

**FRA-70-13.10 PHASE 6A
FRA-70-1322L AND FRA-70-1323C
I-70 WB AND RAMP D3
OVER THE SCIOTO RIVER
PID NO. 89464
FRANKLIN COUNTY, OHIO**

**STRUCTURE FOUNDATION
EXPLORATION REPORT
(REV.1)**

Prepared For:
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Rii Project No. W-13-072

March 2021



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May 6, 2015 (Revised March 30, 2021)

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Re: Structure Foundation Exploration Report (Rev. 1)
FRA-70-13.10 Phase 6A
FRA-70-1322L – I-70 WB over the Scioto River
FRA-70-1323C – Ramp D3 over the Scioto River
PID No. 89464
Rii Project No. W-13-072

Mr. Mosure:

Resource International, Inc. (Rii) is pleased to submit this revised structure foundation exploration report for the above referenced project. Engineering logs have been prepared and are attached to this report along with the results of laboratory testing. This report includes recommendations for the design and construction of the proposed FRA-70-1322L and FRA-70-1323C bridge structures carrying I-70 westbound and Ramp D3, respectively, over the Scioto River as part of the FRA-70-13.10 Phase 6A (PID 89464) project in Columbus, Ohio.

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

Sincerely,

RESOURCE INTERNATIONAL, INC.

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Director – Geotechnical Services

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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-70-1322L and FRA-70-1323C bridge structures carrying I-70 westbound and Ramp D3, respectively, over the Scioto River, as shown on the vicinity map and boring plan presented in Appendix I. The existing structure is a nine-span bridge with a total length of approximately 890 feet. It is understood that the existing I-70 westbound structure will be completely removed and replaced with two (2) separate structures. Based on information provided by ms consultants, it is understood that the proposed FRA-70-1322L and FRA-70-1323C structures will be five-span continuous composite steel girder with reinforced concrete deck structures with capped pile abutments and multi-column piers and will have a total length of approximately 1,018 and 1,020 feet and width of approximately 43 and 53 feet, respectively. The proposed roadway profile grade will be elevated approximately 5 to 15 feet above the existing profile grade along the alignment of the bridge structures.

Exploration and Findings

Between January 14 and May 28, 2014, eight (8) borings, designated as B-016-7-13 and B-113-4-13 through B-114-1-13, were drilled along the proposed bridge alignments at the locations shown on the boring plan provided in Appendix I of the full report. The borings were advanced to completion depths ranging from 48.7 to 88.3 feet below the existing ground surface at the respective boring location. In addition to the borings performed as part of the current exploration, five (5) historic borings, designated as B-001-S-57, B-005-S-57, B-009-S-57, B-013-S-57 and B-020-S-57, were obtained along the entire length of the existing bridge alignments carrying I-70 eastbound and westbound over the Scioto River. The borings were extended to depths ranging from 36.0 to 63.0 feet below the existing grade at the time of the exploration. On December 7, 2020, one (1) additional boring, designated as B-019-5-19, was obtained within the abandoned Mound Street just outside the limits of the approach slab of the abandoned bridge structure over I-70, and was extended to a depth of 60.0 feet below the existing ground surface.

Borings B-113-4-13 and B-113-5-13 were drilled in the grass area along the south side of McDowell Street, just west of the existing pump station, and encountered 6.0 inches of topsoil at the ground surface. Borings B-016-7-13, B-113-9-13 and B-114-1-13 were drilled adjacent to the existing bike path the runs along the east bank of the Scioto River, and encountered 3.0 to 5.0 inches of topsoil at the ground surface. Boring B-019-5-19 was drilled within the existing embankment supporting the abandoned Mound Street and encountered 3.0 inches of asphalt overlying 11.0 inches of concrete at the ground surface.

Beneath the surface materials in borings B-016-7-13, B-113-4-13, B-113-5-13, B-113-9-13 and B-114-1-13, material identified as existing fill or possible fill was encountered extending to depths ranging from 5.5 to 20.5 feet below the ground

surface. The fill material consisted of brown, dark brown, gray and black gravel and sand, gravel with sand and silt, gravel with sand, silt and clay, silt and clay and silty clay (ODOT A-1-b, A-2-4, A-2-6, A-6a, A-6b) and contained brick, concrete and slag fragments as well as root fibers throughout.

Beneath the pavement in boring B-019-5-13, existing embankment fill consisting of gray, dark gray and brown gravel with sand, silt and clay, silty clay and clay (ODOT A-1-b, A-6a, A-6b, A-7-6) was encountered extending to a depth of 37.0 feet, overlying existing fill material comprised of black, red and brown gravel with sand, silt and clay (ODOT A-2-6) extending to a depth of 47.0 feet.

Underlying the surficial materials and existing fill, where encountered, and from the existing ground surface in borings B-113-6-13 through B-113-8-13, natural granular soils were encountered with intermittent seams of cohesive material. The granular soils were generally described as brown, gray, grayish brown, brownish gray, dark brown and black gravel, gravel and sand, gravel with sand and silt, gravel with sand silt and clay, coarse and fine sand and sandy silt (ODOT A-1-a, A-1-b, A-2-4, A-2-6, A-3a, A-4a). The cohesive soils were generally described as gray, brown dark brown, dark gray and light brown sandy silt, silt and clay, silty clay and clay (ODOT A-4a, A-6a, A-6b, A-7-6).

A boulder zone was encountered in boring B-113-5-13 between elevations 668.7 and 674.7 feet msl and in boring B-113-8-13 between elevations 646.8 and 663.6 feet msl. Cobbles and boulders were generally encountered above the bedrock in borings B-113-4-13 through B-113-8-13 starting at elevations of approximately 700 feet msl in borings B-113-4-13 and B-113-5-13 and approximately 675 feet msl in borings B-113-6-13 through B-113-8-13.

Top of bedrock in the borings was encountered at elevations ranging from 644.0 to 660.8 feet msl. The upper portion of the bedrock encountered in the majority of the borings consists of gray shale and mudstone overlying competent limestone and dolomite bedrock. With the exception of boring B-113-8-13, shale/mudstone bedrock was encountered in the remaining borings at elevations ranging from 650.8 to 660.8 feet msl. With the exception of borings B-001-S-57, B-013-S-57 and B-020-S-57, limestone/dolomite bedrock was encountered in the remaining borings at elevations ranging from 634.8 to 650.8 feet msl.

Analyses and Recommendations

Design details of the proposed structure were provided by ms consultants. Based on the information provided, it is understood that the proposed FRA-70-1322L and FRA-70-1323C structures will be five-span continuous composite steel girder with reinforced concrete deck structures with capped pile abutments and multi-column piers. The proposed roadway profile grade will be elevated approximately 5 to 15 feet above the existing profile grade along the alignment of the bridge structures.

Drilled Shaft Recommendations

It is understood that drilled shafts will be utilized at the pier substructure units. Given the proposed loading per shaft at each of the pier locations, friction bearing drilled shafts within the overburden soils and drilled shafts bearing within the weak surficial shale bedrock are not economically feasible foundation options due to the size and number of shafts that would be required to support the proposed loading. Therefore, it is recommended that the drilled shafts be extended through the surficial soils and weak surficial shale bedrock to bear on or within the underlying limestone/dolomite bedrock at the pier locations.

The following table lists the estimated elevation of the top of bedrock as well as the proposed rock sock diameter and length from the design plans and corresponding nominal end bearing resistance to be utilized for the design of the drilled shaft foundations. A resistance factor of $\phi_{qp} = 0.5$ at the strength limit state should be utilized for design.

Drilled Shaft Recommendations

| Structure Reference | Substructure Unit (Boring) | Top of Bedrock Elevation (feet msl) | Top of Limestone Elevation (feet msl) | Rock Socket Diameter ¹ (feet) | Required Socket Length to Top of Limestone / Dolomite (feet) | Proposed Socket Length ¹ (feet) | Nominal End Bearing Resistance ² (ksf) |
|---------------------|----------------------------------|-------------------------------------|---------------------------------------|--|--|--|---|
| FRA-70-1322L | Pier 1 (B-005-S-57) | 652.1 | 651.5 | 5.0 | 0.6 | 5.0 | 765 |
| | Pier 2 (B-009-S-57) | 650.8 | 648.1 | 5.0 | 2.7 | 5.0 | 765 |
| | Pier 3 (B-013-S-57 / B-113-8-13) | 660.8 | 644.0 | 5.0 | 16.8 | 16.8 | 1,831 |
| | Pier 4 (B-020-S-57 / B-113-9-13) | 656.5 | 645.6 | 5.0 | 10.9 | 10.9 | 1,831 |
| FRA-70-1323C | Pier 1 (B-113-6-13) | 652.2 | 647.6 | 5.0 | 4.6 | 7.0 | 765 |
| | Pier 2 (B-113-7-13) | 659.4 | 648.8 | 5.0 | 10.6 | 10.6 | 1,831 |
| | Pier 3 (B-013-S-57 / B-113-8-13) | 663.6 | 644.0 | 5.0 | 16.8 | 19.6 | 1,831 |
| | Pier 4 (B-113-9-13) | 656.3 | 645.6 | 5.0 | 10.7 | 10.7 | 1,831 |

1. Proposed rock socket diameter and length at each substructure unit determined from proposed plan information provided by ms consultants.
2. Nominal end bearing resistance provided is the value that should be utilized in the determination of the end bearing resistance per drilled shaft based on the proposed rock socket length and diameter.

Given the factored end bearing resistances noted above for drilled shafts extended to bear on or within the limestone bedrock, it is anticipated that the axial resistance will be governed by structural resistance of the drilled shaft. Based on the cross section provided for the drilled shaft within the rock socket, which consists of a 5.0-foot diameter shaft with 28 No. 10 longitudinal reinforcement bars, the factored structural resistance is 7,412 kips, as determined in accordance with Section 5.6.4.4 of the 2020 AASHTO LRFD BDS. The factored resistance per shaft provided in the design sheets should be the limiting value between the factored geotechnical resistance and the factored axial compressive resistance of the shaft.

Driven Pile Recommendations

It is understood that driven piles will be utilized at the rear and forward abutment substructure units. Given the depth of bedrock encountered in the borings performed 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 recommended pile lengths and the corresponding factored structural axial resistance ($R_{R \max}$) of steel H-piles.

Driven Pile Recommendations

| Substructure Reference | Pile Size | Pile Elevation | | Pile Length ² (feet) | $R_{R \max}$ ³ (kips/pile) | ϕ ⁴ |
|------------------------|-----------------------|------------------|-------|---------------------------------|---------------------------------------|---------------------|
| | | Top ¹ | Tip | | | |
| Rear Abutment | HP 10x42 ⁵ | 715.5 | 652.7 | 65 | 310 | N/A |
| | HP 12x53 ⁵ | 715.5 | 652.7 | 65 | 380 | N/A |
| | HP 14x73 ⁵ | 715.5 | 652.7 | 65 | 530 | N/A |
| Forward Abutment | HP 10x42 ⁵ | 710.0 / 720.0 | 662.1 | 50 / 60 | 310 | N/A |
| | HP 12x53 ⁵ | 710.0 / 720.0 | 662.1 | 50 / 60 | 380 | N/A |
| | HP 14x73 ⁵ | 710.0 / 720.0 | 662.1 | 50 / 60 | 530 | N/A |

1. 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. Multiple values indicate minimum and maximum pile cutoff elevation along the abutment substructure.
2. 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.
3. 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.
4. 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.
5. A steel pile point is recommended to protect the tips of the H-piles during pile installation.

As noted in Section 4.2 of the full report, a boulder zone was encountered in boring B-113-5-13 between elevations 668.7 and 674.7 feet msl. Additionally, cobbles and boulders were encountered above the bedrock in borings B-113-4-13 and B-113-5-13 starting at an elevation of approximately 700 feet msl. Given the significant presence of cobbles and boulders at the rear abutment, the pile driving operations should be closely monitored to verify that the piles extend to the limestone bedrock. **If a pile cannot be extended through the cobbles and boulders to the estimated elevation of the limestone bedrock, then the pile should be considered a friction bearing pile that is driven to the maximum ultimate bearing value per Section 305.3.4 of the 2020 ODOT BDM.** In this instance, the resistance factor of 0.7 should be applied to the maximum ultimate bearing value provided for the respective pile size utilized.

Consideration was given to the use of friction piles using cast-in-place (CIP) pipe piles; however, given the presence of dense granular soils immediately below the bottom of footing elevation, it is anticipated that refusal will be encountered prior to achieving a sufficient embedment depth for lateral resistance.

Based on plan and profile information provided by ms consultants, approximately 5.5 and 10.0 feet of fill will be required to achieve the final grade elevation at the rear and forward abutment, respectively. The anticipated total settlement due to the embankment loading at the rear and forward abutment is 0.78 and 1.18 inches, respectively. The settlement of the soils beneath the proposed abutment footings is anticipated to be 0.11 and 0.40 inches, respectively, at the rear and forward abutment. Given that the anticipated settlement below the proposed footings will not exceed 0.40 inches, downdrag loads are not anticipated to develop along the piles.

Based on the results of this analysis, driving stresses induced on the H-piles at the forward abutment of both structures **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 top of bedrock using a Delmag 19-42 hammer with a rated energy of approximately 43,000 ft-lbs. Based on the results of the analysis, driving stresses induced on the H-piles at the rear abutment of both structures **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 top of bedrock using a Delmag 30-23 hammer with a rated energy of approximately 73,788 ft-lbs. However, for the piles at the rear abutment of the FRA-70-1322L structure, while the analysis indicates the driving stresses would not exceed 90 percent of the yield stress of the steel, it is anticipated that refusal will occur as the piles approach the bedrock elevation.

CIP Wall Recommendations

Existing embankment fill consisting of very stiff to hard silt and clay and clay (ODOT A-6a, A-7-6) is anticipated at the bearing elevation along the wall alignment, overlying existing fill consisting of medium stiff to stiff silty clay (ODOT A-6b). CIP wall foundations bearing on these soils fill may be proportioned for a factored bearing resistance as indicated in the following table. A geotechnical resistance factor of $\phi_b=0.55$ was considered in calculating the factored bearing resistance at the strength limit state.

Forward Abutment Wingwall CIP Wall Design Parameters

| From Station ¹ | To Station ¹ | Panel ID | Wall Height Analyzed (feet) | Foundation Width (feet) | Bearing Resistance at Strength Limit (ksf) | | Strength Limit Equivalent Bearing Pressure ³ (ksf) |
|---------------------------|-------------------------|----------|-----------------------------|-------------------------|--|-----------------------|---|
| | | | | | Nominal | Factored ² | |
| 3053+26.70 | 3053+57.53 | 3 | 24.3 | 18.5 | 7.36 | 4.05 | 4.03 |
| 3053+57.53 | 3053+88.35 | 4 | 19.2 | 14.0 | 7.23 | 3.98 | 3.62 |
| 3053+88.35 | 3054+19.31 | 5 | 14.2 | 11.0 | 6.57 | 3.61 | 2.57 |
| 3054+19.31 | 3054+50.00 | 6 | 9.3 | 8.8 | 5.92 | 3.26 | 1.63 |

1. Limits of wall determined from plan information provided by ms consultants. Stationing listed is referenced to Ramp D3.
2. A geotechnical resistance factor of $\phi_b=0.55$ 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.

Given that the existing Mound Street embankment will be excavate and removed to construct the wingwall, resulting in a profile grade along Ramp D3 at the top of the wall that is approximately 10.0 feet below the existing grade of the embankment, little to no settlement is anticipated under the loading from the proposed wall along the alignment.

Based on the results of the external and global stability analysis performed for the forward abutment wingwall, the wall sections provided in the design sheets meet all of the external and global stability requirements.

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

The overall purpose of this project is to provide detailed subsurface information and recommendations for the design and construction of the FRA-70/71-13.10/14.36 (Projects 6A/6R) project in Columbus, Ohio. The projects represent the central portion of the FRA-70-8.93 (PID 77369) I-70/71 south innerbelt improvements project, which includes all improvements along I-70 westbound from the I-71/SR-315 interchange to Front Street and along I-71 southbound from I-70 to Greenlawn Avenue. The FRA-70-13.10 (Project 6A) phase will consist of all work associated with the construction of I-70 westbound from SR 315 to Front Street, including Ramps D3 and D7. This project includes the design and construction of one (1) new bridge structure for Ramp D3 over the Scioto River (FRA-70-1323C) and the reconstruction of three (3) bridges, including I-70 westbound over the Scioto River (FRA-70-1322L), I-70 westbound over CSX and Norfolk Southern (NS) Railroad (FRA-70-1358L) and I-70 westbound over Short Street (FRA-70-1373L), as well as the construction of five (5) new retaining walls (Walls E2, E3, E4, E7 and E9) to accommodate the new configuration.

This report is a presentation of the structure foundation exploration performed for the design and construction of the proposed FRA-70-1322L and FRA-70-1323C bridge structures carrying I-70 westbound and Ramp D3, respectively, over the Scioto River, as shown on the vicinity map and boring plan presented in Appendix I. The proposed I-70 westbound will be a two-lane roadway that carries traffic westbound out of downtown Columbus, and the proposed Ramp D3 will be a three-lane ramp that carries traffic from the proposed Mound Street Ramp D7 to I-70 westbound, and will also serve to carry traffic from I-70 westbound to Sullivant Avenue and Rich Street.

The existing I-70 westbound structure is a nine-span bridge with a total length of approximately 890 feet. It is understood that the existing structure consists of a reinforced concrete deck on continuous steel girder beams, and will be completely removed and replaced with two (2) separate structures. Based on information provided by ms consultants, it is understood that both the proposed FRA-70-1322L and FRA-70-1323C structures will be five-span continuous composite steel girder with reinforced concrete deck structures with capped pile abutments and multi-column piers and will have a total length of approximately 1,018 and 1,020 feet and width of approximately 43 and 53 feet, respectively. The proposed roadway profile grade will be elevated approximately 5 to 15 feet above the existing profile grade along the alignment of the bridge structures.

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 west of the Scioto River consists predominantly of the Middle to Lower Devonian-aged Columbus Limestone. 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. East of the Scioto River, the underlying bedrock consists of the Upper Devonian Ohio Shale Formation overlying the Middle Devonian-aged Delaware Limestone Formation. The Ohio Shale formation consists of brownish black to greenish gray, thinly bedded, fissile, carbonaceous shale. The Delaware Limestone consists of bluish gray, thin to medium bedded dolomitic limestone with nodules and layers of chert. Regionally, the bedrock surface forms a broad valley aligned roughly north-to-south beneath the Scioto River. According to bedrock topography mapping, the elevation of the bedrock surface ranges from approximately 600 feet mean sea level (msl) in the valley to approximately 625 feet msl near the project limits. Bedrock consisting of shale over limestone was encountered during this current investigation at elevations ranging from 644.0 to 660.9 feet msl.

2.2 Existing Conditions

The existing bridge structure carries four lanes of I-70 westbound over the Scioto River, and splits at the west end of the structure, where two lanes diverge at the south side of the structure that carry traffic to I-71 southbound and SR-315 northbound, two lanes continue west carrying the I-70 westbound traffic and one lane diverges at the north side of the bridge that carries traffic to SR-315 northbound and Rich Street. The Scioto River in the vicinity of the structure is approximately 450 feet wide with tree-lined banks and is aligned north-to-south underneath the bridge and bends to the northeast just north of the bridge crossing. The terrain at the east and west end of the existing

structure is elevated approximately 25 to 35 feet above the river channel and the surrounding area on either side of the river channel is relatively flat-lying.

3.0 EXPLORATION

Between January 14 and May 28, 2014, eight (8) borings, designated as B-016-7-13 and B-113-4-13 through B-114-1-13, were obtained along the portion of the proposed FRA-71-1503L structure that is adjacent to the proposed alignment of the FRA-70-1322L and FRA-70-1323C structures at the locations shown on the boring plan provided in Appendix I of this report and summarized in Table 1. Borings B-113-4-13 and B-113-5-13 were performed at the western bank of the Scioto River and were extended to a depth of 88.3 and 85.7 feet below existing grade, respectively; borings B-113-6-13 through B-113-8-13 were performed from a barge within the Scioto River and extended to depths ranging from 55.7 to 66.2 feet below the riverbed elevation; and borings B-016-7-13, B-113-9-13 and B-114-1-13 were performed at the eastern bank of the Scioto River, adjacent to the Lower Scioto Greenway bike trail, and were extended to depths of 48.7, 73.0 and 81.0 feet below existing grade, respectively. Based on the length and configuration of the forward abutment left wingwall, on December 7, 2020, one (1) additional boring, designated as B-019-5-19, was obtained within the abandoned Mound Street just outside the limits of the approach slab of the abandoned bridge structure over I-70, and was extended to a depth of 60.0 feet below the existing ground surface.

Table 1. Test Boring Summary

| Boring Number | Reference Alignment | Station ¹ | Offset ¹ | Latitude | Longitude | Ground Elevation (feet msl) | Boring Depth (feet) |
|---------------|---------------------|----------------------|---------------------|--------------|---------------|-----------------------------|---------------------|
| B-016-7-13 | BL Ramp D3 | 3052+85.29 | 31.4' Lt. | 39.953120632 | -83.010292838 | 714.9 | 48.7 |
| B-019-5-19 | BL Ramp D3 | 3053+93.67 | 12.3' Lt. | 39.953167673 | -83.009902628 | 751.0 | 60.0 |
| B-113-4-13 | BL I-71 SB | 249+37.84 | 28.1' Rt. | 39.952169637 | -83.013979325 | 725.2 | 88.3 |
| B-113-5-13 | BL I-71 SB | 250+13.44 | 36.0' Rt. | 39.952235986 | -83.013728661 | 725.7 | 85.7 |
| B-113-6-13 | BL I-71 SB | 251+93.56 | 37.3' Rt. | 39.952409438 | -83.013136525 | 691.5 | 63.7 |
| B-113-7-13 | BL I-71 SB | 254+41.19 | 36.0' Rt. | 39.952639679 | -83.012306009 | 690.3 | 55.7 |
| B-113-8-13 | BL I-71 SB | 256+62.64 | 36.0' Rt. | 39.952842559 | -83.011561408 | 691.0 | 66.2 |
| B-113-9-13 | BL I-71 SB | 258+77.50 | 36.0' Rt. | 39.953039408 | -83.010838937 | 706.3 | 73.0 |
| B-114-1-13 | BL I-71 SB | 260+75.33 | 40.2' Rt. | 39.953209751 | -83.010168725 | 716.6 | 81.0 |



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 truck or all-terrain vehicle (ATV) mounted rotary drilling machine, utilizing either a 3.25-inch or 4.25-inch inside diameter, hollow-stem auger to advance the holes. In general, standard penetration test (SPT) and split spoon sampling were performed at 2.5-foot increments of depth to approximately 20.0 to 30.0 feet and at 5.0-foot increments thereafter to the top of bedrock. For foundation elements subject to scour, continuous sampling and SPT testing were conducted in borings B-113-6-13 through B-113-8-13 for a 6.0-foot interval below the riverbed elevation. 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 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 Appendix III.

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

Where:

N_m = measured N value

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

The hammer for the Mobile B-53, CME 750X and CME 750 drill rigs used for the 2013 exploration borings were calibrated on April 26, 2013, and have drill rod energy ratios of 77.7, 86.8 and 82.6 percent, respectively. The hammer for the CME 750X drill rig used for the 2019 exploration boring was calibrated on September 14, 2020, and has a drill rod energy ratio of 86.2 percent. No calibration factor was applied to the blow counts presented on the historic boring logs, as these were performed using a manual hammer.

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.



The depth to bedrock was determined by split spoon sampler refusal or auger 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. 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 or HQ-sized double-tube diamond bit core barrel (utilizing wire line equipment) was used to core the bedrock. Coring produced 1.85 and 2.45 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:

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

During drilling, Rii personnel prepared field logs showing the encountered subsurface conditions. Soil and rock samples obtained from the drilling operation were preserved and sealed in glass jars or core boxes and delivered to the soil laboratory. In the laboratory, the soil and rock 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 D2216 | 148 |
| Plastic and Liquid Limits | AASHTO T89, T90 | 59 |
| Gradation – Sieve/Hydrometer | AASHTO T88 | 65 |
| Unconfined Compressive Strength of Intact Rock | ASTM D7012 | 15 |
| Determination of the Point Load Strength Index of Rock | ASTM D5731 | 2 |

The tests performed are necessary to classify existing soil and rock 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.

In addition to the borings performed as part of the current exploration, historic borings performed in 1957 by the Department of Highways as part of the FRA-40-12.30 project were obtained from the construction documents on record. Five (5) borings, designated as B-001-S-57, B-005-S-57, B-009-S-57, B-013-S-57 and B-020-S-57, were obtained along the entire length of the existing bridge alignments carrying I-70 eastbound and westbound over the Scioto River. The borings were extended to depths ranging from 36.0 to 63.0 feet below the existing grade at the time of the exploration. 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-113-4-13 and B-113-5-13 were drilled in the grass area along the south side of McDowell Street, just west of the existing pump station, and encountered 6.0 inches of topsoil at the ground surface. Borings B-016-7-13, B-113-9-13 and B-114-1-13 were drilled adjacent to the existing bike path that runs along the east bank of the Scioto River, and encountered 3.0 to 5.0 inches of topsoil at the ground surface. Boring B-019-5-19 was drilled within the existing embankment supporting the abandoned Mound Street and encountered 3.0 inches of asphalt overlying 11.0 inches of concrete at the ground surface. Surface materials were not noted in the 1957 boring logs.

4.2 Subsurface Soils

Beneath the surface materials in borings B-016-7-13, B-113-4-13, B-113-5-13, B-113-9-13 and B-114-1-13, material identified as existing fill or possible fill was encountered extending to depths ranging from 5.5 to 20.5 feet below the ground surface. The fill material consisted of brown, dark brown, gray and black gravel and sand, gravel with sand and silt, gravel with sand, silt and clay, silt and clay and silty clay (ODOT A-1-b, A-2-4, A-2-6, A-6a, A-6b) and contained brick, concrete and slag fragments as well as root fibers throughout.

Beneath the pavement in boring B-019-5-13, existing embankment fill consisting of gray, dark gray and brown gravel with sand, silt and clay, silty clay and clay (ODOT A-1-b, A-6a, A-6b, A-7-6) was encountered extending to a depth of 37.0 feet, overlying existing fill material comprised of black, red and brown gravel with sand, silt and clay (ODOT A-2-6) extending to a depth of 47.0 feet.

Underlying the surficial materials and existing fill, where encountered, and from the existing ground surface in borings B-113-6-13 through B-113-8-13, natural granular soils were encountered with intermittent seams of cohesive material. The granular soils were generally described as brown, gray, grayish brown, brownish gray, dark brown and black gravel, gravel and sand, gravel with sand and silt, gravel with sand silt and clay, coarse and fine sand and sandy silt (ODOT A-1-a, A-1-b, A-2-4, A-2-6, A-3a, A-4a). The cohesive soils were generally described as gray, brown dark brown, dark gray and light brown sandy silt, silt and clay, silty clay and clay (ODOT A-4a, A-6a, A-6b, A-7-6).

A boulder zone was encountered in boring B-113-5-13 between elevations 668.7 and 674.7 feet msl and in boring B-113-8-13 between elevations 646.8 and 663.6 feet msl. Cobbles and boulders were generally encountered above the bedrock in borings B-113-4-13 through B-113-8-13 starting at elevations of approximately 700 feet msl in borings B-113-4-13 and B-113-5-13 and approximately 675 feet msl in borings B-113-6-13 through B-113-8-13.

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 very loose ($N_{60} < 5$ blows per foot [bpf]) to very dense ($N_{60} > 50$ bpf). Overall blow counts recorded from the SPT sampling ranged from 3 bpf to split spoon sampler refusal. The shear strength and consistency of the cohesive soils are primarily derived from the hand penetrometer values (HP). The cohesive soil encountered ranged from very soft ($HP \leq 0.25$ tsf) to hard ($HP > 4.0$ tsf). The unconfined compressive strength of the cohesive soil samples tested, obtained from the hand penetrometer, ranged from 0.25 to over 4.5 tsf (limit of instrument).

Natural moisture contents of the soil samples tested ranged from 4 to 53 percent. The natural moisture content of the cohesive soil samples tested for plasticity index ranged from 8 percent below to 18 percent above their corresponding plastic limits. In general, the soil exhibited natural moisture contents considered to be significantly below to significantly above optimum moisture levels.

4.3 Bedrock

Bedrock was encountered in the borings as presented in Table 3.

Table 3. Top of Bedrock Elevations

| Boring Number | Ground Surface Elevation (feet msl) | Top of Bedrock | | Top of Bedrock Core (Auger Refusal) | |
|---------------|-------------------------------------|----------------|----------------------|-------------------------------------|----------------------|
| | | Depth (feet) | Elevation (feet msl) | Depth (feet) | Elevation (feet msl) |
| B-001-S-57 | 723.4 | N/A | N/A | N/A | N/A |
| B-113-4-13 | 725.2 | 72.5 | 652.7 | 73.3 | 651.9 |
| B-113-5-13 | 725.7 | 73.5 | 652.2 | 73.7 | 652.0 |
| B-005-S-57 | 681.1 | 29.0 | 652.1 | 29.6 | 651.5 |
| B-113-6-13 | 691.5 | 39.3 | 652.2 | 43.9 | 647.6 |
| B-009-S-57 | 685.5 | 34.7 | 650.8 | 34.7 | 650.8 |
| B-113-7-13 | 690.3 | 30.9 | 659.4 | 30.9 | 659.4 |
| B-013-S-57 | 690.8 | 30.0 | 660.8 | 30.5 | 660.3 |
| B-113-8-13 | 691.0 | 47.0 | 644.0 | 47.0 | 644.0 |
| B-020-S-57 | 725.4 | N/A | N/A | N/A | N/A |
| B-113-9-13 | 706.3 | 50.0 | 656.3 | 55.5 | 650.8 |
| B-016-7-13 | 714.9 | N/A | N/A | N/A | N/A |
| B-114-1-13 | 716.6 | 54.5 | 662.1 | 61.0 | 655.6 |
| B-019-5-19 | 751.0 | N/A | N/A | N/A | N/A |

Top of bedrock in the borings was encountered at elevations ranging from 644.0 to 662.1 feet msl. The upper portion of the bedrock encountered in the majority of the borings consists of gray shale and mudstone overlying competent limestone and dolomite bedrock. Table 4 tabulates the depth and elevation that the surficial shale/mudstone bedrock was encountered as well as the top of competent limestone/dolomite bedrock. With the exception of boring B-113-8-13, shale/mudstone bedrock was encountered in the remaining borings at elevations ranging from 650.8 to 660.8 feet msl. With the exception of borings B-001-S-57, B-013-S-57 and B-020-S-57, limestone/dolomite bedrock was encountered in the remaining borings at elevations ranging from 634.8 to 650.8 feet msl.

Table 4. Bedrock Types

| Boring Number | Ground Surface Elevation (feet msl) | Top of Shale/Mudstone | | Top of Limestone/Dolomite | |
|---------------|-------------------------------------|-----------------------|----------------------|---------------------------|----------------------|
| | | Depth (feet) | Elevation (feet msl) | Depth (feet) | Elevation (feet msl) |
| B-001-S-57 | 723.4 | N/A | N/A | N/A | N/A |
| B-113-4-13 | 725.2 | 72.5 | 652.7 | 76.0 | 649.2 |
| B-113-5-13 | 725.7 | 73.5 | 652.2 | 74.9 | 650.8 |
| B-005-S-57 | 681.1 | 29.0 | 652.1 | 29.6 | 651.5 |
| B-113-6-13 | 691.5 | 39.3 | 652.2 | 43.9 | 647.6 |
| B-009-S-57 | 685.5 | 34.7 | 650.8 | 37.4 | 648.1 |
| B-113-7-13 | 690.3 | 30.9 | 659.4 | 41.5 | 648.8 |
| B-013-S-57 | 690.8 | 30.0 | 660.8 | N/A | N/A |
| B-113-8-13 | 691.0 | N/A | N/A | 47.0 | 644.0 |
| B-020-S-57 | 725.4 | N/A | N/A | N/A | N/A |
| B-113-9-13 | 706.3 | 50.0 | 656.3 | 60.7 | 645.6 |
| B-016-7-13 | 714.9 | N/A | N/A | N/A | N/A |
| B-114-1-13 | 716.6 | 54.5 | 662.1 | 75.0 | 641.6 |
| B-019-5-19 | 751.0 | N/A | N/A | N/A | N/A |

The cored bedrock recovered from the current exploration borings consists of shale, mudstone, dolomite and limestone. The mudstone is described as gray, highly weathered, very weak, medium bedded, friable, pyritic, and highly fractured with open, very rough apertures. The shale is described as gray and dark gray, unweathered to highly weathered, very weak to weak, very thin to thin bedded, calcareous, argillaceous, friable, micaceous, fissile and moderately to highly fractured with tight to open, slickensided to rough apertures. The dolomite is described as brown and gray, unweathered to slightly weathered, strong to very strong, medium to very thick bedded, calcareous, crystalline, siliceous, cherty, pyritic and slightly to highly fractured with tight to open, slightly rough apertures. The limestone is generally described as gray and brown, unweathered to slightly weathered, moderately strong to very strong, thin to very thick bedded, arenaceous, calcareous, siliceous, crystalline, dolomitic, cherty, pyritic, stylolitic and intact to highly fractured with tight to open, slightly to very rough apertures.

The percent recovery, RQD values and unconfined compressive strengths of the bedrock core runs from the current exploration borings are summarized in Table 5.

Table 5. Rock Core Summary

| Boring | Core No. | Depth (feet) | Recovery (%) | RQD (%) | Unconfined Compressive Strength |
|------------|----------|--------------|--------------|---------|--|
| B-113-4-13 | RC-1 | 73.3 to 78.3 | 98 | 34 | N/A |
| | RC-2 | 78.3 to 83.3 | 100 | 97 | $q_u @ 78.3' = 7,676 \text{ psi}$ |
| | RC-3 | 83.3 to 88.3 | 100 | 100 | N/A |
| B-113-5-13 | RC-3 | 73.7 to 75.7 | 92 | 21 | N/A |
| | RC-4 | 75.7 to 80.7 | 100 | 94 | $q_u @ 75.7' = 8,702 \text{ psi}$ |
| | RC-5 | 80.7 to 85.7 | 78 | 60 | $q_u @ 80.7' = 7,992 \text{ psi}$ |
| B-113-6-13 | RC-1 | 43.9 to 48.7 | 79 | 79 | $q_u @ 45.9' = 9,906 \text{ psi}$ |
| | RC-2 | 48.7 to 53.7 | 100 | 88 | $q_u @ 50.7' = 11,448 \text{ psi}$ |
| | RC-3 | 53.7 to 58.7 | 100 | 93 | $q_u @ 54.8' = 5,140 \text{ psi}$ |
| | RC-4 | 58.7 to 63.7 | 100 | 90 | N/A |
| B-113-7-13 | RC-3 | 30.9 to 35.7 | 53 | 45 | $q_u @ 30.9' \text{ to } 35.7' = 73 \text{ psi}^1$ |
| | RC-4 | 35.7 to 40.7 | 0 | 0 | N/A |
| | RC-5 | 40.7 to 45.7 | 76 | 58 | $q_u @ 42.2' = 11,119 \text{ psi}$ |
| | RC-6 | 45.7 to 50.7 | 100 | 90 | $q_u @ 50.2' = 9,850 \text{ psi}$ |
| | RC-7 | 50.7 to 55.7 | 100 | 100 | $q_u @ 51.2' = 10,087 \text{ psi}$ |
| B-113-8-13 | RC-4 | 47.0 to 51.2 | 46 | 30 | $q_u @ 47.1' = 12,942 \text{ psi}$ |
| | RC-5 | 51.2 to 56.2 | 100 | 99 | $q_u @ 52.3' = 9,438 \text{ psi}$ |
| | RC-6 | 56.2 to 61.2 | 100 | 97 | $q_u @ 56.8' = 9,657 \text{ psi}$ |
| | RC-7 | 61.2 to 66.2 | 97 | 83 | N/A |
| B-113-9-13 | RC-1 | 55.5 to 58.0 | 7 | 0 | N/A |
| | RC-2 | 58.0 to 63.0 | 70 | 40 | $q_u @ 60.3' = 11,594 \text{ psi}$ |
| | RC-3 | 63.0 to 68.0 | 100 | 100 | $q_u @ 63.0' = 5,086 \text{ psi}$ |
| | RC-4 | 68.0 to 73.0 | 100 | 94 | N/A |
| B-114-1-13 | RC-1 | 61.0 to 66.0 | 95 | 76 | N/A |
| | RC-2 | 66.0 to 71.0 | 100 | 23 | N/A |
| | RC-3 | 71.0 to 76.0 | 75 | 23 | $q_u @ 73.0' = 520 \text{ psi}^1$ |
| | RC-4 | 76.0 to 81.0 | 96 | 94 | $q_u @ 76.0' = 11,340 \text{ psi}$ |

1. Represents the mean unconfined compressive strength of shale sample based on correlations with the mean point load strength index.

It should be noted that bedrock experiences mechanical breaks during the drilling and coring processes. Rii attempted to account for fresh, manmade breaks during tabulation of the RQD analysis. The zones within borings B-113-5-13, B-113-7-13 and B-113-8-13 where boulders were encountered that required rock coring techniques to advance through these zones are not included in the RQD tabulation above. The quality of the cored bedrock, according to the RQD values, ranged from poor ($25 < \text{RQD} \leq 50\%$) to excellent ($\text{RQD} > 90\%$). Please note that core run RC-4 in boring B-113-7-13 did not have any recovery due to a piece of rock that become stuck in the core barrel during the coring process. This resulted in the bedrock becoming pulverized and washing out with the circulation fluid. Also, the first core run in boring B-113-9-13 was only 2.5-feet in length and resulted in an RQD of 0 percent. Due to the short length of the core run, this RQD value is likely not representative of this bedrock stratum.

4.4 Groundwater

Groundwater was encountered in the borings as presented in Table 6.

Table 6. Groundwater

| Boring Number | Ground Elevation (feet msl) | Initial Groundwater | | Upon Completion | |
|---------------|-----------------------------|---------------------|----------------------|------------------|----------------------|
| | | Depth (feet) | Elevation (feet msl) | Depth (feet) | Elevation (feet msl) |
| B-016-7-13 | 714.9 | 19.0 | 695.9 | N/A ¹ | - |
| B-019-5-19 | 751.0 | 48.5 | 702.5 | 57.0 | 694.0 |
| B-113-4-13 | 725.2 | 38.5 | 686.7 | N/A ¹ | - |
| B-113-5-13 | 725.7 | 38.5 | 687.2 | N/A ¹ | - |
| B-113-6-13 | 691.5 | N/A ² | 699.2 | N/A ¹ | - |
| B-113-7-13 | 690.3 | N/A ² | 700.7 | N/A ¹ | - |
| B-113-8-13 | 691.0 | N/A ² | 699.8 | N/A ¹ | - |
| B-113-9-13 | 706.3 | 21.0 | 685.3 | N/A ¹ | - |
| B-114-1-13 | 716.6 | 28.5 | 688.1 | 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.
2. Water elevation listed is the surface elevation of the Scioto River at the respective boring location; therefore, no depth is associated with the elevation listed.

Groundwater was encountered initially during drilling in borings B-016-7-13, B-019-5-19, B-113-4-13, B-113-5-13, B-113-9-13 and B-114-1-13 at depths ranging from 19.0 to 48.5 feet below the existing ground surface, which corresponds elevations ranging from 685.3 to 702.5 feet msl. As previously noted, borings B-113-6-13 through B-113-8-13

were performed within the Scioto River. The elevation of the Scioto River surface ranged from 699.2 to 700.7 feet msl at the time of the drilling. At the completion of the drilling and prior to removing the auger in boring B-019-5-19, groundwater accumulated in the auger stems to a depth of 57.0 feet below grade, which corresponds to an elevation of 694.0 feet msl. The groundwater level at the completion of drilling in the remaining borings could not be measured due to the addition of mud to counteract heaving sands or water as a circulating fluid during the rock coring process in the remaining borings.

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.

4.5 Historic Borings

In general, the historic borings encountered granular soils with intermittent seams of cohesive material overlying shale and limestone bedrock. The granular soils were generally described as loose to very dense brown and gray gravel, gravel and sand, gravel with sand and silt, fine sand and coarse and fine sand (ODOT A-1-a, A-1-b, A-2-4, A-3, A-3a), and the cohesive soils were generally described as hard gray and brown sandy silt and silt and clay (ODOT A-4a, A-6a). Shale bedrock was encountered in borings B-005-S-57, B-009-S-57 and B-013-S-57 at an elevation of 652.0, 651.4 and 661.4 feet msl, respectively. Limestone bedrock was encountered below the shale bedrock in borings B-005-S-57 and B-009-S-57 at an elevation of 652.1 and 648.7 feet msl, respectively. A boulder zone was encountered in boring B-001-S-57 between elevations 661.0 and 667.0 feet msl. Groundwater levels were not noted in the borings performed during the 1957 investigation. In general, the subsurface conditions encountered in the historic borings matched relatively closely with the subsurface conditions encountered in the current exploration borings.

5.0 ANALYSES AND RECOMMENDATIONS

Data obtained from the review of existing geotechnical information and from the current exploration 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.

Design details of the proposed structure were provided by ms consultants. Based on the information provided, it is understood that the proposed FRA-70-1322L and FRA-70-1323C structures will be five-span continuous composite steel girder with reinforced concrete deck structures with capped pile abutments and multi-column piers. The proposed roadway profile grade will be elevated approximately 5 to 15 feet above the existing profile grade along the alignment of the bridge structures.

Proposed structural data was obtained from design details provided by ms consultants and are included in Table 7.

Table 7. Structure and Bridge Design Elevations

| Structure Reference | Substructure Unit (Boring) | Structure Component | Elevation ¹ (feet msl) | Design Maximum Factored Load |
|---------------------|--|---------------------|-----------------------------------|------------------------------|
| FRA-70-1322L | Rear Abutment (B-001-S-57 / B-113-5-13) | Bottom of Footing | 714.5 | 174 kips/pile |
| | Pier 1 (B-005-S-57) | Top of Shaft | 697.6 | 2,270 kips/shaft |
| | Pier 2 (B-009-S-57) | Top of Shaft | 697.6 | 2,630 kips/shaft |
| | Pier 3 (B-013-S-57 / B-113-8-13) | Top of Shaft | 697.6 | 2,550 kips/shaft |
| | Pier 4 (B-020-S-57 / B-113-9-13) | Top of Shaft | 706.0 | 2,475 kips/shaft |
| | Forward Abutment (B-020-S-57 / B-114-1-13) | Bottom of Footing | 719.0 | 194 kips/pile |
| FRA-70-1323C | Rear Abutment (B-113-4-13 / B-113-5-13) | Bottom of Footing | 714.5 | 226 kips/pile |
| | Pier 1 (B-113-6-13) | Top of Shaft | 697.6 | 2,523 kips/shaft |
| | Pier 2 (B-113-7-13) | Top of Shaft | 697.6 | 2,872 kips/shaft |
| | Pier 3 (B-113-8-13) | Top of Shaft | 697.6 | 2,772 kips/shaft |
| | Pier 4 (B-113-9-13) | Top of Shaft | 704.0 | 2,676 kips/shaft |
| | Forward Abutment (B-114-1-13) | Bottom of Footing | 709.0 / 719.0 | 305 kips/pile |

1. Proposed bottom of footing and top of shaft elevations and structural loading based on structure information provided by ms consultants.

Borings B-015-7-13 through B-015-9-13 and B-016-3-13 through B-016-5-13, which were performed for the FRA-70-1321A bridge structure as part of the FRA-70-12.68 Phase 4A project, were also referenced to further delineate the bedrock stratigraphy at the site. A copy of these logs is also provided in Appendix III.

5.1 Drilled Shaft Recommendations

It is understood that drilled shafts will be utilized at the pier substructure units. Given the proposed loading per shaft at each of the pier locations, friction bearing drilled shafts within the overburden soils and drilled shafts bearing within the weak surficial shale bedrock are not economically feasible foundation options due to the size and number of shafts that would be required to support the proposed loading. Therefore, it is recommended that the drilled shafts be extended through the surficial soils and weak surficial shale bedrock to bear on or within the underlying limestone/dolomite bedrock at the pier locations.

Per Section 10.8.3.5.4c of the 2020 AASHTO LRDF Bridge Design Specifications (BDS), a minimum rock socket length of 1.5 times the diameter of the drilled shaft within the rock socket ($1.5B_{RS}$) is required to utilize the full end bearing resistance within the bedrock unit that the shafts are end bearing in/on. However, based on discussions with the ODOT Office of Geotechnical Engineering (OGE), a reduced tip resistance can be utilized for shafts not extended to the required minimum socket length of $1.5B_{RS}$ into bedrock.

Using equation 10.8.3.5.4c-1 of the 2020 AASHTO LRFD BDS, the nominal end bearing resistance for drilled shafts socketed a minimum of $1.5B_{RS}$ into intact rock is 2.5 times the unconfined compressive strength of the bedrock unit that the shaft tip is bearing on or within. Based on unconfined compression tests performed on limestone rock cores obtained from the borings, the unconfined compressive strength ranges from 5,086 to 12,942 psi. Using equation 10.8.3.5.4c-1 and the limiting unconfined compressive strength from the given range for the limestone bedrock, it is recommended that drilled shaft foundations socketed a minimum of $1.5B_{RS}$ into the bedrock to bear on or within the competent limestone bedrock be proportioned for a nominal end bearing resistance of 1,831 ksf at the strength limit state.

Where lateral load demands do not require a rock socket length of $1.5B_{RS}$, the socket length can be reduced or the shaft can bear on the bedrock surface with no rock socket. If the rock socket is reduced to a length less than $1.5B_{RS}$, a reduced nominal end bearing resistance should be utilized based on equations 10.8.3.5.4c-2 and 10.8.3.5.4c-3 of the AASHTO LRFD BDS, which is as follows:

$$q_p = A + q_u \left[m_b \left(\frac{A}{q_u} \right) + s \right]^a$$

In which:

$$A = \sigma'_{vb} + q_u \left[m_b \left(\frac{\sigma'_{vb}}{q_u} \right) + s \right]^a$$

Where:

- σ'_{vb} = vertical effective stress at the socket bearing (tip) elevation (ksf)
- s , a and m_b = Hoek-Brown strength parameters for fractured rock mass determined from GSI in accordance with Section 10.4.6.4 of the AASHTO LRFD BDS
- q_u = unconfined compressive strength of intact rock (ksf)

Based on discussions with ODOT OGE, the condition of the rock mass for the determination of the GSI rating should consider the limestone to have a “closed” joint condition, a “blocky” structure and a “good” joint surface condition. Using this description for the structure and surface conditions of the rock mass, a GSI rating of 70 was determined from Figure 10.4.6.4-1 of the 2020 AASHTO LRFD BDS, and the Hoek-Brown strength parameters s , a and m_b were calculated as 0.036, 0.50 and 3.08, respectively. The vertical effective stress was estimated considering 45 feet of soil overburden with a buoyant unit weight of 57.6 pcf. Using the above noted equations and the limiting unconfined compressive strength from the given range for the limestone bedrock, it is recommended that drilled shaft foundations bearing on or within the competent limestone bedrock with a socket length less than $1.5B_{RS}$ into the bedrock be proportioned for a nominal end bearing resistance of 765 ksf at the strength limit state.

Based on plan information provided by ms consults, the shaft diameter within the overburden soils will be 5.5 feet, and the shaft diameter within the rock socket will be 5.0 feet. Table 8 lists the estimated elevation of the top of bedrock as well as the proposed rock sock diameter and length from the design plans and corresponding nominal end bearing resistance to be utilized for the design of the drilled shaft foundations. A resistance factor of $\phi_{qp} = 0.5$ at the strength limit state should be utilized for design.

Table 8. Drilled Shaft Recommendations

| Structure Reference | Substructure Unit (Boring) | Top of Bedrock Elevation (feet msl) | Top of Limestone Elevation (feet msl) | Rock Socket Diameter ¹ (feet) | Required Socket Length to Top of Limestone / Dolomite (feet) | Proposed Socket Length ¹ (feet) | Nominal End Bearing Resistance ² (ksf) |
|---------------------|----------------------------------|-------------------------------------|---------------------------------------|--|--|--|---|
| FRA-70-1322L | Pier 1 (B-005-S-57) | 652.1 | 651.5 | 5.0 | 0.6 | 5.0 | 765 |
| | Pier 2 (B-009-S-57) | 650.8 | 648.1 | 5.0 | 2.7 | 5.0 | 765 |
| | Pier 3 (B-013-S-57 / B-113-8-13) | 660.8 | 644.0 | 5.0 | 16.8 | 16.8 | 1,831 |
| | Pier 4 (B-020-S-57 / B-113-9-13) | 656.5 | 645.6 | 5.0 | 10.9 | 10.9 | 1,831 |
| FRA-70-1323C | Pier 1 (B-113-6-13) | 652.2 | 647.6 | 5.0 | 4.6 | 7.0 | 765 |
| | Pier 2 (B-113-7-13) | 659.4 | 648.8 | 5.0 | 10.6 | 10.6 | 1,831 |
| | Pier 3 (B-013-S-57 / B-113-8-13) | 663.6 | 644.0 | 5.0 | 16.8 | 19.6 | 1,831 |
| | Pier 4 (B-113-9-13) | 656.3 | 645.6 | 5.0 | 10.7 | 10.7 | 1,831 |

1. Proposed rock socket diameter and length at each substructure unit determined from proposed plan information provided by ms consultants.
2. Nominal end bearing resistance provided is the value that should be utilized in the determination of the end bearing resistance per drilled shaft based on the proposed rock socket length and diameter.

If lateral analysis of the drilled shaft foundations indicates that the rock socket length can be reduced based on the lateral load demands, then the rock socket length may be reduced from those shown in the current design plans. If the rock socket is reduced to a length less than $1.5B_{RS}$, then the reduced bearing resistance of 765 ksf should be utilized for design.

Given the factored end bearing resistances noted above for drilled shafts extended to bear on or within the limestone bedrock, it is anticipated that the axial resistance will be governed by structural resistance of the drilled shaft. Based on the cross section provided for the drilled shaft within the rock socket, which consists of a 5.0-foot diameter shaft with 28 No. 10 longitudinal reinforcement bars, the factored structural resistance is 7,412 kips, as determined in accordance with Section 5.6.4.4 of the 2020 AASHTO LRFD BDS. The factored resistance per shaft provided in the design sheets should be the limiting value between the factored geotechnical resistance and the factored axial compressive resistance of the shaft.

Drilled shafts designed in accordance with the requirements presented above should experience a maximum settlement estimated to be less than 0.5 inches. Group settlement of the shafts, socketed into bedrock, is considered negligible for a minimum spacing of 2.0 shaft diameters center-to-center. Drilled shaft calculations are provided in Appendix VI.

5.1.1 Drilled Shaft Considerations

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

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

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

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

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

It is anticipated that conventional drilled shaft equipment (with a standard soil bit) will be able to penetrate the upper soils to the bedrock depths provided in Table 3. However, depending on the conditions encountered, additional effort may be needed at or above this depth, and within the noted cobble and boulder zones. Below the depths noted, it will likely be necessary to employ more specialized drilling techniques, such as the use of rock teeth or a rock bit. The ability to penetrate the bedrock will be entirely dependent on the drilled shaft contractor and the equipment employed. It is the responsibility of the contractor to determine the most effective excavation procedures. The elevation and hardness of bedrock is subject to change within the project area.

5.2 Driven Pile Recommendations

It is understood that driven piles will be utilized at the rear and forward abutment substructure units. Given the depth of bedrock encountered in the borings performed 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. Table 9 shows 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.

Table 9. Driven Pile Recommendations

| Substructure Reference | Pile Size | Pile Elevation | | Pile Length ² (feet) | R _{R max} ³ (kips/pile) | ϕ ⁴ |
|------------------------|-----------------------|------------------|-------|------------------------------------|--|---------------------|
| | | Top ¹ | Tip | | | |
| Rear Abutment | HP 10x42 ⁵ | 715.5 | 652.7 | 65 | 310 | N/A |
| | HP 12x53 ⁵ | 715.5 | 652.7 | 65 | 380 | N/A |
| | HP 14x73 ⁵ | 715.5 | 652.7 | 65 | 530 | N/A |
| Forward Abutment | HP 10x42 ⁵ | 710.0 / 720.0 | 662.1 | 50 / 60 | 310 | N/A |
| | HP 12x53 ⁵ | 710.0 / 720.0 | 662.1 | 50 / 60 | 380 | N/A |
| | HP 14x73 ⁵ | 710.0 / 720.0 | 662.1 | 50 / 60 | 530 | N/A |

1. 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. Multiple values indicate minimum and maximum pile cutoff elevation along the abutment substructure.
2. 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.
3. 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.
4. 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.
5. A steel pile point is recommended to protect the tips of the H-piles during pile installation.

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 9 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 ($\phi_c = 0.50$ per Section 6.5.4.2 of the 2020 AASHTO LRFD BDS) and a pile fully braced along its length. **These bearing values should not be used for piles that are subjected to bending moments or are not supported by soil for their entire length.** Static or dynamic load testing is not required for H-piles driven to refusal on bedrock. It is anticipated that the piles will be able to be driven a short distance into the shale bedrock at the forward abutment before satisfying the driving conditions that meet the refusal criterion. Settlement is estimated to be less than 1.0 inch for H-piles driven to refusal on bedrock.

As noted in Section 4.2, a boulder zone was encountered in boring B-113-5-13 between elevations 668.7 and 674.7 feet msl. Additionally, cobbles and boulders were encountered above the bedrock in borings B-113-4-13 and B-113-5-13 starting at an elevation of approximately 700 feet msl. Given the significant presence of cobbles and boulders at the rear abutment, the pile driving operations should be closely monitored to verify that the piles extend to the limestone bedrock. **If a pile cannot be extended through the cobbles and boulders to the estimated elevation of the limestone bedrock, then the pile should be considered a friction bearing pile that is driven to the maximum ultimate bearing value per Section 305.3.4 of the 2020 ODOT BDM.** In this instance, the resistance factor of 0.7 should be applied to the maximum ultimate bearing value provided for the respective pile size utilized.

Consideration was given to the use of friction piles using cast-in-place (CIP) pipe piles; however, given the presence of dense granular soils immediately below the bottom of footing elevation, it is anticipated that refusal will be encountered prior to achieving a sufficient embedment depth for lateral resistance.

5.2.1 Downdrag Considerations

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. Based on plan and profile information provided by ms consultants, approximately 5.5 and 10.0 feet of fill will be required to achieve the final grade elevation at the rear and forward abutment, respectively. The anticipated total settlement due to the embankment loading at the rear and forward abutment is 0.78 and 1.18 inches, respectively. The settlement of the soils beneath the proposed abutment footings is anticipated to be 0.11 and 0.40 inches, respectively, at the rear and forward abutment. Given that the anticipated settlement below the proposed footings will not exceed 0.40 inches, downdrag loads are not anticipated to develop along the piles. Settlement calculations are provided in Appendix VIII.

5.2.2 Driveability

A drivability analysis was performed in accordance with Section 10.7.8 of the 2020 AASHTO LRFD BDS using the GRLWEAP software program, and the results are provided in Appendix VI. In the driveability analysis, a Delmag 19-42 hammer with a rated energy of approximately 43,000 ft-lbs was used in conjunction with H-pile sections at the forward abutment of both structures. 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 9.

For the rear abutment of both structures, a larger pile hammer system is required to advance the piles through the overburden soils and boulder field to bear on the top of bedrock. Therefore, a Delmag 30-23 hammer with a rated energy of approximately 73,788 ft-lbs was used in conjunction with H-pile sections at the rear abutment of both structures. Based on the results of the analysis, driving stresses **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 9 at the rear abutment of the FRA-70-1323C structure. However, for the piles at the rear abutment of the FRA-70-1322L structure, while the analysis indicates the driving stresses would not exceed 90 percent of the yield stress of the steel, it is anticipated that refusal will occur as the piles approach the bedrock elevation.

Care should be taken during pile driving operations when approaching the bedrock, 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.

As noted in Section 5.2, if a pile cannot be extended through the cobbles and boulders to the estimated elevation of the limestone bedrock at the rear abutment of the FRA-70-1322L and FRA-70-1323C structures, then the pile should be considered a friction bearing pile that is driven to the maximum ultimate bearing value per Section 305.3.4 of the 2020 ODOT BDM.

Per Section 305.3.5.6 of the 2020 ODOT BDM, steel pile points **shall be used** when the piles are driven to bear on strong bedrock (unconfined compressive strength greater than 7.5 ksi) and is extended through overburden containing layers of very dense granular soils as well as boulders.

5.3 Lateral Design

If lateral load or moments are expected to be applied on the foundation elements, they should be analyzed to verify the shaft or 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 IX. 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 and cross section (for drilled shafts) required to resist the lateral load for a given end condition and deflection. Table 10 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 IX.

Table 10. 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) |

5.4 CIP Wall Recommendations (Forward Abutment Wingwall)

It is understood that a cast-in-place (CIP) retaining wall that is being supported on a shallow spread foundation is being utilized for a portion of the wingwall at the forward abutment between Sta. 3053+26.70 and 3054+50.00 (BL Ramp D3).

Based on the proposed plan and cross section information provided by ms consultants, the wall height ranges from 9.3 to 24.3 feet along this section of the wingwall. The wingwall alignment is situated along the existing supporting the former Mound Street, which will be removed to facilitate the construction of the wall. Based on the cross sections provided, the profile grade of Ramp D3 is approximately 10.0 feet below the existing grade of the embankment.

For CIP walls bearing on earthen foundations, footings should be proportioned such that the factored equivalent bearing pressure exerted at the front of the wall will not exceed the factored bearing resistance at the strength limit state. Further, the footings should also be proportioned such that the entire footing width remains in compression (no tensile stresses form under the footing, pulling the footing up and away from the bearing surface). It is understood that the foundations for CIP walls will bear approximately 4.0 feet below the finished grade. In general, the typical width of a CIP wall foundation (B) is equal to 50 to 70 percent the wall height.

Existing embankment fill was encountered in boring B-019-5-19 extending to an elevation 714.0 feet msl, overlying existing fill consisting of medium stiff to stiff silt and clay and silty clay (ODOT A-6a, A-6b). The existing embankment fill generally consisted of very stiff to hard silt and clay, silty clay and clay (ODOT A-6a, A-6b, A-7-6) with intermittent seams of medium dense to very dense gravel with sand (ODOT A-1-b). Based on the condition of the existing embankment fill encountered in the borings, it is anticipated that the embankment fill was placed and compacted in a controlled manner. Therefore, this soil in its current condition is considered adequate for support of the proposed wingwall.

5.4.1 Strength Parameters Utilized in External and Global Stability Analyses

The shear strength parameters utilized in the external and global stability analyses for the wingwall are provided in Table 11.

Table 11. Shear Strength Parameters Utilized in Stability Analyses

| Material Type | γ (pcf) | ϕ' ⁽¹⁾ (°) | c' ⁽²⁾ (psf) | S_u ⁽³⁾ (psf) |
|--|-------------------|-------------------------------|------------------------------|-------------------------------|
| Item 203 Embankment (Retained Soil) | 120 | 30 | 0 | 2,000 |
| Existing Embankment Fill: Medium Dense Gravel with Sand (ODOT A-1-b) | 125 | 39 | 0 | N/A |
| Existing Embankment Fill: Very Stiff Silt and Clay (ODOT A-6a) | 120 | 27 | 15 | 2,250 |
| Existing Embankment Fill: Very Stiff Clay (ODOT A-7-6) | 120 | 25 | 30 | 2,125 |
| Existing Fill: Medium Stiff to Stiff Silty Clay (ODOT A-6b) | 120 | 26 | 20 | 1,250 |
| Existing Fill: Stiff Silt and Clay (ODOT A-6a) | 115 | 27 | 15 | 1,500 |
| Stiff Sandy Silt (ODOT A-4a) | 115 | 27 | 0 | 1,625 |
| Medium Dense Gravel (ODOT A-1-a) | 125 | 37 | 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).

The shear strength parameters for the existing embankment, fill materials and 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 and based on past experience in the vicinity of the site with projects performed in similar subsurface profiles.

5.4.2 Bearing Stability

Existing embankment fill consisting of very stiff to hard silt and clay and clay (ODOT A-6a, A-7-6) is anticipated at the bearing elevation along the wall alignment, overlying existing fill consisting of medium stiff to stiff silty clay (ODOT A-6b). CIP wall foundations bearing on these soils may be proportioned for a factored bearing resistance as indicated in Table 12. A geotechnical resistance factor of $\phi_b=0.55$ was considered in calculating the factored bearing resistance at the strength limit state. The foundation width presented in the following table is based on the wall section provided in the design sheets.

Table 12. Forward Abutment Wingwall CIP Wall Design Parameters

| From Station ¹ | To Station ¹ | Panel ID | Wall Height Analyzed (feet) | Foundation Width (feet) | Bearing Resistance at Strength Limit (ksf) | | Strength Limit Equivalent Bearing Pressure ³ (ksf) |
|---------------------------|-------------------------|----------|-----------------------------|-------------------------|--|-----------------------|---|
| | | | | | Nominal | Factored ² | |
| 3053+26.70 | 3053+57.53 | 3 | 24.3 | 18.5 | 7.36 | 4.05 | 4.03 |
| 3053+57.53 | 3053+88.35 | 4 | 19.2 | 14.0 | 7.23 | 3.98 | 3.62 |
| 3053+88.35 | 3054+19.31 | 5 | 14.2 | 11.0 | 6.57 | 3.61 | 2.57 |
| 3054+19.31 | 3054+50.00 | 6 | 9.3 | 8.8 | 5.92 | 3.26 | 1.63 |

1. Limits of wall determined from plan information provided by ms consultants. Stationing listed is referenced to Ramp D3.
2. A geotechnical resistance factor of $\phi_b=0.55$ 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.

Rii performed a verification of the bearing pressure exerted on the subgrade material for the maximum specified wall height indicated in Table 12. Based on the minimum footing widths presented, the factored equivalent bearing pressure exerted below the wall **will not exceed** the factored bearing resistance at the strength limit state.

5.4.3 Settlement Considerations

Given that the existing Mound Street embankment will be excavate and removed to construct the wingwall, resulting in a profile grade along Ramp D3 at the top of the wall that is approximately 10.0 feet below the existing grade of the embankment, little to no settlement is anticipated under the loading from the proposed wall along the alignment.

5.4.4 Eccentricity (Overturning Stability)

The resistance of the CIP wall 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 CIP 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 11.6.3.3 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. Based on the required foundation width presented in Table 12 and utilizing the soil parameters listed in Section 5.4.1 for the retained embankment material, the calculated eccentricity of the resultant force **will not exceed** the limiting eccentricity at the strength limit state.

5.4.5 Sliding Stability

The resistance of the CIP wall to sliding was evaluated per Section 11.6.3.6 of the 2020 AASHTO LRFD BDS. Given that the bearing soils 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 friction angle of the foundation soil. Based on the soil parameters listed in Section 5.4.1, a coefficient of sliding friction of 0.47 to 0.49 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 wall. Based on the soil parameters listed in Section 5.4.1, the undrained shear strength of the bearing material is estimated to range from 1.25 to 2.125 ksf.

A geotechnical resistance factor of $\phi_r=1.0$ was considered in calculating the factored shear resistance along the base of the wall. Based on the foundation widths presented in Table 12 and utilizing the soil parameters listed in Section 5.4.1 for the retained embankment material, the resultant horizontal forces on the back of the CIP wall **will not exceed** the factored shear resistance at the strength limit state under drained or undrained conditions.

5.4.6 Global (Overall) Stability

A slope stability analysis was performed to check the global stability of the wall along the alignment. As per 2020 AASHTO LRFD BDS, safety against soil failure shall be evaluated at the service limit state by assuming the concrete and soil backfill to be a rigid body. Soil parameters utilized in external stability analyses are presented Section 5.4.1. For the global stability condition, it was considered that the failure plane will not cross through any portion of the supported soil mass above the concrete or through the

concrete footing itself. The computer software program Slide, manufactured by Rocscience Inc., was utilized to perform the analyses.

Per Section 11.6.2.3 of the 2020 AASHTO LRFD BDS, overall (global) stability for CIP walls that are not 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 $\phi=0.75$ is greater than 1.0. Therefore, global stability is satisfied when a minimum factor of safety of 1.3 is obtained. Based on the recommended footing dimensions listed in Table 12, the resulting factor of safety under drained conditions (long-term stability) and undrained conditions (short-term stability) using the Spencer's analysis method was greater than 1.3.

5.4.7 Final CIP Wall Considerations

Based on the results of the external and global stability analysis performed for the forward abutment wingwall, the wall sections provided in the design sheets meet all of the external and global stability requirements.

Calculations for external (bearing and sliding resistance and limiting eccentricity) and overall (global) stability of the CIP walls are provided in Appendix X.

5.5 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 13 and Table 14.

Table 13. 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 | 120 | 0 | 32° | 0.27 | 0.47 | 6.82 |

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

Table 14. 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 | 50 | 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 | 120 | 0 | 32° | 0.27 | 0.47 | 6.82 |

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 13, 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 14. 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.

5.6 Scour Data

Continuous sampling was performed starting at the top of the riverbed elevation in borings B-113-6-13 through B-113-8-13 for a minimum 6.0-foot interval to determine the D_{50} of the riverbed soil. The riverbed soils are classified as gravel, gravel and sand, gravel with sand and silt, gravel with sand, silt and clay and sandy silt (ODOT A-1-a, A-1-b, A-2-4, A-2-6, A-4a). Based upon the grain size analysis performed, the D_{50} of the riverbed material is summarized in Table 15.

Table 15. Scour Data Summary

| Soil Type | Range of D_{50} (millimeters) |
|-----------|------------------------------------|
| A-1-a | 3.264 – 7.385 |
| A-1-b | 0.463 – 1.471 |
| A-2-4 | 0.902 – 2.424 |
| A-2-6 | 0.902 – 2.424 |
| A-4a | 0.121 |

5.7 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).

5.7.1 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, sheeting boxes may be required. The following table should be utilized as a general guide for implementing OSHA guidelines when estimating excavation back slopes at the various boring locations. Actual excavation back slopes must be field verified by qualified personnel at the time of excavation in strict accordance with OSHA guidelines.

Table 16. Excavation Back Slopes

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

5.7.2 Groundwater Considerations

Based on the groundwater observations made during drilling, groundwater is anticipated during construction of the drilled shafts. 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. In the case of drilled shafts, the utilization of casing will be required below the water table to maintain an open hole and prevent the sidewalls from collapse. In addition, concrete placed below the water table should be placed by tremie method using a rigid tremie pipe. Note that mitigating the water during construction and protecting the excavation 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.

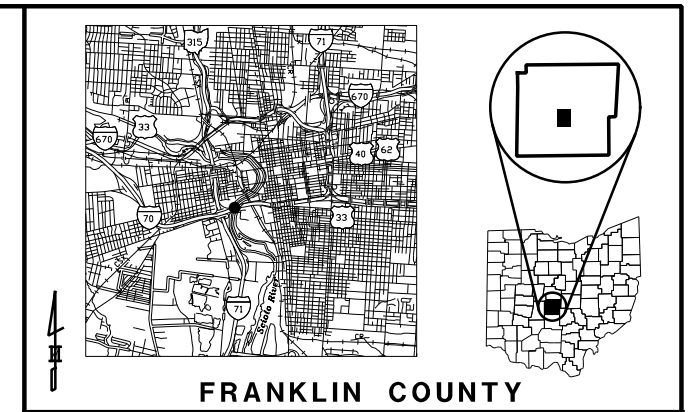
The scope of our services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater or surface water within or beyond the site studied. Any statements in this report or on the test boring logs regarding odors, staining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

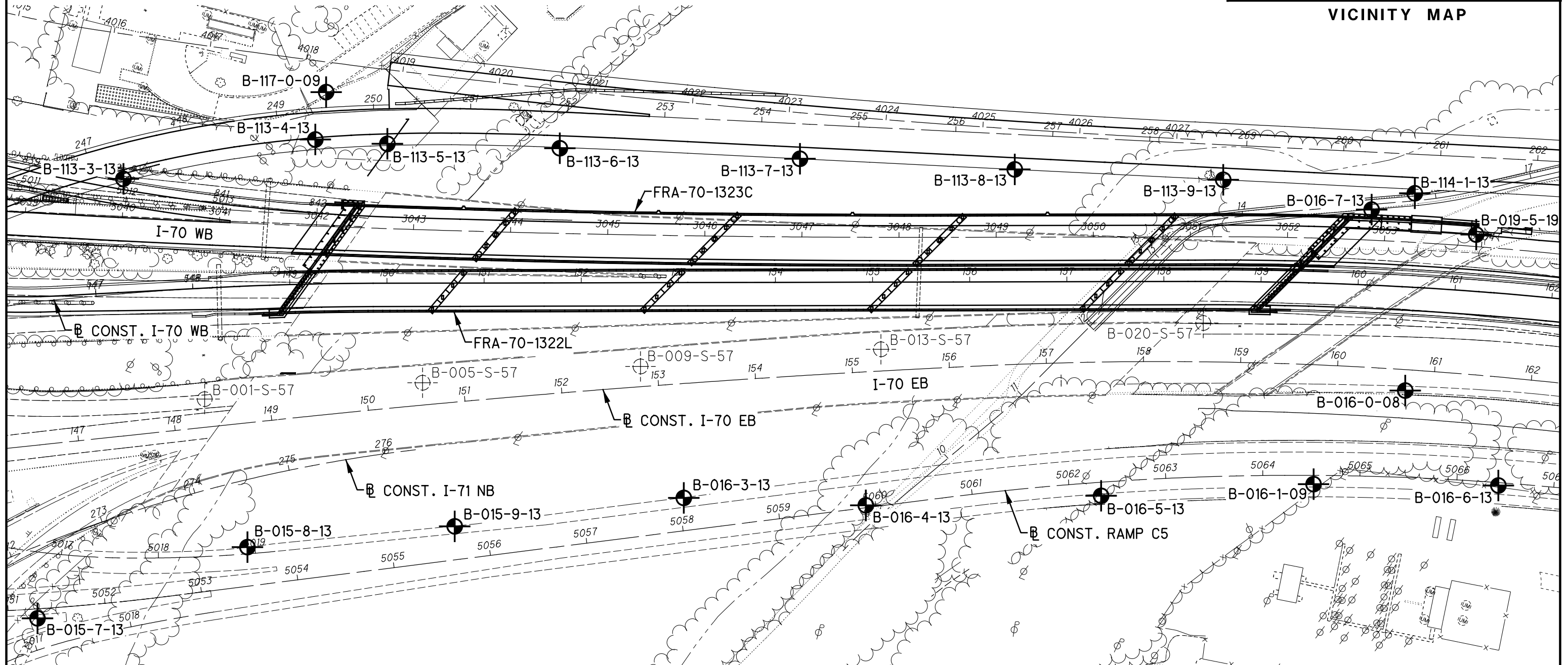


APPENDIX I




VICINITY MAP AND BORING PLAN



FRANKLIN COUNTY
VICINITY MAP



BORING PLAN
FRA-70-1322L AND FRA-70-1323C
FRANKLIN COUNTY, OHIO

| | | | |
|---|---|------------------|--|
| PROJECT NO. Rii W-13-072 | | DRAWN RRM |  RESOURCE INTERNATIONAL, INC. |
| SCALE: 1"=100' 0 50 100  |  | REVIEWED BRT | |
| | | DATE 3/8/2021 | |

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. |

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 |



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.

APPENDIX III

PROJECT BORING LOGS:

**B-015-7-13 through B-015-9-13,
B-016-3-13 through B-016-5-13,
B-016-7-13, B-019-5-19 and
B-113-4-13 through B-114-1-13**

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-70-12.68 - PHASE 4A
 TYPE: STRUCTURE
 PID: 77372 BR ID: FRA-70-1301A
 START: 6/10/13 END: 6/13/13

DRILLING FIRM / OPERATOR: RII / S.M.
 SAMPLING FIRM / LOGGER: RII / A.D.
 DRILLING METHOD: 3.25" HSA / RC
 SAMPLING METHOD: SPT / NQ

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


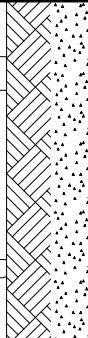

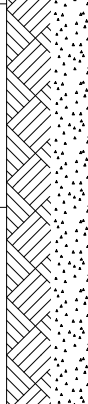
STATION / OFFSET: 5051+29.66 / 9.8' RT
 ALIGNMENT: BL RAMP C5
 ELEVATION: 721.8 (MSL) EOB: 80.5 ft.
 LAT / LONG: 39.950618516, -83.014254653

EXPLORATION ID
B-015-7-13

PAGE
 1 OF 3

| MATERIAL DESCRIPTION AND NOTES | ELEV. 721.8 | 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 (5.0") HARD, BROWN CLAY , SOME FINE GRAVEL, SOME FINE TO COARSE SAND, LITTLE SILT, DRY. | 721.4 | 1 | 4 | | | | | | | | | | | | | | | |
| | | 2 | 15 12 | 37 | 50 | SS-1 | 4.5+ | 24 | 14 | 13 | 15 | 34 | 43 | 19 | 24 | 9 | A-7-6 (8) | |
| DENSE, GRAY GRAVEL , LITTLE FINE TO COARSE SAND, TRACE SILT, TRACE CLAY, DAMP. | 718.8 | 3 | | | | | | | | | | | | | | | | |
| | | 4 | 9 11 12 | 32 | 17 | SS-2 | - | - | - | - | - | - | - | - | - | 6 | A-1-a (V) | |
| STIFF TO VERY STIFF, DARK BROWN TO BROWNISH GRAY SILT AND CLAY , SOME COARSE TO FINE SAND, SOME FINE GRAVEL, DAMP TO MOIST. | 716.3 | 5 | | | | | | | | | | | | | | | | |
| | | 6 | 3 | | | | | | | | | | | | | | | |
| | | 7 | 4 2 | 8 | 61 | SS-3 | 2.00 | - | - | - | - | - | - | - | - | 15 | A-6a (V) | |
| | | 8 | | | | | | | | | | | | | | | | |
| | | 9 | 2 4 4 | 11 | 67 | SS-4 | 2.50 | 26 | 15 | 15 | 16 | 28 | 32 | 17 | 15 | 13 | A-6a (3) | |
| | | 10 | | | | | | | | | | | | | | | | |
| | | 11 | 3 | | | | | | | | | | | | | | | |
| | | 12 | 6 5 | 15 | 56 | SS-5 | 2.00 | - | - | - | - | - | - | - | - | 20 | A-6a (V) | |
| LOOSE TO DENSE, BROWN GRAVEL WITH SAND, SILT, AND CLAY , DAMP. | 708.8 | 13 | | | | | | | | | | | | | | | | |
| | | 14 | 2 3 3 | 8 | 72 | SS-6 | - | - | - | - | - | - | - | - | - | 17 | A-2-6 (V) | |
| | | 15 | | | | | | | | | | | | | | | | |
| | | 16 | 3 | | | | | | | | | | | | | | | |
| | | 17 | 9 5 | 19 | 44 | SS-7 | - | 30 | 20 | 15 | 11 | 24 | 30 | 18 | 12 | 17 | A-2-6 (0) | |
| | | 18 | | | | | | | | | | | | | | | | |
| DENSE TO VERY DENSE, GRAY GRAVEL AND SAND , LITTLE TO SOME SILT, TRACE CLAY, DAMP TO MOIST. | 703.8 | 19 | | | 0 | ST-8 | - | - | - | - | - | - | - | - | - | - | | |
| | | 20 | | | | | | | | | | | | | | | | |
| | | 21 | 5 | | | | | | | | | | | | | | | |
| | | 22 | 18 18 | 50 | 72 | SS-9 | - | - | - | - | - | - | - | - | - | 7 | A-1-b (V) | |
| | | 23 | | | | | | | | | | | | | | | | |
| | | 24 | 11 21 19 | 55 | 67 | SS-10 | - | 49 | 18 | 9 | 23 | 1 | NP | NP | NP | 7 | A-1-b (0) | |
| | | 25 | | | | | | | | | | | | | | | | |
| | | 26 | 12 27 22 | 67 | 83 | SS-11 | - | - | - | - | - | - | - | - | - | 8 | A-1-b (V) | |
| | | 27 | | | | | | | | | | | | | | | | |
| | | 28 | | | | | | | | | | | | | | | | |
| | | 29 | 8 13 17 | 41 | 11 | SS-12 | - | - | - | - | - | - | - | - | - | 10 | A-1-b (V) | |

[illegible]

| | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---------------------|----------------------------------|---|--------|----|----------|-----------------|----------------|-----------|--------------|---------------|-----------|----|------------|----|-----------|----|----|---|-----------------|---|-----------|--|--|--|--|
| PID: 77372 | BR ID: FRA-70-1301A | PROJECT: FRA-70-12.68 - PHASE 4A | STATION / OFFSET: 5051+29.66 / 9.8 RT | | | | | START: 6/10/13 | | END: 6/13/13 | | PG 3 OF 3 | | B-015-7-13 | | | | | | | | | | | | |
| MATERIAL DESCRIPTION AND NOTES | | | ELEV. 659.7 | DEPTHS | | SPT/ RQD | N ₆₀ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) | | | | | ATTERBERG | | | | ODOT CLASS (GI) | BACK FILL | | | | | |
| VERY DENSE, GRAY GRAVEL AND SAND, LITTLE SILT, TRACE CLAY, MOIST TO WET. (same as above) | | |  | 659.7 | TR | 63 | | | | | | | | | | | | | | |  | | | | | |
| | | | | | | 64 | 42 50/4" | - | 100 | SS-19 | - | 54 | 17 | 10 | 16 | 3 | 22 | 17 | 5 | 10 | | A-1-b (0) | | | | |
| | | | | | | 65 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | 66 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | 67 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | 68 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | 69 | 50/5" | - | 20 | SS-20 | - | - | - | - | - | - | - | - | - | 24 | | A-1-b (V) | | | | |
| | | | | | | 70 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | 71 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | 72 | | | | | | | | | | | | | | | | | | | | |
| DOLOMITE : BROWN AND GRAY, SLIGHTLY WEATHERED, STRONG, VERY THIN TO MEDIUM BEDDED, CHERTY, CRYSTALLINE,, SILICEOUS, CALCITE/PYRITE DEPOSITS, CHERT NODULES AND LENSES, MODERATELY FRACTURED TO FRACTURED, OPEN APERTURE, SLIGHTLY ROUGH TO ROUGH; RQD 58%, REC 96%. -CHERT NODULE @ 71.1' -QU @ 72.1' = 12,300 PSI | | |  | 651.3 | TR | 73 | 58 | | 97 | RC-1 | | | | | | | | | | CORE |  | | | | | |
| | | | | | | 74 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | 75 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | 76 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | 77 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | 78 | 58 | | 95 | RC-2 | | | | | | | | | | | | CORE | | | | |
| | | | | | | 79 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | 80 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | 641.3 | EOB | 80 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 30.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BNTONITE POWDER / 50 GAL WATER



B-015-7-13 – RC-1 – Depth from 70.5 to 75.5 feet



B-015-7-13 – RC-2 – Depth from 75.5 to 80.5 feet



PROJECT: FRA-70-12.68 - PHASE 4A
 TYPE: STRUCTURE
 PID: 77372 BR ID: FRA-70-1321A
 START: 5/3/14 END: 5/3/14

DRILLING FIRM / OPERATOR: RII / T.F.
 SAMPLING FIRM / LOGGER: RII / S.B.
 DRILLING METHOD: 4.25" HSA / HQ
 SAMPLING METHOD: SPT / RC

DRILL RIG: CME-750X (SN 310218)
 HAMMER: CME AUTOMATIC
 CALIBRATION DATE: 4/26/13
 ENERGY RATIO (%): 86.8

STATION / OFFSET: 5053+52.86 / 39.9' LT
 ALIGNMENT: BL RAMP C5
 ELEVATION: 692.5 (MSL) EOB: 56.0 ft.
 LAT / LONG: 39.951030, -83.013641

EXPLORATION ID
B-015-8-13

PAGE
 1 OF 2

| MATERIAL DESCRIPTION AND NOTES | ELEV. 692.5 | 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 | | | |
| MEDIUM DENSE, BROWN GRAVEL , SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, WET. | 691.0 | 1 | 12 10 2 | 17 | 33 | SS-1 | - | 62 | 19 | 8 | 6 | 5 | - | - | - | 23 | A-1-a (V) | |
| MEDIUM STIFF, BROWN SILTY CLAY , SOME COARSE TO FINE SAND, SOME FINE GRAVEL, MOIST. | | 2 | WOH WOH 4 | 6 | 33 | SS-2 | 1.00 | 20 | 10 | 11 | 26 | 33 | 38 | 19 | 19 | 25 | A-6b (8) | |
| | | 3 | 1 | | | | | | | | | | | | | | | |
| | 688.0 | 4 | 2 3 | 7 | 33 | SS-3 | 1.00 | 30 | 12 | 12 | 23 | 23 | - | - | - | 29 | A-6b (V) | |
| LOOSE, BROWN GRAVEL WITH SAND, SILT, AND CLAY , MOIST. | | 5 | 1 2 3 | 7 | 33 | SS-4 | - | 54 | 12 | 9 | 14 | 11 | 33 | 20 | 13 | 20 | A-2-6 (0) | |
| | 685.5 | 6 | | | | | | | | | | | | | | | | |
| MEDIUM DENSE TO VERY DENSE, BROWN GRAVEL , SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, WET. | | 7 | | | | | | | | | | | | | | | | |
| -LARGE ROCK RECOVERED IN 3S-5A | | 8 | 1 9 10 | 27 | 0 | SS-5 | - | - | - | - | - | - | - | - | - | - | | |
| | | 9 | 13 | - | 50 | 3S-5A | - | - | - | - | - | - | - | - | - | - | A-1-a (V) | |
| | | 10 | | | | | | | | | | | | | | | | |
| -ROCK FRAGMENTS PRESENT IN SS-6 AND SS-7 | | 11 | 20 50/3" | - | 100 | SS-6 | - | 66 | 16 | 8 | 7 | 3 | NP | NP | NP | 19 | A-1-a (0) | |
| | | 12 | | | | | | | | | | | | | | | | |
| | 678.0 | 13 | 1 5 7 | 17 | 33 | SS-7 | - | - | - | - | - | - | - | - | - | 20 | A-1-a (V) | |
| | | 14 | | | | | | | | | | | | | | | | |
| HARD, DARK BROWN SILTY CLAY , SOME COARSE TO FINE SAND, TRACE FINE GRAVEL, DAMP TO MOIST. | | 15 | 5 | | | | | | | | | | | | | | | |
| | | 16 | 7 12 | 27 | 72 | SS-8 | 4.5+ | 3 | 7 | 16 | 40 | 34 | 32 | 15 | 17 | 14 | A-6b (11) | |
| | | 17 | | | | | | | | | | | | | | | | |
| | | 18 | 15 17 17 | 49 | 44 | SS-9 | 4.5+ | - | - | - | - | - | - | - | - | 16 | A-6b (V) | |
| | | 19 | | | | | | | | | | | | | | | | |
| | | 20 | 10 15 14 | 42 | 94 | SS-10 | 4.5+ | - | - | - | - | - | - | - | - | 14 | A-6b (V) | |
| | 670.5 | 21 | | | | | | | | | | | | | | | | |
| | | 22 | | | | | | | | | | | | | | | | |
| HARD, DARK BROWN SILT AND CLAY , SOME COARSE TO FINE SAND, TRACE FINE GRAVEL, DAMP. | | 23 | 23 23 25 | 69 | 56 | SS-11 | 4.5+ | 7 | 8 | 21 | 34 | 30 | 28 | 15 | 13 | 16 | A-6a (7) | |
| | | 24 | | | | | | | | | | | | | | | | |
| | | 25 | 14 50/3" | - | 100 | SS-12 | 4.5+ | - | - | - | - | - | - | - | - | 13 | A-6a (V) | |
| | 665.5 | 26 | | | | | | | | | | | | | | | | |
| | | 27 | | | | | | | | | | | | | | | | |
| VERY DENSE, BROWN GRAVEL AND SAND , LITTLE SILT, TRACE CLAY, MOIST. | | 28 | 50/2" | - | 0 | SS-13 | - | - | - | - | - | - | - | - | - | - | | |
| | | 29 | | | | | | | | | | | | | | | | |

[illegible]

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER



B-015-8-13 – RC-1 and RC-2 – Depth from 40.3 to 48.0 feet



B-015-8-13 – RC-3 and RC-4 – Depth from 48.0 to 56.0 feet



PROJECT: FRA-70-12.68 - PHASE 4A
 TYPE: STRUCTURE
 PID: 77372 BR ID: FRA-70-1321A
 START: 5/1/14 END: 5/3/14

DRILLING FIRM / OPERATOR: RII / T.F.
 SAMPLING FIRM / LOGGER: RII / S.B.
 DRILLING METHOD: 4.25" HSA / RC
 SAMPLING METHOD: SPT / HQ

DRILL RIG: CME-750X (SN 310218)
 HAMMER: CME AUTOMATIC
 CALIBRATION DATE: 4/26/13
 ENERGY RATIO (%): 86.8

STATION / OFFSET: 5055+67.30 / 34.3' LT
 ALIGNMENT: BL RAMP C5
 ELEVATION: 691.2 (MSL) EOB: 65.2 ft.
 LAT / LONG: 39.951307453, -83.012965722

EXPLORATION ID
B-015-9-13

PAGE
 1 OF 3

| MATERIAL DESCRIPTION AND NOTES | ELEV. 691.2 | DEPTHS | SPT/ RQD | N ₆₀ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) | | | | | ATTERBERG | | | WC | ODOT CLASS (GI) | HOLE SEALED |
|--|----------------|--------|-------------|-----------------|------------|--------------|-------------|---------------|----|----|----|----|-----------|----|----|----|--------------------|----------------|
| | | | | | | | | GR | CS | FS | SI | CL | LL | PL | PI | | | |
| SOFT, BROWN AND BLACK SILT AND CLAY , LITTLE FINE GRAVEL, LITTLE COARSE TO FINE SAND, MOIST. -ROOT FIBERS PRESENT IN SS-1 | 689.7 | 1 | WOH 1 | 4 | 33 | SS-1 | 0.50 | 28 | 21 | 13 | 22 | 16 | - | - | - | 23 | A-6a (V) | |
| LOOSE, BROWN GRAVEL WITH SAND, SILT, AND CLAY , MOIST. -BRICK FRAGMENTS PRESENT IN SS-3 | 686.7 | 2 | 6 4 | 9 | 56 | SS-2 | - | 39 | 15 | 11 | 20 | 15 | 34 | 19 | 15 | 19 | A-2-6 (1) | |
| | | 3 | 1 3 | 9 | 39 | SS-3 | - | 34 | 21 | 11 | 19 | 15 | - | - | - | 18 | A-2-6 (V) | |
| VERY SOFT, BROWN SILT AND CLAY , SOME COARSE TO FINE SAND, SOME FINE GRAVEL, MOIST. | 684.7 | 4 | 3 3 | 7 | 44 | SS-4 | 0.25 | 31 | 18 | 12 | 23 | 16 | 34 | 19 | 15 | 20 | A-6a (2) | |
| | | 5 | 1 3 | 7 | 44 | SS-4 | 0.25 | 31 | 18 | 12 | 23 | 16 | 34 | 19 | 15 | 20 | A-6a (2) | |
| MEDIUM DENSE, BROWN TO GRAY GRAVEL WITH SAND, SILT, AND CLAY , MOIST. | 681.0 | 6 | 5 4 | 12 | 44 | SS-5 | - | 47 | 16 | 9 | 17 | 11 | - | - | - | 15 | A-2-6 (V) | |
| | | 7 | 5 4 | 12 | 44 | SS-5 | - | 47 | 16 | 9 | 17 | 11 | - | - | - | 15 | A-2-6 (V) | |
| | | 8 | 4 4 | | | | | | | | | | | | | | | |
| | | 9 | | | | | | | | | | | | | | | | |
| VERY SOFT TO SOFT, DARK BROWN TO BLACK SILTY CLAY , LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST. | 677.7 | 10 | | | 83 | ST-6 | 0.50 | - | - | - | - | - | - | - | - | 19 | A-2-6 (V) | |
| | | 11 | 1 1 | 3 | 100 | SS-7 | 0.25 | - | - | - | - | - | - | - | - | 33 | A-6b (V) | |
| | | 12 | 1 1 | 3 | 100 | SS-7 | 0.25 | - | - | - | - | - | - | - | - | 53 | A-6b (V) | |
| LOOSE, DARK BROWN GRAVEL WITH SAND AND SILT , LITTLE CLAY, WET. -INTRODUCED MUD @ 14.0' | 672.7 | 13 | | | | | | | | | | | | | | | | |
| | | 14 | 1 2 | 7 | 44 | SS-8 | - | 20 | 6 | 42 | 17 | 15 | 27 | 21 | 6 | 26 | A-2-4 (0) | |
| | | 15 | 2 3 | | | | | | | | | | | | | | | |
| | | 16 | | | | | | | | | | | | | | | | |
| | | 17 | 2 2 | 7 | 89 | SS-9 | - | - | - | - | - | - | - | - | - | 46 | A-2-4 (V) | |
| | | 18 | 2 3 | | | | | | | | | | | | | | | |
| LOOSE, BROWN COARSE AND FINE SAND , LITTLE FINE GRAVEL, TRACE SILT, TRACE CLAY, WET. -WOOD FRAGMENTS PRESENT IN SS-10 -HEAVING SAND ENCOUNTERED @ 20.5' | 670.2 | 19 | 2 3 | 10 | 67 | SS-10 | - | 20 | 25 | 38 | 10 | 7 | NP | NP | NP | 42 | A-3a (0) | |
| | | 20 | 3 4 | | | | | | | | | | | | | | | |
| STIFF TO VERY STIFF, GRAY AND BLACK SILT AND CLAY , SOME COARSE TO FINE SAND, WET. -WOOD FRAGMENTS AND ORGANICS PRESENT THROUGHOUT | 665.2 | 21 | 6 5 | 13 | 33 | SS-11 | - | - | - | - | - | - | - | - | - | 51 | A-6a (V) | |
| | | 22 | 6 5 | 13 | 33 | SS-11 | - | - | - | - | - | - | - | - | - | 51 | A-6a (V) | |
| | | 23 | | | | | | | | | | | | | | | | |
| | | 24 | 7 10 | 27 | 33 | SS-12 | - | - | - | - | - | - | - | - | - | 72 | A-6a (V) | |
| | | 25 | 7 10 | 27 | 33 | SS-12 | - | - | - | - | - | - | - | - | - | 72 | A-6a (V) | |
| | | 26 | | | | | | | | | | | | | | | | |
| HARD, GRAY SILT , LITTLE CLAY, LITTLE COARSE TO FINE SAND, WET. | 662.7 | 27 | 9 11 | 42 | 67 | SS-13 | 4.5+ | 0 | 1 | 21 | 56 | 22 | 20 | 15 | 5 | 20 | A-4b (8) | |
| | | 28 | 9 18 | | | | | | | | | | | | | | | |
| VERY DENSE, BROWN GRAVEL AND SAND , TRACE SILT, TRACE CLAY, MOIST. | | 29 | 50/1" | - | 0 | SS-14 | - | - | - | - | - | - | - | - | - | - | | |

[illegible]




B-015-9-13 – RC-1, RC-2, and RC-3 – Depth from 35.5 to 45.2 feet



B-015-9-13 – RC-4 and RC-5 – Depth from 45.2 to 55.2 feet



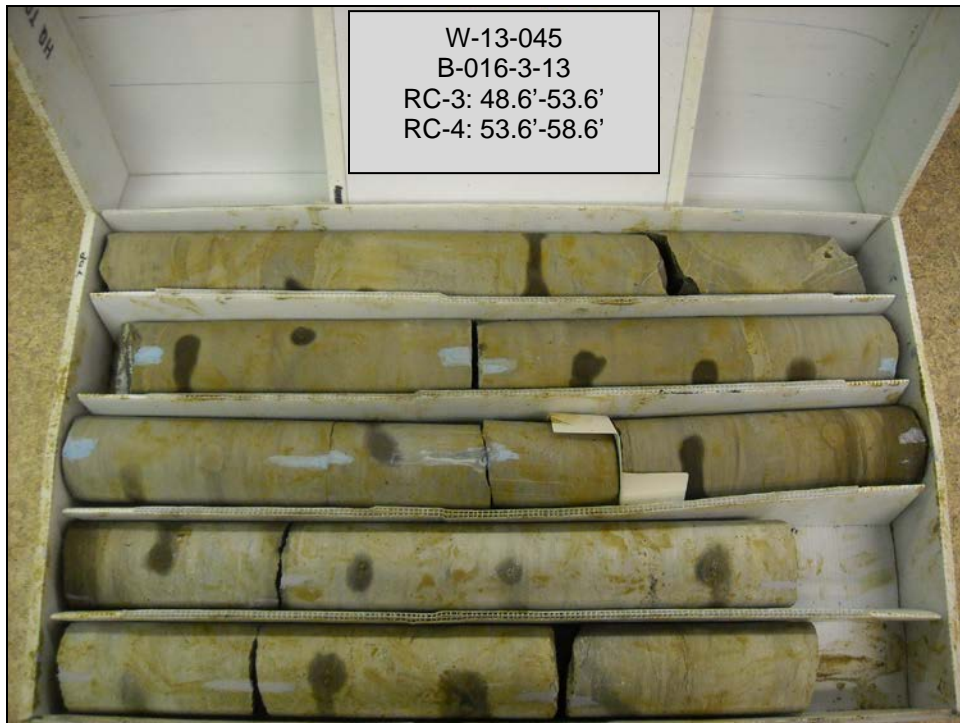
B-015-9-13 – RC-6 and RC-7 – Depth from 55.2 to 65.2 feet

| | | | | | |
|---|----------------------------------|--------------------------------------|---------------------------------|---|-------------------------------------|
|  | PROJECT: FRA-70-12.68 - PHASE 4A | DRILLING FIRM / OPERATOR: RII / T.F. | DRILL RIG: CME-750X (SN 310218) | STATION / OFFSET: 5058+05.01 / 33.7' LT | EXPLORATION ID B-016-3-13 |
| | TYPE: STRUCTURE | SAMPLING FIRM / LOGGER: RII / S.B. | HAMMER: CME AUTOMATIC | ALIGNMENT: BL RAMP C5 | |
| | PID: 77372 BR ID: FRA-70-1321A | DRILLING METHOD: 4.25" HSA / RC | CALIBRATION DATE: 4/26/13 | ELEVATION: 685.0 (MSL) EOB: 58.6 ft. | PAGE 1 OF 2 |
| | START: 4/30/14 END: 5/1/14 | SAMPLING METHOD: SPT / HQ | ENERGY RATIO (%): 86.8 | LAT / LONG: 39.951627935, -83.012227140 | |


| MATERIAL DESCRIPTION AND NOTES | ELEV. 685.0 | DEPTHS | SPT/ RQD | N ₆₀ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) | | | | | ATTERBERG | | | WC | ODOT CLASS (GI) | HOLE SEALED |
|---|----------------|--------|-------------|-----------------|------------|--------------|-------------|---------------|----|----|----|----|-----------|----|----|----|--------------------|----------------|
| | | | | | | | | GR | CS | FS | SI | CL | LL | PL | PI | | | |
| VERY LOOSE, BROWNISH GRAY GRAVEL , SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, WET. -BRICK FRAGMENTS PRESENT IN SS-1 | 683.5 | 1 | 3 2 | 4 | 67 | SS-1 | - | 66 | 16 | 8 | 7 | 3 | NP | NP | NP | 19 | A-1-a (0) | |
| SOFT, BROWNISH GRAY AND BLACK SANDY SILT , SOME FINE GRAVEL, LITTLE CLAY, MOIST TO WET. -ORGANIC ODOR PRESENT IN SS-3 -INTRODUCED MUD @ 4.2' | 680.5 | 2 | 1 2 | 4 | 50 | SS-2 | 0.50 | 24 | 13 | 21 | 27 | 15 | - | - | - | 19 | A-4a (V) | |
| LOOSE TO MEDIUM DENSE, GRAY GRAVEL AND SAND , LITTLE SILT, TRACE CLAY, MOIST TO WET. -ORGANIC ODOR PRESENT IN SS-5 | 674.5 | 3 | 3 5 | 12 | 50 | SS-3 | 0.50 | 24 | 13 | 20 | 28 | 15 | 27 | 18 | 9 | 24 | A-4a (2) | |
| | | 4 | 1 2 | 7 | 33 | SS-4 | - | 42 | 16 | 17 | 16 | 9 | - | - | - | 18 | A-1-b (V) | |
| | | 5 | 14 5 | 16 | 44 | SS-5 | - | 56 | 9 | 11 | 16 | 8 | 31 | 25 | 6 | 21 | A-1-b (0) | |
| | | 6 | 6 | | | | | | | | | | | | | | | |
| | | 7 | 5 6 | 19 | 56 | SS-6 | - | - | - | - | - | - | - | - | - | 22 | A-1-b (V) | |
| MEDIUM DENSE, GRAY GRAVEL , LITTLE COARSE TO FINE SAND, LITTLE SILT, TRACE CLAY, MOIST. | 672.0 | 8 | 5 6 | | | | | | | | | | | | | | | |
| | | 9 | 22 9 | 26 | 100 | SS-7 | - | 69 | 11 | 6 | 10 | 4 | NP | NP | NP | 11 | A-1-a (0) | |
| MEDIUM DENSE, GRAYISH BROWN SANDY SILT , LITTLE FINE GRAVEL, LITTLE CLAY, WET. | 669.5 | 10 | 5 2 | 12 | 100 | SS-8 | - | 12 | 19 | 20 | 38 | 11 | NP | NP | NP | 29 | A-4a (3) | |
| VERY DENSE, BROWN GRAVEL AND SAND , TRACE SILT, WET. | 668.3 | 11 | 6 | | | | | | | | | | | | | | | |
| VERY STIFF, GRAY SANDY SILT , LITTLE CLAY, TRACE FINE GRAVEL, DAMP. | 666.5 | 12 | 7 13 | 72 | 61 | SS-9 | 4.00 | - | - | - | - | - | - | - | - | 9 | A-1-b (V) | |
| VERY DENSE, BROWN GRAVEL , SOME COARSE TO FINE SAND, TRACE SILT, MOIST. -COBBLES ENCOUNTERED @ 18.7' | 664.5 | 13 | 37 | | | | | | | | | | | | | 12 | A-4a (V) | |
| MEDIUM DENSE TO DENSE, GRAY GRAVEL WITH SAND AND SILT , TRACE CLAY, MOIST. -HEAVING SAND ENCOUNTERED @ 23.7' | 659.0 | 14 | 50/5" | - | 100 | SS-10 | - | - | - | - | - | - | - | - | - | 9 | A-1-a (V) | |
| | | 15 | 10 12 | 41 | 33 | SS-11 | - | - | - | - | - | - | 21 | 15 | 6 | 11 | A-2-4 (V) | |
| | | 16 | 16 | | | | | | | | | | | | | | | |
| | | 17 | 14 8 | 22 | 33 | SS-12 | - | - | - | - | - | - | - | - | - | 10 | A-2-4 (V) | |
| VERY DENSE, GRAY GRAVEL , LITTLE COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST. -ROCK FRAGMENTS PRESENT IN SS-13 | | 18 | 7 | | | | | | | | | | | | | | | |
| | | 19 | 50/1" | - | 100 | SS-13 | - | - | - | - | - | - | - | - | - | 5 | A-1-a (V) | |
| | | 20 | | | | | | | | | | | | | | | | |
| | | 21 | | | | | | | | | | | | | | | | |
| | | 22 | | | | | | | | | | | | | | | | |
| | | 23 | | | | | | | | | | | | | | | | |
| | | 24 | | | | | | | | | | | | | | | | |
| | | 25 | | | | | | | | | | | | | | | | |
| | | 26 | | | | | | | | | | | | | | | | |
| | | 27 | | | | | | | | | | | | | | | | |
| | | 28 | | | | | | | | | | | | | | | | |
| | | 29 | | | | | | | | | | | | | | | | |



B-016-3-13 – RC-1 and RC-2 – Depth from 41.2 to 48.6 feet



B-016-3-13 – RC-3 and RC-4 – Depth from 48.6 to 58.6 feet

| | | | | | |
|---|----------------------------------|---|-------------------------------|---|-------------------------------------|
|  | PROJECT: FRA-70-12.68 - PHASE 4A | DRILLING FIRM / OPERATOR: RII / S.M./J.B. | DRILL RIG: CME-750 (SN 98048) | STATION / OFFSET: 5059+89.96 / 2.4' RT | EXPLORATION ID B-016-4-13 |
| | TYPE: STRUCTURE | SAMPLING FIRM / LOGGER: RII / K.R./A.D. | HAMMER: CME AUTOMATIC | ALIGNMENT: BL RAMP C5 | |
| | PID: 77372 BR ID: FRA-70-1321A | DRILLING METHOD: 3.25" HSA / RC | CALIBRATION DATE: 4/26/13 | ELEVATION: 705.0 (MSL) EOB: 61.5 ft. | PAGE 1 OF 3 |
| | START: 8/7/13 END: 8/22/13 | SAMPLING METHOD: SPT / NQ | ENERGY RATIO (%): 82.6 | LAT / LONG: 39.951803928, -83.011598406 | |

| MATERIAL DESCRIPTION AND NOTES | ELEV. 705.0 | 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 | | | |
| 1.0' - TOPSOIL (12.0") | 704.0 | | | | | | | | | | | | | | | | | |
| FILL: STIFF, BROWN AND DARK BROWN SILT AND CLAY, LITTLE COARSE TO FINE SAND, LITTLE FINE GRAVEL, MOIST. -BRICK AND COAL FRAGMENTS PRESENT IN SS-1 | 702.0 | | 4 | 10 | 58 | SS-1 | 1.75 | - | - | - | - | - | - | - | - | 16 | A-6a (V) | |
| FILL: MEDIUM DENSE, BROWN AND GRAY GRAVEL WITH SAND AND SILT, LITTLE CLAY, DAMP TO MOIST. -TRACE ROOT FIBERS AND BRICK FRAGMENTS PRESENT IN SS-3 | 697.0 | | 3 | 17 | 78 | SS-2 | - | 25 | 20 | 23 | 14 | 18 | 19 | 12 | 7 | 10 | A-2-4 (0) | |
| VERY SOFT TO MEDIUM STIFF, BROWN SILTY CLAY, TRACE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST. -TRACE ORGANICS PRESENT IN SS-4 | 691.0 | | 2 | 7 | 83 | SS-4 | 0.75 | 1 | 1 | 7 | 45 | 46 | 40 | 18 | 22 | 29 | A-6b (13) | |
| | | | WOH 1 | 3 | 100 | SS-5 | 0.75 | - | - | - | - | - | - | - | - | 30 | A-6b (V) | |
| MEDIUM DENSE, BROWN GRAVEL AND SAND, LITTLE SILT, TRACE CLAY, MOIST TO WET. | 677.0 | | | 96 | | ST-6 | 0.25 | - | - | - | - | - | - | - | - | 34 | A-6b (V) | |
| | | | | | | | - | - | - | - | - | - | - | - | - | 27 | A-1-b (V) | |
| -INTRODUCED MUD @ 18.5' | | | 7 | 22 | 33 | SS-7 | - | - | - | - | - | - | - | - | - | 19 | A-1-b (V) | |
| -COBBLES ENCOUNTERED @ 20.0' | | | 8 | | | | | | | | | | | | | | | |
| | | | 6 | 17 | 33 | SS-8 | - | - | - | - | - | - | - | - | - | 26 | A-1-b (V) | |
| | | | 6 | | | | | | | | | | | | | | | |
| | | | 4 | 12 | 61 | SS-9 | - | 64 | 12 | 6 | 12 | 6 | 22 | 22 | NP | 14 | A-1-b (0) | |
| | | | 5 | | | | | | | | | | | | | | | |
| | | | 4 | 12 | 33 | SS-10 | - | - | - | - | - | - | - | - | - | 22 | A-1-b (V) | |
| | | | 5 | | | | | | | | | | | | | | | |
| | | | 4 | 14 | 39 | SS-11 | - | - | - | - | - | - | - | - | - | 14 | A-1-b (V) | |
| | | | 4 | | | | | | | | | | | | | | | |
| MEDIUM DENSE, BROWN GRAVEL, SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST. -COBBLES ENCOUNTERED @ 30.0' | | | 13 | 29 | 100 | SS-12 | - | 55 | 23 | 9 | 3 | 10 | 23 | 18 | 5 | 17 | A-1-a (0) | |
| | | | 13 | | | | | | | | | | | | | | | |

[illegible]

2014 ODOT BORING LOG-RII NE BRIDGE ID - OH DOT GDT - 3/14/15 17:33 - U:\GIS\PROJECTS\2013\W-13-045.GPJ

| | | | | | | | | | | | | | | | | | | |
|--|---------------------|----------------------------------|---------------------------------------|---------------|--------------|-----------------|----------------------|-------------|---------------|--|--|--|--|-----------|--|--|--------------------|--------------|
| PID: 77372 | BR ID: FRA-70-1321A | PROJECT: FRA-70-12.68 - PHASE 4A | STATION / OFFSET: 5059+89.96 / 2.4 RT | START: 8/7/13 | END: 8/22/13 | PG 3 OF 3 | B-016-4-13 | | | | | | | | | | | |
| MATERIAL DESCRIPTION AND NOTES | | | ELEV. 642.9 | DEPTHS | SPT/ RQD | N ₆₀ | REC SAMPLE (%) ID | HP (tsf) | GRADATION (%) | | | | | ATTERBERG | | | ODOT CLASS (GI) | BACK FILL |
| -QU @ 59.8' = 12,760 PSI | | | | | | | | | | | | | | | | | | |
| NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 15.5' | | | | | | | | | | | | | | | | | | |
| ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 188 LBS CEMENT / 50 LBS BNTONITE POWDER / 50 GAL WATER | | | | | | | | | | | | | | | | | | |



B-016-4-13 – RC-1 – Depth from 35.5 to 40.5 feet



B-016-4-13 – RC-2, RC-3, and RC-4 – Depth from 45.5 to 56.5 feet



B-016-4-13 – RC-5 – Depth from 56.5 to 61.5 feet



PROJECT: FRA-70-12.68 - PHASE 4A
 TYPE: STRUCTURE
 PID: 77372 BR ID: FRA-70-1321A
 START: 8/9/13 END: 8/13/13

DRILLING FIRM / OPERATOR: RII / T.F.
 SAMPLING FIRM / LOGGER: RII / A.D.
 DRILLING METHOD: 4.25" HSA / RC
 SAMPLING METHOD: SPT / HQ

DRILL RIG: CME-750X (SN 310218)
 HAMMER: CME AUTOMATIC
 CALIBRATION DATE: 4/26/13
 ENERGY RATIO (%): 86.8

STATION / OFFSET: 5062+32.40 / 14' RT
 ALIGNMENT: BL RAMP C5
 ELEVATION: 740.1 (MSL) EOB: 94.9 ft.
 LAT / LONG: 39.952081479, -83.010812274

EXPLORATION ID
B-016-5-13

PAGE
 1 OF 4

| MATERIAL DESCRIPTION AND NOTES | ELEV. 740.1 | 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 | | | |
| 0.3' - ASPHALT (4.0") | 739.8 | | | | | | | | | | | | | | | | | |
| 0.5' - CONCRETE (6.0") | 739.3 | | | | | | | | | | | | | | | | | |
| 0.2' - AGGREGATE BASE (2.0") | 739.1 | | | | | | | | | | | | | | | | | |
| FILL: VERY STIFF, DARK BROWNISH GRAY TO DARK GRAYISH BROWN SILTY CLAY , SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, MOIST. | | 1 | 4 | 7 | 22 | 56 | SS-1 | 2.75 | - | - | - | - | - | - | - | 17 | A-6b (V) | |
| | | 2 | | 8 | | | | | | | | | | | | | | |
| | | 3 | | | | | | | | | | | | | | | | |
| | | 4 | 4 | 6 | 22 | 61 | SS-2 | 2.50 | 19 | 8 | 13 | 36 | 24 | 33 | 17 | 16 | A-6b (7) | |
| | | 5 | | 9 | | | | | | | | | | | | | | |
| | | 6 | 11 | 12 | 35 | 61 | SS-3 | 3.00 | - | - | - | - | - | - | - | 13 | A-6b (V) | |
| | | 7 | | 12 | | | | | | | | | | | | | | |
| | | 8 | | | | | | | | | | | | | | | | |
| | | 9 | 8 | 10 | 33 | 72 | SS-4 | 2.50 | - | - | - | - | - | - | - | 17 | A-6b (V) | |
| | 729.6 | 10 | | 13 | | | | | | | | | | | | | | |
| FILL: MEDIUM DENSE TO DENSE, DARK BROWN GRAVEL WITH SAND, SILT, AND CLAY , MOIST. | | 11 | 8 | 10 | 30 | 78 | SS-5 | - | 28 | 16 | 24 | 4 | 28 | 40 | 19 | 21 | A-2-6 (2) | |
| | | 12 | | 11 | | | | | | | | | | | | | | |
| | | 13 | | | | | | | | | | | | | | | | |
| | | 14 | 5 | 8 | 27 | 83 | SS-6 | - | - | - | - | - | - | - | - | 15 | A-2-6 (V) | |
| | | 15 | | 11 | | | | | | | | | | | | | | |
| | | 16 | | | | | | | | | | | | | | | | |
| | | 17 | 9 | 9 | 33 | 78 | SS-7 | - | - | - | - | - | - | - | - | 20 | A-2-6 (V) | |
| | | 18 | | 14 | | | | | | | | | | | | | | |
| | 722.1 | 19 | 4 | 6 | 13 | 56 | SS-8 | 1.50 | 27 | 18 | 19 | 22 | 14 | 28 | 18 | 10 | A-4a (0) | |
| | | 20 | | 3 | | | | | | | | | | | | | | |
| FILL: STIFF, DARK BROWN SANDY SILT , SOME FINE GRAVEL, LITTLE SILT, DAMP. -COBBLES ENCOUNTERED @ 18.5' -SLAG FRAGMENTS PRESENT IN SS-8 -BRICK AND CONCRETE FRAGMENTS PRESENT IN SS-9 | | 21 | 2 | 4 | 19 | 61 | SS-9 | - | - | - | - | - | - | - | - | 14 | A-4a (V) | |
| | | 22 | | 9 | | | | | | | | | | | | | | |
| | 717.1 | 23 | | | | | | | | | | | | | | | | |
| | | 24 | 18 | 9 | 27 | 39 | SS-10 | - | - | - | - | - | - | - | - | 8 | A-2-4 (V) | |
| | | 25 | | 10 | | | | | | | | | | | | | | |
| | | 26 | 7 | 4 | 13 | 72 | SS-11 | - | 40 | 20 | 13 | 18 | 9 | 26 | 19 | 7 | A-2-4 (0) | |
| | | 27 | | 5 | | | | | | | | | | | | | | |
| | 712.1 | 28 | | | | | | | | | | | | | | | | |
| | | 29 | 7 | 4 | 13 | 72 | SS-12 | - | - | - | - | - | - | - | - | 28 | A-2-6 (V) | |
| | | | | 5 | | | | | | | | | | | | | | |
| MEDIUM DENSE, BROWN GRAVEL WITH SAND, SILT, AND CLAY , WET. | | | | | | | | | | | | | | | | | | |


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2014 ODOT BORING LOG-RII NE BRIDGE ID - OH DOT GDT - 3/14/15 17:34 - U:\GIS\PROJECTS\2013\W-13-045.GPJ

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|---|--|---------------------|--|----------------------------------|--------|--------------------------------------|-----------------|------------|--------------|---------------|---------------|--------------|----|-----------|----|------------|----|----|----|--------------------|--------------|--|--|
| PID: 77372 | | BR ID: FRA-70-1321A | | PROJECT: FRA-70-12.68 - PHASE 4A | | STATION / OFFSET: 5062+32.40 / 14 RT | | | | START: 8/9/13 | | END: 8/13/13 | | PG 4 OF 4 | | B-016-5-13 | | | | | | | |
| MATERIAL DESCRIPTION AND NOTES | | | | ELEV. | DEPTHS | SPT/ RQD | N ₆₀ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) | | | | | ATTERBERG | | | WC | ODOT CLASS (GI) | BACK FILL | | |
| | | | | 645.8 | | | | | | | GR | CS | FS | SI | CL | LL | PL | PI | | | | | |
| | | | | 645.2 | EOB | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 48.5' | | | | | | | | | | | | | | | | | | | | | | | |
| ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 188 LBS CEMENT / 50 LBS BENTONITE POWDER / 50 GAL WATER | | | | | | | | | | | | | | | | | | | | | | | |



B-016-5-13 – RC-1, RC-2, and RC-3 – Depth from 84.9 to 94.9 feet

| | | | | | |
|---|----------------------------------|--------------------------------------|-------------------------------|---|--|
|  | PROJECT: FRA-70-13.10 - PHASE 6A | DRILLING FIRM / OPERATOR: RII / J.B. | DRILL RIG: CME-750 (SN 98048) | STATION / OFFSET: 3052+85.29 / 31.4' LT | EXPLORATION ID B-016-7-13 |
| | TYPE: STRUCTURE | SAMPLING FIRM / LOGGER: RII / C.V. | HAMMER: CME AUTOMATIC | ALIGNMENT: BL RAMP D3 | |
| | PID: 89464 BR ID: N/A | DRILLING METHOD: 4.25" HSA | CALIBRATION DATE: 4/26/13 | ELEVATION: 714.9 (MSL) EOB: 48.7 ft. | PAGE 1 OF 2 |
| | START: 1/14/14 END: 1/15/14 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 82.6 | LAT / LONG: 39.953121, -83.010293 | |

| MATERIAL DESCRIPTION AND NOTES | ELEV. | DEPTHS | SPT/ RQD | N ₆₀ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) | | | | | ATTERBERG | | | WC | ODOT CLASS (GI) | BACK FILL |
|---|-------|--------|-------------|-----------------|------------|--------------|-------------|---------------|----|----|----|----|-----------|----|----|----|--------------------|--------------|
| | | | | | | | | GR | CS | FS | SI | CL | LL | PL | PI | | | |
| 0.3' - TOPSOIL (3.0") FILL: MEDIUM DENSE, DARK BROWN AND BLACK GRAVEL WITH SAND, SILT, AND CLAY , MOIST TO WET. -ROOT FIBERS PRESENT IN SS-1 -COBBLES ENCOUNTERED @ 2.5' -CONCRETE AND LIMESTONE FRAGMENTS PRESENT THROUGHOUT | 714.9 | | | | | | | | | | | | | | | | | |
| | 714.6 | 1 | 8 | | | | | | | | | | | | | | | |
| | | 2 | 6 | 19 | 33 | SS-1 | - | - | - | - | - | - | - | - | - | 21 | A-2-6 (V) | |
| | | 3 | | | | | | | | | | | | | | | | |
| | | 4 | 6 | 17 | 50 | SS-2 | - | 55 | 9 | 7 | 15 | 14 | 35 | 19 | 16 | 10 | A-2-6 (1) | |
| | 709.4 | 5 | 7 | 5 | | | | | | | | | | | | | | |
| FILL: VERY STIFF, BROWN SILTY CLAY , LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST. -STONE FRAGMENTS PRESENT IN SS-3 | | 6 | 4 | 12 | 56 | SS-3 | 2.75 | - | - | - | - | - | - | - | - | 17 | A-6b (V) | |
| | 706.9 | 7 | 4 | 5 | | | | | | | | | | | | | | |
| FILL: DENSE, GRAY GRAVEL WITH SAND AND SILT , TRACE CLAY, DAMP. -COBBLES ENCOUNTERED @ 8.0' -LIMESTONE FRAGMENTS PRESENT THROUGHOUT -ROOT FIBERS PRESENT IN SS-5 | | 8 | | | | | | | | | | | | | | | | |
| | | 9 | 8 | 45 | 33 | SS-4 | - | - | - | - | - | - | - | - | - | 5 | A-2-4 (V) | |
| | | 10 | 18 | 15 | | | | | | | | | | | | | | |
| | | 11 | 18 | 37 | 44 | SS-5 | - | 64 | 14 | 7 | 10 | 5 | 30 | 22 | 8 | 6 | A-2-4 (0) | |
| | 701.9 | 12 | 17 | 10 | | | | | | | | | | | | | | |
| FILL: STIFF TO VERY STIFF, DARK BROWN TO DARK BROWNISH GRAY SILT AND CLAY , LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST. -ROOT FIBERS AND BRICK FRAGMENTS PRESENT IN SS-6 | | 13 | 5 | 19 | 61 | SS-6 | 2.50 | - | - | - | - | - | - | - | - | 17 | A-6a (V) | |
| | | 14 | 7 | 7 | | | | | | | | | | | | | | |
| | | 15 | | | | | | | | | | | | | | | | |
| | | 16 | 4 | 12 | 78 | SS-7 | 1.75 | - | - | - | - | - | - | - | - | 23 | A-6a (V) | |
| | 697.4 | 17 | 5 | 4 | | | | | | | | | | | | | | |
| STIFF, DARK BROWN AND BLACK SILTY CLAY , LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST. -QU @ 17.9' = 1.29 TSF | | 18 | | | 88 | ST-8 | 2.00 | 1 | 2 | 18 | 40 | 39 | 40 | 21 | 19 | 31 | A-6b (12) | |
| | | 19 | | | | | | | | | | | | | | | | |
| | | 20 | | | | | | | | | | | | | | | | |
| | | 21 | | | | | | | | | | | | | | | | |
| | 692.9 | 22 | | | | | | | | | | | | | | | | |
| VERY LOOSE, DARK GRAY GRAVEL WITH SAND AND SILT , LITTLE CLAY, WET. | | 23 | | | | | | | | | | | | | | | | |
| | | 24 | WOH 2 | 4 | 100 | SS-9 | - | 3 | 24 | 39 | 20 | 14 | 29 | 21 | 8 | 40 | A-2-4 (0) | |
| | | 25 | 1 | | | | | | | | | | | | | | | |
| | | 26 | | | | | | | | | | | | | | | | |
| | 687.9 | 27 | | | | | | | | | | | | | | | | |
| VERY DENSE, GRAY GRAVEL WITH SAND , TRACE SILT, TRACE CLAY, MOIST. -COBBLES ENCOUNTERED @ 27.0' -ROCK FRAGMENTS PRESENT IN SS-10 | | 28 | | | | | | | | | | | | | | | | |
| | | 29 | 11 | 37 | 80 | 36 | SS-10 | - | - | - | - | - | - | - | - | 10 | A-1-b (V) | |
| | | | 21 | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|------------|----------------------------------|--|-------|----------|-----------------|---------|----------------|----------|---------------|----|-----------|----|------------|-----------|----|----|----|-----------------|-----------|
| PID: 89464 | BR ID: N/A | PROJECT: FRA-70-13.10 - PHASE 6A | STATION / OFFSET: 3052+85.29 / 31.4 LT | | | | | START: 1/14/14 | | END: 1/15/14 | | PG 2 OF 2 | | B-016-7-13 | | | | | | |
| MATERIAL DESCRIPTION AND NOTES | | ELEV. | DEPTHS | | SPT/ RQD | N ₆₀ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) | | | | | ATTERBERG | | | WC | ODOT CLASS (GI) | BACK FILL |
| | | | | | | | | | | GR | CS | FS | SI | CL | LL | PL | PI | | | |
| VERY DENSE, GRAY GRAVEL WITH SAND , TRACE SILT, TRACE CLAY, MOIST. <i>(same as above)</i> | | 684.9 | | 31 | | | | | | | | | | | | | | | | |
| HARD, GRAY SILT AND CLAY , LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, DRY. | | 677.9 | | 32 | | | | | | | | | | | | | | | | |
| -ROCK FRAGMENTS PRESENT IN SS-11 | | | | 33 | | | | | | | | | | | | | | | | |
| | | | | 34 | 20 | | | | | | | | | | | | | | | |
| | | | | 35 | 21 | 58 | 94 | SS-11 | 4.5+ | - | - | - | - | - | - | - | - | 9 | A-6a (V) | |
| | | | | 36 | | | | | | | | | | | | | | | | |
| VERY DENSE, GRAY GRAVEL WITH SAND , TRACE SILT, TRACE CLAY, WET. | | 672.9 | | 37 | | | | | | | | | | | | | | | | |
| -INTORDUCED MUD @ 37.0' | | | | 38 | | | | | | | | | | | | | | | | |
| -ROCK FRAGMENTS PRESENT IN SS-12 | | | | 39 | 7 | | | | | | | | | | | | | | | |
| | | | | 40 | 14 | 54 | 61 | SS-12 | - | 26 | 31 | 25 | 10 | 8 | NP | NP | NP | 23 | A-1-b (0) | |
| | | | | 41 | | | | | | | | | | | | | | | | |
| -COBBLES ENCOUNTERED @ 41.0' | | 667.9 | | 42 | | | | | | | | | | | | | | | | |
| HARD, GRAY SILT AND CLAY , LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, DAMP. | | | | 43 | | | | | | | | | | | | | | | | |
| -ROCK FRAGMENTS PRESENT IN SS-13 | | | | 44 | 3 | | | | | | | | | | | | | | | |
| | | | | 45 | 35 | 78 | 89 | SS-13 | 4.5+ | - | - | - | - | - | - | - | - | 16 | A-6a (V) | |
| | | | | 46 | | | | | | | | | | | | | | | | |
| VERY DENSE, GRAYISH BROWN GRAVEL WITH SAND , LITTLE SILT, TRACE CLAY, MOIST. | | 666.2 | | 47 | | | | | | | | | | | | | | | | |
| | | | | 48 | | | | | | | | | | | | | | | | |
| | | | EOB | 60/2" | - | 100 | SS-14 | - | - | - | - | - | - | - | - | - | - | 11 | A-1-b (V) | |
| NOTES: GROUNDWATER ENCOUNTERED INITIALLY @ 19.0'; CAVE-IN DEPTH @ 35.0' | | | | | | | | | | | | | | | | | | | | |
| ABANDONMENT METHODS, MATERIALS, QUANTITIES: COMPACTED WITH THE AUGER 50 LBS BENTONITE CHIPS AND SOIL CUTTINGS | | | | | | | | | | | | | | | | | | | | |



PROJECT: FRA-70-13.10 - PHASE 6A
 TYPE: STRUCTURE
 PID: 89464 BR ID: FRA-70-1323C
 START: 12/7/20 END: 12/7/20

DRILLING FIRM / OPERATOR: RII / S.B.
 SAMPLING FIRM / LOGGER: RII / K.S.
 DRILLING METHOD: 3.25" HSA
 SAMPLING METHOD: SPT

DRILL RIG: CME-750X SN 310218
 HAMMER: CME AUTOMATIC
 CALIBRATION DATE: 9/14/20
 ENERGY RATIO (%): 86.2

STATION / OFFSET: 3053+93.67 / 12.3' LT
 ALIGNMENT: BL RAMP D3
 ELEVATION: 751.0 (MSL) EOB: 60.0 ft.
 LAT / LONG: 39.953168, -83.009903

EXPLORATION ID
B-019-5-19


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) | BACK FILL |
|---|-------|--------|-------------|-----------------|------------|--------------|-------------|---------------|----|----|----|----|-----------|----|----|----|--------------------|--------------|
| | | | | | | | | GR | CS | FS | SI | CL | LL | PL | PI | | | |
| 0.3' - ASPHALT (3.0") | 751.0 | | | | | | | | | | | | | | | | | |
| 0.9' - CONCRETE (11.0") | 750.7 | | | | | | | | | | | | | | | | | |
| FILL: HARD, BROWN SILTY CLAY , "AND" FINE GRAVEL, LITTLE FINE TO COARSE SAND, DAMP. -ROCK FRAGMENTS PRESENT IN SS-1 | 749.8 | 1 | 7 | 37 | 67 | SS-1 | 4.50 | - | - | - | - | - | - | - | - | 14 | A-6b (V) | |
| | | 2 | 9 | | | | | | | | | | | | | | | |
| | | 3 | 17 | | | | | | | | | | | | | | | |
| | | 4 | 4 | 27 | 61 | SS-2 | 4.50 | 37 | 12 | 5 | 23 | 23 | 39 | 17 | 22 | 14 | A-6b (6) | |
| | | 5 | 7 | | | | | | | | | | | | | | | |
| | 745.5 | 6 | 12 | | | | | | | | | | | | | | | |
| FILL: MEDIUM DENSE, GRAY GRAVEL WITH SAND , LITTLE SILT, TRACE CLAY, DAMP. | | 7 | 9 | 23 | 50 | SS-3 | - | - | - | - | - | - | - | - | - | 4 | A-1-b (V) | |
| | | 8 | 6 | | | | | | | | | | | | | | | |
| | 743.0 | 9 | 10 | | | | | | | | | | | | | | | |
| FILL: HARD, DARK GRAY TO BROWN SILTY CLAY , SOME FINE GRAVEL, LITTLE COARSE TO FINE SAND, MOIST. -ROCK FRAGMENTS PRESENT IN SS-4 | | 10 | 7 | - | 81 | SS-4 | 4.50 | - | - | - | - | - | - | - | - | 18 | A-6b (V) | |
| | | 11 | 11 | | | | | | | | | | | | | | | |
| | 740.5 | 12 | 50/4" | | | | | | | | | | | | | | | |
| FILL: VERY DENSE, LIGHT BROWN TO GRAY GRAVEL WITH SAND , LITTLE SILT, TRACE CLAY, DAMP. | | 13 | 26 | - | 100 | SS-5 | - | 52 | 19 | 10 | 11 | 8 | 29 | 23 | 6 | 9 | A-1-b (0) | |
| | | 14 | 48 | | | | | | | | | | | | | | | |
| | | 15 | 50/2" | | | | | | | | | | | | | | | |
| -COBBLES @ 13.5' | | 16 | | - | 100 | SS-6 | - | - | - | - | - | - | - | - | - | 5 | A-1-b (V) | |
| | | 17 | 50/3" | | | | | | | | | | | | | | | |
| -ROCK FRAGMENTS PRESENT THROUGHOUT | | 18 | | - | 100 | SS-7 | - | - | - | - | - | - | - | - | - | 9 | A-1-b (V) | |
| | | 19 | 50/5" | | | | | | | | | | | | | | | |
| | 733.5 | 20 | | - | 100 | SS-8 | 4.00 | - | - | - | - | - | - | - | - | 17 | A-6a (V) | |
| FILL: VERY STIFF, BROWN SILT AND CLAY , SOME FINE GRAVEL, LITTLE COARSE TO FINE SAND, MOIST. -ROCK FRAGMENTS PRESENT IN SS-8 | | 21 | 3 | 17 | 83 | | | | | | | | | | | | | |
| | | 22 | 5 | | | | | | | | | | | | | | | |
| | | 23 | 7 | | | | | | | | | | | | | | | |
| | | 24 | 6 | 22 | 33 | SS-9 | 2.50 | - | - | - | - | - | - | - | - | 15 | A-6a (V) | |
| | | 25 | 7 | | | | | | | | | | | | | | | |
| | | 26 | 8 | | | | | | | | | | | | | | | |
| | 724.0 | 27 | | | | | | | | | | | | | | | | |
| FILL: HARD, BROWN CLAY , SOME SILT, TRACE COARSE TO FINE SAND, MOIST. | | 28 | | | | | | | | | | | | | | | | |
| | | 29 | 3 | 17 | 67 | SS-10 | 4.50 | 0 | 3 | 5 | 24 | 68 | 46 | 23 | 23 | 24 | A-7-6 (14) | |
| | | | 5 | | | | | | | | | | | | | | | |
| | | | 7 | | | | | | | | | | | | | | | |

[illegible]

NOTES: GROUNDWATER ENCOUNTERED INITIALLY @ 48.5' AND AT COMPLETION @ 57.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: COMPACTED WITH THE AUGER 50 LBS BENTONITE CHIPS AND SOIL CUTTINGS. PAVEMENT PATCHED WITH ASPHALT COLD PATCH.

| | | | | | |
|---|----------------------------------|--------------------------------------|-------------------------------|--|-------------------------------------|
|  | PROJECT: FRA-70-13.10 - PHASE 6A | DRILLING FIRM / OPERATOR: RII / J.K. | DRILL RIG: CME-55 (SN 386345) | STATION / OFFSET: 249+37.84 / 28.1' RT | EXPLORATION ID B-113-4-13 |
| | TYPE: STRUCTURE | SAMPLING FIRM / LOGGER: RII / S.B. | HAMMER: AUTOMATIC | ALIGNMENT: BL I-71 SB | |
| | PID: 89464 BR ID: FRA-71-1503L | DRILLING METHOD: 3.25" HSA / NQ | CALIBRATION DATE: 10/20/14 | ELEVATION: 725.2 (MSL) EOB: 88.3 ft. | PAGE 1 OF 3 |
| | START: 5/29/14 END: 6/3/14 | SAMPLING METHOD: SPT / RC | ENERGY RATIO (%): 92 | LAT / LONG: 39.952170, -83.013979 | |

| MATERIAL DESCRIPTION AND NOTES | ELEV. 725.2 | DEPTHS | SPT/ RQD | N ₆₀ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) | | | | | ATTERBERG | | | WC | ODOT CLASS (GI) | HOLE SEALED |
|---|----------------|--------|-------------|-----------------|------------|--------------|-------------|---------------|----|----|----|----|-----------|----|----|----|--------------------|----------------|
| | | | | | | | | GR | CS | FS | SI | CL | LL | PL | PI | | | |
| 0.5' - TOPSOIL (6.0") | 724.7 | | | | | | | | | | | | | | | | | |
| POSSIBLE FILL: VERY STIFF TO HARD, DARK BROWN SILT AND CLAY , SOME COARSE TO FINE SAND, SOME FINE GRAVEL, DAMP. | | 1 | 6 | | | | | | | | | | | | | | | |
| | | 2 | 11 | 26 | 78 | SS-1 | 4.50 | - | - | - | - | - | - | - | - | 15 | A-6a (V) | |
| | | 3 | | | | | | | | | | | | | | | | |
| -ROCK, COAL AND BRICK FRAGMENTS PRESENT THROUGHOUT | | 4 | 2 | | | | | | | | | | | | | | | |
| | | 5 | 6 | 18 | 61 | SS-2 | 2.75 | 32 | 14 | 13 | 21 | 20 | 35 | 20 | 15 | 12 | A-6a (3) | |
| | 719.7 | 6 | | | | | | | | | | | | | | | | |
| DENSE, BROWN GRAVEL WITH SAND , TRACE SILT, TRACE CLAY, DAMP. | | 7 | 11 | | | | | | | | | | | | | | | |
| | | 8 | 6 | 20 | 44 | SS-3 | - | - | - | - | - | - | - | - | - | 5 | A-1-b (V) | |
| | | 9 | | | | | | | | | | | | | | | | |
| -ROCK FRAGMENTS PRESENT THROUGHOUT | | 10 | 6 | | | | | | | | | | | | | | | |
| | | 11 | 3 | | | | | | | | | | | | | | | |
| VERY STIFF, BROWN SILT AND CLAY , SOME COARSE TO FINE SAND, SOME FINE GRAVEL, DAMP. | | 12 | 3 | 14 | 67 | SS-5 | 2.50 | 25 | 14 | 14 | 27 | 20 | 28 | 17 | 11 | 16 | A-6a (3) | |
| | 712.2 | 13 | | | | | | | | | | | | | | | | |
| LOOSE, BROWN GRAVEL WITH SAND, SILT, AND CLAY , MOIST. | | 14 | 5 | | | | | | | | | | | | | | | |
| | | 15 | 4 | 11 | 83 | SS-6 | - | 54 | 13 | 7 | 15 | 11 | 30 | 18 | 12 | 13 | A-2-6 (0) | |
| | 709.7 | 16 | | | | | | | | | | | | | | | | |
| LOOSE, BROWN GRAVEL WITH SAND , TRACE SILT, TRACE CLAY, DAMP. | | 17 | 8 | | | | | | | | | | | | | | | |
| | | 18 | 4 | 11 | 56 | SS-7 | - | - | - | - | - | - | - | - | - | 4 | A-1-b (V) | |
| | 707.9 | 19 | | | | | 1.50 | - | - | - | - | - | - | - | - | 16 | A-4a (V) | |
| MEDIUM STIFF TO STIFF, DARK BROWN SANDY SILT , LITTLE CLAY, TRACE FINE GRAVEL, MOIST. | | 20 | 2 | 6 | 72 | SS-8 | 1.00 | 6 | 13 | 20 | 41 | 20 | 32 | 24 | 8 | 23 | A-4a (5) | |
| -TRACE ORGANICS PRESENT THROUGHOUT | | 21 | | | | | | | | | | | | | | | | |
| | 704.7 | 22 | 11 | | | | | | | | | | | | | | | |
| MEDIUM DENSE TO VERY DENSE, BROWN GRAVEL WITH SAND , LITTLE SILT, TRACE CLAY, MOIST. | | 23 | 8 | 30 | 0 | SS-9 | - | - | - | - | - | - | - | - | - | - | | |
| | | 24 | 12 | | 67 | 2S-9A | - | - | - | - | - | - | - | - | - | 8 | A-1-b (V) | |
| -COBBLES PRESENT THROUGHOUT | | 25 | 15 | | 80 | SS-10 | - | 57 | 18 | 6 | 13 | 6 | 23 | 18 | 5 | 8 | A-1-b (0) | |
| | | 26 | 17 | | | | | | | | | | | | | | | |
| -BOULDER PRESENT FROM 25.0' TO 25.5' | | 27 | 50/3" | | | | | | | | | | | | | | | |
| | 699.7 | 28 | | | | | | | | | | | | | | | | |
| VERY DENSE, GRAY GRAVEL , SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, DAMP. | | 29 | 33 | | 100 | SS-11 | - | - | - | - | - | - | - | - | - | - | A-1-a (V) | |
| | | 30 | | | | | | | | | | | | | | | | |
| | | 31 | | | | | | | | | | | | | | | | |
| | | 32 | | | | | | | | | | | | | | | | |
| | | 33 | 25 | 71 | 100 | SS-12 | - | 63 | 17 | 7 | 9 | 4 | NP | NP | NP | 4 | A-1-a (0) | |

[illegible]

[illegible]


ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER



B-113-4-13 – RC-1 and RC-2 – Depth from 73.3 to 83.3 feet



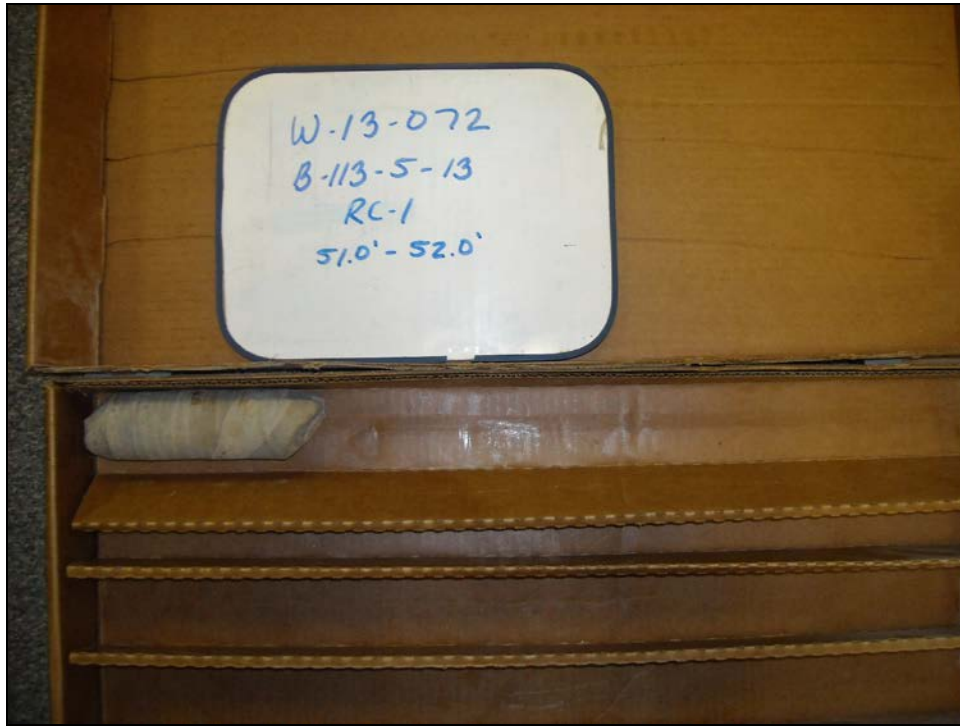
B-113-4-13 – RC-3 – Depth from 83.3 to 88.3 feet

| | | | | | |
|---|----------------------------------|--------------------------------------|------------------------------------|--|-------------------------------------|
|  | PROJECT: FRA-70-13.10 - PHASE 6A | DRILLING FIRM / OPERATOR: RII / J.K. | DRILL RIG: MOBILE B-53 (SN 624400) | STATION / OFFSET: 250+13.44 / 36.0' RT | EXPLORATION ID B-113-5-13 |
| | TYPE: STRUCTURE | SAMPLING FIRM / LOGGER: RII / S.B. | HAMMER: AUTOMATIC | ALIGNMENT: BL I-71 SB | |
| | PID: 89464 BR ID: FRA-71-1503L | DRILLING METHOD: 3.25" HSA / NQ | CALIBRATION DATE: 4/26/13 | ELEVATION: 725.7 (MSL) EOB: 85.7 ft. | PAGE 1 OF 3 |
| | START: 5/27/14 END: 5/28/14 | SAMPLING METHOD: SPT / RC | ENERGY RATIO (%): 77.7 | LAT / LONG: 39.952236, -83.013729 | |

| MATERIAL DESCRIPTION AND NOTES | ELEV. 725.7 | 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 | | | |
| 0.5' - TOPSOIL (6.0") | 725.2 | | | | | | | | | | | | | | | | | |
| FILL: HARD, DARK BROWN SILT AND CLAY , SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, DRY TO DAMP. -BRICK FRAGMENTS PRESENT THROUGHOUT | | 1 | 8 | | | | | | | | | | | | | | | |
| | | 2 | 9 | 25 | 44 | SS-1 | 4.25 | 20 | 13 | 14 | 30 | 23 | 33 | 19 | 14 | 14 | A-6a (5) | |
| | | 3 | 10 | | | | | | | | | | | | | | | |
| | | 4 | 8 | 7 | 17 | 67 | SS-2 | 4.25 | - | - | - | - | - | - | - | 11 | A-6a (V) | |
| | 720.2 | 5 | 6 | | | | | | | | | | | | | | | |
| FILL: LOOSE TO MEDIUM DENSE, BROWN TO DARK BROWN GRAVEL WITH SAND , LITTLE SILT, LITTLE CLAY, MOIST. -ROCK FRAGMENTS PRESENT IN SS-3 | | 6 | 7 | | | | | | | | | | | | | | | |
| | | 7 | 3 | 13 | 44 | SS-3 | - | 39 | 12 | 24 | 13 | 12 | 22 | 16 | 6 | 11 | A-1-b (0) | |
| | | 8 | | | | | | | | | | | | | | | | |
| | | 9 | 3 | 9 | 39 | SS-4 | - | - | - | - | - | - | - | - | - | 13 | A-1-b (V) | |
| | 715.2 | 10 | 4 | | | | | | | | | | | | | | | |
| MEDIUM DENSE, DARK BROWN TO GRAY GRAVEL , TRACE COARSE TO FINE SAND, TRACE SILT, DAMP TO MOIST. | | 11 | 7 | | | | | | | | | | | | | | | |
| | | 12 | 9 | 23 | 33 | SS-5 | - | - | - | - | - | - | - | - | - | 8 | A-1-a (V) | |
| | | 13 | | | | | | | | | | | | | | | | |
| | | 14 | 9 | 8 | 21 | 0 | SS-6 | - | - | - | - | - | - | - | - | - | | |
| | 707.7 | 15 | 5 | - | 83 | 2S-6A | - | - | - | - | - | - | - | - | - | 5 | A-1-a (V) | |
| | | 16 | 14 | | | | | | | | | | | | | | | |
| | | 17 | 11 | 23 | 33 | SS-7 | - | - | - | - | - | - | - | - | - | 3 | A-1-a (V) | |
| | | 18 | 7 | | | | | | | | | | | | | | | |
| MEDIUM DENSE, BROWN GRAVEL WITH SAND , TRACE SILT, TRACE CLAY, DAMP. -ROCK FRAGMENTS PRESENT IN 2S-8A | 705.2 | 19 | 10 | | | | | | | | | | | | | | | |
| | | 20 | 11 | 30 | 0 | SS-8 | - | - | - | - | - | - | - | - | - | - | | |
| | 702.7 | 21 | 9 | - | 100 | 2S-8A | - | 63 | 15 | 6 | 9 | 7 | 23 | 17 | 6 | 6 | A-1-b (0) | |
| | | 22 | 7 | 22 | 94 | SS-9 | 3.00 | - | - | - | - | - | - | - | - | 11 | A-6a (V) | |
| | | 23 | 8 | | | | | | | | | | | | | | | |
| | | 24 | 6 | 13 | 0 | SS-10 | - | - | - | - | - | - | - | - | - | - | | |
| | | 25 | 5 | | | | | | | | | | | | | | | |
| | | 26 | 6 | - | 0 | 2S-10A | - | - | - | - | - | - | - | - | - | - | | |
| | | 27 | 6 | 26 | 44 | SS-11 | - | - | - | - | - | - | - | - | - | 9 | A-1-a (V) | |
| | | 28 | 8 | | | | | | | | | | | | | | | |
| | | 29 | 12 | | | | | | | | | | | | | | | |
| | | 30 | 9 | 58 | 89 | SS-12 | - | 64 | 16 | 5 | 10 | 5 | 22 | 16 | 6 | 6 | A-1-a (0) | |
| -COBBLES PRESENT THROUGHOUT | | | 15 | | | | | | | | | | | | | | | |

[illegible]

[illegible]



B-113-5-13 – RC-1 – Depth from 51.0 to 52.0 feet



B-113-5-13 – RC-2, RC-3, and RC-4 – Depth from 52.0 to 80.7 feet



B-113-5-13 – RC-5 - Depth from 80.7 to 85.7 feet



PROJECT: FRA-70-13.10 - PHASE 6A
 TYPE: STRUCTURE
 PID: 89464 BR ID: FRA-71-1503L
 START: 4/23/14 END: 4/23/14

DRILLING FIRM / OPERATOR: RII / T.F.
 SAMPLING FIRM / LOGGER: RII / S.B.
 DRILLING METHOD: 4.25" HSA / HQ
 SAMPLING METHOD: SPT / RC

DRILL RIG: CME-750X (SN 310218)
 HAMMER: CME AUTOMATIC
 CALIBRATION DATE: 4/26/13
 ENERGY RATIO (%): 86.8

STATION / OFFSET: 251+93.56 / 37.3' RT
 ALIGNMENT: BL I-71 SB
 ELEVATION: 691.5 (MSL) EOB: 63.7 ft.
 LAT / LONG: 39.952409, -83.013137

EXPLORATION ID
B-113-6-13

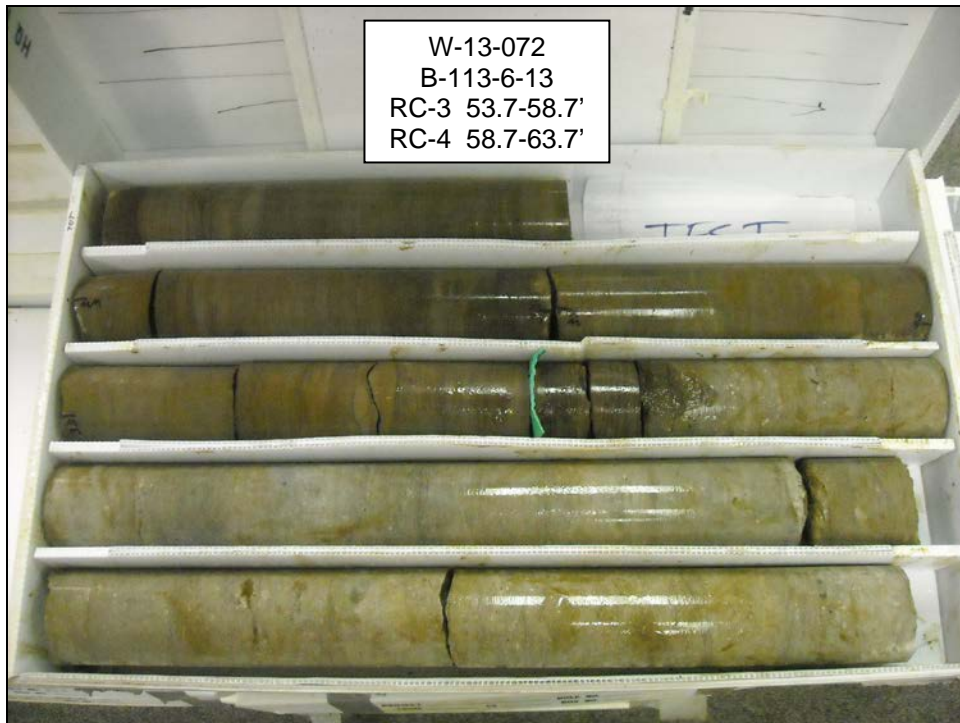
PAGE
 1 OF 3

| MATERIAL DESCRIPTION AND NOTES | ELEV. 691.5 | DEPTHS | SPT/ RQD | N ₆₀ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) | | | | | ATTERBERG | | | WC | ODOT CLASS (GI) | HOLE SEALED |
|---|----------------|--------|-------------|-----------------|------------|--------------|-------------|---------------|----|----|----|----|-----------|----|-----------|----|--------------------|----------------|
| | | | | | | | | GR | CS | FS | SI | CL | LL | PL | PI | | | |
| VERY LOOSE TO LOOSE, BLACK TO BROWN AND GRAY GRAVEL WITH SAND, SILT, AND CLAY , MOIST. -ORGANICS AND PLANT MATERIAL PRESENT IN SS-1 | 691.5 | 1 | 1 | 4 | 33 | SS-1 | - | 42 | 17 | 18 | 14 | 9 | - | - | - | 26 | A-2-6 (V) | |
| | | | 2 | 6 | 56 | SS-2 | 1.50 | 45 | 12 | 11 | 19 | 13 | 31 | 19 | 12 | 17 | A-2-6 (0) | |
| | | | 2 | 6 | 61 | SS-3 | 1.50 | 43 | 14 | 11 | 19 | 13 | 32 | 19 | 13 | 18 | A-2-6 (1) | |
| | | | 2 | 7 | 0 | SS-4 | - | - | - | - | - | - | - | - | - | - | | |
| | | | 6 | - | 100 | 3S-4A | 2.00 | 53 | 17 | 9 | 13 | 8 | - | - | - | 18 | A-2-6 (V) | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| LOOSE TO MEDIUM DENSE, BLACK AND GRAY GRAVEL , LITTLE COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST. -INTRODUCED MUD @ 12.0' | 681.7 | 10 | 6 | - | 50 | 3S-5A | - | - | - | - | - | - | - | - | - | 13 | A-1-a (V) | |
| | | | 8 | 14 | 33 | SS-6 | - | 72 | 13 | 6 | 5 | 4 | NP | NP | NP | 14 | A-1-a (0) | |
| | | | | | | | | | | | | | | | | | | |
| DENSE TO VERY DENSE, BROWN AND GRAY TO BROWN GRAVEL , SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST. | 678.7 | 13 | 13 | | | | | | | | | | | | | | | |
| | | | 32 | 100 | 0 | SS-7 | - | - | - | - | - | - | - | - | - | - | | |
| | | | 50 | - | 100 | 3S-7A | - | - | - | - | - | - | - | - | - | 8 | A-1-a (V) | |
| | | | 10 | 49 | 78 | SS-8 | - | - | - | - | - | - | - | - | - | 9 | A-1-a (V) | |
| | | | 17 | | | | | | | | | | | | | | | |
| | | | 18 | | | | | | | | | | | | | | | |
| | | | 18 | 69 | 89 | SS-9 | - | 66 | 17 | 6 | 7 | 4 | NP | NP | NP | 9 | A-1-a (0) | |
| | | | 24 | | | | | | | | | | | | | | | |
| | | | 20 | | | | | | | | | | | | | | | |
| | | | 20 | 94 | 67 | SS-10 | - | - | - | - | - | - | - | - | - | 8 | A-1-a (V) | |
| | | | 40 | | | | | | | | | | | | | | | |
| | | | 25 | | | | | | | | | | | | | | | |
| | | | 45 | 127 | 100 | SS-11 | - | - | - | - | - | - | - | - | - | 9 | A-1-a (V) | |
| | | | 47 | | | | | | | | | | | | | | | |
| | | | 41 | | | | | | | | | | | | | | | |
| | | | 26 | | | | | | | | | | | | | | | |
| | | | 6 | 123 | 89 | SS-12 | - | 64 | 16 | 6 | 10 | 4 | NP | NP | NP | 9 | A-1-a (0) | |
| 37 | | | | | | | | | | | | | | | | | | |
| 48 | | | | | | | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | | | | | | | |
| 20 | 107 | 61 | SS-13 | - | - | - | - | - | - | - | - | - | - | 8 | A-1-a (V) | | | |
| 36 | | | | | | | | | | | | | | | | | | |
| 38 | | | | | | | | | | | | | | | | | | |


[illegible]



B-113-6-13 – RC-1 and RC-2 – Depth from 43.9 to 53.7 feet



B-113-6-13 – RC-3 and RC-4 – Depth from 53.7 to 63.7 feet

| | | | | | | | | | | | | | | | | | | | | | | |
|---|-----------------------------------|--|--------------------------------------|-------|---------------------------------|----------|--|-----------------|------------------------------|--------------|-------------|---------------|----|----|----|----|-----------|----|----|-----------|--------------------|----------------|
|  | PROJECT: FRA-70-13.10 - PHASE 6A | | DRILLING FIRM / OPERATOR: RII / T.F. | | DRILL RIG: CME-750X (SN 310218) | | STATION / OFFSET: 254+41.19 / 36.0' RT | | EXPLORATION ID B-113-7-13 | | | | | | | | | | | | | |
| | 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: 690.3 (MSL) EOB: 55.7 ft. | | PAGE 1 OF 2 | | | | | | | | | | | | | |
| | START: 4/24/14 END: 4/25/14 | | SAMPLING METHOD: SPT / RC | | ENERGY RATIO (%): 86.8 | | LAT / LONG: 39.952640, -83.012306 | | | | | | | | | | | | | | | |
| | MATERIAL DESCRIPTION AND NOTES | | | ELEV. | DEPTHS | | SPT/ RQD | N ₆₀ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) | | | | | ATTERBERG | | | | ODOT CLASS (GI) | HOLE SEALED |
| | | | 690.3 | | | | | | | | | GR | CS | FS | SI | CL | LL | PL | PI | WC | | |
| VERY LOOSE, GRAYISH BROWN GRAVEL WITH SAND AND SILT , TRACE CLAY, WET. | | | 688.8 | 1 | | WOH 2 | 3 | 33 | SS-1 | - | 24 | 17 | 29 | 20 | 10 | NP | NP | NP | 22 | A-2-4 (0) | | |
| VERY LOOSE TO LOOSE, DARK GRAYISH BROWN TO BLACK GRAVEL WITH SAND , TRACE SILT, TRACE CLAY, WET. | | | 684.3 | 2 | | 2 | 6 | 44 | SS-2 | - | 8 | 47 | 34 | 8 | 3 | - | - | - | 31 | A-1-b (V) | | |
| | | | | 3 | | 1 | | | | | | | | | | | | | | | | |
| | | | | 4 | | 1 | 3 | 44 | SS-3 | - | 12 | 40 | 37 | 8 | 3 | NP | NP | NP | 32 | A-1-b (0) | | |
| | | | | 5 | | 1 | | | | | | | | | | | | | | | | |
| | | | | 6 | | 2 | 4 | 100 | SS-4 | - | 5 | 47 | 36 | 10 | 2 | - | - | - | 28 | A-1-b (V) | | |
| VERY LOOSE TO LOOSE, DARK GRAY SANDY SILT , LITTLE CLAY, TRACE FINE GRAVEL, WET. -INTRODUCED MUD @ 6.4' | | | 680.2 | 7 | | 1 | 3 | 67 | SS-5 | - | 6 | 9 | 48 | 26 | 11 | NP | NP | NP | 53 | A-4a (0) | | |
| | | | | 8 | | 2 | | | | | | | | | | | | | | | | |
| | | | | 9 | | 1 | 6 | 33 | SS-6 | - | - | - | - | - | - | - | - | - | 45 | A-4a (V) | | |
| | | | | 10 | | 3 | | | | | | | | | | | | | | | | |
| | | | | 11 | | 8 | | | | | | | | | | | | | | | | |
| DENSE, GRAYISH BROWN GRAVEL , SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST. -COBBLES PRESENT @ 10.6' | | | 675.2 | 12 | | 10 | 36 | 89 | SS-7 | - | 56 | 24 | 7 | 10 | 3 | NP | NP | NP | 12 | A-1-a (0) | | |
| | | | | 13 | | 15 | | | | | | | | | | | | | | | | |
| | | | | 14 | | 5 | 35 | 100 | SS-8 | - | - | - | - | - | - | - | - | - | 13 | A-1-a (V) | | |
| | | | | 15 | | 8 | | | | | | | | | | | | | | | | |
| | | | | 16 | | 4 | | | | | | | | | | | | | | | | |
| VERY DENSE, GRAY GRAVEL WITH SAND , TRACE SILT, TRACE CLAY, DAMP TO MOIST. | | | 670.5 | 17 | | 35 | 101 | 89 | SS-9 | - | 38 | 38 | 12 | 8 | 4 | NP | NP | NP | 11 | A-1-b (0) | | |
| | | | | 18 | | 35 | | | | | | | | | | | | | | | | |
| | | | | 19 | | 60/3" | - | 100 | SS-10 | - | - | - | - | - | - | - | - | - | 8 | A-1-b (V) | | |
| | | | | 20 | | 0 | 75 | | RC-1 | | | | | | | | | | | CORE | | |
| | | | | 21 | | 35 | - | 100 | SS-11 | - | 60 | 13 | 11 | 12 | 4 | NP | NP | NP | 5 | A-1-b (0) | | |
| -AUGER REFUSAL @ 19.8', SWITCHED TO ROCK CORING AND CORED THROUGH 0.8' THICK LIMESTONE BOULDER, CONTINUED SAMPLING @ 20.8'. LIMESTONE BOULDER | | | 664.7 | 22 | | 50/3" | | | | | | | | | | | | | | | | |
| | | | | 23 | | 60/2" | - | 100 | SS-12 | - | - | - | - | - | - | - | - | - | 9 | A-1-b (V) | | |
| | | | | 24 | | | | | | | | | | | | | | | | | | |
| | | | | 25 | | | | | | | | | | | | | | | | | | |
| | | | | 26 | | 28 | 94 | 67 | SS-13 | - | - | - | - | - | - | - | - | - | 11 | A-2-4 (V) | | |
| VERY DENSE, BROWN GRAVEL WITH SAND AND SILT , TRACE CLAY, MOIST. | | | 662.7 | 27 | | 30 | | | | | | | | | | | | | | | | |
| | | | | 28 | | 35 | | | | | | | | | | | | | | | | |
| | | | | 29 | | 48 | - | 80 | SS-14 | 4.50 | 25 | 8 | 11 | 20 | 36 | 36 | 17 | 19 | 13 | A-6b (8) | | |
| | | | | | | 50 | | | | | | | | | | | | | | | | |
| | | | | | | 50/3" | | | | | | | | | | | | | | | | |
| HARD, BROWN AND GRAY SILTY CLAY , SOME FINE GRAVEL, LITTLE COARSE TO FINE SAND, DAMP. | | | 660.5 | | | | | | | | | | | | | | | | | | | |
| AUGER REFUSAL @ 29.8 FEET | | | | | | | | | | | | | | | | | | | | | | |

[illegible]

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER



B-113-7-13 – RC-1 – Depth from 19.6 to 20.6 feet



B-113-7-13 – RC-2 and RC-3 – Depth from 29.8 to 35.7 feet




B-113-7-13 – RC-4 – Depth from 35.7 to 40.7 feet



B-113-7-13 – RC-5 and RC-6 – Depth from 40.7 to 50.7 feet


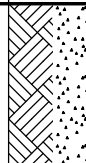


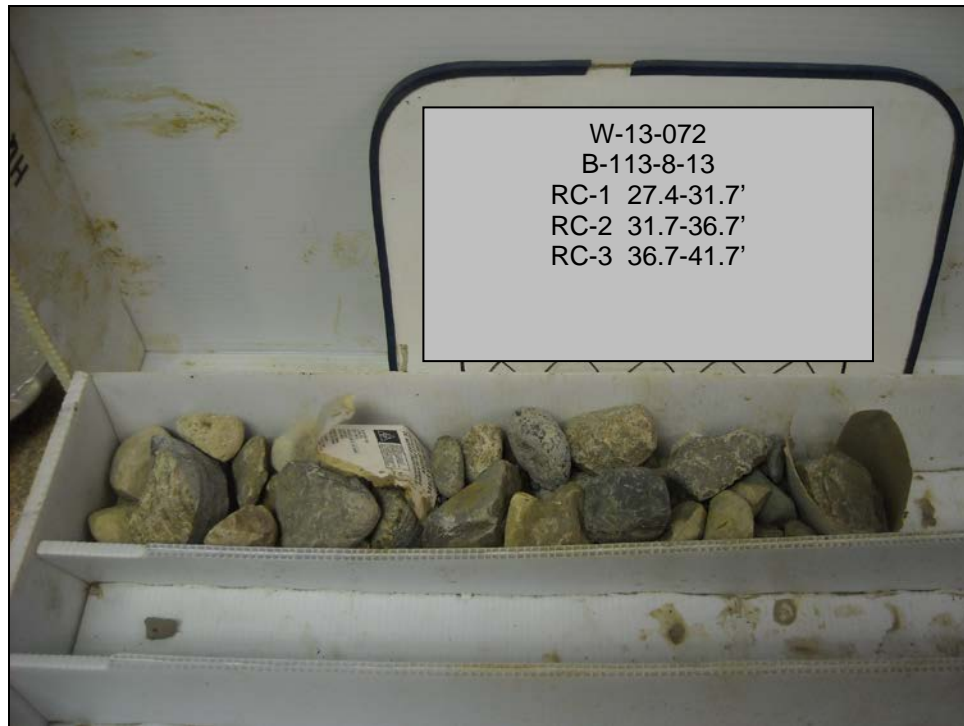
B-113-7-13 – RC-7 – Depth from 50.7 to 55.7 feet

| | | | | | |
|---|----------------------------------|--------------------------------------|---------------------------------|--|--|
|  | PROJECT: FRA-70-13.10 - PHASE 6A | DRILLING FIRM / OPERATOR: RII / T.F. | DRILL RIG: CME-750X (SN 310218) | STATION / OFFSET: 256+62.64 / 36.0' RT | EXPLORATION ID B-113-8-13 |
| | 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: 691.0 (MSL) EOB: 66.2 ft. | PAGE 1 OF 3 |
| | START: 4/28/14 END: 4/29/14 | SAMPLING METHOD: SPT / RC | ENERGY RATIO (%): 86.8 | LAT / LONG: 39.952843, -83.011561 | |

| MATERIAL DESCRIPTION AND NOTES | ELEV. 691.0 | DEPTHS | SPT/ RQD | N ₆₀ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) | | | | | ATTERBERG | | | WC | ODOT CLASS (GI) | HOLE SEALED |
|---|----------------|--------|-------------|-----------------|------------|--------------|-------------|---------------|----|----|----|----|-----------|----|----|----|--------------------|----------------|
| | | | | | | | | GR | CS | FS | SI | CL | LL | PL | PI | | | |
| MEDIUM DENSE, BROWNISH GRAY GRAVEL WITH SAND , TRACE CLAY, TRACE SILT, WET. | 689.5 | 1 | 4 6 | 17 | 33 | SS-1 | - | 43 | 33 | 19 | 2 | 3 | - | - | - | 20 | A-1-b (V) | |
| LOOSE TO MEDIUM DENSE, BROWNISH GRAY GRAVEL , SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST. | | 2 | 5 6 | 16 | 33 | SS-2 | - | 57 | 19 | 11 | 8 | 5 | NP | NP | NP | 14 | A-1-a (0) | |
| | | 3 | 5 4 | 9 | 44 | SS-3 | 3.00 | 56 | 18 | 11 | 9 | 6 | - | - | - | 14 | A-1-a (V) | |
| | | 4 | 3 6 | 17 | 44 | SS-4 | - | 60 | 17 | 10 | 8 | 5 | NP | NP | NP | 15 | A-1-a (0) | |
| | | 5 | | | | | | | | | | | | | | | | |
| | | 6 | | | | | | | | | | | | | | | | |
| | | 7 | | | | | | | | | | | | | | | | |
| -INTRODUCED MUD @ 7.2' | | 8 | 7 8 | 22 | 11 | SS-5 | - | - | - | - | - | - | - | - | - | 17 | A-1-a (V) | |
| MEDIUM DENSE, BROWN COARSE AND FINE SAND , LITTLE FINE GRAVEL, TRACE SILT, WET. | 681.8 | 9 | 10 | - | 100 | 3S-5A | - | 70 | 16 | 6 | 6 | 2 | NP | NP | NP | 13 | A-1-a (0) | |
| MEDIUM DENSE TO DENSE, BROWN GRAVEL , LITTLE COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST. | 679.8 | 10 | 2 7 | 25 | 100 | SS-6 | - | - | - | - | - | - | - | - | - | 21 | A-3a (V) | |
| | | 11 | 10 | | | | | | | | | | | | | | | |
| | | 12 | | | | | | | | | | | | | | | | |
| | | 13 | 9 6 | 19 | 44 | SS-7 | - | - | - | - | - | - | - | - | - | 13 | A-1-a (V) | |
| | | 14 | | | | | | | | | | | | | | | | |
| | | 15 | 7 9 | 38 | 67 | SS-8 | - | 79 | 11 | 3 | 5 | 2 | NP | NP | NP | 14 | A-1-a (0) | |
| VERY DENSE, BROWN AND GRAY SANDY SILT , LITTLE CLAY, TRACE TO LITTLE FINE GRAVEL, MOIST TO WET. | 671.8 | 16 | 17 | | | | | | | | | | | | | | | |
| | | 17 | | | | | | | | | | | | | | | | |
| | | 18 | 11 15 | 45 | 50 | SS-9 | - | - | - | - | - | - | - | - | - | 15 | A-1-a (V) | |
| | | 19 | 16 | | | | | | | | | | | | | | | |
| | | 20 | 22 22 | 74 | 94 | SS-10 | - | 6 | 3 | 27 | 47 | 17 | NP | NP | NP | 15 | A-4a (6) | |
| | | 21 | 29 | | | | | | | | | | | | | | | |
| AUGER REFUSAL @ 27.4 FEET | 663.6 | 22 | 19 20 | 85 | 56 | SS-11 | - | - | - | - | - | - | - | - | - | 19 | A-4a (V) | |
| | | 23 | 39 | | | | | | | | | | | | | | | |
| | | 24 | | | | | | | | | | | | | | | | |
| | | 25 | 18 20 | - | 100 | SS-12 | - | 16 | 10 | 25 | 34 | 15 | NP | NP | NP | 15 | A-4a (3) | |
| | | 26 | 50/5" | | | | | | | | | | | | | | | |
| | | 27 | | | | | | | | | | | | | | | | |
| GRANITE, LIMESTONE AND DOLOMITE BOULDERS | | 28 | 50/3" | - | 0 | SS-13 | - | - | - | - | - | - | - | - | - | - | | |
| | | 29 | | | | | | | | | | | | | | | | |
| | | | 0 | | 14 | RC-1 | | | | | | | | | | | CORE | |

[illegible]

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---------------------|----------------------------------|---|--------|----|-------------|-----------------|----------------|--------------|--------------|---------------|-----------|--|------------|--|-----------|--|--|--|--------------------|---|----|
| PID: 89464 | BR ID: FRA-71-1503L | PROJECT: FRA-70-13.10 - PHASE 6A | STATION / OFFSET: 256+62.64 / 36.0 RT | | | | | START: 4/28/14 | | END: 4/29/14 | | PG 3 OF 3 | | B-113-8-13 | | | | | | | | |
| MATERIAL DESCRIPTION AND NOTES | | | ELEV. 628.9 | DEPTHS | | SPT/ RQD | N ₆₀ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) | | | | | ATTERBERG | | | | ODOT CLASS (GI) | HOLE SEALED | |
| LIMESTONE : BROWN, SLIGHTLY WEATHERED, MODERATELY STRONG, THIN TO MEDIUM BEDDED, DOLOMITIC, SILICEOUS, CHERTY, MODERATELY TO SLIGHTLY FRACTURED, TIGHT TO NARROW APERTURES, ROUGH; RQD 90%, REC 92%. (same as above) | | |  | | 83 | | 97 | RC-7 | | | | | | | | | | | | CORE |  | |
| | | | | | | | | | | | | | | | | | | | | | | 63 |
| | | | | | | | | | | | | | | | | | | | | | | 64 |
| | | | | | | | | | | | | | | | | | | | | | | 65 |
| | | | 624.8 | EOB | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| NOTES: ELEVATION OF SCIOTO RIVER SURFACE @ 699.8 | | | | | | | | | | | | | | | | | | | | | | |
| ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER | | | | | | | | | | | | | | | | | | | | | | |




B-113-8-13 – RC-1, RC-2, and RC-3 – Depth from 27.4 to 41.7 feet



B-113-8-13 – RC-4 and RC-5 – Depth from 46.2 to 56.2 feet



B-113-8-13 – RC-6 and RC-7 – Depth from 56.2 to 66.2 feet

| | | | | | |
|---|----------------------------------|--------------------------------------|------------------------------------|--|--|
|  | PROJECT: FRA-70-13.10 - PHASE 6A | DRILLING FIRM / OPERATOR: RII / T.F. | DRILL RIG: MOBILE B-53 (SN 624400) | STATION / OFFSET: 258+77.50 / 36.0' RT | EXPLORATION ID B-113-9-13 |
| | TYPE: STRUCTURE | SAMPLING FIRM / LOGGER: RII / S.B. | HAMMER: 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: 706.3 (MSL) EOB: 73.0 ft. | |
| | START: 4/1/14 END: 4/3/14 | SAMPLING METHOD: SPT / RC | ENERGY RATIO (%): 77.7 | LAT / LONG: 39.953039, -83.010839 | |
| | | | | | PAGE 1 OF 3 |

| MATERIAL DESCRIPTION AND NOTES | ELEV. 706.3 | 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") | 705.8 | | | | | | | | | | | | | | | | | |
| FILL: VERY STIFF, DARK BROWN SILT AND CLAY, SOME FINE GRAVEL, SOME COARSE TO FINE SAND, DAMP. -ROOT FIBER AND WOOD FRAGMENTS PRESENT IN SS-1 -ROCK FRAGMENTS PRESENT THROUGHOUT -SLAG FRAGMENTS PRESENT IN SS-2 | 700.8 | 1 | 5 | | | | | | | | | | | | | | | |
| | | 2 | 3 | 8 | 61 | SS-1 | 3.50 | - | - | - | - | - | - | - | - | 12 | A-6a (V) | |
| | | 3 | | | | | | | | | | | | | | | | |
| | | 4 | 5 | 12 | 44 | SS-2 | 3.25 | 33 | 14 | 13 | 23 | 17 | 34 | 21 | 13 | 16 | A-6a (2) | |
| FILL: VERY DENSE, BROWN AND GRAY GRAVEL WITH SAND, TRACE SILT, MOIST. -ROCK AND SLAG FRAGMENTS PRESENT IN SS-3 | 698.3 | 5 | | | | | | | | | | | | | | | | |
| | | 6 | 18 | | | | | | | | | | | | | | | |
| FILL: MEDIUM STIFF TO STIFF, GRAY SILTY CLAY, SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, MOIST. -BRICK AND CONCRETE FRAGMENTS PRESENT IN SS-4 -TRACE ROCK FRAGMENTS PRESENT THROUGHOUT | 691.3 | 7 | 34 | 54 | 67 | SS-3 | - | - | - | - | - | - | - | - | - | 12 | A-1-b (V) | |
| | | 8 | | | | | | | | | | | | | | | | |
| | | 9 | 5 | 22 | 50 | SS-4 | 1.25 | - | - | - | - | - | - | - | - | 18 | A-6b (V) | |
| | | 10 | 8 | | | | | | | | | | | | | | | |
| FILL: MEDIUM STIFF TO STIFF, DARK BROWN TO GRAY SILT AND CLAY, SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, MOIST TO WET. -CONSOLIDATION TEST PERFORMED @ 16.3' -QU @ 16.4' = 1,531 PSF (0.77 TSF) -CONCRETE AND SLAG FRAGMENTS PRESENT IN SS-8 | 685.8 | 11 | 4 | | | | | | | | | | | | | | | |
| | | 12 | 4 | 17 | 67 | SS-5 | 0.75 | 19 | 12 | 14 | 31 | 24 | 34 | 18 | 16 | 19 | A-6b (6) | |
| | | 13 | | | | | | | | | | | | | | | | |
| | | 14 | 6 | 8 | 67 | SS-6 | 1.00 | - | - | - | - | - | - | - | - | 19 | A-6b (V) | |
| FILL: MEDIUM STIFF TO STIFF, DARK BROWN TO GRAY SILT AND CLAY, SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, MOIST TO WET. -CONSOLIDATION TEST PERFORMED @ 16.3' -QU @ 16.4' = 1,531 PSF (0.77 TSF) -CONCRETE AND SLAG FRAGMENTS PRESENT IN SS-8 | 683.3 | 15 | 3 | | | | | | | | | | | | | | | |
| | | 16 | | | 69 | ST-7 | 1.50 | 19 | 10 | 13 | 31 | 27 | 32 | 18 | 14 | 18 | A-6a (6) | |
| | | 17 | | | | | | | | | | | | | | | | |
| | | 18 | | | | | | | | | | | | | | | | |
| STIFF, BROWN AND BLACK SANDY SILT, SOME CLAY, LITTLE FINE GRAVEL, MOIST TO WET. -SS-9: LL (OVEN DRIED) = 23%; LOI = 5.6% | 680.8 | 19 | 3 | 5 | 39 | SS-8 | 0.75 | - | - | - | - | - | - | - | - | 26 | A-6a (V) | |
| | | 20 | 2 | | | | | | | | | | | | | | | |
| MEDIUM DENSE, BROWN SANDY SILT, LITTLE FINE GRAVEL, TRACE CLAY, MOIST. -ORGANICS PRESENT THROUGHOUT -ROCK FRAGMENTS PRESENT IN SS-10 | 680.8 | 21 | 2 | 10 | 100 | SS-9 | - | 10 | 4 | 19 | 46 | 21 | 32 | 22 | 10 | 40 | A-4a (6) | |
| | | 22 | 4 | | | | | | | | | | | | | | | |
| VERY DENSE, GRAY SANDY SILT, LITTLE FINE GRAVEL, TRACE CLAY, DAMP TO MOIST. | 680.8 | 23 | | | | | | | | | | | | | | | | |
| | | 24 | 7 | 23 | 56 | SS-10 | - | - | - | - | - | - | - | - | - | 12 | A-4a (V) | |
| | 680.8 | 25 | 8 | | | | | | | | | | | | | | | |
| | | 26 | 10 | 56 | 61 | SS-11 | - | 13 | 15 | 30 | 32 | 10 | NP | NP | NP | 12 | A-4a (1) | |
| | 680.8 | 27 | 17 | | | | | | | | | | | | | | | |
| | | 28 | 26 | | | | | | | | | | | | | | | |
| | 680.8 | 29 | 8 | 61 | 78 | SS-12 | - | - | - | - | - | - | - | - | - | 9 | A-4a (V) | |
| | | 30 | 22 | | | | | | | | | | | | | | | |

[illegible]

| | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|---------------------|--|----------------------------------|--------|---------------------------------------|-----------------|------------|--------------|---------------|---------------|-------------|-----|-----------|--|------------|--|--|----|--------------------|----------------|------|----|----|
| PID: 89464 | | BR ID: FRA-71-1503L | | PROJECT: FRA-70-13.10 - PHASE 6A | | STATION / OFFSET: 258+77.50 / 36.0 RT | | | | START: 4/1/14 | | END: 4/3/14 | | PG 3 OF 3 | | B-113-9-13 | | | | | | | | |
| MATERIAL DESCRIPTION AND NOTES | | | | ELEV. | DEPTHS | SPT/ RQD | N ₆₀ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) | | | | | ATTERBERG | | | WC | ODOT CLASS (GI) | HOLE SEALED | | | |
| | | | | 644.2 | | GR | CS | FS | SI | CL | LL | PL | PI | | | | | | | | | | | |
| LIMESTONE : GRAY TO BLACK, UNWEATHERED, VERY STRONG, THICK TO VERY THICK BEDDED, CALCAREOUS, CRYSTALLINE, CHERTY, ARENACEOUS, DOLOMITIC, PYRITIC, CALCITE DEPOSITS, STYLOLITIC, JOINTED, FRACTURED TO INTACT, OPEN APERTURES, SLIGHTLY ROUGH TO ROUGH; RQD 95%, REC 100%. (same as above) -QU @ 61.8' = 11,594 PSI -QU @ 64.5' = 5,086 PSI | | | | | 633.3 | EOB | 63 | 100 | 100 | RC-3 | | | | | | | | | | CORE | | | | |
| | | | | | | | | | | | | | | | | | | | | | | 64 | | |
| | | | | | | | | | | | | | | | | | | | | | | | 65 | |
| | | | | | | | | | | | | | | | | | | | | | | | | 66 |
| | | | | | | | | 67 | 68 | 69 | 70 | 94 | 100 | RC-4 | | | | | | | | CORE | | |
| | | | | | | | | | | | | | | | | | | | | | | | 71 | |
| | | | | | | | | | | | | | | | | | | | | | | | | 72 |
| | | | | | | | | 73 | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 21.0'; CAVE-IN DEPTH @ 20.0'


ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER



B-113-9-13 – RC-1, RC-2, and RC-3 – Depth from 55.5 to 68.0 feet



B-113-9-13 – RC-4 – Depth from 68.0 to 73.0 feet

| | | | | | |
|---|----------------------------------|--------------------------------------|---------------------------------|--|-------------------------------------|
|  | PROJECT: FRA-70-13.10 - PHASE 6A | DRILLING FIRM / OPERATOR: RII / J.K. | DRILL RIG: CME-750X (SN 310218) | STATION / OFFSET: 260+75.33 / 40.2' RT | EXPLORATION ID B-114-1-13 |
| | TYPE: STRUCTURE | SAMPLING FIRM / LOGGER: RII / J.P. | 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: 716.6 (MSL) EOB: 81.0 ft. | PAGE 1 OF 3 |
| | START: 5/13/14 END: 5/14/14 | SAMPLING METHOD: SPT / RC | ENERGY RATIO (%): 86.8 | LAT / LONG: 39.953210, -83.010169 | |

| MATERIAL DESCRIPTION AND NOTES | ELEV. | 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 | | | |
| 0.3' - TOPSOIL (4.0") FILL: STIFF, BROWN SILTY CLAY , LITTLE COARSE TO FINE SAND, LITTLE FINE GRAVEL, MOIST. -ROOT FIBERS PRESENT IN SS-1 | 716.6 716.3 | | 3 | | | | | | | | | | | | | | | |
| | | 1 | 4 | 10 | 61 | SS | 2.00 | - | - | - | - | - | - | - | - | 15 | A-6b (V) | |
| | 713.6 | 2 | 3 | | | | | | | | | | | | | | | |
| FILL: VERY DENSE, BROWN GRAVEL WITH SAND , TRACE SILT, TRACE CLAY, MOIST. -ROCK FRAGMENTS PRESENT IN SS-2 | | 3 | 50/1" | - | 100 | SS | - | - | - | - | - | - | - | - | - | 10 | A-1-b (V) | |
| | 711.1 | 4 | | | | | | | | | | | | | | | | |
| | | 5 | | | | | | | | | | | | | | | | |
| FILL: STIFF, BROWN TO DARK BROWN SILTY CLAY , SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, DAMP TO MOIST. -ROOT FIBERS AND ROCK FRAGMENTS PRESENT IN SS-3 | | 6 | 8 | | | | | | | | | | | | | | | |
| | | 7 | 4 | 12 | 22 | SS | 1.50 | 14 | 10 | 12 | 39 | 25 | 35 | 19 | 16 | 18 | A-6b (8) | |
| | | 8 | | | | | | | | | | | | | | | | |
| | | 9 | 4 | | | | | | | | | | | | | | | |
| | 706.1 | 10 | 6 | 13 | 56 | SS | 1.50 | - | - | - | - | - | - | - | - | 21 | A-6b (V) | |
| | | 11 | | | | | | | | | | | | | | | | |
| FILL: STIFF TO VERY STIFF, DARK BROWN TO BROWN SILT AND CLAY , SOME COARSE TO FINE SAND, SOME TO AND FINE GRAVEL, DAMP. -CONCRETE FRAGMENTS PRESENT IN SS-5 | | 12 | 5 | 7 | 33 | SS | 1.50 | 33 | 15 | 13 | 24 | 15 | 33 | 20 | 13 | 13 | A-6a (2) | |
| | | 13 | | | | | | | | | | | | | | | | |
| | | 14 | 4 | | | | | | | | | | | | | | | |
| | | 15 | 3 | 12 | 56 | SS | 4.00 | - | - | - | - | - | - | - | - | 13 | A-6a (V) | |
| | | 16 | | | | | | | | | | | | | | | | |
| | | 17 | 5 | | | | | | | | | | | | | | | |
| | | 18 | 7 | 22 | 39 | SS | 2.00 | 38 | 11 | 13 | 24 | 14 | 33 | 20 | 13 | 13 | A-6a (1) | |
| | | 19 | | | | | | | | | | | | | | | | |
| -BRICK FRAGMENTS AND ROOT FIBERS PRESENT IN SS-8 | | 20 | 6 | 19 | 56 | SS | 2.75 | - | - | - | - | - | - | - | - | 17 | A-6a (V) | |
| | 696.1 | 21 | | | | | | | | | | | | | | | | |
| VERY SOFT TO MEDIUM STIFF, BROWN TO DARK BROWN SILTY CLAY , LITTLE COARSE TO FINE SAND, MOIST. | | 22 | 3 | 7 | 89 | SS | 1.00 | 0 | 1 | 10 | 60 | 29 | 37 | 21 | 16 | 29 | A-6b (10) | |
| | | 23 | | | | | | | | | | | | | | | | |
| | | 24 | 4 | 9 | 89 | SS | 0.25 | - | - | - | - | - | - | - | - | 25 | A-6b (V) | |
| | 691.6 | 25 | 3 | | | | | | | | | | | | | | | |
| MEDIUM DENSE TO DENSE, BROWN GRAVEL , SOME COARSE TO FINE SAND, LITTLE SILT, TRACE CLAY, MOIST. | | 26 | | | 0 | ST | - | - | - | - | - | - | - | - | - | - | | |
| | | 27 | | | | | | | | | | | | | | | | |
| | | 28 | | | | | | | | | | | | | | | | |
| | W 688.1 | 29 | 3 | 17 | 67 | SS | - | 55 | 23 | 9 | 10 | 3 | 22 | 18 | 4 | 14 | A-1-a (0) | |
| | | | 4 | | | | | | | | | | | | | | | |

[illegible]

| MATERIAL DESCRIPTION AND NOTES | ELEV. | 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 | | | |
| SHALE : GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, VERY WEAK TO WEAK, VERY THICK BEDDED, CALCAREOUS, ARGILLACEOUS, FRIABLE, MICACEOUS, FISSILE, MODERATELY TO HIGHLY FRACTURED, TIGHT TO OPEN APERTURES, SLICKENSIDED TO SLIGHTLY ROUGH; RQD 37%, REC 89%. <i>(continued)</i> -POINT LOAD STRENGTH @ 73.0' TO 74.0' -MEAN QU = 255 PSI | 654.5 | 63 | 76 | | 95 | RC | | | | | | | | | | CORE | | |
| | 64 | | | | | | | | | | | | | | | | | |
| | 65 | | | | | | | | | | | | | | | | | |
| | | 641.6 | 66 | 23 | | 100 | RC | | | | | | | | | CORE | | |
| | | | 67 | | | | | | | | | | | | | | | |
| | | | 68 | | | | | | | | | | | | | | | |
| | | | 69 | | | | | | | | | | | | | | | |
| | LIMESTONE : GRAY AND BROWN, UNWEATHERED TO SLIGHTLY WEATHERED, VERY STRONG, VERY THICK BEDDED, DOLOMITIC, CALCAREOUS, CRYSTALLINE, CHERTY, PYRITIC, SILICEOUS, SLIGHTLY TO HIGHLY FRACTURED, OPEN APERTURES, SLIGHTLY ROUGH; RQD 95%, REC 96%. -QU @ 76.0' = 11,340 PSI | 635.6 | 70 | 23 | | 75 | RC | | | | | | | | | | CORE | |
| | | | 71 | | | | | | | | | | | | | | | |
| | | | 72 | | | | | | | | | | | | | | | |
| 73 | | | | | | | | | | | | | | | | | | |
| 74 | | | | | | | | | | | | | | | | | | |
| 75 | | | | | | | | | | | | | | | | | | |
| | 631.0 | 76 | 94 | | 96 | RC | | | | | | | | | | CORE | | |
| | | 77 | | | | | | | | | | | | | | | | |
| | | 78 | | | | | | | | | | | | | | | | |
| | | 79 | | | | | | | | | | | | | | | | |
| | | 80 | | | | | | | | | | | | | | | | |
| | | 81 | | | | | | | | | | | | | | | | |



B-114-1-13 – RC-1 and RC-2 – Depth from 61.0 to 71.0 feet



B-114-1-13 – RC-3 and RC-4 – Depth from 71.0 to 81.0 feet

APPENDIX IV

HISTORIC BORING LOGS:

B-001-S-57 through B-020-S-57

STATE OF OHIO
DEPARTMENT OF HIGHWAYS
TESTING LABORATORY

LOG OF BORING

CO., RT. NO. SEC. FRA-40-12.30 BRIDGE NO. FRA-40-1230
REAR ABUTMENT OVER SCIOTO RIVER
 LOCATION: T.H. 1 STA. 21+75 OFFSET C.L. FED. NO.

| ELEV. | DEPTH | NO. BLOWS | SAMPLE NO. | DESCRIPTION |
|-------|-------|-----------|------------|-----------------------------------|
| 724.0 | 0 | | | |
| | 2 | | | |
| | 4 | | | |
| | 6 | | | |
| | 8 | | | |
| 714.0 | 10 | | | |
| | 12 | 18 | 67403 | GRAY AND BROWN SILTY GRAVEL |
| | 14 | | | |
| 709.0 | 16 | 45 | 67404 | GRAVEL |
| | 18 | | | |
| 704.0 | 20 | 30 | 67405 | BROWN CLAY |
| | 22 | | | |
| | 24 | | | |
| 699.0 | 26 | 70 | 67406 | GRAY AND BROWN SILTY SANDY GRAVEL |
| | 28 | | | |
| 694.0 | 30 | | | |
| | 32 | 52 | 67407 | GRAVEL |
| | 34 | | | |
| 689.0 | 36 | 38 | 67408 | GRAVEL |

LOG OF BORING (CONTINUED)

BRIDGE NO. FRA-40-1230 T.H. 1

| ELEV. | DEPTH | NO. BLOWS | SAMPLE NO. | DESCRIPTION |
|-------|-------|-----------|------------|--------------------------|
| 684.0 | 38 | 74 | 67409 | SANDY GRAVEL |
| | 40 | | | |
| | 42 | | | |
| 680.0 | 44 | 90 | 67410 | SILTY SANDY GRAVEL |
| | 46 | | | |
| | 48 | | | |
| 674.0 | 50 | 155 | 67411 | GRAY GRAVELLY SANDY CLAY |
| | 52 | | | |
| | 54 | | | |
| 667.0 | 56 | | | BOULDERS |
| | 58 | | | |
| | 60 | | | |
| 661.0 | 62 | | | LARGE BOULDERS |
| | 64 | | | |
| | 66 | | | |
| | 68 | | | BOTTOM OF HOLE |
| | 70 | | | |
| | 72 | | | |
| | 74 | | | |
| | 76 | | | |
| | 78 | | | |
| | 80 | | | |
| | 82 | | | |
| | | | | |
| | | | | |

STATE OF OHIO
DEPARTMENT OF HIGHWAYS
TESTING LABORATORY

LOG OF BORING

CO., RT. NO., SEC. FRA-40-12,30 BRIDGE NO. FRA-40-1230
SECOND PIER OVER SCIOTO RIVER
 LOCATION: T.H. 5 STA. 24+00 OFFSET C.L. FED. NO.

| ELEV. | DEPTH | NO. BLOWS | SAMPLE NO. | DESCRIPTION |
|-------|-------|-----------|------------|----------------------------------|
| 681.7 | 0 | | | |
| | 2 | | | |
| | 4 | | | |
| 676.4 | 6 | 24 | 66517 | GRAY SANDY GRAVEL |
| | 8 | | | |
| 671.4 | 10 | | | |
| | 12 | 73 | 66518 | GRAY SILTY GRAVELLY SAND |
| | 14 | | | |
| 666.4 | 16 | 180 | 66519 | GRAY SILTY SANDY GRAVEL |
| 663.4 | 18 | -- | --- | COARSE SAND |
| 661.4 | 20 | | | |
| | 22 | 117 | 66520 | GRAY SILTY GRAVEL |
| | 24 | | | |
| 656.4 | 26 | 20 | ---- | FINE SAND, SILT AND SMALL GRAVEL |
| | 28 | | | |
| 652.7 | 30 | 600 | 66521 | WEATHERED SHALE |
| 652.1 | | | | TOP OF ROCK |
| | 32 | | | |
| | 34 | | | HARD DENSE GRAY LIMESTONE |
| 645.7 | 36 | | | BOTTOM OF HOLE |

STATE OF OHIO
DEPARTMENT OF HIGHWAYS
TESTING LABORATORY

LOG OF BORING

CO., RT. NO. SEC. FRA-40-12.30 BRIDGE NO. FRA-40-1230
FOURTH PIER OVER SCIOTO RIVER
 LOCATION: T.H. 2 STA. 26+25 OFFSET C.L. FED. NO.

| ELEV. | DEPTH | NO. BLOWS | SAMPLE NO. | DESCRIPTION |
|-------|-------|-----------|------------|------------------------------------|
| 686.1 | 0 | | | |
| | 2 | | | |
| | 4 | | | |
| | 6 | | | |
| | 8 | | | |
| 677.4 | 10 | 39 | 67412 | GRAY SILTY GRAVELLY SAND |
| | 12 | | | |
| 672.4 | 14 | | | |
| | 16 | 171 | 67413 | GRAY AND BROWN SILTY GRAVELLY SAND |
| 669.4 | 18 | | 67414 | GRAVEL AND STONE FRAGMENTS |
| | 20 | | | |
| | 22 | | | |
| | 24 | | | |
| 662.4 | 26 | 39 | 67415 | SANDY GRAVEL |
| 660.4 | 28 | 190 | 67416 | SANDY GRAVEL |
| | 30 | | | |
| 654.4 | 32 | | | |
| | 34 | 70 | 67417 | GRAVEL |
| 651.4 | | | | TOP OF ROCK |
| | 36 | | | FIRM GRAY CLAY SHALE |

LOG OF BORING (CONTINUED)

BRIDGE NO. PA-45-1230T.H. 9

| ELEV. | DEPTH | NO. BLOWS | SAMPLE NO. | DESCRIPTION |
|-------|-------|-----------|------------|--|
| 648.7 | 38 | | | FIRM GRAY CLAY SHALE |
| 646.0 | 40 | | | DENSE GRAY LIMESTONE WITH DARK WAVY PARTINGS |
| | 42 | | | ↖ BOTTOM OF HOLE |
| | 44 | | | |
| | 46 | | | |
| | 48 | | | |
| | 50 | | | |
| | 52 | | | |
| | 54 | | | |
| | 56 | | | |
| | 58 | | | |
| | 60 | | | |
| | 62 | | | |
| | 64 | | | |
| | 66 | | | |
| | 68 | | | |
| | 70 | | | |
| | 72 | | | |
| | 74 | | | |
| | 76 | | | |
| | 78 | | | |
| | 80 | | | |
| | 82 | | | |

STATE OF OHIO
DEPARTMENT OF HIGHWAYS
TESTING LABORATORY

LOG OF BORING

CO., RT. NO. SEC. FRA -40-12.30 BRIDGE NO. FRA-40-1230
SIXTH PIER OVER SCIOTO RIVER
 LOCATION: T.H. 13 STA. 28+73 OFFSET C.L. FED. NO.

| ELEV. | DEPTH | NO. BLOWS | SAMPLE NO. | DESCRIPTION |
|-------|-------|-----------|------------|------------------------------|
| 691.4 | 0 | | | |
| | 2 | | | |
| | 4 | | | |
| 686.9 | 6 | 15 | 66522 | GRAVEL |
| 682.9 | 8 | 90 | 66523 | BROWN SANDY GRAVEL |
| | 10 | | | |
| | 12 | | | |
| | 14 | | | |
| 676.9 | 16 | 27 | 66524 | GRAY AND BROWN GRAVELLY SAND |
| | 18 | | | |
| 672.9 | 20 | 30 | 66525 | BROWN AND GRAY SANDY GRAVEL |
| | 22 | | | |
| | 24 | | | |
| 666.9 | 26 | 200 | 66526 | BROWN AND GRAY SANDY GRAVEL |
| 665.9 | 28 | | 66527 | STONE FRAGMENTS |
| | 30 | 200 | 66528 | GRAY SOFT SHALE TOP OF ROCK |
| 660.9 | 32 | | 66529 | SHALE |
| | 34 | | | |
| | 36 | | | |

LOG OF BORING (CONTINUED)

BRIDGE NO. EBA-40-1230 T.H. 13

| ELEV. | DEPTH | NO. BLOWS | SAMPLE NO. | DESCRIPTION |
|-------|-------|--------------|---------------|------------------|
| 652.4 | 38 | | | SHALE |
| | 40 | | | ↖ BOTTOM OF HOLE |
| | 42 | | | |
| | 44 | | | |
| | 46 | | | |
| | 48 | | | |
| | 50 | | | |
| | 52 | | | |
| | 54 | | | |
| | 56 | | | |
| | 58 | | | |
| | 60 | | | |
| | 62 | | | |
| | 64 | | | |
| | 66 | | | |
| | 68 | | | |
| | 70 | | | |
| | 72 | | | |
| | 74 | | | |
| | 76 | | | |
| | 78 | | | |
| | 80 | | | |
| | 82 | | | |

STATE OF OHIO
DEPARTMENT OF HIGHWAYS
TESTING LABORATORY

LOG OF BORING

CO., RT. NO. SEC. FRA-40-12.30 BRIDGE NO. FRA-40-1230
FORWARD ABUTMENT OVER SCIOTO RIVER

LOCATION: T.H. 20 STA. 32+05 OFFSET 19' LT FED. NO.

| ELEV. | DEPTH | NO. BLOWS | SAMPLE NO. | DESCRIPTION |
|-------|-------|--------------|---------------|---------------------|
| 726.0 | 0 | | | |
| | 2 | | | |
| | 4 | | | |
| 721.0 | 6 | ---- | ---- | SAND & SMALL GRAVEL |
| | 8 | | | |
| | 10 | | | |
| 715.0 | 12 | 10 | 67937 | SANDY GRAVEL |
| | 14 | | | |
| | 16 | | | |
| 709.0 | 18 | 17 | ---- | SANDY GRAVELLY SILT |
| | 20 | | | |
| 705.0 | 22 | 25 | 67938 | SANDY GRAVELLY SILT |
| | 24 | | | |
| | 26 | | | |
| 700.0 | 28 | 15 | 67939 | BROWN CLAY |
| | 30 | | | |
| 695.0 | 32 | 23 | 67940 | BROWN SILTY GRAVEL |
| | 34 | | | |
| 690.0 | 36 | 25 | 67941 | GRAVEL |

LOG OF BORING (CONTINUED)

BRIDGE NO. FRA-40-1230T.H. 20

| ELEV. | DEPTH | NO. BLOWS | SAMPLE NO. | DESCRIPTION |
|-------|-------|--------------|---------------|---------------------|
| | 38 | | | |
| | 40 | | | |
| 650.5 | | 75 | 67942 | SILTY GRAVEL |
| | 42 | | | ↑ BOTTOM OF HOLE |
| | 44 | | | |
| | 46 | | | |
| | 48 | | | |
| | 50 | | | |
| | 52 | | | |
| | 54 | | | |
| | 56 | | | |
| | 58 | | | |
| | 60 | | | |
| | 62 | | | |
| | 64 | | | |
| | 66 | | | |
| | 68 | | | |
| | 70 | | | |
| | 72 | | | |
| | 74 | | | |
| | 76 | | | |
| | 78 | | | |
| | 80 | | | |
| | 82 | | | |

APPENDIX V

LABORATORY TEST RESULTS



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

UNCONFINED COMPRESSION

ASTM D -2166

PROJECT

FRA-70-13.10 - Phase 6A

JOB No.

W-13-072

BORING / SAMPLE No.

B-016-7-13 / ST-8

SAMPLE DEPTH

17.9 ft.

DATE OF TESTING

1/30/2014

TESTED BY

JJH

Soil Description: Dark brown SILTY CLAY, little coarse to fine sand, trace fine gravel.
Soil Classification: ODOT A-6b

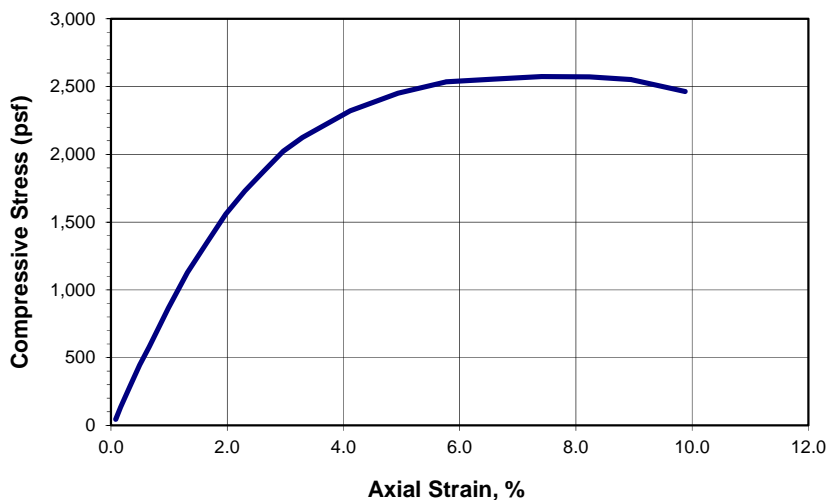
| Physical Characteristics | L.L. | P.L. | P.I. | Gravel% | C. Sand% | F. Sand% | Silt% | Clay% |
|--------------------------|------|------|------|---------|----------|----------|-------|-------|
| | 40 | 23 | 19 | 1 | 2 | 18 | 40 | 39 |

| | | | | | |
|---|------------------------|-----------------------|---------------------|--------|--------------------|
| DIAMETER, D ₀ | 2.860 in | 72.6 mm | STRAIN RATE | 1.00 | %/min |
| AREA, A ₀ | 6.424 in ² | 41.4 cm ² | WET SOIL + PAN MASS | 1300.4 | g |
| HEIGHT, L ₀ | 6.073 in | 154.3 mm | PAN MASS | 77.9 | g |
| VOLUME, V ₀ | 39.015 in ³ | 639.3 cm ³ | DRY SOIL + PAN MASS | 1026.8 | g |
| MACH. RATE | 0.607 | in/min | WET DENSITY | 119.37 | lb/ft ³ |
| WATER CONT. | 28.83 | % | DRY DENSITY | 92.65 | lb/ft ³ |
| UNCONFINED COMPRESSION STRESS, q _u | 2,574 | | psf | 1.29 | tsf |
| HAND PENETROMETER | | | | 2.00 | tsf |

Failure Sketch



Unconfined Compression Test





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

UNCONFINED COMPRESSION

ASTM D -2166

PROJECT

FRA-70-13.10 - Phase 6A

JOB No.

W-13-072

BORING / SAMPLE No.

B-113-9-13 / ST-7

SAMPLE DEPTH

16.4 ft

DATE OF TESTING

4/15/2014

TESTED BY

T.P.

Soil Description: Dark brown SILT AND CLAY, little coarse to fine sand, little fine gravel.
Soil Classification: ODOT A-6a

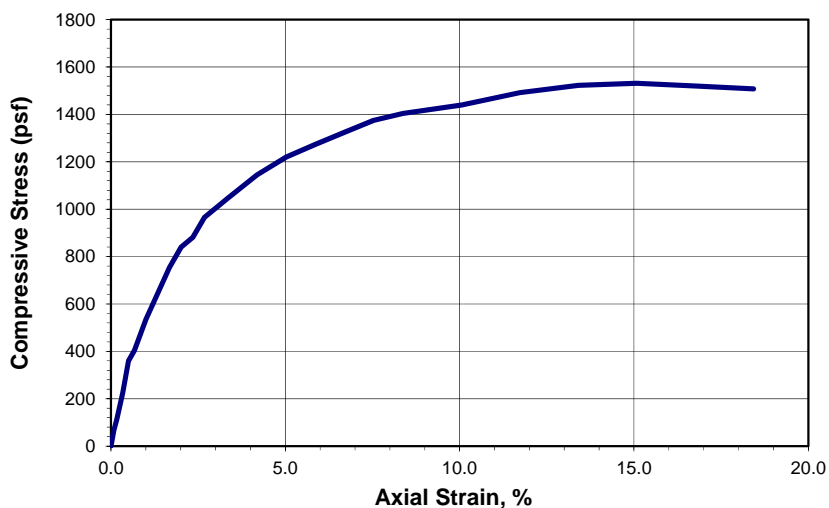
| Physical Characteristics | L.L. | P.L. | P.I. | Gravel% | C. Sand% | F. Sand% | Silt% | Clay% |
|--------------------------|------|------|------|---------|----------|----------|-------|-------|
| | 32 | 18 | 14 | 19 | 10 | 13 | 31 | 27 |

| | | | | | |
|--------------------------------------|------------------------|------------------------|---------------------|--------|--------------------|
| DIAMETER, D_0 | 2.852 in | 72.4 mm | STRAIN RATE | 1.00 | %/min |
| AREA, A_0 | 6.388 in ² | 41.2 cm ² | WET SOIL + PAN MASS | 1367.7 | g |
| HEIGHT, L_0 | 5.969 in | 151.61 mm | PAN MASS | 89 | g |
| VOLUME, V_0 | 38.132 in ³ | 624.87 cm ³ | DRY SOIL + PAN MASS | 1149.7 | g |
| MACH. RATE | 0.597 | in/min | WET DENSITY | 127.75 | lb/ft ³ |
| WATER CONT. | 20.55 | % | DRY DENSITY | 105.97 | lb/ft ³ |
| UNCONFINED COMPRESSION STRESS, q_u | 1,531 psf | | | 0.77 | tsf |
| HAND PENETROMETER | | | | 1.50 | tsf |

Failure Sketch



Unconfined Compression Test





One-Dimensional Consolidation Test Report (ASTM D2435)

Project Number: W-13-072

Boring Number: B-113-9-13

Project Name: FRA-70-13.10 - Phase 6A

Sample No. / Depth: ST-7 / 16.3

Project Location: Columbus, Ohio

Date of Testing: 04/07/2014 to 04/25/2014

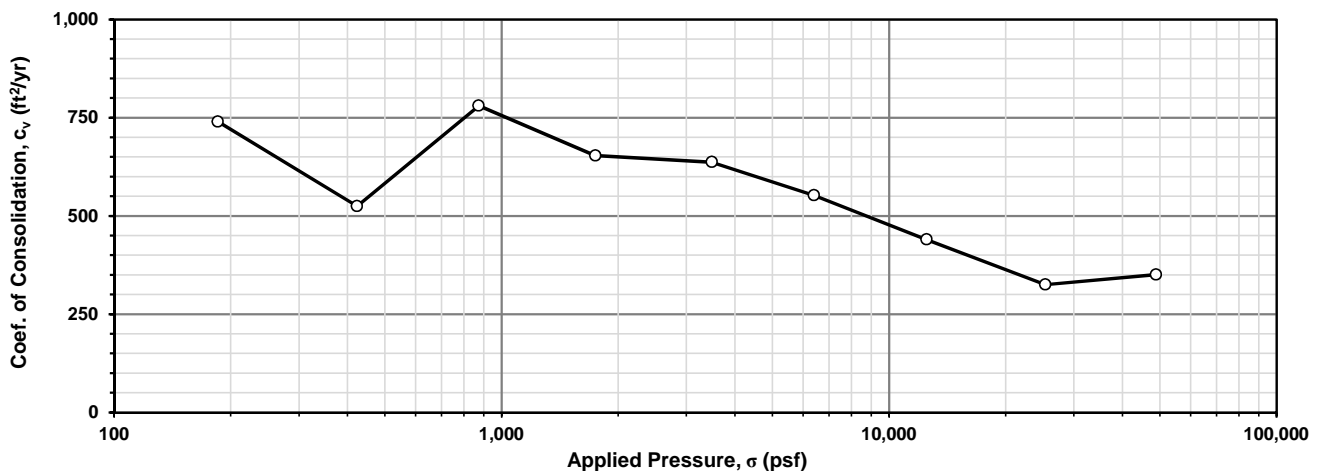
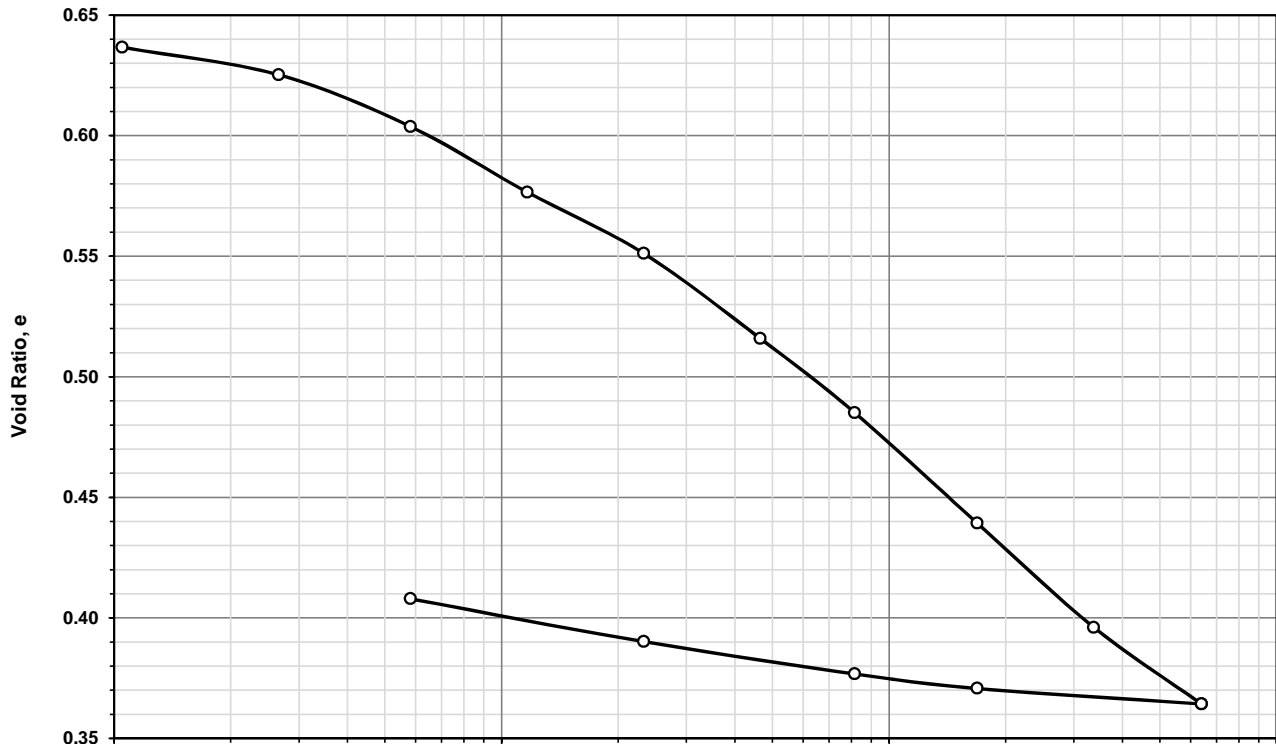
Client: ms consultants, inc.

Technician: Hoyt

Soil Description: Dark brown SILT AND CLAY, little 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% |
|--------------------------|------|------|------|---------|----------|----------|-------|-------|
| | 32 | 18 | 14 | 19 | 10 | 13 | 31 | 27 |

| Natural | | γ_d (pcf) | γ_{sat} (pcf) | σ_{vo}' (psf) | S_G | e_o | σ_p' (psf) | c_c | c_r |
|---------|-------|---------------------|-------------------------|-------------------------|-------|-------|----------------------|-------|-------|
| S_o | w_o | | | | | | | | |
| 91.2% | 18.3% | 101.7 | 123.9 | 1,793 | 2.67 | 0.638 | 1,973 | 0.165 | 0.022 |





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-70-13.10 - Project 6A

Project No.: W-13-072

Date of Testing: 6/23/2014

Test Performed by: K.R./T.K.

Rock Description: Dolomitic Limestone

Boring No.: B-113-4-13

Sample No.: RC-2

Depth (ft): 78.3

Moisture condition: As received

Average Length: 3.967 in

Average Diameter: 1.859 in

Length to diameter ratio: 2.134

Cross Sectional Area: 2.713 in²

Rate of Loading: 56.3 lbs/sec

Testing Time: 370 sec

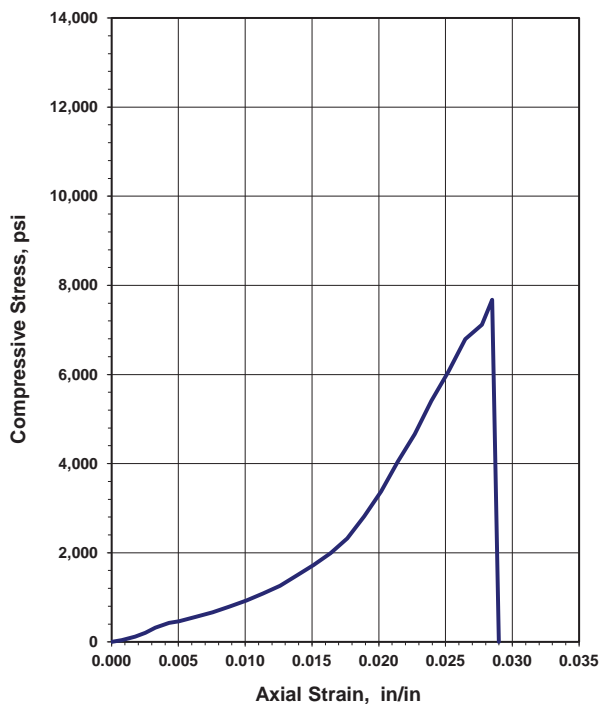
(Rate 2-15 minutes to failure)

Failure Load: 20,830 lbs

Axial Strain at Failure: 0.0285 in/in

Stress: 7,676 psi

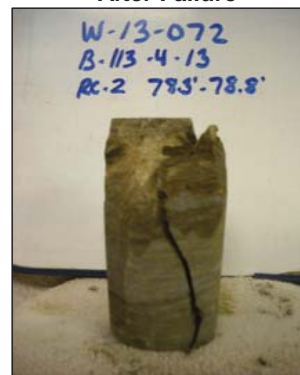
Unconfined Compression Test



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.

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-70-13.10 - Project 6A

Project No.: W-13-072

Date of Testing: 6/20/2014

Test Performed by: K.R./T.K.

Rock Description: Dolomitic Limestone

Boring No.: B-113-5-13

Sample No.: RC-4

Depth (ft): 75.7

Moisture condition: As received

Average Length: 4.047 in

Average Diameter: 1.849 in

Length to diameter ratio: 2.189

Cross Sectional Area: 2.684 in²

Rate of Loading: 49.5 lbs/sec

Testing Time: 472 sec

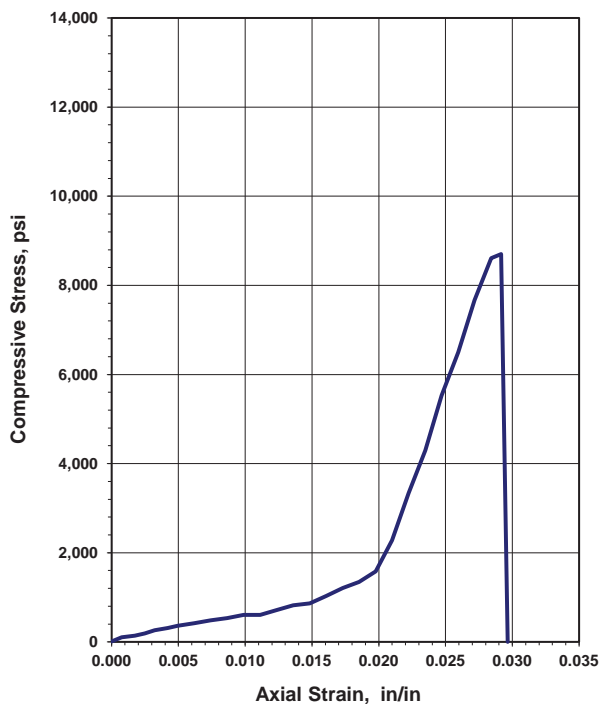
(Rate 2-15 minutes to failure)

Failure Load: 23,360 lbs

Axial Strain at Failure: 0.0292 in/in

Stress: 8,702 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.

Columbus, OH 43231

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Cincinnati, Ohio 45242

Phone (513) 769-6998

Project: FRA-70-13.10 - Project 6A

Project No.: W-13-072

Date of Testing: 6/20/2014

Test Performed by: K.R./T.K.

Rock Description: Dolomitic Limestone

Boring No.: B-113-5-13

Sample No.: RC-5

Depth (ft): 80.7

Moisture condition: As received

Average Length: 4.05 in

Average Diameter: 1.862 in

Length to diameter ratio: 2.175

Cross Sectional Area: 2.722 in²

Rate of Loading: 49.1 lbs/sec

Testing Time: 443 sec

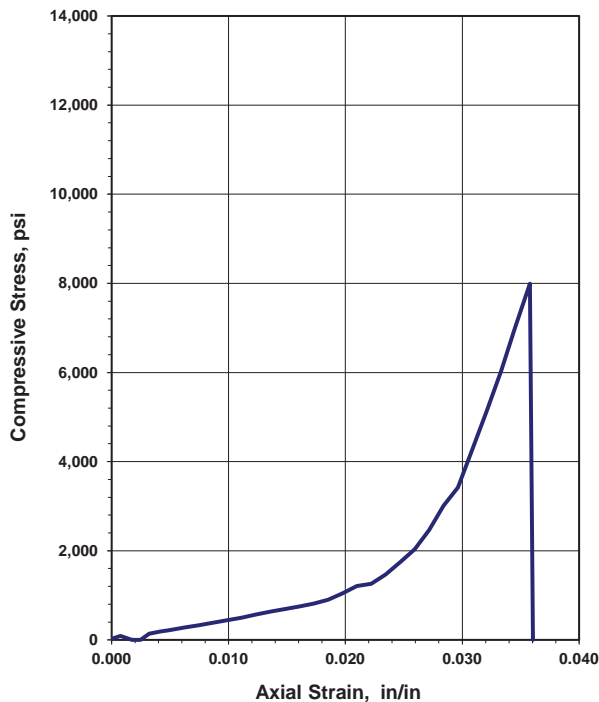
(Rate 2-15 minutes to failure)

Failure Load: 21,760 lbs

Axial Strain at Failure: 0.0358 in/in

Stress: 7,992 psi

Unconfined Compression Test



Before Testing



After Failure



REMARKS: _____



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

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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-70-13.10 - Project 6A

Project No.: W-13-072

Date of Testing: 5/7/2014

Test Performed by: K.R./T.K.

Rock Description: Dolomitic Limestone

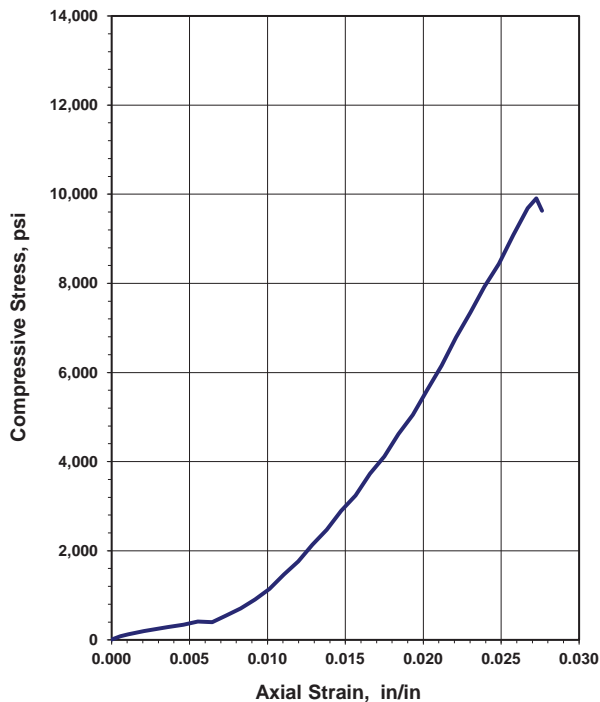
Boring No.: B-113-6-13
Sample No.: RC-1
Depth (ft): 45.9
Moisture condition: As received

Average Length: 5.431 in
Average Diameter: 2.468 in
Length to diameter ratio: 2.201
Cross Sectional Area: 4.781 in²

Rate of Loading: 76.1 lbs/sec
Testing Time: 623 sec
(Rate 2-15 minutes to failure)

Failure Load: 47,380 lbs
Axial Strain at Failure: 0.0273 in/in
Stress: 9,906 psi

Unconfined Compression Test



Before Testing



After Failure



REMARKS: _____



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Project: FRA-70-13.10 - Project 6A

Project No.: W-13-072

Date of Testing: 5/7/2014

Test Performed by: K.R./T.K.

Rock Description: Dolomitic Limestone

Boring No.: B-113-6-13

Sample No.: RC-2

Depth (ft): 50.7

Moisture condition: As received

Average Length: 5.305 in

Average Diameter: 2.485 in

Length to diameter ratio: 2.135

Cross Sectional Area: 4.848 in²

Rate of Loading: 79.3 lbs/sec

Testing Time: 700 sec

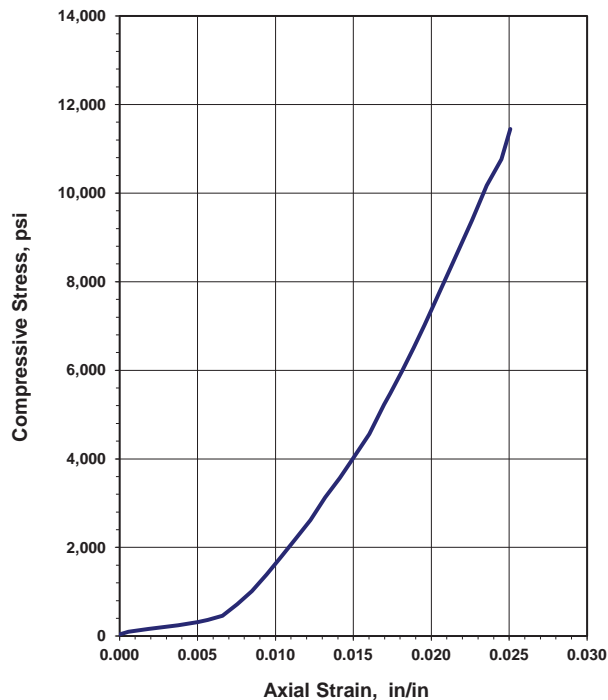
(Rate 2-15 minutes to failure)

Failure Load: 55,510 lbs

Axial Strain at Failure: 0.0251 in/in

Stress: 11,448 psi

Unconfined Compression Test



Before Testing



After Failure



REMARKS: _____



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

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Phone (513) 769-6998

Project: FRA-70-13.10 - Project 6A

Project No.: W-13-072

Date of Testing: 5/7/2014

Test Performed by: K.R./T.K.

Rock Description: Dolomitic Limestone

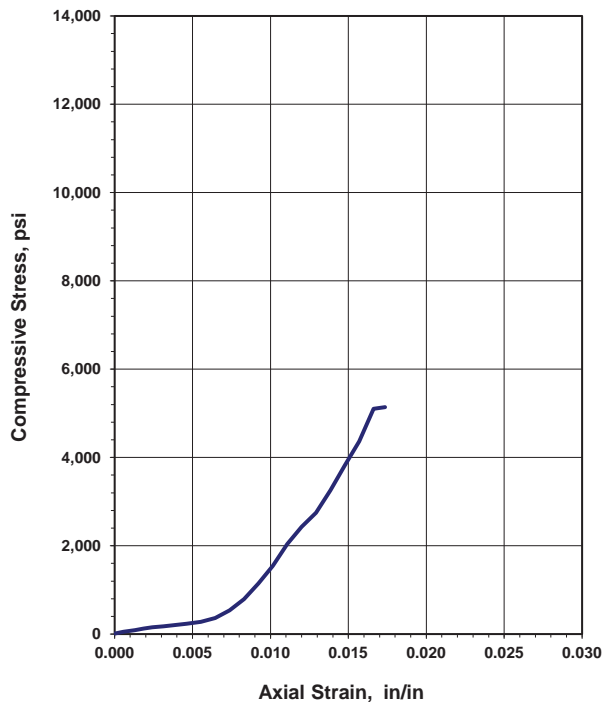
Boring No.: B-113-6-13
Sample No.: RC-3
Depth (ft): 54.8
Moisture condition: As received

Average Length: 5.417 in
Average Diameter: 2.493 in
Length to diameter ratio: 2.173
Cross Sectional Area: 4.879 in²

Rate of Loading: 69.7 lbs/sec
Testing Time: 360 sec
(Rate 2-15 minutes to failure)

Failure Load: 25,080 lbs
Axial Strain at Failure: 0.0174 in/in
Stress: 5,140 psi

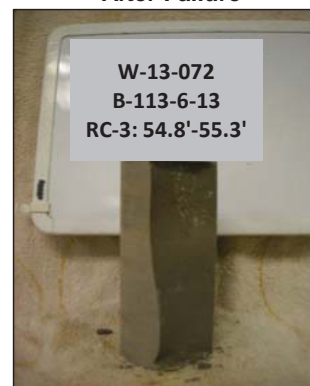
Unconfined Compression Test



Before Testing

Photo Not Available

After Failure



REMARKS: _____



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

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Project: FRA-70-13.10 - Project 6A

Project No.: W-13-072

Date of Testing: 5/7/2014

Test Performed by: K.R./T.K.

Rock Description: Limestone

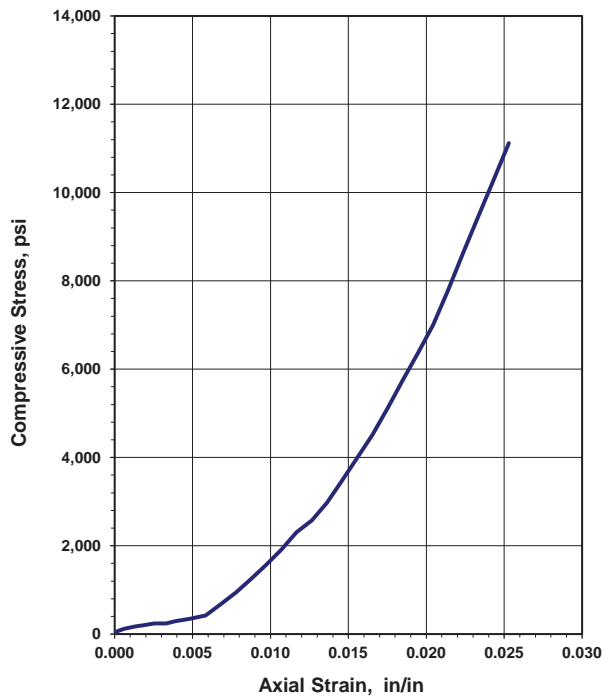
Boring No.: B-113-7-13
Sample No.: RC-5
Depth (ft): 42.2
Moisture condition: As received

Average Length: 5.139 in
Average Diameter: 2.478 in
Length to diameter ratio: 2.074
Cross Sectional Area: 4.820 in²

Rate of Loading: 82.5 lbs/sec
Testing Time: 650 sec
(Rate 2-15 minutes to failure)

Failure Load: 53,610 lbs
Axial Strain at Failure: 0.0253 in/in
Stress: 11,119 psi

Unconfined Compression Test



Before Testing



After Failure



REMARKS: _____



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

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Project: FRA-70-13.10 - Project 6A

Project No.: W-13-072

Date of Testing: 5/7/2014

Test Performed by: K.R./T.K.

Rock Description: Dolomitic Limestone

Boring No.: B-113-7-13

Sample No.: RC-6

Depth (ft): 50.2

Moisture condition: As received

Average Length: 5.478 in

Average Diameter: 2.483 in

Length to diameter ratio: 2.206

Cross Sectional Area: 4.840 in²

Rate of Loading: 72.5 lbs/sec

Testing Time: 658 sec

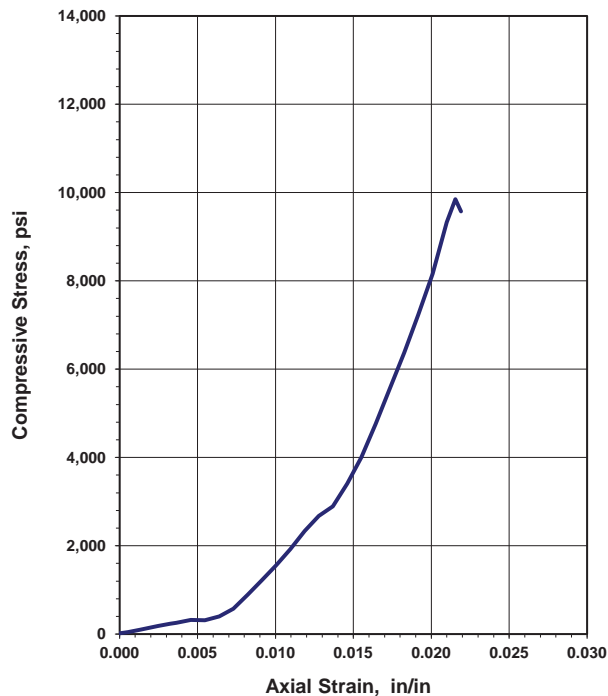
(Rate 2-15 minutes to failure)

Failure Load: 47,680 lbs

Axial Strain at Failure: 0.0215 in/in

Stress: 9,850 psi

Unconfined Compression Test



REMARKS: _____

Before Testing



After Failure





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Project: FRA-70-13.10 - Project 6A

Project No.: W-13-072

Date of Testing: 5/7/2014

Test Performed by: K.R./T.K.

Rock Description: Dolomitic Limestone

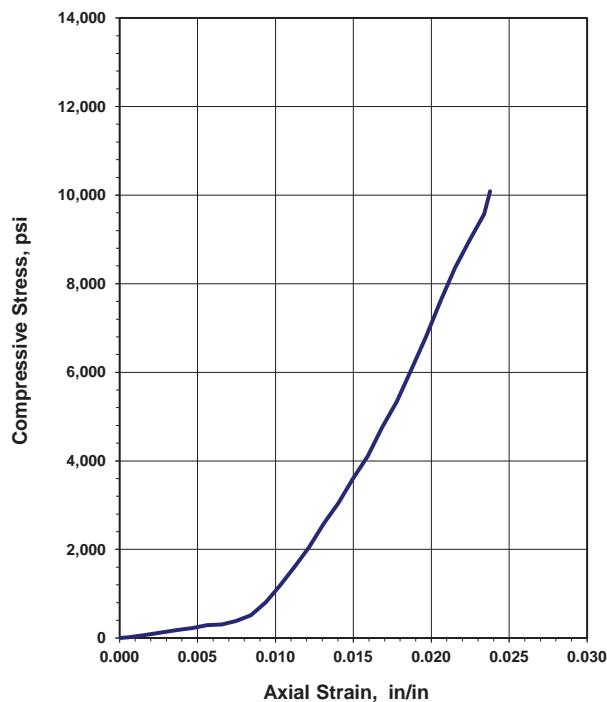
Boring No.: B-113-7-13
Sample No.: RC-7
Depth (ft): 51.2
Moisture condition: As received

Average Length: 5.342 in
Average Diameter: 2.483 in
Length to diameter ratio: 2.151
Cross Sectional Area: 4.840 in²

Rate of Loading: 73.5 lbs/sec
Testing Time: 664 sec
(Rate 2-15 minutes to failure)

Failure Load: 48,830 lbs
Axial Strain at Failure: 0.0238 in/in
Stress: 10,087 psi

Unconfined Compression Test



Before Testing



After Failure



REMARKS: _____



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

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Phone (513) 769-6998

Project: FRA-70-13.10 - Project 6A

Project No.: W-13-072

Date of Testing: 5/15/2014

Test Performed by: C.S./T.K.

Rock Description: Dolomitic Limestone

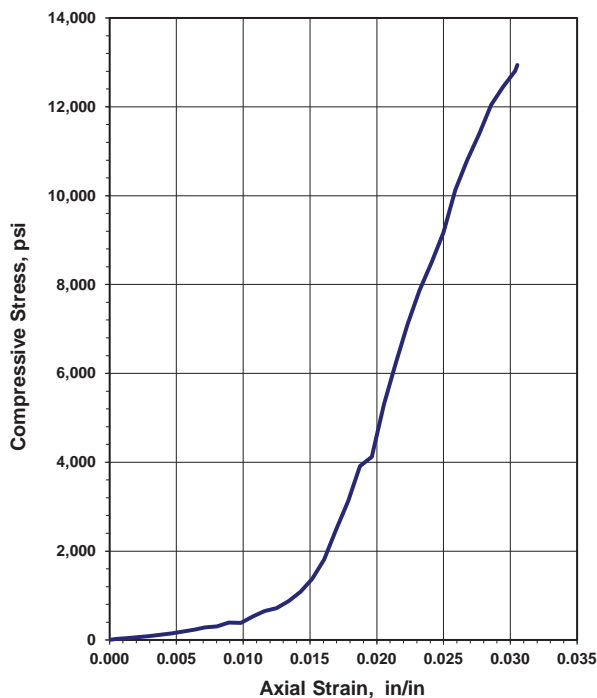
Boring No.: B-113-8-13
Sample No.: RC-4
Depth (ft): 47.1
Moisture condition: Dry

Average Length: 5.602 in
Average Diameter: 2.475 in
Length to diameter ratio: 2.263
Cross Sectional Area: 4.809 in²

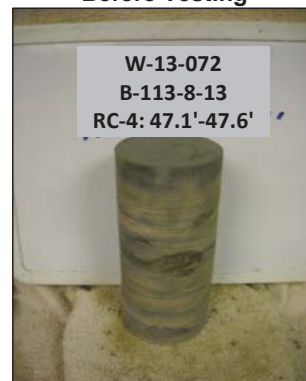
Rate of Loading: 75.2 lbs/sec
Testing Time: 828 sec
(Rate 2-15 minutes to failure)

Failure Load: 62,250 lbs
Axial Strain at Failure: 0.0305 in/in
Stress: 12,942 psi

Unconfined Compression Test



Before Testing



After Failure



REMARKS: _____



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Project: FRA-70-13.10 - Project 6A

Project No.: W-13-072

Date of Testing: 5/15/2014

Test Performed by: C.S./T.K.

Rock Description: Dolomitic Limestone

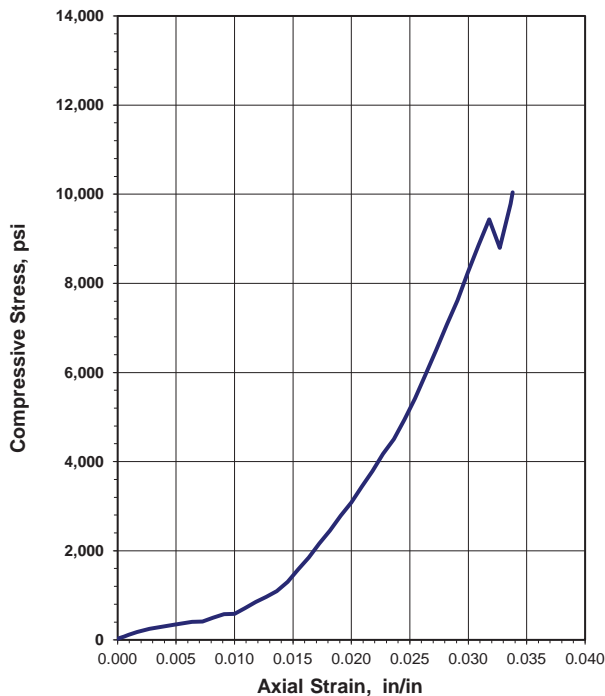
Boring No.: B-113-8-13
Sample No.: RC-5
Depth (ft): 52.3
Moisture condition: Dry

Average Length: 5.503 in
Average Diameter: 2.481 in
Length to diameter ratio: 2.218
Cross Sectional Area: 4.832 in²

Rate of Loading: 60.3 lbs/sec
Testing Time: 757 sec
(Rate 2-15 minutes to failure)

Failure Load: 45,620 lbs
Axial Strain at Failure: 0.0318 in/in
Stress: 9,438 psi

Unconfined Compression Test



Before Testing



After Failure



REMARKS: _____



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

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Phone (513) 769-6998

Project: FRA-70-13.10 - Project 6A
Project No.: W-13-072
Date of Testing: 5/15/2014
Test Performed by: C.S./T.K.

Rock Description: Dolomitic Limestone

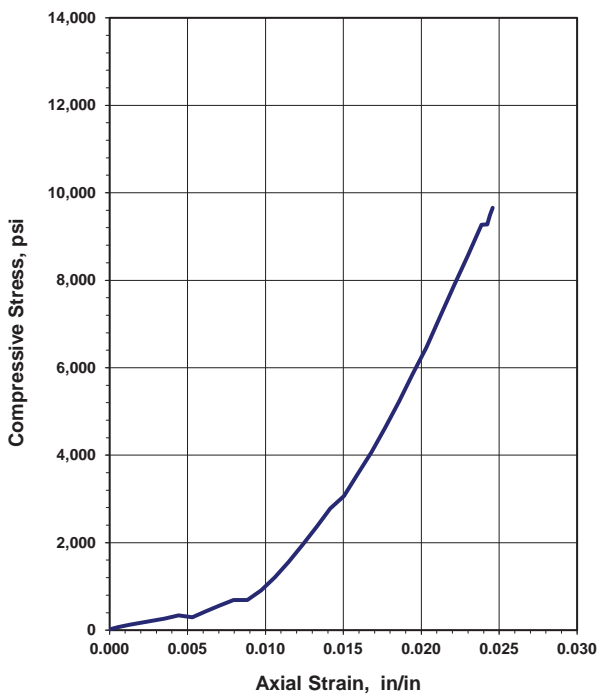
Boring No.: B-113-8-13
Sample No.: RC-6
Depth (ft): 56.8
Moisture condition: Dry

Average Length: 5.655 in
Average Diameter: 2.486 in
Length to diameter ratio: 2.275
Cross Sectional Area: 4.851 in²

Rate of Loading: 73.6 lbs/sec
Testing Time: 637 sec
(Rate 2-15 minutes to failure)

Failure Load: 46,860 lbs
Axial Strain at Failure: 0.0246 in/in
Stress: 9,657 psi

Unconfined Compression Test



Before Testing



After Failure



REMARKS: _____



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**Unconfined Compressive Strength
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Project: FRA-70-13.10 - Project 6A

Project No.: W-13-072

Date of Testing: 4/7/2014

Test Performed by: K.R./T.K.

Rock Description: Dolomitic Limestone

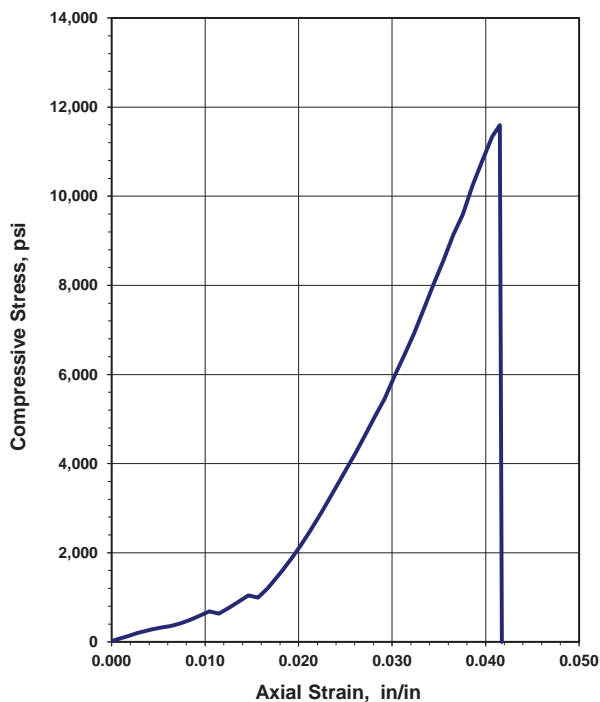
Boring No.: B-113-9-13
Sample No.: RC-2
Depth (ft): 61.8
Moisture condition: As received

Average Length: 4.792 in
Average Diameter: 2.396 in
Length to diameter ratio: 2.000
Cross Sectional Area: 4.507 in²

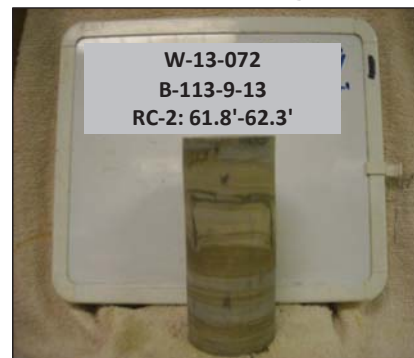
Rate of Loading: 106.7 lbs/sec
Testing Time: 490 sec
(Rate 2-15 minutes to failure)

Failure Load: 52,270 lbs
Axial Strain at Failure: 0.0415 in/in
Stress: 11,594 psi

Unconfined Compression Test



Before Testing



After Failure



REMARKS: _____



RESOURCE INTERNATIONAL, INC.
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**Unconfined Compressive Strength
of Intact Rock Core Specimens (ASTM D 7012-04)**

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Phone (216) 573-0955

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Phone (513) 769-6998

Project: FRA-70-13.10 - Project 6A

Project No.: W-13-072

Date of Testing: 4/7/2014

Test Performed by: K.R./T.K.

Rock Description: Dolomitic Limestone

Boring No.: B-113-9-13

Sample No.: RC-3

Depth (ft): 64.5

Moisture condition: As received

Average Length: 5.221 in

Average Diameter: 2.399 in

Length to diameter ratio: 2.176

Cross Sectional Area: 4.518 in²

Rate of Loading: 70.5 lbs/sec

Testing Time: 326 sec

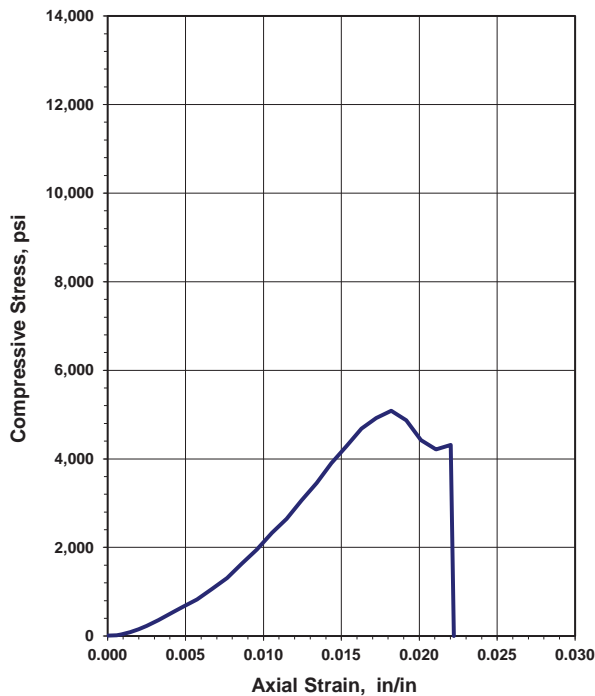
(Rate 2-15 minutes to failure)

Failure Load: 22,980 lbs

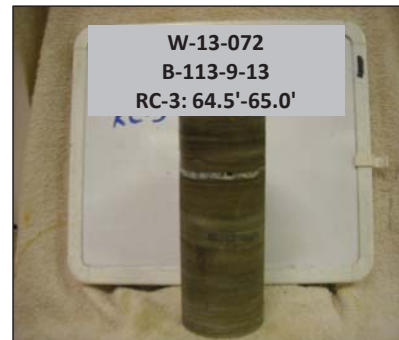
Axial Strain at Failure: 0.0182 in/in

Stress: 5,086 psi

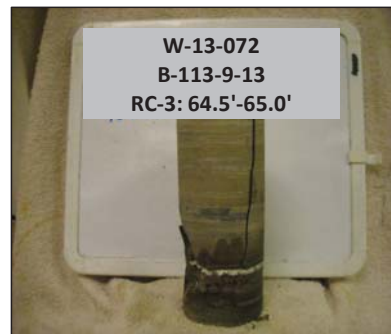
Unconfined Compression Test



Before Testing



After Failure



REMARKS: _____



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Phone (513) 769-6998

Project: FRA-70-13.10 - Project 6A

Project No.: W-13-072

Date of Testing: 6/20/2014

Test Performed by: K.R./T.K.

Rock Description: Dolomitic Limestone

Boring No.: B-114-1-13

Sample No.: RC-4

Depth (ft): 76.0

Moisture condition: As received

Average Length: 5.157 in

Average Diameter: 2.4 in

Length to diameter ratio: 2.149

Cross Sectional Area: 4.522 in²

Rate of Loading: 88.3 lbs/sec

Testing Time: 581 sec

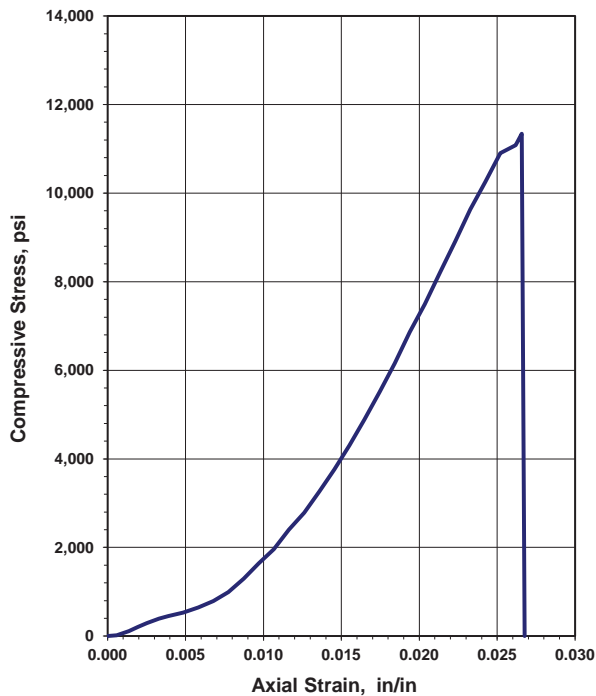
(Rate 2-15 minutes to failure)

Failure Load: 51,290 lbs

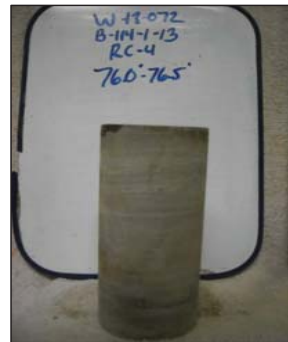
Axial Strain at Failure: 0.0266 in/in

Stress: 11,340 psi

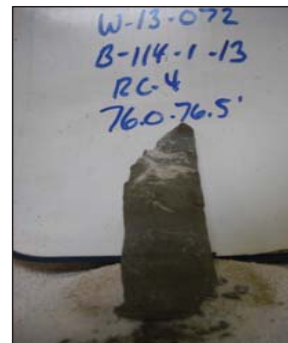
Unconfined Compression Test



Before Testing



After Failure



REMARKS: _____



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**Point Load Strength Index
of Rock Specimens
(ASTM D 5731-08)**

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Phone (216) 573-0955

4480 Lake Forest Drive
Cincinnati, Ohio 45242
Phone (513) 769-6998

Project: FRA-70 6A
Project No.: W-13-072
Date of Testing: 5/2/2014
Test Performed by: E.M.

Rock Description: Gray Shale

Boring No.: B-113-7-13
Sample No.: RC-3
Moisture condition: As received

Test Apparatus: Forney-LA 0080
Serial Number: A125/AZ/0014
Date of Calibration: 8/10/2013

| Sample No. | Test Type | Depth (ft) | Width (mm) | Diameter (mm) | Load (N) | D_e^2 (mm ²) | D_e (mm) | F | Is (MPa) | Is ₍₅₀₎ (MPa) | σ_c (MPa) |
|------------|-----------|------------|------------|---------------|----------|----------------------------|------------|------|----------|--------------------------|------------------|
| 1 | a \perp | 30.9-35.7 | 35.4 | 57.3 | 50 | 2,583 | 50.8 | 1.01 | 0.02 | 0.02 | 0.47 |
| 2 | a \perp | 30.9-35.7 | 42.5 | 63.0 | 50 | 3,409 | 58.4 | 1.07 | 0.01 | 0.02 | 0.36 |
| 3 | a \perp | 30.9-35.7 | 46.4 | 62.8 | 70 | 3,711 | 60.9 | 1.09 | 0.02 | 0.02 | 0.46 |
| 4 | a \perp | 30.9-35.7 | 48.0 | 64.9 | 90 | 3,967 | 63.0 | 1.11 | 0.02 | 0.03 | 0.56 |
| 5 | a \perp | 30.9-35.7 | 46.6 | 63.1 | 100 | 3,747 | 61.2 | 1.10 | 0.03 | 0.03 | 0.65 |
| 6 | | | | | | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | | | | | | |
| 10 | | | | | | | | | | | |

Specific Specimen Shape:

d = diametrical
a = axial
b = block
i = irregular lump
 \perp = perpendicular to bedding plane
 \parallel = parallel to bedding plane

Estimated Uniaxial Compression, $\sigma_c = K \cdot Is$

$$K = \frac{24.5}{\text{Per Table 1 of ASTM D5731}}$$

$$\text{Mean } \sigma_c = \boxed{0.50 \text{ MPa (73 psi)}}$$

STATISTICS

| | |
|-------------------------------------|------------------|
| Mean Is ₍₅₀₎ \perp | 0.02 MPa (3 psi) |
| Mean Is ₍₅₀₎ \parallel | |
| Is ₍₅₀₎ | |

Remarks: _____



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**Point Load Strength Index
of Rock Specimens
(ASTM D 5731-08)**

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Cincinnati, Ohio 45242
Phone (513) 769-6998

Project: FRA-70-13.10 - PHASE 6A

Project No.: W-13-072

Date of Testing: 6/19/2014

Test Performed by: E.M.

Rock Description: Gray Shale

Boring No.: B-114-1-13

Sample No.: RC-3

Moisture condition: As received

Test Apparatus: Forney-LA 0080

Serial Number: A125/AZ/0014

Date of Calibration: 8/10/2013

| Sample No. | Test Type | Depth (ft) | Width (mm) | Diameter (mm) | Load (N) | D_e^2 (mm ²) | D_e (mm) | F | I_s (MPa) | $I_{s(50)}$ (MPa) | σ_c (MPa) |
|------------|-----------|------------|------------|---------------|----------|----------------------------|------------|------|-------------|-------------------|------------------|
| 1 | a \perp | 73.0-74.0 | 26.6 | 61.0 | 350 | 2,066 | 45.5 | 0.96 | 0.17 | 0.16 | 4.15 |
| 2 | a \perp | 73.0-74.0 | 28.0 | 61.0 | 290 | 2,177 | 46.7 | 0.97 | 0.13 | 0.13 | 3.26 |
| 3 | a \perp | 73.0-74.0 | 25.0 | 61.0 | 275 | 1,941 | 44.1 | 0.94 | 0.14 | 0.13 | 3.47 |
| 4 | a \perp | 73.0-74.0 | 27.0 | 60.7 | 295 | 2,086 | 45.7 | 0.96 | 0.14 | 0.14 | 3.46 |
| 6 | | | | | | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | | | | | | |
| 10 | | | | | | | | | | | |

STATISTICS

Mean $I_{s(50)} \perp$

0.14 MPa (20 psi)

Mean $I_{s(50)} \parallel$

$I_{a(50)}$

Specific Specimen Shape:

d = diametrical

a = axial

b = block

i = irregular lump

\perp = perpendicular to bedding plane

\parallel = parallel to bedding plane

Estimated Uniaxial Compression, $\sigma_c = K \cdot I_s$

$K =$ 24.5

*Per Table 1 of ASTM D5731

Mean $\sigma_c =$ **3.59 MPa (520 psi)**

Remarks: _____

APPENDIX VI

DRILLED SHAFT CALCULATIONS

End Bearing Resistance in Bedrock: AASHTO LRFD Section 10.8.3.5.4

Intact Rock (Minimum Embedment $\geq 1.5B$): End Bearing on/in Limestone

$$q_p = 2.5q_u \quad \text{Equation 10.8.3.5.4c-1}$$

$$q_u = 732 \quad \text{ksf}$$

$$q_p = 1,831 \quad \text{ksf}$$

Jointed Rock (or Shafts with Embedment Depth $< 1.5B$): End Bearing on/in Limestone

$$q_p = A + q_u \left[m_b \left(\frac{A}{q_u} \right) + s \right]^a \quad \text{Equation 10.8.3.5.4c-2:}$$

$$A = \sigma'_{vb} + q_u \left[m_b \frac{\sigma'_{vb}}{q_u} + s \right]^a \quad \text{Equation 10.8.3.5.4c-3}$$

$$q_u = 732 \quad \text{ksf}$$

$$GSI = 70 \quad \text{Per Figure 10.4.6.4-1}$$

$$D = 0.0 \quad \text{Per Section 10.4.6.4 for undisturbed foundation excavation}$$

$$m_i = 9 \quad \text{Per Table 10.4.6.4-1}$$

$$s = 0.036 \quad \text{Per Equation 10.4.6.4-2}$$

$$a = 0.50 \quad \text{Per Equation 10.4.6.4-3}$$

$$m_b = 3.08 \quad \text{Per Equation 10.4.6.4-4}$$

$$\sigma'_{vb} = 2.10 \quad \text{ksf} \quad \text{Considering overburden depth of 33.5 feet and bouyant unit weight of overburden of 62.6 psf}$$

$$A = 155.9 \quad \text{ksf} \quad \text{Per Equation 10.8.3.5.4c-3}$$

$$q_p = 765 \quad \text{ksf}$$

Axial Geotechnical Resistance:

$$\text{Shaft Diameter, } D_s = 5.0 \quad \text{ft}$$

End Bearing on/within Limestone with Rock Socket Length $\geq 1.5B$:

$$R_R = \phi_p R_n = \phi_p R_p = \phi_p q_p A_p = 17,975 \quad \text{kips}$$

$$q_p = 1,831 \quad \text{ksf}$$

$$A_p = 19.6 \quad \text{ft}^2$$

$$\phi_p = 0.5$$

End Bearing on/within Limestone with Rock Socket Length $< 1.5B$:

$$R_R = \phi_p R_n = \phi_p R_p = \phi_p q_p A_p = 7,510 \quad \text{kips}$$

$$q_p = 765 \quad \text{ksf}$$

$$A_p = 19.6 \quad \text{ft}^2$$

$$\phi_p = 0.5$$

Axial Structural Resistance of Drilled Shaft within Rock Socket: AASHTO LRFD Section 5.6.4.4

Shaft Diameter, $D_s = 5.0$ ft

Reinforcing Steel Size: No. 10 Bars

$A_{bar} = 1.27$ in²

$N_{bar} = 28$ (Number of Bars)

$A_{st} = A_{bar}N_{bar} = 35.56$ in²

$$P_r = \phi_c P_n \quad \text{Equation 5.6.4.4-1}$$

$$P_n = 0.85[k_c f'_c (A_g - A_{st}) + f_y A_{st}] \quad \text{Equation 5.6.4.4-2}$$

$k_c = 0.85$ (For concrete strength less than 10.0 ksi)

$f'_c = 4.0$ ksi

$A_g = A_p = 19.6$ ft² = 2,827.43 in²

$A_{st} = 35.56$ in²

$f_y = 60$ ksi

$P_n = 9,882$ kips

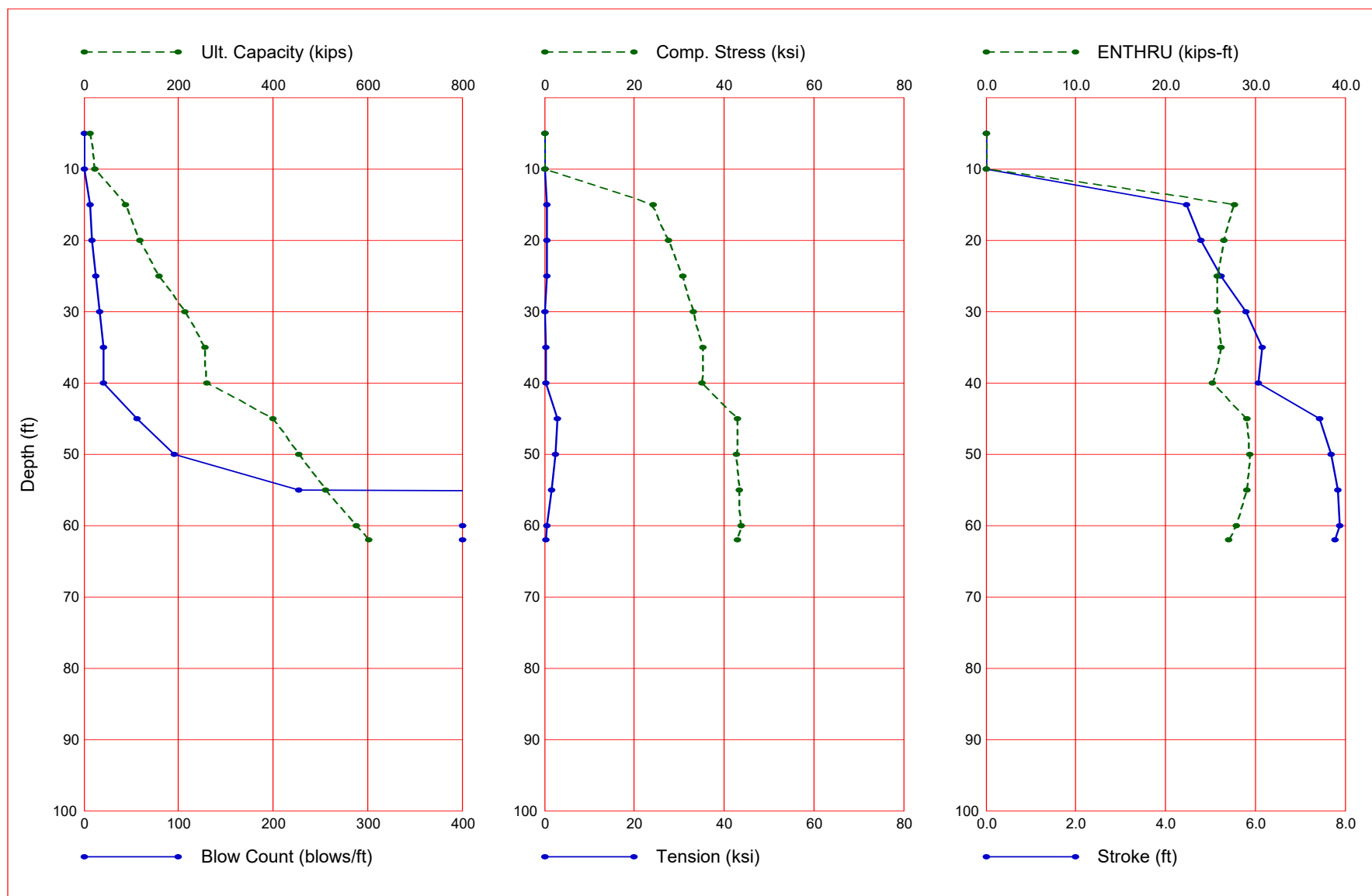
$\phi_p = 0.75$

$P_r = 7,412$ kips

APPENDIX VII

GRLWEAP DRIVEABILITY ANALYSIS OUTPUTS

Gain/Loss 3 at Shaft and Toe 0.670 / 1.000



Gain/Loss 3 at Shaft and Toe 0.670 / 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 | 12.3 | 3.7 | 8.6 | -1.0 | 0.000 | 0.000 | 0.00 | 0.0 |
| 10.0 | 22.6 | 19.7 | 2.9 | -1.0 | 0.000 | 0.000 | 0.00 | 0.0 |
| 15.0 | 89.0 | 57.6 | 31.4 | 6.8 | 24.308 | -0.546 | 4.47 | 27.7 |
| 20.0 | 118.0 | 83.6 | 34.5 | 9.0 | 27.643 | -0.630 | 4.78 | 26.5 |
| 25.0 | 159.2 | 116.8 | 42.3 | 12.3 | 30.734 | -0.443 | 5.24 | 25.8 |
| 30.0 | 213.8 | 155.5 | 58.3 | 16.9 | 33.200 | 0.000 | 5.80 | 25.8 |
| 35.0 | 257.1 | 198.8 | 58.3 | 20.8 | 35.219 | -0.366 | 6.15 | 26.2 |
| 40.0 | 259.6 | 253.4 | 6.2 | 20.9 | 35.089 | -0.301 | 6.07 | 25.2 |
| 45.0 | 399.1 | 335.6 | 63.5 | 56.7 | 42.913 | -2.876 | 7.43 | 29.1 |
| 50.0 | 455.6 | 392.1 | 63.5 | 95.5 | 42.818 | -2.385 | 7.70 | 29.4 |
| 55.0 | 511.3 | 453.0 | 58.3 | 227.6 | 43.422 | -1.546 | 7.85 | 29.1 |
| 60.0 | 575.9 | 517.6 | 58.3 | 9999.0 | 43.743 | -0.622 | 7.88 | 27.9 |
| 62.0 | 603.0 | 544.6 | 58.3 | 9999.0 | 43.082 | -0.303 | 7.77 | 27.0 |

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.
Copyright (c) 1998-2010, Pile Dynamics, Inc.

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

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

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

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

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

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

Input File: J:\GEOTECH\PROJECTS\2013\W-13-072 FRA-70-13.10 PROJECT 6A\ANALYSIS\FRA-70-1322L AND 1323C\DRIVEABILITY\FRA-70-1322L\REAR ABUTMENT\HP 10X42\1322L-RA-10X42.GW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-1322L - Rear Abutment - 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 14 0 3 0 0 0 0 1 0 1 0 0 0 0 0 0 0.000
Pile g Hammer g Toe Area Pile Size Pile Type
32.170 32.170 144.000 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
62.000 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 30-23 1 5
Ram Wt Ram L Ram Dia MaxStrk RtdStrk Efficy
6.60 118.10 16.51 13.44 11.18 0.80
IB. Wt IB. L IB. Dia IB CoR IB R0
1.20 25.00 16.51 0.900 0.010
CompStrk A Chamber V Chamber C Delay C Duratn Exp Coeff VolCStart Vol CEnd
16.30 214.03 280.90 0.0010 0.0020 1.250 0.00 0.00
P atm P1 P2 P3 P4 P5
14.70 1550.00 1395.00 1255.00 1130.00 0.00
Stroke Effic. Pressure R-Weight T-Delay Exp-Coeff Eps-Str Total-AW
11.1800 0.8000 1255.0000 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

| 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 |
| 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 |
| 62.00 | 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

| Hammer Model: | | D 30-23 | | Made by: | DELMAG |
|---------------|----------------|------------------|-------|-------------|-----------------|
| No. | Weight kips | Stiffn k/inch | CoR | C-Slk ft | Dampg k/ft/s |
| 1 | 1.320 | | | | |
| 2 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| 3 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| 4 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| 5 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| lock | 1.200 | 127693.0 | 0.900 | 0.0100 | |
| t | 1.900 | 60155.0 | 0.800 | 0.0100 | 10.0 |
| ned Pile | Top | 9183.3 | | | |

| | | | |
|--------------------|-----------|--------------------------|-----------|
| Hammer File ID No. | 14 | Hammer Type | OE Diesel |
| Stroke Option | FxdP-VarS | Stroke Convergence Crit. | 0.010 |
| Fuel Pump Setting | Max - 2 | | |

| | | | | | |
|----------------------|--------|---------|--------------------|--------|---------|
| Ram Weight | (kips) | 6.60 | Ram Length | (inch) | 118.10 |
| Maximum Stroke | (ft) | 13.44 | | | |
| Rated Stroke | (ft) | 11.18 | Efficiency | | 0.800 |
| Maximum Pressure | (psi) | 1550.00 | Actual Pressure | (psi) | 1255.00 |
| Compression Exponent | | 1.350 | Expansion Exponent | | 1.250 |

1322L-RA-10X42

| | | | | |
|------------------|--------|---------|-------------------|-------------|
| Ram Diameter | (inch) | 16.51 | | |
| Combustion Delay | (s) | 0.00100 | 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-70-1322L - Rear Abutment - HP10x42
 Resource International Inc

02/28/2021
 GRLWEAP Version 2010

| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 5.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 12.3 |
|-----|--------|------------------------|----------------|--------|--------|------------------|
| | 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 | 0.138 | 9183 0.010 0.000 0.85 | 0.0 | 0.000 | 0.100 | 3.26 3.3 12.4 |
| 2 | 0.138 | 9183 0.000 0.000 1.00 | 0.0 | 0.000 | 0.100 | 6.53 3.3 12.4 |
| 18 | 0.138 | 9183 0.000 0.000 1.00 | 0.4 | 0.050 | 0.100 | 58.74 3.3 12.4 |
| 19 | 0.138 | 9183 0.000 0.000 1.00 | 3.2 | 0.050 | 0.100 | 62.00 3.3 12.4 |
| Toe | | | 8.6 | 0.150 | 0.100 | |

2.627 kips total unreduced pile weight (g= 32.17 ft/s2)
 2.627 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 | 11.18 | 0.81 | 0.800 |

FRA-70-1322L - Rear Abutment - HP10x42
 Resource International Inc

02/28/2021
 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 |
| 12.3 | Hammer did not run | | | | | |
| 12.3 | Hammer did not run | | | | | |
| 12.3 | Hammer did not run | | | | | |
| 12.3 | Hammer did not run | | | | | |
| 12.3 | Hammer did not run | | | | | |

FRA-70-1322L - Rear Abutment - HP10x42
 Resource International Inc

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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 10.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|----------|-------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | Total Capacity | | Rut (kips) | | 21.9 | | | | | |
|---------------------|--------|----------------|-------|------------|------|--------|--------|-------|-------|-------|------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 1.8 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 4.9 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 12.3 | 0.150 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 2.9 | 0.150 | 0.100 | | | |

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

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 10.00 | 11.18 | 0.81 | 0.800 |

▲

FRA-70-1322L - Rear Abutment - HP10x42
Resource International Inc02/28/2021
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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 |
| 21.9 | Hammer | did not run | | | | | | | |
| 22.3 | Hammer | did not run | | | | | | | |
| 22.6 | Hammer | did not run | | | | | | | |
| 23.0 | Hammer | did not run | | | | | | | |
| 23.4 | Hammer | did not run | | | | | | | |

▲

FRA-70-1322L - Rear Abutment - HP10x42
Resource International Inc02/28/2021
GRLWEAP Version 2010

| Depth | (ft) | 15.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | Total Capacity | | Rut (kips) | | 84.9 | | | | | |
|---------------------|--------|----------------|-------|------------|------|--------|--------|-------|-------|-------|------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.6 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 3.5 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 6.6 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 21.4 | 0.193 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 21.5 | 0.182 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 31.4 | 0.150 | 0.100 | | | |

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

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 15.00 | 11.18 | 0.81 | 0.800 |

▲

FRA-70-1322L - Rear Abutment - HP10x42
Resource International Inc02/28/2021
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 |

| | | | | | | | | | | | | | |
|----------------|-----|------|------|-------|----|----|-------|----|---|------|------|--|--|
| 1322L-RA-10X42 | | | | | | | | | | | | | |
| 84.9 | 6.5 | 4.34 | 4.38 | -0.34 | 16 | 50 | 23.33 | 16 | 5 | 27.7 | 55.9 | | |
| 86.9 | 6.7 | 4.38 | 4.42 | -0.47 | 16 | 50 | 23.71 | 16 | 5 | 27.6 | 55.7 | | |
| 89.0 | 6.8 | 4.47 | 4.45 | -0.55 | 16 | 50 | 24.31 | 16 | 5 | 27.7 | 55.3 | | |
| 91.0 | 7.1 | 4.46 | 4.50 | -0.60 | 16 | 50 | 24.40 | 16 | 5 | 27.3 | 55.1 | | |
| 93.0 | 7.3 | 4.50 | 4.54 | -0.61 | 16 | 50 | 24.76 | 16 | 5 | 27.2 | 54.9 | | |

FRA-70-1322L - Rear Abutment - HP10x42
 Resource International Inc
 02/28/2021
 GRLWEAP Version 2010

Depth (ft) 20.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 114.0 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 42.42 | 3.3 | 12.4 |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 2.0 | 0.050 | 0.100 | 45.68 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 5.1 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 13.4 | 0.159 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 24.4 | 0.200 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 16.7 | 0.108 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 17.8 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 34.5 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 20.00 | 11.18 | 0.81 | 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 | |
| 114.0 | 8.5 | 4.71 | 4.75 | -0.72 | 14 45 | 27.06 | 16 5 | 26.7 |
| 116.0 | 8.8 | 4.74 | 4.79 | -0.69 | 14 45 | 27.32 | 16 5 | 26.6 |
| 118.0 | 9.0 | 4.78 | 4.82 | -0.63 | 14 45 | 27.64 | 16 5 | 26.5 |
| 120.1 | 9.2 | 4.82 | 4.85 | -0.61 | 14 43 | 27.99 | 16 5 | 26.5 |
| 122.1 | 9.4 | 4.86 | 4.88 | -0.59 | 14 43 | 28.30 | 16 5 | 26.4 |

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Depth (ft) 25.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 155.1 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.7 | 0.050 | 0.100 | 39.16 | 3.3 | 12.4 |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 3.7 | 0.050 | 0.100 | 42.42 | 3.3 | 12.4 |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 6.8 | 0.050 | 0.100 | 45.68 | 3.3 | 12.4 |

| 1322L-RA-10X42 | | | | | | | | | | | |
|----------------|-------|------|-------|-------|------|------|-------|-------|-------|-----|------|
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 22.4 | 0.195 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 20.9 | 0.177 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 16.3 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 19.4 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 22.5 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 42.3 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 25.00 | 11.18 | 0.81 | 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 |
| 155.1 | 11.8 | 5.17 | 5.18 | -0.64 | 13 | 39 | 30.18 | 15 | 5 | 25.9 |
| 157.1 | 12.0 | 5.20 | 5.22 | -0.55 | 13 | 39 | 30.43 | 15 | 5 | 25.8 |
| 159.2 | 12.3 | 5.24 | 5.25 | -0.44 | 13 | 38 | 30.73 | 15 | 5 | 25.8 |
| 161.2 | 12.5 | 5.27 | 5.28 | -0.33 | 13 | 38 | 31.03 | 15 | 5 | 25.8 |
| 163.2 | 12.8 | 5.30 | 5.31 | -0.20 | 12 | 38 | 31.29 | 15 | 5 | 25.7 |

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| Depth | (ft) | 30.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity | Rut | (kips) | 209.8 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|----------------|------|--------|-------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 | | |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 | | |
| 10 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.1 | 0.050 | 0.100 | 32.63 | 3.3 | 12.4 | | |
| 11 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 2.2 | 0.050 | 0.100 | 35.89 | 3.3 | 12.4 | | |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 5.3 | 0.050 | 0.100 | 39.16 | 3.3 | 12.4 | | |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 14.6 | 0.166 | 0.100 | 42.42 | 3.3 | 12.4 | | |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 24.4 | 0.200 | 0.100 | 45.68 | 3.3 | 12.4 | | |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 16.2 | 0.092 | 0.100 | 48.95 | 3.3 | 12.4 | | |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 18.0 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 | | |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 21.1 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 | | |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 23.9 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 | | |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 25.7 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 | | |
| Toe | | | | | | 58.3 | 0.150 | 0.100 | | | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 30.00 | 11.18 | 0.81 | 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 |
| 209.8 | 16.5 | 5.75 | 5.75 | 0.00 | 1 | 0 | 32.78 | 13 | 4 | 25.7 |
| 211.8 | 16.7 | 5.78 | 5.77 | 0.00 | 1 | 0 | 32.99 | 13 | 4 | 25.7 |
| 213.8 | 16.9 | 5.80 | 5.80 | 0.00 | 1 | 0 | 33.20 | 13 | 4 | 25.8 |
| 215.9 | 17.2 | 5.82 | 5.82 | 0.00 | 1 | 0 | 33.43 | 13 | 4 | 25.8 |
| 217.9 | 17.6 | 5.80 | 5.85 | 0.00 | 1 | 0 | 33.43 | 13 | 4 | 25.6 |

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Depth (ft) 35.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in²) 144.000 Pile Type Unknown
 Pile Size (inch) 10.000

| 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 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 253.1 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|-----------------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 9 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.8 | 0.050 | 0.100 | 29.37 | 3.3 | 12.4 |
| 10 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 3.9 | 0.050 | 0.100 | 32.63 | 3.3 | 12.4 |
| 11 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 7.0 | 0.050 | 0.100 | 35.89 | 3.3 | 12.4 |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 23.4 | 0.198 | 0.100 | 39.16 | 3.3 | 12.4 |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 20.3 | 0.171 | 0.100 | 42.42 | 3.3 | 12.4 |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 16.5 | 0.050 | 0.100 | 45.68 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 19.6 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 22.7 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 24.8 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 26.9 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 28.7 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 58.3 | 0.150 | 0.100 | | | |

2.627 kips total unredacted pile weight (g= 32.17 ft/s²)

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 35.00 | 11.18 | 0.81 | 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 | |
| 253.1 | 20.3 | 6.09 | 6.08 | 0.00 | 1 0 | 34.64 | 12 4 | 26.0 |
| 255.1 | 20.5 | 6.12 | 6.10 | -0.10 | 10 50 | 34.95 | 12 4 | 26.1 |
| 257.1 | 20.8 | 6.15 | 6.13 | -0.37 | 10 50 | 35.22 | 12 4 | 26.2 |
| 259.2 | 21.0 | 6.18 | 6.15 | -0.61 | 10 50 | 35.56 | 12 4 | 26.3 |
| 261.2 | 21.3 | 6.21 | 6.18 | -0.85 | 10 50 | 35.83 | 12 4 | 26.3 |

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Depth (ft) 40.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in²) 144.000 Pile Type Unknown
 Pile Size (inch) 10.000

| 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 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 253.9 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|-----------------|
| 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 | in ² |
| 1 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 7 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.1 | 0.050 | 0.100 | 22.84 | 3.3 | 12.4 |
| 8 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 2.4 | 0.050 | 0.100 | 26.11 | 3.3 | 12.4 |
| 9 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 5.5 | 0.050 | 0.100 | 29.37 | 3.3 | 12.4 |
| 10 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 15.7 | 0.172 | 0.100 | 32.63 | 3.3 | 12.4 |
| 11 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 24.4 | 0.200 | 0.100 | 35.89 | 3.3 | 12.4 |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 15.7 | 0.072 | 0.100 | 39.16 | 3.3 | 12.4 |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 18.2 | 0.050 | 0.100 | 42.42 | 3.3 | 12.4 |

| 1322L-RA-10X42 | | | | | | | | | | | | |
|----------------|-------|------|-------|-------|------|------|-------|-------|-------|-----|------|--|
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 21.3 | 0.050 | 0.100 | 45.68 | 3.3 | 12.4 | |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 24.0 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 | |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 25.9 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 | |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 27.9 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 | |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 29.7 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 | |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 37.0 | 0.127 | 0.100 | 62.00 | 3.3 | 12.4 | |
| Toe | | | | | | 6.2 | 0.150 | 0.100 | | | | |

2.627 kips total unredused pile weight (g= 32.17 ft/s2)

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 40.00 | 11.18 | 0.81 | 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 |
| 253.9 | 20.1 | 6.00 | 6.04 | 0.00 | 1 | 0 | 34.50 | 6 | 7 | 25.2 |
| 256.7 | 20.4 | 6.04 | 6.07 | -0.05 | 8 | 50 | 34.83 | 6 | 7 | 25.2 |
| 259.6 | 20.9 | 6.07 | 6.11 | -0.30 | 8 | 50 | 35.09 | 6 | 7 | 25.2 |
| 262.4 | 21.2 | 6.11 | 6.13 | -0.51 | 8 | 50 | 35.49 | 6 | 7 | 25.3 |
| 265.2 | 21.6 | 6.14 | 6.17 | -0.69 | 8 | 50 | 35.77 | 6 | 7 | 25.3 |

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| Depth | (ft) | 45.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | | 386.3 | |
|---------------------|----------------|----------------|-------------|-------------|------|---------------------------|----------------|---------------|-------------|-------------|-------------|--|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 | |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 | |
| 6 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 1.0 | 0.050 | 0.100 | 19.58 | 3.3 | 12.4 | |
| 7 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 4.1 | 0.050 | 0.100 | 22.84 | 3.3 | 12.4 | |
| 8 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 7.3 | 0.051 | 0.100 | 26.11 | 3.3 | 12.4 | |
| 9 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 24.4 | 0.200 | 0.100 | 29.37 | 3.3 | 12.4 | |
| 10 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 19.7 | 0.164 | 0.100 | 32.63 | 3.3 | 12.4 | |
| 11 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 16.7 | 0.050 | 0.100 | 35.89 | 3.3 | 12.4 | |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 19.8 | 0.050 | 0.100 | 39.16 | 3.3 | 12.4 | |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 22.9 | 0.050 | 0.100 | 42.42 | 3.3 | 12.4 | |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 24.9 | 0.050 | 0.100 | 45.68 | 3.3 | 12.4 | |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 27.0 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 | |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 28.8 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 | |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 30.6 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 | |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 48.2 | 0.188 | 0.100 | 58.74 | 3.3 | 12.4 | |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 47.4 | 0.180 | 0.100 | 62.00 | 3.3 | 12.4 | |
| Toe | | | | | | 63.5 | 0.150 | 0.100 | | | | |

2.627 kips total unredused pile weight (g= 32.17 ft/s2)

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 45.00 | 11.18 | 0.81 | 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 |
| 386.3 | 50.5 | 7.31 | 7.28 | -2.73 | 7 | 42 | 41.99 | 9 | 8 | 28.8 |
| 392.7 | 53.2 | 7.37 | 7.34 | -2.83 | 7 | 42 | 42.50 | 9 | 8 | 29.1 |
| 399.1 | 56.7 | 7.43 | 7.40 | -2.88 | 7 | 41 | 42.91 | 9 | 7 | 29.1 |

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 405.5 60.2 7.48 7.46 -2.95 7 41 43.35 9 7 29.3 43.0
 411.9 63.8 7.55 7.51 -3.02 7 41 43.84 9 7 29.5 42.8

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Depth (ft) 50.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 144.000 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 442.8 |
|-----|--------|------------------------|----------------|--------|--------|------------------|
| | 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 | 0.138 | 9183 0.010 0.000 0.85 | 0.0 | 0.000 | 0.100 | 3.26 3.3 12.4 |
| 2 | 0.138 | 9183 0.000 0.000 1.00 | 0.0 | 0.000 | 0.100 | 6.53 3.3 12.4 |
| 4 | 0.138 | 9183 0.000 0.000 1.00 | 0.2 | 0.050 | 0.100 | 13.05 3.3 12.4 |
| 5 | 0.138 | 9183 0.000 0.000 1.00 | 2.6 | 0.050 | 0.100 | 16.32 3.3 12.4 |
| 6 | 0.138 | 9183 0.000 0.000 1.00 | 5.7 | 0.050 | 0.100 | 19.58 3.3 12.4 |
| 7 | 0.138 | 9183 0.000 0.000 1.00 | 16.8 | 0.177 | 0.100 | 22.84 3.3 12.4 |
| 8 | 0.138 | 9183 0.000 0.000 1.00 | 24.4 | 0.200 | 0.100 | 26.11 3.3 12.4 |
| 9 | 0.138 | 9183 0.000 0.000 1.00 | 15.2 | 0.050 | 0.100 | 29.37 3.3 12.4 |
| 10 | 0.138 | 9183 0.000 0.000 1.00 | 18.4 | 0.050 | 0.100 | 32.63 3.3 12.4 |
| 11 | 0.138 | 9183 0.000 0.000 1.00 | 21.5 | 0.050 | 0.100 | 35.89 3.3 12.4 |
| 12 | 0.138 | 9183 0.000 0.000 1.00 | 24.1 | 0.050 | 0.100 | 39.16 3.3 12.4 |
| 13 | 0.138 | 9183 0.000 0.000 1.00 | 26.0 | 0.050 | 0.100 | 42.42 3.3 12.4 |
| 14 | 0.138 | 9183 0.000 0.000 1.00 | 28.0 | 0.050 | 0.100 | 45.68 3.3 12.4 |
| 15 | 0.138 | 9183 0.000 0.000 1.00 | 29.8 | 0.050 | 0.100 | 48.95 3.3 12.4 |
| 16 | 0.138 | 9183 0.000 0.000 1.00 | 38.4 | 0.138 | 0.100 | 52.21 3.3 12.4 |
| 17 | 0.138 | 9183 0.000 0.000 1.00 | 52.0 | 0.200 | 0.100 | 55.47 3.3 12.4 |
| 18 | 0.138 | 9183 0.000 0.000 1.00 | 38.8 | 0.104 | 0.100 | 58.74 3.3 12.4 |
| 19 | 0.138 | 9183 0.000 0.000 1.00 | 37.4 | 0.050 | 0.100 | 62.00 3.3 12.4 |
| Toe | | | 63.5 | 0.150 | 0.100 | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 50.00 | 11.18 | 0.81 | 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 |
| 442.8 | 81.9 | 7.61 7.58 | -2.30 | 6 39 | 42.06 | 7 7 | 29.2 | 42.7 |
| 449.2 | 87.9 | 7.66 7.63 | -2.35 | 6 39 | 42.48 | 7 7 | 29.3 | 42.6 |
| 455.6 | 95.5 | 7.70 7.67 | -2.39 | 6 39 | 42.82 | 7 7 | 29.4 | 42.4 |
| 462.0 | 103.3 | 7.75 7.71 | -2.42 | 6 38 | 43.20 | 7 7 | 29.6 | 42.3 |
| 468.4 | 113.0 | 7.80 7.75 | -2.45 | 6 38 | 43.52 | 7 7 | 29.7 | 42.2 |

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Depth (ft) 55.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 144.000 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 498.6 |
|-----|--------|------------------------|----------------|--------|--------|------------------|
| | | Stiffn C-Slk T-Slk CoR | Soil-S | Soil-D | Quake | LbTop Perim Area |

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| | kips | k/in | ft | ft | kips | s/ft | inch | ft | ft | in2 | |
|-----|-------|------|-------|-------|------|------|-------|-------|-------|-----|------|
| 1 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 3 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 1.1 | 0.050 | 0.100 | 9.79 | 3.3 | 12.4 |
| 4 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 4.3 | 0.050 | 0.100 | 13.05 | 3.3 | 12.4 |
| 5 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 8.5 | 0.091 | 0.100 | 16.32 | 3.3 | 12.4 |
| 6 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 24.4 | 0.200 | 0.100 | 19.58 | 3.3 | 12.4 |
| 7 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 19.1 | 0.156 | 0.100 | 22.84 | 3.3 | 12.4 |
| 8 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 17.0 | 0.050 | 0.100 | 26.11 | 3.3 | 12.4 |
| 9 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 20.0 | 0.050 | 0.100 | 29.37 | 3.3 | 12.4 |
| 10 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 23.1 | 0.050 | 0.100 | 32.63 | 3.3 | 12.4 |
| 11 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 25.0 | 0.050 | 0.100 | 35.89 | 3.3 | 12.4 |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 27.1 | 0.050 | 0.100 | 39.16 | 3.3 | 12.4 |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 29.0 | 0.050 | 0.100 | 42.42 | 3.3 | 12.4 |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 30.7 | 0.050 | 0.100 | 45.68 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 49.5 | 0.192 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 46.3 | 0.174 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 36.5 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 38.4 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 40.3 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 58.3 | 0.150 | 0.100 | | | |

2.627 kips total unredused pile weight (g= 32.17 ft/s2)

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 55.00 | 11.18 | 0.81 | 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 | |
| 498.6 | 174.1 | 7.77 | 7.74 | -1.52 | 4 36 | 42.81 | 6 7 | 28.8 |
| 504.9 | 198.8 | 7.81 | 7.77 | -1.52 | 4 36 | 43.10 | 6 7 | 28.9 |
| 511.3 | 227.6 | 7.85 | 7.79 | -1.55 | 4 36 | 43.42 | 6 7 | 29.1 |
| 517.7 | 274.6 | 7.88 | 7.83 | -1.52 | 4 36 | 43.60 | 6 7 | 29.1 |
| 524.1 | 331.9 | 7.91 | 7.85 | -1.54 | 4 36 | 43.87 | 6 7 | 29.1 |

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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 60.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | | | 563.2 |
|---------------------|----------------|----------------|-------------|-------------|------|---------------------------|----------------|---------------|-------------|-------------|-------------|-------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.2 | 0.050 | 0.100 | 3.26 | 3.3 | 12.4 | |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 2.8 | 0.050 | 0.100 | 6.53 | 3.3 | 12.4 | |
| 3 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 5.9 | 0.050 | 0.100 | 9.79 | 3.3 | 12.4 | |
| 4 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 17.9 | 0.182 | 0.100 | 13.05 | 3.3 | 12.4 | |
| 5 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 23.7 | 0.196 | 0.100 | 16.32 | 3.3 | 12.4 | |
| 6 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 15.4 | 0.050 | 0.100 | 19.58 | 3.3 | 12.4 | |
| 7 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 18.6 | 0.050 | 0.100 | 22.84 | 3.3 | 12.4 | |
| 8 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 21.7 | 0.050 | 0.100 | 26.11 | 3.3 | 12.4 | |
| 9 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 24.3 | 0.050 | 0.100 | 29.37 | 3.3 | 12.4 | |
| 10 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 26.1 | 0.050 | 0.100 | 32.63 | 3.3 | 12.4 | |
| 11 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 28.1 | 0.050 | 0.100 | 35.89 | 3.3 | 12.4 | |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 29.9 | 0.050 | 0.100 | 39.16 | 3.3 | 12.4 | |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 39.7 | 0.148 | 0.100 | 42.42 | 3.3 | 12.4 | |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 52.0 | 0.200 | 0.100 | 45.68 | 3.3 | 12.4 | |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 37.8 | 0.089 | 0.100 | 48.95 | 3.3 | 12.4 | |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 37.5 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 | |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 39.4 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 | |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 41.0 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 | |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 42.6 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 | |
| Toe | | | | | | 58.3 | 0.150 | 0.100 | | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 60.00 | 11.18 | 0.81 | 0.800 |

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| Rut kips | Bl Ct b/ft | Stroke (ft) down | Ten Str up | i t ksi | t Comp Str ksi | i t ENTHRU kip-ft | Bl Rt b/min |
|-------------|---------------|---------------------|---------------|------------|-------------------|-------------------------|----------------|
| 563.2 | 9999.0 | 7.85 | 7.78 | -0.65 | 3 34 | 43.46 | 4 6 28.2 |
| 569.5 | 9999.0 | 7.80 | 7.78 | -0.64 | 3 34 | 43.49 | 4 6 27.8 |
| 575.9 | 9999.0 | 7.88 | 7.80 | -0.62 | 3 33 | 43.74 | 4 6 27.9 |
| 582.3 | 9999.0 | 7.82 | 7.79 | -0.64 | 3 33 | 43.85 | 4 6 27.7 |
| 588.7 | 9999.0 | 7.83 | 7.81 | -0.60 | 3 33 | 44.07 | 4 4 27.6 |

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| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 62.0 | 11.18 | 0.81 | 0.800 |

PILE PROFILE:
Toe Area (in2) 144.000 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 1.6 | 0.050 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 4.7 | 0.050 | 0.100 | 6.53 | 3.3 | 12.4 |
| 3 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 11.1 | 0.138 | 0.100 | 9.79 | 3.3 | 12.4 |
| 4 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 24.4 | 0.200 | 0.100 | 13.05 | 3.3 | 12.4 |
| 5 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 17.8 | 0.135 | 0.100 | 16.32 | 3.3 | 12.4 |
| 6 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 17.4 | 0.050 | 0.100 | 19.58 | 3.3 | 12.4 |
| 7 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 20.5 | 0.050 | 0.100 | 22.84 | 3.3 | 12.4 |
| 8 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 23.4 | 0.050 | 0.100 | 26.11 | 3.3 | 12.4 |
| 9 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 25.3 | 0.050 | 0.100 | 29.37 | 3.3 | 12.4 |
| 10 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 27.4 | 0.050 | 0.100 | 32.63 | 3.3 | 12.4 |
| 11 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 29.2 | 0.050 | 0.100 | 35.89 | 3.3 | 12.4 |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 31.4 | 0.057 | 0.100 | 39.16 | 3.3 | 12.4 |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 52.0 | 0.200 | 0.100 | 42.42 | 3.3 | 12.4 |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 43.9 | 0.158 | 0.100 | 45.68 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 36.7 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 38.7 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 40.5 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 41.9 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 43.7 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 58.3 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 62.00 | 11.18 | 0.81 | 0.800 |

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| Rut kips | Bl Ct b/ft | Stroke (ft) down | Ten Str up | i t ksi | t Comp Str ksi | i t ENTHRU kip-ft | Bl Rt b/min |
|-------------|---------------|---------------------|---------------|------------|-------------------|-------------------------|----------------|
| 590.2 | 9999.0 | 7.75 | 7.73 | -0.31 | 2 33 | 42.80 | 3 6 27.1 |
| 596.6 | 9999.0 | 7.77 | 7.74 | -0.31 | 2 33 | 42.98 | 3 6 27.1 |
| 603.0 | 9999.0 | 7.77 | 7.75 | -0.30 | 2 32 | 43.08 | 3 6 27.0 |
| 609.3 | 9999.0 | 7.78 | 7.76 | -0.28 | 2 32 | 43.39 | 3 4 27.0 |
| 615.7 | 9999.0 | 7.83 | 7.78 | -0.22 | 2 32 | 43.79 | 3 4 27.0 |

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SUMMARY OVER DEPTHS

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | 0.604 | 1.000 | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|--------|---------|---------|--------|--------|
| ft | kip | kip | kip | bl/ft | ksi | ksi | | | ft | kip-ft |
| 5.0 | 12.3 | 3.7 | 8.6 | Hammer | did not | run | | | | |
| 10.0 | 21.9 | 19.0 | 2.9 | Hammer | did not | run | | | | |
| 15.0 | 84.9 | 53.5 | 31.4 | 6.5 | 23.326 | -0.339 | | | 4.34 | 27.7 |
| 20.0 | 114.0 | 79.5 | 34.5 | 8.5 | 27.058 | -0.721 | | | 4.71 | 26.7 |
| 25.0 | 155.1 | 112.7 | 42.3 | 11.8 | 30.175 | -0.637 | | | 5.17 | 25.9 |
| 30.0 | 209.8 | 151.4 | 58.3 | 16.5 | 32.776 | 0.000 | | | 5.75 | 25.7 |
| 35.0 | 253.1 | 194.7 | 58.3 | 20.3 | 34.640 | 0.000 | | | 6.09 | 26.0 |
| 40.0 | 253.9 | 247.7 | 6.2 | 20.1 | 34.505 | 0.000 | | | 6.00 | 25.2 |
| 45.0 | 386.3 | 322.8 | 63.5 | 50.5 | 41.992 | -2.732 | | | 7.31 | 28.8 |
| 50.0 | 442.8 | 379.3 | 63.5 | 81.9 | 42.062 | -2.297 | | | 7.61 | 29.2 |
| 55.0 | 498.6 | 440.2 | 58.3 | 174.1 | 42.812 | -1.518 | | | 7.77 | 28.8 |
| 60.0 | 563.2 | 504.8 | 58.3 | 9999.0 | 43.458 | -0.651 | | | 7.85 | 28.2 |
| 62.0 | 590.2 | 531.8 | 58.3 | 9999.0 | 42.795 | -0.314 | | | 7.75 | 27.1 |

Refusal occurred; no driving time output possible

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | 0.637 | 1.000 | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|--------|---------|---------|--------|--------|
| ft | kip | kip | kip | bl/ft | ksi | ksi | | | ft | kip-ft |
| 5.0 | 12.3 | 3.7 | 8.6 | Hammer | did not | run | | | | |
| 10.0 | 22.3 | 19.4 | 2.9 | Hammer | did not | run | | | | |
| 15.0 | 86.9 | 55.5 | 31.4 | 6.7 | 23.709 | -0.472 | | | 4.38 | 27.6 |
| 20.0 | 116.0 | 81.5 | 34.5 | 8.8 | 27.324 | -0.693 | | | 4.74 | 26.6 |
| 25.0 | 157.1 | 114.8 | 42.3 | 12.0 | 30.433 | -0.548 | | | 5.20 | 25.8 |
| 30.0 | 211.8 | 153.5 | 58.3 | 16.7 | 32.991 | 0.000 | | | 5.78 | 25.7 |
| 35.0 | 255.1 | 196.7 | 58.3 | 20.5 | 34.951 | -0.098 | | | 6.12 | 26.1 |
| 40.0 | 256.7 | 250.5 | 6.2 | 20.4 | 34.829 | -0.052 | | | 6.04 | 25.2 |
| 45.0 | 392.7 | 329.2 | 63.5 | 53.2 | 42.495 | -2.826 | | | 7.37 | 29.1 |
| 50.0 | 449.2 | 385.7 | 63.5 | 87.9 | 42.480 | -2.352 | | | 7.66 | 29.3 |
| 55.0 | 504.9 | 446.6 | 58.3 | 198.8 | 43.099 | -1.521 | | | 7.81 | 28.9 |
| 60.0 | 569.5 | 511.2 | 58.3 | 9999.0 | 43.491 | -0.644 | | | 7.80 | 27.8 |
| 62.0 | 596.6 | 538.2 | 58.3 | 9999.0 | 42.977 | -0.313 | | | 7.77 | 27.1 |

Refusal occurred; no driving time output possible



FRA-70-1322L - Rear Abutment - HP10x42

02/28/2021

Resource International Inc

GRLWEAP Version 2010

SUMMARY OVER DEPTHS

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | 0.670 | 1.000 | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|--------|---------|---------|--------|--------|
| ft | kip | kip | kip | bl/ft | ksi | ksi | | | ft | kip-ft |
| 5.0 | 12.3 | 3.7 | 8.6 | Hammer | did not | run | | | | |
| 10.0 | 22.6 | 19.7 | 2.9 | Hammer | did not | run | | | | |
| 15.0 | 89.0 | 57.6 | 31.4 | 6.8 | 24.308 | -0.546 | | | 4.47 | 27.7 |
| 20.0 | 118.0 | 83.6 | 34.5 | 9.0 | 27.643 | -0.630 | | | 4.78 | 26.5 |
| 25.0 | 159.2 | 116.8 | 42.3 | 12.3 | 30.734 | -0.443 | | | 5.24 | 25.8 |
| 30.0 | 213.8 | 155.5 | 58.3 | 16.9 | 33.200 | 0.000 | | | 5.80 | 25.8 |
| 35.0 | 257.1 | 198.8 | 58.3 | 20.8 | 35.219 | -0.366 | | | 6.15 | 26.2 |
| 40.0 | 259.6 | 253.4 | 6.2 | 20.9 | 35.089 | -0.301 | | | 6.07 | 25.2 |
| 45.0 | 399.1 | 335.6 | 63.5 | 56.7 | 42.913 | -2.876 | | | 7.43 | 29.1 |
| 50.0 | 455.6 | 392.1 | 63.5 | 95.5 | 42.818 | -2.385 | | | 7.70 | 29.4 |
| 55.0 | 511.3 | 453.0 | 58.3 | 227.6 | 43.422 | -1.546 | | | 7.85 | 29.1 |
| 60.0 | 575.9 | 517.6 | 58.3 | 9999.0 | 43.743 | -0.622 | | | 7.88 | 27.9 |
| 62.0 | 603.0 | 544.6 | 58.3 | 9999.0 | 43.082 | -0.303 | | | 7.77 | 27.0 |

Refusal occurred; no driving time output possible

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | 0.703 | 1.000 | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|--------|---------|---------|--------|--------|
| ft | kip | kip | kip | bl/ft | ksi | ksi | | | ft | kip-ft |
| 5.0 | 12.3 | 3.7 | 8.6 | Hammer | did not | run | | | | |
| 10.0 | 23.0 | 20.1 | 2.9 | Hammer | did not | run | | | | |
| 15.0 | 91.0 | 59.6 | 31.4 | 7.1 | 24.396 | -0.603 | | | 4.46 | 27.3 |
| 20.0 | 120.1 | 85.6 | 34.5 | 9.2 | 27.994 | -0.605 | | | 4.82 | 26.5 |
| 25.0 | 161.2 | 118.9 | 42.3 | 12.5 | 31.034 | -0.325 | | | 5.27 | 25.8 |
| 30.0 | 215.9 | 157.5 | 58.3 | 17.2 | 33.426 | 0.000 | | | 5.82 | 25.8 |
| 35.0 | 259.2 | 200.8 | 58.3 | 21.0 | 35.563 | -0.612 | | | 6.18 | 26.3 |
| 40.0 | 262.4 | 256.2 | 6.2 | 21.2 | 35.490 | -0.514 | | | 6.11 | 25.3 |
| 45.0 | 405.5 | 342.0 | 63.5 | 60.2 | 43.354 | -2.949 | | | 7.48 | 29.3 |
| 50.0 | 462.0 | 398.4 | 63.5 | 103.3 | 43.198 | -2.421 | | | 7.75 | 29.6 |
| 55.0 | 517.7 | 459.4 | 58.3 | 274.6 | 43.597 | -1.521 | | | 7.88 | 29.1 |
| 60.0 | 582.3 | 524.0 | 58.3 | 9999.0 | 43.854 | -0.641 | | | 7.82 | 27.7 |

1322L-RA-10X42
62.0 609.3 551.0 58.3 9999.0 43.385 -0.281 7.78 27.0

Refusal occurred; no driving time output possible

↑
FRA-70-1322L - Rear Abutment - HP10x42 02/28/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

| Depth | Rut | G/L at Frictn | End Bg | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|--------|--------|-------------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
| 5.0 | 12.3 | 3.7 | 8.6 | Hammer | did not run | | | |
| 10.0 | 23.4 | 20.4 | 2.9 | Hammer | did not run | | | |
| 15.0 | 93.0 | 61.7 | 31.4 | 7.3 | 24.762 | -0.610 | 4.50 | 27.2 |
| 20.0 | 122.1 | 87.6 | 34.5 | 9.4 | 28.302 | -0.586 | 4.86 | 26.4 |
| 25.0 | 163.2 | 120.9 | 42.3 | 12.8 | 31.294 | -0.201 | 5.30 | 25.7 |
| 30.0 | 217.9 | 159.6 | 58.3 | 17.6 | 33.432 | 0.000 | 5.80 | 25.6 |
| 35.0 | 261.2 | 202.9 | 58.3 | 21.3 | 35.829 | -0.848 | 6.21 | 26.3 |
| 40.0 | 265.2 | 259.0 | 6.2 | 21.6 | 35.767 | -0.690 | 6.14 | 25.3 |
| 45.0 | 411.9 | 348.4 | 63.5 | 63.8 | 43.841 | -3.017 | 7.55 | 29.5 |
| 50.0 | 468.4 | 404.8 | 63.5 | 113.0 | 43.524 | -2.447 | 7.80 | 29.7 |
| 55.0 | 524.1 | 465.8 | 58.3 | 331.9 | 43.871 | -1.539 | 7.91 | 29.1 |
| 60.0 | 588.7 | 530.4 | 58.3 | 9999.0 | 44.066 | -0.600 | 7.83 | 27.6 |
| 62.0 | 615.7 | 557.4 | 58.3 | 9999.0 | 43.786 | -0.221 | 7.83 | 27.0 |

Refusal occurred; no driving time output possible

↑
FRA-70-1322L - Rear Abutment - HP10x42 02/28/2021
Resource International Inc GRLWEAP Version 2010

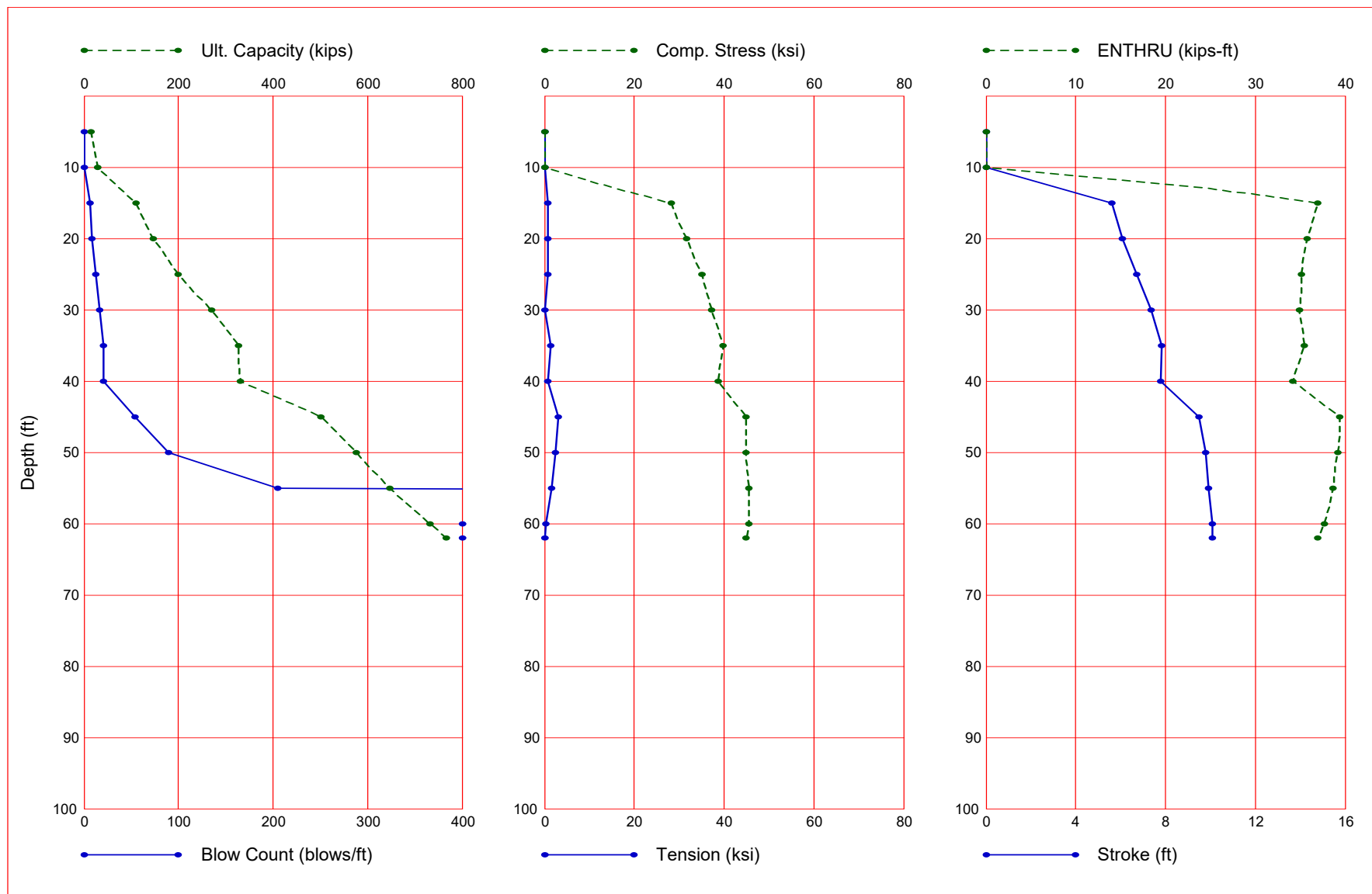
Table of Depths Analyzed with Driving System Modifiers

| Depth | Temp. Length | Wait Time | Equivalent Stroke | Pressure Ratio | Efficy. | Stiffn. Factor | Cushion CoR |
|-------|--------------|-----------|-------------------|----------------|---------|----------------|-------------|
| ft | ft | hr | ft | | | | |
| 5.00 | 62.00 | 0.00 | 11.18 | 0.81 | 0.80 | 1.00 | 1.00 |
| 10.00 | 62.00 | 0.00 | 11.18 | 0.81 | 0.80 | 1.00 | 1.00 |
| 15.00 | 62.00 | 0.00 | 11.18 | 0.81 | 0.80 | 1.00 | 1.00 |
| 20.00 | 62.00 | 0.00 | 11.18 | 0.81 | 0.80 | 1.00 | 1.00 |
| 25.00 | 62.00 | 0.00 | 11.18 | 0.81 | 0.80 | 1.00 | 1.00 |
| 30.00 | 62.00 | 0.00 | 11.18 | 0.81 | 0.80 | 1.00 | 1.00 |
| 35.00 | 62.00 | 0.00 | 11.18 | 0.81 | 0.80 | 1.00 | 1.00 |
| 40.00 | 62.00 | 0.00 | 11.18 | 0.81 | 0.80 | 1.00 | 1.00 |
| 45.00 | 62.00 | 0.00 | 11.18 | 0.81 | 0.80 | 1.00 | 1.00 |
| 50.00 | 62.00 | 0.00 | 11.18 | 0.81 | 0.80 | 1.00 | 1.00 |
| 55.00 | 62.00 | 0.00 | 11.18 | 0.81 | 0.80 | 1.00 | 1.00 |
| 60.00 | 62.00 | 0.00 | 11.18 | 0.81 | 0.80 | 1.00 | 1.00 |
| 62.00 | 62.00 | 0.00 | 11.18 | 0.81 | 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 | 0.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.01 | 0.81 | 15.53 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.09 | 0.81 | 15.66 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.11 | 3.75 | 2.91 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 14.09 | 3.75 | 2.91 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 14.11 | 1.26 | 29.42 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 19.09 | 1.73 | 40.36 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 19.11 | 1.71 | 32.93 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 24.49 | 2.19 | 42.20 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 24.51 | 2.20 | 42.22 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 29.09 | 2.41 | 43.36 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 29.11 | 2.45 | 58.35 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 38.11 | 2.91 | 58.35 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 39.09 | 2.96 | 58.35 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 39.11 | 8.00 | 6.20 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 44.09 | 8.00 | 6.20 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 44.11 | 3.24 | 63.52 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 53.11 | 3.73 | 63.52 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 54.49 | 3.81 | 63.52 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 54.51 | 3.76 | 58.35 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 62.00 | 4.14 | 58.35 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |

Gain/Loss 3 at Shaft and Toe 0.670 / 1.000



Gain/Loss 3 at Shaft and Toe 0.670 / 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 | 15.5 | 4.8 | 10.8 | -1.0 | 0.000 | 0.000 | 0.00 | 0.0 |
| 10.0 | 28.5 | 24.8 | 3.6 | -1.0 | 0.000 | 0.000 | 0.00 | 0.0 |
| 15.0 | 110.0 | 70.7 | 39.2 | 6.9 | 28.269 | -0.753 | 5.60 | 37.0 |
| 20.0 | 147.5 | 104.4 | 43.1 | 8.9 | 31.751 | -0.705 | 6.07 | 35.8 |
| 25.0 | 200.4 | 147.5 | 52.9 | 12.2 | 35.149 | -0.657 | 6.70 | 35.1 |
| 30.0 | 270.5 | 197.5 | 72.9 | 16.9 | 37.242 | 0.000 | 7.37 | 34.9 |
| 35.0 | 326.6 | 253.6 | 72.9 | 20.7 | 39.699 | -1.311 | 7.85 | 35.5 |
| 40.0 | 330.7 | 322.9 | 7.8 | 20.5 | 38.752 | -0.801 | 7.78 | 34.2 |
| 45.0 | 502.1 | 422.8 | 79.4 | 54.3 | 44.920 | -3.074 | 9.48 | 39.4 |
| 50.0 | 575.5 | 496.1 | 79.4 | 89.6 | 44.855 | -2.484 | 9.78 | 39.2 |
| 55.0 | 648.1 | 575.2 | 72.9 | 204.6 | 45.635 | -1.543 | 9.93 | 38.7 |
| 60.0 | 731.9 | 658.9 | 72.9 | 9999.0 | 45.609 | -0.364 | 10.10 | 37.7 |
| 62.0 | 766.9 | 694.0 | 72.9 | 9999.0 | 44.862 | -0.135 | 10.09 | 37.0 |

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\2013\W-13-072 FRA-70-13.10 PROJECT 6A\ANALYSIS\FRA-70-1322L AND 1323C\DRIVEABILITY\FRA-70-1322L\REAR ABUTMENT\HP 12X53\1322L-RA-12X53.GMW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW

Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-1322L - Rear Abutment - 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 14 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0.000
Pile g Hammer g Toe Area Pile Size Pile Type
32.170 32.170 144.000 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
62.000 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 30-23 1 5
Ram Wt Ram L Ram Dia MaxStrk RtdStrk Efficy
6.60 118.10 16.51 13.44 11.18 0.80
IB. Wt IB. L IB. Dia IB CoR IB R0
1.20 25.00 16.51 0.900 0.010
CompStrk A Chamber V Chamber C Delay C Duratn Exp Coeff VolCStart Vol CEnd
16.30 214.03 280.90 0.0010 0.0020 1.250 0.00 0.00
P atm P1 P2 P3 P4 P5
14.70 1550.00 1395.00 1255.00 1130.00 0.00
Stroke Effic. Pressure R-Weight T-Delay Exp-Coeff Eps-Str Total-AW
11.1800 0.8000 1550.0000 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 | 0.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 9.01 | 0.87 | 19.41 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 9.09 | 0.88 | 19.58 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 9.11 | 3.75 | 3.63 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 14.09 | 3.75 | 3.63 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 14.11 | 1.36 | 36.78 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 19.09 | 1.86 | 50.45 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 19.11 | 1.84 | 41.16 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 24.49 | 2.36 | 52.75 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 24.51 | 2.36 | 52.78 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 29.09 | 2.59 | 54.20 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 29.11 | 2.64 | 72.94 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 38.11 | 3.13 | 72.94 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 39.09 | 3.19 | 72.94 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 39.11 | 8.00 | 7.75 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 44.09 | 8.00 | 7.75 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 44.11 | 3.49 | 79.39 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 53.11 | 4.03 | 79.39 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 54.49 | 4.11 | 79.39 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 54.51 | 4.05 | 72.94 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 62.00 | 4.47 | 72.94 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |

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 |
|-------|------|------|-------|------|-------|-------|-------|
| 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 |
| 62.00 | 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-70-1322L - Rear Abutment - HP12x53

| Hammer Model: D 30-23 | | Made by: DELMAG | |
|-----------------------|----------------|------------------|-------|
| No. | Weight kips | Stiffn k/inch | CoR |
| 1 | 1.320 | | |
| 2 | 1.320 | 262846.5 | 1.000 |
| 3 | 1.320 | 262846.5 | 1.000 |
| 4 | 1.320 | 262846.5 | 1.000 |
| 5 | 1.320 | 262846.5 | 1.000 |
| Imp Block | 1.200 | 127693.0 | 0.900 |
| Helmet | 1.900 | 60155.0 | 0.800 |
| Combined Pile Top | | 11479.2 | |

HAMMER OPTIONS:
 Hammer File ID No. 14 Hammer Type OE Diesel
 Stroke Option FxdP-VarS Stroke Convergence Crit. 0.010
 Fuel Pump Setting Maximum

HAMMER DATA:
 Ram Weight (kips) 6.60 Ram Length (inch) 118.10
 Maximum Stroke (ft) 13.44
 Rated Stroke (ft) 11.18 Efficiency 0.800
 Maximum Pressure (psi) 1550.00 Actual Pressure (psi) 1550.00
 Compression Exponent 1.350 Expansion Exponent 1.250

1322L-RA-12X53

| | | | | |
|------------------|--------|---------|-------------------|-------------|
| Ram Diameter | (inch) | 16.51 | | |
| Combustion Delay | (s) | 0.00100 | 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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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 5.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 15.5 |
|-----|--------|------------------------|----------------|--------|--------|------------------|
| | 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 | 0.173 | 11479 0.010 0.000 0.85 | 0.0 | 0.000 | 0.100 | 3.26 4.0 15.5 |
| 2 | 0.173 | 11479 0.000 0.000 1.00 | 0.0 | 0.000 | 0.100 | 6.53 4.0 15.5 |
| 18 | 0.173 | 11479 0.000 0.000 1.00 | 0.6 | 0.050 | 0.100 | 58.74 4.0 15.5 |
| 19 | 0.173 | 11479 0.000 0.000 1.00 | 4.2 | 0.050 | 0.100 | 62.00 4.0 15.5 |
| Toe | | | 10.8 | 0.150 | 0.100 | |

3.283 kips total unredacted pile weight (g= 32.17 ft/s2)
 3.283 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 | |
| 5.00 | 11.18 | 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 |
| 15.5 | Hammer did not run | | | | | |
| 15.5 | Hammer did not run | | | | | |
| 15.5 | Hammer did not run | | | | | |
| 15.5 | Hammer did not run | | | | | |
| 15.5 | Hammer did not run | | | | | |

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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 10.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|----------|-------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | Total Capacity | Rut (kips) | 27.6 | | | | | |
|---------------------|--------|--------|-------|----------------|------------|--------|--------|-------|-------|-------|------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 2.3 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 6.4 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 15.3 | 0.147 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 3.6 | 0.150 | 0.100 | | | |

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

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 10.00 | 11.18 | 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 |
| 27.6 | Hammer | did not run | | | | | | | |
| 28.0 | Hammer | did not run | | | | | | | |
| 28.5 | Hammer | did not run | | | | | | | |
| 28.9 | Hammer | did not run | | | | | | | |
| 29.3 | 1.4 | 3.52 | 3.54 | 0.00 | 1 | 0 | 14.30 | 1 | 6 45.9 62.9 |

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| Depth | (ft) | 15.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | Total Capacity | Rut (kips) | 105.1 | | | | | |
|---------------------|--------|--------|-------|----------------|------------|--------|--------|-------|-------|-------|------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.7 | 0.050 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 4.5 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 8.5 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 25.8 | 0.192 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 26.3 | 0.181 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 39.2 | 0.150 | 0.100 | | | |

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

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 15.00 | 11.18 | 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 |

| | | | | | | | | | | | | | |
|----------------|-----|------|------|-------|----|----|-------|----|---|------|------|--|--|
| 1322L-RA-12X53 | | | | | | | | | | | | | |
| 105.1 | 6.5 | 5.49 | 5.54 | -0.81 | 16 | 50 | 27.71 | 16 | 5 | 37.2 | 50.1 | | |
| 107.5 | 6.7 | 5.55 | 5.59 | -0.79 | 16 | 50 | 28.04 | 16 | 5 | 37.1 | 49.8 | | |
| 110.0 | 6.9 | 5.60 | 5.64 | -0.75 | 16 | 48 | 28.27 | 16 | 5 | 37.0 | 49.6 | | |
| 112.4 | 7.1 | 5.65 | 5.69 | -0.72 | 16 | 48 | 28.53 | 16 | 5 | 36.8 | 49.4 | | |
| 114.9 | 7.3 | 5.70 | 5.73 | -0.67 | 16 | 48 | 28.78 | 17 | 5 | 36.8 | 49.2 | | |

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Depth (ft) 20.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 142.6 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 42.42 | 4.0 | 15.5 |
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 2.6 | 0.050 | 0.100 | 45.68 | 4.0 | 15.5 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 6.6 | 0.050 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 16.6 | 0.157 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 29.3 | 0.200 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 21.2 | 0.106 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 23.1 | 0.050 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 43.1 | 0.150 | 0.100 | | | |

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

Depth Stroke Pressure Efficy
 ft ft Ratio
 20.00 11.18 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 |
| 142.6 | 8.5 | 5.98 | 6.00 | -0.74 | 14 | 43 | 31.16 | 16 | 5 | 36.0 |
| 145.0 | 8.7 | 6.03 | 6.04 | -0.70 | 14 | 41 | 31.47 | 16 | 5 | 35.9 |
| 147.5 | 8.9 | 6.07 | 6.08 | -0.71 | 14 | 41 | 31.75 | 16 | 5 | 35.8 |
| 149.9 | 9.2 | 6.11 | 6.13 | -0.71 | 15 | 40 | 32.05 | 16 | 5 | 35.8 |
| 152.4 | 9.4 | 6.16 | 6.16 | -0.74 | 14 | 40 | 32.33 | 16 | 5 | 35.7 |

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Depth (ft) 25.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 195.5 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 12 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.9 | 0.050 | 0.100 | 39.16 | 4.0 | 15.5 |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 4.7 | 0.050 | 0.100 | 42.42 | 4.0 | 15.5 |
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 8.8 | 0.050 | 0.100 | 45.68 | 4.0 | 15.5 |

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| | | | | | | | | | | | |
|-----|-------|-------|-------|-------|------|------|-------|-------|-------|-----|------|
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 27.0 | 0.195 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 25.6 | 0.175 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 21.1 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 25.2 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 29.2 | 0.050 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 52.9 | 0.150 | 0.100 | | | |

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

| | | | |
|-------|--------|----------|--------|
| Depth | Stroke | Pressure | Efficy |
| ft | ft | Ratio | |
| 25.00 | 11.18 | 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 |
| 195.5 | 11.7 | 6.62 | 6.58 | -0.86 | 13 | 35 | 34.53 | 15 | 5 | 35.3 |
| 197.9 | 12.0 | 6.66 | 6.63 | -0.80 | 13 | 35 | 34.81 | 15 | 5 | 35.2 |
| 200.4 | 12.2 | 6.70 | 6.67 | -0.66 | 13 | 35 | 35.15 | 15 | 5 | 35.1 |
| 202.8 | 12.4 | 6.74 | 6.71 | -0.49 | 13 | 35 | 35.43 | 15 | 5 | 35.0 |
| 205.3 | 12.6 | 6.78 | 6.75 | -0.31 | 13 | 35 | 35.78 | 15 | 5 | 35.0 |

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| | | | |
|------------------------|------|-------|----------------------|
| Depth | (ft) | 30.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| | | | | | | | | | | |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------------|
| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) 265.5 |
| No. | Weight | Stiffn | C-Slk | T-Slk | CoR | Soil-S | Soil-D | Quake | LbTop | Perim |
| | kips | k/in | ft | ft | | kips | s/ft | inch | ft | ft |
| 1 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 |
| 10 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.1 | 0.050 | 0.100 | 32.63 | 4.0 |
| 11 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 2.8 | 0.050 | 0.100 | 35.89 | 4.0 |
| 12 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 6.9 | 0.050 | 0.100 | 39.16 | 4.0 |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 17.9 | 0.164 | 0.100 | 42.42 | 4.0 |
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 29.3 | 0.200 | 0.100 | 45.68 | 4.0 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 20.7 | 0.090 | 0.100 | 48.95 | 4.0 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 23.3 | 0.050 | 0.100 | 52.21 | 4.0 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 27.3 | 0.050 | 0.100 | 55.47 | 4.0 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 30.9 | 0.050 | 0.100 | 58.74 | 4.0 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 33.3 | 0.050 | 0.100 | 62.00 | 4.0 |
| Toe | | | | | | 72.9 | 0.150 | 0.100 | | |

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

| | | | |
|-------|--------|----------|--------|
| Depth | Stroke | Pressure | Efficy |
| ft | ft | Ratio | |
| 30.00 | 11.18 | 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 |
| 265.5 | 16.5 | 7.28 | 7.33 | 0.00 | 1 | 0 | 36.68 | 13 | 4 | 34.7 |
| 268.0 | 16.7 | 7.33 | 7.36 | 0.00 | 1 | 0 | 36.99 | 13 | 4 | 34.9 |
| 270.5 | 16.9 | 7.37 | 7.39 | 0.00 | 1 | 0 | 37.24 | 13 | 4 | 34.9 |
| 272.9 | 17.1 | 7.41 | 7.43 | 0.00 | 1 | 0 | 37.48 | 13 | 4 | 34.9 |
| 275.4 | 17.3 | 7.45 | 7.46 | 0.00 | 1 | 0 | 37.74 | 13 | 4 | 35.0 |

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Depth (ft) 35.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | 321.7 | | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 9 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 1.1 | 0.050 | 0.100 | 29.37 | 4.0 | 15.5 |
| 10 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 5.0 | 0.050 | 0.100 | 32.63 | 4.0 | 15.5 |
| 11 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 9.1 | 0.050 | 0.100 | 35.89 | 4.0 | 15.5 |
| 12 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 28.2 | 0.198 | 0.100 | 39.16 | 4.0 | 15.5 |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 24.9 | 0.169 | 0.100 | 42.42 | 4.0 | 15.5 |
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 21.4 | 0.050 | 0.100 | 45.68 | 4.0 | 15.5 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 25.4 | 0.050 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 29.4 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 32.1 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 34.8 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 37.2 | 0.050 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 72.9 | 0.150 | 0.100 | | | |

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

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 35.00 | 11.18 | 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 |
| 321.7 | 20.0 | 7.78 | 7.76 | -1.42 | 10 | 49 | 39.07 | 12 | 4 35.5 |
| 324.1 | 20.3 | 7.82 | 7.79 | -1.36 | 10 | 49 | 39.38 | 12 | 4 35.5 |
| 326.6 | 20.7 | 7.85 | 7.83 | -1.31 | 10 | 48 | 39.70 | 12 | 4 35.5 |
| 329.0 | 20.9 | 7.89 | 7.85 | -1.29 | 10 | 48 | 39.97 | 12 | 4 35.6 |
| 331.5 | 21.2 | 7.92 | 7.89 | -1.28 | 10 | 47 | 40.29 | 12 | 4 35.6 |

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Depth (ft) 40.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | 323.9 | | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 7 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.1 | 0.050 | 0.100 | 22.84 | 4.0 | 15.5 |
| 8 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 3.1 | 0.050 | 0.100 | 26.11 | 4.0 | 15.5 |
| 9 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 7.2 | 0.050 | 0.100 | 29.37 | 4.0 | 15.5 |
| 10 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 19.3 | 0.171 | 0.100 | 32.63 | 4.0 | 15.5 |
| 11 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 29.3 | 0.200 | 0.100 | 35.89 | 4.0 | 15.5 |
| 12 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 20.2 | 0.071 | 0.100 | 39.16 | 4.0 | 15.5 |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 23.6 | 0.050 | 0.100 | 42.42 | 4.0 | 15.5 |

| 1322L-RA-12X53 | | | | | | | | | | | |
|----------------|-------|-------|-------|-------|------|------|-------|-------|-------|-----|------|
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 27.6 | 0.050 | 0.100 | 45.68 | 4.0 | 15.5 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 31.1 | 0.050 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 33.5 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 36.2 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 38.5 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 46.6 | 0.124 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 7.8 | 0.150 | 0.100 | | | |

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

| | | | |
|-------|--------|----------|--------|
| Depth | Stroke | Pressure | Efficy |
| ft | ft | Ratio | |
| 40.00 | 11.18 | 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 |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|----|---|------------------|----------------|
| 323.9 | 19.7 | 7.69 | 7.71 | -0.83 | 8 | 50 | 38.25 | 10 | 4 | 34.2 | 42.5 |
| 327.3 | 20.0 | 7.73 | 7.74 | -0.80 | 8 | 49 | 38.55 | 10 | 4 | 34.3 | 42.4 |
| 330.7 | 20.5 | 7.78 | 7.79 | -0.80 | 8 | 48 | 38.75 | 10 | 3 | 34.2 | 42.2 |
| 334.1 | 20.8 | 7.82 | 7.83 | -0.83 | 8 | 48 | 39.06 | 10 | 3 | 34.3 | 42.1 |
| 337.4 | 21.1 | 7.86 | 7.86 | -0.87 | 8 | 47 | 39.37 | 10 | 4 | 34.6 | 42.0 |

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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 45.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 486.8 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 6 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 1.3 | 0.050 | 0.100 | 19.58 | 4.0 | 15.5 |
| 7 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 5.3 | 0.050 | 0.100 | 22.84 | 4.0 | 15.5 |
| 8 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 9.4 | 0.051 | 0.100 | 26.11 | 4.0 | 15.5 |
| 9 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 29.3 | 0.200 | 0.100 | 29.37 | 4.0 | 15.5 |
| 10 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 24.3 | 0.162 | 0.100 | 32.63 | 4.0 | 15.5 |
| 11 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 21.7 | 0.050 | 0.100 | 35.89 | 4.0 | 15.5 |
| 12 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 25.7 | 0.050 | 0.100 | 39.16 | 4.0 | 15.5 |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 29.6 | 0.050 | 0.100 | 42.42 | 4.0 | 15.5 |
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 32.3 | 0.050 | 0.100 | 45.68 | 4.0 | 15.5 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 35.0 | 0.050 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 37.4 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 39.7 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 58.5 | 0.187 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 57.9 | 0.178 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 79.4 | 0.150 | 0.100 | | | |

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

| | | | |
|-------|--------|----------|--------|
| Depth | Stroke | Pressure | Efficy |
| ft | ft | Ratio | |
| 45.00 | 11.18 | 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 | |
| 486.8 | 48.8 | 9.34 | 9.33 | -2.96 | 7 | 38 | 44.04 | 9 | 3 | 39.0 | 38.7 |
| 494.5 | 51.1 | 9.40 | 9.38 | -3.07 | 7 | 38 | 44.51 | 9 | 3 | 39.4 | 38.5 |
| 502.1 | 54.3 | 9.48 | 9.46 | -3.07 | 7 | 38 | 44.92 | 9 | 3 | 39.4 | 38.4 |

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509.8 57.1 9.53 9.51 -3.18 7 38 45.33 9 3 39.7 38.3
517.5 60.8 9.60 9.59 -3.17 7 38 45.72 9 3 39.8 38.1

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FRA-70-1322L - Rear Abutment - HP12x53 02/28/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 50.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 560.1 |
|-----|--------|------------------------|----------------|--------|--------|------------------|
| | 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 | 0.173 | 11479 0.010 0.000 0.85 | 0.0 | 0.000 | 0.100 | 3.26 4.0 15.5 |
| 2 | 0.173 | 11479 0.000 0.000 1.00 | 0.0 | 0.000 | 0.100 | 6.53 4.0 15.5 |
| 4 | 0.173 | 11479 0.000 0.000 1.00 | 0.2 | 0.050 | 0.100 | 13.05 4.0 15.5 |
| 5 | 0.173 | 11479 0.000 0.000 1.00 | 3.3 | 0.050 | 0.100 | 16.32 4.0 15.5 |
| 6 | 0.173 | 11479 0.000 0.000 1.00 | 7.4 | 0.050 | 0.100 | 19.58 4.0 15.5 |
| 7 | 0.173 | 11479 0.000 0.000 1.00 | 20.5 | 0.176 | 0.100 | 22.84 4.0 15.5 |
| 8 | 0.173 | 11479 0.000 0.000 1.00 | 29.3 | 0.200 | 0.100 | 26.11 4.0 15.5 |
| 9 | 0.173 | 11479 0.000 0.000 1.00 | 19.7 | 0.050 | 0.100 | 29.37 4.0 15.5 |
| 10 | 0.173 | 11479 0.000 0.000 1.00 | 23.8 | 0.050 | 0.100 | 32.63 4.0 15.5 |
| 11 | 0.173 | 11479 0.000 0.000 1.00 | 27.8 | 0.050 | 0.100 | 35.89 4.0 15.5 |
| 12 | 0.173 | 11479 0.000 0.000 1.00 | 31.2 | 0.050 | 0.100 | 39.16 4.0 15.5 |
| 13 | 0.173 | 11479 0.000 0.000 1.00 | 33.7 | 0.050 | 0.100 | 42.42 4.0 15.5 |
| 14 | 0.173 | 11479 0.000 0.000 1.00 | 36.3 | 0.050 | 0.100 | 45.68 4.0 15.5 |
| 15 | 0.173 | 11479 0.000 0.000 1.00 | 38.6 | 0.050 | 0.100 | 48.95 4.0 15.5 |
| 16 | 0.173 | 11479 0.000 0.000 1.00 | 48.1 | 0.135 | 0.100 | 52.21 4.0 15.5 |
| 17 | 0.173 | 11479 0.000 0.000 1.00 | 62.6 | 0.200 | 0.100 | 55.47 4.0 15.5 |
| 18 | 0.173 | 11479 0.000 0.000 1.00 | 49.4 | 0.102 | 0.100 | 58.74 4.0 15.5 |
| 19 | 0.173 | 11479 0.000 0.000 1.00 | 48.5 | 0.050 | 0.100 | 62.00 4.0 15.5 |
| Toe | | | 79.4 | 0.150 | 0.100 | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 50.00 | 11.18 | 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 |
| 560.1 | 77.2 | 9.67 9.65 | -2.47 | 6 36 | 44.26 | 7 3 | 39.0 | 38.0 |
| 567.8 | 83.2 | 9.71 9.70 | -2.49 | 6 36 | 44.53 | 7 3 | 39.1 | 37.9 |
| 575.5 | 89.6 | 9.78 9.76 | -2.48 | 6 35 | 44.85 | 7 3 | 39.2 | 37.8 |
| 583.1 | 96.9 | 9.81 9.80 | -2.51 | 6 35 | 45.14 | 7 3 | 39.4 | 37.7 |
| 590.8 | 106.0 | 9.87 9.86 | -2.49 | 6 35 | 45.44 | 7 3 | 39.4 | 37.6 |

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Depth (ft) 55.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 632.7 |
|-----|--------|------------------------|----------------|--------|--------|------------------|
| | | Stiffn C-Slk T-Slk CoR | Soil-S | Soil-D | Quake | LbTop Perim Area |

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| | kips | k/in | ft | ft | kips | s/ft | inch | ft | ft | in2 | |
|-----|-------|-------|-------|-------|------|------|-------|-------|-------|-----|------|
| 1 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 3 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 1.5 | 0.050 | 0.100 | 9.79 | 4.0 | 15.5 |
| 4 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 5.5 | 0.050 | 0.100 | 13.05 | 4.0 | 15.5 |
| 5 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 10.8 | 0.089 | 0.100 | 16.32 | 4.0 | 15.5 |
| 6 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 29.3 | 0.200 | 0.100 | 19.58 | 4.0 | 15.5 |
| 7 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 23.7 | 0.154 | 0.100 | 22.84 | 4.0 | 15.5 |
| 8 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 22.0 | 0.050 | 0.100 | 26.11 | 4.0 | 15.5 |
| 9 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 25.9 | 0.050 | 0.100 | 29.37 | 4.0 | 15.5 |
| 10 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 29.9 | 0.050 | 0.100 | 32.63 | 4.0 | 15.5 |
| 11 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 32.4 | 0.050 | 0.100 | 35.89 | 4.0 | 15.5 |
| 12 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 35.2 | 0.050 | 0.100 | 39.16 | 4.0 | 15.5 |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 37.5 | 0.050 | 0.100 | 42.42 | 4.0 | 15.5 |
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 39.9 | 0.050 | 0.100 | 45.68 | 4.0 | 15.5 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 59.9 | 0.192 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 56.9 | 0.172 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 47.3 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 49.9 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 52.3 | 0.050 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 72.9 | 0.150 | 0.100 | | | |

3.283 kips total unredused pile weight (g= 32.17 ft/s2)

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 55.00 | 11.18 | 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 | |
| 632.7 | 161.3 | 9.86 | 9.86 | -1.51 | 4 33 | 45.01 | 6 3 | 38.4 |
| 640.4 | 177.7 | 9.91 | 9.88 | -1.54 | 4 33 | 45.40 | 6 3 | 38.7 |
| 648.1 | 204.6 | 9.93 | 9.91 | -1.54 | 4 33 | 45.63 | 6 3 | 38.7 |
| 655.8 | 241.5 | 9.96 | 9.94 | -1.52 | 4 33 | 45.93 | 6 3 | 38.6 |
| 663.5 | 281.6 | 10.01 | 9.97 | -1.51 | 4 33 | 46.23 | 6 3 | 38.7 |

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| Depth | (ft) | 60.0 | Standard Soil Setup |
|------------------------|-------|----------------------|---------------------|
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | | | 716.5 |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|-------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.3 | 0.050 | 0.100 | 3.26 | 4.0 | 15.5 | |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 3.6 | 0.050 | 0.100 | 6.53 | 4.0 | 15.5 | |
| 3 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 7.7 | 0.050 | 0.100 | 9.79 | 4.0 | 15.5 | |
| 4 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 21.8 | 0.181 | 0.100 | 13.05 | 4.0 | 15.5 | |
| 5 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 28.6 | 0.196 | 0.100 | 16.32 | 4.0 | 15.5 | |
| 6 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 20.0 | 0.050 | 0.100 | 19.58 | 4.0 | 15.5 | |
| 7 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 24.1 | 0.050 | 0.100 | 22.84 | 4.0 | 15.5 | |
| 8 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 28.1 | 0.050 | 0.100 | 26.11 | 4.0 | 15.5 | |
| 9 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 31.4 | 0.050 | 0.100 | 29.37 | 4.0 | 15.5 | |
| 10 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 33.8 | 0.050 | 0.100 | 32.63 | 4.0 | 15.5 | |
| 11 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 36.5 | 0.050 | 0.100 | 35.89 | 4.0 | 15.5 | |
| 12 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 38.8 | 0.050 | 0.100 | 39.16 | 4.0 | 15.5 | |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 49.6 | 0.145 | 0.100 | 42.42 | 4.0 | 15.5 | |
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 62.6 | 0.200 | 0.100 | 45.68 | 4.0 | 15.5 | |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 48.4 | 0.087 | 0.100 | 48.95 | 4.0 | 15.5 | |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 48.7 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 | |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 51.2 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 | |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 53.2 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 | |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 55.3 | 0.050 | 0.100 | 62.00 | 4.0 | 15.5 | |
| Toe | | | | | | 72.9 | 0.150 | 0.100 | | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 60.00 | 11.18 | 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 |
|-------------|---------------|---------------------|---------------|-------|---|-----------------|-------|---|------------------|----------------|
| 716.5 | 2830.0 | 10.04 | 9.95 | -0.59 | 3 | 31 | 45.16 | 4 | 2 | 37.8 |
| 724.2 | 9999.0 | 10.07 | 10.03 | -0.42 | 3 | 31 | 45.34 | 4 | 2 | 37.7 |
| 731.9 | 9999.0 | 10.10 | 10.08 | -0.36 | 3 | 31 | 45.61 | 4 | 2 | 37.7 |
| 739.6 | 9999.0 | 10.13 | 10.09 | -0.35 | 3 | 31 | 45.88 | 4 | 2 | 37.9 |
| 747.2 | 9999.0 | 10.16 | 10.13 | -0.29 | 3 | 31 | 46.03 | 4 | 2 | 37.8 |

▲
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| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 62.0 | 11.18 | 1.00 | 0.800 |

PILE PROFILE:

| Toe Area in2 | Pile Type | Unknown |
|-----------------|-----------|---------|
| 144.000 | | |

| 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| 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 | 751.5 Area in2 |
|-----|----------------|---|------|----------------------------------|----------------------------------|--------------------------------|----------------------|
| 1 | 0.173 | 11479 0.010 0.000 0.85 | 0.85 | 2.0 | 0.050 0.100 | 3.26 4.0 | 15.5 |
| 2 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 6.1 | 0.050 0.100 | 6.53 4.0 | 15.5 |
| 3 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 13.9 | 0.135 0.100 | 9.79 4.0 | 15.5 |
| 4 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 29.3 | 0.200 0.100 | 13.05 4.0 | 15.5 |
| 5 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 22.3 | 0.132 0.100 | 16.32 4.0 | 15.5 |
| 6 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 22.6 | 0.050 0.100 | 19.58 4.0 | 15.5 |
| 7 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 26.5 | 0.050 0.100 | 22.84 4.0 | 15.5 |
| 8 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 30.3 | 0.050 0.100 | 26.11 4.0 | 15.5 |
| 9 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 32.8 | 0.050 0.100 | 29.37 4.0 | 15.5 |
| 10 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 35.6 | 0.050 0.100 | 32.63 4.0 | 15.5 |
| 11 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 37.9 | 0.050 0.100 | 35.89 4.0 | 15.5 |
| 12 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 40.6 | 0.056 0.100 | 39.16 4.0 | 15.5 |
| 13 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 62.6 | 0.200 0.100 | 42.42 4.0 | 15.5 |
| 14 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 54.5 | 0.156 0.100 | 45.68 4.0 | 15.5 |
| 15 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 47.7 | 0.050 0.100 | 48.95 4.0 | 15.5 |
| 16 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 50.2 | 0.050 0.100 | 52.21 4.0 | 15.5 |
| 17 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 52.5 | 0.050 0.100 | 55.47 4.0 | 15.5 |
| 18 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 54.4 | 0.050 0.100 | 58.74 4.0 | 15.5 |
| 19 | 0.173 | 11479 0.000 0.000 1.00 | 1.00 | 56.7 | 0.050 0.100 | 62.00 4.0 | 15.5 |
| Toe | | | | 72.9 | 0.150 0.100 | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 62.00 | 11.18 | 1.00 | 0.800 |

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 FRA-70-1322L - Rear Abutment - HP12x53 02/28/2021
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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 |
|-------------|---------------|---------------------|---------------|-------|---|-----------------|-------|---|------------------|----------------|
| 751.5 | 9999.0 | 10.07 | 10.05 | -0.17 | 2 | 30 | 44.48 | 4 | 2 | 37.1 |
| 759.2 | 9999.0 | 10.08 | 10.06 | -0.17 | 2 | 30 | 44.72 | 4 | 2 | 37.2 |
| 766.9 | 9999.0 | 10.09 | 10.09 | -0.14 | 2 | 31 | 44.86 | 4 | 2 | 37.0 |
| 774.6 | 9999.0 | 10.09 | 10.08 | -0.11 | 2 | 31 | 45.17 | 3 | 4 | 36.9 |
| 782.3 | 9999.0 | 10.09 | 10.07 | -0.07 | 2 | 49 | 45.49 | 3 | 4 | 36.8 |

▲
 FRA-70-1322L - Rear Abutment - HP12x53 02/28/2021

SUMMARY OVER DEPTHS

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: 0.604 1.000 | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------------|---------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ksi | ft | kip-ft |
| 5.0 | 15.5 | 4.8 | 10.8 | Hammer | did not | run | | | |
| 10.0 | 27.6 | 24.0 | 3.6 | Hammer | did not | run | | | |
| 15.0 | 105.1 | 65.8 | 39.2 | 6.5 | 27.715 | -0.812 | 5.49 | 37.2 | |
| 20.0 | 142.6 | 99.5 | 43.1 | 8.5 | 31.157 | -0.745 | 5.98 | 36.0 | |
| 25.0 | 195.5 | 142.5 | 52.9 | 11.7 | 34.529 | -0.856 | 6.62 | 35.3 | |
| 30.0 | 265.5 | 192.6 | 72.9 | 16.5 | 36.685 | 0.000 | 7.28 | 34.7 | |
| 35.0 | 321.7 | 248.7 | 72.9 | 20.0 | 39.074 | -1.416 | 7.78 | 35.5 | |
| 40.0 | 323.9 | 316.1 | 7.8 | 19.7 | 38.250 | -0.830 | 7.69 | 34.2 | |
| 45.0 | 486.8 | 407.4 | 79.4 | 48.8 | 44.043 | -2.958 | 9.34 | 39.0 | |
| 50.0 | 560.1 | 480.7 | 79.4 | 77.2 | 44.258 | -2.466 | 9.67 | 39.0 | |
| 55.0 | 632.7 | 559.8 | 72.9 | 161.3 | 45.009 | -1.508 | 9.86 | 38.4 | |
| 60.0 | 716.5 | 643.6 | 72.9 | 2830.0 | 45.165 | -0.587 | 10.04 | 37.8 | |
| 62.0 | 751.5 | 678.6 | 72.9 | 9999.0 | 44.483 | -0.171 | 10.07 | 37.1 | |

Refusal occurred; no driving time output possible

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: 0.637 1.000 | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------------|---------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ksi | ft | kip-ft |
| 5.0 | 15.5 | 4.8 | 10.8 | Hammer | did not | run | | | |
| 10.0 | 28.0 | 24.4 | 3.6 | Hammer | did not | run | | | |
| 15.0 | 107.5 | 68.3 | 39.2 | 6.7 | 28.038 | -0.786 | 5.55 | 37.1 | |
| 20.0 | 145.0 | 101.9 | 43.1 | 8.7 | 31.467 | -0.704 | 6.03 | 35.9 | |
| 25.0 | 197.9 | 145.0 | 52.9 | 12.0 | 34.812 | -0.797 | 6.66 | 35.2 | |
| 30.0 | 268.0 | 195.1 | 72.9 | 16.7 | 36.986 | 0.000 | 7.33 | 34.9 | |
| 35.0 | 324.1 | 251.2 | 72.9 | 20.3 | 39.379 | -1.360 | 7.82 | 35.5 | |
| 40.0 | 327.3 | 319.5 | 7.8 | 20.0 | 38.548 | -0.797 | 7.73 | 34.3 | |
| 45.0 | 494.5 | 415.1 | 79.4 | 51.1 | 44.512 | -3.068 | 9.40 | 39.4 | |
| 50.0 | 567.8 | 488.4 | 79.4 | 83.2 | 44.531 | -2.486 | 9.71 | 39.1 | |
| 55.0 | 640.4 | 567.5 | 72.9 | 177.7 | 45.404 | -1.542 | 9.91 | 38.7 | |
| 60.0 | 724.2 | 651.2 | 72.9 | 9999.0 | 45.337 | -0.417 | 10.07 | 37.7 | |
| 62.0 | 759.2 | 686.3 | 72.9 | 9999.0 | 44.718 | -0.169 | 10.08 | 37.2 | |

Refusal occurred; no driving time output possible

▲

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Resource International Inc

GRLWEAP Version 2010

SUMMARY OVER DEPTHS

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: 0.670 1.000 | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------------|---------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ksi | ft | kip-ft |
| 5.0 | 15.5 | 4.8 | 10.8 | Hammer | did not | run | | | |
| 10.0 | 28.5 | 24.8 | 3.6 | Hammer | did not | run | | | |
| 15.0 | 110.0 | 70.7 | 39.2 | 6.9 | 28.269 | -0.753 | 5.60 | 37.0 | |
| 20.0 | 147.5 | 104.4 | 43.1 | 8.9 | 31.751 | -0.705 | 6.07 | 35.8 | |
| 25.0 | 200.4 | 147.5 | 52.9 | 12.2 | 35.149 | -0.657 | 6.70 | 35.1 | |
| 30.0 | 270.5 | 197.5 | 72.9 | 16.9 | 37.242 | 0.000 | 7.37 | 34.9 | |
| 35.0 | 326.6 | 253.6 | 72.9 | 20.7 | 39.699 | -1.311 | 7.85 | 35.5 | |
| 40.0 | 330.7 | 322.9 | 7.8 | 20.5 | 38.752 | -0.801 | 7.78 | 34.2 | |
| 45.0 | 502.1 | 422.8 | 79.4 | 54.3 | 44.920 | -3.074 | 9.48 | 39.4 | |
| 50.0 | 575.5 | 496.1 | 79.4 | 89.6 | 44.855 | -2.484 | 9.78 | 39.2 | |
| 55.0 | 648.1 | 575.2 | 72.9 | 204.6 | 45.635 | -1.543 | 9.93 | 38.7 | |
| 60.0 | 731.9 | 658.9 | 72.9 | 9999.0 | 45.609 | -0.364 | 10.10 | 37.7 | |
| 62.0 | 766.9 | 694.0 | 72.9 | 9999.0 | 44.862 | -0.135 | 10.09 | 37.0 | |

Refusal occurred; no driving time output possible

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: 0.703 1.000 | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------------|---------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ksi | ft | kip-ft |
| 5.0 | 15.5 | 4.8 | 10.8 | Hammer | did not | run | | | |
| 10.0 | 28.9 | 25.3 | 3.6 | Hammer | did not | run | | | |
| 15.0 | 112.4 | 73.2 | 39.2 | 7.1 | 28.531 | -0.717 | 5.65 | 36.8 | |
| 20.0 | 149.9 | 106.9 | 43.1 | 9.2 | 32.050 | -0.714 | 6.11 | 35.8 | |
| 25.0 | 202.8 | 149.9 | 52.9 | 12.4 | 35.428 | -0.490 | 6.74 | 35.0 | |
| 30.0 | 272.9 | 200.0 | 72.9 | 17.1 | 37.481 | 0.000 | 7.41 | 34.9 | |
| 35.0 | 329.0 | 256.1 | 72.9 | 20.9 | 39.967 | -1.290 | 7.89 | 35.6 | |
| 40.0 | 334.1 | 326.3 | 7.8 | 20.8 | 39.055 | -0.830 | 7.82 | 34.3 | |
| 45.0 | 509.8 | 430.4 | 79.4 | 57.1 | 45.327 | -3.178 | 9.53 | 39.7 | |
| 50.0 | 583.1 | 503.8 | 79.4 | 96.9 | 45.143 | -2.507 | 9.81 | 39.4 | |
| 55.0 | 655.8 | 582.9 | 72.9 | 241.5 | 45.928 | -1.517 | 9.96 | 38.6 | |
| 60.0 | 739.6 | 666.6 | 72.9 | 9999.0 | 45.883 | -0.348 | 10.13 | 37.9 | |

1322L-RA-12X53
62.0 774.6 701.6 72.9 9999.0 45.171 -0.111 10.09 36.9

Refusal occurred; no driving time output possible

↑
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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 | 15.5 | 4.8 | 10.8 | Hammer | did not | run | | |
| 10.0 | 29.3 | 25.7 | 3.6 | 1.4 | 14.297 | 0.000 | 3.52 | 45.9 |
| 15.0 | 114.9 | 75.7 | 39.2 | 7.3 | 28.777 | -0.668 | 5.70 | 36.8 |
| 20.0 | 152.4 | 109.3 | 43.1 | 9.4 | 32.328 | -0.739 | 6.16 | 35.7 |
| 25.0 | 205.3 | 152.4 | 52.9 | 12.6 | 35.777 | -0.309 | 6.78 | 35.0 |
| 30.0 | 275.4 | 202.4 | 72.9 | 17.3 | 37.744 | 0.000 | 7.45 | 35.0 |
| 35.0 | 331.5 | 258.6 | 72.9 | 21.2 | 40.293 | -1.285 | 7.92 | 35.6 |
| 40.0 | 337.4 | 329.7 | 7.8 | 21.1 | 39.366 | -0.868 | 7.86 | 34.6 |
| 45.0 | 517.5 | 438.1 | 79.4 | 60.8 | 45.723 | -3.173 | 9.60 | 39.8 |
| 50.0 | 590.8 | 511.4 | 79.4 | 106.0 | 45.442 | -2.487 | 9.87 | 39.4 |
| 55.0 | 663.5 | 590.6 | 72.9 | 281.6 | 46.232 | -1.513 | 10.01 | 38.7 |
| 60.0 | 747.2 | 674.3 | 72.9 | 9999.0 | 46.032 | -0.290 | 10.16 | 37.8 |
| 62.0 | 782.3 | 709.3 | 72.9 | 9999.0 | 45.494 | -0.067 | 10.09 | 36.8 |

Refusal occurred; no driving time output possible

↑
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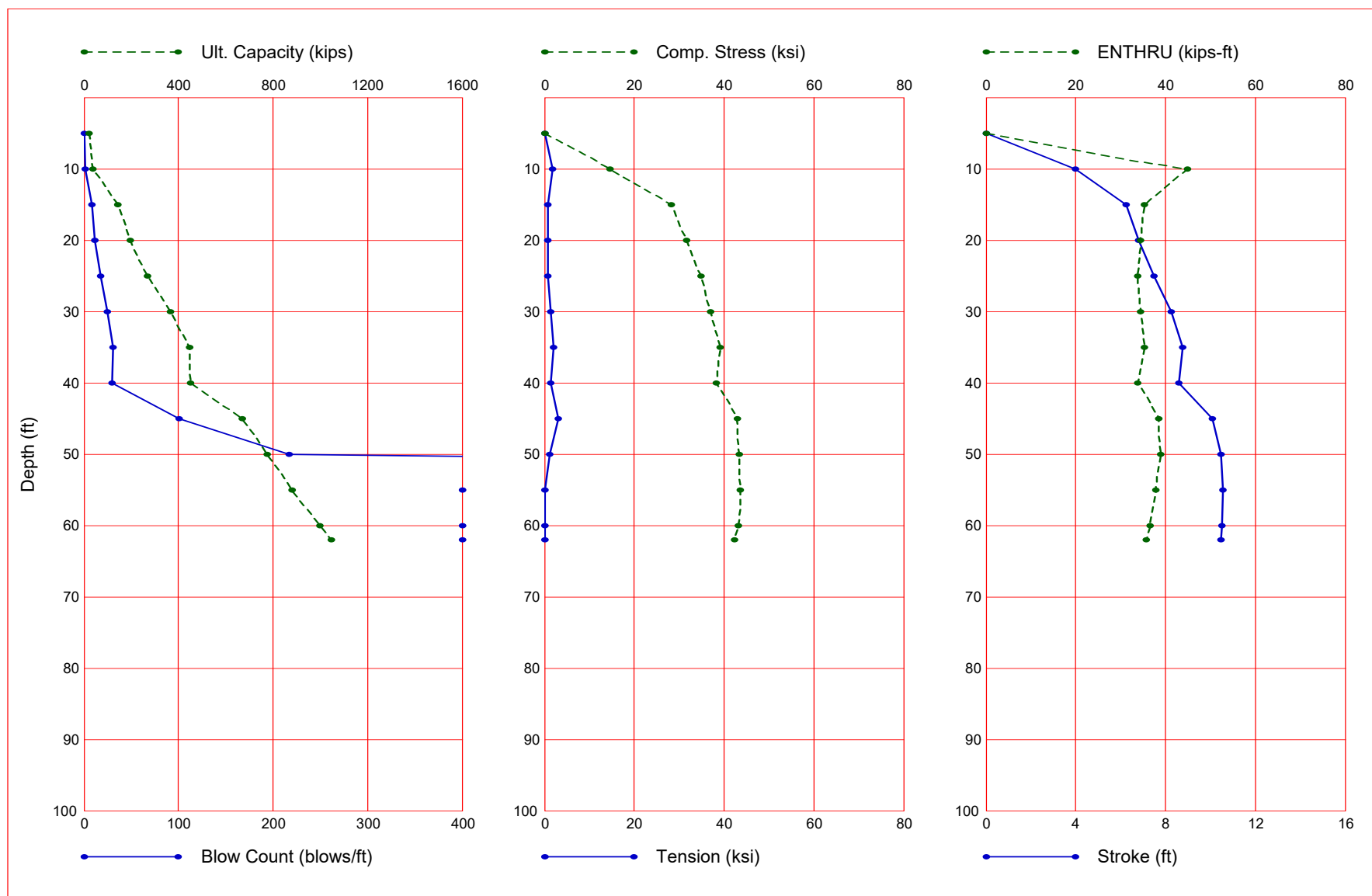
Table of Depths Analyzed with Driving System Modifiers

| Depth | Temp. Length | Wait Time | Equivalent Stroke | Pressure Ratio | Efficy. | Stiffn. Factor | Cushion CoR |
|-------|--------------|-----------|-------------------|----------------|---------|----------------|-------------|
| ft | ft | hr | ft | | | | |
| 5.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 10.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 15.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 20.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 25.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 30.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 35.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 40.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 45.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 50.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 55.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 60.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 62.00 | 62.00 | 0.00 | 11.18 | 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 | 0.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.01 | 0.87 | 19.41 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.09 | 0.88 | 19.58 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.11 | 3.75 | 3.63 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 14.09 | 3.75 | 3.63 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 14.11 | 1.36 | 36.78 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 19.09 | 1.86 | 50.45 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 19.11 | 1.84 | 41.16 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 24.49 | 2.36 | 52.75 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 24.51 | 2.36 | 52.78 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 29.09 | 2.59 | 54.20 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 29.11 | 2.64 | 72.94 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 38.11 | 3.13 | 72.94 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 39.09 | 3.19 | 72.94 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 39.11 | 8.00 | 7.75 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 44.09 | 8.00 | 7.75 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 44.11 | 3.49 | 79.39 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 53.11 | 4.03 | 79.39 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 54.49 | 4.11 | 79.39 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 54.51 | 4.05 | 72.94 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 62.00 | 4.47 | 72.94 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |

Gain/Loss 3 at Shaft and Toe 0.670 / 1.000



Gain/Loss 3 at Shaft and Toe 0.670 / 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 | 21.6 | 6.7 | 14.9 | -1.0 | 0.000 | 0.000 | 0.00 | 0.0 |
| 10.0 | 38.0 | 33.0 | 5.0 | 1.7 | 14.602 | -1.882 | 4.00 | 45.0 |
| 15.0 | 142.7 | 88.5 | 54.2 | 9.1 | 28.335 | -0.838 | 6.23 | 35.4 |
| 20.0 | 195.6 | 136.2 | 59.5 | 12.1 | 31.675 | -0.803 | 6.80 | 34.5 |
| 25.0 | 270.1 | 197.0 | 73.1 | 17.4 | 34.983 | -0.737 | 7.48 | 33.9 |
| 30.0 | 368.5 | 267.8 | 100.7 | 24.4 | 37.043 | -1.490 | 8.25 | 34.5 |
| 35.0 | 448.0 | 347.3 | 100.7 | 31.3 | 39.207 | -2.062 | 8.75 | 35.3 |
| 40.0 | 451.6 | 440.9 | 10.7 | 30.2 | 38.231 | -1.295 | 8.61 | 33.9 |
| 45.0 | 671.7 | 562.1 | 109.6 | 101.0 | 43.020 | -3.091 | 10.08 | 38.4 |
| 50.0 | 775.8 | 666.2 | 109.6 | 217.4 | 43.314 | -1.070 | 10.49 | 39.0 |
| 55.0 | 879.1 | 778.4 | 100.7 | 3540.7 | 43.712 | 0.000 | 10.58 | 37.9 |
| 60.0 | 997.8 | 897.1 | 100.7 | 9999.0 | 43.138 | 0.000 | 10.52 | 36.6 |
| 62.0 | 1047.4 | 946.7 | 100.7 | 9999.0 | 42.275 | 0.000 | 10.48 | 35.8 |

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\2013\W-13-072 FRA-70-13.10 PROJECT 6A\ANALYSIS\FRA-70-1322L AND 1323C\DRIVEABILITY\FRA-70-1322L\REAR
ABUTMENT\HP 14X73\1322L-RA-14X73.GMW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

```

FRA-70-1322L - Rear Abutment - HP14x73
OUT OSG HAM STR FUL PEL N SPL N-U P-D %SK ISM 0 PHI RSA ITR H-D MXT DEX
-100 0 14 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0.000

Pile g Hammer g Toe Area Pile Size Pile Type
32.170 32.170 144.000 14.000 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
62.000 21.40 29000.0 492.000 4.700 0 0.850 0.010
FFatigue F0 0-Bottom
0 0.000 0.000

Manufac Hmr Name HmrType No Seg-s
DELMAG D 30-23 1 5
Ram Wt Ram L Ram Dia MaxStrk RtdStrk Efficy
6.60 118.10 16.51 13.44 11.18 0.80
IB. Wt IB. L IB. Dia IB CoR IB R0
1.20 25.00 16.51 0.900 0.010
CompStrk A Chamber V Chamber C Delay C Duratn Exp Coeff VolCStart Vol CEnd
16.30 214.03 280.90 0.0010 0.0020 1.250 0.00 0.00
P atm P1 P2 P3 P4 P5
14.70 1550.00 1395.00 1255.00 1130.00 0.00
Stroke Effic. Pressure R-Weight T-Delay Exp-Coeff Eps-Str Total-AW
11.1800 0.8000 1550.0000 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 | 0.03 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 9.01 | 1.04 | 26.79 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 9.09 | 1.05 | 27.03 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 9.11 | 3.75 | 5.02 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 14.09 | 3.75 | 5.02 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 14.11 | 1.62 | 50.78 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 19.09 | 2.22 | 69.65 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 19.11 | 2.20 | 56.83 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 24.49 | 2.82 | 72.83 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 24.51 | 2.82 | 72.87 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 29.09 | 3.10 | 74.83 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 29.11 | 3.16 | 100.70 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 38.11 | 3.75 | 100.70 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 39.09 | 3.82 | 100.70 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 39.11 | 8.00 | 10.70 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 44.09 | 8.00 | 10.70 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 44.11 | 4.19 | 109.62 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 53.11 | 4.83 | 109.62 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 54.49 | 4.93 | 109.62 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 54.51 | 4.85 | 100.70 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 62.00 | 5.34 | 100.70 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |

Gain/Loss factors: shaft and toe

| Dpth | Rskn | Rtoe | Qs | Qt | Js | Jt | SU F | LimL | TSf0 |
|---------|---------|---------|---------|---------|-------|-------|-------|------|------|
| 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 | | |
| 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 | | |
| 62.00 | 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-70-1322L - Rear Abutment - HP14x73

| Hammer Model: D 30-23 | | Made by: DELMAG | |
|-----------------------|----------------|------------------|-------|
| No. | Weight kips | Stiffn k/inch | CoR |
| 1 | 1.320 | | |
| 2 | 1.320 | 262846.5 | 1.000 |
| 3 | 1.320 | 262846.5 | 1.000 |
| 4 | 1.320 | 262846.5 | 1.000 |
| 5 | 1.320 | 262846.5 | 1.000 |
| Imp Block | 1.200 | 127693.0 | 0.900 |
| Helmet | 1.900 | 60155.0 | 0.800 |
| Combined Pile Top | | 15848.7 | |

HAMMER OPTIONS:
 Hammer File ID No. 14 Hammer Type OE Diesel
 Stroke Option FxdP-VarS Stroke Convergence Crit. 0.010
 Fuel Pump Setting Maximum

HAMMER DATA:
 Ram Weight (kips) 6.60 Ram Length (inch) 118.10
 Maximum Stroke (ft) 13.44
 Rated Stroke (ft) 11.18 Efficiency 0.800
 Maximum Pressure (psi) 1550.00 Actual Pressure (psi) 1550.00
 Compression Exponent 1.350 Expansion Exponent 1.250

1322L-RA-14X73

| | | | | |
|------------------|--------|---------|-------------------|-------------|
| Ram Diameter | (inch) | 16.51 | | |
| Combustion Delay | (s) | 0.00100 | 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-70-1322L - Rear Abutment - HP14x73 02/28/2021
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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 5.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 21.6 |
|-----|--------|------------------------|----------------|--------|--------|------------------|
| | 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 | 0.239 | 15849 0.010 0.000 0.85 | 0.0 | 0.000 | 0.100 | 3.26 4.7 21.4 |
| 2 | 0.239 | 15849 0.000 0.000 1.00 | 0.0 | 0.000 | 0.100 | 6.53 4.7 21.4 |
| 18 | 0.239 | 15849 0.000 0.000 1.00 | 0.8 | 0.050 | 0.100 | 58.74 4.7 21.4 |
| 19 | 0.239 | 15849 0.000 0.000 1.00 | 5.9 | 0.050 | 0.100 | 62.00 4.7 21.4 |
| Toe | | | 14.9 | 0.150 | 0.100 | |

4.533 kips total unreduced pile weight (g= 32.17 ft/s2)
 4.533 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 | Stroke | Pressure | Efficy |
| ft | ft | Ratio | |
| 5.00 | 11.18 | 1.00 | 0.800 |

FRA-70-1322L - Rear Abutment - HP14x73 02/28/2021
 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 |
| 21.6 | Hammer did not run | | | | | |
| 21.6 | Hammer did not run | | | | | |
| 21.6 | Hammer did not run | | | | | |
| 21.6 | Hammer did not run | | | | | |
| 21.6 | Hammer did not run | | | | | |

FRA-70-1322L - Rear Abutment - HP14x73 02/28/2021
 Resource International Inc GRLWEAP Version 2010

| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 10.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|----------|-------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
|----------|-------|---------|-----------|---------|

Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | Total Capacity Rut (kips) | | | | 37.0 | | | |
|---------------------|--------|--------|-------|---------------------------|------|--------|--------|-------|-------|-------|------|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 3.2 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 9.0 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 19.7 | 0.141 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 5.0 | 0.150 | 0.100 | | | |

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

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 10.00 | 11.18 | 1.00 | 0.800 |

▲

FRA-70-1322L - Rear Abutment - HP14x73
Resource International Inc02/28/2021
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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 |
| 37.0 | 1.6 | 3.97 | 3.95 | -1.93 | 4 | 11 | 14.35 | 1 | 2 | 45.3 |
| 37.5 | 1.6 | 3.98 | 3.96 | -1.91 | 4 | 11 | 14.49 | 1 | 2 | 45.2 |
| 38.0 | 1.7 | 4.00 | 3.98 | -1.88 | 4 | 11 | 14.60 | 1 | 2 | 45.0 |
| 38.6 | 1.7 | 3.97 | 4.01 | -1.89 | 4 | 11 | 14.58 | 1 | 2 | 44.7 |
| 39.1 | 1.7 | 3.99 | 4.02 | -1.85 | 4 | 11 | 14.73 | 1 | 2 | 44.6 |

▲

FRA-70-1322L - Rear Abutment - HP14x73
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| Depth | (ft) | 15.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
|-----------|--------|---------|-----------|---------|
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | Total Capacity Rut (kips) | | | | 136.9 | | | |
|---------------------|--------|--------|-------|---------------------------|------|--------|--------|-------|-------|-------|------|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 1.0 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 6.3 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 12.1 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 31.1 | 0.191 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 32.3 | 0.178 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 54.2 | 0.150 | 0.100 | | | |

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

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 15.00 | 11.18 | 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 |

| | | | | | | | | | | | | | |
|----------------|-----|------|------|-------|----|----|-------|----|---|------|------|--|--|
| 1322L-RA-14X73 | | | | | | | | | | | | | |
| 136.9 | 8.6 | 6.13 | 6.15 | -0.88 | 16 | 45 | 27.92 | 16 | 5 | 35.7 | 47.5 | | |
| 139.8 | 8.8 | 6.18 | 6.20 | -0.87 | 16 | 44 | 28.12 | 16 | 5 | 35.5 | 47.3 | | |
| 142.7 | 9.1 | 6.23 | 6.24 | -0.84 | 16 | 44 | 28.34 | 16 | 5 | 35.4 | 47.2 | | |
| 145.6 | 9.3 | 6.28 | 6.28 | -0.80 | 16 | 43 | 28.51 | 16 | 5 | 35.3 | 47.0 | | |
| 148.5 | 9.5 | 6.32 | 6.33 | -0.76 | 16 | 43 | 28.70 | 16 | 5 | 35.2 | 46.8 | | |

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Depth (ft) 20.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 Pile Type Unknown
 Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 189.8 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 42.42 | 4.7 | 21.4 |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 3.6 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 9.4 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 21.2 | 0.151 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 34.7 | 0.200 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 28.7 | 0.100 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 32.6 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 59.5 | 0.150 | 0.100 | | | |

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

Depth Stroke Pressure Efficy
 ft ft Ratio
 20.00 11.18 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 | |
| 189.8 | 11.6 | 6.72 | 6.67 | -0.70 | 15 36 | 31.25 | 16 5 | 34.7 |
| 192.7 | 11.9 | 6.76 | 6.71 | -0.75 | 15 36 | 31.47 | 16 5 | 34.5 |
| 195.6 | 12.1 | 6.80 | 6.75 | -0.80 | 15 36 | 31.67 | 16 5 | 34.5 |
| 198.5 | 12.4 | 6.83 | 6.79 | -0.85 | 14 36 | 31.89 | 16 5 | 34.4 |
| 201.4 | 12.7 | 6.88 | 6.84 | -0.89 | 14 36 | 32.20 | 16 5 | 34.3 |

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Depth (ft) 25.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 Pile Type Unknown
 Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 264.3 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 1.2 | 0.050 | 0.100 | 39.16 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 6.7 | 0.050 | 0.100 | 42.42 | 4.7 | 21.4 |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 12.4 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 |

| 1322L-RA-14X73 | | | | | | | | | | | |
|----------------|-------|-------|-------|-------|------|------|-------|-------|-------|-----|------|
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 32.3 | 0.194 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 31.7 | 0.172 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 29.9 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 35.6 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 41.2 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 73.1 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 25.00 | 11.18 | 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 |
|-------------|---------------|----------------|------------|----------------|----|----|-----------------|----|---|------------------|----------------|
| 264.3 | 16.8 | 7.40 | 7.40 | -0.98 | 13 | 32 | 34.42 | 15 | 5 | 34.0 | 43.3 |
| 267.2 | 17.1 | 7.45 | 7.43 | -0.86 | 13 | 32 | 34.70 | 15 | 5 | 34.0 | 43.2 |
| 270.1 | 17.4 | 7.48 | 7.47 | -0.74 | 13 | 32 | 34.98 | 15 | 5 | 33.9 | 43.1 |
| 273.0 | 17.7 | 7.51 | 7.51 | -0.59 | 13 | 32 | 35.21 | 15 | 5 | 33.8 | 43.0 |
| 275.9 | 18.0 | 7.55 | 7.55 | -0.44 | 13 | 32 | 35.42 | 15 | 5 | 33.7 | 42.9 |

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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 30.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity | Rut | (kips) | | | 362.7 |
|---------------------|--------|--------|-------|-------|------|----------------|--------|--------|-------|-------|-------|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.1 | 0.050 | 0.100 | 32.63 | 4.7 | 21.4 |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 4.0 | 0.050 | 0.100 | 35.89 | 4.7 | 21.4 |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 9.7 | 0.050 | 0.100 | 39.16 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 22.6 | 0.159 | 0.100 | 42.42 | 4.7 | 21.4 |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 34.7 | 0.200 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 28.4 | 0.085 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 33.0 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 38.6 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 43.7 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 47.1 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 100.7 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 30.00 | 11.18 | 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 |
|-------------|---------------|----------------|------------|----------------|----|----|-----------------|----|---|------------------|----------------|
| 362.7 | 23.9 | 8.20 | 8.16 | -1.44 | 11 | 48 | 36.62 | 13 | 4 | 34.4 | 41.3 |
| 365.6 | 24.2 | 8.23 | 8.18 | -1.46 | 11 | 47 | 36.82 | 13 | 4 | 34.5 | 41.2 |
| 368.5 | 24.4 | 8.25 | 8.20 | -1.49 | 11 | 47 | 37.04 | 13 | 4 | 34.5 | 41.1 |
| 371.4 | 24.7 | 8.28 | 8.23 | -1.52 | 11 | 47 | 37.24 | 13 | 4 | 34.6 | 41.1 |
| 374.3 | 25.0 | 8.31 | 8.25 | -1.55 | 11 | 47 | 37.42 | 13 | 4 | 34.7 | 41.0 |

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Depth (ft) 35.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in²) 144.000 Pile Type Unknown
 Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 442.2 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|-----------------|
| 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 | in ² |
| 1 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 9 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 1.5 | 0.050 | 0.100 | 29.37 | 4.7 | 21.4 |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 7.1 | 0.050 | 0.100 | 32.63 | 4.7 | 21.4 |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 12.8 | 0.050 | 0.100 | 35.89 | 4.7 | 21.4 |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 33.6 | 0.197 | 0.100 | 39.16 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 31.2 | 0.164 | 0.100 | 42.42 | 4.7 | 21.4 |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 30.3 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 35.9 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 41.6 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 45.4 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 49.3 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 52.8 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 100.7 | 0.150 | 0.100 | | | |

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

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 35.00 | 11.18 | 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 | |
| 442.2 | 30.4 | 8.69 | 8.63 | -1.99 | 10 43 | 38.71 | 12 4 | 35.3 |
| 445.1 | 30.7 | 8.72 | 8.65 | -2.04 | 10 43 | 39.01 | 12 4 | 35.4 |
| 448.0 | 31.3 | 8.75 | 8.68 | -2.06 | 10 42 | 39.21 | 12 4 | 35.3 |
| 450.9 | 31.6 | 8.77 | 8.70 | -2.12 | 10 42 | 39.47 | 12 4 | 35.5 |
| 453.8 | 32.1 | 8.80 | 8.74 | -2.17 | 10 42 | 39.68 | 12 4 | 35.4 |

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Depth (ft) 40.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in²) 144.000 Pile Type Unknown
 Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 443.6 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|-----------------|
| 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 | in ² |
| 1 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 7 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.2 | 0.050 | 0.100 | 22.84 | 4.7 | 21.4 |
| 8 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 4.4 | 0.050 | 0.100 | 26.11 | 4.7 | 21.4 |
| 9 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 10.1 | 0.050 | 0.100 | 29.37 | 4.7 | 21.4 |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 24.0 | 0.166 | 0.100 | 32.63 | 4.7 | 21.4 |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 34.7 | 0.200 | 0.100 | 35.89 | 4.7 | 21.4 |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 28.1 | 0.068 | 0.100 | 39.16 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 33.4 | 0.050 | 0.100 | 42.42 | 4.7 | 21.4 |

| 1322L-RA-14X73 | | | | | | | | | | | |
|----------------|-------|-------|-------|-------|------|------|-------|-------|-------|-----|------|
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 38.9 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 43.9 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 47.4 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 51.2 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 54.5 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 62.0 | 0.117 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 10.7 | 0.150 | 0.100 | | | |

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

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 40.00 | 11.18 | 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 |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|----|---|------------------|----------------|
| 443.6 | 29.3 | 8.54 | 8.51 | -1.06 | 8 | 41 | 37.75 | 10 | 3 | 33.7 | 40.5 |
| 447.6 | 29.7 | 8.58 | 8.53 | -1.19 | 8 | 41 | 38.02 | 10 | 3 | 33.9 | 40.4 |
| 451.6 | 30.2 | 8.61 | 8.57 | -1.30 | 8 | 41 | 38.23 | 10 | 3 | 33.9 | 40.3 |
| 455.7 | 30.8 | 8.65 | 8.61 | -1.39 | 8 | 41 | 38.42 | 10 | 3 | 34.0 | 40.2 |
| 459.7 | 31.5 | 8.69 | 8.65 | -1.46 | 8 | 40 | 38.61 | 10 | 3 | 34.0 | 40.1 |

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| Depth | (ft) | 45.0 | Standard Soil Setup |
|------------------------|-------|----------------------|---------------------|
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
|-----------|--------|---------|-----------|---------|
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | | | 653.5 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|-------|--|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 | | |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 | | |
| 6 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 1.8 | 0.050 | 0.100 | 19.58 | 4.7 | 21.4 | | |
| 7 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 7.4 | 0.050 | 0.100 | 22.84 | 4.7 | 21.4 | | |
| 8 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 13.2 | 0.051 | 0.100 | 26.11 | 4.7 | 21.4 | | |
| 9 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 34.7 | 0.200 | 0.100 | 29.37 | 4.7 | 21.4 | | |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 30.8 | 0.157 | 0.100 | 32.63 | 4.7 | 21.4 | | |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 30.7 | 0.050 | 0.100 | 35.89 | 4.7 | 21.4 | | |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 36.3 | 0.050 | 0.100 | 39.16 | 4.7 | 21.4 | | |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 41.9 | 0.050 | 0.100 | 42.42 | 4.7 | 21.4 | | |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 45.6 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 | | |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 49.6 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 | | |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 53.0 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 | | |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 56.3 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 | | |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 71.1 | 0.185 | 0.100 | 58.74 | 4.7 | 21.4 | | |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 71.5 | 0.175 | 0.100 | 62.00 | 4.7 | 21.4 | | |
| Toe | | | | | | 109.6 | 0.150 | 0.100 | | | | | |

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

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 45.00 | 11.18 | 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 | |
| 653.5 | 89.5 | 9.98 | 9.97 | -3.00 | 7 | 35 | 42.40 | 9 | 3 | 38.1 | 37.5 |
| 662.6 | 95.8 | 10.03 | 10.02 | -3.02 | 7 | 34 | 42.74 | 9 | 3 | 38.1 | 37.4 |
| 671.7 | 101.0 | 10.08 | 10.06 | -3.09 | 7 | 34 | 43.02 | 9 | 3 | 38.4 | 37.3 |

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680.8 108.1 10.13 10.10 -3.12 7 34 43.33 9 3 38.6 37.2
689.9 117.1 10.16 10.15 -3.14 7 34 43.63 9 3 38.5 37.1

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Depth (ft) 50.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | Total Capacity Rut (kips) | | 757.6 | | | | | | | |
|---------------------|--------|---------------------------|-------|-------|------|--------|--------|-------|-------|-------|------|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 4 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.3 | 0.050 | 0.100 | 13.05 | 4.7 | 21.4 |
| 5 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 4.7 | 0.050 | 0.100 | 16.32 | 4.7 | 21.4 |
| 6 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 10.5 | 0.050 | 0.100 | 19.58 | 4.7 | 21.4 |
| 7 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 25.4 | 0.172 | 0.100 | 22.84 | 4.7 | 21.4 |
| 8 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 34.7 | 0.200 | 0.100 | 26.11 | 4.7 | 21.4 |
| 9 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 27.9 | 0.050 | 0.100 | 29.37 | 4.7 | 21.4 |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 33.7 | 0.050 | 0.100 | 32.63 | 4.7 | 21.4 |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 39.3 | 0.050 | 0.100 | 35.89 | 4.7 | 21.4 |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 44.1 | 0.050 | 0.100 | 39.16 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 47.6 | 0.050 | 0.100 | 42.42 | 4.7 | 21.4 |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 51.4 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 54.7 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 63.2 | 0.128 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 74.1 | 0.200 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 67.3 | 0.096 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 68.9 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 109.6 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 50.00 | 11.18 | 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 | |
| 757.6 | 186.0 | 10.28 | 10.24 | -1.56 | 6 32 | 42.56 | 7 3 | 38.2 |
| 766.7 | 194.9 | 10.47 | 10.37 | -1.12 | 5 32 | 43.19 | 7 3 | 38.9 |
| 775.8 | 217.4 | 10.49 | 10.41 | -1.07 | 5 32 | 43.31 | 7 3 | 39.0 |
| 784.9 | 247.1 | 10.52 | 10.44 | -1.00 | 5 33 | 43.50 | 7 3 | 39.0 |
| 794.0 | 293.7 | 10.54 | 10.48 | -0.85 | 5 33 | 43.68 | 7 3 | 38.8 |

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Depth (ft) 55.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | Total Capacity Rut (kips) | | 860.9 | | | | | | | |
|---------------------|--------|---------------------------|-------|-------|-----|--------|--------|-------|-------|-------|------|
| No. | Weight | Stiffn | C-Slk | T-Slk | CoR | Soil-S | Soil-D | Quake | LbTop | Perim | Area |

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| | kips | k/in | ft | ft | kips | s/ft | inch | ft | ft | in2 | |
|-----|-------|-------|-------|-------|------|-------|-------|-------|-------|-----|------|
| 1 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 3 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 2.1 | 0.050 | 0.100 | 9.79 | 4.7 | 21.4 |
| 4 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 7.8 | 0.050 | 0.100 | 13.05 | 4.7 | 21.4 |
| 5 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 14.8 | 0.084 | 0.100 | 16.32 | 4.7 | 21.4 |
| 6 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 34.7 | 0.200 | 0.100 | 19.58 | 4.7 | 21.4 |
| 7 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 30.3 | 0.148 | 0.100 | 22.84 | 4.7 | 21.4 |
| 8 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 31.1 | 0.050 | 0.100 | 26.11 | 4.7 | 21.4 |
| 9 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 36.6 | 0.050 | 0.100 | 29.37 | 4.7 | 21.4 |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 42.2 | 0.050 | 0.100 | 32.63 | 4.7 | 21.4 |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 45.8 | 0.050 | 0.100 | 35.89 | 4.7 | 21.4 |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 49.8 | 0.050 | 0.100 | 39.16 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 53.2 | 0.050 | 0.100 | 42.42 | 4.7 | 21.4 |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 56.5 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 72.1 | 0.190 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 71.0 | 0.168 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 67.2 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 70.8 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 74.1 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 100.7 | 0.150 | 0.100 | | | |

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

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 55.00 | 11.18 | 1.00 | 0.800 |

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| Rut kips | Bl Ct b/ft | Stroke (ft) | | Ten Str up ksi | i | t | Comp Str ksi | i | t | ENTHRU kip-ft | Bl Rt b/min |
|-------------|---------------|-------------|-------|-------------------|---|----|-----------------|---|---|------------------|----------------|
| 860.9 | 905.2 | 10.56 | 10.49 | -0.16 | 3 | 50 | 43.28 | 6 | 3 | 38.2 | 36.5 |
| 870.0 | 1536.4 | 10.57 | 10.52 | -0.09 | 3 | 50 | 43.46 | 6 | 3 | 38.1 | 36.5 |
| 879.1 | 3540.7 | 10.58 | 10.53 | 0.00 | 1 | 0 | 43.71 | 6 | 3 | 37.9 | 36.5 |
| 888.2 | 7210.0 | 10.59 | 10.53 | 0.00 | 1 | 0 | 43.85 | 6 | 3 | 38.1 | 36.5 |
| 897.3 | 9999.0 | 10.60 | 10.53 | 0.00 | 1 | 0 | 44.10 | 6 | 3 | 37.9 | 36.5 |

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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 60.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | | | 979.6 | |
|---------------------|----------------|----------------|-------------|-------------|------|---------------------------|----------------|---------------|-------------|-------------|-------------|-------|--|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.4 | 0.050 | 0.100 | 3.26 | 4.7 | 21.4 | | |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 5.1 | 0.050 | 0.100 | 6.53 | 4.7 | 21.4 | | |
| 3 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 10.9 | 0.050 | 0.100 | 9.79 | 4.7 | 21.4 | | |
| 4 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 26.8 | 0.178 | 0.100 | 13.05 | 4.7 | 21.4 | | |
| 5 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 34.1 | 0.195 | 0.100 | 16.32 | 4.7 | 21.4 | | |
| 6 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 28.3 | 0.050 | 0.100 | 19.58 | 4.7 | 21.4 | | |
| 7 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 34.1 | 0.050 | 0.100 | 22.84 | 4.7 | 21.4 | | |
| 8 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 39.7 | 0.050 | 0.100 | 26.11 | 4.7 | 21.4 | | |
| 9 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 44.4 | 0.050 | 0.100 | 29.37 | 4.7 | 21.4 | | |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 47.9 | 0.050 | 0.100 | 32.63 | 4.7 | 21.4 | | |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 51.7 | 0.050 | 0.100 | 35.89 | 4.7 | 21.4 | | |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 54.9 | 0.050 | 0.100 | 39.16 | 4.7 | 21.4 | | |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 64.3 | 0.139 | 0.100 | 42.42 | 4.7 | 21.4 | | |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 74.1 | 0.200 | 0.100 | 45.68 | 4.7 | 21.4 | | |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 66.9 | 0.082 | 0.100 | 48.95 | 4.7 | 21.4 | | |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 69.1 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 | | |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 72.7 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 | | |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 75.4 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 | | |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 78.3 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 | | |
| Toe | | | | | | 100.7 | 0.150 | 0.100 | | | | | |

1322L-RA-14X73

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 60.00 | 11.18 | 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 ksi | t ENTHRU kip-ft | Bl Rt b/min |
|-------------|---------------|---------------------|---------------|----------|-------------------|----------|--------------------|----------------|
| 979.6 | 9999.0 | 10.53 | 10.45 | 0.00 | 1 0 | 42.86 | 4 2 | 36.8 |
| 988.7 | 9999.0 | 10.52 | 10.46 | 0.00 | 1 0 | 43.01 | 4 2 | 36.5 |
| 997.8 | 9999.0 | 10.52 | 10.45 | 0.00 | 1 0 | 43.14 | 4 2 | 36.6 |
| 1006.9 | 9999.0 | 10.52 | 10.45 | 0.00 | 1 0 | 43.25 | 4 2 | 36.3 |
| 1016.0 | 9999.0 | 10.52 | 10.45 | 0.00 | 1 0 | 43.37 | 4 2 | 36.2 |

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| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 62.0 | 11.18 | 1.00 | 0.800 |

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| No. | Weight kips | Stiffn k/in | C-Slk ft | T-Slk ft | CoR | Soil-S kips | Soil-D s/ft | Quake inch | Rut ft | 1029.2 Perim ft | Area in2 |
|-----|----------------|----------------|-------------|-------------|------|----------------|----------------|---------------|-----------|-----------------------|-------------|
| 1 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 2.9 | 0.050 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 8.6 | 0.050 | 0.100 | 6.53 | 4.7 | 21.4 |
| 3 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 18.2 | 0.129 | 0.100 | 9.79 | 4.7 | 21.4 |
| 4 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 34.7 | 0.200 | 0.100 | 13.05 | 4.7 | 21.4 |
| 5 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 29.4 | 0.125 | 0.100 | 16.32 | 4.7 | 21.4 |
| 6 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 31.9 | 0.050 | 0.100 | 19.58 | 4.7 | 21.4 |
| 7 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 37.4 | 0.050 | 0.100 | 22.84 | 4.7 | 21.4 |
| 8 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 42.9 | 0.050 | 0.100 | 26.11 | 4.7 | 21.4 |
| 9 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 46.3 | 0.050 | 0.100 | 29.37 | 4.7 | 21.4 |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 50.4 | 0.050 | 0.100 | 32.63 | 4.7 | 21.4 |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 53.7 | 0.050 | 0.100 | 35.89 | 4.7 | 21.4 |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 57.3 | 0.055 | 0.100 | 39.16 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 74.1 | 0.200 | 0.100 | 42.42 | 4.7 | 21.4 |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 69.8 | 0.150 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 67.7 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 71.3 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 74.5 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 77.0 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 80.3 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 100.7 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 62.00 | 11.18 | 1.00 | 0.800 |

▲
FRA-70-1322L - Rear Abutment - HP14x73 02/28/2021
Resource International Inc GRLWEAP Version 2010

| Rut kips | Bl Ct b/ft | Stroke (ft) down | Ten Str up | i ksi | t Comp Str ksi | i ksi | t ENTHRU kip-ft | Bl Rt b/min |
|-------------|---------------|---------------------|---------------|----------|-------------------|----------|--------------------|----------------|
| 1029.2 | 9999.0 | 10.46 | 10.38 | 0.00 | 1 0 | 41.94 | 4 2 | 35.8 |
| 1038.3 | 9999.0 | 10.47 | 10.38 | 0.00 | 1 0 | 42.14 | 4 2 | 35.7 |
| 1047.4 | 9999.0 | 10.48 | 10.38 | 0.00 | 1 0 | 42.28 | 4 2 | 35.8 |
| 1056.5 | 9999.0 | 10.39 | 10.37 | 0.00 | 1 0 | 42.18 | 4 2 | 35.3 |
| 1065.6 | 9999.0 | 10.39 | 10.37 | 0.00 | 1 0 | 42.31 | 4 2 | 35.3 |

▲
FRA-70-1322L - Rear Abutment - HP14x73 02/28/2021

SUMMARY OVER DEPTHS

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: 0.604 | 1.000 | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|--------|---------------|------------------|------------|---------|--------|---------|---------|--------|--------|
| ft | kip | kip | kip | bl/ft | ksi | ksi | ksi | ksi | ft | kip-ft |
| 5.0 | 21.6 | 6.7 | 14.9 | Hammer | did not | run | | | | |
| 10.0 | 37.0 | 32.0 | 5.0 | 1.6 | 14.352 | -1.932 | 3.97 | 45.3 | | |
| 15.0 | 136.9 | 82.7 | 54.2 | 8.6 | 27.916 | -0.884 | 6.13 | 35.7 | | |
| 20.0 | 189.8 | 130.3 | 59.5 | 11.6 | 31.252 | -0.699 | 6.72 | 34.7 | | |
| 25.0 | 264.3 | 191.2 | 73.1 | 16.8 | 34.424 | -0.977 | 7.40 | 34.0 | | |
| 30.0 | 362.7 | 262.0 | 100.7 | 23.9 | 36.616 | -1.436 | 8.20 | 34.4 | | |
| 35.0 | 442.2 | 341.5 | 100.7 | 30.4 | 38.707 | -1.986 | 8.69 | 35.3 | | |
| 40.0 | 443.6 | 432.9 | 10.7 | 29.3 | 37.750 | -1.063 | 8.54 | 33.7 | | |
| 45.0 | 653.5 | 543.9 | 109.6 | 89.5 | 42.401 | -2.996 | 9.98 | 38.1 | | |
| 50.0 | 757.6 | 648.0 | 109.6 | 186.0 | 42.557 | -1.558 | 10.28 | 38.2 | | |
| 55.0 | 860.9 | 760.2 | 100.7 | 905.2 | 43.285 | -0.163 | 10.56 | 38.2 | | |
| 60.0 | 979.6 | 878.9 | 100.7 | 9999.0 | 42.862 | 0.000 | 10.53 | 36.8 | | |
| 62.0 | 1029.2 | 928.5 | 100.7 | 9999.0 | 41.943 | 0.000 | 10.46 | 35.8 | | |

Refusal occurred; no driving time output possible

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: 0.637 | 1.000 | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|--------|---------------|------------------|------------|---------|--------|---------|---------|--------|--------|
| ft | kip | kip | kip | bl/ft | ksi | ksi | ksi | ksi | ft | kip-ft |
| 5.0 | 21.6 | 6.7 | 14.9 | Hammer | did not | run | | | | |
| 10.0 | 37.5 | 32.5 | 5.0 | 1.6 | 14.490 | -1.906 | 3.98 | 45.2 | | |
| 15.0 | 139.8 | 85.6 | 54.2 | 8.8 | 28.116 | -0.874 | 6.18 | 35.5 | | |
| 20.0 | 192.7 | 133.2 | 59.5 | 11.9 | 31.470 | -0.753 | 6.76 | 34.5 | | |
| 25.0 | 267.2 | 194.1 | 73.1 | 17.1 | 34.695 | -0.864 | 7.45 | 34.0 | | |
| 30.0 | 365.6 | 264.9 | 100.7 | 24.2 | 36.821 | -1.462 | 8.23 | 34.5 | | |
| 35.0 | 445.1 | 344.4 | 100.7 | 30.7 | 39.011 | -2.036 | 8.72 | 35.4 | | |
| 40.0 | 447.6 | 436.9 | 10.7 | 29.7 | 38.023 | -1.192 | 8.58 | 33.9 | | |
| 45.0 | 662.6 | 553.0 | 109.6 | 95.8 | 42.741 | -3.016 | 10.03 | 38.1 | | |
| 50.0 | 766.7 | 657.1 | 109.6 | 194.9 | 43.186 | -1.123 | 10.47 | 38.9 | | |
| 55.0 | 870.0 | 769.3 | 100.7 | 1536.4 | 43.458 | -0.087 | 10.57 | 38.1 | | |
| 60.0 | 988.7 | 888.0 | 100.7 | 9999.0 | 43.007 | 0.000 | 10.52 | 36.5 | | |
| 62.0 | 1038.3 | 937.6 | 100.7 | 9999.0 | 42.138 | 0.000 | 10.47 | 35.7 | | |

Refusal occurred; no driving time output possible

▲

FRA-70-1322L - Rear Abutment - HP14x73
Resource International Inc02/28/2021
GRLWEAP Version 2010

SUMMARY OVER DEPTHS

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: 0.670 | 1.000 | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|--------|---------------|------------------|------------|---------|--------|---------|---------|--------|--------|
| ft | kip | kip | kip | bl/ft | ksi | ksi | ksi | ksi | ft | kip-ft |
| 5.0 | 21.6 | 6.7 | 14.9 | Hammer | did not | run | | | | |
| 10.0 | 38.0 | 33.0 | 5.0 | 1.7 | 14.602 | -1.882 | 4.00 | 45.0 | | |
| 15.0 | 142.7 | 88.5 | 54.2 | 9.1 | 28.335 | -0.838 | 6.23 | 35.4 | | |
| 20.0 | 195.6 | 136.2 | 59.5 | 12.1 | 31.675 | -0.803 | 6.80 | 34.5 | | |
| 25.0 | 270.1 | 197.0 | 73.1 | 17.4 | 34.983 | -0.737 | 7.48 | 33.9 | | |
| 30.0 | 368.5 | 267.8 | 100.7 | 24.4 | 37.043 | -1.490 | 8.25 | 34.5 | | |
| 35.0 | 448.0 | 347.3 | 100.7 | 31.3 | 39.207 | -2.062 | 8.75 | 35.3 | | |
| 40.0 | 451.6 | 440.9 | 10.7 | 30.2 | 38.231 | -1.295 | 8.61 | 33.9 | | |
| 45.0 | 671.7 | 562.1 | 109.6 | 101.0 | 43.020 | -3.091 | 10.08 | 38.4 | | |
| 50.0 | 775.8 | 666.2 | 109.6 | 217.4 | 43.314 | -1.070 | 10.49 | 39.0 | | |
| 55.0 | 879.1 | 778.4 | 100.7 | 3540.7 | 43.712 | 0.000 | 10.58 | 37.9 | | |
| 60.0 | 997.8 | 897.1 | 100.7 | 9999.0 | 43.138 | 0.000 | 10.52 | 36.6 | | |
| 62.0 | 1047.4 | 946.7 | 100.7 | 9999.0 | 42.275 | 0.000 | 10.48 | 35.8 | | |

Refusal occurred; no driving time output possible

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: 0.703 | 1.000 | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|--------|---------------|------------------|------------|---------|--------|---------|---------|--------|--------|
| ft | kip | kip | kip | bl/ft | ksi | ksi | ksi | ksi | ft | kip-ft |
| 5.0 | 21.6 | 6.7 | 14.9 | Hammer | did not | run | | | | |
| 10.0 | 38.6 | 33.5 | 5.0 | 1.7 | 14.578 | -1.889 | 3.97 | 44.7 | | |
| 15.0 | 145.6 | 91.4 | 54.2 | 9.3 | 28.509 | -0.797 | 6.28 | 35.3 | | |
| 20.0 | 198.5 | 139.1 | 59.5 | 12.4 | 31.885 | -0.850 | 6.83 | 34.4 | | |
| 25.0 | 273.0 | 199.9 | 73.1 | 17.7 | 35.213 | -0.595 | 7.51 | 33.8 | | |
| 30.0 | 371.4 | 270.7 | 100.7 | 24.7 | 37.243 | -1.516 | 8.28 | 34.6 | | |
| 35.0 | 450.9 | 350.2 | 100.7 | 31.6 | 39.474 | -2.125 | 8.77 | 35.5 | | |
| 40.0 | 455.7 | 445.0 | 10.7 | 30.8 | 38.417 | -1.385 | 8.65 | 34.0 | | |
| 45.0 | 680.8 | 571.2 | 109.6 | 108.1 | 43.335 | -3.125 | 10.13 | 38.6 | | |
| 50.0 | 784.9 | 675.3 | 109.6 | 247.1 | 43.499 | -0.998 | 10.52 | 39.0 | | |
| 55.0 | 888.2 | 787.5 | 100.7 | 7210.0 | 43.854 | 0.000 | 10.59 | 38.1 | | |
| 60.0 | 1006.9 | 906.2 | 100.7 | 9999.0 | 43.250 | 0.000 | 10.52 | 36.3 | | |

1322L-RA-14X73
62.0 1056.5 955.8 100.7 9999.0 42.179 0.000 10.39 35.3

Refusal occurred; no driving time output possible

↑
FRA-70-1322L - Rear Abutment - HP14x73 02/28/2021
Resource International Inc 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 | 21.6 | 6.7 | 14.9 | Hammer | did not | run | | |
| 10.0 | 39.1 | 34.1 | 5.0 | 1.7 | 14.730 | -1.845 | 3.99 | 44.6 |
| 15.0 | 148.5 | 94.3 | 54.2 | 9.5 | 28.702 | -0.757 | 6.32 | 35.2 |
| 20.0 | 201.4 | 142.0 | 59.5 | 12.7 | 32.195 | -0.887 | 6.88 | 34.3 |
| 25.0 | 275.9 | 202.8 | 73.1 | 18.0 | 35.422 | -0.441 | 7.55 | 33.7 |
| 30.0 | 374.3 | 273.6 | 100.7 | 25.0 | 37.422 | -1.547 | 8.31 | 34.7 |
| 35.0 | 453.8 | 353.1 | 100.7 | 32.1 | 39.676 | -2.168 | 8.80 | 35.4 |
| 40.0 | 459.7 | 449.0 | 10.7 | 31.5 | 38.614 | -1.459 | 8.69 | 34.0 |
| 45.0 | 689.9 | 580.3 | 109.6 | 117.1 | 43.625 | -3.144 | 10.16 | 38.5 |
| 50.0 | 794.0 | 684.4 | 109.6 | 293.7 | 43.680 | -0.851 | 10.54 | 38.8 |
| 55.0 | 897.3 | 796.6 | 100.7 | 9999.0 | 44.098 | 0.000 | 10.60 | 37.9 |
| 60.0 | 1016.0 | 915.3 | 100.7 | 9999.0 | 43.374 | 0.000 | 10.52 | 36.2 |
| 62.0 | 1065.6 | 964.9 | 100.7 | 9999.0 | 42.306 | 0.000 | 10.39 | 35.3 |

Refusal occurred; no driving time output possible

↑
FRA-70-1322L - Rear Abutment - HP14x73 02/28/2021
Resource International Inc GRLWEAP Version 2010

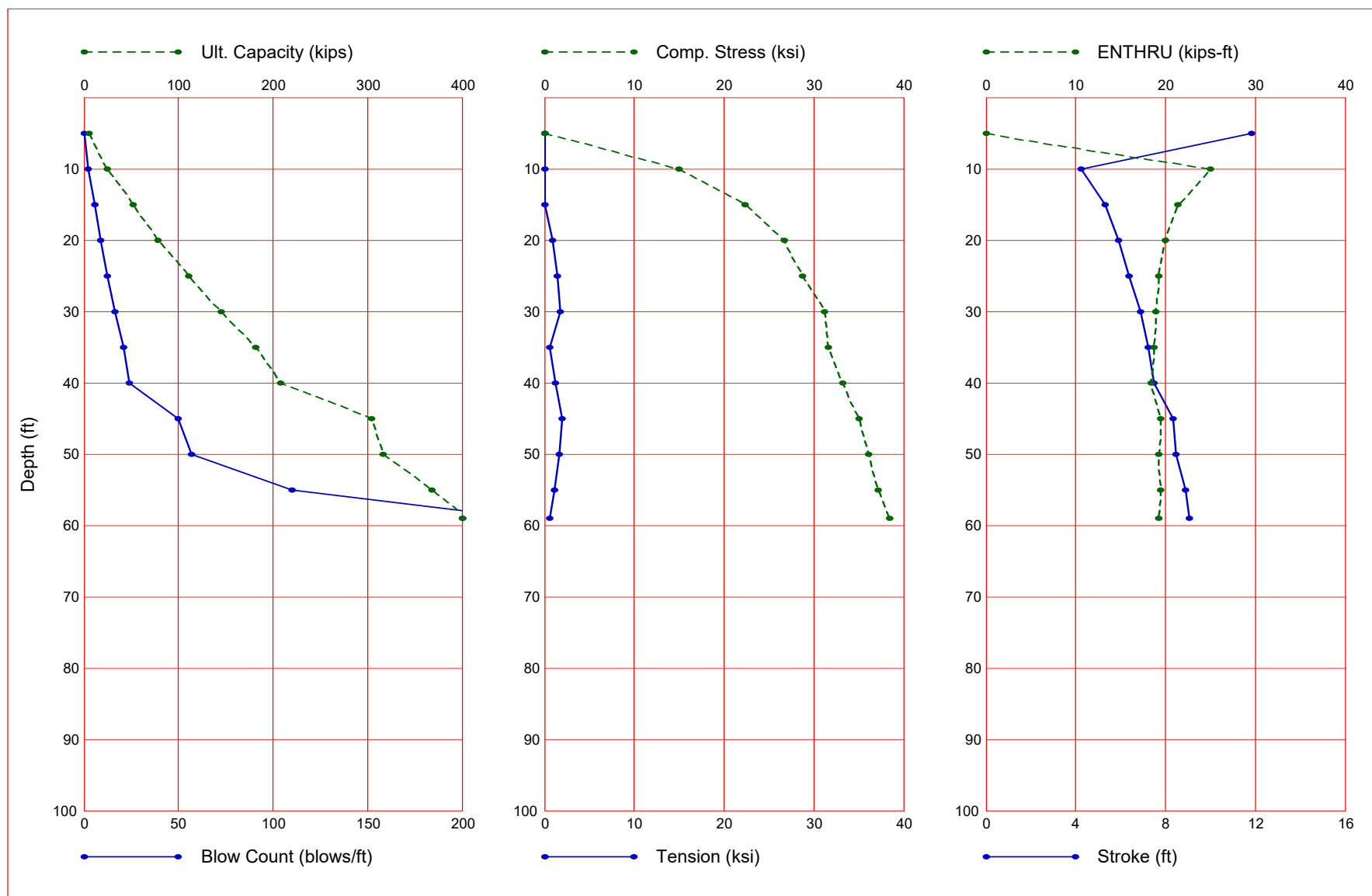
Table of Depths Analyzed with Driving System Modifiers

| Depth | Temp. Length | Wait Time | Equivalent Stroke | Pressure Ratio | Efficy. | Stiffn. Factor | Cushion CoR |
|-------|--------------|-----------|-------------------|----------------|---------|----------------|-------------|
| ft | ft | hr | ft | | | | |
| 5.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 10.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 15.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 20.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 25.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 30.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 35.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 40.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 45.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 50.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 55.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 60.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 62.00 | 62.00 | 0.00 | 11.18 | 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 | 0.03 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.01 | 1.04 | 26.79 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.09 | 1.05 | 27.03 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.11 | 3.75 | 5.02 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 14.09 | 3.75 | 5.02 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 14.11 | 1.62 | 50.78 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 19.09 | 2.22 | 69.65 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 19.11 | 2.20 | 56.83 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 24.49 | 2.82 | 72.83 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 24.51 | 2.82 | 72.87 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 29.09 | 3.10 | 74.83 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 29.11 | 3.16 | 100.70 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 38.11 | 3.75 | 100.70 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 39.09 | 3.82 | 100.70 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 39.11 | 8.00 | 10.70 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 44.09 | 8.00 | 10.70 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 44.11 | 4.19 | 109.62 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 53.11 | 4.83 | 109.62 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 54.49 | 4.93 | 109.62 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 54.51 | 4.85 | 100.70 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 62.00 | 5.34 | 100.70 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |

Gain/Loss 3 at Shaft and Toe 0.670 / 1.000



Gain/Loss 3 at Shaft and Toe 0.670 / 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 | 5.1 | 2.4 | 2.8 | 0.0 | 0.000 | 0.000 | 11.86 | 0.0 |
| 10.0 | 24.8 | 22.7 | 2.0 | 2.2 | 14.983 | 0.000 | 4.26 | 25.0 |
| 15.0 | 52.2 | 50.8 | 1.5 | 5.7 | 22.378 | 0.000 | 5.32 | 21.4 |
| 20.0 | 78.2 | 67.1 | 11.1 | 8.9 | 26.765 | -0.947 | 5.89 | 20.0 |
| 25.0 | 110.9 | 90.4 | 20.5 | 12.4 | 28.698 | -1.488 | 6.39 | 19.2 |
| 30.0 | 145.6 | 122.4 | 23.1 | 16.5 | 31.240 | -1.749 | 6.90 | 18.9 |
| 35.0 | 181.6 | 158.5 | 23.1 | 20.9 | 31.602 | -0.611 | 7.24 | 18.7 |
| 40.0 | 207.7 | 203.7 | 4.0 | 24.0 | 33.243 | -1.180 | 7.49 | 18.4 |
| 45.0 | 303.9 | 260.5 | 43.4 | 50.0 | 35.088 | -1.986 | 8.33 | 19.5 |
| 50.0 | 316.7 | 313.1 | 3.7 | 56.9 | 36.133 | -1.608 | 8.45 | 19.2 |
| 55.0 | 368.6 | 364.9 | 3.7 | 110.1 | 37.220 | -1.157 | 8.90 | 19.5 |
| 59.0 | 408.0 | 404.3 | 3.7 | 233.8 | 38.490 | -0.637 | 9.06 | 19.3 |

Total Continuous Driving Time 47.00 minutes; Total Number of Blows 1948 (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\2013\W-13-072 FRA-70-13.10 PROJECT 6A\ANALYSIS\FRA-70-1322L AND 1323C\DRIVEABILITY\FRA-70-1322L\FORWARD
ABUTMENT\HP 10X42\1322L-FA-10X42.GMW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-1322L - For Abutment - 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 32.170 144.000 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
59.000 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 R0
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 | 0.01 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 7.59 | 0.44 | 4.22 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 7.61 | 2.62 | 2.03 | 0.10 | 0.10 | 0.20 | 0.15 | 1.21 | 6.00 | 24.000 |
| 13.09 | 2.62 | 2.03 | 0.10 | 0.10 | 0.20 | 0.15 | 1.21 | 6.00 | 24.000 |
| 13.11 | 1.37 | 1.45 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 18.09 | 1.37 | 1.45 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 18.11 | 1.04 | 10.06 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 23.09 | 1.34 | 12.91 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 23.11 | 1.62 | 19.21 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 28.99 | 2.05 | 23.13 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 29.01 | 2.05 | 23.13 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 30.69 | 2.11 | 23.13 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 30.71 | 2.12 | 23.13 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 38.99 | 2.44 | 23.13 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 39.01 | 5.12 | 3.97 | 0.10 | 0.10 | 0.20 | 0.15 | 1.21 | 6.00 | 24.000 |
| 41.49 | 5.12 | 3.97 | 0.10 | 0.10 | 0.20 | 0.15 | 1.21 | 6.00 | 24.000 |
| 41.51 | 3.01 | 43.36 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 46.49 | 3.26 | 43.36 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 46.51 | 4.75 | 3.68 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 55.51 | 4.66 | 3.68 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 59.00 | 4.17 | 3.68 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |

Gain/Loss factors: shaft and toe

| Dpth | L | Wait | Strk | Pmx% | Eff. | Stff | CoR |
|---------|---------|---------|---------|---------|-------|-------|-------|
| 0.60400 | 0.63700 | 0.67000 | 0.70300 | 0.73600 | | | |
| 1.00000 | 1.00000 | 1.00000 | 1.00000 | 1.00000 | | | |
| 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 |
| 59.00 | 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-70-1322L - For Abutment - HP10x42

| Hammer Model: D 19-42 | | Made by: DELMAG | |
|-----------------------|----------------|------------------|-------|
| No. | Weight kips | Stiffn k/inch | CoR |
| 1 | 0.800 | | |
| 2 | 0.800 | 140046.6 | 1.000 |
| 3 | 0.800 | 140046.6 | 1.000 |
| 4 | 0.800 | 140046.6 | 1.000 |
| 5 | 0.800 | 140046.6 | 1.000 |
| Imp Block | 0.753 | 70735.6 | 0.900 |
| Helmet | 1.900 | 60155.0 | 0.800 |
| Combined Pile Top | | 9142.4 | |

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-70-1322L - For Abutment - HP10x42
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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 5.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 59.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 5.1 | |
|---------------------|--------|-------|-------|------|--------|---------------------------|-------|-------|-------|------|--|
| 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 0.139 | 9142 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 3.3 | 12.4 | |
| 2 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 3.3 | 12.4 | |
| 17 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 0.3 | 0.050 | 0.100 | 55.72 | 3.3 | 12.4 | |
| 18 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 2.1 | 0.050 | 0.100 | 59.00 | 3.3 | 12.4 | |
| Toe | | | | | 2.8 | 0.150 | 0.100 | | | | |

2.500 kips total unreduced pile weight (g= 32.17 ft/s2)
 2.500 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 |
| Output Time Interval | 1 | Analysis Time-Input (ms) |
| Output Level: Normal | | 0 |
| Gravity Mass, Pile, Hammer: | 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) 5.2 5.1
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.2 5.1
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.2 5.1
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.2 5.1
 Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.2 5.1
 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 |
|-------------|---------------|---------------------|----------------------|------|---|-----------------|------|---|------------------|----------------|
| 5.1 | 0.0 | 10.81 | 0.00 | 0.00 | 1 | 0 | 0.00 | 1 | 0 | 78.4 |
| 5.1 | 0.0 | 11.86 | 0.00 | 0.00 | 1 | 0 | 0.00 | 1 | 0 | 74.4 |
| 5.1 | 0.0 | 11.86 | 0.00 | 0.00 | 1 | 0 | 0.00 | 1 | 0 | 74.4 |
| 5.1 | 0.0 | 11.86 | 0.00 | 0.00 | 1 | 0 | 0.00 | 1 | 0 | 74.4 |
| 5.1 | 0.0 | 11.86 | 0.00 | 0.00 | 1 | 0 | 0.00 | 1 | 0 | 74.4 |

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Depth (ft) 10.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 59.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.141

| No. | Weight kips | Pile and Soil Model Stiffn C-Slk T-Slk k/in ft ft | CoR | Total Capacity Soil-S kips | Soil-D s/ft | Quake inch | Rut LbTop ft | (kips) Perim ft | 24.1 Area in2 |
|-----|----------------|---|------|----------------------------------|----------------|---------------|--------------------|-----------------------|---------------------|
| 1 | 0.139 | 9142 0.010 0.000 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 3.3 | 12.4 | |
| 2 | 0.139 | 9142 0.000 0.000 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 3.3 | 12.4 | |
| 15 | 0.139 | 9142 0.000 0.000 1.00 | 0.0 | 0.050 | 0.100 | 49.17 | 3.3 | 12.4 | |
| 16 | 0.139 | 9142 0.000 0.000 1.00 | 1.1 | 0.050 | 0.100 | 52.44 | 3.3 | 12.4 | |
| 17 | 0.139 | 9142 0.000 0.000 1.00 | 3.2 | 0.050 | 0.100 | 55.72 | 3.3 | 12.4 | |
| 18 | 0.139 | 9142 0.000 0.000 1.00 | 17.7 | 0.192 | 0.100 | 59.00 | 3.3 | 12.4 | |
| Toe | | | | 2.0 | 0.150 | 0.100 | | | |

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

2.500 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 |

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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 |
|-------------|---------------|---------------------|----------------------|------|---|-----------------|-------|---|------------------|----------------|
| 24.1 | 2.1 | 4.21 | 4.19 | 0.00 | 1 | 0 | 14.60 | 1 | 2 | 25.1 |
| 24.4 | 2.1 | 4.24 | 4.21 | 0.00 | 1 | 0 | 14.80 | 1 | 2 | 25.1 |
| 24.8 | 2.2 | 4.26 | 4.22 | 0.00 | 1 | 0 | 14.98 | 1 | 2 | 25.0 |
| 25.1 | 2.2 | 4.24 | 4.26 | 0.00 | 1 | 0 | 14.95 | 1 | 2 | 24.8 |
| 25.5 | 2.3 | 4.26 | 4.28 | 0.00 | 1 | 0 | 15.08 | 1 | 2 | 24.7 |

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Depth (ft) 15.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 59.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.141

| No. | Weight kips | Pile and Soil Model Stiffn C-Slk T-Slk k/in ft ft | CoR | Total Capacity Soil-S kips | Soil-D s/ft | Quake inch | Rut LbTop ft | (kips) Perim ft | 50.0 Area in2 |
|-----|----------------|---|-----|----------------------------------|----------------|---------------|--------------------|-----------------------|---------------------|
| 1 | 0.139 | 9142 0.010 0.000 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 3.3 | 12.4 | |
| 2 | 0.139 | 9142 0.000 0.000 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 3.3 | 12.4 | |
| 14 | 0.139 | 9142 0.000 0.000 1.00 | 0.3 | 0.050 | 0.100 | 45.89 | 3.3 | 12.4 | |

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| | | | | | | | | | | | |
|-----|-------|------|-------|-------|------|------|-------|-------|-------|-----|------|
| 15 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 2.2 | 0.050 | 0.100 | 49.17 | 3.3 | 12.4 |
| 16 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 8.8 | 0.156 | 0.100 | 52.44 | 3.3 | 12.4 |
| 17 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 22.6 | 0.200 | 0.100 | 55.72 | 3.3 | 12.4 |
| 18 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 14.7 | 0.200 | 0.100 | 59.00 | 3.3 | 12.4 |
| Toe | | | | | | 1.5 | 0.150 | 0.100 | | | |

2.500 kips total unreduced pile weight (g= 32.17 ft/s2)
2.500 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-70-1322L - For Abutment - HP10x42 02/28/2021
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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 |
| 50.0 | 5.4 | 5.26 5.23 | 0.00 | 1 | 0 | 21.90 | 15 | 5 | 21.6 | 51.5 |
| 51.1 | 5.5 | 5.29 5.26 | 0.00 | 1 | 0 | 22.13 | 15 | 5 | 21.5 | 51.4 |
| 52.2 | 5.7 | 5.32 5.30 | 0.00 | 1 | 0 | 22.38 | 15 | 5 | 21.4 | 51.2 |
| 53.3 | 5.8 | 5.35 5.33 | 0.00 | 1 | 0 | 22.58 | 15 | 5 | 21.3 | 51.0 |
| 54.4 | 5.9 | 5.38 5.36 | 0.00 | 1 | 0 | 22.79 | 15 | 5 | 21.2 | 50.9 |

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| | | | |
|------------------------|------|-------|----------------------|
| Depth | (ft) | 20.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 59.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.141

| | | | | | | |
|-----|--------|------------------------|----------------|--------------|--------|-------|
| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 75.1 |
| | kips | Stiffn C-Slk T-Slk CoR | Soil-S | Soil-D Quake | LbTop | Perim |
| | | k/in ft ft | kips s/ft inch | ft | ft | in2 |
| 1 | 0.139 | 9142 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.28 | 3.3 |
| 2 | 0.139 | 9142 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.56 | 3.3 |
| 12 | 0.139 | 9142 0.000 0.000 1.00 | 0.0 | 0.050 0.100 | 39.33 | 3.3 |
| 13 | 0.139 | 9142 0.000 0.000 1.00 | 1.2 | 0.050 0.100 | 42.61 | 3.3 |
| 14 | 0.139 | 9142 0.000 0.000 1.00 | 3.3 | 0.050 0.100 | 45.89 | 3.3 |
| 15 | 0.139 | 9142 0.000 0.000 1.00 | 18.7 | 0.193 0.100 | 49.17 | 3.3 |
| 16 | 0.139 | 9142 0.000 0.000 1.00 | 21.2 | 0.200 0.100 | 52.44 | 3.3 |
| 17 | 0.139 | 9142 0.000 0.000 1.00 | 9.0 | 0.200 0.100 | 55.72 | 3.3 |
| 18 | 0.139 | 9142 0.000 0.000 1.00 | 10.6 | 0.121 0.100 | 59.00 | 3.3 |
| Toe | | | 11.1 | 0.150 0.100 | | |

2.500 kips total unreduced pile weight (g= 32.17 ft/s2)
2.500 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 |
| 75.1 | 8.5 | 5.80 5.85 | -1.02 | 13 | 48 | 26.25 | 15 | 5 | 20.0 | 48.8 |
| 76.6 | 8.7 | 5.84 5.88 | -0.90 | 13 | 48 | 26.52 | 15 | 5 | 20.0 | 48.6 |
| 78.2 | 8.9 | 5.89 5.92 | -0.95 | 14 | 45 | 26.77 | 15 | 5 | 20.0 | 48.4 |
| 79.8 | 9.1 | 5.92 5.96 | -0.99 | 14 | 44 | 26.99 | 15 | 5 | 19.8 | 48.3 |
| 81.3 | 9.3 | 5.96 5.99 | -1.02 | 14 | 45 | 27.20 | 15 | 5 | 19.8 | 48.2 |

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| | | | |
|------------------------|------|-------|----------------------|
| Depth | (ft) | 25.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

1322L-FA-10X42

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 59.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.141

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 107.8 |
|-----|--------|------------------------|----------------|--------------|--------|-------|
| | kips | Stiffn C-Slk T-Slk CoR | Soil-S | Soil-D Quake | LbTop | Perim |
| | | k/in ft ft | kips | s/ft inch | ft | ft |
| 1 | 0.139 | 9142 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.28 | 3.3 |
| 2 | 0.139 | 9142 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.56 | 3.3 |
| 11 | 0.139 | 9142 0.000 0.000 1.00 | 0.4 | 0.050 0.100 | 36.06 | 3.3 |
| 12 | 0.139 | 9142 0.000 0.000 1.00 | 2.3 | 0.050 0.100 | 39.33 | 3.3 |
| 13 | 0.139 | 9142 0.000 0.000 1.00 | 9.8 | 0.163 0.100 | 42.61 | 3.3 |
| 14 | 0.139 | 9142 0.000 0.000 1.00 | 22.6 | 0.200 0.100 | 45.89 | 3.3 |
| 15 | 0.139 | 9142 0.000 0.000 1.00 | 14.0 | 0.200 0.100 | 49.17 | 3.3 |
| 16 | 0.139 | 9142 0.000 0.000 1.00 | 9.2 | 0.188 0.100 | 52.44 | 3.3 |
| 17 | 0.139 | 9142 0.000 0.000 1.00 | 12.5 | 0.050 0.100 | 55.72 | 3.3 |
| 18 | 0.139 | 9142 0.000 0.000 1.00 | 16.5 | 0.050 0.100 | 59.00 | 3.3 |
| Toe | | | 20.5 | 0.150 0.100 | | |

2.500 kips total unredacted pile weight (g= 32.17 ft/s2)

2.500 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 |
| 107.8 | 11.9 | 6.32 6.34 | -1.48 | 12 | 38 | 28.36 | 13 | 4 |
| 109.3 | 12.1 | 6.35 6.37 | -1.49 | 12 | 38 | 28.51 | 13 | 4 |
| 110.9 | 12.4 | 6.39 6.39 | -1.49 | 12 | 38 | 28.70 | 13 | 5 |
| 112.5 | 12.7 | 6.41 6.44 | -1.47 | 12 | 38 | 28.83 | 13 | 4 |
| 114.0 | 12.9 | 6.44 6.46 | -1.44 | 12 | 38 | 29.01 | 13 | 4 |



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| Depth | (ft) | 30.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 59.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.141

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 142.5 |
|-----|--------|------------------------|----------------|--------------|--------|-------|
| | kips | Stiffn C-Slk T-Slk CoR | Soil-S | Soil-D Quake | LbTop | Perim |
| | | k/in ft ft | kips | s/ft inch | ft | ft |
| 1 | 0.139 | 9142 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.28 | 3.3 |
| 2 | 0.139 | 9142 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.56 | 3.3 |
| 9 | 0.139 | 9142 0.000 0.000 1.00 | 0.0 | 0.050 0.100 | 29.50 | 3.3 |
| 10 | 0.139 | 9142 0.000 0.000 1.00 | 1.3 | 0.050 0.100 | 32.78 | 3.3 |
| 11 | 0.139 | 9142 0.000 0.000 1.00 | 3.4 | 0.050 0.100 | 36.06 | 3.3 |
| 12 | 0.139 | 9142 0.000 0.000 1.00 | 19.6 | 0.195 0.100 | 39.33 | 3.3 |
| 13 | 0.139 | 9142 0.000 0.000 1.00 | 20.5 | 0.200 0.100 | 42.61 | 3.3 |
| 14 | 0.139 | 9142 0.000 0.000 1.00 | 9.0 | 0.200 0.100 | 45.89 | 3.3 |
| 15 | 0.139 | 9142 0.000 0.000 1.00 | 10.8 | 0.113 0.100 | 49.17 | 3.3 |
| 16 | 0.139 | 9142 0.000 0.000 1.00 | 14.0 | 0.050 0.100 | 52.44 | 3.3 |
| 17 | 0.139 | 9142 0.000 0.000 1.00 | 19.1 | 0.050 0.100 | 55.72 | 3.3 |
| 18 | 0.139 | 9142 0.000 0.000 1.00 | 21.6 | 0.050 0.100 | 59.00 | 3.3 |
| Toe | | | 23.1 | 0.150 0.100 | | |

2.500 kips total unredacted pile weight (g= 32.17 ft/s2)

2.500 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 |
| 142.5 | 16.0 | 6.86 | 6.80 | -1.78 | 10 | 32 | 30.93 | 12 | 4 | 18.9 |
| 144.0 | 16.2 | 6.88 | 6.81 | -1.79 | 10 | 32 | 31.09 | 12 | 4 | 19.0 |
| 145.6 | 16.5 | 6.90 | 6.85 | -1.75 | 10 | 32 | 31.24 | 12 | 4 | 18.9 |
| 147.1 | 16.7 | 6.92 | 6.87 | -1.70 | 10 | 32 | 31.37 | 12 | 4 | 18.9 |
| 148.7 | 17.0 | 6.95 | 6.90 | -1.65 | 9 | 32 | 31.56 | 12 | 4 | 18.9 |

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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 35.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 59.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.141

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 178.5 |
|-----|--------|------------------------|----------------|--------|--------|------------------|
| | 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 | 0.139 | 9142 0.010 0.000 0.85 | 0.0 | 0.000 | 0.100 | 3.28 3.3 12.4 |
| 2 | 0.139 | 9142 0.000 0.000 1.00 | 0.0 | 0.000 | 0.100 | 6.56 3.3 12.4 |
| 8 | 0.139 | 9142 0.000 0.000 1.00 | 0.5 | 0.050 | 0.100 | 26.22 3.3 12.4 |
| 9 | 0.139 | 9142 0.000 0.000 1.00 | 2.4 | 0.050 | 0.100 | 29.50 3.3 12.4 |
| 10 | 0.139 | 9142 0.000 0.000 1.00 | 10.7 | 0.169 | 0.100 | 32.78 3.3 12.4 |
| 11 | 0.139 | 9142 0.000 0.000 1.00 | 22.6 | 0.200 | 0.100 | 36.06 3.3 12.4 |
| 12 | 0.139 | 9142 0.000 0.000 1.00 | 13.3 | 0.200 | 0.100 | 39.33 3.3 12.4 |
| 13 | 0.139 | 9142 0.000 0.000 1.00 | 9.3 | 0.181 | 0.100 | 42.61 3.3 12.4 |
| 14 | 0.139 | 9142 0.000 0.000 1.00 | 12.6 | 0.050 | 0.100 | 45.89 3.3 12.4 |
| 15 | 0.139 | 9142 0.000 0.000 1.00 | 16.8 | 0.050 | 0.100 | 49.17 3.3 12.4 |
| 16 | 0.139 | 9142 0.000 0.000 1.00 | 20.5 | 0.050 | 0.100 | 52.44 3.3 12.4 |
| 17 | 0.139 | 9142 0.000 0.000 1.00 | 22.6 | 0.050 | 0.100 | 55.72 3.3 12.4 |
| 18 | 0.139 | 9142 0.000 0.000 1.00 | 24.0 | 0.050 | 0.100 | 59.00 3.3 12.4 |
| Toe | | | 23.1 | 0.150 | 0.100 | |

2.500 kips total unreduced pile weight (g= 32.17 ft/s2)
 2.500 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 |
| 178.5 | 20.3 | 7.21 | 7.18 | -0.78 | 8 | 31 | 31.37 | 10 | 4 | 18.7 |
| 180.1 | 20.6 | 7.22 | 7.20 | -0.70 | 8 | 31 | 31.47 | 10 | 4 | 18.6 |
| 181.6 | 20.9 | 7.24 | 7.22 | -0.61 | 8 | 31 | 31.60 | 10 | 4 | 18.7 |
| 183.2 | 21.1 | 7.27 | 7.24 | -0.53 | 8 | 31 | 31.75 | 10 | 4 | 18.7 |
| 184.7 | 21.4 | 7.29 | 7.26 | -0.45 | 8 | 31 | 31.91 | 10 | 4 | 18.6 |

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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 40.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
| Pile Size | (inch) | 10.000 | | |

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| 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 |
| 59.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | Total Capacity Rut | | | (kips) | | | 204.0 |
|---------------------|--------|--------|-------|-------|------|--------------------|--------|-------|--------|-------|------|-------|
| 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 | 0.139 | 9142 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 3.3 | 12.4 | |
| 2 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 3.3 | 12.4 | |
| 6 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 19.67 | 3.3 | 12.4 | |
| 7 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 1.4 | 0.050 | 0.100 | 22.94 | 3.3 | 12.4 | |
| 8 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 3.5 | 0.050 | 0.100 | 26.22 | 3.3 | 12.4 | |
| 9 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 20.5 | 0.197 | 0.100 | 29.50 | 3.3 | 12.4 | |
| 10 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 19.8 | 0.200 | 0.100 | 32.78 | 3.3 | 12.4 | |
| 11 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 9.0 | 0.200 | 0.100 | 36.06 | 3.3 | 12.4 | |
| 12 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 11.0 | 0.105 | 0.100 | 39.33 | 3.3 | 12.4 | |
| 13 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 14.2 | 0.050 | 0.100 | 42.61 | 3.3 | 12.4 | |
| 14 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 19.3 | 0.050 | 0.100 | 45.89 | 3.3 | 12.4 | |
| 15 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 21.8 | 0.050 | 0.100 | 49.17 | 3.3 | 12.4 | |
| 16 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 23.3 | 0.050 | 0.100 | 52.44 | 3.3 | 12.4 | |
| 17 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 24.7 | 0.050 | 0.100 | 55.72 | 3.3 | 12.4 | |
| 18 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 31.5 | 0.122 | 0.100 | 59.00 | 3.3 | 12.4 | |
| Toe | | | | | | 4.0 | 0.150 | 0.100 | | | | |

2.500 kips total unreduded pile weight (g= 32.17 ft/s2)

2.500 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 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 |
|-------------|---------------|---------------------|---------------|-------|---|-----------------|-------|---|------------------|----------------|
| 204.0 | 23.4 | 7.45 | 7.43 | -1.21 | 7 | 50 | 32.94 | 9 | 3 | 18.3 |
| 205.8 | 23.7 | 7.46 | 7.45 | -1.22 | 8 | 50 | 33.07 | 9 | 4 | 18.3 |
| 207.7 | 24.0 | 7.49 | 7.47 | -1.18 | 8 | 50 | 33.24 | 9 | 4 | 18.4 |
| 209.5 | 24.2 | 7.51 | 7.49 | -1.10 | 8 | 50 | 33.41 | 9 | 4 | 18.4 |
| 211.4 | 24.6 | 7.53 | 7.52 | -1.02 | 7 | 50 | 33.54 | 9 | 4 | 18.3 |

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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 45.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | 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 |
| 59.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | Total | Capacity | Rut | (kips) | | | 299.3 |
|---------------------|--------|--------|-------|-------|------|--------|----------|-------|--------|-------|------|-------|
| 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 | 0.139 | 9142 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 3.3 | 12.4 | |
| 2 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 3.3 | 12.4 | |
| 5 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 0.5 | 0.050 | 0.100 | 16.39 | 3.3 | 12.4 | |
| 6 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 2.5 | 0.050 | 0.100 | 19.67 | 3.3 | 12.4 | |
| 7 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 11.7 | 0.174 | 0.100 | 22.94 | 3.3 | 12.4 | |
| 8 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 22.6 | 0.200 | 0.100 | 26.22 | 3.3 | 12.4 | |
| 9 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 12.6 | 0.200 | 0.100 | 29.50 | 3.3 | 12.4 | |
| 10 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 9.5 | 0.175 | 0.100 | 32.78 | 3.3 | 12.4 | |
| 11 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 12.7 | 0.050 | 0.100 | 36.06 | 3.3 | 12.4 | |
| 12 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 17.1 | 0.050 | 0.100 | 39.33 | 3.3 | 12.4 | |
| 13 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 20.6 | 0.050 | 0.100 | 42.61 | 3.3 | 12.4 | |
| 14 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 22.7 | 0.050 | 0.100 | 45.89 | 3.3 | 12.4 | |
| 15 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 24.1 | 0.050 | 0.100 | 49.17 | 3.3 | 12.4 | |
| 16 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 25.5 | 0.050 | 0.100 | 52.44 | 3.3 | 12.4 | |
| 17 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 40.3 | 0.179 | 0.100 | 55.72 | 3.3 | 12.4 | |

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18 0.139 9142 0.000 0.000 1.00 33.5 0.050 0.100 59.00 3.3 12.4
 Toe 43.4 0.150 0.100

2.500 kips total unreduced pile weight (g= 32.17 ft/s2)
 2.500 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 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 | |
|-------------|---------------|---------------------|----------------------|-------|---|-----------------|-------|---|------------------|----------------|------|
| 299.3 | 48.1 | 8.27 | 8.34 | -1.90 | 7 | 20 | 34.73 | 7 | 3 | 19.4 | 41.0 |
| 301.6 | 49.0 | 8.30 | 8.36 | -1.93 | 7 | 20 | 34.92 | 7 | 3 | 19.5 | 40.9 |
| 303.9 | 50.0 | 8.33 | 8.38 | -1.99 | 7 | 20 | 35.09 | 7 | 3 | 19.5 | 40.9 |
| 306.1 | 51.4 | 8.36 | 8.42 | -1.99 | 7 | 20 | 35.26 | 7 | 3 | 19.5 | 40.8 |
| 308.4 | 52.3 | 8.38 | 8.43 | -2.06 | 7 | 19 | 35.41 | 7 | 3 | 19.6 | 40.7 |

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Depth (ft) 50.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 59.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.141

| 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 | Rut (kips) LbTop Perim Area ft ft in2 |
|-----|----------------|---|------|----------------------------------|----------------------|---|
| 1 | 0.139 | 9142 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.28 3.3 12.4 | |
| 2 | 0.139 | 9142 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.56 3.3 12.4 | |
| 3 | 0.139 | 9142 0.000 0.000 1.00 | 0.1 | 0.050 0.100 | 9.83 3.3 12.4 | |
| 4 | 0.139 | 9142 0.000 0.000 1.00 | 1.5 | 0.050 0.100 | 13.11 3.3 12.4 | |
| 5 | 0.139 | 9142 0.000 0.000 1.00 | 3.6 | 0.050 0.100 | 16.39 3.3 12.4 | |
| 6 | 0.139 | 9142 0.000 0.000 1.00 | 21.5 | 0.198 0.100 | 19.67 3.3 12.4 | |
| 7 | 0.139 | 9142 0.000 0.000 1.00 | 19.1 | 0.200 0.100 | 22.94 3.3 12.4 | |
| 8 | 0.139 | 9142 0.000 0.000 1.00 | 9.0 | 0.200 0.100 | 26.22 3.3 12.4 | |
| 9 | 0.139 | 9142 0.000 0.000 1.00 | 11.2 | 0.097 0.100 | 29.50 3.3 12.4 | |
| 10 | 0.139 | 9142 0.000 0.000 1.00 | 14.5 | 0.050 0.100 | 32.78 3.3 12.4 | |
| 11 | 0.139 | 9142 0.000 0.000 1.00 | 19.4 | 0.050 0.100 | 36.06 3.3 12.4 | |
| 12 | 0.139 | 9142 0.000 0.000 1.00 | 21.9 | 0.050 0.100 | 39.33 3.3 12.4 | |
| 13 | 0.139 | 9142 0.000 0.000 1.00 | 23.4 | 0.050 0.100 | 42.61 3.3 12.4 | |
| 14 | 0.139 | 9142 0.000 0.000 1.00 | 24.8 | 0.050 0.100 | 45.89 3.3 12.4 | |
| 15 | 0.139 | 9142 0.000 0.000 1.00 | 32.4 | 0.131 0.100 | 49.17 3.3 12.4 | |
| 16 | 0.139 | 9142 0.000 0.000 1.00 | 37.6 | 0.130 0.100 | 52.44 3.3 12.4 | |
| 17 | 0.139 | 9142 0.000 0.000 1.00 | 34.2 | 0.065 0.100 | 55.72 3.3 12.4 | |
| 18 | 0.139 | 9142 0.000 0.000 1.00 | 30.9 | 0.200 0.100 | 59.00 3.3 12.4 | |
| Toe | | | 3.7 | 0.150 0.100 | | |

2.500 kips total unreduced pile weight (g= 32.17 ft/s2)
 2.500 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 (ft) down | Ten Str up ksi | i | t | Comp Str ksi | i | t | ENTHRU kip-ft | Bl Rt b/min | |
|-------------|---------------|---------------------|----------------------|-------|---|-----------------|-------|---|------------------|----------------|------|
| 308.6 | 52.7 | 8.36 | 8.42 | -1.53 | 5 | 38 | 35.67 | 6 | 3 | 19.0 | 40.8 |
| 312.7 | 54.7 | 8.40 | 8.45 | -1.58 | 5 | 38 | 35.89 | 6 | 3 | 19.1 | 40.7 |
| 316.7 | 56.9 | 8.45 | 8.49 | -1.61 | 5 | 38 | 36.13 | 6 | 3 | 19.2 | 40.6 |
| 320.8 | 59.7 | 8.49 | 8.53 | -1.62 | 5 | 38 | 36.35 | 6 | 3 | 19.2 | 40.5 |
| 324.9 | 62.1 | 8.54 | 8.57 | -1.64 | 5 | 37 | 36.59 | 6 | 3 | 19.3 | 40.4 |

Depth (ft) 55.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 59.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | Total | Capacity | Rut | (kips) | | 355.4 |
|---------------------|--------|--------|-------|-------|------|--------|----------|-------|--------|-------|-------|
| 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 | 0.139 | 9142 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 3.3 | 12.4 |
| 2 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 0.6 | 0.050 | 0.100 | 6.56 | 3.3 | 12.4 |
| 3 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 2.6 | 0.050 | 0.100 | 9.83 | 3.3 | 12.4 |
| 4 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 12.7 | 0.178 | 0.100 | 13.11 | 3.3 | 12.4 |
| 5 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 22.6 | 0.200 | 0.100 | 16.39 | 3.3 | 12.4 |
| 6 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 11.9 | 0.200 | 0.100 | 19.67 | 3.3 | 12.4 |
| 7 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 9.6 | 0.168 | 0.100 | 22.94 | 3.3 | 12.4 |
| 8 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 12.9 | 0.050 | 0.100 | 26.22 | 3.3 | 12.4 |
| 9 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 17.4 | 0.050 | 0.100 | 29.50 | 3.3 | 12.4 |
| 10 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 20.7 | 0.050 | 0.100 | 32.78 | 3.3 | 12.4 |
| 11 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 22.8 | 0.050 | 0.100 | 36.06 | 3.3 | 12.4 |
| 12 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 24.1 | 0.050 | 0.100 | 39.33 | 3.3 | 12.4 |
| 13 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 25.5 | 0.050 | 0.100 | 42.61 | 3.3 | 12.4 |
| 14 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 40.7 | 0.178 | 0.100 | 45.89 | 3.3 | 12.4 |
| 15 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 33.6 | 0.050 | 0.100 | 49.17 | 3.3 | 12.4 |
| 16 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 32.6 | 0.152 | 0.100 | 52.44 | 3.3 | 12.4 |
| 17 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 30.8 | 0.200 | 0.100 | 55.72 | 3.3 | 12.4 |
| 18 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 30.6 | 0.200 | 0.100 | 59.00 | 3.3 | 12.4 |
| Toe | | | | | | 3.7 | 0.150 | 0.100 | | | |

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

2.500 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 |

| 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 | | |
|-------------|---------------|---------------------|---------------|----------|---|-----------------|-------|--------------------|----------------|------|------|
| 355.4 | 92.1 | 8.79 | 8.77 | -1.07 | 4 | 35 | 36.73 | 4 | 3 | 19.2 | 39.9 |
| 362.0 | 100.6 | 8.85 | 8.81 | -1.11 | 4 | 35 | 36.98 | 4 | 3 | 19.3 | 39.8 |
| 368.6 | 110.1 | 8.90 | 8.85 | -1.16 | 4 | 35 | 37.22 | 4 | 3 | 19.5 | 39.7 |
| 375.3 | 122.6 | 8.95 | 8.90 | -1.18 | 4 | 35 | 37.44 | 4 | 3 | 19.5 | 39.6 |
| 381.9 | 134.5 | 8.99 | 8.93 | -1.23 | 4 | 34 | 37.67 | 4 | 3 | 19.7 | 39.5 |

Depth (ft) 59.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 59.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.141

| 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 | 0.139 | 9142 | 0.010 | 0.000 | 0.85 | 1.0 | 0.050 | 0.100 | 3.28 | 3.3 | 12.4 |
| 2 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 3.1 | 0.050 | 0.100 | 6.56 | 3.3 | 12.4 |

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| | | | | | | | | | | | |
|-----|-------|------|-------|-------|------|------|-------|-------|-------|-----|------|
| 3 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 16.8 | 0.190 | 0.100 | 9.83 | 3.3 | 12.4 |
| 4 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 22.6 | 0.200 | 0.100 | 13.11 | 3.3 | 12.4 |
| 5 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 9.0 | 0.200 | 0.100 | 16.39 | 3.3 | 12.4 |
| 6 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 10.3 | 0.137 | 0.100 | 19.67 | 3.3 | 12.4 |
| 7 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 13.3 | 0.050 | 0.100 | 22.94 | 3.3 | 12.4 |
| 8 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 18.6 | 0.050 | 0.100 | 26.22 | 3.3 | 12.4 |
| 9 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 21.3 | 0.050 | 0.100 | 29.50 | 3.3 | 12.4 |
| 10 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 23.1 | 0.050 | 0.100 | 32.78 | 3.3 | 12.4 |
| 11 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 24.5 | 0.050 | 0.100 | 36.06 | 3.3 | 12.4 |
| 12 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 27.6 | 0.079 | 0.100 | 39.33 | 3.3 | 12.4 |
| 13 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 40.3 | 0.165 | 0.100 | 42.61 | 3.3 | 12.4 |
| 14 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 34.0 | 0.050 | 0.100 | 45.89 | 3.3 | 12.4 |
| 15 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 31.7 | 0.180 | 0.100 | 49.17 | 3.3 | 12.4 |
| 16 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 30.8 | 0.200 | 0.100 | 52.44 | 3.3 | 12.4 |
| 17 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 30.5 | 0.200 | 0.100 | 55.72 | 3.3 | 12.4 |
| 18 | 0.139 | 9142 | 0.000 | 0.000 | 1.00 | 28.8 | 0.200 | 0.100 | 59.00 | 3.3 | 12.4 |
| Toe | | | | | | 3.7 | 0.150 | 0.100 | | | |

2.500 kips total unredacted pile weight (g= 32.17 ft/s2)

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

| | | | |
|-------|--------|----------|--------|
| Depth | Stroke | Pressure | Efficy |
| ft | ft | Ratio | |
| 59.00 | 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 |
| 390.8 | 163.2 | 8.98 | 8.92 | -0.60 | 3 | 33 | 38.01 | 3 | 3 | 19.1 |
| 399.4 | 191.5 | 9.02 | 8.95 | -0.63 | 3 | 33 | 38.24 | 3 | 3 | 19.3 |
| 408.0 | 233.8 | 9.06 | 8.99 | -0.64 | 3 | 32 | 38.49 | 3 | 3 | 19.3 |
| 416.5 | 293.7 | 9.10 | 9.03 | -0.65 | 3 | 32 | 38.68 | 3 | 3 | 19.4 |
| 425.1 | 385.4 | 9.14 | 9.06 | -0.67 | 3 | 32 | 38.92 | 3 | 3 | 19.5 |

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SUMMARY OVER DEPTHS

| Depth | Rut | G/L at Frictn | End Bg | Shaft and | Toe: 0.604 | 1.000 | Stroke | ENTHRU |
|-------|-------|---------------|--------|-----------|------------|--------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
| 5.0 | 5.1 | 2.4 | 2.8 | 0.0 | 0.000 | 0.000 | 10.81 | 0.0 |
| 10.0 | 24.1 | 22.0 | 2.0 | 2.1 | 14.603 | 0.000 | 4.21 | 25.1 |
| 15.0 | 50.0 | 48.6 | 1.5 | 5.4 | 21.904 | 0.000 | 5.26 | 21.6 |
| 20.0 | 75.1 | 63.9 | 11.1 | 8.5 | 26.248 | -1.017 | 5.80 | 20.0 |
| 25.0 | 107.8 | 87.3 | 20.5 | 11.9 | 28.356 | -1.477 | 6.32 | 19.2 |
| 30.0 | 142.5 | 119.3 | 23.1 | 16.0 | 30.925 | -1.780 | 6.86 | 18.9 |
| 35.0 | 178.5 | 155.4 | 23.1 | 20.3 | 31.370 | -0.785 | 7.21 | 18.7 |
| 40.0 | 204.0 | 200.0 | 4.0 | 23.4 | 32.944 | -1.209 | 7.45 | 18.3 |
| 45.0 | 299.3 | 256.0 | 43.4 | 48.1 | 34.728 | -1.897 | 8.27 | 19.4 |
| 50.0 | 308.6 | 304.9 | 3.7 | 52.7 | 35.672 | -1.529 | 8.36 | 19.0 |
| 55.0 | 355.4 | 351.7 | 3.7 | 92.1 | 36.732 | -1.067 | 8.79 | 19.2 |
| 59.0 | 390.8 | 387.1 | 3.7 | 163.2 | 38.012 | -0.603 | 8.98 | 19.1 |

Total Driving Time 41 minutes;
 Starting at penetration 5.0 ft
 Total No. of Blows 1684

| Depth | Rut | G/L at Frictn | End Bg | Shaft and | Toe: 0.637 | 1.000 | Stroke | ENTHRU |
|-------|-------|---------------|--------|-----------|------------|--------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
| 5.0 | 5.1 | 2.4 | 2.8 | 0.0 | 0.000 | 0.000 | 11.86 | 0.0 |
| 10.0 | 24.4 | 22.4 | 2.0 | 2.1 | 14.804 | 0.000 | 4.24 | 25.1 |
| 15.0 | 51.1 | 49.7 | 1.5 | 5.5 | 22.134 | 0.000 | 5.29 | 21.5 |
| 20.0 | 76.6 | 65.5 | 11.1 | 8.7 | 26.519 | -0.898 | 5.84 | 20.0 |
| 25.0 | 109.3 | 88.9 | 20.5 | 12.1 | 28.510 | -1.490 | 6.35 | 19.2 |
| 30.0 | 144.0 | 120.9 | 23.1 | 16.2 | 31.086 | -1.791 | 6.88 | 19.0 |
| 35.0 | 180.1 | 156.9 | 23.1 | 20.6 | 31.474 | -0.698 | 7.22 | 18.6 |
| 40.0 | 205.8 | 201.9 | 4.0 | 23.7 | 33.069 | -1.224 | 7.46 | 18.3 |
| 45.0 | 301.6 | 258.2 | 43.4 | 49.0 | 34.918 | -1.935 | 8.30 | 19.5 |
| 50.0 | 312.7 | 309.0 | 3.7 | 54.7 | 35.891 | -1.575 | 8.40 | 19.1 |
| 55.0 | 362.0 | 358.3 | 3.7 | 100.6 | 36.980 | -1.112 | 8.85 | 19.3 |
| 59.0 | 399.4 | 395.7 | 3.7 | 191.5 | 38.240 | -0.626 | 9.02 | 19.3 |

Total Driving Time 44 minutes;
 Starting at penetration 5.0 ft
 Total No. of Blows 1798

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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 | 5.1 | 2.4 | 2.8 | 0.0 | 0.000 | 0.000 | 11.86 | 0.0 |
| 10.0 | 24.8 | 22.7 | 2.0 | 2.2 | 14.983 | 0.000 | 4.26 | 25.0 |
| 15.0 | 52.2 | 50.8 | 1.5 | 5.7 | 22.378 | 0.000 | 5.32 | 21.4 |
| 20.0 | 78.2 | 67.1 | 11.1 | 8.9 | 26.765 | -0.947 | 5.89 | 20.0 |
| 25.0 | 110.9 | 90.4 | 20.5 | 12.4 | 28.698 | -1.488 | 6.39 | 19.2 |
| 30.0 | 145.6 | 122.4 | 23.1 | 16.5 | 31.240 | -1.749 | 6.90 | 18.9 |
| 35.0 | 181.6 | 158.5 | 23.1 | 20.9 | 31.602 | -0.611 | 7.24 | 18.7 |
| 40.0 | 207.7 | 203.7 | 4.0 | 24.0 | 33.243 | -1.180 | 7.49 | 18.4 |
| 45.0 | 303.9 | 260.5 | 43.4 | 50.0 | 35.088 | -1.986 | 8.33 | 19.5 |
| 50.0 | 316.7 | 313.1 | 3.7 | 56.9 | 36.133 | -1.608 | 8.45 | 19.2 |
| 55.0 | 368.6 | 364.9 | 3.7 | 110.1 | 37.220 | -1.157 | 8.90 | 19.5 |
| 59.0 | 408.0 | 404.3 | 3.7 | 233.8 | 38.490 | -0.637 | 9.06 | 19.3 |

Total Driving Time 47 minutes; Total No. of Blows 1948
Starting at penetration 5.0 ft

| 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 | 5.1 | 2.4 | 2.8 | 0.0 | 0.000 | 0.000 | 11.86 | 0.0 |
| 10.0 | 25.1 | 23.1 | 2.0 | 2.2 | 14.948 | 0.000 | 4.24 | 24.8 |
| 15.0 | 53.3 | 51.9 | 1.5 | 5.8 | 22.584 | 0.000 | 5.35 | 21.3 |
| 20.0 | 79.8 | 68.6 | 11.1 | 9.1 | 26.985 | -0.989 | 5.92 | 19.8 |
| 25.0 | 112.5 | 92.0 | 20.5 | 12.7 | 28.830 | -1.470 | 6.41 | 19.0 |
| 30.0 | 147.1 | 124.0 | 23.1 | 16.7 | 31.367 | -1.700 | 6.92 | 18.9 |
| 35.0 | 183.2 | 160.1 | 23.1 | 21.1 | 31.750 | -0.530 | 7.27 | 18.7 |
| 40.0 | 209.5 | 205.6 | 4.0 | 24.2 | 33.413 | -1.102 | 7.51 | 18.4 |
| 45.0 | 306.1 | 262.8 | 43.4 | 51.4 | 35.259 | -1.990 | 8.36 | 19.5 |
| 50.0 | 320.8 | 317.1 | 3.7 | 59.7 | 36.350 | -1.623 | 8.49 | 19.2 |
| 55.0 | 375.3 | 371.6 | 3.7 | 122.6 | 37.436 | -1.185 | 8.95 | 19.5 |
| 59.0 | 416.5 | 412.9 | 3.7 | 293.7 | 38.682 | -0.654 | 9.10 | 19.4 |

Total Driving Time 53 minutes; Total No. of Blows 2153
Starting at penetration 5.0 ft

↑
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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 | 5.1 | 2.4 | 2.8 | 0.0 | 0.000 | 0.000 | 11.86 | 0.0 |
| 10.0 | 25.5 | 23.4 | 2.0 | 2.3 | 15.079 | 0.000 | 4.26 | 24.7 |
| 15.0 | 54.4 | 53.0 | 1.5 | 5.9 | 22.788 | 0.000 | 5.38 | 21.2 |
| 20.0 | 81.3 | 70.2 | 11.1 | 9.3 | 27.203 | -1.023 | 5.96 | 19.8 |
| 25.0 | 114.0 | 93.5 | 20.5 | 12.9 | 29.011 | -1.440 | 6.44 | 19.1 |
| 30.0 | 148.7 | 125.6 | 23.1 | 17.0 | 31.561 | -1.648 | 6.95 | 18.9 |
| 35.0 | 184.7 | 161.6 | 23.1 | 21.4 | 31.905 | -0.445 | 7.29 | 18.6 |
| 40.0 | 211.4 | 207.4 | 4.0 | 24.6 | 33.545 | -1.024 | 7.53 | 18.3 |
| 45.0 | 308.4 | 265.1 | 43.4 | 52.3 | 35.413 | -2.057 | 8.38 | 19.6 |
| 50.0 | 324.9 | 321.2 | 3.7 | 62.1 | 36.594 | -1.642 | 8.54 | 19.3 |
| 55.0 | 381.9 | 378.2 | 3.7 | 134.5 | 37.674 | -1.226 | 8.99 | 19.7 |
| 59.0 | 425.1 | 421.4 | 3.7 | 385.4 | 38.923 | -0.666 | 9.14 | 19.5 |

Total Driving Time 59 minutes; Total No. of Blows 2416
Starting at penetration 5.0 ft

↑
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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 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 |
| 10.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 |
| 15.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 |
| 20.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 |
| 25.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 |
| 30.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 |

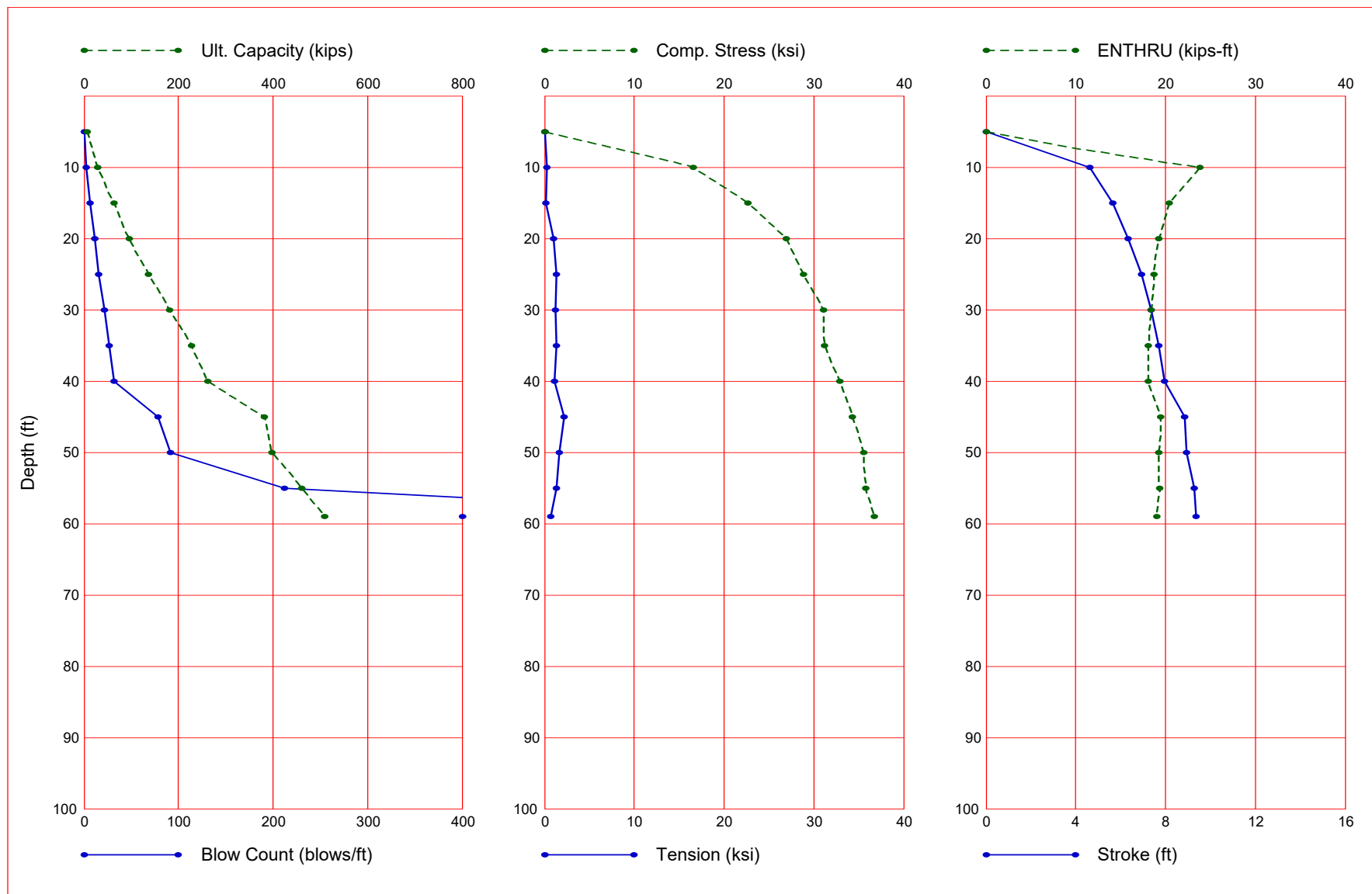
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| | | | | | | | |
|-------|-------|------|-------|------|------|------|------|
| 35.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 40.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 45.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 50.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 55.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 59.00 | 59.00 | 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 | 0.01 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 7.59 | 0.44 | 4.22 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 7.61 | 2.62 | 2.03 | 0.100 | 0.100 | 0.200 | 0.150 | 0.515 | 6.000 | 24.000 |
| 13.09 | 2.62 | 2.03 | 0.100 | 0.100 | 0.200 | 0.150 | 0.515 | 6.000 | 24.000 |
| 13.11 | 1.37 | 1.45 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 18.09 | 1.37 | 1.45 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 18.11 | 1.04 | 10.06 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 23.09 | 1.34 | 12.91 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 23.11 | 1.62 | 19.21 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 28.99 | 2.05 | 23.13 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 29.01 | 2.05 | 23.13 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 30.69 | 2.11 | 23.13 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 30.71 | 2.12 | 23.13 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 38.99 | 2.44 | 23.13 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 39.01 | 5.12 | 3.97 | 0.100 | 0.100 | 0.200 | 0.150 | 0.515 | 6.000 | 24.000 |
| 41.49 | 5.12 | 3.97 | 0.100 | 0.100 | 0.200 | 0.150 | 0.515 | 6.000 | 24.000 |
| 41.51 | 3.01 | 43.36 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 46.49 | 3.26 | 43.36 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 46.51 | 4.75 | 3.68 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 55.51 | 4.66 | 3.68 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 59.00 | 4.17 | 3.68 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |

Gain/Loss 3 at Shaft and Toe 0.670 / 1.000



Gain/Loss 3 at Shaft and Toe 0.670 / 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 | 6.5 | 3.0 | 3.5 | -1.0 | 0.000 | 0.000 | 0.00 | 0.0 |
| 10.0 | 30.3 | 27.8 | 2.5 | 2.7 | 16.536 | -0.266 | 4.62 | 23.8 |
| 15.0 | 63.3 | 61.5 | 1.8 | 7.0 | 22.634 | -0.175 | 5.64 | 20.4 |
| 20.0 | 95.6 | 81.6 | 13.9 | 11.2 | 26.961 | -1.030 | 6.32 | 19.3 |
| 25.0 | 137.2 | 111.6 | 25.6 | 16.1 | 28.802 | -1.385 | 6.92 | 18.7 |
| 30.0 | 181.8 | 152.8 | 28.9 | 21.9 | 31.115 | -1.186 | 7.36 | 18.4 |
| 35.0 | 228.2 | 199.3 | 28.9 | 27.1 | 31.241 | -1.334 | 7.70 | 18.1 |
| 40.0 | 261.3 | 256.3 | 5.0 | 32.3 | 32.899 | -1.072 | 7.95 | 18.1 |
| 45.0 | 382.1 | 327.9 | 54.2 | 78.6 | 34.302 | -2.199 | 8.87 | 19.5 |
| 50.0 | 397.3 | 392.7 | 4.6 | 91.7 | 35.603 | -1.664 | 8.95 | 19.2 |
| 55.0 | 460.5 | 455.9 | 4.6 | 212.5 | 35.795 | -1.299 | 9.27 | 19.4 |
| 59.0 | 509.6 | 505.0 | 4.6 | 786.3 | 36.757 | -0.743 | 9.35 | 19.0 |

Total Continuous Driving Time 100.00 minutes; Total Number of Blows 3970 (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\2013\W-13-072 FRA-70-13.10 PROJECT 6A\ANALYSIS\FRA-70-1322L AND 1323C\DRIVEABILITY\FRA-70-1322L\FORWARD

ABUTMENT\HP 12X53\1322L-FA-12X53.GMW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW

Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-1322L - For Abutment - 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 32.170 144.000 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
59.000 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 R0
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 | 0.01 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 7.59 | 0.46 | 5.27 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 7.61 | 2.62 | 2.54 | 0.10 | 0.10 | 0.20 | 0.15 | 1.21 | 6.00 | 24.000 |
| 13.09 | 2.62 | 2.54 | 0.10 | 0.10 | 0.20 | 0.15 | 1.21 | 6.00 | 24.000 |
| 13.11 | 1.37 | 1.82 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 18.09 | 1.37 | 1.82 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 18.11 | 1.11 | 12.59 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 23.09 | 1.42 | 16.17 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 23.11 | 1.74 | 24.01 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 28.99 | 2.20 | 28.91 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 29.01 | 2.20 | 28.91 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 30.69 | 2.26 | 28.91 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 30.71 | 2.26 | 28.91 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 38.99 | 2.61 | 28.91 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 39.01 | 5.12 | 4.96 | 0.10 | 0.10 | 0.20 | 0.15 | 1.21 | 6.00 | 24.000 |
| 41.49 | 5.12 | 4.96 | 0.10 | 0.10 | 0.20 | 0.15 | 1.21 | 6.00 | 24.000 |
| 41.51 | 3.23 | 54.20 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 46.49 | 3.50 | 54.20 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 46.51 | 4.75 | 4.60 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 55.51 | 4.75 | 4.60 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 59.00 | 4.45 | 4.60 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |

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 |
|-------|------|------|-------|------|-------|-------|-------|
| 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 |
| 59.00 | 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-70-1322L - For Abutment - HP12x53

| Hammer Model: D 19-42 | | Made by: DELMAG | |
|-----------------------|----------------|------------------|-------|
| No. | Weight kips | Stiffn k/inch | CoR |
| 1 | 0.800 | | |
| 2 | 0.800 | 140046.6 | 1.000 |
| 3 | 0.800 | 140046.6 | 1.000 |
| 4 | 0.800 | 140046.6 | 1.000 |
| 5 | 0.800 | 140046.6 | 1.000 |
| Imp Block | 0.753 | 70735.6 | 0.900 |
| Helmet | 1.900 | 60155.0 | 0.800 |
| Combined Pile Top | | 11428.0 | |

C-Slk ft Dampg k/ft/s
 0.0000 0.0000 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-70-1322L - For Abutment - HP12x53 02/28/2021
 Resource International Inc GRLWEAP Version 2010

| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 5.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 59.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 6.5 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.174 | 11428 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 4.0 | 15.5 |
| 2 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 4.0 | 15.5 |
| 17 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 0.4 | 0.050 | 0.100 | 55.72 | 4.0 | 15.5 |
| 18 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 2.7 | 0.050 | 0.100 | 59.00 | 4.0 | 15.5 |
| Toe | | | | | | 3.5 | 0.150 | 0.100 | | | |

3.125 kips total unreduced pile weight (g= 32.17 ft/s2)
 3.125 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 |
| Output Time Interval | 1 | Analysis Time-Input (ms) |
| 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 |

FRA-70-1322L - For Abutment - HP12x53 02/28/2021
 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 | kip-ft | b/min |
| 6.5 | Hammer did not run | | | | | |
| 6.5 | Hammer did not run | | | | | |
| 6.5 | Hammer did not run | | | | | |
| 6.5 | Hammer did not run | | | | | |
| 6.5 | Hammer did not run | | | | | |

FRA-70-1322L - For Abutment - HP12x53 02/28/2021
 Resource International Inc GRLWEAP Version 2010

| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 10.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 59.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | Total Capacity Rut (kips) | | | 29.5 | |
|---------------------|--------|--------|-------|---------------------------|------|--------|--------|-------|
| No. | Weight | Stiffn | C-Slk | T-Slk | CoR | Soil-S | Soil-D | Quake |
| kips | k/in | ft | ft | | | kips | s/ft | inch |
| 1 | 0.174 | 11428 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 |
| 2 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 |
| 15 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 |
| 16 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 1.4 | 0.050 | 0.100 |
| 17 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 4.0 | 0.050 | 0.100 |
| 18 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 21.4 | 0.191 | 0.100 |
| Toe | | | | | | 2.5 | 0.150 | 0.100 |

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

3.125 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-70-1322L - For Abutment - HP12x53 02/28/2021
 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 |
| 29.5 | 2.6 | 4.58 | 4.57 | -0.26 | 2 | 9 | 16.28 | 1 | 2 | 24.0 |
| 29.9 | 2.6 | 4.60 | 4.58 | -0.28 | 2 | 9 | 16.42 | 1 | 2 | 23.9 |
| 30.3 | 2.7 | 4.62 | 4.60 | -0.27 | 2 | 9 | 16.54 | 1 | 2 | 23.8 |
| 30.7 | 2.7 | 4.64 | 4.62 | -0.28 | 2 | 9 | 16.69 | 1 | 2 | 23.8 |
| 31.2 | 2.8 | 4.66 | 4.64 | -0.27 | 2 | 9 | 16.81 | 1 | 2 | 23.7 |

FRA-70-1322L - For Abutment - HP12x53 02/28/2021
 Resource International Inc GRLWEAP Version 2010

| Depth | (ft) | 15.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | 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 |
| 59.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | Total Capacity Rut (kips) | | | 60.7 | |
|---------------------|--------|--------|-------|---------------------------|------|--------|--------|-------|
| No. | Weight | Stiffn | C-Slk | T-Slk | CoR | Soil-S | Soil-D | Quake |
| kips | k/in | ft | ft | | | kips | s/ft | inch |
| 1 | 0.174 | 11428 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 |
| 2 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 |
| 14 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 0.4 | 0.050 | 0.100 |
| 15 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 2.8 | 0.050 | 0.100 |
| 16 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 10.8 | 0.155 | 0.100 |
| 17 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 27.2 | 0.200 | 0.100 |
| 18 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 17.7 | 0.200 | 0.100 |
| Toe | | | | | | 1.8 | 0.150 | 0.100 |

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

3.125 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-70-1322L - For Abutment - HP12x53 02/28/2021
 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 |
| 60.7 | 6.6 | 5.63 | 5.62 | 0.00 | 1 | 0 | 22.49 | 15 | 5 | 20.7 |

| | | | | | | | | | | | | |
|----------------|-----|------|------|-------|----|----|-------|----|---|------|------|--|
| 1322L-FA-12X53 | | | | | | | | | | | | |
| 62.0 | 6.8 | 5.67 | 5.65 | 0.00 | 1 | 0 | 22.64 | 15 | 5 | 20.7 | 49.6 | |
| 63.3 | 7.0 | 5.64 | 5.70 | -0.17 | 16 | 50 | 22.63 | 15 | 5 | 20.4 | 49.5 | |
| 64.6 | 7.2 | 5.68 | 5.73 | -0.37 | 15 | 50 | 22.79 | 15 | 5 | 20.3 | 49.4 | |
| 66.0 | 7.4 | 5.71 | 5.76 | -0.53 | 15 | 50 | 22.91 | 15 | 5 | 20.3 | 49.2 | |

FRA-70-1322L - For Abutment - HP12x53
 Resource International Inc

02/28/2021
 GRLWEAP Version 2010

Depth (ft) 20.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 59.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 91.8 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|------|
| 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 | 11428 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 4.0 | 15.5 |
| 2 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 4.0 | 15.5 |
| 12 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 39.33 | 4.0 | 15.5 |
| 13 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 1.6 | 0.050 | 0.100 | 42.61 | 4.0 | 15.5 |
| 14 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 4.2 | 0.050 | 0.100 | 45.89 | 4.0 | 15.5 |
| 15 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 22.5 | 0.193 | 0.100 | 49.17 | 4.0 | 15.5 |
| 16 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 25.5 | 0.200 | 0.100 | 52.44 | 4.0 | 15.5 |
| 17 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 10.8 | 0.200 | 0.100 | 55.72 | 4.0 | 15.5 |
| 18 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 13.3 | 0.119 | 0.100 | 59.00 | 4.0 | 15.5 |
| Toe | | | | | | 13.9 | 0.150 | 0.100 | | | |

3.125 kips total unreduced pile weight (g= 32.17 ft/s2)
 3.125 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 | | | | |
| 91.8 | 10.7 | 6.25 | 6.27 | -1.07 | 14 | 45 | 26.54 | 15 | 5 | 19.4 | 47.1 |
| 93.7 | 11.0 | 6.29 | 6.31 | -1.05 | 15 | 42 | 26.75 | 15 | 5 | 19.3 | 47.0 |
| 95.6 | 11.2 | 6.32 | 6.34 | -1.03 | 15 | 42 | 26.96 | 15 | 5 | 19.3 | 46.8 |
| 97.5 | 11.5 | 6.36 | 6.37 | -0.99 | 15 | 42 | 27.15 | 15 | 5 | 19.2 | 46.7 |
| 99.3 | 11.8 | 6.39 | 6.41 | -0.93 | 15 | 42 | 27.35 | 15 | 5 | 19.1 | 46.6 |

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Depth (ft) 25.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 59.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 133.5 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.174 | 11428 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 4.0 | 15.5 |
| 2 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 4.0 | 15.5 |
| 11 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 0.5 | 0.050 | 0.100 | 36.06 | 4.0 | 15.5 |
| 12 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 2.9 | 0.050 | 0.100 | 39.33 | 4.0 | 15.5 |
| 13 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 12.0 | 0.162 | 0.100 | 42.61 | 4.0 | 15.5 |
| 14 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 27.2 | 0.200 | 0.100 | 45.89 | 4.0 | 15.5 |

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| | | | | | | | | | | | |
|-----|-------|-------|-------|-------|------|------|-------|-------|-------|-----|------|
| 15 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 16.8 | 0.200 | 0.100 | 49.17 | 4.0 | 15.5 |
| 16 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 11.2 | 0.187 | 0.100 | 52.44 | 4.0 | 15.5 |
| 17 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 16.1 | 0.050 | 0.100 | 55.72 | 4.0 | 15.5 |
| 18 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 21.2 | 0.050 | 0.100 | 59.00 | 4.0 | 15.5 |
| Toe | | | | | | 25.6 | 0.150 | 0.100 | | | |

3.125 kips total unreduced pile weight (g= 32.17 ft/s²)
 3.125 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 |
| 133.5 | 15.5 | 6.78 | 6.80 | -1.20 | 7 | 33 | 28.29 | 13 | 4 | 18.6 |
| 135.3 | 15.7 | 6.89 | 6.82 | -1.30 | 8 | 33 | 28.67 | 13 | 4 | 18.8 |
| 137.2 | 16.1 | 6.92 | 6.87 | -1.38 | 8 | 33 | 28.80 | 13 | 4 | 18.7 |
| 139.1 | 16.5 | 6.96 | 6.90 | -1.46 | 8 | 33 | 28.98 | 13 | 4 | 18.7 |
| 141.0 | 16.9 | 6.99 | 6.94 | -1.54 | 7 | 33 | 29.14 | 13 | 4 | 18.6 |

▲
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| Depth | (ft) | 30.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| Toe Area | (in ²) | 144.000 | 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 |
| 59.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.141

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 178.0 |
|-----|--------|------------------------|----------------|--------------|--------|-------|
| | kips | Stiffn C-Slk T-Slk CoR | Soil-S | Soil-D Quake | LbTop | Perim |
| | | k/in ft ft | kips | s/ft inch | ft | ft |
| 1 | 0.174 | 11428 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.28 | 4.0 |
| 2 | 0.174 | 11428 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.56 | 4.0 |
| 9 | 0.174 | 11428 0.000 0.000 1.00 | 0.0 | 0.050 0.100 | 29.50 | 4.0 |
| 10 | 0.174 | 11428 0.000 0.000 1.00 | 1.7 | 0.050 0.100 | 32.78 | 4.0 |
| 11 | 0.174 | 11428 0.000 0.000 1.00 | 4.3 | 0.050 0.100 | 36.06 | 4.0 |
| 12 | 0.174 | 11428 0.000 0.000 1.00 | 23.7 | 0.195 0.100 | 39.33 | 4.0 |
| 13 | 0.174 | 11428 0.000 0.000 1.00 | 24.6 | 0.200 0.100 | 42.61 | 4.0 |
| 14 | 0.174 | 11428 0.000 0.000 1.00 | 10.8 | 0.200 0.100 | 45.89 | 4.0 |
| 15 | 0.174 | 11428 0.000 0.000 1.00 | 13.6 | 0.111 0.100 | 49.17 | 4.0 |
| 16 | 0.174 | 11428 0.000 0.000 1.00 | 17.9 | 0.050 0.100 | 52.44 | 4.0 |
| 17 | 0.174 | 11428 0.000 0.000 1.00 | 24.6 | 0.050 0.100 | 55.72 | 4.0 |
| 18 | 0.174 | 11428 0.000 0.000 1.00 | 27.9 | 0.050 0.100 | 59.00 | 4.0 |
| Toe | | | 28.9 | 0.150 0.100 | | |

3.125 kips total unreduced pile weight (g= 32.17 ft/s²)
 3.125 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 |
| 178.0 | 21.1 | 7.31 | 7.28 | -1.24 | 11 | 31 | 30.85 | 12 | 4 | 18.5 |
| 179.9 | 21.5 | 7.34 | 7.31 | -1.18 | 11 | 31 | 31.01 | 12 | 4 | 18.5 |
| 181.8 | 21.9 | 7.36 | 7.34 | -1.19 | 12 | 27 | 31.11 | 12 | 4 | 18.4 |
| 183.6 | 22.2 | 7.39 | 7.36 | -1.24 | 12 | 27 | 31.29 | 12 | 4 | 18.4 |
| 185.5 | 22.6 | 7.40 | 7.38 | -1.28 | 11 | 27 | 31.40 | 12 | 4 | 18.3 |

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Depth (ft) 35.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in²) 144.000 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 |
| 59.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.141

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 224.4 |
|-----|--------|------------------------|----------------|--------------|--------|--------------------|
| | 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 in ² |
| 1 | 0.174 | 11428 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.28 | 4.0 15.5 |
| 2 | 0.174 | 11428 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.56 | 4.0 15.5 |
| 8 | 0.174 | 11428 0.000 0.000 1.00 | 0.6 | 0.050 0.100 | 26.22 | 4.0 15.5 |
| 9 | 0.174 | 11428 0.000 0.000 1.00 | 3.1 | 0.050 0.100 | 29.50 | 4.0 15.5 |
| 10 | 0.174 | 11428 0.000 0.000 1.00 | 13.1 | 0.168 0.100 | 32.78 | 4.0 15.5 |
| 11 | 0.174 | 11428 0.000 0.000 1.00 | 27.2 | 0.200 0.100 | 36.06 | 4.0 15.5 |
| 12 | 0.174 | 11428 0.000 0.000 1.00 | 16.0 | 0.200 0.100 | 39.33 | 4.0 15.5 |
| 13 | 0.174 | 11428 0.000 0.000 1.00 | 11.4 | 0.180 0.100 | 42.61 | 4.0 15.5 |
| 14 | 0.174 | 11428 0.000 0.000 1.00 | 16.2 | 0.050 0.100 | 45.89 | 4.0 15.5 |
| 15 | 0.174 | 11428 0.000 0.000 1.00 | 21.6 | 0.050 0.100 | 49.17 | 4.0 15.5 |
| 16 | 0.174 | 11428 0.000 0.000 1.00 | 26.4 | 0.050 0.100 | 52.44 | 4.0 15.5 |
| 17 | 0.174 | 11428 0.000 0.000 1.00 | 29.1 | 0.050 0.100 | 55.72 | 4.0 15.5 |
| 18 | 0.174 | 11428 0.000 0.000 1.00 | 30.9 | 0.050 0.100 | 59.00 | 4.0 15.5 |
| Toe | | | 28.9 | 0.150 0.100 | | |

3.125 kips total unreduced pile weight (g= 32.17 ft/s²)3.125 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 |
| 224.4 | 26.3 | 7.67 7.64 | -1.41 | 9 | 26 31.03 | 10 | 4 18.2 | 42.7 |
| 226.3 | 26.7 | 7.68 7.67 | -1.37 | 9 | 26 31.13 | 10 | 4 18.1 | 42.6 |
| 228.2 | 27.1 | 7.70 7.69 | -1.33 | 9 | 26 31.24 | 10 | 4 18.1 | 42.5 |
| 230.0 | 27.4 | 7.73 7.72 | -1.29 | 9 | 26 31.38 | 10 | 4 18.2 | 42.5 |
| 231.9 | 27.8 | 7.75 7.74 | -1.24 | 9 | 26 31.48 | 10 | 4 18.2 | 42.4 |

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Depth (ft) 40.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in²) 144.000 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 |
| 59.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.141

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 256.8 |
|-----|--------|------------------------|----------------|--------------|--------|--------------------|
| | 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 in ² |
| 1 | 0.174 | 11428 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.28 | 4.0 15.5 |
| 2 | 0.174 | 11428 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.56 | 4.0 15.5 |
| 6 | 0.174 | 11428 0.000 0.000 1.00 | 0.1 | 0.050 0.100 | 19.67 | 4.0 15.5 |
| 7 | 0.174 | 11428 0.000 0.000 1.00 | 1.8 | 0.050 0.100 | 22.94 | 4.0 15.5 |
| 8 | 0.174 | 11428 0.000 0.000 1.00 | 4.4 | 0.050 0.100 | 26.22 | 4.0 15.5 |
| 9 | 0.174 | 11428 0.000 0.000 1.00 | 24.7 | 0.196 0.100 | 29.50 | 4.0 15.5 |
| 10 | 0.174 | 11428 0.000 0.000 1.00 | 23.8 | 0.200 0.100 | 32.78 | 4.0 15.5 |
| 11 | 0.174 | 11428 0.000 0.000 1.00 | 10.8 | 0.200 0.100 | 36.06 | 4.0 15.5 |
| 12 | 0.174 | 11428 0.000 0.000 1.00 | 13.9 | 0.103 0.100 | 39.33 | 4.0 15.5 |
| 13 | 0.174 | 11428 0.000 0.000 1.00 | 18.3 | 0.050 0.100 | 42.61 | 4.0 15.5 |

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| | | | | | | | | | | | |
|-----|-------|-------|-------|-------|------|------|-------|-------|-------|-----|------|
| 14 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 24.8 | 0.050 | 0.100 | 45.89 | 4.0 | 15.5 |
| 15 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 28.0 | 0.050 | 0.100 | 49.17 | 4.0 | 15.5 |
| 16 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 30.0 | 0.050 | 0.100 | 52.44 | 4.0 | 15.5 |
| 17 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 31.8 | 0.050 | 0.100 | 55.72 | 4.0 | 15.5 |
| 18 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 39.4 | 0.120 | 0.100 | 59.00 | 4.0 | 15.5 |
| Toe | | | | | | 5.0 | 0.150 | 0.100 | | | |

3.125 kips total unreduced pile weight (g= 32.17 ft/s2)
 3.125 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 | t | Comp Str ksi | i | t | ENTHRU kip-ft | Bl Rt b/min |
|-------------|---------------|---------------------|---------------|-------|---|-----------------|-------|---|------------------|----------------|
| 256.8 | 31.2 | 7.91 | 7.90 | -1.23 | 7 | 45 | 32.65 | 9 | 3 | 18.1 |
| 259.0 | 31.7 | 7.93 | 7.92 | -1.15 | 7 | 45 | 32.77 | 9 | 3 | 18.1 |
| 261.3 | 32.3 | 7.95 | 7.95 | -1.07 | 7 | 45 | 32.90 | 9 | 3 | 18.1 |
| 263.5 | 32.6 | 7.96 | 7.96 | -0.96 | 7 | 45 | 33.02 | 9 | 3 | 18.2 |
| 265.7 | 33.1 | 8.00 | 7.99 | -0.87 | 7 | 45 | 33.22 | 9 | 3 | 18.2 |

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| | | | |
|------------------------|------|-------|----------------------|
| Depth | (ft) | 45.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 59.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) 376.6 | | | | | |
|---------------------|----------------|----------------|-------------|-------------|------|---------------------------------|----------------|---------------|-------------|-------------|-------------|
| 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 | 0.174 | 11428 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 4.0 | 15.5 |
| 2 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 4.0 | 15.5 |
| 5 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 0.7 | 0.050 | 0.100 | 16.39 | 4.0 | 15.5 |
| 6 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 3.2 | 0.050 | 0.100 | 19.67 | 4.0 | 15.5 |
| 7 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 14.3 | 0.172 | 0.100 | 22.94 | 4.0 | 15.5 |
| 8 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 27.2 | 0.200 | 0.100 | 26.22 | 4.0 | 15.5 |
| 9 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 15.2 | 0.200 | 0.100 | 29.50 | 4.0 | 15.5 |
| 10 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 11.6 | 0.173 | 0.100 | 32.78 | 4.0 | 15.5 |
| 11 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 16.3 | 0.050 | 0.100 | 36.06 | 4.0 | 15.5 |
| 12 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 22.0 | 0.050 | 0.100 | 39.33 | 4.0 | 15.5 |
| 13 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 26.5 | 0.050 | 0.100 | 42.61 | 4.0 | 15.5 |
| 14 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 29.2 | 0.050 | 0.100 | 45.89 | 4.0 | 15.5 |
| 15 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 31.0 | 0.050 | 0.100 | 49.17 | 4.0 | 15.5 |
| 16 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 32.8 | 0.050 | 0.100 | 52.44 | 4.0 | 15.5 |
| 17 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 49.1 | 0.178 | 0.100 | 55.72 | 4.0 | 15.5 |
| 18 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 43.4 | 0.050 | 0.100 | 59.00 | 4.0 | 15.5 |
| Toe | | | | | | 54.2 | 0.150 | 0.100 | | | |

3.125 kips total unreduced pile weight (g= 32.17 ft/s2)
 3.125 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 | t | Comp Str ksi | i | t | ENTHRU kip-ft | Bl Rt b/min |
|-------------|---------------|---------------------|---------------|-------|---|-----------------|-------|---|------------------|----------------|
| 376.6 | 74.3 | 8.82 | 8.82 | -2.15 | 7 | 37 | 34.08 | 7 | 3 | 19.5 |
| 379.3 | 76.4 | 8.84 | 8.84 | -2.17 | 7 | 37 | 34.19 | 7 | 3 | 19.5 |
| 382.1 | 78.6 | 8.87 | 8.87 | -2.20 | 7 | 37 | 34.30 | 7 | 3 | 19.5 |
| 384.8 | 79.8 | 8.89 | 8.87 | -2.21 | 7 | 37 | 34.41 | 7 | 3 | 19.6 |

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387.5 82.2 8.91 8.90 -2.24 7 37 34.54 7 3 19.6 39.6

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Depth (ft) 50.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 59.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 387.5 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.174 | 11428 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 4.0 | 15.5 |
| 2 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 4.0 | 15.5 |
| 3 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 0.1 | 0.050 | 0.100 | 9.83 | 4.0 | 15.5 |
| 4 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 2.0 | 0.050 | 0.100 | 13.11 | 4.0 | 15.5 |
| 5 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 4.6 | 0.050 | 0.100 | 16.39 | 4.0 | 15.5 |
| 6 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 25.8 | 0.198 | 0.100 | 19.67 | 4.0 | 15.5 |
| 7 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 23.0 | 0.200 | 0.100 | 22.94 | 4.0 | 15.5 |
| 8 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 10.8 | 0.200 | 0.100 | 26.22 | 4.0 | 15.5 |
| 9 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 14.2 | 0.095 | 0.100 | 29.50 | 4.0 | 15.5 |
| 10 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 18.6 | 0.050 | 0.100 | 32.78 | 4.0 | 15.5 |
| 11 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 25.0 | 0.050 | 0.100 | 36.06 | 4.0 | 15.5 |
| 12 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 28.1 | 0.050 | 0.100 | 39.33 | 4.0 | 15.5 |
| 13 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 30.1 | 0.050 | 0.100 | 42.61 | 4.0 | 15.5 |
| 14 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 31.9 | 0.050 | 0.100 | 45.89 | 4.0 | 15.5 |
| 15 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 40.4 | 0.129 | 0.100 | 49.17 | 4.0 | 15.5 |
| 16 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 47.0 | 0.127 | 0.100 | 52.44 | 4.0 | 15.5 |
| 17 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 44.0 | 0.064 | 0.100 | 55.72 | 4.0 | 15.5 |
| 18 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 37.3 | 0.200 | 0.100 | 59.00 | 4.0 | 15.5 |
| Toe | | | | | | 4.6 | 0.150 | 0.100 | | | |

3.125 kips total unreduced pile weight (g= 32.17 ft/s2)
3.125 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 | |
| 387.5 | 82.9 | 8.87 | 8.86 | -1.56 | 6 35 | 35.21 | 6 3 | 19.1 39.7 |
| 392.4 | 87.2 | 8.91 | 8.89 | -1.61 | 5 17 | 35.41 | 6 3 | 19.1 39.6 |
| 397.3 | 91.7 | 8.95 | 8.92 | -1.66 | 5 16 | 35.60 | 6 3 | 19.2 39.6 |
| 402.2 | 96.5 | 8.99 | 8.96 | -1.72 | 5 16 | 35.78 | 6 3 | 19.3 39.5 |
| 407.1 | 101.6 | 9.02 | 8.99 | -1.76 | 5 16 | 35.96 | 6 3 | 19.4 39.4 |

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Depth (ft) 55.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 59.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 444.4 | |
|---------------------|--------|--------|-------|-------|-----|---------------------------|--------|-------|-------|-------|------|
| 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 |

| 1322L-FA-12X53 | | | | | | | | | | | |
|----------------|-------|-------|-------|-------|------|------|-------|-------|-------|-----|------|
| 1 | 0.174 | 11428 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 4.0 | 15.5 |
| 2 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 0.8 | 0.050 | 0.100 | 6.56 | 4.0 | 15.5 |
| 3 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 3.3 | 0.050 | 0.100 | 9.83 | 4.0 | 15.5 |
| 4 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 15.4 | 0.176 | 0.100 | 13.11 | 4.0 | 15.5 |
| 5 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 27.2 | 0.200 | 0.100 | 16.39 | 4.0 | 15.5 |
| 6 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 14.3 | 0.200 | 0.100 | 19.67 | 4.0 | 15.5 |
| 7 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 11.8 | 0.167 | 0.100 | 22.94 | 4.0 | 15.5 |
| 8 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 16.5 | 0.050 | 0.100 | 26.22 | 4.0 | 15.5 |
| 9 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 22.3 | 0.050 | 0.100 | 29.50 | 4.0 | 15.5 |
| 10 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 26.7 | 0.050 | 0.100 | 32.78 | 4.0 | 15.5 |
| 11 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 29.3 | 0.050 | 0.100 | 36.06 | 4.0 | 15.5 |
| 12 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 31.1 | 0.050 | 0.100 | 39.33 | 4.0 | 15.5 |
| 13 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 32.9 | 0.050 | 0.100 | 42.61 | 4.0 | 15.5 |
| 14 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 49.5 | 0.177 | 0.100 | 45.89 | 4.0 | 15.5 |
| 15 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 43.5 | 0.050 | 0.100 | 49.17 | 4.0 | 15.5 |
| 16 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 40.5 | 0.150 | 0.100 | 52.44 | 4.0 | 15.5 |
| 17 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 37.3 | 0.200 | 0.100 | 55.72 | 4.0 | 15.5 |
| 18 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 37.3 | 0.200 | 0.100 | 59.00 | 4.0 | 15.5 |
| Toe | | | | | | 4.6 | 0.150 | 0.100 | | | |

3.125 kips total unreduced pile weight (g= 32.17 ft/s2)
3.125 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 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 |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 444.4 | 167.1 | 9.20 | 9.15 | -1.26 | 4 | 32 | 35.45 | 4 | 3 | 19.3 | 39.1 |
| 452.5 | 187.6 | 9.24 | 9.18 | -1.28 | 4 | 32 | 35.63 | 4 | 3 | 19.4 | 39.0 |
| 460.5 | 212.5 | 9.27 | 9.21 | -1.30 | 4 | 32 | 35.79 | 4 | 3 | 19.4 | 38.9 |
| 468.5 | 247.2 | 9.31 | 9.24 | -1.30 | 4 | 31 | 35.98 | 4 | 3 | 19.4 | 38.9 |
| 476.5 | 285.6 | 9.34 | 9.26 | -1.32 | 4 | 31 | 36.16 | 4 | 3 | 19.5 | 38.8 |

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| | | | |
|------------------------|------|-------|----------------------|
| Depth | (ft) | 59.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 59.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | | | | | | |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|--------|-------|
| No. | Weight | Stiffn | C-Slk | T-Slk | CoR | Soil-S | Soil-D | Quake | Rut | (kips) | 488.7 |
| | kips | k/in | ft | ft | | kips | s/ft | inch | LbTop | Perim | Area |
| 1 | 0.174 | 11428 | 0.010 | 0.000 | 0.85 | 1.3 | 0.050 | 0.100 | 3.28 | 4.0 | 15.5 |
| 2 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 3.9 | 0.050 | 0.100 | 6.56 | 4.0 | 15.5 |
| 3 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 20.3 | 0.189 | 0.100 | 9.83 | 4.0 | 15.5 |
| 4 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 27.1 | 0.200 | 0.100 | 13.11 | 4.0 | 15.5 |
| 5 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 10.8 | 0.200 | 0.100 | 16.39 | 4.0 | 15.5 |
| 6 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 12.8 | 0.135 | 0.100 | 19.67 | 4.0 | 15.5 |
| 7 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 17.1 | 0.050 | 0.100 | 22.94 | 4.0 | 15.5 |
| 8 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 23.9 | 0.050 | 0.100 | 26.22 | 4.0 | 15.5 |
| 9 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 27.4 | 0.050 | 0.100 | 29.50 | 4.0 | 15.5 |
| 10 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 29.7 | 0.050 | 0.100 | 32.78 | 4.0 | 15.5 |
| 11 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 31.5 | 0.050 | 0.100 | 36.06 | 4.0 | 15.5 |
| 12 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 35.2 | 0.078 | 0.100 | 39.33 | 4.0 | 15.5 |
| 13 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 49.5 | 0.163 | 0.100 | 42.61 | 4.0 | 15.5 |
| 14 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 44.0 | 0.050 | 0.100 | 45.89 | 4.0 | 15.5 |
| 15 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 38.8 | 0.178 | 0.100 | 49.17 | 4.0 | 15.5 |
| 16 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 37.3 | 0.200 | 0.100 | 52.44 | 4.0 | 15.5 |
| 17 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 37.3 | 0.200 | 0.100 | 55.72 | 4.0 | 15.5 |
| 18 | 0.174 | 11428 | 0.000 | 0.000 | 1.00 | 36.1 | 0.200 | 0.100 | 59.00 | 4.0 | 15.5 |
| Toe | | | | | | 4.6 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 59.00 | 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 ksi | ENTHRU kip-ft | Bl Rt b/min | |
|-------------|---------------|---------------------|---------------|----------|----------|-----------------|----------|----------|------------------|----------------|------|
| 488.7 | 379.9 | 9.29 | 9.22 | -0.72 | 3 | 30 | 36.45 | 3 | 3 | 19.0 | 38.9 |
| 499.2 | 518.1 | 9.32 | 9.25 | -0.73 | 3 | 30 | 36.61 | 3 | 3 | 19.0 | 38.9 |
| 509.6 | 786.3 | 9.35 | 9.27 | -0.74 | 3 | 29 | 36.76 | 3 | 3 | 19.0 | 38.8 |
| 520.1 | 1519.2 | 9.37 | 9.29 | -0.75 | 3 | 29 | 36.90 | 3 | 3 | 19.0 | 38.8 |
| 530.5 | 9092.4 | 9.39 | 9.31 | -0.76 | 3 | 29 | 37.06 | 3 | 3 | 19.0 | 38.7 |

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SUMMARY OVER DEPTHS

| Depth ft | Rut kips | Frictn kips | End Bg kips | Bl Ct b/ft | Com Str ksi | Ten Str ksi | Stroke ft | ENTHRU kip-ft |
|-------------|-------------|----------------|----------------|---------------|----------------|----------------|--------------|------------------|
| 5.0 | 6.5 | 3.0 | 3.5 | Hammer | did not run | | | |
| 10.0 | 29.5 | 26.9 | 2.5 | 2.6 | 16.284 | -0.263 | 4.58 | 24.0 |
| 15.0 | 60.7 | 58.9 | 1.8 | 6.6 | 22.490 | 0.000 | 5.63 | 20.7 |
| 20.0 | 91.8 | 77.9 | 13.9 | 10.7 | 26.540 | -1.072 | 6.25 | 19.4 |
| 25.0 | 133.5 | 107.9 | 25.6 | 15.5 | 28.291 | -1.199 | 6.78 | 18.6 |
| 30.0 | 178.0 | 149.1 | 28.9 | 21.1 | 30.853 | -1.241 | 7.31 | 18.5 |
| 35.0 | 224.4 | 195.5 | 28.9 | 26.3 | 31.030 | -1.413 | 7.67 | 18.2 |
| 40.0 | 256.8 | 251.9 | 5.0 | 31.2 | 32.646 | -1.229 | 7.91 | 18.1 |
| 45.0 | 376.6 | 322.4 | 54.2 | 74.3 | 34.079 | -2.150 | 8.82 | 19.5 |
| 50.0 | 387.5 | 382.9 | 4.6 | 82.9 | 35.210 | -1.563 | 8.87 | 19.1 |
| 55.0 | 444.4 | 439.8 | 4.6 | 167.1 | 35.454 | -1.259 | 9.20 | 19.3 |
| 59.0 | 488.7 | 484.1 | 4.6 | 379.9 | 36.445 | -0.721 | 9.29 | 19.0 |

Total Driving Time 71 minutes;
 Starting at penetration 5.0 ft Total No. of Blows 2866

| Depth ft | Rut kips | Frictn kips | End Bg kips | Bl Ct b/ft | Com Str ksi | Ten Str ksi | Stroke ft | ENTHRU kip-ft |
|-------------|-------------|----------------|----------------|---------------|----------------|----------------|--------------|------------------|
| 5.0 | 6.5 | 3.0 | 3.5 | Hammer | did not run | | | |
| 10.0 | 29.9 | 27.3 | 2.5 | 2.6 | 16.415 | -0.281 | 4.60 | 23.9 |
| 15.0 | 62.0 | 60.2 | 1.8 | 6.8 | 22.642 | 0.000 | 5.67 | 20.7 |
| 20.0 | 93.7 | 79.8 | 13.9 | 11.0 | 26.748 | -1.048 | 6.29 | 19.3 |
| 25.0 | 135.3 | 109.8 | 25.6 | 15.7 | 28.675 | -1.299 | 6.89 | 18.8 |
| 30.0 | 179.9 | 151.0 | 28.9 | 21.5 | 31.011 | -1.181 | 7.34 | 18.5 |
| 35.0 | 226.3 | 197.4 | 28.9 | 26.7 | 31.134 | -1.374 | 7.68 | 18.1 |
| 40.0 | 259.0 | 254.1 | 5.0 | 31.7 | 32.773 | -1.154 | 7.93 | 18.1 |
| 45.0 | 379.3 | 325.1 | 54.2 | 76.4 | 34.190 | -2.175 | 8.84 | 19.5 |
| 50.0 | 392.4 | 387.8 | 4.6 | 87.2 | 35.409 | -1.612 | 8.91 | 19.1 |
| 55.0 | 452.5 | 447.9 | 4.6 | 187.6 | 35.635 | -1.280 | 9.24 | 19.4 |
| 59.0 | 499.2 | 494.6 | 4.6 | 518.1 | 36.613 | -0.732 | 9.32 | 19.0 |

Total Driving Time 82 minutes;
 Starting at penetration 5.0 ft Total No. of Blows 3276

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SUMMARY OVER DEPTHS

| Depth ft | Rut kips | Frictn kips | End Bg kips | Bl Ct b/ft | Com Str ksi | Ten Str ksi | Stroke ft | ENTHRU kip-ft |
|-------------|-------------|----------------|----------------|---------------|----------------|----------------|--------------|------------------|
| 5.0 | 6.5 | 3.0 | 3.5 | Hammer | did not run | | | |
| 10.0 | 30.3 | 27.8 | 2.5 | 2.7 | 16.536 | -0.266 | 4.62 | 23.8 |
| 15.0 | 63.3 | 61.5 | 1.8 | 7.0 | 22.634 | -0.175 | 5.64 | 20.4 |
| 20.0 | 95.6 | 81.6 | 13.9 | 11.2 | 26.961 | -1.030 | 6.32 | 19.3 |
| 25.0 | 137.2 | 111.6 | 25.6 | 16.1 | 28.802 | -1.385 | 6.92 | 18.7 |
| 30.0 | 181.8 | 152.8 | 28.9 | 21.9 | 31.115 | -1.186 | 7.36 | 18.4 |
| 35.0 | 228.2 | 199.3 | 28.9 | 27.1 | 31.241 | -1.334 | 7.70 | 18.1 |
| 40.0 | 261.3 | 256.3 | 5.0 | 32.3 | 32.899 | -1.072 | 7.95 | 18.1 |
| 45.0 | 382.1 | 327.9 | 54.2 | 78.6 | 34.302 | -2.199 | 8.87 | 19.5 |
| 50.0 | 397.3 | 392.7 | 4.6 | 91.7 | 35.603 | -1.664 | 8.95 | 19.2 |
| 55.0 | 460.5 | 455.9 | 4.6 | 212.5 | 35.795 | -1.299 | 9.27 | 19.4 |
| 59.0 | 509.6 | 505.0 | 4.6 | 786.3 | 36.757 | -0.743 | 9.35 | 19.0 |

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Total Driving Time 100 minutes; Total No. of Blows 3970
 Starting at penetration 5.0 ft

| G/L at Shaft and Toe: 0.703 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 | 6.5 | 3.0 | 3.5 | Hammer | did not run | | | | |
| 10.0 | 30.7 | 28.2 | 2.5 | 2.7 | 16.692 | -0.281 | 4.64 | 23.8 | |
| 15.0 | 64.6 | 62.8 | 1.8 | 7.2 | 22.793 | -0.365 | 5.68 | 20.3 | |
| 20.0 | 97.5 | 83.5 | 13.9 | 11.5 | 27.153 | -0.987 | 6.36 | 19.2 | |
| 25.0 | 139.1 | 113.5 | 25.6 | 16.5 | 28.985 | -1.460 | 6.96 | 18.7 | |
| 30.0 | 183.6 | 154.7 | 28.9 | 22.2 | 31.291 | -1.242 | 7.39 | 18.4 | |
| 35.0 | 230.0 | 201.1 | 28.9 | 27.4 | 31.385 | -1.290 | 7.73 | 18.2 | |
| 40.0 | 263.5 | 258.5 | 5.0 | 32.6 | 33.019 | -0.963 | 7.96 | 18.2 | |
| 45.0 | 384.8 | 330.6 | 54.2 | 79.8 | 34.406 | -2.213 | 8.89 | 19.6 | |
| 50.0 | 402.2 | 397.6 | 4.6 | 96.5 | 35.782 | -1.720 | 8.99 | 19.3 | |
| 55.0 | 468.5 | 463.9 | 4.6 | 247.2 | 35.980 | -1.300 | 9.31 | 19.4 | |
| 59.0 | 520.1 | 515.5 | 4.6 | 1519.2 | 36.905 | -0.751 | 9.37 | 19.0 | |

Total Driving Time 143 minutes; Total No. of Blows 5631
 Starting at penetration 5.0 ft

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SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.736 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 | 6.5 | 3.0 | 3.5 | Hammer | did not run | | | | |
| 10.0 | 31.2 | 28.6 | 2.5 | 2.8 | 16.805 | -0.268 | 4.66 | 23.7 | |
| 15.0 | 66.0 | 64.1 | 1.8 | 7.4 | 22.913 | -0.531 | 5.71 | 20.3 | |
| 20.0 | 99.3 | 85.4 | 13.9 | 11.8 | 27.346 | -0.934 | 6.39 | 19.1 | |
| 25.0 | 141.0 | 115.4 | 25.6 | 16.9 | 29.138 | -1.537 | 6.99 | 18.6 | |
| 30.0 | 185.5 | 156.6 | 28.9 | 22.6 | 31.400 | -1.283 | 7.40 | 18.3 | |
| 35.0 | 231.9 | 203.0 | 28.9 | 27.8 | 31.478 | -1.236 | 7.75 | 18.2 | |
| 40.0 | 265.7 | 260.7 | 5.0 | 33.1 | 33.220 | -0.870 | 8.00 | 18.2 | |
| 45.0 | 387.5 | 333.3 | 54.2 | 82.2 | 34.545 | -2.239 | 8.91 | 19.6 | |
| 50.0 | 407.1 | 402.5 | 4.6 | 101.6 | 35.958 | -1.758 | 9.02 | 19.4 | |
| 55.0 | 476.5 | 471.9 | 4.6 | 285.6 | 36.161 | -1.323 | 9.34 | 19.5 | |
| 59.0 | 530.5 | 525.9 | 4.6 | 9092.4 | 37.056 | -0.759 | 9.39 | 19.0 | |

Total Driving Time 540 minutes; Total No. of Blows 20998
 Starting at penetration 5.0 ft

FRA-70-1322L - For Abutment - HP12x53 02/28/2021
 Resource International Inc GRLWEAP Version 2010

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 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 10.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 15.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 20.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 25.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 30.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 35.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 40.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 45.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 50.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 55.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 59.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |

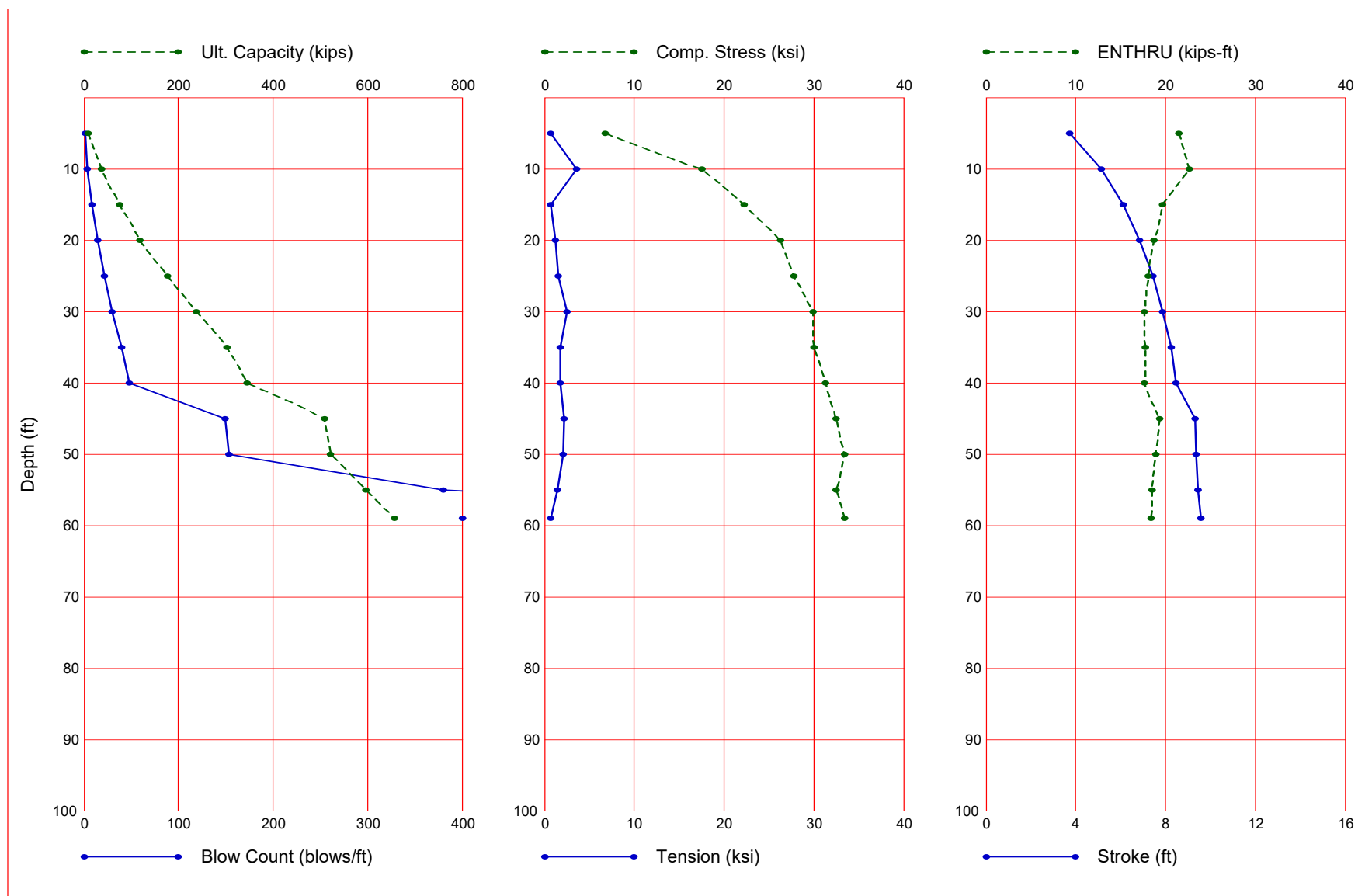
Soil Layer Resistance Values

| 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 | 0.01 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 7.59 | 0.46 | 5.27 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 7.61 | 2.62 | 2.54 | 0.100 | 0.100 | 0.200 | 0.150 | 0.515 | 6.000 | 24.000 |
| 13.09 | 2.62 | 2.54 | 0.100 | 0.100 | 0.200 | 0.150 | 0.515 | 6.000 | 24.000 |
| 13.11 | 1.37 | 1.82 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 18.09 | 1.37 | 1.82 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 18.11 | 1.11 | 12.59 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 23.09 | 1.42 | 16.17 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |

1322L-FA-12X53

| | | | | | | | | | |
|-------|------|-------|-------|-------|-------|-------|-------|-------|---------|
| 23.11 | 1.74 | 24.01 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 28.99 | 2.20 | 28.91 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 29.01 | 2.20 | 28.91 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 30.69 | 2.26 | 28.91 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 30.71 | 2.26 | 28.91 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 38.99 | 2.61 | 28.91 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 39.01 | 5.12 | 4.96 | 0.100 | 0.100 | 0.200 | 0.150 | 0.515 | 6.000 | 24.000 |
| 41.49 | 5.12 | 4.96 | 0.100 | 0.100 | 0.200 | 0.150 | 0.515 | 6.000 | 24.000 |
| 41.51 | 3.23 | 54.20 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 46.49 | 3.50 | 54.20 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 46.51 | 4.75 | 4.60 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 55.51 | 4.75 | 4.60 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 59.00 | 4.45 | 4.60 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |

Gain/Loss 3 at Shaft and Toe 0.670 / 1.000



Gain/Loss 3 at Shaft and Toe 0.670 / 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 | 8.9 | 4.2 | 4.8 | 1.2 | 6.761 | -0.741 | 3.72 | 21.5 |
| 10.0 | 37.7 | 34.2 | 3.5 | 3.3 | 17.530 | -3.582 | 5.12 | 22.7 |
| 15.0 | 76.7 | 74.1 | 2.5 | 8.6 | 22.291 | -0.732 | 6.12 | 19.7 |
| 20.0 | 118.9 | 99.6 | 19.3 | 14.2 | 26.268 | -1.201 | 6.85 | 18.7 |
| 25.0 | 176.4 | 141.1 | 35.3 | 22.1 | 27.784 | -1.556 | 7.43 | 18.1 |
| 30.0 | 238.4 | 198.5 | 39.9 | 30.3 | 29.876 | -2.541 | 7.88 | 17.7 |
| 35.0 | 303.1 | 263.2 | 39.9 | 40.3 | 30.013 | -1.756 | 8.25 | 17.8 |
| 40.0 | 346.0 | 339.1 | 6.8 | 48.6 | 31.351 | -1.732 | 8.46 | 17.7 |
| 45.0 | 509.3 | 434.4 | 74.8 | 149.3 | 32.494 | -2.229 | 9.33 | 19.4 |
| 50.0 | 522.3 | 515.9 | 6.3 | 153.6 | 33.404 | -2.079 | 9.36 | 18.9 |
| 55.0 | 597.1 | 590.7 | 6.3 | 380.4 | 32.493 | -1.474 | 9.43 | 18.5 |
| 59.0 | 656.6 | 650.3 | 6.3 | 990.5 | 33.442 | -0.707 | 9.58 | 18.4 |

Total Continuous Driving Time 155.00 minutes; Total Number of Blows 6048 (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\2013\W-13-072 FRA-70-13.10 PROJECT 6A\ANALYSIS\FRA-70-1322L AND 1323C\DRIVEABILITY\FRA-70-1322L\FORWARD

ABUTMENT\HP 14X73\1322L-FA-14X73.GMW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW

Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-1322L - For Abutment - HP14x73
OUT OSG HAM STR FUL PEL N SPL N-U P-D %SK ISM 0 PHI RSA ITR H-D MXT DEX
-100 0 41 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0.000
Pile g Hammer g Toe Area Pile Size Pile Type
32.170 32.170 144.000 14.000 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
59.000 21.40 29000.0 492.000 4.700 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 | 0.01 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 7.59 | 0.54 | 7.28 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 7.61 | 2.62 | 3.51 | 0.10 | 0.10 | 0.20 | 0.15 | 1.21 | 6.00 | 24.000 |
| 13.09 | 2.62 | 3.51 | 0.10 | 0.10 | 0.20 | 0.15 | 1.21 | 6.00 | 24.000 |
| 13.11 | 1.37 | 2.51 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 18.09 | 1.37 | 2.51 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 18.11 | 1.28 | 17.38 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 23.09 | 1.65 | 22.35 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 23.11 | 2.05 | 33.15 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 28.99 | 2.58 | 39.92 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 29.01 | 2.59 | 39.92 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 30.69 | 2.66 | 39.92 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 30.71 | 2.66 | 39.92 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 38.99 | 3.07 | 39.92 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 39.01 | 5.12 | 6.85 | 0.10 | 0.10 | 0.20 | 0.15 | 1.21 | 6.00 | 24.000 |
| 41.49 | 5.12 | 6.85 | 0.10 | 0.10 | 0.20 | 0.15 | 1.21 | 6.00 | 24.000 |
| 41.51 | 3.86 | 74.83 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 46.49 | 4.18 | 74.83 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 46.51 | 4.75 | 6.35 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 55.51 | 4.75 | 6.35 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 59.00 | 4.70 | 6.35 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |

Gain/Loss factors: shaft and toe

| Dpth | L | Wait | Strk | Pmx% | Eff. | Stff | CoR |
|---------|---------|---------|---------|---------|-------|-------|-------|
| 0.60400 | 0.63700 | 0.67000 | 0.70300 | 0.73600 | | | |
| 1.00000 | 1.00000 | 1.00000 | 1.00000 | 1.00000 | | | |
| 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 |
| 59.00 | 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-70-1322L - For Abutment - HP14x73

| Hammer Model: | D 19-42 | Made by: | DELMAG |
|-------------------|----------------|------------------|--------|
| No. | Weight kips | Stiffn k/inch | CoR |
| 1 | 0.800 | | |
| 2 | 0.800 | 140046.6 | 1.000 |
| 3 | 0.800 | 140046.6 | 1.000 |
| 4 | 0.800 | 140046.6 | 1.000 |
| 5 | 0.800 | 140046.6 | 1.000 |
| Imp Block | 0.753 | 70735.6 | 0.900 |
| Helmet | 1.900 | 60155.0 | 0.800 |
| Combined Pile Top | | 15778.0 | |

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) 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-70-1322L - For Abutment - HP14x73 02/28/2021
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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 5.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 59.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | | | 8.9 |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|-----|
| 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 | 0.240 | 15778 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 4.7 | 21.4 | |
| 2 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 4.7 | 21.4 | |
| 17 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 0.5 | 0.050 | 0.100 | 55.72 | 4.7 | 21.4 | |
| 18 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 3.7 | 0.050 | 0.100 | 59.00 | 4.7 | 21.4 | |
| Toe | | | | | | 4.8 | 0.150 | 0.100 | | | | |

4.314 kips total unreduced pile weight (g= 32.17 ft/s2)
 4.314 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 | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 5.00 | 10.81 | 1.00 | 0.800 |

FRA-70-1322L - For Abutment - HP14x73 02/28/2021
 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 | |
| 8.9 | 1.2 | 3.72 | 3.72 | -0.74 | 6 42 | 6.76 | 1 7 | 21.5 |
| 8.9 | 1.2 | 3.72 | 3.72 | -0.74 | 6 42 | 6.76 | 1 7 | 21.5 |
| 8.9 | 1.2 | 3.72 | 3.72 | -0.74 | 6 42 | 6.76 | 1 7 | 21.5 |
| 8.9 | 1.2 | 3.72 | 3.72 | -0.74 | 6 42 | 6.76 | 1 7 | 21.5 |
| 8.9 | 1.2 | 3.72 | 3.72 | -0.74 | 6 42 | 6.76 | 1 7 | 21.5 |

FRA-70-1322L - For Abutment - HP14x73 02/28/2021
 Resource International Inc GRLWEAP Version 2010

| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 10.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 59.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 36.7 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|------|
| 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 | 0.240 | 15778 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 4.7 | 21.4 |
| 2 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 4.7 | 21.4 |
| 15 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 49.17 | 4.7 | 21.4 |
| 16 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 2.0 | 0.050 | 0.100 | 52.44 | 4.7 | 21.4 |
| 17 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 5.5 | 0.050 | 0.100 | 55.72 | 4.7 | 21.4 |
| 18 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 25.7 | 0.190 | 0.100 | 59.00 | 4.7 | 21.4 |
| Toe | | | | | | 3.5 | 0.150 | 0.100 | | | |

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

4.314 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 |

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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 | |
| 36.7 | 3.2 | 5.08 | 5.06 | -3.61 | 5 8 | 17.34 | 7 3 | 22.8 |
| 37.2 | 3.3 | 5.10 | 5.07 | -3.60 | 5 8 | 17.44 | 7 3 | 22.8 |
| 37.7 | 3.3 | 5.12 | 5.09 | -3.58 | 5 8 | 17.53 | 8 3 | 22.7 |
| 38.2 | 3.4 | 5.13 | 5.11 | -3.56 | 5 8 | 17.63 | 7 3 | 22.6 |
| 38.7 | 3.5 | 5.15 | 5.13 | -3.52 | 5 8 | 17.69 | 7 3 | 22.6 |

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| Depth | (ft) | 15.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
|-----------|--------|---------|-----------|---------|
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 59.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 73.5 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|------|
| 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 | 0.240 | 15778 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 4.7 | 21.4 |
| 2 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 4.7 | 21.4 |
| 14 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 0.6 | 0.050 | 0.100 | 45.89 | 4.7 | 21.4 |
| 15 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 3.8 | 0.050 | 0.100 | 49.17 | 4.7 | 21.4 |
| 16 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 13.5 | 0.150 | 0.100 | 52.44 | 4.7 | 21.4 |
| 17 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 32.2 | 0.200 | 0.100 | 55.72 | 4.7 | 21.4 |
| 18 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 20.9 | 0.200 | 0.100 | 59.00 | 4.7 | 21.4 |
| Toe | | | | | | 2.5 | 0.150 | 0.100 | | | |

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

4.314 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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| 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 | |
| 73.5 | 8.1 | 6.05 | 6.07 | -0.77 | 5 8 | 22.03 | 15 5 | 19.8 |

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| | | | | | | | | | | | |
|------|-----|------|------|-------|----|----|-------|----|---|------|------|
| 75.1 | 8.4 | 6.08 | 6.11 | -0.65 | 15 | 50 | 22.17 | 15 | 5 | 19.7 | 47.8 |
| 76.7 | 8.6 | 6.12 | 6.14 | -0.73 | 15 | 50 | 22.29 | 15 | 5 | 19.7 | 47.7 |
| 78.2 | 8.8 | 6.15 | 6.18 | -0.80 | 15 | 50 | 22.43 | 15 | 5 | 19.6 | 47.5 |
| 79.8 | 9.1 | 6.19 | 6.21 | -0.86 | 15 | 50 | 22.54 | 15 | 5 | 19.6 | 47.4 |

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Depth (ft) 20.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 59.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 114.5 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.240 | 15778 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 4.7 | 21.4 |
| 2 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 4.7 | 21.4 |
| 12 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 39.33 | 4.7 | 21.4 |
| 13 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 2.1 | 0.050 | 0.100 | 42.61 | 4.7 | 21.4 |
| 14 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 5.7 | 0.050 | 0.100 | 45.89 | 4.7 | 21.4 |
| 15 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 26.9 | 0.192 | 0.100 | 49.17 | 4.7 | 21.4 |
| 16 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 30.1 | 0.200 | 0.100 | 52.44 | 4.7 | 21.4 |
| 17 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 12.8 | 0.200 | 0.100 | 55.72 | 4.7 | 21.4 |
| 18 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 17.5 | 0.114 | 0.100 | 59.00 | 4.7 | 21.4 |
| Toe | | | | | | 19.3 | 0.150 | 0.100 | | | |

4.314 kips total unredused pile weight (g= 32.17 ft/s2)
4.314 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 | |
| 114.5 | 13.5 | 6.78 | 6.73 | -1.20 | 12 39 | 25.93 | 15 5 | 18.7 45.4 |
| 116.7 | 13.8 | 6.82 | 6.77 | -1.21 | 12 39 | 26.10 | 15 5 | 18.6 45.3 |
| 118.9 | 14.2 | 6.85 | 6.79 | -1.20 | 12 39 | 26.27 | 15 5 | 18.7 45.2 |
| 121.1 | 14.5 | 6.88 | 6.82 | -1.19 | 12 39 | 26.46 | 15 5 | 18.6 45.1 |
| 123.3 | 14.9 | 6.91 | 6.86 | -1.16 | 12 39 | 26.59 | 15 5 | 18.5 45.0 |

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Depth (ft) 25.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 59.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 172.0 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.240 | 15778 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 4.7 | 21.4 |
| 2 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 4.7 | 21.4 |
| 11 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 0.7 | 0.050 | 0.100 | 36.06 | 4.7 | 21.4 |
| 12 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 4.0 | 0.050 | 0.100 | 39.33 | 4.7 | 21.4 |
| 13 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 14.8 | 0.157 | 0.100 | 42.61 | 4.7 | 21.4 |
| 14 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 32.2 | 0.200 | 0.100 | 45.89 | 4.7 | 21.4 |

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| | | | | | | | | | | | |
|-----|-------|-------|-------|-------|------|------|-------|-------|-------|-----|------|
| 15 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 19.9 | 0.200 | 0.100 | 49.17 | 4.7 | 21.4 |
| 16 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 13.5 | 0.185 | 0.100 | 52.44 | 4.7 | 21.4 |
| 17 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 22.0 | 0.050 | 0.100 | 55.72 | 4.7 | 21.4 |
| 18 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 29.4 | 0.050 | 0.100 | 59.00 | 4.7 | 21.4 |
| Toe | | | | | | 35.3 | 0.150 | 0.100 | | | |

4.314 kips total unredacted pile weight (g= 32.17 ft/s²)
 4.314 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 |
| 172.0 | 21.2 | 7.38 7.35 | -1.61 | 6 | 33 | 27.55 | 13 | 4 | 18.2 | 43.5 |
| 174.2 | 21.7 | 7.41 7.38 | -1.58 | 6 | 33 | 27.66 | 13 | 4 | 18.1 | 43.4 |
| 176.4 | 22.1 | 7.43 7.41 | -1.56 | 6 | 33 | 27.78 | 13 | 4 | 18.1 | 43.4 |
| 178.6 | 22.6 | 7.46 7.43 | -1.53 | 13 | 28 | 27.89 | 13 | 4 | 18.1 | 43.3 |
| 180.8 | 23.1 | 7.48 7.47 | -1.59 | 13 | 28 | 28.00 | 13 | 4 | 18.0 | 43.2 |

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| Depth | (ft) | 30.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| Toe Area | (in ²) | 144.000 | Pile Type | Unknown |
|-----------|--------------------|---------|-----------|---------|
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 59.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.141

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 234.0 | |
|-----|--------|------------------------|----------------|----------------|--------------|-------------|--|
| | kips | Stiffn C-Slk T-Slk | CoR | Soil-S | Soil-D Quake | LbTop Perim | |
| | | k/in ft ft | | kips s/ft inch | | ft ft | |
| 1 | 0.240 | 15778 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.28 | 4.7 21.4 | |
| 2 | 0.240 | 15778 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.56 | 4.7 21.4 | |
| 9 | 0.240 | 15778 0.000 0.000 1.00 | 0.0 | 0.050 0.100 | 29.50 | 4.7 21.4 | |
| 10 | 0.240 | 15778 0.000 0.000 1.00 | 2.3 | 0.050 0.100 | 32.78 | 4.7 21.4 | |
| 11 | 0.240 | 15778 0.000 0.000 1.00 | 5.9 | 0.050 0.100 | 36.06 | 4.7 21.4 | |
| 12 | 0.240 | 15778 0.000 0.000 1.00 | 28.2 | 0.194 0.100 | 39.33 | 4.7 21.4 | |
| 13 | 0.240 | 15778 0.000 0.000 1.00 | 29.2 | 0.200 0.100 | 42.61 | 4.7 21.4 | |
| 14 | 0.240 | 15778 0.000 0.000 1.00 | 12.8 | 0.200 0.100 | 45.89 | 4.7 21.4 | |
| 15 | 0.240 | 15778 0.000 0.000 1.00 | 17.9 | 0.106 0.100 | 49.17 | 4.7 21.4 | |
| 16 | 0.240 | 15778 0.000 0.000 1.00 | 24.6 | 0.050 0.100 | 52.44 | 4.7 21.4 | |
| 17 | 0.240 | 15778 0.000 0.000 1.00 | 34.3 | 0.050 0.100 | 55.72 | 4.7 21.4 | |
| 18 | 0.240 | 15778 0.000 0.000 1.00 | 38.8 | 0.050 0.100 | 59.00 | 4.7 21.4 | |
| Toe | | | | 39.9 | 0.150 0.100 | | |

4.314 kips total unredacted pile weight (g= 32.17 ft/s²)
 4.314 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 |
| 234.0 | 29.7 | 7.84 7.83 | -2.65 | 8 | 27 | 29.62 | 12 | 4 | 17.7 | 42.2 |
| 236.2 | 30.1 | 7.85 7.85 | -2.60 | 8 | 27 | 29.72 | 12 | 4 | 17.6 | 42.1 |
| 238.4 | 30.3 | 7.88 7.86 | -2.54 | 8 | 27 | 29.88 | 12 | 4 | 17.7 | 42.1 |
| 240.6 | 30.8 | 7.89 7.89 | -2.49 | 8 | 26 | 29.92 | 12 | 4 | 17.6 | 42.1 |
| 242.8 | 31.1 | 7.91 7.90 | -2.42 | 8 | 27 | 30.07 | 12 | 4 | 17.6 | 42.0 |

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Depth (ft) 35.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 Pile Type Unknown
 Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 59.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.141

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 298.7 |
|-----|--------|------------------------|----------------|--------------|--------|------------|
| | 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 | 0.240 | 15778 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.28 | 4.7 21.4 |
| 2 | 0.240 | 15778 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.56 | 4.7 21.4 |
| 8 | 0.240 | 15778 0.000 0.000 1.00 | 0.8 | 0.050 0.100 | 26.22 | 4.7 21.4 |
| 9 | 0.240 | 15778 0.000 0.000 1.00 | 4.2 | 0.050 0.100 | 29.50 | 4.7 21.4 |
| 10 | 0.240 | 15778 0.000 0.000 1.00 | 16.2 | 0.164 0.100 | 32.78 | 4.7 21.4 |
| 11 | 0.240 | 15778 0.000 0.000 1.00 | 32.2 | 0.200 0.100 | 36.06 | 4.7 21.4 |
| 12 | 0.240 | 15778 0.000 0.000 1.00 | 18.9 | 0.200 0.100 | 39.33 | 4.7 21.4 |
| 13 | 0.240 | 15778 0.000 0.000 1.00 | 13.9 | 0.178 0.100 | 42.61 | 4.7 21.4 |
| 14 | 0.240 | 15778 0.000 0.000 1.00 | 22.2 | 0.050 0.100 | 45.89 | 4.7 21.4 |
| 15 | 0.240 | 15778 0.000 0.000 1.00 | 29.9 | 0.050 0.100 | 49.17 | 4.7 21.4 |
| 16 | 0.240 | 15778 0.000 0.000 1.00 | 36.7 | 0.050 0.100 | 52.44 | 4.7 21.4 |
| 17 | 0.240 | 15778 0.000 0.000 1.00 | 40.6 | 0.050 0.100 | 55.72 | 4.7 21.4 |
| 18 | 0.240 | 15778 0.000 0.000 1.00 | 43.1 | 0.050 0.100 | 59.00 | 4.7 21.4 |
| Toe | | | 39.9 | 0.150 0.100 | | |

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

4.314 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 |
| 298.7 | 39.2 | 8.21 8.20 | -1.59 | 10 | 21 29.83 | 10 | 4 17.8 | 41.3 |
| 300.9 | 39.8 | 8.23 8.22 | -1.68 | 10 | 21 29.93 | 10 | 4 17.8 | 41.2 |
| 303.1 | 40.3 | 8.25 8.24 | -1.76 | 10 | 21 30.01 | 10 | 4 17.8 | 41.2 |
| 305.3 | 41.1 | 8.26 8.26 | -1.83 | 10 | 21 30.05 | 10 | 4 17.8 | 41.1 |
| 307.5 | 41.4 | 8.28 8.27 | -1.91 | 10 | 21 30.16 | 10 | 4 17.9 | 41.1 |



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Depth (ft) 40.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 Pile Type Unknown
 Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 59.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.141

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 340.7 |
|-----|--------|------------------------|----------------|--------------|--------|------------|
| | 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 | 0.240 | 15778 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.28 | 4.7 21.4 |
| 2 | 0.240 | 15778 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.56 | 4.7 21.4 |
| 6 | 0.240 | 15778 0.000 0.000 1.00 | 0.1 | 0.050 0.100 | 19.67 | 4.7 21.4 |
| 7 | 0.240 | 15778 0.000 0.000 1.00 | 2.5 | 0.050 0.100 | 22.94 | 4.7 21.4 |
| 8 | 0.240 | 15778 0.000 0.000 1.00 | 6.1 | 0.050 0.100 | 26.22 | 4.7 21.4 |
| 9 | 0.240 | 15778 0.000 0.000 1.00 | 29.4 | 0.196 0.100 | 29.50 | 4.7 21.4 |
| 10 | 0.240 | 15778 0.000 0.000 1.00 | 28.2 | 0.200 0.100 | 32.78 | 4.7 21.4 |
| 11 | 0.240 | 15778 0.000 0.000 1.00 | 12.8 | 0.200 0.100 | 36.06 | 4.7 21.4 |
| 12 | 0.240 | 15778 0.000 0.000 1.00 | 18.4 | 0.098 0.100 | 39.33 | 4.7 21.4 |
| 13 | 0.240 | 15778 0.000 0.000 1.00 | 25.1 | 0.050 0.100 | 42.61 | 4.7 21.4 |

| | | | | | | | | | | | |
|----------------|-------|-------|-------|-------|------|------|-------|-------|-------|-----|------|
| 1322L-FA-14X73 | | | | | | | | | | | |
| 14 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 34.5 | 0.050 | 0.100 | 45.89 | 4.7 | 21.4 |
| 15 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 39.0 | 0.050 | 0.100 | 49.17 | 4.7 | 21.4 |
| 16 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 41.9 | 0.050 | 0.100 | 52.44 | 4.7 | 21.4 |
| 17 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 44.4 | 0.050 | 0.100 | 55.72 | 4.7 | 21.4 |
| 18 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 51.5 | 0.114 | 0.100 | 59.00 | 4.7 | 21.4 |
| Toe | | | | | | 6.8 | 0.150 | 0.100 | | | |

4.314 kips total unreduced pile weight (g= 32.17 ft/s2)
4.314 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 | ksi | i | t | Comp Str ksi | i | t | ENTHRU kip-ft | Bl Rt b/min |
|-------------|---------------|---------------------|---------------|-------|---|----|-----------------|---|---|------------------|----------------|
| 340.7 | 47.1 | 8.43 | 8.42 | -1.88 | 9 | 41 | 31.11 | 9 | 3 | 17.7 | 40.7 |
| 343.3 | 48.1 | 8.44 | 8.44 | -1.80 | 9 | 41 | 31.21 | 9 | 3 | 17.6 | 40.7 |
| 346.0 | 48.6 | 8.46 | 8.46 | -1.73 | 8 | 41 | 31.35 | 9 | 3 | 17.7 | 40.7 |
| 348.6 | 49.4 | 8.49 | 8.48 | -1.67 | 8 | 21 | 31.44 | 9 | 3 | 17.7 | 40.6 |
| 351.2 | 50.4 | 8.51 | 8.50 | -1.66 | 8 | 21 | 31.62 | 9 | 3 | 17.7 | 40.6 |

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| | | |
|------------------------|-------|----------------------------|
| Depth (ft) | 45.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor 1.000 |

PILE PROFILE:

| | | | |
|------------------|---------|-----------|---------|
| Toe Area (in2) | 144.000 | Pile Type | Unknown |
| Pile Size (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 59.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | | | 502.8 |
|---------------------|----------------|----------------|-------------|-------------|------|---------------------------|----------------|---------------|-------------|-------------|-------------|-------|
| 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 | 0.240 | 15778 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 4.7 | 21.4 | |
| 2 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 4.7 | 21.4 | |
| 5 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 0.9 | 0.050 | 0.100 | 16.39 | 4.7 | 21.4 | |
| 6 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 4.4 | 0.050 | 0.100 | 19.67 | 4.7 | 21.4 | |
| 7 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 17.5 | 0.169 | 0.100 | 22.94 | 4.7 | 21.4 | |
| 8 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 32.2 | 0.200 | 0.100 | 26.22 | 4.7 | 21.4 | |
| 9 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 18.0 | 0.200 | 0.100 | 29.50 | 4.7 | 21.4 | |
| 10 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 14.3 | 0.170 | 0.100 | 32.78 | 4.7 | 21.4 | |
| 11 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 22.4 | 0.050 | 0.100 | 36.06 | 4.7 | 21.4 | |
| 12 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 30.5 | 0.050 | 0.100 | 39.33 | 4.7 | 21.4 | |
| 13 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 37.0 | 0.050 | 0.100 | 42.61 | 4.7 | 21.4 | |
| 14 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 40.7 | 0.050 | 0.100 | 45.89 | 4.7 | 21.4 | |
| 15 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 43.2 | 0.050 | 0.100 | 49.17 | 4.7 | 21.4 | |
| 16 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 45.7 | 0.050 | 0.100 | 52.44 | 4.7 | 21.4 | |
| 17 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 60.0 | 0.175 | 0.100 | 55.72 | 4.7 | 21.4 | |
| 18 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 61.3 | 0.050 | 0.100 | 59.00 | 4.7 | 21.4 | |
| Toe | | | | | | 74.8 | 0.150 | 0.100 | | | | |

4.314 kips total unreduced pile weight (g= 32.17 ft/s2)
4.314 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 | ksi | i | t | Comp Str ksi | i | t | ENTHRU kip-ft | Bl Rt b/min |
|-------------|---------------|---------------------|---------------|-------|---|----|-----------------|---|---|------------------|----------------|
| 502.8 | 139.8 | 9.29 | 9.26 | -2.20 | 7 | 34 | 32.32 | 7 | 3 | 19.3 | 38.9 |
| 506.0 | 144.4 | 9.31 | 9.28 | -2.21 | 7 | 34 | 32.41 | 7 | 3 | 19.4 | 38.8 |
| 509.3 | 149.3 | 9.33 | 9.30 | -2.23 | 7 | 34 | 32.49 | 7 | 3 | 19.4 | 38.8 |
| 512.5 | 156.3 | 9.35 | 9.32 | -2.25 | 7 | 33 | 32.56 | 7 | 3 | 19.3 | 38.8 |

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515.7 161.8 9.37 9.34 -2.29 7 16 32.64 7 3 19.4 38.7

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Depth (ft) 50.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in²) 144.000 Pile Type Unknown
Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 59.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 510.6 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|-----------------|
| 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 | in ² |
| 1 | 0.240 | 15778 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 | 4.7 | 21.4 |
| 2 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.56 | 4.7 | 21.4 |
| 3 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 0.1 | 0.050 | 0.100 | 9.83 | 4.7 | 21.4 |
| 4 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 2.7 | 0.050 | 0.100 | 13.11 | 4.7 | 21.4 |
| 5 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 6.3 | 0.050 | 0.100 | 16.39 | 4.7 | 21.4 |
| 6 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 30.7 | 0.198 | 0.100 | 19.67 | 4.7 | 21.4 |
| 7 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 27.2 | 0.200 | 0.100 | 22.94 | 4.7 | 21.4 |
| 8 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 12.8 | 0.200 | 0.100 | 26.22 | 4.7 | 21.4 |
| 9 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 18.9 | 0.090 | 0.100 | 29.50 | 4.7 | 21.4 |
| 10 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 25.6 | 0.050 | 0.100 | 32.78 | 4.7 | 21.4 |
| 11 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 34.8 | 0.050 | 0.100 | 36.06 | 4.7 | 21.4 |
| 12 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 39.2 | 0.050 | 0.100 | 39.33 | 4.7 | 21.4 |
| 13 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 42.0 | 0.050 | 0.100 | 42.61 | 4.7 | 21.4 |
| 14 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 44.5 | 0.050 | 0.100 | 45.89 | 4.7 | 21.4 |
| 15 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 52.4 | 0.122 | 0.100 | 49.17 | 4.7 | 21.4 |
| 16 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 61.4 | 0.121 | 0.100 | 52.44 | 4.7 | 21.4 |
| 17 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 61.6 | 0.062 | 0.100 | 55.72 | 4.7 | 21.4 |
| 18 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 44.2 | 0.200 | 0.100 | 59.00 | 4.7 | 21.4 |
| Toe | | | | | | 6.3 | 0.150 | 0.100 | | | |

4.314 kips total unreduced pile weight (g= 32.17 ft/s²)4.314 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 | |
| 510.6 | 137.3 | 9.30 | 9.24 | -2.22 | 4 16 | 33.13 | 6 3 | 18.8 38.9 |
| 516.5 | 144.2 | 9.33 | 9.26 | -2.16 | 4 17 | 33.22 | 6 3 | 18.9 38.9 |
| 522.3 | 153.6 | 9.36 | 9.29 | -2.08 | 4 16 | 33.40 | 6 3 | 18.9 38.8 |
| 528.1 | 164.4 | 9.38 | 9.31 | -1.98 | 4 16 | 33.53 | 6 3 | 18.9 38.8 |
| 533.9 | 176.3 | 9.41 | 9.34 | -1.90 | 4 16 | 33.64 | 6 3 | 19.0 38.7 |

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FRA-70-1322L - For Abutment - HP14x73
Resource International Inc

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GRLWEAP Version 2010

Depth (ft) 55.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in²) 144.000 Pile Type Unknown
Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 59.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 578.1 | |
|---------------------|--------|--------|-------|-------|-----|---------------------------|--------|-------|-------|-------|-----------------|
| 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 |

| 1322L-FA-14X73 | | | | | | | | | |
|----------------|-------|-------|-------|-------|------|------|-------|-------|----------------|
| 1 | 0.240 | 15778 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.28 4.7 21.4 |
| 2 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 1.1 | 0.050 | 0.100 | 6.56 4.7 21.4 |
| 3 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 4.6 | 0.050 | 0.100 | 9.83 4.7 21.4 |
| 4 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 18.8 | 0.173 | 0.100 | 13.11 4.7 21.4 |
| 5 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 32.2 | 0.200 | 0.100 | 16.39 4.7 21.4 |
| 6 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 17.0 | 0.200 | 0.100 | 19.67 4.7 21.4 |
| 7 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 14.7 | 0.163 | 0.100 | 22.94 4.7 21.4 |
| 8 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 22.6 | 0.050 | 0.100 | 26.22 4.7 21.4 |
| 9 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 31.0 | 0.050 | 0.100 | 29.50 4.7 21.4 |
| 10 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 37.2 | 0.050 | 0.100 | 32.78 4.7 21.4 |
| 11 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 40.8 | 0.050 | 0.100 | 36.06 4.7 21.4 |
| 12 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 43.3 | 0.050 | 0.100 | 39.33 4.7 21.4 |
| 13 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 45.8 | 0.050 | 0.100 | 42.61 4.7 21.4 |
| 14 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 60.6 | 0.174 | 0.100 | 45.89 4.7 21.4 |
| 15 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 61.5 | 0.050 | 0.100 | 49.17 4.7 21.4 |
| 16 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 52.2 | 0.144 | 0.100 | 52.44 4.7 21.4 |
| 17 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 44.2 | 0.200 | 0.100 | 55.72 4.7 21.4 |
| 18 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 44.2 | 0.200 | 0.100 | 59.00 4.7 21.4 |
| Toe | | | | | | 6.3 | 0.150 | 0.100 | |

4.314 kips total unreduced pile weight (g= 32.17 ft/s2)
4.314 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 |
| 578.1 | 285.6 | 9.49 | 9.41 | -1.43 | 4 | 29 | 32.52 | 4 | 2 | 18.6 |
| 587.6 | 322.1 | 9.51 | 9.43 | -1.45 | 4 | 28 | 32.62 | 4 | 2 | 18.6 |
| 597.1 | 380.4 | 9.43 | 9.42 | -1.47 | 4 | 28 | 32.49 | 4 | 3 | 18.5 |
| 606.6 | 440.8 | 9.45 | 9.45 | -1.48 | 4 | 28 | 32.58 | 4 | 2 | 18.4 |
| 616.1 | 516.7 | 9.47 | 9.47 | -1.49 | 4 | 28 | 32.66 | 4 | 2 | 18.5 |

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| Depth | (ft) | 59.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
|-----------|--------|---------|-----------|---------|
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 59.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.141

| Pile and Soil Model | | | | | | | | | |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|----------------|
| No. | Weight | Stiffn | C-Slk | T-Slk | CoR | Soil-S | Soil-D | Quake | Rut |
| | kips | k/in | ft | ft | | kips | s/ft | inch | (kips) |
| 1 | 0.240 | 15778 | 0.010 | 0.000 | 0.85 | 1.8 | 0.050 | 0.100 | 3.28 4.7 21.4 |
| 2 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 5.4 | 0.050 | 0.100 | 6.56 4.7 21.4 |
| 3 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 24.4 | 0.187 | 0.100 | 9.83 4.7 21.4 |
| 4 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 32.1 | 0.200 | 0.100 | 13.11 4.7 21.4 |
| 5 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 12.8 | 0.200 | 0.100 | 16.39 4.7 21.4 |
| 6 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 16.5 | 0.129 | 0.100 | 19.67 4.7 21.4 |
| 7 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 23.4 | 0.050 | 0.100 | 22.94 4.7 21.4 |
| 8 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 33.3 | 0.050 | 0.100 | 26.22 4.7 21.4 |
| 9 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 38.2 | 0.050 | 0.100 | 29.50 4.7 21.4 |
| 10 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 41.4 | 0.050 | 0.100 | 32.78 4.7 21.4 |
| 11 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 43.9 | 0.050 | 0.100 | 36.06 4.7 21.4 |
| 12 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 47.9 | 0.074 | 0.100 | 39.33 4.7 21.4 |
| 13 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 61.9 | 0.158 | 0.100 | 42.61 4.7 21.4 |
| 14 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 62.2 | 0.050 | 0.100 | 45.89 4.7 21.4 |
| 15 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 47.9 | 0.175 | 0.100 | 49.17 4.7 21.4 |
| 16 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 44.2 | 0.200 | 0.100 | 52.44 4.7 21.4 |
| 18 | 0.240 | 15778 | 0.000 | 0.000 | 1.00 | 44.0 | 0.200 | 0.100 | 59.00 4.7 21.4 |
| Toe | | | | | | 6.3 | 0.150 | 0.100 | |

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

1322L-FA-14X73

Depth Stroke Pressure Efficy
ft ft Ratio
59.00 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 ksi | ENTHRU kip-ft | Bl Rt b/min |
|-------------|---------------|---------------------|---------------|----------|----------|-----------------|----------|----------|------------------|----------------|
| 631.8 | 564.6 | 9.52 | 9.52 | -0.67 | 3 | 27 | 33.20 | 3 | 2 | 18.3 |
| 644.2 | 731.8 | 9.55 | 9.54 | -0.68 | 3 | 27 | 33.31 | 3 | 2 | 18.3 |
| 656.6 | 990.5 | 9.58 | 9.54 | -0.71 | 3 | 26 | 33.44 | 3 | 2 | 18.4 |
| 669.1 | 1474.6 | 9.59 | 9.58 | -0.68 | 3 | 26 | 33.56 | 3 | 2 | 18.4 |
| 681.5 | 2442.6 | 9.61 | 9.61 | -0.64 | 3 | 26 | 33.68 | 3 | 2 | 18.4 |

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SUMMARY OVER DEPTHS

| Depth ft | Rut kips | G/L at Frictn kips | Shaft and End Bg kips | Toe: 0.604 1.000 Bl Ct bl/ft | Com Str ksi | Ten Str ksi | Stroke ft | ENTHRU kip-ft |
|-------------|-------------|--------------------------|-----------------------------|------------------------------------|----------------|----------------|--------------|------------------|
| 5.0 | 8.9 | 4.2 | 4.8 | 1.2 | 6.761 | -0.741 | 3.72 | 21.5 |
| 10.0 | 36.7 | 33.2 | 3.5 | 3.2 | 17.344 | -3.614 | 5.08 | 22.8 |
| 15.0 | 73.5 | 71.0 | 2.5 | 8.1 | 22.025 | -0.772 | 6.05 | 19.8 |
| 20.0 | 114.5 | 95.2 | 19.3 | 13.5 | 25.932 | -1.203 | 6.78 | 18.7 |
| 25.0 | 172.0 | 136.6 | 35.3 | 21.2 | 27.548 | -1.606 | 7.38 | 18.2 |
| 30.0 | 234.0 | 194.1 | 39.9 | 29.7 | 29.616 | -2.650 | 7.84 | 17.7 |
| 35.0 | 298.7 | 258.7 | 39.9 | 39.2 | 29.831 | -1.594 | 8.21 | 17.8 |
| 40.0 | 340.7 | 333.8 | 6.8 | 47.1 | 31.113 | -1.884 | 8.43 | 17.7 |
| 45.0 | 502.8 | 428.0 | 74.8 | 139.8 | 32.317 | -2.197 | 9.29 | 19.3 |
| 50.0 | 510.6 | 504.3 | 6.3 | 137.3 | 33.127 | -2.221 | 9.30 | 18.8 |
| 55.0 | 578.1 | 571.7 | 6.3 | 285.6 | 32.518 | -1.433 | 9.49 | 18.6 |
| 59.0 | 631.8 | 625.4 | 6.3 | 564.6 | 33.200 | -0.672 | 9.52 | 18.3 |

Total Driving Time 118 minutes;
Starting at penetration 5.0 ft Total No. of Blows 4612

| Depth ft | Rut kips | G/L at Frictn kips | Shaft and End Bg kips | Toe: 0.637 1.000 Bl Ct bl/ft | Com Str ksi | Ten Str ksi | Stroke ft | ENTHRU kip-ft |
|-------------|-------------|--------------------------|-----------------------------|------------------------------------|----------------|----------------|--------------|------------------|
| 5.0 | 8.9 | 4.2 | 4.8 | 1.2 | 6.761 | -0.741 | 3.72 | 21.5 |
| 10.0 | 37.2 | 33.7 | 3.5 | 3.3 | 17.438 | -3.599 | 5.10 | 22.8 |
| 15.0 | 75.1 | 72.6 | 2.5 | 8.4 | 22.168 | -0.648 | 6.08 | 19.7 |
| 20.0 | 116.7 | 97.4 | 19.3 | 13.8 | 26.100 | -1.209 | 6.82 | 18.6 |
| 25.0 | 174.2 | 138.9 | 35.3 | 21.7 | 27.659 | -1.582 | 7.41 | 18.1 |
| 30.0 | 236.2 | 196.3 | 39.9 | 30.1 | 29.717 | -2.599 | 7.85 | 17.6 |
| 35.0 | 300.9 | 261.0 | 39.9 | 39.8 | 29.932 | -1.676 | 8.23 | 17.8 |
| 40.0 | 343.3 | 336.5 | 6.8 | 48.1 | 31.211 | -1.797 | 8.44 | 17.6 |
| 45.0 | 506.0 | 431.2 | 74.8 | 144.4 | 32.406 | -2.209 | 9.31 | 19.4 |
| 50.0 | 516.5 | 510.1 | 6.3 | 144.2 | 33.219 | -2.164 | 9.33 | 18.9 |
| 55.0 | 587.6 | 581.2 | 6.3 | 322.1 | 32.618 | -1.449 | 9.51 | 18.6 |
| 59.0 | 644.2 | 637.8 | 6.3 | 731.8 | 33.314 | -0.681 | 9.55 | 18.3 |

Total Driving Time 132 minutes;
Starting at penetration 5.0 ft Total No. of Blows 5185

▲
FRA-70-1322L - For Abutment - HP14x73 02/28/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

| Depth ft | Rut kips | G/L at Frictn kips | Shaft and End Bg kips | Toe: 0.670 1.000 Bl Ct bl/ft | Com Str ksi | Ten Str ksi | Stroke ft | ENTHRU kip-ft |
|-------------|-------------|--------------------------|-----------------------------|------------------------------------|----------------|----------------|--------------|------------------|
| 5.0 | 8.9 | 4.2 | 4.8 | 1.2 | 6.761 | -0.741 | 3.72 | 21.5 |
| 10.0 | 37.7 | 34.2 | 3.5 | 3.3 | 17.530 | -3.582 | 5.12 | 22.7 |
| 15.0 | 76.7 | 74.1 | 2.5 | 8.6 | 22.291 | -0.732 | 6.12 | 19.7 |
| 20.0 | 118.9 | 99.6 | 19.3 | 14.2 | 26.268 | -1.201 | 6.85 | 18.7 |
| 25.0 | 176.4 | 141.1 | 35.3 | 22.1 | 27.784 | -1.556 | 7.43 | 18.1 |
| 30.0 | 238.4 | 198.5 | 39.9 | 30.3 | 29.876 | -2.541 | 7.88 | 17.7 |
| 35.0 | 303.1 | 263.2 | 39.9 | 40.3 | 30.013 | -1.756 | 8.25 | 17.8 |
| 40.0 | 346.0 | 339.1 | 6.8 | 48.6 | 31.351 | -1.732 | 8.46 | 17.7 |
| 45.0 | 509.3 | 434.4 | 74.8 | 149.3 | 32.494 | -2.229 | 9.33 | 19.4 |
| 50.0 | 522.3 | 515.9 | 6.3 | 153.6 | 33.404 | -2.079 | 9.36 | 18.9 |
| 55.0 | 597.1 | 590.7 | 6.3 | 380.4 | 32.493 | -1.474 | 9.43 | 18.5 |
| 59.0 | 656.6 | 650.3 | 6.3 | 990.5 | 33.442 | -0.707 | 9.58 | 18.4 |

Total Driving Time 155 minutes; Total No. of Blows 6048

Starting at penetration 5.0 ft

| G/L at Shaft and Toe: 0.703 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 | 8.9 | 4.2 | 4.8 | 1.2 | 6.761 | -0.741 | 3.72 | 21.5 | |
| 10.0 | 38.2 | 34.7 | 3.5 | 3.4 | 17.634 | -3.558 | 5.13 | 22.6 | |
| 15.0 | 78.2 | 75.7 | 2.5 | 8.8 | 22.430 | -0.800 | 6.15 | 19.6 | |
| 20.0 | 121.1 | 101.8 | 19.3 | 14.5 | 26.458 | -1.188 | 6.88 | 18.6 | |
| 25.0 | 178.6 | 143.3 | 35.3 | 22.6 | 27.890 | -1.525 | 7.46 | 18.1 | |
| 30.0 | 240.6 | 200.7 | 39.9 | 30.8 | 29.922 | -2.489 | 7.89 | 17.6 | |
| 35.0 | 305.3 | 265.4 | 39.9 | 41.1 | 30.050 | -1.834 | 8.26 | 17.8 | |
| 40.0 | 348.6 | 341.7 | 6.8 | 49.4 | 31.444 | -1.672 | 8.49 | 17.7 | |
| 45.0 | 512.5 | 437.7 | 74.8 | 156.3 | 32.561 | -2.254 | 9.35 | 19.3 | |
| 50.0 | 528.1 | 521.7 | 6.3 | 164.4 | 33.527 | -1.985 | 9.38 | 18.9 | |
| 55.0 | 606.6 | 600.2 | 6.3 | 440.8 | 32.584 | -1.480 | 9.45 | 18.4 | |
| 59.0 | 669.1 | 662.7 | 6.3 | 1474.6 | 33.565 | -0.680 | 9.59 | 18.4 | |

Total Driving Time 190 minutes; Total No. of Blows 7394
 Starting at penetration 5.0 ft

↑
 FRA-70-1322L - For Abutment - HP14x73 02/28/2021
 Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.736 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 | 8.9 | 4.2 | 4.8 | 1.2 | 6.761 | -0.741 | 3.72 | 21.5 | |
| 10.0 | 38.7 | 35.2 | 3.5 | 3.5 | 17.693 | -3.516 | 5.15 | 22.6 | |
| 15.0 | 79.8 | 77.3 | 2.5 | 9.1 | 22.540 | -0.857 | 6.19 | 19.6 | |
| 20.0 | 123.3 | 104.1 | 19.3 | 14.9 | 26.592 | -1.157 | 6.91 | 18.5 | |
| 25.0 | 180.8 | 145.5 | 35.3 | 23.1 | 28.004 | -1.586 | 7.48 | 18.0 | |
| 30.0 | 242.8 | 202.9 | 39.9 | 31.1 | 30.071 | -2.419 | 7.91 | 17.6 | |
| 35.0 | 307.5 | 267.6 | 39.9 | 41.4 | 30.158 | -1.906 | 8.28 | 17.9 | |
| 40.0 | 351.2 | 344.4 | 6.8 | 50.4 | 31.624 | -1.655 | 8.51 | 17.7 | |
| 45.0 | 515.7 | 440.9 | 74.8 | 161.8 | 32.644 | -2.292 | 9.37 | 19.4 | |
| 50.0 | 533.9 | 527.6 | 6.3 | 176.3 | 33.637 | -1.904 | 9.41 | 19.0 | |
| 55.0 | 616.1 | 609.7 | 6.3 | 516.7 | 32.664 | -1.494 | 9.47 | 18.5 | |
| 59.0 | 681.5 | 675.1 | 6.3 | 2442.6 | 33.682 | -0.641 | 9.61 | 18.4 | |

Total Driving Time 252 minutes; Total No. of Blows 9770
 Starting at penetration 5.0 ft

↑
 FRA-70-1322L - For Abutment - HP14x73 02/28/2021
 Resource International Inc GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

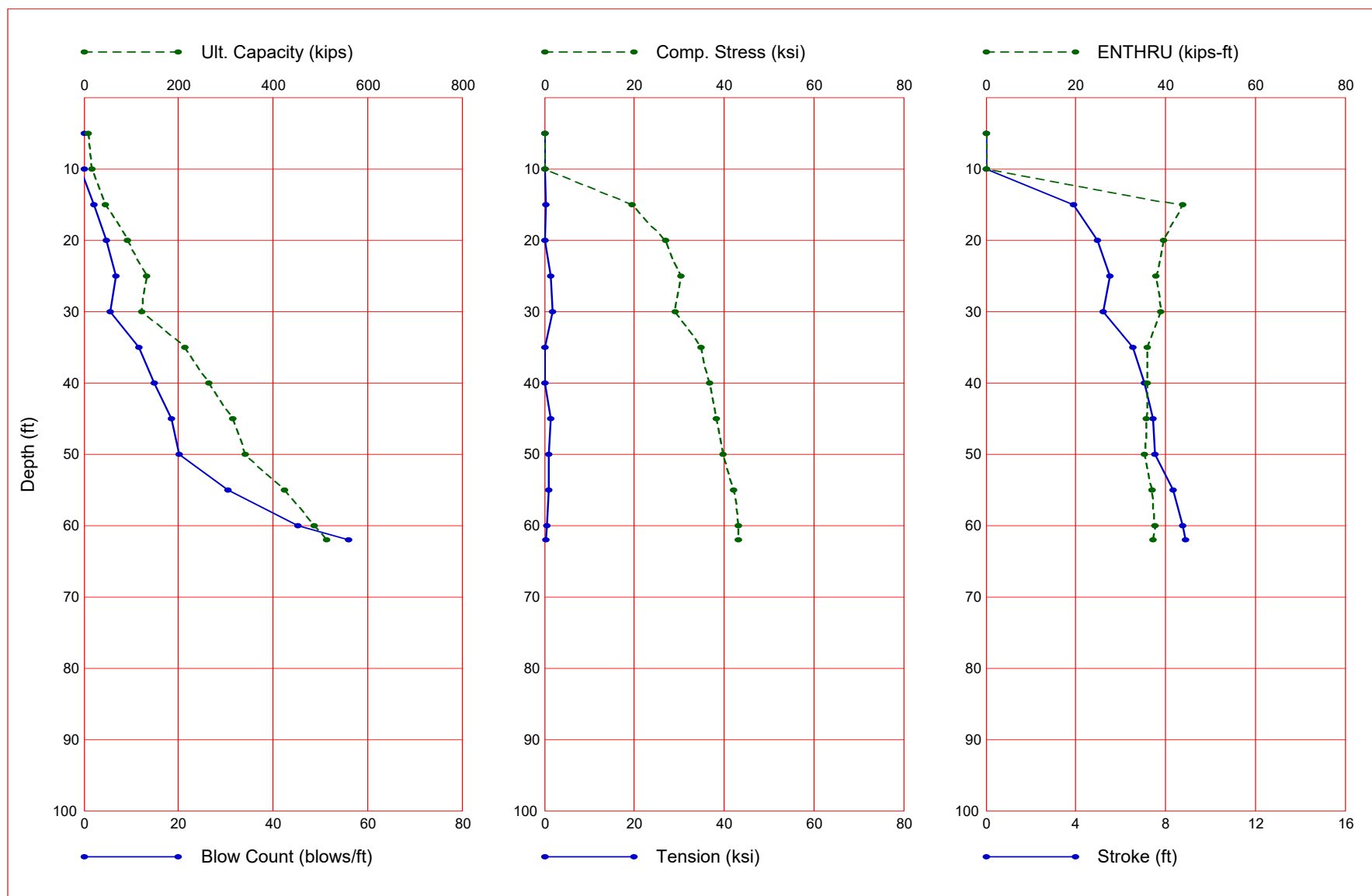
| Depth | Temp. Length | Wait Time | Equivalent Stroke | Pressure Ratio | Efficy. | Stiffn. Factor | Cushion CoR |
|-------|--------------|-----------|-------------------|----------------|---------|----------------|-------------|
| ft | ft | hr | ft | | | | |
| 5.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 10.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 15.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 20.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 25.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 30.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 35.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 40.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 45.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 50.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 55.00 | 59.00 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 59.00 | 59.00 | 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 | 0.01 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 7.59 | 0.54 | 7.28 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 7.61 | 2.62 | 3.51 | 0.100 | 0.100 | 0.200 | 0.150 | 0.515 | 6.000 | 24.000 |
| 13.09 | 2.62 | 3.51 | 0.100 | 0.100 | 0.200 | 0.150 | 0.515 | 6.000 | 24.000 |
| 13.11 | 1.37 | 2.51 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 18.09 | 1.37 | 2.51 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 18.11 | 1.28 | 17.38 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 23.09 | 1.65 | 22.35 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 23.11 | 2.05 | 33.15 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |

| 1322L-FA-14X73 | | | | | | | | | |
|----------------|------|-------|-------|-------|-------|-------|-------|-------|---------|
| 28.99 | 2.58 | 39.92 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 29.01 | 2.59 | 39.92 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 30.69 | 2.66 | 39.92 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 30.71 | 2.66 | 39.92 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 38.99 | 3.07 | 39.92 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 39.01 | 5.12 | 6.85 | 0.100 | 0.100 | 0.200 | 0.150 | 0.515 | 6.000 | 24.000 |
| 41.49 | 5.12 | 6.85 | 0.100 | 0.100 | 0.200 | 0.150 | 0.515 | 6.000 | 24.000 |
| 41.51 | 3.86 | 74.83 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 46.49 | 4.18 | 74.83 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 46.51 | 4.75 | 6.35 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 55.51 | 4.75 | 6.35 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 59.00 | 4.70 | 6.35 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |

Gain/Loss 3 at Shaft and Toe 0.670 / 1.000



Gain/Loss 3 at Shaft and Toe 0.670 / 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 | 8.6 | 3.2 | 5.4 | -1.0 | 0.000 | 0.000 | 0.00 | 0.0 |
| 10.0 | 17.6 | 15.5 | 2.1 | -1.0 | 0.000 | 0.000 | 0.00 | 0.0 |
| 15.0 | 46.1 | 35.8 | 10.3 | 2.2 | 19.575 | -0.308 | 3.92 | 43.9 |
| 20.0 | 92.1 | 58.7 | 33.4 | 4.8 | 26.959 | -0.202 | 4.97 | 39.6 |
| 25.0 | 133.2 | 91.2 | 41.9 | 6.8 | 30.421 | -1.290 | 5.54 | 37.8 |
| 30.0 | 121.9 | 115.5 | 6.3 | 5.5 | 29.024 | -1.746 | 5.21 | 38.9 |
| 35.0 | 213.2 | 154.8 | 58.3 | 11.7 | 34.978 | -0.196 | 6.57 | 36.0 |
| 40.0 | 264.6 | 201.1 | 63.5 | 14.9 | 36.809 | 0.000 | 7.07 | 35.9 |
| 45.0 | 315.8 | 252.2 | 63.5 | 18.5 | 38.340 | -1.362 | 7.43 | 35.8 |
| 50.0 | 342.0 | 306.1 | 36.0 | 20.2 | 39.810 | -0.924 | 7.55 | 35.2 |
| 55.0 | 423.3 | 365.0 | 58.3 | 30.4 | 42.210 | -1.018 | 8.34 | 37.1 |
| 60.0 | 486.7 | 428.3 | 58.3 | 45.3 | 43.154 | -0.594 | 8.76 | 37.6 |
| 62.0 | 513.2 | 454.9 | 58.3 | 56.1 | 43.226 | -0.309 | 8.90 | 37.3 |

Total Continuous Driving Time 18.00 minutes; Total Number of Blows 787 (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\2013\W-13-072 FRA-70-13.10 PROJECT 6A\ANALYSIS\FRA-70-1322L AND 1323C\DRIVEABILITY\FRA-70-1323C\REAR ABUTMENT\HP 10X42\1323C-RA-10X42.GW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-1323C - Rear Abutment - 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 14 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0.000
Pile g Hammer g Toe Area Pile Size Pile Type
32.170 32.170 144.000 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 WPlle Peri CI CoR ROut
62.000 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 30-23 1 5
Ram Wt Ram L Ram Dia MaxStrk RtdStrk Efficy
6.60 118.10 16.51 13.44 11.18 0.80
IB. Wt IB. L IB. Dia IB CoR IB RO
1.20 25.00 16.51 0.900 0.010
CompStrk A Chamber V Chamber C Delay C Duratn Exp Coeff VolCStart Vol CEnd
16.30 214.03 280.90 0.0010 0.0020 1.250 0.00 0.00
P atm P1 P2 P3 P4 P5
14.70 1550.00 1395.00 1255.00 1130.00 0.00
Stroke Effic. Pressure R-Weight T-Delay Exp-Coeff Eps-Str Total-AW
11.1800 0.8000 1550.0000 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 | 0.01 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 9.01 | 0.71 | 9.65 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 9.29 | 0.73 | 9.95 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 9.31 | 2.75 | 2.13 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 11.79 | 2.75 | 2.13 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 11.81 | 0.77 | 8.13 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 16.79 | 1.10 | 11.59 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 16.81 | 1.44 | 27.69 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 24.49 | 2.15 | 41.43 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 24.51 | 2.16 | 41.46 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 25.79 | 2.22 | 42.69 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 25.81 | 1.29 | 6.33 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 30.79 | 1.40 | 6.33 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 30.81 | 2.46 | 58.35 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 39.79 | 2.92 | 58.35 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 39.81 | 2.95 | 63.52 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 45.79 | 3.28 | 63.52 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 45.81 | 3.16 | 35.96 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 50.79 | 3.41 | 35.96 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 50.81 | 3.50 | 58.35 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 59.81 | 3.96 | 58.35 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 62.00 | 4.07 | 58.35 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |

Gain/Loss factors: shaft and toe

| Dpth | L | Wait | Strk | Pmx% | Eff. | Stff | CoR |
|---------|---------|---------|---------|---------|-------|-------|-------|
| 0.60400 | 0.63700 | 0.67000 | 0.70300 | 0.73600 | | | |
| 1.00000 | 1.00000 | 1.00000 | 1.00000 | 1.00000 | | | |
| 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 |
| 62.00 | 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-70-1323C - Rear Abutment - HP10x42

Hammer Model: D 30-23 Made by: DELMAG

| No. | Weight kips | Stiffn k/inch | CoR | C-Slk ft | Dampg k/ft/s |
|-------------------|----------------|------------------|-------|-------------|-----------------|
| 1 | 1.320 | | | | |
| 2 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| 3 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| 4 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| 5 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| Imp Block | 1.200 | 127693.0 | 0.900 | 0.0100 | |
| Helmet | 1.900 | 60155.0 | 0.800 | 0.0100 | 10.0 |
| Combined Pile Top | | 9183.3 | | | |

HAMMER OPTIONS:
 Hammer File ID No. 14 Hammer Type OE Diesel
 Stroke Option FxdP-VarS Stroke Convergence Crit. 0.010
 Fuel Pump Setting Maximum

HAMMER DATA:
 Ram Weight (kips) 6.60 Ram Length (inch) 118.10
 Maximum Stroke (ft) 13.44
 Rated Stroke (ft) 11.18 Efficiency 0.800
 Maximum Pressure (psi) 1550.00 Actual Pressure (psi) 1550.00

1323C-RA-10X42
 Compression Exponent 1.350 Expansion Exponent 1.250
 Ram Diameter (inch) 16.51
 Combustion Delay (s) 0.00100 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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Depth (ft) 5.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 144.000 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| | | | | | | | | | | | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 8.6 | |
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.4 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 2.9 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 5.4 | 0.150 | 0.100 | | | |

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

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile
 No. of Slacks/Splices 0 Pile Segments: Automatic
 Pile Damping (%) 1
 Pile Damping Fact.(k/ft/s) 0.435

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 | Efficcy |
| ft | ft | Ratio | |
| 5.00 | 11.18 | 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 |
| 8.6 | Hammer did not run | | | | | | | |
| 8.6 | Hammer did not run | | | | | | | |
| 8.6 | Hammer did not run | | | | | | | |
| 8.6 | Hammer did not run | | | | | | | |
| 8.6 | Hammer did not run | | | | | | | |

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Depth (ft) 10.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

1323C-RA-10X42
 Toe Area (in2) 144.000 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | 17.2 | | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 1.6 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 4.3 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 9.2 | 0.131 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 2.1 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 10.00 | 11.18 | 1.00 | 0.800 |

▲ FRA-70-1323C - Rear Abutment - HP10x42 02/28/2021
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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 |
| 17.2 | Hammer | did not run | | | | |
| 17.4 | Hammer | did not run | | | | |
| 17.6 | Hammer | did not run | | | | |
| 17.9 | Hammer | did not run | | | | |
| 18.1 | Hammer | did not run | | | | |

▲ FRA-70-1323C - Rear Abutment - HP10x42 02/28/2021
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| Depth | (ft) | 15.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor 1.000 |

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | 44.6 | | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.5 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 3.0 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 5.8 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 15.3 | 0.188 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 9.7 | 0.058 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 10.3 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 15.00 | 11.18 | 1.00 | 0.800 |

▲ FRA-70-1323C - Rear Abutment - HP10x42 02/28/2021
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| Rut | Bl Ct | Stroke (ft) | Ten Str | i t Comp Str | i t ENTHRU | Bl Rt |
|-----|-------|-------------|---------|--------------|------------|-------|
|-----|-------|-------------|---------|--------------|------------|-------|

| 1323C-RA-10X42 | | | | | | | | | | | |
|----------------|------|------|------|-------|----|----|-------|---|--------|-------|------|
| kips | b/ft | down | up | ksi | | | ksi | | kip-ft | b/min | |
| 44.6 | 2.1 | 3.86 | 3.89 | -0.38 | 16 | 83 | 19.19 | 1 | 6 | 44.2 | 60.0 |
| 45.4 | 2.2 | 3.89 | 3.92 | -0.37 | 16 | 82 | 19.31 | 1 | 4 | 44.0 | 59.8 |
| 46.1 | 2.2 | 3.92 | 3.94 | -0.31 | 15 | 81 | 19.58 | 1 | 4 | 43.9 | 59.6 |
| 46.9 | 2.3 | 3.98 | 3.95 | -0.27 | 16 | 79 | 19.80 | 1 | 4 | 44.0 | 59.3 |
| 47.6 | 2.3 | 4.00 | 3.98 | -0.18 | 16 | 78 | 19.93 | 1 | 4 | 43.8 | 59.1 |

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Depth (ft) 20.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 90.6 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 42.42 | 3.3 | 12.4 |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 1.7 | 0.050 | 0.100 | 45.68 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 4.5 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 10.0 | 0.143 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 13.3 | 0.164 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 10.7 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 17.0 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 33.4 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficcy |
|-------|--------|----------|---------|
| ft | ft | Ratio | |
| 20.00 | 11.18 | 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 | |
| 90.6 | 4.7 | 4.93 | 4.89 | 0.00 | 1 | 0 | 26.70 | 53.1 |
| 91.4 | 4.7 | 4.95 | 4.91 | -0.06 | 15 | 50 | 26.83 | 53.0 |
| 92.1 | 4.8 | 4.97 | 4.92 | -0.20 | 15 | 50 | 26.96 | 52.9 |
| 92.9 | 4.8 | 4.99 | 4.94 | -0.34 | 15 | 50 | 27.07 | 52.8 |
| 93.6 | 4.9 | 5.00 | 4.96 | -0.46 | 15 | 50 | 27.18 | 52.7 |

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Depth (ft) 25.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 131.7 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.6 | 0.050 | 0.100 | 39.16 | 3.3 | 12.4 |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 3.2 | 0.050 | 0.100 | 42.42 | 3.3 | 12.4 |

| | | | | | | | | | | | |
|----------------|-------|------|-------|-------|------|------|-------|-------|-------|-----|------|
| 1323C-RA-10X42 | | | | | | | | | | | |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 6.0 | 0.050 | 0.100 | 45.68 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 15.6 | 0.188 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 9.6 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 13.9 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 18.8 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 22.1 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 41.9 | 0.150 | 0.100 | | | |

2.627 kips total unredused pile weight (g= 32.17 ft/s2)

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

| | | | |
|-------|--------|----------|--------|
| Depth | Stroke | Pressure | Efficy |
| ft | ft | Ratio | |
| 25.00 | 11.18 | 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 |
| 131.7 | 6.7 | 5.51 5.50 | -1.31 | 13 | 44 30.09 | 15 | 5 37.8 | 50.1 |
| 132.4 | 6.8 | 5.52 5.51 | -1.30 | 12 | 44 30.23 | 15 | 5 37.8 | 50.0 |
| 133.2 | 6.8 | 5.54 5.53 | -1.29 | 12 | 44 30.42 | 15 | 5 37.8 | 49.9 |
| 133.9 | 6.9 | 5.50 5.55 | -1.29 | 12 | 44 30.34 | 15 | 5 37.4 | 50.0 |
| 134.7 | 7.0 | 5.52 5.57 | -1.28 | 12 | 44 30.47 | 15 | 5 37.3 | 49.9 |

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| | | | |
|------------------------|------|-------|----------------------------|
| Depth | (ft) | 30.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| | | | | | | | | | | | |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 120.4 |
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 10 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.1 | 0.050 | 0.100 | 32.63 | 3.3 | 12.4 |
| 11 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 1.9 | 0.050 | 0.100 | 35.89 | 3.3 | 12.4 |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 4.7 | 0.050 | 0.100 | 39.16 | 3.3 | 12.4 |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 10.7 | 0.153 | 0.100 | 42.42 | 3.3 | 12.4 |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 12.8 | 0.156 | 0.100 | 45.68 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 11.0 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 17.3 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 20.6 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 20.5 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 14.5 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 6.3 | 0.150 | 0.100 | | | |

2.627 kips total unredused pile weight (g= 32.17 ft/s2)

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

| | | | |
|-------|--------|----------|--------|
| Depth | Stroke | Pressure | Efficy |
| ft | ft | Ratio | |
| 30.00 | 11.18 | 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 |
| 120.4 | 5.4 | 5.12 5.14 | -1.60 | 11 | 45 28.69 | 10 | 6 38.7 | 51.9 |
| 121.1 | 5.5 | 5.14 5.15 | -1.70 | 11 | 45 28.87 | 11 | 6 38.7 | 51.8 |
| 121.9 | 5.5 | 5.21 5.15 | -1.75 | 11 | 45 29.02 | 10 | 6 38.9 | 51.7 |
| 122.6 | 5.6 | 5.22 5.17 | -1.82 | 11 | 45 29.13 | 10 | 6 38.9 | 51.6 |
| 123.4 | 5.6 | 5.23 5.19 | -1.87 | 11 | 45 29.24 | 10 | 6 38.8 | 51.5 |

FRA-70-1323C - Rear Abutment - HP10x42 02/28/2021

Resource International Inc

Depth (ft) 35.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 211.7 | |
|---------------------|----------------|----------------|-------------|-------------|------|---------------------------|----------------|---------------|-------------|-------------|-------------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 9 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.7 | 0.050 | 0.100 | 29.37 | 3.3 | 12.4 |
| 10 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 3.4 | 0.050 | 0.100 | 32.63 | 3.3 | 12.4 |
| 11 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 6.2 | 0.050 | 0.100 | 35.89 | 3.3 | 12.4 |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 15.6 | 0.188 | 0.100 | 39.16 | 3.3 | 12.4 |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 9.8 | 0.050 | 0.100 | 42.42 | 3.3 | 12.4 |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 14.3 | 0.050 | 0.100 | 45.68 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 19.0 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 22.3 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 15.9 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 18.2 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 27.9 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 58.3 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 35.00 | 11.18 | 1.00 | 0.800 |

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FRA-70-1323C - Rear Abutment - HP10x42 02/28/2021
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 |
| 211.7 | 11.5 | 6.55 | 6.50 | -0.32 | 10 | 34 | 34.73 | 12 | 4 | 36.1 |
| 212.4 | 11.6 | 6.55 | 6.52 | -0.26 | 10 | 34 | 34.79 | 12 | 4 | 36.0 |
| 213.2 | 11.7 | 6.57 | 6.53 | -0.20 | 10 | 34 | 34.98 | 12 | 4 | 36.0 |
| 213.9 | 11.8 | 6.58 | 6.55 | -0.13 | 10 | 34 | 35.11 | 12 | 4 | 36.0 |
| 214.6 | 11.9 | 6.60 | 6.57 | -0.06 | 10 | 34 | 35.20 | 12 | 4 | 35.9 |

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FRA-70-1323C - Rear Abutment - HP10x42 02/28/2021
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Depth (ft) 40.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 263.1 | |
|---------------------|----------------|----------------|-------------|-------------|------|---------------------------|----------------|---------------|-------------|-------------|-------------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 7 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.1 | 0.050 | 0.100 | 22.84 | 3.3 | 12.4 |
| 8 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 2.1 | 0.050 | 0.100 | 26.11 | 3.3 | 12.4 |
| 9 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 4.9 | 0.050 | 0.100 | 29.37 | 3.3 | 12.4 |
| 10 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 11.5 | 0.161 | 0.100 | 32.63 | 3.3 | 12.4 |
| 11 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 12.2 | 0.146 | 0.100 | 35.89 | 3.3 | 12.4 |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 11.4 | 0.050 | 0.100 | 39.16 | 3.3 | 12.4 |

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| | | | | | | | | | | | |
|-----|-------|------|-------|-------|------|------|-------|-------|-------|-----|------|
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 17.5 | 0.050 | 0.100 | 42.42 | 3.3 | 12.4 |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 20.8 | 0.050 | 0.100 | 45.68 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 20.0 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 14.5 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 25.0 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 28.9 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 30.7 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 63.5 | 0.150 | 0.100 | | | |

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

| | | | |
|-------|--------|----------|--------|
| Depth | Stroke | Pressure | Efficy |
| ft | ft | Ratio | |
| 40.00 | 11.18 | 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 | |
| 263.1 | 14.8 | 7.04 | 7.04 | 0.00 | 1 | 0 | 36.53 | 10 | 4 | 35.8 | 44.3 |
| 263.8 | 14.8 | 7.06 | 7.05 | 0.00 | 1 | 0 | 36.71 | 10 | 4 | 35.9 | 44.3 |
| 264.6 | 14.9 | 7.07 | 7.06 | 0.00 | 1 | 0 | 36.81 | 10 | 4 | 35.9 | 44.2 |
| 265.3 | 15.0 | 7.07 | 7.07 | 0.00 | 1 | 0 | 36.87 | 10 | 4 | 35.8 | 44.2 |
| 266.1 | 15.0 | 7.09 | 7.08 | 0.00 | 1 | 0 | 36.97 | 10 | 4 | 35.8 | 44.2 |

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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 45.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | Total Capacity Rut (kips) | | | | | 314.3 | |
|---------------------|--------|--------|-------|-------|---------------------------|--------|--------|-------|-------|-------|------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 6 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.9 | 0.050 | 0.100 | 19.58 | 3.3 | 12.4 |
| 7 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 3.6 | 0.050 | 0.100 | 22.84 | 3.3 | 12.4 |
| 8 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 6.3 | 0.050 | 0.100 | 26.11 | 3.3 | 12.4 |
| 9 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 15.7 | 0.188 | 0.100 | 29.37 | 3.3 | 12.4 |
| 10 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 9.9 | 0.050 | 0.100 | 32.63 | 3.3 | 12.4 |
| 11 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 14.7 | 0.050 | 0.100 | 35.89 | 3.3 | 12.4 |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 19.2 | 0.050 | 0.100 | 39.16 | 3.3 | 12.4 |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 22.4 | 0.050 | 0.100 | 42.42 | 3.3 | 12.4 |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 15.3 | 0.050 | 0.100 | 45.68 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 19.0 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 28.0 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 29.8 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 31.8 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 33.9 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 63.5 | 0.150 | 0.100 | | | |

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

| | | | |
|-------|--------|----------|--------|
| Depth | Stroke | Pressure | Efficy |
| ft | ft | Ratio | |
| 45.00 | 11.18 | 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 | |
| 314.3 | 18.3 | 7.41 | 7.46 | -1.38 | 7 | 48 | 38.17 | 7 | 7 | 35.9 | 43.2 |
| 315.0 | 18.4 | 7.42 | 7.47 | -1.38 | 7 | 48 | 38.31 | 7 | 7 | 35.9 | 43.1 |

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| | | | | | | | | | | | |
|-------|------|------|------|-------|---|----|-------|---|---|------|------|
| 315.8 | 18.5 | 7.43 | 7.49 | -1.36 | 7 | 48 | 38.34 | 7 | 7 | 35.8 | 43.1 |
| 316.5 | 18.6 | 7.44 | 7.50 | -1.35 | 7 | 48 | 38.47 | 7 | 7 | 35.8 | 43.1 |
| 317.3 | 18.7 | 7.46 | 7.51 | -1.35 | 7 | 48 | 38.61 | 7 | 7 | 35.8 | 43.0 |

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Depth (ft) 50.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 144.000 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 340.5 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 4 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.1 | 0.050 | 0.100 | 13.05 | 3.3 | 12.4 |
| 5 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 2.3 | 0.050 | 0.100 | 16.32 | 3.3 | 12.4 |
| 6 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 5.1 | 0.050 | 0.100 | 19.58 | 3.3 | 12.4 |
| 7 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 12.2 | 0.168 | 0.100 | 22.84 | 3.3 | 12.4 |
| 8 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 11.7 | 0.136 | 0.100 | 26.11 | 3.3 | 12.4 |
| 9 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 11.8 | 0.050 | 0.100 | 29.37 | 3.3 | 12.4 |
| 10 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 17.7 | 0.050 | 0.100 | 32.63 | 3.3 | 12.4 |
| 11 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 21.0 | 0.050 | 0.100 | 35.89 | 3.3 | 12.4 |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 19.5 | 0.050 | 0.100 | 39.16 | 3.3 | 12.4 |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 14.6 | 0.050 | 0.100 | 42.42 | 3.3 | 12.4 |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 25.9 | 0.050 | 0.100 | 45.68 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 29.0 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 30.8 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 33.0 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 34.6 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 35.4 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 36.0 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 50.00 | 11.18 | 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 | | | | |
| 340.5 | 20.0 | 7.53 | 7.60 | -0.96 | 6 | 46 | 39.65 | 6 | 7 | 35.2 | 42.8 |
| 341.3 | 20.1 | 7.54 | 7.61 | -0.94 | 6 | 46 | 39.72 | 6 | 7 | 35.2 | 42.8 |
| 342.0 | 20.2 | 7.55 | 7.62 | -0.92 | 6 | 46 | 39.81 | 6 | 7 | 35.2 | 42.8 |
| 342.8 | 20.3 | 7.56 | 7.63 | -0.91 | 6 | 46 | 39.94 | 6 | 7 | 35.3 | 42.7 |
| 343.5 | 20.4 | 7.58 | 7.64 | -0.89 | 6 | 46 | 40.01 | 6 | 7 | 35.3 | 42.7 |

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Depth (ft) 55.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 144.000 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

Pile and Soil Model Total Capacity Rut (kips) 421.8

| 1323C-RA-10X42 | | | | | | | | | | | |
|----------------|----------------|----------------|-------------|-------------|------|----------------|----------------|---------------|-------------|-------------|-------------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 3.3 | 12.4 |
| 3 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 1.0 | 0.050 | 0.100 | 9.79 | 3.3 | 12.4 |
| 4 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 3.8 | 0.050 | 0.100 | 13.05 | 3.3 | 12.4 |
| 5 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 6.6 | 0.052 | 0.100 | 16.32 | 3.3 | 12.4 |
| 6 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 15.7 | 0.187 | 0.100 | 19.58 | 3.3 | 12.4 |
| 7 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 10.1 | 0.050 | 0.100 | 22.84 | 3.3 | 12.4 |
| 8 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 15.2 | 0.050 | 0.100 | 26.11 | 3.3 | 12.4 |
| 9 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 19.4 | 0.050 | 0.100 | 29.37 | 3.3 | 12.4 |
| 10 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 22.6 | 0.050 | 0.100 | 32.63 | 3.3 | 12.4 |
| 11 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 14.7 | 0.050 | 0.100 | 35.89 | 3.3 | 12.4 |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 19.9 | 0.050 | 0.100 | 39.16 | 3.3 | 12.4 |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 28.1 | 0.050 | 0.100 | 42.42 | 3.3 | 12.4 |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 29.9 | 0.050 | 0.100 | 45.68 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 32.0 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 34.0 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 34.8 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 36.6 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 39.1 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 58.3 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy Ratio |
|-------------|--------------|-------------------|-----------------|
| 55.00 | 11.18 | 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 |
|-------------|---------------|---------------------|---------------|-------|---|----|-----------------|---|---|------------------|----------------|
| 421.8 | 30.1 | 8.32 | 8.30 | -1.02 | 4 | 40 | 41.99 | 6 | 7 | 36.9 | 40.9 |
| 422.6 | 30.3 | 8.33 | 8.31 | -1.02 | 4 | 40 | 42.10 | 6 | 7 | 37.0 | 40.9 |
| 423.3 | 30.4 | 8.34 | 8.31 | -1.02 | 4 | 40 | 42.21 | 6 | 7 | 37.1 | 40.8 |
| 424.1 | 30.8 | 8.35 | 8.33 | -1.00 | 4 | 40 | 42.19 | 6 | 7 | 37.0 | 40.8 |
| 424.8 | 31.0 | 8.36 | 8.33 | -1.00 | 4 | 40 | 42.31 | 6 | 7 | 37.0 | 40.8 |

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| | | | |
|------------------------|------|-------|----------------------|
| Depth | (ft) | 60.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | | |
|---------------------|----------------|----------------|-------------|-------------|------|----------------|----------------|---------------|-------------|-------------|-------------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 0.2 | 0.050 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 2.5 | 0.050 | 0.100 | 6.53 | 3.3 | 12.4 |
| 3 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 5.2 | 0.050 | 0.100 | 9.79 | 3.3 | 12.4 |
| 4 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 13.0 | 0.174 | 0.100 | 13.05 | 3.3 | 12.4 |
| 5 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 11.2 | 0.123 | 0.100 | 16.32 | 3.3 | 12.4 |
| 6 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 12.2 | 0.050 | 0.100 | 19.58 | 3.3 | 12.4 |
| 7 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 17.9 | 0.050 | 0.100 | 22.84 | 3.3 | 12.4 |
| 8 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 21.2 | 0.050 | 0.100 | 26.11 | 3.3 | 12.4 |
| 9 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 18.9 | 0.050 | 0.100 | 29.37 | 3.3 | 12.4 |
| 10 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 14.7 | 0.050 | 0.100 | 32.63 | 3.3 | 12.4 |
| 11 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 26.7 | 0.050 | 0.100 | 35.89 | 3.3 | 12.4 |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 29.1 | 0.050 | 0.100 | 39.16 | 3.3 | 12.4 |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 30.9 | 0.050 | 0.100 | 42.42 | 3.3 | 12.4 |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 33.1 | 0.050 | 0.100 | 45.68 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 34.6 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 35.5 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 38.1 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 40.0 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 41.8 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |

Toe 58.3 0.150 0.100

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 60.00 | 11.18 | 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 |
|-------------|---------------|---------------------|---------------|-------|---|----|-----------------|---|---|------------------|----------------|
| 485.2 | 44.7 | 8.75 | 8.70 | -0.61 | 3 | 37 | 43.05 | 4 | 6 | 37.5 | 39.9 |
| 485.9 | 45.2 | 8.75 | 8.71 | -0.59 | 3 | 37 | 43.06 | 4 | 6 | 37.4 | 39.9 |
| 486.7 | 45.3 | 8.76 | 8.71 | -0.59 | 3 | 37 | 43.15 | 4 | 6 | 37.6 | 39.9 |
| 487.4 | 45.9 | 8.76 | 8.71 | -0.58 | 3 | 37 | 43.17 | 4 | 6 | 37.5 | 39.9 |
| 488.2 | 46.6 | 8.77 | 8.73 | -0.56 | 3 | 37 | 43.17 | 4 | 6 | 37.4 | 39.9 |

↑
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| Depth (ft) | 62.0 | Standard Soil Setup |
|------------------------|-------|----------------------------|
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor 1.000 |

PILE PROFILE:

| Toe Area Pile Size | (in2) (inch) | 144.000 10.000 | Pile Type | Unknown |
|-----------------------|-----------------|-------------------|-----------|---------|
|-----------------------|-----------------|-------------------|-----------|---------|

| 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 |
| 62.0 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) 511.7 | | | | | |
|---------------------|----------------|----------------|-------------|-------------|------|---------------------------------|----------------|---------------|-------------|-------------|-------------|
| 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 | 0.138 | 9183 | 0.010 | 0.000 | 0.85 | 1.4 | 0.050 | 0.100 | 3.26 | 3.3 | 12.4 |
| 2 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 4.2 | 0.050 | 0.100 | 6.53 | 3.3 | 12.4 |
| 3 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 8.4 | 0.115 | 0.100 | 9.79 | 3.3 | 12.4 |
| 4 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 14.4 | 0.176 | 0.100 | 13.05 | 3.3 | 12.4 |
| 5 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 10.4 | 0.050 | 0.100 | 16.32 | 3.3 | 12.4 |
| 6 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 16.1 | 0.050 | 0.100 | 19.58 | 3.3 | 12.4 |
| 7 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 19.9 | 0.050 | 0.100 | 22.84 | 3.3 | 12.4 |
| 8 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 22.1 | 0.050 | 0.100 | 26.11 | 3.3 | 12.4 |
| 9 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 14.3 | 0.050 | 0.100 | 29.37 | 3.3 | 12.4 |
| 10 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 21.7 | 0.050 | 0.100 | 32.63 | 3.3 | 12.4 |
| 11 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 28.4 | 0.050 | 0.100 | 35.89 | 3.3 | 12.4 |
| 12 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 30.2 | 0.050 | 0.100 | 39.16 | 3.3 | 12.4 |
| 13 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 32.3 | 0.050 | 0.100 | 42.42 | 3.3 | 12.4 |
| 14 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 34.3 | 0.050 | 0.100 | 45.68 | 3.3 | 12.4 |
| 15 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 34.9 | 0.050 | 0.100 | 48.95 | 3.3 | 12.4 |
| 16 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 37.0 | 0.050 | 0.100 | 52.21 | 3.3 | 12.4 |
| 17 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 39.3 | 0.050 | 0.100 | 55.47 | 3.3 | 12.4 |
| 18 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 41.1 | 0.050 | 0.100 | 58.74 | 3.3 | 12.4 |
| 19 | 0.138 | 9183 | 0.000 | 0.000 | 1.00 | 42.9 | 0.050 | 0.100 | 62.00 | 3.3 | 12.4 |
| Toe | | | | | | 58.3 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 62.00 | 11.18 | 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 |
|-------------|---------------|---------------------|---------------|-------|---|----|-----------------|---|---|------------------|----------------|
| 511.7 | 54.5 | 8.89 | 8.83 | -0.33 | 2 | 36 | 43.19 | 3 | 6 | 37.5 | 39.7 |
| 512.5 | 55.2 | 8.89 | 8.84 | -0.32 | 2 | 36 | 43.21 | 3 | 6 | 37.4 | 39.6 |
| 513.2 | 56.1 | 8.90 | 8.84 | -0.31 | 2 | 36 | 43.23 | 3 | 6 | 37.3 | 39.7 |
| 514.0 | 56.2 | 8.90 | 8.84 | -0.31 | 2 | 36 | 43.31 | 3 | 6 | 37.5 | 39.7 |
| 514.7 | 57.0 | 8.91 | 8.84 | -0.30 | 2 | 36 | 43.34 | 3 | 6 | 37.4 | 39.6 |

SUMMARY OVER DEPTHS

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
| 5.0 | 8.6 | 3.2 | 5.4 | Hammer | did not | run | | |
| 10.0 | 17.2 | 15.1 | 2.1 | Hammer | did not | run | | |
| 15.0 | 44.6 | 34.3 | 10.3 | 2.1 | 19.186 | -0.377 | 3.86 | 44.2 |
| 20.0 | 90.6 | 57.3 | 33.4 | 4.7 | 26.696 | 0.000 | 4.93 | 39.7 |
| 25.0 | 131.7 | 89.7 | 41.9 | 6.7 | 30.091 | -1.308 | 5.51 | 37.8 |
| 30.0 | 120.4 | 114.1 | 6.3 | 5.4 | 28.691 | -1.601 | 5.12 | 38.7 |
| 35.0 | 211.7 | 153.3 | 58.3 | 11.5 | 34.727 | -0.324 | 6.55 | 36.1 |
| 40.0 | 263.1 | 199.6 | 63.5 | 14.8 | 36.530 | 0.000 | 7.04 | 35.8 |
| 45.0 | 314.3 | 250.7 | 63.5 | 18.3 | 38.169 | -1.383 | 7.41 | 35.9 |
| 50.0 | 340.5 | 304.6 | 36.0 | 20.0 | 39.646 | -0.957 | 7.53 | 35.2 |
| 55.0 | 421.8 | 363.5 | 58.3 | 30.1 | 41.986 | -1.016 | 8.32 | 36.9 |
| 60.0 | 485.2 | 426.8 | 58.3 | 44.7 | 43.053 | -0.611 | 8.75 | 37.5 |
| 62.0 | 511.7 | 453.4 | 58.3 | 54.5 | 43.187 | -0.328 | 8.89 | 37.5 |

Total Driving Time 18 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 776

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
| 5.0 | 8.6 | 3.2 | 5.4 | Hammer | did not | run | | |
| 10.0 | 17.4 | 15.3 | 2.1 | Hammer | did not | run | | |
| 15.0 | 45.4 | 35.0 | 10.3 | 2.2 | 19.307 | -0.372 | 3.89 | 44.0 |
| 20.0 | 91.4 | 58.0 | 33.4 | 4.7 | 26.831 | -0.063 | 4.95 | 39.6 |
| 25.0 | 132.4 | 90.5 | 41.9 | 6.8 | 30.227 | -1.298 | 5.52 | 37.8 |
| 30.0 | 121.1 | 114.8 | 6.3 | 5.5 | 28.866 | -1.698 | 5.14 | 38.7 |
| 35.0 | 212.4 | 154.1 | 58.3 | 11.6 | 34.787 | -0.259 | 6.55 | 36.0 |
| 40.0 | 263.8 | 200.3 | 63.5 | 14.8 | 36.705 | 0.000 | 7.06 | 35.9 |
| 45.0 | 315.0 | 251.5 | 63.5 | 18.4 | 38.314 | -1.377 | 7.42 | 35.9 |
| 50.0 | 341.3 | 305.3 | 36.0 | 20.1 | 39.724 | -0.940 | 7.54 | 35.2 |
| 55.0 | 422.6 | 364.2 | 58.3 | 30.3 | 42.103 | -1.017 | 8.33 | 37.0 |
| 60.0 | 485.9 | 427.6 | 58.3 | 45.2 | 43.061 | -0.591 | 8.75 | 37.4 |
| 62.0 | 512.5 | 454.1 | 58.3 | 55.2 | 43.206 | -0.318 | 8.89 | 37.4 |

Total Driving Time 18 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 783

SUMMARY OVER DEPTHS

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
| 5.0 | 8.6 | 3.2 | 5.4 | Hammer | did not | run | | |
| 10.0 | 17.6 | 15.5 | 2.1 | Hammer | did not | run | | |
| 15.0 | 46.1 | 35.8 | 10.3 | 2.2 | 19.575 | -0.308 | 3.92 | 43.9 |
| 20.0 | 92.1 | 58.7 | 33.4 | 4.8 | 26.959 | -0.202 | 4.97 | 39.6 |
| 25.0 | 133.2 | 91.2 | 41.9 | 6.8 | 30.421 | -1.290 | 5.54 | 37.8 |
| 30.0 | 121.9 | 115.5 | 6.3 | 5.5 | 29.024 | -1.746 | 5.21 | 38.9 |
| 35.0 | 213.2 | 154.8 | 58.3 | 11.7 | 34.978 | -0.196 | 6.57 | 36.0 |
| 40.0 | 264.6 | 201.1 | 63.5 | 14.9 | 36.809 | 0.000 | 7.07 | 35.9 |
| 45.0 | 315.8 | 252.2 | 63.5 | 18.5 | 38.340 | -1.362 | 7.43 | 35.8 |
| 50.0 | 342.0 | 306.1 | 36.0 | 20.2 | 39.810 | -0.924 | 7.55 | 35.2 |
| 55.0 | 423.3 | 365.0 | 58.3 | 30.4 | 42.210 | -1.018 | 8.34 | 37.1 |
| 60.0 | 486.7 | 428.3 | 58.3 | 45.3 | 43.154 | -0.594 | 8.76 | 37.6 |
| 62.0 | 513.2 | 454.9 | 58.3 | 56.1 | 43.226 | -0.309 | 8.90 | 37.3 |

Total Driving Time 18 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 787

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
| 5.0 | 8.6 | 3.2 | 5.4 | Hammer | did not | run | | |
| 10.0 | 17.9 | 15.7 | 2.1 | Hammer | did not | run | | |
| 15.0 | 46.9 | 36.5 | 10.3 | 2.3 | 19.802 | -0.273 | 3.98 | 44.0 |
| 20.0 | 92.9 | 59.5 | 33.4 | 4.8 | 27.074 | -0.336 | 4.99 | 39.5 |
| 25.0 | 133.9 | 92.0 | 41.9 | 6.9 | 30.340 | -1.287 | 5.50 | 37.4 |
| 30.0 | 122.6 | 116.3 | 6.3 | 5.6 | 29.129 | -1.815 | 5.22 | 38.9 |
| 35.0 | 213.9 | 155.6 | 58.3 | 11.8 | 35.108 | -0.130 | 6.58 | 36.0 |
| 40.0 | 265.3 | 201.8 | 63.5 | 15.0 | 36.867 | 0.000 | 7.07 | 35.8 |

| | | | | | | | | |
|----------------|-------|-------|------|------|--------|--------|------|------|
| 1323C-RA-10X42 | | | | | | | | |
| 45.0 | 316.5 | 253.0 | 63.5 | 18.6 | 38.471 | -1.355 | 7.44 | 35.8 |
| 50.0 | 342.8 | 306.8 | 36.0 | 20.3 | 39.937 | -0.909 | 7.56 | 35.3 |
| 55.0 | 424.1 | 365.7 | 58.3 | 30.8 | 42.191 | -0.997 | 8.35 | 37.0 |
| 60.0 | 487.4 | 429.1 | 58.3 | 45.9 | 43.168 | -0.576 | 8.76 | 37.5 |
| 62.0 | 514.0 | 455.6 | 58.3 | 56.2 | 43.311 | -0.309 | 8.90 | 37.5 |

Total Driving Time 19 minutes; Total No. of Blows 795
Starting at penetration 5.0 ft

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SUMMARY OVER DEPTHS

| Depth ft | Rut kips | G/L at Frictn kips | Shaft and End Bg kips | Toe: Bl Ct bl/ft | 0.736 Com Str ksi | 1.000 Ten Str ksi | Stroke ft | ENTHRU kip-ft |
|-------------|-------------|--------------------------|-----------------------------|------------------------|-------------------------|-------------------------|--------------|------------------|
| | | | | | | | | |
| 5.0 | 8.6 | 3.2 | 5.4 | Hammer | did not | run | | |
| 10.0 | 18.1 | 15.9 | 2.1 | Hammer | did not | run | | |
| 15.0 | 47.6 | 37.3 | 10.3 | 2.3 | 19.930 | -0.184 | 4.00 | 43.8 |
| 20.0 | 93.6 | 60.2 | 33.4 | 4.9 | 27.179 | -0.465 | 5.00 | 39.4 |
| 25.0 | 134.7 | 92.7 | 41.9 | 7.0 | 30.473 | -1.277 | 5.52 | 37.3 |
| 30.0 | 123.4 | 117.0 | 6.3 | 5.6 | 29.242 | -1.875 | 5.23 | 38.8 |
| 35.0 | 214.6 | 156.3 | 58.3 | 11.9 | 35.199 | -0.062 | 6.60 | 35.9 |
| 40.0 | 266.1 | 202.5 | 63.5 | 15.0 | 36.973 | 0.000 | 7.09 | 35.8 |
| 45.0 | 317.3 | 253.7 | 63.5 | 18.7 | 38.612 | -1.349 | 7.46 | 35.8 |
| 50.0 | 343.5 | 307.6 | 36.0 | 20.4 | 40.013 | -0.894 | 7.58 | 35.3 |
| 55.0 | 424.8 | 366.5 | 58.3 | 31.0 | 42.312 | -0.999 | 8.36 | 37.0 |
| 60.0 | 488.2 | 429.8 | 58.3 | 46.6 | 43.172 | -0.556 | 8.77 | 37.4 |
| 62.0 | 514.7 | 456.3 | 58.3 | 57.0 | 43.338 | -0.302 | 8.91 | 37.4 |

Total Driving Time 19 minutes; Total No. of Blows 803
Starting at penetration 5.0 ft

▲
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Table of Depths Analyzed with Driving System Modifiers

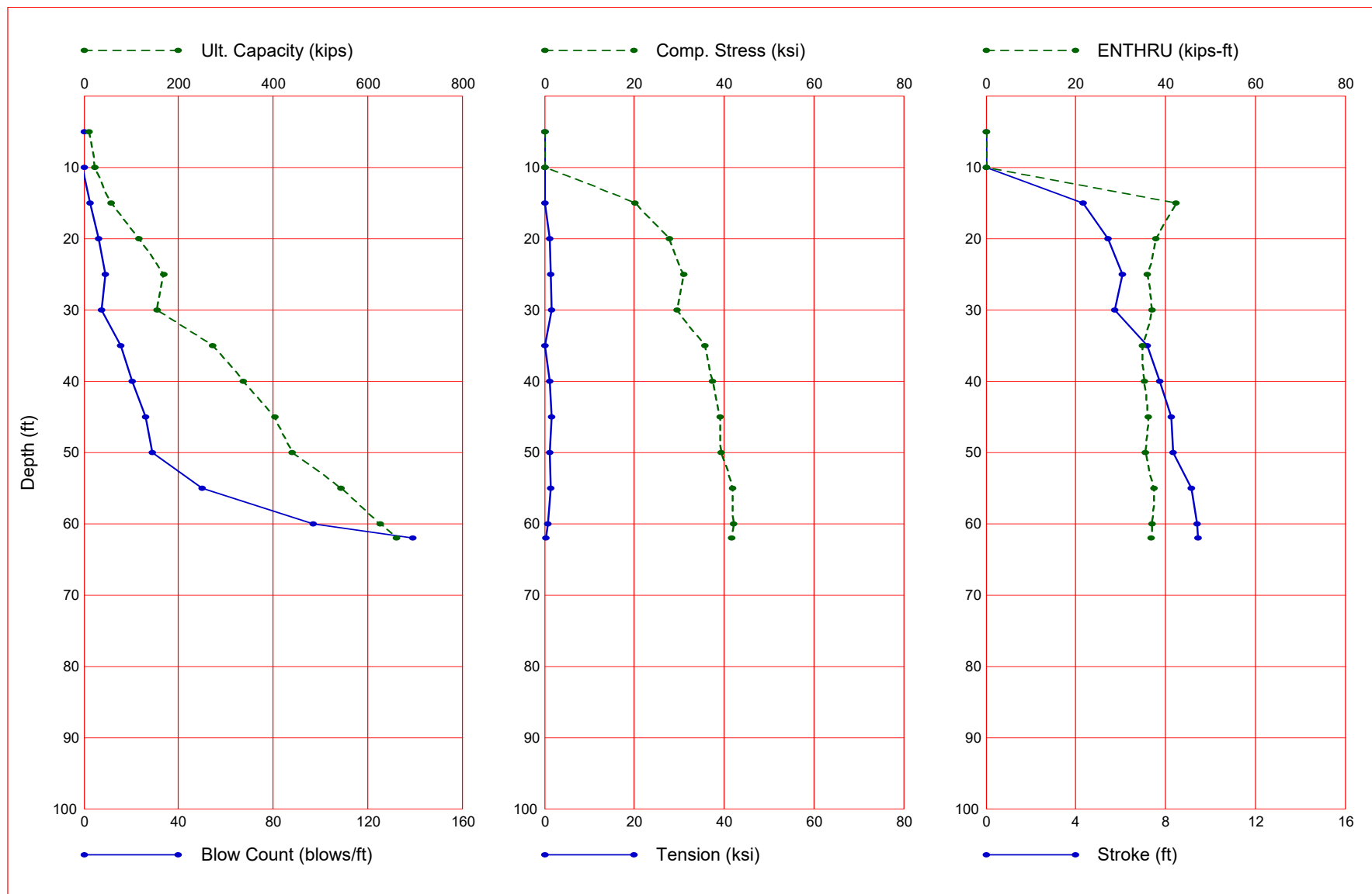
| Depth ft | Temp. Length ft | Wait Time hr | Equivalent Stroke ft | Pressure Ratio | Efficy. | Stiffn. Factor | Cushion CoR |
|-------------|-----------------------|--------------------|----------------------------|-------------------|---------|-------------------|----------------|
| 5.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 10.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 15.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 20.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 25.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 30.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 35.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 40.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 45.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 50.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 55.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 60.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 62.00 | 62.00 | 0.00 | 11.18 | 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 | 0.01 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.01 | 0.71 | 9.65 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.29 | 0.73 | 9.95 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.31 | 2.75 | 2.13 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 11.79 | 2.75 | 2.13 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 11.81 | 0.77 | 8.13 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 16.79 | 1.10 | 11.59 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 16.81 | 1.44 | 27.69 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 24.49 | 2.15 | 41.43 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 24.51 | 2.16 | 41.46 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 25.79 | 2.22 | 42.69 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 25.81 | 1.29 | 6.33 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 30.79 | 1.40 | 6.33 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 30.81 | 2.46 | 58.35 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 39.79 | 2.92 | 58.35 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 39.81 | 2.95 | 63.52 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 45.79 | 3.28 | 63.52 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 45.81 | 3.16 | 35.96 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 50.79 | 3.41 | 35.96 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |

| | | | | | | | | | | |
|-------|------|-------|-------|-------|-------|-------|-------|----------------|-------|--|
| | | | | | | | | 1323C-RA-10X42 | | |
| 50.81 | 3.50 | 58.35 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 | |
| 59.81 | 3.96 | 58.35 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 | |
| 62.00 | 4.07 | 58.35 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 | |

Gain/Loss 3 at Shaft and Toe 0.670 / 1.000



Gain/Loss 3 at Shaft and Toe 0.670 / 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 | 10.9 | 4.2 | 6.7 | -1.0 | 0.000 | 0.000 | 0.00 | 0.0 |
| 10.0 | 22.3 | 19.7 | 2.7 | -1.0 | 0.000 | 0.000 | 0.00 | 0.0 |
| 15.0 | 57.7 | 44.8 | 12.9 | 2.8 | 20.205 | 0.000 | 4.35 | 42.3 |
| 20.0 | 116.2 | 74.5 | 41.7 | 6.1 | 27.805 | -1.138 | 5.45 | 37.9 |
| 25.0 | 168.9 | 116.5 | 52.4 | 9.0 | 30.969 | -1.383 | 6.06 | 36.0 |
| 30.0 | 155.5 | 147.6 | 7.9 | 7.3 | 29.612 | -1.499 | 5.73 | 37.1 |
| 35.0 | 271.4 | 198.5 | 72.9 | 15.6 | 35.663 | 0.000 | 7.21 | 34.9 |
| 40.0 | 337.8 | 258.4 | 79.4 | 20.4 | 37.352 | -1.252 | 7.75 | 35.4 |
| 45.0 | 404.3 | 324.9 | 79.4 | 26.3 | 39.208 | -1.607 | 8.25 | 36.1 |
| 50.0 | 439.5 | 394.5 | 45.0 | 29.1 | 39.342 | -1.200 | 8.35 | 35.6 |
| 55.0 | 543.8 | 470.9 | 72.9 | 50.2 | 41.823 | -1.354 | 9.14 | 37.5 |
| 60.0 | 626.0 | 553.0 | 72.9 | 97.1 | 42.227 | -0.714 | 9.39 | 37.0 |
| 62.0 | 660.4 | 587.4 | 72.9 | 139.0 | 41.694 | -0.422 | 9.46 | 36.7 |

Total Continuous Driving Time 32.00 minutes; Total Number of Blows 1310 (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\2013\W-13-072 FRA-70-13.10 PROJECT 6A\ANALYSIS\FRA-70-1322L AND 1323C\DRIVEABILITY\FRA-70-1323C\REAR ABUTMENT\HP 12X53\1323C-RA-12X53.GMW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-1323C - Rear Abutment - 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 14 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0.000
Pile g Hammer g Toe Area Pile Size Pile Type
32.170 32.170 144.000 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
62.000 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 30-23 1 5
Ram Wt Ram L Ram Dia MaxStrk RtdStrk Efficy
6.60 118.10 16.51 13.44 11.18 0.80
IB. Wt IB. L IB. Dia IB CoR IB R0
1.20 25.00 16.51 0.900 0.010
CompStrk A Chamber V Chamber C Delay C Duratn Exp Coeff VolCStart Vol CEnd
16.30 214.03 280.90 0.0010 0.0020 1.250 0.00 0.00
P atm P1 P2 P3 P4 P5
14.70 1550.00 1395.00 1255.00 1130.00 0.00
Stroke Effic. Pressure R-Weight T-Delay Exp-Coeff Eps-Str Total-AW
11.1800 0.8000 1550.0000 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 | 0.01 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 9.01 | 0.76 | 12.06 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 9.29 | 0.79 | 12.44 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 9.31 | 2.75 | 2.66 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 11.79 | 2.75 | 2.66 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 11.81 | 0.83 | 10.17 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 16.79 | 1.18 | 14.49 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 16.81 | 1.55 | 34.61 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 24.49 | 2.32 | 51.79 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 24.51 | 2.32 | 51.82 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 25.79 | 2.39 | 53.36 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 25.81 | 1.36 | 7.91 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 30.79 | 1.49 | 7.91 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 30.81 | 2.65 | 72.94 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 39.79 | 3.14 | 72.94 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 39.81 | 3.19 | 79.39 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 45.79 | 3.54 | 79.39 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 45.81 | 3.40 | 44.95 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 50.79 | 3.66 | 44.95 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 50.81 | 3.77 | 72.94 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 59.81 | 4.26 | 72.94 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 62.00 | 4.39 | 72.94 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |

Gain/Loss factors: shaft and toe

| Dpth | L | Wait | Strk | Pmx% | Eff. | Stff | CoR |
|---------|---------|---------|---------|---------|-------|-------|-------|
| 0.60400 | 0.63700 | 0.67000 | 0.70300 | 0.73600 | | | |
| 1.00000 | 1.00000 | 1.00000 | 1.00000 | 1.00000 | | | |
| 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 |
| 62.00 | 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-70-1323C - Rear Abutment - HP12x53

Hammer Model: D 30-23 Made by: DELMAG

| No. | Weight kips | Stiffn k/inch | CoR | C-Slk ft | Dampg k/ft/s |
|-------------------|----------------|------------------|-------|-------------|-----------------|
| 1 | 1.320 | | | | |
| 2 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| 3 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| 4 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| 5 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| Imp Block | 1.200 | 127693.0 | 0.900 | 0.0100 | |
| Helmet | 1.900 | 60155.0 | 0.800 | 0.0100 | 10.0 |
| Combined Pile Top | | 11479.2 | | | |

HAMMER OPTIONS:

| Hammer File ID No. | 14 | Hammer Type | OE Diesel |
|--------------------|-----------|--------------------------|-----------|
| Stroke Option | FxdP-VarS | Stroke Convergence Crit. | 0.010 |
| Fuel Pump Setting | Maximum | | |

HAMMER DATA:

| Ram Weight | (kips) | 6.60 | Ram Length | (inch) | 118.10 |
|------------------|--------|---------|-----------------|--------|---------|
| Maximum Stroke | (ft) | 13.44 | | | |
| Rated Stroke | (ft) | 11.18 | Efficiency | | 0.800 |
| Maximum Pressure | (psi) | 1550.00 | Actual Pressure | (psi) | 1550.00 |

1323C-RA-12X53
 Compression Exponent 1.350 Expansion Exponent 1.250
 Ram Diameter (inch) 16.51
 Combustion Delay (s) 0.00100 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-70-1323C - Rear Abutment - HP12x53 02/28/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 5.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| | | | | | | | | | | | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 10.9 | |
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.5 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 3.7 | 0.050 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 6.7 | 0.150 | 0.100 | | | |

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

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile
 No. of Slacks/Splices 0 Pile Segments: Automatic
 Pile Damping (%) 1
 Pile Damping Fact.(k/ft/s) 0.544

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 | Efficcy |
| ft | ft | Ratio | |
| 5.00 | 11.18 | 1.00 | 0.800 |

↑
 FRA-70-1323C - Rear Abutment - HP12x53 02/28/2021
 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 |
| 10.9 | | Hammer did not run | | | | | | |
| 10.9 | | Hammer did not run | | | | | | |
| 10.9 | | Hammer did not run | | | | | | |
| 10.9 | | Hammer did not run | | | | | | |
| 10.9 | | Hammer did not run | | | | | | |

↑
 FRA-70-1323C - Rear Abutment - HP12x53 02/28/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 10.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

1323C-RA-12X53
 Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | 21.8 | | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 2.0 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 5.6 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 11.5 | 0.128 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 2.7 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 10.00 | 11.18 | 1.00 | 0.800 |

▲ FRA-70-1323C - Rear Abutment - HP12x53 02/28/2021
 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 |
| 21.8 | | Hammer did not run | | | | | | |
| 22.1 | | Hammer did not run | | | | | | |
| 22.3 | | Hammer did not run | | | | | | |
| 22.6 | | Hammer did not run | | | | | | |
| 22.8 | | Hammer did not run | | | | | | |

▲ FRA-70-1323C - Rear Abutment - HP12x53 02/28/2021
 Resource International Inc GRLWEAP Version 2010

| Depth | (ft) | 15.0 | Standard Soil Setup |
|------------------------|-------|----------------------|---------------------|
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | 55.9 | | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.6 | 0.050 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 3.9 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 7.5 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 18.6 | 0.187 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 12.4 | 0.058 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 12.9 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 15.00 | 11.18 | 1.00 | 0.800 |

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| Rut | Bl Ct | Stroke (ft) | Ten Str | i | t Comp Str | i | t ENTHRU | Bl Rt |
|-----|-------|-------------|---------|---|------------|---|----------|-------|
|-----|-------|-------------|---------|---|------------|---|----------|-------|

| 1323C-RA-12X53 | | | | | | | | | | | |
|----------------|------|------|------|------|---|---|-------|---|--------|-------|------|
| kips | b/ft | down | up | ksi | | | ksi | | kip-ft | b/min | |
| 55.9 | 2.7 | 4.29 | 4.27 | 0.00 | 1 | 0 | 19.82 | 2 | 2 | 42.6 | 57.2 |
| 56.8 | 2.8 | 4.32 | 4.30 | 0.00 | 1 | 0 | 20.00 | 3 | 2 | 42.5 | 56.9 |
| 57.7 | 2.8 | 4.35 | 4.33 | 0.00 | 1 | 0 | 20.21 | 3 | 2 | 42.3 | 56.8 |
| 58.6 | 2.9 | 4.38 | 4.35 | 0.00 | 1 | 0 | 20.44 | 4 | 2 | 42.2 | 56.6 |
| 59.5 | 2.9 | 4.41 | 4.38 | 0.00 | 1 | 0 | 20.64 | 4 | 2 | 42.1 | 56.4 |

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Depth (ft) 20.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 114.4 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 42.42 | 4.0 | 15.5 |
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 2.2 | 0.050 | 0.100 | 45.68 | 4.0 | 15.5 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 5.8 | 0.050 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 12.4 | 0.141 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 16.4 | 0.162 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 13.7 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 22.0 | 0.050 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 41.7 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 20.00 | 11.18 | 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 | |
| 114.4 | 6.0 | 5.42 | 5.39 | -1.15 | 15 50 | 27.63 | 15 5 | 38.1 |
| 115.3 | 6.1 | 5.43 | 5.41 | -1.14 | 14 49 | 27.67 | 16 5 | 37.9 |
| 116.2 | 6.1 | 5.45 | 5.43 | -1.14 | 14 49 | 27.81 | 15 5 | 37.9 |
| 117.1 | 6.2 | 5.47 | 5.45 | -1.14 | 14 49 | 27.93 | 16 5 | 37.8 |
| 118.0 | 6.3 | 5.49 | 5.46 | -1.15 | 14 47 | 28.05 | 16 5 | 37.8 |

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Depth (ft) 25.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 167.1 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 12 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.8 | 0.050 | 0.100 | 39.16 | 4.0 | 15.5 |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 4.2 | 0.050 | 0.100 | 42.42 | 4.0 | 15.5 |

| 1323C-RA-12X53 | | | | | | | | | | | | |
|----------------|-------|-------|-------|-------|------|------|-------|-------|-------|-----|------|--|
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 7.7 | 0.050 | 0.100 | 45.68 | 4.0 | 15.5 | |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 18.9 | 0.188 | 0.100 | 48.95 | 4.0 | 15.5 | |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 12.3 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 | |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 17.9 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 | |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 24.4 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 | |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 28.6 | 0.050 | 0.100 | 62.00 | 4.0 | 15.5 | |
| Toe | | | | | | 52.4 | 0.150 | 0.100 | | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 25.00 | 11.18 | 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 |
|-------------|---------------|----------------|------------|----------------|----|----|-----------------|----|---|------------------|----------------|
| 167.1 | 8.8 | 6.02 | 6.04 | -1.39 | 13 | 39 | 30.66 | 15 | 5 | 36.0 | 47.9 |
| 168.0 | 8.9 | 6.03 | 6.06 | -1.39 | 13 | 39 | 30.81 | 15 | 5 | 36.0 | 47.9 |
| 168.9 | 9.0 | 6.06 | 6.07 | -1.38 | 13 | 39 | 30.97 | 15 | 5 | 36.0 | 47.8 |
| 169.8 | 9.1 | 6.07 | 6.09 | -1.38 | 13 | 39 | 31.11 | 15 | 5 | 36.0 | 47.7 |
| 170.7 | 9.2 | 6.08 | 6.11 | -1.37 | 13 | 39 | 31.22 | 15 | 5 | 35.8 | 47.7 |

▲
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| Depth | (ft) | 30.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 153.7 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 10 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.1 | 0.050 | 0.100 | 32.63 | 4.0 | 15.5 |
| 11 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 2.5 | 0.050 | 0.100 | 35.89 | 4.0 | 15.5 |
| 12 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 6.1 | 0.050 | 0.100 | 39.16 | 4.0 | 15.5 |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 13.3 | 0.151 | 0.100 | 42.42 | 4.0 | 15.5 |
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 15.8 | 0.154 | 0.100 | 45.68 | 4.0 | 15.5 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 14.1 | 0.050 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 22.4 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 26.6 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 26.5 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 18.5 | 0.050 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 7.9 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 30.00 | 11.18 | 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 |
|-------------|---------------|---------------------|---------------|-------|----|-----------------|-------|----|------------------|----------------|
| 153.7 | 7.1 | 5.70 | 5.69 | -1.70 | 12 | 43 | 29.38 | 13 | 4 | 37.2 |
| 154.6 | 7.2 | 5.71 | 5.70 | -1.60 | 12 | 43 | 29.50 | 13 | 4 | 37.1 |
| 155.5 | 7.3 | 5.73 | 5.71 | -1.50 | 12 | 43 | 29.61 | 13 | 4 | 37.1 |
| 156.4 | 7.3 | 5.74 | 5.73 | -1.42 | 12 | 39 | 29.70 | 13 | 4 | 37.0 |
| 157.3 | 7.4 | 5.70 | 5.75 | -1.51 | 12 | 39 | 29.61 | 13 | 4 | 36.6 |

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Depth (ft) 35.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 269.6 | |
|---------------------|----------------|----------------|-------------|-------------|------|---------------------------|----------------|---------------|-------------|-------------|-------------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 9 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.9 | 0.050 | 0.100 | 29.37 | 4.0 | 15.5 |
| 10 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 4.4 | 0.050 | 0.100 | 32.63 | 4.0 | 15.5 |
| 11 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 8.0 | 0.050 | 0.100 | 35.89 | 4.0 | 15.5 |
| 12 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 18.9 | 0.187 | 0.100 | 39.16 | 4.0 | 15.5 |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 12.5 | 0.050 | 0.100 | 42.42 | 4.0 | 15.5 |
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 18.5 | 0.050 | 0.100 | 45.68 | 4.0 | 15.5 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 24.6 | 0.050 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 28.8 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 20.4 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 23.4 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 36.2 | 0.050 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 72.9 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy Ratio |
|-------------|--------------|-------------------|-----------------|
| 35.00 | 11.18 | 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 |
|-------------|---------------|---------------------|---------------|------|---|---|-----------------|----|---|------------------|----------------|
| 269.6 | 15.4 | 7.19 | 7.18 | 0.00 | 1 | 0 | 35.40 | 12 | 4 | 35.0 | 43.9 |
| 270.5 | 15.5 | 7.19 | 7.19 | 0.00 | 1 | 0 | 35.49 | 12 | 4 | 35.0 | 43.9 |
| 271.4 | 15.6 | 7.21 | 7.21 | 0.00 | 1 | 0 | 35.66 | 12 | 4 | 34.9 | 43.8 |
| 272.3 | 15.7 | 7.22 | 7.21 | 0.00 | 1 | 0 | 35.75 | 12 | 4 | 35.0 | 43.8 |
| 273.2 | 15.8 | 7.24 | 7.23 | 0.00 | 1 | 0 | 35.94 | 12 | 4 | 34.9 | 43.7 |

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Depth (ft) 40.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 336.0 | |
|---------------------|----------------|----------------|-------------|-------------|------|---------------------------|----------------|---------------|-------------|-------------|-------------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 7 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.1 | 0.050 | 0.100 | 22.84 | 4.0 | 15.5 |
| 8 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 2.7 | 0.050 | 0.100 | 26.11 | 4.0 | 15.5 |
| 9 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 6.3 | 0.050 | 0.100 | 29.37 | 4.0 | 15.5 |
| 10 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 14.2 | 0.159 | 0.100 | 32.63 | 4.0 | 15.5 |
| 11 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 15.2 | 0.144 | 0.100 | 35.89 | 4.0 | 15.5 |
| 12 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 14.6 | 0.050 | 0.100 | 39.16 | 4.0 | 15.5 |

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| | | | | | | | | | | | |
|-----|-------|-------|-------|-------|------|------|-------|-------|-------|-----|------|
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 22.6 | 0.050 | 0.100 | 42.42 | 4.0 | 15.5 |
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 26.9 | 0.050 | 0.100 | 45.68 | 4.0 | 15.5 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 25.8 | 0.050 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 18.5 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 32.4 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 37.4 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 39.8 | 0.050 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 79.4 | 0.150 | 0.100 | | | |

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

| | | | |
|-------|--------|----------|--------|
| Depth | Stroke | Pressure | Efficy |
| ft | ft | Ratio | |
| 40.00 | 11.18 | 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 |
| 336.0 | 20.2 | 7.73 | 7.74 | -1.25 | 8 48 | 37.16 | 10 | 3 | 35.3 | 42.4 |
| 336.9 | 20.3 | 7.74 | 7.74 | -1.25 | 8 47 | 37.25 | 10 | 3 | 35.4 | 42.3 |
| 337.8 | 20.4 | 7.75 | 7.75 | -1.25 | 8 47 | 37.35 | 10 | 3 | 35.4 | 42.3 |
| 338.7 | 20.6 | 7.76 | 7.77 | -1.25 | 8 47 | 37.42 | 10 | 3 | 35.3 | 42.3 |
| 339.6 | 20.6 | 7.77 | 7.78 | -1.24 | 8 47 | 37.54 | 10 | 3 | 35.3 | 42.2 |

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| | | | |
|------------------------|------|-------|----------------------|
| Depth | (ft) | 45.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 402.5 |
|-----|--------|------------------------|----------------|--------------|--------|-------|
| | kips | Stiffn C-Slk T-Slk CoR | Soil-S | Soil-D Quake | LbTop | Perim |
| | | k/in ft ft | kips | s/ft inch | ft | ft |
| 1 | 0.173 | 11479 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.26 | 4.0 |
| 2 | 0.173 | 11479 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.53 | 4.0 |
| 6 | 0.173 | 11479 0.000 0.000 1.00 | 1.1 | 0.050 0.100 | 19.58 | 4.0 |
| 7 | 0.173 | 11479 0.000 0.000 1.00 | 4.6 | 0.050 0.100 | 22.84 | 4.0 |
| 8 | 0.173 | 11479 0.000 0.000 1.00 | 8.2 | 0.050 0.100 | 26.11 | 4.0 |
| 9 | 0.173 | 11479 0.000 0.000 1.00 | 19.0 | 0.187 0.100 | 29.37 | 4.0 |
| 10 | 0.173 | 11479 0.000 0.000 1.00 | 12.7 | 0.050 0.100 | 32.63 | 4.0 |
| 11 | 0.173 | 11479 0.000 0.000 1.00 | 19.0 | 0.050 0.100 | 35.89 | 4.0 |
| 12 | 0.173 | 11479 0.000 0.000 1.00 | 24.9 | 0.050 0.100 | 39.16 | 4.0 |
| 13 | 0.173 | 11479 0.000 0.000 1.00 | 29.1 | 0.050 0.100 | 42.42 | 4.0 |
| 14 | 0.173 | 11479 0.000 0.000 1.00 | 19.6 | 0.050 0.100 | 45.68 | 4.0 |
| 15 | 0.173 | 11479 0.000 0.000 1.00 | 24.5 | 0.050 0.100 | 48.95 | 4.0 |
| 16 | 0.173 | 11479 0.000 0.000 1.00 | 36.3 | 0.050 0.100 | 52.21 | 4.0 |
| 17 | 0.173 | 11479 0.000 0.000 1.00 | 38.6 | 0.050 0.100 | 55.47 | 4.0 |
| 18 | 0.173 | 11479 0.000 0.000 1.00 | 41.3 | 0.050 0.100 | 58.74 | 4.0 |
| 19 | 0.173 | 11479 0.000 0.000 1.00 | 44.0 | 0.050 0.100 | 62.00 | 4.0 |
| Toe | | | 79.4 | 0.150 0.100 | | |

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

| | | | |
|-------|--------|----------|--------|
| Depth | Stroke | Pressure | Efficy |
| ft | ft | Ratio | |
| 45.00 | 11.18 | 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 |
| 402.5 | 26.0 | 8.23 | 8.23 | -1.59 | 7 42 | 38.86 | 9 | 3 | 36.0 | 41.1 |
| 403.4 | 26.1 | 8.24 | 8.23 | -1.60 | 7 42 | 39.04 | 9 | 3 | 36.1 | 41.1 |

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| | | | | | | | | | | | |
|-------|------|------|------|-------|---|----|-------|---|---|------|------|
| 404.3 | 26.3 | 8.25 | 8.24 | -1.61 | 7 | 42 | 39.21 | 9 | 3 | 36.1 | 41.1 |
| 405.2 | 26.4 | 8.26 | 8.25 | -1.62 | 7 | 42 | 39.36 | 9 | 3 | 36.2 | 41.0 |
| 406.1 | 26.5 | 8.27 | 8.25 | -1.63 | 7 | 42 | 39.47 | 9 | 3 | 36.2 | 41.0 |

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Depth (ft) 50.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 437.7 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 4 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.2 | 0.050 | 0.100 | 13.05 | 4.0 | 15.5 |
| 5 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 2.9 | 0.050 | 0.100 | 16.32 | 4.0 | 15.5 |
| 6 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 6.5 | 0.050 | 0.100 | 19.58 | 4.0 | 15.5 |
| 7 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 15.1 | 0.166 | 0.100 | 22.84 | 4.0 | 15.5 |
| 8 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 14.6 | 0.133 | 0.100 | 26.11 | 4.0 | 15.5 |
| 9 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 15.2 | 0.050 | 0.100 | 29.37 | 4.0 | 15.5 |
| 10 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 22.9 | 0.050 | 0.100 | 32.63 | 4.0 | 15.5 |
| 11 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 27.2 | 0.050 | 0.100 | 35.89 | 4.0 | 15.5 |
| 12 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 25.1 | 0.050 | 0.100 | 39.16 | 4.0 | 15.5 |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 18.6 | 0.050 | 0.100 | 42.42 | 4.0 | 15.5 |
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 33.5 | 0.050 | 0.100 | 45.68 | 4.0 | 15.5 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 37.6 | 0.050 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 40.0 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 42.9 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 44.8 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 45.8 | 0.050 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 45.0 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficcy |
|-------|--------|----------|---------|
| ft | ft | Ratio | |
| 50.00 | 11.18 | 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 | |
| 437.7 | 28.9 | 8.33 | 8.36 | -1.17 | 5 40 | 39.09 | 7 3 | 35.4 40.8 |
| 438.6 | 29.0 | 8.34 | 8.36 | -1.19 | 5 40 | 39.22 | 7 3 | 35.5 40.8 |
| 439.5 | 29.1 | 8.35 | 8.37 | -1.20 | 5 40 | 39.34 | 7 3 | 35.6 40.8 |
| 440.4 | 29.4 | 8.36 | 8.39 | -1.20 | 5 40 | 39.38 | 7 3 | 35.5 40.8 |
| 441.3 | 29.5 | 8.37 | 8.39 | -1.22 | 5 40 | 39.54 | 7 3 | 35.5 40.8 |

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Depth (ft) 55.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

Pile and Soil Model Total Capacity Rut (kips) 542.0

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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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.0 | 15.5 |
| 3 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 1.3 | 0.050 | 0.100 | 9.79 | 4.0 | 15.5 |
| 4 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 4.8 | 0.050 | 0.100 | 13.05 | 4.0 | 15.5 |
| 5 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 8.5 | 0.052 | 0.100 | 16.32 | 4.0 | 15.5 |
| 6 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 19.0 | 0.187 | 0.100 | 19.58 | 4.0 | 15.5 |
| 7 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 12.9 | 0.050 | 0.100 | 22.84 | 4.0 | 15.5 |
| 8 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 19.6 | 0.050 | 0.100 | 26.11 | 4.0 | 15.5 |
| 9 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 25.2 | 0.050 | 0.100 | 29.37 | 4.0 | 15.5 |
| 10 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 29.3 | 0.050 | 0.100 | 32.63 | 4.0 | 15.5 |
| 11 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 18.8 | 0.050 | 0.100 | 35.89 | 4.0 | 15.5 |
| 12 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 25.6 | 0.050 | 0.100 | 39.16 | 4.0 | 15.5 |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 36.5 | 0.050 | 0.100 | 42.42 | 4.0 | 15.5 |
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 38.8 | 0.050 | 0.100 | 45.68 | 4.0 | 15.5 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 41.5 | 0.050 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 44.2 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 45.0 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 47.4 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 50.7 | 0.050 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 72.9 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy Ratio |
|-------------|--------------|-------------------|-----------------|
| 55.00 | 11.18 | 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 |
|-------------|---------------|---------------------|---------------|-------|---|----|-----------------|---|---|------------------|----------------|
| 542.0 | 49.4 | 9.13 | 9.07 | -1.36 | 5 | 36 | 41.52 | 6 | 3 | 37.4 | 39.2 |
| 542.9 | 50.2 | 9.13 | 9.08 | -1.34 | 5 | 36 | 41.67 | 6 | 3 | 37.3 | 39.1 |
| 543.8 | 50.2 | 9.14 | 9.07 | -1.35 | 5 | 36 | 41.82 | 6 | 3 | 37.5 | 39.1 |
| 544.7 | 51.0 | 9.15 | 9.08 | -1.32 | 5 | 36 | 41.89 | 6 | 3 | 37.4 | 39.1 |
| 545.6 | 51.8 | 9.15 | 9.10 | -1.30 | 4 | 36 | 42.05 | 6 | 3 | 37.3 | 39.1 |

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

PILE PROFILE:

| | | | | | | | |
|-----------|--------|---------|-----------|---------|---------|---------|--------|
| Toe Area | (in2) | 144.000 | 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| 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 | LbTop ft | Perim ft | Area in2 |
|-----|----------------|---------------------------------------|-------------|-------------|------|----------------|----------------|---------------|-------------|-------------|-------------|
| 1 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 0.3 | 0.050 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 3.2 | 0.050 | 0.100 | 6.53 | 4.0 | 15.5 |
| 3 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 6.8 | 0.050 | 0.100 | 9.79 | 4.0 | 15.5 |
| 4 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 15.9 | 0.172 | 0.100 | 13.05 | 4.0 | 15.5 |
| 5 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 14.1 | 0.120 | 0.100 | 16.32 | 4.0 | 15.5 |
| 6 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 15.7 | 0.050 | 0.100 | 19.58 | 4.0 | 15.5 |
| 7 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 23.2 | 0.050 | 0.100 | 22.84 | 4.0 | 15.5 |
| 8 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 27.4 | 0.050 | 0.100 | 26.11 | 4.0 | 15.5 |
| 9 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 24.4 | 0.050 | 0.100 | 29.37 | 4.0 | 15.5 |
| 10 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 18.7 | 0.050 | 0.100 | 32.63 | 4.0 | 15.5 |
| 11 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 34.6 | 0.050 | 0.100 | 35.89 | 4.0 | 15.5 |
| 12 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 37.7 | 0.050 | 0.100 | 39.16 | 4.0 | 15.5 |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 40.1 | 0.050 | 0.100 | 42.42 | 4.0 | 15.5 |
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 43.0 | 0.050 | 0.100 | 45.68 | 4.0 | 15.5 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 44.8 | 0.050 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 45.9 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 49.3 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 51.9 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 54.2 | 0.050 | 0.100 | 62.00 | 4.0 | 15.5 |

Toe 72.9 0.150 0.100

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 60.00 | 11.18 | 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 |
|-------------|---------------|---------------------|---------------|-------|---|----|-----------------|---|---|------------------|----------------|
| 624.2 | 93.9 | 9.39 | 9.39 | -0.75 | 3 | 33 | 42.11 | 4 | 2 | 37.1 | 38.6 |
| 625.1 | 95.6 | 9.39 | 9.39 | -0.73 | 3 | 33 | 42.15 | 4 | 2 | 37.0 | 38.6 |
| 626.0 | 97.1 | 9.39 | 9.39 | -0.71 | 3 | 33 | 42.23 | 4 | 2 | 37.0 | 38.6 |
| 626.9 | 99.0 | 9.39 | 9.40 | -0.69 | 3 | 33 | 42.36 | 4 | 2 | 36.9 | 38.6 |
| 627.8 | 100.1 | 9.39 | 9.39 | -0.69 | 3 | 33 | 42.41 | 4 | 2 | 36.9 | 38.6 |

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| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 62.0 | 11.18 | 1.00 | 0.800 |

PILE PROFILE:
Toe Area (in2) 144.000 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 |
| 62.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.504

| 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 | 0.173 | 11479 | 0.010 | 0.000 | 0.85 | 1.8 | 0.050 | 0.100 | 3.26 | 4.0 | 15.5 |
| 2 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 5.4 | 0.050 | 0.100 | 6.53 | 4.0 | 15.5 |
| 3 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 10.6 | 0.113 | 0.100 | 9.79 | 4.0 | 15.5 |
| 4 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 17.6 | 0.175 | 0.100 | 13.05 | 4.0 | 15.5 |
| 5 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 13.3 | 0.050 | 0.100 | 16.32 | 4.0 | 15.5 |
| 6 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 20.9 | 0.050 | 0.100 | 19.58 | 4.0 | 15.5 |
| 7 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 25.8 | 0.050 | 0.100 | 22.84 | 4.0 | 15.5 |
| 8 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 28.5 | 0.050 | 0.100 | 26.11 | 4.0 | 15.5 |
| 9 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 18.3 | 0.050 | 0.100 | 29.37 | 4.0 | 15.5 |
| 10 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 28.0 | 0.050 | 0.100 | 32.63 | 4.0 | 15.5 |
| 11 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 36.8 | 0.050 | 0.100 | 35.89 | 4.0 | 15.5 |
| 12 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 39.1 | 0.050 | 0.100 | 39.16 | 4.0 | 15.5 |
| 13 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 41.9 | 0.050 | 0.100 | 42.42 | 4.0 | 15.5 |
| 14 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 44.6 | 0.050 | 0.100 | 45.68 | 4.0 | 15.5 |
| 15 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 45.1 | 0.050 | 0.100 | 48.95 | 4.0 | 15.5 |
| 16 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 47.9 | 0.050 | 0.100 | 52.21 | 4.0 | 15.5 |
| 17 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 51.0 | 0.050 | 0.100 | 55.47 | 4.0 | 15.5 |
| 18 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 53.3 | 0.050 | 0.100 | 58.74 | 4.0 | 15.5 |
| 19 | 0.173 | 11479 | 0.000 | 0.000 | 1.00 | 55.6 | 0.050 | 0.100 | 62.00 | 4.0 | 15.5 |
| Toe | | | | | | 72.9 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 62.00 | 11.18 | 1.00 | 0.800 |

↑
FRA-70-1323C - Rear Abutment - HP12x53 02/28/2021
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 |
|-------------|---------------|---------------------|---------------|-------|---|----|-----------------|---|---|------------------|----------------|
| 658.6 | 134.1 | 9.47 | 9.46 | -0.44 | 3 | 32 | 41.60 | 3 | 2 | 36.8 | 38.4 |
| 659.5 | 138.9 | 9.48 | 9.47 | -0.41 | 3 | 32 | 41.69 | 3 | 2 | 36.6 | 38.4 |
| 660.4 | 139.0 | 9.46 | 9.45 | -0.42 | 3 | 32 | 41.69 | 3 | 2 | 36.7 | 38.4 |
| 661.3 | 144.9 | 9.48 | 9.47 | -0.39 | 3 | 32 | 41.76 | 3 | 2 | 36.5 | 38.4 |
| 662.2 | 149.4 | 9.46 | 9.47 | -0.37 | 3 | 32 | 41.75 | 3 | 2 | 36.4 | 38.4 |

SUMMARY OVER DEPTHS

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
| 5.0 | 10.9 | 4.2 | 6.7 | Hammer | did not | run | | |
| 10.0 | 21.8 | 19.2 | 2.7 | Hammer | did not | run | | |
| 15.0 | 55.9 | 43.0 | 12.9 | 2.7 | 19.818 | 0.000 | 4.29 | 42.6 |
| 20.0 | 114.4 | 72.7 | 41.7 | 6.0 | 27.628 | -1.152 | 5.42 | 38.1 |
| 25.0 | 167.1 | 114.7 | 52.4 | 8.8 | 30.663 | -1.385 | 6.02 | 36.0 |
| 30.0 | 153.7 | 145.8 | 7.9 | 7.1 | 29.376 | -1.700 | 5.70 | 37.2 |
| 35.0 | 269.6 | 196.7 | 72.9 | 15.4 | 35.402 | 0.000 | 7.19 | 35.0 |
| 40.0 | 336.0 | 256.6 | 79.4 | 20.2 | 37.162 | -1.254 | 7.73 | 35.3 |
| 45.0 | 402.5 | 323.1 | 79.4 | 26.0 | 38.856 | -1.586 | 8.23 | 36.0 |
| 50.0 | 437.7 | 392.7 | 45.0 | 28.9 | 39.089 | -1.173 | 8.33 | 35.4 |
| 55.0 | 542.0 | 469.1 | 72.9 | 49.4 | 41.516 | -1.363 | 9.13 | 37.4 |
| 60.0 | 624.2 | 551.2 | 72.9 | 93.9 | 42.108 | -0.754 | 9.39 | 37.1 |
| 62.0 | 658.6 | 585.6 | 72.9 | 134.1 | 41.599 | -0.443 | 9.47 | 36.8 |

Total Driving Time 32 minutes; Total No. of Blows 1284
Starting at penetration 5.0 ft

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
| 5.0 | 10.9 | 4.2 | 6.7 | Hammer | did not | run | | |
| 10.0 | 22.1 | 19.4 | 2.7 | Hammer | did not | run | | |
| 15.0 | 56.8 | 43.9 | 12.9 | 2.8 | 19.999 | 0.000 | 4.32 | 42.5 |
| 20.0 | 115.3 | 73.6 | 41.7 | 6.1 | 27.672 | -1.142 | 5.43 | 37.9 |
| 25.0 | 168.0 | 115.6 | 52.4 | 8.9 | 30.812 | -1.386 | 6.03 | 36.0 |
| 30.0 | 154.6 | 146.7 | 7.9 | 7.2 | 29.504 | -1.596 | 5.71 | 37.1 |
| 35.0 | 270.5 | 197.6 | 72.9 | 15.5 | 35.492 | 0.000 | 7.19 | 35.0 |
| 40.0 | 336.9 | 257.5 | 79.4 | 20.3 | 37.245 | -1.255 | 7.74 | 35.4 |
| 45.0 | 403.4 | 324.0 | 79.4 | 26.1 | 39.043 | -1.596 | 8.24 | 36.1 |
| 50.0 | 438.6 | 393.6 | 45.0 | 29.0 | 39.223 | -1.191 | 8.34 | 35.5 |
| 55.0 | 542.9 | 470.0 | 72.9 | 50.2 | 41.666 | -1.341 | 9.13 | 37.3 |
| 60.0 | 625.1 | 552.1 | 72.9 | 95.6 | 42.153 | -0.733 | 9.39 | 37.0 |
| 62.0 | 659.5 | 586.5 | 72.9 | 138.9 | 41.694 | -0.412 | 9.48 | 36.6 |

Total Driving Time 32 minutes; Total No. of Blows 1302
Starting at penetration 5.0 ft

SUMMARY OVER DEPTHS

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
| 5.0 | 10.9 | 4.2 | 6.7 | Hammer | did not | run | | |
| 10.0 | 22.3 | 19.7 | 2.7 | Hammer | did not | run | | |
| 15.0 | 57.7 | 44.8 | 12.9 | 2.8 | 20.205 | 0.000 | 4.35 | 42.3 |
| 20.0 | 116.2 | 74.5 | 41.7 | 6.1 | 27.805 | -1.138 | 5.45 | 37.9 |
| 25.0 | 168.9 | 116.5 | 52.4 | 9.0 | 30.969 | -1.383 | 6.06 | 36.0 |
| 30.0 | 155.5 | 147.6 | 7.9 | 7.3 | 29.612 | -1.499 | 5.73 | 37.1 |
| 35.0 | 271.4 | 198.5 | 72.9 | 15.6 | 35.663 | 0.000 | 7.21 | 34.9 |
| 40.0 | 337.8 | 258.4 | 79.4 | 20.4 | 37.352 | -1.252 | 7.75 | 35.4 |
| 45.0 | 404.3 | 324.9 | 79.4 | 26.3 | 39.208 | -1.607 | 8.25 | 36.1 |
| 50.0 | 439.5 | 394.5 | 45.0 | 29.1 | 39.342 | -1.200 | 8.35 | 35.6 |
| 55.0 | 543.8 | 470.9 | 72.9 | 50.2 | 41.823 | -1.354 | 9.14 | 37.5 |
| 60.0 | 626.0 | 553.0 | 72.9 | 97.1 | 42.227 | -0.714 | 9.39 | 37.0 |
| 62.0 | 660.4 | 587.4 | 72.9 | 139.0 | 41.694 | -0.422 | 9.46 | 36.7 |

Total Driving Time 32 minutes; Total No. of Blows 1310
Starting at penetration 5.0 ft

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
| 5.0 | 10.9 | 4.2 | 6.7 | Hammer | did not | run | | |
| 10.0 | 22.6 | 19.9 | 2.7 | Hammer | did not | run | | |
| 15.0 | 58.6 | 45.7 | 12.9 | 2.9 | 20.436 | 0.000 | 4.38 | 42.2 |
| 20.0 | 117.1 | 75.4 | 41.7 | 6.2 | 27.931 | -1.142 | 5.47 | 37.8 |
| 25.0 | 169.8 | 117.4 | 52.4 | 9.1 | 31.114 | -1.378 | 6.07 | 36.0 |
| 30.0 | 156.4 | 148.5 | 7.9 | 7.3 | 29.695 | -1.425 | 5.74 | 37.0 |
| 35.0 | 272.3 | 199.3 | 72.9 | 15.7 | 35.755 | 0.000 | 7.22 | 35.0 |
| 40.0 | 338.7 | 259.3 | 79.4 | 20.6 | 37.425 | -1.245 | 7.76 | 35.3 |

| | | | | | | | | |
|----------------|-------|-------|------|-------|--------|--------|------|------|
| 1323C-RA-12X53 | | | | | | | | |
| 45.0 | 405.2 | 325.8 | 79.4 | 26.4 | 39.355 | -1.618 | 8.26 | 36.2 |
| 50.0 | 440.4 | 395.4 | 45.0 | 29.4 | 39.383 | -1.199 | 8.36 | 35.5 |
| 55.0 | 544.7 | 471.8 | 72.9 | 51.0 | 41.886 | -1.322 | 9.15 | 37.4 |
| 60.0 | 626.9 | 553.9 | 72.9 | 99.0 | 42.360 | -0.692 | 9.39 | 36.9 |
| 62.0 | 661.3 | 588.3 | 72.9 | 144.9 | 41.762 | -0.385 | 9.48 | 36.5 |

Total Driving Time 33 minutes; Total No. of Blows 1333
Starting at penetration 5.0 ft

▲
FRA-70-1323C - Rear Abutment - HP12x53 02/28/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

| Depth ft | Rut kips | G/L at Frictn kips | Shaft and End Bg kips | Toe: Bl Ct bl/ft | 0.736 Com Str ksi | 1.000 Ten Str ksi | Stroke ft | ENTHRU kip-ft |
|-------------|-------------|--------------------------|-----------------------------|------------------------|-------------------------|-------------------------|--------------|------------------|
| | | | | | | | | |
| 5.0 | 10.9 | 4.2 | 6.7 | Hammer | did not | run | | |
| 10.0 | 22.8 | 20.2 | 2.7 | Hammer | did not | run | | |
| 15.0 | 59.5 | 46.6 | 12.9 | 2.9 | 20.644 | 0.000 | 4.41 | 42.1 |
| 20.0 | 118.0 | 76.3 | 41.7 | 6.3 | 28.048 | -1.148 | 5.49 | 37.8 |
| 25.0 | 170.7 | 118.3 | 52.4 | 9.2 | 31.222 | -1.372 | 6.08 | 35.8 |
| 30.0 | 157.3 | 149.4 | 7.9 | 7.4 | 29.608 | -1.513 | 5.70 | 36.6 |
| 35.0 | 273.2 | 200.2 | 72.9 | 15.8 | 35.937 | 0.000 | 7.24 | 34.9 |
| 40.0 | 339.6 | 260.2 | 79.4 | 20.6 | 37.537 | -1.244 | 7.77 | 35.3 |
| 45.0 | 406.1 | 326.7 | 79.4 | 26.5 | 39.472 | -1.628 | 8.27 | 36.2 |
| 50.0 | 441.3 | 396.3 | 45.0 | 29.5 | 39.535 | -1.218 | 8.37 | 35.5 |
| 55.0 | 545.6 | 472.7 | 72.9 | 51.8 | 42.053 | -1.304 | 9.15 | 37.3 |
| 60.0 | 627.8 | 554.8 | 72.9 | 100.1 | 42.407 | -0.688 | 9.39 | 36.9 |
| 62.0 | 662.2 | 589.2 | 72.9 | 149.4 | 41.745 | -0.373 | 9.46 | 36.4 |

Total Driving Time 33 minutes; Total No. of Blows 1349
Starting at penetration 5.0 ft

▲
FRA-70-1323C - Rear Abutment - HP12x53 02/28/2021
Resource International Inc GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

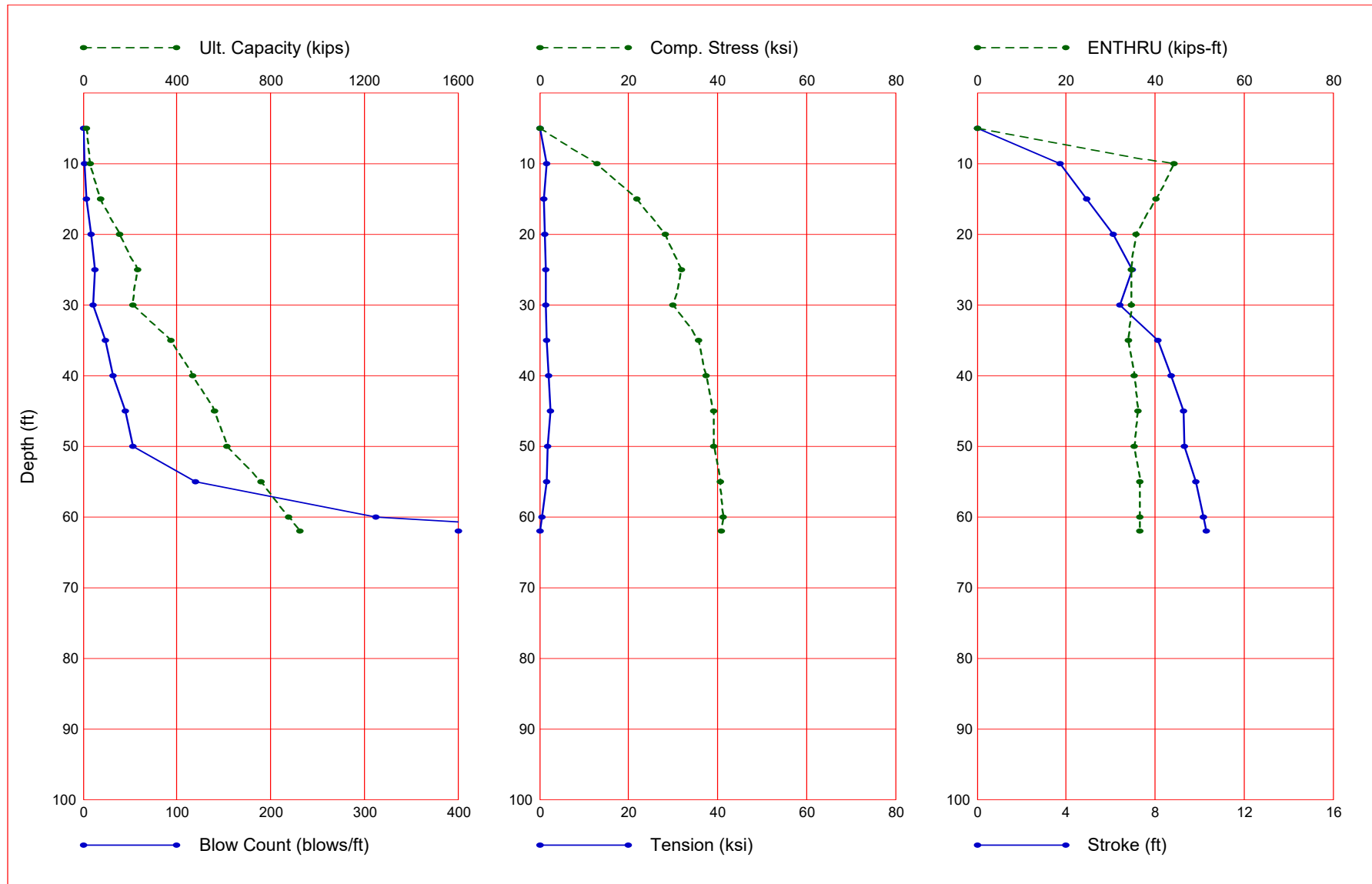
| Depth ft | Temp. Length ft | Wait Time hr | Equivalent Stroke ft | Pressure Ratio | Efficy. | Stiffn. Factor | Cushion CoR |
|-------------|-----------------------|--------------------|----------------------------|-------------------|---------|-------------------|----------------|
| 5.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 10.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 15.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 20.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 25.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 30.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 35.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 40.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 45.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 50.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 55.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 60.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 62.00 | 62.00 | 0.00 | 11.18 | 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 | 0.01 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.01 | 0.76 | 12.06 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.29 | 0.79 | 12.44 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.31 | 2.75 | 2.66 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 11.79 | 2.75 | 2.66 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 11.81 | 0.83 | 10.17 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 16.79 | 1.18 | 14.49 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 16.81 | 1.55 | 34.61 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 24.49 | 2.32 | 51.79 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 24.51 | 2.32 | 51.82 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 25.79 | 2.39 | 53.36 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 25.81 | 1.36 | 7.91 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 30.79 | 1.49 | 7.91 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 30.81 | 2.65 | 72.94 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 39.79 | 3.14 | 72.94 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 39.81 | 3.19 | 79.39 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 45.79 | 3.54 | 79.39 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 45.81 | 3.40 | 44.95 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 50.79 | 3.66 | 44.95 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |

| 1323C-RA-12X53 | | | | | | | | | |
|----------------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 50.81 | 3.77 | 72.94 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 59.81 | 4.26 | 72.94 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 62.00 | 4.39 | 72.94 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |

Gain/Loss 3 at Shaft and Toe 0.670 / 1.000



Gain/Loss 3 at Shaft and Toe 0.670 / 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 | 15.1 | 5.9 | 9.2 | -1.0 | 0.000 | 0.000 | 0.00 | 0.0 |
| 10.0 | 30.1 | 26.4 | 3.7 | 1.4 | 12.819 | -1.558 | 3.74 | 44.3 |
| 15.0 | 76.4 | 58.5 | 17.9 | 3.7 | 21.927 | -0.954 | 4.93 | 40.2 |
| 20.0 | 157.9 | 100.2 | 57.6 | 8.7 | 28.216 | -1.268 | 6.13 | 35.7 |
| 25.0 | 232.0 | 159.6 | 72.4 | 13.1 | 31.809 | -1.327 | 6.96 | 34.7 |
| 30.0 | 213.1 | 202.2 | 10.9 | 10.2 | 29.874 | -1.374 | 6.44 | 34.6 |
| 35.0 | 374.5 | 273.8 | 100.7 | 23.5 | 35.768 | -1.607 | 8.11 | 34.1 |
| 40.0 | 468.4 | 358.8 | 109.6 | 32.1 | 37.469 | -1.954 | 8.74 | 35.4 |
| 45.0 | 562.7 | 453.1 | 109.6 | 45.2 | 39.191 | -2.347 | 9.26 | 36.2 |
| 50.0 | 613.5 | 551.5 | 62.1 | 53.4 | 39.213 | -1.900 | 9.33 | 35.3 |
| 55.0 | 760.3 | 659.6 | 100.7 | 120.3 | 40.595 | -1.683 | 9.85 | 36.5 |
| 60.0 | 876.7 | 776.0 | 100.7 | 312.5 | 41.197 | -0.509 | 10.16 | 36.5 |
| 62.0 | 925.4 | 824.7 | 100.7 | 565.7 | 40.893 | 0.000 | 10.30 | 36.5 |

Total Continuous Driving Time 84.00 minutes; Total Number of Blows 3213 (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\2013\W-13-072 FRA-70-13.10 PROJECT 6A\ANALYSIS\FRA-70-1322L AND 1323C\DRIVEABILITY\FRA-70-1323C\REAR ABUTMENT\HP 14X73\1323C-RA-14X73.GMW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-1323C - Rear Abutment - HP14x73
OUT OSG HAM STR FUL PEL N SPL N-U P-D %SK ISM 0 PHI RSA ITR H-D MXT DEX
-100 0 14 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0.000
Pile g Hammer g Toe Area Pile Size Pile Type
32.170 32.170 144.000 14.000 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
62.000 21.40 29000.0 492.000 4.700 0 0.850 0.010
FFatigue F0 0-Bottom
0 0.000 0.000
Manufac Hmr Name HmrType No Seg-s
DELMAG D 30-23 1 5
Ram Wt Ram L Ram Dia MaxStrk RtdStrk Efficy
6.60 118.10 16.51 13.44 11.18 0.80
IB. Wt IB. L IB. Dia IB CoR IB RO
1.20 25.00 16.51 0.900 0.010
CompStrk A Chamber V Chamber C Delay C Duratn Exp Coeff VolCStart Vol CEnd
16.30 214.03 280.90 0.0010 0.0020 1.250 0.00 0.00
P atm P1 P2 P3 P4 P5
14.70 1550.00 1395.00 1255.00 1130.00 0.00
Stroke Effic. Pressure R-Weight T-Delay Exp-Coeff Eps-Str Total-AW
11.1800 0.8000 1550.0000 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 | 0.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 9.01 | 0.90 | 16.65 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 9.29 | 0.93 | 17.17 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 9.31 | 2.75 | 3.68 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 11.79 | 2.75 | 3.68 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 11.81 | 0.97 | 14.04 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 16.79 | 1.38 | 20.01 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 16.81 | 1.85 | 47.78 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 24.49 | 2.77 | 71.50 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 24.51 | 2.77 | 71.55 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 25.79 | 2.85 | 73.67 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 25.81 | 1.56 | 10.93 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 30.79 | 1.70 | 10.93 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 30.81 | 3.17 | 100.70 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 39.79 | 3.76 | 100.70 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 39.81 | 3.82 | 109.62 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 45.79 | 4.25 | 109.62 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 45.81 | 4.05 | 62.06 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 50.79 | 4.36 | 62.06 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 50.81 | 4.51 | 100.70 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 59.81 | 5.10 | 100.70 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 62.00 | 5.25 | 100.70 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |

Gain/Loss factors: shaft and toe

| Dpth | L | Wait | Strk | Pmx% | Eff. | Stff | CoR |
|---------|---------|---------|---------|---------|-------|-------|-------|
| 0.60400 | 0.63700 | 0.67000 | 0.70300 | 0.73600 | | | |
| 1.00000 | 1.00000 | 1.00000 | 1.00000 | 1.00000 | | | |
| 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 |
| 62.00 | 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-70-1323C - Rear Abutment - HP14x73

Hammer Model: D 30-23 Made by: DELMAG

| No. | Weight kips | Stiffn k/inch | CoR | C-Slk ft | Dampg k/ft/s |
|-------------------|----------------|------------------|-------|-------------|-----------------|
| 1 | 1.320 | | | | |
| 2 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| 3 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| 4 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| 5 | 1.320 | 262846.5 | 1.000 | 0.0000 | |
| Imp Block | 1.200 | 127693.0 | 0.900 | 0.0100 | |
| Helmet | 1.900 | 60155.0 | 0.800 | 0.0100 | 10.0 |
| Combined Pile Top | | 15848.7 | | | |

HAMMER OPTIONS:
 Hammer File ID No. 14 Hammer Type OE Diesel
 Stroke Option FxdP-VarS Stroke Convergence Crit. 0.010
 Fuel Pump Setting Maximum

HAMMER DATA:
 Ram Weight (kips) 6.60 Ram Length (inch) 118.10
 Maximum Stroke (ft) 13.44
 Rated Stroke (ft) 11.18 Efficiency 0.800
 Maximum Pressure (psi) 1550.00 Actual Pressure (psi) 1550.00

1323C-RA-14X73
 Compression Exponent 1.350 Expansion Exponent 1.250
 Ram Diameter (inch) 16.51
 Combustion Delay (s) 0.00100 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-70-1323C - Rear Abutment - HP14x73 02/28/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 5.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 144.000 Pile Type Unknown
 Pile Size (inch) 14.000

| | | | | | | | |
|---------|-------|--------|---------|-------|---------|---------|--------|
| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| | | | | | | | | | | | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 15.1 | |
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.7 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 5.2 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 9.2 | 0.150 | 0.100 | | | |

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

PILE, SOIL, ANALYSIS OPTIONS:
 Uniform pile
 No. of Slacks/Splices 0 Pile Segments: Automatic
 Pile Damping (%) 1
 Pile Damping Fact.(k/ft/s) 0.751
 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 | Stroke | Pressure | Efficacy |
| ft | ft | Ratio | |
| 5.00 | 11.18 | 1.00 | 0.800 |

↑
 FRA-70-1323C - Rear Abutment - HP14x73 02/28/2021
 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 |
| 15.1 | Hammer | did not run | | | | | | |
| 15.1 | Hammer | did not run | | | | | | |
| 15.1 | Hammer | did not run | | | | | | |
| 15.1 | Hammer | did not run | | | | | | |
| 15.1 | Hammer | did not run | | | | | | |

↑
 FRA-70-1323C - Rear Abutment - HP14x73 02/28/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 10.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

1323C-RA-14X73
 Toe Area (in2) 144.000 Pile Type Unknown
 Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 29.5 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 2.8 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 7.8 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 15.2 | 0.122 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 3.7 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 10.00 | 11.18 | 1.00 | 0.800 |

▲ FRA-70-1323C - Rear Abutment - HP14x73 02/28/2021
 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 | |
| 29.5 | 1.4 | 3.68 | 3.71 | -1.30 | 5 11 | 12.57 | 1 4 | 44.0 61.5 |
| 29.8 | 1.4 | 3.69 | 3.72 | -1.30 | 5 11 | 12.60 | 1 4 | 44.0 61.4 |
| 30.1 | 1.4 | 3.74 | 3.71 | -1.56 | 4 11 | 12.82 | 1 4 | 44.3 61.3 |
| 30.4 | 1.4 | 3.71 | 3.74 | -1.39 | 4 11 | 12.72 | 1 4 | 44.0 61.3 |
| 30.7 | 1.4 | 3.72 | 3.75 | -1.48 | 4 11 | 12.82 | 1 4 | 44.2 61.2 |

▲ FRA-70-1323C - Rear Abutment - HP14x73 02/28/2021
 Resource International Inc GRLWEAP Version 2010

| Depth | (ft) | 15.0 | Standard Soil Setup |
|------------------------|-------|----------------------|---------------------|
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

Toe Area (in2) 144.000 Pile Type Unknown
 Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 74.3 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.9 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 5.5 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 10.5 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 22.5 | 0.185 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 17.0 | 0.057 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 17.9 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 15.00 | 11.18 | 1.00 | 0.800 |

▲ FRA-70-1323C - Rear Abutment - HP14x73 02/28/2021
 Resource International Inc GRLWEAP Version 2010

| Rut | Bl Ct | Stroke (ft) | Ten Str | i | t Comp Str | i | t ENTHRU | Bl Rt |
|-----|-------|-------------|---------|---|------------|---|----------|-------|
|-----|-------|-------------|---------|---|------------|---|----------|-------|

| 1323C-RA-14X73 | | | | | | | | | | | |
|----------------|------|------|------|-------|---|----|-------|----|--------|-------|------|
| kips | b/ft | down | up | ksi | | | ksi | | kip-ft | b/min | |
| 74.3 | 3.6 | 4.88 | 4.84 | -1.01 | 3 | 11 | 21.64 | 10 | 4 | 40.4 | 53.6 |
| 75.3 | 3.6 | 4.90 | 4.86 | -1.02 | 3 | 11 | 21.79 | 10 | 4 | 40.3 | 53.5 |
| 76.4 | 3.7 | 4.93 | 4.89 | -0.95 | 3 | 11 | 21.93 | 10 | 4 | 40.2 | 53.4 |
| 77.5 | 3.8 | 4.96 | 4.91 | -0.99 | 3 | 11 | 22.11 | 11 | 4 | 40.1 | 53.2 |
| 78.5 | 3.9 | 4.98 | 4.94 | -0.91 | 3 | 11 | 22.21 | 11 | 4 | 39.9 | 53.1 |

FRA-70-1323C - Rear Abutment - HP14x73 02/28/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 20.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 Pile Type Unknown
 Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 155.7 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.050 | 0.100 | 42.42 | 4.7 | 21.4 |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 3.1 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 8.2 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 16.1 | 0.135 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 20.6 | 0.157 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 19.0 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 31.1 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 57.6 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 20.00 | 11.18 | 1.00 | 0.800 |

FRA-70-1323C - Rear Abutment - HP14x73 02/28/2021
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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 | |
|-------------|---------------|---------------------|---------------|-------|----|-----------------|-------|----|------------------|----------------|------|
| 155.7 | 8.5 | 6.10 | 6.13 | -1.38 | 14 | 43 | 28.04 | 15 | 5 | 35.8 | 47.6 |
| 156.8 | 8.6 | 6.12 | 6.14 | -1.32 | 14 | 43 | 28.12 | 16 | 5 | 35.7 | 47.6 |
| 157.9 | 8.7 | 6.13 | 6.15 | -1.27 | 14 | 43 | 28.22 | 16 | 5 | 35.7 | 47.5 |
| 158.9 | 8.8 | 6.14 | 6.17 | -1.21 | 14 | 43 | 28.29 | 16 | 5 | 35.6 | 47.5 |
| 160.0 | 8.8 | 6.16 | 6.18 | -1.17 | 14 | 43 | 28.44 | 16 | 5 | 35.6 | 47.4 |

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Depth (ft) 25.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 Pile Type Unknown
 Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 229.9 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|-------|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 1.1 | 0.050 | 0.100 | 39.16 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 5.8 | 0.050 | 0.100 | 42.42 | 4.7 | 21.4 |

| 1323C-RA-14X73 | | | | | | | | | | | |
|----------------|-------|-------|-------|-------|------|------|-------|-------|-------|-----|------|
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 10.8 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 22.8 | 0.186 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 17.1 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 25.1 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 34.4 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 40.3 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 72.4 | 0.150 | 0.100 | | | |

4.533 kips total unredused pile weight (g= 32.17 ft/s2)

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 25.00 | 11.18 | 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 |
|-------------|---------------|----------------|------------|----------------|----|----|-----------------|----|---|------------------|----------------|
| 229.9 | 12.8 | 6.92 | 6.87 | -1.28 | 13 | 34 | 31.55 | 15 | 5 | 34.7 | 44.9 |
| 230.9 | 13.0 | 6.94 | 6.89 | -1.30 | 13 | 34 | 31.62 | 15 | 5 | 34.6 | 44.8 |
| 232.0 | 13.1 | 6.96 | 6.91 | -1.33 | 13 | 34 | 31.81 | 15 | 5 | 34.7 | 44.7 |
| 233.1 | 13.2 | 6.97 | 6.92 | -1.36 | 13 | 33 | 31.94 | 15 | 5 | 34.6 | 44.7 |
| 234.1 | 13.3 | 6.98 | 6.94 | -1.40 | 13 | 33 | 32.06 | 15 | 5 | 34.6 | 44.6 |

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| Depth | (ft) | 30.0 | Standard Soil Setup |
|------------------------|-------|----------------------|---------------------|
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
|-----------|--------|---------|-----------|---------|
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | 211.0 | | |
|---------------------|----------------|----------------|-------------|-------------|------|---------------------------|----------------|---------------|-------------|-------------|-------------|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.1 | 0.050 | 0.100 | 32.63 | 4.7 | 21.4 |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 3.5 | 0.050 | 0.100 | 35.89 | 4.7 | 21.4 |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 8.5 | 0.050 | 0.100 | 39.16 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 17.1 | 0.145 | 0.100 | 42.42 | 4.7 | 21.4 |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 20.0 | 0.149 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 19.6 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 31.6 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 37.6 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 37.1 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 25.0 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 10.9 | 0.150 | 0.100 | | | |

4.533 kips total unredused pile weight (g= 32.17 ft/s2)

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 30.00 | 11.18 | 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 | |
|-------------|---------------|---------------------|---------------|----------|----|-----------------|-------|----|------------------|----------------|------|
| 211.0 | 10.1 | 6.40 | 6.43 | -1.48 | 12 | 39 | 29.66 | 13 | 4 | 34.6 | 46.5 |
| 212.0 | 10.2 | 6.42 | 6.44 | -1.43 | 12 | 39 | 29.75 | 13 | 4 | 34.6 | 46.5 |
| 213.1 | 10.2 | 6.44 | 6.46 | -1.37 | 12 | 39 | 29.87 | 13 | 4 | 34.6 | 46.4 |
| 214.2 | 10.3 | 6.45 | 6.47 | -1.30 | 12 | 39 | 30.01 | 13 | 4 | 34.6 | 46.3 |
| 215.2 | 10.4 | 6.47 | 6.49 | -1.26 | 12 | 39 | 30.08 | 13 | 4 | 34.5 | 46.3 |

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Resource International Inc

Depth (ft) 35.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 372.4 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 9 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 1.3 | 0.050 | 0.100 | 29.37 | 4.7 | 21.4 |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 6.1 | 0.050 | 0.100 | 32.63 | 4.7 | 21.4 |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 11.2 | 0.050 | 0.100 | 35.89 | 4.7 | 21.4 |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 22.9 | 0.185 | 0.100 | 39.16 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 17.3 | 0.050 | 0.100 | 42.42 | 4.7 | 21.4 |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 25.9 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 34.8 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 40.7 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 27.9 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 32.3 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 51.2 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 100.7 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 35.00 | 11.18 | 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 |
| 372.4 | 23.3 | 8.09 | 8.08 | -1.61 | 10 | 47 | 35.57 | 12 | 4 | 34.1 |
| 373.5 | 23.4 | 8.10 | 8.09 | -1.61 | 10 | 47 | 35.68 | 12 | 4 | 34.1 |
| 374.5 | 23.5 | 8.11 | 8.10 | -1.61 | 10 | 47 | 35.77 | 12 | 4 | 34.1 |
| 375.6 | 23.6 | 8.13 | 8.11 | -1.60 | 10 | 47 | 35.91 | 12 | 4 | 34.2 |
| 376.7 | 23.7 | 8.14 | 8.11 | -1.60 | 10 | 47 | 36.10 | 12 | 4 | 34.2 |

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Depth (ft) 40.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 466.3 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 7 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.2 | 0.050 | 0.100 | 22.84 | 4.7 | 21.4 |
| 8 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 3.8 | 0.050 | 0.100 | 26.11 | 4.7 | 21.4 |
| 9 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 8.8 | 0.050 | 0.100 | 29.37 | 4.7 | 21.4 |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 18.0 | 0.154 | 0.100 | 32.63 | 4.7 | 21.4 |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 19.5 | 0.139 | 0.100 | 35.89 | 4.7 | 21.4 |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 20.3 | 0.050 | 0.100 | 39.16 | 4.7 | 21.4 |

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|----------------|-------|-------|-------|-------|------|-------|-------|-------|-------|-----|------|
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 32.0 | 0.050 | 0.100 | 42.42 | 4.7 | 21.4 |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 38.0 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 36.1 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 25.1 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 45.6 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 53.0 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 56.3 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 109.6 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 40.00 | 11.18 | 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 | |
| 466.3 | 31.8 | 8.72 | 8.66 | -1.94 | 8 | 41 | 37.32 | 10 | 3 | 35.4 | 40.1 |
| 467.4 | 32.1 | 8.73 | 8.68 | -1.93 | 8 | 41 | 37.46 | 10 | 3 | 35.3 | 40.0 |
| 468.4 | 32.1 | 8.74 | 8.68 | -1.95 | 8 | 41 | 37.47 | 10 | 3 | 35.4 | 40.0 |
| 469.5 | 32.4 | 8.75 | 8.70 | -1.95 | 8 | 41 | 37.61 | 10 | 3 | 35.3 | 40.0 |
| 470.5 | 32.5 | 8.75 | 8.70 | -1.97 | 8 | 41 | 37.65 | 10 | 3 | 35.4 | 40.0 |

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| Depth | (ft) | 45.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
|-----------|--------|---------|-----------|---------|
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | Total | Capacity | Rut | (kips) | | 560.6 |
|---------------------|--------|--------|-------|-------|------|--------|----------|-------|--------|-------|-------|
| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 6 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 1.6 | 0.050 | 0.100 | 19.58 | 4.7 | 21.4 |
| 7 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 6.5 | 0.050 | 0.100 | 22.84 | 4.7 | 21.4 |
| 8 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 11.5 | 0.050 | 0.100 | 26.11 | 4.7 | 21.4 |
| 9 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 23.0 | 0.185 | 0.100 | 29.37 | 4.7 | 21.4 |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 17.6 | 0.050 | 0.100 | 32.63 | 4.7 | 21.4 |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 26.7 | 0.050 | 0.100 | 35.89 | 4.7 | 21.4 |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 35.2 | 0.050 | 0.100 | 39.16 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 41.0 | 0.050 | 0.100 | 42.42 | 4.7 | 21.4 |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 26.7 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 33.9 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 51.5 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 54.7 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 58.6 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 62.5 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 109.6 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 45.00 | 11.18 | 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 | |
| 560.6 | 44.6 | 9.24 | 9.17 | -2.37 | 7 | 38 | 38.97 | 9 | 3 | 36.3 | 38.9 |
| 561.7 | 44.6 | 9.25 | 9.16 | -2.38 | 7 | 38 | 39.04 | 9 | 3 | 36.4 | 38.9 |

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| | | | | | | | | | | | |
|-------|------|------|------|-------|---|----|-------|---|---|------|------|
| 562.7 | 45.2 | 9.26 | 9.19 | -2.35 | 7 | 38 | 39.19 | 9 | 3 | 36.2 | 38.9 |
| 563.8 | 45.2 | 9.27 | 9.18 | -2.36 | 7 | 37 | 39.28 | 9 | 3 | 36.4 | 38.9 |
| 564.9 | 45.8 | 9.28 | 9.20 | -2.33 | 7 | 37 | 39.43 | 9 | 3 | 36.3 | 38.9 |

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| | | | |
|------------------------|-------|----------------------|---------------------|
| Depth | (ft) | 50.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| No. | Weight | Stiffn | C-Slk | T-Slk | CoR | Soil-S | Soil-D | Quake | Rut | (kips) | 611.4 |
|-----|--------|--------|-------|-------|------|--------|--------|-------|-------|--------|-------|
| | kips | k/in | ft | ft | | kips | s/ft | inch | LbTop | Perim | Area |
| | | | | | | | | | ft | ft | in2 |
| 1 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 4 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.3 | 0.050 | 0.100 | 13.05 | 4.7 | 21.4 |
| 5 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 4.1 | 0.050 | 0.100 | 16.32 | 4.7 | 21.4 |
| 6 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 9.1 | 0.050 | 0.100 | 19.58 | 4.7 | 21.4 |
| 7 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 18.9 | 0.161 | 0.100 | 22.84 | 4.7 | 21.4 |
| 8 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 19.0 | 0.128 | 0.100 | 26.11 | 4.7 | 21.4 |
| 9 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 21.1 | 0.050 | 0.100 | 29.37 | 4.7 | 21.4 |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 32.4 | 0.050 | 0.100 | 32.63 | 4.7 | 21.4 |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 38.4 | 0.050 | 0.100 | 35.89 | 4.7 | 21.4 |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 35.0 | 0.050 | 0.100 | 39.16 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 25.2 | 0.050 | 0.100 | 42.42 | 4.7 | 21.4 |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 47.3 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 53.2 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 56.6 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 60.8 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 63.5 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 64.5 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 62.1 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficcy |
|-------|--------|----------|---------|
| ft | ft | Ratio | |
| 50.00 | 11.18 | 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 | |
| 611.4 | 52.2 | 9.32 | 9.27 | -1.94 | 6 35 | 39.02 | 7 3 | 35.4 |
| 612.5 | 52.8 | 9.33 | 9.28 | -1.92 | 6 35 | 39.16 | 7 3 | 35.4 |
| 613.5 | 53.4 | 9.33 | 9.29 | -1.90 | 6 35 | 39.21 | 7 3 | 35.3 |
| 614.6 | 53.2 | 9.34 | 9.28 | -1.91 | 6 35 | 39.26 | 7 3 | 35.4 |
| 615.7 | 53.8 | 9.35 | 9.29 | -1.88 | 6 35 | 39.38 | 7 3 | 35.4 |

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| | | | |
|------------------------|-------|----------------------|---------------------|
| Depth | (ft) | 55.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

Pile and Soil Model Total Capacity Rut (kips) 758.1

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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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.53 | 4.7 | 21.4 |
| 3 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 1.8 | 0.050 | 0.100 | 9.79 | 4.7 | 21.4 |
| 4 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 6.8 | 0.050 | 0.100 | 13.05 | 4.7 | 21.4 |
| 5 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 11.9 | 0.052 | 0.100 | 16.32 | 4.7 | 21.4 |
| 6 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 23.1 | 0.185 | 0.100 | 19.58 | 4.7 | 21.4 |
| 7 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 17.9 | 0.050 | 0.100 | 22.84 | 4.7 | 21.4 |
| 8 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 27.5 | 0.050 | 0.100 | 26.11 | 4.7 | 21.4 |
| 9 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 35.6 | 0.050 | 0.100 | 29.37 | 4.7 | 21.4 |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 41.4 | 0.050 | 0.100 | 32.63 | 4.7 | 21.4 |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 25.5 | 0.050 | 0.100 | 35.89 | 4.7 | 21.4 |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 35.5 | 0.050 | 0.100 | 39.16 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 51.7 | 0.050 | 0.100 | 42.42 | 4.7 | 21.4 |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 55.0 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 58.9 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 62.7 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 63.6 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 66.9 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 71.8 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |
| Toe | | | | | | 100.7 | 0.150 | 0.100 | | | |

4.533 kips total unredacted pile weight (g= 32.17 ft/s2)

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy Ratio |
|-------------|--------------|-------------------|-----------------|
| 55.00 | 11.18 | 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 |
|-------------|---------------|---------------------|---------------|-------|---|----|-----------------|---|---|------------------|----------------|
| 758.1 | 113.6 | 9.96 | 9.87 | -1.70 | 5 | 32 | 40.77 | 6 | 3 | 37.0 | 37.6 |
| 759.2 | 119.3 | 9.86 | 9.85 | -1.69 | 5 | 32 | 40.60 | 6 | 3 | 36.5 | 37.7 |
| 760.3 | 120.3 | 9.85 | 9.84 | -1.68 | 5 | 32 | 40.59 | 6 | 3 | 36.5 | 37.7 |
| 761.3 | 123.1 | 9.87 | 9.86 | -1.63 | 5 | 32 | 40.76 | 6 | 3 | 36.3 | 37.7 |
| 762.4 | 123.3 | 9.86 | 9.84 | -1.64 | 5 | 32 | 40.76 | 6 | 3 | 36.4 | 37.7 |

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| Depth ft | (ft) | 60.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| Toe Area in2 | (in2) | 144.000 | Pile Type | Unknown |
|-------------------|--------|---------|-----------|---------|
| Pile Size inch | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| 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 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 0.4 | 0.050 | 0.100 | 3.26 | 4.7 | 21.4 |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 4.4 | 0.050 | 0.100 | 6.53 | 4.7 | 21.4 |
| 3 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 9.5 | 0.050 | 0.100 | 9.79 | 4.7 | 21.4 |
| 4 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 19.8 | 0.168 | 0.100 | 13.05 | 4.7 | 21.4 |
| 5 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 18.5 | 0.115 | 0.100 | 16.32 | 4.7 | 21.4 |
| 6 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 21.8 | 0.050 | 0.100 | 19.58 | 4.7 | 21.4 |
| 7 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 32.8 | 0.050 | 0.100 | 22.84 | 4.7 | 21.4 |
| 8 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 38.7 | 0.050 | 0.100 | 26.11 | 4.7 | 21.4 |
| 9 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 33.9 | 0.050 | 0.100 | 29.37 | 4.7 | 21.4 |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 25.3 | 0.050 | 0.100 | 32.63 | 4.7 | 21.4 |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 49.0 | 0.050 | 0.100 | 35.89 | 4.7 | 21.4 |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 53.4 | 0.050 | 0.100 | 39.16 | 4.7 | 21.4 |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 56.9 | 0.050 | 0.100 | 42.42 | 4.7 | 21.4 |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 61.1 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 63.5 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 64.7 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 69.8 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 73.5 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 76.8 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 |

Toe 100.7 0.150 0.100

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 60.00 | 11.18 | 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 |
|-------------|---------------|---------------------|---------------|-------|---|----|-----------------|---|---|------------------|----------------|
| 874.5 | 301.9 | 10.16 | 10.15 | -0.52 | 3 | 30 | 41.12 | 4 | 2 | 36.6 | 37.2 |
| 875.6 | 308.1 | 10.16 | 10.15 | -0.51 | 3 | 30 | 41.18 | 4 | 2 | 36.5 | 37.2 |
| 876.7 | 312.5 | 10.16 | 10.14 | -0.51 | 3 | 30 | 41.20 | 4 | 2 | 36.5 | 37.2 |
| 877.7 | 319.1 | 10.16 | 10.14 | -0.50 | 3 | 30 | 41.27 | 4 | 2 | 36.5 | 37.2 |
| 878.8 | 325.5 | 10.16 | 10.14 | -0.50 | 3 | 30 | 41.29 | 4 | 2 | 36.5 | 37.2 |

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| Depth (ft) | 62.0 | Standard Soil Setup |
|------------------------|-------|----------------------------|
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor 1.000 |

PILE PROFILE:

| Toe Area in ² | 144.000 | Pile Type | Unknown |
|-----------------------------|---------|-----------|---------|
| Pile Size (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 62.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.504

| Pile and Soil Model | | | | | | | | | | Total Capacity | Rut (kips) | 923.2 |
|---------------------|----------------|----------------|-------------|-------------|------|----------------|----------------|---------------|-------------|----------------|-------------------------|-------|
| 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 in ² | |
| 1 | 0.239 | 15849 | 0.010 | 0.000 | 0.85 | 2.5 | 0.050 | 0.100 | 3.26 | 4.7 | 21.4 | |
| 2 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 7.5 | 0.050 | 0.100 | 6.53 | 4.7 | 21.4 | |
| 3 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 14.2 | 0.107 | 0.100 | 9.79 | 4.7 | 21.4 | |
| 4 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 21.7 | 0.172 | 0.100 | 13.05 | 4.7 | 21.4 | |
| 5 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 18.5 | 0.050 | 0.100 | 16.32 | 4.7 | 21.4 | |
| 6 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 29.4 | 0.050 | 0.100 | 19.58 | 4.7 | 21.4 | |
| 7 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 36.4 | 0.050 | 0.100 | 22.84 | 4.7 | 21.4 | |
| 8 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 40.2 | 0.050 | 0.100 | 26.11 | 4.7 | 21.4 | |
| 9 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 24.7 | 0.050 | 0.100 | 29.37 | 4.7 | 21.4 | |
| 10 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 39.1 | 0.050 | 0.100 | 32.63 | 4.7 | 21.4 | |
| 11 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 52.1 | 0.050 | 0.100 | 35.89 | 4.7 | 21.4 | |
| 12 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 55.4 | 0.050 | 0.100 | 39.16 | 4.7 | 21.4 | |
| 13 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 59.5 | 0.050 | 0.100 | 42.42 | 4.7 | 21.4 | |
| 14 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 63.3 | 0.050 | 0.100 | 45.68 | 4.7 | 21.4 | |
| 15 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 63.6 | 0.050 | 0.100 | 48.95 | 4.7 | 21.4 | |
| 16 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 67.7 | 0.050 | 0.100 | 52.21 | 4.7 | 21.4 | |
| 17 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 72.3 | 0.050 | 0.100 | 55.47 | 4.7 | 21.4 | |
| 18 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 75.6 | 0.050 | 0.100 | 58.74 | 4.7 | 21.4 | |
| 19 | 0.239 | 15849 | 0.000 | 0.000 | 1.00 | 78.8 | 0.050 | 0.100 | 62.00 | 4.7 | 21.4 | |
| Toe | | | | | | 100.7 | 0.150 | 0.100 | | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 62.00 | 11.18 | 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 |
|-------------|---------------|---------------------|---------------|------|---|----|-----------------|---|---|------------------|----------------|
| 923.2 | 536.1 | 10.31 | 10.23 | 0.00 | 1 | 0 | 40.81 | 3 | 2 | 36.5 | 37.0 |
| 924.3 | 550.7 | 10.30 | 10.22 | 0.00 | 1 | 0 | 40.84 | 3 | 2 | 36.5 | 37.0 |
| 925.4 | 565.7 | 10.30 | 10.22 | 0.00 | 1 | 0 | 40.89 | 3 | 2 | 36.5 | 37.0 |
| 926.4 | 579.2 | 10.30 | 10.21 | 0.00 | 1 | 0 | 40.95 | 3 | 2 | 36.5 | 37.0 |
| 927.5 | 597.5 | 10.29 | 10.20 | 0.00 | 2 | 46 | 40.96 | 3 | 2 | 36.5 | 37.0 |

SUMMARY OVER DEPTHS

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
| 5.0 | 15.1 | 5.9 | 9.2 | Hammer | did not | run | | |
| 10.0 | 29.5 | 25.8 | 3.7 | 1.4 | 12.573 | -1.301 | 3.68 | 44.0 |
| 15.0 | 74.3 | 56.4 | 17.9 | 3.6 | 21.636 | -1.007 | 4.88 | 40.4 |
| 20.0 | 155.7 | 98.1 | 57.6 | 8.5 | 28.037 | -1.382 | 6.10 | 35.8 |
| 25.0 | 229.9 | 157.5 | 72.4 | 12.8 | 31.552 | -1.281 | 6.92 | 34.7 |
| 30.0 | 211.0 | 200.0 | 10.9 | 10.1 | 29.660 | -1.484 | 6.40 | 34.6 |
| 35.0 | 372.4 | 271.7 | 100.7 | 23.3 | 35.569 | -1.610 | 8.09 | 34.1 |
| 40.0 | 466.3 | 356.7 | 109.6 | 31.8 | 37.324 | -1.942 | 8.72 | 35.4 |
| 45.0 | 560.6 | 451.0 | 109.6 | 44.6 | 38.968 | -2.370 | 9.24 | 36.3 |
| 50.0 | 611.4 | 549.3 | 62.1 | 52.2 | 39.022 | -1.943 | 9.32 | 35.4 |
| 55.0 | 758.1 | 657.4 | 100.7 | 113.6 | 40.769 | -1.700 | 9.96 | 37.0 |
| 60.0 | 874.5 | 773.8 | 100.7 | 301.9 | 41.123 | -0.522 | 10.16 | 36.6 |
| 62.0 | 923.2 | 822.5 | 100.7 | 536.1 | 40.807 | 0.000 | 10.31 | 36.5 |

Total Driving Time 81 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 3099

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
| 5.0 | 15.1 | 5.9 | 9.2 | Hammer | did not | run | | |
| 10.0 | 29.8 | 26.1 | 3.7 | 1.4 | 12.597 | -1.303 | 3.69 | 44.0 |
| 15.0 | 75.3 | 57.5 | 17.9 | 3.6 | 21.786 | -1.022 | 4.90 | 40.3 |
| 20.0 | 156.8 | 99.2 | 57.6 | 8.6 | 28.123 | -1.322 | 6.12 | 35.7 |
| 25.0 | 230.9 | 158.6 | 72.4 | 13.0 | 31.623 | -1.300 | 6.94 | 34.6 |
| 30.0 | 212.0 | 201.1 | 10.9 | 10.2 | 29.753 | -1.426 | 6.42 | 34.6 |
| 35.0 | 373.5 | 272.8 | 100.7 | 23.4 | 35.684 | -1.608 | 8.10 | 34.1 |
| 40.0 | 467.4 | 357.7 | 109.6 | 32.1 | 37.460 | -1.934 | 8.73 | 35.3 |
| 45.0 | 561.7 | 452.1 | 109.6 | 44.6 | 39.035 | -2.379 | 9.25 | 36.4 |
| 50.0 | 612.5 | 550.4 | 62.1 | 52.8 | 39.156 | -1.924 | 9.33 | 35.4 |
| 55.0 | 759.2 | 658.5 | 100.7 | 119.3 | 40.597 | -1.691 | 9.86 | 36.5 |
| 60.0 | 875.6 | 774.9 | 100.7 | 308.1 | 41.184 | -0.514 | 10.16 | 36.5 |
| 62.0 | 924.3 | 823.6 | 100.7 | 550.7 | 40.839 | 0.000 | 10.30 | 36.5 |

Total Driving Time 83 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 3172

SUMMARY OVER DEPTHS

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
| 5.0 | 15.1 | 5.9 | 9.2 | Hammer | did not | run | | |
| 10.0 | 30.1 | 26.4 | 3.7 | 1.4 | 12.819 | -1.558 | 3.74 | 44.3 |
| 15.0 | 76.4 | 58.5 | 17.9 | 3.7 | 21.927 | -0.954 | 4.93 | 40.2 |
| 20.0 | 157.9 | 100.2 | 57.6 | 8.7 | 28.216 | -1.268 | 6.13 | 35.7 |
| 25.0 | 232.0 | 159.6 | 72.4 | 13.1 | 31.809 | -1.327 | 6.96 | 34.7 |
| 30.0 | 213.1 | 202.2 | 10.9 | 10.2 | 29.874 | -1.374 | 6.44 | 34.6 |
| 35.0 | 374.5 | 273.8 | 100.7 | 23.5 | 35.768 | -1.607 | 8.11 | 34.1 |
| 40.0 | 468.4 | 358.8 | 109.6 | 32.1 | 37.469 | -1.954 | 8.74 | 35.4 |
| 45.0 | 562.7 | 453.1 | 109.6 | 45.2 | 39.191 | -2.347 | 9.26 | 36.2 |
| 50.0 | 613.5 | 551.5 | 62.1 | 53.4 | 39.213 | -1.900 | 9.33 | 35.3 |
| 55.0 | 760.3 | 659.6 | 100.7 | 120.3 | 40.595 | -1.683 | 9.85 | 36.5 |
| 60.0 | 876.7 | 776.0 | 100.7 | 312.5 | 41.197 | -0.509 | 10.16 | 36.5 |
| 62.0 | 925.4 | 824.7 | 100.7 | 565.7 | 40.893 | 0.000 | 10.30 | 36.5 |

Total Driving Time 84 minutes;
Starting at penetration 5.0 ft

Total No. of Blows 3213

| Depth | Rut | G/L at Frictn | Shaft and End Bg | Toe: Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
|-------|-------|---------------|------------------|------------|---------|---------|--------|--------|
| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
| 5.0 | 15.1 | 5.9 | 9.2 | Hammer | did not | run | | |
| 10.0 | 30.4 | 26.7 | 3.7 | 1.4 | 12.719 | -1.388 | 3.71 | 44.0 |
| 15.0 | 77.5 | 59.6 | 17.9 | 3.8 | 22.110 | -0.994 | 4.96 | 40.1 |
| 20.0 | 158.9 | 101.3 | 57.6 | 8.8 | 28.290 | -1.214 | 6.14 | 35.6 |
| 25.0 | 233.1 | 160.7 | 72.4 | 13.2 | 31.941 | -1.363 | 6.97 | 34.6 |
| 30.0 | 214.2 | 203.2 | 10.9 | 10.3 | 30.012 | -1.298 | 6.45 | 34.6 |
| 35.0 | 375.6 | 274.9 | 100.7 | 23.6 | 35.913 | -1.604 | 8.13 | 34.2 |
| 40.0 | 469.5 | 359.9 | 109.6 | 32.4 | 37.608 | -1.950 | 8.75 | 35.3 |

| | | | | | | | | |
|----------------|-------|-------|-------|-------|--------|--------|-------|------|
| 1323C-RA-14X73 | | | | | | | | |
| 45.0 | 563.8 | 454.2 | 109.6 | 45.2 | 39.282 | -2.363 | 9.27 | 36.4 |
| 50.0 | 614.6 | 552.5 | 62.1 | 53.2 | 39.264 | -1.905 | 9.34 | 35.4 |
| 55.0 | 761.3 | 660.6 | 100.7 | 123.1 | 40.763 | -1.632 | 9.87 | 36.3 |
| 60.0 | 877.7 | 777.0 | 100.7 | 319.1 | 41.266 | -0.501 | 10.16 | 36.5 |
| 62.0 | 926.4 | 825.7 | 100.7 | 579.2 | 40.953 | 0.000 | 10.30 | 36.5 |

Total Driving Time 86 minutes; Total No. of Blows 3268
Starting at penetration 5.0 ft

▲
FRA-70-1323C - Rear Abutment - HP14x73 02/28/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

| Depth ft | Rut kips | G/L at Frictn kips | Shaft and End Bg kips | Toe: Bl Ct bl/ft | 0.736 Com Str ksi | 1.000 Ten Str ksi | Stroke ft | ENTHRU kip-ft |
|-------------|-------------|--------------------------|-----------------------------|------------------------|-------------------------|-------------------------|--------------|------------------|
| | | | | | | | | |
| 5.0 | 15.1 | 5.9 | 9.2 | Hammer | did not | run | | |
| 10.0 | 30.7 | 27.0 | 3.7 | 1.4 | 12.815 | -1.480 | 3.72 | 44.2 |
| 15.0 | 78.5 | 60.7 | 17.9 | 3.9 | 22.210 | -0.909 | 4.98 | 39.9 |
| 20.0 | 160.0 | 102.4 | 57.6 | 8.8 | 28.438 | -1.169 | 6.16 | 35.6 |
| 25.0 | 234.1 | 161.8 | 72.4 | 13.3 | 32.058 | -1.398 | 6.98 | 34.6 |
| 30.0 | 215.2 | 204.3 | 10.9 | 10.4 | 30.076 | -1.258 | 6.47 | 34.5 |
| 35.0 | 376.7 | 276.0 | 100.7 | 23.7 | 36.099 | -1.604 | 8.14 | 34.2 |
| 40.0 | 470.5 | 360.9 | 109.6 | 32.5 | 37.646 | -1.968 | 8.75 | 35.4 |
| 45.0 | 564.9 | 455.2 | 109.6 | 45.8 | 39.429 | -2.332 | 9.28 | 36.3 |
| 50.0 | 615.7 | 553.6 | 62.1 | 53.8 | 39.376 | -1.880 | 9.35 | 35.4 |
| 55.0 | 762.4 | 661.7 | 100.7 | 123.3 | 40.763 | -1.645 | 9.86 | 36.4 |
| 60.0 | 878.8 | 778.1 | 100.7 | 325.5 | 41.289 | -0.495 | 10.16 | 36.5 |
| 62.0 | 927.5 | 826.8 | 100.7 | 597.5 | 40.962 | -0.001 | 10.29 | 36.5 |

Total Driving Time 87 minutes; Total No. of Blows 3318
Starting at penetration 5.0 ft

▲
FRA-70-1323C - Rear Abutment - HP14x73 02/28/2021
Resource International Inc GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

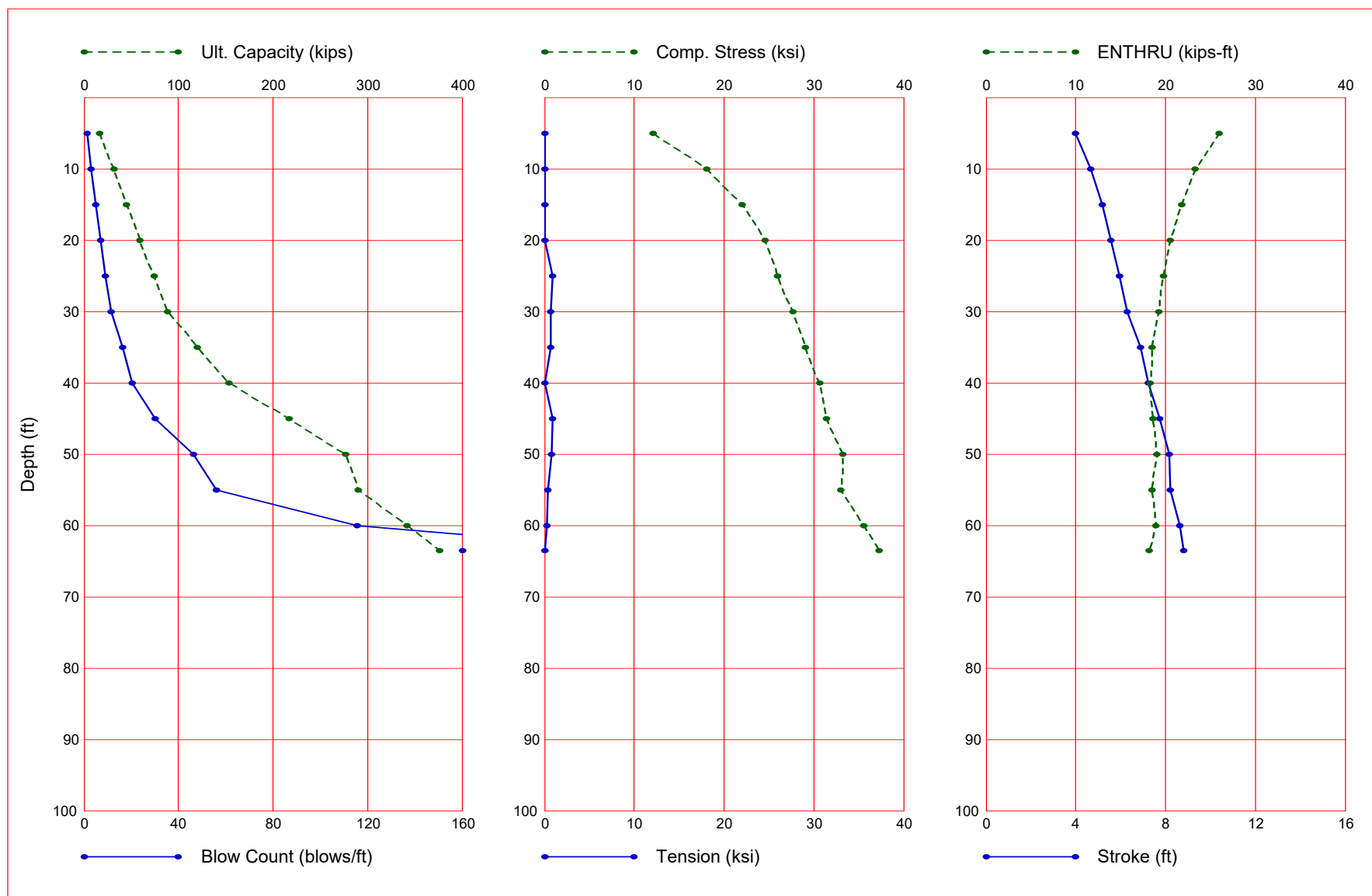
| Depth ft | Temp. Length ft | Wait Time hr | Equivalent Stroke ft | Pressure Ratio | Efficy. | Stiffn. Factor | Cushion CoR |
|-------------|-----------------------|--------------------|----------------------------|-------------------|---------|-------------------|----------------|
| 5.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 10.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 15.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 20.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 25.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 30.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 35.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 40.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 45.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 50.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 55.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 60.00 | 62.00 | 0.00 | 11.18 | 1.00 | 0.80 | 1.00 | 1.00 |
| 62.00 | 62.00 | 0.00 | 11.18 | 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 | 0.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.01 | 0.90 | 16.65 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.29 | 0.93 | 17.17 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 9.31 | 2.75 | 3.68 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 11.79 | 2.75 | 3.68 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 11.81 | 0.97 | 14.04 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 16.79 | 1.38 | 20.01 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 16.81 | 1.85 | 47.78 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 24.49 | 2.77 | 71.50 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 24.51 | 2.77 | 71.55 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 25.79 | 2.85 | 73.67 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 25.81 | 1.56 | 10.93 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 30.79 | 1.70 | 10.93 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 30.81 | 3.17 | 100.70 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 39.79 | 3.76 | 100.70 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 39.81 | 3.82 | 109.62 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 45.79 | 4.25 | 109.62 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 45.81 | 4.05 | 62.06 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 50.79 | 4.36 | 62.06 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |

| 1323C-RA-14X73 | | | | | | | | | |
|----------------|------|--------|-------|-------|-------|-------|-------|-------|-------|
| 50.81 | 4.51 | 100.70 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 59.81 | 5.10 | 100.70 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 62.00 | 5.25 | 100.70 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |

Gain/Loss 3 at Shaft and Toe 0.670 / 1.000



Gain/Loss 3 at Shaft and Toe 0.670 / 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 | 16.8 | 15.2 | 1.5 | 1.6 | 12.056 | 0.000 | 3.99 | 26.0 |
| 10.0 | 31.4 | 30.3 | 1.2 | 3.2 | 18.076 | 0.000 | 4.69 | 23.3 |
| 15.0 | 45.2 | 44.0 | 1.2 | 5.0 | 21.978 | 0.000 | 5.20 | 21.8 |
| 20.0 | 59.4 | 57.9 | 1.5 | 6.9 | 24.606 | 0.000 | 5.55 | 20.5 |
| 25.0 | 74.6 | 73.1 | 1.5 | 9.1 | 25.971 | -0.940 | 5.97 | 19.8 |
| 30.0 | 88.9 | 88.1 | 0.8 | 11.4 | 27.699 | -0.731 | 6.31 | 19.2 |
| 35.0 | 119.6 | 101.9 | 17.7 | 16.5 | 29.041 | -0.648 | 6.87 | 18.5 |
| 40.0 | 153.8 | 136.0 | 17.7 | 20.6 | 30.682 | 0.000 | 7.22 | 18.3 |
| 45.0 | 217.2 | 181.2 | 36.0 | 30.3 | 31.425 | -0.855 | 7.74 | 18.6 |
| 50.0 | 276.5 | 233.1 | 43.4 | 46.5 | 33.231 | -0.848 | 8.15 | 19.0 |
| 55.0 | 289.7 | 286.0 | 3.7 | 55.9 | 33.034 | -0.387 | 8.21 | 18.5 |
| 60.0 | 341.5 | 337.8 | 3.7 | 115.5 | 35.558 | -0.231 | 8.64 | 18.9 |
| 63.5 | 375.9 | 372.2 | 3.7 | 241.5 | 37.265 | 0.000 | 8.79 | 18.2 |

Total Continuous Driving Time 47.00 minutes; Total Number of Blows 1945 (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\2013\W-13-072 FRA-70-13.10 PROJECT 6A\ANALYSIS\FRA-70-1322L AND 1323C\DRIVEABILITY\FRA-70-1323C\FORWARD
ABUTMENT\HP 10X42\1323C-FA-10X42.GMW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-1323C - For Abutment - 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 32.170 144.000 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
63.500 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 | 1.38 | 1.55 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 9.01 | 1.39 | 1.55 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 9.19 | 1.39 | 1.55 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 9.21 | 1.24 | 1.16 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 18.21 | 1.25 | 1.16 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 19.69 | 1.26 | 1.16 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 19.71 | 1.37 | 1.45 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 28.71 | 1.38 | 1.45 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 29.69 | 1.40 | 1.45 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 29.71 | 0.92 | 0.77 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 34.19 | 0.92 | 0.77 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 34.21 | 1.96 | 17.74 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 41.19 | 2.19 | 17.74 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 41.21 | 2.83 | 35.96 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 46.19 | 3.06 | 35.96 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 46.21 | 3.09 | 43.36 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 51.19 | 3.34 | 43.36 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 51.21 | 4.75 | 3.68 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 60.21 | 4.66 | 3.68 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 63.50 | 4.20 | 3.68 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |

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 |
| 63.50 | 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-70-1323C - For Abutment - 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 | | 8966.4 | | | |

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-70-1323C - For Abutment - HP10x42 02/28/2021
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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 5.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 63.5 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) 15.3 | | | | | |
|---------------------|--------|--------|-------|-------|------|--------------------------------|--------|-------|-------|-------|------|
| 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 | 0.142 | 8966 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 3.3 | 12.4 |
| 2 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 3.3 | 12.4 |
| 18 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 4.5 | 0.200 | 0.100 | 60.16 | 3.3 | 12.4 |
| 19 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 63.50 | 3.3 | 12.4 |
| Toe | | | | | | 1.5 | 0.150 | 0.100 | | | |

2.690 kips total unreduced pile weight (g= 32.17 ft/s2)
 2.690 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 |

FRA-70-1323C - For Abutment - HP10x42 02/28/2021
 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 | |
| 15.3 | 1.6 | 3.87 | 3.89 | 0.00 | 1 0 | 11.21 | 1 7 | 25.9 |
| 16.0 | 1.6 | 3.95 | 3.92 | 0.00 | 1 0 | 11.61 | 1 2 | 26.0 |
| 16.8 | 1.6 | 3.99 | 3.96 | 0.00 | 1 0 | 12.06 | 1 2 | 26.0 |
| 17.5 | 1.7 | 4.03 | 4.00 | 0.00 | 1 0 | 12.50 | 1 2 | 25.9 |
| 18.3 | 1.8 | 4.07 | 4.04 | 0.00 | 1 0 | 12.88 | 1 2 | 25.8 |

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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 10.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
| Pile Size | (inch) | 10.000 | | |

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| 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 |
| 63.5 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 28.4 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|------|
| 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 | 0.142 | 8966 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 3.3 | 12.4 |
| 2 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 3.3 | 12.4 |
| 17 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.1 | 0.200 | 0.100 | 56.82 | 3.3 | 12.4 |
| 18 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 60.16 | 3.3 | 12.4 |
| 19 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.0 | 0.200 | 0.100 | 63.50 | 3.3 | 12.4 |
| Toe | | | | | | 1.2 | 0.150 | 0.100 | | | |

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

2.690 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 |

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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 | |
| 28.4 | 2.9 | 4.56 | 4.54 | 0.00 | 1 0 | 17.16 | 1 2 | 23.8 |
| 29.9 | 3.0 | 4.63 | 4.61 | 0.00 | 1 0 | 17.68 | 1 2 | 23.6 |
| 31.4 | 3.2 | 4.69 | 4.67 | 0.00 | 1 0 | 18.08 | 2 2 | 23.3 |
| 32.9 | 3.4 | 4.75 | 4.73 | 0.00 | 1 0 | 18.48 | 4 3 | 23.2 |
| 34.4 | 3.6 | 4.81 | 4.79 | 0.00 | 1 0 | 18.84 | 5 3 | 23.0 |

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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 15.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 63.5 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 40.9 |
|---------------------|--------|--------|-------|-------|------|--------|--------|-------|-------|---------------------------|------|
| 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 | 0.142 | 8966 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 3.3 | 12.4 |
| 2 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 3.3 | 12.4 |
| 15 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 4.5 | 0.200 | 0.100 | 50.13 | 3.3 | 12.4 |
| 16 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 53.47 | 3.3 | 12.4 |
| 17 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 56.82 | 3.3 | 12.4 |
| 18 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.5 | 0.200 | 0.100 | 60.16 | 3.3 | 12.4 |
| 19 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.3 | 0.200 | 0.100 | 63.50 | 3.3 | 12.4 |
| Toe | | | | | | 1.2 | 0.150 | 0.100 | | | |

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

2.690 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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| 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 | |
| 40.9 | 4.4 | 5.05 | 5.02 | 0.00 | 1 0 | 20.93 | 15 5 | 22.2 |
| 43.0 | 4.7 | 5.13 | 5.10 | 0.00 | 1 0 | 21.47 | 15 5 | 22.0 |

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| | | | | | | | | | | | |
|------|-----|------|------|------|---|---|-------|----|---|------|------|
| 45.2 | 5.0 | 5.20 | 5.17 | 0.00 | 1 | 0 | 21.98 | 15 | 5 | 21.8 | 51.9 |
| 47.4 | 5.3 | 5.26 | 5.23 | 0.00 | 1 | 0 | 22.50 | 15 | 5 | 21.6 | 51.5 |
| 49.5 | 5.6 | 5.33 | 5.30 | 0.00 | 1 | 0 | 22.97 | 15 | 5 | 21.4 | 51.2 |

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Depth (ft) 20.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 144.000 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 |
| 63.5 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 53.7 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.142 | 8966 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 3.3 | 12.4 |
| 2 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 3.3 | 12.4 |
| 14 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.0 | 0.200 | 0.100 | 46.79 | 3.3 | 12.4 |
| 15 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 50.13 | 3.3 | 12.4 |
| 16 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.0 | 0.200 | 0.100 | 53.47 | 3.3 | 12.4 |
| 17 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.3 | 0.200 | 0.100 | 56.82 | 3.3 | 12.4 |
| 18 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.3 | 0.200 | 0.100 | 60.16 | 3.3 | 12.4 |
| 19 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.4 | 0.200 | 0.100 | 63.50 | 3.3 | 12.4 |
| Toe | | | | | | 1.5 | 0.150 | 0.100 | | | |

2.690 kips total unredueed pile weight (g= 32.17 ft/s2)
 2.690 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 |
| 53.7 | 6.1 | 5.45 | 5.43 | 0.00 | 1 | 0 | 23.90 | 14 | 5 | 21.1 |
| 56.5 | 6.5 | 5.53 | 5.52 | 0.00 | 1 | 0 | 24.34 | 14 | 5 | 20.8 |
| 59.4 | 6.9 | 5.55 | 5.60 | 0.00 | 1 | 0 | 24.61 | 14 | 5 | 20.5 |
| 62.2 | 7.4 | 5.63 | 5.69 | -0.16 | 14 | 50 | 25.06 | 14 | 5 | 20.3 |
| 65.1 | 7.8 | 5.72 | 5.75 | -0.54 | 14 | 48 | 25.53 | 14 | 5 | 20.2 |

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Depth (ft) 25.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 144.000 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 |
| 63.5 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 67.4 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.142 | 8966 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 3.3 | 12.4 |
| 2 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 3.3 | 12.4 |
| 12 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 4.4 | 0.200 | 0.100 | 40.11 | 3.3 | 12.4 |
| 13 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 43.45 | 3.3 | 12.4 |
| 14 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 46.79 | 3.3 | 12.4 |
| 15 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.5 | 0.200 | 0.100 | 50.13 | 3.3 | 12.4 |
| 16 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.3 | 0.200 | 0.100 | 53.47 | 3.3 | 12.4 |
| 17 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.3 | 0.200 | 0.100 | 56.82 | 3.3 | 12.4 |

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| | | | | | | | | | | | |
|-----|-------|------|-------|-------|------|-----|-------|-------|-------|-----|------|
| 18 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.8 | 0.200 | 0.100 | 60.16 | 3.3 | 12.4 |
| 19 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 63.50 | 3.3 | 12.4 |
| Toe | | | | | | 1.5 | 0.150 | 0.100 | | | |

2.690 kips total unreduced pile weight (g= 32.17 ft/s2)
 2.690 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 |
| 67.4 | 8.1 | 5.79 | 5.83 | -0.72 | 12 | 47 | 25.09 | 12 | 4 | 20.0 |
| 71.0 | 8.6 | 5.88 | 5.91 | -0.91 | 12 | 47 | 25.54 | 12 | 4 | 19.9 |
| 74.6 | 9.1 | 5.97 | 6.00 | -0.94 | 12 | 47 | 25.97 | 12 | 4 | 19.8 |
| 78.2 | 9.7 | 6.06 | 6.08 | -0.86 | 12 | 47 | 26.37 | 12 | 4 | 19.6 |
| 81.8 | 10.3 | 6.14 | 6.16 | -0.68 | 11 | 47 | 26.76 | 12 | 4 | 19.5 |

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| | | | |
|------------------------|------|-------|----------------------------|
| Depth | (ft) | 30.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 63.5 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | | 80.2 |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.142 | 8966 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 3.3 | 12.4 |
| 2 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 3.3 | 12.4 |
| 11 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.9 | 0.200 | 0.100 | 36.76 | 3.3 | 12.4 |
| 12 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 40.11 | 3.3 | 12.4 |
| 13 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.0 | 0.200 | 0.100 | 43.45 | 3.3 | 12.4 |
| 14 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.3 | 0.200 | 0.100 | 46.79 | 3.3 | 12.4 |
| 15 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.3 | 0.200 | 0.100 | 50.13 | 3.3 | 12.4 |
| 16 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.4 | 0.200 | 0.100 | 53.47 | 3.3 | 12.4 |
| 17 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 56.82 | 3.3 | 12.4 |
| 18 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 60.16 | 3.3 | 12.4 |
| 19 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.9 | 0.200 | 0.100 | 63.50 | 3.3 | 12.4 |
| Toe | | | | | | 0.8 | 0.150 | 0.100 | | | |

2.690 kips total unreduced pile weight (g= 32.17 ft/s2)
 2.690 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 |
| 80.2 | 10.0 | 6.12 | 6.14 | -0.85 | 11 | 46 | 26.83 | 11 | 4 | 19.5 |
| 84.5 | 10.7 | 6.22 | 6.23 | -0.55 | 10 | 46 | 27.26 | 11 | 4 | 19.3 |
| 88.9 | 11.4 | 6.31 | 6.32 | -0.73 | 11 | 41 | 27.70 | 11 | 4 | 19.2 |
| 93.2 | 12.1 | 6.40 | 6.41 | -0.86 | 11 | 41 | 28.14 | 11 | 4 | 19.0 |
| 97.6 | 12.9 | 6.48 | 6.50 | -0.87 | 11 | 41 | 28.53 | 11 | 4 | 18.9 |

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| | | | |
|------------------------|------|-------|----------------------------|
| Depth | (ft) | 35.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor 1.000 |

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 63.5 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.686

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 110.1 |
|-----|--------|------------------------|---------------------|-------|--------|-------|
| | 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 | 0.142 | 8966 0.010 0.000 0.85 | 0.0 0.000 0.100 | 3.34 | 3.3 | 12.4 |
| 2 | 0.142 | 8966 0.000 0.000 1.00 | 0.0 0.000 0.100 | 6.68 | 3.3 | 12.4 |
| 9 | 0.142 | 8966 0.000 0.000 1.00 | 4.3 0.200 0.100 | 30.08 | 3.3 | 12.4 |
| 10 | 0.142 | 8966 0.000 0.000 1.00 | 9.2 0.200 0.100 | 33.42 | 3.3 | 12.4 |
| 11 | 0.142 | 8966 0.000 0.000 1.00 | 9.2 0.200 0.100 | 36.76 | 3.3 | 12.4 |
| 12 | 0.142 | 8966 0.000 0.000 1.00 | 8.6 0.200 0.100 | 40.11 | 3.3 | 12.4 |
| 13 | 0.142 | 8966 0.000 0.000 1.00 | 8.3 0.200 0.100 | 43.45 | 3.3 | 12.4 |
| 14 | 0.142 | 8966 0.000 0.000 1.00 | 8.3 0.200 0.100 | 46.79 | 3.3 | 12.4 |
| 15 | 0.142 | 8966 0.000 0.000 1.00 | 8.8 0.200 0.100 | 50.13 | 3.3 | 12.4 |
| 16 | 0.142 | 8966 0.000 0.000 1.00 | 9.2 0.200 0.100 | 53.47 | 3.3 | 12.4 |
| 17 | 0.142 | 8966 0.000 0.000 1.00 | 9.2 0.200 0.100 | 56.82 | 3.3 | 12.4 |
| 18 | 0.142 | 8966 0.000 0.000 1.00 | 7.4 0.200 0.100 | 60.16 | 3.3 | 12.4 |
| 19 | 0.142 | 8966 0.000 0.000 1.00 | 9.9 0.140 0.100 | 63.50 | 3.3 | 12.4 |
| Toe | | | 17.7 0.150 0.100 | | | |

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

2.690 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 |
| 110.1 | 14.6 | 6.72 6.66 | -0.40 | 9 | 35 28.36 | 9 | 4 18.8 | 45.6 |
| 114.9 | 15.6 | 6.80 6.75 | -0.61 | 9 | 35 28.69 | 9 | 4 18.7 | 45.3 |
| 119.6 | 16.5 | 6.87 6.84 | -0.65 | 9 | 35 29.04 | 9 | 4 18.5 | 45.0 |
| 124.4 | 17.3 | 6.95 6.92 | -0.48 | 9 | 35 29.35 | 9 | 4 18.5 | 44.8 |
| 129.1 | 18.1 | 7.03 6.99 | -0.19 | 9 | 34 29.66 | 9 | 4 18.4 | 44.5 |



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| Depth | (ft) | 40.0 | Standard Soil Setup |
|------------------------|------|-------|----------------------|
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 63.5 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.686

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 144.2 |
|-----|--------|------------------------|---------------------|-------|--------|-------|
| | 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 | 0.142 | 8966 0.010 0.000 0.85 | 0.0 0.000 0.100 | 3.34 | 3.3 | 12.4 |
| 2 | 0.142 | 8966 0.000 0.000 1.00 | 0.0 0.000 0.100 | 6.68 | 3.3 | 12.4 |
| 8 | 0.142 | 8966 0.000 0.000 1.00 | 8.9 0.200 0.100 | 26.74 | 3.3 | 12.4 |
| 9 | 0.142 | 8966 0.000 0.000 1.00 | 9.2 0.200 0.100 | 30.08 | 3.3 | 12.4 |
| 10 | 0.142 | 8966 0.000 0.000 1.00 | 9.0 0.200 0.100 | 33.42 | 3.3 | 12.4 |
| 11 | 0.142 | 8966 0.000 0.000 1.00 | 8.3 0.200 0.100 | 36.76 | 3.3 | 12.4 |
| 12 | 0.142 | 8966 0.000 0.000 1.00 | 8.3 0.200 0.100 | 40.11 | 3.3 | 12.4 |
| 13 | 0.142 | 8966 0.000 0.000 1.00 | 8.4 0.200 0.100 | 43.45 | 3.3 | 12.4 |
| 14 | 0.142 | 8966 0.000 0.000 1.00 | 9.2 0.200 0.100 | 46.79 | 3.3 | 12.4 |
| 15 | 0.142 | 8966 0.000 0.000 1.00 | 9.2 0.200 0.100 | 50.13 | 3.3 | 12.4 |
| 16 | 0.142 | 8966 0.000 0.000 1.00 | 9.0 0.200 0.100 | 53.47 | 3.3 | 12.4 |
| 17 | 0.142 | 8966 0.000 0.000 1.00 | 6.1 0.200 0.100 | 56.82 | 3.3 | 12.4 |
| 18 | 0.142 | 8966 0.000 0.000 1.00 | 17.9 0.071 0.100 | 60.16 | 3.3 | 12.4 |

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19 0.142 8966 0.000 0.000 1.00 23.1 0.050 0.100 63.50 3.3 12.4
Toe 17.7 0.150 0.100

2.690 kips total unredueed pile weight (g= 32.17 ft/s2)
2.690 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 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 | |
|-------------|---------------|---------------------|----------------------|-------|---|-----------------|-------|---|------------------|----------------|------|
| 144.2 | 19.0 | 7.08 | 7.05 | -0.60 | 8 | 33 | 30.01 | 8 | 3 | 18.4 | 44.3 |
| 149.0 | 19.8 | 7.14 | 7.12 | -0.22 | 8 | 33 | 30.33 | 8 | 3 | 18.3 | 44.1 |
| 153.8 | 20.6 | 7.22 | 7.19 | 0.00 | 1 | 0 | 30.68 | 8 | 3 | 18.3 | 43.9 |
| 158.5 | 21.4 | 7.27 | 7.26 | 0.00 | 1 | 0 | 30.95 | 8 | 3 | 18.2 | 43.7 |
| 163.3 | 22.1 | 7.34 | 7.32 | 0.00 | 1 | 0 | 31.25 | 8 | 3 | 18.2 | 43.5 |

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Depth (ft) 45.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 63.5 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.686

| 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 | Rut (kips) LbTop Perim Area ft ft in2 |
|-----|----------------|---|------|----------------------------------|----------------------|---|
| 1 | 0.142 | 8966 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.34 3.3 12.4 | |
| 2 | 0.142 | 8966 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.68 3.3 12.4 | |
| 6 | 0.142 | 8966 0.000 0.000 1.00 | 4.2 | 0.200 0.100 | 20.05 3.3 12.4 | |
| 7 | 0.142 | 8966 0.000 0.000 1.00 | 9.2 | 0.200 0.100 | 23.39 3.3 12.4 | |
| 8 | 0.142 | 8966 0.000 0.000 1.00 | 9.2 | 0.200 0.100 | 26.74 3.3 12.4 | |
| 9 | 0.142 | 8966 0.000 0.000 1.00 | 8.6 | 0.200 0.100 | 30.08 3.3 12.4 | |
| 10 | 0.142 | 8966 0.000 0.000 1.00 | 8.3 | 0.200 0.100 | 33.42 3.3 12.4 | |
| 11 | 0.142 | 8966 0.000 0.000 1.00 | 8.3 | 0.200 0.100 | 36.76 3.3 12.4 | |
| 12 | 0.142 | 8966 0.000 0.000 1.00 | 8.8 | 0.200 0.100 | 40.11 3.3 12.4 | |
| 13 | 0.142 | 8966 0.000 0.000 1.00 | 9.2 | 0.200 0.100 | 43.45 3.3 12.4 | |
| 14 | 0.142 | 8966 0.000 0.000 1.00 | 9.2 | 0.200 0.100 | 46.79 3.3 12.4 | |
| 15 | 0.142 | 8966 0.000 0.000 1.00 | 7.5 | 0.200 0.100 | 50.13 3.3 12.4 | |
| 16 | 0.142 | 8966 0.000 0.000 1.00 | 9.8 | 0.141 0.100 | 53.47 3.3 12.4 | |
| 17 | 0.142 | 8966 0.000 0.000 1.00 | 22.5 | 0.050 0.100 | 56.82 3.3 12.4 | |
| 18 | 0.142 | 8966 0.000 0.000 1.00 | 24.7 | 0.050 0.100 | 60.16 3.3 12.4 | |
| 19 | 0.142 | 8966 0.000 0.000 1.00 | 32.3 | 0.050 0.100 | 63.50 3.3 12.4 | |
| Toe | | | 36.0 | 0.150 0.100 | | |

2.690 kips total unredueed pile weight (g= 32.17 ft/s2)
2.690 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 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 | |
|-------------|---------------|---------------------|----------------------|-------|---|-----------------|-------|---|------------------|----------------|------|
| 207.6 | 27.9 | 7.63 | 7.61 | -0.75 | 6 | 48 | 30.96 | 6 | 3 | 18.6 | 42.7 |
| 212.4 | 29.1 | 7.69 | 7.67 | -0.82 | 6 | 47 | 31.21 | 6 | 3 | 18.6 | 42.6 |
| 217.2 | 30.3 | 7.74 | 7.73 | -0.85 | 6 | 47 | 31.43 | 6 | 3 | 18.6 | 42.4 |
| 221.9 | 31.5 | 7.80 | 7.79 | -0.87 | 6 | 46 | 31.70 | 6 | 3 | 18.6 | 42.3 |
| 226.7 | 32.8 | 7.84 | 7.84 | -0.88 | 6 | 45 | 31.90 | 6 | 3 | 18.7 | 42.1 |

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Depth (ft) 50.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in²) 144.000 Pile Type Unknown
 Pile Size (inch) 10.000

| 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 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |
| 63.5 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | 267.0 | | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|-----------------|
| 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 | in ² |
| 1 | 0.142 | 8966 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 3.3 | 12.4 |
| 2 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 3.3 | 12.4 |
| 5 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.8 | 0.200 | 0.100 | 16.71 | 3.3 | 12.4 |
| 6 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 20.05 | 3.3 | 12.4 |
| 7 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.0 | 0.200 | 0.100 | 23.39 | 3.3 | 12.4 |
| 8 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.3 | 0.200 | 0.100 | 26.74 | 3.3 | 12.4 |
| 9 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.3 | 0.200 | 0.100 | 30.08 | 3.3 | 12.4 |
| 10 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.4 | 0.200 | 0.100 | 33.42 | 3.3 | 12.4 |
| 11 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 36.76 | 3.3 | 12.4 |
| 12 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 40.11 | 3.3 | 12.4 |
| 13 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.0 | 0.200 | 0.100 | 43.45 | 3.3 | 12.4 |
| 14 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 6.1 | 0.200 | 0.100 | 46.79 | 3.3 | 12.4 |
| 15 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 17.7 | 0.072 | 0.100 | 50.13 | 3.3 | 12.4 |
| 16 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 23.1 | 0.050 | 0.100 | 53.47 | 3.3 | 12.4 |
| 17 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 28.9 | 0.050 | 0.100 | 56.82 | 3.3 | 12.4 |
| 18 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 33.2 | 0.050 | 0.100 | 60.16 | 3.3 | 12.4 |
| 19 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 35.2 | 0.050 | 0.100 | 63.50 | 3.3 | 12.4 |
| Toe | | | | | | 43.4 | 0.150 | 0.100 | | | |

2.690 kips total unredacted pile weight (g= 32.17 ft/s²)

2.690 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 |
| 267.0 | 42.2 | 8.06 | 8.06 | -0.78 | 5 | 43 | 32.74 | 5 | 3 | 19.0 |
| 271.7 | 44.2 | 8.10 | 8.10 | -0.80 | 5 | 42 | 32.97 | 5 | 3 | 19.0 |
| 276.5 | 46.5 | 8.15 | 8.15 | -0.85 | 5 | 42 | 33.23 | 5 | 3 | 19.0 |
| 281.3 | 49.0 | 8.21 | 8.20 | -0.92 | 5 | 41 | 33.51 | 5 | 3 | 19.0 |
| 286.0 | 52.2 | 8.18 | 8.25 | -1.03 | 5 | 41 | 33.59 | 5 | 3 | 18.9 |



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Depth (ft) 55.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in²) 144.000 Pile Type Unknown
 Pile Size (inch) 10.000

| 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 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |
| 63.5 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | 276.2 | | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|-----------------|
| 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 | in ² |
| 1 | 0.142 | 8966 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 3.3 | 12.4 |
| 2 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 3.3 | 12.4 |
| 3 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 4.2 | 0.200 | 0.100 | 10.03 | 3.3 | 12.4 |
| 4 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 13.37 | 3.3 | 12.4 |
| 5 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 16.71 | 3.3 | 12.4 |

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| | | | | | | | | | | | |
|-----|-------|------|-------|-------|------|------|-------|-------|-------|-----|------|
| 6 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.6 | 0.200 | 0.100 | 20.05 | 3.3 | 12.4 |
| 7 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.3 | 0.200 | 0.100 | 23.39 | 3.3 | 12.4 |
| 8 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.3 | 0.200 | 0.100 | 26.74 | 3.3 | 12.4 |
| 9 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 8.8 | 0.200 | 0.100 | 30.08 | 3.3 | 12.4 |
| 10 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 33.42 | 3.3 | 12.4 |
| 11 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.2 | 0.200 | 0.100 | 36.76 | 3.3 | 12.4 |
| 12 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 7.5 | 0.200 | 0.100 | 40.11 | 3.3 | 12.4 |
| 13 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 9.6 | 0.143 | 0.100 | 43.45 | 3.3 | 12.4 |
| 14 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 22.5 | 0.050 | 0.100 | 46.79 | 3.3 | 12.4 |
| 15 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 24.6 | 0.050 | 0.100 | 50.13 | 3.3 | 12.4 |
| 16 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 32.3 | 0.050 | 0.100 | 53.47 | 3.3 | 12.4 |
| 17 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 34.2 | 0.050 | 0.100 | 56.82 | 3.3 | 12.4 |
| 18 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 35.4 | 0.078 | 0.100 | 60.16 | 3.3 | 12.4 |
| 19 | 0.142 | 8966 | 0.000 | 0.000 | 1.00 | 31.5 | 0.200 | 0.100 | 63.50 | 3.3 | 12.4 |
| Toe | | | | | | 3.7 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficacy |
|-------------|--------------|-------------------|----------|
| 55.00 | 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 | |
|-------------|---------------|---------------------|----------------------|-------|---|-----------------|-------|---|------------------|----------------|------|
| 276.2 | 47.5 | 8.15 | 8.15 | -0.42 | 3 | 41 | 32.64 | 3 | 3 | 18.6 | 41.4 |
| 283.0 | 52.0 | 8.13 | 8.21 | -0.40 | 3 | 40 | 32.73 | 3 | 3 | 18.4 | 41.3 |
| 289.7 | 55.9 | 8.21 | 8.27 | -0.39 | 3 | 39 | 33.03 | 3 | 3 | 18.5 | 41.2 |
| 296.4 | 60.6 | 8.28 | 8.33 | -0.37 | 3 | 39 | 33.36 | 3 | 3 | 18.5 | 41.0 |
| 303.1 | 65.7 | 8.35 | 8.38 | -0.39 | 3 | 38 | 33.63 | 3 | 3 | 18.6 | 40.9 |

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| | | | |
|------------------------|-------|----------------------|-------|
| Depth (ft) | 60.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor | 1.000 |

| | | | | |
|---------------|--------|---------|-----------|---------|
| PILE PROFILE: | | | | |
| Toe Area | (in2) | 144.000 | 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 |
| 63.5 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.686

| No. | Weight kips | Pile and Soil Model Stiffn C-Slk T-Slk CoR | Total Capacity Soil-S Quake | Rut (kips) | 323.0 |
|-----|----------------|---|--------------------------------|-------------|-------|
| | | k/in ft ft | s/ft inch | LbTop Perim | Area |
| 1 | 0.142 | 8966 0.010 0.000 0.85 | 0.0 0.000 0.100 | 3.34 3.3 | 12.4 |
| 2 | 0.142 | 8966 0.000 0.000 1.00 | 8.7 0.200 0.100 | 6.68 3.3 | 12.4 |
| 3 | 0.142 | 8966 0.000 0.000 1.00 | 9.2 0.200 0.100 | 10.03 3.3 | 12.4 |
| 4 | 0.142 | 8966 0.000 0.000 1.00 | 9.0 0.200 0.100 | 13.37 3.3 | 12.4 |
| 5 | 0.142 | 8966 0.000 0.000 1.00 | 8.3 0.200 0.100 | 16.71 3.3 | 12.4 |
| 6 | 0.142 | 8966 0.000 0.000 1.00 | 8.3 0.200 0.100 | 20.05 3.3 | 12.4 |
| 7 | 0.142 | 8966 0.000 0.000 1.00 | 8.4 0.200 0.100 | 23.39 3.3 | 12.4 |
| 8 | 0.142 | 8966 0.000 0.000 1.00 | 9.2 0.200 0.100 | 26.74 3.3 | 12.4 |
| 9 | 0.142 | 8966 0.000 0.000 1.00 | 9.2 0.200 0.100 | 30.08 3.3 | 12.4 |
| 10 | 0.142 | 8966 0.000 0.000 1.00 | 9.0 0.200 0.100 | 33.42 3.3 | 12.4 |
| 11 | 0.142 | 8966 0.000 0.000 1.00 | 6.1 0.200 0.100 | 36.76 3.3 | 12.4 |
| 12 | 0.142 | 8966 0.000 0.000 1.00 | 17.6 0.073 0.100 | 40.11 3.3 | 12.4 |
| 13 | 0.142 | 8966 0.000 0.000 1.00 | 23.1 0.050 0.100 | 43.45 3.3 | 12.4 |
| 14 | 0.142 | 8966 0.000 0.000 1.00 | 28.8 0.050 0.100 | 46.79 3.3 | 12.4 |
| 15 | 0.142 | 8966 0.000 0.000 1.00 | 33.1 0.050 0.100 | 50.13 3.3 | 12.4 |
| 16 | 0.142 | 8966 0.000 0.000 1.00 | 35.2 0.050 0.100 | 53.47 3.3 | 12.4 |
| 17 | 0.142 | 8966 0.000 0.000 1.00 | 33.4 0.157 0.100 | 56.82 3.3 | 12.4 |
| 18 | 0.142 | 8966 0.000 0.000 1.00 | 31.4 0.200 0.100 | 60.16 3.3 | 12.4 |
| 19 | 0.142 | 8966 0.000 0.000 1.00 | 31.2 0.200 0.100 | 63.50 3.3 | 12.4 |
| Toe | | | 3.7 0.150 0.100 | | |

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

| Depth | Stroke | Pressure | Efficacy |
|-------|--------|----------|----------|
|-------|--------|----------|----------|

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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 | |
|-------------|---------------|---------------------|----------------------|-------|---|-----------------|-------|---|------------------|----------------|------|
| 323.0 | 87.2 | 8.51 | 8.51 | -0.21 | 2 | 37 | 34.83 | 2 | 2 | 18.8 | 40.5 |
| 332.2 | 99.5 | 8.58 | 8.56 | -0.22 | 2 | 36 | 35.20 | 2 | 2 | 18.9 | 40.4 |
| 341.5 | 115.5 | 8.64 | 8.61 | -0.23 | 2 | 36 | 35.56 | 2 | 2 | 18.9 | 40.3 |
| 350.8 | 135.6 | 8.69 | 8.65 | -0.24 | 2 | 36 | 35.88 | 2 | 2 | 18.9 | 40.2 |
| 360.1 | 165.2 | 8.74 | 8.70 | -0.23 | 2 | 35 | 36.18 | 2 | 2 | 18.9 | 40.1 |

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Depth (ft) 63.5 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 144.000 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 |
| 63.5 | 12.40 | 29000. | 492.0 | 3.3 | 0 | 16524. | 21.8 |

Wave Travel Time 2L/c (ms) 7.686

| No. | Weight kips | Pile and Soil Model Stiffn C-Slk T-Slk k/in ft ft | CoR | Total Capacity Soil-S Soil-D Quake kips s/ft inch | Rut LbTop | (kips) Perim | 354.0 Area in2 |
|-----|----------------|---|------|---|--------------|-----------------|----------------------|
| 1 | 0.142 | 8966 0.010 0.000 0.85 | 0.85 | 9.2 0.200 0.100 | 3.34 | 3.3 | 12.4 |
| 2 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 9.2 0.200 0.100 | 6.68 | 3.3 | 12.4 |
| 3 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 9.0 0.200 0.100 | 10.03 | 3.3 | 12.4 |
| 4 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 8.3 0.200 0.100 | 13.37 | 3.3 | 12.4 |
| 5 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 8.3 0.200 0.100 | 16.71 | 3.3 | 12.4 |
| 6 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 8.4 0.200 0.100 | 20.05 | 3.3 | 12.4 |
| 7 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 9.2 0.200 0.100 | 23.39 | 3.3 | 12.4 |
| 8 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 9.2 0.200 0.100 | 26.74 | 3.3 | 12.4 |
| 9 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 8.9 0.200 0.100 | 30.08 | 3.3 | 12.4 |
| 10 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 6.1 0.200 0.100 | 33.42 | 3.3 | 12.4 |
| 11 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 18.4 0.069 0.100 | 36.76 | 3.3 | 12.4 |
| 12 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 23.2 0.050 0.100 | 40.11 | 3.3 | 12.4 |
| 13 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 29.2 0.050 0.100 | 43.45 | 3.3 | 12.4 |
| 14 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 33.2 0.050 0.100 | 46.79 | 3.3 | 12.4 |
| 15 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 35.3 0.050 0.100 | 50.13 | 3.3 | 12.4 |
| 16 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 33.2 0.163 0.100 | 53.47 | 3.3 | 12.4 |
| 17 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 31.4 0.200 0.100 | 56.82 | 3.3 | 12.4 |
| 18 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 31.2 0.200 0.100 | 60.16 | 3.3 | 12.4 |
| 19 | 0.142 | 8966 0.000 0.000 1.00 | 1.00 | 29.5 0.200 0.100 | 63.50 | 3.3 | 12.4 |
| Toe | | | | 3.7 0.150 0.100 | | | |

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

Depth Stroke Pressure Efficcy
ft ft Ratio
63.50 10.81 1.00 0.800

▲ FRA-70-1323C - For Abutment - HP10x42 02/28/2021
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 | |
|-------------|---------------|---------------------|----------------------|------|---|-----------------|-------|---|------------------|----------------|------|
| 354.0 | 144.3 | 8.70 | 8.65 | 0.00 | 1 | 0 | 36.51 | 1 | 2 | 18.2 | 40.2 |
| 364.9 | 185.9 | 8.75 | 8.70 | 0.00 | 1 | 0 | 36.91 | 1 | 2 | 18.1 | 40.0 |
| 375.9 | 241.5 | 8.79 | 8.73 | 0.00 | 1 | 0 | 37.27 | 1 | 2 | 18.2 | 40.0 |
| 386.9 | 344.3 | 8.84 | 8.77 | 0.00 | 1 | 0 | 37.63 | 1 | 2 | 18.1 | 39.9 |
| 397.8 | 532.9 | 8.87 | 8.80 | 0.00 | 1 | 0 | 38.00 | 1 | 2 | 18.1 | 39.8 |

▲ FRA-70-1323C - For Abutment - HP10x42 02/28/2021
Resource International Inc GRLWEAP Version 2010

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

1323C-FA-10X42

| ft | kips | kips | kips | bl/ft | ksi | ksi | ft | kip-ft |
|------|-------|-------|------|-------|--------|--------|------|--------|
| 5.0 | 15.3 | 13.7 | 1.5 | 1.6 | 11.208 | 0.000 | 3.87 | 25.9 |
| 10.0 | 28.4 | 27.3 | 1.2 | 2.9 | 17.164 | 0.000 | 4.56 | 23.8 |
| 15.0 | 40.9 | 39.7 | 1.2 | 4.4 | 20.933 | 0.000 | 5.05 | 22.2 |
| 20.0 | 53.7 | 52.2 | 1.5 | 6.1 | 23.903 | 0.000 | 5.45 | 21.1 |
| 25.0 | 67.4 | 65.9 | 1.5 | 8.1 | 25.095 | -0.718 | 5.79 | 20.0 |
| 30.0 | 80.2 | 79.4 | 0.8 | 10.0 | 26.830 | -0.850 | 6.12 | 19.5 |
| 35.0 | 110.1 | 92.4 | 17.7 | 14.6 | 28.359 | -0.401 | 6.72 | 18.8 |
| 40.0 | 144.2 | 126.5 | 17.7 | 19.0 | 30.006 | -0.603 | 7.08 | 18.4 |
| 45.0 | 207.6 | 171.7 | 36.0 | 27.9 | 30.956 | -0.748 | 7.63 | 18.6 |
| 50.0 | 267.0 | 223.6 | 43.4 | 42.2 | 32.738 | -0.779 | 8.06 | 19.0 |
| 55.0 | 276.2 | 272.6 | 3.7 | 47.5 | 32.643 | -0.419 | 8.15 | 18.6 |
| 60.0 | 323.0 | 319.3 | 3.7 | 87.2 | 34.827 | -0.215 | 8.51 | 18.8 |
| 63.5 | 354.0 | 350.3 | 3.7 | 144.3 | 36.509 | 0.000 | 8.70 | 18.2 |

Total Driving Time 36 minutes; Total No. of Blows 1540
Starting at penetration 5.0 ft

| G/L at Shaft and Toe: 0.637 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 | 16.0 | 14.5 | 1.5 | 1.6 | 11.610 | 0.000 | 3.95 | 26.0 |
| 10.0 | 29.9 | 28.8 | 1.2 | 3.0 | 17.676 | 0.000 | 4.63 | 23.6 |
| 15.0 | 43.0 | 41.9 | 1.2 | 4.7 | 21.471 | 0.000 | 5.13 | 22.0 |
| 20.0 | 56.5 | 55.1 | 1.5 | 6.5 | 24.344 | 0.000 | 5.53 | 20.8 |
| 25.0 | 71.0 | 69.5 | 1.5 | 8.6 | 25.539 | -0.913 | 5.88 | 19.9 |
| 30.0 | 84.5 | 83.8 | 0.8 | 10.7 | 27.256 | -0.553 | 6.22 | 19.3 |
| 35.0 | 114.9 | 97.1 | 17.7 | 15.6 | 28.690 | -0.615 | 6.80 | 18.7 |
| 40.0 | 149.0 | 131.3 | 17.7 | 19.8 | 30.327 | -0.224 | 7.14 | 18.3 |
| 45.0 | 212.4 | 176.4 | 36.0 | 29.1 | 31.211 | -0.819 | 7.69 | 18.6 |
| 50.0 | 271.7 | 228.4 | 43.4 | 44.2 | 32.969 | -0.800 | 8.10 | 19.0 |
| 55.0 | 283.0 | 279.3 | 3.7 | 52.0 | 32.731 | -0.403 | 8.13 | 18.4 |
| 60.0 | 332.2 | 328.6 | 3.7 | 99.5 | 35.196 | -0.218 | 8.58 | 18.9 |
| 63.5 | 364.9 | 361.3 | 3.7 | 185.9 | 36.910 | 0.000 | 8.75 | 18.1 |

Total Driving Time 41 minutes; Total No. of Blows 1724
Starting at penetration 5.0 ft

↑

FRA-70-1323C - For Abutment - HP10x42
Resource International Inc

02/28/2021
GRLWEAP Version 2010

SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.670 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 | 16.8 | 15.2 | 1.5 | 1.6 | 12.056 | 0.000 | 3.99 | 26.0 |
| 10.0 | 31.4 | 30.3 | 1.2 | 3.2 | 18.076 | 0.000 | 4.69 | 23.3 |
| 15.0 | 45.2 | 44.0 | 1.2 | 5.0 | 21.978 | 0.000 | 5.20 | 21.8 |
| 20.0 | 59.4 | 57.9 | 1.5 | 6.9 | 24.606 | 0.000 | 5.55 | 20.5 |
| 25.0 | 74.6 | 73.1 | 1.5 | 9.1 | 25.971 | -0.940 | 5.97 | 19.8 |
| 30.0 | 88.9 | 88.1 | 0.8 | 11.4 | 27.699 | -0.731 | 6.31 | 19.2 |
| 35.0 | 119.6 | 101.9 | 17.7 | 16.5 | 29.041 | -0.648 | 6.87 | 18.5 |
| 40.0 | 153.8 | 136.0 | 17.7 | 20.6 | 30.682 | 0.000 | 7.22 | 18.3 |
| 45.0 | 217.2 | 181.2 | 36.0 | 30.3 | 31.425 | -0.855 | 7.74 | 18.6 |
| 50.0 | 276.5 | 233.1 | 43.4 | 46.5 | 33.231 | -0.848 | 8.15 | 19.0 |
| 55.0 | 289.7 | 286.0 | 3.7 | 55.9 | 33.034 | -0.387 | 8.21 | 18.5 |
| 60.0 | 341.5 | 337.8 | 3.7 | 115.5 | 35.558 | -0.231 | 8.64 | 18.9 |
| 63.5 | 375.9 | 372.2 | 3.7 | 241.5 | 37.265 | 0.000 | 8.79 | 18.2 |

Total Driving Time 47 minutes; Total No. of Blows 1945
Starting at penetration 5.0 ft

| G/L at Shaft and Toe: 0.703 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 | 17.5 | 16.0 | 1.5 | 1.7 | 12.502 | 0.000 | 4.03 | 25.9 |
| 10.0 | 32.9 | 31.8 | 1.2 | 3.4 | 18.478 | 0.000 | 4.75 | 23.2 |
| 15.0 | 47.4 | 46.2 | 1.2 | 5.3 | 22.501 | 0.000 | 5.26 | 21.6 |
| 20.0 | 62.2 | 60.8 | 1.5 | 7.4 | 25.055 | -0.162 | 5.63 | 20.3 |
| 25.0 | 78.2 | 76.7 | 1.5 | 9.7 | 26.372 | -0.857 | 6.06 | 19.6 |
| 30.0 | 93.2 | 92.4 | 0.8 | 12.1 | 28.142 | -0.863 | 6.40 | 19.0 |
| 35.0 | 124.4 | 106.6 | 17.7 | 17.3 | 29.350 | -0.482 | 6.95 | 18.5 |
| 40.0 | 158.5 | 140.8 | 17.7 | 21.4 | 30.954 | 0.000 | 7.27 | 18.2 |
| 45.0 | 221.9 | 186.0 | 36.0 | 31.5 | 31.697 | -0.870 | 7.80 | 18.6 |
| 50.0 | 281.3 | 237.9 | 43.4 | 49.0 | 33.514 | -0.922 | 8.21 | 19.0 |
| 55.0 | 296.4 | 292.7 | 3.7 | 60.6 | 33.355 | -0.370 | 8.28 | 18.5 |
| 60.0 | 350.8 | 347.1 | 3.7 | 135.6 | 35.876 | -0.240 | 8.69 | 18.9 |
| 63.5 | 386.9 | 383.2 | 3.7 | 344.3 | 37.629 | 0.000 | 8.84 | 18.1 |

Total Driving Time 55 minutes; Total No. of Blows 2272

Starting at penetration 5.0 ft

▲

FRA-70-1323C - For Abutment - HP10x42
Resource International Inc02/28/2021
GRLWEAP Version 2010

SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.736 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 | 18.3 | 16.7 | 1.5 | 1.8 | 12.876 | 0.000 | 4.07 | 25.8 | |
| 10.0 | 34.4 | 33.2 | 1.2 | 3.6 | 18.836 | 0.000 | 4.81 | 23.0 | |
| 15.0 | 49.5 | 48.4 | 1.2 | 5.6 | 22.966 | 0.000 | 5.33 | 21.4 | |
| 20.0 | 65.1 | 63.6 | 1.5 | 7.8 | 25.527 | -0.536 | 5.72 | 20.2 | |
| 25.0 | 81.8 | 80.3 | 1.5 | 10.3 | 26.761 | -0.679 | 6.14 | 19.5 | |
| 30.0 | 97.6 | 96.8 | 0.8 | 12.9 | 28.533 | -0.866 | 6.48 | 18.9 | |
| 35.0 | 129.1 | 111.4 | 17.7 | 18.1 | 29.659 | -0.191 | 7.03 | 18.4 | |
| 40.0 | 163.3 | 145.6 | 17.7 | 22.1 | 31.255 | 0.000 | 7.34 | 18.2 | |
| 45.0 | 226.7 | 190.7 | 36.0 | 32.8 | 31.903 | -0.884 | 7.84 | 18.7 | |
| 50.0 | 286.0 | 242.7 | 43.4 | 52.2 | 33.588 | -1.026 | 8.18 | 18.9 | |
| 55.0 | 303.1 | 299.4 | 3.7 | 65.7 | 33.630 | -0.386 | 8.35 | 18.6 | |
| 60.0 | 360.1 | 356.4 | 3.7 | 165.2 | 36.183 | -0.228 | 8.74 | 18.9 | |
| 63.5 | 397.8 | 394.2 | 3.7 | 532.9 | 37.995 | 0.000 | 8.87 | 18.1 | |

Total Driving Time 68 minutes; Total No. of Blows 2792

Starting at penetration 5.0 ft

▲

FRA-70-1323C - For Abutment - HP10x42
Resource International Inc02/28/2021
GRLWEAP Version 2010

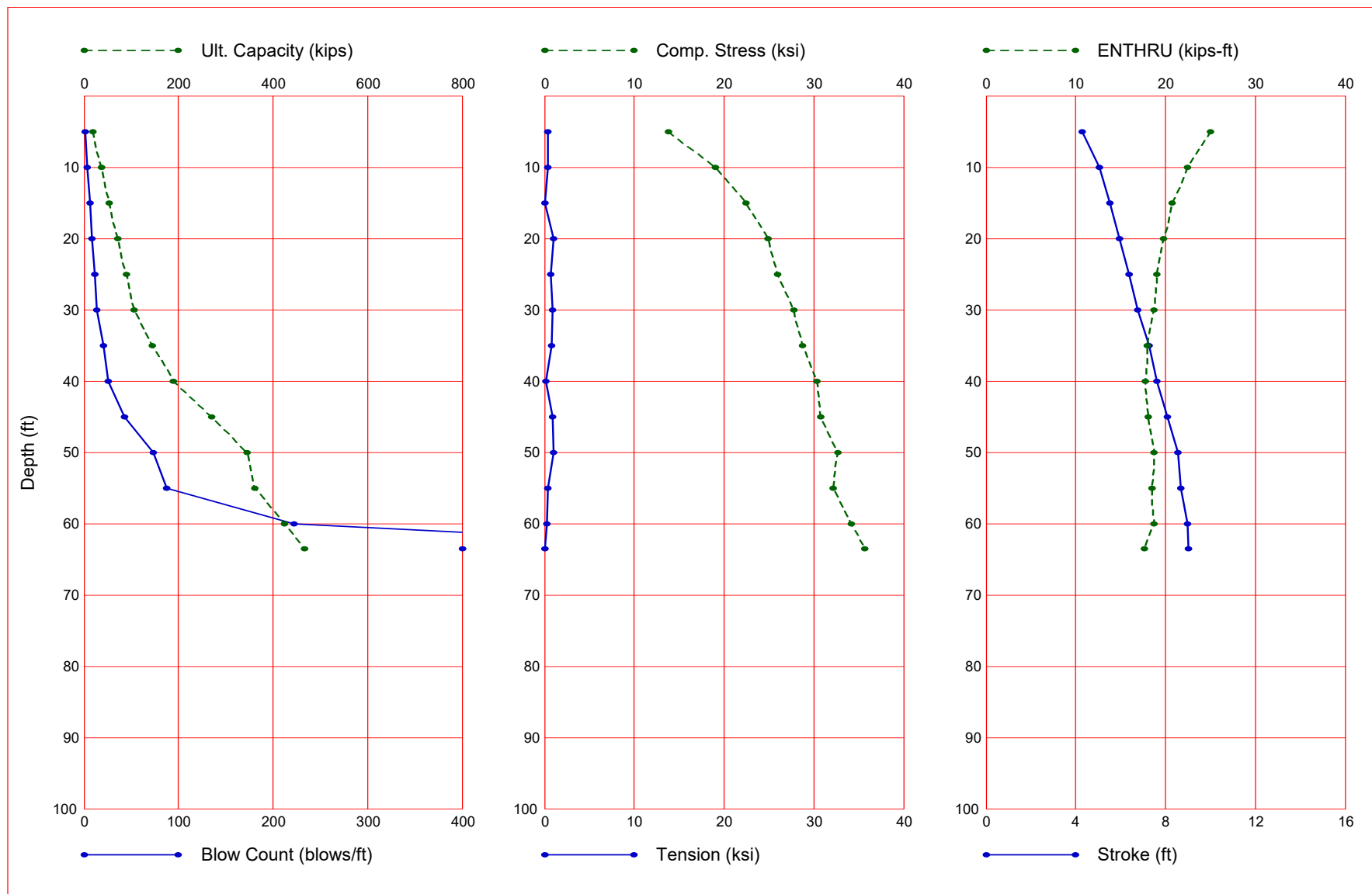
Table of Depths Analyzed with Driving System Modifiers

| Depth | Temp. | Wait | Equivalent | Pressure | | Stiffn. | Cushion |
|-------|--------|------|------------|----------|---------|---------|---------|
| ft | Length | Time | Stroke | Ratio | Efficy. | Factor | CoR |
| | ft | hr | ft | | | | |
| 5.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 10.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 15.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 20.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 25.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 30.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 35.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 40.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 45.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 50.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 55.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 60.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 63.50 | 63.50 | 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 | 1.38 | 1.55 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 9.01 | 1.39 | 1.55 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 9.19 | 1.39 | 1.55 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 9.21 | 1.24 | 1.16 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 18.21 | 1.25 | 1.16 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 19.69 | 1.26 | 1.16 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 19.71 | 1.37 | 1.45 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 28.71 | 1.38 | 1.45 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 29.69 | 1.40 | 1.45 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 29.71 | 0.92 | 0.77 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 34.19 | 0.92 | 0.77 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 34.21 | 1.96 | 17.74 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 41.19 | 2.19 | 17.74 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 41.21 | 2.83 | 35.96 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 46.19 | 3.06 | 35.96 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 46.21 | 3.09 | 43.36 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 51.19 | 3.34 | 43.36 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 51.21 | 4.75 | 3.68 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 60.21 | 4.66 | 3.68 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 63.50 | 4.20 | 3.68 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |

Gain/Loss 3 at Shaft and Toe 0.670 / 1.000



Gain/Loss 3 at Shaft and Toe 0.670 / 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 | 20.2 | 18.3 | 1.9 | 1.9 | 13.847 | -0.357 | 4.29 | 25.0 |
| 10.0 | 37.7 | 36.3 | 1.5 | 3.9 | 19.021 | -0.337 | 5.07 | 22.4 |
| 15.0 | 54.3 | 52.8 | 1.5 | 6.1 | 22.438 | 0.000 | 5.51 | 20.7 |
| 20.0 | 71.3 | 69.4 | 1.8 | 8.5 | 24.888 | -0.994 | 5.96 | 19.8 |
| 25.0 | 89.5 | 87.7 | 1.8 | 11.3 | 25.966 | -0.741 | 6.37 | 19.0 |
| 30.0 | 106.6 | 105.6 | 1.0 | 14.0 | 27.771 | -0.874 | 6.76 | 18.7 |
| 35.0 | 144.8 | 122.6 | 22.2 | 21.2 | 28.781 | -0.776 | 7.29 | 18.0 |
| 40.0 | 188.6 | 166.4 | 22.2 | 25.9 | 30.347 | -0.202 | 7.62 | 17.8 |
| 45.0 | 269.7 | 224.8 | 45.0 | 42.6 | 30.804 | -0.927 | 8.08 | 18.1 |
| 50.0 | 346.2 | 292.0 | 54.2 | 73.3 | 32.670 | -0.992 | 8.57 | 18.7 |
| 55.0 | 361.5 | 356.9 | 4.6 | 87.5 | 32.204 | -0.414 | 8.67 | 18.5 |
| 60.0 | 424.7 | 420.1 | 4.6 | 222.0 | 34.189 | -0.236 | 8.99 | 18.7 |
| 63.5 | 467.7 | 463.1 | 4.6 | 750.1 | 35.631 | 0.000 | 9.04 | 17.7 |

Total Continuous Driving Time 92.00 minutes; Total Number of Blows 3734 (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\2013\W-13-072 FRA-70-13.10 PROJECT 6A\ANALYSIS\FRA-70-1322L AND 1323C\DRIVEABILITY\FRA-70-1323C\FORWARD
ABUTMENT\HP 12X53\1323C-FA-12X53.GMW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-1323C - For Abutment - 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 32.170 144.000 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
63.500 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 R0
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 | 1.38 | 1.94 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 9.01 | 1.38 | 1.94 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 9.19 | 1.38 | 1.94 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 9.21 | 1.24 | 1.45 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 18.21 | 1.24 | 1.45 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 19.69 | 1.25 | 1.45 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 19.71 | 1.37 | 1.82 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 28.71 | 1.37 | 1.82 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 29.69 | 1.37 | 1.82 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 29.71 | 0.92 | 0.97 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 34.19 | 0.92 | 0.97 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 34.21 | 2.09 | 22.18 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 41.19 | 2.34 | 22.18 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 41.21 | 3.04 | 44.95 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 46.19 | 3.29 | 44.95 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 46.21 | 3.33 | 54.20 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 51.19 | 3.59 | 54.20 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 51.21 | 4.75 | 4.60 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 60.21 | 4.75 | 4.60 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 63.50 | 4.48 | 4.60 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |

Gain/Loss factors: shaft and toe

| Dpth | L | Wait | Strk | Pmx% | Eff. | Stff | CoR |
|---------|---------|---------|---------|---------|-------|-------|-------|
| 0.60400 | 0.63700 | 0.67000 | 0.70300 | 0.73600 | | | |
| 1.00000 | 1.00000 | 1.00000 | 1.00000 | 1.00000 | | | |
| 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 |
| 63.50 | 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-70-1323C - For Abutment - HP12x53

| Hammer Model: | D 19-42 | Made by: | DELMAG |
|-------------------|----------------|------------------|--------|
| No. | Weight kips | Stiffn k/inch | CoR |
| 1 | 0.800 | | |
| 2 | 0.800 | 140046.6 | 1.000 |
| 3 | 0.800 | 140046.6 | 1.000 |
| 4 | 0.800 | 140046.6 | 1.000 |
| 5 | 0.800 | 140046.6 | 1.000 |
| Imp Block | 0.753 | 70735.6 | 0.900 |
| Helmet | 1.900 | 60155.0 | 0.800 |
| Combined Pile Top | | 11208.0 | |

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) 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-70-1323C - For Abutment - HP12x53 02/28/2021
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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 5.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 63.5 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) 18.4 | | | | | |
|---------------------|--------|--------|-------|-------|------|--------------------------------|--------|-------|-------|-------|------|
| 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 | 11208 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.0 | 15.5 |
| 2 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 4.0 | 15.5 |
| 18 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 5.4 | 0.200 | 0.100 | 60.16 | 4.0 | 15.5 |
| 19 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 11.0 | 0.200 | 0.100 | 63.50 | 4.0 | 15.5 |
| Toe | | | | | | 1.9 | 0.150 | 0.100 | | | |

3.363 kips total unreduced pile weight (g= 32.17 ft/s2)
 3.363 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 | |
| 5.00 | 10.81 | 1.00 | 0.800 |

FRA-70-1323C - For Abutment - HP12x53 02/28/2021
 Resource International Inc GRLWEAP Version 2010

| Rut | B1 Ct | Stroke (ft) | Ten Str | i | t Comp Str | i | t ENTHRU | B1 Rt |
|------|-------|-------------|---------|-------|------------|--------|----------|-------|
| kips | b/ft | down | up | ksi | ksi | kip-ft | b/min | |
| 18.4 | 1.8 | 4.23 | 4.21 | -0.38 | 3 12 | 13.23 | 1 2 | 25.4 |
| 19.3 | 1.8 | 4.29 | 4.25 | -0.36 | 3 12 | 13.67 | 1 2 | 25.3 |
| 20.2 | 1.9 | 4.29 | 4.31 | -0.36 | 3 12 | 13.85 | 1 2 | 25.0 |
| 21.1 | 2.0 | 4.33 | 4.35 | -0.34 | 3 12 | 14.18 | 1 2 | 24.8 |
| 22.0 | 2.1 | 4.37 | 4.40 | -0.32 | 3 12 | 14.50 | 1 2 | 24.7 |

FRA-70-1323C - For Abutment - HP12x53 02/28/2021
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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 10.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 63.5 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | Total Capacity Rut | | | (kips) | | | 34.2 |
|---------------------|--------|--------|-------|-------|------|--------------------|--------|-------|--------|-------|------|------|
| 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 | 0.177 | 11208 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.0 | 15.5 | |
| 2 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 4.0 | 15.5 | |
| 17 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.9 | 0.200 | 0.100 | 56.82 | 4.0 | 15.5 | |
| 18 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 11.0 | 0.200 | 0.100 | 60.16 | 4.0 | 15.5 | |
| 19 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.8 | 0.200 | 0.100 | 63.50 | 4.0 | 15.5 | |
| Toe | | | | | | 1.5 | 0.150 | 0.100 | | | | |

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

3.363 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-70-1323C - For Abutment - HP12x53 02/28/2021
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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 | |
|-------------|---------------|---------------------|---------------|-------|---|-----------------|-------|----|------------------|----------------|------|
| 34.2 | 3.5 | 4.94 | 4.91 | -0.44 | 2 | 10 | 18.25 | 6 | 3 | 22.9 | 53.4 |
| 35.9 | 3.7 | 5.00 | 4.97 | -0.36 | 2 | 10 | 18.64 | 8 | 3 | 22.6 | 53.0 |
| 37.7 | 3.9 | 5.07 | 5.04 | -0.34 | 3 | 12 | 19.02 | 8 | 3 | 22.4 | 52.7 |
| 39.5 | 4.1 | 5.13 | 5.10 | -0.31 | 3 | 12 | 19.37 | 10 | 4 | 22.2 | 52.4 |
| 41.3 | 4.4 | 5.19 | 5.16 | -0.24 | 3 | 12 | 19.70 | 10 | 4 | 22.0 | 52.1 |

▲
FRA-70-1323C - For Abutment - HP12x53 02/28/2021
Resource International Inc GRLWEAP Version 2010

| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 15.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | 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 |
| 63.5 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | Total Capacity | | Rut (kips) | | 49.1 | |
|---------------------|--------|--------|-------|-------|------|----------------|--------|------------|-------|-------|------|
| 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 | 0.177 | 11208 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.0 | 15.5 |
| 2 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 4.0 | 15.5 |
| 15 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 5.4 | 0.200 | 0.100 | 50.13 | 4.0 | 15.5 |
| 16 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 11.0 | 0.200 | 0.100 | 53.47 | 4.0 | 15.5 |
| 18 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.2 | 0.200 | 0.100 | 60.16 | 4.0 | 15.5 |
| 19 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.0 | 0.200 | 0.100 | 63.50 | 4.0 | 15.5 |
| Toe | | | | | | 1.5 | 0.150 | 0.100 | | | |

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

3.363 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-70-1323C - For Abutment - HP12x53 02/28/2021
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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 | |
| 49.1 | 5.4 | 5.42 | 5.40 | -0.22 | 3 | 12 | 21.75 | 15 | 5 | 21.3 | 50.8 |
| 51.7 | 5.8 | 5.50 | 5.48 | -0.12 | 19 | 14 | 22.21 | 15 | 5 | 21.1 | 50.4 |
| 54.3 | 6.1 | 5.51 | 5.56 | 0.00 | 1 | 0 | 22.44 | 15 | 5 | 20.7 | 50.2 |

1323C-FA-12X53
 56.9 6.5 5.58 5.63 0.00 1 0 22.82 15 5 20.6 49.9
 59.5 6.8 5.65 5.70 0.00 1 0 23.22 15 5 20.4 49.6

▲
 FRA-70-1323C - For Abutment - HP12x53 02/28/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 20.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 144.000 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 |
| 63.5 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.686

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 64.4 |
|-----|--------|------------------------|----------------|--------------|-------------|------|
| | 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 | 11208 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.34 4.0 | 15.5 |
| 2 | 0.177 | 11208 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.68 4.0 | 15.5 |
| 14 | 0.177 | 11208 0.000 0.000 1.00 | 10.8 | 0.200 0.100 | 46.79 4.0 | 15.5 |
| 15 | 0.177 | 11208 0.000 0.000 1.00 | 11.0 | 0.200 0.100 | 50.13 4.0 | 15.5 |
| 16 | 0.177 | 11208 0.000 0.000 1.00 | 10.8 | 0.200 0.100 | 53.47 4.0 | 15.5 |
| 17 | 0.177 | 11208 0.000 0.000 1.00 | 10.0 | 0.200 0.100 | 56.82 4.0 | 15.5 |
| 19 | 0.177 | 11208 0.000 0.000 1.00 | 10.1 | 0.200 0.100 | 63.50 4.0 | 15.5 |
| Toe | | | 1.8 | 0.150 0.100 | | |

3.363 kips total unreduced pile weight (g= 32.17 ft/s2)
 3.363 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-70-1323C - For Abutment - HP12x53 02/28/2021
 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 |
| 64.4 | 7.5 | 5.79 5.83 | -0.17 | 16 48 | 24.03 | 14 5 | 20.1 | 48.9 |
| 67.8 | 8.0 | 5.87 5.90 | -0.60 | 14 48 | 24.45 | 14 5 | 20.0 | 48.6 |
| 71.3 | 8.5 | 5.96 5.99 | -0.99 | 14 48 | 24.89 | 14 5 | 19.8 | 48.2 |
| 74.7 | 9.1 | 6.05 6.07 | -1.21 | 14 48 | 25.32 | 14 5 | 19.6 | 47.9 |
| 78.1 | 9.6 | 6.12 6.14 | -1.18 | 14 48 | 25.69 | 14 5 | 19.6 | 47.6 |

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 FRA-70-1323C - For Abutment - HP12x53 02/28/2021
 Resource International Inc GRLWEAP Version 2010

Depth (ft) 25.0 Standard Soil Setup
 Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
 Toe Area (in2) 144.000 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 |
| 63.5 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.686

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 80.9 |
|-----|--------|------------------------|----------------|--------------|-------------|------|
| | 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 | 11208 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.34 4.0 | 15.5 |
| 2 | 0.177 | 11208 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.68 4.0 | 15.5 |
| 12 | 0.177 | 11208 0.000 0.000 1.00 | 5.3 | 0.200 0.100 | 40.11 4.0 | 15.5 |
| 13 | 0.177 | 11208 0.000 0.000 1.00 | 11.0 | 0.200 0.100 | 43.45 4.0 | 15.5 |
| 15 | 0.177 | 11208 0.000 0.000 1.00 | 10.2 | 0.200 0.100 | 50.13 4.0 | 15.5 |
| 16 | 0.177 | 11208 0.000 0.000 1.00 | 10.0 | 0.200 0.100 | 53.47 4.0 | 15.5 |
| 18 | 0.177 | 11208 0.000 0.000 1.00 | 10.6 | 0.200 0.100 | 60.16 4.0 | 15.5 |
| 19 | 0.177 | 11208 0.000 0.000 1.00 | 11.0 | 0.200 0.100 | 63.50 4.0 | 15.5 |
| Toe | | | 1.8 | 0.150 0.100 | | |

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3.363 kips total unreduced pile weight (g= 32.17 ft/s2)
3.363 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 | Ten Str ksi | i | t | Comp Str ksi | i | t | ENTHRU kip-ft | Bl Rt b/min |
|-------------|---------------|---------------------|---------------|----------------|----|----|-----------------|----|---|------------------|----------------|
| 80.9 | 10.0 | 6.20 | 6.22 | -1.17 | 10 | 47 | 25.22 | 12 | 4 | 19.4 | 47.3 |
| 85.2 | 10.6 | 6.29 | 6.31 | -0.93 | 9 | 47 | 25.61 | 12 | 4 | 19.2 | 47.0 |
| 89.5 | 11.3 | 6.37 | 6.39 | -0.74 | 12 | 41 | 25.97 | 12 | 4 | 19.0 | 46.7 |
| 93.8 | 11.9 | 6.45 | 6.47 | -0.91 | 12 | 41 | 26.29 | 12 | 4 | 18.9 | 46.4 |
| 98.2 | 12.6 | 6.53 | 6.54 | -1.00 | 12 | 41 | 26.66 | 12 | 4 | 18.8 | 46.1 |

↑
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| Depth (ft) | 30.0 | Standard Soil Setup |
|------------------------|-------|----------------------------|
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor 1.000 |

PILE PROFILE:
Toe Area (in2) 144.000 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 |
| 63.5 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.686

| 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 | Rut (kips) inch | 96.2 LbTop Perim Area ft ft in2 |
|-----|----------------|---|------|----------------|----------------------|--------------------|---------------------------------------|
| 1 | 0.177 | 11208 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.34 | 4.0 | 15.5 |
| 2 | 0.177 | 11208 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.68 | 4.0 | 15.5 |
| 11 | 0.177 | 11208 0.000 0.000 1.00 | 10.7 | 0.200 0.100 | 36.76 | 4.0 | 15.5 |
| 12 | 0.177 | 11208 0.000 0.000 1.00 | 11.0 | 0.200 0.100 | 40.11 | 4.0 | 15.5 |
| 13 | 0.177 | 11208 0.000 0.000 1.00 | 10.8 | 0.200 0.100 | 43.45 | 4.0 | 15.5 |
| 14 | 0.177 | 11208 0.000 0.000 1.00 | 10.0 | 0.200 0.100 | 46.79 | 4.0 | 15.5 |
| 16 | 0.177 | 11208 0.000 0.000 1.00 | 10.1 | 0.200 0.100 | 53.47 | 4.0 | 15.5 |
| 17 | 0.177 | 11208 0.000 0.000 1.00 | 11.0 | 0.200 0.100 | 56.82 | 4.0 | 15.5 |
| 19 | 0.177 | 11208 0.000 0.000 1.00 | 10.7 | 0.200 0.100 | 63.50 | 4.0 | 15.5 |
| Toe | | | 1.0 | 0.150 0.100 | | | |

3.363 kips total unreduced pile weight (g= 32.17 ft/s2)
3.363 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 | Ten Str ksi | i | t | Comp Str ksi | i | t | ENTHRU kip-ft | Bl Rt b/min |
|-------------|---------------|---------------------|---------------|----------------|----|----|-----------------|----|---|------------------|----------------|
| 96.2 | 12.3 | 6.51 | 6.53 | -0.94 | 11 | 41 | 26.73 | 11 | 4 | 18.8 | 46.2 |
| 101.4 | 13.0 | 6.68 | 6.62 | -0.97 | 11 | 41 | 27.37 | 11 | 4 | 18.8 | 45.8 |
| 106.6 | 14.0 | 6.76 | 6.71 | -0.87 | 11 | 41 | 27.77 | 11 | 4 | 18.7 | 45.5 |
| 111.8 | 15.0 | 6.85 | 6.80 | -0.70 | 10 | 35 | 28.15 | 11 | 4 | 18.5 | 45.2 |
| 117.0 | 16.1 | 6.93 | 6.89 | -0.95 | 10 | 35 | 28.51 | 11 | 4 | 18.4 | 44.9 |

↑
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| Depth (ft) | 35.0 | Standard Soil Setup |
|------------------------|-------|----------------------------|
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor 1.000 |

PILE PROFILE:
Toe Area (in2) 144.000 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 |
|---------------|-------------|--------------|-------------------|-------------|---------|-----------------|----------------|
| | | | | | | | |

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| | | | | | | | |
|------|-------|--------|-------|-----|---|--------|------|
| 0.0 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |
| 63.5 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 133.3 |
|---------------------|----------------|----------------|-------------|-------------|------|----------------|----------------|---------------|-------------|---------------------------|-------------|
| 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 | 0.177 | 11208 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.0 | 15.5 |
| 2 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 4.0 | 15.5 |
| 9 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 5.2 | 0.200 | 0.100 | 30.08 | 4.0 | 15.5 |
| 10 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 11.0 | 0.200 | 0.100 | 33.42 | 4.0 | 15.5 |
| 12 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.3 | 0.200 | 0.100 | 40.11 | 4.0 | 15.5 |
| 13 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.0 | 0.200 | 0.100 | 43.45 | 4.0 | 15.5 |
| 15 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.6 | 0.200 | 0.100 | 50.13 | 4.0 | 15.5 |
| 16 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 11.0 | 0.200 | 0.100 | 53.47 | 4.0 | 15.5 |
| 18 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 8.9 | 0.200 | 0.100 | 60.16 | 4.0 | 15.5 |
| 19 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 12.3 | 0.138 | 0.100 | 63.50 | 4.0 | 15.5 |
| Toe | | | | | | 22.2 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy Ratio |
|-------------|--------------|-------------------|-----------------|
| 35.00 | 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 |
|-------------|---------------|---------------------|---------------|-------|---|----|-----------------|---|---|------------------|----------------|
| 133.3 | 19.0 | 7.14 | 7.11 | -1.11 | 9 | 35 | 28.16 | 9 | 4 | 18.2 | 44.2 |
| 139.0 | 20.0 | 7.22 | 7.19 | -1.02 | 9 | 34 | 28.52 | 9 | 4 | 18.1 | 43.9 |
| 144.8 | 21.2 | 7.29 | 7.28 | -0.78 | 9 | 34 | 28.78 | 9 | 3 | 18.0 | 43.7 |
| 150.5 | 22.0 | 7.37 | 7.35 | -0.47 | 9 | 34 | 29.09 | 9 | 3 | 17.9 | 43.5 |
| 156.2 | 22.8 | 7.43 | 7.41 | -0.09 | 9 | 34 | 29.33 | 9 | 4 | 17.8 | 43.3 |

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| Depth ft | Stroke ft | Pressure Ratio | Efficy Ratio |
|-------------|--------------|-------------------|-----------------|
| 40.0 | 10.81 | 1.00 | 0.800 |

PILE PROFILE:

| Toe Area in2 | 144.000 | 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 |
| 63.5 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 177.2 |
|---------------------|----------------|----------------|-------------|-------------|------|----------------|----------------|---------------|-------------|---------------------------|-------------|
| 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 | 0.177 | 11208 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.0 | 15.5 |
| 2 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 4.0 | 15.5 |
| 8 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.7 | 0.200 | 0.100 | 26.74 | 4.0 | 15.5 |
| 9 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 11.0 | 0.200 | 0.100 | 30.08 | 4.0 | 15.5 |
| 10 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.8 | 0.200 | 0.100 | 33.42 | 4.0 | 15.5 |
| 11 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.0 | 0.200 | 0.100 | 36.76 | 4.0 | 15.5 |
| 13 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.0 | 0.200 | 0.100 | 43.45 | 4.0 | 15.5 |
| 14 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 11.0 | 0.200 | 0.100 | 46.79 | 4.0 | 15.5 |
| 16 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.7 | 0.200 | 0.100 | 53.47 | 4.0 | 15.5 |
| 17 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 7.4 | 0.200 | 0.100 | 56.82 | 4.0 | 15.5 |
| 18 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 22.8 | 0.070 | 0.100 | 60.16 | 4.0 | 15.5 |
| 19 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 29.7 | 0.050 | 0.100 | 63.50 | 4.0 | 15.5 |
| Toe | | | | | | 22.2 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy Ratio |
|-------------|--------------|-------------------|-----------------|
| 40.00 | 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 | |
|-------------|---------------|---------------------|----------------------|-------|---|-----------------|-------|---|------------------|----------------|------|
| 177.2 | 24.0 | 7.50 | 7.48 | -0.03 | 8 | 28 | 29.76 | 8 | 3 | 17.8 | 43.1 |
| 182.9 | 24.9 | 7.56 | 7.54 | 0.00 | 1 | 0 | 30.08 | 8 | 3 | 17.8 | 42.9 |
| 188.6 | 25.9 | 7.62 | 7.61 | -0.20 | 8 | 50 | 30.35 | 8 | 3 | 17.8 | 42.8 |
| 194.3 | 27.0 | 7.68 | 7.68 | -0.38 | 8 | 50 | 30.61 | 8 | 3 | 17.7 | 42.6 |
| 200.0 | 28.0 | 7.74 | 7.73 | -0.46 | 8 | 50 | 30.89 | 8 | 3 | 17.8 | 42.4 |

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| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 45.00 | 10.81 | 1.00 | 0.800 |

PILE PROFILE:

| Toe Area in2 | Pile Type | Unknown |
|-----------------|-----------|---------|
| 144.000 | | |

| 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 |
| 63.5 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.686

| 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 | 258.3 Area in2 |
|-----|----------------|---|------|----------------------------------|----------------------------------|--------------------------------|----------------------|
| 1 | 0.177 | 11208 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.34 | 4.0 | 15.5 |
| 2 | 0.177 | 11208 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.68 | 4.0 | 15.5 |
| 6 | 0.177 | 11208 0.000 0.000 1.00 | 5.1 | 0.200 0.100 | 20.05 | 4.0 | 15.5 |
| 7 | 0.177 | 11208 0.000 0.000 1.00 | 11.0 | 0.200 0.100 | 23.39 | 4.0 | 15.5 |
| 9 | 0.177 | 11208 0.000 0.000 1.00 | 10.3 | 0.200 0.100 | 30.08 | 4.0 | 15.5 |
| 10 | 0.177 | 11208 0.000 0.000 1.00 | 10.0 | 0.200 0.100 | 33.42 | 4.0 | 15.5 |
| 12 | 0.177 | 11208 0.000 0.000 1.00 | 10.6 | 0.200 0.100 | 40.11 | 4.0 | 15.5 |
| 13 | 0.177 | 11208 0.000 0.000 1.00 | 11.0 | 0.200 0.100 | 43.45 | 4.0 | 15.5 |
| 15 | 0.177 | 11208 0.000 0.000 1.00 | 8.9 | 0.200 0.100 | 50.13 | 4.0 | 15.5 |
| 16 | 0.177 | 11208 0.000 0.000 1.00 | 12.1 | 0.139 0.100 | 53.47 | 4.0 | 15.5 |
| 17 | 0.177 | 11208 0.000 0.000 1.00 | 28.9 | 0.050 0.100 | 56.82 | 4.0 | 15.5 |
| 18 | 0.177 | 11208 0.000 0.000 1.00 | 31.8 | 0.050 0.100 | 60.16 | 4.0 | 15.5 |
| 19 | 0.177 | 11208 0.000 0.000 1.00 | 41.7 | 0.050 0.100 | 63.50 | 4.0 | 15.5 |
| Toe | | | 45.0 | 0.150 0.100 | | | |

3.363 kips total unreduced pile weight (g= 32.17 ft/s2)
3.363 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 ksi | i | t | Comp Str ksi | i | t | ENTHRU kip-ft | Bl Rt b/min | |
|-------------|---------------|---------------------|----------------------|-------|---|-----------------|-------|---|------------------|----------------|------|
| 258.3 | 38.4 | 8.05 | 8.06 | -0.72 | 6 | 44 | 30.63 | 7 | 3 | 18.3 | 41.6 |
| 264.0 | 40.0 | 8.11 | 8.10 | -0.82 | 6 | 43 | 30.83 | 7 | 3 | 18.4 | 41.5 |
| 269.7 | 42.6 | 8.08 | 8.16 | -0.93 | 6 | 43 | 30.80 | 7 | 3 | 18.1 | 41.5 |
| 275.4 | 44.5 | 8.14 | 8.21 | -1.03 | 6 | 42 | 31.05 | 7 | 3 | 18.2 | 41.3 |
| 281.1 | 46.5 | 8.20 | 8.26 | -1.12 | 6 | 41 | 31.29 | 7 | 3 | 18.3 | 41.2 |

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| Depth ft | Stroke ft | Pressure Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 50.0 | | | |

PILE PROFILE:

| Toe Area in2 | Pile Type | Unknown |
|-----------------|-----------|---------|
| 144.000 | | |

| 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 |
| 63.5 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.686

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| Pile and Soil Model | | | | | | Total Capacity | | | Rut (kips) | | 334.7 | |
|---------------------|--------|--------|-------|-------|------|----------------|--------|-------|------------|-------|-------|--|
| 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 | 11208 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.0 | 15.5 | |
| 2 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 4.0 | 15.5 | |
| 5 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.6 | 0.200 | 0.100 | 16.71 | 4.0 | 15.5 | |
| 6 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 11.0 | 0.200 | 0.100 | 20.05 | 4.0 | 15.5 | |
| 7 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.8 | 0.200 | 0.100 | 23.39 | 4.0 | 15.5 | |
| 8 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.0 | 0.200 | 0.100 | 26.74 | 4.0 | 15.5 | |
| 10 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.0 | 0.200 | 0.100 | 33.42 | 4.0 | 15.5 | |
| 11 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 11.0 | 0.200 | 0.100 | 36.76 | 4.0 | 15.5 | |
| 13 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.7 | 0.200 | 0.100 | 43.45 | 4.0 | 15.5 | |
| 14 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 7.4 | 0.200 | 0.100 | 46.79 | 4.0 | 15.5 | |
| 15 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 22.6 | 0.071 | 0.100 | 50.13 | 4.0 | 15.5 | |
| 16 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 29.7 | 0.050 | 0.100 | 53.47 | 4.0 | 15.5 | |
| 17 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 37.3 | 0.050 | 0.100 | 56.82 | 4.0 | 15.5 | |
| 18 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 42.9 | 0.050 | 0.100 | 60.16 | 4.0 | 15.5 | |
| 19 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 45.6 | 0.050 | 0.100 | 63.50 | 4.0 | 15.5 | |
| Toe | | | | | | 54.2 | 0.150 | 0.100 | | | | |

3.363 kips total unreduced pile weight (g= 32.17 ft/s2)
3.363 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 |
| 334.7 | 65.5 | 8.47 | 8.51 | -1.07 | 5 | 39 | 32.19 | 5 | 3 | 18.6 |
| 340.5 | 69.3 | 8.52 | 8.55 | -1.02 | 5 | 39 | 32.43 | 5 | 3 | 18.7 |
| 346.2 | 73.3 | 8.57 | 8.59 | -0.99 | 5 | 38 | 32.67 | 5 | 3 | 18.7 |
| 351.9 | 77.7 | 8.62 | 8.62 | -1.01 | 5 | 38 | 32.90 | 5 | 3 | 18.8 |
| 357.6 | 83.3 | 8.66 | 8.67 | -1.03 | 5 | 37 | 33.12 | 5 | 3 | 18.8 |

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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 55.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | 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 |
| 63.5 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | Total Capacity | Rut | (kips) | | | 345.4 |
|---------------------|--------|--------|-------|-------|------|----------------|--------|--------|-------|-------|-------|
| 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 | 11208 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.0 | 15.5 |
| 2 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 4.0 | 15.5 |
| 3 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 5.0 | 0.200 | 0.100 | 10.03 | 4.0 | 15.5 |
| 4 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 11.0 | 0.200 | 0.100 | 13.37 | 4.0 | 15.5 |
| 6 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.3 | 0.200 | 0.100 | 20.05 | 4.0 | 15.5 |
| 7 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.0 | 0.200 | 0.100 | 23.39 | 4.0 | 15.5 |
| 9 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.5 | 0.200 | 0.100 | 30.08 | 4.0 | 15.5 |
| 10 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 11.0 | 0.200 | 0.100 | 33.42 | 4.0 | 15.5 |
| 12 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 8.9 | 0.200 | 0.100 | 40.11 | 4.0 | 15.5 |
| 13 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 12.0 | 0.141 | 0.100 | 43.45 | 4.0 | 15.5 |
| 14 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 28.9 | 0.050 | 0.100 | 46.79 | 4.0 | 15.5 |
| 15 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 31.7 | 0.050 | 0.100 | 50.13 | 4.0 | 15.5 |
| 16 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 41.7 | 0.050 | 0.100 | 53.47 | 4.0 | 15.5 |
| 17 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 44.3 | 0.050 | 0.100 | 56.82 | 4.0 | 15.5 |
| 18 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 45.5 | 0.076 | 0.100 | 60.16 | 4.0 | 15.5 |
| 19 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 38.1 | 0.200 | 0.100 | 63.50 | 4.0 | 15.5 |
| Toe | | | | | | 4.6 | 0.150 | 0.100 | | | |

3.363 kips total unreduced pile weight (g= 32.17 ft/s2)
3.363 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 |
| 345.4 | 73.4 | 8.55 | 8.57 | -0.38 | 3 | 36 | 31.71 | 3 | 2 | 18.3 |
| 353.5 | 79.7 | 8.61 | 8.61 | -0.42 | 3 | 36 | 31.97 | 3 | 2 | 18.4 |
| 361.5 | 87.5 | 8.67 | 8.66 | -0.41 | 3 | 36 | 32.20 | 3 | 2 | 18.5 |
| 369.6 | 96.5 | 8.72 | 8.71 | -0.41 | 3 | 35 | 32.44 | 3 | 2 | 18.5 |
| 377.7 | 106.7 | 8.77 | 8.75 | -0.46 | 3 | 35 | 32.66 | 3 | 3 | 18.6 |

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| | | | |
|------------------------|-------|----------------------|---------------------|
| Depth | (ft) | 60.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------------------|---------|-----------|---------|
| Toe Area | (in ²) | 144.000 | 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 |
| 63.5 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.686

| No. | Weight | Stiffn | C-Slk | T-Slk | CoR | Soil-S | Soil-D | Quake | Rut | (kips) | 402.4 |
|-----|--------|--------|-------|-------|------|--------|--------|-------|-------|--------|-------|
| | kips | k/in | ft | ft | | kips | s/ft | inch | LbTop | Perim | Area |
| 1 | 0.177 | 11208 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.0 | 15.5 |
| 2 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.5 | 0.200 | 0.100 | 6.68 | 4.0 | 15.5 |
| 3 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 11.0 | 0.200 | 0.100 | 10.03 | 4.0 | 15.5 |
| 4 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.8 | 0.200 | 0.100 | 13.37 | 4.0 | 15.5 |
| 5 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.0 | 0.200 | 0.100 | 16.71 | 4.0 | 15.5 |
| 7 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.0 | 0.200 | 0.100 | 23.39 | 4.0 | 15.5 |
| 8 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 11.0 | 0.200 | 0.100 | 26.74 | 4.0 | 15.5 |
| 10 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.8 | 0.200 | 0.100 | 33.42 | 4.0 | 15.5 |
| 11 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 7.4 | 0.200 | 0.100 | 36.76 | 4.0 | 15.5 |
| 12 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 22.5 | 0.072 | 0.100 | 40.11 | 4.0 | 15.5 |
| 13 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 29.7 | 0.050 | 0.100 | 43.45 | 4.0 | 15.5 |
| 14 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 37.2 | 0.050 | 0.100 | 46.79 | 4.0 | 15.5 |
| 15 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 42.9 | 0.050 | 0.100 | 50.13 | 4.0 | 15.5 |
| 16 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 45.6 | 0.050 | 0.100 | 53.47 | 4.0 | 15.5 |
| 17 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 41.4 | 0.155 | 0.100 | 56.82 | 4.0 | 15.5 |
| 18 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 38.1 | 0.200 | 0.100 | 60.16 | 4.0 | 15.5 |
| 19 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 38.1 | 0.200 | 0.100 | 63.50 | 4.0 | 15.5 |
| Toe | | | | | | 4.6 | 0.150 | 0.100 | | | |

3.363 kips total unreduced pile weight (g= 32.17 ft/s²)
 3.363 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 |
| 402.4 | 154.5 | 8.90 | 8.85 | -0.24 | 2 | 34 | 33.65 | 2 | 2 | 18.6 |
| 413.5 | 181.8 | 8.94 | 8.88 | -0.24 | 2 | 33 | 33.92 | 2 | 2 | 18.7 |
| 424.7 | 222.0 | 8.99 | 8.92 | -0.24 | 2 | 33 | 34.19 | 2 | 2 | 18.7 |
| 435.9 | 283.1 | 9.01 | 8.95 | -0.24 | 2 | 32 | 34.39 | 2 | 2 | 18.7 |
| 447.1 | 372.4 | 9.04 | 8.98 | -0.25 | 2 | 32 | 34.65 | 2 | 2 | 18.7 |

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| | | | |
|------------------------|-------|----------------------|---------------------|
| Depth | (ft) | 63.5 | Standard Soil Setup |
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

1323C-FA-12X53
 Toe Area (in2) 144.000 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 |
| 63.5 | 15.50 | 29000. | 492.0 | 4.0 | 0 | 16524. | 27.2 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | | 441.1 |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|-------|
| 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 | 0.177 | 11208 | 0.010 | 0.000 | 0.85 | 11.0 | 0.200 | 0.100 | 3.34 | 4.0 | 15.5 |
| 2 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 11.0 | 0.200 | 0.100 | 6.68 | 4.0 | 15.5 |
| 3 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.8 | 0.200 | 0.100 | 10.03 | 4.0 | 15.5 |
| 4 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.0 | 0.200 | 0.100 | 13.37 | 4.0 | 15.5 |
| 6 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.1 | 0.200 | 0.100 | 20.05 | 4.0 | 15.5 |
| 7 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 11.0 | 0.200 | 0.100 | 23.39 | 4.0 | 15.5 |
| 9 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 10.6 | 0.200 | 0.100 | 30.08 | 4.0 | 15.5 |
| 10 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 7.4 | 0.200 | 0.100 | 33.42 | 4.0 | 15.5 |
| 11 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 23.5 | 0.068 | 0.100 | 36.76 | 4.0 | 15.5 |
| 12 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 29.8 | 0.050 | 0.100 | 40.11 | 4.0 | 15.5 |
| 13 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 37.7 | 0.050 | 0.100 | 43.45 | 4.0 | 15.5 |
| 14 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 43.0 | 0.050 | 0.100 | 46.79 | 4.0 | 15.5 |
| 15 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 45.7 | 0.050 | 0.100 | 50.13 | 4.0 | 15.5 |
| 16 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 41.0 | 0.161 | 0.100 | 53.47 | 4.0 | 15.5 |
| 17 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 38.1 | 0.200 | 0.100 | 56.82 | 4.0 | 15.5 |
| 19 | 0.177 | 11208 | 0.000 | 0.000 | 1.00 | 37.0 | 0.200 | 0.100 | 63.50 | 4.0 | 15.5 |
| Toe | | | | | | 4.6 | 0.150 | 0.100 | | | |

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

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft | ft | Ratio | |
| 63.50 | 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 |
| 441.1 | 297.9 | 9.04 | 8.96 | 0.00 | 1 | 0 | 35.20 | 1 | 2 | 18.0 |
| 454.4 | 415.1 | 9.10 | 9.01 | 0.00 | 1 | 0 | 35.56 | 1 | 2 | 18.0 |
| 467.7 | 750.1 | 9.04 | 9.05 | 0.00 | 1 | 0 | 35.63 | 1 | 2 | 17.7 |
| 481.0 | 1598.9 | 9.17 | 9.08 | 0.00 | 1 | 0 | 36.15 | 1 | 2 | 17.9 |
| 494.4 | 9999.0 | 9.10 | 9.10 | 0.00 | 1 | 0 | 36.21 | 1 | 2 | 17.7 |

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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 | |
| 5.0 | 18.4 | 16.5 | 1.9 | 1.8 | 13.234 | -0.377 | 4.23 | 25.4 | |
| 10.0 | 34.2 | 32.7 | 1.5 | 3.5 | 18.253 | -0.441 | 4.94 | 22.9 | |
| 15.0 | 49.1 | 47.6 | 1.5 | 5.4 | 21.747 | -0.222 | 5.42 | 21.3 | |
| 20.0 | 64.4 | 62.6 | 1.8 | 7.5 | 24.027 | -0.165 | 5.79 | 20.1 | |
| 25.0 | 80.9 | 79.1 | 1.8 | 10.0 | 25.222 | -1.174 | 6.20 | 19.4 | |
| 30.0 | 96.2 | 95.2 | 1.0 | 12.3 | 26.730 | -0.942 | 6.51 | 18.8 | |
| 35.0 | 133.3 | 111.2 | 22.2 | 19.0 | 28.164 | -1.109 | 7.14 | 18.2 | |
| 40.0 | 177.2 | 155.0 | 22.2 | 24.0 | 29.761 | -0.027 | 7.50 | 17.8 | |
| 45.0 | 258.3 | 213.3 | 45.0 | 38.4 | 30.631 | -0.719 | 8.05 | 18.3 | |
| 50.0 | 334.7 | 280.5 | 54.2 | 65.5 | 32.186 | -1.066 | 8.47 | 18.6 | |
| 55.0 | 345.4 | 340.8 | 4.6 | 73.4 | 31.709 | -0.384 | 8.55 | 18.3 | |
| 60.0 | 402.4 | 397.8 | 4.6 | 154.5 | 33.649 | -0.243 | 8.90 | 18.6 | |
| 63.5 | 441.1 | 436.5 | 4.6 | 297.9 | 35.199 | 0.000 | 9.04 | 18.0 | |

Total Driving Time 61 minutes; Total No. of Blows 2477
 Starting at penetration 5.0 ft

| G/L at Shaft and Toe: 0.637 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 | 19.3 | 17.4 | 1.9 | 1.8 | 13.670 | -0.364 | 4.29 | 25.3 | |
| 10.0 | 35.9 | 34.5 | 1.5 | 3.7 | 18.635 | -0.364 | 5.00 | 22.6 | |
| 15.0 | 51.7 | 50.2 | 1.5 | 5.8 | 22.214 | -0.118 | 5.50 | 21.1 | |

| | | | | | | | | |
|----------------|-------|-------|------|-------|--------|--------|------|------|
| 1323C-FA-12X53 | | | | | | | | |
| 20.0 | 67.8 | 66.0 | 1.8 | 8.0 | 24.450 | -0.605 | 5.87 | 20.0 |
| 25.0 | 85.2 | 83.4 | 1.8 | 10.6 | 25.606 | -0.932 | 6.29 | 19.2 |
| 30.0 | 101.4 | 100.4 | 1.0 | 13.0 | 27.372 | -0.973 | 6.68 | 18.8 |
| 35.0 | 139.0 | 116.9 | 22.2 | 20.0 | 28.520 | -1.023 | 7.22 | 18.1 |
| 40.0 | 182.9 | 160.7 | 22.2 | 24.9 | 30.079 | 0.000 | 7.56 | 17.8 |
| 45.0 | 264.0 | 219.0 | 45.0 | 40.0 | 30.826 | -0.821 | 8.11 | 18.4 |
| 50.0 | 340.5 | 286.3 | 54.2 | 69.3 | 32.425 | -1.016 | 8.52 | 18.7 |
| 55.0 | 353.5 | 348.9 | 4.6 | 79.7 | 31.966 | -0.419 | 8.61 | 18.4 |
| 60.0 | 413.5 | 408.9 | 4.6 | 181.8 | 33.918 | -0.244 | 8.94 | 18.7 |
| 63.5 | 454.4 | 449.8 | 4.6 | 415.1 | 35.555 | 0.000 | 9.10 | 18.0 |

Total Driving Time 71 minutes; Total No. of Blows 2879
Starting at penetration 5.0 ft

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SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.670 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 | 20.2 | 18.3 | 1.9 | 1.9 | 13.847 | -0.357 | 4.29 | 25.0 |
| 10.0 | 37.7 | 36.3 | 1.5 | 3.9 | 19.021 | -0.337 | 5.07 | 22.4 |
| 15.0 | 54.3 | 52.8 | 1.5 | 6.1 | 22.438 | 0.000 | 5.51 | 20.7 |
| 20.0 | 71.3 | 69.4 | 1.8 | 8.5 | 24.888 | -0.994 | 5.96 | 19.8 |
| 25.0 | 89.5 | 87.7 | 1.8 | 11.3 | 25.966 | -0.741 | 6.37 | 19.0 |
| 30.0 | 106.6 | 105.6 | 1.0 | 14.0 | 27.771 | -0.874 | 6.76 | 18.7 |
| 35.0 | 144.8 | 122.6 | 22.2 | 21.2 | 28.781 | -0.776 | 7.29 | 18.0 |
| 40.0 | 188.6 | 166.4 | 22.2 | 25.9 | 30.347 | -0.202 | 7.62 | 17.8 |
| 45.0 | 269.7 | 224.8 | 45.0 | 42.6 | 30.804 | -0.927 | 8.08 | 18.1 |
| 50.0 | 346.2 | 292.0 | 54.2 | 73.3 | 32.670 | -0.992 | 8.57 | 18.7 |
| 55.0 | 361.5 | 356.9 | 4.6 | 87.5 | 32.204 | -0.414 | 8.67 | 18.5 |
| 60.0 | 424.7 | 420.1 | 4.6 | 222.0 | 34.189 | -0.236 | 8.99 | 18.7 |
| 63.5 | 467.7 | 463.1 | 4.6 | 750.1 | 35.631 | 0.000 | 9.04 | 17.7 |

Total Driving Time 92 minutes; Total No. of Blows 3734
Starting at penetration 5.0 ft

| G/L at Shaft and Toe: 0.703 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 | 21.1 | 19.2 | 1.9 | 2.0 | 14.177 | -0.339 | 4.33 | 24.8 |
| 10.0 | 39.5 | 38.1 | 1.5 | 4.1 | 19.373 | -0.309 | 5.13 | 22.2 |
| 15.0 | 56.9 | 55.4 | 1.5 | 6.5 | 22.821 | 0.000 | 5.58 | 20.6 |
| 20.0 | 74.7 | 72.9 | 1.8 | 9.1 | 25.315 | -1.209 | 6.05 | 19.6 |
| 25.0 | 93.8 | 92.0 | 1.8 | 11.9 | 26.293 | -0.911 | 6.45 | 18.9 |
| 30.0 | 111.8 | 110.8 | 1.0 | 15.0 | 28.147 | -0.697 | 6.85 | 18.5 |
| 35.0 | 150.5 | 128.3 | 22.2 | 22.0 | 29.091 | -0.467 | 7.37 | 17.9 |
| 40.0 | 194.3 | 172.1 | 22.2 | 27.0 | 30.612 | -0.375 | 7.68 | 17.7 |
| 45.0 | 275.4 | 230.5 | 45.0 | 44.5 | 31.052 | -1.032 | 8.14 | 18.2 |
| 50.0 | 351.9 | 297.7 | 54.2 | 77.7 | 32.904 | -1.009 | 8.62 | 18.8 |
| 55.0 | 369.6 | 365.0 | 4.6 | 96.5 | 32.445 | -0.411 | 8.72 | 18.5 |
| 60.0 | 435.9 | 431.3 | 4.6 | 283.1 | 34.391 | -0.236 | 9.01 | 18.7 |
| 63.5 | 481.0 | 476.4 | 4.6 | 1598.9 | 36.151 | 0.000 | 9.17 | 17.9 |

Total Driving Time 140 minutes; Total No. of Blows 5578
Starting at penetration 5.0 ft

↑
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SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.736 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 | 22.0 | 20.1 | 1.9 | 2.1 | 14.499 | -0.318 | 4.37 | 24.7 |
| 10.0 | 41.3 | 39.8 | 1.5 | 4.4 | 19.699 | -0.240 | 5.19 | 22.0 |
| 15.0 | 59.5 | 58.0 | 1.5 | 6.8 | 23.216 | 0.000 | 5.65 | 20.4 |
| 20.0 | 78.1 | 76.3 | 1.8 | 9.6 | 25.695 | -1.178 | 6.12 | 19.6 |
| 25.0 | 98.2 | 96.3 | 1.8 | 12.6 | 26.657 | -0.996 | 6.53 | 18.8 |
| 30.0 | 117.0 | 116.0 | 1.0 | 16.1 | 28.508 | -0.953 | 6.93 | 18.4 |
| 35.0 | 156.2 | 134.0 | 22.2 | 22.8 | 29.326 | -0.091 | 7.43 | 17.8 |
| 40.0 | 200.0 | 177.9 | 22.2 | 28.0 | 30.891 | -0.460 | 7.74 | 17.8 |
| 45.0 | 281.1 | 236.2 | 45.0 | 46.5 | 31.292 | -1.119 | 8.20 | 18.3 |
| 50.0 | 357.6 | 303.4 | 54.2 | 83.3 | 33.122 | -1.029 | 8.66 | 18.8 |
| 55.0 | 377.7 | 373.1 | 4.6 | 106.7 | 32.658 | -0.462 | 8.77 | 18.6 |
| 60.0 | 447.1 | 442.5 | 4.6 | 372.4 | 34.648 | -0.246 | 9.04 | 18.7 |
| 63.5 | 494.4 | 489.8 | 4.6 | 9999.0 | 36.208 | 0.000 | 9.10 | 17.7 |

Refusal occurred; no driving time output possible



FRA-70-1323C - For Abutment - HP12x53
Resource International Inc

02/28/2021
GRLWEAP Version 2010

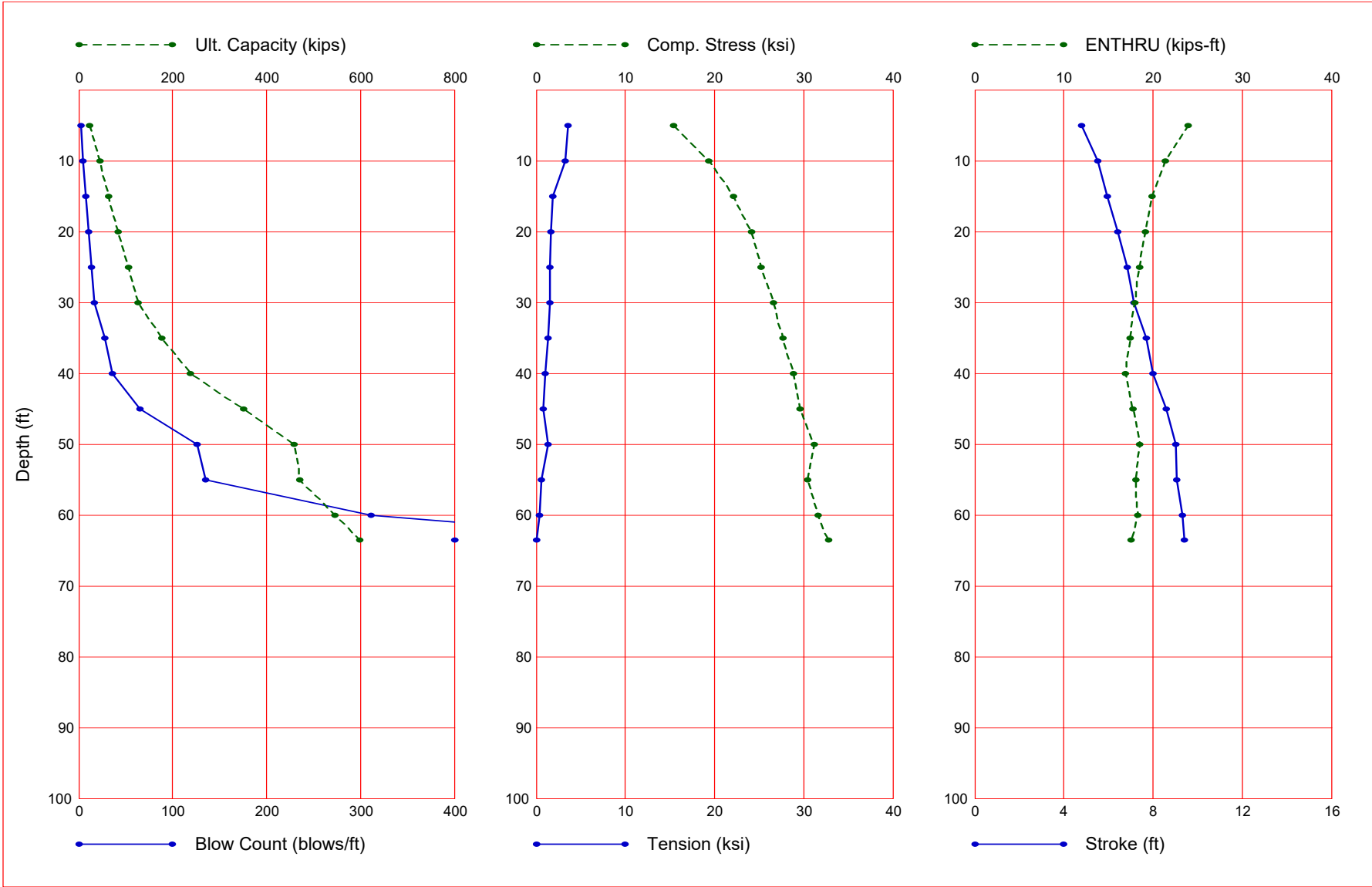
Table of Depths Analyzed with Driving System Modifiers

| Depth | Temp. | Wait | Equivalent | Pressure | | Stiffn. | Cushion |
|-------|--------|------|------------|----------|---------|---------|---------|
| ft | Length | Time | Stroke | Ratio | Efficy. | Factor | CoR |
| | ft | hr | ft | | | | |
| 5.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 10.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 15.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 20.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 25.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 30.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 35.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 40.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 45.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 50.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 55.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 60.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 63.50 | 63.50 | 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 | klps | inch | inch | s/ft | s/ft | Normlzd | ft | hrs |
| 0.01 | 1.38 | 1.94 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 9.01 | 1.38 | 1.94 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 9.19 | 1.38 | 1.94 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 9.21 | 1.24 | 1.45 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 18.21 | 1.24 | 1.45 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 19.69 | 1.25 | 1.45 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 19.71 | 1.37 | 1.82 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 28.71 | 1.37 | 1.82 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 29.69 | 1.37 | 1.82 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 29.71 | 0.92 | 0.97 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 34.19 | 0.92 | 0.97 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 34.21 | 2.09 | 22.18 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 41.19 | 2.34 | 22.18 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 41.21 | 3.04 | 44.95 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 46.19 | 3.29 | 44.95 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 46.21 | 3.33 | 54.20 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 51.19 | 3.59 | 54.20 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 51.21 | 4.75 | 4.60 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 60.21 | 4.75 | 4.60 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 63.50 | 4.48 | 4.60 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |

Gain/Loss 3 at Shaft and Toe 0.670 / 1.000



Gain/Loss 3 at Shaft and Toe 0.670 / 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 | 24.3 | 21.6 | 2.7 | 2.2 | 15.431 | -3.538 | 4.78 | 23.9 |
| 10.0 | 45.0 | 42.9 | 2.0 | 4.7 | 19.349 | -3.220 | 5.51 | 21.4 |
| 15.0 | 64.5 | 62.5 | 2.0 | 7.3 | 22.174 | -1.856 | 5.96 | 19.9 |
| 20.0 | 84.7 | 82.2 | 2.5 | 10.3 | 24.208 | -1.675 | 6.41 | 19.1 |
| 25.0 | 106.3 | 103.8 | 2.5 | 13.5 | 25.220 | -1.573 | 6.85 | 18.5 |
| 30.0 | 126.3 | 125.0 | 1.3 | 17.2 | 26.616 | -1.500 | 7.15 | 18.0 |
| 35.0 | 177.1 | 146.4 | 30.6 | 27.4 | 27.629 | -1.311 | 7.71 | 17.4 |
| 40.0 | 237.7 | 207.1 | 30.6 | 36.2 | 28.851 | -1.041 | 7.98 | 16.9 |
| 45.0 | 351.1 | 289.1 | 62.1 | 65.4 | 29.644 | -0.787 | 8.58 | 17.8 |
| 50.0 | 458.8 | 384.0 | 74.8 | 126.4 | 31.160 | -1.300 | 9.02 | 18.5 |
| 55.0 | 471.2 | 464.8 | 6.3 | 135.0 | 30.424 | -0.610 | 9.06 | 18.1 |
| 60.0 | 546.0 | 539.6 | 6.3 | 311.8 | 31.655 | -0.361 | 9.33 | 18.3 |
| 63.5 | 598.1 | 591.8 | 6.3 | 636.6 | 32.843 | 0.000 | 9.42 | 17.5 |

Total Continuous Driving Time 118.00 minutes; Total Number of Blows 4662 (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\2013\W-13-072 FRA-70-13.10 PROJECT 6A\ANALYSIS\FRA-70-1322L AND 1323C\DRIVEABILITY\FRA-70-1323C\FORWARD
ABUTMENT\HP 14X73\1323C-FA-14X73.GMW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW
Hammer File Version: 2003 (12/4/2018)

Input File Contents

FRA-70-1323C - For Abutment - HP14x73
OUT OSG HAM STR FUL PEL N SPL N-U P-D %SK ISM 0 PHI RSA ITR H-D MXT DEX
-100 0 41 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0.000
Pile g Hammer g Toe Area Pile Size Pile Type
32.170 32.170 144.000 14.000 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
63.500 21.40 29000.0 492.000 4.700 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 R0
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 | 1.38 | 2.67 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 9.01 | 1.38 | 2.67 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 9.19 | 1.38 | 2.67 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 9.21 | 1.24 | 2.01 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 18.21 | 1.24 | 2.01 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 19.69 | 1.24 | 2.01 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 19.71 | 1.37 | 2.51 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 28.71 | 1.37 | 2.51 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 29.69 | 1.37 | 2.51 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 29.71 | 0.92 | 1.34 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 34.19 | 0.92 | 1.34 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 34.21 | 2.45 | 30.62 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 41.19 | 2.73 | 30.62 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 41.21 | 3.62 | 62.06 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 46.19 | 3.92 | 62.06 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 46.21 | 3.97 | 74.83 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 51.19 | 4.29 | 74.83 | 0.10 | 0.10 | 0.05 | 0.15 | 1.00 | 6.00 | 1.000 |
| 51.21 | 4.75 | 6.35 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 60.21 | 4.75 | 6.35 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |
| 63.50 | 4.72 | 6.35 | 0.10 | 0.10 | 0.20 | 0.15 | 1.49 | 6.00 | 168.000 |

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 |
| 63.50 | 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-70-1323C - For Abutment - HP14x73

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 | | 15474.3 | | | |

HAMMER OPTIONS:

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

HAMMER DATA:

| Ram Weight | (kips) | 4.00 | Ram Length | (inch) | 129.10 |
|----------------------|--------|---------|--------------------|--------|---------|
| Maximum Stroke | (ft) | 11.86 | | | |
| Rated Stroke | (ft) | 10.81 | Efficiency | | 0.800 |
| Maximum Pressure | (psi) | 1600.00 | Actual Pressure | (psi) | 1600.00 |
| Compression Exponent | | 1.350 | Expansion Exponent | | 1.250 |
| Ram Diameter | (inch) | 12.60 | | | |

Combustion Delay (s) 0.00200 Ignition Duration (s) 0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

| | | | | | |
|----------------------|-----------|---------|----------------------|-----------|------|
| HAMMER CUSHION | | | PILE CUSHION | | |
| Cross Sect. Area | (in2) | 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-70-1323C - For Abutment - HP14x73 02/28/2021
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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 5.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 63.5 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | Total Capacity Rut (kips) | | | | 22.2 | |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| 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 | 0.244 | 15474 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.7 | 21.4 |
| 2 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 4.7 | 21.4 |
| 18 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 6.5 | 0.200 | 0.100 | 60.16 | 4.7 | 21.4 |
| 19 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 63.50 | 4.7 | 21.4 |
| Toe | | | | | | 2.7 | 0.150 | 0.100 | | | |

4.643 kips total unreduced pile weight (g= 32.17 ft/s2)
 4.643 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 |
| Output Time Interval | 1 | Analysis Time-Input (ms) |
| 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 |

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 Resource International Inc GRLWEAP Version 2010

| Rut | B1 Ct | Stroke (ft) | Ten Str | i | t Comp Str | i | t ENTHRU | B1 Rt |
|------|-------|-------------|---------|-------|------------|--------|----------|-------|
| kips | b/ft | down | up | ksi | ksi | kip-ft | b/min | |
| 22.2 | 2.1 | 4.65 | 4.69 | -3.25 | 6 9 | 14.69 | 1 2 | 24.0 |
| 23.2 | 2.2 | 4.69 | 4.73 | -3.33 | 6 9 | 14.96 | 1 2 | 23.9 |
| 24.3 | 2.2 | 4.78 | 4.77 | -3.54 | 6 9 | 15.43 | 1 2 | 23.9 |
| 25.4 | 2.3 | 4.83 | 4.81 | -3.58 | 6 9 | 15.70 | 1 2 | 23.8 |
| 26.4 | 2.5 | 4.87 | 4.86 | -3.60 | 6 9 | 15.96 | 4 3 | 23.7 |

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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 10.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 63.5 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | Total Capacity Rut | | | (kips) | | | 40.7 |
|---------------------|--------|--------|-------|-------|------|--------------------|--------|-------|--------|-------|------|------|
| 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 | 0.244 | 15474 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.7 | 21.4 | |
| 2 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 4.7 | 21.4 | |
| 17 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.9 | 0.200 | 0.100 | 56.82 | 4.7 | 21.4 | |
| 18 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 60.16 | 4.7 | 21.4 | |
| 19 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.7 | 0.200 | 0.100 | 63.50 | 4.7 | 21.4 | |
| Toe | | | | | | 2.0 | 0.150 | 0.100 | | | | |

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

4.643 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 |

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FRA-70-1323C - For Abutment - HP14x73 02/28/2021
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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 | |
| 40.7 | 4.2 | 5.38 | 5.37 | -3.57 | 6 | 9 | 18.76 | 10 | 4 | 21.8 | 51.1 |
| 42.8 | 4.4 | 5.44 | 5.43 | -3.42 | 6 | 9 | 19.05 | 12 | 4 | 21.6 | 50.8 |
| 45.0 | 4.7 | 5.51 | 5.49 | -3.22 | 6 | 9 | 19.35 | 12 | 4 | 21.4 | 50.6 |
| 47.1 | 5.0 | 5.56 | 5.55 | -3.02 | 6 | 9 | 19.67 | 16 | 5 | 21.3 | 50.2 |
| 49.2 | 5.3 | 5.56 | 5.62 | -2.71 | 6 | 9 | 19.80 | 16 | 5 | 20.9 | 50.1 |

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| | | | | |
|------------------------|------|-------|----------------------|-------|
| Depth | (ft) | 15.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
|-----------|--------|---------|-----------|---------|
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 63.5 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | Total Capacity | | Rut (kips) | | 58.4 | |
|---------------------|--------|--------|-------|-------|------|----------------|--------|------------|-------|-------|------|
| 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 | 0.244 | 15474 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.7 | 21.4 |
| 2 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 4.7 | 21.4 |
| 15 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 6.3 | 0.200 | 0.100 | 50.13 | 4.7 | 21.4 |
| 16 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 53.47 | 4.7 | 21.4 |
| 18 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.1 | 0.200 | 0.100 | 60.16 | 4.7 | 21.4 |
| 19 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 11.8 | 0.200 | 0.100 | 63.50 | 4.7 | 21.4 |
| Toe | | | | | | 2.0 | 0.150 | 0.100 | | | |

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

4.643 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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| 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 | |
| 58.4 | 6.5 | 5.82 | 5.85 | -2.38 | 6 | 9 | 21.46 | 15 | 5 | 20.3 | 49.0 |
| 61.4 | 6.9 | 5.89 | 5.92 | -2.11 | 6 | 9 | 21.80 | 15 | 5 | 20.1 | 48.6 |
| 64.5 | 7.3 | 5.96 | 5.99 | -1.86 | 6 | 9 | 22.17 | 15 | 5 | 19.9 | 48.3 |

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67.6 7.7 6.03 6.06 -1.60 2 10 22.49 15 5 19.8 48.0
70.7 8.2 6.10 6.13 -1.42 2 10 22.81 15 5 19.7 47.8

▲
FRA-70-1323C - For Abutment - HP14x73 02/28/2021
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Depth (ft) 20.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 63.5 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.686

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 76.6 |
|-----|--------|------------------------|----------------|--------------|--------|------------|
| | 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 | 0.244 | 15474 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.34 | 4.7 21.4 |
| 2 | 0.244 | 15474 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.68 | 4.7 21.4 |
| 14 | 0.244 | 15474 0.000 0.000 1.00 | 12.8 | 0.200 0.100 | 46.79 | 4.7 21.4 |
| 15 | 0.244 | 15474 0.000 0.000 1.00 | 13.0 | 0.200 0.100 | 50.13 | 4.7 21.4 |
| 16 | 0.244 | 15474 0.000 0.000 1.00 | 12.8 | 0.200 0.100 | 53.47 | 4.7 21.4 |
| 17 | 0.244 | 15474 0.000 0.000 1.00 | 11.8 | 0.200 0.100 | 56.82 | 4.7 21.4 |
| 19 | 0.244 | 15474 0.000 0.000 1.00 | 11.9 | 0.200 0.100 | 63.50 | 4.7 21.4 |
| Toe | | | 2.5 | 0.150 0.100 | | |

4.643 kips total unreduced pile weight (g= 32.17 ft/s2)
4.643 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 |
| 76.6 | 9.1 | 6.25 6.27 | -2.12 | 17 | 7 23.50 | 14 | 5 19.4 | 47.2 |
| 80.7 | 9.7 | 6.33 6.35 | -1.94 | 17 | 7 23.88 | 14 | 5 19.2 | 46.9 |
| 84.7 | 10.3 | 6.41 6.43 | -1.67 | 17 | 7 24.21 | 14 | 5 19.1 | 46.6 |
| 88.8 | 11.0 | 6.49 6.50 | -1.45 | 18 | 14 24.58 | 14 | 5 19.1 | 46.3 |
| 92.8 | 11.6 | 6.56 6.58 | -1.33 | 18 | 14 24.89 | 14 | 5 18.9 | 46.1 |

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Depth (ft) 25.0 Standard Soil Setup
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 63.5 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.686

| No. | Weight | Pile and Soil Model | Total Capacity | Rut | (kips) | 96.1 |
|-----|--------|------------------------|----------------|--------------|--------|------------|
| | 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 | 0.244 | 15474 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.34 | 4.7 21.4 |
| 2 | 0.244 | 15474 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.68 | 4.7 21.4 |
| 12 | 0.244 | 15474 0.000 0.000 1.00 | 6.2 | 0.200 0.100 | 40.11 | 4.7 21.4 |
| 13 | 0.244 | 15474 0.000 0.000 1.00 | 13.0 | 0.200 0.100 | 43.45 | 4.7 21.4 |
| 15 | 0.244 | 15474 0.000 0.000 1.00 | 12.1 | 0.200 0.100 | 50.13 | 4.7 21.4 |
| 16 | 0.244 | 15474 0.000 0.000 1.00 | 11.8 | 0.200 0.100 | 53.47 | 4.7 21.4 |
| 18 | 0.244 | 15474 0.000 0.000 1.00 | 12.5 | 0.200 0.100 | 60.16 | 4.7 21.4 |
| 19 | 0.244 | 15474 0.000 0.000 1.00 | 13.0 | 0.200 0.100 | 63.50 | 4.7 21.4 |
| Toe | | | 2.5 | 0.150 0.100 | | |

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4.643 kips total unreduced pile weight (g= 32.17 ft/s2)
4.643 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 | i | t | Comp Str ksi | i | t | ENTHRU kip-ft | Bl Rt b/min | |
|-------------|---------------|---------------------|---------------|-------|----|-----------------|-------|----|------------------|----------------|------|
| 96.1 | 12.0 | 6.63 | 6.64 | -1.97 | 17 | 7 | 24.46 | 12 | 4 | 18.7 | 45.8 |
| 101.2 | 12.7 | 6.78 | 6.72 | -1.82 | 17 | 7 | 24.92 | 12 | 4 | 18.7 | 45.4 |
| 106.3 | 13.5 | 6.85 | 6.80 | -1.57 | 17 | 7 | 25.22 | 12 | 4 | 18.5 | 45.2 |
| 111.4 | 14.4 | 6.93 | 6.87 | -1.25 | 17 | 7 | 25.53 | 12 | 4 | 18.4 | 44.9 |
| 116.5 | 15.3 | 6.99 | 6.95 | -1.04 | 12 | 42 | 25.76 | 12 | 4 | 18.3 | 44.7 |

↑
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| Depth (ft) | 30.0 | Standard Soil Setup |
|------------------------|-------|----------------------|
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor |
| | | 1.000 |

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 63.5 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.686

| 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 | Rut (kips) inch | 114.0 LbTop Perim | Area ft ft in2 |
|-----|----------------|---|------|----------------|----------------------|--------------------|----------------------|-------------------|
| 1 | 0.244 | 15474 0.010 0.000 0.85 | 0.0 | 0.000 0.100 | 3.34 | 4.7 | 21.4 | |
| 2 | 0.244 | 15474 0.000 0.000 1.00 | 0.0 | 0.000 0.100 | 6.68 | 4.7 | 21.4 | |
| 11 | 0.244 | 15474 0.000 0.000 1.00 | 12.7 | 0.200 0.100 | 36.76 | 4.7 | 21.4 | |
| 12 | 0.244 | 15474 0.000 0.000 1.00 | 13.0 | 0.200 0.100 | 40.11 | 4.7 | 21.4 | |
| 13 | 0.244 | 15474 0.000 0.000 1.00 | 12.8 | 0.200 0.100 | 43.45 | 4.7 | 21.4 | |
| 14 | 0.244 | 15474 0.000 0.000 1.00 | 11.8 | 0.200 0.100 | 46.79 | 4.7 | 21.4 | |
| 16 | 0.244 | 15474 0.000 0.000 1.00 | 11.9 | 0.200 0.100 | 53.47 | 4.7 | 21.4 | |
| 17 | 0.244 | 15474 0.000 0.000 1.00 | 13.0 | 0.200 0.100 | 56.82 | 4.7 | 21.4 | |
| 19 | 0.244 | 15474 0.000 0.000 1.00 | 12.6 | 0.200 0.100 | 63.50 | 4.7 | 21.4 | |
| Toe | | | 1.3 | 0.150 0.100 | | | | |

4.643 kips total unreduced pile weight (g= 32.17 ft/s2)
4.643 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 | i | t | Comp Str ksi | i | t | ENTHRU kip-ft | Bl Rt b/min | |
|-------------|---------------|---------------------|---------------|-------|----|-----------------|-------|----|------------------|----------------|------|
| 114.0 | 14.8 | 6.98 | 6.94 | -2.11 | 17 | 7 | 25.91 | 11 | 4 | 18.2 | 44.8 |
| 120.2 | 16.0 | 7.06 | 7.03 | -1.82 | 17 | 7 | 26.26 | 11 | 4 | 18.1 | 44.5 |
| 126.3 | 17.2 | 7.15 | 7.12 | -1.50 | 17 | 7 | 26.62 | 11 | 4 | 18.0 | 44.2 |
| 132.5 | 18.6 | 7.23 | 7.21 | -1.23 | 17 | 7 | 26.93 | 11 | 4 | 17.9 | 44.0 |
| 138.6 | 20.0 | 7.32 | 7.30 | -1.19 | 8 | 35 | 27.26 | 11 | 4 | 17.8 | 43.7 |

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| Depth (ft) | 35.0 | Standard Soil Setup |
|------------------------|-------|----------------------|
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor |
| | | 1.000 |

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 14.000

| 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 |
|---------------|-------------|--------------|-------------------|-------------|---------|-----------------|----------------|
| | | | | | | | |

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| | | | | | | | |
|------|-------|--------|-------|-----|---|--------|------|
| 0.0 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 63.5 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 163.5 |
|---------------------|----------------|----------------|-------------|-------------|------|----------------|----------------|---------------|-------------|---------------------------|-------------|
| 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 | 0.244 | 15474 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.7 | 21.4 |
| 2 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 4.7 | 21.4 |
| 9 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 6.1 | 0.200 | 0.100 | 30.08 | 4.7 | 21.4 |
| 10 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 33.42 | 4.7 | 21.4 |
| 12 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.1 | 0.200 | 0.100 | 40.11 | 4.7 | 21.4 |
| 13 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 11.8 | 0.200 | 0.100 | 43.45 | 4.7 | 21.4 |
| 15 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.5 | 0.200 | 0.100 | 50.13 | 4.7 | 21.4 |
| 16 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 53.47 | 4.7 | 21.4 |
| 18 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 10.5 | 0.200 | 0.100 | 60.16 | 4.7 | 21.4 |
| 19 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 15.9 | 0.132 | 0.100 | 63.50 | 4.7 | 21.4 |
| Toe | | | | | | 30.6 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy Ratio |
|-------------|--------------|-------------------|-----------------|
| 35.00 | 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 |
|-------------|---------------|---------------------|---------------|-------|---|----|-----------------|---|---|------------------|----------------|
| 163.5 | 24.3 | 7.57 | 7.55 | -1.07 | 9 | 29 | 27.16 | 9 | 3 | 17.7 | 42.9 |
| 170.3 | 25.9 | 7.64 | 7.63 | -1.21 | 9 | 29 | 27.40 | 9 | 3 | 17.6 | 42.7 |
| 177.1 | 27.4 | 7.71 | 7.71 | -1.31 | 9 | 29 | 27.63 | 9 | 3 | 17.4 | 42.5 |
| 183.8 | 28.5 | 7.78 | 7.78 | -1.27 | 9 | 29 | 27.91 | 9 | 3 | 17.4 | 42.4 |
| 190.6 | 29.6 | 7.83 | 7.84 | -1.15 | 9 | 29 | 28.09 | 9 | 3 | 17.2 | 42.2 |

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| | | | |
|------------------------|------|-------|----------------------|
| Depth | (ft) | 40.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | | 0.604 | Toe Gain/Loss Factor |
| | | | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------|---------|-----------|---------|
| Toe Area | (in2) | 144.000 | Pile Type | Unknown |
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 63.5 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | | | | | Total Capacity Rut (kips) | 224.2 |
|---------------------|----------------|----------------|-------------|-------------|------|----------------|----------------|---------------|-------------|---------------------------|-------------|
| 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 | 0.244 | 15474 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.7 | 21.4 |
| 2 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 4.7 | 21.4 |
| 8 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.6 | 0.200 | 0.100 | 26.74 | 4.7 | 21.4 |
| 9 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 30.08 | 4.7 | 21.4 |
| 10 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.8 | 0.200 | 0.100 | 33.42 | 4.7 | 21.4 |
| 11 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 11.8 | 0.200 | 0.100 | 36.76 | 4.7 | 21.4 |
| 13 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 11.9 | 0.200 | 0.100 | 43.45 | 4.7 | 21.4 |
| 14 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 46.79 | 4.7 | 21.4 |
| 16 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.7 | 0.200 | 0.100 | 53.47 | 4.7 | 21.4 |
| 17 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 8.8 | 0.200 | 0.100 | 56.82 | 4.7 | 21.4 |
| 18 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 31.1 | 0.068 | 0.100 | 60.16 | 4.7 | 21.4 |
| 19 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 41.1 | 0.050 | 0.100 | 63.50 | 4.7 | 21.4 |
| Toe | | | | | | 30.6 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy Ratio |
|-------------|--------------|-------------------|-----------------|
| 40.00 | 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 | |
|-------------|---------------|---------------------|----------------------|-------|---|-----------------|-------|---|------------------|----------------|------|
| 224.2 | 32.8 | 7.94 | 7.94 | -1.66 | 8 | 28 | 28.61 | 8 | 3 | 17.2 | 41.9 |
| 231.0 | 34.4 | 8.00 | 8.00 | -1.39 | 8 | 28 | 28.85 | 8 | 3 | 17.1 | 41.8 |
| 237.7 | 36.2 | 7.98 | 8.06 | -1.04 | 8 | 28 | 28.85 | 8 | 3 | 16.9 | 41.7 |
| 244.5 | 37.7 | 8.04 | 8.11 | -0.68 | 8 | 28 | 29.09 | 8 | 3 | 17.0 | 41.6 |
| 251.3 | 39.2 | 8.10 | 8.15 | -0.58 | 5 | 46 | 29.35 | 8 | 3 | 17.1 | 41.5 |

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| Depth ft | Standard Soil Setup Toe Gain/Loss Factor |
|-------------|---|
| 45.0 | 0.604 |

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 63.5 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.686

| 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 LbTop ft | Perim ft | Area in2 |
|-----|----------------|------------------------------------|-------------|-------------|------|-------------------------------|----------------|---------------|-----------------|-------------|-------------|
| 1 | 0.244 | 15474 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.7 | 21.4 |
| 2 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 4.7 | 21.4 |
| 6 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 6.0 | 0.200 | 0.100 | 20.05 | 4.7 | 21.4 |
| 7 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 23.39 | 4.7 | 21.4 |
| 9 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.2 | 0.200 | 0.100 | 30.08 | 4.7 | 21.4 |
| 10 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 11.8 | 0.200 | 0.100 | 33.42 | 4.7 | 21.4 |
| 12 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.5 | 0.200 | 0.100 | 40.11 | 4.7 | 21.4 |
| 13 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 43.45 | 4.7 | 21.4 |
| 15 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 10.6 | 0.200 | 0.100 | 50.13 | 4.7 | 21.4 |
| 16 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 15.7 | 0.133 | 0.100 | 53.47 | 4.7 | 21.4 |
| 17 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 40.0 | 0.050 | 0.100 | 56.82 | 4.7 | 21.4 |
| 18 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 44.1 | 0.050 | 0.100 | 60.16 | 4.7 | 21.4 |
| 19 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 58.9 | 0.050 | 0.100 | 63.50 | 4.7 | 21.4 |
| Toe | | | | | | 62.1 | 0.150 | 0.100 | | | |

4.643 kips total unreduced pile weight (g= 32.17 ft/s2)
4.643 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 ksi | i | t | Comp Str ksi | i | t | ENTHRU kip-ft | Bl Rt b/min | |
|-------------|---------------|---------------------|----------------------|-------|---|-----------------|-------|---|------------------|----------------|------|
| 337.6 | 59.0 | 8.50 | 8.53 | -0.90 | 6 | 42 | 29.38 | 7 | 3 | 17.7 | 40.5 |
| 344.4 | 61.9 | 8.53 | 8.56 | -0.81 | 6 | 41 | 29.51 | 7 | 3 | 17.8 | 40.5 |
| 351.1 | 65.4 | 8.58 | 8.61 | -0.79 | 6 | 38 | 29.64 | 7 | 3 | 17.8 | 40.4 |
| 357.9 | 68.6 | 8.63 | 8.65 | -0.96 | 6 | 38 | 29.82 | 7 | 3 | 17.9 | 40.3 |
| 364.7 | 72.6 | 8.67 | 8.70 | -1.05 | 6 | 38 | 29.98 | 6 | 3 | 17.9 | 40.1 |

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| Depth ft | Standard Soil Setup Toe Gain/Loss Factor |
|-------------|---|
| 50.0 | 0.604 |

PILE PROFILE:
Toe Area (in2) 144.000 Pile Type Unknown
Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 63.5 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.686

1323C-FA-14X73

| Pile and Soil Model | | | | | | Total Capacity | | | Rut (kips) | | 445.3 | |
|---------------------|----------------|----------------|-------------|-------------|------|----------------|----------------|---------------|-------------|-------------|-------------|--|
| 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 | 0.244 | 15474 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.7 | 21.4 | |
| 2 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 4.7 | 21.4 | |
| 5 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.5 | 0.200 | 0.100 | 16.71 | 4.7 | 21.4 | |
| 6 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 20.05 | 4.7 | 21.4 | |
| 7 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.8 | 0.200 | 0.100 | 23.39 | 4.7 | 21.4 | |
| 8 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 11.8 | 0.200 | 0.100 | 26.74 | 4.7 | 21.4 | |
| 10 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 11.9 | 0.200 | 0.100 | 33.42 | 4.7 | 21.4 | |
| 11 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 36.76 | 4.7 | 21.4 | |
| 13 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.7 | 0.200 | 0.100 | 43.45 | 4.7 | 21.4 | |
| 14 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 8.8 | 0.200 | 0.100 | 46.79 | 4.7 | 21.4 | |
| 15 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 30.9 | 0.068 | 0.100 | 50.13 | 4.7 | 21.4 | |
| 16 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 41.1 | 0.050 | 0.100 | 53.47 | 4.7 | 21.4 | |
| 17 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 52.2 | 0.050 | 0.100 | 56.82 | 4.7 | 21.4 | |
| 18 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 60.5 | 0.050 | 0.100 | 60.16 | 4.7 | 21.4 | |
| 19 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 64.5 | 0.050 | 0.100 | 63.50 | 4.7 | 21.4 | |
| Toe | | | | | | 74.8 | 0.150 | 0.100 | | | | |

4.643 kips total unreduced pile weight (g= 32.17 ft/s2)
4.643 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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| 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 | |
|-------------|---------------|---------------------|---------------|-------|---|-----------------|-------|---|------------------|----------------|------|
| 445.3 | 111.0 | 8.95 | 8.94 | -1.17 | 5 | 17 | 30.81 | 5 | 3 | 18.4 | 39.6 |
| 452.1 | 118.2 | 8.98 | 8.96 | -1.24 | 5 | 17 | 30.99 | 5 | 3 | 18.5 | 39.5 |
| 458.8 | 126.4 | 9.02 | 8.99 | -1.30 | 5 | 17 | 31.16 | 5 | 3 | 18.5 | 39.4 |
| 465.6 | 135.4 | 9.05 | 9.02 | -1.35 | 5 | 17 | 31.29 | 5 | 3 | 18.5 | 39.4 |
| 472.4 | 145.7 | 9.09 | 9.05 | -1.38 | 5 | 17 | 31.44 | 5 | 3 | 18.6 | 39.3 |

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| | | | |
|------------------------|-------|----------------------|-------|
| Depth (ft) | 55.0 | Standard Soil Setup | |
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | |
|------------------|---------|-----------|---------|
| Toe Area (in2) | 144.000 | Pile Type | Unknown |
| Pile Size (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 63.5 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.686

| Pile and Soil Model | | | | | | Total Capacity | Rut | (kips) | | | 452.1 |
|---------------------|----------------|----------------|-------------|-------------|------|----------------|----------------|---------------|-------------|-------------|-------------|
| 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 | 0.244 | 15474 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.7 | 21.4 |
| 2 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 0.0 | 0.000 | 0.100 | 6.68 | 4.7 | 21.4 |
| 3 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 5.9 | 0.200 | 0.100 | 10.03 | 4.7 | 21.4 |
| 4 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 13.37 | 4.7 | 21.4 |
| 6 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.2 | 0.200 | 0.100 | 20.05 | 4.7 | 21.4 |
| 7 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 11.8 | 0.200 | 0.100 | 23.39 | 4.7 | 21.4 |
| 9 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.5 | 0.200 | 0.100 | 30.08 | 4.7 | 21.4 |
| 10 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 33.42 | 4.7 | 21.4 |
| 12 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 10.6 | 0.200 | 0.100 | 40.11 | 4.7 | 21.4 |
| 13 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 15.4 | 0.135 | 0.100 | 43.45 | 4.7 | 21.4 |
| 14 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 40.0 | 0.050 | 0.100 | 46.79 | 4.7 | 21.4 |
| 15 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 44.0 | 0.050 | 0.100 | 50.13 | 4.7 | 21.4 |
| 16 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 58.8 | 0.050 | 0.100 | 53.47 | 4.7 | 21.4 |
| 17 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 62.5 | 0.050 | 0.100 | 56.82 | 4.7 | 21.4 |
| 18 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 63.1 | 0.073 | 0.100 | 60.16 | 4.7 | 21.4 |
| 19 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 45.1 | 0.200 | 0.100 | 63.50 | 4.7 | 21.4 |
| Toe | | | | | | 6.3 | 0.150 | 0.100 | | | |

4.643 kips total unreduced pile weight (g= 32.17 ft/s2)
4.643 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 | |
| 452.1 | 113.0 | 8.97 | 8.95 | -0.42 | 4 | 18 | 30.14 | 4 | 2 | 18.0 | 39.6 |
| 461.6 | 122.5 | 9.02 | 8.98 | -0.51 | 3 | 32 | 30.26 | 4 | 2 | 18.1 | 39.5 |
| 471.2 | 135.0 | 9.06 | 9.01 | -0.61 | 3 | 32 | 30.42 | 4 | 2 | 18.1 | 39.4 |
| 480.7 | 149.7 | 9.10 | 9.05 | -0.66 | 3 | 32 | 30.57 | 4 | 2 | 18.1 | 39.3 |
| 490.3 | 167.2 | 9.14 | 9.08 | -0.67 | 3 | 31 | 30.71 | 4 | 2 | 18.2 | 39.2 |

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| | | | |
|------------------------|-------|----------------------|---------------------|
| Depth | (ft) | 60.0 | Standard Soil Setup |
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

| | | | | |
|-----------|--------------------|---------|-----------|---------|
| Toe Area | (in ²) | 144.000 | Pile Type | Unknown |
| Pile Size | (inch) | 14.000 | | |

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 63.5 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.686

| No. | Weight | Stiffn | C-Slk | T-Slk | CoR | Soil-S | Soil-D | Quake | Rut | (kips) | 519.5 |
|-----|--------|--------|-------|-------|------|--------|--------|-------|-------|--------|-------|
| | kips | k/in | ft | ft | | kips | s/ft | inch | LbTop | Perim | Area |
| 1 | 0.244 | 15474 | 0.010 | 0.000 | 0.85 | 0.0 | 0.000 | 0.100 | 3.34 | 4.7 | 21.4 |
| 2 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.4 | 0.200 | 0.100 | 6.68 | 4.7 | 21.4 |
| 3 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 10.03 | 4.7 | 21.4 |
| 4 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.8 | 0.200 | 0.100 | 13.37 | 4.7 | 21.4 |
| 5 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 11.8 | 0.200 | 0.100 | 16.71 | 4.7 | 21.4 |
| 7 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 11.9 | 0.200 | 0.100 | 23.39 | 4.7 | 21.4 |
| 8 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 26.74 | 4.7 | 21.4 |
| 10 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.7 | 0.200 | 0.100 | 33.42 | 4.7 | 21.4 |
| 11 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 8.8 | 0.200 | 0.100 | 36.76 | 4.7 | 21.4 |
| 12 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 30.6 | 0.069 | 0.100 | 40.11 | 4.7 | 21.4 |
| 13 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 41.1 | 0.050 | 0.100 | 43.45 | 4.7 | 21.4 |
| 14 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 52.1 | 0.050 | 0.100 | 46.79 | 4.7 | 21.4 |
| 15 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 60.5 | 0.050 | 0.100 | 50.13 | 4.7 | 21.4 |
| 16 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 64.4 | 0.050 | 0.100 | 53.47 | 4.7 | 21.4 |
| 17 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 53.0 | 0.149 | 0.100 | 56.82 | 4.7 | 21.4 |
| 18 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 45.1 | 0.200 | 0.100 | 60.16 | 4.7 | 21.4 |
| 19 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 45.1 | 0.200 | 0.100 | 63.50 | 4.7 | 21.4 |
| Toe | | | | | | 6.3 | 0.150 | 0.100 | | | |

4.643 kips total unreduced pile weight (g= 32.17 ft/s²)
 4.643 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 | |
| 519.5 | 227.0 | 9.26 | 9.18 | -0.30 | 2 | 30 | 31.27 | 2 | 2 | 18.3 | 39.0 |
| 532.7 | 264.3 | 9.30 | 9.21 | -0.34 | 2 | 30 | 31.46 | 2 | 2 | 18.3 | 38.9 |
| 546.0 | 311.8 | 9.33 | 9.24 | -0.36 | 2 | 30 | 31.65 | 2 | 2 | 18.3 | 38.9 |
| 559.2 | 375.8 | 9.37 | 9.28 | -0.34 | 2 | 29 | 31.84 | 2 | 2 | 18.4 | 38.8 |
| 572.4 | 467.5 | 9.39 | 9.31 | -0.28 | 2 | 29 | 32.01 | 2 | 2 | 18.3 | 38.7 |

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| | | | |
|------------------------|-------|----------------------|---------------------|
| Depth | (ft) | 63.5 | Standard Soil Setup |
| Shaft Gain/Loss Factor | 0.604 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

1323C-FA-14X73
 Toe Area (in2) 144.000 Pile Type Unknown
 Pile Size (inch) 14.000

| 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 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |
| 63.5 | 21.40 | 29000. | 492.0 | 4.7 | 0 | 16524. | 37.6 |

Wave Travel Time 2L/c (ms) 7.686

| 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 s/ft | Quake inch | LbTop ft | Perim ft | Area in2 |
|-----|----------------|------------------------------------|----------|----------|------|-------------------------------|---------------------------|---------------|-------------|-------------|-------------|
| 1 | 0.244 | 15474 | 0.010 | 0.000 | 0.85 | 13.0 | 0.200 | 0.100 | 3.34 | 4.7 | 21.4 |
| 2 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 6.68 | 4.7 | 21.4 |
| 3 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.7 | 0.200 | 0.100 | 10.03 | 4.7 | 21.4 |
| 4 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 11.8 | 0.200 | 0.100 | 13.37 | 4.7 | 21.4 |
| 6 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 11.9 | 0.200 | 0.100 | 20.05 | 4.7 | 21.4 |
| 7 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 13.0 | 0.200 | 0.100 | 23.39 | 4.7 | 21.4 |
| 9 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 12.5 | 0.200 | 0.100 | 30.08 | 4.7 | 21.4 |
| 10 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 8.8 | 0.200 | 0.100 | 33.42 | 4.7 | 21.4 |
| 11 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 32.1 | 0.065 | 0.100 | 36.76 | 4.7 | 21.4 |
| 12 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 41.2 | 0.050 | 0.100 | 40.11 | 4.7 | 21.4 |
| 13 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 52.9 | 0.050 | 0.100 | 43.45 | 4.7 | 21.4 |
| 14 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 60.7 | 0.050 | 0.100 | 46.79 | 4.7 | 21.4 |
| 15 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 64.6 | 0.050 | 0.100 | 50.13 | 4.7 | 21.4 |
| 16 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 52.0 | 0.156 | 0.100 | 53.47 | 4.7 | 21.4 |
| 17 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 45.1 | 0.200 | 0.100 | 56.82 | 4.7 | 21.4 |
| 19 | 0.244 | 15474 | 0.000 | 0.000 | 1.00 | 44.9 | 0.200 | 0.100 | 63.50 | 4.7 | 21.4 |
| Toe | | | | | | 6.3 | 0.150 | 0.100 | | | |

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

| Depth ft | Stroke ft | Pressure Ratio | Efficy 0.800 |
|-------------|--------------|-------------------|-----------------|
| 63.50 | 10.81 | 1.00 | 0.800 |

↑
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| 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 |
|-------------|---------------|---------------------|---------------|----------------|---|---|-----------------|---|---|------------------|----------------|
| 566.5 | 369.5 | 9.37 | 9.29 | 0.00 | 1 | 0 | 32.41 | 1 | 2 | 17.6 | 38.8 |
| 582.3 | 470.4 | 9.40 | 9.31 | 0.00 | 1 | 0 | 32.64 | 1 | 2 | 17.6 | 38.7 |
| 598.1 | 636.6 | 9.42 | 9.34 | 0.00 | 1 | 0 | 32.84 | 1 | 2 | 17.5 | 38.7 |
| 614.0 | 930.6 | 9.44 | 9.36 | 0.00 | 1 | 0 | 33.05 | 1 | 2 | 17.4 | 38.6 |
| 629.8 | 1560.7 | 9.46 | 9.38 | 0.00 | 1 | 0 | 33.26 | 1 | 2 | 17.4 | 38.6 |

↑
 FRA-70-1323C - For Abutment - HP14x73 02/28/2021
 Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

| Depth ft | Rut kips | G/L at Frictn kips | Shaft and End Bg kips | Toe: 0.604 1.000 Bl Ct b/ft | Com Str ksi | Ten Str ksi | Stroke ft | ENTHRU kip-ft |
|-------------|-------------|-----------------------|--------------------------|--------------------------------|----------------|----------------|--------------|------------------|
| 5.0 | 22.2 | 19.5 | 2.7 | 2.1 | 14.694 | -3.247 | 4.65 | 24.0 |
| 10.0 | 40.7 | 38.7 | 2.0 | 4.2 | 18.762 | -3.567 | 5.38 | 21.8 |
| 15.0 | 58.4 | 56.4 | 2.0 | 6.5 | 21.460 | -2.383 | 5.82 | 20.3 |
| 20.0 | 76.6 | 74.1 | 2.5 | 9.1 | 23.503 | -2.119 | 6.25 | 19.4 |
| 25.0 | 96.1 | 93.6 | 2.5 | 12.0 | 24.461 | -1.974 | 6.63 | 18.7 |
| 30.0 | 114.0 | 112.7 | 1.3 | 14.8 | 25.909 | -2.106 | 6.98 | 18.2 |
| 35.0 | 163.5 | 132.9 | 30.6 | 24.3 | 27.157 | -1.071 | 7.57 | 17.7 |
| 40.0 | 224.2 | 193.6 | 30.6 | 32.8 | 28.610 | -1.658 | 7.94 | 17.2 |
| 45.0 | 337.6 | 275.6 | 62.1 | 59.0 | 29.382 | -0.904 | 8.50 | 17.7 |
| 50.0 | 445.3 | 370.5 | 74.8 | 111.0 | 30.809 | -1.175 | 8.95 | 18.4 |
| 55.0 | 452.1 | 445.7 | 6.3 | 113.0 | 30.135 | -0.420 | 8.97 | 18.0 |
| 60.0 | 519.5 | 513.1 | 6.3 | 227.0 | 31.266 | -0.300 | 9.26 | 18.3 |
| 63.5 | 566.5 | 560.2 | 6.3 | 369.5 | 32.407 | 0.000 | 9.37 | 17.6 |

Total Driving Time 89 minutes; Total No. of Blows 3551
 Starting at penetration 5.0 ft

| Depth ft | Rut kips | G/L at Frictn kips | Shaft and End Bg kips | Toe: 0.637 1.000 Bl Ct b/ft | Com Str ksi | Ten Str ksi | Stroke ft | ENTHRU kip-ft |
|-------------|-------------|-----------------------|--------------------------|--------------------------------|----------------|----------------|--------------|------------------|
| 5.0 | 23.2 | 20.6 | 2.7 | 2.2 | 14.958 | -3.326 | 4.69 | 23.9 |
| 10.0 | 42.8 | 40.8 | 2.0 | 4.4 | 19.054 | -3.416 | 5.44 | 21.6 |
| 15.0 | 61.4 | 59.4 | 2.0 | 6.9 | 21.799 | -2.109 | 5.89 | 20.1 |

| | | | | | | | | | |
|----------------|-------|-------|------|-------|--------|--------|------|------|--|
| 1323C-FA-14X73 | | | | | | | | | |
| 20.0 | 80.7 | 78.2 | 2.5 | 9.7 | 23.882 | -1.943 | 6.33 | 19.2 | |
| 25.0 | 101.2 | 98.7 | 2.5 | 12.7 | 24.921 | -1.817 | 6.78 | 18.7 | |
| 30.0 | 120.2 | 118.8 | 1.3 | 16.0 | 26.260 | -1.823 | 7.06 | 18.1 | |
| 35.0 | 170.3 | 139.7 | 30.6 | 25.9 | 27.404 | -1.211 | 7.64 | 17.6 | |
| 40.0 | 231.0 | 200.4 | 30.6 | 34.4 | 28.845 | -1.392 | 8.00 | 17.1 | |
| 45.0 | 344.4 | 282.3 | 62.1 | 61.9 | 29.514 | -0.809 | 8.53 | 17.8 | |
| 50.0 | 452.1 | 377.2 | 74.8 | 118.2 | 30.993 | -1.245 | 8.98 | 18.5 | |
| 55.0 | 461.6 | 455.3 | 6.3 | 122.5 | 30.265 | -0.508 | 9.02 | 18.1 | |
| 60.0 | 532.7 | 526.4 | 6.3 | 264.3 | 31.461 | -0.337 | 9.30 | 18.3 | |
| 63.5 | 582.3 | 576.0 | 6.3 | 470.4 | 32.638 | 0.000 | 9.40 | 17.6 | |

Total Driving Time 101 minutes; Total No. of Blows 4016
Starting at penetration 5.0 ft

▲
FRA-70-1323C - For Abutment - HP14x73 02/28/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.670 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 | 24.3 | 21.6 | 2.7 | 2.2 | 15.431 | -3.538 | 4.78 | 23.9 | |
| 10.0 | 45.0 | 42.9 | 2.0 | 4.7 | 19.349 | -3.220 | 5.51 | 21.4 | |
| 15.0 | 64.5 | 62.5 | 2.0 | 7.3 | 22.174 | -1.856 | 5.96 | 19.9 | |
| 20.0 | 84.7 | 82.2 | 2.5 | 10.3 | 24.208 | -1.675 | 6.41 | 19.1 | |
| 25.0 | 106.3 | 103.8 | 2.5 | 13.5 | 25.220 | -1.573 | 6.85 | 18.5 | |
| 30.0 | 126.3 | 125.0 | 1.3 | 17.2 | 26.616 | -1.500 | 7.15 | 18.0 | |
| 35.0 | 177.1 | 146.4 | 30.6 | 27.4 | 27.629 | -1.311 | 7.71 | 17.4 | |
| 40.0 | 237.7 | 207.1 | 30.6 | 36.2 | 28.851 | -1.041 | 7.98 | 16.9 | |
| 45.0 | 351.1 | 289.1 | 62.1 | 65.4 | 29.644 | -0.787 | 8.58 | 17.8 | |
| 50.0 | 458.8 | 384.0 | 74.8 | 126.4 | 31.160 | -1.300 | 9.02 | 18.5 | |
| 55.0 | 471.2 | 464.8 | 6.3 | 135.0 | 30.424 | -0.610 | 9.06 | 18.1 | |
| 60.0 | 546.0 | 539.6 | 6.3 | 311.8 | 31.655 | -0.361 | 9.33 | 18.3 | |
| 63.5 | 598.1 | 591.8 | 6.3 | 636.6 | 32.843 | 0.000 | 9.42 | 17.5 | |

Total Driving Time 118 minutes; Total No. of Blows 4662
Starting at penetration 5.0 ft

| G/L at Shaft and Toe: 0.703 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 | 25.4 | 22.7 | 2.7 | 2.3 | 15.704 | -3.575 | 4.83 | 23.8 | |
| 10.0 | 47.1 | 45.1 | 2.0 | 5.0 | 19.666 | -3.022 | 5.56 | 21.3 | |
| 15.0 | 67.6 | 65.6 | 2.0 | 7.7 | 22.488 | -1.601 | 6.03 | 19.8 | |
| 20.0 | 88.8 | 86.3 | 2.5 | 11.0 | 24.581 | -1.450 | 6.49 | 19.1 | |
| 25.0 | 111.4 | 108.9 | 2.5 | 14.4 | 25.529 | -1.254 | 6.93 | 18.4 | |
| 30.0 | 132.5 | 131.1 | 1.3 | 18.6 | 26.933 | -1.226 | 7.23 | 17.9 | |
| 35.0 | 183.8 | 153.2 | 30.6 | 28.5 | 27.914 | -1.266 | 7.78 | 17.4 | |
| 40.0 | 244.5 | 213.9 | 30.6 | 37.7 | 29.090 | -0.678 | 8.04 | 17.0 | |
| 45.0 | 357.9 | 295.8 | 62.1 | 68.6 | 29.825 | -0.956 | 8.63 | 17.9 | |
| 50.0 | 465.6 | 390.8 | 74.8 | 135.4 | 31.293 | -1.351 | 9.05 | 18.5 | |
| 55.0 | 480.7 | 474.4 | 6.3 | 149.7 | 30.572 | -0.663 | 9.10 | 18.1 | |
| 60.0 | 559.2 | 552.8 | 6.3 | 375.8 | 31.840 | -0.342 | 9.37 | 18.4 | |
| 63.5 | 614.0 | 607.6 | 6.3 | 930.6 | 33.046 | 0.000 | 9.44 | 17.4 | |

Total Driving Time 142 minutes; Total No. of Blows 5614
Starting at penetration 5.0 ft

▲
FRA-70-1323C - For Abutment - HP14x73 02/28/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.736 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 | 26.4 | 23.8 | 2.7 | 2.5 | 15.961 | -3.603 | 4.87 | 23.7 | |
| 10.0 | 49.2 | 47.2 | 2.0 | 5.3 | 19.798 | -2.709 | 5.56 | 20.9 | |
| 15.0 | 70.7 | 68.7 | 2.0 | 8.2 | 22.807 | -1.422 | 6.10 | 19.7 | |
| 20.0 | 92.8 | 90.3 | 2.5 | 11.6 | 24.886 | -1.328 | 6.56 | 18.9 | |
| 25.0 | 116.5 | 114.0 | 2.5 | 15.3 | 25.760 | -1.035 | 6.99 | 18.3 | |
| 30.0 | 138.6 | 137.3 | 1.3 | 20.0 | 27.261 | -1.194 | 7.32 | 17.8 | |
| 35.0 | 190.6 | 160.0 | 30.6 | 29.6 | 28.085 | -1.148 | 7.83 | 17.2 | |
| 40.0 | 251.3 | 220.6 | 30.6 | 39.2 | 29.348 | -0.579 | 8.10 | 17.1 | |
| 45.0 | 364.7 | 302.6 | 62.1 | 72.6 | 29.979 | -1.045 | 8.67 | 17.9 | |
| 50.0 | 472.4 | 397.5 | 74.8 | 145.7 | 31.444 | -1.383 | 9.09 | 18.6 | |
| 55.0 | 490.3 | 483.9 | 6.3 | 167.2 | 30.714 | -0.669 | 9.14 | 18.2 | |
| 60.0 | 572.4 | 566.1 | 6.3 | 467.5 | 32.007 | -0.284 | 9.39 | 18.3 | |
| 63.5 | 629.8 | 623.4 | 6.3 | 1560.7 | 33.263 | 0.000 | 9.46 | 17.4 | |

1323C-FA-14X73

Total Driving Time 186 minutes;
 Starting at penetration 5.0 ft

Total No. of Blows 7297

▲
 FRA-70-1323C - For Abutment - HP14x73
 Resource International Inc

02/28/2021
 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 | | | | |
| 5.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 10.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 15.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 20.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 25.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 30.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 35.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 40.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 45.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 50.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 55.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 60.00 | 63.50 | 0.00 | 10.81 | 1.00 | 0.80 | 1.00 | 1.00 |
| 63.50 | 63.50 | 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 | 1.38 | 2.67 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 9.01 | 1.38 | 2.67 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 9.19 | 1.38 | 2.67 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 9.21 | 1.24 | 2.01 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 18.21 | 1.24 | 2.01 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 19.69 | 1.24 | 2.01 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 19.71 | 1.37 | 2.51 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 28.71 | 1.37 | 2.51 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 29.69 | 1.37 | 2.51 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 29.71 | 0.92 | 1.34 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 34.19 | 0.92 | 1.34 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 34.21 | 2.45 | 30.62 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 41.19 | 2.73 | 30.62 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 41.21 | 3.62 | 62.06 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 46.19 | 3.92 | 62.06 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 46.21 | 3.97 | 74.83 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 51.19 | 4.29 | 74.83 | 0.100 | 0.100 | 0.050 | 0.150 | 0.000 | 6.000 | 1.000 |
| 51.21 | 4.75 | 6.35 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 60.21 | 4.75 | 6.35 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |
| 63.50 | 4.72 | 6.35 | 0.100 | 0.100 | 0.200 | 0.150 | 1.000 | 6.000 | 168.000 |

APPENDIX VIII

SETTLEMENT CALCULATIONS

W-13-072 FRA-70-13.10 (FRA-70-1322L and 1323C Bridge Structure)
Embankment Settlement

Calculated By: BRT Date: 1/21/2015
Checked By: JPS Date: 1/22/2015

Borings B-113-4-13 (Rear Abutments)

5.5' net embankment height considered - Existing grade is at 725.0 and proposed profile grade is at 730.5 for a net embankment height of 5.5'

H= 5.5 ft
B= 50.0 ft
 γ_{BF} = 120 pcf
D_w = 27.5 ft Below Ground Surface
 $\Delta\sigma$ = 660 psf At Ground Surface

| | | | | | | | | | | | | | | | | | | | | Total Embankment Settlement | | | | |
|-------|-------------|-----------|------------------|------|------------------------|------------------------|----------------|----------------------------|------------------------------|-------------------------------|------------------------|----|-------------|-------------|-------------|----------|-------------------|-------------|---------|-----------------------------|------------------------------|-------------------------------|---------------------|------------|
| Layer | Soil Class. | Soil Type | Layer Depth (ft) | | Layer Thickness H (ft) | Depth to Midpoint (ft) | γ (pcf) | σ_{vo} Bottom (psf) | σ_{vo} Midpoint (psf) | σ_{vo}' Midpoint (psf) | $\sigma_p^{(1)}$ (psf) | LL | $C_c^{(2)}$ | $C_r^{(3)}$ | $e_o^{(4)}$ | N_{60} | $(N1)_{60}^{(5)}$ | $C_u^{(6)}$ | Z_r/B | $I^{(7)}$ | $\Delta\sigma_v^{(8)}$ (psf) | $\sigma_{v'}'$ Midpoint (psf) | $S_c^{(9,10)}$ (ft) | S_c (in) |
| 1 | A-6a | C | 0.0 | 2.5 | 2.5 | 1.3 | 120 | 300 | 156 | 156 | 3,156 | 35 | 0.225 | 0.011 | 0.546 | | | | 0.03 | 1.000 | 660 | 816 | 0.013 | 0.157 |
| | A-6a | C | 2.5 | 5.5 | 3.0 | 4.0 | 120 | 660 | 480 | 480 | 3,480 | 35 | 0.225 | 0.011 | 0.546 | | | | 0.08 | 0.998 | 659 | 1,139 | 0.008 | 0.098 |
| 2 | A-1-b | G | 5.5 | 8.0 | 2.5 | 6.8 | 125 | 973 | 816 | 816 | 3,816 | | | | | 17 | 22 | 79 | 0.14 | 0.992 | 655 | 1,471 | 0.008 | 0.097 |
| | A-1-b | G | 8.0 | 10.5 | 2.5 | 9.3 | 125 | 1,285 | 1,129 | 1,129 | 4,129 | | | | | 17 | 20 | 75 | 0.19 | 0.982 | 648 | 1,777 | 0.007 | 0.079 |
| 3 | A-6a | C | 10.5 | 13.0 | 2.5 | 11.8 | 115 | 1,573 | 1,429 | 1,429 | 4,429 | 28 | 0.162 | 0.016 | 0.491 | | | | 0.24 | 0.965 | 637 | 2,066 | 0.004 | 0.052 |
| 4 | A-2-6 | G | 13.0 | 17.0 | 4.0 | 15.0 | 120 | 2,053 | 1,813 | 1,813 | 4,813 | | | | | 9 | 9 | 56 | 0.30 | 0.937 | 618 | 2,431 | 0.009 | 0.110 |
| 5 | A-4a | C | 17.0 | 20.5 | 3.5 | 18.8 | 115 | 2,455 | 2,254 | 2,254 | 5,254 | 32 | 0.198 | 0.020 | 0.522 | | | | 0.38 | 0.896 | 591 | 2,845 | 0.005 | 0.055 |
| 6 | A-1-b | G | 20.5 | 23.0 | 2.5 | 21.8 | 135 | 2,793 | 2,624 | 2,624 | 5,624 | | | | | 63 | 57 | 202 | 0.44 | 0.859 | 567 | 3,191 | 0.001 | 0.013 |
| | A-1-b | G | 23.0 | 25.5 | 2.5 | 24.3 | 135 | 3,130 | 2,961 | 2,961 | 5,961 | | | | | 63 | 55 | 191 | 0.49 | 0.828 | 546 | 3,508 | 0.001 | 0.012 |
| 7 | A-1-a | G | 25.5 | 31.0 | 5.5 | 28.3 | 135 | 3,873 | 3,501 | 3,454 | 6,454 | | | | | 87 | 71 | 275 | 0.57 | 0.777 | 513 | 3,967 | 0.001 | 0.014 |
| | A-1-a | G | 31.0 | 37.0 | 6.0 | 34.0 | 135 | 4,683 | 4,278 | 3,872 | 6,872 | | | | | 87 | 68 | 256 | 0.68 | 0.707 | 467 | 4,339 | 0.001 | 0.014 |
| 8 | A-1-b | G | 37.0 | 43.0 | 6.0 | 40.0 | 135 | 5,493 | 5,088 | 4,308 | 7,308 | | | | | 52 | 39 | 126 | 0.80 | 0.642 | 424 | 4,731 | 0.002 | 0.023 |
| | A-1-b | G | 43.0 | 50.0 | 7.0 | 46.5 | 135 | 6,438 | 5,965 | 4,779 | 7,779 | | | | | 52 | 37 | 120 | 0.93 | 0.580 | 383 | 5,162 | 0.002 | 0.023 |
| | A-1-b | G | 50.0 | 57.0 | 7.0 | 53.5 | 135 | 7,383 | 6,910 | 5,288 | 8,288 | | | | | 52 | 35 | 114 | 1.07 | 0.522 | 345 | 5,632 | 0.002 | 0.020 |
| 9 | A-1-a | G | 57.0 | 64.0 | 7.0 | 60.5 | 135 | 8,328 | 7,855 | 5,796 | 8,796 | | | | | 100 | 65 | 238 | 1.21 | 0.474 | 313 | 6,109 | 0.001 | 0.008 |
| | A-1-a | G | 64.0 | 72.0 | 8.0 | 68.0 | 135 | 9,408 | 8,868 | 6,340 | 9,340 | | | | | 100 | 62 | 223 | 1.36 | 0.430 | 284 | 6,624 | 0.001 | 0.008 |
| | | | | | | | | | | | | | | | | | | | | Total Settlement: | | 0.784 in | | |

- $\sigma_p' = \sigma_{vo}' + \sigma_m$. Estimate σ_m of 3,000 psf for moderately overconsolidated soil deposit; Ref. Table 11.2, Coduto 2003
- $C_c = 0.009(LL-10)$; Ref. Table 26, FHWA GEC 5
- $C_r = 0.05(C_c)$ for embankment fill and $0.10(C_c)$ for natural cohesive soils; Ref. Section 5.4.2.5 of FHWA GEC 5
- $e_o = (C_u/1.15) + 0.35$; Ref. Table 8-2, Holtz and Kovacs 1981
- $(N1)_{60} = C_u N_{60}$, where $C_u = [0.77 \log(40/\sigma_{vo}')] \leq 2.0$ ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
- Bearing capacity index; Ref. Figure 10.6.2.4-1, AASHTO LRFD BDS
- Influence factor for strip loaded footing
- $\Delta\sigma_v = q_e(I)$
- $S_c = [C_u/(1+e_o)](H) \log(\sigma_p'/\sigma_{vo}')$ for $\sigma_p' < \sigma_{vo}' < \sigma_{v'}'$; $[C_r/(1+e_o)](H) \log(\sigma_p'/\sigma_{vo}')$ for $\sigma_{vo}' < \sigma_{v'}' < \sigma_p'$; $[C_r/(1+e_o)](H) \log(\sigma_p'/\sigma_{vo}') + [C_u/(1+e_o)](H) \log(\sigma_{v'}'/\sigma_p')$ for $\sigma_{vo}' < \sigma_p' < \sigma_{v'}'$; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesive soil layers)
- $S_c = H(1/C') \log(\sigma_{v'}'/\sigma_{vo}')$; Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)

W-13-072 FRA-70-13.10 (FRA-70-1322L and 1323C Bridge Structure)
Embankment Settlement

Calculated By: BRT
Checked By: JPS
Date: 1/21/2015
Date: 1/22/2015

Borings B-113-4-13 (Rear Abutments)

5.5' net embankment height considered - Existing grade is at 725.0 and proposed profile grade is at 730.5 for a net embankment height of 5.5'

H= 5.5 ft
B= 50.0 ft
 γ_{bf} = 120 pcf
 D_w = 27.5 ft Below Ground Surface
 $\Delta\sigma$ = 660 psf At Ground Surface

| Settlement Below Abutment Footing for Downdrag Analysis | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|-----------|-----------|------------------|------|----------------------|------------------------|---------|------------------------------|--------------------------------|---------------------------------|--------------------------------------|----|-------------------------------|-------------------------------|-------------------------------|-----------------|-----------------------------------|-------------------------------|-------------------|-------------------|--------------------------------------|---|---------------------------------------|---------------------|------------------------|
| Layer | Soil Type | Soil Type | Layer Depth (ft) | | 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 _u ⁽⁶⁾ | Z _r /B | I ⁽⁷⁾ | Δσ _v ⁽⁸⁾ (psf) | σ _{v'} [*] Midpoint (psf) | S _c ^(9,10) (ft) | S _c (in) | Relative Movement (in) |
| 3 | A-6a | C | 0.0 | 2.5 | 2.5 | 1.3 | 115 | 288 | 150 | 150 | 3,150 | 28 | 0.162 | 0.008 | 0.491 | | | | 0.03 | 0.002 | 1 | 151 | 0.000 | 0.001 | 0.110 |
| 4 | A-2-6 | G | 2.5 | 6.5 | 4.0 | 4.5 | 120 | 768 | 528 | 528 | 3,528 | | | | | 9 | 13 | 61 | 0.09 | 0.048 | 31 | 559 | 0.002 | 0.020 | 0.091 |
| 5 | A-4a | C | 6.5 | 10.0 | 3.5 | 8.3 | 115 | 1,170 | 969 | 969 | 3,969 | 32 | 0.198 | 0.010 | 0.522 | | | | 0.17 | 0.140 | 92 | 1,061 | 0.001 | 0.011 | 0.080 |
| 6 | A-1-b | G | 10.0 | 12.5 | 2.5 | 11.3 | 135 | 1,508 | 1,339 | 1,339 | 4,339 | | | | | 63 | 72 | 277 | 0.23 | 0.202 | 133 | 1,472 | 0.000 | 0.004 | 0.075 |
| | A-1-b | G | 12.5 | 15.0 | 2.5 | 13.8 | 135 | 1,845 | 1,676 | 1,676 | 4,676 | | | | | 63 | 67 | 250 | 0.28 | 0.241 | 159 | 1,836 | 0.000 | 0.005 | 0.071 |
| 7 | A-1-a | G | 15.0 | 20.5 | 5.5 | 17.8 | 135 | 2,588 | 2,216 | 2,216 | 5,216 | | | | | 87 | 84 | 355 | 0.36 | 0.287 | 189 | 2,405 | 0.001 | 0.007 | 0.064 |
| | A-1-a | G | 20.5 | 26.5 | 6.0 | 23.5 | 135 | 3,398 | 2,993 | 2,993 | 5,993 | | | | | 87 | 75 | 300 | 0.47 | 0.325 | 215 | 3,207 | 0.001 | 0.007 | 0.057 |
| 8 | A-1-b | G | 26.5 | 32.5 | 6.0 | 29.5 | 135 | 4,208 | 3,803 | 3,678 | 6,678 | | | | | 52 | 42 | 136 | 0.59 | 0.346 | 228 | 3,906 | 0.001 | 0.014 | 0.043 |
| | A-1-b | G | 32.5 | 39.5 | 7.0 | 36.0 | 135 | 5,153 | 4,680 | 4,150 | 7,150 | | | | | 52 | 39 | 128 | 0.72 | 0.355 | 234 | 4,384 | 0.001 | 0.016 | 0.027 |
| | A-1-b | G | 39.5 | 46.5 | 7.0 | 43.0 | 135 | 6,098 | 5,625 | 4,658 | 7,658 | | | | | 52 | 37 | 122 | 0.86 | 0.355 | 234 | 4,892 | 0.001 | 0.015 | 0.013 |
| 9 | A-1-a | G | 46.5 | 53.5 | 7.0 | 50.0 | 135 | 7,043 | 6,570 | 5,166 | 8,166 | | | | | 100 | 68 | 259 | 1.00 | 0.348 | 230 | 5,396 | 0.001 | 0.006 | 0.007 |
| | A-1-a | G | 53.5 | 61.5 | 8.0 | 57.5 | 135 | 8,123 | 7,583 | 5,711 | 8,711 | | | | | 100 | 65 | 241 | 1.15 | 0.337 | 222 | 5,933 | 0.001 | 0.007 | 0.000 |
| 1. σ _p [*] = σ _{vo} + σ _m ; Estimate σ _m of 3,000 psf for moderately overconsolidated soil deposit; Ref. Table 11.2, Coduto 2003 | | | | | | | | | | | | | | | | | | | | Total Settlement: | | | | 0.111 in | |

1. $\sigma_p' = \sigma_{vo}' + \sigma_m$; Estimate σ_m of 3,000 psf for moderately overconsolidated soil deposit; Ref. Table 11.2, Coduto 2003
2. $C_c = 0.009(LL-10)$; Ref. Table 26, FHWA GEC 5
3. $C_r = 0.05(C_c)$ for embankment fill and $0.10(C_c)$ for natural cohesive soils; Ref. Section 5.4.2.5 of FHWA GEC 5
4. $e_o = (C_r/1.15)+0.35$; Ref. Table 8-2, Holtz and Kovacs 1981
5. $(N1)_{60} = C_u N_{60}$, where $C_u = [0.77 \log(40/\sigma_{vo}')] \leq 2.0$ 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. $\Delta\sigma_v = q_e(l)$
9. $S_c = [C_r/(1+e_o)](H) \log(\sigma_{v'}/\sigma_{vo}')$ for $\sigma_{v'}' \leq \sigma_{vo}' < \sigma_{v'}$; $[C_r/(1+e_o)](H) \log(\sigma_p'/\sigma_{vo}')$ for $\sigma_{v'}' < \sigma_{v'}$; $[C_r/(1+e_o)](H) \log(\sigma_p'/\sigma_{vo}')$ for $\sigma_{v'}' < \sigma_p' < \sigma_{v'}$; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesiv soil layers)
10. $S_c = H(1/C') \log(\sigma_{v'}/\sigma_{vo}')$; 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 $t = 0$

Depth of Downdrag: 0.0 ft.

W-13-072 FRA-70-13.10 (FRA-70-1322L and 1323C Bridge Structure)
Embankment Settlement

Calculated By: BRT Date: 1/21/2015
Checked By: JPS Date: 1/22/2015

Borings B-016-0-08 and B-016-7-13 (Forward Abutments)

10.0' net embankment height considered - Existing grade is at 727.0 and proposed profile grade is at 737.0 for a net embankment height of 10.0'

H= 10.0 ft
B= 50.0 ft
 γ_{BF} = 120 pcf
 D_w = 29.0 ft Below Ground Surface
 $\Delta\sigma$ = 1,200 psf At Ground Surface

| | | | | | | | | | | | | | | | | | | | | Total Embankment Settlement | | | | |
|-------|-------------|-----------|------------------|------|------------------------|------------------------|----------------|----------------------------|------------------------------|-------------------------------|------------------------|----|-------------|-------------|-------------|----------|-------------------|-------------|---------|-----------------------------|------------------------------|-------------------------------|---------------------|------------|
| Layer | Soil Class. | Soil Type | Layer Depth (ft) | | Layer Thickness H (ft) | Depth to Midpoint (ft) | γ (pcf) | σ_{vo} Bottom (psf) | σ_{vo} Midpoint (psf) | σ_{vo}' Midpoint (psf) | $\sigma_p^{(1)}$ (psf) | LL | $C_c^{(2)}$ | $C_r^{(3)}$ | $e_o^{(4)}$ | N_{60} | $(N1)_{60}^{(5)}$ | $C_u^{(6)}$ | Z_r/B | $I^{(7)}$ | $\Delta\sigma_v^{(8)}$ (psf) | $\sigma_{v'}'$ Midpoint (psf) | $S_c^{(9,10)}$ (ft) | S_c (in) |
| 1 | A-2-4 | G | 0.0 | 6.0 | 6.0 | 3.0 | 130 | 780 | 390 | 390 | 3,390 | | | | | 43 | 67 | 249 | 0.06 | 0.999 | 1,199 | 1,589 | 0.015 | 0.176 |
| 2 | A-6a | C | 6.0 | 8.5 | 2.5 | 7.3 | 115 | 1,068 | 924 | 924 | 3,924 | 35 | 0.225 | 0.011 | 0.546 | | | | 0.15 | 0.991 | 1,189 | 2,112 | 0.007 | 0.078 |
| | A-6a | C | 8.5 | 11.0 | 2.5 | 9.8 | 115 | 1,355 | 1,211 | 1,211 | 4,211 | 35 | 0.225 | 0.011 | 0.546 | | | | 0.20 | 0.979 | 1,175 | 2,386 | 0.005 | 0.064 |
| | A-6a | C | 11.0 | 13.5 | 2.5 | 12.3 | 115 | 1,643 | 1,499 | 1,499 | 4,499 | 35 | 0.225 | 0.023 | 0.546 | | | | 0.25 | 0.961 | 1,154 | 2,653 | 0.009 | 0.108 |
| 3 | A-3a | G | 13.5 | 15.5 | 2.0 | 14.5 | 120 | 1,883 | 1,763 | 1,763 | 4,763 | | | | | 7 | 7 | 49 | 0.29 | 0.942 | 1,130 | 2,893 | 0.009 | 0.106 |
| | A-3a | G | 15.5 | 18.0 | 2.5 | 16.8 | 120 | 2,183 | 2,033 | 2,033 | 5,033 | | | | | 7 | 7 | 48 | 0.34 | 0.919 | 1,102 | 3,135 | 0.010 | 0.117 |
| 4 | A-6a | C | 18.0 | 20.0 | 2.0 | 19.0 | 115 | 2,413 | 2,298 | 2,298 | 5,298 | 31 | 0.189 | 0.019 | 0.514 | | | | 0.38 | 0.893 | 1,072 | 3,369 | 0.004 | 0.050 |
| | A-6a | C | 20.0 | 22.5 | 2.5 | 21.3 | 115 | 2,700 | 2,556 | 2,556 | 5,556 | 31 | 0.189 | 0.019 | 0.514 | | | | 0.43 | 0.866 | 1,039 | 3,595 | 0.005 | 0.055 |
| | A-6a | C | 22.5 | 25.0 | 2.5 | 23.8 | 115 | 2,988 | 2,844 | 2,844 | 5,844 | 31 | 0.189 | 0.019 | 0.514 | | | | 0.48 | 0.834 | 1,001 | 3,845 | 0.004 | 0.049 |
| 5 | A-6b | C | 25.0 | 28.0 | 3.0 | 26.5 | 120 | 3,348 | 3,168 | 3,168 | 6,168 | 40 | 0.270 | 0.027 | 0.585 | | | | 0.53 | 0.799 | 959 | 4,127 | 0.006 | 0.070 |
| | A-6b | C | 28.0 | 31.0 | 3.0 | 29.5 | 120 | 3,708 | 3,528 | 3,496 | 6,496 | 40 | 0.270 | 0.027 | 0.585 | | | | 0.59 | 0.762 | 914 | 4,410 | 0.005 | 0.062 |
| 6 | A-2-4 | G | 31.0 | 36.0 | 5.0 | 33.5 | 120 | 4,308 | 4,008 | 3,727 | 6,727 | | | | | 4 | 3 | 49 | 0.67 | 0.713 | 856 | 4,583 | 0.009 | 0.111 |
| 7 | A-1-b | G | 36.0 | 41.0 | 5.0 | 38.5 | 135 | 4,983 | 4,645 | 4,052 | 7,052 | | | | | 80 | 61 | 221 | 0.77 | 0.657 | 789 | 4,841 | 0.002 | 0.021 |
| 8 | A-6a | C | 41.0 | 46.0 | 5.0 | 43.5 | 130 | 5,633 | 5,308 | 4,403 | 7,403 | 30 | 0.180 | 0.018 | 0.507 | | | | 0.87 | 0.607 | 729 | 5,131 | 0.004 | 0.048 |
| 9 | A-1-b | G | 46.0 | 51.0 | 5.0 | 48.5 | 135 | 6,308 | 5,970 | 4,753 | 7,753 | | | | | 54 | 38 | 125 | 0.97 | 0.562 | 675 | 5,428 | 0.002 | 0.028 |
| 10 | A-6a | C | 51.0 | 56.0 | 5.0 | 53.5 | 130 | 6,958 | 6,633 | 5,104 | 8,104 | 30 | 0.180 | 0.018 | 0.507 | | | | 1.07 | 0.522 | 627 | 5,731 | 0.003 | 0.036 |
| | | | | | | | | | | | | | | | | | | | | Total Settlement: | | 1.181 in | | |

1. $\sigma_p' = \sigma_{vo}' + \sigma_m$; Estimate σ_m of 3,000 psf for moderately overconsolidated soil deposit; Ref. Table 11.2, Coduto 2003
2. $C_c = 0.009(LL-10)$; Ref. Table 26, FHWA GEC 5
3. $C_r = 0.05(C_c)$ for embankment fill and $0.10(C_c)$ for natural cohesive soils; Ref. Section 5.4.2.5 of FHWA GEC 5
4. $e_o = (C_u/1.15) + 0.35$; Ref. Table 8-2, Holtz and Kovacs 1981
5. $(N1)_{60} = C_u N_{60}$, where $C_u = [0.77 \log(40/\sigma_{vo}')] \leq 2.0$ 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. $\Delta\sigma_v = q_e(I)$
9. $S_c = [C_u/(1+e_o)](H) \log(\sigma_p'/\sigma_{vo}')$ for $\sigma_p' < \sigma_{vo}' < \sigma_{v'}'$; $[C_r/(1+e_o)](H) \log(\sigma_p'/\sigma_{vo}')$ for $\sigma_{vo}' < \sigma_{v'}' \leq \sigma_p'$; $[C_r/(1+e_o)](H) \log(\sigma_p'/\sigma_{vo}') + [C_u/(1+e_o)](H) \log(\sigma_{v'}'/\sigma_p')$ for $\sigma_{vo}' < \sigma_p' < \sigma_{v'}'$; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesive soil layers)
10. $S_c = H(1/C') \log(\sigma_{v'}'/\sigma_{vo}')$; Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)

W-13-072 FRA-70-13.10 (FRA-70-1322L and 1323C Bridge Structure)
Embankment Settlement

Calculated By: BRT Date: 1/21/2015
Checked By: JPS Date: 1/22/2015

Borings B-016-0-08 and B-016-7-13 (Forward Abutments)

10.0' net embankment height considered - Existing grade is at 727.0 and proposed profile grade is at 737.0 for a net embankment height of 10.0'

H= 10.0 ft
B= 50.0 ft
 γ_{ef} = 120 pcf
 D_u = 29.0 ft Below Ground Surface
 $\Delta\sigma$ = 1,200 psf At Ground Surface

| Settlement Below Abutment Footing for Downdrag Analysis | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|-----------|-----------|------------------|------|----------------------|------------------------|---------|------------------------------|--------------------------------|---|--------------------------------------|----|-------------------------------|-------------------------------|-------------------------------|-----------------|-----------------------------------|-------------------------------|-------------------|-------------------|--------------------------------------|--|---------------------------------------|---------------------|------------------------|
| Layer | Soil Type | Soil Type | Layer Depth (ft) | | 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 _u ⁽⁶⁾ | Z _f /B | I ⁽⁷⁾ | Δσ _v ⁽⁸⁾ (psf) | σ _v ['] Midpoint (psf) | S _c ^(9,10) (ft) | S _c (in) | Relative Movement (in) |
| 1 | A-2-4 | G | 4.0 | 6.0 | 2.0 | 5.0 | 130 | 780 | 650 | 650 | 3,650 | | | | | 43 | 59 | 211 | 0.10 | 0.059 | 71 | 721 | 0.000 | 0.005 | 0.398 |
| 2 | A-6a | C | 6.0 | 8.5 | 2.5 | 7.3 | 115 | 1,068 | 924 | 924 | 3,924 | 35 | 0.225 | 0.011 | 0.546 | | | | 0.15 | 0.116 | 139 | 1,063 | 0.001 | 0.013 | 0.384 |
| | A-6a | C | 8.5 | 11.0 | 2.5 | 9.8 | 115 | 1,355 | 1,211 | 1,211 | 4,211 | 35 | 0.225 | 0.011 | 0.546 | | | | 0.20 | 0.173 | 207 | 1,419 | 0.001 | 0.015 | 0.369 |
| | A-6a | C | 11.0 | 13.5 | 2.5 | 12.3 | 115 | 1,643 | 1,499 | 1,499 | 4,499 | 35 | 0.225 | 0.023 | 0.546 | | | | 0.25 | 0.219 | 263 | 1,761 | 0.003 | 0.031 | 0.339 |
| 3 | A-3a | G | 13.5 | 15.5 | 2.0 | 14.5 | 120 | 1,883 | 1,763 | 1,763 | 4,763 | | | | | 7 | 7 | 49 | 0.29 | 0.251 | 302 | 2,064 | 0.003 | 0.034 | 0.305 |
| | A-3a | G | 15.5 | 18.0 | 2.5 | 16.8 | 120 | 2,183 | 2,033 | 2,033 | 5,033 | | | | | 7 | 7 | 48 | 0.34 | 0.277 | 332 | 2,365 | 0.003 | 0.041 | 0.264 |
| 4 | A-6a | C | 18.0 | 20.0 | 2.0 | 19.0 | 115 | 2,413 | 2,298 | 2,298 | 5,298 | 31 | 0.189 | 0.019 | 0.514 | | | | 0.38 | 0.297 | 357 | 2,654 | 0.002 | 0.019 | 0.245 |
| | A-6a | C | 20.0 | 22.5 | 2.5 | 21.3 | 115 | 2,700 | 2,556 | 2,556 | 5,556 | 31 | 0.189 | 0.019 | 0.514 | | | | 0.43 | 0.313 | 376 | 2,932 | 0.002 | 0.022 | 0.223 |
| | A-6a | C | 22.5 | 25.0 | 2.5 | 23.8 | 115 | 2,988 | 2,844 | 2,844 | 5,844 | 31 | 0.189 | 0.019 | 0.514 | | | | 0.48 | 0.327 | 392 | 3,236 | 0.002 | 0.021 | 0.202 |
| 5 | A-6b | C | 25.0 | 28.0 | 3.0 | 26.5 | 120 | 3,348 | 3,168 | 3,168 | 6,168 | 40 | 0.270 | 0.027 | 0.585 | | | | 0.53 | 0.338 | 405 | 3,573 | 0.003 | 0.032 | 0.170 |
| | A-6b | C | 28.0 | 31.0 | 3.0 | 29.5 | 120 | 3,708 | 3,528 | 3,496 | 6,496 | 40 | 0.270 | 0.027 | 0.585 | | | | 0.59 | 0.346 | 415 | 3,912 | 0.002 | 0.030 | 0.140 |
| 6 | A-2-4 | G | 31.0 | 36.0 | 5.0 | 33.5 | 120 | 4,308 | 4,008 | 3,727 | 6,727 | | | | | 4 | 3 | 49 | 0.67 | 0.353 | 423 | 4,150 | 0.005 | 0.058 | 0.082 |
| 7 | A-1-b | G | 36.0 | 41.0 | 5.0 | 38.5 | 135 | 4,983 | 4,645 | 4,052 | 7,052 | | | | | 80 | 61 | 221 | 0.77 | 0.356 | 427 | 4,479 | 0.001 | 0.012 | 0.070 |
| 8 | A-6a | C | 41.0 | 46.0 | 5.0 | 43.5 | 130 | 5,633 | 5,308 | 4,403 | 7,403 | 30 | 0.180 | 0.018 | 0.507 | | | | 0.87 | 0.354 | 425 | 4,828 | 0.002 | 0.029 | 0.042 |
| 9 | A-1-b | G | 46.0 | 51.0 | 5.0 | 48.5 | 135 | 6,308 | 5,970 | 4,753 | 7,753 | | | | | 54 | 38 | 125 | 0.97 | 0.350 | 420 | 5,173 | 0.001 | 0.018 | 0.024 |
| 10 | A-6a | C | 51.0 | 56.0 | 5.0 | 53.5 | 130 | 6,958 | 6,633 | 5,104 | 8,104 | 30 | 0.180 | 0.018 | 0.507 | | | | 1.07 | 0.343 | 412 | 5,516 | 0.002 | 0.024 | 0.000 |
| 1. σ _p ['] = σ _{vo} ['] +σ _m ; Estimate σ _m of 3,000 psf for moderately overconsolidated soil deposit; Ref. Table 11.2, Coduto 2003 | | | | | | | | | | | | | | | | | | | | Total Settlement: | | | 0.403 in | | |

1. $\sigma_p' = \sigma_{vo}' + \sigma_m$; Estimate σ_m of 3,000 psf for moderately overconsolidated soil deposit; Ref. Table 11.2, Coduto 2003

2. $C_c = 0.009(LL-10)$; Ref. Table 26, FHWA GEC 5

3. $C_r = 0.05(C_c)$ for embankment fill and $0.10(C_c)$ for natural cohesive soils; Ref. Section 5.4.2.5 of FHWA GEC 5

4. $e_o = (C_u/1.15) + 0.35$; Ref. Table 8-2, Holtz and Kovacs 1981

5. $(N1)_{60} = C_u N_{60}$, where $C_u = [0.77 \log(40/\sigma_{vo}')] \leq 2.0$ 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. $\Delta\sigma_v = q_e(I)$

9. $S_c = [C_u/(1+e_o)](H) \log(\sigma_p'/\sigma_{vo}')$ for $\sigma_p' \leq \sigma_{vo}' < \sigma_{v'}'$; $[C_u/(1+e_o)](H) \log(\sigma_p'/\sigma_{vo}')$ for $\sigma_{vo}' < \sigma_{v'}' \leq \sigma_p'$; $[C_r/(1+e_o)](H) \log(\sigma_p'/\sigma_{vo}') + [C_u/(1+e_o)](H) \log(\sigma_{v'}'/\sigma_p')$ for $\sigma_{vo}' < \sigma_p' < \sigma_{v'}'$; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesiv soil layers)

10. $S_c = H(1/C) \log(\sigma_p'/\sigma_{vo}')$; 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

Depth of Downdrag: **0.0 ft.**

APPENDIX IX

LATERAL DESIGN PARAMETERS

| <div>FRA-70-1322L</div> <div>I-70 WB over the Scioto River</div> <div>Lateral Design Parameters</div> | | | | | | | | | | | | |
|---|----------------------|-------------|-----------|--------|-----------------|------------------|---------|----------|--------------------|------------------------------------|---|------------|
| 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) |
| Rear Abutment (B-001-S-57 / B-113-5-13) | 723.4 to 705.4 | A-1-a | G | 4 | 32 | 38 | 130 | 130 | φ = 41° | 315 pci | - | - |
| | 705.4 to 700.4 | A-6a | C | 3 | 30 | 30 | 125 | 125 | Su = 3,750 psf | 1,250 pci | 0.0048 | - |
| | 700.4 to 695.4 | A-1-b | G | 4 | 70 | 58 | 135 | 135 | φ = 42° | 355 pci | - | - |
| | 695.4 to 685.4 | A-1-a | G | 4 | 45 | 34 | 130 | 130 | φ = 41° | 315 pci | - | - |
| | 685.4 to 675.4 | A-1-a | G | 4 | 82 | 57 | 135 | 72.6 | φ = 43° | 215 pci | - | - |
| | 675.4 to 670.4 | A-6a | C | 2 | 100 | 100 | 130 | 67.6 | Su = 8,000 psf | 2,665 pci | 0.0033 | - |
| | 670.4 to 660.0 | Boulders | G | 4 | 100 | 63 | 140 | 77.6 | φ = 45° | 255 pci | - | - |
| | 660.0 to 652.2 | A-1-a | G | 4 | 100 | 59 | 135 | 72.6 | φ = 43° | 215 pci | - | - |
| | 652.2 to 650.8 | Mudstone | R | 9 | - | - | 150 | 87.6 | Qu = 200 psi | 0.0005 | 20,000 psi | 15 |
| | 650.8 to 637.0 | Limestone | R | 9 | - | - | 165 | 102.6 | Qu = 10,000 psi | 0.00005 | 1,000,000 psi | 77 |
| Pier 1 (B-005-S-57) | 681.1 to 673.1 | A-1-a | G | 4 | 24 | 41 | 125 | 62.6 | φ = 42° | 195 pci | - | - |
| | 673.1 to 668.1 | A-3a | G | 4 | 73 | 99 | 135 | 72.6 | φ = 40° | 155 pci | - | - |
| | 668.1 to 658.1 | A-1-a | G | 4 | 100 | 117 | 135 | 72.6 | φ = 43° | 215 pci | - | - |
| | 658.1 to 654.1 | A-2-4 | G | 4 | 20 | 21 | 125 | 62.6 | φ = 37° | 110 pci | - | - |
| | 654.1 to 652.1 | A-1-a | G | 4 | 100 | 102 | 135 | 72.6 | φ = 43° | 215 pci | - | - |
| | 652.1 to 651.5 | Shale | R | 9 | - | - | 150 | 87.6 | Qu = 200 psi | 0.0005 | 20,000 psi | 15 |
| | 651.5 to 645.1 | Limestone | R | 9 | - | - | 165 | 102.6 | Qu = 10,000 psi | 0.00005 | 1,000,000 psi | 85 |
| Pier 2 (B-009-S-57) | 685.5 to 673.5 | A-1-b | G | 4 | 24 | 37 | 125 | 62.6 | φ = 40° | 155 pci | - | - |
| | 673.5 to 669.5 | A-1-b | G | 4 | 73 | 93 | 135 | 72.6 | φ = 42° | 195 pci | - | - |
| | 669.5 to 659.5 | A-1-a | G | 4 | 100 | 112 | 135 | 72.6 | φ = 43° | 215 pci | - | - |
| | 659.5 to 655.5 | A-1-a | G | 4 | 20 | 20 | 125 | 62.6 | φ = 38° | 125 pci | - | - |
| | 655.5 to 650.8 | A-1-a | G | 4 | 100 | 97 | 135 | 72.6 | φ = 43° | 215 pci | - | - |
| | 650.8 to 648.1 | Shale | R | 9 | - | - | 150 | 87.6 | Qu = 200 psi | 0.0005 | 20,000 psi | 15 |
| | 648.1 to 645.4 | Limestone | R | 9 | - | - | 165 | 102.6 | Qu = 10,000 psi | 0.00005 | 1,000,000 psi | 85 |
| Pier 3 (B-013-S-57 / B-113-8-13) | 690.8 to 683.8 | A-1-a | G | 4 | 15 | 26 | 125 | 62.6 | φ = 39° | 140 pci | - | - |
| | 683.8 to 678.8 | A-1-a | G | 4 | 90 | 125 | 135 | 72.6 | φ = 43° | 215 pci | - | - |
| | 678.8 to 673.8 | A-3a | G | 4 | 27 | 34 | 125 | 62.6 | φ = 38° | 125 pci | - | - |
| | 673.8 to 668.8 | A-1-a | G | 4 | 30 | 35 | 130 | 67.6 | φ = 41° | 175 pci | - | - |
| | 668.8 to 660.8 | A-1-a | G | 4 | 100 | 105 | 135 | 72.6 | φ = 43° | 215 pci | - | - |
| | 660.8 to 644.0 | Shale | R | 9 | - | - | 150 | 87.6 | Qu = 200 psi | 0.0005 | 20,000 psi | 15 |
| | 644.0 to 634.4 | Dolomite | R | 9 | - | - | 165 | 102.6 | Qu = 10,000 psi | 0.00005 | 1,000,000 psi | 40 |
| | 634.4 to 625.0 | Limestone | R | 9 | - | - | 165 | 102.6 | Qu = 10,000 psi | 0.00005 | 1,000,000 psi | 90 |
| Pier 4 (B-020-S-57 / B-113-9-13) | 725.4 to 711.4 | A-1-b | G | 4 | 10 | 13 | 120 | 120 | φ = 36° | 160 pci | - | - |
| | 711.4 to 701.4 | A-4a | C | 3 | 21 | 21 | 120 | 120 | Su = 2,625 psf | 875 pci | 0.0055 | - |
| | 701.4 to 696.4 | A-6a | C | 3 | 15 | 15 | 120 | 120 | Su = 1,875 psf | 625 pci | 0.0065 | - |
| | 696.4 to 691.4 | A-2-4 | G | 4 | 23 | 18 | 125 | 125 | φ = 36° | 160 pci | - | - |
| | 691.4 to 683.8 | A-1-a | G | 4 | 25 | 18 | 125 | 62.6 | φ = 38° | 125 pci | - | - |
| | 683.8 to 674.3 | A-4a | G | 4 | 58 | 40 | 130 | 67.6 | φ = 36° | 95 pci | - | - |
| | 674.3 to 669.3 | A-2-4 | G | 4 | 45 | 30 | 135 | 72.6 | φ = 38° | 125 pci | - | - |
| | 669.3 to 656.3 | A-2-4 | G | 4 | 75 | 47 | 135 | 72.6 | φ = 40° | 155 pci | - | - |
| | 656.3 to 650.8 | Shale | R | 9 | - | - | 150 | 87.6 | Qu = 200 psi | 0.0005 | 20,000 psi | 15 |
| | 650.8 to 645.6 | Mudstone | R | 9 | - | - | 150 | 87.6 | Qu = 200 psi | 0.0005 | 20,000 psi | 15 |
| | 645.6 to 633.3 | Limestone | R | 9 | - | - | 165 | 102.6 | Qu = 10,000 psi | 0.00005 | 1,000,000 psi | 95 |
| Forward Abutment (B-020-S-57 / B-114-1-13) | 725.4 to 711.4 | A-1-b | G | 4 | 10 | 13 | 120 | 120 | φ = 36° | 160 pci | - | - |
| | 711.4 to 701.4 | A-4a | C | 3 | 21 | 21 | 120 | 120 | Su = 2,625 psf | 875 pci | 0.0055 | - |
| | 701.4 to 696.4 | A-6a | C | 3 | 15 | 15 | 120 | 120 | Su = 1,875 psf | 625 pci | 0.0065 | - |
| | 696.4 to 691.4 | A-2-4 | G | 4 | 23 | 18 | 125 | 125 | φ = 36° | 160 pci | - | - |
| | 691.4 to 684.4 | A-1-a | G | 4 | 25 | 18 | 125 | 62.6 | φ = 38° | 125 pci | - | - |
| | 684.4 to 682.1 | A-1-a | G | 4 | 29 | 21 | 130 | 67.6 | φ = 39° | 140 pci | - | - |
| | 682.1 to 679.6 | A-4a | C | 2 | 41 | 41 | 125 | 62.6 | Su = 5,125 psf | 1,710 pci | 0.0043 | - |
| | 679.6 to 674.6 | A-2-4 | G | 4 | 100 | 69 | 135 | 72.6 | φ = 41° | 175 pci | - | - |
| | 674.6 to 662.1 | A-6b | C | 2 | 38 | 38 | 125 | 62.6 | Su = 4,750 psf | 1,585 pci | 0.0044 | - |
| | 662.1 to 655.6 | Shale | R | 9 | - | - | 150 | 87.6 | Qu = 200 psi | 0.0005 | 20,000 psi | 15 |
| | 655.6 to 641.6 | Shale | R | 9 | - | - | 150 | 87.6 | Qu = 360 psi | 0.0005 | 32,000 psi | 37 |
| | 641.6 to 635.6 | Limestone | R | 9 | - | - | 165 | 102.6 | Qu = 10,000 psi | 0.00005 | 1,000,000 psi | 95 |

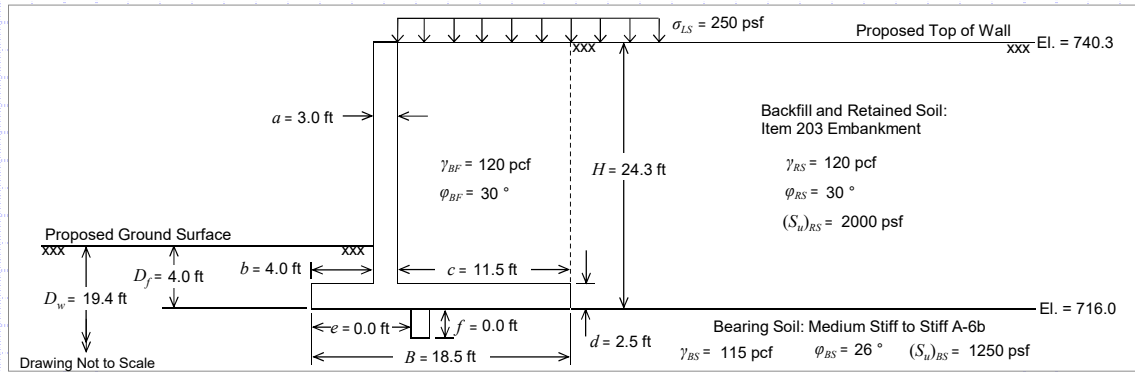
| <div>FRA-70-1323C</div> <div>Ramp D3 over the Scioto River</div> <div>Lateral Design Parameters</div> | | | | | | | | | | | | |
|---|----------------------|-------------|-----------|--------|-----------------|------------------|---------|----------|--------------------|------------------------------------|---|------------|
| 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) |
| Rear Abutment (B-113-5-13) | 725.7 to 720.2 | A-6a | C | 3 | 21 | 21 | 120 | 120 | Su = 2,625 psf | 875 pci | 0.0055 | - |
| | 720.2 to 715.2 | A-1-b | G | 4 | 11 | 14 | 120 | 120 | φ = 36° | 160 pci | - | - |
| | 715.2 to 705.2 | A-1-a | G | 4 | 22 | 22 | 125 | 125 | φ = 39° | 250 pci | - | - |
| | 705.2 to 702.7 | A-6a | C | 3 | 22 | 22 | 120 | 120 | Su = 2,750 psf | 915 pci | 0.0053 | - |
| | 702.7 to 697.7 | A-1-a | G | 4 | 19 | 16 | 125 | 125 | φ = 37° | 190 pci | - | - |
| | 697.7 to 688.7 | A-1-a | G | 4 | 52 | 40 | 135 | 135 | φ = 41° | 315 pci | - | - |
| | 688.7 to 683.7 | A-1-b | G | 4 | 13 | 9 | 120 | 57.6 | φ = 34° | 70 pci | - | - |
| | 683.7 to 674.7 | A-1-a | G | 4 | 100 | 67 | 135 | 72.6 | φ = 43° | 215 pci | - | - |
| | 674.7 to 668.7 | Boulders | G | 4 | 100 | 64 | 140 | 77.6 | φ = 45° | 255 pci | - | - |
| | 668.7 to 663.7 | A-3a | G | 4 | 85 | 52 | 135 | 72.6 | φ = 40° | 155 pci | - | - |
| | 663.7 to 652.2 | A-1-a | G | 4 | 100 | 59 | 135 | 72.6 | φ = 43° | 215 pci | - | - |
| | 652.2 to 650.8 | Mudstone | R | 9 | - | - | 150 | 87.6 | Qu = 200 psi | 0.0005 | 20,000 psi | 15 |
| | 650.8 to 640.0 | Limestone | R | 9 | - | - | 165 | 102.6 | Qu = 10,000 psi | 0.00005 | 1,000,000 psi | 77 |
| Pier 1 (B-113-6-13) | 691.5 to 681.7 | A-2-6 | G | 4 | 5 | 8 | 120 | 57.6 | φ = 33° | 60 pci | - | - |
| | 681.7 to 678.7 | A-1-a | G | 4 | 14 | 19 | 125 | 62.6 | φ = 38° | 125 pci | - | - |
| | 678.7 to 661.2 | A-1-a | G | 4 | 89 | 100 | 135 | 72.6 | φ = 43° | 215 pci | - | - |
| | 661.2 to 652.2 | A-1-b | G | 4 | 94 | 89 | 135 | 72.6 | φ = 42° | 195 pci | - | - |
| | 652.2 to 647.6 | Shale | R | 9 | - | - | 150 | 87.6 | Qu = 200 psi | 0.0005 | 20,000 psi | 15 |
| | 647.6 to 627.8 | Limestone | R | 9 | - | - | 165 | 102.6 | Qu = 10,000 psi | 0.00005 | 1,000,000 psi | 88 |
| Pier 2 (B-113-7-13) | 690.3 to 684.3 | A-1-b | G | 4 | 4 | 7 | 120 | 57.6 | φ = 33° | 60 pci | - | - |
| | 684.3 to 680.2 | A-4a | G | 4 | 4 | 6 | 120 | 57.6 | φ = 29° | 25 pci | - | - |
| | 680.2 to 675.2 | A-1-a | G | 4 | 35 | 47 | 130 | 67.6 | φ = 42° | 195 pci | - | - |
| | 675.2 to 670.6 | A-1-b | G | 4 | 100 | 121 | 135 | 72.6 | φ = 42° | 195 pci | - | - |
| | 670.6 to 669.6 | Boulders | G | 4 | 100 | 115 | 140 | 77.6 | φ = 45° | 255 pci | - | - |
| | 669.6 to 664.7 | A-1-b | G | 4 | 100 | 110 | 135 | 72.6 | φ = 42° | 195 pci | - | - |
| | 664.7 to 662.7 | A-2-4 | G | 4 | 94 | 98 | 135 | 72.6 | φ = 41° | 175 pci | - | - |
| | 662.7 to 660.5 | A-6b | C | 2 | 100 | 100 | 130 | 67.6 | Su = 8,000 psf | 2,665 pci | 0.0033 | - |
| | 660.5 to 659.4 | Boulders | G | 4 | 100 | 100 | 140 | 77.6 | φ = 45° | 255 pci | - | - |
| | 659.4 to 648.8 | Shale | R | 9 | - | - | 150 | 87.6 | Qu = 750 psi | 0.00025 | 68,000 psi | 21 |
| | 648.8 to 634.6 | Limestone | R | 9 | - | - | 165 | 102.6 | Qu = 10,000 psi | 0.00005 | 1,000,000 psi | 81 |
| Pier 3 (B-113-8-13) | 691.0 to 676.8 | A-1-a | G | 4 | 18 | 27 | 125 | 62.6 | φ = 40° | 155 pci | - | - |
| | 676.8 to 671.8 | A-1-a | G | 4 | 42 | 51 | 130 | 67.6 | φ = 43° | 215 pci | - | - |
| | 671.8 to 663.6 | A-4a | G | 4 | 86 | 94 | 135 | 72.6 | φ = 38° | 125 pci | - | - |
| | 663.6 to 659.5 | Boulders | G | 4 | 100 | 100 | 140 | 77.6 | φ = 45° | 255 pci | - | - |
| | 659.5 to 646.8 | A-1-a | G | 4 | 87 | 80 | 135 | 72.6 | φ = 43° | 215 pci | - | - |
| | 646.8 to 644.0 | A-6b | C | 2 | 100 | 100 | 130 | 67.6 | Su = 8,000 psf | 2,665 pci | 0.0033 | - |
| | 644.0 to 634.4 | Dolomite | R | 9 | - | - | 165 | 102.6 | Qu = 10,000 psi | 0.00005 | 1,000,000 psi | 40 |
| | 634.4 to 624.8 | Limestone | R | 9 | - | - | 165 | 102.6 | Qu = 10,000 psi | 0.00005 | 1,000,000 psi | 90 |
| Pier 4 (B-113-9-13) | 706.3 to 700.8 | A-6a | C | 3 | 10 | 10 | 115 | 115 | Su = 1,250 psf | 365 pci | 0.0080 | - |
| | 700.8 to 698.3 | A-1-b | G | 4 | 54 | 71 | 135 | 135 | φ = 42° | 355 pci | - | - |
| | 698.3 to 693.3 | A-6b | C | 3 | 19 | 19 | 120 | 120 | Su = 2,375 psf | 790 pci | 0.0058 | - |
| | 693.3 to 691.3 | A-6b | C | 3 | 8 | 8 | 115 | 115 | Su = 1,000 psf | 235 pci | 0.0090 | - |
| | 691.3 to 685.8 | A-6a | C | 1 | 5 | 5 | 110 | 110 | Su = 625 psf | 85 pci | 0.0125 | - |
| | 685.8 to 683.3 | A-4a | C | 2 | 10 | 10 | 115 | 52.6 | Su = 1,250 psf | 365 pci | 0.0080 | - |
| | 683.3 to 680.8 | A-4a | G | 4 | 23 | 21 | 125 | 62.6 | φ = 34° | 70 pci | - | - |
| | 680.8 to 674.3 | A-4a | G | 4 | 58 | 51 | 135 | 72.6 | φ = 38° | 125 pci | - | - |
| | 674.3 to 669.3 | A-2-4 | G | 4 | 45 | 37 | 135 | 72.6 | φ = 39° | 140 pci | - | - |
| | 669.3 to 656.3 | A-2-4 | G | 4 | 75 | 58 | 135 | 72.6 | φ = 41° | 175 pci | - | - |
| | 656.3 to 650.8 | Shale | R | 9 | - | - | 150 | 87.6 | Qu = 200 psi | 0.0005 | 20,000 psi | 15 |
| | 650.8 to 645.6 | Mudstone | R | 9 | - | - | 150 | 87.6 | Qu = 200 psi | 0.0005 | 20,000 psi | 15 |
| | 645.6 to 633.3 | Limestone | R | 9 | - | - | 165 | 102.6 | Qu = 10,000 psi | 0.00005 | 1,000,000 psi | 95 |
| Forward Abutment (B-114-1-13) | 716.6 to 706.1 | A-6b | C | 3 | 12 | 12 | 115 | 115 | Su = 1,500 psf | 500 pci | 0.0070 | - |
| | 706.1 to 696.1 | A-6a | C | 3 | 15 | 15 | 120 | 120 | Su = 1,875 psf | 625 pci | 0.0065 | - |
| | 696.1 to 691.6 | A-6b | C | 3 | 8 | 8 | 115 | 115 | Su = 1,000 psf | 235 pci | 0.0090 | - |
| | 691.6 to 684.6 | A-1-a | G | 4 | 17 | 14 | 125 | 62.6 | φ = 37° | 110 pci | - | - |
| | 684.6 to 679.6 | A-1-a | G | 4 | 41 | 32 | 130 | 67.6 | φ = 40° | 155 pci | - | - |
| | 679.6 to 674.6 | A-2-4 | G | 4 | 100 | 76 | 135 | 72.6 | φ = 41° | 175 pci | - | - |
| | 674.6 to 662.1 | A-6b | C | 2 | 38 | 38 | 125 | 62.6 | Su = 4,750 psf | 1,585 pci | 0.0044 | - |
| | 662.1 to 655.6 | Shale | R | 9 | - | - | 150 | 87.6 | Qu = 200 psi | 0.0005 | 20,000 psi | 15 |
| | 655.6 to 641.6 | Shale | R | 9 | - | - | 150 | 87.6 | Qu = 360 psi | 0.0005 | 32,000 psi | 37 |
| | 641.6 to 635.6 | Limestone | R | 9 | - | - | 165 | 102.6 | Qu = 10,000 psi | 0.00005 | 1,000,000 psi | 95 |

APPENDIX X

CIP WALL CALCULATIONS (FORWARD ABUTMENT WINGWALL)



FRA-70-1323C - Forward Abutment Wingwall - Panel 3 - CIP Wall Without Shear Key - Borings B-019-5-19 and B-114-1-13



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 24.3 ft |
| Foundation Width (Entire Base Width), (B) = | 18.5 ft |
| Stem Width, (a) = | 3.0 ft |
| Toe Width, (b) = | 4.0 ft |
| Heel Width, (c) = | 11.5 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D_f) = | 4.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ_LS) = | 250 psf |
| Depth to Groundwater, (D_w) = | 19.4 ft |

Bearing and Retained/Backfill Soil Properties:

| | |
|--|----------|
| Bearing Soil Unit Weight, (γ_BS) = | 115 pcf |
| Bearing Soil Friction Angle, (φ_BS) = | 26° |
| Bearing Soil Undrained Shear Strength, [(s_u)_BS] = | 1250 psf |
| Backfill and Retained Soil Unit Weight, (γ_BF, γ_RS) = | 120 pcf |
| Retained Soil Friction Angle, (φ_RS) = | 30° |
| Retained Soil Undrained Shear Strength, [(s_u)_RS] = | 2000 psf |
| Active Earth Pressure Coefficient, (K_a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K_p) = | 7.410 |

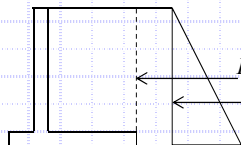
LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 10.6.3.4

Sliding Force:



$$P_H = P_{EH} + P_{LS}$$

$$P_{EH} = \frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf}) (24.3 \text{ ft})^2 (0.297) (1.50) = 15.78 \text{ kip/ft}$$

$$P_{LS} = \sigma_{LS} H K_a \gamma_{LS} = (250 \text{ psf}) (24.3 \text{ ft}) (0.297) (1.75) = 3.16 \text{ kip/ft}$$

$$P_H = 15.78 \text{ kip/ft} + 3.16 \text{ kip/ft} = 18.94 \text{ kip/ft}$$

Check Sliding Resistance

Nominal Sliding Resisting: $R_n = R_\tau + R_{ep}$

$$R_{ep} = \gamma_{BS} D_f j K_p \gamma_{ep} + \frac{1}{2} \gamma_{BS} f^2 K_p \gamma_{ep}$$

$$R_{ep} = (115 \text{ pcf}) (4.0 \text{ ft}) (0.0 \text{ ft}) (7.41) (0.90) + \frac{1}{2} (115 \text{ pcf}) (0.0 \text{ ft})^2 (7.41) (0.90) = 0.00 \text{ kip/ft}$$

Check Drained Condition: $R_\tau = P_V \tan \delta$

$$P_V = DC_1 + DC_2 + P_{EV} = \gamma_c \cdot [B \cdot d + (H - d) \cdot a] \cdot \gamma_{DC} + \gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV}$$

$$P_V = (150 \text{ pcf}) [(18.5 \text{ ft}) (2.5 \text{ ft}) + (24.3 \text{ ft} - 2.5 \text{ ft}) (3.0 \text{ ft})] (0.90) + (120 \text{ pcf}) (24.3 \text{ ft} - 2.5 \text{ ft}) (11.5 \text{ ft}) (1.00) = 45.16 \text{ kip/ft}$$

$$\tan \delta = \tan \phi_{BS} = \tan(26^\circ) = 0.49$$

$$R_\tau = (45.16 \text{ kip/ft}) (0.49) = 22.13 \text{ kip/ft}$$

Verify Sliding Force Less Than Factored Sliding Resistance - Drained Condition

$$P_H \leq \phi_n \cdot R_n \rightarrow P_H \leq \phi_\tau \cdot R_\tau + \phi_{ep} \cdot R_{ep} \rightarrow 18.94 \text{ kip/ft} \leq (22.13 \text{ kip/ft}) (1.00) + (0.00 \text{ kip/ft}) (0.50) = 22.13 \text{ kip/ft}$$

$$= 18.94 \text{ kip/ft} \leq 22.13 \text{ kip/ft}$$

OK

Use $\phi_\tau = 1.00$ Use $\phi_{ep} = 0.50$ (Per AASHTO LRFD BDM Tables 10.5.5.2.2-1 and 11.5.7-1)



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 24.3 ft |
| Foundation Width (Entire Base Width), (B) = | 18.5 ft |
| Stem Width, (a) = | 3.0 ft |
| Toe Width, (b) = | 4.0 ft |
| Heel Width, (c) = | 11.5 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 4.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 19.4 ft |

Bearing and Retained/Backfill Soil Properties:

| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 115 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 26 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 1250 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

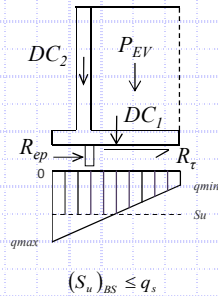
LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 10.6.3.4 (Continued)

Check Undrained Condition: $R_{\tau} = ((S_u)_{BS} \leq q_s) \cdot B$



$$(S_u)_{BS} = 1.25 \text{ ksf}$$

$$q_{max} = \frac{1}{2} \sigma_{max} = (4.09 \text{ ksf}) / 2 = 2.05 \text{ ksf}$$

$$q_{min} = \frac{1}{2} \sigma_{min} = (0.79 \text{ ksf}) / 2 = 0.40 \text{ ksf}$$

$$\sigma_{max} = \frac{P_v}{B} \left(1 + 6 \frac{e}{B} \right) = (45.16 \text{ kip/ft} / 18.5 \text{ ft}) [1 + 6(2.08 \text{ ft} / 18.5 \text{ ft})] = 4.09 \text{ ksf}$$

$$\sigma_{min} = \frac{P_v}{B} \left(1 - 6 \frac{e}{B} \right) = (45.16 \text{ kip/ft} / 18.5 \text{ ft}) [1 - 6(2.08 \text{ ft} / 18.5 \text{ ft})] = 0.79 \text{ ksf}$$

$$R_{\tau} = 0.5(1.25 \text{ ksf} - 0.4 \text{ ksf})[(18.5 \text{ ft}(1.25 \text{ ksf} - 0.4 \text{ ksf})) / (2.05 \text{ ksf} - 0.4 \text{ ksf})] + (1.25 \text{ ksf} - 0.4 \text{ ksf})[(18.5 \text{ ft}(2.05 \text{ ksf} - 1.25 \text{ ksf})) / (2.05 \text{ ksf} - 0.4 \text{ ksf})] + (0.4 \text{ ksf})(18.5 \text{ ft}) = 19.07 \text{ kip/ft}$$

Verify Sliding Force Less Than Factored Sliding Resistance - Undrained Condition

$$P_H \leq \phi_n \cdot R_n \rightarrow P_H \leq \phi_{\tau} \cdot R_{\tau} + \phi_{ep} \cdot R_{ep} \rightarrow 18.94 \text{ kip/ft} \leq (19.07 \text{ kip/ft})(1.00) + (0.00 \text{ kip/ft})(0.50) = 19.07$$

$$= 18.94 \text{ kip/ft} \leq 19.07 \text{ kip/ft} \quad \text{OK}$$

$$\text{Use } \phi_{\tau} = 1.00 \quad \text{Use } \phi_{ep} = 0.50 \quad (\text{Per AASHTO LRFD BDM Tables 10.5.5.2.2-1 and 11.5.7-1})$$



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 24.3 ft |
| Foundation Width (Entire Base Width), (B) = | 18.5 ft |
| Stem Width, (a) = | 3.0 ft |
| Toe Width, (b) = | 4.0 ft |
| Heel Width, (c) = | 11.5 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 4.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 19.4 ft |

Bearing and Retained/Backfill Soil Properties:

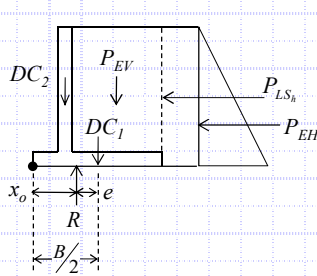
| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 115 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 26 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 1250 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Eccentricity (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.6.3.3



$$e = \frac{B}{2} - x_o$$

$$x_o = \frac{M_V - M_H}{P_V} = (489.89 \text{ kip-ft/ft} - 166.21 \text{ kip-ft/ft}) / (45.16 \text{ kip/ft}) = 7.17 \text{ ft}$$

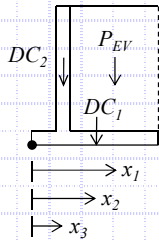
$$M_V = 489.89 \text{ kip-ft/ft}$$

$$M_H = 166.21 \text{ kip-ft/ft}$$

$$P_V = P_{EV} + DC_1 + DC_2 = 30.08 \text{ kip/ft} + 6.24 \text{ kip/ft} + 8.83 \text{ kip/ft} = 45.16 \text{ kip/ft}$$

$$e = (18.5 \text{ ft} / 2) - 7.17 \text{ ft} = 2.08 \text{ ft}$$

Resisting Moment, M_V:



$$M_V = P_{EV}(x_1) + DC_1(x_2) + DC_2(x_3)$$

$$P_{EV} = \gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV} = (120 \text{ pcf})(24.3 \text{ ft} - 2.5 \text{ ft})(11.5 \text{ ft})(1.00) = 30.08 \text{ kip/ft}$$

$$DC_1 = \gamma_c \cdot B \cdot d \cdot \gamma_{DC} = (150 \text{ pcf})(18.5 \text{ ft})(2.5 \text{ ft})(0.90) = 6.24 \text{ kip/ft}$$

$$DC_2 = \gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC} = (150 \text{ pcf})(24.3 \text{ ft} - 2.5 \text{ ft})(3.0 \text{ ft})(0.90) = 8.83 \text{ kip/ft}$$

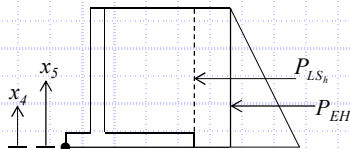
$$x_1 = a + b + \frac{c}{2} = 3.0 \text{ ft} + 4.0 \text{ ft} + (11.5 \text{ ft} / 2) = 12.8 \text{ ft}$$

$$x_2 = \frac{B}{2} = 18.5 \text{ ft} / 2 = 9.3 \text{ ft}$$

$$x_3 = b + \frac{a}{2} = 4.0 \text{ ft} + (3.0 \text{ ft} / 2) = 5.5 \text{ ft}$$

$$M_V = (30.08 \text{ kip/ft})(12.8 \text{ ft}) + (6.24 \text{ kip/ft})(9.3 \text{ ft}) + (8.83 \text{ kip/ft})(5.5 \text{ ft}) = 489.89 \text{ kip-ft/ft}$$

Overturning Moment, M_H:



$$M_H = P_{EH}(x_2) + P_{LS}(x_3)$$

$$P_{EH} = \frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf})(24.3 \text{ ft})^2 (0.297)(1.50) = 15.78 \text{ kip/ft}$$

$$P_{LS} = \sigma_{LS} H K_a \gamma_{LS} = (250 \text{ psf})(24.3 \text{ ft})(0.297)(1.75) = 3.16 \text{ kip/ft}$$

$$x_2 = \frac{H}{3} = (24.3 \text{ ft}) / 3 = 8.10 \text{ ft}$$

$$x_3 = \frac{H}{2} = (24.3 \text{ ft}) / 2 = 12.15 \text{ ft}$$

$$M_H = (15.78 \text{ kip/ft})(8.1 \text{ ft}) + (3.16 \text{ kip/ft})(12.15 \text{ ft}) = 166.21 \text{ kip-ft/ft}$$

Limiting Eccentricity:

$$e_{\max} = \frac{B}{3} \rightarrow e_{\max} = (18.5 \text{ ft}) / 3 = 6.17 \text{ ft}$$

Check Eccentricity

$$e < e_{\max} \rightarrow 2.08 \text{ ft} < 6.17 \text{ ft} \quad \text{OK}$$



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 24.3 ft |
| Foundation Width (Entire Base Width), (B) = | 18.5 ft |
| Stem Width, (a) = | 3.0 ft |
| Toe Width, (b) = | 4.0 ft |
| Heel Width, (c) = | 11.5 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 4.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 19.4 ft |

Bearing and Retained/Backfill Soil Properties:

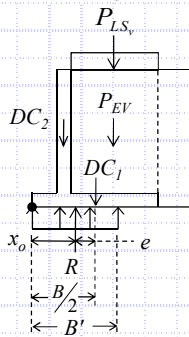
| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 115 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 26 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 1250 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.6.3.2



$$q_{eq} = \frac{P_V}{B'}$$

$$B' = B - 2e = 18.5 \text{ ft} - 2(0.60 \text{ ft}) = 17.30 \text{ ft}$$

$$e = \frac{B}{2} - x_o = (18.5 \text{ ft} / 2) - 8.65 \text{ ft} = 0.60 \text{ ft}$$

$$x_o = \frac{M_V - M_H}{P_V} = (768.67 \text{ kip-ft/ft} - 166.21 \text{ kip-ft/ft}) / (69.64 \text{ kip/ft}) = 8.65 \text{ ft}$$

$$q_{eq} = (69.64 \text{ kip/ft}) / (17.30 \text{ ft}) = 4.03 \text{ ksf}$$

Resisting Moment, M_V:

$$M_V = P_{EV}(x_1) + P_{LS_v}(x_1) + DC_1(x_2) + DC_2(x_3)$$

$$P_{EV} = \gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV} = (120 \text{ pcf})(24.3 \text{ ft} - 2.5 \text{ ft})(11.5 \text{ ft})(1.35) = 40.61 \text{ kip/ft}$$

$$P_{LS_v} = \sigma_{LS} \cdot B \cdot \gamma_{LS} = (250 \text{ psf})(18.5 \text{ ft})(1.75) = 8.094 \text{ kip/ft}$$

$$DC_1 = \gamma_c \cdot B \cdot d \cdot \gamma_{DC} = (150 \text{ pcf})(18.5 \text{ ft})(2.5 \text{ ft})(1.25) = 8.67 \text{ kip/ft}$$

$$DC_2 = \gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC} = (150 \text{ pcf})(24.3 \text{ ft} - 2.5 \text{ ft})(3.0 \text{ ft})(1.25) = 12.26 \text{ kip/ft}$$

$$x_1 = a + b + c/2 = 3.0 \text{ ft} + 4.0 \text{ ft} + (11.5 \text{ ft} / 2) = 12.8 \text{ ft}$$

$$x_2 = B/2 = 18.5 \text{ ft} / 2 = 9.3 \text{ ft}$$

$$x_3 = b + a/2 = 4.0 \text{ ft} + (3.0 \text{ ft} / 2) = 5.5 \text{ ft}$$

$$M_V = (40.61 \text{ kip/ft})(12.8 \text{ ft}) + (8.09 \text{ kip/ft})(12.8 \text{ ft}) + (8.67 \text{ kip/ft})(9.3 \text{ ft}) + (12.26 \text{ kip/ft})(5.5 \text{ ft}) = 768.67 \text{ kip-ft/ft}$$

Overturning Moment, M_H:

$$M_H = P_{EH}(x_4) + P_{LS_h}(x_5)$$

$$P_{EH} = \frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf})(24.3 \text{ ft})^2 (0.297)(1.50) = 15.78 \text{ kip/ft}$$

$$P_{LS_h} = \sigma_{LS} H K_a \gamma_{LS} = (250 \text{ psf})(24.3 \text{ ft})(0.297)(1.75) = 3.16 \text{ kip/ft}$$

$$x_4 = H/3 = (24.3 \text{ ft}) / 3 = 8.10 \text{ ft}$$

$$x_5 = H/2 = (24.3 \text{ ft}) / 2 = 12.15 \text{ ft}$$

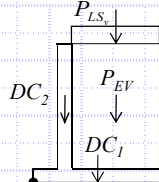
$$M_H = (15.78 \text{ kip/ft})(8.1 \text{ ft}) + (3.16 \text{ kip/ft})(12.15 \text{ ft}) = 166.21 \text{ kip-ft/ft}$$

Vertical Force, P_V:

$$P_V = P_{EV} + P_{LS_v} + DC_1 + DC_2$$

$$P_V = 40.61 \text{ kip/ft} + 8.09 \text{ kip/ft} + 8.67 \text{ kip/ft} + 12.26 \text{ kip/ft}$$

$$P_V = 69.64 \text{ kip/ft}$$





CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 24.3 ft |
| Foundation Width (Entire Base Width), (B) = | 18.5 ft |
| Stem Width, (a) = | 3.0 ft |
| Toe Width, (b) = | 4.0 ft |
| Heel Width, (c) = | 11.5 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 4.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 19.4 ft |

Bearing and Retained/Backfill Soil Properties:

| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 115 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 26 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 1250 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.6.3.2 (Continued)

Check Bearing Resistance - Drained Condition

$$\text{Nominal Bearing Resistance: } q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \frac{1}{2} \gamma B' N_{\gamma m} C_{w\gamma}$$

$$N_{cm} = N_c s_c i_c = 23.901$$

$$N_{qm} = N_q s_q d_q i_q = 13.546$$

$$N_{\gamma m} = N_{\gamma} s_{\gamma} i_{\gamma} = 11.837$$

$$N_c = 22.254$$

$$s_c = 1 + (17.3 \text{ ft} / 124 \text{ ft}) (11.854 / 22.254)$$

$$= 1.074$$

$$i_c = 1.000 \text{ (Assumed)}$$

$$N_q = 11.854$$

$$s_q = 1 + (17.3 \text{ ft} / 124 \text{ ft}) \tan(26^\circ) = 1.068$$

$$d_q = 1 + 2 \tan(26^\circ) [1 - \sin(26^\circ)]^2 \tan^{-1}(4.0 \text{ ft} / 17.3 \text{ ft})$$

$$= 1.070$$

$$i_q = 1.000 \text{ (Assumed)}$$

$$C_{wq} = 19.4 \text{ ft} > 4.0 \text{ ft} = 1.000$$

$$N_{\gamma} = 12.539$$

$$s_{\gamma} = 1 - 0.4 (17.3 \text{ ft} / 124 \text{ ft}) = 0.944$$

$$i_{\gamma} = 1.000 \text{ (Assumed)}$$

$$C_{w\gamma} = 19.4 \text{ ft} < 1.5 (17.3 \text{ ft}) + 4.0 \text{ ft} = 0.874$$

$$q_n = (0 \text{ psf})(23.901) + (115 \text{ pcf})(4.0 \text{ ft})(13.546)(1.000) + \frac{1}{2}(115 \text{ pcf})(17.3 \text{ ft})(11.837)(0.874) = 16.52 \text{ ksf}$$

Verify Equivalent Pressure Less Than Factored Bearing Resistance

$$q_{eq} \leq q_n \cdot \phi_b \rightarrow 4.03 \text{ ksf} \leq (16.52 \text{ ksf})(0.55) = 9.09 \text{ ksf} \rightarrow 4.03 \text{ ksf} \leq 9.09 \text{ ksf} \quad \text{OK}$$

$$\text{Use } \phi_b = 0.55 \text{ (Per AASHTO LRFD BDM Table 11.5.7-1)}$$

Check Bearing Resistance - Undrained Condition

$$\text{Nominal Bearing Resistance: } q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \frac{1}{2} \gamma B' N_{\gamma m} C_{w\gamma}$$

$$N_{cm} = N_c s_c i_c = 5.520$$

$$N_{qm} = N_q s_q d_q i_q = 1.000$$

$$N_{\gamma m} = N_{\gamma} s_{\gamma} i_{\gamma} = 0.000$$

$$N_c = 5.140$$

$$s_c = 1 + (17.3 \text{ ft} / [(5)(124 \text{ ft})]) = 1.074$$

$$i_c = 1.000 \text{ (Assumed)}$$

$$N_q = 1.000$$

$$s_q = 1.000$$

$$d_q = 1 + 2 \tan(0^\circ) [1 - \sin(0^\circ)]^2 \tan^{-1}(4.0 \text{ ft} / 17.3 \text{ ft})$$

$$= 1.000$$

$$i_q = 1.000 \text{ (Assumed)}$$

$$C_{wq} = 19.4 \text{ ft} > 4.0 \text{ ft} = 1.000$$

$$N_{\gamma} = 0.000$$

$$s_{\gamma} = 1.000$$

$$i_{\gamma} = 1.000 \text{ (Assumed)}$$

$$C_{w\gamma} = 19.4 \text{ ft} < 1.5 (17.3 \text{ ft}) + 4.0 \text{ ft} = 0.874$$

$$q_n = (1250 \text{ psf})(5.520) + (115 \text{ pcf})(4.0 \text{ ft})(1.000)(1.000) + \frac{1}{2}(115 \text{ pcf})(17.3 \text{ ft})(0.000)(0.874) = 7.36 \text{ ksf}$$

Verify Equivalent Pressure Less Than Factored Bearing Resistance

$$q_{eq} \leq q_n \cdot \phi_b \rightarrow 4.03 \text{ ksf} \leq (7.36 \text{ ksf})(0.55) = 4.05 \text{ ksf} \rightarrow 4.03 \text{ ksf} \leq 4.05 \text{ ksf} \quad \text{OK}$$

$$\text{Use } \phi_b = 0.55 \text{ (Per AASHTO LRFD BDM Table 11.5.7-1)}$$



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 24.3 ft |
| Foundation Width (Entire Base Width), (B) = | 18.5 ft |
| Stem Width, (a) = | 3.0 ft |
| Toe Width, (b) = | 4.0 ft |
| Heel Width, (c) = | 11.5 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 4.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 19.4 ft |

Bearing and Retained/Backfill Soil Properties:

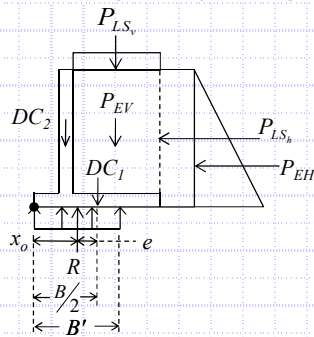
| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 115 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 26 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 1250 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.6.3.2



$$q_{eq} = P_V / B'$$

$$B' = B - 2e = 18.5 \text{ ft} - 2(0.44 \text{ ft}) = 17.62 \text{ ft}$$

$$e = B/2 - x_o = (18.5 \text{ ft} / 2) - 8.81 \text{ ft} = 0.44 \text{ ft}$$

$$x_o = \frac{M_V - M_H}{P_V} = (560.67 \text{ kip-ft/ft} - 107.15 \text{ kip-ft/ft}) / (51.46 \text{ kip/ft}) = 8.81 \text{ ft}$$

$$q_{eq} = (51.46 \text{ kip/ft}) / (17.62 \text{ ft}) = 2.92 \text{ ksf}$$

$$M_V = [(\gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV}) + (\sigma_{LS} \cdot B \cdot \gamma_{LS})] \left(a + b + \frac{c}{2} \right) + (\gamma_c \cdot B \cdot d \cdot \gamma_{DC}) \left(\frac{B}{2} \right) + (\gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC}) \left(b + \frac{a}{2} \right)$$

$$M_V = [(120 \text{ pcf})(24.3 \text{ ft} - 2.5 \text{ ft})(11.5 \text{ ft})(1.00) + (250 \text{ psf})(18.5 \text{ ft})(1.00)](3.0 \text{ ft} + 4.0 \text{ ft} + (11.5 \text{ ft} / 2)) + [(150 \text{ pcf})(24.3 \text{ ft} - 2.5 \text{ ft})(3.0 \text{ ft})(1.00)](4.0 \text{ ft} + (3.0 \text{ ft} / 2)) = 560.67 \text{ kip-ft/ft}$$

$$M_H = \left(\frac{1}{2} \gamma_{RS} \cdot H^2 \cdot K_a \cdot \gamma_{EH} \right) \left(\frac{H}{3} \right) + (\sigma_{LS} \cdot H \cdot K_a \cdot \gamma_{LS}) \left(\frac{H}{2} \right)$$

$$M_H = \left[\frac{1}{2} (120 \text{ pcf})(24.3 \text{ ft})^2 (0.297)(1.00) \right] (24.3 \text{ ft} / 3) + [(250 \text{ psf})(24.3 \text{ ft})(0.297)(1.00)] (24.3 \text{ ft} / 2) = 107.15 \text{ kip-ft/ft}$$

$$P_V = (\gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV}) + (\sigma_{LS} \cdot B \cdot \gamma_{LS}) + (\gamma_c \cdot B \cdot d \cdot \gamma_{DC}) + (\gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC})$$

$$P_V = (120 \text{ pcf})(24.3 \text{ ft} - 2.5 \text{ ft})(11.5 \text{ ft})(1.00) + (250 \text{ psf})(18.5 \text{ ft})(1.00) + (150 \text{ pcf})(24.3 \text{ ft} - 2.5 \text{ ft})(3.0 \text{ ft})(1.00) + (150 \text{ pcf})(24.3 \text{ ft} - 2.5 \text{ ft})(3.0 \text{ ft})(1.00) = 51.46 \text{ kip/ft}$$

Settlement (See Attached Spreadsheet Calculations):

Total Settlement at Maximum Wall Height: (S_t)_{max} = N/A in

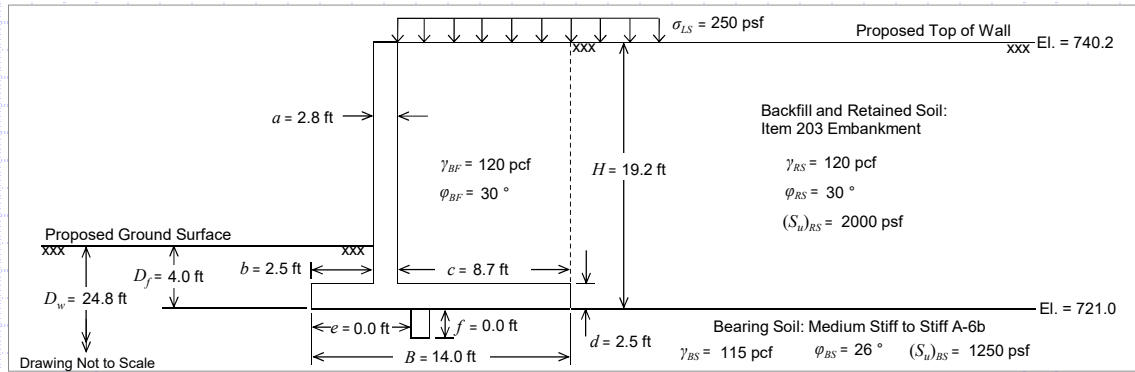
Total Settlement at Minimum Wall Height: (S_t)_{min} = N/A in

Differential Settlement Along Wall Alignment: δ_s = N/A

δ_s < 1/500 → N/A < 1/500



FRA-70-1323C - Forward Abutment Wingwall - Panel 4 - CIP Wall Without Shear Key - Borings B-019-5-19 and B-114-1-13



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 19.2 ft |
| Foundation Width (Entire Base Width), (B) = | 14.0 ft |
| Stem Width, (a) = | 2.8 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 8.7 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 4.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 24.8 ft |

Bearing and Retained/Backfill Soil Properties:

| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 115 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 26° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 1250 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

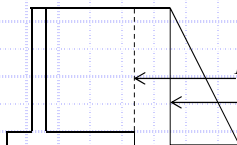
LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 10.6.3.4

Sliding Force:



$$P_H = P_{EH} + P_{LS}$$

$$P_{EH} = \frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf}) (19.2 \text{ ft})^2 (0.297) (1.50) = 9.85 \text{ kip/ft}$$

$$P_{LS} = \sigma_{LS} H K_a \gamma_{LS} = (250 \text{ psf}) (19.2 \text{ ft}) (0.297) (1.75) = 2.49 \text{ kip/ft}$$

$$P_H = 9.85 \text{ kip/ft} + 2.49 \text{ kip/ft} = 12.34 \text{ kip/ft}$$

Check Sliding Resistance

$$\text{Nominal Sliding Resisting: } R_n = R_\tau + R_{ep}$$

$$R_{ep} = \gamma_{BS} D_f J K_p \gamma_{ep} + \frac{1}{2} \gamma_{BS} f^2 K_p \gamma_{ep}$$

$$R_{ep} = (115 \text{ pcf}) (4.0 \text{ ft}) (0.0 \text{ ft}) (7.41) (0.90) + \frac{1}{2} (115 \text{ pcf}) (0.0 \text{ ft})^2 (7.41) (0.90) = 0.00 \text{ kip/ft}$$

$$\text{Check Drained Condition: } R_\tau = P_v \tan \delta$$

$$P_v = DC_1 + DC_2 + P_{EV} = \gamma_c \cdot [B \cdot d + (H - d) \cdot a] \cdot \gamma_{DC} + \gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV}$$

$$P_v = (150 \text{ pcf}) [(14.0 \text{ ft}) (2.5 \text{ ft}) + (19.2 \text{ ft} - 2.5 \text{ ft}) (2.8 \text{ ft})] (0.90) + (120 \text{ pcf}) (19.2 \text{ ft} - 2.5 \text{ ft}) (8.7 \text{ ft}) (1.00) = 28.47 \text{ kip/ft}$$

$$\tan \delta = \tan \phi_{BS} = \tan(26) = 0.49$$

$$R_\tau = (28.47 \text{ kip/ft}) (0.49) = 13.95 \text{ kip/ft}$$

Verify Sliding Force Less Than Factored Sliding Resistance - Drained Condition

$$P_H \leq \phi_n \cdot R_n \rightarrow P_H \leq \phi_\tau \cdot R_\tau + \phi_{ep} \cdot R_{ep} \rightarrow 12.34 \text{ kip/ft} \leq (13.95 \text{ kip/ft}) (1.00) + (0.00 \text{ kip/ft}) (0.50) = 13.95 \text{ kip/ft}$$

$$= 12.34 \text{ kip/ft} \leq 13.95 \text{ kip/ft}$$

OK

$$\text{Use } \phi_\tau = 1.00 \quad \text{Use } \phi_{ep} = 0.50 \quad (\text{Per AASHTO LRFD BDM Tables 10.5.5.2.2-1 and 11.5.7-1})$$



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 19.2 ft |
| Foundation Width (Entire Base Width), (B) = | 14.0 ft |
| Stem Width, (a) = | 2.8 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 8.7 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 4.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 24.8 ft |

Bearing and Retained/Backfill Soil Properties:

| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 115 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 26 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 1250 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

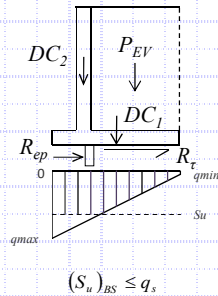
LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 10.6.3.4 (Continued)

Check Undrained Condition: $R_{\tau} = ((S_u)_{BS} \leq q_s) \cdot B$



$$(S_u)_{BS} = 1.25 \text{ ksf}$$

$$q_{max} = \frac{1}{2} \sigma_{max} = (3.88 \text{ ksf}) / 2 = 1.94 \text{ ksf}$$

$$q_{min} = \frac{1}{2} \sigma_{min} = (0.19 \text{ ksf}) / 2 = 0.10 \text{ ksf}$$

$$\sigma_{max} = \frac{P_v}{B} \left(1 + 6 \frac{e}{B} \right) = (28.47 \text{ kip/ft} / 14.0 \text{ ft}) [1 + 6(2.12 \text{ ft} / 14.0 \text{ ft})] = 3.88 \text{ ksf}$$

$$\sigma_{min} = \frac{P_v}{B} \left(1 - 6 \frac{e}{B} \right) = (28.47 \text{ kip/ft} / 14.0 \text{ ft}) [1 - 6(2.12 \text{ ft} / 14.0 \text{ ft})] = 0.19 \text{ ksf}$$

$$R_{\tau} = 0.5(1.25 \text{ ksf} - 0.1 \text{ ksf})[(14.0 \text{ ft}(1.25 \text{ ksf} - 0.1 \text{ ksf})) / (1.94 \text{ ksf} - 0.1 \text{ ksf})] + (1.25 \text{ ksf} - 0.1 \text{ ksf})[(14.0 \text{ ft}(1.94 \text{ ksf} - 1.25 \text{ ksf})) / (1.94 \text{ ksf} - 0.1 \text{ ksf})] + (0.1 \text{ ksf})(14.0 \text{ ft}) = 12.47 \text{ kip/ft}$$

Verify Sliding Force Less Than Factored Sliding Resistance - Undrained Condition

$$P_H \leq \phi_n \cdot R_n \rightarrow P_H \leq \phi_{\tau} \cdot R_{\tau} + \phi_{ep} \cdot R_{ep} \rightarrow 12.34 \text{ kip/ft} \leq (12.47 \text{ kip/ft})(1.00) + (0.00 \text{ kip/ft})(0.50) = 12.47$$

$$= 12.34 \text{ kip/ft} \leq 12.47 \text{ kip/ft} \quad \text{OK}$$

$$\text{Use } \phi_{\tau} = 1.00 \quad \text{Use } \phi_{ep} = 0.50 \quad (\text{Per AASHTO LRFD BDM Tables 10.5.5.2.2-1 and 11.5.7-1})$$



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 19.2 ft |
| Foundation Width (Entire Base Width), (B) = | 14.0 ft |
| Stem Width, (a) = | 2.8 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 8.7 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 4.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 24.8 ft |

Bearing and Retained/Backfill Soil Properties:

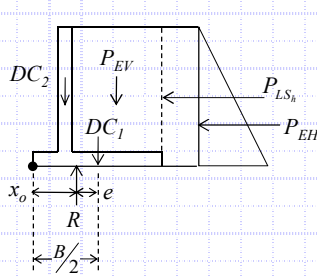
| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 115 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 26 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 1250 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Eccentricity (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.6.3.3



$$e = \frac{B}{2} - x_o$$

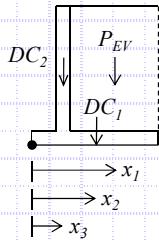
$$x_o = \frac{M_V - M_H}{P_V} = \frac{(225.94 \text{ kip-ft/ft} - 86.94 \text{ kip-ft/ft})}{(28.47 \text{ kip/ft})} = 4.88 \text{ ft}$$

$$\left. \begin{aligned} M_V &= 225.94 \text{ kip-ft/ft} \\ M_H &= 86.94 \text{ kip-ft/ft} \end{aligned} \right\} \text{ Defined below}$$

$$P_V = P_{EV} + DC_1 + DC_2 = 17.43 \text{ kip/ft} + 4.73 \text{ kip/ft} + 6.31 \text{ kip/ft} = 28.47 \text{ kip/ft}$$

$$e = (14.0 \text{ ft} / 2) - 4.88 \text{ ft} = 2.12 \text{ ft}$$

Resisting Moment, M_V:



$$M_V = P_{EV}(x_1) + DC_1(x_2) + DC_2(x_3)$$

$$P_{EV} = \gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV} = (120 \text{ pcf})(19.2 \text{ ft} - 2.5 \text{ ft})(8.7 \text{ ft})(1.00) = 17.43 \text{ kip/ft}$$

$$DC_1 = \gamma_c \cdot B \cdot d \cdot \gamma_{DC} = (150 \text{ pcf})(14.0 \text{ ft})(2.5 \text{ ft})(0.90) = 4.73 \text{ kip/ft}$$

$$DC_2 = \gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC} = (150 \text{ pcf})(19.2 \text{ ft} - 2.5 \text{ ft})(2.8 \text{ ft})(0.90) = 6.31 \text{ kip/ft}$$

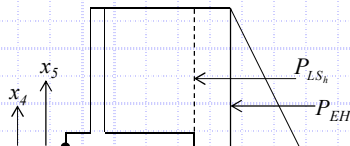
$$x_1 = a + b + \frac{c}{2} = 2.8 \text{ ft} + 2.5 \text{ ft} + (8.7 \text{ ft} / 2) = 9.7 \text{ ft}$$

$$x_2 = \frac{B}{2} = 14.0 \text{ ft} / 2 = 7.0 \text{ ft}$$

$$x_3 = b + \frac{a}{2} = 2.5 \text{ ft} + (2.8 \text{ ft} / 2) = 3.9 \text{ ft}$$

$$M_V = (17.43 \text{ kip/ft})(9.7 \text{ ft}) + (4.73 \text{ kip/ft})(7.0 \text{ ft}) + (6.31 \text{ kip/ft})(3.9 \text{ ft}) = 225.94 \text{ kip-ft/ft}$$

Overturning Moment, M_H:



$$M_H = P_{EH}(x_2) + P_{LS}(x_3)$$

$$P_{EH} = \frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf})(19.2 \text{ ft})^2 (0.297)(1.50) = 9.85 \text{ kip/ft}$$

$$P_{LS} = \sigma_{LS} H K_a \gamma_{LS} = (250 \text{ psf})(19.2 \text{ ft})(0.297)(1.75) = 2.49 \text{ kip/ft}$$

$$x_2 = \frac{H}{3} = (19.2 \text{ ft}) / 3 = 6.40 \text{ ft}$$

$$x_3 = \frac{H}{2} = (19.2 \text{ ft}) / 2 = 9.60 \text{ ft}$$

$$M_H = (9.85 \text{ kip/ft})(6.4 \text{ ft}) + (2.49 \text{ kip/ft})(9.60 \text{ ft}) = 86.94 \text{ kip-ft/ft}$$

Limiting Eccentricity:

$$e_{\max} = \frac{B}{3} \rightarrow e_{\max} = (14.0 \text{ ft}) / 3 = 4.67 \text{ ft}$$

Check Eccentricity

$$e < e_{\max} \rightarrow 2.12 \text{ ft} < 4.67 \text{ ft} \quad \text{OK}$$



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 19.2 ft |
| Foundation Width (Entire Base Width), (B) = | 14.0 ft |
| Stem Width, (a) = | 2.8 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 8.7 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 4.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 24.8 ft |

Bearing and Retained/Backfill Soil Properties:

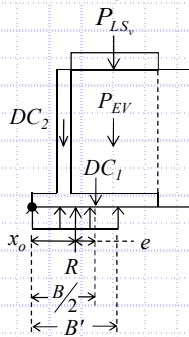
| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 115 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 26 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 1250 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.6.3.2



$$q_{eq} = \frac{P_V}{B'}$$

$$B' = B - 2e = 14.0 \text{ ft} - 2(0.79 \text{ ft}) = 12.42 \text{ ft}$$

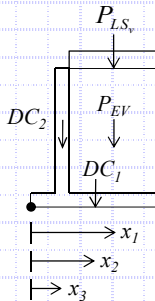
$$e = \frac{B}{2} - x_o = (14.0 \text{ ft} / 2) - 6.21 \text{ ft} = 0.79 \text{ ft}$$

$$x_o = \frac{M_V - M_H}{P_V} = (366.37 \text{ kip-ft} - 86.94 \text{ kip-ft}) / (44.99 \text{ kip/ft}) = 6.21 \text{ ft}$$

$$q_{eq} = (44.99 \text{ kip/ft}) / (12.42 \text{ ft}) = 3.62 \text{ ksf}$$

Resisting Moment, M_V :

$$M_V = P_{EV}(x_1) + P_{LS_v}(x_1) + DC_1(x_2) + DC_2(x_3)$$



$$P_{EV} = \gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV} = (120 \text{ pcf})(19.2 \text{ ft} - 2.5 \text{ ft})(8.7 \text{ ft})(1.35) = 23.54 \text{ kip/ft}$$

$$P_{LS_v} = \sigma_{LS} \cdot B \cdot \gamma_{LS} = (250 \text{ psf})(14.0 \text{ ft})(1.75) = 6.125 \text{ kip/ft}$$

$$DC_1 = \gamma_c \cdot B \cdot d \cdot \gamma_{DC} = (150 \text{ pcf})(14.0 \text{ ft})(2.5 \text{ ft})(1.25) = 6.56 \text{ kip/ft}$$

$$DC_2 = \gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC} = (150 \text{ pcf})(19.2 \text{ ft} - 2.5 \text{ ft})(2.8 \text{ ft})(1.25) = 8.77 \text{ kip/ft}$$

$$x_1 = a + b + c/2 = 2.8 \text{ ft} + 2.5 \text{ ft} + (8.7 \text{ ft} / 2) = 9.7 \text{ ft}$$

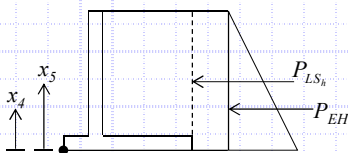
$$x_2 = B/2 = 14.0 \text{ ft} / 2 = 7.0 \text{ ft}$$

$$x_3 = b + a/2 = 2.5 \text{ ft} + (2.8 \text{ ft} / 2) = 3.9 \text{ ft}$$

$$M_V = (23.54 \text{ kip/ft})(9.7 \text{ ft}) + (6.13 \text{ kip/ft})(9.7 \text{ ft}) + (6.56 \text{ kip/ft})(7.0 \text{ ft}) + (8.77 \text{ kip/ft})(3.9 \text{ ft}) = 366.37 \text{ kip-ft/ft}$$

Overturning Moment, M_H :

$$M_H = P_{EH}(x_4) + P_{LS_h}(x_5)$$



$$P_{EH} = \frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf})(19.2 \text{ ft})^2 (0.297)(1.50) = 9.85 \text{ kip/ft}$$

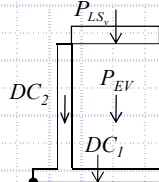
$$P_{LS_h} = \sigma_{LS} H K_a \gamma_{LS} = (250 \text{ psf})(19.2 \text{ ft})(0.297)(1.75) = 2.49 \text{ kip/ft}$$

$$x_4 = H/3 = (19.2 \text{ ft}) / 3 = 6.40 \text{ ft}$$

$$x_5 = H/2 = (19.2 \text{ ft}) / 2 = 9.60 \text{ ft}$$

$$M_H = (9.85 \text{ kip/ft})(6.4 \text{ ft}) + (2.49 \text{ kip/ft})(9.60 \text{ ft}) = 86.94 \text{ kip-ft/ft}$$

Vertical Force, P_V :



$$P_V = P_{EV} + P_{LS_v} + DC_1 + DC_2$$

$$P_V = 23.54 \text{ kip/ft} + 6.13 \text{ kip/ft} + 6.56 \text{ kip/ft} + 8.77 \text{ kip/ft}$$

$$P_V = 44.99 \text{ kip/ft}$$



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 19.2 ft |
| Foundation Width (Entire Base Width), (B) = | 14.0 ft |
| Stem Width, (a) = | 2.8 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 8.7 ft |
| Footings Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 4.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 24.8 ft |

Bearing and Retained/Backfill Soil Properties:

| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 115 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 26 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 1250 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.6.3.2 (Continued)

Check Bearing Resistance - Drained Condition

$$\text{Nominal Bearing Resistance: } q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \frac{1}{2} \gamma B' N_{\gamma m} C_{w\gamma}$$

$$N_{cm} = N_c s_c i_c = 23.433$$

$$N_{qm} = N_q s_q d_q i_q = 13.629$$

$$N_{\gamma m} = N_{\gamma} s_{\gamma} i_{\gamma} = 12.037$$

$$N_c = 22.254$$

$$s_c = 1 + (12.42 \text{ ft} / 124 \text{ ft}) (11.854 / 22.254)$$

$$= 1.053$$

$$i_c = 1.000 \text{ (Assumed)}$$

$$N_q = 11.854$$

$$s_q = 1 + (12.42 \text{ ft} / 124 \text{ ft}) \tan(26^\circ) = 1.049$$

$$d_q = 1 + 2 \tan(26^\circ) [1 - \sin(26^\circ)]^2 \tan^{-1}(4.0 \text{ ft} / 12.42 \text{ ft})$$

$$= 1.096$$

$$i_q = 1.000 \text{ (Assumed)}$$

$$C_{wq} = 24.8 \text{ ft} > 4.0 \text{ ft} = 1.000$$

$$N_{\gamma} = 12.539$$

$$s_{\gamma} = 1 - 0.4 (12.42 \text{ ft} / 124 \text{ ft}) = 0.960$$

$$i_{\gamma} = 1.000 \text{ (Assumed)}$$

$$C_{w\gamma} = 24.8 \text{ ft} > 1.5 (12.42 \text{ ft}) + 4.0 \text{ ft} = 1.000$$

$$q_n = (0 \text{ psf})(23.433) + (115 \text{ pcf})(4.0 \text{ ft})(13.629)(1.000) + \frac{1}{2}(115 \text{ pcf})(12.4 \text{ ft})(12.037)(1.000) = 14.87 \text{ ksf}$$

Verify Equivalent Pressure Less Than Factored Bearing Resistance

$$q_{eq} \leq q_n \cdot \phi_b \rightarrow 3.62 \text{ ksf} \leq (14.87 \text{ ksf})(0.55) = 8.18 \text{ ksf} \rightarrow 3.62 \text{ ksf} \leq 8.18 \text{ ksf} \quad \text{OK}$$

$$\text{Use } \phi_b = 0.55 \text{ (Per AASHTO LRFD BDM Table 11.5.7-1)}$$

Check Bearing Resistance - Undrained Condition

$$\text{Nominal Bearing Resistance: } q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \frac{1}{2} \gamma B' N_{\gamma m} C_{w\gamma}$$

$$N_{cm} = N_c s_c i_c = 5.412$$

$$N_{qm} = N_q s_q d_q i_q = 1.000$$

$$N_{\gamma m} = N_{\gamma} s_{\gamma} i_{\gamma} = 0.000$$

$$N_c = 5.140$$

$$s_c = 1 + (12.42 \text{ ft} / [(5)(124 \text{ ft})]) = 1.053$$

$$i_c = 1.000 \text{ (Assumed)}$$

$$N_q = 1.000$$

$$s_q = 1.000$$

$$d_q = 1 + 2 \tan(0^\circ) [1 - \sin(0^\circ)]^2 \tan^{-1}(4.0 \text{ ft} / 12.42 \text{ ft})$$

$$= 1.000$$

$$i_q = 1.000 \text{ (Assumed)}$$

$$C_{wq} = 24.8 \text{ ft} > 4.0 \text{ ft} = 1.000$$

$$N_{\gamma} = 0.000$$

$$s_{\gamma} = 1.000$$

$$i_{\gamma} = 1.000 \text{ (Assumed)}$$

$$C_{w\gamma} = 24.8 \text{ ft} > 1.5 (12.42 \text{ ft}) + 4.0 \text{ ft} = 1.000$$

$$q_n = (1250 \text{ psf})(5.412) + (115 \text{ pcf})(4.0 \text{ ft})(1.000)(1.000) + \frac{1}{2}(115 \text{ pcf})(12.4 \text{ ft})(0.000)(1.000) = 7.23 \text{ ksf}$$

Verify Equivalent Pressure Less Than Factored Bearing Resistance

$$q_{eq} \leq q_n \cdot \phi_b \rightarrow 3.62 \text{ ksf} \leq (7.23 \text{ ksf})(0.55) = 3.98 \text{ ksf} \rightarrow 3.62 \text{ ksf} \leq 3.98 \text{ ksf} \quad \text{OK}$$

$$\text{Use } \phi_b = 0.55 \text{ (Per AASHTO LRFD BDM Table 11.5.7-1)}$$



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 19.2 ft |
| Foundation Width (Entire Base Width), (B) = | 14.0 ft |
| Stem Width, (a) = | 2.8 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 8.7 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 4.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 24.8 ft |

Bearing and Retained/Backfill Soil Properties:

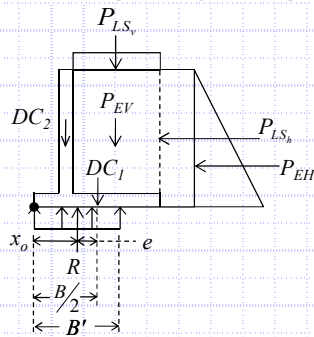
| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 115 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 26 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 1250 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.6.3.2



$$q_{eq} = P_V / B'$$

$$B' = B - 2e = 14.0 \text{ ft} - 2(0.66 \text{ ft}) = 12.68 \text{ ft}$$

$$e = B/2 - x_o = (14.0 \text{ ft} / 2) - 6.34 \text{ ft} = 0.66 \text{ ft}$$

$$x_o = \frac{M_V - M_H}{P_V} = (266.13 \text{ kip-ft/ft} - 55.73 \text{ kip-ft/ft}) / (33.20 \text{ kip/ft}) = 6.34 \text{ ft}$$

$$q_{eq} = (33.20 \text{ kip/ft}) / (12.68 \text{ ft}) = 2.62 \text{ ksf}$$

$$M_V = [(\gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV}) + (\sigma_{LS} \cdot B \cdot \gamma_{LS})] \left(a + b + \frac{c}{2} \right) + (\gamma_c \cdot B \cdot d \cdot \gamma_{DC}) \left(\frac{B}{2} \right) + (\gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC}) \left(b + \frac{a}{2} \right)$$

$$M_V = [(120 \text{ pcf})(19.2 \text{ ft} - 2.5 \text{ ft})(8.7 \text{ ft})(1.00) + (250 \text{ psf})(14.0 \text{ ft})(1.00)](2.8 \text{ ft} + 2.5 \text{ ft} + (8.7 \text{ ft} / 2)) + [(150 \text{ pcf})(14.0 \text{ ft})(2.5 \text{ ft})(1.00)](14.0 \text{ ft} / 2) + [(150 \text{ pcf})(19.2 \text{ ft} - 2.5 \text{ ft})(2.8 \text{ ft})(1.00)](2.5 \text{ ft} + (2.8 \text{ ft} / 2)) = 266.13 \text{ kip-ft/ft}$$

$$M_H = \left(\frac{1}{2} \gamma_{RS} \cdot H^2 \cdot K_a \cdot \gamma_{EH} \right) \left(\frac{H}{3} \right) + (\sigma_{LS} \cdot H \cdot K_a \cdot \gamma_{LS}) \left(\frac{H}{2} \right)$$

$$M_H = \left[\frac{1}{2} (120 \text{ pcf})(19.2 \text{ ft})^2 (0.297)(1.00) \right] (19.2 \text{ ft} / 3) + [(250 \text{ psf})(19.2 \text{ ft})(0.297)(1.00)] (19.2 \text{ ft} / 2) = 55.73 \text{ kip-ft/ft}$$

$$P_V = (\gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV}) + (\sigma_{LS} \cdot B \cdot \gamma_{LS}) + (\gamma_c \cdot B \cdot d \cdot \gamma_{DC}) + (\gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC})$$

$$P_V = (120 \text{ pcf})(19.2 \text{ ft} - 2.5 \text{ ft})(8.7 \text{ ft})(1.00) + (250 \text{ psf})(14.0 \text{ ft})(1.00) + (150 \text{ pcf})(14.0 \text{ ft})(2.5 \text{ ft})(1.00) + (150 \text{ pcf})(19.2 \text{ ft} - 2.5 \text{ ft})(2.8 \text{ ft})(1.00) = 33.2 \text{ kip/ft}$$

Settlement (See Attached Spreadsheet Calculations):

Total Settlement at Maximum Wall Height: (S_t)_{max} = N/A in

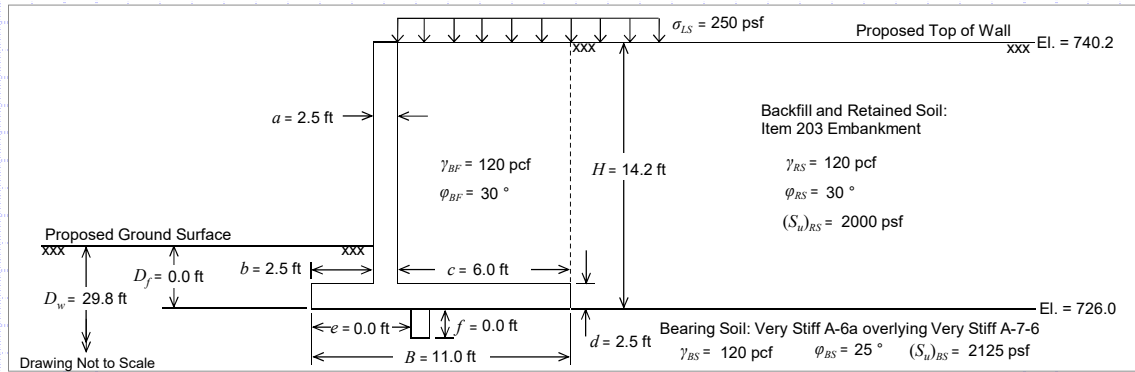
Total Settlement at Minimum Wall Height: (S_t)_{min} = N/A in

Differential Settlement Along Wall Alignment: δ_s = N/A

δ_s < 1/500 → N/A < 1/500



FRA-70-1323C - Forward Abutment Wingwall - Panel 5 - CIP Wall Without Shear Key - Borings B-019-5-19 and B-114-1-13



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 14.2 ft |
| Foundation Width (Entire Base Width), (B) = | 11.0 ft |
| Stem Width, (a) = | 2.5 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 6.0 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D_f) = | 0.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ_LS) = | 250 psf |
| Depth to Groundwater, (D_w) = | 29.8 ft |

Bearing and Retained/Backfill Soil Properties:

| | |
|--|----------|
| Bearing Soil Unit Weight, (γ_BS) = | 120 pcf |
| Bearing Soil Friction Angle, (φ_BS) = | 25° |
| Bearing Soil Undrained Shear Strength, [(s_u)_BS] = | 2125 psf |
| Backfill and Retained Soil Unit Weight, (γ_BF, γ_RS) = | 120 pcf |
| Retained Soil Friction Angle, (φ_RS) = | 30° |
| Retained Soil Undrained Shear Strength, [(s_u)_RS] = | 2000 psf |
| Active Earth Pressure Coefficient, (K_a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K_p) = | 7.410 |

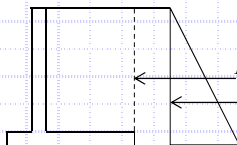
LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 10.6.3.4

Sliding Force:



$$P_H = P_{EH} + P_{LS_h}$$

$$P_{EH} = \frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf}) (14.2 \text{ ft})^2 (0.297) (1.50) = 5.39 \text{ kip/ft}$$

$$P_{LS_h} = \sigma_{LS} H K_a \gamma_{LS} = (250 \text{ psf}) (14.2 \text{ ft}) (0.297) (1.75) = 1.85 \text{ kip/ft}$$

$$P_H = 5.39 \text{ kip/ft} + 1.85 \text{ kip/ft} = 7.24 \text{ kip/ft}$$

Check Sliding Resistance

$$\text{Nominal Sliding Resisting: } R_n = R_\tau + R_{ep}$$

$$R_{ep} = \gamma_{BS} D_f f K_p \gamma_{ep} + \frac{1}{2} \gamma_{BS} f^2 K_p \gamma_{ep}$$

$$R_{ep} = (120 \text{ pcf}) (0.0 \text{ ft}) (0.0 \text{ ft}) (7.41) (0.90) + \frac{1}{2} (120 \text{ pcf}) (0.0 \text{ ft})^2 (7.41) (0.90) = 0.00 \text{ kip/ft}$$

$$\text{Check Drained Condition: } R_\tau = P_V \tan \delta$$

$$P_V = DC_1 + DC_2 + P_{EV} = \gamma_c \cdot [B \cdot d + (H - d) \cdot a] \cdot \gamma_{DC} + \gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV}$$

$$P_V = (150 \text{ pcf}) [(11.0 \text{ ft}) (2.5 \text{ ft}) + (14.2 \text{ ft} - 2.5 \text{ ft}) (2.5 \text{ ft})] (0.90) + (120 \text{ pcf}) (14.2 \text{ ft} - 2.5 \text{ ft}) (6.0 \text{ ft}) (1.00) = 16.09 \text{ kip/ft}$$

$$\tan \delta = \tan \phi_{BS} = \tan(25) = 0.47$$

$$R_\tau = (16.09 \text{ kip/ft}) (0.47) = 7.56 \text{ kip/ft}$$

Verify Sliding Force Less Than Factored Sliding Resistance - Drained Condition

$$P_H \leq \phi_n \cdot R_n \rightarrow P_H \leq \phi_\tau \cdot R_\tau + \phi_{ep} \cdot R_{ep} \rightarrow 7.24 \text{ kip/ft} \leq (7.56 \text{ kip/ft}) (1.00) + (0.00 \text{ kip/ft}) (0.50) = 7.56 \text{ kip/ft}$$

$$= 7.24 \text{ kip/ft} \leq 7.56 \text{ kip/ft}$$

OK

$$\text{Use } \phi_\tau = 1.00 \quad \text{Use } \phi_{ep} = 0.50 \quad (\text{Per AASHTO LRFD BDM Tables 10.5.5.2.2-1 and 11.5.7-1})$$

CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 14.2 ft |
| Foundation Width (Entire Base Width), (B) = | 11.0 ft |
| Stem Width, (a) = | 2.5 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 6.0 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D_f) = | 0.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ_{LS}) = | 250 psf |
| Depth to Groundwater, (D_w) = | 29.8 ft |

Bearing and Retained/Backfill Soil Properties:

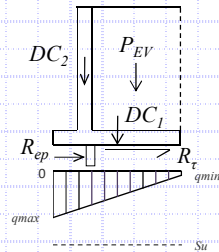
| | |
|---|----------|
| Bearing Soil Unit Weight, (γ_{BS}) = | 120 pcf |
| Bearing Soil Friction Angle, (φ_{BS}) = | 25° |
| Bearing Soil Undrained Shear Strength, $[(s_u)_{BS}]$ = | 2125 psf |
| Backfill and Retained Soil Unit Weight, (γ_{BF} , γ_{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ_{RS}) = | 30° |
| Retained Soil Undrained Shear Strength, $[(s_u)_{RS}]$ = | 2000 psf |
| Active Earth Pressure Coefficient, (K_a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K_p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP | |
|-------------|------|------|------|------|------|--|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 | } (AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure) |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 | |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | |

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 10.6.3.4 (Continued)

Check Undrained Condition: $R_{\tau} = ((S_u)_{BS} \leq q_s) \cdot B$



$$(S_u)_{BS} = 2.13 \text{ ksf}$$

$$q_{max} = 1/2 \sigma_{max} = (2.68 \text{ ksf}) / 2 = 1.34 \text{ ksf}$$

$$q_{min} = 1/2 \sigma_{min} = (0.25 \text{ ksf}) / 2 = 0.13 \text{ ksf}$$

$$\sigma_{max} = P_v / B \left(1 + 6 \frac{e}{B} \right) = (16.09 \text{ kip/ft} / 11.0 \text{ ft}) [1 + 6(1.52 \text{ ft} / 11.0 \text{ ft})] = 2.68 \text{ ksf}$$

$$\sigma_{min} = P_v / B \left(1 - 6 \frac{e}{B} \right) = (16.09 \text{ kip/ft} / 11.0 \text{ ft}) [1 - 6(1.52 \text{ ft} / 11.0 \text{ ft})] = 0.25 \text{ ksf}$$

$$R_r = 0.5(1.34 \text{ ksf} - 0.13 \text{ ksf})(11.0 \text{ ft}) + (0.13 \text{ ksf})(11.0 \text{ ft}) = 8.09 \text{ kip/ft}$$

Verify Sliding Force Less Than Factored Sliding Resistance - Undrained Condition

$$P_H \leq \phi_n \cdot R_n \longrightarrow P_H \leq \phi_r \cdot R_r + \phi_{ep} \cdot R_{ep} \longrightarrow 7.24 \text{ kip/ft} \leq (8.09 \text{ kip/ft})(1.00) + (0.00 \text{ kip/ft})(0.50) = 8.09$$

$$= 7.24 \text{ kip/ft} \leq 8.09 \text{ kip/ft} \quad \text{OK}$$

Use $\varphi_{\tau} = 1.00$ Use $\varphi_{ep} = 0.50$ (Per AASHTO LRFD BDM Tables 10.5.5.2.2-1 and 11.5.7-1)



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 14.2 ft |
| Foundation Width (Entire Base Width), (B) = | 11.0 ft |
| Stem Width, (a) = | 2.5 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 6.0 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 0.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 29.8 ft |

Bearing and Retained/Backfill Soil Properties:

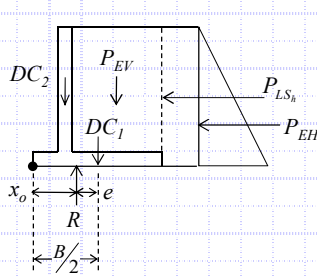
| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 120 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 25 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 2125 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Eccentricity (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.6.3.3



$$e = \frac{B}{2} - x_o$$

$$x_o = \frac{M_V - M_H}{P_V} = \frac{(102.62 \text{ kip-ft/ft} - 38.63 \text{ kip-ft/ft})}{(16.09 \text{ kip/ft})} = 3.98 \text{ ft}$$

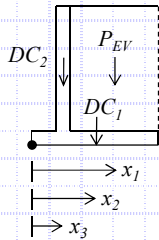
$$M_V = 102.62 \text{ kip-ft/ft}$$

$$M_H = 38.63 \text{ kip-ft/ft}$$

$$P_V = P_{EV} + DC_1 + DC_2 = 8.42 \text{ kip/ft} + 3.71 \text{ kip/ft} + 3.95 \text{ kip/ft} = 16.09 \text{ kip/ft}$$

$$e = \left(\frac{11.0 \text{ ft}}{2} \right) - 3.98 \text{ ft} = 1.52 \text{ ft}$$

Resisting Moment, M_V:



$$M_V = P_{EV}(x_1) + DC_1(x_2) + DC_2(x_3)$$

$$P_{EV} = \gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV} = (120 \text{ pcf})(14.2 \text{ ft} - 2.5 \text{ ft})(6.0 \text{ ft})(1.00) = 8.42 \text{ kip/ft}$$

$$DC_1 = \gamma_c \cdot B \cdot d \cdot \gamma_{DC} = (150 \text{ pcf})(11.0 \text{ ft})(2.5 \text{ ft})(0.90) = 3.71 \text{ kip/ft}$$

$$DC_2 = \gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC} = (150 \text{ pcf})(14.2 \text{ ft} - 2.5 \text{ ft})(2.5 \text{ ft})(0.90) = 3.95 \text{ kip/ft}$$

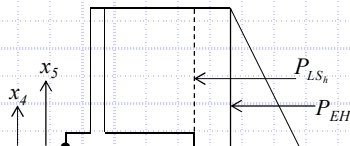
$$x_1 = a + b + \frac{c}{2} = 2.5 \text{ ft} + 2.5 \text{ ft} + (6.0 \text{ ft} / 2) = 8.0 \text{ ft}$$

$$x_2 = \frac{B}{2} = 11.0 \text{ ft} / 2 = 5.5 \text{ ft}$$

$$x_3 = b + \frac{a}{2} = 2.5 \text{ ft} + (2.5 \text{ ft} / 2) = 3.8 \text{ ft}$$

$$M_V = (8.42 \text{ kip/ft})(8.0 \text{ ft}) + (3.71 \text{ kip/ft})(5.5 \text{ ft}) + (3.95 \text{ kip/ft})(3.8 \text{ ft}) = 102.62 \text{ kip-ft/ft}$$

Overturning Moment, M_H:



$$M_H = P_{EH}(x_2) + P_{LS}(x_3)$$

$$P_{EH} = \frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf})(14.2 \text{ ft})^2 (0.297)(1.50) = 5.39 \text{ kip/ft}$$

$$P_{LS} = \sigma_{LS} H K_a \gamma_{LS} = (250 \text{ psf})(14.2 \text{ ft})(0.297)(1.75) = 1.85 \text{ kip/ft}$$

$$x_2 = \frac{H}{3} = (14.2 \text{ ft}) / 3 = 4.73 \text{ ft}$$

$$x_3 = \frac{H}{2} = (14.2 \text{ ft}) / 2 = 7.10 \text{ ft}$$

$$M_H = (5.39 \text{ kip/ft})(4.73 \text{ ft}) + (1.85 \text{ kip/ft})(7.10 \text{ ft}) = 38.63 \text{ kip-ft/ft}$$

Limiting Eccentricity:

$$e_{\max} = \frac{B}{3} \rightarrow e_{\max} = (11.0 \text{ ft}) / 3 = 3.67 \text{ ft}$$

Check Eccentricity

$$e < e_{\max} \rightarrow 1.52 \text{ ft} < 3.67 \text{ ft} \quad \text{OK}$$



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 14.2 ft |
| Foundation Width (Entire Base Width), (B) = | 11.0 ft |
| Stem Width, (a) = | 2.5 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 6.0 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 0.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 29.8 ft |

Bearing and Retained/Backfill Soil Properties:

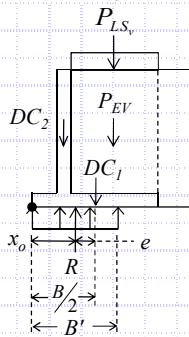
| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 120 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 25° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 2125 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.6.3.2



$$q_{eq} = \frac{P_V}{B'}$$

$$B' = B - 2e = 11.0 \text{ ft} - 2(0.29 \text{ ft}) = 10.42 \text{ ft}$$

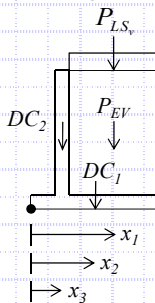
$$e = \frac{B}{2} - x_o = (11.0 \text{ ft} / 2) - 5.21 \text{ ft} = 0.29 \text{ ft}$$

$$x_o = \frac{M_V - M_H}{P_V} = (178.40 \text{ kip-ft} - 38.63 \text{ kip-ft}) / (26.83 \text{ kip/ft}) = 5.21 \text{ ft}$$

$$q_{eq} = (26.83 \text{ kip/ft}) / (10.42 \text{ ft}) = 2.57 \text{ ksf}$$

Resisting Moment, M_V:

$$M_V = P_{EV}(x_1) + P_{LS}(x_1) + DC_1(x_2) + DC_2(x_3)$$



$$P_{EV} = \gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV} = (120 \text{ pcf})(14.2 \text{ ft} - 2.5 \text{ ft})(6.0 \text{ ft})(1.35) = 11.37 \text{ kip/ft}$$

$$P_{LS} = \sigma_{LS} \cdot B \cdot \gamma_{LS} = (250 \text{ psf})(11.0 \text{ ft})(1.75) = 4.813 \text{ kip/ft}$$

$$DC_1 = \gamma_c \cdot B \cdot d \cdot \gamma_{DC} = (150 \text{ pcf})(11.0 \text{ ft})(2.5 \text{ ft})(1.25) = 5.16 \text{ kip/ft}$$

$$DC_2 = \gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC} = (150 \text{ pcf})(14.2 \text{ ft} - 2.5 \text{ ft})(2.5 \text{ ft})(1.25) = 5.48 \text{ kip/ft}$$

$$x_1 = a + b + c/2 = 2.5 \text{ ft} + 2.5 \text{ ft} + (6.0 \text{ ft} / 2) = 8.0 \text{ ft}$$

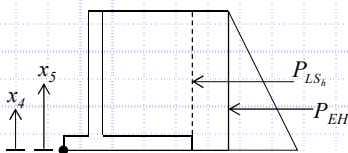
$$x_2 = B/2 = 11.0 \text{ ft} / 2 = 5.5 \text{ ft}$$

$$x_3 = b + a/2 = 2.5 \text{ ft} + (2.5 \text{ ft} / 2) = 3.8 \text{ ft}$$

$$M_V = (11.37 \text{ kip/ft})(8.0 \text{ ft}) + (4.81 \text{ kip/ft})(8.0 \text{ ft}) + (5.16 \text{ kip/ft})(5.5 \text{ ft}) + (5.48 \text{ kip/ft})(3.8 \text{ ft}) = 178.40 \text{ kip-ft/ft}$$

Overturning Moment, M_H:

$$M_H = P_{EH}(x_4) + P_{LS}(x_5)$$



$$P_{EH} = \frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH} = \frac{1}{2}(120 \text{ pcf})(14.2 \text{ ft})^2(0.297)(1.50) = 5.39 \text{ kip/ft}$$

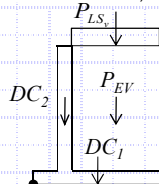
$$P_{LS} = \sigma_{LS} H K_a \gamma_{LS} = (250 \text{ psf})(14.2 \text{ ft})(0.297)(1.75) = 1.85 \text{ kip/ft}$$

$$x_4 = H/3 = (14.2 \text{ ft}) / 3 = 4.73 \text{ ft}$$

$$x_5 = H/2 = (14.2 \text{ ft}) / 2 = 7.10 \text{ ft}$$

$$M_H = (5.39 \text{ kip/ft})(4.73 \text{ ft}) + (1.85 \text{ kip/ft})(7.10 \text{ ft}) = 38.63 \text{ kip-ft/ft}$$

Vertical Force, P_V:



$$P_V = P_{EV} + P_{LS} + DC_1 + DC_2$$

$$P_V = 11.37 \text{ kip/ft} + 4.81 \text{ kip/ft} + 5.16 \text{ kip/ft} + 5.48 \text{ kip/ft}$$

$$P_V = 26.83 \text{ kip/ft}$$



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 14.2 ft |
| Foundation Width (Entire Base Width), (B) = | 11.0 ft |
| Stem Width, (a) = | 2.5 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 6.0 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 0.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 29.8 ft |

Bearing and Retained/Backfill Soil Properties:

| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 120 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 25 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 2125 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.6.3.2 (Continued)

Check Bearing Resistance - Drained Condition

$$\text{Nominal Bearing Resistance: } q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \frac{1}{2} \gamma B' N_{\gamma m} C_{w\gamma}$$

$$N_{cm} = N_c s_c i_c = 21.612$$

$$N_{qm} = N_q s_q d_q i_q = 11.078$$

$$N_{\gamma m} = N_{\gamma} s_{\gamma} i_{\gamma} = 10.506$$

$$N_c = 20.721$$

$$s_c = 1 + (10.42 \text{ ft} / 124 \text{ ft}) (10.662 / 20.721)$$

$$= 1.043$$

$$i_c = 1.000 \text{ (Assumed)}$$

$$N_q = 10.662$$

$$s_q = 1 + (10.42 \text{ ft} / 124 \text{ ft}) \tan(25^\circ) = 1.039$$

$$d_q = 1 + 2 \tan(25^\circ) [1 - \sin(25^\circ)]^2 \tan^{-1} (0.0 \text{ ft} / 10.42 \text{ ft})$$

$$= 1.000$$

$$i_q = 1.000 \text{ (Assumed)}$$

$$C_{wq} = 29.8 \text{ ft} > 0.0 \text{ ft} = 1.000$$

$$N_{\gamma} = 10.876$$

$$s_{\gamma} = 1 - 0.4 (10.42 \text{ ft} / 124 \text{ ft}) = 0.966$$

$$i_{\gamma} = 1.000 \text{ (Assumed)}$$

$$C_{w\gamma} = 29.8 \text{ ft} > 1.5 (10.42 \text{ ft}) + 0.0 \text{ ft} = 1.000$$

$$q_n = (0 \text{ psf})(21.612) + (120 \text{ pcf})(0.0 \text{ ft})(11.078)(1.000) + \frac{1}{2} (120 \text{ pcf})(10.4 \text{ ft})(10.506)(1.000) = 6.57 \text{ ksf}$$

Verify Equivalent Pressure Less Than Factored Bearing Resistance

$$q_{eq} \leq q_n \cdot \phi_b \rightarrow 2.57 \text{ ksf} \leq (6.57 \text{ ksf})(0.55) = 3.61 \text{ ksf} \rightarrow 2.57 \text{ ksf} \leq 3.61 \text{ ksf} \quad \text{OK}$$

$$\text{Use } \phi_b = 0.55 \text{ (Per AASHTO LRFD BDM Table 11.5.7-1)}$$

Check Bearing Resistance - Undrained Condition

$$\text{Nominal Bearing Resistance: } q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \frac{1}{2} \gamma B' N_{\gamma m} C_{w\gamma}$$

$$N_{cm} = N_c s_c i_c = 5.361$$

$$N_{qm} = N_q s_q d_q i_q = 1.000$$

$$N_{\gamma m} = N_{\gamma} s_{\gamma} i_{\gamma} = 0.000$$

$$N_c = 5.140$$

$$s_c = 1 + (10.42 \text{ ft} / [(5)(124 \text{ ft})]) = 1.043$$

$$i_c = 1.000 \text{ (Assumed)}$$

$$N_q = 1.000$$

$$s_q = 1.000$$

$$d_q = 1 + 2 \tan(0^\circ) [1 - \sin(0^\circ)]^2 \tan^{-1} (0.0 \text{ ft} / 10.42 \text{ ft})$$

$$= 1.000$$

$$i_q = 1.000 \text{ (Assumed)}$$

$$C_{wq} = 29.8 \text{ ft} > 0.0 \text{ ft} = 1.000$$

$$N_{\gamma} = 0.000$$

$$s_{\gamma} = 1.000$$

$$i_{\gamma} = 1.000 \text{ (Assumed)}$$

$$C_{w\gamma} = 29.8 \text{ ft} > 1.5 (10.42 \text{ ft}) + 0.0 \text{ ft} = 1.000$$

$$q_n = (2125 \text{ psf})(5.361) + (120 \text{ pcf})(0.0 \text{ ft})(1.000)(1.000) + \frac{1}{2} (120 \text{ pcf})(10.4 \text{ ft})(0.000)(1.000) = 11.39 \text{ ksf}$$

Verify Equivalent Pressure Less Than Factored Bearing Resistance

$$q_{eq} \leq q_n \cdot \phi_b \rightarrow 2.57 \text{ ksf} \leq (11.39 \text{ ksf})(0.55) = 6.26 \text{ ksf} \rightarrow 2.57 \text{ ksf} \leq 6.26 \text{ ksf} \quad \text{OK}$$

$$\text{Use } \phi_b = 0.55 \text{ (Per AASHTO LRFD BDM Table 11.5.7-1)}$$



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 14.2 ft |
| Foundation Width (Entire Base Width), (B) = | 11.0 ft |
| Stem Width, (a) = | 2.5 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 6.0 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 0.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 29.8 ft |

Bearing and Retained/Backfill Soil Properties:

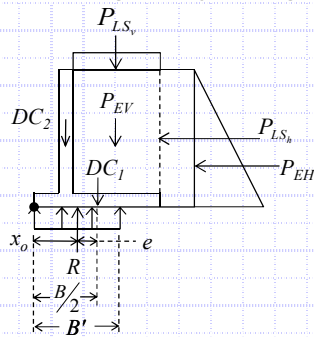
| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 120 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 25 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 2125 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.6.3.2



$$q_{eq} = \frac{P_v}{B'}$$

$$B' = B - 2e = 11.0 \text{ ft} - 2(0.22 \text{ ft}) = 10.56 \text{ ft}$$

$$e = \frac{B}{2} - x_o = (11.0 \text{ ft} / 2) - 5.28 \text{ ft} = 0.22 \text{ ft}$$

$$x_o = \frac{M_v - M_H}{P_v} = (128.53 \text{ kip-ft/ft} - 24.49 \text{ kip-ft/ft}) / (19.69 \text{ kip/ft}) = 5.28 \text{ ft}$$

$$q_{eq} = (19.69 \text{ kip/ft}) / (10.56 \text{ ft}) = 1.86 \text{ ksf}$$

$$M_v = [(\gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV}) + (\sigma_{LS} \cdot B \cdot \gamma_{LS})] \left(a + b + \frac{c}{2} \right) + (\gamma_c \cdot B \cdot d \cdot \gamma_{DC}) \left(\frac{B}{2} \right) + (\gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC}) \left(b + \frac{a}{2} \right)$$

$$M_v = [(120 \text{ pcf})(14.2 \text{ ft} - 2.5 \text{ ft})(6.0 \text{ ft})(1.00) + (250 \text{ psf})(11.0 \text{ ft})(1.00)](2.5 \text{ ft} + 2.5 \text{ ft} + (6.0 \text{ ft} / 2)) + [(150 \text{ pcf})(11.0 \text{ ft})(2.5 \text{ ft})(1.00)](11.0 \text{ ft} / 2) + [(150 \text{ pcf})(14.2 \text{ ft} - 2.5 \text{ ft})(2.5 \text{ ft})(1.00)](2.5 \text{ ft} + (2.5 \text{ ft} / 2)) = 128.53 \text{ kip-ft/ft}$$

$$M_H = \left(\frac{1}{2} \gamma_{RS} \cdot H^2 \cdot K_a \cdot \gamma_{EH} \right) \left(\frac{H}{3} \right) + (\sigma_{LS} \cdot H \cdot K_a \cdot \gamma_{LS}) \left(\frac{H}{2} \right)$$

$$M_H = \left[\frac{1}{2} (120 \text{ pcf})(14.2 \text{ ft})^2 (0.297)(1.00) \right] (14.2 \text{ ft} / 3) + [(250 \text{ psf})(14.2 \text{ ft})(0.297)(1.00)] (14.2 \text{ ft} / 2) = 24.49 \text{ kip-ft/ft}$$

$$P_v = (\gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV}) + (\sigma_{LS} \cdot B \cdot \gamma_{LS}) + (\gamma_c \cdot B \cdot d \cdot \gamma_{DC}) + (\gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC})$$

$$P_v = (120 \text{ pcf})(14.2 \text{ ft} - 2.5 \text{ ft})(6.0 \text{ ft})(1.00) + (250 \text{ psf})(11.0 \text{ ft})(1.00) + (150 \text{ pcf})(11.0 \text{ ft})(2.5 \text{ ft})(1.00) + (150 \text{ pcf})(14.2 \text{ ft} - 2.5 \text{ ft})(2.5 \text{ ft})(1.00) = 19.69 \text{ kip/ft}$$

Settlement (See Attached Spreadsheet Calculations):

Total Settlement at Maximum Wall Height: (S_t)_{max} = N/A in

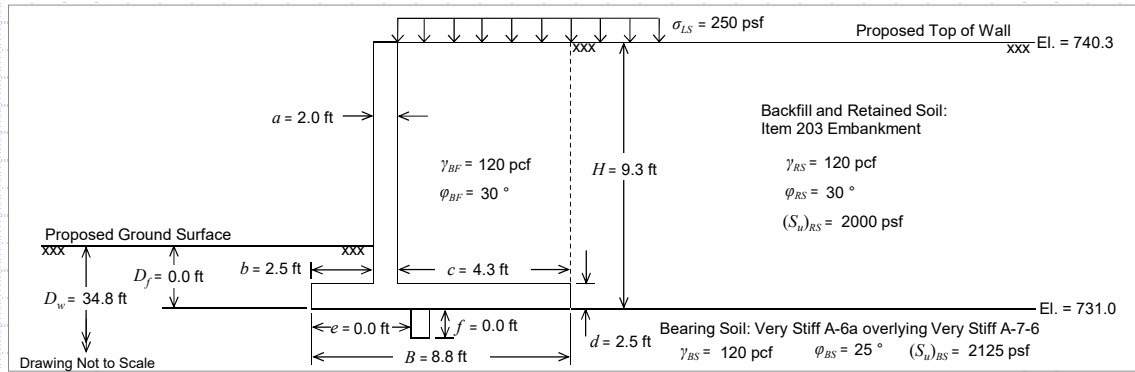
Total Settlement at Minimum Wall Height: (S_t)_{min} = N/A in

Differential Settlement Along Wall Alignment: δ_s = N/A

δ_s < 1/500 → N/A < 1/500



FRA-70-1323C - Forward Abutment Wingwall - Panel 6 - CIP Wall Without Shear Key - Borings B-019-5-19 and B-114-1-13



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 9.3 ft |
| Foundation Width (Entire Base Width), (B) = | 8.8 ft |
| Stem Width, (a) = | 2.0 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 4.3 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 0.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 34.8 ft |

Bearing and Retained/Backfill Soil Properties:

| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 120 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 25° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 2125 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

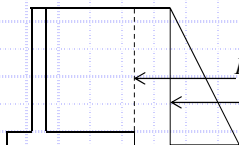
LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 10.6.3.4

Sliding Force:



$$P_H = P_{EH} + P_{LS_h}$$

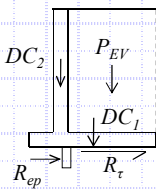
$$P_{EH} = \frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf}) (9.3 \text{ ft})^2 (0.297) (1.50) = 2.31 \text{ kip/ft}$$

$$P_{LS_h} = \sigma_{LS} H K_a \gamma_{LS} = (250 \text{ psf}) (9.3 \text{ ft}) (0.297) (1.75) = 1.21 \text{ kip/ft}$$

$$P_H = 2.31 \text{ kip/ft} + 1.21 \text{ kip/ft} = 3.52 \text{ kip/ft}$$

Check Sliding Resistance

Nominal Sliding Resisting: $R_n = R_\tau + R_{ep}$



$$R_{ep} = \gamma_{BS} D_f J K_p \gamma_{ep} + \frac{1}{2} \gamma_{BS} f^2 K_p \gamma_{ep}$$

$$R_{ep} = (120 \text{ pcf}) (0.0 \text{ ft}) (0.0 \text{ ft}) (7.41) (0.90) + \frac{1}{2} (120 \text{ pcf}) (0.0 \text{ ft})^2 (7.41) (0.90) = 0.00 \text{ kip/ft}$$

Check Drained Condition: $R_\tau = P_V \tan \delta$

$$P_V = DC_1 + DC_2 + P_{EV} = \gamma_c \cdot [B \cdot d + (H - d) \cdot a] \cdot \gamma_{DC} + \gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV}$$

$$P_V = (150 \text{ pcf}) [(8.8 \text{ ft}) (2.5 \text{ ft}) + (9.3 \text{ ft} - 2.5 \text{ ft}) (2.0 \text{ ft})] (0.90) + (120 \text{ pcf}) (9.3 \text{ ft} - 2.5 \text{ ft}) (4.3 \text{ ft}) (1.00) = 8.31 \text{ kip/ft}$$

$$\tan \delta = \tan \phi_{BS} = \tan(25) = 0.47$$

$$R_\tau = (8.31 \text{ kip/ft}) (0.47) = 3.91 \text{ kip/ft}$$

Verify Sliding Force Less Than Factored Sliding Resistance - Drained Condition

$$P_H \leq \phi_n \cdot R_n \rightarrow P_H \leq \phi_\tau \cdot R_\tau + \phi_{ep} \cdot R_{ep} \rightarrow 3.52 \text{ kip/ft} \leq (3.91 \text{ kip/ft}) (1.00) + (0.00 \text{ kip/ft}) (0.50) = 3.91 \text{ kip/ft}$$

$$= 3.52 \text{ kip/ft} \leq 3.91 \text{ kip/ft}$$

OK

Use $\phi_\tau = 1.00$ Use $\phi_{ep} = 0.50$ (Per AASHTO LRFD BDM Tables 10.5.5.2.2-1 and 11.5.7-1)



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 9.3 ft |
| Foundation Width (Entire Base Width), (B) = | 8.8 ft |
| Stem Width, (a) = | 2.0 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 4.3 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 0.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 34.8 ft |

Bearing and Retained/Backfill Soil Properties:

| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 120 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 25 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 2125 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

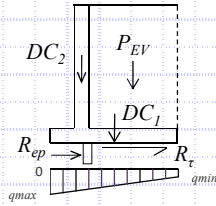
LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 10.6.3.4 (Continued)

Check Undrained Condition: $R_{\tau} = ((s_u)_{BS} \leq q_s) \cdot B$



$$(s_u)_{BS} = 2.13 \text{ ksf}$$

$$q_{max} = \frac{1}{2} \sigma_{max} = (1.45 \text{ ksf}) / 2 = 0.73 \text{ ksf}$$

$$q_{min} = \frac{1}{2} \sigma_{min} = (0.44 \text{ ksf}) / 2 = 0.22 \text{ ksf}$$

$$\sigma_{max} = \frac{P_v}{B} \left(1 + 6 \frac{e}{B} \right) = (8.31 \text{ kip/ft} / 8.8 \text{ ft}) [1 + 6(0.79 \text{ ft} / 8.8 \text{ ft})] = 1.45 \text{ ksf}$$

$$\sigma_{min} = \frac{P_v}{B} \left(1 - 6 \frac{e}{B} \right) = (8.31 \text{ kip/ft} / 8.8 \text{ ft}) [1 - 6(0.79 \text{ ft} / 8.8 \text{ ft})] = 0.44 \text{ ksf}$$

$$R_{\tau} = 0.5(0.73 \text{ ksf} - 0.22 \text{ ksf})(8.8 \text{ ft}) + (0.22 \text{ ksf})(8.8 \text{ ft}) = 4.18 \text{ kip/ft}$$

Verify Sliding Force Less Than Factored Sliding Resistance - Undrained Condition

$$P_H \leq \phi_n \cdot R_n \rightarrow P_H \leq \phi_{\tau} \cdot R_{\tau} + \phi_{ep} \cdot R_{ep} \rightarrow 3.52 \text{ kip/ft} \leq (4.18 \text{ kip/ft})(1.00) + (0.00 \text{ kip/ft})(0.50) = 4.18$$

$$= 3.52 \text{ kip/ft} \leq 4.18 \text{ kip/ft} \quad \text{OK}$$

$$\text{Use } \phi_{\tau} = 1.00 \quad \text{Use } \phi_{ep} = 0.50 \quad (\text{Per AASHTO LRFD BDM Tables 10.5.5.2.2-1 and 11.5.7-1})$$



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 9.3 ft |
| Foundation Width (Entire Base Width), (B) = | 8.8 ft |
| Stem Width, (a) = | 2.0 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 4.3 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 0.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 34.8 ft |

Bearing and Retained/Backfill Soil Properties:

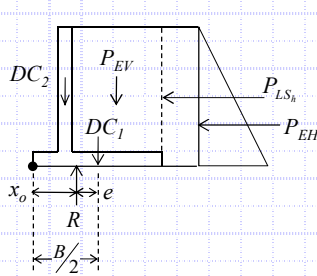
| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 120 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 25 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 2125 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Eccentricity (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.6.3.3



$$e = \frac{B}{2} - x_o$$

$$x_o = \frac{M_V - M_H}{P_V} = \frac{(42.83 \text{ kip-ft/ft} - 12.79 \text{ kip-ft/ft})}{(8.31 \text{ kip/ft})} = 3.61 \text{ ft}$$

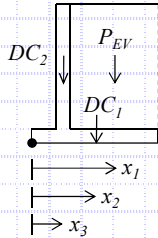
$$M_V = 42.83 \text{ kip-ft/ft}$$

$$M_H = 12.79 \text{ kip-ft/ft}$$

$$P_V = P_{EV} + DC_1 + DC_2 = 3.51 \text{ kip/ft} + 2.97 \text{ kip/ft} + 1.84 \text{ kip/ft} = 8.31 \text{ kip/ft}$$

$$e = (8.8 \text{ ft} / 2) - 3.61 \text{ ft} = 0.79 \text{ ft}$$

Resisting Moment, M_V:



$$M_V = P_{EV}(x_1) + DC_1(x_2) + DC_2(x_3)$$

$$P_{EV} = \gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV} = (120 \text{ pcf})(9.3 \text{ ft} - 2.5 \text{ ft})(4.3 \text{ ft})(1.00) = 3.51 \text{ kip/ft}$$

$$DC_1 = \gamma_c \cdot B \cdot d \cdot \gamma_{DC} = (150 \text{ pcf})(8.8 \text{ ft})(2.5 \text{ ft})(0.90) = 2.97 \text{ kip/ft}$$

$$DC_2 = \gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC} = (150 \text{ pcf})(9.3 \text{ ft} - 2.5 \text{ ft})(2.0 \text{ ft})(0.90) = 1.84 \text{ kip/ft}$$

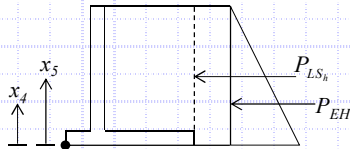
$$x_1 = a + b + \frac{c}{2} = 2.0 \text{ ft} + 2.5 \text{ ft} + (4.3 \text{ ft} / 2) = 6.7 \text{ ft}$$

$$x_2 = \frac{B}{2} = 8.8 \text{ ft} / 2 = 4.4 \text{ ft}$$

$$x_3 = b + \frac{a}{2} = 2.5 \text{ ft} + (2.0 \text{ ft} / 2) = 3.5 \text{ ft}$$

$$M_V = (3.51 \text{ kip/ft})(6.7 \text{ ft}) + (2.97 \text{ kip/ft})(4.4 \text{ ft}) + (1.84 \text{ kip/ft})(3.5 \text{ ft}) = 42.83 \text{ kip-ft/ft}$$

Overturning Moment, M_H:



$$M_H = P_{EH}(x_2) + P_{LS_h}(x_3)$$

$$P_{EH} = \frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf})(9.3 \text{ ft})^2 (0.297)(1.50) = 2.31 \text{ kip/ft}$$

$$P_{LS_h} = \sigma_{LS} H K_a \gamma_{LS} = (250 \text{ psf})(9.3 \text{ ft})(0.297)(1.75) = 1.21 \text{ kip/ft}$$

$$x_2 = \frac{H}{3} = (9.3 \text{ ft}) / 3 = 3.10 \text{ ft}$$

$$x_3 = \frac{H}{2} = (9.3 \text{ ft}) / 2 = 4.65 \text{ ft}$$

$$M_H = (2.31 \text{ kip/ft})(3.1 \text{ ft}) + (1.21 \text{ kip/ft})(4.65 \text{ ft}) = 12.79 \text{ kip-ft/ft}$$

Limiting Eccentricity:

$$e_{\max} = \frac{B}{3} \rightarrow e_{\max} = (8.8 \text{ ft}) / 3 = 2.93 \text{ ft}$$

Check Eccentricity

$$e < e_{\max} \rightarrow 0.79 \text{ ft} < 2.93 \text{ ft} \quad \text{OK}$$



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 9.3 ft |
| Foundation Width (Entire Base Width), (B) = | 8.8 ft |
| Stem Width, (a) = | 2.0 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 4.3 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 0.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 34.8 ft |

Bearing and Retained/Backfill Soil Properties:

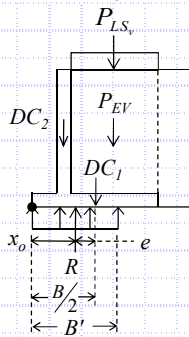
| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 120 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 25° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 2125 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.6.3.2



$$q_{eq} = \frac{P_V}{B'}$$

$$B' = B - 2e = 8.8 \text{ ft} - 2(-0.28 \text{ ft}) = 9.36 \text{ ft}$$

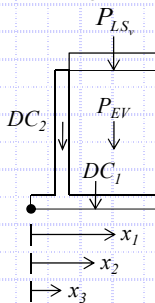
$$e = \frac{B}{2} - x_o = (8.8 \text{ ft} / 2) - 4.68 \text{ ft} = -0.28 \text{ ft}$$

$$x_o = \frac{M_V - M_H}{P_V} = (84.18 \text{ kip-ft/ft} - 12.79 \text{ kip-ft/ft}) / (15.26 \text{ kip/ft}) = 4.68 \text{ ft}$$

$$q_{eq} = (15.26 \text{ kip/ft}) / (9.36 \text{ ft}) = 1.63 \text{ ksf}$$

Resisting Moment, M_V:

$$M_V = P_{EV}(x_1) + P_{LS_v}(x_1) + DC_1(x_2) + DC_2(x_3)$$



$$P_{EV} = \gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV} = (120 \text{ pcf})(9.3 \text{ ft} - 2.5 \text{ ft})(4.3 \text{ ft})(1.35) = 4.74 \text{ kip/ft}$$

$$P_{LS_v} = \sigma_{LS} \cdot B \cdot \gamma_{LS} = (250 \text{ psf})(8.8 \text{ ft})(1.75) = 3.85 \text{ kip/ft}$$

$$DC_1 = \gamma_c \cdot B \cdot d \cdot \gamma_{DC} = (150 \text{ pcf})(8.8 \text{ ft})(2.5 \text{ ft})(1.25) = 4.13 \text{ kip/ft}$$

$$DC_2 = \gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC} = (150 \text{ pcf})(9.3 \text{ ft} - 2.5 \text{ ft})(2.0 \text{ ft})(1.25) = 2.55 \text{ kip/ft}$$

$$x_1 = a + b + c/2 = 2.0 \text{ ft} + 2.5 \text{ ft} + (4.3 \text{ ft} / 2) = 6.7 \text{ ft}$$

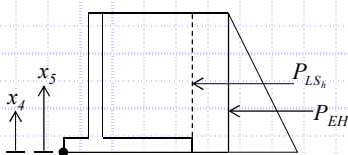
$$x_2 = B/2 = 8.8 \text{ ft} / 2 = 4.4 \text{ ft}$$

$$x_3 = b + a/2 = 2.5 \text{ ft} + (2.0 \text{ ft} / 2) = 3.5 \text{ ft}$$

$$M_V = (4.74 \text{ kip/ft})(6.7 \text{ ft}) + (3.85 \text{ kip/ft})(6.7 \text{ ft}) + (4.13 \text{ kip/ft})(4.4 \text{ ft}) + (2.55 \text{ kip/ft})(3.5 \text{ ft}) = 84.18 \text{ kip-ft/ft}$$

Overturning Moment, M_H:

$$M_H = P_{EH}(x_4) + P_{LS_h}(x_5)$$



$$P_{EH} = \frac{1}{2} \gamma_{RS} H^2 K_a \gamma_{EH} = \frac{1}{2} (120 \text{ pcf})(9.3 \text{ ft})^2 (0.297)(1.50) = 2.31 \text{ kip/ft}$$

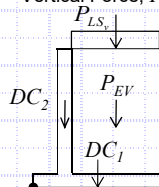
$$P_{LS_h} = \sigma_{LS} H K_a \gamma_{LS} = (250 \text{ psf})(9.3 \text{ ft})(0.297)(1.75) = 1.21 \text{ kip/ft}$$

$$x_4 = H/3 = (9.3 \text{ ft}) / 3 = 3.10 \text{ ft}$$

$$x_5 = H/2 = (9.3 \text{ ft}) / 2 = 4.65 \text{ ft}$$

$$M_H = (2.31 \text{ kip/ft})(3.1 \text{ ft}) + (1.21 \text{ kip/ft})(4.65 \text{ ft}) = 12.79 \text{ kip-ft/ft}$$

Vertical Force, P_V:



$$P_V = P_{EV} + P_{LS_v} + DC_1 + DC_2$$

$$P_V = 4.74 \text{ kip/ft} + 3.85 \text{ kip/ft} + 4.13 \text{ kip/ft} + 2.55 \text{ kip/ft}$$

$$P_V = 15.26 \text{ kip/ft}$$



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 9.3 ft |
| Foundation Width (Entire Base Width), (B) = | 8.8 ft |
| Stem Width, (a) = | 2.0 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 4.3 ft |
| Footings Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 0.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 34.8 ft |

Bearing and Retained/Backfill Soil Properties:

| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 120 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 25 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 2125 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.6.3.2 (Continued)

Check Bearing Resistance - Drained Condition

$$\text{Nominal Bearing Resistance: } q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \frac{1}{2} \gamma B' N_{\gamma m} C_{w\gamma}$$

$$N_{cm} = N_c s_c i_c = 21.529$$

$$N_{qm} = N_q s_q d_q i_q = 11.035$$

$$N_{\gamma m} = N_{\gamma} s_{\gamma} i_{\gamma} = 10.550$$

$$N_c = 20.721$$

$$s_c = 1 + (9.36 \text{ ft} / 124 \text{ ft}) (10.662 / 20.721)$$

$$= 1.039$$

$$i_c = 1.000 \text{ (Assumed)}$$

$$N_q = 10.662$$

$$s_q = 1 + (9.36 \text{ ft} / 124 \text{ ft}) \tan(25^\circ) = 1.035$$

$$d_q = 1 + 2 \tan(25^\circ) [1 - \sin(25^\circ)]^2 \tan^{-1} (0.0 \text{ ft} / 9.36 \text{ ft})$$

$$= 1.000$$

$$i_q = 1.000 \text{ (Assumed)}$$

$$C_{wq} = 34.8 \text{ ft} > 0.0 \text{ ft} = 1.000$$

$$N_{\gamma} = 10.876$$

$$s_{\gamma} = 1 - 0.4 (9.36 \text{ ft} / 124 \text{ ft}) = 0.970$$

$$i_{\gamma} = 1.000 \text{ (Assumed)}$$

$$C_{w\gamma} = 34.8 \text{ ft} > 1.5 (9.36 \text{ ft}) + 0.0 \text{ ft} = 1.000$$

$$q_n = (0 \text{ psf})(21.529) + (120 \text{ pcf})(0.0 \text{ ft})(11.035)(1.000) + \frac{1}{2} (120 \text{ pcf})(9.4 \text{ ft})(10.550)(1.000) = 5.92 \text{ ksf}$$

Verify Equivalent Pressure Less Than Factored Bearing Resistance

$$q_{eq} \leq q_n \cdot \phi_b \rightarrow 1.63 \text{ ksf} \leq (5.92 \text{ ksf})(0.55) = 3.26 \text{ ksf} \rightarrow 1.63 \text{ ksf} \leq 3.26 \text{ ksf} \quad \text{OK}$$

$$\text{Use } \phi_b = 0.55 \text{ (Per AASHTO LRFD BDM Table 11.5.7-1)}$$

Check Bearing Resistance - Undrained Condition

$$\text{Nominal Bearing Resistance: } q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \frac{1}{2} \gamma B' N_{\gamma m} C_{w\gamma}$$

$$N_{cm} = N_c s_c i_c = 5.340$$

$$N_{qm} = N_q s_q d_q i_q = 1.000$$

$$N_{\gamma m} = N_{\gamma} s_{\gamma} i_{\gamma} = 0.000$$

$$N_c = 5.140$$

$$s_c = 1 + (9.36 \text{ ft} / [(5)(124 \text{ ft})]) = 1.039$$

$$i_c = 1.000 \text{ (Assumed)}$$

$$N_q = 1.000$$

$$s_q = 1.000$$

$$d_q = 1 + 2 \tan(0^\circ) [1 - \sin(0^\circ)]^2 \tan^{-1} (0.0 \text{ ft} / 9.36 \text{ ft})$$

$$= 1.000$$

$$i_q = 1.000 \text{ (Assumed)}$$

$$C_{wq} = 34.8 \text{ ft} > 0.0 \text{ ft} = 1.000$$

$$N_{\gamma} = 0.000$$

$$s_{\gamma} = 1.000$$

$$i_{\gamma} = 1.000 \text{ (Assumed)}$$

$$C_{w\gamma} = 34.8 \text{ ft} > 1.5 (9.36 \text{ ft}) + 0.0 \text{ ft} = 1.000$$

$$q_n = (2125 \text{ psf})(5.340) + (120 \text{ pcf})(0.0 \text{ ft})(1.000)(1.000) + \frac{1}{2} (120 \text{ pcf})(9.4 \text{ ft})(0.000)(1.000) = 11.35 \text{ ksf}$$

Verify Equivalent Pressure Less Than Factored Bearing Resistance

$$q_{eq} \leq q_n \cdot \phi_b \rightarrow 1.63 \text{ ksf} \leq (11.35 \text{ ksf})(0.55) = 6.24 \text{ ksf} \rightarrow 1.63 \text{ ksf} \leq 6.24 \text{ ksf} \quad \text{OK}$$

$$\text{Use } \phi_b = 0.55 \text{ (Per AASHTO LRFD BDM Table 11.5.7-1)}$$



CIP Wall Dimensions and Surcharge Loading

| | |
|---|---------|
| Wall Height, (H) = | 9.3 ft |
| Foundation Width (Entire Base Width), (B) = | 8.8 ft |
| Stem Width, (a) = | 2.0 ft |
| Toe Width, (b) = | 2.5 ft |
| Heel Width, (c) = | 4.3 ft |
| Footing Thickness, (d) = | 2.5 ft |
| Location of Shear Key, (e) = | 0.0 ft |
| Depth of Shear Key, (f) = | 0.0 ft |
| Embedment Depth, (D _f) = | 0.0 ft |
| Wall Length, (L) = | 124 ft |
| Live Surcharge Load, (σ _{LS}) = | 250 psf |
| Depth to Groundwater, (D _w) = | 34.8 ft |

Bearing and Retained/Backfill Soil Properties:

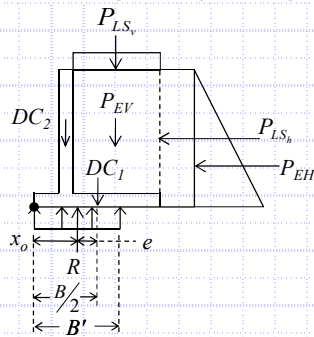
| | |
|--|----------|
| Bearing Soil Unit Weight, (γ _{BS}) = | 120 pcf |
| Bearing Soil Friction Angle, (φ _{BS}) = | 25 ° |
| Bearing Soil Undrained Shear Strength, [(s _u) _{BS}] = | 2125 psf |
| Backfill and Retained Soil Unit Weight, (γ _{BF} , γ _{RS}) = | 120 pcf |
| Retained Soil Friction Angle, (φ _{RS}) = | 30 ° |
| Retained Soil Undrained Shear Strength, [(s _u) _{RS}] = | 2000 psf |
| Active Earth Pressure Coefficient, (K _a) = | 0.297 |
| Passive Earth Pressure Coefficient, (K _p) = | 7.410 |

LRFD Load Factors

| | DC | EV | EH | LS | EP |
|-------------|------|------|------|------|------|
| Strength Ia | 0.90 | 1.00 | 1.50 | 1.75 | 0.90 |
| Strength Ib | 1.25 | 1.35 | 1.50 | 1.75 | 0.90 |
| Service I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.6.3.2



$$q_{eq} = P_V / B'$$

$$B' = B - 2e = 8.8 \text{ ft} - 2(-0.27 \text{ ft}) = 9.34 \text{ ft}$$

$$e = B/2 - x_o = (8.8 \text{ ft} / 2) - 4.67 \text{ ft} = -0.27 \text{ ft}$$

$$x_o = \frac{M_V - M_H}{P_V} = (59.62 \text{ kip-ft/ft} - 7.99 \text{ kip-ft/ft}) / (11.05 \text{ kip/ft}) = 4.67 \text{ ft}$$

$$q_{eq} = (11.05 \text{ kip/ft}) / (9.34 \text{ ft}) = 1.18 \text{ ksf}$$

$$M_V = [(\gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV}) + (\sigma_{LS} \cdot B \cdot \gamma_{LS})] \left(a + b + \frac{c}{2} \right) + (\gamma_c \cdot B \cdot d \cdot \gamma_{DC}) \left(\frac{B}{2} \right) + (\gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC}) \left(b + \frac{a}{2} \right)$$

$$M_V = [(120 \text{ pcf})(9.3 \text{ ft} - 2.5 \text{ ft})(4.3 \text{ ft})(1.00) + (250 \text{ psf})(8.8 \text{ ft})(1.00)](2.0 \text{ ft} + 2.5 \text{ ft} + (4.3 \text{ ft} / 2)) + [(150 \text{ pcf})(8.8 \text{ ft})(2.5 \text{ ft})(1.00)](8.8 \text{ ft} / 2) + [(150 \text{ pcf})(9.3 \text{ ft} - 2.5 \text{ ft})(2.0 \text{ ft})(1.00)](2.5 \text{ ft} + (2.0 \text{ ft} / 2)) = 59.62 \text{ kip-ft/ft}$$

$$M_H = \left(\frac{1}{2} \gamma_{RS} \cdot H^2 \cdot K_a \cdot \gamma_{EH} \right) \left(\frac{H}{3} \right) + (\sigma_{LS} \cdot H \cdot K_a \cdot \gamma_{LS}) \left(\frac{H}{2} \right)$$

$$M_H = \left[\frac{1}{2} (120 \text{ pcf})(9.3 \text{ ft})^2 (0.297)(1.00) \right] (9.3 \text{ ft} / 3) + [(250 \text{ psf})(9.3 \text{ ft})(0.297)(1.00)] (9.3 \text{ ft} / 2) = 7.99 \text{ kip-ft/ft}$$

$$P_V = (\gamma_{BF} \cdot (H - d) \cdot c \cdot \gamma_{EV}) + (\sigma_{LS} \cdot B \cdot \gamma_{LS}) + (\gamma_c \cdot B \cdot d \cdot \gamma_{DC}) + (\gamma_c \cdot (H - d) \cdot a \cdot \gamma_{DC})$$

$$P_V = (120 \text{ pcf})(9.3 \text{ ft} - 2.5 \text{ ft})(4.3 \text{ ft})(1.00) + (250 \text{ psf})(8.8 \text{ ft})(1.00) + (150 \text{ pcf})(8.8 \text{ ft})(2.5 \text{ ft})(1.00) + (150 \text{ pcf})(9.3 \text{ ft} - 2.5 \text{ ft})(2.0 \text{ ft})(1.00) = 11.05 \text{ kip/ft}$$

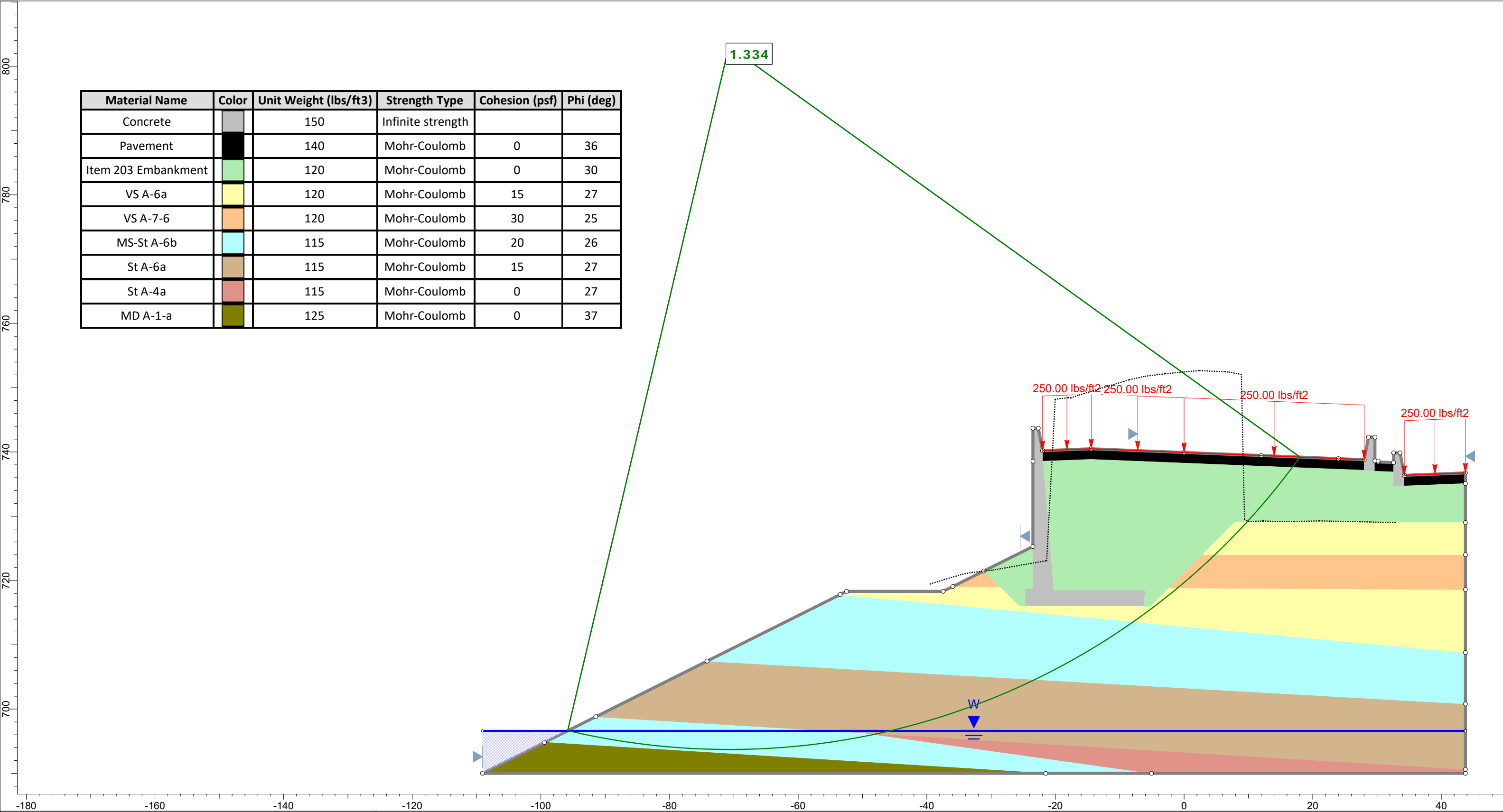
Settlement (See Attached Spreadsheet Calculations):

$$\text{Total Settlement at Maximum Wall Height: } (S_t)_{\max} = \text{N/A in}$$

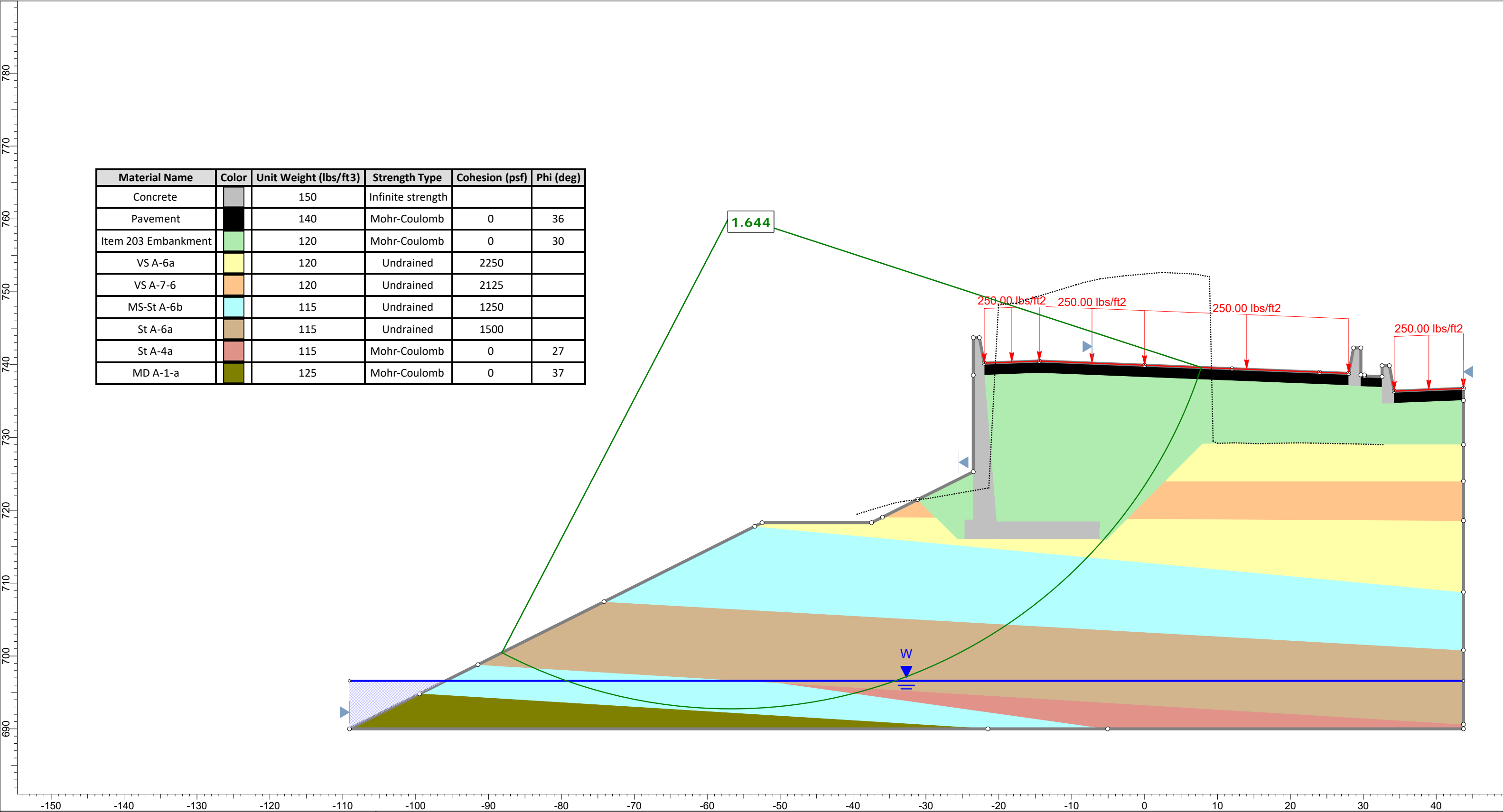
$$\text{Total Settlement at Minimum Wall Height: } (S_t)_{\min} = \text{N/A in}$$

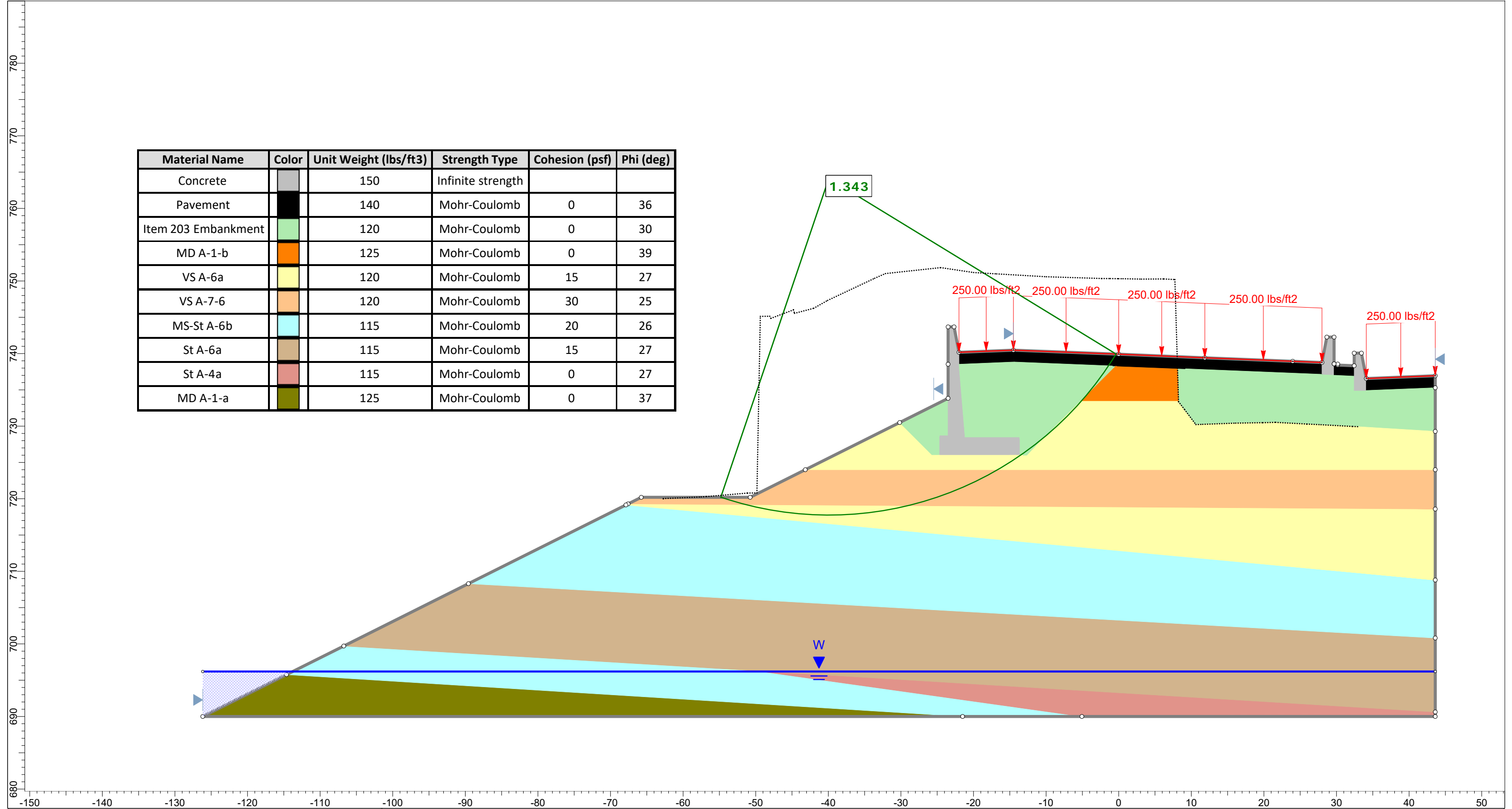
$$\text{Differential Settlement Along Wall Alignment: } \delta_s = \text{N/A}$$

$$\delta_s < 1/500 \rightarrow \text{N/A} < 1/500$$



| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---------------------|-------|-----------------------|-------------------|----------------|-----------|
| Concrete | | 150 | Infinite strength | | |
| Pavement | | 140 | Mohr-Coulomb | 0 | 36 |
| Item 203 Embankment | | 120 | Mohr-Coulomb | 0 | 30 |
| VS A-6a | | 120 | Mohr-Coulomb | 15 | 27 |
| VS A-7-6 | | 120 | Mohr-Coulomb | 30 | 25 |
| MS-St A-6b | | 115 | Mohr-Coulomb | 20 | 26 |
| St A-6a | | 115 | Mohr-Coulomb | 15 | 27 |
| St A-4a | | 115 | Mohr-Coulomb | 0 | 27 |
| MD A-1-a | | 125 | Mohr-Coulomb | 0 | 37 |





| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---------------------|-------|-----------------------|-------------------|----------------|-----------|
| Concrete | | 150 | Infinite strength | | |
| Pavement | | 140 | Mohr-Coulomb | 0 | 36 |
| Item 203 Embankment | | 120 | Mohr-Coulomb | 0 | 30 |
| MD A-1-b | | 125 | Mohr-Coulomb | 0 | 39 |
| VS A-6a | | 120 | Mohr-Coulomb | 15 | 27 |
| VS A-7-6 | | 120 | Mohr-Coulomb | 30 | 25 |
| MS-St A-6b | | 115 | Mohr-Coulomb | 20 | 26 |
| St A-6a | | 115 | Mohr-Coulomb | 15 | 27 |
| St A-4a | | 115 | Mohr-Coulomb | 0 | 27 |
| MD A-1-a | | 125 | Mohr-Coulomb | 0 | 37 |

