Resource International, Inc.

HAM-75-7.85
HAM-75-0992
PEDESTRIAN PATH BRIDGE OVER I-75
PID NO. 77889
HAMILTON COUNTY, OHIO

DRAFT STRUCTURE FOUNDATION EXPLORATION REPORT

Prepared For:
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Rii Project No. B-10-020

August, 2013

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June 22, 2012 (Revised August 8, 2013)

Mr. Edward D. Kagel, P.E.
Director of Transportation
EMH&T
5500 New Albany Road
Columbus, Ohio 43054

Re: Draft Structure Foundation Exploration
HAM-75-7.85
HAM-75-0992 – Pedestrian Path Bridge over I-75
PID No. 77889
Rii Project No. B-10-020

Dear Mr. Kagel:

Resource International, Inc. (Rii) is pleased to submit this DRAFT structure foundation exploration report for the 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 proposed replacement of the HAM-75-0992 bridge carrying a pedestrian path over I-75 as part of the HAM-75-7.85 project. The proposed bridge is located approximately 0.6 miles south of the Lockland Split on the north side of Cincinnati, in Hamilton County, 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.

Brian R. Trenner, P.E.
Project Engineer

Jonathan P. Sterenberg, P.E.
Director of Geotechnical Services

Enclosure: DRAFT Structure Foundation Exploration Report

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EXECUTIVE SUMMARY

Resource International, Inc. (Rii) has completed a DRAFT structure foundation exploration performed for the HAM-75-0992 bridge structure carrying a pedestrian path over I-75. The existing structure is a four-span bridge with a total length of approximately 210 feet. It is understood that the existing structure will be completely removed and replaced with a two-span steel truss structure with a concrete deck and a total length of approximately 210 feet.

A preliminary structure foundation exploration was performed by CTL Engineering for this bridge structure replacement as part of the HAM-75-2.30 Step 7 Preliminary Engineering (PID No. 76257) and their findings are presented in the report dated December 13, 2007. No additional borings were obtained at this structure for the current exploration. Therefore, all recommendations contained herein are based on information obtained from the preliminary exploration. For a complete summary of the field operations and findings for the borings performed by CTL Engineering, please reference the December 2007 report.

Exploration and Findings

Two borings, designated as B-211-0-07 and B-212-0-07, were performed for this bridge, one at each proposed abutment location, as part of a preliminary geotechnical exploration performed CTL Engineering. The borings were advanced to a completion depth of 70.0 and 50.0 feet below the existing ground surface, respectively.

In general, the borings performed by CTL encountered primarily natural granular soils with intermittent seams of cohesive material. The granular soils were generally described as loose to very dense, brown gravel, gravel and sand, gravel with sand and silt and coarse and fine sand (ODOT A-1-a, A-1-b, A-2-4, A-3a). The cohesive soils were generally described as soft to very stiff, brown sandy silt (ODOT A-4a). Existing fill consisting of brown silt and clay overlying gravel and sand (ODOT A-6a, A-1-b) was encountered in boring B-211 and extended to a depth of 18.5 feet below the ground surface. Groundwater was encountered in boring B-211 at an elevation of 505.8 feet msl. No groundwater elevation was indicated on the log for boring B-212

Bedrock was not encountered in any of the borings performed for this exploration.

Analyses and Recommendations

Design details of the structure proposed were provided to Rii by Barr & Prevost. It is understood that the new structure will consist of a two-span steel truss structure with a concrete deck, semi-integral abutments with an MSE wall at the rear abutment and soldier pile and lagging wall with tieback anchors at the forward abutment, and a concrete T-type pier, all supported on deep foundation systems comprised of driven

piles. It is understood that the existing structure will be completely removed and that the proposed structure will be located along the same alignment as the existing.

It is understood that the design of the soldier pile and lagging retaining wall in front of the forward abutment will be performed Rii as part of Retaining Wall V, which crosses this abutment location along its alignment adjacent to Summit Road. Therefore, recommendations for the design and construction of this wall will be provided in the Structure Foundation Exploration Report for Retaining Wall V. Recommendations for the deep foundation system for the abutment are presented in the following section.

Deep Foundation Recommendations

It is recommended that a deep foundation system consisting of driven piles be employed for support of the proposed bridge foundation elements. Based on the soil encountered at this site, it is recommended that 14.0 or 16.0 inch cast-in-place (CIP) pipe piles (ODOT Item 507.06) be employed for foundation support. The following table shows recommended pile lengths of the CIP pipe piles and the corresponding ultimate bearing value (R_{ndr}) and LRFD reduction factors (φ).

Pile Recommendations

Boring No.	Ground Elevation [1]	Pile Size [2]	Elevations (ft msl)		Embedment Depth [4] (feet)	R_{ndr} [5,6] (kips/pile)	Sleeve Length [7] (ft)	φ [8]
			Top [3]	Tip				
B-212 (Rear Abutment)	549.7	14” CIP	556.2	517.2	39	185	15.7	0.7
		16” CIP	556.2	524.2	32	180	15.7	0.7
B-211 (Pier)	564.3	14” CIP	543.0	492.0	51	235	N/A	0.7
		16” CIP	543.0	501.0	42	235	N/A	0.7
B-211 (Forward Abutment)	564.3	14” CIP	559.8	521.8	38	170	N/A	0.7
		16” CIP	559.8	533.8	26	165	N/A	0.7

1. *Ground elevation listed is the ground elevation at the boring location.*
2. *The pile wall thickness utilized in the analysis was determined in accordance with the equation provided in ODOT Item 507.06 and was rounded up to the nearest 1/16-inch increment.*
3. *Pile top elevation is at the proposed bottom of footing elevation.*
4. *Embedment depths represent the length of pile in contact with the soil.*
5. *The embedment depth and corresponding ultimate bearing value listed above are based on the structural loading information provided by Barr & Prevost.*
6. *The ultimate bearing value listed does not include capacity reduction due to downdrag loads at the rear abutment. Downdrag loads and considerations are presented in Section 5.1.2.*
7. *Sleeve length represents the required length of pile that should be sleeved within the MSE wall backfill at the rear abutment.*
8. *The resistance factor listed considers dynamic testing of the pile elements will be performed per Section 303.4.2.7 of the ODOT BDM. Alternate resistance factors may be applied based on the type and frequency of field testing specified.*

NOTE: The top of pile elevation coincides with the bottom of footing elevations, and the estimated pile lengths reflect exclusively the length of the pile in contact with the soil. **Embedment length of the pile into the footing is not included.** Estimated pile lengths are rounded up to the nearest foot.

According to proposed profile information provided by Barr & Prevost, the proposed profile grade at the rear abutment will be raised approximately 3.0 feet from the existing profile grade. Based on the relatively small difference between the existing and proposed profile grades, downdrag forces will be negligible.

MSE Wall Recommendations

It is proposed to construct an MSE wall at the rear abutment of the proposed structure. Based upon the proposed plan information, a wall height of 23.5 feet from the top of the leveling pad to the proposed profile grade of the roadway is anticipated at the rear abutment.

The anticipated bearing materials at the rear abutment consist of medium dense to dense gravel and sand (ODOT A-1-b). MSE wall foundations bearing on this soil or engineered fill, placed and compacted as described in Section 5.4 of the full report, may be proportioned for a nominal bearing resistance as indicated in the following table. A geotechnical resistance factor of φ_b=0.65 was considered in calculating the factored nominal bearing resistance at the strength limit state. Based on the minimum length of reinforced soil mass presented in the table below and utilizing the soil parameters listed in Section 5.2.1 of the full report, the bearing pressure on the front portion of the wall **will not exceed** the factored nominal bearing resistance at the strength limit state at the rear abutment provided the subgrade is prepared as noted above.

HAM-75-0992 MSE Wall Spread Footing Design Parameters

Boring No.	Maximum Wall Height (ft)	Minimum Reinforcement Length [1]	Nominal Bearing Resistance (ksf)		Settlement [3] (in)
			Service	Strength [2]	
B-212 (Rear Abutment)	23.5	0.7(H)	13.2	39.6	Negligible

1. *The minimum reinforcement length is expressed as a percentage of the wall height, H.*
2. *The nominal bearing resistance at the strength limit state is unfactored. Rii recommends that a resistance factor of φ_b=0.65 be considered when calculating the factored nominal bearing resistance at the strength limit state.*
3. *Due to the relatively small difference between the existing and proposed profile grades, little to no settlement of the foundation soils is anticipated due to the construction of the wall.*

For MSE walls bearing on soil, the limiting eccentricity is one-fourth of the base width of the wall. Based on the soil parameters listed in Section 5.2.1 of the full report, for an MSE wall designed with a minimum strap length as noted above, the calculated eccentricity of the resultant force **will not exceed** the limiting eccentricity at the strength limit state.

Based on the soil parameters listed in Section 5.2.1 of the full report for the foundation and reinforced soil backfill, a coefficient of sliding friction of 0.62 was utilized for design at the rear abutment. A geotechnical resistance factor of φ_τ=1.0 was considered when calculating the factored shear resistance between the foundation soil and reinforced soil backfill for sliding. Based on the minimum length of reinforced soil mass presented in above and utilizing the soil parameters listed in Section 5.2.1 of the full report for the for the foundation and reinforced soil backfill, the resultant horizontal forces on the back of the MSE wall **will not exceed** the factored shear resistance at the strength limit state.

Overall (global) stability for MSE walls supporting structural elements is satisfied when a minimum factor of safety of 1.54 is obtained under loading conditions at the service limit state. Based on the soil parameters listed in Section 5.2.1 of the full report, for MSE walls designed with minimum strap lengths as noted above, the resulting factor of safety under drained and undrained conditions was greater than 1.54.

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 HAM-75-7.85 project in Hamilton County, Ohio. This project represents the northern portion of HAM-75-2.30 Mill Creek Expressway improvements. The project will consist of roadway improvements, several new retaining walls and bridge replacements along I-75 from Vine Street to State Route 126. The project site is located in the community limits of St. Bernard, Elmwood Place, Roselawn, and Cincinnati, in Hamilton County, Ohio.

This DRAFT report is a presentation of the structure foundation exploration performed for the HAM-75-0992 bridge structure carrying a pedestrian path over I-75, as shown on the vicinity map and boring plan presented in Appendix II. The existing structure is a four-span bridge with a total length of approximately 210 feet. It is understood that the existing structure will be completely removed and replaced with a two-span steel truss structure with a concrete deck and a total length of approximately 210 feet.

A preliminary structure foundation exploration was performed by CTL Engineering for this bridge structure replacement as part of the HAM-75-2.30 Step 7 Preliminary Engineering (PID No. 76257) and their findings are presented in the report dated December 13, 2007. No additional borings were obtained at this structure for the current exploration. Therefore, all recommendations contained herein are based on information obtained from the preliminary exploration. For a complete summary of the field operations and findings for the borings performed by CTL Engineering, please reference the December 2007 report.

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 grouped by age, depositional process and geomorphic occurrence. Physiographically, the site lies within the Illinoian Till Plain of the Till Plains Section. This area is characterized by rolling ground moraine deposits with many buried valleys alternating between broad floodplains and bedrock gorges. The site area contains silty loam till deposited as ground moraine covered with loess and dissected by the modern day Mill Creek. Ground moraines are deposited during the retreat of a glacier which results in an undifferentiated mixture of clay, silt, sand and gravel. The valley area also contains outwash and alluvium which eroded from hills and valleys with moderate relief. 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 particles to cobbles, usually deposited in present and former floodplain areas.

Based on Bedrock Geology and Topography Maps of the area, from the Ohio Department of Natural Resources (ODNR), the underlying bedrock consists of the Ordovician-aged Point Pleasant Formation. The Point Pleasant Formation, encountered in the bedrock valleys, is comprised of interbedded limestone and shale, averaging 60 percent limestone and 40 percent shale, and ranges from 0 to 80 feet thick. The bedrock surface forms a narrow valley just west and parallel to I-75 and is aligned northeast to southwest in the vicinity of the structure. The bedrock surface at the bottom of this valley is at an approximate elevation of 350 feet mean sea level (msl) and slopes up to the southeast under I-75 in the area of the structure. The bedrock surface lies at an approximate elevation of 400 feet msl directly beneath the structure. According to bedrock topography mapping, the depth to bedrock in the vicinity of the structure is approximately 150 to 170 below the ground surface. An illustration of the general geology of Ohio is presented in Appendix I.

2.2 Existing Conditions

The site for the proposed HAM-75-0992 structure is located at the existing overpass of the pedestrian path over I-75, approximately 0.6 miles south of the Lockland Split. The existing structure is a four-span bridge that is approximately 8 feet wide and 210 feet long and carries a pedestrian path between Summit Road and City Center Drive. I-75 underneath the pedestrian path bridge is a six-lane, asphalt paved roadway. The terrain in the vicinity of the structure is elevated along the east side of I-75 where Summit Road runs parallel to I-75 and there is little to no difference in elevation between the terrain west of I-75 and the mainline. I-75 through this area is relatively flat.

3.0 EXPLORATION

A preliminary geotechnical exploration was performed within this project study area by CTL Engineering for the HAM-75-2.30 project (PID No. 76257). Their findings were published in the report dated December 13, 2007. Two borings, designated as B-211-0-07 and B-212-0-07, were performed for this bridge, one at each proposed abutment location. The borings were advanced to a completion depth of 70.0 and 50.0 feet below the existing ground surface, respectively, and SPT sampling was performed at a maximum of 5.0-foot intervals to obtain representative soil samples for laboratory classification testing. Rii has included a plan showing the soil borings performed in the project area in Appendix II.

An automatic drop hammer was utilized by CTL Engineering to generate consistent energy transfer to the sampler. No calibration data is available for the hammer used during the SPT testing for the borings performed for this project. Therefore, an estimated drill rod energy ratio of 80 percent was utilized to determine the energy corrected blow counts.

4.0 FINDINGS

In general, the borings performed by CTL encountered primarily natural granular soils with intermittent seams of cohesive material. The granular soils were generally described as loose to very dense, brown gravel, gravel and sand, gravel with sand and silt and coarse and fine sand (ODOT A-1-a, A-1-b, A-2-4, A-3a). The cohesive soils were generally described as soft to very stiff, brown sandy silt (ODOT A-4a). Existing fill consisting of brown silt and clay overlying gravel and sand (ODOT A-6a, A-1-b) was encountered in boring B-211 and extended to a depth of 18.5 feet below the ground surface. Groundwater was encountered in boring B-211 at an elevation of 505.8 feet msl. No groundwater elevation was indicated on the log for boring B-212.

5.0 ANALYSES AND RECOMMENDATIONS

Data obtained from the drilling and testing program have been used to determine 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 the structure foundation systems, 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 structure proposed were provided to Rii by Barr & Prevost. It is understood that the new structure will consist of a two-span steel truss structure with a concrete deck, semi-integral abutments with an MSE wall at the rear abutment and soldier pile and lagging wall with tieback anchors at the forward abutment, and a concrete T-type pier, all supported on deep foundation systems comprised of driven piles. It is understood that the existing structure will be completely removed and that the proposed structure will be located along the same alignment as the existing.

It is understood that the design of the soldier pile and lagging retaining wall in front of the forward abutment will be performed Rii as part of Retaining Wall V, which crosses this abutment location along its alignment adjacent to Summit Road. Therefore, recommendations for the design and construction of this wall will be provided in the Structure Foundation Exploration Report for Retaining Wall V. Recommendations for the deep foundation system for the abutment are presented in the following section.

Proposed structural data was obtained from preliminary design details provided by Barr & Prevost and are included in Table 1:

Table 1. Structure & Bridge Design Elevations

Reference	Reference Boring [1]	Structure Component	Elevation [2] (feet)
Rear Abutment	B-212-0-07	Profile Grade	564.0
		Bottom of Footing	556.2
		Bottom of Wall (Leveling Pad)	540.5
Pier	B-211-0-07	Bottom of Footing	543.0
Forward Abutment	B-211-0-07	Profile Grade	568.0
		Bottom of Footing	559.8
		Bottom of Wall	546.8 [3]

1. *Boring B-211 was used for the analysis at both the pier and forward abutment.*
2. *Elevations based on structure information provided by Barr & Prevost.*
3. *Bottom of wall elevation provided by the Rii design team.*

In addition to the design elevations, proposed structural loading information was provided by Barr & Prevost for each substructure unit and are included in Table 2:

Table 2. Structural Loading Details

Substructure Reference	Maximum Factored Load per Pile (kips)	Required R_{ndr} per Pile [1] (kips)
Rear Abutment	125	179
Pier	164	234
Forward Abutment	115	165

1. *Required R_{ndr} based on a resistance factor of 0.7.*

5.1 Deep Foundation Recommendations

It is recommended that a deep foundation system consisting of driven piles be employed for support of the proposed bridge foundation elements. Based on the soil encountered at this site, it is recommended that 14.0 or 16.0 inch cast-in-place (CIP) pipe piles (ODOT Item 507.06) be employed for foundation support. Table 3 shows

recommended pile lengths of the CIP pipe piles and the corresponding ultimate bearing value (R_{ndr}) and LRFD reduction factors (φ).

Table 3. Pile Recommendations

Boring No.	Ground Elevation [1]	Pile Size [2]	Elevations (ft msl)		Embedment Depth [4] (feet)	R_{ndr} [5,6] (kips/pile)	Sleeve Length [7] (ft)	φ [8]
			Top [3]	Tip				
B-212 (Rear Abutment)	549.7	14" CIP	556.2	517.2	39	185	15.7	0.7
		16" CIP	556.2	524.2	32	180	15.7	0.7
B-211 (Pier)	564.3	14" CIP	543.0	492.0	51	235	N/A	0.7
		16" CIP	543.0	501.0	42	235	N/A	0.7
B-211 (Forward Abutment)	564.3	14" CIP	559.8	521.8	38	170	N/A	0.7
		16" CIP	559.8	533.8	26	165	N/A	0.7

1. *Ground elevation listed is the ground elevation at the boring location.*
2. *The pile wall thickness utilized in the analysis was determined in accordance with the equation provided in ODOT Item 507.06 and was rounded up to the nearest 1/16-inch increment.*
3. *Pile top elevation is at the proposed bottom of footing elevation.*
4. *Embedment depths represent the length of pile in contact with the soil.*
5. *The embedment depth and corresponding ultimate bearing value listed above are based on the structural loading information provided by Barr & Prevost.*
6. *The ultimate bearing value listed does not include capacity reduction due to downdrag loads at the rear abutment. Downdrag loads and considerations are presented in Section 5.1.2.*
7. *Sleeve length represents the required length of pile that should be sleeved within the MSE wall backfill at the rear abutment.*
8. *The resistance factor listed considers dynamic testing of the pile elements will be performed per Section 303.4.2.7 of the ODOT BDM. Alternate resistance factors may be applied based on the type and frequency of field testing specified.*

NOTE: The top of pile elevation coincides with the bottom of footing elevations, and the estimated pile lengths reflect exclusively the length of the pile in contact with the soil. **Embedment length of the pile into the footing is not included.** Estimated pile lengths are rounded up to the nearest foot.

The piles were analyzed utilizing DRIVEN software (Appendix IV). A drivability analysis in accordance with Section 10.7.8 of the 2010 AASHTO LRFD Bridge Design Specifications (BDS) was also performed using the GRLWEAP program, and results of this analysis are presented in Section 5.1.1 of this report. Please note that the embedment depth and corresponding ultimate bearing value for CIP piles presented in Table 3 were determined based on the required factored resistance for the proposed structural loading at each substructure unit provided by Barr & Prevost. The minimum

wall thickness utilized in the driveability analysis for CIP piles was determined from the following equation per ODOT Item 507.06 for the ultimate bearing value listed in Table 3 for the respective pile size. Settlement is estimated to be less than 1.0 inch for CIP piles driven to the frictional resistance listed in Table 3.

$$t = UBV / 900{,}000$$

Where:
t = pile wall thickness in inches
UBV = design ultimate bearing value in pounds

We emphasize that the pile lengths and ultimate bearing values presented in Table 3 are estimates using empirical equations based on the derived characteristics of the soils encountered in the subject borings drilled. The most accurate method for determining pile capacities and lengths is to drive test piling at the site and perform static load testing in accordance with the ASTM D1143 procedure. Dynamic pile load testing should be performed in accordance with ASTM D4945. The actual pile capacities should be verified using static or dynamic pile load testing as detailed in the 2007 ODOT Bridge Design Manual (BDM). Further installation considerations are presented in Section 5.1.3.

The geotechnical resistance factor listed in Table 3 represents the recommended value based on the performance of a minimum of two dynamic pile load tests at the site as specified in Section 303.4.2.7 of the 2007 ODOT BDM. A higher resistance factor may be utilized if alternate or additional field load testing of the pile elements is performed. The 2010 AASHTO LRFD BDS provides alternate resistance factors for use in design based on the type and frequency of field load testing. Figure 1 presents the various testing types and frequency of testing, and lists the corresponding resistance factor that may be selected. ***If no field load testing of the piles (static or dynamic) is performed, then a geotechnical resistance factor of 0.35 should be used for design.***

Figure 1: AASHTO Resistance Factors for Driven Pile Foundations

Table 10.5.5.2.3-1—Resistance Factors for Driven Piles

Condition/Resistance Determination Method		Resistance Factor
Nominal Bearing Resistance of Single Pile—Dynamic Analysis and Static Load Test Methods, φ_{dyn}	Driving criteria established by successful static load test of at least one pile per site condition and dynamic testing* of at least two piles per site condition, but no less than 2% of the production piles	0.80
	Driving criteria established by successful static load test of at least one pile per site condition without dynamic testing	0.75
	Driving criteria established by dynamic testing* conducted on 100% of production piles	0.75
	Driving criteria established by dynamic testing,* quality control by dynamic testing* of at least two piles per site condition, but no less than 2% of the production piles	0.65
	Wave equation analysis, without pile dynamic measurements or load test but with field confirmation of hammer performance	0.50
	FHWA-modified Gates dynamic pile formula (End of Drive condition only)	0.40
	Engineering News (as defined in Article 10.7.3.8.5) dynamic pile formula (End of Drive condition only)	0.10

* Dynamic testing requires signal matching, and best estimates of nominal resistance are made from a restrike. Dynamic tests are calibrated to the static load test, when available.

5.1.1 Driveability

Rii performed a driveability analysis using GRLWEAP (Appendix V). In the driveability analysis, a Delmag 19-42 hammer with a rated energy of approximately 43,000 ft-lbs was used in conjunction with CIP pipe pile sections. Based on the results of this analysis using a wall thickness as determined from ODOT Item 507.06, it appears that the driving stresses induced on the CIP pipe piles **would not exceed** 90 percent of the yield stress for A252, Grade 2 steel (f_y = 35 ksi, 0.9f_y = 31.5 ksi) if driven to the depths provided in Table 3 for the respective pile size. Please note that the required pile wall thickness was determined using the equation provided in ODOT Item 507.06, and that the pile wall thickness utilized in the driveability analysis was rounded up to the near 1/16-inch increment unless otherwise noted in Table 3.

Since no boring was advanced at the proposed pier location, actual driving conditions during pile installation may differ from the conditions predicted in the analysis and provided above.

5.1.2 Downdrag Forces

According to proposed profile information provided by Barr & Prevost, the proposed profile grade at the rear abutment will be raised approximately 3.0 feet from the existing profile grade. Based on the relatively small difference between the existing and proposed profile grades, downdrag forces will be negligible.

5.1.3 Driven Pile Considerations

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

It is recommended that the contractor submit a wave equation analysis (bearing graph) of his driving equipment, or the necessary pile driving and equipment data to perform the wave equation analysis, for hammer approval. A constant capacity wave equation analysis (inspector's chart) should also be performed to assist field personnel during inspection in accordance with the 2007 ODOT BDM.

As noted in Section 5.1.1, due to the fact that no boring was obtained at the proposed pier location and that the subsurface conditions were extrapolated beyond the bottom of the boring for B-211, actual driving conditions during pile installation may differ from the conditions predicted in the analysis. **Therefore, it is strongly recommended that pile load testing be performed the proposed pier location to determine the actual pile driving criteria for construction.**

5.2 MSE Wall Recommendations

It is proposed to construct an MSE wall at the rear abutment of the proposed structure. MSE walls are constructed on earthen foundations at a minimum depth of 3.0 feet below grade, as defined by the top of the leveling pad to the ground surface located 4.0 feet from the face of the wall. Note that the reinforced soil mass extends from the foundation bearing elevation to the top of MSE wall. The width of the MSE wall foundation (B) is defined by the length of the reinforced soil mass. Per the ODOT BDM (October 2007) and Supplemental Specification (SS) 840, the minimum length of the reinforced soil mass is equal to 70 percent the height of the MSE wall or 8.0 feet whichever is greater. A non-structural bearing leveling pad consisting of a minimum of 6-inches of unreinforced concrete should be placed at the base of the wall for constructability purposes. Please note that the leveling pad is not a structural foundation.

Based upon the proposed plan information, a wall height of 23.5 feet from the top of the leveling pad to the proposed profile grade of the roadway is anticipated at the rear abutment. Therefore, it is considered that the minimum reinforcement length and the effective foundation width (B) of the MSE wall for external and global stability calculations will be approximately 16.5 feet. For the analysis, the foundation width was

set at 70 percent of the wall height and the foundation width was increased, if required, until external and global stability requirements were satisfied.

It is recommended that the foundation subgrade (beneath the reinforced soil mass) for the MSE wall be critically proof-rolled and stabilized to create a workable subgrade for the MSE wall reinforced soil mass. Unstable soils, primarily those containing silt (A-4a/A-4b), if encountered, may be stabilized as noted below:

- Undercut 24 inches +/- pending results of proof-roll;
- Place ODOT Item 712.09 Type D Geotextile Fabric;
- Placement of 24 inches of 703. 02A Granular Fill.

Please note that this recommendation for stabilization of unsuitable soils, as identified during the proof roll of the subgrade, are in addition to the foundation preparation measures provided in ODOT SS 840.

For MSE walls, Rii recommends that consideration be given to driving the piles prior to the placement of fill and sleeving the piles extending above the existing ground surface with a plastic pipe casing as noted in Section 5.1.2. The MSE wall may then be constructed around the pile sleeves to full height.

5.2.1 Strength Parameters Utilized in External and Global Stability Analyses

The shear strength parameters utilized in the external and global stability analyses for the MSE walls at the abutments are provided in Table 4.

Table 4. Shear Strength Parameters Utilized in Stability Analyses

Material Type	Unit Weight, γ (pcf)	Effective Friction Angle, φ' (°)	Effective Cohesion, c' (psf)	Undrained Shear Strength, S_u (psf)
MSE Wall Backfill (Select granular fill)	120	34	0	N/A
Embankment Fill (Fill material derived from onsite soils)	120	30	400	2,000
Medium Dense to Dense Granular Soil (A-1-a, A-1-b, A-3a)	130	32	0	N/A

Shear strength parameters for the reinforced soil backfill are provided in ODOT SS 840. Per SS 840, the select granular backfill in the reinforced zone must meet the shear strength requirements provided in Table 4. Shear strength parameters for new embankment fill were determined using ODOT Geotechnical Bulletin 6 (GB-6) as a guide. The shear strength parameters for the embankment fill listed in Table 4 above are the limiting values based on the assumption that the embankment fill utilized will consist of silt and clay, sandy silt (ODOT A-6a, A-4a) or granular material. The friction angle for the natural granular soil encountered was determined based on correlations with the N_{60} value from the SPT testing of the soil.

5.2.2 Bearing Stability

The anticipated bearing materials at the rear abutment consist of medium dense to dense gravel and sand (ODOT A-1-b). MSE wall foundations bearing on this soil or engineered fill, placed and compacted as described in Section 5.4, may be proportioned for a nominal bearing resistance as indicated in Table 5. A geotechnical resistance factor of φ_b=0.65 was considered in calculating the factored nominal bearing resistance at the strength limit state. The reinforcement length presented in the following table represents the minimum foundation width required to satisfy external and global stability requirements, expressed as a percentage of the wall height.

Table 5. HAM-75-0992 MSE Wall Spread Footing Design Parameters

Boring No.	Maximum Wall Height (ft)	Minimum Reinforcement Length [1]	Nominal Bearing Resistance (ksf)		Settlement [3] (in)
			Service	Strength [2]	
B-212 (Rear Abutment)	23.5	0.7(H)	13.2	39.6	Negligible

1. *The minimum reinforcement length is expressed as a percentage of the wall height, H.*
2. *The nominal bearing resistance at the strength limit state is unfactored. Rii recommends that a resistance factor of φ_b=0.65 be considered when calculating the factored nominal bearing resistance at the strength limit state.*
3. *Due to the relatively small difference between the existing and proposed profile grades, little to no settlement of the foundation soils is anticipated due to the construction of the wall.*

Rii performed a verification of the bearing pressure exerted on the subgrade soils for the maximum specified wall height indicated in Table 5. Based on the minimum length of reinforced soil mass presented in Table 5 and utilizing the soil parameters listed in Section 5.2.1, the bearing pressure on the front portion of the wall **will not exceed** the factored nominal bearing resistance at the strength limit state at the rear abutment provided the subgrade is prepared as noted above.

Based profile information provided by Barr & Prevost, it is anticipated that approximately 20.5 feet of cut will be required achieve the proposed bottom of wall elevation at the rear abutment. Therefore, a net embankment height (embankment height above existing grade up to the proposed profile grade) of 3.0 feet was considered for settlement. Due to the relatively small difference between the existing and proposed profile grades, little to no settlement of the foundation soils is anticipated due to the construction of the wall.

5.2.3 Eccentricity (Overturning Stability)

The resistance of the MSE 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 MSE walls, overturning stability is determined by calculating the eccentricity of the resultant force from the midpoint of the base of the wall and comparing this value to a limiting eccentricity value. Per Section 11.10.5.5 of the 2010 AASHTO LRFD BDS, for foundations bearing on soil or bedrock, the location of the resultant of the reaction forces shall be within the middle one-half of the base width. Therefore, the limiting eccentricity is one-fourth of the base width of the wall. Rii performed a verification of the eccentricity of the resultant force for the maximum specified wall height indicated in Table 5. Based on the minimum length of reinforced soil mass presented in Table 5 and utilizing the soil parameters listed in Section 5.2.1 for the retained embankment material, the calculated eccentricity of the resultant force **will not exceed** the limiting eccentricity at the strength limit state.

5.2.4 Sliding Stability

The resistance of the MSE wall to sliding will be dependent on the friction between the reinforced soil backfill and bearing soils per Section 11.10.5.3 of the 2010 AASHTO LRFD BDS. For MSE walls, sliding resistance is determined by multiplying a coefficient of sliding friction “f” times the total vertical force at the base of the wall. The coefficient of sliding friction is determined based on the limiting friction angle between the foundation soil and the reinforced soil backfill. Based on the soil parameters listed in Section 5.2.1 for the foundation and reinforced soil backfill, a coefficient of sliding friction of 0.62 was utilized for design at the rear abutment. A geotechnical resistance factor of φ_τ=1.0 was considered when calculating the factored shear resistance between the foundation soil and reinforced soil backfill for sliding. Based on the minimum length of reinforced soil mass presented in Table 5 and utilizing the soil parameters listed in Section 5.2.1 for the for the foundation and reinforced soil backfill, the resultant horizontal forces on the back of the MSE wall **will not exceed** the factored shear resistance at the strength limit state.

5.2.5 Overall (Global) Stability

A slope stability analysis was performed to check the global stability of the wall. As per AASHTO LRFD BDS, safety against soil failure shall be evaluated at the service limit state by assuming the reinforced soil mass to be a rigid body. Soil parameters utilized in external stability analyses are presented in Section 5.2.1. For the global stability condition, it was considered that the failure plane will not cross through the reinforced soil mass.

Per Section 11.6.2.3 of the 2010 AASHTO LRFD BDS, overall (global) stability for MSE walls supporting structural elements is satisfied if the product of the factor of safety from the slope stability output multiplied by the resistance factor φ=0.65 is greater than 1.0. Therefore, global stability is satisfied when a minimum factor of safety of 1.54 is obtained. For an MSE wall designed with the minimum strap length listed in Table 5, the resulting factor of safety under drained conditions (long-term stability) greater than 1.54. The wall was also evaluated under undrained conditions (short-term stability) to verify the stability of the wall during and immediately following construction. The resulting factor of safety under undrained conditions was also greater than 1.54.

Calculations for external (bearing and sliding resistance and limiting eccentricity) and overall (global) stability of the MSE wall are provided in Appendix VI.

5.2.6 Final MSE Wall Considerations

Based on the results of the external and global stability analysis performed for the MSE wall, the recommended controlling strap length is 0.7 times the maximum height of the MSE wall (measured from the top of the leveling pad to the proposed profile grade of the roadway) at the rear abutment. All of the external and global stability calculations indicate that adequate resistance is available for support of the MSE wall at the rear abutment for a strap length equal to 70 percent of the wall height.

5.3 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 6 and Table 7.

Table 6. Estimated Undrained (Short-term) Soil Parameters for Design

Soil Type	γ (pcf) [1]	c (psf)	φ	k_a	k_o	k_p
Soft to Medium Stiff Cohesive Soil	110	750	0°	1.0	1.0	1.0
Stiff Cohesive Soil	115	1,500	0°	1.0	1.0	1.0
Very Stiff to Hard Cohesive Soil	120	3,500	0°	1.0	1.0	1.0
Loose Granular Soil	120	0	28°	0.36	0.53	2.77
Medium Dense Granular Soil	125	0	30°	0.33	0.50	3.00
Dense to Very Dense Granular Soil	130	0	34°	0.28	0.44	3.54
Compacted Cohesive Engineered Fill	125	1,500	0°	1.0	1.0	1.0
Compacted Granular Engineered Fill	135	0	33°	0.30	0.46	3.39

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

Table 7. Estimated Drained (Long-term) Soil Parameters for Design

Soil Type	γ (pcf) [1]	c (psf)	φ	k_a	k_o	k_p
Soft to Medium Stiff Natural Cohesive Soil	115	0	21°	0.47	0.36	2.12
Stiff to Hard Natural Cohesive Soil	120	0	26°	0.39	0.56	2.56
Loose Granular Soil	120	0	28°	0.36	0.53	2.77
Medium Dense Granular Soil	125	0	30°	0.33	0.50	3.00
Dense to Very Dense Granular Soil	130	0	34°	0.28	0.44	3.54
Compacted Cohesive Engineered Fill	125	0	28°	0.36	0.53	2.77
Compacted Granular Engineered Fill	135	0	33°	0.30	0.46	3.39

1. *When below groundwater table, use effective unit weight, γ' = γ - 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. 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.

5.4 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).

Fill soil placed for foundation and pavement support should be placed in loose lifts not to exceed 8.0 inches. Fill soil placed under pavement or structures shall be compacted to not less than 100 percent of maximum dry density obtained by the Standard Proctor Test (ASTM D698). Fill soil containing excess moisture shall be required to dry prior to or during compaction to a moisture content not greater than 3.0 percent above or below optimum. However, for material that displays pronounced elasticity or deformation under the action of loaded rubber tire construction equipment, the moisture content shall be reduced to optimum if necessary to secure stability. Drying of wet soil shall be expedited by the use of plows, discs, or by other approved methods when so ordered by the site geotechnical engineer.

Generally, materials utilized for engineered fill should free of waste construction debris and other deleterious materials and meet the following requirements:

- Maximum Dry Density per ASTM D698 > 110 pcf
- Liquid Limit < 40
- Plasticity Index < 15
- Organic Matter < 3 percent
- Maximum Particle Size < 3 inches
- Silt Content (between 0.075 and 0.005 mm) < 45 percent

Compacted granular fill shall meet the above specification and additionally shall have a maximum 35 percent passing the No. 200 sieve.

5.4.1 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 8. 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

5.4.2 Groundwater Considerations

Based on the groundwater observations made during drilling, little to no groundwater seepage is anticipated during construction of the bridge foundation element or MSE wall at the rear abutment. However, where/if groundwater is encountered, proper groundwater control should be employed and maintained to prevent disturbance to excavation bottoms consisting of cohesive soil, and to prevent the possible development of a quick or "boiling" condition where soft silts and/or fine sands are encountered. It is preferable that the groundwater level, if encountered, be maintained at least 36 inches below the deepest excavation. Any seepage or groundwater encountered at this site should be able to be controlled by pumping from temporary sumps. Additional measures may be required depending on seasonal fluctuations of the groundwater level. Note that determining and maintaining actual groundwater levels during construction is the responsibility of the contractor.

6.0 LIMITATIONS OF STUDY

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

Our 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 preliminary 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

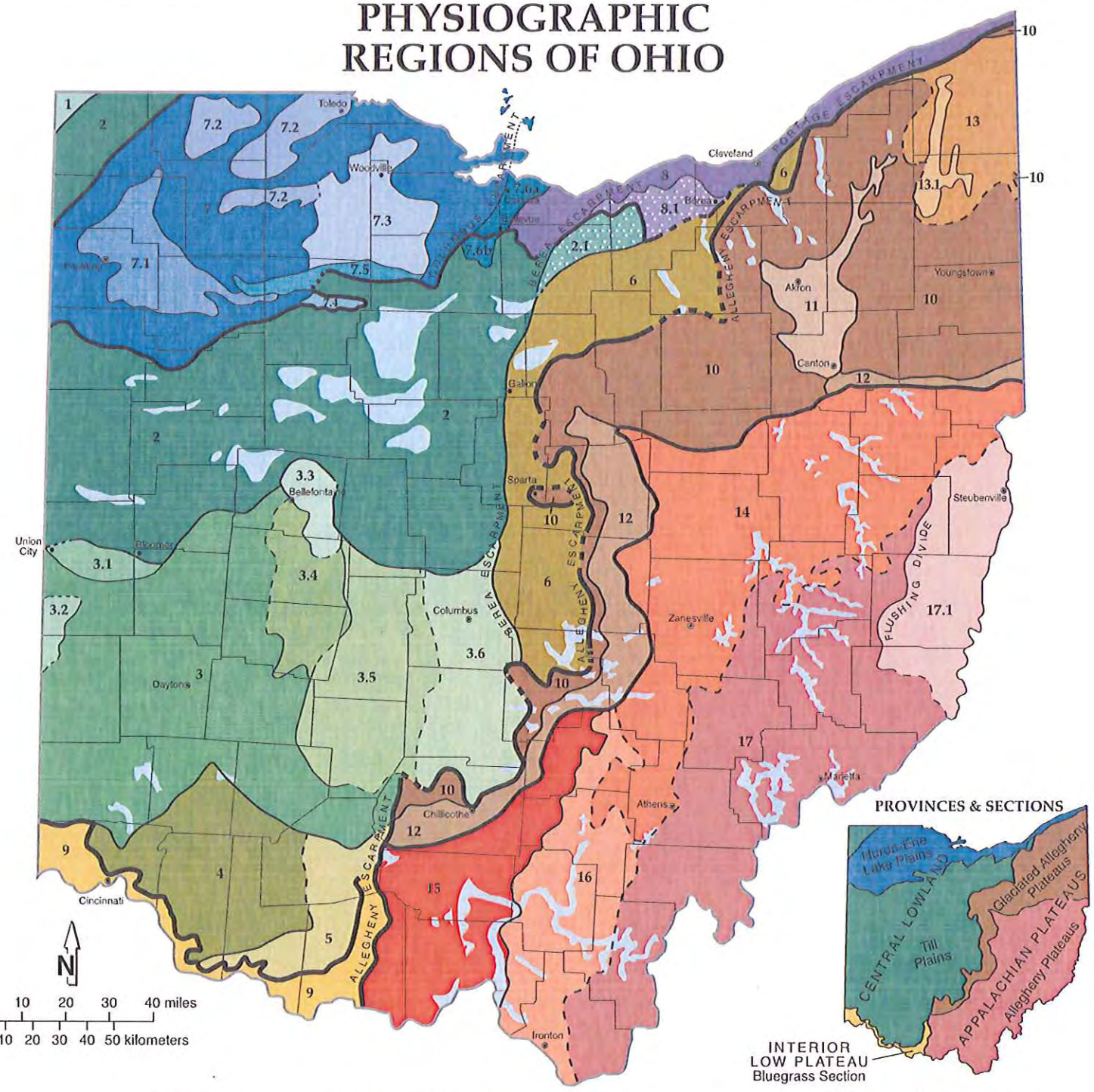
STATE GEOLOGY

STATE OF OHIO
Ted Strickland, Governor

DEPARTMENT OF NATURAL RESOURCES
Sean D. Logan, Director

DIVISION OF GEOLOGICAL SURVEY
Lawrence H. Wickstrom, Chief

PHYSIOGRAPHIC REGIONS OF OHIO



Till Plains

- 1. Steuben Till Plain
- 2. Central Ohio Clayey Till Plain
  - 2.1. Berea Headlands of the Till Plain
- 3. Southern Ohio Loamy Till Plain
  - 3.1. Union City-Bloomer Transitional Terrain
  - 3.2. Whitewater Interlobate Plain
  - 3.3. Bellefontaine Upland
  - 3.4. Mad River Interlobate Plain
  - 3.5. Darby Plain
  - 3.6. Columbus Lowland
- 4. Illinoian Till Plain
- 5. Dissected Illinoian Till Plain
- 6. Galion Glaciated Low Plateau

Transitional boundary

Lake basin/deposits outside Huron-Erie Lake Plains

Huron-Erie Lake Plains

- 7. Maumee Lake Plains
  - 7.1. Paulding Clay Basin
  - 7.2. Maumee Sand Plains
  - 7.3. Woodville Lake-Plain Reefs
  - 7.4. Findlay Embayment
  - 7.5. Fostoria Lake-Plain Shoals
  - 7.6a and 7.6b. Bellevue-Castalia Karst Plain
- 8. Erie Lake Plain
  - 8.1. Berea Headlands of the Erie Lake Plain

Bluegrass Section

- 9. Outer Bluegrass Region

Glaciated Allegheny Plateaus

- 10. Killbuck-Glaciated Pittsburgh Plateau
- 11. Akron-Canton Interlobate Plateau
- 12. Illinoian Glaciated Allegheny Plateau
- 13. Grand River Low Plateau
  - 13.1 Grand River Finger-Lake Plain

Allegheny Plateaus

- 14. Muskingum-Pittsburgh Plateau
- 15. Shawnee-Mississippian Plateau
- 16. Ironton Plateau
- 17. Marietta Plateau
  - 17.1. Little Switzerland Plateau

4/98

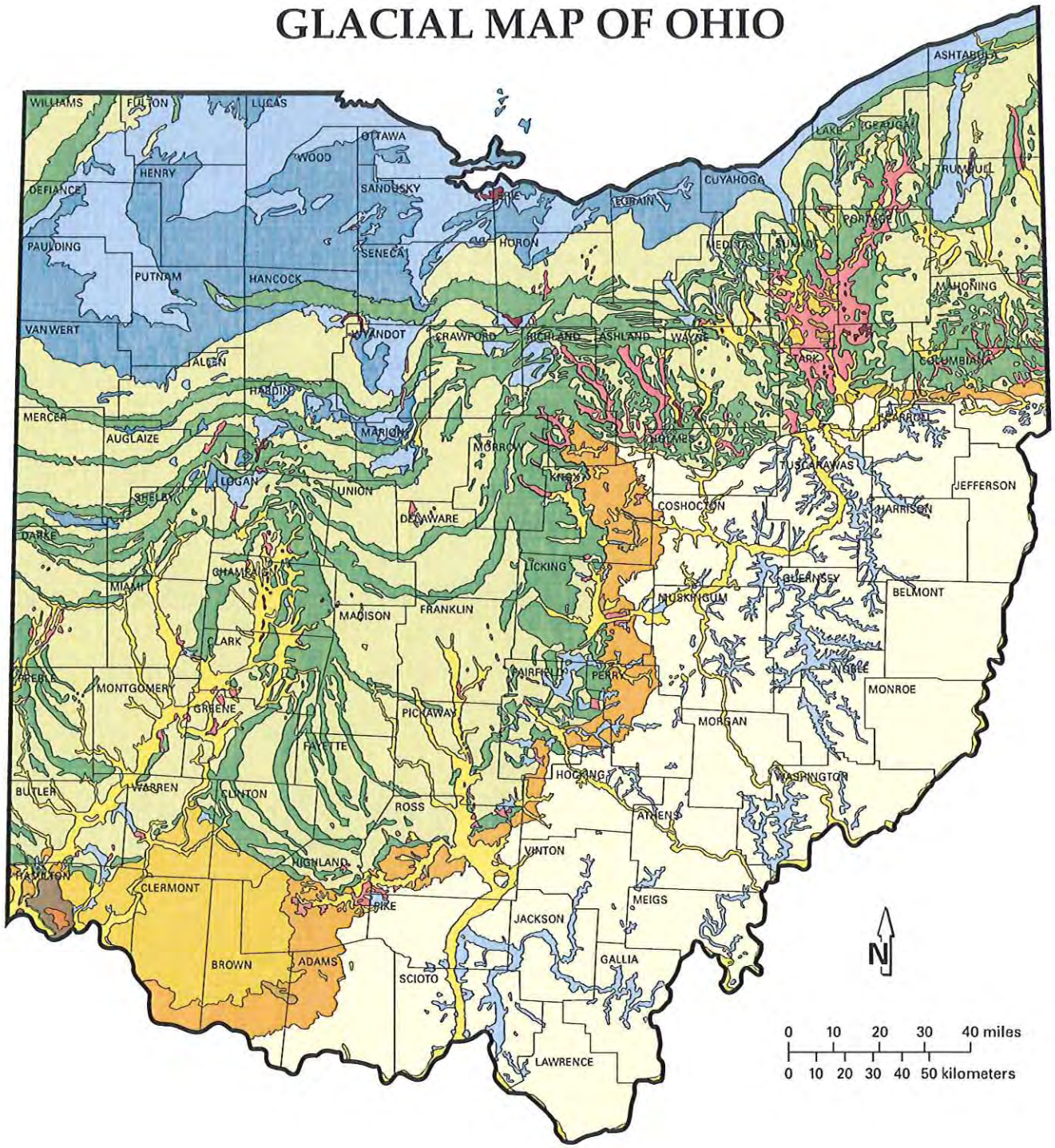
Recommended citation: Ohio Division of Geological Survey, 1998, Physiographic regions of Ohio: Ohio Department of Natural Resources, Division of Geological Survey, page-size map with text, 2 p., scale 1:2,100,00.

STATE OF OHIO
Bob Taft, Governor

DEPARTMENT OF NATURAL RESOURCES
Samuel W. Speck, Director

DIVISION OF GEOLOGICAL SURVEY
Thomas M. Berg, Chief

GLACIAL MAP OF OHIO



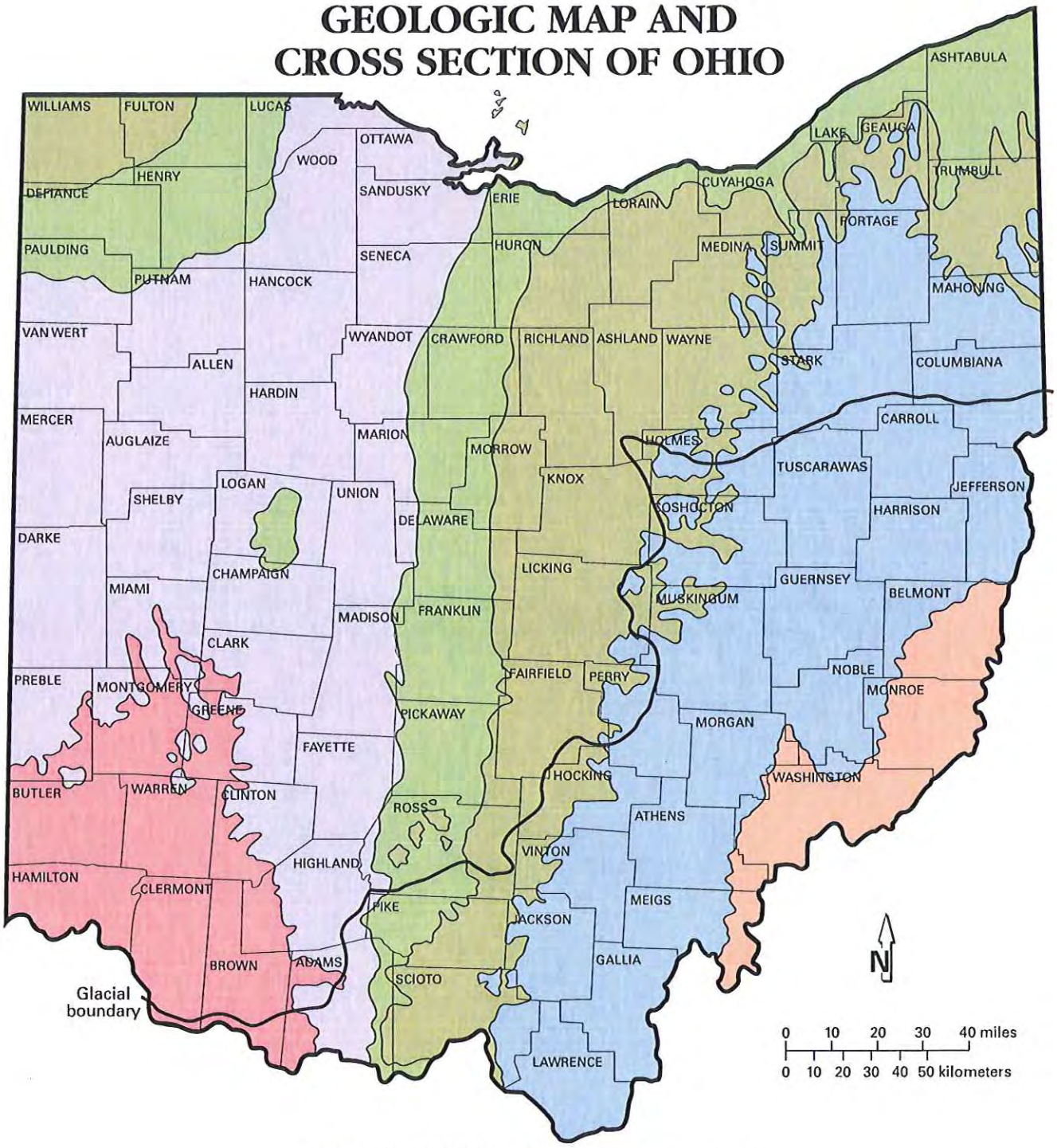
WISCONSINAN (14,000 to 24,000 years old)	ILLINOIAN (130,000 to 300,000 years old)	PRE-ILLINOIAN (older than 300,000 years)	
Ground moraine	Ground moraine	Ground moraine	Kames and eskers
Wave-planed ground moraine	Dissected ground moraine	Dissected ground moraine	Outwash
End moraine	Hummocky moraine		Lake deposits
			Peat
			Colluvium

STATE OF OHIO
Bob Taft, Governor

DEPARTMENT OF NATURAL RESOURCES
Samuel W. Speck, Director

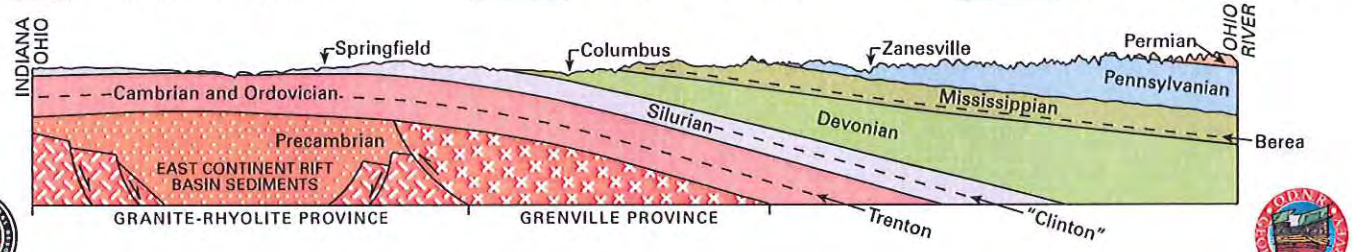
DIVISION OF GEOLOGICAL SURVEY
Thomas M. Berg, Chief

GEOLOGIC MAP AND CROSS SECTION OF OHIO



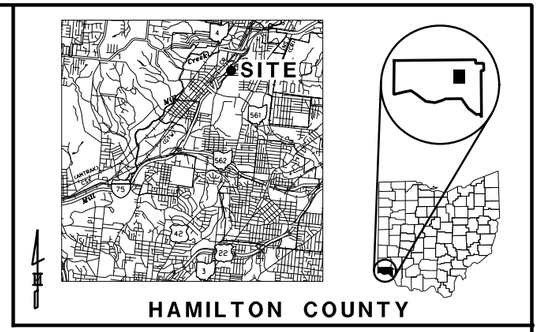
GEOLOGIC SYSTEM (million years before present)

- Permian (286-245)
- Pennsylvanian (320-286)
- Mississippian (360-320)
- Devonian (408-360)
- Silurian (438-408)
- Ordovician (505-438)



APPENDIX II

VICINITY MAP AND BORING PLAN



VICINITY MAP

I-75

SUMMIT RD.

SECTION RD.

B-001-0-92

B-002-0-92

B-012-0-07

B-212-0-07

N-005-0-06

B-211-0-07

B-011-0-07

2007 CTL BORINGS

HISTORIC BORINGS

BORING PLAN

HAM-75-0992 - PEDESTRIAN PATH BRIDGE OVER I-75

HAMILTON COUNTY, OHIO

PROJECT NO. Rii B-10-020	DRAWN RRM
SCALE: 1"=30' (0 15 30)	REVIEWED BRT
	DATE 6-22-12

RESOURCE INTERNATIONAL, INC.

APPENDIX III

2007 CTL ENGINEERING BORING LOGS

LOG OF BORING

Project Identification: HAM-75-2.30 PID 76257
Hamilton County, Ohio

Date Started 10/5/07 Sampler: Type SS Dia. 1.375"
Date Completed 10/5/07 Casing: Length 70.0ft Dia. 3.25"

Water Elev. 505.8ft

Boring No. B-211 Station & Offset 521+64.73, 107.8 RT Surface Elev. 564.3ft

CTL Project No. 04120070g

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
564.3	0	7/5/5			MEDIUM STIFF TO STIFF, BROWN SILT AND CLAY, SOME SAND, LITTLE GRAVEL, DAMP -FILL	1								13	VISUAL
560.8	4	3/3/7			NO RECOVERY	2									VISUAL
558.3	6	4/2/4				3								9	VISUAL
555.8	8	3/4/2			8.0' LOOSE, BROWN GRAVEL AND/ OR STONE FRAGMENTS WITH SAND, LITTLE SILT, TRACE CLAY, RED BRICK, DAMP -FILL	4	43	14	20	17	6	NP	NP	7	A-1-b
553.3	12	6/4/3			NO RECOVERY	5									VISUAL
550.8	14	30/21/9			13.5' LOOSE TO MEDIUM DENSE, GRAVEL AND/ OR STONE FRAGMENTS WITH SAND, LITTLE SILT, MOSTLY RED BRICK FRAGMENTS, LIMESTONE FRAGMENTS, DAMP	6								5	VISUAL
548.3	16	8/6/4			-FILL	7	64	11	5	20	0	NP	NP	4	A-1-b
545.8	20	4/3/2			18.5' LOOSE, DARK BROWN GRAVEL AND/ OR STONE FRAGMENTS WITH SAND AND SILT, TRACE CLAY, DAMP	8								6	VISUAL
543.3	22	3/3/3			21.0' SOFT TO MEDIUM STIFF, BROWN SANDY SILT, LITTLE CLAY, TRACE GRAVEL, DAMP	9	0	12	48	24	16	NP	NP	12	A-4a
540.8	24	1/1/3				10	1	16	43	26	14	NP	NP	5	A-4a
538.3	26	6/2/1				11								13	VISUAL
535.8	28	13/21/13			28.5' MEDIUM DENSE TO DENSE, BROWN GRAVEL AND/ OR STONE FRAGMENTS WITH SAND, TRACE CLAY, TRACE TO LITTLE SILT, DAMP	12	49	13	25	10	3	NP	NP	5	A-1-b
530.8	34	8/10/12			NO RECOVERY	13									VISUAL

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

Project Identification: HAM-75-2.30 PID 76257
Hamilton County, Ohio

Boring No. B-211

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
529.3															
	36														
	38														
525.8		30/24/19			NO RECOVERY	14									VISUAL
	40														
523.3					41.0'										
	42	6/10/12			VERY STIFF, BROWN SANDY SILT, LITTLE CLAY, DAMP	15	0	2	60	21	17	NP	NP	4	A-4a
520.8	44	6/10/14				16								5	VISUAL
	46														
	48														
515.8		7/7/6			48.5' MEDIUM DENSE, BROWN COARSE AND FINE SAND, TRACE GRAVEL, LITTLE SILT, LITTLE CLAY, DAMP	17	0	17	49	18	16	NP	NP	4	A-3a
	50														
	52														
510.8	54	11/11/12				18								7	VISUAL
	56														
					57.0'										
	58														
505.8		4/6/8			MEDIUM DENSE, BROWN COARSE AND FINE SAND, LITTLE SILT, LITTLE CLAY, WET	19	0	0	65	17	18	NP	NP	27	A-3a
	60														
	62														
500.8	64	4/5/8				20								27	VISUAL
	66														
	68														
495.8		11/17/27			68.5' HARD, BROWN SANDY SILT, TRACE CLAY, MOIST	21	0	0	55	43	2	NP	NP	14	A-4a
494.3	70				70.0'										
					BOTTOM OF BORING = 70.0'										

LOG OF BORING

Project Identification: HAM-75-2.30 PID 76257
Hamilton County, Ohio

Date Started 10/5/07 Sampler: Type SS Dia. 1.375"
Date Completed 10/5/07 Casing: Length 50ft Dia. 3.25"

Water Elev.

Boring No. B-212 Station & Offset 522+49.2, 86.1 LT Surface Elev. 549.7ft

CTL Project No. 04120070g

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
549.7	0														
549.7		8/8/6			STIFF, BROWN SANDY SILT, SOME GRAVEL, LITTLE CLAY, DRY	1								2	VISUAL
	2														
546.2					3.5'										
	4	12/8/8			MEDIUM DENSE, BROWN COARSE AND FINE SAND, SOME SILT, TRACE TO LITTLE GRAVEL, DAMP	2	5	6	56	33	0	NP	NP	3	A-3a
543.7	6														
		9/6/7				3								3	VISUAL
	8														
541.2															
		10/7/8				4	12	18	45	25	0	NP	NP	5	A-3a
	10														
					10.5'										
538.7		15/17/16			MEDIUM DENSE TO DENSE, BROWN GRAVEL AND/ OR STONE FRAGMENTS WITH SAND, TRACE CLAY, TRACE SILT, DAMP	5								6	VISUAL
	12														
536.2															
	14	18/22/24				6	39	27	17	10	7	NP	NP	3	A-1-b
533.7	16														
		10/10/12				7								2	VISUAL
	18														
531.2															
		10/12/14				8	47	30	10	8	5	NP	NP	4	A-1-b
	20														
	22														
526.2															
	24	8/8/8				9								4	VISUAL
	26														
					27.0'										
	28														
521.2		20/10/12			MEDIUM DENSE, BROWN COARSE AND FINE SAND, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, DAMP	10	5	43	39	11	2	NP	NP	4	A-3a
	30														
	32				32.0'										
516.2															
	34	44/14/8			MEDIUM DENSE, BROWN GRAVEL AND/ OR STONE FRAGMENTS WITH SAND, LITTLE SILT, TRACE CLAY,	11	29	24	27	19	1	NP	NP	5	A-1-b

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

Project Identification: HAM-75-2.30 PID 76257
Hamilton County, Ohio

Boring No. B-212

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
514.7																	
	36						DAMP										
	38																
511.2						38.5'											
		50-2"					VERY DENSE, BROWN GRAVEL AND/ OR STONE FRAGMENTS WITH SAND, LITTLE SILT, TRACE CLAY, DRY	12								1	VISUAL
	40																
	42					41.5'											
506.2																	
	44	36/12/12					MEDIUM DENSE, BROWN GRAVEL AND/ OR STONE FRAGMENTS, LITTLE SAND, TRACE SILT, TRACE CLAY, DRY	13								1	VISUAL
	46																
	48																
501.2		28/14/12						14	82	6	8	3	1	NP	NP	1	A-1-a
499.7	50					50.0'											

BOTTOM OF BORING = 50.0'

APPENDIX IV

DRIVEN ANALYSIS OUTPUT

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: J:\GEOTECH\ANALYSIS\D2BZEP~U.2\B-212.DVN
Project Name: HAM-75-0992 - B-212 Project Date: 06/18/2012
Project Client: EMHT
Computed By: Brian Trenner
Project Manager: Jonathan Sterenberg

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 0.00 ft
Diameter of Pile: 14.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	34.70 ft
	- Driving/Restrike	34.70 ft
	- Ultimate:	34.70 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesionless	6.00 ft	0.00%	130.00 pcf	33.0/33.0	Nordlund
2	Cohesionless	7.00 ft	0.00%	130.00 pcf	32.0/32.0	Nordlund
3	Cohesionless	5.00 ft	0.00%	125.00 pcf	30.0/30.0	Nordlund
4	Cohesionless	21.00 ft	0.00%	130.00 pcf	32.0/32.0	Nordlund
5	Cohesionless	2.00 ft	0.00%	130.00 pcf	32.0/32.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.65 psf	21.99	N/A	0.00 Kips
5.99 ft	Cohesionless	389.35 psf	21.99	N/A	4.05 Kips
6.01 ft	Cohesionless	780.65 psf	21.33	N/A	4.07 Kips
12.99 ft	Cohesionless	1234.35 psf	21.33	N/A	17.61 Kips
13.01 ft	Cohesionless	1690.62 psf	19.99	N/A	17.65 Kips
17.99 ft	Cohesionless	2001.88 psf	19.99	N/A	30.11 Kips
18.01 ft	Cohesionless	2315.65 psf	21.33	N/A	30.17 Kips
27.01 ft	Cohesionless	2900.65 psf	21.33	N/A	71.16 Kips
34.69 ft	Cohesionless	3399.85 psf	21.33	N/A	119.22 Kips
34.71 ft	Cohesionless	4486.34 psf	21.33	N/A	119.36 Kips
38.99 ft	Cohesionless	4631.00 psf	21.33	N/A	150.47 Kips
39.01 ft	Cohesionless	4777.02 psf	21.33	N/A	150.62 Kips
40.99 ft	Cohesionless	4843.94 psf	21.33	N/A	165.68 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.30 psf	47.20	53.45 Kips	0.04 Kips
5.99 ft	Cohesionless	778.70 psf	47.20	53.45 Kips	25.37 Kips
6.01 ft	Cohesionless	781.30 psf	40.40	35.28 Kips	21.11 Kips
12.99 ft	Cohesionless	1688.70 psf	40.40	35.28 Kips	35.28 Kips
13.01 ft	Cohesionless	1691.25 psf	30.00	14.24 Kips	14.24 Kips
17.99 ft	Cohesionless	2313.75 psf	30.00	14.24 Kips	14.24 Kips
18.01 ft	Cohesionless	2316.30 psf	40.40	35.28 Kips	35.28 Kips
27.01 ft	Cohesionless	3486.30 psf	40.40	35.28 Kips	35.28 Kips
34.69 ft	Cohesionless	4484.70 psf	40.40	35.28 Kips	35.28 Kips
34.71 ft	Cohesionless	4486.68 psf	40.40	35.28 Kips	35.28 Kips
38.99 ft	Cohesionless	4776.00 psf	40.40	35.28 Kips	35.28 Kips
39.01 ft	Cohesionless	4777.36 psf	40.40	35.28 Kips	35.28 Kips
40.99 ft	Cohesionless	4911.20 psf	40.40	35.28 Kips	35.28 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.04 Kips	0.04 Kips
5.99 ft	4.05 Kips	25.37 Kips	29.41 Kips
6.01 ft	4.07 Kips	21.11 Kips	25.18 Kips
12.99 ft	17.61 Kips	35.28 Kips	52.88 Kips
13.01 ft	17.65 Kips	14.24 Kips	31.89 Kips
17.99 ft	30.11 Kips	14.24 Kips	44.35 Kips
18.01 ft	30.17 Kips	35.28 Kips	65.45 Kips
27.01 ft	71.16 Kips	35.28 Kips	106.44 Kips
34.69 ft	119.22 Kips	35.28 Kips	154.49 Kips
34.71 ft	119.36 Kips	35.28 Kips	154.63 Kips
38.99 ft	150.47 Kips	35.28 Kips	185.75 Kips
39.01 ft	150.62 Kips	35.28 Kips	185.90 Kips
40.99 ft	165.68 Kips	35.28 Kips	200.96 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.65 psf	21.99	N/A	0.00 Kips
5.99 ft	Cohesionless	389.35 psf	21.99	N/A	4.05 Kips
6.01 ft	Cohesionless	780.65 psf	21.33	N/A	4.07 Kips
12.99 ft	Cohesionless	1234.35 psf	21.33	N/A	17.61 Kips
13.01 ft	Cohesionless	1690.62 psf	19.99	N/A	17.65 Kips
17.99 ft	Cohesionless	2001.88 psf	19.99	N/A	30.11 Kips
18.01 ft	Cohesionless	2315.65 psf	21.33	N/A	30.17 Kips
27.01 ft	Cohesionless	2900.65 psf	21.33	N/A	71.16 Kips
34.69 ft	Cohesionless	3399.85 psf	21.33	N/A	119.22 Kips
34.71 ft	Cohesionless	4486.34 psf	21.33	N/A	119.36 Kips
38.99 ft	Cohesionless	4631.00 psf	21.33	N/A	150.47 Kips
39.01 ft	Cohesionless	4777.02 psf	21.33	N/A	150.62 Kips
40.99 ft	Cohesionless	4843.94 psf	21.33	N/A	165.68 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.30 psf	47.20	53.45 Kips	0.04 Kips
5.99 ft	Cohesionless	778.70 psf	47.20	53.45 Kips	25.37 Kips
6.01 ft	Cohesionless	781.30 psf	40.40	35.28 Kips	21.11 Kips
12.99 ft	Cohesionless	1688.70 psf	40.40	35.28 Kips	35.28 Kips
13.01 ft	Cohesionless	1691.25 psf	30.00	14.24 Kips	14.24 Kips
17.99 ft	Cohesionless	2313.75 psf	30.00	14.24 Kips	14.24 Kips
18.01 ft	Cohesionless	2316.30 psf	40.40	35.28 Kips	35.28 Kips
27.01 ft	Cohesionless	3486.30 psf	40.40	35.28 Kips	35.28 Kips
34.69 ft	Cohesionless	4484.70 psf	40.40	35.28 Kips	35.28 Kips
34.71 ft	Cohesionless	4486.68 psf	40.40	35.28 Kips	35.28 Kips
38.99 ft	Cohesionless	4776.00 psf	40.40	35.28 Kips	35.28 Kips
39.01 ft	Cohesionless	4777.36 psf	40.40	35.28 Kips	35.28 Kips
40.99 ft	Cohesionless	4911.20 psf	40.40	35.28 Kips	35.28 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.04 Kips	0.04 Kips
5.99 ft	4.05 Kips	25.37 Kips	29.41 Kips
6.01 ft	4.07 Kips	21.11 Kips	25.18 Kips
12.99 ft	17.61 Kips	35.28 Kips	52.88 Kips
13.01 ft	17.65 Kips	14.24 Kips	31.89 Kips
17.99 ft	30.11 Kips	14.24 Kips	44.35 Kips
18.01 ft	30.17 Kips	35.28 Kips	65.45 Kips
27.01 ft	71.16 Kips	35.28 Kips	106.44 Kips
34.69 ft	119.22 Kips	35.28 Kips	154.49 Kips
34.71 ft	119.36 Kips	35.28 Kips	154.63 Kips
38.99 ft	150.47 Kips	35.28 Kips	185.75 Kips
39.01 ft	150.62 Kips	35.28 Kips	185.90 Kips
40.99 ft	165.68 Kips	35.28 Kips	200.96 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.65 psf	21.99	N/A	0.00 Kips
5.99 ft	Cohesionless	389.35 psf	21.99	N/A	4.05 Kips
6.01 ft	Cohesionless	780.65 psf	21.33	N/A	4.07 Kips
12.99 ft	Cohesionless	1234.35 psf	21.33	N/A	17.61 Kips
13.01 ft	Cohesionless	1690.62 psf	19.99	N/A	17.65 Kips
17.99 ft	Cohesionless	2001.88 psf	19.99	N/A	30.11 Kips
18.01 ft	Cohesionless	2315.65 psf	21.33	N/A	30.17 Kips
27.01 ft	Cohesionless	2900.65 psf	21.33	N/A	71.16 Kips
34.69 ft	Cohesionless	3399.85 psf	21.33	N/A	119.22 Kips
34.71 ft	Cohesionless	4486.34 psf	21.33	N/A	119.36 Kips
38.99 ft	Cohesionless	4631.00 psf	21.33	N/A	150.47 Kips
39.01 ft	Cohesionless	4777.02 psf	21.33	N/A	150.62 Kips
40.99 ft	Cohesionless	4843.94 psf	21.33	N/A	165.68 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.30 psf	47.20	53.45 Kips	0.04 Kips
5.99 ft	Cohesionless	778.70 psf	47.20	53.45 Kips	25.37 Kips
6.01 ft	Cohesionless	781.30 psf	40.40	35.28 Kips	21.11 Kips
12.99 ft	Cohesionless	1688.70 psf	40.40	35.28 Kips	35.28 Kips
13.01 ft	Cohesionless	1691.25 psf	30.00	14.24 Kips	14.24 Kips
17.99 ft	Cohesionless	2313.75 psf	30.00	14.24 Kips	14.24 Kips
18.01 ft	Cohesionless	2316.30 psf	40.40	35.28 Kips	35.28 Kips
27.01 ft	Cohesionless	3486.30 psf	40.40	35.28 Kips	35.28 Kips
34.69 ft	Cohesionless	4484.70 psf	40.40	35.28 Kips	35.28 Kips
34.71 ft	Cohesionless	4486.68 psf	40.40	35.28 Kips	35.28 Kips
38.99 ft	Cohesionless	4776.00 psf	40.40	35.28 Kips	35.28 Kips
39.01 ft	Cohesionless	4777.36 psf	40.40	35.28 Kips	35.28 Kips
40.99 ft	Cohesionless	4911.20 psf	40.40	35.28 Kips	35.28 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.04 Kips	0.04 Kips
5.99 ft	4.05 Kips	25.37 Kips	29.41 Kips
6.01 ft	4.07 Kips	21.11 Kips	25.18 Kips
12.99 ft	17.61 Kips	35.28 Kips	52.88 Kips
13.01 ft	17.65 Kips	14.24 Kips	31.89 Kips
17.99 ft	30.11 Kips	14.24 Kips	44.35 Kips
18.01 ft	30.17 Kips	35.28 Kips	65.45 Kips
27.01 ft	71.16 Kips	35.28 Kips	106.44 Kips
34.69 ft	119.22 Kips	35.28 Kips	154.49 Kips
34.71 ft	119.36 Kips	35.28 Kips	154.63 Kips
38.99 ft	150.47 Kips	35.28 Kips	185.75 Kips
39.01 ft	150.62 Kips	35.28 Kips	185.90 Kips
40.99 ft	165.68 Kips	35.28 Kips	200.96 Kips

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: J:\GEOTECH\ANALYSIS\D2BZEP~U.2\B-212.DVN
Project Name: HAM-75-0992 - B-212 Project Date: 06/18/2012
Project Client: EMHT
Computed By: Brian Trenner
Project Manager: Jonathan Sterenberg

PILE INFORMATION

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

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	34.70 ft
	- Driving/Restrike	34.70 ft
	- Ultimate:	34.70 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesionless	6.00 ft	0.00%	130.00 pcf	33.0/33.0	Nordlund
2	Cohesionless	7.00 ft	0.00%	130.00 pcf	32.0/32.0	Nordlund
3	Cohesionless	5.00 ft	0.00%	125.00 pcf	30.0/30.0	Nordlund
4	Cohesionless	14.00 ft	0.00%	130.00 pcf	32.0/32.0	Nordlund
5	Cohesionless	9.00 ft	0.00%	130.00 pcf	32.0/32.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.65 psf	24.17	N/A	0.00 Kips
5.99 ft	Cohesionless	389.35 psf	24.17	N/A	5.54 Kips
6.01 ft	Cohesionless	780.65 psf	23.44	N/A	5.58 Kips
12.99 ft	Cohesionless	1234.35 psf	23.44	N/A	24.00 Kips
13.01 ft	Cohesionless	1690.62 psf	21.97	N/A	24.07 Kips
17.99 ft	Cohesionless	2001.88 psf	21.97	N/A	40.85 Kips
18.01 ft	Cohesionless	2315.65 psf	23.44	N/A	40.93 Kips
27.01 ft	Cohesionless	2900.65 psf	23.44	N/A	96.75 Kips
31.99 ft	Cohesionless	3224.35 psf	23.44	N/A	137.31 Kips
32.01 ft	Cohesionless	4135.65 psf	23.44	N/A	137.49 Kips
34.69 ft	Cohesionless	4309.85 psf	23.44	N/A	162.19 Kips
34.71 ft	Cohesionless	4486.34 psf	23.44	N/A	162.38 Kips
40.99 ft	Cohesionless	4698.60 psf	23.44	N/A	225.46 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.30 psf	47.20	69.81 Kips	0.06 Kips
5.99 ft	Cohesionless	778.70 psf	47.20	69.81 Kips	33.13 Kips
6.01 ft	Cohesionless	781.30 psf	40.40	46.08 Kips	27.57 Kips
12.99 ft	Cohesionless	1688.70 psf	40.40	46.08 Kips	46.08 Kips
13.01 ft	Cohesionless	1691.25 psf	30.00	18.60 Kips	18.60 Kips
17.99 ft	Cohesionless	2313.75 psf	30.00	18.60 Kips	18.60 Kips
18.01 ft	Cohesionless	2316.30 psf	40.40	46.08 Kips	46.08 Kips
27.01 ft	Cohesionless	3486.30 psf	40.40	46.08 Kips	46.08 Kips
31.99 ft	Cohesionless	4133.70 psf	40.40	46.08 Kips	46.08 Kips
32.01 ft	Cohesionless	4136.30 psf	40.40	46.08 Kips	46.08 Kips
34.69 ft	Cohesionless	4484.70 psf	40.40	46.08 Kips	46.08 Kips
34.71 ft	Cohesionless	4486.68 psf	40.40	46.08 Kips	46.08 Kips
40.99 ft	Cohesionless	4911.20 psf	40.40	46.08 Kips	46.08 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.06 Kips	0.06 Kips
5.99 ft	5.54 Kips	33.13 Kips	38.67 Kips
6.01 ft	5.58 Kips	27.57 Kips	33.15 Kips
12.99 ft	24.00 Kips	46.08 Kips	70.08 Kips
13.01 ft	24.07 Kips	18.60 Kips	42.67 Kips
17.99 ft	40.85 Kips	18.60 Kips	59.44 Kips
18.01 ft	40.93 Kips	46.08 Kips	87.01 Kips
27.01 ft	96.75 Kips	46.08 Kips	142.83 Kips
31.99 ft	137.31 Kips	46.08 Kips	183.39 Kips
32.01 ft	137.49 Kips	46.08 Kips	183.57 Kips
34.69 ft	162.19 Kips	46.08 Kips	208.26 Kips
34.71 ft	162.38 Kips	46.08 Kips	208.45 Kips
40.99 ft	225.46 Kips	46.08 Kips	271.54 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.65 psf	24.17	N/A	0.00 Kips
5.99 ft	Cohesionless	389.35 psf	24.17	N/A	5.54 Kips
6.01 ft	Cohesionless	780.65 psf	23.44	N/A	5.58 Kips
12.99 ft	Cohesionless	1234.35 psf	23.44	N/A	24.00 Kips
13.01 ft	Cohesionless	1690.62 psf	21.97	N/A	24.07 Kips
17.99 ft	Cohesionless	2001.88 psf	21.97	N/A	40.85 Kips
18.01 ft	Cohesionless	2315.65 psf	23.44	N/A	40.93 Kips
27.01 ft	Cohesionless	2900.65 psf	23.44	N/A	96.75 Kips
31.99 ft	Cohesionless	3224.35 psf	23.44	N/A	137.31 Kips
32.01 ft	Cohesionless	4135.65 psf	23.44	N/A	137.49 Kips
34.69 ft	Cohesionless	4309.85 psf	23.44	N/A	162.19 Kips
34.71 ft	Cohesionless	4486.34 psf	23.44	N/A	162.38 Kips
40.99 ft	Cohesionless	4698.60 psf	23.44	N/A	225.46 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.30 psf	47.20	69.81 Kips	0.06 Kips
5.99 ft	Cohesionless	778.70 psf	47.20	69.81 Kips	33.13 Kips
6.01 ft	Cohesionless	781.30 psf	40.40	46.08 Kips	27.57 Kips
12.99 ft	Cohesionless	1688.70 psf	40.40	46.08 Kips	46.08 Kips
13.01 ft	Cohesionless	1691.25 psf	30.00	18.60 Kips	18.60 Kips
17.99 ft	Cohesionless	2313.75 psf	30.00	18.60 Kips	18.60 Kips
18.01 ft	Cohesionless	2316.30 psf	40.40	46.08 Kips	46.08 Kips
27.01 ft	Cohesionless	3486.30 psf	40.40	46.08 Kips	46.08 Kips
31.99 ft	Cohesionless	4133.70 psf	40.40	46.08 Kips	46.08 Kips
32.01 ft	Cohesionless	4136.30 psf	40.40	46.08 Kips	46.08 Kips
34.69 ft	Cohesionless	4484.70 psf	40.40	46.08 Kips	46.08 Kips
34.71 ft	Cohesionless	4486.68 psf	40.40	46.08 Kips	46.08 Kips
40.99 ft	Cohesionless	4911.20 psf	40.40	46.08 Kips	46.08 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.06 Kips	0.06 Kips
5.99 ft	5.54 Kips	33.13 Kips	38.67 Kips
6.01 ft	5.58 Kips	27.57 Kips	33.15 Kips
12.99 ft	24.00 Kips	46.08 Kips	70.08 Kips
13.01 ft	24.07 Kips	18.60 Kips	42.67 Kips
17.99 ft	40.85 Kips	18.60 Kips	59.44 Kips
18.01 ft	40.93 Kips	46.08 Kips	87.01 Kips
27.01 ft	96.75 Kips	46.08 Kips	142.83 Kips
31.99 ft	137.31 Kips	46.08 Kips	183.39 Kips
32.01 ft	137.49 Kips	46.08 Kips	183.57 Kips
34.69 ft	162.19 Kips	46.08 Kips	208.26 Kips
34.71 ft	162.38 Kips	46.08 Kips	208.45 Kips
40.99 ft	225.46 Kips	46.08 Kips	271.54 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.65 psf	24.17	N/A	0.00 Kips
5.99 ft	Cohesionless	389.35 psf	24.17	N/A	5.54 Kips
6.01 ft	Cohesionless	780.65 psf	23.44	N/A	5.58 Kips
12.99 ft	Cohesionless	1234.35 psf	23.44	N/A	24.00 Kips
13.01 ft	Cohesionless	1690.62 psf	21.97	N/A	24.07 Kips
17.99 ft	Cohesionless	2001.88 psf	21.97	N/A	40.85 Kips
18.01 ft	Cohesionless	2315.65 psf	23.44	N/A	40.93 Kips
27.01 ft	Cohesionless	2900.65 psf	23.44	N/A	96.75 Kips
31.99 ft	Cohesionless	3224.35 psf	23.44	N/A	137.31 Kips
32.01 ft	Cohesionless	4135.65 psf	23.44	N/A	137.49 Kips
34.69 ft	Cohesionless	4309.85 psf	23.44	N/A	162.19 Kips
34.71 ft	Cohesionless	4486.34 psf	23.44	N/A	162.38 Kips
40.99 ft	Cohesionless	4698.60 psf	23.44	N/A	225.46 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.30 psf	47.20	69.81 Kips	0.06 Kips
5.99 ft	Cohesionless	778.70 psf	47.20	69.81 Kips	33.13 Kips
6.01 ft	Cohesionless	781.30 psf	40.40	46.08 Kips	27.57 Kips
12.99 ft	Cohesionless	1688.70 psf	40.40	46.08 Kips	46.08 Kips
13.01 ft	Cohesionless	1691.25 psf	30.00	18.60 Kips	18.60 Kips
17.99 ft	Cohesionless	2313.75 psf	30.00	18.60 Kips	18.60 Kips
18.01 ft	Cohesionless	2316.30 psf	40.40	46.08 Kips	46.08 Kips
27.01 ft	Cohesionless	3486.30 psf	40.40	46.08 Kips	46.08 Kips
31.99 ft	Cohesionless	4133.70 psf	40.40	46.08 Kips	46.08 Kips
32.01 ft	Cohesionless	4136.30 psf	40.40	46.08 Kips	46.08 Kips
34.69 ft	Cohesionless	4484.70 psf	40.40	46.08 Kips	46.08 Kips
34.71 ft	Cohesionless	4486.68 psf	40.40	46.08 Kips	46.08 Kips
40.99 ft	Cohesionless	4911.20 psf	40.40	46.08 Kips	46.08 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.06 Kips	0.06 Kips
5.99 ft	5.54 Kips	33.13 Kips	38.67 Kips
6.01 ft	5.58 Kips	27.57 Kips	33.15 Kips
12.99 ft	24.00 Kips	46.08 Kips	70.08 Kips
13.01 ft	24.07 Kips	18.60 Kips	42.67 Kips
17.99 ft	40.85 Kips	18.60 Kips	59.44 Kips
18.01 ft	40.93 Kips	46.08 Kips	87.01 Kips
27.01 ft	96.75 Kips	46.08 Kips	142.83 Kips
31.99 ft	137.31 Kips	46.08 Kips	183.39 Kips
32.01 ft	137.49 Kips	46.08 Kips	183.57 Kips
34.69 ft	162.19 Kips	46.08 Kips	208.26 Kips
34.71 ft	162.38 Kips	46.08 Kips	208.45 Kips
40.99 ft	225.46 Kips	46.08 Kips	271.54 Kips

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: J:\GEOTECH\ANALYSIS\D2BZEP~U.2\B-211-P.DVN
Project Name: HAM-75-0992 -B-211- ier Project Date: 06/18/2012
Project Client: EMHT
Computed By: Brian Trenner
Project Manager: Jonathan Sterenberg

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 0.00 ft
Diameter of Pile: 14.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	41.00 ft
	- Driving/Restrike	41.00 ft
	- Ultimate:	41.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesionless	7.00 ft	0.00%	120.00 pcf	28.0/28.0	Nordlund
2	Cohesionless	12.50 ft	0.00%	130.00 pcf	34.0/34.0	Nordlund
3	Cohesionless	7.50 ft	0.00%	130.00 pcf	32.0/32.0	Nordlund
4	Cohesionless	24.00 ft	0.00%	125.00 pcf	30.0/30.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.60 psf	18.66	N/A	0.00 Kips
6.99 ft	Cohesionless	419.40 psf	18.66	N/A	3.11 Kips
7.01 ft	Cohesionless	840.65 psf	22.66	N/A	3.13 Kips
16.01 ft	Cohesionless	1425.65 psf	22.66	N/A	27.59 Kips
19.49 ft	Cohesionless	1651.85 psf	22.66	N/A	42.42 Kips
19.51 ft	Cohesionless	2465.65 psf	21.33	N/A	42.51 Kips
26.99 ft	Cohesionless	2951.85 psf	21.33	N/A	77.18 Kips
27.01 ft	Cohesionless	3440.63 psf	19.99	N/A	77.28 Kips
36.01 ft	Cohesionless	4003.13 psf	19.99	N/A	122.27 Kips
40.99 ft	Cohesionless	4314.38 psf	19.99	N/A	152.60 Kips
41.01 ft	Cohesionless	5190.31 psf	19.99	N/A	152.73 Kips
50.01 ft	Cohesionless	5472.01 psf	19.99	N/A	214.23 Kips
50.99 ft	Cohesionless	5502.69 psf	19.99	N/A	221.31 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.20 psf	22.80	14.24 Kips	0.02 Kips
6.99 ft	Cohesionless	838.80 psf	22.80	14.24 Kips	10.96 Kips
7.01 ft	Cohesionless	841.30 psf	55.60	78.59 Kips	33.14 Kips
16.01 ft	Cohesionless	2011.30 psf	55.60	78.59 Kips	78.59 Kips
19.49 ft	Cohesionless	2463.70 psf	55.60	78.59 Kips	78.59 Kips
19.51 ft	Cohesionless	2466.30 psf	40.40	35.28 Kips	35.28 Kips
26.99 ft	Cohesionless	3438.70 psf	40.40	35.28 Kips	35.28 Kips
27.01 ft	Cohesionless	3441.25 psf	30.00	14.24 Kips	14.24 Kips
36.01 ft	Cohesionless	4566.25 psf	30.00	14.24 Kips	14.24 Kips
40.99 ft	Cohesionless	5188.75 psf	30.00	14.24 Kips	14.24 Kips
41.01 ft	Cohesionless	5190.63 psf	30.00	14.24 Kips	14.24 Kips
50.01 ft	Cohesionless	5754.03 psf	30.00	14.24 Kips	14.24 Kips
50.99 ft	Cohesionless	5815.37 psf	30.00	14.24 Kips	14.24 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.02 Kips	0.02 Kips
6.99 ft	3.11 Kips	10.96 Kips	14.07 Kips
7.01 ft	3.13 Kips	33.14 Kips	36.28 Kips
16.01 ft	27.59 Kips	78.59 Kips	106.18 Kips
19.49 ft	42.42 Kips	78.59 Kips	121.02 Kips
19.51 ft	42.51 Kips	35.28 Kips	77.79 Kips
26.99 ft	77.18 Kips	35.28 Kips	112.46 Kips
27.01 ft	77.28 Kips	14.24 Kips	91.52 Kips
36.01 ft	122.27 Kips	14.24 Kips	136.51 Kips
40.99 ft	152.60 Kips	14.24 Kips	166.84 Kips
41.01 ft	152.73 Kips	14.24 Kips	166.97 Kips
50.01 ft	214.23 Kips	14.24 Kips	228.47 Kips
50.99 ft	221.31 Kips	14.24 Kips	235.55 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.60 psf	18.66	N/A	0.00 Kips
6.99 ft	Cohesionless	419.40 psf	18.66	N/A	3.11 Kips
7.01 ft	Cohesionless	840.65 psf	22.66	N/A	3.13 Kips
16.01 ft	Cohesionless	1425.65 psf	22.66	N/A	27.59 Kips
19.49 ft	Cohesionless	1651.85 psf	22.66	N/A	42.42 Kips
19.51 ft	Cohesionless	2465.65 psf	21.33	N/A	42.51 Kips
26.99 ft	Cohesionless	2951.85 psf	21.33	N/A	77.18 Kips
27.01 ft	Cohesionless	3440.63 psf	19.99	N/A	77.28 Kips
36.01 ft	Cohesionless	4003.13 psf	19.99	N/A	122.27 Kips
40.99 ft	Cohesionless	4314.38 psf	19.99	N/A	152.60 Kips
41.01 ft	Cohesionless	5190.31 psf	19.99	N/A	152.73 Kips
50.01 ft	Cohesionless	5472.01 psf	19.99	N/A	214.23 Kips
50.99 ft	Cohesionless	5502.69 psf	19.99	N/A	221.31 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.20 psf	22.80	14.24 Kips	0.02 Kips
6.99 ft	Cohesionless	838.80 psf	22.80	14.24 Kips	10.96 Kips
7.01 ft	Cohesionless	841.30 psf	55.60	78.59 Kips	33.14 Kips
16.01 ft	Cohesionless	2011.30 psf	55.60	78.59 Kips	78.59 Kips
19.49 ft	Cohesionless	2463.70 psf	55.60	78.59 Kips	78.59 Kips
19.51 ft	Cohesionless	2466.30 psf	40.40	35.28 Kips	35.28 Kips
26.99 ft	Cohesionless	3438.70 psf	40.40	35.28 Kips	35.28 Kips
27.01 ft	Cohesionless	3441.25 psf	30.00	14.24 Kips	14.24 Kips
36.01 ft	Cohesionless	4566.25 psf	30.00	14.24 Kips	14.24 Kips
40.99 ft	Cohesionless	5188.75 psf	30.00	14.24 Kips	14.24 Kips
41.01 ft	Cohesionless	5190.63 psf	30.00	14.24 Kips	14.24 Kips
50.01 ft	Cohesionless	5754.03 psf	30.00	14.24 Kips	14.24 Kips
50.99 ft	Cohesionless	5815.37 psf	30.00	14.24 Kips	14.24 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.02 Kips	0.02 Kips
6.99 ft	3.11 Kips	10.96 Kips	14.07 Kips
7.01 ft	3.13 Kips	33.14 Kips	36.28 Kips
16.01 ft	27.59 Kips	78.59 Kips	106.18 Kips
19.49 ft	42.42 Kips	78.59 Kips	121.02 Kips
19.51 ft	42.51 Kips	35.28 Kips	77.79 Kips
26.99 ft	77.18 Kips	35.28 Kips	112.46 Kips
27.01 ft	77.28 Kips	14.24 Kips	91.52 Kips
36.01 ft	122.27 Kips	14.24 Kips	136.51 Kips
40.99 ft	152.60 Kips	14.24 Kips	166.84 Kips
41.01 ft	152.73 Kips	14.24 Kips	166.97 Kips
50.01 ft	214.23 Kips	14.24 Kips	228.47 Kips
50.99 ft	221.31 Kips	14.24 Kips	235.55 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.60 psf	18.66	N/A	0.00 Kips
6.99 ft	Cohesionless	419.40 psf	18.66	N/A	3.11 Kips
7.01 ft	Cohesionless	840.65 psf	22.66	N/A	3.13 Kips
16.01 ft	Cohesionless	1425.65 psf	22.66	N/A	27.59 Kips
19.49 ft	Cohesionless	1651.85 psf	22.66	N/A	42.42 Kips
19.51 ft	Cohesionless	2465.65 psf	21.33	N/A	42.51 Kips
26.99 ft	Cohesionless	2951.85 psf	21.33	N/A	77.18 Kips
27.01 ft	Cohesionless	3440.63 psf	19.99	N/A	77.28 Kips
36.01 ft	Cohesionless	4003.13 psf	19.99	N/A	122.27 Kips
40.99 ft	Cohesionless	4314.38 psf	19.99	N/A	152.60 Kips
41.01 ft	Cohesionless	5190.31 psf	19.99	N/A	152.73 Kips
50.01 ft	Cohesionless	5472.01 psf	19.99	N/A	214.23 Kips
50.99 ft	Cohesionless	5502.69 psf	19.99	N/A	221.31 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.20 psf	22.80	14.24 Kips	0.02 Kips
6.99 ft	Cohesionless	838.80 psf	22.80	14.24 Kips	10.96 Kips
7.01 ft	Cohesionless	841.30 psf	55.60	78.59 Kips	33.14 Kips
16.01 ft	Cohesionless	2011.30 psf	55.60	78.59 Kips	78.59 Kips
19.49 ft	Cohesionless	2463.70 psf	55.60	78.59 Kips	78.59 Kips
19.51 ft	Cohesionless	2466.30 psf	40.40	35.28 Kips	35.28 Kips
26.99 ft	Cohesionless	3438.70 psf	40.40	35.28 Kips	35.28 Kips
27.01 ft	Cohesionless	3441.25 psf	30.00	14.24 Kips	14.24 Kips
36.01 ft	Cohesionless	4566.25 psf	30.00	14.24 Kips	14.24 Kips
40.99 ft	Cohesionless	5188.75 psf	30.00	14.24 Kips	14.24 Kips
41.01 ft	Cohesionless	5190.63 psf	30.00	14.24 Kips	14.24 Kips
50.01 ft	Cohesionless	5754.03 psf	30.00	14.24 Kips	14.24 Kips
50.99 ft	Cohesionless	5815.37 psf	30.00	14.24 Kips	14.24 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.02 Kips	0.02 Kips
6.99 ft	3.11 Kips	10.96 Kips	14.07 Kips
7.01 ft	3.13 Kips	33.14 Kips	36.28 Kips
16.01 ft	27.59 Kips	78.59 Kips	106.18 Kips
19.49 ft	42.42 Kips	78.59 Kips	121.02 Kips
19.51 ft	42.51 Kips	35.28 Kips	77.79 Kips
26.99 ft	77.18 Kips	35.28 Kips	112.46 Kips
27.01 ft	77.28 Kips	14.24 Kips	91.52 Kips
36.01 ft	122.27 Kips	14.24 Kips	136.51 Kips
40.99 ft	152.60 Kips	14.24 Kips	166.84 Kips
41.01 ft	152.73 Kips	14.24 Kips	166.97 Kips
50.01 ft	214.23 Kips	14.24 Kips	228.47 Kips
50.99 ft	221.31 Kips	14.24 Kips	235.55 Kips

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: J:\GEOTECH\ANALYSIS\D2BZEP~U.2\B-211-P.DVN
Project Name: HAM-75-0992 -B-211- ier Project Date: 06/18/2012
Project Client: EMHT
Computed By: Brian Trenner
Project Manager: Jonathan Sterenberg

PILE INFORMATION

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

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	41.00 ft
	- Driving/Restrike	41.00 ft
	- Ultimate:	41.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesionless	7.00 ft	0.00%	120.00 pcf	28.0/28.0	Nordlund
2	Cohesionless	12.50 ft	0.00%	130.00 pcf	34.0/34.0	Nordlund
3	Cohesionless	7.50 ft	0.00%	130.00 pcf	32.0/32.0	Nordlund
4	Cohesionless	15.00 ft	0.00%	125.00 pcf	30.0/30.0	Nordlund
5	Cohesionless	9.00 ft	0.00%	125.00 pcf	30.0/30.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.60 psf	20.51	N/A	0.00 Kips
6.99 ft	Cohesionless	419.40 psf	20.51	N/A	4.16 Kips
7.01 ft	Cohesionless	840.65 psf	24.90	N/A	4.19 Kips
16.01 ft	Cohesionless	1425.65 psf	24.90	N/A	37.81 Kips
19.49 ft	Cohesionless	1651.85 psf	24.90	N/A	58.21 Kips
19.51 ft	Cohesionless	2465.65 psf	23.44	N/A	58.33 Kips
26.99 ft	Cohesionless	2951.85 psf	23.44	N/A	105.54 Kips
27.01 ft	Cohesionless	3440.63 psf	21.97	N/A	105.67 Kips
36.01 ft	Cohesionless	4003.13 psf	21.97	N/A	166.29 Kips
40.99 ft	Cohesionless	4314.38 psf	21.97	N/A	207.16 Kips
41.01 ft	Cohesionless	5190.31 psf	21.97	N/A	207.33 Kips
41.99 ft	Cohesionless	5220.99 psf	21.97	N/A	215.94 Kips
42.01 ft	Cohesionless	5252.91 psf	21.97	N/A	216.12 Kips
50.99 ft	Cohesionless	5533.99 psf	21.97	N/A	299.73 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.20 psf	22.80	18.60 Kips	0.02 Kips
6.99 ft	Cohesionless	838.80 psf	22.80	18.60 Kips	14.31 Kips
7.01 ft	Cohesionless	841.30 psf	55.60	102.65 Kips	43.29 Kips
16.01 ft	Cohesionless	2011.30 psf	55.60	102.65 Kips	102.65 Kips
19.49 ft	Cohesionless	2463.70 psf	55.60	102.65 Kips	102.65 Kips
19.51 ft	Cohesionless	2466.30 psf	40.40	46.08 Kips	46.08 Kips
26.99 ft	Cohesionless	3438.70 psf	40.40	46.08 Kips	46.08 Kips
27.01 ft	Cohesionless	3441.25 psf	30.00	18.60 Kips	18.60 Kips
36.01 ft	Cohesionless	4566.25 psf	30.00	18.60 Kips	18.60 Kips
40.99 ft	Cohesionless	5188.75 psf	30.00	18.60 Kips	18.60 Kips
41.01 ft	Cohesionless	5190.63 psf	30.00	18.60 Kips	18.60 Kips
41.99 ft	Cohesionless	5251.97 psf	30.00	18.60 Kips	18.60 Kips
42.01 ft	Cohesionless	5253.23 psf	30.00	18.60 Kips	18.60 Kips
50.99 ft	Cohesionless	5815.37 psf	30.00	18.60 Kips	18.60 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.02 Kips	0.02 Kips
6.99 ft	4.16 Kips	14.31 Kips	18.47 Kips
7.01 ft	4.19 Kips	43.29 Kips	47.48 Kips
16.01 ft	37.81 Kips	102.65 Kips	140.47 Kips
19.49 ft	58.21 Kips	102.65 Kips	160.86 Kips
19.51 ft	58.33 Kips	46.08 Kips	104.40 Kips
26.99 ft	105.54 Kips	46.08 Kips	151.61 Kips
27.01 ft	105.67 Kips	18.60 Kips	124.27 Kips
36.01 ft	166.29 Kips	18.60 Kips	184.89 Kips
40.99 ft	207.16 Kips	18.60 Kips	225.76 Kips
41.01 ft	207.33 Kips	18.60 Kips	225.93 Kips
41.99 ft	215.94 Kips	18.60 Kips	234.54 Kips
42.01 ft	216.12 Kips	18.60 Kips	234.72 Kips
50.99 ft	299.73 Kips	18.60 Kips	318.33 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.60 psf	20.51	N/A	0.00 Kips
6.99 ft	Cohesionless	419.40 psf	20.51	N/A	4.16 Kips
7.01 ft	Cohesionless	840.65 psf	24.90	N/A	4.19 Kips
16.01 ft	Cohesionless	1425.65 psf	24.90	N/A	37.81 Kips
19.49 ft	Cohesionless	1651.85 psf	24.90	N/A	58.21 Kips
19.51 ft	Cohesionless	2465.65 psf	23.44	N/A	58.33 Kips
26.99 ft	Cohesionless	2951.85 psf	23.44	N/A	105.54 Kips
27.01 ft	Cohesionless	3440.63 psf	21.97	N/A	105.67 Kips
36.01 ft	Cohesionless	4003.13 psf	21.97	N/A	166.29 Kips
40.99 ft	Cohesionless	4314.38 psf	21.97	N/A	207.16 Kips
41.01 ft	Cohesionless	5190.31 psf	21.97	N/A	207.33 Kips
41.99 ft	Cohesionless	5220.99 psf	21.97	N/A	215.94 Kips
42.01 ft	Cohesionless	5252.91 psf	21.97	N/A	216.12 Kips
50.99 ft	Cohesionless	5533.99 psf	21.97	N/A	299.73 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.20 psf	22.80	18.60 Kips	0.02 Kips
6.99 ft	Cohesionless	838.80 psf	22.80	18.60 Kips	14.31 Kips
7.01 ft	Cohesionless	841.30 psf	55.60	102.65 Kips	43.29 Kips
16.01 ft	Cohesionless	2011.30 psf	55.60	102.65 Kips	102.65 Kips
19.49 ft	Cohesionless	2463.70 psf	55.60	102.65 Kips	102.65 Kips
19.51 ft	Cohesionless	2466.30 psf	40.40	46.08 Kips	46.08 Kips
26.99 ft	Cohesionless	3438.70 psf	40.40	46.08 Kips	46.08 Kips
27.01 ft	Cohesionless	3441.25 psf	30.00	18.60 Kips	18.60 Kips
36.01 ft	Cohesionless	4566.25 psf	30.00	18.60 Kips	18.60 Kips
40.99 ft	Cohesionless	5188.75 psf	30.00	18.60 Kips	18.60 Kips
41.01 ft	Cohesionless	5190.63 psf	30.00	18.60 Kips	18.60 Kips
41.99 ft	Cohesionless	5251.97 psf	30.00	18.60 Kips	18.60 Kips
42.01 ft	Cohesionless	5253.23 psf	30.00	18.60 Kips	18.60 Kips
50.99 ft	Cohesionless	5815.37 psf	30.00	18.60 Kips	18.60 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.02 Kips	0.02 Kips
6.99 ft	4.16 Kips	14.31 Kips	18.47 Kips
7.01 ft	4.19 Kips	43.29 Kips	47.48 Kips
16.01 ft	37.81 Kips	102.65 Kips	140.47 Kips
19.49 ft	58.21 Kips	102.65 Kips	160.86 Kips
19.51 ft	58.33 Kips	46.08 Kips	104.40 Kips
26.99 ft	105.54 Kips	46.08 Kips	151.61 Kips
27.01 ft	105.67 Kips	18.60 Kips	124.27 Kips
36.01 ft	166.29 Kips	18.60 Kips	184.89 Kips
40.99 ft	207.16 Kips	18.60 Kips	225.76 Kips
41.01 ft	207.33 Kips	18.60 Kips	225.93 Kips
41.99 ft	215.94 Kips	18.60 Kips	234.54 Kips
42.01 ft	216.12 Kips	18.60 Kips	234.72 Kips
50.99 ft	299.73 Kips	18.60 Kips	318.33 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.60 psf	20.51	N/A	0.00 Kips
6.99 ft	Cohesionless	419.40 psf	20.51	N/A	4.16 Kips
7.01 ft	Cohesionless	840.65 psf	24.90	N/A	4.19 Kips
16.01 ft	Cohesionless	1425.65 psf	24.90	N/A	37.81 Kips
19.49 ft	Cohesionless	1651.85 psf	24.90	N/A	58.21 Kips
19.51 ft	Cohesionless	2465.65 psf	23.44	N/A	58.33 Kips
26.99 ft	Cohesionless	2951.85 psf	23.44	N/A	105.54 Kips
27.01 ft	Cohesionless	3440.63 psf	21.97	N/A	105.67 Kips
36.01 ft	Cohesionless	4003.13 psf	21.97	N/A	166.29 Kips
40.99 ft	Cohesionless	4314.38 psf	21.97	N/A	207.16 Kips
41.01 ft	Cohesionless	5190.31 psf	21.97	N/A	207.33 Kips
41.99 ft	Cohesionless	5220.99 psf	21.97	N/A	215.94 Kips
42.01 ft	Cohesionless	5252.91 psf	21.97	N/A	216.12 Kips
50.99 ft	Cohesionless	5533.99 psf	21.97	N/A	299.73 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.20 psf	22.80	18.60 Kips	0.02 Kips
6.99 ft	Cohesionless	838.80 psf	22.80	18.60 Kips	14.31 Kips
7.01 ft	Cohesionless	841.30 psf	55.60	102.65 Kips	43.29 Kips
16.01 ft	Cohesionless	2011.30 psf	55.60	102.65 Kips	102.65 Kips
19.49 ft	Cohesionless	2463.70 psf	55.60	102.65 Kips	102.65 Kips
19.51 ft	Cohesionless	2466.30 psf	40.40	46.08 Kips	46.08 Kips
26.99 ft	Cohesionless	3438.70 psf	40.40	46.08 Kips	46.08 Kips
27.01 ft	Cohesionless	3441.25 psf	30.00	18.60 Kips	18.60 Kips
36.01 ft	Cohesionless	4566.25 psf	30.00	18.60 Kips	18.60 Kips
40.99 ft	Cohesionless	5188.75 psf	30.00	18.60 Kips	18.60 Kips
41.01 ft	Cohesionless	5190.63 psf	30.00	18.60 Kips	18.60 Kips
41.99 ft	Cohesionless	5251.97 psf	30.00	18.60 Kips	18.60 Kips
42.01 ft	Cohesionless	5253.23 psf	30.00	18.60 Kips	18.60 Kips
50.99 ft	Cohesionless	5815.37 psf	30.00	18.60 Kips	18.60 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.02 Kips	0.02 Kips
6.99 ft	4.16 Kips	14.31 Kips	18.47 Kips
7.01 ft	4.19 Kips	43.29 Kips	47.48 Kips
16.01 ft	37.81 Kips	102.65 Kips	140.47 Kips
19.49 ft	58.21 Kips	102.65 Kips	160.86 Kips
19.51 ft	58.33 Kips	46.08 Kips	104.40 Kips
26.99 ft	105.54 Kips	46.08 Kips	151.61 Kips
27.01 ft	105.67 Kips	18.60 Kips	124.27 Kips
36.01 ft	166.29 Kips	18.60 Kips	184.89 Kips
40.99 ft	207.16 Kips	18.60 Kips	225.76 Kips
41.01 ft	207.33 Kips	18.60 Kips	225.93 Kips
41.99 ft	215.94 Kips	18.60 Kips	234.54 Kips
42.01 ft	216.12 Kips	18.60 Kips	234.72 Kips
50.99 ft	299.73 Kips	18.60 Kips	318.33 Kips

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: J:\GEOTECH\ANALYSIS\D2BZEP~U.2\B-211-A.DVN
Project Name: HAM-75-0992 -B-211- Abut Project Date: 06/18/2012
Project Client: EMHT
Computed By: Brian Trenner
Project Manager: Jonathan Sterenberg

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 0.00 ft
Diameter of Pile: 14.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	54.00 ft
	- Driving/Restrike	54.00 ft
	- Ultimate:	54.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesionless	24.00 ft	0.00%	120.00 pcf	28.0/28.0	Nordlund
2	Cohesionless	12.50 ft	0.00%	130.00 pcf	34.0/34.0	Nordlund
3	Cohesionless	1.50 ft	0.00%	130.00 pcf	32.0/32.0	Nordlund
4	Cohesionless	6.00 ft	0.00%	130.00 pcf	32.0/32.0	Nordlund
5	Cohesionless	20.00 ft	0.00%	125.00 pcf	30.0/30.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.60 psf	18.66	N/A	0.00 Kips
9.01 ft	Cohesionless	540.60 psf	18.66	N/A	5.16 Kips
18.01 ft	Cohesionless	1080.60 psf	18.66	N/A	20.63 Kips
23.99 ft	Cohesionless	1439.40 psf	18.66	N/A	36.60 Kips
24.01 ft	Cohesionless	2880.65 psf	22.66	N/A	36.69 Kips
33.01 ft	Cohesionless	3465.65 psf	22.66	N/A	96.12 Kips
36.49 ft	Cohesionless	3691.85 psf	22.66	N/A	124.48 Kips
36.51 ft	Cohesionless	4505.65 psf	21.33	N/A	124.64 Kips
37.99 ft	Cohesionless	4601.85 psf	21.33	N/A	135.33 Kips
38.01 ft	Cohesionless	4700.65 psf	21.33	N/A	135.48 Kips
43.99 ft	Cohesionless	5089.35 psf	21.33	N/A	183.27 Kips
44.01 ft	Cohesionless	5480.62 psf	19.99	N/A	183.42 Kips
53.01 ft	Cohesionless	6043.12 psf	19.99	N/A	251.34 Kips
53.99 ft	Cohesionless	6104.38 psf	19.99	N/A	259.50 Kips
54.01 ft	Cohesionless	6730.31 psf	19.99	N/A	259.67 Kips
63.01 ft	Cohesionless	7012.01 psf	19.99	N/A	338.47 Kips
63.99 ft	Cohesionless	7042.69 psf	19.99	N/A	347.44 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.20 psf	22.80	14.24 Kips	0.02 Kips
9.01 ft	Cohesionless	1081.20 psf	22.80	14.24 Kips	14.13 Kips
18.01 ft	Cohesionless	2161.20 psf	22.80	14.24 Kips	14.24 Kips
23.99 ft	Cohesionless	2878.80 psf	22.80	14.24 Kips	14.24 Kips
24.01 ft	Cohesionless	2881.30 psf	55.60	78.59 Kips	78.59 Kips
33.01 ft	Cohesionless	4051.30 psf	55.60	78.59 Kips	78.59 Kips
36.49 ft	Cohesionless	4503.70 psf	55.60	78.59 Kips	78.59 Kips
36.51 ft	Cohesionless	4506.30 psf	40.40	35.28 Kips	35.28 Kips
37.99 ft	Cohesionless	4698.70 psf	40.40	35.28 Kips	35.28 Kips
38.01 ft	Cohesionless	4701.30 psf	40.40	35.28 Kips	35.28 Kips
43.99 ft	Cohesionless	5478.70 psf	40.40	35.28 Kips	35.28 Kips
44.01 ft	Cohesionless	5481.25 psf	30.00	14.24 Kips	14.24 Kips
53.01 ft	Cohesionless	6606.25 psf	30.00	14.24 Kips	14.24 Kips
53.99 ft	Cohesionless	6728.75 psf	30.00	14.24 Kips	14.24 Kips
54.01 ft	Cohesionless	6730.63 psf	30.00	14.24 Kips	14.24 Kips
63.01 ft	Cohesionless	7294.03 psf	30.00	14.24 Kips	14.24 Kips
63.99 ft	Cohesionless	7355.37 psf	30.00	14.24 Kips	14.24 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.02 Kips	0.02 Kips
9.01 ft	5.16 Kips	14.13 Kips	19.29 Kips
18.01 ft	20.63 Kips	14.24 Kips	34.87 Kips
23.99 ft	36.60 Kips	14.24 Kips	50.84 Kips
24.01 ft	36.69 Kips	78.59 Kips	115.28 Kips
33.01 ft	96.12 Kips	78.59 Kips	174.72 Kips
36.49 ft	124.48 Kips	78.59 Kips	203.08 Kips
36.51 ft	124.64 Kips	35.28 Kips	159.92 Kips
37.99 ft	135.33 Kips	35.28 Kips	170.61 Kips
38.01 ft	135.48 Kips	35.28 Kips	170.76 Kips
43.99 ft	183.27 Kips	35.28 Kips	218.54 Kips
44.01 ft	183.42 Kips	14.24 Kips	197.66 Kips
53.01 ft	251.34 Kips	14.24 Kips	265.58 Kips
53.99 ft	259.50 Kips	14.24 Kips	273.74 Kips
54.01 ft	259.67 Kips	14.24 Kips	273.91 Kips
63.01 ft	338.47 Kips	14.24 Kips	352.71 Kips
63.99 ft	347.44 Kips	14.24 Kips	361.68 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.60 psf	18.66	N/A	0.00 Kips
9.01 ft	Cohesionless	540.60 psf	18.66	N/A	5.16 Kips
18.01 ft	Cohesionless	1080.60 psf	18.66	N/A	20.63 Kips
23.99 ft	Cohesionless	1439.40 psf	18.66	N/A	36.60 Kips
24.01 ft	Cohesionless	2880.65 psf	22.66	N/A	36.69 Kips
33.01 ft	Cohesionless	3465.65 psf	22.66	N/A	96.12 Kips
36.49 ft	Cohesionless	3691.85 psf	22.66	N/A	124.48 Kips
36.51 ft	Cohesionless	4505.65 psf	21.33	N/A	124.64 Kips
37.99 ft	Cohesionless	4601.85 psf	21.33	N/A	135.33 Kips
38.01 ft	Cohesionless	4700.65 psf	21.33	N/A	135.48 Kips
43.99 ft	Cohesionless	5089.35 psf	21.33	N/A	183.27 Kips
44.01 ft	Cohesionless	5480.62 psf	19.99	N/A	183.42 Kips
53.01 ft	Cohesionless	6043.12 psf	19.99	N/A	251.34 Kips
53.99 ft	Cohesionless	6104.38 psf	19.99	N/A	259.50 Kips
54.01 ft	Cohesionless	6730.31 psf	19.99	N/A	259.67 Kips
63.01 ft	Cohesionless	7012.01 psf	19.99	N/A	338.47 Kips
63.99 ft	Cohesionless	7042.69 psf	19.99	N/A	347.44 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.20 psf	22.80	14.24 Kips	0.02 Kips
9.01 ft	Cohesionless	1081.20 psf	22.80	14.24 Kips	14.13 Kips
18.01 ft	Cohesionless	2161.20 psf	22.80	14.24 Kips	14.24 Kips
23.99 ft	Cohesionless	2878.80 psf	22.80	14.24 Kips	14.24 Kips
24.01 ft	Cohesionless	2881.30 psf	55.60	78.59 Kips	78.59 Kips
33.01 ft	Cohesionless	4051.30 psf	55.60	78.59 Kips	78.59 Kips
36.49 ft	Cohesionless	4503.70 psf	55.60	78.59 Kips	78.59 Kips
36.51 ft	Cohesionless	4506.30 psf	40.40	35.28 Kips	35.28 Kips
37.99 ft	Cohesionless	4698.70 psf	40.40	35.28 Kips	35.28 Kips
38.01 ft	Cohesionless	4701.30 psf	40.40	35.28 Kips	35.28 Kips
43.99 ft	Cohesionless	5478.70 psf	40.40	35.28 Kips	35.28 Kips
44.01 ft	Cohesionless	5481.25 psf	30.00	14.24 Kips	14.24 Kips
53.01 ft	Cohesionless	6606.25 psf	30.00	14.24 Kips	14.24 Kips
53.99 ft	Cohesionless	6728.75 psf	30.00	14.24 Kips	14.24 Kips
54.01 ft	Cohesionless	6730.63 psf	30.00	14.24 Kips	14.24 Kips
63.01 ft	Cohesionless	7294.03 psf	30.00	14.24 Kips	14.24 Kips
63.99 ft	Cohesionless	7355.37 psf	30.00	14.24 Kips	14.24 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.02 Kips	0.02 Kips
9.01 ft	5.16 Kips	14.13 Kips	19.29 Kips
18.01 ft	20.63 Kips	14.24 Kips	34.87 Kips
23.99 ft	36.60 Kips	14.24 Kips	50.84 Kips
24.01 ft	36.69 Kips	78.59 Kips	115.28 Kips
33.01 ft	96.12 Kips	78.59 Kips	174.72 Kips
36.49 ft	124.48 Kips	78.59 Kips	203.08 Kips
36.51 ft	124.64 Kips	35.28 Kips	159.92 Kips
37.99 ft	135.33 Kips	35.28 Kips	170.61 Kips
38.01 ft	135.48 Kips	35.28 Kips	170.76 Kips
43.99 ft	183.27 Kips	35.28 Kips	218.54 Kips
44.01 ft	183.42 Kips	14.24 Kips	197.66 Kips
53.01 ft	251.34 Kips	14.24 Kips	265.58 Kips
53.99 ft	259.50 Kips	14.24 Kips	273.74 Kips
54.01 ft	259.67 Kips	14.24 Kips	273.91 Kips
63.01 ft	338.47 Kips	14.24 Kips	352.71 Kips
63.99 ft	347.44 Kips	14.24 Kips	361.68 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.60 psf	18.66	N/A	0.00 Kips
9.01 ft	Cohesionless	540.60 psf	18.66	N/A	5.16 Kips
18.01 ft	Cohesionless	1080.60 psf	18.66	N/A	20.63 Kips
23.99 ft	Cohesionless	1439.40 psf	18.66	N/A	36.60 Kips
24.01 ft	Cohesionless	2880.65 psf	22.66	N/A	36.69 Kips
33.01 ft	Cohesionless	3465.65 psf	22.66	N/A	96.12 Kips
36.49 ft	Cohesionless	3691.85 psf	22.66	N/A	124.48 Kips
36.51 ft	Cohesionless	4505.65 psf	21.33	N/A	124.64 Kips
37.99 ft	Cohesionless	4601.85 psf	21.33	N/A	135.33 Kips
38.01 ft	Cohesionless	4700.65 psf	21.33	N/A	135.48 Kips
43.99 ft	Cohesionless	5089.35 psf	21.33	N/A	183.27 Kips
44.01 ft	Cohesionless	5480.62 psf	19.99	N/A	183.42 Kips
53.01 ft	Cohesionless	6043.12 psf	19.99	N/A	251.34 Kips
53.99 ft	Cohesionless	6104.38 psf	19.99	N/A	259.50 Kips
54.01 ft	Cohesionless	6730.31 psf	19.99	N/A	259.67 Kips
63.01 ft	Cohesionless	7012.01 psf	19.99	N/A	338.47 Kips
63.99 ft	Cohesionless	7042.69 psf	19.99	N/A	347.44 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.20 psf	22.80	14.24 Kips	0.02 Kips
9.01 ft	Cohesionless	1081.20 psf	22.80	14.24 Kips	14.13 Kips
18.01 ft	Cohesionless	2161.20 psf	22.80	14.24 Kips	14.24 Kips
23.99 ft	Cohesionless	2878.80 psf	22.80	14.24 Kips	14.24 Kips
24.01 ft	Cohesionless	2881.30 psf	55.60	78.59 Kips	78.59 Kips
33.01 ft	Cohesionless	4051.30 psf	55.60	78.59 Kips	78.59 Kips
36.49 ft	Cohesionless	4503.70 psf	55.60	78.59 Kips	78.59 Kips
36.51 ft	Cohesionless	4506.30 psf	40.40	35.28 Kips	35.28 Kips
37.99 ft	Cohesionless	4698.70 psf	40.40	35.28 Kips	35.28 Kips
38.01 ft	Cohesionless	4701.30 psf	40.40	35.28 Kips	35.28 Kips
43.99 ft	Cohesionless	5478.70 psf	40.40	35.28 Kips	35.28 Kips
44.01 ft	Cohesionless	5481.25 psf	30.00	14.24 Kips	14.24 Kips
53.01 ft	Cohesionless	6606.25 psf	30.00	14.24 Kips	14.24 Kips
53.99 ft	Cohesionless	6728.75 psf	30.00	14.24 Kips	14.24 Kips
54.01 ft	Cohesionless	6730.63 psf	30.00	14.24 Kips	14.24 Kips
63.01 ft	Cohesionless	7294.03 psf	30.00	14.24 Kips	14.24 Kips
63.99 ft	Cohesionless	7355.37 psf	30.00	14.24 Kips	14.24 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.02 Kips	0.02 Kips
9.01 ft	5.16 Kips	14.13 Kips	19.29 Kips
18.01 ft	20.63 Kips	14.24 Kips	34.87 Kips
23.99 ft	36.60 Kips	14.24 Kips	50.84 Kips
24.01 ft	36.69 Kips	78.59 Kips	115.28 Kips
33.01 ft	96.12 Kips	78.59 Kips	174.72 Kips
36.49 ft	124.48 Kips	78.59 Kips	203.08 Kips
36.51 ft	124.64 Kips	35.28 Kips	159.92 Kips
37.99 ft	135.33 Kips	35.28 Kips	170.61 Kips
38.01 ft	135.48 Kips	35.28 Kips	170.76 Kips
43.99 ft	183.27 Kips	35.28 Kips	218.54 Kips
44.01 ft	183.42 Kips	14.24 Kips	197.66 Kips
53.01 ft	251.34 Kips	14.24 Kips	265.58 Kips
53.99 ft	259.50 Kips	14.24 Kips	273.74 Kips
54.01 ft	259.67 Kips	14.24 Kips	273.91 Kips
63.01 ft	338.47 Kips	14.24 Kips	352.71 Kips
63.99 ft	347.44 Kips	14.24 Kips	361.68 Kips

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: J:\GEOTECH\ANALYSIS\D2BZEP~U.2\B-211-A.DVN
Project Name: HAM-75-0992 -B-211- Abut Project Date: 06/18/2012
Project Client: EMHT
Computed By: Brian Trenner
Project Manager: Jonathan Sterenberg

PILE INFORMATION

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

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	54.00 ft
	- Driving/Restrike	54.00 ft
	- Ultimate:	54.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesionless	24.00 ft	0.00%	120.00 pcf	28.0/28.0	Nordlund
2	Cohesionless	2.00 ft	0.00%	130.00 pcf	34.0/34.0	Nordlund
3	Cohesionless	10.50 ft	0.00%	130.00 pcf	34.0/34.0	Nordlund
4	Cohesionless	7.50 ft	0.00%	130.00 pcf	32.0/32.0	Nordlund
5	Cohesionless	20.00 ft	0.00%	125.00 pcf	30.0/30.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.60 psf	20.51	N/A	0.00 Kips
9.01 ft	Cohesionless	540.60 psf	20.51	N/A	6.91 Kips
18.01 ft	Cohesionless	1080.60 psf	20.51	N/A	27.61 Kips
23.99 ft	Cohesionless	1439.40 psf	20.51	N/A	48.98 Kips
24.01 ft	Cohesionless	2880.65 psf	24.90	N/A	49.10 Kips
25.99 ft	Cohesionless	3009.35 psf	24.90	N/A	64.71 Kips
26.01 ft	Cohesionless	3140.65 psf	24.90	N/A	64.87 Kips
35.01 ft	Cohesionless	3725.65 psf	24.90	N/A	152.71 Kips
36.49 ft	Cohesionless	3821.85 psf	24.90	N/A	169.80 Kips
36.51 ft	Cohesionless	4505.65 psf	23.44	N/A	170.01 Kips
43.99 ft	Cohesionless	4991.85 psf	23.44	N/A	249.84 Kips
44.01 ft	Cohesionless	5480.62 psf	21.97	N/A	250.05 Kips
53.01 ft	Cohesionless	6043.12 psf	21.97	N/A	341.56 Kips
53.99 ft	Cohesionless	6104.38 psf	21.97	N/A	352.56 Kips
54.01 ft	Cohesionless	6730.31 psf	21.97	N/A	352.78 Kips
63.01 ft	Cohesionless	7012.01 psf	21.97	N/A	458.96 Kips
63.99 ft	Cohesionless	7042.69 psf	21.97	N/A	471.04 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.20 psf	22.80	18.60 Kips	0.02 Kips
9.01 ft	Cohesionless	1081.20 psf	22.80	18.60 Kips	18.45 Kips
18.01 ft	Cohesionless	2161.20 psf	22.80	18.60 Kips	18.60 Kips
23.99 ft	Cohesionless	2878.80 psf	22.80	18.60 Kips	18.60 Kips
24.01 ft	Cohesionless	2881.30 psf	55.60	102.65 Kips	102.65 Kips
25.99 ft	Cohesionless	3138.70 psf	55.60	102.65 Kips	102.65 Kips
26.01 ft	Cohesionless	3141.30 psf	55.60	102.65 Kips	102.65 Kips
35.01 ft	Cohesionless	4311.30 psf	55.60	102.65 Kips	102.65 Kips
36.49 ft	Cohesionless	4503.70 psf	55.60	102.65 Kips	102.65 Kips
36.51 ft	Cohesionless	4506.30 psf	40.40	46.08 Kips	46.08 Kips
43.99 ft	Cohesionless	5478.70 psf	40.40	46.08 Kips	46.08 Kips
44.01 ft	Cohesionless	5481.25 psf	30.00	18.60 Kips	18.60 Kips
53.01 ft	Cohesionless	6606.25 psf	30.00	18.60 Kips	18.60 Kips
53.99 ft	Cohesionless	6728.75 psf	30.00	18.60 Kips	18.60 Kips
54.01 ft	Cohesionless	6730.63 psf	30.00	18.60 Kips	18.60 Kips
63.01 ft	Cohesionless	7294.03 psf	30.00	18.60 Kips	18.60 Kips
63.99 ft	Cohesionless	7355.37 psf	30.00	18.60 Kips	18.60 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.02 Kips	0.02 Kips
9.01 ft	6.91 Kips	18.45 Kips	25.36 Kips
18.01 ft	27.61 Kips	18.60 Kips	46.20 Kips
23.99 ft	48.98 Kips	18.60 Kips	67.58 Kips
24.01 ft	49.10 Kips	102.65 Kips	151.75 Kips
25.99 ft	64.71 Kips	102.65 Kips	167.36 Kips
26.01 ft	64.87 Kips	102.65 Kips	167.53 Kips
35.01 ft	152.71 Kips	102.65 Kips	255.36 Kips
36.49 ft	169.80 Kips	102.65 Kips	272.45 Kips
36.51 ft	170.01 Kips	46.08 Kips	216.09 Kips
43.99 ft	249.84 Kips	46.08 Kips	295.92 Kips
44.01 ft	250.05 Kips	18.60 Kips	268.65 Kips
53.01 ft	341.56 Kips	18.60 Kips	360.16 Kips
53.99 ft	352.56 Kips	18.60 Kips	371.15 Kips
54.01 ft	352.78 Kips	18.60 Kips	371.38 Kips
63.01 ft	458.96 Kips	18.60 Kips	477.56 Kips
63.99 ft	471.04 Kips	18.60 Kips	489.64 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.60 psf	20.51	N/A	0.00 Kips
9.01 ft	Cohesionless	540.60 psf	20.51	N/A	6.91 Kips
18.01 ft	Cohesionless	1080.60 psf	20.51	N/A	27.61 Kips
23.99 ft	Cohesionless	1439.40 psf	20.51	N/A	48.98 Kips
24.01 ft	Cohesionless	2880.65 psf	24.90	N/A	49.10 Kips
25.99 ft	Cohesionless	3009.35 psf	24.90	N/A	64.71 Kips
26.01 ft	Cohesionless	3140.65 psf	24.90	N/A	64.87 Kips
35.01 ft	Cohesionless	3725.65 psf	24.90	N/A	152.71 Kips
36.49 ft	Cohesionless	3821.85 psf	24.90	N/A	169.80 Kips
36.51 ft	Cohesionless	4505.65 psf	23.44	N/A	170.01 Kips
43.99 ft	Cohesionless	4991.85 psf	23.44	N/A	249.84 Kips
44.01 ft	Cohesionless	5480.62 psf	21.97	N/A	250.05 Kips
53.01 ft	Cohesionless	6043.12 psf	21.97	N/A	341.56 Kips
53.99 ft	Cohesionless	6104.38 psf	21.97	N/A	352.56 Kips
54.01 ft	Cohesionless	6730.31 psf	21.97	N/A	352.78 Kips
63.01 ft	Cohesionless	7012.01 psf	21.97	N/A	458.96 Kips
63.99 ft	Cohesionless	7042.69 psf	21.97	N/A	471.04 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.20 psf	22.80	18.60 Kips	0.02 Kips
9.01 ft	Cohesionless	1081.20 psf	22.80	18.60 Kips	18.45 Kips
18.01 ft	Cohesionless	2161.20 psf	22.80	18.60 Kips	18.60 Kips
23.99 ft	Cohesionless	2878.80 psf	22.80	18.60 Kips	18.60 Kips
24.01 ft	Cohesionless	2881.30 psf	55.60	102.65 Kips	102.65 Kips
25.99 ft	Cohesionless	3138.70 psf	55.60	102.65 Kips	102.65 Kips
26.01 ft	Cohesionless	3141.30 psf	55.60	102.65 Kips	102.65 Kips
35.01 ft	Cohesionless	4311.30 psf	55.60	102.65 Kips	102.65 Kips
36.49 ft	Cohesionless	4503.70 psf	55.60	102.65 Kips	102.65 Kips
36.51 ft	Cohesionless	4506.30 psf	40.40	46.08 Kips	46.08 Kips
43.99 ft	Cohesionless	5478.70 psf	40.40	46.08 Kips	46.08 Kips
44.01 ft	Cohesionless	5481.25 psf	30.00	18.60 Kips	18.60 Kips
53.01 ft	Cohesionless	6606.25 psf	30.00	18.60 Kips	18.60 Kips
53.99 ft	Cohesionless	6728.75 psf	30.00	18.60 Kips	18.60 Kips
54.01 ft	Cohesionless	6730.63 psf	30.00	18.60 Kips	18.60 Kips
63.01 ft	Cohesionless	7294.03 psf	30.00	18.60 Kips	18.60 Kips
63.99 ft	Cohesionless	7355.37 psf	30.00	18.60 Kips	18.60 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.02 Kips	0.02 Kips
9.01 ft	6.91 Kips	18.45 Kips	25.36 Kips
18.01 ft	27.61 Kips	18.60 Kips	46.20 Kips
23.99 ft	48.98 Kips	18.60 Kips	67.58 Kips
24.01 ft	49.10 Kips	102.65 Kips	151.75 Kips
25.99 ft	64.71 Kips	102.65 Kips	167.36 Kips
26.01 ft	64.87 Kips	102.65 Kips	167.53 Kips
35.01 ft	152.71 Kips	102.65 Kips	255.36 Kips
36.49 ft	169.80 Kips	102.65 Kips	272.45 Kips
36.51 ft	170.01 Kips	46.08 Kips	216.09 Kips
43.99 ft	249.84 Kips	46.08 Kips	295.92 Kips
44.01 ft	250.05 Kips	18.60 Kips	268.65 Kips
53.01 ft	341.56 Kips	18.60 Kips	360.16 Kips
53.99 ft	352.56 Kips	18.60 Kips	371.15 Kips
54.01 ft	352.78 Kips	18.60 Kips	371.38 Kips
63.01 ft	458.96 Kips	18.60 Kips	477.56 Kips
63.99 ft	471.04 Kips	18.60 Kips	489.64 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesionless	0.60 psf	20.51	N/A	0.00 Kips
9.01 ft	Cohesionless	540.60 psf	20.51	N/A	6.91 Kips
18.01 ft	Cohesionless	1080.60 psf	20.51	N/A	27.61 Kips
23.99 ft	Cohesionless	1439.40 psf	20.51	N/A	48.98 Kips
24.01 ft	Cohesionless	2880.65 psf	24.90	N/A	49.10 Kips
25.99 ft	Cohesionless	3009.35 psf	24.90	N/A	64.71 Kips
26.01 ft	Cohesionless	3140.65 psf	24.90	N/A	64.87 Kips
35.01 ft	Cohesionless	3725.65 psf	24.90	N/A	152.71 Kips
36.49 ft	Cohesionless	3821.85 psf	24.90	N/A	169.80 Kips
36.51 ft	Cohesionless	4505.65 psf	23.44	N/A	170.01 Kips
43.99 ft	Cohesionless	4991.85 psf	23.44	N/A	249.84 Kips
44.01 ft	Cohesionless	5480.62 psf	21.97	N/A	250.05 Kips
53.01 ft	Cohesionless	6043.12 psf	21.97	N/A	341.56 Kips
53.99 ft	Cohesionless	6104.38 psf	21.97	N/A	352.56 Kips
54.01 ft	Cohesionless	6730.31 psf	21.97	N/A	352.78 Kips
63.01 ft	Cohesionless	7012.01 psf	21.97	N/A	458.96 Kips
63.99 ft	Cohesionless	7042.69 psf	21.97	N/A	471.04 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesionless	1.20 psf	22.80	18.60 Kips	0.02 Kips
9.01 ft	Cohesionless	1081.20 psf	22.80	18.60 Kips	18.45 Kips
18.01 ft	Cohesionless	2161.20 psf	22.80	18.60 Kips	18.60 Kips
23.99 ft	Cohesionless	2878.80 psf	22.80	18.60 Kips	18.60 Kips
24.01 ft	Cohesionless	2881.30 psf	55.60	102.65 Kips	102.65 Kips
25.99 ft	Cohesionless	3138.70 psf	55.60	102.65 Kips	102.65 Kips
26.01 ft	Cohesionless	3141.30 psf	55.60	102.65 Kips	102.65 Kips
35.01 ft	Cohesionless	4311.30 psf	55.60	102.65 Kips	102.65 Kips
36.49 ft	Cohesionless	4503.70 psf	55.60	102.65 Kips	102.65 Kips
36.51 ft	Cohesionless	4506.30 psf	40.40	46.08 Kips	46.08 Kips
43.99 ft	Cohesionless	5478.70 psf	40.40	46.08 Kips	46.08 Kips
44.01 ft	Cohesionless	5481.25 psf	30.00	18.60 Kips	18.60 Kips
53.01 ft	Cohesionless	6606.25 psf	30.00	18.60 Kips	18.60 Kips
53.99 ft	Cohesionless	6728.75 psf	30.00	18.60 Kips	18.60 Kips
54.01 ft	Cohesionless	6730.63 psf	30.00	18.60 Kips	18.60 Kips
63.01 ft	Cohesionless	7294.03 psf	30.00	18.60 Kips	18.60 Kips
63.99 ft	Cohesionless	7355.37 psf	30.00	18.60 Kips	18.60 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.02 Kips	0.02 Kips
9.01 ft	6.91 Kips	18.45 Kips	25.36 Kips
18.01 ft	27.61 Kips	18.60 Kips	46.20 Kips
23.99 ft	48.98 Kips	18.60 Kips	67.58 Kips
24.01 ft	49.10 Kips	102.65 Kips	151.75 Kips
25.99 ft	64.71 Kips	102.65 Kips	167.36 Kips
26.01 ft	64.87 Kips	102.65 Kips	167.53 Kips
35.01 ft	152.71 Kips	102.65 Kips	255.36 Kips
36.49 ft	169.80 Kips	102.65 Kips	272.45 Kips
36.51 ft	170.01 Kips	46.08 Kips	216.09 Kips
43.99 ft	249.84 Kips	46.08 Kips	295.92 Kips
44.01 ft	250.05 Kips	18.60 Kips	268.65 Kips
53.01 ft	341.56 Kips	18.60 Kips	360.16 Kips
53.99 ft	352.56 Kips	18.60 Kips	371.15 Kips
54.01 ft	352.78 Kips	18.60 Kips	371.38 Kips
63.01 ft	458.96 Kips	18.60 Kips	477.56 Kips
63.99 ft	471.04 Kips	18.60 Kips	489.64 Kips

APPENDIX V

GRLWEAP DRIVEABILITY ANALYSIS

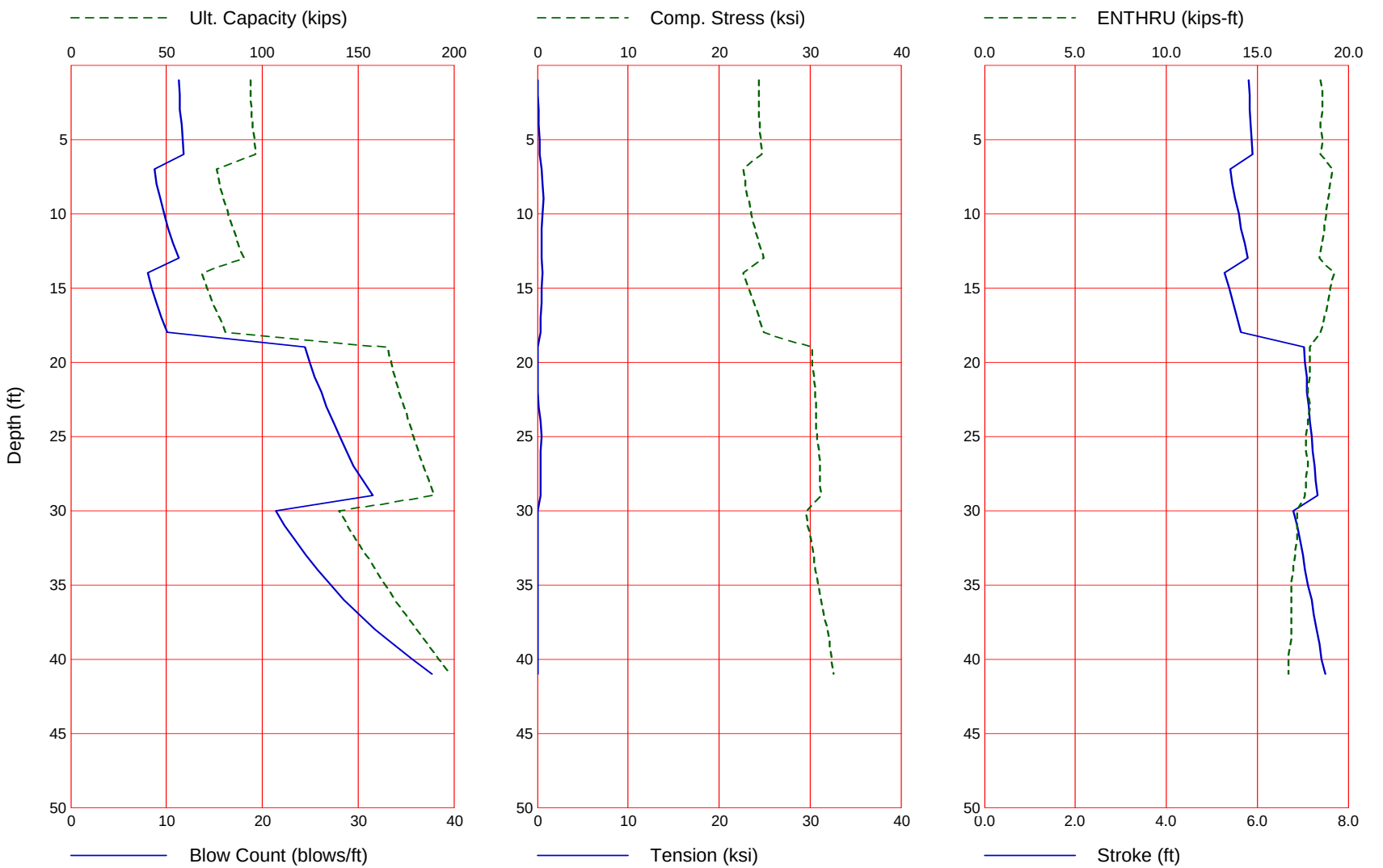
Resource International Inc

Jun 18 2012

HAM-75-0992 - B-212-0-07 - 14" CIP

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.0	93.9	0.1	93.8	11.3	24.341	-0.075	5.82	18.5
2.0	94.1	0.3	93.8	11.4	24.370	-0.095	5.83	18.6
3.0	94.5	0.7	93.8	11.4	24.414	-0.128	5.84	18.6
4.0	95.1	1.3	93.8	11.6	24.493	-0.173	5.85	18.5
5.0	95.8	2.0	93.8	11.7	24.566	-0.229	5.87	18.6
6.0	96.7	2.9	93.8	11.8	24.670	-0.307	5.89	18.5
7.0	76.0	4.5	71.4	8.8	22.616	-0.456	5.41	19.1
8.0	77.8	6.3	71.4	9.0	22.869	-0.580	5.46	19.0
9.0	79.8	8.4	71.4	9.4	23.196	-0.653	5.52	18.9
10.0	82.1	10.7	71.4	9.8	23.559	-0.566	5.59	18.8
11.0	84.6	13.2	71.4	10.2	23.958	-0.531	5.65	18.7
12.0	87.4	16.0	71.4	10.7	24.369	-0.512	5.72	18.6
13.0	90.4	19.0	71.4	11.3	24.869	-0.463	5.79	18.4
14.0	68.5	21.6	46.9	8.1	22.669	-0.534	5.29	19.2
15.0	71.3	24.4	46.9	8.5	23.240	-0.499	5.38	19.0
16.0	74.3	27.4	46.9	9.0	23.858	-0.447	5.47	18.9
17.0	77.5	30.6	46.9	9.5	24.423	-0.418	5.56	18.7
18.0	80.9	34.0	46.9	10.1	24.922	-0.384	5.65	18.5
19.0	165.4	35.9	129.5	24.5	30.246	0.000	7.03	17.9
20.0	167.4	37.9	129.5	25.0	30.290	0.000	7.05	17.9
21.0	169.5	40.0	129.5	25.5	30.421	0.000	7.09	17.9
22.0	171.6	42.1	129.5	26.2	30.555	0.000	7.10	17.8
23.0	173.9	44.4	129.5	26.7	30.718	-0.200	7.14	17.9
24.0	176.3	46.8	129.5	27.4	30.656	-0.356	7.16	17.8
25.0	178.8	49.3	129.5	28.1	30.784	-0.431	7.19	17.7
26.0	181.4	51.9	129.5	28.8	30.967	-0.422	7.23	17.7
27.0	184.1	54.6	129.5	29.5	31.075	-0.383	7.26	17.8
28.0	186.9	57.4	129.5	30.5	31.070	-0.389	7.29	17.7
29.0	189.8	60.3	129.5	31.5	31.223	-0.379	7.32	17.6
30.0	139.9	64.0	75.9	21.4	29.634	0.000	6.80	17.2
31.0	144.5	68.6	75.9	22.3	29.752	0.000	6.87	17.2
32.0	149.2	73.3	75.9	23.4	30.127	0.000	6.94	17.2
33.0	154.0	78.1	75.9	24.6	30.435	0.000	7.00	17.1
34.0	159.0	83.1	75.9	25.8	30.596	-0.005	7.06	17.0
35.0	164.2	88.3	75.9	27.2	30.835	-0.044	7.12	16.9
36.0	169.5	93.6	75.9	28.5	31.203	-0.033	7.19	16.9
37.0	174.9	99.0	75.9	30.1	31.535	-0.037	7.24	16.9
38.0	180.5	104.6	75.9	31.7	31.962	-0.045	7.30	16.9
39.0	186.3	110.4	75.9	33.7	32.160	-0.033	7.37	16.8
40.0	192.2	116.3	75.9	35.7	32.398	-0.010	7.42	16.7
41.0	198.3	122.3	75.9	37.7	32.618	0.000	7.49	16.7

Total Continuous Driving Time 18.00 minutes; Total Number of Blows 811

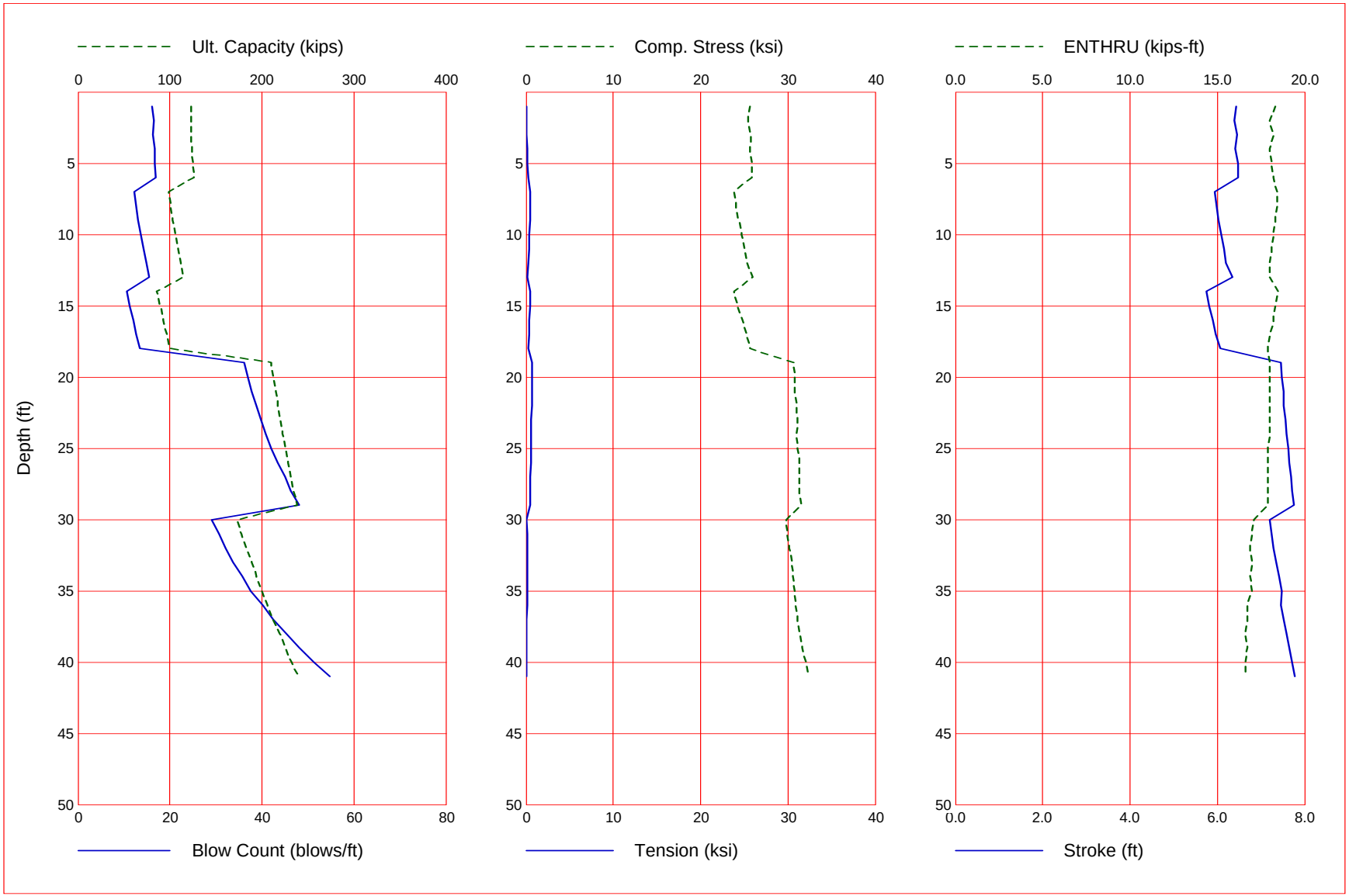
Resource International Inc

Jun 18 2012

HAM-75-0992 - B-212-0-07 - 16" CIP

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.0	122.6	0.1	122.5	16.2	25.673	-0.036	6.44	18.3
2.0	122.9	0.4	122.5	16.5	25.490	-0.056	6.38	18.0
3.0	123.3	0.8	122.5	16.4	25.724	-0.088	6.45	18.2
4.0	124.0	1.5	122.5	16.7	25.620	-0.137	6.40	18.0
5.0	124.8	2.3	122.5	16.8	25.855	-0.195	6.47	18.1
6.0	125.8	3.4	122.5	17.0	25.912	-0.264	6.48	18.2
7.0	98.5	5.1	93.3	12.3	23.847	-0.445	5.94	18.4
8.0	100.5	7.2	93.3	12.7	24.051	-0.528	5.98	18.4
9.0	102.9	9.6	93.3	13.1	24.322	-0.482	6.03	18.3
10.0	105.5	12.2	93.3	13.7	24.641	-0.389	6.08	18.2
11.0	108.4	15.1	93.3	14.2	25.037	-0.327	6.15	18.1
12.0	111.6	18.2	93.3	14.9	25.382	-0.237	6.20	18.0
13.0	115.0	21.7	93.3	15.5	25.999	-0.156	6.34	18.0
14.0	85.9	24.7	61.2	10.7	23.797	-0.466	5.74	18.5
15.0	89.2	27.9	61.2	11.3	24.291	-0.435	5.81	18.3
16.0	92.6	31.4	61.2	12.0	24.788	-0.378	5.89	18.2
17.0	96.3	35.0	61.2	12.7	25.237	-0.339	5.97	18.0
18.0	100.1	38.9	61.2	13.4	25.691	-0.289	6.06	17.9
19.0	210.2	41.0	169.1	36.1	30.655	-0.690	7.45	18.0
20.0	212.4	43.3	169.1	36.9	30.723	-0.657	7.48	18.0
21.0	214.8	45.7	169.1	37.8	30.785	-0.658	7.51	18.0
22.0	217.3	48.2	169.1	38.7	30.958	-0.643	7.53	18.0
23.0	219.9	50.8	169.1	39.8	31.103	-0.621	7.56	18.0
24.0	222.7	53.5	169.1	40.9	31.038	-0.593	7.59	18.0
25.0	225.5	56.4	169.1	42.1	31.118	-0.585	7.62	17.9
26.0	228.5	59.3	169.1	43.5	31.289	-0.558	7.65	17.9
27.0	231.5	62.4	169.1	45.0	31.347	-0.516	7.68	17.9
28.0	234.7	65.6	169.1	46.2	31.309	-0.522	7.71	17.9
29.0	238.1	68.9	169.1	48.0	31.496	-0.494	7.75	17.9
30.0	172.3	73.2	99.2	29.1	29.855	-0.080	7.19	17.1
31.0	177.5	78.4	99.2	30.6	29.868	-0.121	7.24	17.0
32.0	182.9	83.8	99.2	32.2	30.114	-0.129	7.29	16.9
33.0	188.4	89.3	99.2	33.8	30.403	-0.119	7.35	17.0
34.0	194.2	95.0	99.2	35.8	30.527	-0.118	7.41	16.9
35.0	200.1	100.9	99.2	37.5	30.745	-0.125	7.47	17.0
36.0	206.1	107.0	99.2	40.2	30.862	-0.114	7.45	16.7
37.0	212.3	113.2	99.2	42.4	31.144	-0.091	7.52	16.7
38.0	218.8	119.6	99.2	45.3	31.295	-0.084	7.59	16.6
39.0	225.3	126.2	99.2	48.1	31.672	-0.081	7.65	16.7
40.0	232.1	132.9	99.2	51.4	32.031	-0.061	7.72	16.6
41.0	239.0	139.8	99.2	54.8	32.270	-0.018	7.78	16.6

Total Continuous Driving Time 27.00 minutes; Total Number of Blows 1166

Resource International Inc

Aug 09 2013

HAM-75-0992 - B-211 - Pier - 14" CIP

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

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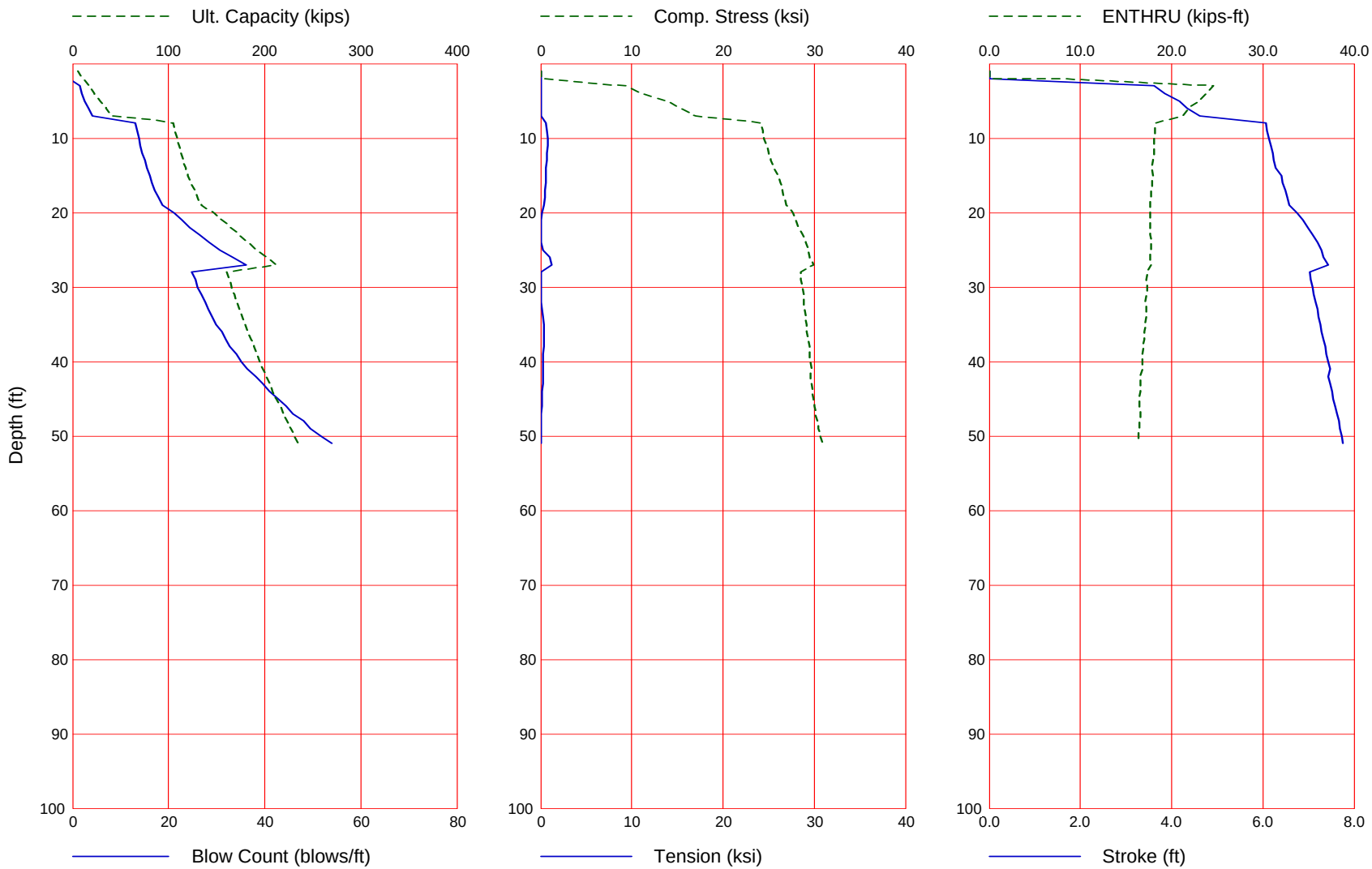

Resource International Inc
HAM-75-0992 - B-211 - Pier - 14" CIP

Aug 09 2013
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.0	5.2	0.1	5.1	-1.0	0.000	0.000	0.00	0.0
2.0	10.7	0.4	10.3	-1.0	0.000	0.000	0.00	0.0
3.0	16.4	1.0	15.4	1.5	9.341	0.000	3.61	24.6
4.0	22.3	1.8	20.5	1.9	11.061	0.000	3.85	23.8
5.0	28.4	2.7	25.7	2.6	14.032	0.000	4.16	23.0
6.0	34.7	4.0	30.8	3.3	15.390	0.000	4.34	21.8
7.0	41.3	5.4	35.9	4.1	17.043	0.000	4.61	21.3
8.0	105.0	6.8	98.2	13.1	24.165	-0.570	6.07	18.3
9.0	106.6	8.4	98.2	13.4	24.321	-0.663	6.09	18.2
10.0	108.4	10.2	98.2	13.8	24.527	-0.751	6.13	18.1
11.0	110.4	12.2	98.2	14.1	24.764	-0.805	6.17	18.1
12.0	112.6	14.4	98.2	14.5	25.011	-0.744	6.21	18.1
13.0	115.0	16.8	98.2	15.0	25.272	-0.657	6.25	18.0
14.0	117.6	19.4	98.2	15.5	25.589	-0.629	6.29	17.9
15.0	120.4	22.2	98.2	16.0	26.039	-0.610	6.40	18.0
16.0	123.4	25.2	98.2	16.6	26.262	-0.544	6.44	17.9
17.0	126.6	28.4	98.2	17.2	26.477	-0.491	6.49	17.8
18.0	130.1	31.8	98.2	17.9	26.707	-0.453	6.54	17.8
19.0	133.7	35.4	98.2	18.7	26.982	-0.382	6.59	17.7
20.0	146.9	39.6	107.3	21.1	27.639	-0.192	6.76	17.7
21.0	155.5	44.3	111.1	22.7	28.014	-0.092	6.87	17.7
22.0	164.3	49.3	114.9	24.5	28.353	-0.018	6.98	17.7
23.0	173.3	54.6	118.7	26.5	28.743	-0.009	7.09	17.7
24.0	182.6	60.0	122.5	28.4	29.084	-0.071	7.19	17.8
25.0	192.1	65.7	126.3	30.7	29.367	-0.311	7.28	17.8
26.0	201.8	71.7	130.2	33.4	29.443	-0.987	7.32	17.7
27.0	211.8	77.9	134.0	36.1	29.869	-1.213	7.44	17.8
28.0	160.7	80.3	80.4	24.9	28.549	0.000	7.02	17.3
29.0	163.1	82.8	80.4	25.6	28.585	0.000	7.05	17.2
30.0	165.7	85.3	80.4	26.1	28.714	0.000	7.09	17.3
31.0	168.3	87.9	80.4	26.9	28.808	0.000	7.12	17.2
32.0	171.0	90.6	80.4	27.6	28.875	0.000	7.15	17.1
33.0	173.7	93.3	80.4	28.3	28.966	-0.170	7.19	17.2
34.0	176.5	96.2	80.4	29.0	29.114	-0.314	7.23	17.2
35.0	179.4	99.1	80.4	29.9	29.205	-0.386	7.26	17.1
36.0	182.4	102.0	80.4	31.0	29.225	-0.362	7.29	17.0
37.0	185.4	105.0	80.4	31.9	29.336	-0.332	7.32	17.0
38.0	188.5	108.1	80.4	32.8	29.450	-0.321	7.36	16.9
39.0	191.7	111.3	80.4	34.1	29.517	-0.290	7.40	16.8
40.0	194.9	114.5	80.4	35.2	29.573	-0.256	7.43	16.8
41.0	198.2	117.8	80.4	36.4	29.719	-0.255	7.47	16.8
42.0	201.6	121.2	80.4	38.1	29.591	-0.251	7.43	16.6
43.0	205.0	124.6	80.4	39.5	29.656	-0.217	7.47	16.6
44.0	208.5	128.1	80.4	41.0	29.782	-0.179	7.51	16.6
45.0	212.1	131.7	80.4	42.8	29.905	-0.164	7.54	16.5
46.0	215.7	135.3	80.4	44.4	29.984	-0.142	7.58	16.5

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

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
47.0	219.4	139.0	80.4	45.9	30.153	-0.093	7.62	16.6
48.0	223.2	142.8	80.4	48.0	30.329	-0.071	7.66	16.5
49.0	227.1	146.7	80.4	49.6	30.480	-0.045	7.69	16.5
50.0	231.0	150.6	80.4	51.7	30.667	0.000	7.73	16.4
51.0	234.9	154.6	80.4	53.9	30.907	0.000	7.76	16.3

Total Continuous Driving Time 29.00 minutes; Total Number of Blows 1270

Resource International Inc

Aug 09 2013

HAM-75-0992 - B-211 - Pier - 16" CIP

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

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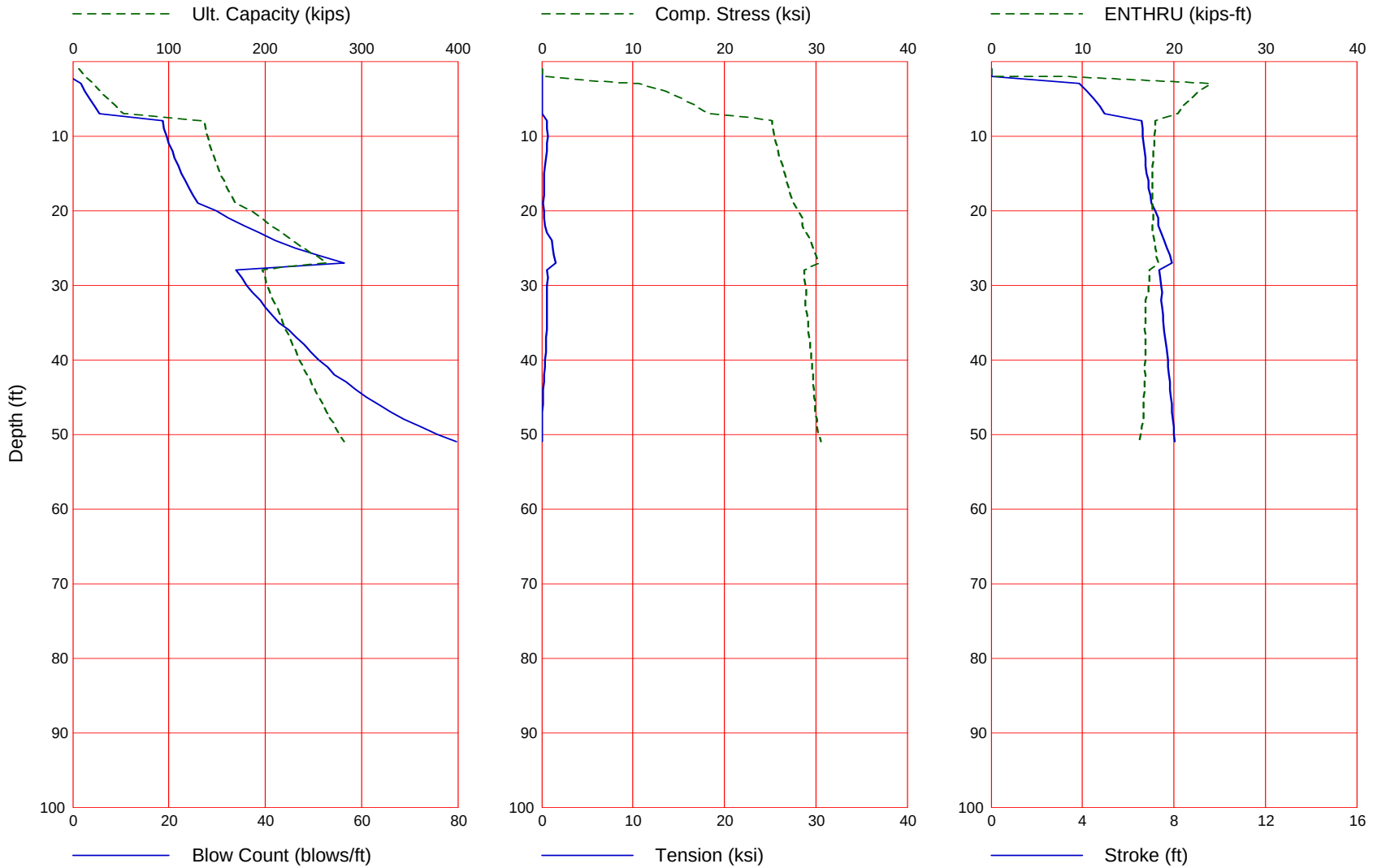

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.0	6.8	0.1	6.7	-1.0	0.000	0.000	0.00	0.0
2.0	13.9	0.5	13.4	-1.0	0.000	0.000	0.00	0.0
3.0	21.2	1.1	20.1	1.8	10.568	0.000	3.87	24.0
4.0	28.8	2.0	26.8	2.6	13.599	0.000	4.22	22.8
5.0	36.6	3.1	33.5	3.5	15.362	0.000	4.49	21.8
6.0	44.7	4.5	40.2	4.5	16.865	0.000	4.74	21.0
7.0	53.1	6.2	46.9	5.5	18.183	0.000	4.98	20.4
8.0	136.1	7.8	128.3	18.7	25.222	-0.534	6.61	18.0
9.0	137.9	9.6	128.3	19.0	25.326	-0.624	6.63	18.0
10.0	139.9	11.6	128.3	19.5	25.473	-0.684	6.65	17.9
11.0	142.2	13.9	128.3	20.0	25.677	-0.633	6.68	17.9
12.0	144.8	16.4	128.3	20.7	25.895	-0.543	6.71	17.8
13.0	147.5	19.2	128.3	21.2	26.132	-0.430	6.75	17.8
14.0	150.5	22.2	128.3	22.0	26.398	-0.355	6.78	17.6
15.0	153.7	25.4	128.3	22.6	26.611	-0.290	6.82	17.7
16.0	157.1	28.8	128.3	23.4	26.854	-0.227	6.87	17.6
17.0	160.8	32.5	128.3	24.3	27.051	-0.250	6.91	17.6
18.0	164.7	36.4	128.3	25.1	27.284	-0.239	6.97	17.6
19.0	168.8	40.5	128.3	26.1	27.533	-0.196	7.02	17.6
20.0	185.4	45.2	140.2	29.8	28.150	-0.219	7.19	17.7
21.0	195.8	50.7	145.1	32.4	28.492	-0.265	7.30	17.8
22.0	206.5	56.4	150.1	35.6	28.545	-0.350	7.33	17.6
23.0	217.4	62.4	155.1	38.8	28.982	-0.616	7.46	17.7
24.0	228.7	68.6	160.1	42.1	29.404	-1.098	7.58	17.9
25.0	240.2	75.1	165.0	46.2	29.726	-1.243	7.70	18.0
26.0	251.9	81.9	170.0	51.0	29.998	-1.376	7.83	18.1
27.0	264.0	89.0	175.0	56.5	30.355	-1.504	7.93	18.3
28.0	196.7	91.8	105.0	34.0	28.756	-0.616	7.38	17.3
29.0	199.6	94.6	105.0	35.1	28.782	-0.672	7.41	17.3
30.0	202.5	97.5	105.0	36.2	28.869	-0.637	7.43	17.2
31.0	205.5	100.5	105.0	37.3	29.012	-0.624	7.48	17.2
32.0	208.5	103.6	105.0	38.9	28.850	-0.625	7.43	16.9
33.0	211.7	106.7	105.0	40.1	28.898	-0.593	7.47	16.9
34.0	214.9	109.9	105.0	41.5	29.064	-0.558	7.51	16.9
35.0	218.2	113.2	105.0	42.9	29.161	-0.563	7.55	16.9
36.0	221.6	116.6	105.0	44.8	29.223	-0.539	7.59	16.8
37.0	225.0	120.1	105.0	46.4	29.296	-0.496	7.63	16.9
38.0	228.6	123.6	105.0	48.0	29.434	-0.474	7.67	16.9
39.0	232.2	127.2	105.0	49.6	29.465	-0.450	7.70	16.9
40.0	235.9	130.9	105.0	51.2	29.502	-0.404	7.73	16.9
41.0	239.6	134.7	105.0	53.0	29.625	-0.346	7.76	16.8
42.0	243.5	138.5	105.0	54.4	29.711	-0.318	7.79	16.9
43.0	247.4	142.4	105.0	56.8	29.697	-0.261	7.82	16.8
44.0	251.4	146.4	105.0	58.9	29.795	-0.200	7.85	16.8
45.0	255.5	150.5	105.0	61.0	29.848	-0.195	7.88	16.7
46.0	259.7	154.7	105.0	63.5	29.887	-0.158	7.90	16.7

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

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
47.0	263.9	158.9	105.0	66.1	29.971	-0.101	7.93	16.7
48.0	268.2	163.2	105.0	68.7	30.095	-0.078	7.96	16.7
49.0	272.6	167.6	105.0	72.5	30.183	-0.048	7.98	16.5
50.0	277.1	172.1	105.0	75.9	30.364	-0.004	8.01	16.4
51.0	281.6	176.7	105.0	79.6	30.584	0.000	8.04	16.3

Total Continuous Driving Time 43.00 minutes; Total Number of Blows 1832

Resource International Inc

Aug 09 2013

HAM-75-0992 - B-211 - Abut - 14" CIP

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

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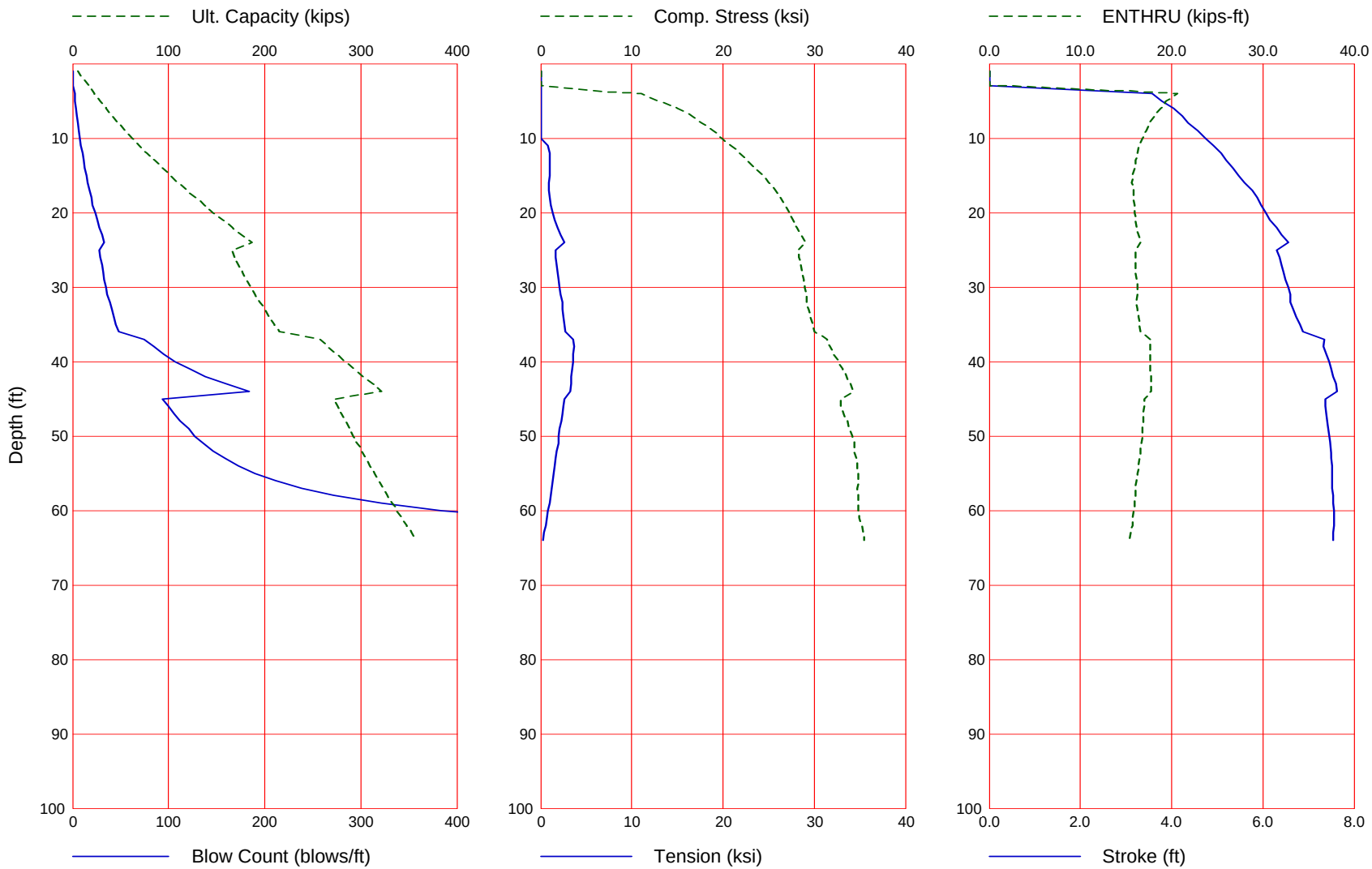

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.0	5.2	0.1	5.1	-1.0	0.000	0.000	0.00	0.0
2.0	10.7	0.4	10.3	-1.0	0.000	0.000	0.00	0.0
3.0	16.4	1.0	15.4	-1.0	0.000	0.000	0.00	0.0
4.0	22.3	1.8	20.5	2.1	11.080	0.000	3.58	20.6
5.0	28.4	2.7	25.7	2.9	12.940	0.000	3.79	19.4
6.0	34.7	4.0	30.8	3.7	15.013	0.000	4.04	18.8
7.0	41.3	5.4	35.9	4.6	16.576	0.000	4.23	18.1
8.0	48.1	7.0	41.0	5.6	17.639	0.000	4.37	17.5
9.0	55.1	8.9	46.2	6.6	18.907	0.000	4.58	17.2
10.0	62.3	11.0	51.3	7.7	19.940	0.000	4.75	16.8
11.0	69.7	13.3	56.4	8.9	20.875	-0.775	4.92	16.5
12.0	77.4	15.8	61.6	10.2	21.837	-0.976	5.08	16.3
13.0	85.3	18.6	66.7	11.6	22.625	-1.034	5.20	16.0
14.0	93.4	21.6	71.8	13.1	23.570	-1.054	5.35	15.9
15.0	101.7	24.7	77.0	14.6	24.366	-1.000	5.48	15.7
16.0	110.2	28.1	82.1	16.2	25.008	-0.943	5.60	15.6
17.0	119.0	31.8	87.2	17.7	25.752	-0.917	5.77	15.8
18.0	128.0	35.6	92.4	19.4	26.297	-0.980	5.88	15.8
19.0	137.2	39.7	97.5	21.2	26.806	-1.105	5.97	15.9
20.0	146.6	44.0	102.6	23.4	27.233	-1.304	6.06	15.9
21.0	156.2	48.5	107.8	25.6	27.655	-1.530	6.16	16.0
22.0	166.1	53.2	112.9	27.8	28.116	-1.851	6.30	16.2
23.0	176.2	58.2	118.0	30.6	28.558	-2.171	6.42	16.4
24.0	186.5	63.3	123.1	33.4	29.067	-2.567	6.55	16.6
25.0	165.2	66.9	98.2	28.2	28.222	-1.652	6.31	16.1
26.0	168.9	70.7	98.2	29.3	28.325	-1.702	6.36	16.1
27.0	172.8	74.6	98.2	30.5	28.526	-1.795	6.40	16.1
28.0	176.9	78.6	98.2	31.8	28.693	-1.889	6.45	16.1
29.0	181.1	82.8	98.2	33.2	28.815	-1.995	6.50	16.2
30.0	185.4	87.2	98.2	34.7	28.993	-2.081	6.55	16.3
31.0	190.0	91.7	98.2	36.4	29.219	-2.196	6.61	16.3
32.0	194.7	96.4	98.2	38.6	29.198	-2.349	6.60	16.2
33.0	199.5	101.3	98.2	40.6	29.358	-2.440	6.67	16.3
34.0	204.5	106.3	98.2	42.7	29.624	-2.518	6.73	16.4
35.0	209.7	111.4	98.2	45.1	29.849	-2.610	6.81	16.5
36.0	215.0	116.8	98.2	47.7	30.035	-2.677	6.88	16.6
37.0	257.6	123.6	134.0	74.4	31.438	-3.623	7.34	17.6
38.0	266.1	132.1	134.0	84.1	31.726	-3.628	7.33	17.6
39.0	274.8	140.9	134.0	94.6	32.158	-3.598	7.39	17.6
40.0	283.8	149.8	134.0	107.3	32.653	-3.537	7.45	17.7
41.0	293.0	159.0	134.0	122.2	33.117	-3.440	7.50	17.7
42.0	302.4	168.5	134.0	138.5	33.599	-3.377	7.55	17.8
43.0	312.1	178.2	134.0	159.8	33.936	-3.327	7.60	17.8
44.0	322.0	188.1	134.0	183.9	34.243	-3.287	7.63	17.8
45.0	272.3	191.9	80.4	94.1	32.897	-2.637	7.36	17.0
46.0	276.2	195.8	80.4	100.0	32.911	-2.482	7.37	17.0

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

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
47.0	280.2	199.8	80.4	105.7	33.216	-2.401	7.40	16.9
48.0	284.2	203.8	80.4	112.2	33.616	-2.288	7.42	16.9
49.0	288.3	207.9	80.4	120.6	33.847	-2.105	7.44	16.8
50.0	292.5	212.1	80.4	127.5	34.162	-2.005	7.46	16.8
51.0	296.7	216.3	80.4	135.8	34.384	-1.926	7.47	16.7
52.0	301.0	220.6	80.4	146.8	34.436	-1.811	7.49	16.6
53.0	305.4	225.0	80.4	158.3	34.629	-1.679	7.50	16.5
54.0	309.8	229.4	80.4	172.4	34.763	-1.591	7.52	16.4
55.0	314.3	233.9	80.4	190.2	34.778	-1.487	7.52	16.3
56.0	318.8	238.5	80.4	211.1	34.778	-1.352	7.53	16.2
57.0	323.5	243.1	80.4	238.8	34.744	-1.229	7.53	16.1
58.0	328.1	247.8	80.4	271.9	34.828	-1.127	7.54	16.0
59.0	332.9	252.5	80.4	321.4	34.790	-0.982	7.55	15.9
60.0	337.7	257.3	80.4	384.6	34.811	-0.816	7.56	15.8
61.0	342.6	262.2	80.4	482.6	34.958	-0.710	7.56	15.7
62.0	347.5	267.2	80.4	620.3	35.255	-0.588	7.56	15.7
63.0	352.6	272.2	80.4	967.5	35.325	-0.418	7.55	15.5
64.0	357.6	277.3	80.4	1915.7	35.433	-0.287	7.55	15.3

Total Continuous Driving Time 176.00 minutes; Total Number of Blows 7628

Resource International Inc

Aug 09 2013

HAM-75-0992 - B-211 - Abut - 16" CIP

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

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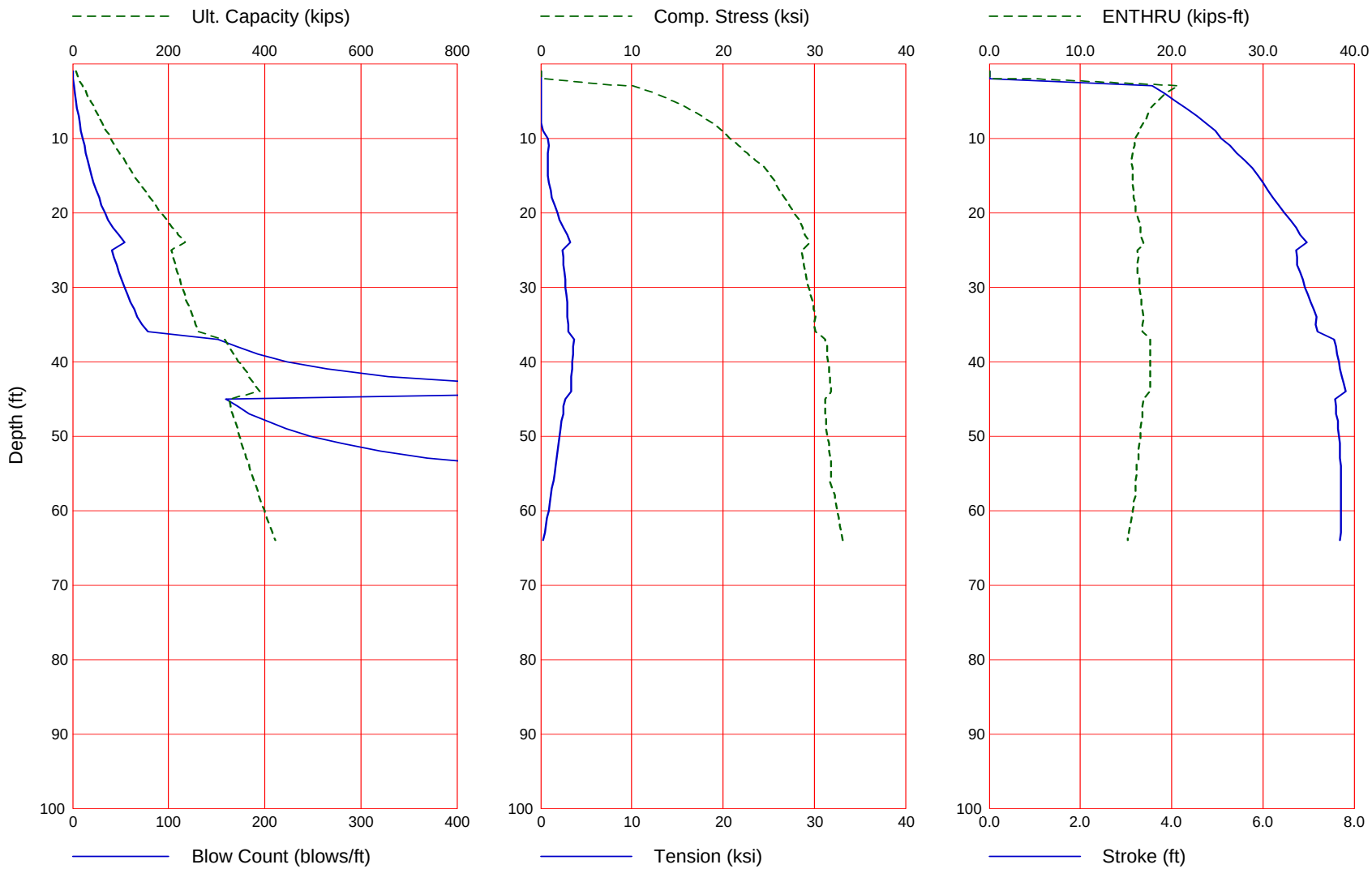

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.0	6.8	0.1	6.7	-1.0	0.000	0.000	0.00	0.0
2.0	13.9	0.5	13.4	-1.0	0.000	0.000	0.00	0.0
3.0	21.2	1.1	20.1	2.0	9.956	0.000	3.58	20.7
4.0	28.8	2.0	26.8	2.9	12.619	0.000	3.85	19.4
5.0	36.7	3.1	33.5	3.9	14.591	0.000	4.09	18.4
6.0	44.7	4.5	40.2	5.0	16.177	0.000	4.31	17.7
7.0	53.1	6.2	46.9	6.2	17.629	0.000	4.55	17.3
8.0	61.7	8.0	53.6	7.5	18.840	0.000	4.75	16.9
9.0	70.5	10.2	60.3	9.0	19.930	-0.296	4.95	16.5
10.0	79.6	12.6	67.0	10.6	20.758	-0.799	5.09	16.1
11.0	88.9	15.2	73.7	12.3	21.698	-0.872	5.27	15.9
12.0	98.5	18.1	80.4	14.1	22.654	-0.823	5.43	15.7
13.0	108.4	21.2	87.1	16.0	23.547	-0.812	5.59	15.6
14.0	118.5	24.6	93.8	17.9	24.559	-0.811	5.78	15.7
15.0	128.8	28.3	100.5	19.9	25.176	-0.817	5.90	15.7
16.0	139.4	32.2	107.2	22.2	25.731	-0.917	6.00	15.7
17.0	150.3	36.3	113.9	24.6	26.199	-1.105	6.11	15.8
18.0	161.4	40.7	120.6	27.5	26.706	-1.272	6.22	15.8
19.0	172.7	45.4	127.3	30.2	27.295	-1.520	6.35	16.0
20.0	184.3	50.3	134.0	33.7	27.839	-1.815	6.48	16.1
21.0	196.2	55.4	140.7	37.3	28.311	-2.126	6.61	16.4
22.0	208.3	60.8	147.4	41.7	28.707	-2.518	6.74	16.6
23.0	220.6	66.5	154.1	47.7	28.960	-2.906	6.81	16.6
24.0	233.2	72.4	160.8	53.8	29.501	-3.294	6.97	16.9
25.0	204.8	76.5	128.3	41.3	28.689	-2.383	6.72	16.3
26.0	209.1	80.8	128.3	43.2	28.789	-2.467	6.76	16.4
27.0	213.5	85.2	128.3	46.0	28.806	-2.550	6.75	16.3
28.0	218.2	89.8	128.3	48.4	29.004	-2.659	6.81	16.3
29.0	223.0	94.7	128.3	50.7	29.191	-2.749	6.87	16.5
30.0	228.0	99.7	128.3	53.9	29.348	-2.761	6.93	16.5
31.0	233.2	104.8	128.3	57.0	29.564	-2.837	6.99	16.6
32.0	238.5	110.2	128.3	59.8	29.761	-2.954	7.06	16.7
33.0	244.1	115.7	128.3	63.9	29.871	-2.951	7.12	16.8
34.0	249.8	121.5	128.3	67.5	30.113	-2.968	7.17	16.9
35.0	255.7	127.4	128.3	72.9	30.075	-3.016	7.16	16.8
36.0	261.8	133.4	128.3	78.0	30.159	-3.015	7.20	16.8
37.0	316.3	141.3	175.0	151.1	31.227	-3.666	7.56	17.7
38.0	326.0	151.0	175.0	170.6	31.360	-3.563	7.60	17.6
39.0	336.0	161.0	175.0	193.0	31.431	-3.523	7.63	17.6
40.0	346.2	171.2	175.0	222.9	31.501	-3.490	7.67	17.6
41.0	356.7	181.8	175.0	264.6	31.638	-3.448	7.70	17.6
42.0	367.5	192.6	175.0	328.6	31.730	-3.391	7.74	17.6
43.0	378.6	203.6	175.0	440.5	31.755	-3.354	7.77	17.6
44.0	389.9	215.0	175.0	635.5	31.869	-3.321	7.81	17.6
45.0	324.3	219.4	105.0	159.0	31.179	-2.704	7.58	16.9
46.0	328.8	223.8	105.0	172.0	31.218	-2.513	7.60	16.8

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

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
47.0	333.3	228.4	105.0	183.7	31.215	-2.458	7.61	16.8
48.0	338.0	233.0	105.0	202.3	31.293	-2.307	7.64	16.7
49.0	342.6	237.7	105.0	222.3	31.320	-2.134	7.65	16.6
50.0	347.4	242.4	105.0	247.3	31.453	-2.027	7.66	16.6
51.0	352.2	247.3	105.0	280.0	31.594	-1.955	7.68	16.5
52.0	357.2	252.2	105.0	320.8	31.646	-1.851	7.69	16.4
53.0	362.1	257.2	105.0	369.6	31.827	-1.724	7.69	16.4
54.0	367.2	262.2	105.0	457.8	31.832	-1.608	7.71	16.2
55.0	372.3	267.3	105.0	568.1	31.882	-1.519	7.71	16.2
56.0	377.5	272.6	105.0	786.7	31.780	-1.387	7.72	16.1
57.0	382.8	277.8	105.0	1225.3	31.961	-1.246	7.72	16.0
58.0	388.2	283.2	105.0	2356.0	32.244	-1.152	7.72	16.0
59.0	393.6	288.6	105.0	9999.0	32.359	-1.007	7.72	15.8
60.0	399.1	294.1	105.0	9999.0	32.513	-0.855	7.71	15.7
61.0	404.7	299.7	105.0	9999.0	32.657	-0.736	7.71	15.6
62.0	410.3	305.4	105.0	9999.0	32.833	-0.610	7.71	15.5
63.0	416.1	311.1	105.0	9999.0	32.952	-0.465	7.71	15.3
64.0	421.9	316.9	105.0	9999.0	33.079	-0.319	7.70	15.2

Refusal occurred; no driving time output possible

APPENDIX VI

MSE WALL CALCULATIONS

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JOB	HAM-75-7.85	NO.	B-10-020
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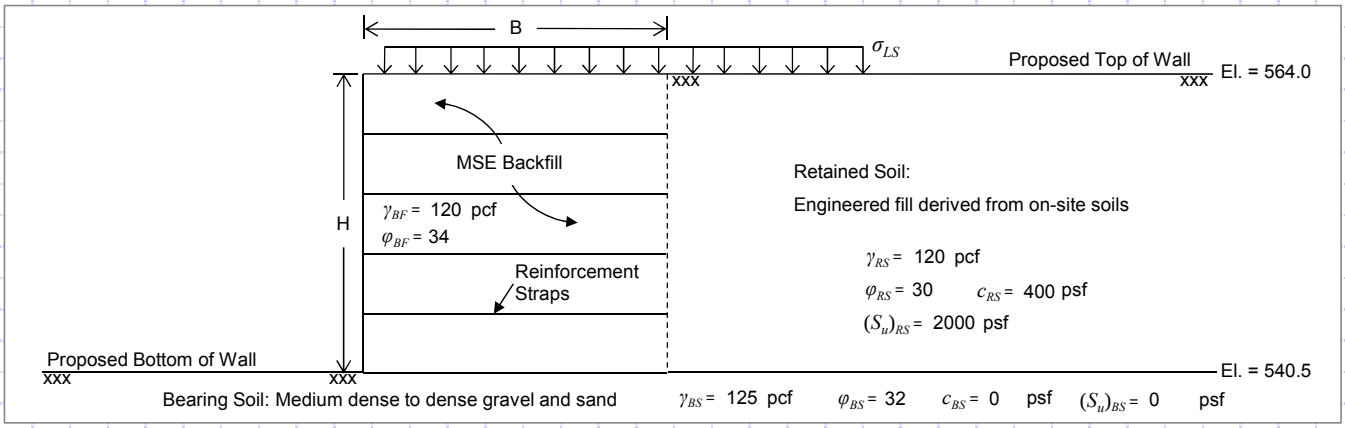
HAM-75-0992 - MSE Wall - Rear Abutment

MSE Wall - Rear Abutment - B-212 - (23.5 ft. Wall Height)



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	23.5	ft
MSE Wall Width (Reinforcement Length), (B) =	16.5	ft
Live Surcharge Load, (σ_{LS}) =	0	psf
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{BS}) =	400	psf
Retained Soil Undrained Shear Strength, [$(S_u)_{RS}$] =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.333	
MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°

Bearing Soil Properties:

Bearing Soil Unit Weight, (γ_{BS}) =	125	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	32	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, [$(S_u)_{BS}$] =	0	psf
Embedment Depth, (D) =	3.0	ft

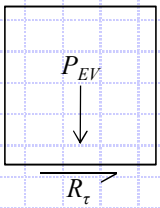
LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Sections 11.6.3.6 and 11.10.5.3

Nominal Sliding Resistance: $R_\tau = P_{EV} \cdot \tan\delta$



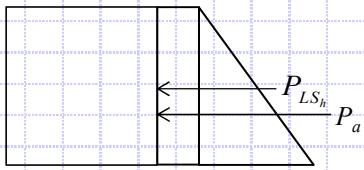
$P_{EV} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV}$ = (120 pcf)(23.5 ft)(16.5 ft)(1.00) = 46.53 kip/ft

$\tan\delta = (\tan\varphi_{BS} \le \tan\varphi_{BF})$

$\tan\delta =$ tan(32) ≤ tan(34) ⟶ 0.62 ≤ 0.67 ⟶ $\tan\delta =$ 0.62

R_τ = (46.53 kip/ft)(0.62) = 28.85 kip/ft

Sliding Force: $P_H = P_{EH} + P_{LS_h}$



$P_{EH} = \frac{1}{2}\gamma_{RS} H^2 K_a \gamma_{EH}$ = ½(120 pcf)(23.5 ft)²(0.333)(1.5) = 16.55 kip/ft

$P_{LS_h} = \sigma_{LS} H K_a \gamma_{LS}$ = (0 psf)(23.5 ft)(0.333)(1.75) = 0 kip/ft

P_H = 16.55 kip/ft + 0 kip/ft = 16.55 kip/ft

Check Sliding Resistance

$P_H \le R_\tau \cdot \phi_\tau$ ⟶ 16.55 kip/ft ≤ (28.85 kip/ft)(1.0) = 28.85 kip/ft ⟶ 16.55 kip/ft ≤ 28.85 kip/ft **OK**

Use φ_τ = **1.0** *(Per AASHTO LRFD BDM Table 11.5.6-1)*

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HAM-75-0992 - MSE Wall - Rear Abutment

MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	23.5	ft
MSE Wall Width (Reinforcement Length), (B) =	16.5	ft
Live Surcharge Load, (σ_{LS}) =	0	psf
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{BS}) =	400	psf
Retained Soil Undrained Shear Strength, $[(S_u)_{RS}]$ =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.333	
MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°

Bearing Soil Properties:

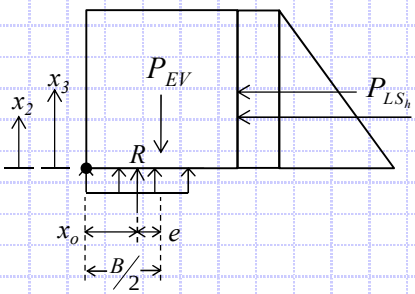
Bearing Soil Unit Weight, (γ_{BS}) =	125	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	32	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, $[(s_u)_{BS}]$ =	0	psf
Embedment Depth, (D) =	3.0	ft

LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Eccentricity (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.6.3.3



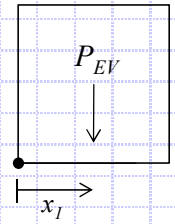
$$e = B/2 - x_o$$

$$x_o = \frac{M_{EV} - M_H}{P_{EV}} = \text{(383.87 kip·ft/ft - 129.59 kip·ft/ft) / (46.53 kip/ft)} = 5.46 \text{ ft}$$

M_{EV} = 383.87 kip·ft/ft
M_H = 129.59 kip·ft/ft
P_{EV} = 46.53 kip/ft
} Defined below

$e =$ (16.5 ft)/2 - 5.46 ft = 2.79 ft

Resisting Moment, M_{EV}:



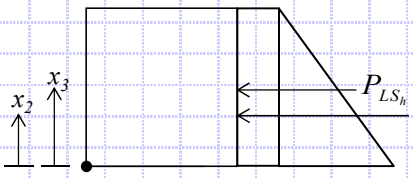
$$M_{EV} = P_{EV}(x_1)$$

$$P_{EV} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV} = \text{(120 pcf)(23.5 ft)(16.5 ft)(1.00)} = 46.53 \text{ kip/ft}$$

$$x_1 = B/2 = \text{(16.5 ft) / 2} = 8.25 \text{ ft}$$

$$M_{EV} = \text{(46.53 kip/ft)(8.25 ft)} = 383.87 \text{ kip·ft/ft}$$

Overturning Moment, M_H:



$$M_H = P_{EH}(x_2) + P_{LS_h}(x_3)$$

$$P_{EH} = \tfrac{1}{2}\gamma_{RS} H^2 K_a \gamma_{EH} = \text{½(120 pcf)(23.5 ft)²(0.333)(1.5)} = 16.55 \text{ kip/ft}$$

$$P_{LS_h} = \sigma_{LS} H K_a \gamma_{LS} = \text{(0 psf)(23.5 ft)(0.333)(1.75)} = 0 \text{ kip/ft}$$

$$x_2 = H/3 = \text{(23.5 ft) / 3} = 7.83 \text{ ft}$$

$$x_3 = H/2 = \text{(23.5 ft) / 2} = 11.75 \text{ ft}$$

$$M_H = \text{(16.55 kip/ft)(7.83 ft) + (0 kip/ft)(11.75 ft)} = 129.59 \text{ kip·ft/ft}$$

Limiting Eccentricity:

$$e_{max} = B/4 \longrightarrow e_{max} = \text{(16.5 ft) / 4} = 4.13 \text{ ft}$$

Check Eccentricity

$$e < e_{max} \longrightarrow \text{2.79 ft} \le \text{4.13 ft} \quad \textbf{OK}$$

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JOB	HAM-75-7.85	NO.	B-10-020
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HAM-75-0992 - MSE Wall - Rear Abutment

MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	23.5	ft
MSE Wall Width (Reinforcement Length), (B) =	16.5	ft
Live Surcharge Load, (σ_{LS}) =	0	psf
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{BS}) =	400	psf
Retained Soil Undrained Shear Strength, [(S_u)$_{RS}$] =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.333	
MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°

Bearing Soil Properties:

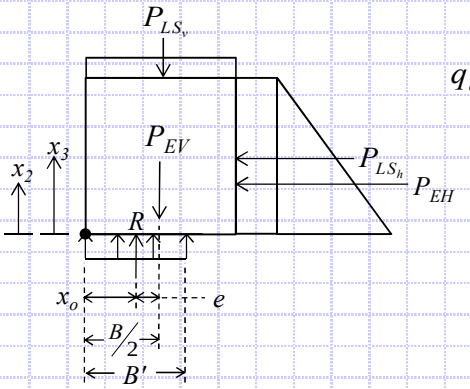
Bearing Soil Unit Weight, (γ_{BS}) =	125	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	32	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, [(s_u)$_{BS}$] =	0	psf
Embedment Depth, (D) =	3.0	ft

LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.6.3.2



$$q_{eq} = P_V / B'$$

$B' = B - 2e$ = 16.5 ft - 2(2.06 ft) = 12.38 ft

$e = B/2 - x_o$ = (16.5 ft) / 2 - 6.19 ft = 2.06 ft

$x_o = \frac{M_V - M_H}{P_V}$ = (518.23 kip·ft/ft - 129.59 kip·ft/ft) / 62.82 kip/ft = 6.19 ft

q_{eq} = (62.82 kip/ft) / (12.38 ft) = 5.07 ksf

$$M_V = P_{EV}(x_1) + P_{LS_v}(x_1) = (\gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV})(x_1) + (\sigma_{LS} \cdot B \cdot \gamma_{LS})(x_1)$$

M_V = [(120 pcf)(23.5 ft)(16.5 ft)(1.35)](8.25 ft) + [(0 psf)(16.5 ft)(1.75)](8.25 ft) = 518.23 kip·ft/ft

$$M_H = P_{EH}(x_2) + P_{LS_h}(x_3) = (\tfrac{1}{2}\gamma_{RS} H^2 K_a \gamma_{EH})(x_2) + (\sigma_{LS} H K_a \gamma_{LS})(x_3)$$

M_H = [½(120 pcf)(23.5 ft)²(0.333)(1.5)](7.83 ft) + [(0 psf)(23.5 ft)(0.333)(1.75)](11.75 ft) = 129.59 kip·ft/ft

$$P_V = P_{EV} + P_{LS} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV} + \sigma_{LS} \cdot B \cdot \gamma_{LS}$$

P_V = (120 pcf)(23.5 ft)(16.5 ft)(1.35) + (0 psf)(16.5 ft)(1.75) = 62.82 kip/ft

Nominal Bearing Resistance:

$q_n = cN_c + \gamma D N_q + \tfrac{1}{2}\gamma B N_\gamma$ = (0 psf)(44) + (125 pcf)(3.0 ft)(28.5) + ½(125 pcf)(16.5 ft)(28.0) = 39.6 ksf

N_c = 44.0 N_q = 28.5 N_γ = 28.0

Check Bearing Capacity

$q_{eq} \le q_n \cdot \phi_b$ ⟶ 5.07 ksf ≤ (39.6 ksf)(0.65) = 25.74 ksf ⟶ 5.07 ksf ≤ 25.74 ksf **OK**

Use φ_b = **0.65** *(Per AASHTO LRFD BDM Table 11.5.6-1)*

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HAM-75-0992 - MSE Wall - Rear Abutment

MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	23.5	ft
MSE Wall Width (Reinforcement Length), (B) =	16.5	ft
Live Surcharge Load, (σ_{LS}) =	0	psf
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{BS}) =	400	psf
Retained Soil Undrained Shear Strength, [(S_u)$_{RS}$] =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.333	
MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°

Bearing Soil Properties:

Bearing Soil Unit Weight, (γ_{BS}) =	125	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	32	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, [(s_u)$_{BS}$] =	0	psf
Embedment Depth, (D) =	3.0	ft

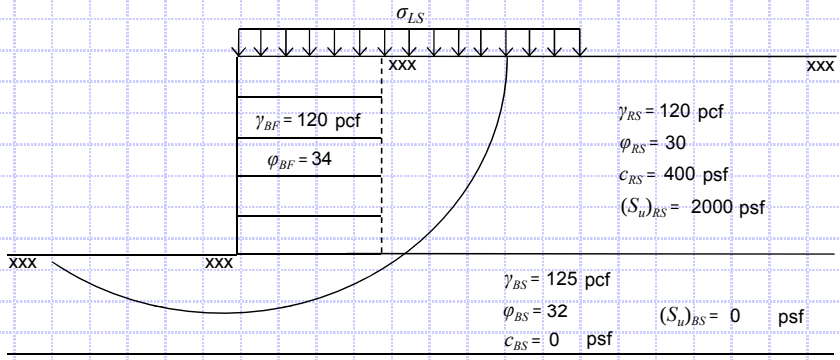
LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

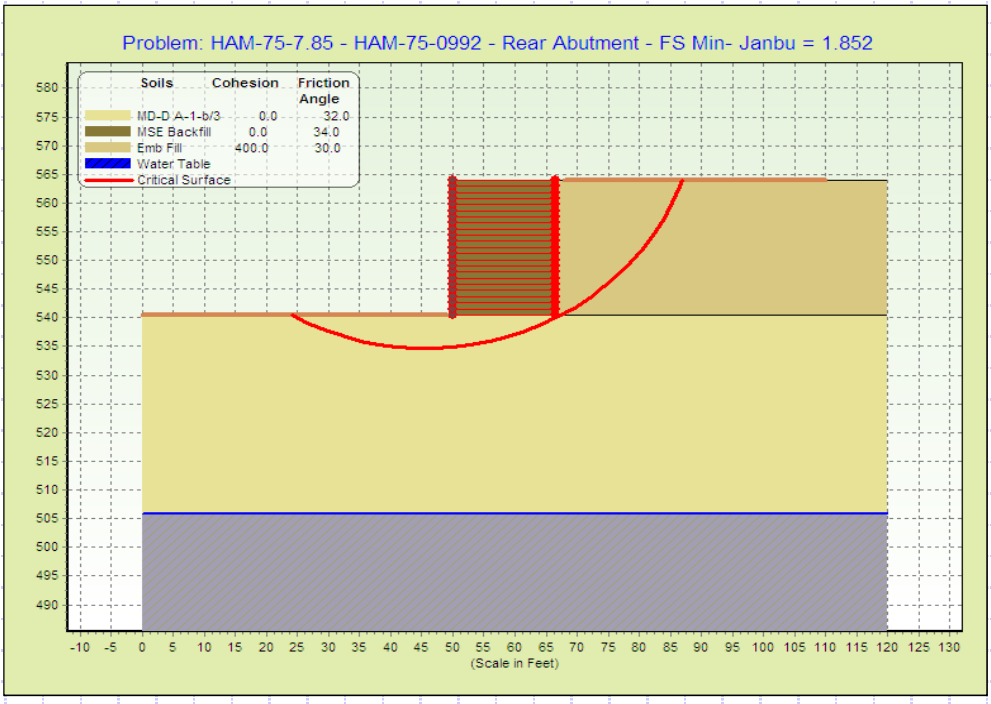
Check Overall (Global) Stability (Loading Case - Service I) - AASHTO LRFD BDM Sections 11.6.2.3 and 11.10.5.2

Long Term Stability - Drained Conditions



Loading scenario modeled as shown to the left and analyzed for slope stability using STABL for Windows software.

Graphical output shown below and tabular output results are provided as a separate attachment.



Check Overall (Global) Stability

$1.0 \le FS \cdot \phi_{GS}$ ⟶ 1.00 ≤ (1.852)(0.65) = 1.20 ⟶ 1.00 ≤ 1.20 **OK**

FS = **1.852** *(From STABL Slope Stability Analysis)*

Use φ_{GS} = **0.65** *(Per AASHTO LRFD BDM Section 11.6.2.3)*

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HAM-75-0992 - MSE Wall - Rear Abutment

MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	23.5	ft
MSE Wall Width (Reinforcement Length), (B) =	16.5	ft
Live Surcharge Load, (σ_{LS}) =	0	psf
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{BS}) =	400	psf
Retained Soil Undrained Shear Strength, [$(S_u)_{RS}$] =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.333	
MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°

Bearing Soil Properties:

Bearing Soil Unit Weight, (γ_{BS}) =	125	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	32	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, [$(s_u)_{BS}$] =	0	psf
Embedment Depth, (D) =	3.0	ft

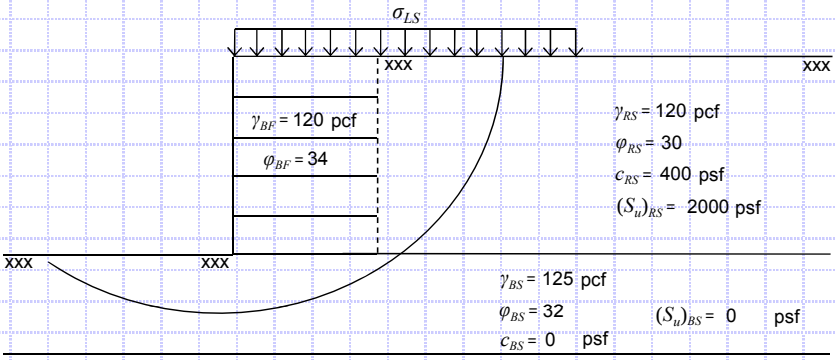
LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

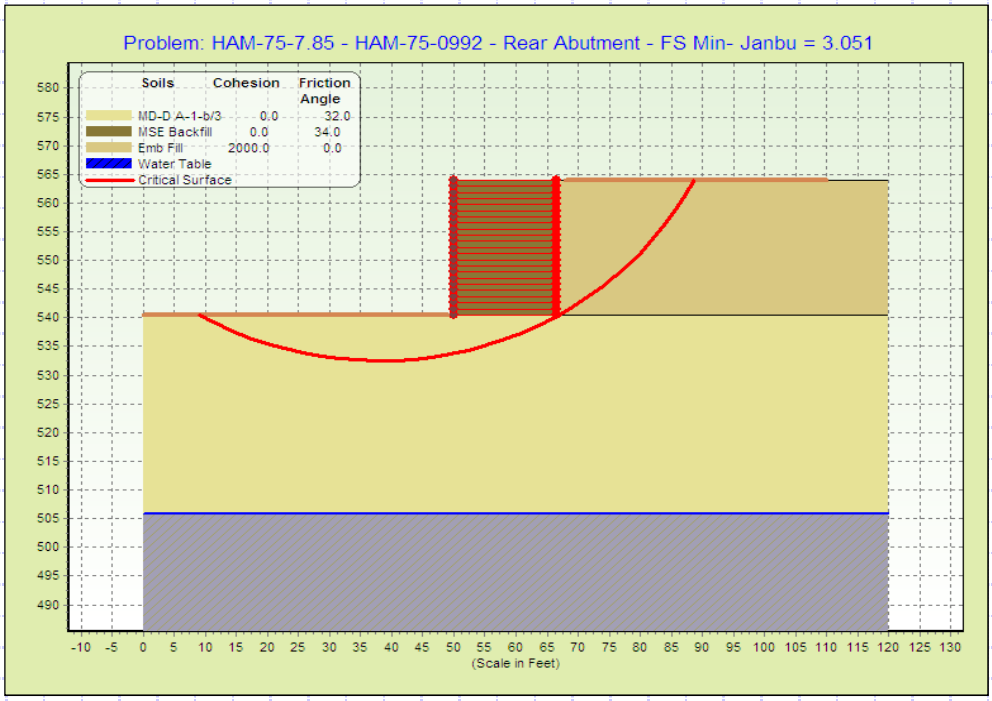
Check Overall (Global) Stability (Loading Case - Service I) - AASHTO LRFD BDM Sections 11.6.2.3 and 11.10.5.2 ***(Cont'd)***

Short Term Stability - Undrained Conditions



Loading scenario modeled as shown to the left and analyzed for slope stability using STABL for Windows software.

Graphical output shown below and tabular output results are provided as a separate attachment.



Check Overall (Global) Stability

$1.0 \le FS \cdot \phi_{GS}$ ⟶ 1.00 ≤ (3.051)(0.65) = 1.98 ⟶ 1.00 ≤ 1.98 **OK**

FS = **3.051** *(From STABL Slope Stability Analysis)*

Use φ_{GS} = **0.65** *(Per AASHTO LRFD BDM Section 11.6.2.3)*

** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION HAM-75-7.85 - HAM-75-0992 - Rear Abutmen
t

BOUNDARY COORDINATES

4 Top Boundaries
7 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	540.50	50.00	540.50	3
2	50.00	540.50	50.10	564.00	1
3	50.10	564.00	66.60	564.00	1
4	66.60	564.00	120.00	564.00	2
5	50.00	540.50	66.50	540.50	3
6	66.50	540.50	66.60	564.00	2
7	66.50	540.50	120.00	540.50	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	125.0	0.0	34.0	0.00	0.0	1
2	120.0	130.0	400.0	30.0	0.00	0.0	1
3	125.0	130.0	0.0	32.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	505.80
2	120.00	505.80

GEOSYNTHETIC DATA

1 Geosynthetics(s) group(s) specified

Ngroup no	Bnr no	Y-top (ft)	Y-bot (ft)	Levels no	Length (ft)	Spacing (ft)	Efficiency	Tallow (lbs/ft)
1	2	540.5	564.0	23	16.5	-1.07	1.0	7500.0

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

500 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 50 Points Equally Spaced
Along The Ground Surface Between X = 0.00 ft.
and X = 49.00 ft.

Each Surface Terminates Between X = 68.00 ft.
and X = 110.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =500.00 ft.

3.00 ft. Line Segments Define Each Trial Failure Surface.

Factor Of Safety Calculation Has Gone Through 30 Iterations,
without convergence

The Trial Failure Surface In Question Is Defined
By The Following 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	19.00	540.50
2	21.41	538.72
3	23.99	537.18
4	26.70	535.90
5	29.53	534.90
6	32.44	534.17
7	35.41	533.73
8	38.41	533.59
9	41.40	533.73
10	44.37	534.17
11	47.28	534.90
12	50.11	535.91
13	52.82	537.19
14	55.40	538.73
15	57.81	540.51
16	60.04	542.52
17	62.06	544.74
18	63.85	547.14
19	65.40	549.71
20	66.69	552.42
21	67.71	555.24
22	68.46	558.15
23	68.91	561.11
24	69.07	564.00

Factor Of Safety For The Preceding Specified Surface = 12.243

Factor Of Safety Calculation Has Gone Through 30 Iterations,
without convergence

The Trial Failure Surface In Question Is Defined
By The Following 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	540.50
2	24.56	538.93
3	27.26	537.63
4	30.08	536.60
5	32.99	535.87
6	35.95	535.43
7	38.95	535.29
8	41.95	535.45
9	44.91	535.92
10	47.81	536.68
11	50.62	537.73
12	53.31	539.06
13	55.86	540.65
14	58.22	542.49
15	60.40	544.56
16	62.35	546.84
17	64.06	549.30
18	65.52	551.92
19	66.70	554.68
20	67.61	557.54
21	68.21	560.48
22	68.52	563.46
23	68.52	564.00

Factor Of Safety For The Preceding Specified Surface = -2.746

Factor Of Safety Calculation Has Gone Through 30 Iterations,
without convergence

The Trial Failure Surface In Question Is Defined
By The Following 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	34.00	540.50
2	36.86	539.59
3	39.80	539.01
4	42.79	538.76
5	45.79	538.84
6	48.76	539.25
7	51.67	539.98
8	54.48	541.04
9	57.16	542.40
10	59.66	544.04
11	61.97	545.96
12	64.06	548.11
13	65.89	550.49
14	67.45	553.05
15	68.72	555.77
16	69.67	558.61

17	70.31	561.55
18	70.56	564.00

Factor Of Safety For The Preceding Specified Surface = -3.167
1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	24.00	540.50
2	26.65	539.09
3	29.39	537.86
4	32.20	536.83
5	35.08	535.99
6	38.01	535.35
7	40.98	534.92
8	43.97	534.69
9	46.97	534.67
10	49.97	534.86
11	52.94	535.25
12	55.88	535.84
13	58.78	536.64
14	61.61	537.63
15	64.36	538.82
16	67.03	540.19
17	69.60	541.75
18	72.05	543.47
19	74.38	545.36
20	76.57	547.41
21	78.62	549.61
22	80.51	551.94
23	82.23	554.39
24	83.78	556.96
25	85.15	559.63
26	86.34	562.38
27	86.91	564.00

*** 1.852 ***

Individual data on the 31 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Earthquake Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.6	233.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2.7	692.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	2.8	1110.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	2.9	1472.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	2.9	1768.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	3.0	1989.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	3.0	2128.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	3.0	2181.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	3.0	2146.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	22.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.1	211.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	2.8	9950.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	2.9	10112.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	2.9	9696.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

15	2.8	9172.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	2.8	8553.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	2.1	6331.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.1	288.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.4	1232.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.5	1441.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	2.1	5651.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	2.5	6296.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	2.3	5470.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	2.2	4633.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	2.0	3803.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	1.9	3000.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	1.7	2243.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	1.6	1550.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	1.4	939.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	1.2	425.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.6	55.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Individual data on the 23 geosynthetics

Group	Level	Slice	Head Coordinates (ft)		End Coordinates (ft)		T (lbs)	Length (ft)	Tallow (lbs)	T/Tall %
1	1	0	50.1	564.0	66.6	564.0	0.0	16.5	7500.0	0.0
1	2	0	50.1	562.9	66.6	562.9	0.0	16.5	7500.0	0.0
1	3	0	50.1	561.9	66.6	561.9	0.0	16.5	7500.0	0.0
1	4	0	50.1	560.8	66.6	560.8	0.0	16.5	7500.0	0.0
1	5	0	50.1	559.7	66.6	559.7	0.0	16.5	7500.0	0.0
1	6	0	50.1	558.7	66.6	558.7	0.0	16.5	7500.0	0.0
1	7	0	50.1	557.6	66.6	557.6	0.0	16.5	7500.0	0.0
1	8	0	50.1	556.5	66.6	556.5	0.0	16.5	7500.0	0.0
1	9	0	50.1	555.5	66.6	555.5	0.0	16.5	7500.0	0.0
1	10	0	50.1	554.4	66.6	554.4	0.0	16.5	7500.0	0.0
1	11	0	50.1	553.3	66.6	553.3	0.0	16.5	7500.0	0.0
1	12	0	50.0	552.2	66.6	552.2	0.0	16.5	7500.0	0.0
1	13	0	50.0	551.2	66.5	551.2	0.0	16.5	7500.0	0.0
1	14	0	50.0	550.1	66.5	550.1	0.0	16.5	7500.0	0.0
1	15	0	50.0	549.0	66.5	549.0	0.0	16.5	7500.0	0.0
1	16	0	50.0	548.0	66.5	548.0	0.0	16.5	7500.0	0.0
1	17	0	50.0	546.9	66.5	546.9	0.0	16.5	7500.0	0.0
1	18	0	50.0	545.8	66.5	545.8	0.0	16.5	7500.0	0.0
1	19	0	50.0	544.8	66.5	544.8	0.0	16.5	7500.0	0.0
1	20	0	50.0	543.7	66.5	543.7	0.0	16.5	7500.0	0.0
1	21	0	50.0	542.6	66.5	542.6	0.0	16.5	7500.0	0.0
1	22	0	50.0	541.6	66.5	541.6	0.0	16.5	7500.0	0.0
1	23	0	50.0	540.5	66.5	540.5	0.0	16.5	7500.0	0.0

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	540.50
2	24.38	538.67
3	26.91	537.06
4	29.57	535.68
5	32.35	534.53
6	35.21	533.63
7	38.14	532.99
8	41.11	532.60
9	44.11	532.48
10	47.11	532.61
11	50.08	533.01
12	53.01	533.67
13	55.87	534.58
14	58.63	535.73
15	61.29	537.13
16	63.82	538.75
17	66.19	540.58
18	68.39	542.62
19	70.41	544.84
20	72.22	547.23
21	73.82	549.77
22	75.20	552.43
23	76.33	555.21
24	77.22	558.08

25	77.85	561.01
26	78.22	563.99
27	78.22	564.00

*** 1.855 ***

1

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.00	540.50
2	25.50	538.84
3	28.11	537.37
4	30.83	536.11
5	33.64	535.05
6	36.53	534.22
7	39.46	533.61
8	42.44	533.22
9	45.43	533.06
10	48.43	533.13
11	51.42	533.43
12	54.37	533.96
13	57.27	534.71
14	60.11	535.68
15	62.87	536.86
16	65.53	538.25
17	68.07	539.84
18	70.49	541.62
19	72.76	543.58
20	74.88	545.71
21	76.82	547.99
22	78.59	550.42
23	80.17	552.97
24	81.55	555.63
25	82.72	558.39
26	83.67	561.24
27	84.37	564.00

*** 1.858 ***

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.00	540.50
2	19.59	538.99
3	22.28	537.66
4	25.04	536.49
5	27.88	535.50
6	30.77	534.70
7	33.70	534.08
8	36.67	533.64
9	39.66	533.40
10	42.66	533.35
11	45.66	533.48
12	48.64	533.81
13	51.59	534.33
14	54.51	535.03
15	57.38	535.91
16	60.18	536.98
17	62.91	538.22
18	65.56	539.63
19	68.11	541.21
20	70.56	542.95
21	72.89	544.84
22	75.09	546.87

23	77.17	549.04
24	79.10	551.34
25	80.88	553.75
26	82.50	556.27
27	83.96	558.89
28	85.26	561.60
29	86.22	564.00

*** 1.869 ***

1

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	36.00	540.50
2	38.67	539.13
3	41.46	538.03
4	44.35	537.21
5	47.30	536.67
6	50.29	536.42
7	53.29	536.46
8	56.27	536.80
9	59.20	537.42
10	62.06	538.33
11	64.82	539.51
12	67.45	540.95
13	69.93	542.64
14	72.23	544.57
15	74.33	546.71
16	76.22	549.04
17	77.86	551.55
18	79.26	554.20
19	80.39	556.98
20	81.25	559.86
21	81.82	562.80
22	81.93	564.00

*** 1.875 ***

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.00	540.50
2	17.41	538.72
3	19.95	537.11
4	22.59	535.70
5	25.34	534.48
6	28.16	533.46
7	31.05	532.65
8	33.99	532.06
9	36.96	531.68
10	39.96	531.51
11	42.96	531.57
12	45.95	531.84
13	48.91	532.33
14	51.82	533.03
15	54.68	533.94
16	57.46	535.06
17	60.16	536.38
18	62.75	537.89
19	65.23	539.58
20	67.57	541.45
21	69.78	543.48
22	71.83	545.67
23	73.72	548.01

24	75.43	550.47
25	76.96	553.05
26	78.29	555.74
27	79.43	558.51
28	80.36	561.37
29	81.02	564.00

*** 1.876 ***

1

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	21.00	540.50
2	23.63	539.06
3	26.35	537.79
4	29.15	536.70
5	32.01	535.80
6	34.92	535.08
7	37.87	534.55
8	40.85	534.21
9	43.85	534.06
10	46.85	534.11
11	49.84	534.35
12	52.81	534.78
13	55.74	535.41
14	58.63	536.22
15	61.46	537.22
16	64.22	538.39
17	66.90	539.74
18	69.48	541.27
19	71.96	542.95
20	74.33	544.80
21	76.58	546.79
22	78.69	548.92
23	80.66	551.18
24	82.47	553.57
25	84.13	556.07
26	85.63	558.67
27	86.96	561.36
28	88.05	564.00

*** 1.886 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	34.00	540.50
2	36.64	539.07
3	39.39	537.88
4	42.24	536.95
5	45.17	536.27
6	48.14	535.87
7	51.14	535.73
8	54.13	535.86
9	57.10	536.27
10	60.03	536.94
11	62.88	537.87
12	65.64	539.05
13	68.27	540.48
14	70.77	542.14
15	73.11	544.02
16	75.27	546.11
17	77.23	548.38
18	78.98	550.81

19	80.50	553.40
20	81.79	556.11
21	82.82	558.93
22	83.60	561.82
23	83.97	564.00

*** 1.898 ***

1

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.00	540.50
2	27.71	539.21
3	30.50	538.10
4	33.35	537.19
5	36.27	536.46
6	39.22	535.94
7	42.20	535.61
8	45.20	535.48
9	48.20	535.55
10	51.18	535.82
11	54.15	536.29
12	57.07	536.96
13	59.95	537.82
14	62.76	538.87
15	65.49	540.10
16	68.13	541.52
17	70.68	543.11
18	73.11	544.87
19	75.42	546.78
20	77.60	548.85
21	79.63	551.05
22	81.51	553.39
23	83.23	555.85
24	84.79	558.41
25	86.16	561.08
26	87.36	563.83
27	87.42	564.00

*** 1.899 ***

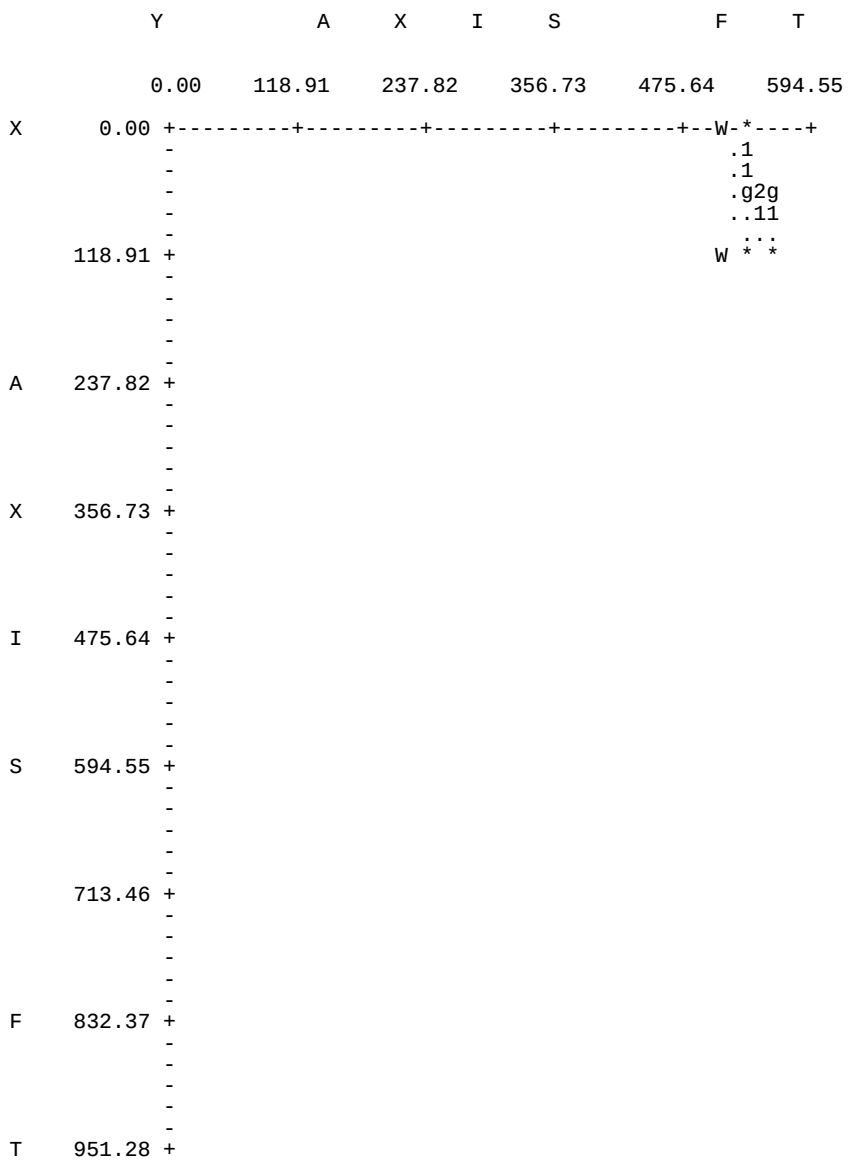
Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.00	540.50
2	19.35	538.64
3	21.84	536.96
4	24.44	535.47
5	27.15	534.18
6	29.95	533.10
7	32.82	532.23
8	35.75	531.58
9	38.72	531.15
10	41.71	530.94
11	44.71	530.96
12	47.70	531.21
13	50.66	531.68
14	53.58	532.37
15	56.44	533.28
16	59.23	534.40
17	61.92	535.72
18	64.50	537.25
19	66.96	538.96
20	69.29	540.86

21	71.47	542.92
22	73.48	545.14
23	75.33	547.51
24	76.99	550.01
25	78.46	552.62
26	79.72	555.34
27	80.78	558.15
28	81.63	561.03
29	82.26	563.96
30	82.27	564.00

*** 1.904 ***

1



** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION HAM-75-7.85 - HAM-75-0992 - Rear Abutmen
t

BOUNDARY COORDINATES

4 Top Boundaries
7 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	540.50	50.00	540.50	3
2	50.00	540.50	50.10	564.00	1
3	50.10	564.00	66.60	564.00	1
4	66.60	564.00	120.00	564.00	2
5	50.00	540.50	66.50	540.50	3
6	66.50	540.50	66.60	564.00	2
7	66.50	540.50	120.00	540.50	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	125.0	0.0	34.0	0.00	0.0	1
2	120.0	130.0	2000.0	0.0	0.00	0.0	1
3	125.0	130.0	0.0	32.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	505.80
2	120.00	505.80

GEOSYNTHETIC DATA

1 Geosynthetics(s) group(s) specified

Ngroup no	Bnr no	Y-top (ft)	Y-bot (ft)	Levels no	Length (ft)	Spacing (ft)	Efficiency	Tallow (lbs/ft)
1	2	540.5	564.0	23	16.5	-1.07	1.0	7500.0

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

500 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 50 Points Equally Spaced Along The Ground Surface Between X = 0.00 ft.
and X = 49.00 ft.

Each Surface Terminates Between X = 68.00 ft.
and X = 110.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =500.00 ft.

3.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	9.00	540.50
2	11.62	539.03
3	14.31	537.71
4	17.06	536.52
5	19.88	535.49
6	22.75	534.61
7	25.66	533.88
8	28.60	533.30
9	31.57	532.88
10	34.56	532.62
11	37.56	532.52
12	40.56	532.58
13	43.55	532.80
14	46.53	533.18
15	49.48	533.71
16	52.40	534.40
17	55.28	535.25
18	58.11	536.24
19	60.88	537.38
20	63.59	538.67
21	66.23	540.11
22	68.78	541.67
23	71.25	543.38
24	73.63	545.21
25	75.91	547.16

26	78.07	549.24
27	80.13	551.42
28	82.07	553.71
29	83.88	556.10
30	85.56	558.59
31	87.11	561.16
32	88.52	563.80
33	88.61	564.00

*** 3.051 ***

Individual data on the 37 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.6	240.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2.7	716.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	2.8	1166.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	2.8	1581.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	2.9	1954.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	2.9	2276.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	2.9	2543.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	3.0	2750.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	3.0	2893.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	3.0	2970.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	3.0	2979.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	3.0	2920.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	3.0	2794.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	3.0	2603.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.5	437.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.1	224.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	2.3	8316.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	2.9	10161.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	2.8	9663.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	2.8	9099.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	2.7	8475.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	2.6	7800.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.3	779.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.1	284.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.3	765.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	1.9	5261.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	2.5	6364.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	2.4	5619.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	2.3	4864.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	2.2	4111.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	2.1	3372.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	1.9	2657.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	1.8	1977.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	1.7	1344.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	1.5	767.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	1.4	257.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Individual data on the 23 geosynthetics

Group	Level	Slice	Head Coordinates (ft)		End Coordinates (ft)		T (lbs)	Length (ft)	Tallow (lbs)	T/Tall %
1	1	0	50.1	564.0	66.6	564.0	0.0	16.5	7500.0	0.0
1	2	0	50.1	562.9	66.6	562.9	0.0	16.5	7500.0	0.0
1	3	0	50.1	561.9	66.6	561.9	0.0	16.5	7500.0	0.0
1	4	0	50.1	560.8	66.6	560.8	0.0	16.5	7500.0	0.0
1	5	0	50.1	559.7	66.6	559.7	0.0	16.5	7500.0	0.0
1	6	0	50.1	558.7	66.6	558.7	0.0	16.5	7500.0	0.0
1	7	0	50.1	557.6	66.6	557.6	0.0	16.5	7500.0	0.0
1	8	0	50.1	556.5	66.6	556.5	0.0	16.5	7500.0	0.0
1	9	0	50.1	555.5	66.6	555.5	0.0	16.5	7500.0	0.0
1	10	0	50.1	554.4	66.6	554.4	0.0	16.5	7500.0	0.0
1	11	0	50.1	553.3	66.6	553.3	0.0	16.5	7500.0	0.0
1	12	0	50.0	552.2	66.6	552.2	0.0	16.5	7500.0	0.0

1	13	0	50.0	551.2	66.5	551.2	0.0	16.5	7500.0	0.0
1	14	0	50.0	550.1	66.5	550.1	0.0	16.5	7500.0	0.0
1	15	0	50.0	549.0	66.5	549.0	0.0	16.5	7500.0	0.0
1	16	0	50.0	548.0	66.5	548.0	0.0	16.5	7500.0	0.0
1	17	0	50.0	546.9	66.5	546.9	0.0	16.5	7500.0	0.0
1	18	0	50.0	545.8	66.5	545.8	0.0	16.5	7500.0	0.0
1	19	0	50.0	544.8	66.5	544.8	0.0	16.5	7500.0	0.0
1	20	0	50.0	543.7	66.5	543.7	0.0	16.5	7500.0	0.0
1	21	0	50.0	542.6	66.5	542.6	0.0	16.5	7500.0	0.0
1	22	0	50.0	541.6	66.5	541.6	0.0	16.5	7500.0	0.0
1	23	0	50.0	540.5	66.5	540.5	0.0	16.5	7500.0	0.0

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.00	540.50
2	12.53	538.89
3	15.15	537.42
4	17.84	536.10
5	20.61	534.93
6	23.43	533.92
7	26.30	533.06
8	29.22	532.36
9	32.17	531.83
10	35.15	531.45
11	38.14	531.25
12	41.14	531.20
13	44.14	531.33
14	47.13	531.62
15	50.09	532.07
16	53.03	532.68
17	55.92	533.46
18	58.78	534.40
19	61.57	535.49
20	64.30	536.73
21	66.96	538.13
22	69.53	539.66
23	72.02	541.34
24	74.41	543.15
25	76.70	545.09
26	78.88	547.16
27	80.94	549.34
28	82.87	551.63
29	84.68	554.02
30	86.35	556.52
31	87.88	559.10
32	89.27	561.76
33	90.29	564.00

*** 3.072 ***

1

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.00	540.50
2	19.59	538.99
3	22.28	537.66
4	25.04	536.49
5	27.88	535.50
6	30.77	534.70
7	33.70	534.08
8	36.67	533.64
9	39.66	533.40
10	42.66	533.35
11	45.66	533.48
12	48.64	533.81
13	51.59	534.33
14	54.51	535.03

15	57.38	535.91
16	60.18	536.98
17	62.91	538.22
18	65.56	539.63
19	68.11	541.21
20	70.56	542.95
21	72.89	544.84
22	75.09	546.87
23	77.17	549.04
24	79.10	551.34
25	80.88	553.75
26	82.50	556.27
27	83.96	558.89
28	85.26	561.60
29	86.22	564.00

*** 3.080 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	16.00	540.50
2	18.56	538.94
3	21.21	537.53
4	23.94	536.28
5	26.73	535.19
6	29.59	534.26
7	32.49	533.51
8	35.43	532.92
9	38.40	532.51
10	41.39	532.27
11	44.39	532.21
12	47.39	532.32
13	50.38	532.61
14	53.34	533.07
15	56.27	533.71
16	59.16	534.52
17	62.00	535.49
18	64.78	536.63
19	67.48	537.92
20	70.11	539.38
21	72.64	540.98
22	75.08	542.73
23	77.41	544.62
24	79.62	546.65
25	81.71	548.80
26	83.68	551.06
27	85.51	553.44
28	87.19	555.92
29	88.73	558.50
30	90.11	561.16
31	91.34	563.90
32	91.38	564.00

*** 3.087 ***

1

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.00	540.50
2	19.74	539.28
3	22.54	538.19
4	25.39	537.25
5	28.28	536.46

6	31.21	535.81
7	34.17	535.32
8	37.15	534.97
9	40.14	534.78
10	43.14	534.74
11	46.14	534.85
12	49.13	535.12
13	52.10	535.54
14	55.04	536.10
15	57.96	536.82
16	60.83	537.68
17	63.66	538.69
18	66.43	539.84
19	69.14	541.13
20	71.77	542.56
21	74.34	544.12
22	76.82	545.80
23	79.21	547.61
24	81.51	549.54
25	83.70	551.59
26	85.79	553.74
27	87.77	556.00
28	89.63	558.35
29	91.36	560.80
30	92.97	563.33
31	93.35	564.00

*** 3.095 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	21.00	540.50
2	23.63	539.06
3	26.35	537.79
4	29.15	536.70
5	32.01	535.80
6	34.92	535.08
7	37.87	534.55
8	40.85	534.21
9	43.85	534.06
10	46.85	534.11
11	49.84	534.35
12	52.81	534.78
13	55.74	535.41
14	58.63	536.22
15	61.46	537.22
16	64.22	538.39
17	66.90	539.74
18	69.48	541.27
19	71.96	542.95
20	74.33	544.80
21	76.58	546.79
22	78.69	548.92
23	80.66	551.18
24	82.47	553.57
25	84.13	556.07
26	85.63	558.67
27	86.96	561.36
28	88.05	564.00

*** 3.099 ***

1

Failure Surface Specified By 33 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	13.00	540.50
2	15.51	538.86
3	18.12	537.37
4	20.80	536.02
5	23.55	534.83
6	26.36	533.79
7	29.23	532.92
8	32.15	532.20
9	35.10	531.65
10	38.07	531.27
11	41.06	531.05
12	44.06	531.01
13	47.06	531.13
14	50.05	531.42
15	53.01	531.87
16	55.95	532.50
17	58.84	533.28
18	61.69	534.23
19	64.48	535.34
20	67.20	536.60
21	69.85	538.01
22	72.41	539.57
23	74.88	541.27
24	77.25	543.10
25	79.52	545.07
26	81.67	547.16
27	83.70	549.37
28	85.61	551.69
29	87.38	554.11
30	89.01	556.63
31	90.50	559.23
32	91.83	561.92
33	92.73	564.00

*** 3.101 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.00	540.50
2	19.61	539.02
3	22.30	537.69
4	25.06	536.51
5	27.88	535.49
6	30.75	534.62
7	33.66	533.90
8	36.61	533.35
9	39.59	532.97
10	42.58	532.74
11	45.58	532.68
12	48.58	532.79
13	51.56	533.06
14	54.53	533.49
15	57.47	534.08
16	60.38	534.84
17	63.23	535.75
18	66.04	536.82
19	68.78	538.05
20	71.45	539.42
21	74.04	540.93
22	76.54	542.59
23	78.95	544.38
24	81.25	546.29
25	83.45	548.34
26	85.53	550.50
27	87.49	552.77
28	89.32	555.14
29	91.02	557.62
30	92.58	560.18
31	94.00	562.82

32	94.55	564.00

*** 3.105 ***

1

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4.00	540.50
2	6.48	538.81
3	9.04	537.25
4	11.68	535.83
5	14.40	534.54
6	17.17	533.40
7	20.00	532.40
8	22.87	531.55
9	25.79	530.85
10	28.74	530.30
11	31.71	529.90
12	34.70	529.66
13	37.70	529.57
14	40.70	529.63
15	43.69	529.85
16	46.67	530.23
17	49.62	530.76
18	52.54	531.44
19	55.43	532.27
20	58.26	533.25
21	61.05	534.37
22	63.77	535.63
23	66.42	537.04
24	68.99	538.58
25	71.48	540.25
26	73.89	542.04
27	76.19	543.96
28	78.40	545.99
29	80.50	548.14
30	82.48	550.39
31	84.34	552.74
32	86.08	555.18
33	87.70	557.71
34	89.18	560.32
35	90.52	563.01
36	90.95	564.00

*** 3.112 ***

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	20.00	540.50
2	22.64	539.07
3	25.35	537.79
4	28.14	536.68
5	30.98	535.72
6	33.88	534.93
7	36.81	534.31
8	39.78	533.86
9	42.76	533.58
10	45.76	533.47
11	48.76	533.53
12	51.75	533.77
13	54.72	534.18
14	57.67	534.76
15	60.57	535.51

16	63.43	536.42
17	66.23	537.50
18	68.96	538.74
19	71.62	540.13
20	74.19	541.67
21	76.67	543.36
22	79.05	545.19
23	81.32	547.15
24	83.47	549.24
25	85.50	551.45
26	87.40	553.77
27	89.16	556.20
28	90.78	558.73
29	92.25	561.34
30	93.55	564.00

*** 3.113 ***

1