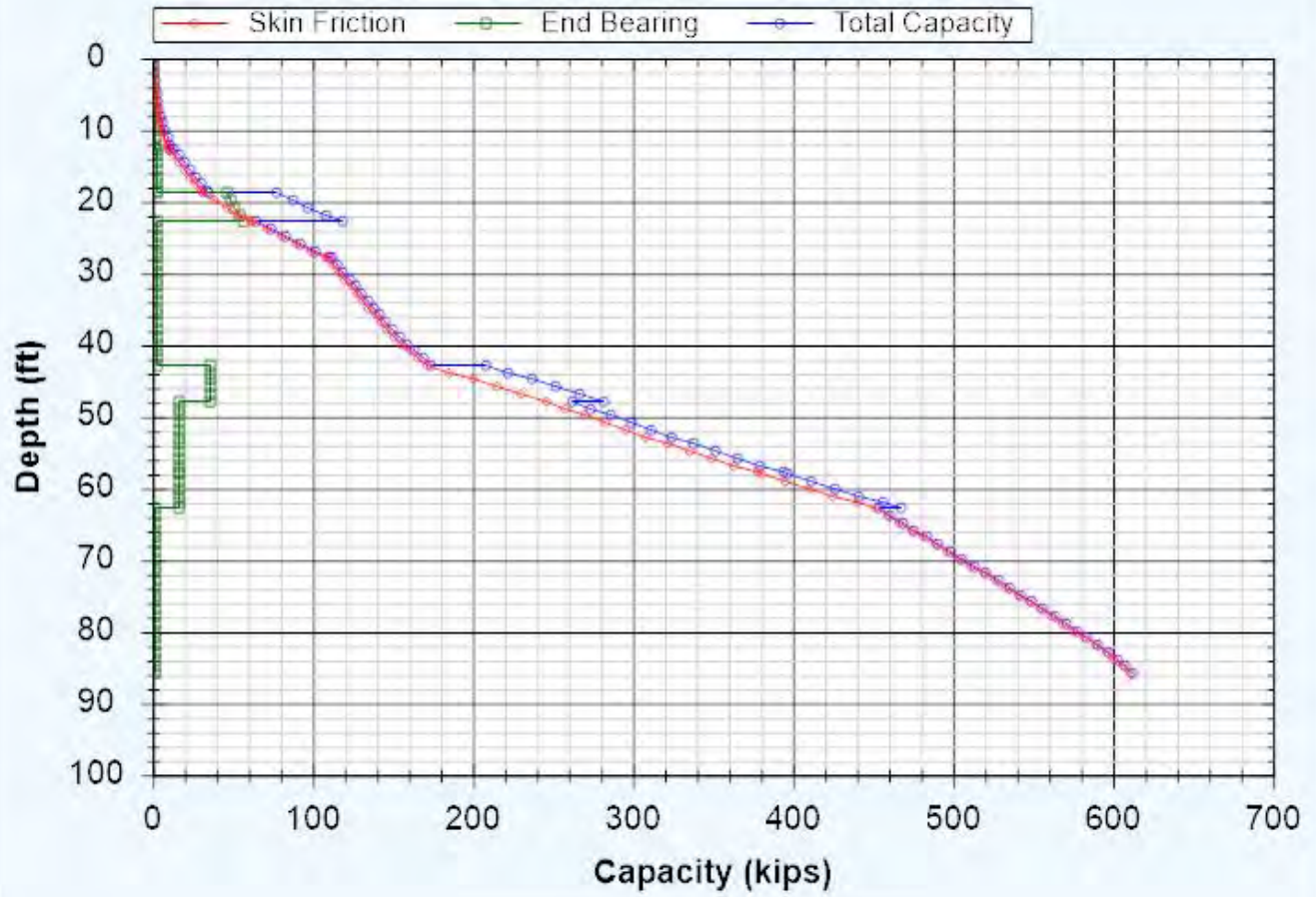
Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.06 kips	0.16 kips	0.22 kips
2.00 ft	0.25 kips	0.32 kips	0.57 kips
3.00 ft	0.57 kips	0.47 kips	1.04 kips
4.00 ft	1.00 kips	0.63 kips	1.64 kips
5.00 ft	1.57 kips	0.79 kips	2.36 kips
6.00 ft	2.26 kips	0.95 kips	3.21 kips
7.00 ft	3.08 kips	1.10 kips	4.18 kips
8.00 ft	4.02 kips	1.26 kips	5.28 kips
9.00 ft	5.09 kips	1.42 kips	6.51 kips
10.00 ft	6.28 kips	1.43 kips	7.71 kips
11.00 ft	7.60 kips	1.43 kips	9.03 kips
12.00 ft	9.04 kips	1.43 kips	10.47 kips
12.49 ft	9.79 kips	1.43 kips	11.23 kips
12.51 ft	9.85 kips	3.03 kips	12.87 kips
13.50 ft	13.29 kips	3.03 kips	16.32 kips
14.50 ft	16.77 kips	3.03 kips	19.80 kips
15.50 ft	20.25 kips	3.03 kips	23.28 kips
16.50 ft	23.73 kips	3.03 kips	26.76 kips
17.50 ft	27.21 kips	3.03 kips	30.24 kips
18.50 ft	30.69 kips	3.03 kips	33.72 kips
18.79 ft	31.70 kips	3.03 kips	34.73 kips
18.81 ft	31.80 kips	45.89 kips	77.69 kips
19.80 ft	38.64 kips	48.60 kips	87.25 kips
20.80 ft	45.95 kips	51.35 kips	97.30 kips
21.80 ft	53.67 kips	54.09 kips	107.76 kips
22.79 ft	61.70 kips	56.81 kips	118.51 kips
22.81 ft	61.87 kips	2.30 kips	64.17 kips
23.80 ft	71.20 kips	2.30 kips	73.50 kips
24.80 ft	80.62 kips	2.30 kips	82.92 kips
25.80 ft	90.04 kips	2.30 kips	92.34 kips
26.80 ft	99.46 kips	2.30 kips	101.76 kips
27.79 ft	108.79 kips	2.30 kips	111.09 kips
27.81 ft	108.92 kips	2.79 kips	111.71 kips
28.80 ft	112.63 kips	2.79 kips	115.42 kips
29.80 ft	116.39 kips	2.79 kips	119.17 kips
30.80 ft	120.14 kips	2.79 kips	122.92 kips
31.80 ft	123.89 kips	2.79 kips	126.67 kips
32.80 ft	127.64 kips	2.79 kips	130.42 kips
33.80 ft	131.39 kips	2.79 kips	134.17 kips
34.80 ft	135.14 kips	2.79 kips	137.92 kips
35.80 ft	138.89 kips	2.79 kips	141.68 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.80 ft	142.64 kips	2.79 kips	145.43 kips
37.80 ft	146.39 kips	2.79 kips	149.18 kips
38.80 ft	151.05 kips	2.79 kips	153.83 kips
39.80 ft	155.86 kips	2.79 kips	158.65 kips
40.80 ft	160.85 kips	2.79 kips	163.63 kips
41.80 ft	165.99 kips	2.79 kips	168.78 kips
42.79 ft	171.25 kips	2.79 kips	174.04 kips
42.81 ft	171.44 kips	36.46 kips	207.90 kips
43.80 ft	185.44 kips	36.46 kips	221.90 kips
44.80 ft	199.94 kips	36.46 kips	236.40 kips
45.80 ft	214.81 kips	36.46 kips	251.27 kips
46.80 ft	230.03 kips	36.46 kips	266.49 kips
47.79 ft	245.46 kips	36.46 kips	281.92 kips
47.81 ft	245.74 kips	16.32 kips	262.06 kips
48.80 ft	257.62 kips	16.32 kips	273.94 kips
49.80 ft	269.89 kips	16.32 kips	286.21 kips
50.80 ft	282.42 kips	16.32 kips	298.73 kips
51.80 ft	295.21 kips	16.32 kips	311.52 kips
52.80 ft	308.26 kips	16.32 kips	324.58 kips
53.80 ft	321.58 kips	16.32 kips	337.89 kips
54.80 ft	335.15 kips	16.32 kips	351.47 kips
55.80 ft	349.00 kips	16.32 kips	365.31 kips
56.80 ft	363.10 kips	16.32 kips	379.42 kips
57.80 ft	377.47 kips	16.32 kips	393.79 kips
57.99 ft	380.23 kips	16.32 kips	396.55 kips
58.01 ft	380.52 kips	16.32 kips	396.84 kips
59.00 ft	394.99 kips	16.32 kips	411.31 kips
60.00 ft	409.75 kips	16.32 kips	426.07 kips
61.00 ft	424.64 kips	16.32 kips	440.96 kips
62.00 ft	439.67 kips	16.32 kips	455.99 kips
62.79 ft	451.64 kips	16.32 kips	467.96 kips
62.81 ft	451.87 kips	1.82 kips	453.69 kips
63.80 ft	459.23 kips	1.82 kips	461.05 kips
64.80 ft	466.67 kips	1.82 kips	468.49 kips
65.80 ft	474.11 kips	1.82 kips	475.93 kips
66.80 ft	481.55 kips	1.82 kips	483.36 kips
67.80 ft	488.98 kips	1.82 kips	490.80 kips
68.80 ft	496.42 kips	1.82 kips	498.24 kips
69.80 ft	503.86 kips	1.82 kips	505.68 kips
70.80 ft	511.30 kips	1.82 kips	513.11 kips
71.80 ft	518.73 kips	1.82 kips	520.55 kips
72.80 ft	526.17 kips	1.82 kips	527.99 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.80 ft	533.34 kips	1.82 kips	535.16 kips
74.80 ft	540.46 kips	1.82 kips	542.27 kips
75.80 ft	547.53 kips	1.82 kips	549.34 kips
76.80 ft	554.55 kips	1.82 kips	556.36 kips
77.80 ft	561.52 kips	1.82 kips	563.33 kips
78.80 ft	568.44 kips	1.82 kips	570.25 kips
79.80 ft	575.31 kips	1.82 kips	577.13 kips
80.80 ft	582.13 kips	1.82 kips	583.95 kips
81.80 ft	588.91 kips	1.82 kips	590.72 kips
82.80 ft	595.63 kips	1.82 kips	597.45 kips
83.80 ft	600.87 kips	1.82 kips	602.68 kips
84.80 ft	605.91 kips	1.82 kips	607.73 kips
85.79 ft	610.73 kips	1.82 kips	612.54 kips

Bearing Capacity - Nominal



Pier 1
(B-014-3-19)

DrivenPiles - Report

General Project Information

Filename: ...-20-025 FRA-70-13.01\Analysis\Driven Piles\Pier 1\FRA-70-13.01 - Pier 1 HP 12x53-B-014-3-19.dvn
Project Name: FRA-70-13.01 Pier 1 (B-014-3-19)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile
Top of Pile: 7.15 ft
Diameter of Pile: 12.00 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling: 12.00 ft
Driving/Restrike: 12.00 ft
Nominal: 12.00 ft

Nominal Considations:

Local Scour: 0.00 ft
Long Term Scour: 0.00 ft
Soft Soil: 0.00 ft

Nominal Profile

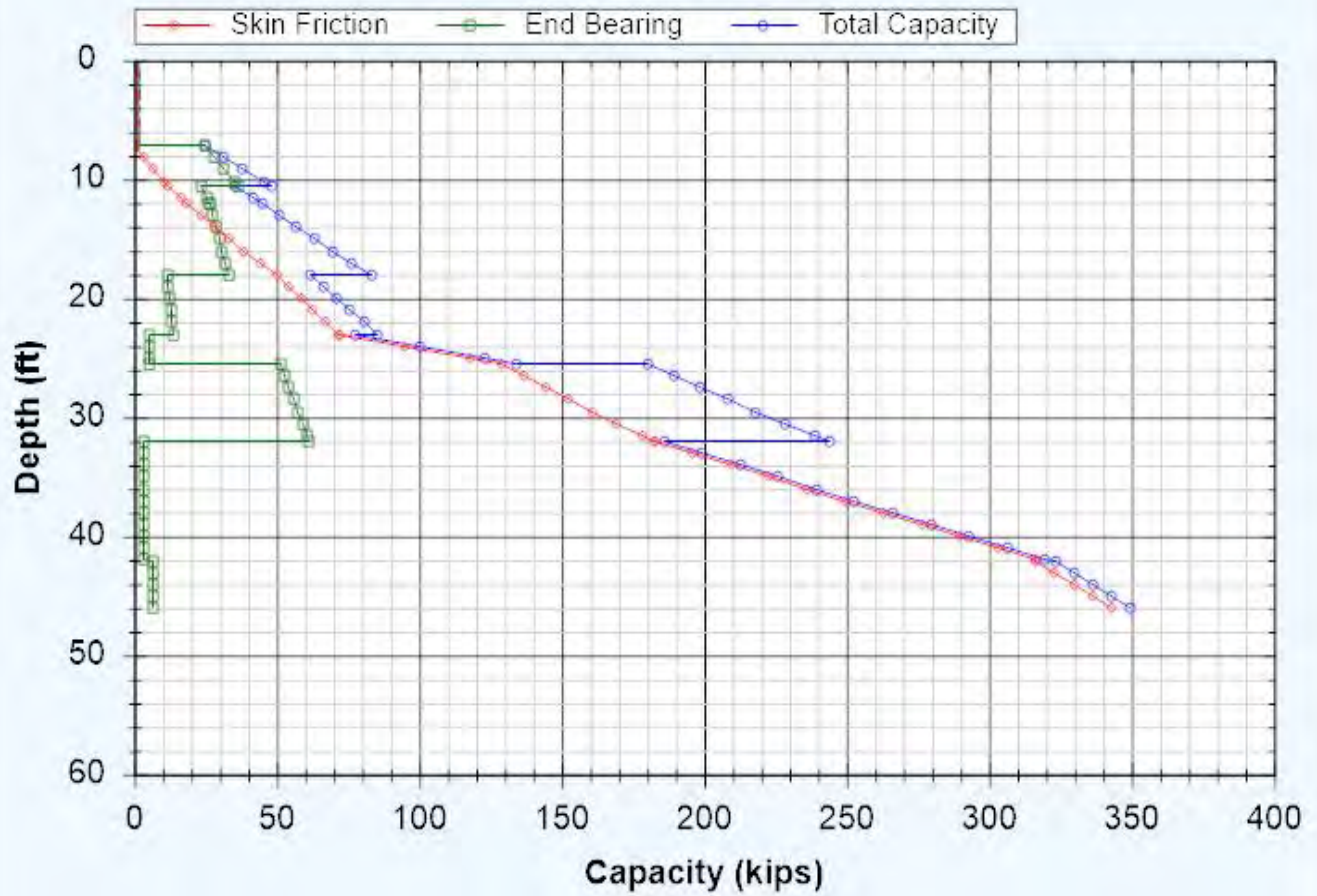
Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesionless	1.50 ft	1.200	130.00 pcf	41.0/41.0	Nordlund
2	Cohesionless	1.50 ft	1.000	135.00 pcf	43.0/43.0	Nordlund
3	Cohesionless	2.50 ft	1.000	130.00 pcf	43.0/43.0	Nordlund
4	Cohesionless	5.00 ft	1.000	135.00 pcf	43.0/43.0	Nordlund
5	Cohesionless	7.50 ft	1.000	130.00 pcf	41.0/41.0	Nordlund
6	Cohesionless	5.00 ft	1.000	130.00 pcf	36.0/36.0	Nordlund
7	Cohesive	2.50 ft	1.500	135.00 pcf	5750.00 psf	T-80 Sand
8	Cohesionless	6.50 ft	1.000	140.00 pcf	42.0/42.0	Nordlund
9	Cohesive	10.00 ft	1.500	135.00 pcf	3375.00 psf	T-80 Sand
10	Cohesive	4.00 ft	1.500	140.00 pcf	7000.00 psf	T-80 Same

Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.49 ft	0.00 kips	0.00 kips	0.00 kips
5.51 ft	0.00 kips	0.00 kips	0.00 kips
6.50 ft	0.00 kips	0.00 kips	0.00 kips
7.14 ft	0.00 kips	0.00 kips	0.00 kips
7.16 ft	0.03 kips	24.52 kips	24.55 kips
8.15 ft	3.04 kips	27.99 kips	31.02 kips
9.15 ft	6.47 kips	31.48 kips	37.96 kips
10.15 ft	10.32 kips	34.98 kips	45.30 kips
10.49 ft	11.72 kips	36.17 kips	47.89 kips
10.51 ft	11.80 kips	23.18 kips	34.98 kips
11.50 ft	16.06 kips	25.31 kips	41.37 kips
11.99 ft	18.31 kips	26.36 kips	44.68 kips
12.01 ft	18.41 kips	26.40 kips	44.80 kips
13.00 ft	23.14 kips	27.50 kips	50.65 kips
14.00 ft	28.13 kips	28.62 kips	56.75 kips
15.00 ft	33.31 kips	29.74 kips	63.06 kips
16.00 ft	38.70 kips	30.86 kips	69.56 kips
17.00 ft	44.28 kips	31.98 kips	76.26 kips
17.99 ft	50.00 kips	33.09 kips	83.09 kips
18.01 ft	50.10 kips	11.58 kips	61.67 kips
19.00 ft	54.17 kips	11.96 kips	66.13 kips
20.00 ft	58.41 kips	12.35 kips	70.77 kips
21.00 ft	62.79 kips	12.74 kips	75.53 kips
22.00 ft	67.31 kips	13.12 kips	80.44 kips
22.99 ft	71.92 kips	13.51 kips	85.42 kips
23.01 ft	72.19 kips	5.57 kips	77.76 kips
24.00 ft	94.77 kips	5.57 kips	100.34 kips
25.00 ft	117.58 kips	5.57 kips	123.15 kips
25.49 ft	128.76 kips	5.57 kips	134.33 kips
25.51 ft	129.06 kips	51.19 kips	180.26 kips
26.50 ft	136.59 kips	52.76 kips	189.34 kips
27.50 ft	144.42 kips	54.33 kips	198.75 kips

Depth	Skin Friction	End Bearing	Total Capacity
28.50 ft	152.48 kips	55.91 kips	208.39 kips
29.50 ft	160.78 kips	57.49 kips	218.27 kips
30.50 ft	169.30 kips	59.07 kips	228.37 kips
31.50 ft	178.06 kips	60.64 kips	238.70 kips
31.99 ft	182.43 kips	61.42 kips	243.85 kips
32.01 ft	182.66 kips	3.27 kips	185.93 kips
33.00 ft	195.91 kips	3.27 kips	199.18 kips
34.00 ft	209.30 kips	3.27 kips	212.57 kips
35.00 ft	222.68 kips	3.27 kips	225.95 kips
36.00 ft	236.07 kips	3.27 kips	239.34 kips
37.00 ft	249.46 kips	3.27 kips	252.73 kips
38.00 ft	262.85 kips	3.27 kips	266.12 kips
39.00 ft	276.23 kips	3.27 kips	279.50 kips
40.00 ft	289.62 kips	3.27 kips	292.89 kips
41.00 ft	303.01 kips	3.27 kips	306.28 kips
41.99 ft	316.26 kips	3.27 kips	319.53 kips
42.01 ft	316.46 kips	6.78 kips	323.24 kips
43.00 ft	323.01 kips	6.78 kips	329.79 kips
44.00 ft	329.61 kips	6.78 kips	336.40 kips
45.00 ft	336.22 kips	6.78 kips	343.00 kips
45.99 ft	342.76 kips	6.78 kips	349.55 kips

Bearing Capacity - Restrike

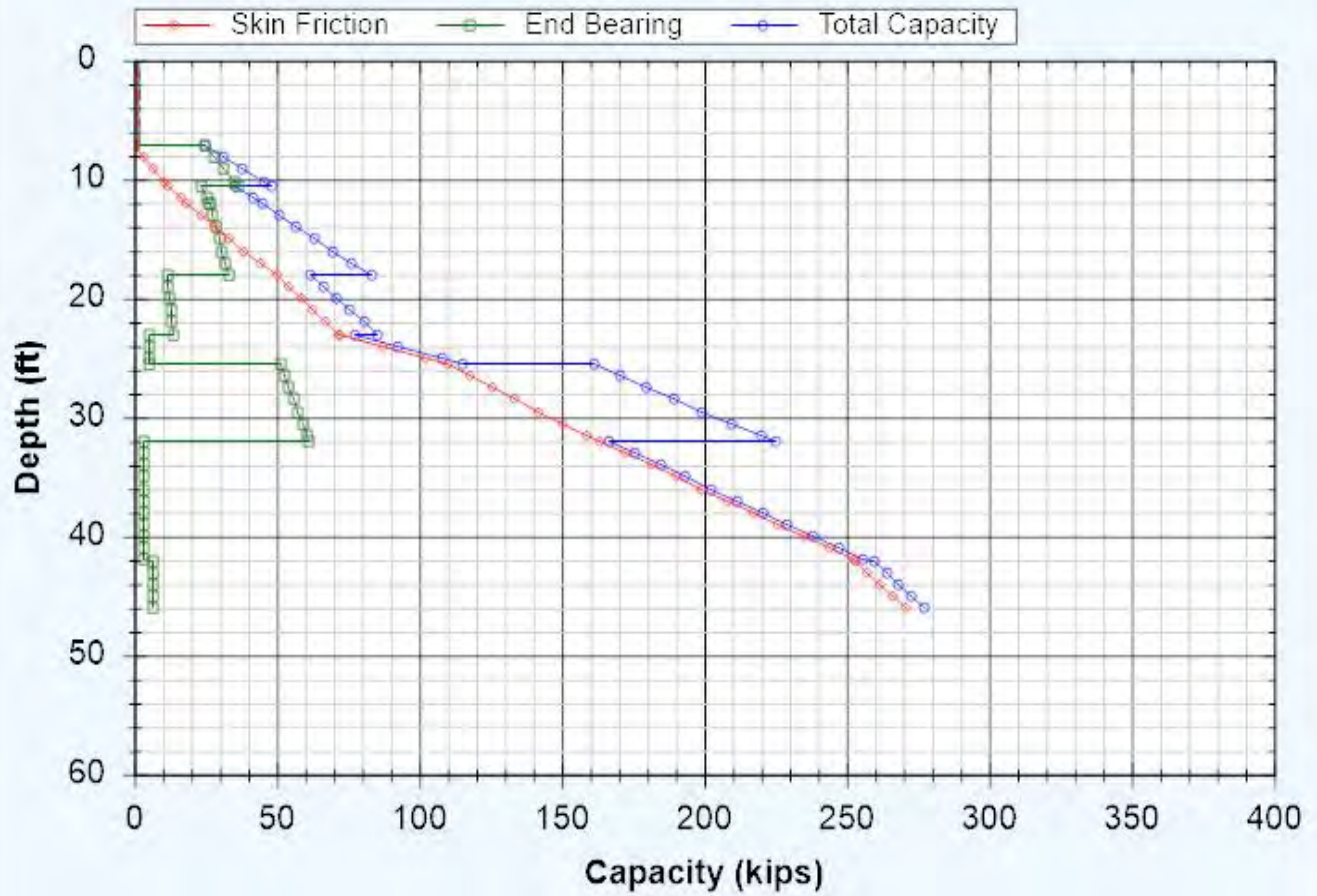


Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.49 ft	0.00 kips	0.00 kips	0.00 kips
5.51 ft	0.00 kips	0.00 kips	0.00 kips
6.50 ft	0.00 kips	0.00 kips	0.00 kips
7.14 ft	0.00 kips	0.00 kips	0.00 kips
7.16 ft	0.03 kips	24.52 kips	24.55 kips
8.15 ft	3.04 kips	27.99 kips	31.02 kips
9.15 ft	6.47 kips	31.48 kips	37.96 kips
10.15 ft	10.32 kips	34.98 kips	45.30 kips
10.49 ft	11.72 kips	36.17 kips	47.89 kips
10.51 ft	11.80 kips	23.18 kips	34.98 kips
11.50 ft	16.06 kips	25.31 kips	41.37 kips
11.99 ft	18.31 kips	26.36 kips	44.68 kips
12.01 ft	18.41 kips	26.40 kips	44.80 kips
13.00 ft	23.14 kips	27.50 kips	50.65 kips
14.00 ft	28.13 kips	28.62 kips	56.75 kips
15.00 ft	33.31 kips	29.74 kips	63.06 kips
16.00 ft	38.70 kips	30.86 kips	69.56 kips
17.00 ft	44.28 kips	31.98 kips	76.26 kips
17.99 ft	50.00 kips	33.09 kips	83.09 kips
18.01 ft	50.10 kips	11.58 kips	61.67 kips
19.00 ft	54.17 kips	11.96 kips	66.13 kips
20.00 ft	58.41 kips	12.35 kips	70.77 kips
21.00 ft	62.79 kips	12.74 kips	75.53 kips
22.00 ft	67.31 kips	13.12 kips	80.44 kips
22.99 ft	71.92 kips	13.51 kips	85.42 kips
23.01 ft	72.12 kips	5.57 kips	77.69 kips
24.00 ft	87.17 kips	5.57 kips	92.74 kips
25.00 ft	102.38 kips	5.57 kips	107.95 kips
25.49 ft	109.83 kips	5.57 kips	115.40 kips
25.51 ft	110.06 kips	51.19 kips	161.25 kips
26.50 ft	117.58 kips	52.76 kips	170.34 kips
27.50 ft	125.42 kips	54.33 kips	179.75 kips

Depth	Skin Friction	End Bearing	Total Capacity
28.50 ft	133.48 kips	55.91 kips	189.39 kips
29.50 ft	141.77 kips	57.49 kips	199.26 kips
30.50 ft	150.30 kips	59.07 kips	209.36 kips
31.50 ft	159.05 kips	60.64 kips	219.70 kips
31.99 ft	163.43 kips	61.42 kips	224.84 kips
32.01 ft	163.61 kips	3.27 kips	166.88 kips
33.00 ft	172.44 kips	3.27 kips	175.71 kips
34.00 ft	181.37 kips	3.27 kips	184.64 kips
35.00 ft	190.29 kips	3.27 kips	193.56 kips
36.00 ft	199.22 kips	3.27 kips	202.49 kips
37.00 ft	208.14 kips	3.27 kips	211.41 kips
38.00 ft	217.07 kips	3.27 kips	220.34 kips
39.00 ft	226.00 kips	3.27 kips	229.26 kips
40.00 ft	234.92 kips	3.27 kips	238.19 kips
41.00 ft	243.85 kips	3.27 kips	247.12 kips
41.99 ft	252.68 kips	3.27 kips	255.95 kips
42.01 ft	252.82 kips	6.78 kips	259.60 kips
43.00 ft	257.18 kips	6.78 kips	263.96 kips
44.00 ft	261.58 kips	6.78 kips	268.36 kips
45.00 ft	265.99 kips	6.78 kips	272.77 kips
45.99 ft	270.35 kips	6.78 kips	277.13 kips

Bearing Capacity - Driving

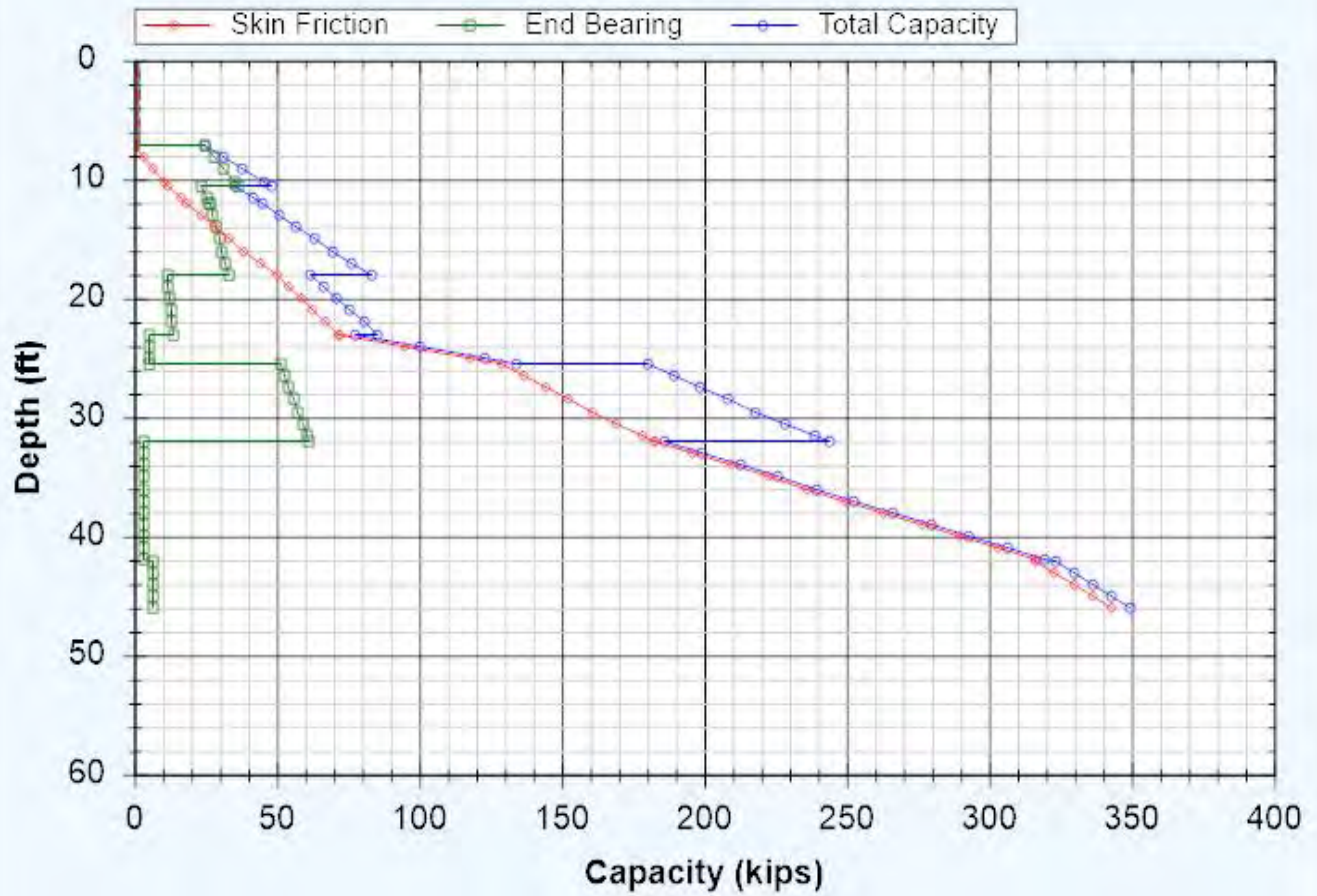


Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.49 ft	0.00 kips	0.00 kips	0.00 kips
5.51 ft	0.00 kips	0.00 kips	0.00 kips
6.50 ft	0.00 kips	0.00 kips	0.00 kips
7.14 ft	0.00 kips	0.00 kips	0.00 kips
7.16 ft	0.03 kips	24.52 kips	24.55 kips
8.15 ft	3.04 kips	27.99 kips	31.02 kips
9.15 ft	6.47 kips	31.48 kips	37.96 kips
10.15 ft	10.32 kips	34.98 kips	45.30 kips
10.49 ft	11.72 kips	36.17 kips	47.89 kips
10.51 ft	11.80 kips	23.18 kips	34.98 kips
11.50 ft	16.06 kips	25.31 kips	41.37 kips
11.99 ft	18.31 kips	26.36 kips	44.68 kips
12.01 ft	18.41 kips	26.40 kips	44.80 kips
13.00 ft	23.14 kips	27.50 kips	50.65 kips
14.00 ft	28.13 kips	28.62 kips	56.75 kips
15.00 ft	33.31 kips	29.74 kips	63.06 kips
16.00 ft	38.70 kips	30.86 kips	69.56 kips
17.00 ft	44.28 kips	31.98 kips	76.26 kips
17.99 ft	50.00 kips	33.09 kips	83.09 kips
18.01 ft	50.10 kips	11.58 kips	61.67 kips
19.00 ft	54.17 kips	11.96 kips	66.13 kips
20.00 ft	58.41 kips	12.35 kips	70.77 kips
21.00 ft	62.79 kips	12.74 kips	75.53 kips
22.00 ft	67.31 kips	13.12 kips	80.44 kips
22.99 ft	71.92 kips	13.51 kips	85.42 kips
23.01 ft	72.19 kips	5.57 kips	77.76 kips
24.00 ft	94.77 kips	5.57 kips	100.34 kips
25.00 ft	117.58 kips	5.57 kips	123.15 kips
25.49 ft	128.76 kips	5.57 kips	134.33 kips
25.51 ft	129.06 kips	51.19 kips	180.26 kips
26.50 ft	136.59 kips	52.76 kips	189.34 kips
27.50 ft	144.42 kips	54.33 kips	198.75 kips

Depth	Skin Friction	End Bearing	Total Capacity
28.50 ft	152.48 kips	55.91 kips	208.39 kips
29.50 ft	160.78 kips	57.49 kips	218.27 kips
30.50 ft	169.30 kips	59.07 kips	228.37 kips
31.50 ft	178.06 kips	60.64 kips	238.70 kips
31.99 ft	182.43 kips	61.42 kips	243.85 kips
32.01 ft	182.66 kips	3.27 kips	185.93 kips
33.00 ft	195.91 kips	3.27 kips	199.18 kips
34.00 ft	209.30 kips	3.27 kips	212.57 kips
35.00 ft	222.68 kips	3.27 kips	225.95 kips
36.00 ft	236.07 kips	3.27 kips	239.34 kips
37.00 ft	249.46 kips	3.27 kips	252.73 kips
38.00 ft	262.85 kips	3.27 kips	266.12 kips
39.00 ft	276.23 kips	3.27 kips	279.50 kips
40.00 ft	289.62 kips	3.27 kips	292.89 kips
41.00 ft	303.01 kips	3.27 kips	306.28 kips
41.99 ft	316.26 kips	3.27 kips	319.53 kips
42.01 ft	316.46 kips	6.78 kips	323.24 kips
43.00 ft	323.01 kips	6.78 kips	329.79 kips
44.00 ft	329.61 kips	6.78 kips	336.40 kips
45.00 ft	336.22 kips	6.78 kips	343.00 kips
45.99 ft	342.76 kips	6.78 kips	349.55 kips

Bearing Capacity - Nominal



Pier 2
(B-014-4-19)

DrivenPiles - Report

General Project Information

Filename: ...-20-025 FRA-70-13.01\Analysis\Driven Piles\Pier 2\FRA-70-13.01 - Pier 2 HP 12x53-B-014-4-19.dvn
Project Name: FRA-70-13.01 Pier 2 (B-014-4-19)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile
Top of Pile: 5.40 ft
Diameter of Pile: 12.00 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling: 8.00 ft
Driving/Restrike: 8.00 ft
Nominal: 8.00 ft

Nominal Considations:

Local Scour: 0.00 ft
Long Term Scour: 0.00 ft
Soft Soil: 0.00 ft

Nominal Profile

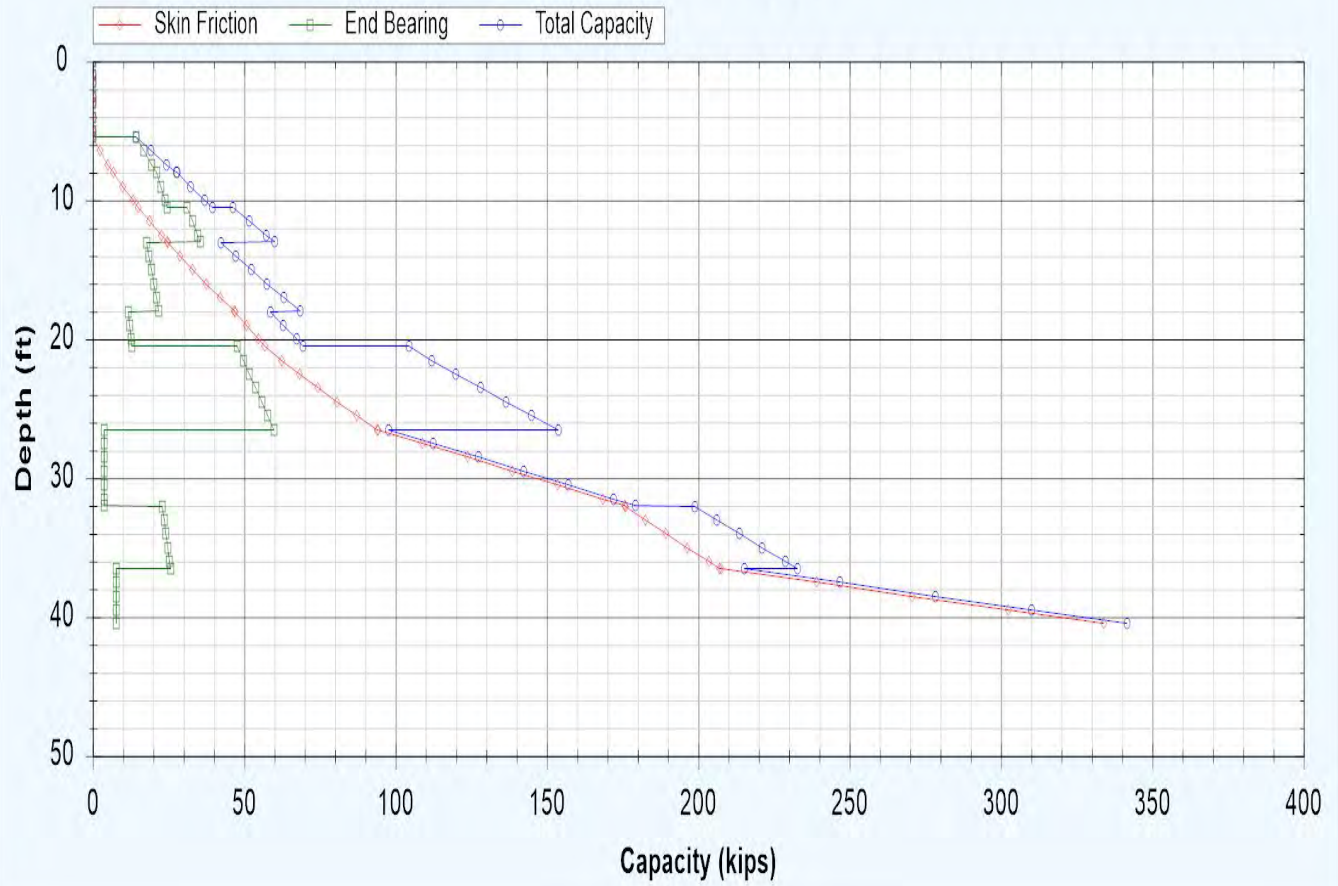
Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesive	1.50 ft	1.500	125.00 pcf	3125.00 psf	T-80 Same
2	Cohesive	1.50 ft	1.500	130.00 pcf	4625.00 psf	T-80 Same
3	Cohesionless	7.50 ft	1.000	130.00 pcf	42.0/42.0	Nordlund
4	Cohesionless	2.50 ft	1.000	130.00 pcf	43.0/43.0	Nordlund
5	Cohesionless	5.00 ft	1.000	125.00 pcf	40.0/40.0	Nordlund
6	Cohesionless	2.50 ft	1.000	125.00 pcf	37.0/37.0	Nordlund
7	Cohesionless	6.00 ft	1.000	140.00 pcf	43.0/43.0	Nordlund
8	Cohesive	5.50 ft	1.500	130.00 pcf	3750.00 psf	T-80 Sand
9	Cohesionless	4.50 ft	1.000	130.00 pcf	38.0/38.0	Nordlund
10	Cohesive	4.00 ft	1.500	135.00 pcf	8000.00 psf	T-80 Sand

Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.39 ft	0.00 kips	0.00 kips	0.00 kips
5.41 ft	0.02 kips	14.14 kips	14.17 kips
6.40 ft	2.26 kips	16.76 kips	19.02 kips
7.40 ft	4.90 kips	19.40 kips	24.31 kips
7.99 ft	6.65 kips	20.96 kips	27.61 kips
8.01 ft	6.71 kips	21.00 kips	27.71 kips
9.00 ft	9.85 kips	22.36 kips	32.21 kips
10.00 ft	13.22 kips	23.74 kips	36.96 kips
10.49 ft	14.94 kips	24.41 kips	39.35 kips
10.51 ft	15.02 kips	31.15 kips	46.16 kips
11.50 ft	18.68 kips	32.88 kips	51.56 kips
12.50 ft	22.59 kips	34.63 kips	57.22 kips
12.99 ft	24.57 kips	35.49 kips	60.06 kips
13.01 ft	24.65 kips	17.71 kips	42.37 kips
14.00 ft	28.69 kips	18.51 kips	47.20 kips
15.00 ft	32.96 kips	19.32 kips	52.27 kips
16.00 ft	37.40 kips	20.13 kips	57.53 kips
17.00 ft	42.02 kips	20.94 kips	62.96 kips
17.99 ft	46.78 kips	21.74 kips	68.52 kips
18.01 ft	46.87 kips	11.70 kips	58.57 kips
19.00 ft	50.67 kips	12.13 kips	62.80 kips
20.00 ft	54.66 kips	12.56 kips	67.22 kips
20.49 ft	56.66 kips	12.77 kips	69.44 kips
20.51 ft	56.76 kips	47.69 kips	104.45 kips
21.50 ft	62.33 kips	49.68 kips	112.01 kips
22.50 ft	68.20 kips	51.69 kips	119.89 kips
23.50 ft	74.29 kips	53.70 kips	127.99 kips
24.50 ft	80.62 kips	55.71 kips	136.33 kips
25.50 ft	87.18 kips	57.72 kips	144.90 kips
26.49 ft	93.90 kips	59.71 kips	153.62 kips
26.51 ft	94.12 kips	3.63 kips	97.76 kips
27.50 ft	108.85 kips	3.63 kips	112.48 kips

Depth	Skin Friction	End Bearing	Total Capacity
28.50 ft	123.72 kips	3.63 kips	127.36 kips
29.50 ft	138.60 kips	3.63 kips	142.23 kips
30.50 ft	153.47 kips	3.63 kips	157.11 kips
31.50 ft	168.35 kips	3.63 kips	171.98 kips
31.99 ft	175.64 kips	3.63 kips	179.27 kips
32.01 ft	175.85 kips	22.98 kips	198.83 kips
33.00 ft	182.47 kips	23.55 kips	206.02 kips
34.00 ft	189.32 kips	24.13 kips	213.45 kips
35.00 ft	196.34 kips	24.71 kips	221.05 kips
36.00 ft	203.52 kips	25.29 kips	228.81 kips
36.49 ft	207.10 kips	25.58 kips	232.68 kips
36.51 ft	207.49 kips	7.75 kips	215.24 kips
37.50 ft	238.91 kips	7.75 kips	246.66 kips
38.50 ft	270.64 kips	7.75 kips	278.39 kips
39.50 ft	302.37 kips	7.75 kips	310.12 kips
40.49 ft	333.79 kips	7.75 kips	341.54 kips

Bearing Capacity - Restrike

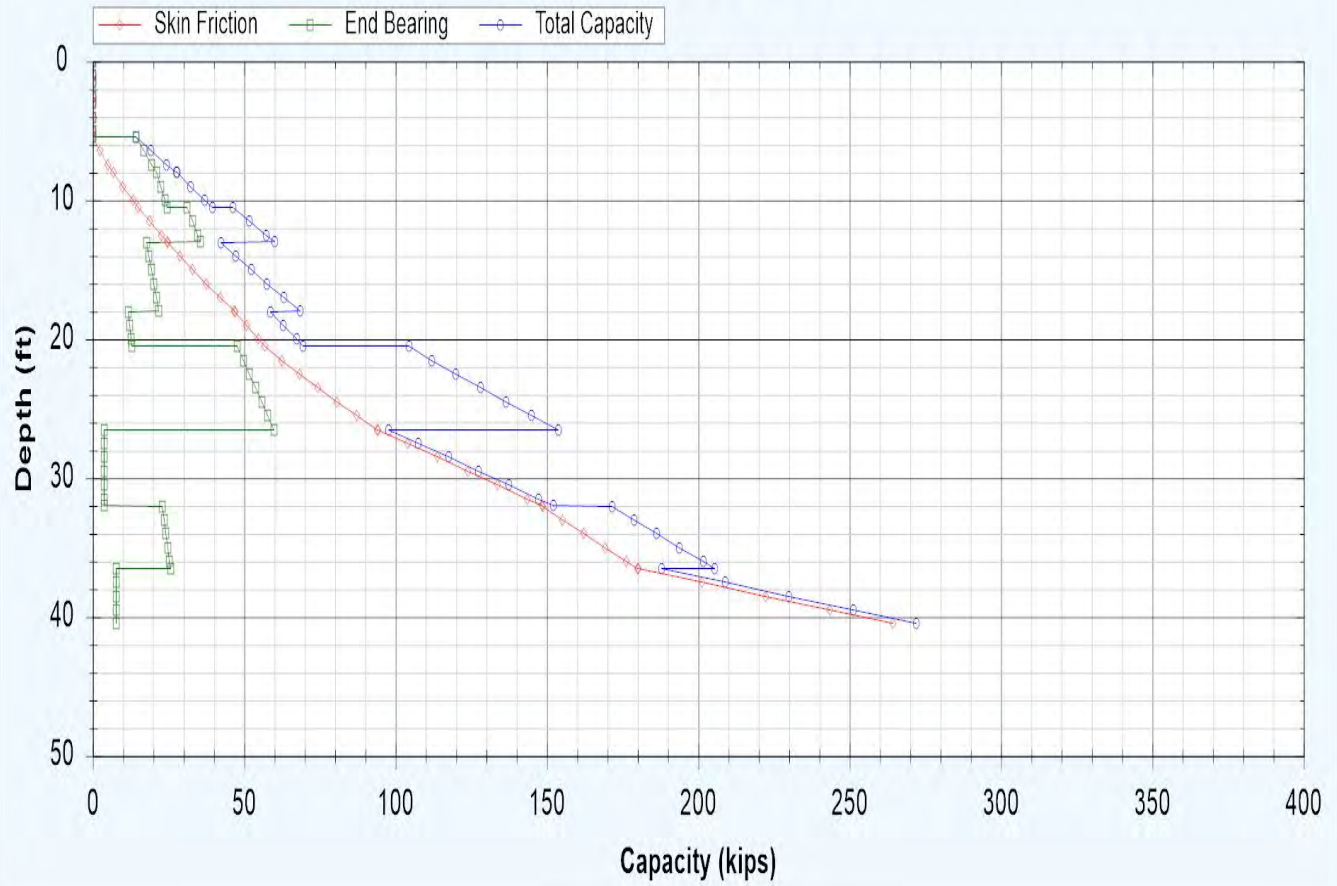


Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.39 ft	0.00 kips	0.00 kips	0.00 kips
5.41 ft	0.02 kips	14.14 kips	14.17 kips
6.40 ft	2.26 kips	16.76 kips	19.02 kips
7.40 ft	4.90 kips	19.40 kips	24.31 kips
7.99 ft	6.65 kips	20.96 kips	27.61 kips
8.01 ft	6.71 kips	21.00 kips	27.71 kips
9.00 ft	9.85 kips	22.36 kips	32.21 kips
10.00 ft	13.22 kips	23.74 kips	36.96 kips
10.49 ft	14.94 kips	24.41 kips	39.35 kips
10.51 ft	15.02 kips	31.15 kips	46.16 kips
11.50 ft	18.68 kips	32.88 kips	51.56 kips
12.50 ft	22.59 kips	34.63 kips	57.22 kips
12.99 ft	24.57 kips	35.49 kips	60.06 kips
13.01 ft	24.65 kips	17.71 kips	42.37 kips
14.00 ft	28.69 kips	18.51 kips	47.20 kips
15.00 ft	32.96 kips	19.32 kips	52.27 kips
16.00 ft	37.40 kips	20.13 kips	57.53 kips
17.00 ft	42.02 kips	20.94 kips	62.96 kips
17.99 ft	46.78 kips	21.74 kips	68.52 kips
18.01 ft	46.87 kips	11.70 kips	58.57 kips
19.00 ft	50.67 kips	12.13 kips	62.80 kips
20.00 ft	54.66 kips	12.56 kips	67.22 kips
20.49 ft	56.66 kips	12.77 kips	69.44 kips
20.51 ft	56.76 kips	47.69 kips	104.45 kips
21.50 ft	62.33 kips	49.68 kips	112.01 kips
22.50 ft	68.20 kips	51.69 kips	119.89 kips
23.50 ft	74.29 kips	53.70 kips	127.99 kips
24.50 ft	80.62 kips	55.71 kips	136.33 kips
25.50 ft	87.18 kips	57.72 kips	144.90 kips
26.49 ft	93.90 kips	59.71 kips	153.62 kips
26.51 ft	94.07 kips	3.63 kips	97.71 kips
27.50 ft	103.89 kips	3.63 kips	107.52 kips

Depth	Skin Friction	End Bearing	Total Capacity
28.50 ft	113.81 kips	3.63 kips	117.44 kips
29.50 ft	123.73 kips	3.63 kips	127.36 kips
30.50 ft	133.64 kips	3.63 kips	137.28 kips
31.50 ft	143.56 kips	3.63 kips	147.19 kips
31.99 ft	148.42 kips	3.63 kips	152.05 kips
32.01 ft	148.58 kips	22.98 kips	171.56 kips
33.00 ft	155.20 kips	23.55 kips	178.75 kips
34.00 ft	162.05 kips	24.13 kips	186.18 kips
35.00 ft	169.07 kips	24.71 kips	193.78 kips
36.00 ft	176.25 kips	25.29 kips	201.54 kips
36.49 ft	179.83 kips	25.58 kips	205.41 kips
36.51 ft	180.12 kips	7.75 kips	187.87 kips
37.50 ft	201.06 kips	7.75 kips	208.81 kips
38.50 ft	222.22 kips	7.75 kips	229.97 kips
39.50 ft	243.38 kips	7.75 kips	251.13 kips
40.49 ft	264.32 kips	7.75 kips	272.07 kips

Bearing Capacity - Driving

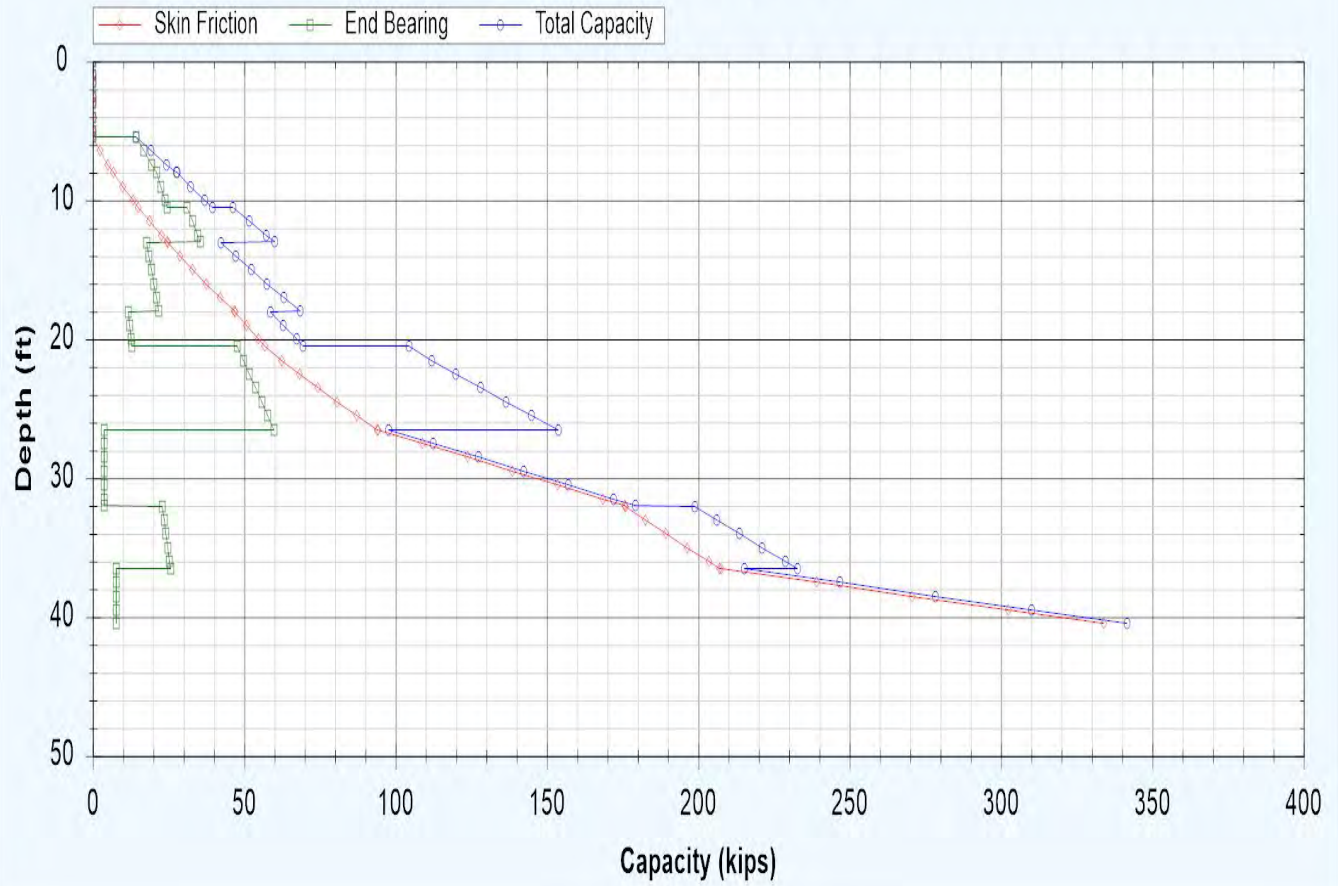


Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.39 ft	0.00 kips	0.00 kips	0.00 kips
5.41 ft	0.02 kips	14.14 kips	14.17 kips
6.40 ft	2.26 kips	16.76 kips	19.02 kips
7.40 ft	4.90 kips	19.40 kips	24.31 kips
7.99 ft	6.65 kips	20.96 kips	27.61 kips
8.01 ft	6.71 kips	21.00 kips	27.71 kips
9.00 ft	9.85 kips	22.36 kips	32.21 kips
10.00 ft	13.22 kips	23.74 kips	36.96 kips
10.49 ft	14.94 kips	24.41 kips	39.35 kips
10.51 ft	15.02 kips	31.15 kips	46.16 kips
11.50 ft	18.68 kips	32.88 kips	51.56 kips
12.50 ft	22.59 kips	34.63 kips	57.22 kips
12.99 ft	24.57 kips	35.49 kips	60.06 kips
13.01 ft	24.65 kips	17.71 kips	42.37 kips
14.00 ft	28.69 kips	18.51 kips	47.20 kips
15.00 ft	32.96 kips	19.32 kips	52.27 kips
16.00 ft	37.40 kips	20.13 kips	57.53 kips
17.00 ft	42.02 kips	20.94 kips	62.96 kips
17.99 ft	46.78 kips	21.74 kips	68.52 kips
18.01 ft	46.87 kips	11.70 kips	58.57 kips
19.00 ft	50.67 kips	12.13 kips	62.80 kips
20.00 ft	54.66 kips	12.56 kips	67.22 kips
20.49 ft	56.66 kips	12.77 kips	69.44 kips
20.51 ft	56.76 kips	47.69 kips	104.45 kips
21.50 ft	62.33 kips	49.68 kips	112.01 kips
22.50 ft	68.20 kips	51.69 kips	119.89 kips
23.50 ft	74.29 kips	53.70 kips	127.99 kips
24.50 ft	80.62 kips	55.71 kips	136.33 kips
25.50 ft	87.18 kips	57.72 kips	144.90 kips
26.49 ft	93.90 kips	59.71 kips	153.62 kips
26.51 ft	94.12 kips	3.63 kips	97.76 kips
27.50 ft	108.85 kips	3.63 kips	112.48 kips

Depth	Skin Friction	End Bearing	Total Capacity
28.50 ft	123.72 kips	3.63 kips	127.36 kips
29.50 ft	138.60 kips	3.63 kips	142.23 kips
30.50 ft	153.47 kips	3.63 kips	157.11 kips
31.50 ft	168.35 kips	3.63 kips	171.98 kips
31.99 ft	175.64 kips	3.63 kips	179.27 kips
32.01 ft	175.85 kips	22.98 kips	198.83 kips
33.00 ft	182.47 kips	23.55 kips	206.02 kips
34.00 ft	189.32 kips	24.13 kips	213.45 kips
35.00 ft	196.34 kips	24.71 kips	221.05 kips
36.00 ft	203.52 kips	25.29 kips	228.81 kips
36.49 ft	207.10 kips	25.58 kips	232.68 kips
36.51 ft	207.49 kips	7.75 kips	215.24 kips
37.50 ft	238.91 kips	7.75 kips	246.66 kips
38.50 ft	270.64 kips	7.75 kips	278.39 kips
39.50 ft	302.37 kips	7.75 kips	310.12 kips
40.49 ft	333.79 kips	7.75 kips	341.54 kips

Bearing Capacity - Nominal



DrivenPiles - Report

General Project Information

Filename: ...-20-025 FRA-70-13.01\Analysis\Driven Piles\Pier 2\FRA-70-13.01 - Pier 2 HP 14x73-B-014-4-19.dvn
Project Name: FRA-70-13.01 Pier 2 (B-014-4-19)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile - HP 12x73
Top of Pile: 5.40 ft
Diameter of Pile: 14.60 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling: 8.00 ft
Driving/Restrike: 8.00 ft
Nominal: 8.00 ft

Nominal Considations:

Local Scour: 0.00 ft
Long Term Scour: 0.00 ft
Soft Soil: 0.00 ft

Nominal Profile

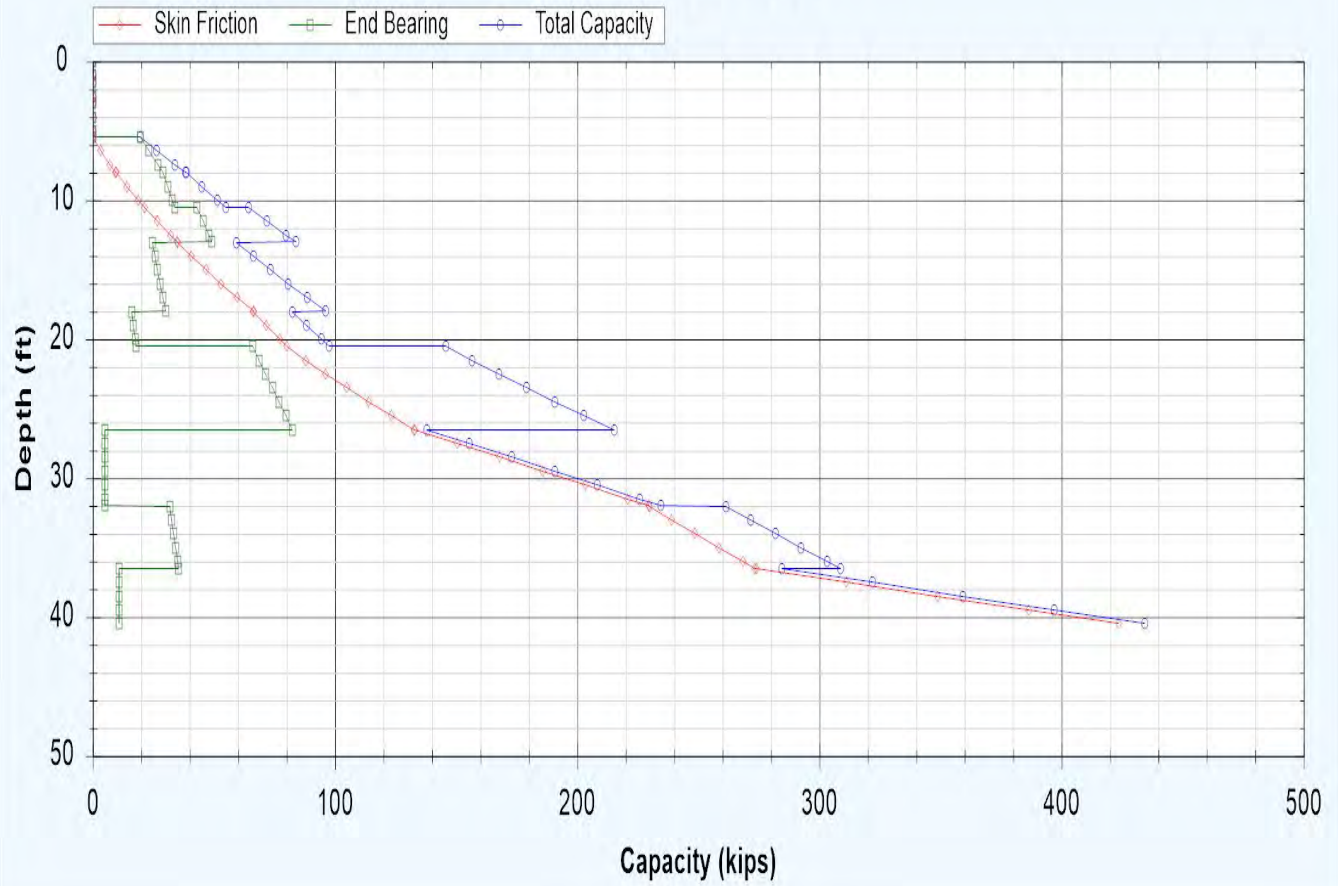
Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesive	1.50 ft	1.500	125.00 pcf	3125.00 psf	T-80 Same
2	Cohesive	1.50 ft	1.500	130.00 pcf	4625.00 psf	T-80 Same
3	Cohesionless	7.50 ft	1.000	130.00 pcf	42.0/42.0	Nordlund
4	Cohesionless	2.50 ft	1.000	130.00 pcf	43.0/43.0	Nordlund
5	Cohesionless	5.00 ft	1.000	125.00 pcf	40.0/40.0	Nordlund
6	Cohesionless	2.50 ft	1.000	125.00 pcf	37.0/37.0	Nordlund
7	Cohesionless	6.00 ft	1.000	140.00 pcf	43.0/43.0	Nordlund
8	Cohesive	5.50 ft	1.500	130.00 pcf	3750.00 psf	T-80 Sand
9	Cohesionless	4.50 ft	1.000	130.00 pcf	38.0/38.0	Nordlund
10	Cohesive	4.00 ft	1.500	135.00 pcf	8000.00 psf	T-80 Sand

Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.39 ft	0.00 kips	0.00 kips	0.00 kips
5.41 ft	0.03 kips	19.53 kips	19.56 kips
6.40 ft	3.20 kips	23.14 kips	26.34 kips
7.40 ft	6.95 kips	26.79 kips	33.73 kips
7.99 ft	9.41 kips	28.94 kips	38.35 kips
8.01 ft	9.50 kips	29.00 kips	38.50 kips
9.00 ft	13.95 kips	30.88 kips	44.82 kips
10.00 ft	18.72 kips	32.77 kips	51.50 kips
10.49 ft	21.17 kips	33.70 kips	54.87 kips
10.51 ft	21.27 kips	43.00 kips	64.27 kips
11.50 ft	26.47 kips	45.39 kips	71.86 kips
12.50 ft	32.00 kips	47.81 kips	79.82 kips
12.99 ft	34.82 kips	49.00 kips	83.82 kips
13.01 ft	34.93 kips	24.45 kips	59.39 kips
14.00 ft	40.64 kips	25.56 kips	66.19 kips
15.00 ft	46.65 kips	26.67 kips	73.33 kips
16.00 ft	52.93 kips	27.79 kips	80.72 kips
17.00 ft	59.46 kips	28.91 kips	88.36 kips
17.99 ft	66.18 kips	30.01 kips	96.19 kips
18.01 ft	66.30 kips	16.15 kips	82.45 kips
19.00 ft	71.57 kips	16.74 kips	88.31 kips
20.00 ft	77.08 kips	17.34 kips	94.42 kips
20.49 ft	79.85 kips	17.64 kips	97.49 kips
20.51 ft	79.99 kips	65.84 kips	145.83 kips
21.50 ft	87.89 kips	68.59 kips	156.48 kips
22.50 ft	96.21 kips	71.37 kips	167.57 kips
23.50 ft	104.85 kips	74.14 kips	178.99 kips
24.50 ft	113.82 kips	76.92 kips	190.74 kips
25.50 ft	123.12 kips	79.69 kips	202.82 kips
26.49 ft	132.66 kips	82.44 kips	215.10 kips
26.51 ft	132.93 kips	5.02 kips	137.95 kips
27.50 ft	150.38 kips	5.02 kips	155.39 kips
28.50 ft	168.00 kips	5.02 kips	173.02 kips

Depth	Skin Friction	End Bearing	Total Capacity
29.50 ft	185.63 kips	5.02 kips	190.64 kips
30.50 ft	203.25 kips	5.02 kips	208.27 kips
31.50 ft	220.88 kips	5.02 kips	225.89 kips
31.99 ft	229.52 kips	5.02 kips	234.53 kips
32.01 ft	229.78 kips	31.72 kips	261.51 kips
33.00 ft	239.01 kips	32.52 kips	271.53 kips
34.00 ft	248.56 kips	33.32 kips	281.88 kips
35.00 ft	258.35 kips	34.12 kips	292.47 kips
36.00 ft	268.37 kips	34.92 kips	303.29 kips
36.49 ft	273.36 kips	35.31 kips	308.67 kips
36.51 ft	273.84 kips	10.70 kips	284.54 kips
37.50 ft	311.06 kips	10.70 kips	321.76 kips
38.50 ft	348.66 kips	10.70 kips	359.36 kips
39.50 ft	386.26 kips	10.70 kips	396.96 kips
40.49 ft	423.49 kips	10.70 kips	434.19 kips

Bearing Capacity - Restrike

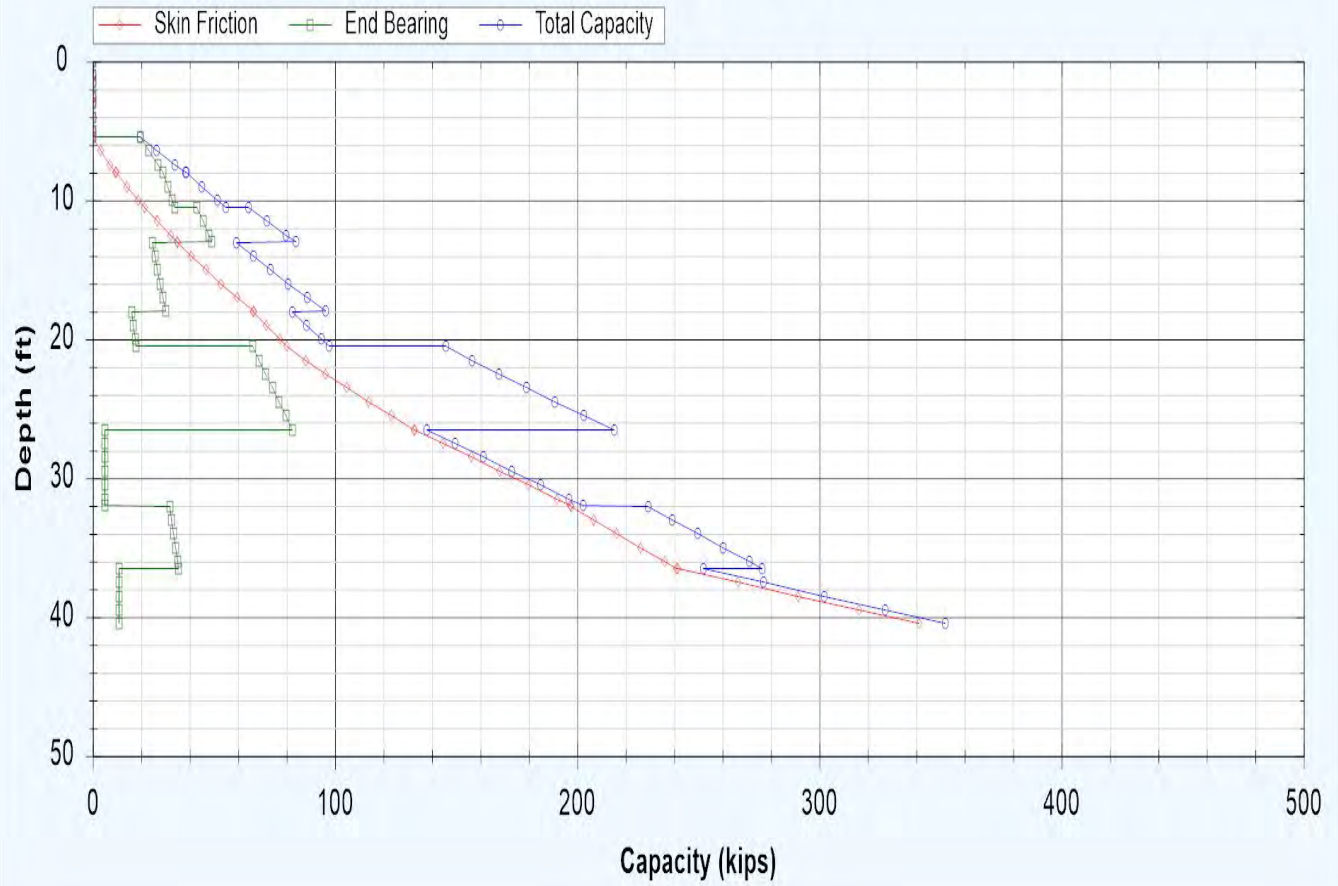


Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.39 ft	0.00 kips	0.00 kips	0.00 kips
5.41 ft	0.03 kips	19.53 kips	19.56 kips
6.40 ft	3.20 kips	23.14 kips	26.34 kips
7.40 ft	6.95 kips	26.79 kips	33.73 kips
7.99 ft	9.41 kips	28.94 kips	38.35 kips
8.01 ft	9.50 kips	29.00 kips	38.50 kips
9.00 ft	13.95 kips	30.88 kips	44.82 kips
10.00 ft	18.72 kips	32.77 kips	51.50 kips
10.49 ft	21.17 kips	33.70 kips	54.87 kips
10.51 ft	21.27 kips	43.00 kips	64.27 kips
11.50 ft	26.47 kips	45.39 kips	71.86 kips
12.50 ft	32.00 kips	47.81 kips	79.82 kips
12.99 ft	34.82 kips	49.00 kips	83.82 kips
13.01 ft	34.93 kips	24.45 kips	59.39 kips
14.00 ft	40.64 kips	25.56 kips	66.19 kips
15.00 ft	46.65 kips	26.67 kips	73.33 kips
16.00 ft	52.93 kips	27.79 kips	80.72 kips
17.00 ft	59.46 kips	28.91 kips	88.36 kips
17.99 ft	66.18 kips	30.01 kips	96.19 kips
18.01 ft	66.30 kips	16.15 kips	82.45 kips
19.00 ft	71.57 kips	16.74 kips	88.31 kips
20.00 ft	77.08 kips	17.34 kips	94.42 kips
20.49 ft	79.85 kips	17.64 kips	97.49 kips
20.51 ft	79.99 kips	65.84 kips	145.83 kips
21.50 ft	87.89 kips	68.59 kips	156.48 kips
22.50 ft	96.21 kips	71.37 kips	167.57 kips
23.50 ft	104.85 kips	74.14 kips	178.99 kips
24.50 ft	113.82 kips	76.92 kips	190.74 kips
25.50 ft	123.12 kips	79.69 kips	202.82 kips
26.49 ft	132.66 kips	82.44 kips	215.10 kips
26.51 ft	132.87 kips	5.02 kips	137.89 kips
27.50 ft	144.50 kips	5.02 kips	149.52 kips
28.50 ft	156.26 kips	5.02 kips	161.27 kips

Depth	Skin Friction	End Bearing	Total Capacity
29.50 ft	168.01 kips	5.02 kips	173.02 kips
30.50 ft	179.76 kips	5.02 kips	184.77 kips
31.50 ft	191.51 kips	5.02 kips	196.52 kips
31.99 ft	197.27 kips	5.02 kips	202.28 kips
32.01 ft	197.47 kips	31.72 kips	229.20 kips
33.00 ft	206.70 kips	32.52 kips	239.22 kips
34.00 ft	216.26 kips	33.32 kips	249.57 kips
35.00 ft	226.04 kips	34.12 kips	260.16 kips
36.00 ft	236.06 kips	34.92 kips	270.98 kips
36.49 ft	241.05 kips	35.31 kips	276.36 kips
36.51 ft	241.41 kips	10.70 kips	252.11 kips
37.50 ft	266.22 kips	10.70 kips	276.92 kips
38.50 ft	291.29 kips	10.70 kips	301.99 kips
39.50 ft	316.36 kips	10.70 kips	327.06 kips
40.49 ft	341.18 kips	10.70 kips	351.88 kips

Bearing Capacity - Driving

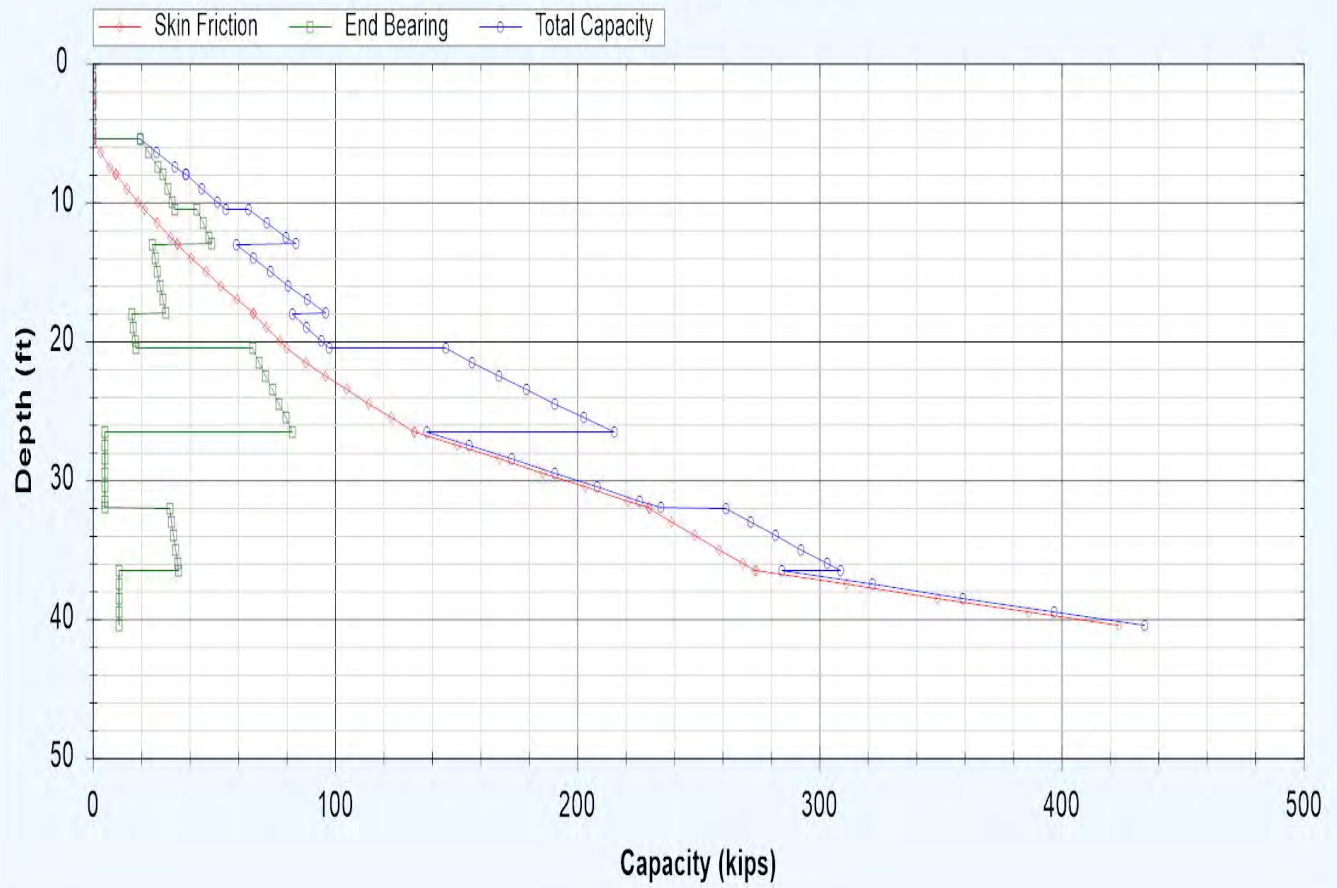


Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.39 ft	0.00 kips	0.00 kips	0.00 kips
5.41 ft	0.03 kips	19.53 kips	19.56 kips
6.40 ft	3.20 kips	23.14 kips	26.34 kips
7.40 ft	6.95 kips	26.79 kips	33.73 kips
7.99 ft	9.41 kips	28.94 kips	38.35 kips
8.01 ft	9.50 kips	29.00 kips	38.50 kips
9.00 ft	13.95 kips	30.88 kips	44.82 kips
10.00 ft	18.72 kips	32.77 kips	51.50 kips
10.49 ft	21.17 kips	33.70 kips	54.87 kips
10.51 ft	21.27 kips	43.00 kips	64.27 kips
11.50 ft	26.47 kips	45.39 kips	71.86 kips
12.50 ft	32.00 kips	47.81 kips	79.82 kips
12.99 ft	34.82 kips	49.00 kips	83.82 kips
13.01 ft	34.93 kips	24.45 kips	59.39 kips
14.00 ft	40.64 kips	25.56 kips	66.19 kips
15.00 ft	46.65 kips	26.67 kips	73.33 kips
16.00 ft	52.93 kips	27.79 kips	80.72 kips
17.00 ft	59.46 kips	28.91 kips	88.36 kips
17.99 ft	66.18 kips	30.01 kips	96.19 kips
18.01 ft	66.30 kips	16.15 kips	82.45 kips
19.00 ft	71.57 kips	16.74 kips	88.31 kips
20.00 ft	77.08 kips	17.34 kips	94.42 kips
20.49 ft	79.85 kips	17.64 kips	97.49 kips
20.51 ft	79.99 kips	65.84 kips	145.83 kips
21.50 ft	87.89 kips	68.59 kips	156.48 kips
22.50 ft	96.21 kips	71.37 kips	167.57 kips
23.50 ft	104.85 kips	74.14 kips	178.99 kips
24.50 ft	113.82 kips	76.92 kips	190.74 kips
25.50 ft	123.12 kips	79.69 kips	202.82 kips
26.49 ft	132.66 kips	82.44 kips	215.10 kips
26.51 ft	132.93 kips	5.02 kips	137.95 kips
27.50 ft	150.38 kips	5.02 kips	155.39 kips
28.50 ft	168.00 kips	5.02 kips	173.02 kips

Depth	Skin Friction	End Bearing	Total Capacity
29.50 ft	185.63 kips	5.02 kips	190.64 kips
30.50 ft	203.25 kips	5.02 kips	208.27 kips
31.50 ft	220.88 kips	5.02 kips	225.89 kips
31.99 ft	229.52 kips	5.02 kips	234.53 kips
32.01 ft	229.78 kips	31.72 kips	261.51 kips
33.00 ft	239.01 kips	32.52 kips	271.53 kips
34.00 ft	248.56 kips	33.32 kips	281.88 kips
35.00 ft	258.35 kips	34.12 kips	292.47 kips
36.00 ft	268.37 kips	34.92 kips	303.29 kips
36.49 ft	273.36 kips	35.31 kips	308.67 kips
36.51 ft	273.84 kips	10.70 kips	284.54 kips
37.50 ft	311.06 kips	10.70 kips	321.76 kips
38.50 ft	348.66 kips	10.70 kips	359.36 kips
39.50 ft	386.26 kips	10.70 kips	396.96 kips
40.49 ft	423.49 kips	10.70 kips	434.19 kips

Bearing Capacity - Nominal



**Forward Abutment
(B-014-7-20)**

DrivenPiles - Report

General Project Information

Filename: ...nalysis\Driven Piles\Forward Abutment\FRA-70-13.01 - Forward Abutment HP 10x42-B-014-7-20.dvn
Project Name: FRA-70-13.01 Forward Abutment (B-014-7-20)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile - HP 10x42
Top of Pile: 0.00 ft
Diameter of Pile: 10.08 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling: 38.00 ft
Driving/Restrike: 38.00 ft
Nominal: 38.00 ft

Nominal Considations:

Local Scour: 0.00 ft
Long Term Scour: 0.00 ft
Soft Soil: 0.00 ft

Nominal Profile

Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesionless	13.90 ft	1.000	120.00 pcf	28.0/28.0	Nordlund
2	Cohesive	5.10 ft	1.500	120.00 pcf	2750.00 psf	T-80 Same
3	Cohesive	5.50 ft	1.500	130.00 pcf	6250.00 psf	T-80 Same
4	Cohesive	13.50 ft	2.000	130.00 pcf	5000.00 psf	T-80 Same
5	Cohesionless	7.00 ft	1.000	135.00 pcf	42.0/42.0	Nordlund
6	Cohesionless	10.00 ft	1.000	130.00 pcf	40.0/40.0	Nordlund
7	Cohesive	6.00 ft	1.500	125.00 pcf	2875.00 psf	T-80 Sand
8	Cohesionless	8.60 ft	1.000	130.00 pcf	40.0/40.0	Nordlund
9	Cohesive	7.20 ft	1.500	125.00 pcf	4000.00 psf	T-80 Sand

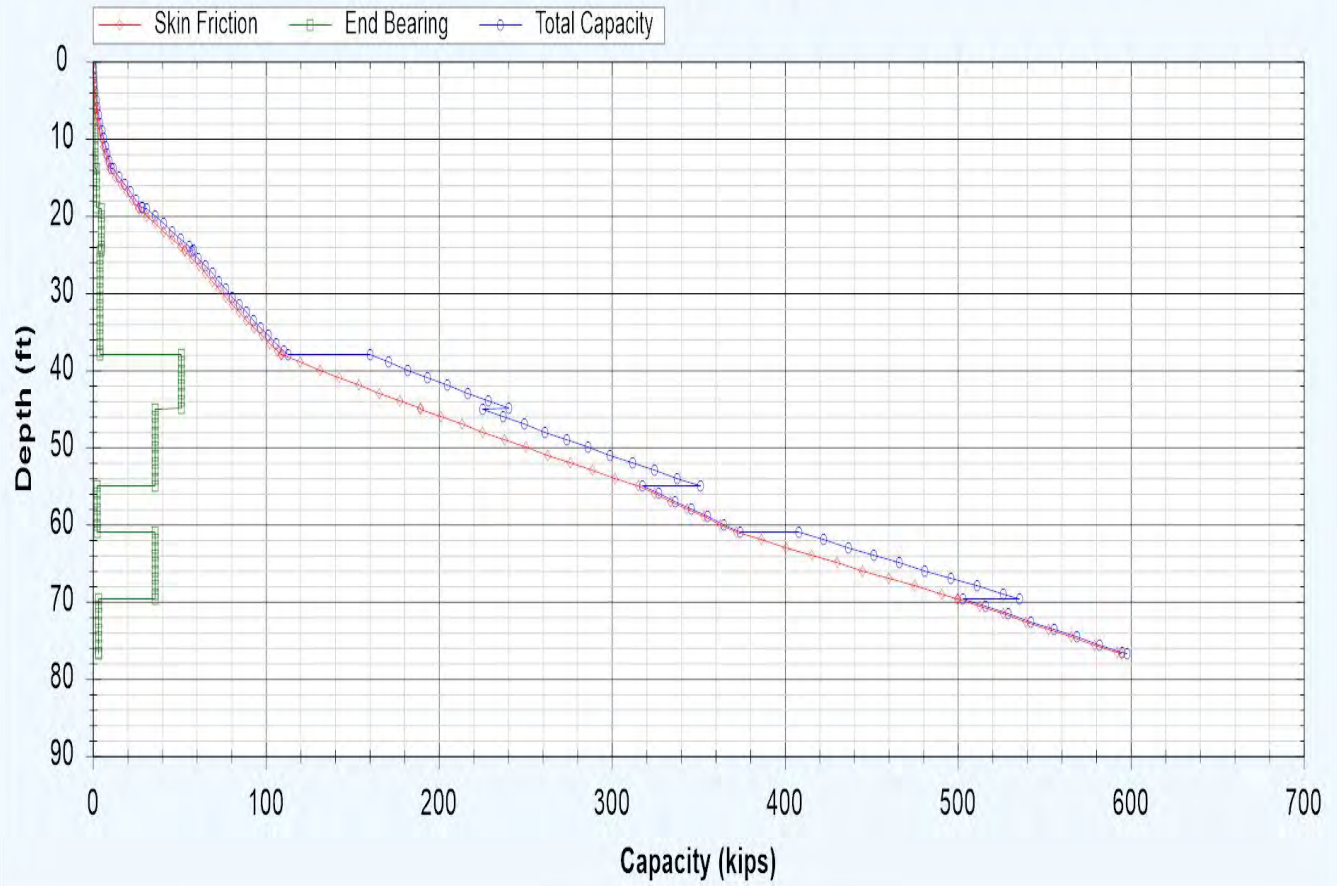
Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.05 kips	0.13 kips	0.18 kips
2.00 ft	0.20 kips	0.25 kips	0.45 kips
3.00 ft	0.45 kips	0.38 kips	0.83 kips
4.00 ft	0.80 kips	0.51 kips	1.30 kips
5.00 ft	1.24 kips	0.63 kips	1.88 kips
6.00 ft	1.79 kips	0.76 kips	2.55 kips
7.00 ft	2.44 kips	0.88 kips	3.32 kips
8.00 ft	3.18 kips	1.01 kips	4.19 kips
9.00 ft	4.03 kips	1.14 kips	5.17 kips
10.00 ft	4.98 kips	1.15 kips	6.12 kips
11.00 ft	6.02 kips	1.15 kips	7.17 kips
12.00 ft	7.16 kips	1.15 kips	8.31 kips
13.00 ft	8.41 kips	1.15 kips	9.55 kips
13.89 ft	9.60 kips	1.15 kips	10.75 kips
13.91 ft	9.65 kips	2.13 kips	11.78 kips
14.90 ft	12.88 kips	2.13 kips	15.01 kips
15.90 ft	16.15 kips	2.13 kips	18.28 kips
16.90 ft	19.42 kips	2.13 kips	21.55 kips
17.90 ft	22.69 kips	2.13 kips	24.83 kips
18.90 ft	25.96 kips	2.13 kips	28.10 kips
18.99 ft	26.26 kips	2.13 kips	28.39 kips
19.01 ft	26.34 kips	4.84 kips	31.18 kips
20.00 ft	31.19 kips	4.84 kips	36.04 kips
21.00 ft	36.10 kips	4.84 kips	40.94 kips
22.00 ft	41.00 kips	4.84 kips	45.84 kips
23.00 ft	45.90 kips	4.84 kips	50.75 kips
24.00 ft	50.80 kips	4.84 kips	55.65 kips
24.49 ft	53.21 kips	4.84 kips	58.05 kips
24.51 ft	53.29 kips	3.87 kips	57.17 kips
25.50 ft	57.18 kips	3.87 kips	61.05 kips
26.50 ft	61.10 kips	3.87 kips	64.97 kips
27.50 ft	65.02 kips	3.87 kips	68.90 kips
28.50 ft	68.94 kips	3.87 kips	72.82 kips
29.50 ft	72.87 kips	3.87 kips	76.74 kips
30.50 ft	76.79 kips	3.87 kips	80.66 kips
31.50 ft	80.71 kips	3.87 kips	84.58 kips
32.50 ft	84.63 kips	3.87 kips	88.51 kips
33.50 ft	88.77 kips	3.87 kips	92.65 kips
34.50 ft	93.12 kips	3.87 kips	96.99 kips
35.50 ft	97.54 kips	3.87 kips	101.42 kips
36.50 ft	102.05 kips	3.87 kips	105.92 kips

Depth	Skin Friction	End Bearing	Total Capacity
37.50 ft	106.63 kips	3.87 kips	110.51 kips
37.99 ft	108.91 kips	3.87 kips	112.78 kips
38.01 ft	109.06 kips	51.03 kips	160.09 kips
39.00 ft	119.93 kips	51.03 kips	170.96 kips
40.00 ft	131.08 kips	51.03 kips	182.10 kips
41.00 ft	142.39 kips	51.03 kips	193.42 kips
42.00 ft	153.87 kips	51.03 kips	204.89 kips
43.00 ft	165.51 kips	51.03 kips	216.54 kips
44.00 ft	177.33 kips	51.03 kips	228.35 kips
44.99 ft	189.18 kips	51.03 kips	240.21 kips
45.01 ft	189.42 kips	35.96 kips	225.38 kips
46.00 ft	201.21 kips	35.96 kips	237.17 kips
47.00 ft	213.26 kips	35.96 kips	249.22 kips
48.00 ft	225.47 kips	35.96 kips	261.43 kips
49.00 ft	237.83 kips	35.96 kips	273.79 kips
50.00 ft	250.35 kips	35.96 kips	286.31 kips
51.00 ft	263.01 kips	35.96 kips	298.97 kips
52.00 ft	275.83 kips	35.96 kips	311.79 kips
53.00 ft	288.80 kips	35.96 kips	324.76 kips
54.00 ft	301.92 kips	35.96 kips	337.88 kips
54.99 ft	315.06 kips	35.96 kips	351.02 kips
55.01 ft	315.29 kips	2.23 kips	317.51 kips
56.00 ft	324.67 kips	2.23 kips	326.90 kips
57.00 ft	334.14 kips	2.23 kips	336.37 kips
58.00 ft	343.62 kips	2.23 kips	345.85 kips
59.00 ft	353.09 kips	2.23 kips	355.32 kips
60.00 ft	362.57 kips	2.23 kips	364.80 kips
60.99 ft	371.95 kips	2.23 kips	374.18 kips
61.01 ft	372.19 kips	35.96 kips	408.15 kips
62.00 ft	386.31 kips	35.96 kips	422.27 kips
63.00 ft	400.74 kips	35.96 kips	436.70 kips
64.00 ft	415.31 kips	35.96 kips	451.27 kips
65.00 ft	430.04 kips	35.96 kips	466.00 kips
66.00 ft	444.92 kips	35.96 kips	480.88 kips
67.00 ft	459.95 kips	35.96 kips	495.91 kips
68.00 ft	475.13 kips	35.96 kips	511.09 kips
69.00 ft	490.46 kips	35.96 kips	526.42 kips
69.59 ft	499.58 kips	35.96 kips	535.54 kips
69.61 ft	499.87 kips	3.10 kips	502.97 kips
70.60 ft	512.92 kips	3.10 kips	516.02 kips
71.60 ft	526.10 kips	3.10 kips	529.20 kips
72.60 ft	539.29 kips	3.10 kips	542.39 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.60 ft	552.47 kips	3.10 kips	555.57 kips
74.60 ft	565.65 kips	3.10 kips	568.75 kips
75.60 ft	578.84 kips	3.10 kips	581.94 kips
76.60 ft	592.02 kips	3.10 kips	595.12 kips
76.79 ft	594.53 kips	3.10 kips	597.63 kips

Bearing Capacity - Restrike



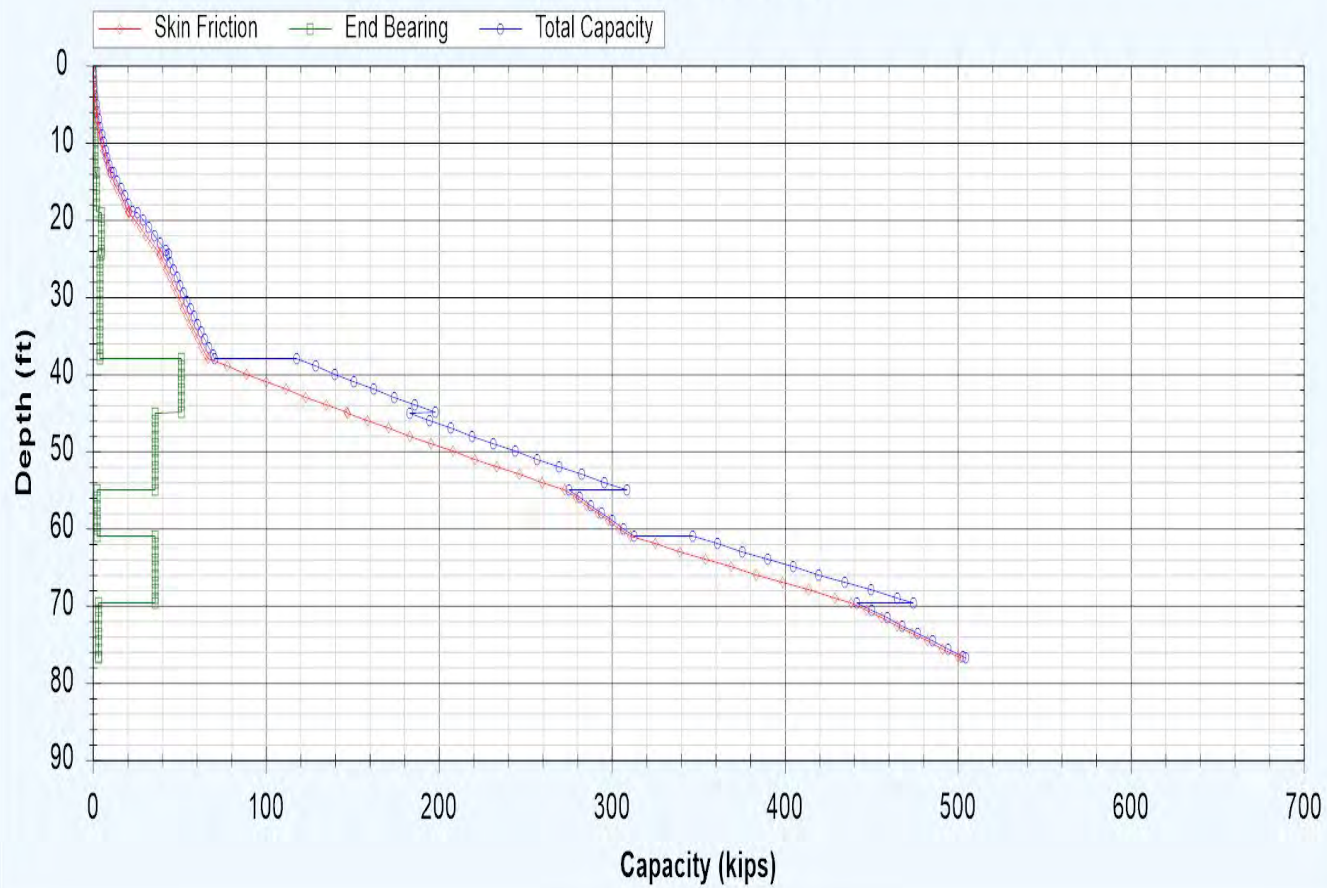
Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.05 kips	0.13 kips	0.18 kips
2.00 ft	0.20 kips	0.25 kips	0.45 kips
3.00 ft	0.45 kips	0.38 kips	0.83 kips
4.00 ft	0.80 kips	0.51 kips	1.30 kips
5.00 ft	1.24 kips	0.63 kips	1.88 kips
6.00 ft	1.79 kips	0.76 kips	2.55 kips
7.00 ft	2.44 kips	0.88 kips	3.32 kips
8.00 ft	3.18 kips	1.01 kips	4.19 kips
9.00 ft	4.03 kips	1.14 kips	5.17 kips
10.00 ft	4.98 kips	1.15 kips	6.12 kips
11.00 ft	6.02 kips	1.15 kips	7.17 kips
12.00 ft	7.16 kips	1.15 kips	8.31 kips
13.00 ft	8.41 kips	1.15 kips	9.55 kips
13.89 ft	9.60 kips	1.15 kips	10.75 kips
13.91 ft	9.63 kips	2.13 kips	11.77 kips
14.90 ft	11.79 kips	2.13 kips	13.92 kips
15.90 ft	13.97 kips	2.13 kips	16.10 kips
16.90 ft	16.15 kips	2.13 kips	18.28 kips
17.90 ft	18.33 kips	2.13 kips	20.47 kips
18.90 ft	20.51 kips	2.13 kips	22.65 kips
18.99 ft	20.71 kips	2.13 kips	22.84 kips
19.01 ft	20.76 kips	4.84 kips	25.61 kips
20.00 ft	24.00 kips	4.84 kips	28.84 kips
21.00 ft	27.27 kips	4.84 kips	32.11 kips
22.00 ft	30.54 kips	4.84 kips	35.38 kips
23.00 ft	33.81 kips	4.84 kips	38.65 kips
24.00 ft	37.07 kips	4.84 kips	41.92 kips
24.49 ft	38.68 kips	4.84 kips	43.52 kips
24.51 ft	38.73 kips	3.87 kips	42.60 kips
25.50 ft	40.67 kips	3.87 kips	44.55 kips
26.50 ft	42.63 kips	3.87 kips	46.51 kips
27.50 ft	44.59 kips	3.87 kips	48.47 kips
28.50 ft	46.55 kips	3.87 kips	50.43 kips
29.50 ft	48.51 kips	3.87 kips	52.39 kips
30.50 ft	50.48 kips	3.87 kips	54.35 kips
31.50 ft	52.44 kips	3.87 kips	56.31 kips
32.50 ft	54.40 kips	3.87 kips	58.27 kips
33.50 ft	56.47 kips	3.87 kips	60.34 kips
34.50 ft	58.64 kips	3.87 kips	62.51 kips
35.50 ft	60.85 kips	3.87 kips	64.73 kips
36.50 ft	63.10 kips	3.87 kips	66.98 kips

Depth	Skin Friction	End Bearing	Total Capacity
37.50 ft	65.40 kips	3.87 kips	69.27 kips
37.99 ft	66.53 kips	3.87 kips	70.41 kips
38.01 ft	66.67 kips	51.03 kips	117.69 kips
39.00 ft	77.54 kips	51.03 kips	128.56 kips
40.00 ft	88.68 kips	51.03 kips	139.71 kips
41.00 ft	99.99 kips	51.03 kips	151.02 kips
42.00 ft	111.47 kips	51.03 kips	162.50 kips
43.00 ft	123.12 kips	51.03 kips	174.14 kips
44.00 ft	134.93 kips	51.03 kips	185.96 kips
44.99 ft	146.79 kips	51.03 kips	197.81 kips
45.01 ft	147.03 kips	35.96 kips	182.99 kips
46.00 ft	158.81 kips	35.96 kips	194.77 kips
47.00 ft	170.87 kips	35.96 kips	206.83 kips
48.00 ft	183.08 kips	35.96 kips	219.04 kips
49.00 ft	195.44 kips	35.96 kips	231.40 kips
50.00 ft	207.95 kips	35.96 kips	243.91 kips
51.00 ft	220.62 kips	35.96 kips	256.58 kips
52.00 ft	233.43 kips	35.96 kips	269.39 kips
53.00 ft	246.40 kips	35.96 kips	282.36 kips
54.00 ft	259.52 kips	35.96 kips	295.48 kips
54.99 ft	272.66 kips	35.96 kips	308.62 kips
55.01 ft	272.86 kips	2.23 kips	275.09 kips
56.00 ft	279.11 kips	2.23 kips	281.34 kips
57.00 ft	285.43 kips	2.23 kips	287.66 kips
58.00 ft	291.75 kips	2.23 kips	293.98 kips
59.00 ft	298.07 kips	2.23 kips	300.29 kips
60.00 ft	304.38 kips	2.23 kips	306.61 kips
60.99 ft	310.64 kips	2.23 kips	312.87 kips
61.01 ft	310.84 kips	35.96 kips	346.80 kips
62.00 ft	324.97 kips	35.96 kips	360.93 kips
63.00 ft	339.39 kips	35.96 kips	375.35 kips
64.00 ft	353.97 kips	35.96 kips	389.93 kips
65.00 ft	368.69 kips	35.96 kips	404.65 kips
66.00 ft	383.57 kips	35.96 kips	419.53 kips
67.00 ft	398.60 kips	35.96 kips	434.56 kips
68.00 ft	413.78 kips	35.96 kips	449.74 kips
69.00 ft	429.12 kips	35.96 kips	465.08 kips
69.59 ft	438.24 kips	35.96 kips	474.20 kips
69.61 ft	438.48 kips	3.10 kips	441.58 kips
70.60 ft	447.18 kips	3.10 kips	450.28 kips
71.60 ft	455.97 kips	3.10 kips	459.07 kips
72.60 ft	464.76 kips	3.10 kips	467.86 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.60 ft	473.55 kips	3.10 kips	476.65 kips
74.60 ft	482.34 kips	3.10 kips	485.44 kips
75.60 ft	491.13 kips	3.10 kips	494.23 kips
76.60 ft	499.92 kips	3.10 kips	503.02 kips
76.79 ft	501.59 kips	3.10 kips	504.69 kips

Bearing Capacity - Driving



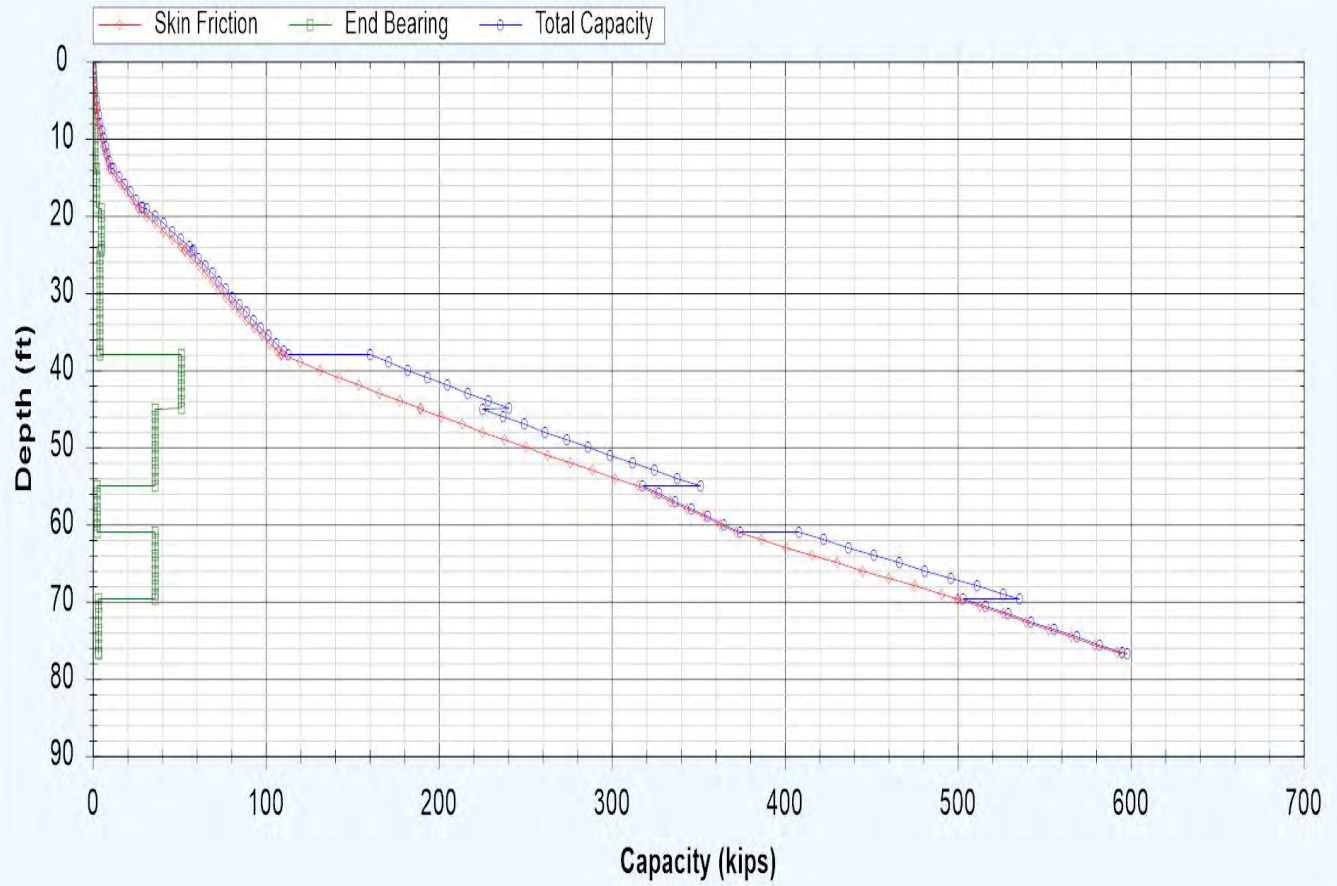
Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.05 kips	0.13 kips	0.18 kips
2.00 ft	0.20 kips	0.25 kips	0.45 kips
3.00 ft	0.45 kips	0.38 kips	0.83 kips
4.00 ft	0.80 kips	0.51 kips	1.30 kips
5.00 ft	1.24 kips	0.63 kips	1.88 kips
6.00 ft	1.79 kips	0.76 kips	2.55 kips
7.00 ft	2.44 kips	0.88 kips	3.32 kips
8.00 ft	3.18 kips	1.01 kips	4.19 kips
9.00 ft	4.03 kips	1.14 kips	5.17 kips
10.00 ft	4.98 kips	1.15 kips	6.12 kips
11.00 ft	6.02 kips	1.15 kips	7.17 kips
12.00 ft	7.16 kips	1.15 kips	8.31 kips
13.00 ft	8.41 kips	1.15 kips	9.55 kips
13.89 ft	9.60 kips	1.15 kips	10.75 kips
13.91 ft	9.65 kips	2.13 kips	11.78 kips
14.90 ft	12.88 kips	2.13 kips	15.01 kips
15.90 ft	16.15 kips	2.13 kips	18.28 kips
16.90 ft	19.42 kips	2.13 kips	21.55 kips
17.90 ft	22.69 kips	2.13 kips	24.83 kips
18.90 ft	25.96 kips	2.13 kips	28.10 kips
18.99 ft	26.26 kips	2.13 kips	28.39 kips
19.01 ft	26.34 kips	4.84 kips	31.18 kips
20.00 ft	31.19 kips	4.84 kips	36.04 kips
21.00 ft	36.10 kips	4.84 kips	40.94 kips
22.00 ft	41.00 kips	4.84 kips	45.84 kips
23.00 ft	45.90 kips	4.84 kips	50.75 kips
24.00 ft	50.80 kips	4.84 kips	55.65 kips
24.49 ft	53.21 kips	4.84 kips	58.05 kips
24.51 ft	53.29 kips	3.87 kips	57.17 kips
25.50 ft	57.18 kips	3.87 kips	61.05 kips
26.50 ft	61.10 kips	3.87 kips	64.97 kips
27.50 ft	65.02 kips	3.87 kips	68.90 kips
28.50 ft	68.94 kips	3.87 kips	72.82 kips
29.50 ft	72.87 kips	3.87 kips	76.74 kips
30.50 ft	76.79 kips	3.87 kips	80.66 kips
31.50 ft	80.71 kips	3.87 kips	84.58 kips
32.50 ft	84.63 kips	3.87 kips	88.51 kips
33.50 ft	88.77 kips	3.87 kips	92.65 kips
34.50 ft	93.12 kips	3.87 kips	96.99 kips
35.50 ft	97.54 kips	3.87 kips	101.42 kips
36.50 ft	102.05 kips	3.87 kips	105.92 kips

Depth	Skin Friction	End Bearing	Total Capacity
37.50 ft	106.63 kips	3.87 kips	110.51 kips
37.99 ft	108.91 kips	3.87 kips	112.78 kips
38.01 ft	109.06 kips	51.03 kips	160.09 kips
39.00 ft	119.93 kips	51.03 kips	170.96 kips
40.00 ft	131.08 kips	51.03 kips	182.10 kips
41.00 ft	142.39 kips	51.03 kips	193.42 kips
42.00 ft	153.87 kips	51.03 kips	204.89 kips
43.00 ft	165.51 kips	51.03 kips	216.54 kips
44.00 ft	177.33 kips	51.03 kips	228.35 kips
44.99 ft	189.18 kips	51.03 kips	240.21 kips
45.01 ft	189.42 kips	35.96 kips	225.38 kips
46.00 ft	201.21 kips	35.96 kips	237.17 kips
47.00 ft	213.26 kips	35.96 kips	249.22 kips
48.00 ft	225.47 kips	35.96 kips	261.43 kips
49.00 ft	237.83 kips	35.96 kips	273.79 kips
50.00 ft	250.35 kips	35.96 kips	286.31 kips
51.00 ft	263.01 kips	35.96 kips	298.97 kips
52.00 ft	275.83 kips	35.96 kips	311.79 kips
53.00 ft	288.80 kips	35.96 kips	324.76 kips
54.00 ft	301.92 kips	35.96 kips	337.88 kips
54.99 ft	315.06 kips	35.96 kips	351.02 kips
55.01 ft	315.29 kips	2.23 kips	317.51 kips
56.00 ft	324.67 kips	2.23 kips	326.90 kips
57.00 ft	334.14 kips	2.23 kips	336.37 kips
58.00 ft	343.62 kips	2.23 kips	345.85 kips
59.00 ft	353.09 kips	2.23 kips	355.32 kips
60.00 ft	362.57 kips	2.23 kips	364.80 kips
60.99 ft	371.95 kips	2.23 kips	374.18 kips
61.01 ft	372.19 kips	35.96 kips	408.15 kips
62.00 ft	386.31 kips	35.96 kips	422.27 kips
63.00 ft	400.74 kips	35.96 kips	436.70 kips
64.00 ft	415.31 kips	35.96 kips	451.27 kips
65.00 ft	430.04 kips	35.96 kips	466.00 kips
66.00 ft	444.92 kips	35.96 kips	480.88 kips
67.00 ft	459.95 kips	35.96 kips	495.91 kips
68.00 ft	475.13 kips	35.96 kips	511.09 kips
69.00 ft	490.46 kips	35.96 kips	526.42 kips
69.59 ft	499.58 kips	35.96 kips	535.54 kips
69.61 ft	499.87 kips	3.10 kips	502.97 kips
70.60 ft	512.92 kips	3.10 kips	516.02 kips
71.60 ft	526.10 kips	3.10 kips	529.20 kips
72.60 ft	539.29 kips	3.10 kips	542.39 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.60 ft	552.47 kips	3.10 kips	555.57 kips
74.60 ft	565.65 kips	3.10 kips	568.75 kips
75.60 ft	578.84 kips	3.10 kips	581.94 kips
76.60 ft	592.02 kips	3.10 kips	595.12 kips
76.79 ft	594.53 kips	3.10 kips	597.63 kips

Bearing Capacity - Nominal



DrivenPiles - Report

General Project Information

Filename: ...nalysis\Driven Piles\Forward Abutment\FRA-70-13.01 - Forward Abutment HP 12x53-B-014-7-20.dvn
Project Name: FRA-70-13.01 Forward Abutment (B-014-7-20)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile - HP 12x53
Top of Pile: 0.00 ft
Diameter of Pile: 12.00 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling: 38.00 ft
Driving/Restrike: 38.00 ft
Nominal: 38.00 ft

Nominal Considations:

Local Scour: 0.00 ft
Long Term Scour: 0.00 ft
Soft Soil: 0.00 ft

Nominal Profile

Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesionless	13.90 ft	1.000	120.00 pcf	28.0/28.0	Nordlund
2	Cohesive	5.10 ft	1.500	120.00 pcf	2750.00 psf	T-80 Same
3	Cohesive	5.50 ft	1.500	130.00 pcf	6250.00 psf	T-80 Same
4	Cohesive	13.50 ft	2.000	130.00 pcf	5000.00 psf	T-80 Same
5	Cohesionless	7.00 ft	1.000	135.00 pcf	42.0/42.0	Nordlund
6	Cohesionless	10.00 ft	1.000	130.00 pcf	40.0/40.0	Nordlund
7	Cohesive	6.00 ft	1.500	125.00 pcf	2875.00 psf	T-80 Sand
8	Cohesionless	8.60 ft	1.000	130.00 pcf	40.0/40.0	Nordlund
9	Cohesive	7.20 ft	1.500	125.00 pcf	4000.00 psf	T-80 Sand

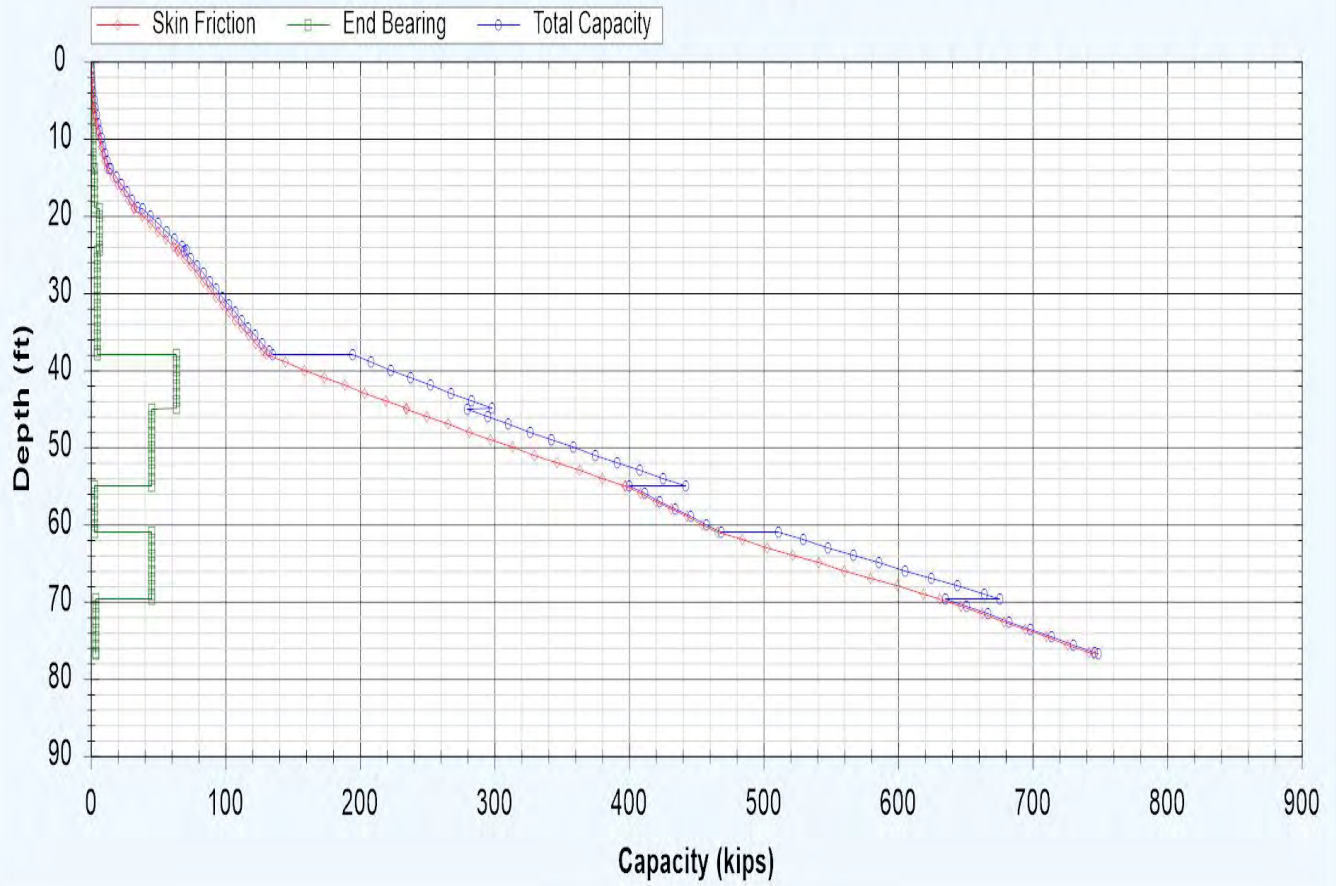
Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.06 kips	0.16 kips	0.22 kips
2.00 ft	0.25 kips	0.32 kips	0.57 kips
3.00 ft	0.57 kips	0.47 kips	1.04 kips
4.00 ft	1.00 kips	0.63 kips	1.64 kips
5.00 ft	1.57 kips	0.79 kips	2.36 kips
6.00 ft	2.26 kips	0.95 kips	3.21 kips
7.00 ft	3.08 kips	1.10 kips	4.18 kips
8.00 ft	4.02 kips	1.26 kips	5.28 kips
9.00 ft	5.09 kips	1.42 kips	6.51 kips
10.00 ft	6.28 kips	1.43 kips	7.71 kips
11.00 ft	7.60 kips	1.43 kips	9.03 kips
12.00 ft	9.04 kips	1.43 kips	10.47 kips
13.00 ft	10.61 kips	1.43 kips	12.04 kips
13.89 ft	12.11 kips	1.43 kips	13.55 kips
13.91 ft	12.17 kips	2.66 kips	14.83 kips
14.90 ft	16.07 kips	2.66 kips	18.73 kips
15.90 ft	20.00 kips	2.66 kips	22.67 kips
16.90 ft	23.94 kips	2.66 kips	26.60 kips
17.90 ft	27.87 kips	2.66 kips	30.54 kips
18.90 ft	31.81 kips	2.66 kips	34.47 kips
18.99 ft	32.17 kips	2.66 kips	34.83 kips
19.01 ft	32.26 kips	6.05 kips	38.32 kips
20.00 ft	38.10 kips	6.05 kips	44.16 kips
21.00 ft	44.01 kips	6.05 kips	50.06 kips
22.00 ft	49.91 kips	6.05 kips	55.96 kips
23.00 ft	55.81 kips	6.05 kips	61.86 kips
24.00 ft	61.71 kips	6.05 kips	67.76 kips
24.49 ft	64.60 kips	6.05 kips	70.65 kips
24.51 ft	64.70 kips	4.84 kips	69.55 kips
25.50 ft	69.38 kips	4.84 kips	74.22 kips
26.50 ft	74.10 kips	4.84 kips	78.94 kips
27.50 ft	78.82 kips	4.84 kips	83.66 kips
28.50 ft	83.54 kips	4.84 kips	88.38 kips
29.50 ft	88.26 kips	4.84 kips	93.10 kips
30.50 ft	92.98 kips	4.84 kips	97.82 kips
31.50 ft	97.70 kips	4.84 kips	102.54 kips
32.50 ft	102.42 kips	4.84 kips	107.26 kips
33.50 ft	107.14 kips	4.84 kips	111.98 kips
34.50 ft	111.86 kips	4.84 kips	116.70 kips
35.50 ft	117.02 kips	4.84 kips	121.87 kips
36.50 ft	122.27 kips	4.84 kips	127.11 kips

Depth	Skin Friction	End Bearing	Total Capacity
37.50 ft	127.59 kips	4.84 kips	132.44 kips
37.99 ft	130.23 kips	4.84 kips	135.08 kips
38.01 ft	130.43 kips	63.78 kips	194.21 kips
39.00 ft	144.52 kips	63.78 kips	208.30 kips
40.00 ft	158.97 kips	63.78 kips	222.75 kips
41.00 ft	173.63 kips	63.78 kips	237.41 kips
42.00 ft	188.51 kips	63.78 kips	252.29 kips
43.00 ft	203.61 kips	63.78 kips	267.39 kips
44.00 ft	218.92 kips	63.78 kips	282.70 kips
44.99 ft	234.29 kips	63.78 kips	298.07 kips
45.01 ft	234.60 kips	44.95 kips	279.55 kips
46.00 ft	249.85 kips	44.95 kips	294.80 kips
47.00 ft	265.44 kips	44.95 kips	310.39 kips
48.00 ft	281.23 kips	44.95 kips	326.18 kips
49.00 ft	297.22 kips	44.95 kips	342.17 kips
50.00 ft	313.41 kips	44.95 kips	358.36 kips
51.00 ft	329.79 kips	44.95 kips	374.74 kips
52.00 ft	346.37 kips	44.95 kips	391.32 kips
53.00 ft	363.15 kips	44.95 kips	408.10 kips
54.00 ft	380.12 kips	44.95 kips	425.07 kips
54.99 ft	397.12 kips	44.95 kips	442.07 kips
55.01 ft	397.40 kips	2.79 kips	400.19 kips
56.00 ft	408.69 kips	2.79 kips	411.48 kips
57.00 ft	420.10 kips	2.79 kips	422.88 kips
58.00 ft	431.50 kips	2.79 kips	434.29 kips
59.00 ft	442.91 kips	2.79 kips	445.69 kips
60.00 ft	454.31 kips	2.79 kips	457.10 kips
60.99 ft	465.60 kips	2.79 kips	468.39 kips
61.01 ft	465.90 kips	44.95 kips	510.85 kips
62.00 ft	484.17 kips	44.95 kips	529.12 kips
63.00 ft	502.83 kips	44.95 kips	547.78 kips
64.00 ft	521.68 kips	44.95 kips	566.63 kips
65.00 ft	540.73 kips	44.95 kips	585.68 kips
66.00 ft	559.98 kips	44.95 kips	604.93 kips
67.00 ft	579.42 kips	44.95 kips	624.37 kips
68.00 ft	599.06 kips	44.95 kips	644.01 kips
69.00 ft	618.89 kips	44.95 kips	663.84 kips
69.59 ft	630.69 kips	44.95 kips	675.64 kips
69.61 ft	631.05 kips	3.87 kips	634.92 kips
70.60 ft	646.76 kips	3.87 kips	650.63 kips
71.60 ft	662.62 kips	3.87 kips	666.50 kips
72.60 ft	678.49 kips	3.87 kips	682.37 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.60 ft	694.36 kips	3.87 kips	698.23 kips
74.60 ft	710.22 kips	3.87 kips	714.10 kips
75.60 ft	726.09 kips	3.87 kips	729.97 kips
76.60 ft	741.96 kips	3.87 kips	745.83 kips
76.79 ft	744.97 kips	3.87 kips	748.85 kips

Bearing Capacity - Restrike



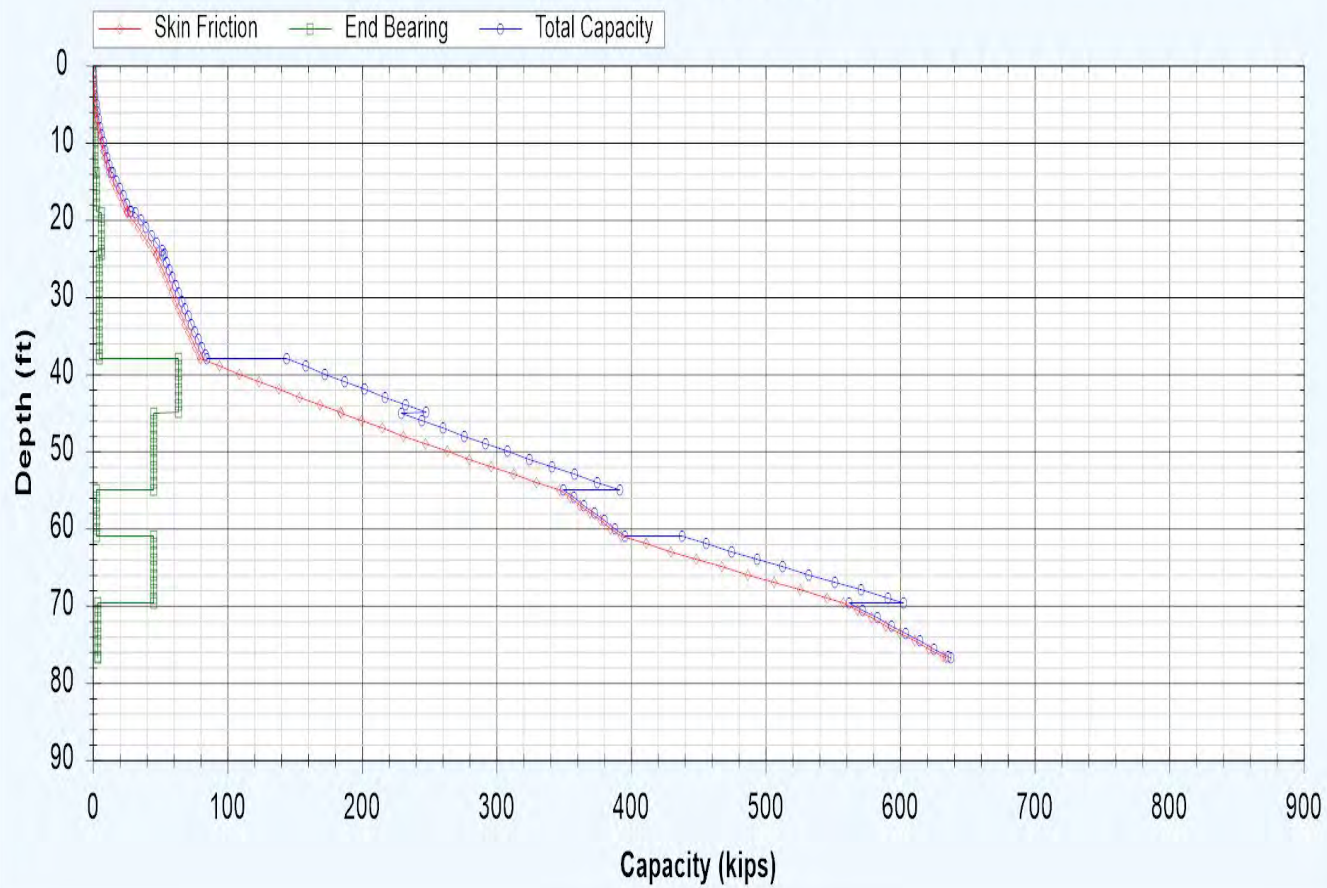
Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.06 kips	0.16 kips	0.22 kips
2.00 ft	0.25 kips	0.32 kips	0.57 kips
3.00 ft	0.57 kips	0.47 kips	1.04 kips
4.00 ft	1.00 kips	0.63 kips	1.64 kips
5.00 ft	1.57 kips	0.79 kips	2.36 kips
6.00 ft	2.26 kips	0.95 kips	3.21 kips
7.00 ft	3.08 kips	1.10 kips	4.18 kips
8.00 ft	4.02 kips	1.26 kips	5.28 kips
9.00 ft	5.09 kips	1.42 kips	6.51 kips
10.00 ft	6.28 kips	1.43 kips	7.71 kips
11.00 ft	7.60 kips	1.43 kips	9.03 kips
12.00 ft	9.04 kips	1.43 kips	10.47 kips
13.00 ft	10.61 kips	1.43 kips	12.04 kips
13.89 ft	12.11 kips	1.43 kips	13.55 kips
13.91 ft	12.16 kips	2.66 kips	14.82 kips
14.90 ft	14.75 kips	2.66 kips	17.42 kips
15.90 ft	17.38 kips	2.66 kips	20.04 kips
16.90 ft	20.00 kips	2.66 kips	22.67 kips
17.90 ft	22.63 kips	2.66 kips	25.29 kips
18.90 ft	25.25 kips	2.66 kips	27.92 kips
18.99 ft	25.49 kips	2.66 kips	28.15 kips
19.01 ft	25.55 kips	6.05 kips	31.61 kips
20.00 ft	29.45 kips	6.05 kips	35.50 kips
21.00 ft	33.38 kips	6.05 kips	39.44 kips
22.00 ft	37.32 kips	6.05 kips	43.37 kips
23.00 ft	41.25 kips	6.05 kips	47.30 kips
24.00 ft	45.18 kips	6.05 kips	51.24 kips
24.49 ft	47.11 kips	6.05 kips	53.17 kips
24.51 ft	47.17 kips	4.84 kips	52.02 kips
25.50 ft	49.51 kips	4.84 kips	54.35 kips
26.50 ft	51.87 kips	4.84 kips	56.71 kips
27.50 ft	54.23 kips	4.84 kips	59.07 kips
28.50 ft	56.59 kips	4.84 kips	61.43 kips
29.50 ft	58.95 kips	4.84 kips	63.79 kips
30.50 ft	61.31 kips	4.84 kips	66.15 kips
31.50 ft	63.67 kips	4.84 kips	68.51 kips
32.50 ft	66.03 kips	4.84 kips	70.87 kips
33.50 ft	68.39 kips	4.84 kips	73.24 kips
34.50 ft	70.75 kips	4.84 kips	75.60 kips
35.50 ft	73.33 kips	4.84 kips	78.18 kips
36.50 ft	75.96 kips	4.84 kips	80.80 kips

Depth	Skin Friction	End Bearing	Total Capacity
37.50 ft	78.62 kips	4.84 kips	83.46 kips
37.99 ft	79.94 kips	4.84 kips	84.78 kips
38.01 ft	80.11 kips	63.78 kips	143.89 kips
39.00 ft	94.20 kips	63.78 kips	157.98 kips
40.00 ft	108.65 kips	63.78 kips	172.43 kips
41.00 ft	123.31 kips	63.78 kips	187.09 kips
42.00 ft	138.19 kips	63.78 kips	201.97 kips
43.00 ft	153.29 kips	63.78 kips	217.07 kips
44.00 ft	168.60 kips	63.78 kips	232.38 kips
44.99 ft	183.97 kips	63.78 kips	247.75 kips
45.01 ft	184.28 kips	44.95 kips	229.23 kips
46.00 ft	199.52 kips	44.95 kips	244.47 kips
47.00 ft	215.12 kips	44.95 kips	260.07 kips
48.00 ft	230.91 kips	44.95 kips	275.86 kips
49.00 ft	246.90 kips	44.95 kips	291.85 kips
50.00 ft	263.09 kips	44.95 kips	308.04 kips
51.00 ft	279.47 kips	44.95 kips	324.42 kips
52.00 ft	296.05 kips	44.95 kips	341.00 kips
53.00 ft	312.83 kips	44.95 kips	357.78 kips
54.00 ft	329.80 kips	44.95 kips	374.75 kips
54.99 ft	346.79 kips	44.95 kips	391.74 kips
55.01 ft	347.04 kips	2.79 kips	349.83 kips
56.00 ft	354.57 kips	2.79 kips	357.36 kips
57.00 ft	362.17 kips	2.79 kips	364.96 kips
58.00 ft	369.78 kips	2.79 kips	372.56 kips
59.00 ft	377.38 kips	2.79 kips	380.17 kips
60.00 ft	384.98 kips	2.79 kips	387.77 kips
60.99 ft	392.51 kips	2.79 kips	395.30 kips
61.01 ft	392.77 kips	44.95 kips	437.72 kips
62.00 ft	411.05 kips	44.95 kips	456.00 kips
63.00 ft	429.70 kips	44.95 kips	474.65 kips
64.00 ft	448.55 kips	44.95 kips	493.50 kips
65.00 ft	467.60 kips	44.95 kips	512.55 kips
66.00 ft	486.85 kips	44.95 kips	531.80 kips
67.00 ft	506.29 kips	44.95 kips	551.24 kips
68.00 ft	525.93 kips	44.95 kips	570.88 kips
69.00 ft	545.77 kips	44.95 kips	590.72 kips
69.59 ft	557.56 kips	44.95 kips	602.51 kips
69.61 ft	557.87 kips	3.87 kips	561.74 kips
70.60 ft	568.34 kips	3.87 kips	572.22 kips
71.60 ft	578.92 kips	3.87 kips	582.79 kips
72.60 ft	589.50 kips	3.87 kips	593.37 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.60 ft	600.08 kips	3.87 kips	603.95 kips
74.60 ft	610.65 kips	3.87 kips	614.53 kips
75.60 ft	621.23 kips	3.87 kips	625.11 kips
76.60 ft	631.81 kips	3.87 kips	635.69 kips
76.79 ft	633.82 kips	3.87 kips	637.70 kips

Bearing Capacity - Driving



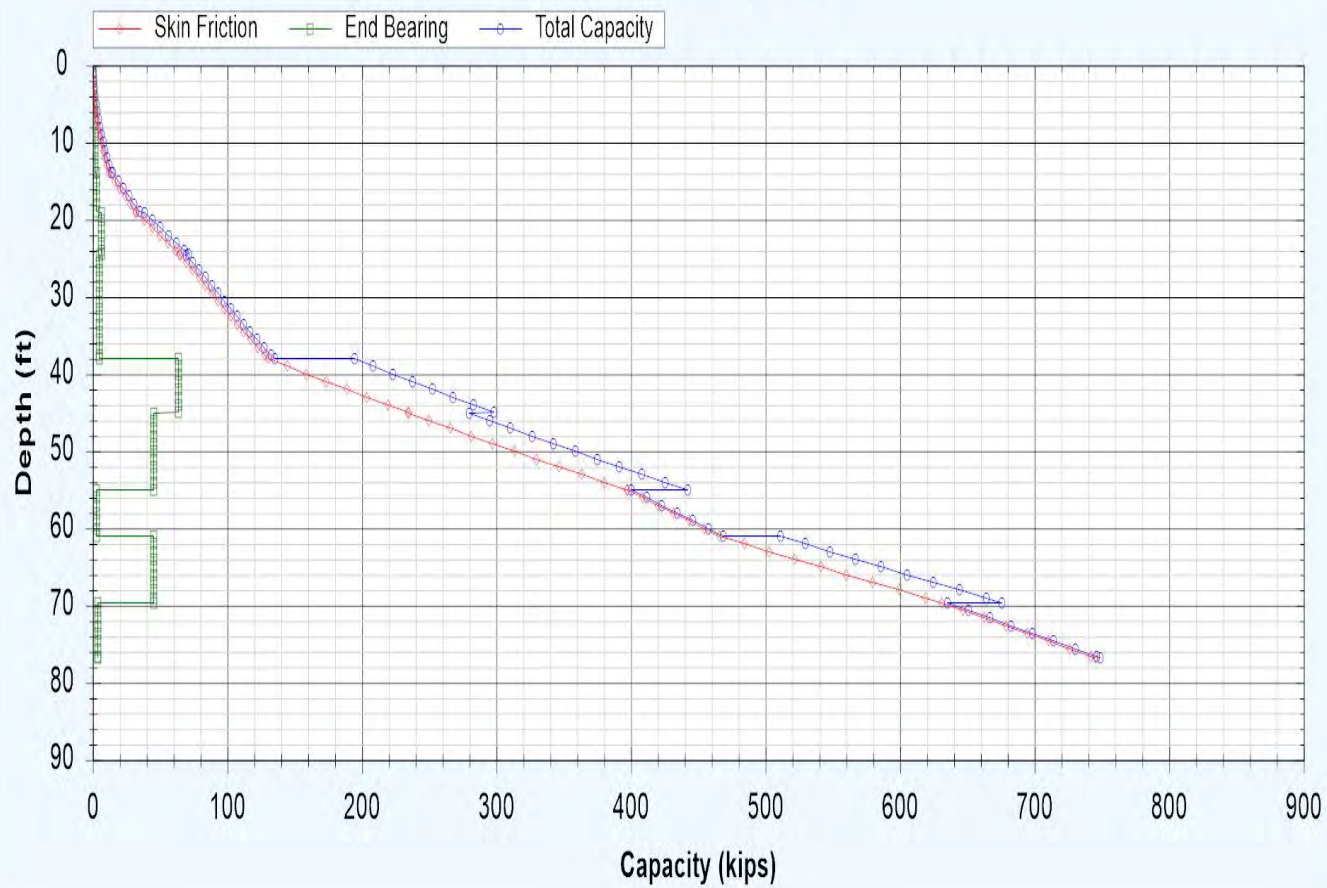
Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.06 kips	0.16 kips	0.22 kips
2.00 ft	0.25 kips	0.32 kips	0.57 kips
3.00 ft	0.57 kips	0.47 kips	1.04 kips
4.00 ft	1.00 kips	0.63 kips	1.64 kips
5.00 ft	1.57 kips	0.79 kips	2.36 kips
6.00 ft	2.26 kips	0.95 kips	3.21 kips
7.00 ft	3.08 kips	1.10 kips	4.18 kips
8.00 ft	4.02 kips	1.26 kips	5.28 kips
9.00 ft	5.09 kips	1.42 kips	6.51 kips
10.00 ft	6.28 kips	1.43 kips	7.71 kips
11.00 ft	7.60 kips	1.43 kips	9.03 kips
12.00 ft	9.04 kips	1.43 kips	10.47 kips
13.00 ft	10.61 kips	1.43 kips	12.04 kips
13.89 ft	12.11 kips	1.43 kips	13.55 kips
13.91 ft	12.17 kips	2.66 kips	14.83 kips
14.90 ft	16.07 kips	2.66 kips	18.73 kips
15.90 ft	20.00 kips	2.66 kips	22.67 kips
16.90 ft	23.94 kips	2.66 kips	26.60 kips
17.90 ft	27.87 kips	2.66 kips	30.54 kips
18.90 ft	31.81 kips	2.66 kips	34.47 kips
18.99 ft	32.17 kips	2.66 kips	34.83 kips
19.01 ft	32.26 kips	6.05 kips	38.32 kips
20.00 ft	38.10 kips	6.05 kips	44.16 kips
21.00 ft	44.01 kips	6.05 kips	50.06 kips
22.00 ft	49.91 kips	6.05 kips	55.96 kips
23.00 ft	55.81 kips	6.05 kips	61.86 kips
24.00 ft	61.71 kips	6.05 kips	67.76 kips
24.49 ft	64.60 kips	6.05 kips	70.65 kips
24.51 ft	64.70 kips	4.84 kips	69.55 kips
25.50 ft	69.38 kips	4.84 kips	74.22 kips
26.50 ft	74.10 kips	4.84 kips	78.94 kips
27.50 ft	78.82 kips	4.84 kips	83.66 kips
28.50 ft	83.54 kips	4.84 kips	88.38 kips
29.50 ft	88.26 kips	4.84 kips	93.10 kips
30.50 ft	92.98 kips	4.84 kips	97.82 kips
31.50 ft	97.70 kips	4.84 kips	102.54 kips
32.50 ft	102.42 kips	4.84 kips	107.26 kips
33.50 ft	107.14 kips	4.84 kips	111.98 kips
34.50 ft	111.86 kips	4.84 kips	116.70 kips
35.50 ft	117.02 kips	4.84 kips	121.87 kips
36.50 ft	122.27 kips	4.84 kips	127.11 kips

Depth	Skin Friction	End Bearing	Total Capacity
37.50 ft	127.59 kips	4.84 kips	132.44 kips
37.99 ft	130.23 kips	4.84 kips	135.08 kips
38.01 ft	130.43 kips	63.78 kips	194.21 kips
39.00 ft	144.52 kips	63.78 kips	208.30 kips
40.00 ft	158.97 kips	63.78 kips	222.75 kips
41.00 ft	173.63 kips	63.78 kips	237.41 kips
42.00 ft	188.51 kips	63.78 kips	252.29 kips
43.00 ft	203.61 kips	63.78 kips	267.39 kips
44.00 ft	218.92 kips	63.78 kips	282.70 kips
44.99 ft	234.29 kips	63.78 kips	298.07 kips
45.01 ft	234.60 kips	44.95 kips	279.55 kips
46.00 ft	249.85 kips	44.95 kips	294.80 kips
47.00 ft	265.44 kips	44.95 kips	310.39 kips
48.00 ft	281.23 kips	44.95 kips	326.18 kips
49.00 ft	297.22 kips	44.95 kips	342.17 kips
50.00 ft	313.41 kips	44.95 kips	358.36 kips
51.00 ft	329.79 kips	44.95 kips	374.74 kips
52.00 ft	346.37 kips	44.95 kips	391.32 kips
53.00 ft	363.15 kips	44.95 kips	408.10 kips
54.00 ft	380.12 kips	44.95 kips	425.07 kips
54.99 ft	397.12 kips	44.95 kips	442.07 kips
55.01 ft	397.40 kips	2.79 kips	400.19 kips
56.00 ft	408.69 kips	2.79 kips	411.48 kips
57.00 ft	420.10 kips	2.79 kips	422.88 kips
58.00 ft	431.50 kips	2.79 kips	434.29 kips
59.00 ft	442.91 kips	2.79 kips	445.69 kips
60.00 ft	454.31 kips	2.79 kips	457.10 kips
60.99 ft	465.60 kips	2.79 kips	468.39 kips
61.01 ft	465.90 kips	44.95 kips	510.85 kips
62.00 ft	484.17 kips	44.95 kips	529.12 kips
63.00 ft	502.83 kips	44.95 kips	547.78 kips
64.00 ft	521.68 kips	44.95 kips	566.63 kips
65.00 ft	540.73 kips	44.95 kips	585.68 kips
66.00 ft	559.98 kips	44.95 kips	604.93 kips
67.00 ft	579.42 kips	44.95 kips	624.37 kips
68.00 ft	599.06 kips	44.95 kips	644.01 kips
69.00 ft	618.89 kips	44.95 kips	663.84 kips
69.59 ft	630.69 kips	44.95 kips	675.64 kips
69.61 ft	631.05 kips	3.87 kips	634.92 kips
70.60 ft	646.76 kips	3.87 kips	650.63 kips
71.60 ft	662.62 kips	3.87 kips	666.50 kips
72.60 ft	678.49 kips	3.87 kips	682.37 kips

Depth	Skin Friction	End Bearing	Total Capacity
73.60 ft	694.36 kips	3.87 kips	698.23 kips
74.60 ft	710.22 kips	3.87 kips	714.10 kips
75.60 ft	726.09 kips	3.87 kips	729.97 kips
76.60 ft	741.96 kips	3.87 kips	745.83 kips
76.79 ft	744.97 kips	3.87 kips	748.85 kips

Bearing Capacity - Nominal

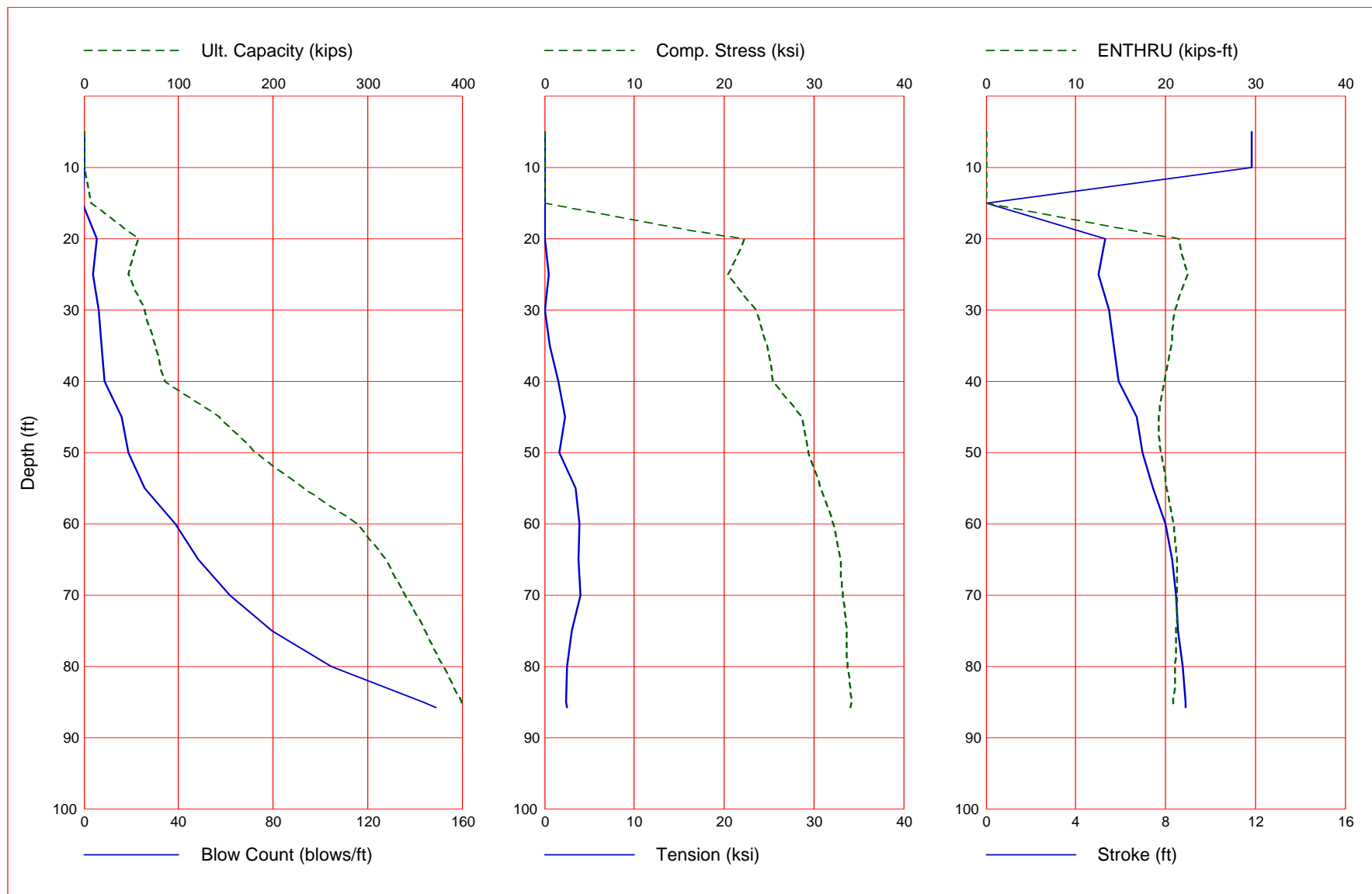


APPENDIX VIII

GRLWEAP DRIVEABILITY ANALYSIS OUTPUTS

**Rear Abutment
(B-015-1-13)**

Gain/Loss 3 at Shaft and Toe 0.571 / 1.000



Gain/Loss 3 at Shaft and Toe 0.571 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	0.1	0.0	0.1	0.0	0.000	0.000	11.86	0.0
10.0	0.2	0.0	0.2	0.0	0.000	0.000	11.86	0.0
15.0	7.2	4.8	2.4	-1.0	0.000	0.000	0.00	0.0
20.0	57.6	18.6	39.0	5.4	22.207	0.000	5.33	21.5
25.0	47.0	45.2	1.8	3.9	20.416	-0.440	5.02	22.5
30.0	64.5	62.3	2.2	6.2	23.556	0.000	5.49	21.1
35.0	75.0	72.8	2.2	7.3	24.808	-0.557	5.71	20.6
40.0	85.9	83.6	2.2	8.7	25.487	-1.582	5.89	19.9
45.0	143.7	114.7	28.9	15.8	28.587	-2.274	6.73	19.3
50.0	181.7	168.8	12.9	18.8	29.343	-1.691	6.99	19.5
55.0	232.9	220.0	12.9	25.7	30.774	-3.486	7.45	20.1
60.0	289.1	276.1	12.9	38.8	32.184	-3.840	8.01	21.0
65.0	319.5	318.1	1.4	48.3	33.038	-3.823	8.29	21.3
70.0	340.1	338.6	1.4	61.8	33.263	-3.967	8.47	21.3
75.0	360.6	359.1	1.4	79.4	33.607	-3.065	8.57	21.2
80.0	380.6	379.2	1.4	104.9	33.744	-2.511	8.76	21.1
85.0	399.7	398.2	1.4	143.6	34.168	-2.347	8.90	20.8
85.8	402.5	401.1	1.4	148.9	34.071	-2.458	8.90	20.8

Total Continuous Driving Time 63.00 minutes; Total Number of Blows 2599 (starting at penetration 5.0 ft)

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.
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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: J:\GEOTECH\PROJECTS\2020\W-20-025 FRA-70-13.01\ANALYSIS\DRIVEABILITY\REAR ABUTMENT\FRA-70-13.01 - REAR ABUTMENT HP
10X42-B-015-1-13-CASE-1.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1

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	12.300	10.000	Unknown															
W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp													
1.900	227.000	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												
85.790	12.40	29000.0	492.000	3.300	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	0.10	0.05	0.15	1.00	6.00	24.000
3.00	0.00	0.05	0.10	0.10	0.05	0.15	1.00	6.00	24.000
6.00	0.00	0.11	0.10	0.10	0.05	0.15	1.00	6.00	24.000
9.00	0.00	0.16	0.10	0.10	0.05	0.15	1.00	6.00	24.000
12.00	0.00	0.22	0.10	0.10	0.05	0.15	1.00	6.00	24.000
12.49	0.00	0.22	0.10	0.10	0.05	0.15	1.00	6.00	24.000
12.51	0.88	2.40	0.10	0.10	0.15	0.15	1.50	6.00	336.000
18.79	0.88	2.40	0.10	0.10	0.15	0.15	1.50	6.00	336.000
18.81	1.57	36.41	0.10	0.10	0.05	0.15	1.00	6.00	24.000
21.80	1.85	42.93	0.10	0.10	0.05	0.15	1.00	6.00	24.000
22.79	1.95	45.08	0.10	0.10	0.05	0.15	1.00	6.00	24.000
22.81	2.38	1.83	0.10	0.10	0.20	0.15	1.75	6.00	720.000
27.79	2.38	1.83	0.10	0.10	0.20	0.15	1.75	6.00	720.000
27.81	0.95	2.21	0.10	0.10	0.15	0.15	1.50	6.00	336.000
36.80	0.96	2.21	0.10	0.10	0.15	0.15	1.50	6.00	336.000
39.80	1.03	2.21	0.10	0.10	0.15	0.15	1.50	6.00	336.000
42.79	1.11	2.21	0.10	0.10	0.15	0.15	1.50	6.00	336.000
42.81	3.28	28.93	0.10	0.10	0.05	0.15	1.00	6.00	24.000
45.80	3.54	28.93	0.10	0.10	0.05	0.15	1.00	6.00	24.000
47.79	3.71	28.93	0.10	0.10	0.05	0.15	1.00	6.00	24.000
47.81	2.81	12.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
50.80	3.00	12.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
53.80	3.18	12.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
56.80	3.37	12.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
57.99	3.44	12.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
58.01	3.45	12.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
61.00	3.54	12.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
62.79	3.60	12.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
62.81	1.88	1.44	0.10	0.10	0.15	0.15	1.50	6.00	336.000
71.80	1.87	1.44	0.10	0.10	0.15	0.15	1.50	6.00	336.000
74.80	1.85	1.44	0.10	0.10	0.15	0.15	1.50	6.00	336.000
77.80	1.83	1.44	0.10	0.10	0.15	0.15	1.50	6.00	336.000
80.80	1.78	1.44	0.10	0.10	0.15	0.15	1.50	6.00	336.000
83.80	1.70	1.44	0.10	0.10	0.15	0.15	1.50	6.00	336.000
85.79	1.64	1.44	0.10	0.10	0.15	0.15	1.50	6.00	336.000

Gain/Loss factors: shaft and toe

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
5.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
10.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
15.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
20.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
25.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
30.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
35.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
40.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
45.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
50.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
55.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
60.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
65.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
70.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
75.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
80.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
85.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
85.79	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

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1

Hammer Model:	D 19-42	Made by:	DELMAG
No.	Weight kips	Stiffn k/inch	CoR C-Slk ft 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	1.900	60155.0	0.800 0.0100
Combined Pile Top		9081.9	5.8

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)	227.00	Cross Sect. Area (in2)
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus (ksi)
Thickness	(inch)	2.00	Thickness (inch)
Coeff of Restitution		0.8	Coeff of Restitution
RoundOut	(ft)	0.0	RoundOut (ft)
Stiffness	(kips/in)	60155.0	Stiffness (kips/in)



FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1 10/24/2021
Resource International Inc GRLWEAP Version 2010

Depth	(ft)	5.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor

PILE PROFILE:

Toe Area	(in2)	12.300	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)				0.1	
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	85.79	3.3	12.4
Toe						0.1	0.150	0.100			

3.635 kips total unreduced pile weight (g= 32.17 ft/s2)
3.635 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)	0.435

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
5.00	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.3 0.1
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.3 0.1
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.3 0.1
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.3 0.1
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.3 0.1
 Hammer+Pile Weight > Rult: Pile Runs

↑
 FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
0.1	0.0	10.81	0.00	0.00	1	0	0.00	1	0	0.0	78.4
0.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4
0.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4
0.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4
0.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4

↑
 FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 10.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

No.	Weight kips	Pile and Soil Model Stiffn C-Slk T-Slk k/in ft ft	CoR	Soil-S kips	Total Capacity Soil-D Quake s/ft inch	Rut (kips) LbTop Perim ft ft	0.2 Area in2
1	0.140	9082 0.010 0.000 0.85	0.0	0.000 0.100	3.30 3.3	12.4	
2	0.140	9082 0.000 0.000 1.00	0.0	0.000 0.100	6.60 3.3	12.4	
23	0.140	9082 0.000 0.000 1.00	0.0	0.050 0.100	75.89 3.3	12.4	
26	0.140	9082 0.000 0.000 1.00	0.0	0.050 0.100	85.79 3.3	12.4	
Toe				0.2 0.150 0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
10.00	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.3 0.2
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.3 0.2
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.3 0.2
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.3 0.2
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.3 0.2
 Hammer+Pile Weight > Rult: Pile Runs

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
0.2	0.0	10.81	0.00	0.00	1	0	0.00	1	0	0.0
0.2	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0
0.2	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0
0.2	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0
0.2	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0

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Depth ft	(ft)	15.0	Standard Soil Setup
Shaft Gain/Loss Factor	0.486	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area in2	12.300	Pile Type	Unknown
Pile Size inch	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

No.	Weight kips	Pile and Soil Model Stiffn C-Slk T-Slk k/in ft ft	CoR	Soil-S kips	Soil-D Quake s/ft inch	Rut (kips) LbTop Perim ft ft	Area in2
1	0.140	9082 0.010 0.000 0.85	0.0	0.000 0.100	3.30 3.3	12.4	
2	0.140	9082 0.000 0.000 1.00	0.0	0.000 0.100	6.60 3.3	12.4	
22	0.140	9082 0.000 0.000 1.00	0.0	0.050 0.100	72.59 3.3	12.4	
26	0.140	9082 0.000 0.000 1.00	4.3	0.150 0.100	85.79 3.3	12.4	
Toe				2.4	0.150 0.100		

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
15.00	10.81	1.00	0.800

▲
 FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1 10/24/2021
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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
6.7	Hammer did not run									
7.0	Hammer did not run									
7.2	Hammer did not run									
7.5	Hammer did not run									
7.7	Hammer did not run									

▲
 FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1 10/24/2021

Depth (ft) 20.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)				56.4	
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	65.99	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	1.6	0.149	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	10.1	0.099	0.100	85.79	3.3	12.4
Toe						39.0	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
20.00	10.81	1.00	0.800



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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
56.4	5.2	5.31	5.28	0.00	1	0	22.07	22	6 21.6
57.0	5.3	5.32	5.29	0.00	1	0	22.15	22	6 21.6
57.6	5.4	5.33	5.31	0.00	1	0	22.21	22	6 21.5
58.2	5.4	5.35	5.32	0.00	1	0	22.32	22	6 21.5
58.8	5.5	5.36	5.33	0.00	1	0	22.37	22	6 21.5



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Depth (ft) 25.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)				44.4	
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	62.69	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	4.5	0.150	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	17.0	0.057	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	15.3	0.157	0.100	85.79	3.3	12.4
Toe						1.8	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
25.00	10.81	1.00	0.800

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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
44.4	3.6	4.94	4.91	-0.61	2	12	19.95	16	5	22.8
45.7	3.7	4.98	4.94	-0.52	2	12	20.19	17	5	22.7
47.0	3.9	5.02	4.98	-0.44	3	15	20.42	18	5	22.5
48.4	4.0	5.06	5.02	-0.44	3	15	20.67	18	5	22.4
49.7	4.1	5.09	5.05	-0.43	3	15	20.87	19	6	22.3

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Depth	(ft)	30.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:
 Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

No.	Weight	Pile and Soil Model	Total Capacity	Rut	(kips)	59.5
	kips	Stiffn C-Slk T-Slk CoR	Soil-S	Soil-D Quake	LbTop	Perim Area
		k/in ft ft	kips	s/ft inch	ft	ft in2
1	0.140	9082 0.010 0.000 0.85	0.0	0.000 0.100	3.30	3.3 12.4
2	0.140	9082 0.000 0.000 1.00	0.0	0.000 0.100	6.60	3.3 12.4
17	0.140	9082 0.000 0.000 1.00	0.0	0.050 0.100	56.09	3.3 12.4
21	0.140	9082 0.000 0.000 1.00	1.7	0.150 0.100	69.29	3.3 12.4
22	0.140	9082 0.000 0.000 1.00	5.7	0.150 0.100	72.59	3.3 12.4
23	0.140	9082 0.000 0.000 1.00	10.5	0.095 0.100	75.89	3.3 12.4
24	0.140	9082 0.000 0.000 1.00	18.5	0.084 0.100	79.19	3.3 12.4
25	0.140	9082 0.000 0.000 1.00	12.6	0.200 0.100	82.49	3.3 12.4
26	0.140	9082 0.000 0.000 1.00	8.3	0.178 0.100	85.79	3.3 12.4
Toe			2.2	0.150 0.100		

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
30.00	10.81	1.00	0.800

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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
59.5	5.5	5.37	5.34	-0.10	4	14	22.89	22	6	21.4
62.0	5.8	5.43	5.40	0.00	1	0	23.20	22	6	21.2
64.5	6.2	5.49	5.46	0.00	1	0	23.56	22	6	21.1
67.1	6.5	5.54	5.52	0.00	1	0	23.85	22	6	21.0
69.6	6.8	5.59	5.58	0.00	1	0	24.12	22	6	20.8

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Depth	(ft)	35.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:
 Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)			69.0		
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	52.79	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	4.7	0.150	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	17.5	0.055	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	15.0	0.161	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	11.4	0.196	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	85.79	3.3	12.4
Toe						2.2	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
35.00	10.81	1.00	0.800

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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	
69.0	6.7	5.58	5.57	-0.54	25 18	24.16	20 6	20.8
72.0	7.0	5.64	5.63	-0.56	25 18	24.47	20 6	20.7
75.0	7.3	5.71	5.69	-0.56	25 18	24.81	20 6	20.6
78.1	7.8	5.71	5.77	-0.82	21 50	24.91	20 6	20.2
81.1	8.1	5.78	5.83	-1.25	20 50	25.20	20 6	20.1

▲

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1
Resource International Inc

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Depth	(ft)	40.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	12.300	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)			78.7		
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
14	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	46.19	3.3	12.4
18	0.140	9082	0.000	0.000	1.00	1.9	0.150	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	10.9	0.092	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	18.3	0.089	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	12.6	0.200	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	8.1	0.176	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	6.3	0.150	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	6.5	0.150	0.100	85.79	3.3	12.4
Toe						2.2	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
40.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	i ksi	t 23	Comp Str ksi	i 18	t 19	ENTHRU kip-ft	Bl Rt b/min
78.7	7.8	5.74	5.79	-1.22	23	24.81	19	6	20.1	49.1
82.3	8.2	5.81	5.86	-1.23	23	25.14	19	6	20.0	48.8
85.9	8.7	5.89	5.93	-1.58	8	25.49	19	6	19.9	48.4
89.4	9.2	5.96	6.00	-1.88	7	25.80	19	6	19.8	48.1
93.0	9.7	6.04	6.07	-1.95	18	26.12	19	6	19.8	47.8

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth	(ft)	45.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:
 Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

No.	Weight kips	Pile and Soil Model Stiffn C-Slk T-Slk k/in ft ft	CoR	Total Capacity Soil-S kips	Rut (kips) Soil-D Quake s/ft inch	LbTop ft	Perim ft	Area in2
1	0.140	9082 0.010 0.000 0.85	0.0	0.000 0.100	3.30	3.3	12.4	
2	0.140	9082 0.000 0.000 1.00	0.0	0.000 0.100	6.60	3.3	12.4	
13	0.140	9082 0.000 0.000 1.00	0.0	0.050 0.100	42.89	3.3	12.4	
17	0.140	9082 0.000 0.000 1.00	4.9	0.150 0.100	56.09	3.3	12.4	
18	0.140	9082 0.000 0.000 1.00	5.7	0.150 0.100	59.39	3.3	12.4	
19	0.140	9082 0.000 0.000 1.00	17.9	0.053 0.100	62.69	3.3	12.4	
20	0.140	9082 0.000 0.000 1.00	14.8	0.165 0.100	65.99	3.3	12.4	
21	0.140	9082 0.000 0.000 1.00	11.2	0.195 0.100	69.29	3.3	12.4	
22	0.140	9082 0.000 0.000 1.00	6.2	0.150 0.100	72.59	3.3	12.4	
23	0.140	9082 0.000 0.000 1.00	6.2	0.150 0.100	75.89	3.3	12.4	
24	0.140	9082 0.000 0.000 1.00	6.3	0.150 0.100	79.19	3.3	12.4	
25	0.140	9082 0.000 0.000 1.00	6.8	0.150 0.100	82.49	3.3	12.4	
26	0.140	9082 0.000 0.000 1.00	26.9	0.064 0.100	85.79	3.3	12.4	
Toe			28.9	0.150 0.100				

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
45.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	i ksi	t 38	Comp Str ksi	i 17	t 5	ENTHRU kip-ft	Bl Rt b/min
135.9	14.9	6.59	6.60	-2.61	17	28.05	17	5	19.3	45.8
139.7	15.3	6.69	6.63	-2.48	17	28.38	17	5	19.4	45.6
143.7	15.8	6.73	6.68	-2.27	17	28.59	17	5	19.3	45.5
147.6	16.3	6.76	6.72	-2.03	16	28.76	17	5	19.4	45.4
151.5	16.8	6.81	6.77	-1.83	13	28.97	17	5	19.3	45.2

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth	(ft)	50.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)			174.0		
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
11	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	36.30	3.3	12.4
15	0.140	9082	0.000	0.000	1.00	2.1	0.150	0.100	49.49	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	11.3	0.089	0.100	56.09	3.3	12.4
18	0.140	9082	0.000	0.000	1.00	18.1	0.094	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	12.6	0.200	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	7.9	0.174	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	6.3	0.150	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	6.5	0.150	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	12.3	0.110	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	37.8	0.050	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	34.2	0.050	0.100	85.79	3.3	12.4
Toe						12.9	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
50.00	10.81	1.00	0.800



FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1 10/24/2021
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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
174.0	17.8	6.90	6.85	-1.99	9	36	28.97	16	5	19.3
177.8	18.3	6.94	6.89	-1.85	15	34	29.15	16	5	19.4
181.7	18.8	6.99	6.94	-1.69	16	34	29.34	16	5	19.5
185.7	19.4	7.04	6.99	-1.89	14	30	29.54	16	5	19.6
189.6	20.0	7.09	7.05	-2.12	15	30	29.73	16	5	19.6



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Depth	(ft)	55.0	Standard Soil Setup
Shaft Gain/Loss Factor	0.486	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)			225.2		
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
10	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	33.00	3.3	12.4
14	0.140	9082	0.000	0.000	1.00	5.1	0.150	0.100	46.19	3.3	12.4
15	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	49.49	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	18.4	0.052	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	14.6	0.169	0.100	56.09	3.3	12.4

18	0.140	9082	0.000	0.000	1.00	11.0	0.194	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	6.3	0.150	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	6.8	0.150	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	27.8	0.062	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	37.6	0.050	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	32.1	0.050	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	34.4	0.050	0.100	85.79	3.3	12.4
Toe						12.9	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
55.00	10.81	1.00	0.800

↑
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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	i ksi	t ksi	Comp Str ksi	i ksi	t kip-ft	ENTHRU kip-ft	Bl Rt b/min
225.2	24.1	7.33	7.31	-3.37	14	28	30.33	14	4	19.9
229.0	24.8	7.39	7.34	-3.45	14	28	30.55	14	5	20.1
232.9	25.7	7.45	7.40	-3.49	14	28	30.77	14	4	20.1
236.9	26.4	7.50	7.46	-3.42	14	28	31.01	14	5	20.2
240.8	27.3	7.56	7.51	-3.31	14	28	31.22	14	5	20.3

↑
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Depth	(ft)	60.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in ²)	12.300	Pile Type	Unknown
Pile Size	(inch)	10.000		

L b Top ft	Area in ²	E-Mod ksi	Spec Wt lb/ft ³	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model										Total Capacity Rut (kips)	281.3
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 in ²
1	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
8	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	26.40	3.3	12.4
12	0.140	9082	0.000	0.000	1.00	2.3	0.150	0.100	39.60	3.3	12.4
13	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	42.89	3.3	12.4
14	0.140	9082	0.000	0.000	1.00	11.7	0.086	0.100	46.19	3.3	12.4
15	0.140	9082	0.000	0.000	1.00	17.9	0.099	0.100	49.49	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	12.6	0.200	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	7.7	0.172	0.100	56.09	3.3	12.4
18	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	6.3	0.150	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	6.6	0.150	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	13.2	0.105	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	37.9	0.050	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	34.0	0.050	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	33.3	0.050	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	35.5	0.050	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	37.6	0.050	0.100	85.79	3.3	12.4
Toe						12.9	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
60.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke down	(ft) up	Ten ksi	Str	i	t	Comp	Str	i	t	ENTHRU kip-ft	Bl Rt b/min
281.3	35.9	7.91	7.88	-3.46	12	25		31.86	13	4		20.9	41.9
285.2	37.3	7.97	7.94	-3.64	12	25		32.04	13	4		20.9	41.8
289.1	38.8	8.01	7.99	-3.84	12	25		32.18	13	4		21.0	41.7
293.0	40.1	8.07	8.04	-4.01	12	25		32.40	13	4		21.1	41.5
296.9	41.7	8.12	8.09	-4.16	12	25		32.56	13	4		21.2	41.4

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Depth (ft) 65.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)			310.8		
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
7	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	23.10	3.3	12.4
11	0.140	9082	0.000	0.000	1.00	5.2	0.150	0.100	36.30	3.3	12.4
12	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	39.60	3.3	12.4
13	0.140	9082	0.000	0.000	1.00	18.8	0.050	0.100	42.89	3.3	12.4
14	0.140	9082	0.000	0.000	1.00	14.3	0.173	0.100	46.19	3.3	12.4
15	0.140	9082	0.000	0.000	1.00	10.8	0.193	0.100	49.49	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	56.09	3.3	12.4
18	0.140	9082	0.000	0.000	1.00	6.4	0.150	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	6.8	0.150	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	28.8	0.061	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	37.4	0.050	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	32.2	0.050	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	34.4	0.050	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	36.7	0.050	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	38.2	0.050	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	21.2	0.101	0.100	85.79	3.3	12.4
Toe						1.4	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
65.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke down	(ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
310.8	44.4	8.18	8.15	-3.62	11	24	32.61	11	4	21.1	41.3
315.1	46.5	8.23	8.21	-3.67	9	23	32.82	11	4	21.2	41.1
319.5	48.3	8.29	8.26	-3.82	9	23	33.04	11	4	21.3	41.0
323.9	51.1	8.34	8.32	-3.92	10	23	33.21	11	4	21.3	40.9
328.3	53.8	8.39	8.37	-4.02	10	23	33.41	11	4	21.4	40.7

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Depth (ft) 70.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.300 Pile Type Unknown
Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)				329.4	
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
5	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	16.50	3.3	12.4
9	0.140	9082	0.000	0.000	1.00	2.4	0.150	0.100	29.70	3.3	12.4
10	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	33.00	3.3	12.4
11	0.140	9082	0.000	0.000	1.00	12.1	0.083	0.100	36.30	3.3	12.4
12	0.140	9082	0.000	0.000	1.00	17.7	0.104	0.100	39.60	3.3	12.4
13	0.140	9082	0.000	0.000	1.00	12.6	0.200	0.100	42.89	3.3	12.4
14	0.140	9082	0.000	0.000	1.00	7.5	0.170	0.100	46.19	3.3	12.4
15	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	49.49	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	6.3	0.150	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	6.6	0.150	0.100	56.09	3.3	12.4
18	0.140	9082	0.000	0.000	1.00	14.1	0.100	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	38.0	0.050	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	33.7	0.050	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	33.4	0.050	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	35.6	0.050	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	37.6	0.050	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	33.9	0.061	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	85.79	3.3	12.4
Toe						1.4	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
70.00	10.81	1.00	0.800



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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
329.4	54.2	8.36	8.35	-3.98	9	23	32.90	10	4 21.1 40.8
334.7	58.0	8.42	8.42	-3.96	9	22	33.09	10	4 21.2 40.7
340.1	61.8	8.47	8.47	-3.97	9	22	33.26	10	4 21.3 40.5
345.5	65.7	8.53	8.52	-4.03	10	22	33.45	10	4 21.4 40.4
350.9	70.7	8.59	8.58	-4.08	10	22	33.64	10	4 21.5 40.3



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Depth	(ft)	75.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area (in2) 12.300 Pile Type Unknown
Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)				347.8	
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
4	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	13.20	3.3	12.4
8	0.140	9082	0.000	0.000	1.00	5.4	0.150	0.100	26.40	3.3	12.4
9	0.140	9082	0.000	0.000	1.00	6.1	0.144	0.100	29.70	3.3	12.4
10	0.140	9082	0.000	0.000	1.00	18.9	0.050	0.100	33.00	3.3	12.4
11	0.140	9082	0.000	0.000	1.00	14.1	0.177	0.100	36.30	3.3	12.4
12	0.140	9082	0.000	0.000	1.00	10.6	0.193	0.100	39.60	3.3	12.4
13	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	42.89	3.3	12.4
14	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	46.19	3.3	12.4
15	0.140	9082	0.000	0.000	1.00	6.4	0.150	0.100	49.49	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	6.8	0.150	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	29.7	0.059	0.100	56.09	3.3	12.4
18	0.140	9082	0.000	0.000	1.00	37.2	0.050	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	32.3	0.050	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	34.5	0.050	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	36.7	0.050	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	38.3	0.050	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	20.3	0.105	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	85.79	3.3	12.4
Toe						1.4	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
75.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min	
347.8	66.8	8.52	8.52	-3.23	10	22	33.34	8	3	21.0	40.4
354.1	72.9	8.50	8.57	-3.17	10	22	33.36	8	3	21.0	40.4
360.6	79.4	8.57	8.63	-3.06	10	22	33.61	8	3	21.2	40.2
367.0	88.2	8.64	8.71	-2.93	10	22	33.85	8	3	21.2	40.1
373.5	96.4	8.71	8.76	-2.86	8	20	34.06	8	3	21.4	39.9

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 Resource International Inc

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Depth	(ft)	80.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in ²)	12.300	Pile Type	Unknown
Pile Size	(inch)	10.000		

L b Top ft	Area in ²	E-Mod ksi	Spec Wt lb/ft ³	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

No.	Weight kips	Pile and Soil Model Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Total Soil-S kips	Capacity Soil-D s/ft	Rut Quake inch	(kips) LbTop ft	Perim ft	Area in ²
1	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	6.60	3.3	12.4
6	0.140	9082	0.000	0.000	1.00	2.6	0.150	0.100	19.80	3.3	12.4
7	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	23.10	3.3	12.4
8	0.140	9082	0.000	0.000	1.00	12.5	0.081	0.100	26.40	3.3	12.4
9	0.140	9082	0.000	0.000	1.00	17.6	0.109	0.100	29.70	3.3	12.4
10	0.140	9082	0.000	0.000	1.00	12.6	0.200	0.100	33.00	3.3	12.4
11	0.140	9082	0.000	0.000	1.00	7.3	0.168	0.100	36.30	3.3	12.4
12	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	39.60	3.3	12.4
13	0.140	9082	0.000	0.000	1.00	6.3	0.150	0.100	42.89	3.3	12.4
14	0.140	9082	0.000	0.000	1.00	6.6	0.150	0.100	46.19	3.3	12.4
15	0.140	9082	0.000	0.000	1.00	15.0	0.096	0.100	49.49	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	38.1	0.050	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	33.5	0.050	0.100	56.09	3.3	12.4

18	0.140	9082	0.000	0.000	1.00	33.4	0.050	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	35.7	0.050	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	37.7	0.050	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	33.1	0.063	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	12.1	0.150	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	11.9	0.150	0.100	85.79	3.3	12.4
Toe						1.4	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
80.00	10.81	1.00	0.800

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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
365.9	85.0	8.62	8.69	-2.78	6	23	33.31	7	3	20.8
373.2	93.8	8.69	8.74	-2.63	6	23	33.52	7	3	20.9
380.6	104.9	8.76	8.80	-2.51	7	19	33.74	7	3	21.1
388.1	120.1	8.82	8.86	-2.64	7	19	33.92	7	3	21.1
395.5	136.0	8.88	8.89	-2.82	7	19	34.11	7	3	21.3

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1
 Resource International Inc

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 GRLWEAP Version 2010

Depth	(ft)	85.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	12.300	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

No.	Weight	Pile and Soil Model	Total Capacity	Rut	(kips)	383.0
	kips	Stiffn C-Slk T-Slk CoR	Soil-S	Soil-D Quake	LbTop	Perim
		k/in ft ft		s/ft inch	ft	ft
1	0.140	9082 0.010 0.000 0.85	0.0	0.050 0.100	3.30	3.3
2	0.140	9082 0.000 0.000 1.00	0.0	0.050 0.100	6.60	3.3
5	0.140	9082 0.000 0.000 1.00	5.6	0.150 0.100	16.50	3.3
6	0.140	9082 0.000 0.000 1.00	6.4	0.139 0.100	19.80	3.3
7	0.140	9082 0.000 0.000 1.00	19.0	0.050 0.100	23.10	3.3
8	0.140	9082 0.000 0.000 1.00	13.8	0.181 0.100	26.40	3.3
9	0.140	9082 0.000 0.000 1.00	10.4	0.192 0.100	29.70	3.3
10	0.140	9082 0.000 0.000 1.00	6.2	0.150 0.100	33.00	3.3
11	0.140	9082 0.000 0.000 1.00	6.2	0.150 0.100	36.30	3.3
12	0.140	9082 0.000 0.000 1.00	6.4	0.150 0.100	39.60	3.3
13	0.140	9082 0.000 0.000 1.00	6.9	0.150 0.100	42.89	3.3
14	0.140	9082 0.000 0.000 1.00	30.7	0.058 0.100	46.19	3.3
15	0.140	9082 0.000 0.000 1.00	37.0	0.050 0.100	49.49	3.3
16	0.140	9082 0.000 0.000 1.00	32.3	0.050 0.100	52.79	3.3
17	0.140	9082 0.000 0.000 1.00	34.6	0.050 0.100	56.09	3.3
18	0.140	9082 0.000 0.000 1.00	36.8	0.050 0.100	59.39	3.3
19	0.140	9082 0.000 0.000 1.00	38.3	0.050 0.100	62.69	3.3
20	0.140	9082 0.000 0.000 1.00	19.5	0.108 0.100	65.99	3.3
21	0.140	9082 0.000 0.000 1.00	12.2	0.150 0.100	69.29	3.3
22	0.140	9082 0.000 0.000 1.00	12.2	0.150 0.100	72.59	3.3
23	0.140	9082 0.000 0.000 1.00	12.1	0.150 0.100	75.89	3.3
24	0.140	9082 0.000 0.000 1.00	12.0	0.150 0.100	79.19	3.3
25	0.140	9082 0.000 0.000 1.00	11.7	0.150 0.100	82.49	3.3
26	0.140	9082 0.000 0.000 1.00	11.2	0.150 0.100	85.79	3.3
Toe			1.4	0.150 0.100		

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
85.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
383.0	106.0	8.77	8.79	-2.24	25	7	33.71	5	3	20.6
391.2	120.8	8.83	8.84	-2.27	25	7	33.94	5	3	20.8
399.7	143.6	8.90	8.89	-2.35	25	7	34.17	5	3	20.8
408.1	171.2	8.94	8.93	-2.36	25	7	34.36	5	3	20.9
416.5	211.2	8.99	8.96	-2.42	25	7	34.54	5	3	21.0

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth	(ft)	85.8	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	12.300	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

No.	Weight kips	Pile and Soil Model Stiffn C-Slk T-Slk CoR	Total Capacity Soil-S	Rut (kips) Soil-D Quake	385.6 LbTop Perim Area
		k/in ft ft	kips	s/ft inch	ft ft in2
1	0.140	9082 0.010 0.000 0.85	0.0	0.050 0.100	3.30 3.3 12.4
2	0.140	9082 0.000 0.000 1.00	0.0	0.050 0.100	6.60 3.3 12.4
4	0.140	9082 0.000 0.000 1.00	1.2	0.149 0.100	13.20 3.3 12.4
5	0.140	9082 0.000 0.000 1.00	5.7	0.150 0.100	16.50 3.3 12.4
6	0.140	9082 0.000 0.000 1.00	9.3	0.106 0.100	19.80 3.3 12.4
7	0.140	9082 0.000 0.000 1.00	19.0	0.067 0.100	23.10 3.3 12.4
8	0.140	9082 0.000 0.000 1.00	12.6	0.200 0.100	26.40 3.3 12.4
9	0.140	9082 0.000 0.000 1.00	8.9	0.182 0.100	29.70 3.3 12.4
10	0.140	9082 0.000 0.000 1.00	6.2	0.150 0.100	33.00 3.3 12.4
11	0.140	9082 0.000 0.000 1.00	6.3	0.150 0.100	36.30 3.3 12.4
12	0.140	9082 0.000 0.000 1.00	6.5	0.150 0.100	39.60 3.3 12.4
13	0.140	9082 0.000 0.000 1.00	7.8	0.142 0.100	42.89 3.3 12.4
14	0.140	9082 0.000 0.000 1.00	37.3	0.050 0.100	46.19 3.3 12.4
15	0.140	9082 0.000 0.000 1.00	35.3	0.050 0.100	49.49 3.3 12.4
16	0.140	9082 0.000 0.000 1.00	32.9	0.050 0.100	52.79 3.3 12.4
17	0.140	9082 0.000 0.000 1.00	35.1	0.050 0.100	56.09 3.3 12.4
18	0.140	9082 0.000 0.000 1.00	37.2	0.050 0.100	59.39 3.3 12.4
19	0.140	9082 0.000 0.000 1.00	38.6	0.050 0.100	62.69 3.3 12.4
20	0.140	9082 0.000 0.000 1.00	13.1	0.144 0.100	65.99 3.3 12.4
21	0.140	9082 0.000 0.000 1.00	12.2	0.150 0.100	69.29 3.3 12.4
22	0.140	9082 0.000 0.000 1.00	12.2	0.150 0.100	72.59 3.3 12.4
23	0.140	9082 0.000 0.000 1.00	12.1	0.150 0.100	75.89 3.3 12.4
24	0.140	9082 0.000 0.000 1.00	11.9	0.150 0.100	79.19 3.3 12.4
25	0.140	9082 0.000 0.000 1.00	11.6	0.150 0.100	82.49 3.3 12.4
26	0.140	9082 0.000 0.000 1.00	11.0	0.150 0.100	85.79 3.3 12.4
Toe			1.4	0.150 0.100	

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
85.79	10.81	1.00	0.800

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Rut	Bl Ct	Stroke (ft)	Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt
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kips	b/ft	down	up	ksi	ksi	kip-ft	b/min
385.6	109.1	8.78	8.80	-2.33	33.66	20.6	39.8
394.0	125.4	8.85	8.84	-2.40	33.89	20.7	39.7
402.5	148.9	8.90	8.89	-2.46	34.07	20.8	39.6
411.1	181.4	8.96	8.93	-2.50	34.26	20.9	39.5
419.6	235.0	9.01	8.98	-2.55	34.44	20.9	39.4

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 Resource International Inc

10/24/2021
 GRLWEAP Version 2010

SUMMARY OVER DEPTHS

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.0	0.1	0.0	0.1	0.0	0.000	0.000	10.81	0.0
10.0	0.2	0.0	0.2	0.0	0.000	0.000	10.81	0.0
15.0	6.7	4.3	2.4	Hammer	did not	run		
20.0	56.4	17.4	39.0	5.2	22.067	0.000	5.31	21.6
25.0	44.4	42.5	1.8	3.6	19.946	-0.607	4.94	22.8
30.0	59.5	57.3	2.2	5.5	22.893	-0.104	5.37	21.4
35.0	69.0	66.8	2.2	6.7	24.159	-0.543	5.58	20.8
40.0	78.7	76.5	2.2	7.8	24.810	-1.223	5.74	20.1
45.0	135.9	107.0	28.9	14.9	28.046	-2.608	6.59	19.3
50.0	174.0	161.0	12.9	17.8	28.969	-1.990	6.90	19.3
55.0	225.2	212.2	12.9	24.1	30.326	-3.367	7.33	19.9
60.0	281.3	268.4	12.9	35.9	31.864	-3.460	7.91	20.9
65.0	310.8	309.4	1.4	44.4	32.610	-3.615	8.18	21.1
70.0	329.4	327.9	1.4	54.2	32.900	-3.985	8.36	21.1
75.0	347.8	346.4	1.4	66.8	33.335	-3.226	8.52	21.0
80.0	365.9	364.5	1.4	85.0	33.307	-2.782	8.62	20.8
85.0	383.0	381.6	1.4	106.0	33.715	-2.236	8.77	20.6
85.8	385.6	384.2	1.4	109.1	33.662	-2.334	8.78	20.6

Total Driving Time 53 minutes;
 Starting at penetration 5.0 ft

Total No. of Blows 2211

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.0	0.1	0.0	0.1	0.0	0.000	0.000	11.86	0.0
10.0	0.2	0.0	0.2	0.0	0.000	0.000	11.86	0.0
15.0	7.0	4.6	2.4	Hammer	did not	run		
20.0	57.0	18.0	39.0	5.3	22.146	0.000	5.32	21.6
25.0	45.7	43.9	1.8	3.7	20.191	-0.524	4.98	22.7
30.0	62.0	59.8	2.2	5.8	23.204	0.000	5.43	21.2
35.0	72.0	69.8	2.2	7.0	24.472	-0.564	5.64	20.7
40.0	82.3	80.0	2.2	8.2	25.145	-1.235	5.81	20.0
45.0	139.7	110.8	28.9	15.3	28.381	-2.476	6.69	19.4
50.0	177.8	164.9	12.9	18.3	29.149	-1.848	6.94	19.4
55.0	229.0	216.1	12.9	24.8	30.551	-3.445	7.39	20.1
60.0	285.2	272.2	12.9	37.3	32.035	-3.643	7.97	20.9
65.0	315.1	313.7	1.4	46.5	32.817	-3.671	8.23	21.2
70.0	334.7	333.2	1.4	58.0	33.090	-3.963	8.42	21.2
75.0	354.1	352.7	1.4	72.9	33.359	-3.170	8.50	21.0
80.0	373.2	371.7	1.4	93.8	33.523	-2.626	8.69	20.9
85.0	391.2	389.8	1.4	120.8	33.940	-2.272	8.83	20.8
85.8	394.0	392.5	1.4	125.4	33.888	-2.401	8.85	20.7

Total Driving Time 58 minutes;
 Starting at penetration 5.0 ft

Total No. of Blows 2384

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1
 Resource International Inc

10/24/2021
 GRLWEAP Version 2010

SUMMARY OVER DEPTHS

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.0	0.1	0.0	0.1	0.0	0.000	0.000	11.86	0.0
10.0	0.2	0.0	0.2	0.0	0.000	0.000	11.86	0.0
15.0	7.2	4.8	2.4	Hammer	did not	run		
20.0	57.6	18.6	39.0	5.4	22.207	0.000	5.33	21.5
25.0	47.0	45.2	1.8	3.9	20.416	-0.440	5.02	22.5
30.0	64.5	62.3	2.2	6.2	23.556	0.000	5.49	21.1
35.0	75.0	72.8	2.2	7.3	24.808	-0.557	5.71	20.6

40.0	85.9	83.6	2.2	8.7	25.487	-1.582	5.89	19.9
45.0	143.7	114.7	28.9	15.8	28.587	-2.274	6.73	19.3
50.0	181.7	168.8	12.9	18.8	29.343	-1.691	6.99	19.5
55.0	232.9	220.0	12.9	25.7	30.774	-3.486	7.45	20.1
60.0	289.1	276.1	12.9	38.8	32.184	-3.840	8.01	21.0
65.0	319.5	318.1	1.4	48.3	33.038	-3.823	8.29	21.3
70.0	340.1	338.6	1.4	61.8	33.263	-3.967	8.47	21.3
75.0	360.6	359.1	1.4	79.4	33.607	-3.065	8.57	21.2
80.0	380.6	379.2	1.4	104.9	33.744	-2.511	8.76	21.1
85.0	399.7	398.2	1.4	143.6	34.168	-2.347	8.90	20.8
85.8	402.5	401.1	1.4	148.9	34.071	-2.458	8.90	20.8

Total Driving Time 63 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 2599

G/L at Shaft and Toe: 0.614 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	
5.0	0.1	0.0	0.1	0.0	0.000	0.000	11.86	0.0	
10.0	0.2	0.0	0.2	0.0	0.000	0.000	11.86	0.0	
15.0	7.5	5.1	2.4	Hammer did not run					
20.0	58.2	19.2	39.0	5.4	22.323	0.000	5.35	21.5	
25.0	48.4	46.6	1.8	4.0	20.673	-0.441	5.06	22.4	
30.0	67.1	64.8	2.2	6.5	23.854	0.000	5.54	21.0	
35.0	78.1	75.9	2.2	7.8	24.914	-0.818	5.71	20.2	
40.0	89.4	87.2	2.2	9.2	25.802	-1.880	5.96	19.8	
45.0	147.6	118.7	28.9	16.3	28.761	-2.030	6.76	19.4	
50.0	185.7	172.7	12.9	19.4	29.537	-1.893	7.04	19.6	
55.0	236.9	223.9	12.9	26.4	31.007	-3.418	7.50	20.2	
60.0	293.0	280.1	12.9	40.1	32.399	-4.011	8.07	21.1	
65.0	323.9	322.4	1.4	51.1	33.210	-3.922	8.34	21.3	
70.0	345.5	344.1	1.4	65.7	33.449	-4.030	8.53	21.4	
75.0	367.0	365.6	1.4	88.2	33.851	-2.929	8.64	21.2	
80.0	388.1	386.6	1.4	120.1	33.923	-2.643	8.82	21.1	
85.0	408.1	406.6	1.4	171.2	34.355	-2.359	8.94	20.9	
85.8	411.1	409.6	1.4	181.4	34.261	-2.500	8.96	20.9	

Total Driving Time 70 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 2869

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FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1
Resource International Inc

10/24/2021
GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.657 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	
5.0	0.1	0.0	0.1	0.0	0.000	0.000	11.86	0.0	
10.0	0.2	0.0	0.2	0.0	0.000	0.000	11.86	0.0	
15.0	7.7	5.3	2.4	Hammer did not run					
20.0	58.8	19.8	39.0	5.5	22.368	0.000	5.36	21.5	
25.0	49.7	47.9	1.8	4.1	20.870	-0.433	5.09	22.3	
30.0	69.6	67.4	2.2	6.8	24.115	0.000	5.59	20.8	
35.0	81.1	78.9	2.2	8.1	25.203	-1.252	5.78	20.1	
40.0	93.0	90.8	2.2	9.7	26.121	-1.954	6.04	19.8	
45.0	151.5	122.6	28.9	16.8	28.971	-1.827	6.81	19.3	
50.0	189.6	176.6	12.9	20.0	29.727	-2.124	7.09	19.6	
55.0	240.8	227.9	12.9	27.3	31.224	-3.309	7.56	20.3	
60.0	296.9	284.0	12.9	41.7	32.564	-4.155	8.12	21.2	
65.0	328.3	326.8	1.4	53.8	33.409	-4.017	8.39	21.4	
70.0	350.9	349.5	1.4	70.7	33.643	-4.078	8.59	21.5	
75.0	373.5	372.0	1.4	96.4	34.062	-2.860	8.71	21.4	
80.0	395.5	394.1	1.4	136.0	34.107	-2.825	8.88	21.3	
85.0	416.5	415.0	1.4	211.2	34.538	-2.420	8.99	21.0	
85.8	419.6	418.2	1.4	235.0	34.436	-2.545	9.01	20.9	

Total Driving Time 78 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 3189

↑

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case1
Resource International Inc

10/24/2021
GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

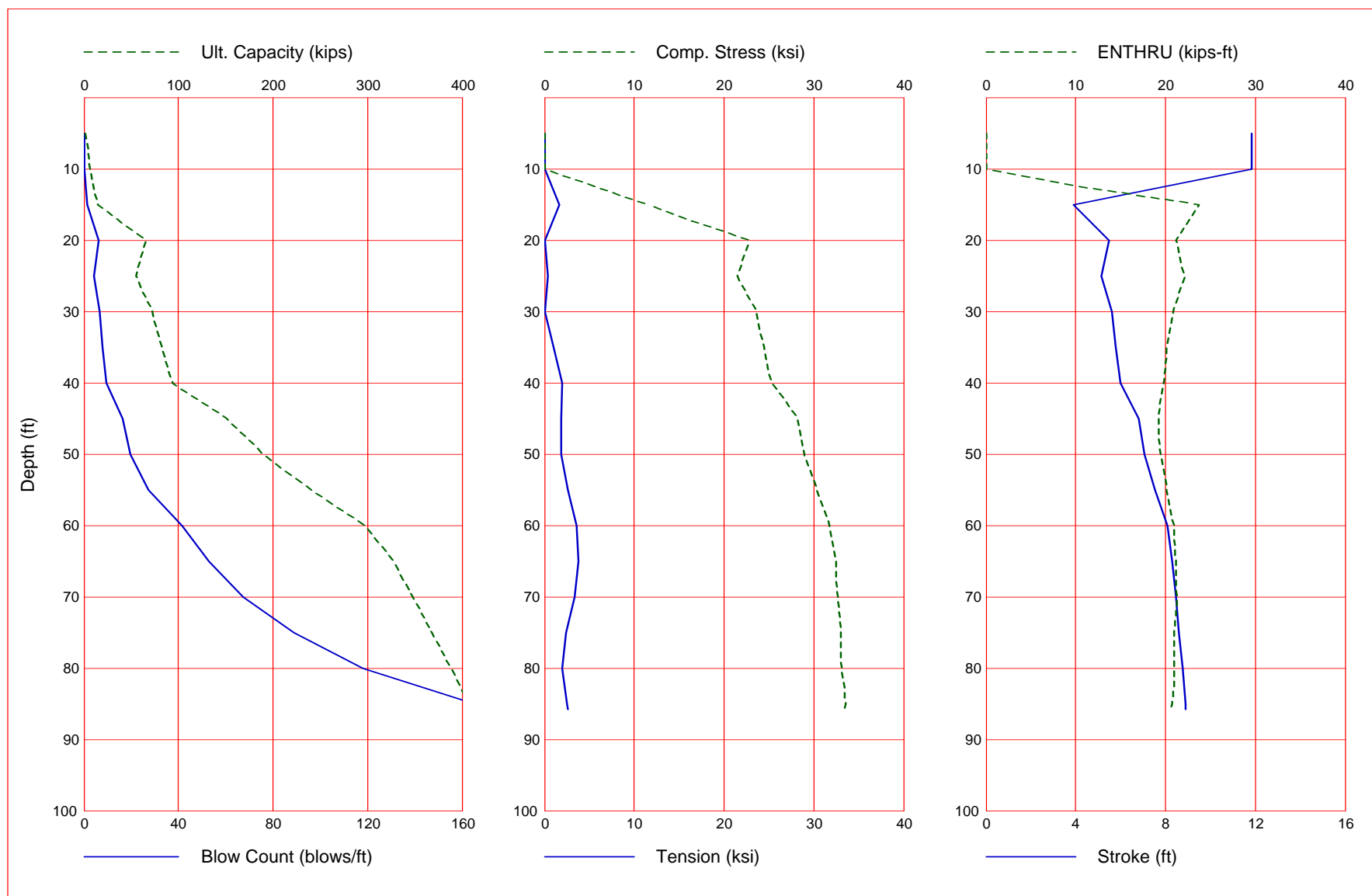
Temp. Wait Equivalent Pressure Stiffn. Cushion

Depth ft	Length ft	Time hr	Stroke ft	Ratio	Efficy.	Factor	CoR
5.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
10.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
15.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
20.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
25.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
30.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
35.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
40.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
45.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
50.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
55.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
60.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
65.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
70.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
75.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
80.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
85.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
85.79	85.79	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	0.100	0.050	0.150	0.000	6.000	24.000
3.00	0.00	0.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
6.00	0.00	0.11	0.100	0.100	0.050	0.150	0.000	6.000	24.000
9.00	0.00	0.16	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.00	0.00	0.22	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.49	0.00	0.22	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.51	0.88	2.40	0.100	0.100	0.150	0.150	0.778	6.000	336.000
18.79	0.88	2.40	0.100	0.100	0.150	0.150	0.778	6.000	336.000
18.81	1.57	36.41	0.100	0.100	0.050	0.150	0.000	6.000	24.000
21.80	1.85	42.93	0.100	0.100	0.050	0.150	0.000	6.000	24.000
22.79	1.95	45.08	0.100	0.100	0.050	0.150	0.000	6.000	24.000
22.81	2.38	1.83	0.100	0.100	0.200	0.150	1.000	6.000	720.000
27.79	2.38	1.83	0.100	0.100	0.200	0.150	1.000	6.000	720.000
27.81	0.95	2.21	0.100	0.100	0.150	0.150	0.778	6.000	336.000
36.80	0.96	2.21	0.100	0.100	0.150	0.150	0.778	6.000	336.000
39.80	1.03	2.21	0.100	0.100	0.150	0.150	0.778	6.000	336.000
42.79	1.11	2.21	0.100	0.100	0.150	0.150	0.778	6.000	336.000
42.81	3.28	28.93	0.100	0.100	0.050	0.150	0.000	6.000	24.000
45.80	3.54	28.93	0.100	0.100	0.050	0.150	0.000	6.000	24.000
47.79	3.71	28.93	0.100	0.100	0.050	0.150	0.000	6.000	24.000
47.81	2.81	12.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
50.80	3.00	12.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
53.80	3.18	12.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
56.80	3.37	12.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
57.99	3.44	12.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
58.01	3.45	12.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
61.00	3.54	12.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
62.79	3.60	12.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
62.81	1.88	1.44	0.100	0.100	0.150	0.150	0.778	6.000	336.000
71.80	1.87	1.44	0.100	0.100	0.150	0.150	0.778	6.000	336.000
74.80	1.85	1.44	0.100	0.100	0.150	0.150	0.778	6.000	336.000
77.80	1.83	1.44	0.100	0.100	0.150	0.150	0.778	6.000	336.000
80.80	1.78	1.44	0.100	0.100	0.150	0.150	0.778	6.000	336.000
83.80	1.70	1.44	0.100	0.100	0.150	0.150	0.778	6.000	336.000
85.79	1.64	1.44	0.100	0.100	0.150	0.150	0.778	6.000	336.000

Gain/Loss 3 at Shaft and Toe 0.571 / 1.000



Gain/Loss 3 at Shaft and Toe 0.571 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	1.9	1.2	0.6	0.0	0.000	0.000	11.86	0.0
10.0	6.1	5.0	1.1	0.0	0.000	0.000	11.86	0.0
15.0	15.0	12.6	2.4	1.4	11.539	-1.666	3.89	23.7
20.0	65.7	26.4	39.3	6.1	22.914	0.000	5.47	21.2
25.0	54.8	53.0	1.8	4.4	21.452	-0.423	5.16	22.1
30.0	72.3	70.1	2.2	6.8	23.653	0.000	5.60	20.8
35.0	82.8	80.6	2.2	8.0	24.432	-1.046	5.76	20.1
40.0	93.7	91.4	2.2	9.4	25.365	-1.942	6.01	19.8
45.0	151.7	122.5	29.2	16.5	28.182	-1.874	6.79	19.3
50.0	189.6	176.6	13.1	19.8	28.964	-1.837	7.07	19.5
55.0	240.8	227.8	13.1	27.2	30.368	-2.663	7.51	20.1
60.0	297.0	283.9	13.1	41.5	31.745	-3.558	8.07	21.0
65.0	327.3	325.8	1.5	52.7	32.486	-3.744	8.31	21.2
70.0	347.9	346.4	1.5	67.4	32.680	-3.338	8.49	21.3
75.0	368.4	366.9	1.5	88.8	32.996	-2.382	8.59	21.0
80.0	388.4	387.0	1.5	118.0	33.158	-1.981	8.77	21.0
85.0	407.5	406.0	1.5	165.4	33.539	-2.490	8.88	20.7
85.8	410.3	408.9	1.5	179.3	33.418	-2.630	8.89	20.5

Total Continuous Driving Time 70.00 minutes; Total Number of Blows 2890 (starting at penetration 5.0 ft)

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.
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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: J:\GEOTECH\PROJECTS\2020\W-20-025 FRA-70-13.01\ANALYSIS\DRIVEABILITY\REAR ABUTMENT\HP 10X42 - CASE-2\FRA-70-13.01 - REAR ABUTMENT HP 10X42-B-015-1-13-CASE-2.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2

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	12.400	10.000	Unknown														
W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp												
1.900	227.000	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											
85.790	12.40	29000.0	492.000	3.300	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	0.10	0.05	0.15	1.00	6.00	24.000
3.00	0.09	0.38	0.10	0.10	0.05	0.15	1.00	6.00	24.000
6.00	0.18	0.76	0.10	0.10	0.05	0.15	1.00	6.00	24.000
9.00	0.27	1.14	0.10	0.10	0.05	0.15	1.00	6.00	24.000
12.00	0.36	1.15	0.10	0.10	0.05	0.15	1.00	6.00	24.000
12.49	0.38	1.15	0.10	0.10	0.05	0.15	1.00	6.00	24.000
12.51	0.88	2.42	0.10	0.10	0.15	0.15	1.50	6.00	336.000
18.79	0.88	2.42	0.10	0.10	0.15	0.15	1.50	6.00	336.000
18.81	1.57	36.71	0.10	0.10	0.05	0.15	1.00	6.00	24.000
21.80	1.85	43.28	0.10	0.10	0.05	0.15	1.00	6.00	24.000
22.79	1.95	45.45	0.10	0.10	0.05	0.15	1.00	6.00	24.000
22.81	2.38	1.84	0.10	0.10	0.20	0.15	1.75	6.00	720.000
27.79	2.38	1.84	0.10	0.10	0.20	0.15	1.75	6.00	720.000
27.81	0.95	2.23	0.10	0.10	0.15	0.15	1.50	6.00	336.000
36.80	0.96	2.23	0.10	0.10	0.15	0.15	1.50	6.00	336.000
39.80	1.03	2.23	0.10	0.10	0.15	0.15	1.50	6.00	336.000
42.79	1.11	2.23	0.10	0.10	0.15	0.15	1.50	6.00	336.000
42.81	3.28	29.17	0.10	0.10	0.05	0.15	1.00	6.00	24.000
45.80	3.54	29.17	0.10	0.10	0.05	0.15	1.00	6.00	24.000
47.79	3.71	29.17	0.10	0.10	0.05	0.15	1.00	6.00	24.000
47.81	2.81	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.000
50.80	3.00	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.000
53.80	3.18	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.000
56.80	3.37	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.000
57.99	3.44	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.000
58.01	3.45	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.000
61.00	3.54	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.000
62.79	3.60	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.000
62.81	1.88	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.000
71.80	1.87	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.000
74.80	1.85	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.000
77.80	1.83	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.000
80.80	1.78	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.000
83.80	1.70	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.000
85.79	1.64	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.000

Gain/Loss factors: shaft and toe

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
5.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
10.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
15.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
20.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
25.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
30.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
35.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
40.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
45.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
50.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
55.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
60.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
65.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
70.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
75.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
80.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
85.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
85.79	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

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2

Hammer Model:	D 19-42	Made by:	DELMAG
No.	Weight kips	Stiffn k/inch	CoR C-Slk ft 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	1.900	60155.0	0.800 0.0100
Combined Pile Top		9081.9	5.8

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)	227.00	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)	60155.0	Stiffness	(kips/in)	0.0



FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
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Depth	(ft)	5.0	Standard Soil Setup	
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	12.400	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)				1.9	
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	0.1	0.050	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	1.1	0.050	0.100	85.79	3.3	12.4
Toe						0.6	0.150	0.100			

3.635 kips total unreduced pile weight (g= 32.17 ft/s2)
3.635 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)	0.435

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
5.00	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.3 1.9
 Hammer+Pile Weight > Rult: Pile Runs

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INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.3 1.9
 Hammer+Pile Weight > Rult: Pile Runs

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 FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t Comp Str ksi	i	t ENTHRU kip-ft	Bl Rt b/min
1.9	0.0	10.81	0.00	0.00	1	0	0.00	78.4
1.9	0.0	11.86	0.00	0.00	1	0	0.00	74.4
1.9	0.0	11.86	0.00	0.00	1	0	0.00	74.4
1.9	0.0	11.86	0.00	0.00	1	0	0.00	74.4
1.9	0.0	11.86	0.00	0.00	1	0	0.00	74.4

▲
 FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 10.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 12.400 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

No.	Weight kips	Pile and Soil Model Stiffn C-Slk T-Slk k/in ft ft	CoR	Total Capacity Soil-S kips	Soil-D Quake s/ft inch	Rut (kips) LbTop Perim ft ft	6.1 Area in2
1	0.140	9082 0.010 0.000 0.85	0.0	0.000 0.100	3.30 3.3	12.4	
2	0.140	9082 0.000 0.000 1.00	0.0	0.000 0.100	6.60 3.3	12.4	
23	0.140	9082 0.000 0.000 1.00	0.0	0.050 0.100	75.89 3.3	12.4	
24	0.140	9082 0.000 0.000 1.00	0.6	0.050 0.100	79.19 3.3	12.4	
25	0.140	9082 0.000 0.000 1.00	1.7	0.050 0.100	82.49 3.3	12.4	
26	0.140	9082 0.000 0.000 1.00	2.7	0.050 0.100	85.79 3.3	12.4	
Toe				1.1	0.150 0.100		

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
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10.00 10.81 1.00 0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.3 6.1
Hammer+Pile Weight > Rult: Pile Runs

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INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.3 6.1
Hammer+Pile Weight > Rult: Pile Runs

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FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
Resource International Inc GRLWEAP Version 2010

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
6.1	0.0	10.81	0.00	0.00	1	0	0.00	1	0	78.4
6.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	74.4
6.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	74.4
6.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	74.4
6.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	74.4

↑
FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 15.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type Unknown
Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	Rut	(kips)	14.6
	kips	k/in	ft	ft		kips	s/ft	inch	LbTop	Perim	Area
1	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	0.2	0.050	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	1.1	0.050	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	2.2	0.050	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	3.3	0.050	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	5.3	0.138	0.100	85.79	3.3	12.4
Toe						2.4	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
15.00	10.81	1.00	0.800

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FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
Resource International Inc GRLWEAP Version 2010

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
14.6	1.4	3.86	3.88	-1.82	9	16	11.41	1	7	60.3
14.8	1.4	3.92	3.88	-1.65	9	16	11.52	1	7	60.0

15.0	1.4	3.89	3.90	-1.67	9	16	11.54	1	7	23.7	60.0
15.3	1.4	3.90	3.92	-1.63	9	16	11.56	1	7	23.9	60.0
15.5	1.4	3.91	3.93	-1.56	9	16	11.64	1	7	23.9	59.9

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2
 Resource International Inc

10/24/2021
 GRLWEAP Version 2010

Depth	(ft)	20.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	12.400	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model							Total Capacity Rut (kips) 64.5				
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	0.6	0.050	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	1.7	0.050	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	2.8	0.050	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	4.3	0.099	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	10.1	0.099	0.100	85.79	3.3	12.4
Toe						39.3	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
20.00	10.81	1.00	0.800

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2
 Resource International Inc

10/24/2021
 GRLWEAP Version 2010

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	
64.5	6.0	5.44	5.41	0.00	1 0 22.80	22	6 21.2	50.6
65.1	6.1	5.46	5.43	0.00	1 0 22.88	22	6 21.2	50.5
65.7	6.1	5.47	5.44	0.00	1 0 22.91	22	6 21.2	50.5
66.3	6.2	5.48	5.45	0.00	1 0 23.00	22	6 21.2	50.4
66.9	6.3	5.49	5.47	0.00	1 0 23.02	22	6 21.1	50.3

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2
 Resource International Inc

10/24/2021
 GRLWEAP Version 2010

Depth	(ft)	25.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	12.400	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model							Total Capacity Rut (kips) 52.2				
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	0.2	0.050	0.100	62.69	3.3	12.4

20	0.140	9082	0.000	0.000	1.00	1.2	0.050	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	2.3	0.050	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	3.3	0.050	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	5.4	0.140	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	17.0	0.057	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	15.3	0.157	0.100	85.79	3.3	12.4
Toe						1.8	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
25.00	10.81	1.00	0.800

↑
FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
52.2	4.1	5.09	5.06	-0.50	2	12	21.06	20	6	22.3
53.5	4.3	5.13	5.09	-0.43	3	15	21.26	20	6	22.2
54.8	4.4	5.16	5.12	-0.42	3	15	21.45	20	6	22.1
56.2	4.6	5.20	5.15	-0.42	3	15	21.64	20	6	22.0
57.5	4.7	5.23	5.19	-0.42	3	15	21.82	21	6	21.9

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Depth (ft)	30.0	Standard Soil Setup	
Shaft Gain/Loss Factor	0.486	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in ²)	12.400	Pile Type	Unknown
Pile Size (inch)	10.000		

L b Top ft	Area in ²	E-Mod ksi	Spec Wt lb/ft ³	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity	Rut	(kips)			67.3
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	56.09	3.3	12.4
18	0.140	9082	0.000	0.000	1.00	0.6	0.050	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	1.7	0.050	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	2.8	0.050	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	4.3	0.103	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	10.5	0.095	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	18.5	0.084	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	12.6	0.200	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	8.3	0.178	0.100	85.79	3.3	12.4
Toe						2.2	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
30.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min	
67.3	6.2	5.49	5.47	0.00	1	0	23.12	21	6	21.1	50.4
69.8	6.6	5.55	5.53	0.00	1	0	23.39	21	6	20.9	50.1

72.3	6.8	5.60	5.58	0.00	1	0	23.65	21	6	20.8	49.8
74.9	7.1	5.66	5.63	-0.14	22	50	23.93	21	6	20.7	49.6
77.4	7.4	5.70	5.69	-0.54	21	50	24.17	21	6	20.5	49.3

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Depth	(ft)	35.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	12.400	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)					76.8
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	0.2	0.050	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	1.2	0.050	0.100	56.09	3.3	12.4
18	0.140	9082	0.000	0.000	1.00	2.3	0.050	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	3.4	0.050	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	5.4	0.141	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	17.5	0.055	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	15.0	0.161	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	11.4	0.196	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	85.79	3.3	12.4
Toe						2.2	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
35.00	10.81	1.00	0.800

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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
76.8	7.2	5.69	5.68	-0.70	25	18	24.05	20	6	20.5
79.8	7.6	5.75	5.74	-0.67	25	18	24.33	20	6	20.4
82.8	8.0	5.76	5.81	-1.05	20	50	24.43	20	6	20.1
85.9	8.4	5.83	5.88	-1.36	20	50	24.75	20	6	20.0
88.9	8.8	5.89	5.94	-1.56	20	49	25.06	20	6	20.0

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Depth	(ft)	40.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	12.400	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)					86.6
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
14	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	46.19	3.3	12.4
15	0.140	9082	0.000	0.000	1.00	0.7	0.050	0.100	49.49	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	1.8	0.050	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	2.8	0.050	0.100	56.09	3.3	12.4
18	0.140	9082	0.000	0.000	1.00	4.4	0.106	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	10.9	0.092	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	18.3	0.089	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	12.6	0.200	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	8.1	0.176	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	6.3	0.150	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	6.5	0.150	0.100	85.79	3.3	12.4
Toe						2.2	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
40.00	10.81	1.00	0.800

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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
86.6	8.4	5.86	5.90	-1.60	8	24.74	18	5	20.0	48.6
90.1	8.9	5.93	5.97	-1.89	7	25.04	18	5	19.8	48.3
93.7	9.4	6.01	6.04	-1.94	7	25.37	18	5	19.8	48.0
97.3	10.0	6.08	6.11	-1.93	16	25.68	18	5	19.7	47.7
100.8	10.6	6.16	6.19	-1.94	17	25.99	18	5	19.6	47.4

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 Resource International Inc GRLWEAP Version 2010

Depth	(ft)	45.0	Standard Soil Setup	
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor	1.000

PILE PROFILE:				
Toe Area	(in2)	12.400	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)			143.9		
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
13	0.140	9082	0.000	0.000	1.00	0.2	0.050	0.100	42.89	3.3	12.4
14	0.140	9082	0.000	0.000	1.00	1.2	0.050	0.100	46.19	3.3	12.4
15	0.140	9082	0.000	0.000	1.00	2.3	0.050	0.100	49.49	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	3.4	0.050	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	5.5	0.143	0.100	56.09	3.3	12.4
18	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	17.9	0.053	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	14.8	0.165	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	11.2	0.195	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	6.3	0.150	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	6.8	0.150	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	26.9	0.064	0.100	85.79	3.3	12.4
Toe						29.2	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
45.00	10.81	1.00	0.800

↑
 FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
143.9	15.6	6.71	6.66	-2.23	14	38	27.82	17	5	19.3
147.8	16.0	6.75	6.70	-2.06	14	38	28.01	17	5	19.3
151.7	16.5	6.79	6.74	-1.87	13	38	28.18	17	5	19.3
155.6	17.0	6.83	6.78	-1.72	11	37	28.40	17	5	19.3
159.5	17.5	6.87	6.83	-1.55	11	37	28.56	17	5	19.3

↑
 FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
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Depth	(ft)	50.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	12.400	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

No.	Weight kips	Pile and Soil Model Stiffn C-Slk T-Slk k/in ft ft	CoR	Total Capacity Soil-S kips	Rut Soil-D Quake s/ft inch	(kips) LbTop Perim ft ft	181.9 Area in2
1	0.140	9082 0.010 0.000 0.85	0.0	0.000 0.100	3.30 3.3	12.4	
2	0.140	9082 0.000 0.000 1.00	0.0	0.000 0.100	6.60 3.3	12.4	
11	0.140	9082 0.000 0.000 1.00	0.0	0.050 0.100	36.30 3.3	12.4	
12	0.140	9082 0.000 0.000 1.00	0.7	0.050 0.100	39.60 3.3	12.4	
13	0.140	9082 0.000 0.000 1.00	1.8	0.050 0.100	42.89 3.3	12.4	
14	0.140	9082 0.000 0.000 1.00	2.9	0.050 0.100	46.19 3.3	12.4	
15	0.140	9082 0.000 0.000 1.00	4.5	0.109 0.100	49.49 3.3	12.4	
16	0.140	9082 0.000 0.000 1.00	5.7	0.150 0.100	52.79 3.3	12.4	
17	0.140	9082 0.000 0.000 1.00	11.3	0.089 0.100	56.09 3.3	12.4	
18	0.140	9082 0.000 0.000 1.00	18.1	0.094 0.100	59.39 3.3	12.4	
19	0.140	9082 0.000 0.000 1.00	12.6	0.200 0.100	62.69 3.3	12.4	
20	0.140	9082 0.000 0.000 1.00	7.9	0.174 0.100	65.99 3.3	12.4	
21	0.140	9082 0.000 0.000 1.00	6.2	0.150 0.100	69.29 3.3	12.4	
22	0.140	9082 0.000 0.000 1.00	6.3	0.150 0.100	72.59 3.3	12.4	
23	0.140	9082 0.000 0.000 1.00	6.5	0.150 0.100	75.89 3.3	12.4	
24	0.140	9082 0.000 0.000 1.00	12.3	0.110 0.100	79.19 3.3	12.4	
25	0.140	9082 0.000 0.000 1.00	37.8	0.050 0.100	82.49 3.3	12.4	
26	0.140	9082 0.000 0.000 1.00	34.2	0.050 0.100	85.79 3.3	12.4	
Toe			13.1	0.150 0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
50.00	10.81	1.00	0.800

↑
 FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
181.9	18.7	6.97	6.93	-1.67	8	36	28.60	15	5	19.3
185.7	19.2	7.02	6.97	-1.61	13	30	28.76	15	5	19.4
189.6	19.8	7.07	7.03	-1.84	13	30	28.96	15	5	19.5
193.6	20.3	7.11	7.07	-2.04	13	30	29.16	15	5	19.6
197.5	21.0	7.15	7.12	-2.19	13	30	29.31	15	5	19.6

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 FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021

Depth (ft) 55.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.400 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)				233.1	
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
10	0.140	9082	0.000	0.000	1.00	0.2	0.050	0.100	33.00	3.3	12.4
11	0.140	9082	0.000	0.000	1.00	1.3	0.050	0.100	36.30	3.3	12.4
12	0.140	9082	0.000	0.000	1.00	2.4	0.050	0.100	39.60	3.3	12.4
13	0.140	9082	0.000	0.000	1.00	3.4	0.050	0.100	42.89	3.3	12.4
14	0.140	9082	0.000	0.000	1.00	5.5	0.144	0.100	46.19	3.3	12.4
15	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	49.49	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	18.4	0.052	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	14.6	0.169	0.100	56.09	3.3	12.4
18	0.140	9082	0.000	0.000	1.00	11.0	0.194	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	6.3	0.150	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	6.8	0.150	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	27.8	0.062	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	37.6	0.050	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	32.1	0.050	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	34.4	0.050	0.100	85.79	3.3	12.4
Toe						13.1	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
55.00	10.81	1.00	0.800



FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2
 Resource International Inc

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GRLWEAP Version 2010

Rut	Bl Ct	Stroke	Ten Str	i	t Comp	Str	i	t ENTHRU	Bl Rt
kips	b/ft	down	up	ksi		ksi		kip-ft	b/min
233.1	25.5	7.41	7.37	-2.82	13	28	29.93	14	5 20.0 43.3
236.9	26.4	7.45	7.42	-2.77	13	28	30.12	14	4 20.0 43.2
240.8	27.2	7.51	7.47	-2.66	13	28	30.37	14	4 20.1 43.0
244.8	28.1	7.56	7.52	-2.54	12	27	30.57	14	5 20.2 42.9
248.7	29.0	7.61	7.57	-2.56	12	27	30.79	14	5 20.3 42.7



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 Resource International Inc

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GRLWEAP Version 2010

Depth (ft) 60.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.400 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model	Total Capacity Rut (kips)	289.2
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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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
8	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	26.40	3.3	12.4
9	0.140	9082	0.000	0.000	1.00	0.7	0.050	0.100	29.70	3.3	12.4
10	0.140	9082	0.000	0.000	1.00	1.8	0.050	0.100	33.00	3.3	12.4
11	0.140	9082	0.000	0.000	1.00	2.9	0.050	0.100	36.30	3.3	12.4
12	0.140	9082	0.000	0.000	1.00	4.6	0.112	0.100	39.60	3.3	12.4
13	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	42.89	3.3	12.4
14	0.140	9082	0.000	0.000	1.00	11.7	0.086	0.100	46.19	3.3	12.4
15	0.140	9082	0.000	0.000	1.00	17.9	0.099	0.100	49.49	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	12.6	0.200	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	7.7	0.172	0.100	56.09	3.3	12.4
18	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	6.3	0.150	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	6.6	0.150	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	13.2	0.105	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	37.9	0.050	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	34.0	0.050	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	33.3	0.050	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	35.5	0.050	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	37.6	0.050	0.100	85.79	3.3	12.4
Toe						13.1	0.150	0.100			

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

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

Depth Stroke Pressure Efficcy
ft ft Ratio
60.00 10.81 1.00 0.800

▲

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2
Resource International Inc

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min	
289.2	38.5	7.98	7.94	-3.27	11	25	31.42	12	4	20.9	41.8
293.0	39.9	8.02	7.99	-3.43	11	25	31.57	12	4	20.9	41.6
297.0	41.5	8.07	8.04	-3.56	11	25	31.74	12	4	21.0	41.5
300.9	43.0	8.11	8.09	-3.68	11	25	31.92	12	4	21.1	41.4
304.8	44.5	8.16	8.13	-3.80	12	25	32.08	12	4	21.3	41.3

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FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2
Resource International Inc

10/24/2021

GRLWEAP Version 2010

Depth (ft) 65.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.400 Pile Type Unknown
Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)	318.6				
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
7	0.140	9082	0.000	0.000	1.00	0.3	0.050	0.100	23.10	3.3	12.4
8	0.140	9082	0.000	0.000	1.00	1.3	0.050	0.100	26.40	3.3	12.4
9	0.140	9082	0.000	0.000	1.00	2.4	0.050	0.100	29.70	3.3	12.4
10	0.140	9082	0.000	0.000	1.00	3.5	0.050	0.100	33.00	3.3	12.4
11	0.140	9082	0.000	0.000	1.00	5.6	0.146	0.100	36.30	3.3	12.4
12	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	39.60	3.3	12.4
13	0.140	9082	0.000	0.000	1.00	18.8	0.050	0.100	42.89	3.3	12.4
14	0.140	9082	0.000	0.000	1.00	14.3	0.173	0.100	46.19	3.3	12.4
15	0.140	9082	0.000	0.000	1.00	10.8	0.193	0.100	49.49	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	56.09	3.3	12.4

18	0.140	9082	0.000	0.000	1.00	6.4	0.150	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	6.8	0.150	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	28.8	0.061	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	37.4	0.050	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	32.2	0.050	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	34.4	0.050	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	36.7	0.050	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	38.2	0.050	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	21.2	0.101	0.100	85.79	3.3	12.4
Toe						1.5	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
65.00	10.81	1.00	0.800

↑
FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
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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
318.6	47.9	8.22	8.19	-3.61	8	32.09	11	4	21.0	41.2
322.9	50.1	8.26	8.25	-3.69	8	32.28	11	4	21.1	41.0
327.3	52.7	8.31	8.30	-3.74	8	32.49	11	4	21.2	40.9
331.7	55.4	8.36	8.35	-3.80	8	32.68	11	4	21.3	40.8
336.1	58.3	8.41	8.40	-3.85	8	32.87	11	4	21.4	40.7

↑
FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
Resource International Inc GRLWEAP Version 2010

Depth	(ft)	70.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	12.400	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)	337.2				
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000	0.100	6.60	3.3	12.4
5	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	16.50	3.3	12.4
6	0.140	9082	0.000	0.000	1.00	0.8	0.050	0.100	19.80	3.3	12.4
7	0.140	9082	0.000	0.000	1.00	1.9	0.050	0.100	23.10	3.3	12.4
8	0.140	9082	0.000	0.000	1.00	2.9	0.050	0.100	26.40	3.3	12.4
9	0.140	9082	0.000	0.000	1.00	4.6	0.115	0.100	29.70	3.3	12.4
10	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	33.00	3.3	12.4
11	0.140	9082	0.000	0.000	1.00	12.1	0.083	0.100	36.30	3.3	12.4
12	0.140	9082	0.000	0.000	1.00	17.7	0.104	0.100	39.60	3.3	12.4
13	0.140	9082	0.000	0.000	1.00	12.6	0.200	0.100	42.89	3.3	12.4
14	0.140	9082	0.000	0.000	1.00	7.5	0.170	0.100	46.19	3.3	12.4
15	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	49.49	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	6.3	0.150	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	6.6	0.150	0.100	56.09	3.3	12.4
18	0.140	9082	0.000	0.000	1.00	14.1	0.100	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	38.0	0.050	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	33.7	0.050	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	33.4	0.050	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	35.6	0.050	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	37.6	0.050	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	33.9	0.061	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	85.79	3.3	12.4
Toe						1.5	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
70.00	10.81	1.00	0.800

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 Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
337.2	58.7	8.38	8.37	-3.38	9	22	32.35	9	3	21.1
342.5	63.6	8.43	8.44	-3.32	9	22	32.52	9	3	21.1
347.9	67.4	8.49	8.48	-3.34	9	22	32.68	9	3	21.3
353.3	72.7	8.55	8.53	-3.31	9	22	32.89	9	3	21.3
358.7	80.4	8.51	8.59	-3.33	10	22	32.81	9	3	21.2

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 Resource International Inc GRLWEAP Version 2010

Depth	(ft)	75.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	12.400	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

No.	Weight kips	Pile and Soil Model Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Total Capacity Soil-S kips	Rut (kips) Soil-D Quake s/ft inch	355.6 LbTop Perim ft ft	Area in2
1	0.140	9082	0.010	0.000	0.85	0.0	0.000 0.100	3.30 3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.000 0.100	6.60 3.3	12.4
4	0.140	9082	0.000	0.000	1.00	0.3	0.050 0.100	13.20 3.3	12.4
5	0.140	9082	0.000	0.000	1.00	1.3	0.050 0.100	16.50 3.3	12.4
6	0.140	9082	0.000	0.000	1.00	2.4	0.050 0.100	19.80 3.3	12.4
7	0.140	9082	0.000	0.000	1.00	3.5	0.050 0.100	23.10 3.3	12.4
8	0.140	9082	0.000	0.000	1.00	5.6	0.147 0.100	26.40 3.3	12.4
9	0.140	9082	0.000	0.000	1.00	6.1	0.144 0.100	29.70 3.3	12.4
10	0.140	9082	0.000	0.000	1.00	18.9	0.050 0.100	33.00 3.3	12.4
11	0.140	9082	0.000	0.000	1.00	14.1	0.177 0.100	36.30 3.3	12.4
12	0.140	9082	0.000	0.000	1.00	10.6	0.193 0.100	39.60 3.3	12.4
13	0.140	9082	0.000	0.000	1.00	6.2	0.150 0.100	42.89 3.3	12.4
14	0.140	9082	0.000	0.000	1.00	6.2	0.150 0.100	46.19 3.3	12.4
15	0.140	9082	0.000	0.000	1.00	6.4	0.150 0.100	49.49 3.3	12.4
16	0.140	9082	0.000	0.000	1.00	6.8	0.150 0.100	52.79 3.3	12.4
17	0.140	9082	0.000	0.000	1.00	29.7	0.059 0.100	56.09 3.3	12.4
18	0.140	9082	0.000	0.000	1.00	37.2	0.050 0.100	59.39 3.3	12.4
19	0.140	9082	0.000	0.000	1.00	32.3	0.050 0.100	62.69 3.3	12.4
20	0.140	9082	0.000	0.000	1.00	34.5	0.050 0.100	65.99 3.3	12.4
21	0.140	9082	0.000	0.000	1.00	36.7	0.050 0.100	69.29 3.3	12.4
22	0.140	9082	0.000	0.000	1.00	38.3	0.050 0.100	72.59 3.3	12.4
23	0.140	9082	0.000	0.000	1.00	20.3	0.105 0.100	75.89 3.3	12.4
24	0.140	9082	0.000	0.000	1.00	12.2	0.150 0.100	79.19 3.3	12.4
25	0.140	9082	0.000	0.000	1.00	12.2	0.150 0.100	82.49 3.3	12.4
26	0.140	9082	0.000	0.000	1.00	12.2	0.150 0.100	85.79 3.3	12.4
Toe						1.5	0.150 0.100		

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
75.00	10.81	1.00	0.800

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Rut	Bl Ct	Stroke (ft)	Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt
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kips	b/ft	down	up	ksi			ksi		kip-ft	b/min	
355.6	73.8	8.47	8.54	-2.62	6	23	32.58	8	3	20.8	40.5
361.9	80.0	8.52	8.59	-2.50	6	23	32.78	8	3	21.0	40.4
368.4	88.8	8.59	8.66	-2.38	6	23	33.00	8	3	21.0	40.2
374.8	96.8	8.67	8.72	-2.36	6	20	33.27	8	3	21.2	40.0
381.3	108.6	8.71	8.77	-2.49	6	20	33.44	8	3	21.2	39.9

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 80.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 12.400 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)			373.7		
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	0.140	9082	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	0.0	0.050	0.100	6.60	3.3	12.4
3	0.140	9082	0.000	0.000	1.00	0.8	0.050	0.100	9.90	3.3	12.4
4	0.140	9082	0.000	0.000	1.00	1.9	0.050	0.100	13.20	3.3	12.4
5	0.140	9082	0.000	0.000	1.00	3.0	0.050	0.100	16.50	3.3	12.4
6	0.140	9082	0.000	0.000	1.00	4.7	0.118	0.100	19.80	3.3	12.4
7	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	23.10	3.3	12.4
8	0.140	9082	0.000	0.000	1.00	12.5	0.081	0.100	26.40	3.3	12.4
9	0.140	9082	0.000	0.000	1.00	17.6	0.109	0.100	29.70	3.3	12.4
10	0.140	9082	0.000	0.000	1.00	12.6	0.200	0.100	33.00	3.3	12.4
11	0.140	9082	0.000	0.000	1.00	7.3	0.168	0.100	36.30	3.3	12.4
12	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	39.60	3.3	12.4
13	0.140	9082	0.000	0.000	1.00	6.3	0.150	0.100	42.89	3.3	12.4
14	0.140	9082	0.000	0.000	1.00	6.6	0.150	0.100	46.19	3.3	12.4
15	0.140	9082	0.000	0.000	1.00	15.0	0.096	0.100	49.49	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	38.1	0.050	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	33.5	0.050	0.100	56.09	3.3	12.4
18	0.140	9082	0.000	0.000	1.00	33.4	0.050	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	35.7	0.050	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	37.7	0.050	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	33.1	0.063	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	12.1	0.150	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	11.9	0.150	0.100	85.79	3.3	12.4
Toe						1.5	0.150	0.100			

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

Depth Stroke Pressure Efficy
 ft ft Ratio
 80.00 10.81 1.00 0.800

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
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Rut	Bl Ct	Stroke	(ft)	Ten Str	i	t Comp Str	i	t ENTHRU	Bl Rt	
kips	b/ft	down	up	ksi				kip-ft	b/min	
373.7	94.4	8.64	8.69	-2.21	5	23	32.75	6 3	20.7	40.1
381.0	104.8	8.71	8.74	-2.07	5	23	32.97	6 3	20.8	40.0
388.4	118.0	8.77	8.79	-1.98	6	19	33.16	6 3	21.0	39.9
395.9	136.2	8.83	8.84	-2.07	6	19	33.37	6 3	21.1	39.7
403.3	159.6	8.89	8.89	-2.17	6	19	33.55	6 3	21.1	39.6

FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 85.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.400 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
85.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)						390.8	
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	0.140	9082	0.010	0.000	0.85	0.3	0.050	0.100	3.30	3.3	12.4		
2	0.140	9082	0.000	0.000	1.00	1.4	0.050	0.100	6.60	3.3	12.4		
3	0.140	9082	0.000	0.000	1.00	2.5	0.050	0.100	9.90	3.3	12.4		
4	0.140	9082	0.000	0.000	1.00	3.5	0.050	0.100	13.20	3.3	12.4		
5	0.140	9082	0.000	0.000	1.00	5.7	0.149	0.100	16.50	3.3	12.4		
6	0.140	9082	0.000	0.000	1.00	6.4	0.139	0.100	19.80	3.3	12.4		
7	0.140	9082	0.000	0.000	1.00	19.0	0.050	0.100	23.10	3.3	12.4		
8	0.140	9082	0.000	0.000	1.00	13.8	0.181	0.100	26.40	3.3	12.4		
9	0.140	9082	0.000	0.000	1.00	10.4	0.192	0.100	29.70	3.3	12.4		
10	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	33.00	3.3	12.4		
11	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	36.30	3.3	12.4		
12	0.140	9082	0.000	0.000	1.00	6.4	0.150	0.100	39.60	3.3	12.4		
13	0.140	9082	0.000	0.000	1.00	6.9	0.150	0.100	42.89	3.3	12.4		
14	0.140	9082	0.000	0.000	1.00	30.7	0.058	0.100	46.19	3.3	12.4		
15	0.140	9082	0.000	0.000	1.00	37.0	0.050	0.100	49.49	3.3	12.4		
16	0.140	9082	0.000	0.000	1.00	32.3	0.050	0.100	52.79	3.3	12.4		
17	0.140	9082	0.000	0.000	1.00	34.6	0.050	0.100	56.09	3.3	12.4		
18	0.140	9082	0.000	0.000	1.00	36.8	0.050	0.100	59.39	3.3	12.4		
19	0.140	9082	0.000	0.000	1.00	38.3	0.050	0.100	62.69	3.3	12.4		
20	0.140	9082	0.000	0.000	1.00	19.5	0.108	0.100	65.99	3.3	12.4		
21	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	69.29	3.3	12.4		
22	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	72.59	3.3	12.4		
23	0.140	9082	0.000	0.000	1.00	12.1	0.150	0.100	75.89	3.3	12.4		
24	0.140	9082	0.000	0.000	1.00	12.0	0.150	0.100	79.19	3.3	12.4		
25	0.140	9082	0.000	0.000	1.00	11.7	0.150	0.100	82.49	3.3	12.4		
26	0.140	9082	0.000	0.000	1.00	11.2	0.150	0.100	85.79	3.3	12.4		
Toe						1.5	0.150	0.100					

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

Depth Stroke Pressure Efficy
 ft ft Ratio
 85.00 10.81 1.00 0.800

▲ FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
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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	
390.8	117.9	8.77	8.77	-2.42	25	7	33.14	5	3 20.5	39.9
399.0	137.6	8.82	8.81	-2.47	25	7	33.32	5	3 20.6	39.8
407.5	165.4	8.88	8.86	-2.49	25	7	33.54	5	3 20.7	39.7
415.9	203.0	8.93	8.89	-2.55	25	7	33.72	5	3 20.8	39.6
424.3	267.2	8.98	8.94	-2.58	25	7	33.91	5	3 20.8	39.5

▲ FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 85.8 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.400 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8

85.8 12.40 29000. 492.0 3.3 0 16524. 21.8

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)			393.4		
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	0.140	9082	0.010	0.000	0.85	0.5	0.050	0.100	3.30	3.3	12.4
2	0.140	9082	0.000	0.000	1.00	1.6	0.050	0.100	6.60	3.3	12.4
3	0.140	9082	0.000	0.000	1.00	2.7	0.050	0.100	9.90	3.3	12.4
4	0.140	9082	0.000	0.000	1.00	4.1	0.091	0.100	13.20	3.3	12.4
5	0.140	9082	0.000	0.000	1.00	5.7	0.150	0.100	16.50	3.3	12.4
6	0.140	9082	0.000	0.000	1.00	9.3	0.106	0.100	19.80	3.3	12.4
7	0.140	9082	0.000	0.000	1.00	19.0	0.067	0.100	23.10	3.3	12.4
8	0.140	9082	0.000	0.000	1.00	12.6	0.200	0.100	26.40	3.3	12.4
9	0.140	9082	0.000	0.000	1.00	8.9	0.182	0.100	29.70	3.3	12.4
10	0.140	9082	0.000	0.000	1.00	6.2	0.150	0.100	33.00	3.3	12.4
11	0.140	9082	0.000	0.000	1.00	6.3	0.150	0.100	36.30	3.3	12.4
12	0.140	9082	0.000	0.000	1.00	6.5	0.150	0.100	39.60	3.3	12.4
13	0.140	9082	0.000	0.000	1.00	7.8	0.142	0.100	42.89	3.3	12.4
14	0.140	9082	0.000	0.000	1.00	37.3	0.050	0.100	46.19	3.3	12.4
15	0.140	9082	0.000	0.000	1.00	35.3	0.050	0.100	49.49	3.3	12.4
16	0.140	9082	0.000	0.000	1.00	32.9	0.050	0.100	52.79	3.3	12.4
17	0.140	9082	0.000	0.000	1.00	35.1	0.050	0.100	56.09	3.3	12.4
18	0.140	9082	0.000	0.000	1.00	37.2	0.050	0.100	59.39	3.3	12.4
19	0.140	9082	0.000	0.000	1.00	38.6	0.050	0.100	62.69	3.3	12.4
20	0.140	9082	0.000	0.000	1.00	13.1	0.144	0.100	65.99	3.3	12.4
21	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	69.29	3.3	12.4
22	0.140	9082	0.000	0.000	1.00	12.2	0.150	0.100	72.59	3.3	12.4
23	0.140	9082	0.000	0.000	1.00	12.1	0.150	0.100	75.89	3.3	12.4
24	0.140	9082	0.000	0.000	1.00	11.9	0.150	0.100	79.19	3.3	12.4
25	0.140	9082	0.000	0.000	1.00	11.6	0.150	0.100	82.49	3.3	12.4
26	0.140	9082	0.000	0.000	1.00	11.0	0.150	0.100	85.79	3.3	12.4
Toe						1.5	0.150	0.100			

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

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

Depth Stroke Pressure Efficy
ft ft Ratio
85.79 10.81 1.00 0.800



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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		
393.4	122.4	8.78	8.76	-2.54	25	7	33.04	5	3	20.5	39.9
401.8	146.9	8.83	8.82	-2.58	25	7	33.22	5	3	20.5	39.8
410.3	179.3	8.89	8.86	-2.63	25	7	33.42	5	3	20.5	39.7
418.9	223.4	8.94	8.90	-2.65	25	7	33.60	5	3	20.6	39.6
427.4	302.8	8.99	8.94	-2.70	25	7	33.76	5	3	20.6	39.5



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Resource International Inc

10/24/2021
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SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.486 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	
5.0	1.9	1.2	0.6	0.0	0.000	0.000	10.81	0.0	
10.0	6.1	5.0	1.1	0.0	0.000	0.000	10.81	0.0	
15.0	14.6	12.1	2.4	1.4	11.410	-1.823	3.86	23.5	
20.0	64.5	25.2	39.3	6.0	22.795	0.000	5.44	21.2	
25.0	52.2	50.3	1.8	4.1	21.064	-0.502	5.09	22.3	
30.0	67.3	65.1	2.2	6.2	23.125	0.000	5.49	21.1	
35.0	76.8	74.6	2.2	7.2	24.046	-0.701	5.69	20.5	
40.0	86.6	84.3	2.2	8.4	24.743	-1.604	5.86	20.0	
45.0	143.9	114.8	29.2	15.6	27.815	-2.233	6.71	19.3	
50.0	181.9	168.8	13.1	18.7	28.598	-1.667	6.97	19.3	
55.0	233.1	220.0	13.1	25.5	29.933	-2.817	7.41	20.0	
60.0	289.2	276.2	13.1	38.5	31.418	-3.270	7.98	20.9	
65.0	318.6	317.2	1.5	47.9	32.091	-3.611	8.22	21.0	
70.0	337.2	335.7	1.5	58.7	32.345	-3.376	8.38	21.1	
75.0	355.6	354.2	1.5	73.8	32.581	-2.623	8.47	20.8	

80.0	373.7	372.2	1.5	94.4	32.749	-2.212	8.64	20.7
85.0	390.8	389.4	1.5	117.9	33.136	-2.416	8.77	20.5
85.8	393.4	392.0	1.5	122.4	33.042	-2.541	8.78	20.5

Total Driving Time 58 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 2422

Depth	Rut	G/L at Frictn	Shaft End Bg	and Toe: 0.528	1.000	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi			ksi	ft	kip-ft
5.0	1.9	1.2	0.6	0.0	0.000	0.000	0.000	0.000	11.86	0.0
10.0	6.1	5.0	1.1	0.0	0.000	0.000	0.000	0.000	11.86	0.0
15.0	14.8	12.4	2.4	1.4	11.516	-1.654	3.92	23.5		
20.0	65.1	25.8	39.3	6.1	22.879	0.000	5.46	21.2		
25.0	53.5	51.6	1.8	4.3	21.258	-0.428	5.13	22.2		
30.0	69.8	67.6	2.2	6.6	23.386	0.000	5.55	20.9		
35.0	79.8	77.5	2.2	7.6	24.333	-0.672	5.75	20.4		
40.0	90.1	87.8	2.2	8.9	25.042	-1.894	5.93	19.8		
45.0	147.8	118.6	29.2	16.0	28.009	-2.065	6.75	19.3		
50.0	185.7	172.6	13.1	19.2	28.763	-1.614	7.02	19.4		
55.0	236.9	223.9	13.1	26.4	30.124	-2.767	7.45	20.0		
60.0	293.0	280.0	13.1	39.9	31.571	-3.431	8.02	20.9		
65.0	322.9	321.5	1.5	50.1	32.280	-3.693	8.26	21.1		
70.0	342.5	341.0	1.5	63.6	32.518	-3.321	8.43	21.1		
75.0	361.9	360.5	1.5	80.0	32.779	-2.499	8.52	21.0		
80.0	381.0	379.5	1.5	104.8	32.966	-2.065	8.71	20.8		
85.0	399.0	397.6	1.5	137.6	33.325	-2.474	8.82	20.6		
85.8	401.8	400.3	1.5	146.9	33.222	-2.581	8.83	20.5		

Total Driving Time 64 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 2629

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SUMMARY OVER DEPTHS

Depth	Rut	G/L at Frictn	Shaft End Bg	and Toe: 0.571	1.000	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi			ksi	ft	kip-ft
5.0	1.9	1.2	0.6	0.0	0.000	0.000	0.000	0.000	11.86	0.0
10.0	6.1	5.0	1.1	0.0	0.000	0.000	0.000	0.000	11.86	0.0
15.0	15.0	12.6	2.4	1.4	11.539	-1.666	3.89	23.7		
20.0	65.7	26.4	39.3	6.1	22.914	0.000	5.47	21.2		
25.0	54.8	53.0	1.8	4.4	21.452	-0.423	5.16	22.1		
30.0	72.3	70.1	2.2	6.8	23.653	0.000	5.60	20.8		
35.0	82.8	80.6	2.2	8.0	24.432	-1.046	5.76	20.1		
40.0	93.7	91.4	2.2	9.4	25.365	-1.942	6.01	19.8		
45.0	151.7	122.5	29.2	16.5	28.182	-1.874	6.79	19.3		
50.0	189.6	176.6	13.1	19.8	28.964	-1.837	7.07	19.5		
55.0	240.8	227.8	13.1	27.2	30.368	-2.663	7.51	20.1		
60.0	297.0	283.9	13.1	41.5	31.745	-3.558	8.07	21.0		
65.0	327.3	325.8	1.5	52.7	32.486	-3.744	8.31	21.2		
70.0	347.9	346.4	1.5	67.4	32.680	-3.338	8.49	21.3		
75.0	368.4	366.9	1.5	88.8	32.996	-2.382	8.59	21.0		
80.0	388.4	387.0	1.5	118.0	33.158	-1.981	8.77	21.0		
85.0	407.5	406.0	1.5	165.4	33.539	-2.490	8.88	20.7		
85.8	410.3	408.9	1.5	179.3	33.418	-2.630	8.89	20.5		

Total Driving Time 70 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 2890

Depth	Rut	G/L at Frictn	Shaft End Bg	and Toe: 0.614	1.000	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi			ksi	ft	kip-ft
5.0	1.9	1.2	0.6	0.0	0.000	0.000	0.000	0.000	11.86	0.0
10.0	6.1	5.0	1.1	0.0	0.000	0.000	0.000	0.000	11.86	0.0
15.0	15.3	12.9	2.4	1.4	11.560	-1.625	3.90	23.9		
20.0	66.3	27.0	39.3	6.2	22.997	0.000	5.48	21.2		
25.0	56.2	54.3	1.8	4.6	21.637	-0.422	5.20	22.0		
30.0	74.9	72.6	2.2	7.1	23.927	-0.138	5.66	20.7		
35.0	85.9	83.6	2.2	8.4	24.753	-1.364	5.83	20.0		
40.0	97.3	95.0	2.2	10.0	25.679	-1.927	6.08	19.7		
45.0	155.6	126.5	29.2	17.0	28.398	-1.716	6.83	19.3		
50.0	193.6	180.5	13.1	20.3	29.158	-2.039	7.11	19.6		
55.0	244.8	231.7	13.1	28.1	30.567	-2.538	7.56	20.2		
60.0	300.9	287.9	13.1	43.0	31.920	-3.679	8.11	21.1		

65.0	331.7	330.2	1.5	55.4	32.678	-3.799	8.36	21.3
70.0	353.3	351.8	1.5	72.7	32.887	-3.313	8.55	21.3
75.0	374.8	373.4	1.5	96.8	33.274	-2.359	8.67	21.2
80.0	395.9	394.4	1.5	136.2	33.369	-2.066	8.83	21.1
85.0	415.9	414.4	1.5	203.0	33.723	-2.550	8.93	20.8
85.8	418.9	417.4	1.5	223.4	33.603	-2.654	8.94	20.6

Total Driving Time 79 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 3211

▲
FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2
Resource International Inc

10/24/2021
GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.657 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	
5.0	1.9	1.2	0.6	0.0	0.000	0.000	11.86	0.0	
10.0	6.1	5.0	1.1	0.0	0.000	0.000	11.86	0.0	
15.0	15.5	13.1	2.4	1.4	11.639	-1.559	3.91	23.9	
20.0	66.9	27.6	39.3	6.3	23.024	0.000	5.49	21.1	
25.0	57.5	55.7	1.8	4.7	21.822	-0.419	5.23	21.9	
30.0	77.4	75.2	2.2	7.4	24.170	-0.536	5.70	20.5	
35.0	88.9	86.7	2.2	8.8	25.063	-1.555	5.89	20.0	
40.0	100.8	98.6	2.2	10.6	25.987	-1.938	6.16	19.6	
45.0	159.5	130.4	29.2	17.5	28.556	-1.547	6.87	19.3	
50.0	197.5	184.4	13.1	21.0	29.308	-2.193	7.15	19.6	
55.0	248.7	235.6	13.1	29.0	30.786	-2.562	7.61	20.3	
60.0	304.8	291.8	13.1	44.5	32.085	-3.799	8.16	21.3	
65.0	336.1	334.6	1.5	58.3	32.871	-3.846	8.41	21.4	
70.0	358.7	357.3	1.5	80.4	32.810	-3.333	8.51	21.2	
75.0	381.3	379.8	1.5	108.6	33.435	-2.489	8.71	21.2	
80.0	403.3	401.9	1.5	159.6	33.546	-2.174	8.89	21.1	
85.0	424.3	422.8	1.5	267.2	33.909	-2.575	8.98	20.8	
85.8	427.4	426.0	1.5	302.8	33.763	-2.699	8.99	20.6	

Total Driving Time 91 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 3685

▲
FRA-70-13.01-RA-B-015-1-13-HP10x42-Case2
Resource International Inc

10/24/2021
GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

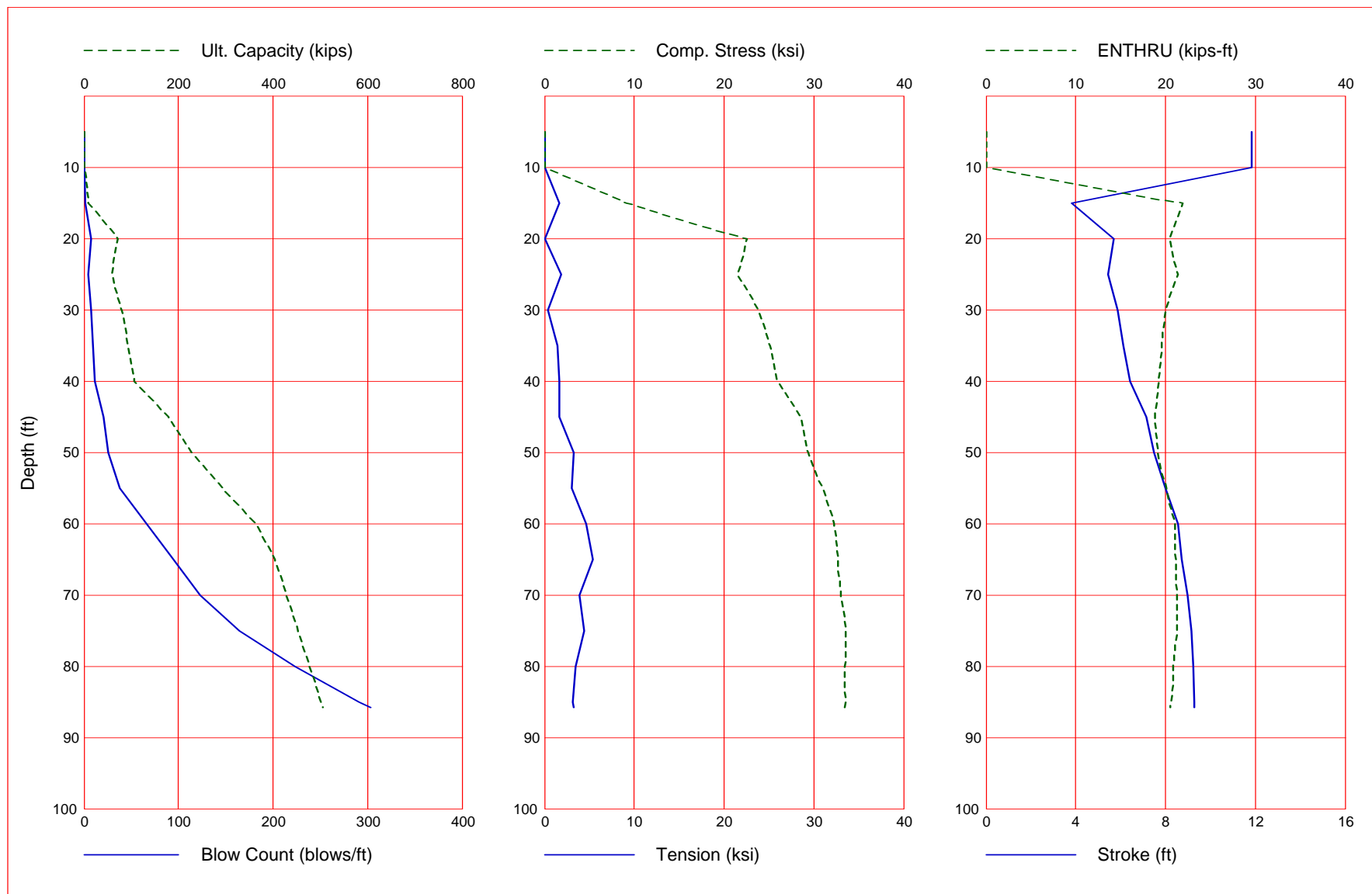
Depth	Temp.	Wait	Equivalent	Pressure	Stiffn.	Cushion
ft	Length	Time	Stroke	Ratio	Factor	CoR
	ft	hr	ft			
5.00	85.79	0.00	10.81	1.00	0.80	1.00
10.00	85.79	0.00	10.81	1.00	0.80	1.00
15.00	85.79	0.00	10.81	1.00	0.80	1.00
20.00	85.79	0.00	10.81	1.00	0.80	1.00
25.00	85.79	0.00	10.81	1.00	0.80	1.00
30.00	85.79	0.00	10.81	1.00	0.80	1.00
35.00	85.79	0.00	10.81	1.00	0.80	1.00
40.00	85.79	0.00	10.81	1.00	0.80	1.00
45.00	85.79	0.00	10.81	1.00	0.80	1.00
50.00	85.79	0.00	10.81	1.00	0.80	1.00
55.00	85.79	0.00	10.81	1.00	0.80	1.00
60.00	85.79	0.00	10.81	1.00	0.80	1.00
65.00	85.79	0.00	10.81	1.00	0.80	1.00
70.00	85.79	0.00	10.81	1.00	0.80	1.00
75.00	85.79	0.00	10.81	1.00	0.80	1.00
80.00	85.79	0.00	10.81	1.00	0.80	1.00
85.00	85.79	0.00	10.81	1.00	0.80	1.00
85.79	85.79	0.00	10.81	1.00	0.80	1.00

Soil Layer Resistance Values

Depth	Shaft	End	Shaft	Toe	Shaft	Toe	Soil	Limit	Setup
ft	Res.	Bearing	Quake	Quake	Damping	Damping	Setup	Distance	Time
	k/ft2	kips	inch	inch	s/ft	s/ft	Normlzd	ft	hrs
0.01	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
3.00	0.09	0.38	0.100	0.100	0.050	0.150	0.000	6.000	24.000
6.00	0.18	0.76	0.100	0.100	0.050	0.150	0.000	6.000	24.000
9.00	0.27	1.14	0.100	0.100	0.050	0.150	0.000	6.000	24.000

12.00	0.36	1.15	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.49	0.38	1.15	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.51	0.88	2.42	0.100	0.100	0.150	0.150	0.778	6.000	336.000
18.79	0.88	2.42	0.100	0.100	0.150	0.150	0.778	6.000	336.000
18.81	1.57	36.71	0.100	0.100	0.050	0.150	0.000	6.000	24.000
21.80	1.85	43.28	0.100	0.100	0.050	0.150	0.000	6.000	24.000
22.79	1.95	45.45	0.100	0.100	0.050	0.150	0.000	6.000	24.000
22.81	2.38	1.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
27.79	2.38	1.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
27.81	0.95	2.23	0.100	0.100	0.150	0.150	0.778	6.000	336.000
36.80	0.96	2.23	0.100	0.100	0.150	0.150	0.778	6.000	336.000
39.80	1.03	2.23	0.100	0.100	0.150	0.150	0.778	6.000	336.000
42.79	1.11	2.23	0.100	0.100	0.150	0.150	0.778	6.000	336.000
42.81	3.28	29.17	0.100	0.100	0.050	0.150	0.000	6.000	24.000
45.80	3.54	29.17	0.100	0.100	0.050	0.150	0.000	6.000	24.000
47.79	3.71	29.17	0.100	0.100	0.050	0.150	0.000	6.000	24.000
47.81	2.81	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
50.80	3.00	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
53.80	3.18	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
56.80	3.37	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
57.99	3.44	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
58.01	3.45	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
61.00	3.54	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
62.79	3.60	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
62.81	1.88	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
71.80	1.87	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
74.80	1.85	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
77.80	1.83	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
80.80	1.78	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
83.80	1.70	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
85.79	1.64	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000

Gain/Loss 3 at Shaft and Toe 0.571 / 1.000



Gain/Loss 3 at Shaft and Toe 0.571 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	0.1	0.0	0.1	0.0	0.000	0.000	11.86	0.0
10.0	0.2	0.0	0.2	0.0	0.000	0.000	11.86	0.0
15.0	8.8	5.8	3.0	1.3	9.070	-1.686	3.81	21.9
20.0	72.1	23.0	49.2	7.1	22.522	0.000	5.71	20.4
25.0	58.8	56.5	2.3	4.9	21.471	-1.911	5.43	21.4
30.0	79.9	77.1	2.8	7.9	23.869	-0.344	5.87	20.0
35.0	92.7	89.9	2.8	9.5	25.092	-1.413	6.14	19.6
40.0	105.6	102.8	2.8	11.4	25.932	-1.603	6.40	19.2
45.0	178.4	142.0	36.5	20.5	28.487	-1.686	7.15	18.8
50.0	227.8	211.5	16.3	25.8	29.380	-3.244	7.47	19.1
55.0	293.4	277.1	16.3	38.1	30.981	-2.998	8.02	20.1
60.0	365.3	349.0	16.3	66.6	32.259	-4.658	8.57	21.1
65.0	403.8	402.0	1.8	95.1	32.734	-5.341	8.73	21.2
70.0	428.5	426.7	1.8	122.6	33.013	-3.924	8.96	21.3
75.0	453.2	451.4	1.8	164.4	33.528	-4.434	9.14	21.3
80.0	477.6	475.8	1.8	223.7	33.403	-3.427	9.24	20.9
85.0	501.5	499.6	1.8	291.4	33.569	-3.174	9.30	20.6
85.8	505.1	503.3	1.8	303.2	33.463	-3.258	9.29	20.5

Total Continuous Driving Time 124.00 minutes; Total Number of Blows 4957 (starting at penetration 5.0 ft)

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.
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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: J:\GEOTECH\PROJECTS\2020\W-20-025 FRA-70-13.01\ANALYSIS\DRIVEABILITY\REAR ABUTMENT\HP 12X53 - CASE-1\FRA-70-13.01 - REAR ABUTMENT HP 15X53-B-015-1-13-CASE-1.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1
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 15.500 12.000 Unknown
W Cp A Cp E Cp T Cp CoR ROut StCp
1.900 227.000 530.0 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 WPlle Peri CI CoR ROut
85.790 15.50 29000.0 492.000 3.970 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 Efficy 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	0.10	0.05	0.15	1.00	6.00	24.000
3.00	0.00	0.07	0.10	0.10	0.05	0.15	1.00	6.00	24.000
6.00	0.00	0.14	0.10	0.10	0.05	0.15	1.00	6.00	24.000
9.00	0.00	0.20	0.10	0.10	0.05	0.15	1.00	6.00	24.000
12.00	0.00	0.27	0.10	0.10	0.05	0.15	1.00	6.00	24.000
12.49	0.00	0.28	0.10	0.10	0.05	0.15	1.00	6.00	24.000
12.51	0.88	3.03	0.10	0.10	0.15	0.15	1.50	6.00	336.000
18.79	0.88	3.03	0.10	0.10	0.15	0.15	1.50	6.00	336.000
18.81	1.69	45.89	0.10	0.10	0.05	0.15	1.00	6.00	24.000
21.80	2.00	54.09	0.10	0.10	0.05	0.15	1.00	6.00	24.000
22.79	2.10	56.81	0.10	0.10	0.05	0.15	1.00	6.00	24.000
22.81	2.38	2.30	0.10	0.10	0.20	0.15	1.75	6.00	720.000
27.79	2.38	2.30	0.10	0.10	0.20	0.15	1.75	6.00	720.000
27.81	0.95	2.79	0.10	0.10	0.20	0.15	1.50	6.00	336.000
39.80	0.99	2.79	0.10	0.10	0.15	0.15	1.50	6.00	336.000
42.79	1.05	2.79	0.10	0.10	0.15	0.15	1.50	6.00	336.000
42.81	3.52	36.46	0.10	0.10	0.05	0.15	1.00	6.00	24.000
45.80	3.79	36.46	0.10	0.10	0.05	0.15	1.00	6.00	24.000
47.79	3.97	36.46	0.10	0.10	0.05	0.15	1.00	6.00	24.000
47.81	2.99	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
50.80	3.19	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
53.80	3.39	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
56.80	3.59	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
57.99	3.67	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
58.01	3.67	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
61.00	3.77	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
62.79	3.83	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
62.81	1.88	1.82	0.10	0.10	0.15	0.15	1.50	6.00	336.000
74.80	1.86	1.82	0.10	0.10	0.15	0.15	1.50	6.00	336.000
77.80	1.84	1.82	0.10	0.10	0.15	0.15	1.50	6.00	336.000
80.80	1.83	1.82	0.10	0.10	0.15	0.15	1.50	6.00	336.000
83.80	1.79	1.82	0.10	0.10	0.15	0.15	1.50	6.00	336.000
85.79	1.74	1.82	0.10	0.10	0.15	0.15	1.50	6.00	336.000

Gain/Loss factors: shaft and toe

0.48600 0.52800 0.57100 0.61400 0.65700
 1.00000 1.00000 1.00000 1.00000 1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
5.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
10.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
15.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
20.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
25.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
30.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
35.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
40.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
45.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
50.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
55.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
60.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
65.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
70.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
75.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
80.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
85.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
85.79	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

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1

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	1.900	60155.0	0.800	0.0100	5.8
Combined Pile Top		11352.3			

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

Cross Sect. Area	(in2)	227.00
Elastic-Modulus	(ksi)	530.0
Thickness	(inch)	2.00
Coeff of Restitution		0.8
RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0

PILE CUSHION

Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	0.00
Coeff of Restitution		1.0
RoundOut	(ft)	0.0
Stiffness	(kips/in)	0.0



FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1
Resource International Inc

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GRLWEAP Version 2010

Depth	(ft)	5.0	Standard Soil Setup	
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)				0.1	
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	85.79	4.0	15.5
Toe						0.1	0.150	0.100			

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

4.543 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)	0.544
Driveability Analysis			
Soil Damping Option	Smith		

Depth ft	Stroke ft	Pressure Ratio	Efficy
5.00	10.81	1.00	0.800

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INITIAL STATIC ANALYSIS: Total Wt, Sum(R)      7.2      0.1
  Hammer+Pile Weight > Rult: Pile Runs
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INITIAL STATIC ANALYSIS: Total Wt, Sum(R)      7.2      0.1
  Hammer+Pile Weight > Rult: Pile Runs
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INITIAL STATIC ANALYSIS: Total Wt, Sum(R)      7.2      0.1
Hammer+Pile Weight > Rult: Pile Runs
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INITIAL STATIC ANALYSIS: Total Wt, Sum(R)      7.2      0.1
  Hammer+Pile Weight > Rult: Pile Runs
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INITIAL STATIC ANALYSIS: Total Wt, Sum(R)      7.2      0.1
Hammer+Pile Weight > Rult: Pile Runs
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FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1
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Rut kips	Bl Ct b/ft	Stroke down	(ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
0.1	0.0	10.81	0.00	0.00	1	0	0.00	1	0	0.0	78.4
0.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4
0.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4
0.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4
0.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1 10/24/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft)	10.0	Standard Soil Setup	
Shaft Gain/Loss Factor	0.486	Toe Gain/Loss Factor	1.000

PILE PROFILE:				
Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time $2L/c$ (ms) 10.383

Pile and Soil Model							Total Capacity Rut (kips)				0.2	
No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTot ft	Perim ft	Area in ²	
1	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5	
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5	
23	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	75.89	4.0	15.5	
26	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	85.79	4.0	15.5	
Toe						0.2	0.150	0.100				

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
10.00	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.2 0.2

Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.2 0.2
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.2 0.2
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.2 0.2
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.2 0.2
Hammer+Pile Weight > Rult: Pile Runs

↑
FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1 10/24/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min	
0.2	0.0	10.81	0.00	0.00	1	0	0.00	1	0	0.0	78.4
0.2	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4
0.2	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4
0.2	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4
0.2	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4

↑
FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1 10/24/2021
Resource International Inc GRLWEAP Version 2010

Depth	(ft)	15.0	Standard Soil Setup	
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

No.	Weight kips	Pile and Soil Model Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Total Capacity Soil-S kips	Rut (kips) Soil-D Quake s/ft inch	8.3 LbTop ft	Perim ft	Area in2
1	0.175	11352	0.010	0.000	0.85	0.0	0.000 0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000 0.100	6.60	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	0.0	0.050 0.100	72.59	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	5.2	0.150 0.100	85.79	4.0	15.5
Toe						3.0	0.150 0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
15.00	10.81	1.00	0.800

↑
FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1 10/24/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min	
8.3	1.2	3.74	3.74	-1.21	10	32	8.78	1	7	20.9	61.0
8.5	1.2	3.78	3.77	-1.48	10	16	8.96	1	7	21.4	60.8
8.8	1.3	3.81	3.80	-1.69	10	16	9.07	1	7	21.9	60.6
9.1	1.3	3.85	3.84	-1.81	10	16	9.19	1	7	22.2	60.4
9.4	1.3	3.88	3.84	-1.87	9	16	9.33	1	7	21.9	60.2

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FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1 10/24/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 20.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
 Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)			70.7		
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	65.99	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	1.9	0.149	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	12.7	0.097	0.100	85.79	4.0	15.5
Toe						49.2	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
20.00	10.81	1.00	0.800



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 Resource International Inc

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 GRLWEAP Version 2010

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
70.7	6.9	5.69	5.74	0.00	1	0	22.41	22	6 20.4 49.3
71.4	7.0	5.70	5.75	0.00	1	0	22.48	22	6 20.4 49.3
72.1	7.1	5.71	5.77	0.00	1	0	22.52	22	6 20.4 49.2
72.8	7.2	5.73	5.78	0.00	1	0	22.57	22	6 20.4 49.2
73.6	7.3	5.74	5.79	0.00	1	0	22.64	22	6 20.3 49.1



FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1
 Resource International Inc

10/24/2021
 GRLWEAP Version 2010

Depth (ft) 25.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
 Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)			55.6		
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	62.69	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	5.4	0.150	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	22.0	0.056	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	19.0	0.155	0.100	85.79	4.0	15.5
Toe						2.3	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
25.00	10.81	1.00	0.800

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1 10/24/2021
 Resource International Inc GRLWEAP Version 2010

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
55.6	4.6	5.36 5.33	-2.27	3	12	21.02	22 6	21.7 51.2
57.2	4.7	5.40 5.37	-2.09	3	12	21.27	22 6	21.5 51.0
58.8	4.9	5.43 5.41	-1.91	3	12	21.47	22 6	21.4 50.8
60.5	5.1	5.46 5.45	-1.70	3	12	21.68	22 6	21.3 50.6
62.1	5.3	5.50 5.48	-1.51	3	12	21.86	23 6	21.2 50.5

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth	(ft)	30.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	Rut	(kips)	73.9
	kips	k/in	ft	ft		kips	s/ft	inch	LbTop	Perim	Area
1	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	56.09	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	2.1	0.150	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	13.2	0.093	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	23.8	0.082	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	15.1	0.200	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	10.0	0.198	0.100	85.79	4.0	15.5
Toe						2.8	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
30.00	10.81	1.00	0.800

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1 10/24/2021
 Resource International Inc GRLWEAP Version 2010

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
73.9	7.2	5.75 5.80	-0.45	2	12	23.31	22 6	20.2 49.1
76.9	7.5	5.81 5.86	-0.29	26	18	23.60	22 6	20.1 48.8
79.9	7.9	5.87 5.91	-0.34	22	50	23.87	22 6	20.0 48.6
83.0	8.2	5.93 5.97	-0.76	22	50	24.13	22 6	19.9 48.3
86.0	8.6	5.99 6.02	-1.03	22	50	24.41	22 6	19.8 48.1

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth	(ft)	35.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)			85.4		
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	52.79	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	5.7	0.150	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	22.6	0.055	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	18.7	0.159	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	13.7	0.200	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	7.5	0.191	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	7.6	0.177	0.100	85.79	4.0	15.5
Toe						2.8	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficacy
35.00	10.81	1.00	0.800

▲ FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1 10/24/2021
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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min	
85.4	8.5	6.00	6.03	-1.26	25	18	24.48	20	6	19.7	48.1
89.0	9.0	6.07	6.10	-1.11	20	50	24.77	20	6	19.6	47.8
92.7	9.5	6.14	6.16	-1.41	20	50	25.09	20	6	19.6	47.5
96.3	10.0	6.21	6.23	-1.59	20	50	25.35	20	6	19.4	47.3
100.0	10.6	6.27	6.29	-1.52	20	50	25.65	20	6	19.4	47.0

▲ FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1 10/24/2021
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Depth (ft)	40.0	Standard Soil Setup
Shaft Gain/Loss Factor	0.486	Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type Unknown
Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)			97.1		
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	46.19	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	2.3	0.150	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	13.8	0.090	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	23.5	0.087	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	15.1	0.200	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	9.8	0.198	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	7.5	0.184	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	7.6	0.170	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	7.7	0.156	0.100	85.79	4.0	15.5
Toe						2.8	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
40.00	10.81	1.00	0.800

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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
97.1	10.1	6.24 6.26	-1.67	24	8	25.29	19 6	19.3 47.1
101.3	10.7	6.32 6.33	-1.60	6	47	25.64	19 6	19.3 46.9
105.6	11.4	6.40 6.41	-1.60	7	47	25.93	19 6	19.2 46.6
109.9	12.2	6.47 6.48	-1.79	18	40	26.21	19 6	19.2 46.3
114.3	12.9	6.53 6.55	-2.14	19	40	26.48	19 6	19.1 46.1

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth	(ft)	45.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	Rut (kips)	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	LbTop	ft	in2
1	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
13	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	42.89	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	5.9	0.150	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	23.2	0.053	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	18.3	0.163	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	13.5	0.200	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	7.5	0.190	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	7.6	0.176	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	7.7	0.163	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	7.8	0.151	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	34.3	0.063	0.100	85.79	4.0	15.5
Toe						36.5	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
45.00	10.81	1.00	0.800

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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
169.1	19.2	7.06 7.04	-1.96	17	35	28.11	17 5	18.7 44.4
173.7	19.8	7.10 7.07	-1.81	17	35	28.31	17 5	18.8 44.3
178.4	20.5	7.15 7.13	-1.69	17	35	28.49	17 5	18.8 44.1
183.1	21.2	7.20 7.18	-1.79	17	30	28.70	17 5	18.9 43.9
187.8	21.8	7.26 7.23	-2.09	17	30	28.96	17 5	19.0 43.8

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Depth	(ft)	50.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
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Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model					Total Capacity	Rut (kips)	218.5				
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
11	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	36.30	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	2.5	0.150	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	14.3	0.087	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	23.2	0.092	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	15.1	0.200	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	9.6	0.197	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	7.5	0.183	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	7.6	0.169	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	7.7	0.156	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	15.0	0.107	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	48.8	0.050	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	43.9	0.050	0.100	85.79	4.0	15.5
Toe						16.3	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
50.00	10.81	1.00	0.800

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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	
218.5	24.0	7.38	7.36	-3.00	16	29	29.06	16	5	19.1	43.4
223.1	24.9	7.43	7.41	-3.15	16	29	29.22	16	5	19.1	43.3
227.8	25.8	7.47	7.45	-3.24	16	29	29.38	16	5	19.1	43.2
232.5	26.7	7.52	7.50	-3.29	16	29	29.58	16	5	19.2	43.0
237.2	27.6	7.56	7.55	-3.26	16	29	29.74	16	5	19.3	42.9

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Depth	(ft)	55.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model					Total Capacity	Rut (kips)	284.1				
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
10	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	33.00	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	6.1	0.150	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	23.8	0.051	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	18.0	0.168	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	13.3	0.200	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	7.5	0.190	0.100	62.69	4.0	15.5

20	0.175	11352	0.000	0.000	1.00	7.6	0.176	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	7.7	0.162	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	7.9	0.151	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	35.6	0.061	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	48.5	0.050	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	41.2	0.050	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	44.0	0.050	0.100	85.79	4.0	15.5
Toe						16.3	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
55.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	i ksi	t Comp	Str ksi	i	t ENTHRU kip-ft	Bl Rt b/min
284.1	35.4	7.92	7.88	-2.74	14	28	30.59	14	4 19.9
288.7	36.9	7.97	7.94	-2.86	14	26	30.78	14	4 19.9
293.4	38.1	8.02	7.98	-3.00	14	26	30.98	14	4 20.1
298.1	39.8	8.06	8.04	-3.12	14	26	31.13	14	4 20.1
302.8	41.4	8.12	8.09	-3.21	14	26	31.37	14	4 20.2

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Depth (ft)	60.0	Standard Soil Setup
Shaft Gain/Loss Factor	0.486	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2)	15.500	Pile Type	Unknown
Pile Size (inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips) 356.0					
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
8	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	26.40	4.0	15.5
12	0.175	11352	0.000	0.000	1.00	2.7	0.150	0.100	39.60	4.0	15.5
13	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	42.89	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	14.8	0.084	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	22.9	0.097	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	15.1	0.200	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	9.3	0.197	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	7.5	0.183	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	7.6	0.169	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	7.7	0.155	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	16.2	0.102	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	48.9	0.050	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	43.6	0.050	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	42.6	0.050	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	45.5	0.050	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	48.1	0.050	0.100	85.79	4.0	15.5
Toe						16.3	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
60.00	10.81	1.00	0.800

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1 10/24/2021

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
356.0	59.4	8.49	8.47	-4.18	12	22	31.94	13	4	21.0	40.5
360.6	62.6	8.52	8.51	-4.44	12	22	32.06	13	4	21.0	40.4
365.3	66.6	8.57	8.57	-4.66	12	22	32.26	13	4	21.1	40.3
370.0	70.2	8.62	8.61	-4.91	12	22	32.41	13	4	21.2	40.2
374.7	74.0	8.67	8.65	-5.15	12	22	32.56	13	4	21.3	40.1

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FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1

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Resource International Inc

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Depth ft	Stroke ft	Pressure Ratio	Efficy
65.0	10.81	1.00	0.800

PILE PROFILE:

Toe Area in2	Pile Type	Unknown
15.500		
12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

No.	Weight kips	Pile and Soil Model Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	Rut (kips) LbTop ft	Perim ft	Area in2
1	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
7	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	23.10	4.0	15.5
11	0.175	11352	0.000	0.000	1.00	6.3	0.150	0.100	36.30	4.0	15.5
12	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	39.60	4.0	15.5
13	0.175	11352	0.000	0.000	1.00	24.3	0.050	0.100	42.89	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	17.6	0.172	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	13.0	0.200	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	7.5	0.189	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	7.6	0.176	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	7.7	0.162	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	7.9	0.151	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	36.8	0.060	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	48.2	0.050	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	41.2	0.050	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	44.1	0.050	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	47.0	0.050	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	49.0	0.050	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	26.5	0.100	0.100	85.79	4.0	15.5
Toe						1.8	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
65.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
393.4	81.8	8.71	8.71	-5.08	11	22	32.56	11	4	21.1	40.0
398.5	90.0	8.67	8.76	-5.20	11	22	32.52	11	4	21.0	40.0
403.8	95.1	8.73	8.80	-5.34	11	22	32.73	11	4	21.2	39.9
409.1	101.8	8.80	8.85	-5.40	11	22	32.93	11	4	21.3	39.8
414.3	108.3	8.86	8.90	-5.50	11	22	33.13	11	4	21.4	39.6

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FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1

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Resource International Inc

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Depth ft	Stroke ft	Pressure Ratio	Efficy
70.0	10.81	1.00	0.800

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)			415.7		
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
5	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	16.50	4.0	15.5
9	0.175	11352	0.000	0.000	1.00	2.9	0.150	0.100	29.70	4.0	15.5
10	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	33.00	4.0	15.5
11	0.175	11352	0.000	0.000	1.00	15.4	0.082	0.100	36.30	4.0	15.5
12	0.175	11352	0.000	0.000	1.00	22.6	0.102	0.100	39.60	4.0	15.5
13	0.175	11352	0.000	0.000	1.00	15.1	0.200	0.100	42.89	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	9.1	0.197	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	7.6	0.182	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	7.6	0.169	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	7.7	0.155	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	17.4	0.097	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	49.0	0.050	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	43.3	0.050	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	42.7	0.050	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	45.6	0.050	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	48.2	0.050	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	43.3	0.060	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	85.79	4.0	15.5
Toe						1.8	0.150	0.100			

4.543 kips total unreduded pile weight (g= 32.17 ft/s2)

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
70.00	10.81	1.00	0.800



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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
415.7	102.6	8.84	8.88	-4.10	11	22	32.65	10	4	21.0	39.7
422.0	110.9	8.90	8.93	-4.03	11	22	32.84	10	4	21.2	39.6
428.5	122.6	8.96	8.97	-3.92	11	21	33.01	10	4	21.3	39.5
435.0	134.6	9.02	9.03	-3.90	9	19	33.20	10	4	21.4	39.3
441.5	147.8	9.08	9.07	-4.06	9	19	33.37	10	4	21.5	39.2



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Resource International Inc

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GRLWEAP Version 2010

Depth (ft)	75.0	Standard Soil Setup
Shaft Gain/Loss Factor	0.486	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)			437.9		
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5

4	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	13.20	4.0	15.5
8	0.175	11352	0.000	0.000	1.00	6.5	0.150	0.100	26.40	4.0	15.5
9	0.175	11352	0.000	0.000	1.00	7.4	0.144	0.100	29.70	4.0	15.5
10	0.175	11352	0.000	0.000	1.00	24.5	0.050	0.100	33.00	4.0	15.5
11	0.175	11352	0.000	0.000	1.00	17.3	0.176	0.100	36.30	4.0	15.5
12	0.175	11352	0.000	0.000	1.00	12.8	0.200	0.100	39.60	4.0	15.5
13	0.175	11352	0.000	0.000	1.00	7.5	0.189	0.100	42.89	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	7.6	0.175	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	7.7	0.161	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	7.9	0.151	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	38.1	0.058	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	47.9	0.050	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	41.3	0.050	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	44.2	0.050	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	47.0	0.050	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	49.0	0.050	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	25.4	0.103	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	85.79	4.0	15.5
Toe						1.8	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
75.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
437.9	126.5	9.02	9.03	-4.22	8	19	33.13	8	3	21.1
445.5	143.7	9.08	9.08	-4.34	8	19	33.33	8	3	21.2
453.2	164.4	9.14	9.13	-4.43	8	19	33.53	8	3	21.3
460.9	187.4	9.20	9.17	-4.51	8	19	33.73	8	3	21.4
468.7	207.9	9.25	9.21	-4.57	8	19	33.91	8	3	21.5

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case1 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft)	80.0	Standard Soil Setup
Shaft Gain/Loss Factor	0.486	Toe Gain/Loss Factor
		1.000

PILE PROFILE:

Toe Area (in2)	15.500	Pile Type	Unknown
Pile Size (inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

No.	Weight kips	Pile and Soil Model Stiffn C-Slk T-Slk CoR	Soil-S kips	Total Capacity Soil-D Quake s/ft	Rut (kips) LbTop	Perim ft	Area in2
1	0.175	11352 0.010 0.000 0.85	0.0	0.000 0.100	3.30	4.0	15.5
2	0.175	11352 0.000 0.000 1.00	0.0	0.050 0.100	6.60	4.0	15.5
6	0.175	11352 0.000 0.000 1.00	3.2	0.150 0.100	19.80	4.0	15.5
7	0.175	11352 0.000 0.000 1.00	6.9	0.150 0.100	23.10	4.0	15.5
8	0.175	11352 0.000 0.000 1.00	15.9	0.079 0.100	26.40	4.0	15.5
9	0.175	11352 0.000 0.000 1.00	22.4	0.106 0.100	29.70	4.0	15.5
10	0.175	11352 0.000 0.000 1.00	15.1	0.200 0.100	33.00	4.0	15.5
11	0.175	11352 0.000 0.000 1.00	8.9	0.196 0.100	36.30	4.0	15.5
12	0.175	11352 0.000 0.000 1.00	7.6	0.182 0.100	39.60	4.0	15.5
13	0.175	11352 0.000 0.000 1.00	7.6	0.168 0.100	42.89	4.0	15.5
14	0.175	11352 0.000 0.000 1.00	7.7	0.155 0.100	46.19	4.0	15.5
15	0.175	11352 0.000 0.000 1.00	18.6	0.093 0.100	49.49	4.0	15.5
16	0.175	11352 0.000 0.000 1.00	49.2	0.050 0.100	52.79	4.0	15.5
17	0.175	11352 0.000 0.000 1.00	43.0	0.050 0.100	56.09	4.0	15.5
18	0.175	11352 0.000 0.000 1.00	42.8	0.050 0.100	59.39	4.0	15.5
19	0.175	11352 0.000 0.000 1.00	45.7	0.050 0.100	62.69	4.0	15.5

20	0.175	11352	0.000	0.000	1.00	48.2	0.050	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	42.2	0.062	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	14.6	0.150	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	14.5	0.150	0.100	85.79	4.0	15.5
Toe						1.8	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
80.00	10.81	1.00	0.800

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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	
459.9	171.8	9.14	9.12	-3.47	7 19	33.07	7 3	20.8
468.7	197.4	9.19	9.16	-3.49	7 19	33.22	7 3	20.9
477.6	223.7	9.24	9.21	-3.43	7 18	33.40	7 3	20.9
486.6	253.6	9.29	9.24	-3.43	7 18	33.53	7 3	21.1
495.5	290.0	9.33	9.28	-3.35	6 18	33.70	7 3	21.1

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Depth	(ft)	85.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

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	0.175	11352	0.010	0.000	0.85	0.0	0.050	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	6.60	4.0	15.5
5	0.175	11352	0.000	0.000	1.00	6.7	0.150	0.100	16.50	4.0	15.5
6	0.175	11352	0.000	0.000	1.00	7.9	0.139	0.100	19.80	4.0	15.5
7	0.175	11352	0.000	0.000	1.00	24.6	0.050	0.100	23.10	4.0	15.5
8	0.175	11352	0.000	0.000	1.00	16.9	0.180	0.100	26.40	4.0	15.5
9	0.175	11352	0.000	0.000	1.00	12.6	0.200	0.100	29.70	4.0	15.5
10	0.175	11352	0.000	0.000	1.00	7.5	0.189	0.100	33.00	4.0	15.5
11	0.175	11352	0.000	0.000	1.00	7.6	0.175	0.100	36.30	4.0	15.5
12	0.175	11352	0.000	0.000	1.00	7.7	0.161	0.100	39.60	4.0	15.5
13	0.175	11352	0.000	0.000	1.00	7.9	0.151	0.100	42.89	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	39.3	0.057	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	47.6	0.050	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	41.4	0.050	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	44.3	0.050	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	47.1	0.050	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	49.1	0.050	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	24.3	0.107	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	14.6	0.150	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	14.4	0.150	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	14.1	0.150	0.100	85.79	4.0	15.5
Toe						1.8	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
85.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min	
481.4	215.9	9.21	9.19	-3.12	23	8	33.27	5	3	20.5	39.0
491.3	249.4	9.26	9.24	-3.14	25	7	33.41	5	3	20.5	38.9
501.5	291.4	9.30	9.27	-3.17	25	7	33.57	5	3	20.6	38.8
511.6	343.6	9.34	9.30	-3.19	25	7	33.73	5	3	20.6	38.8
521.8	408.3	9.37	9.33	-3.22	25	7	33.89	5	3	20.7	38.7

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Depth Shaft Gain/Loss Factor	(ft) Factor	85.8 0.486	Standard Soil Setup Toe Gain/Loss Factor	1.000
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PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

No.	Weight kips	Pile and Soil Model Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Total Capacity Soil-S kips	Rut Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11352	0.010	0.000	0.85	0.0	0.050	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	6.60	4.0	15.5
4	0.175	11352	0.000	0.000	1.00	1.5	0.149	0.100	13.20	4.0	15.5
5	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	16.50	4.0	15.5
6	0.175	11352	0.000	0.000	1.00	11.7	0.104	0.100	19.80	4.0	15.5
7	0.175	11352	0.000	0.000	1.00	24.5	0.066	0.100	23.10	4.0	15.5
8	0.175	11352	0.000	0.000	1.00	15.1	0.200	0.100	26.40	4.0	15.5
9	0.175	11352	0.000	0.000	1.00	10.7	0.199	0.100	29.70	4.0	15.5
10	0.175	11352	0.000	0.000	1.00	7.5	0.185	0.100	33.00	4.0	15.5
11	0.175	11352	0.000	0.000	1.00	7.6	0.171	0.100	36.30	4.0	15.5
12	0.175	11352	0.000	0.000	1.00	7.7	0.158	0.100	39.60	4.0	15.5
13	0.175	11352	0.000	0.000	1.00	9.1	0.141	0.100	42.89	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	48.2	0.050	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	45.4	0.050	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	42.1	0.050	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	45.0	0.050	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	47.7	0.050	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	49.4	0.050	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	15.9	0.144	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	14.6	0.150	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	14.5	0.150	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	14.3	0.150	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	14.0	0.150	0.100	85.79	4.0	15.5
Toe						1.8	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
85.79	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min	
484.7	221.1	9.22	9.18	-3.20	23	8	33.20	5	3	20.5	39.0

494.8	256.9	9.26	9.22	-3.23	25	7	33.33	5	3	20.5	38.9
505.1	303.2	9.29	9.26	-3.26	25	7	33.46	5	3	20.5	38.8
515.5	359.3	9.33	9.29	-3.29	25	7	33.60	5	3	20.6	38.8
525.8	430.6	9.37	9.32	-3.30	25	7	33.73	5	3	20.6	38.7

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SUMMARY OVER DEPTHS

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.0	0.1	0.0	0.1	0.0	0.000	0.000	10.81	0.0
10.0	0.2	0.0	0.2	0.0	0.000	0.000	10.81	0.0
15.0	8.3	5.2	3.0	1.2	8.781	-1.209	3.74	20.9
20.0	70.7	21.5	49.2	6.9	22.406	0.000	5.69	20.4
25.0	55.6	53.3	2.3	4.6	21.024	-2.265	5.36	21.7
30.0	73.9	71.1	2.8	7.2	23.310	-0.447	5.75	20.2
35.0	85.4	82.6	2.8	8.5	24.476	-1.264	6.00	19.7
40.0	97.1	94.3	2.8	10.1	25.291	-1.672	6.24	19.3
45.0	169.1	132.7	36.5	19.2	28.109	-1.961	7.06	18.7
50.0	218.5	202.2	16.3	24.0	29.065	-3.000	7.38	19.1
55.0	284.1	267.8	16.3	35.4	30.586	-2.739	7.92	19.9
60.0	356.0	339.7	16.3	59.4	31.940	-4.180	8.49	21.0
65.0	393.4	391.6	1.8	81.8	32.559	-5.084	8.71	21.1
70.0	415.7	413.9	1.8	102.6	32.649	-4.096	8.84	21.0
75.0	437.9	436.1	1.8	126.5	33.132	-4.222	9.02	21.1
80.0	459.9	458.1	1.8	171.8	33.072	-3.472	9.14	20.8
85.0	481.4	479.6	1.8	215.9	33.268	-3.119	9.21	20.5
85.8	484.7	482.9	1.8	221.1	33.202	-3.203	9.22	20.5

Total Driving Time 100 minutes;
 Starting at penetration 5.0 ft

Total No. of Blows 4007

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.0	0.1	0.0	0.1	0.0	0.000	0.000	11.86	0.0
10.0	0.2	0.0	0.2	0.0	0.000	0.000	11.86	0.0
15.0	8.5	5.5	3.0	1.2	8.965	-1.484	3.78	21.4
20.0	71.4	22.2	49.2	7.0	22.478	0.000	5.70	20.4
25.0	57.2	54.9	2.3	4.7	21.266	-2.086	5.40	21.5
30.0	76.9	74.1	2.8	7.5	23.602	-0.291	5.81	20.1
35.0	89.0	86.2	2.8	9.0	24.766	-1.112	6.07	19.6
40.0	101.3	98.5	2.8	10.7	25.640	-1.605	6.32	19.3
45.0	173.7	137.3	36.5	19.8	28.311	-1.814	7.10	18.8
50.0	223.1	206.8	16.3	24.9	29.219	-3.145	7.43	19.1
55.0	288.7	272.4	16.3	36.9	30.783	-2.862	7.97	19.9
60.0	360.6	344.3	16.3	62.6	32.064	-4.436	8.52	21.0
65.0	398.5	396.7	1.8	90.0	32.525	-5.196	8.67	21.0
70.0	422.0	420.2	1.8	110.9	32.839	-4.030	8.90	21.2
75.0	445.5	443.6	1.8	143.7	33.331	-4.343	9.08	21.2
80.0	468.7	466.8	1.8	197.4	33.223	-3.492	9.19	20.9
85.0	491.3	489.5	1.8	249.4	33.412	-3.136	9.26	20.5
85.8	494.8	493.0	1.8	256.9	33.331	-3.235	9.26	20.5

Total Driving Time 111 minutes;
 Starting at penetration 5.0 ft

Total No. of Blows 4454

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SUMMARY OVER DEPTHS

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.0	0.1	0.0	0.1	0.0	0.000	0.000	11.86	0.0
10.0	0.2	0.0	0.2	0.0	0.000	0.000	11.86	0.0
15.0	8.8	5.8	3.0	1.3	9.070	-1.686	3.81	21.9
20.0	72.1	23.0	49.2	7.1	22.522	0.000	5.71	20.4
25.0	58.8	56.5	2.3	4.9	21.471	-1.911	5.43	21.4
30.0	79.9	77.1	2.8	7.9	23.869	-0.344	5.87	20.0
35.0	92.7	89.9	2.8	9.5	25.092	-1.413	6.14	19.6
40.0	105.6	102.8	2.8	11.4	25.932	-1.603	6.40	19.2
45.0	178.4	142.0	36.5	20.5	28.487	-1.686	7.15	18.8

50.0	227.8	211.5	16.3	25.8	29.380	-3.244	7.47	19.1
55.0	293.4	277.1	16.3	38.1	30.981	-2.998	8.02	20.1
60.0	365.3	349.0	16.3	66.6	32.259	-4.658	8.57	21.1
65.0	403.8	402.0	1.8	95.1	32.734	-5.341	8.73	21.2
70.0	428.5	426.7	1.8	122.6	33.013	-3.924	8.96	21.3
75.0	453.2	451.4	1.8	164.4	33.528	-4.434	9.14	21.3
80.0	477.6	475.8	1.8	223.7	33.403	-3.427	9.24	20.9
85.0	501.5	499.6	1.8	291.4	33.569	-3.174	9.30	20.6
85.8	505.1	503.3	1.8	303.2	33.463	-3.258	9.29	20.5

Total Driving Time 124 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 4957

G/L at Shaft and Toe: 0.614 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
5.0	0.1	0.0	0.1	0.0	0.000	0.000	11.86	0.0
10.0	0.2	0.0	0.2	0.0	0.000	0.000	11.86	0.0
15.0	9.1	6.1	3.0	1.3	9.188	-1.815	3.85	22.2
20.0	72.8	23.7	49.2	7.2	22.574	0.000	5.73	20.4
25.0	60.5	58.2	2.3	5.1	21.678	-1.705	5.46	21.3
30.0	83.0	80.2	2.8	8.2	24.132	-0.759	5.93	19.9
35.0	96.3	93.5	2.8	10.0	25.354	-1.591	6.21	19.4
40.0	109.9	107.1	2.8	12.2	26.208	-1.791	6.47	19.2
45.0	183.1	146.7	36.5	21.2	28.695	-1.794	7.20	18.9
50.0	232.5	216.2	16.3	26.7	29.577	-3.288	7.52	19.2
55.0	298.1	281.8	16.3	39.8	31.134	-3.119	8.06	20.1
60.0	370.0	353.7	16.3	70.2	32.414	-4.908	8.62	21.2
65.0	409.1	407.2	1.8	101.8	32.934	-5.405	8.80	21.3
70.0	435.0	433.2	1.8	134.6	33.199	-3.897	9.02	21.4
75.0	460.9	459.1	1.8	187.4	33.734	-4.511	9.20	21.4
80.0	486.6	484.8	1.8	253.6	33.529	-3.429	9.29	21.1
85.0	511.6	509.8	1.8	343.6	33.728	-3.188	9.34	20.6
85.8	515.5	513.7	1.8	359.3	33.604	-3.287	9.33	20.6

Total Driving Time 139 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 5534

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SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.657 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
5.0	0.1	0.0	0.1	0.0	0.000	0.000	11.86	0.0
10.0	0.2	0.0	0.2	0.0	0.000	0.000	11.86	0.0
15.0	9.4	6.4	3.0	1.3	9.332	-1.865	3.88	21.9
20.0	73.6	24.4	49.2	7.3	22.643	0.000	5.74	20.3
25.0	62.1	59.8	2.3	5.3	21.863	-1.511	5.50	21.2
30.0	86.0	83.2	2.8	8.6	24.409	-1.026	5.99	19.8
35.0	100.0	97.2	2.8	10.6	25.648	-1.519	6.27	19.4
40.0	114.3	111.5	2.8	12.9	26.476	-2.140	6.53	19.1
45.0	187.8	151.4	36.5	21.8	28.958	-2.087	7.26	19.0
50.0	237.2	220.9	16.3	27.6	29.739	-3.256	7.56	19.3
55.0	302.8	286.5	16.3	41.4	31.369	-3.210	8.12	20.2
60.0	374.7	358.4	16.3	74.0	32.556	-5.151	8.67	21.3
65.0	414.3	412.5	1.8	108.3	33.130	-5.499	8.86	21.4
70.0	441.5	439.7	1.8	147.8	33.370	-4.061	9.08	21.5
75.0	468.7	466.9	1.8	207.9	33.908	-4.575	9.25	21.5
80.0	495.5	493.7	1.8	290.0	33.697	-3.351	9.33	21.1
85.0	521.8	520.0	1.8	408.3	33.890	-3.216	9.37	20.7
85.8	525.8	524.0	1.8	430.6	33.729	-3.295	9.37	20.6

Total Driving Time 156 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 6176

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Table of Depths Analyzed with Driving System Modifiers

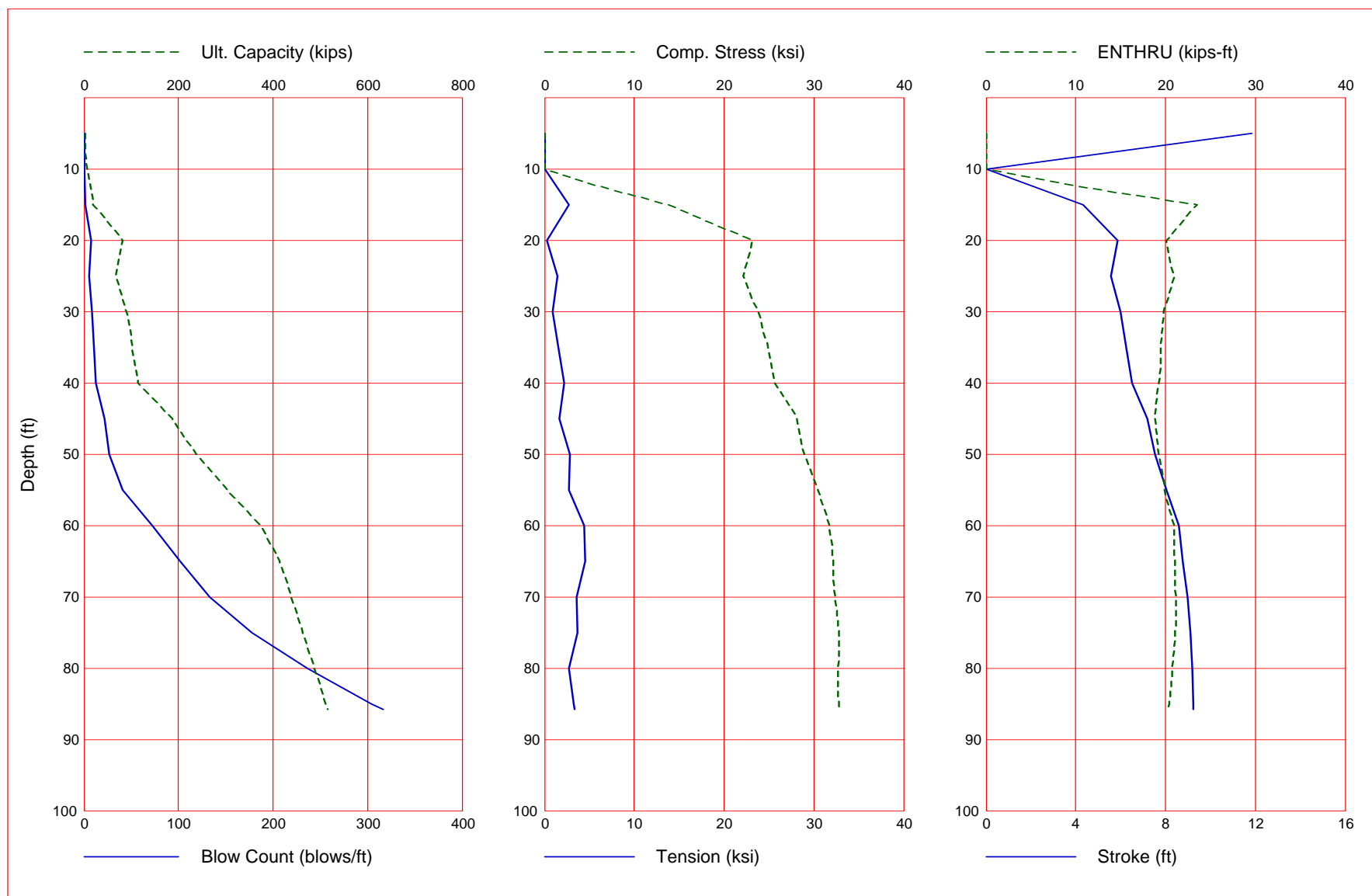
Depth	Temp.	Wait	Equivalent	Pressure	Efficy.	Stiffn.	Cushion
ft	Length	Time	Stroke	Ratio		Factor	CoR
	ft	hr	ft				

5.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
10.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
15.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
20.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
25.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
30.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
35.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
40.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
45.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
50.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
55.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
60.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
65.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
70.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
75.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
80.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
85.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
85.79	85.79	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	0.100	0.050	0.150	0.000	6.000	24.000
3.00	0.00	0.07	0.100	0.100	0.050	0.150	0.000	6.000	24.000
6.00	0.00	0.14	0.100	0.100	0.050	0.150	0.000	6.000	24.000
9.00	0.00	0.20	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.00	0.00	0.27	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.49	0.00	0.28	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.51	0.88	3.03	0.100	0.100	0.150	0.150	0.778	6.000	336.000
18.79	0.88	3.03	0.100	0.100	0.150	0.150	0.778	6.000	336.000
18.81	1.69	45.89	0.100	0.100	0.050	0.150	0.000	6.000	24.000
21.80	2.00	54.09	0.100	0.100	0.050	0.150	0.000	6.000	24.000
22.79	2.10	56.81	0.100	0.100	0.050	0.150	0.000	6.000	24.000
22.81	2.38	2.30	0.100	0.100	0.200	0.150	1.000	6.000	720.000
27.79	2.38	2.30	0.100	0.100	0.200	0.150	1.000	6.000	720.000
27.81	0.95	2.79	0.100	0.100	0.200	0.150	0.778	6.000	336.000
39.80	0.99	2.79	0.100	0.100	0.150	0.150	0.778	6.000	336.000
42.79	1.05	2.79	0.100	0.100	0.150	0.150	0.778	6.000	336.000
42.81	3.52	36.46	0.100	0.100	0.050	0.150	0.000	6.000	24.000
45.80	3.79	36.46	0.100	0.100	0.050	0.150	0.000	6.000	24.000
47.79	3.97	36.46	0.100	0.100	0.050	0.150	0.000	6.000	24.000
47.81	2.99	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
50.80	3.19	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
53.80	3.39	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
56.80	3.59	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
57.99	3.67	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
58.01	3.67	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
61.00	3.77	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
62.79	3.83	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
62.81	1.88	1.82	0.100	0.100	0.150	0.150	0.778	6.000	336.000
74.80	1.86	1.82	0.100	0.100	0.150	0.150	0.778	6.000	336.000
77.80	1.84	1.82	0.100	0.100	0.150	0.150	0.778	6.000	336.000
80.80	1.83	1.82	0.100	0.100	0.150	0.150	0.778	6.000	336.000
83.80	1.79	1.82	0.100	0.100	0.150	0.150	0.778	6.000	336.000
85.79	1.74	1.82	0.100	0.100	0.150	0.150	0.778	6.000	336.000

Gain/Loss 3 at Shaft and Toe 0.571 / 1.000



Gain/Loss 3 at Shaft and Toe 0.571 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	2.4	1.6	0.8	0.0	0.000	0.000	11.86	0.0
10.0	7.7	6.3	1.4	-1.0	0.000	0.000	0.00	0.0
15.0	18.7	15.6	3.0	1.6	13.845	-2.736	4.31	23.5
20.0	81.9	32.8	49.2	7.9	23.162	-0.257	5.85	20.1
25.0	68.7	66.4	2.3	5.8	22.082	-1.486	5.58	21.0
30.0	89.7	87.0	2.8	8.6	23.860	-0.936	5.99	19.8
35.0	102.5	99.7	2.8	10.2	24.857	-1.509	6.24	19.5
40.0	115.4	112.6	2.8	12.3	25.681	-2.163	6.49	19.2
45.0	188.2	151.8	36.5	21.3	28.120	-1.615	7.21	18.8
50.0	237.6	221.3	16.3	27.0	28.967	-2.794	7.53	19.2
55.0	303.2	286.9	16.3	40.8	30.419	-2.705	8.03	19.9
60.0	375.1	358.8	16.3	72.2	31.699	-4.402	8.60	21.0
65.0	413.6	411.8	1.8	101.6	32.153	-4.561	8.75	21.1
70.0	438.3	436.5	1.8	133.3	32.423	-3.522	8.97	21.2
75.0	463.0	461.2	1.8	177.8	32.843	-3.719	9.11	21.1
80.0	487.4	485.6	1.8	236.2	32.706	-2.734	9.20	20.7
85.0	511.3	509.5	1.8	304.1	32.845	-3.274	9.25	20.4
85.8	514.9	513.1	1.8	316.4	32.702	-3.392	9.25	20.2

Total Continuous Driving Time 133.00 minutes; Total Number of Blows 5290 (starting at penetration 5.0 ft)

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.
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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: J:\GEOTECH\PROJECTS\2020\W-20-025 FRA-70-13.01\ANALYSIS\DRIVEABILITY\REAR ABUTMENT\HP 12X53 - CASE-2\FRA-70-13.01 - REAR ABUTMENT HP 15X53-B-015-1-13-CASE-2.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

```

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2
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 15.500 12.000 Unknown
W Cp A Cp E Cp T Cp CoR ROut StCp
1.900 227.000 530.0 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
85.790 15.50 29000.0 492.000 3.970 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 Efficy 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	0.10	0.05	0.15	1.00	6.00	24.000
3.00	0.09	0.47	0.10	0.10	0.05	0.15	1.00	6.00	24.000
6.00	0.19	0.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
9.00	0.28	1.42	0.10	0.10	0.05	0.15	1.00	6.00	24.000
12.00	0.38	1.43	0.10	0.10	0.05	0.15	1.00	6.00	24.000
12.49	0.40	1.43	0.10	0.10	0.05	0.15	1.00	6.00	24.000
12.51	0.88	3.03	0.10	0.10	0.15	0.15	1.50	6.00	336.000
18.79	0.88	3.03	0.10	0.10	0.15	0.15	1.50	6.00	336.000
18.81	1.69	45.89	0.10	0.10	0.05	0.15	1.00	6.00	24.000
21.80	2.00	54.09	0.10	0.10	0.05	0.15	1.00	6.00	24.000
22.79	2.10	56.81	0.10	0.10	0.05	0.15	1.00	6.00	24.000
22.81	2.38	2.30	0.10	0.10	0.20	0.15	1.75	6.00	720.000
27.79	2.38	2.30	0.10	0.10	0.20	0.15	1.75	6.00	720.000
27.81	0.95	2.79	0.10	0.10	0.15	0.15	1.50	6.00	336.000
39.80	0.99	2.79	0.10	0.10	0.15	0.15	1.50	6.00	336.000
42.79	1.05	2.79	0.10	0.10	0.15	0.15	1.50	6.00	336.000
42.81	3.52	36.46	0.10	0.10	0.05	0.15	1.00	6.00	24.000
45.80	3.79	36.46	0.10	0.10	0.05	0.15	1.00	6.00	24.000
47.79	3.97	36.46	0.10	0.10	0.05	0.15	1.00	6.00	24.000
47.81	2.99	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
50.80	3.19	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
53.80	3.39	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
56.80	3.59	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
57.99	3.67	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
58.01	3.67	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
61.00	3.77	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
62.79	3.83	16.32	0.10	0.10	0.05	0.15	1.00	6.00	24.000
62.81	1.88	1.82	0.10	0.10	0.15	0.15	1.50	6.00	336.000
74.80	1.86	1.82	0.10	0.10	0.15	0.15	1.50	6.00	336.000
77.80	1.84	1.82	0.10	0.10	0.15	0.15	1.50	6.00	336.000
80.80	1.83	1.82	0.10	0.10	0.15	0.15	1.50	6.00	336.000
83.80	1.79	1.82	0.10	0.10	0.15	0.15	1.50	6.00	336.000
85.79	1.74	1.82	0.10	0.10	0.15	0.15	1.50	6.00	336.000

Gain/Loss factors: shaft and toe

0.48600 0.52800 0.57100 0.61400 0.65700
 1.00000 1.00000 1.00000 1.00000 1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
5.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
10.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
15.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
20.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
25.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
30.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
35.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
40.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
45.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
50.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
55.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
60.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
65.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
70.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
75.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
80.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
85.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
85.79	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

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2

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	1.900	60155.0	0.800	0.0100	5.8
Combined Pile Top		11352.3			

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

Cross Sect. Area	(in2)	227.00
Elastic-Modulus	(ksi)	530.0
Thickness	(inch)	2.00
Coeff of Restitution		0.8
RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0

PILE CUSHION

Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	0.00
Coeff of Restitution		1.0
RoundOut	(ft)	0.0
Stiffness	(kips/in)	0.0



FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2
Resource International Inc

10/24/2021
GRLWEAP Version 2010

Depth	(ft)	5.0	Standard Soil Setup	
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)				2.4	
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	0.2	0.050	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	1.4	0.050	0.100	85.79	4.0	15.5
Toe						0.8	0.150	0.100			

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

4.543 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)	0.544
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	Stroke	Pressure	Efficacy
ft	ft	Ratio	
5.00	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.2 2.4
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.2 2.4
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INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 7.2 2.4
 Hammer+Pile Weight > Rult: Pile Runs

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 FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2 10/24/2021
 Resource International Inc GRLWEAP Version 2010

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	
2.4	0.0	10.81	0.00	0.00	1 0	0.00	1 0	0.0 78.4
2.4	0.0	11.86	0.00	0.00	1 0	0.00	1 0	0.0 74.4
2.4	0.0	11.86	0.00	0.00	1 0	0.00	1 0	0.0 74.4
2.4	0.0	11.86	0.00	0.00	1 0	0.00	1 0	0.0 74.4
2.4	0.0	11.86	0.00	0.00	1 0	0.00	1 0	0.0 74.4

↑
 FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth	(ft)	10.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:
 Toe Area (in2) 15.500 Pile Type Unknown
 Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)				7.7	
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	0.7	0.050	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	2.1	0.050	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	3.5	0.050	0.100	85.79	4.0	15.5
Toe						1.4	0.150	0.100			

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

Depth	Stroke	Pressure	Efficacy
ft	ft	Ratio	
10.00	10.81	1.00	0.800

↑

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2
Resource International Inc

10/24/2021
GRLWEAP Version 2010

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
7.7	Hammer	did not run				
7.7	Hammer	did not run				
7.7	Hammer	did not run				
7.7	Hammer	did not run				
7.7	Hammer	did not run				

^
FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2
Resource International Inc

10/24/2021
GRLWEAP Version 2010

Depth Shaft Gain/Loss Factor	(ft) 0.486	Standard Soil Setup Toe Gain/Loss Factor	1.000
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PILE PROFILE:

Toe Area Pile Size	(in2) (inch)	15.500 12.000	Pile Type	Unknown
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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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	0.2	0.050	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	1.4	0.050	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	2.8	0.050	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	4.2	0.050	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	6.4	0.138	0.100	85.79	4.0	15.5
Toe						3.0	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
15.00	10.81	1.00	0.800

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FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2
Resource International Inc

10/24/2021
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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
18.1	1.5	4.27 4.25	-2.82	9 57 13.59	1 2 23.3	57.4
18.4	1.6	4.29 4.26	-2.72	7 56 13.70	1 2 23.4	57.3
18.7	1.6	4.31 4.26	-2.74	9 57 13.84	1 2 23.5	57.2
18.9	1.6	4.32 4.28	-2.72	9 57 13.95	1 2 23.5	57.2
19.2	1.6	4.29 4.30	-2.86	6 56 13.85	1 2 23.5	57.2

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FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2
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Depth Shaft Gain/Loss Factor	(ft) 0.486	Standard Soil Setup Toe Gain/Loss Factor	1.000
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PILE PROFILE:

Toe Area Pile Size	(in2) (inch)	15.500 12.000	Pile Type	Unknown
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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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model	Total Capacity Rut (kips)	80.5
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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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	0.8	0.050	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	2.1	0.050	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	3.5	0.050	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	5.3	0.098	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	12.7	0.097	0.100	85.79	4.0	15.5
Toe						49.2	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
20.00	10.81	1.00	0.800



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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
80.5	7.7	5.82	5.87	-0.20	22	50	23.08	22	6	20.2	48.8
81.2	7.8	5.84	5.88	-0.23	22	50	23.11	22	6	20.1	48.7
81.9	7.9	5.85	5.89	-0.26	22	50	23.16	22	6	20.1	48.7
82.7	7.9	5.86	5.90	-0.30	22	50	23.22	22	6	20.1	48.6
83.4	8.0	5.87	5.91	-0.35	22	50	23.26	22	6	20.0	48.6



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Depth	(ft)	25.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut	(kips)		65.4		
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	0.2	0.050	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	1.5	0.050	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	2.8	0.050	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	4.2	0.050	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	6.5	0.139	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	22.0	0.056	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	19.0	0.155	0.100	85.79	4.0	15.5
Toe						2.3	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
25.00	10.81	1.00	0.800



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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
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65.4	5.4	5.52	5.50	-1.86	3	12	21.75	20	6	21.2	50.4
67.0	5.6	5.55	5.53	-1.67	3	12	21.92	21	6	21.1	50.2
68.7	5.8	5.58	5.56	-1.49	3	12	22.08	21	6	21.0	50.0
70.3	6.0	5.62	5.60	-1.30	3	12	22.23	21	6	21.0	49.9
71.9	6.2	5.65	5.63	-1.14	2	12	22.34	21	6	20.8	49.7

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Depth (ft) 30.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
 Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model							Total Capacity Rut (kips)			83.7	
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	0.8	0.050	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	2.2	0.050	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	3.5	0.050	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	5.4	0.101	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	13.2	0.093	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	23.8	0.082	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	15.1	0.200	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	10.0	0.178	0.100	85.79	4.0	15.5
Toe						2.8	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
30.00	10.81	1.00	0.800

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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		
83.7	7.8	5.87	5.92	-0.49	26	19	23.35	21	6	20.0	48.6
86.7	8.2	5.93	5.97	-0.69	21	50	23.62	21	6	19.8	48.3
89.7	8.6	5.99	6.02	-0.94	20	50	23.86	21	6	19.8	48.1
92.8	9.0	6.05	6.08	-1.14	20	50	24.13	21	6	19.7	47.9
95.8	9.4	6.10	6.13	-1.36	20	50	24.35	21	6	19.6	47.7

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 35.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
 Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model	Total Capacity Rut (kips)	95.2
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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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	0.3	0.050	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	1.5	0.050	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	2.9	0.050	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	4.3	0.050	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	6.6	0.141	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	22.6	0.055	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	18.7	0.159	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	13.7	0.196	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	7.5	0.150	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	7.6	0.150	0.100	85.79	4.0	15.5
Toe						2.8	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
35.00	10.81	1.00	0.800

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 Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
95.2	9.2	6.10	6.13	-1.69	25	8	24.26	20	6	19.6	47.7
98.8	9.7	6.17	6.19	-1.57	25	8	24.55	20	6	19.5	47.4
102.5	10.2	6.24	6.26	-1.51	25	8	24.86	20	6	19.5	47.1
106.1	10.8	6.31	6.32	-1.48	6	47	25.15	20	6	19.4	46.9
109.8	11.4	6.36	6.38	-1.45	6	47	25.36	20	6	19.3	46.7

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Depth	(ft)	40.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)			106.9		
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	0.9	0.050	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	2.2	0.050	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	3.6	0.050	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	5.5	0.105	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	13.8	0.090	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	23.5	0.087	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	15.1	0.200	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	9.8	0.176	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	7.5	0.150	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	7.6	0.150	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	7.7	0.150	0.100	85.79	4.0	15.5
Toe						2.8	0.150	0.100			

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

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

Depth Stroke Pressure Efficy
ft ft Ratio
40.00 10.81 1.00 0.800

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FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2 10/24/2021
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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
106.9	10.9	6.34	6.36	-2.11	24	8	25.11	18	5	19.2	46.8
111.1	11.6	6.41	6.43	-1.94	24	8	25.39	18	5	19.2	46.5
115.4	12.3	6.49	6.50	-2.16	15	39	25.68	18	5	19.2	46.2
119.7	13.0	6.55	6.56	-2.54	14	39	25.93	18	5	19.2	46.0
124.1	13.7	6.62	6.62	-2.77	13	38	26.16	18	5	19.1	45.8

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FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2 10/24/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 45.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	Rut ft	Perim ft	Area in2
1	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
13	0.175	11352	0.000	0.000	1.00	0.3	0.050	0.100	42.89	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	1.6	0.050	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	2.9	0.050	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	4.3	0.050	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	6.6	0.143	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	23.2	0.053	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	18.3	0.163	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	13.5	0.195	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	7.5	0.150	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	7.6	0.150	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	7.7	0.150	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	7.8	0.150	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	34.3	0.063	0.100	85.79	4.0	15.5
Toe						36.5	0.150	0.100			

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

Depth Stroke Pressure Efficy
ft ft Ratio
45.00 10.81 1.00 0.800

▲
FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2 10/24/2021
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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
178.9	19.9	7.12	7.08	-1.54	8	37	27.75	17	5	18.7	44.3
183.5	20.6	7.17	7.13	-1.38	14	31	27.94	17	5	18.8	44.1
188.2	21.3	7.21	7.20	-1.61	15	30	28.12	17	5	18.8	43.9
192.9	22.0	7.27	7.25	-1.83	15	30	28.35	17	5	18.9	43.8
197.7	22.7	7.31	7.30	-2.02	15	30	28.49	17	5	18.9	43.6

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FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2 10/24/2021
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Depth (ft) 50.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut	(kips)		228.3		
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
11	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	36.30	4.0	15.5
12	0.175	11352	0.000	0.000	1.00	0.9	0.050	0.100	39.60	4.0	15.5
13	0.175	11352	0.000	0.000	1.00	2.3	0.050	0.100	42.89	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	3.6	0.050	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	5.5	0.108	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	14.3	0.087	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	23.2	0.092	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	15.1	0.200	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	9.6	0.174	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	7.5	0.150	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	7.6	0.150	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	7.7	0.150	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	15.0	0.107	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	48.8	0.050	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	43.9	0.050	0.100	85.79	4.0	15.5
Toe						16.3	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
50.00	10.81	1.00	0.800



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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
228.3	25.3	7.44	7.42	-2.71	15 29	28.62	15 5	19.0
232.9	26.1	7.48	7.46	-2.78	14 29	28.78	15 5	19.1
237.6	27.0	7.53	7.51	-2.79	14 29	28.97	15 5	19.2
242.3	28.0	7.58	7.56	-2.75	14 29	29.13	15 5	19.2
247.1	28.9	7.62	7.61	-2.62	13 29	29.29	15 5	19.3



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Depth	(ft)	55.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut	(kips)		293.9		
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
10	0.175	11352	0.000	0.000	1.00	0.3	0.050	0.100	33.00	4.0	15.5

11	0.175	11352	0.000	0.000	1.00	1.6	0.050	0.100	36.30	4.0	15.5
12	0.175	11352	0.000	0.000	1.00	3.0	0.050	0.100	39.60	4.0	15.5
13	0.175	11352	0.000	0.000	1.00	4.3	0.050	0.100	42.89	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	6.7	0.144	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	23.8	0.051	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	18.0	0.168	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	13.3	0.194	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	7.5	0.150	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	7.6	0.150	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	7.7	0.150	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	7.9	0.150	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	35.6	0.061	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	48.5	0.050	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	41.2	0.050	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	44.0	0.050	0.100	85.79	4.0	15.5
Toe						16.3	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
55.00	10.81	1.00	0.800

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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
293.9	37.4	7.94	7.91	-2.39	12	25	30.06	14	4	19.9
298.5	38.9	7.99	7.96	-2.57	12	25	30.23	14	5	20.0
303.2	40.8	8.03	8.02	-2.71	12	25	30.42	14	4	19.9
307.9	42.3	8.09	8.08	-2.92	11	23	30.63	14	4	20.1
312.6	43.9	8.15	8.13	-3.22	11	23	30.85	14	4	20.2

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Depth	(ft)	60.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

No.	Weight	Pile and Soil Model	Total Capacity	Rut	(kips)	365.8
	kips	Stiffn C-Slk T-Slk CoR	Soil-S	Soil-D	Quake	LbTop Perim Area
		k/in ft ft	kips	s/ft	inch	ft ft in2
1	0.175	11352 0.010 0.000 0.85	0.0	0.000	0.100	3.30 4.0 15.5
2	0.175	11352 0.000 0.000 1.00	0.0	0.000	0.100	6.60 4.0 15.5
8	0.175	11352 0.000 0.000 1.00	0.0	0.050	0.100	26.40 4.0 15.5
9	0.175	11352 0.000 0.000 1.00	0.9	0.050	0.100	29.70 4.0 15.5
10	0.175	11352 0.000 0.000 1.00	2.3	0.050	0.100	33.00 4.0 15.5
11	0.175	11352 0.000 0.000 1.00	3.7	0.050	0.100	36.30 4.0 15.5
12	0.175	11352 0.000 0.000 1.00	5.6	0.111	0.100	39.60 4.0 15.5
13	0.175	11352 0.000 0.000 1.00	6.9	0.150	0.100	42.89 4.0 15.5
14	0.175	11352 0.000 0.000 1.00	14.8	0.084	0.100	46.19 4.0 15.5
15	0.175	11352 0.000 0.000 1.00	22.9	0.097	0.100	49.49 4.0 15.5
16	0.175	11352 0.000 0.000 1.00	15.1	0.200	0.100	52.79 4.0 15.5
17	0.175	11352 0.000 0.000 1.00	9.3	0.172	0.100	56.09 4.0 15.5
18	0.175	11352 0.000 0.000 1.00	7.5	0.150	0.100	59.39 4.0 15.5
19	0.175	11352 0.000 0.000 1.00	7.6	0.150	0.100	62.69 4.0 15.5
20	0.175	11352 0.000 0.000 1.00	7.7	0.150	0.100	65.99 4.0 15.5
21	0.175	11352 0.000 0.000 1.00	16.2	0.102	0.100	69.29 4.0 15.5
22	0.175	11352 0.000 0.000 1.00	48.9	0.050	0.100	72.59 4.0 15.5
23	0.175	11352 0.000 0.000 1.00	43.6	0.050	0.100	75.89 4.0 15.5
24	0.175	11352 0.000 0.000 1.00	42.6	0.050	0.100	79.19 4.0 15.5
25	0.175	11352 0.000 0.000 1.00	45.5	0.050	0.100	82.49 4.0 15.5

26	0.175	11352	0.000	0.000	1.00	48.1	0.050	0.100	85.79	4.0	15.5
Toe						16.3	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
60.00	10.81	1.00	0.800

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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
365.8	65.0	8.49	8.49	-4.00	10	22	31.36	12	4	20.8
370.4	68.5	8.54	8.54	-4.18	11	22	31.55	12	4	20.9
375.1	72.2	8.60	8.58	-4.40	11	22	31.70	12	4	21.0
379.8	76.7	8.63	8.63	-4.60	11	22	31.84	12	4	21.1
384.5	81.3	8.68	8.67	-4.79	11	22	32.02	12	4	21.2

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Depth	(ft)	65.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)					403.2
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
7	0.175	11352	0.000	0.000	1.00	0.3	0.050	0.100	23.10	4.0	15.5
8	0.175	11352	0.000	0.000	1.00	1.6	0.050	0.100	26.40	4.0	15.5
9	0.175	11352	0.000	0.000	1.00	3.0	0.050	0.100	29.70	4.0	15.5
10	0.175	11352	0.000	0.000	1.00	4.4	0.050	0.100	33.00	4.0	15.5
11	0.175	11352	0.000	0.000	1.00	6.7	0.146	0.100	36.30	4.0	15.5
12	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	39.60	4.0	15.5
13	0.175	11352	0.000	0.000	1.00	24.3	0.050	0.100	42.89	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	17.6	0.172	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	13.0	0.193	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	7.5	0.150	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	7.6	0.150	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	7.7	0.150	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	7.9	0.150	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	36.8	0.060	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	48.2	0.050	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	41.2	0.050	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	44.1	0.050	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	47.0	0.050	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	49.0	0.050	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	26.5	0.100	0.100	85.79	4.0	15.5
Toe						1.8	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
65.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke down	(ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
403.2	90.3	8.63	8.71	-4.39	11	22	31.74	11	4	20.8	40.1
408.4	96.5	8.69	8.77	-4.48	11	22	31.94	11	4	20.9	40.0
413.6	101.6	8.75	8.81	-4.56	11	22	32.15	11	4	21.1	39.9
418.9	107.9	8.81	8.85	-4.65	11	22	32.34	11	4	21.2	39.8
424.1	114.8	8.86	8.89	-4.72	11	22	32.54	11	4	21.3	39.7

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 Resource International Inc

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 GRLWEAP Version 2010

Depth (ft) 70.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
 Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut (kips)					425.5	
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5	
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5	
5	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	16.50	4.0	15.5	
6	0.175	11352	0.000	0.000	1.00	1.0	0.050	0.100	19.80	4.0	15.5	
7	0.175	11352	0.000	0.000	1.00	2.3	0.050	0.100	23.10	4.0	15.5	
8	0.175	11352	0.000	0.000	1.00	3.7	0.050	0.100	26.40	4.0	15.5	
9	0.175	11352	0.000	0.000	1.00	5.7	0.114	0.100	29.70	4.0	15.5	
10	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	33.00	4.0	15.5	
11	0.175	11352	0.000	0.000	1.00	15.4	0.082	0.100	36.30	4.0	15.5	
12	0.175	11352	0.000	0.000	1.00	22.6	0.102	0.100	39.60	4.0	15.5	
13	0.175	11352	0.000	0.000	1.00	15.1	0.200	0.100	42.89	4.0	15.5	
14	0.175	11352	0.000	0.000	1.00	9.1	0.170	0.100	46.19	4.0	15.5	
15	0.175	11352	0.000	0.000	1.00	7.6	0.150	0.100	49.49	4.0	15.5	
16	0.175	11352	0.000	0.000	1.00	7.6	0.150	0.100	52.79	4.0	15.5	
17	0.175	11352	0.000	0.000	1.00	7.7	0.150	0.100	56.09	4.0	15.5	
18	0.175	11352	0.000	0.000	1.00	17.4	0.097	0.100	59.39	4.0	15.5	
19	0.175	11352	0.000	0.000	1.00	49.0	0.050	0.100	62.69	4.0	15.5	
20	0.175	11352	0.000	0.000	1.00	43.3	0.050	0.100	65.99	4.0	15.5	
21	0.175	11352	0.000	0.000	1.00	42.7	0.050	0.100	69.29	4.0	15.5	
22	0.175	11352	0.000	0.000	1.00	45.6	0.050	0.100	72.59	4.0	15.5	
23	0.175	11352	0.000	0.000	1.00	48.2	0.050	0.100	75.89	4.0	15.5	
24	0.175	11352	0.000	0.000	1.00	43.3	0.060	0.100	79.19	4.0	15.5	
25	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	82.49	4.0	15.5	
26	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	85.79	4.0	15.5	
Toe						1.8	0.150	0.100				

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

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

Depth (ft) 70.00
 Stroke (ft) 10.81
 Pressure Ratio 1.00
 Efficy 0.800

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2
 Resource International Inc

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min	
425.5	111.7	8.85	8.88	-3.21	8	19	32.08	9	3	21.0	39.7
431.8	121.6	8.90	8.93	-3.39	8	19	32.25	9	3	21.1	39.6
438.3	133.3	8.97	8.98	-3.52	8	19	32.42	9	3	21.2	39.4
444.8	145.5	9.02	9.02	-3.68	8	19	32.60	9	3	21.3	39.3
451.3	161.2	9.09	9.07	-3.79	8	19	32.79	9	3	21.4	39.2

FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2
 Resource International Inc

10/24/2021
 GRLWEAP Version 2010

Depth (ft) 75.0 Standard Soil Setup

Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity Rut	(kips)		447.7		
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.000	0.100	6.60	4.0	15.5
4	0.175	11352	0.000	0.000	1.00	0.4	0.050	0.100	13.20	4.0	15.5
5	0.175	11352	0.000	0.000	1.00	1.7	0.050	0.100	16.50	4.0	15.5
6	0.175	11352	0.000	0.000	1.00	3.1	0.050	0.100	19.80	4.0	15.5
7	0.175	11352	0.000	0.000	1.00	4.4	0.050	0.100	23.10	4.0	15.5
8	0.175	11352	0.000	0.000	1.00	6.8	0.147	0.100	26.40	4.0	15.5
9	0.175	11352	0.000	0.000	1.00	7.4	0.144	0.100	29.70	4.0	15.5
10	0.175	11352	0.000	0.000	1.00	24.5	0.050	0.100	33.00	4.0	15.5
11	0.175	11352	0.000	0.000	1.00	17.3	0.176	0.100	36.30	4.0	15.5
12	0.175	11352	0.000	0.000	1.00	12.8	0.193	0.100	39.60	4.0	15.5
13	0.175	11352	0.000	0.000	1.00	7.5	0.150	0.100	42.89	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	7.6	0.150	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	7.7	0.150	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	7.9	0.150	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	38.1	0.058	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	47.9	0.050	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	41.3	0.050	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	44.2	0.050	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	47.0	0.050	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	49.0	0.050	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	25.4	0.103	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	85.79	4.0	15.5
Toe						1.8	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
75.00	10.81	1.00	0.800



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Rut	Bl Ct	Stroke	Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt	
kips	b/ft	down	up	ksi		ksi			kip-ft	b/min	
447.7	140.4	9.00	9.02	-3.55	8	19	32.43	8	3	20.9	39.4
455.3	157.2	9.06	9.06	-3.64	8	19	32.64	8	3	21.0	39.3
463.0	177.8	9.11	9.10	-3.72	8	19	32.84	8	3	21.1	39.2
470.8	196.7	9.18	9.14	-3.76	8	19	33.05	8	3	21.2	39.1
478.5	217.2	9.23	9.18	-3.79	8	19	33.23	8	3	21.4	39.0



FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2
Resource International Inc

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GRLWEAP Version 2010

Depth (ft) 80.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity	Rut	(kips)		469.7	
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	0.175	11352	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	0.0	0.050	0.100	6.60	4.0	15.5
3	0.175	11352	0.000	0.000	1.00	1.0	0.050	0.100	9.90	4.0	15.5
4	0.175	11352	0.000	0.000	1.00	2.4	0.050	0.100	13.20	4.0	15.5
5	0.175	11352	0.000	0.000	1.00	3.8	0.050	0.100	16.50	4.0	15.5
6	0.175	11352	0.000	0.000	1.00	5.8	0.117	0.100	19.80	4.0	15.5
7	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	23.10	4.0	15.5
8	0.175	11352	0.000	0.000	1.00	15.9	0.079	0.100	26.40	4.0	15.5
9	0.175	11352	0.000	0.000	1.00	22.4	0.106	0.100	29.70	4.0	15.5
10	0.175	11352	0.000	0.000	1.00	15.1	0.200	0.100	33.00	4.0	15.5
11	0.175	11352	0.000	0.000	1.00	8.9	0.168	0.100	36.30	4.0	15.5
12	0.175	11352	0.000	0.000	1.00	7.6	0.150	0.100	39.60	4.0	15.5
13	0.175	11352	0.000	0.000	1.00	7.6	0.150	0.100	42.89	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	7.7	0.150	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	18.6	0.093	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	49.2	0.050	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	43.0	0.050	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	42.8	0.050	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	45.7	0.050	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	48.2	0.050	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	42.2	0.062	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	14.6	0.150	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	14.5	0.150	0.100	85.79	4.0	15.5
Toe						1.8	0.150	0.100			

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

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

Depth Stroke Pressure Efficcy
ft ft Ratio
80.00 10.81 1.00 0.800

^ FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2 10/24/2021
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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	
469.7	187.0	9.10	9.08	-2.85	23	8	32.39	6	3	20.5	39.2
478.5	208.7	9.15	9.13	-2.71	25	7	32.53	6	3	20.7	39.1
487.4	236.2	9.20	9.18	-2.73	25	7	32.71	6	3	20.7	39.0
496.4	267.0	9.25	9.21	-2.72	25	7	32.86	6	3	20.8	38.9
505.4	306.4	9.29	9.24	-2.74	25	7	32.99	6	3	20.9	38.9

^ FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2 10/24/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 85.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

Pile and Soil Model						Total Capacity	Rut	(kips)	491.2		
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	0.175	11352	0.010	0.000	0.85	0.4	0.050	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	1.7	0.050	0.100	6.60	4.0	15.5
3	0.175	11352	0.000	0.000	1.00	3.1	0.050	0.100	9.90	4.0	15.5
4	0.175	11352	0.000	0.000	1.00	4.5	0.050	0.100	13.20	4.0	15.5
5	0.175	11352	0.000	0.000	1.00	6.9	0.149	0.100	16.50	4.0	15.5

6	0.175	11352	0.000	0.000	1.00	7.9	0.139	0.100	19.80	4.0	15.5
7	0.175	11352	0.000	0.000	1.00	24.6	0.050	0.100	23.10	4.0	15.5
8	0.175	11352	0.000	0.000	1.00	16.9	0.180	0.100	26.40	4.0	15.5
9	0.175	11352	0.000	0.000	1.00	12.6	0.192	0.100	29.70	4.0	15.5
10	0.175	11352	0.000	0.000	1.00	7.5	0.150	0.100	33.00	4.0	15.5
11	0.175	11352	0.000	0.000	1.00	7.6	0.150	0.100	36.30	4.0	15.5
12	0.175	11352	0.000	0.000	1.00	7.7	0.150	0.100	39.60	4.0	15.5
13	0.175	11352	0.000	0.000	1.00	7.9	0.150	0.100	42.89	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	39.3	0.057	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	47.6	0.050	0.100	49.49	4.0	15.5
16	0.175	11352	0.000	0.000	1.00	41.4	0.050	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	44.3	0.050	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	47.1	0.050	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	49.1	0.050	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	24.3	0.107	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	14.6	0.150	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	14.4	0.150	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	14.1	0.150	0.100	85.79	4.0	15.5
Toe						1.8	0.150	0.100			

4.543 kips total un-reduced pile weight (g= 32.17 ft/s²)

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
85.00	10.81	1.00	0.800

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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
491.2	224.3	9.18	9.13	-3.29	23	8	32.57	5	3	20.3
501.1	260.2	9.21	9.17	-3.26	25	7	32.70	5	3	20.3
511.3	304.1	9.25	9.20	-3.27	25	7	32.84	5	3	20.4
521.4	359.2	9.28	9.23	-3.32	25	7	32.98	5	3	20.4
531.6	429.6	9.32	9.27	-3.35	25	7	33.11	5	3	20.4

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 Resource International Inc GRLWEAP Version 2010

Depth	(ft)	85.8	Standard Soil Setup
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in ²)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

L b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
ft	in ²	ksi	lb/ft ³	ft		ft/s	k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
85.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 10.383

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	in ²
1	0.175	11352	0.010	0.000	0.85	0.7	0.050	0.100	3.30	4.0	15.5
2	0.175	11352	0.000	0.000	1.00	2.1	0.050	0.100	6.60	4.0	15.5
3	0.175	11352	0.000	0.000	1.00	3.4	0.050	0.100	9.90	4.0	15.5
4	0.175	11352	0.000	0.000	1.00	5.1	0.090	0.100	13.20	4.0	15.5
5	0.175	11352	0.000	0.000	1.00	6.9	0.150	0.100	16.50	4.0	15.5
6	0.175	11352	0.000	0.000	1.00	11.7	0.104	0.100	19.80	4.0	15.5
7	0.175	11352	0.000	0.000	1.00	24.5	0.066	0.100	23.10	4.0	15.5
8	0.175	11352	0.000	0.000	1.00	15.1	0.200	0.100	26.40	4.0	15.5
9	0.175	11352	0.000	0.000	1.00	10.7	0.182	0.100	29.70	4.0	15.5
10	0.175	11352	0.000	0.000	1.00	7.5	0.150	0.100	33.00	4.0	15.5
11	0.175	11352	0.000	0.000	1.00	7.6	0.150	0.100	36.30	4.0	15.5
12	0.175	11352	0.000	0.000	1.00	7.7	0.150	0.100	39.60	4.0	15.5
13	0.175	11352	0.000	0.000	1.00	9.1	0.141	0.100	42.89	4.0	15.5
14	0.175	11352	0.000	0.000	1.00	48.2	0.050	0.100	46.19	4.0	15.5
15	0.175	11352	0.000	0.000	1.00	45.4	0.050	0.100	49.49	4.0	15.5

16	0.175	11352	0.000	0.000	1.00	42.1	0.050	0.100	52.79	4.0	15.5
17	0.175	11352	0.000	0.000	1.00	45.0	0.050	0.100	56.09	4.0	15.5
18	0.175	11352	0.000	0.000	1.00	47.7	0.050	0.100	59.39	4.0	15.5
19	0.175	11352	0.000	0.000	1.00	49.4	0.050	0.100	62.69	4.0	15.5
20	0.175	11352	0.000	0.000	1.00	15.9	0.144	0.100	65.99	4.0	15.5
21	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	69.29	4.0	15.5
22	0.175	11352	0.000	0.000	1.00	14.7	0.150	0.100	72.59	4.0	15.5
23	0.175	11352	0.000	0.000	1.00	14.6	0.150	0.100	75.89	4.0	15.5
24	0.175	11352	0.000	0.000	1.00	14.5	0.150	0.100	79.19	4.0	15.5
25	0.175	11352	0.000	0.000	1.00	14.3	0.150	0.100	82.49	4.0	15.5
26	0.175	11352	0.000	0.000	1.00	14.0	0.150	0.100	85.79	4.0	15.5
Toe						1.8	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
85.79	10.81	1.00	0.800

▲
FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2 10/24/2021
Resource International Inc GRLWEAP Version 2010

Rut	Bl Ct	Stroke (ft)	Ten Str	i	t Comp Str	i	t ENTHRU	Bl Rt
kips	b/ft	down	up	ksi	ksi	ksi	kip-ft	b/min
494.5	231.1	9.18	9.13	-3.35	23	8	32.45	5
504.6	267.9	9.22	9.16	-3.35	25	7	32.59	5
514.9	316.4	9.25	9.20	-3.39	25	7	32.70	5
525.3	375.5	9.28	9.22	-3.40	25	7	32.81	5
535.6	451.2	9.32	9.26	-3.42	25	7	32.94	5

▲
FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2 10/24/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

Depth	Rut	G/L at	Shaft and	Toe:	0.486	1.000		
ft	kips	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
		kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.0	2.4	1.6	0.8	0.0	0.000	0.000	10.81	0.0
10.0	7.7	6.3	1.4	Hammer did not run				
15.0	18.1	15.0	3.0	1.5	13.592	-2.819	4.27	23.3
20.0	80.5	31.3	49.2	7.7	23.076	-0.196	5.82	20.2
25.0	65.4	63.1	2.3	5.4	21.751	-1.859	5.52	21.2
30.0	83.7	80.9	2.8	7.8	23.348	-0.485	5.87	20.0
35.0	95.2	92.4	2.8	9.2	24.261	-1.691	6.10	19.6
40.0	106.9	104.1	2.8	10.9	25.110	-2.108	6.34	19.2
45.0	178.9	142.5	36.5	19.9	27.750	-1.543	7.12	18.7
50.0	228.3	212.0	16.3	25.3	28.619	-2.707	7.44	19.0
55.0	293.9	277.6	16.3	37.4	30.061	-2.392	7.94	19.9
60.0	365.8	349.5	16.3	65.0	31.357	-4.002	8.49	20.8
65.0	403.2	401.4	1.8	90.3	31.744	-4.392	8.63	20.8
70.0	425.5	423.7	1.8	111.7	32.077	-3.214	8.85	21.0
75.0	447.7	445.9	1.8	140.4	32.432	-3.551	9.00	20.9
80.0	469.7	467.9	1.8	187.0	32.392	-2.845	9.10	20.5
85.0	491.2	489.4	1.8	224.3	32.572	-3.286	9.18	20.3
85.8	494.5	492.7	1.8	231.1	32.454	-3.352	9.18	20.2

Total Driving Time 108 minutes;
Starting at penetration 5.0 ft Total No. of Blows 4339

Depth	Rut	G/L at	Shaft and	Toe:	0.528	1.000		
ft	kips	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
		kips	kips	bl/ft	ksi	ksi	ft	kip-ft
5.0	2.4	1.6	0.8	0.0	0.000	0.000	11.86	0.0
10.0	7.7	6.3	1.4	Hammer did not run				
15.0	18.4	15.3	3.0	1.6	13.697	-2.722	4.29	23.4
20.0	81.2	32.0	49.2	7.8	23.110	-0.233	5.84	20.1
25.0	67.0	64.7	2.3	5.6	21.921	-1.672	5.55	21.1
30.0	86.7	83.9	2.8	8.2	23.616	-0.689	5.93	19.8
35.0	98.8	96.0	2.8	9.7	24.548	-1.573	6.17	19.5
40.0	111.1	108.3	2.8	11.6	25.387	-1.937	6.41	19.2
45.0	183.5	147.1	36.5	20.6	27.942	-1.384	7.17	18.8
50.0	232.9	216.6	16.3	26.1	28.778	-2.777	7.48	19.1
55.0	298.5	282.2	16.3	38.9	30.230	-2.568	7.99	20.0
60.0	370.4	354.1	16.3	68.5	31.553	-4.184	8.54	20.9

65.0	408.4	406.5	1.8	96.5	31.941	-4.478	8.69	20.9
70.0	431.8	430.0	1.8	121.6	32.254	-3.388	8.90	21.1
75.0	455.3	453.5	1.8	157.2	32.644	-3.643	9.06	21.0
80.0	478.5	476.7	1.8	208.7	32.530	-2.713	9.15	20.7
85.0	501.1	499.3	1.8	260.2	32.705	-3.256	9.21	20.3
85.8	504.6	502.8	1.8	267.9	32.593	-3.348	9.22	20.3

Total Driving Time 119 minutes; Total No. of Blows 4769
Starting at penetration 5.0 ft

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FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2
Resource International Inc

10/24/2021
GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.571 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
5.0	2.4	1.6	0.8	0.0	0.000	0.000	11.86	0.0
10.0	7.7	6.3	1.4	Hammer did not run				
15.0	18.7	15.6	3.0	1.6	13.845	-2.736	4.31	23.5
20.0	81.9	32.8	49.2	7.9	23.162	-0.257	5.85	20.1
25.0	68.7	66.4	2.3	5.8	22.082	-1.486	5.58	21.0
30.0	89.7	87.0	2.8	8.6	23.860	-0.936	5.99	19.8
35.0	102.5	99.7	2.8	10.2	24.857	-1.509	6.24	19.5
40.0	115.4	112.6	2.8	12.3	25.681	-2.163	6.49	19.2
45.0	188.2	151.8	36.5	21.3	28.120	-1.615	7.21	18.8
50.0	237.6	221.3	16.3	27.0	28.967	-2.794	7.53	19.2
55.0	303.2	286.9	16.3	40.8	30.419	-2.705	8.03	19.9
60.0	375.1	358.8	16.3	72.2	31.699	-4.402	8.60	21.0
65.0	413.6	411.8	1.8	101.6	32.153	-4.561	8.75	21.1
70.0	438.3	436.5	1.8	133.3	32.423	-3.522	8.97	21.2
75.0	463.0	461.2	1.8	177.8	32.843	-3.719	9.11	21.1
80.0	487.4	485.6	1.8	236.2	32.706	-2.734	9.20	20.7
85.0	511.3	509.5	1.8	304.1	32.845	-3.274	9.25	20.4
85.8	514.9	513.1	1.8	316.4	32.702	-3.392	9.25	20.2

Total Driving Time 133 minutes; Total No. of Blows 5290
Starting at penetration 5.0 ft

G/L at Shaft and Toe: 0.614 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
5.0	2.4	1.6	0.8	0.0	0.000	0.000	11.86	0.0
10.0	7.7	6.3	1.4	Hammer did not run				
15.0	18.9	15.9	3.0	1.6	13.951	-2.717	4.32	23.5
20.0	82.7	33.5	49.2	7.9	23.223	-0.303	5.86	20.1
25.0	70.3	68.0	2.3	6.0	22.230	-1.304	5.62	21.0
30.0	92.8	90.0	2.8	9.0	24.134	-1.138	6.05	19.7
35.0	106.1	103.4	2.8	10.8	25.148	-1.478	6.31	19.4
40.0	119.7	117.0	2.8	13.0	25.926	-2.536	6.55	19.2
45.0	192.9	156.5	36.5	22.0	28.353	-1.830	7.27	18.9
50.0	242.3	226.0	16.3	28.0	29.127	-2.749	7.58	19.2
55.0	307.9	291.6	16.3	42.3	30.630	-2.916	8.09	20.1
60.0	379.8	363.5	16.3	76.7	31.844	-4.602	8.63	21.1
65.0	418.9	417.0	1.8	107.9	32.343	-4.646	8.81	21.2
70.0	444.8	443.0	1.8	145.5	32.598	-3.684	9.02	21.3
75.0	470.8	468.9	1.8	196.7	33.047	-3.757	9.18	21.2
80.0	496.4	494.6	1.8	267.0	32.861	-2.717	9.25	20.8
85.0	521.4	519.6	1.8	359.2	32.975	-3.315	9.28	20.4
85.8	525.3	523.5	1.8	375.5	32.814	-3.400	9.28	20.3

Total Driving Time 148 minutes; Total No. of Blows 5860
Starting at penetration 5.0 ft

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FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2
Resource International Inc

10/24/2021
GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.657 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
5.0	2.4	1.6	0.8	0.0	0.000	0.000	11.86	0.0
10.0	7.7	6.3	1.4	Hammer did not run				
15.0	19.2	16.2	3.0	1.6	13.854	-2.863	4.29	23.5
20.0	83.4	34.2	49.2	8.0	23.259	-0.349	5.87	20.0

25.0	71.9	69.6	2.3	6.2	22.342	-1.139	5.65	20.8
30.0	95.8	93.0	2.8	9.4	24.348	-1.360	6.10	19.6
35.0	109.8	107.0	2.8	11.4	25.363	-1.447	6.36	19.3
40.0	124.1	121.3	2.8	13.7	26.162	-2.766	6.62	19.1
45.0	197.7	161.2	36.5	22.7	28.487	-2.020	7.31	18.9
50.0	247.1	230.7	16.3	28.9	29.287	-2.624	7.62	19.3
55.0	312.6	296.3	16.3	43.9	30.854	-3.224	8.15	20.2
60.0	384.5	368.2	16.3	81.3	32.022	-4.792	8.68	21.2
65.0	424.1	422.3	1.8	114.8	32.544	-4.718	8.86	21.3
70.0	451.3	449.5	1.8	161.2	32.786	-3.789	9.09	21.4
75.0	478.5	476.7	1.8	217.2	33.227	-3.789	9.23	21.4
80.0	505.4	503.5	1.8	306.4	32.993	-2.736	9.29	20.9
85.0	531.6	529.8	1.8	429.6	33.112	-3.348	9.32	20.4
85.8	535.6	533.8	1.8	451.2	32.939	-3.423	9.32	20.4

Total Driving Time 166 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 6556

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FRA-70-13.01-RA-B-015-1-13-HP12x53-Case2
Resource International Inc

10/24/2021
GRLWEAP Version 2010

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
5.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
10.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
15.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
20.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
25.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
30.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
35.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
40.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
45.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
50.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
55.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
60.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
65.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
70.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
75.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
80.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
85.00	85.79	0.00	10.81	1.00	0.80	1.00	1.00
85.79	85.79	0.00	10.81	1.00	0.80	1.00	1.00

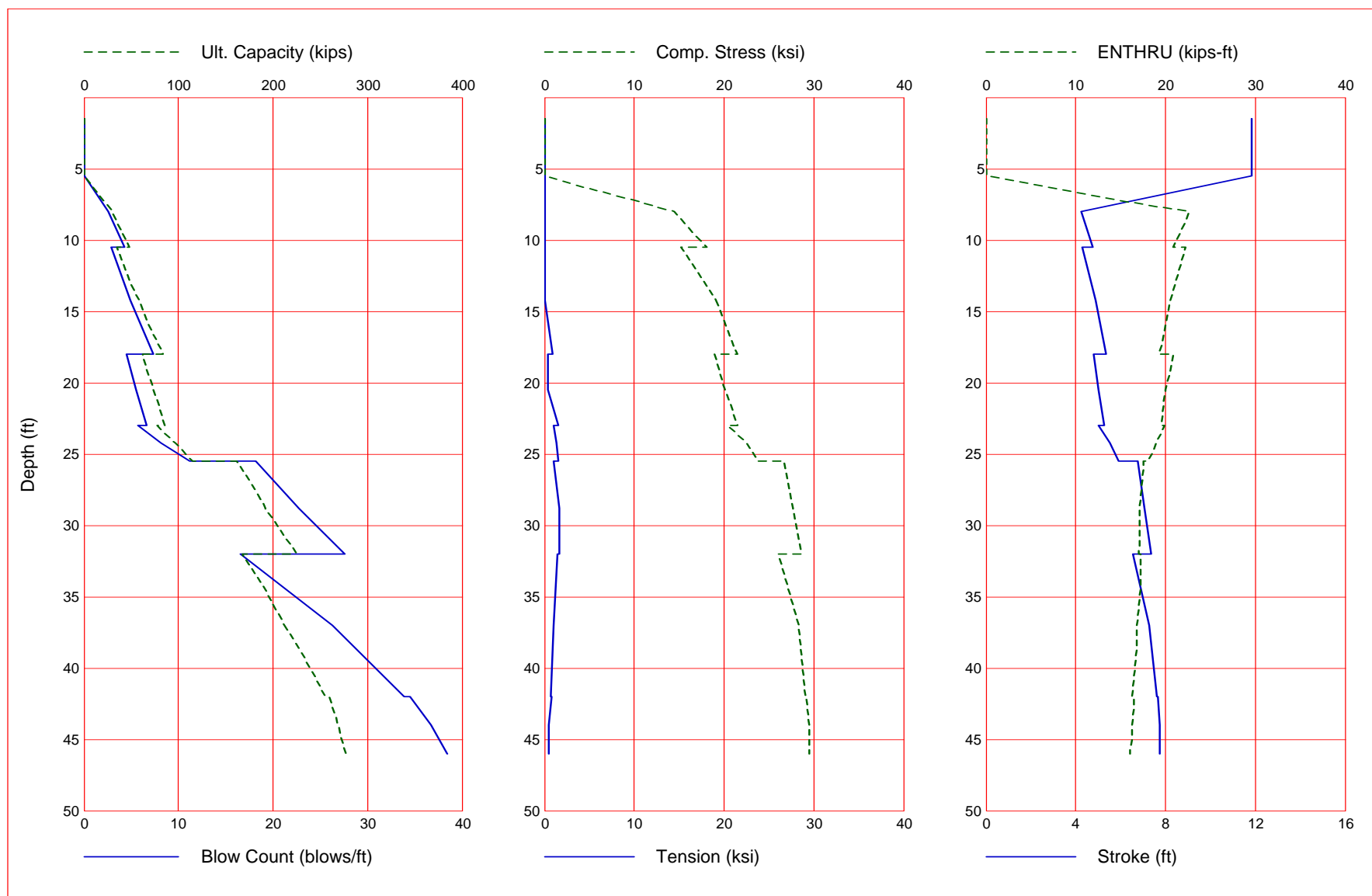
Soil Layer Resistance Values

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	0.100	0.050	0.150	0.000	6.000	24.000
3.00	0.09	0.47	0.100	0.100	0.050	0.150	0.000	6.000	24.000
6.00	0.19	0.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
9.00	0.28	1.42	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.00	0.38	1.43	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.49	0.40	1.43	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.51	0.88	3.03	0.100	0.100	0.150	0.150	0.778	6.000	336.000
18.79	0.88	3.03	0.100	0.100	0.150	0.150	0.778	6.000	336.000
18.81	1.69	45.89	0.100	0.100	0.050	0.150	0.000	6.000	24.000
21.80	2.00	54.09	0.100	0.100	0.050	0.150	0.000	6.000	24.000
22.79	2.10	56.81	0.100	0.100	0.050	0.150	0.000	6.000	24.000
22.81	2.38	2.30	0.100	0.100	0.200	0.150	1.000	6.000	720.000
27.79	2.38	2.30	0.100	0.100	0.200	0.150	1.000	6.000	720.000
27.81	0.95	2.79	0.100	0.100	0.150	0.150	0.778	6.000	336.000
39.80	0.99	2.79	0.100	0.100	0.150	0.150	0.778	6.000	336.000
42.79	1.05	2.79	0.100	0.100	0.150	0.150	0.778	6.000	336.000
42.81	3.52	36.46	0.100	0.100	0.050	0.150	0.000	6.000	24.000
45.80	3.79	36.46	0.100	0.100	0.050	0.150	0.000	6.000	24.000
47.79	3.97	36.46	0.100	0.100	0.050	0.150	0.000	6.000	24.000
47.81	2.99	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
50.80	3.19	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
53.80	3.39	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
56.80	3.59	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
57.99	3.67	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
58.01	3.67	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
61.00	3.77	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000

62.79	3.83	16.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
62.81	1.88	1.82	0.100	0.100	0.150	0.150	0.778	6.000	336.000
74.80	1.86	1.82	0.100	0.100	0.150	0.150	0.778	6.000	336.000
77.80	1.84	1.82	0.100	0.100	0.150	0.150	0.778	6.000	336.000
80.80	1.83	1.82	0.100	0.100	0.150	0.150	0.778	6.000	336.000
83.80	1.79	1.82	0.100	0.100	0.150	0.150	0.778	6.000	336.000
85.79	1.74	1.82	0.100	0.100	0.150	0.150	0.778	6.000	336.000

Pier 1
(B-014-3-19)

Gain/Loss 3 at Shaft and Toe 0.667 / 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.
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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: J:\GEOTECH\PROJECTS\2020\W-20-025
FRA-70-13.01\ANALYSIS\DRIVEABILITY\PIER 1\FRA-70-13.01 - PIER 1 HP
12X53-B-014-3-19.GWW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW

Hammer File Version: 2003 (2/22/2013)

Input File Contents

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2

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	15.500	12.040	H Pile

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
1.900	227.000	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
45.980	15.50	29000.0	492.000	3.970	0	0.850	0.010

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	0.002	0.002	1.250	0.00	0.00	0.00	

P atm	P1	P2	P3	P4	P5
14.70	1520.00	1368.00	1231.00	1108.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1520.0000	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
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Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000
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Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	0.00	0.00	0.10	0.10	0.05	0.15	1.20	6.00	168.0

1.49	0.00	0.00	0.10	0.10	0.05	0.15	1.20	6.00	168.0
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1.51	0.00	0.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
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2.99	0.00	0.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
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5.49	0.00	0.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
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7.14	0.00	0.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
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7.16	0.71	24.52	0.10	0.10	0.05	0.15	1.00	6.00	24.0
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8.15	0.82	27.99	0.10	0.10	0.05	0.15	1.00	6.00	24.0
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9.15	0.92	31.48	0.10	0.10	0.05	0.15	1.00	6.00	24.0
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10.15	1.02	34.98	0.10	0.10	0.05	0.15	1.00	6.00	24.0
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10.49	1.05	36.17	0.10	0.10	0.05	0.15	1.00	6.00	24.0
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10.51	1.04	23.18	0.10	0.10	0.05	0.15	1.00	6.00	24.0
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11.50	1.13	25.31	0.10	0.10	0.05	0.15	1.00	6.00	24.0
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11.99	1.18	26.36	0.10	0.10	0.05	0.15	1.00	6.00	24.0
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12.01	1.18	26.40	0.10	0.10	0.05	0.15	1.00	6.00	24.0
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13.00	1.23	27.50	0.10	0.10	0.05	0.15	1.00	6.00	24.0
14.00	1.28	28.62	0.10	0.10	0.05	0.15	1.00	6.00	24.0
15.00	1.33	29.74	0.10	0.10	0.05	0.15	1.00	6.00	24.0
16.00	1.38	30.87	0.10	0.10	0.05	0.15	1.00	6.00	24.0
17.00	1.43	31.98	0.10	0.10	0.05	0.15	1.00	6.00	24.0
17.99	1.48	33.09	0.10	0.10	0.05	0.15	1.00	6.00	24.0
18.01	1.02	11.58	0.10	0.10	0.05	0.15	1.00	6.00	24.0
19.00	1.05	11.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
20.00	1.09	12.35	0.10	0.10	0.05	0.15	1.00	6.00	24.0
21.00	1.12	12.74	0.10	0.10	0.05	0.15	1.00	6.00	24.0
22.00	1.16	13.12	0.10	0.10	0.05	0.15	1.00	6.00	24.0
22.99	1.19	13.51	0.10	0.10	0.05	0.15	1.00	6.00	24.0
23.01	5.75	5.57	0.10	0.10	0.15	0.15	1.50	6.00	336.0
25.49	5.75	5.57	0.10	0.10	0.15	0.15	1.50	6.00	336.0
25.51	1.89	51.19	0.10	0.10	0.05	0.15	1.00	6.00	24.0
26.50	1.95	52.76	0.10	0.10	0.05	0.15	1.00	6.00	24.0
27.50	2.00	54.33	0.10	0.10	0.05	0.15	1.00	6.00	24.0
28.50	2.06	55.91	0.10	0.10	0.05	0.15	1.00	6.00	24.0
29.50	2.12	57.49	0.10	0.10	0.05	0.15	1.00	6.00	24.0
30.50	2.18	59.07	0.10	0.10	0.05	0.15	1.00	6.00	24.0
31.50	2.24	60.64	0.10	0.10	0.05	0.15	1.00	6.00	24.0
31.99	2.27	61.42	0.10	0.10	0.05	0.15	1.00	6.00	24.0
32.01	3.38	3.27	0.10	0.10	0.15	0.15	1.50	6.00	336.0
41.99	3.38	3.27	0.10	0.10	0.15	0.15	1.50	6.00	336.0
42.01	1.67	6.78	0.10	0.10	0.15	0.15	1.50	6.00	336.0
45.98	1.67	6.78	0.10	0.10	0.15	0.15	1.50	6.00	336.0

Gain/Loss factors: shaft and toe

0.60000	0.63300	0.66700	0.70000	0.73300
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
1.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
1.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
2.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
2.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
3.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
4.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
5.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
5.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
8.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
10.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
10.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
14.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
17.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
18.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
20.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
22.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
23.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
24.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
25.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
25.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000

28.75	0.00	0.00	0.000	0.000	0.000	0.000	0.000
31.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
32.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
37.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
41.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
42.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
43.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
45.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1 0 10.81000 11.86000

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GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

Version 2010

English Units

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2

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	140046.7	1.000	0.0100			
3	0.800	140046.7	1.000	0.0100			
4	0.800	140046.7	1.000	0.0100			
5	0.800	140046.7	1.000	0.0100			
Imp Block	0.753	70735.6	0.900	0.0100			
Helmet	1.900	60155.0	0.800	0.0100	5.8		
Combined Pile Top		11405.3					

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)	1520.00	Actual Pressure	(psi)	1520.00
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)	227.00	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)	60155.0	Stiffness	(kips/in)	0.0

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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

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GRLWEAP Version 2010

Depth	(ft)	1.5		
Shaft Gain/Loss Factor		0.600	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	45.98	4.0	15.5
Toe						0.0	0.150	0.100			

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

2.435 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)	0.544

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	Stroke	Pressure	Efficy
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ft	ft	Ratio	
1.48	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

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 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

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 FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
 Resource International Inc GRLWEAP Version 2010

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
1		0 10.81	000			11.86	000		

↑
 FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
 Resource International Inc GRLWEAP Version 2010

Depth	(ft)	1.5	
Shaft Gain/Loss Factor		0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	45.98	4.0	15.5
Toe						0.0	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
1.52	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

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INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

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 FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
 Resource International Inc GRLWEAP Version 2010

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
1		0 10.81	000			11.86	000		

↑
 FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
 Resource International Inc GRLWEAP Version 2010

Depth	(ft)	2.2
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5	
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5	
14	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	45.98	4.0	15.5	
Toe						0.0	0.150	0.100				

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
2.25	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
 Resource International Inc

06/27/2021
 GRLWEAP Version 2010

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
1		0	10.81000		11.86000				

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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

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GRLWEAP Version 2010

Depth (ft) 3.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	45.98	4.0	15.5
Toe						0.0	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
2.98	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
 Resource International Inc GRLWEAP Version 2010

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
1		0 10.81	000			11.86	000		

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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
 Resource International Inc GRLWEAP Version 2010

Depth	(ft)	3.0		
Shaft Gain/Loss Factor		0.600	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	45.98	4.0	15.5
Toe						0.0	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
3.02	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

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 FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
 Resource International Inc GRLWEAP Version 2010

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
1		0	10.81000		11.86000				

↑
 FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
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Depth	(ft)	4.2	
Shaft Gain/Loss Factor		0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	45.98	4.0	15.5
Toe						0.0	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
4.25	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

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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
1		0 10.81	000		11.86	000			

↑
 FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
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Depth	(ft)	5.5
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	45.98	4.0	15.5
Toe						0.0	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
5.48	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

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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
1		0 10.81	000		11.86	000			

↑
FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
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Depth	(ft)	5.5
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile

Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	45.98	4.0	15.5
Toe						0.0	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
5.52	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
 Hammer+Pile Weight > Rult: Pile Runs

↑
 FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
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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
1		0	10.81000			11.86000		

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

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Depth	(ft)	8.0	
Shaft Gain/Loss Factor		0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips) 30.0					
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	39.41	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	2.6	0.050	0.100	45.98	4.0	15.5
Toe						27.5	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
8.00	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
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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
30.0	2.6	4.23	4.21	0.00	1	0	14.45	1	2 22.7 57.6
30.0	2.6	4.23	4.21	0.00	1	0	14.45	1	2 22.7 57.6
30.0	2.6	4.23	4.21	0.00	1	0	14.45	1	2 22.7 57.6
30.0	2.6	4.23	4.21	0.00	1	0	14.45	1	2 22.7 57.6
30.0	2.6	4.23	4.21	0.00	1	0	14.45	1	2 22.7 57.6
1		0	10.81000			11.86000			

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2

06/27/2021

Depth (ft) 10.5
 Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
 Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips) 47.8					
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	36.13	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	0.1	0.050	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	11.6	0.050	0.100	45.98	4.0	15.5
Toe						36.1	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
10.48	10.81	1.00	0.800



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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
47.8	4.3	4.76	4.73	0.00	1	0	18.12	7	3	20.9	54.3
47.8	4.3	4.76	4.73	0.00	1	0	18.12	7	3	20.9	54.3
47.8	4.3	4.76	4.73	0.00	1	0	18.12	7	3	20.9	54.3
47.8	4.3	4.76	4.73	0.00	1	0	18.12	7	3	20.9	54.3
47.8	4.3	4.76	4.73	0.00	1	0	18.12	7	3	20.9	54.3
1		0	10.81	000			11.86	000			



FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
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Depth (ft) 10.5

Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips)					35.1
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	36.13	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	0.2	0.050	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	11.6	0.050	0.100	45.98	4.0	15.5
Toe						23.2	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
10.52	10.81	1.00	0.800



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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
35.1	2.9	4.28	4.31	0.00	1	0	15.21	1	2	22.2
35.1	2.9	4.28	4.31	0.00	1	0	15.21	1	2	22.2
35.1	2.9	4.28	4.31	0.00	1	0	15.21	1	2	22.2
35.1	2.9	4.28	4.31	0.00	1	0	15.21	1	2	22.2
35.1	2.9	4.28	4.31	0.00	1	0	15.21	1	2	22.2
1		0	10.81000				11.86000			



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Depth (ft) 14.2
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips)			58.3		
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	32.84	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	1.6	0.050	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	12.2	0.050	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	15.7	0.050	0.100	45.98	4.0	15.5
Toe						28.9	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
14.25	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Rut	Bl Ct	Stroke (ft)	Ten Str	i	t Comp	Str	i	t ENTHRU	Bl Rt
kips	b/ft	down	up			ksi		kip-ft	b/min
58.3	4.9	4.90	4.86	0.00	1	0	19.16	10	4
58.3	4.9	4.90	4.86	0.00	1	0	19.16	10	4
58.3	4.9	4.90	4.86	0.00	1	0	19.16	10	4
58.3	4.9	4.90	4.86	0.00	1	0	19.16	10	4
58.3	4.9	4.90	4.86	0.00	1	0	19.16	10	4
1		0	10.81000				11.86000		

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

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Depth	(ft)	18.0
Shaft Gain/Loss Factor		0.600
Toe Gain/Loss Factor		1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips)			83.1		
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	29.56	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	3.0	0.050	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	12.7	0.050	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	16.1	0.050	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	18.2	0.050	0.100	45.98	4.0	15.5
Toe						33.1	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
17.98	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

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
83.1	7.3	5.37	5.34	-0.94	11	45	21.53	11	4
83.1	7.3	5.37	5.34	-0.94	11	45	21.53	11	4
83.1	7.3	5.37	5.34	-0.94	11	45	21.53	11	4
83.1	7.3	5.37	5.34	-0.94	11	45	21.53	11	4
83.1	7.3	5.37	5.34	-0.94	11	45	21.53	11	4
1		0	10.81	0.00			11.86	0.00	

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth	(ft)	18.0
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor
		1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips)			61.8		
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	29.56	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	3.1	0.050	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	12.8	0.050	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	16.1	0.050	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	18.2	0.050	0.100	45.98	4.0	15.5
Toe						11.6	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
18.02	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

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
61.8	4.5	4.81	4.77	-0.36	2	8	18.92	10	4	20.8
61.8	4.5	4.81	4.77	-0.36	2	8	18.92	10	4	20.8
61.8	4.5	4.81	4.77	-0.36	2	8	18.92	10	4	20.8
61.8	4.5	4.81	4.77	-0.36	2	8	18.92	10	4	20.8
61.8	4.5	4.81	4.77	-0.36	2	8	18.92	10	4	20.8
1		0	10.81000				11.86000			

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

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GRLWEAP Version 2010

Depth	(ft)	20.5
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity			Rut (kips)			73.2	
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5		
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5		
8	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	26.27	4.0	15.5		
10	0.174	11405	0.000	0.000	1.00	0.6	0.050	0.100	32.84	4.0	15.5		
11	0.174	11405	0.000	0.000	1.00	11.8	0.050	0.100	36.13	4.0	15.5		
12	0.174	11405	0.000	0.000	1.00	15.4	0.050	0.100	39.41	4.0	15.5		
13	0.174	11405	0.000	0.000	1.00	17.7	0.050	0.100	42.70	4.0	15.5		
14	0.174	11405	0.000	0.000	1.00	15.1	0.050	0.100	45.98	4.0	15.5		
Toe						12.5	0.150	0.100					

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
20.50	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp	Str	i	t	ENTHRU kip-ft	Bl Rt b/min
73.2	5.5	5.00	5.01	-0.34	5	47	20.10	11	4	20.0	52.7	
73.2	5.5	5.00	5.01	-0.34	5	47	20.10	11	4	20.0	52.7	
73.2	5.5	5.00	5.01	-0.34	5	47	20.10	11	4	20.0	52.7	
73.2	5.5	5.00	5.01	-0.34	5	47	20.10	11	4	20.0	52.7	
73.2	5.5	5.00	5.01	-0.34	5	47	20.10	11	4	20.0	52.7	
1		0	10.81000		11.86000							

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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth	(ft)	23.0
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips)						85.4
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5	
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5	
8	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	26.27	4.0	15.5	
10	0.174	11405	0.000	0.000	1.00	9.1	0.050	0.100	32.84	4.0	15.5	
11	0.174	11405	0.000	0.000	1.00	14.7	0.050	0.100	36.13	4.0	15.5	
12	0.174	11405	0.000	0.000	1.00	17.2	0.050	0.100	39.41	4.0	15.5	
13	0.174	11405	0.000	0.000	1.00	16.2	0.050	0.100	42.70	4.0	15.5	
14	0.174	11405	0.000	0.000	1.00	14.8	0.050	0.100	45.98	4.0	15.5	
Toe						13.5	0.150	0.100				

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
22.98	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	Str ksi	i	t	Comp	Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
85.4	6.6	5.28	5.24	-1.58	8	45	21.53	10	4	19.6	51.4	
85.4	6.6	5.28	5.24	-1.58	8	45	21.53	10	4	19.6	51.4	
85.4	6.6	5.28	5.24	-1.58	8	45	21.53	10	4	19.6	51.4	
85.4	6.6	5.28	5.24	-1.58	8	45	21.53	10	4	19.6	51.4	
85.4	6.6	5.28	5.24	-1.58	8	45	21.53	10	4	19.6	51.4	
1		0	10.81	0.00			11.86	0.00				

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth	(ft)	23.0
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity			Rut (kips)			77.9	
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5		
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5		
7	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	22.99	4.0	15.5		
10	0.174	11405	0.000	0.000	1.00	9.3	0.050	0.100	32.84	4.0	15.5		
11	0.174	11405	0.000	0.000	1.00	14.7	0.050	0.100	36.13	4.0	15.5		
12	0.174	11405	0.000	0.000	1.00	17.2	0.050	0.100	39.41	4.0	15.5		
13	0.174	11405	0.000	0.000	1.00	16.1	0.050	0.100	42.70	4.0	15.5		
14	0.174	11405	0.000	0.000	1.00	15.0	0.052	0.100	45.98	4.0	15.5		
Toe						5.6	0.150	0.100					

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
23.02	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
77.9	5.7	5.03	5.05	-1.02	7	47	20.47	10	4	19.9	52.5
77.9	5.7	5.03	5.05	-1.01	7	47	20.50	10	4	19.9	52.5
77.9	5.7	5.03	5.05	-1.03	7	47	20.47	10	4	19.9	52.5
77.9	5.7	5.03	5.05	-1.02	7	47	20.48	10	4	19.9	52.5
78.0	5.7	5.03	5.05	-1.02	7	47	20.50	10	4	19.9	52.5
1		0	10.81000				11.86000				

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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth	(ft)	24.2
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips)						94.8
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5	
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5	
7	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	22.99	4.0	15.5	
9	0.174	11405	0.000	0.000	1.00	2.0	0.050	0.100	29.56	4.0	15.5	
10	0.174	11405	0.000	0.000	1.00	12.3	0.050	0.100	32.84	4.0	15.5	
11	0.174	11405	0.000	0.000	1.00	15.8	0.050	0.100	36.13	4.0	15.5	
12	0.174	11405	0.000	0.000	1.00	18.0	0.050	0.100	39.41	4.0	15.5	
13	0.174	11405	0.000	0.000	1.00	14.5	0.050	0.100	42.70	4.0	15.5	
14	0.174	11405	0.000	0.000	1.00	26.5	0.125	0.100	45.98	4.0	15.5	
Toe						5.6	0.150	0.100				

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.25	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp	Str	i	t	ENTHRU kip-ft	Bl Rt b/min
94.8	8.0	5.50	5.48	-1.31	9	45	22.41	10	4	19.0	50.3	
95.7	8.1	5.52	5.49	-1.30	10	41	22.49	10	4	19.0	50.2	
96.7	8.2	5.54	5.52	-1.34	10	41	22.57	10	4	18.9	50.1	
97.6	8.4	5.56	5.53	-1.39	10	41	22.66	10	4	18.9	50.0	
98.5	8.5	5.58	5.56	-1.41	10	41	22.73	10	4	18.8	49.9	
1		0	10.81000				11.86000					

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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth	(ft)	25.5
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity			Rut	111.6		
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5	
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5	
7	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	22.99	4.0	15.5	
9	0.174	11405	0.000	0.000	1.00	6.1	0.050	0.100	29.56	4.0	15.5	
10	0.174	11405	0.000	0.000	1.00	13.8	0.050	0.100	32.84	4.0	15.5	
11	0.174	11405	0.000	0.000	1.00	16.7	0.050	0.100	36.13	4.0	15.5	
12	0.174	11405	0.000	0.000	1.00	17.1	0.050	0.100	39.41	4.0	15.5	
13	0.174	11405	0.000	0.000	1.00	14.4	0.050	0.100	42.70	4.0	15.5	
14	0.174	11405	0.000	0.000	1.00	37.8	0.144	0.100	45.98	4.0	15.5	
Toe						5.6	0.150	0.100				

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
25.48	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

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
111.6	10.6	5.82	5.87	-1.32	9	35	23.55	9	4	18.1
113.5	10.9	5.86	5.91	-1.44	9	35	23.71	9	4	18.1
115.4	11.2	5.91	5.95	-1.53	9	35	23.87	9	4	18.1
117.3	11.5	5.94	5.98	-1.57	9	35	23.96	9	4	17.9
119.1	11.8	5.97	6.01	-1.58	9	35	24.09	9	4	17.9
	1	0	10.81000				11.86000			

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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth	(ft)	25.5
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor
		1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips)			157.7		
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	22.99	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	6.3	0.050	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	13.9	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	16.7	0.050	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	17.1	0.050	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	14.4	0.050	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	38.0	0.144	0.100	45.98	4.0	15.5
Toe						51.2	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
25.52	10.81	1.00	0.800

↑
FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

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
157.7	17.8	6.64	6.65	-1.02	9	30	26.36	9	3	17.3	45.7
159.6	18.1	6.67	6.68	-1.02	9	30	26.46	10	4	17.3	45.6
161.5	18.2	6.76	6.70	-1.01	9	29	26.75	9	3	17.5	45.4
163.4	18.6	6.79	6.73	-0.99	9	29	26.83	10	4	17.4	45.3
165.3	18.9	6.81	6.75	-1.00	9	29	26.89	10	4	17.4	45.2
	1		0	10.81000			11.86000				

↑
FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
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Depth	(ft)	28.8
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
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Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips)			188.2		
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
6	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	19.71	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	6.1	0.050	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	13.8	0.050	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	16.7	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	17.2	0.050	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	14.4	0.050	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	37.6	0.143	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	26.1	0.053	0.100	45.98	4.0	15.5
Toe						56.3	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
28.75	10.81	1.00	0.800

↑

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
188.2	22.0	7.01	6.98	-1.72	8	50	27.55	9	3	17.2	44.6
190.1	22.3	7.04	7.00	-1.72	8	49	27.62	9	3	17.2	44.5
192.0	22.7	7.06	7.03	-1.70	8	49	27.66	9	3	17.1	44.4
193.9	22.9	7.07	7.05	-1.71	8	49	27.74	9	3	17.2	44.4
195.8	23.2	7.10	7.07	-1.70	8	49	27.82	9	3	17.2	44.3
1		0	10.81	000			11.86	000			

↑

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Depth Shaft Gain/Loss Factor	(ft) 0.600	Toe Gain/Loss Factor	32.0 1.000
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PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
 Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips)			221.1		
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
5	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	16.42	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	5.9	0.050	0.100	22.99	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	13.8	0.050	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	16.7	0.050	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	17.2	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	14.4	0.050	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	37.1	0.143	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	26.4	0.057	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	28.3	0.050	0.100	45.98	4.0	15.5
Toe						61.4	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
31.98	10.81	1.00	0.800



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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
221.1	26.8	7.31	7.28	-1.67	7	46	28.39	8	3	17.1	43.7
223.0	27.2	7.33	7.30	-1.65	7	45	28.45	8	3	17.0	43.6
224.9	27.6	7.34	7.33	-1.64	7	45	28.49	8	3	17.0	43.5
226.8	27.8	7.36	7.34	-1.65	7	45	28.55	8	3	17.1	43.5
228.7	28.2	7.38	7.36	-1.64	7	45	28.62	8	3	17.1	43.4
1		0	10.81	000			11.86	000			



FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
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Depth (ft) 32.0
 Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
 Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips)			163.4		
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
5	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	16.42	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	6.0	0.050	0.100	22.99	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	13.8	0.050	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	16.7	0.050	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	17.2	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	14.4	0.050	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	37.5	0.143	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	26.1	0.054	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	28.3	0.051	0.100	45.98	4.0	15.5
Toe						3.3	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
32.02	10.81	1.00	0.800



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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp	Str	ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
163.4	16.0	6.48	6.51	-1.57	8	30	25.82	8	3	17.2	46.2		
165.2	16.3	6.51	6.54	-1.54	8	30	25.93	8	3	17.2	46.1		
167.2	16.6	6.55	6.56	-1.49	8	30	26.07	8	3	17.2	46.0		
169.1	17.0	6.58	6.60	-1.43	8	30	26.13	8	3	17.1	45.9		
171.0	17.4	6.61	6.63	-1.36	8	30	26.24	8	3	17.1	45.8		
	1	0	10.81	0.00			11.86	0.00					



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Depth (ft) 37.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips)				203.4	
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
3	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	9.85	4.0	15.5
5	0.174	11405	0.000	0.000	1.00	0.8	0.050	0.100	16.42	4.0	15.5
6	0.174	11405	0.000	0.000	1.00	11.9	0.050	0.100	19.71	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	15.5	0.050	0.100	22.99	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	17.8	0.050	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	15.0	0.050	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	22.9	0.114	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	35.1	0.125	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	27.1	0.050	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	27.6	0.112	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	26.4	0.150	0.100	45.98	4.0	15.5
Toe						3.3	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
37.00	10.81	1.00	0.800

↑
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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
203.4	24.8	7.20	7.16	-1.31	6	47	28.15	6	3	16.9
207.5	25.5	7.23	7.20	-1.20	6	47	28.23	6	3	16.8

211.7	26.3	7.27	7.25	-1.04	6	46	28.37	6	3	16.8	43.8
215.8	27.0	7.30	7.28	-1.01	6	44	28.47	6	3	16.8	43.7
219.9	27.7	7.34	7.32	-1.05	6	44	28.55	6	3	16.7	43.6
	1	0	10.81000				11.86000				

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2

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Resource International Inc

GRLWEAP Version 2010

Depth	(ft)	42.0		
Shaft Gain/Loss Factor		0.600	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips)			243.4		
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	6.57	4.0	15.5
4	0.174	11405	0.000	0.000	1.00	6.4	0.050	0.100	13.14	4.0	15.5
5	0.174	11405	0.000	0.000	1.00	13.9	0.050	0.100	16.42	4.0	15.5
6	0.174	11405	0.000	0.000	1.00	16.8	0.050	0.100	19.71	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	17.0	0.050	0.100	22.99	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	14.5	0.050	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	38.1	0.143	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	25.9	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	28.3	0.056	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	26.4	0.150	0.100	39.41	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	26.4	0.150	0.100	45.98	4.0	15.5
Toe						3.3	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
41.98	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2

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Resource International Inc

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
243.4	31.5	7.54	7.53	-0.43	4	42	28.85	5	3	16.2	43.0
249.7	32.5	7.58	7.57	-0.47	4	38	28.96	5	3	16.3	42.9
256.2	33.9	7.63	7.63	-0.68	4	38	29.10	5	3	16.3	42.7
262.5	35.2	7.68	7.67	-0.83	4	38	29.21	5	3	16.4	42.6
268.8	36.2	7.72	7.71	-0.86	4	37	29.36	5	3	16.6	42.5
	1	0	10.81	0.00			11.86	0.00			

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

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Depth (ft) 42.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips)			247.2		
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	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	6.57	4.0	15.5
4	0.174	11405	0.000	0.000	1.00	6.6	0.050	0.100	13.14	4.0	15.5
5	0.174	11405	0.000	0.000	1.00	14.0	0.050	0.100	16.42	4.0	15.5
6	0.174	11405	0.000	0.000	1.00	16.8	0.050	0.100	19.71	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	17.0	0.050	0.100	22.99	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	14.5	0.050	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	38.3	0.143	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	25.9	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	28.3	0.058	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	26.4	0.150	0.100	39.41	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	26.3	0.150	0.100	45.98	4.0	15.5
Toe						6.8	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
42.02	10.81	1.00	0.800

↑

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Resource International Inc

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
247.2	32.2	7.57	7.56	-0.36	4	39	28.91	5	3	16.3	42.9
253.5	33.4	7.62	7.61	-0.59	4	38	29.05	5	3	16.3	42.8
260.0	34.5	7.67	7.65	-0.79	4	38	29.19	5	3	16.5	42.7
266.3	35.8	7.71	7.69	-0.86	4	38	29.31	5	3	16.5	42.6
272.6	37.1	7.75	7.74	-0.83	4	37	29.44	5	3	16.6	42.4
	1	0	10.81	000			11.86	000			

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
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Depth (ft) 44.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity Rut (kips)			255.0		
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	0.174	11405	0.010	0.000	0.85	0.0	0.050	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	6.57	4.0	15.5
3	0.174	11405	0.000	0.000	1.00	2.1	0.050	0.100	9.85	4.0	15.5
4	0.174	11405	0.000	0.000	1.00	12.4	0.050	0.100	13.14	4.0	15.5
5	0.174	11405	0.000	0.000	1.00	15.8	0.050	0.100	16.42	4.0	15.5
6	0.174	11405	0.000	0.000	1.00	18.1	0.050	0.100	19.71	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	14.4	0.050	0.100	22.99	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	26.7	0.126	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	32.7	0.114	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	27.4	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	27.4	0.123	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	26.4	0.150	0.100	39.41	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	18.3	0.150	0.100	45.98	4.0	15.5
Toe						6.8	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
43.98	10.81	1.00	0.800

↑

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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
255.0	33.9	7.64	7.62	-0.56	4	38	29.23	4	3	16.2
261.7	35.2	7.68	7.67	-0.63	4	38	29.35	4	3	16.3
268.6	36.7	7.73	7.72	-0.53	4	37	29.49	4	2	16.3
275.3	38.1	7.77	7.76	-0.48	4	36	29.60	4	3	16.4
282.1	39.6	7.82	7.81	-0.46	4	36	29.73	4	2	16.5
1		0	10.81000			11.86000				

↑

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Depth	(ft)	46.0
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor
		1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model						Total Capacity			Rut (kips)		
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	0.174	11405	0.010	0.000	0.85	0.0	0.050	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	6.57	4.0	15.5
3	0.174	11405	0.000	0.000	1.00	9.1	0.050	0.100	9.85	4.0	15.5
4	0.174	11405	0.000	0.000	1.00	14.7	0.050	0.100	13.14	4.0	15.5
5	0.174	11405	0.000	0.000	1.00	17.2	0.050	0.100	16.42	4.0	15.5
6	0.174	11405	0.000	0.000	1.00	16.1	0.050	0.100	19.71	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	14.8	0.050	0.100	22.99	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	40.2	0.140	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	26.4	0.050	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	28.1	0.085	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	26.4	0.150	0.100	36.13	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	23.6	0.150	0.100	42.70	4.0	15.5

14 0.174 11405 0.000 0.000 1.00 13.0 0.150 0.100 45.98 4.0 15.5
 Toe 6.8 0.150 0.100

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

Depth Stroke Pressure Efficy
 ft ft Ratio
 45.98 10.81 1.00 0.800

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	i ksi	t ksi	Comp Str ksi	i ksi	t ksi	ENTHRU kip-ft	Bl Rt b/min
262.9	35.1	7.68	7.67	-0.62	13	10	29.28	3	2	16.1
270.1	36.7	7.73	7.72	-0.53	14	10	29.42	3	2	16.1
277.4	38.4	7.76	7.77	-0.47	14	10	29.51	3	2	16.1
284.6	40.1	7.81	7.82	-0.40	14	10	29.62	3	2	16.2
291.8	41.6	7.86	7.85	-0.52	3	34	29.76	3	2	16.3

↑

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
 Resource International Inc

06/27/2021
 GRLWEAP Version 2010

SUMMARY OVER DEPTHS

Depth ft	Rut kips	G/L at Shaft and Toe: 0.600 1.000		Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
		Frictn kips	End Bg kips					
1.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
4.2	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
8.0	30.0	2.6	27.5	2.6	14.448	0.000	4.23	22.7
10.5	47.8	11.7	36.1	4.3	18.124	0.000	4.76	20.9
10.5	35.1	11.9	23.2	2.9	15.211	0.000	4.28	22.2
14.2	58.3	29.4	28.9	4.9	19.163	0.000	4.90	20.5
18.0	83.1	50.0	33.1	7.3	21.532	-0.940	5.37	19.3
18.0	61.8	50.2	11.6	4.5	18.916	-0.355	4.81	20.8
20.5	73.2	60.6	12.5	5.5	20.098	-0.336	5.00	20.0
23.0	85.4	71.9	13.5	6.6	21.534	-1.583	5.28	19.6
23.0	77.9	72.3	5.6	5.7	20.466	-1.025	5.03	19.9
24.2	94.8	89.2	5.6	8.0	22.412	-1.313	5.50	19.0
25.5	111.6	106.0	5.6	10.6	23.551	-1.320	5.82	18.1
25.5	157.7	106.5	51.2	17.8	26.359	-1.015	6.64	17.3

28.8	188.2	131.9	56.3	22.0	27.546	-1.725	7.01	17.2
32.0	221.1	159.7	61.4	26.8	28.394	-1.673	7.31	17.1
32.0	163.4	160.1	3.3	16.0	25.820	-1.568	6.48	17.2
37.0	203.4	200.1	3.3	24.8	28.150	-1.308	7.20	16.9
42.0	243.4	240.2	3.3	31.5	28.847	-0.431	7.54	16.2
42.0	247.2	240.4	6.8	32.2	28.914	-0.362	7.57	16.3
44.0	255.0	248.2	6.8	33.9	29.231	-0.564	7.64	16.2
46.0	262.9	256.1	6.8	35.1	29.283	-0.621	7.68	16.1

Total Driving Time	14 minutes;	Total No. of Blows	616
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G/L at Shaft and Toe: 0.633 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
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
4.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
8.0	30.0	2.6	27.5	2.6	14.448	0.000	4.23	22.7
10.5	47.8	11.7	36.1	4.3	18.124	0.000	4.76	20.9
10.5	35.1	11.9	23.2	2.9	15.211	0.000	4.28	22.2
14.2	58.3	29.4	28.9	4.9	19.163	0.000	4.90	20.5
18.0	83.1	50.0	33.1	7.3	21.532	-0.940	5.37	19.3
18.0	61.8	50.2	11.6	4.5	18.916	-0.355	4.81	20.8
20.5	73.2	60.6	12.5	5.5	20.098	-0.336	5.00	20.0
23.0	85.4	71.9	13.5	6.6	21.534	-1.583	5.28	19.6
23.0	77.9	72.3	5.6	5.7	20.501	-1.011	5.03	19.9
24.2	95.7	90.1	5.6	8.1	22.486	-1.297	5.52	19.0
25.5	113.5	107.9	5.6	10.9	23.712	-1.442	5.86	18.1
25.5	159.6	108.4	51.2	18.1	26.460	-1.019	6.67	17.3
28.8	190.1	133.8	56.3	22.3	27.623	-1.717	7.04	17.2
32.0	223.0	161.6	61.4	27.2	28.451	-1.652	7.33	17.0
32.0	165.2	162.0	3.3	16.3	25.926	-1.538	6.51	17.2
37.0	207.5	204.2	3.3	25.5	28.234	-1.197	7.23	16.8
42.0	249.7	246.4	3.3	32.5	28.963	-0.469	7.58	16.3
42.0	253.5	246.7	6.8	33.4	29.048	-0.590	7.62	16.3
44.0	261.7	254.9	6.8	35.2	29.353	-0.625	7.68	16.3
46.0	270.1	263.3	6.8	36.7	29.420	-0.534	7.73	16.1

Total Driving Time	14 minutes;	Total No. of Blows	632
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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

SUMMARY OVER DEPTHS

Depth ft	Rut kips	G/L at Shaft and Toe: 0.667 1.000		Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
		Frictn kips	End Bg kips					
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
4.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
8.0	30.0	2.6	27.5	2.6	14.448	0.000	4.23	22.7
10.5	47.8	11.7	36.1	4.3	18.124	0.000	4.76	20.9
10.5	35.1	11.9	23.2	2.9	15.211	0.000	4.28	22.2
14.2	58.3	29.4	28.9	4.9	19.163	0.000	4.90	20.5
18.0	83.1	50.0	33.1	7.3	21.532	-0.940	5.37	19.3
18.0	61.8	50.2	11.6	4.5	18.916	-0.355	4.81	20.8
20.5	73.2	60.6	12.5	5.5	20.098	-0.336	5.00	20.0
23.0	85.4	71.9	13.5	6.6	21.534	-1.583	5.28	19.6
23.0	77.9	72.4	5.6	5.7	20.472	-1.032	5.03	19.9
24.2	96.7	91.1	5.6	8.2	22.568	-1.344	5.54	18.9
25.5	115.4	109.8	5.6	11.2	23.866	-1.530	5.91	18.1
25.5	161.5	110.3	51.2	18.2	26.752	-1.009	6.76	17.5
28.8	192.0	135.7	56.3	22.7	27.656	-1.701	7.06	17.1
32.0	224.9	163.5	61.4	27.6	28.488	-1.635	7.34	17.0
32.0	167.2	163.9	3.3	16.6	26.072	-1.492	6.55	17.2
37.0	211.7	208.4	3.3	26.3	28.372	-1.037	7.27	16.8
42.0	256.2	252.9	3.3	33.9	29.100	-0.682	7.63	16.3
42.0	260.0	253.2	6.8	34.5	29.191	-0.790	7.67	16.5
44.0	268.6	261.8	6.8	36.7	29.485	-0.531	7.73	16.3
46.0	277.4	270.7	6.8	38.4	29.507	-0.469	7.76	16.1

Total Driving Time	15 minutes;	Total No. of Blows	649
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Depth ft	Rut kips	G/L at Shaft and Toe:		0.700 1.000		Stroke ft	ENTHRU kip-ft	
		Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi			Ten Str ksi
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
4.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
8.0	30.0	2.6	27.5	2.6	14.448	0.000	4.23	22.7
10.5	47.8	11.7	36.1	4.3	18.124	0.000	4.76	20.9
10.5	35.1	11.9	23.2	2.9	15.211	0.000	4.28	22.2
14.2	58.3	29.4	28.9	4.9	19.163	0.000	4.90	20.5
18.0	83.1	50.0	33.1	7.3	21.532	-0.940	5.37	19.3

18.0	61.8	50.2	11.6	4.5	18.916	-0.355	4.81	20.8
20.5	73.2	60.6	12.5	5.5	20.098	-0.336	5.00	20.0
23.0	85.4	71.9	13.5	6.6	21.534	-1.583	5.28	19.6
23.0	77.9	72.4	5.6	5.7	20.484	-1.025	5.03	19.9
24.2	97.6	92.0	5.6	8.4	22.662	-1.386	5.56	18.9
25.5	117.3	111.7	5.6	11.5	23.961	-1.567	5.94	17.9
25.5	163.4	112.2	51.2	18.6	26.826	-0.995	6.79	17.4
28.8	193.9	137.6	56.3	22.9	27.737	-1.708	7.07	17.2
32.0	226.8	165.4	61.4	27.8	28.552	-1.645	7.36	17.1
32.0	169.1	165.8	3.3	17.0	26.133	-1.432	6.58	17.1
37.0	215.8	212.5	3.3	27.0	28.475	-1.006	7.30	16.8
42.0	262.5	259.2	3.3	35.2	29.214	-0.828	7.68	16.4
42.0	266.3	259.5	6.8	35.8	29.310	-0.859	7.71	16.5
44.0	275.3	268.6	6.8	38.1	29.596	-0.484	7.77	16.4
46.0	284.6	277.8	6.8	40.1	29.616	-0.404	7.81	16.2

Total Driving Time 15 minutes; Total No. of Blows 664



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Resource International Inc

06/27/2021
GRLWEAP Version 2010

SUMMARY OVER DEPTHS

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	G/L at Shaft and Toe: 0.733 1.000		Stroke ft	ENTHRU kip-ft
					Com Str	Ten Str		
					ksi	ksi		
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
4.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
8.0	30.0	2.6	27.5	2.6	14.448	0.000	4.23	22.7
10.5	47.8	11.7	36.1	4.3	18.124	0.000	4.76	20.9
10.5	35.1	11.9	23.2	2.9	15.211	0.000	4.28	22.2
14.2	58.3	29.4	28.9	4.9	19.163	0.000	4.90	20.5
18.0	83.1	50.0	33.1	7.3	21.532	-0.940	5.37	19.3
18.0	61.8	50.2	11.6	4.5	18.916	-0.355	4.81	20.8
20.5	73.2	60.6	12.5	5.5	20.098	-0.336	5.00	20.0
23.0	85.4	71.9	13.5	6.6	21.534	-1.583	5.28	19.6
23.0	78.0	72.4	5.6	5.7	20.497	-1.023	5.03	19.9
24.2	98.5	93.0	5.6	8.5	22.727	-1.415	5.58	18.8
25.5	119.1	113.5	5.6	11.8	24.093	-1.582	5.97	17.9
25.5	165.3	114.1	51.2	18.9	26.895	-0.997	6.81	17.4
28.8	195.8	139.5	56.3	23.2	27.818	-1.705	7.10	17.2
32.0	228.7	167.3	61.4	28.2	28.621	-1.641	7.38	17.1
32.0	171.0	167.7	3.3	17.4	26.241	-1.359	6.61	17.1
37.0	219.9	216.6	3.3	27.7	28.546	-1.053	7.34	16.7

42.0	268.8	265.5	3.3	36.2	29.356	-0.861	7.72	16.6
42.0	272.6	265.8	6.8	37.1	29.443	-0.828	7.75	16.6
44.0	282.1	275.3	6.8	39.6	29.725	-0.459	7.82	16.5
46.0	291.8	285.0	6.8	41.6	29.763	-0.521	7.86	16.3

Total Driving Time 15 minutes; Total No. of Blows 678



FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2
Resource International Inc

06/27/2021
GRLWEAP Version 2010

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
1.48	45.98	0.00	10.81	1.00	0.80	1.00	1.00
1.52	45.98	0.00	10.81	1.00	0.80	1.00	1.00
2.25	45.98	0.00	10.81	1.00	0.80	1.00	1.00
2.98	45.98	0.00	10.81	1.00	0.80	1.00	1.00
3.02	45.98	0.00	10.81	1.00	0.80	1.00	1.00
4.25	45.98	0.00	10.81	1.00	0.80	1.00	1.00
5.48	45.98	0.00	10.81	1.00	0.80	1.00	1.00
5.52	45.98	0.00	10.81	1.00	0.80	1.00	1.00
8.00	45.98	0.00	10.81	1.00	0.80	1.00	1.00
10.48	45.98	0.00	10.81	1.00	0.80	1.00	1.00
10.52	45.98	0.00	10.81	1.00	0.80	1.00	1.00
14.25	45.98	0.00	10.81	1.00	0.80	1.00	1.00
17.98	45.98	0.00	10.81	1.00	0.80	1.00	1.00
18.02	45.98	0.00	10.81	1.00	0.80	1.00	1.00
20.50	45.98	0.00	10.81	1.00	0.80	1.00	1.00
22.98	45.98	0.00	10.81	1.00	0.80	1.00	1.00
23.02	45.98	0.00	10.81	1.00	0.80	1.00	1.00
24.25	45.98	0.00	10.81	1.00	0.80	1.00	1.00
25.48	45.98	0.00	10.81	1.00	0.80	1.00	1.00
25.52	45.98	0.00	10.81	1.00	0.80	1.00	1.00
28.75	45.98	0.00	10.81	1.00	0.80	1.00	1.00
31.98	45.98	0.00	10.81	1.00	0.80	1.00	1.00
32.02	45.98	0.00	10.81	1.00	0.80	1.00	1.00
37.00	45.98	0.00	10.81	1.00	0.80	1.00	1.00
41.98	45.98	0.00	10.81	1.00	0.80	1.00	1.00
42.02	45.98	0.00	10.81	1.00	0.80	1.00	1.00
43.98	45.98	0.00	10.81	1.00	0.80	1.00	1.00
45.98	45.98	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
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0.01	0.00	0.00	0.100	0.100	0.050	0.150	0.500	6.000	168.000
1.49	0.00	0.00	0.100	0.100	0.050	0.150	0.500	6.000	168.000
1.51	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
2.99	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
5.49	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
7.14	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
7.16	0.71	24.52	0.100	0.100	0.050	0.150	0.000	6.000	24.000
8.15	0.82	27.99	0.100	0.100	0.050	0.150	0.000	6.000	24.000
9.15	0.92	31.48	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.15	1.02	34.98	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.49	1.05	36.17	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.51	1.04	23.18	0.100	0.100	0.050	0.150	0.000	6.000	24.000
11.50	1.13	25.31	0.100	0.100	0.050	0.150	0.000	6.000	24.000
11.99	1.18	26.36	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.01	1.18	26.40	0.100	0.100	0.050	0.150	0.000	6.000	24.000
13.00	1.23	27.50	0.100	0.100	0.050	0.150	0.000	6.000	24.000
14.00	1.28	28.62	0.100	0.100	0.050	0.150	0.000	6.000	24.000
15.00	1.33	29.74	0.100	0.100	0.050	0.150	0.000	6.000	24.000
16.00	1.38	30.87	0.100	0.100	0.050	0.150	0.000	6.000	24.000
17.00	1.43	31.98	0.100	0.100	0.050	0.150	0.000	6.000	24.000
17.99	1.48	33.09	0.100	0.100	0.050	0.150	0.000	6.000	24.000
18.01	1.02	11.58	0.100	0.100	0.050	0.150	0.000	6.000	24.000
19.00	1.05	11.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
20.00	1.09	12.35	0.100	0.100	0.050	0.150	0.000	6.000	24.000
21.00	1.12	12.74	0.100	0.100	0.050	0.150	0.000	6.000	24.000
22.00	1.16	13.12	0.100	0.100	0.050	0.150	0.000	6.000	24.000
22.99	1.19	13.51	0.100	0.100	0.050	0.150	0.000	6.000	24.000
23.01	5.75	5.57	0.100	0.100	0.150	0.150	1.000	6.000	336.000
25.49	5.75	5.57	0.100	0.100	0.150	0.150	1.000	6.000	336.000
25.51	1.89	51.19	0.100	0.100	0.050	0.150	0.000	6.000	24.000
26.50	1.95	52.76	0.100	0.100	0.050	0.150	0.000	6.000	24.000
27.50	2.00	54.33	0.100	0.100	0.050	0.150	0.000	6.000	24.000
28.50	2.06	55.91	0.100	0.100	0.050	0.150	0.000	6.000	24.000
29.50	2.12	57.49	0.100	0.100	0.050	0.150	0.000	6.000	24.000
30.50	2.18	59.07	0.100	0.100	0.050	0.150	0.000	6.000	24.000
31.50	2.24	60.64	0.100	0.100	0.050	0.150	0.000	6.000	24.000
31.99	2.27	61.42	0.100	0.100	0.050	0.150	0.000	6.000	24.000
32.01	3.38	3.27	0.100	0.100	0.150	0.150	1.000	6.000	336.000
41.99	3.38	3.27	0.100	0.100	0.150	0.150	1.000	6.000	336.000
42.01	1.67	6.78	0.100	0.100	0.150	0.150	1.000	6.000	336.000
45.98	1.67	6.78	0.100	0.100	0.150	0.150	1.000	6.000	336.000

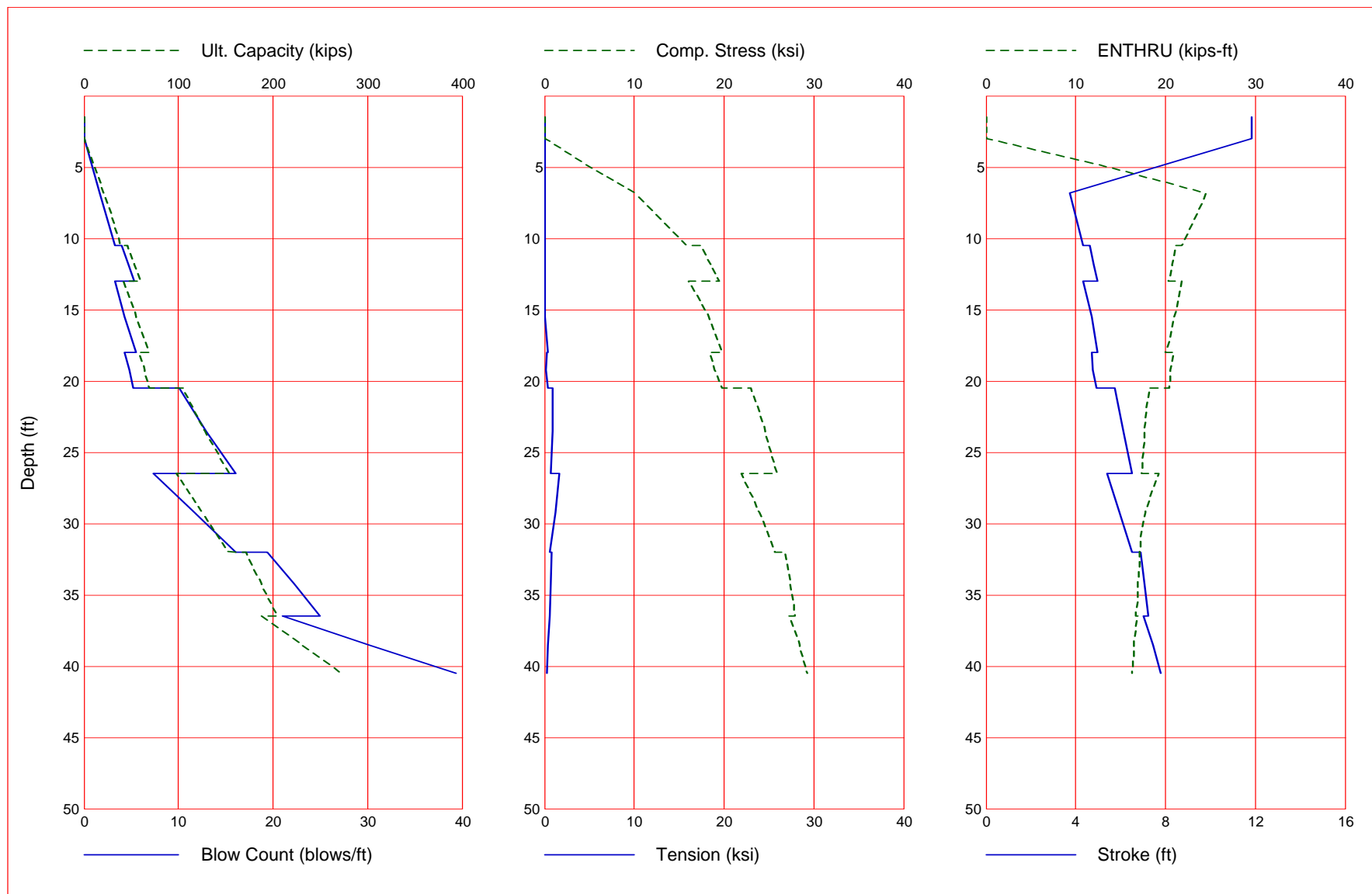
Gain/Loss 3 at Shaft and Toe 0.667 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
4.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
8.0	30.0	2.6	27.5	2.6	14.448	0.000	4.23	22.7
10.5	47.8	11.7	36.1	4.3	18.124	0.000	4.76	20.9
10.5	35.1	11.9	23.2	2.9	15.211	0.000	4.28	22.2
14.2	58.3	29.4	28.9	4.9	19.163	0.000	4.90	20.5
18.0	83.1	50.0	33.1	7.3	21.532	-0.940	5.37	19.3
18.0	61.8	50.2	11.6	4.5	18.916	-0.355	4.81	20.8
20.5	73.2	60.6	12.5	5.5	20.098	-0.336	5.00	20.0
23.0	85.4	71.9	13.5	6.6	21.534	-1.583	5.28	19.6
23.0	77.9	72.4	5.6	5.7	20.472	-1.032	5.03	19.9
24.2	96.7	91.1	5.6	8.2	22.568	-1.344	5.54	18.9
25.5	115.4	109.8	5.6	11.2	23.866	-1.530	5.91	18.1
25.5	161.5	110.3	51.2	18.2	26.752	-1.009	6.76	17.5
28.8	192.0	135.7	56.3	22.7	27.656	-1.701	7.06	17.1
32.0	224.9	163.5	61.4	27.6	28.488	-1.635	7.34	17.0
32.0	167.2	163.9	3.3	16.6	26.072	-1.492	6.55	17.2
37.0	211.7	208.4	3.3	26.3	28.372	-1.037	7.27	16.8
42.0	256.2	252.9	3.3	33.9	29.100	-0.682	7.63	16.3
42.0	260.0	253.2	6.8	34.5	29.191	-0.790	7.67	16.5
44.0	268.6	261.8	6.8	36.7	29.485	-0.531	7.73	16.3
46.0	277.4	270.7	6.8	38.4	29.507	-0.469	7.76	16.1

Total Continuous Driving Time 15.00 minutes; Total Number of Blows 649

Pier 2
(B-014-4-19)

Gain/Loss 3 at Shaft and Toe 0.667 / 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.
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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 restrrike 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: J:\GEOTECH\PROJECTS\2020\W-20-025
FRA-70-13.01\ANALYSIS\DRIVEABILITY\PIER 2\FRA-70-13.01 - PIER 2 HP
12X53-B-014-4-19.GWW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (2/22/2013)

Input File Contents

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21

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		15.500		12.040		H Pile																			
W Cp		A Cp		E Cp		T Cp		CoR		ROut		StCp															
1.900		227.000		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													
40.490		15.50		29000.0		492.000		3.970		0		0.850		0.010													
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		0.002		0.002		1.250		0.00		0.00		0.00											
P atm		P1		P2		P3		P4		P5																	
14.70		1520.00		1368.00		1231.00		1108.00		0.00																	
Stroke		Effic.		Pressure		R-Weight		T-Delay		Exp-Coeff		Eps-Str		Total-AW													
10.8100		0.8000		1520.0000		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																					
Res. Distribution																											
Dpth	Rskn		Rtoe		Qs		Qt		Js		Jt		SU F		LimD		SU T										
0.01	0.00		0.00		0.10		0.10		0.20		0.15		1.50		6.00		336.0										
1.49	0.00		0.00		0.10		0.10		0.20		0.15		1.50		6.00		336.0										
2.99	0.00		0.00		0.10		0.10		0.20		0.15		1.50		6.00		336.0										
3.01	0.00		0.00		0.10		0.10		0.05		0.15		1.00		6.00		24.0										
5.39	0.00		0.00		0.10		0.10		0.05		0.15		1.00		6.00		24.0										
5.41	0.52		14.14		0.10		0.10		0.05		0.15		1.00		6.00		24.0										
6.40	0.62		16.76		0.10		0.10		0.05		0.15		1.00		6.00		24.0										
7.40	0.72		19.40		0.10		0.10		0.05		0.15		1.00		6.00		24.0										
7.99	0.77		20.96		0.10		0.10		0.05		0.15		1.00		6.00		24.0										
8.01	0.77		21.00		0.10		0.10		0.05		0.15		1.00		6.00		24.0										
9.00	0.82		22.36		0.10		0.10		0.05		0.15		1.00		6.00		24.0										
10.00	0.88		23.74		0.10		0.10		0.05		0.15		1.00		6.00		24.0										
10.49	0.90		24.41		0.10		0.10		0.05		0.15		1.00		6.00		24.0										
10.51	0.91		31.15		0.10		0.10		0.05		0.15		1.00		6.00		24.0										
11.50	0.96		32.88		0.10		0.10		0.05		0.15		1.00		6.00		24.0										

12.50	1.01	34.63	0.10	0.10	0.05	0.15	1.00	6.00	24.0
12.99	1.03	35.49	0.10	0.10	0.05	0.15	1.00	6.00	24.0
13.01	1.01	17.71	0.10	0.10	0.05	0.15	1.00	6.00	24.0
14.00	1.05	18.51	0.10	0.10	0.05	0.15	1.00	6.00	24.0
15.00	1.10	19.32	0.10	0.10	0.05	0.15	1.00	6.00	24.0
16.00	1.14	20.13	0.10	0.10	0.05	0.15	1.00	6.00	24.0
17.00	1.19	20.94	0.10	0.10	0.05	0.15	1.00	6.00	24.0
17.99	1.24	21.74	0.10	0.10	0.05	0.15	1.00	6.00	24.0
18.01	0.95	11.70	0.10	0.10	0.05	0.15	1.00	6.00	24.0
19.00	0.99	12.13	0.10	0.10	0.05	0.15	1.00	6.00	24.0
20.00	1.02	12.56	0.10	0.10	0.05	0.15	1.00	6.00	24.0
20.49	1.04	12.77	0.10	0.10	0.05	0.15	1.00	6.00	24.0
20.51	1.39	47.69	0.10	0.10	0.05	0.15	1.00	6.00	24.0
21.50	1.45	49.68	0.10	0.10	0.05	0.15	1.00	6.00	24.0
22.50	1.51	51.69	0.10	0.10	0.05	0.15	1.00	6.00	24.0
23.50	1.57	53.70	0.10	0.10	0.05	0.15	1.00	6.00	24.0
24.50	1.62	55.71	0.10	0.10	0.05	0.15	1.00	6.00	24.0
25.50	1.68	57.72	0.10	0.10	0.05	0.15	1.00	6.00	24.0
26.49	1.74	59.71	0.10	0.10	0.05	0.15	1.00	6.00	24.0
26.51	3.75	3.63	0.10	0.10	0.15	0.15	1.50	6.00	336.0
31.99	3.75	3.63	0.10	0.10	0.15	0.15	1.50	6.00	336.0
32.01	1.66	22.98	0.10	0.10	0.05	0.15	1.00	6.00	24.0
33.00	1.71	23.55	0.10	0.10	0.05	0.15	1.00	6.00	24.0
34.00	1.75	24.13	0.10	0.10	0.05	0.15	1.00	6.00	24.0
35.00	1.79	24.71	0.10	0.10	0.05	0.15	1.00	6.00	24.0
36.00	1.83	25.29	0.10	0.10	0.05	0.15	1.00	6.00	24.0
36.49	1.85	25.58	0.10	0.10	0.05	0.15	1.00	6.00	24.0
36.51	8.00	7.75	0.10	0.10	0.15	0.15	1.50	6.00	336.0
40.49	8.00	7.75	0.10	0.10	0.15	0.15	1.50	6.00	336.0

Gain/Loss factors: shaft and toe

0.60000	0.63300	0.66700	0.70000	0.73300			
1.00000	1.00000	1.00000	1.00000	1.00000			
Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
1.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
1.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
2.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
2.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
3.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
6.75	0.00	0.00	0.000	0.000	0.000	0.000	0.000
10.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
10.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
11.75	0.00	0.00	0.000	0.000	0.000	0.000	0.000
12.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
13.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
15.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
17.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
18.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
19.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
20.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
20.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000

23.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
26.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
26.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
29.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
31.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
32.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
34.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
36.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
36.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
38.49	0.00	0.00	0.000	0.000	0.000	0.000	0.000
40.49	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1 0 10.81000 11.86000



GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

Version 2010

English Units

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21

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	140046.7	1.000 0.0100
3	0.800	140046.7	1.000 0.0100
4	0.800	140046.7	1.000 0.0100
5	0.800	140046.7	1.000 0.0100
Imp Block	0.753	70735.6	0.900 0.0100
Helmet	1.900	60155.0	0.800 0.0100 5.8
Combined Pile Top		11101.5	

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)	1520.00	Actual Pressure	(psi)	1520.00
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

Cross Sect. Area (in2) 227.00
 Elastic-Modulus (ksi) 530.0
 Thickness (inch) 2.00
 Coeff of Restitution 0.8
 RoundOut (ft) 0.0
 Stiffness (kips/in) 60155.0

PILE CUSHION

Cross Sect. Area (in2) 0.00
 Elastic-Modulus (ksi) 0.0
 Thickness (inch) 0.00
 Coeff of Restitution 1.0
 RoundOut (ft) 0.0
 Stiffness (kips/in) 0.0



FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
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Depth (ft) 1.5
 Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
 Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	40.49	4.0	15.5
Toe						0.0	0.150	0.100			

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

2.144 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) 0.544

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	Stroke	Pressure	Efficy
ft	ft	Ratio	
1.48	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
 Hammer+Pile Weight > Rult: Pile Runs

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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
1		0	10.81000		11.86000				

↑
 FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
 Resource International Inc GRLWEAP Version 2010

Depth	(ft)	1.5
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	40.49	4.0	15.5
Toe						0.0	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
1.52	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

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Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

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FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i t Comp Str ksi	i t ENTHRU kip-ft	Bl Rt b/min
1		0	10.81000	11.86000		

↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth	(ft)	2.2
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	40.49	4.0	15.5
Toe						0.0	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
2.25	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
 Hammer+Pile Weight > Rult: Pile Runs

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 FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
 Resource International Inc GRLWEAP Version 2010

Rut	Bl Ct	Stroke (ft)	Ten Str	i	t Comp Str	i	t ENTHRU	Bl Rt
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kips	b/ft	down	up	ksi		ksi	kip-ft	b/min
1		0	10.81	000		11.86	000	



FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
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Depth	(ft)	3.0	
Shaft Gain/Loss Factor		0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	40.49	4.0	15.5
Toe						0.0	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
2.98	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0

Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

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FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i t Comp Str ksi	i t ENTHRU kip-ft	Bl Rt b/min
1		0	10.81000	11.86000		

↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft)	3.0
Shaft Gain/Loss Factor	0.600
Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in2)	15.500	Pile Type	H Pile
Pile Size (inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

No.	Pile and Soil Model	Total Capacity	Rut (kips)	
Weight kips	Stiffn C-Slk T-Slk CoR k/in ft ft	Soil-S Soil-D kips s/ft	Quake inch	LbTop Perim Area ft ft in2
1	0.179 11102 0.010 0.000 0.85	0.0 0.000	0.100	3.37 4.0 15.5
2	0.179 11102 0.000 0.000 1.00	0.0 0.000	0.100	6.75 4.0 15.5
12	0.179 11102 0.000 0.000 1.00	0.0 0.050	0.100	40.49 4.0 15.5
Toe		0.0 0.150	0.100	

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
3.02	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
 Hammer+Pile Weight > Rult: Pile Runs

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 FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i t Comp Str ksi	i t ENTHRU kip-ft	Bl Rt b/min
1		0	10.81000	11.86000		

↑
 FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft)	6.8
Shaft Gain/Loss Factor	0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2)	15.500	Pile Type	H Pile
Pile Size (inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)			20.8		
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	3.1	0.050	0.100	40.49	4.0	15.5
Toe						17.7	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
6.75	10.81	1.00	0.800

↑

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 Resource International Inc

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min	
20.8	1.7	3.75	3.74	0.00	1	0	10.06	1	2	24.5	61.2
20.8	1.7	3.75	3.74	0.00	1	0	10.06	1	2	24.5	61.2
20.8	1.7	3.75	3.74	0.00	1	0	10.06	1	2	24.5	61.2
20.8	1.7	3.75	3.74	0.00	1	0	10.06	1	2	24.5	61.2
20.8	1.7	3.75	3.74	0.00	1	0	10.06	1	2	24.5	61.2
1	0	10.81	0.00	11.86	0.00						

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Depth	(ft)	10.5
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor
		1.000

PILE PROFILE:

Toe Area	(in ²)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

L b Top ft	Area in ²	E-Mod ksi	Spec Wt lb/ft ³	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

No.	Weight kips	Pile and Soil Model Stiffn C-Slk T-Slk CoR	Soil-S kips	Soil-D s/ft	Quake inch	Rut (kips) LbTop	Perim ft	Area in ²
1	0.179	11102 0.010 0.000 0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102 0.000 0.000 1.00	0.0	0.000	0.100	6.75	4.0	15.5
9	0.179	11102 0.000 0.000 1.00	0.0	0.200	0.100	30.37	4.0	15.5
10	0.179	11102 0.000 0.000 1.00	0.0	0.050	0.100	33.74	4.0	15.5
11	0.179	11102 0.000 0.000 1.00	4.1	0.050	0.100	37.12	4.0	15.5
12	0.179	11102 0.000 0.000 1.00	10.8	0.050	0.100	40.49	4.0	15.5
Toe			24.4	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
10.48	10.81	1.00	0.800

↑

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Resource International Inc

06/27/2021
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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
39.3	3.3	4.34	4.38	0.00	1	0	15.87	1	2	21.8
39.3	3.3	4.34	4.38	0.00	1	0	15.87	1	2	21.8
39.3	3.3	4.34	4.38	0.00	1	0	15.87	1	2	21.8
39.3	3.3	4.34	4.38	0.00	1	0	15.87	1	2	21.8
39.3	3.3	4.34	4.38	0.00	1	0	15.87	1	2	21.8
1		0	10.81	000			11.86	000		

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth	(ft)	10.5
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor
		1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)					46.2
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	4.2	0.050	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	10.9	0.050	0.100	40.49	4.0	15.5
Toe						31.2	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
10.52	10.81	1.00	0.800

↑

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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
46.2	4.0	4.63	4.61	0.00	1	0	17.49	5	3	21.2
46.2	4.0	4.63	4.61	0.00	1	0	17.49	5	3	21.2
46.2	4.0	4.63	4.61	0.00	1	0	17.49	5	3	21.2
46.2	4.0	4.63	4.61	0.00	1	0	17.49	5	3	21.2
46.2	4.0	4.63	4.61	0.00	1	0	17.49	5	3	21.2
1		0	10.81	000			11.86	000		

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Depth	(ft)	11.8
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity			Rut (kips)			53.0
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5	
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5	
9	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	30.37	4.0	15.5	
10	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	33.74	4.0	15.5	
11	0.179	11102	0.000	0.000	1.00	7.9	0.050	0.100	37.12	4.0	15.5	
12	0.179	11102	0.000	0.000	1.00	11.8	0.050	0.100	40.49	4.0	15.5	
Toe						33.3	0.150	0.100				

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	

11.75 10.81 1.00 0.800



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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
53.0	4.7	4.80	4.77	0.00	1	0	18.51	7	3	20.7	54.0
53.0	4.7	4.80	4.77	0.00	1	0	18.51	7	3	20.7	54.0
53.0	4.7	4.80	4.77	0.00	1	0	18.51	7	3	20.7	54.0
53.0	4.7	4.80	4.77	0.00	1	0	18.51	7	3	20.7	54.0
53.0	4.7	4.80	4.77	0.00	1	0	18.51	7	3	20.7	54.0
1		0	10.81	0.00			11.86	0.00			



FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
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Depth (ft) 13.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)			60.0		
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	1.9	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	10.0	0.050	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	12.7	0.050	0.100	40.49	4.0	15.5
Toe						35.5	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
12.98	10.81	1.00	0.800



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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
60.0	5.3	4.96	4.92	0.00	1	0	19.41	9	4	20.3
60.0	5.3	4.96	4.92	0.00	1	0	19.41	9	4	20.3
60.0	5.3	4.96	4.92	0.00	1	0	19.41	9	4	20.3
60.0	5.3	4.96	4.92	0.00	1	0	19.41	9	4	20.3
60.0	5.3	4.96	4.92	0.00	1	0	19.41	9	4	20.3
1		0	10.81	000			11.86	000		

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FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

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Depth (ft) 13.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)			42.4		
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	1.9	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	10.1	0.050	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	12.7	0.050	0.100	40.49	4.0	15.5
Toe						17.7	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
13.02	10.81	1.00	0.800

↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
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Rut kips	Bl Ct b/ft	Stroke (ft) down	(ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
42.4	3.3	4.34	4.38	0.00	1	0	16.04	1	2	21.8	56.7
42.4	3.3	4.34	4.38	0.00	1	0	16.04	1	2	21.8	56.7
42.4	3.3	4.34	4.38	0.00	1	0	16.04	1	2	21.8	56.7
42.4	3.3	4.34	4.38	0.00	1	0	16.04	1	2	21.8	56.7
42.4	3.3	4.34	4.38	0.00	1	0	16.04	1	2	21.8	56.7
1		0		10.81000			11.86000				

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FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
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GRLWEAP Version 2010

Depth	(ft)	15.5
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor
		1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)			54.9		
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	9.1	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	12.1	0.050	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	14.1	0.050	0.100	40.49	4.0	15.5
Toe						19.7	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
15.50	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
54.9	4.3	4.71	4.67	0.00	1	0	18.25	8	3	21.0	54.6
54.9	4.3	4.71	4.67	0.00	1	0	18.25	8	3	21.0	54.6
54.9	4.3	4.71	4.67	0.00	1	0	18.25	8	3	21.0	54.6
54.9	4.3	4.71	4.67	0.00	1	0	18.25	8	3	21.0	54.6
54.9	4.3	4.71	4.67	0.00	1	0	18.25	8	3	21.0	54.6
1		0	10.81	0.00			11.86	0.00			

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FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

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GRLWEAP Version 2010

Depth (ft) 18.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)			68.5		
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	6.2	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	11.4	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	13.6	0.050	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	15.5	0.050	0.100	40.49	4.0	15.5
Toe						21.7	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
17.98	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
68.5	5.5	4.95	4.97	-0.40	9	49	19.76	9	4	20.0	53.0
68.5	5.5	4.95	4.97	-0.40	9	49	19.76	9	4	20.0	53.0
68.5	5.5	4.95	4.97	-0.40	9	49	19.76	9	4	20.0	53.0
68.5	5.5	4.95	4.97	-0.40	9	49	19.76	9	4	20.0	53.0
68.5	5.5	4.95	4.97	-0.40	9	49	19.76	9	4	20.0	53.0
	1	0	10.81	0.00			11.86	0.00			

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FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

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GRLWEAP Version 2010

Depth (ft) 18.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)			58.7		
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	6.4	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	11.5	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	13.6	0.050	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	15.5	0.050	0.100	40.49	4.0	15.5
Toe						11.7	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
18.02	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	(ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
58.7	4.3	4.70	4.66	-0.22	3	9	18.44	9	4	21.0	54.7
58.7	4.3	4.70	4.66	-0.22	3	9	18.44	9	4	21.0	54.7
58.7	4.3	4.70	4.66	-0.22	3	9	18.44	9	4	21.0	54.7
58.7	4.3	4.70	4.66	-0.22	3	9	18.44	9	4	21.0	54.7
58.7	4.3	4.70	4.66	-0.22	3	9	18.44	9	4	21.0	54.7
1		0		10.81000	11.86000						

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FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth (ft) 19.2
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)			63.9		
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	0.8	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	9.5	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	12.3	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	14.3	0.050	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	14.8	0.050	0.100	40.49	4.0	15.5
Toe						12.2	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
19.25	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
63.9	4.8	4.77	4.79	-0.13	3	9	18.93	9	4	20.5	54.0
63.9	4.8	4.77	4.79	-0.13	3	9	18.93	9	4	20.5	54.0
63.9	4.8	4.77	4.79	-0.13	3	9	18.93	9	4	20.5	54.0
63.9	4.8	4.77	4.79	-0.13	3	9	18.93	9	4	20.5	54.0
63.9	4.8	4.77	4.79	-0.13	3	9	18.93	9	4	20.5	54.0
1		0	10.81	0.00			11.86	0.00			

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth (ft) 20.5
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in²) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in ²	E-Mod ksi	Spec Wt lb/ft ³	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)			69.4		
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 in ²
1	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	3.8	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	10.7	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	13.1	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	15.0	0.050	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	14.1	0.050	0.100	40.49	4.0	15.5
Toe						12.8	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
20.48	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

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Rut kips	Bl Ct b/ft	Stroke (ft) down	(ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
69.4	5.2	4.94	4.89	-0.32	9	49	19.76	8	3	20.4	53.2
69.4	5.2	4.94	4.89	-0.32	9	49	19.76	8	3	20.4	53.2
69.4	5.2	4.94	4.89	-0.32	9	49	19.76	8	3	20.4	53.2
69.4	5.2	4.94	4.89	-0.32	9	49	19.76	8	3	20.4	53.2
69.4	5.2	4.94	4.89	-0.32	9	49	19.76	8	3	20.4	53.2
1		0	10.81	000			11.86	000			

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth	(ft)	20.5
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)			104.6		
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	3.9	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	10.8	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	13.1	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	15.0	0.050	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	14.1	0.050	0.100	40.49	4.0	15.5
Toe						47.7	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
20.52	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21

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Resource International Inc

GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
104.6	10.1	5.72	5.78	-0.87	8	40	23.02	8	3	18.2	49.1
104.6	10.1	5.72	5.78	-0.87	8	40	23.02	8	3	18.2	49.1
104.6	10.1	5.72	5.78	-0.87	8	40	23.02	8	3	18.2	49.1
104.6	10.1	5.72	5.78	-0.87	8	40	23.02	8	3	18.2	49.1
104.6	10.1	5.72	5.78	-0.87	8	40	23.02	8	3	18.2	49.1
1		0	10.81	000			11.86	000			

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21

06/27/2021

Resource International Inc

GRLWEAP Version 2010

Depth (ft)	23.5
Shaft Gain/Loss Factor	0.600
Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in2)	15.500	Pile Type	H Pile
Pile Size (inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)			128.1		
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	2.8	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	10.4	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	12.9	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	14.7	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	14.3	0.050	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	19.1	0.050	0.100	40.49	4.0	15.5
Toe						53.7	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
23.50	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
128.1	12.9	6.13	6.16	-0.92	7	32	24.58	8	3	17.7	47.5
128.1	12.9	6.13	6.16	-0.92	7	32	24.58	8	3	17.7	47.5
128.1	12.9	6.13	6.16	-0.92	7	32	24.58	8	3	17.7	47.5
128.1	12.9	6.13	6.16	-0.92	7	32	24.58	8	3	17.7	47.5
128.1	12.9	6.13	6.16	-0.92	7	32	24.58	8	3	17.7	47.5
					1	0	10.81000			11.86000	

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FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth (ft) 26.5
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)			153.6		
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
5	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	16.87	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	1.9	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	10.0	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	12.7	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	14.5	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	14.6	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	18.3	0.050	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	22.0	0.050	0.100	40.49	4.0	15.5
Toe						59.7	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
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26.48 10.81 1.00 0.800



FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

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GRLWEAP Version 2010

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
153.6	16.0	6.49 6.50	-0.68	6 30 25.83	7 3 17.3	46.2
153.6	16.0	6.49 6.50	-0.68	6 30 25.83	7 3 17.3	46.2
153.6	16.0	6.49 6.50	-0.68	6 30 25.83	7 3 17.3	46.2
153.6	16.0	6.49 6.50	-0.68	6 30 25.83	7 3 17.3	46.2
153.6	16.0	6.49 6.50	-0.68	6 30 25.83	7 3 17.3	46.2
1	0	10.81000	11.86000			



FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth (ft) 26.5
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)			97.9		
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
5	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	16.87	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	2.0	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	10.1	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	12.7	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	14.5	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	14.5	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	18.4	0.050	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	22.1	0.051	0.100	40.49	4.0	15.5
Toe						3.6	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
26.52	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

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
97.9	7.3	5.39	5.34	-1.62	6	41	21.87	7	3	50.8
97.9	7.3	5.39	5.34	-1.63	6	41	21.87	7	3	50.8
97.9	7.3	5.39	5.34	-1.63	6	41	21.87	7	3	50.8
97.9	7.4	5.39	5.35	-1.64	6	41	21.87	7	3	50.8
97.9	7.3	5.39	5.34	-1.63	6	41	21.87	7	3	50.8
1		0	10.81	000			11.86	000		

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth	(ft)	29.2
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity			Rut (kips)			122.3
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5	
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5	
4	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	13.50	4.0	15.5	
5	0.179	11102	0.000	0.000	1.00	0.5	0.050	0.100	16.87	4.0	15.5	
6	0.179	11102	0.000	0.000	1.00	9.4	0.050	0.100	20.25	4.0	15.5	
7	0.179	11102	0.000	0.000	1.00	12.3	0.050	0.100	23.62	4.0	15.5	
8	0.179	11102	0.000	0.000	1.00	14.2	0.050	0.100	26.99	4.0	15.5	
9	0.179	11102	0.000	0.000	1.00	14.9	0.050	0.100	30.37	4.0	15.5	
10	0.179	11102	0.000	0.000	1.00	17.0	0.050	0.100	33.74	4.0	15.5	
11	0.179	11102	0.000	0.000	1.00	21.5	0.050	0.100	37.12	4.0	15.5	
12	0.179	11102	0.000	0.000	1.00	28.9	0.140	0.100	40.49	4.0	15.5	
Toe						3.6	0.150	0.100				

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
29.25	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

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GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
122.3	11.2	5.95	5.93	-1.03	6	32	23.99	6	3	18.1	48.3
123.6	11.4	5.98	5.96	-1.11	6	32	24.08	6	3	18.1	48.2
125.0	11.7	5.95	6.00	-1.20	6	32	24.00	6	3	17.8	48.2
126.4	12.0	5.99	6.03	-1.24	6	32	24.14	6	3	17.8	48.0
127.7	12.2	6.02	6.06	-1.27	6	32	24.23	6	3	17.8	47.9
1	0	10.81	000				11.86	000			

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FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth	(ft)	32.0
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor
		1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips) 146.6					
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
3	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	10.12	4.0	15.5
4	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	13.50	4.0	15.5
5	0.179	11102	0.000	0.000	1.00	7.8	0.050	0.100	16.87	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	11.8	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	13.9	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	15.3	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	15.7	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	21.0	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	27.4	0.128	0.100	37.12	4.0	15.5

12	0.179	11102	0.000	0.000	1.00	30.1	0.150	0.100	40.49	4.0	15.5
Toe						3.6	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
31.98	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

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
146.6	15.1	6.40 6.42	-0.82	5	31	25.43	5	3	17.3	46.5
149.3	15.5	6.45 6.47	-0.70	5	31	25.57	5	3	17.2	46.4
152.1	16.0	6.49 6.51	-0.57	5	31	25.70	5	3	17.1	46.2
154.8	16.4	6.54 6.55	-0.54	5	50	25.87	5	3	17.2	46.1
157.5	16.9	6.58 6.59	-0.77	5	50	25.97	5	3	17.1	45.9
	1	0 10.81	000			11.86	000			

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth	(ft)	32.0
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)			166.3		
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
3	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	10.12	4.0	15.5
4	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	13.50	4.0	15.5
5	0.179	11102	0.000	0.000	1.00	7.9	0.050	0.100	16.87	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	11.8	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	13.9	0.050	0.100	23.62	4.0	15.5

8	0.179	11102	0.000	0.000	1.00	15.2	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	15.8	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	21.0	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	27.5	0.129	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	30.1	0.150	0.100	40.49	4.0	15.5
Toe						23.0	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
32.02	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
166.3	18.4	6.79	6.73	-0.78	5	49	26.63	5	3	17.1	45.3
169.0	18.8	6.83	6.77	-0.78	5	49	26.74	5	3	17.2	45.2
171.8	19.4	6.87	6.81	-0.78	5	48	26.87	5	3	17.1	45.1
174.5	19.8	6.91	6.84	-0.80	5	48	26.99	5	3	17.1	44.9
177.2	20.3	6.94	6.88	-0.85	5	47	27.10	5	3	17.1	44.8
1		0	10.81	0.00			11.86	0.00			

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth (ft)	34.2
Shaft Gain/Loss Factor	0.600
Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in ²)	15.500	Pile Type	H Pile
Pile Size (inch)	12.040		

L b Top ft	Area in ²	E-Mod ksi	Spec Wt lb/ft ³	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)			182.8		
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 in ²
1	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	6.75	4.0	15.5
3	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	10.12	4.0	15.5

4	0.179	11102	0.000	0.000	1.00	4.5	0.050	0.100	13.50	4.0	15.5
5	0.179	11102	0.000	0.000	1.00	11.0	0.050	0.100	16.87	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	13.3	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	15.1	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	14.3	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	20.1	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	24.7	0.099	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	30.1	0.150	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	25.3	0.102	0.100	40.49	4.0	15.5
Toe						24.3	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
34.25	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21

06/27/2021

Resource International Inc

GRLWEAP Version 2010

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
182.8	21.0	6.99	6.93	-0.72	4	46	27.14	5	3	44.7
185.5	21.6	7.02	6.97	-0.73	4	46	27.22	5	3	44.6
188.3	22.2	7.06	7.01	-0.72	4	46	27.35	5	3	44.4
191.0	22.8	7.09	7.05	-0.71	4	46	27.42	5	3	44.3
193.7	23.2	7.12	7.08	-0.69	4	46	27.51	5	3	44.2
1		0	10.81	000			11.86	000		

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21

06/27/2021

Resource International Inc

GRLWEAP Version 2010

Depth	(ft)	36.5
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor
		1.000

PILE PROFILE:

Toe Area	(in ²)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

L b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
ft	in ²	ksi	lb/ft ³	ft		ft/s	k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model					Total Capacity Rut (kips)					200.1
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	6.75	4.0	15.5
3	0.179	11102	0.000	0.000	1.00	1.6	0.050	0.100	10.12	4.0	15.5
4	0.179	11102	0.000	0.000	1.00	9.9	0.050	0.100	13.50	4.0	15.5
5	0.179	11102	0.000	0.000	1.00	12.6	0.050	0.100	16.87	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	14.4	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	14.6	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	18.0	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	21.9	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	29.9	0.148	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	27.7	0.132	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	23.9	0.050	0.100	40.49	4.0	15.5
Toe						25.6	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
36.48	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21

06/27/2021

Resource International Inc

GRLWEAP Version 2010

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
200.1	23.9	7.17	7.12	-0.59	4	44	27.69	4	2	16.8	44.1
202.8	24.4	7.19	7.15	-0.61	4	44	27.76	4	3	16.8	44.0
205.5	25.0	7.22	7.19	-0.62	4	42	27.86	4	2	16.7	43.9
208.2	25.4	7.25	7.21	-0.68	4	42	27.95	4	3	16.8	43.9
210.9	25.9	7.27	7.24	-0.73	4	42	28.03	4	3	16.8	43.8
1		0	10.81000				11.86000				

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21

06/27/2021

Resource International Inc

GRLWEAP Version 2010

Depth	(ft)	36.5		
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor	1.000	

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)						182.8
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	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5	
2	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	6.75	4.0	15.5	
3	0.179	11102	0.000	0.000	1.00	1.7	0.050	0.100	10.12	4.0	15.5	
4	0.179	11102	0.000	0.000	1.00	9.9	0.050	0.100	13.50	4.0	15.5	
5	0.179	11102	0.000	0.000	1.00	12.6	0.050	0.100	16.87	4.0	15.5	
6	0.179	11102	0.000	0.000	1.00	14.5	0.050	0.100	20.25	4.0	15.5	
7	0.179	11102	0.000	0.000	1.00	14.6	0.050	0.100	23.62	4.0	15.5	
8	0.179	11102	0.000	0.000	1.00	18.1	0.050	0.100	26.99	4.0	15.5	
9	0.179	11102	0.000	0.000	1.00	21.9	0.050	0.100	30.37	4.0	15.5	
10	0.179	11102	0.000	0.000	1.00	29.9	0.148	0.100	33.74	4.0	15.5	
11	0.179	11102	0.000	0.000	1.00	27.6	0.131	0.100	37.12	4.0	15.5	
12	0.179	11102	0.000	0.000	1.00	24.2	0.052	0.100	40.49	4.0	15.5	
Toe						7.8	0.150	0.100				

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
36.52	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

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GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp	Str	i	t	ENTHRU kip-ft	Bl Rt b/min
182.8	20.0	6.84	6.86	-0.68	4	46	26.78	4	3	16.8	45.0	
185.5	20.3	6.96	6.89	-0.67	4	46	27.10	4	3	17.0	44.8	
188.3	21.0	7.00	6.94	-0.63	4	46	27.21	4	3	16.9	44.7	
191.0	21.6	7.04	6.98	-0.59	4	46	27.32	4	2	16.9	44.5	
193.8	22.2	7.08	7.02	-0.57	4	44	27.47	4	3	16.9	44.4	
1		0	10.81	0.00			11.86	0.00				

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth	(ft)	38.5		
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor	1.000	

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity			Rut (kips)			220.3	
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	0.179	11102	0.010	0.000	0.85	0.0	0.200	0.100	3.37	4.0	15.5		
2	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	6.75	4.0	15.5		
3	0.179	11102	0.000	0.000	1.00	7.1	0.050	0.100	10.12	4.0	15.5		
4	0.179	11102	0.000	0.000	1.00	11.6	0.050	0.100	13.50	4.0	15.5		
5	0.179	11102	0.000	0.000	1.00	13.7	0.050	0.100	16.87	4.0	15.5		
6	0.179	11102	0.000	0.000	1.00	15.4	0.050	0.100	20.25	4.0	15.5		
7	0.179	11102	0.000	0.000	1.00	15.3	0.050	0.100	23.62	4.0	15.5		
8	0.179	11102	0.000	0.000	1.00	20.8	0.050	0.100	26.99	4.0	15.5		
9	0.179	11102	0.000	0.000	1.00	26.9	0.123	0.100	30.37	4.0	15.5		
10	0.179	11102	0.000	0.000	1.00	30.1	0.150	0.100	33.74	4.0	15.5		
11	0.179	11102	0.000	0.000	1.00	23.7	0.065	0.100	37.12	4.0	15.5		
12	0.179	11102	0.000	0.000	1.00	48.0	0.136	0.100	40.49	4.0	15.5		
Toe						7.8	0.150	0.100					

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
38.49	10.81	1.00	0.800

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min	
220.3	28.5	7.38	7.37	-0.53	3	41	28.19	3	2	16.5	43.5
225.1	29.3	7.42	7.40	-0.48	3	41	28.29	3	2	16.5	43.4
230.1	30.1	7.45	7.43	-0.41	3	41	28.39	3	2	16.5	43.3
234.8	31.2	7.49	7.48	-0.46	3	39	28.50	3	2	16.4	43.1
239.6	32.1	7.53	7.52	-0.49	3	39	28.61	3	2	16.4	43.0
1		0	10.81	0.00			11.86	0.00			

↑

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

Depth (ft)	40.5
Shaft Gain/Loss Factor	0.600
Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	H Pile
Pile Size	(inch)	12.040		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model						Total Capacity Rut (kips)			258.5		
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	0.179	11102	0.010	0.000	0.85	0.0	0.050	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	3.1	0.050	0.100	6.75	4.0	15.5
3	0.179	11102	0.000	0.000	1.00	10.5	0.050	0.100	10.12	4.0	15.5
4	0.179	11102	0.000	0.000	1.00	13.0	0.050	0.100	13.50	4.0	15.5
5	0.179	11102	0.000	0.000	1.00	14.8	0.050	0.100	16.87	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	14.2	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	19.4	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	23.4	0.078	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	30.1	0.150	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	26.4	0.117	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	31.4	0.100	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	64.3	0.150	0.100	40.49	4.0	15.5
Toe						7.8	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
40.49	10.81	1.00	0.800

↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

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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
258.5	36.2	7.68	7.66	-0.29	3	36	29.04	3	2	16.3	42.7
265.3	37.8	7.73	7.72	-0.27	3	36	29.17	3	2	16.3	42.5
272.4	39.3	7.78	7.78	-0.29	3	35	29.32	3	2	16.3	42.4
279.3	40.8	7.82	7.82	-0.39	3	35	29.43	3	2	16.4	42.3
286.2	42.4	7.87	7.87	-0.48	3	34	29.56	3	2	16.5	42.1

↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21
Resource International Inc

06/27/2021
GRLWEAP Version 2010

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
1.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
6.8	20.8	3.1	17.7	1.7	10.065	0.000	3.75	24.5
10.5	39.3	14.9	24.4	3.3	15.867	0.000	4.34	21.8
10.5	46.2	15.1	31.2	4.0	17.487	0.000	4.63	21.2
11.8	53.0	19.7	33.3	4.7	18.514	0.000	4.80	20.7
13.0	60.0	24.6	35.5	5.3	19.414	0.000	4.96	20.3
13.0	42.4	24.7	17.7	3.3	16.036	0.000	4.34	21.8
15.5	54.9	35.2	19.7	4.3	18.248	0.000	4.71	21.0
18.0	68.5	46.8	21.7	5.5	19.765	-0.398	4.95	20.0
18.0	58.7	46.9	11.7	4.3	18.437	-0.217	4.70	21.0
19.2	63.9	51.7	12.2	4.8	18.933	-0.131	4.77	20.5
20.5	69.4	56.7	12.8	5.2	19.759	-0.320	4.94	20.4
20.5	104.6	56.9	47.7	10.1	23.022	-0.873	5.72	18.2
23.5	128.1	74.4	53.7	12.9	24.581	-0.915	6.13	17.7
26.5	153.6	93.9	59.7	16.0	25.833	-0.683	6.49	17.3
26.5	97.9	94.2	3.6	7.3	21.874	-1.625	5.39	19.3
29.2	122.3	118.6	3.6	11.2	23.986	-1.025	5.95	18.1
32.0	146.6	143.0	3.6	15.1	25.426	-0.821	6.40	17.3
32.0	166.3	143.3	23.0	18.4	26.627	-0.776	6.79	17.1
34.2	182.8	158.5	24.3	21.0	27.137	-0.721	6.99	17.0
36.5	200.1	174.5	25.6	23.9	27.695	-0.594	7.17	16.8
36.5	182.8	175.1	7.8	20.0	26.781	-0.683	6.84	16.8
38.5	220.3	212.6	7.8	28.5	28.190	-0.528	7.38	16.5
40.5	258.5	250.7	7.8	36.2	29.037	-0.290	7.68	16.3

Total Driving Time 9 minutes; Total No. of Blows 403

G/L at Shaft and Toe: 0.633 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
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	20.8	3.1	17.7	1.7	10.065	0.000	3.75	24.5
10.5	39.3	14.9	24.4	3.3	15.867	0.000	4.34	21.8
10.5	46.2	15.1	31.2	4.0	17.487	0.000	4.63	21.2
11.8	53.0	19.7	33.3	4.7	18.514	0.000	4.80	20.7
13.0	60.0	24.6	35.5	5.3	19.414	0.000	4.96	20.3
13.0	42.4	24.7	17.7	3.3	16.036	0.000	4.34	21.8
15.5	54.9	35.2	19.7	4.3	18.248	0.000	4.71	21.0

18.0	68.5	46.8	21.7	5.5	19.765	-0.398	4.95	20.0
18.0	58.7	46.9	11.7	4.3	18.437	-0.217	4.70	21.0
19.2	63.9	51.7	12.2	4.8	18.933	-0.131	4.77	20.5
20.5	69.4	56.7	12.8	5.2	19.759	-0.320	4.94	20.4
20.5	104.6	56.9	47.7	10.1	23.022	-0.873	5.72	18.2
23.5	128.1	74.4	53.7	12.9	24.581	-0.915	6.13	17.7
26.5	153.6	93.9	59.7	16.0	25.833	-0.683	6.49	17.3
26.5	97.9	94.3	3.6	7.3	21.867	-1.626	5.39	19.3
29.2	123.6	120.0	3.6	11.4	24.085	-1.114	5.98	18.1
32.0	149.3	145.7	3.6	15.5	25.575	-0.701	6.45	17.2
32.0	169.0	146.0	23.0	18.8	26.744	-0.776	6.83	17.2
34.2	185.5	161.2	24.3	21.6	27.216	-0.729	7.02	17.0
36.5	202.8	177.2	25.6	24.4	27.760	-0.614	7.19	16.8
36.5	185.5	177.8	7.8	20.3	27.102	-0.668	6.96	17.0
38.5	225.1	217.4	7.8	29.3	28.291	-0.477	7.42	16.5
40.5	265.3	257.6	7.8	37.8	29.174	-0.270	7.73	16.3

Total Driving Time 9 minutes; Total No. of Blows 410

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FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21

06/27/2021

Resource International Inc

GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.667 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
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	20.8	3.1	17.7	1.7	10.065	0.000	3.75	24.5
10.5	39.3	14.9	24.4	3.3	15.867	0.000	4.34	21.8
10.5	46.2	15.1	31.2	4.0	17.487	0.000	4.63	21.2
11.8	53.0	19.7	33.3	4.7	18.514	0.000	4.80	20.7
13.0	60.0	24.6	35.5	5.3	19.414	0.000	4.96	20.3
13.0	42.4	24.7	17.7	3.3	16.036	0.000	4.34	21.8
15.5	54.9	35.2	19.7	4.3	18.248	0.000	4.71	21.0
18.0	68.5	46.8	21.7	5.5	19.765	-0.398	4.95	20.0
18.0	58.7	46.9	11.7	4.3	18.437	-0.217	4.70	21.0
19.2	63.9	51.7	12.2	4.8	18.933	-0.131	4.77	20.5
20.5	69.4	56.7	12.8	5.2	19.759	-0.320	4.94	20.4
20.5	104.6	56.9	47.7	10.1	23.022	-0.873	5.72	18.2
23.5	128.1	74.4	53.7	12.9	24.581	-0.915	6.13	17.7
26.5	153.6	93.9	59.7	16.0	25.833	-0.683	6.49	17.3
26.5	97.9	94.3	3.6	7.3	21.868	-1.626	5.39	19.3
29.2	125.0	121.4	3.6	11.7	23.998	-1.196	5.95	17.8
32.0	152.1	148.5	3.6	16.0	25.697	-0.569	6.49	17.1
32.0	171.8	148.8	23.0	19.4	26.869	-0.778	6.87	17.1

34.2	188.3	164.0	24.3	22.2	27.347	-0.723	7.06	16.9
36.5	205.5	180.0	25.6	25.0	27.864	-0.625	7.22	16.7
36.5	188.3	180.6	7.8	21.0	27.208	-0.635	7.00	16.9
38.5	230.1	222.3	7.8	30.1	28.388	-0.409	7.45	16.5
40.5	272.4	264.7	7.8	39.3	29.320	-0.287	7.78	16.3

Total Driving Time 9 minutes; Total No. of Blows 417

G/L at Shaft and Toe: 0.700 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	
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0	
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0	
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0	
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0	
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0	
6.8	20.8	3.1	17.7	1.7	10.065	0.000	3.75	24.5	
10.5	39.3	14.9	24.4	3.3	15.867	0.000	4.34	21.8	
10.5	46.2	15.1	31.2	4.0	17.487	0.000	4.63	21.2	
11.8	53.0	19.7	33.3	4.7	18.514	0.000	4.80	20.7	
13.0	60.0	24.6	35.5	5.3	19.414	0.000	4.96	20.3	
13.0	42.4	24.7	17.7	3.3	16.036	0.000	4.34	21.8	
15.5	54.9	35.2	19.7	4.3	18.248	0.000	4.71	21.0	
18.0	68.5	46.8	21.7	5.5	19.765	-0.398	4.95	20.0	
18.0	58.7	46.9	11.7	4.3	18.437	-0.217	4.70	21.0	
19.2	63.9	51.7	12.2	4.8	18.933	-0.131	4.77	20.5	
20.5	69.4	56.7	12.8	5.2	19.759	-0.320	4.94	20.4	
20.5	104.6	56.9	47.7	10.1	23.022	-0.873	5.72	18.2	
23.5	128.1	74.4	53.7	12.9	24.581	-0.915	6.13	17.7	
26.5	153.6	93.9	59.7	16.0	25.833	-0.683	6.49	17.3	
26.5	97.9	94.3	3.6	7.4	21.874	-1.637	5.39	19.3	
29.2	126.4	122.7	3.6	12.0	24.137	-1.238	5.99	17.8	
32.0	154.8	151.2	3.6	16.4	25.870	-0.542	6.54	17.2	
32.0	174.5	151.5	23.0	19.8	26.988	-0.799	6.91	17.1	
34.2	191.0	166.7	24.3	22.8	27.419	-0.711	7.09	16.8	
36.5	208.2	182.7	25.6	25.4	27.952	-0.683	7.25	16.8	
36.5	191.0	183.3	7.8	21.6	27.317	-0.587	7.04	16.9	
38.5	234.8	227.1	7.8	31.2	28.502	-0.463	7.49	16.4	
40.5	279.3	271.5	7.8	40.8	29.429	-0.388	7.82	16.4	

Total Driving Time 9 minutes; Total No. of Blows 426

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Resource International Inc

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SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.733 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	

1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	20.8	3.1	17.7	1.7	10.065	0.000	3.75	24.5
10.5	39.3	14.9	24.4	3.3	15.867	0.000	4.34	21.8
10.5	46.2	15.1	31.2	4.0	17.487	0.000	4.63	21.2
11.8	53.0	19.7	33.3	4.7	18.514	0.000	4.80	20.7
13.0	60.0	24.6	35.5	5.3	19.414	0.000	4.96	20.3
13.0	42.4	24.7	17.7	3.3	16.036	0.000	4.34	21.8
15.5	54.9	35.2	19.7	4.3	18.248	0.000	4.71	21.0
18.0	68.5	46.8	21.7	5.5	19.765	-0.398	4.95	20.0
18.0	58.7	46.9	11.7	4.3	18.437	-0.217	4.70	21.0
19.2	63.9	51.7	12.2	4.8	18.933	-0.131	4.77	20.5
20.5	69.4	56.7	12.8	5.2	19.759	-0.320	4.94	20.4
20.5	104.6	56.9	47.7	10.1	23.022	-0.873	5.72	18.2
23.5	128.1	74.4	53.7	12.9	24.581	-0.915	6.13	17.7
26.5	153.6	93.9	59.7	16.0	25.833	-0.683	6.49	17.3
26.5	97.9	94.3	3.6	7.3	21.872	-1.628	5.39	19.3
29.2	127.7	124.1	3.6	12.2	24.225	-1.267	6.02	17.8
32.0	157.5	153.9	3.6	16.9	25.970	-0.766	6.58	17.1
32.0	177.2	154.2	23.0	20.3	27.100	-0.846	6.94	17.1
34.2	193.7	169.4	24.3	23.2	27.512	-0.692	7.12	16.9
36.5	210.9	185.4	25.6	25.9	28.028	-0.735	7.27	16.8
36.5	193.8	186.0	7.8	22.2	27.467	-0.570	7.08	16.9
38.5	239.6	231.9	7.8	32.1	28.609	-0.486	7.53	16.4
40.5	286.2	278.4	7.8	42.4	29.565	-0.477	7.87	16.5

Total Driving Time 9 minutes; Total No. of Blows 433



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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
1.48	40.49	0.00	10.81	1.00	0.80	1.00	1.00
1.52	40.49	0.00	10.81	1.00	0.80	1.00	1.00
2.25	40.49	0.00	10.81	1.00	0.80	1.00	1.00
2.98	40.49	0.00	10.81	1.00	0.80	1.00	1.00
3.02	40.49	0.00	10.81	1.00	0.80	1.00	1.00
6.75	40.49	0.00	10.81	1.00	0.80	1.00	1.00
10.48	40.49	0.00	10.81	1.00	0.80	1.00	1.00
10.52	40.49	0.00	10.81	1.00	0.80	1.00	1.00
11.75	40.49	0.00	10.81	1.00	0.80	1.00	1.00
12.98	40.49	0.00	10.81	1.00	0.80	1.00	1.00

13.02	40.49	0.00	10.81	1.00	0.80	1.00	1.00
15.50	40.49	0.00	10.81	1.00	0.80	1.00	1.00
17.98	40.49	0.00	10.81	1.00	0.80	1.00	1.00
18.02	40.49	0.00	10.81	1.00	0.80	1.00	1.00
19.25	40.49	0.00	10.81	1.00	0.80	1.00	1.00
20.48	40.49	0.00	10.81	1.00	0.80	1.00	1.00
20.52	40.49	0.00	10.81	1.00	0.80	1.00	1.00
23.50	40.49	0.00	10.81	1.00	0.80	1.00	1.00
26.48	40.49	0.00	10.81	1.00	0.80	1.00	1.00
26.52	40.49	0.00	10.81	1.00	0.80	1.00	1.00
29.25	40.49	0.00	10.81	1.00	0.80	1.00	1.00
31.98	40.49	0.00	10.81	1.00	0.80	1.00	1.00
32.02	40.49	0.00	10.81	1.00	0.80	1.00	1.00
34.25	40.49	0.00	10.81	1.00	0.80	1.00	1.00
36.48	40.49	0.00	10.81	1.00	0.80	1.00	1.00
36.52	40.49	0.00	10.81	1.00	0.80	1.00	1.00
38.49	40.49	0.00	10.81	1.00	0.80	1.00	1.00
40.49	40.49	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	0.100	0.200	0.150	1.000	6.000	336.000
1.49	0.00	0.00	0.100	0.100	0.200	0.150	1.000	6.000	336.000
2.99	0.00	0.00	0.100	0.100	0.200	0.150	1.000	6.000	336.000
3.01	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
5.39	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
5.41	0.52	14.14	0.100	0.100	0.050	0.150	0.000	6.000	24.000
6.40	0.62	16.76	0.100	0.100	0.050	0.150	0.000	6.000	24.000
7.40	0.72	19.40	0.100	0.100	0.050	0.150	0.000	6.000	24.000
7.99	0.77	20.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
8.01	0.77	21.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
9.00	0.82	22.36	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.00	0.88	23.74	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.49	0.90	24.41	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.51	0.91	31.15	0.100	0.100	0.050	0.150	0.000	6.000	24.000
11.50	0.96	32.88	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.50	1.01	34.63	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.99	1.03	35.49	0.100	0.100	0.050	0.150	0.000	6.000	24.000
13.01	1.01	17.71	0.100	0.100	0.050	0.150	0.000	6.000	24.000
14.00	1.05	18.51	0.100	0.100	0.050	0.150	0.000	6.000	24.000
15.00	1.10	19.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
16.00	1.14	20.13	0.100	0.100	0.050	0.150	0.000	6.000	24.000
17.00	1.19	20.94	0.100	0.100	0.050	0.150	0.000	6.000	24.000
17.99	1.24	21.74	0.100	0.100	0.050	0.150	0.000	6.000	24.000
18.01	0.95	11.70	0.100	0.100	0.050	0.150	0.000	6.000	24.000
19.00	0.99	12.13	0.100	0.100	0.050	0.150	0.000	6.000	24.000
20.00	1.02	12.56	0.100	0.100	0.050	0.150	0.000	6.000	24.000

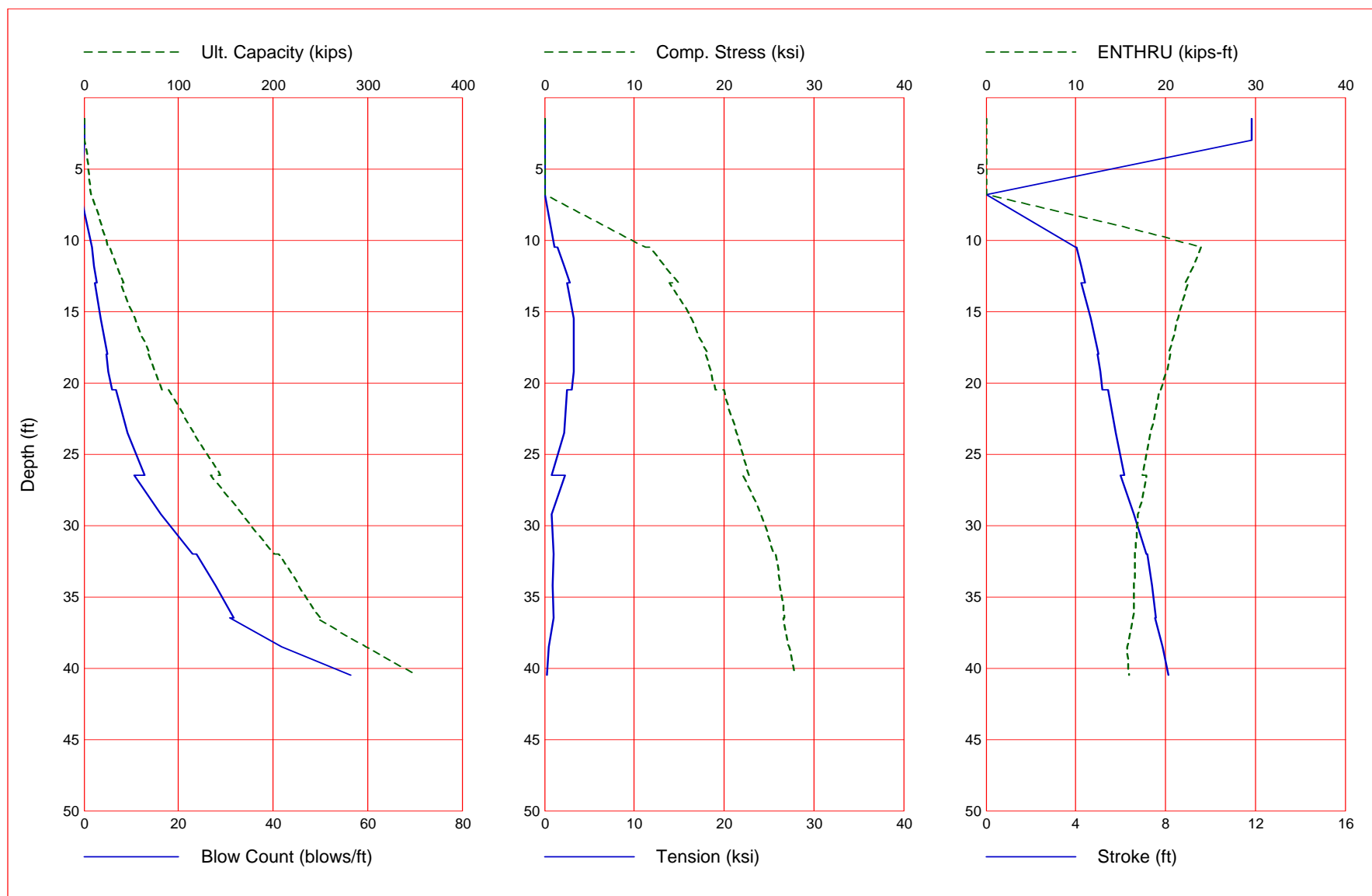
20.49	1.04	12.77	0.100	0.100	0.050	0.150	0.000	6.000	24.000
20.51	1.39	47.69	0.100	0.100	0.050	0.150	0.000	6.000	24.000
21.50	1.45	49.68	0.100	0.100	0.050	0.150	0.000	6.000	24.000
22.50	1.51	51.69	0.100	0.100	0.050	0.150	0.000	6.000	24.000
23.50	1.57	53.70	0.100	0.100	0.050	0.150	0.000	6.000	24.000
24.50	1.62	55.71	0.100	0.100	0.050	0.150	0.000	6.000	24.000
25.50	1.68	57.72	0.100	0.100	0.050	0.150	0.000	6.000	24.000
26.49	1.74	59.71	0.100	0.100	0.050	0.150	0.000	6.000	24.000
26.51	3.75	3.63	0.100	0.100	0.150	0.150	1.000	6.000	336.000
31.99	3.75	3.63	0.100	0.100	0.150	0.150	1.000	6.000	336.000
32.01	1.66	22.98	0.100	0.100	0.050	0.150	0.000	6.000	24.000
33.00	1.71	23.55	0.100	0.100	0.050	0.150	0.000	6.000	24.000
34.00	1.75	24.13	0.100	0.100	0.050	0.150	0.000	6.000	24.000
35.00	1.79	24.71	0.100	0.100	0.050	0.150	0.000	6.000	24.000
36.00	1.83	25.29	0.100	0.100	0.050	0.150	0.000	6.000	24.000
36.49	1.85	25.58	0.100	0.100	0.050	0.150	0.000	6.000	24.000
36.51	8.00	7.75	0.100	0.100	0.150	0.150	1.000	6.000	336.000
40.49	8.00	7.75	0.100	0.100	0.150	0.150	1.000	6.000	336.000

Gain/Loss 3 at Shaft and Toe 0.667 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	20.8	3.1	17.7	1.7	10.065	0.000	3.75	24.5
10.5	39.3	14.9	24.4	3.3	15.867	0.000	4.34	21.8
10.5	46.2	15.1	31.2	4.0	17.487	0.000	4.63	21.2
11.8	53.0	19.7	33.3	4.7	18.514	0.000	4.80	20.7
13.0	60.0	24.6	35.5	5.3	19.414	0.000	4.96	20.3
13.0	42.4	24.7	17.7	3.3	16.036	0.000	4.34	21.8
15.5	54.9	35.2	19.7	4.3	18.248	0.000	4.71	21.0
18.0	68.5	46.8	21.7	5.5	19.765	-0.398	4.95	20.0
18.0	58.7	46.9	11.7	4.3	18.437	-0.217	4.70	21.0
19.2	63.9	51.7	12.2	4.8	18.933	-0.131	4.77	20.5
20.5	69.4	56.7	12.8	5.2	19.759	-0.320	4.94	20.4
20.5	104.6	56.9	47.7	10.1	23.022	-0.873	5.72	18.2
23.5	128.1	74.4	53.7	12.9	24.581	-0.915	6.13	17.7
26.5	153.6	93.9	59.7	16.0	25.833	-0.683	6.49	17.3
26.5	97.9	94.3	3.6	7.3	21.868	-1.626	5.39	19.3
29.2	125.0	121.4	3.6	11.7	23.998	-1.196	5.95	17.8
32.0	152.1	148.5	3.6	16.0	25.697	-0.569	6.49	17.1
32.0	171.8	148.8	23.0	19.4	26.869	-0.778	6.87	17.1
34.2	188.3	164.0	24.3	22.2	27.347	-0.723	7.06	16.9
36.5	205.5	180.0	25.6	25.0	27.864	-0.625	7.22	16.7
36.5	188.3	180.6	7.8	21.0	27.208	-0.635	7.00	16.9
38.5	230.1	222.3	7.8	30.1	28.388	-0.409	7.45	16.5
40.5	272.4	264.7	7.8	39.3	29.320	-0.287	7.78	16.3

Total Continuous Driving Time 9.00 minutes; Total Number of Blows 417

Gain/Loss 4 at Shaft and Toe 0.703 / 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.
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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 restrrike 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: J:\GEOTECH\PROJECTS\2020\W-20-025
FRA-70-13.01\ANALYSIS\DRIVEABILITY\PIER 2\DOWNDRAG\FRA-70-13.01 - PIER 2 HP 14X73 -
B-014-4-19-WDD.GWW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
 Hammer File Version: 2003 (2/22/2013)

Input File Contents

FRA-70-13.01 : 06/25/2021 : HSK

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	21.400	14.580	H Pile
W Cp	A Cp	E Cp	T Cp	CoR
1.900	227.000	530.0	2.000	0.800
A Cu	E Cu	T Cu	CoR	ROut
0.000	0.0	0.000	0.000	0.000
LPle	APle	EPle	WPle	Peri
40.480	21.40	29000.0	492.000	4.699
				0
				0.850
				0.010

Manufac	Hmr Name	HmrType	No	Seg-s
DELMAG	D 19-42	1	5	
Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk
4.00	129.10	12.60	11.86	10.81
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
16.65	124.70	157.70	0.002	0.002
P atm	P1	P2	P3	P4
14.70	1520.00	1368.00	1231.00	1108.00
Stroke	Effic.	Pressure	R-Weight	T-Delay
10.8100	0.8000	1520.0000	0.0000	0.0000
Qs	Qt	Js	Jt	Qx
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	

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	0.00	0.00	0.10	0.10	0.20	0.15	1.50	6.00	336.0
1.49	0.00	0.00	0.10	0.10	0.20	0.15	1.50	6.00	336.0
1.51	0.00	0.00	0.10	0.10	0.20	0.15	1.50	6.00	336.0
2.99	0.00	0.00	0.10	0.10	0.20	0.15	1.50	6.00	336.0
3.01	0.00	0.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
5.39	0.00	0.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
5.40	0.62	2.90	0.10	0.10	0.05	0.15	1.00	6.00	24.0
7.99	0.92	4.30	0.10	0.10	0.05	0.15	1.00	6.00	24.0
8.01	0.93	4.31	0.10	0.10	0.05	0.15	1.00	6.00	24.0
10.49	1.08	5.01	0.10	0.10	0.05	0.15	1.00	6.00	24.0
10.51	1.09	6.39	0.10	0.10	0.05	0.15	1.00	6.00	24.0
12.99	1.24	7.28	0.10	0.10	0.05	0.15	1.00	6.00	24.0
13.01	1.20	3.63	0.10	0.10	0.05	0.15	1.00	6.00	24.0
17.99	1.47	4.46	0.10	0.10	0.05	0.15	1.00	6.00	24.0
18.01	1.11	2.40	0.10	0.10	0.05	0.15	1.00	6.00	24.0

20.49	1.21	2.62	0.10	0.10	0.05	0.15	1.00	6.00	24.0
20.51	1.66	9.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
26.49	2.08	12.25	0.10	0.10	0.05	0.15	1.00	6.00	24.0
26.51	3.75	0.75	0.10	0.10	0.15	0.15	1.50	6.00	336.0
31.99	3.75	0.75	0.10	0.10	0.15	0.15	1.50	6.00	336.0
32.01	1.96	4.71	0.10	0.10	0.05	0.15	1.00	6.00	24.0
36.49	2.18	5.25	0.10	0.10	0.05	0.15	1.00	6.00	24.0
36.51	8.00	1.59	0.10	0.10	0.15	0.15	1.50	6.00	336.0
40.48	8.00	1.59	0.10	0.10	0.15	0.15	1.50	6.00	336.0

Gain/Loss factors: shaft and toe

0.60400	0.63700	0.67000	0.70300	0.73600
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
1.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
1.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
2.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
2.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
3.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
6.75	0.00	0.00	0.000	0.000	0.000	0.000	0.000
10.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
10.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
11.75	0.00	0.00	0.000	0.000	0.000	0.000	0.000
12.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
13.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
15.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
17.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
18.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
19.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
20.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
20.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
23.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
26.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
26.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
29.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
31.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
32.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
34.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
36.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
36.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
38.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
40.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1 0 10.81000 11.86000



GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

Version 2010

English Units

FRA-70-13.01 : 06/25/2021 : HSK

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	140046.7	1.000	0.0100	
3	0.800	140046.7	1.000	0.0100	
4	0.800	140046.7	1.000	0.0100	
5	0.800	140046.7	1.000	0.0100	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	1.900	60155.0	0.800	0.0100	5.8
Combined Pile Top		15331.0			

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)	1520.00	Actual Pressure	(psi)	1520.00
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

Cross Sect. Area	(in2)	227.00
Elastic-Modulus	(ksi)	530.0
Thickness	(inch)	2.00
Coeff of Restitution		0.8
RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0

PILE CUSHION

Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	0.00
Coeff of Restitution		1.0
RoundOut	(ft)	0.0
Stiffness	(kips/in)	0.0



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Resource International Inc

06/27/2021
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Depth	(ft)	1.5		
Shaft Gain/Loss Factor		0.604	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	21.400	Pile Type	H Pile
----------	-------	--------	-----------	--------

Pile Size (inch) 14.580

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	40.48	4.7	21.4
Toe						0.0	0.150	0.100			

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

2.960 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) 0.751

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
1.48	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0

Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

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Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i t Comp Str ksi	i t ENTHRU kip-ft	Bl Rt b/min
1		0	10.81000	11.86000		

↑
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Resource International Inc GRLWEAP Version 2010

Depth (ft)	1.5
Shaft Gain/Loss Factor	0.604
Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in2)	21.400	Pile Type	H Pile
Pile Size (inch)	14.580		

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

No.	Weight kips	Pile and Soil Model Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Total Capacity Soil-S kips	Soil-D s/ft	Rut (kips) Quake inch	LbTop ft	Perim ft	Area in2
1	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	40.48	4.7	21.4
Toe						0.0	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
1.52	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
 Hammer+Pile Weight > Rult: Pile Runs

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i t Comp Str ksi	i t ENTHRU kip-ft	Bl Rt b/min
1		0	10.81000	11.86000		

↑
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Depth	(ft)	2.2	
Shaft Gain/Loss Factor		0.604	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	21.400	Pile Type	H Pile
Pile Size	(inch)	14.580		

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	40.48	4.7	21.4
Toe						0.0	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
2.25	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
 Hammer+Pile Weight > Rult: Pile Runs

↑
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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
1		0	10.81000		11.86000				

↑
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Depth	(ft)	3.0
Shaft Gain/Loss Factor	0.604	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	21.400	Pile Type	H Pile
Pile Size	(inch)	14.580		

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	40.48	4.7	21.4
Toe						0.0	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
2.98	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i t Comp Str ksi	i t ENTHRU kip-ft	Bl Rt b/min
1		0	10.81000	11.86000		

↑
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Depth	(ft)	3.0
Shaft Gain/Loss Factor	0.604	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	21.400	Pile Type	H Pile
Pile Size	(inch)	14.580		

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	40.48	4.7	21.4
Toe						0.0	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
3.02	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

↑

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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
 1 0 10.81000 11.86000

↑

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Depth (ft) 6.8
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in²) 21.400 Pile Type H Pile
 Pile Size (inch) 14.580

L b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
ft	in ²	ksi	lb/ft ³	ft		ft/s	k/ft/s
0.0	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips)						8.1
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	in ²	
1	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4	
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4	
10	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	33.73	4.7	21.4	
11	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	37.11	4.7	21.4	
12	0.247	15331	0.000	0.000	1.00	4.5	0.050	0.100	40.48	4.7	21.4	
Toe						3.6	0.150	0.100				

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
6.75	10.81	1.00	0.800

↑

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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
8.1	Hammer	did not run							
8.1	Hammer	did not run							
8.1	Hammer	did not run							
8.1	Hammer	did not run							
8.1	Hammer	did not run							
1		0	10.81000			11.86000			

↑

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Depth (ft) 10.5
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 21.400 Pile Type H Pile
Pile Size (inch) 14.580

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips) 26.1					
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	5.8	0.050	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	15.3	0.050	0.100	40.48	4.7	21.4
Toe						5.0	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
10.48	10.81	1.00	0.800



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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
26.1	1.7	3.97	3.93	-1.16	5	6	11.26	1	2	24.1	59.7
26.1	1.7	3.97	3.93	-1.16	5	6	11.26	1	2	24.1	59.7
26.1	1.7	3.97	3.93	-1.16	5	6	11.26	1	2	24.1	59.7
26.1	1.7	3.97	3.93	-1.16	5	6	11.26	1	2	24.1	59.7
26.1	1.7	3.97	3.93	-1.16	5	6	11.26	1	2	24.1	59.7
1	0	10.81	000		11.86	000					



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Depth (ft) 10.5
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 21.400 Pile Type H Pile
 Pile Size (inch) 14.580

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips)			27.7		
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	6.0	0.050	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	15.4	0.050	0.100	40.48	4.7	21.4
Toe						6.4	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
10.52	10.81	1.00	0.800



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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
27.7	1.8	4.02	4.00	-1.39	5	6	11.72	1	2	23.9	59.2
27.7	1.8	4.02	4.00	-1.39	5	6	11.72	1	2	23.9	59.2
27.7	1.8	4.02	4.00	-1.39	5	6	11.72	1	2	23.9	59.2
27.7	1.8	4.02	4.00	-1.39	5	6	11.72	1	2	23.9	59.2
27.7	1.8	4.02	4.00	-1.39	5	6	11.72	1	2	23.9	59.2
1		0	10.81	000			11.86	000			



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Depth (ft) 11.8

Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 21.400 Pile Type H Pile
Pile Size (inch) 14.580

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips)				34.7	
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	11.1	0.050	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	16.7	0.050	0.100	40.48	4.7	21.4
Toe						6.8	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
11.75	10.81	1.00	0.800

↑

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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		
34.7	2.2	4.23	4.21	-2.24	4	6	13.42	1	2	23.1	57.7
34.7	2.2	4.23	4.21	-2.24	4	6	13.42	1	2	23.1	57.7
34.7	2.2	4.23	4.21	-2.24	4	6	13.42	1	2	23.1	57.7
34.7	2.2	4.23	4.21	-2.24	4	6	13.42	1	2	23.1	57.7
34.7	2.2	4.23	4.21	-2.24	4	6	13.42	1	2	23.1	57.7
1		0	10.81	000			11.86	000			

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Depth (ft) 13.0
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 21.400 Pile Type H Pile
 Pile Size (inch) 14.580

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips)			42.0		
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	2.6	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	14.2	0.050	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	17.9	0.050	0.100	40.48	4.7	21.4
Toe						7.3	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
12.98	10.81	1.00	0.800



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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
42.0	2.8	4.42 4.41	-2.84	4	6	14.83	1	2	22.2	56.4
42.0	2.8	4.42 4.41	-2.84	4	6	14.83	1	2	22.2	56.4
42.0	2.8	4.42 4.41	-2.84	4	6	14.83	1	2	22.2	56.4
42.0	2.8	4.42 4.41	-2.84	4	6	14.83	1	2	22.2	56.4
42.0	2.8	4.42 4.41	-2.84	4	6	14.83	1	2	22.2	56.4
1		0 10.81000				11.86000				



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Depth	(ft)	
Shaft Gain/Loss Factor	0.604	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 21.400 Pile Type H Pile

Pile Size (inch) 14.580

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips)			38.6		
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	2.8	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	14.2	0.050	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	18.0	0.050	0.100	40.48	4.7	21.4
Toe						3.6	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
13.02	10.81	1.00	0.800

↑

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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	
38.6	2.4	4.26	4.29	-2.55	4	6	13.88	1	2	22.6	57.3
38.6	2.4	4.26	4.29	-2.55	4	6	13.88	1	2	22.6	57.3
38.6	2.4	4.26	4.29	-2.55	4	6	13.88	1	2	22.6	57.3
38.6	2.4	4.26	4.29	-2.55	4	6	13.88	1	2	22.6	57.3
38.6	2.4	4.26	4.29	-2.55	4	6	13.88	1	2	22.6	57.3
1		0	10.81000			11.86000					

↑

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Depth	(ft)	15.5	
Shaft Gain/Loss Factor	0.604	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	21.400	Pile Type	H Pile
Pile Size	(inch)	14.580		

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity			Rut (kips)			53.8
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4	
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4	
8	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	26.99	4.7	21.4	
9	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	30.36	4.7	21.4	
10	0.247	15331	0.000	0.000	1.00	12.8	0.050	0.100	33.73	4.7	21.4	
11	0.247	15331	0.000	0.000	1.00	17.1	0.050	0.100	37.11	4.7	21.4	
12	0.247	15331	0.000	0.000	1.00	19.8	0.050	0.100	40.48	4.7	21.4	
Toe						4.0	0.150	0.100				

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
15.50	10.81	1.00	0.800

↑

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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
53.8	3.5	4.68	4.64	-3.29	4	6	16.32	7	3	21.4	54.8
53.8	3.5	4.68	4.64	-3.29	4	6	16.32	7	3	21.4	54.8
53.8	3.5	4.68	4.64	-3.29	4	6	16.32	7	3	21.4	54.8
53.8	3.5	4.68	4.64	-3.29	4	6	16.32	7	3	21.4	54.8
53.8	3.5	4.68	4.64	-3.29	4	6	16.32	7	3	21.4	54.8
1		0	10.81000				11.86000				

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Depth	(ft)	18.0
Shaft Gain/Loss Factor	0.604	Toe Gain/Loss Factor
		1.000

PILE PROFILE:

Toe Area	(in2)	21.400	Pile Type	H Pile
Pile Size	(inch)	14.580		

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity			Rut (kips)			70.6	
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4		
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4		
7	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	23.61	4.7	21.4		
8	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	26.99	4.7	21.4		
9	0.247	15331	0.000	0.000	1.00	8.9	0.050	0.100	30.36	4.7	21.4		
10	0.247	15331	0.000	0.000	1.00	16.2	0.050	0.100	33.73	4.7	21.4		
11	0.247	15331	0.000	0.000	1.00	19.2	0.050	0.100	37.11	4.7	21.4		
12	0.247	15331	0.000	0.000	1.00	21.8	0.050	0.100	40.48	4.7	21.4		
Toe						4.5	0.150	0.100					

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
17.98	10.81	1.00	0.800

↑

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	Str ksi	i	t	Comp	Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
70.6	4.9	5.03	4.98	-3.20	4	6	18.21	9	4	20.3	52.9	
70.6	4.9	5.03	4.98	-3.20	4	6	18.21	9	4	20.3	52.9	
70.6	4.9	5.03	4.98	-3.20	4	6	18.21	9	4	20.3	52.9	
70.6	4.9	5.03	4.98	-3.20	4	6	18.21	9	4	20.3	52.9	
70.6	4.9	5.03	4.98	-3.20	4	6	18.21	9	4	20.3	52.9	
1		0	10.81	0.00			11.86	0.00				

↑

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Depth	(ft)	18.0
Shaft Gain/Loss Factor	0.604	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	21.400	Pile Type	H Pile
Pile Size	(inch)	14.580		

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips) 68.7					
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	9.0	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	16.2	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	19.2	0.050	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	21.8	0.050	0.100	40.48	4.7	21.4
Toe						2.4	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
18.02	10.81	1.00	0.800

↑

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp	Str	ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
68.7	4.7	4.97	4.93	-3.28	4	6	17.98	9	4	20.5	53.2		
68.7	4.7	4.97	4.93	-3.28	4	6	17.98	9	4	20.5	53.2		
68.7	4.7	4.97	4.93	-3.28	4	6	17.98	9	4	20.5	53.2		
68.7	4.7	4.97	4.93	-3.28	4	6	17.98	9	4	20.5	53.2		
68.7	4.7	4.97	4.93	-3.28	4	6	17.98	9	4	20.5	53.2		
1		0	10.81000		11.86000								

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Depth	(ft)	19.2
Shaft Gain/Loss Factor	0.604	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	21.400	Pile Type	H Pile
Pile Size	(inch)	14.580		

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips) 75.4					
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	1.1	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	13.5	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	17.5	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	20.1	0.050	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	20.8	0.050	0.100	40.48	4.7	21.4
Toe						2.5	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
19.25	10.81	1.00	0.800

↑

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp	Str	i	t	ENTHRU kip-ft	Bl Rt b/min
75.4	5.2	5.10	5.05	-3.23	4	6	18.56	9	4	20.1	52.5	
75.4	5.2	5.10	5.05	-3.23	4	6	18.56	9	4	20.1	52.5	
75.4	5.2	5.10	5.05	-3.23	4	6	18.56	9	4	20.1	52.5	
75.4	5.2	5.10	5.05	-3.23	4	6	18.56	9	4	20.1	52.5	
75.4	5.2	5.10	5.05	-3.23	4	6	18.56	9	4	20.1	52.5	
1		0	10.81000		11.86000							

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Depth	(ft)	20.5
Shaft Gain/Loss Factor	0.604	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	21.400	Pile Type	H Pile
Pile Size	(inch)	14.580		

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips) 82.4					
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	5.3	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	15.2	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	18.6	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	21.1	0.050	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	19.6	0.050	0.100	40.48	4.7	21.4
Toe						2.6	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
20.48	10.81	1.00	0.800

↑

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	Str ksi	i	t	Comp	Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
82.4	5.9	5.19	5.21	-3.03	4	6	19.02	8	3	19.5	51.8	
82.4	5.9	5.19	5.21	-3.03	4	6	19.02	8	3	19.5	51.8	
82.4	5.9	5.19	5.21	-3.03	4	6	19.02	8	3	19.5	51.8	
82.4	5.9	5.19	5.21	-3.03	4	6	19.02	8	3	19.5	51.8	
82.4	5.9	5.19	5.21	-3.03	4	6	19.02	8	3	19.5	51.8	
1		0	10.81000				11.86000					

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Depth	(ft)	20.5
Shaft Gain/Loss Factor	0.604	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	21.400	Pile Type	H Pile
Pile Size	(inch)	14.580		

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips) 89.8					
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	5.5	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	15.2	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	18.6	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	21.1	0.050	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	19.6	0.050	0.100	40.48	4.7	21.4
Toe						9.8	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
20.52	10.81	1.00	0.800

↑

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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
89.8	6.8	5.43 5.39	-2.53	4	6 19.95	8	3 19.4	50.7
89.8	6.8	5.43 5.39	-2.53	4	6 19.95	8	3 19.4	50.7
89.8	6.8	5.43 5.39	-2.53	4	6 19.95	8	3 19.4	50.7
89.8	6.8	5.43 5.39	-2.53	4	6 19.95	8	3 19.4	50.7
89.8	6.8	5.43 5.39	-2.53	4	6 19.95	8	3 19.4	50.7
1		0 10.81000			11.86000			

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Depth	(ft)	23.5
Shaft Gain/Loss Factor		0.604
Toe Gain/Loss Factor		1.000

PILE PROFILE:

Toe Area	(in2)	21.400	Pile Type	H Pile
Pile Size	(inch)	14.580		

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity			Rut (kips)			115.8
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4	
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4	
6	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	20.24	4.7	21.4	
7	0.247	15331	0.000	0.000	1.00	4.0	0.050	0.100	23.61	4.7	21.4	
8	0.247	15331	0.000	0.000	1.00	14.7	0.050	0.100	26.99	4.7	21.4	
9	0.247	15331	0.000	0.000	1.00	18.3	0.050	0.100	30.36	4.7	21.4	
10	0.247	15331	0.000	0.000	1.00	20.8	0.050	0.100	33.73	4.7	21.4	
11	0.247	15331	0.000	0.000	1.00	20.0	0.050	0.100	37.11	4.7	21.4	
12	0.247	15331	0.000	0.000	1.00	27.0	0.050	0.100	40.48	4.7	21.4	
Toe						11.0	0.150	0.100				

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
23.50	10.81	1.00	0.800

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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
115.8	9.3	5.80 5.78	-2.14	8	38	21.40	8	3	18.3	49.0
115.8	9.3	5.80 5.78	-2.14	8	38	21.40	8	3	18.3	49.0
115.8	9.3	5.80 5.78	-2.14	8	38	21.40	8	3	18.3	49.0
115.8	9.3	5.80 5.78	-2.14	8	38	21.40	8	3	18.3	49.0
115.8	9.3	5.80 5.78	-2.14	8	38	21.40	8	3	18.3	49.0
1		0 10.81000				11.86000				

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Depth	(ft)	26.5
Shaft Gain/Loss Factor	0.604	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	21.400	Pile Type	H Pile
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Pile Size (inch) 14.580

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips) 144.8					
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	2.7	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	14.2	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	18.0	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	20.4	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	20.3	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	25.8	0.050	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	31.1	0.050	0.100	40.48	4.7	21.4
Toe						12.2	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
26.48	10.81	1.00	0.800

↑

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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
144.8	12.8	6.18	6.23	-0.79	5	31	22.79	7	3	17.4	47.4
144.8	12.8	6.18	6.23	-0.79	5	31	22.79	7	3	17.4	47.4
144.8	12.8	6.18	6.23	-0.79	5	31	22.79	7	3	17.4	47.4
144.8	12.8	6.18	6.23	-0.79	5	31	22.79	7	3	17.4	47.4
144.8	12.8	6.18	6.23	-0.79	5	31	22.79	7	3	17.4	47.4
1		0	10.81	000			11.86	000			

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Depth	(ft)	26.5
Shaft Gain/Loss Factor	0.604	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 21.400 Pile Type H Pile
 Pile Size (inch) 14.580

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips)			133.7		
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	2.8	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	14.2	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	18.0	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	20.5	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	20.3	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	25.9	0.050	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	31.2	0.051	0.100	40.48	4.7	21.4
Toe						0.8	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
26.52	10.81	1.00	0.800



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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
133.7	10.7	6.00	5.99	-2.25	10	5	22.16	7	3	17.9	48.2
133.7	10.8	6.01	5.99	-2.31	10	5	22.20	7	3	17.9	48.1
133.7	10.7	6.00	5.99	-2.26	10	5	22.17	7	3	17.9	48.2
133.7	10.7	6.00	5.99	-2.25	10	5	22.17	7	3	17.9	48.2
133.8	10.8	6.00	5.99	-2.27	10	5	22.19	7	3	17.9	48.2
1		0	10.81	000			11.86	000			



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Depth (ft) 29.2

Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 21.400 Pile Type H Pile
Pile Size (inch) 14.580

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips)			162.8		
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
4	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	13.49	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	0.7	0.050	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	13.3	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	17.3	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	20.0	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	20.9	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	24.0	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	30.5	0.050	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	35.3	0.139	0.100	40.48	4.7	21.4
Toe						0.8	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
29.25	10.81	1.00	0.800



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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		
162.8	15.6	6.53	6.55	-0.73	6	29	23.88	6	3	17.0	46.1
164.4	15.9	6.55	6.57	-0.94	6	50	23.94	6	3	16.9	46.0
166.0	16.1	6.58	6.59	-0.94	6	50	24.04	6	3	16.9	46.0
167.6	16.3	6.60	6.61	-0.84	5	49	24.11	6	3	16.9	45.9
169.2	16.6	6.62	6.63	-0.73	6	29	24.14	6	3	16.8	45.8
	1	0	10.81000				11.86000				



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Depth (ft) 32.0
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 21.400 Pile Type H Pile
 Pile Size (inch) 14.580

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips)			191.8		
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
3	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	10.12	4.7	21.4
4	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	13.49	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	11.1	0.050	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	16.7	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	19.6	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	21.5	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	22.0	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	29.8	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	34.6	0.125	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	35.9	0.150	0.100	40.48	4.7	21.4
Toe						0.8	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
31.98	10.81	1.00	0.800



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Rut	Bl Ct	Stroke (ft)	Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt
kips	b/ft	down	up			ksi			kip-ft	b/min
191.8	21.0	6.96	6.97	-0.97	5	45	25.04	5	3	16.5
195.0	21.4	7.07	7.00	-1.01	5	45	25.35	5	3	16.7
198.2	22.2	7.11	7.05	-1.04	5	44	25.45	5	3	16.6
201.4	22.9	7.15	7.10	-1.06	5	44	25.58	5	3	16.6

204.6 23.6 7.19 7.14 -1.07 5 44 25.68 5 3 16.5 44.1
 1 0 10.81000 11.86000

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Depth (ft) 32.0
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 21.400 Pile Type H Pile
 Pile Size (inch) 14.580

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips) 196.2					
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
3	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	10.12	4.7	21.4
4	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	13.49	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	11.3	0.050	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	16.7	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	19.6	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	21.4	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	22.2	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	29.8	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	34.6	0.126	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	35.9	0.150	0.100	40.48	4.7	21.4
Toe						4.7	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
32.02	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
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196.2	21.9	7.01	7.03	-1.01	5	44	25.23	5	3	16.5	44.5
199.4	22.5	7.12	7.07	-1.04	5	44	25.51	5	3	16.6	44.3
202.6	23.2	7.16	7.11	-1.06	5	44	25.63	5	3	16.6	44.2
205.8	23.8	7.20	7.15	-1.06	5	44	25.75	5	3	16.6	44.1
209.0	24.6	7.25	7.20	-1.06	5	44	25.88	5	3	16.5	43.9
	1	0	10.81	0.00			11.86	0.00			

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Depth (ft) 34.2
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 21.400 Pile Type H Pile
Pile Size (inch) 14.580

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips)				217.6	
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	6.75	4.7	21.4
3	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	10.12	4.7	21.4
4	0.247	15331	0.000	0.000	1.00	6.4	0.050	0.100	13.49	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	15.5	0.050	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	18.8	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	21.3	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	19.9	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	28.5	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	33.0	0.094	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	35.9	0.150	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	33.3	0.098	0.100	40.48	4.7	21.4
Toe						5.0	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
34.25	10.81	1.00	0.800

↑

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Resource International Inc

GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
217.6	25.7	7.30	7.25	-0.95	4	42	25.87	5	3	16.5	43.8
220.8	26.5	7.34	7.29	-0.96	5	42	25.98	5	3	16.5	43.6
224.0	27.1	7.37	7.33	-0.92	4	42	26.08	5	3	16.5	43.5
227.2	27.9	7.41	7.37	-0.90	4	42	26.16	5	3	16.5	43.4
230.4	28.7	7.44	7.41	-0.88	4	42	26.27	5	3	16.4	43.3
1		0	10.81	000	11.86		000				

↑

FRA-70-13.01 : 06/25/2021 : HSK

06/27/2021

Resource International Inc

GRLWEAP Version 2010

Depth	(ft)	36.5
Shaft Gain/Loss Factor	0.604	Toe Gain/Loss Factor
		1.000

PILE PROFILE:

Toe Area	(in ²)	21.400	Pile Type	H Pile
Pile Size	(inch)	14.580		

L b Top ft	Area in ²	E-Mod ksi	Spec Wt lb/ft ³	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips)			240.1		
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 in ²
1	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	6.75	4.7	21.4
3	0.247	15331	0.000	0.000	1.00	2.3	0.050	0.100	10.12	4.7	21.4
4	0.247	15331	0.000	0.000	1.00	14.0	0.050	0.100	13.49	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	17.8	0.050	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	20.4	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	20.4	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	25.4	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	31.0	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	35.8	0.148	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	34.5	0.129	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	33.2	0.050	0.100	40.48	4.7	21.4
Toe						5.2	0.150	0.100			

2.960 kips total unreduced pile weight (g= 32.17 ft/s²)2.960 kips total reduced pile weight (g= 32.17 ft/s²)

Depth	Stroke	Pressure	Efficy
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ft	ft	Ratio	
36.48	10.81	1.00	0.800



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Resource International Inc

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GRLWEAP Version 2010

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	
240.1	29.4	7.48	7.45	-0.88	4	24	26.39	4	2	16.4	43.2
243.3	30.2	7.51	7.48	-0.91	4	24	26.47	4	2	16.4	43.1
246.5	31.0	7.54	7.52	-0.95	4	24	26.57	4	2	16.3	43.0
249.7	31.7	7.57	7.54	-0.97	4	24	26.67	4	2	16.4	43.0
252.9	32.4	7.59	7.57	-0.97	4	24	26.71	4	2	16.3	42.9
1		0	10.81	0.00			11.86	0.00			



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Depth	(ft)	36.5	
Shaft Gain/Loss Factor		0.604	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	21.400	Pile Type	H Pile
Pile Size	(inch)	14.580		

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips)			237.2		
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	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	6.75	4.7	21.4
3	0.247	15331	0.000	0.000	1.00	2.4	0.050	0.100	10.12	4.7	21.4
4	0.247	15331	0.000	0.000	1.00	14.1	0.050	0.100	13.49	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	17.9	0.050	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	20.4	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	20.4	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	25.6	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	31.1	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	35.8	0.148	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	34.4	0.128	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	33.6	0.052	0.100	40.48	4.7	21.4
Toe						1.6	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
36.52	10.81	1.00	0.800

↑

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
237.2	28.6	7.44	7.41	-0.90	12	5	26.32	4	2	16.4	43.3
240.4	29.4	7.48	7.45	-0.92	4	24	26.39	4	2	16.4	43.2
243.6	30.2	7.51	7.49	-0.96	4	24	26.46	4	2	16.4	43.1
246.8	30.9	7.54	7.51	-0.99	4	24	26.58	4	2	16.4	43.0
250.0	31.7	7.57	7.54	-1.01	4	24	26.65	4	2	16.4	43.0
1	0	10.81	000	11.86	000						

↑

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Depth (ft)	38.5
Shaft Gain/Loss Factor	0.604
Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in ²)	21.400	Pile Type	H Pile
Pile Size (inch)	14.580		

L b Top ft	Area in ²	E-Mod ksi	Spec Wt lb/ft ³	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips) 281.7					
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 in ²
1	0.247	15331	0.010	0.000	0.85	0.0	0.200	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	6.75	4.7	21.4
3	0.247	15331	0.000	0.000	1.00	10.0	0.050	0.100	10.12	4.7	21.4
4	0.247	15331	0.000	0.000	1.00	16.4	0.050	0.100	13.49	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	19.4	0.050	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	21.7	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	21.3	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	29.5	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	34.3	0.119	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	35.9	0.150	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	32.6	0.064	0.100	37.11	4.7	21.4

12	0.247	15331	0.000	0.000	1.00	59.1	0.134	0.100	40.48	4.7	21.4
Toe						1.6	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
38.48	10.81	1.00	0.800

↑

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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
281.7	38.4	7.79 7.78	-0.60	3	39	27.09	3	2	15.9	42.4
287.3	39.6	7.82 7.82	-0.49	3	39	27.15	3	2	15.8	42.3
293.0	40.7	7.84 7.84	-0.43	3	35	27.21	3	2	15.7	42.2
298.6	41.8	7.87 7.87	-0.53	3	35	27.29	3	2	15.7	42.1
304.3	43.0	7.90 7.90	-0.60	3	34	27.38	3	2	15.8	42.0
	1	0	10.81000			11.86000				

↑

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Depth	(ft)	40.5
Shaft Gain/Loss Factor	0.604	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	21.400	Pile Type	H Pile
Pile Size	(inch)	14.580		

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	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model						Total Capacity Rut (kips)			327.1		
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	0.247	15331	0.010	0.000	0.85	0.0	0.050	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	4.4	0.050	0.100	6.75	4.7	21.4
3	0.247	15331	0.000	0.000	1.00	14.9	0.050	0.100	10.12	4.7	21.4
4	0.247	15331	0.000	0.000	1.00	18.4	0.050	0.100	13.49	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	20.9	0.050	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	19.9	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	27.4	0.050	0.100	23.61	4.7	21.4

8	0.247	15331	0.000	0.000	1.00	32.1	0.074	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	35.9	0.150	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	33.8	0.114	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	41.3	0.095	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	76.6	0.150	0.100	40.48	4.7	21.4
Toe						1.6	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
40.48	10.81	1.00	0.800

↑

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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
327.1	50.1	7.97 8.05	-0.22	2	33	27.53	3	2	15.7	41.8
335.2	51.9	8.02 8.08	-0.28	3	32	27.67	3	2	15.8	41.6
343.3	54.1	8.07 8.13	-0.27	3	32	27.79	3	2	15.9	41.5
351.5	56.4	8.12 8.18	-0.25	3	32	27.91	3	2	15.9	41.4
359.6	58.7	8.17 8.22	-0.32	3	31	28.03	3	2	16.0	41.3

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06/27/2021
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SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.604 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	
1.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0	
1.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0	
2.2	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0	
3.0	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0	
3.0	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0	
6.8	8.1	4.5	3.6	Hammer did not run					
10.5	26.1	21.1	5.0	1.7	11.256	-1.163	3.97	24.1	
10.5	27.7	21.3	6.4	1.8	11.721	-1.387	4.02	23.9	
11.8	34.7	27.8	6.8	2.2	13.422	-2.235	4.23	23.1	
13.0	42.0	34.8	7.3	2.8	14.827	-2.841	4.42	22.2	
13.0	38.6	35.0	3.6	2.4	13.883	-2.548	4.26	22.6	
15.5	53.8	49.8	4.0	3.5	16.322	-3.293	4.68	21.4	
18.0	70.6	66.1	4.5	4.9	18.210	-3.201	5.03	20.3	
18.0	68.7	66.3	2.4	4.7	17.976	-3.282	4.97	20.5	
19.2	75.4	72.9	2.5	5.2	18.557	-3.233	5.10	20.1	
20.5	82.4	79.8	2.6	5.9	19.015	-3.028	5.19	19.5	

20.5	89.8	80.1	9.8	6.8	19.951	-2.525	5.43	19.4
23.5	115.8	104.8	11.0	9.3	21.397	-2.139	5.80	18.3
26.5	144.8	132.5	12.2	12.8	22.788	-0.788	6.18	17.4
26.5	133.7	133.0	0.8	10.7	22.164	-2.250	6.00	17.9
29.2	162.8	162.0	0.8	15.6	23.876	-0.730	6.53	17.0
32.0	191.8	191.1	0.8	21.0	25.044	-0.972	6.96	16.5
32.0	196.2	191.5	4.7	21.9	25.231	-1.014	7.01	16.5
34.2	217.6	212.6	5.0	25.7	25.868	-0.947	7.30	16.5
36.5	240.1	234.9	5.2	29.4	26.388	-0.879	7.48	16.4
36.5	237.2	235.6	1.6	28.6	26.324	-0.896	7.44	16.4
38.5	281.7	280.1	1.6	38.4	27.093	-0.595	7.79	15.9
40.5	327.1	325.5	1.6	50.1	27.530	-0.222	7.97	15.7

Total Driving Time	10 minutes;	Total No. of Blows	451
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Depth	Rut	G/L at Shaft and Toe: Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	8.1	4.5	3.6	Hammer did not run				
10.5	26.1	21.1	5.0	1.7	11.256	-1.163	3.97	24.1
10.5	27.7	21.3	6.4	1.8	11.721	-1.387	4.02	23.9
11.8	34.7	27.8	6.8	2.2	13.422	-2.235	4.23	23.1
13.0	42.0	34.8	7.3	2.8	14.827	-2.841	4.42	22.2
13.0	38.6	35.0	3.6	2.4	13.883	-2.548	4.26	22.6
15.5	53.8	49.8	4.0	3.5	16.322	-3.293	4.68	21.4
18.0	70.6	66.1	4.5	4.9	18.210	-3.201	5.03	20.3
18.0	68.7	66.3	2.4	4.7	17.976	-3.282	4.97	20.5
19.2	75.4	72.9	2.5	5.2	18.557	-3.233	5.10	20.1
20.5	82.4	79.8	2.6	5.9	19.015	-3.028	5.19	19.5
20.5	89.8	80.1	9.8	6.8	19.951	-2.525	5.43	19.4
23.5	115.8	104.8	11.0	9.3	21.397	-2.139	5.80	18.3
26.5	144.8	132.5	12.2	12.8	22.788	-0.788	6.18	17.4
26.5	133.7	133.0	0.8	10.8	22.198	-2.309	6.01	17.9
29.2	164.4	163.6	0.8	15.9	23.942	-0.944	6.55	16.9
32.0	195.0	194.3	0.8	21.4	25.352	-1.015	7.07	16.7
32.0	199.4	194.7	4.7	22.5	25.514	-1.042	7.12	16.6
34.2	220.8	215.8	5.0	26.5	25.981	-0.958	7.34	16.5
36.5	243.3	238.1	5.2	30.2	26.466	-0.913	7.51	16.4
36.5	240.4	238.8	1.6	29.4	26.388	-0.916	7.48	16.4
38.5	287.3	285.7	1.6	39.6	27.152	-0.489	7.82	15.8
40.5	335.2	333.6	1.6	51.9	27.669	-0.283	8.02	15.8

Total Driving Time	10 minutes;	Total No. of Blows	461
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FRA-70-13.01 : 06/25/2021 : HSK

06/27/2021

SUMMARY OVER DEPTHS

Depth ft	Rut kips	G/L at Shaft and Toe: 0.670 1.000		End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
		Frictn kips	Frictn kips						
1.5	0.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	8.1	4.5	3.6	Hammer did not run					
10.5	26.1	21.1	5.0	1.7	11.256	-1.163	3.97	24.1	
10.5	27.7	21.3	6.4	1.8	11.721	-1.387	4.02	23.9	
11.8	34.7	27.8	6.8	2.2	13.422	-2.235	4.23	23.1	
13.0	42.0	34.8	7.3	2.8	14.827	-2.841	4.42	22.2	
13.0	38.6	35.0	3.6	2.4	13.883	-2.548	4.26	22.6	
15.5	53.8	49.8	4.0	3.5	16.322	-3.293	4.68	21.4	
18.0	70.6	66.1	4.5	4.9	18.210	-3.201	5.03	20.3	
18.0	68.7	66.3	2.4	4.7	17.976	-3.282	4.97	20.5	
19.2	75.4	72.9	2.5	5.2	18.557	-3.233	5.10	20.1	
20.5	82.4	79.8	2.6	5.9	19.015	-3.028	5.19	19.5	
20.5	89.8	80.1	9.8	6.8	19.951	-2.525	5.43	19.4	
23.5	115.8	104.8	11.0	9.3	21.397	-2.139	5.80	18.3	
26.5	144.8	132.5	12.2	12.8	22.788	-0.788	6.18	17.4	
26.5	133.7	133.0	0.8	10.7	22.174	-2.260	6.00	17.9	
29.2	166.0	165.2	0.8	16.1	24.044	-0.941	6.58	16.9	
32.0	198.2	197.4	0.8	22.2	25.446	-1.042	7.11	16.6	
32.0	202.6	197.9	4.7	23.2	25.628	-1.057	7.16	16.6	
34.2	224.0	219.0	5.0	27.1	26.083	-0.922	7.37	16.5	
36.5	246.5	241.3	5.2	31.0	26.571	-0.948	7.54	16.3	
36.5	243.6	242.0	1.6	30.2	26.463	-0.956	7.51	16.4	
38.5	293.0	291.4	1.6	40.7	27.214	-0.426	7.84	15.7	
40.5	343.3	341.7	1.6	54.1	27.790	-0.266	8.07	15.9	

Total Driving Time

11 minutes;

Total No. of Blows

471

Depth ft	Rut kips	G/L at Shaft and Toe: 0.703 1.000		End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
		Frictn kips	Frictn kips						
1.5	0.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	8.1	4.5	3.6	Hammer did not run					
10.5	26.1	21.1	5.0	1.7	11.256	-1.163	3.97	24.1	
10.5	27.7	21.3	6.4	1.8	11.721	-1.387	4.02	23.9	
11.8	34.7	27.8	6.8	2.2	13.422	-2.235	4.23	23.1	

13.0	42.0	34.8	7.3	2.8	14.827	-2.841	4.42	22.2
13.0	38.6	35.0	3.6	2.4	13.883	-2.548	4.26	22.6
15.5	53.8	49.8	4.0	3.5	16.322	-3.293	4.68	21.4
18.0	70.6	66.1	4.5	4.9	18.210	-3.201	5.03	20.3
18.0	68.7	66.3	2.4	4.7	17.976	-3.282	4.97	20.5
19.2	75.4	72.9	2.5	5.2	18.557	-3.233	5.10	20.1
20.5	82.4	79.8	2.6	5.9	19.015	-3.028	5.19	19.5
20.5	89.8	80.1	9.8	6.8	19.951	-2.525	5.43	19.4
23.5	115.8	104.8	11.0	9.3	21.397	-2.139	5.80	18.3
26.5	144.8	132.5	12.2	12.8	22.788	-0.788	6.18	17.4
26.5	133.7	133.0	0.8	10.7	22.166	-2.253	6.00	17.9
29.2	167.6	166.8	0.8	16.3	24.111	-0.841	6.60	16.9
32.0	201.4	200.6	0.8	22.9	25.579	-1.059	7.15	16.6
32.0	205.8	201.1	4.7	23.8	25.753	-1.063	7.20	16.6
34.2	227.2	222.2	5.0	27.9	26.159	-0.902	7.41	16.5
36.5	249.7	244.4	5.2	31.7	26.670	-0.969	7.57	16.4
36.5	246.8	245.2	1.6	30.9	26.584	-0.987	7.54	16.4
38.5	298.6	297.0	1.6	41.8	27.295	-0.526	7.87	15.7
40.5	351.5	349.9	1.6	56.4	27.909	-0.254	8.12	15.9

Total Driving Time 11 minutes;

Total No. of Blows 480

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FRA-70-13.01 : 06/25/2021 : HSK
Resource International Inc

06/27/2021
GRLWEAP Version 2010

SUMMARY OVER DEPTHS

Depth	Rut	G/L at Shaft and Toe: 0.736 1.000	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips		kips	kips	bl/ft	ksi	ksi	ft	kip-ft
1.5	0.0		0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0		0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0		0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0		0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0		0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	8.1		4.5	3.6	Hammer	did not	run		
10.5	26.1		21.1	5.0	1.7	11.256	-1.163	3.97	24.1
10.5	27.7		21.3	6.4	1.8	11.721	-1.387	4.02	23.9
11.8	34.7		27.8	6.8	2.2	13.422	-2.235	4.23	23.1
13.0	42.0		34.8	7.3	2.8	14.827	-2.841	4.42	22.2
13.0	38.6		35.0	3.6	2.4	13.883	-2.548	4.26	22.6
15.5	53.8		49.8	4.0	3.5	16.322	-3.293	4.68	21.4
18.0	70.6		66.1	4.5	4.9	18.210	-3.201	5.03	20.3
18.0	68.7		66.3	2.4	4.7	17.976	-3.282	4.97	20.5
19.2	75.4		72.9	2.5	5.2	18.557	-3.233	5.10	20.1
20.5	82.4		79.8	2.6	5.9	19.015	-3.028	5.19	19.5
20.5	89.8		80.1	9.8	6.8	19.951	-2.525	5.43	19.4
23.5	115.8		104.8	11.0	9.3	21.397	-2.139	5.80	18.3
26.5	144.8		132.5	12.2	12.8	22.788	-0.788	6.18	17.4
26.5	133.8		133.0	0.8	10.8	22.190	-2.266	6.00	17.9

29.2	169.2	168.4	0.8	16.6	24.139	-0.728	6.62	16.8
32.0	204.6	203.8	0.8	23.6	25.683	-1.067	7.19	16.5
32.0	209.0	204.3	4.7	24.6	25.879	-1.062	7.25	16.5
34.2	230.4	225.4	5.0	28.7	26.270	-0.882	7.44	16.4
36.5	252.9	247.6	5.2	32.4	26.710	-0.969	7.59	16.3
36.5	250.0	248.4	1.6	31.7	26.653	-1.010	7.57	16.4
38.5	304.3	302.7	1.6	43.0	27.377	-0.604	7.90	15.8
40.5	359.6	358.0	1.6	58.7	28.030	-0.320	8.17	16.0

Total Driving Time 11 minutes;

Total No. of Blows 491



FRA-70-13.01 : 06/25/2021 : HSK

06/27/2021

Resource International Inc

GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

Depth	Temp. Length	Wait Time	Equivalent Stroke	Pressure Ratio	Efficy.	Stiffn. Factor	Cushion CoR
ft	ft	hr	ft				
1.48	40.48	0.00	10.81	1.00	0.80	1.00	1.00
1.52	40.48	0.00	10.81	1.00	0.80	1.00	1.00
2.25	40.48	0.00	10.81	1.00	0.80	1.00	1.00
2.98	40.48	0.00	10.81	1.00	0.80	1.00	1.00
3.02	40.48	0.00	10.81	1.00	0.80	1.00	1.00
6.75	40.48	0.00	10.81	1.00	0.80	1.00	1.00
10.48	40.48	0.00	10.81	1.00	0.80	1.00	1.00
10.52	40.48	0.00	10.81	1.00	0.80	1.00	1.00
11.75	40.48	0.00	10.81	1.00	0.80	1.00	1.00
12.98	40.48	0.00	10.81	1.00	0.80	1.00	1.00
13.02	40.48	0.00	10.81	1.00	0.80	1.00	1.00
15.50	40.48	0.00	10.81	1.00	0.80	1.00	1.00
17.98	40.48	0.00	10.81	1.00	0.80	1.00	1.00
18.02	40.48	0.00	10.81	1.00	0.80	1.00	1.00
19.25	40.48	0.00	10.81	1.00	0.80	1.00	1.00
20.48	40.48	0.00	10.81	1.00	0.80	1.00	1.00
20.52	40.48	0.00	10.81	1.00	0.80	1.00	1.00
23.50	40.48	0.00	10.81	1.00	0.80	1.00	1.00
26.48	40.48	0.00	10.81	1.00	0.80	1.00	1.00
26.52	40.48	0.00	10.81	1.00	0.80	1.00	1.00
29.25	40.48	0.00	10.81	1.00	0.80	1.00	1.00
31.98	40.48	0.00	10.81	1.00	0.80	1.00	1.00
32.02	40.48	0.00	10.81	1.00	0.80	1.00	1.00
34.25	40.48	0.00	10.81	1.00	0.80	1.00	1.00
36.48	40.48	0.00	10.81	1.00	0.80	1.00	1.00
36.52	40.48	0.00	10.81	1.00	0.80	1.00	1.00
38.48	40.48	0.00	10.81	1.00	0.80	1.00	1.00
40.48	40.48	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values									
Depth	Shaft	End	Shaft	Toe	Shaft	Toe	Soil	Limit	Setup
ft	Res.	Bearing	Quake	Quake	Damping	Damping	Setup	Distance	Time
	k/ft2	kips	inch	inch	s/ft	s/ft	Normlzd	ft	hrs
0.01	0.00	0.00	0.100	0.100	0.200	0.150	1.000	6.000	336.000
1.49	0.00	0.00	0.100	0.100	0.200	0.150	1.000	6.000	336.000
1.51	0.00	0.00	0.100	0.100	0.200	0.150	1.000	6.000	336.000
2.99	0.00	0.00	0.100	0.100	0.200	0.150	1.000	6.000	336.000
3.01	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
5.39	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
5.40	0.62	2.90	0.100	0.100	0.050	0.150	0.000	6.000	24.000
7.99	0.92	4.30	0.100	0.100	0.050	0.150	0.000	6.000	24.000
8.01	0.93	4.31	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.49	1.08	5.01	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.51	1.09	6.39	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.99	1.24	7.28	0.100	0.100	0.050	0.150	0.000	6.000	24.000
13.01	1.20	3.63	0.100	0.100	0.050	0.150	0.000	6.000	24.000
17.99	1.47	4.46	0.100	0.100	0.050	0.150	0.000	6.000	24.000
18.01	1.11	2.40	0.100	0.100	0.050	0.150	0.000	6.000	24.000
20.49	1.21	2.62	0.100	0.100	0.050	0.150	0.000	6.000	24.000
20.51	1.66	9.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
26.49	2.08	12.25	0.100	0.100	0.050	0.150	0.000	6.000	24.000
26.51	3.75	0.75	0.100	0.100	0.150	0.150	1.000	6.000	336.000
31.99	3.75	0.75	0.100	0.100	0.150	0.150	1.000	6.000	336.000
32.01	1.96	4.71	0.100	0.100	0.050	0.150	0.000	6.000	24.000
36.49	2.18	5.25	0.100	0.100	0.050	0.150	0.000	6.000	24.000
36.51	8.00	1.59	0.100	0.100	0.150	0.150	1.000	6.000	336.000
40.48	8.00	1.59	0.100	0.100	0.150	0.150	1.000	6.000	336.000

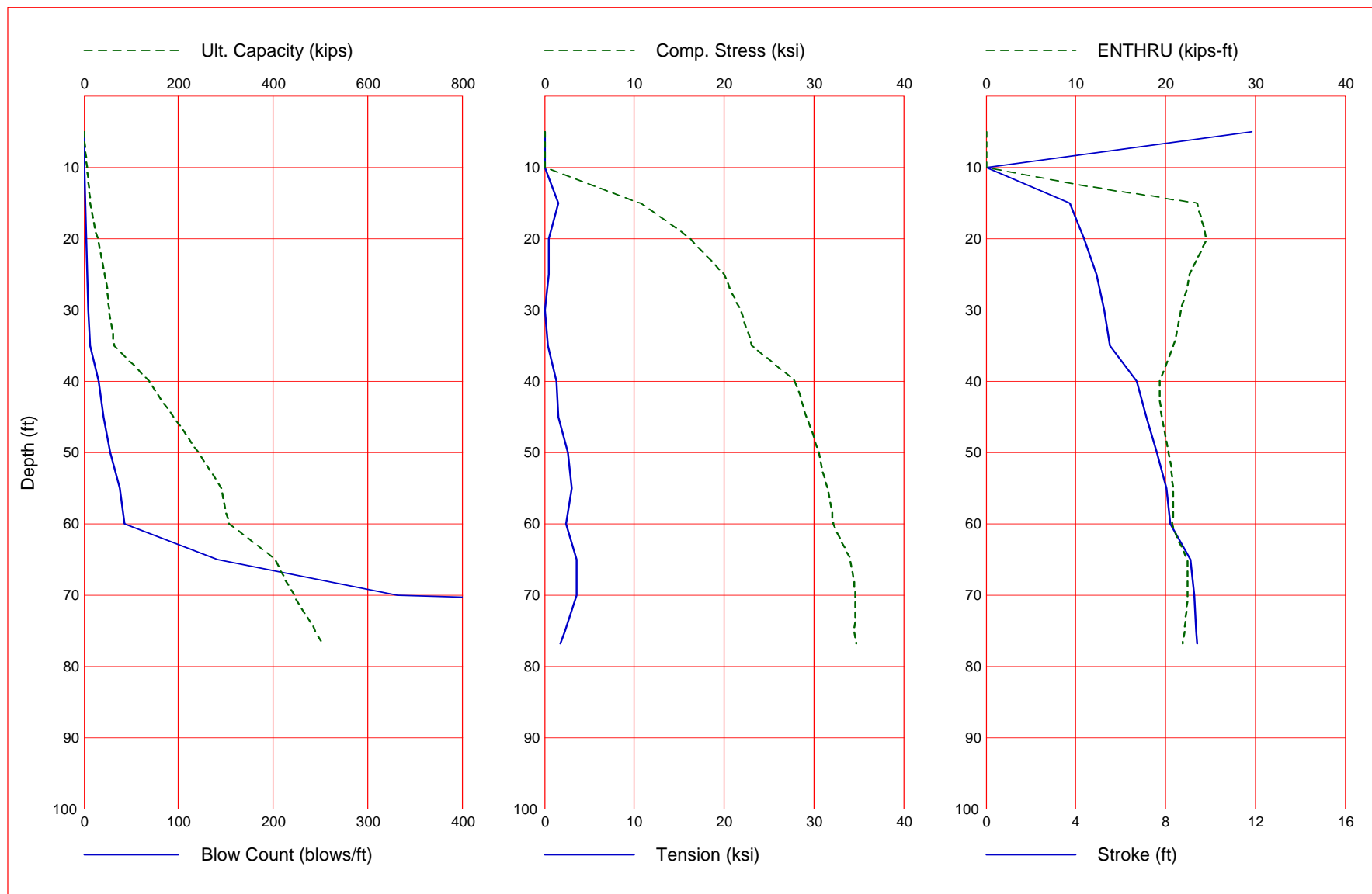
Gain/Loss 4 at Shaft and Toe 0.703 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	8.1	4.5	3.6	-1.0	0.000	0.000	0.00	0.0
10.5	26.1	21.1	5.0	1.7	11.256	-1.163	3.97	24.1
10.5	27.7	21.3	6.4	1.8	11.721	-1.387	4.02	23.9
11.8	34.7	27.8	6.8	2.2	13.422	-2.235	4.23	23.1
13.0	42.0	34.8	7.3	2.8	14.827	-2.841	4.42	22.2
13.0	38.6	35.0	3.6	2.4	13.883	-2.548	4.26	22.6
15.5	53.8	49.8	4.0	3.5	16.322	-3.293	4.68	21.4
18.0	70.6	66.1	4.5	4.9	18.210	-3.201	5.03	20.3
18.0	68.7	66.3	2.4	4.7	17.976	-3.282	4.97	20.5
19.2	75.4	72.9	2.5	5.2	18.557	-3.233	5.10	20.1
20.5	82.4	79.8	2.6	5.9	19.015	-3.028	5.19	19.5
20.5	89.8	80.1	9.8	6.8	19.951	-2.525	5.43	19.4
23.5	115.8	104.8	11.0	9.3	21.397	-2.139	5.80	18.3
26.5	144.8	132.5	12.2	12.8	22.788	-0.788	6.18	17.4
26.5	133.7	133.0	0.8	10.7	22.166	-2.253	6.00	17.9
29.2	167.6	166.8	0.8	16.3	24.111	-0.841	6.60	16.9
32.0	201.4	200.6	0.8	22.9	25.579	-1.059	7.15	16.6
32.0	205.8	201.1	4.7	23.8	25.753	-1.063	7.20	16.6
34.2	227.2	222.2	5.0	27.9	26.159	-0.902	7.41	16.5
36.5	249.7	244.4	5.2	31.7	26.670	-0.969	7.57	16.4
36.5	246.8	245.2	1.6	30.9	26.584	-0.987	7.54	16.4
38.5	298.6	297.0	1.6	41.8	27.295	-0.526	7.87	15.7
40.5	351.5	349.9	1.6	56.4	27.909	-0.254	8.12	15.9

Total Continuous Driving Time 11.00 minutes; Total Number of Blows 480

**Forward Abutment
(B-014-7-20)**

Gain/Loss 3 at Shaft and Toe 0.500 / 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
5.0	1.9	1.2	0.6	0.0	0.000	0.000	11.86	0.0
10.0	6.1	5.0	1.1	-1.0	0.000	0.000	0.00	0.0
15.0	14.1	12.0	2.1	1.3	10.769	-1.579	3.73	23.5
20.0	28.8	24.0	4.8	2.1	16.272	-0.485	4.36	24.6
25.0	43.6	39.7	3.8	3.7	19.957	-0.476	4.94	22.7
30.0	53.4	49.6	3.8	5.0	21.790	-0.067	5.25	21.7
35.0	63.3	59.5	3.8	6.4	23.142	-0.423	5.53	20.9
40.0	138.3	87.7	50.6	15.8	27.919	-1.310	6.74	19.4
45.0	189.1	146.0	43.1	21.0	29.133	-1.496	7.16	19.6
50.0	242.8	207.1	35.7	28.2	30.604	-2.609	7.61	20.3
55.0	291.0	272.0	18.9	37.7	31.530	-3.083	8.03	20.9
60.0	305.9	303.7	2.2	43.5	32.115	-2.441	8.20	20.7
65.0	403.7	368.1	35.7	141.4	34.080	-3.593	9.09	22.5
70.0	444.4	441.4	3.1	331.4	34.642	-3.591	9.28	22.5
75.0	488.4	485.4	3.1	1631.3	34.537	-2.337	9.38	22.1
76.8	504.2	501.1	3.1	5666.3	34.742	-1.793	9.40	21.9

Total Continuous Driving Time 355.00 minutes; Total Number of Blows 13797 (starting at penetration 5.0 ft)

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.
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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: J:\GEOTECH\PROJECTS\2020\W-20-025 FRA-70-13.01\ANALYSIS\DRIVEABILITY\FORWARD ABUTMENT\FRA-70-13.01 FORWARD ABUTMENT
HP 10X42 (B-014-7-20).GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-13.01 - FA - B-014-7-20 - HP10x42

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	12.300	10.000	Unknown															
W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp													
1.900	227.000	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												
76.790	12.40	29000.0	492.000	3.300	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	0.10	0.05	0.15	1.00	6.00	24.000
3.00	0.09	0.38	0.10	0.10	0.05	0.15	1.00	6.00	24.000
6.00	0.18	0.75	0.10	0.10	0.05	0.15	1.00	6.00	24.000
9.00	0.27	1.13	0.10	0.10	0.05	0.15	1.00	6.00	24.000
12.00	0.36	1.14	0.10	0.10	0.05	0.15	1.00	6.00	24.000
13.89	0.42	1.14	0.10	0.10	0.05	0.15	1.00	6.00	24.000
13.91	0.99	2.11	0.10	0.10	0.15	0.15	1.50	6.00	336.000
18.99	0.99	2.11	0.10	0.10	0.15	0.15	1.50	6.00	336.000
19.01	1.49	4.80	0.10	0.10	0.15	0.15	1.50	6.00	336.000
24.49	1.49	4.80	0.10	0.10	0.15	0.15	1.50	6.00	336.000
24.51	1.19	3.84	0.10	0.10	0.20	0.15	2.00	6.00	720.000
33.50	1.20	3.84	0.10	0.10	0.20	0.15	2.00	6.00	720.000
36.50	1.23	3.84	0.10	0.10	0.20	0.15	2.00	6.00	720.000
37.99	1.25	3.84	0.10	0.10	0.20	0.15	2.00	6.00	720.000
38.01	3.31	50.61	0.10	0.10	0.05	0.15	1.00	6.00	24.000
41.00	3.46	50.61	0.10	0.10	0.05	0.15	1.00	6.00	24.000
44.00	3.61	50.61	0.10	0.10	0.05	0.15	1.00	6.00	24.000
44.99	3.66	50.61	0.10	0.10	0.05	0.15	1.00	6.00	24.000
45.01	3.59	35.67	0.10	0.10	0.05	0.15	1.00	6.00	24.000
48.00	3.73	35.67	0.10	0.10	0.05	0.15	1.00	6.00	24.000
51.00	3.87	35.67	0.10	0.10	0.05	0.15	1.00	6.00	24.000
54.00	4.00	35.67	0.10	0.10	0.05	0.15	1.00	6.00	24.000
54.99	4.05	35.67	0.10	0.10	0.05	0.15	1.00	6.00	24.000
55.01	2.88	2.21	0.10	0.10	0.15	0.15	1.50	6.00	336.000
60.99	2.88	2.21	0.10	0.10	0.15	0.15	1.50	6.00	336.000
61.01	4.31	35.67	0.10	0.10	0.05	0.15	1.00	6.00	24.000
64.00	4.45	35.67	0.10	0.10	0.05	0.15	1.00	6.00	24.000
67.00	4.58	35.67	0.10	0.10	0.05	0.15	1.00	6.00	24.000
69.59	4.70	35.67	0.10	0.10	0.05	0.15	1.00	6.00	24.000
69.61	4.00	3.08	0.10	0.10	0.15	0.15	1.50	6.00	336.000
76.79	4.00	3.08	0.10	0.10	0.15	0.15	1.50	6.00	336.000

Gain/Loss factors: shaft and toe

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
5.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
10.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
15.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
20.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
25.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
30.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
35.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
40.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
45.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
50.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
55.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
60.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
65.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
70.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
75.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
76.79	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

FRA-70-13.01 - FA - B-014-7-20 - HP10x42

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	1.900	60155.0	0.800	0.0100	5.8
Combined Pile Top		8975.6			

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)	227.00	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)	60155.0	Stiffness	(kips/in)	0.0



FRA-70-13.01 - FA - B-014-7-20 - HP10x42 10/24/2021
Resource International Inc GRLWEAP Version 2010

Depth	(ft)	5.0	Standard Soil Setup	
Shaft Gain/Loss Factor		0.400	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	12.300	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
76.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips)				1.9	
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	0.141	8976	0.010	0.000	0.85	0.0	0.000	0.100	3.34	3.3	12.4
2	0.141	8976	0.000	0.000	1.00	0.0	0.000	0.100	6.68	3.3	12.4
22	0.141	8976	0.000	0.000	1.00	0.1	0.050	0.100	73.45	3.3	12.4
23	0.141	8976	0.000	0.000	1.00	1.1	0.050	0.100	76.79	3.3	12.4
Toe						0.6	0.150	0.100			

3.253 kips total unreduced pile weight (g= 32.17 ft/s2)
3.253 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)	0.435
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	Stroke	Pressure	Efficy
ft	ft	Ratio	
5.00	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.9 1.9
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.9 1.9
 Hammer+Pile Weight > Rult: Pile Runs

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INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.9 1.9
 Hammer+Pile Weight > Rult: Pile Runs

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 FRA-70-13.01 - FA - B-014-7-20 - HP10x42 10/24/2021
 Resource International Inc GRLWEAP Version 2010

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	
1.9	0.0	10.81	0.00	0.00	1 0	0.00	1 0	0.0 78.4
1.9	0.0	11.86	0.00	0.00	1 0	0.00	1 0	0.0 74.4
1.9	0.0	11.86	0.00	0.00	1 0	0.00	1 0	0.0 74.4
1.9	0.0	11.86	0.00	0.00	1 0	0.00	1 0	0.0 74.4
1.9	0.0	11.86	0.00	0.00	1 0	0.00	1 0	0.0 74.4

^
 FRA-70-13.01 - FA - B-014-7-20 - HP10x42 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth	(ft)	10.0	Standard Soil Setup
Shaft Gain/Loss Factor	0.400	Toe Gain/Loss Factor	1.000

PILE PROFILE:
 Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
76.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 9.294

No.	Weight	Pile and Soil Model	Total Capacity	Rut	(kips)	6.1
	kips	Stiffn C-Slk T-Slk CoR	Soil-S	Soil-D	Quake	LbTop Perim Area
		k/in ft ft	kips	s/ft	inch	ft ft in2
1	0.141	8976 0.010 0.000 0.85	0.0	0.000	0.100	3.34 3.3 12.4
2	0.141	8976 0.000 0.000 1.00	0.0	0.000	0.100	6.68 3.3 12.4
21	0.141	8976 0.000 0.000 1.00	0.6	0.050	0.100	70.11 3.3 12.4
22	0.141	8976 0.000 0.000 1.00	1.7	0.050	0.100	73.45 3.3 12.4
23	0.141	8976 0.000 0.000 1.00	2.8	0.050	0.100	76.79 3.3 12.4
Toe			1.1	0.150	0.100	

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
10.00	10.81	1.00	0.800

^
 FRA-70-13.01 - FA - B-014-7-20 - HP10x42 10/24/2021
 Resource International Inc GRLWEAP Version 2010

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	

6.1 Hammer did not run
 6.1 Hammer did not run
 6.1 Hammer did not run
 6.1 Hammer did not run
 6.1 Hammer did not run

↑
 FRA-70-13.01 - FA - B-014-7-20 - HP10x42 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 15.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
76.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips) 13.9					
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	0.141	8976	0.010	0.000	0.85	0.0	0.000	0.100	3.34	3.3	12.4
2	0.141	8976	0.000	0.000	1.00	0.0	0.000	0.100	6.68	3.3	12.4
19	0.141	8976	0.000	0.000	1.00	0.1	0.050	0.100	63.44	3.3	12.4
20	0.141	8976	0.000	0.000	1.00	1.1	0.050	0.100	66.77	3.3	12.4
21	0.141	8976	0.000	0.000	1.00	2.2	0.050	0.100	70.11	3.3	12.4
22	0.141	8976	0.000	0.000	1.00	3.3	0.050	0.100	73.45	3.3	12.4
23	0.141	8976	0.000	0.000	1.00	5.0	0.106	0.100	76.79	3.3	12.4
Toe						2.1	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
15.00	10.81	1.00	0.800

↑
 FRA-70-13.01 - FA - B-014-7-20 - HP10x42 10/24/2021
 Resource International Inc GRLWEAP Version 2010

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	
13.9	1.3	3.72	3.73	-1.55	10 14	10.72	1 7	23.5
14.0	1.3	3.72	3.74	-1.55	10 14	10.71	1 7	23.5
14.1	1.3	3.73	3.74	-1.58	10 14	10.77	1 7	23.5
14.3	1.3	3.73	3.75	-1.58	10 14	10.76	1 7	23.5
14.4	1.3	3.74	3.75	-1.62	10 14	10.83	1 7	23.6

↑
 FRA-70-13.01 - FA - B-014-7-20 - HP10x42 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 20.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
76.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips) 27.4					
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	0.141	8976	0.010	0.000	0.85	0.0	0.000	0.100	3.34	3.3	12.4
2	0.141	8976	0.000	0.000	1.00	0.0	0.000	0.100	6.68	3.3	12.4
18	0.141	8976	0.000	0.000	1.00	0.5	0.050	0.100	60.10	3.3	12.4

19	0.141	8976	0.000	0.000	1.00	1.7	0.050	0.100	63.44	3.3	12.4
20	0.141	8976	0.000	0.000	1.00	2.8	0.050	0.100	66.77	3.3	12.4
21	0.141	8976	0.000	0.000	1.00	3.9	0.050	0.100	70.11	3.3	12.4
22	0.141	8976	0.000	0.000	1.00	6.2	0.142	0.100	73.45	3.3	12.4
23	0.141	8976	0.000	0.000	1.00	7.5	0.150	0.100	76.79	3.3	12.4
Toe						4.8	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficacy
20.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
27.4	2.0	4.31	4.34	-0.51	4	14	15.82	1	2	24.8
28.1	2.1	4.34	4.37	-0.50	3	14	16.02	1	2	24.7
28.8	2.1	4.36	4.40	-0.49	3	14	16.27	1	2	24.6
29.6	2.2	4.43	4.41	-0.46	3	14	16.67	1	2	24.6
30.3	2.3	4.46	4.44	-0.44	3	14	16.87	2	2	24.5

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Depth	(ft)	25.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.400	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	12.300	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
76.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips)						40.5
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	0.141	8976	0.010	0.000	0.85	0.0	0.000	0.100	3.34	3.3	12.4	
2	0.141	8976	0.000	0.000	1.00	0.0	0.000	0.100	6.68	3.3	12.4	
16	0.141	8976	0.000	0.000	1.00	0.1	0.050	0.100	53.42	3.3	12.4	
17	0.141	8976	0.000	0.000	1.00	1.1	0.050	0.100	56.76	3.3	12.4	
18	0.141	8976	0.000	0.000	1.00	2.2	0.050	0.100	60.10	3.3	12.4	
19	0.141	8976	0.000	0.000	1.00	3.3	0.050	0.100	63.44	3.3	12.4	
20	0.141	8976	0.000	0.000	1.00	5.0	0.105	0.100	66.77	3.3	12.4	
21	0.141	8976	0.000	0.000	1.00	6.6	0.150	0.100	70.11	3.3	12.4	
22	0.141	8976	0.000	0.000	1.00	9.2	0.150	0.100	73.45	3.3	12.4	
23	0.141	8976	0.000	0.000	1.00	9.1	0.156	0.100	76.79	3.3	12.4	
Toe						3.8	0.150	0.100				

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficacy
25.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
40.5	3.4	4.84	4.81	-0.47	3	14	19.36	12	4	23.1
42.0	3.5	4.89	4.85	-0.48	3	14	19.66	13	4	22.9
43.6	3.7	4.94	4.90	-0.48	3	14	19.96	14	5	22.7
45.1	3.9	4.99	4.95	-0.46	3	13	20.24	15	5	22.6
46.7	4.1	5.03	4.99	-0.41	3	13	20.53	16	5	22.4

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Depth (ft) 30.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.300 Pile Type Unknown
Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
76.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model										Total Capacity Rut (kips)	48.3
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	0.141	8976	0.010	0.000	0.85	0.0	0.000	0.100	3.34	3.3	12.4
2	0.141	8976	0.000	0.000	1.00	0.0	0.000	0.100	6.68	3.3	12.4
15	0.141	8976	0.000	0.000	1.00	0.5	0.050	0.100	50.08	3.3	12.4
16	0.141	8976	0.000	0.000	1.00	1.7	0.050	0.100	53.42	3.3	12.4
17	0.141	8976	0.000	0.000	1.00	2.8	0.050	0.100	56.76	3.3	12.4
18	0.141	8976	0.000	0.000	1.00	3.9	0.050	0.100	60.10	3.3	12.4
19	0.141	8976	0.000	0.000	1.00	6.2	0.142	0.100	63.44	3.3	12.4
20	0.141	8976	0.000	0.000	1.00	7.5	0.150	0.100	66.77	3.3	12.4
21	0.141	8976	0.000	0.000	1.00	9.8	0.150	0.100	70.11	3.3	12.4
22	0.141	8976	0.000	0.000	1.00	6.9	0.180	0.100	73.45	3.3	12.4
23	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	76.79	3.3	12.4
Toe						3.8	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficcy
ft	ft	Ratio	
30.00	10.81	1.00	0.800

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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	
48.3	4.4	5.11	5.08	-0.44	3 13	21.06	15 5	22.2
50.9	4.7	5.18	5.15	-0.23	4 13	21.45	16 5	21.9
53.4	5.0	5.25	5.21	-0.07	4 13	21.79	16 5	21.7
56.0	5.3	5.31	5.28	0.00	1 0	22.12	16 5	21.5
58.5	5.6	5.37	5.35	0.00	1 0	22.44	17 5	21.3

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Depth (ft) 35.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.300 Pile Type Unknown
Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
76.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model										Total Capacity Rut (kips)	56.3
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	0.141	8976	0.010	0.000	0.85	0.0	0.000	0.100	3.34	3.3	12.4
2	0.141	8976	0.000	0.000	1.00	0.0	0.000	0.100	6.68	3.3	12.4
13	0.141	8976	0.000	0.000	1.00	0.1	0.050	0.100	43.40	3.3	12.4
14	0.141	8976	0.000	0.000	1.00	1.1	0.050	0.100	46.74	3.3	12.4
15	0.141	8976	0.000	0.000	1.00	2.2	0.050	0.100	50.08	3.3	12.4

16	0.141	8976	0.000	0.000	1.00	3.3	0.050	0.100	53.42	3.3	12.4
17	0.141	8976	0.000	0.000	1.00	5.0	0.105	0.100	56.76	3.3	12.4
18	0.141	8976	0.000	0.000	1.00	6.6	0.150	0.100	60.10	3.3	12.4
19	0.141	8976	0.000	0.000	1.00	9.2	0.150	0.100	63.44	3.3	12.4
20	0.141	8976	0.000	0.000	1.00	9.2	0.156	0.100	66.77	3.3	12.4
21	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	70.11	3.3	12.4
22	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	73.45	3.3	12.4
23	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	76.79	3.3	12.4
Toe						3.8	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
35.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
56.3	5.4	5.35	5.33	-0.20	21	16	22.26	15	5	21.4
59.8	5.9	5.44	5.42	-0.30	21	16	22.69	17	5	21.2
63.3	6.4	5.53	5.51	-0.42	21	16	23.14	17	5	20.9
66.8	6.9	5.61	5.60	-0.40	21	16	23.55	17	5	20.7
70.4	7.4	5.64	5.69	-0.78	16	49	23.76	17	5	20.4

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Depth	(ft)	40.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.400	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	12.300	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
76.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips)					130.0
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	0.141	8976	0.010	0.000	0.85	0.0	0.000	0.100	3.34	3.3	12.4
2	0.141	8976	0.000	0.000	1.00	0.0	0.000	0.100	6.68	3.3	12.4
12	0.141	8976	0.000	0.000	1.00	0.5	0.050	0.100	40.06	3.3	12.4
13	0.141	8976	0.000	0.000	1.00	1.6	0.050	0.100	43.40	3.3	12.4
14	0.141	8976	0.000	0.000	1.00	2.8	0.050	0.100	46.74	3.3	12.4
15	0.141	8976	0.000	0.000	1.00	3.9	0.050	0.100	50.08	3.3	12.4
16	0.141	8976	0.000	0.000	1.00	6.2	0.141	0.100	53.42	3.3	12.4
17	0.141	8976	0.000	0.000	1.00	7.5	0.150	0.100	56.76	3.3	12.4
18	0.141	8976	0.000	0.000	1.00	9.8	0.150	0.100	60.10	3.3	12.4
19	0.141	8976	0.000	0.000	1.00	6.9	0.180	0.100	63.44	3.3	12.4
20	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	66.77	3.3	12.4
21	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	70.11	3.3	12.4
22	0.141	8976	0.000	0.000	1.00	5.4	0.200	0.100	73.45	3.3	12.4
23	0.141	8976	0.000	0.000	1.00	24.3	0.080	0.100	76.79	3.3	12.4
Toe						50.6	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
40.00	10.81	1.00	0.800

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Rut	Bl Ct	Stroke (ft)	Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt
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kips	b/ft	down	up	ksi			ksi			kip-ft	b/min
130.0	14.6	6.64	6.58	-1.33	13	37	27.43	16	5	19.5	45.8
134.2	15.2	6.69	6.64	-1.29	13	37	27.69	16	5	19.4	45.6
138.3	15.8	6.74	6.69	-1.31	14	35	27.92	16	5	19.4	45.5
142.5	16.4	6.79	6.74	-1.38	14	35	28.19	16	5	19.3	45.3
146.6	17.0	6.83	6.79	-1.41	13	35	28.38	16	5	19.3	45.2

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Depth (ft) 45.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
76.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model										Total Capacity Rut (kips)	180.9
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	0.141	8976	0.010	0.000	0.85	0.0	0.000	0.100	3.34	3.3	12.4
2	0.141	8976	0.000	0.000	1.00	0.0	0.000	0.100	6.68	3.3	12.4
10	0.141	8976	0.000	0.000	1.00	0.1	0.050	0.100	33.39	3.3	12.4
11	0.141	8976	0.000	0.000	1.00	1.1	0.050	0.100	36.73	3.3	12.4
12	0.141	8976	0.000	0.000	1.00	2.2	0.050	0.100	40.06	3.3	12.4
13	0.141	8976	0.000	0.000	1.00	3.3	0.050	0.100	43.40	3.3	12.4
14	0.141	8976	0.000	0.000	1.00	5.0	0.104	0.100	46.74	3.3	12.4
15	0.141	8976	0.000	0.000	1.00	6.6	0.150	0.100	50.08	3.3	12.4
16	0.141	8976	0.000	0.000	1.00	9.1	0.150	0.100	53.42	3.3	12.4
17	0.141	8976	0.000	0.000	1.00	9.2	0.156	0.100	56.76	3.3	12.4
18	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	60.10	3.3	12.4
19	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	63.44	3.3	12.4
20	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	66.77	3.3	12.4
21	0.141	8976	0.000	0.000	1.00	8.4	0.167	0.100	70.11	3.3	12.4
22	0.141	8976	0.000	0.000	1.00	37.5	0.050	0.100	73.45	3.3	12.4
23	0.141	8976	0.000	0.000	1.00	39.4	0.050	0.100	76.79	3.3	12.4
Toe						43.1	0.150	0.100			

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

Depth (ft) 45.00
 Stroke (ft) 10.81
 Pressure Ratio 1.00
 Efficacy 0.800

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Rut kips	Bl Ct b/ft	Stroke down	(ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
180.9	19.6	7.05	7.01	-1.53	11	34	28.68	14	5	19.6	44.4
185.0	20.3	7.10	7.07	-1.37	11	34	28.89	14	5	19.6	44.3
189.1	21.0	7.16	7.13	-1.50	10	29	29.13	14	5	19.6	44.1
193.3	21.7	7.21	7.18	-1.66	11	29	29.33	14	5	19.6	43.9
197.4	22.3	7.26	7.23	-1.84	11	28	29.55	14	5	19.8	43.8

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Depth (ft) 50.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8

76.8 12.40 29000. 492.0 3.3 0 16524. 21.8

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips)			234.5		
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	0.141	8976	0.010	0.000	0.85	0.0	0.000	0.100	3.34	3.3	12.4
2	0.141	8976	0.000	0.000	1.00	0.0	0.000	0.100	6.68	3.3	12.4
9	0.141	8976	0.000	0.000	1.00	0.5	0.050	0.100	30.05	3.3	12.4
10	0.141	8976	0.000	0.000	1.00	1.6	0.050	0.100	33.39	3.3	12.4
11	0.141	8976	0.000	0.000	1.00	2.8	0.050	0.100	36.73	3.3	12.4
12	0.141	8976	0.000	0.000	1.00	3.9	0.050	0.100	40.06	3.3	12.4
13	0.141	8976	0.000	0.000	1.00	6.2	0.141	0.100	43.40	3.3	12.4
14	0.141	8976	0.000	0.000	1.00	7.5	0.150	0.100	46.74	3.3	12.4
15	0.141	8976	0.000	0.000	1.00	9.8	0.150	0.100	50.08	3.3	12.4
16	0.141	8976	0.000	0.000	1.00	6.9	0.179	0.100	53.42	3.3	12.4
17	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	56.76	3.3	12.4
18	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	60.10	3.3	12.4
19	0.141	8976	0.000	0.000	1.00	5.4	0.200	0.100	63.44	3.3	12.4
20	0.141	8976	0.000	0.000	1.00	24.2	0.080	0.100	66.77	3.3	12.4
21	0.141	8976	0.000	0.000	1.00	38.5	0.050	0.100	70.11	3.3	12.4
22	0.141	8976	0.000	0.000	1.00	39.9	0.050	0.100	73.45	3.3	12.4
23	0.141	8976	0.000	0.000	1.00	41.2	0.050	0.100	76.79	3.3	12.4
Toe						35.7	0.150	0.100			

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

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

Depth Stroke Pressure Efficy
ft ft Ratio
50.00 10.81 1.00 0.800

↑

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Rut kips	Bl Ct b/ft	Stroke down	(ft) up	Ten ksi	Str	i	t	Comp	Str	i	t	ENTHRU kip-ft	Bl Rt b/min
234.5	26.4	7.50	7.47	-2.46	10	27			30.14	13	4	20.1	43.0
238.7	27.3	7.55	7.53	-2.51	10	26			30.38	13	4	20.2	42.9
242.8	28.2	7.61	7.57	-2.61	11	26			30.60	13	4	20.3	42.8
246.9	29.3	7.66	7.63	-2.74	11	26			30.79	13	4	20.3	42.6
251.1	30.4	7.72	7.68	-2.92	10	25			31.05	13	4	20.4	42.5

↑

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Depth (ft) 55.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.300 Pile Type Unknown
Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
76.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips)			282.7		
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	0.141	8976	0.010	0.000	0.85	0.0	0.000	0.100	3.34	3.3	12.4
2	0.141	8976	0.000	0.000	1.00	0.0	0.000	0.100	6.68	3.3	12.4
7	0.141	8976	0.000	0.000	1.00	0.1	0.050	0.100	23.37	3.3	12.4
8	0.141	8976	0.000	0.000	1.00	1.1	0.050	0.100	26.71	3.3	12.4
9	0.141	8976	0.000	0.000	1.00	2.2	0.050	0.100	30.05	3.3	12.4
10	0.141	8976	0.000	0.000	1.00	3.3	0.050	0.100	33.39	3.3	12.4
11	0.141	8976	0.000	0.000	1.00	5.0	0.104	0.100	36.73	3.3	12.4
12	0.141	8976	0.000	0.000	1.00	6.6	0.150	0.100	40.06	3.3	12.4
13	0.141	8976	0.000	0.000	1.00	9.1	0.150	0.100	43.40	3.3	12.4
14	0.141	8976	0.000	0.000	1.00	9.2	0.156	0.100	46.74	3.3	12.4
15	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	50.08	3.3	12.4
16	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	53.42	3.3	12.4

17	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	56.76	3.3	12.4
18	0.141	8976	0.000	0.000	1.00	8.3	0.168	0.100	60.10	3.3	12.4
19	0.141	8976	0.000	0.000	1.00	37.5	0.050	0.100	63.44	3.3	12.4
20	0.141	8976	0.000	0.000	1.00	39.4	0.050	0.100	66.77	3.3	12.4
21	0.141	8976	0.000	0.000	1.00	40.4	0.050	0.100	70.11	3.3	12.4
22	0.141	8976	0.000	0.000	1.00	42.1	0.050	0.100	73.45	3.3	12.4
23	0.141	8976	0.000	0.000	1.00	43.8	0.050	0.100	76.79	3.3	12.4
Toe						18.9	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
55.00	10.81	1.00	0.800

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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	
282.7	34.7	7.92	7.87	-3.06	9 25	31.13	11 4	20.8
286.8	36.3	7.97	7.94	-3.08	10 24	31.29	11 4	20.8
291.0	37.7	8.03	8.00	-3.08	10 24	31.53	11 4	20.9
295.1	39.2	8.09	8.05	-3.09	10 24	31.75	11 4	21.0
299.2	41.1	8.15	8.13	-3.09	10 24	31.98	12 4	21.0

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Depth	(ft)	60.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.400	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	12.300	Pile Type	Unknown
Pile Size	(inch)	10.000		

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	12.40	29000.	492.0	3.3	0	16524.	21.8
76.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 9.294

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	0.141	8976	0.010	0.000	0.85	0.0	0.000	0.100	3.34	3.3	12.4
2	0.141	8976	0.000	0.000	1.00	0.0	0.000	0.100	6.68	3.3	12.4
6	0.141	8976	0.000	0.000	1.00	0.5	0.050	0.100	20.03	3.3	12.4
7	0.141	8976	0.000	0.000	1.00	1.6	0.050	0.100	23.37	3.3	12.4
8	0.141	8976	0.000	0.000	1.00	2.7	0.050	0.100	26.71	3.3	12.4
9	0.141	8976	0.000	0.000	1.00	3.9	0.050	0.100	30.05	3.3	12.4
10	0.141	8976	0.000	0.000	1.00	6.2	0.141	0.100	33.39	3.3	12.4
11	0.141	8976	0.000	0.000	1.00	7.5	0.150	0.100	36.73	3.3	12.4
12	0.141	8976	0.000	0.000	1.00	9.8	0.150	0.100	40.06	3.3	12.4
13	0.141	8976	0.000	0.000	1.00	6.9	0.179	0.100	43.40	3.3	12.4
14	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	46.74	3.3	12.4
15	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	50.08	3.3	12.4
16	0.141	8976	0.000	0.000	1.00	5.4	0.200	0.100	53.42	3.3	12.4
17	0.141	8976	0.000	0.000	1.00	24.0	0.081	0.100	56.76	3.3	12.4
18	0.141	8976	0.000	0.000	1.00	38.5	0.050	0.100	60.10	3.3	12.4
19	0.141	8976	0.000	0.000	1.00	39.9	0.050	0.100	63.44	3.3	12.4
20	0.141	8976	0.000	0.000	1.00	41.2	0.050	0.100	66.77	3.3	12.4
21	0.141	8976	0.000	0.000	1.00	42.9	0.050	0.100	70.11	3.3	12.4
22	0.141	8976	0.000	0.000	1.00	31.7	0.092	0.100	73.45	3.3	12.4
23	0.141	8976	0.000	0.000	1.00	19.0	0.150	0.100	76.79	3.3	12.4
Toe						2.2	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
60.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
294.4	38.7	8.05	8.01	-1.93	8	23	31.54	10	4	20.5	41.6
300.2	41.0	8.11	8.09	-2.13	9	23	31.79	10	4	20.6	41.4
305.9	43.5	8.20	8.17	-2.44	10	22	32.12	10	4	20.7	41.2
311.6	46.1	8.26	8.25	-2.78	10	22	32.33	10	4	20.8	41.1
317.3	48.7	8.34	8.31	-3.05	10	22	32.63	10	4	20.9	40.9

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Depth (ft) 65.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
76.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 9.294

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	0.141	8976	0.010	0.000	0.85	0.0	0.000	0.100	3.34	3.3	12.4
2	0.141	8976	0.000	0.000	1.00	0.0	0.000	0.100	6.68	3.3	12.4
4	0.141	8976	0.000	0.000	1.00	0.1	0.050	0.100	13.35	3.3	12.4
5	0.141	8976	0.000	0.000	1.00	1.1	0.050	0.100	16.69	3.3	12.4
6	0.141	8976	0.000	0.000	1.00	2.2	0.050	0.100	20.03	3.3	12.4
7	0.141	8976	0.000	0.000	1.00	3.3	0.050	0.100	23.37	3.3	12.4
8	0.141	8976	0.000	0.000	1.00	4.9	0.103	0.100	26.71	3.3	12.4
9	0.141	8976	0.000	0.000	1.00	6.6	0.150	0.100	30.05	3.3	12.4
10	0.141	8976	0.000	0.000	1.00	9.1	0.150	0.100	33.39	3.3	12.4
11	0.141	8976	0.000	0.000	1.00	9.2	0.155	0.100	36.73	3.3	12.4
12	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	40.06	3.3	12.4
13	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	43.40	3.3	12.4
14	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	46.74	3.3	12.4
15	0.141	8976	0.000	0.000	1.00	8.1	0.170	0.100	50.08	3.3	12.4
16	0.141	8976	0.000	0.000	1.00	37.5	0.050	0.100	53.42	3.3	12.4
17	0.141	8976	0.000	0.000	1.00	39.4	0.050	0.100	56.76	3.3	12.4
18	0.141	8976	0.000	0.000	1.00	40.4	0.050	0.100	60.10	3.3	12.4
19	0.141	8976	0.000	0.000	1.00	42.1	0.050	0.100	63.44	3.3	12.4
20	0.141	8976	0.000	0.000	1.00	43.8	0.050	0.100	66.77	3.3	12.4
21	0.141	8976	0.000	0.000	1.00	19.1	0.149	0.100	70.11	3.3	12.4
22	0.141	8976	0.000	0.000	1.00	24.7	0.123	0.100	73.45	3.3	12.4
23	0.141	8976	0.000	0.000	1.00	48.6	0.050	0.100	76.79	3.3	12.4
Toe						35.7	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficacy
65.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
391.7	112.4	8.97	8.98	-3.68	8	21	33.64	8	3	22.3	39.4
397.7	125.6	9.03	9.03	-3.64	8	21	33.84	9	3	22.4	39.3
403.7	141.4	9.09	9.08	-3.59	8	21	34.08	9	3	22.5	39.2
409.8	158.3	9.16	9.12	-3.55	8	21	34.34	9	3	22.6	39.1
415.8	187.4	9.21	9.18	-3.47	8	21	34.55	9	3	22.6	39.0

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Depth (ft) 70.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
76.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips) 432.0					
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	0.141	8976	0.010	0.000	0.85	0.0	0.000	0.100	3.34	3.3	12.4
2	0.141	8976	0.000	0.000	1.00	0.0	0.000	0.100	6.68	3.3	12.4
3	0.141	8976	0.000	0.000	1.00	0.5	0.050	0.100	10.02	3.3	12.4
4	0.141	8976	0.000	0.000	1.00	1.6	0.050	0.100	13.35	3.3	12.4
5	0.141	8976	0.000	0.000	1.00	2.7	0.050	0.100	16.69	3.3	12.4
6	0.141	8976	0.000	0.000	1.00	3.8	0.050	0.100	20.03	3.3	12.4
7	0.141	8976	0.000	0.000	1.00	6.2	0.141	0.100	23.37	3.3	12.4
8	0.141	8976	0.000	0.000	1.00	7.5	0.150	0.100	26.71	3.3	12.4
9	0.141	8976	0.000	0.000	1.00	9.8	0.150	0.100	30.05	3.3	12.4
10	0.141	8976	0.000	0.000	1.00	7.0	0.179	0.100	33.39	3.3	12.4
11	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	36.73	3.3	12.4
12	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	40.06	3.3	12.4
13	0.141	8976	0.000	0.000	1.00	5.4	0.200	0.100	43.40	3.3	12.4
14	0.141	8976	0.000	0.000	1.00	23.9	0.081	0.100	46.74	3.3	12.4
15	0.141	8976	0.000	0.000	1.00	38.4	0.050	0.100	50.08	3.3	12.4
16	0.141	8976	0.000	0.000	1.00	39.9	0.050	0.100	53.42	3.3	12.4
17	0.141	8976	0.000	0.000	1.00	41.2	0.050	0.100	56.76	3.3	12.4
18	0.141	8976	0.000	0.000	1.00	42.9	0.050	0.100	60.10	3.3	12.4
19	0.141	8976	0.000	0.000	1.00	31.8	0.091	0.100	63.44	3.3	12.4
20	0.141	8976	0.000	0.000	1.00	19.0	0.150	0.100	66.77	3.3	12.4
21	0.141	8976	0.000	0.000	1.00	39.2	0.072	0.100	70.11	3.3	12.4
22	0.141	8976	0.000	0.000	1.00	49.5	0.050	0.100	73.45	3.3	12.4
23	0.141	8976	0.000	0.000	1.00	48.1	0.061	0.100	76.79	3.3	12.4
Toe						3.1	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
70.00	10.81	1.00	0.800

▲ FRA-70-13.01 - FA - B-014-7-20 - HP10x42 10/24/2021
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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		
432.0	213.9	9.18	9.17	-3.64	7	20	34.24	7	3	22.3	39.0
438.2	269.0	9.23	9.22	-3.60	7	20	34.42	7	3	22.3	38.9
444.4	331.4	9.28	9.24	-3.59	7	20	34.64	7	3	22.5	38.8
450.7	448.7	9.33	9.28	-3.53	7	20	34.81	7	3	22.5	38.7
456.9	613.9	9.37	9.33	-3.46	7	20	34.98	7	3	22.5	38.7

▲ FRA-70-13.01 - FA - B-014-7-20 - HP10x42 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 75.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 12.300 Pile Type Unknown
 Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
76.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model					Total Capacity Rut (kips)					471.6	
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	0.141	8976	0.010	0.000	0.85	0.1	0.050	0.100	3.34	3.3	12.4
2	0.141	8976	0.000	0.000	1.00	1.1	0.050	0.100	6.68	3.3	12.4
3	0.141	8976	0.000	0.000	1.00	2.2	0.050	0.100	10.02	3.3	12.4
4	0.141	8976	0.000	0.000	1.00	3.3	0.050	0.100	13.35	3.3	12.4
5	0.141	8976	0.000	0.000	1.00	4.9	0.102	0.100	16.69	3.3	12.4
6	0.141	8976	0.000	0.000	1.00	6.6	0.150	0.100	20.03	3.3	12.4
7	0.141	8976	0.000	0.000	1.00	9.1	0.150	0.100	23.37	3.3	12.4
8	0.141	8976	0.000	0.000	1.00	9.3	0.155	0.100	26.71	3.3	12.4
9	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	30.05	3.3	12.4
10	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	33.39	3.3	12.4
11	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	36.73	3.3	12.4
12	0.141	8976	0.000	0.000	1.00	8.0	0.171	0.100	40.06	3.3	12.4
13	0.141	8976	0.000	0.000	1.00	37.5	0.050	0.100	43.40	3.3	12.4
14	0.141	8976	0.000	0.000	1.00	39.4	0.050	0.100	46.74	3.3	12.4
15	0.141	8976	0.000	0.000	1.00	40.4	0.050	0.100	50.08	3.3	12.4
16	0.141	8976	0.000	0.000	1.00	42.1	0.050	0.100	53.42	3.3	12.4
17	0.141	8976	0.000	0.000	1.00	43.8	0.050	0.100	56.76	3.3	12.4
18	0.141	8976	0.000	0.000	1.00	19.2	0.149	0.100	60.10	3.3	12.4
19	0.141	8976	0.000	0.000	1.00	24.5	0.124	0.100	63.44	3.3	12.4
20	0.141	8976	0.000	0.000	1.00	48.6	0.050	0.100	66.77	3.3	12.4
21	0.141	8976	0.000	0.000	1.00	50.3	0.050	0.100	70.11	3.3	12.4
22	0.141	8976	0.000	0.000	1.00	36.0	0.108	0.100	73.45	3.3	12.4
23	0.141	8976	0.000	0.000	1.00	26.4	0.150	0.100	76.79	3.3	12.4
Toe						3.1	0.150	0.100			

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

Depth ft Stroke ft Pressure Ratio Efficacy
75.00 10.81 1.00 0.800

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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
471.6	661.2	9.41	9.33	-2.66	7 20	34.44	6 3	22.3	38.6	
480.0	1032.9	9.35	9.34	-2.50	7 20	34.38	6 3	22.2	38.7	
488.4	1631.3	9.38	9.37	-2.34	7 20	34.54	6 3	22.1	38.6	
496.9	3404.4	9.40	9.39	-2.20	6 20	34.64	6 3	22.1	38.6	
505.3	9999.0	9.42	9.42	-2.07	6 20	34.77	6 3	22.1	38.5	

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Depth (ft) 76.8 Standard Soil Setup
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.300 Pile Type Unknown
Pile Size (inch) 10.000

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	12.40	29000.	492.0	3.3	0	16524.	21.8
76.8	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model					Total Capacity Rut (kips)					485.8	
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	0.141	8976	0.010	0.000	0.85	0.6	0.050	0.100	3.34	3.3	12.4
2	0.141	8976	0.000	0.000	1.00	1.7	0.050	0.100	6.68	3.3	12.4
3	0.141	8976	0.000	0.000	1.00	2.8	0.050	0.100	10.02	3.3	12.4
4	0.141	8976	0.000	0.000	1.00	3.9	0.050	0.100	13.35	3.3	12.4
5	0.141	8976	0.000	0.000	1.00	6.2	0.142	0.100	16.69	3.3	12.4
6	0.141	8976	0.000	0.000	1.00	7.6	0.150	0.100	20.03	3.3	12.4
7	0.141	8976	0.000	0.000	1.00	9.8	0.150	0.100	23.37	3.3	12.4
8	0.141	8976	0.000	0.000	1.00	6.8	0.181	0.100	26.71	3.3	12.4

9	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	30.05	3.3	12.4
10	0.141	8976	0.000	0.000	1.00	5.3	0.200	0.100	33.39	3.3	12.4
11	0.141	8976	0.000	0.000	1.00	5.4	0.200	0.100	36.73	3.3	12.4
12	0.141	8976	0.000	0.000	1.00	24.9	0.078	0.100	40.06	3.3	12.4
13	0.141	8976	0.000	0.000	1.00	38.5	0.050	0.100	43.40	3.3	12.4
14	0.141	8976	0.000	0.000	1.00	39.9	0.050	0.100	46.74	3.3	12.4
15	0.141	8976	0.000	0.000	1.00	41.3	0.050	0.100	50.08	3.3	12.4
16	0.141	8976	0.000	0.000	1.00	43.0	0.050	0.100	53.42	3.3	12.4
17	0.141	8976	0.000	0.000	1.00	30.9	0.094	0.100	56.76	3.3	12.4
18	0.141	8976	0.000	0.000	1.00	19.0	0.150	0.100	60.10	3.3	12.4
19	0.141	8976	0.000	0.000	1.00	40.2	0.070	0.100	63.44	3.3	12.4
20	0.141	8976	0.000	0.000	1.00	49.5	0.050	0.100	66.77	3.3	12.4
21	0.141	8976	0.000	0.000	1.00	47.3	0.064	0.100	70.11	3.3	12.4
22	0.141	8976	0.000	0.000	1.00	26.4	0.150	0.100	73.45	3.3	12.4
23	0.141	8976	0.000	0.000	1.00	26.4	0.150	0.100	76.79	3.3	12.4
Toe						3.1	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
76.79	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min	
485.8	1125.3	9.36	9.36	-2.11	7	20	34.49	5	3	22.0	38.6
495.0	1970.9	9.39	9.38	-1.95	7	20	34.61	5	3	21.9	38.6
504.2	5666.3	9.40	9.40	-1.79	6	20	34.74	5	3	21.9	38.6
513.4	9999.0	9.43	9.42	-1.68	6	20	34.87	5	3	21.9	38.5
522.6	9999.0	9.45	9.45	-1.57	6	20	35.01	5	3	21.8	38.5

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SUMMARY OVER DEPTHS

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.0	1.9	1.2	0.6	0.0	0.000	0.000	10.81	0.0
10.0	6.1	5.0	1.1	Hammer did not run				
15.0	13.9	11.8	2.1	1.3	10.715	-1.547	3.72	23.5
20.0	27.4	22.6	4.8	2.0	15.821	-0.510	4.31	24.8
25.0	40.5	36.6	3.8	3.4	19.357	-0.469	4.84	23.1
30.0	48.3	44.5	3.8	4.4	21.058	-0.440	5.11	22.2
35.0	56.3	52.4	3.8	5.4	22.256	-0.200	5.35	21.4
40.0	130.0	79.4	50.6	14.6	27.431	-1.330	6.64	19.5
45.0	180.9	137.7	43.1	19.6	28.682	-1.533	7.05	19.6
50.0	234.5	198.9	35.7	26.4	30.136	-2.455	7.50	20.1
55.0	282.7	263.8	18.9	34.7	31.133	-3.064	7.92	20.8
60.0	294.4	292.2	2.2	38.7	31.543	-1.933	8.05	20.5
65.0	391.7	356.0	35.7	112.4	33.643	-3.678	8.97	22.3
70.0	432.0	428.9	3.1	213.9	34.245	-3.638	9.18	22.3
75.0	471.6	468.5	3.1	661.2	34.444	-2.659	9.41	22.3
76.8	485.8	482.7	3.1	1125.3	34.490	-2.110	9.36	22.0

Total Driving Time 143 minutes;
 Starting at penetration 5.0 ft

Total No. of Blows 5635

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.0	1.9	1.2	0.6	0.0	0.000	0.000	11.86	0.0
10.0	6.1	5.0	1.1	Hammer did not run				
15.0	14.0	11.9	2.1	1.3	10.709	-1.550	3.72	23.5
20.0	28.1	23.3	4.8	2.1	16.022	-0.503	4.34	24.7
25.0	42.0	38.2	3.8	3.5	19.662	-0.482	4.89	22.9
30.0	50.9	47.0	3.8	4.7	21.446	-0.232	5.18	21.9
35.0	59.8	55.9	3.8	5.9	22.690	-0.301	5.44	21.2
40.0	134.2	83.6	50.6	15.2	27.692	-1.288	6.69	19.4
45.0	185.0	141.9	43.1	20.3	28.892	-1.370	7.10	19.6
50.0	238.7	203.0	35.7	27.3	30.378	-2.512	7.55	20.2

55.0	286.8	267.9	18.9	36.3	31.286	-3.076	7.97	20.8
60.0	300.2	298.0	2.2	41.0	31.794	-2.132	8.11	20.6
65.0	397.7	362.0	35.7	125.6	33.841	-3.640	9.03	22.4
70.0	438.2	435.2	3.1	269.0	34.415	-3.604	9.23	22.3
75.0	480.0	477.0	3.1	1032.9	34.380	-2.503	9.35	22.2
76.8	495.0	491.9	3.1	1970.9	34.609	-1.947	9.39	21.9

Total Driving Time 205 minutes; Total No. of Blows 8031
Starting at penetration 5.0 ft

▲
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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	
5.0	1.9	1.2	0.6	0.0	0.000	0.000	11.86	0.0	
10.0	6.1	5.0	1.1	Hammer did not run					
15.0	14.1	12.0	2.1	1.3	10.769	-1.579	3.73	23.5	
20.0	28.8	24.0	4.8	2.1	16.272	-0.485	4.36	24.6	
25.0	43.6	39.7	3.8	3.7	19.957	-0.476	4.94	22.7	
30.0	53.4	49.6	3.8	5.0	21.790	-0.067	5.25	21.7	
35.0	63.3	59.5	3.8	6.4	23.142	-0.423	5.53	20.9	
40.0	138.3	87.7	50.6	15.8	27.919	-1.310	6.74	19.4	
45.0	189.1	146.0	43.1	21.0	29.133	-1.496	7.16	19.6	
50.0	242.8	207.1	35.7	28.2	30.604	-2.609	7.61	20.3	
55.0	291.0	272.0	18.9	37.7	31.530	-3.083	8.03	20.9	
60.0	305.9	303.7	2.2	43.5	32.115	-2.441	8.20	20.7	
65.0	403.7	368.1	35.7	141.4	34.080	-3.593	9.09	22.5	
70.0	444.4	441.4	3.1	331.4	34.642	-3.591	9.28	22.5	
75.0	488.4	485.4	3.1	1631.3	34.537	-2.337	9.38	22.1	
76.8	504.2	501.1	3.1	5666.3	34.742	-1.793	9.40	21.9	

Total Driving Time 355 minutes; Total No. of Blows 13797
Starting at penetration 5.0 ft

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	
5.0	1.9	1.2	0.6	0.0	0.000	0.000	11.86	0.0	
10.0	6.1	5.0	1.1	Hammer did not run					
15.0	14.3	12.1	2.1	1.3	10.756	-1.580	3.73	23.5	
20.0	29.6	24.8	4.8	2.2	16.673	-0.461	4.43	24.6	
25.0	45.1	41.3	3.8	3.9	20.244	-0.459	4.99	22.6	
30.0	56.0	52.1	3.8	5.3	22.122	0.000	5.31	21.5	
35.0	66.8	63.0	3.8	6.9	23.546	-0.405	5.61	20.7	
40.0	142.5	91.9	50.6	16.4	28.194	-1.380	6.79	19.3	
45.0	193.3	150.2	43.1	21.7	29.330	-1.658	7.21	19.6	
50.0	246.9	211.3	35.7	29.3	30.789	-2.741	7.66	20.3	
55.0	295.1	276.2	18.9	39.2	31.750	-3.089	8.09	21.0	
60.0	311.6	309.4	2.2	46.1	32.331	-2.776	8.26	20.8	
65.0	409.8	374.1	35.7	158.3	34.337	-3.550	9.16	22.6	
70.0	450.7	447.6	3.1	448.7	34.812	-3.534	9.33	22.5	
75.0	496.9	493.8	3.1	3404.4	34.641	-2.195	9.40	22.1	
76.8	513.4	510.3	3.1	9999.0	34.872	-1.683	9.43	21.9	

Refusal occurred; no driving time output possible

▲
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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	
5.0	1.9	1.2	0.6	0.0	0.000	0.000	11.86	0.0	
10.0	6.1	5.0	1.1	Hammer did not run					
15.0	14.4	12.3	2.1	1.3	10.829	-1.619	3.74	23.6	
20.0	30.3	25.5	4.8	2.3	16.869	-0.437	4.46	24.5	
25.0	46.7	42.9	3.8	4.1	20.530	-0.412	5.03	22.4	
30.0	58.5	54.7	3.8	5.6	22.439	0.000	5.37	21.3	
35.0	70.4	66.5	3.8	7.4	23.762	-0.777	5.64	20.4	
40.0	146.6	96.0	50.6	17.0	28.383	-1.410	6.83	19.3	
45.0	197.4	154.3	43.1	22.3	29.550	-1.845	7.26	19.8	

50.0	251.1	215.4	35.7	30.4	31.048	-2.923	7.72	20.4
55.0	299.2	280.3	18.9	41.1	31.982	-3.095	8.15	21.0
60.0	317.3	315.1	2.2	48.7	32.631	-3.047	8.34	20.9
65.0	415.8	380.1	35.7	187.4	34.551	-3.468	9.21	22.6
70.0	456.9	453.8	3.1	613.9	34.979	-3.455	9.37	22.5
75.0	505.3	502.2	3.1	9999.0	34.774	-2.071	9.42	22.1
76.8	522.6	519.5	3.1	9999.0	35.009	-1.570	9.45	21.8

Refusal occurred; no driving time output possible



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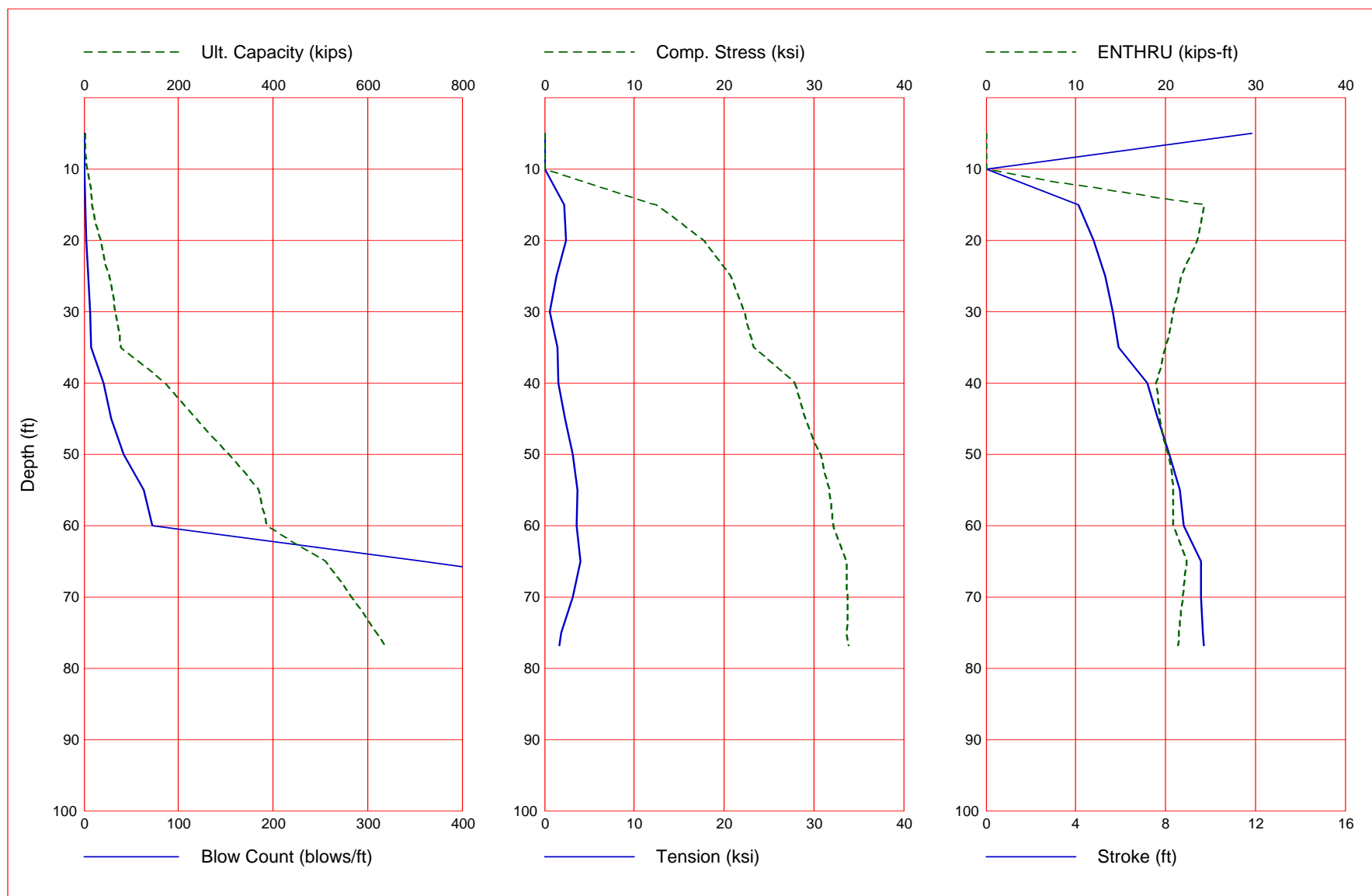
Table of Depths Analyzed with Driving System Modifiers

Depth	Temp.	Wait	Equivalent	Pressure		Stiffn.	Cushion
ft	Length	Time	Stroke	Ratio	Efficy.	Factor	CoR
	ft	hr	ft				
5.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
10.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
15.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
20.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
25.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
30.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
35.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
40.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
45.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
50.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
55.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
60.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
65.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
70.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
75.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
76.79	76.79	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

Depth	Shaft	End	Shaft	Toe	Shaft	Toe	Soil	Limit	Setup
ft	Res.	Bearing	Quake	Quake	Damping	Damping	Setup	Distance	Time
	k/ft2	kips	inch	inch	s/ft	s/ft	Normlzd	ft	hrs
0.01	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
3.00	0.09	0.38	0.100	0.100	0.050	0.150	0.000	6.000	24.000
6.00	0.18	0.75	0.100	0.100	0.050	0.150	0.000	6.000	24.000
9.00	0.27	1.13	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.00	0.36	1.14	0.100	0.100	0.050	0.150	0.000	6.000	24.000
13.89	0.42	1.14	0.100	0.100	0.050	0.150	0.000	6.000	24.000
13.91	0.99	2.11	0.100	0.100	0.150	0.150	0.667	6.000	336.000
18.99	0.99	2.11	0.100	0.100	0.150	0.150	0.667	6.000	336.000
19.01	1.49	4.80	0.100	0.100	0.150	0.150	0.667	6.000	336.000
24.49	1.49	4.80	0.100	0.100	0.150	0.150	0.667	6.000	336.000
24.51	1.19	3.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
33.50	1.20	3.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
36.50	1.23	3.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
37.99	1.25	3.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
38.01	3.31	50.61	0.100	0.100	0.050	0.150	0.000	6.000	24.000
41.00	3.46	50.61	0.100	0.100	0.050	0.150	0.000	6.000	24.000
44.00	3.61	50.61	0.100	0.100	0.050	0.150	0.000	6.000	24.000
44.99	3.66	50.61	0.100	0.100	0.050	0.150	0.000	6.000	24.000
45.01	3.59	35.67	0.100	0.100	0.050	0.150	0.000	6.000	24.000
48.00	3.73	35.67	0.100	0.100	0.050	0.150	0.000	6.000	24.000
51.00	3.87	35.67	0.100	0.100	0.050	0.150	0.000	6.000	24.000
54.00	4.00	35.67	0.100	0.100	0.050	0.150	0.000	6.000	24.000
54.99	4.05	35.67	0.100	0.100	0.050	0.150	0.000	6.000	24.000
55.01	2.88	2.21	0.100	0.100	0.150	0.150	0.667	6.000	336.000
60.99	2.88	2.21	0.100	0.100	0.150	0.150	0.667	6.000	336.000
61.01	4.31	35.67	0.100	0.100	0.050	0.150	0.000	6.000	24.000
64.00	4.45	35.67	0.100	0.100	0.050	0.150	0.000	6.000	24.000
67.00	4.58	35.67	0.100	0.100	0.050	0.150	0.000	6.000	24.000
69.59	4.70	35.67	0.100	0.100	0.050	0.150	0.000	6.000	24.000
69.61	4.00	3.08	0.100	0.100	0.150	0.150	0.667	6.000	336.000
76.79	4.00	3.08	0.100	0.100	0.150	0.150	0.667	6.000	336.000

Gain/Loss 3 at Shaft and Toe 0.500 / 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
5.0	2.4	1.6	0.8	0.0	0.000	0.000	11.86	0.0
10.0	7.7	6.3	1.4	-1.0	0.000	0.000	0.00	0.0
15.0	17.7	15.0	2.7	1.5	12.425	-2.192	4.11	24.4
20.0	35.5	29.5	6.1	2.7	17.813	-2.416	4.81	23.5
25.0	53.2	48.4	4.8	4.6	20.799	-1.368	5.33	21.7
30.0	65.1	60.2	4.8	6.2	22.219	-0.609	5.64	20.8
35.0	77.0	72.2	4.8	8.0	23.305	-1.408	5.90	20.0
40.0	171.9	108.1	63.8	20.8	27.932	-1.499	7.18	18.9
45.0	238.0	183.6	54.4	28.6	29.109	-2.306	7.64	19.4
50.0	307.6	262.7	45.0	42.4	30.761	-3.196	8.18	20.3
55.0	370.4	346.6	23.8	63.6	31.681	-3.645	8.63	20.9
60.0	387.4	384.6	2.8	72.6	32.135	-3.551	8.79	20.9
65.0	512.3	467.3	45.0	359.0	33.651	-3.957	9.56	22.3
70.0	565.7	561.8	3.9	632.2	33.738	-3.199	9.56	21.9
75.0	618.6	614.7	3.9	2387.6	33.619	-1.900	9.67	21.5
76.8	637.6	633.7	3.9	9999.0	33.835	-1.615	9.70	21.4

Refusal occurred; no driving time output possible

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.
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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: J:\GEOTECH\PROJECTS\2020\W-20-025 FRA-70-13.01\ANALYSIS\DRIVEABILITY\FORWARD ABUTMENT\HP 12X53\FRA-70-13.01 FORWARD
ABUTMENT HP 12X53 (B-014-7-20).GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-13.01 - FA - B-014-7-20 - HP12x53

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	15.500	12.000	Unknown															
W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp													
1.900	227.000	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												
76.790	15.50	29000.0	492.000	3.970	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	0.10	0.05	0.15	1.00	6.00	24.000
3.00	0.09	0.47	0.10	0.10	0.05	0.15	1.00	6.00	24.000
6.00	0.19	0.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
9.00	0.28	1.42	0.10	0.10	0.05	0.15	1.00	6.00	24.000
12.00	0.38	1.43	0.10	0.10	0.05	0.15	1.00	6.00	24.000
13.89	0.44	1.43	0.10	0.10	0.05	0.15	1.00	6.00	24.000
13.91	0.99	2.66	0.10	0.10	0.15	0.15	1.50	6.00	336.000
18.99	0.99	2.66	0.10	0.10	0.15	0.15	1.50	6.00	336.000
19.01	1.49	6.05	0.10	0.10	0.15	0.15	1.50	6.00	336.000
24.49	1.49	6.05	0.10	0.10	0.15	0.15	1.50	6.00	336.000
24.51	1.19	4.84	0.10	0.10	0.20	0.15	2.00	6.00	720.000
36.50	1.21	4.84	0.10	0.10	0.20	0.15	2.00	6.00	720.000
37.99	1.23	4.84	0.10	0.10	0.20	0.15	2.00	6.00	720.000
38.01	3.56	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.000
41.00	3.72	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.000
44.00	3.89	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.000
44.99	3.94	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.000
45.01	3.86	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
48.00	4.01	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
51.00	4.16	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
54.00	4.30	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
54.99	4.35	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
55.01	2.88	2.79	0.10	0.10	0.15	0.15	1.50	6.00	336.000
60.99	2.88	2.79	0.10	0.10	0.15	0.15	1.50	6.00	336.000
61.01	4.63	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
64.00	4.78	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
67.00	4.93	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
69.59	5.05	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.000
69.61	4.00	3.88	0.10	0.10	0.15	0.15	1.50	6.00	336.000
76.79	4.00	3.88	0.10	0.10	0.15	0.15	1.50	6.00	336.000

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
5.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
10.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
15.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
20.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
25.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
30.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
35.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
40.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
45.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
50.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
55.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
60.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
65.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
70.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
75.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
76.79	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

FRA-70-13.01 - FA - B-014-7-20 - HP12x53

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	1.900	60155.0	0.800	0.0100	5.8
Combined Pile Top		11219.4			

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)	227.00	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)	60155.0	Stiffness	(kips/in)	0.0



FRA-70-13.01 - FA - B-014-7-20 - HP12x53

10/24/2021

Resource International Inc

GRLWEAP Version 2010

Depth	(ft)	5.0	Standard Soil Setup	
Shaft Gain/Loss Factor		0.400	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
76.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model					Total Capacity Rut (kips)					2.4	
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	0.177	11219	0.010	0.000	0.85	0.0	0.000	0.100	3.34	4.0	15.5
2	0.177	11219	0.000	0.000	1.00	0.0	0.000	0.100	6.68	4.0	15.5
22	0.177	11219	0.000	0.000	1.00	0.2	0.050	0.100	73.45	4.0	15.5
23	0.177	11219	0.000	0.000	1.00	1.4	0.050	0.100	76.79	4.0	15.5
Toe						0.8	0.150	0.100			

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

4.067 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)	0.544
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			

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
7.7	Hammer	did not run				

7.7 Hammer did not run
 7.7 Hammer did not run
 7.7 Hammer did not run
 7.7 Hammer did not run

↑
 FRA-70-13.01 - FA - B-014-7-20 - HP12x53 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 15.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 15.500 Pile Type Unknown
 Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
76.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips)			17.4		
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	0.177	11219	0.010	0.000	0.85	0.0	0.000	0.100	3.34	4.0	15.5
2	0.177	11219	0.000	0.000	1.00	0.0	0.000	0.100	6.68	4.0	15.5
19	0.177	11219	0.000	0.000	1.00	0.2	0.050	0.100	63.44	4.0	15.5
20	0.177	11219	0.000	0.000	1.00	1.4	0.050	0.100	66.77	4.0	15.5
21	0.177	11219	0.000	0.000	1.00	2.8	0.050	0.100	70.11	4.0	15.5
22	0.177	11219	0.000	0.000	1.00	4.2	0.050	0.100	73.45	4.0	15.5
23	0.177	11219	0.000	0.000	1.00	6.2	0.104	0.100	76.79	4.0	15.5
Toe						2.7	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
15.00	10.81	1.00	0.800

↑
 FRA-70-13.01 - FA - B-014-7-20 - HP12x53 10/24/2021
 Resource International Inc GRLWEAP Version 2010

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	
17.4	1.5	4.09	4.11	-2.09	6 50	12.26	1 2 24.3	58.6
17.6	1.5	4.10	4.12	-2.29	6 50	12.34	1 2 24.4	58.6
17.7	1.5	4.11	4.13	-2.19	6 50	12.43	1 2 24.4	58.6
17.8	1.5	4.12	4.13	-2.28	6 50	12.48	1 2 24.5	58.5
18.0	1.5	4.16	4.13	-2.47	6 50	12.75	1 2 24.7	58.4

↑
 FRA-70-13.01 - FA - B-014-7-20 - HP12x53 10/24/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 20.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 15.500 Pile Type Unknown
 Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
76.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips)			33.8		
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	0.177	11219	0.010	0.000	0.85	0.0	0.000	0.100	3.34	4.0	15.5
2	0.177	11219	0.000	0.000	1.00	0.0	0.000	0.100	6.68	4.0	15.5
18	0.177	11219	0.000	0.000	1.00	0.7	0.050	0.100	60.10	4.0	15.5
19	0.177	11219	0.000	0.000	1.00	2.1	0.050	0.100	63.44	4.0	15.5

20	0.177	11219	0.000	0.000	1.00	3.5	0.050	0.100	66.77	4.0	15.5
21	0.177	11219	0.000	0.000	1.00	4.9	0.050	0.100	70.11	4.0	15.5
22	0.177	11219	0.000	0.000	1.00	7.5	0.142	0.100	73.45	4.0	15.5
23	0.177	11219	0.000	0.000	1.00	9.1	0.150	0.100	76.79	4.0	15.5
Toe						6.1	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
20.00	10.81	1.00	0.800

↑
FRA-70-13.01 - FA - B-014-7-20 - HP12x53 10/24/2021
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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
33.8	2.5	4.76 4.73	-2.45	3	11 17.45	7	3 23.8	54.4
34.7	2.6	4.78 4.76	-2.43	3	11 17.63	8	3 23.7	54.2
35.5	2.7	4.81 4.79	-2.42	3	11 17.81	9	4 23.5	54.1
36.4	2.8	4.84 4.82	-2.38	3	11 17.98	9	4 23.4	53.9
37.3	2.9	4.87 4.84	-2.35	3	11 18.15	10	4 23.3	53.8

↑
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Depth	(ft)	25.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.400	Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
76.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips) 49.5					
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	0.177	11219	0.010	0.000	0.85	0.0	0.000	0.100	3.34	4.0	15.5
2	0.177	11219	0.000	0.000	1.00	0.0	0.000	0.100	6.68	4.0	15.5
16	0.177	11219	0.000	0.000	1.00	0.2	0.050	0.100	53.42	4.0	15.5
17	0.177	11219	0.000	0.000	1.00	1.4	0.050	0.100	56.76	4.0	15.5
18	0.177	11219	0.000	0.000	1.00	2.8	0.050	0.100	60.10	4.0	15.5
19	0.177	11219	0.000	0.000	1.00	4.2	0.050	0.100	63.44	4.0	15.5
20	0.177	11219	0.000	0.000	1.00	6.2	0.104	0.100	66.77	4.0	15.5
21	0.177	11219	0.000	0.000	1.00	7.9	0.150	0.100	70.11	4.0	15.5
22	0.177	11219	0.000	0.000	1.00	11.0	0.150	0.100	73.45	4.0	15.5
23	0.177	11219	0.000	0.000	1.00	11.0	0.156	0.100	76.79	4.0	15.5
Toe						4.8	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
25.00	10.81	1.00	0.800

↑
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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
49.5	4.2	5.24 5.21	-1.74	3	11 20.32	17	5 22.0	51.8
51.3	4.4	5.29 5.26	-1.56	3	11 20.57	17	5 21.9	51.6
53.2	4.6	5.33 5.30	-1.37	3	11 20.80	17	5 21.7	51.3
55.1	4.8	5.38 5.35	-1.23	2	11 21.04	17	5 21.6	51.1
57.0	5.0	5.42 5.39	-1.09	2	11 21.24	17	5 21.4	50.9

↑
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Depth (ft) 30.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
 Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
76.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips)			59.0		
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	0.177	11219	0.010	0.000	0.85	0.0	0.000	0.100	3.34	4.0	15.5
2	0.177	11219	0.000	0.000	1.00	0.0	0.000	0.100	6.68	4.0	15.5
15	0.177	11219	0.000	0.000	1.00	0.7	0.050	0.100	50.08	4.0	15.5
16	0.177	11219	0.000	0.000	1.00	2.1	0.050	0.100	53.42	4.0	15.5
17	0.177	11219	0.000	0.000	1.00	3.5	0.050	0.100	56.76	4.0	15.5
18	0.177	11219	0.000	0.000	1.00	4.9	0.050	0.100	60.10	4.0	15.5
19	0.177	11219	0.000	0.000	1.00	7.5	0.141	0.100	63.44	4.0	15.5
20	0.177	11219	0.000	0.000	1.00	9.1	0.150	0.100	66.77	4.0	15.5
21	0.177	11219	0.000	0.000	1.00	11.8	0.150	0.100	70.11	4.0	15.5
22	0.177	11219	0.000	0.000	1.00	8.3	0.180	0.100	73.45	4.0	15.5
23	0.177	11219	0.000	0.000	1.00	6.3	0.200	0.100	76.79	4.0	15.5
Toe						4.8	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
30.00	10.81	1.00	0.800



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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	
59.0	5.4	5.50	5.48	-1.10	2 11	21.56	16 5	21.1 50.4
62.0	5.8	5.57	5.55	-0.88	2 11	21.92	16 5	21.0 50.1
65.1	6.2	5.64	5.63	-0.61	2 11	22.22	16 5	20.8 49.8
68.1	6.6	5.71	5.70	-0.42	22 17	22.50	18 5	20.6 49.4
71.2	7.1	5.72	5.78	-0.54	16 50	22.65	19 6	20.3 49.2



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Depth (ft) 35.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
 Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
76.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips)			68.5		
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	0.177	11219	0.010	0.000	0.85	0.0	0.000	0.100	3.34	4.0	15.5
2	0.177	11219	0.000	0.000	1.00	0.0	0.000	0.100	6.68	4.0	15.5
13	0.177	11219	0.000	0.000	1.00	0.2	0.050	0.100	43.40	4.0	15.5
14	0.177	11219	0.000	0.000	1.00	1.4	0.050	0.100	46.74	4.0	15.5
15	0.177	11219	0.000	0.000	1.00	2.8	0.050	0.100	50.08	4.0	15.5
16	0.177	11219	0.000	0.000	1.00	4.2	0.050	0.100	53.42	4.0	15.5

17	0.177	11219	0.000	0.000	1.00	6.2	0.103	0.100	56.76	4.0	15.5
18	0.177	11219	0.000	0.000	1.00	7.9	0.150	0.100	60.10	4.0	15.5
19	0.177	11219	0.000	0.000	1.00	11.0	0.150	0.100	63.44	4.0	15.5
20	0.177	11219	0.000	0.000	1.00	11.0	0.156	0.100	66.77	4.0	15.5
21	0.177	11219	0.000	0.000	1.00	6.3	0.200	0.100	70.11	4.0	15.5
22	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	73.45	4.0	15.5
23	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	76.79	4.0	15.5
Toe						4.8	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
35.00	10.81	1.00	0.800

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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
68.5	6.8	5.70	5.75	-1.13	22 17	22.47	15 5	20.3
72.8	7.5	5.80	5.85	-0.97	16 50	22.89	17 5	20.1
77.0	8.0	5.90	5.94	-1.41	16 49	23.31	17 5	20.0
81.3	8.5	5.99	6.02	-1.54	16 49	23.69	17 5	19.8
85.5	9.1	6.07	6.10	-1.55	16 49	24.09	17 5	19.6

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Depth	(ft)	40.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.400	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
76.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity	Rut (kips)	161.9		
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	0.177	11219	0.010	0.000	0.85	0.0	0.000 0.100	3.34	4.0	15.5
2	0.177	11219	0.000	0.000	1.00	0.0	0.000 0.100	6.68	4.0	15.5
12	0.177	11219	0.000	0.000	1.00	0.7	0.050 0.100	40.06	4.0	15.5
13	0.177	11219	0.000	0.000	1.00	2.1	0.050 0.100	43.40	4.0	15.5
14	0.177	11219	0.000	0.000	1.00	3.5	0.050 0.100	46.74	4.0	15.5
15	0.177	11219	0.000	0.000	1.00	4.9	0.050 0.100	50.08	4.0	15.5
16	0.177	11219	0.000	0.000	1.00	7.5	0.141 0.100	53.42	4.0	15.5
17	0.177	11219	0.000	0.000	1.00	9.0	0.150 0.100	56.76	4.0	15.5
18	0.177	11219	0.000	0.000	1.00	11.8	0.150 0.100	60.10	4.0	15.5
19	0.177	11219	0.000	0.000	1.00	8.3	0.180 0.100	63.44	4.0	15.5
20	0.177	11219	0.000	0.000	1.00	6.3	0.200 0.100	66.77	4.0	15.5
21	0.177	11219	0.000	0.000	1.00	6.4	0.200 0.100	70.11	4.0	15.5
22	0.177	11219	0.000	0.000	1.00	6.4	0.200 0.100	73.45	4.0	15.5
23	0.177	11219	0.000	0.000	1.00	31.3	0.078 0.100	76.79	4.0	15.5
Toe						63.8	0.150 0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
40.00	10.81	1.00	0.800

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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

161.9	19.3	7.06	7.03	-1.82	13	35	27.44	16	5	18.9	44.4
166.9	20.1	7.12	7.09	-1.70	13	34	27.67	16	5	18.8	44.2
171.9	20.8	7.18	7.15	-1.50	13	34	27.93	16	5	18.9	44.0
176.8	21.5	7.23	7.22	-1.31	12	34	28.15	16	5	18.8	43.9
181.8	22.1	7.28	7.26	-1.21	13	32	28.39	16	5	18.9	43.7

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Depth (ft) 45.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
 Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
76.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips)				228.0	
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	0.177	11219	0.010	0.000	0.85	0.0	0.000	0.100	3.34	4.0	15.5
2	0.177	11219	0.000	0.000	1.00	0.0	0.000	0.100	6.68	4.0	15.5
10	0.177	11219	0.000	0.000	1.00	0.2	0.050	0.100	33.39	4.0	15.5
11	0.177	11219	0.000	0.000	1.00	1.4	0.050	0.100	36.73	4.0	15.5
12	0.177	11219	0.000	0.000	1.00	2.8	0.050	0.100	40.06	4.0	15.5
13	0.177	11219	0.000	0.000	1.00	4.2	0.050	0.100	43.40	4.0	15.5
14	0.177	11219	0.000	0.000	1.00	6.2	0.103	0.100	46.74	4.0	15.5
15	0.177	11219	0.000	0.000	1.00	7.9	0.150	0.100	50.08	4.0	15.5
16	0.177	11219	0.000	0.000	1.00	11.0	0.150	0.100	53.42	4.0	15.5
17	0.177	11219	0.000	0.000	1.00	11.1	0.156	0.100	56.76	4.0	15.5
18	0.177	11219	0.000	0.000	1.00	6.3	0.200	0.100	60.10	4.0	15.5
19	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	63.44	4.0	15.5
20	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	66.77	4.0	15.5
21	0.177	11219	0.000	0.000	1.00	10.4	0.164	0.100	70.11	4.0	15.5
22	0.177	11219	0.000	0.000	1.00	48.6	0.050	0.100	73.45	4.0	15.5
23	0.177	11219	0.000	0.000	1.00	51.0	0.050	0.100	76.79	4.0	15.5
Toe						54.4	0.150	0.100			

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
45.00	10.81	1.00	0.800

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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				
228.0	26.5	7.53	7.51	-2.09	12	28	28.75	14	5	19.3	43.0
233.0	27.7	7.58	7.58	-2.20	11	27	28.93	14	4	19.3	42.8
238.0	28.6	7.64	7.62	-2.31	11	27	29.11	14	5	19.4	42.7
243.0	29.6	7.69	7.67	-2.40	12	27	29.34	14	5	19.5	42.6
247.9	30.8	7.74	7.73	-2.51	13	26	29.48	14	4	19.5	42.4

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Depth (ft) 50.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
 Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
76.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut	(kips)		297.7		
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	0.177	11219	0.010	0.000	0.85	0.0	0.000	0.100	3.34	4.0	15.5
2	0.177	11219	0.000	0.000	1.00	0.0	0.000	0.100	6.68	4.0	15.5
9	0.177	11219	0.000	0.000	1.00	0.7	0.050	0.100	30.05	4.0	15.5
10	0.177	11219	0.000	0.000	1.00	2.1	0.050	0.100	33.39	4.0	15.5
11	0.177	11219	0.000	0.000	1.00	3.5	0.050	0.100	36.73	4.0	15.5
12	0.177	11219	0.000	0.000	1.00	4.9	0.050	0.100	40.06	4.0	15.5
13	0.177	11219	0.000	0.000	1.00	7.5	0.141	0.100	43.40	4.0	15.5
14	0.177	11219	0.000	0.000	1.00	9.0	0.150	0.100	46.74	4.0	15.5
15	0.177	11219	0.000	0.000	1.00	11.8	0.150	0.100	50.08	4.0	15.5
16	0.177	11219	0.000	0.000	1.00	8.3	0.179	0.100	53.42	4.0	15.5
17	0.177	11219	0.000	0.000	1.00	6.3	0.200	0.100	56.76	4.0	15.5
18	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	60.10	4.0	15.5
19	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	63.44	4.0	15.5
20	0.177	11219	0.000	0.000	1.00	31.1	0.078	0.100	66.77	4.0	15.5
21	0.177	11219	0.000	0.000	1.00	49.8	0.050	0.100	70.11	4.0	15.5
22	0.177	11219	0.000	0.000	1.00	51.7	0.050	0.100	73.45	4.0	15.5
23	0.177	11219	0.000	0.000	1.00	53.3	0.050	0.100	76.79	4.0	15.5
Toe						45.0	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficacy
50.00	10.81	1.00	0.800

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FRA-70-13.01 - FA - B-014-7-20 - HP12x53
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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up	i ksi	t ksi	Comp Str ksi	i ksi	t kip-ft	ENTHRU kip-ft	Bl Rt b/min
297.7	39.2	8.08	8.06	-3.14	10	25	30.31	13	4	20.1
302.6	40.6	8.13	8.11	-3.16	11	24	30.57	13	4	20.3
307.6	42.4	8.18	8.18	-3.20	11	24	30.76	13	4	20.3
312.6	44.3	8.24	8.23	-3.21	11	24	30.94	13	4	20.4
317.6	46.0	8.30	8.28	-3.22	11	24	31.19	13	4	20.5

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Depth ft	(ft)	55.0	Standard Soil Setup
Shaft Gain/Loss Factor		0.400	Toe Gain/Loss Factor
			1.000

PILE PROFILE:

Toe Area in2	15.500	Pile Type	Unknown
Pile Size inch	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
76.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips)			360.5		
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	0.177	11219	0.010	0.000	0.85	0.0	0.000	0.100	3.34	4.0	15.5
2	0.177	11219	0.000	0.000	1.00	0.0	0.000	0.100	6.68	4.0	15.5
7	0.177	11219	0.000	0.000	1.00	0.2	0.050	0.100	23.37	4.0	15.5
8	0.177	11219	0.000	0.000	1.00	1.4	0.050	0.100	26.71	4.0	15.5
9	0.177	11219	0.000	0.000	1.00	2.8	0.050	0.100	30.05	4.0	15.5
10	0.177	11219	0.000	0.000	1.00	4.2	0.050	0.100	33.39	4.0	15.5
11	0.177	11219	0.000	0.000	1.00	6.1	0.102	0.100	36.73	4.0	15.5
12	0.177	11219	0.000	0.000	1.00	7.9	0.150	0.100	40.06	4.0	15.5
13	0.177	11219	0.000	0.000	1.00	11.0	0.150	0.100	43.40	4.0	15.5
14	0.177	11219	0.000	0.000	1.00	11.1	0.156	0.100	46.74	4.0	15.5
15	0.177	11219	0.000	0.000	1.00	6.3	0.200	0.100	50.08	4.0	15.5
16	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	53.42	4.0	15.5
17	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	56.76	4.0	15.5

18	0.177	11219	0.000	0.000	1.00	10.2	0.166	0.100	60.10	4.0	15.5
19	0.177	11219	0.000	0.000	1.00	48.6	0.050	0.100	63.44	4.0	15.5
20	0.177	11219	0.000	0.000	1.00	51.0	0.050	0.100	66.77	4.0	15.5
21	0.177	11219	0.000	0.000	1.00	52.2	0.050	0.100	70.11	4.0	15.5
22	0.177	11219	0.000	0.000	1.00	54.4	0.050	0.100	73.45	4.0	15.5
23	0.177	11219	0.000	0.000	1.00	56.6	0.050	0.100	76.79	4.0	15.5
Toe						23.8	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
55.00	10.81	1.00	0.800

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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	
360.5	57.3	8.53	8.51	-3.47	11	22	31.33	11	4	20.7	40.4
365.4	60.4	8.58	8.57	-3.56	11	22	31.50	11	4	20.8	40.3
370.4	63.6	8.63	8.62	-3.65	11	22	31.68	11	4	20.9	40.2
375.4	66.4	8.69	8.67	-3.72	11	22	31.88	11	4	21.1	40.1
380.4	70.5	8.73	8.72	-3.76	11	22	32.02	12	4	21.1	40.0

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Depth	(ft)	60.0	Standard Soil Setup	
Shaft Gain/Loss Factor		0.400	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
76.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 9.294

No.	Weight	Pile and Soil Model	Total Capacity	Rut	(kips)	373.7	
	kips	Stiffn C-Slk T-Slk CoR	Soil-S	Soil-D Quake	LbTop	Perim	Area
		k/in ft ft	kips	s/ft inch	ft	ft	in2
1	0.177	11219 0.010 0.000 0.85	0.0	0.000 0.100	3.34	4.0	15.5
2	0.177	11219 0.000 0.000 1.00	0.0	0.000 0.100	6.68	4.0	15.5
6	0.177	11219 0.000 0.000 1.00	0.7	0.050 0.100	20.03	4.0	15.5
7	0.177	11219 0.000 0.000 1.00	2.1	0.050 0.100	23.37	4.0	15.5
8	0.177	11219 0.000 0.000 1.00	3.5	0.050 0.100	26.71	4.0	15.5
9	0.177	11219 0.000 0.000 1.00	4.9	0.050 0.100	30.05	4.0	15.5
10	0.177	11219 0.000 0.000 1.00	7.5	0.141 0.100	33.39	4.0	15.5
11	0.177	11219 0.000 0.000 1.00	9.0	0.150 0.100	36.73	4.0	15.5
12	0.177	11219 0.000 0.000 1.00	11.8	0.150 0.100	40.06	4.0	15.5
13	0.177	11219 0.000 0.000 1.00	8.3	0.179 0.100	43.40	4.0	15.5
14	0.177	11219 0.000 0.000 1.00	6.3	0.200 0.100	46.74	4.0	15.5
15	0.177	11219 0.000 0.000 1.00	6.4	0.200 0.100	50.08	4.0	15.5
16	0.177	11219 0.000 0.000 1.00	6.4	0.200 0.100	53.42	4.0	15.5
17	0.177	11219 0.000 0.000 1.00	30.9	0.079 0.100	56.76	4.0	15.5
18	0.177	11219 0.000 0.000 1.00	49.8	0.050 0.100	60.10	4.0	15.5
19	0.177	11219 0.000 0.000 1.00	51.7	0.050 0.100	63.44	4.0	15.5
20	0.177	11219 0.000 0.000 1.00	53.3	0.050 0.100	66.77	4.0	15.5
21	0.177	11219 0.000 0.000 1.00	55.5	0.050 0.100	70.11	4.0	15.5
22	0.177	11219 0.000 0.000 1.00	40.1	0.090 0.100	73.45	4.0	15.5
23	0.177	11219 0.000 0.000 1.00	22.9	0.150 0.100	76.79	4.0	15.5
Toe			2.8	0.150 0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
60.00	10.81	1.00	0.800

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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
373.7	63.8	8.65	8.66	-3.54	6	21	31.68	10	4	20.6
380.6	68.2	8.72	8.72	-3.51	7	21	31.93	10	4	20.7
387.4	72.6	8.79	8.78	-3.55	7	21	32.14	10	4	20.9
394.3	79.4	8.78	8.85	-3.66	8	20	32.18	10	4	20.9
401.2	85.5	8.86	8.90	-3.82	9	20	32.43	10	4	21.0

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Depth ft	(ft)	65.0	Standard Soil Setup
Shaft Gain/Loss Factor	0.400	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area in2	15.500	Pile Type	Unknown
Pile Size inch	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
76.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 9.294

No.	Weight kips	Pile and Soil Model Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Total Capacity Soil-S kips	Soil-D s/ft	Quake inch	Rut (kips) LbTop ft	Perim ft	Area in2
1	0.177	11219	0.010	0.000	0.85	0.0	0.000	0.100	3.34	4.0	15.5
2	0.177	11219	0.000	0.000	1.00	0.0	0.000	0.100	6.68	4.0	15.5
4	0.177	11219	0.000	0.000	1.00	0.2	0.050	0.100	13.35	4.0	15.5
5	0.177	11219	0.000	0.000	1.00	1.4	0.050	0.100	16.69	4.0	15.5
6	0.177	11219	0.000	0.000	1.00	2.8	0.050	0.100	20.03	4.0	15.5
7	0.177	11219	0.000	0.000	1.00	4.2	0.050	0.100	23.37	4.0	15.5
8	0.177	11219	0.000	0.000	1.00	6.1	0.102	0.100	26.71	4.0	15.5
9	0.177	11219	0.000	0.000	1.00	7.9	0.150	0.100	30.05	4.0	15.5
10	0.177	11219	0.000	0.000	1.00	11.0	0.150	0.100	33.39	4.0	15.5
11	0.177	11219	0.000	0.000	1.00	11.1	0.155	0.100	36.73	4.0	15.5
12	0.177	11219	0.000	0.000	1.00	6.3	0.200	0.100	40.06	4.0	15.5
13	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	43.40	4.0	15.5
14	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	46.74	4.0	15.5
15	0.177	11219	0.000	0.000	1.00	10.0	0.168	0.100	50.08	4.0	15.5
16	0.177	11219	0.000	0.000	1.00	48.6	0.050	0.100	53.42	4.0	15.5
17	0.177	11219	0.000	0.000	1.00	51.0	0.050	0.100	56.76	4.0	15.5
18	0.177	11219	0.000	0.000	1.00	52.2	0.050	0.100	60.10	4.0	15.5
19	0.177	11219	0.000	0.000	1.00	54.4	0.050	0.100	63.44	4.0	15.5
20	0.177	11219	0.000	0.000	1.00	56.6	0.050	0.100	66.77	4.0	15.5
21	0.177	11219	0.000	0.000	1.00	23.0	0.149	0.100	70.11	4.0	15.5
22	0.177	11219	0.000	0.000	1.00	30.5	0.122	0.100	73.45	4.0	15.5
23	0.177	11219	0.000	0.000	1.00	62.9	0.050	0.100	76.79	4.0	15.5
Toe						45.0	0.150	0.100			

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
65.00	10.81	1.00	0.800

↑
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Rut kips	Bl Ct b/ft	Stroke (ft) down	Ten Str up ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
497.8	260.9	9.47	9.39	-4.04	8	20	33.37	8	3	22.3
505.0	308.9	9.52	9.43	-4.02	8	20	33.50	8	3	22.4
512.3	359.0	9.56	9.48	-3.96	8	20	33.65	8	3	22.3
519.5	420.9	9.60	9.51	-3.94	8	20	33.83	9	3	22.4
526.8	538.3	9.54	9.53	-3.90	8	20	33.74	9	3	22.2

↑
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Depth (ft) 70.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
 Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
76.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model										Total Capacity Rut (kips)	550.7
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	0.177	11219	0.010	0.000	0.85	0.0	0.000	0.100	3.34	4.0	15.5
2	0.177	11219	0.000	0.000	1.00	0.0	0.000	0.100	6.68	4.0	15.5
3	0.177	11219	0.000	0.000	1.00	0.7	0.050	0.100	10.02	4.0	15.5
4	0.177	11219	0.000	0.000	1.00	2.1	0.050	0.100	13.35	4.0	15.5
5	0.177	11219	0.000	0.000	1.00	3.5	0.050	0.100	16.69	4.0	15.5
6	0.177	11219	0.000	0.000	1.00	4.9	0.050	0.100	20.03	4.0	15.5
7	0.177	11219	0.000	0.000	1.00	7.5	0.140	0.100	23.37	4.0	15.5
8	0.177	11219	0.000	0.000	1.00	9.0	0.150	0.100	26.71	4.0	15.5
9	0.177	11219	0.000	0.000	1.00	11.8	0.150	0.100	30.05	4.0	15.5
10	0.177	11219	0.000	0.000	1.00	8.4	0.179	0.100	33.39	4.0	15.5
11	0.177	11219	0.000	0.000	1.00	6.3	0.200	0.100	36.73	4.0	15.5
12	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	40.06	4.0	15.5
13	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	43.40	4.0	15.5
14	0.177	11219	0.000	0.000	1.00	30.7	0.079	0.100	46.74	4.0	15.5
15	0.177	11219	0.000	0.000	1.00	49.8	0.050	0.100	50.08	4.0	15.5
16	0.177	11219	0.000	0.000	1.00	51.6	0.050	0.100	53.42	4.0	15.5
17	0.177	11219	0.000	0.000	1.00	53.3	0.050	0.100	56.76	4.0	15.5
18	0.177	11219	0.000	0.000	1.00	55.5	0.050	0.100	60.10	4.0	15.5
19	0.177	11219	0.000	0.000	1.00	40.2	0.089	0.100	63.44	4.0	15.5
20	0.177	11219	0.000	0.000	1.00	22.9	0.150	0.100	66.77	4.0	15.5
21	0.177	11219	0.000	0.000	1.00	50.2	0.071	0.100	70.11	4.0	15.5
22	0.177	11219	0.000	0.000	1.00	64.0	0.050	0.100	73.45	4.0	15.5
23	0.177	11219	0.000	0.000	1.00	61.9	0.060	0.100	76.79	4.0	15.5
Toe						3.9	0.150	0.100			

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

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

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
70.00	10.81	1.00	0.800



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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	
550.7	432.9	9.50	9.49	-3.67	8 20	33.48	7 3	21.8
558.2	521.8	9.53	9.52	-3.43	8 20	33.60	7 3	21.8
565.7	632.2	9.56	9.54	-3.20	8 20	33.74	7 3	21.9
573.1	770.5	9.59	9.57	-2.99	7 20	33.87	7 3	21.8
580.6	968.7	9.60	9.59	-2.80	7 20	33.97	7 3	21.9



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Depth (ft) 75.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type Unknown
 Pile Size (inch) 12.000

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	15.50	29000.	492.0	4.0	0	16524.	27.2
76.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips)					598.4
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	0.177	11219	0.010	0.000	0.85	0.1	0.050	0.100	3.34	4.0	15.5
2	0.177	11219	0.000	0.000	1.00	1.4	0.050	0.100	6.68	4.0	15.5
3	0.177	11219	0.000	0.000	1.00	2.8	0.050	0.100	10.02	4.0	15.5
4	0.177	11219	0.000	0.000	1.00	4.2	0.050	0.100	13.35	4.0	15.5
5	0.177	11219	0.000	0.000	1.00	6.1	0.101	0.100	16.69	4.0	15.5
6	0.177	11219	0.000	0.000	1.00	7.9	0.150	0.100	20.03	4.0	15.5
7	0.177	11219	0.000	0.000	1.00	10.9	0.150	0.100	23.37	4.0	15.5
8	0.177	11219	0.000	0.000	1.00	11.1	0.155	0.100	26.71	4.0	15.5
9	0.177	11219	0.000	0.000	1.00	6.3	0.200	0.100	30.05	4.0	15.5
10	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	33.39	4.0	15.5
11	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	36.73	4.0	15.5
12	0.177	11219	0.000	0.000	1.00	9.8	0.169	0.100	40.06	4.0	15.5
13	0.177	11219	0.000	0.000	1.00	48.6	0.050	0.100	43.40	4.0	15.5
14	0.177	11219	0.000	0.000	1.00	51.0	0.050	0.100	46.74	4.0	15.5
15	0.177	11219	0.000	0.000	1.00	52.2	0.050	0.100	50.08	4.0	15.5
16	0.177	11219	0.000	0.000	1.00	54.4	0.050	0.100	53.42	4.0	15.5
17	0.177	11219	0.000	0.000	1.00	56.6	0.050	0.100	56.76	4.0	15.5
18	0.177	11219	0.000	0.000	1.00	23.2	0.149	0.100	60.10	4.0	15.5
19	0.177	11219	0.000	0.000	1.00	30.3	0.122	0.100	63.44	4.0	15.5
20	0.177	11219	0.000	0.000	1.00	62.9	0.050	0.100	66.77	4.0	15.5
21	0.177	11219	0.000	0.000	1.00	65.1	0.050	0.100	70.11	4.0	15.5
22	0.177	11219	0.000	0.000	1.00	45.1	0.106	0.100	73.45	4.0	15.5
23	0.177	11219	0.000	0.000	1.00	31.8	0.150	0.100	76.79	4.0	15.5
Toe						3.9	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
75.00	10.81	1.00	0.800

▲

FRA-70-13.01 - FA - B-014-7-20 - HP12x53
Resource International Inc

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Rut kips	Bl Ct b/ft	Stroke down	(ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
598.4	983.7	9.62	9.61	-2.26	7	20	33.38	6	3	21.6	38.2
608.5	1419.3	9.65	9.64	-2.02	7	19	33.51	6	3	21.5	38.1
618.6	2387.6	9.67	9.67	-1.90	5	36	33.62	6	3	21.5	38.1
628.7	6829.1	9.69	9.67	-1.83	5	36	33.74	6	3	21.6	38.0
638.8	9999.0	9.70	9.70	-1.76	5	17	33.79	6	3	21.5	38.0

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Depth	(ft)	76.8	Standard Soil Setup	
Shaft Gain/Loss Factor		0.400	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type	Unknown
Pile Size	(inch)	12.000		

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	15.50	29000.	492.0	4.0	0	16524.	27.2
76.8	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 9.294

Pile and Soil Model						Total Capacity Rut (kips)					615.4
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	0.177	11219	0.010	0.000	0.85	0.7	0.050	0.100	3.34	4.0	15.5
2	0.177	11219	0.000	0.000	1.00	2.1	0.050	0.100	6.68	4.0	15.5
3	0.177	11219	0.000	0.000	1.00	3.5	0.050	0.100	10.02	4.0	15.5
4	0.177	11219	0.000	0.000	1.00	4.9	0.050	0.100	13.35	4.0	15.5
5	0.177	11219	0.000	0.000	1.00	7.5	0.142	0.100	16.69	4.0	15.5
6	0.177	11219	0.000	0.000	1.00	9.1	0.150	0.100	20.03	4.0	15.5
7	0.177	11219	0.000	0.000	1.00	11.8	0.150	0.100	23.37	4.0	15.5
8	0.177	11219	0.000	0.000	1.00	8.2	0.181	0.100	26.71	4.0	15.5
9	0.177	11219	0.000	0.000	1.00	6.3	0.200	0.100	30.05	4.0	15.5

10	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	33.39	4.0	15.5
11	0.177	11219	0.000	0.000	1.00	6.4	0.200	0.100	36.73	4.0	15.5
12	0.177	11219	0.000	0.000	1.00	32.1	0.076	0.100	40.06	4.0	15.5
13	0.177	11219	0.000	0.000	1.00	49.9	0.050	0.100	43.40	4.0	15.5
14	0.177	11219	0.000	0.000	1.00	51.7	0.050	0.100	46.74	4.0	15.5
15	0.177	11219	0.000	0.000	1.00	53.4	0.050	0.100	50.08	4.0	15.5
16	0.177	11219	0.000	0.000	1.00	55.6	0.050	0.100	53.42	4.0	15.5
17	0.177	11219	0.000	0.000	1.00	39.1	0.093	0.100	56.76	4.0	15.5
18	0.177	11219	0.000	0.000	1.00	22.9	0.150	0.100	60.10	4.0	15.5
19	0.177	11219	0.000	0.000	1.00	51.5	0.069	0.100	63.44	4.0	15.5
20	0.177	11219	0.000	0.000	1.00	64.1	0.050	0.100	66.77	4.0	15.5
21	0.177	11219	0.000	0.000	1.00	60.8	0.063	0.100	70.11	4.0	15.5
22	0.177	11219	0.000	0.000	1.00	31.8	0.150	0.100	73.45	4.0	15.5
23	0.177	11219	0.000	0.000	1.00	31.8	0.150	0.100	76.79	4.0	15.5
Toe						3.9	0.150	0.100			

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

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

Depth ft	Stroke ft	Pressure Ratio	Efficy
76.79	10.81	1.00	0.800

↑
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Rut kips	Bl Ct b/ft	Stroke down	(ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
615.4	1503.3	9.66	9.65	-1.82	5	36	33.62	5	3	21.5	38.1
626.5	2825.4	9.68	9.66	-1.72	5	36	33.74	5	3	21.5	38.1
637.6	9999.0	9.70	9.69	-1.62	5	35	33.83	5	3	21.4	38.0
648.6	9999.0	9.70	9.70	-1.60	5	35	33.89	5	3	21.3	38.0
659.7	9999.0	9.72	9.70	-1.67	5	35	34.01	5	3	21.4	38.0

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SUMMARY OVER DEPTHS

Depth ft	Rut kips	G/L at Frictn kips	Shaft and End Bg kips	Toe: 0.400 Bl Ct b/ft	1.000 Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.0	2.4	1.6	0.8	0.0	0.000	0.000	10.81	0.0
10.0	7.7	6.3	1.4	Hammer did not run				
15.0	17.4	14.7	2.7	1.5	12.260	-2.094	4.09	24.3
20.0	33.8	27.7	6.1	2.5	17.448	-2.448	4.76	23.8
25.0	49.5	44.6	4.8	4.2	20.320	-1.744	5.24	22.0
30.0	59.0	54.1	4.8	5.4	21.561	-1.102	5.50	21.1
35.0	68.5	63.7	4.8	6.8	22.475	-1.134	5.70	20.3
40.0	161.9	98.1	63.8	19.3	27.439	-1.819	7.06	18.9
45.0	228.0	173.7	54.4	26.5	28.753	-2.086	7.53	19.3
50.0	297.7	252.7	45.0	39.2	30.313	-3.145	8.08	20.1
55.0	360.5	336.6	23.8	57.3	31.326	-3.466	8.53	20.7
60.0	373.7	370.9	2.8	63.8	31.683	-3.543	8.65	20.6
65.0	497.8	452.8	45.0	260.9	33.369	-4.037	9.47	22.3
70.0	550.7	546.8	3.9	432.9	33.482	-3.670	9.50	21.8
75.0	598.4	594.5	3.9	983.7	33.376	-2.262	9.62	21.6
76.8	615.4	611.5	3.9	1503.3	33.615	-1.820	9.66	21.5

Total Driving Time 240 minutes;
Starting at penetration 5.0 ft
Total No. of Blows 9288

Depth ft	Rut kips	G/L at Frictn kips	Shaft and End Bg kips	Toe: 0.450 Bl Ct b/ft	1.000 Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.0	2.4	1.6	0.8	0.0	0.000	0.000	11.86	0.0
10.0	7.7	6.3	1.4	Hammer did not run				
15.0	17.6	14.9	2.7	1.5	12.343	-2.291	4.10	24.4
20.0	34.7	28.6	6.1	2.6	17.631	-2.428	4.78	23.7
25.0	51.3	46.5	4.8	4.4	20.571	-1.558	5.29	21.9
30.0	62.0	57.2	4.8	5.8	21.924	-0.884	5.57	21.0
35.0	72.8	67.9	4.8	7.5	22.894	-0.968	5.80	20.1
40.0	166.9	103.1	63.8	20.1	27.674	-1.696	7.12	18.8
45.0	233.0	178.6	54.4	27.7	28.933	-2.198	7.58	19.3
50.0	302.6	257.7	45.0	40.6	30.569	-3.164	8.13	20.3
55.0	365.4	341.6	23.8	60.4	31.501	-3.564	8.58	20.8

60.0	380.6	377.8	2.8	68.2	31.935	-3.514	8.72	20.7
65.0	505.0	460.1	45.0	308.9	33.504	-4.023	9.52	22.4
70.0	558.2	554.3	3.9	521.8	33.603	-3.428	9.53	21.8
75.0	608.5	604.6	3.9	1419.3	33.509	-2.025	9.65	21.5
76.8	626.5	622.6	3.9	2825.4	33.736	-1.722	9.68	21.5

Total Driving Time 330 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 12696

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Resource International Inc

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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
5.0	2.4	1.6	0.8	0.0	0.000	0.000	11.86	0.0
10.0	7.7	6.3	1.4	Hammer did not run				
15.0	17.7	15.0	2.7	1.5	12.425	-2.192	4.11	24.4
20.0	35.5	29.5	6.1	2.7	17.813	-2.416	4.81	23.5
25.0	53.2	48.4	4.8	4.6	20.799	-1.368	5.33	21.7
30.0	65.1	60.2	4.8	6.2	22.219	-0.609	5.64	20.8
35.0	77.0	72.2	4.8	8.0	23.305	-1.408	5.90	20.0
40.0	171.9	108.1	63.8	20.8	27.932	-1.499	7.18	18.9
45.0	238.0	183.6	54.4	28.6	29.109	-2.306	7.64	19.4
50.0	307.6	262.7	45.0	42.4	30.761	-3.196	8.18	20.3
55.0	370.4	346.6	23.8	63.6	31.681	-3.645	8.63	20.9
60.0	387.4	384.6	2.8	72.6	32.135	-3.551	8.79	20.9
65.0	512.3	467.3	45.0	359.0	33.651	-3.957	9.56	22.3
70.0	565.7	561.8	3.9	632.2	33.738	-3.199	9.56	21.9
75.0	618.6	614.7	3.9	2387.6	33.619	-1.900	9.67	21.5
76.8	637.6	633.7	3.9	9999.0	33.835	-1.615	9.70	21.4

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
5.0	2.4	1.6	0.8	0.0	0.000	0.000	11.86	0.0
10.0	7.7	6.3	1.4	Hammer did not run				
15.0	17.8	15.2	2.7	1.5	12.479	-2.279	4.12	24.5
20.0	36.4	30.3	6.1	2.8	17.979	-2.376	4.84	23.4
25.0	55.1	50.2	4.8	4.8	21.043	-1.231	5.38	21.6
30.0	68.1	63.3	4.8	6.6	22.498	-0.421	5.71	20.6
35.0	81.3	76.4	4.8	8.5	23.692	-1.535	5.99	19.8
40.0	176.8	113.1	63.8	21.5	28.148	-1.307	7.23	18.8
45.0	243.0	188.6	54.4	29.6	29.342	-2.395	7.69	19.5
50.0	312.6	267.6	45.0	44.3	30.942	-3.213	8.24	20.4
55.0	375.4	351.6	23.8	66.4	31.878	-3.721	8.69	21.1
60.0	394.3	391.5	2.8	79.4	32.177	-3.657	8.78	20.9
65.0	519.5	474.6	45.0	420.9	33.831	-3.940	9.60	22.4
70.0	573.1	569.3	3.9	770.5	33.871	-2.988	9.59	21.8
75.0	628.7	624.8	3.9	6829.1	33.741	-1.834	9.69	21.6
76.8	648.6	644.7	3.9	9999.0	33.894	-1.601	9.70	21.3

Refusal occurred; no driving time output possible

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Resource International Inc

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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
5.0	2.4	1.6	0.8	0.0	0.000	0.000	11.86	0.0
10.0	7.7	6.3	1.4	Hammer did not run				
15.0	18.0	15.3	2.7	1.5	12.755	-2.475	4.16	24.7
20.0	37.3	31.2	6.1	2.9	18.152	-2.354	4.87	23.3
25.0	57.0	52.1	4.8	5.0	21.241	-1.092	5.42	21.4
30.0	71.2	66.4	4.8	7.1	22.653	-0.538	5.72	20.3
35.0	85.5	80.7	4.8	9.1	24.094	-1.549	6.07	19.6
40.0	181.8	118.0	63.8	22.1	28.388	-1.215	7.28	18.9
45.0	247.9	193.6	54.4	30.8	29.478	-2.510	7.74	19.5
50.0	317.6	272.6	45.0	46.0	31.192	-3.221	8.30	20.5
55.0	380.4	356.5	23.8	70.5	32.016	-3.762	8.73	21.1

60.0	401.2	398.4	2.8	85.5	32.433	-3.821	8.86	21.0
65.0	526.8	481.8	45.0	538.3	33.744	-3.897	9.54	22.2
70.0	580.6	576.7	3.9	968.7	33.966	-2.803	9.60	21.9
75.0	638.8	635.0	3.9	9999.0	33.786	-1.762	9.70	21.5
76.8	659.7	655.8	3.9	9999.0	34.011	-1.669	9.72	21.4

Refusal occurred; no driving time output possible

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Table of Depths Analyzed with Driving System Modifiers

Depth	Temp.	Wait	Equivalent	Pressure		Stiffn.	Cushion
ft	Length	Time	Stroke	Ratio	Efficy.	Factor	CoR
	ft	hr	ft				
5.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
10.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
15.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
20.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
25.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
30.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
35.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
40.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
45.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
50.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
55.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
60.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
65.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
70.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
75.00	76.79	0.00	10.81	1.00	0.80	1.00	1.00
76.79	76.79	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

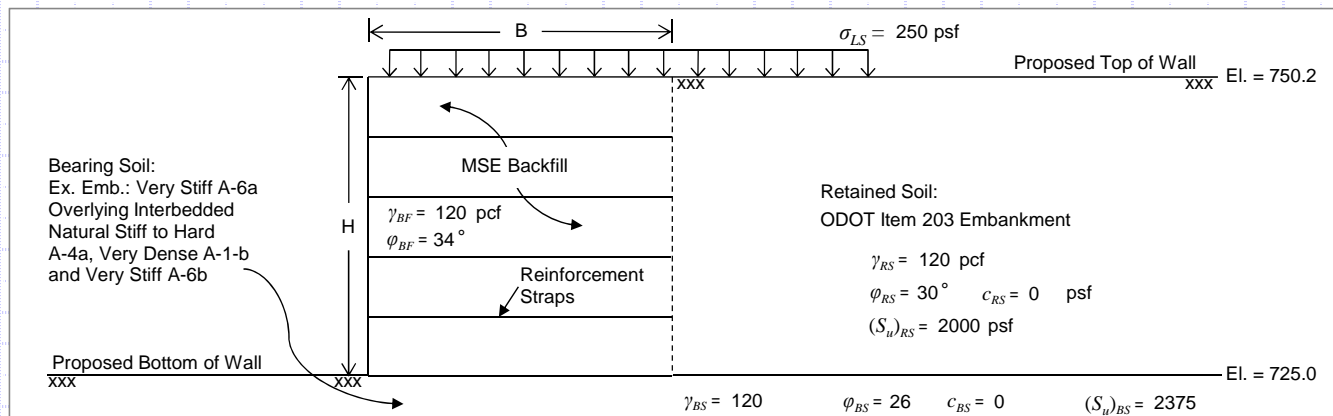
Depth	Shaft	End	Shaft	Toe	Shaft	Toe	Soil	Limit	Setup
ft	Res.	Bearing	Quake	Quake	Damping	Damping	Setup	Distance	Time
	k/ft2	kips	inch	inch	s/ft	s/ft	Normlzd	ft	hrs
0.01	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
3.00	0.09	0.47	0.100	0.100	0.050	0.150	0.000	6.000	24.000
6.00	0.19	0.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
9.00	0.28	1.42	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.00	0.38	1.43	0.100	0.100	0.050	0.150	0.000	6.000	24.000
13.89	0.44	1.43	0.100	0.100	0.050	0.150	0.000	6.000	24.000
13.91	0.99	2.66	0.100	0.100	0.150	0.150	0.667	6.000	336.000
18.99	0.99	2.66	0.100	0.100	0.150	0.150	0.667	6.000	336.000
19.01	1.49	6.05	0.100	0.100	0.150	0.150	0.667	6.000	336.000
24.49	1.49	6.05	0.100	0.100	0.150	0.150	0.667	6.000	336.000
24.51	1.19	4.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
36.50	1.21	4.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
37.99	1.23	4.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
38.01	3.56	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
41.00	3.72	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
44.00	3.89	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
44.99	3.94	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
45.01	3.86	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
48.00	4.01	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
51.00	4.16	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
54.00	4.30	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
54.99	4.35	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
55.01	2.88	2.79	0.100	0.100	0.150	0.150	0.667	6.000	336.000
60.99	2.88	2.79	0.100	0.100	0.150	0.150	0.667	6.000	336.000
61.01	4.63	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
64.00	4.78	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
67.00	4.93	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
69.59	5.05	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
69.61	4.00	3.88	0.100	0.100	0.150	0.150	0.667	6.000	336.000
76.79	4.00	3.88	0.100	0.100	0.150	0.150	0.667	6.000	336.000

APPNDIX IX

MSE WALL CALCULATIONS



Retaining Wall W4 - FRA-70-1301R - Rear Abutment - B-015-1-13 - Level Backfill - 25.2 ft. Wall Height



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	25.2 ft
MSE Wall Width (Reinforcement Length), (B) =	20.2 ft
MSE Wall Length, (L) =	88 ft
Live Surcharge Load, (σ _{LS}) =	250 psf
Retained Soil Unit Weight, (γ _{RS}) =	120 pcf
Retained Soil Friction Angle, (φ _{RS}) =	30°
Retained Soil Drained Cohesion ¹ , (c _{BS}) =	0 psf
Retained Soil Undrained Shear Strength, [(S _u) _{RS}] =	2000 psf
Retained Soil Active Earth Pressure Coeff., (K _a) =	0.297
MSE Backfill Unit Weight, (γ _{BF}) =	120 pcf
MSE Backfill Friction Angle, (φ _{BF}) =	34°

Bearing Soil Properties¹:

Bearing Soil Unit Weight, (γ _{BS}) =	120	120 pcf
Bearing Soil Friction Angle, (φ _{BS}) =	26	27°
Bearing Soil Drained Cohesion, (c _{BS}) =	0	0 psf
Bearing Soil Undrained Shear Strength, [(S _u) _{BS}] =	2375	2375 psf
Embedment Depth, (D _f) =	3.0 ft	
Depth to Groundwater (Below Bot. of Wall), (D _w) =	36.8 ft	

LRFD Load Factors

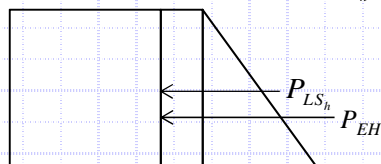
	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

¹ Soil properties for bearing resistance based on critical soil type w/ 1.5B below the bottom of wall. Soil properties for sliding resistance based on soil type w/ 3.0 ft. below the bottom of wall.

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.10.5.3

Sliding Force: $P_H = P_{EH} + P_{LS_h}$



Sliding Force at Bottom of Wall (Top of Foundation Preparation):

$$P_{EH} = \frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf}) (25.2 \text{ ft})^2 (0.297) (1.5) = 16.97 \text{ kip/ft}$$

$$P_{LS_h} = \sigma_{LS} H K_a \gamma_{LS} = (250 \text{ psf}) (25.2 \text{ ft}) (0.297) (1.75) = 3.27 \text{ kip/ft}$$

$$P_H = 16.97 \text{ kip/ft} + 3.27 \text{ kip/ft} = 20.24 \text{ kip/ft}$$

Sliding Force at Bottom of Foundation Preparation:

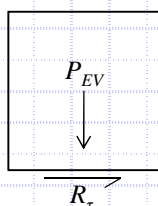
$$P_{EH} = \frac{1}{2} \gamma_{RS} (H + 1)^2 (K_a) (\gamma_{EH}) = \frac{1}{2} (120 \text{ pcf}) (25.2 \text{ ft} + 1 \text{ ft})^2 (0.297) (1.5) = 18.35 \text{ kip/ft}$$

$$P_{LS_h} = \sigma_{LS} (H + 1) (K_a) (\gamma_{LS}) = (250 \text{ psf}) (25.2 \text{ ft} + 1 \text{ ft}) (0.297) (1.75) = 3.4 \text{ kip/ft}$$

$$P_H = 18.35 \text{ kip/ft} + 3.4 \text{ kip/ft} = 21.75 \text{ kip/ft}$$

Check Sliding Resistance - Drained Condition (At Bottom of Foundation Preparation, 1.0-foot Below Bottom of Wall)

Nominal Sliding Resistance: $R_t = P_{EV} \cdot \tan \delta$



$$P_E = \gamma_{BF} (H + 1) (B) (\gamma_{EV}) = (120 \text{ pcf}) (25.2 \text{ ft} + 1 \text{ ft}) (20.2 \text{ ft}) (1.00) = 63.51 \text{ kip/ft}$$

$$\tan \delta = (\tan \phi_{BS} \leq \tan \phi_{BF}) \rightarrow \tan(27) \leq \tan(34) \rightarrow 0.51 \leq 0.67 = 0.51$$

$$R_t = (63.51 \text{ kip/ft}) (0.51) = 32.39 \text{ kip/ft}$$

Verify Sliding Force Less Than Factored Sliding Resistance - Drained Condition (Bottom of Foundation Preparation)

$$P_H \leq R_t \cdot \phi_\tau \rightarrow 21.75 \text{ kip/ft} \leq (32.39 \text{ kip/ft}) (1.0) = 32.39 \text{ kip/ft} \rightarrow 21.75 \text{ kip/ft} \leq 32.39 \text{ kip/ft}$$

Use $\phi_\tau = 1.0$ (Per AASHTO LRFD BDM Table 11.5.7-1)

OK



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	25.2 ft
MSE Wall Width (Reinforcement Length), (B) =	20.2 ft
MSE Wall Length, (L) =	88 ft
Live Surcharge Load, (σ_{LS}) =	250 psf
Retained Soil Unit Weight, (γ_{RS}) =	120 pcf
Retained Soil Friction Angle, (ϕ_{RS}) =	30°
Retained Soil Drained Cohesion, (c_{BS}) =	0 psf
Retained Soil Undrained Shear Strength, [$(s_u)_{RS}$] =	2000 psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.297
MSE Backfill Unit Weight, (γ_{BF}) =	120 pcf
MSE Backfill Friction Angle, (ϕ_{BF}) =	34°

Bearing Soil Properties ¹:

	Bearing	Sliding
Bearing Soil Unit Weight, (γ_{BS}) =	120	120 pcf
Bearing Soil Friction Angle, (ϕ_{BS}) =	26	27°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	0 psf
Bearing Soil Undrained Shear Strength, [$(s_u)_{BS}$] =	2375	2375 psf
Embedment Depth, (D_f) =	3.0 ft	
Depth to Grounwater (Below Bot. of Wall), (D_w) =	36.8 ft	

LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

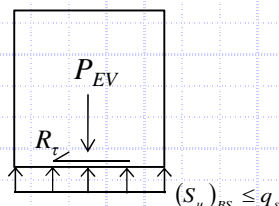
(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

1. Soil properties for bearing resistance based on critical soil type w/ 1.5B below the bottom of wall. Soil properties for sliding resistance based on soil type w/ 3.0 ft. below the bottom of wall.

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.10.5.3 (Continued)

Check Sliding Resistance - Undrained Condition (At Bottom of Foundation Preparation, 1.0-foot Below Bottom of Wall)

Nominal Sliding Resisting:



$$R_{\tau} = ((S_u)_{BS} \leq q_s) \cdot B$$

$$(S_u)_{BS} = 2.38 \text{ ksf}$$

$$q_s = \frac{\sigma_v}{2} = (3.14 \text{ ksf}) / 2 = 1.57 \text{ ksf}$$

$$\sigma_v = \frac{P_{EV}}{B} = (63.51 \text{ kip/ft}) / (20.2 \text{ ft}) = 3.14 \text{ ksf}$$

$$R_{\tau} = (2.38 \text{ ksf} \leq 1.57 \text{ ksf})(20.2 \text{ ft}) = 31.71 \text{ kip/ft}$$

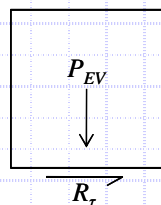
Verify Sliding Force Less Than Factored Sliding Resistance - Undrained Condition (Bottom of Foundation Preparation)

$$P_H \leq R_{\tau} \cdot \phi_{\tau} \rightarrow 21.75 \text{ kip/ft} \leq (31.71 \text{ kip/ft})(1.0) = 31.71 \text{ kip/ft} \rightarrow 21.75 \text{ kip/ft} \leq 31.71 \text{ kip/ft} \quad \text{OK}$$

Use $\phi_{\tau} = 1.0$ (Per AASHTO LRFD BDM Table 11.5.7-1)

Check Sliding Resistance - Drained Condition (At Bottom of Wall, Top of Foundation Preparation)

Nominal Sliding Resistance:



$$R_{\tau} = P_{EV} \cdot \tan \delta$$

$$P_{EV} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV} = (120 \text{ pcf})(25.2 \text{ ft})(20.2 \text{ ft})(1.00) = 61.08 \text{ kip/ft}$$

$$\tan \delta = (\tan \phi_{BS} \leq \tan \phi_{BF})$$

$$\tan \delta = \tan(34) \leq \tan(34) \rightarrow 0.67 \leq 0.67 \rightarrow \tan \delta = 0.67$$

$$R_{\tau} = (61.08 \text{ kip/ft})(0.67) = 40.92 \text{ kip/ft}$$

Verify Sliding Force Less Than Factored Sliding Resistance - Drained Condition (Bottom of Wall)

$$P_H \leq R_{\tau} \cdot \phi_{\tau} \rightarrow 20.24 \text{ kip/ft} \leq (40.92 \text{ kip/ft})(1.0) = 40.92 \text{ kip/ft} \rightarrow 20.24 \text{ kip/ft} \leq 40.92 \text{ kip/ft} \quad \text{OK}$$

Use $\phi_{\tau} = 1.0$ (Per AASHTO LRFD BDM Table 11.5.7-1)



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	25.2 ft
MSE Wall Width (Reinforcement Length), (B) =	20.2 ft
MSE Wall Length, (L) =	88 ft
Live Surcharge Load, (σ_{LS}) =	250 psf
Retained Soil Unit Weight, (γ_{RS}) =	120 pcf
Retained Soil Friction Angle, (ϕ_{RS}) =	30°
Retained Soil Drained Cohesion, (c_{BS}) =	0 psf
Retained Soil Undrained Shear Strength, [$(s_u)_{RS}$] =	2000 psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.297
MSE Backfill Unit Weight, (γ_{BF}) =	120 pcf
MSE Backfill Friction Angle, (ϕ_{BF}) =	34°

Bearing Soil Properties ¹:

	Bearing	Sliding
Bearing Soil Unit Weight, (γ_{BS}) =	120	120 pcf
Bearing Soil Friction Angle, (ϕ_{BS}) =	26	27°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	0 psf
Bearing Soil Undrained Shear Strength, [$(s_u)_{BS}$] =	2375	2375 psf
Embedment Depth, (D_f) =	3.0 ft	
Depth to Grounwater (Below Bot. of Wall), (D_w) =	36.8 ft	

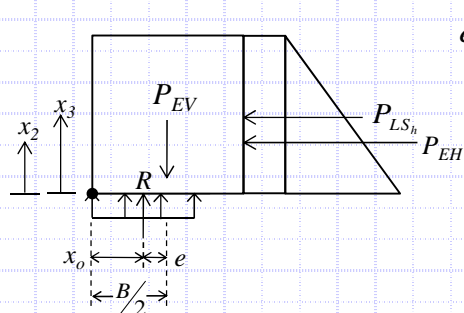
LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

1. Soil properties for bearing resistance based on critical soil type w/ 1.5B below the bottom of wall. Soil properties for sliding resistance based on soil type w/ 3.0 ft. below the bottom of wall.

Check Eccentricity (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.10.5.5



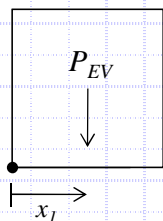
$$e = B/2 - x_o$$

$$x_o = \frac{M_{EV} - M_H}{P_{EV}} = (616.91 \text{ kip-ft/ft} - 183.75 \text{ kip-ft/ft}) / (61.08 \text{ kip/ft}) = 7.09 \text{ ft}$$

$$\begin{aligned} M_{EV} &= 616.91 \text{ kip-ft/ft} \\ M_H &= 183.75 \text{ kip-ft/ft} \\ P_{EV} &= 61.08 \text{ kip/ft} \end{aligned} \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} \text{Defined below}$$

$$e = (20.2 \text{ ft})/2 - 7.09 \text{ ft} = 3.01 \text{ ft}$$

Resisting Moment, M_{EV} :



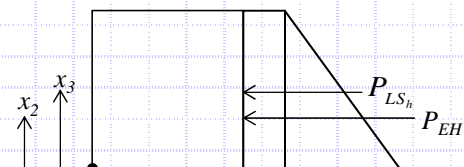
$$M_{EV} = P_{EV}(x_1)$$

$$P_{EV} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV} = (120 \text{ pcf})(25.2 \text{ ft})(20.2 \text{ ft})(1.00) = 61.08 \text{ kip/ft}$$

$$x_1 = B/2 = (20.2 \text{ ft})/2 = 10.10 \text{ ft}$$

$$M_{EV} = (61.08 \text{ kip/ft})(10.10 \text{ ft}) = 616.91 \text{ kip-ft/ft}$$

Overturning Moment, M_H :



$$M_H = P_{EH}(x_2) + P_{LS_h}(x_3)$$

$$P_{EH} = \frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH} = \frac{1}{2}(120 \text{ pcf})(25.2 \text{ ft})^2(0.297)(1.5) = 16.97 \text{ kip/ft}$$

$$P_{LS_h} = \sigma_{LS} H K_a \gamma_{LS} = (250 \text{ psf})(25.2 \text{ ft})(0.297)(1.75) = 3.27 \text{ kip/ft}$$

$$x_2 = H/3 = (25.2 \text{ ft})/3 = 8.40 \text{ ft}$$

$$x_3 = H/2 = (25.2 \text{ ft})/2 = 12.60 \text{ ft}$$

$$M_H = (16.97 \text{ kip/ft})(8.4 \text{ ft}) + (3.27 \text{ kip/ft})(12.60 \text{ ft}) = 183.75 \text{ kip-ft/ft}$$

Check Eccentricity

$$e < e_{\max} \rightarrow 3.01 \text{ ft} < 6.73 \text{ ft} \quad \text{OK}$$

$$\text{Limiting Eccentricity: } e_{\max} = B/3 \rightarrow e_{\max} = (20.2 \text{ ft})/3 = 6.73 \text{ ft}$$



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	25.2 ft
MSE Wall Width (Reinforcement Length), (B) =	20.2 ft
MSE Wall Length, (L) =	88 ft
Live Surcharge Load, (σ_{LS}) =	250 psf
Retained Soil Unit Weight, (γ_{RS}) =	120 pcf
Retained Soil Friction Angle, (ϕ_{RS}) =	30°
Retained Soil Drained Cohesion, (c_{BS}) =	0 psf
Retained Soil Undrained Shear Strength, [$(s_u)_{RS}$] =	2000 psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.297
MSE Backfill Unit Weight, (γ_{BF}) =	120 pcf
MSE Backfill Friction Angle, (ϕ_{BF}) =	34°

Bearing Soil Properties ¹:

	Bearing	Sliding
Bearing Soil Unit Weight, (γ_{BS}) =	120	120 pcf
Bearing Soil Friction Angle, (ϕ_{BS}) =	26	27°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	0 psf
Bearing Soil Undrained Shear Strength, [$(s_u)_{BS}$] =	2375	2375 psf
Embedment Depth, (D_f) =	3.0 ft	
Depth to Groundwater (Below Bot. of Wall), (D_w) =	36.8 ft	

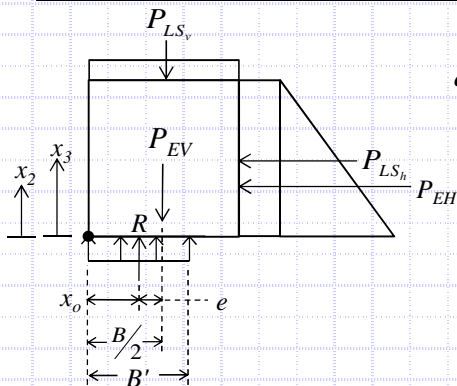
LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

1. Soil properties for bearing resistance based on critical soil type w/ 1.5B below the bottom of wall. Soil properties for sliding resistance based on soil type w/ 3.0 ft. below the bottom of wall.

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.10.5.4



$$q_{eq} = \frac{P_v}{B'}$$

$$B' = B - 2e = 20.2 \text{ ft} - 2(2.01 \text{ ft}) = 16.18 \text{ ft}$$

$$e = \frac{B}{2} - x_o = (20.2 \text{ ft}) / 2 - 8.09 \text{ ft} = 2.01 \text{ ft}$$

$$x_o = \frac{M_v - M_H}{P_v} = (922.15 \text{ kip-ft/ft} - 183.84 \text{ kip-ft/ft}) / 91.3 \text{ kip/ft} = 8.09 \text{ ft}$$

$$q_{eq} = (91.3 \text{ kip/ft}) / (16.18 \text{ ft}) = 5.64 \text{ ksf}$$

$$M_v = P_{EV}(x_1) + P_{LS_v}(x_1) = (\gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV})(x_1) + (\sigma_{LS} \cdot B \cdot \gamma_{LS})(x_1)$$

$$M_v = [(120 \text{ pcf})(25.2 \text{ ft})(20.2 \text{ ft})(1.35)](10.1 \text{ ft}) + [(250 \text{ psf})(20.2 \text{ ft})(1.75)](10.1 \text{ ft}) = 922.15 \text{ kip-ft/ft}$$

$$M_H = P_{EH}(x_2) + P_{LS_h}(x_3) = \left(\frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH}\right)(x_2) + (\sigma_{LS} H K_a \gamma_{LS})(x_3)$$

$$M_H = \left[\frac{1}{2}(120 \text{ pcf})(25.2 \text{ ft})^2(0.297)(1.5)\right](8.4 \text{ ft}) + [(250 \text{ psf})(25.2 \text{ ft})(0.297)(1.75)](12.6 \text{ ft}) = 183.84 \text{ kip-ft/ft}$$

$$P_v = P_{EV} + P_{LS} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV} + \sigma_{LS} \cdot B \cdot \gamma_{LS}$$

$$P_v = (120 \text{ pcf})(25.2 \text{ ft})(20.2 \text{ ft})(1.35) + (250 \text{ psf})(20.2 \text{ ft})(1.75) = 91.3 \text{ kip/ft}$$

Check Bearing Resistance - Drained Condition

$$\text{Nominal Bearing Resistance: } q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \frac{1}{2} \gamma B N_{\gamma m} C_{w\gamma}$$

$$N_{cm} = N_c s_c i_c =$$

$$N_{qm} = N_q s_q d_q i_q =$$

$$N_{\gamma m} = N_\gamma s_\gamma i_\gamma =$$

$$N_c =$$

$$s_c =$$

$$i_c =$$

$$i_c =$$

$$N_q =$$

$$s_q =$$

$$d_q =$$

$$i_q =$$

$$C_{wq} =$$

$$N_\gamma =$$

$$s_\gamma =$$

$$i_\gamma =$$

$$C_{w\gamma} =$$

$$q_n = 24.00 \text{ ksf} \quad (\text{Bearing Resistance Determined Using Limit Equilibrium Methodology, See Attached Results})$$

Verify Equivalent Pressure Less Than Factored Bearing Resistance

Use $\phi_b = 0.65$ (Per AASHTO LRFD BDM Table 11.5.7-1)

$$q_{eq} \leq q_n \cdot \phi_b \rightarrow 5.64 \text{ ksf} \leq (24.00 \text{ ksf})(0.65) = 15.60 \text{ ksf} \rightarrow 5.64 \text{ ksf} \leq 15.60 \text{ ksf}$$

OK



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	25.2 ft
MSE Wall Width (Reinforcement Length), (B) =	20.2 ft
MSE Wall Length, (L) =	88 ft
Live Surcharge Load, (σ_{LS}) =	250 psf
Retained Soil Unit Weight, (γ_{RS}) =	120 pcf
Retained Soil Friction Angle, (ϕ_{RS}) =	30°
Retained Soil Drained Cohesion, (c_{BS}) =	0 psf
Retained Soil Undrained Shear Strength, [$(s_u)_{RS}$] =	2000 psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.297
MSE Backfill Unit Weight, (γ_{BF}) =	120 pcf
MSE Backfill Friction Angle, (ϕ_{BF}) =	34°

Bearing Soil Properties ¹:

	Bearing	Sliding
Bearing Soil Unit Weight, (γ_{BS}) =	120	120 pcf
Bearing Soil Friction Angle, (ϕ_{BS}) =	26	27°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	0 psf
Bearing Soil Undrained Shear Strength, [$(s_u)_{BS}$] =	2375	2375 psf
Embedment Depth, (D_f) =	3.0 ft	
Depth to Groundwater (Below Bot. of Wall), (D_w) =	36.8 ft	

LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

1. Soil properties for bearing resistance based on critical soil type w/ 1.5B below the bottom of wall. Soil properties for sliding resistance based on soil type w/ 3.0 ft. below the bottom of wall.

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.10.5.4 (Continued)

Check Bearing Resistance - Undrained Condition

$$\text{Nominal Bearing Resistance: } q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \frac{1}{2} \gamma B N_{\gamma m} C_{w\gamma}$$

$$N_{cm} = N_c s_c i_c =$$

$$\begin{aligned} N_c &= \\ s_c &= \\ i_c &= \end{aligned}$$

$$N_{qm} = N_q s_q d_q i_q =$$

$$\begin{aligned} N_q &= \\ s_q &= \\ d_q &= \\ i_q &= \\ C_{wq} &= \end{aligned}$$

$$N_{\gamma m} = N_{\gamma} s_{\gamma} i_{\gamma} =$$

$$\begin{aligned} N_{\gamma} &= \\ s_{\gamma} &= \\ i_{\gamma} &= \\ C_{w\gamma} &= \end{aligned}$$

$$q_n = 14.05 \text{ ksf} \quad (\text{Bearing Resistance Determined Using Limit Equilibrium Methodology, See Attached Results})$$

Verify Equivalent Pressure Less Than Factored Bearing Resistance

$$q_{eq} \leq q_n \cdot \phi_b \rightarrow 5.64 \text{ ksf} \leq (14.05 \text{ ksf})(0.65) = 9.13 \text{ ksf} \rightarrow 5.64 \text{ ksf} \leq 9.13 \text{ ksf} \quad \text{OK}$$

$$\text{Use } \phi_b = 0.65 \quad (\text{Per AASHTO LRFD BDM Table 11.5.7-1})$$



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	25.2 ft
MSE Wall Width (Reinforcement Length), (B) =	20.2 ft
MSE Wall Length, (L) =	88 ft
Live Surcharge Load, (σ_{LS}) =	250 psf
Retained Soil Unit Weight, (γ_{RS}) =	120 pcf
Retained Soil Friction Angle, (ϕ_{RS}) =	30 °
Retained Soil Drained Cohesion, (c_{BS}) =	0 psf
Retained Soil Undrained Shear Strength, [$(s_u)_{RS}$] =	2000 psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.297
MSE Backfill Unit Weight, (γ_{BF}) =	120 pcf
MSE Backfill Friction Angle, (ϕ_{BF}) =	34 °

Bearing Soil Properties ¹:

	Bearing	Sliding
Bearing Soil Unit Weight, (γ_{BS}) =	120	120 pcf
Bearing Soil Friction Angle, (ϕ_{BS}) =	26	27 °
Bearing Soil Drained Cohesion, (c_{BS}) =	0	0 psf
Bearing Soil Undrained Shear Strength, [$(s_u)_{BS}$] =	2375	2375 psf
Embedment Depth, (D_f) =	3.0 ft	
Depth to Groundwater (Below Bot. of Wall), (D_w) =	36.8 ft	

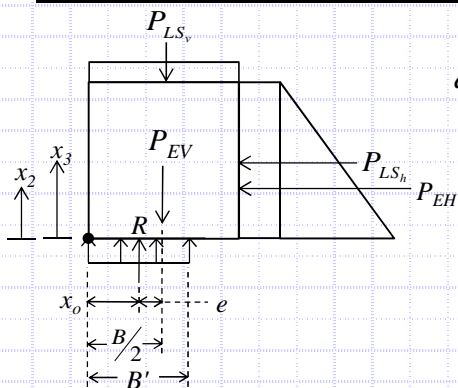
LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

1. Soil properties for bearing resistance based on critical soil type w/ 1.5B below the bottom of wall. Soil properties for sliding resistance based on soil type w/ 3.0 ft. below the bottom of wall.

Settlement Analysis (Loading Case - Service I) - AASHTO LRFD BDM Section 11.10.4.1



$$q_{eq} = P_v / B'$$

$$B' = B - 2e = 20.2 \text{ ft} - 2(1.79 \text{ ft}) = 16.62 \text{ ft}$$

$$e = \frac{B}{2} - x_o = (20.2 \text{ ft}) / 2 - 8.31 \text{ ft} = 1.79 \text{ ft}$$

$$x_o = \frac{M_v - M_H}{P_v} = (667.96 \text{ kip-ft/ft} - 118.63 \text{ kip-ft/ft}) / 66.13 \text{ kip/ft} = 8.31 \text{ ft}$$

$$q_{eq} = (66.13 \text{ kip/ft}) / (16.62 \text{ ft}) = 3.98 \text{ ksf}$$

$$M_v = P_{EV}(x_1) + P_{LS_v}(x_1) = (\gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV})(x_1) + (\sigma_{LS} \cdot B \cdot \gamma_{LS})(x_1)$$

$$M_v = [(120 \text{ pcf})(25.2 \text{ ft})(20.2 \text{ ft})(1.00)](10.1 \text{ ft}) + [(250 \text{ psf})(20.2 \text{ ft})(1.00)](10.1 \text{ ft}) = 667.96 \text{ kip-ft/ft}$$

$$M_H = P_{EH}(x_2) + P_{LS_h}(x_3) = (\frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH})(x_2) + (\sigma_{LS} H K_a \gamma_{LS})(x_3)$$

$$M_H = [\frac{1}{2}(120 \text{ pcf})(25.2 \text{ ft})^2(0.297)(1.00)](8.4 \text{ ft}) + [(250 \text{ psf})(25.2 \text{ ft})(0.297)(1.00)](12.6 \text{ ft}) = 118.63 \text{ kip-ft/ft}$$

$$P_v = P_{EV} + P_{LS} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV} + \sigma_{LS} \cdot B \cdot \gamma_{LS}$$

$$P_v = (120 \text{ pcf})(25.2 \text{ ft})(20.2 \text{ ft})(1.00) + (250 \text{ psf})(20.2 \text{ ft})(1.00) = 66.13 \text{ kip/ft}$$

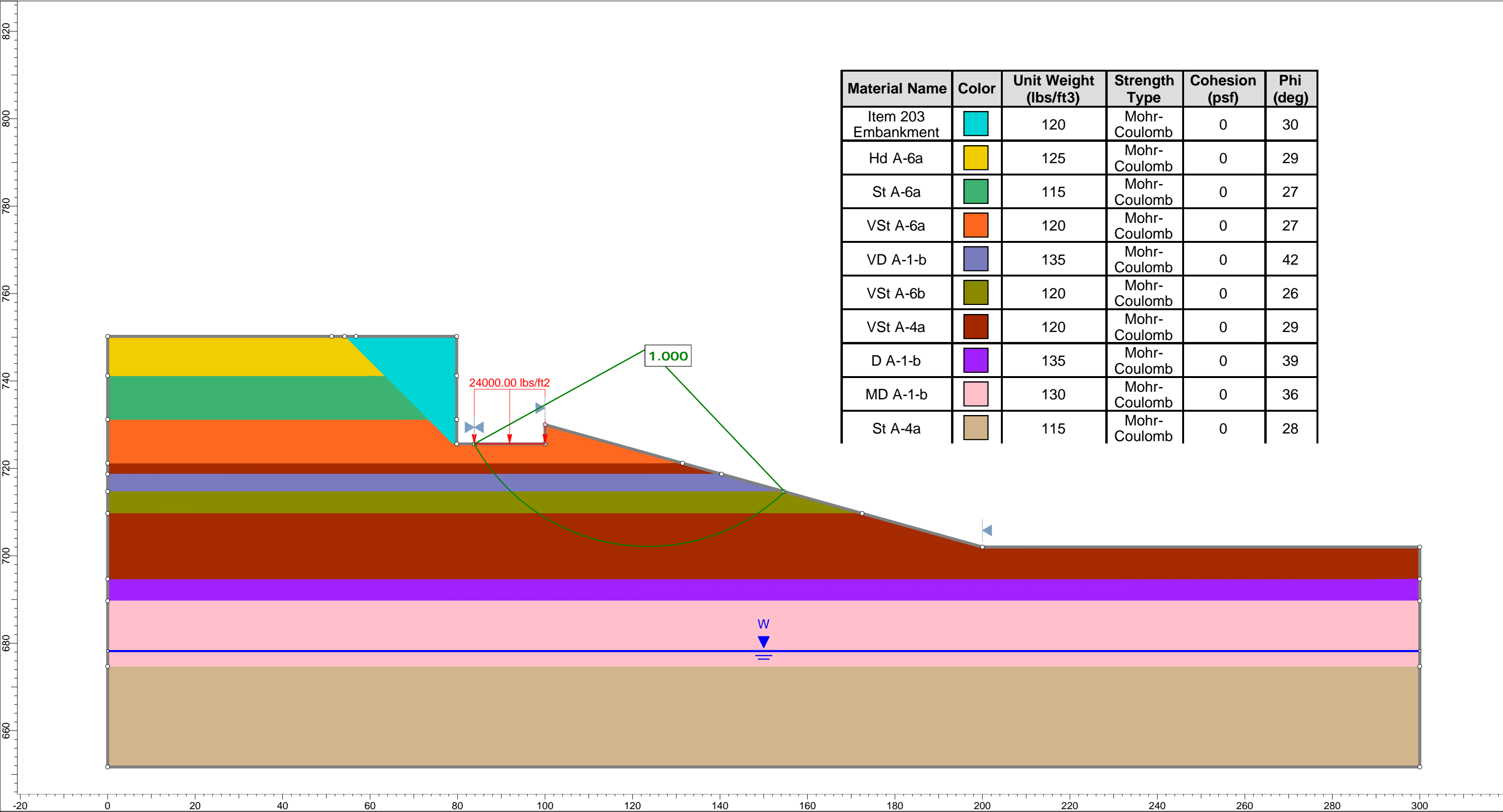
Settlement:

$$\text{Total Settlement at Center of Reinforced Soil Mass: } S_r = 2.904 \text{ in}$$

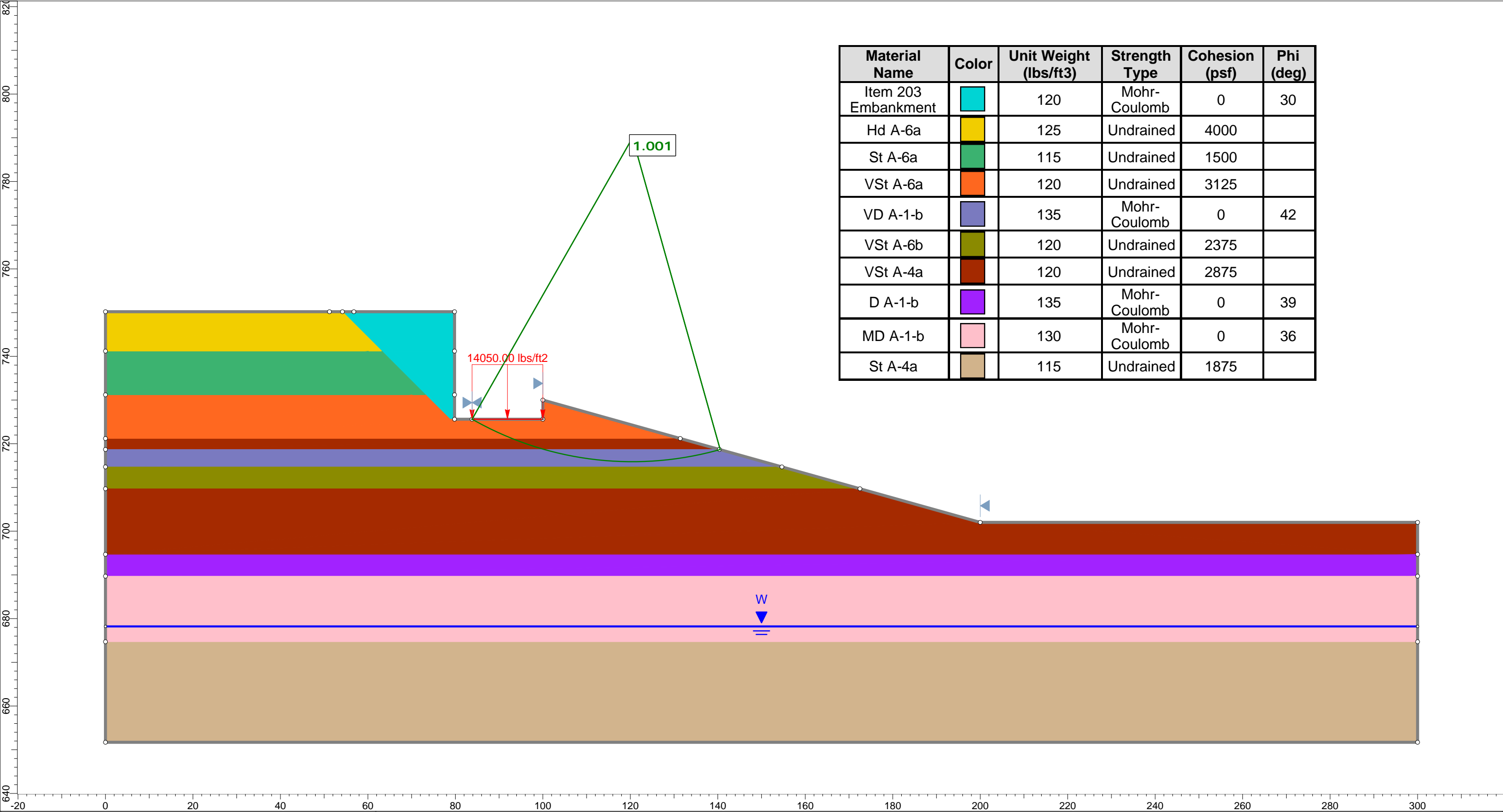
$$\text{Total Settlement at Wall Facing: } S_l = 1.827 \text{ in}$$

Time Rate of Consolidation and Downdrag Depths and Loads:

Hold Period	Degree of Consolidation	Settlement Remaining at Completion of Hold Period	Depth of Downdrag
24 days	90 %	0.182 in	0.0 ft



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Item 203 Embankment	<div></div>	120	Mohr-Coulomb	0	30
Hd A-6a	<div></div>	125	Mohr-Coulomb	0	29
St A-6a	<div></div>	115	Mohr-Coulomb	0	27
VSt A-6a	<div></div>	120	Mohr-Coulomb	0	27
VD A-1-b	<div></div>	135	Mohr-Coulomb	0	42
VSt A-6b	<div></div>	120	Mohr-Coulomb	0	26
VSt A-4a	<div></div>	120	Mohr-Coulomb	0	29
D A-1-b	<div></div>	135	Mohr-Coulomb	0	39
MD A-1-b	<div></div>	130	Mohr-Coulomb	0	36
St A-4a	<div></div>	115	Mohr-Coulomb	0	28



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Item 203 Embankment		120	Mohr-Coulomb	0	30
Hd A-6a		125	Undrained	4000	
St A-6a		115	Undrained	1500	
VSt A-6a		120	Undrained	3125	
VD A-1-b		135	Mohr-Coulomb	0	42
VSt A-6b		120	Undrained	2375	
VSt A-4a		120	Undrained	2875	
D A-1-b		135	Mohr-Coulomb	0	39
MD A-1-b		130	Mohr-Coulomb	0	36
St A-4a		115	Undrained	1875	

W-20-025 - FRA-70-13.01 - Retaining Wall W4
MSE Wall Settlement - Rear Abutment

Calculated By: BRT Date: 10/22/2021
Checked By: JPS Date: 10/22/2021

Boring B-015-1-13

H= 25.2 ft Total wall height
B'= 16.6 ft Effective footing width due to eccentricity
D_w= 36.8 ft Depth below bottom of footing
q_b = 3,980 psf Equivalent bearing pressure at bottom of wall

																					Total Settlement at Center of Reinforced Soil Mass					Total Settlement at Facing of Wall					
Layer	Soil Class.	Soil Type	Layer Depth (ft)		Elevation (ft msl)		Layer Thickness H (ft)	Depth to Midpoint (ft)	γ (pcf)	σ _{vo} Bottom (psf)	σ _{vo} Midpoint (psf)	σ _{vo} ' Midpoint (psf)	σ _p ' ⁽¹⁾ (psf)	LL	C _c ⁽²⁾	C _r ⁽³⁾	e _o ⁽⁴⁾	N ₆₀	(N1) ₆₀ ⁽⁵⁾	C' ⁽⁶⁾	Z _r /B	I ⁽⁷⁾	Δσ _v ⁽⁸⁾ (psf)	σ _{vf} ' Midpoint (psf)	S _c ^(9,10) (ft)	S _c (in)	I ⁽⁷⁾	Δσ _v ⁽⁸⁾ (psf)	σ _{vf} ' Midpoint (psf)	S _c ^(9,10) (ft)	S _c (in)
1	A-6a	C	0.0	3.0	725.0	722.0	3.0	1.5	120	360	180	180	2,680	27	0.080	0.016	0.355				0.09	0.998	3,970	4,150	0.075	0.902	0.500	1,989	2,169	0.038	0.460
	A-6a	C	3.0	6.3	722.0	718.7	3.3	4.7	120	756	558	558	3,058	27	0.080	0.016	0.355				0.28	0.946	3,766	4,324	0.058	0.697	0.496	1,973	2,531	0.026	0.307
2	A-1-b	G	6.3	10.3	718.7	714.7	4.0	8.3	135	1,296	1,026	1,026	3,526					69	85	357	0.50	0.818	3,257	4,283	0.007	0.083	0.480	1,909	2,935	0.005	0.061
3	A-6b	C	10.3	12.8	714.7	712.2	2.5	11.6	120	1,596	1,446	1,446	3,946	37	0.109	0.023	0.563				0.70	0.698	2,780	4,226	0.021	0.255	0.456	1,814	3,260	0.013	0.156
	A-6b	C	12.8	15.3	712.2	709.7	2.5	14.1	120	1,896	1,746	1,746	4,246	37	0.109	0.023	0.563				0.85	0.618	2,462	4,208	0.014	0.169	0.433	1,725	3,471	0.011	0.132
4	A-4a	C	15.3	20.3	709.7	704.7	5.0	17.8	120	2,496	2,196	2,196	4,696	26	0.137	0.018	0.698				1.07	0.522	2,076	4,272	0.015	0.184	0.398	1,583	3,779	0.012	0.150
	A-4a	C	20.3	25.3	704.7	699.7	5.0	22.8	120	3,096	2,796	2,796	5,296	26	0.137	0.018	0.698				1.37	0.427	1,699	4,495	0.011	0.131	0.352	1,400	4,196	0.009	0.112
	A-4a	C	25.3	30.3	699.7	694.7	5.0	27.8	120	3,696	3,396	3,396	5,896	26	0.137	0.018	0.698				1.67	0.359	1,430	4,826	0.008	0.097	0.311	1,240	4,636	0.007	0.086
5	A-1-b	G	30.3	35.3	694.7	689.7	5.0	32.8	135	4,371	4,034	4,034	6,534					49	38	122	1.98	0.309	1,231	5,264	0.005	0.057	0.277	1,104	5,137	0.004	0.052
6	A-1-b	G	35.3	42.8	689.7	682.2	7.5	39.1	130	5,346	4,859	4,718	7,218					30	21	77	2.35	0.263	1,046	5,764	0.008	0.101	0.243	965	5,683	0.008	0.094
	A-1-b	G	42.8	50.3	682.2	674.7	7.5	46.6	130	6,321	5,834	5,225	7,725					30	20	75	2.80	0.222	885	6,110	0.007	0.081	0.210	835	6,060	0.006	0.077
7	A-4a	C	50.3	58.3	674.7	666.7	8.0	54.3	115	7,241	6,781	5,689	8,189	21	0.099	0.015	0.436				3.27	0.192	763	6,452	0.005	0.054	0.183	730	6,419	0.004	0.052
	A-4a	C	58.3	66.3	666.7	658.7	8.0	62.3	115	8,161	7,701	6,110	8,610	21	0.099	0.015	0.436				3.75	0.168	667	6,777	0.004	0.045	0.162	645	6,755	0.004	0.043
	A-4a	C	66.3	76.6	658.7	648.4	10.3	71.5	115	9,346	8,753	6,591	9,091	21	0.099	0.015	0.436				4.30	0.147	583	7,175	0.004	0.047	0.143	568	7,160	0.004	0.046
1. σ _p ' = σ _{vo} ' + σ _m ; Use σ _m = 2,500 psf based on consolidation test results																					Total Settlement:			2.904 in		Total Settlement:			1.827 in		

1. $\sigma_p' = \sigma_{vo}' + \sigma_m$; Use $\sigma_m = 2,500$ psf based on consolidation test results
2. Used actual values from consolidation test results where applicable; For all other layers, used $C_c = 0.009(LL-10)$; Ref. Table 6-9, FHWA GEC 5
3. Used actual values from consolidation test results where applicable; For all other layers, used $C_r = 0.15(C_c)$ for natural soil deposits; Ref. Section 8.11, Holtz and Kovacs 1981
4. Used actual values from consolidation test results where applicable; For all other layers, used $e_o = (C_c/1.15)+0.35$; Ref. Table 8-2, Holtz and Kovacs 1981
5. $(N1)_{60} = C_n N_{60}$, where $C_n = [0.77\log(40/\sigma_{vo}')] \leq 2.0$ ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS
7. Influence factor for strip loaded footing
8. $\Delta\sigma_v = q_b(I)$
9. $S_c = [C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_{vo}')$ for $\sigma_p' \leq \sigma_{vo}' < \sigma_{vf}'$; $[C_r/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')$ for $\sigma_{vo}' < \sigma_{vf}' \leq \sigma_p'$; $[C_r/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}') + [C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_p')$ for $\sigma_{vo}' < \sigma_p' < \sigma_{vf}'$; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesive soil layers)
10. $S_c = H(1/C')\log(\sigma_{vf}'/\sigma_{vo}')$; Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)

W-20-025 - FRA-70-13.01 - Retaining Wall W4
MSE Wall Settlement - Rear Abutment

Calculated By: BRT

Checked By: JPS

Date: 10/22/2021

Date: 10/22/2021

Boring B-015-1-13

H=

25.2

ft

Total wall height

B'=

16.6

ft

Effective footing width due to eccentricity

D_w=

36.8

ft

Depth below bottom of footing

q_b =

3,980

psf

Equivalent bearing pressure at bottom of wall

t =

24

days

Time following completion of construction

																									Total Settlement at Facing of Wall			Settlement Complete at 90% of Primary Consolidation					
Layer	Soil Class.	Soil Type	Layer Depth (ft)		Elevation (ft msl)		Layer Thickness (ft)	Depth to Midpoint (ft)	γ (pcf)	σ _{vo} Bottom (psf)	σ _{vo} Midpoint (psf)	σ _{vo} ' Midpoint (psf)	σ _p ⁽¹⁾ (psf)	LL	C _c ⁽²⁾	C _r ⁽³⁾	e _o ⁽⁴⁾	N ₆₀	(N1) ₆₀ ⁽⁵⁾	C' ⁽⁶⁾	Z _r /B	I _r ⁽⁷⁾	Δσ _v ⁽⁸⁾ (psf)	σ _v ' Midpoint (psf)	S _c ^(9,10) (ft)	S _c (in)	Layer Settlement (in)	c _v (ft²/yr)	H _{dr} (ft)	T _v	U (%)	(S _o) _t ⁽¹¹⁾ (in)	Layer Settlement (in)
1	A-6a	C	0.0	3.0	725.0	722.0	3.0	1.5	120	360	180	180	2,680	27	0.080	0.016	0.355				0.09	0.500	1,989	2,169	0.038	0.460	0.767	200	3.0	1.461	98	0.450	0.745
	A-6a	C	3.0	6.3	722.0	718.7	3.3	4.7	120	756	558	558	3,058	27	0.080	0.016	0.355				0.28	0.496	1,973	2,531	0.026	0.307		200	3.3	1.208	96	0.295	
2	A-1-b	G	6.3	10.3	718.7	714.7	4.0	8.3	135	1,296	1,026	1,026	3,526					69	85	357	0.50	0.480	1,909	2,935	0.005	0.061	0.061				100	0.061	0.061
3	A-6b	C	10.3	12.8	714.7	712.2	2.5	11.6	120	1,596	1,446	1,446	3,946	37	0.109	0.023	0.563				0.70	0.456	1,814	3,260	0.013	0.156	0.288	175	2.5	1.841	99	0.154	0.252
	A-6b	C	12.8	15.3	712.2	709.7	2.5	14.1	120	1,896	1,746	1,746	4,246	37	0.109	0.023	0.563				0.85	0.433	1,725	3,471	0.011	0.132		175	5.0	0.460	74	0.097	
4	A-4a	C	15.3	20.3	709.7	704.7	5.0	17.8	120	2,496	2,196	2,196	4,696	26	0.137	0.018	0.698				1.07	0.398	1,583	3,779	0.012	0.150	0.348	400	7.5	0.468	74	0.111	0.280
	A-4a	C	20.3	25.3	704.7	699.7	5.0	22.8	120	3,096	2,796	2,796	5,296	26	0.137	0.018	0.698				1.37	0.352	1,400	4,196	0.009	0.112		400	7.5	0.468	74	0.083	
	A-4a	C	25.3	30.3	699.7	694.7	5.0	27.8	120	3,696	3,396	3,396	5,896	26	0.137	0.018	0.698				1.67	0.311	1,240	4,636	0.007	0.086		400	2.5	4.208	100	0.086	
5	A-1-b	G	30.3	35.3	694.7	689.7	5.0	32.8	135	4,371	4,034	4,034	6,534					49	38	122	1.98	0.277	1,104	5,137	0.004	0.052	0.052				100	0.052	0.052
6	A-1-b	G	35.3	42.8	689.7	682.2	7.5	39.1	130	5,346	4,859	4,718	7,218					30	21	77	2.35	0.243	965	5,683	0.008	0.094	0.171				100	0.094	0.171
	A-1-b	G	42.8	50.3	682.2	674.7	7.5	46.6	130	6,321	5,834	5,225	7,725					30	20	75	2.80	0.210	835	6,060	0.006	0.077					100	0.077	
7	A-4a	C	50.3	58.3	674.7	666.7	8.0	54.3	115	7,241	6,781	5,689	8,189	21	0.099	0.015	0.436				3.27	0.183	730	6,419	0.004	0.052	0.141	400	4.0	1.644	99	0.052	0.085
	A-4a	C	58.3	66.3	666.7	658.7	8.0	62.3	115	8,161	7,701	6,110	8,610	21	0.099	0.015	0.436				3.75	0.162	645	6,755	0.004	0.043		400	12.0	0.183	48	0.021	
	A-4a	C	66.3	76.6	658.7	648.4	10.3	71.5	115	9,346	8,753	6,591	9,091	21	0.099	0.015	0.436				4.30	0.143	568	7,160	0.004	0.046		400	21.2	0.059	27	0.012	

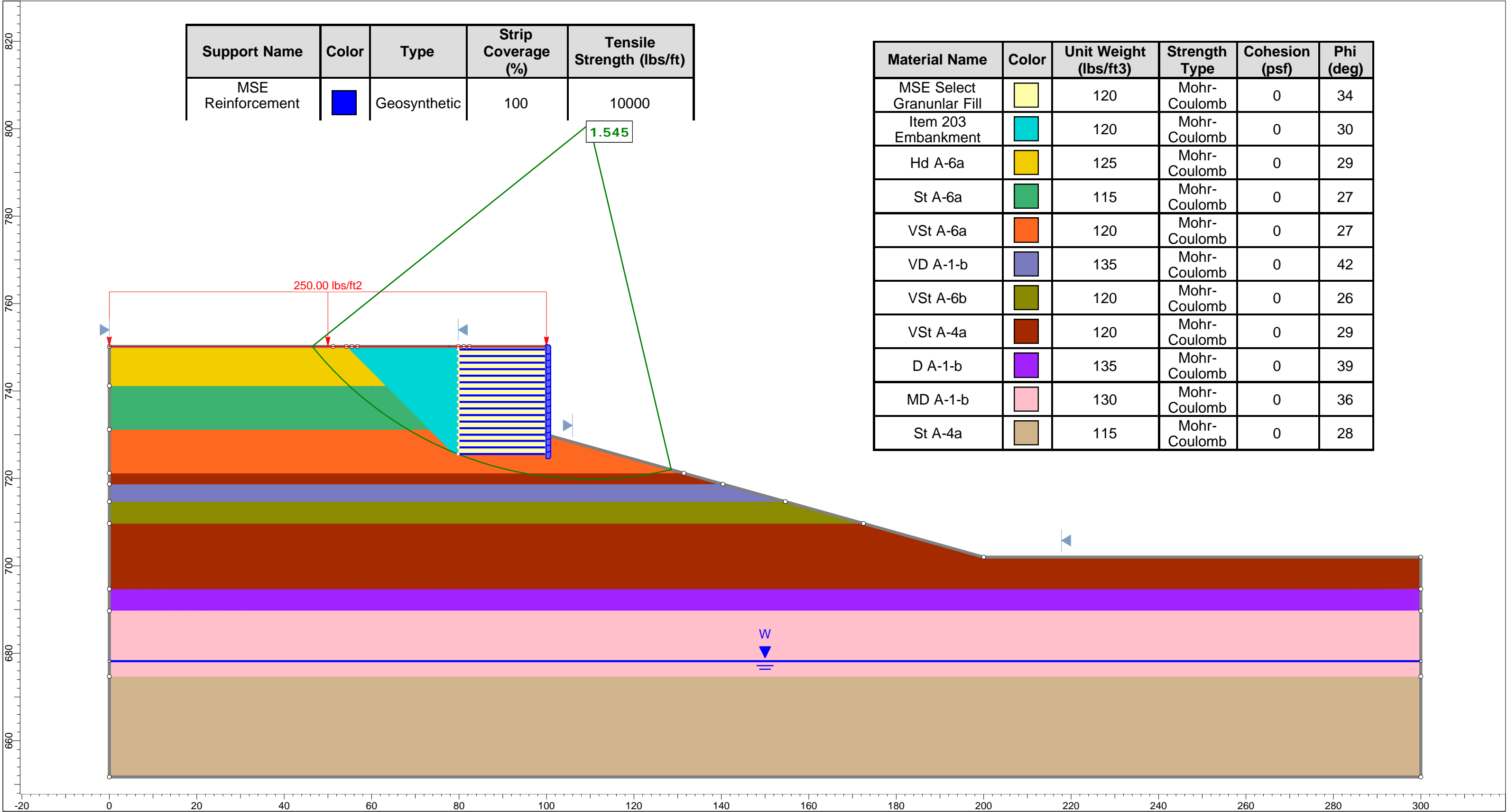
1. σ_p' = σ_{vo}' + σ_m'; Use σ_m = 2,500 psf based on consolidation test results
2. Used actual values from consolidation test results where applicable; For all other layers, used C_c = 0.009(LL-10); Ref. Table 6-9, FHWA GEC 5
3. Used actual values from consolidation test results where applicable; For all other layers, used C_r = 0.15(C_c) for natural soil deposits; Ref. Section 8.11, Holtz and Kovacs 1981
4. Used actual values from consolidation test results where applicable; For all other layers, used e_o = (C_r/1.15)+0.35; Ref. Table 8-2, Holtz and Kovacs 1981
5. (N1)₆₀ = C_nN₆₀, where C_N = [0.77log(40/σ_{vo}')] ≤ 2.0 ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS
7. Influence factor for strip loaded footing
8. Δσ_v = q_b(I)
9. S_c = [C_c/(1+e_o)](H)log(σ_v'/σ_{vo}')for σ_p' ≤ σ_{vo}' < σ_v'; [C_r/(1+e_o)](H)log(σ_p'/σ_{vo}') for σ_{vo}' < σ_v' ≤ σ_p'; [Cr/(1+e_o)](H)log(σ_p/σ_{vo}')+[C_c/(1+e_o)](H)log(σ_v'/σ_p') for σ_{vo}' < σ_p' < σ_v'; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesive soil layers)
10. S_c = H(1/C')log(σ_v'/σ_{vo}') ; Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)
11. (S_c)_t = S_c(U/100); U = 100 for all granular soils at time t = 0

(S_c)_t = 1.645 in

Settlement Remaining After Hold Period: 0.182 in

Support Name	Color	Type	Strip Coverage (%)	Tensile Strength (lbs/ft)
MSE Reinforcement	<div></div>	Geosynthetic	100	10000

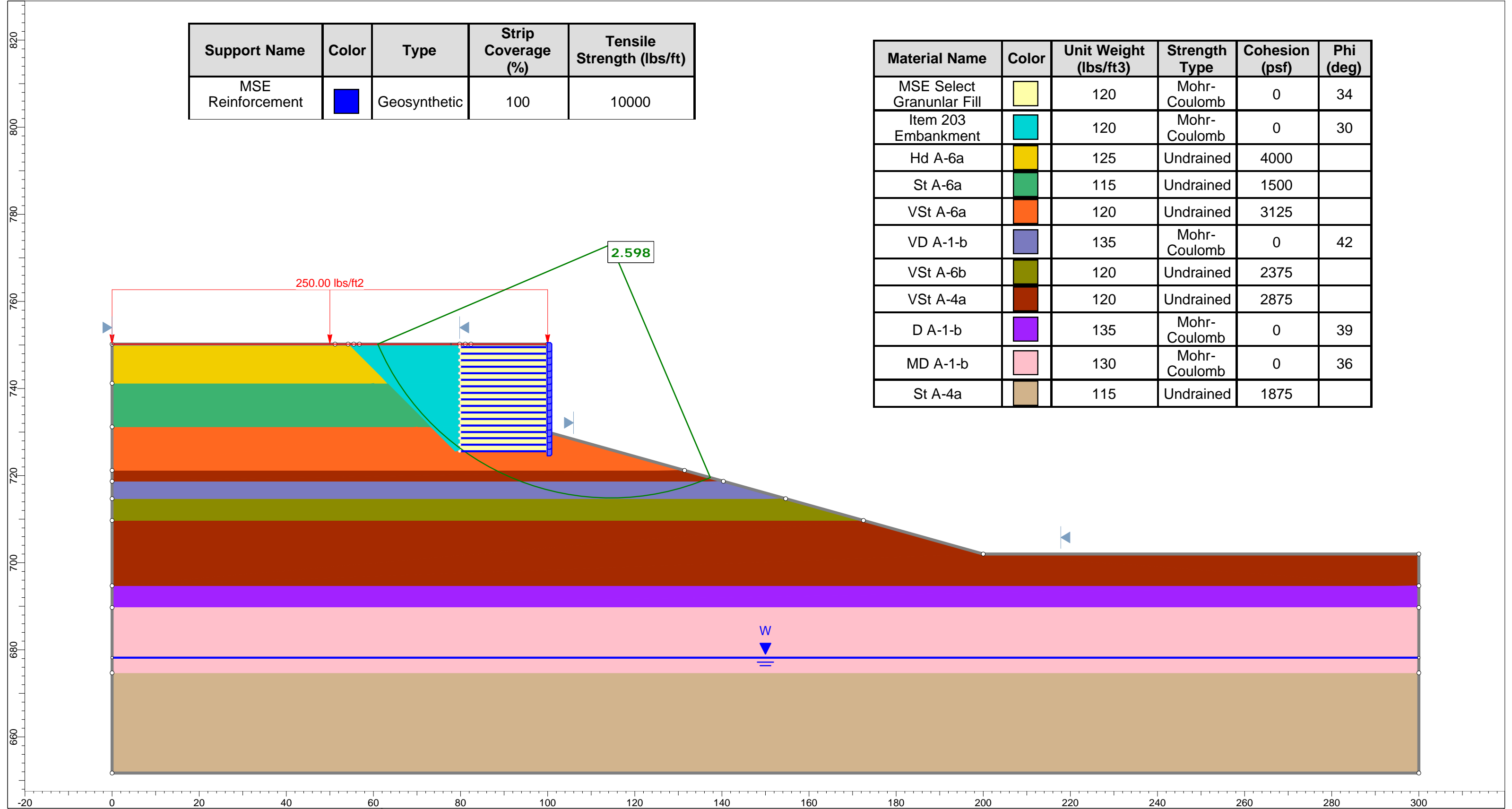
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
MSE Select Granular Fill	<div></div>	120	Mohr-Coulomb	0	34
Item 203 Embankment	<div></div>	120	Mohr-Coulomb	0	30
Hd A-6a	<div></div>	125	Mohr-Coulomb	0	29
St A-6a	<div></div>	115	Mohr-Coulomb	0	27
VSt A-6a	<div></div>	120	Mohr-Coulomb	0	27
VD A-1-b	<div></div>	135	Mohr-Coulomb	0	42
VSt A-6b	<div></div>	120	Mohr-Coulomb	0	26
VSt A-4a	<div></div>	120	Mohr-Coulomb	0	29
D A-1-b	<div></div>	135	Mohr-Coulomb	0	39
MD A-1-b	<div></div>	130	Mohr-Coulomb	0	36
St A-4a	<div></div>	115	Mohr-Coulomb	0	28



<div><div>RESOURCE INTERNATIONAL</div><div>Rii</div><div>SLIDEINTERPRET 9.009</div></div> <div>Resource International, Inc.</div> <div>Planning Engineering Construction Management Technology</div>	Project	FRA-70-13.01 - FRA-70-1301R - Rear Abutment - Retaining Wall W4 - Global Stability		
	Analysis Description	25.2 ft Wall Height - B-015-1-13 - Drained - Circular - Spencer		
	Drawn By	BRT	Scale	1:250
	Date	10/23/2021	Company	Resource International Inc.
			File Name	Retaining Wall W4 - Global Stability.slmd

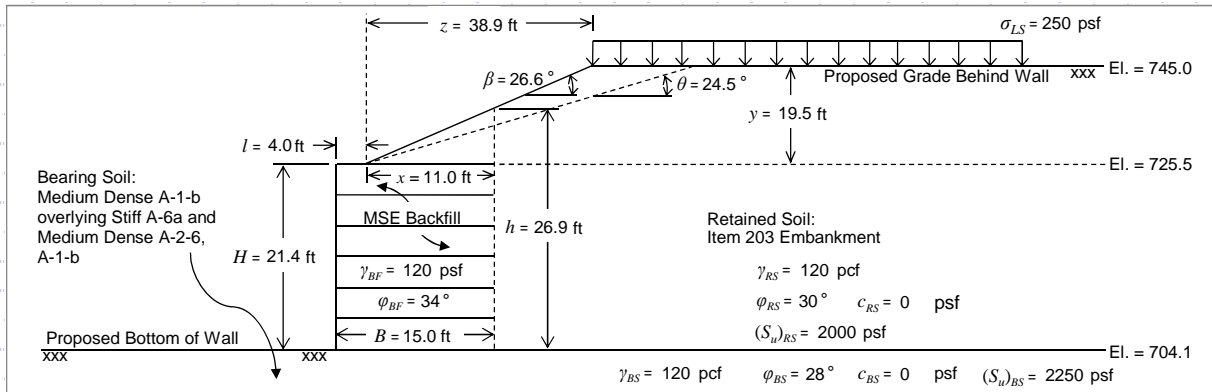
Support Name	Color	Type	Strip Coverage (%)	Tensile Strength (lbs/ft)
MSE Reinforcement	<div></div>	Geosynthetic	100	10000

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
MSE Select Granular Fill	<div></div>	120	Mohr-Coulomb	0	34
Item 203 Embankment	<div></div>	120	Mohr-Coulomb	0	30
Hd A-6a	<div></div>	125	Undrained	4000	
St A-6a	<div></div>	115	Undrained	1500	
VSt A-6a	<div></div>	120	Undrained	3125	
VD A-1-b	<div></div>	135	Mohr-Coulomb	0	42
VSt A-6b	<div></div>	120	Undrained	2375	
VSt A-4a	<div></div>	120	Undrained	2875	
D A-1-b	<div></div>	135	Mohr-Coulomb	0	39
MD A-1-b	<div></div>	130	Mohr-Coulomb	0	36
St A-4a	<div></div>	115	Undrained	1875	





Retaining Wall W6 - FRA-70-1301R - Forward Abutment - B-108-5-13, B-012-E-68 - 2:1 Broken Backslope - 21.4 ft. Wall Height



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	21.4 ft
MSE Wall Width (Reinforcement Length), (B) =	15.0 ft
Distance from Wall Face to Toe of Backslope, (l) =	4.0 ft
MSE Wall Length, (L) =	68 ft
MSE Wall Effective Height, (h) =	26.9 ft
Retained Soil Backslope, (β) =	26.6°
Effective Retained Soil Backslope, (θ) =	24.5°
Distance from Toe to Top of Backslope, (z) =	38.9 ft
Retained Soil Unit Weight, (γ _{RS}) =	120 pcf
Retained Soil Friction Angle, (φ _{RS}) =	30°
Retained Soil Drained Cohesion, (c _{RS}) =	0 psf
Retained Soil Undrained Shear Strength, [(S _u) _{RS}] =	2000 psf
Retained Soil Active Earth Pressure Coeff., (K _a) =	0.477
Live Surcharge Load, (σ _{LS}) =	250 psf

MSE Backfill and Bearing Soil Properties 1:

	Bearing	Sliding
Bearing Soil Unit Weight, (γ _{BS}) =	120	125 pcf
Bearing Soil Friction Angle, (φ _{BS}) =	28	41°
Bearing Soil Drained Cohesion, (c _{BS}) =	0	0 psf
Bearing Soil Undrained Shear Strength, [(S _u) _{BS}] =	2250	0 psf
MSE Backfill Unit Weight, (γ _{BF}) =	120 pcf	
MSE Backfill Friction Angle, (φ _{BF}) =	34°	
Embedment Depth, (D _f) =	4.0 ft	
Depth to GW (Below Bot. of Wall), (D _w) =	14.1 ft	

LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

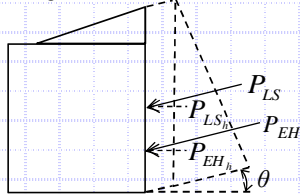
(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

1. Soil properties for bearing resistance based on critical soil type w/ 1.5B below the bottom of wall. Soil properties for sliding resistance based on soil type w/ 3.0 ft. below the bottom of wall.

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Sections 11.6.3.6 and 11.10.5.3

Sliding Force at Bottom of Foundation Preparation:

$$P_H = (P_{EH} + P_{LS}) \cos \theta$$



$$P_{EH} = \frac{1}{2} \gamma_{RS} (h + 1)^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf}) (26.9 \text{ ft} + 1 \text{ ft})^2 (0.477) (1.50) = 33.44 \text{ kip/ft}$$

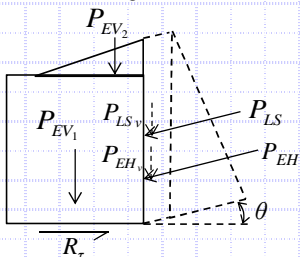
$$P_{EH} = \sigma_{LS} (h + 1) K_a \gamma_{LS} = (250 \text{ psf}) (26.9 \text{ ft} + 1 \text{ ft}) (0.477) (1.75) = 5.21 \text{ kip/ft}$$

$$P_H = (33.44 \text{ kip/ft} + 5.21 \text{ kip/ft}) \cos(24.5^\circ) = 35.17 \text{ kip/ft}$$

Check Sliding Resistance - Drained Condition (At Bottom of Wall, Top of Foundation Preparation)

Nominal Sliding Resistance:

$$R_r = (P_{EV_1} + P_{EV_2} + P_{EH} \sin \theta) \tan \delta \quad (\text{Neglect } P_{LSv} \text{ for conservatism})$$



$$P_{EV_1} = \gamma_{BF} (H + 1) B \gamma_{EV} = (120 \text{ pcf}) (21.4 \text{ ft} + 1 \text{ ft}) (15.0 \text{ ft}) (1.00) = 40.32 \text{ kip/ft}$$

$$P_{EV_2} = \frac{1}{2} \gamma_{RS} (h - H) (B - l) \gamma_{EV} = \frac{1}{2} (120 \text{ pcf}) (26.9 \text{ ft} - 21.4 \text{ ft}) (15.0 \text{ ft} - 4.0 \text{ ft}) (1.00) = 3.64 \text{ kip/ft}$$

$$P_{EH} = \frac{1}{2} \gamma_{RS} (h + 1)^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf}) (26.9 \text{ ft} + 1 \text{ ft})^2 (0.477) (1.50) = 33.44 \text{ kip/ft}$$

$$\tan \delta = (\tan \phi_{BS} \leq \tan \phi_{BF}) \rightarrow \tan(41^\circ) \leq \tan(34^\circ) \rightarrow 0.87 \leq 0.67 = 0.67$$

$$R_r = [40.32 \text{ kip/ft} + 3.64 \text{ kip/ft} + (33.44 \text{ kip/ft}) \sin(24.5^\circ)] (0.67) = 38.74 \text{ kip/ft}$$

Verify Sliding Force Less Than Factored Sliding Resistance - Drained Condition (At Bottom of Wall)

$$P_H \leq R_r \cdot \phi_r \rightarrow 35.17 \text{ kip/ft} \leq (38.74 \text{ kip/ft}) (1.0) = 38.74 \text{ kip/ft} \rightarrow 35.17 \text{ kip/ft} \leq 38.74 \text{ kip/ft} \quad \text{OK}$$

Use $\phi_r = 1.0$ (Per AASHTO LRFD BDM Table 11.5.6-1)



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	21.4 ft
MSE Wall Width (Reinforcement Length), (B) =	15.0 ft
Distance from Wall Face to Toe of Backslope, (l) =	4.0 ft
MSE Wall Length, (L) =	68 ft
MSE Wall Effective Height, (h) =	26.9 ft
Retained Soil Backslope, (β) =	26.6 °
Effective Retained Soil Backslope, (θ) =	24.5 °
Distance from Toe to Top of Backslope, (z) =	38.9 ft
Retained Soil Unit Weight, (γ_{RS}) =	120 pcf
Retained Soil Friction Angle, (ϕ_{RS}) =	30 °
Retained Soil Drained Cohesion, (c_{RS}) =	0 psf
Retained Soil Undrained Shear Strength, [$(s_u)_{RS}$] =	2000 psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.477
Live Surcharge Load, (σ_{LS}) =	250 psf

MSE Backfill and Bearing Soil Properties 1:

	Bearing	Sliding
Bearing Soil Unit Weight, (γ_{BS}) =	120	125 pcf
Bearing Soil Friction Angle, (ϕ_{BS}) =	28	41 °
Bearing Soil Drained Cohesion, (c_{BS}) =	0	0 psf
Bearing Soil Undrained Shear Strength, [$(s_u)_{BS}$] =	2250	0 psf
MSE Backfill Unit Weight, (γ_{BF}) =	120 pcf	
MSE Backfill Friction Angle, (ϕ_{BF}) =	34 °	
Embedment Depth, (D_f) =	4.0 ft	
Depth to GW (Below Bot. of Wall), (D_w) =	14.1 ft	

LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

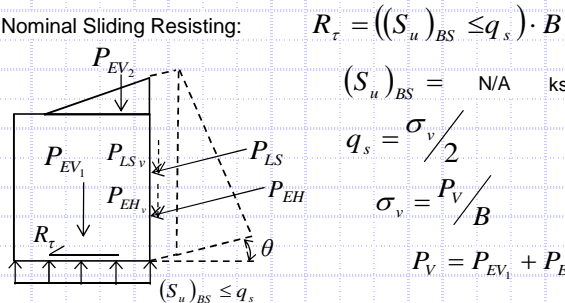
(AASHTO LRFD BDM Tables
3.4.1-1 and 3.4.1-2 - Active
Earth Pressure)

1. Soil properties for bearing resistance based on critical soil type w/ 1.5B below the bottom of wall. Soil properties for sliding resistance based on soil type w/ 3.0 ft. below the bottom of wall.

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.10.5.3 (Continued)

Check Sliding Resistance - Undrained Condition (At Bottom of Foundation Preparation, 1.0-foot Below Bottom of Wall)

Nominal Sliding Resisting:



(Neglect P_{LSv} for conservatism)

$$R_{\tau} = ((s_u)_{BS} \leq q_s) \cdot B$$

$$(s_u)_{BS} = \text{N/A} \quad \text{ksf}$$

$$q_s = \sigma_v / 2$$

$$\sigma_v = P_v / B$$

$$P_v = P_{EV1} + P_{EV2} + P_{EH} \sin \theta$$

$$P_{EV1} = \gamma_{BF}(H+1)B\gamma_{EV} = (120 \text{ pcf})(21.4 \text{ ft} + 1 \text{ ft})(15.0 \text{ ft})(1.00) = 40.32 \text{ kip/ft}$$

$$P_{EV2} = \frac{1}{2}\gamma_{RS}(h-H)(B-l)\gamma_{EV}$$

$$P_{EV2} = \frac{1}{2}(120 \text{ pcf})(26.9 \text{ ft} - 21.4 \text{ ft})(15.0 \text{ ft} - 4.0 \text{ ft})(1.00) = 3.64 \text{ kip/ft}$$

$$P_{EH} = \frac{1}{2}\gamma_{RS}(h+1)^2K_a\gamma_{EH}$$

$$P_{EH} = \frac{1}{2}(120 \text{ pcf})(26.9 \text{ ft} + 1 \text{ ft})^2(0.477)(1.50) = 33.44 \text{ kip/ft}$$

$$P_v = 40.32 \text{ kip/ft} + 3.64 \text{ kip/ft} + (33.44 \text{ kip/ft})\sin(24.5^\circ) = 57.83 \text{ kip/ft}$$

$$\sigma_v = (57.83 \text{ kip/ft}) / (15.0 \text{ ft}) = 3.86 \text{ ksf}$$

$$q_s = (3.86 \text{ ksf}) / 2 = 1.93 \text{ ksf}$$

$$R_{\tau} = (\text{N/A ksf} \leq 1.93 \text{ ksf})(15.0 \text{ ft}) = \text{N/A} \text{ kip/ft}$$

Verify Sliding Force Less Than Factored Sliding Resistance - Undrained Condition (Bottom of Foundation Preparation)

$$P_H \leq R_{\tau} \cdot \phi_{\tau} \rightarrow \text{N/A} \rightarrow \text{N/A}$$

Use $\phi_{\tau} = 1.0$ (Per AASHTO LRFD BDM Table 11.5.6-1)



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	21.4 ft
MSE Wall Width (Reinforcement Length), (B) =	15.0 ft
Distance from Wall Face to Toe of Backslope, (l) =	4.0 ft
MSE Wall Length, (L) =	68 ft
MSE Wall Effective Height, (h) =	26.9 ft
Retained Soil Backslope, (β) =	26.6 °
Effective Retained Soil Backslope, (θ) =	24.5 °
Distance from Toe to Top of Backslope, (z) =	38.9 ft
Retained Soil Unit Weight, (γ_{RS}) =	120 pcf
Retained Soil Friction Angle, (ϕ_{RS}) =	30 °
Retained Soil Drained Cohesion, (c_{RS}) =	0 psf
Retained Soil Undrained Shear Strength, [$(s_u)_{RS}$] =	2000 psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.477
Live Surcharge Load, (σ_{LS}) =	250 psf

MSE Backfill and Bearing Soil Properties 1:

	Bearing	Sliding
Bearing Soil Unit Weight, (γ_{BS}) =	120	125 pcf
Bearing Soil Friction Angle, (ϕ_{BS}) =	28	41 °
Bearing Soil Drained Cohesion, (c_{BS}) =	0	0 psf
Bearing Soil Undrained Shear Strength, [$(s_u)_{BS}$] =	2250	0 psf
MSE Backfill Unit Weight, (γ_{BF}) =	120 pcf	
MSE Backfill Friction Angle, (ϕ_{BF}) =	34 °	
Embedment Depth, (D_f) =	4.0 ft	
Depth to GW (Below Bot. of Wall), (D_w) =	14.1 ft	

LRFD Load Factors

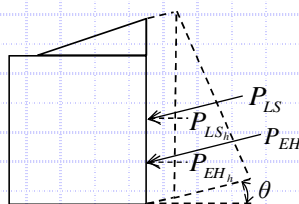
	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

1. Soil properties for bearing resistance based on critical soil type w/ 1.5B below the bottom of wall. Soil properties for sliding resistance based on soil type w/ 3.0 ft. below the bottom of wall.

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.10.5.3 (Continued)

Sliding Force at Top of Foundation Preparation:



$$P_H = (P_{EH} + P_{LS}) \cos \theta$$

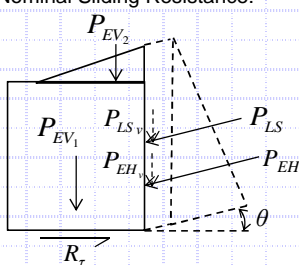
$$P_{EH} = \frac{1}{2} \gamma_{RS} h^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf}) (26.9 \text{ ft})^2 (0.477) (1.50) = 31.08 \text{ kip/ft}$$

$$P_{LS} = \sigma_{LS} h K_a \gamma_{LS} = (250 \text{ psf}) (26.9 \text{ ft}) (0.477) (1.75) = 5.02 \text{ kip/ft}$$

$$P_H = (31.08 \text{ kip/ft} + 5.02 \text{ kip/ft}) \cos(24.5^\circ) = 32.85 \text{ kip/ft}$$

Check Sliding Resistance - Drained Condition (At Bottom of Wall, Top of Foundation Preparation)

Nominal Sliding Resistance: $R_\tau = (P_{EV_1} + P_{EV_2} + P_{EH} \sin \theta) \tan \delta$ (Neglect P_{LSv} for conservatism)



$$P_{EV_1} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV} = (120 \text{ pcf}) (21.4 \text{ ft}) (15.0 \text{ ft}) (1.00) = 38.52 \text{ kip/ft}$$

$$P_{EV_2} = \frac{1}{2} \gamma_{RS} (h - H) (B - l) \gamma_{EV} = \frac{1}{2} (120 \text{ pcf}) (26.9 \text{ ft} - 21.4 \text{ ft}) (15.0 \text{ ft} - 4.0 \text{ ft}) (1.00) = 3.64 \text{ kip/ft}$$

$$P_{EH} = \frac{1}{2} \gamma_{RS} h^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf}) (26.9 \text{ ft})^2 (0.477) (1.50) = 31.08 \text{ kip/ft}$$

$$\tan \delta = (\tan \phi_{BS} \leq \tan \phi_{BF}) \rightarrow \tan(34^\circ) \leq \tan(34^\circ) \rightarrow 0.67 \leq 0.67 = 0.67$$

$$R_\tau = [38.52 \text{ kip/ft} + 3.64 \text{ kip/ft} + (31.08 \text{ kip/ft}) \sin(24.5^\circ)] (0.67) = 36.88 \text{ kip/ft}$$

Verify Sliding Force Less Than Factored Sliding Resistance - Drained Condition (Bottom of Wall)

$$P_H \leq R_\tau \cdot \phi_\tau \rightarrow 32.85 \text{ kip/ft} \leq (36.88 \text{ kip/ft}) (1.0) = 36.88 \text{ kip/ft} \rightarrow 32.85 \text{ kip/ft} \leq 36.88 \text{ kip/ft} \quad \text{OK}$$

Use $\phi_\tau = 1.0$ (Per AASHTO LRFD BDM Table 11.5.6-1)



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	21.4 ft
MSE Wall Width (Reinforcement Length), (B) =	15.0 ft
Distance from Wall Face to Toe of Backslope, (l) =	4.0 ft
MSE Wall Length, (L) =	68 ft
MSE Wall Effective Height, (h) =	26.9 ft
Retained Soil Backslope, (β) =	26.6 °
Effective Retained Soil Backslope, (θ) =	24.5 °
Distance from Toe to Top of Backslope, (z) =	38.9 ft
Retained Soil Unit Weight, (γ_{RS}) =	120 pcf
Retained Soil Friction Angle, (ϕ_{RS}) =	30 °
Retained Soil Drained Cohesion, (c_{RS}) =	0 psf
Retained Soil Undrained Shear Strength, [$(s_u)_{RS}$] =	2000 psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.477
Live Surcharge Load, (σ_{LS}) =	250 psf

MSE Backfill and Bearing Soil Properties 1:

	Bearing	Sliding
Bearing Soil Unit Weight, (γ_{BS}) =	120	125 pcf
Bearing Soil Friction Angle, (ϕ_{BS}) =	28	41 °
Bearing Soil Drained Cohesion, (c_{BS}) =	0	0 psf
Bearing Soil Undrained Shear Strength, [$(s_u)_{BS}$] =	2250	0 psf
MSE Backfill Unit Weight, (γ_{BF}) =	120 pcf	
MSE Backfill Friction Angle, (ϕ_{BF}) =	34 °	
Embedment Depth, (D_f) =	4.0 ft	
Depth to GW (Below Bot. of Wall), (D_w) =	14.1 ft	

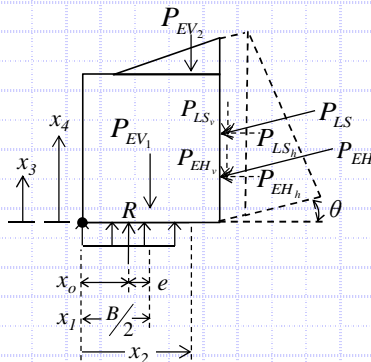
LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

1. Soil properties for bearing resistance based on critical soil type w/ 1.5B below the bottom of wall. Soil properties for sliding resistance based on soil type w/ 3.0 ft. below the bottom of wall.

Check Eccentricity (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.6.3.3



$$e = \frac{B}{2} - x_o$$

$$x_o = \frac{M_v - M_H}{P_v} = \frac{(523.47 \text{ kip-ft/ft} - 322.47 \text{ kip-ft/ft})}{(55.05 \text{ kip/ft})} = 3.65 \text{ ft}$$

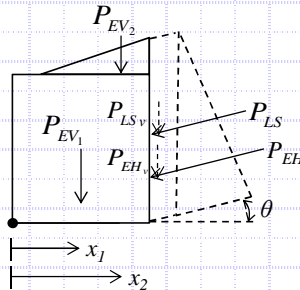
$$\begin{aligned} M_v &= 523.47 \text{ kip-ft/ft} \\ M_H &= 322.47 \text{ kip-ft/ft} \\ P_v &= P_{EV1} + P_{EV2} + P_{EH} \sin \theta = 38.52 \text{ kip/ft} + 3.64 \text{ kip/ft} + (31.08 \text{ kip/ft}) \sin(24.5^\circ) = 55.05 \text{ kip/ft} \end{aligned}$$

Defined below

$$e = (15.0 \text{ ft} / 2) - 3.65 \text{ ft} = 3.85 \text{ ft}$$

Resisting Moment, M_v :

$$M_v = P_{EV1}(x_1) + P_{EV2}(x_2) + P_{EH} \sin \theta (B) \quad (\text{Neglect } P_{LSv} \text{ for conservatism})$$



$$P_{EV1} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV} = (120 \text{ pcf})(21.4 \text{ ft})(15.0 \text{ ft})(1.00) = 38.52 \text{ kip/ft}$$

$$P_{EV2} = \frac{1}{2} \gamma_{RS} (h - H)(B - l) \gamma_{EV} = \frac{1}{2} (120 \text{ pcf})(26.9 \text{ ft} - 21.4 \text{ ft})(15.0 \text{ ft} - 4.0 \text{ ft})(1.00) = 3.64 \text{ kip/ft}$$

$$P_{EH} = \frac{1}{2} \gamma_{RS} h^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf})(26.9 \text{ ft})^2 (0.477)(1.50) = 31.08 \text{ kip/ft}$$

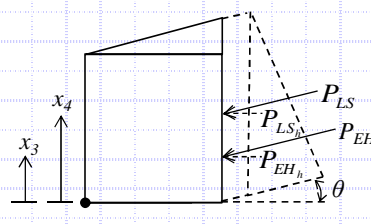
$$x_1 = \frac{B}{2} = (15.0 \text{ ft}) / 2 = 7.50 \text{ ft}$$

$$x_2 = l + \frac{2}{3}(B - l) = 4.0 \text{ ft} + \frac{2}{3}(15.0 \text{ ft} - 4.0 \text{ ft}) = 11.33 \text{ ft}$$

$$M_v = (38.52 \text{ kip/ft})(7.50 \text{ ft}) + (3.64 \text{ kip/ft})(11.33 \text{ ft}) + (31.08 \text{ kip/ft}) \sin(24.5^\circ)(15 \text{ ft}) = 523.47 \text{ kip-ft/ft}$$

Overturning Moment, M_H :

$$M_H = P_{EH} \cos \theta (x_3) + P_{LS} \cos \theta (x_4)$$



$$P_{EH} = \frac{1}{2} \gamma_{RS} h^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf})(26.9 \text{ ft})^2 (0.477)(1.50) = 31.08 \text{ kip/ft}$$

$$P_{LS} = \sigma_{LS} h K_a \gamma_{LS} = (250 \text{ psf})(26.9 \text{ ft})(0.477)(1.75) = 5.62 \text{ kip/ft}$$

$$x_3 = \frac{h}{3} = (26.9 \text{ ft}) / 3 = 8.97 \text{ ft}$$

$$x_4 = \frac{h}{2} = (26.9 \text{ ft}) / 2 = 13.45 \text{ ft}$$

$$M_H = (31.08 \text{ kip/ft}) \cos(24.5^\circ)(8.97 \text{ ft}) + (5.62 \text{ kip/ft}) \cos(24.5^\circ)(13.45 \text{ ft}) = 322.47 \text{ kip-ft/ft}$$

Check Eccentricity

$$\text{Limiting Eccentricity: } e_{\max} = \frac{B}{3} \rightarrow e_{\max} = (15.0 \text{ ft}) / 3 = 5.00 \text{ ft}$$

$$e < e_{\max} \rightarrow 3.85 \text{ ft} < 5.00 \text{ ft}$$

OK



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	21.4 ft
MSE Wall Width (Reinforcement Length), (B) =	15.0 ft
Distance from Wall Face to Toe of Backslope, (l) =	4.0 ft
MSE Wall Length, (L) =	68 ft
MSE Wall Effective Height, (h) =	26.9 ft
Retained Soil Backslope, (β) =	26.6 °
Effective Retained Soil Backslope, (θ) =	24.5 °
Distance from Toe to Top of Backslope, (z) =	38.9 ft
Retained Soil Unit Weight, (γ_{RS}) =	120 pcf
Retained Soil Friction Angle, (ϕ_{RS}) =	30 °
Retained Soil Drained Cohesion, (c_{RS}) =	0 psf
Retained Soil Undrained Shear Strength, [$(s_u)_{RS}$] =	2000 psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.477
Live Surcharge Load, (σ_{LS}) =	250 psf

MSE Backfill and Bearing Soil Properties 1:

	Bearing	Sliding
Bearing Soil Unit Weight, (γ_{BS}) =	120	125 pcf
Bearing Soil Friction Angle, (ϕ_{BS}) =	28	41 °
Bearing Soil Drained Cohesion, (c_{BS}) =	0	0 psf
Bearing Soil Undrained Shear Strength, [$(s_u)_{BS}$] =	2250	0 psf
MSE Backfill Unit Weight, (γ_{BF}) =	120 pcf	
MSE Backfill Friction Angle, (ϕ_{BF}) =	34 °	
Embedment Depth, (D_f) =	4.0 ft	
Depth to GW (Below Bot. of Wall), (D_w) =	14.1 ft	

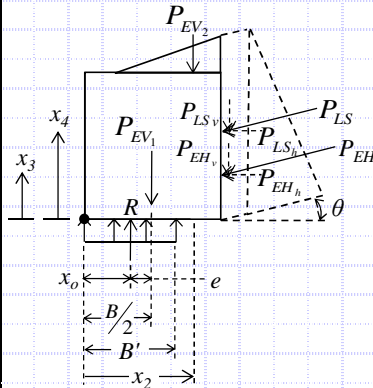
LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

1. Soil properties for bearing resistance based on critical soil type w/ 1.5B below the bottom of wall. Soil properties for sliding resistance based on soil type w/ 3.0 ft. below the bottom of wall.

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.6.3.2



$$q_{eq} = \frac{P_v}{B'}$$

$$B' = B - 2e = 15.0 \text{ ft} - 2(2.97 \text{ ft}) = 9.06 \text{ ft}$$

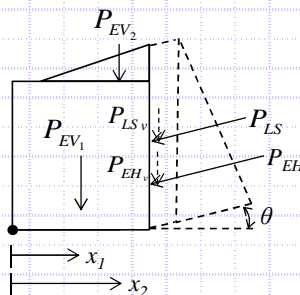
$$e = \frac{B}{2} - x_o = (15.0 \text{ ft} / 2) - 4.53 \text{ ft} = 2.97 \text{ ft}$$

$$x_o = \frac{M_v - M_H}{P_v} = (638.96 \text{ kip-ft/ft} - 322.47 \text{ kip-ft/ft}) / 69.80 \text{ kip/ft} = 4.53 \text{ ft}$$

$$q_{eq} = (69.8 \text{ kip/ft}) / (9.06 \text{ ft}) = 7.70 \text{ ksf}$$

Resisting Moment, M_v :

$$M_v = P_{EV1}(x_1) + P_{EV2}(x_2) + P_{EH} \sin \theta (B)$$



$$P_{EV1} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV} = (120 \text{ pcf})(21.4 \text{ ft})(15.0 \text{ ft})(1.35) = 52.00 \text{ kip/ft}$$

$$P_{EV2} = \frac{1}{2} \gamma_{RS} (h - H)(B - l) \gamma_{EV} = \frac{1}{2} (120 \text{ pcf})(26.9 \text{ ft} - 21.4 \text{ ft})(15.0 \text{ ft} - 4.0 \text{ ft})(1.35) = 4.91 \text{ kip/ft}$$

$$P_{EH} = \frac{1}{2} \gamma_{RS} h^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf})(26.9 \text{ ft})^2 (0.477)(1.50) = 31.08 \text{ kip/ft}$$

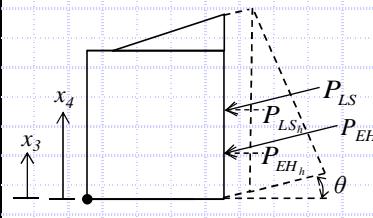
$$x_1 = \frac{B}{2} = (15.0 \text{ ft}) / 2 = 7.50 \text{ ft}$$

$$x_2 = l + \frac{2}{3}(B - l) = 4.0 \text{ ft} + \frac{2}{3}(15.0 \text{ ft} - 4.0 \text{ ft}) = 11.33 \text{ ft}$$

$$M_v = (52 \text{ kip/ft})(7.50 \text{ ft}) + (4.91 \text{ kip/ft})(11.3 \text{ ft}) + (31.08 \text{ kip/ft}) \sin(24.5^\circ)(15 \text{ ft}) = 638.96 \text{ kip-ft/ft}$$

Overturning Moment, M_H :

$$M_H = P_{EH} \cos \theta (x_3) + P_{LS} \cos \theta (x_4)$$



$$P_{EH} = \frac{1}{2} \gamma_{RS} h^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf})(26.9 \text{ ft})^2 (0.477)(1.50) = 31.08 \text{ kip/ft}$$

$$P_{LS} = \sigma_{LS} h K_a \gamma_{LS} = (250 \text{ psf})(26.9 \text{ ft})(0.477)(1.75) = 5.62 \text{ kip/ft}$$

$$x_3 = \frac{h}{3} = (26.9 \text{ ft}) / 3 = 8.97 \text{ ft}$$

$$x_4 = \frac{h}{2} = (26.9 \text{ ft}) / 2 = 13.45 \text{ ft}$$

$$M_H = (31.08 \text{ kip/ft}) \cos(24.5^\circ)(8.97 \text{ ft}) + (5.62 \text{ kip/ft}) \cos(24.5^\circ)(13.45 \text{ ft}) = 322.47 \text{ kip-ft/ft}$$

Vertical Forces, P_v :

$$P_v = P_{EV1} + P_{EV2} + P_{EH} \sin \theta$$

$$P_v = 52 \text{ kip/ft} + 4.91 \text{ kip/ft} + (31.08 \text{ kip/ft}) \sin(24.5^\circ) = 69.8 \text{ kip/ft}$$



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	21.4 ft
MSE Wall Width (Reinforcement Length), (B) =	15.0 ft
Distance from Wall Face to Toe of Backslope, (l) =	4.0 ft
MSE Wall Length, (L) =	68 ft
MSE Wall Effective Height, (h) =	26.9 ft
Retained Soil Backslope, (β) =	26.6 °
Effective Retained Soil Backslope, (θ) =	24.5 °
Distance from Toe to Top of Backslope, (z) =	38.9 ft
Retained Soil Unit Weight, (γ_{RS}) =	120 pcf
Retained Soil Friction Angle, (ϕ_{RS}) =	30 °
Retained Soil Drained Cohesion, (c_{RS}) =	0 psf
Retained Soil Undrained Shear Strength, [$(s_u)_{RS}$] =	2000 psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.477
Live Surcharge Load, (σ_{LS}) =	250 psf

MSE Backfill and Bearing Soil Properties 1:

	Bearing	Sliding
Bearing Soil Unit Weight, (γ_{BS}) =	120	125 pcf
Bearing Soil Friction Angle, (ϕ_{BS}) =	28	41 °
Bearing Soil Drained Cohesion, (c_{BS}) =	0	0 psf
Bearing Soil Undrained Shear Strength, [$(s_u)_{BS}$] =	2250	0 psf
MSE Backfill Unit Weight, (γ_{BF}) =	120 pcf	
MSE Backfill Friction Angle, (ϕ_{BF}) =	34 °	
Embedment Depth, (D_f) =	4.0 ft	
Depth to GW (Below Bot. of Wall), (D_w) =	7.9 ft	

LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables
3.4.1-1 and 3.4.1-2 - Active
Earth Pressure)

1. Soil properties for bearing resistance based on critical soil type w/ 1.5B below the bottom of wall. Soil properties for sliding resistance based on soil type w/ 3.0 ft. below the bottom of wall.

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.10.5.4 (Continued)

Check Bearing Resistance - Drained Condition

$$\text{Nominal Bearing Resistance: } q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \frac{1}{2} \gamma B' N_{\gamma m} C_{w\gamma}$$

$$N_{cm} = N_c s_c i_c = 28.38$$

$$N_{qm} = N_q s_q d_q i_q = 17.8$$

$$N_{\gamma m} = N_\gamma s_\gamma i_\gamma = 15.0$$

$$N_c = 25.80$$

$$s_c = 1 + (9.06 \text{ ft}/68 \text{ ft})(14.72/25.8) = 1.100$$

$$i_c = 1.000 \text{ (Assumed)}$$

$$N_q = 14.72$$

$$s_q = 1 + (9.06 \text{ ft}/68 \text{ ft}) \tan(28) = 1.100$$

$$d_q = 1 + 2 \tan(28) [1 - \sin(28)]^2 \tan^{-1}(4.0 \text{ ft}/9.06 \text{ ft}) = 1.100$$

$$i_q = 1.000 \text{ (Assumed)}$$

$$C_{wq} = 7.9 \text{ ft} > 4.0 \text{ ft} = 1.000$$

$$N_\gamma = 16.72$$

$$s_\gamma = 1 - 0.4(9.06 \text{ ft}/68 \text{ ft}) = 0.900$$

$$i_\gamma = 1.000 \text{ (Assumed)}$$

$$C_{w\gamma} = 7.9 \text{ ft} < 1.5(9.06 \text{ ft}) + 4.0 \text{ ft} = 0.500$$

$$q_n = (0)(28.38) + (120)(4.0 \text{ ft})(17.8)(1.0) + \frac{1}{2}(120)(9.1 \text{ ft})(15.0)(0.5) = 12.64 \text{ ksf}$$

Verify Equivalent Pressure Less Than Factored Bearing Resistance

$$q_{eq} \leq q_n \cdot \phi_b \rightarrow 7.70 \text{ ksf} \leq (12.64 \text{ ksf})(0.65) = 8.22 \text{ ksf} \rightarrow 7.70 \text{ ksf} \leq 8.22 \text{ ksf} \quad \text{OK}$$

Use $\phi_b = 0.65$ (Per AASHTO LRFD BDM Table 11.5.6-1)

Check Bearing Resistance - Undrained Condition

$$\text{Nominal Bearing Resistance: } q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \frac{1}{2} \gamma B' N_{\gamma m} C_{w\gamma}$$

$$N_{cm} = N_c s_c i_c = 5.140$$

$$N_{qm} = N_q s_q d_q i_q = 1.000$$

$$N_{\gamma m} = N_\gamma s_\gamma i_\gamma = 0.000$$

$$N_c = 5.140$$

$$s_c = 1 + (9.06 \text{ ft}/[(5)(68 \text{ ft})]) = 1.000$$

$$i_c = 1.000 \text{ (Assumed)}$$

$$N_q = 1.000$$

$$s_q = 1.000$$

$$d_q = 1 + 2 \tan(0) [1 - \sin(0)]^2 \tan^{-1}(4.0 \text{ ft}/9.06 \text{ ft}) = 1.000$$

$$i_q = 1.000$$

$$i_q = 1.000 \text{ (Assumed)}$$

$$C_{wq} = 7.9 \text{ ft} > 4.0 \text{ ft} = 1.000$$

$$N_\gamma = 0.000$$

$$s_\gamma = 1.000$$

$$i_\gamma = 1.000 \text{ (Assumed)}$$

$$C_{w\gamma} = 7.9 \text{ ft} < 1.5(9.06 \text{ ft}) + 4.0 \text{ ft} = 0.500$$

$$q_n = (2250)(5.14) + (120)(4.0 \text{ ft})(1.0)(1.0) + \frac{1}{2}(120)(9.1 \text{ ft})(0.0)(0.5) = 12.05 \text{ ksf}$$

Verify Equivalent Pressure Less Than Factored Bearing Resistance

$$q_{eq} \leq q_n \cdot \phi_b \rightarrow 7.70 \text{ ksf} \leq (12.05 \text{ ksf})(0.65) = 7.83 \text{ ksf} \rightarrow 7.70 \text{ ksf} \leq 7.83 \text{ ksf} \quad \text{OK}$$

Use $\phi_b = 0.65$ (Per AASHTO LRFD BDM Table 11.5.6-1)



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	21.4 ft
MSE Wall Width (Reinforcement Length), (B) =	15.0 ft
Distance from Wall Face to Toe of Backslope, (l) =	4.0 ft
MSE Wall Length, (L) =	68 ft
MSE Wall Effective Height, (h) =	26.9 ft
Retained Soil Backslope, (β) =	26.6 °
Effective Retained Soil Backslope, (θ) =	24.5 °
Distance from Toe to Top of Backslope, (z) =	38.9 ft
Retained Soil Unit Weight, (γ _{RS}) =	120 pcf
Retained Soil Friction Angle, (φ _{RS}) =	30 °
Retained Soil Drained Cohesion, (c _{RS}) =	0 psf
Retained Soil Undrained Shear Strength, [(s _u) _{RS}] =	2000 psf
Retained Soil Active Earth Pressure Coeff., (K _a) =	0.477
Live Surcharge Load, (σ _{LS}) =	250 psf

MSE Backfill and Bearing Soil Properties 1:

	Bearing	Sliding
Bearing Soil Unit Weight, (γ _{BS}) =	120	125 pcf
Bearing Soil Friction Angle, (φ _{BS}) =	28	41 °
Bearing Soil Drained Cohesion, (c _{BS}) =	0	0 psf
Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] =	2250	0 psf
MSE Backfill Unit Weight, (γ _{BF}) =	120 pcf	
MSE Backfill Friction Angle, (φ _{BF}) =	34 °	
Embedment Depth, (D _f) =	4.0 ft	
Depth to GW (Below Bot. of Wall), (D _w) =	14.1 ft	

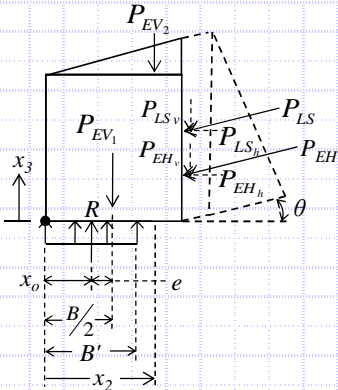
LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables
3.4.1-1 and 3.4.1-2 - Active
Earth Pressure)

1. Soil properties for bearing resistance based on critical soil type w/ 1.5B below the bottom of wall. Soil properties for sliding resistance based on soil type w/ 3.0 ft. below the bottom of wall.

Settlement Analysis (Loading Case - Service I) - AASHTO LRFD BDM Section 11.10.4.1



$$q_{eq} = \frac{P_v}{B'}$$

$$B' = B - 2e = 15.0 \text{ ft} - 2(2.56 \text{ ft}) = 9.88 \text{ ft}$$

$$e = \frac{B}{2} - x_o = (15.0 \text{ ft} / 2) - 4.94 \text{ ft} = 2.56 \text{ ft}$$

$$x_o = \frac{M_v - M_H}{P_v} = (459.01 \text{ kip-ft/ft} - 208.42 \text{ kip-ft/ft}) / 50.75 \text{ kip/ft} = 4.94 \text{ ft}$$

$$q_{eq} = (50.75 \text{ kip/ft}) / (9.88 \text{ ft}) = 5.14 \text{ ksf}$$

$$M_v = P_{EV1}(x_1) + P_{EV2}(x_2) + P_{EH} \sin \theta (B) = (\gamma_{BF} H B \gamma_{EV} (\frac{1}{2} B) + (\frac{1}{2} \gamma_{RS} (h - H) (B - l) \gamma_{EV} (l + \frac{2}{3} (B - l)) + (\frac{1}{2} \gamma_{RS} h^2 K_a \gamma_{EH} \sin \theta) (B)$$

$$M_v = [(120 \text{ pcf})(21.4 \text{ ft})(15.0 \text{ ft})(1.00)](\frac{1}{2}(15.0 \text{ ft})) + [\frac{1}{2}(120 \text{ pcf})(26.9 \text{ ft} - 21.4 \text{ ft})(15.0 \text{ ft} - 4.0 \text{ ft})(1.00)][4.0 \text{ ft} + \frac{2}{3}(15.0 \text{ ft} - 4.0 \text{ ft})] + [\frac{1}{2}(120 \text{ pcf})(26.9 \text{ ft})^2(0.477)(1.00)\sin(24.5^\circ)](15.0 \text{ ft}) = 459.01 \text{ kip-ft/ft}$$

$$M_H = P_{EH} \cos \theta (x_3) + P_{LS} \cos \theta (x_4) = (\frac{1}{2} \gamma_{RS} h^2 K_a \gamma_{EH} \cos \theta) (\frac{h}{3}) + (\sigma_{LS} h K_a \gamma_{LS} \cos \theta) (\frac{h}{2})$$

$$M_H = \frac{1}{2}[(120 \text{ pcf})(26.9 \text{ ft})^2(0.477)(1.00)\cos(24.5^\circ)](26.9 \text{ ft} / 3) + [(250 \text{ psf})(26.9 \text{ ft})(0.477)(1.00)\cos(24.5^\circ)](26.9 \text{ ft} / 2) = 208.42 \text{ kip-ft/ft}$$

$$P_v = P_{EV1} + P_{EV2} + P_{EH} \sin \theta = (\gamma_{BF} H B \gamma_{EV}) + (\frac{1}{2} \gamma_{RS} (h - H) (B - l) \gamma_{EV}) + (\frac{1}{2} \gamma_{RS} h^2 K_a \gamma_{EH} \sin \theta)$$

$$P_v = (120 \text{ pcf})(21.4 \text{ ft})(15.0 \text{ ft})(1.00) + \frac{1}{2}(120 \text{ pcf})(26.9 \text{ ft} - 21.4 \text{ ft})(15.0 \text{ ft} - 4.0 \text{ ft})(1.00) + \frac{1}{2}(120 \text{ pcf})(26.9 \text{ ft})^2(0.477)(1.00)\sin(24.5^\circ) = 50.75 \text{ kip/ft}$$

Settlement, Time Rate of Consolidation and Differential Settlement:

Station Along Wall Alignment	Total Settlement at Center of Reinforced Soil Mass	Total Settlement at Wall Facing	Time for 100% Consolidation	Distance Along Wall Facing	Differential Settlement Along Wall Facing
141+77	0.393 in	0.297 in	1 days		
142+23	1.924 in	1.575 in	2 days	50 ft	1 in / 40 ft

W-20-025 - FRA-70-13.01 - Retaining Wall W6
MSE Wall Settlement - South of Forward Abutment

Calculated By: BRT

Checked By: JPS

Date: 10/22/2021

Date: 10/22/2021

Boring B-108-5-13

H=

21.4

ft

Total wall height

B'=

9.9

ft

Effective footing width due to eccentricity

D_w=

14.1

ft

Depth below bottom of footing

q_b =

4,330

psf

Equivalent bearing pressure at bottom of wall

																					Total Settlement at Center of Reinforced Soil Mass					Total Settlement at Facing of Wall					
Layer	Soil Class.	Soil Type	Layer Depth (ft)		ELevation (ft msl)		Layer Thickness H (ft)	Depth to Midpoint (ft)	γ (pcf)	σ _{vo} Bottom (psf)	σ _{vo} Midpoint (psf)	σ _{vo} ' Midpoint (psf)	σ _p ' (1) (psf)	LL	C _c (2)	C _r (3)	e _o (4)	N ₆₀	(N1) ₆₀ (5)	C' (6)	Z _r /B	I (7)	Δσ _v (8) (psf)	σ _{vf} ' Midpoint (psf)	S _c (9,10) (ft)	S _c (in)	I (7)	Δσ _v (8) (psf)	σ _{vf} ' Midpoint (psf)	S _c (9,10) (ft)	S _c (in)
1	A-1-b	G	0.0	3.0	704.1	701.1	3.0	1.5	125	375	188	188	2,688					25	45	148	0.15	0.989	4,284	4,471	0.028	0.334	0.499	2,162	2,349	0.022	0.266
	A-1-b	G	3.0	6.0	701.1	698.1	3.0	4.5	125	750	563	563	3,063					25	36	116	0.45	0.847	3,668	4,231	0.023	0.272	0.484	2,096	2,659	0.017	0.209
2	A-6a	C	6.0	9.3	698.1	694.8	3.3	7.7	120	1,146	948	948	3,448	30	0.080	0.016	0.355				0.77	0.656	2,840	3,788	0.030	0.358	0.445	1,925	2,873	0.019	0.225
3	A-2-6	G	9.3	11.8	694.8	692.3	2.5	10.6	125	1,459	1,302	1,302	3,802					18	21	76	1.07	0.524	2,269	3,572	0.014	0.174	0.399	1,726	3,029	0.012	0.146
	A-2-6	G	11.8	14.3	692.3	689.8	2.5	13.1	125	1,771	1,615	1,615	4,115					18	19	73	1.32	0.442	1,913	3,528	0.012	0.140	0.360	1,558	3,173	0.010	0.121
4	A-1-a	G	14.3	16.8	689.8	687.3	2.5	15.6	130	2,096	1,934	1,843	4,343					29	30	98	1.57	0.380	1,646	3,489	0.007	0.084	0.325	1,406	3,249	0.006	0.075
	A-1-a	G	16.8	19.3	687.3	684.8	2.5	18.1	130	2,421	2,259	2,012	4,512					29	29	96	1.82	0.333	1,441	3,453	0.006	0.073	0.294	1,273	3,285	0.006	0.066
	A-1-a	G	19.3	21.8	684.8	682.3	2.5	20.6	130	2,746	2,584	2,181	4,681					29	28	94	2.08	0.295	1,279	3,460	0.005	0.064	0.267	1,158	3,339	0.005	0.059
5	A-1-b	G	21.8	24.3	682.3	679.8	2.5	23.1	125	3,059	2,902	2,344	4,844					19	18	70	2.33	0.265	1,149	3,493	0.006	0.074	0.245	1,059	3,403	0.006	0.069
	A-1-b	G	24.3	26.8	679.8	677.3	2.5	25.6	125	3,371	3,215	2,500	5,000					19	18	69	2.58	0.241	1,042	3,543	0.005	0.065	0.225	974	3,474	0.005	0.062
6	A-1-a	G	26.8	33.8	677.3	670.3	7.0	30.3	130	4,281	3,826	2,815	5,315					37	33	107	3.06	0.204	885	3,700	0.008	0.093	0.194	842	3,657	0.007	0.089
	A-1-a	G	33.8	40.8	670.3	663.3	7.0	37.3	130	5,191	4,736	3,288	5,788					37	31	102	3.77	0.167	723	4,011	0.006	0.071	0.162	699	3,988	0.006	0.069
7	A-4a	C	40.8	49.3	663.3	654.8	8.5	45.1	125	6,254	5,722	3,791	6,291	21	0.099	0.015	0.436				4.55	0.139	601	4,392	0.006	0.067	0.136	587	4,378	0.005	0.066
	A-4a	C	49.3	58.3	654.8	645.8	9.0	53.8	125	7,379	6,816	4,339	6,839	21	0.099	0.015	0.436				5.43	0.116	504	4,843	0.004	0.053	0.115	496	4,835	0.004	0.053
1. σ _p ' = σ _{vo} +σ _m ; Use σ _m = 2,500 psf based on consolidation test results																					Total Settlement:			1.924 in		Total Settlement:			1.575 in		

1. σ_p' = σ_{vo}' + σ_m; Use σ_m = 2,500 psf based on consolidation test results
2. Used actual values from consolidation test results where applicable; For all other layers, used C_c = 0.009(LL-10); Ref. Table 6-9, FHWA GEC 5
3. Used actual values from consolidation test results where applicable; For all other layers, used C_r = 0.15(C_c) for natural soil deposits; Ref. Section 8.11, Holtz and Kovacs 1981
4. Used actual values from consolidation test results where applicable; For all other layers, used e_o = (C_c/1.15)+0.35; Ref. Table 8-2, Holtz and Kovacs 1981
5. (N1)₆₀ = C_nN₆₀, where C_N = [0.77log(40/σ_{vo}')] ≤ 2.0 ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS
7. Influence factor for strip loaded footing
8. Δσ_v = q_b(I)
9. S_c = [C_c/(1+e_o)](H)log(σ_{vf}'/σ_{vo}')for σ_p' ≤ σ_{vo}' < σ_{vf}'; [C_r/(1+e_o)](H)log(σ_p'/σ_{vo}') for σ_{vo}' < σ_{vf}' ≤ σ_p'; [C_r/(1+e_o)](H)log(σ_p'/σ_{vo}')+[C_c/(1+e_o)](H)log(σ_{vf}'/σ_p') for σ_{vo}' < σ_p' < σ_{vf}'; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesive soil layers)
10. S_c = H(1/C')log(σ_{vf}'/σ_{vo}'); Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)

W-20-025 - FRA-70-13.01 - Retaining Wall W6
MSE Wall Settlement - South of Forward Abutment

Calculated By: BRT

Checked By: JPS

Date: 10/22/2021

Date: 10/22/2021

Boring B-108-5-13

H=

21.4

ft

Total wall height

B'=

9.9

ft

Effective footing width due to eccentricity

D_w=

14.1

ft

Depth below bottom of footing

q_b =

4,330

psf

Equivalent bearing pressure at bottom of wall

t =

3

days

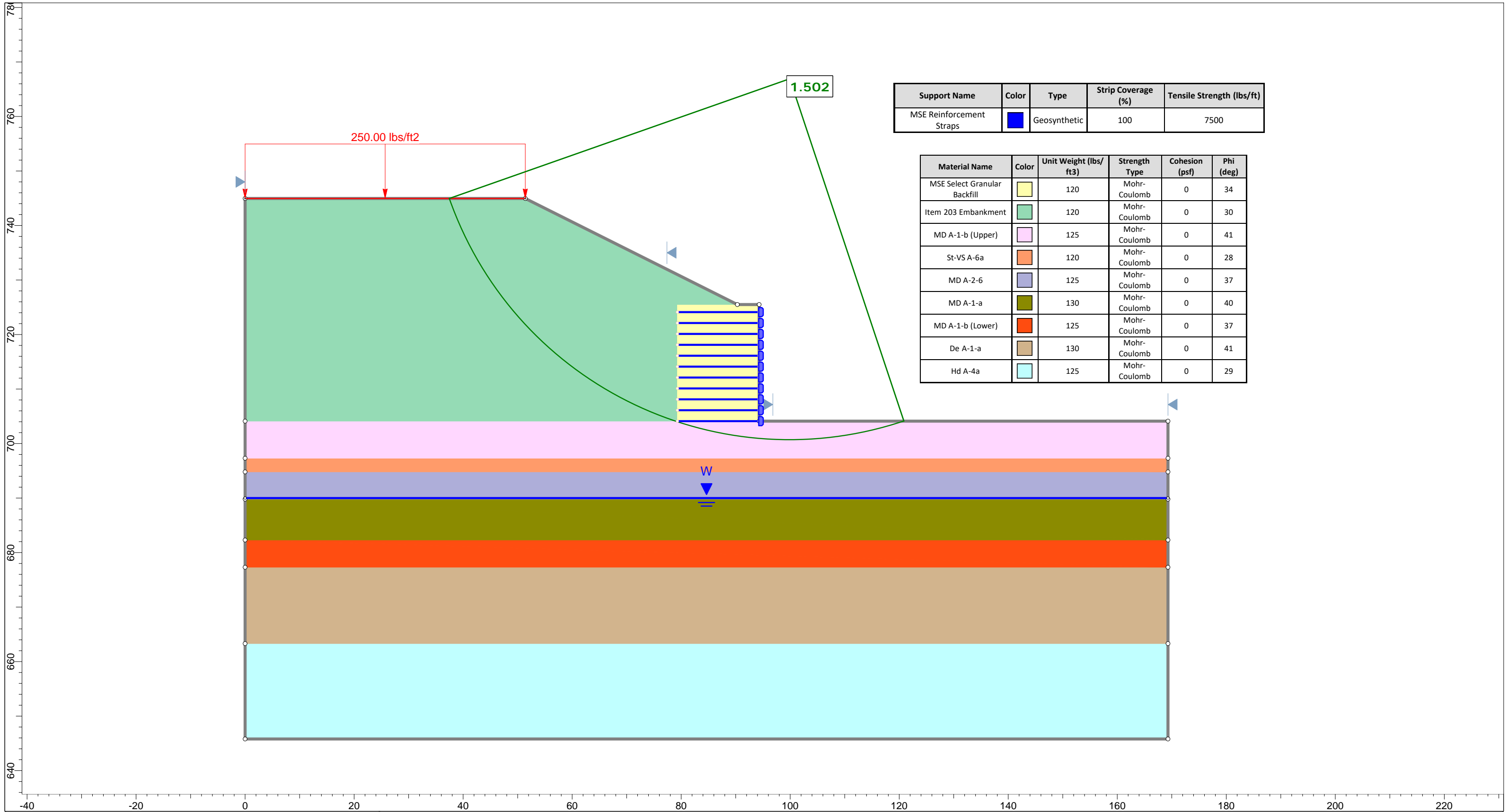
Time following completion of construction

																							Total Settlement at Facing of Wall			Settlement Complete at 92% of Primary Consolidation								
Layer	Soil Class.	Soil Type	Layer Depth (ft)		Elevation (ft msl)		Layer Thickness (ft)	Depth to Midpoint (ft)	γ (pcf)	σ _{vo} Bottom (psf)	σ _{vo} Midpoint (psf)	σ _{vo} ' Midpoint (psf)	σ _p ⁽¹⁾ (psf)	LL	C _c ⁽²⁾	C _r ⁽³⁾	e _o ⁽⁴⁾	N ₆₀	(N1) ₆₀ ⁽⁵⁾	C' ⁽⁶⁾	Z _r /B	I _r ⁽⁷⁾	Δσ _v ⁽⁸⁾ (psf)	σ _v ' Midpoint (psf)	S _c ^(9,10) (ft)	S _c (in)	Layer Settlement (in)	c _v (ft ² /yr)	H _{dr} (ft)	T _v	U (%)	(S ₃) _t ⁽¹¹⁾ (in)	Layer Settlement (in)	
1	A-1-b	G	0.0	3.0	704.1	701.1	3.0	1.5	125	375	188	188	2,688					25	45	148	0.15	0.499	2,162	2,349	0.022	0.266	0.701					100	0.266	0.660
	A-1-b	G	3.0	6.0	701.1	698.1	3.0	4.5	125	750	563	563	3,063					25	36	116	0.45	0.484	2,096	2,659	0.017	0.209						100	0.209	
2	A-6a	C	6.0	9.3	698.1	694.8	3.3	7.7	120	1,146	948	948	3,448	30	0.080	0.016	0.355				0.77	0.445	1,925	2,873	0.019	0.225		200	1.7	0.604	82	0.185		
2	A-2-6	G	9.3	11.8	694.8	692.3	2.5	10.6	125	1,459	1,302	1,302	3,802					18	21	76	1.07	0.399	1,726	3,029	0.012	0.146	0.266					100	0.146	0.266
	A-2-6	G	11.8	14.3	692.3	689.8	2.5	13.1	125	1,771	1,615	1,615	4,115					18	19	73	1.32	0.360	1,558	3,173	0.010	0.121						100	0.121	
3	A-1-a	G	14.3	16.8	689.8	687.3	2.5	15.6	130	2,096	1,934	1,843	4,343					29	30	98	1.57	0.325	1,406	3,249	0.006	0.075	0.200					100	0.075	0.200
	A-1-a	G	16.8	19.3	687.3	684.8	2.5	18.1	130	2,421	2,259	2,012	4,512					29	29	96	1.82	0.294	1,273	3,285	0.006	0.066						100	0.066	
	A-1-a	G	19.3	21.8	684.8	682.3	2.5	20.6	130	2,746	2,584	2,181	4,681					29	28	94	2.08	0.267	1,158	3,339	0.005	0.059						100	0.059	
4	A-1-b	G	21.8	24.3	682.3	679.8	2.5	23.1	125	3,059	2,902	2,344	4,844					19	18	70	2.33	0.245	1,059	3,403	0.006	0.069	0.131					100	0.069	0.131
	A-1-b	G	24.3	26.8	679.8	677.3	2.5	25.6	125	3,371	3,215	2,500	5,000					19	18	69	2.58	0.225	974	3,474	0.005	0.062						100	0.062	
5	A-1-a	G	26.8	33.8	677.3	670.3	7.0	30.3	130	4,281	3,826	2,815	5,315					37	33	107	3.06	0.194	842	3,657	0.007	0.089	0.158					100	0.089	0.158
	A-1-a	G	33.8	40.8	670.3	663.3	7.0	37.3	130	5,191	4,736	3,288	5,788					37	31	102	3.77	0.162	699	3,988	0.006	0.069						100	0.069	
6	A-4a	C	40.8	49.3	663.3	654.8	8.5	45.1	125	6,254	5,722	3,791	6,291	21	0.099	0.015	0.436				4.55	0.136	587	4,378	0.005	0.066	0.118	400	4.3	0.182	48	0.032	0.040	
	A-4a	C	49.3	58.3	654.8	645.8	9.0	53.8	125	7,379	6,816	4,339	6,839	21	0.099	0.015	0.436				5.43	0.115	496	4,835	0.004	0.053		400	13.0	0.019	16	0.008		

1. σ_p' = σ_{vo}' + σ_m'; Use σ_m = 2,500 psf based on consolidation test results
2. Used actual values from consolidation test results where applicable; For all other layers, used C_c = 0.009(LL-10); Ref. Table 6-9, FHWA GEC 5
3. Used actual values from consolidation test results where applicable; For all other layers, used C_r = 0.15(C_c) for natural soil deposits; Ref. Section 8.11, Holtz and Kovacs 1981
4. Used actual values from consolidation test results where applicable; For all other layers, used e_o = (C_r/1.15)+0.35; Ref. Table 8-2, Holtz and Kovacs 1981
5. (N1)₆₀ = C_nN₆₀, where C_n = [0.77log(40/σ_{vo}')] ≤ 2.0 ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS
7. Influence factor for strip loaded footing
8. Δσ_v = q_b(I)
9. S_c = [C_r/(1+e_o)](H)log(σ_v'/σ_{vo}')for σ_p' ≤ σ_{vo}' < σ_v'; [C_r/(1+e_o)](H)log(σ_p'/σ_{vo}') for σ_{vo}' < σ_v' ≤ σ_p'; [Cr/(1+e_o)](H)log(σ_p'/σ_{vo}')+[C_r/(1+e_o)](H)log(σ_v'/σ_p') for σ_{vo}' < σ_p' < σ_v'; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesive soil layers)
10. S_c = H(1/C')log(σ_v'/σ_{vo}'); Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)
11. (S_c)_t = S_c(U/100); U = 100 for all granular soils at time t = 0

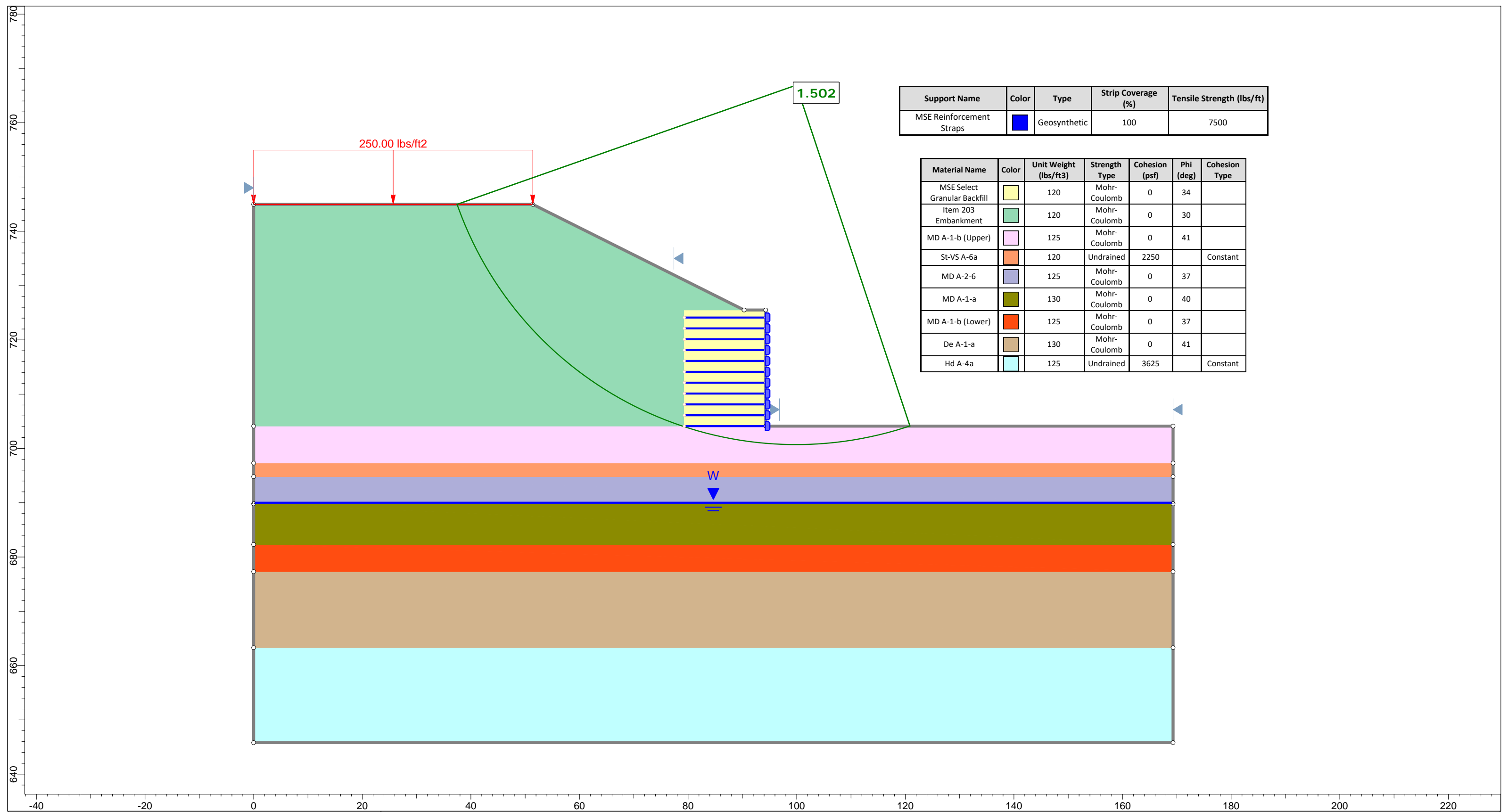
(S_c)_t = 1.457 in

Settlement Remaining After Hold Period: 0.119 in



Support Name	Color	Type	Strip Coverage (%)	Tensile Strength (lbs/ft)
MSE Reinforcement Straps	<div></div>	Geosynthetic	100	7500

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
MSE Select Granular Backfill	<div></div>	120	Mohr-Coulomb	0	34
Item 203 Embankment	<div></div>	120	Mohr-Coulomb	0	30
MD A-1-b (Upper)	<div></div>	125	Mohr-Coulomb	0	41
St-VS A-6a	<div></div>	120	Mohr-Coulomb	0	28
MD A-2-6	<div></div>	125	Mohr-Coulomb	0	37
MD A-1-a	<div></div>	130	Mohr-Coulomb	0	40
MD A-1-b (Lower)	<div></div>	125	Mohr-Coulomb	0	37
De A-1-a	<div></div>	130	Mohr-Coulomb	0	41
Hd A-4a	<div></div>	125	Mohr-Coulomb	0	29



Support Name	Color	Type	Strip Coverage (%)	Tensile Strength (lbs/ft)
MSE Reinforcement Straps	■	Geosynthetic	100	7500

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type
MSE Select Granular Backfill	■	120	Mohr-Coulomb	0	34	
Item 203 Embankment	■	120	Mohr-Coulomb	0	30	
MD A-1-b (Upper)	■	125	Mohr-Coulomb	0	41	
St-VS A-6a	■	120	Undrained	2250		Constant
MD A-2-6	■	125	Mohr-Coulomb	0	37	
MD A-1-a	■	130	Mohr-Coulomb	0	40	
MD A-1-b (Lower)	■	125	Mohr-Coulomb	0	37	
De A-1-a	■	130	Mohr-Coulomb	0	41	
Hd A-4a	■	125	Undrained	3625		Constant

APPENDIX X

EMBANKMENT SETTLEMENT ANALYSIS RESULTS

W-20-025 - FRA-70-13.01
Downdrag Analysis - Pier 2

Calculated By: HSK
Checked By: BRT

Date: 6/24/2021
Date: 6/24/2021

Boring B-014-4-19 - Ground Surface Elevation @ 698.8 ft msl and Bottom of Footing Elevation @ 693.4 ft msl

H =

22.0

ft

Future embankment height

B =

53.0

ft

Total width of all foundations

D_w =

8.0

ft

Depth below ground surface

q_e =

2,640

psf

Layer	Soil Class.	Soil Type	Layer Depth (ft)		Elevation (ft msl)		Layer Thickness (ft)	Depth to Midpoint (ft)	γ (pcf)	σ _{vo} Bottom (psf)	σ _{vo} Midpoint (psf)	σ _{vo} ' Midpoint (psf)	σ _p ' ⁽¹⁾ (psf)	LL	C _c ⁽²⁾	C _r ⁽³⁾	e _o ⁽⁴⁾	N ₆₀	(N1) ₆₀ ⁽⁵⁾	C' ⁽⁶⁾	Z _f /B	I ⁽⁷⁾	Δσ _v ⁽⁸⁾ (psf)	σ _{vf} ' Midpoint (psf)	S _c ^(9,10) (ft)	S _c (in)	Relative Movement (in)
1	A-6a	C	0.0	1.5	698.8	697.3	1.5	0.8	125	188	94	94	4,094	33	0.109	0.023	0.563				0.01	1.000	2,640	2,734	0.032	0.388	
	A-6a	C	1.5	3.0	697.3	695.8	1.5	2.3	130	383	285	285	4,285	33	0.109	0.023	0.563				0.04	1.000	2,639	2,924	0.022	0.268	
2	A-1-a	G	3.0	5.4	695.8	693.4	2.4	4.2	130	695	539	539	4,539					34	49	165	0.08	0.998	2,636	3,174	0.011	0.134	
	A-1-a	G	5.4	10.5	693.4	688.3	5.1	8.0	130	1,358	1,026	1,026	5,026					34	42	136	0.15	0.990	2,613	3,639	0.021	0.247	1.008
3	A-1-a	G	10.5	13.0	688.3	685.8	2.5	11.8	130	1,683	1,520	1,286	5,286					44	51	172	0.22	0.970	2,561	3,847	0.007	0.083	0.925
4	A-1-a	G	13.0	18.0	685.8	680.8	5.0	15.5	125	2,308	1,995	1,527	5,527					26	28	94	0.29	0.941	2,483	4,010	0.022	0.266	0.659
5	A-1-a	G	18.0	20.5	680.8	678.3	2.5	19.3	125	2,620	2,464	1,762	5,762					15	16	66	0.36	0.903	2,383	4,145	0.014	0.170	0.489
6	A-1-a	G	20.5	26.5	678.3	672.3	6.0	23.5	140	3,460	3,040	2,073	6,073					73	72	281	0.44	0.854	2,255	4,328	0.007	0.082	0.407
7	A-4a	C	26.5	32.0	672.3	666.8	5.5	29.3	130	4,175	3,818	2,492	6,492	20	0.090	0.014	0.428				0.55	0.785	2,073	4,565	0.014	0.164	0.243
8	A-1-b	G	32.0	36.5	666.8	662.3	4.5	34.3	130	4,760	4,468	2,830	6,830					25	22	79	0.65	0.727	1,920	4,750	0.013	0.154	0.090
9	A-4a	C	36.5	40.5	662.3	658.3	4.0	38.5	135	5,300	5,030	3,127	7,127	20	0.090	0.014	0.428				0.73	0.681	1,798	4,925	0.007	0.090	0.000

1. σ_p' = σ_{vo}' + σ_m. Estimate σ_m of 2,000 psf in existing fill material and 4,000 psf (moderately overconsolidated) for natural soil deposits; Ref. Table 11.2, Coduto 2003

2. C_c = 0.009(LL-10); Ref. Table 6-9, FHWA GEC 5

3. C_r = 0.15(C_c) for the existing fill and 0.10(C_c) for the natural soil deposits; Ref. Section 8.11, Holtz and Kovacs 1981

4. e_o = (C_c/1.15) + 0.35; Ref. Table 8-2, Holtz and Kovacs 1981

5. (N1)₆₀ = C_nN₆₀, where C_N = [0.77log(40/σ_{vo}')] ≤ 2.0 ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS

6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS

7. Influence factor for strip loaded footing

8. Δσ_v = q_e(I)

9. S_c = [C_c/(1+e_o)](H)log(σ_{vf}'/σ_{vo}') for σ_p' ≤ σ_{vo}' < σ_{vf}'; [C_r/(1+e_o)](H)log(σ_p'/σ_{vo}') for σ_{vo}' < σ_{vf}' ≤ σ_p'; [C_r/(1+e_o)](H)log(σ_p'/σ_{vo}') + [C_c/(1+e_o)](H)log(σ_{vf}'/σ_p') for σ_{vo}' < σ_p' < σ_{vf}'; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesiv soil layers)

10. S_c = H(1/C')log(σ_{vf}'/σ_{vo}'); Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)

Total Settlement Below Ground Surface Elevation: 2.045 in

Total Settlement Below Bottom of Footing Elevation: 1.255 in

Depth of Downdrag Below Bottom of Footing: 18.0 ft

W-20-025 - FRA-70-13.01
Embankment Settlement - Forward Abutment Spill Through Slope

Calculated By: HSK
Checked By: BRT
Date: 6/24/2021
Date: 6/24/2021

Boring B-014-7-20

H = 29.5 ft Embankment Height
B = 80.0 ft Embankment Width along Abutment Footing
D_w = 24.5 ft Depth Below Bottom of Embankment
γ = 120 pcf Unit Weight of Embankment
q = 3,540 psf Applied Pressure from Embankment Loading

t = 105 days Time following completion of construction

																								Total Embankment Settlement			Settlement Complete at 90% of Primary Consolidation						Remaining Settlement at 90% of Primary Consolidation		
Layer	Soil Class.	Soil Type	Layer Depth (ft)		Elevation (ft msl)		Layer Thickness (ft)	Depth to Midpoint (ft)	γ (pcf)	σ _{vo} Bottom (psf)	σ _{vo} Midpoint (psf)	σ _{vo} ' Midpoint (psf)	σ _p ' (1) (psf)	LL	C _c (2)	C _r (3)	e _o (4)	N ₆₀	(N1) ₆₀ (5)	C' (6)	Z _f /B	I (7)	Δσ _v (8) (psf)	σ _v ' Midpoint (psf)	S _c (9,10) (ft)	S _c (in)	Layer Settlement (in)	c _v (ft ² /yr)	H _{dr} (ft)	T _v	U (%)	(S _d) _t (11) (in)	Layer Settlement (in)	S _c - (S _d) _t (in)	Relative Movement (in)
1	A-6a	C	0.0	2.5	714.5	712.0	2.5	1.3	120	300	150	150	2,650	32	0.109	0.023	0.563				0.02	1.000	3,540	3,690	0.071	0.851	1.486	200	1.3	36.822	100	0.851	1.486	0.000	0.474
	A-6a	C	2.5	5.0	712.0	709.5	2.5	3.8	120	600	450	450	2,950	32	0.109	0.023	0.563				0.05	1.000	3,539	3,989	0.053	0.635		200	3.8	4.091	100	0.635		0.000	0.474
2	A-6a	C	5.0	7.5	709.5	707.0	2.5	6.3	130	925	763	763	3,263	32	0.109	0.023	0.563				0.08	0.998	3,534	4,297	0.044	0.529	1.070	200	6.3	1.473	98	0.518	0.984	0.011	0.463
	A-6a	C	7.5	10.5	707.0	704.0	3.0	9.0	130	1,315	1,120	1,120	3,620	32	0.109	0.023	0.563				0.11	0.995	3,524	4,644	0.045	0.541		200	9.0	0.710	86	0.466		0.076	0.388
3	A-7-6	C	10.5	13.5	704.0	701.0	3.0	12.0	130	1,705	1,510	1,510	4,010	42	0.234	0.029	0.987				0.15	0.990	3,503	5,013	0.053	0.634	2.327	150	12.0	0.300	61	0.387	1.939	0.247	0.140
	A-7-6	C	13.5	17.0	701.0	697.5	3.5	15.3	130	2,160	1,933	1,933	4,433	42	0.234	0.029	0.987				0.19	0.980	3,469	5,402	0.054	0.646		150	8.8	0.564	80	0.517		0.129	0.011
	A-7-6	C	17.0	20.5	697.5	694.0	3.5	18.8	130	2,615	2,388	2,388	4,888	42	0.234	0.029	0.987				0.23	0.966	3,418	5,806	0.047	0.561		150	5.3	1.566	98	0.549		0.011	0.000
	A-7-6	C	20.5	24.0	694.0	690.5	3.5	22.3	130	3,070	2,843	2,843	5,343	42	0.234	0.029	0.987				0.28	0.947	3,353	6,196	0.041	0.486		150	1.8	14.090	100	0.486		0.000	0.000
4	A-1-b	G	24.0	27.5	690.5	687.0	3.5	25.8	135	3,543	3,306	3,228	5,728					100	84	355	0.32	0.926	3,277	6,505	0.003	0.036	0.071				100	0.036	0.071	0.000	0.000
	A-1-b	G	27.5	31.0	687.0	683.5	3.5	29.3	135	4,015	3,779	3,482	5,982					100	82	338	0.37	0.901	3,191	6,673	0.003	0.035					100	0.035		0.000	0.000
5	A-1-a	G	31.0	36.0	683.5	678.5	5.0	33.5	130	4,665	4,340	3,778	6,278					40	32	103	0.42	0.870	3,078	6,857	0.013	0.150	0.290				100	0.150	0.290	0.000	0.000
	A-1-a	G	36.0	41.0	678.5	673.5	5.0	38.5	130	5,315	4,990	4,116	6,616					40	30	100	0.48	0.830	2,939	7,055	0.012	0.140					100	0.140		0.000	0.000
6	A-4a	C	41.0	47.0	673.5	667.5	6.0	44.0	125	6,065	5,690	4,473	6,973	19	0.081	0.012	0.420				0.55	0.787	2,784	7,258	0.016	0.190	0.190	400	3.0	12.785	100	0.190	0.190	0.000	0.000
7	A-1-a	G	47.0	55.6	667.5	658.9	8.6	51.3	130	7,183	6,624	4,952	7,452					45	31	103	0.64	0.730	2,585	7,537	0.015	0.183	0.183				100	0.183	0.183	0.000	0.000
6	A-4a	C	55.6	62.8	658.9	651.7	7.2	59.2	125	8,083	7,633	5,468	7,968	19	0.081	0.012	0.420				0.74	0.674	2,385	7,852	0.010	0.116	0.116	400	7.2	2.220	100	0.116	0.116	0.000	0.000

1. σ_p' = σ_{vo}' + σ_m'; Use σ_m = 2,500 psf based on consolidation test results
2. Used actual values from consolidation test results where applicable; For all other layers, used C_c = 0.009(LL-10); Ref. Table 6-9, FHWA GEC 5
3. Used actual values from consolidation test results where applicable; For all other layers, used C_r = 0.15(C_c) for natural soil deposits; Ref. Section 8.11, Holtz and Kovacs 1981
4. Used actual values from consolidation test results where applicable; For all other layers, used e_o = (C_r/1.15)+0.35; Ref. Table 8-2, Holtz and Kovacs 1981
5. (N1)₆₀ = C_pN₆₀, where C_N = [0.77log(40/σ_{vo}')] ≤ 2.0 ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS
7. Influence factor for strip loaded footing
8. Δσ_v = q_s(l)
9. S_c = [C_d/(1+e_o)](H)log(σ_v'/σ_{vo}')for σ_p' ≤ σ_{vo}' < σ_v'; [C_r/(1+e_o)](H)log(σ_p'/σ_{vo}') for σ_{vo}' < σ_v' ≤ σ_p'; [Cr/(1+e_o)](H)log(σ_p'/σ_{vo}')+[C_d/(1+e_o)](H)log(σ_v'/σ_p') for σ_{vo}' < σ_p' < σ_v'; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesive soil layers)
10. S_c = H(1/C')log(σ_v'/σ_{vo}'); Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)
11. (S_d)_t = S_c(U/100); U = 100 for all granular soils at time t = 0

S_c = 5.734 in

(S_d)_t = 5.143 in

Settlement Remaining After Hold Period: 0.590 in

Depth of Downdrag: 8.5 ft

W-20-025 - FRA-70-13.01
Embankment Settlement - Forward Abutment Spill Through Slope

Calculated By: HSK
Checked By: BRT
Date: 6/24/2021
Date: 6/24/2021

Boring B-014-7-20

H = 29.5 ft Embankment Height
B = 80.0 ft Embankment Width along Abutment Footing
D_w = 24.5 ft Depth Below Bottom of Embankment
γ = 120 pcf Unit Weight of Embankment
q = 3,540 psf Applied Pressure from Embankment Loading

t = 30 days Time following completion of construction

																								Total Embankment Settlement			Settlement Complete at 74% of Primary Consolidation							Remaining Settlement at 74% of Primary Consolidation	
Layer	Soil Class.	Soil Type	Layer Depth (ft)		Elevation (ft msl)		Layer Thickness (ft)	Depth to Midpoint (ft)	γ (pcf)	σ _{vo} Bottom (psf)	σ _{vo} Midpoint (psf)	σ _{vo} ¹ Midpoint (psf)	σ _p ¹⁽¹⁾ (psf)	LL	C _c ⁽²⁾	C _r ⁽³⁾	e _o ⁽⁴⁾	N ₆₀	(N1) ₆₀ ⁽⁵⁾	C _u ⁽⁶⁾	Z _f /B	I _f ⁽⁷⁾	Δσ _v ⁽⁸⁾ (psf)	σ _v ¹ Midpoint (psf)	S _c ^(9,10) (ft)	S _c (in)	Layer Settlement (in)	c _v (ft ² /yr)	H _{dr} (ft)	T _v	U (%)	(S _o) _t ⁽¹¹⁾ (in)	Layer Settlement (in)	S _c - (S _o) _t (in)	Relative Movement (in)
1	A-6a	C	0.0	2.5	714.5	712.0	2.5	1.3	120	300	150	150	2,650	32	0.109	0.023	0.563				0.02	1.000	3,540	3,690	0.071	0.851	1.486	200	1.3	10.521	100	0.851	1.454	0.000	1.402
	A-6a	C	2.5	5.0	712.0	709.5	2.5	3.8	120	600	450	450	2,950	32	0.109	0.023	0.563				0.05	1.000	3,539	3,989	0.053	0.635		200	3.8	1.169	95	0.603		0.032	1.370
2	A-6a	C	5.0	7.5	709.5	707.0	2.5	6.3	130	925	763	763	3,263	32	0.109	0.023	0.563				0.08	0.998	3,534	4,297	0.044	0.529	1.070	200	6.3	0.421	71	0.376	0.652	0.153	1.216
	A-6a	C	7.5	10.5	707.0	704.0	3.0	9.0	130	1,315	1,120	1,120	3,620	32	0.109	0.023	0.563				0.11	0.995	3,524	4,644	0.045	0.541		200	9.0	0.203	51	0.276		0.265	0.951
3	A-7-6	C	10.5	13.5	704.0	701.0	3.0	12.0	130	1,705	1,510	1,510	4,010	42	0.234	0.029	0.987				0.15	0.990	3,503	5,013	0.053	0.634	2.327	150	12.0	0.086	33	0.209	1.395	0.425	0.526
	A-7-6	C	13.5	17.0	701.0	697.5	3.5	15.3	130	2,160	1,933	1,933	4,433	42	0.234	0.029	0.987				0.19	0.980	3,469	5,402	0.054	0.646		150	8.8	0.161	45	0.291		0.355	0.171
	A-7-6	C	17.0	20.5	697.5	694.0	3.5	18.8	130	2,615	2,388	2,388	4,888	42	0.234	0.029	0.987				0.23	0.966	3,418	5,806	0.047	0.561		150	5.3	0.447	73	0.409		0.151	0.020
	A-7-6	C	20.5	24.0	694.0	690.5	3.5	22.3	130	3,070	2,843	2,843	5,343	42	0.234	0.029	0.987				0.28	0.947	3,353	6,196	0.041	0.486		150	1.8	4.026	100	0.486		0.000	0.020
4	A-1-b	G	24.0	27.5	690.5	687.0	3.5	25.8	135	3,543	3,306	3,228	5,728					100	84	355	0.32	0.926	3,277	6,505	0.003	0.036	0.071				100	0.036	0.071	0.000	0.020
	A-1-b	G	27.5	31.0	687.0	683.5	3.5	29.3	135	4,015	3,779	3,482	5,982					100	82	338	0.37	0.901	3,191	6,673	0.003	0.035					100	0.035		0.000	0.020
5	A-1-a	G	31.0	36.0	683.5	678.5	5.0	33.5	130	4,665	4,340	3,778	6,278					40	32	103	0.42	0.870	3,078	6,857	0.013	0.150	0.290				100	0.150	0.290	0.000	0.020
	A-1-a	G	36.0	41.0	678.5	673.5	5.0	38.5	130	5,315	4,990	4,116	6,616					40	30	100	0.48	0.830	2,939	7,055	0.012	0.140					100	0.140		0.000	0.020
6	A-4a	C	41.0	47.0	673.5	667.5	6.0	44.0	125	6,065	5,690	4,473	6,973	19	0.081	0.012	0.420				0.55	0.787	2,784	7,258	0.016	0.190	0.190	400	3.0	3.653	100	0.190	0.190	0.000	0.020
7	A-1-a	G	47.0	55.6	667.5	658.9	8.6	51.3	130	7,183	6,624	4,952	7,452					45	31	103	0.64	0.730	2,585	7,537	0.015	0.183	0.183				100	0.183	0.183	0.000	0.020
6	A-4a	C	55.6	62.8	658.9	651.7	7.2	59.2	125	8,083	7,633	5,468	7,968	19	0.081	0.012	0.420				0.74	0.674	2,385	7,852	0.010	0.116	0.116	400	7.2	0.634	83	0.096	0.096	0.020	0.000

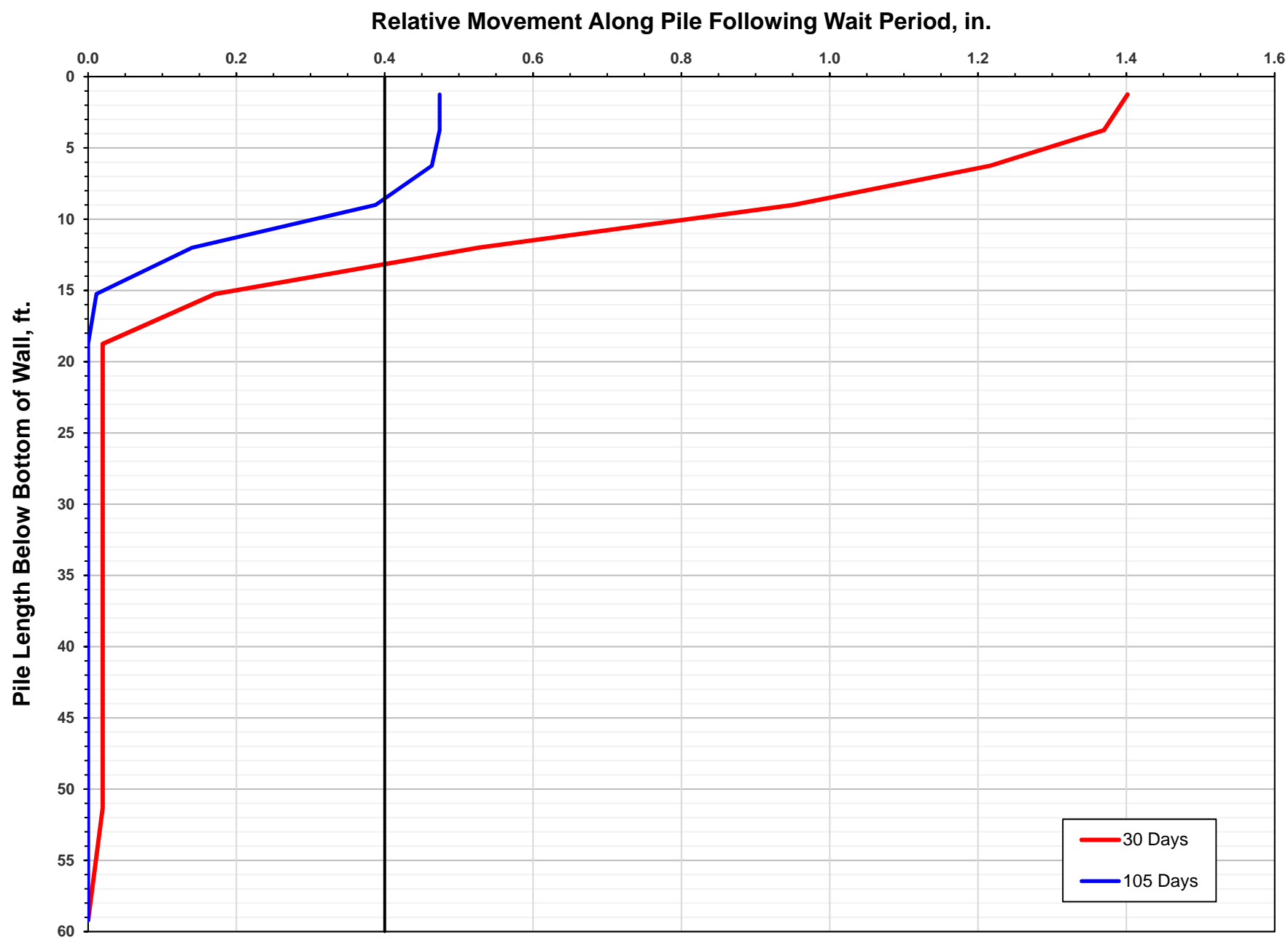
1. σ_p¹ = σ_{vo}¹+σ_m¹; Use σ_m = 2,500 psf based on consolidation test results
2. Used actual values from consolidation test results where applicable; For all other layers, used C_c = 0.009(LL-10); Ref. Table 6-9, FHWA GEC 5
3. Used actual values from consolidation test results where applicable; For all other layers, used C_r = 0.15(C_c) for natural soil deposits; Ref. Section 8.11, Holtz and Kovacs 1981
4. Used actual values from consolidation test results where applicable; For all other layers, used e_o = (C_r/1.15)+0.35; Ref. Table 8-2, Holtz and Kovacs 1981
5. (N1)₆₀ = C_uN₆₀, where C_N = [0.77log(40/σ_{vo}¹)] ≤ 2.0 ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS
7. Influence factor for strip loaded footing
8. Δσ_v = q_o(I)
9. S_c = [C_r/(1+e_o)](H)log(σ_v¹/σ_{vo}¹)for σ_p¹ ≤ σ_{vo}¹ < σ_v¹; [C_r/(1+e_o)](H)log(σ_p¹/σ_{vo}¹) for σ_{vo}¹ < σ_v¹ ≤ σ_p¹; [C_r/(1+e_o)](H)log(σ_p¹/σ_{vo}¹)+[C_r/(1+e_o)](H)log(σ_v¹/σ_p¹) for σ_{vo}¹ < σ_p¹ < σ_v¹; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesive soil layers)
10. S_c = H(1/C')log(σ_v¹/σ_{vo}¹); Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)
11. (S_o)_t = S_c(U/100); U = 100 for all granular soils at time t = 0

S_c = 5.734 in

(S_o)_t = 4.236 in

Settlement Remaining After Hold Period: 1.498 in

Depth of Downdrag: 13.0 ft



APPENDIX XI

LATERAL DESIGN PARAMETERS

Boring No.	Elevation (feet msl)	Soil Class.	Soil Type	Strata	N ₆₀	N1 ₆₀	γ (pcf)	γ' (pcf)	Strength Parameter	k (soil) k _{rm} (rock)	ε ₅₀ (soil) E _r (rock)	RQD (rock)
B-014-2-19 (Rear Abutment)	744.5 to 736.3	A-4a	C	3	23	23	125	125	Su = 2,875 psf	960 pci	0.0052	-
	736.3 to 729.0	A-6a	C	3	15	15	120	120	Su = 1,875 psf	625 pci	0.0065	-
	729.0 to 724.0	A-6a	C	3	25	25	125	125	Su = 3,125 psf	1,040 pci	0.0050	-
	724.0 to 721.5	A-6a	C	3	17	17	130	130	Su = 2,125 psf	710 pci	0.0062	-
	721.5 to 719.0	A-4a	C	3	33	33	135	135	Su = 4,125 psf	1,375 pci	0.0046	-
	719.0 to 716.5	A-4a	C	3	23	23	130	130	Su = 2,875 psf	960 pci	0.0052	-
	716.5 to 702.5	A-4a	C	3	102	102	140	140	Su = 8,000 psf	2,665 pci	0.0033	-
	702.5 to 695.3	A-7-6	C	3	23	23	135	135	Su = 2,875 psf	960 pci	0.0052	-
	695.3 to 692.5	A-4a	C	3	42	42	140	140	Su = 5,250 psf	1,750 pci	0.0043	-
	692.5 to 682.5	A-1-b	G	4	83	46	140	140	φ = 41°	315 pci	-	-
	682.5 to 672.5	A-1-b	G	4	28	14	135	72.6	φ = 36°	95 pci	-	-
	672.5 to 662.5	A-1-b	G	4	41	20	140	77.6	φ = 37°	110 pci	-	-
	662.5 to 649.9	Boulders	G	4	120	55	140	77.6	φ = 45°	255 pci	-	-
B-015-1-13 (Rear Abubment)	746.7 to 741.2	A-6a	C	3	32	32	125	125	Su = 4,000 psf	1,335 pci	0.0047	-
	741.2 to 731.2	A-6a	C	3	12	12	115	115	Su = 1,500 psf	500 pci	0.0070	-
	731.2 to 718.7	A-6a	C	3	25	25	120	120	Su = 3,125 psf	1,040 pci	0.0050	-
	718.7 to 714.7	A-1-b	G	4	69	56	135	135	φ = 42°	355 pci	-	-
	714.7 to 709.7	A-6b	C	3	19	19	120	120	Su = 2,375 psf	790 pci	0.0058	-
	709.7 to 694.7	A-4a	C	3	23	23	120	120	Su = 2,875 psf	960 pci	0.0052	-
	694.7 to 689.7	A-1-b	G	4	49	29	135	135	φ = 39°	250 pci	-	-
	689.7 to 674.7	A-1-b	G	4	30	16	130	130	φ = 36°	160 pci	-	-
	674.7 to 651.7	A-4a	C	2	15	15	115	52.6	Su = 1,875 psf	625 pci	0.0065	-
B-003-E-68 (Rear Abutment)	718.4 to 710.4	A-4a	C	3	25	25	120	120	Su = 3,125 psf	1,040 pci	0.0050	-
	710.4 to 705.4	A-1-b	G	4	30	34	130	130	φ = 40°	280 pci	-	-
	705.4 to 700.4	A-7-6	C	3	22	22	125	125	Su = 2,750 psf	915 pci	0.0053	-
	700.4 to 685.4	A-1-a	G	4	100	84	135	135	φ = 43°	395 pci	-	-
	685.4 to 675.4	A-1-a	G	4	20	15	125	62.6	φ = 37°	110 pci	-	-
	675.4 to 670.4	A-1-a	G	4	54	38	135	72.6	φ = 41°	175 pci	-	-
	670.4 to 665.4	A-1-b	G	4	26	18	125	62.6	φ = 37°	110 pci	-	-
	665.4 to 648.4	A-4a	C	2	27	27	125	62.6	Su = 3,375 psf	1,125 pci	0.0049	-
	648.4 to 643.4	Limestone	R	9	-	-	165	102.6	Qu = 10,000 psi	0.00005	1,000,000 psi	85
B-014-3-19 (Pier 1)	700.9 to 699.4	A-2-4	G	4	33	66	130	130	φ = 41°	315 pci	-	-
	699.4 to 697.9	A-1-a	G	4	85	139	135	135	φ = 43°	395 pci	-	-
	697.9 to 695.4	A-1-a	G	4	42	60	130	130	φ = 43°	395 pci	-	-
	695.4 to 690.4	A-1-a	G	4	71	86	135	135	φ = 43°	395 pci	-	-
	690.4 to 682.9	A-1-a	G	4	36	38	130	67.6	φ = 41°	175 pci	-	-
	682.9 to 677.9	A-1-b	G	4	16	16	130	67.6	φ = 36°	95 pci	-	-
	677.9 to 675.4	A-4a	C	2	46	46	135	72.6	Su = 5,750 psf	1,915 pci	0.0041	-
	675.4 to 668.9	A-1-b	G	4	101	90	140	77.6	φ = 42°	195 pci	-	-
	668.9 to 658.9	A-4a	C	2	27	27	135	72.6	Su = 3,375 psf	1,125 pci	0.0049	-
	658.9 to 654.9	A-4a	C	2	56	56	140	77.6	Su = 7,000 psf	2,335 pci	0.0037	-
	654.9 to 646.1	Limestone	R	9	-	-	165	102.6	Qu = 10,000 psi	0.00005	1,000,000 psi	32
B-015-2-13 (Pier 1)	700.4 to 694.9	A-2-4	G	4	32	50	130	130	φ = 41°	315 pci	-	-
	694.9 to 689.9	A-1-b	G	4	48	59	130	130	φ = 42°	355 pci	-	-
	689.9 to 682.4	A-1-b	G	4	13	14	125	62.6	φ = 36°	95 pci	-	-
	682.4 to 677.4	A-1-b	G	4	29	29	130	67.6	φ = 39°	140 pci	-	-
	677.4 to 668.4	A-1-a	G	4	36	33	130	67.6	φ = 41°	175 pci	-	-
	668.4 to 658.4	A-4a	C	2	45	45	130	67.6	Su = 5,625 psf	1,875 pci	0.0041	-
	658.4 to 641.9	A-4a	C	2	32	32	125	62.6	Su = 4,000 psf	1,335 pci	0.0047	-
	641.9 to 631.9	Limestone	R	9	-	-	165	102.6	Qu = 10,000 psi	0.00005	1,000,000 psi	63
B-014-4-19 (Pier 2)	698.8 to 697.3	A-6a	C	3	25	25	125	125	Su = 3,125 psf	1,040 pci	0.0050	-
	697.3 to 695.8	A-6a	C	3	37	37	130	130	Su = 4,625 psf	1,540 pci	0.0045	-
	695.8 to 688.3	A-1-a	G	4	34	44	130	130	φ = 42°	355 pci	-	-
	688.3 to 685.8	A-1-a	G	4	44	51	130	67.6	φ = 43°	215 pci	-	-
	685.8 to 680.8	A-1-a	G	4	26	28	125	62.6	φ = 40°	155 pci	-	-
	680.8 to 678.3	A-1-a	G	4	15	16	125	62.6	φ = 37°	110 pci	-	-
	678.3 to 672.3	A-1-a	G	4	73	72	140	77.6	φ = 43°	215 pci	-	-
	672.3 to 666.8	A-4a	C	2	30	30	130	67.6	Su = 3,750 psf	1,250 pci	0.0048	-
	666.8 to 662.3	A-1-b	G	4	25	22	130	67.6	φ = 38°	125 pci	-	-
	662.3 to 658.3	A-4a	C	2	120	120	135	72.6	Su = 8,000 psf	2,665 pci	0.0033	-
	658.3 to 649.1	Limestone	R	9	-	-	165	102.6	Qu = 10,000 psi	0.00005	1,000,000 psi	72
B-108-5-13 (Forward Abutment)	700.3 to 697.3	A-1-b	G	4	25	45	125	125	φ = 41°	315 pci	-	-
	697.3 to 694.8	A-6a	C	3	18	18	120	120	Su = 2,250 psf	750 pci	0.0060	-
	694.8 to 689.8	A-2-6	G	4	18	22	125	125	φ = 37°	190 pci	-	-
	689.8 to 682.3	A-1-a	G	4	29	31	130	67.6	φ = 40°	155 pci	-	-
	682.3 to 677.3	A-1-b	G	4	19	19	125	62.6	φ = 37°	110 pci	-	-
	677.3 to 663.3	A-1-a	G	4	37	34	130	67.6	φ = 41°	175 pci	-	-
	663.3 to 645.8	A-4a	C	2	29	29	125	62.6	Su = 3,625 psf	1,210 pci	0.0048	-
	645.8 to 637.3	Limestone	R	9	-	-	165	102.6	Qu = 10,000 psi	0.00005	1,000,000 psi	79
B-108-6-13 (Forward Abutment)	714.5 to 709.0	A-2-4	G	4	26	41	125	125	φ = 40°	280 pci	-	-
	709.0 to 689.0	A-6a	C	3	9	9	115	115	Su = 1,125 psf	300 pci	0.0085	-
	689.0 to 677.5	A-4a	C	3	10	10	115	115	Su = 1,250 psf	365 pci	0.0080	-
	677.5 to 672.5	A-1-a	G	4	26	19	125	62.6	φ = 38°	125 pci	-	-
	672.5 to 667.5	A-1-a	G	4	54	38	135	72.6	φ = 41°	175 pci	-	-
	667.5 to 657.0	A-4a	C	2	92	92	130	67.6	Su = 8,000 psf	2,665 pci	0.0033	-
	657.0 to 647.4	Limestone	R	9	-	-	165	102.6	Qu = 10,000 psi	0.00005	1,000,000 psi	73
B-012-E-68 (Forward Abutment)	704.4 to 695.4	A-1-a	G	4	18	26	125	125	φ = 39°	250 pci	-	-
	695.4 to 684.4	A-1-b	G	4	7	7	120	120	φ = 33°	95 pci	-	-
	684.4 to 674.4	A-1-a	G	4	37	34	130	67.6	φ = 41°	175 pci	-	-
	674.4 to 664.4	A-2-4	G	4	100	85	135	72.6	φ = 41°	175 pci	-	-
	664.4 to 659.4	A-4a	G	4	26	21	125	62.6	φ = 34°	70 pci	-	-
	659.4 to 654.4	A-4a	C	2	100	100	130	67.6	Su = 8,000 psf	2,665 pci	0.0033	-
	654.4 to 646.4	A-2-4	G	4	37	27	130	67.6	φ = 38°	125 pci	-	-
	646.4 to 644.4	Limestone	R	9	-	-	165	102.6	Qu = 10,000 psi	0.00005	1,000,000 psi	85
B-014-7-20 (Forward Abutment)	715.5 to 709.5	A-6a	C	3	22	22	120	120	Su = 2,750 psf	915 pci	0.0053	-
	709.5 to 704.0	A-6a	C	3	50	50	130	130	Su = 6,250 psf	2,085 pci	0.0039	-
	704.0 to 690.5	A-7-6	C	3	40	40	130	130	Su = 5,000 psf	1,665 pci	0.0043	-
	690.5 to 683.5	A-1-b	G	4	100	82	135	72.6	φ = 42°	195 pci	-	-
	683.5 to 673.5	A-1-a	G	4	40	31	130	67.6	φ = 40°	155 pci	-	-
	673.5 to 667.5	A-4a	C	2	23	23	125	62.6	Su = 2,875 psf	960 pci	0.0052	-
	667.5 to 658.9	A-1-a	G	4	45	31	130	67.6	φ = 40°	155 pci	-	-

APPENDIX XII

GB1 ANALYSIS OUTPUTS

OHIO DEPARTMENT OF TRANSPORTATION**OFFICE OF GEOTECHNICAL ENGINEERING****PLAN SUBGRADES
Geotechnical Bulletin GB1****FRA-70-13.01
105430****Subsurface exploration for improvements along I-70 EB from Souder Avenue to the
FRA-70-1321R bridge structure in Franklin County, Ohio.****Resource International, Inc.****Prepared By:** Leila Sadeghi, Ph.D., Brian Trenner, P.E.
Date prepared: Wednesday, May 13, 2020**Resource International, Inc.
6350 Presidential Gateway
Columbus, Ohio 43231
Phone: 614.823.4949
leilas@resourceinternational.com****NO. OF BORINGS:** **3**



#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-014-1-19	BL I-70 EB	130+97	21	Lt	CME 55	91	736.5	735.1	1.4 C
2	B-019-5-19	BL I-70 EB	135+82	16	Lt	CME 55	91	744.5	743.0	1.5 C
3	B-019-8-19	BL I-70 EB	145+09	10	Lt	CME 55	91	736.1	734.7	1.4 C



#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics					Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)	
			From	To	From	To	N ₆₀	N _{60L}		LL	PL	PI	% Silt	% Clay	P200	M _c	M _{OPT}	Class		GI	Unsuitable	Unstable	Unsuitable		Unstable
1	B 014-1 19	SS-1	1.5	3.0	0.1	1.6	15	15		19	14	5	18	5	23	8	6	A-1-b	0	1900					
		SS-2	3.0	4.5	1.6	3.1	30		3.5	21	17	4	26	10	36	13	12	A-4a	0						
		SS-3	4.5	6.0	3.1	4.6	35		3.5							13	10	A-4a	8						
		SS-4	6.0	7.5	4.6	6.1	39		4.5							11	14	A-6a	10						
2	B 019-5 19	SS-1	1.5	3.0	0.0	1.5	21	21	3.5	19	16	3	24	12	36	16	11	A-4a	0	1500		Mc			
		SS-2	3.5	5.0	2.0	3.5	29		3.75							11	10	A-4a	8						
		2S-3A	6.0	8.0	4.5	6.5	21		3							13	10	A-4a	8						
		SS-4	8.5	10.0	7.0	8.5	15		3	26	15	11	32	20	52	14	14	A-6a							
3	B 019-8 19	SS-1B	1.5	3.0	0.1	1.6	27	23	3.5	36	21	15	33	18	51	13	16	A-6a	5	640					
		SS-2	3.0	4.5	1.6	3.1	23		3.5	33	23	10	26	18	44	20	18	A-4a	2						
		SS-3	4.5	6.0	3.1	4.6	29		3							21	10	A-4a	8						
		SS-4	6.0	7.3	4.6	5.9	50		4.25							14	10	A-4a	8						

PID: 105430

County-Route-Section: FRA-70-13.01

No. of Borings: 3

Geotechnical Consultant: Resource International, Inc.

Prepared By: Leila Sadeghi, Ph.D., Brian Trenner, P.E.

Date prepared: 5/13/2020

Chemical Stabilization Options		
320	Rubblize & Roll	Option
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	NA

Excavate and Replace Stabilization Options	
Global Geotextile Override(N60L):	12"
Average(HP):	0"
Global Geogrid Override(N60L):	0"
Average(HP):	0"

Design CBR	8
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% Samples within 6 feet of subgrade			
N ₆₀ ≤ 5	0%	HP ≤ 0.5	0%
N ₆₀ < 12	0%	0.5 < HP ≤ 1	0%
12 ≤ N ₆₀ < 15	0%	1 < HP ≤ 2	0%
N ₆₀ ≥ 20	91%	HP > 2	91%
M+	9%		
Rock	0%		
Unsuitable	0%		

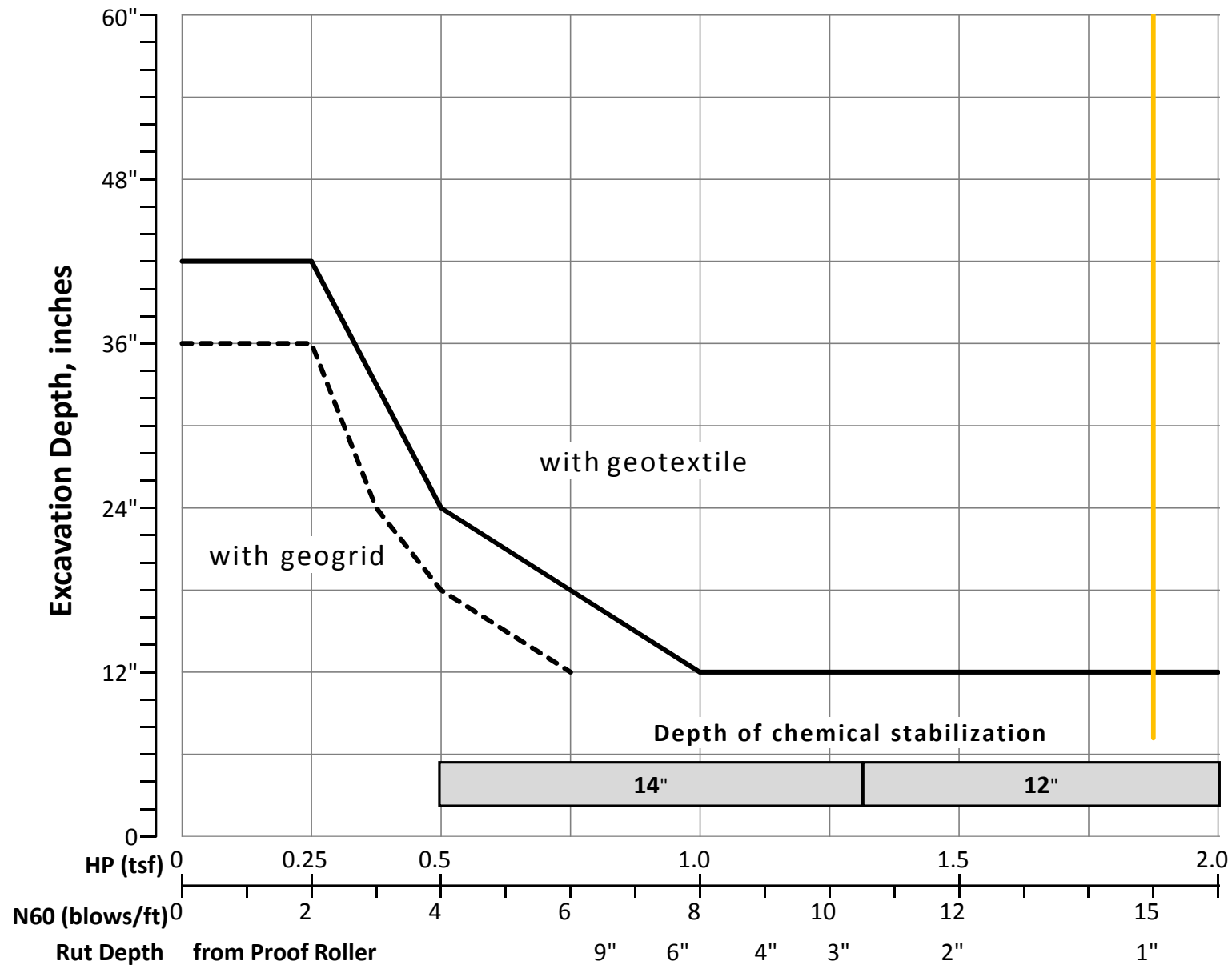
Excavate and Replace at Surface	
Average	0"
Maximum	0"
Minimum	0"

% Proposed Subgrade Surface	
Unstable & Unsuitable	17%
Unstable	17%
Unsuitable	0%

	N ₆₀	N _{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M _C	M _{OPT}	GI
Average	28	20	3.55	26	18	8	27	14	40	14	12	5
Maximum	50	23	4.50	36	23	15	33	20	52	21	18	10
Minimum	15	15	3.00	19	14	3	18	5	23	8	6	0

Classification Counts by Sample																		Totals
ODOT Class	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b
Count	0	0	1	0	0	0	0	0	0	8	0	0	3	0	0	0	0	12
Percent	0%	0%	8%	0%	0%	0%	0%	0%	0%	67%	0%	0%	25%	0%	0%	0%	0%	100%
% Rock Granular Cohesive	0%	75%										25%						100%
Surface Class Count	0	0	1	0	0	0	0	0	0	4	0	0	1	0	0	0	0	6
Surface Class Percent	0%	0%	17%	0%	0%	0%	0%	0%	0%	67%	0%	0%	17%	0%	0%	0%	0%	100%

GB1 Figure B – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
3.55		<input type="checkbox"/> HP
19.67	15.00	<input checked="" type="checkbox"/> N60L

Average HP

Average N_{60L}



The subgrade analysis workbook consists of five worksheets. Each worksheet functions independently. In all of the worksheets the fields are color coded as follows:

- Every yellow highlighted field indicates a field to be entered by the user.
- Every salmon field is to indicate a problem/issue.
- Every gray or green field is a heading/informational field.

IMPORTANT: The sequence of filling out the data needs to be followed as outlined below:

1. Cover Sheet: this worksheet is designed for the purpose of entering the project information.
Enter all the following fields:

County-Route-Section	This includes the county, route, section number assigned to the project.
PID	the Project Identification Number
Project Description	See Cover Sheet for list of example details
Geotechnical Consultant	The Geotechnical Consultant performing the analysis.
Prepared By	The preparer of the subgrade analysis
Date prepared	The date the analysis is performed.
Contact Information	Name, address, telephone #, and email address
No. of Borings	Enter the total number of borings within the alignment that is being

2. Boring Logs Entry Worksheet: this worksheet has a programming code that will run in the background every time the sheet is activated and will make the sheet unresponsive for less than a minute. The code is designed to read the total number of borings from the cover sheet and generate the needed number of fields.

- a. All yellow highlighted fields are user's entry.
- b. ODOT **has developed** a text table export from gINT (**GB 1 Borings Log Entry Tab**) that will allow for copy and paste of all highlighted fields with the exception of proposed subgrade elevation. The designer must provide a proposed subgrade elevation in order for the spreadsheet to function properly.
- c. The Cut/Fill field is a calculated field that, based on the difference between the boring elevation and the proposed subgrade elevation, will highlight the cell either gray and adds the letter "C" to the end in a cut situation or highlights the cell in light purple and adds the letter "F" to the end in a fill situation.
- d. Every duplicate boring ID will be highlighted in salmon background and red text.
- e. **IMPORTANT:** After entering all the borings' information, the user must click "Add Subgrade Analysis Entry Fields" button. This will generate all the required fields in the "Subgrade Analysis" Worksheet.

3. Subgrade Analysis Worksheet:

- a. The boring number and boring ID is read from the "Boring Logs Entry Worksheet" excluding every boring that has six feet or more of fill.
- b. All yellow highlighted fields are to be entered by the user and salmon highlighted fields indicates a problem or issue.

c. Every sample that has a Sulfate Content greater than or equal to 3000 will be highlighted in light salmon background. Every sample that has a Sulfate Content greater than or equal to 8000 will be highlighted in darker salmon background. **Note the revised sulfate criteria in GB1 issued July 20, 2018.**

d. Unsuitable/Unstable:

- i. Unsuitable samples that are within 3 feet of the top of subgrade will be highlighted with salmon background and the class will be showing in this field.
- ii. Unstable Samples that are within 3 feet of top of subgrade will be highlighted with salmon background and text to indicate the problem as follows:

Criterion	Stabilization Need Check	Text displayed in the field
A-1-a, A-1-b, A-3, or A-3a Soil Class	No Stabilization is needed	
HP ≥ 1.875	No Stabilization is needed	
N ₆₀ ≥ 15	No Stabilization is needed	
1.875 \geq HP ≥ 1.5 and M _c \geq Opt. M _c +3	Unstable Subgrade	HP & Mc
15 \geq N ₆₀ ≥ 12 and M _c \geq Opt. M _c +3	Unstable Subgrade	N ₆₀ & Mc
HP ≤ 1.5	Unstable Subgrade	HP
N ₆₀ ≤ 12	Unstable Subgrade	N ₆₀

iii. The field is formulated to check for HP first and check for N₆₀ second.

e. Excavate and Replace (Item 204) is going to be calculated based on the subgrade depth for each sample indicating an unsuitable or unstable problem.

f. Recommendation:

- i. Geotextile Option is calculated and rounded to a multiple of 3 inches based on the subgrade depth for every sample indicating an unsuitable or unstable problem.
- ii. GEOGRID Option is only offered in case of unstable subgrade problem and if the geotextile option indicates the need to excavate greater than 12 inches.

PLEASE NOTE: The Problem, Excavate & Replace, and Recommendation Fields are the responsibility of the Designer. These fields are being enhanced to attempt to capture the ODOT philosophy regarding the GB1 stabilization chart, but are considered still under development. If there are discrepancies between the spreadsheet output and the GB1 chart - the chart governs in conjunction with engineering judgement. Please contact Steve Taliaferro at stephen.taliaferro@dot.ohio.gov if you have any questions.

PLEASE NOTE: It is the Designer's responsibility to identify the most representative data when samples have been separated into multiple specimen (say 1.5 to 2.3 feet and 2.3 to 3.0 feet). The spreadsheet is not capable at this time of addressing this issue within a direct data export from gINT.

4. Results Summary:

All fields in this sheet are password protected and are either calculated or read from the other worksheets.

5. Graph Worksheet:



This worksheet is designed to read the average N_{60L} and the average HP from the Cover Sheet and plot a blue line for Average HP and orange line for Average N_{60L} on GB1 Figure B – Subgrade Stabilization. The Override Table can be used to enter HP and/or N_{60L} values that are different than the calculated averages. The Override values will change the global undercut recommendation in the Results Summary.