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January 4, 2024

Matthew McCue, CLARB, ASLA  
Deputy Director  
Geauga Park District  
9160 Robinson Road  
Chardon, OH 44024

**RE:** Amendment to Final Report of Structure Foundation Exploration For West Woods Structure Replacements (PID #118538)

Dear Matthew McCue:

This letter is to confirm an amendment to the above-referenced Final Report of Structure Foundation Exploration for West Woods Structure Replacements dated December 18, 2023.

The Ultimate Bearing Value (UBV) of the piles has been updated from 300 kips as indicated in the report to a value of 257 kips.

This amendment should be attached to the above-referenced final report and be made part thereof.

Sincerely,

Richard Hessler  
Geotechnical Engineer

Eric W. Tse  
Senior Geotechnical Engineer

RJH/ewt

**CC:** Matt Lawler

West Woods Bridge - SFE Final Report Cover Letter Amendment (01-04-24).docx



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**FINAL REPORT  
OF  
STRUCTURE FOUNDATION EXPLORATION  
FOR WEST WOODS**

*Structure Replacements*

*PID #118538*

Prepared For:

Geauga Park District  
9160 Robinson Road  
Chardon, Ohio 44024

Prepared By:



DLZ Job No. 2122-1012.00

December 18, 2023



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## EXECUTIVE SUMMARY

This report includes the findings of the subsurface exploration performed for the proposed replacement of the existing roadway and Bridle Trail bridges across a tributary of Silver Creek in Geauga Park, in Russell Township, Geauga County, Ohio. The project will consist of replacing the existing bridges with a 20-foot wide by 52-foot long, 3-sided culvert with wingwalls.

The purpose of this exploration was to: 1) determine the subsurface conditions to the depths of the borings, 2) evaluate the engineering characteristics of the subsurface materials, and 3) provide information to assist in the design of the structure foundation.

DLZ determined the subsurface conditions by drilling two borings, B-001-0-21 and B-002-0-21 (B-001 and B-002) adjacent to the rear and forward abutments, respectively, on October 25 and 26, 2021. The borings encountered 4 to 6 inches of asphalt concrete overlying 6 inches of aggregate base. Below the pavement materials the borings generally encountered cohesive soils consisting of sandy silt (A-4a), silt (A-4b), silt and clay (A-6a), silty clay (A-6b), and clay (A-7-6) to depths of 26.0 and 38.5 feet, in borings B-001 and B-002 respectively. Underlying the cohesive soils, the borings generally encountered loose to dense granular soils consisting of gravel (A-1-a), gravel with sand (A-1-b) and coarse and fine sand (A-3a) to the boring completion depths. However, very stiff sandy silt (A-4a) was encountered at the end of boring B-002-0-21, between the depths of 78.5 and 80 feet.

The borings encountered groundwater seepage at depths of 14.5 and 22.4 feet below the ground surface (elevations 1066.7 and 1056.9). Borings encountered measurable water levels at depths of 5.3 and 10.4 prior to adding water to advance the borings (elevations 1075.9 and 1068.9). The borings encountered water levels at the completion at depths of 4.1 and 3.1 feet (elevations 1077.1 and 1076.2). These final water measurements included water added to the borings as part of the drilling process.

The bottom of the pile cap will bear at elevation 1066.7 feet. The subsurface materials encountered at these bearing elevations and immediately below (i.e., foundation soils) are predominantly interbedded stiff to very stiff cohesive soils and loose to medium dense granular soils.

It is understood that the alignment of the creek will be shifted to the south approximately 10 to 15 feet to the south which will result in placement of new fill of up to approximately 6 feet inside the existing creek channel north of the culvert (forward abutment) with no grade change and no placement of new fill to the south of the culvert (rear abutment). Settlement was considered regarding the proposed channel fill. The analysis resulted in a total settlement of 1.3 inches. A period of approximately 8 months is required to reduce the settlement to approximately 0.4 inches to minimize downdrag on the forward abutment piles; otherwise, downdrag must be accounted for in the forward abutment foundation design.



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Driven piles are considered suitable for foundation support of the proposed culvert. The following table (Table A) provides a summary of estimated pile lengths and corresponding nominal driving resistance,  $R_{ndr}$ , for 16-inch [nominal outside] diameter cast-in-place (CIP) reinforced concrete piles (i.e. driven closed-end steel pipe piles that are filled with concrete after being driven to the required ultimate bearing value or  $R_{ndr}$ ). A resistance factor ( $\Phi_{DYN}$ ) of 0.70 should be used when determining the factored bearing resistance provided that dynamic load testing is performed in accordance with ODOT CMS 523 on a minimum of two (2) piles.

**Table A: Estimated Pile Lengths**

Pile Diameter	UBV (kips)	Boring/T.O.B. El <sup>1</sup>	Est. Pile Cutoff El <sup>2</sup>	Est. Pile Length <sup>3</sup>	Pile Points Required	Pre-Bore Elevation
Rear Abutment						
16"	300 kips	B-001-0-21/1081.2	1068.7	55 ft	No	N/A
Forward Abutment						
16"	300 kips	B-002-0-21/1079.3	1068.7	55 ft	No	N/A

<sup>1</sup>T.O.B. is top of boring

<sup>2</sup>Assumed 2 feet above the bottom of footing elevation as shown on the Bridge Site Plan.

<sup>3</sup>Estimated Pile length for vertical piles (non-battered) based upon estimated pile cutoff less pile tip elevation and rounded to the nearest 5 feet per ODOT BDM section 305.3.5.2.

Pile spacing must be six times the pile diameter or greater to neglect group effects in accordance with ODOT BDM 305.3.4.

Drag loads for the forward abutment piles were estimated in accordance with the 2023 ODOT Bridge Design Manual (BDM) 305.3.2.2 using the software APile v2019 by Ensoft, Inc. The APile analysis resulted in unfactored drag loads of approximately 74 kips per pile. There are no downdrag loads on the rear abutment piles because placement of new fill is not anticipated.

Drivability analysis indicates that pipe piles can be driven to the estimated ultimate bearing value (UBV) of 300 kips using a commonly available pile hammer and ASTM A252, Grade 3 ( $F_y = 45$  ksi) steel with a minimum nominal wall thickness of  $\frac{1}{4}$  inch for the pipe piles without excessive blow counts (less than 100 blows per foot) or overstressing the piles (i.e. less than 90 percent of the yield stress) during driving. Pile points are not recommended.

The factored drag load is determined using a load factor of 1.05 as per ODOT BDM C305.3.2.2. This results in factored drag loads of 78 kips for the 16-inch diameter CIP piles. This factored drag load should be used for evaluation of the factored structural resistance of the piles per article 305.3.2.2 of the ODOT BDM. In



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accordance with ODOT BDM 305.3.2, when checking the structural resistance of the pile ( $P_r$ ) including drag load, the resistance factor for steel piles in compression under good driving conditions may be used.

Lateral load analyses were performed using LPile v.2022 with guidance from section 305.1.2 of the ODOT BDM and associated commentary. The analysis considered an unfactored lateral load of 8.2 kips per pile and a factored lateral load of 12.33 kips per pile. Additionally, an unfactored axial load of approximately 22.1 kips and factored axial load of 20.5 kips (Strength Ia) and 28.2 kips (Strength Ib) were also used in the analyses. The rear abutment soil profile resulted in the highest deflection and moments comparing to that at the forward abutment. The deflection of a single pile was approximately 0.17 inches at the service lateral load and the maximum factored shear and moment were 12,330 lbs and 465,548 in-lb, respectively.

The overburden soil conditions at the site are consistent with Seismic Site Class D as defined by 2020 ODOT BDM.



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## 1.0 INTRODUCTION

This report includes the findings of the subsurface exploration performed for the proposed replacement of the existing roadway and Bridle Trail bridges across a tributary of Silver Creek in Geauga Park, in Russell Township, Geauga County, Ohio. The project will consist of replacing the existing bridges with a 20-foot wide by 52-foot long, 3-sided culvert. The exploration has been performed essentially in accordance with DLZ Ohio, Inc.'s proposal for the subsurface exploration dated September 14, 2021, and generally in accordance with the Ohio Department of Transportation's (ODOT's) Specifications for Geotechnical Explorations (SGE) dated January 2021.

The purpose of this exploration was to: 1) determine the subsurface conditions to the depths of the borings, 2) evaluate the engineering characteristics of the subsurface materials, and 3) provide information to assist in the design of the structure foundations.

The geotechnical engineer has planned and supervised the performance of the geotechnical engineering services, considered the findings, and prepared this report in accordance with generally accepted geotechnical engineering practices. No other warranties, either expressed or implied, are made as to the professional advice included in this report.

## 2.0 GEOLOGY AND OBSERVATIONS OF THE PROJECT

The project area is located in the Glaciated Allegheny Plateau Section of the Appalachian Plateau and just south of the Portage Escarpment. The area is generally characterized by thin drift over sandstone bedrock with drift thicknesses of about 10 feet, however, in valleys, the glacial drift can extend to depths of up to 200 feet. Bedrock outcrops are present to the immediate northeast of the project area within Geauga Park.

DLZ performed a field reconnaissance for the site on October 3, 2021. The project area is in Geauga Park within a rural area. The tributary of Silver Creek flows from east to west beneath the existing bridges. During the site visit, DLZ observed that the tributary flowed only through a small percentage of the bridges. The pavement appeared in good condition with very little cracking. DLZ observed eroded areas filled with large stone fragments adjacent to the southeast corner of the abutment wingwall.

## 3.0 EXPLORATION

### 3.1 FIELD EXPLORATION

DLZ determined the subsurface conditions by drilling two borings, B-001-0-21 and B-002-0-21 (B-001 and B-002) at the rear and forward abutments, respectively, on October 25 and 26, 2021. DLZ drilled borings B-001

and B-002 to depths of 80.0 feet each below the ground surface using a truck mounted rotary drill rig, which had the hammer calibrated on April 5, 2021 (hammer efficiency of 86.2 percent).

Boring locations and ground surface elevations were surveyed in the field by representatives of DLZ Ohio, Inc. Appendix I presents the boring plan, which shows the as-drilled boring locations, and the boring logs.

### **3.2 LABORATORY TESTING PROGRAM**

The laboratory testing program consisted of performing visual classifications using the AASHTO classification system as modified by ODOT (ref. ODOT SGE section 600) and general index tests on soil samples. The general index tests consisted of grain-size analyses, moisture content, and plasticity determinations. The boring logs present the laboratory testing results and are included in Appendix I.

## **4.0 FINDINGS**

### **4.1 SOIL CONDITIONS**

The borings encountered 4 to 6 inches of asphalt concrete overlying 6 inches of aggregate base. Below the pavement materials the borings generally encountered cohesive soils consisting of sandy silt (A-4a), silt (A-4b), silt and clay (A-6a), silty clay (A-6b), and clay (A-7-6) to depths of 26.0 and 38.5 feet, in borings B-001 and B-002 respectively. Underlying the cohesive soils, the borings generally encountered loose to dense granular soils consisting of gravel (A-1-a), gravel with sand (A-1-b) and coarse and fine sand (A-3a) to the boring completion depths. However, very stiff sandy silt (A-4a) was encountered at the end of boring B-002-0-21, between the depths of 78.5 and 80 feet.

### **4.2 GROUNDWATER CONDITIONS**

The borings encountered groundwater seepage at depths of 14.5 and 22.4 feet below the ground surface. Borings encountered measurable water levels at depths of 5.3 and 10.4 feet prior to adding water to advance the borings. The borings encountered water levels at the completion at depths of 4.1 and 3.1. These final water measurements included water added to the borings as part of the drilling process.

DLZ took water level measurements inside the hollow-stem augers, which could have isolated seepage inside the borings. Consequently, the water levels measurements might not represent actual groundwater conditions at the site. Water levels at the site will likely correspond with water levels in the tributary of Silver Creek.

## **5.0 ANALYSIS AND RECOMMENDATIONS**

### **5.1 GENERAL CONSIDERATIONS**

DLZ understands that the proposed replacement structure will consist of a 3-sided culvert that will cross the tributary of Silver Creek perpendicular to the alignment of the existing bridges. While roadway grade changes along the culvert alignment will be negligible, approximately 2.7 to 3.6 feet of soil will be over the culvert and

a portion of the existing creek channel located north of the forward abutment will be filled to the roadway surface (fill of up to 6 feet).

The recommendations provided in this report are based on the above-mentioned design information provided to DLZ. If any changes to the design are made, DLZ should be notified so that the following recommendations can be reviewed and updated as necessary.

## **5.2 SUBGRADE CONDITION AND PREPARATION**

The borings encountered 4 to 6 inches of asphalt concrete. The existing pavement and structure should be removed in general accordance with Ohio Department of Transportation (ODOT) Construction and Material Specifications (CMS) Item 202 "Removal of Structures and Obstructions."

Remove all topsoil, vegetation, organic soils, fill, and other materials deemed unsuitable by the geotechnical engineer, from the footprints of the proposed improvements and up to five feet beyond. Stockpiling of any topsoil and existing fill for use as fill is allowable in non-structural areas.

The subgrade should be proof-rolled and inspected by a soil technician with the general guidance of a geotechnical engineer to determine if any soft, yielding areas are present. Undercut any yielding areas to firm, non-yielding soils, and replace with engineered fill. On-site soils, other than topsoil and fill containing debris and organic material, are acceptable as general fill and backfill materials. However, the material may require moisture adjustments to achieve proper compaction and stability.

## **5.3 CREEK CHANNEL FILL**

It is understood that the alignment of the creek will be shifted to the south approximately 10 to 15 feet which will result in placement of new fill of up to approximately 6 feet thick north of the forward abutment. There are no grade changes and no new fill south of the rear abutment.

Settlement was considered regarding the channel fill. The analysis resulted in a total settlement of 1.3 inches. Approximately 16 months would be required to achieve 90 percent of the settlement. A period of approximately 8 months is required to reduce the settlement to approximately 0.4 inches to minimize downdrag on the forward abutment piles; otherwise, downdrag must be accounted for in the abutment foundation design.

## **5.4 CULVERT FOUNDATION RECOMMENDATIONS**

The removal of the existing bridges as well as the placement of any backfill should be in accordance with ODOT CMS Item 202.

The bottom of the pile cap will bear at elevation 1066.7 feet. The subsurface materials encountered at these bearing elevations and immediately below (i.e., foundation soils) are predominantly interbedded stiff to very stiff cohesive soils and loose to medium dense granular soils.

Based on the boring information, driven piles are considered suitable for foundation support of the proposed culvert. The following table (Table 1) provides a summary of estimated pile lengths and corresponding nominal driving resistance,  $R_{ndr}$ , for 16-inch [nominal outside] diameter cast-in-place (CIP) reinforced concrete piles (i.e. driven closed-end steel pipe piles that are filled with concrete after being driven to the required ultimate bearing value or  $R_{ndr}$ ). A resistance factor ( $\Phi_{DYN}$ ) of 0.70 should be used when determining the factored bearing resistance provided that dynamic load testing is performed in accordance with ODOT CMS 523 on a minimum of two (2) piles.

**Table 1: Estimated Pile Lengths**

Pile Diameter	UBV (kips)	Boring/T.O.B. EI <sup>1</sup>	Est. Pile Cutoff EI <sup>2</sup>	Est. Pile Length <sup>3</sup>	Pile Points Required	Pre-Bore Elevation
Rear Abutment						
16"	300 kips	B-001-0-21/1081.2	1068.7	55 ft	No	N/A
Forward Abutment						
16"	300 kips	B-002-0-21/1079.3	1068.7	55 ft	No	N/A

<sup>1</sup>T.O.B. is top of boring

<sup>2</sup>Assumed 2 feet above the bottom of footing elevation as shown on the Bridge Site Plan.

<sup>3</sup>Estimated Pile length for vertical piles (non-battered) based upon estimated pile cutoff less pile tip elevation and rounded to the nearest 5 feet per ODOT BDM section 305.3.5.2.

Pile spacing must be six times the pile diameter or greater to neglect group effects in accordance with ODOT BDM 305.3.4.

Due to the estimated ground settlement that will occur after pile installation at the forward abutment, downdrag must be assumed for the pile design at the forward abutment substructure. Drag loads for the 16-inch CIP piles were estimated in accordance with the 2023 ODOT Bridge Design Manual (BDM) 305.3.2.2 using the software APile v2019 by Ensoft, Inc. The APile analysis resulted in unfactored drag loads of approximately 74 kips per pile.

The factored drag load is determined using a load factor of 1.05 as per ODOT BDM C305.3.2.2. This results in factored drag loads of 78 kips for the 16-inch piles. This factored drag load should be used for evaluation of the factored structural resistance of the piles per article 305.3.2.2 of the ODOT BDM. In accordance with ODOT BDM 305.3.2, when checking the structural resistance of the pile ( $P_r$ ) including drag load, the resistance factor for steel piles in compression under good driving conditions may be used. Results of the APile analysis are in Appendix II.

Drivability analysis, using the software GRLWeap 14 by Pile Dynamics, indicates that pipe piles can be driven to the estimated ultimate bearing value (UBV) of 300 kips using a commonly available pile hammer and and ASTM A252, Grade 3 ( $F_y = 45$  ksi) steel with a minimum nominal wall thickness of 1/4-inch for the pipe piles without excessive blow counts (less than 100 blows per foot) or overstressing the piles (i.e. less than 90 percent of the yield stress) during driving. Pile points are not recommended. The drivability analysis results are included in Appendix II. It should be noted that the capacities calculated in the drivability analyses are not intended to represent the long-term static capacity calculated in the static analysis and were only performed to validate piles that could be driven to the lengths estimated by the static analyses.

Adequate rock channel protection or some other means should be provided at the inlet and outlet ends of the culvert to prevent soil scour in accordance with Item 601 of ODOT CMS.

#### **5.4.1 LATERAL ANALYSIS**

Soil parameters for lateral load ( $P-y$ ) analysis of the pile foundations per ODOT BDM section 305.3.5.8 are included in the following Table 2. Battered piles should not be used for the abutments due to anticipated downdrag (ref. ODOT BDM 305.3.5.8).

**Table 2: Lateral Load Analysis Parameters**

Depth	Soil Model Type	Effective Unit Wt. (pcf)	Friction Angle, $\phi$ (degrees)	Undrained cohesion, $s_u$ (psf)	Soil Modulus, $k$ (pci)	$\epsilon_{50}$ Strain
Rear Abutment						
0.0 – 1.3	Stiff Clay	57.6	-	1500	-	0.007
1.3 – 6.6	Loose Granular Soils	57.6	28	-	20	-
6.6 – 11.6	Very Stiff Clay	62.6	-	2000	-	0.007
11.6 – 29.1	Loose Granular Soils	62.6	30	-	40	-
29.1 – 49.1	Medium Dense Granular Soils	62.6	32	-	60	-
49.1 – 65.6	Dense Granular Soils	67.6	34	-	125	-
Forward Abutment						
0.0 – 10.9	Stiff Clay	57.6	-	1500	-	0.007
10.9 – 20.9	Very Stiff Clay	62.6	-	2500	-	0.005
20.9 – 25.9	Stiff Clay	62.6		1000	-	0.007
25.9 – 30.9	Loose Granular Soils	62.6	28	-	20	-
30.9 – 67.4	Medium Dense Granular Soils	62.6	32	-	60	-

Lateral load analyses were performed using LPile v.2022 with guidance from section 305.1.2 of the ODOT BDM and associated commentary. The analysis considered an unfactored lateral load of 8.2 kips per pile and a factored lateral load of 12.33 kips per pile. Additionally, an unfactored axial load of approximately 22.1 kips and factored axial load of 20.5 kips (Strength Ia) and 28.2 kips (Strength Ib) were also used in the analyses. The rear abutment soil profile resulted in the highest deflection and moments comparing to that at the forward abutment. The deflection of a single pile was approximately 0.17 inches at the service lateral load and the maximum factored shear and moment were 12,330 lbs and 465,548 in-lb, respectively. The results of the lateral analyses are presented in Appendix II.

## 5.5 SCOUR ANALYSIS

Particle size analyses are being performed on a number of samples for scour analysis as indicated in the table below.

**Table3: D<sub>50</sub> Particle Size Analysis**

Boring	Sample	Depth (ft)	D50 Size (mm)
B-001-0-21	SS-4	8.5	0.006
B-001-0-21	SS-5	10.0	0.03
B-001-0-21	SS-6	11.5	0.053
B-001-0-21	SS-7	13.0	0.039
B-002-0-21	SS-4	8.5	0.081
B-002-0-21	SS-5	10.0	0.016
B-002-0-21	SS-6	11.5	0.02
B-002-0-21	SS-7	13.0	0.016

## 5.6 EXCAVATIONS AND GROUNDWATER CONSIDERATIONS

The borings encountered groundwater seepage at depths of 14.5 and 22.4 feet below the ground surface. Borings encountered measurable water levels at depths of 5.3 and 10.4 feet prior to adding water to advance the borings. The groundwater levels in the vicinity of the culvert will likely correspond with water levels in the adjacent tributary of Silver Creek.

Contractors should be prepared to deal with any water from seepage or precipitation which enters the excavations. Excavations extending below the water table into granular deposits can result in "quick conditions" and complete loss of soil strength or bottom heave when the confining effect of the overburden is removed, and groundwater is not properly controlled. To prevent this occurrence and ensure "dry" working conditions, areas of proposed excavation should be properly dewatered and the water level maintained at least three feet below the bottom of the proposed excavation during construction. However, given the presence of silts within the bottom of the proposed excavation, it may be necessary to maintain the water level at depths of greater than three feet below the excavation bottom to prevent water pumping through the bottom of the excavation.

Soils at the anticipated bearing elevations contain relatively high amounts of silt. Consequently, keeping these soils dry will be necessary as moisture would destabilize the silty soils and cause a disturbed base of excavation.

All excavations should be constructed in accordance with applicable local, state and federal safety regulations including the current OSHA Excavation and Trench Safety Standards (29 CFR Part 1926).



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Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. The above information is provided only for general guidance. Under no circumstances should the information provided be interpreted to mean that anyone other than the construction Contractor assumes responsibility for construction site safety. The Contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom, and to protect adjacent structures and site features.

### 5.7 SEISMIC SITE CLASSIFICATION

The overburden soil conditions at the site are consistent with Seismic Site Class D as defined in the 2020 ODOT BDM.

## 6.0 CLOSING REMARKS

We appreciate having the opportunity to be of service to you on this project. Please do not hesitate to call if you have any questions concerning this report.

Respectfully submitted,

**DLZ OHIO, INC.**

Richard Hessler  
Geotechnical Engineer

Eric W. Tse  
Senior Geotechnical Engineer

RJH/ewt



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## APPENDIX I

*General Information*

*Legend – Boring Terminology*

*Boring Location Plan*

*Boring Logs (2)*

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## **GENERAL INFORMATION DRILLING PROCEDURES AND LOGS OF BORINGS**

Drilling and sampling were conducted in accordance with procedures generally recognized and accepted as standardized methods of investigation of subsurface conditions concerning geotechnical engineering considerations. Borings were drilled with either a truck-mounted or ATV-mounted drill rig.

Drive split-barrel sampling was performed in 1.5 foot increments at intervals not exceeding 5 feet. In the event the sampler encountered resistance to penetration of 6 inches or less after 50 blows of the drop hammer, the sampling increment was discontinued. Standard penetration data were recorded and one or more representative samples were preserved from each sampling increment.

In borings where rock was cored, NXM or NQ size diamond coring tools were used.

In the laboratory all samples were visually classified by a soils engineer. A limited number of samples, considered representative of foundation materials present, were selected for performance of grain-size analyses and plasticity characteristics tests. The results of these tests are shown on the boring logs.

The boring logs included in the Appendix have been prepared on the basis of the field record of drilling and sampling, and the results of the laboratory examination and testing of samples. Stratification lines on the boring logs indicating changes in soil stratigraphy represent depths of changes approximated by the driller, by sampling effort and recovery, and by laboratory test results. Actual depths to changes may differ somewhat from the estimated depths, or transitions may occur gradually and not be sharply defined. The boring logs presented in this report therefore contain both factual and interpretative information and are not an exact copy of the field log.

Although it is considered that the borings have disclosed information generally representative of site conditions, it should be expected that between borings conditions may occur which are not precisely represented by any one of the borings. Soil deposition processes and natural geologic forces are such that soil and rock types and conditions may change in short vertical intervals and horizontal distances.

Soil/rock samples will be stored at our laboratory for a period of six months. After this period of time, they will be discarded, unless notified to the contrary by the client.

## LEGEND – BORING LOG TERMINOLOGY

Explanation of each column, progressing from left to right

1. Depth (in feet) – refers to distance below the ground surface.
2. Elevation (in feet) – is referenced to mean sea level, unless otherwise noted.
3. Standard Penetration (N) – the number of blows required to drive a 2-inch O.D., 1-3/8 inch I.D., split-barrel sampler, using a 140-pound hammer with a 30-inch free fall. The blows are recorded in 6-inch drive increments. Standard penetration resistance is determined from the total number of blows required for one foot of penetration by summing the second and third 6-inch increments of an 18-inch drive.  
50/n – indicates number of blows (50) to drive a split-barrel sampler a certain number of inches (n) other than the normal 6-inch increment.
4. The length of the sampler drive is indicated graphically by horizontal lines across the “Standard Penetration” and “Recovery” columns.
5. Sample recovery from each drive is indicated numerically in the column headed “Recovery”.
6. The drive sample location is designated by the heavy vertical bar in the “Sample No., Drive” column.
7. The length of hydraulically pressed “Undisturbed” samples is indicated graphically by horizontal lines across the “Press” column.
8. Sample numbers are designated consecutively, increasing in depth.
9. Soil Description

- a. The following terms are used to describe the relative compactness and consistency of soils:

### Granular Soils – Compactness

<u>Term</u>	<u>Blows/Foot Standard Penetration</u>
Very Loose	less than 5
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 – 50
Very Dense	over 50

### Cohesive Soils – Consistency

<u>Term</u>	<u>Unconfined Compression tons/sq.ft.</u>	<u>Blows/Foot Standard Penetration</u>	<u>Hand Manipulation</u>
Very Soft	less than 0.25	less than 2	Easily penetrated 2-in. by fist
Soft	0.25 – 0.50	2 – 4	Easily penetrated 2-in. by thumb
Medium Stiff	0.50 – 1.0	5 – 8	Penetrated by thumb with moderate effort
Stiff	1.0 – 2.0	9 – 15	Readily indented by thumb but not penetrated
Very Stiff	2.0 – 4.0	16 – 30	Readily indented by thumbnail
Hard	over 4.0	over 30	Indented with difficulty by thumbnail

- b. Color – If a soil is a uniform color throughout, the term is single, modified by such adjective as light and dark. If the predominant color is shaded by a secondary color, the secondary color precedes the primary color. If two major and distinct colors are swirled throughout the soil, the colors are modified by the term “mottled”.
- c. Texture is based on the Ohio Department of Transportation Classification System. Soil particle size definitions are as follows:

<u>Description</u>	<u>Size</u>	<u>Description</u>	<u>Size</u>
Boulders	Larger than 12"	Sand	– Coarse – Fine
Cobbles	12" to 3"		2.0 mm to 0.42 mm 0.42 mm to 0.074 mm
Gravel – Coarse	3" to ¾"	Silt	0.074 mm to 0.005 mm
– Fine	¾" to 2.0 mm	Clay	smaller than 0.005 mm

d. The main soil component is listed first. The minor components are listed in order of decreasing percentage of particle size.

e. Modifiers to main soil descriptions are indicated as a percentage by weight of particle sizes.

trace	0 to 10%
little	10 to 20%
some	20 to 35%
"and"	35 to 50%

f. Moisture content of **cohesionless soils** (sands and gravels) is described as follows:

<u>Term</u>	<u>Relative Moisture or Appearance</u>
Dry	Soil leaves no moisture when pressed between fingers
Damp	Soil leaves very little moisture when pressed between fingers.
Moist	Soil leaves small amount of moisture when pressed between fingers.
Wet	The pore space is filled with water and water can be poured from sample with ease.

g. The moisture content of **cohesive soils** (silts and clays) is expressed relative to plastic properties.

<u>Term</u>	<u>Relative Moisture or Appearance</u>
Dry	Brittle to powdery; Moisture content well below plastic limit
Damp	Moisture content below plastic limit
Moist	Moisture content above plastic limit to -3% liquid limit
Wet	Moisture content near or above liquid limit

## 10. Rock Hardness and Rock Quality Designation

a. The following terms are used to describe the relative strength of the **bedrock**.

<u>Term</u>	<u>Description</u>
Very Weak	Core can be carved with a knife and scratched by fingernail. Can be excavated readily with a point of a pick. Pieces 1-inch or more in thickness can be broken by finger pressure.
Weak	Core can be grooved or gouged readily by a knife or pick. Can be excavated in small fragments by moderate blows of a pick point. Small, thin pieces can be broken by finger pressure.
Slightly Strong	Core can be grooved or gouged 0.05 inch deep by firm pressure of a knife or pick point. Can be excavated in small chips to pieces about 1-inch maximum size by hard blows of the point of a geologist's pick.
Moderately Strong	Core can be scratched with a knife or pick. Grooves or gouges to ¼" deep can be excavated by hand blows of a geologist's pick. Requires moderate hammer blows to detach hand specimen.
Strong	Core can be scratched with a knife or pick only with difficulty. Requires hard hammer blows to detach hand specimen. Sharp and resistant edges are present on hand specimen.
Very Strong	Core cannot be scratched by a knife or sharp pick. Breaking of hand specimens requires hard repeated blows of the geologist hammer.
Extremely Strong	Core cannot be scratched by a knife or sharp pick. Chipping of hand specimens requires hard repeated blows of the geologist hammer.

b. Rock Quality Designation, RQD – This value is expressed in percent and is an indirect measure of rock soundness. It is obtained by summing the total length of all core pieces which are at least four inches long, and then dividing this sum by the total length of the core run.

11. Gradation – when tests are performed, the percentage of each particle size is listed in the appropriate column (defined in Item 9c).

12. When a test is performed to determine the natural moisture content, liquid limit moisture content, or plastic limit moisture content, the moisture content is indicated in tabular form.

13. The corrected standard penetration ( $N_{60}$ ) value in blows per foot is indicated in tabular form.



**DLZ**

As Drilled Boring Location

Legend

Scale in feet

0

50

100

Geauga Park District  
West Woods Bridges Replacement  
Boring Location Plan

Orientation







PROJECT: WEST WOODS BRIDGES		DRILLING FIRM / OPERATOR: DLZ / TZ		DRILL RIG: '21 CME 75-492-027		STATION / OFFSET: 13+39, 5' RT.		EXPLORATION ID B-002-0-21												
TYPE: CULVERT		SAMPLING FIRM / LOGGER: DLZ / SH		HAMMER: CME AUTOMATIC		ALIGNMENT:														
PID: 118538 SFN: 2830008		DRILLING METHOD: 3.25" HSA		CALIBRATION DATE: 4/5/21		ELEVATION: 1079.3 (MSL) EOB: 80.0 ft.		PAGE 1 OF 3												
START: 10/26/21 END: 10/26/21		SAMPLING METHOD: SPT		ENERGY RATIO (%): 86.2		LAT / LONG: 41.458717, 81.303550														
MATERIAL DESCRIPTION AND NOTES			ELEV. 1079.3	DEPTHs		SPT/ RQD	N <sub>60</sub>	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)		ATTERBERG		WC	ODOT CLASS (GI)	ABAN- DONED			
Asphalt Concrete - 6"			1078.3		1															
Aggregate Base - 6"			1075.8		2	4	4	56	SS-1	2.50	-	-	-	-	-	16	A-6b (V)			
Very stiff grayish brown SILTY CLAY (A-6b), little to some fine to coarse sand; damp to moist.			1069.3		3															
Stiff to very stiff brown SANDY SILT (A-4a), little gravel; damp to moist.			1069.3		4	2	3	89	SS-2	3.50	17	14	22	25	22	24	15	A-4a (2)		
@ 8.5' - 10.0'; gray.			1069.3		5															
Very stiff gray SILT (A-4b); damp to moist.			1060.8		6	2	2	67	SS-3	3.50	-	-	-	-	-	-	14	A-4a (V)		
			1060.8		7	2	2													
			1058.3		8															
Very stiff gray SILTY CLAY (A-6b), little fine to coarse sand, trace gravel; moist.			1058.3		9	2	3	100	SS-4	1.50	20	18	13	27	22	-	-	16	A-4a (V)	
			1058.3		10	3	4													
Stiff gray SANDY SILT (A-4a), some fine to coarse sand, little gravel; damp.			1055.8		11	4	5	100	SS-5	2.25	3	3	6	66	22	-	-	22	A-4b (V)	
			1055.8		12	2	3	89	SS-6	3.25	7	4	8	61	20	-	-	17	A-4b (V)	
Very stiff gray CLAY (A-7-6), trace to little fine to coarse sand, trace gravel; damp to moist.			1050.8		13	2	2	78	SS-7	3.25	3	2	6	67	22	-	-	20	A-4b (V)	
			1050.8		14	2	2	72	SS-8	2.50	-	-	-	-	-	-	-	22	A-4b (V)	
Stiff to very stiff gray SANDY SILT (A-4a), trace gravel; damp.			1050.8		15	2	8													
			1050.8		16															
			1050.8		17															
			1050.8		18															
			1050.8		19	2	2	72	SS-9	3.25	-	-	-	-	-	-	-	11	A-6b (V)	
			1050.8		20	3														
			1050.8		21	4	3	9	SS-10	1.25	-	-	-	-	-	18	11	7	10	A-4a (V)
			1050.8		22	3	3													
			1050.8		23															
			1050.8		24	3	5	17	SS-11	2.50	-	-	-	-	-	-	-	16	A-7-6 (V)	
			1050.8		25	5	7													
			1050.8		26	7	10	24	SS-12	2.50	-	-	-	-	-	-	-	18	A-7-6 (V)	
			1050.8		27	4	16	37	SS-13	2.00	-	-	-	-	-	-	-	9	A-4a (V)	
			1050.8		28															
			1050.8		29															



PID:	SFN:	PROJECT:	WEST WOODS BRIDGES	STATION / OFFSET:	13+39, 5' RT.	START:	10/26/21	END:	10/26/21	PG 3 OF 3	B-002-0-21									
<b>MATERIAL DESCRIPTION AND NOTES</b>			ELEV.	DEPTH(S)	SPT/RQD	N <sub>60</sub>	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	ABANDONED
			1017.1							GR	CS	FS	SI	CL	LL	PL	PI			
Medium dense COARSE AND FINE SAND (A-3a), some gravel; wet. (continued)				1015.8																
Medium dense gray GRAVEL (A-1-a), some sand; wet.					7 9	23	-	SS-20	-	-	-	-	-	-	-	-	-	A-1-a (V)		
Medium dense COARSE AND FINE SAND (A-3a), some gravel; wet.				1005.8																
Very stiff gray SANDY SILT (A-4a), little gravel; damp to moist.				1000.8	5 7 8	22	50	SS-21	-	63	22	9	4	2	-	-	-	10	A-1-a (V)	
Medium dense COARSE AND FINE SAND (A-3a), some gravel; wet.				999.3	6 7 9	23	83	SS-22	-	-	-	-	-	-	-	-	-	A-3a (V)		
Very stiff gray SANDY SILT (A-4a), little gravel; damp to moist.					7 10 20	43	50	SS-23	3.25	-	-	-	-	-	-	-	-	7	A-4a (V)	
EOB																				

NOTES: SEEPAGE - 22.4' / WATER LEVEL PRIOR TO ADDING WATER - 10.4' / WATER AT COMPLETION - 3.1'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED



INNOVATIVE IDEAS  
EXCEPTIONAL DESIGN  
UNMATCHED CLIENT SERVICE

STRUCTURE FOUNDATION EXPLORATION  
FOR WEST WOODS

## APPENDIX II

*Settlement*

*Pile Calculations – Axial Resistance*

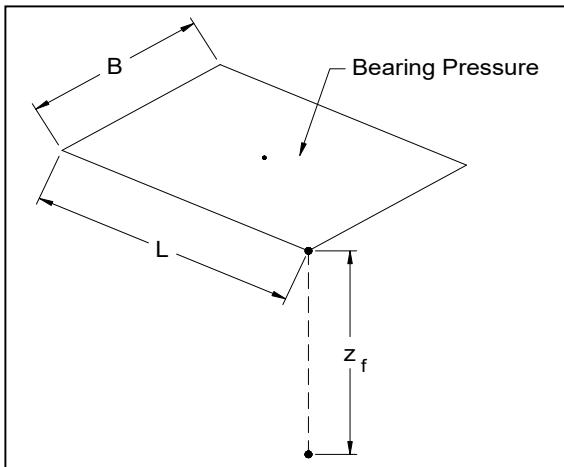
*Pile Calculations – Drivability*

*Pile Calculations – Lateral Analyses*

---

Client	Geauga Parks	JOB NUMBER	2122-1012.00	
Project	West Woods Culvert	SHEET NO.	1 OF 1	
Item	Settlement under 720 psf load	COMP. BY	RJH DATE 11/20/23	
	Up to 6 feet of fill north of Fwd Abutment	CHECKED BY	EWT	DATE 11/20/23
Settlement at Point A (Center of Fill)				

## SETTLEMENT ANALYSIS - RECTANGULAR FOOTING



### Profile Information

Groundwater Table: D = 0.0 ft

Output Range: z = 0 to 80 ft

### Footprint and Loading

Bearing Pressure q = 720 psf

Width B = 10 ft

Length L = 52 ft

Multiplication Factor x = 4 Factor for  $\Delta\sigma_z$  (Superposition)

Reference: Newmark (1935); Geotechnical Engineering Principles and Practices; Coduto, 1999

### Cohesionless

No.	Bot. of Laye	Soil Type	Settlement is calculated at mid-point of layer					Soils		Cohesive Soils		
			$\gamma_{soil}$ (pcf)	$\sigma'_c$ (psf)	$\sigma'_o$ (psf)	$\Delta\sigma_z$ (psf)	$\sigma'_f$ (psf)	C'	$C_r$	$C_c$	$e_o$	
1	4.0 ft	Clay	120	10,000	115	719	834			0.02	0.15	0.405
2	16.0 ft	Clay	125	10,000	606	598	1,204			0.02	0.19	0.500
3	36.0 ft	Clay	125	10,000	1,628	321	1,948			0.01	0.15	0.390
4	76.0 ft	Sand	125	10,000	3,506	138	3,644		65.0			
5												
6												
7												
8												
9												
10												

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

### Overconsolidated Soils - Case I ( $\sigma'_o < \sigma'_c$ ) Eqn:11.24

$$(\delta_c)_{ult} = \sum \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_o}\right)$$

### Overconsolidated Soils - Case II ( $\sigma'_o < \sigma'_c < \sigma'_f$ ) Eqn:11.25

$$(\delta_c)_{ult} = \sum \left[ \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_c}{\sigma'_o}\right) + \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_c}\right) \right]$$

### Normally Consolidated Soils ( $\sigma'_o = \sigma'_c$ ) Eqn: 11.23

$$(\delta_c)_{ult} = \sum \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_o}\right)$$

Reference: FHWA NHI-00-045

### Cohesionless Soils ( $\sigma'_o = \sigma'_c$ )

$$(\delta_c)_{ult} = \sum \frac{1}{C'} H \log\left(\frac{\sigma'_f}{\sigma'_o}\right)$$



SUBJECT

Client Geauga Parks

JOB NUMBER \_\_\_\_\_

Project West Woods Culvert

SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_

Item 720

COMP. BY \_\_\_\_\_ DATE \_\_\_\_\_

Up to 6 feet of fill north of Fwd Abutment

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

### INCREASE IN VERTICAL STRESS DUE TO FOOTING LOAD

Vertical stress below corner of a uniformly loaded flexible rectangular area (Newmark)

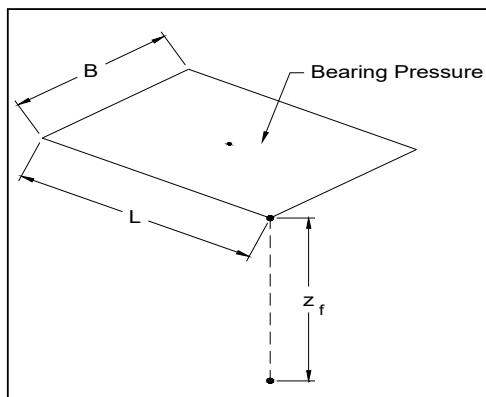
If;  $B^2 + L^2 + z_f^2 < B^2 L^2 / z^2$  then

$$\sigma_z = \frac{q}{4\pi} \left[ \left( \frac{2BLz_f \sqrt{B^2 + L^2 + z_f^2}}{z_f^2(B^2 + L^2 + z_f^2) + B^2 L^2} \right) \left( \frac{B^2 + L^2 + 2z_f^2}{B^2 + L^2 + z_f^2} \right) + \pi - \sin^{-1} \frac{2BLz_f \sqrt{B^2 + L^2 + z_f^2}}{z_f^2(B^2 + L^2 + z_f^2) + B^2 L^2} \right]$$

Otherwise,

$$\sigma_z = \frac{q}{4\pi} \left[ \left( \frac{2BLz_f \sqrt{B^2 + L^2 + z_f^2}}{z_f^2(B^2 + L^2 + z_f^2) + B^2 L^2} \right) \left( \frac{B^2 + L^2 + 2z_f^2}{B^2 + L^2 + z_f^2} \right) + \sin^{-1} \frac{2BLz_f \sqrt{B^2 + L^2 + z_f^2}}{z_f^2(B^2 + L^2 + z_f^2) + B^2 L^2} \right]$$

Point	$z_{bgs}$ (ft)	$\Delta\sigma_z$ (psf)
1	2.0	179.7
2	10.0	149.5
3	26.0	80.2
4	56.0	34.6
5	0.0	0.0
6	0.0	0.0
7	0.0	0.0
8	0.0	0.0
9	0.0	0.0
10	0.0	0.0



$q = 720$  psf

$B = 10$  ft

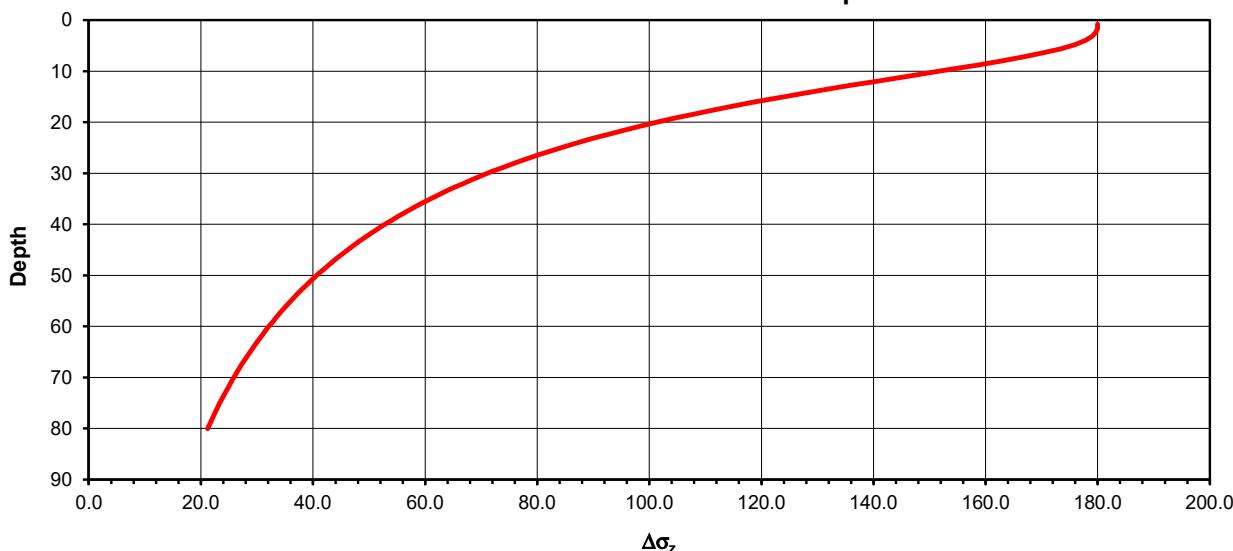
$L = 52$  ft

depth range

$z = 0$  to 80

Graph does not show multiplication of stress for superposition

Vertical Stress Increase Vs. Depth



Reference: Newmark (1935); Geotechnical Engineering Principles and Practices; Coduto, 1999



CLIENT	Geauga Parks	JOB NUMBER	2122-1012.00	
PROJECT	West Woods Culvert	SHEET NO.	1	OF 2
SUBJECT	Time Rate of Settlement	COMP. BY	RJH	DATE 11/20/2023
	Creek Channel Fill	CHECKED BY	EWT	DATE 11/21/2023
	Ref. Boring B-002-0-21			

### Time Rate of Settlement Calculation

Determine the time for primary consolidation to occur.

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

Eq. 3-26 EM 1110-1-1904

$t$  = time for settlement (days)

$c_v$  = coefficient of consolidation ( $\text{ft}^2/\text{day}$ )

$H_{dr}$  = height of drainage path (ft)

$T_v$  = time factor

Converting to equivalent layer i heights ( $H'_n$ ):

$$\begin{aligned} c_{v1} &= 0.600 \\ c_{v2} &= \\ c_{v3} &= \end{aligned}$$

$$\begin{aligned} H_1 &= 36.0 \\ H_2 &= \\ H_3 &= \end{aligned}$$

$$\begin{aligned} H'_1 &= 36.0 \\ H'_2 &= \\ H'_3 &= \end{aligned}$$

Cohesive Soils
N/A
N/A

$Cv=0.6$  based on an average LL of 22 Figure 4 DM 7.1-144

$$H'_{dr} = 18.0 \text{ ft}$$

Two way drainage with transformed layer thickness

$$\begin{aligned} T_v &= 0.403 \\ T_v &= 0.848 \end{aligned}$$

70% 0.4 inches remaining

90% 0.1 inches remaining

Table 11.8, 90% Consolidation (U), Ref. *Principles of Geotechnical Engineering*, Das 7th. Ed.

Consider a 18 ft consolidation layer with underlying cohesive soils.

$$t = \frac{T_v * H'_{dr}^2}{c_{vi}} = \frac{0.403 * 18.0^2}{0.60} = 218 \text{ days} = 7.3 \text{ months} = 0.6 \text{ years}$$

$$t = \frac{T_v * H'_{dr}^2}{c_{vi}} = \frac{0.848 * 18.0^2}{0.60} = 458 \text{ days} = 15.3 \text{ months} = 1.3 \text{ years}$$

See graph on following page (Note that "% Settlement" on graph refers to total consolidation settlement).

Geauga Parks

West Woods Culvert

Time Rate of Settlement

Typical

JOB NUMBER

1622-1007-05

SHEET NO.

2 OF 2

COMP. BY

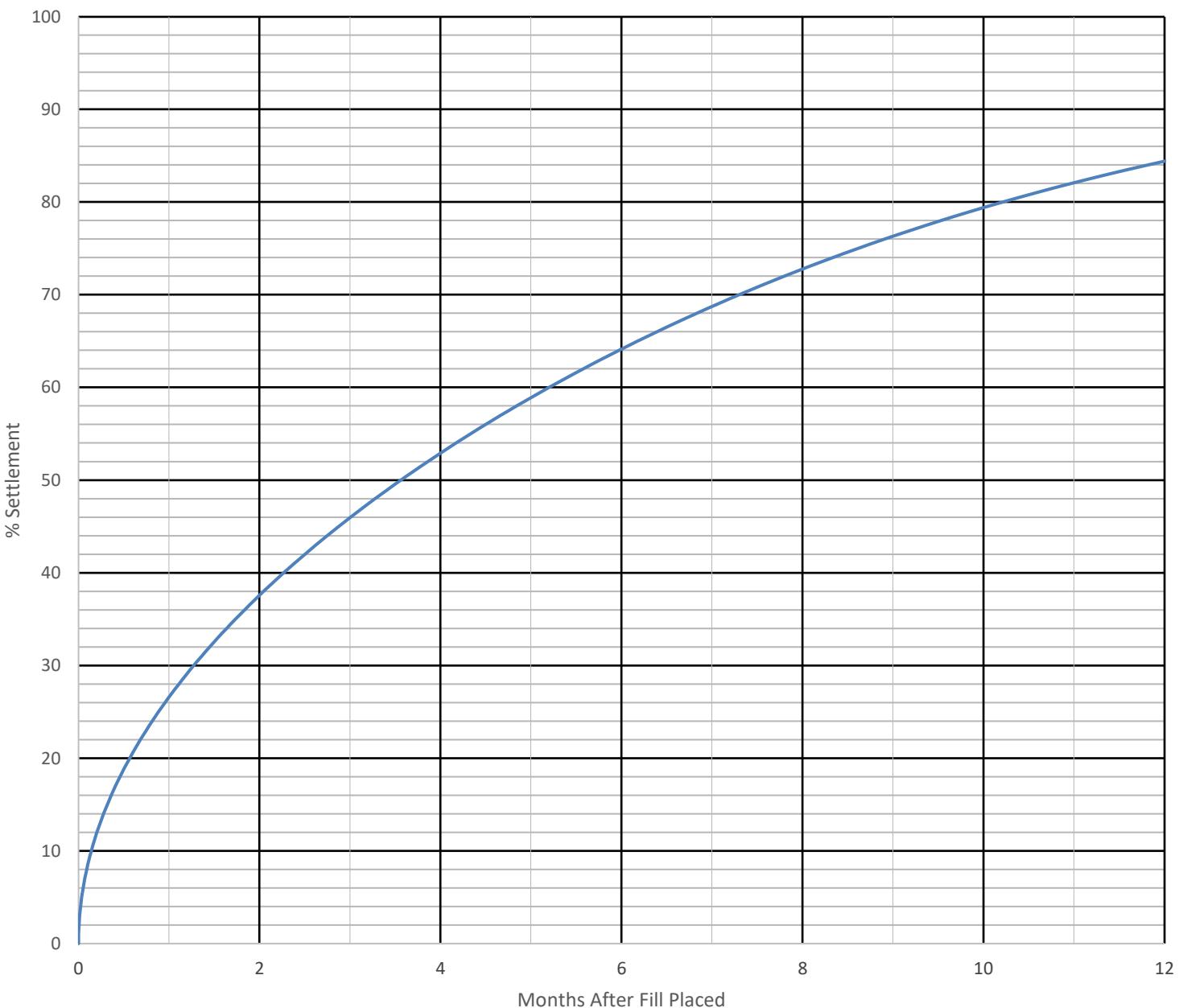
RJH DATE 11/20/2023

CHECKED BY

EWT DATE 11/21/2023

Ref. Boring B-002-0-21

## Analysis 1, Embankment Section



$$U\% = 1 \text{ to } 99$$

$$T_v = \frac{\left(\frac{\pi}{4}\right) * \left(\frac{U\%}{100}\right)^2}{\left[1 - \left(\frac{U\%}{100}\right)^{5.6}\right]^{0.357}}$$

Eq 11.65, Das, Principles of Geotechnical Engineering, 7th Ed.

$$t = \frac{T_v * H'^2}{c_{vi} * 30}$$

time in months

=====  
Calc'd: RJH Date: 12/18/23  
Chk'd: EWT Date: 12/18/23

APILE for Windows, Version 2019.9.3

Serial Number : 139693274

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

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=====

This program is licensed to :

DLZ Corporation  
Columbus, Ohio

Path to file locations : X:\Projects\2021\2122\101200 Geauga Park WW  
Br\118538\400-Engineering\Geotechnical\EngData\Calcs\2023\Update\  
Name of input data file : South Abutment (B-001) 16-inch dia.ap9d  
Name of output file : South Abutment (B-001) 16-inch dia.ap9o  
Name of plot output file : South Abutment (B-001) 16-inch dia.ap9p

-----  
Time and Date of Analysis  
-----

Date: December 18, 2023 Time: 13:56:10

1

\*\*\*\*\*  
\* INPUT INFORMATION \*  
\*\*\*\*\*

West Woods - Rear Abutment (16-in)

DESIGNER : Richard Hessler

JOB NUMBER : 2122-1012.00

METHOD FOR UNIT LOAD TRANSFERS :

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

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

TYPE OF LOADING :

- COMPRESSION

PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile

- Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 12.37 IN<sup>2</sup>

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 16.00 IN.
- INTERNAL DIAMETER, ID = 15.50 IN.
- TOTAL PILE LENGTH, TL = 63.00 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 2.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH  
USED IN COMPUTATION = 0.50 FT.
- LENGTH OF ENHANCED  
END SECTION = 63.00 FT.
- INTERNAL DIAMETER OF  
ENHANCED END SECTION = 15.50 IN.

PLUGGED/UNPLUGGED CONDITIONS :

Plugged for open-ended pile

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT^3	FRICITION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	CLAY	0.80*	57.60	0.00	8.00**
1.30	CLAY	0.80*	57.60	0.00	8.00**
1.30	SAND	0.80*	57.60	28.00	16.80**
6.60	SAND	0.80*	57.60	28.00	16.80**
6.60	CLAY	0.80*	62.60	0.00	8.00**
11.60	CLAY	0.80*	62.60	0.00	8.00**
11.60	SAND	0.80*	62.60	30.00	20.00**
29.10	SAND	0.80*	62.60	30.00	20.00**
29.10	SAND	0.80*	62.60	32.00	28.00**
49.10	SAND	0.80*	62.60	32.00	28.00**
49.10	SAND	0.80*	67.60	34.00	36.00**
65.60	SAND	0.80*	67.60	34.00	36.00**

\* VALUE ASSUMED BY THE PROGRAM

\*\* VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT FRICITION KSF	SKIN KSF	UNIT BEARING KSF
0.10E+08*	0.10E+08*	1.50	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.50	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	2.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	2.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00

\* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING

0.00	1.000	1.000
1.30	1.000	1.000
1.30	1.000	1.000
6.60	1.000	1.000
6.60	1.000	1.000
11.60	1.000	1.000
11.60	1.000	1.000
29.10	1.000	1.000
29.10	1.000	1.000
49.10	1.000	1.000
49.10	1.000	1.000
65.60	1.000	1.000

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\* COMPUTATION RESULT \*  
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\* FED. HWY. METHOD \*  
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PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	7.3	7.3
0.50	0.0	5.2	5.2
1.00	1.3	5.5	6.8
1.50	3.9	5.9	9.8
2.00	5.2	6.4	11.7
2.50	5.3	6.9	12.3
3.00	5.4	5.2	10.6
3.50	5.6	3.4	9.0
4.00	5.7	3.9	9.7
4.50	5.9	4.4	10.3
5.00	6.1	4.9	11.0
5.50	6.3	7.7	14.0
6.00	6.5	10.3	16.9
6.50	6.8	13.0	19.7
7.00	7.0	15.5	22.6
7.50	8.6	18.0	26.6
8.00	11.5	20.4	32.0
8.50	14.4	22.8	37.2
9.00	17.3	25.1	42.4
9.50	20.2	25.1	45.3
10.00	23.0	25.1	48.2

10.50	25.9	24.2	50.1
11.00	28.8	23.4	52.2
11.50	31.7	22.6	54.3
12.00	34.8	21.7	56.6
12.50	36.8	20.9	57.7
13.00	37.4	20.1	57.5
13.50	38.1	19.3	57.3
14.00	38.7	18.5	57.2
14.50	39.4	18.6	58.0
15.00	40.2	18.6	58.8
15.50	40.9	18.6	59.5
16.00	41.7	18.6	60.3
16.50	42.5	18.6	61.1
17.00	43.3	18.6	61.9
17.50	44.2	18.6	62.8
18.00	45.1	18.6	63.7
18.50	46.0	18.6	64.6
19.00	46.9	18.6	65.5
19.50	47.9	18.6	66.5
20.00	48.9	18.6	67.5
20.50	49.9	18.6	68.5
21.00	50.9	18.6	69.5
21.50	52.0	18.6	70.6
22.00	53.1	18.6	71.6
22.50	54.2	18.6	72.8
23.00	55.3	18.6	73.9
23.50	56.5	18.6	75.1
24.00	57.7	18.6	76.3
24.50	58.9	18.6	77.5
25.00	60.1	18.6	78.7
25.50	61.4	18.6	80.0
26.00	62.7	18.6	81.3
26.50	64.0	18.6	82.6
27.00	65.3	18.6	83.9
27.50	66.7	18.6	85.3
28.00	68.1	22.0	90.1
28.50	69.5	25.5	95.0
29.00	71.0	28.9	99.9
29.50	72.4	32.3	104.8
30.00	74.1	35.8	109.9
30.50	76.1	39.2	115.3
31.00	78.0	42.6	120.7
31.50	80.0	46.1	126.1
32.00	82.0	46.1	128.1
32.50	84.1	46.1	130.2
33.00	86.2	46.1	132.3
33.50	88.3	46.1	134.4
34.00	90.5	46.1	136.6
34.50	92.7	46.1	138.7
35.00	94.9	46.1	141.0

35.50	97.1	46.1	143.2
36.00	99.4	46.1	145.5
36.50	101.7	46.1	147.8
37.00	104.1	46.1	150.2
37.50	106.5	46.1	152.6
38.00	108.9	46.1	155.0
38.50	111.3	46.1	157.4
39.00	113.8	46.1	159.9
39.50	116.3	46.1	162.4
40.00	118.9	46.1	165.0
40.50	121.5	46.1	167.5
41.00	124.1	46.1	170.1
41.50	126.7	46.1	172.8
42.00	129.4	46.1	175.5
42.50	132.1	46.1	178.2
43.00	134.8	46.1	180.9
43.50	137.6	46.1	183.7
44.00	140.4	46.1	186.5
44.50	143.2	46.1	189.3
45.00	146.1	46.1	192.2
45.50	149.0	46.1	195.1
46.00	152.0	46.1	198.0
46.50	154.9	46.1	201.0
47.00	157.9	46.1	204.0
47.50	161.0	46.1	207.0
48.00	164.0	53.1	217.2
48.50	167.1	60.2	227.3
49.00	170.2	67.3	237.5
49.50	173.4	74.4	247.8
50.00	177.0	81.4	258.4
50.50	180.9	88.5	269.4
51.00	184.9	95.6	280.5
51.50	188.9	102.7	291.6
52.00	193.0	102.7	295.7
52.50	197.1	102.7	299.8
53.00	201.3	102.7	303.9
53.50	205.5	102.7	308.1
54.00	209.7	102.7	312.4
54.50	214.0	102.7	316.7
55.00	218.4	102.7	321.0
55.50	222.7	102.7	325.4
56.00	227.2	102.7	329.8
56.50	231.6	102.7	334.3
57.00	236.1	102.7	338.8
57.50	240.7	102.7	343.3
58.00	245.3	102.7	347.9
58.50	249.9	102.7	352.6
59.00	254.6	102.7	357.2
59.50	259.3	102.7	361.9
60.00	264.1	102.7	366.7

60.50	268.9	102.7	371.5
61.00	273.7	102.7	376.4

NOTES:

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

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*****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
*****
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T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00	0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00	0.0000E+00 0.2560E-01 0.4960E-01 0.9120E-01 0.1280E+00 0.1600E+00 0.3200E+00 0.4800E+00 0.8000E+00 0.3200E+01
2	10	0.6750E+00	0.0000E+00 0.9067E+00 0.1511E+01 0.2267E+01 0.2720E+01 0.3022E+01 0.2720E+01 0.2720E+01 0.2720E+01 0.2720E+01	0.0000E+00 0.2560E-01 0.4960E-01 0.9120E-01 0.1280E+00 0.1600E+00 0.3200E+00 0.4800E+00 0.8000E+00 0.3200E+01
3	10	0.1258E+01	0.0000E+00 0.2591E+01 0.4318E+01 0.6477E+01 0.7772E+01 0.8635E+01 0.7772E+01	0.0000E+00 0.2560E-01 0.4960E-01 0.9120E-01 0.1280E+00 0.1600E+00 0.3200E+00

			0.7772E+01	0.4800E+00
			0.7772E+01	0.8000E+00
			0.7772E+01	0.3200E+01
4	10	0.1300E+01	0.0000E+00	0.0000E+00
			0.2591E+01	0.2560E-01
			0.4318E+01	0.4960E-01
			0.6477E+01	0.9120E-01
			0.7772E+01	0.1280E+00
			0.8635E+01	0.1600E+00
			0.8635E+01	0.3200E+00
			0.8635E+01	0.4800E+00
			0.8635E+01	0.8000E+00
			0.8635E+01	0.3200E+01
5	10	0.3975E+01	0.0000E+00	0.0000E+00
			0.1578E+00	0.2560E-01
			0.2631E+00	0.4960E-01
			0.3946E+00	0.9120E-01
			0.4735E+00	0.1280E+00
			0.5261E+00	0.1600E+00
			0.5261E+00	0.3200E+00
			0.5261E+00	0.4800E+00
			0.5261E+00	0.8000E+00
			0.5261E+00	0.3200E+01
6	10	0.6558E+01	0.0000E+00	0.0000E+00
			0.2604E+00	0.2560E-01
			0.4340E+00	0.4960E-01
			0.6510E+00	0.9120E-01
			0.7812E+00	0.1280E+00
			0.8680E+00	0.1600E+00
			0.8680E+00	0.3200E+00
			0.8680E+00	0.4800E+00
			0.8680E+00	0.8000E+00
			0.8680E+00	0.3200E+01
7	10	0.6600E+01	0.0000E+00	0.0000E+00
			0.2621E+00	0.2560E-01
			0.4368E+00	0.4960E-01
			0.6552E+00	0.9120E-01
			0.7862E+00	0.1280E+00
			0.8735E+00	0.1600E+00
			0.7862E+00	0.3200E+00
			0.7862E+00	0.4800E+00
			0.7862E+00	0.8000E+00
			0.7862E+00	0.3200E+01
8	10	0.9125E+01	0.0000E+00	0.0000E+00
			0.2867E+01	0.2560E-01

			0.4778E+01	0.4960E-01
			0.7167E+01	0.9120E-01
			0.8600E+01	0.1280E+00
			0.9556E+01	0.1600E+00
			0.8600E+01	0.3200E+00
			0.8600E+01	0.4800E+00
			0.8600E+01	0.8000E+00
			0.8600E+01	0.3200E+01
9	10	0.1156E+02	0.0000E+00	0.0000E+00
			0.2993E+01	0.2560E-01
			0.4988E+01	0.4960E-01
			0.7483E+01	0.9120E-01
			0.8979E+01	0.1280E+00
			0.9977E+01	0.1600E+00
			0.8979E+01	0.3200E+00
			0.8979E+01	0.4800E+00
			0.8979E+01	0.8000E+00
			0.8979E+01	0.3200E+01
10	10	0.1160E+02	0.0000E+00	0.0000E+00
			0.3016E+01	0.2560E-01
			0.5027E+01	0.4960E-01
			0.7540E+01	0.9120E-01
			0.9048E+01	0.1280E+00
			0.1005E+02	0.1600E+00
			0.1005E+02	0.3200E+00
			0.1005E+02	0.4800E+00
			0.1005E+02	0.8000E+00
			0.1005E+02	0.3200E+01
11	10	0.2038E+02	0.0000E+00	0.0000E+00
			0.1011E+01	0.2560E-01
			0.1686E+01	0.4960E-01
			0.2529E+01	0.9120E-01
			0.3034E+01	0.1280E+00
			0.3372E+01	0.1600E+00
			0.3372E+01	0.3200E+00
			0.3372E+01	0.4800E+00
			0.3372E+01	0.8000E+00
			0.3372E+01	0.3200E+01
12	10	0.2906E+02	0.0000E+00	0.0000E+00
			0.1455E+01	0.2560E-01
			0.2425E+01	0.4960E-01
			0.3637E+01	0.9120E-01
			0.4364E+01	0.1280E+00
			0.4849E+01	0.1600E+00
			0.4849E+01	0.3200E+00
			0.4849E+01	0.4800E+00

			0.4849E+01	0.8000E+00
			0.4849E+01	0.3200E+01
13	10	0.2910E+02	0.0000E+00	0.0000E+00
			0.1457E+01	0.2560E-01
			0.2428E+01	0.4960E-01
			0.3642E+01	0.9120E-01
			0.4371E+01	0.1280E+00
			0.4856E+01	0.1600E+00
			0.4856E+01	0.3200E+00
			0.4856E+01	0.4800E+00
			0.4856E+01	0.8000E+00
			0.4856E+01	0.3200E+01
14	10	0.3913E+02	0.0000E+00	0.0000E+00
			0.2491E+01	0.2560E-01
			0.4152E+01	0.4960E-01
			0.6229E+01	0.9120E-01
			0.7474E+01	0.1280E+00
			0.8305E+01	0.1600E+00
			0.8305E+01	0.3200E+00
			0.8305E+01	0.4800E+00
			0.8305E+01	0.8000E+00
			0.8305E+01	0.3200E+01
15	10	0.4906E+02	0.0000E+00	0.0000E+00
			0.3133E+01	0.2560E-01
			0.5222E+01	0.4960E-01
			0.7833E+01	0.9120E-01
			0.9400E+01	0.1280E+00
			0.1044E+02	0.1600E+00
			0.1044E+02	0.3200E+00
			0.1044E+02	0.4800E+00
			0.1044E+02	0.8000E+00
			0.1044E+02	0.3200E+01
16	10	0.4910E+02	0.0000E+00	0.0000E+00
			0.3136E+01	0.2560E-01
			0.5226E+01	0.4960E-01
			0.7840E+01	0.9120E-01
			0.9408E+01	0.1280E+00
			0.1045E+02	0.1600E+00
			0.1045E+02	0.3200E+00
			0.1045E+02	0.4800E+00
			0.1045E+02	0.8000E+00
			0.1045E+02	0.3200E+01
17	10	0.5738E+02	0.0000E+00	0.0000E+00
			0.4534E+01	0.2560E-01
			0.7557E+01	0.4960E-01

			0.1134E+02	0.9120E-01
			0.1360E+02	0.1280E+00
			0.1511E+02	0.1600E+00
			0.1511E+02	0.3200E+00
			0.1511E+02	0.4800E+00
			0.1511E+02	0.8000E+00
			0.1511E+02	0.3200E+01
18	10	0.6556E+02	0.0000E+00	0.0000E+00
			0.4843E+01	0.2560E-01
			0.8072E+01	0.4960E-01
			0.1211E+02	0.9120E-01
			0.1453E+02	0.1280E+00
			0.1614E+02	0.1600E+00
			0.1614E+02	0.3200E+00
			0.1614E+02	0.4800E+00
			0.1614E+02	0.8000E+00
			0.1614E+02	0.3200E+01

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

LOAD VERSUS SETTLEMENT CURVE  
\*\*\*\*\*

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.1115E+01	0.1240E-02	0.8020E-01	0.1000E-03
0.1115E+02	0.1240E-01	0.8020E+00	0.1000E-02
0.5355E+02	0.6148E-01	0.4010E+01	0.5000E-02
0.9596E+02	0.1173E+00	0.8020E+01	0.1000E-01
0.1578E+03	0.2108E+00	0.1604E+02	0.2000E-01
0.2342E+03	0.3682E+00	0.2829E+02	0.5000E-01

0.2708E+03	0.4639E+00	0.3266E+02	0.8000E-01
0.2875E+03	0.5149E+00	0.3558E+02	0.1000E+00
0.3206E+03	0.6812E+00	0.5016E+02	0.2000E+00
0.3380E+03	0.1018E+01	0.6748E+02	0.5000E+00
0.3515E+03	0.1346E+01	0.8096E+02	0.8000E+00
0.3577E+03	0.1559E+01	0.8717E+02	0.1000E+01
0.3731E+03	0.2592E+01	0.1027E+03	0.2000E+01

=====  
Calc'd: RJH Date: 12/18/23  
Chk'd: EWT Date: 12/18/23

APILE for Windows, Version 2019.9.3

Serial Number : 139693274

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

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This program is licensed to :

DLZ Corporation  
Columbus, Ohio

Path to file locations : X:\Projects\2021\2122\101200 Geauga Park WW  
Br\118538\400-Engineering\Geotechnical\EngData\Calcs\2023\Update\  
Name of input data file : North Abutment (B-002) 16-inch dia (UBV  
300k).ap9d  
Name of output file : North Abutment (B-002) 16-inch dia (UBV  
300k).ap9o  
Name of plot output file : North Abutment (B-002) 16-inch dia (UBV  
300k).ap9p

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Time and Date of Analysis  
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Date: December 18, 2023 Time: 13:54:47

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\* INPUT INFORMATION \*  
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West Woods - Forward Abutment (16-in)

DESIGNER : Richard Hessler

JOB NUMBER : 2122-1012.00

METHOD FOR UNIT LOAD TRANSFERS :

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

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

TYPE OF LOADING :

- COMPRESSION

PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile

- Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 12.37 IN<sup>2</sup>

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 16.00 IN.
- INTERNAL DIAMETER, ID = 15.50 IN.
- TOTAL PILE LENGTH, TL = 54.00 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 2.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH  
USED IN COMPUTATION = 0.50 FT.
- LENGTH OF ENHANCED  
END SECTION = 54.00 FT.
- INTERNAL DIAMETER OF  
ENHANCED END SECTION = 15.50 IN.

PLUGGED/UNPLUGGED CONDITIONS :

Plugged for open-ended pile

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT^3	FRICITION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	CLAY	0.80*	57.60	0.00	8.00**
10.90	CLAY	0.80*	57.60	0.00	8.00**
10.90	CLAY	0.80*	62.60	0.00	8.00**
20.90	CLAY	0.80*	62.60	0.00	8.00**
20.90	CLAY	0.80*	62.60	0.00	8.00**
25.90	CLAY	0.80*	62.60	0.00	8.00**
25.90	SAND	0.80*	62.60	28.00	16.80**
30.90	SAND	0.80*	62.60	28.00	16.80**
30.90	SAND	0.80*	62.60	32.00	28.00**
55.90	SAND	0.80*	62.60	32.00	28.00**
55.90	SAND	0.80*	62.60	32.00	28.00**
67.40	SAND	0.80*	62.60	32.00	28.00**

\* VALUE ASSUMED BY THE PROGRAM

\*\* VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT FRICITION KSF	SKIN KSF	UNIT BEARING KSF
0.10E+08*	0.10E+08*	1.50	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.50	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	2.50	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	2.50	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00	0.00

\* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING  
WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT  
PLAN TO LIMIT THE COMPUTED DATA.

LRFD FACTOR    LRFD FACTOR

DEPTH FT.	ON UNIT FRICTION	ON UNIT BEARING
0.00	1.000	1.000
10.90	1.000	1.000
10.90	1.000	1.000
20.90	1.000	1.000
20.90	1.000	1.000
25.90	1.000	1.000
25.90	1.000	1.000
30.90	1.000	1.000
30.90	1.000	1.000
55.90	1.000	1.000
55.90	1.000	1.000
67.40	1.000	1.000

1

\*\*\*\*\*  
\* COMPUTATION RESULT \*  
\*\*\*\*\*

\*\*\*\*\*  
\* FED. HWY. METHOD \*  
\*\*\*\*\*

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	9.4	9.4
0.50	0.0	9.4	9.4
1.00	1.3	11.8	13.1
1.50	3.9	14.1	18.0
2.00	6.5	16.5	23.0
2.50	9.1	18.8	28.0
3.00	11.7	18.8	30.6
3.50	14.3	18.8	33.2
4.00	16.9	18.8	35.8
4.50	19.5	18.8	38.4
5.00	22.1	18.8	41.0
5.50	24.7	18.8	43.6
6.00	27.3	18.8	46.2
6.50	30.0	18.8	48.8
7.00	32.6	18.8	51.4
7.50	35.2	18.8	54.0
8.00	37.8	18.8	56.6
8.50	40.4	18.8	59.2

9.00	43.0	18.8	61.8
9.50	45.6	20.4	66.0
10.00	48.2	22.0	70.2
10.50	51.0	23.6	74.6
11.00	53.9	25.1	79.0
11.50	56.8	26.7	83.5
12.00	59.7	28.3	88.0
12.50	62.7	29.8	92.5
13.00	65.6	31.4	97.0
13.50	68.6	31.4	100.0
14.00	71.5	31.4	102.9
14.50	74.4	31.4	105.9
15.00	77.4	31.4	108.8
15.50	80.3	31.4	111.7
16.00	83.3	31.4	114.7
16.50	86.2	31.4	117.6
17.00	89.2	31.4	120.6
17.50	92.1	31.4	123.5
18.00	95.0	31.4	126.5
18.50	98.0	31.4	129.4
19.00	100.9	31.4	132.3
19.50	103.9	29.1	132.9
20.00	107.0	26.7	133.7
20.50	110.4	24.3	134.8
21.00	114.0	22.0	136.0
21.50	116.7	19.6	136.4
22.00	118.8	17.3	136.1
22.50	120.9	14.9	135.8
23.00	122.9	12.6	135.5
23.50	125.0	12.6	137.6
24.00	127.1	12.6	139.6
24.50	129.1	13.3	142.5
25.00	131.2	14.1	145.3
25.50	133.3	14.8	148.1
26.00	135.4	15.6	151.0
26.50	137.0	16.3	153.3
27.00	138.1	17.1	155.2
27.50	139.3	17.8	157.1
28.00	140.4	18.6	159.0
28.50	141.6	18.6	160.2
29.00	142.8	18.6	161.4
29.50	144.1	22.0	166.1
30.00	145.3	25.5	170.8
30.50	146.6	28.9	175.5
31.00	147.9	32.3	180.2
31.50	149.5	35.8	185.3
32.00	151.5	39.2	190.7
32.50	153.6	42.6	196.2
33.00	155.6	46.1	201.7
33.50	157.8	46.1	203.8

34.00	159.9	46.1	206.0
34.50	162.1	46.1	208.1
35.00	164.3	46.1	210.3
35.50	166.5	46.1	212.6
36.00	168.8	46.1	214.8
36.50	171.0	46.1	217.1
37.00	173.4	46.1	219.5
37.50	175.7	46.1	221.8
38.00	178.1	46.1	224.2
38.50	180.6	46.1	226.6
39.00	183.0	46.1	229.1
39.50	185.5	46.1	231.6
40.00	188.0	46.1	234.1
40.50	190.6	46.1	236.7
41.00	193.2	46.1	239.3
41.50	195.8	46.1	241.9
42.00	198.5	46.1	244.5
42.50	201.1	46.1	247.2
43.00	203.9	46.1	249.9
43.50	206.6	46.1	252.7
44.00	209.4	46.1	255.5
44.50	212.2	46.1	258.3
45.00	215.1	46.1	261.1
45.50	218.0	46.1	264.0
46.00	220.9	46.1	266.9
46.50	223.8	46.1	269.9
47.00	226.8	46.1	272.9
47.50	229.8	46.1	275.9
48.00	232.8	46.1	278.9
48.50	235.9	46.1	282.0
49.00	239.0	46.1	285.1
49.50	242.2	46.1	288.3
50.00	245.3	46.1	291.4
50.50	248.6	46.1	294.6
51.00	251.8	46.1	297.9
51.50	255.1	46.1	301.1
52.00	258.4	46.1	304.4

NOTES:

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

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

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.0000E+00	0.2560E-01
			0.0000E+00	0.4960E-01
			0.0000E+00	0.9120E-01
			0.0000E+00	0.1280E+00
			0.0000E+00	0.1600E+00
			0.0000E+00	0.3200E+00
			0.0000E+00	0.4800E+00
			0.0000E+00	0.8000E+00
			0.0000E+00	0.3200E+01
2	10	0.5475E+01		
			0.0000E+00	0.0000E+00
			0.2591E+01	0.2560E-01
			0.4318E+01	0.4960E-01
			0.6477E+01	0.9120E-01
			0.7772E+01	0.1280E+00
			0.8635E+01	0.1600E+00
			0.7772E+01	0.3200E+00
			0.7772E+01	0.4800E+00
			0.7772E+01	0.8000E+00
			0.7772E+01	0.3200E+01
3	10	0.1086E+02		
			0.0000E+00	0.0000E+00
			0.2841E+01	0.2560E-01
			0.4735E+01	0.4960E-01
			0.7102E+01	0.9120E-01
			0.8522E+01	0.1280E+00
			0.9469E+01	0.1600E+00
			0.8522E+01	0.3200E+00
			0.8522E+01	0.4800E+00
			0.8522E+01	0.8000E+00
			0.8522E+01	0.3200E+01
4	10	0.1090E+02		
			0.0000E+00	0.0000E+00
			0.2840E+01	0.2560E-01
			0.4733E+01	0.4960E-01
			0.7099E+01	0.9120E-01
			0.8519E+01	0.1280E+00
			0.9466E+01	0.1600E+00
			0.8519E+01	0.3200E+00
			0.8519E+01	0.4800E+00
			0.8519E+01	0.8000E+00
			0.8519E+01	0.3200E+01
5	10	0.1593E+02		

			0.0000E+00	0.0000E+00
			0.2928E+01	0.2560E-01
			0.4879E+01	0.4960E-01
			0.7319E+01	0.9120E-01
			0.8783E+01	0.1280E+00
			0.9759E+01	0.1600E+00
			0.8783E+01	0.3200E+00
			0.8783E+01	0.4800E+00
			0.8783E+01	0.8000E+00
			0.8783E+01	0.3200E+01
6	10	0.2086E+02	0.0000E+00	0.0000E+00
			0.3479E+01	0.2560E-01
			0.5799E+01	0.4960E-01
			0.8698E+01	0.9120E-01
			0.1044E+02	0.1280E+00
			0.1160E+02	0.1600E+00
			0.1044E+02	0.3200E+00
			0.1044E+02	0.4800E+00
			0.1044E+02	0.8000E+00
			0.1044E+02	0.3200E+01
7	10	0.2090E+02	0.0000E+00	0.0000E+00
			0.3465E+01	0.2560E-01
			0.5775E+01	0.4960E-01
			0.8663E+01	0.9120E-01
			0.1040E+02	0.1280E+00
			0.1155E+02	0.1600E+00
			0.1040E+02	0.3200E+00
			0.1040E+02	0.4800E+00
			0.1040E+02	0.8000E+00
			0.1040E+02	0.3200E+01
8	10	0.2343E+02	0.0000E+00	0.0000E+00
			0.2057E+01	0.2560E-01
			0.3429E+01	0.4960E-01
			0.5143E+01	0.9120E-01
			0.6171E+01	0.1280E+00
			0.6857E+01	0.1600E+00
			0.6171E+01	0.3200E+00
			0.6171E+01	0.4800E+00
			0.6171E+01	0.8000E+00
			0.6171E+01	0.3200E+01
9	10	0.2586E+02	0.0000E+00	0.0000E+00
			0.2083E+01	0.2560E-01
			0.3472E+01	0.4960E-01
			0.5208E+01	0.9120E-01
			0.6250E+01	0.1280E+00
			0.6944E+01	0.1600E+00

			0.6250E+01	0.3200E+00
			0.6250E+01	0.4800E+00
			0.6250E+01	0.8000E+00
			0.6250E+01	0.3200E+01
10	10	0.2590E+02	0.0000E+00	0.0000E+00
			0.2083E+01	0.2560E-01
			0.3472E+01	0.4960E-01
			0.5208E+01	0.9120E-01
			0.6250E+01	0.1280E+00
			0.6944E+01	0.1600E+00
			0.6944E+01	0.3200E+00
			0.6944E+01	0.4800E+00
			0.6944E+01	0.8000E+00
			0.6944E+01	0.3200E+01
11	10	0.2843E+02	0.0000E+00	0.0000E+00
			0.1189E+01	0.2560E-01
			0.1981E+01	0.4960E-01
			0.2972E+01	0.9120E-01
			0.3566E+01	0.1280E+00
			0.3962E+01	0.1600E+00
			0.3962E+01	0.3200E+00
			0.3962E+01	0.4800E+00
			0.3962E+01	0.8000E+00
			0.3962E+01	0.3200E+01
12	10	0.3086E+02	0.0000E+00	0.0000E+00
			0.1294E+01	0.2560E-01
			0.2156E+01	0.4960E-01
			0.3234E+01	0.9120E-01
			0.3881E+01	0.1280E+00
			0.4312E+01	0.1600E+00
			0.4312E+01	0.3200E+00
			0.4312E+01	0.4800E+00
			0.4312E+01	0.8000E+00
			0.4312E+01	0.3200E+01
13	10	0.3090E+02	0.0000E+00	0.0000E+00
			0.1296E+01	0.2560E-01
			0.2159E+01	0.4960E-01
			0.3239E+01	0.9120E-01
			0.3887E+01	0.1280E+00
			0.4318E+01	0.1600E+00
			0.4318E+01	0.3200E+00
			0.4318E+01	0.4800E+00
			0.4318E+01	0.8000E+00
			0.4318E+01	0.3200E+01
14	10	0.4343E+02	0.0000E+00	0.0000E+00

			0.2749E+01	0.2560E-01
			0.4581E+01	0.4960E-01
			0.6872E+01	0.9120E-01
			0.8246E+01	0.1280E+00
			0.9162E+01	0.1600E+00
			0.9162E+01	0.3200E+00
			0.9162E+01	0.4800E+00
			0.9162E+01	0.8000E+00
			0.9162E+01	0.3200E+01
15	10	0.5586E+02	0.0000E+00	0.0000E+00
			0.3303E+01	0.2560E-01
			0.5504E+01	0.4960E-01
			0.8256E+01	0.9120E-01
			0.9908E+01	0.1280E+00
			0.1101E+02	0.1600E+00
			0.1101E+02	0.3200E+00
			0.1101E+02	0.4800E+00
			0.1101E+02	0.8000E+00
			0.1101E+02	0.3200E+01
16	10	0.5590E+02	0.0000E+00	0.0000E+00
			0.3303E+01	0.2560E-01
			0.5504E+01	0.4960E-01
			0.8256E+01	0.9120E-01
			0.9908E+01	0.1280E+00
			0.1101E+02	0.1600E+00
			0.1101E+02	0.3200E+00
			0.1101E+02	0.4800E+00
			0.1101E+02	0.8000E+00
			0.1101E+02	0.3200E+01
17	10	0.6168E+02	0.0000E+00	0.0000E+00
			0.3303E+01	0.2560E-01
			0.5504E+01	0.4960E-01
			0.8256E+01	0.9120E-01
			0.9908E+01	0.1280E+00
			0.1101E+02	0.1600E+00
			0.1101E+02	0.3200E+00
			0.1101E+02	0.4800E+00
			0.1101E+02	0.8000E+00
			0.1101E+02	0.3200E+01
18	10	0.6736E+02	0.0000E+00	0.0000E+00
			0.3303E+01	0.2560E-01
			0.5504E+01	0.4960E-01
			0.8256E+01	0.9120E-01
			0.9908E+01	0.1280E+00
			0.1101E+02	0.1600E+00
			0.1101E+02	0.3200E+00

0.1101E+02	0.4800E+00
0.1101E+02	0.8000E+00
0.1101E+02	0.3200E+01

TIP LOAD KIP	TIP MOVEMENT IN.
-----------------	---------------------

0.0000E+00	0.0000E+00
0.2880E+01	0.8000E-02
0.5760E+01	0.1600E-01
0.1152E+02	0.3200E-01
0.2304E+02	0.2080E+00
0.3456E+02	0.6720E+00
0.4147E+02	0.1168E+01
0.4608E+02	0.1600E+01
0.4608E+02	0.2400E+01
0.4608E+02	0.3200E+01

#### LOAD VERSUS SETTLEMENT CURVE

\*\*\*\*\*

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.8198E+00	0.6923E-03	0.3600E-01	0.1000E-03
0.8198E+01	0.6923E-02	0.3600E+00	0.1000E-02
0.4117E+02	0.3474E-01	0.1800E+01	0.5000E-02
0.7665E+02	0.6784E-01	0.3600E+01	0.1000E-01
0.1302E+03	0.1252E+00	0.7199E+01	0.2000E-01
0.2085E+03	0.2349E+00	0.1270E+02	0.5000E-01
0.2397E+03	0.3070E+00	0.1466E+02	0.8000E-01
0.2506E+03	0.3453E+00	0.1597E+02	0.1000E+00
0.2675E+03	0.4794E+00	0.2251E+02	0.2000E+00
0.2749E+03	0.7931E+00	0.3029E+02	0.5000E+00
0.2809E+03	0.1104E+01	0.3634E+02	0.8000E+00
0.2837E+03	0.1309E+01	0.3913E+02	0.1000E+01
0.2907E+03	0.2322E+01	0.4608E+02	0.2000E+01

## Neutral Plane Analysis (Downdrag - FHWA)

X

Show Resistance Curves

Pile Penetration at Toe (ft)

52

Permanent Load (kips)

157

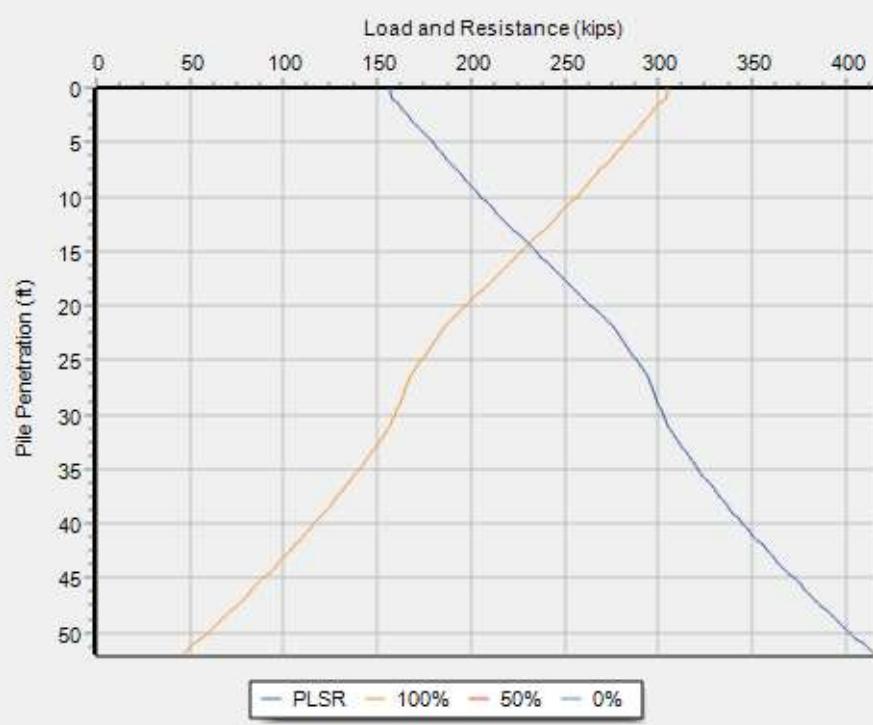
### Curves

- Permanent Load plus Side Resistance (PLSR)
- Mobilized Resistance, 100% toe, minus Side Resistance (100%)
- Mobilized Resistance, 50% toe, minus Side Resistance (50%)
- Mobilized Resistance, 0% toe, minus Side Resistance (0%)

	Neutral Axis (ft)	Axial Load (kips)	Drag Force (kips)
100%	14.37931	230.7	73.7
50%			
0%			

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## GRLWEAP: Wave Equation Analysis of Pile Foundations

Rear Abutment Calculations + 16-in

11/21/2023

DLZ OHIO

GRLWEAP 14.1.15.0

**ABOUT THE WAVE EQUATION ANALYSIS RESULTS**

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

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

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

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

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

Calc'd: RJH	Date: 11/21/23
Chk'd: EWT	Date: 11/21/23

**HAMMER DATA**

Hammer Model:	D 19-42	Made By:	DELMAG
Hammer ID:	41	Hammer Type:	OED
Hammer Database Type:	PDI		
Hammer Database Name:			PDIHammer.gwh

**Hammer and Drive System Segment Data**

Segment -	Weight kips	Stiffness kips/in	COR -	C-Slack in	Damping kips/ft/s
1	0.800	140,084.4	1.000	0.000	
2	0.800	140,084.4	1.000	0.000	
3	0.800	140,084.4	1.000	0.000	
4	0.800	140,084.4	1.000	0.000	
5	0.800	70,754.7	0.900	0.120	
Imp Block	0.753	60,155.6	0.800	0.120	
Helmet	1.900				4.4

Ram Weight: (kips)	4.00	Ram Length: (ft)	10.76
Ram Area: (in <sup>2</sup> )	124.69		
Maximum (Eq) Stroke: (ft)	10.81	Actual (Eq) Stroke: (ft)	10.81
Efficiency:	0.800	Rated Energy: (kip-ft)	43.24
Maximum Pressure: (psi)	1,600.00	Actual Pressure: (psi)	1,600.00
Combustion Delay: (ms)	2.00	Ignition Duration: (ms)	2.00
Expansion Exponent:	1.25		

Hammer Cushion	Pile Cushion		
Cross Sect. Area: (in <sup>2</sup> )	227.00	Cross Sect. Area: (in <sup>2</sup> )	0.00
Elastic Modulus: (ksi)	530.0	Elastic Modulus: (ksi)	0.0
Thickness: (in)	2.00	Thickness: (in)	0.00
Coeff. of Restitution:	0.800	Coeff. of Restitution:	0.500
Stiffness: (kips/in)	60,155.6	Stiffness: (kips/in)	0.0

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp Length ft	Wait Time Hr	Hammer
0.50	55.0	0.0	DELMAG D 19-42
1.00	55.0	0.0	DELMAG D 19-42
1.50	55.0	0.0	DELMAG D 19-42
2.00	55.0	0.0	DELMAG D 19-42
2.50	55.0	0.0	DELMAG D 19-42
3.00	55.0	0.0	DELMAG D 19-42
3.50	55.0	0.0	DELMAG D 19-42
4.00	55.0	0.0	DELMAG D 19-42
4.50	55.0	0.0	DELMAG D 19-42
5.00	55.0	0.0	DELMAG D 19-42
5.50	55.0	0.0	DELMAG D 19-42
6.00	55.0	0.0	DELMAG D 19-42
6.50	55.0	0.0	DELMAG D 19-42
7.00	55.0	0.0	DELMAG D 19-42
7.50	55.0	0.0	DELMAG D 19-42
8.00	55.0	0.0	DELMAG D 19-42
8.50	55.0	0.0	DELMAG D 19-42
9.00	55.0	0.0	DELMAG D 19-42
9.50	55.0	0.0	DELMAG D 19-42
10.00	55.0	0.0	DELMAG D 19-42
10.50	55.0	0.0	DELMAG D 19-42
11.00	55.0	0.0	DELMAG D 19-42
11.50	55.0	0.0	DELMAG D 19-42
12.00	55.0	0.0	DELMAG D 19-42
12.50	55.0	0.0	DELMAG D 19-42
13.00	55.0	0.0	DELMAG D 19-42
13.50	55.0	0.0	DELMAG D 19-42
14.00	55.0	0.0	DELMAG D 19-42
14.50	55.0	0.0	DELMAG D 19-42
15.00	55.0	0.0	DELMAG D 19-42
15.50	55.0	0.0	DELMAG D 19-42
16.00	55.0	0.0	DELMAG D 19-42
16.50	55.0	0.0	DELMAG D 19-42
17.00	55.0	0.0	DELMAG D 19-42
17.50	55.0	0.0	DELMAG D 19-42
18.00	55.0	0.0	DELMAG D 19-42
18.50	55.0	0.0	DELMAG D 19-42
19.00	55.0	0.0	DELMAG D 19-42
19.50	55.0	0.0	DELMAG D 19-42

Rear Abutment Calculations + 16-in	DLZ OHIO		
20.00	55.0	0.0	DELMAG D 19-42
20.50	55.0	0.0	DELMAG D 19-42
21.00	55.0	0.0	DELMAG D 19-42
21.50	55.0	0.0	DELMAG D 19-42
22.00	55.0	0.0	DELMAG D 19-42
22.50	55.0	0.0	DELMAG D 19-42
23.00	55.0	0.0	DELMAG D 19-42
23.50	55.0	0.0	DELMAG D 19-42
24.00	55.0	0.0	DELMAG D 19-42
24.50	55.0	0.0	DELMAG D 19-42
25.00	55.0	0.0	DELMAG D 19-42
25.50	55.0	0.0	DELMAG D 19-42
26.00	55.0	0.0	DELMAG D 19-42
26.50	55.0	0.0	DELMAG D 19-42
27.00	55.0	0.0	DELMAG D 19-42
27.50	55.0	0.0	DELMAG D 19-42
28.00	55.0	0.0	DELMAG D 19-42
28.50	55.0	0.0	DELMAG D 19-42
29.00	55.0	0.0	DELMAG D 19-42
29.50	55.0	0.0	DELMAG D 19-42
30.00	55.0	0.0	DELMAG D 19-42
30.50	55.0	0.0	DELMAG D 19-42
31.00	55.0	0.0	DELMAG D 19-42
31.50	55.0	0.0	DELMAG D 19-42
32.00	55.0	0.0	DELMAG D 19-42
32.50	55.0	0.0	DELMAG D 19-42
33.00	55.0	0.0	DELMAG D 19-42
33.50	55.0	0.0	DELMAG D 19-42
34.00	55.0	0.0	DELMAG D 19-42
34.50	55.0	0.0	DELMAG D 19-42
35.00	55.0	0.0	DELMAG D 19-42
35.50	55.0	0.0	DELMAG D 19-42
36.00	55.0	0.0	DELMAG D 19-42
36.50	55.0	0.0	DELMAG D 19-42
37.00	55.0	0.0	DELMAG D 19-42
37.50	55.0	0.0	DELMAG D 19-42
38.00	55.0	0.0	DELMAG D 19-42
38.50	55.0	0.0	DELMAG D 19-42
39.00	55.0	0.0	DELMAG D 19-42
39.50	55.0	0.0	DELMAG D 19-42
40.00	55.0	0.0	DELMAG D 19-42
40.50	55.0	0.0	DELMAG D 19-42

Rear Abutment Calculations + 16-in DLZ OHIO

41.00	55.0	0.0	DELMAG D 19-42
41.50	55.0	0.0	DELMAG D 19-42
42.00	55.0	0.0	DELMAG D 19-42
42.50	55.0	0.0	DELMAG D 19-42
43.00	55.0	0.0	DELMAG D 19-42
43.50	55.0	0.0	DELMAG D 19-42
44.00	55.0	0.0	DELMAG D 19-42
44.50	55.0	0.0	DELMAG D 19-42
45.00	55.0	0.0	DELMAG D 19-42
45.50	55.0	0.0	DELMAG D 19-42
46.00	55.0	0.0	DELMAG D 19-42
46.50	55.0	0.0	DELMAG D 19-42
47.00	55.0	0.0	DELMAG D 19-42
47.50	55.0	0.0	DELMAG D 19-42
48.00	55.0	0.0	DELMAG D 19-42
48.50	55.0	0.0	DELMAG D 19-42
49.00	55.0	0.0	DELMAG D 19-42
49.50	55.0	0.0	DELMAG D 19-42
50.00	55.0	0.0	DELMAG D 19-42
50.50	55.0	0.0	DELMAG D 19-42
51.00	55.0	0.0	DELMAG D 19-42
51.50	55.0	0.0	DELMAG D 19-42
52.00	55.0	0.0	DELMAG D 19-42
52.50	55.0	0.0	DELMAG D 19-42
53.00	55.0	0.0	DELMAG D 19-42

Other Information for DELMAG D 19-42

Depth ft	Stroke ft	Diesel Pressure %	Efficiency -	P.C. Stiff. Fact. -	P.C. COR -
0.50	10.8	100.0	0.80	1.0	0.50
1.00	10.8	100.0	0.80	1.0	0.50
1.50	10.8	100.0	0.80	1.0	0.50
2.00	10.8	100.0	0.80	1.0	0.50
2.50	10.8	100.0	0.80	1.0	0.50
3.00	10.8	100.0	0.80	1.0	0.50
3.50	10.8	100.0	0.80	1.0	0.50
4.00	10.8	100.0	0.80	1.0	0.50
4.50	10.8	100.0	0.80	1.0	0.50
5.00	10.8	100.0	0.80	1.0	0.50
5.50	10.8	100.0	0.80	1.0	0.50
6.00	10.8	100.0	0.80	1.0	0.50
6.50	10.8	100.0	0.80	1.0	0.50

Rear Abutment Calculations + 16-in DLZ OHIO

7.00	10.8	100.0	0.80	1.0	0.50
7.50	10.8	100.0	0.80	1.0	0.50
8.00	10.8	100.0	0.80	1.0	0.50
8.50	10.8	100.0	0.80	1.0	0.50
9.00	10.8	100.0	0.80	1.0	0.50
9.50	10.8	100.0	0.80	1.0	0.50
10.00	10.8	100.0	0.80	1.0	0.50
10.50	10.8	100.0	0.80	1.0	0.50
11.00	10.8	100.0	0.80	1.0	0.50
11.50	10.8	100.0	0.80	1.0	0.50
12.00	10.8	100.0	0.80	1.0	0.50
12.50	10.8	100.0	0.80	1.0	0.50
13.00	10.8	100.0	0.80	1.0	0.50
13.50	10.8	100.0	0.80	1.0	0.50
14.00	10.8	100.0	0.80	1.0	0.50
14.50	10.8	100.0	0.80	1.0	0.50
15.00	10.8	100.0	0.80	1.0	0.50
15.50	10.8	100.0	0.80	1.0	0.50
16.00	10.8	100.0	0.80	1.0	0.50
16.50	10.8	100.0	0.80	1.0	0.50
17.00	10.8	100.0	0.80	1.0	0.50
17.50	10.8	100.0	0.80	1.0	0.50
18.00	10.8	100.0	0.80	1.0	0.50
18.50	10.8	100.0	0.80	1.0	0.50
19.00	10.8	100.0	0.80	1.0	0.50
19.50	10.8	100.0	0.80	1.0	0.50
20.00	10.8	100.0	0.80	1.0	0.50
20.50	10.8	100.0	0.80	1.0	0.50
21.00	10.8	100.0	0.80	1.0	0.50
21.50	10.8	100.0	0.80	1.0	0.50
22.00	10.8	100.0	0.80	1.0	0.50
22.50	10.8	100.0	0.80	1.0	0.50
23.00	10.8	100.0	0.80	1.0	0.50
23.50	10.8	100.0	0.80	1.0	0.50
24.00	10.8	100.0	0.80	1.0	0.50
24.50	10.8	100.0	0.80	1.0	0.50
25.00	10.8	100.0	0.80	1.0	0.50
25.50	10.8	100.0	0.80	1.0	0.50
26.00	10.8	100.0	0.80	1.0	0.50
26.50	10.8	100.0	0.80	1.0	0.50
27.00	10.8	100.0	0.80	1.0	0.50
27.50	10.8	100.0	0.80	1.0	0.50

## Rear Abutment Calculations + 16-in DLZ OHIO

28.00	10.8	100.0	0.80	1.0	0.50
28.50	10.8	100.0	0.80	1.0	0.50
29.00	10.8	100.0	0.80	1.0	0.50
29.50	10.8	100.0	0.80	1.0	0.50
30.00	10.8	100.0	0.80	1.0	0.50
30.50	10.8	100.0	0.80	1.0	0.50
31.00	10.8	100.0	0.80	1.0	0.50
31.50	10.8	100.0	0.80	1.0	0.50
32.00	10.8	100.0	0.80	1.0	0.50
32.50	10.8	100.0	0.80	1.0	0.50
33.00	10.8	100.0	0.80	1.0	0.50
33.50	10.8	100.0	0.80	1.0	0.50
34.00	10.8	100.0	0.80	1.0	0.50
34.50	10.8	100.0	0.80	1.0	0.50
35.00	10.8	100.0	0.80	1.0	0.50
35.50	10.8	100.0	0.80	1.0	0.50
36.00	10.8	100.0	0.80	1.0	0.50
36.50	10.8	100.0	0.80	1.0	0.50
37.00	10.8	100.0	0.80	1.0	0.50
37.50	10.8	100.0	0.80	1.0	0.50
38.00	10.8	100.0	0.80	1.0	0.50
38.50	10.8	100.0	0.80	1.0	0.50
39.00	10.8	100.0	0.80	1.0	0.50
39.50	10.8	100.0	0.80	1.0	0.50
40.00	10.8	100.0	0.80	1.0	0.50
40.50	10.8	100.0	0.80	1.0	0.50
41.00	10.8	100.0	0.80	1.0	0.50
41.50	10.8	100.0	0.80	1.0	0.50
42.00	10.8	100.0	0.80	1.0	0.50
42.50	10.8	100.0	0.80	1.0	0.50
43.00	10.8	100.0	0.80	1.0	0.50
43.50	10.8	100.0	0.80	1.0	0.50
44.00	10.8	100.0	0.80	1.0	0.50
44.50	10.8	100.0	0.80	1.0	0.50
45.00	10.8	100.0	0.80	1.0	0.50
45.50	10.8	100.0	0.80	1.0	0.50
46.00	10.8	100.0	0.80	1.0	0.50
46.50	10.8	100.0	0.80	1.0	0.50
47.00	10.8	100.0	0.80	1.0	0.50
47.50	10.8	100.0	0.80	1.0	0.50
48.00	10.8	100.0	0.80	1.0	0.50
48.50	10.8	100.0	0.80	1.0	0.50

Rear Abutment Calculations + 16-in DLZ OHIO

49.00	10.8	100.0	0.80	1.0	0.50
49.50	10.8	100.0	0.80	1.0	0.50
50.00	10.8	100.0	0.80	1.0	0.50
50.50	10.8	100.0	0.80	1.0	0.50
51.00	10.8	100.0	0.80	1.0	0.50
51.50	10.8	100.0	0.80	1.0	0.50
52.00	10.8	100.0	0.80	1.0	0.50
52.50	10.8	100.0	0.80	1.0	0.50
53.00	10.8	100.0	0.80	1.0	0.50

PILE, SOIL, ANALYSIS OPTIONS

Analysis type:	Driveability Analysis	Soil Damping Option:	Smith
Max No Analysis Iterations:	0	Time Increment/Critical:	160
Residual Stress Analysis:	0	Analysis Time-Input(ms):	0
Output Level:	Normal	Gravitational Acceleration (ft/s <sup>2</sup> ):	32.169
Hammer Gravity (ft/s <sup>2</sup> ):	32.169	Pile Gravity (ft/s <sup>2</sup> ):	32.169

## Driveability Analysis

Analysis Depth (ft)	53.00	Standard Soil Setup	
Hammer Name	DELMAG D 19-42	Hammer ID	41
Diesel Pressure: (psi)	230.40	Stroke (ft)	10.81
Efficiency	0.80		
Shaft Gain/Loss Factor	1.000	Toe Gain/Loss Factor	1.000
Shaft Gain/Loss Factor	0.900	Toe Gain/Loss Factor	1.000
Shaft Gain/Loss Factor	0.800	Toe Gain/Loss Factor	1.000
Shaft Gain/Loss Factor	0.700	Toe Gain/Loss Factor	1.000
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor	1.000

## SOIL RESISTANCE PARAMETERS

Depth ft	Unit ksf	Unit Rt ksf	Qs in	Qt in	Js s/ft	Jt s/ft	Setup -	F.Limit ft	D.Setup Hours	TEB Area in <sup>2</sup>
0.00	1.2	13.5	0.10	0.160	0.150	0.2	1.5	6.00	168.0	201.06
1.50	1.2	13.5	0.10	0.160	0.150	0.2	1.5	6.00	168.0	201.06
1.50	0.0	1.1	0.10	0.184	0.050	0.2	1.0	6.00	1.0	201.06
3.20	0.1	2.3	0.10	0.184	0.050	0.2	1.0	6.00	1.0	201.06
4.90	0.1	3.5	0.10	0.184	0.050	0.2	1.0	6.00	1.0	201.06
6.60	0.1	4.7	0.10	0.184	0.050	0.2	1.0	6.00	1.0	201.06
6.60	2.0	18.0	0.10	0.161	0.150	0.2	1.5	6.00	168.0	201.06
11.60	2.0	18.0	0.10	0.161	0.150	0.2	1.5	6.00	168.0	201.06
11.60	0.3	12.1	0.10	0.267	0.050	0.2	1.0	6.00	1.0	201.06
13.35	0.3	13.3	0.10	0.267	0.050	0.2	1.0	6.00	1.0	201.06
15.10	0.4	13.3	0.10	0.267	0.050	0.2	1.0	6.00	1.0	201.06
16.85	0.4	13.3	0.10	0.267	0.050	0.2	1.0	6.00	1.0	201.06
18.60	0.5	13.3	0.10	0.267	0.050	0.2	1.0	6.00	1.0	201.06
22.10	0.5	13.3	0.10	0.267	0.050	0.2	1.0	6.00	1.0	201.06
23.85	0.6	13.3	0.10	0.267	0.050	0.2	1.0	6.00	1.0	201.06
25.60	0.6	13.3	0.10	0.267	0.050	0.2	1.0	6.00	1.0	201.06
27.35	0.7	13.3	0.10	0.267	0.050	0.2	1.0	6.00	1.0	201.06
29.10	0.7	13.3	0.10	0.267	0.050	0.2	1.0	6.00	1.0	201.06
29.10	0.9	33.1	0.10	0.194	0.050	0.2	1.0	6.00	1.0	201.06
30.77	1.0	33.1	0.10	0.194	0.050	0.2	1.0	6.00	1.0	201.06
32.43	1.0	33.1	0.10	0.194	0.050	0.2	1.0	6.00	1.0	201.06
34.10	1.1	33.1	0.10	0.194	0.050	0.2	1.0	6.00	1.0	201.06
35.77	1.1	33.1	0.10	0.194	0.050	0.2	1.0	6.00	1.0	201.06
37.43	1.2	33.1	0.10	0.194	0.050	0.2	1.0	6.00	1.0	201.06
39.10	1.2	33.1	0.10	0.194	0.050	0.2	1.0	6.00	1.0	201.06
40.77	1.3	33.1	0.10	0.194	0.050	0.2	1.0	6.00	1.0	201.06
42.43	1.3	33.1	0.10	0.194	0.050	0.2	1.0	6.00	1.0	201.06
44.10	1.4	33.1	0.10	0.194	0.050	0.2	1.0	6.00	1.0	201.06

Rear Abutment Calculations + 16-in DLZ OHIO

45.77	1.5	33.1	0.10	0.194	0.050	0.2	1.0	6.00	1.0	201.06
47.43	1.5	33.1	0.10	0.194	0.050	0.2	1.0	6.00	1.0	201.06
49.10	1.6	33.1	0.10	0.194	0.050	0.2	1.0	6.00	1.0	201.06
49.10	1.9	73.6	0.10	0.174	0.050	0.2	1.0	6.00	1.0	201.06
50.75	2.0	73.6	0.10	0.174	0.050	0.2	1.0	6.00	1.0	201.06
52.40	2.0	73.6	0.10	0.174	0.050	0.2	1.0	6.00	1.0	201.06
54.05	2.1	73.6	0.10	0.174	0.050	0.2	1.0	6.00	1.0	201.06

PILE PROFILE

Lb Top	X-Area	E-Mod	Spec. Wt	Perim.	C-Index	Wave Sp	Impedance
ft	in <sup>2</sup>	ksi	lb/ft <sup>3</sup>	ft	-	ft/s	kips/ft/s
0.00	12.4	30,000	492.00	4.189	0	16,806.4	22.1
55.00	12.4	30,000	492.00	4.189	0	16,806.4	22.1

PILE AND SOIL MODEL Total Capacity Rut (kips): 327.204

Seg.	Weight	Stiffn.	C-Slk	T-Slk	COR	Ru	Js/Jt	Qs/Qt	LbTop	Perim.	X-Area	
-	-	kips	kips/in	in	in	-	kips	s/ft	in	ft	ft	in <sup>2</sup>
1	0.14	9,559	0.12	0.00	0.85	6.4	0.150	0.10	3.24	4.19	12.4	
2	0.14	9,559	0.00	0.00	1.00	2.1	0.100	0.10	6.47	4.19	12.4	
3	0.14	9,559	0.00	0.00	1.00	10.2	0.100	0.10	9.71	4.19	12.4	
4	0.14	9,559	0.00	0.00	1.00	27.1	0.150	0.10	12.94	4.19	12.4	
5	0.14	9,559	0.00	0.00	1.00	8.9	0.100	0.10	16.18	4.19	12.4	
6	0.14	9,559	0.00	0.00	1.00	5.2	0.050	0.10	19.41	4.19	12.4	
7	0.14	9,559	0.00	0.00	1.00	6.4	0.050	0.10	22.65	4.19	12.4	
8	0.14	9,559	0.00	0.00	1.00	7.5	0.050	0.10	25.88	4.19	12.4	
9	0.14	9,559	0.00	0.00	1.00	8.6	0.050	0.10	29.12	4.19	12.4	
10	0.14	9,559	0.00	0.00	1.00	10.7	0.050	0.10	32.35	4.19	12.4	
11	0.14	9,559	0.00	0.00	1.00	13.7	0.050	0.10	35.59	4.19	12.4	
12	0.14	9,559	0.00	0.00	1.00	15.1	0.050	0.10	38.82	4.19	12.4	
13	0.14	9,559	0.00	0.00	1.00	16.5	0.050	0.10	42.06	4.19	12.4	
14	0.14	9,559	0.00	0.00	1.00	17.9	0.050	0.10	45.29	4.19	12.4	
15	0.14	9,559	0.00	0.00	1.00	19.3	0.050	0.10	48.53	4.19	12.4	
16	0.14	9,559	0.00	0.00	1.00	21.7	0.050	0.10	51.76	4.19	12.4	
17	0.14	9,559	0.00	0.00	1.00	27.1	0.050	0.10	55.00	4.19	12.4	
Toe						102.8	0.150	0.17	55.00			

2.325 kips total unreduced pile weight ( $g = 32.169 \text{ ft/s}^2$ )

2.325 kips total reduced pile weight ( $g = 32.169 \text{ ft/s}^2$ )

OTHER OPTIONS

Pile Damping (%):	1	Pile Damping Fact. (kips/ft/s):	0.442
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## EXTREMA TABLE at 53.0 FT; HAMMER: D 19-42

Shaft/Toe Gain/Loss Factor = 1.000/1.000

Hammer	DEL MAG D 19-42			Efficiency	Time Inc. = 0.076 ms		
	Lb Top	Mx.T-For.	Mx.C-For		Mx.T-Str.	Mx.C-Str.	ENTHRU
ft	kips	kips	ksi	ksi	ft/s	in	kip-ft
3.2	0.0	416.1	0.00	33.64	15.47	0.682	18.16
6.5	0.0	408.9	0.00	33.06	14.84	0.655	17.37
9.7	0.0	428.5	0.00	34.64	13.97	0.626	16.49
12.9	0.0	414.6	0.00	33.52	13.16	0.597	14.29
16.2	0.0	340.6	0.00	27.54	12.89	0.569	12.23
19.4	0.0	324.3	0.00	26.22	12.65	0.542	11.44
22.6	0.0	320.5	0.00	25.91	12.43	0.515	10.82
25.9	0.0	315.8	0.00	25.53	12.19	0.488	10.18
29.1	0.0	310.9	0.00	25.13	11.91	0.463	9.52
32.4	0.0	305.8	0.00	24.72	11.56	0.438	8.84
35.6	0.0	299.0	0.00	24.17	11.17	0.415	8.10
38.8	0.0	288.4	0.00	23.31	10.77	0.393	7.34
42.1	0.0	275.4	0.00	22.27	10.35	0.372	6.58
45.3	0.0	259.4	0.00	20.97	10.08	0.352	5.84
48.5	0.0	237.3	0.00	19.18	10.73	0.335	5.12
51.8	0.0	215.4	0.00	17.41	11.44	0.320	4.41
55.0	0.0	210.5	0.00	17.02	11.12	0.306	4.03

Converged Stroke (ft) 8.32 Fixed Combustion Pressure (psi) 1,600.0  
 (Eq) Strokes Analyzed and Last Return (ft)  
 10.81 8.24 8.32

Shaft/Toe Gain/Loss Factor = 0.900/1.000

Hammer	DEL MAG D 19-42			Efficiency	Time Inc. = 0.076 ms		
	Lb Top	Mx.T-For.	Mx.C-For		Mx.T-Str.	Mx.C-Str.	ENTHRU
ft	kips	kips	ksi	ksi	ft/s	in	kip-ft
3.2	0.0	414.8	0.00	33.53	15.39	0.705	18.83
6.5	0.0	411.1	0.00	33.24	14.78	0.678	18.05
9.7	0.0	428.0	0.00	34.60	13.97	0.648	17.16
12.9	0.0	412.0	0.00	33.31	13.28	0.619	15.02
16.2	0.0	344.9	0.00	27.88	13.04	0.591	13.01
19.4	0.0	329.7	0.00	26.66	12.80	0.563	12.19
22.6	0.0	326.3	0.00	26.38	12.57	0.536	11.56
25.9	0.0	322.0	0.00	26.03	12.32	0.509	10.90
29.1	0.0	317.3	0.00	25.65	12.03	0.483	10.22

Rear Abutment Calculations + 16-in DLZ OHIO

32.4	0.0	312.4	0.00	25.26	11.68	0.459	9.52
35.6	0.0	305.6	0.00	24.70	11.27	0.435	8.75
38.8	0.0	295.1	0.00	23.85	10.84	0.413	7.95
42.1	0.0	281.6	0.00	22.77	10.42	0.392	7.15
45.3	0.0	262.6	0.00	21.23	10.37	0.373	6.37
48.5	0.0	242.0	0.00	19.56	10.95	0.356	5.60
51.8	0.0	222.8	0.00	18.01	11.45	0.340	4.85
55.0	0.0	219.7	0.00	17.76	11.06	0.327	4.44

Converged Stroke (ft) 8.29 Fixed Combustion Pressure (psi) 1,600.0  
 (Eq) Strokes Analyzed and Last Return (ft)  
 10.81 8.20 8.29 8.29

Shaft/Toe Gain/Loss Factor = 0.800/1.000

Rut = 318.1 kips Rtoe = 102.8 kips Time Inc. = 0.076 ms

Hammer DELMAG D 19-42 Efficiency 0.800

Lb Top	Mx.T-For.	Mx.C-For	Mx.T-Str.	Mx.C-Str.	Mx Vel.	Mx Dis.	ENTHRU
ft	kips	kips	ksi	ksi	ft/s	in	Kip-ft
3.2	0.0	411.1	0.00	33.24	15.26	0.725	19.17
6.5	0.0	409.6	0.00	33.11	14.64	0.696	18.42
9.7	0.0	424.1	0.00	34.28	13.91	0.667	17.55
12.9	0.0	408.6	0.00	33.03	13.35	0.637	15.53
16.2	0.0	348.2	0.00	28.15	13.13	0.608	13.62
19.4	0.0	334.6	0.00	27.05	12.90	0.580	12.81
22.6	0.0	331.4	0.00	26.79	12.67	0.553	12.16
25.9	0.0	327.2	0.00	26.45	12.40	0.526	11.48
29.1	0.0	322.7	0.00	26.09	12.10	0.501	10.79
32.4	0.0	318.1	0.00	25.71	11.73	0.476	10.07
35.6	0.0	311.2	0.00	25.16	11.30	0.453	9.27
38.8	0.0	300.7	0.00	24.31	10.86	0.430	8.44
42.1	0.0	286.9	0.00	23.19	10.42	0.409	7.61
45.3	0.0	265.6	0.00	21.47	10.61	0.390	6.79
48.5	0.0	245.7	0.00	19.86	11.08	0.373	6.00
51.8	0.0	230.6	0.00	18.64	11.43	0.358	5.20
55.0	0.0	226.7	0.00	18.33	10.95	0.345	4.77

Converged Stroke (ft) 8.27 Fixed Combustion Pressure (psi) 1,600.0  
 (Eq) Strokes Analyzed and Last Return (ft)  
 10.81 8.17 8.26 8.27

Shaft/Toe Gain/Loss Factor = 0.700/1.000

Rut = 313.1 kips Rtoe = 102.8 kips Time Inc. = 0.076 ms

11/21/2023 13/29 GRLWEAP 14.1.15.0

## Rear Abutment Calculations + 16-in DLZ OHIO

Hammer		DELMAG D 19-42		Efficiency		0.800	
Lb Top	Mx.T-For.	Mx.C-For	Mx.T-Str.	Mx.C-Str.	Mx Vel.	Mx Dis.	ENTHRU
ft	kips	kips	ksi	ksi	ft/s	in	kip-ft
3.2	0.0	408.7	0.00	33.04	15.21	0.746	19.61
6.5	0.0	408.2	0.00	33.00	14.58	0.718	18.89
9.7	1.4	420.3	0.11	33.98	13.87	0.687	18.04
12.9	0.0	406.8	0.00	32.88	13.45	0.657	16.15
16.2	0.0	353.2	0.00	28.55	13.26	0.629	14.36
19.4	0.0	340.7	0.00	27.54	13.04	0.601	13.55
22.6	0.0	337.5	0.00	27.28	12.79	0.573	12.88
25.9	0.0	333.5	0.00	26.96	12.53	0.547	12.19
29.1	0.0	329.2	0.00	26.61	12.21	0.521	11.48
32.4	0.0	324.7	0.00	26.25	11.83	0.497	10.73
35.6	0.0	317.7	0.00	25.69	11.39	0.473	9.90
38.8	0.0	306.9	0.00	24.81	10.92	0.450	9.03
42.1	0.0	292.6	0.00	23.65	10.48	0.430	8.17
45.3	0.0	270.0	0.00	21.82	10.85	0.411	7.32
48.5	0.0	250.8	0.00	20.27	11.26	0.394	6.48
51.8	0.0	238.7	0.00	19.30	11.41	0.378	5.63
55.0	0.0	233.9	0.00	18.90	10.87	0.365	5.18

Converged Stroke (ft) 8.24 Fixed Combustion Pressure (psi) 1,600.0  
 (Eq) Strokes Analyzed and Last Return (ft)  
 10.81 8.14 8.26 8.24

Shaft/Toe Gain/Loss Factor = 0.600/1.000

Rut = 308.2 kips Rtoe = 102.8 kips Time Inc. = 0.076 ms  
 Hammer DELMAG D 19-42 Efficiency 0.800

Lb Top	Mx.T-For.	Mx.C-For	Mx.T-Str.	Mx.C-Str.	Mx Vel.	Mx Dis.	ENTHRU
ft	kips	kips	ksi	ksi	ft/s	in	kip-ft
3.2	0.0	405.2	0.00	32.76	15.12	0.766	19.92
6.5	0.8	405.6	0.06	32.79	14.53	0.737	19.22
9.7	3.2	415.3	0.26	33.57	13.86	0.706	18.41
12.9	0.0	403.8	0.00	32.65	13.57	0.676	16.68
16.2	0.0	358.1	0.00	28.95	13.36	0.647	15.03
19.4	0.0	346.4	0.00	28.01	13.13	0.619	14.22
22.6	0.0	343.4	0.00	27.76	12.89	0.592	13.54
25.9	0.0	339.4	0.00	27.44	12.62	0.565	12.83
29.1	0.0	335.2	0.00	27.10	12.29	0.540	12.11
32.4	0.0	330.6	0.00	26.73	11.91	0.515	11.33
35.6	0.0	323.8	0.00	26.17	11.47	0.491	10.48
38.8	0.0	312.6	0.00	25.27	10.98	0.469	9.57

Rear Abutment Calculations + 16-in DLZ OHIO

42.1	0.0	297.4	0.00	24.04	10.53	0.448	8.68
45.3	0.0	274.0	0.00	22.15	11.04	0.429	7.79
48.5	0.0	255.0	0.00	20.61	11.37	0.412	6.91
51.8	0.0	245.6	0.00	19.86	11.37	0.397	6.03
55.0	0.0	239.9	0.00	19.39	10.78	0.384	5.55

Converged Stroke (ft) 8.22 Fixed Combustion Pressure (psi) 1,600.0  
 (Eq) Strokes Analyzed and Last Return (ft)  
 10.81 8.09 8.22 8.22

SUMMARY TABLE at 53.0 FT; HAMMER: D 19-42

Rut kips	Bl Ct b/ft	Stk Dn ft	Stk Up Mx ft	T-Str ksi	LTop Mx ft	C-Str ksi	LTop ENTHRU ft	Bl Rt kip-ft	ActRes b/min	Bl Rt kips
327.2	65.5	8.32	0.00	0.00	3.2	34.64	9.7	18.2	41.0	327.2
323.0	58.9	8.29	0.00	0.00	3.2	34.60	9.7	18.8	41.0	323.0
318.1	54.4	8.27	0.00	0.00	3.2	34.28	9.7	19.2	41.1	318.1
313.1	49.9	8.24	0.00	0.11	9.7	33.98	9.7	19.6	41.1	313.1
308.2	46.4	8.22	0.00	0.26	9.7	33.57	9.7	19.9	41.2	308.2

## SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 1.000/1.000									
Depth ft	Rut kips	Rshaft kips	Rtoe kips	Bl Ct b/ft	Mx C-Str ksi	Mx T-Str ksi	Stroke ft	ENTHRU kip-ft	Hammer -
0.5	21.4	2.6	18.8	1.8	12.38	0.00	3.99	25.9	D 19-42
1.0	24.0	5.2	18.8	2.0	13.68	0.00	4.12	25.3	D 19-42
1.5	26.6	7.7	18.8	2.3	15.05	0.39	4.21	25.0	D 19-42
2.0	9.8	7.8	2.0	0.0	0.00	0.00	0.00	0.0	D 19-42
2.5	10.4	7.9	2.5	0.0	0.00	0.00	0.00	0.0	D 19-42
3.0	11.0	8.0	3.0	0.0	0.00	0.00	0.00	0.0	D 19-42
3.5	11.6	8.1	3.5	1.0	2.96	0.00	3.12	13.5	D 19-42
4.0	12.3	8.3	4.0	1.2	3.18	0.00	3.20	12.7	D 19-42
4.5	12.9	8.5	4.5	1.4	3.39	0.01	3.29	12.3	D 19-42
5.0	13.6	8.7	5.0	1.4	3.32	0.06	3.25	12.1	D 19-42
5.5	14.3	8.9	5.5	1.5	3.42	0.08	3.30	11.6	D 19-42
6.0	15.1	9.1	6.0	1.1	10.03	0.00	3.56	27.8	D 19-42
6.5	15.8	9.4	6.4	1.1	10.29	0.00	3.61	27.7	D 19-42
7.0	37.9	12.8	25.1	3.3	17.75	0.69	4.59	23.4	D 19-42
7.5	42.1	17.0	25.1	3.7	18.67	0.80	4.72	23.0	D 19-42
8.0	46.3	21.2	25.1	4.0	19.18	1.02	4.79	22.8	D 19-42
8.5	50.5	25.4	25.1	4.4	19.84	1.02	4.89	22.4	D 19-42
9.0	54.7	29.5	25.1	4.8	20.53	1.20	5.00	22.1	D 19-42
9.5	58.9	33.7	25.1	5.2	21.20	1.37	5.11	21.9	D 19-42
10.0	63.0	37.9	25.1	6.1	22.42	1.09	5.36	21.3	D 19-42
10.5	67.2	42.1	25.1	6.6	23.11	1.26	5.46	21.1	D 19-42
11.0	71.4	46.3	25.1	7.1	23.73	1.25	5.56	20.9	D 19-42
11.5	75.6	50.5	25.1	7.4	23.75	1.37	5.62	20.6	D 19-42
12.0	69.0	51.8	17.2	6.0	22.56	1.58	5.31	21.4	D 19-42
12.5	70.2	52.4	17.7	6.2	22.74	1.54	5.34	21.4	D 19-42
13.0	71.3	53.1	18.2	6.3	22.86	1.49	5.37	21.3	D 19-42
13.5	72.3	53.7	18.6	7.0	23.61	1.16	5.53	20.9	D 19-42
14.0	73.0	54.4	18.6	7.2	23.87	1.11	5.55	20.8	D 19-42
14.5	73.8	55.2	18.6	7.1	23.83	1.15	5.54	20.9	D 19-42
15.0	74.5	55.9	18.6	6.6	23.43	1.46	5.43	21.2	D 19-42
15.5	75.3	56.7	18.6	6.6	23.56	1.45	5.44	21.1	D 19-42
16.0	76.1	57.5	18.6	6.7	23.68	1.42	5.46	21.0	D 19-42
16.5	77.0	58.4	18.6	7.5	23.90	1.12	5.61	20.6	D 19-42
17.0	77.8	59.2	18.6	7.6	24.04	1.16	5.64	20.5	D 19-42
17.5	78.7	60.1	18.6	7.8	24.31	1.19	5.67	20.4	D 19-42
18.0	79.6	61.0	18.6	7.7	24.20	1.24	5.66	20.5	D 19-42
18.5	80.6	62.0	18.6	7.1	24.02	1.36	5.54	20.9	D 19-42
19.0	81.5	62.9	18.6	7.2	24.17	1.41	5.55	20.9	D 19-42

Rear Abutment Calculations + 16-in DLZ OHIO

19.5	82.5	63.9	18.6	7.3	24.21	1.43	5.58	20.8	D 19-42
20.0	83.5	64.9	18.6	8.1	24.41	1.23	5.73	20.3	D 19-42
20.5	84.6	66.0	18.6	8.3	24.70	1.25	5.76	20.3	D 19-42
21.0	85.7	67.1	18.6	8.3	24.89	1.32	5.76	20.2	D 19-42
21.5	86.8	68.2	18.6	7.7	24.49	1.46	5.65	20.6	D 19-42
22.0	87.9	69.3	18.6	7.8	24.63	1.50	5.67	20.6	D 19-42
22.5	89.0	70.5	18.6	8.0	24.60	1.54	5.70	20.3	D 19-42
23.0	90.2	71.6	18.6	8.7	25.33	1.59	5.84	20.1	D 19-42
23.5	91.4	72.8	18.6	8.9	25.20	1.67	5.87	20.0	D 19-42
24.0	92.7	74.1	18.6	9.1	25.41	1.72	5.90	20.0	D 19-42
24.5	93.9	75.3	18.6	9.1	25.73	1.79	5.89	20.0	D 19-42
25.0	95.2	76.6	18.6	8.6	25.14	1.92	5.81	20.1	D 19-42
25.5	96.5	77.9	18.6	8.7	25.29	2.07	5.83	20.1	D 19-42
26.0	97.9	79.3	18.6	8.9	25.46	2.14	5.85	20.1	D 19-42
26.5	99.2	80.6	18.6	9.6	25.83	1.97	5.98	19.8	D 19-42
27.0	100.6	82.0	18.6	9.8	25.94	1.94	6.01	19.7	D 19-42
27.5	102.0	83.4	18.6	9.9	26.28	1.99	6.02	19.7	D 19-42
28.0	103.5	84.9	18.6	9.3	25.76	2.22	5.93	19.9	D 19-42
28.5	105.0	86.4	18.6	9.5	25.93	2.13	5.96	19.8	D 19-42
29.0	106.5	87.9	18.6	9.7	26.11	2.02	5.98	19.8	D 19-42
29.5	135.9	89.7	46.2	14.6	28.78	1.08	6.63	19.0	D 19-42
30.0	137.9	91.7	46.2	14.9	28.29	1.10	6.66	19.0	D 19-42
30.5	139.9	93.7	46.2	15.3	28.51	1.10	6.70	18.9	D 19-42
31.0	141.9	95.7	46.2	15.3	28.95	1.12	6.70	19.0	D 19-42
31.5	144.0	97.8	46.2	14.7	28.52	1.14	6.65	19.0	D 19-42
32.0	146.1	99.9	46.2	15.0	28.73	1.16	6.68	19.0	D 19-42
32.5	148.2	102.0	46.2	16.2	29.76	1.06	6.79	18.8	D 19-42
33.0	150.4	104.2	46.2	16.5	29.25	0.96	6.83	18.9	D 19-42
33.5	152.6	106.4	46.2	17.0	29.07	0.92	6.87	18.8	D 19-42
34.0	154.8	108.6	46.2	17.1	29.48	0.99	6.88	18.8	D 19-42
34.5	157.1	110.9	46.2	16.4	29.11	1.12	6.82	18.9	D 19-42
35.0	159.4	113.2	46.2	16.8	29.36	1.19	6.85	18.9	D 19-42
35.5	161.7	115.5	46.2	17.2	29.57	1.25	6.89	18.8	D 19-42
36.0	164.1	117.9	46.2	18.4	30.41	1.06	7.00	18.9	D 19-42
36.5	166.5	120.3	46.2	18.9	29.89	1.04	7.05	18.8	D 19-42
37.0	168.9	122.7	46.2	19.4	30.05	1.04	7.08	18.8	D 19-42
37.5	171.4	125.2	46.2	18.4	29.86	1.11	7.00	18.9	D 19-42
38.0	173.9	127.7	46.2	18.8	30.07	1.12	7.04	18.9	D 19-42
38.5	176.4	130.2	46.2	19.1	30.33	1.12	7.06	18.9	D 19-42
39.0	179.0	132.8	46.2	20.5	31.25	0.99	7.17	18.8	D 19-42
39.5	181.6	135.4	46.2	21.0	30.71	0.86	7.20	18.7	D 19-42
40.0	184.2	138.0	46.2	21.5	30.62	0.80	7.25	18.6	D 19-42

## Rear Abutment Calculations + 16-in DLZ OHIO

40.5	186.9	140.7	46.2	21.6	31.02	0.79	7.25	18.7	D 19-42
41.0	189.6	143.4	46.2	21.1	30.54	0.87	7.22	18.7	D 19-42
41.5	192.4	146.2	46.2	21.4	30.78	0.86	7.24	18.8	D 19-42
42.0	195.1	148.9	46.2	21.8	31.00	0.83	7.26	18.7	D 19-42
42.5	197.9	151.7	46.2	23.4	31.44	0.59	7.36	18.4	D 19-42
43.0	200.8	154.6	46.2	23.9	31.15	0.53	7.38	18.5	D 19-42
43.5	203.7	157.5	46.2	24.5	31.32	0.52	7.41	18.5	D 19-42
44.0	206.6	160.4	46.2	23.6	31.01	0.58	7.37	18.5	D 19-42
44.5	209.5	163.3	46.2	23.9	31.17	0.61	7.39	18.6	D 19-42
45.0	212.5	166.3	46.2	24.5	31.35	0.63	7.42	18.5	D 19-42
45.5	215.5	169.3	46.2	26.0	32.22	0.49	7.50	18.3	D 19-42
46.0	218.5	172.3	46.2	26.4	31.69	0.41	7.52	18.4	D 19-42
46.5	221.6	175.4	46.2	27.2	31.86	0.40	7.56	18.2	D 19-42
47.0	224.7	178.5	46.2	27.2	32.30	0.42	7.56	18.3	D 19-42
47.5	227.8	181.6	46.2	26.6	31.69	0.49	7.54	18.4	D 19-42
48.0	231.0	184.8	46.2	27.1	31.84	0.51	7.56	18.4	D 19-42
48.5	234.2	188.0	46.2	27.5	32.01	0.52	7.58	18.4	D 19-42
49.0	237.5	191.3	46.2	29.5	32.46	0.24	7.67	18.2	D 19-42
49.5	298.0	195.1	102.8	50.2	33.94	0.33	8.19	18.9	D 19-42
50.0	302.0	199.2	102.8	52.8	34.20	0.32	8.22	18.7	D 19-42
50.5	306.1	203.3	102.8	49.9	33.85	0.38	8.20	19.0	D 19-42
51.0	310.2	207.4	102.8	51.4	33.93	0.38	8.22	19.0	D 19-42
51.5	314.4	211.6	102.8	53.3	34.06	0.38	8.25	18.9	D 19-42
52.0	318.6	215.8	102.8	59.6	34.50	0.21	8.29	18.6	D 19-42
52.5	322.9	220.1	102.8	62.5	34.33	0.00	8.30	18.4	D 19-42
53.0	327.2	224.4	102.8	65.5	34.64	0.00	8.32	18.2	D 19-42

G/L at Shaft and Toe: 0.900/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Bl Ct b/ft	Mx C-Str ksi	Mx T-Str ksi	Stroke ft	ENTHRU kip-ft	Hammer -
0.5	21.2	2.3	18.8	1.7	12.15	0.00	3.99	26.2	D 19-42
1.0	23.5	4.6	18.8	2.0	13.29	0.00	4.10	25.5	D 19-42
1.5	25.8	7.0	18.8	2.2	14.57	0.21	4.19	25.2	D 19-42
2.0	9.4	7.4	2.0	0.0	0.00	0.00	0.00	0.0	D 19-42
2.5	10.0	7.5	2.5	0.0	0.00	0.00	0.00	0.0	D 19-42
3.0	10.6	7.6	3.0	0.0	0.00	0.00	0.00	0.0	D 19-42
3.5	11.2	7.7	3.5	1.0	2.86	0.00	3.09	13.9	D 19-42
4.0	11.7	7.7	4.0	1.1	3.06	0.00	3.16	13.3	D 19-42
4.5	12.2	7.8	4.5	1.2	3.26	0.00	3.24	12.8	D 19-42
5.0	13.2	8.3	5.0	1.3	3.26	0.05	3.23	12.4	D 19-42
5.5	14.0	8.5	5.5	1.5	3.38	0.07	3.28	11.9	D 19-42
6.0	14.7	8.7	6.0	1.6	3.49	0.09	3.34	11.4	D 19-42

## Rear Abutment Calculations + 16-in DLZ OHIO

6.5	15.4	9.0	6.4	1.1	10.19	0.00	3.60	27.8	D 19-42
7.0	37.2	12.1	25.1	3.2	17.44	0.64	4.57	23.7	D 19-42
7.5	41.1	15.9	25.1	3.6	18.29	0.78	4.69	23.3	D 19-42
8.0	45.3	20.2	25.1	3.9	18.85	0.99	4.78	23.0	D 19-42
8.5	49.2	24.1	25.1	4.2	19.46	0.97	4.87	22.7	D 19-42
9.0	53.0	27.8	25.1	4.6	20.06	1.15	4.96	22.5	D 19-42
9.5	56.7	31.6	25.1	4.9	20.65	1.33	5.06	22.2	D 19-42
10.0	59.8	34.7	25.1	5.7	21.75	1.04	5.27	21.7	D 19-42
10.5	63.7	38.5	25.1	6.2	22.38	1.26	5.37	21.5	D 19-42
11.0	67.5	42.4	25.1	6.6	22.99	1.27	5.46	21.3	D 19-42
11.5	71.8	46.7	25.1	6.9	23.31	1.36	5.53	21.2	D 19-42
12.0	65.9	48.6	17.2	5.7	21.91	1.14	5.24	21.8	D 19-42
12.5	67.0	49.2	17.7	5.8	22.06	1.14	5.27	21.8	D 19-42
13.0	68.1	49.9	18.2	5.9	22.23	1.43	5.30	21.7	D 19-42
13.5	68.4	49.8	18.6	6.5	22.91	1.20	5.43	21.4	D 19-42
14.0	68.9	50.3	18.6	6.6	23.13	1.16	5.46	21.3	D 19-42
14.5	69.9	51.3	18.6	6.6	23.14	1.20	5.45	21.3	D 19-42
15.0	71.4	52.8	18.6	6.2	22.85	1.47	5.36	21.5	D 19-42
15.5	72.1	53.5	18.6	6.3	22.97	1.46	5.37	21.5	D 19-42
16.0	72.9	54.3	18.6	6.3	23.10	1.46	5.39	21.5	D 19-42
16.5	73.0	54.4	18.6	6.9	23.45	1.14	5.51	21.2	D 19-42
17.0	73.8	55.2	18.6	7.0	23.54	1.08	5.54	21.1	D 19-42
17.5	74.5	55.9	18.6	7.1	23.81	1.02	5.56	21.1	D 19-42
18.0	75.8	57.2	18.6	7.1	23.76	1.08	5.56	21.0	D 19-42
18.5	77.4	58.8	18.6	6.7	23.51	1.33	5.47	21.3	D 19-42
19.0	78.4	59.8	18.6	6.8	23.65	1.33	5.49	21.3	D 19-42
19.5	79.3	60.7	18.6	6.9	23.72	1.34	5.51	21.2	D 19-42
20.0	79.6	61.0	18.6	7.6	23.77	1.22	5.64	20.7	D 19-42
20.5	80.5	61.9	18.6	7.7	24.02	1.20	5.67	20.6	D 19-42
21.0	81.8	63.2	18.6	7.7	24.15	1.24	5.67	20.6	D 19-42
21.5	83.6	65.0	18.6	7.3	23.99	1.42	5.58	21.0	D 19-42
22.0	84.7	66.1	18.6	7.4	24.13	1.44	5.60	21.0	D 19-42
22.5	85.9	67.3	18.6	7.5	24.28	1.46	5.62	20.9	D 19-42
23.0	86.3	67.7	18.6	8.2	24.58	1.39	5.75	20.5	D 19-42
23.5	87.4	68.8	18.6	8.3	24.55	1.44	5.78	20.5	D 19-42
24.0	88.5	69.9	18.6	8.5	24.77	1.51	5.81	20.4	D 19-42
24.5	90.1	71.5	18.6	8.5	25.05	1.58	5.81	20.4	D 19-42
25.0	92.0	73.4	18.6	8.1	24.58	1.57	5.74	20.6	D 19-42
25.5	93.4	74.8	18.6	8.3	24.71	1.76	5.77	20.5	D 19-42
26.0	94.7	76.1	18.6	8.4	24.88	1.91	5.79	20.4	D 19-42
26.5	95.2	76.6	18.6	9.1	25.14	1.91	5.90	20.2	D 19-42
27.0	96.5	77.9	18.6	9.2	25.36	1.95	5.93	20.1	D 19-42

## Rear Abutment Calculations + 16-in DLZ OHIO

27.5	98.2	79.6	18.6	9.3	25.66	2.05	5.94	20.1	D 19-42
28.0	100.3	81.7	18.6	8.9	25.22	2.31	5.88	20.2	D 19-42
28.5	101.8	83.2	18.6	9.1	25.41	2.28	5.90	20.2	D 19-42
29.0	103.3	84.7	18.6	9.2	25.53	2.22	5.92	20.1	D 19-42
29.5	132.0	85.8	46.2	13.8	28.10	1.10	6.55	19.4	D 19-42
30.0	133.8	87.6	46.2	14.1	27.79	1.04	6.59	19.3	D 19-42
30.5	135.7	89.5	46.2	14.4	28.03	1.04	6.62	19.3	D 19-42
31.0	138.0	91.8	46.2	14.5	28.40	1.08	6.64	19.3	D 19-42
31.5	140.8	94.6	46.2	14.1	28.04	1.13	6.59	19.4	D 19-42
32.0	142.9	96.7	46.2	14.4	28.20	1.17	6.62	19.3	D 19-42
32.5	144.3	98.1	46.2	15.3	29.03	1.09	6.72	19.2	D 19-42
33.0	146.4	100.2	46.2	15.6	28.58	1.01	6.75	19.2	D 19-42
33.5	148.5	102.2	46.2	16.0	28.64	0.98	6.79	19.2	D 19-42
34.0	151.0	104.8	46.2	16.2	28.97	0.96	6.81	19.1	D 19-42
34.5	153.9	107.7	46.2	15.7	28.63	1.08	6.76	19.2	D 19-42
35.0	156.2	110.0	46.2	16.1	28.83	1.15	6.80	19.1	D 19-42
35.5	158.5	112.3	46.2	16.4	29.08	1.25	6.83	19.2	D 19-42
36.0	160.1	113.9	46.2	17.3	29.73	1.07	6.92	19.3	D 19-42
36.5	162.4	116.2	46.2	17.8	29.49	1.09	6.96	19.3	D 19-42
37.0	164.7	118.5	46.2	18.3	29.71	1.08	7.00	19.2	D 19-42
37.5	168.2	122.0	46.2	17.8	29.24	1.13	6.95	19.1	D 19-42
38.0	170.7	124.5	46.2	18.1	29.43	1.14	6.98	19.1	D 19-42
38.5	173.3	127.1	46.2	18.3	29.83	1.15	7.01	19.3	D 19-42
39.0	175.1	128.9	46.2	19.5	30.58	1.06	7.11	19.1	D 19-42
39.5	177.6	131.4	46.2	19.9	30.12	0.92	7.14	19.1	D 19-42
40.0	180.1	133.9	46.2	20.4	30.29	0.89	7.17	19.0	D 19-42
40.5	183.1	136.9	46.2	20.6	30.62	0.88	7.19	19.0	D 19-42
41.0	186.4	140.2	46.2	20.1	30.19	0.94	7.15	19.2	D 19-42
41.5	189.2	143.0	46.2	20.6	30.31	0.93	7.19	19.1	D 19-42
42.0	192.0	145.8	46.2	20.9	30.49	0.91	7.22	19.1	D 19-42
42.5	194.0	147.8	46.2	22.2	30.85	0.70	7.30	18.9	D 19-42
43.0	196.7	150.5	46.2	22.7	30.86	0.65	7.33	18.8	D 19-42
43.5	199.4	153.2	46.2	23.3	31.04	0.59	7.36	18.8	D 19-42
44.0	203.4	157.2	46.2	22.6	30.75	0.60	7.32	18.9	D 19-42
44.5	206.3	160.1	46.2	22.9	30.87	0.61	7.34	19.0	D 19-42
45.0	209.3	163.1	46.2	23.4	30.96	0.61	7.38	18.8	D 19-42
45.5	211.6	165.4	46.2	24.8	31.57	0.49	7.45	18.7	D 19-42
46.0	214.5	168.3	46.2	25.3	31.42	0.41	7.48	18.6	D 19-42
46.5	217.5	171.2	46.2	25.8	31.59	0.41	7.50	18.6	D 19-42
47.0	220.9	174.7	46.2	26.0	31.93	0.43	7.52	18.6	D 19-42
47.5	224.7	178.5	46.2	25.6	31.46	0.50	7.49	18.7	D 19-42
48.0	227.8	181.6	46.2	26.0	31.56	0.51	7.52	18.7	D 19-42

## Rear Abutment Calculations + 16-in DLZ OHIO

48.5	231.1	184.9	46.2	26.4	31.66	0.53	7.54	18.8	D 19-42
49.0	233.5	187.3	46.2	28.0	32.02	0.26	7.62	18.5	D 19-42
49.5	293.9	191.0	102.8	46.7	33.76	0.34	8.16	19.3	D 19-42
50.0	297.8	195.0	102.8	48.5	34.01	0.34	8.18	19.2	D 19-42
50.5	302.9	200.1	102.8	47.0	33.69	0.38	8.18	19.3	D 19-42
51.0	307.0	204.2	102.8	48.5	33.77	0.38	8.20	19.3	D 19-42
51.5	311.2	208.4	102.8	50.1	33.84	0.39	8.23	19.3	D 19-42
52.0	314.7	211.9	102.8	54.2	34.37	0.24	8.26	19.2	D 19-42
52.5	318.9	216.0	102.8	56.7	34.36	0.01	8.28	19.0	D 19-42
53.0	323.0	220.2	102.8	58.9	34.60	0.00	8.29	18.8	D 19-42

G/L at Shaft and Toe: 0.800/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Bl Ct b/ft	Mx C-Str ksi	Mx T-Str ksi	Stroke ft	ENTHRU kip-ft	Hammer -
0.5	20.9	2.1	18.8	1.7	12.15	0.00	3.98	26.3	D 19-42
1.0	23.0	4.1	18.8	1.9	13.14	0.00	4.08	26.0	D 19-42
1.5	25.0	6.2	18.8	2.1	13.99	0.00	4.18	25.4	D 19-42
2.0	8.6	6.6	2.0	0.0	0.00	0.00	0.00	0.0	D 19-42
2.5	9.2	6.7	2.5	0.0	0.00	0.00	0.00	0.0	D 19-42
3.0	9.8	6.8	3.0	0.0	0.00	0.00	0.00	0.0	D 19-42
3.5	10.4	6.9	3.5	0.0	0.00	0.00	0.00	0.0	D 19-42
4.0	10.9	6.9	4.0	1.0	2.89	0.00	3.11	14.0	D 19-42
4.5	11.5	7.0	4.5	1.1	3.08	0.00	3.18	13.4	D 19-42
5.0	12.5	7.5	5.0	1.2	3.13	0.01	3.18	12.8	D 19-42
5.5	13.2	7.7	5.5	1.3	3.28	0.04	3.24	12.5	D 19-42
6.0	13.9	8.0	6.0	1.4	3.38	0.07	3.29	11.9	D 19-42
6.5	14.7	8.2	6.4	1.6	3.49	0.09	3.35	11.5	D 19-42
7.0	36.1	11.0	25.1	3.1	16.87	0.58	4.56	23.8	D 19-42
7.5	39.6	14.4	25.1	3.4	17.80	0.72	4.65	23.6	D 19-42
8.0	43.4	18.2	25.1	3.7	18.37	0.84	4.73	23.4	D 19-42
8.5	46.8	21.7	25.1	4.0	18.92	1.05	4.82	23.1	D 19-42
9.0	50.2	25.1	25.1	4.3	19.40	1.03	4.90	22.8	D 19-42
9.5	53.5	28.4	25.1	4.6	19.93	1.18	4.98	22.5	D 19-42
10.0	56.2	31.1	25.1	5.3	20.95	1.08	5.17	22.1	D 19-42
10.5	59.6	34.5	25.1	5.7	21.55	1.04	5.27	21.9	D 19-42
11.0	63.1	37.9	25.1	6.0	22.14	1.08	5.35	21.7	D 19-42
11.5	66.9	41.8	25.1	6.3	22.46	1.35	5.42	21.6	D 19-42
12.0	60.9	43.7	17.2	5.2	20.87	1.23	5.12	22.3	D 19-42
12.5	62.0	44.3	17.7	5.3	21.06	1.26	5.15	22.2	D 19-42
13.0	63.2	44.9	18.2	5.4	21.26	1.18	5.18	22.1	D 19-42
13.5	63.4	44.8	18.6	5.9	21.94	0.93	5.31	21.8	D 19-42
14.0	64.0	45.4	18.6	6.0	22.17	1.14	5.33	21.8	D 19-42

## Rear Abutment Calculations + 16-in DLZ OHIO

14.5	65.0	46.4	18.6	6.0	22.21	1.25	5.33	21.8	D 19-42
15.0	66.4	47.8	18.6	5.7	21.90	1.05	5.24	22.0	D 19-42
15.5	67.2	48.6	18.6	5.8	22.05	1.08	5.26	21.9	D 19-42
16.0	68.0	49.4	18.6	5.8	22.19	1.24	5.28	21.9	D 19-42
16.5	68.1	49.5	18.6	6.3	22.56	1.22	5.39	21.6	D 19-42
17.0	68.8	50.2	18.6	6.4	22.75	1.18	5.42	21.5	D 19-42
17.5	69.6	51.0	18.6	6.5	22.97	1.14	5.44	21.5	D 19-42
18.0	70.8	52.2	18.6	6.5	22.96	1.19	5.44	21.5	D 19-42
18.5	72.4	53.8	18.6	6.2	22.70	1.47	5.36	21.7	D 19-42
19.0	73.4	54.8	18.6	6.3	22.86	1.46	5.38	21.7	D 19-42
19.5	74.4	55.8	18.6	6.4	22.95	1.44	5.40	21.6	D 19-42
20.0	74.6	56.0	18.6	6.9	23.20	1.06	5.52	21.3	D 19-42
20.5	75.5	56.9	18.6	7.0	23.44	1.03	5.55	21.3	D 19-42
21.0	76.9	58.3	18.6	7.0	23.49	1.14	5.55	21.2	D 19-42
21.5	78.6	60.0	18.6	6.7	23.30	1.30	5.48	21.4	D 19-42
22.0	79.8	61.2	18.6	6.8	23.45	1.33	5.50	21.3	D 19-42
22.5	80.9	62.3	18.6	6.9	23.58	1.37	5.52	21.3	D 19-42
23.0	81.3	62.7	18.6	7.5	23.71	1.29	5.64	20.9	D 19-42
23.5	82.4	63.8	18.6	7.6	23.77	1.29	5.67	20.9	D 19-42
24.0	83.5	64.9	18.6	7.8	23.98	1.30	5.70	20.7	D 19-42
24.5	85.1	66.5	18.6	7.8	24.21	1.38	5.71	20.8	D 19-42
25.0	87.1	68.5	18.6	7.4	23.99	1.38	5.63	21.1	D 19-42
25.5	88.4	69.8	18.6	7.6	24.15	1.41	5.65	21.1	D 19-42
26.0	89.7	71.1	18.6	7.8	24.10	1.45	5.69	20.8	D 19-42
26.5	90.3	71.7	18.6	8.4	24.43	1.48	5.80	20.6	D 19-42
27.0	91.5	72.9	18.6	8.6	24.65	1.63	5.83	20.6	D 19-42
27.5	93.3	74.7	18.6	8.6	24.93	1.83	5.84	20.5	D 19-42
28.0	95.4	76.8	18.6	8.3	24.54	2.04	5.78	20.7	D 19-42
28.5	96.8	78.2	18.6	8.5	24.68	2.18	5.81	20.6	D 19-42
29.0	98.3	79.7	18.6	8.6	24.86	2.28	5.84	20.6	D 19-42
29.5	127.0	80.8	46.2	13.0	27.34	1.12	6.46	19.6	D 19-42
30.0	128.9	82.7	46.2	13.3	27.25	1.11	6.50	19.6	D 19-42
30.5	130.7	84.5	46.2	13.5	27.46	1.09	6.52	19.6	D 19-42
31.0	133.1	86.9	46.2	13.7	27.77	1.09	6.54	19.6	D 19-42
31.5	135.8	89.6	46.2	13.3	27.41	1.13	6.50	19.7	D 19-42
32.0	137.9	91.7	46.2	13.5	27.55	1.13	6.53	19.6	D 19-42
32.5	139.3	93.1	46.2	14.3	28.27	1.06	6.62	19.5	D 19-42
33.0	141.4	95.2	46.2	14.7	27.92	1.00	6.66	19.5	D 19-42
33.5	143.5	97.3	46.2	15.0	28.14	1.01	6.69	19.5	D 19-42
34.0	146.0	99.8	46.2	15.2	28.41	1.03	6.72	19.4	D 19-42
34.5	148.9	102.7	46.2	14.8	28.03	1.14	6.67	19.6	D 19-42
35.0	151.2	105.0	46.2	15.1	28.20	1.16	6.71	19.5	D 19-42

## Rear Abutment Calculations + 16-in DLZ OHIO

35.5	153.6	107.4	46.2	15.5	28.38	1.16	6.75	19.4	D 19-42
36.0	155.2	109.0	46.2	16.4	28.82	1.01	6.84	19.4	D 19-42
36.5	157.5	111.3	46.2	16.8	28.85	1.06	6.87	19.4	D 19-42
37.0	159.8	113.6	46.2	17.2	29.05	1.08	6.92	19.3	D 19-42
37.5	163.3	117.1	46.2	16.7	28.75	1.16	6.87	19.4	D 19-42
38.0	165.8	119.6	46.2	17.1	28.89	1.15	6.90	19.4	D 19-42
38.5	168.3	122.1	46.2	17.4	29.03	1.14	6.93	19.4	D 19-42
39.0	170.1	123.9	46.2	18.5	29.69	1.07	7.03	19.3	D 19-42
39.5	172.6	126.4	46.2	18.8	29.73	0.94	7.06	19.4	D 19-42
40.0	175.1	128.9	46.2	19.2	29.89	0.93	7.10	19.3	D 19-42
40.5	178.1	131.9	46.2	19.5	30.21	0.94	7.11	19.4	D 19-42
41.0	181.5	135.3	46.2	19.2	29.58	0.99	7.09	19.3	D 19-42
41.5	184.2	138.0	46.2	19.4	29.90	1.00	7.11	19.5	D 19-42
42.0	187.0	140.8	46.2	19.8	30.02	0.99	7.14	19.5	D 19-42
42.5	189.0	142.8	46.2	20.9	30.32	0.80	7.23	19.3	D 19-42
43.0	191.7	145.5	46.2	21.3	30.52	0.76	7.25	19.3	D 19-42
43.5	194.5	148.3	46.2	21.9	30.67	0.71	7.29	19.2	D 19-42
44.0	198.4	152.2	46.2	21.3	30.40	0.67	7.26	19.3	D 19-42
44.5	201.4	155.2	46.2	21.8	30.50	0.65	7.28	19.3	D 19-42
45.0	204.3	158.1	46.2	22.2	30.59	0.63	7.31	19.2	D 19-42
45.5	206.6	160.4	46.2	23.4	31.10	0.45	7.38	19.1	D 19-42
46.0	209.5	163.3	46.2	24.0	31.07	0.40	7.41	19.0	D 19-42
46.5	212.5	166.3	46.2	24.4	31.30	0.41	7.44	19.1	D 19-42
47.0	215.9	169.7	46.2	24.7	31.55	0.43	7.46	19.0	D 19-42
47.5	219.7	173.5	46.2	24.4	31.13	0.50	7.44	19.0	D 19-42
48.0	222.9	176.7	46.2	24.8	31.23	0.51	7.47	19.0	D 19-42
48.5	226.1	179.9	46.2	25.2	31.33	0.52	7.49	19.0	D 19-42
49.0	228.6	182.4	46.2	26.6	31.69	0.29	7.56	18.9	D 19-42
49.5	288.9	186.1	102.8	43.8	33.48	0.34	8.13	19.5	D 19-42
50.0	292.8	190.0	102.8	45.2	33.67	0.35	8.15	19.5	D 19-42
50.5	298.0	195.1	102.8	44.1	33.41	0.39	8.15	19.6	D 19-42
51.0	302.1	199.3	102.8	45.1	33.51	0.39	8.17	19.7	D 19-42
51.5	306.3	203.4	102.8	46.2	33.60	0.39	8.19	19.7	D 19-42
52.0	309.8	206.9	102.8	49.9	34.07	0.27	8.23	19.6	D 19-42
52.5	313.9	211.1	102.8	51.8	34.07	0.07	8.24	19.4	D 19-42
53.0	318.1	215.3	102.8	54.4	34.28	0.00	8.27	19.2	D 19-42

G/L at Shaft and Toe: 0.700/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Bl Ct b/ft	Mx C-Str ksi	Mx T-Str ksi	Stroke ft	ENTHRU kip-ft	Hammer -
0.5	20.7	1.8	18.8	1.7	12.14	0.00	3.98	26.5	D 19-42
1.0	22.5	3.6	18.8	1.8	12.83	0.00	4.06	26.2	D 19-42

Rear Abutment Calculations + 16-in DLZ OHIO

1.5	24.3	5.4	18.8	2.0	13.70	0.00	4.14	25.8	D 19-42
2.0	7.9	5.9	2.0	0.0	0.00	0.00	0.00	0.0	D 19-42
2.5	8.4	6.0	2.5	0.0	0.00	0.00	0.00	0.0	D 19-42
3.0	9.1	6.1	3.0	0.0	0.00	0.00	0.00	0.0	D 19-42
3.5	9.6	6.1	3.5	0.0	0.00	0.00	0.00	0.0	D 19-42
4.0	10.1	6.2	4.0	0.0	0.00	0.00	0.00	0.0	D 19-42
4.5	10.7	6.2	4.5	0.9	2.89	0.00	3.13	14.2	D 19-42
5.0	11.7	6.7	5.0	1.0	2.97	0.00	3.14	13.5	D 19-42
5.5	12.4	7.0	5.5	1.2	3.13	0.01	3.19	12.9	D 19-42
6.0	13.1	7.2	6.0	1.3	3.29	0.04	3.25	12.5	D 19-42
6.5	13.9	7.4	6.4	1.5	3.38	0.06	3.30	11.9	D 19-42
7.0	35.0	9.9	25.1	3.0	16.54	0.52	4.53	24.1	D 19-42
7.5	38.0	12.9	25.1	3.3	17.34	0.71	4.62	23.9	D 19-42
8.0	41.4	16.3	25.1	3.5	17.89	0.81	4.68	23.7	D 19-42
8.5	44.5	19.3	25.1	3.8	18.39	0.79	4.76	23.4	D 19-42
9.0	47.4	22.3	25.1	4.0	18.84	1.05	4.83	23.1	D 19-42
9.5	50.3	25.2	25.1	4.3	19.27	1.04	4.90	22.9	D 19-42
10.0	52.6	27.4	25.1	4.9	20.14	0.96	5.07	22.5	D 19-42
10.5	55.6	30.4	25.1	5.2	20.69	1.10	5.16	22.3	D 19-42
11.0	58.6	33.5	25.1	5.5	21.22	1.06	5.24	22.1	D 19-42
11.5	62.1	36.9	25.1	5.8	21.60	1.04	5.29	22.0	D 19-42
12.0	55.9	38.7	17.2	4.7	19.83	1.07	5.00	22.7	D 19-42
12.5	57.1	39.3	17.7	4.8	19.99	1.04	5.03	22.6	D 19-42
13.0	58.2	40.0	18.2	4.9	20.18	1.00	5.06	22.5	D 19-42
13.5	58.4	39.8	18.6	5.4	20.85	1.05	5.18	22.3	D 19-42
14.0	59.0	40.4	18.6	5.5	21.07	1.05	5.20	22.2	D 19-42
14.5	60.0	41.4	18.6	5.5	21.12	1.06	5.21	22.2	D 19-42
15.0	61.4	42.8	18.6	5.2	20.83	1.19	5.13	22.4	D 19-42
15.5	62.2	43.6	18.6	5.3	20.99	1.18	5.14	22.4	D 19-42
16.0	63.0	44.4	18.6	5.3	21.15	1.12	5.16	22.3	D 19-42
16.5	63.1	44.5	18.6	5.7	21.60	0.86	5.27	22.1	D 19-42
17.0	63.8	45.2	18.6	5.8	21.84	0.86	5.29	22.0	D 19-42
17.5	64.6	46.0	18.6	5.9	22.06	1.21	5.32	21.9	D 19-42
18.0	65.9	47.3	18.6	5.9	22.09	1.25	5.32	21.9	D 19-42
18.5	67.5	48.9	18.6	5.7	21.84	1.01	5.25	22.0	D 19-42
19.0	68.4	49.8	18.6	5.7	22.01	1.08	5.27	22.1	D 19-42
19.5	69.4	50.8	18.6	5.8	22.11	1.22	5.29	22.0	D 19-42
20.0	69.6	51.0	18.6	6.3	22.43	1.23	5.40	21.7	D 19-42
20.5	70.6	52.0	18.6	6.4	22.65	1.19	5.43	21.7	D 19-42
21.0	71.9	53.3	18.6	6.4	22.72	1.23	5.43	21.7	D 19-42
21.5	73.7	55.1	18.6	6.1	22.54	1.45	5.37	21.8	D 19-42
22.0	74.8	56.2	18.6	6.2	22.70	1.40	5.39	21.8	D 19-42

## Rear Abutment Calculations + 16-in DLZ OHIO

22.5	75.9	57.3	18.6	6.4	22.86	1.34	5.41	21.7	D 19-42
23.0	76.4	57.8	18.6	6.8	23.19	1.08	5.52	21.4	D 19-42
23.5	77.5	58.9	18.6	7.0	23.20	1.17	5.55	21.4	D 19-42
24.0	78.6	60.0	18.6	7.1	23.43	1.22	5.58	21.4	D 19-42
24.5	80.1	61.5	18.6	7.1	23.58	1.30	5.58	21.3	D 19-42
25.0	82.1	63.5	18.6	6.9	23.33	1.45	5.52	21.5	D 19-42
25.5	83.4	64.8	18.6	7.0	23.49	1.49	5.55	21.4	D 19-42
26.0	84.7	66.1	18.6	7.1	23.59	1.43	5.58	21.4	D 19-42
26.5	85.3	66.7	18.6	7.7	23.78	1.31	5.69	21.0	D 19-42
27.0	86.6	68.0	18.6	7.9	23.90	1.34	5.72	20.9	D 19-42
27.5	88.3	69.7	18.6	7.9	24.15	1.39	5.73	20.9	D 19-42
28.0	90.4	71.8	18.6	7.6	24.00	1.36	5.67	21.2	D 19-42
28.5	91.9	73.3	18.6	7.8	24.18	1.60	5.70	21.2	D 19-42
29.0	93.4	74.8	18.6	7.9	24.38	1.80	5.73	21.1	D 19-42
29.5	122.1	75.9	46.2	12.2	26.63	1.07	6.37	19.9	D 19-42
30.0	123.9	77.7	46.2	12.5	26.71	1.07	6.40	19.8	D 19-42
30.5	125.8	79.6	46.2	12.7	26.90	1.10	6.43	19.9	D 19-42
31.0	128.1	81.9	46.2	12.8	27.16	1.15	6.45	19.8	D 19-42
31.5	130.9	84.7	46.2	12.6	26.79	1.25	6.42	19.8	D 19-42
32.0	133.0	86.8	46.2	12.8	26.94	1.23	6.44	19.9	D 19-42
32.5	134.4	88.2	46.2	13.5	27.54	1.03	6.53	19.8	D 19-42
33.0	136.5	90.3	46.2	13.8	27.42	0.95	6.57	19.7	D 19-42
33.5	138.5	92.3	46.2	14.1	27.61	0.98	6.60	19.7	D 19-42
34.0	141.1	94.9	46.2	14.2	27.88	1.03	6.62	19.8	D 19-42
34.5	144.0	97.8	46.2	14.0	27.52	1.12	6.60	19.8	D 19-42
35.0	146.3	100.1	46.2	14.3	27.65	1.17	6.63	19.7	D 19-42
35.5	148.6	102.4	46.2	14.6	27.79	1.21	6.66	19.7	D 19-42
36.0	150.2	104.0	46.2	15.4	28.16	1.00	6.75	19.6	D 19-42
36.5	152.5	106.3	46.2	15.7	28.37	0.97	6.78	19.6	D 19-42
37.0	154.8	108.6	46.2	16.1	28.54	1.02	6.82	19.6	D 19-42
37.5	158.3	112.1	46.2	15.7	28.29	1.14	6.78	19.7	D 19-42
38.0	160.8	114.6	46.2	16.1	28.41	1.16	6.82	19.6	D 19-42
38.5	163.3	117.1	46.2	16.5	28.55	1.17	6.86	19.6	D 19-42
39.0	165.2	119.0	46.2	17.4	29.12	1.08	6.94	19.5	D 19-42
39.5	167.7	121.5	46.2	17.8	29.10	0.93	6.98	19.5	D 19-42
40.0	170.2	124.0	46.2	18.1	29.46	0.93	7.01	19.7	D 19-42
40.5	173.2	127.0	46.2	18.3	29.75	0.95	7.03	19.7	D 19-42
41.0	176.5	130.3	46.2	18.2	29.16	1.00	7.01	19.5	D 19-42
41.5	179.3	133.1	46.2	18.4	29.48	1.03	7.04	19.7	D 19-42
42.0	182.0	135.8	46.2	18.8	29.59	1.03	7.07	19.7	D 19-42
42.5	184.1	137.9	46.2	19.8	29.93	0.87	7.15	19.6	D 19-42
43.0	186.8	140.6	46.2	20.3	30.12	0.82	7.19	19.5	D 19-42

## Rear Abutment Calculations + 16-in DLZ OHIO

43.5	189.5	143.3	46.2	20.6	30.28	0.81	7.21	19.6	D 19-42
44.0	193.5	147.3	46.2	20.3	30.02	0.77	7.19	19.5	D 19-42
44.5	196.4	150.2	46.2	20.6	30.11	0.73	7.21	19.6	D 19-42
45.0	199.4	153.2	46.2	21.1	30.21	0.71	7.25	19.5	D 19-42
45.5	201.7	155.5	46.2	22.0	30.71	0.56	7.31	19.5	D 19-42
46.0	204.6	158.4	46.2	22.6	30.73	0.38	7.34	19.4	D 19-42
46.5	207.5	161.3	46.2	23.1	30.91	0.39	7.37	19.4	D 19-42
47.0	210.9	164.7	46.2	23.4	31.17	0.42	7.39	19.3	D 19-42
47.5	214.7	168.5	46.2	23.2	30.78	0.55	7.38	19.4	D 19-42
48.0	217.9	171.7	46.2	23.6	30.86	0.54	7.40	19.4	D 19-42
48.5	221.1	174.9	46.2	24.1	30.97	0.52	7.43	19.3	D 19-42
49.0	223.6	177.4	46.2	25.1	31.37	0.30	7.49	19.3	D 19-42
49.5	283.9	181.1	102.8	40.8	33.08	0.37	8.08	19.8	D 19-42
50.0	287.9	185.0	102.8	42.2	33.33	0.36	8.11	19.8	D 19-42
50.5	293.0	190.2	102.8	41.2	33.08	0.50	8.10	20.0	D 19-42
51.0	297.1	194.3	102.8	42.3	33.19	0.49	8.13	20.0	D 19-42
51.5	301.3	198.5	102.8	43.4	33.32	0.47	8.16	20.0	D 19-42
52.0	304.8	202.0	102.8	46.4	33.69	0.29	8.20	19.9	D 19-42
52.5	308.9	206.1	102.8	48.2	33.73	0.13	8.22	19.7	D 19-42
53.0	313.1	210.3	102.8	49.9	33.98	0.11	8.24	19.6	D 19-42

## G/L at Shaft and Toe: 0.600/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Bl Ct b/ft	Mx C-Str ksi	Mx T-Str ksi	Stroke ft	ENTHRU kip-ft	Hammer -
0.5	20.4	1.5	18.8	1.6	12.21	0.00	3.97	26.6	D 19-42
1.0	21.9	3.1	18.8	1.8	12.73	0.00	4.04	26.4	D 19-42
1.5	23.5	4.6	18.8	1.9	13.09	0.00	4.12	25.9	D 19-42
2.0	7.1	5.1	2.0	0.0	0.00	0.00	0.00	0.0	D 19-42
2.5	7.7	5.2	2.5	0.0	0.00	0.00	0.00	0.0	D 19-42
3.0	8.3	5.3	3.0	0.0	0.00	0.00	0.00	0.0	D 19-42
3.5	8.8	5.4	3.5	0.0	0.00	0.00	0.00	0.0	D 19-42
4.0	9.4	5.4	4.0	0.0	0.00	0.00	0.00	0.0	D 19-42
4.5	9.9	5.4	4.5	0.0	0.00	0.00	0.00	0.0	D 19-42
5.0	10.9	6.0	5.0	0.0	0.00	0.00	0.00	0.0	D 19-42
5.5	11.6	6.2	5.5	1.0	2.97	0.00	3.14	13.6	D 19-42
6.0	12.4	6.4	6.0	1.2	3.14	0.00	3.19	12.9	D 19-42
6.5	13.1	6.7	6.4	1.3	3.31	0.03	3.26	12.5	D 19-42
7.0	33.9	8.8	25.1	2.9	16.28	0.47	4.50	24.3	D 19-42
7.5	36.5	11.4	25.1	3.1	16.95	0.61	4.57	24.1	D 19-42
8.0	39.5	14.4	25.1	3.3	17.37	0.74	4.64	23.9	D 19-42
8.5	42.1	17.0	25.1	3.6	17.88	0.83	4.71	23.7	D 19-42
9.0	44.6	19.5	25.1	3.8	18.31	0.78	4.77	23.5	D 19-42

## Rear Abutment Calculations + 16-in DLZ OHIO

9.5	47.1	22.0	25.1	4.0	18.67	1.07	4.83	23.3	D 19-42
10.0	48.9	23.8	25.1	4.5	19.35	0.89	4.97	22.8	D 19-42
10.5	51.5	26.4	25.1	4.8	19.84	0.98	5.04	22.7	D 19-42
11.0	54.1	29.0	25.1	5.0	20.31	1.07	5.12	22.5	D 19-42
11.5	57.2	32.1	25.1	5.2	20.63	1.23	5.17	22.4	D 19-42
12.0	51.0	33.7	17.2	4.2	18.94	0.98	4.87	23.1	D 19-42
12.5	52.1	34.4	17.7	4.3	19.11	1.01	4.90	23.1	D 19-42
13.0	53.2	35.0	18.2	4.4	19.27	1.09	4.93	23.0	D 19-42
13.5	53.5	34.9	18.6	4.8	19.75	0.88	5.04	22.7	D 19-42
14.0	54.1	35.5	18.6	4.9	19.93	0.86	5.06	22.6	D 19-42
14.5	55.1	36.5	18.6	4.9	20.00	0.90	5.07	22.6	D 19-42
15.0	56.5	37.9	18.6	4.7	19.74	0.99	5.00	22.8	D 19-42
15.5	57.3	38.7	18.6	4.8	19.90	0.94	5.02	22.8	D 19-42
16.0	58.1	39.5	18.6	4.8	20.04	0.91	5.04	22.7	D 19-42
16.5	58.2	39.6	18.6	5.2	20.53	1.02	5.14	22.5	D 19-42
17.0	58.9	40.3	18.6	5.3	20.77	1.06	5.16	22.4	D 19-42
17.5	59.6	41.0	18.6	5.4	21.01	1.03	5.19	22.4	D 19-42
18.0	60.9	42.3	18.6	5.4	21.07	1.00	5.19	22.4	D 19-42
18.5	62.5	43.9	18.6	5.2	20.88	1.10	5.13	22.5	D 19-42
19.0	63.5	44.9	18.6	5.3	21.05	1.02	5.15	22.4	D 19-42
19.5	64.4	45.8	18.6	5.3	21.21	0.94	5.17	22.4	D 19-42
20.0	64.7	46.1	18.6	5.7	21.59	0.80	5.27	22.2	D 19-42
20.5	65.6	47.0	18.6	5.8	21.84	1.13	5.30	22.1	D 19-42
21.0	66.9	48.3	18.6	5.9	21.92	1.23	5.31	22.1	D 19-42
21.5	68.7	50.1	18.6	5.6	21.75	1.12	5.25	22.2	D 19-42
22.0	69.8	51.2	18.6	5.7	21.92	1.22	5.28	22.2	D 19-42
22.5	71.0	52.4	18.6	5.8	22.09	1.30	5.30	22.1	D 19-42
23.0	71.4	52.8	18.6	6.2	22.52	1.26	5.40	21.9	D 19-42
23.5	72.5	53.9	18.6	6.4	22.56	1.25	5.43	21.8	D 19-42
24.0	73.6	55.0	18.6	6.5	22.81	1.15	5.46	21.7	D 19-42
24.5	75.2	56.6	18.6	6.6	22.87	1.06	5.47	21.7	D 19-42
25.0	77.2	58.6	18.6	6.3	22.75	1.24	5.41	21.9	D 19-42
25.5	78.5	59.9	18.6	6.4	22.92	1.29	5.44	21.8	D 19-42
26.0	79.8	61.2	18.6	6.6	23.02	1.33	5.47	21.7	D 19-42
26.5	80.4	61.8	18.6	7.0	23.39	1.29	5.56	21.5	D 19-42
27.0	81.6	63.0	18.6	7.2	23.48	1.31	5.60	21.4	D 19-42
27.5	83.3	64.7	18.6	7.2	23.59	1.31	5.61	21.4	D 19-42
28.0	85.4	66.8	18.6	7.0	23.47	1.29	5.56	21.5	D 19-42
28.5	86.9	68.3	18.6	7.2	23.65	1.25	5.59	21.5	D 19-42
29.0	88.4	69.8	18.6	7.3	23.84	1.27	5.62	21.4	D 19-42
29.5	117.1	70.9	46.2	11.5	26.16	1.10	6.27	20.2	D 19-42
30.0	118.9	72.7	46.2	11.7	26.18	1.08	6.30	20.2	D 19-42

## Rear Abutment Calculations + 16-in DLZ OHIO

30.5	120.8	74.6	46.2	12.0	26.33	1.06	6.33	20.1	D 19-42
31.0	123.2	77.0	46.2	12.1	26.56	1.08	6.36	20.0	D 19-42
31.5	125.9	79.7	46.2	11.9	26.25	1.22	6.33	20.1	D 19-42
32.0	128.0	81.8	46.2	12.1	26.44	1.25	6.36	20.1	D 19-42
32.5	129.4	83.2	46.2	12.7	26.95	1.15	6.44	20.0	D 19-42
33.0	131.5	85.3	46.2	12.9	26.94	1.02	6.47	20.0	D 19-42
33.5	133.6	87.4	46.2	13.2	27.09	0.95	6.51	20.0	D 19-42
34.0	136.1	89.9	46.2	13.4	27.35	0.99	6.53	20.0	D 19-42
34.5	139.0	92.8	46.2	13.2	27.01	1.12	6.51	20.0	D 19-42
35.0	141.3	95.1	46.2	13.5	27.16	1.16	6.54	20.0	D 19-42
35.5	143.7	97.5	46.2	13.8	27.33	1.21	6.57	20.0	D 19-42
36.0	145.3	99.1	46.2	14.5	27.69	1.04	6.66	19.9	D 19-42
36.5	147.5	101.3	46.2	14.8	27.84	1.01	6.70	19.8	D 19-42
37.0	149.8	103.6	46.2	15.1	28.04	1.02	6.73	19.9	D 19-42
37.5	153.3	107.1	46.2	14.8	27.79	1.16	6.70	19.9	D 19-42
38.0	155.8	109.6	46.2	15.2	27.94	1.19	6.73	19.9	D 19-42
38.5	158.4	112.2	46.2	15.5	28.08	1.20	6.77	19.8	D 19-42
39.0	160.2	114.0	46.2	16.3	28.58	1.10	6.85	19.7	D 19-42
39.5	162.7	116.5	46.2	16.7	28.64	0.96	6.89	19.8	D 19-42
40.0	165.2	119.0	46.2	17.2	28.81	0.93	6.93	19.7	D 19-42
40.5	168.2	122.0	46.2	17.4	29.06	0.93	6.95	19.7	D 19-42
41.0	171.6	125.4	46.2	17.2	28.74	0.96	6.93	19.8	D 19-42
41.5	174.3	128.1	46.2	17.5	28.88	0.99	6.97	19.8	D 19-42
42.0	177.1	130.9	46.2	17.9	28.98	1.03	7.00	19.7	D 19-42
42.5	179.1	132.9	46.2	18.6	29.54	0.92	7.07	19.9	D 19-42
43.0	181.8	135.6	46.2	19.1	29.69	0.85	7.10	19.8	D 19-42
43.5	184.6	138.4	46.2	19.6	29.87	0.85	7.14	19.8	D 19-42
44.0	188.5	142.3	46.2	19.2	29.64	0.84	7.11	19.9	D 19-42
44.5	191.4	145.2	46.2	19.6	29.75	0.80	7.14	19.9	D 19-42
45.0	194.4	148.2	46.2	20.0	29.86	0.77	7.17	19.8	D 19-42
45.5	196.7	150.5	46.2	20.9	30.26	0.68	7.25	19.7	D 19-42
46.0	199.6	153.4	46.2	21.4	30.30	0.49	7.28	19.7	D 19-42
46.5	202.6	156.4	46.2	21.9	30.50	0.40	7.31	19.6	D 19-42
47.0	206.0	159.8	46.2	22.3	30.73	0.41	7.33	19.5	D 19-42
47.5	209.8	163.6	46.2	22.0	30.39	0.56	7.31	19.7	D 19-42
48.0	213.0	166.8	46.2	22.4	30.49	0.58	7.34	19.7	D 19-42
48.5	216.2	170.0	46.2	22.9	30.62	0.58	7.38	19.6	D 19-42
49.0	218.6	172.4	46.2	24.1	30.93	0.33	7.44	19.4	D 19-42
49.5	279.0	176.2	102.8	38.0	32.71	0.47	8.04	20.1	D 19-42
50.0	282.9	180.1	102.8	39.3	32.94	0.47	8.07	20.1	D 19-42
50.5	288.0	185.2	102.8	38.4	32.73	0.62	8.06	20.3	D 19-42
51.0	292.2	189.3	102.8	39.7	32.82	0.62	8.10	20.2	D 19-42

Rear Abutment Calculations + 16-in									DLZ OHIO
51.5	296.3	193.5	102.8	40.9	32.94	0.61	8.13	20.2	D 19-42
52.0	299.8	197.0	102.8	43.2	33.36	0.46	8.17	20.2	D 19-42
52.5	304.0	201.2	102.8	44.9	33.40	0.30	8.20	20.0	D 19-42
53.0	308.2	205.3	102.8	46.4	33.57	0.26	8.22	19.9	D 19-42

## GRLWEAP: Wave Equation Analysis of Pile Foundations

Fwd Abutment Calculations + 16-in

11/21/2023

DLZ OHIO

GRLWEAP 14.1.15.0

**ABOUT THE WAVE EQUATION ANALYSIS RESULTS**

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

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

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

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

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

Calc'd: RJH	Date: 11/21/23
Chk'd: EWT	Date: 11/21/23

**HAMMER DATA**

Hammer Model:	D 19-42	Made By:	DELMAG
Hammer ID:	41	Hammer Type:	OED
Hammer Database Type:	PDI		
Hammer Database Name:			PDIHammer.gwh

**Hammer and Drive System Segment Data**

Segment -	Weight kips	Stiffness kips/in	COR -	C-Slack in	Damping kips/ft/s
1	0.800	140,084.4	1.000	0.000	
2	0.800	140,084.4	1.000	0.000	
3	0.800	140,084.4	1.000	0.000	
4	0.800	140,084.4	1.000	0.000	
5	0.800	70,754.7	0.900	0.120	
Imp Block	0.753	60,155.6	0.800	0.120	
Helmet	1.900				4.4

Ram Weight: (kips)	4.00	Ram Length: (ft)	10.76
Ram Area: (in <sup>2</sup> )	124.69		
Maximum (Eq) Stroke: (ft)	10.81	Actual (Eq) Stroke: (ft)	10.81
Efficiency:	0.800	Rated Energy: (kip-ft)	43.24
Maximum Pressure: (psi)	1,600.00	Actual Pressure: (psi)	1,600.00
Combustion Delay: (ms)	2.00	Ignition Duration: (ms)	2.00
Expansion Exponent:	1.25		

Hammer Cushion	Pile Cushion		
Cross Sect. Area: (in <sup>2</sup> )	227.00	Cross Sect. Area: (in <sup>2</sup> )	0.00
Elastic Modulus: (ksi)	530.0	Elastic Modulus: (ksi)	0.0
Thickness: (in)	2.00	Thickness: (in)	0.00
Coeff. of Restitution:	0.800	Coeff. of Restitution:	0.500
Stiffness: (kips/in)	60,155.6	Stiffness: (kips/in)	0.0

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp Length ft	Wait Time Hr	Hammer
0.50	54.0	0.0	DELMAG D 19-42
1.00	54.0	0.0	DELMAG D 19-42
1.50	54.0	0.0	DELMAG D 19-42
2.00	54.0	0.0	DELMAG D 19-42
2.50	54.0	0.0	DELMAG D 19-42
3.00	54.0	0.0	DELMAG D 19-42
3.50	54.0	0.0	DELMAG D 19-42
4.00	54.0	0.0	DELMAG D 19-42
4.50	54.0	0.0	DELMAG D 19-42
5.00	54.0	0.0	DELMAG D 19-42
5.50	54.0	0.0	DELMAG D 19-42
6.00	54.0	0.0	DELMAG D 19-42
6.50	54.0	0.0	DELMAG D 19-42
7.00	54.0	0.0	DELMAG D 19-42
7.50	54.0	0.0	DELMAG D 19-42
8.00	54.0	0.0	DELMAG D 19-42
8.50	54.0	0.0	DELMAG D 19-42
9.00	54.0	0.0	DELMAG D 19-42
9.50	54.0	0.0	DELMAG D 19-42
10.00	54.0	0.0	DELMAG D 19-42
10.50	54.0	0.0	DELMAG D 19-42
11.00	54.0	0.0	DELMAG D 19-42
11.50	54.0	0.0	DELMAG D 19-42
12.00	54.0	0.0	DELMAG D 19-42
12.50	54.0	0.0	DELMAG D 19-42
13.00	54.0	0.0	DELMAG D 19-42
13.50	54.0	0.0	DELMAG D 19-42
14.00	54.0	0.0	DELMAG D 19-42
14.50	54.0	0.0	DELMAG D 19-42
15.00	54.0	0.0	DELMAG D 19-42
15.50	54.0	0.0	DELMAG D 19-42
16.00	54.0	0.0	DELMAG D 19-42
16.50	54.0	0.0	DELMAG D 19-42
17.00	54.0	0.0	DELMAG D 19-42
17.50	54.0	0.0	DELMAG D 19-42
18.00	54.0	0.0	DELMAG D 19-42
18.50	54.0	0.0	DELMAG D 19-42
19.00	54.0	0.0	DELMAG D 19-42
19.50	54.0	0.0	DELMAG D 19-42

Fwd Abutment Calculations + 16-in DLZ OHIO

20.00	54.0	0.0	DELMAG D 19-42
20.50	54.0	0.0	DELMAG D 19-42
21.00	54.0	0.0	DELMAG D 19-42
21.50	54.0	0.0	DELMAG D 19-42
22.00	54.0	0.0	DELMAG D 19-42
22.50	54.0	0.0	DELMAG D 19-42
23.00	54.0	0.0	DELMAG D 19-42
23.50	54.0	0.0	DELMAG D 19-42
24.00	54.0	0.0	DELMAG D 19-42
24.50	54.0	0.0	DELMAG D 19-42
25.00	54.0	0.0	DELMAG D 19-42
25.50	54.0	0.0	DELMAG D 19-42
26.00	54.0	0.0	DELMAG D 19-42
26.50	54.0	0.0	DELMAG D 19-42
27.00	54.0	0.0	DELMAG D 19-42
27.50	54.0	0.0	DELMAG D 19-42
28.00	54.0	0.0	DELMAG D 19-42
28.50	54.0	0.0	DELMAG D 19-42
29.00	54.0	0.0	DELMAG D 19-42
29.50	54.0	0.0	DELMAG D 19-42
30.00	54.0	0.0	DELMAG D 19-42
30.50	54.0	0.0	DELMAG D 19-42
31.00	54.0	0.0	DELMAG D 19-42
31.50	54.0	0.0	DELMAG D 19-42
32.00	54.0	0.0	DELMAG D 19-42
32.50	54.0	0.0	DELMAG D 19-42
33.00	54.0	0.0	DELMAG D 19-42
33.50	54.0	0.0	DELMAG D 19-42
34.00	54.0	0.0	DELMAG D 19-42
34.50	54.0	0.0	DELMAG D 19-42
35.00	54.0	0.0	DELMAG D 19-42
35.50	54.0	0.0	DELMAG D 19-42
36.00	54.0	0.0	DELMAG D 19-42
36.50	54.0	0.0	DELMAG D 19-42
37.00	54.0	0.0	DELMAG D 19-42
37.50	54.0	0.0	DELMAG D 19-42
38.00	54.0	0.0	DELMAG D 19-42
38.50	54.0	0.0	DELMAG D 19-42
39.00	54.0	0.0	DELMAG D 19-42
39.50	54.0	0.0	DELMAG D 19-42
40.00	54.0	0.0	DELMAG D 19-42
40.50	54.0	0.0	DELMAG D 19-42

Fwd Abutment Calculations + 16-in DLZ OHIO

41.00	54.0	0.0	DELMAG D 19-42
41.50	54.0	0.0	DELMAG D 19-42
42.00	54.0	0.0	DELMAG D 19-42
42.50	54.0	0.0	DELMAG D 19-42
43.00	54.0	0.0	DELMAG D 19-42
43.50	54.0	0.0	DELMAG D 19-42
44.00	54.0	0.0	DELMAG D 19-42
44.50	54.0	0.0	DELMAG D 19-42
45.00	54.0	0.0	DELMAG D 19-42
45.50	54.0	0.0	DELMAG D 19-42
46.00	54.0	0.0	DELMAG D 19-42
46.50	54.0	0.0	DELMAG D 19-42
47.00	54.0	0.0	DELMAG D 19-42
47.50	54.0	0.0	DELMAG D 19-42
48.00	54.0	0.0	DELMAG D 19-42
48.50	54.0	0.0	DELMAG D 19-42
49.00	54.0	0.0	DELMAG D 19-42
49.50	54.0	0.0	DELMAG D 19-42
50.00	54.0	0.0	DELMAG D 19-42
50.50	54.0	0.0	DELMAG D 19-42
51.00	54.0	0.0	DELMAG D 19-42
51.50	54.0	0.0	DELMAG D 19-42
52.00	54.0	0.0	DELMAG D 19-42

Other Information for DELMAG D 19-42

Depth ft	Stroke ft	Diesel Pressure %	Efficiency -	P.C. Stiff. Fact. -	P.C. COR -
0.50	10.8	100.0	0.80	1.0	0.50
1.00	10.8	100.0	0.80	1.0	0.50
1.50	10.8	100.0	0.80	1.0	0.50
2.00	10.8	100.0	0.80	1.0	0.50
2.50	10.8	100.0	0.80	1.0	0.50
3.00	10.8	100.0	0.80	1.0	0.50
3.50	10.8	100.0	0.80	1.0	0.50
4.00	10.8	100.0	0.80	1.0	0.50
4.50	10.8	100.0	0.80	1.0	0.50
5.00	10.8	100.0	0.80	1.0	0.50
5.50	10.8	100.0	0.80	1.0	0.50
6.00	10.8	100.0	0.80	1.0	0.50
6.50	10.8	100.0	0.80	1.0	0.50
7.00	10.8	100.0	0.80	1.0	0.50
7.50	10.8	100.0	0.80	1.0	0.50

Fwd Abutment Calculations + 16-in DLZ OHIO

8.00	10.8	100.0	0.80	1.0	0.50
8.50	10.8	100.0	0.80	1.0	0.50
9.00	10.8	100.0	0.80	1.0	0.50
9.50	10.8	100.0	0.80	1.0	0.50
10.00	10.8	100.0	0.80	1.0	0.50
10.50	10.8	100.0	0.80	1.0	0.50
11.00	10.8	100.0	0.80	1.0	0.50
11.50	10.8	100.0	0.80	1.0	0.50
12.00	10.8	100.0	0.80	1.0	0.50
12.50	10.8	100.0	0.80	1.0	0.50
13.00	10.8	100.0	0.80	1.0	0.50
13.50	10.8	100.0	0.80	1.0	0.50
14.00	10.8	100.0	0.80	1.0	0.50
14.50	10.8	100.0	0.80	1.0	0.50
15.00	10.8	100.0	0.80	1.0	0.50
15.50	10.8	100.0	0.80	1.0	0.50
16.00	10.8	100.0	0.80	1.0	0.50
16.50	10.8	100.0	0.80	1.0	0.50
17.00	10.8	100.0	0.80	1.0	0.50
17.50	10.8	100.0	0.80	1.0	0.50
18.00	10.8	100.0	0.80	1.0	0.50
18.50	10.8	100.0	0.80	1.0	0.50
19.00	10.8	100.0	0.80	1.0	0.50
19.50	10.8	100.0	0.80	1.0	0.50
20.00	10.8	100.0	0.80	1.0	0.50
20.50	10.8	100.0	0.80	1.0	0.50
21.00	10.8	100.0	0.80	1.0	0.50
21.50	10.8	100.0	0.80	1.0	0.50
22.00	10.8	100.0	0.80	1.0	0.50
22.50	10.8	100.0	0.80	1.0	0.50
23.00	10.8	100.0	0.80	1.0	0.50
23.50	10.8	100.0	0.80	1.0	0.50
24.00	10.8	100.0	0.80	1.0	0.50
24.50	10.8	100.0	0.80	1.0	0.50
25.00	10.8	100.0	0.80	1.0	0.50
25.50	10.8	100.0	0.80	1.0	0.50
26.00	10.8	100.0	0.80	1.0	0.50
26.50	10.8	100.0	0.80	1.0	0.50
27.00	10.8	100.0	0.80	1.0	0.50
27.50	10.8	100.0	0.80	1.0	0.50
28.00	10.8	100.0	0.80	1.0	0.50
28.50	10.8	100.0	0.80	1.0	0.50

Fwd Abutment Calculations + 16-in DLZ OHIO

29.00	10.8	100.0	0.80	1.0	0.50
29.50	10.8	100.0	0.80	1.0	0.50
30.00	10.8	100.0	0.80	1.0	0.50
30.50	10.8	100.0	0.80	1.0	0.50
31.00	10.8	100.0	0.80	1.0	0.50
31.50	10.8	100.0	0.80	1.0	0.50
32.00	10.8	100.0	0.80	1.0	0.50
32.50	10.8	100.0	0.80	1.0	0.50
33.00	10.8	100.0	0.80	1.0	0.50
33.50	10.8	100.0	0.80	1.0	0.50
34.00	10.8	100.0	0.80	1.0	0.50
34.50	10.8	100.0	0.80	1.0	0.50
35.00	10.8	100.0	0.80	1.0	0.50
35.50	10.8	100.0	0.80	1.0	0.50
36.00	10.8	100.0	0.80	1.0	0.50
36.50	10.8	100.0	0.80	1.0	0.50
37.00	10.8	100.0	0.80	1.0	0.50
37.50	10.8	100.0	0.80	1.0	0.50
38.00	10.8	100.0	0.80	1.0	0.50
38.50	10.8	100.0	0.80	1.0	0.50
39.00	10.8	100.0	0.80	1.0	0.50
39.50	10.8	100.0	0.80	1.0	0.50
40.00	10.8	100.0	0.80	1.0	0.50
40.50	10.8	100.0	0.80	1.0	0.50
41.00	10.8	100.0	0.80	1.0	0.50
41.50	10.8	100.0	0.80	1.0	0.50
42.00	10.8	100.0	0.80	1.0	0.50
42.50	10.8	100.0	0.80	1.0	0.50
43.00	10.8	100.0	0.80	1.0	0.50
43.50	10.8	100.0	0.80	1.0	0.50
44.00	10.8	100.0	0.80	1.0	0.50
44.50	10.8	100.0	0.80	1.0	0.50
45.00	10.8	100.0	0.80	1.0	0.50
45.50	10.8	100.0	0.80	1.0	0.50
46.00	10.8	100.0	0.80	1.0	0.50
46.50	10.8	100.0	0.80	1.0	0.50
47.00	10.8	100.0	0.80	1.0	0.50
47.50	10.8	100.0	0.80	1.0	0.50
48.00	10.8	100.0	0.80	1.0	0.50
48.50	10.8	100.0	0.80	1.0	0.50
49.00	10.8	100.0	0.80	1.0	0.50
49.50	10.8	100.0	0.80	1.0	0.50

Fwd Abutment Calculations + 16-in					DLZ OHIO
50.00	10.8	100.0	0.80	1.0	0.50
50.50	10.8	100.0	0.80	1.0	0.50
51.00	10.8	100.0	0.80	1.0	0.50
51.50	10.8	100.0	0.80	1.0	0.50
52.00	10.8	100.0	0.80	1.0	0.50

#### PILE, SOIL, ANALYSIS OPTIONS

Analysis type:	Driveability Analysis	Soil Damping Option:	Smith
Max No Analysis Iterations:	0	Time Increment/Critical:	160
Residual Stress Analysis:	0	Analysis Time-Input(ms):	0
Output Level:	Normal	Gravitational Acceleration (ft/s <sup>2</sup> ):	32.169
Hammer Gravity (ft/s <sup>2</sup> ):	32.169	Pile Gravity (ft/s <sup>2</sup> ):	32.169

## Driveability Analysis

Analysis Depth (ft)	52.00	Standard Soil Setup	
Hammer Name	DELMAG D 19-42	Hammer ID	41
Diesel Pressure: (psi)	230.40	Stroke (ft)	10.81
Efficiency	0.80		
Shaft Gain/Loss Factor	1.000	Toe Gain/Loss Factor	1.000
Shaft Gain/Loss Factor	0.900	Toe Gain/Loss Factor	1.000
Shaft Gain/Loss Factor	0.800	Toe Gain/Loss Factor	1.000
Shaft Gain/Loss Factor	0.700	Toe Gain/Loss Factor	1.000
Shaft Gain/Loss Factor	0.600	Toe Gain/Loss Factor	1.000

## SOIL RESISTANCE PARAMETERS

Depth	Unit	Rs	Unit	Rt	Qs	Qt	Js	Jt	Setup	F.Limit	D.Setup	TEB	Area
ft	ksf	ksf	in	in	s/in	s/in	s/ft	s/ft	-	ft	Hours	in <sup>2</sup>	
0.00	1.2	13.5	0.10	0.190	0.150	0.150	0.2	0.2	1.5	6.00	168.0	201.06	
10.90	1.2	13.5	0.10	0.190	0.150	0.150	0.2	0.2	1.5	6.00	168.0	201.06	
10.90	1.1	22.5	0.10	0.160	0.150	0.150	0.2	0.2	1.5	6.00	168.0	201.06	
20.90	1.1	22.5	0.10	0.160	0.150	0.150	0.2	0.2	1.5	6.00	168.0	201.06	
20.90	0.9	9.0	0.10	0.170	0.150	0.150	0.2	0.2	1.5	6.00	168.0	201.06	
25.90	0.9	9.0	0.10	0.170	0.150	0.150	0.2	0.2	1.5	6.00	168.0	201.06	
25.90	0.5	13.3	0.10	0.267	0.050	0.050	0.2	0.2	1.0	6.00	1.0	201.06	
27.57	0.6	13.3	0.10	0.267	0.050	0.050	0.2	0.2	1.0	6.00	1.0	201.06	
30.90	0.6	13.3	0.10	0.267	0.050	0.050	0.2	0.2	1.0	6.00	1.0	201.06	
32.57	0.7	13.3	0.10	0.267	0.050	0.050	0.2	0.2	1.0	6.00	1.0	201.06	
34.23	0.7	13.3	0.10	0.267	0.050	0.050	0.2	0.2	1.0	6.00	1.0	201.06	
35.90	0.8	13.3	0.10	0.267	0.050	0.050	0.2	0.2	1.0	6.00	1.0	201.06	
39.23	0.8	13.3	0.10	0.267	0.050	0.050	0.2	0.2	1.0	6.00	1.0	201.06	
40.90	0.9	13.3	0.10	0.267	0.050	0.050	0.2	0.2	1.0	6.00	1.0	201.06	
44.23	0.9	13.3	0.10	0.267	0.050	0.050	0.2	0.2	1.0	6.00	1.0	201.06	
45.90	1.0	13.3	0.10	0.267	0.050	0.050	0.2	0.2	1.0	6.00	1.0	201.06	
45.90	1.4	33.1	0.10	0.201	0.050	0.050	0.2	0.2	1.0	6.00	1.0	201.06	
47.57	1.5	33.1	0.10	0.201	0.050	0.050	0.2	0.2	1.0	6.00	1.0	201.06	
49.23	1.6	33.1	0.10	0.201	0.050	0.050	0.2	0.2	1.0	6.00	1.0	201.06	
50.90	1.6	33.1	0.10	0.201	0.050	0.050	0.2	0.2	1.0	6.00	1.0	201.06	
52.57	1.7	33.1	0.10	0.201	0.050	0.050	0.2	0.2	1.0	6.00	1.0	201.06	

## PILE PROFILE

Lb Top	X-Area	E-Mod	Spec. Wt	Perim.	C-Index	Wave Sp	Impedance
ft	in <sup>2</sup>	ksi	lb/ft <sup>3</sup>	ft	-	ft/s	kips/ft/s
0.00	12.4	30,000	492.00	4.189	0	16,806.4	22.1
54.00	12.4	30,000	492.00	4.189	0	16,806.4	22.1

## Fwd Abutment Calculations + 16-in

DLZ OHIO

PILE AND SOIL MODEL						Total Capacity Rut (kips):					269.990	
Seg.	Weight	Stiffn.	C-SIk	T-SIk	COR	Ru	Js/Jt	Qs/Qt	LbTop	Perim.	X-Area	
-	kips	kips/in	in	in	-	kips	s/ft	in	ft	ft	in <sup>2</sup>	
1	0.13	10,308	0.12	0.00	0.85	5.2	0.150	0.10	3.00	4.19	12.4	
2	0.13	10,308	0.00	0.00	1.00	15.5	0.150	0.10	6.00	4.19	12.4	
4	0.13	10,308	0.00	0.00	1.00	15.5	0.150	0.10	12.00	4.19	12.4	
5	0.13	10,308	0.00	0.00	1.00	14.4	0.150	0.10	15.00	4.19	12.4	
6	0.13	10,308	0.00	0.00	1.00	13.9	0.150	0.10	18.00	4.19	12.4	
7	0.13	10,308	0.00	0.00	1.00	13.9	0.150	0.10	21.00	4.19	12.4	
8	0.13	10,308	0.00	0.00	1.00	13.0	0.150	0.10	24.00	4.19	12.4	
9	0.13	10,308	0.00	0.00	1.00	11.4	0.150	0.10	27.00	4.19	12.4	
10	0.13	10,308	0.00	0.00	1.00	8.3	0.100	0.10	30.00	4.19	12.4	
11	0.13	10,308	0.00	0.00	1.00	7.7	0.050	0.10	33.00	4.19	12.4	
12	0.13	10,308	0.00	0.00	1.00	8.5	0.050	0.10	36.00	4.19	12.4	
13	0.13	10,308	0.00	0.00	1.00	9.3	0.050	0.10	39.00	4.19	12.4	
14	0.13	10,308	0.00	0.00	1.00	10.1	0.050	0.10	42.00	4.19	12.4	
15	0.13	10,308	0.00	0.00	1.00	10.9	0.050	0.10	45.00	4.19	12.4	
16	0.13	10,308	0.00	0.00	1.00	11.9	0.050	0.10	48.00	4.19	12.4	
17	0.13	10,308	0.00	0.00	1.00	18.8	0.050	0.10	51.00	4.19	12.4	
18	0.13	10,308	0.00	0.00	1.00	20.0	0.050	0.10	54.00	4.19	12.4	
Toe						46.2	0.150	0.20	54.00			

2.282 kips total unreduced pile weight ( $g = 32.169 \text{ ft/s}^2$ )2.282 kips total reduced pile weight ( $g = 32.169 \text{ ft/s}^2$ )

## OTHER OPTIONS

Pile Damping (%):	1	Pile Damping Fact. (kips/ft/s):	0.442
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## EXTREMA TABLE at 52.0 FT; HAMMER: D 19-42

Shaft/Toe Gain/Loss Factor = 1.000/1.000

Hammer	Rut = 270.0 kips			Rtoe = 46.2 kips		Time Inc. = 0.076 ms		
	Lb Top	Mx.T-For.	Mx.C-For	DEL MAG D 19-42	Efficiency		0.800	
ft	kips	kips	ksi	ksi	ft/s	in	kip-ft	
3.0	0.0	442.1	0.00	35.74	14.52	0.582	16.89	
6.0	0.0	444.7	0.00	35.95	13.66	0.564	15.75	
9.0	0.0	415.7	0.00	33.60	12.83	0.547	14.18	
12.0	0.0	386.9	0.00	31.28	12.05	0.530	12.70	
15.0	0.0	359.2	0.00	29.04	11.30	0.514	11.37	
18.0	0.0	335.5	0.00	27.12	10.60	0.500	10.17	
21.0	0.0	312.7	0.00	25.28	10.09	0.486	9.05	
24.0	0.0	288.4	0.00	23.31	9.65	0.475	8.03	
27.0	0.0	263.7	0.00	21.31	9.31	0.465	7.14	
30.0	0.0	242.1	0.00	19.57	9.15	0.456	6.48	
33.0	0.0	231.7	0.00	18.73	9.00	0.447	6.05	
36.0	0.0	226.0	0.00	18.27	8.85	0.438	5.66	
39.0	0.0	218.9	0.00	17.69	8.70	0.429	5.25	
42.0	0.0	207.9	0.00	16.80	9.27	0.420	4.82	
45.0	0.0	200.9	0.00	16.24	10.38	0.412	4.37	
48.0	0.0	186.6	0.00	15.08	10.87	0.405	3.90	
51.0	0.0	155.7	0.00	12.59	11.15	0.398	3.28	
54.0	0.0	116.5	0.00	9.42	11.84	0.392	2.91	

Converged Stroke (ft) 8.08 Fixed Combustion Pressure (psi) 1,600.0

(Eq) Strokes Analyzed and Last Return (ft)

10.81 7.97 8.09 8.08

Shaft/Toe Gain/Loss Factor = 0.900/1.000

Hammer	Rut = 258.0 kips			Rtoe = 46.2 kips		Time Inc. = 0.076 ms		
	Lb Top	Mx.T-For.	Mx.C-For	DEL MAG D 19-42	Efficiency		0.800	
ft	kips	kips	ksi	ksi	ft/s	in	kip-ft	
3.0	0.0	435.7	0.00	35.22	14.30	0.612	17.35	
6.0	0.0	438.4	0.00	35.44	13.53	0.595	16.27	
9.0	0.0	412.0	0.00	33.31	12.79	0.578	14.77	
12.0	0.0	386.2	0.00	31.22	12.11	0.562	13.36	
15.0	0.0	360.8	0.00	29.16	11.46	0.547	12.06	
18.0	0.0	338.6	0.00	27.37	10.85	0.533	10.89	
21.0	0.0	317.0	0.00	25.63	10.31	0.521	9.81	
24.0	0.0	294.4	0.00	23.80	9.88	0.510	8.80	

Fwd Abutment Calculations + 16-in DLZ OHIO

27.0	0.0	272.3	0.00	22.01	9.59	0.501	7.92
30.0	0.0	252.8	0.00	20.43	9.32	0.492	7.25
33.0	0.0	242.7	0.00	19.62	9.23	0.482	6.77
36.0	0.0	237.2	0.00	19.17	9.06	0.473	6.35
39.0	0.0	229.8	0.00	18.57	9.04	0.463	5.90
42.0	0.0	215.5	0.00	17.42	9.73	0.455	5.43
45.0	0.0	205.0	0.00	16.57	10.83	0.447	4.94
48.0	0.0	189.7	0.00	15.33	11.29	0.440	4.42
51.0	0.0	157.4	0.00	12.73	11.35	0.433	3.74
54.0	0.0	123.4	0.00	9.97	11.92	0.428	3.32

Converged Stroke (ft) 7.98 Fixed Combustion Pressure (psi) 1,600.0

(Eq) Strokes Analyzed and Last Return (ft)

10.81 7.84 7.99 7.98

Shaft/Toe Gain/Loss Factor = 0.800/1.000

Rut = 245.9 kips Rtoe = 46.2 kips Time Inc. = 0.076 ms

Hammer DELMAG D 19-42 Efficiency 0.800

Lb Top ft	Mx.T-For. kips	Mx.C-For kips	Mx.T-Str. ksi	Mx.C-Str. ksi	Mx Vel. ft/s	Mx Dis. in	ENTHRU kip-ft
3.0	0.0	428.1	0.00	34.61	14.16	0.644	17.75
6.0	0.0	430.5	0.00	34.80	13.45	0.627	16.73
9.0	0.0	407.3	0.00	32.93	12.80	0.611	15.32
12.0	0.0	384.1	0.00	31.05	12.20	0.596	13.98
15.0	0.0	361.3	0.00	29.21	11.64	0.582	12.74
18.0	0.0	341.0	0.00	27.57	11.10	0.569	11.63
21.0	0.0	321.2	0.00	25.97	10.62	0.558	10.58
24.0	0.0	300.5	0.00	24.30	10.24	0.548	9.61
27.0	0.0	280.4	0.00	22.67	9.97	0.538	8.75
30.0	0.0	263.1	0.00	21.27	9.71	0.529	8.06
33.0	0.0	253.5	0.00	20.49	9.49	0.519	7.56
36.0	0.0	248.0	0.00	20.05	9.31	0.510	7.10
39.0	0.0	240.4	0.00	19.44	9.36	0.501	6.61
42.0	0.0	226.0	0.00	18.27	10.17	0.492	6.10
45.0	0.0	210.1	0.00	16.98	11.25	0.485	5.56
48.0	0.0	193.0	0.00	15.60	11.70	0.478	4.98
51.0	0.0	159.3	0.00	12.88	11.60	0.471	4.23
54.0	0.0	129.8	0.00	10.49	12.00	0.465	3.77

Converged Stroke (ft) 7.88 Fixed Combustion Pressure (psi) 1,600.0

(Eq) Strokes Analyzed and Last Return (ft)

10.81 7.70 7.90 7.88

Shaft/Toe Gain/Loss Factor = 0.700/1.000

Rut = 233.7 kips

Rtoe = 46.2 kips

Time Inc. = 0.076 ms

Hammer

DELMAG D 19-42

Efficiency

0.800

Lb Top ft	Mx.T-For. kips	Mx.C-For kips	Mx.T-Str. ksi	Mx.C-Str. ksi	Mx Vel. ft/s	Mx Dis. in	ENTHRU kip-ft
3.0	0.0	419.0	0.00	33.87	14.04	0.686	18.10
6.0	0.0	420.8	0.00	34.02	13.41	0.669	17.16
9.0	0.0	400.8	0.00	32.40	12.83	0.653	15.84
12.0	0.0	380.3	0.00	30.74	12.30	0.638	14.57
15.0	0.0	360.4	0.00	29.13	11.81	0.623	13.39
18.0	0.0	342.2	0.00	27.67	11.34	0.609	12.32
21.0	0.0	324.6	0.00	26.24	10.92	0.597	11.32
24.0	0.0	306.0	0.00	24.74	10.58	0.585	10.37
27.0	0.0	288.2	0.00	23.30	10.32	0.575	9.54
30.0	0.0	273.3	0.00	22.09	10.08	0.565	8.86
33.0	0.0	263.8	0.00	21.33	9.81	0.555	8.33
36.0	0.0	258.4	0.00	20.89	9.53	0.546	7.84
39.0	0.0	250.6	0.00	20.26	9.62	0.537	7.32
42.0	0.0	236.3	0.00	19.10	10.56	0.529	6.76
45.0	0.0	215.7	0.00	17.44	11.62	0.522	6.17
48.0	0.0	196.4	0.00	15.87	12.07	0.514	5.54
51.0	0.0	161.1	0.00	13.03	11.89	0.507	4.72
54.0	0.0	136.0	0.00	10.99	12.07	0.502	4.21

Converged Stroke (ft) 7.78 Fixed Combustion Pressure (psi) 1,600.0

(Eq) Strokes Analyzed and Last Return (ft)

10.81 7.56 7.79 7.78

Shaft/Toe Gain/Loss Factor = 0.600/1.000

Rut = 221.6 kips

Rtoe = 46.2 kips

Time Inc. = 0.076 ms

Hammer

DELMAG D 19-42

Efficiency

0.800

Lb Top ft	Mx.T-For. kips	Mx.C-For kips	Mx.T-Str. ksi	Mx.C-Str. ksi	Mx Vel. ft/s	Mx Dis. in	ENTHRU kip-ft
3.0	0.0	408.3	0.00	33.01	13.93	0.736	18.59
6.0	0.0	410.2	0.00	33.16	13.39	0.720	17.73
9.0	0.0	392.9	0.00	31.76	12.89	0.704	16.51
12.0	0.0	375.6	0.00	30.37	12.41	0.689	15.33
15.0	0.0	358.3	0.00	28.96	11.97	0.675	14.23
18.0	0.0	342.8	0.00	27.72	11.55	0.661	13.23
21.0	0.0	327.5	0.00	26.47	11.20	0.648	12.27
24.0	0.0	311.2	0.00	25.16	10.89	0.635	11.36

Fwd Abutment Calculations + 16-in DLZ OHIO

27.0	0.0	296.0	0.00	23.93	10.65	0.623	10.55
30.0	0.0	283.3	0.00	22.91	10.41	0.610	9.86
33.0	0.0	274.4	0.00	22.18	10.16	0.600	9.28
36.0	0.0	268.6	0.00	21.71	9.88	0.590	8.74
39.0	0.0	260.4	0.00	21.05	9.94	0.581	8.17
42.0	0.0	246.1	0.00	19.89	10.97	0.573	7.56
45.0	0.0	223.2	0.00	18.05	11.97	0.565	6.91
48.0	0.0	200.8	0.00	16.23	12.42	0.558	6.21
51.0	0.0	163.8	0.00	13.24	12.21	0.551	5.30
54.0	0.0	142.4	0.00	11.51	12.13	0.545	4.75

Converged Stroke (ft) 7.64 Fixed Combustion Pressure (psi) 1,600.0

(Eq) Strokes Analyzed and Last Return (ft)

10.81 7.40 7.66 7.64

SUMMARY TABLE at 52.0 FT; HAMMER: D 19-42

Rut kips	BI Ct b/ft	Stk Dn ft	Stk Up Mx ft	T-Str ksi	LTop Mx ft	C-Str ksi	LTop ENTHRU ft	BL RT kip-ft	ActRes b/min	ActRes kips
270.0	43.6	8.08	0.00	0.00	3.0	35.95	6.0	16.9	41.5	270.0
258.0	38.8	7.98	0.00	0.00	3.0	35.44	6.0	17.4	41.8	258.0
245.9	34.7	7.88	0.00	0.00	3.0	34.80	6.0	17.7	42.0	245.9
233.7	31.5	7.78	0.00	0.00	3.0	34.02	6.0	18.1	42.3	233.7
221.6	28.3	7.64	0.00	0.00	3.0	33.16	6.0	18.6	42.6	221.6

## SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 1.000/1.000									
Depth ft	Rut kips	Rshaft kips	Rtoe kips	Bl Ct b/ft	Mx C-Str ksi	Mx T-Str ksi	Stroke ft	ENTHRU kip-ft	Hammer -
0.5	21.4	2.6	18.8	1.7	12.04	0.00	3.98	26.0	D 19-42
1.0	24.0	5.2	18.8	2.0	13.54	0.00	4.09	25.5	D 19-42
1.5	26.6	7.7	18.8	2.3	14.78	0.40	4.20	25.0	D 19-42
2.0	29.2	10.3	18.8	2.5	15.39	0.47	4.32	24.4	D 19-42
2.5	31.7	12.9	18.8	2.8	16.04	0.67	4.42	24.0	D 19-42
3.0	34.3	15.5	18.8	3.1	16.64	0.58	4.52	23.6	D 19-42
3.5	36.9	18.0	18.8	3.3	17.47	0.67	4.60	23.4	D 19-42
4.0	39.5	20.6	18.8	3.6	18.09	0.79	4.68	23.1	D 19-42
4.5	42.0	23.2	18.8	3.9	18.70	0.81	4.76	22.8	D 19-42
5.0	44.6	25.8	18.8	4.2	19.16	0.78	4.84	22.5	D 19-42
5.5	47.2	28.3	18.8	4.5	19.67	0.84	4.92	22.3	D 19-42
6.0	49.8	30.9	18.8	4.8	20.17	0.94	5.00	22.1	D 19-42
6.5	52.3	33.5	18.8	5.1	20.70	0.99	5.09	21.9	D 19-42
7.0	54.9	36.1	18.8	5.4	21.17	1.00	5.16	21.7	D 19-42
7.5	57.5	38.6	18.8	5.7	21.67	1.04	5.24	21.5	D 19-42
8.0	60.1	41.2	18.8	6.0	22.17	1.04	5.31	21.4	D 19-42
8.5	62.6	43.8	18.8	6.3	22.67	1.19	5.38	21.2	D 19-42
9.0	65.2	46.4	18.8	6.6	23.16	1.15	5.45	21.1	D 19-42
9.5	67.8	48.9	18.8	6.9	23.45	1.12	5.53	20.8	D 19-42
10.0	70.4	51.5	18.8	7.3	23.96	1.07	5.59	20.6	D 19-42
10.5	72.9	54.1	18.8	7.6	24.42	1.10	5.66	20.4	D 19-42
11.0	88.0	56.6	31.4	9.6	26.20	1.27	5.98	19.9	D 19-42
11.5	90.4	58.9	31.4	9.9	26.58	1.31	6.03	19.8	D 19-42
12.0	92.7	61.3	31.4	10.2	26.96	1.31	6.07	19.8	D 19-42
12.5	95.0	63.6	31.4	10.5	26.77	1.25	6.12	19.6	D 19-42
13.0	97.3	65.9	31.4	10.8	27.07	1.24	6.16	19.6	D 19-42
13.5	99.6	68.2	31.4	11.1	27.42	1.27	6.21	19.5	D 19-42
14.0	101.9	70.5	31.4	11.5	27.79	1.29	6.25	19.4	D 19-42
14.5	104.3	72.8	31.4	11.8	28.17	1.31	6.29	19.4	D 19-42
15.0	106.6	75.2	31.4	12.1	28.51	1.33	6.33	19.3	D 19-42
15.5	108.9	77.5	31.4	12.5	28.30	1.27	6.38	19.2	D 19-42
16.0	111.2	79.8	31.4	12.8	28.17	1.30	6.42	19.2	D 19-42
16.5	113.5	82.1	31.4	13.2	28.55	1.31	6.47	19.1	D 19-42
17.0	115.8	84.4	31.4	13.5	28.90	1.33	6.52	19.1	D 19-42
17.5	118.2	86.7	31.4	13.9	29.27	1.35	6.56	19.0	D 19-42
18.0	120.5	89.1	31.4	14.2	29.63	1.37	6.60	19.0	D 19-42
18.5	122.8	91.4	31.4	14.5	29.63	1.31	6.64	19.1	D 19-42
19.0	125.1	93.7	31.4	14.9	29.40	1.32	6.68	19.1	D 19-42

## Fwd Abutment Calculations + 16-in

DLZ OHIO

19.5	127.4	96.0	31.4	15.3	29.66	1.33	6.72	19.0	D 19-42
20.0	129.7	98.3	31.4	15.7	30.01	1.34	6.77	18.9	D 19-42
20.5	132.0	100.6	31.4	16.1	30.37	1.36	6.81	18.9	D 19-42
21.0	115.4	102.9	12.6	13.5	29.42	1.34	6.54	18.9	D 19-42
21.5	117.3	104.8	12.6	13.8	29.20	1.27	6.57	18.9	D 19-42
22.0	119.2	106.7	12.6	14.1	28.97	1.24	6.61	18.8	D 19-42
22.5	121.1	108.6	12.6	14.4	29.22	1.21	6.65	18.8	D 19-42
23.0	123.0	110.5	12.6	14.7	29.57	1.18	6.69	18.8	D 19-42
23.5	124.9	112.4	12.6	14.9	30.11	1.20	6.71	18.9	D 19-42
24.0	126.8	114.3	12.6	15.3	30.44	1.26	6.75	18.9	D 19-42
24.5	128.7	116.2	12.6	15.6	30.18	1.25	6.79	18.8	D 19-42
25.0	130.6	118.1	12.6	15.9	29.93	1.30	6.82	18.8	D 19-42
25.5	132.5	120.0	12.6	16.3	30.17	1.33	6.86	18.7	D 19-42
26.0	140.3	121.7	18.6	17.6	30.62	1.32	6.94	18.7	D 19-42
26.5	141.5	122.9	18.6	17.9	30.89	1.30	6.97	18.6	D 19-42
27.0	142.6	124.0	18.6	18.1	31.18	1.27	6.99	18.6	D 19-42
27.5	143.8	125.2	18.6	18.4	30.89	1.12	7.02	18.5	D 19-42
28.0	145.0	126.4	18.6	18.6	30.60	1.09	7.03	18.5	D 19-42
28.5	146.2	127.6	18.6	18.9	30.80	1.08	7.06	18.4	D 19-42
29.0	147.5	128.9	18.6	18.7	31.03	1.17	7.05	18.5	D 19-42
29.5	148.8	130.2	18.6	19.0	31.30	1.18	7.08	18.4	D 19-42
30.0	150.0	131.5	18.6	19.2	31.62	1.22	7.09	18.4	D 19-42
30.5	151.4	132.8	18.6	19.6	31.31	1.14	7.13	18.3	D 19-42
31.0	152.7	134.1	18.6	19.8	31.01	1.17	7.15	18.3	D 19-42
31.5	154.1	135.5	18.6	20.1	31.24	1.18	7.17	18.3	D 19-42
32.0	155.5	136.9	18.6	20.0	31.44	1.18	7.16	18.3	D 19-42
32.5	156.9	138.3	18.6	20.2	31.77	1.17	7.18	18.3	D 19-42
33.0	158.3	139.7	18.6	20.6	32.04	1.17	7.21	18.2	D 19-42
33.5	159.7	141.1	18.6	20.9	31.73	0.99	7.24	18.2	D 19-42
34.0	161.2	142.6	18.6	21.2	31.43	0.94	7.25	18.2	D 19-42
34.5	162.7	144.1	18.6	21.5	31.65	0.89	7.27	18.1	D 19-42
35.0	164.2	145.6	18.6	21.5	31.88	0.88	7.27	18.1	D 19-42
35.5	165.8	147.2	18.6	21.8	32.19	0.84	7.29	18.1	D 19-42
36.0	167.3	148.7	18.6	22.1	32.46	0.79	7.31	18.1	D 19-42
36.5	168.9	150.3	18.6	22.3	32.14	0.64	7.33	18.1	D 19-42
37.0	170.5	151.9	18.6	22.6	31.85	0.62	7.35	18.0	D 19-42
37.5	172.2	153.6	18.6	22.7	32.08	0.55	7.37	18.0	D 19-42
38.0	173.8	155.2	18.6	22.6	32.28	0.70	7.37	17.9	D 19-42
38.5	175.5	156.9	18.6	22.9	32.58	0.63	7.40	17.8	D 19-42
39.0	177.2	158.6	18.6	23.1	32.86	0.57	7.41	17.8	D 19-42
39.5	178.9	160.3	18.6	23.3	32.57	0.46	7.42	17.8	D 19-42
40.0	180.7	162.1	18.6	23.6	32.24	0.46	7.45	17.7	D 19-42

Fwd Abutment Calculations + 16-in DLZ OHIO

40.5	182.4	163.8	18.6	23.8	32.53	0.44	7.46	17.7	D 19-42
41.0	184.2	165.6	18.6	23.7	32.73	0.47	7.47	17.7	D 19-42
41.5	186.0	167.4	18.6	24.1	32.97	0.45	7.50	17.6	D 19-42
42.0	187.9	169.3	18.6	24.3	33.28	0.42	7.51	17.6	D 19-42
42.5	189.7	171.1	18.6	24.5	32.96	0.33	7.52	17.6	D 19-42
43.0	191.6	173.0	18.6	24.9	32.94	0.34	7.55	17.5	D 19-42
43.5	193.5	174.9	18.6	25.3	33.08	0.33	7.58	17.4	D 19-42
44.0	195.4	176.8	18.6	25.0	33.24	0.37	7.57	17.5	D 19-42
44.5	197.4	178.8	18.6	25.4	33.43	0.35	7.59	17.4	D 19-42
45.0	199.3	180.7	18.6	25.6	33.74	0.34	7.61	17.4	D 19-42
45.5	201.3	182.7	18.6	26.1	33.43	0.26	7.63	17.3	D 19-42
46.0	231.2	184.9	46.2	33.6	33.95	0.12	7.87	17.4	D 19-42
46.5	234.2	188.0	46.2	34.4	34.10	0.11	7.89	17.3	D 19-42
47.0	237.3	191.1	46.2	34.4	34.28	0.14	7.89	17.4	D 19-42
47.5	240.4	194.2	46.2	35.3	34.61	0.13	7.91	17.3	D 19-42
48.0	243.6	197.4	46.2	36.2	34.93	0.11	7.94	17.3	D 19-42
48.5	246.7	200.5	46.2	37.1	34.75	0.05	7.96	17.2	D 19-42
49.0	250.0	203.8	46.2	38.0	34.60	0.05	7.98	17.2	D 19-42
49.5	253.2	207.0	46.2	39.0	34.87	0.05	8.00	17.2	D 19-42
50.0	256.5	210.3	46.2	39.0	35.29	0.06	7.99	17.3	D 19-42
50.5	259.8	213.6	46.2	40.0	35.75	0.06	8.01	17.2	D 19-42
51.0	263.2	217.0	46.2	41.1	36.21	0.07	8.03	17.2	D 19-42
51.5	266.6	220.4	46.2	42.3	36.10	0.00	8.06	17.1	D 19-42
52.0	270.0	223.8	46.2	43.6	35.95	0.00	8.08	16.9	D 19-42

G/L at Shaft and Toe: 0.900/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Bl Ct b/ft	Mx C-Str ksi	Mx T-Str ksi	Stroke ft	ENTHRU kip-ft	Hammer -
0.5	21.2	2.3	18.8	1.7	11.81	0.00	3.97	26.2	D 19-42
1.0	23.5	4.6	18.8	1.9	13.18	0.00	4.07	25.8	D 19-42
1.5	25.8	7.0	18.8	2.2	14.10	0.18	4.19	25.2	D 19-42
2.0	28.1	9.3	18.8	2.4	15.03	0.44	4.29	24.8	D 19-42
2.5	30.4	11.6	18.8	2.7	15.58	0.61	4.38	24.3	D 19-42
3.0	32.8	13.9	18.8	2.9	16.14	0.64	4.47	24.0	D 19-42
3.5	35.1	16.2	18.8	3.1	16.71	0.57	4.55	23.7	D 19-42
4.0	37.4	18.5	18.8	3.4	17.46	0.71	4.62	23.5	D 19-42
4.5	39.7	20.9	18.8	3.6	18.02	0.80	4.70	23.3	D 19-42
5.0	42.0	23.2	18.8	3.9	18.55	0.82	4.77	23.0	D 19-42
5.5	44.4	25.5	18.8	4.1	18.96	0.78	4.84	22.8	D 19-42
6.0	46.7	27.8	18.8	4.4	19.41	0.83	4.91	22.6	D 19-42
6.5	49.0	30.1	18.8	4.7	19.85	0.88	4.98	22.4	D 19-42
7.0	51.3	32.5	18.8	4.9	20.30	0.97	5.06	22.2	D 19-42

Fwd Abutment Calculations + 16-in DLZ OHIO

7.5	53.6	34.8	18.8	5.2	20.76	1.00	5.13	22.1	D 19-42
8.0	55.9	37.1	18.8	5.5	21.22	1.02	5.20	21.9	D 19-42
8.5	58.3	39.4	18.8	5.7	21.65	1.05	5.27	21.7	D 19-42
9.0	60.6	41.7	18.8	6.0	22.10	1.07	5.33	21.5	D 19-42
9.5	62.9	44.1	18.8	6.3	22.62	1.18	5.39	21.4	D 19-42
10.0	65.2	46.4	18.8	6.6	22.90	1.15	5.46	21.1	D 19-42
10.5	67.5	48.7	18.8	6.9	23.36	1.11	5.52	21.0	D 19-42
11.0	82.4	51.0	31.4	8.7	25.26	1.22	5.86	20.4	D 19-42
11.5	84.5	53.0	31.4	9.0	25.62	1.21	5.91	20.3	D 19-42
12.0	86.5	55.1	31.4	9.3	25.97	1.22	5.95	20.2	D 19-42
12.5	88.6	57.2	31.4	9.6	25.85	1.20	5.99	20.2	D 19-42
13.0	90.7	59.3	31.4	9.8	26.21	1.22	6.03	20.1	D 19-42
13.5	92.8	61.4	31.4	10.1	26.53	1.22	6.08	20.0	D 19-42
14.0	94.9	63.5	31.4	10.4	26.88	1.23	6.12	19.9	D 19-42
14.5	97.0	65.6	31.4	10.7	27.22	1.25	6.16	19.9	D 19-42
15.0	99.1	67.6	31.4	11.0	27.53	1.28	6.20	19.8	D 19-42
15.5	101.1	69.7	31.4	11.3	27.36	1.21	6.24	19.7	D 19-42
16.0	103.2	71.8	31.4	11.6	27.29	1.23	6.28	19.6	D 19-42
16.5	105.3	73.9	31.4	11.9	27.61	1.24	6.32	19.5	D 19-42
17.0	107.4	76.0	31.4	12.2	27.95	1.26	6.35	19.5	D 19-42
17.5	109.5	78.1	31.4	12.5	28.27	1.28	6.40	19.4	D 19-42
18.0	111.6	80.1	31.4	12.8	28.60	1.30	6.44	19.4	D 19-42
18.5	113.6	82.2	31.4	13.1	28.44	1.24	6.48	19.4	D 19-42
19.0	115.7	84.3	31.4	13.4	28.26	1.26	6.52	19.4	D 19-42
19.5	117.8	86.4	31.4	13.7	28.53	1.29	6.56	19.3	D 19-42
20.0	119.9	88.5	31.4	14.1	28.87	1.30	6.60	19.2	D 19-42
20.5	122.0	90.6	31.4	14.4	29.22	1.30	6.64	19.2	D 19-42
21.0	105.1	92.6	12.6	11.9	28.30	1.19	6.34	19.4	D 19-42
21.5	106.9	94.3	12.6	12.2	28.13	1.11	6.37	19.4	D 19-42
22.0	108.6	96.0	12.6	12.4	27.93	1.14	6.41	19.3	D 19-42
22.5	110.3	97.7	12.6	12.7	28.21	1.21	6.45	19.2	D 19-42
23.0	112.0	99.4	12.6	12.9	28.53	1.26	6.48	19.2	D 19-42
23.5	113.7	101.1	12.6	13.2	28.83	1.26	6.51	19.2	D 19-42
24.0	115.4	102.8	12.6	13.4	29.12	1.23	6.55	19.1	D 19-42
24.5	117.1	104.6	12.6	13.7	28.93	1.08	6.58	19.1	D 19-42
25.0	118.8	106.3	12.6	13.9	28.75	1.03	6.62	19.1	D 19-42
25.5	120.5	108.0	12.6	14.2	29.00	1.03	6.66	19.0	D 19-42
26.0	128.5	109.9	18.6	15.3	29.70	1.24	6.74	19.2	D 19-42
26.5	129.6	111.0	18.6	15.5	29.97	1.27	6.76	19.2	D 19-42
27.0	130.8	112.2	18.6	15.8	30.22	1.29	6.79	19.1	D 19-42
27.5	131.9	113.3	18.6	16.0	29.99	1.22	6.81	19.1	D 19-42
28.0	133.0	114.4	18.6	16.2	29.73	1.20	6.84	19.0	D 19-42

## Fwd Abutment Calculations + 16-in

DLZ OHIO

28.5	134.2	115.6	18.6	16.4	29.99	1.17	6.85	19.1	D 19-42
29.0	135.6	117.1	18.6	16.2	30.16	1.20	6.84	19.1	D 19-42
29.5	136.9	118.3	18.6	16.5	30.43	1.16	6.87	19.0	D 19-42
30.0	138.2	119.6	18.6	16.8	30.71	1.11	6.89	19.0	D 19-42
30.5	139.5	120.9	18.6	17.1	30.44	0.94	6.93	18.9	D 19-42
31.0	140.7	122.1	18.6	17.3	30.23	0.93	6.94	18.9	D 19-42
31.5	142.0	123.4	18.6	17.6	30.44	0.95	6.97	18.9	D 19-42
32.0	143.6	125.0	18.6	17.4	30.65	0.96	6.96	19.0	D 19-42
32.5	145.0	126.4	18.6	17.7	30.92	1.00	7.00	18.8	D 19-42
33.0	146.5	127.9	18.6	18.1	31.20	1.03	7.02	18.8	D 19-42
33.5	147.9	129.3	18.6	18.4	30.95	0.91	7.05	18.7	D 19-42
34.0	149.2	130.6	18.6	18.7	30.72	0.89	7.07	18.8	D 19-42
34.5	150.6	132.0	18.6	19.0	30.94	0.89	7.10	18.8	D 19-42
35.0	152.4	133.8	18.6	18.9	31.13	1.06	7.09	18.7	D 19-42
35.5	153.9	135.3	18.6	19.2	31.42	1.08	7.13	18.7	D 19-42
36.0	155.5	136.9	18.6	19.6	31.73	1.12	7.15	18.7	D 19-42
36.5	157.0	138.4	18.6	19.9	31.48	1.00	7.17	18.7	D 19-42
37.0	158.6	140.0	18.6	20.4	31.20	0.98	7.21	18.6	D 19-42
37.5	160.1	141.5	18.6	20.7	31.43	0.97	7.23	18.6	D 19-42
38.0	162.0	143.4	18.6	20.5	31.64	1.08	7.22	18.6	D 19-42
38.5	163.7	145.1	18.6	20.9	31.94	1.03	7.25	18.5	D 19-42
39.0	165.4	146.8	18.6	21.1	32.22	0.99	7.27	18.5	D 19-42
39.5	167.0	148.4	18.6	21.3	31.92	0.78	7.29	18.5	D 19-42
40.0	168.7	150.1	18.6	21.6	31.63	0.74	7.31	18.4	D 19-42
40.5	170.4	151.8	18.6	21.9	31.84	0.78	7.34	18.3	D 19-42
41.0	172.4	153.8	18.6	21.6	32.08	0.80	7.33	18.4	D 19-42
41.5	174.2	155.6	18.6	21.9	32.34	0.84	7.35	18.3	D 19-42
42.0	176.0	157.4	18.6	22.1	32.63	0.83	7.37	18.3	D 19-42
42.5	177.8	159.2	18.6	22.4	32.34	0.63	7.39	18.2	D 19-42
43.0	179.6	161.0	18.6	22.8	32.08	0.56	7.42	18.1	D 19-42
43.5	181.4	162.8	18.6	23.0	32.27	0.45	7.44	18.1	D 19-42
44.0	183.6	165.0	18.6	22.9	32.51	0.49	7.44	18.1	D 19-42
44.5	185.5	166.9	18.6	23.2	32.77	0.50	7.46	18.0	D 19-42
45.0	187.5	168.9	18.6	23.4	33.05	0.51	7.48	18.0	D 19-42
45.5	189.4	170.9	18.6	23.7	32.83	0.39	7.49	18.0	D 19-42
46.0	219.2	173.0	46.2	30.4	33.24	0.17	7.76	17.7	D 19-42
46.5	222.1	175.9	46.2	31.0	33.41	0.18	7.78	17.7	D 19-42
47.0	225.5	179.3	46.2	31.0	33.73	0.22	7.77	17.8	D 19-42
47.5	228.6	182.4	46.2	31.8	34.03	0.23	7.81	17.7	D 19-42
48.0	231.7	185.5	46.2	32.4	34.37	0.23	7.82	17.7	D 19-42
48.5	234.9	188.7	46.2	33.2	34.24	0.12	7.85	17.7	D 19-42
49.0	238.0	191.8	46.2	34.1	34.10	0.11	7.88	17.6	D 19-42

## Fwd Abutment Calculations + 16-in

DLZ OHIO

49.5	241.1	194.9	46.2	34.7	34.36	0.11	7.89	17.7	D 19-42
50.0	244.7	198.5	46.2	35.1	34.77	0.12	7.90	17.6	D 19-42
50.5	248.0	201.8	46.2	36.0	35.21	0.12	7.93	17.6	D 19-42
51.0	251.3	205.1	46.2	36.7	35.71	0.11	7.94	17.7	D 19-42
51.5	254.7	208.5	46.2	37.7	35.57	0.00	7.96	17.5	D 19-42
52.0	258.0	211.8	46.2	38.8	35.44	0.00	7.98	17.4	D 19-42

G/L at Shaft and Toe: 0.800/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Bl Ct b/ft	Mx C-Str ksi	Mx T-Str ksi	Stroke ft	ENTHRUHammer kip-ft	-
0.5	20.9	2.1	18.8	1.7	11.92	0.00	3.97	26.3	D 19-42
1.0	23.0	4.1	18.8	1.9	12.81	0.00	4.06	26.0	D 19-42
1.5	25.0	6.2	18.8	2.1	13.78	0.00	4.15	25.6	D 19-42
2.0	27.1	8.2	18.8	2.3	14.82	0.45	4.23	25.3	D 19-42
2.5	29.2	10.3	18.8	2.5	15.17	0.48	4.34	24.7	D 19-42
3.0	31.2	12.4	18.8	2.7	15.65	0.66	4.42	24.4	D 19-42
3.5	33.3	14.4	18.8	2.9	16.16	0.57	4.50	24.1	D 19-42
4.0	35.3	16.5	18.8	3.2	16.66	0.58	4.57	23.8	D 19-42
4.5	37.4	18.5	18.8	3.4	17.33	0.72	4.63	23.7	D 19-42
5.0	39.5	20.6	18.8	3.6	17.83	0.79	4.69	23.5	D 19-42
5.5	41.5	22.7	18.8	3.8	18.30	0.79	4.76	23.2	D 19-42
6.0	43.6	24.7	18.8	4.0	18.71	0.77	4.82	23.0	D 19-42
6.5	45.6	26.8	18.8	4.3	19.06	0.78	4.89	22.8	D 19-42
7.0	47.7	28.9	18.8	4.5	19.45	0.84	4.95	22.6	D 19-42
7.5	49.8	30.9	18.8	4.7	19.84	0.90	5.01	22.5	D 19-42
8.0	51.8	33.0	18.8	5.0	20.24	0.99	5.08	22.3	D 19-42
8.5	53.9	35.0	18.8	5.2	20.65	1.00	5.14	22.1	D 19-42
9.0	55.9	37.1	18.8	5.4	21.06	1.02	5.20	22.0	D 19-42
9.5	58.0	39.2	18.8	5.7	21.51	1.02	5.27	21.9	D 19-42
10.0	60.1	41.2	18.8	5.9	21.95	0.98	5.32	21.7	D 19-42
10.5	62.1	43.3	18.8	6.2	22.36	1.19	5.38	21.7	D 19-42
11.0	76.7	45.3	31.4	8.0	24.23	1.13	5.74	20.8	D 19-42
11.5	78.6	47.2	31.4	8.2	24.56	1.19	5.78	20.8	D 19-42
12.0	80.4	49.0	31.4	8.4	24.90	1.22	5.82	20.7	D 19-42
12.5	82.3	50.9	31.4	8.7	24.93	1.18	5.87	20.5	D 19-42
13.0	84.1	52.7	31.4	9.0	25.26	1.17	5.91	20.5	D 19-42
13.5	86.0	54.6	31.4	9.2	25.57	1.13	5.94	20.4	D 19-42
14.0	87.8	56.4	31.4	9.4	25.89	1.15	5.98	20.3	D 19-42
14.5	89.7	58.3	31.4	9.7	26.21	1.18	6.02	20.2	D 19-42
15.0	91.5	60.1	31.4	9.9	26.50	1.20	6.06	20.2	D 19-42
15.5	93.4	62.0	31.4	10.2	26.37	1.14	6.09	20.1	D 19-42
16.0	95.2	63.8	31.4	10.4	26.38	1.17	6.13	20.1	D 19-42

Fwd Abutment Calculations + 16-in DLZ OHIO

16.5	97.1	65.7	31.4	10.7	26.67	1.18	6.17	20.0	D 19-42
17.0	99.0	67.5	31.4	10.9	26.98	1.20	6.20	19.9	D 19-42
17.5	100.8	69.4	31.4	11.2	27.26	1.22	6.24	19.8	D 19-42
18.0	102.7	71.2	31.4	11.5	27.55	1.25	6.27	19.8	D 19-42
18.5	104.5	73.1	31.4	11.7	27.41	1.17	6.30	19.8	D 19-42
19.0	106.4	74.9	31.4	12.0	27.29	1.18	6.34	19.7	D 19-42
19.5	108.2	76.8	31.4	12.3	27.60	1.18	6.38	19.6	D 19-42
20.0	110.1	78.7	31.4	12.5	27.88	1.20	6.42	19.6	D 19-42
20.5	111.9	80.5	31.4	12.8	28.18	1.22	6.45	19.6	D 19-42
21.0	94.9	82.3	12.6	10.4	27.18	1.20	6.14	19.9	D 19-42
21.5	96.4	83.8	12.6	10.6	27.02	1.15	6.17	19.8	D 19-42
22.0	97.9	85.3	12.6	10.8	26.91	1.14	6.20	19.8	D 19-42
22.5	99.4	86.9	12.6	11.1	27.17	1.11	6.23	19.7	D 19-42
23.0	100.9	88.4	12.6	11.3	27.47	1.05	6.26	19.7	D 19-42
23.5	102.5	89.9	12.6	11.5	27.73	1.02	6.29	19.7	D 19-42
24.0	104.0	91.4	12.6	11.7	27.99	1.05	6.32	19.6	D 19-42
24.5	105.5	92.9	12.6	11.9	27.82	1.02	6.36	19.5	D 19-42
25.0	107.0	94.5	12.6	12.2	27.70	1.09	6.39	19.4	D 19-42
25.5	108.5	96.0	12.6	12.4	27.96	1.18	6.42	19.4	D 19-42
26.0	116.3	97.7	18.6	13.4	28.46	1.06	6.52	19.4	D 19-42
26.5	117.5	98.9	18.6	13.5	28.72	1.02	6.54	19.4	D 19-42
27.0	118.6	100.0	18.6	13.8	28.94	1.00	6.58	19.3	D 19-42
27.5	119.8	101.2	18.6	13.9	28.76	0.92	6.60	19.3	D 19-42
28.0	120.9	102.3	18.6	14.1	28.57	0.94	6.63	19.2	D 19-42
28.5	122.0	103.4	18.6	14.3	28.83	1.00	6.64	19.3	D 19-42
29.0	123.5	104.9	18.6	14.2	28.94	1.06	6.64	19.2	D 19-42
29.5	124.8	106.2	18.6	14.4	29.18	1.12	6.66	19.2	D 19-42
30.0	126.1	107.5	18.6	14.6	29.46	1.16	6.68	19.2	D 19-42
30.5	127.3	108.7	18.6	14.8	29.25	1.06	6.71	19.2	D 19-42
31.0	128.6	110.0	18.6	15.1	29.06	1.04	6.74	19.1	D 19-42
31.5	129.8	111.2	18.6	15.3	29.31	1.01	6.76	19.2	D 19-42
32.0	131.5	112.9	18.6	15.1	29.46	1.01	6.75	19.2	D 19-42
32.5	132.9	114.3	18.6	15.4	29.72	0.96	6.78	19.1	D 19-42
33.0	134.3	115.7	18.6	15.7	29.95	0.89	6.80	19.1	D 19-42
33.5	135.7	117.1	18.6	15.9	29.79	0.71	6.83	19.1	D 19-42
34.0	137.1	118.5	18.6	16.2	29.59	0.74	6.86	19.0	D 19-42
34.5	138.5	119.9	18.6	16.3	30.02	0.78	6.88	19.2	D 19-42
35.0	140.3	121.7	18.6	16.3	29.99	0.84	6.87	19.0	D 19-42
35.5	141.8	123.2	18.6	16.6	30.28	0.87	6.90	19.0	D 19-42
36.0	143.4	124.8	18.6	16.9	30.54	0.87	6.93	19.0	D 19-42
36.5	144.9	126.3	18.6	17.2	30.35	0.77	6.97	18.9	D 19-42
37.0	146.4	127.8	18.6	17.4	30.36	0.82	6.99	19.1	D 19-42

Fwd Abutment Calculations + 16-in DLZ OHIO

37.5	147.9	129.4	18.6	17.7	30.57	0.87	7.02	19.0	D 19-42
38.0	149.8	131.2	18.6	17.7	30.55	1.03	7.01	18.9	D 19-42
38.5	151.5	132.9	18.6	18.1	30.80	1.04	7.05	18.8	D 19-42
39.0	153.2	134.6	18.6	18.3	31.29	1.07	7.07	19.0	D 19-42
39.5	154.9	136.3	18.6	18.6	31.10	0.97	7.09	19.0	D 19-42
40.0	156.5	137.9	18.6	19.0	30.90	0.95	7.12	19.0	D 19-42
40.5	158.2	139.6	18.6	19.3	31.09	0.93	7.15	18.9	D 19-42
41.0	160.2	141.6	18.6	19.2	31.25	0.93	7.15	18.9	D 19-42
41.5	162.1	143.5	18.6	19.5	31.54	0.88	7.17	18.9	D 19-42
42.0	163.9	145.3	18.6	19.9	31.82	0.81	7.19	18.9	D 19-42
42.5	165.7	147.1	18.6	20.4	31.59	0.61	7.23	18.7	D 19-42
43.0	167.5	148.9	18.6	20.7	31.39	0.62	7.25	18.7	D 19-42
43.5	169.3	150.7	18.6	21.1	31.54	0.64	7.27	18.7	D 19-42
44.0	171.4	152.8	18.6	20.9	31.76	0.64	7.26	18.7	D 19-42
44.5	173.4	154.8	18.6	21.3	32.02	0.67	7.30	18.6	D 19-42
45.0	175.4	156.8	18.6	21.5	32.28	0.70	7.32	18.6	D 19-42
45.5	177.3	158.7	18.6	21.8	32.08	0.56	7.35	18.5	D 19-42
46.0	207.0	160.8	46.2	27.6	32.62	0.26	7.63	18.2	D 19-42
46.5	210.0	163.8	46.2	28.1	32.80	0.23	7.65	18.2	D 19-42
47.0	213.3	167.1	46.2	28.2	33.07	0.24	7.65	18.2	D 19-42
47.5	216.4	170.2	46.2	28.7	33.39	0.25	7.68	18.2	D 19-42
48.0	219.6	173.4	46.2	29.3	33.72	0.26	7.70	18.2	D 19-42
48.5	222.7	176.5	46.2	30.2	33.60	0.15	7.74	18.0	D 19-42
49.0	225.8	179.6	46.2	30.7	33.51	0.15	7.76	18.1	D 19-42
49.5	229.0	182.8	46.2	31.4	33.78	0.15	7.78	18.1	D 19-42
50.0	232.5	186.3	46.2	31.5	34.15	0.15	7.78	18.1	D 19-42
50.5	235.8	189.6	46.2	32.4	34.58	0.15	7.82	18.0	D 19-42
51.0	239.2	193.0	46.2	33.1	35.03	0.15	7.84	18.0	D 19-42
51.5	242.5	196.3	46.2	34.0	34.90	0.00	7.87	17.8	D 19-42
52.0	245.9	199.7	46.2	34.7	34.80	0.00	7.88	17.7	D 19-42

G/L at Shaft and Toe: 0.700/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Bl Ct b/ft	Mx C-Str ksi	Mx T-Str ksi	Stroke ft	ENTHRU kip-ft	Hammer -
0.5	20.7	1.8	18.8	1.7	11.99	0.00	3.96	26.5	D 19-42
1.0	22.5	3.6	18.8	1.8	12.49	0.00	4.04	26.2	D 19-42
1.5	24.3	5.4	18.8	2.0	13.20	0.00	4.13	25.7	D 19-42
2.0	26.1	7.2	18.8	2.2	14.20	0.26	4.20	25.5	D 19-42
2.5	27.9	9.0	18.8	2.4	14.77	0.44	4.29	25.1	D 19-42
3.0	29.7	10.8	18.8	2.6	15.21	0.54	4.37	24.7	D 19-42
3.5	31.5	12.6	18.8	2.8	15.64	0.63	4.43	24.4	D 19-42
4.0	33.3	14.4	18.8	2.9	16.07	0.56	4.50	24.2	D 19-42

Fwd Abutment Calculations + 16-in DLZ OHIO

4.5	35.1	16.2	18.8	3.1	16.51	0.57	4.57	23.9	D 19-42
5.0	36.9	18.0	18.8	3.3	17.14	0.69	4.61	23.9	D 19-42
5.5	38.7	19.8	18.8	3.5	17.55	0.79	4.67	23.7	D 19-42
6.0	40.5	21.6	18.8	3.7	17.97	0.81	4.73	23.5	D 19-42
6.5	42.3	23.4	18.8	3.9	18.39	0.80	4.79	23.3	D 19-42
7.0	44.1	25.2	18.8	4.1	18.73	0.73	4.84	23.1	D 19-42
7.5	45.9	27.0	18.8	4.3	19.03	0.78	4.90	22.9	D 19-42
8.0	47.7	28.9	18.8	4.5	19.34	0.85	4.95	22.8	D 19-42
8.5	49.5	30.7	18.8	4.7	19.66	0.90	5.01	22.6	D 19-42
9.0	51.3	32.5	18.8	4.9	20.02	0.99	5.07	22.5	D 19-42
9.5	53.1	34.3	18.8	5.1	20.41	0.93	5.12	22.4	D 19-42
10.0	54.9	36.1	18.8	5.3	20.81	0.95	5.18	22.3	D 19-42
10.5	56.7	37.9	18.8	5.5	21.20	0.99	5.23	22.1	D 19-42
11.0	71.1	39.6	31.4	7.2	23.16	1.10	5.61	21.2	D 19-42
11.5	72.7	41.3	31.4	7.4	23.45	1.11	5.65	21.0	D 19-42
12.0	74.3	42.9	31.4	7.6	23.75	1.10	5.69	21.0	D 19-42
12.5	75.9	44.5	31.4	7.8	23.96	1.11	5.73	20.9	D 19-42
13.0	77.5	46.1	31.4	8.1	24.25	1.13	5.76	20.9	D 19-42
13.5	79.2	47.7	31.4	8.3	24.54	1.16	5.80	20.9	D 19-42
14.0	80.8	49.4	31.4	8.5	24.83	1.18	5.84	20.7	D 19-42
14.5	82.4	51.0	31.4	8.7	25.12	1.17	5.87	20.7	D 19-42
15.0	84.0	52.6	31.4	8.9	25.40	1.16	5.91	20.6	D 19-42
15.5	85.6	54.2	31.4	9.1	25.31	1.09	5.94	20.6	D 19-42
16.0	87.3	55.8	31.4	9.3	25.46	1.07	5.97	20.5	D 19-42
16.5	88.9	57.5	31.4	9.5	25.71	1.14	6.01	20.4	D 19-42
17.0	90.5	59.1	31.4	9.7	25.98	1.16	6.04	20.4	D 19-42
17.5	92.1	60.7	31.4	10.0	26.23	1.15	6.07	20.3	D 19-42
18.0	93.8	62.3	31.4	10.2	26.50	1.16	6.10	20.3	D 19-42
18.5	95.4	64.0	31.4	10.4	26.36	1.10	6.14	20.2	D 19-42
19.0	97.0	65.6	31.4	10.6	26.44	1.12	6.17	20.2	D 19-42
19.5	98.6	67.2	31.4	10.9	26.69	1.14	6.20	20.1	D 19-42
20.0	100.2	68.8	31.4	11.1	26.93	1.16	6.23	20.0	D 19-42
20.5	101.9	70.4	31.4	11.3	27.16	1.18	6.26	20.0	D 19-42
21.0	84.6	72.0	12.6	9.0	26.05	1.25	5.94	20.5	D 19-42
21.5	85.9	73.3	12.6	9.2	25.91	1.28	5.97	20.4	D 19-42
22.0	87.2	74.7	12.6	9.3	25.93	1.24	6.00	20.4	D 19-42
22.5	88.6	76.0	12.6	9.5	26.14	1.17	6.03	20.2	D 19-42
23.0	89.9	77.3	12.6	9.7	26.40	1.16	6.05	20.2	D 19-42
23.5	91.2	78.7	12.6	9.9	26.60	1.17	6.08	20.1	D 19-42
24.0	92.6	80.0	12.6	10.1	26.83	1.19	6.11	20.1	D 19-42
24.5	93.9	81.3	12.6	10.2	26.70	1.16	6.13	20.1	D 19-42
25.0	95.2	82.6	12.6	10.4	26.63	1.12	6.16	20.0	D 19-42

## Fwd Abutment Calculations + 16-in

DLZ OHIO

25.5	96.5	84.0	12.6	10.6	26.88	1.08	6.18	20.0	D 19-42
26.0	104.2	85.6	18.6	11.6	27.32	0.90	6.29	19.8	D 19-42
26.5	105.3	86.7	18.6	11.8	27.56	0.93	6.31	19.8	D 19-42
27.0	106.5	87.9	18.6	12.0	27.77	0.96	6.34	19.7	D 19-42
27.5	107.6	89.0	18.6	12.1	27.60	0.93	6.37	19.7	D 19-42
28.0	108.7	90.1	18.6	12.3	27.50	0.99	6.39	19.6	D 19-42
28.5	109.9	91.3	18.6	12.4	27.75	0.98	6.41	19.7	D 19-42
29.0	111.4	92.8	18.6	12.3	27.83	1.01	6.40	19.6	D 19-42
29.5	112.6	94.0	18.6	12.5	28.05	0.96	6.43	19.5	D 19-42
30.0	113.9	95.3	18.6	12.7	28.29	0.87	6.45	19.6	D 19-42
30.5	115.2	96.6	18.6	12.9	28.14	0.69	6.48	19.5	D 19-42
31.0	116.4	97.8	18.6	13.0	27.99	0.67	6.50	19.5	D 19-42
31.5	117.7	99.1	18.6	13.2	28.24	0.70	6.53	19.5	D 19-42
32.0	119.3	100.7	18.6	13.1	28.34	0.77	6.52	19.5	D 19-42
32.5	120.7	102.1	18.6	13.3	28.59	0.81	6.54	19.5	D 19-42
33.0	122.2	103.6	18.6	13.5	28.82	0.87	6.58	19.4	D 19-42
33.5	123.6	105.0	18.6	13.7	28.69	0.83	6.60	19.4	D 19-42
34.0	124.9	106.3	18.6	13.9	28.55	0.81	6.63	19.4	D 19-42
34.5	126.3	107.7	18.6	14.2	28.79	0.80	6.65	19.4	D 19-42
35.0	128.1	109.5	18.6	14.0	28.92	0.76	6.64	19.4	D 19-42
35.5	129.6	111.1	18.6	14.3	29.13	0.72	6.67	19.3	D 19-42
36.0	131.2	112.6	18.6	14.6	29.38	0.68	6.71	19.3	D 19-42
36.5	132.7	114.2	18.6	14.8	29.25	0.57	6.73	19.3	D 19-42
37.0	134.3	115.7	18.6	15.0	29.10	0.62	6.76	19.3	D 19-42
37.5	135.8	117.2	18.6	15.3	29.34	0.68	6.79	19.3	D 19-42
38.0	137.7	119.1	18.6	15.2	29.47	0.75	6.78	19.3	D 19-42
38.5	139.4	120.8	18.6	15.5	29.73	0.81	6.81	19.3	D 19-42
39.0	141.1	122.5	18.6	15.8	29.98	0.80	6.85	19.2	D 19-42
39.5	142.7	124.1	18.6	16.1	29.84	0.73	6.87	19.2	D 19-42
40.0	144.4	125.8	18.6	16.4	29.69	0.76	6.91	19.1	D 19-42
40.5	146.1	127.5	18.6	16.7	29.90	0.83	6.94	19.1	D 19-42
41.0	148.1	129.5	18.6	16.6	30.06	0.92	6.93	19.1	D 19-42
41.5	149.9	131.3	18.6	16.9	30.31	0.95	6.96	19.1	D 19-42
42.0	151.7	133.1	18.6	17.3	30.59	0.96	6.99	19.1	D 19-42
42.5	153.5	134.9	18.6	17.6	30.43	0.84	7.02	19.0	D 19-42
43.0	155.3	136.7	18.6	17.8	30.49	0.74	7.05	19.2	D 19-42
43.5	157.1	138.5	18.6	18.3	30.46	0.71	7.08	19.0	D 19-42
44.0	159.3	140.7	18.6	18.3	30.61	0.67	7.08	18.9	D 19-42
44.5	161.2	142.6	18.6	18.6	30.89	0.63	7.10	18.9	D 19-42
45.0	163.2	144.6	18.6	19.0	31.16	0.60	7.14	18.8	D 19-42
45.5	165.2	146.6	18.6	19.4	31.06	0.49	7.16	18.9	D 19-42
46.0	164.9	148.7	46.2	25.3	31.94	0.30	7.50	18.6	D 19-42

Fwd Abutment Calculations + 16-in DLZ OHIO

46.5	197.8	151.6	46.2	25.7	32.10	0.31	7.53	18.6	D 19-42
47.0	201.2	155.0	46.2	25.6	32.38	0.33	7.52	18.7	D 19-42
47.5	204.3	158.1	46.2	26.2	32.65	0.31	7.55	18.6	D 19-42
48.0	207.4	161.2	46.2	26.7	32.96	0.29	7.58	18.6	D 19-42
48.5	210.6	164.4	46.2	27.3	32.92	0.15	7.61	18.6	D 19-42
49.0	213.7	167.5	46.2	27.9	32.83	0.16	7.63	18.5	D 19-42
49.5	216.8	170.6	46.2	28.4	33.07	0.16	7.66	18.5	D 19-42
50.0	220.4	174.2	46.2	28.6	33.43	0.18	7.67	18.5	D 19-42
50.5	223.7	177.5	46.2	29.3	33.79	0.18	7.70	18.4	D 19-42
51.0	227.1	180.8	46.2	29.9	34.19	0.18	7.72	18.4	D 19-42
51.5	230.4	184.2	46.2	30.6	34.12	0.01	7.74	18.3	D 19-42
52.0	233.7	187.5	46.2	31.5	34.02	0.00	7.78	18.1	D 19-42

G/L at Shaft and Toe: 0.600/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Bl Ct b/ft	Mx C-Str ksi	Mx T-Str ksi	Stroke ft	ENTHRU kip-ft	Hammer -
0.5	20.4	1.5	18.8	1.6	12.06	0.00	3.95	26.6	D 19-42
1.0	21.9	3.1	18.8	1.8	12.51	0.00	4.02	26.5	D 19-42
1.5	23.5	4.6	18.8	1.9	12.75	0.00	4.11	25.9	D 19-42
2.0	25.0	6.2	18.8	2.1	13.54	0.00	4.17	25.7	D 19-42
2.5	26.6	7.7	18.8	2.2	14.41	0.40	4.23	25.6	D 19-42
3.0	28.1	9.3	18.8	2.4	14.79	0.44	4.31	25.1	D 19-42
3.5	29.7	10.8	18.8	2.6	15.17	0.53	4.37	24.8	D 19-42
4.0	31.2	12.4	18.8	2.7	15.55	0.63	4.43	24.6	D 19-42
4.5	32.8	13.9	18.8	2.9	15.92	0.59	4.49	24.4	D 19-42
5.0	34.3	15.5	18.8	3.0	16.26	0.54	4.54	24.1	D 19-42
5.5	35.9	17.0	18.8	3.2	16.82	0.62	4.59	24.1	D 19-42
6.0	37.4	18.5	18.8	3.4	17.19	0.74	4.64	23.9	D 19-42
6.5	38.9	20.1	18.8	3.5	17.56	0.74	4.69	23.8	D 19-42
7.0	40.5	21.6	18.8	3.7	17.92	0.76	4.74	23.6	D 19-42
7.5	42.0	23.2	18.8	3.9	18.27	0.82	4.79	23.4	D 19-42
8.0	43.6	24.7	18.8	4.0	18.58	0.72	4.84	23.2	D 19-42
8.5	45.1	26.3	18.8	4.2	18.87	0.76	4.88	23.1	D 19-42
9.0	46.7	27.8	18.8	4.4	19.11	0.81	4.93	22.9	D 19-42
9.5	48.2	29.4	18.8	4.5	19.38	0.83	4.97	22.8	D 19-42
10.0	49.8	30.9	18.8	4.7	19.66	0.87	5.02	22.7	D 19-42
10.5	51.3	32.5	18.8	4.9	19.99	0.94	5.07	22.6	D 19-42
11.0	65.4	34.0	31.4	6.5	22.26	1.13	5.47	21.7	D 19-42
11.5	66.8	35.4	31.4	6.7	22.34	1.13	5.51	21.4	D 19-42
12.0	68.2	36.8	31.4	6.9	22.61	1.12	5.55	21.4	D 19-42
12.5	69.6	38.1	31.4	7.0	22.89	1.09	5.58	21.4	D 19-42
13.0	70.9	39.5	31.4	7.2	23.16	1.07	5.61	21.3	D 19-42

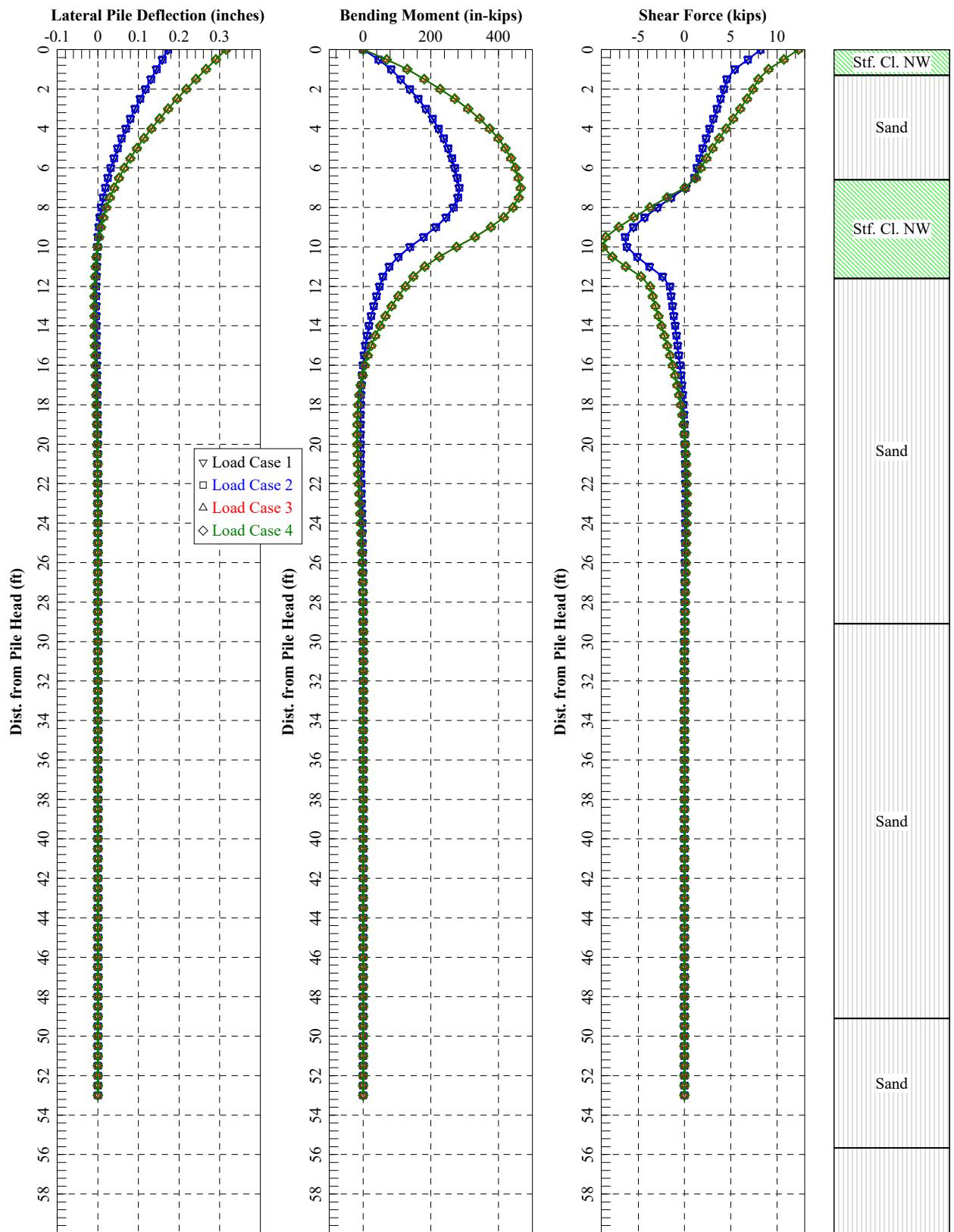
Fwd Abutment Calculations + 16-in DLZ OHIO

13.5	72.3	40.9	31.4	7.4	23.43	1.05	5.65	21.2	D 19-42
14.0	73.7	42.3	31.4	7.5	23.70	1.05	5.68	21.1	D 19-42
14.5	75.1	43.7	31.4	7.7	23.95	1.07	5.71	21.1	D 19-42
15.0	76.5	45.1	31.4	7.9	24.21	1.10	5.75	21.1	D 19-42
15.5	77.9	46.5	31.4	8.1	24.18	1.10	5.78	21.0	D 19-42
16.0	79.3	47.9	31.4	8.3	24.44	1.12	5.81	21.0	D 19-42
16.5	80.7	49.3	31.4	8.4	24.69	1.13	5.84	20.9	D 19-42
17.0	82.1	50.7	31.4	8.6	24.91	1.12	5.87	20.8	D 19-42
17.5	83.5	52.0	31.4	8.8	25.16	1.11	5.90	20.8	D 19-42
18.0	84.8	53.4	31.4	9.0	25.39	1.09	5.93	20.7	D 19-42
18.5	86.2	54.8	31.4	9.2	25.30	1.07	5.96	20.6	D 19-42
19.0	87.6	56.2	31.4	9.3	25.45	1.12	5.99	20.6	D 19-42
19.5	89.0	57.6	31.4	9.5	25.67	1.14	6.02	20.5	D 19-42
20.0	90.4	59.0	31.4	9.7	25.90	1.12	6.05	20.5	D 19-42
20.5	91.8	60.4	31.4	9.9	26.12	1.09	6.07	20.4	D 19-42
21.0	74.3	61.7	12.6	7.6	24.74	1.04	5.72	21.0	D 19-42
21.5	75.4	62.9	12.6	7.8	24.64	1.05	5.75	20.9	D 19-42
22.0	76.6	64.0	12.6	7.9	24.72	1.09	5.77	20.9	D 19-42
22.5	77.7	65.1	12.6	8.1	24.93	1.10	5.80	20.9	D 19-42
23.0	78.8	66.3	12.6	8.2	25.14	1.08	5.83	20.8	D 19-42
23.5	80.0	67.4	12.6	8.4	25.35	1.12	5.86	20.7	D 19-42
24.0	81.1	68.6	12.6	8.6	25.56	1.19	5.88	20.7	D 19-42
24.5	82.3	69.7	12.6	8.7	25.49	1.22	5.90	20.7	D 19-42
25.0	83.4	70.8	12.6	8.9	25.46	1.28	5.93	20.6	D 19-42
25.5	84.5	72.0	12.6	9.0	25.65	1.31	5.96	20.5	D 19-42
26.0	92.0	73.4	18.6	9.9	26.17	1.03	6.06	20.4	D 19-42
26.5	93.2	74.6	18.6	10.0	26.36	1.06	6.08	20.3	D 19-42
27.0	94.3	75.7	18.6	10.2	26.54	1.09	6.11	20.2	D 19-42
27.5	95.5	76.9	18.6	10.4	26.44	1.02	6.13	20.2	D 19-42
28.0	96.6	78.0	18.6	10.5	26.36	1.02	6.15	20.2	D 19-42
28.5	97.7	79.1	18.6	10.7	26.58	1.00	6.17	20.2	D 19-42
29.0	99.2	80.6	18.6	10.6	26.64	1.14	6.16	20.1	D 19-42
29.5	100.5	81.9	18.6	10.8	26.87	1.10	6.19	20.1	D 19-42
30.0	101.8	83.2	18.6	10.9	27.08	1.05	6.21	20.1	D 19-42
30.5	103.0	84.4	18.6	11.1	26.95	0.90	6.24	20.0	D 19-42
31.0	104.3	85.7	18.6	11.3	26.85	0.82	6.27	19.9	D 19-42
31.5	105.5	87.0	18.6	11.5	27.08	0.74	6.29	19.9	D 19-42
32.0	107.2	88.6	18.6	11.4	27.14	0.79	6.28	19.9	D 19-42
32.5	108.6	90.0	18.6	11.5	27.37	0.80	6.31	19.8	D 19-42
33.0	110.0	91.4	18.6	11.7	27.60	0.83	6.33	19.8	D 19-42
33.5	111.4	92.8	18.6	11.9	27.50	0.70	6.36	19.8	D 19-42
34.0	112.8	94.2	18.6	12.1	27.38	0.62	6.39	19.7	D 19-42

Fwd Abutment Calculations + 16-in DLZ OHIO

34.5	114.2	95.6	18.6	12.3	27.61	0.51	6.41	19.7	D 19-42
35.0	116.0	97.4	18.6	12.2	27.71	0.57	6.40	19.7	D 19-42
35.5	117.5	98.9	18.6	12.4	27.95	0.65	6.44	19.6	D 19-42
36.0	119.1	100.5	18.6	12.6	28.18	0.66	6.46	19.6	D 19-42
36.5	120.6	102.0	18.6	12.8	28.08	0.57	6.49	19.6	D 19-42
37.0	122.1	103.5	18.6	13.0	27.99	0.59	6.52	19.6	D 19-42
37.5	123.7	105.1	18.6	13.2	28.20	0.60	6.55	19.6	D 19-42
38.0	125.5	106.9	18.6	13.1	28.30	0.57	6.54	19.6	D 19-42
38.5	127.2	108.6	18.6	13.3	28.55	0.55	6.57	19.6	D 19-42
39.0	128.9	110.3	18.6	13.6	28.80	0.51	6.60	19.5	D 19-42
39.5	130.6	112.0	18.6	13.8	28.70	0.42	6.63	19.5	D 19-42
40.0	132.2	113.6	18.6	14.1	28.56	0.45	6.67	19.4	D 19-42
40.5	133.9	115.3	18.6	14.3	28.78	0.51	6.70	19.4	D 19-42
41.0	135.9	117.3	18.6	14.3	28.87	0.56	6.69	19.4	D 19-42
41.5	137.8	119.2	18.6	14.5	29.16	0.67	6.72	19.5	D 19-42
42.0	139.6	121.0	18.6	14.8	29.41	0.73	6.75	19.4	D 19-42
42.5	141.4	122.8	18.6	15.1	29.32	0.66	6.79	19.4	D 19-42
43.0	143.2	124.6	18.6	15.4	29.21	0.66	6.82	19.3	D 19-42
43.5	145.0	126.4	18.6	15.7	29.40	0.71	6.85	19.3	D 19-42
44.0	147.1	128.5	18.6	15.7	29.51	0.73	6.85	19.3	D 19-42
44.5	149.1	130.5	18.6	15.9	29.80	0.74	6.88	19.3	D 19-42
45.0	151.1	132.5	18.6	16.3	30.03	0.72	6.92	19.2	D 19-42
45.5	153.0	134.4	18.6	16.7	29.98	0.61	6.95	19.2	D 19-42
46.0	182.7	136.5	46.2	23.0	31.19	0.31	7.36	19.1	D 19-42
46.5	185.7	139.5	46.2	23.4	31.35	0.31	7.38	19.1	D 19-42
47.0	189.0	142.8	46.2	23.5	31.59	0.33	7.39	19.1	D 19-42
47.5	192.1	145.9	46.2	23.9	31.86	0.34	7.41	19.1	D 19-42
48.0	195.3	149.1	46.2	24.4	32.15	0.34	7.45	19.0	D 19-42
48.5	198.4	152.2	46.2	25.0	32.09	0.20	7.48	18.9	D 19-42
49.0	201.5	155.3	46.2	25.5	32.06	0.18	7.51	18.9	D 19-42
49.5	204.7	158.5	46.2	25.8	32.30	0.17	7.52	18.9	D 19-42
50.0	208.2	162.0	46.2	26.0	32.58	0.17	7.54	18.9	D 19-42
50.5	211.5	165.3	46.2	26.6	32.93	0.18	7.57	18.9	D 19-42
51.0	214.9	168.7	46.2	27.3	33.25	0.18	7.60	18.8	D 19-42
51.5	218.2	172.0	46.2	27.7	33.24	0.05	7.61	18.8	D 19-42
52.0	221.6	175.4	46.2	28.3	33.16	0.00	7.64	18.6	D 19-42





West Woods - Rear Abutment (B-001)

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LPile for Windows, Version 2022-12.005

Analysis of Individual Piles and Drilled Shafts  
Subjected to Lateral Loading Using the p-y Method  
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Files Used for Analysis  
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Path to file locations:

\Projects\2021\2122\101200 Geauga Park WW  
Br\118538\400-Engineering\Geotechnical\EngData\Calcs\2023\

Name of input data file:

Rear Abutment - Lateral Analysis.lp12d

Name of output report file:

Rear Abutment - Lateral Analysis.lp12o

Name of plot output file:

Rear Abutment - Lateral Analysis.lp12p

Name of runtime message file:

Rear Abutment - Lateral Analysis.lp12r

Date and Time of Analysis

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Date: November 22, 2023

Time: 9:25:09

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Problem Title  
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Project Name: West Woods Bridge Replacement

Job Number: 2122-1012.00

Client: Geauga Parks

Engineer: RJH

Description: Pile Lateral Analysis

-----  
Program Options and Settings  
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Computational Options:

- Conventional Analysis

Engineering Units Used for Data Input and Computations:

- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- |  |   |               |
|--|---|---------------|
| - Maximum number of iterations allowed | = | 500           |
| - Deflection tolerance for convergence | = | 1.0000E-05 in |
| - Maximum allowable deflection         | = | 100.0000 in   |
| - Number of pile increments            | = | 106           |

Loading Type and Number of Cycles of Loading:

- Static loading specified
- Analysis uses p-y modification factors for p-y curves
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

**Output Options:**

- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

**Pile Structural Properties and Geometry**

Number of pile sections defined	=	1
Total length of pile	=	53.000 ft
Depth of ground surface below top of pile	=	0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head	Pile Diameter
	feet	inches
1	0.000	16.0000
2	53.000	16.0000

**Input Structural Properties for Pile Sections:**

**Pile Section No. 1:**

Section 1 is an elastic pile

Cross-sectional Shape	=	Circular Pipe
Length of section	=	53.000000 ft
Width of top of section	=	16.000000 in
Width of bottom of section	=	16.000000 in
Wall Thickness at Top	=	0.250000 in
Wall Thickness at Bottom	=	0.250000 in
Top Area	=	12.370021 sq. in
Bottom Area	=	12.370021 sq. in
Moment of Inertia at Top	=	383.663935 in^4
Moment of Inertia at Bottom	=	383.663935 in^4
Elastic Modulus	=	29000000. psi

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#### Soil and Rock Layering Information

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The soil profile is modelled using 6 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer	=	0.0000 ft
Distance from top of pile to bottom of layer	=	1.300000 ft
Effective unit weight at top of layer	=	57.600000 pcf
Effective unit weight at bottom of layer	=	57.600000 pcf
Undrained cohesion at top of layer	=	1500. psf
Undrained cohesion at bottom of layer	=	1500. psf
Epsilon-50 at top of layer	=	0.007000
Epsilon-50 at bottom of layer	=	0.007000

Layer 2 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	1.300000 ft
Distance from top of pile to bottom of layer	=	6.600000 ft
Effective unit weight at top of layer	=	57.600000 pcf
Effective unit weight at bottom of layer	=	57.600000 pcf
Friction angle at top of layer	=	28.000000 deg.
Friction angle at bottom of layer	=	28.000000 deg.
Subgrade k at top of layer	=	20.000000 pci
Subgrade k at bottom of layer	=	20.000000 pci

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	6.600000 ft
Distance from top of pile to bottom of layer	=	11.600000 ft
Effective unit weight at top of layer	=	62.600000 pcf
Effective unit weight at bottom of layer	=	62.600000 pcf

Undrained cohesion at top of layer	=	2000. psf
Undrained cohesion at bottom of layer	=	2000. psf
Epsilon-50 at top of layer	=	0.007000
Epsilon-50 at bottom of layer	=	0.007000

Layer 4 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	11.600000 ft
Distance from top of pile to bottom of layer	=	29.100000 ft
Effective unit weight at top of layer	=	62.600000 pcf
Effective unit weight at bottom of layer	=	62.600000 pcf
Friction angle at top of layer	=	30.000000 deg.
Friction angle at bottom of layer	=	30.000000 deg.
Subgrade k at top of layer	=	40.000000 pci
Subgrade k at bottom of layer	=	40.000000 pci

Layer 5 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	29.100000 ft
Distance from top of pile to bottom of layer	=	49.100000 ft
Effective unit weight at top of layer	=	62.600000 pcf
Effective unit weight at bottom of layer	=	62.600000 pcf
Friction angle at top of layer	=	32.000000 deg.
Friction angle at bottom of layer	=	32.000000 deg.
Subgrade k at top of layer	=	60.000000 pci
Subgrade k at bottom of layer	=	60.000000 pci

Layer 6 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	49.100000 ft
Distance from top of pile to bottom of layer	=	65.600000 ft
Effective unit weight at top of layer	=	67.600000 pcf
Effective unit weight at bottom of layer	=	67.600000 pcf
Friction angle at top of layer	=	34.000000 deg.
Friction angle at bottom of layer	=	34.000000 deg.
Subgrade k at top of layer	=	125.000000 pci
Subgrade k at bottom of layer	=	125.000000 pci

(Depth of the lowest soil layer extends 12.600 ft below the pile tip)

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Summary of Input Soil Properties

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Layer E50 Num. or krm	Soil Type Name (p-y Curve Type) kpy pci	Layer Depth ft	Effective Unit Wt. pcf	Cohesion psf	Angle of Friction deg.
1 0.00700	Stiff Clay -- w/o Free Water --	0.00 1.3000	57.6000 57.6000	1500. 1500.	-- --
2 --	Sand 20.0000 (Reese, et al.) 20.0000	1.3000 6.6000	57.6000 57.6000	-- --	28.0000 28.0000
3 0.00700	Stiff Clay -- w/o Free Water --	6.6000 11.6000	62.6000 62.6000	2000. 2000.	-- --
4 --	Sand 40.0000 (Reese, et al.) 40.0000	11.6000 29.1000	62.6000 62.6000	-- --	30.0000 30.0000
5 --	Sand 60.0000 (Reese, et al.) 60.0000	29.1000 49.1000	62.6000 62.6000	-- --	32.0000 32.0000
6 --	Sand 125.0000 (Reese, et al.) 125.0000	49.1000 65.6000	67.6000 67.6000	-- --	34.0000 34.0000

#### Modification Factors for p-y Curves

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	0.000	1.0000	1.0000
2	53.000	1.0000	1.0000

### Static Loading Type

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Static loading criteria were used when computing p-y curves for all analyses.

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### Pile-head Loading and Pile-head Fixity Conditions

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Number of loads specified = 4

Load Compute No.	Load Top y vs. Pile Length	Type	Condition Run Analysis 1	Condition 2	Axial Thrust Force, lbs
1	1	V =	8220. lbs	M = 0.0000 in-lbs	0.0000000
No		Yes			
2	1	V =	8220. lbs	M = 0.0000 in-lbs	22080.
No		Yes			
3	1	V =	12330. lbs	M = 0.0000 in-lbs	20510.
No		Yes			
4	1	V =	12330. lbs	M = 0.0000 in-lbs	28230.
No		Yes			

V = shear force applied normal to pile axis

M = bending moment applied to pile head

y = lateral deflection normal to pile axis

S = pile slope relative to original pile batter angle

R = rotational stiffness applied to pile head

Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).

Thrust force is assumed to be acting axially for all pile batter angles.

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### Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

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Moment-curvature properties were derived from elastic section properties

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	8499.
2	1.3000	5.3228	No	No	8499.	31852.
3	6.6000	3.9786	No	No	40351.	74942.
4	11.6000	14.1115	No	No	115293.	732639.
5	29.1000	27.4794	Yes	No	847932.	2086596.
6	49.1000	42.7118	Yes	No	2934527.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection  
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head	=	8220.0 lbs
Applied moment at pile head	=	0.0 in-lbs
Axial thrust load on pile head	=	0.0 lbs

Res.	Depth feet	Deflect. Es*H lb/inch	Bending Spr. Lat. Load inches lb/inch	Moment in-lbs lb/inch	Shear Force lbs	Slope radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil p
	0.00	0.1723	7.72E-08		8220.	-0.00236	1.61E-09	1.11E+10	
	-221.420	3856.	0.00						

0.5000	0.1581	45334.	6861.	-0.00234	945.2949	1.11E+10
-231.662	8790.	0.00				
1.0000	0.1441	82329.	5443.	-0.00231	1717.	1.11E+10
-240.949	10030.	0.00				
1.5000	0.1304	110650.	4579.	-0.00226	2307.	1.11E+10
-46.950	2160.	0.00				
2.0000	0.1170	137280.	4270.	-0.00219	2863.	1.11E+10
-56.183	2880.	0.00				
2.5000	0.1041	161887.	3914.	-0.00211	3376.	1.11E+10
-62.473	3600.	0.00				
3.0000	0.09172	184246.	3528.	-0.00202	3842.	1.11E+10
-66.039	4320.	0.00				
3.5000	0.07992	204227.	3129.	-0.00191	4258.	1.11E+10
-67.129	5040.	0.00				
4.0000	0.06877	221792.	2729.	-0.00180	4625.	1.11E+10
-66.020	5760.	0.00				
4.5000	0.05834	236980.	2342.	-0.00167	4941.	1.11E+10
-63.012	6480.	0.00				
5.0000	0.04868	249899.	1978.	-0.00154	5211.	1.11E+10
-58.421	7200.	0.00				
5.5000	0.03983	260716.	1645.	-0.00140	5436.	1.11E+10
-52.579	7920.	0.00				
6.0000	0.03182	269639.	1350.	-0.00126	5622.	1.11E+10
-45.828	8640.	0.00				
6.5000	0.02469	276913.	1097.	-0.00111	5774.	1.11E+10
-38.515	9360.	0.00				
7.0000	0.01845	282800.	175.7863	-9.64E-04	5897.	1.11E+10
-268.465	87306.	0.00				
7.5000	0.01313	279022.	-1401.	-8.12E-04	5818.	1.11E+10
-257.041	117500.	0.00				
8.0000	0.00870	265991.	-2896.	-6.65E-04	5546.	1.11E+10
-241.419	166422.	0.00				
8.5000	0.00514	244269.	-4280.	-5.28E-04	5093.	1.11E+10
-219.964	256625.	0.00				
9.0000	0.00237	214628.	-5505.	-4.04E-04	4475.	1.11E+10
-188.124	475820.	0.00				
9.5000	2.96E-04	178214.	-6397.	-2.98E-04	3716.	1.11E+10
-109.280	2215115.	0.00				
10.0000	-0.00120	137867.	-6214.	-2.13E-04	2875.	1.11E+10
170.2810	848878.	0.00				
10.5000	-0.00226	103650.	-5085.	-1.48E-04	2161.	1.11E+10
206.0388	547716.	0.00				
11.0000	-0.00298	76850.	-3783.	-9.90E-05	1602.	1.11E+10
228.0170	459836.	0.00				
11.5000	-0.00344	58258.	-2366.	-6.25E-05	1215.	1.11E+10
244.0385	425072.	0.00				
12.0000	-0.00373	48452.	-1570.	-3.38E-05	1010.	1.11E+10
21.4597	34560.	0.00				
12.5000	-0.00385	39419.	-1436.	-1.01E-05	821.9437	1.11E+10
23.0991	36000.	0.00				

13.0000	-0.00385	31217.	-1295.	8.97E-06	650.9220	1.11E+10
24.0022	37440.	0.00				
13.5000	-0.00374	23879.	-1150.	2.38E-05	497.9176	1.11E+10
24.2492	38880.	0.00				
14.0000	-0.00356	17414.	-1006.	3.50E-05	363.1161	1.11E+10
23.9269	40320.	0.00				
14.5000	-0.00332	11811.	-864.531	4.28E-05	246.2755	1.11E+10
23.1253	41760.	0.00				
15.0000	-0.00305	7040.	-729.352	4.79E-05	146.7940	1.11E+10
21.9343	43200.	0.00				
15.5000	-0.00275	3059.	-602.226	5.06E-05	63.7777	1.11E+10
20.4413	44640.	0.00				
16.0000	-0.00244	-186.759	-484.715	5.14E-05	3.8942	1.11E+10
18.7287	46080.	0.00				
16.5000	-0.00213	-2758.	-377.911	5.06E-05	57.5073	1.11E+10
16.8728	47520.	0.00				
17.0000	-0.00183	-4722.	-282.468	4.86E-05	98.4547	1.11E+10
14.9416	48960.	0.00				
17.5000	-0.00155	-6148.	-198.657	4.57E-05	128.1861	1.11E+10
12.9952	50400.	0.00				
18.0000	-0.00128	-7106.	-126.419	4.21E-05	148.1625	1.11E+10
11.0842	51840.	0.00				
18.5000	-0.00104	-7665.	-65.414	3.81E-05	159.8185	1.11E+10
9.2506	53280.	0.00				
19.0000	-8.25E-04	-7891.	-15.080	3.39E-05	164.5305	1.11E+10
7.5275	54720.	0.00				
19.5000	-6.35E-04	-7846.	25.3207	2.97E-05	163.5919	1.11E+10
5.9394	56160.	0.00				
20.0000	-4.69E-04	-7587.	56.6494	2.55E-05	158.1948	1.11E+10
4.5035	57600.	0.00				
20.5000	-3.28E-04	-7166.	79.8489	2.16E-05	149.4171	1.11E+10
3.2297	59040.	0.00				
21.0000	-2.11E-04	-6629.	95.9037	1.78E-05	138.2151	1.11E+10
2.1219	60480.	0.00				
21.5000	-1.14E-04	-6015.	105.8066	1.44E-05	125.4202	1.11E+10
1.1790	61920.	0.00				
22.0000	-3.74E-05	-5359.	110.5300	1.14E-05	111.7402	1.11E+10
0.3954	63360.	0.00				
22.5000	2.20E-05	-4689.	111.0031	8.65E-06	97.7635	1.11E+10
-0.238	64800.	0.00				
23.0000	6.63E-05	-4027.	108.0938	6.30E-06	83.9652	1.11E+10
-0.732	66240.	0.00				
23.5000	9.76E-05	-3391.	102.5961	4.30E-06	70.7163	1.11E+10
-1.101	67680.	0.00				
24.0000	1.18E-04	-2796.	95.2213	2.63E-06	58.2937	1.11E+10
-1.358	69120.	0.00				
24.5000	1.29E-04	-2249.	86.5936	1.27E-06	46.8902	1.11E+10
-1.518	70560.	0.00				
25.0000	1.33E-04	-1757.	77.2486	1.88E-07	36.6263	1.11E+10
-1.597	72000.	0.00				

25.5000	1.31E-04	-1322.	67.6350	-6.42E-07	27.5611	1.11E+10
-1.608	73440.	0.00				
26.0000	1.25E-04	-944.903	58.1185	-1.25E-06	19.7027	1.11E+10
-1.564	74880.	0.00				
26.5000	1.16E-04	-624.353	48.9869	-1.68E-06	13.0187	1.11E+10
-1.479	76320.	0.00				
27.0000	1.05E-04	-357.061	40.4570	-1.94E-06	7.4453	1.11E+10
-1.364	77760.	0.00				
27.5000	9.30E-05	-138.868	32.6822	-2.08E-06	2.8956	1.11E+10
-1.228	79200.	0.00				
28.0000	8.03E-05	35.1256	25.7599	-2.10E-06	0.7324	1.11E+10
-1.080	80640.	0.00				
28.5000	6.78E-05	170.2501	19.7393	-2.05E-06	3.5500	1.11E+10
-0.927	82080.	0.00				
29.0000	5.58E-05	271.9973	14.6292	-1.93E-06	5.6716	1.11E+10
-0.776	83520.	0.00				
29.5000	4.46E-05	345.8003	9.4565	-1.76E-06	7.2105	1.11E+10
-0.948	127440.	0.00				
30.0000	3.46E-05	385.4752	4.3690	-1.56E-06	8.0378	1.11E+10
-0.748	129600.	0.00				
30.5000	2.59E-05	398.2286	0.4221	-1.35E-06	8.3037	1.11E+10
-0.568	131760.	0.00				
31.0000	1.84E-05	390.5406	-2.512	-1.14E-06	8.1434	1.11E+10
-0.410	133920.	0.00				
31.5000	1.22E-05	368.0831	-4.571	-9.36E-07	7.6751	1.11E+10
-0.276	136080.	0.00				
32.0000	7.15E-06	335.6900	-5.893	-7.46E-07	6.9997	1.11E+10
-0.165	138240.	0.00				
32.5000	3.21E-06	297.3686	-6.612	-5.76E-07	6.2006	1.11E+10
-0.07517	140400.	0.00				
33.0000	2.39E-07	256.3412	-6.855	-4.26E-07	5.3451	1.11E+10
-0.00569	142560.	0.00				
33.5000	-1.90E-06	215.1090	-6.734	-2.99E-07	4.4854	1.11E+10
0.04593	144720.	0.00				
34.0000	-3.35E-06	175.5302	-6.350	-1.94E-07	3.6601	1.11E+10
0.08205	146880.	0.00				
34.5000	-4.23E-06	138.9054	-5.789	-1.09E-07	2.8964	1.11E+10
0.1051	149040.	0.00				
35.0000	-4.66E-06	106.0643	-5.121	-4.31E-08	2.2116	1.11E+10
0.1175	151200.	0.00				
35.5000	-4.75E-06	77.4523	-4.405	6.39E-09	1.6150	1.11E+10
0.1214	153360.	0.00				
36.0000	-4.58E-06	53.2097	-3.684	4.16E-08	1.1095	1.11E+10
0.1188	155520.	0.00				
36.5000	-4.25E-06	33.2453	-2.992	6.49E-08	0.6932	1.11E+10
0.1117	157680.	0.00				
37.0000	-3.81E-06	17.3010	-2.353	7.86E-08	0.3608	1.11E+10
0.1014	159840.	0.00				
37.5000	-3.31E-06	5.0066	-1.781	8.46E-08	0.1044	1.11E+10
0.08927	162000.	0.00				

38.0000	-2.79E-06	-4.074	-1.284	8.48E-08	0.08495	1.11E+10
0.07636	164160.	0.00				
38.5000	-2.29E-06	-10.405	-0.865	8.09E-08	0.2170	1.11E+10
0.06344	166320.	0.00				
39.0000	-1.82E-06	-14.453	-0.521	7.42E-08	0.3014	1.11E+10
0.05110	168480.	0.00				
39.5000	-1.40E-06	-16.661	-0.249	6.58E-08	0.3474	1.11E+10
0.03976	170640.	0.00				
40.0000	-1.03E-06	-17.438	-0.04045	5.66E-08	0.3636	1.11E+10
0.02966	172800.	0.00				
40.5000	-7.18E-07	-17.147	0.1114	4.73E-08	0.3575	1.11E+10
0.02095	174960.	0.00				
41.0000	-4.62E-07	-16.101	0.2152	3.83E-08	0.3357	1.11E+10
0.01365	177120.	0.00				
41.5000	-2.58E-07	-14.564	0.2793	3.01E-08	0.3037	1.11E+10
0.00772	179280.	0.00				
42.0000	-1.01E-07	-12.750	0.3116	2.27E-08	0.2659	1.11E+10
0.00307	181440.	0.00				
42.5000	1.42E-08	-10.825	0.3195	1.64E-08	0.2257	1.11E+10
-4.35E-04	183600.	0.00				
43.0000	9.48E-08	-8.916	0.3094	1.10E-08	0.1859	1.11E+10
-0.00294	185760.	0.00				
43.5000	1.47E-07	-7.112	0.2868	6.71E-09	0.1483	1.11E+10
-0.00459	187920.	0.00				
44.0000	1.75E-07	-5.474	0.2564	3.31E-09	0.1141	1.11E+10
-0.00555	190080.	0.00				
44.5000	1.86E-07	-4.035	0.2218	7.51E-10	0.08414	1.11E+10
-0.00597	192240.	0.00				
45.0000	1.84E-07	-2.811	0.1860	-1.09E-09	0.05862	1.11E+10
-0.00597	194400.	0.00				
45.5000	1.73E-07	-1.803	0.1511	-2.34E-09	0.03759	1.11E+10
-0.00567	196560.	0.00				
46.0000	1.56E-07	-0.999	0.1185	-3.09E-09	0.02082	1.11E+10
-0.00518	198720.	0.00				
46.5000	1.36E-07	-0.381	0.08933	-3.47E-09	0.00794	1.11E+10
-0.00456	200880.	0.00				
47.0000	1.15E-07	0.07334	0.06402	-3.55E-09	0.00153	1.11E+10
-0.00388	203040.	0.00				
47.5000	9.35E-08	0.3876	0.04279	-3.42E-09	0.00808	1.11E+10
-0.00320	205200.	0.00				
48.0000	7.36E-08	0.5869	0.02558	-3.16E-09	0.01224	1.11E+10
-0.00254	207360.	0.00				
48.5000	5.55E-08	0.6946	0.01213	-2.82E-09	0.01448	1.11E+10
-0.00194	209520.	0.00				
49.0000	3.98E-08	0.7325	0.00211	-2.43E-09	0.01527	1.11E+10
-0.00140	211680.	0.00				
49.5000	2.63E-08	0.7199	-0.00797	-2.04E-09	0.01501	1.11E+10
-0.00196	445500.	0.00				
50.0000	1.53E-08	0.6368	-0.01727	-1.67E-09	0.01328	1.11E+10
-0.00115	450000.	0.00				

50.5000	6.25E-09	0.5126	-0.02213	-1.36E-09	0.01069	1.11E+10
-4.74E-04	454500.	0.00				
51.0000	-1.10E-09	0.3713	-0.02330	-1.13E-09	0.00774	1.11E+10
8.44E-05	459000.	0.00				
51.5000	-7.26E-09	0.2330	-0.02136	-9.63E-10	0.00486	1.11E+10
5.61E-04	463500.	0.00				
52.0000	-1.27E-08	0.1149	-0.01672	-8.70E-10	0.00240	1.11E+10
9.88E-04	468000.	0.00				
52.5000	-1.77E-08	0.03237	-0.00958	-8.30E-10	6.75E-04	1.11E+10
0.00139	472500.	0.00				
53.0000	-2.26E-08	0.00	0.00	-8.21E-10	0.00	1.11E+10
0.00180	238500.	0.00				

\* The above values of total stress are combined axial and bending stresses.

#### Output Summary for Load Case No. 1:

Pile-head deflection	=	0.17227809 inches
Computed slope at pile head	=	-0.0023567 radians
Maximum bending moment	=	282800. inch-lbs
Maximum shear force	=	8220. lbs
Depth of maximum bending moment	=	7.00000000 feet below pile head
Depth of maximum shear force	=	0.000000 feet below pile head
Number of iterations	=	16
Number of zero deflection points	=	5

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#### Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 2

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#### Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head	=	8220.0 lbs
Applied moment at pile head	=	0.0 in-lbs
Axial thrust load on pile head	=	22080.0 lbs

Depth	Deflect.	Bending	Shear	Slope	Total	Bending	Soil
Res.	Soil	Spr.	Distrib.				
X	y	Moment	Force	S	Stress	Stiffness	p
Es*H	Lat.	Load					
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	
lb/inch	lb/inch	lb/inch					
0.00	0.1735	0.00	8220.	-0.00237	1785.	1.11E+10	
-221.823	3835.	0.00					

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0.5000	0.1593	45642.	6858.	-0.00236	2737.	1.11E+10
-232.083	8742.	0.00				
1.0000	0.1452	82925.	5438.	-0.00233	3514.	1.11E+10
-241.385	9975.	0.00				
1.5000	0.1314	111513.	4572.	-0.00227	4110.	1.11E+10
-47.290	2160.	0.00				
2.0000	0.1179	138390.	4260.	-0.00221	4671.	1.11E+10
-56.587	2880.	0.00				
2.5000	0.1049	163221.	3902.	-0.00213	5188.	1.11E+10
-62.921	3600.	0.00				
3.0000	0.09238	185774.	3513.	-0.00203	5659.	1.11E+10
-66.510	4320.	0.00				
3.5000	0.08048	205920.	3111.	-0.00193	6079.	1.11E+10
-67.606	5040.	0.00				
4.0000	0.06926	223617.	2709.	-0.00181	6448.	1.11E+10
-66.486	5760.	0.00				
4.5000	0.05875	238905.	2319.	-0.00169	6767.	1.11E+10
-63.454	6480.	0.00				
5.0000	0.04902	251892.	1952.	-0.00155	7037.	1.11E+10
-58.829	7200.	0.00				
5.5000	0.04011	262742.	1617.	-0.00141	7264.	1.11E+10
-52.945	7920.	0.00				
6.0000	0.03204	271668.	1320.	-0.00127	7450.	1.11E+10
-46.145	8640.	0.00				
6.5000	0.02486	278913.	1065.	-0.00112	7601.	1.11E+10
-38.781	9360.	0.00				
7.0000	0.01858	284742.	141.6357	-9.70E-04	7722.	1.11E+10
-268.923	86860.	0.00				
7.5000	0.01321	280870.	-1438.	-8.18E-04	7642.	1.11E+10
-257.476	116906.	0.00				
8.0000	0.00876	267708.	-2935.	-6.70E-04	7367.	1.11E+10
-241.818	165599.	0.00				
8.5000	0.00517	245822.	-4322.	-5.32E-04	6911.	1.11E+10
-220.305	255439.	0.00				
9.0000	0.00238	215987.	-5548.	-4.07E-04	6289.	1.11E+10
-188.344	474157.	0.00				
9.5000	2.91E-04	179357.	-6435.	-3.00E-04	5525.	1.11E+10
-107.334	2215115.	0.00				
10.0000	-0.00122	138849.	-6244.	-2.15E-04	4680.	1.11E+10
170.9129	839506.	0.00				
10.5000	-0.00228	104485.	-5111.	-1.49E-04	3964.	1.11E+10
206.6627	542773.	0.00				
11.0000	-0.00301	77553.	-3805.	-9.99E-05	3402.	1.11E+10
228.6706	455906.	0.00				
11.5000	-0.00348	58848.	-2385.	-6.31E-05	3012.	1.11E+10
244.7225	421519.	0.00				
12.0000	-0.00377	48948.	-1586.	-3.41E-05	2806.	1.11E+10
21.6981	34560.	0.00				
12.5000	-0.00389	39826.	-1451.	-1.01E-05	2615.	1.11E+10
23.3534	36000.	0.00				

13.0000	-0.00389	31542.	-1308.	9.11E-06	2443.	1.11E+10
24.2648	37440.	0.00				
13.5000	-0.00378	24129.	-1162.	2.41E-05	2288.	1.11E+10
24.5131	38880.	0.00				
14.0000	-0.00360	17597.	-1015.	3.54E-05	2152.	1.11E+10
24.1860	40320.	0.00				
14.5000	-0.00336	11934.	-872.764	4.33E-05	2034.	1.11E+10
23.3745	41760.	0.00				
15.0000	-0.00308	7112.	-736.133	4.85E-05	1933.	1.11E+10
22.1693	43200.	0.00				
15.5000	-0.00278	3088.	-607.648	5.12E-05	1849.	1.11E+10
20.6589	44640.	0.00				
16.0000	-0.00246	-193.037	-488.892	5.20E-05	1789.	1.11E+10
18.9266	46080.	0.00				
16.5000	-0.00215	-2793.	-380.964	5.12E-05	1843.	1.11E+10
17.0493	47520.	0.00				
17.0000	-0.00185	-4778.	-284.528	4.92E-05	1885.	1.11E+10
15.0962	48960.	0.00				
17.5000	-0.00156	-6220.	-199.856	4.62E-05	1915.	1.11E+10
13.1276	50400.	0.00				
18.0000	-0.00130	-7189.	-126.888	4.26E-05	1935.	1.11E+10
11.1951	51840.	0.00				
18.5000	-0.00105	-7754.	-65.280	3.85E-05	1947.	1.11E+10
9.3409	53280.	0.00				
19.0000	-8.33E-04	-7982.	-14.462	3.43E-05	1951.	1.11E+10
7.5984	54720.	0.00				
19.5000	-6.40E-04	-7937.	26.3114	3.00E-05	1950.	1.11E+10
5.9928	56160.	0.00				
20.0000	-4.73E-04	-7674.	57.9127	2.58E-05	1945.	1.11E+10
4.5410	57600.	0.00				
20.5000	-3.31E-04	-7248.	81.2957	2.18E-05	1936.	1.11E+10
3.2533	59040.	0.00				
21.0000	-2.12E-04	-6705.	97.4568	1.80E-05	1925.	1.11E+10
2.1337	60480.	0.00				
21.5000	-1.14E-04	-6084.	107.4005	1.46E-05	1912.	1.11E+10
1.1809	61920.	0.00				
22.0000	-3.69E-05	-5420.	112.1106	1.15E-05	1898.	1.11E+10
0.3892	63360.	0.00				
22.5000	2.32E-05	-4741.	112.5272	8.73E-06	1884.	1.11E+10
-0.250	64800.	0.00				
23.0000	6.79E-05	-4072.	109.5285	6.35E-06	1870.	1.11E+10
-0.749	66240.	0.00				
23.5000	9.94E-05	-3429.	103.9175	4.33E-06	1856.	1.11E+10
-1.121	67680.	0.00				
24.0000	1.20E-04	-2826.	96.4138	2.64E-06	1844.	1.11E+10
-1.380	69120.	0.00				
24.5000	1.31E-04	-2272.	87.6485	1.27E-06	1832.	1.11E+10
-1.542	70560.	0.00				
25.0000	1.35E-04	-1774.	78.1633	1.76E-07	1822.	1.11E+10
-1.620	72000.	0.00				

25.5000	1.33E-04	-1335.	68.4118	-6.62E-07	1813.	1.11E+10
-1.630	73440.	0.00				
26.0000	1.27E-04	-953.310	58.7635	-1.28E-06	1805.	1.11E+10
-1.586	74880.	0.00				
26.5000	1.18E-04	-629.069	49.5091	-1.71E-06	1798.	1.11E+10
-1.499	76320.	0.00				
27.0000	1.07E-04	-358.749	40.8677	-1.97E-06	1792.	1.11E+10
-1.381	77760.	0.00				
27.5000	9.42E-05	-138.135	32.9937	-2.11E-06	1788.	1.11E+10
-1.243	79200.	0.00				
28.0000	8.13E-05	37.7343	25.9854	-2.13E-06	1786.	1.11E+10
-1.093	80640.	0.00				
28.5000	6.86E-05	174.2549	19.8920	-2.08E-06	1789.	1.11E+10
-0.938	82080.	0.00				
29.0000	5.64E-05	276.9881	14.7219	-1.95E-06	1791.	1.11E+10
-0.785	83520.	0.00				
29.5000	4.51E-05	351.4351	9.4908	-1.79E-06	1792.	1.11E+10
-0.959	127440.	0.00				
30.0000	3.50E-05	391.3504	4.3481	-1.58E-06	1793.	1.11E+10
-0.756	129600.	0.00				
30.5000	2.61E-05	404.0324	0.3608	-1.37E-06	1793.	1.11E+10
-0.573	131760.	0.00				
31.0000	1.85E-05	396.0430	-2.601	-1.15E-06	1793.	1.11E+10
-0.414	133920.	0.00				
31.5000	1.23E-05	373.1255	-4.677	-9.47E-07	1793.	1.11E+10
-0.278	136080.	0.00				
32.0000	7.18E-06	340.1739	-6.007	-7.55E-07	1792.	1.11E+10
-0.165	138240.	0.00				
32.5000	3.20E-06	301.2448	-6.727	-5.82E-07	1791.	1.11E+10
-0.07485	140400.	0.00				
33.0000	1.95E-07	259.5993	-6.966	-4.31E-07	1790.	1.11E+10
-0.00463	142560.	0.00				
33.5000	-1.97E-06	217.7685	-6.837	-3.02E-07	1790.	1.11E+10
0.04749	144720.	0.00				
34.0000	-3.43E-06	177.6318	-6.443	-1.95E-07	1789.	1.11E+10
0.08392	146880.	0.00				
34.5000	-4.31E-06	140.5034	-5.870	-1.10E-07	1788.	1.11E+10
0.1071	149040.	0.00				
35.0000	-4.74E-06	107.2217	-5.190	-4.27E-08	1787.	1.11E+10
0.1195	151200.	0.00				
35.5000	-4.83E-06	78.2348	-4.461	7.26E-09	1787.	1.11E+10
0.1233	153360.	0.00				
36.0000	-4.66E-06	53.6827	-3.729	4.28E-08	1786.	1.11E+10
0.1207	155520.	0.00				
36.5000	-4.31E-06	33.4710	-3.027	6.63E-08	1786.	1.11E+10
0.1133	157680.	0.00				
37.0000	-3.86E-06	17.3361	-2.379	8.00E-08	1785.	1.11E+10
0.1028	159840.	0.00				
37.5000	-3.35E-06	4.9016	-1.799	8.60E-08	1785.	1.11E+10
0.09049	162000.	0.00				

38.0000	-2.83E-06	-4.276	-1.296	8.62E-08	1785.	1.11E+10
0.07736	164160.	0.00				
38.5000	-2.32E-06	-10.668	-0.871	8.22E-08	1785.	1.11E+10
0.06423	166320.	0.00				
39.0000	-1.84E-06	-14.747	-0.523	7.53E-08	1785.	1.11E+10
0.05171	168480.	0.00				
39.5000	-1.41E-06	-16.964	-0.247	6.68E-08	1785.	1.11E+10
0.04020	170640.	0.00				
40.0000	-1.04E-06	-17.732	-0.03680	5.74E-08	1785.	1.11E+10
0.02996	172800.	0.00				
40.5000	-7.25E-07	-17.421	0.1165	4.79E-08	1785.	1.11E+10
0.02113	174960.	0.00				
41.0000	-4.65E-07	-16.347	0.2210	3.88E-08	1785.	1.11E+10
0.01373	177120.	0.00				
41.5000	-2.59E-07	-14.778	0.2854	3.04E-08	1785.	1.11E+10
0.00773	179280.	0.00				
42.0000	-1.00E-07	-12.930	0.3177	2.30E-08	1785.	1.11E+10
0.00303	181440.	0.00				
42.5000	1.68E-08	-10.972	0.3252	1.65E-08	1785.	1.11E+10
-5.13E-04	183600.	0.00				
43.0000	9.81E-08	-9.032	0.3146	1.11E-08	1785.	1.11E+10
-0.00304	185760.	0.00				
43.5000	1.50E-07	-7.200	0.2914	6.74E-09	1785.	1.11E+10
-0.00470	187920.	0.00				
44.0000	1.79E-07	-5.537	0.2603	3.31E-09	1785.	1.11E+10
-0.00567	190080.	0.00				
44.5000	1.90E-07	-4.078	0.2250	7.15E-10	1785.	1.11E+10
-0.00608	192240.	0.00				
45.0000	1.88E-07	-2.837	0.1885	-1.15E-09	1785.	1.11E+10
-0.00608	194400.	0.00				
45.5000	1.76E-07	-1.815	0.1530	-2.40E-09	1785.	1.11E+10
-0.00577	196560.	0.00				
46.0000	1.59E-07	-1.001	0.1199	-3.16E-09	1785.	1.11E+10
-0.00526	198720.	0.00				
46.5000	1.38E-07	-0.375	0.09027	-3.53E-09	1785.	1.11E+10
-0.00462	200880.	0.00				
47.0000	1.16E-07	0.08353	0.06460	-3.61E-09	1785.	1.11E+10
-0.00394	203040.	0.00				
47.5000	9.47E-08	0.4008	0.04307	-3.48E-09	1785.	1.11E+10
-0.00324	205200.	0.00				
48.0000	7.45E-08	0.6013	0.02563	-3.21E-09	1785.	1.11E+10
-0.00257	207360.	0.00				
48.5000	5.62E-08	0.7091	0.01202	-2.86E-09	1785.	1.11E+10
-0.00196	209520.	0.00				
49.0000	4.02E-08	0.7463	0.00187	-2.47E-09	1785.	1.11E+10
-0.00142	211680.	0.00				
49.5000	2.66E-08	0.7323	-0.00830	-2.07E-09	1785.	1.11E+10
-0.00197	445500.	0.00				
50.0000	1.54E-08	0.6472	-0.01769	-1.70E-09	1785.	1.11E+10
-0.00115	450000.	0.00				

50.5000	6.25E-09	0.5205	-0.02257	-1.38E-09	1785.	1.11E+10
-4.73E-04	454500.	0.00				
51.0000	-1.20E-09	0.3767	-0.02371	-1.14E-09	1785.	1.11E+10
9.17E-05	459000.	0.00				
51.5000	-7.42E-09	0.2363	-0.02172	-9.74E-10	1785.	1.11E+10
5.74E-04	463500.	0.00				
52.0000	-1.29E-08	0.1164	-0.01698	-8.79E-10	1785.	1.11E+10
0.00101	468000.	0.00				
52.5000	-1.80E-08	0.03273	-0.00972	-8.39E-10	1785.	1.11E+10
0.00142	472500.	0.00				
53.0000	-2.29E-08	0.00	0.00	-8.30E-10	1785.	1.11E+10
0.00182	238500.	0.00				

\* The above values of total stress are combined axial and bending stresses.

#### Output Summary for Load Case No. 2:

Pile-head deflection	=	0.17353519 inches
Computed slope at pile head	=	-0.0023744 radians
Maximum bending moment	=	284742. inch-lbs
Maximum shear force	=	8220. lbs
Depth of maximum bending moment	=	7.0000000 feet below pile head
Depth of maximum shear force	=	0.000000 feet below pile head
Number of iterations	=	16
Number of zero deflection points	=	5

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#### Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 3

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#### Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head	=	12330.0 lbs
Applied moment at pile head	=	0.0 in-lbs
Axial thrust load on pile head	=	20510.0 lbs

Depth	Deflect.	Bending	Shear	Slope	Total	Bending	Soil
Res.	Soil	Spr.	Distrib.				
X	y	Moment	Force	S	Stress	Stiffness	p
Es*H	Lat.	Load					
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	
lb/inch	lb/inch	lb/inch					
0.00	0.3149	-1.03E-07	12330.	-0.00414	1658.	1.11E+10	
-257.458	2453.	0.00					

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0.5000	0.2901	69855.	10749.	-0.00412	3115.	1.11E+10
-269.601	5577.	0.00				
1.0000	0.2655	130000.	9098.	-0.00407	4369.	1.11E+10
-280.687	6344.	0.00				
1.5000	0.2413	180032.	7995.	-0.00398	5412.	1.11E+10
-86.853	2160.	0.00				
2.0000	0.2176	226925.	7421.	-0.00387	6390.	1.11E+10
-104.470	2880.	0.00				
2.5000	0.1948	270042.	6757.	-0.00374	7289.	1.11E+10
-116.860	3600.	0.00				
3.0000	0.1728	308934.	6034.	-0.00358	8100.	1.11E+10
-124.389	4320.	0.00				
3.5000	0.1518	343328.	5278.	-0.00341	8817.	1.11E+10
-127.475	5040.	0.00				
4.0000	0.1319	373109.	4516.	-0.00322	9438.	1.11E+10
-126.587	5760.	0.00				
4.5000	0.1132	398309.	3769.	-0.00301	9963.	1.11E+10
-122.227	6480.	0.00				
5.0000	0.09577	419082.	3058.	-0.00279	10397.	1.11E+10
-114.929	7200.	0.00				
5.5000	0.07973	435690.	2397.	-0.00256	10743.	1.11E+10
-105.246	7920.	0.00				
6.0000	0.06510	448480.	1800.	-0.00232	11010.	1.11E+10
-93.742	8640.	0.00				
6.5000	0.05192	457866.	1276.	-0.00207	11205.	1.11E+10
-80.989	9360.	0.00				
7.0000	0.04022	464306.	54.6508	-0.00182	11340.	1.11E+10
-326.213	48670.	0.00				
7.5000	0.03002	458971.	-1872.	-0.00158	11228.	1.11E+10
-316.108	63185.	0.00				
8.0000	0.02130	442226.	-3727.	-0.00133	10879.	1.11E+10
-301.985	85050.	0.00				
8.5000	0.01402	414580.	-5481.	-0.00110	10303.	1.11E+10
-282.676	120961.	0.00				
9.0000	0.00808	376730.	-7095.	-8.89E-04	9513.	1.11E+10
-255.610	189799.	0.00				
9.5000	0.00336	329654.	-8501.	-6.98E-04	8532.	1.11E+10
-212.766	380126.	0.00				
10.0000	-2.97E-04	274895.	-8798.	-5.35E-04	7390.	1.11E+10
113.5435	2292844.	0.00				
10.5000	-0.00306	224206.	-7791.	-4.01E-04	6333.	1.11E+10
222.2686	435373.	0.00				
11.0000	-0.00510	181504.	-6341.	-2.91E-04	5443.	1.11E+10
260.8719	306684.	0.00				
11.5000	-0.00656	148182.	-4699.	-2.02E-04	4748.	1.11E+10
286.5808	262235.	0.00				
12.0000	-0.00753	125166.	-3709.	-1.29E-04	4268.	1.11E+10
43.3779	34560.	0.00				
12.5000	-0.00810	103704.	-3433.	-6.68E-05	3820.	1.11E+10
48.5985	36000.	0.00				

13.0000	-0.00833	83984.	-3131.	-1.62E-05	3409.	1.11E+10
51.9984	37440.	0.00				
13.5000	-0.00829	66131.	-2814.	2.42E-05	3037.	1.11E+10
53.7494	38880.	0.00				
14.0000	-0.00804	50208.	-2491.	5.56E-05	2705.	1.11E+10
54.0441	40320.	0.00				
14.5000	-0.00763	36228.	-2169.	7.89E-05	2413.	1.11E+10
53.0869	41760.	0.00				
15.0000	-0.00710	24156.	-1857.	9.52E-05	2162.	1.11E+10
51.0867	43200.	0.00				
15.5000	-0.00649	13922.	-1559.	1.05E-04	1948.	1.11E+10
48.2496	44640.	0.00				
16.0000	-0.00583	5423.	-1280.	1.11E-04	1771.	1.11E+10
44.7736	46080.	0.00				
16.5000	-0.00516	-1463.	-1023.	1.12E-04	1689.	1.11E+10
40.8442	47520.	0.00				
17.0000	-0.00449	-6879.	-790.522	1.09E-04	1801.	1.11E+10
36.6304	48960.	0.00				
17.5000	-0.00384	-10976.	-583.782	1.05E-04	1887.	1.11E+10
32.2829	50400.	0.00				
18.0000	-0.00323	-13911.	-403.136	9.80E-05	1948.	1.11E+10
27.9323	51840.	0.00				
18.5000	-0.00267	-15838.	-248.274	8.99E-05	1988.	1.11E+10
23.6884	53280.	0.00				
19.0000	-0.00215	-16912.	-118.287	8.11E-05	2011.	1.11E+10
19.6405	54720.	0.00				
19.5000	-0.00169	-17278.	-11.791	7.19E-05	2018.	1.11E+10
15.8581	56160.	0.00				
20.0000	-0.00129	-17071.	72.9585	6.26E-05	2014.	1.11E+10
12.3919	57600.	0.00				
20.5000	-9.43E-04	-16417.	137.9606	5.36E-05	2000.	1.11E+10
9.2755	59040.	0.00				
21.0000	-6.48E-04	-15429.	185.3695	4.50E-05	1980.	1.11E+10
6.5275	60480.	0.00				
21.5000	-4.02E-04	-14204.	217.4108	3.70E-05	1954.	1.11E+10
4.1530	61920.	0.00				
22.0000	-2.03E-04	-12829.	236.3082	2.97E-05	1926.	1.11E+10
2.1461	63360.	0.00				
22.5000	-4.56E-05	-11376.	244.2226	2.32E-05	1895.	1.11E+10
0.4920	64800.	0.00				
23.0000	7.53E-05	-9904.	243.2043	1.75E-05	1865.	1.11E+10
-0.831	66240.	0.00				
23.5000	1.64E-04	-8462.	235.1554	1.25E-05	1834.	1.11E+10
-1.851	67680.	0.00				
24.0000	2.26E-04	-7085.	221.8047	8.33E-06	1806.	1.11E+10
-2.599	69120.	0.00				
24.5000	2.64E-04	-5802.	204.6908	4.86E-06	1779.	1.11E+10
-3.106	70560.	0.00				
25.0000	2.84E-04	-4630.	185.1544	2.04E-06	1755.	1.11E+10
-3.406	72000.	0.00				

25.5000	2.89E-04	-3581.	164.3374	-1.71E-07	1733.	1.11E+10
-3.533	73440.	0.00				
26.0000	2.82E-04	-2658.	143.1885	-1.85E-06	1713.	1.11E+10
-3.517	74880.	0.00				
26.5000	2.66E-04	-1862.	122.4724	-3.07E-06	1697.	1.11E+10
-3.388	76320.	0.00				
27.0000	2.45E-04	-1188.	102.7838	-3.89E-06	1683.	1.11E+10
-3.174	77760.	0.00				
27.5000	2.20E-04	-627.559	84.5621	-4.38E-06	1671.	1.11E+10
-2.899	79200.	0.00				
28.0000	1.92E-04	-171.817	68.1085	-4.60E-06	1662.	1.11E+10
-2.585	80640.	0.00				
28.5000	1.64E-04	190.8750	53.6036	-4.59E-06	1662.	1.11E+10
-2.250	82080.	0.00				
29.0000	1.37E-04	472.5567	41.1238	-4.42E-06	1668.	1.11E+10
-1.910	83520.	0.00				
29.5000	1.11E-04	685.4467	28.2897	-4.10E-06	1672.	1.11E+10
-2.368	127440.	0.00				
30.0000	8.80E-05	813.0431	15.4846	-3.70E-06	1675.	1.11E+10
-1.900	129600.	0.00				
30.5000	6.71E-05	872.1723	5.3628	-3.24E-06	1676.	1.11E+10
-1.474	131760.	0.00				
31.0000	4.90E-05	878.1947	-2.342	-2.77E-06	1676.	1.11E+10
-1.095	133920.	0.00				
31.5000	3.38E-05	844.7480	-7.929	-2.31E-06	1676.	1.11E+10
-0.767	136080.	0.00				
32.0000	2.14E-05	783.6203	-11.707	-1.87E-06	1674.	1.11E+10
-0.492	138240.	0.00				
32.5000	1.14E-05	704.7289	-13.983	-1.47E-06	1673.	1.11E+10
-0.267	140400.	0.00				
33.0000	3.74E-06	616.1800	-15.051	-1.11E-06	1671.	1.11E+10
-0.08896	142560.	0.00				
33.5000	-1.93E-06	524.3876	-15.179	-8.04E-07	1669.	1.11E+10
0.04648	144720.	0.00				
34.0000	-5.90E-06	434.2336	-14.606	-5.45E-07	1667.	1.11E+10
0.1445	146880.	0.00				
34.5000	-8.47E-06	349.2514	-13.541	-3.34E-07	1665.	1.11E+10
0.2104	149040.	0.00				
35.0000	-9.91E-06	271.8206	-12.161	-1.67E-07	1664.	1.11E+10
0.2497	151200.	0.00				
35.5000	-1.05E-05	203.3619	-10.609	-3.85E-08	1662.	1.11E+10
0.2676	153360.	0.00				
36.0000	-1.04E-05	144.5233	-9.000	5.53E-08	1661.	1.11E+10
0.2688	155520.	0.00				
36.5000	-9.81E-06	95.3528	-7.420	1.20E-07	1660.	1.11E+10
0.2577	157680.	0.00				
37.0000	-8.93E-06	55.4526	-5.933	1.61E-07	1659.	1.11E+10
0.2379	159840.	0.00				
37.5000	-7.88E-06	24.1140	-4.581	1.82E-07	1659.	1.11E+10
0.2127	162000.	0.00				

38.0000	-6.75E-06	0.4304	-3.390	1.89E-07	1658.	1.11E+10
0.1846	164160.	0.00				
38.5000	-5.61E-06	-16.609	-2.369	1.84E-07	1658.	1.11E+10
0.1556	166320.	0.00				
39.0000	-4.53E-06	-28.047	-1.521	1.72E-07	1659.	1.11E+10
0.1273	168480.	0.00				
39.5000	-3.54E-06	-34.901	-0.837	1.55E-07	1659.	1.11E+10
0.1008	170640.	0.00				
40.0000	-2.67E-06	-38.124	-0.304	1.36E-07	1659.	1.11E+10
0.07684	172800.	0.00				
40.5000	-1.92E-06	-38.579	0.09445	1.15E-07	1659.	1.11E+10
0.05586	174960.	0.00				
41.0000	-1.29E-06	-37.019	0.3761	9.46E-08	1659.	1.11E+10
0.03803	177120.	0.00				
41.5000	-7.80E-07	-34.089	0.5601	7.54E-08	1659.	1.11E+10
0.02332	179280.	0.00				
42.0000	-3.83E-07	-30.316	0.6648	5.81E-08	1659.	1.11E+10
0.01158	181440.	0.00				
42.5000	-8.33E-08	-26.125	0.7072	4.29E-08	1659.	1.11E+10
0.00255	183600.	0.00				
43.0000	1.32E-07	-21.840	0.7026	2.99E-08	1658.	1.11E+10
-0.00407	185760.	0.00				
43.5000	2.76E-07	-17.701	0.6645	1.93E-08	1658.	1.11E+10
-0.00864	187920.	0.00				
44.0000	3.63E-07	-13.872	0.6041	1.08E-08	1658.	1.11E+10
-0.01149	190080.	0.00				
44.5000	4.05E-07	-10.455	0.5307	4.20E-09	1658.	1.11E+10
-0.01297	192240.	0.00				
45.0000	4.13E-07	-7.505	0.4516	-6.45E-10	1658.	1.11E+10
-0.01339	194400.	0.00				
45.5000	3.97E-07	-5.036	0.3724	-4.03E-09	1658.	1.11E+10
-0.01301	196560.	0.00				
46.0000	3.65E-07	-3.035	0.2971	-6.20E-09	1658.	1.11E+10
-0.01208	198720.	0.00				
46.5000	3.23E-07	-1.469	0.2284	-7.42E-09	1658.	1.11E+10
-0.01081	200880.	0.00				
47.0000	2.76E-07	-0.292	0.1680	-7.89E-09	1658.	1.11E+10
-0.00934	203040.	0.00				
47.5000	2.28E-07	0.5490	0.1166	-7.82E-09	1658.	1.11E+10
-0.00780	205200.	0.00				
48.0000	1.82E-07	1.1091	0.07433	-7.38E-09	1658.	1.11E+10
-0.00629	207360.	0.00				
48.5000	1.40E-07	1.4427	0.04083	-6.69E-09	1658.	1.11E+10
-0.00487	209520.	0.00				
49.0000	1.02E-07	1.6008	0.01544	-5.87E-09	1658.	1.11E+10
-0.00359	211680.	0.00				
49.5000	6.92E-08	1.6295	-0.01073	-5.00E-09	1658.	1.11E+10
-0.00513	445500.	0.00				
50.0000	4.18E-08	1.4732	-0.03554	-4.16E-09	1658.	1.11E+10
-0.00314	450000.	0.00				

50.5000	1.92E-08	1.2040	-0.04932	-3.44E-09	1658.	1.11E+10
-0.00146	454500.	0.00				
51.0000	5.71E-10	0.8822	-0.05383	-2.87E-09	1658.	1.11E+10
-4.37E-05	459000.	0.00				
51.5000	-1.52E-08	0.5588	-0.05043	-2.49E-09	1658.	1.11E+10
0.00118	463500.	0.00				
52.0000	-2.93E-08	0.2777	-0.04004	-2.26E-09	1658.	1.11E+10
0.00228	468000.	0.00				
52.5000	-4.24E-08	0.07878	-0.02319	-2.16E-09	1658.	1.11E+10
0.00334	472500.	0.00				
53.0000	-5.52E-08	0.00	0.00	-2.14E-09	1658.	1.11E+10
0.00439	238500.	0.00				

\* The above values of total stress are combined axial and bending stresses.

#### Output Summary for Load Case No. 3:

Pile-head deflection	=	0.31491446 inches
Computed slope at pile head	=	-0.0041404 radians
Maximum bending moment	=	464306. inch-lbs
Maximum shear force	=	12330. lbs
Depth of maximum bending moment	=	7.00000000 feet below pile head
Depth of maximum shear force	=	0.000000 feet below pile head
Number of iterations	=	19
Number of zero deflection points	=	5

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#### Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 4

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#### Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head	=	12330.0 lbs
Applied moment at pile head	=	0.0 in-lbs
Axial thrust load on pile head	=	28230.0 lbs

Depth	Deflect.	Bending	Shear	Slope	Total	Bending	Soil
Res.	Soil	Spr.	Distrib.				
X	y	Moment	Force	S	Stress	Stiffness	p
Es*H	Lat.	Load					
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	
lb/inch	lb/inch	lb/inch					
0.00	0.3158	2.06E-07	12330.	-0.00415	2282.	1.11E+10	
-257.632	2448.	0.00					

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0.5000	0.2909	70046.	10748.	-0.00413	3743.	1.11E+10
-269.783	5565.	0.00				
1.0000	0.2662	130373.	9096.	-0.00408	5001.	1.11E+10
-280.876	6332.	0.00				
1.5000	0.2419	180577.	7992.	-0.00400	6047.	1.11E+10
-87.085	2160.	0.00				
2.0000	0.2182	227629.	7416.	-0.00389	7029.	1.11E+10
-104.747	2880.	0.00				
2.5000	0.1953	270890.	6751.	-0.00375	7931.	1.11E+10
-117.168	3600.	0.00				
3.0000	0.1732	309908.	6025.	-0.00359	8744.	1.11E+10
-124.714	4320.	0.00				
3.5000	0.1522	344408.	5267.	-0.00342	9464.	1.11E+10
-127.806	5040.	0.00				
4.0000	0.1322	374275.	4503.	-0.00322	10086.	1.11E+10
-126.913	5760.	0.00				
4.5000	0.1135	399539.	3755.	-0.00302	10613.	1.11E+10
-122.540	6480.	0.00				
5.0000	0.09602	420356.	3042.	-0.00279	11047.	1.11E+10
-115.221	7200.	0.00				
5.5000	0.07993	436986.	2379.	-0.00256	11394.	1.11E+10
-105.510	7920.	0.00				
6.0000	0.06526	449778.	1781.	-0.00232	11661.	1.11E+10
-93.975	8640.	0.00				
6.5000	0.05204	459145.	1256.	-0.00208	11856.	1.11E+10
-81.189	9360.	0.00				
7.0000	0.04031	465548.	32.6864	-0.00183	11990.	1.11E+10
-326.422	48582.	0.00				
7.5000	0.03009	460157.	-1896.	-0.00158	11877.	1.11E+10
-316.311	63075.	0.00				
8.0000	0.02135	443337.	-3751.	-0.00134	11526.	1.11E+10
-302.179	84906.	0.00				
8.5000	0.01405	415598.	-5506.	-0.00110	10948.	1.11E+10
-282.860	120768.	0.00				
9.0000	0.00810	377638.	-7122.	-8.91E-04	10156.	1.11E+10
-255.776	189538.	0.00				
9.5000	0.00336	330436.	-8528.	-7.00E-04	9172.	1.11E+10
-212.900	379895.	0.00				
10.0000	-3.03E-04	275539.	-8820.	-5.37E-04	8028.	1.11E+10
115.6585	2292844.	0.00				
10.5000	-0.00308	224780.	-7805.	-4.02E-04	6969.	1.11E+10
222.4375	433841.	0.00				
11.0000	-0.00512	182009.	-6355.	-2.92E-04	6077.	1.11E+10
261.0663	305780.	0.00				
11.5000	-0.00658	148620.	-4711.	-2.03E-04	5381.	1.11E+10
286.7942	261512.	0.00				
12.0000	-0.00756	125541.	-3720.	-1.29E-04	4900.	1.11E+10
43.5262	34560.	0.00				
12.5000	-0.00813	104018.	-3444.	-6.70E-05	4451.	1.11E+10
48.7619	36000.	0.00				

13.0000	-0.00836	84241.	-3141.	-1.63E-05	4039.	1.11E+10
52.1713	37440.	0.00				
13.5000	-0.00832	66335.	-2822.	2.43E-05	3665.	1.11E+10
53.9266	38880.	0.00				
14.0000	-0.00807	50364.	-2498.	5.58E-05	3332.	1.11E+10
54.2211	40320.	0.00				
14.5000	-0.00765	36340.	-2176.	7.92E-05	3040.	1.11E+10
53.2596	41760.	0.00				
15.0000	-0.00712	24230.	-1862.	9.55E-05	2787.	1.11E+10
51.2518	43200.	0.00				
15.5000	-0.00651	13963.	-1563.	1.06E-04	2573.	1.11E+10
48.4044	44640.	0.00				
16.0000	-0.00585	5437.	-1283.	1.11E-04	2396.	1.11E+10
44.9161	46080.	0.00				
16.5000	-0.00517	-1472.	-1025.	1.12E-04	2313.	1.11E+10
40.9729	47520.	0.00				
17.0000	-0.00450	-6906.	-792.292	1.10E-04	2426.	1.11E+10
36.7444	48960.	0.00				
17.5000	-0.00385	-11017.	-584.913	1.05E-04	2512.	1.11E+10
32.3819	50400.	0.00				
18.0000	-0.00324	-13961.	-403.718	9.83E-05	2573.	1.11E+10
28.0164	51840.	0.00				
18.5000	-0.00268	-15895.	-248.395	9.02E-05	2614.	1.11E+10
23.7580	53280.	0.00				
19.0000	-0.00216	-16972.	-118.031	8.14E-05	2636.	1.11E+10
19.6964	54720.	0.00				
19.5000	-0.00170	-17339.	-11.238	7.21E-05	2644.	1.11E+10
15.9013	56160.	0.00				
20.0000	-0.00129	-17131.	73.7357	6.28E-05	2639.	1.11E+10
12.4235	57600.	0.00				
20.5000	-9.45E-04	-16475.	138.8966	5.38E-05	2626.	1.11E+10
9.2968	59040.	0.00				
21.0000	-6.49E-04	-15483.	186.4067	4.52E-05	2605.	1.11E+10
6.5399	60480.	0.00				
21.5000	-4.03E-04	-14254.	218.4996	3.71E-05	2579.	1.11E+10
4.1578	61920.	0.00				
22.0000	-2.03E-04	-12873.	237.4070	2.98E-05	2551.	1.11E+10
2.1447	63360.	0.00				
22.5000	-4.50E-05	-11415.	245.2976	2.33E-05	2520.	1.11E+10
0.4855	64800.	0.00				
23.0000	7.62E-05	-9938.	244.2289	1.75E-05	2489.	1.11E+10
-0.842	66240.	0.00				
23.5000	1.65E-04	-8490.	236.1099	1.26E-05	2459.	1.11E+10
-1.865	67680.	0.00				
24.0000	2.27E-04	-7109.	222.6753	8.35E-06	2430.	1.11E+10
-2.614	69120.	0.00				
24.5000	2.65E-04	-5821.	205.4690	4.86E-06	2403.	1.11E+10
-3.122	70560.	0.00				
25.0000	2.85E-04	-4645.	185.8362	2.04E-06	2379.	1.11E+10
-3.422	72000.	0.00				

25.5000	2.90E-04	-3591.	164.9227	-1.82E-07	2357.	1.11E+10
-3.549	73440.	0.00				
26.0000	2.83E-04	-2665.	143.6802	-1.87E-06	2338.	1.11E+10
-3.532	74880.	0.00				
26.5000	2.67E-04	-1866.	122.8760	-3.09E-06	2321.	1.11E+10
-3.403	76320.	0.00				
27.0000	2.46E-04	-1190.	103.1062	-3.91E-06	2307.	1.11E+10
-3.187	77760.	0.00				
27.5000	2.21E-04	-627.893	84.8116	-4.40E-06	2295.	1.11E+10
-2.911	79200.	0.00				
28.0000	1.93E-04	-170.645	68.2942	-4.62E-06	2286.	1.11E+10
-2.595	80640.	0.00				
28.5000	1.65E-04	193.2022	53.7346	-4.61E-06	2286.	1.11E+10
-2.258	82080.	0.00				
29.0000	1.38E-04	475.7339	41.2093	-4.43E-06	2292.	1.11E+10
-1.917	83520.	0.00				
29.5000	1.12E-04	689.2155	28.3303	-4.12E-06	2297.	1.11E+10
-2.376	127440.	0.00				
30.0000	8.83E-05	817.0930	15.4821	-3.71E-06	2299.	1.11E+10
-1.907	129600.	0.00				
30.5000	6.73E-05	876.2589	5.3281	-3.26E-06	2300.	1.11E+10
-1.478	131760.	0.00				
31.0000	4.92E-05	882.1337	-2.399	-2.78E-06	2301.	1.11E+10
-1.098	133920.	0.00				
31.5000	3.39E-05	848.4079	-8.000	-2.32E-06	2300.	1.11E+10
-0.769	136080.	0.00				
32.0000	2.14E-05	786.9152	-11.786	-1.88E-06	2299.	1.11E+10
-0.493	138240.	0.00				
32.5000	1.14E-05	707.6104	-14.065	-1.47E-06	2297.	1.11E+10
-0.267	140400.	0.00				
33.0000	3.72E-06	618.6301	-15.131	-1.11E-06	2295.	1.11E+10
-0.08838	142560.	0.00				
33.5000	-1.97E-06	526.4116	-15.254	-8.06E-07	2293.	1.11E+10
0.04748	144720.	0.00				
34.0000	-5.95E-06	435.8542	-14.674	-5.47E-07	2291.	1.11E+10
0.1457	146880.	0.00				
34.5000	-8.53E-06	350.5031	-13.602	-3.35E-07	2289.	1.11E+10
0.2118	149040.	0.00				
35.0000	-9.97E-06	272.7454	-12.213	-1.67E-07	2288.	1.11E+10
0.2512	151200.	0.00				
35.5000	-1.05E-05	204.0054	-10.652	-3.80E-08	2286.	1.11E+10
0.2690	153360.	0.00				
36.0000	-1.04E-05	144.9317	-9.035	5.61E-08	2285.	1.11E+10
0.2702	155520.	0.00				
36.5000	-9.85E-06	95.5708	-7.447	1.21E-07	2284.	1.11E+10
0.2589	157680.	0.00				
37.0000	-8.97E-06	55.5217	-5.954	1.62E-07	2283.	1.11E+10
0.2390	159840.	0.00				
37.5000	-7.91E-06	24.0715	-4.596	1.83E-07	2283.	1.11E+10
0.2136	162000.	0.00				

38.0000	-6.77E-06	0.3088	-3.399	1.90E-07	2282.	1.11E+10
0.1853	164160.	0.00				
38.5000	-5.63E-06	-16.783	-2.375	1.85E-07	2282.	1.11E+10
0.1562	166320.	0.00				
39.0000	-4.55E-06	-28.250	-1.523	1.73E-07	2283.	1.11E+10
0.1278	168480.	0.00				
39.5000	-3.56E-06	-35.115	-0.836	1.56E-07	2283.	1.11E+10
0.1011	170640.	0.00				
40.0000	-2.68E-06	-38.337	-0.301	1.36E-07	2283.	1.11E+10
0.07709	172800.	0.00				
40.5000	-1.92E-06	-38.779	0.09784	1.15E-07	2283.	1.11E+10
0.05602	174960.	0.00				
41.0000	-1.29E-06	-37.202	0.3802	9.50E-08	2283.	1.11E+10
0.03811	177120.	0.00				
41.5000	-7.81E-07	-34.249	0.5645	7.57E-08	2283.	1.11E+10
0.02334	179280.	0.00				
42.0000	-3.82E-07	-30.453	0.6692	5.83E-08	2283.	1.11E+10
0.01156	181440.	0.00				
42.5000	-8.17E-08	-26.238	0.7114	4.30E-08	2283.	1.11E+10
0.00250	183600.	0.00				
43.0000	1.34E-07	-21.930	0.7065	3.00E-08	2283.	1.11E+10
-0.00414	185760.	0.00				
43.5000	2.78E-07	-17.770	0.6679	1.93E-08	2283.	1.11E+10
-0.00872	187920.	0.00				
44.0000	3.65E-07	-13.922	0.6070	1.08E-08	2282.	1.11E+10
-0.01158	190080.	0.00				
44.5000	4.08E-07	-10.490	0.5331	4.18E-09	2282.	1.11E+10
-0.01306	192240.	0.00				
45.0000	4.16E-07	-7.527	0.4535	-6.81E-10	2282.	1.11E+10
-0.01347	194400.	0.00				
45.5000	3.99E-07	-5.047	0.3739	-4.07E-09	2282.	1.11E+10
-0.01308	196560.	0.00				
46.0000	3.67E-07	-3.038	0.2982	-6.25E-09	2282.	1.11E+10
-0.01215	198720.	0.00				
46.5000	3.24E-07	-1.467	0.2292	-7.47E-09	2282.	1.11E+10
-0.01086	200880.	0.00				
47.0000	2.77E-07	-0.286	0.1685	-7.94E-09	2282.	1.11E+10
-0.00938	203040.	0.00				
47.5000	2.29E-07	0.5578	0.1169	-7.87E-09	2282.	1.11E+10
-0.00783	205200.	0.00				
48.0000	1.83E-07	1.1192	0.07440	-7.41E-09	2282.	1.11E+10
-0.00632	207360.	0.00				
48.5000	1.40E-07	1.4532	0.04078	-6.72E-09	2282.	1.11E+10
-0.00489	209520.	0.00				
49.0000	1.02E-07	1.6109	0.01530	-5.89E-09	2282.	1.11E+10
-0.00360	211680.	0.00				
49.5000	6.94E-08	1.6387	-0.01096	-5.02E-09	2282.	1.11E+10
-0.00515	445500.	0.00				
50.0000	4.19E-08	1.4810	-0.03585	-4.18E-09	2282.	1.11E+10
-0.00314	450000.	0.00				

50.5000	1.93E-08	1.2100	-0.04965	-3.45E-09	2282.	1.11E+10
-0.00146	454500.	0.00				
51.0000	5.07E-10	0.8864	-0.05414	-2.89E-09	2282.	1.11E+10
-3.88E-05	459000.	0.00				
51.5000	-1.54E-08	0.5612	-0.05070	-2.49E-09	2282.	1.11E+10
0.00119	463500.	0.00				
52.0000	-2.94E-08	0.2788	-0.04025	-2.27E-09	2282.	1.11E+10
0.00230	468000.	0.00				
52.5000	-4.26E-08	0.07905	-0.02330	-2.17E-09	2282.	1.11E+10
0.00335	472500.	0.00				
53.0000	-5.55E-08	0.00	0.00	-2.15E-09	2282.	1.11E+10
0.00441	238500.	0.00				

\* The above values of total stress are combined axial and bending stresses.

#### Output Summary for Load Case No. 4:

Pile-head deflection	=	0.31576319 inches
Computed slope at pile head	=	-0.0041520 radians
Maximum bending moment	=	465548. inch-lbs
Maximum shear force	=	12330. lbs
Depth of maximum bending moment	=	7.00000000 feet below pile head
Depth of maximum shear force	=	0.000000 feet below pile head
Number of iterations	=	19
Number of zero deflection points	=	5

---

#### Summary of Pile-head Responses for Conventional Analyses

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#### Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs  
 Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians  
 Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.  
 Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs  
 Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Load	Load	Axial	Pile-head	Pile-head	Max			
Shear Max Moment								
Case Type	Pile-head	Type	Pile-head	Loading	Deflection	Rotation	in	
Pile	in Pile							
No.	1	Load 1	2	Load 2	lbs	inches	radians	lbs
		in-lbs						
1	V, lb	8220.	M, in-lb	0.00	0.00	0.1723	-0.00236	

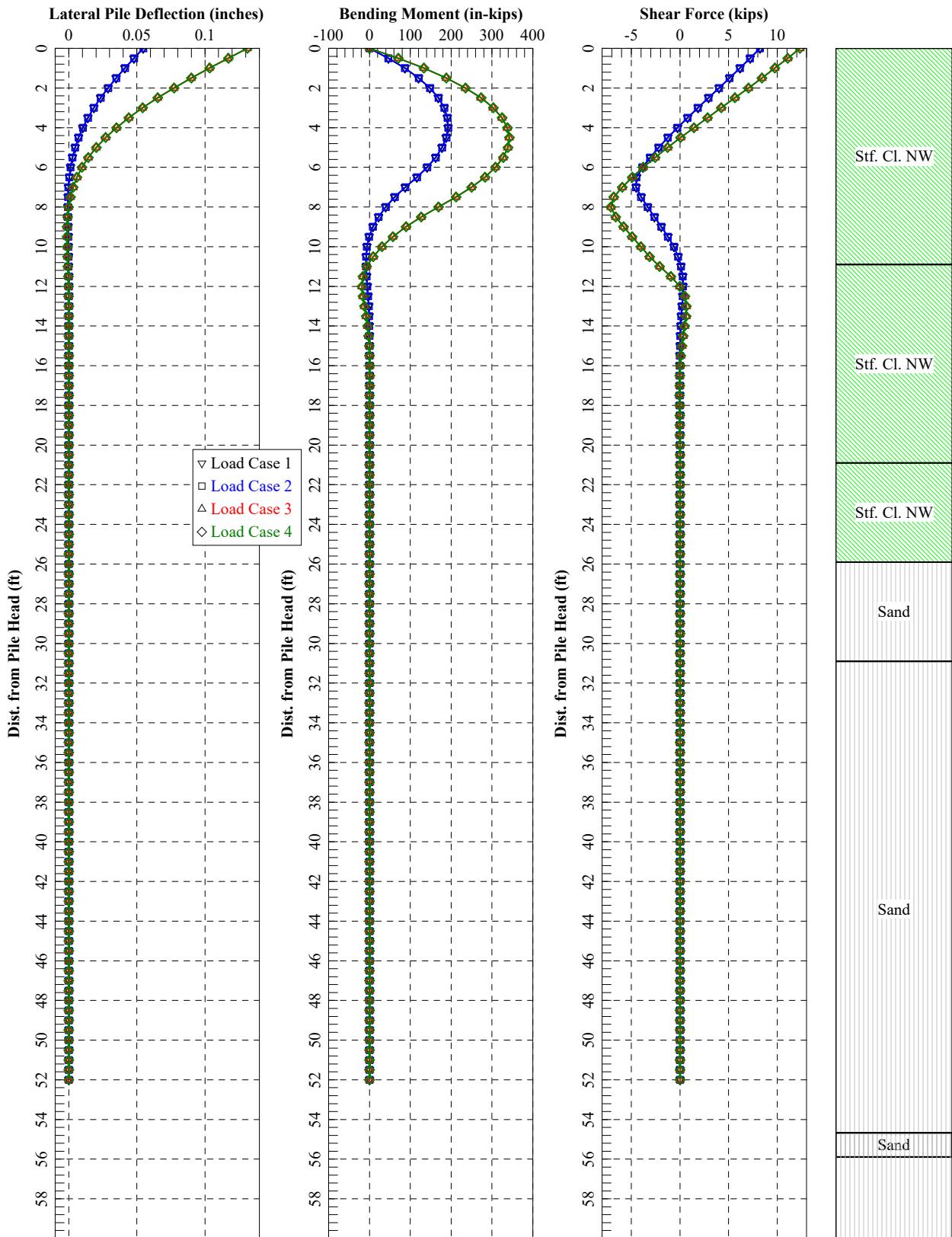
---

8220.	282800.					
2	V, lb	8220.	M, in-lb	0.00	22080.	0.1735
8220.	284742.					-0.00237
3	V, lb	12330.	M, in-lb	0.00	20510.	0.3149
12330.	464306.					-0.00414
4	V, lb	12330.	M, in-lb	0.00	28230.	0.3158
12330.	465548.					-0.00415

Maximum pile-head deflection = 0.3157631906 inches

Maximum pile-head rotation = -0.0041520117 radians = -0.237893 deg.

The analysis ended normally.



West Woods - Forward Abutment (B-002)

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LPile for Windows, Version 2022-12.005

Analysis of Individual Piles and Drilled Shafts  
Subjected to Lateral Loading Using the p-y Method  
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-----  
Files Used for Analysis  
-----

Path to file locations:

\Projects\2021\2122\101200 Geauga Park WW  
Br\118538\400-Engineering\Geotechnical\EngData\Calcs\2023\

Name of input data file:

Fwd Abutment - Lateral Analysis.lp12d

Name of output report file:

Fwd Abutment - Lateral Analysis.lp12o

Name of plot output file:

Fwd Abutment - Lateral Analysis.lp12p

Name of runtime message file:

Fwd Abutment - Lateral Analysis.lp12r

Date and Time of Analysis

---

Date: November 21, 2023

Time: 21:17:11

-----  
Problem Title  
-----

Project Name: West Woods Bridge Replacement

Job Number: 2122-1012.00

Client: Geauga Parks

Engineer: RJH

Description: Pile Lateral Analysis

-----  
Program Options and Settings  
-----

Computational Options:

- Conventional Analysis

Engineering Units Used for Data Input and Computations:

- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- |  |   |               |
|--|---|---------------|
| - Maximum number of iterations allowed | = | 500           |
| - Deflection tolerance for convergence | = | 1.0000E-05 in |
| - Maximum allowable deflection         | = | 100.0000 in   |
| - Number of pile increments            | = | 104           |

Loading Type and Number of Cycles of Loading:

- Static loading specified
- Analysis uses p-y modification factors for p-y curves
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

**Output Options:**

- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

**Pile Structural Properties and Geometry**

Number of pile sections defined	=	1
Total length of pile	=	52.000 ft
Depth of ground surface below top of pile	=	0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head	Pile Diameter
	feet	inches
1	0.000	16.0000
2	52.000	16.0000

**Input Structural Properties for Pile Sections:**

Pile Section No. 1:

Section 1 is an elastic pile

Cross-sectional Shape	=	Circular Pipe
Length of section	=	52.000000 ft
Width of top of section	=	16.000000 in
Width of bottom of section	=	16.000000 in
Wall Thickness at Top	=	0.250000 in
Wall Thickness at Bottom	=	0.250000 in
Top Area	=	12.370021 sq. in
Bottom Area	=	12.370021 sq. in
Moment of Inertia at Top	=	383.663935 in^4
Moment of Inertia at Bottom	=	383.663935 in^4
Elastic Modulus	=	29000000. psi

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#### Soil and Rock Layering Information

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The soil profile is modelled using 6 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer	=	0.0000 ft
Distance from top of pile to bottom of layer	=	10.900000 ft
Effective unit weight at top of layer	=	57.600000 pcf
Effective unit weight at bottom of layer	=	57.600000 pcf
Undrained cohesion at top of layer	=	1500. psf
Undrained cohesion at bottom of layer	=	1500. psf
Epsilon-50 at top of layer	=	0.007000
Epsilon-50 at bottom of layer	=	0.007000

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	10.900000 ft
Distance from top of pile to bottom of layer	=	20.900000 ft
Effective unit weight at top of layer	=	62.600000 pcf
Effective unit weight at bottom of layer	=	62.600000 pcf
Undrained cohesion at top of layer	=	2500. psf
Undrained cohesion at bottom of layer	=	2500. psf
Epsilon-50 at top of layer	=	0.005000
Epsilon-50 at bottom of layer	=	0.005000

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	20.900000 ft
Distance from top of pile to bottom of layer	=	25.900000 ft
Effective unit weight at top of layer	=	62.600000 pcf
Effective unit weight at bottom of layer	=	62.600000 pcf

Undrained cohesion at top of layer	=	1000.00000 psf
Undrained cohesion at bottom of layer	=	1000.00000 psf
Epsilon-50 at top of layer	=	0.007000
Epsilon-50 at bottom of layer	=	0.007000

Layer 4 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	25.900000 ft
Distance from top of pile to bottom of layer	=	30.900000 ft
Effective unit weight at top of layer	=	62.600000 pcf
Effective unit weight at bottom of layer	=	62.600000 pcf
Friction angle at top of layer	=	28.000000 deg.
Friction angle at bottom of layer	=	28.000000 deg.
Subgrade k at top of layer	=	20.000000 pci
Subgrade k at bottom of layer	=	20.000000 pci

Layer 5 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	30.900000 ft
Distance from top of pile to bottom of layer	=	55.900000 ft
Effective unit weight at top of layer	=	62.600000 pcf
Effective unit weight at bottom of layer	=	62.600000 pcf
Friction angle at top of layer	=	32.000000 deg.
Friction angle at bottom of layer	=	32.000000 deg.
Subgrade k at top of layer	=	60.000000 pci
Subgrade k at bottom of layer	=	60.000000 pci

Layer 6 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	55.900000 ft
Distance from top of pile to bottom of layer	=	67.400000 ft
Effective unit weight at top of layer	=	62.600000 pcf
Effective unit weight at bottom of layer	=	62.600000 pcf
Friction angle at top of layer	=	32.000000 deg.
Friction angle at bottom of layer	=	32.000000 deg.
Subgrade k at top of layer	=	60.000000 pci
Subgrade k at bottom of layer	=	60.000000 pci

(Depth of the lowest soil layer extends 15.400 ft below the pile tip)

---

Summary of Input Soil Properties

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Layer E50 Num. or krm	Soil Type Name (p-y Curve Type) kpy pci	Layer Depth ft	Effective Unit Wt. pcf	Cohesion psf	Angle of Friction deg.
1 0.00700	Stiff Clay -- w/o Free Water --	0.00 10.9000	57.6000 57.6000	1500. 1500.	-- --
2 0.00500	Stiff Clay -- w/o Free Water --	10.9000 20.9000	62.6000 62.6000	2500. 2500.	-- --
3 0.00700	Stiff Clay -- w/o Free Water --	20.9000 25.9000	62.6000 62.6000	1000.0000 1000.0000	-- --
4 --	Sand 20.0000 (Reese, et al.) 20.0000	25.9000 30.9000	62.6000 62.6000	-- --	28.0000 28.0000
5 --	Sand 60.0000 (Reese, et al.) 60.0000	30.9000 55.9000	62.6000 62.6000	-- --	32.0000 32.0000
6 --	Sand 60.0000 (Reese, et al.) 60.0000	55.9000 67.4000	62.6000 62.6000	-- --	32.0000 32.0000

#### Modification Factors for p-y Curves

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	0.000	1.0000	1.0000
2	52.000	1.0000	1.0000

### Static Loading Type

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Static loading criteria were used when computing p-y curves for all analyses.

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### Pile-head Loading and Pile-head Fixity Conditions

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Number of loads specified = 4

Load Compute No.	Load Top y vs. Pile Length	Type	Condition Run Analysis 1	Condition 2	Axial Thrust Force, lbs
1	1	V =	8220. lbs	M = 0.0000 in-lbs	0.0000000
No		Yes			
2	1	V =	8220. lbs	M = 0.0000 in-lbs	22080.
No		Yes			
3	1	V =	12330. lbs	M = 0.0000 in-lbs	20510.
No		Yes			
4	1	V =	12330. lbs	M = 0.0000 in-lbs	28230.
No		Yes			

V = shear force applied normal to pile axis

M = bending moment applied to pile head

y = lateral deflection normal to pile axis

S = pile slope relative to original pile batter angle

R = rotational stiffness applied to pile head

Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).

Thrust force is assumed to be acting axially for all pile batter angles.

---

### Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

---

Moment-curvature properties were derived from elastic section properties

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Pile Head ft	Top of Layer Below Pile Head ft	Equivalent Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	114688.	
2	10.9000	7.6184	3.2816	Yes	No	114688.	262841.
3	20.9000	36.0585	30.0585	Yes	No	377528.	60150.
4	25.9000	25.0618	0.0618	No	No	437678.	227918.
5	30.9000	24.6750	0.2250	Yes	No	665596.	2313730.
6	55.9000	55.9000	0.0000	No	No	2979326.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection  
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head	=	8220.0 lbs
Applied moment at pile head	=	0.0 in-lbs
Axial thrust load on pile head	=	0.0 lbs

Res.	Depth feet	Deflect. Soil Spr. X Es*H lb/inch	Bending Distrib. y Lat. Load inches lb/inch	Moment in-lbs lb/inch	Shear Force lbs	Slope radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil p	
	0.00	0.05460	-4.29E-09		8220.	-0.00113	8.94E-11	1.11E+10		
	-166.145	9130.	0.00							

0.5000	0.04780	46329.	7206.	-0.00112	966.0412	1.11E+10
-171.792	21562.	0.00				
1.0000	0.04116	86474.	6162.	-0.00108	1803.	1.11E+10
-176.154	25678.	0.00				
1.5000	0.03480	120278.	5096.	-0.00103	2508.	1.11E+10
-179.142	30888.	0.00				
2.0000	0.02883	147632.	4017.	-9.56E-04	3078.	1.11E+10
-180.665	37605.	0.00				
2.5000	0.02333	168482.	2933.	-8.70E-04	3513.	1.11E+10
-180.618	46451.	0.00				
3.0000	0.01838	182830.	1855.	-7.76E-04	3812.	1.11E+10
-178.887	58397.	0.00				
3.5000	0.01402	190738.	792.0126	-6.75E-04	3977.	1.11E+10
-175.336	75031.	0.00				
4.0000	0.01028	192334.	-243.372	-5.72E-04	4010.	1.11E+10
-169.792	99106.	0.00				
4.5000	0.00716	187818.	-1239.	-4.69E-04	3916.	1.11E+10
-162.013	135764.	0.00				
5.0000	0.00465	177469.	-2180.	-3.71E-04	3701.	1.11E+10
-151.625	195710.	0.00				
5.5000	0.00271	161662.	-3048.	-2.79E-04	3371.	1.11E+10
-137.928	305257.	0.00				
6.0000	0.00130	140889.	-3820.	-1.98E-04	2938.	1.11E+10
-119.237	551718.	0.00				
6.5000	3.38E-04	115823.	-4443.	-1.29E-04	2415.	1.11E+10
-88.558	1570935.	0.00				
7.0000	-2.45E-04	87570.	-4501.	-7.37E-05	1826.	1.11E+10
69.2766	1693220.	0.00				
7.5000	-5.46E-04	61810.	-3973.	-3.34E-05	1289.	1.11E+10
106.7565	1173436.	0.00				
8.0000	-6.46E-04	39894.	-3307.	-5.97E-06	831.8540	1.11E+10
115.1686	1069256.	0.00				
8.5000	-6.18E-04	22124.	-2609.	1.07E-05	461.3169	1.11E+10
117.6181	1142733.	0.00				
9.0000	-5.17E-04	8588.	-1908.	1.90E-05	179.0706	1.11E+10
116.1043	1346693.	0.00				
9.5000	-3.89E-04	-768.346	-1225.	2.11E-05	16.0212	1.11E+10
111.4701	1718346.	0.00				
10.0000	-2.64E-04	-6112.	-620.374	1.93E-05	127.4373	1.11E+10
90.0580	2049515.	0.00				
10.5000	-1.58E-04	-8213.	-183.761	1.54E-05	171.2507	1.11E+10
55.4797	2108898.	0.00				
11.0000	-7.86E-05	-8317.	106.9969	1.10E-05	173.4178	1.11E+10
41.4397	3162692.	0.00				
11.5000	-2.63E-05	-6929.	274.2687	6.85E-06	144.4780	1.11E+10
14.3175	3266722.	0.00				
12.0000	3.60E-06	-5026.	311.1491	3.63E-06	104.7906	1.11E+10
-2.024	3370764.	0.00				
12.5000	1.72E-05	-3195.	275.1202	1.41E-06	66.6226	1.11E+10
-9.986	3474817.	0.00				

13.0000	2.05E-05	-1724.	208.4020	8.53E-08	35.9503	1.11E+10
-12.254	3578880.	0.00				
13.5000	1.83E-05	-694.262	138.0035	-5.67E-07	14.4765	1.11E+10
-11.212	3682951.	0.00				
14.0000	1.37E-05	-68.063	78.3441	-7.72E-07	1.4192	1.11E+10
-8.674	3787029.	0.00				
14.5000	9.00E-06	245.8673	34.8134	-7.24E-07	5.1267	1.11E+10
-5.836	3891114.	0.00				
15.0000	5.05E-06	349.6976	7.2153	-5.64E-07	7.2917	1.11E+10
-3.363	3995206.	0.00				
15.5000	2.23E-06	332.4505	-7.454	-3.80E-07	6.9321	1.11E+10
-1.526	4099303.	0.00				
16.0000	4.93E-07	260.2511	-13.070	-2.20E-07	5.4266	1.11E+10
-0.345	4203405.	0.00				
16.5000	-4.06E-07	175.6137	-13.232	-1.02E-07	3.6618	1.11E+10
0.2913	4307511.	0.00				
17.0000	-7.37E-07	101.4647	-10.733	-2.78E-08	2.1157	1.11E+10
0.5416	4411622.	0.00				
17.5000	-7.39E-07	46.8129	-7.440	1.22E-08	0.9761	1.11E+10
0.5562	4515736.	0.00				
18.0000	-5.90E-07	12.1857	-4.408	2.81E-08	0.2541	1.11E+10
0.4543	4619854.	0.00				
18.5000	-4.02E-07	-6.085	-2.104	2.98E-08	0.1269	1.11E+10
0.3138	4687500.	0.00				
19.0000	-2.33E-07	-13.060	-0.617	2.46E-08	0.2723	1.11E+10
0.1820	4687500.	0.00				
19.5000	-1.06E-07	-13.485	0.1788	1.74E-08	0.2812	1.11E+10
0.08315	4687500.	0.00				
20.0000	-2.36E-08	-10.915	0.4835	1.09E-08	0.2276	1.11E+10
0.01843	4687500.	0.00				
20.5000	2.39E-08	-7.682	0.4827	5.85E-09	0.1602	1.11E+10
-0.01870	4687500.	0.00				
21.0000	4.66E-08	-5.122	0.3865	2.40E-09	0.1068	1.11E+10
-0.01339	1723730.	0.00				
21.5000	5.27E-08	-3.045	0.3009	1.95E-10	0.06348	1.11E+10
-0.01514	1723730.	0.00				
22.0000	4.89E-08	-1.512	0.2133	-1.03E-09	0.03152	1.11E+10
-0.01406	1723730.	0.00				
22.5000	4.03E-08	-0.485	0.1364	-1.57E-09	0.01011	1.11E+10
-0.01158	1723730.	0.00				
23.0000	3.01E-08	0.1252	0.07576	-1.67E-09	0.00261	1.11E+10
-0.00864	1723730.	0.00				
23.5000	2.03E-08	0.4242	0.03237	-1.52E-09	0.00884	1.11E+10
-0.00582	1723730.	0.00				
24.0000	1.18E-08	0.5136	0.00472	-1.27E-09	0.01071	1.11E+10
-0.00340	1723730.	0.00				
24.5000	5.05E-09	0.4808	-0.00982	-1.00E-09	0.01003	1.11E+10
-0.00145	1723730.	0.00				
25.0000	-1.74E-10	0.3958	-0.01402	-7.64E-10	0.00825	1.11E+10
5.01E-05	1723730.	0.00				

25.5000	-4.12E-09	0.3125	-0.01033	-5.73E-10	0.00652	1.11E+10
0.00118	1723730.	0.00				
26.0000	-7.04E-09	0.2718	-0.00665	-4.15E-10	0.00567	1.11E+10
4.40E-05	37440.	0.00				
26.5000	-9.10E-09	0.2327	-0.00634	-2.79E-10	0.00485	1.11E+10
5.78E-05	38160.	0.00				
27.0000	-1.04E-08	0.1957	-0.00597	-1.63E-10	0.00408	1.11E+10
6.73E-05	38880.	0.00				
27.5000	-1.11E-08	0.1611	-0.00555	-6.72E-11	0.00336	1.11E+10
7.30E-05	39600.	0.00				
28.0000	-1.12E-08	0.1292	-0.00510	1.11E-11	0.00269	1.11E+10
7.53E-05	40320.	0.00				
28.5000	-1.09E-08	0.09994	-0.00465	7.29E-11	0.00208	1.11E+10
7.47E-05	41040.	0.00				
29.0000	-1.03E-08	0.07337	-0.00421	1.20E-10	0.00153	1.11E+10
7.19E-05	41760.	0.00				
29.5000	-9.49E-09	0.04940	-0.00379	1.53E-10	0.00103	1.11E+10
6.72E-05	42480.	0.00				
30.0000	-8.49E-09	0.02784	-0.00341	1.74E-10	5.81E-04	1.11E+10
6.11E-05	43200.	0.00				
30.5000	-7.40E-09	0.00848	-0.00306	1.83E-10	1.77E-04	1.11E+10
5.42E-05	43920.	0.00				
31.0000	-6.29E-09	-0.00892	-0.00248	1.83E-10	1.86E-04	1.11E+10
1.40E-04	133920.	0.00				
31.5000	-5.21E-09	-0.02127	-0.00170	1.75E-10	4.44E-04	1.11E+10
1.18E-04	136080.	0.00				
32.0000	-4.19E-09	-0.02937	-0.00106	1.61E-10	6.12E-04	1.11E+10
9.65E-05	138240.	0.00				
32.5000	-3.27E-09	-0.03400	-5.41E-04	1.44E-10	7.09E-04	1.11E+10
7.65E-05	140400.	0.00				
33.0000	-2.46E-09	-0.03587	-1.37E-04	1.26E-10	7.48E-04	1.11E+10
5.84E-05	142560.	0.00				
33.5000	-1.76E-09	-0.03564	1.66E-04	1.06E-10	7.43E-04	1.11E+10
4.25E-05	144720.	0.00				
34.0000	-1.18E-09	-0.03388	3.80E-04	8.75E-11	7.06E-04	1.11E+10
2.90E-05	146880.	0.00				
34.5000	-7.13E-10	-0.03108	5.20E-04	7.00E-11	6.48E-04	1.11E+10
1.77E-05	149040.	0.00				
35.0000	-3.43E-10	-0.02764	5.99E-04	5.41E-11	5.76E-04	1.11E+10
8.65E-06	151200.	0.00				
35.5000	-6.30E-11	-0.02389	6.30E-04	4.02E-11	4.98E-04	1.11E+10
1.61E-06	153360.	0.00				
36.0000	1.40E-10	-0.02008	6.24E-04	2.84E-11	4.19E-04	1.11E+10
-3.62E-06	155520.	0.00				
36.5000	2.78E-10	-0.01640	5.91E-04	1.85E-11	3.42E-04	1.11E+10
-7.30E-06	157680.	0.00				
37.0000	3.62E-10	-0.01299	5.40E-04	1.06E-11	2.71E-04	1.11E+10
-9.65E-06	159840.	0.00				
37.5000	4.05E-10	-0.00992	4.79E-04	4.45E-12	2.07E-04	1.11E+10
-1.09E-05	162000.	0.00				

38.0000	4.16E-10	-0.00724	4.12E-04	0.00	1.51E-04	1.11E+10
-1.14E-05	164160.	0.00				
38.5000	4.03E-10	-0.00498	3.44E-04	-3.47E-12	1.04E-04	1.11E+10
-1.12E-05	166320.	0.00				
39.0000	3.74E-10	-0.00311	2.79E-04	-5.65E-12	6.49E-05	1.11E+10
-1.05E-05	168480.	0.00				
39.5000	3.35E-10	-0.00163	2.19E-04	-6.93E-12	3.40E-05	1.11E+10
-9.53E-06	170640.	0.00				
40.0000	2.91E-10	-4.88E-04	1.65E-04	-7.50E-12	1.02E-05	1.11E+10
-8.38E-06	172800.	0.00				
40.5000	2.45E-10	3.52E-04	1.19E-04	-7.54E-12	7.34E-06	1.11E+10
-7.15E-06	174960.	0.00				
41.0000	2.00E-10	9.35E-04	7.94E-05	-7.19E-12	1.95E-05	1.11E+10
-5.92E-06	177120.	0.00				
41.5000	1.59E-10	0.00130	4.74E-05	-6.59E-12	2.72E-05	1.11E+10
-4.74E-06	179280.	0.00				
42.0000	1.21E-10	0.00150	2.22E-05	-5.83E-12	3.13E-05	1.11E+10
-3.67E-06	181440.	0.00				
42.5000	8.88E-11	0.00157	3.00E-06	-5.00E-12	3.27E-05	1.11E+10
-2.72E-06	183600.	0.00				
43.0000	6.13E-11	0.00154	-1.08E-05	-4.17E-12	3.21E-05	1.11E+10
-1.90E-06	185760.	0.00				
43.5000	3.88E-11	0.00144	-2.02E-05	-3.36E-12	3.00E-05	1.11E+10
-1.21E-06	187920.	0.00				
44.0000	2.09E-11	0.00130	-2.58E-05	-2.62E-12	2.71E-05	1.11E+10
-6.63E-07	190080.	0.00				
44.5000	7.28E-12	0.00113	-2.85E-05	-1.97E-12	2.36E-05	1.11E+10
-2.33E-07	192240.	0.00				
45.0000	-2.71E-12	9.55E-04	-2.89E-05	-1.41E-12	1.99E-05	1.11E+10
8.77E-08	194400.	0.00				
45.5000	-9.60E-12	7.83E-04	-2.77E-05	0.00	1.63E-05	1.11E+10
3.15E-07	196560.	0.00				
46.0000	-1.40E-11	6.23E-04	-2.54E-05	0.00	1.30E-05	1.11E+10
4.63E-07	198720.	0.00				
46.5000	-1.63E-11	4.79E-04	-2.24E-05	0.00	9.98E-06	1.11E+10
5.46E-07	200880.	0.00				
47.0000	-1.71E-11	3.54E-04	-1.90E-05	0.00	7.39E-06	1.11E+10
5.79E-07	203040.	0.00				
47.5000	-1.68E-11	2.51E-04	-1.55E-05	0.00	5.23E-06	1.11E+10
5.74E-07	205200.	0.00				
48.0000	-1.56E-11	1.68E-04	-1.22E-05	0.00	3.50E-06	1.11E+10
5.40E-07	207360.	0.00				
48.5000	-1.39E-11	1.04E-04	-9.12E-06	0.00	2.18E-06	1.11E+10
4.86E-07	209520.	0.00				
49.0000	-1.19E-11	5.85E-05	-6.40E-06	0.00	1.22E-06	1.11E+10
4.19E-07	211680.	0.00				
49.5000	-9.64E-12	2.76E-05	-4.11E-06	0.00	5.76E-07	1.11E+10
3.44E-07	213840.	0.00				
50.0000	-7.33E-12	9.13E-06	-2.29E-06	0.00	1.90E-07	1.11E+10
2.64E-07	216000.	0.00				

50.5000	-4.98E-12	1.23E-07	-9.58E-07	0.00	2.56E-09	1.11E+10
1.81E-07	218160.	0.00				
51.0000	-2.63E-12	-2.37E-06	-1.25E-07	0.00	4.93E-08	1.11E+10
9.66E-08	220320.	0.00				
51.5000	0.00	-1.38E-06	1.97E-07	0.00	2.87E-08	1.11E+10
1.08E-08	222480.	0.00				
52.0000	2.04E-12	0.00	0.00	0.00	0.00	1.11E+10
-7.65E-08	112320.	0.00				

\* The above values of total stress are combined axial and bending stresses.

#### Output Summary for Load Case No. 1:

Pile-head deflection	=	0.05459539 inches
Computed slope at pile head	=	-0.0011320 radians
Maximum bending moment	=	192334. inch-lbs
Maximum shear force	=	8220. lbs
Depth of maximum bending moment	=	4.0000000 feet below pile head
Depth of maximum shear force	=	0.000000 feet below pile head
Number of iterations	=	21
Number of zero deflection points	=	8

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#### Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 2

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Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head	=	8220.0 lbs
Applied moment at pile head	=	0.0 in-lbs
Axial thrust load on pile head	=	22080.0 lbs

Depth	Deflect.	Bending	Shear	Slope	Total	Bending	Soil
Res.	Soil	Spr.	Distrib.				
X	y	Es*H	Moment	Force	S	Stress	Stiffness
feet	inches	Lat.	Load	lbs	radians	psi*	lb-in^2
lb/inch	lb/inch	lb/inch					
0.00	0.05484	-2.14E-08	8220.	-0.00114	1785.	1.11E+10	
-166.331	9099.	0.00					
0.5000	0.04802	46477.	7205.	-0.00112	2754.	1.11E+10	
-171.987	21489.	0.00					
1.0000	0.04135	86758.	6160.	-0.00109	3594.	1.11E+10	
-176.356	25590.	0.00					

1.5000	0.03496	120685.	5093.	-0.00103	4301.	1.11E+10
-179.352	30780.	0.00				
2.0000	0.02896	148147.	4012.	-9.60E-04	4874.	1.11E+10
-180.879	37472.	0.00				
2.5000	0.02344	169086.	2927.	-8.74E-04	5311.	1.11E+10
-180.837	46283.	0.00				
3.0000	0.01847	183503.	1847.	-7.79E-04	5611.	1.11E+10
-179.110	58180.	0.00				
3.5000	0.01409	191459.	783.1952	-6.78E-04	5777.	1.11E+10
-175.561	74745.	0.00				
4.0000	0.01033	193081.	-253.539	-5.74E-04	5811.	1.11E+10
-170.017	98715.	0.00				
4.5000	0.00720	188569.	-1250.	-4.72E-04	5717.	1.11E+10
-162.238	135206.	0.00				
5.0000	0.00468	178202.	-2193.	-3.73E-04	5501.	1.11E+10
-151.847	194863.	0.00				
5.5000	0.00273	162357.	-3063.	-2.81E-04	5170.	1.11E+10
-138.145	303839.	0.00				
6.0000	0.00131	141526.	-3835.	-1.99E-04	4736.	1.11E+10
-119.449	548844.	0.00				
6.5000	3.42E-04	116386.	-4460.	-1.29E-04	4212.	1.11E+10
-88.781	1559535.	0.00				
7.0000	-2.46E-04	88041.	-4518.	-7.42E-05	3621.	1.11E+10
69.4525	1693220.	0.00				
7.5000	-5.49E-04	62189.	-3989.	-3.37E-05	3082.	1.11E+10
106.9027	1168503.	0.00				
8.0000	-6.51E-04	40182.	-3322.	-6.10E-06	2623.	1.11E+10
115.3562	1063982.	0.00				
8.5000	-6.22E-04	22325.	-2623.	1.08E-05	2250.	1.11E+10
117.8322	1136468.	0.00				
9.0000	-5.21E-04	8709.	-1920.	1.91E-05	1967.	1.11E+10
116.3358	1338625.	0.00				
9.5000	-3.93E-04	-720.738	-1236.	2.13E-05	1800.	1.11E+10
111.7110	1707207.	0.00				
10.0000	-2.66E-04	-6128.	-628.108	1.94E-05	1913.	1.11E+10
90.8992	2049515.	0.00				
10.5000	-1.59E-04	-8263.	-187.291	1.56E-05	1957.	1.11E+10
56.0398	2108898.	0.00				
11.0000	-7.95E-05	-8380.	106.5506	1.11E-05	1960.	1.11E+10
41.9074	3162692.	0.00				
11.5000	-2.67E-05	-6988.	275.8546	6.92E-06	1931.	1.11E+10
14.5273	3266722.	0.00				
12.0000	3.53E-06	-5072.	313.4876	3.67E-06	1891.	1.11E+10
-1.983	3370764.	0.00				
12.5000	1.73E-05	-3227.	277.4253	1.43E-06	1852.	1.11E+10
-10.038	3474817.	0.00				
13.0000	2.07E-05	-1743.	210.2796	9.05E-08	1821.	1.11E+10
-12.344	3578880.	0.00				
13.5000	1.84E-05	-703.293	139.3301	-5.69E-07	1800.	1.11E+10
-11.306	3682951.	0.00				

14.0000	1.39E-05	-70.715	79.1567	-7.78E-07	1786.	1.11E+10
-8.752	3787029.	0.00				
14.5000	9.09E-06	246.7938	35.2240	-7.30E-07	1790.	1.11E+10
-5.892	3891114.	0.00				
15.0000	5.10E-06	352.1667	7.3532	-5.69E-07	1792.	1.11E+10
-3.398	3995206.	0.00				
15.5000	2.26E-06	335.1833	-7.474	-3.83E-07	1792.	1.11E+10
-1.544	4099303.	0.00				
16.0000	5.02E-07	262.5801	-13.162	-2.22E-07	1790.	1.11E+10
-0.352	4203405.	0.00				
16.5000	-4.07E-07	177.2964	-13.341	-1.04E-07	1789.	1.11E+10
0.2920	4307511.	0.00				
17.0000	-7.42E-07	102.5113	-10.829	-2.82E-08	1787.	1.11E+10
0.5454	4411622.	0.00				
17.5000	-7.45E-07	47.3536	-7.510	1.22E-08	1786.	1.11E+10
0.5608	4515736.	0.00				
18.0000	-5.95E-07	12.3829	-4.453	2.83E-08	1785.	1.11E+10
0.4584	4619854.	0.00				
18.5000	-4.05E-07	-6.086	-2.127	3.00E-08	1785.	1.11E+10
0.3168	4687500.	0.00				
19.0000	-2.35E-07	-13.150	-0.625	2.48E-08	1785.	1.11E+10
0.1838	4687500.	0.00				
19.5000	-1.08E-07	-13.596	0.1784	1.76E-08	1785.	1.11E+10
0.08409	4687500.	0.00				
20.0000	-2.40E-08	-11.013	0.4869	1.10E-08	1785.	1.11E+10
0.01874	4687500.	0.00				
20.5000	2.40E-08	-7.756	0.4868	5.91E-09	1785.	1.11E+10
-0.01878	4687500.	0.00				
21.0000	4.70E-08	-5.173	0.3900	2.43E-09	1785.	1.11E+10
-0.01349	1723730.	0.00				
21.5000	5.31E-08	-3.076	0.3037	2.02E-10	1785.	1.11E+10
-0.01527	1723730.	0.00				
22.0000	4.94E-08	-1.529	0.2154	-1.04E-09	1785.	1.11E+10
-0.01419	1723730.	0.00				
22.5000	4.07E-08	-0.492	0.1378	-1.58E-09	1785.	1.11E+10
-0.01168	1723730.	0.00				
23.0000	3.04E-08	0.1248	0.07653	-1.68E-09	1785.	1.11E+10
-0.00872	1723730.	0.00				
23.5000	2.05E-08	0.4272	0.03273	-1.53E-09	1785.	1.11E+10
-0.00588	1723730.	0.00				
24.0000	1.19E-08	0.5179	0.00480	-1.28E-09	1785.	1.11E+10
-0.00343	1723730.	0.00				
24.5000	5.10E-09	0.4851	-0.00990	-1.01E-09	1785.	1.11E+10
-0.00147	1723730.	0.00				
25.0000	-1.70E-10	0.3994	-0.01415	-7.71E-10	1785.	1.11E+10
4.90E-05	1723730.	0.00				
25.5000	-4.15E-09	0.3155	-0.01042	-5.78E-10	1785.	1.11E+10
0.00119	1723730.	0.00				
26.0000	-7.11E-09	0.2745	-0.00671	-4.19E-10	1785.	1.11E+10
4.44E-05	37440.	0.00				

26.5000	-9.18E-09	0.2351	-0.00640	-2.82E-10	1785.	1.11E+10
5.84E-05	38160.	0.00				
27.0000	-1.05E-08	0.1977	-0.00602	-1.65E-10	1785.	1.11E+10
6.80E-05	38880.	0.00				
27.5000	-1.12E-08	0.1628	-0.00560	-6.80E-11	1785.	1.11E+10
7.37E-05	39600.	0.00				
28.0000	-1.13E-08	0.1305	-0.00515	1.11E-11	1785.	1.11E+10
7.60E-05	40320.	0.00				
28.5000	-1.10E-08	0.1010	-0.00470	7.35E-11	1785.	1.11E+10
7.55E-05	41040.	0.00				
29.0000	-1.04E-08	0.07417	-0.00425	1.21E-10	1785.	1.11E+10
7.26E-05	41760.	0.00				
29.5000	-9.58E-09	0.04995	-0.00383	1.54E-10	1785.	1.11E+10
6.78E-05	42480.	0.00				
30.0000	-8.58E-09	0.02817	-0.00344	1.75E-10	1785.	1.11E+10
6.18E-05	43200.	0.00				
30.5000	-7.48E-09	0.00860	-0.00309	1.85E-10	1785.	1.11E+10
5.47E-05	43920.	0.00				
31.0000	-6.35E-09	-0.00899	-0.00250	1.85E-10	1785.	1.11E+10
1.42E-04	133920.	0.00				
31.5000	-5.26E-09	-0.02147	-0.00172	1.77E-10	1785.	1.11E+10
1.19E-04	136080.	0.00				
32.0000	-4.23E-09	-0.02967	-0.00107	1.63E-10	1785.	1.11E+10
9.75E-05	138240.	0.00				
32.5000	-3.30E-09	-0.03435	-5.45E-04	1.46E-10	1785.	1.11E+10
7.72E-05	140400.	0.00				
33.0000	-2.48E-09	-0.03624	-1.36E-04	1.27E-10	1785.	1.11E+10
5.90E-05	142560.	0.00				
33.5000	-1.78E-09	-0.03601	1.69E-04	1.07E-10	1785.	1.11E+10
4.29E-05	144720.	0.00				
34.0000	-1.19E-09	-0.03424	3.86E-04	8.84E-11	1785.	1.11E+10
2.92E-05	146880.	0.00				
34.5000	-7.19E-10	-0.03141	5.27E-04	7.07E-11	1785.	1.11E+10
1.78E-05	149040.	0.00				
35.0000	-3.45E-10	-0.02793	6.07E-04	5.47E-11	1785.	1.11E+10
8.70E-06	151200.	0.00				
35.5000	-6.24E-11	-0.02414	6.38E-04	4.06E-11	1785.	1.11E+10
1.59E-06	153360.	0.00				
36.0000	1.42E-10	-0.02029	6.31E-04	2.87E-11	1785.	1.11E+10
-3.69E-06	155520.	0.00				
36.5000	2.82E-10	-0.01657	5.98E-04	1.87E-11	1785.	1.11E+10
-7.40E-06	157680.	0.00				
37.0000	3.67E-10	-0.01312	5.46E-04	1.07E-11	1785.	1.11E+10
-9.78E-06	159840.	0.00				
37.5000	4.10E-10	-0.01002	4.84E-04	4.47E-12	1785.	1.11E+10
-1.11E-05	162000.	0.00				
38.0000	4.21E-10	-0.00732	4.16E-04	0.00	1785.	1.11E+10
-1.15E-05	164160.	0.00				
38.5000	4.08E-10	-0.00503	3.48E-04	-3.53E-12	1785.	1.11E+10
-1.13E-05	166320.	0.00				

39.0000	3.78E-10	-0.00314	2.82E-04	-5.73E-12	1785.	1.11E+10
-1.06E-05	168480.	0.00				
39.5000	3.39E-10	-0.00164	2.21E-04	-7.02E-12	1785.	1.11E+10
-9.64E-06	170640.	0.00				
40.0000	2.94E-10	-4.89E-04	1.67E-04	-7.60E-12	1785.	1.11E+10
-8.47E-06	172800.	0.00				
40.5000	2.48E-10	3.60E-04	1.20E-04	-7.63E-12	1785.	1.11E+10
-7.23E-06	174960.	0.00				
41.0000	2.03E-10	9.49E-04	8.00E-05	-7.28E-12	1785.	1.11E+10
-5.98E-06	177120.	0.00				
41.5000	1.60E-10	0.00132	4.77E-05	-6.67E-12	1785.	1.11E+10
-4.79E-06	179280.	0.00				
42.0000	1.23E-10	0.00152	2.22E-05	-5.90E-12	1785.	1.11E+10
-3.71E-06	181440.	0.00				
42.5000	8.96E-11	0.00159	2.85E-06	-5.06E-12	1785.	1.11E+10
-2.74E-06	183600.	0.00				
43.0000	6.18E-11	0.00156	-1.11E-05	-4.21E-12	1785.	1.11E+10
-1.91E-06	185760.	0.00				
43.5000	3.91E-11	0.00146	-2.05E-05	-3.40E-12	1785.	1.11E+10
-1.22E-06	187920.	0.00				
44.0000	2.10E-11	0.00131	-2.62E-05	-2.65E-12	1785.	1.11E+10
-6.67E-07	190080.	0.00				
44.5000	7.25E-12	0.00114	-2.89E-05	-1.99E-12	1785.	1.11E+10
-2.32E-07	192240.	0.00				
45.0000	-2.84E-12	9.66E-04	-2.93E-05	-1.42E-12	1785.	1.11E+10
9.19E-08	194400.	0.00				
45.5000	-9.80E-12	7.92E-04	-2.81E-05	0.00	1785.	1.11E+10
3.21E-07	196560.	0.00				
46.0000	-1.42E-11	6.30E-04	-2.57E-05	0.00	1785.	1.11E+10
4.70E-07	198720.	0.00				
46.5000	-1.66E-11	4.84E-04	-2.26E-05	0.00	1785.	1.11E+10
5.55E-07	200880.	0.00				
47.0000	-1.74E-11	3.58E-04	-1.92E-05	0.00	1785.	1.11E+10
5.87E-07	203040.	0.00				
47.5000	-1.70E-11	2.53E-04	-1.57E-05	0.00	1785.	1.11E+10
5.81E-07	205200.	0.00				
48.0000	-1.58E-11	1.70E-04	-1.23E-05	0.00	1785.	1.11E+10
5.47E-07	207360.	0.00				
48.5000	-1.41E-11	1.05E-04	-9.21E-06	0.00	1785.	1.11E+10
4.92E-07	209520.	0.00				
49.0000	-1.20E-11	5.90E-05	-6.46E-06	0.00	1785.	1.11E+10
4.24E-07	211680.	0.00				
49.5000	-9.76E-12	2.78E-05	-4.14E-06	0.00	1785.	1.11E+10
3.48E-07	213840.	0.00				
50.0000	-7.40E-12	9.17E-06	-2.30E-06	0.00	1785.	1.11E+10
2.67E-07	216000.	0.00				
50.5000	-5.02E-12	1.09E-07	-9.53E-07	0.00	1785.	1.11E+10
1.83E-07	218160.	0.00				
51.0000	-2.64E-12	-2.37E-06	-1.14E-07	0.00	1785.	1.11E+10
9.70E-08	220320.	0.00				

51.5000	0.00	-1.36E-06	2.06E-07	0.00	1785.	1.11E+10
9.89E-09	222480.	0.00				
52.0000	2.10E-12	0.00	0.00	0.00	1785.	1.11E+10
-7.87E-08	112320.	0.00				

\* The above values of total stress are combined axial and bending stresses.

#### Output Summary for Load Case No. 2:

Pile-head deflection	=	0.05484027 inches
Computed slope at pile head	=	-0.0011367 radians
Maximum bending moment	=	193081. inch-lbs
Maximum shear force	=	8220. lbs
Depth of maximum bending moment	=	4.00000000 feet below pile head
Depth of maximum shear force	=	0.000000 feet below pile head
Number of iterations	=	21
Number of zero deflection points	=	8

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#### Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 3

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Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head	=	12330.0 lbs
Applied moment at pile head	=	0.0 in-lbs
Axial thrust load on pile head	=	20510.0 lbs

Depth Res. X Es*H feet lb/inch	Deflect. Soil Spr. Lat. Load inches lb/inch	Bending Distrib. Moment in-lbs lb/inch	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil p
0.00	0.1310	4.29E-08	12330.	-0.00233	1658.	1.11E+10	
-206.756	4736.	0.00					
0.5000	0.1170	70545.	11065.	-0.00231	3129.	1.11E+10	
-214.845	11021.	0.00					
1.0000	0.1032	133352.	9756.	-0.00226	4439.	1.11E+10	
-221.646	12886.	0.00					
1.5000	0.08986	188170.	8410.	-0.00217	5582.	1.11E+10	
-227.077	15161.	0.00					
2.0000	0.07714	234801.	7035.	-0.00206	6554.	1.11E+10	
-231.052	17972.	0.00					

2.5000	0.06517	273098.	5642.	-0.00192	7353.	1.11E+10
-233.484	21495.	0.00				
3.0000	0.05409	302972.	4238.	-0.00177	7975.	1.11E+10
-234.275	25988.	0.00				
3.5000	0.04399	324392.	2835.	-0.00160	8422.	1.11E+10
-233.320	31826.	0.00				
4.0000	0.03493	337391.	1444.	-0.00142	8693.	1.11E+10
-230.499	39589.	0.00				
4.5000	0.02697	342070.	75.5349	-0.00123	8791.	1.11E+10
-225.667	50199.	0.00				
5.0000	0.02012	338601.	-1257.	-0.00105	8718.	1.11E+10
-218.639	65207.	0.00				
5.5000	0.01436	327240.	-2541.	-8.72E-04	8482.	1.11E+10
-209.164	87400.	0.00				
6.0000	0.00966	308326.	-3759.	-7.00E-04	8087.	1.11E+10
-196.856	122284.	0.00				
6.5000	0.00596	282306.	-4893.	-5.41E-04	7545.	1.11E+10
-181.035	182357.	0.00				
7.0000	0.00317	249749.	-5916.	-3.98E-04	6866.	1.11E+10
-160.228	303514.	0.00				
7.5000	0.00119	211408.	-6786.	-2.73E-04	6066.	1.11E+10
-129.784	656315.	0.00				
8.0000	-1.10E-04	168380.	-7076.	-1.71E-04	5169.	1.11E+10
33.3588	1811985.	0.00				
8.5000	-8.63E-04	126542.	-6592.	-9.12E-05	4297.	1.11E+10
127.8405	889231.	0.00				
9.0000	-0.00121	89298.	-5778.	-3.30E-05	3520.	1.11E+10
143.4326	714020.	0.00				
9.5000	-0.00126	57212.	-4899.	6.47E-06	2851.	1.11E+10
149.4780	712343.	0.00				
10.0000	-0.00113	30503.	-4002.	3.01E-05	2294.	1.11E+10
149.7630	796836.	0.00				
10.5000	-8.98E-04	9184.	-3116.	4.08E-05	1850.	1.11E+10
145.5638	972988.	0.00				
11.0000	-6.38E-04	-6896.	-2078.	4.14E-05	1802.	1.11E+10
200.4375	1885398.	0.00				
11.5000	-4.00E-04	-15760.	-923.589	3.53E-05	1987.	1.11E+10
184.2882	2761504.	0.00				
12.0000	-2.14E-04	-17988.	-10.143	2.62E-05	2033.	1.11E+10
120.1938	3370764.	0.00				
12.5000	-8.57E-05	-15888.	499.3099	1.71E-05	1989.	1.11E+10
49.6238	3474817.	0.00				
13.0000	-8.83E-06	-12000.	663.9858	9.57E-06	1908.	1.11E+10
5.2682	3578880.	0.00				
13.5000	2.92E-05	-7922.	626.0318	4.20E-06	1823.	1.11E+10
-17.920	3682951.	0.00				
14.0000	4.16E-05	-4489.	493.5318	8.55E-07	1752.	1.11E+10
-26.247	3787029.	0.00				
14.5000	3.95E-05	-2000.	338.0348	-8.95E-07	1700.	1.11E+10
-25.585	3891114.	0.00				

15.0000	3.08E-05	-432.415	199.6602	-1.55E-06	1667.	1.11E+10
-20.540	3995206.	0.00				
15.5000	2.08E-05	396.0370	95.3220	-1.56E-06	1666.	1.11E+10
-14.240	4099303.	0.00				
16.0000	1.21E-05	711.8322	27.1316	-1.26E-06	1673.	1.11E+10
-8.490	4203405.	0.00				
16.5000	5.70E-06	721.9262	-10.615	-8.75E-07	1673.	1.11E+10
-4.092	4307511.	0.00				
17.0000	1.62E-06	584.6654	-26.455	-5.23E-07	1670.	1.11E+10
-1.188	4411622.	0.00				
17.5000	-5.76E-07	404.5967	-28.718	-2.56E-07	1666.	1.11E+10
0.4338	4515736.	0.00				
18.0000	-1.46E-06	240.1162	-24.046	-8.24E-08	1663.	1.11E+10
1.1236	4619854.	0.00				
18.5000	-1.57E-06	116.0705	-17.006	1.36E-08	1660.	1.11E+10
1.2230	4687500.	0.00				
19.0000	-1.30E-06	36.0434	-10.300	5.46E-08	1659.	1.11E+10
1.0124	4687500.	0.00				
19.5000	-9.10E-07	-7.539	-5.130	6.23E-08	1658.	1.11E+10
0.7108	4687500.	0.00				
20.0000	-5.48E-07	-25.533	-1.713	5.34E-08	1659.	1.11E+10
0.4282	4687500.	0.00				
20.5000	-2.69E-07	-28.111	0.2017	3.89E-08	1659.	1.11E+10
0.2101	4687500.	0.00				
21.0000	-8.08E-08	-23.123	0.9018	2.51E-08	1659.	1.11E+10
0.02322	1723730.	0.00				
21.5000	3.25E-08	-17.296	0.9434	1.42E-08	1658.	1.11E+10
-0.00934	1723730.	0.00				
22.0000	8.99E-08	-11.805	0.8380	6.38E-09	1658.	1.11E+10
-0.02582	1723730.	0.00				
22.5000	1.09E-07	-7.242	0.6665	1.24E-09	1658.	1.11E+10
-0.03132	1723730.	0.00				
23.0000	1.05E-07	-3.807	0.4823	-1.74E-09	1658.	1.11E+10
-0.03010	1723730.	0.00				
23.5000	8.82E-08	-1.455	0.3160	-3.16E-09	1658.	1.11E+10
-0.02533	1723730.	0.00				
24.0000	6.69E-08	-0.01396	0.1824	-3.55E-09	1658.	1.11E+10
-0.01921	1723730.	0.00				
24.5000	4.55E-08	0.7349	0.08548	-3.36E-09	1658.	1.11E+10
-0.01308	1723730.	0.00				
25.0000	2.66E-08	1.0126	0.02331	-2.89E-09	1658.	1.11E+10
-0.00764	1723730.	0.00				
25.5000	1.09E-08	1.0153	-0.00900	-2.34E-09	1658.	1.11E+10
-0.00313	1723730.	0.00				
26.0000	-1.49E-09	0.9051	-0.01837	-1.82E-09	1658.	1.11E+10
9.31E-06	37440.	0.00				
26.5000	-1.10E-08	0.7953	-0.01814	-1.36E-09	1658.	1.11E+10
6.97E-05	38160.	0.00				
27.0000	-1.79E-08	0.6878	-0.01758	-9.64E-10	1658.	1.11E+10
1.16E-04	38880.	0.00				

27.5000	-2.25E-08	0.5845	-0.01679	-6.21E-10	1658.	1.11E+10
1.49E-04	39600.	0.00				
28.0000	-2.53E-08	0.4865	-0.01583	-3.32E-10	1658.	1.11E+10
1.70E-04	40320.	0.00				
28.5000	-2.65E-08	0.3946	-0.01478	-9.43E-11	1658.	1.11E+10
1.81E-04	41040.	0.00				
29.0000	-2.64E-08	0.3092	-0.01368	9.54E-11	1658.	1.11E+10
1.84E-04	41760.	0.00				
29.5000	-2.54E-08	0.2304	-0.01259	2.41E-10	1658.	1.11E+10
1.80E-04	42480.	0.00				
30.0000	-2.35E-08	0.1580	-0.01154	3.46E-10	1658.	1.11E+10
1.70E-04	43200.	0.00				
30.5000	-2.12E-08	0.09178	-0.01057	4.13E-10	1658.	1.11E+10
1.55E-04	43920.	0.00				
31.0000	-1.86E-08	0.03111	-0.00886	4.46E-10	1658.	1.11E+10
4.15E-04	133920.	0.00				
31.5000	-1.59E-08	-0.01463	-0.00653	4.51E-10	1658.	1.11E+10
3.60E-04	136080.	0.00				
32.0000	-1.32E-08	-0.04742	-0.00454	4.34E-10	1658.	1.11E+10
3.04E-04	138240.	0.00				
32.5000	-1.07E-08	-0.06927	-0.00289	4.02E-10	1658.	1.11E+10
2.49E-04	140400.	0.00				
33.0000	-8.35E-09	-0.08215	-0.00154	3.62E-10	1658.	1.11E+10
1.98E-04	142560.	0.00				
33.5000	-6.32E-09	-0.08787	-4.89E-04	3.16E-10	1658.	1.11E+10
1.52E-04	144720.	0.00				
34.0000	-4.56E-09	-0.08810	3.03E-04	2.68E-10	1658.	1.11E+10
1.12E-04	146880.	0.00				
34.5000	-3.10E-09	-0.08430	8.69E-04	2.22E-10	1658.	1.11E+10
7.69E-05	149040.	0.00				
35.0000	-1.90E-09	-0.07772	0.00124	1.78E-10	1658.	1.11E+10
4.80E-05	151200.	0.00				
35.5000	-9.60E-10	-0.06942	0.00146	1.38E-10	1658.	1.11E+10
2.45E-05	153360.	0.00				
36.0000	-2.42E-10	-0.06022	0.00155	1.03E-10	1658.	1.11E+10
6.27E-06	155520.	0.00				
36.5000	2.82E-10	-0.05080	0.00155	7.35E-11	1658.	1.11E+10
-7.40E-06	157680.	0.00				
37.0000	6.41E-10	-0.04164	0.00148	4.86E-11	1658.	1.11E+10
-1.71E-05	159840.	0.00				
37.5000	8.65E-10	-0.03309	0.00136	2.85E-11	1658.	1.11E+10
-2.34E-05	162000.	0.00				
38.0000	9.83E-10	-0.02538	0.00120	1.27E-11	1658.	1.11E+10
-2.69E-05	164160.	0.00				
38.5000	1.02E-09	-0.01864	0.00104	0.00	1658.	1.11E+10
-2.82E-05	166320.	0.00				
39.0000	9.93E-10	-0.01291	8.71E-04	-7.67E-12	1658.	1.11E+10
-2.79E-05	168480.	0.00				
39.5000	9.26E-10	-0.00818	7.09E-04	-1.34E-11	1658.	1.11E+10
-2.63E-05	170640.	0.00				

40.0000	8.32E-10	-0.00440	5.58E-04	-1.68E-11	1658.	1.11E+10
-2.40E-05	172800.	0.00				
40.5000	7.25E-10	-0.00149	4.22E-04	-1.83E-11	1658.	1.11E+10
-2.11E-05	174960.	0.00				
41.0000	6.12E-10	6.68E-04	3.05E-04	-1.86E-11	1658.	1.11E+10
-1.81E-05	177120.	0.00				
41.5000	5.02E-10	0.00217	2.06E-04	-1.78E-11	1658.	1.11E+10
-1.50E-05	179280.	0.00				
42.0000	3.99E-10	0.00314	1.24E-04	-1.64E-11	1658.	1.11E+10
-1.21E-05	181440.	0.00				
42.5000	3.06E-10	0.00367	6.01E-05	-1.45E-11	1658.	1.11E+10
-9.35E-06	183600.	0.00				
43.0000	2.24E-10	0.00386	1.12E-05	-1.25E-11	1658.	1.11E+10
-6.95E-06	185760.	0.00				
43.5000	1.56E-10	0.00381	-2.42E-05	-1.04E-11	1658.	1.11E+10
-4.88E-06	187920.	0.00				
44.0000	9.93E-11	0.00358	-4.83E-05	-8.43E-12	1658.	1.11E+10
-3.15E-06	190080.	0.00				
44.5000	5.45E-11	0.00323	-6.29E-05	-6.60E-12	1658.	1.11E+10
-1.74E-06	192240.	0.00				
45.0000	2.01E-11	0.00282	-7.01E-05	-4.97E-12	1658.	1.11E+10
-6.51E-07	194400.	0.00				
45.5000	-5.14E-12	0.00239	-7.16E-05	-3.56E-12	1658.	1.11E+10
1.68E-07	196560.	0.00				
46.0000	-2.26E-11	0.00196	-6.88E-05	-2.39E-12	1658.	1.11E+10
7.50E-07	198720.	0.00				
46.5000	-3.38E-11	0.00157	-6.32E-05	-1.43E-12	1658.	1.11E+10
1.13E-06	200880.	0.00				
47.0000	-3.98E-11	0.00121	-5.57E-05	0.00	1658.	1.11E+10
1.35E-06	203040.	0.00				
47.5000	-4.20E-11	8.96E-04	-4.74E-05	0.00	1658.	1.11E+10
1.44E-06	205200.	0.00				
48.0000	-4.13E-11	6.38E-04	-3.88E-05	0.00	1658.	1.11E+10
1.43E-06	207360.	0.00				
48.5000	-3.85E-11	4.31E-04	-3.05E-05	0.00	1658.	1.11E+10
1.34E-06	209520.	0.00				
49.0000	-3.43E-11	2.72E-04	-2.28E-05	0.00	1658.	1.11E+10
1.21E-06	211680.	0.00				
49.5000	-2.92E-11	1.57E-04	-1.61E-05	0.00	1658.	1.11E+10
1.04E-06	213840.	0.00				
50.0000	-2.37E-11	7.90E-05	-1.04E-05	0.00	1658.	1.11E+10
8.52E-07	216000.	0.00				
50.5000	-1.78E-11	3.19E-05	-5.88E-06	0.00	1658.	1.11E+10
6.48E-07	218160.	0.00				
51.0000	-1.19E-11	8.13E-06	-2.63E-06	0.00	1658.	1.11E+10
4.37E-07	220320.	0.00				
51.5000	-5.94E-12	1.05E-07	-6.58E-07	0.00	1658.	1.11E+10
2.20E-07	222480.	0.00				
52.0000	0.00	0.00	0.00	0.00	1658.	1.11E+10
-9.35E-10	112320.	0.00				

\* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 3:

Pile-head deflection = 0.13096104 inches  
Computed slope at pile head = -0.0023325 radians  
Maximum bending moment = 342070. inch-lbs  
Maximum shear force = 12330. lbs  
Depth of maximum bending moment = 4.50000000 feet below pile head  
Depth of maximum shear force = 0.000000 feet below pile head  
Number of iterations = 24  
Number of zero deflection points = 8

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Computed Values of Pile Loading and Deflection  
for Lateral Loading for Load Case Number 4

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Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 12330.0 lbs  
Applied moment at pile head = 0.0 in-lbs  
Axial thrust load on pile head = 28230.0 lbs

Res.	Depth	Deflect.	Bending	Shear	Slope	Total	Bending	Soil
	Soil	Spr.	Distrib.	Force	S	Stress	Stiffness	p
	X	y	Moment	lbs	radians	psi*	lb-in^2	
	Es*H	Lat.	Load	feet	inches	in-lbs	lb/inch	lb/inch
	0.00	0.1312	-6.00E-08	12330.	-0.00234	2282.	1.11E+10	
-206.866		4729.	0.00					
0.5000		0.1172	70652.	11065.	-0.00232	3755.	1.11E+10	
-214.961		11003.	0.00					
1.0000		0.1034	133559.	9754.	-0.00226	5067.	1.11E+10	
-221.767		12865.	0.00					
1.5000		0.09006	188471.	8407.	-0.00218	6212.	1.11E+10	
-227.202		15136.	0.00					
2.0000		0.07731	235186.	7032.	-0.00206	7186.	1.11E+10	
-231.182		17942.	0.00					
2.5000		0.06532	273557.	5638.	-0.00192	7986.	1.11E+10	
-233.616		21459.	0.00					
3.0000		0.05421	303492.	4234.	-0.00177	8610.	1.11E+10	
-234.410		25943.	0.00					

3.5000	0.04409	324962.	2830.	-0.00160	9058.	1.11E+10
-233.458	31770.	0.00				
4.0000	0.03502	337997.	1438.	-0.00142	9330.	1.11E+10
-230.638	39518.	0.00				
4.5000	0.02704	342698.	68.5722	-0.00124	9428.	1.11E+10
-225.807	50106.	0.00				
5.0000	0.02017	339239.	-1265.	-0.00105	9356.	1.11E+10
-218.779	65082.	0.00				
5.5000	0.01440	327873.	-2549.	-8.74E-04	9119.	1.11E+10
-209.303	87226.	0.00				
6.0000	0.00969	308941.	-3768.	-7.02E-04	8724.	1.11E+10
-196.993	122029.	0.00				
6.5000	0.00597	282890.	-4903.	-5.42E-04	8181.	1.11E+10
-181.169	181955.	0.00				
7.0000	0.00318	250292.	-5927.	-3.99E-04	7501.	1.11E+10
-160.356	302788.	0.00				
7.5000	0.00119	211897.	-6798.	-2.74E-04	6701.	1.11E+10
-129.906	654466.	0.00				
8.0000	-1.10E-04	168806.	-7088.	-1.71E-04	5802.	1.11E+10
33.2414	1811985.	0.00				
8.5000	-8.65E-04	126897.	-6605.	-9.16E-05	4928.	1.11E+10
127.9262	887444.	0.00				
9.0000	-0.00121	89582.	-5790.	-3.32E-05	4150.	1.11E+10
143.5478	712304.	0.00				
9.5000	-0.00126	57426.	-4911.	6.42E-06	3480.	1.11E+10
149.6119	710432.	0.00				
10.0000	-0.00113	30650.	-4012.	3.02E-05	2921.	1.11E+10
149.9112	794477.	0.00				
10.5000	-9.02E-04	9269.	-3125.	4.09E-05	2475.	1.11E+10
145.7235	969795.	0.00				
11.0000	-6.41E-04	-6867.	-2086.	4.16E-05	2425.	1.11E+10
200.6840	1878466.	0.00				
11.5000	-4.03E-04	-15778.	-930.367	3.55E-05	2611.	1.11E+10
184.5461	2749953.	0.00				
12.0000	-2.15E-04	-18043.	-13.778	2.64E-05	2658.	1.11E+10
120.9835	3370764.	0.00				
12.5000	-8.64E-05	-15952.	499.3398	1.72E-05	2615.	1.11E+10
50.0557	3474817.	0.00				
13.0000	-9.13E-06	-12057.	665.8358	9.63E-06	2534.	1.11E+10
5.4429	3578880.	0.00				
13.5000	2.92E-05	-7965.	628.4487	4.23E-06	2448.	1.11E+10
-17.905	3682951.	0.00				
14.0000	4.17E-05	-4517.	495.7861	8.69E-07	2376.	1.11E+10
-26.316	3787029.	0.00				
14.5000	3.96E-05	-2016.	339.7931	-8.92E-07	2324.	1.11E+10
-25.682	3891114.	0.00				
15.0000	3.10E-05	-439.242	200.8488	-1.55E-06	2291.	1.11E+10
-20.633	3995206.	0.00				
15.5000	2.10E-05	394.7460	96.0105	-1.57E-06	2290.	1.11E+10
-14.313	4099303.	0.00				

16.0000	1.22E-05	713.4152	27.4483	-1.27E-06	2297.	1.11E+10
-8.541	4203405.	0.00				
16.5000	5.74E-06	724.5548	-10.537	-8.80E-07	2297.	1.11E+10
-4.121	4307511.	0.00				
17.0000	1.63E-06	587.2652	-26.506	-5.26E-07	2294.	1.11E+10
-1.202	4411622.	0.00				
17.5000	-5.72E-07	406.6641	-28.819	-2.58E-07	2291.	1.11E+10
0.4304	4515736.	0.00				
18.0000	-1.46E-06	241.5200	-24.151	-8.33E-08	2287.	1.11E+10
1.1258	4619854.	0.00				
18.5000	-1.57E-06	116.8834	-17.091	1.34E-08	2285.	1.11E+10
1.2273	4687500.	0.00				
19.0000	-1.30E-06	36.4202	-10.359	5.47E-08	2283.	1.11E+10
1.0169	4687500.	0.00				
19.5000	-9.14E-07	-7.438	-5.165	6.25E-08	2282.	1.11E+10
0.7144	4687500.	0.00				
20.0000	-5.51E-07	-25.577	-1.729	5.36E-08	2283.	1.11E+10
0.4307	4687500.	0.00				
20.5000	-2.71E-07	-28.207	0.1979	3.91E-08	2283.	1.11E+10
0.2117	4687500.	0.00				
21.0000	-8.18E-08	-23.215	0.9034	2.53E-08	2283.	1.11E+10
0.02351	1723730.	0.00				
21.5000	3.21E-08	-17.375	0.9463	1.43E-08	2282.	1.11E+10
-0.00924	1723730.	0.00				
22.0000	8.99E-08	-11.865	0.8411	6.43E-09	2282.	1.11E+10
-0.02583	1723730.	0.00				
22.5000	1.09E-07	-7.284	0.6694	1.27E-09	2282.	1.11E+10
-0.03140	1723730.	0.00				
23.0000	1.05E-07	-3.833	0.4846	-1.73E-09	2282.	1.11E+10
-0.03020	1723730.	0.00				
23.5000	8.85E-08	-1.469	0.3177	-3.16E-09	2282.	1.11E+10
-0.02543	1723730.	0.00				
24.0000	6.72E-08	-0.01961	0.1835	-3.56E-09	2282.	1.11E+10
-0.01930	1723730.	0.00				
24.5000	4.58E-08	0.7344	0.08611	-3.37E-09	2282.	1.11E+10
-0.01315	1723730.	0.00				
25.0000	2.68E-08	1.0149	0.02359	-2.90E-09	2282.	1.11E+10
-0.00769	1723730.	0.00				
25.5000	1.10E-08	1.0185	-0.00896	-2.35E-09	2282.	1.11E+10
-0.00316	1723730.	0.00				
26.0000	-1.43E-09	0.9081	-0.01843	-1.83E-09	2282.	1.11E+10
8.95E-06	37440.	0.00				
26.5000	-1.09E-08	0.7980	-0.01819	-1.37E-09	2282.	1.11E+10
6.96E-05	38160.	0.00				
27.0000	-1.79E-08	0.6903	-0.01764	-9.68E-10	2282.	1.11E+10
1.16E-04	38880.	0.00				
27.5000	-2.26E-08	0.5867	-0.01684	-6.24E-10	2282.	1.11E+10
1.49E-04	39600.	0.00				
28.0000	-2.54E-08	0.4884	-0.01588	-3.34E-10	2282.	1.11E+10
1.70E-04	40320.	0.00				

28.5000	-2.66E-08	0.3962	-0.01483	-9.57E-11	2282.	1.11E+10
1.82E-04	41040.	0.00				
29.0000	-2.65E-08	0.3105	-0.01373	9.49E-11	2282.	1.11E+10
1.84E-04	41760.	0.00				
29.5000	-2.54E-08	0.2314	-0.01263	2.41E-10	2282.	1.11E+10
1.80E-04	42480.	0.00				
30.0000	-2.36E-08	0.1588	-0.01158	3.46E-10	2282.	1.11E+10
1.70E-04	43200.	0.00				
30.5000	-2.13E-08	0.09232	-0.01061	4.14E-10	2282.	1.11E+10
1.56E-04	43920.	0.00				
31.0000	-1.86E-08	0.03141	-0.00889	4.47E-10	2282.	1.11E+10
4.16E-04	133920.	0.00				
31.5000	-1.59E-08	-0.01451	-0.00656	4.52E-10	2282.	1.11E+10
3.61E-04	136080.	0.00				
32.0000	-1.32E-08	-0.04744	-0.00456	4.35E-10	2282.	1.11E+10
3.05E-04	138240.	0.00				
32.5000	-1.07E-08	-0.06940	-0.00290	4.04E-10	2282.	1.11E+10
2.50E-04	140400.	0.00				
33.0000	-8.38E-09	-0.08234	-0.00155	3.63E-10	2282.	1.11E+10
1.99E-04	142560.	0.00				
33.5000	-6.34E-09	-0.08810	-4.92E-04	3.17E-10	2282.	1.11E+10
1.53E-04	144720.	0.00				
34.0000	-4.58E-09	-0.08835	3.03E-04	2.69E-10	2282.	1.11E+10
1.12E-04	146880.	0.00				
34.5000	-3.11E-09	-0.08456	8.71E-04	2.23E-10	2282.	1.11E+10
7.72E-05	149040.	0.00				
35.0000	-1.91E-09	-0.07797	0.00125	1.79E-10	2282.	1.11E+10
4.82E-05	151200.	0.00				
35.5000	-9.64E-10	-0.06965	0.00147	1.39E-10	2282.	1.11E+10
2.47E-05	153360.	0.00				
36.0000	-2.43E-10	-0.06043	0.00156	1.04E-10	2282.	1.11E+10
6.31E-06	155520.	0.00				
36.5000	2.82E-10	-0.05098	0.00156	7.38E-11	2282.	1.11E+10
-7.41E-06	157680.	0.00				
37.0000	6.43E-10	-0.04179	0.00148	4.88E-11	2282.	1.11E+10
-1.71E-05	159840.	0.00				
37.5000	8.68E-10	-0.03321	0.00136	2.86E-11	2282.	1.11E+10
-2.34E-05	162000.	0.00				
38.0000	9.86E-10	-0.02548	0.00121	1.28E-11	2282.	1.11E+10
-2.70E-05	164160.	0.00				
38.5000	1.02E-09	-0.01871	0.00104	0.00	2282.	1.11E+10
-2.83E-05	166320.	0.00				
39.0000	9.96E-10	-0.01296	8.74E-04	-7.68E-12	2282.	1.11E+10
-2.80E-05	168480.	0.00				
39.5000	9.29E-10	-0.00822	7.11E-04	-1.34E-11	2282.	1.11E+10
-2.64E-05	170640.	0.00				
40.0000	8.35E-10	-0.00442	5.60E-04	-1.68E-11	2282.	1.11E+10
-2.41E-05	172800.	0.00				
40.5000	7.27E-10	-0.00150	4.24E-04	-1.84E-11	2282.	1.11E+10
-2.12E-05	174960.	0.00				

41.0000	6.14E-10	6.68E-04	3.06E-04	-1.86E-11	2282.	1.11E+10
-1.81E-05	177120.	0.00				
41.5000	5.04E-10	0.00218	2.06E-04	-1.79E-11	2282.	1.11E+10
-1.51E-05	179280.	0.00				
42.0000	4.00E-10	0.00315	1.25E-04	-1.64E-11	2282.	1.11E+10
-1.21E-05	181440.	0.00				
42.5000	3.07E-10	0.00368	6.03E-05	-1.46E-11	2282.	1.11E+10
-9.39E-06	183600.	0.00				
43.0000	2.25E-10	0.00388	1.13E-05	-1.25E-11	2282.	1.11E+10
-6.97E-06	185760.	0.00				
43.5000	1.56E-10	0.00382	-2.43E-05	-1.05E-11	2282.	1.11E+10
-4.89E-06	187920.	0.00				
44.0000	9.96E-11	0.00359	-4.85E-05	-8.47E-12	2282.	1.11E+10
-3.16E-06	190080.	0.00				
44.5000	5.47E-11	0.00324	-6.32E-05	-6.62E-12	2282.	1.11E+10
-1.75E-06	192240.	0.00				
45.0000	2.02E-11	0.00283	-7.04E-05	-4.99E-12	2282.	1.11E+10
-6.53E-07	194400.	0.00				
45.5000	-5.17E-12	0.00240	-7.19E-05	-3.57E-12	2282.	1.11E+10
1.69E-07	196560.	0.00				
46.0000	-2.27E-11	0.00197	-6.91E-05	-2.40E-12	2282.	1.11E+10
7.53E-07	198720.	0.00				
46.5000	-3.39E-11	0.00157	-6.34E-05	-1.44E-12	2282.	1.11E+10
1.14E-06	200880.	0.00				
47.0000	-4.00E-11	0.00121	-5.60E-05	0.00	2282.	1.11E+10
1.35E-06	203040.	0.00				
47.5000	-4.22E-11	9.00E-04	-4.76E-05	0.00	2282.	1.11E+10
1.44E-06	205200.	0.00				
48.0000	-4.15E-11	6.41E-04	-3.89E-05	0.00	2282.	1.11E+10
1.43E-06	207360.	0.00				
48.5000	-3.87E-11	4.33E-04	-3.06E-05	0.00	2282.	1.11E+10
1.35E-06	209520.	0.00				
49.0000	-3.44E-11	2.73E-04	-2.29E-05	0.00	2282.	1.11E+10
1.22E-06	211680.	0.00				
49.5000	-2.94E-11	1.57E-04	-1.61E-05	0.00	2282.	1.11E+10
1.05E-06	213840.	0.00				
50.0000	-2.38E-11	7.94E-05	-1.04E-05	0.00	2282.	1.11E+10
8.55E-07	216000.	0.00				
50.5000	-1.79E-11	3.21E-05	-5.90E-06	0.00	2282.	1.11E+10
6.51E-07	218160.	0.00				
51.0000	-1.19E-11	8.23E-06	-2.63E-06	0.00	2282.	1.11E+10
4.38E-07	220320.	0.00				
51.5000	-5.95E-12	1.43E-07	-6.57E-07	0.00	2282.	1.11E+10
2.21E-07	222480.	0.00				
52.0000	0.00	0.00	0.00	0.00	2282.	1.11E+10
-1.45E-09	112320.	0.00				

\* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 4:

Pile-head deflection	=	0.13124070 inches
Computed slope at pile head	=	-0.0023371 radians
Maximum bending moment	=	342698. inch-lbs
Maximum shear force	=	12330. lbs
Depth of maximum bending moment	=	4.50000000 feet below pile head
Depth of maximum shear force	=	0.000000 feet below pile head
Number of iterations	=	24
Number of zero deflection points	=	8

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Summary of Pile-head Responses for Conventional Analyses

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Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs  
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians  
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.  
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs  
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case Shear Type Pile No.	Load Max Moment in Pile in-lbs	Load Pile-head Type in Load 1 in-lbs	Load Pile-head Type 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max in lbs
1	V, lb 8220.	8220. M, in-lb 192334.		0.00	0.00	0.05460	-0.00113
2	V, lb 8220.	8220. M, in-lb 193081.		0.00	22080.	0.05484	-0.00114
3	V, lb 12330.	12330. M, in-lb 342070.		0.00	20510.	0.1310	-0.00233
4	V, lb 12330.	12330. M, in-lb 342698.		0.00	28230.	0.1312	-0.00234

Maximum pile-head deflection = 0.1312406968 inches

Maximum pile-head rotation = -0.0023370686 radians = -0.133904 deg.

The analysis ended normally.