ALL-US30 Rest Areas TP Site #14 Expansion (PID 122869)

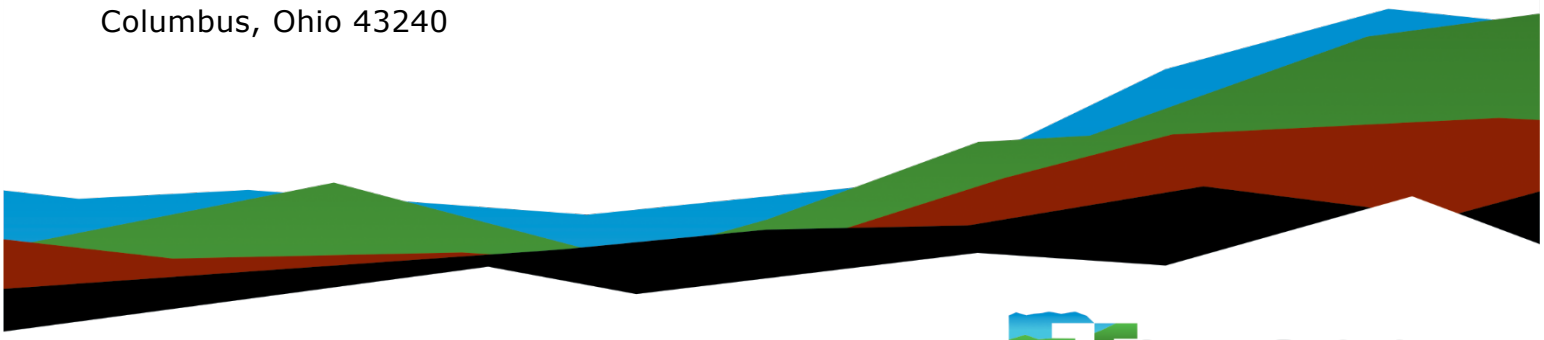
Roadway Exploration Report

Lima, Allen County, Ohio

July 24, 2026 | Terracon Project No. N4255372

Prepared for:

Gannet Fleming TranSystems
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Attn: Ms. Gail Massie, P.E. – Vice President | Project Manager
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Re: Roadway Exploration Report
ALL-US30 Rest Areas TP Site #14 Expansion (PID 122869)
Lima, Allen County, Ohio
Terracon Project No. N4255372

Dear Ms. Massie:

We have completed the scope of Roadway Exploration services for the above referenced project in general accordance with Terracon Proposal No. PN4255372 dated December 17, 2025.

This report presents the findings of our subsurface exploration, laboratory testing results, subgrade analysis, and construction recommendations for the proposed reconstruction and expansion of the US 30 East Bound (EB) and West Bound (WB) rest areas (truck parking areas) in Lima, Allen County, Ohio.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon

Amanda Warren, P.E.
(Oklahoma)
Project Engineer

Kevin M. Ernst, P.E.

Principal, Regional Manager

STATE OF OHIO
KEVIN M. ERNST
E-56245
REGISTERED
PROFESSIONAL ENGINEER

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Site Location and Exploration Plans
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Supporting Information

Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the terracon logo will bring you back to this page. For more interactive features, please view your project online at **client.terracon.com**.

Refer to each individual Attachment for a listing of contents.

Executive Summary

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed reconstruction and expansion of the US30 East Bound (EB) and West Bound (WB) rest areas in Lima, Allen County, Ohio. The project includes expansion of the existing rest areas with pavement construction in the expansion areas, and pavement reconstruction in the existing truck parking and drive areas.

Twenty-one (21) borings, designated as B-001-0-25 through B-021-0-25, were performed at the project site. Borings B-005 through B-021-0-25 were performed between February 17 to February 19, 2026, to depths varying between approximately 7.5 to 25 feet below the existing ground surface. Borings B-001 through B-004-0-25 were performed on February 27, 2026, to depths varying between approximately 10 to 25 feet below the existing ground surface.

The borings were drilled in paved and unpaved areas. The existing pavement section encountered in Boring B-018-0-25 consisted of a concrete layer over aggregate base layer. The concrete thickness is about 6 inches. The aggregate base thickness is about 3 inches. Boring B-021-0-25 encountered an aggregate base layer with a thickness of about 8 inches. Borings B-005-0-25 through B-017-0-25, B-019-0-25, and B-020-0-25 encountered topsoil with thickness ranged from about 6 to 14 inches.

The native soils beneath the pavement/topsoil consisted of cohesive soils including stiff to hard silt and clay (A-6a), silty clay (A-6b), sandy silt (A-4a), and clay (A-7-6).

Although, unsuitable soils - silt (A-4b), as described by Section 600 of ODOT GDM, were encountered in Boring B-014-0-25 at a depth of 6 to 8.5 feet below existing ground surface, no remediation is expected as the nearby subgrade area is a fill section, more than 3 feet above the referenced soil layer.

With respect to sulfate content of the subgrade soils, based on the project laboratory testing program, sulfate content results were less than 100 parts per million (ppm), well below the 5,000-ppm considered by ODOT to be problematic with respect to chemical stabilization.

Groundwater was observed only in boring B-014-0-25 during drilling at a depth of about 11 feet below the ground surface elevation. Groundwater was not observed in this boring at completion of drilling. Groundwater was not encountered during drilling or at completion of drilling any of the other borings.

Based on the results of the subgrade analyses, a CBR value of 5 is recommended for the design of the proposed roadway construction after subgrade remediation measures are

implemented. In general, the subgrade soils may be stabilized by either global subgrade improvement by chemical stabilization (lime stabilization) or by earthwork construction practices such as undercutting and replacement. The subgrade borings have an average silt amount of 33% and PI value of 20. Based on ODOT OGE experience with multiple projects where average silt content exceeded 30% and average PI values not more than 23, the subgrade analyses spreadsheets results were reevaluated, and cement stabilization was recommended for the project.

Based on the subsurface conditions encountered at the site, it is recommended that a shallow foundation system could be utilized for support of the pit latrine structures. The recommended spread footing depth and the corresponding bearing resistance and estimated settlement are presented in the report.

Based on the subsurface profile encountered at the site, and the requirements outlined in Section 1202.2 of ODOT GDM, the average shear strength of the soils that meets or exceeds either Su = 2,000 psf (for cohesive soils) or ϕ_f = 30° (for granular soils). Therefore, we recommend a Standard Foundation Design be considered for the light poles planned for this project.

High mast light tower foundations are designed in accordance with Section 1202.1 of ODOT GDM and the ORE standard drawing HL-20.21. Standard drawing HL-20.21 provides basic dimensions of the drilled shaft foundation unit. Overturning resistance for light tower drilled shaft foundations was checked by performing p-y analysis at the Extreme Limit State using L-Pile software, checking that the vertical foundation element does not have very large deflection (typically around 100 inches) or infinite or incalculable deflection (failure of the program to converge at a solution).

Based on the results of L-Pile analyses, we recommend that the drilled shafts should have a minimum embedment depth of at least 8 feet deep and should be terminated within native cohesive soil of at least stiff consistency or native granular soils of medium dense relative density.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **General Comments** should be read for an understanding of the report limitations.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed construction and expansion of the US30 East Bound (EB) and West Bound (WB) rest areas in Lima, Allen County, Ohio. The purpose of these services was to provide information and geotechnical engineering recommendations related to:

- Subsurface soil conditions
- Short-term groundwater observations
- Subgrade analysis
- Subgrade preparation
- Design and construction recommendations related to pavement subgrade
- Foundation design and construction for pit latrine structure and light towers
- Floor slab design and construction for pit latrine structure
- Earthwork and excavation considerations
- Drainage and groundwater considerations

The geotechnical engineering Scope of Services for this project included the advancement of test borings, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and boring locations are shown on the **Site Location** and **Exploration Plans**, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs and/or as separate graphs in the **Exploration and Laboratory Results** section.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Project Description	The project includes expansion of the existing rest areas with pavement construction in the expansion areas and pavement reconstruction in the existing truck parking and drive areas. We also understand that all WB rest area and EB rest area pavements will be replaced as part of the construction.

Item	Description
Grading/Slopes	Based on the provided Stage 3 plan and profile sheets for the project, the grading of the proposed constructions is as follows: ■ Up to 5.9 feet cut and up to 2.7 feet of fill are anticipated to be required to develop design grades at expansion areas of the EB/WB rest areas. ■ Up to 2 feet cut/fill is anticipated to be required to develop the design grades at existing pavement replacement areas of the EB/WB rest area. ■ The design grades at Ramps A and B for the WB rest area are anticipated to match the existing grades with minimal cut/fill required. ■ The design grades at Ramps C and D for the EB rest area are anticipated to match the existing grades with minimal cut/fill required.

Terracon should be notified if any of the above information is inconsistent with the planned construction, especially the grading limits, as modifications to our recommendations may be necessary.

Site Location and Description

The following description of site conditions is derived from our site visit in association with field exploration and our review of the provided plans for the project and the publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located at Ohio Department of Transportation (ODOT) US 30 EB and WB rest areas in Lima, Allen County, Ohio. The approximate coordinates of the EB rest area are 40.82383, -84.06225. The approximate coordinates of the WB rest area are 40.82503, -84.06198. See **Site Location**
Existing Improvements	Existing US 30 EB and WB rest areas with truck parking areas, driveways and buildings, and associated landscape areas. Wooded areas are located southwest of the EB rest area and north of the WB rest area.

Item	Description
Current Ground Cover	Asphalt and concrete pavement and topsoil
Existing Topography	Based on the provided Stage 3 plan and profile sheets for the project, the site at EB rest area with ramps is generally sloping upward from southwest to northeast with ground surface elevations ranging from about 827 to 837 feet above Mean Sea Level (MSL). The site at WB rest area with ramps is generally sloping upward from northwest to southeast with ground surface elevations ranging from about 827 to 835 feet above Mean Sea Level (MSL).

Reconnaissance

At the time of our site reconnaissance visit on February 10, 2026, the existing EB and WB rest areas were observed to be concrete paved truck parking areas with associated rest buildings and landscape areas. The EB and WB areas are connected to the US 30 mainline through asphalt paved roadway ramps. Overhead and underground utilities that run within and adjacent to the rest areas were observed. The expansion areas were found to consist of undeveloped areas with isolated trees and wooded areas, Wooded areas at the southwest of the EB rest area and north of the WB rest area. Rattlesnake Creek is located within the wooded area southwest of EB rest area.

General Geology

The project site is located within the Interior Plains within Till Plains section of the Central Lowland physiographic province of Ohio. This region consists of clayey, high-lime Wisconsinan-age till from a northeastern source (Erie glacial lobe) and lacustrine materials over Lower Paleozoic-age carbonate rocks and shales. ODNR's "Geology of Water in Ohio, Bulletin 44", states the project area was glaciated by the Wisconsinan glacier.

Based on the Ohio Department of Natural Resources (ODNR) Quaternary Geology Map of Ohio, the project site is mapped within the Late Wisconsinan aged Ground Moraine Region. The surficial geology at the project site consists of clay, silt, and sand. The Ground Moraine is characterized as Clayey till (Hiram till), Ground moraine, flat to gently undulating.

Bedrock at the site can be described as Silurian aged, Salina Undifferentiated Group. The bedrock is predominantly dolomite with lesser amounts of anhydrite, gypsum, salt, and

shale. Based on ODNR bedrock contours mapping, the top of bedrock elevation is anticipated to be between about 800 and 820 feet above Mean Sea Level (MSL).

According to United States Geologic Survey (USGS) mapping, the site is mapped within an area that is susceptible to karst with carbonate rocks buried under less than or equal 50 feet of glacially derived insoluble sediments in a humid climate. According to ODNR sinkhole mapping, there are no known/documented sinkholes within a 27-mile radius of the project site. If the client would like to further evaluate the risk associated with the possible karst features, Terracon can perform a combination of desktop karst study and site reconnaissance to further evaluate the risk.

Exploration

Field Exploration

Twenty-one (21) borings, designated as B-001-0-25 through B-021-0-25, were performed at the project site. Borings B-005 through B-021-0-25 were performed between February 17 to February 19, 2026, to depths varying between approximately 7.5 to 25 feet below the existing ground surface. Borings B-001 through B-004-0-25 were performed on February 27, 2026, to depths varying between approximately 10 to 25 feet below the existing ground surface.

Borings B-009-0-25, B-011-0-25, B-012-0-25, B-018-0-25, and B-021-0-25 were performed in general accordance with Section 303.3 of the Ohio Department of Transportation (ODOT) Specifications for Geotechnical Explorations (SGE) for borings used for evaluation of existing pavement subgrade (Type A). Borings B-002-0-25, B-003-0-25, B-008-0-25 and B-015-0-25 were performed in general accordance with Section 303.4 of the Ohio Department of Transportation (ODOT) Specifications for Geotechnical Explorations (SGE) for roadway borings (Type B). As requested, five (5) additional Type B borings at EB rest area and five (5) additional Type B borings at WB rest area were advanced to a depth of 25 feet to verify if special designs for light towers will be necessary. We understand that the design of the foundations will be performed using nearby boring data. Therefore, Type B Borings B-001-0-25, B-005-0-25 through B-007-0-25, B-010-0-25, B-013-0-25, B-014-0-25, B-016-0-25, B-017-0-25, and B-020-0-25 were advanced to a depth of 25 feet. Borings B-004-0-25 and B-019-0-25 were performed in general accordance with Section 303.7 of the ODOT SGE for structure borings (Type E6). The approximate locations of the borings are illustrated on the attached **Exploration Plans** and are summarized in the following table.

Test Boing Summary

Boring Number	Location	Station	Offset[1] (feet)	Direction	Surface Elevation[2] (feet)	Latitude[2]	Longitude[2]	Depth (feet)[3]
B-001-0-25	EB Rest Area	751+38	482.3	Rt	830.3	40.823093	-84.064920	25
B-002-0-25		751+62	273.0	Rt	828.3	40.823668	-84.064839	10
B-003-0-25		753+69	476.5	Rt	831.5	40.823115	-84.064084	10
B-004-0-25		752+78	311.8	Rt	828.4	40.823565	-84.064418	20
B-005-0-25		754+04	221.7	Rt	828.7	40.823814	-84.063965	25

Boring Number	Location	Station	Offset[1] (feet)	Direction	Surface Elevation[2] (feet)	Latitude[2]	Longitude[2]	Depth (feet)[3]
B-006-0-25		755+64	383.1	Rt	830.1	40.823375	-84.063383	25
B-007-0-25		756+82	237.6	Rt	831.0	40.823777	-84.062961	25
B-008-0-25		756+71	130.8	Rt	831.4	40.824070	-84.063006	10
B-009-0-25		759+35	274.4	Rt	837.2	40.823682	-84.062046	7.5
B-010-0-25		759+42	138.0	Rt	837.4	40.824057	-84.062024	25
B-011-0-25		761+68	158.9	Rt	835.8	40.824005	-84.061210	7.5
B-012-0-25		754+82	125.3	Lt	829.4	40.824769	-84.063695	7.5
B-013-0-25		757+81	136.3	Lt	831.5	40.82481	-84.062615	25
B-014-0-25		758+18	464.7	Lt	827.5	40.825708	-84.062490	25
B-015-0-25		758+21	337.8	Lt	828.6	40.825360	-84.062478	10
B-016-0-25	WB Rest Area	759+93	380.9	Lt	830.2	40.825482	-84.061858	25
B-017-0-25		760+75	110.3	Lt	834.9	40.82474	-84.061553	25
B-018-0-25		760+96	228.2	Lt	831.6	40.825065	-84.061478	7.5
B-019-0-25		760+96	441.4	Lt	829.4	40.825651	-84.061485	20
B-020-0-25		763+16	319.3	Lt	828.6	40.82532	-84.060686	25
B-021-0-25		765+82	119.7	Lt	833.6	40.824779	-84.059719	7.5

1. The offsets are in reference to the US 30 EB parking alignment for the EB rest area, and in reference to the US 30 WB parking alignment for the WB rest area.
2. The boring coordinates at the boring locations were measured using handheld GPS equipment (estimated horizontal accuracy of about ±10 feet) and referencing existing site features. The as drilled coordinates and surface elevations at the boring locations were provided by DGL Consulting Engineers, LLC.
3. Below ground surface.

The borings were located in the field prior to drilling operations by Terracon personnel using a handheld GPS unit. The as drilled coordinates and surface elevations at boring locations were provided by DGL Consulting Engineers, LLC. Borings coordinates and elevations presented in the preceding table, and on the boring logs presented in the **Exploration and Laboratory Results** are approximate. The location and elevation information should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were drilled with a track-mounted rotary drill rig utilizing a 3¼-inch I.D. continuous flight hollow stem auger to advance the boreholes between sampling attempts. For pavement reconstruction and expansion areas, split-barrel sampling was performed at 2.5-feet intervals to a depth of 7.5 to 25 feet below existing site grades. For the structure boring (Type E6), split-barrel sampling was performed at 2.5-feet intervals in overburden material to a depth of 20 feet.

In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a 140-pound automatic hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is corrected to an equivalent (60 percent) energy ratio (N_{60}) utilizing the hammer efficiency energy ratio which is approximately 88.8% for the equipment used during our exploration.

In the field, the samples recovered at the boring locations were examined and field logs were prepared indicating the conditions encountered at each location. Representative portions of soil samples obtained from split-barrel samplers during the field exploration were preserved in sealable glass jars.

Following the completion of drilling, Type A and B boreholes were backfilled with auger cuttings mixed with bentonite chips. Type E boreholes were sealed using cement bentonite grout. Where borings penetrated the existing pavement surface, the roadway surface was repaired using Quickrete.

Laboratory Testing Program

As part of the testing program, all samples were examined in the laboratory by a geotechnical engineer. Soil samples were classified in general accordance with ODOT SGE Section 600 Laboratory Testing based on the texture and plasticity of the soils.

Visual classification was performed on all recovered soil samples. Atterberg limits, moisture content, grain size analysis, and sulfate content in soils testing were performed on selected soil samples.

Findings

Boring logs have been prepared based on the information obtained from the field logs prepared at the time of drilling, the visual examination performed in the laboratory, and the laboratory testing results. Soil classification was performed in general accordance with the current ODOT SGE. The following sections summarize the subsurface conditions encountered in the borings.

Subsurface Profile

The existing pavement section encountered in Boring B-018-0-25 consisted of a concrete layer over aggregate base layer. The concrete thickness is about 6 inches. The aggregate base thickness is about 3 inches. Boring B-021-0-25 encountered an aggregate base layer with a thickness of about 8 inches. Borings B-001-0-25 through B-

017-0-25, B-019-0-25, and B-020-0-25 encountered topsoil with thickness ranged from about 6 to 14 inches.

The native soils beneath the pavement/topsoil consisted of cohesive soils including stiff to hard silt and clay (A-6a), silty clay (A-6b), sandy silt (A-4a), and clay (A-7-6).

Unsuitable soils, as described by Section 600 of ODOT GDM, were encountered in Boring B-014-0-25 at a depth of 6 to 8.5 feet below existing ground surface. The unsuitable soils encountered in this boring were described as silt (A-4b).

With respect to sulfate content of the subgrade soils, based on the project laboratory testing program, sulfate content results were less than 100 parts per million (ppm), well below the 5,000-ppm considered by ODOT to be problematic with respect to chemical stabilization.

The table below summarizes the results of sulfate testing performed on subgrade samples. It should be noted that soils with sulfate content greater than 5,000 parts per million (ppm) prohibit subgrade stabilization using chemical stabilization methods according to section 600 of ODOT Geotechnical Design Manual (GDM). None of the test results exceeded the 5,000-ppm sulfate concentration level considered by ODOT to be problematic with respect to chemical stabilization. The results of lab testing are shown on the boring logs and presented in the **Exploration and Laboratory Results** attachments of this report.

Summary of Sulphate Testing Results

Boring ID	Sample Depth (feet) [1]	Sulfate Concentration (ppm)
B-001-0-25	2 – 3.5	<100
B-002-0-25	0 – 1.5	<100
B-003-0-25	0 - 1.5	<100
B-005-0-25	2 – 3.5	<100
B-006-0-25	0 – 1.5	<100
B-007-0-25	0 – 1.5	<100
B-008-0-25	2 – 3.5	<100
B-009-0-25	0 – 1.5	<100
B-010-0-25	2 – 3.5	<100
B-011-0-25	0 – 1.5	<100
B-012-0-25	2 – 3.5	<100
B-013-0-25	2 – 3.5	<100
B-014-0-25	0 – 1.5	<100
B-015-0-25	2 – 3.5	<100

Boring ID	Sample Depth (feet) [1]	Sulfate Concentration (ppm)
B-016-0-25	0 – 1.5	<100
B-017-0-25	0 – 1.5	<100
B-018-0-25	1 - 2.5	<100
B-020-0-25	0 – 1.5	<100
B-021-0-25	2 – 3.5	<100

1. Below ground surface

Groundwater

Groundwater was observed only in boring B-014-0-25 during drilling at a depth of about 11 feet below the ground surface elevation. Groundwater was not observed in this boring at completion of drilling. Groundwater was not encountered during drilling or at completion of drilling any of the other borings.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, water level in Rattlesnake Creek, runoff, and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Analyses and Recommendations

Subgrade Analysis

Based on the provided Stage 3 plan and profile drawings for the proposed improvements, it is anticipated that proposed subgrade elevations will require up to 5.9 feet of cut and up to 2.7 feet of fill at EB and WB expansion areas. Also, it is anticipated that proposed subgrade elevations will generally match the existing subgrade at the existing pavement replacement and ramp areas where we are assuming that up to 2 feet cut/fill will be required to establish the proposed final grades; other than that required to remediate areas that currently have unsuitable/unstable subgrade. If these assumptions are not consistent with the project plans, please notify Terracon.

Based on our laboratory testing, the subgrade soils to a depth of up to about 7.5 feet below the surface have moisture contents ranging from about 7 to 43 percent, with an average moisture content of the subgrade soils across the project area of about 18 percent. Plasticity indices ranged from about 5 to 35, with an average plasticity index of

about 20. A summary of the subgrade soils is tabulated on ODOT's **Subgrade Analysis** spreadsheet in Attachments section of this report.

Generally, subgrade soils with a moisture content exceeding the optimum moisture content of the soil by three or more percentage points, or that have low N-values, are considered to be unstable soils, per ODOT GDM Section 600 guideline. Subgrade soils with a moisture content exceeding the optimum moisture content of the soil by three or more percentage points were encountered in borings B-005-0-25 through B-018-0-25, B-020-0-25, and B-021-0-25. Granular soils with N60L<15 and/or cohesive soils with N60L<12 or HP<2 tsf were encountered in borings B-005-0-25 through B-007-0-25, B-011-0-25 through B-013-0-25, B-014-0-25, B-016-0-25, and B-017-0-25, indicating weak/loose subgrade conditions.

Although, unsuitable soils - silt (A-4b), as described by Section 600 of ODOT GDM, were encountered in Boring B-014-0-25 at a depth of 6 to 8.5 feet below existing ground surface, no remediation is expected as the nearby subgrade area is a fill section, more than 3 feet above the referenced soil layer.

Because of the moisture sensitive nature of the cohesive soils (A-4a, A-6a, A-6b, and A-7-6) encountered in the borings, Terracon recommends that construction traffic over the completed subgrades should be minimized.

Based on the results of **Subgrade Analysis**, two pavement remediation options are recommended. Once the initial site preparation activities consisting of removal of the existing surficial layers and cutting required to establish the proposed subgrade elevation are completed, the subgrade stabilization could either comprise of undercut and replacement or chemical stabilization. Also, considering the relatively high soil moisture contents encountered in some of the borings, installation of a drainage system including construction of underdrains and ditches are recommended as a practical solution to promote drainage of the subgrade and improve subgrade stability.

The undercut and replacement option would consist of an undercut below the design subgrade elevation to a minimum depth of 12 to 24 inches (24 inches at Boring B-002-0-25 and B-012-0-25). In order to identify possible loose or soft/yielding areas at the bottom of undercut, the exposed subgrade should either be densified with a smooth drum roller if granular soils are exposed or proof-rolled with rubber-tired equipment if cohesive soils are exposed. The actual depths and limits of undercutting should be determined by the Engineer in the field based on the results of proof-rolling and subgrade observations performed in accordance with ODOT Construction and Materials Specifications (CMS) Item 204. Any areas that exhibit rutting, instability, or other indications of soft or loose soils should be over excavated and replaced in accordance with ODOT CMS Item 204. In addition, effective measures to promote drainage of groundwater and surface water should be incorporated into the design (i.e., grading of subgrade and surface, berms, ditches, etc.). Once the bottom of undercut is

reestablished, ODOT Item 712.09 Geotextile Fabric Type D should be installed at the bottom of the excavation followed by replacement of the undercut with Item 204 Granular Type B Material.

Alternatively, chemical stabilization using Item 206 (Chemically Stabilized Subgrade) with lime/cement can be used to a minimum depth of 12 inches to stabilize the subgrade for this project. The recommendations based on subgrade analyses spreadsheet results that subgrade soils may be stabilized by global subgrade improvement by chemical stabilization (lime stabilization). The subgrade borings have an average silt amount of 33% and PI value of 20. Based on ODOT OGE experience with multiple projects where average silt content exceeded 30% and average PI values not more than 23, the subgrade analyses spreadsheets results were reevaluated, and cement stabilization was recommended for the project.

In general, chemical stabilization is more economical when stabilizing large areas (approximately greater than 1 mile of roadway). Furthermore, in accordance with Section 605 of ODOT GDM, generally, chemical stabilization is more economical when stabilizing large areas (approximately greater than 1 mile of roadway) but should not be eliminated from consideration when remediating smaller areas. An exception to this may be segmented areas requiring multiple mobilizations of specialized equipment. The size of the project, the variability of the soils encountered, existing shallow underground utilities, and proximity of nearby residences should be considered in evaluating the use of chemical stabilization for the project. Results of subgrade analysis performed per section 600 of ODOT GDM guideline are presented in **Subgrade Analysis** in the attachments of this report.

Based on the results of our **Subgrade Analysis**, after the subgrade improvement/ stabilization measures recommended above are implemented, a CBR value of 5 can be used for pavement design.

Pavement Overlay Construction

If overlay construction is planned, total pavement thickness should be evaluated based on average CBR of 4, and the design traffic volume. The pavement design engineer should identify and assess the condition of the existing pavement to determine the final appropriate overlay design.

General Subgrade Preparation

Subgrade preparation for the new pavement and shoulder areas should be performed in accordance with ODOT CMS Items 203 and 204. Prior to subgrade preparation, perform clearing and grubbing, including removal of stumps and roots, in accordance with ODOT CMS Item 201. Remove existing pavement and base materials as well as other

structures or obstructions, as necessary, in accordance with ODOT CMS Item 202. The pavement subgrade should be stripped of any topsoil, organics, or other deleterious or unsuitable materials.

Once the pavement reconstruction areas have been stripped, excavated to the design subgrade elevation or to the design undercut elevation (if applicable), the exposed subgrade should be proofrolled with a heavy piece of construction equipment to verify stability is achieved. It should be noted that fill containing organic materials or other deleterious materials may be encountered at other locations or at lower depths within the pavement alignment that were not disclosed by the borings. The actual depths and limits of undercutting should be determined by the Engineer in the field based on visual observations.

Any fill placed to achieve the final grade of the roadway pavement should follow requirements of ODOT CMS Item 203 and compacted to the specified percentage of the maximum dry density provided by ODOT CMS Item 204. The fill materials should be relatively free of debris, organic materials, and any deleterious materials deemed by the Engineer. No frozen materials should be incorporated into the fill, and no pavement, utilities, or fill should be placed on top of frozen materials.

All potential imported fill materials should be identified and approved by the Engineer prior to placement. Approval requires that moisture-density relationship tests, hydrometer analysis, and Atterberg limits be determined for each fill material prior to their placement. No particle size larger than two inches in any direction should be placed as fill, and any particle size greater than 3-inches should be broken down to less than 2-inches or removed from the lift. Aggregate base and pavement construction must be performed in accordance with ODOT CMS 300 and 400.

Shallow Foundation Recommendations

A shallow foundation system could be utilized for support of the proposed pit latrine structures. The proposed shallow foundations/spread footings for the 2-stall pit latrine at WB rest area are anticipated to be embedded at an elevation of 825.9 feet on very stiff to hard silt and clay (A-6a) soils (approximately 3.5 feet below existing ground surface). We recommend that the shallow foundations bearing on hard silt and clay (A-6a) be designed for a nominal bearing resistance of 6,700 psf with a resistance factor of ϕ_b = 0.45, corresponding to a factored bearing resistance of about 3,000 psf. Considering structural loading equivalent to this factored bearing resistance, we estimate that total settlement of the footings bearing on hard silt and clay at elevation 825.9 feet will be on the order of 1 inch or less with a differential settlement of about ½ to ¾ inch. The proposed shallow foundations/spread footings for the 2-stall pit latrine at EB rest area are anticipated to be embedded at an elevation of 824.9 feet on very stiff silt and clay (A-6a) soils (approximately 3.5 feet below existing ground surface). We recommend that the shallow foundations bearing on hard silt and clay (A-6a) be designed for a nominal

bearing resistance of 6,700 psf with a resistance factor of ϕ_b = 0.45, corresponding to a factored bearing resistance of about 3,000 psf. Considering structural loading equivalent to this factored bearing resistance, we estimate that total settlement of the footings bearing on hard silt and clay at elevation 824.9 feet will be on the order of 1 inch or less with a differential settlement of about ½ to ¾ inch. Differential settlements are noted for equivalent-loaded foundations and bearing elevation as measured over a span of 50 feet.

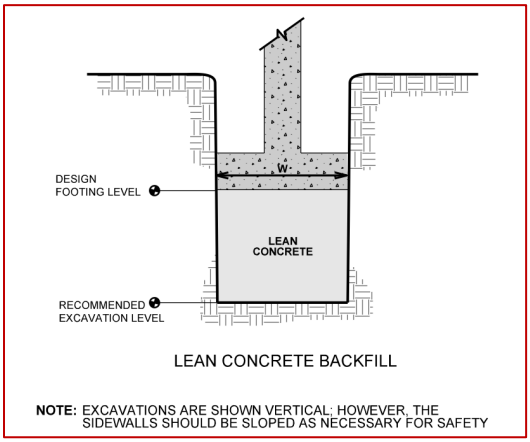
The anticipated differential settlement should be evaluated by the structural engineer as consideration in the design of a shallow foundation system. Note that the nominal bearing resistance of the foundations should not be greater than the compressive resistance of the footing concrete.

The ultimate coefficient of sliding friction recommended for contact between the concrete and foundation soil at borings B-004-0-25 and B-019-0-25 is 0.35 with a resistance factor of ϕ_T = 0.9.

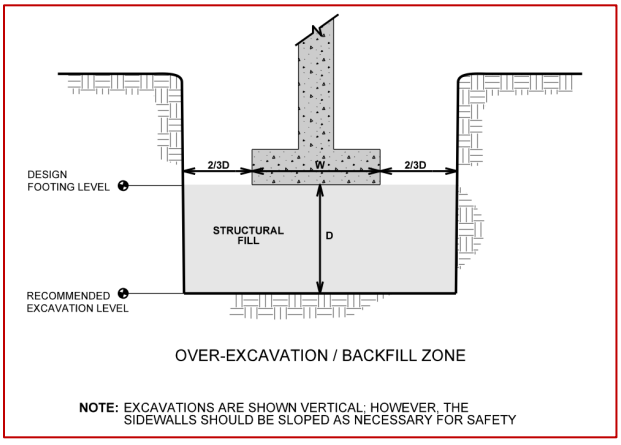
The foundation excavations should be examined after excavations to verify that the entire bearing surface consists of suitable soil/structural fill. Subgrade preparation for the new foundations should be performed in accordance with ODOT CMS Item 200 (Earthwork). Prior to subgrade preparation, perform clearing and grubbing, including removal of stumps and roots, in accordance with ODOT CMS Item 201. Remove existing pavement and base materials as well as other structures or obstructions, as necessary, in accordance with ODOT CMS Item 202. The subgrade should be stripped of any topsoil, organics, or other deleterious or unsuitable materials (if any). It is recommended that the geotechnical engineer be retained to observe and test the foundation bearing materials.

Foundation Construction Considerations

Terracon should be retained for foundation bearing material verification and observation of footing construction. Newly placed ODOT CMS Item 203 embankment material or ODOT CMS Item 611 structural backfill Type 1 is anticipated in the footing excavations at the planned bearing elevation. However, if unsuitable conditions are encountered at or below the planned bearing elevation, the footing excavations should be stepped down to suitable material. Suitable materials comprise of newly placed ODOT backfill materials, native stiff or better cohesive soils or native medium dense or better granular soils. The footings may bear directly on these suitable soils at the lower level or on lean concrete backfill placed in the excavations. The lean concrete replacement zone is illustrated on the sketch below.



The footings could also bear on properly compacted, dense-graded, granular fill down to suitable soils. Where structural fill is preferred for this application, the over-excavation should extend laterally beyond all edges of the footings at least 8 inches per foot of over-excavation depth below the footing base elevation. The maximum depth of the overexcavation can be limited to 5 feet or two times the footing width, whichever is greater if the granular fill backfill option is chosen. If unstable soils are encountered at the bottom of the overexcavation, the exposed subgrade should be stabilized by punching in AASHTO #2 gravel into the subgrade. The over-excavation should then be backfilled up to the footing base elevation with well graded, granular material placed in lifts of 8 inches or less in loose thickness and compacted to at least 98% of the material's standard Proctor maximum dry density (ASTM D-698). The over-excavation and backfill procedures are depicted in the following figures.



The final foundation bearing surfaces should be free of water and loose cuttings prior to placing concrete. Concrete placement should take place as soon as practical following excavation and approval of the final bearing surfaces to avoid degradation/disturbance of the bearing materials from exposure to adverse weather conditions, sidewall cave-ins or other construction activities. Should the bearing soils become disturbed, saturated, or frozen, the affected soil should be removed prior to concrete placement.

Floor Slabs

Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

Floor Slab Design Parameters

Item	Description
Floor Slab Subgrade	Subgrade prepared in accordance with recommendations provided in this report [1, 3]
Aggregate Base	Minimum 6 inches of ODOT CMS Item 304 or equivalent dense graded, compacted, granular material containing less than 6 percent fines (material passing the #200 sieve).
Estimated Modulus of Subgrade Reaction [2]	110 pounds per square inch per inch (psi/in)

1. The subgrade should be maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become desiccated or wet prior to construction of the floor slabs, the affected material should be removed, or the materials scarified, moisture conditioned to near optimum and recompacted.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in this report, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.
3. Floor slab areas should be structurally independent of any building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, when the project includes humidity-controlled areas, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut contraction joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations, refer to the ACI Design Manual. Joints or cracks should be sealed with a waterproof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Floor Slab Construction Considerations

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should observe the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

Light Pole Foundation Recommendations

According to Section 1202.2 of ODOT Geotechnical Design Manual (GDM), light pole foundations are designed in accordance with the ODOT Office of Roadway Engineering (ORE) Traffic Engineering Manual (TEM) Section 1140-6, and ORE standard drawing HL-20.11. According to HL-20.11, a Standard Foundation Design can be used if the average shear strength of the soils over the foundation length, L, meets or exceeds either Su = 2,000 psf (for cohesive soils) or ϕ_f = 30° (for granular soils). Otherwise, a Special Foundation Design should be performed.

Based on the subsurface profile encountered in the borings drilled for light poles at the EB and WB rest areas (B-001-0-25, B-005-0-25 through B-007-0-25, B-010-0-25, B-013-0-25, B-014-0-25, B-016-0-25, B-017-0-25, and B-020-0-25), the average shear strength of the soils at both rest areas meets or exceeds either Su = 2,000 psf (for cohesive soils) or ϕ_f = 30° (for granular soils). Therefore, we recommend a Standard Foundation Design be considered for the light poles planned for this project.

High Mast Light Tower Foundations

High mast light tower foundations are designed in accordance with Section 1202.1 of ODOT GDM and the ORE standard drawing HL-20.21. Standard drawing HL-20.21

provides basic dimensions of the drilled shaft foundation unit. The diameter of the drilled shaft foundation unit is generally controlled by the required bolt circle diameter for attachment of the tower mounting plate or pole base.

The length of the drilled shaft foundation unit for a light tower is dependent on an Extreme Limit State check against overturning and a Service Limit State check against excessive lateral deflection.

The wind load against the support tower and the luminaries should be calculated in accordance with AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LRFDLTS) Articles 3.4 and 3.8.

In the Extreme Limit State, the only geotechnical check is for resistance against overturning. The load to be resisted is from wind against the support tower and against the luminaries, which is transferred to the top of the foundation as a lateral shear load and a moment. In accordance with LRFDLTS, the Extreme Limit State design wind speed is 115 miles per hour, and the wind (W) load factor is 1.00.

According to Section 1202.1 of ODOT GDM, overturning resistance for light tower drilled shaft foundations should be checked with either:

1) A p-y analysis at the Extreme Limit State, checking that the vertical foundation element does not have very large deflection (typically around 100 inches) or infinite or incalculable deflection (failure of the program to converge at a solution). It is otherwise acceptable for the Extreme Limit State analysis deflection to be quite large (on the order of 10 to 20 inches). For input into this analysis, the resultant factored shear and moment loads at the top of the vertical foundation element should be calculated. The full geotechnical profile should be input over the drilled shaft foundation length with separate soil properties for each identified soil stratum. For the weight of the tower, a minimum dead load of components (DC) load factor of 0.90 should be used.

2) A moment equilibrium analysis about the tip of the vertical foundation element using the Broms' Method with Extreme Limit State load factors and resistance factors, in accordance with the commentary in LRFD C11.8.4.1. The check of overturning resistance will give the minimum length and diameter of the vertical foundation element necessary to satisfy the requirements of stability. The maximum factored shear and moment in the drilled shaft for considerations of structural resistance should be determined in accordance with AASHTO LRFD Article 10.8.3.9.

   In the Service Limit State, check against excessive lateral deflection should be performed. The Service Limit State deflection criterion is a maximum resultant projected deflection at the top of the tower of 10% of the height of the tower in accordance with LRFDLTS Article 10.4.2. The resultant projected deflection is the

sum of the deflection at the top of the foundation plus the lateral rotation in radians at the top of the foundation times the height of the tower above the foundation. The design wind speed for the Service Limit State is 76 mph in accordance with LRFDLTS Figure 3.8-4b.

Overturning resistance for light tower drilled shaft foundations was checked by performing p-y analysis at the Extreme Limit State using L-Pile software for the soil conditions encountered in the borings, checking that the vertical foundation element does not have very large deflection (typically around 100 inches) or infinite or incalculable deflection (failure of the program to converge at a solution). It is otherwise acceptable for the Extreme Limit State analysis deflection to be quite large (on the order of 10 to 20 inches). The L-Pile parameters for the onsite soils used in the analysis are provided in the **Recommended L-Pile Parameters for Lateral Pile Analysis** section of this report. The following loads and loading conditions were provided by Lanham Engineering, LLC for the high mast tower foundations design verification at each tower location.

Two luminaires per tower:

- Service Limit State
  - Shear = 670 lbs., Moment = 210,400 in-lbs., Weight = 2,800 lbs.
- Extreme Limit State
  - Shear = 1,500 lbs., Moment = 483,200 in-lbs., Weight = 3,100 lbs.
- Strength Limit State
  - Shear = 1,500 lbs., Moment = 483,200 in-lbs., Weight = 2,600 lbs.

Three luminaires per tower:

- Service Limit State
  - Shear = 1,000 lbs., Moment = 315,600 in-lbs., Weight = 4,200 lbs.
- Extreme Limit State
  - Shear = 2,250 lbs., Moment = 724,800 in-lbs., Weight = 4,600 lbs.
- Strength Limit State
  - Shear = 2,250 lbs., Moment = 724,800 in-lbs., Weight = 3,800 lbs.

All deflections were calculated using both the two and the three luminaire loadings. The proposed top of 3 feet diameter shaft was assumed to be 1 foot above proposed ground with “Free Head” condition. With an embedment depth of 8 feet, the total shaft length was set as 9 feet. The resulting deflection values at each tower foundation (associated boring location) are shown in the table below for Service Limit State case. The results of L-Pile analyses are included in the **L-Pile Analysis** attachment of this report.

Service Limit State deflections were calculated as the sum of the lateral deflection at the top of the foundation and the lateral displacement resulting from foundation rotation.

The rotational displacement was computed by multiplying the rotation at the top of the foundation (in radians) by the height of the tower above the foundation (45 feet). The results of the analysis are summarized in the following table.

Boring ID	Service Limit State Deflection					
	Two Luminaire Loading Case			Three Luminaire Loading Case		
	Pile Head Deflection (inches)	Pile Head Rotation (radians)	Service Limit State Deflection (inches)	Pile Head Deflection (inches)	Pile Head Rotation (radians)	Service Limit State Deflection (inches)
B-001-0-25	0.003643	0.0000688	0.04	0.007456	0.0001276	0.06
B-005-0-25	0.107113	0.0013900	0.66	0.476439	0.0001000	0.55
B-006-0-25	0.023965	0.0003264	0.18	0.102207	0.0013400	0.64
B-007-0-25	0.107113	0.0013900	0.65	0.476439	0.0061300	3.74
B-010-0-25	0.004334	0.0000773	0.04	0.011652	0.0001799	0.06
B-013-0-25	0.094190	0.0001090	0.63	0.409091	0.0046800	3.10
B-014-0-25	0.029390	0.0003966	0.25	0.473505	0.0063200	3.74
B-016-0-25	0.005376	0.0000902	0.05	0.017898	0.0002579	0.18
B-017-0-25	0.031193	0.0003718	0.25	0.136404	0.0015600	1.22
B-020-0-25	0.038810	0.0005119	0.31	0.173985	0.0022300	1.28

Based on the results of L-Pile analyses performed for similar loads and loading conditions and similar test borings, we recommend that the drilled shafts should have a minimum embedment depth of at least 8 feet and should be terminated within native cohesive soil of at least stiff consistency or native granular soils of medium dense relative density.

Drilled Shaft Design Parameters

Boring B-001-0-25

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_f (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}
0 to 3 [3]	Soft Clay	120	250/0	--	--	0.50 (Tip) 0.55 (Side) [6] 0.4 (uplift resistance)
3 to 16	A-6a	125	4,000/0	1.1	18	
16 to 25	A-6a	120	2,500/0	1	15	

1. Below existing ground surface. See Findings and the boring logs for soil stratigraphy details.
2. Design capacities are dependent upon the method of installation, and quality control parameters. The values provided are estimates and should be verified when installation protocol has been finalized.
3. According to Section 1201 of ODOT GDM, the top 3 feet starting from the proposed ground surface should be assumed to be a soft clay with undrained shear strength of S_u = 250 psf (correlating approximately to an SPT N_{60} = 2 bpf), regardless of the soils revealed in the boring, unless shallow bedrock is at a depth of less than 3 feet below proposed grade. This is to account for soils weakened by freeze-thaw or other disturbance. The depths in the table are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the soil profile based on cut, at grade or fill condition. For at grade condition, the depths included in the table apply to the design.
4. Compressive side friction should be ignored for about one shaft diameter from the base of a shaft when a combination of side friction and end bearing are being used to develop the required capacity. In designing to resist uplift loading, a 0.4 Resistance Factor should be applied to the nominal side resistance along with the effective weight of the drilled shaft.
5. Drilled shafts should penetrate at least one shaft diameter into the bearing stratum when designing for the allowable end bearing pressures.
6. Side Resistance factor is applicable to the nominal side resistance in compression.
7. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

Boring B-005-0-25

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_f (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}
0 to 3 [3]	Soft Clay	120	250/0	--	--	0.50 (Tip) 0.55 (Side) [6] 0.4 (uplift resistance)
3 to 4	A-7-6	120	1,000/0	0.75	--	
4 to 8.5	A-6a	120	1,000/0	0.75	--	
8.5 to 13.5	A-4a	125	3,500/0	1.2	21	

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_f (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}
13.5 to 25	A-6a	120	2,000/0	0.9	12	

1. Below existing ground surface. See Findings and the boring logs for soil stratigraphy details.
2. Design capacities are dependent upon the method of installation, and quality control parameters. The values provided are estimates and should be verified when installation protocol has been finalized.
3. According to Section 1201 of ODOT GDM, the top 3 feet starting from the proposed ground surface should be assumed to be a soft clay with undrained shear strength of S_u = 250 psf (correlating approximately to an SPT N_{60} = 2 bpf), regardless of the soils revealed in the boring, unless shallow bedrock is at a depth of less than 3 feet below proposed grade. This is to account for soils weakened by freeze-thaw or other disturbance. The depths in the table are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the soil profile based on cut, at grade or fill condition. For at grade condition, the depths included in the table apply to the design.
4. Compressive side friction should be ignored for about one shaft diameter from the base of a shaft when a combination of side friction and end bearing are being used to develop the required capacity. In designing to resist uplift loading, a 0.4 Resistance Factor should be applied to the nominal side resistance along with the effective weight of the drilled shaft.
5. Drilled shafts should penetrate at least one shaft diameter into the bearing stratum when designing for the allowable end bearing pressures.
6. Side Resistance factor is applicable to the nominal side resistance in compression.
7. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

Boring B-006-0-25

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_f (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}
0 to 3 [3]	Soft Clay	120	250/0	--	--	0.50 (Tip) 0.55 (Side) [6] 0.4 (uplift resistance)
3 to 8.5	A-7-6	120	1,500/0	0.85	--	
8.5 to 13.5	A-6a	125	3,500/0	1.2	21	
13.5 to 16	A-4a	120	2,500/0	1	15	
16 to 25	A-6a	120	2,500/0	1	15	

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_f (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}

1. Below existing ground surface. See Findings and the boring logs for soil and bedrock stratigraphy details.
2. Design capacities are dependent upon the method of installation, and quality control parameters. The values provided are estimates and should be verified when installation protocol has been finalized.
3. According to Section 1201 of ODOT GDM, the top 3 feet starting from the proposed ground surface should be assumed to be a soft clay with undrained shear strength of S_u = 250 psf (correlating approximately to an SPT N_{60} = 2 bpf), regardless of the soils revealed in the boring, unless shallow bedrock is at a depth of less than 3 feet below proposed grade. This is to account for soils weakened by freeze-thaw or other disturbance. The depths in the table are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the soil profile based on cut, at grade or fill condition. For at grade condition, the depths included in the table apply to the design.
4. Compressive side friction should be ignored for about one shaft diameter from the base of a shaft when a combination of side friction and end bearing are being used to develop the required capacity. In designing to resist uplift loading, a 0.4 Resistance Factor should be applied to the nominal side resistance along with the effective weight of the drilled shaft.
5. Drilled shafts should penetrate at least one shaft diameter into the bearing stratum when designing for the allowable end bearing pressures.
6. Side Resistance factor is applicable to the nominal side resistance in compression.
7. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

Boring B-007-0-25

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_f (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}
0 to 3 [3]	Soft Clay	120	250/0	--	--	0.50 (Tip) 0.55 (Side) [6] 0.4 (uplift resistance)
3 to 4	A-6b	120	1,000/0	0.75	--	
4 to 8.5	A-7-6	120	1,000/0	0.75	--	
8.5 to 13.5	A-6a	125	3,000/0	1.1	18	
13.5 to 25	A-6a	120	2,500/0	1	15	

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_r (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}

1. Below existing ground surface. See Findings and the boring logs for soil and bedrock stratigraphy details.
2. Design capacities are dependent upon the method of installation, and quality control parameters. The values provided are estimates and should be verified when the installation protocol has been finalized.
3. According to Section 1201 of ODOT GDM, the top 3 feet starting from the proposed ground surface should be assumed to be a soft clay with undrained shear strength of S_u = 250 psf (correlating approximately to an SPT N_{60} = 2 bpf), regardless of the soils revealed in the boring, unless shallow bedrock is at a depth of less than 3 feet below proposed grade. This is to account for soils weakened by freeze-thaw or other disturbance. The depths in the table are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the soil profile based on cut, at grade or fill condition. For at grade condition, the depths included in the table apply to the design.
4. Compressive side friction should be ignored for about one shaft diameter from the base of a shaft when a combination of side friction and end bearing are being used to develop the required capacity. In designing to resist uplift loading, a 0.4 Resistance Factor should be applied to the nominal side resistance along with the effective weight of the drilled shaft.
5. Drilled shafts should penetrate at least one shaft diameter into the bearing stratum when designing for the allowable end bearing pressures.
6. Side Resistance factor is applicable to the nominal side resistance in compression.
7. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

Boring B-010-0-25

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_r (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}
0 to 3 [3]	Soft Clay	120	250/0	--	--	0.50 (Tip) 0.55 (Side) [6] 0.4 (uplift resistance)
3 to 8.5	A-4a	125	3,500/0	1.2	--	
8.5 to 18.5	A-6a	120	2,000/0	0.9	12	
18.5 to 25	A-4a	120	2,000/0	0.9	12	

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_r (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}

1. Below existing ground surface. See Findings and the boring logs for soil and bedrock stratigraphy details.
2. Design capacities are dependent upon the method of installation, and quality control parameters. The values provided are estimates and should be verified when installation protocol has been finalized.
3. According to Section 1201 of ODOT GDM, the top 3 feet starting from the proposed ground surface should be assumed to be a soft clay with undrained shear strength of S_u = 250 psf (correlating approximately to an SPT N_{60} = 2 bpf), regardless of the soils revealed in the boring, unless shallow bedrock is at a depth of less than 3 feet below proposed grade. This is to account for soils weakened by freeze-thaw or other disturbance. The depths in the table are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the soil profile based on cut, at grade or fill condition. For at grade condition, the depths included in the table apply to the design.
4. Compressive side friction should be ignored for about one shaft diameter from the base of a shaft when a combination of side friction and end bearing are being used to develop the required capacity. In designing to resist uplift loading, a 0.4 Resistance Factor should be applied to the nominal side resistance along with the effective weight of the drilled shaft.
5. Drilled shafts should penetrate at least one shaft diameter into the bearing stratum when designing for the allowable end bearing pressures.
6. Side Resistance factor is applicable to the nominal side resistance in compression.
7. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

Boring B-013-0-25

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_r (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}
0 to 3 [3]	Soft Clay	120	250/0	--	--	0.50 (Tip) 0.55 (Side) [6] 0.4 (uplift resistance)
3 to 4	A-6b	120	750/0	0.6	--	
4 to 6	A-7-6	120	750/0	0.6	--	
6 to 13.5	A-7-6	120	2,000/0	0.9	12	
13.5 to 25	A-4a	120	2,000/0	0.9	12	

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_f (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}

1. Below existing ground surface. See Findings and the boring logs for soil and bedrock stratigraphy details.
2. Design capacities are dependent upon the method of installation, and quality control parameters. The values provided are estimates and should be verified when installation protocol has been finalized.
3. According to Section 1201 of ODOT GDM, the top 3 feet starting from the proposed ground surface should be assumed to be a soft clay with undrained shear strength of S_u = 250 psf (correlating approximately to an SPT N_{60} = 2 bpf), regardless of the soils revealed in the boring, unless shallow bedrock is at a depth of less than 3 feet below proposed grade. This is to account for soils weakened by freeze-thaw or other disturbance. The depths in the table are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the soil profile based on cut, at grade or fill condition. For at grade condition, the depths included in the table apply to the design.
4. Compressive side friction should be ignored for about one shaft diameter from the base of a shaft when a combination of side friction and end bearing are being used to develop the required capacity. In designing to resist uplift loading, a 0.4 Resistance Factor should be applied to the nominal side resistance along with the effective weight of the drilled shaft.
5. Drilled shafts should penetrate at least one shaft diameter into the bearing stratum when designing for the allowable end bearing pressures.
6. Side Resistance factor is applicable to the nominal side resistance in compression.
7. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

Boring B-014-0-25

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_f (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}
0 to 3 [3]	Soft Clay	120	250/0	--	--	0.50 (Tip) 0.55 (Side) [6] 0.4 (uplift resistance)
3 to 6	A-7-6	120	750/0	0.6	--	
6 to 8.5	A-4b	120	750/0	0.6	--	
8.5 to 13.5	A-6a	120	1,000/0	0.75	8	
13.5 to 25	A-6a	120	2,000/0	0.9	12	

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_f (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}

1. Below existing ground surface. See Findings and the boring logs for soil and bedrock stratigraphy details.
2. Design capacities are dependent upon the method of installation, and quality control parameters. The values provided are estimates and should be verified when installation protocol have been finalized.
3. According to Section 1201 of ODOT GDM, the top 3 feet starting from the proposed ground surface should be assumed to be a soft clay with undrained shear strength of S_u = 250 psf (correlating approximately to an SPT N_{60} = 2 bpf), regardless of the soils revealed in the boring, unless shallow bedrock is at a depth of less than 3 feet below proposed grade. This is to account for soils weakened by freeze-thaw or other disturbance. The depths in the table are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the soil profile based on cut, at grade or fill condition. For at grade condition, the depths included in the table apply to the design.
4. Compressive side friction should be ignored for about one shaft diameter from the base of a shaft when a combination of side friction and end bearing are being used to develop the required capacity. In designing to resist uplift loading, a 0.4 Resistance Factor should be applied to the nominal side resistance along with the effective weight of the drilled shaft.
5. Drilled shafts should penetrate at least one shaft diameter into the bearing stratum when designing for the allowable end bearing pressures.
6. Side Resistance factor is applicable to the nominal side resistance in compression.
7. Groundwater was encountered at 11 feet during drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

Boring B-016-0-25

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_f (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}
0 to 3 [3]	Soft Clay	120	250/0	--	--	0.50 (Tip) 0.55 (Side) [6] 0.4 (uplift resistance)
3 to 4	A-6b	125	3,000/0	1.1	--	
4 to 8.5	A-6a	125	3,000/0	1.1	--	
8.5 to 13.5	A-6b	125	3,000/0	1.1	18	
13.5 to 25	A-6b	120	2,000/0	0.9	12	

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_r (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}

1. Below existing ground surface. See Findings and the boring logs for soil and bedrock stratigraphy details.
2. Design capacities are dependent upon the method of installation, and quality control parameters. The values provided are estimates and should be verified when installation protocol have been finalized.
3. According to Section 1201 of ODOT GDM, the top 3 feet starting from the proposed ground surface should be assumed to be a soft clay with undrained shear strength of S_u = 250 psf (correlating approximately to an SPT N_{60} = 2 bpf), regardless of the soils revealed in the boring, unless shallow bedrock is at a depth of less than 3 feet below proposed grade. This is to account for soils weakened by freeze-thaw or other disturbance. The depths in the table are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the soil profile based on cut, at grade or fill condition. For at grade condition, the depths included in the table apply to the design.
4. Compressive side friction should be ignored for about one shaft diameter from the base of a shaft when a combination of side friction and end bearing are being used to develop the required capacity. In designing to resist uplift loading, a 0.4 Resistance Factor should be applied to the nominal side resistance along with the effective weight of the drilled shaft.
5. Drilled shafts should penetrate at least one shaft diameter into the bearing stratum when designing for the allowable end bearing pressures.
6. Side Resistance factor is applicable to the nominal side resistance in compression.
7. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

Boring B-017-0-25

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_r (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}
0 to 3 [3]	Soft Clay	120	250/0	--	--	0.50 (Tip) 0.55 (Side) [6] 0.4 (uplift resistance)
3 to 4	A-7-6	120	1,000/0	0.75	--	
4 to 6	A-6a	120	1,000/0	0.75	--	
6 to 13.5	A-6a	125	3,500/0	1.2	21	
13.5 to 18.5	A-6a	120	2,000/0	0.9	12	
18.5 to 25	A-4a	120	2,000/0	0.9	12	

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_r (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}

1. Below existing ground surface. See Findings and the boring logs for soil and bedrock stratigraphy details.
2. Design capacities are dependent upon the method of installation, and quality control parameters. The values provided are estimates and should be verified when installation protocol have been finalized.
3. According to Section 1201 of ODOT GDM, the top 3 feet starting from the proposed ground surface should be assumed to be a soft clay with undrained shear strength of S_u = 250 psf (correlating approximately to an SPT N_{60} = 2 bpf), regardless of the soils revealed in the boring, unless shallow bedrock is at a depth of less than 3 feet below proposed grade. This is to account for soils weakened by freeze-thaw or other disturbance. The depths in the table are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the soil profile based on cut, at grade or fill condition. For at grade condition, the depths included in the table apply to the design.
4. Compressive side friction should be ignored for about one shaft diameter from the base of a shaft when a combination of side friction and end bearing are being used to develop the required capacity. In designing to resist uplift loading, a 0.4 Resistance Factor should be applied to the nominal side resistance along with the effective weight of the drilled shaft.
5. Drilled shafts should penetrate at least one shaft diameter into the bearing stratum when designing for the allowable end bearing pressures.
6. Side Resistance factor is applicable to the nominal side resistance in compression.
7. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

Boring B-020-0-25

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_r (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}
0 to 3 [3]	Soft Clay	120	250/0	--	--	0.50 (Tip) 0.55 (Side) [6] 0.4 (uplift resistance)
3 to 8.5	A-6a	120	1,500/0	0.85	--	
8.5 to 18.5	A-6a	120	2,500/0	1	15	
18.5 to 23.5	A-4a	120	1,000/0	0.75	8	
23.5 to 25	A-7-6	120	1,000/0	0.75	8	

Approximate Depth [1] (feet)	Material	Total Unit Weight, γ (pcf)	Estimated S_u/ϕ_f (psf/degrees)	Unfactored Nominal Unit Side Resistance, q_s (ksf) [2, 4]	Unfactored Nominal Unit Tip Resistance, q_p (ksf) [2, 5]	Resistance Factor, φ_{stat}

1. Below existing ground surface. See Findings and the boring logs for soil and bedrock stratigraphy details.
2. Design capacities are dependent upon the method of installation, and quality control parameters. The values provided are estimates and should be verified when installation protocol have been finalized.
3. According to Section 1201 of ODOT GDM, the top 3 feet starting from the proposed ground surface should be assumed to be a soft clay with undrained shear strength of S_u = 250 psf (correlating approximately to an SPT N_{60} = 2 bpf), regardless of the soils revealed in the boring, unless shallow bedrock is at a depth of less than 3 feet below proposed grade. This is to account for soils weakened by freeze-thaw or other disturbance. The depths in the table are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the soil profile based on cut, at grade or fill condition. For at grade condition, the depths included in the table apply to the design.
4. Compressive side friction should be ignored for about one shaft diameter from the base of a shaft when a combination of side friction and end bearing are being used to develop the required capacity. In designing to resist uplift loading, a 0.4 Resistance Factor should be applied to the nominal side resistance along with the effective weight of the drilled shaft.
5. Drilled shafts should penetrate at least one shaft diameter into the bearing stratum when designing for the allowable end bearing pressures.
6. Side Resistance factor is applicable to the nominal side resistance in compression.

Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

Recommended L-Pile Parameters for Lateral Pile Analysis

The following table provides input values for use in LPILE analyses. The soil and bedrock parameters were estimated based on the test borings, laboratory test results, and our experience with these soil types.

The tables below present the recommended L-Pile parameters for each boring to be used for lateral pile analysis. For the effective unit weight (γ') of soils below the groundwater table, subtract 62.4 pcf from the values under Total Unit Weight (pcf) column.

BORING B-001-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
Soft Clay	3.0	Soft Clay (Matlock)	120	250	--	Allow LPILE Software to Use Default Values	
Silt and Clay (A-6a)	16.0	Stiff Clay without Free Water (Reese)	125	4,000	--		
Silt and Clay (A-6a)[3]	25.0	Stiff Clay without Free Water (Reese)	120	2,500	--		

1. See test boring logs and Findings for more details on Stratigraphy.
2. Below the existing ground surface at the time when the boring was drilled. The depths are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the layers below based on cut, at grade or fill condition. For at grade condition, the tabulated depths apply.
3. Boring terminated within this layer.
4. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

BORING B-005-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
Soft Clay	3.0	Soft Clay (Matlock)	120	250	--	Allow LPILE Software to Use Default Values	
Clay (A-7-6)	4.0	Stiff Clay without Free Water (Reese)	120	1,000	--		

BORING B-005-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
Silt and Clay (A-6a)	8.5	Stiff Clay without Free Water (Reese)	120	1,000	--		
Sandy Silt (A-4a)	13.5	Stiff Clay without Free Water (Reese)	125	3,500	--		
Silt and Clay (A-6a)[3]	25.0	Stiff Clay without Free Water (Reese)	120	2,000	--		

1. See test boring logs and Findings for more details on Stratigraphy.
2. Below the existing ground surface at the time when the boring was drilled. The depths are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the layers below based on cut, at grade or fill condition. For at grade condition, the tabulated depths apply.
3. Boring terminated within this layer.
4. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

BORING B-006-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
Soft Clay	3.0	Soft Clay (Matlock)	120	250	--	Allow LPILE Software to Use Default Values	
Clay (A-7-6)	8.5	Stiff Clay without Free	120	1,500	--		

BORING B-006-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
		Water (Reese)					
Silt and Clay (A-6a)	13.5	Stiff Clay without Free Water (Reese)	125	3,500	--		
Sandy Silt (A-4a)	16.0	Stiff Clay without Free Water (Reese)	120	2,500	--		
Silt and Clay (A-6a)[3]	25.0	Stiff Clay without Free Water (Reese)	120	2,500	--		

1. See test boring logs and Findings for more details on Stratigraphy.
2. Below the existing ground surface at the time when the boring was drilled. The depths are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the layers below based on cut, at grade or fill condition. For at grade condition, the tabulated depths apply.
3. Boring terminated within this layer.
1. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

BORING B-007-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
Soft Clay	3.0	Soft Clay (Matlock)	120	250	--	Allow LPILE Software to Use Default Values	
Silty Clay (A-6b)	4.0	Stiff Clay without Free	120	1,000	--		

BORING B-007-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
		Water (Reese)					
Clay (A-7-6)	8.5	Stiff Clay without Free Water (Reese)	120	1,000	--		
Silt and Clay (A-6a)	13.5	Stiff Clay without Free Water (Reese)	125	3,000	--		
Silt and Clay (A-6a) [3]	25.0	Stiff Clay without Free Water (Reese)	120	2,500	--		

1. See test boring logs and Findings for more details on Stratigraphy.
2. Below the existing ground surface at the time when the boring was drilled. The depths are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the layers below based on cut, at grade or fill condition. For at grade condition, the tabulated depths apply.
3. Boring terminated within this layer.
4. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

BORING B-010-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
Soft Clay	3.0	Soft Clay (Matlock)	120	250	--	Allow LPILE Software to Use Default Values	
Sandy Silt (A-4a)	8.5	Stiff Clay without Free	125	3,500	--		

BORING B-010-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
		Water (Reese)					
Silt and Clay (A-6a)	18.5	Stiff Clay without Free Water (Reese)	120	2,000	--		
Sandy Silt (A-4a)[3]	25.0	Stiff Clay without Free Water (Reese)	120	2,000	--		

1. See test boring logs and Findings for more details on Stratigraphy.
2. Below the existing ground surface at the time when the boring was drilled. The depths are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the layers below based on cut, at grade or fill condition. For at grade condition, the tabulated depths apply.
3. Boring terminated within this layer.
4. Groundwater was encountered at 23.5 feet during drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

BORING B-013-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
Soft Clay	3.0	Soft Clay (Matlock)	120	250	--	Allow LPILE Software to Use Default Values	
Silty Clay (A-6b)	4.0	Stiff Clay without Free Water (Reese)	120	750	--		

BORING B-013-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
Clay (A-7-6)	6.0	Stiff Clay without Free Water (Reese)	120	750	--		
Clay (A-7-6)	13.5	Stiff Clay without Free Water (Reese)	120	2,000	--		
Sandy Silt (A-4a)[3]	25.0	Stiff Clay without Free Water (Reese)	120	2,000	--		

1. See test boring logs and Findings for more details on Stratigraphy.
2. Below the existing ground surface at the time when the boring was drilled. The depths are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the layers below based on cut, at grade or fill condition. For at grade condition, the tabulated depths apply.
3. Boring terminated within this layer.
4. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

BORING B-014-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
Soft Clay	3.0	Soft Clay (Matlock)	120	250	--	Allow LPILE Software to Use Default Values	
Clay (A-7-6)	6.0	Stiff Clay without Free	120	750	--		

BORING B-014-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
		Water (Reese)					
Silt (A-4b)	8.5	Stiff Clay without Free Water (Reese)	120	750	--		
Silt and Clay (A-6a)[3]	13.5	Stiff Clay without Free Water (Reese)	120	1,000	--		
Silt and Clay (A-6a)[3]	25.0	Stiff Clay without Free Water (Reese)	120	2,000	--		

1. See test boring logs and Findings for more details on Stratigraphy.
2. Below the existing ground surface at the time when the boring was drilled. The depths are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the layers below based on cut, at grade or fill condition. For at grade condition, the tabulated depths apply.
3. Boring terminated within this layer.
4. Groundwater was encountered at 11 feet during drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

BORING B-016-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
Soft Clay	3.0	Soft Clay (Matlock)	120	250	--	Allow LPILE Software to Use Default Values	
Silty Clay (A-6b)	14.0	Stiff Clay without	125	3,000	--		

BORING B-016-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
		Free Water (Reese)					
Silt and Clay (A-6a)	16.0	Stiff Clay without Free Water (Reese)	125	3,000	--		
Silty Clay (A-6b)	24.0	Stiff Clay without Free Water (Reese)	125	3,000	--		
Silty Clay (A-6b)[3]	25.0	Stiff Clay without Free Water (Reese)	120	2,000	--		

1. See test boring logs and Findings for more details on Stratigraphy.
2. Below the existing ground surface at the time when the boring was drilled. The depths are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the layers below based on cut, at grade or fill condition. For at grade condition, the tabulated depths apply.
3. Boring terminated within this layer.
4. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

BORING B-017-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
Soft Clay	3.0	Soft Clay (Matlock)	120	250	--	Allow LPILE Software to	

BORING B-017-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
Clay (A-7-6)	4.0	Stiff Clay without Free Water (Reese)	120	1,000	--	Use Default Values	
Silt and Clay (A-6a)	6.0	Stiff Clay without Free Water (Reese)	120	1,000	--		
Silt and Clay (A-6a)	13.5	Stiff Clay without Free Water (Reese)	125	3,500	--		
Silt and Clay (A-6a)	18.5	Stiff Clay without Free Water (Reese)	120	2,000	--		
Sandy Silt (A-4a)[3]	25.0	Stiff Clay without Free Water (Reese)	120	2,000	--		

1. See test boring logs and Findings for more details on Stratigraphy.
2. Below the existing ground surface at the time when the boring was drilled. The depths are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the layers below based on cut, at grade or fill condition. For at grade condition, the tabulated depths apply.
3. Boring terminated within this layer.
4. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

BORING B-020-0-25							
Soil Layer/Type[1]	**Approximate Bottom Depth of Layer[2] (feet)**	**LPILE Model**	**Total Unit Weight (pcf)**	**Undrained Shear Strength (psf)**	**Soil Friction Angle (deg)**	**K (pci)**	**ε_{50}**
Soft Clay	3.0	Soft Clay (Matlock)	120	250	--	Allow LPILE Software to Use Default Values	
Silt and Clay (A-6a)	8.5	Stiff Clay without Free Water (Reese)	120	1,500	--		
Silt and Clay (A-6a)	18.5	Stiff Clay without Free Water (Reese)	120	2,500	--		
Sandy Silt (A-4a)	23.5	Stiff Clay without Free Water (Reese)	120	1,000	--		
Clay (A-7-6)[3]	25.0	Stiff Clay without Free Water (Reese)	120	1,000	--		

1. See test boring logs and Findings for more details on Stratigraphy.
2. Below the existing ground surface at the time when the boring was drilled.
3. Boring terminated within this layer. The depths are not adjusted for the proposed ground at drilled shaft foundation location. The designer should adjust the layers below based on cut, at grade or fill condition. For at grade condition, the tabulated depths apply.
4. Groundwater was not encountered during drilling or upon completion of drilling. Based on Section 1201 of ODOT GDM, the groundwater depth should be assumed at 3 feet below the proposed ground surface. The effective unit weight of soil should be used below the groundwater level.

The structural capacity of the drilled shafts should be checked to ensure that they can safely accommodate the combined stresses induced by axial and lateral forces. Lateral deflections of drilled shaft foundations should be evaluated using an appropriate analysis method, and will depend upon the element's diameter, length, configuration, stiffness and "fixed head" or "free head" condition. The load-carrying capacity of drilled shaft foundations may be increased by increasing the section. Proper reinforcing steel should

be included in the drilled shaft designs for resistance of the combined axial loads and bending moments.

Drilled Shaft Construction Considerations

In general, drilled shaft installation should be in accordance with C&MS Items 524 and BDM section 305.4. Key considerations include:

- The concrete shall have a minimum 28-day specified compressive strength of 4,500 psi.
- It is recommended that the top of rock and design rock socket, if applicable, be shown for each drilled shaft on the plans, with these elevations being determined using the test borings and minimum embedment requirements from axial load analyses.
- The final tip elevation should be determined by inspection of each shaft excavation in the field by a qualified geotechnical technician.
- The foundation drawings should identify those shafts where the minimum embedment lengths are based on axial and/or lateral load analyses.
- The drilled shaft specifications should be clear that the design bottom of the drilled shaft elevations shown on the plans is for estimation purposes only. The actual determination of the bottom elevation will be made during the installation per C&MS Items 524.08 & 09.
- Typical drilled shaft construction notes should be prepared by the designer per BDM section 606.8.

Earthwork Considerations

All embankment materials should be spread and compacted in accordance with Items 203.06 and 203.07 and subgrade materials should be spread and compacted in accordance with Items 204.07 and 204.03. Frozen materials should not be incorporated into any new fill nor should new fill, pavement materials, or structures be placed on top of frozen materials. Material to be utilized as borrow should be restricted to conform to Item 203.02R and 203.3 for embankment construction and Item 204.2 for subgrade.

Earthwork, including subgrade preparation should be performed in accordance with respective items in Section 200 of the current ODOT CMS. Consideration may be given to using the in-situ soils or from the local borrow sources. However, the material may require moisture adjustments to achieve proper compaction. Potentially, chemical treatment may be used for any borrow materials and existing embankment soil with high moisture contents. Chemical treatment should be performed in accordance with ODOT Item 205.

Excavation Considerations

If the excavation depths are greater than 5 feet, the excavation sides will need to be laid back or shored. As a minimum, all excavations should be sloped or braced as required by Occupational Health and Safety Administration (OSHA) regulations to provide stability and safe working conditions. Reference to OSHA 29CFR, Part 1926, Subpart P should be included in the job specifications.

The grading contractor, by his contract, is usually 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. Slope heights, slope inclinations and/or excavation depths should in no case exceed those specified in local, state, or federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

Under no circumstances should the information provided in this report be interpreted to mean that Terracon is responsible for construction site safety or the contractor's activities. Construction site safety is the sole responsibility of the contractor, who shall also be solely responsible for the means, methods, and sequencing of the construction operations.

Where structures, roadways, underground utilities, etc. exist adjacent to or within the zone of influence of the excavations, care must be taken to protect these structures, roadways, underground utilities, etc. from possible damages due to construction activities. If structures and underground utilities are located near an excavation, a pre-construction survey should be performed on all existing structures and underground utilities located within 100 feet of the excavation. It is the Contractor's responsibility to prevent undermining of existing foundations and prevent any damage to adjacent structures or facilities.

Drainage and Groundwater Considerations

Groundwater was observed only in boring B-014-0-25 during drilling at a depth of about 11 feet below the ground surface elevation. Groundwater was not observed in this boring at completion of drilling. Groundwater was not encountered during drilling or at completion of drilling any of the other borings. The contractor is responsible for employing appropriate dewatering methods to control seepage and facilitate construction, if needed. Terracon recommends that the contractor determine the method of surface water drainage during the construction activities to assess the impact groundwater may have on construction.

During construction, site grading should be developed to direct surface water flow away from, or around, the site. Exposed subgrades should be sloped to provide positive drainage so that saturation of subgrades is avoided. Surface water should not be permitted to accumulate on the site.

Final surrounding grades should be sloped away from the proposed embankments on all sides to prevent ponding of water. Due to the nature of the soil profile, trapped water infiltration or groundwater seepage may be encountered, particularly after periods of precipitation. In such an event, sump and pumping methods may be used for temporary dewatering.

Cut and Fill Slopes

As mentioned earlier, the project includes up to 3 feet cut and up to 5 feet of fill at the expansion areas of EB and WB rest areas. If cut slopes are considered for this project, slope angles of 3H:1V are preferred for cut slopes in soil, however cut slope angles should not be designed or constructed steeper than 2H:1V. Erosion protection should be performed in accordance with guidelines and requirements of ODOT CMS Item 670 (Erosion Protection). For slope erosion protection, the Contractor may use sodding (ODOT CMS Item 660.02) or erosion control mats (ODOT CMS Item 712.11).

Fill slopes should be designed and constructed in accordance with Section 800 ODOT GDM for special benching and sidehill embankment fills. Fill slopes should not exceed 2H:1V slope angle. Embankment construction should follow the requirements of Item 203 of ODOT CMS.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. If the

owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly affect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

Attachments

Site Location and Exploration Plans

Contents:

Site Location
Exploration Plan (2 pages)

Note: All attachments are one page unless noted above.

Site Location

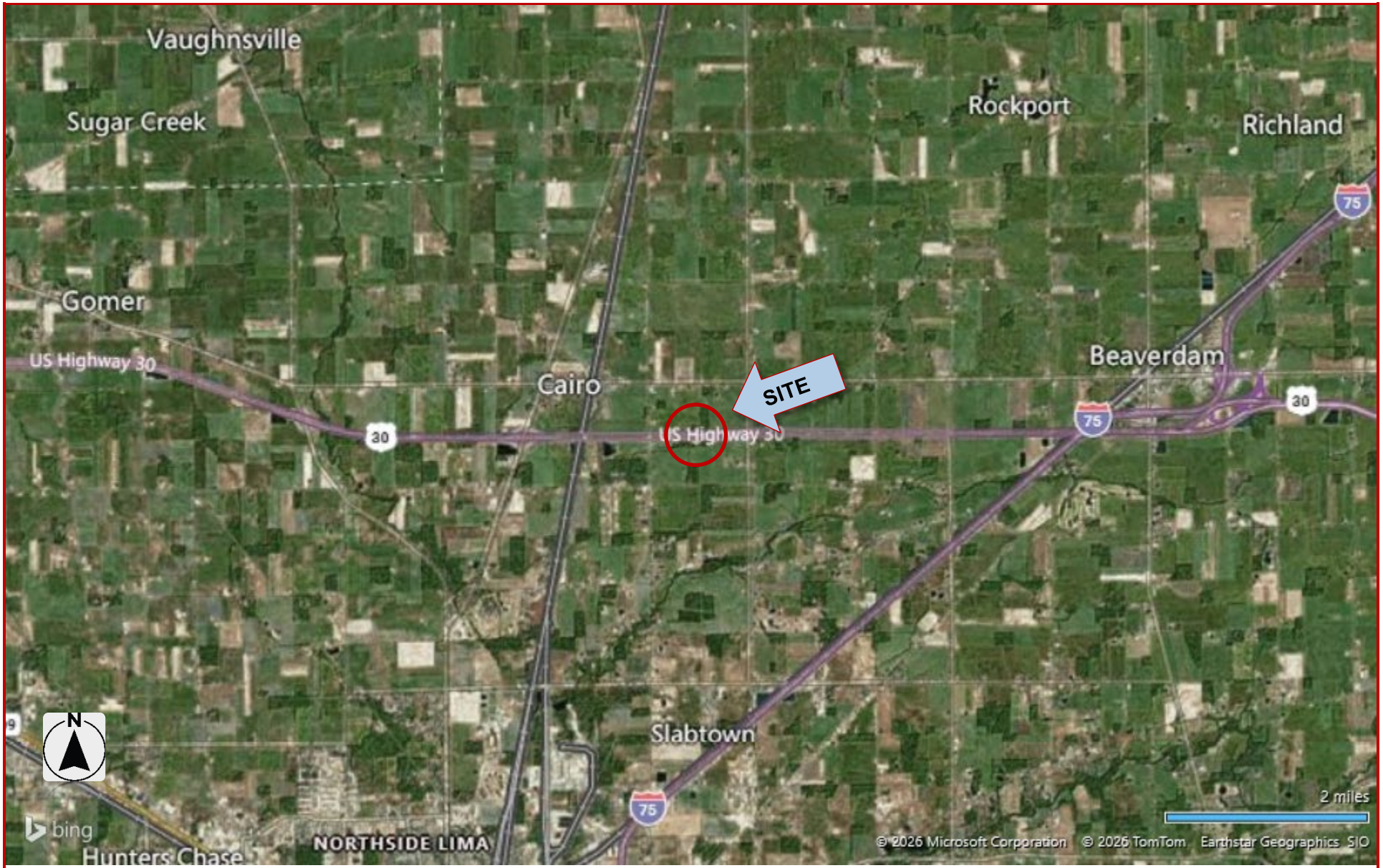


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan – EB Rest Area

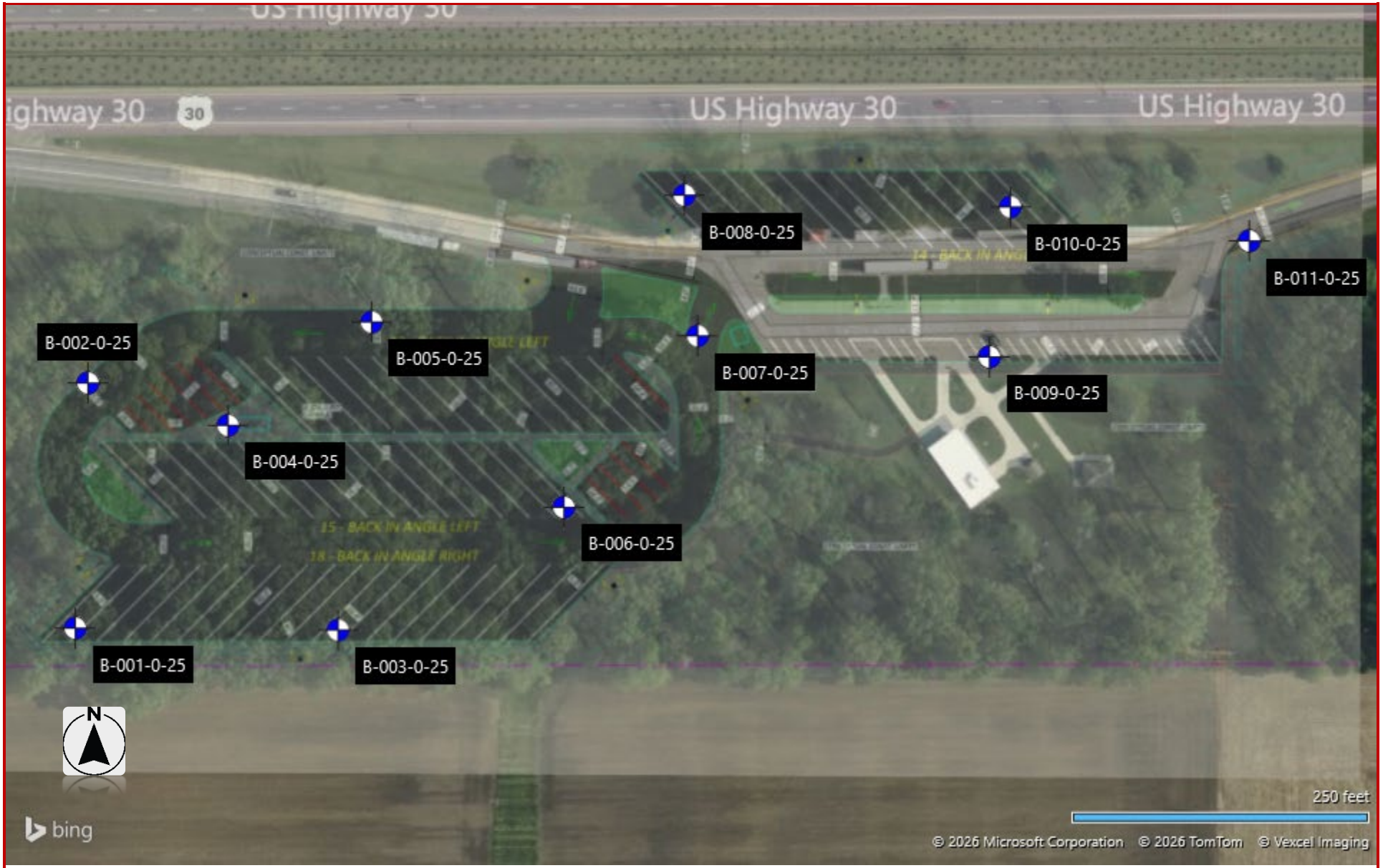


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan – WB Rest Area

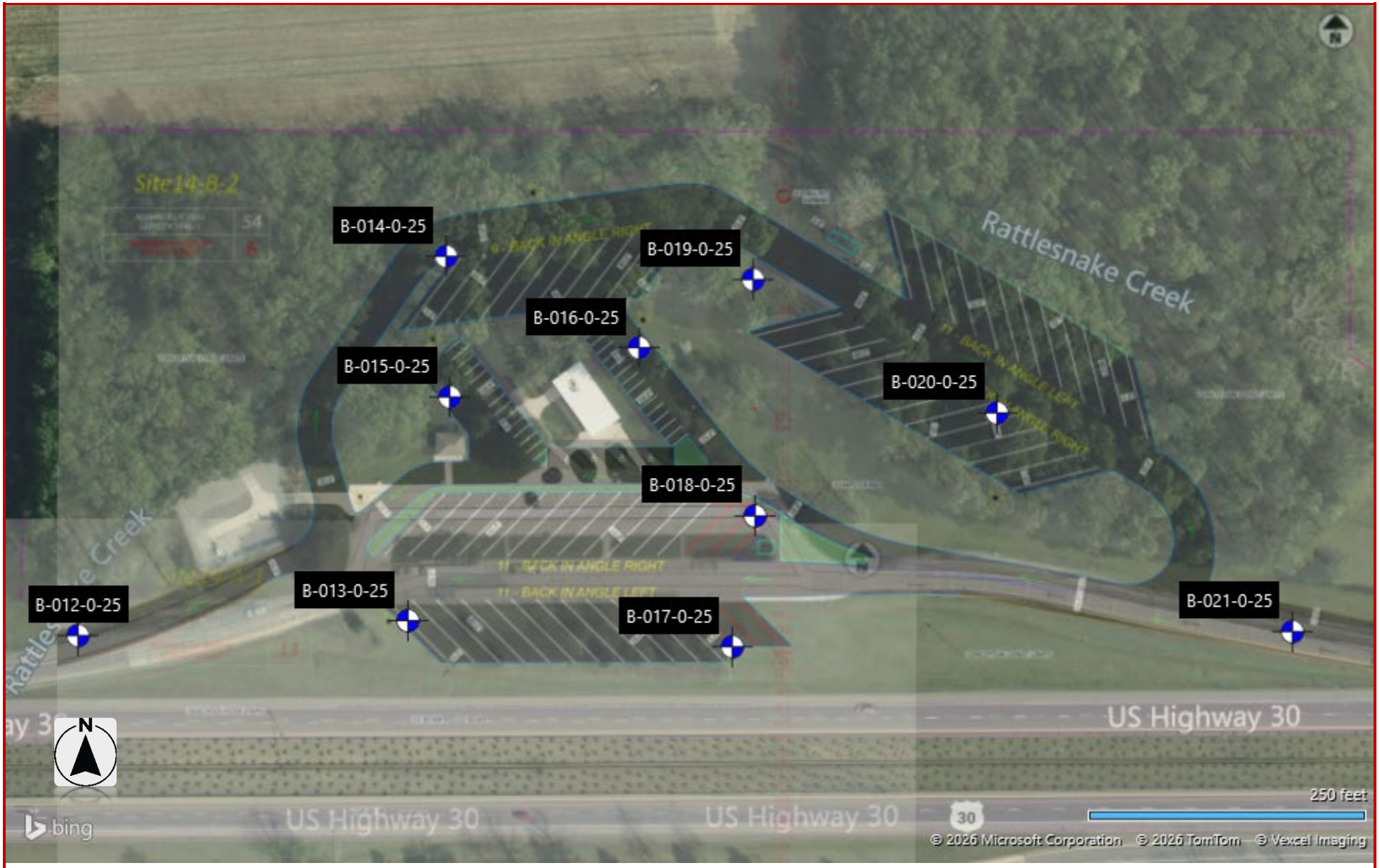


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration and Laboratory Results

Contents:

Boring Logs (B-001-0-25 through B-021-0-25) (21 Pages)
Atterberg Limits (3 pages)
Grain Size Distribution (9 pages)
Sulfate Content (2 pages)

Note: All attachments are one page unless noted above.

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:33 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. BROOKS	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 751+38, 482' RT.	EXPLORATION ID B-001-0-25
TYPE: LIGHT TOWER	SAMPLING FIRM / LOGGER: T.C / G. GRUBE	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 EB	
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 830.3 (MSL) EOB: 25.0 ft.	PAGE 1 OF 1
START: 2/27/26 END: 2/27/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.823093, -84.064920	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
TOPSOIL (8")	830.3 829.6		2 3 4	10	100	SS-1	3.00	12	2	8	31	47	41	23	18	25	A-7-6 (11)	-	
VERY STIFF, BROWN MOTTLED WITH GRAY, **CLAY**, TRACE FINE TO COARSE SAND, LITTLE GRAVEL, SLIGHTLY ORGANIC, MOIST		1																	
	826.3	2	6 9 9	27	100	SS-2	4.00	-	-	-	-	-	-	-	-	23	A-7-6 (V)	<100	
VERY STIFF TO HARD, BROWN, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, LITTLE TO SOME GRAVEL, DAMP		3																	
		4	6 9 16	37	100	SS-3	4.5+	24	5	8	26	37	32	19	13	14	A-6a (7)	-	
		5																	
		6	9 18 24	62	100	SS-4	4.5+	-	-	-	-	-	-	-	-	12	A-6a (V)	-	
		7																	
		8																	
		9	12 12 15	40	100	SS-5	4.5+	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
		10																	
		11																	
		12	12 13 15	41	100	SS-6	4.5+	-	-	-	-	-	-	-	-	16	A-6a (V)	-	
		13																	
@13.5'; COLOR CHANGES TO GRAY		14	9 10 15	37	100	SS-7	4.00	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
		15																	
		16																	
		17	8 9 11	30	100	SS-8	3.75	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
		18																	
		19	7 8 9	25	100	SS-9	3.75	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
		20																	
		21																	
		22																	
		23																	
	805.3	24	4 5 7	18	100	SS-10	3.50	-	-	-	-	-	-	-	-	-	A-6a (V)	-	
	EOB	25																	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH BENTONITE GROUT

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:33 - C:\USERS\AALHOSAINA\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. BROOKS	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 751+62, 273' RT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: T.C / G. GRUBE	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 EB
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 828.3 (MSL) EOB: 10.0 ft.
START: 2/27/26 END: 2/27/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.823668, -84.064839

EXPLORATION ID B-002-0-25

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
TOPSOIL (8")	828.3 827.6																		
VERY STIFF, BROWN MOTTLED WITH GRAY, **SILT AND CLAY**, SOME FINE TO COARSE SAND, LITTLE GRAVEL, DAMP	826.3		0 3 4	10	89	SS-1	3.00	22	6	20	28	24	26	15	11	15	A-6a (4)	<100	
STIFF, BROWN MOTTLED WITH GRAY, **SILT**, "AND" FINE TO COARSE SAND, LITTLE GRAVEL, DAMP	823.8		3 4 5	13	100	SS-2	2.00	13	17	25	26	19	22	17	5	15	A-4a (2)	-	
STIFF TO VERY STIFF, BROWN, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP			3 3 4	10	100	SS-3	1.50	-	-	-	-	-	-	-	-	20	A-6a (V)	-	
			4 5 9	21	100	SS-4	2.50	-	-	-	-	-	-	-	-	17	A-6a (V)	-	
	818.3	EOB	6 7 8	22	100	SS-5	4.00	-	-	-	-	-	-	-	-	9	A-6a (V)	-	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:33 - C:\USERS\AALHOSAINA\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. BROOKS	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 753+69, 477' RT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: T.C / G. GRUBE	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 EB
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 831.5 (MSL) EOB: 10.0 ft.
START: 2/27/26 END: 2/27/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.823115, -84.064084

EXPLORATION ID B-003-0-25

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 831.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
TOPSOIL (10")	830.7																		
VERY STIFF TO HARD, BROWN MOTTLED WITH GRAY, **CLAY**, TRACE FINE TO COARSE SAND, TRACE TO LITTLE GRAVEL, DAMP	827.5	1	3 3 4	10	100	SS-1	2.50	-	-	-	-	-	-	-	-	23	A-7-6 (V)	<100	
		2																	
		3	4 5 6	16	100	SS-2	4.5+	19	2	8	28	43	42	27	15	20	A-7-6 (10)	-	
		4																	
HARD, BROWN, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP		5	5 8 11	28	100	SS-3	4.5+	9	5	10	30	46	34	20	14	17	A-6a (10)	-	
		6																	
		7	9 17 21	56	100	SS-4	4.5+	-	-	-	-	-	-	-	-	10	A-6a (V)	-	
		8																	
	821.5	9	12 13 15	41	100	SS-5	4.5+	-	-	-	-	-	-	-	-	13	A-6a (V)	-	
		EOB 10																	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. BROOKS	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 752+78, 312' RT.	EXPLORATION ID B-004-0-25
TYPE: BUILDING	SAMPLING FIRM / LOGGER: T.C / G. GRUBE	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 EB	
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 828.4 (MSL) EOB: 20.0 ft.	PAGE 1 OF 1
START: 2/27/26 END: 2/27/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.823565, -84.064418	

MATERIAL DESCRIPTION AND NOTES	ELEV. 828.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
TOPSOIL (8")	827.7																		
VERY STIFF, BROWN MOTTLED WITH GRAY, **CLAY**, LITTLE FINE TO COARSE SAND, LITTLE TO SOME GRAVEL, DAMP	819.9	1	3 4 4	12	100	SS-1	2.50	-	-	-	-	-	-	-	-	20	A-7-6 (V)	-	
		2 3	3 4 5	13	100	SS-2	2.75	23	2	9	25	41	41	27	14	23	A-7-6 (8)	-	
		4 5	3 4 4	12	100	SS-3	2.00	-	-	-	-	-	-	-	-	21	A-7-6 (V)	-	
		6 7	3 4 6	15	100	SS-4	3.50	-	-	-	-	-	-	-	-	25	A-7-6 (V)	-	
VERY STIFF, GRAY, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP		8 9	5 5 7	18	100	SS-5	3.50	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
		10 11 12	5 6 7	19	100	SS-6	2.50	-	-	-	-	-	-	-	-	16	A-6a (V)	-	
		13 14 15	5 5 6	16	100	SS-7	3.75	6	5	11	38	40	26	16	10	16	A-4a (8)	-	
		16 17	5 6 7	19	100	SS-8	3.50	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
	808.4	EOB 18 19 20	6 6 7	19	100	SS-9	3.25	-	-	-	-	-	-	-	-	14	A-6a (V)	-	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH BENTONITE GROUT

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. KEIFE	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 754+04, 222' RT.	EXPLORATION ID B-005-0-25
TYPE: LIGHT TOWER	SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 EB	
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 828.7 (MSL) EOB: 25.0 ft.	PAGE 1 OF 1
START: 2/18/26 END: 2/18/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.823815, -84.063965	

MATERIAL DESCRIPTION AND NOTES	ELEV. 828.7	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
TOPSOIL (8")	828.0																		
VERY STIFF TO HARD, BROWN, **CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, MOIST	824.7	1	2 3 5	12	100	SS-1	2.25	1	1	12	39	47	50	24	26	25	A-7-6 (16)	-	
		2 3	5 9 11	30	44	SS-2	4.5+	-	-	-	-	-	-	-	-	16	A-7-6 (V)	<100	
HARD, BROWN, **SILT AND CLAY**, TRACE TO LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP	820.2	4 5	4 5 6	16	72	SS-3	4.5+	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
		6 7	5 6 7	19	17	SS-4	4.5+	-	-	-	-	-	-	-	-	17	A-6a (V)	-	
HARD, GRAY, **SANDY SILT**, TRACE TO LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP	815.2	8 9 10	12 17 21	56	100	SS-5	4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	-	
		11 12	12 18 28	68	39	SS-6	4.5+	9	3	13	35	40	25	15	10	12	A-4a (8)	-	
HARD, GRAY, **SILT AND CLAY**, TRACE TO LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP TO MOIST		14	4 8 10	27	72	SS-7	4.5+	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
		16 17	7 11 13	36	100	SS-8	4.5+	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
		19	3 9 7	24	50	SS-9	4.25	3	4	13	36	44	26	15	11	16	A-6a (8)	-	
	803.7	EOB 24 25	4 7 7	21	39	SS-10	4.50	-	-	-	-	-	-	-	-	16	A-6a (V)	-	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH BENTONITE GROUT

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. KEIFE	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 755+64, 383' RT.	EXPLORATION ID B-006-0-25
TYPE: LIGHT TOWER	SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 EB	
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 830.1 (MSL) EOB: 25.0 ft.	PAGE 1 OF 1
START: 2/18/26 END: 2/18/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.823375, -84.063383	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
TOPSOIL (12")	830.1																		
	829.1		3 4 4	12	100	SS-1	3.25	1	2	13	30	54	43	20	23	22	A-7-6 (14)	<100	
VERY STIFF TO HARD, BROWN MOTTLED WITH GRAY, **CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, DAMP TO MOIST			5 5 6	16	61	SS-2	3.75	-	-	-	-	-	-	-	-	21	A-7-6 (V)	-	
			6 8 8	24	78	SS-3	4.5+	1	2	13	30	54	42	20	22	14	A-7-6 (13)	-	
	821.6		8 9 11	30	28	SS-4	4.5+	-	-	-	-	-	-	-	-	16	A-7-6 (V)	-	
VERY STIFF TO HARD, BROWN, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, DAMP			10 20 21	61	100	SS-5	4.25	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
	816.6		11 15 21	53	50	SS-6	4.5+	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
HARD, GRAY, **SANDY SILT**, TRACE GRAVEL, DAMP	814.1		6 8 10	27	78	SS-7	3.50	4	3	13	37	43	25	15	10	14	A-4a (8)	-	
HARD, GRAY, **SILT AND CLAY**, TRACE TO LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP			7 10 13	34	100	SS-8	4.50	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
			7 11 11	33	17	SS-9	4.50	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
	805.1	EOB	8 11 16	40	100	SS-10	4.5+	-	-	-	-	-	-	-	-	15	A-6a (V)	-	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH BENTONITE GROUT

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. KEIFE	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 756+82, 238' RT.
TYPE: LIGHT TOWER	SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 EB
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 831.0 (MSL) EOB: 25.0 ft.
START: 2/18/26 END: 2/18/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.823777, -84.062961

EXPLORATION ID B-007-0-25

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 831.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
TOPSOIL (10")	830.2																		
VERY STIFF TO HARD, BROWN MOTTLED WITH GRAY, **SILT AND CLAY**, TRACE FINE TO COARSE SAND, TRACE GRAVEL, DAMP TO MOIST	827.0		3 3 5	12	89	SS-1	3.50	-	-	-	-	-	-	-	-	43	A-6b (V)	<100	
			4 5 5	15	33	SS-2	3.75	1	1	13	35	50	38	17	21	20	A-6b (12)	-	
VERY STIFF, BROWN MOTTLED WITH GRAY, **CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, MOIST	822.5		5 5 7	18	50	SS-3	3.50	2	2	11	29	56	47	17	30	24	A-7-6 (17)	-	
			8 8 9	25	56	SS-4	3.75	-	-	-	-	-	-	-	-	23	A-7-6 (V)	-	
VERY STIFF TO HARD, GRAY, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP			6 12 15	40	100	SS-5	4.5+	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
			12 16 20	53	67	SS-6	4.5+	-	-	-	-	-	-	-	-	-	A-6a (V)	-	
			7 8 11	28	56	SS-7	3.50	-	-	-	-	-	-	-	-	-	A-6a (V)	-	
			9 11 12	34	89	SS-8	4.50	-	-	-	-	-	-	-	-	-	A-6a (V)	-	
			8 12 13	37	33	SS-9	4.50	-	-	-	-	-	-	-	-	-	A-6a (V)	-	
	806.0	EOB	10 12 18	44	100	SS-10	4.5+	-	-	-	-	-	-	-	-	-	A-6a (V)	-	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS; BACKFILLED WITH BENTONITE GROUT

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINA1\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. KEIFE	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 756+71, 131' RT.	EXPLORATION ID B-008-0-25
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 EB	
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 831.4 (MSL) EOB: 10.0 ft.	PAGE 1 OF 1
START: 2/18/26 END: 2/18/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.824070, -84.063006	

MATERIAL DESCRIPTION AND NOTES	ELEV. 831.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
TOPSOIL (8")	830.7																		
VERY STIFF, BROWN, **SILT AND CLAY**, SOME FINE TO COARSE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, DAMP	829.4		3 4 6	15	61	SS-1	4.00	2	3	19	34	42	31	17	14	17	A-6a (10)	-	
HARD, BROWN, **CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, MOIST	827.4		4 5 8	19	94	SS-2	4.5+	0	2	13	31	54	46	17	29	18	A-7-6 (17)	<100	
HARD, BROWN, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, DAMP			6 6 8	21	39	SS-3	4.5+	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
			8 14 12	38	83	SS-4	4.5+	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
	821.4	EOB	7 20 26	68	78	SS-5	4.5+	-	-	-	-	-	-	-	-	14	A-6a (V)	-	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14) | DRILLING FIRM / OPERATOR: T.C / D. KEIFE | DRILL RIG: MOBILE B-57 (#613) | STATION / OFFSET: 759+35, 274' RT. | EXPLORATION ID B-009-0-25

TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR | HAMMER: MOBILE AUTOMATIC | ALIGNMENT: US-30 EB

PID: 122869 SFN: N/A | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 3/26/25 | ELEVATION: 837.2 (MSL) EOB: 7.5 ft. | PAGE 1 OF 1

START: 2/18/26 END: 2/18/26 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 88.8 | LAT / LONG: 40.823682, -84.062046

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
TOPSOIL (10")	837.2 836.4																		
VERY STIFF TO HARD, BROWN, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, DAMP		1	4 5 7	18	78	SS-1	4.50	-	-	-	-	-	-	-	-	17	A-6a (V)	<100	
		2	5 6 6	18	50	SS-2	3.00	4	4	12	33	47	33	18	15	18	A-6a (10)	-	
		3	4 6 8	21	67	SS-3	4.5+	4	6	14	31	45	31	17	14	15	A-6a (10)	-	
		4	5 7 7	21	100	SS-4	4.00	-	-	-	-	-	-	-	-	16	A-6a (V)	-	
		5	6 9 16	37	56	SS-5	4.5+	-	-	-	-	-	-	-	-	16	A-6a (V)	-	
	829.7	6 EOB																	
		7																	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. KEIFE	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 759+42, 138' RT.	EXPLORATION ID B-010-0-25
TYPE: LIGHT TOWER	SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 EB	
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 837.4 (MSL) EOB: 25.0 ft.	PAGE 1 OF 1
START: 2/18/26 END: 2/18/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.824057, -84.062024	

MATERIAL DESCRIPTION AND NOTES	ELEV. 837.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
TOPSOIL (6")	836.9																		
VERY STIFF, BROWN, **CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, MOIST	835.4	1	4 6 6	18	78	SS-1	4.00	1	2	14	27	56	41	16	25	22	A-7-6 (14)	-	
HARD, BROWN, **SANDY SILT**, LITTLE TO SOME FINE TO COARSE SAND, TRACE GRAVEL, DAMP		2 3	8 11 19	44	100	SS-2	-	2	3	19	36	40	25	15	10	10	A-4a (8)	<100	
		4 5	11 27 32	87	83	SS-3	-	-	-	-	-	-	-	-	-	7	A-4a (V)	-	
		6 7	22 32 38	104	50	SS-4	4.5+	-	-	-	-	-	-	-	-	14	A-4a (V)	-	
	828.9	8																	
VERY STIFF TO HARD, BROWN, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP		9 10	8 11 20	46	100	SS-5	4.5+	-	-	-	-	-	-	-	-	17	A-6a (V)	-	
		11 12	15 28 32	89	50	SS-6	4.5+	-	-	-	-	-	-	-	-	17	A-6a (V)	-	
		13 14	6 10 12	33	83	SS-7	4.5+	-	-	-	-	-	-	-	-	17	A-6a (V)	-	
		15 16 17	24 17 20	55	100	SS-8	4.5+	-	-	-	-	-	-	-	-	17	A-6a (V)	-	
	818.9	18																	
HARD, GRAY, **SANDY SILT**, TRACE GRAVEL, DAMP		19 20	5 7 9	24	100	SS-9	2.50	3	4	14	38	41	26	16	10	16	A-4a (8)	-	
		21 22 23					-	-	-	-	-	-	-	-	-	-		-	
	812.4	24	5 8 8	24	100	SS-10	3.00	-	-	-	-	-	-	-	-	16	A-4a (V)	-	
		EOB 25																	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH BENTONITE GROUT

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. KEIFE	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 761+68, 159' RT.
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 EB
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 835.8 (MSL) EOB: 7.5 ft.
START: 2/18/26 END: 2/18/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.824005, -84.061210

EXPLORATION ID B-011-0-25

MATERIAL DESCRIPTION AND NOTES	ELEV. 835.8	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
TOPSOIL (6")	835.3																		
VERY STIFF TO HARD, BROWN, **CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, DAMP TO MOIST		1	2 4 5	13	50	SS-1	4.5+	-	-	-	-	-	-	-	-	18	A-7-6 (V)	<100	
		2 3	4 6 6	18	100	SS-2	3.50	0	1	10	35	54	51	17	34	20	A-7-6 (18)	-	
	831.8																		
VERY STIFF, BROWN, **SILTY CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, MOIST		4 5	5 6 6	18	39	SS-3	3.75	1	2	15	33	49	39	19	20	21	A-6b (12)	-	
		6 7	5 8 10	27	100	SS-4	2.50	-	-	-	-	-	-	-	-	21	A-6b (V)	-	
	828.3	EOB																	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. KEIFE	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 754+82, 125' LT.	EXPLORATION ID B-012-0-25
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 WB	
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 829.4 (MSL) EOB: 7.5 ft.	PAGE 1 OF 1
START: 2/17/26 END: 2/17/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.824769, -84.063695	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
TOPSOIL (8")	829.4 / 828.7																		
VERY STIFF, BROWN, **SILTY CLAY**, LITTLE FINE TO COARSE SAND, TRACE TO LITTLE GRAVEL, SLIGHTLY ORGANIC, DAMP TO MOIST		1	3 4 5	13	61	SS-1	3.25	15	5	13	30	37	35	18	17	17	A-6b (9)	-	
		2 3	4 4 5	13	94	SS-2	2.00	0	3	14	34	49	39	16	23	18	A-6b (13)	<100	
		4 5	2 3 3	9	67	SS-3	2.00	-	-	-	-	-	-	-	-	34	A-6b (V)	-	
	821.9	EOB 6 7	4 5 6	16	100	SS-4	2.00	-	-	-	-	-	-	-	-	24	A-6b (V)	-	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. KEIFE	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 757+81, 136' LT.	EXPLORATION ID B-013-0-25
TYPE: LIGHT TOWER	SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 WB	
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 831.5 (MSL) EOB: 25.0 ft.	PAGE 1 OF 1
START: 2/17/26 END: 2/17/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.824806, -84.062615	

MATERIAL DESCRIPTION AND NOTES	ELEV. 831.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
TOPSOIL (12")	830.5	1	2 3 5	12	100	SS-1	2.75	0	4	16	64	16	38	20	18	22	A-6b (11)	-	
VERY STIFF, BROWN, **SILTY CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, DAMP		2 3	4 6 7	19	94	SS-2	3.50	-	-	-	-	-	-	-	-	22	A-6b (V)	<100	
	827.5	4 5	5 5 4	13	100	SS-3	4.25	1	2	12	27	58	43	18	25	21	A-7-6 (15)	-	
VERY STIFF TO HARD, BROWN, **CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP TO MOIST		6 7 8	8 12 11	34	56	SS-4	4.5+	-	-	-	-	-	-	-	-	17	A-7-6 (V)	-	
		9 10	10 10 21	46	100	SS-5	4.5+	-	-	-	-	-	-	-	-	14	A-7-6 (V)	-	
	818.0	11 12 13	10 12 14	38	100	SS-6	4.5+	-	-	-	-	-	-	-	-	15	A-7-6 (V)	-	
VERY STIFF, GRAY, **SANDY SILT**, TRACE GRAVEL, DAMP		14 15	5 7 11	27	67	SS-7	3.00	4	3	13	39	41	25	15	10	15	A-4a (8)	-	
		16 17 18	8 10 12	33	100	SS-8	2.25	-	-	-	-	-	-	-	-	16	A-4a (V)	-	
		19 20 21 22 23	3 6 8	21	100	SS-9	3.75	-	-	-	-	-	-	-	-	16	A-4a (V)	-	
	806.5 EOB	24 25	7 12 13	37	100	SS-10	4.00	-	-	-	-	-	-	-	-	14	A-4a (V)	-	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH BENTONITE GROUT

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14) | DRILLING FIRM / OPERATOR: T.C / D. KEIFE | DRILL RIG: MOBILE B-57 (#613) | STATION / OFFSET: 758+18, 465' LT. | EXPLORATION ID B-014-0-25

TYPE: LIGHT TOWER | SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR | HAMMER: MOBILE AUTOMATIC | ALIGNMENT: US-30 WB

PID: 122869 SFN: N/A | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 3/26/25 | ELEVATION: 827.5 (MSL) EOB: 25.0 ft. | PAGE 1 OF 1

START: 2/19/26 END: 2/19/26 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 88.8 | LAT / LONG: 40.825708, -84.062490

MATERIAL DESCRIPTION AND NOTES	ELEV. 827.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
TOPSOIL (12")	826.5	1	4 6 7	19	94	SS-1	2.75	1	1	14	34	50	51	16	35	23	A-7-6 (18)	<100	
STIFF TO HARD, BROWN, **CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, MOIST		2 3	5 9 9	27	44	SS-2	4.5+	1	1	12	37	49	49	16	33	19	A-7-6 (18)	-	
		4 5	4 4 6	15	78	SS-3	1.75	-	-	-	-	-	-	-	-	22	A-7-6 (V)	-	
	821.5	6																	
VERY STIFF, BROWN MOTTLED WITH GRAY, **SILT**, TRACE FINE TO COARSE SAND, TRACE GRAVEL, WET		7	4 5 6	16	56	SS-4	1.00	0	1	7	70	22	28	20	8	27	A-4b (8)	-	
	819.0	8																	
VERY STIFF, GRAY, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP		9	4 5 7	18	72	SS-5	4.00	-	-	-	-	-	-	-	-	17	A-6a (V)	-	
		W 816.5 10 11																	
		12	4 5 6	16	39	SS-6	3.25	-	-	-	-	-	-	-	-	19	A-6a (V)	-	
		13 14	5 9 9	27	44	SS-7	3.00	-	-	-	-	-	-	-	-	16	A-6a (V)	-	
		15 16	6 8 8	24	100	SS-8	4.00	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
		17 18																	
		19	3 7 8	22	6	SS-9	2.50	-	-	-	-	-	-	-	-	18	A-6a (V)	-	
		20 21 22 23																	
	802.5	EOB 24 25	5 7 10	25	11	SS-10	3.00	-	-	-	-	-	-	-	-	17	A-6a (V)	-	

NOTES: GROUNDWATER WAS ENCOUNTERED AT 11 FEET DURING DRILLING. GROUNDWATER WAS NOT OBSERVED UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH BENTONITE GROUT

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. KEIFE	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 758+21, 338' LT.	EXPLORATION ID B-015-0-25
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 WB	
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 828.6 (MSL) EOB: 10.0 ft.	PAGE 1 OF 1
START: 2/19/26 END: 2/19/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.825360, -84.062478	

MATERIAL DESCRIPTION AND NOTES	ELEV. 828.6	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
TOPSOIL (10")	827.8																		
HARD, BROWN, **CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, DAMP		1	4 5 8	19	83	SS-1	4.5+	0	1	11	41	47	42	21	21	21	A-7-6 (13)	-	
		2 3	6 6 6	18	89	SS-2	4.5+	-	-	-	-	-	-	-	-	17	A-7-6 (V)	<100	
		4 5	8 9 9	27	56	SS-3	4.5+	10	3	10	29	48	45	19	26	17	A-7-6 (15)	-	
		6 7	7 10 12	33	78	SS-4	4.5+	-	-	-	-	-	-	-	-	16	A-7-6 (V)	-	
		8 9	5 7 12	28	83	SS-5	4.5+	-	-	-	-	-	-	-	-	20	A-7-6 (V)	-	
	818.6	EOB 10																	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. KEIFE	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 759+93, 381' LT.	EXPLORATION ID B-016-0-25
TYPE: LIGHT TOWER	SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 WB	
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 830.2 (MSL) EOB: 25.0 ft.	PAGE 1 OF 1
START: 2/19/26 END: 2/19/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.825482, -84.061858	

MATERIAL DESCRIPTION AND NOTES	ELEV. 830.2	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
TOPSOIL (5")	829.8																		
VERY STIFF TO HARD, BROWN, **SILTY CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, DAMP	826.2	1	4 4 5	13	56	SS-1	2.75	-	-	-	-	-	-	-	-	21	A-6b (V)	<100	
		2 3	7 8 14	33	61	SS-2	4.5+	3	4	13	31	49	36	18	18	12	A-6b (11)	-	
HARD, BROWN, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP	821.7	4 5	12 15 18	49	56	SS-3	4.5+	3	4	12	33	48	33	18	15	12	A-6a (V)	-	
		6 7 8	19 24 30	80	100	SS-4	4.5+	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
VERY STIFF TO HARD, BROWN, **SILTY CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP		9 10	9 14 14	41	100	SS-5	4.00	3	4	10	29	54	36	19	17	18	A-6b (V)	-	
- color changes to gray at 11 feet		11 12 13	13 17 22	58	56	SS-6	4.5+	-	-	-	-	-	-	-	-	18	A-6b (V)	-	
		14 15	4 7 10	25	83	SS-7	2.50	-	-	-	-	-	-	-	-	14	A-6b (V)	-	
		16 17 18	4 7 12	28	100	SS-8	4.25	-	-	-	-	-	-	-	-	14	A-6b (V)	-	
		19 20 21 22 23	4 6 8	21	100	SS-9	4.25	-	-	-	-	-	-	-	-	14	A-6b (V)	-	
	805.2	EOB 24 25	4 7 8	22	100	SS-10	3.25	-	-	-	-	-	-	-	-	16	A-6b (V)	-	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH BENTONITE GROUT

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. KEIFE	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 760+75, 110' LT.
TYPE: LIGHT TOWER	SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 WB
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 834.9 (MSL) EOB: 25.0 ft.
START: 2/17/26 END: 2/17/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.824741, -84.061553

EXPLORATION ID B-017-0-25

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
TOPSOIL (12")	834.9																		
VERY STIFF TO HARD, BROWN, **CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, DAMP TO MOIST	833.9		2 2 3	7	94	SS-1	2.50	1	1	10	36	52	43	17	26	24	A-7-6 (15)	<100	
	830.9		6 7 9	24	44	SS-2	4.5+	1	4	14	36	45	42	16	26	10	A-7-6 (15)	-	
VERY STIFF TO HARD, BROWN, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP			6 8 8	24	67	SS-3	-	-	-	-	-	-	-	-	-	10	A-6a (V)	-	
HARD, BROWN, **SILT AND CLAY**, TRACE FINE TO COARSE SAND, TRACE GRAVEL, DRY	826.4		14 28 32	89	72	SS-4	4.5+	-	-	-	-	-	-	-	-	11	A-6a (V)	-	
VERY STIFF TO HARD, BROWN, **SILT AND CLAY**, TRACE FINE TO COARSE SAND, TRACE GRAVEL, DAMP			7 16 21	55	78	SS-5	4.5+	-	-	-	-	-	-	-	-	17	A-6a (V)	-	
			22 32 41	108	100	SS-6	4.5+	-	-	-	-	-	-	-	-	16	A-6a (V)	-	
- color changes to gray mottled with brown at 13.5 feet			5 8 11	28	100	SS-7	4.5+	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
	816.4		8 15 21	53	11	SS-8	3.25	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
VERY STIFF, GRAY, **SANDY SILT**, TRACE GRAVEL, MOIST			4 8 11	28	11	SS-9	3.75	3	5	12	39	41	24	14	10	15	A-4a (8)	-	
	809.9	EOB	6 11 14	37	100	SS-10	3.75	-	-	-	-	-	-	-	-	15	A-4a (V)	-	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH BENTONITE GROUT

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINA\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. KEIFE	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 760+96, 228' LT.	EXPLORATION ID B-018-0-25
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 WB	
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 831.6 (MSL) EOB: 7.5 ft.	PAGE 1 OF 1
START: 2/17/26 END: 2/17/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.825065, -84.061478	

MATERIAL DESCRIPTION AND NOTES	ELEV. 831.6	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
CONCRETE (6")	831.1																		
AGGREGATE BASE (4")	830.8																		
HARD, BROWN, **SILT AND CLAY**, SOME FINE TO COARSE SAND, TRACE GRAVEL, DAMP	829.1	1	2 4 7	16	56	SS-1	4.5+	3	5	17	34	41	28	15	13	14	A-6a (9)	<100	
HARD, BROWN, **SILTY CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP TO MOIST		2																	
@4 TO 5.5 FEET, ENCOUNTERED POSSIBLE COBBLES/BOULDER		3	3 7 11	27	50	SS-2	4.5+	3	3	12	30	52	34	18	16	20	A-6b (10)	-	
		4																	
		5	15 20 18	56	0	SS-3	-	-	-	-	-	-	-	-	-	-	A-6b (V)	-	
		6																	
	824.1	7 EOB	19 27 27	80	33	SS-4	4.5+	-	-	-	-	-	-	-	-	17	A-6b (V)	-	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS; POURED QUICKCRETE

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. KEIFE	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 760+96, 441' LT.	EXPLORATION ID B-019-0-25
TYPE: BUILDING	SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 WB	
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 829.4 (MSL) EOB: 20.0 ft.	PAGE 1 OF 1
START: 2/19/26 END: 2/19/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.825651, -84.061485	

MATERIAL DESCRIPTION AND NOTES	ELEV. 829.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
TOPSOIL (10")	828.6																		
VERY STIFF, BROWN, **CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, MOIST	827.4	1	3 3 5	12	100	SS-1	3.50	1	1	12	36	50	46	21	25	22	A-7-6 (15)	-	
VERY STIFF TO HARD, BROWN, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, DAMP		2 3	3 7 7	21	50	SS-2	4.50	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
		4 5	7 7 6	19	100	SS-3	4.5+	-	-	-	-	-	-	-	-	17	A-6a (V)	-	
		6 7	7 12 13	37	22	SS-4	4.5+	-	-	-	-	-	-	-	-	21	A-6a (V)	-	
@8.5 FEET; COLOR CHANGES TO GRAY		8 9	7 11 16	40	78	SS-5	4.50	-	-	-	-	-	-	-	-	18	A-6a (V)	-	
		10 11 12	11 14 16	44	100	SS-6	4.25	-	-	-	-	-	-	-	-	19	A-6a (V)	-	
	815.9	13																	
VERY STIFF TO HARD, GRAY, **SANDY SILT**, TRACE GRAVEL, DAMP		14	5 6 9	22	100	SS-7	4.5+	4	3	13	40	40	26	16	10	13	A-4a (8)	-	
		15 16 17	12 18 18	53	72	SS-8	4.5+	-	-	-	-	-	-	-	-	14	A-4a (V)	-	
		18 19	4 6 8	21	100	SS-9	4.25	-	-	-	-	-	-	-	-	15	A-4a (V)	-	
	809.4	EOB 20																	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH BENTONITE GROUT

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. KEIFE	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 763+16, 319' LT.	EXPLORATION ID B-020-0-25
TYPE: LIGHT TOWER	SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 WB	
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 828.6 (MSL) EOB: 25.0 ft.	PAGE 1 OF 1
START: 2/19/26 END: 2/19/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.825320, -84.060686	

MATERIAL DESCRIPTION AND NOTES	ELEV. 828.6	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
TOPSOIL (11")	827.7																		
HARD, BROWN, **SILTY CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, DAMP	826.6																		
HARD, BROWN, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP		1	4 5 6	16	78	SS-1	4.5+	1	1	12	37	49	39	21	18	20	A-6b (11)	<100	
		2																	
		3	5 6 10	24	78	SS-2	4.5+	-	-	-	-	-	-	-	-	16	A-6a (V)	-	
		4																	
		5	5 8 10	27	56	SS-3	4.5+	-	-	-	-	-	-	-	-	16	A-6a (V)	-	
		6																	
		7	10 10 12	33	83	SS-4	4.5+	-	-	-	-	-	-	-	-	17	A-6a (V)	-	
		8																	
		9	7 11 16	40	72	SS-5	4.5+	-	-	-	-	-	-	-	-	18	A-6a (V)	-	
		10																	
		11	11 18 18	53	100	SS-6	4.5+	-	-	-	-	-	-	-	-	13	A-6a (V)	-	
	815.1	12																	
HARD, GRAY, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP		13																	
		14	7 9 12	31	100	SS-7	4.5+	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
		15																	
		16																	
		17	12 12 15	40	33	SS-8	4.5+	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
	810.1	18																	
VERY STIFF, GRAY, **SANDY SILT**, TRACE GRAVEL, DAMP		19	3 4 7	16	100	SS-9	3.50	4	4	13	36	43	26	16	10	15	A-4a (8)	-	
		20																	
		21																	
		22																	
	805.1	23																	
STIFF, GRAY, **CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP		24	3 4 6	15	100	SS-10	1.75	-	-	-	-	-	-	-	-	22	A-7-6 (V)	-	
	803.6 EOB	25																	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH BENTONITE GROUT

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/12/26 14:34 - C:\USERS\AALHOSAINAT\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING

PROJECT: ALL-US30 REST AREAS (SITE 14)	DRILLING FIRM / OPERATOR: T.C / D. KEIFE	DRILL RIG: MOBILE B-57 (#613)	STATION / OFFSET: 765+82, 120' LT.	EXPLORATION ID B-021-0-25
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: T.C / Z. TAYLOR	HAMMER: MOBILE AUTOMATIC	ALIGNMENT: US-30 WB	
PID: 122869 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/26/25	ELEVATION: 833.6 (MSL) EOB: 7.5 ft.	PAGE 1 OF 1
START: 2/17/26 END: 2/17/26	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.8	LAT / LONG: 40.824779, -84.059719	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
AGGREGATE BASE (8")	833.6 832.9	1	4 4 7	16	67	SS-1	3.75	1	3	13	37	46	41	21	20	21	A-7-6 (12)	-	
VERY STIFF, BROWN, **CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP	831.6	2 3	4 6 11	25	56	SS-2	4.00	-	-	-	-	-	-	-	-	18	A-6a (V)	<100	
VERY STIFF TO HARD, BROWN, **SILT AND CLAY**, LITTLE FINE TO COARSE SAND, TRACE GRAVEL, DAMP		4 5	4 7 9	24	100	SS-3	4.00	3	4	12	33	48	30	17	13	16	A-6a (9)	-	
	826.1	6 7 EOB	14 19 24	64	56	SS-4	4.5+	-	-	-	-	-	-	-	-	16	A-6a (V)	-	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING OR UPON COMPLETION OF DRILLING

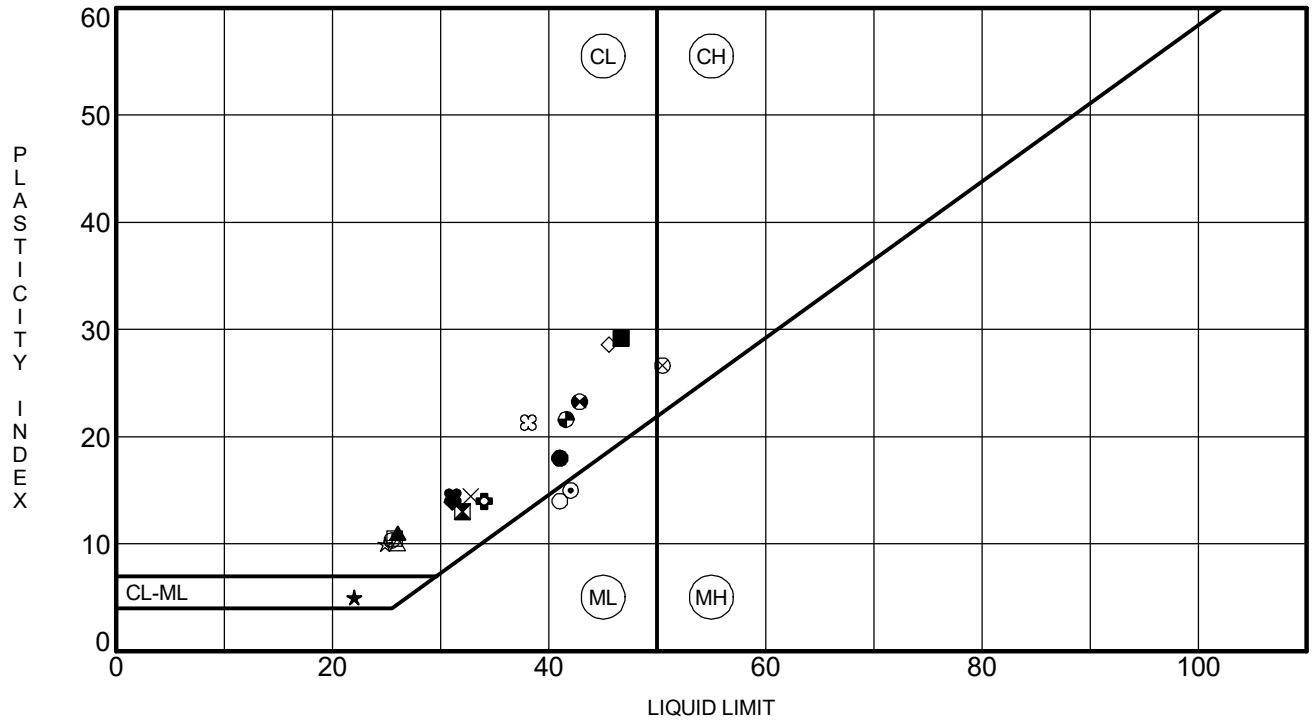
ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS; POURED QUICKCRETE

ATTERBERG LIMITS' RESULTS

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT ALL-US30 REST AREAS (SITE 14) **PID** 122869

OGE NUMBER N4255372 **PROJECT TYPE** ROADWAY



	Specimen Identification		LL	PL	PI	Fines	ODOT (Modified AASHTO) ~ USCS Classification
●	B-001-0-25	0.0	41	23	18	78	A-7-6 ~ LEAN CLAY with SAND(CL)
⊠	B-001-0-25	4.0	32	19	13	63	A-6a ~ SANDY LEAN CLAY with GRAVEL(CL)
▲	B-002-0-25	0.0	26	15	11	52	A-6a ~ SANDY LEAN CLAY(CL)
★	B-002-0-25	2.0	22	17	5	45	A-4a ~ SILTY, CLAYEY SAND(SC-SM)
⊙	B-003-0-25	2.0	42	27	15	71	A-7-6 ~ SILT with SAND(ML)
✿	B-003-0-25	4.0	34	20	14	76	A-6a ~ LEAN CLAY with SAND(CL)
○	B-004-0-25	2.0	41	27	14	66	A-7-6 ~ SANDY SILT(ML)
△	B-004-0-25	13.5	26	16	10	78	A-4a ~ LEAN CLAY with SAND(CL)
⊗	B-005-0-25	0.0	50	24	26	86	A-7-6 ~ FAT CLAY(CH)
⊕	B-005-0-25	11.0	25	15	10	75	A-4a ~ LEAN CLAY with SAND(CL)
□	B-005-0-25	18.5	26	15	11	80	A-6a ~ LEAN CLAY with SAND(CL)
⊛	B-006-0-25	0.0	43	20	23	84	A-7-6 ~ LEAN CLAY with SAND(CL)
◕	B-006-0-25	4.0	42	20	22	84	A-7-6 ~ LEAN CLAY with SAND(CL)
☆	B-006-0-25	13.5	25	15	10	80	A-4a ~ LEAN CLAY with SAND(CL)
⊠	B-007-0-25	2.0	38	17	21	85	A-6b ~ LEAN CLAY with SAND(CL)
■	B-007-0-25	4.0	47	17	30	85	A-7-6 ~ LEAN CLAY(CL)
◆	B-008-0-25	0.0	31	17	14	76	A-6a ~ LEAN CLAY with SAND(CL)
◇	B-008-0-25	2.0	46	17	29	85	A-7-6 ~ LEAN CLAY with SAND(CL)
×	B-009-0-25	1.5	33	18	15	80	A-6a ~ LEAN CLAY with SAND(CL)
✱	B-009-0-25	3.0	31	17	14	76	A-6a ~ LEAN CLAY with SAND(CL)

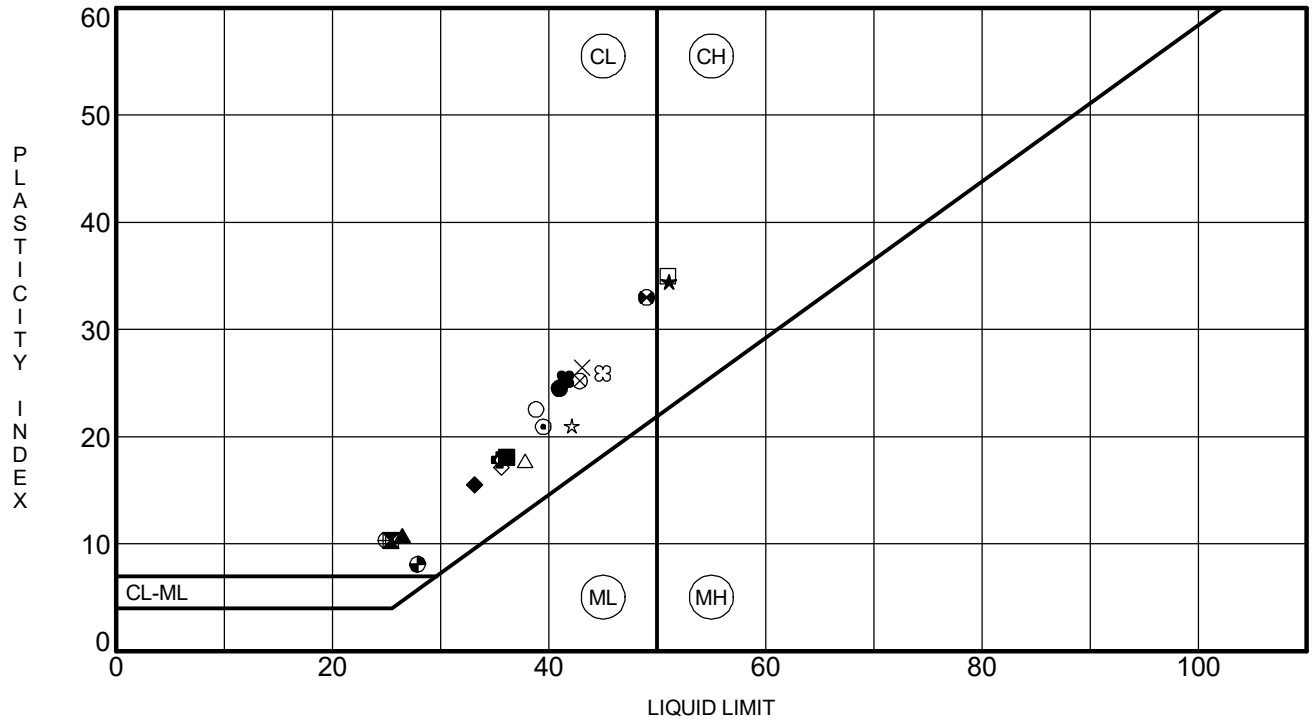
ATTERBERG LIMITS - OH DOT.GDT - 5/12/26 12:55 - C:\USERS\AALHOSAINATIONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING SITE #14 EXPANSION (PID 122869) - GENERAL\07 WORKING FILES\03 MODELS\N4255372 - ALLE

ATTERBERG LIMITS' RESULTS

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT ALL-US30 REST AREAS (SITE 14) **PID** 122869

OGE NUMBER N4255372 **PROJECT TYPE** ROADWAY



	Specimen Identification		LL	PL	PI	Fines	ODOT (Modified AASHTO) ~ USCS Classification
●	B-010-0-25	0.0	41	16	25	83	A-7-6 ~ LEAN CLAY with SAND(CL)
⊠	B-010-0-25	2.0	25	15	10	76	A-4a ~ LEAN CLAY with SAND(CL)
▲	B-010-0-25	18.5	26	16	10	79	A-4a ~ LEAN CLAY with SAND(CL)
★	B-011-0-25	2.0	51	17	34	89	A-7-6 ~ FAT CLAY(CH)
⊙	B-011-0-25	4.0	39	19	20	82	A-6b ~ LEAN CLAY with SAND(CL)
✿	B-012-0-25	0.0	35	18	17	67	A-6b ~ SANDY LEAN CLAY(CL)
○	B-012-0-25	2.0	39	16	23	83	A-6b ~ LEAN CLAY with SAND(CL)
△	B-013-0-25	0.0	38	20	18	80	A-6b ~ LEAN CLAY with SAND(CL)
⊗	B-013-0-25	4.0	43	18	25	85	A-7-6 ~ LEAN CLAY(CL)
⊕	B-013-0-25	13.5	25	15	10	80	A-4a ~ LEAN CLAY with SAND(CL)
□	B-014-0-25	0.0	51	16	35	84	A-7-6 ~ FAT CLAY with SAND(CH)
⊛	B-014-0-25	2.0	49	16	33	86	A-7-6 ~ LEAN CLAY(CL)
◒	B-014-0-25	6.0	28	20	8	92	A-4b ~ LEAN CLAY(CL)
☆	B-015-0-25	0.0	42	21	21	88	A-7-6 ~ LEAN CLAY(CL)
⊠	B-015-0-25	4.0	45	19	26	77	A-7-6 ~ LEAN CLAY with SAND(CL)
■	B-016-0-25	2.0	36	18	18	80	A-6b ~ LEAN CLAY with SAND(CL)
◆	B-016-0-25	4.0	33	18	15	81	A-6a ~ LEAN CLAY with SAND(CL)
◇	B-016-0-25	8.5	36	19	17	83	A-6b ~ LEAN CLAY with SAND(CL)
×	B-017-0-25	0.0	43	17	26	88	A-7-6 ~ LEAN CLAY(CL)
⊠	B-017-0-25	2.0	42	16	26	81	A-7-6 ~ LEAN CLAY with SAND(CL)

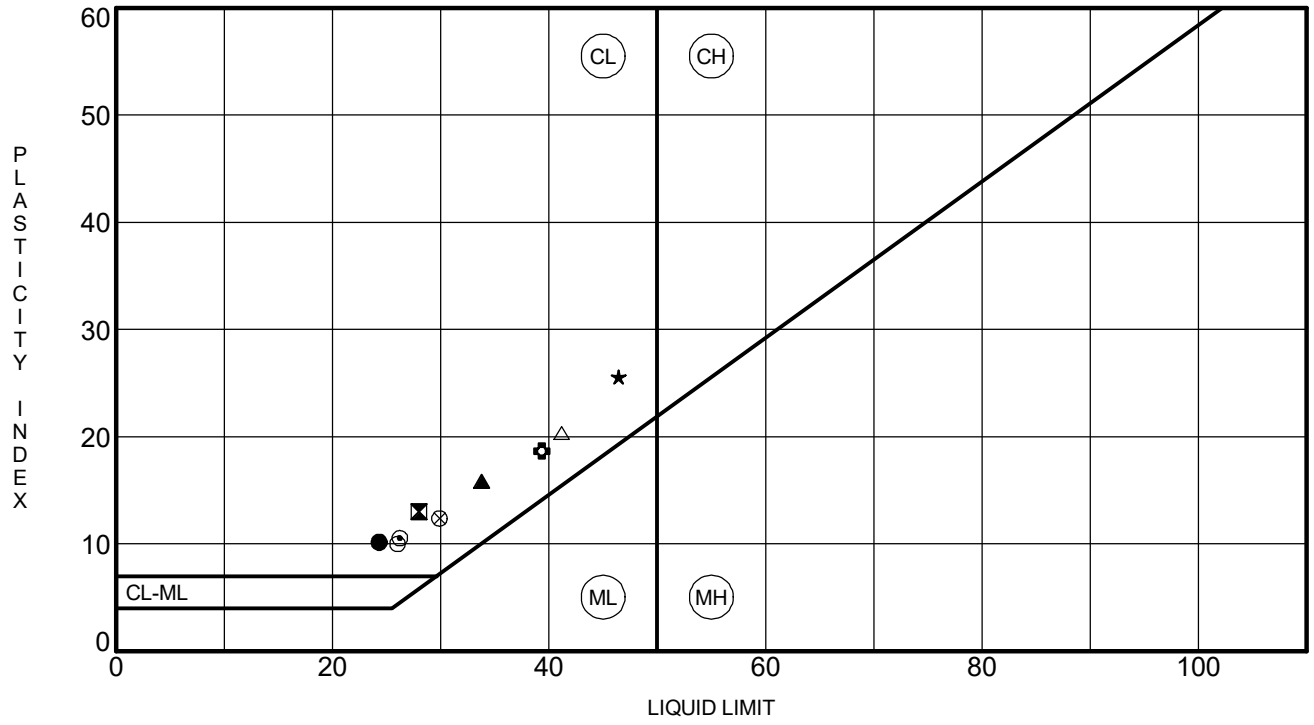
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ATTERBERG LIMITS' RESULTS

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT ALL-US30 REST AREAS (SITE 14) **PID** 122869

OGE NUMBER N4255372 **PROJECT TYPE** ROADWAY



	Specimen Identification		LL	PL	PI	Fines	ODOT (Modified AASHTO) ~ USCS Classification
●	**B-017-0-25**	**18.5**	**24**	**14**	**10**	**80**	**A-4a ~ LEAN CLAY with SAND(CL)**
⊠	**B-018-0-25**	**1.0**	**28**	**15**	**13**	**75**	**A-6a ~ LEAN CLAY with SAND(CL)**
▲	**B-018-0-25**	**2.5**	**34**	**18**	**16**	**82**	**A-6b ~ LEAN CLAY with SAND(CL)**
★	**B-019-0-25**	**0.0**	**46**	**21**	**25**	**86**	**A-7-6 ~ LEAN CLAY(CL)**
⊙	**B-019-0-25**	**13.5**	**26**	**16**	**10**	**80**	**A-4a ~ LEAN CLAY with SAND(CL)**
✿	**B-020-0-25**	**0.0**	**39**	**21**	**18**	**86**	**A-6b ~ LEAN CLAY(CL)**
○	**B-020-0-25**	**18.5**	**26**	**16**	**10**	**79**	**A-4a ~ LEAN CLAY with SAND(CL)**
△	**B-021-0-25**	**0.0**	**41**	**21**	**20**	**83**	**A-7-6 ~ LEAN CLAY with SAND(CL)**
⊗	**B-021-0-25**	**4.0**	**30**	**17**	**13**	**81**	**A-6a ~ LEAN CLAY with SAND(CL)**

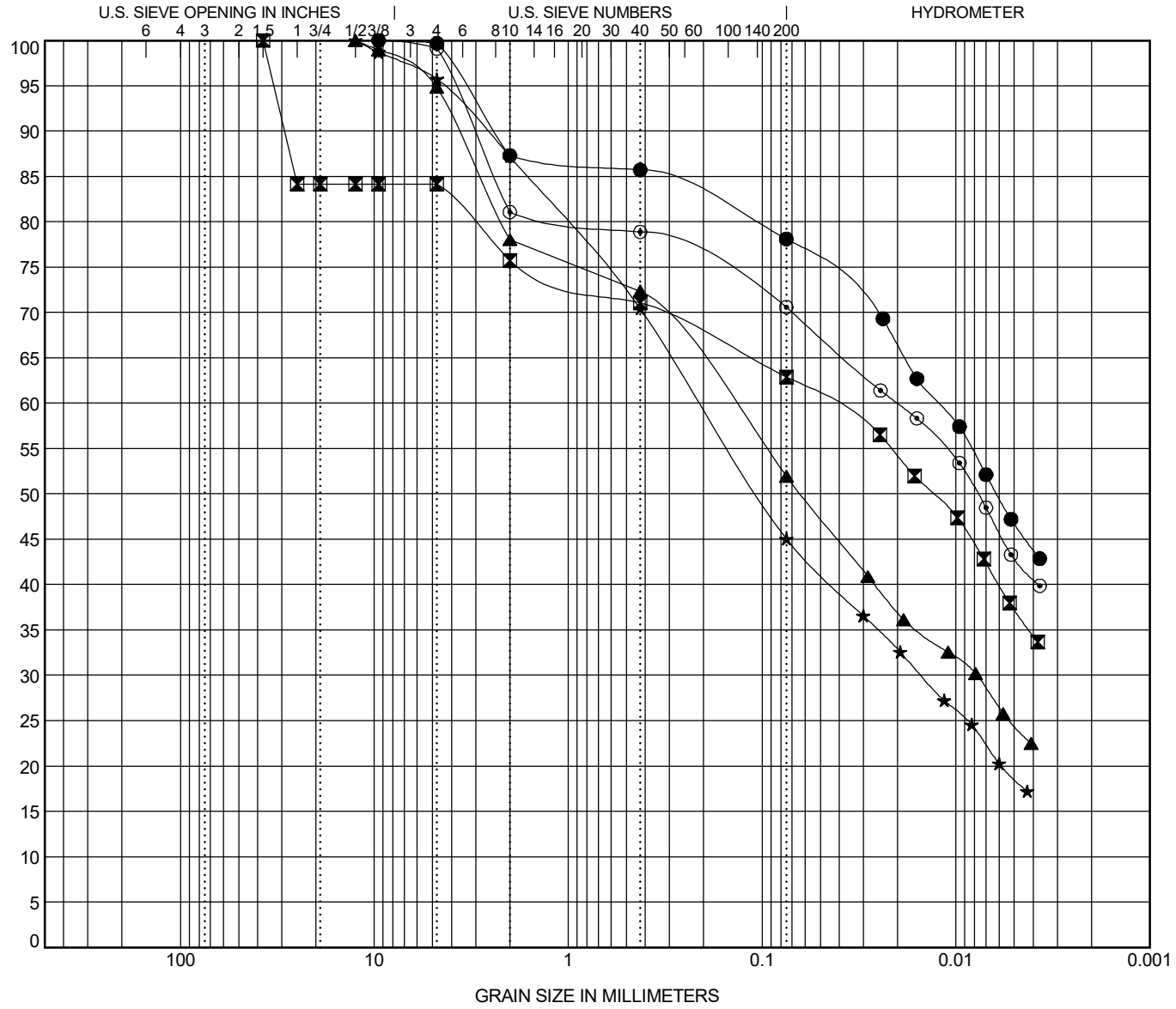
ATTERBERG LIMITS - OH DOT.GDT - 5/12/26 12:55 - C:\USERS\AALHOSAINA\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING SITE #14 EXPANSION (PID 122869) - GENERAL\07 WORKING FILES\03 MODELS\N4255372 - ALL

GRAIN SIZE DISTRIBUTION

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT ALL-US30 REST AREAS (SITE 14) **PID** 122869

OGE NUMBER N4255372 **PROJECT TYPE** ROADWAY



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	B-001-0-25	0.0	**A-7-6 ~ LEAN CLAY with SAND(CL)**	**41**	**23**	**18**
⊠	B-001-0-25	4.0	**A-6a ~ SANDY LEAN CLAY with GRAVEL(CL)**	**32**	**19**	**13**
▲	B-002-0-25	0.0	**A-6a ~ SANDY LEAN CLAY(CL)**	**26**	**15**	**11**
★	B-002-0-25	2.0	**A-4a ~ SILTY, CLAYEY SAND(SC-SM)**	**22**	**17**	**5**
⊙	B-003-0-25	2.0	**A-7-6 ~ SILT with SAND(ML)**	**42**	**27**	**15**

Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	B-001-0-25	0.0	**2.413**	**0.006**			**12**	**2**	**8**	**31**	**47**		
⊠	B-001-0-25	4.0	**29.039**	**0.013**			**24**	**5**	**8**	**26**	**37**		
▲	B-002-0-25	0.0	**3.706**	**0.063**	**0.008**		**22**	**6**	**20**	**28**	**24**		
★	B-002-0-25	2.0	**2.651**	**0.105**	**0.015**		**13**	**17**	**25**	**26**	**19**		
⊙	B-003-0-25	2.0	**3.069**	**0.008**			**19**	**2**	**8**	**28**	**43**		

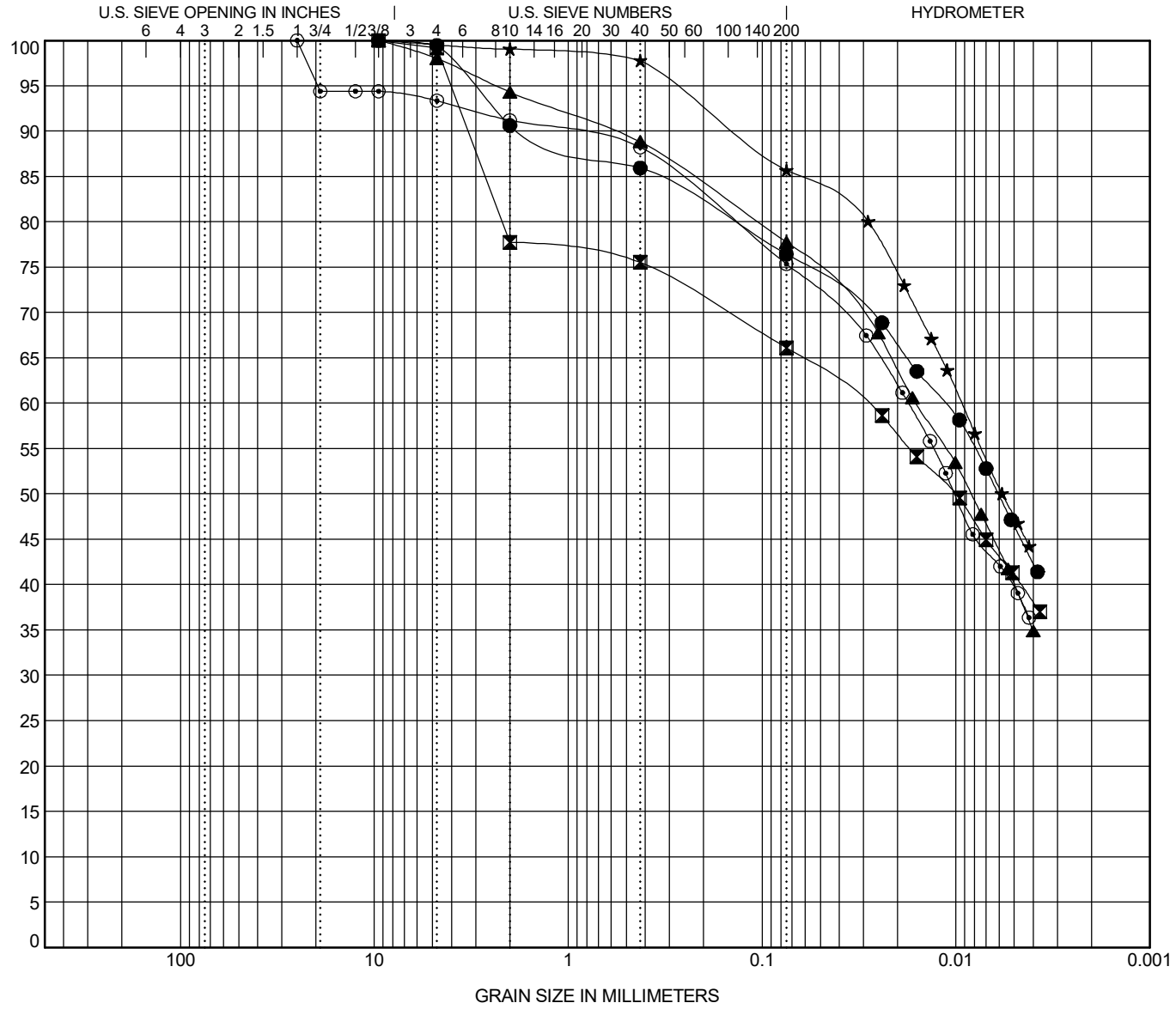
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GRAIN SIZE DISTRIBUTION

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT ALL-US30 REST AREAS (SITE 14) **PID** 122869

OGE NUMBER N4255372 **PROJECT TYPE** ROADWAY



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	B-003-0-25	4.0	**A-6a ~ LEAN CLAY with SAND(CL)**	**34**	**20**	**14**
⊠	B-004-0-25	2.0	**A-7-6 ~ SANDY SILT(ML)**	**41**	**27**	**14**
▲	B-004-0-25	13.5	**A-4a ~ LEAN CLAY with SAND(CL)**	**26**	**16**	**10**
★	B-005-0-25	0.0	**A-7-6 ~ FAT CLAY(CH)**	**50**	**24**	**26**
⊙	B-005-0-25	11.0	**A-4a ~ LEAN CLAY with SAND(CL)**	**25**	**15**	**10**

Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	B-003-0-25	4.0	**1.63**	**0.006**			**9**	**5**	**10**	**30**	**46**		
⊠	B-004-0-25	2.0	**3.278**	**0.01**			**23**	**2**	**9**	**25**	**41**		
▲	B-004-0-25	13.5	**0.592**	**0.008**			**6**	**5**	**11**	**38**	**40**		
★	B-005-0-25	0.0	**0.139**	**0.006**			**1**	**1**	**12**	**39**	**47**		
⊙	B-005-0-25	11.0	**1.074**	**0.01**			**9**	**3**	**13**	**35**	**40**		

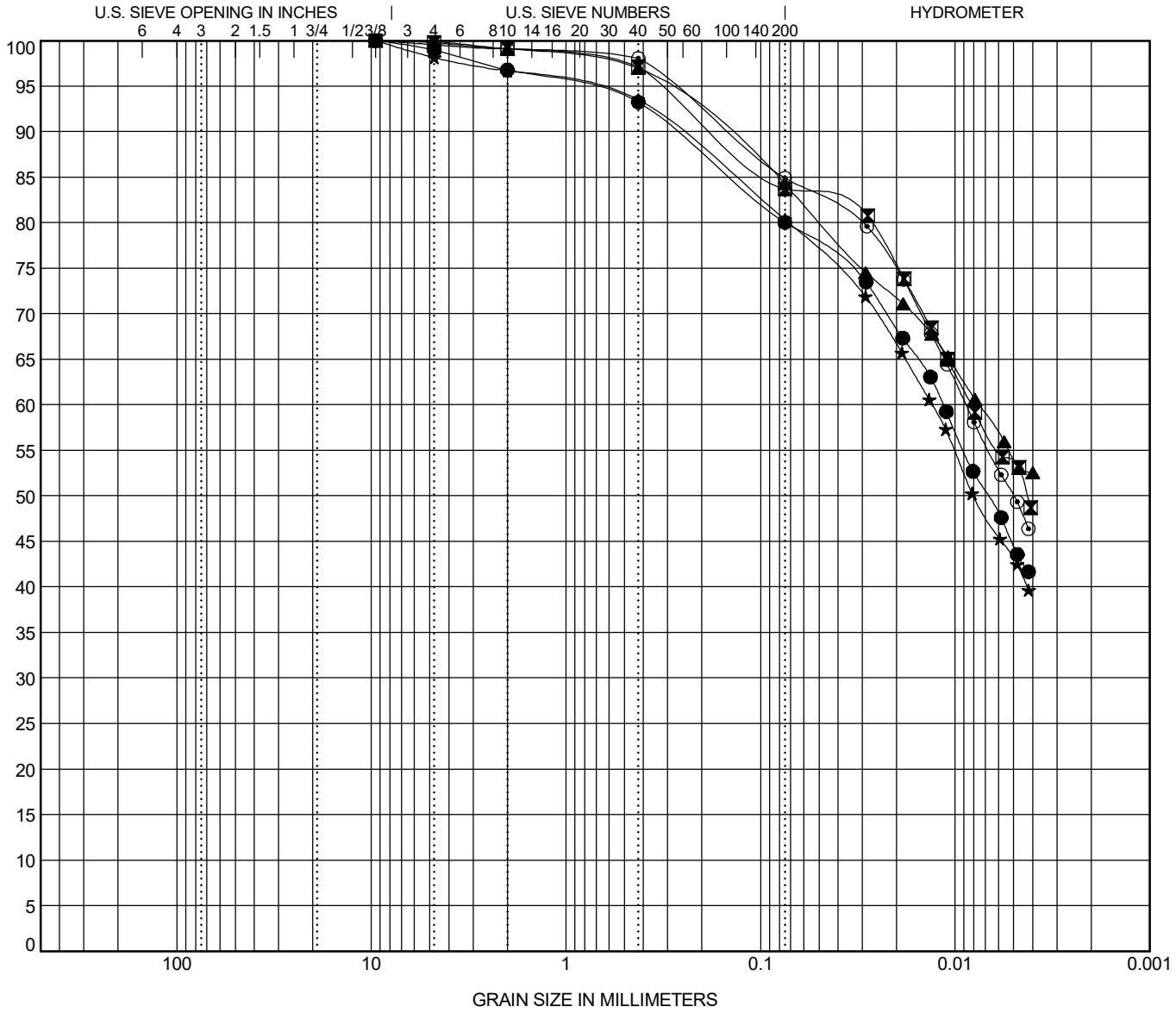
GRAIN SIZE - OH DOT.GDT - 5/12/26 12:56 - C:\USERS\AALHOSAINA\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING SITE #14 EXPANSION (PID 122869) - GENERAL\07 WORKING FILES\03 MODELS\N4255372 - ALLEN COUN

GRAIN SIZE DISTRIBUTION

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OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT ALL-US30 REST AREAS (SITE 14) **PID** 122869

OGE NUMBER N4255372 **PROJECT TYPE** ROADWAY



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	B-005-0-25	18.5	**A-6a ~ LEAN CLAY with SAND(CL)**	**26**	**15**	**11**
⊠	B-006-0-25	0.0	**A-7-6 ~ LEAN CLAY with SAND(CL)**	**43**	**20**	**23**
▲	B-006-0-25	4.0	**A-7-6 ~ LEAN CLAY with SAND(CL)**	**42**	**20**	**22**
★	B-006-0-25	13.5	**A-4a ~ LEAN CLAY with SAND(CL)**	**25**	**15**	**10**
⊙	B-007-0-25	2.0	**A-6b ~ LEAN CLAY with SAND(CL)**	**38**	**17**	**21**

Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	B-005-0-25	18.5	**0.278**	**0.007**			**3**	**4**	**13**	**36**	**44**		
⊠	B-006-0-25	0.0	**0.169**	**0.004**			**1**	**2**	**13**	**30**	**54**		
▲	B-006-0-25	4.0	**0.164**				**1**	**2**	**13**	**30**	**54**		
★	B-006-0-25	13.5	**0.268**	**0.008**			**4**	**3**	**13**	**37**	**43**		
⊙	B-007-0-25	2.0	**0.147**	**0.005**			**1**	**1**	**13**	**35**	**50**		

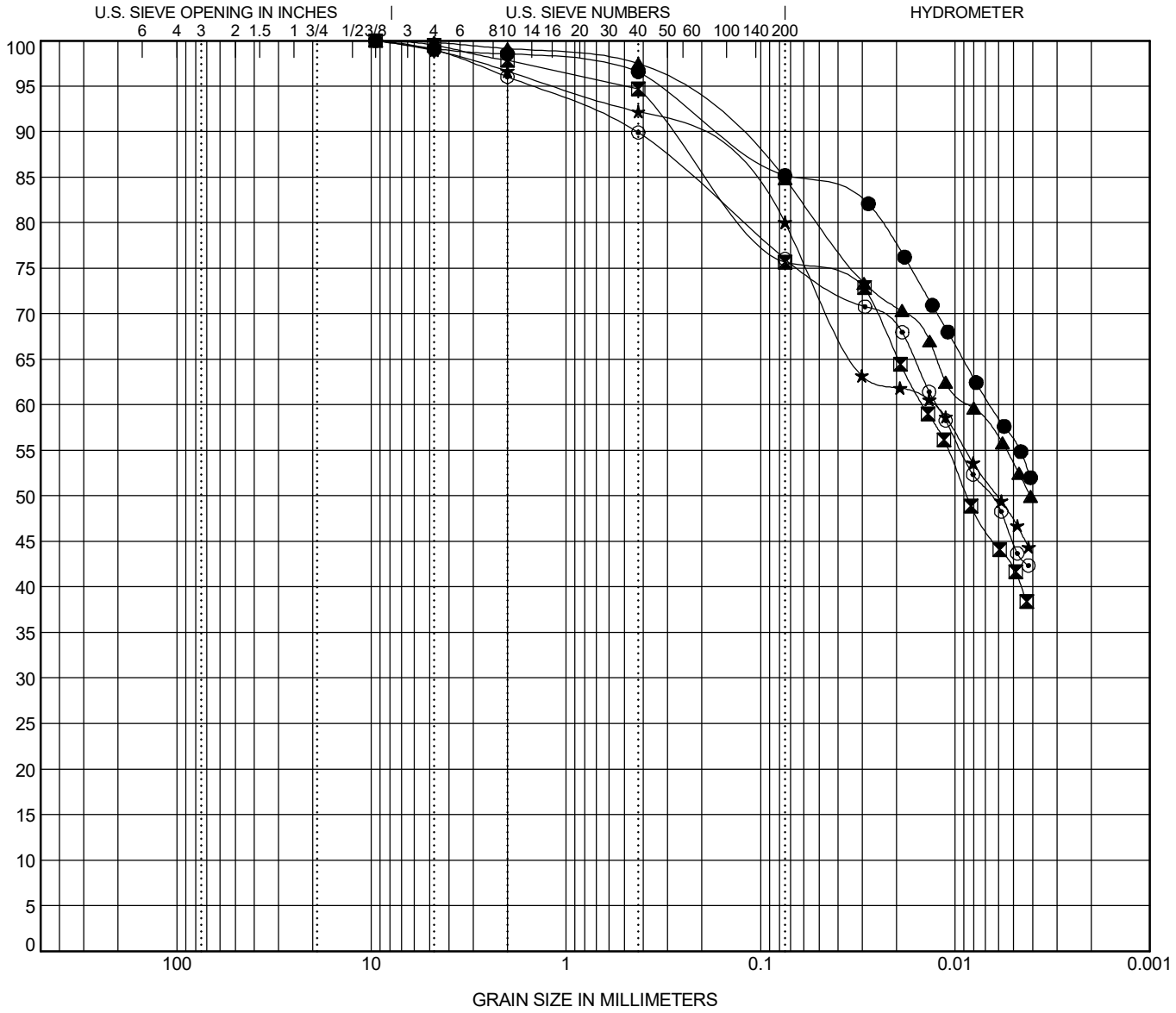
GRAIN SIZE - OH DOT.GDT - 5/12/26 12:56 - C:\USERS\AALHOSAINA\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING SITE #14 EXPANSION (PID 122869) - GENERAL\07 WORKING FILES\03 MODELS\N4255372 - ALLEN COUN

GRAIN SIZE DISTRIBUTION

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT ALL-US30 REST AREAS (SITE 14) **PID** 122869

OGE NUMBER N4255372 **PROJECT TYPE** ROADWAY



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	B-007-0-25	4.0	**A-7-6 ~ LEAN CLAY(CL)**	**47**	**17**	**30**
⊠	B-008-0-25	0.0	**A-6a ~ LEAN CLAY with SAND(CL)**	**31**	**17**	**14**
▲	B-008-0-25	2.0	**A-7-6 ~ LEAN CLAY with SAND(CL)**	**46**	**17**	**29**
★	B-009-0-25	1.5	**A-6a ~ LEAN CLAY with SAND(CL)**	**33**	**18**	**15**
⊙	B-009-0-25	3.0	**A-6a ~ LEAN CLAY with SAND(CL)**	**31**	**17**	**14**

Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	B-007-0-25	4.0	**0.156**				**2**	**2**	**11**	**29**	**56**		
⊠	B-008-0-25	0.0	**0.276**	**0.009**			**2**	**3**	**19**	**34**	**42**		
▲	B-008-0-25	2.0	**0.152**	**0.004**			**0**	**2**	**13**	**31**	**54**		
★	B-009-0-25	1.5	**0.311**	**0.006**			**4**	**4**	**12**	**33**	**47**		
⊙	B-009-0-25	3.0	**0.435**	**0.007**			**4**	**6**	**14**	**31**	**45**		

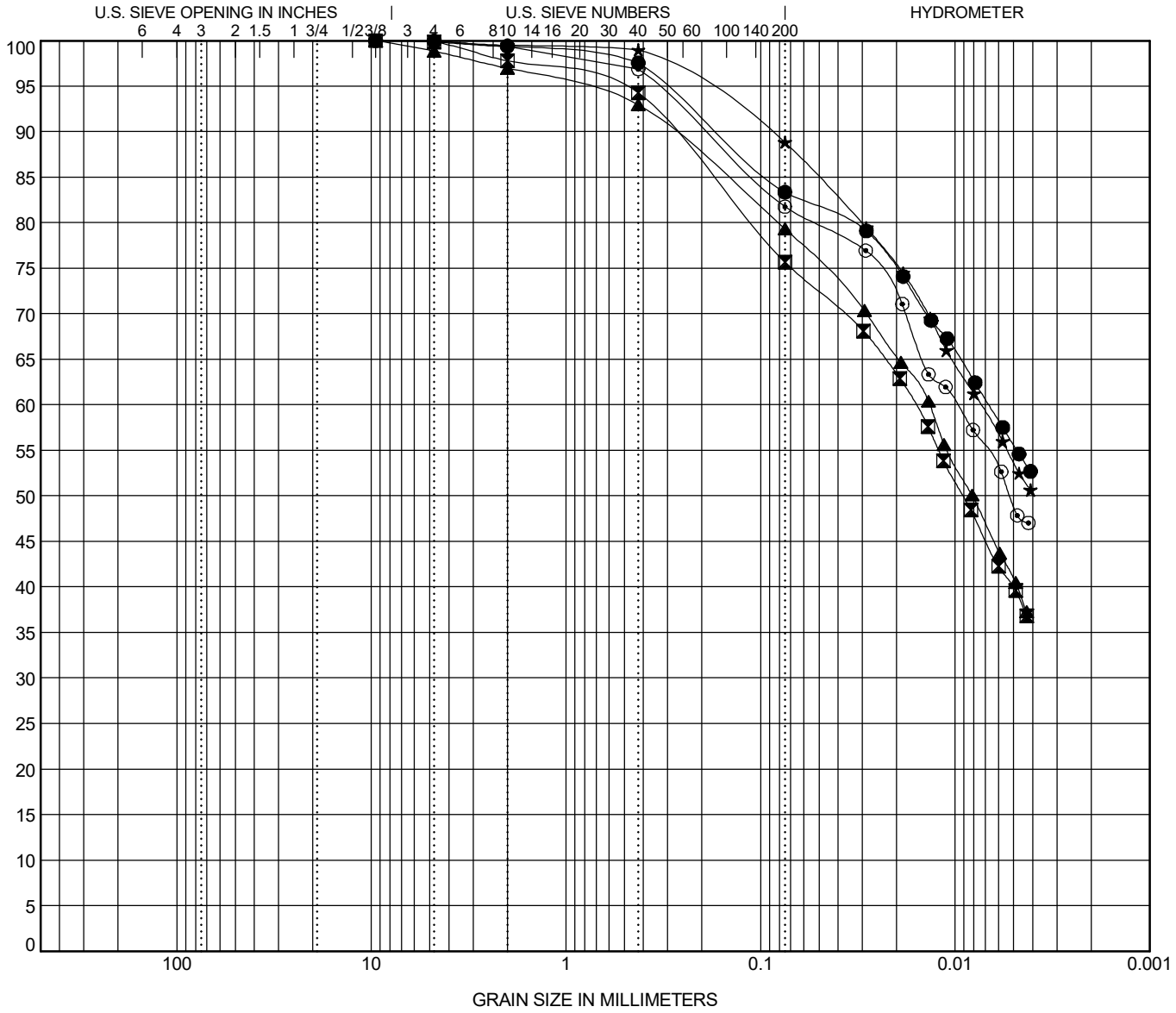
GRAIN SIZE - OH DOT.GDT - 5/12/26 12:56 - C:\USERS\AALHOSAINA\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING SITE #14 EXPANSION (PID 122869) - GENERAL\07 WORKING FILES\03 MODELS\N4255372 - ALLEN COUN

GRAIN SIZE DISTRIBUTION

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT ALL-US30 REST AREAS (SITE 14) **PID** 122869

OGE NUMBER N4255372 **PROJECT TYPE** ROADWAY



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	B-010-0-25	0.0	**A-7-6 ~ LEAN CLAY with SAND(CL)**	**41**	**16**	**25**
⊠	B-010-0-25	2.0	**A-4a ~ LEAN CLAY with SAND(CL)**	**25**	**15**	**10**
▲	B-010-0-25	18.5	**A-4a ~ LEAN CLAY with SAND(CL)**	**26**	**16**	**10**
★	B-011-0-25	2.0	**A-7-6 ~ FAT CLAY(CH)**	**51**	**17**	**34**
⊙	B-011-0-25	4.0	**A-6b ~ LEAN CLAY with SAND(CL)**	**39**	**19**	**20**

Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	B-010-0-25	0.0	**0.169**				**1**	**2**	**14**	**27**	**56**		
⊠	B-010-0-25	2.0	**0.285**	**0.009**			**2**	**3**	**19**	**36**	**40**		
▲	B-010-0-25	18.5	**0.292**	**0.008**			**3**	**4**	**14**	**38**	**41**		
★	B-011-0-25	2.0	**0.091**				**0**	**1**	**10**	**35**	**54**		
⊙	B-011-0-25	4.0	**0.193**	**0.005**			**1**	**2**	**15**	**33**	**49**		

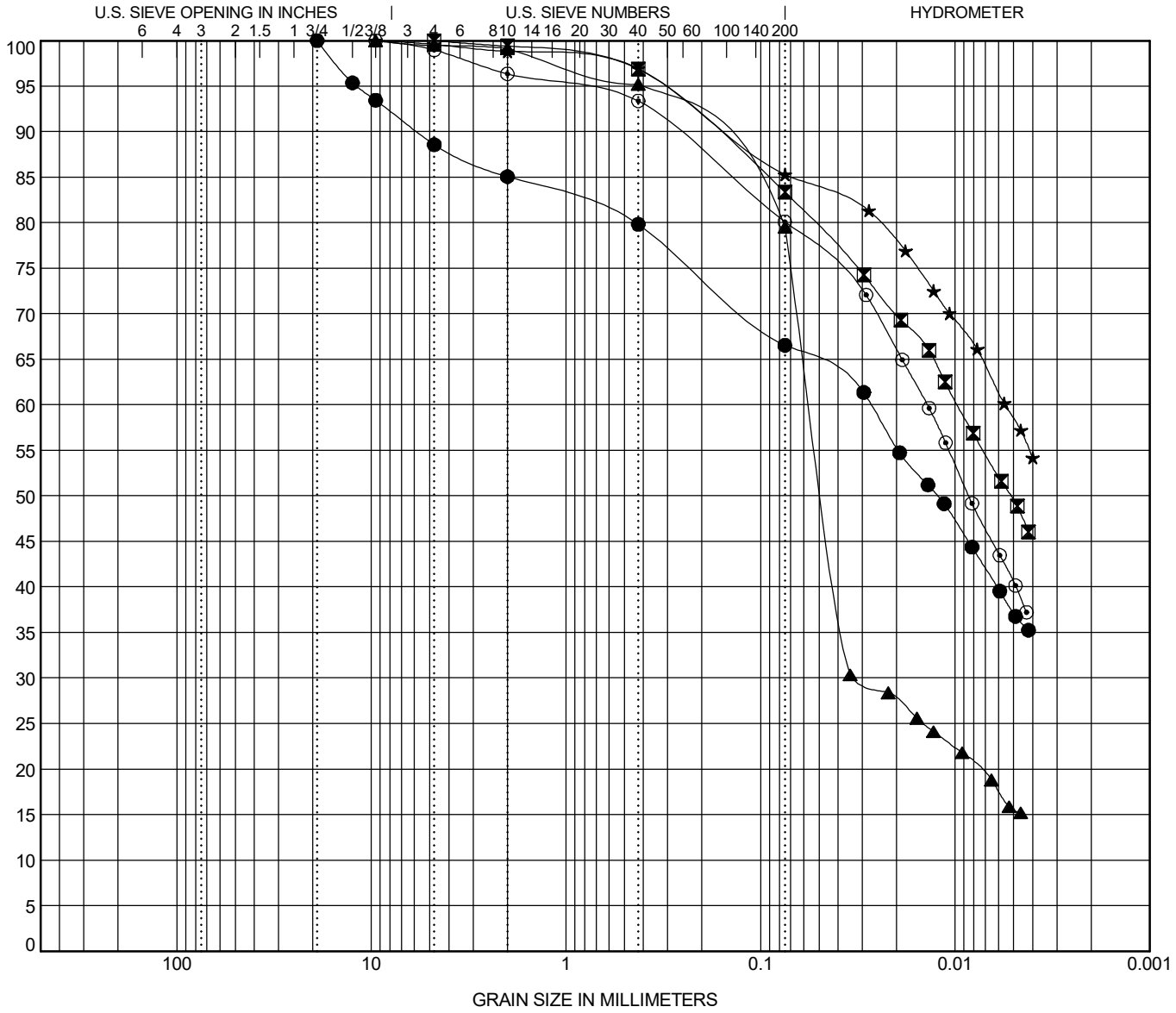
GRAIN SIZE - OH DOT.GDT - 5/12/26 12:56 - C:\USERS\AALHOSAINA\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING SITE #14 EXPANSION (PID 122869) - GENERAL\07 WORKING FILES\03 MODELS\N4255372 - ALLEN COUN

GRAIN SIZE DISTRIBUTION

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT ALL-US30 REST AREAS (SITE 14) **PID** 122869

OGE NUMBER N4255372 **PROJECT TYPE** ROADWAY



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	B-012-0-25	0.0	**A-6b ~ SANDY LEAN CLAY(CL)**	35	18	17
⊠	B-012-0-25	2.0	**A-6b ~ LEAN CLAY with SAND(CL)**	39	16	23
▲	B-013-0-25	0.0	**A-6b ~ LEAN CLAY with SAND(CL)**	38	20	18
★	B-013-0-25	4.0	**A-7-6 ~ LEAN CLAY(CL)**	43	18	25
⊙	B-013-0-25	13.5	**A-4a ~ LEAN CLAY with SAND(CL)**	25	15	10

Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	B-012-0-25	0.0	5.823	0.012			15	5	13	30	37		
⊠	B-012-0-25	2.0	0.176	0.005			0	3	14	34	49		
▲	B-013-0-25	0.0	0.239	0.047	0.032		0	4	16	64	16		
★	B-013-0-25	4.0	0.151				1	2	12	27	58		
⊙	B-013-0-25	13.5	0.273	0.009			4	3	13	39	41		

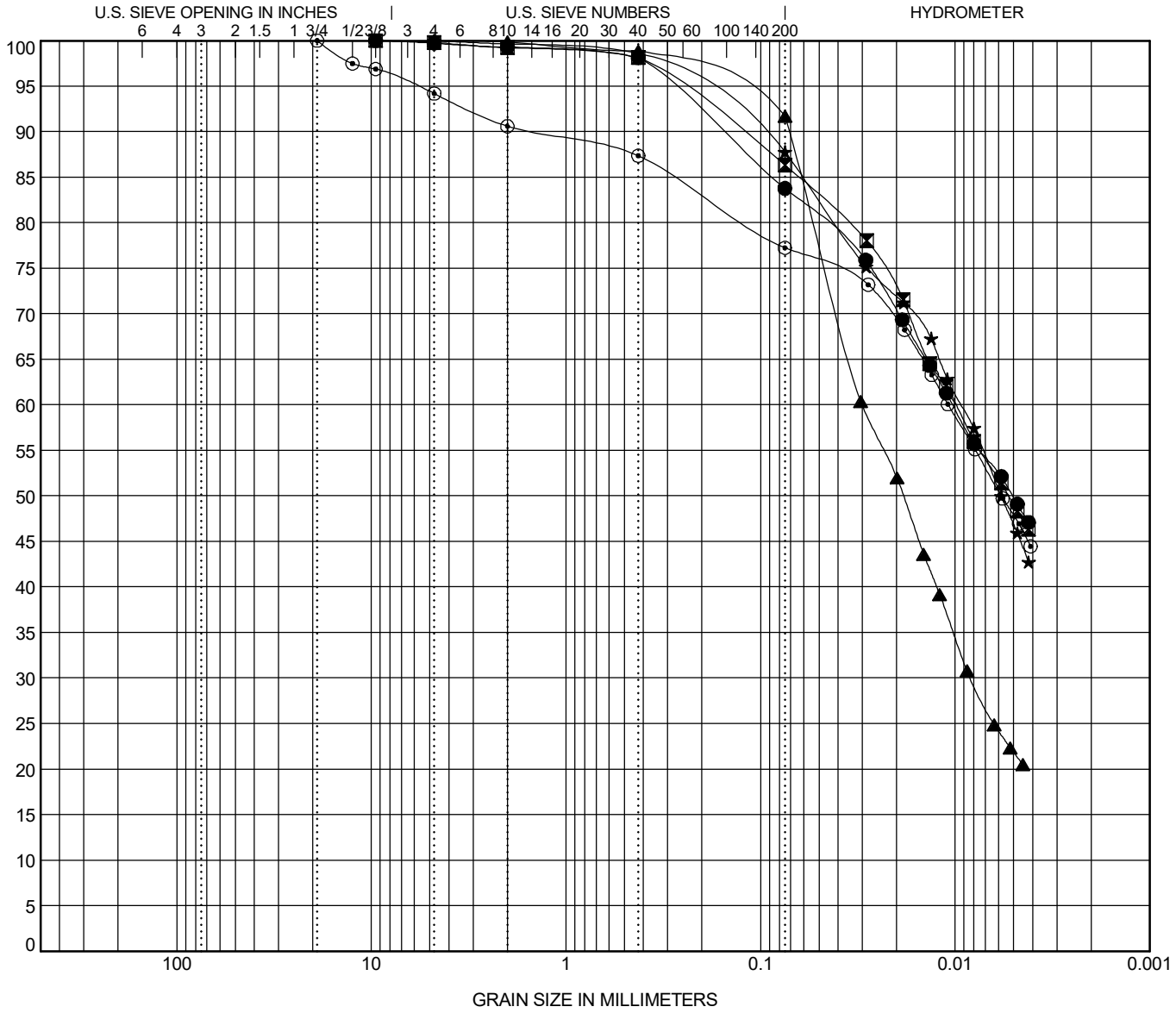
GRAIN SIZE - OH DOT.GDT - 5/12/26 12:56 - C:\USERS\AALHOSAINA\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING SITE #14 EXPANSION (PID 122869) - GENERAL\07 WORKING FILES\03 MODELSIN4255372 - ALLEN COUN

GRAIN SIZE DISTRIBUTION

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT ALL-US30 REST AREAS (SITE 14) **PID** 122869

OGE NUMBER N4255372 **PROJECT TYPE** ROADWAY



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	B-014-0-25	0.0	**A-7-6 ~ FAT CLAY with SAND(CH)**	**51**	**16**	**35**
⊠	B-014-0-25	2.0	**A-7-6 ~ LEAN CLAY(CL)**	**49**	**16**	**33**
▲	B-014-0-25	6.0	**A-4b ~ LEAN CLAY(CL)**	**28**	**20**	**8**
★	B-015-0-25	0.0	**A-7-6 ~ LEAN CLAY(CL)**	**42**	**21**	**21**
⊙	B-015-0-25	4.0	**A-7-6 ~ LEAN CLAY with SAND(CL)**	**45**	**19**	**26**

Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	B-014-0-25	0.0	**0.159**	**0.005**			**1**	**1**	**14**	**34**	**50**		
⊠	B-014-0-25	2.0	**0.129**	**0.005**			**1**	**1**	**12**	**37**	**49**		
▲	B-014-0-25	6.0	**0.071**	**0.018**	**0.008**		**0**	**1**	**7**	**70**	**22**		
★	B-015-0-25	0.0	**0.107**	**0.006**			**0**	**1**	**11**	**41**	**47**		
⊙	B-015-0-25	4.0	**1.506**	**0.006**			**10**	**3**	**10**	**29**	**48**		

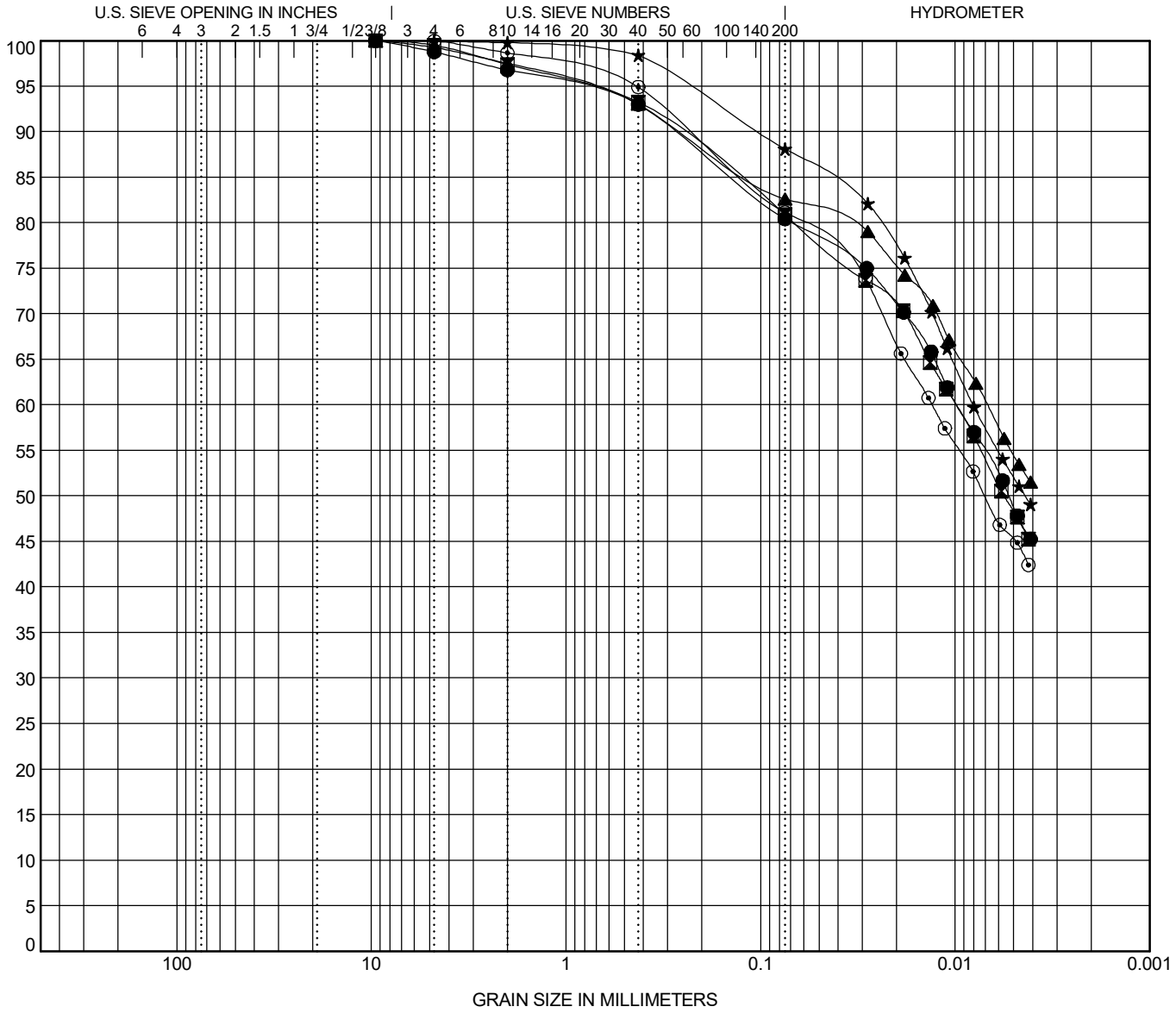
GRAIN SIZE - OH DOT.GDT - 5/12/26 12:56 - C:\USERS\AALHOSAINA\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING SITE #14 EXPANSION (PID 122869) - GENERAL\07 WORKING FILES\03 MODELSIN4255372 - ALLEN COUN

GRAIN SIZE DISTRIBUTION

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT ALL-US30 REST AREAS (SITE 14) **PID** 122869

OGE NUMBER N4255372 **PROJECT TYPE** ROADWAY



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	B-016-0-25	2.0	**A-6b ~ LEAN CLAY with SAND(CL)**	**36**	**18**	**18**
⊠	B-016-0-25	4.0	**A-6a ~ LEAN CLAY with SAND(CL)**	**33**	**18**	**15**
▲	B-016-0-25	8.5	**A-6b ~ LEAN CLAY with SAND(CL)**	**36**	**19**	**17**
★	B-017-0-25	0.0	**A-7-6 ~ LEAN CLAY(CL)**	**43**	**17**	**26**
⊙	B-017-0-25	2.0	**A-7-6 ~ LEAN CLAY with SAND(CL)**	**42**	**16**	**26**

Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	B-016-0-25	2.0	**0.281**	**0.005**			**3**	**4**	**13**	**31**	**49**		
⊠	B-016-0-25	4.0	**0.269**	**0.006**			**3**	**4**	**12**	**33**	**48**		
▲	B-016-0-25	8.5	**0.257**				**3**	**4**	**10**	**29**	**54**		
★	B-017-0-25	0.0	**0.103**	**0.004**			**1**	**1**	**10**	**36**	**52**		
⊙	B-017-0-25	2.0	**0.229**	**0.007**			**1**	**4**	**14**	**36**	**45**		

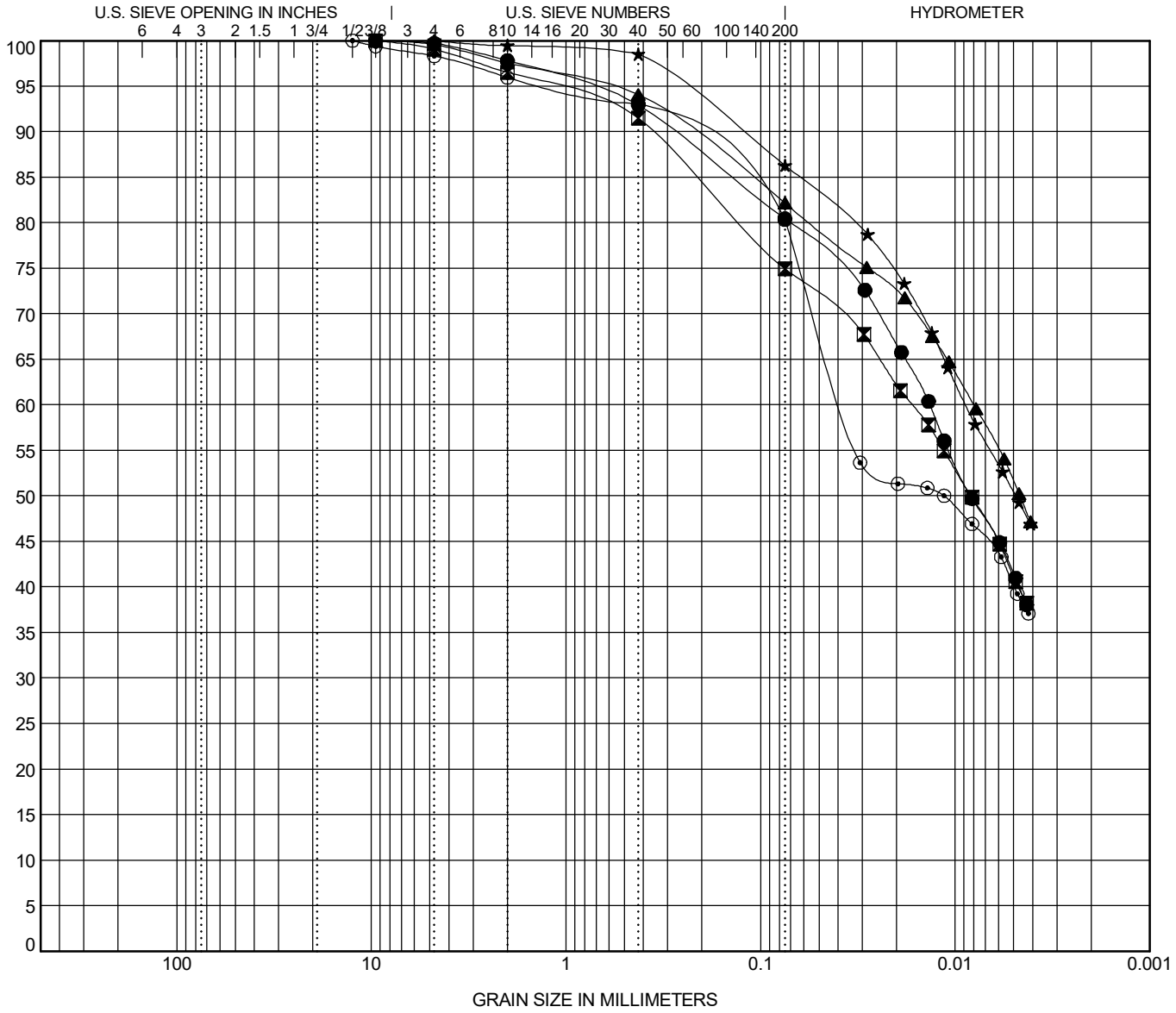
GRAIN SIZE - OH DOT.GDT - 5/12/26 12:56 - C:\USERS\AALHOSAINA\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING SITE #14 EXPANSION (PID 122869) - GENERAL\07 WORKING FILES\03 MODELS\N4255372 - ALLEN COUN

GRAIN SIZE DISTRIBUTION

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT ALL-US30 REST AREAS (SITE 14) **PID** 122869

OGE NUMBER N4255372 **PROJECT TYPE** ROADWAY



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	B-017-0-25	18.5	**A-4a ~ LEAN CLAY with SAND(CL)**	**24**	**14**	**10**
⊠	B-018-0-25	1.0	**A-6a ~ LEAN CLAY with SAND(CL)**	**28**	**15**	**13**
▲	B-018-0-25	2.5	**A-6b ~ LEAN CLAY with SAND(CL)**	**34**	**18**	**16**
★	B-019-0-25	0.0	**A-7-6 ~ LEAN CLAY(CL)**	**46**	**21**	**25**
⊙	B-019-0-25	13.5	**A-4a ~ LEAN CLAY with SAND(CL)**	**26**	**16**	**10**

Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	B-017-0-25	18.5	**0.283**	**0.008**			**3**	**5**	**12**	**39**	**41**		
⊠	B-018-0-25	1.0	**0.364**	**0.008**			**3**	**5**	**17**	**34**	**41**		
▲	B-018-0-25	2.5	**0.234**	**0.005**			**3**	**3**	**12**	**30**	**52**		
★	B-019-0-25	0.0	**0.127**	**0.005**			**1**	**1**	**12**	**36**	**50**		
⊙	B-019-0-25	13.5	**0.278**	**0.011**			**4**	**3**	**13**	**40**	**40**		

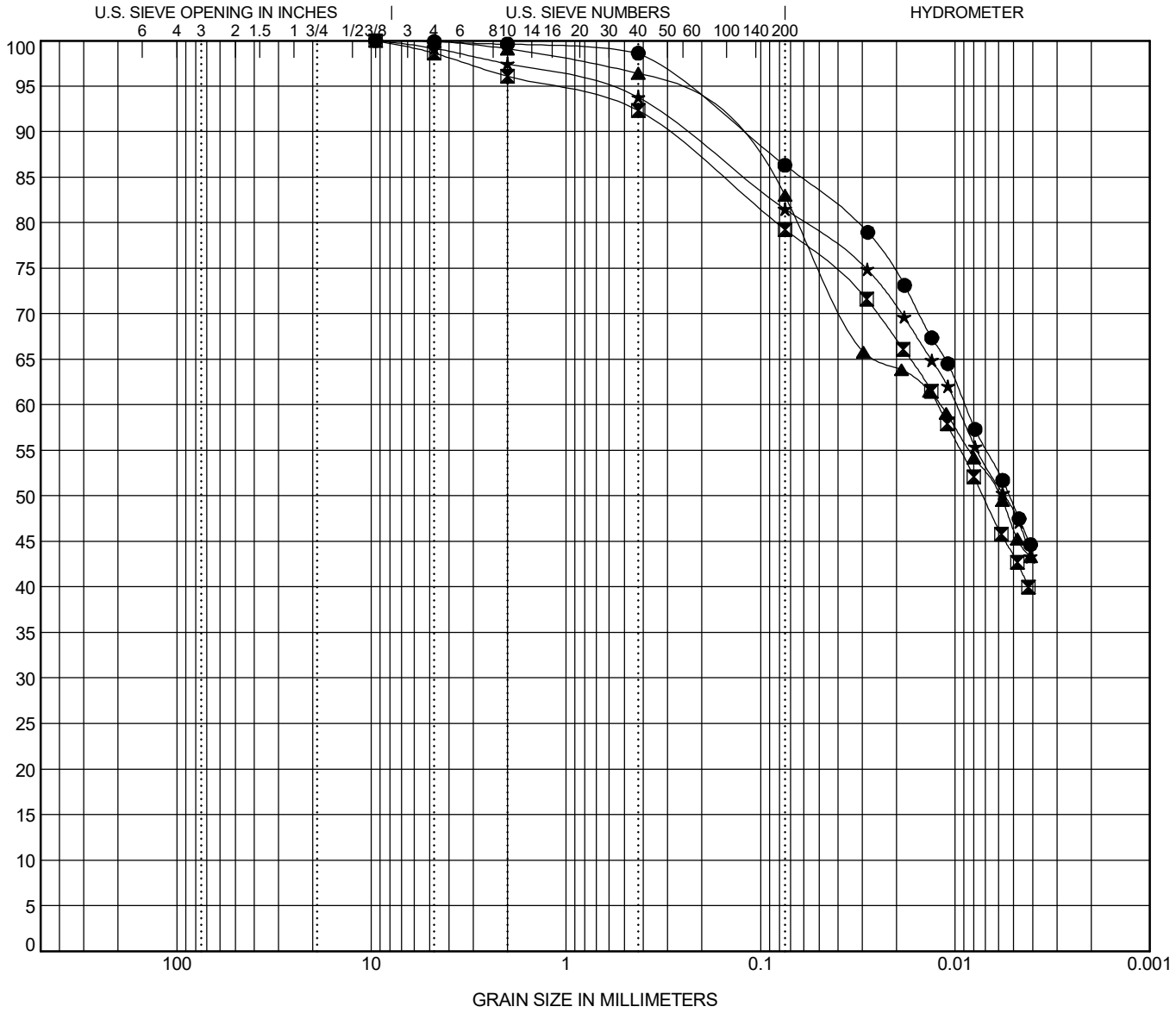
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GRAIN SIZE DISTRIBUTION

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT ALL-US30 REST AREAS (SITE 14) **PID** 122869

OGE NUMBER N4255372 **PROJECT TYPE** ROADWAY



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

	Specimen Identification		ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	B-020-0-25	0.0	A-6b ~ LEAN CLAY(CL)	39	21	18
⊠	B-020-0-25	18.5	A-4a ~ LEAN CLAY with SAND(CL)	26	16	10
▲	B-021-0-25	0.0	A-7-6 ~ LEAN CLAY with SAND(CL)	41	21	20
★	B-021-0-25	4.0	A-6a ~ LEAN CLAY with SAND(CL)	30	17	13

	Specimen Identification		D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	B-020-0-25	0.0	0.126	0.005			1	1	12	37	49		
⊠	B-020-0-25	18.5	0.313	0.007			4	4	13	36	43		
▲	B-021-0-25	0.0	0.185	0.006			1	3	13	37	46		
★	B-021-0-25	4.0	0.249	0.006			3	4	12	33	48		

GRAIN SIZE - OH DOT.GDT - 5/12/26 12:57 - C:\USERS\AALHOSAINA\ONEDRIVE - TERRACON CONSULTANTS INC\N4255372 ALLEN COUNTY TRUCK PARKING SITE #14 EXPANSION (PID 122869) - GENERAL\07 WORKING FILES\03 MODELSIN4255372 - ALLEN COUN

611 Lunken Park Dr.
Cincinnati, OH 45226-1813
513-321-5816

Client

Gannett Fleming TranSystems
8890 Lyra Dr Ste 110
Columbus, OH 43240

Project

Allen County Truck Parking Site #14 Expansion (PID 122869)
US-30
Lima, OH 45807

Project No. N4255372

SUPPLEMENT 1122
DETERMINING SULFATE CONTENT IN SOILS

Sample Type:	Bag
Tested Performed By:	Keoki Buell
Date Tested:	3/13/26-4/20/2026

Lab Number	Hole Number	ODOT Classification	Sample Depth	Sulfate Concentration, ppm
954	B-005	A-7-6	2.0-3.5	<100
955	B-006	Topsoil/A-7-6	0.0-1.5	<100
956	B-007	Topsoil/A-6B	0.0-1.5	<100
957	B-008	A-7-6	2.0-3.5	<100
958	B-009	Topsoil/A-6A	0.0-1.5	<100
959	B-010	A-4A	2.0-3.5	<100
960	B-011	Topsoil/A-7-6	0.0-1.5	<100
961	B-012	A-6B	2.0-3.5	<100
962	B-013	A-6B	2.0-3.5	<100
963	B-014	Topsoil/A-7-6	0.0-1.5	<100*
964	B-015	A-7-6	2.0-3.5	<100
965	B-016	Topsoil/A-6B	0.0-1.5	<100
966	B-017	Topsoil/A-7-6	0.0-1.5	<100*
967	B-018	A-6A	1.0-2.5	<100*
968	B-020	Topsoil/A-6B	0.0-1.5	<100
969	B-021	A-6A	2.0-3.5	<100

Equipment Used
Chemetrics Sulfate Vacu-vials Kit
Chemetrics V-2000 Photometer
Note: Readings shown on the device were "Under range", indicating a concentration of < 100 ppm. A star (*) next to the reading indicates that only two trials were performed due to limited amount of sample.

Client

Gannett Fleming TranSystems
8890 Lyra Dr Ste 110
Columbus, OH 43240

Project

Allen County Truck Parking Site #14 Expansion (PID 122869)
US-30
Lima, OH 45807

Project No. N4255372

SUPPLEMENT 1122
DETERMINING SULFATE CONTENT IN SOILS

Sample Type:	Split Spoon
Soaking Time (hrs)	24 hours
Dilution Ratio:	1:20
Test Performed By:	Keoki Buell
Date Tested:	5/10/2026-5/11/2026

Lab Number	Boring	Depth	ODOT Classification	Sulfate Concentration, ppm
1745	B-001	2.0-3.5	A-7-6	<100
1746	B-002	0.0-1.5	A-6A/Topsoil	<100
1747	B-003	1.5	A-7-6	<100

Equipment Used
Chemetrics Sulfate Vacu-vials Kit
Chemetrics V-2000 Photometer
Note: Readings shown on the device were "Under range", indicating a concentration of < 100 ppm.

Subgrade Analysis

Contents:

Subgrade Analysis (13 pages)

Note: All attachments are one page unless noted above.

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Design Manual Section 600

ALL-US30 Rest Areas TP (Site #14)
122869

Construction of truck parking at ALL-US30 EB & WB rest areas (Site #14). Development will be completed under PID 122863

Terracon Consultants, Inc.

Prepared By: Ahmad Al-Hosainat, Ph.D.
Date prepared: Wednesday, April 15, 2026

Ahmad Al-Hosainat
800 Morrison Road
Columbus
Ohio 43230
614-328-1195
Ahmad.Al-Hosainat@terracon.com

NO. OF BORINGS: 19

NO. OF DCPS: 0

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.81 7/21/2025

Add DCP Test Data Worksheets

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-001-0-25	US 30 EB	751+38	482	Rt	Mobile B-57 (#613)	89	830.3	829.3	1.0 C
2	B-002-0-25	US 30 EB	751+62	273	Rt	Mobile B-57 (#613)	89	828.3	827.3	1.0 C
3	B-003-0-25	US 30 EB	753+69	477	Rt	Mobile B-57 (#613)	89	831.5	830.5	1.0 C
4	B-005-0-25	US 30 EB	754+04	222	Rt	Mobile B-57 (#613)	89	828.7	827.7	1.0 C
5	B-006-0-25	US 30 EB	755+64	383	Rt	Mobile B-57 (#613)	89	830.1	829.1	1.0 C
6	B-007-0-25	US 30 EB	756+82	238	Rt	Mobile B-57 (#613)	89	831.0	830.0	1.0 C
7	B-008-0-25	US 30 EB	756+71	131	Rt	Mobile B-57 (#613)	89	831.4	830.4	1.0 C
8	B-009-0-25	US 30 EB	759+35	274	Rt	Mobile B-57 (#613)	89	837.2	836.2	1.0 C
9	B-010-0-25	US 30 EB	759+42	138	Rt	Mobile B-57 (#613)	89	837.4	836.4	1.0 C
10	B-011-0-25	US 30 EB	761+68	159	Rt	Mobile B-57 (#613)	89	835.8	834.8	1.0 C
11	B-012-0-25	US 30 WB	754+82	125	Lt	Mobile B-57 (#613)	89	829.4	828.4	1.0 C
12	B-013-0-25	US 30 WB	757+81	136	Lt	Mobile B-57 (#613)	89	831.5	830.5	1.0 C
13	B-014-0-25	US 30 WB	758+18	465	Lt	Mobile B-57 (#613)	89	827.5	826.5	1.0 C
14	B-015-0-25	US 30 WB	758+21	338	Lt	Mobile B-57 (#613)	89	828.6	827.6	1.0 C
15	B-016-0-25	US 30 WB	759+93	381	Lt	Mobile B-57 (#613)	89	830.2	829.2	1.0 C
16	B-017-0-25	US 30 WB	760+75	110	Lt	Mobile B-57 (#613)	89	834.9	833.9	1.0 C
17	B-018-0-25	US 30 WB	760+96	228	Lt	Mobile B-57 (#613)	89	831.6	830.6	1.0 C
18	B-020-0-25	US 30 WB	763+16	319	Lt	Mobile B-57 (#613)	89	828.6	827.6	1.0 C
19	B-021-0-25	US 30 WB	765+82	120	Lt	Mobile B-57 (#613)	89	833.6	832.6	1.0 C

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.81 7/21/2025

Add DCP Test Data Worksheets

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.81 7/21/2025

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	1	0.0	1.5	-1.0	0.5	10		3								14	A-6a	10			N_{60}		12"	12"
	001-0	2	2.0	3.5	1.0	2.5	27		4								14	A-6a	10						204 Geotextile
	25	3	4.0	5.5	3.0	4.5	37		4.5								14	A-6a	10						
		4	6.0	7.5	5.0	6.5	62	10	4.5								14	A-6a	10						
2	B	1	0.0	1.5	-1.0	0.5	10		3								18	A-7-6	16			N_{60}		12"	12"
	002-0	2	2.0	3.5	1.0	2.5	13		2								14	A-6a	10						204 Geotextile
	25	3	4.5	6.0	3.5	5.0	10		1.5								14	A-6a	10						
		4	6.0	7.5	5.0	6.5	21	10	2.5								14	A-6a	10						
3	B	1	0.0	1.5	-1.0	0.5	10		2.5								14	A-6a	10			N_{60}		12"	12"
	003-0	2	2.0	3.5	1.0	2.5	16		4.5								14	A-6a	10						204 Geotextile
	25	3	4.0	5.5	3.0	4.5	28		4.5								14	A-6a	10						
		4	6.0	7.5	5.0	6.5	56	10	4.5								14	A-6a	10						
4	B	1	0.0	1.5	-1.0	0.5	12		2.25	50	24	26	39	47	86	25	21	A-7-6	16			N_{60} & Mc		12"	12"
	005-0	2	2.0	3.5	1.0	2.5	30		4.5							16	18	A-7-6	16						204 Geotextile
	25	3	4.0	5.5	3.0	4.5	16		4.5							15	14	A-6a	10						
		4	6.0	7.5	5.0	6.5	19	12	4.5							17	14	A-6a	10						
5	B	1	0.0	1.5	-1.0	0.5	12		3.25	43	20	23	30	54	84	22	18	A-7-6	14			N_{60} & Mc		12"	12"
	006-0	2	2.0	3.5	1.0	2.5	16		3.75							21	18	A-7-6	16			Mc			204 Geotextile
	25	3	4.0	5.5	3.0	4.5	24		4.5	42	20	22	30	54	84	14	18	A-7-6	13						
		4	6.0	7.5	5.0	6.5	30	12	4.5							16	18	A-7-6	16						
6	B	1	0.0	1.5	-1.0	0.5	12		3.5							43	16	A-6b	16			N_{60} & Mc		12"	12"
	007-0	2	2.0	3.5	1.0	2.5	15		3.75	38	17	21	35	50	85	20	16	A-6b	12			Mc			204 Geotextile
	25	3	4.0	5.5	3.0	4.5	18		3.5	47	17	30	29	56	85	24	18	A-7-6	17						
		4	6.0	7.5	5.0	6.5	25	12	3.75							23	18	A-7-6	16						
7	B	1	0.0	1.5	-1.0	0.5	15		4	31	17	14	34	42	76	17	14	A-6a	10			Mc			12"
	008-0	2	2.0	3.5	1.0	2.5	19		4.5	46	17	29	31	54	85	18	18	A-7-6	17						204 Geotextile
	25	3	4.0	5.5	3.0	4.5	21		4.5							15	14	A-6a	10						
		4	6.0	7.5	5.0	6.5	38	15	4.5							15	14	A-6a	10						
8	B	1	0.0	1.5	-1.0	0.5	18		4.5							17	14	A-6a	10			Mc			12"
	009-0	2	1.5	3.0	0.5	2.0	18		3	33	18	15	33	47	80	18	14	A-6a	10			Mc			204 Geotextile
	25	3	3.0	4.5	2.0	3.5	21		4.5	31	17	14	31	45	76	15	14	A-6a	10						
		4	4.5	6.0	3.5	5.0	21	18	4							16	14	A-6a	10						
9	B	1	0.0	1.5	-1.0	0.5	18		4	41	16	25	27	56	83	22	18	A-7-6	14			Mc			12"
	010-0	2	2.0	3.5	1.0	2.5	44		-	25	15	10	36	40	76	10	10	A-4a	8						204 Geotextile
	25	3	4.0	5.5	3.0	4.5	87		-							7	10	A-4a	8						

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.81 7/21/2025

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
		4	6.0	7.5	5.0	6.5	104	18	4.5							14	10	A-4a	8						
10	B	1	0.0	1.5	-1.0	0.5	13		4.5							18	18	A-7-6	16						12"
	011-0	2	2.0	3.5	1.0	2.5	18		3.5	51	17	34	35	54	89	20	18	A-7-6	18						204 Geotextile
	25	3	4.0	5.5	3.0	4.5	18		3.75	39	19	20	33	49	82	21	16	A-6b	12						
		4	6.0	7.5	5.0	6.5	27	13	2.5							21	16	A-6b	16						
11	B	1	0.0	1.5	-1.0	0.5	13		3.25	35	18	17	30	37	67	17	16	A-6b	9						12"
	012-0	2	2.0	3.5	1.0	2.5	13		2	39	16	23	34	49	83	18	16	A-6b	13						204 Geotextile
	25	3	4.0	5.5	3.0	4.5	9		2							34	16	A-6b	16						
		4	6.0	7.5	5.0	6.5	16	9	2							24	16	A-6b	16						
12	B	1	0.0	1.5	-1.0	0.5	12		2.75	38	20	18	64	16	80	22	16	A-6b	11			N_{60} & Mc		12"	12"
	013-0	2	2.0	3.5	1.0	2.5	19		3.5							22	16	A-6b	16			Mc			204 Geotextile
	25	3	4.0	5.5	3.0	4.5	13		4.25	43	18	25	27	58	85	21	18	A-7-6	15						
		4	6.0	7.5	5.0	6.5	34	12	4.5							17	18	A-7-6	16						
13	B	1	0.0	1.5	-1.0	0.5	19		2.75	51	16	35	34	50	84	23	18	A-7-6	18			Mc			12"
	014-0	2	2.0	3.5	1.0	2.5	27		4.5	49	16	33	37	49	86	19	18	A-7-6	18						204 Geotextile
	25	3	4.0	5.5	3.0	4.5	15		1.75							22	18	A-7-6	16						
		4	6.0	7.5	5.0	6.5	16	15	1	28	20	8	70	22	92	27	15	A-4b	8						
14	B	1	0.0	1.5	-1.0	0.5	19		4.5	42	21	21	41	47	88	21	18	A-7-6	13			Mc			12"
	015-0	2	2.0	3.5	1.0	2.5	18		4.5							17	18	A-7-6	16						204 Geotextile
	25	3	4.0	5.5	3.0	4.5	27		4.5	45	19	26	29	48	77	17	18	A-7-6	15						
		4	6.0	7.5	5.0	6.5	33	18	4.5							16	18	A-7-6	16						
15	B	1	0.0	1.5	-1.0	0.5	13		2.75							21	16	A-6b	16			N_{60} & Mc		12"	12"
	016-0	2	2.0	3.5	1.0	2.5	33		4.5	36	18	18	31	49	80	12	16	A-6b	11						204 Geotextile
	25	3	4.0	5.5	3.0	4.5	49		4.5	33	18	15	33	48	81	12	14	A-6a	10						
		4	6.0	7.5	5.0	6.5	80	13	4.5							15	14	A-6a	10						
16	B	1	0.0	1.5	-1.0	0.5	7		2.5	43	17	26	36	52	88	24	18	A-7-6	15			N_{60} & Mc		15"	18"
	017-0	2	2.0	3.5	1.0	2.5	24		4.5	42	16	26	36	45	81	10	18	A-7-6	15						204 Geotextile
	25	3	4.0	5.5	3.0	4.5	24		-							10	14	A-6a	10						
		4	6.0	7.5	5.0	6.5	89	7	4.5							11	14	A-6a	10						
17	B	1	1.0	2.5	0.0	1.5	16		4.5	28	15	13	34	41	75	14	14	A-6a	9						12"
	018-0	2	2.5	4.0	1.5	3.0	27		4.5	34	18	16	30	52	82	20	16	A-6b	10			Mc			204 Geotextile
	25	3	4.0	5.5	3.0	4.5	56		-							-	16	A-6b	16						
		4	6.0	7.5	5.0	6.5	80	16	4.5							17	16	A-6b	16						
18	B	1	0.0	1.5	-1.0	0.5	16		4.5	39	21	18	37	49	86	20	16	A-6b	11			Mc			12"
	020-0	2	2.0	3.5	1.0	2.5	24		4.5							16	14	A-6a	10						204 Geotextile

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.81 7/21/2025

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
	25	3	4.0	5.5	3.0	4.5	27		4.5							16	14	A-6a	10						
		4	6.0	7.5	5.0	6.5	33	16	4.5							17	14	A-6a	10						
19	B	1	0.0	1.5	-1.0	0.5	16		3.75	41	21	20	37	46	83	21	18	A-7-6	12			Mc			**12"**
	021-0	2	2.0	3.5	1.0	2.5	25		4							18	14	A-6a	10			Mc			**204 Geotextile**
	25	3	4.0	5.5	3.0	4.5	24		4	30	17	13	33	48	81	16	14	A-6a	9						
		4	6.0	7.5	5.0	6.5	64	16	4.5							19	14	A-6a	10						

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.81 7/21/2025

PID: 122869

County-Route-Section: ALL-US30 Rest Areas TP (Site #14)

No. of Borings: 19

Geotechnical Consultant: Terracon Consultants, Inc.

Prepared By: Ahmad Al-Hosainat, Ph.D.

Date prepared: 4/15/2026

Chemical Stabilization Options		
320	Rubblize & Roll	Option
206	Cement Stabilization	No
	Lime Stabilization	Option
206	Depth	12"

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L):	12"
Average(HP):	0"
Global Geogrid Average(N60L):	0"
Average(HP):	0"

Design CBR	5

% Samples within 3 feet of subgrade			
$N_{60} \leq 5$	0%	HP ≤ 0.5	0%
$N_{60} < 12$	7%	0.5 < HP ≤ 1	0%
$12 \leq N_{60} < 15$	13%	1 < HP ≤ 2	5%
$N_{60} \geq 20$	28%	HP > 2	63%
M+	25%		
Rock	0%		
Unsuitable Soil	0%		

Excavate and Replace at Surface	
Average	12"
Maximum	18"
Minimum	12"

% Proposed Subgrade Surface	
Unstable & Unsuitable	56%
Unstable	56%
Unsuitable (Soil & Rock)	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	27	13	3.77	39	18	21	35	47	82	19	16	12
Maximum	104	18	4.50	51	24	35	70	58	92	43	21	18
Minimum	7	7	1.00	25	15	8	27	16	67	7	10	8

Classification Counts by Sample

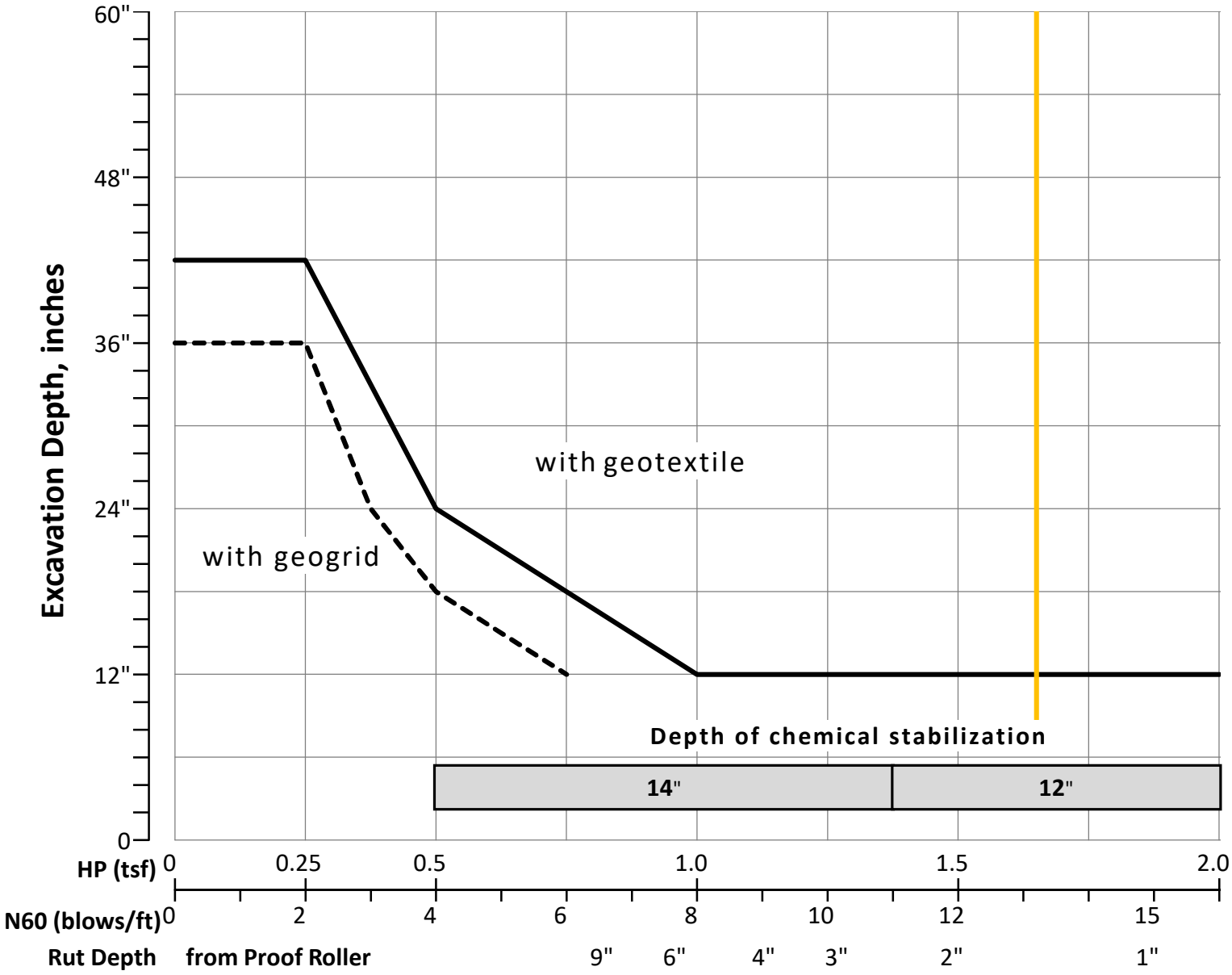
ODOT Class	UCF	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	0	0	0	0	0	0	0	0	0	3	1	0	31	16	0	25	0	0	76
Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	1%	0%	41%	21%	0%	33%	0%	0%	100%
% Rock|Granular|Cohesive	0%	0%	4%									96%								100%
Surface Class Count	0	0	0	0	0	0	0	0	0	0	1	0	0	12	10	0	16	0	0	39
Surface Class Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	31%	26%	0%	41%	0%	0%	100%

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.81 7/21/2025

Fig. 600-1 – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
3.77	0.50	☐ HP
13.26	6.00	☐ N60L

Average HP

Average N_{60L}

The subgrade analysis workbook consists of five worksheets. Each worksheet functions independently. In all of the worksheets the fields are color coded as follows:

- Every yellow highlighted field indicates a field to be entered by the user.
- Every salmon field is to indicate a problem/issue.
- Every gray or green field is a heading/informational field.

IMPORTANT: The sequence of filling out the data needs to be followed as outlined below:

1. Cover Sheet: this worksheet is designed for the purpose of entering the project information. Enter all the following fields:

County-Route-Section	This includes the county, route, section number assigned to the project.
PID	the Project Identification Number
Project Description	See Cover Sheet for list of example details
Geotechnical Consultant	The Geotechnical Consultant performing the analysis.
Prepared By	The preparer of the subgrade analysis
Date prepared	The date the analysis is performed.
Contact Information	Name, address, telephone #, and email address
No. of Borings	Enter the total number of borings (including locations of test pits, hand auger samples, etc.) within the alignment that is being analyzed. This field is a required field.
No. of DCPs	Enter the total number of dynamic cone penetration (DCP) test fields within the alignment that is being analyzed that do NOT have hand auger samples present alongside the exploration. Do NOT include Wildcat DCP explorations in this total. Any hand auger samples should be treated as borings and included with in the boring count.

2. Boring Logs Entry Worksheet: this worksheet has a programming code that will run in the background every time the sheet is activated and will make the sheet unresponsive for less than a minute. The code is designed to read the total number of borings from the cover sheet and generate the needed number of fields.

   a. All yellow highlighted fields are user's entry.

   b. ODOT has developed a text table export from gINT *(GB 1 Borings Log Entry Tab)* that will allow for copy and paste of all highlighted fields with the exception of proposed subgrade elevation. The designer must provide a proposed subgrade elevation in order for the spreadsheet to function properly.

   c. The Cut/Fill field is a calculated field that, based on the difference between the boring elevation and the proposed subgrade elevation, will highlight the cell either gray and adds the letter "C" to the end in a cut situation or highlights the cell in light purple and adds the letter "F" to the end in a fill situation.

   d. Every duplicate boring ID will be highlighted in salmon background and red text.

   e. **IMPORTANT**: <u>After</u> entering all the borings' information, the user must click "Add Subgrade Analysis Entry Fields" button. This will generate all the required fields in the "Subgrade Analysis" Worksheet.

f. **IMPORTANT**: When entering the borings' information, make sure to enter "Hand Auger" in the "Drill Rig" column for soil samples taken for Dynamic Cone Penetration (DCP) Tests and "DCP" for any DCP Tests performed without taking soil samples. This allows the workbook to generate worksheets to enter the gathered DCP data into when the user clicks the "Add DCP Test Data Worksheets" button.

3. Subgrade Analysis Worksheet:

a. The boring number and boring ID is read from the "Boring Logs Entry Worksheet" excluding every boring that has six feet or more of fill.
b. All yellow highlighted fields are to be entered by the user and salmon highlighted fields indicates a problem or issue.
c. Every sample that has a Sulfate Content greater than or equal to 3000 will be
d. Unsuitable/Unstable:
i. Unsuitable samples that are within 3 feet of the top of subgrade will be highlighted with salmon background and the class will be showing in this field.
ii. Unstable Samples that are within 3 feet of top of subgrade will be highlighted

Criterion	Stabilization Need Check	Text displayed in the
A-1-a, A-1-b, A-3, or A-3a Soil Class	No Stabilization is needed	
HP ≥ 1.875	No Stabilization is needed	
$N_{60} \geq 15$	No Stabilization is needed	
$1.875 \geq HP \geq 1.5$ and $M_c \geq$ Opt. M_c+3	Unstable Subgrade	HP & Mc
$15 \geq N_{60} \geq 12$ and $M_c \geq$ Opt. M_c+3	Unstable Subgrade	N_{60} & Mc
HP ≤ 1.5	Unstable Subgrade	HP
$N_{60} \leq 12$	Unstable Subgrade	N_{60}

iii. The field is formulated to check for HP first and check for N_{60} second.
f. Excavate and Replace (Item 204) is going to be calculated based on the subgrade depth for each sample indicating an unsuitable or unstable problem.
g. Recommendation:
i. Geotextile Option is calculated and rounded to a multiple of 3 inches based on the subgrade depth for every sample indicating an unsuitable or unstable problem.
ii. GEOGRID Option is only offered in case of unstable subgrade problem and if the geotextile option indicates the need to excavate greater than 12 inches.

PLEASE NOTE: The Problem, Excavate & Replace, and Recommendation Fields are the responsibility of the Designer. These fields are being enhanced to attempt to capture the ODOT philosophy regarding the subgrade stabilization chart, but are considered still under development. If there are discrepancies between the spreadsheet output and the stabilization chart - the chart governs in conjunction with engineering judgement. Please contact Steve Taliaferro at stephen.taliaferro@dot.ohio.gov if you have any questions.

PLEASE NOTE: It is the Designer's responsibility to identify the most representative data when samples have been separated into multiple specimen (say 1.5 to 2.3 feet and 2.3 to 3.0 feet). The spreadsheet is not capable at this time of addressing this issue within a direct data export from gINT.

4. Results Summary:

   All fields in this sheet are password protected and are either calculated or read from the other worksheets.
   The spreadsheet calcaulates the % unstable and % unsuitable soils based on the number of

5. Graph Worksheet:

   This worksheet is designed to read the average N_{60L} and the average HP from the Cover Sheet and

Version	Release Date	Author	Updates
N/A	02/01/2006	Bill Christense	
N/A	01/18/2007	Bill Christense	
N/A	02/01/2007	Bill Christense	
9.07	02/15/2007	Bill Christense	
9.09	08/10/2007	Bill Christense	
11.00	07/07/2010	Bill Christense	
12.00	12/13/2011	Bill Christense	
13.00	01/15/2016	Bill Christense	
13.00	08/05/2016	Bill Christense	
14.00	11/14/2017	Amal Mohi	
14.00	11/16/2017	Amal Mohi	
14.20	01/23/2018	Amal Mohi	
14.30	07/20/2018	Amal Mohi	
14.30	09/28/2018	Amal Mohi	
14.40	10/01/2018	Amal Mohi	
14.50	01/18/2019	Amal Mohi	
14.60	02/11/2022	Amal Mohi	
14.70	02/08/2024	Andrew Chudzik	Updated the formula for flagging sulfates so it no longer flagged sulfate entries of "<100". In the "% samples within 6 feet of subgrade" table in the Results Summary tab; adjusted the calculation of % Rock within 6 feet.
14.70	02/16/2024	Andrew Chudzik	Adjusted unsuitable soil counts at the surface (within 3 ft of top of subgrade) to include rock as well as adjusted text to clarify which unsuitable materials (soil or rock) were being included in the spreadsheet's calculations. Changed the table header from "% samples within 6 ft of subgrade" to "% samples within 3 feet of subgrade" to reflect this change. Also, adjusted the way N60L is calculated so that refusal blow counts entered as "50/X"" do not get counted and artificially lower the N60 values.
14.70	04/04/2024	Andrew Chudzik	Fixed issue where "NP" was being flagged as a soil sample having a Liquid Limit (LL) of > 65. Also, adjusted how recommended cut depths for A-4b material is calculated.
14.70	05/13/2024	Andrew Chudzik	Changed the 861 Geogrid recommendation on the Subgrade Analysis tab to 204 Geogrid to match current construction item standards. Started work on adjusting the Spreadsheet so it can produce Automatic Dynamic Cone Penetration (DCP) Sounding Reports. The Spreadsheet also marks the DCP Sounding Reports with the Design CBR and bottom of subgrade elevation for reference to poor performing soils.
14.70	11/06/2024	Andrew Chudzik	Updated the spreadsheet so it no longer counts hand auger samples taken for DCP explorations toward the Unstable Soils total.
14.80	01/17/2025	Andrew Chudzik	Adjusted the spreadsheet so it creates a number of DCP worksheets based on number of "Hand Auger" entries in the Drill Rig Column in the Boring Logs Entry tab. Widths for the Station Column in the Boring logs Entry Tab were widened so the information is shown properly.

14.80	06/18/2025	Andrew Chudzik	The cell reporting the percentage of samples with Unsuitable Soil within 3 ft of the subgrade on the Results Summary tab was grabbing its data from the wrong reference row. This was updated to the appropriate reference row.
14.81	07/21/2025	Andrew Chudzik	Removed a left over reference to a different spreadsheet from the calculations in the "Mopt", "GI" and "Unstable" columns within the Subgrade Analysis tab. Added a formula to the title sheet to hide the instructions once a date is entered. Added the Updates tab to the spreadsheet.

L-Pile Analyses

Contents:

L-Pile Analyses for B-001-0-25 through B-020-0-25 (286 pages)

Note: All attachments are one page unless noted above.

==========

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
© 1985-2024 by Ensoft, Inc.
All Rights Reserved

This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\2 luminarie loading\

Name of the input data file:
N4255372_ALL_B-1.lp12d

Name of the output report file:
N4255372_ALL_B-1.lp12o

Name of the plot output file:
N4255372_ALL_B-1.lp12p

Name of the runtime message file:
N4255372_ALL_B-1.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 9:26:29

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-001-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	17.000000 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	=	4000. psf
Undrained cohesion at bottom of layer	=	4000. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	17.000000 ft
Distance from top of pile to bottom of layer	=	26.000000 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	=	2500. psf
Undrained cohesion at bottom of layer	=	2500. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

(Depth of the lowest soil layer extends 17.000 ft below the pile tip)

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	1.000	1.0000	1.0000
2	20.000	1.0000	1.0000

Static Loading Type

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 670.000000 lbs	M = 210400. in-lbs	2800.
2	1	V = 1500. lbs	M = 483200. in-lbs	3100.
3	1	V = 1500. lbs	M = 483200. in-lbs	2600.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in
Transverse Reinforcement		
Type: Spiral		
Number of Transverse Reinf. (per spacing)	=	29
Spacing of Transverse Reinf.	=	4.500000 in
Yield Stress of Transverse Reinf.	=	60000. psi
Diameter of Transverse Reinf.	=	0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	4366.378 kips
Tensile Load for Cracking of Concrete	=	-470.222 kips
Nominal Axial Tensile Capacity	=	-960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000

6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.34165 psi
Compression Strain at Peak Stress	=	0.001886
Tensile Strain at Fracture of Concrete	=	-0.0001154
Maximum Coarse Aggregate Size	=	0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	2.600
2	2.800
3	3.100

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load	Axial Thrust	Nominal Mom. Cap.	Max. Comp.	Max.

Tens. No.	kips	in-kip	Strain	Strain
1	2.600	12528.126	0.00300000	-0.00995206
2	2.800	12530.132	0.00300000	-0.00994997
3	3.100	12533.141	0.00300000	-0.00994684

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load	Resist. Factor	Nominal Ax. Thrust	Nominal Moment Cap	Ult. (Fac) Ax. Thrust	Ult. (Fac) Moment Cap	Bend. Stiff. at Ult Mom
No.		kips	in-kips	kips	in-kips	kip-in^2
1	0.65	2.600000	12528.	1.690000	8143.	96754995.
2	0.65	2.800000	12530.	1.820000	8145.	96772491.
3	0.65	3.100000	12533.	2.015000	8147.	96798736.
1	0.75	2.600000	12528.	1.950000	9396.	95139949.
2	0.75	2.800000	12530.	2.100000	9398.	95157340.
3	0.75	3.100000	12533.	2.325000	9400.	95183423.
1	0.90	2.600000	12528.	2.340000	11275.	72359421.

2	0.90	2.800000	12530.	2.520000	11277. 72380624.
3	0.90	3.100000	12533.	2.790000	11280. 72412429.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	9129.
2	4.0000	0.2515	No	No	9129.	211004.
3	17.0000	16.0000	No	No	220133.	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 670. lbs
Moment = 210400. in-lbs
Axial Load = 2800. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.00364346	235119.	-5965.
8.55000	0.00435903	234243.	-6633.
8.10000	0.00674800	233019.	-7804.
7.65000	0.01391024	230436.	-9118.
7.20000	0.03382365	227176.	-10282.

6.75000	0.10594394	224637.	-11583.
6.30000	0.35000084	222913.	-12849.
5.85000	1.46320974	222769.	-14424.
5.40000	8.03841156	227252.	-16422.

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

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

Shear force at pile head = 1500.0 lbs
Applied moment at pile head = 483200.0 in-lbs
Axial thrust load on pile head = 3100.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	0.02804	483200.	1500.	0.000	3.889E+11

Output Summary for Load Case No. 2:

Pile-head deflection = 0.02804141 inches
Computed slope at pile head = -0.0004025 radians
Maximum bending moment = 539965. inch-lbs
Maximum shear force = -16246. lbs
Depth of maximum bending moment = 4.05000000 feet below pile head
Depth of maximum shear force = 6.66000000 feet below pile head
Number of iterations = 26
Number of zero deflection points = 1
Pile deflection at ground = 0.02330155 inches

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

Shear = 1500. lbs
Moment = 483200. in-lbs
Axial Load = 3100. lbs

Pile Length	Pile Head Deflection	Maximum Moment	Maximum Shear

feet	inches	ln-lbs	lbs
9.00000	0.02804141	539965.	-16246.
8.55000	0.05292022	535432.	-17625.
8.10000	0.12350409	529501.	-19334.
7.65000	0.30510410	523368.	-21207.
7.20000	0.77367698	517753.	-23208.
6.75000	2.44509400	515035.	-25894.
6.30000	8.69479076	518230.	-29484.

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

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

Shear force at pile head = 1500.0 lbs
Applied moment at pile head = 483200.0 in-lbs
Axial thrust load on pile head = 2600.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	0.02804	483200.	1500.	0.000	3.889E+11

Output Summary for Load Case No. 3:

Pile-head deflection = 0.02803851 inches
Computed slope at pile head = -0.0004025 radians
Maximum bending moment = 539957. inch-lbs
Maximum shear force = -16246. lbs
Depth of maximum bending moment = 4.05000000 feet below pile head
Depth of maximum shear force = 6.66000000 feet below pile head
Number of iterations = 26
Number of zero deflection points = 1
Pile deflection at ground = 0.02329909 inches

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

Shear = 1500. lbs
Moment = 483200. in-lbs

Axial Load = 2600. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.02803851	539957.	-16246.
8.55000	0.05290899	535416.	-17624.
8.10000	0.12344077	529464.	-19332.
7.65000	0.30471504	523291.	-21200.
7.20000	0.77118250	517578.	-23189.
6.75000	2.42040546	514529.	-25825.
6.30000	8.36645934	516329.	-29184.

Summary of Pile-head Responses for Conventional Analyses

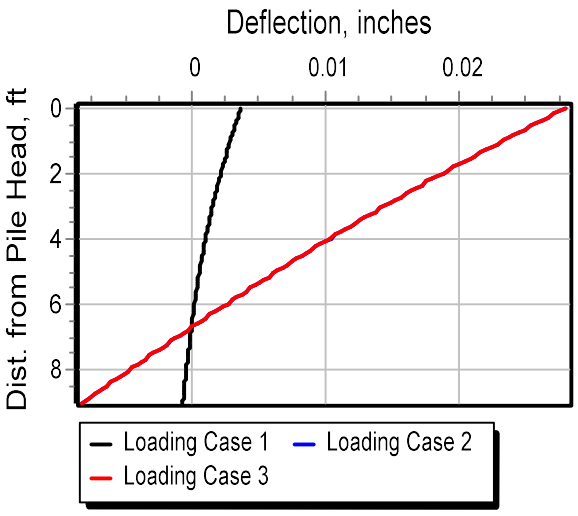
Definitions of Pile-head Loading Conditions:

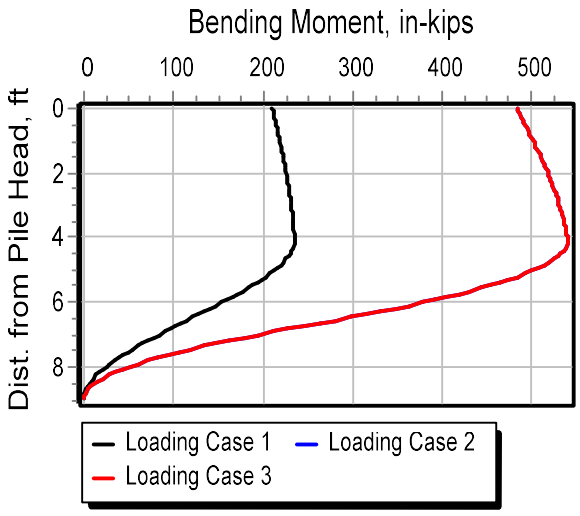
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

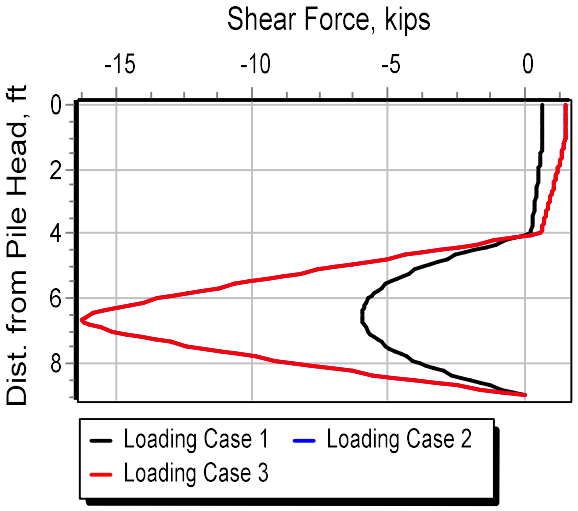
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.003643	-0.0000688	-5965.	235119.
2	1	0.028041	-0.0004025	-16246.	539965.
3	1	0.028039	-0.0004025	-16246.	539957.

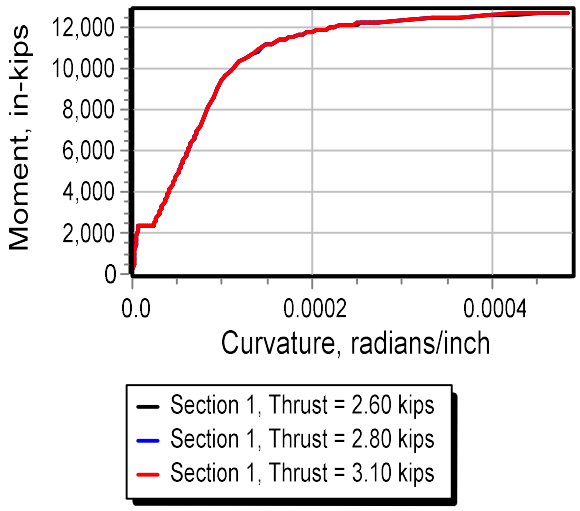
Maximum pile-head deflection = 0.0280414144 inches
Maximum pile-head rotation   = -0.0004025415 radians = -0.023064 deg.

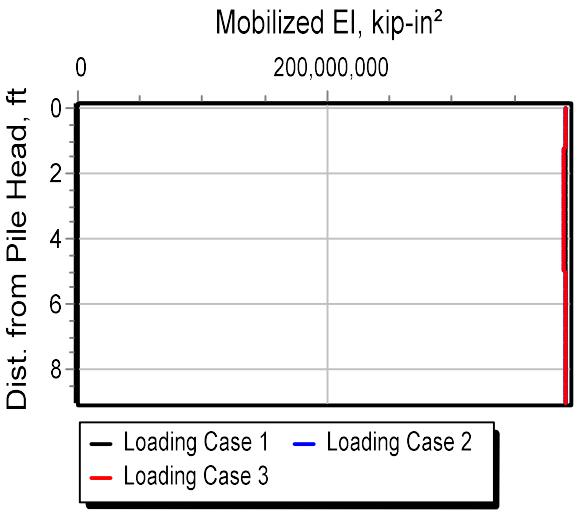
The analysis ended normally.

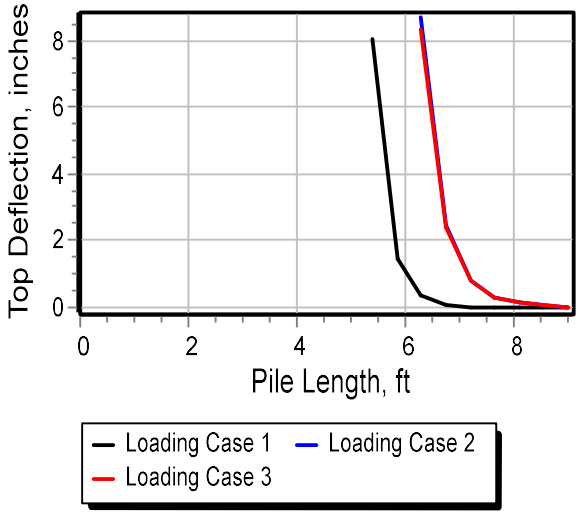

Deflection, inches
0
0.01
0.02
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
100
200
300
400
500
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-15
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 2.60 kips
Section 1, Thrust = 2.80 kips
Section 1, Thrust = 3.10 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\2 luminarie loading\

Name of the input data file:
N4255372_ALL_B-5.lp12d

Name of the output report file:
N4255372_ALL_B-5.lp12o

Name of the plot output file:
N4255372_ALL_B-5.lp12p

Name of the runtime message file:
N4255372_ALL_B-5.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 9:29:40

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-005-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	5.000000 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	=	1000.000000 psf
Undrained cohesion at bottom of layer	=	1000.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	5.000000 ft
Distance from top of pile to bottom of layer	=	9.500000 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	=	1000.000000 psf
Undrained cohesion at bottom of layer	=	1000.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	9.500000 ft

```
   Distance from top of pile to bottom of layer        =    14.500000 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                  =        3500. psf
   Undrained cohesion at bottom of layer               =        3500. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    14.500000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =        2000. psf
   Undrained cohesion at bottom of layer               =        2000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



-------------------------------------------------------------------------------
                      Modification Factors for p-y Curves
-------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1            1.000         1.0000         1.0000
  2           20.000         1.0000         1.0000



-------------------------------------------------------------------------------
                               Static Loading Type
-------------------------------------------------------------------------------

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 670.000000 lbs	M = 210400. in-lbs	2800.
2	1	V = 1500. lbs	M = 483200. in-lbs	3100.
3	1	V = 1500. lbs	M = 483200. in-lbs	2600.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94

Offset of Center of Rebar Cage from Center of Pile = 0.0000 in
Transverse Reinforcement
Type: Spiral
Number of Transverse Reinf. (per spacing) = 29
Spacing of Transverse Reinf. = 4.500000 in
Yield Stress of Transverse Reinf. = 60000. psi
Diameter of Transverse Reinf. = 0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 4366.378 kips
Tensile Load for Cracking of Concrete = -470.222 kips
Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	2.600
2	2.800
3	3.100

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	2.600	12528.126	0.00300000	-0.00995206
2	2.800	12530.132	0.00300000	-0.00994997
3	3.100	12533.141	0.00300000	-0.00994684

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for

reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	2.600000	12528.	1.690000	8143.	96754995.
2	0.65	2.800000	12530.	1.820000	8145.	96772491.
3	0.65	3.100000	12533.	2.015000	8147.	96798736.
1	0.75	2.600000	12528.	1.950000	9396.	95139949.
2	0.75	2.800000	12530.	2.100000	9398.	95157340.
3	0.75	3.100000	12533.	2.325000	9400.	95183423.
1	0.90	2.600000	12528.	2.340000	11275.	72359421.
2	0.90	2.800000	12530.	2.520000	11277.	72380624.
3	0.90	3.100000	12533.	2.790000	11280.	72412429.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	8972.
2	4.0000	0.9534	No	No	8972.	10197.
3	5.0000	1.9569	Yes	No	19169.	48100.
4	9.5000	8.5000	No	No	67269.	0.00
5	14.5000	13.5000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 670. lbs
Moment = 210400. in-lbs
Axial Load = 2800. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.10711297	224878.	-6207.
8.55000	0.18774213	223605.	-6526.
8.10000	0.37419760	223000.	-6937.
7.65000	0.75892921	222667.	-7373.
7.20000	1.50000787	222161.	-7796.
6.75000	3.47823209	223215.	-8395.
6.30000	9.49578136	227758.	-9439.

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

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

Shear force at pile head = 1500.0 lbs
Applied moment at pile head = 483200.0 in-lbs
Axial thrust load on pile head = 3100.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	2.27836	483200.	1500.	0.000	3.889E+11

Output Summary for Load Case No. 2:

Pile-head deflection = 2.27835987 inches
Computed slope at pile head = -0.0293548 radians
Maximum bending moment = 515342. inch-lbs
Maximum shear force = -13833. lbs
Depth of maximum bending moment = 2.34000000 feet below pile head
Depth of maximum shear force = 6.48000000 feet below pile head
Number of iterations = 44
Number of zero deflection points = 1
Pile deflection at ground = 1.92619355 inches

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

Shear = 1500. lbs
Moment = 483200. in-lbs
Axial Load = 3100. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	2.27835987	515342.	-13833.
8.55000	4.03868895	514360.	-14642.
8.10000	8.55518006	517307.	-15928.
7.65000	24.29360050	532623.	-18682.

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

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

Shear force at pile head = 1500.0 lbs
Applied moment at pile head = 483200.0 in-lbs
Axial thrust load on pile head = 2600.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	2.25595	483200.	1500.	0.000	3.889E+11

Output Summary for Load Case No. 3:

Pile-head deflection	=	2.25594892 inches
Computed slope at pile head	=	-0.0290659 radians
Maximum bending moment	=	514954. inch-lbs
Maximum shear force	=	-13795. lbs
Depth of maximum bending moment	=	2.25000000 feet below pile head
Depth of maximum shear force	=	6.48000000 feet below pile head
Number of iterations	=	44
Number of zero deflection points	=	1
Pile deflection at ground	=	1.90724852 inches

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

Shear	=	1500. lbs
Moment	=	483200. in-lbs
Axial Load	=	2600. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	2.25594892	514954.	-13795.
8.55000	3.96719583	513671.	-14569.
8.10000	8.22002960	515706.	-15750.
7.65000	19.69411590	523977.	-17688.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

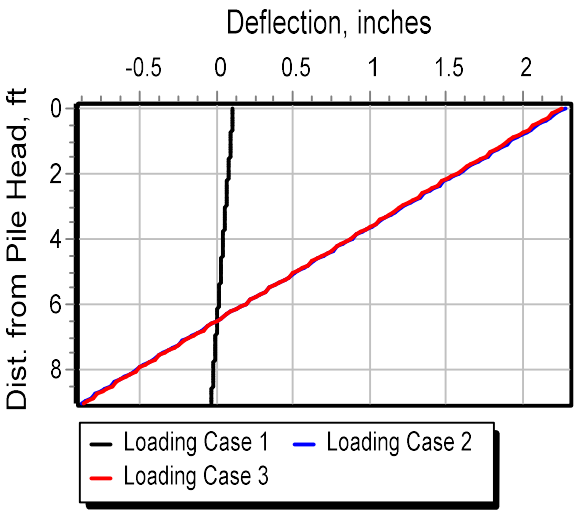
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

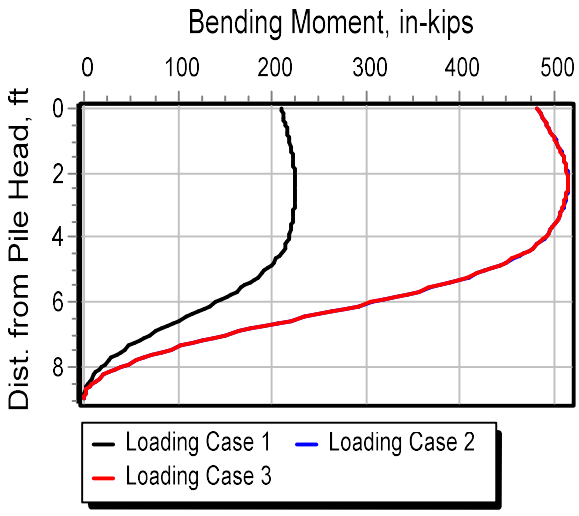
Load Case	Load	Pile-head Deflection	Pile-head Rotation	Max Shear in Pile	Max Moment in Pile

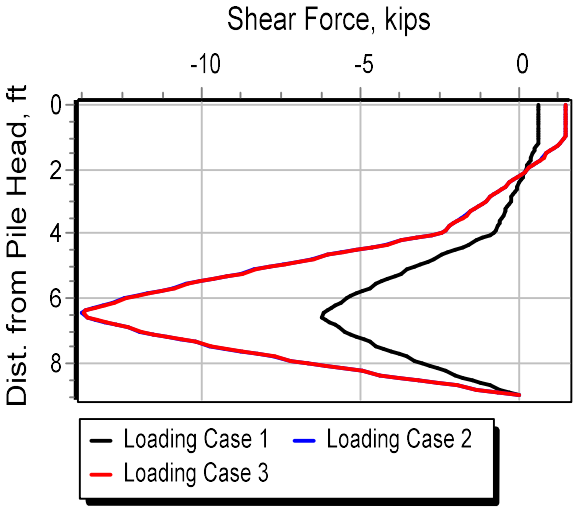
No.	Type	inches	radians	lbs	in-lbs
1	1	0.107113	-0.00139	-6207.	224878.
2	1	2.278360	-0.02935	-13833.	515342.
3	1	2.255949	-0.02907	-13795.	514954.

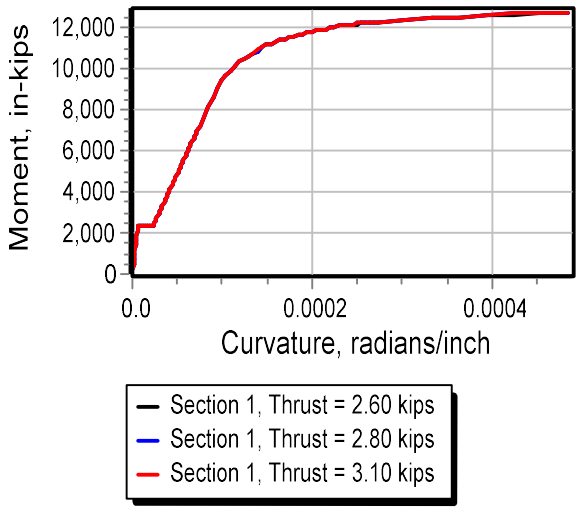
Maximum pile-head deflection = 2.2783598669 inches
Maximum pile-head rotation = -0.0293547515 radians = -1.681903 deg.

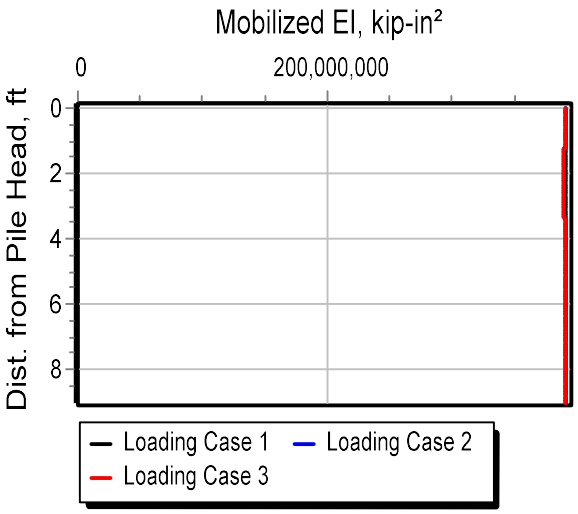
The analysis ended normally.

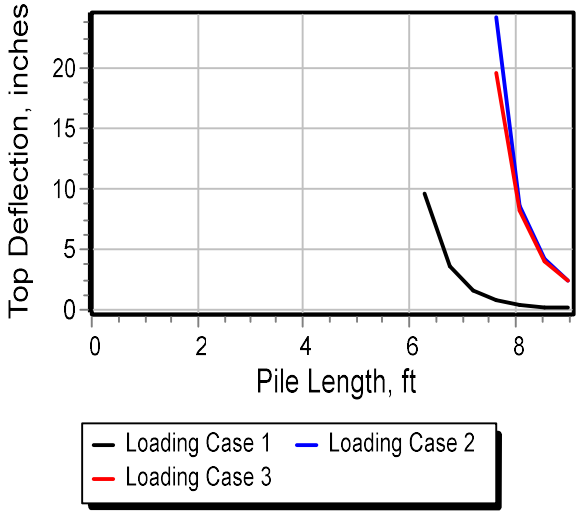

Deflection, inches
-0.5
0
0.5
1
1.5
2
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
100
200
300
400
500
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 2.60 kips
Section 1, Thrust = 2.80 kips
Section 1, Thrust = 3.10 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
20
15
10
5
0
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\2 luminarie loading\

Name of the input data file:
N4255372_ALL_B-6.lp12d

Name of the output report file:
N4255372_ALL_B-6.lp12o

Name of the plot output file:
N4255372_ALL_B-6.lp12p

Name of the runtime message file:
N4255372_ALL_B-6.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 9:33:38

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-006-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	0.0000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	9.500000 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	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	9.500000 ft
Distance from top of pile to bottom of layer	=	14.500000 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	=	3500. psf
Undrained cohesion at bottom of layer	=	3500. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	14.500000 ft

```
   Distance from top of pile to bottom of layer        =    17.000000 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                  =        2500. psf
   Undrained cohesion at bottom of layer               =        2500. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    17.000000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =        2500. psf
   Undrained cohesion at bottom of layer               =        2500. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



-------------------------------------------------------------------------------
                      Modification Factors for p-y Curves
-------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1            1.000         1.0000         1.0000
  2           20.000         1.0000         1.0000



-------------------------------------------------------------------------------
                               Static Loading Type
-------------------------------------------------------------------------------

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 670.000000 lbs	M = 210400. in-lbs	2800.
2	1	V = 1500. lbs	M = 483200. in-lbs	3100.
3	1	V = 1500. lbs	M = 483200. in-lbs	2600.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94

Offset of Center of Rebar Cage from Center of Pile = 0.0000 in
Transverse Reinforcement
Type: Spiral
Number of Transverse Reinf. (per spacing) = 29
Spacing of Transverse Reinf. = 4.500000 in
Yield Stress of Transverse Reinf. = 60000. psi
Diameter of Transverse Reinf. = 0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 4366.378 kips
Tensile Load for Cracking of Concrete = -470.222 kips
Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	2.600
2	2.800
3	3.100

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	2.600	12528.126	0.00300000	-0.00995206
2	2.800	12530.132	0.00300000	-0.00994997
3	3.100	12533.141	0.00300000	-0.00994684

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for

reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	2.600000	12528.	1.690000	8143.	96754995.
2	0.65	2.800000	12530.	1.820000	8145.	96772491.
3	0.65	3.100000	12533.	2.015000	8147.	96798736.
1	0.75	2.600000	12528.	1.950000	9396.	95139949.
2	0.75	2.800000	12530.	2.100000	9398.	95157340.
3	0.75	3.100000	12533.	2.325000	9400.	95183423.
1	0.90	2.600000	12528.	2.340000	11275.	72359421.
2	0.90	2.800000	12530.	2.520000	11277.	72380624.
3	0.90	3.100000	12533.	2.790000	11280.	72412429.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	12972.
2	4.0000	0.9256	No	No	12972.	85084.
3	9.5000	9.5000	No	No	98056.	0.00
4	14.5000	14.5000	No	No	0.00	0.00
5	17.0000	17.0000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 670. lbs
Moment = 210400. in-lbs
Axial Load = 2800. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.02396487	219548.	-6031.
8.55000	0.04130665	218153.	-6379.
8.10000	0.07863126	216778.	-6738.
7.65000	0.15080647	215643.	-7060.
7.20000	0.29025640	214741.	-7360.
6.75000	0.59345440	213998.	-7625.
6.30000	1.20537352	213523.	-7844.
5.85000	2.55805839	213346.	-7979.
5.40000	5.71020729	213782.	-8070.

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

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

Shear force at pile head = 1500.0 lbs
Applied moment at pile head = 483200.0 in-lbs
Axial thrust load on pile head = 3100.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	0.47061	483200.	1500.	-59.9476	3.889E+11

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     0.47060610 inches
Computed slope at pile head      =     -0.0060917 radians
Maximum bending moment           =        500778. inch-lbs
Maximum shear force              =        -13395. lbs
Depth of maximum bending moment  =     1.89000000 feet below pile head
Depth of maximum shear force     =     6.48000000 feet below pile head
Number of iterations             =             37
Number of zero deflection points =              1
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

```
Shear      =           1500. lbs
Moment     =         483200. in-lbs
Axial Load =           3100. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.47060610	500778.	-13395.
8.55000	0.81062913	498347.	-14013.
8.10000	1.51299118	496180.	-14723.
7.65000	2.86847033	494697.	-15459.
7.20000	5.58450203	494113.	-16294.
6.75000	12.33451900	495375.	-17484.

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

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

```
Shear force at pile head                          =       1500.0 lbs
Applied moment at pile head                       =     483200.0 in-lbs
Axial thrust load on pile head                    =       2600.0 lbs
```

Depth X	Deflect. y	Bending Moment	Shear Force	Soil Res. p	Bending Stiffness

feet	inches	in-lbs	lbs	lb/inch	lb-in^2
0.000	0.46968	483200.	1500.	-59.9083	3.889E+11

Output Summary for Load Case No. 3:

Pile-head deflection = 0.46968263 inches
Computed slope at pile head = -0.0060797 radians
Maximum bending moment = 500719. inch-lbs
Maximum shear force = -13388. lbs
Depth of maximum bending moment = 1.89000000 feet below pile head
Depth of maximum shear force = 6.48000000 feet below pile head
Number of iterations = 37
Number of zero deflection points = 1

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

Shear = 1500. lbs
Moment = 483200. in-lbs
Axial Load = 2600. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.46968263	500719.	-13388.
8.55000	0.80790372	498256.	-14000.
8.10000	1.50352940	496025.	-14697.
7.65000	2.83436997	494432.	-15407.
7.20000	5.45330122	493606.	-16185.
6.75000	11.65351627	494142.	-17197.

Summary of Pile-head Responses for Conventional Analyses

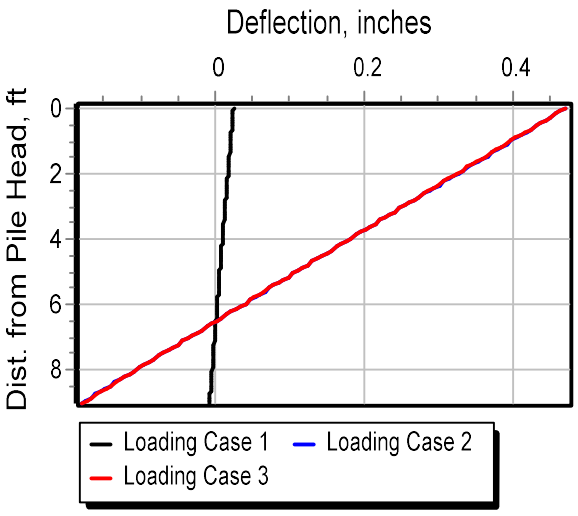
Definitions of Pile-head Loading Conditions:

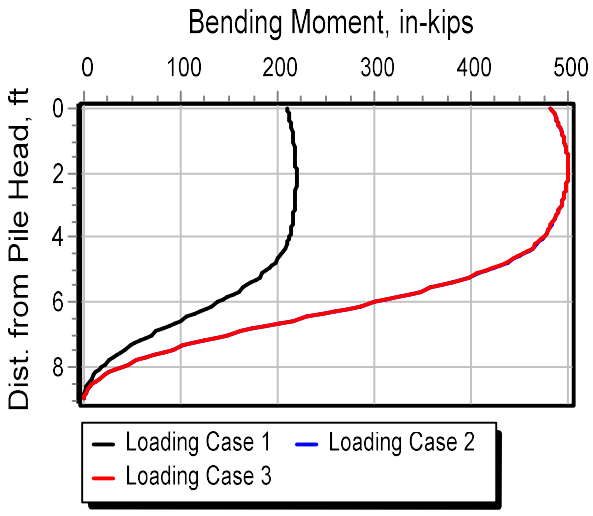
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

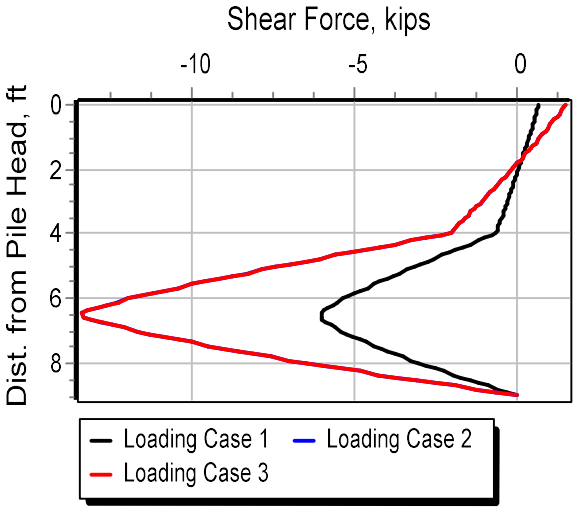
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.023965	-0.0003264	-6031.	219548.
2	1	0.470606	-0.00609	-13395.	500778.
3	1	0.469683	-0.00608	-13388.	500719.

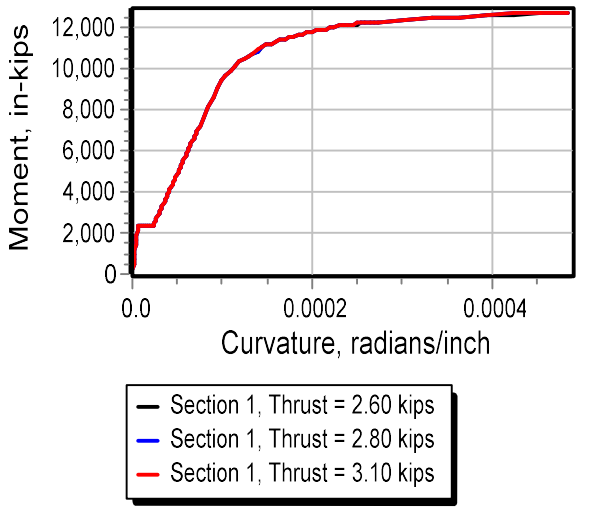
Maximum pile-head deflection = 0.4706060964 inches
Maximum pile-head rotation = -0.0060916734 radians = -0.349027 deg.

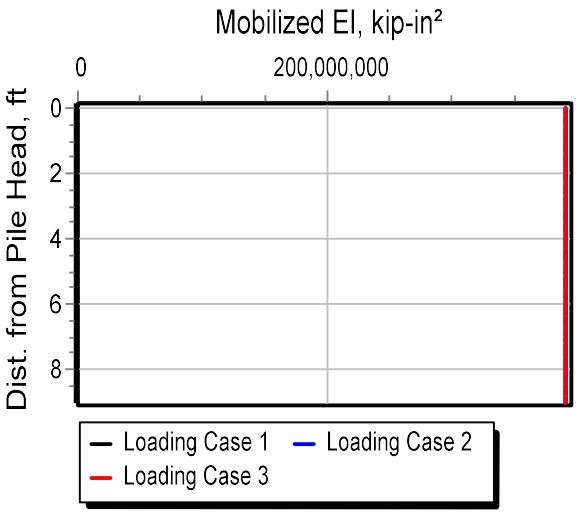
The analysis ended normally.

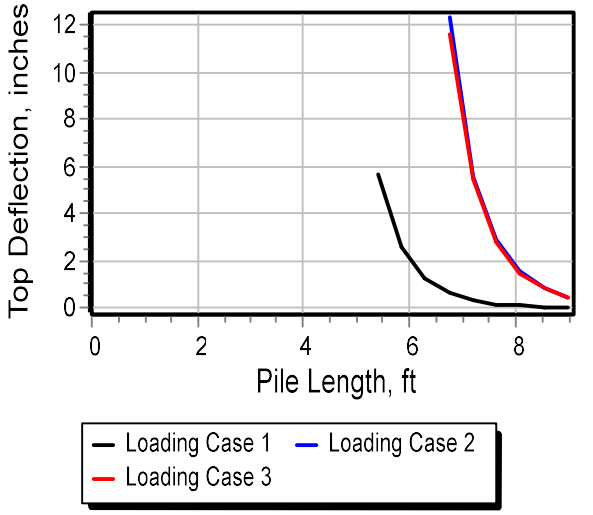

Deflection, inches
0
0.2
0.4
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
100
200
300
400
500
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 2.60 kips
Section 1, Thrust = 2.80 kips
Section 1, Thrust = 3.10 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
12
10
8
6
4
2
0
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\2 luminarie loading\

Name of the input data file:
N4255372_ALL_B-7.lp12d

Name of the output report file:
N4255372_ALL_B-7.lp12o

Name of the plot output file:
N4255372_ALL_B-7.lp12p

Name of the runtime message file:
N4255372_ALL_B-7.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 9:36:10

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-007-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	5.000000 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	=	1000.000000 psf
Undrained cohesion at bottom of layer	=	1000.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	5.000000 ft
Distance from top of pile to bottom of layer	=	9.500000 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	=	1000.000000 psf
Undrained cohesion at bottom of layer	=	1000.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	9.500000 ft

```
   Distance from top of pile to bottom of layer        =    14.500000 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                  =        3000. psf
   Undrained cohesion at bottom of layer               =        3000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    14.500000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =        2500. psf
   Undrained cohesion at bottom of layer               =        2500. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



-------------------------------------------------------------------------------
                      Modification Factors for p-y Curves
-------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1            1.000         1.0000         1.0000
  2           20.000         1.0000         1.0000



-------------------------------------------------------------------------------
                               Static Loading Type
-------------------------------------------------------------------------------

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 670.000000 lbs	M = 210400. in-lbs	2800.
2	1	V = 1500. lbs	M = 483200. in-lbs	3100.
3	1	V = 1500. lbs	M = 483200. in-lbs	2600.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94

Offset of Center of Rebar Cage from Center of Pile = 0.0000 in
Transverse Reinforcement
Type: Spiral
Number of Transverse Reinf. (per spacing) = 29
Spacing of Transverse Reinf. = 4.500000 in
Yield Stress of Transverse Reinf. = 60000. psi
Diameter of Transverse Reinf. = 0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 4366.378 kips
Tensile Load for Cracking of Concrete = -470.222 kips
Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	2.600
2	2.800
3	3.100

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	2.600	12528.126	0.00300000	-0.00995206
2	2.800	12530.132	0.00300000	-0.00994997
3	3.100	12533.141	0.00300000	-0.00994684

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for

reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	2.600000	12528.	1.690000	8143.	96754995.
2	0.65	2.800000	12530.	1.820000	8145.	96772491.
3	0.65	3.100000	12533.	2.015000	8147.	96798736.
1	0.75	2.600000	12528.	1.950000	9396.	95139949.
2	0.75	2.800000	12530.	2.100000	9398.	95157340.
3	0.75	3.100000	12533.	2.325000	9400.	95183423.
1	0.90	2.600000	12528.	2.340000	11275.	72359421.
2	0.90	2.800000	12530.	2.520000	11277.	72380624.
3	0.90	3.100000	12533.	2.790000	11280.	72412429.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	8972.
2	4.0000	0.9534	No	No	8972.	10197.
3	5.0000	1.9569	Yes	No	19169.	48100.
4	9.5000	8.5000	No	No	67269.	0.00
5	14.5000	13.5000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 670. lbs
Moment = 210400. in-lbs
Axial Load = 2800. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.10711297	224878.	-6207.
8.55000	0.18774213	223605.	-6526.
8.10000	0.37419760	223000.	-6937.
7.65000	0.75892921	222667.	-7373.
7.20000	1.50000787	222161.	-7796.
6.75000	3.47823209	223215.	-8395.
6.30000	9.49578136	227758.	-9439.

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

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

Shear force at pile head = 1500.0 lbs
Applied moment at pile head = 483200.0 in-lbs
Axial thrust load on pile head = 3100.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	2.27836	483200.	1500.	0.000	3.889E+11

Output Summary for Load Case No. 2:

Pile-head deflection = 2.27835987 inches
Computed slope at pile head = -0.0293548 radians
Maximum bending moment = 515342. inch-lbs
Maximum shear force = -13833. lbs
Depth of maximum bending moment = 2.34000000 feet below pile head
Depth of maximum shear force = 6.48000000 feet below pile head
Number of iterations = 44
Number of zero deflection points = 1
Pile deflection at ground = 1.92619355 inches

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

Shear = 1500. lbs
Moment = 483200. in-lbs
Axial Load = 3100. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	2.27835987	515342.	-13833.
8.55000	4.03868895	514360.	-14642.
8.10000	8.55518006	517307.	-15928.
7.65000	24.29360050	532623.	-18682.

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

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

Shear force at pile head = 1500.0 lbs
Applied moment at pile head = 483200.0 in-lbs
Axial thrust load on pile head = 2600.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	2.25595	483200.	1500.	0.000	3.889E+11

Output Summary for Load Case No. 3:

Pile-head deflection	=	2.25594892 inches
Computed slope at pile head	=	-0.0290659 radians
Maximum bending moment	=	514954. inch-lbs
Maximum shear force	=	-13795. lbs
Depth of maximum bending moment	=	2.25000000 feet below pile head
Depth of maximum shear force	=	6.48000000 feet below pile head
Number of iterations	=	44
Number of zero deflection points	=	1
Pile deflection at ground	=	1.90724852 inches

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

Shear	=	1500. lbs
Moment	=	483200. in-lbs
Axial Load	=	2600. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	2.25594892	514954.	-13795.
8.55000	3.96719583	513671.	-14569.
8.10000	8.22002960	515706.	-15750.
7.65000	19.69411590	523977.	-17688.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

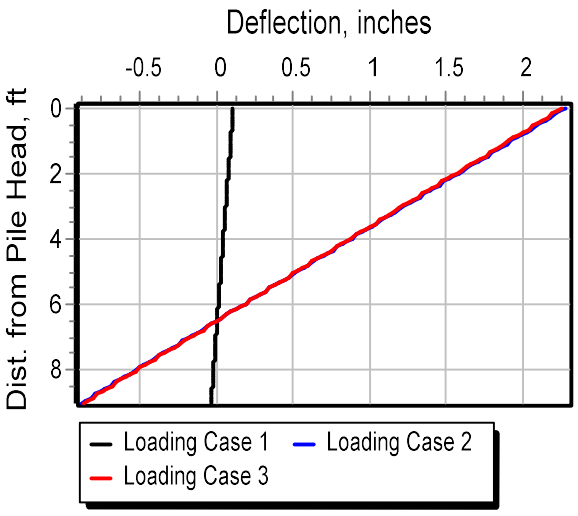
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

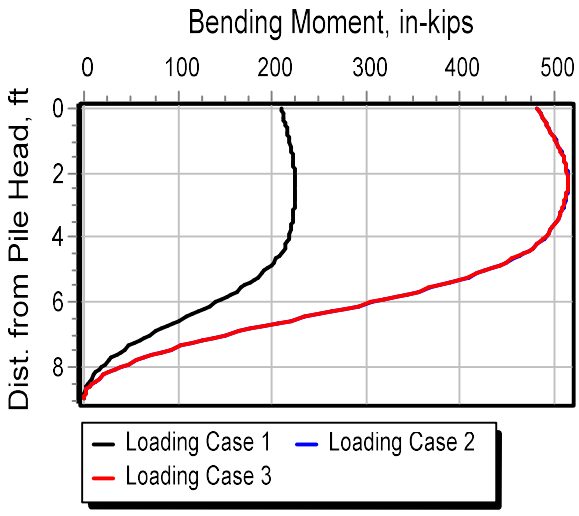
Load Case	Load	Pile-head Deflection	Pile-head Rotation	Max Shear in Pile	Max Moment in Pile

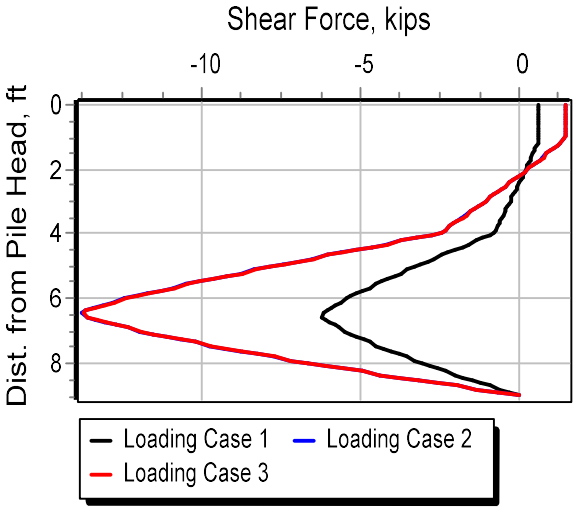
No.	Type	inches	radians	lbs	in-lbs
1	1	0.107113	-0.00139	-6207.	224878.
2	1	2.278360	-0.02935	-13833.	515342.
3	1	2.255949	-0.02907	-13795.	514954.

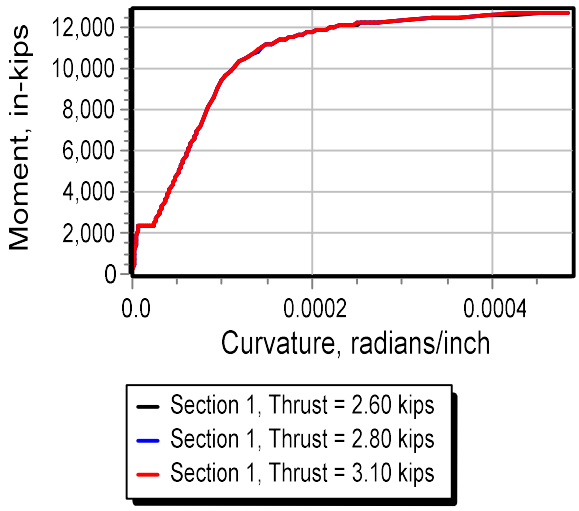
Maximum pile-head deflection = 2.2783598669 inches
Maximum pile-head rotation = -0.0293547515 radians = -1.681903 deg.

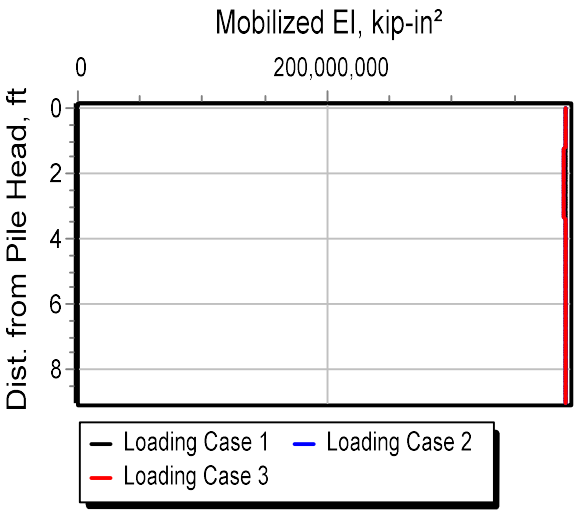
The analysis ended normally.

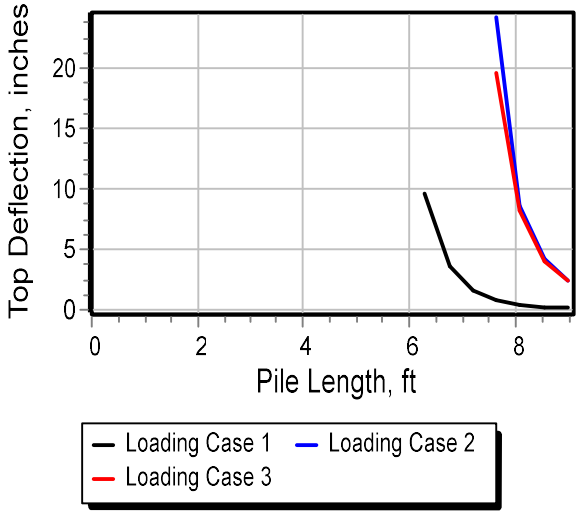

Deflection, inches
-0.5
0
0.5
1
1.5
2
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
100
200
300
400
500
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 2.60 kips
Section 1, Thrust = 2.80 kips
Section 1, Thrust = 3.10 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
20
15
10
5
0
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

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License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\2 luminarie loading\

Name of the input data file:
N4255372_ALL_B-10.lp12d

Name of the output report file:
N4255372_ALL_B-10.lp12o

Name of the plot output file:
N4255372_ALL_B-10.lp12p

Name of the runtime message file:
N4255372_ALL_B-10.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 9:40:14

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-010-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	9.500000 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	=	3500. psf
Undrained cohesion at bottom of layer	=	3500. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	9.500000 ft
Distance from top of pile to bottom of layer	=	19.500000 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	=	2000. psf
Undrained cohesion at bottom of layer	=	2000. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	19.500000 ft

Distance from top of pile to bottom of layer	=	26.000000 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	=	2000. psf
Undrained cohesion at bottom of layer	=	2000. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

(Depth of the lowest soil layer extends 17.000 ft below the pile tip)

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	1.000	1.0000	1.0000
2	20.000	1.0000	1.0000

Static Loading Type

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 670.000000 lbs	M = 210400. in-lbs	2800.
2	1	V = 1500. lbs	M = 483200. in-lbs	3100.
3	1	V = 1500. lbs	M = 483200. in-lbs	2600.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Transverse Reinforcement
Type: Spiral

Number of Transverse Reinf. (per spacing)	=	29
Spacing of Transverse Reinf.	=	4.500000 in
Yield Stress of Transverse Reinf.	=	60000. psi
Diameter of Transverse Reinf.	=	0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	4366.378 kips
Tensile Load for Cracking of Concrete	=	-470.222 kips

Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips

1	2.600
2	2.800
3	3.100

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	2.600	12528.126	0.00300000	-0.00995206
2	2.800	12530.132	0.00300000	-0.00994997
3	3.100	12533.141	0.00300000	-0.00994684

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	2.600000	12528.	1.690000	8143.	96754995.
2	0.65	2.800000	12530.	1.820000	8145.	

96772491.
   3   0.65   3.100000   12533.   2.015000   8147.
96798736.

   1   0.75   2.600000   12528.   1.950000   9396.
95139949.
   2   0.75   2.800000   12530.   2.100000   9398.
95157340.
   3   0.75   3.100000   12533.   2.325000   9400.
95183423.

   1   0.90   2.600000   12528.   2.340000   11275.
72359421.
   2   0.90   2.800000   12530.   2.520000   11277.
72380624.
   3   0.90   3.100000   12533.   2.790000   11280.
72412429.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	9103.
2	4.0000	0.2862	No	No	9103.	185456.
3	9.5000	8.5000	No	No	194559.	0.00
4	19.5000	18.5000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

```
Shear      =            670. lbs
Moment     =         210400. in-lbs
Axial Load =           2800. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.00433441	234557.	-6089.
8.55000	0.00584359	233255.	-6904.
8.10000	0.01087391	231190.	-8061.
7.65000	0.02465503	228480.	-9143.
7.20000	0.06045817	225707.	-10111.
6.75000	0.18359869	223712.	-11212.
6.30000	0.57854874	222488.	-12360.
5.85000	2.29368486	223131.	-13786.
5.40000	13.16829682	231653.	-16108.

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

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

```
Shear force at pile head                          =       1500.0 lbs
Applied moment at pile head                       =     483200.0 in-lbs
Axial thrust load on pile head                    =       3100.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	0.05102	483200.	1500.	0.000	3.889E+11

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     0.05102118 inches
Computed slope at pile head      =     -0.0006899 radians
Maximum bending moment           =        536291. inch-lbs
Maximum shear force              =        -16193. lbs
Depth of maximum bending moment  =     4.05000000 feet below pile head
Depth of maximum shear force     =     6.66000000 feet below pile head
Number of iterations             =             29
Number of zero deflection points =              1
Pile deflection at ground        =     0.04283307 inches
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

Shear = 1500. lbs
Moment = 483200. in-lbs
Axial Load = 3100. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.05102118	536291.	-16193.
8.55000	0.09820665	530812.	-17389.
8.10000	0.22883538	524772.	-18982.
7.65000	0.55690150	520068.	-20744.
7.20000	1.37975341	515792.	-22613.
6.75000	4.25658987	515164.	-25206.
6.30000	16.04461833	524587.	-29298.

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

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

Shear force at pile head = 1500.0 lbs
Applied moment at pile head = 483200.0 in-lbs
Axial thrust load on pile head = 2600.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	0.05101	483200.	1500.	0.000	3.889E+11

Output Summary for Load Case No. 3:

Pile-head deflection = 0.05101084 inches
Computed slope at pile head = -0.0006898 radians
Maximum bending moment = 536276. inch-lbs
Maximum shear force = -16192. lbs
Depth of maximum bending moment = 4.05000000 feet below pile head
Depth of maximum shear force = 6.66000000 feet below pile head

Number of iterations = 29
Number of zero deflection points = 1
Pile deflection at ground = 0.04282429 inches

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

Shear = 1500. lbs
Moment = 483200. in-lbs
Axial Load = 2600. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.05101084	536276.	-16192.
8.55000	0.09816667	530784.	-17387.
8.10000	0.22861587	524714.	-18977.
7.65000	0.55560350	519941.	-20732.
7.20000	1.37180846	515508.	-22578.
6.75000	4.18046856	514319.	-25084.
6.30000	14.83324058	520626.	-28690.

Summary of Pile-head Responses for Conventional Analyses

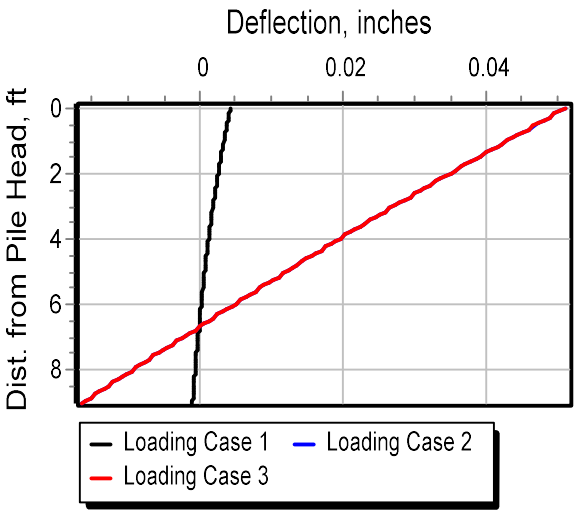
Definitions of Pile-head Loading Conditions:

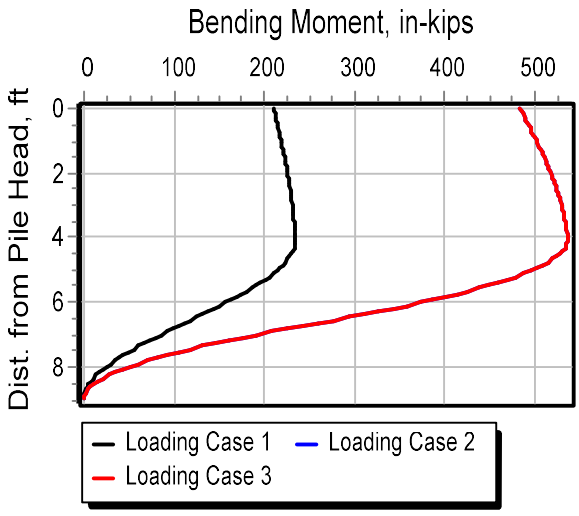
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

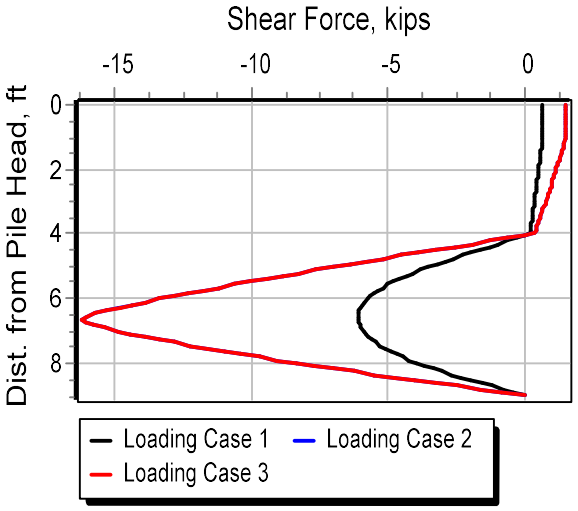
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.004334	-0.0000773	-6089.	234557.
2	1	0.051021	-0.0006899	-16193.	536291.
3	1	0.051011	-0.0006898	-16192.	536276.

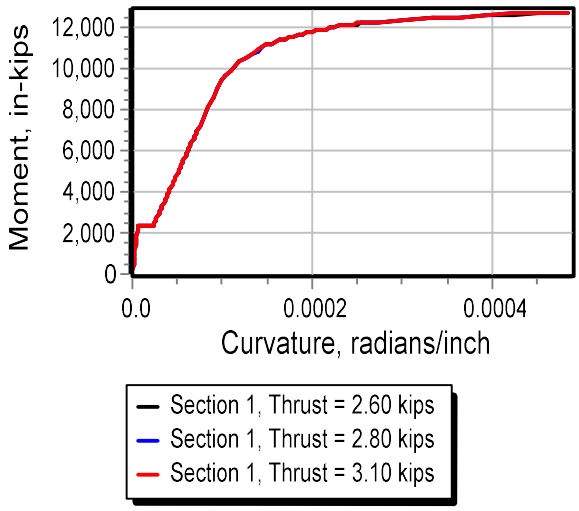
```
Maximum pile-head deflection = 0.0510211833 inches
Maximum pile-head rotation   = -0.0006898956 radians = -0.039528 deg.

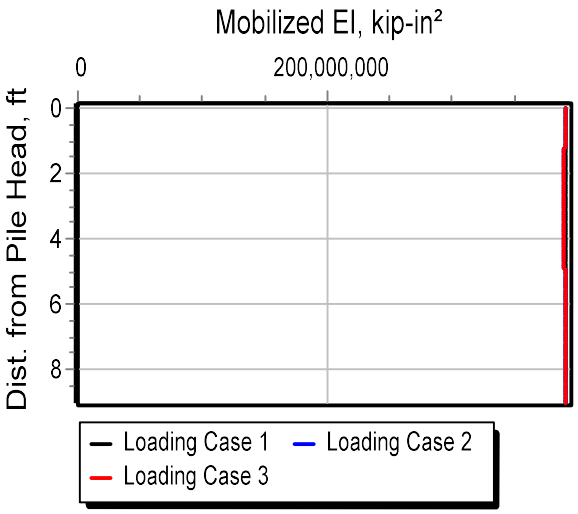
The analysis ended normally.
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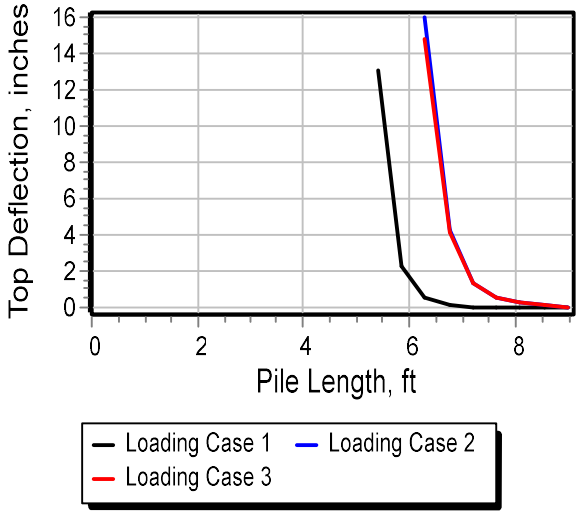

Deflection, inches
0
0.02
0.04
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
100
200
300
400
500
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-15
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 2.60 kips
Section 1, Thrust = 2.80 kips
Section 1, Thrust = 3.10 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
16
14
12
10
8
6
4
2
0
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

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

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\2 luminarie loading\

Name of the input data file:
N4255372_ALL_B-13.lp12d

Name of the output report file:
N4255372_ALL_B-13.lp12o

Name of the plot output file:
N4255372_ALL_B-13.lp12p

Name of the runtime message file:
N4255372_ALL_B-13.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 9:42:39

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-013-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	5.000000 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	=	750.000000 psf
Undrained cohesion at bottom of layer	=	750.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	5.000000 ft
Distance from top of pile to bottom of layer	=	7.000000 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	=	750.000000 psf
Undrained cohesion at bottom of layer	=	750.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	7.000000 ft

```
   Distance from top of pile to bottom of layer        =    14.500000 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                  =        2000. psf
   Undrained cohesion at bottom of layer               =        2000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    14.500000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =        2000. psf
   Undrained cohesion at bottom of layer               =        2000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



--------------------------------------------------------------------------------
                       Modification Factors for p-y Curves
--------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1            1.000         1.0000         1.0000
  2           20.000         1.0000         1.0000



--------------------------------------------------------------------------------
                               Static Loading Type
--------------------------------------------------------------------------------

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 670.000000 lbs	M = 210400. in-lbs	2800.
2	1	V = 1500. lbs	M = 483200. in-lbs	3100.
3	1	V = 1500. lbs	M = 483200. in-lbs	2600.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94

Offset of Center of Rebar Cage from Center of Pile = 0.0000 in
Transverse Reinforcement
Type: Spiral
Number of Transverse Reinf. (per spacing) = 29
Spacing of Transverse Reinf. = 4.500000 in
Yield Stress of Transverse Reinf. = 60000. psi
Diameter of Transverse Reinf. = 0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 4366.378 kips
Tensile Load for Cracking of Concrete = -470.222 kips
Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	2.600
2	2.800
3	3.100

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	2.600	12528.126	0.00300000	-0.00995206
2	2.800	12530.132	0.00300000	-0.00994997
3	3.100	12533.141	0.00300000	-0.00994684

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for

reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	2.600000	12528.	1.690000	8143.	96754995.
2	0.65	2.800000	12530.	1.820000	8145.	96772491.
3	0.65	3.100000	12533.	2.015000	8147.	96798736.
1	0.75	2.600000	12528.	1.950000	9396.	95139949.
2	0.75	2.800000	12530.	2.100000	9398.	95157340.
3	0.75	3.100000	12533.	2.325000	9400.	95183423.
1	0.90	2.600000	12528.	2.340000	11275.	72359421.
2	0.90	2.800000	12530.	2.520000	11277.	72380624.
3	0.90	3.100000	12533.	2.790000	11280.	72412429.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	8959.
2	4.0000	1.2431	No	No	8959.	7975.
3	5.0000	2.2505	Yes	No	16933.	17832.
4	7.0000	1.8155	Yes	No	34766.	43010.
5	14.5000	13.5000	No	No	77776.	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 670. lbs
Moment = 210400. in-lbs
Axial Load = 2800. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.09419050	225037.	-6555.
8.55000	0.16364825	223730.	-6547.
8.10000	0.31268678	223116.	-6699.
7.65000	0.67621747	222661.	-6761.
7.20000	2.01237128	222295.	-6982.
6.75000	6.94734789	225678.	-7936.

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

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

Shear force at pile head = 1500.0 lbs
Applied moment at pile head = 483200.0 in-lbs
Axial thrust load on pile head = 3100.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	1.89302	483200.	1500.	0.000	3.889E+11

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     1.89301518 inches
Computed slope at pile head      =     -0.0216146 radians
Maximum bending moment           =        515285. inch-lbs
Maximum shear force              =        -14372. lbs
Depth of maximum bending moment  =     2.34000000 feet below pile head
Depth of maximum shear force     =     7.29000000 feet below pile head
Number of iterations             =             42
Number of zero deflection points =              1
Pile deflection at ground        =     1.63373074 inches
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

```
Shear      =           1500. lbs
Moment     =         483200. in-lbs
Axial Load =           3100. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	1.89301518	515285.	-14372.
8.55000	3.26138258	513778.	-14451.
8.10000	6.40322830	515280.	-14988.
7.65000	16.39201832	523160.	-16011.

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

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

```
Shear force at pile head                              =       1500.0 lbs
Applied moment at pile head                           =     483200.0 in-lbs
Axial thrust load on pile head                        =       2600.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	1.87999	483200.	1500.	0.000	3.889E+11

Output Summary for Load Case No. 3:

Pile-head deflection	=	1.87999391 inches
Computed slope at pile head	=	-0.0214653 radians
Maximum bending moment	=	514999. inch-lbs
Maximum shear force	=	-14344. lbs
Depth of maximum bending moment	=	2.34000000 feet below pile head
Depth of maximum shear force	=	7.29000000 feet below pile head
Number of iterations	=	42
Number of zero deflection points	=	1
Pile deflection at ground	=	1.62250134 inches

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

Shear	=	1500. lbs
Moment	=	483200. in-lbs
Axial Load	=	2600. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	1.87999391	514999.	-14344.
8.55000	3.22262534	513294.	-14403.
8.10000	6.24647611	514252.	-14882.
7.65000	15.18397425	519762.	-15660.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

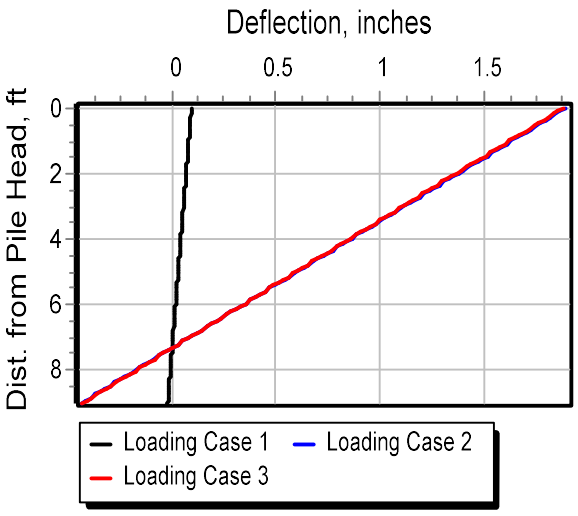
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

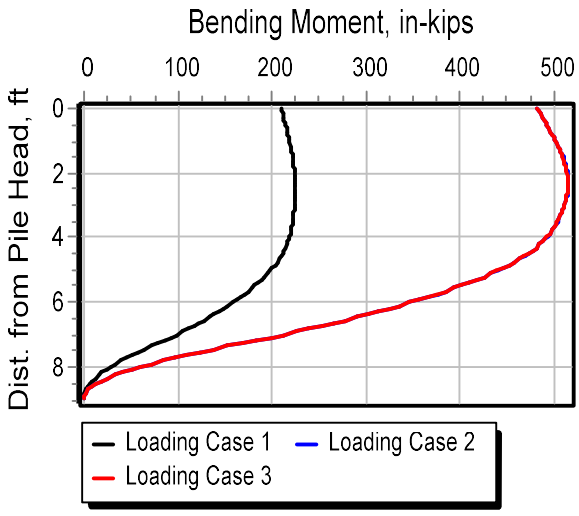
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs

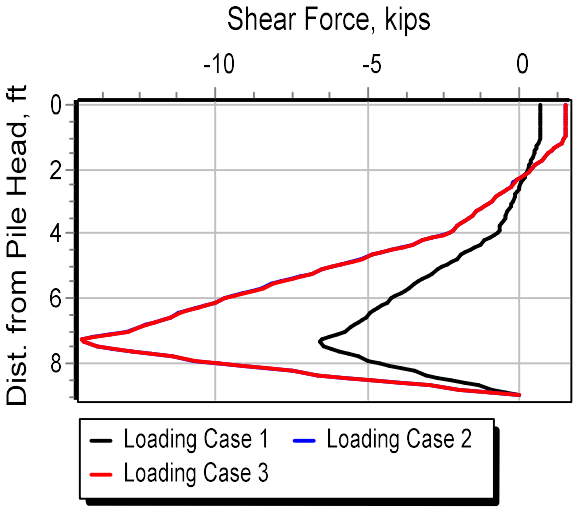
1	1	0.094190	-0.00109	-6555.	225037.
2	1	1.893015	-0.02161	-14372.	515285.
3	1	1.879994	-0.02147	-14344.	514999.

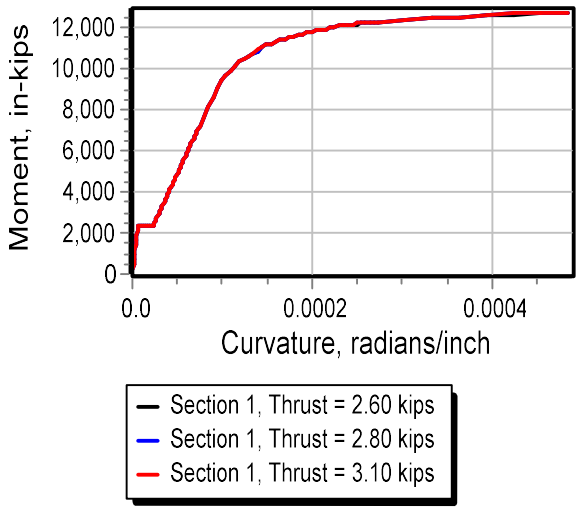
Maximum pile-head deflection = 1.8930151840 inches
Maximum pile-head rotation = -0.0216145934 radians = -1.238425 deg.

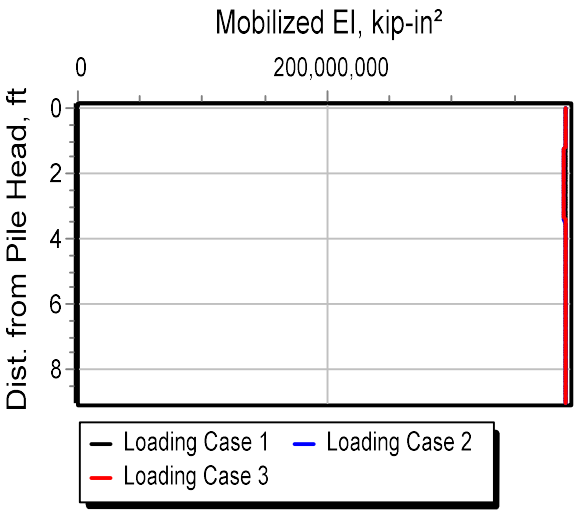
The analysis ended normally.

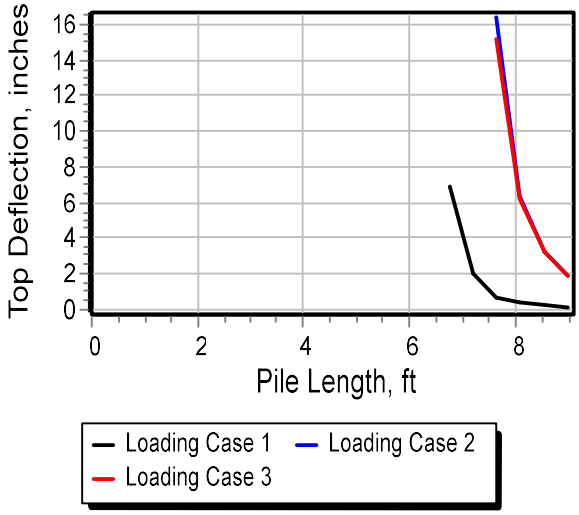

Deflection, inches
0
0.5
1
1.5
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
100
200
300
400
500
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 2.60 kips
Section 1, Thrust = 2.80 kips
Section 1, Thrust = 3.10 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
16
14
12
10
8
6
4
2
0
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\2 luminarie loading\

Name of the input data file:
N4255372_ALL_B-14.lp12d

Name of the output report file:
N4255372_ALL_B-14.lp12o

Name of the plot output file:
N4255372_ALL_B-14.lp12p

Name of the runtime message file:
N4255372_ALL_B-14.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 9:46:11

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-014-0-25

Program Options and Settings

Computational Options:
 - Conventional Analysis
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- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	100

Loading Type and Number of Cycles of Loading:
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 - Analysis uses p-y modification factors for p-y curves
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- Loading by lateral soil movements acting on pile not selected
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Output Options:
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- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 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 feet	Pile Diameter inches
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2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	0.0000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	7.000000 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	=	750.000000 psf
Undrained cohesion at bottom of layer	=	750.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	7.000000 ft
Distance from top of pile to bottom of layer	=	9.500000 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	=	750.000000 psf
Undrained cohesion at bottom of layer	=	750.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	9.500000 ft

```
   Distance from top of pile to bottom of layer        =    14.500000 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                  =  1000.000000 psf
   Undrained cohesion at bottom of layer               =  1000.000000 psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    14.500000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =        2000. psf
   Undrained cohesion at bottom of layer               =        2000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



-------------------------------------------------------------------------------
                      Modification Factors for p-y Curves
-------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1            1.000         1.0000         1.0000
  2           20.000         1.0000         1.0000



-------------------------------------------------------------------------------
                               Static Loading Type
-------------------------------------------------------------------------------

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 670.000000 lbs	M = 210400. in-lbs	2800.
2	1	V = 1500. lbs	M = 483200. in-lbs	3100.
3	1	V = 1500. lbs	M = 483200. in-lbs	2600.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94

Offset of Center of Rebar Cage from Center of Pile = 0.0000 in
Transverse Reinforcement
Type: Spiral
Number of Transverse Reinf. (per spacing) = 29
Spacing of Transverse Reinf. = 4.500000 in
Yield Stress of Transverse Reinf. = 60000. psi
Diameter of Transverse Reinf. = 0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 4366.378 kips
Tensile Load for Cracking of Concrete = -470.222 kips
Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	2.600
2	2.800
3	3.100

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	2.600	12528.126	0.00300000	-0.00995206
2	2.800	12530.132	0.00300000	-0.00994997
3	3.100	12533.141	0.00300000	-0.00994684

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for

reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	2.600000	12528.	1.690000	8143.	96754995.
2	0.65	2.800000	12530.	1.820000	8145.	96772491.
3	0.65	3.100000	12533.	2.015000	8147.	96798736.
1	0.75	2.600000	12528.	1.950000	9396.	95139949.
2	0.75	2.800000	12530.	2.100000	9398.	95157340.
3	0.75	3.100000	12533.	2.325000	9400.	95183423.
1	0.90	2.600000	12528.	2.340000	11275.	72359421.
2	0.90	2.800000	12530.	2.520000	11277.	72380624.
3	0.90	3.100000	12533.	2.790000	11280.	72412429.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	12917.
2	4.0000	1.7473	No	No	12917.	26864.
3	7.0000	4.7836	Yes	No	39781.	20917.
4	9.5000	9.5000	No	No	60698.	0.00
5	14.5000	14.5000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 670. lbs
Moment = 210400. in-lbs
Axial Load = 2800. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.11436306	216080.	-5159.
8.55000	0.18184949	215352.	-5346.
8.10000	0.30338501	214674.	-5540.
7.65000	0.50832063	214124.	-5735.
7.20000	0.86234573	213703.	-5938.
6.75000	1.52181962	213421.	-6144.
6.30000	2.75486180	213362.	-6407.
5.85000	5.39311585	213785.	-6779.
5.40000	13.70583778	216388.	-7896.

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

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

Shear force at pile head = 1500.0 lbs
Applied moment at pile head = 483200.0 in-lbs
Axial thrust load on pile head = 3100.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	2.08695	483200.	1500.	-98.4885	3.889E+11

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     2.08695005 inches
Computed slope at pile head      =     -0.0280553 radians
Maximum bending moment           =        495221. inch-lbs
Maximum shear force              =        -11318. lbs
Depth of maximum bending moment  =     1.26000000 feet below pile head
Depth of maximum shear force     =     6.21000000 feet below pile head
Number of iterations             =             42
Number of zero deflection points =              1
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

```
Shear      =           1500. lbs
Moment     =         483200. in-lbs
Axial Load =           3100. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	2.08695005	495221.	-11318.
8.55000	3.32910626	494351.	-11812.
8.10000	5.63238310	493961.	-12407.
7.65000	10.07073756	494609.	-13223.

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

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

```
Shear force at pile head                          =       1500.0 lbs
Applied moment at pile head                       =     483200.0 in-lbs
Axial thrust load on pile head                    =       2600.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2

```
      0.000      2.06818      483200.        1500.     -98.1924    3.889E+11

Output Summary for Load Case No. 3:

Pile-head deflection             =     2.06818110 inches
Computed slope at pile head      =     -0.0278025 radians
Maximum bending moment           =        495035. inch-lbs
Maximum shear force              =        -11289. lbs
Depth of maximum bending moment  =     1.26000000 feet below pile head
Depth of maximum shear force     =     6.21000000 feet below pile head
Number of iterations             =             41
Number of zero deflection points =              1



--------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 3
--------------------------------------------------------------------------------

Boundary Condition Type 1, Shear and Moment

Shear      =           1500. lbs
Moment     =         483200. in-lbs
Axial Load =           2600. lbs


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
    feet         inches        ln-lbs          lbs
------------  ------------  ------------  ------------
    9.00000    2.06818110       495035.       -11289.
    8.55000    3.28051641       494066.       -11762.
    8.10000    5.49026367       493489.       -12313.
    7.65000    9.59025893       493686.       -13031.
    7.20000   20.61491349       497519.       -14523.

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

Definitions of Pile-head Loading Conditions:

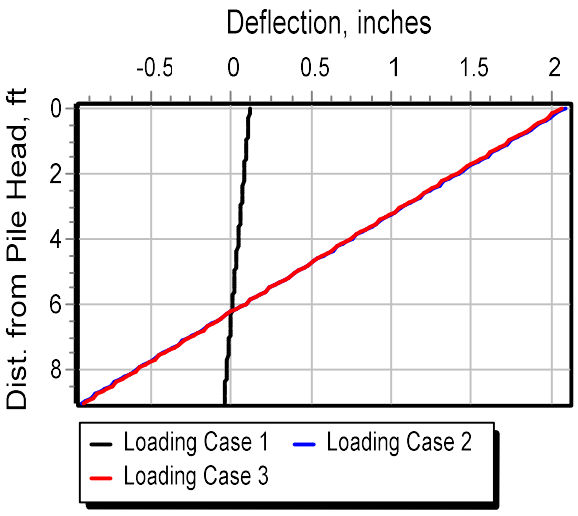
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

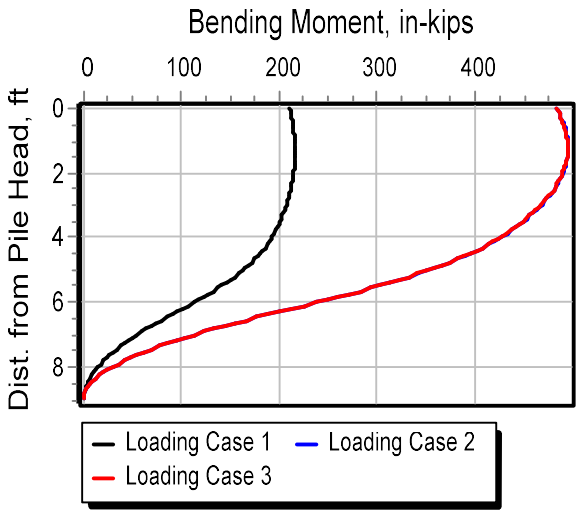

Load            Pile-head      Pile-head      Max Shear     Max Moment
```

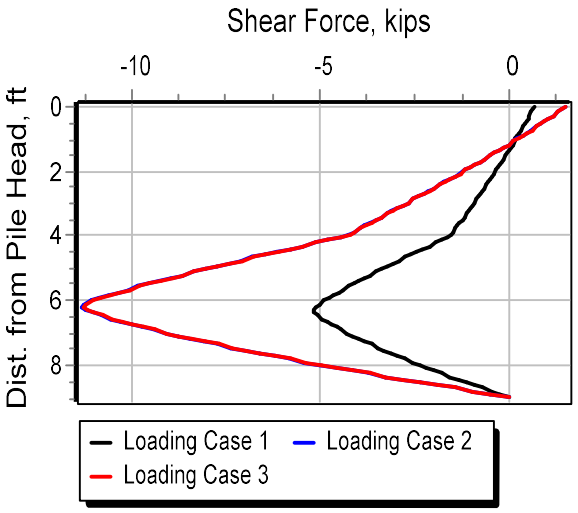
Case No.	Load Type	Deflection inches	Rotation radians	in Pile lbs	in Pile in-lbs
1	1	0.114363	-0.00153	-5159.	216080.
2	1	2.086950	-0.02806	-11318.	495221.
3	1	2.068181	-0.02780	-11289.	495035.

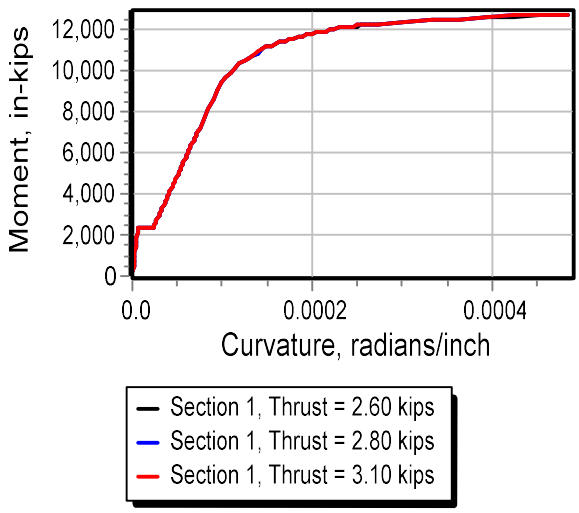
Maximum pile-head deflection = 2.0869500472 inches
Maximum pile-head rotation = -0.0280553285 radians = -1.607452 deg.

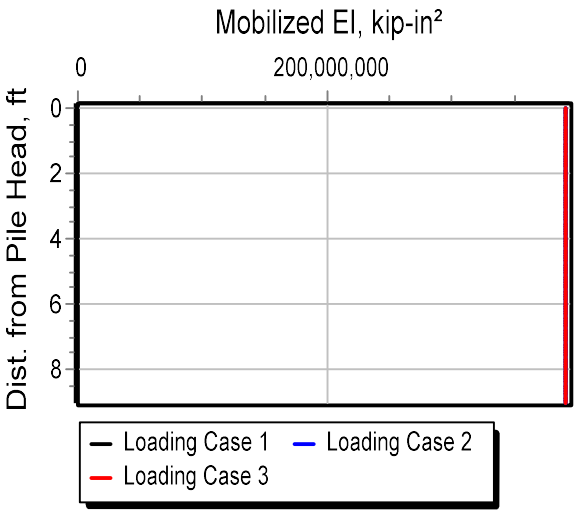
The analysis ended normally.

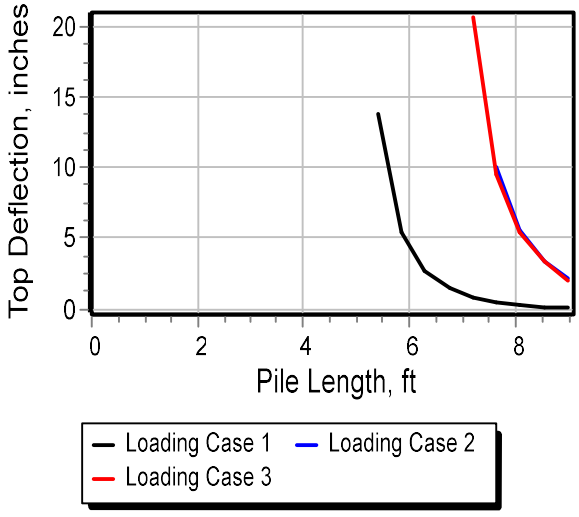

Deflection, inches
-0.5
0
0.5
1
1.5
2
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
100
200
300
400
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 2.60 kips
Section 1, Thrust = 2.80 kips
Section 1, Thrust = 3.10 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
20
15
10
5
0
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\2 luminarie loading\

Name of the input data file:
N4255372_ALL_B-16.lp12d

Name of the output report file:
N4255372_ALL_B-16.lp12o

Name of the plot output file:
N4255372_ALL_B-16.lp12p

Name of the runtime message file:
N4255372_ALL_B-16.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 9:51:57

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-016-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	15.000000 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	=	3000. psf
Undrained cohesion at bottom of layer	=	3000. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	15.000000 ft
Distance from top of pile to bottom of layer	=	17.000000 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	=	3000. psf
Undrained cohesion at bottom of layer	=	3000. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	17.000000 ft

```
   Distance from top of pile to bottom of layer        =    25.000000 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                  =        3000. psf
   Undrained cohesion at bottom of layer               =        3000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    25.000000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =        2000. psf
   Undrained cohesion at bottom of layer               =        2000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



-------------------------------------------------------------------------------
                      Modification Factors for p-y Curves
-------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1            1.000         1.0000         1.0000
  2           20.000         1.0000         1.0000



-------------------------------------------------------------------------------
                               Static Loading Type
-------------------------------------------------------------------------------

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 670.000000 lbs	M = 210400. in-lbs	2800.
2	1	V = 1500. lbs	M = 483200. in-lbs	3100.
3	1	V = 1500. lbs	M = 483200. in-lbs	2600.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94

Offset of Center of Rebar Cage from Center of Pile = 0.0000 in
Transverse Reinforcement
Type: Spiral
Number of Transverse Reinf. (per spacing) = 29
Spacing of Transverse Reinf. = 4.500000 in
Yield Stress of Transverse Reinf. = 60000. psi
Diameter of Transverse Reinf. = 0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 4366.378 kips
Tensile Load for Cracking of Concrete = -470.222 kips
Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	2.600
2	2.800
3	3.100

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	2.600	12528.126	0.00300000	-0.00995206
2	2.800	12530.132	0.00300000	-0.00994997
3	3.100	12533.141	0.00300000	-0.00994684

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for

reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	2.600000	12528.	1.690000	8143.	96754995.
2	0.65	2.800000	12530.	1.820000	8145.	96772491.
3	0.65	3.100000	12533.	2.015000	8147.	96798736.
1	0.75	2.600000	12528.	1.950000	9396.	95139949.
2	0.75	2.800000	12530.	2.100000	9398.	95157340.
3	0.75	3.100000	12533.	2.325000	9400.	95183423.
1	0.90	2.600000	12528.	2.340000	11275.	72359421.
2	0.90	2.800000	12530.	2.520000	11277.	72380624.
3	0.90	3.100000	12533.	2.790000	11280.	72412429.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	9077.
2	4.0000	0.3324	No	No	9077.	159924.
3	15.0000	14.0000	No	No	169001.	0.00
4	17.0000	16.0000	No	No	0.00	0.00
5	25.0000	24.0000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 670. lbs
Moment = 210400. in-lbs
Axial Load = 2800. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.00537617	233835.	-6283.
8.55000	0.00819723	232029.	-7126.
8.10000	0.01686546	229520.	-8134.
7.65000	0.03924454	227161.	-9056.
7.20000	0.09506097	224756.	-9901.
6.75000	0.27940452	223148.	-10881.
6.30000	0.84862736	222299.	-11934.
5.85000	3.24517347	223697.	-13270.

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

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

Shear force at pile head = 1500.0 lbs
Applied moment at pile head = 483200.0 in-lbs
Axial thrust load on pile head = 3100.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	0.08331	483200.	1500.	0.000	3.889E+11

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.08331364 inches
Computed slope at pile head	=	-0.0010945 radians
Maximum bending moment	=	532741. inch-lbs
Maximum shear force	=	-16033. lbs
Depth of maximum bending moment	=	4.05000000 feet below pile head
Depth of maximum shear force	=	6.66000000 feet below pile head
Number of iterations	=	32
Number of zero deflection points	=	1
Pile deflection at ground	=	0.07027063 inches

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

Shear	=	1500. lbs
Moment	=	483200. in-lbs
Axial Load	=	3100. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.08331364	532741.	-16033.
8.55000	0.16074636	526736.	-17143.
8.10000	0.37070222	521751.	-18656.
7.65000	0.88802007	518089.	-20331.
7.20000	2.15854555	514887.	-22107.
6.75000	6.61716977	516372.	-24727.

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

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

Shear force at pile head	=	1500.0 lbs
Applied moment at pile head	=	483200.0 in-lbs
Axial thrust load on pile head	=	2600.0 lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Soil Res. p	Bending Stiffness

feet	inches	in-lbs	lbs	lb/inch	lb-in^2
0.000	0.08329	483200.	1500.	0.000	3.889E+11

Output Summary for Load Case No. 3:

```
Pile-head deflection             =     0.08328514 inches
Computed slope at pile head      =     -0.0010941 radians
Maximum bending moment           =        532718. inch-lbs
Maximum shear force              =        -16031. lbs
Depth of maximum bending moment  =     4.05000000 feet below pile head
Depth of maximum shear force     =     6.66000000 feet below pile head
Number of iterations             =             32
Number of zero deflection points =              1
Pile deflection at ground        =     0.07024644 inches
```

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

```
Shear      =           1500. lbs
Moment     =         483200. in-lbs
Axial Load =           2600. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.08328514	532718.	-16031.
8.55000	0.16063798	526694.	-17139.
8.10000	0.37012569	521664.	-18648.
7.65000	0.88472379	517900.	-20311.
7.20000	2.13907895	514459.	-22053.
6.75000	6.42832994	515034.	-24536.
6.30000	28.31613022	533232.	-29730.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

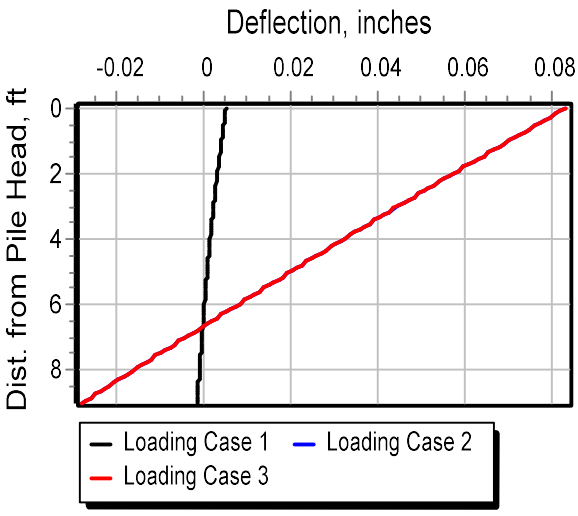
```
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
```

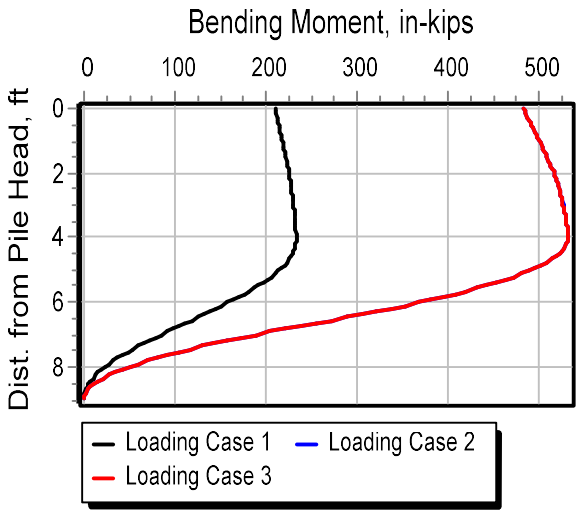
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

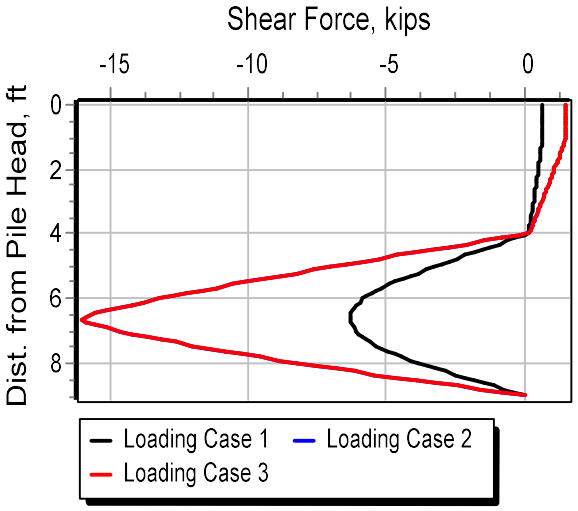
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.005376	-0.0000902	-6283.	233835.
2	1	0.083314	-0.00109	-16033.	532741.
3	1	0.083285	-0.00109	-16031.	532718.

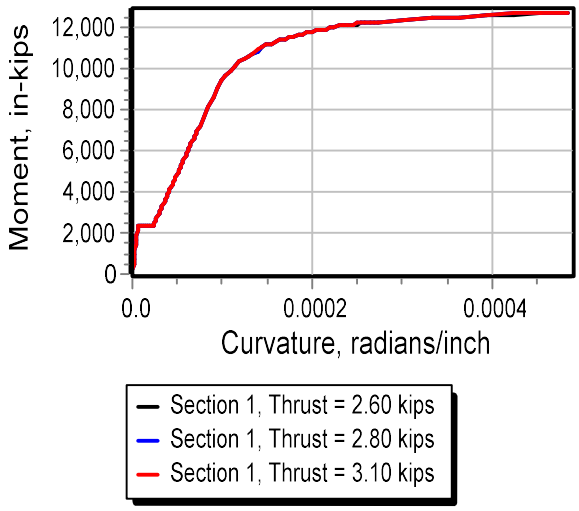
Maximum pile-head deflection = 0.0833136390 inches
Maximum pile-head rotation = -0.0010944706 radians = -0.062709 deg.

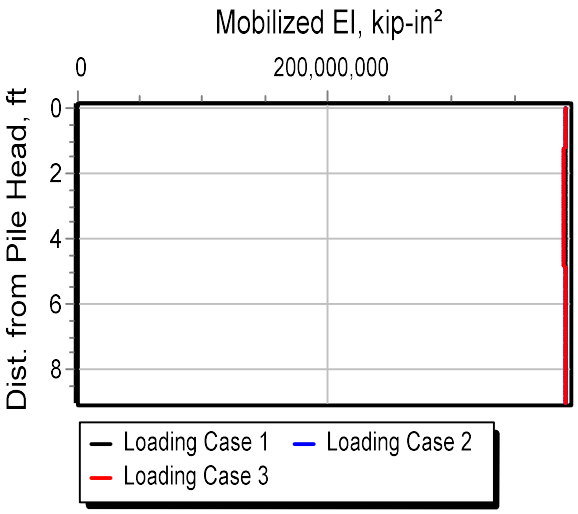
The analysis ended normally.

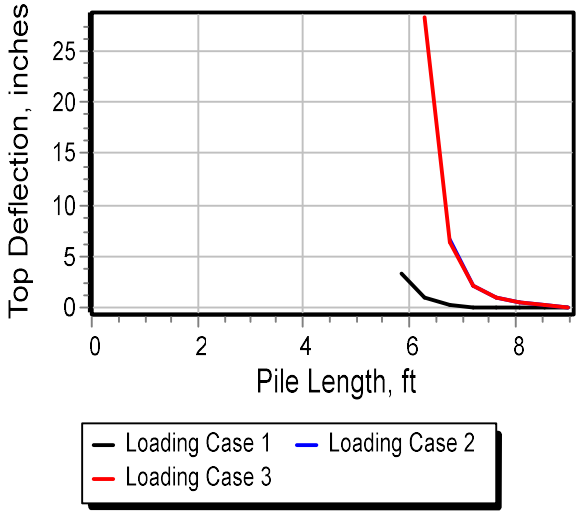

Deflection, inches
-0.02
0
0.02
0.04
0.06
0.08
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
100
200
300
400
500
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-15
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 2.60 kips
Section 1, Thrust = 2.80 kips
Section 1, Thrust = 3.10 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
25
20
15
10
5
0
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\2 luminarie loading\

Name of the input data file:
N4255372_ALL_B-17.lp12d

Name of the output report file:
N4255372_ALL_B-17.lp12o

Name of the plot output file:
N4255372_ALL_B-17.lp12p

Name of the runtime message file:
N4255372_ALL_B-17.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 9:55:42

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-017-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 6 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	5.000000 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	=	1000.000000 psf
Undrained cohesion at bottom of layer	=	1000.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	5.000000 ft
Distance from top of pile to bottom of layer	=	7.000000 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	=	1000.000000 psf
Undrained cohesion at bottom of layer	=	1000.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	7.000000 ft

```
   Distance from top of pile to bottom of layer        =    14.500000 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                  =        3500. psf
   Undrained cohesion at bottom of layer               =        3500. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    14.500000 ft
   Distance from top of pile to bottom of layer        =    19.500000 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                  =        2000. psf
   Undrained cohesion at bottom of layer               =        2000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 6 is stiff clay without free water

   Distance from top of pile to top of layer           =    19.500000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =        2000. psf
   Undrained cohesion at bottom of layer               =        2000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



-------------------------------------------------------------------------------
                      Modification Factors for p-y Curves
-------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1            1.000         1.0000         1.0000
```

```
  2           20.000         1.0000         1.0000
```

Static Loading Type

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 670.000000 lbs	M = 210400. in-lbs	2800.
2	1	V = 1500. lbs	M = 483200. in-lbs	3100.
3	1	V = 1500. lbs	M = 483200. in-lbs	2600.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Transverse Reinforcement
Type: Spiral

Number of Transverse Reinf. (per spacing)	=	29
Spacing of Transverse Reinf.	=	4.500000 in
Yield Stress of Transverse Reinf.	=	60000. psi
Diameter of Transverse Reinf.	=	0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	4366.378 kips
Tensile Load for Cracking of Concrete	=	-470.222 kips
Nominal Axial Tensile Capacity	=	-960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.34165 psi
Compression Strain at Peak Stress	=	0.001886
Tensile Strain at Fracture of Concrete	=	-0.0001154
Maximum Coarse Aggregate Size	=	0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	2.600
2	2.800
3	3.100

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	2.600	12528.126	0.00300000	-0.00995206
2	2.800	12530.132	0.00300000	-0.00994997
3	3.100	12533.141	0.00300000	-0.00994684

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	2.600000	12528.	1.690000	8143.	96754995.
2	0.65	2.800000	12530.	1.820000	8145.	96772491.
3	0.65	3.100000	12533.	2.015000	8147.	96798736.
1	0.75	2.600000	12528.	1.950000	9396.	95139949.
2	0.75	2.800000	12530.	2.100000	9398.	95157340.
3	0.75	3.100000	12533.	2.325000	9400.	95183423.
1	0.90	2.600000	12528.	2.340000	11275.	72359421.
2	0.90	2.800000	12530.	2.520000	11277.	72380624.
3	0.90	3.100000	12533.	2.790000	11280.	72412429.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	8972.
2	4.0000	0.9534	No	No	8972.	10197.
3	5.0000	1.9569	Yes	No	19169.	22728.
4	7.0000	1.2778	Yes	No	41897.	72050.
5	14.5000	13.5000	No	No	113947.	0.00
6	19.5000	18.5000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 670. lbs
Moment = 210400. in-lbs
Axial Load = 2800. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.03119340	227547.	-7257.
8.55000	0.05819048	225666.	-7320.
8.10000	0.11937700	224482.	-7467.
7.65000	0.26632530	223493.	-7498.
7.20000	0.90240658	222130.	-7583.
6.75000	3.47823209	223215.	-8395.
6.30000	9.49578136	227758.	-9439.

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

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

Shear force at pile head = 1500.0 lbs
Applied moment at pile head = 483200.0 in-lbs
Axial thrust load on pile head = 3100.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	0.64606	483200.	1500.	0.000	3.889E+11

Output Summary for Load Case No. 2:

Pile-head deflection = 0.64605574 inches
Computed slope at pile head = -0.0072618 radians
Maximum bending moment = 518789. inch-lbs
Maximum shear force = -16266. lbs
Depth of maximum bending moment = 2.79000000 feet below pile head
Depth of maximum shear force = 7.47000000 feet below pile head
Number of iterations = 39
Number of zero deflection points = 1
Pile deflection at ground = 0.55900463 inches

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

Shear = 1500. lbs
Moment = 483200. in-lbs
Axial Load = 3100. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.64605574	518789.	-16266.
8.55000	1.20033204	515664.	-16219.
8.10000	2.43891000	514652.	-16464.
7.65000	5.62385888	515656.	-16757.

Computed Values of Pile Loading and Deflection

for Lateral Loading for Load Case Number 3

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

Shear force at pile head = 1500.0 lbs
Applied moment at pile head = 483200.0 in-lbs
Axial thrust load on pile head = 2600.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	0.64456	483200.	1500.	0.000	3.889E+11

Output Summary for Load Case No. 3:

Pile-head deflection = 0.64455563 inches
Computed slope at pile head = -0.0072450 radians
Maximum bending moment = 518678. inch-lbs
Maximum shear force = -16256. lbs
Depth of maximum bending moment = 2.79000000 feet below pile head
Depth of maximum shear force = 7.47000000 feet below pile head
Number of iterations = 39
Number of zero deflection points = 1
Pile deflection at ground = 0.55770574 inches

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

Shear = 1500. lbs
Moment = 483200. in-lbs
Axial Load = 2600. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.64455563	518678.	-16256.
8.55000	1.19519401	515471.	-16200.
8.10000	2.41776501	514265.	-16424.
7.65000	5.50273645	514702.	-16655.

Summary of Pile-head Responses for Conventional Analyses

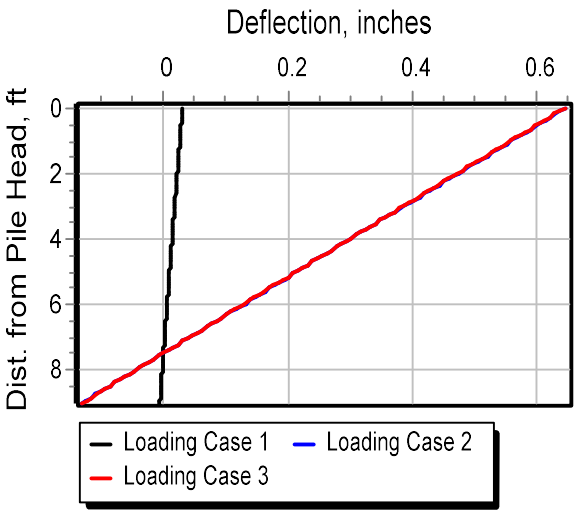
Definitions of Pile-head Loading Conditions:

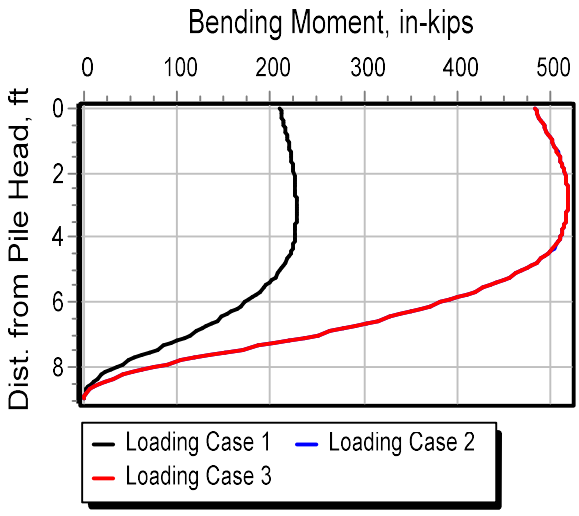
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

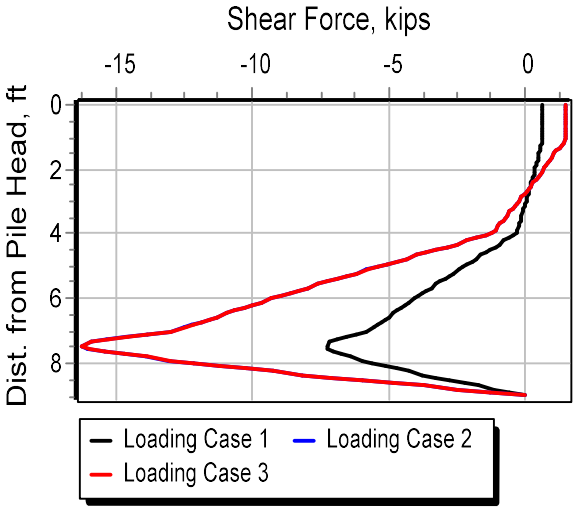
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.031193	-0.0003718	-7257.	227547.
2	1	0.646056	-0.00726	-16266.	518789.
3	1	0.644556	-0.00725	-16256.	518678.

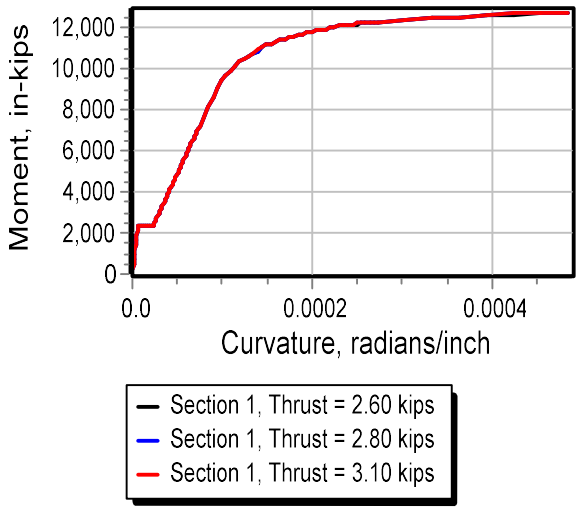
Maximum pile-head deflection = 0.6460557433 inches
Maximum pile-head rotation = -0.0072618133 radians = -0.416071 deg.

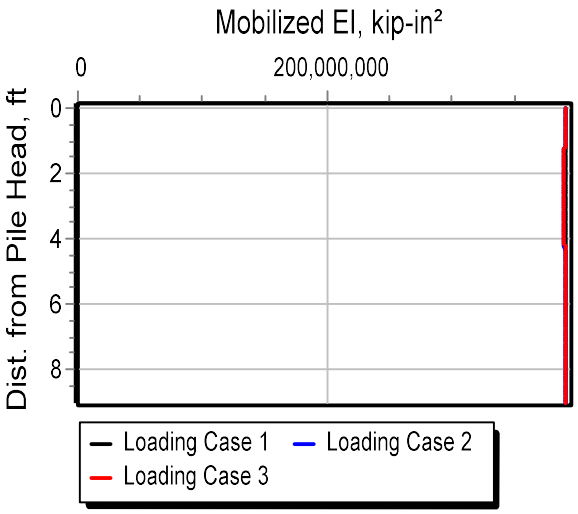
The analysis ended normally.

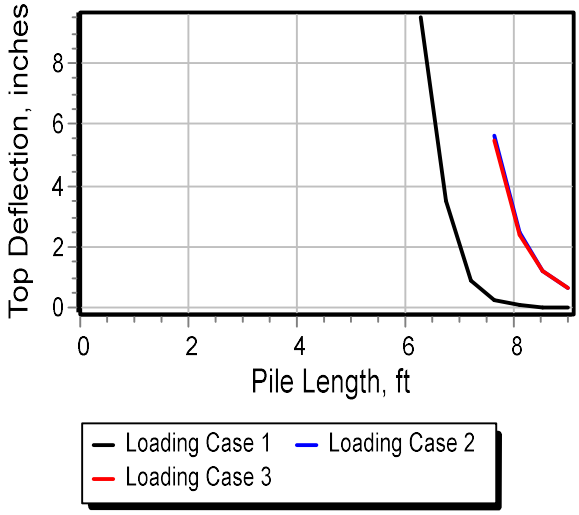

Deflection, inches
0
0.2
0.4
0.6
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
100
200
300
400
500
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-15
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 2.60 kips
Section 1, Thrust = 2.80 kips
Section 1, Thrust = 3.10 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
0
2
4
6
8
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\2 luminarie loading\

Name of the input data file:
N4255372_ALL_B-20.lp12d

Name of the output report file:
N4255372_ALL_B-20.lp12o

Name of the plot output file:
N4255372_ALL_B-20.lp12p

Name of the runtime message file:
N4255372_ALL_B-20.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 9:58:14

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-020-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	9.500000 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	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	9.500000 ft
Distance from top of pile to bottom of layer	=	19.500000 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	=	2500. psf
Undrained cohesion at bottom of layer	=	2500. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	19.500000 ft

```
   Distance from top of pile to bottom of layer        =    24.500000 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                  =  1000.000000 psf
   Undrained cohesion at bottom of layer               =  1000.000000 psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    24.500000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =  1000.000000 psf
   Undrained cohesion at bottom of layer               =  1000.000000 psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



-------------------------------------------------------------------------------
                      Modification Factors for p-y Curves
-------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1           1.000         1.0000         1.0000
  2          20.000         1.0000         1.0000



-------------------------------------------------------------------------------
                               Static Loading Type
-------------------------------------------------------------------------------

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 670.000000 lbs	M = 210400. in-lbs	2800.
2	1	V = 1500. lbs	M = 483200. in-lbs	3100.
3	1	V = 1500. lbs	M = 483200. in-lbs	2600.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94

Offset of Center of Rebar Cage from Center of Pile = 0.0000 in
Transverse Reinforcement
Type: Spiral
Number of Transverse Reinf. (per spacing) = 29
Spacing of Transverse Reinf. = 4.500000 in
Yield Stress of Transverse Reinf. = 60000. psi
Diameter of Transverse Reinf. = 0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 4366.378 kips
Tensile Load for Cracking of Concrete = -470.222 kips
Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	2.600
2	2.800
3	3.100

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	2.600	12528.126	0.00300000	-0.00995206
2	2.800	12530.132	0.00300000	-0.00994997
3	3.100	12533.141	0.00300000	-0.00994684

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for

reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	2.600000	12528.	1.690000	8143.	96754995.
2	0.65	2.800000	12530.	1.820000	8145.	96772491.
3	0.65	3.100000	12533.	2.015000	8147.	96798736.
1	0.75	2.600000	12528.	1.950000	9396.	95139949.
2	0.75	2.800000	12530.	2.100000	9398.	95157340.
3	0.75	3.100000	12533.	2.325000	9400.	95183423.
1	0.90	2.600000	12528.	2.340000	11275.	72359421.
2	0.90	2.800000	12530.	2.520000	11277.	72380624.
3	0.90	3.100000	12533.	2.790000	11280.	72412429.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	8998.
2	4.0000	0.6492	No	No	8998.	83446.
3	9.5000	8.5000	No	No	92444.	0.00
4	19.5000	18.5000	No	No	0.00	0.00
5	24.5000	23.5000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 670. lbs
Moment = 210400. in-lbs
Axial Load = 2800. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.03881044	227083.	-6558.
8.55000	0.07062045	225344.	-6975.
8.10000	0.14922078	224198.	-7479.
7.65000	0.32228024	223333.	-8009.
7.20000	0.68166772	222274.	-8504.
6.75000	1.67685474	222315.	-9143.
6.30000	4.40217204	223896.	-9943.

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

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

Shear force at pile head = 1500.0 lbs
Applied moment at pile head = 483200.0 in-lbs
Axial thrust load on pile head = 3100.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	0.84209	483200.	1500.	0.000	3.889E+11

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     0.84209031 inches
Computed slope at pile head      =     -0.0107348 radians
Maximum bending moment           =        518004. inch-lbs
Maximum shear force              =        -14671. lbs
Depth of maximum bending moment  =     2.70000000 feet below pile head
Depth of maximum shear force     =     6.57000000 feet below pile head
Number of iterations             =             40
Number of zero deflection points =              1
Pile deflection at ground        =     0.71336330 inches
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

```
Shear      =           1500. lbs
Moment     =         483200. in-lbs
Axial Load =           3100. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.84209031	518004.	-14671.
8.55000	1.53480706	515343.	-15521.
8.10000	3.26563320	514992.	-16736.
7.65000	7.43435905	517311.	-18274.
7.20000	19.20013224	526010.	-20645.

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

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

```
Shear force at pile head                          =       1500.0 lbs
Applied moment at pile head                       =     483200.0 in-lbs
Axial thrust load on pile head                    =       2600.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2

```
      0.000      0.83907      483200.        1500.        0.000    3.889E+11

Output Summary for Load Case No. 3:

Pile-head deflection             =     0.83907286 inches
Computed slope at pile head      =     -0.0106964 radians
Maximum bending moment           =        517845. inch-lbs
Maximum shear force              =        -14657. lbs
Depth of maximum bending moment  =     2.70000000 feet below pile head
Depth of maximum shear force     =     6.57000000 feet below pile head
Number of iterations             =             40
Number of zero deflection points =              1
Pile deflection at ground        =     0.71080660 inches



--------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 3
--------------------------------------------------------------------------------

Boundary Condition Type 1, Shear and Moment

Shear      =           1500. lbs
Moment     =         483200. in-lbs
Axial Load =           2600. lbs


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
    feet         inches        ln-lbs          lbs
------------  ------------  ------------  ------------
    9.00000    0.83907286       517845.       -14657.
    8.55000    1.52476471       515068.       -15493.
    8.10000    3.21974959       514406.       -16671.
    7.65000    7.18722708       515877.       -18105.
    7.20000   17.21515584       521079.       -20042.

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

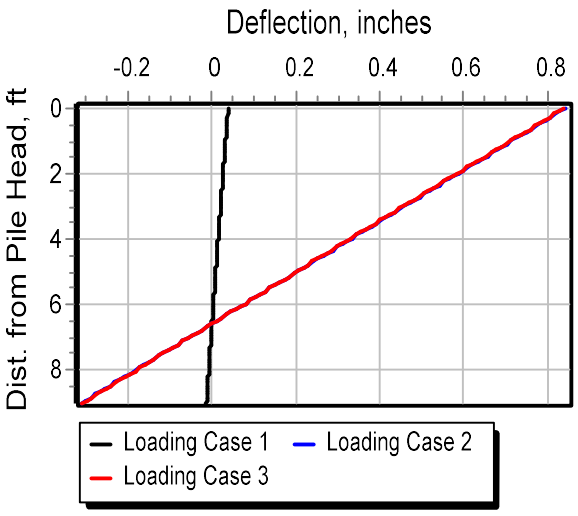
Definitions of Pile-head Loading Conditions:

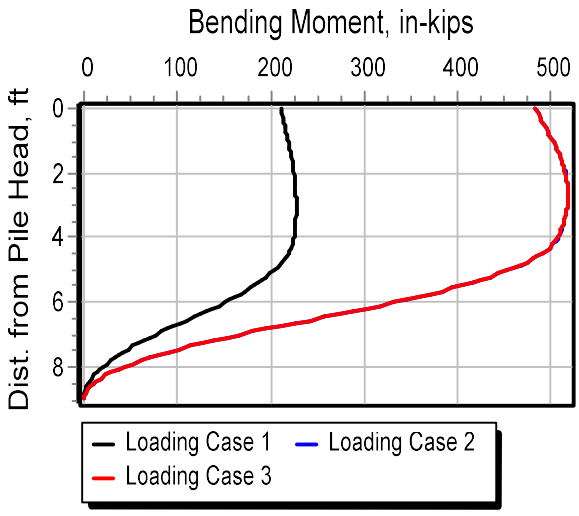
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

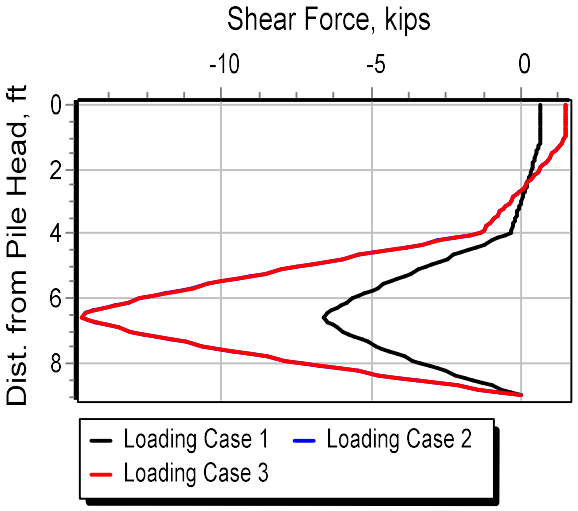
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.038810	-0.0005119	-6558.	227083.
2	1	0.842090	-0.01073	-14671.	518004.
3	1	0.839073	-0.01070	-14657.	517845.

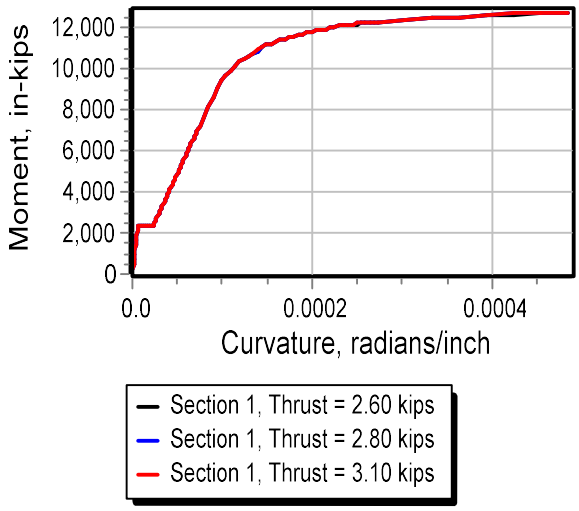
Maximum pile-head deflection = 0.8420903144 inches
Maximum pile-head rotation = -0.0107348056 radians = -0.615059 deg.

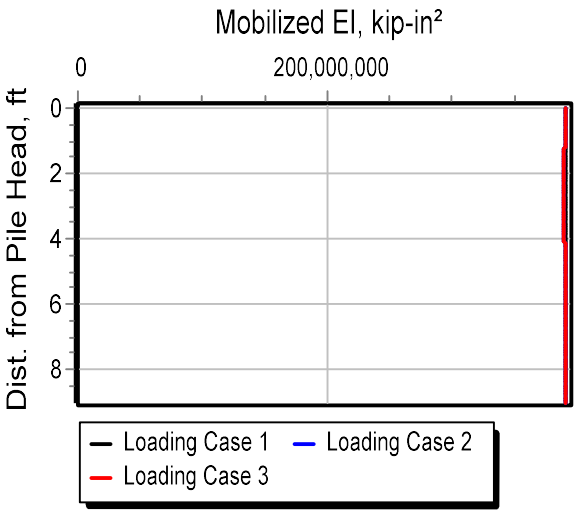
The analysis ended normally.

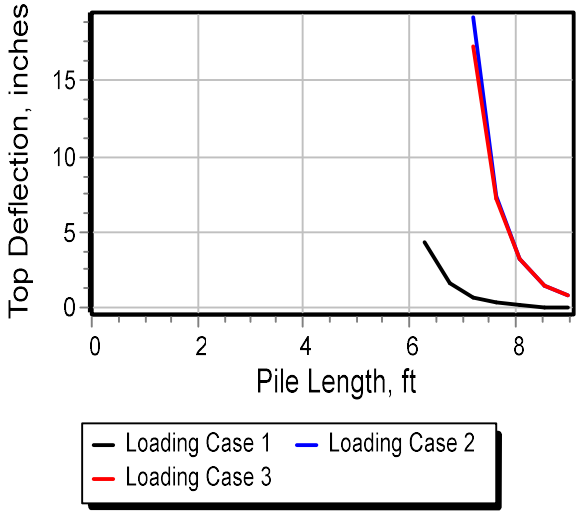

Deflection, inches
-0.2
0
0.2
0.4
0.6
0.8
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
100
200
300
400
500
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 2.60 kips
Section 1, Thrust = 2.80 kips
Section 1, Thrust = 3.10 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
15
10
5
0
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

B-001-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.003643	-0.0000688	-5965.	235119.
2	1	0.028041	-0.0004025	-16246.	539965.
3	1	0.028039	-0.0004025	-16246.	539957.

Service limit state Deflection: .004 + .00007 X 12 X45= **0.04"**

B-005-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.107113	-0.00139	-6207.	224878.
2	1	2.278360	-0.02935	-13833.	515342.
3	1	2.255949	-0.02907	-13795.	514954.

Service limit state Deflection: .12 + .001 X 12 X45= **0.66"**

B-006-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.023965	-0.0003264	-6031.	219548.
2	1	0.470606	-0.00609	-13395.	500778.
3	1	0.469683	-0.00608	-13388.	500719.

Service limit state Deflection: .02 + .0003 X 12 X45= **0.18"**

B-007-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.107113	-0.00139	-6207.	224878.
2	1	2.278360	-0.02935	-13833.	515342.
3	1	2.255949	-0.02907	-13795.	514954.

Service limit state Deflection: .11 + .001 X 12 X45= **0.65"**

B-010-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.004334	-0.0000773	-6089.	234557.
2	1	0.051021	-0.0006899	-16193.	536291.
3	1	0.051011	-0.0006898	-16192.	536276.

Service limit state Deflection: .004 + .00007 X 12 X45= **0.04"**

B-013-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.094190	-0.00109	-6555.	225037.

2	1	1.893015	-0.02161	-14372.	515285.
3	1	1.879994	-0.02147	-14344.	514999.

Service limit state Deflection: .09 + .001 X 12 X45= **0.63"**

B-014-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.029390	-0.0003966	-6685.	227846.
2	1	0.640647	-0.00826	-15040.	519160.
3	1	0.638879	-0.00824	-15029.	519033.

Service limit state Deflection: .03 + .0004 X 12 X45= **0.25"**

B-016-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.005376	-0.0000902	-6283.	233835.
2	1	0.083314	-0.00109	-16033.	532741.
3	1	0.083285	-0.00109	-16031.	532718.

Service limit state Deflection: .005 + .00009 X 12 X45= **0.05"**

B-017-0-25

Load Case No.	Load Type	Pile-head Deflection	Pile-head Rotation	Max Shear in Pile	Max Moment in Pile

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.031193	-0.0003718	-7257.	227547.
2	1	0.646056	-0.00726	-16266.	518789.
3	1	0.644556	-0.00725	-16256.	518678.

Service limit state Deflection: .03 + .0004 X 12 X45= **0.25"**

B-020-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.038810	-0.0005119	-6558.	227083.
2	1	0.842090	-0.01073	-14671.	518004.
3	1	0.839073	-0.01070	-14657.	517845.

Service limit state Deflection: .04 + .0005 X 12 X45= **0.31"**

==========

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\3 luminaire loading\

Name of the input data file:
N4255372_ALL_B-1.lp12d

Name of the output report file:
N4255372_ALL_B-1.lp12o

Name of the plot output file:
N4255372_ALL_B-1.lp12p

Name of the runtime message file:
N4255372_ALL_B-1.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 11:27:14

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-001-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	17.000000 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	=	4000. psf
Undrained cohesion at bottom of layer	=	4000. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	17.000000 ft
Distance from top of pile to bottom of layer	=	26.000000 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	=	2500. psf
Undrained cohesion at bottom of layer	=	2500. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

(Depth of the lowest soil layer extends 17.000 ft below the pile tip)

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	1.000	1.0000	1.0000
2	20.000	1.0000	1.0000

Static Loading Type

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 1000.000000 lbs	M = 315600. in-lbs	4200.
2	1	V = 2250. lbs	M = 724800. in-lbs	4600.
3	1	V = 2250. lbs	M = 724800. in-lbs	3800.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in
Transverse Reinforcement		
Type: Spiral		
Number of Transverse Reinf. (per spacing)	=	29
Spacing of Transverse Reinf.	=	4.500000 in
Yield Stress of Transverse Reinf.	=	60000. psi
Diameter of Transverse Reinf.	=	0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	4366.378 kips
Tensile Load for Cracking of Concrete	=	-470.222 kips
Nominal Axial Tensile Capacity	=	-960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000

6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.34165 psi
Compression Strain at Peak Stress	=	0.001886
Tensile Strain at Fracture of Concrete	=	-0.0001154
Maximum Coarse Aggregate Size	=	0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	3.800
2	4.200
3	4.600

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load	Axial Thrust	Nominal Mom. Cap.	Max. Comp.	Max.

Tens. No.	kips	in-kip	Strain	Strain
1	3.800	12540.163	0.00300000	-0.00993952
2	4.200	12544.175	0.00300000	-0.00993534
3	4.600	12548.187	0.00300000	-0.00993115

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	3.800000	12540.	2.470000	8151.	96860090.
2	0.65	4.200000	12544.	2.730000	8154.	96895160.
3	0.65	4.600000	12548.	2.990000	8156.	96930231.
1	0.75	3.800000	12540.	2.850000	9405.	95244260.
2	0.75	4.200000	12544.	3.150000	9408.	95279011.
3	0.75	4.600000	12548.	3.450000	9411.	95313752.
1	0.90	3.800000	12540.	3.420000	11286.	72486643.

2	0.90	4.200000	12544.	3.780000	11290.
72529052.					
3	0.90	4.600000	12548.	4.140000	11293.
72571461.					

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	9129.
2	4.0000	0.2515	No	No	9129.	211004.
3	17.0000	16.0000	No	No	220133.	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 1000. lbs
Moment = 315600. in-lbs
Axial Load = 4200. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.00745646	354068.	-9857.
8.55000	0.01190531	351754.	-11137.
8.10000	0.02551018	348508.	-12610.
7.65000	0.06138494	344028.	-14020.
7.20000	0.15539831	339589.	-15380.

6.75000	0.49021522	336612.	-17149.
6.30000	1.64752725	335679.	-19168.
5.85000	8.48203434	343976.	-22846.

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

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

Shear force at pile head = 2250.0 lbs
Applied moment at pile head = 724800.0 in-lbs
Axial thrust load on pile head = 4600.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	0.12499	724800.	2250.	0.000	3.882E+11

Output Summary for Load Case No. 2:

Pile-head deflection = 0.12498675 inches
Computed slope at pile head = -0.0016391 radians
Maximum bending moment = 807575. inch-lbs
Maximum shear force = -24502. lbs
Depth of maximum bending moment = 4.05000000 feet below pile head
Depth of maximum shear force = 6.66000000 feet below pile head
Number of iterations = 34
Number of zero deflection points = 1
Pile deflection at ground = 0.10545348 inches

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

Shear = 2250. lbs
Moment = 724800. in-lbs
Axial Load = 4600. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs

9.00000	0.12498675	807575.	-24502.
8.55000	0.24608556	800110.	-26312.
8.10000	0.58639133	791236.	-28808.
7.65000	1.46845238	784481.	-31665.
7.20000	3.84328411	780270.	-34964.
6.75000	14.46364248	792517.	-40957.

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

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

Shear force at pile head = 2250.0 lbs
Applied moment at pile head = 724800.0 in-lbs
Axial thrust load on pile head = 3800.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	0.12492	724800.	2250.	0.000	3.882E+11

Output Summary for Load Case No. 3:

Pile-head deflection = 0.12491795 inches
Computed slope at pile head = -0.0016383 radians
Maximum bending moment = 807518. inch-lbs
Maximum shear force = -24498. lbs
Depth of maximum bending moment = 4.05000000 feet below pile head
Depth of maximum shear force = 6.66000000 feet below pile head
Number of iterations = 34
Number of zero deflection points = 1
Pile deflection at ground = 0.10539508 inches

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

Shear = 2250. lbs
Moment = 724800. in-lbs
Axial Load = 3800. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.12491795	807518.	-24498.
8.55000	0.24581247	799998.	-26304.
8.10000	0.58483243	790979.	-28788.
7.65000	1.45865251	783898.	-31609.
7.20000	3.77513242	778835.	-34799.
6.75000	13.39466538	786208.	-40126.

Summary of Pile-head Responses for Conventional Analyses

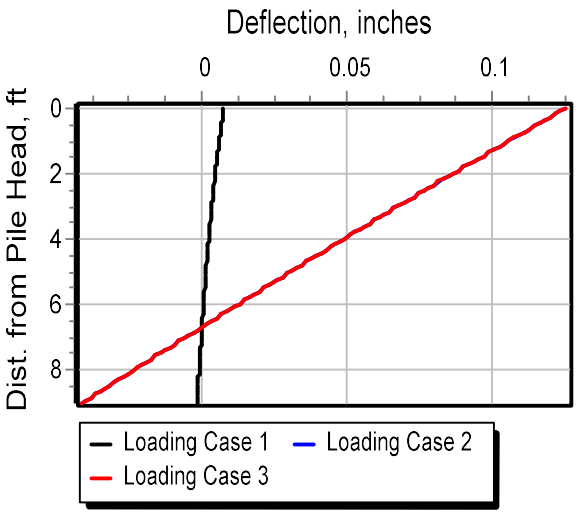
Definitions of Pile-head Loading Conditions:

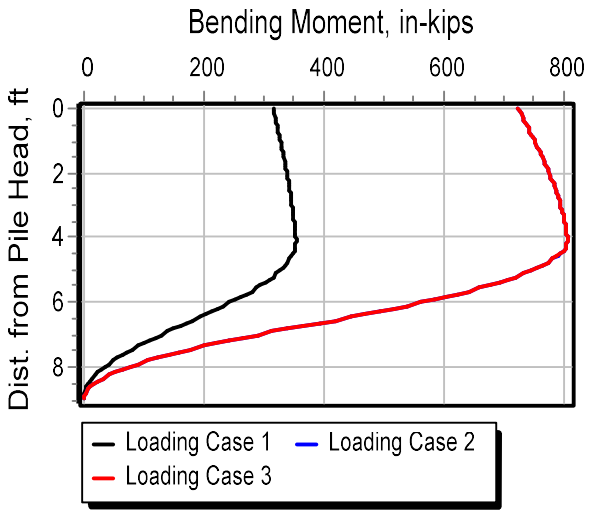
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

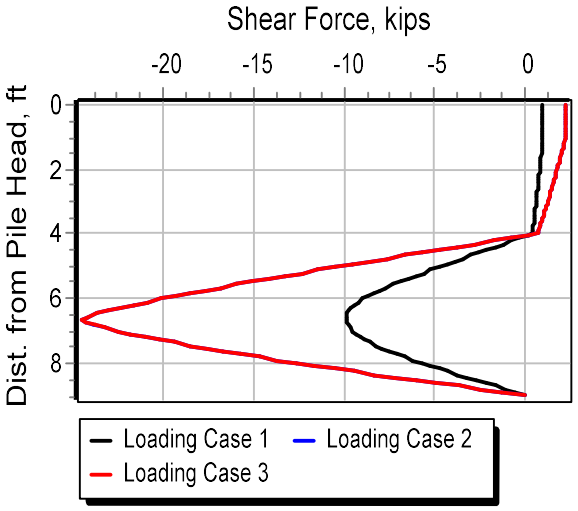
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.007456	-0.0001276	-9857.	354068.
2	1	0.124987	-0.00164	-24502.	807575.
3	1	0.124918	-0.00164	-24498.	807518.

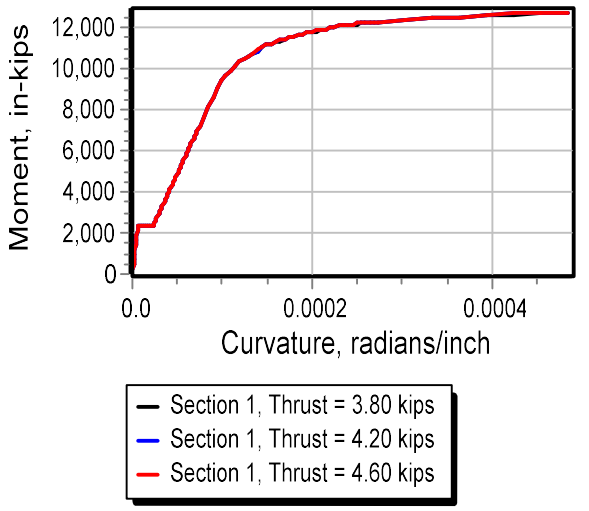
Maximum pile-head deflection = 0.1249867477 inches
Maximum pile-head rotation = -0.0016391219 radians = -0.093915 deg.

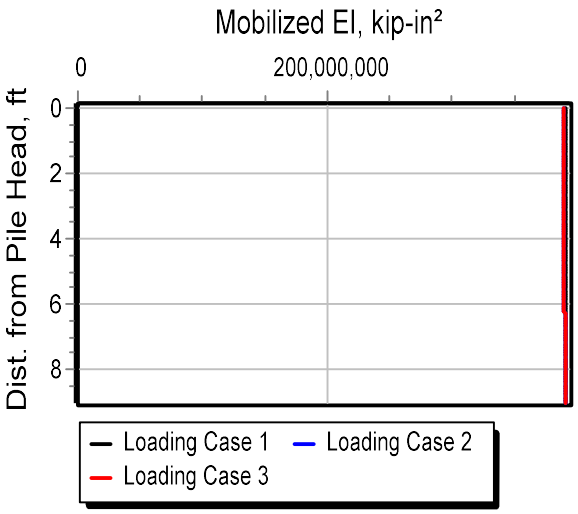
The analysis ended normally.

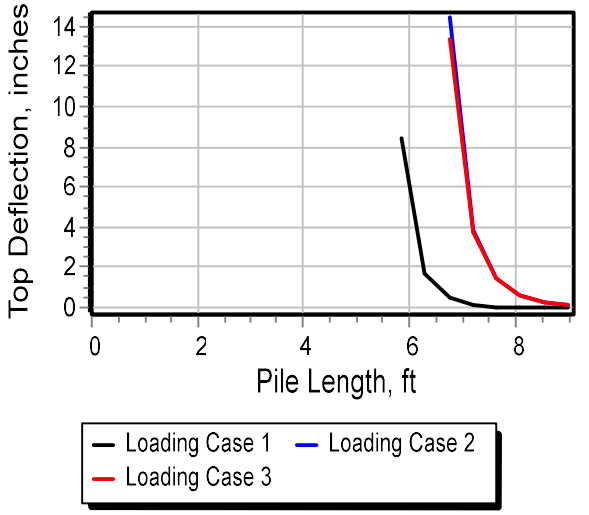

Deflection, inches
0
0.05
0.1
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
200
400
600
800
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-20
-15
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 3.80 kips
Section 1, Thrust = 4.20 kips
Section 1, Thrust = 4.60 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
14
12
10
8
6
4
2
0
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\3 luminaire loading\

Name of the input data file:
N4255372_ALL_B-5.lp12d

Name of the output report file:
N4255372_ALL_B-5.lp12o

Name of the plot output file:
N4255372_ALL_B-5.lp12p

Name of the runtime message file:
N4255372_ALL_B-5.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 11:28:53

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-005-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	5.000000 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	=	1000.000000 psf
Undrained cohesion at bottom of layer	=	1000.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	5.000000 ft
Distance from top of pile to bottom of layer	=	9.500000 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	=	1000.000000 psf
Undrained cohesion at bottom of layer	=	1000.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	9.500000 ft

```
   Distance from top of pile to bottom of layer        =    14.500000 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                  =        3500. psf
   Undrained cohesion at bottom of layer               =        3500. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    14.500000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =        2000. psf
   Undrained cohesion at bottom of layer               =        2000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



-------------------------------------------------------------------------------
                      Modification Factors for p-y Curves
-------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1            1.000         1.0000         1.0000
  2           20.000         1.0000         1.0000



-------------------------------------------------------------------------------
                               Static Loading Type
-------------------------------------------------------------------------------

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 1000.000000 lbs	M = 315600. in-lbs	4200.
2	1	V = 2250. lbs	M = 724800. in-lbs	4600.
3	1	V = 2250. lbs	M = 724800. in-lbs	3800.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94

Offset of Center of Rebar Cage from Center of Pile = 0.0000 in
Transverse Reinforcement
Type: Spiral
Number of Transverse Reinf. (per spacing) = 29
Spacing of Transverse Reinf. = 4.500000 in
Yield Stress of Transverse Reinf. = 60000. psi
Diameter of Transverse Reinf. = 0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 4366.378 kips
Tensile Load for Cracking of Concrete = -470.222 kips
Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	3.800
2	4.200
3	4.600

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	3.800	12540.163	0.00300000	-0.00993952
2	4.200	12544.175	0.00300000	-0.00993534
3	4.600	12548.187	0.00300000	-0.00993115

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for

reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	3.800000	12540.	2.470000	8151.	96860090.
2	0.65	4.200000	12544.	2.730000	8154.	96895160.
3	0.65	4.600000	12548.	2.990000	8156.	96930231.
1	0.75	3.800000	12540.	2.850000	9405.	95244260.
2	0.75	4.200000	12544.	3.150000	9408.	95279011.
3	0.75	4.600000	12548.	3.450000	9411.	95313752.
1	0.90	3.800000	12540.	3.420000	11286.	72486643.
2	0.90	4.200000	12544.	3.780000	11290.	72529052.
3	0.90	4.600000	12548.	4.140000	11293.	72571461.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	8972.
2	4.0000	0.9534	No	No	8972.	10197.
3	5.0000	1.9569	Yes	No	19169.	48100.
4	9.5000	8.5000	No	No	67269.	0.00
5	14.5000	13.5000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 1000. lbs
Moment = 315600. in-lbs
Axial Load = 4200. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.47643889	336977.	-9175.
8.55000	0.83787849	335557.	-9659.
8.10000	1.69339859	335655.	-10343.
7.65000	3.63910688	337266.	-11218.
7.20000	8.47841493	341716.	-12470.

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

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

Shear force at pile head = 2250.0 lbs
Applied moment at pile head = 724800.0 in-lbs
Axial thrust load on pile head = 4600.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	12.63514	724803.	2250.	0.000	3.882E+11

Output Summary for Load Case No. 2:

Pile-head deflection = 12.63513864 inches

```
Computed slope at pile head      =     -0.1640436 radians
Maximum bending moment           =        787002. inch-lbs
Maximum shear force              =        -21778. lbs
Depth of maximum bending moment  =     2.34000000 feet below pile head
Depth of maximum shear force     =     6.39000000 feet below pile head
Number of iterations             =             64
Number of zero deflection points =              1
Pile deflection at ground        =    10.66675179 inches
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

```
Shear      =           2250. lbs
Moment     =         724800. in-lbs
Axial Load =           4600. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	12.63513864	787002.	-21778.

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

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

```
Shear force at pile head                          =       2250.0 lbs
Applied moment at pile head                       =     724800.0 in-lbs
Axial thrust load on pile head                    =       3800.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	11.79541	724797.	2250.	0.000	3.882E+11

Output Summary for Load Case No. 3:

```
Pile-head deflection             =    11.79540843 inches
Computed slope at pile head      =     -0.1530206 radians
```

Maximum bending moment = 782641. inch-lbs
Maximum shear force = -21359. lbs
Depth of maximum bending moment = 2.34000000 feet below pile head
Depth of maximum shear force = 6.39000000 feet below pile head
Number of iterations = 55
Number of zero deflection points = 1
Pile deflection at ground = 9.95929843 inches

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

Shear = 2250. lbs
Moment = 724800. in-lbs
Axial Load = 3800. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	11.79540843	782641.	-21359.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

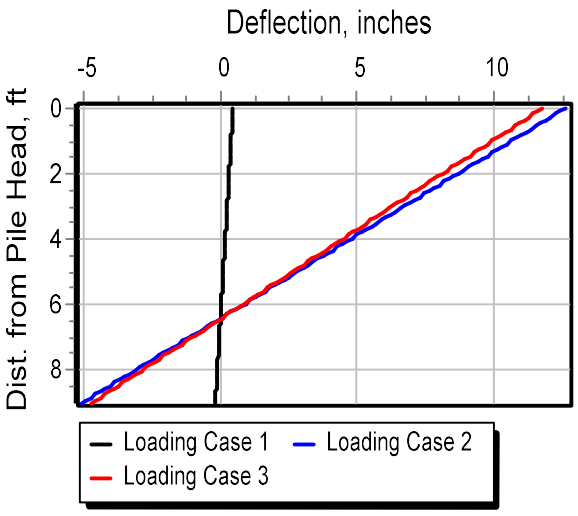
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

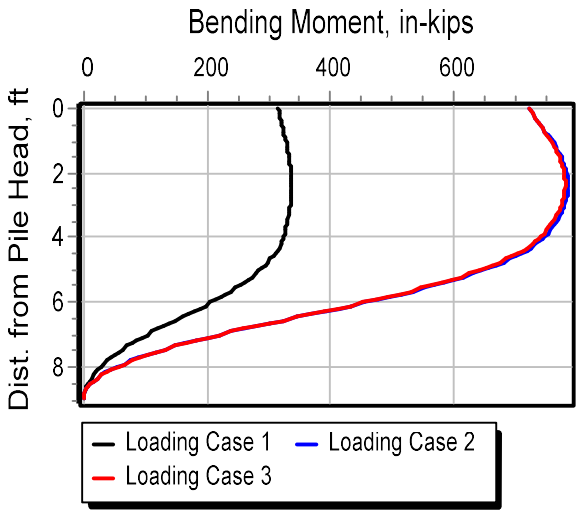
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.476439	-0.00613	-9175.	336977.
2	1	12.635139	-0.16404	-21778.	787002.
3	1	11.795408	-0.15302	-21359.	782641.

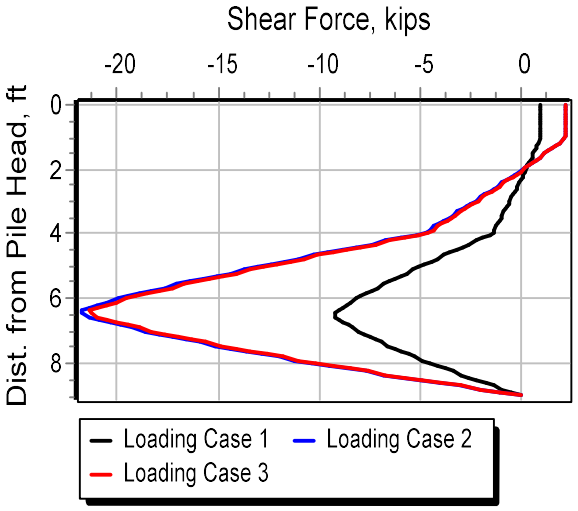
Maximum pile-head deflection = 12.6351386399 inches

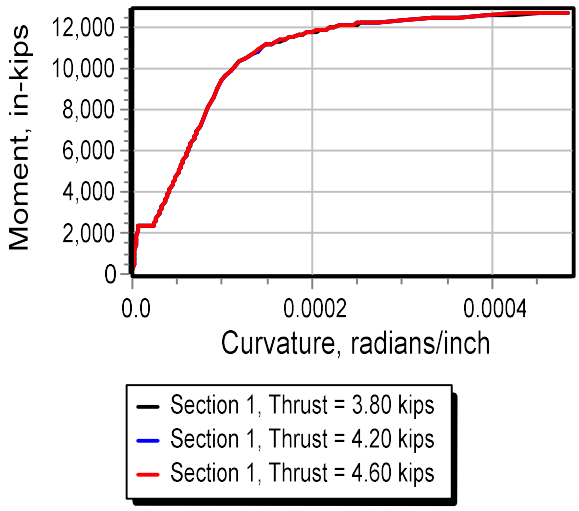
Maximum pile-head rotation   = -0.1640436333 radians = -9.399008 deg.

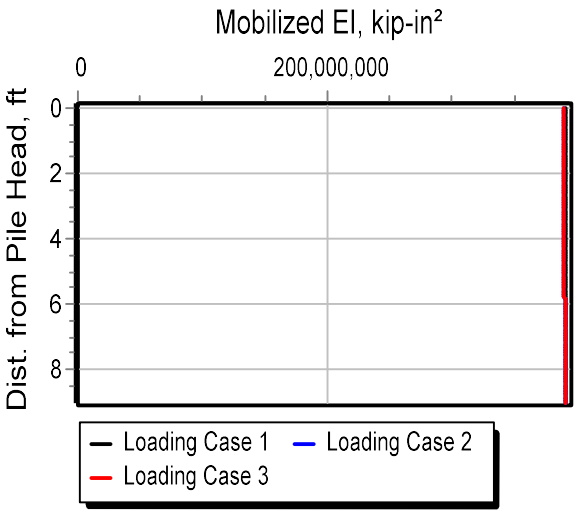
The analysis ended normally.

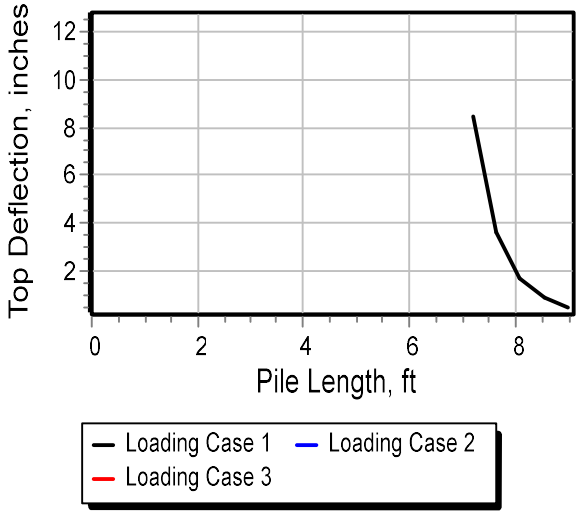

Deflection, inches
-5
0
5
10
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
200
400
600
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-20
-15
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 3.80 kips
Section 1, Thrust = 4.20 kips
Section 1, Thrust = 4.60 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
12
10
8
6
4
2
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

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License Type : (Enterprise Cloud License)

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

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\3 luminaire loading\

Name of the input data file:
N4255372_ALL_B-6.lp12d

Name of the output report file:
N4255372_ALL_B-6.lp12o

Name of the plot output file:
N4255372_ALL_B-6.lp12p

Name of the runtime message file:
N4255372_ALL_B-6.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 11:30:10

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-006-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	0.0000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	9.500000 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	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	9.500000 ft
Distance from top of pile to bottom of layer	=	14.500000 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	=	3500. psf
Undrained cohesion at bottom of layer	=	3500. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	14.500000 ft

```
   Distance from top of pile to bottom of layer        =    17.000000 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                  =        2500. psf
   Undrained cohesion at bottom of layer               =        2500. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    17.000000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =        2500. psf
   Undrained cohesion at bottom of layer               =        2500. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



-------------------------------------------------------------------------------
                      Modification Factors for p-y Curves
-------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1            1.000         1.0000         1.0000
  2           20.000         1.0000         1.0000



-------------------------------------------------------------------------------
                               Static Loading Type
-------------------------------------------------------------------------------

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 1000.000000 lbs	M = 315600. in-lbs	4200.
2	1	V = 2250. lbs	M = 724800. in-lbs	4600.
3	1	V = 2250. lbs	M = 724800. in-lbs	3800.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94

Offset of Center of Rebar Cage from Center of Pile = 0.0000 in
Transverse Reinforcement
Type: Spiral
Number of Transverse Reinf. (per spacing) = 29
Spacing of Transverse Reinf. = 4.500000 in
Yield Stress of Transverse Reinf. = 60000. psi
Diameter of Transverse Reinf. = 0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 4366.378 kips
Tensile Load for Cracking of Concrete = -470.222 kips
Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	3.800
2	4.200
3	4.600

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	3.800	12540.163	0.00300000	-0.00993952
2	4.200	12544.175	0.00300000	-0.00993534
3	4.600	12548.187	0.00300000	-0.00993115

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for

reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	3.800000	12540.	2.470000	8151.	96860090.
2	0.65	4.200000	12544.	2.730000	8154.	96895160.
3	0.65	4.600000	12548.	2.990000	8156.	96930231.
1	0.75	3.800000	12540.	2.850000	9405.	95244260.
2	0.75	4.200000	12544.	3.150000	9408.	95279011.
3	0.75	4.600000	12548.	3.450000	9411.	95313752.
1	0.90	3.800000	12540.	3.420000	11286.	72486643.
2	0.90	4.200000	12544.	3.780000	11290.	72529052.
3	0.90	4.600000	12548.	4.140000	11293.	72571461.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	12972.
2	4.0000	0.9256	No	No	12972.	85084.
3	9.5000	9.5000	No	No	98056.	0.00
4	14.5000	14.5000	No	No	0.00	0.00
5	17.0000	17.0000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 1000. lbs
Moment = 315600. in-lbs
Axial Load = 4200. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.10220700	328329.	-8957.
8.55000	0.17702856	326447.	-9396.
8.10000	0.33446680	324666.	-9868.
7.65000	0.63574238	323290.	-10339.
7.20000	1.22410464	322333.	-10831.
6.75000	2.55207082	321884.	-11343.
6.30000	5.63103990	322553.	-12027.

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

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

Shear force at pile head = 2250.0 lbs
Applied moment at pile head = 724800.0 in-lbs
Axial thrust load on pile head = 4600.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	2.10909	724800.	2250.	-98.8356	3.882E+11

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     2.10909088 inches
Computed slope at pile head      =     -0.0272354 radians
Maximum bending moment           =        750969. inch-lbs
Maximum shear force              =        -19840. lbs
Depth of maximum bending moment  =     1.80000000 feet below pile head
Depth of maximum shear force     =     6.48000000 feet below pile head
Number of iterations             =             43
Number of zero deflection points =              1
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

```
Shear      =           2250. lbs
Moment     =         724800. in-lbs
Axial Load =           4600. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	2.10909088	750969.	-19840.
8.55000	3.68301723	748741.	-20910.
8.10000	7.19757557	748026.	-22297.
7.65000	15.63670571	751896.	-24458.

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

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

```
Shear force at pile head                              =       2250.0 lbs
Applied moment at pile head                           =     724800.0 in-lbs
Axial thrust load on pile head                        =       3800.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	2.08895	724800.	2250.	-98.5199	3.882E+11

Output Summary for Load Case No. 3:

```
Pile-head deflection             =     2.08894845 inches
Computed slope at pile head      =     -0.0269735 radians
Maximum bending moment           =        750558. inch-lbs
Maximum shear force              =        -19787. lbs
Depth of maximum bending moment  =     1.80000000 feet below pile head
Depth of maximum shear force     =     6.48000000 feet below pile head
Number of iterations             =             43
Number of zero deflection points =              1
```

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

```
Shear      =           2250. lbs
Moment     =         724800. in-lbs
Axial Load =           3800. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	2.08894845	750558.	-19787.
8.55000	3.62048289	748069.	-20810.
8.10000	6.95299628	746709.	-22081.
7.65000	14.30340596	748358.	-23853.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

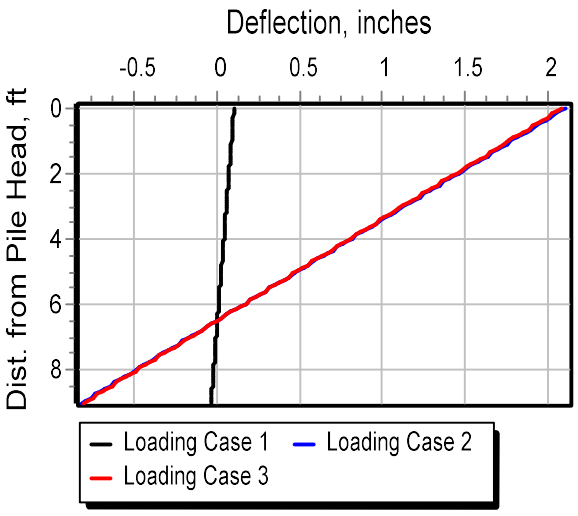
```
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs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

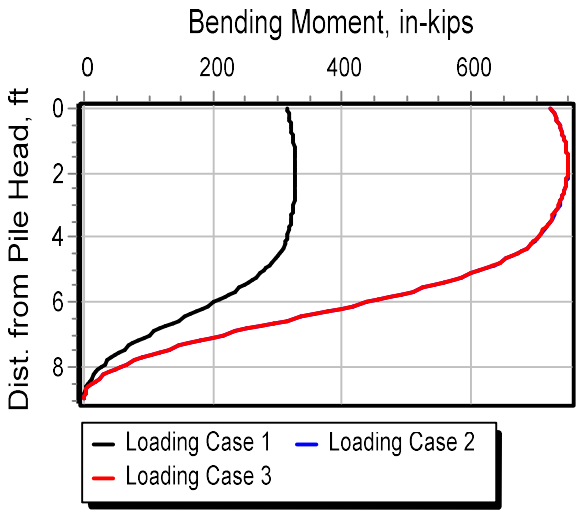
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs

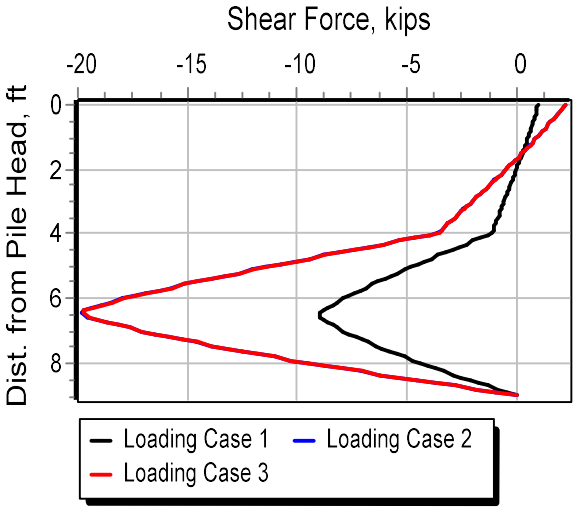
1	1	0.102207	-0.00134	-8957.	328329.
2	1	2.109091	-0.02724	-19840.	750969.
3	1	2.088948	-0.02697	-19787.	750558.

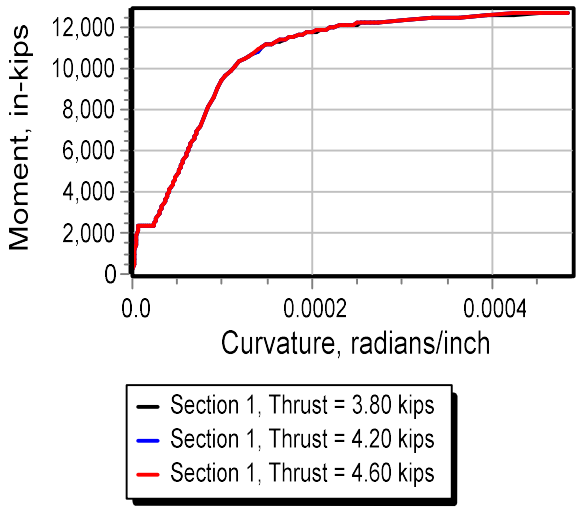
Maximum pile-head deflection = 2.1090908817 inches
Maximum pile-head rotation = -0.0272354216 radians = -1.560475 deg.

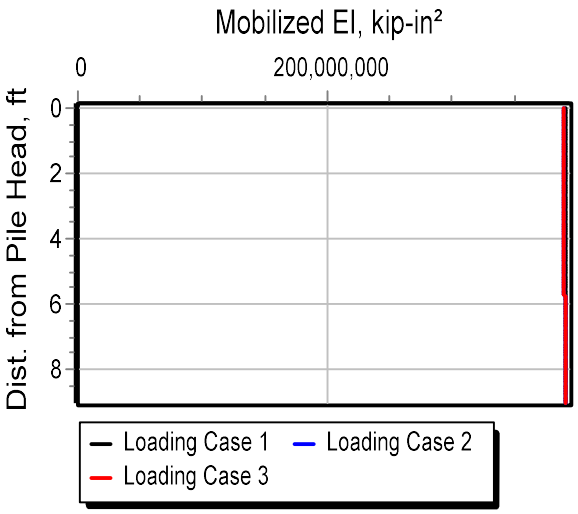
The analysis ended normally.

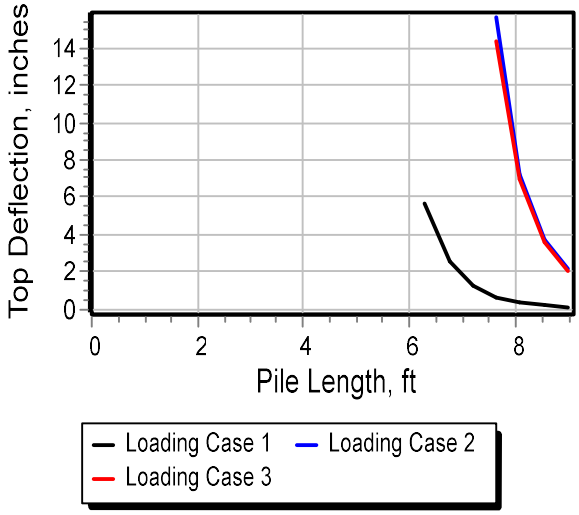

Deflection, inches
-0.5
0
0.5
1
1.5
2
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
200
400
600
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-20
-15
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 3.80 kips
Section 1, Thrust = 4.20 kips
Section 1, Thrust = 4.60 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
14
12
10
8
6
4
2
0
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

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License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\3 luminaire loading\

Name of the input data file:
N4255372_ALL_B-7.lp12d

Name of the output report file:
N4255372_ALL_B-7.lp12o

Name of the plot output file:
N4255372_ALL_B-7.lp12p

Name of the runtime message file:
N4255372_ALL_B-7.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 11:31:27

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-007-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	5.000000 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	=	1000.000000 psf
Undrained cohesion at bottom of layer	=	1000.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	5.000000 ft
Distance from top of pile to bottom of layer	=	9.500000 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	=	1000.000000 psf
Undrained cohesion at bottom of layer	=	1000.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	9.500000 ft

```
   Distance from top of pile to bottom of layer        =    14.500000 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                  =        3000. psf
   Undrained cohesion at bottom of layer               =        3000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    14.500000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =        2500. psf
   Undrained cohesion at bottom of layer               =        2500. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



-------------------------------------------------------------------------------
                      Modification Factors for p-y Curves
-------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1            1.000         1.0000         1.0000
  2           20.000         1.0000         1.0000



-------------------------------------------------------------------------------
                               Static Loading Type
-------------------------------------------------------------------------------

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 1000.000000 lbs	M = 315600. in-lbs	4200.
2	1	V = 2250. lbs	M = 724800. in-lbs	4600.
3	1	V = 2250. lbs	M = 724800. in-lbs	3800.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94

Offset of Center of Rebar Cage from Center of Pile = 0.0000 in
Transverse Reinforcement
Type: Spiral
Number of Transverse Reinf. (per spacing) = 29
Spacing of Transverse Reinf. = 4.500000 in
Yield Stress of Transverse Reinf. = 60000. psi
Diameter of Transverse Reinf. = 0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 4366.378 kips
Tensile Load for Cracking of Concrete = -470.222 kips
Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	3.800
2	4.200
3	4.600

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	3.800	12540.163	0.00300000	-0.00993952
2	4.200	12544.175	0.00300000	-0.00993534
3	4.600	12548.187	0.00300000	-0.00993115

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for

reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	3.800000	12540.	2.470000	8151.	96860090.
2	0.65	4.200000	12544.	2.730000	8154.	96895160.
3	0.65	4.600000	12548.	2.990000	8156.	96930231.
1	0.75	3.800000	12540.	2.850000	9405.	95244260.
2	0.75	4.200000	12544.	3.150000	9408.	95279011.
3	0.75	4.600000	12548.	3.450000	9411.	95313752.
1	0.90	3.800000	12540.	3.420000	11286.	72486643.
2	0.90	4.200000	12544.	3.780000	11290.	72529052.
3	0.90	4.600000	12548.	4.140000	11293.	72571461.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	8972.
2	4.0000	0.9534	No	No	8972.	10197.
3	5.0000	1.9569	Yes	No	19169.	48100.
4	9.5000	8.5000	No	No	67269.	0.00
5	14.5000	13.5000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 1000. lbs
Moment = 315600. in-lbs
Axial Load = 4200. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.47643889	336977.	-9175.
8.55000	0.83787849	335557.	-9659.
8.10000	1.69339859	335655.	-10343.
7.65000	3.63910688	337266.	-11218.
7.20000	8.47841493	341716.	-12470.

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

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

Shear force at pile head = 2250.0 lbs
Applied moment at pile head = 724800.0 in-lbs
Axial thrust load on pile head = 4600.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	12.63514	724803.	2250.	0.000	3.882E+11

Output Summary for Load Case No. 2:

Pile-head deflection = 12.63513864 inches

```
Computed slope at pile head      =     -0.1640436 radians
Maximum bending moment           =        787002. inch-lbs
Maximum shear force              =        -21778. lbs
Depth of maximum bending moment  =     2.34000000 feet below pile head
Depth of maximum shear force     =     6.39000000 feet below pile head
Number of iterations             =             64
Number of zero deflection points =              1
Pile deflection at ground        =    10.66675179 inches
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

```
Shear      =           2250. lbs
Moment     =         724800. in-lbs
Axial Load =           4600. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	12.63513864	787002.	-21778.

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

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

```
Shear force at pile head                          =       2250.0 lbs
Applied moment at pile head                       =     724800.0 in-lbs
Axial thrust load on pile head                    =       3800.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	11.79541	724797.	2250.	0.000	3.882E+11

Output Summary for Load Case No. 3:

```
Pile-head deflection             =    11.79540843 inches
Computed slope at pile head      =     -0.1530206 radians
```

Maximum bending moment = 782641. inch-lbs
Maximum shear force = -21359. lbs
Depth of maximum bending moment = 2.34000000 feet below pile head
Depth of maximum shear force = 6.39000000 feet below pile head
Number of iterations = 55
Number of zero deflection points = 1
Pile deflection at ground = 9.95929843 inches

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

Shear = 2250. lbs
Moment = 724800. in-lbs
Axial Load = 3800. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	11.79540843	782641.	-21359.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

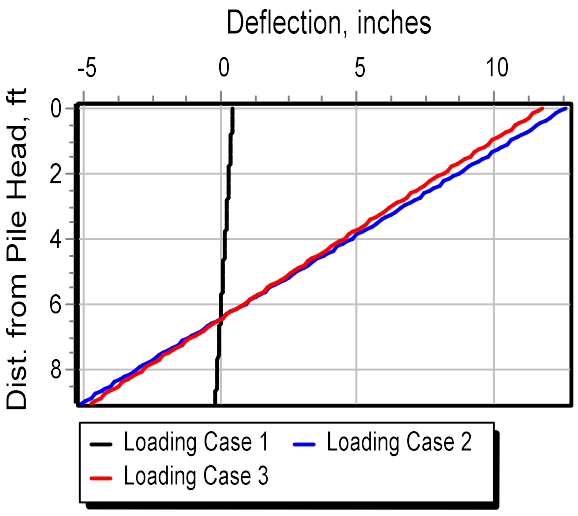
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

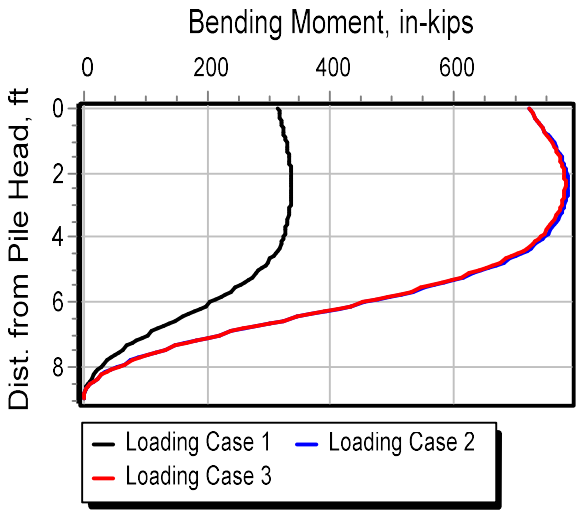
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.476439	-0.00613	-9175.	336977.
2	1	12.635139	-0.16404	-21778.	787002.
3	1	11.795408	-0.15302	-21359.	782641.

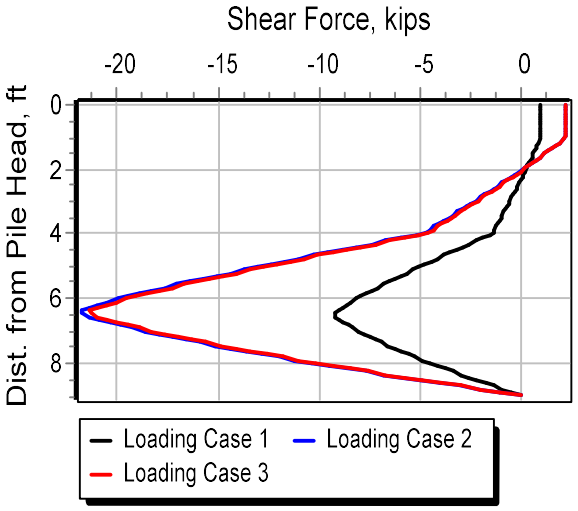
Maximum pile-head deflection = 12.6351386399 inches

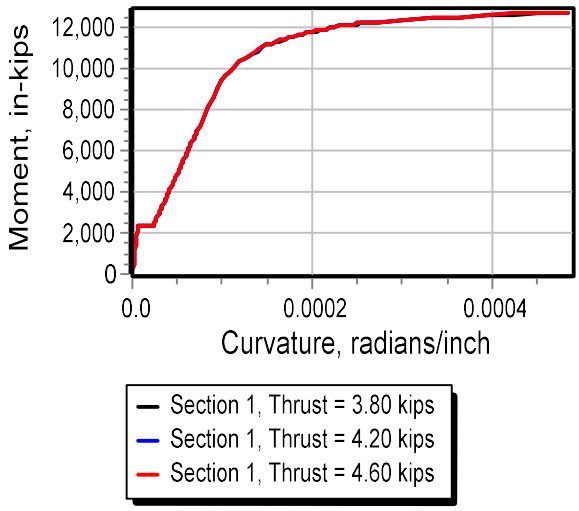
Maximum pile-head rotation   = -0.1640436333 radians = -9.399008 deg.

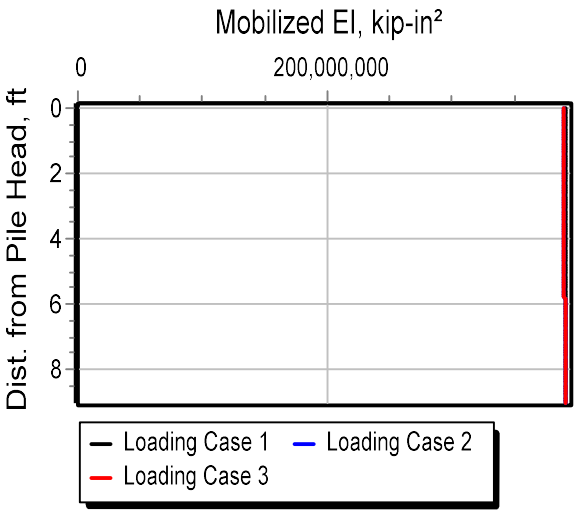
The analysis ended normally.

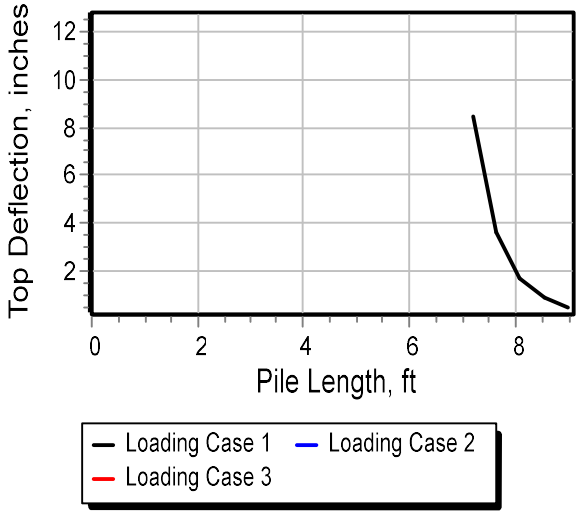

Deflection, inches
-5
0
5
10
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
200
400
600
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-20
-15
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 3.80 kips
Section 1, Thrust = 4.20 kips
Section 1, Thrust = 4.60 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
12
10
8
6
4
2
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\3 luminaire loading\

Name of the input data file:
N4255372_ALL_B-10.lp12d

Name of the output report file:
N4255372_ALL_B-10.lp12o

Name of the plot output file:
N4255372_ALL_B-10.lp12p

Name of the runtime message file:
N4255372_ALL_B-10.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 11:32:33

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-010-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	9.500000 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	=	3500. psf
Undrained cohesion at bottom of layer	=	3500. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	9.500000 ft
Distance from top of pile to bottom of layer	=	19.500000 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	=	2000. psf
Undrained cohesion at bottom of layer	=	2000. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	19.500000 ft

Distance from top of pile to bottom of layer	=	26.000000 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	=	2000. psf
Undrained cohesion at bottom of layer	=	2000. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

(Depth of the lowest soil layer extends 17.000 ft below the pile tip)

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	1.000	1.0000	1.0000
2	20.000	1.0000	1.0000

Static Loading Type

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 1000.000000 lbs	M = 315600. in-lbs	4200.
2	1	V = 2250. lbs	M = 724800. in-lbs	4600.
3	1	V = 2250. lbs	M = 724800. in-lbs	3800.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Transverse Reinforcement
Type: Spiral

Number of Transverse Reinf. (per spacing)	=	29
Spacing of Transverse Reinf.	=	4.500000 in
Yield Stress of Transverse Reinf.	=	60000. psi
Diameter of Transverse Reinf.	=	0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	4366.378 kips
Tensile Load for Cracking of Concrete	=	-470.222 kips

Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips

1	3.800
2	4.200
3	4.600

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	3.800	12540.163	0.00300000	-0.00993952
2	4.200	12544.175	0.00300000	-0.00993534
3	4.600	12548.187	0.00300000	-0.00993115

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	3.800000	12540.	2.470000	8151.	96860090.
2	0.65	4.200000	12544.	2.730000	8154.	

96895160.
   3   0.65   4.600000   12548.   2.990000   8156.
96930231.

   1   0.75   3.800000   12540.   2.850000   9405.
95244260.
   2   0.75   4.200000   12544.   3.150000   9408.
95279011.
   3   0.75   4.600000   12548.   3.450000   9411.
95313752.

   1   0.90   3.800000   12540.   3.420000   11286.
72486643.
   2   0.90   4.200000   12544.   3.780000   11290.
72529052.
   3   0.90   4.600000   12548.   4.140000   11293.
72571461.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	9103.
2	4.0000	0.2862	No	No	9103.	185456.
3	9.5000	8.5000	No	No	194559.	0.00
4	19.5000	18.5000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 1000. lbs
Moment = 315600. in-lbs
Axial Load = 4200. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.01165205	352265.	-10233.
8.55000	0.02067625	349187.	-11290.
8.10000	0.04645094	345135.	-12524.
7.65000	0.11211713	341373.	-13751.
7.20000	0.27819647	337778.	-14996.
6.75000	0.84766771	335799.	-16608.
6.30000	2.79306648	336360.	-18581.
5.85000	19.23083139	359351.	-24147.

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

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

Shear force at pile head = 2250.0 lbs
Applied moment at pile head = 724800.0 in-lbs
Axial thrust load on pile head = 4600.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	0.23563	724800.	2250.	0.000	3.882E+11

Output Summary for Load Case No. 2:

Pile-head deflection = 0.23563419 inches
Computed slope at pile head = -0.0030254 radians
Maximum bending moment = 801472. inch-lbs
Maximum shear force = -24181. lbs
Depth of maximum bending moment = 4.05000000 feet below pile head
Depth of maximum shear force = 6.66000000 feet below pile head
Number of iterations = 36
Number of zero deflection points = 1
Pile deflection at ground = 0.19946583 inches

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

Shear = 2250. lbs
Moment = 724800. in-lbs
Axial Load = 4600. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.23563419	801472.	-24181.
8.55000	0.46287442	792838.	-25901.
8.10000	1.09118991	785676.	-28295.
7.65000	2.71200619	781858.	-31100.
7.20000	7.18750721	782232.	-34566.

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

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

Shear force at pile head = 2250.0 lbs
Applied moment at pile head = 724800.0 in-lbs
Axial thrust load on pile head = 3800.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	0.23538	724800.	2250.	0.000	3.882E+11

Output Summary for Load Case No. 3:

Pile-head deflection = 0.23538422 inches
Computed slope at pile head = -0.0030222 radians
Maximum bending moment = 801367. inch-lbs
Maximum shear force = -24175. lbs
Depth of maximum bending moment = 4.05000000 feet below pile head
Depth of maximum shear force = 6.66000000 feet below pile head
Number of iterations = 36
Number of zero deflection points = 1
Pile deflection at ground = 0.19925357 inches

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

Shear = 2250. lbs
Moment = 724800. in-lbs
Axial Load = 3800. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.23538422	801367.	-24175.
8.55000	0.46190148	792638.	-25886.
8.10000	1.08577838	785244.	-28258.
7.65000	2.67831884	780856.	-30997.
7.20000	6.94161641	779575.	-34247.

Summary of Pile-head Responses for Conventional Analyses

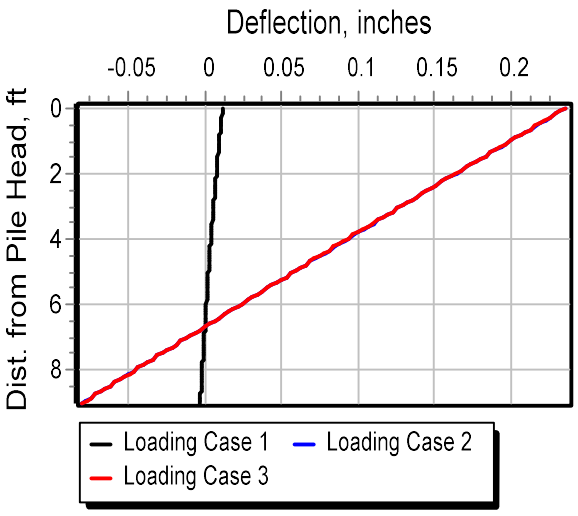
Definitions of Pile-head Loading Conditions:

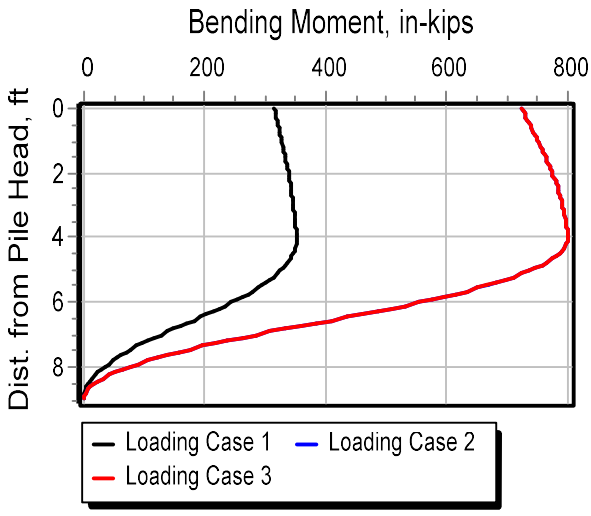
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

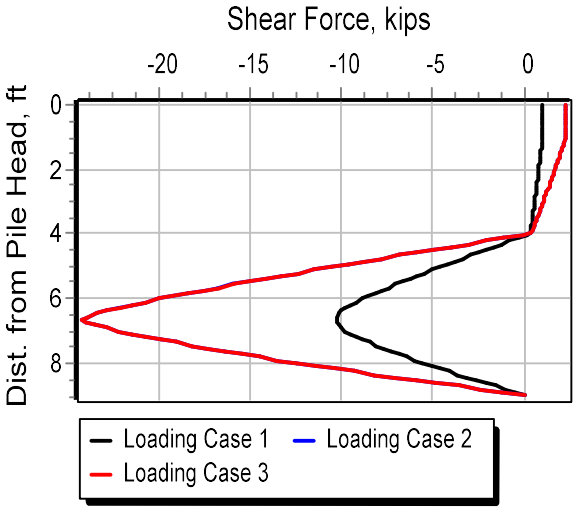
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.011652	-0.0001799	-10233.	352265.
2	1	0.235634	-0.00303	-24181.	801472.
3	1	0.235384	-0.00302	-24175.	801367.

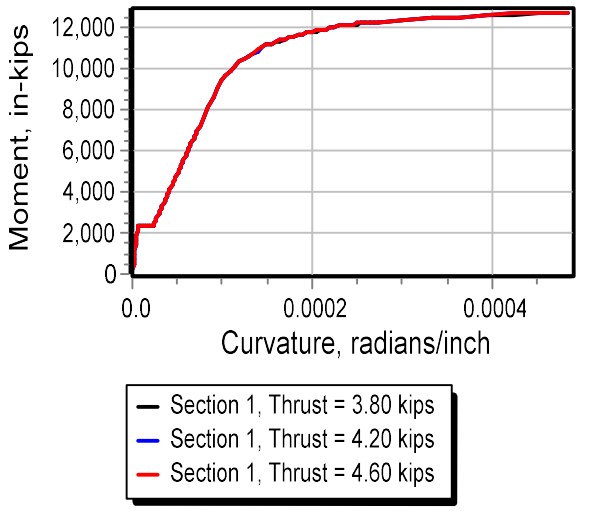
Maximum pile-head deflection = 0.2356341910 inches
Maximum pile-head rotation = -0.0030253804 radians = -0.173342 deg.

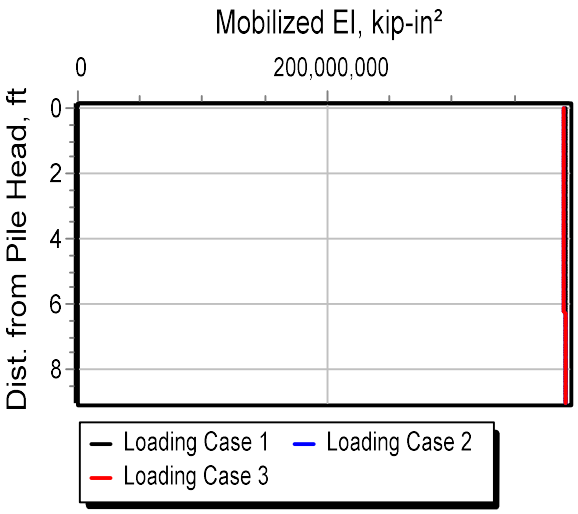
The analysis ended normally.

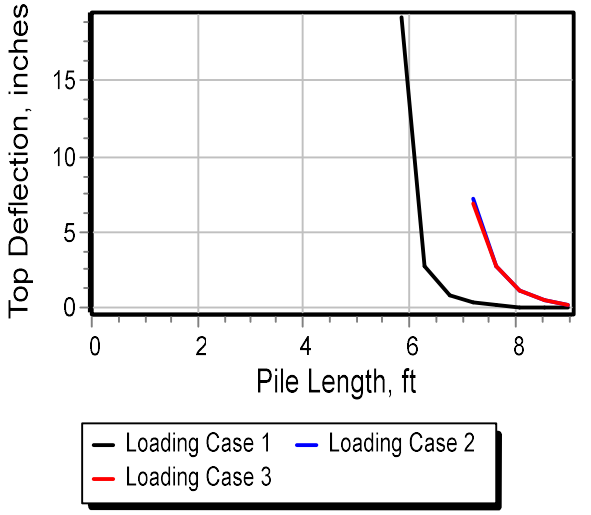

Deflection, inches
-0.05
0
0.05
0.1
0.15
0.2
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
200
400
600
800
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-20
-15
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 3.80 kips
Section 1, Thrust = 4.20 kips
Section 1, Thrust = 4.60 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
15
10
5
0
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\3 luminaire loading\

Name of the input data file:
N4255372_ALL_B-13.lp12d

Name of the output report file:
N4255372_ALL_B-13.lp12o

Name of the plot output file:
N4255372_ALL_B-13.lp12p

Name of the runtime message file:
N4255372_ALL_B-13.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 11:33:56

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-013-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	5.000000 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	=	750.000000 psf
Undrained cohesion at bottom of layer	=	750.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	5.000000 ft
Distance from top of pile to bottom of layer	=	7.000000 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	=	750.000000 psf
Undrained cohesion at bottom of layer	=	750.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	7.000000 ft

```
   Distance from top of pile to bottom of layer        =    14.500000 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                  =        2000. psf
   Undrained cohesion at bottom of layer               =        2000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    14.500000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =        2000. psf
   Undrained cohesion at bottom of layer               =        2000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



--------------------------------------------------------------------------------
                       Modification Factors for p-y Curves
--------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1            1.000         1.0000         1.0000
  2           20.000         1.0000         1.0000



--------------------------------------------------------------------------------
                               Static Loading Type
--------------------------------------------------------------------------------

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 1000.000000 lbs	M = 315600. in-lbs	4200.
2	1	V = 2250. lbs	M = 724800. in-lbs	4600.
3	1	V = 2250. lbs	M = 724800. in-lbs	3800.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94

Offset of Center of Rebar Cage from Center of Pile = 0.0000 in
Transverse Reinforcement
Type: Spiral
Number of Transverse Reinf. (per spacing) = 29
Spacing of Transverse Reinf. = 4.500000 in
Yield Stress of Transverse Reinf. = 60000. psi
Diameter of Transverse Reinf. = 0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 4366.378 kips
Tensile Load for Cracking of Concrete = -470.222 kips
Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	3.800
2	4.200
3	4.600

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	3.800	12540.163	0.00300000	-0.00993952
2	4.200	12544.175	0.00300000	-0.00993534
3	4.600	12548.187	0.00300000	-0.00993115

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for

reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	3.800000	12540.	2.470000	8151.	96860090.
2	0.65	4.200000	12544.	2.730000	8154.	96895160.
3	0.65	4.600000	12548.	2.990000	8156.	96930231.
1	0.75	3.800000	12540.	2.850000	9405.	95244260.
2	0.75	4.200000	12544.	3.150000	9408.	95279011.
3	0.75	4.600000	12548.	3.450000	9411.	95313752.
1	0.90	3.800000	12540.	3.420000	11286.	72486643.
2	0.90	4.200000	12544.	3.780000	11290.	72529052.
3	0.90	4.600000	12548.	4.140000	11293.	72571461.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	8959.
2	4.0000	1.2431	No	No	8959.	7975.
3	5.0000	2.2505	Yes	No	16933.	17832.
4	7.0000	1.8155	Yes	No	34766.	43010.
5	14.5000	13.5000	No	No	77776.	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 1000. lbs
Moment = 315600. in-lbs
Axial Load = 4200. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.40909108	337127.	-9613.
8.55000	0.70661972	335575.	-9616.
8.10000	1.35969578	335383.	-9889.
7.65000	3.07852208	336492.	-10166.
7.20000	13.39911945	347452.	-11825.

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

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

Shear force at pile head = 2250.0 lbs
Applied moment at pile head = 724800.0 in-lbs
Axial thrust load on pile head = 4600.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	9.37814	724800.	2250.	0.000	3.882E+11

Output Summary for Load Case No. 2:

Pile-head deflection = 9.37813694 inches

```
Computed slope at pile head      =     -0.1072811 radians
Maximum bending moment           =        781526. inch-lbs
Maximum shear force              =        -21918. lbs
Depth of maximum bending moment  =     2.34000000 feet below pile head
Depth of maximum shear force     =     7.29000000 feet below pile head
Number of iterations             =             52
Number of zero deflection points =              1
Pile deflection at ground        =     8.09089989 inches
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

```
Shear      =           2250. lbs
Moment     =         724800. in-lbs
Axial Load =           4600. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	9.37813694	781526.	-21918.
8.55000	18.51371634	789522.	-23052.

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

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

```
Shear force at pile head                          =       2250.0 lbs
Applied moment at pile head                       =     724800.0 in-lbs
Axial thrust load on pile head                    =       3800.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	9.00839	724800.	2250.	0.000	3.882E+11

Output Summary for Load Case No. 3:

```
Pile-head deflection             =     9.00838612 inches
```

```
Computed slope at pile head      =     -0.1030524 radians
Maximum bending moment           =        778937. inch-lbs
Maximum shear force              =        -21676. lbs
Depth of maximum bending moment  =     2.34000000 feet below pile head
Depth of maximum shear force     =     7.29000000 feet below pile head
Number of iterations             =             53
Number of zero deflection points =              1
Pile deflection at ground        =     7.77189386 inches
```

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

```
Shear      =           2250. lbs
Moment     =         724800. in-lbs
Axial Load =           3800. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	9.00838612	778937.	-21676.
8.55000	16.82770930	783158.	-22430.

Summary of Pile-head Responses for Conventional Analyses

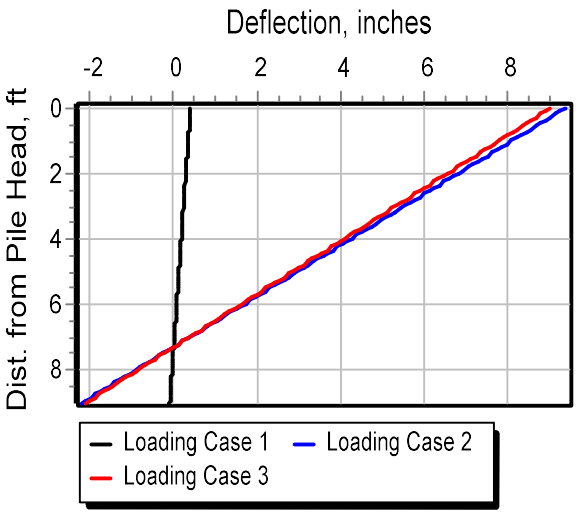
Definitions of Pile-head Loading Conditions:

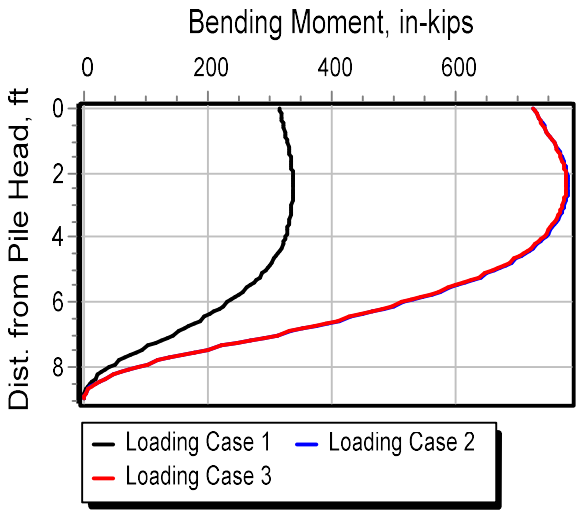
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

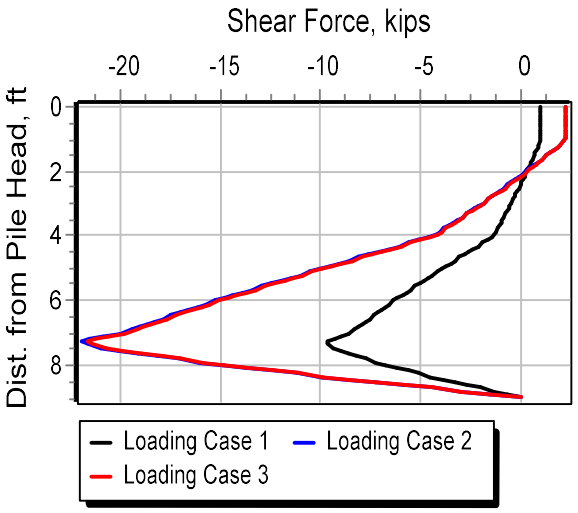
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.409091	-0.00468	-9613.	337127.
2	1	9.378137	-0.10728	-21918.	781526.
3	1	9.008386	-0.10305	-21676.	778937.

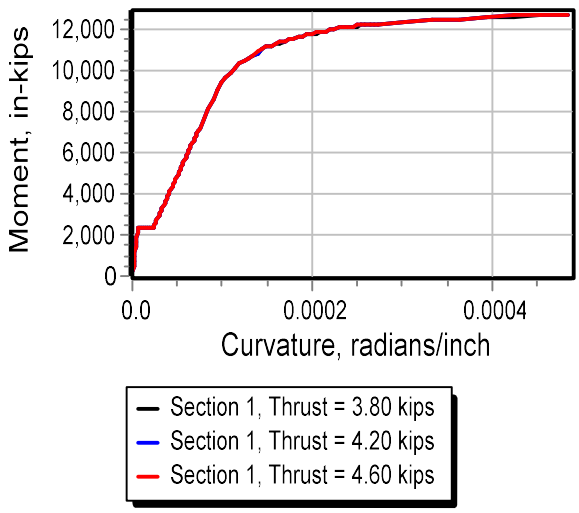
```
Maximum pile-head deflection = 9.3781369448 inches
Maximum pile-head rotation   = -0.1072811350 radians = -6.146756 deg.

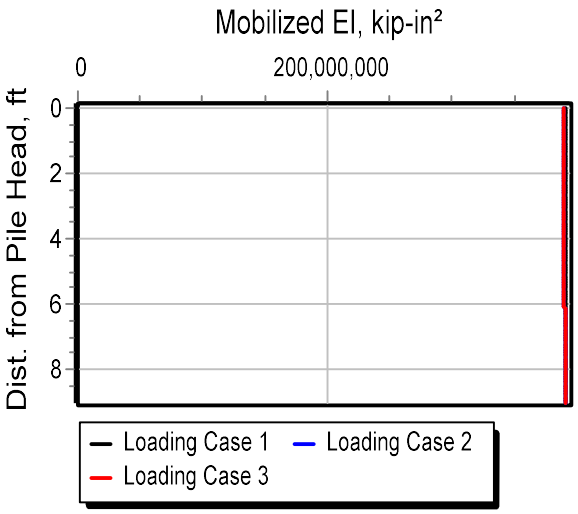
The analysis ended normally.
```

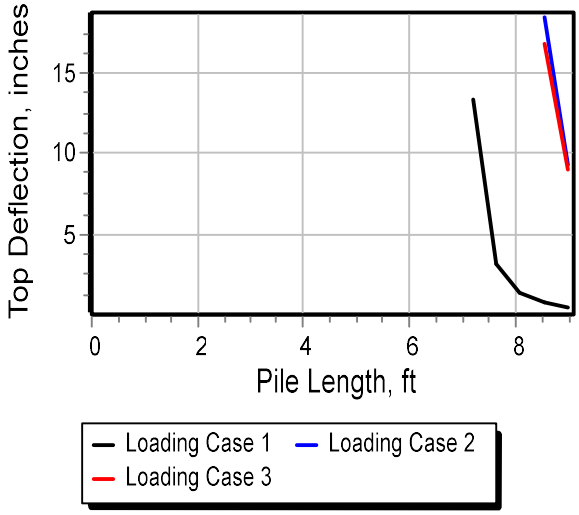

Deflection, inches
-2
0
2
4
6
8
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
200
400
600
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-20
-15
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 3.80 kips
Section 1, Thrust = 4.20 kips
Section 1, Thrust = 4.60 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
15
10
5
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\3 luminaire loading\

Name of the input data file:
N4255372_ALL_B-14.lp12d

Name of the output report file:
N4255372_ALL_B-14.lp12o

Name of the plot output file:
N4255372_ALL_B-14.lp12p

Name of the runtime message file:
N4255372_ALL_B-14.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 11:35:19

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-014-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	0.0000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	7.000000 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	=	750.000000 psf
Undrained cohesion at bottom of layer	=	750.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	7.000000 ft
Distance from top of pile to bottom of layer	=	9.500000 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	=	750.000000 psf
Undrained cohesion at bottom of layer	=	750.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	9.500000 ft

```
   Distance from top of pile to bottom of layer        =    14.500000 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                  =  1000.000000 psf
   Undrained cohesion at bottom of layer               =  1000.000000 psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    14.500000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =        2000. psf
   Undrained cohesion at bottom of layer               =        2000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



-------------------------------------------------------------------------------
                      Modification Factors for p-y Curves
-------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1            1.000         1.0000         1.0000
  2           20.000         1.0000         1.0000



-------------------------------------------------------------------------------
                               Static Loading Type
-------------------------------------------------------------------------------

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 1000.000000 lbs	M = 315600. in-lbs	4200.
2	1	V = 2250. lbs	M = 724800. in-lbs	4600.
3	1	V = 2250. lbs	M = 724800. in-lbs	3800.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94

Offset of Center of Rebar Cage from Center of Pile = 0.0000 in
Transverse Reinforcement
Type: Spiral
Number of Transverse Reinf. (per spacing) = 29
Spacing of Transverse Reinf. = 4.500000 in
Yield Stress of Transverse Reinf. = 60000. psi
Diameter of Transverse Reinf. = 0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 4366.378 kips
Tensile Load for Cracking of Concrete = -470.222 kips
Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	3.800
2	4.200
3	4.600

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	3.800	12540.163	0.00300000	-0.00993952
2	4.200	12544.175	0.00300000	-0.00993534
3	4.600	12548.187	0.00300000	-0.00993115

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for

reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	3.800000	12540.	2.470000	8151.	96860090.
2	0.65	4.200000	12544.	2.730000	8154.	96895160.
3	0.65	4.600000	12548.	2.990000	8156.	96930231.
1	0.75	3.800000	12540.	2.850000	9405.	95244260.
2	0.75	4.200000	12544.	3.150000	9408.	95279011.
3	0.75	4.600000	12548.	3.450000	9411.	95313752.
1	0.90	3.800000	12540.	3.420000	11286.	72486643.
2	0.90	4.200000	12544.	3.780000	11290.	72529052.
3	0.90	4.600000	12548.	4.140000	11293.	72571461.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	12917.
2	4.0000	1.7473	No	No	12917.	26864.
3	7.0000	4.7836	Yes	No	39781.	20917.
4	9.5000	9.5000	No	No	60698.	0.00
5	14.5000	14.5000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 1000. lbs
Moment = 315600. in-lbs
Axial Load = 4200. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.47350489	323816.	-7565.
8.55000	0.75253361	322945.	-7861.
8.10000	1.25600844	322242.	-8183.
7.65000	2.14343162	321861.	-8555.
7.20000	3.82424956	321974.	-9044.
6.75000	7.72401790	323391.	-9821.

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

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

Shear force at pile head = 2250.0 lbs
Applied moment at pile head = 724800.0 in-lbs
Axial thrust load on pile head = 4600.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	10.23780	724800.	2250.	-167.3464	3.882E+11

Output Summary for Load Case No. 2:

```
Pile-head deflection             =    10.23780147 inches
Computed slope at pile head      =     -0.1394711 radians
Maximum bending moment           =        748201. inch-lbs
Maximum shear force              =        -17525. lbs
Depth of maximum bending moment  =     1.35000000 feet below pile head
Depth of maximum shear force     =     6.12000000 feet below pile head
Number of iterations             =             53
Number of zero deflection points =              1
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

```
Shear      =           2250. lbs
Moment     =         724800. in-lbs
Axial Load =           4600. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	10.23780147	748201.	-17525.

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

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

```
Shear force at pile head                          =       2250.0 lbs
Applied moment at pile head                       =     724800.0 in-lbs
Axial thrust load on pile head                    =       3800.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	9.69654	724800.	2250.	-164.3437	3.882E+11

Output Summary for Load Case No. 3:

```
Pile-head deflection             =     9.69654361 inches
Computed slope at pile head      =     -0.1320909 radians
```

Maximum bending moment = 746435. inch-lbs
Maximum shear force = -17251. lbs
Depth of maximum bending moment = 1.26000000 feet below pile head
Depth of maximum shear force = 6.12000000 feet below pile head
Number of iterations = 50
Number of zero deflection points = 1

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

Shear = 2250. lbs
Moment = 724800. in-lbs
Axial Load = 3800. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	9.69654361	746435.	-17251.
8.55000	17.78040948	750099.	-18763.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

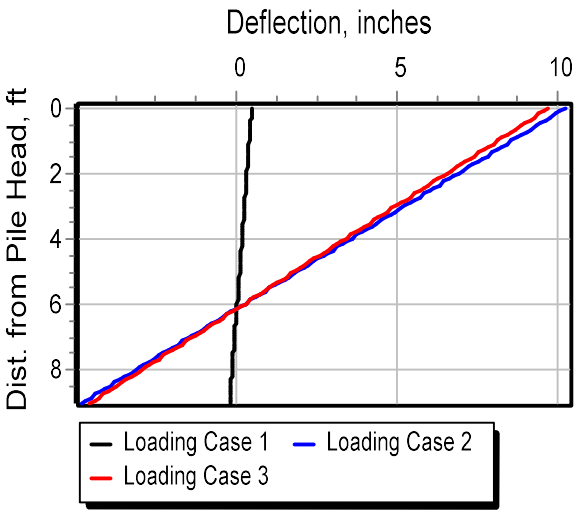
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

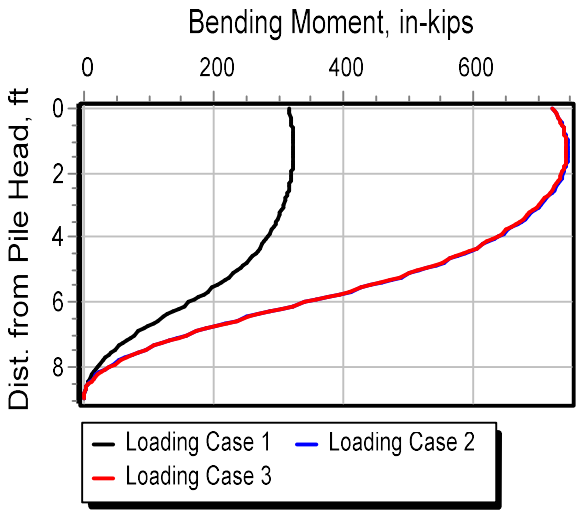
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.473505	-0.00632	-7565.	323816.
2	1	10.237801	-0.13947	-17525.	748201.
3	1	9.696544	-0.13209	-17251.	746435.

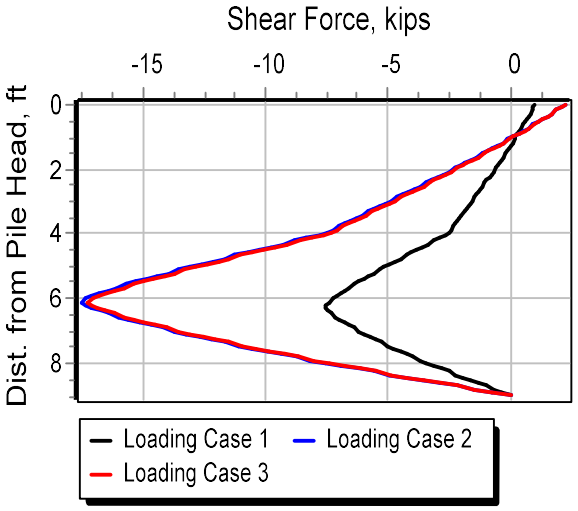
Maximum pile-head deflection = 10.2378014654 inches

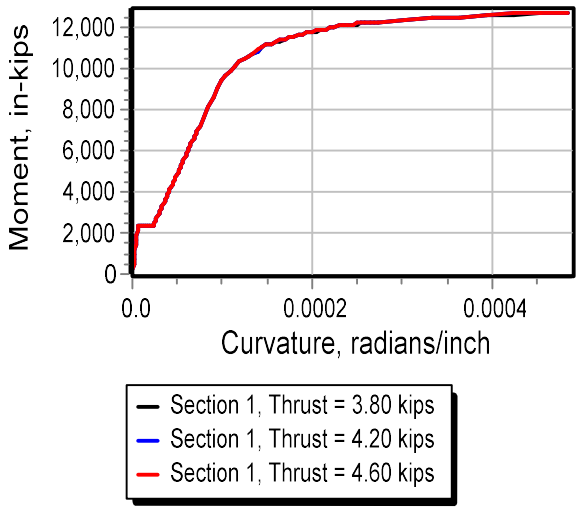
Maximum pile-head rotation   = -0.1394710551 radians = -7.991103 deg.

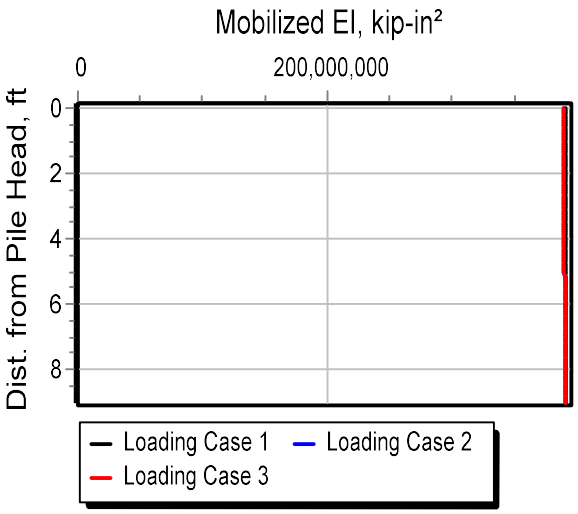
The analysis ended normally.

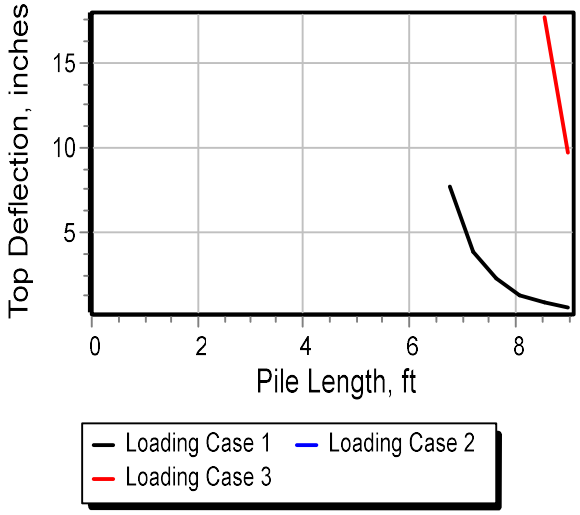

Deflection, inches
0
5
10
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
200
400
600
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-15
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 3.80 kips
Section 1, Thrust = 4.20 kips
Section 1, Thrust = 4.60 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
15
10
5
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\3 luminaire loading\

Name of the input data file:
N4255372_ALL_B-16.lp12d

Name of the output report file:
N4255372_ALL_B-16.lp12o

Name of the plot output file:
N4255372_ALL_B-16.lp12p

Name of the runtime message file:
N4255372_ALL_B-16.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 11:36:26

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-016-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	15.000000 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	=	3000. psf
Undrained cohesion at bottom of layer	=	3000. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	15.000000 ft
Distance from top of pile to bottom of layer	=	17.000000 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	=	3000. psf
Undrained cohesion at bottom of layer	=	3000. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	17.000000 ft

```
   Distance from top of pile to bottom of layer        =    25.000000 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                  =        3000. psf
   Undrained cohesion at bottom of layer               =        3000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    25.000000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =        2000. psf
   Undrained cohesion at bottom of layer               =        2000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



-------------------------------------------------------------------------------
                      Modification Factors for p-y Curves
-------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1            1.000         1.0000         1.0000
  2           20.000         1.0000         1.0000



-------------------------------------------------------------------------------
                               Static Loading Type
-------------------------------------------------------------------------------

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 1000.000000 lbs	M = 315600. in-lbs	4200.
2	1	V = 2250. lbs	M = 724800. in-lbs	4600.
3	1	V = 2250. lbs	M = 724800. in-lbs	3800.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94

Offset of Center of Rebar Cage from Center of Pile = 0.0000 in
Transverse Reinforcement
Type: Spiral
Number of Transverse Reinf. (per spacing) = 29
Spacing of Transverse Reinf. = 4.500000 in
Yield Stress of Transverse Reinf. = 60000. psi
Diameter of Transverse Reinf. = 0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 4366.378 kips
Tensile Load for Cracking of Concrete = -470.222 kips
Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	3.800
2	4.200
3	4.600

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	3.800	12540.163	0.00300000	-0.00993952
2	4.200	12544.175	0.00300000	-0.00993534
3	4.600	12548.187	0.00300000	-0.00993115

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for

reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	3.800000	12540.	2.470000	8151.	96860090.
2	0.65	4.200000	12544.	2.730000	8154.	96895160.
3	0.65	4.600000	12548.	2.990000	8156.	96930231.
1	0.75	3.800000	12540.	2.850000	9405.	95244260.
2	0.75	4.200000	12544.	3.150000	9408.	95279011.
3	0.75	4.600000	12548.	3.450000	9411.	95313752.
1	0.90	3.800000	12540.	3.420000	11286.	72486643.
2	0.90	4.200000	12544.	3.780000	11290.	72529052.
3	0.90	4.600000	12548.	4.140000	11293.	72571461.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	9077.
2	4.0000	0.3324	No	No	9077.	159924.
3	15.0000	14.0000	No	No	169001.	0.00
4	17.0000	16.0000	No	No	0.00	0.00
5	25.0000	24.0000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 1000. lbs
Moment = 315600. in-lbs
Axial Load = 4200. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.01789769	350315.	-10359.
8.55000	0.03306517	346647.	-11263.
8.10000	0.07503779	342770.	-12365.
7.65000	0.17957474	339680.	-13489.
7.20000	0.43661517	336691.	-14653.
6.75000	1.29414158	335537.	-16188.
6.30000	4.25281580	337710.	-18160.

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

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

Shear force at pile head = 2250.0 lbs
Applied moment at pile head = 724800.0 in-lbs
Axial thrust load on pile head = 4600.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	0.38981	724800.	2250.	0.000	3.882E+11

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     0.38981198 inches
Computed slope at pile head      =     -0.0049591 radians
Maximum bending moment           =        795776. inch-lbs
Maximum shear force              =        -23881. lbs
Depth of maximum bending moment  =     4.05000000 feet below pile head
Depth of maximum shear force     =     6.66000000 feet below pile head
Number of iterations             =             38
Number of zero deflection points =              1
Pile deflection at ground        =     0.33043887 inches
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

```
Shear      =           2250. lbs
Moment     =         724800. in-lbs
Axial Load =           4600. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.38981198	795776.	-23881.
8.55000	0.76034259	787738.	-25524.
8.10000	1.77584595	782623.	-27850.
7.65000	4.41527571	781539.	-30681.
7.20000	12.20714966	788019.	-34621.

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

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

```
Shear force at pile head                          =       2250.0 lbs
Applied moment at pile head                       =     724800.0 in-lbs
Axial thrust load on pile head                    =       3800.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2

```
      0.000      0.38912      724800.        2250.        0.000    3.882E+11

Output Summary for Load Case No. 3:

Pile-head deflection             =     0.38912182 inches
Computed slope at pile head      =     -0.0049504 radians
Maximum bending moment           =        795607. inch-lbs
Maximum shear force              =        -23869. lbs
Depth of maximum bending moment  =     4.05000000 feet below pile head
Depth of maximum shear force     =     6.66000000 feet below pile head
Number of iterations             =             38
Number of zero deflection points =              1
Pile deflection at ground        =     0.32985279 inches



--------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 3
--------------------------------------------------------------------------------

Boundary Condition Type 1, Shear and Moment

Shear      =           2250. lbs
Moment     =         724800. in-lbs
Axial Load =           3800. lbs


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
    feet         inches        ln-lbs          lbs
------------  ------------  ------------  ------------
    9.00000    0.38912182       795607.       -23869.
    8.55000    0.75770426       787436.       -25501.
    8.10000    1.76142061       781972.       -27790.
    7.65000    4.32440622       779956.       -30510.
    7.20000   11.45413506       783150.       -34032.

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

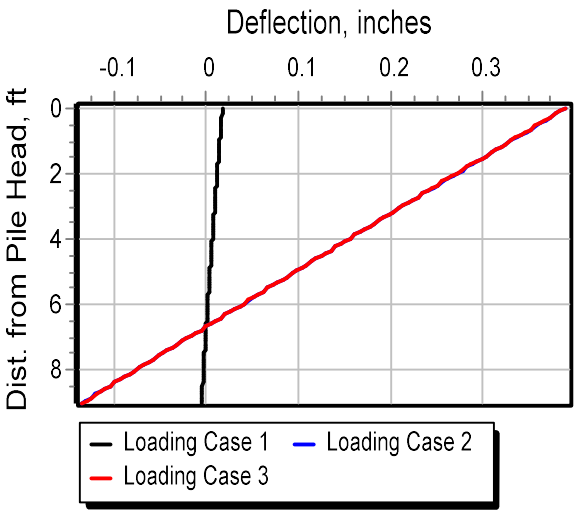
Definitions of Pile-head Loading Conditions:

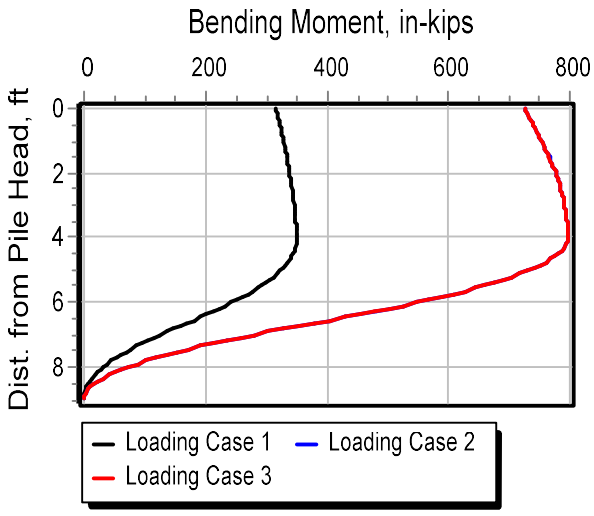
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

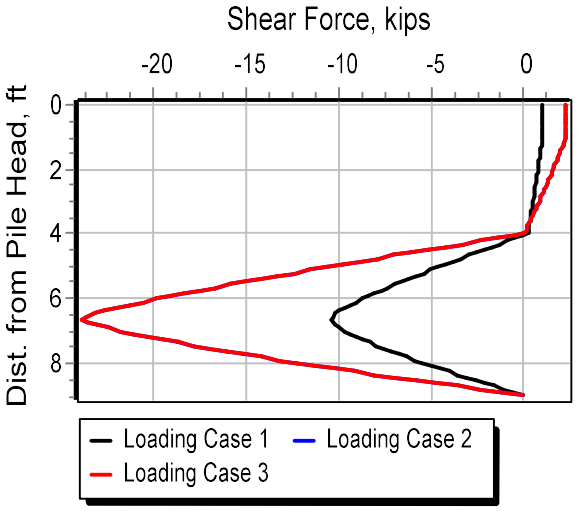
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.017898	-0.0002579	-10359.	350315.
2	1	0.389812	-0.00496	-23881.	795776.
3	1	0.389122	-0.00495	-23869.	795607.

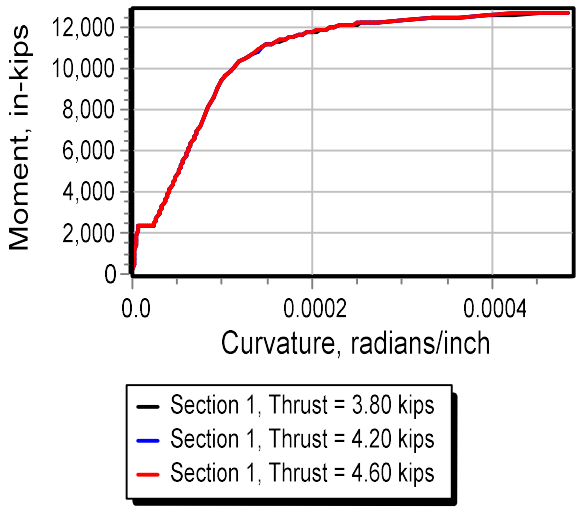
Maximum pile-head deflection = 0.3898119750 inches
Maximum pile-head rotation = -0.0049591101 radians = -0.284136 deg.

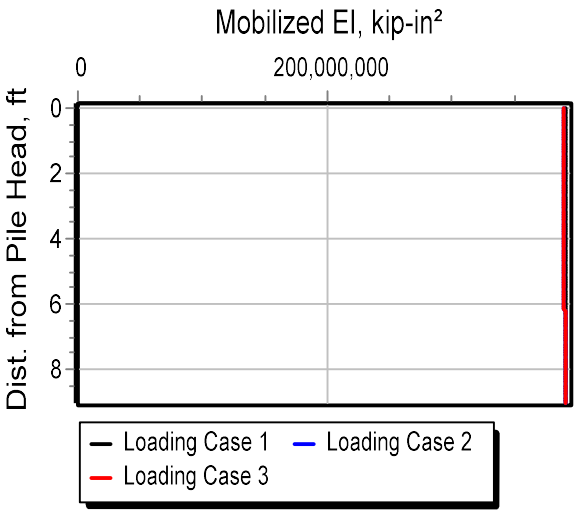
The analysis ended normally.

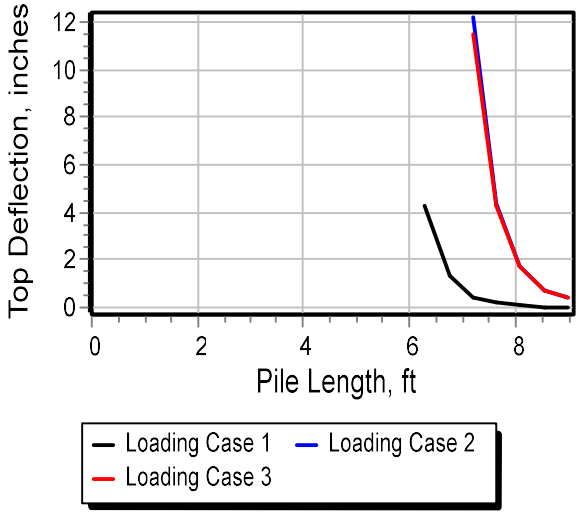

Deflection, inches
-0.1
0
0.1
0.2
0.3
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
200
400
600
800
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-20
-15
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 3.80 kips
Section 1, Thrust = 4.20 kips
Section 1, Thrust = 4.60 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
12
10
8
6
4
2
0
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This software is licensed for exclusive use by:
Terracon

==========

This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\3 luminaire loading\

Name of the input data file:
N4255372_ALL_B-17.lp12d

Name of the output report file:
N4255372_ALL_B-17.lp12o

Name of the plot output file:
N4255372_ALL_B-17.lp12p

Name of the runtime message file:
N4255372_ALL_B-17.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 11:37:32

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-017-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 6 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	5.000000 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	=	1000.000000 psf
Undrained cohesion at bottom of layer	=	1000.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	5.000000 ft
Distance from top of pile to bottom of layer	=	7.000000 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	=	1000.000000 psf
Undrained cohesion at bottom of layer	=	1000.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	7.000000 ft

```
   Distance from top of pile to bottom of layer        =    14.500000 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                  =        3500. psf
   Undrained cohesion at bottom of layer               =        3500. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    14.500000 ft
   Distance from top of pile to bottom of layer        =    19.500000 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                  =        2000. psf
   Undrained cohesion at bottom of layer               =        2000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 6 is stiff clay without free water

   Distance from top of pile to top of layer           =    19.500000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =        2000. psf
   Undrained cohesion at bottom of layer               =        2000. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



-------------------------------------------------------------------------------
                      Modification Factors for p-y Curves
-------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1            1.000         1.0000         1.0000
```

```
  2           20.000         1.0000         1.0000
```

Static Loading Type

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 1000.000000 lbs	M = 315600. in-lbs	4200.
2	1	V = 2250. lbs	M = 724800. in-lbs	4600.
3	1	V = 2250. lbs	M = 724800. in-lbs	3800.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Transverse Reinforcement
Type: Spiral

Number of Transverse Reinf. (per spacing)	=	29
Spacing of Transverse Reinf.	=	4.500000 in
Yield Stress of Transverse Reinf.	=	60000. psi
Diameter of Transverse Reinf.	=	0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	4366.378 kips
Tensile Load for Cracking of Concrete	=	-470.222 kips
Nominal Axial Tensile Capacity	=	-960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.34165 psi
Compression Strain at Peak Stress	=	0.001886
Tensile Strain at Fracture of Concrete	=	-0.0001154
Maximum Coarse Aggregate Size	=	0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	3.800
2	4.200
3	4.600

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	3.800	12540.163	0.00300000	-0.00993952
2	4.200	12544.175	0.00300000	-0.00993534
3	4.600	12548.187	0.00300000	-0.00993115

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	3.800000	12540.	2.470000	8151.	96860090.
2	0.65	4.200000	12544.	2.730000	8154.	96895160.
3	0.65	4.600000	12548.	2.990000	8156.	96930231.
1	0.75	3.800000	12540.	2.850000	9405.	95244260.
2	0.75	4.200000	12544.	3.150000	9408.	95279011.
3	0.75	4.600000	12548.	3.450000	9411.	95313752.
1	0.90	3.800000	12540.	3.420000	11286.	72486643.
2	0.90	4.200000	12544.	3.780000	11290.	72529052.
3	0.90	4.600000	12548.	4.140000	11293.	72571461.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	8972.
2	4.0000	0.9534	No	No	8972.	10197.
3	5.0000	1.9569	Yes	No	19169.	22728.
4	7.0000	1.2778	Yes	No	41897.	72050.
5	14.5000	13.5000	No	No	113947.	0.00
6	19.5000	18.5000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 1000. lbs
Moment = 315600. in-lbs
Axial Load = 4200. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.13640355	340264.	-10871.
8.55000	0.25539545	337760.	-10846.
8.10000	0.52201149	336461.	-10993.
7.65000	1.17643127	335790.	-11071.
7.20000	4.37598090	337116.	-11567.

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

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

Shear force at pile head = 2250.0 lbs
Applied moment at pile head = 724800.0 in-lbs
Axial thrust load on pile head = 4600.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	3.00149	724800.	2250.	0.000	3.882E+11

Output Summary for Load Case No. 2:

Pile-head deflection = 3.00149034 inches
Computed slope at pile head = -0.0335764 radians
Maximum bending moment = 779678. inch-lbs
Maximum shear force = -24162. lbs
Depth of maximum bending moment = 2.70000000 feet below pile head
Depth of maximum shear force = 7.47000000 feet below pile head
Number of iterations = 45
Number of zero deflection points = 1
Pile deflection at ground = 2.59870980 inches

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

Shear = 2250. lbs
Moment = 724800. in-lbs
Axial Load = 4600. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	3.00149034	779678.	-24162.
8.55000	5.72254985	778195.	-24317.
8.10000	12.72270656	784978.	-25525.

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

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

Shear force at pile head = 2250.0 lbs
Applied moment at pile head = 724800.0 in-lbs
Axial thrust load on pile head = 3800.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	2.96616	724800.	2250.	0.000	3.882E+11

Output Summary for Load Case No. 3:

Pile-head deflection = 2.96615654 inches
Computed slope at pile head = -0.0331819 radians
Maximum bending moment = 778850. inch-lbs
Maximum shear force = -24085. lbs
Depth of maximum bending moment = 2.70000000 feet below pile head
Depth of maximum shear force = 7.47000000 feet below pile head
Number of iterations = 45
Number of zero deflection points = 1
Pile deflection at ground = 2.56811035 inches

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

Shear = 2250. lbs
Moment = 724800. in-lbs
Axial Load = 3800. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	2.96615654	778850.	-24085.
8.55000	5.59258759	776625.	-24166.
8.10000	12.03801280	781039.	-25131.

Summary of Pile-head Responses for Conventional Analyses

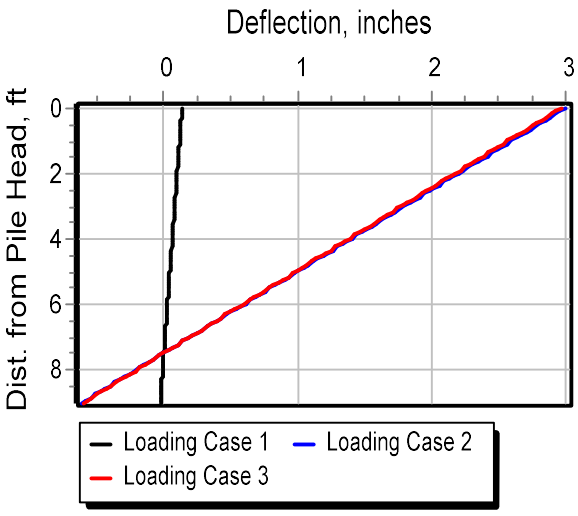
Definitions of Pile-head Loading Conditions:

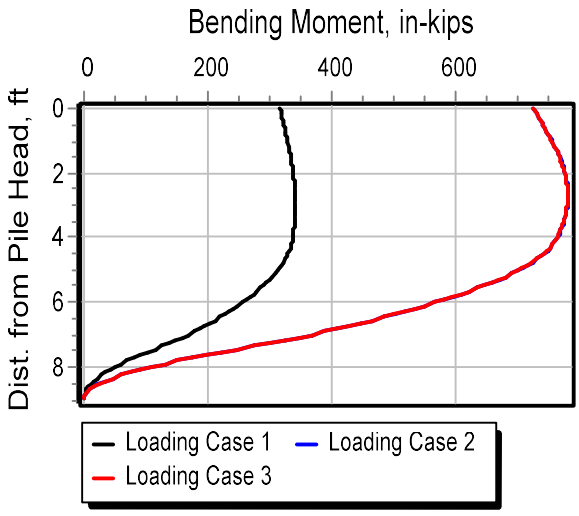
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load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

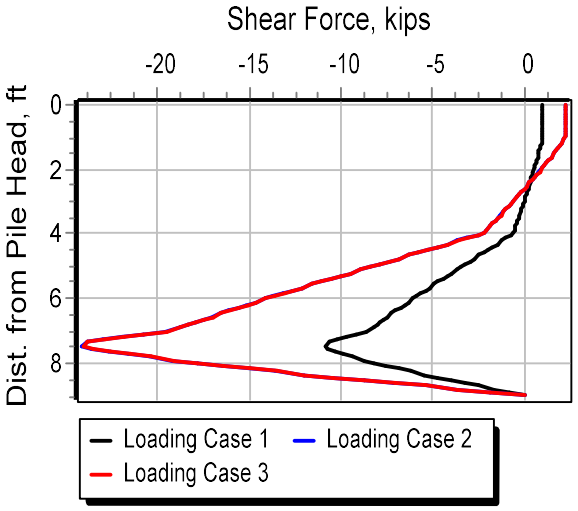
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.136404	-0.00156	-10871.	340264.
2	1	3.001490	-0.03358	-24162.	779678.
3	1	2.966157	-0.03318	-24085.	778850.

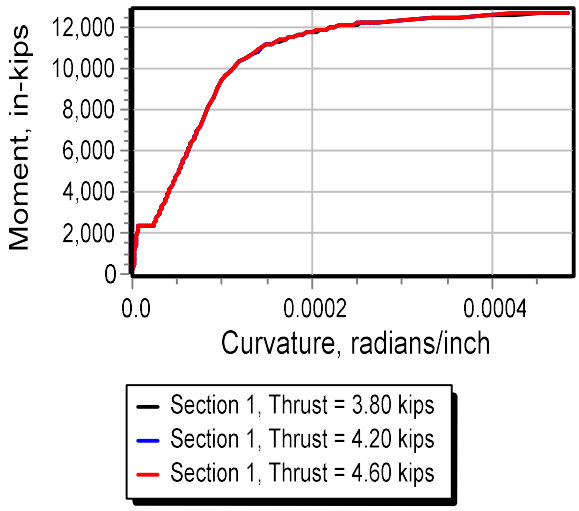
Maximum pile-head deflection = 3.0014903362 inches
Maximum pile-head rotation = -0.0335764034 radians = -1.923786 deg.

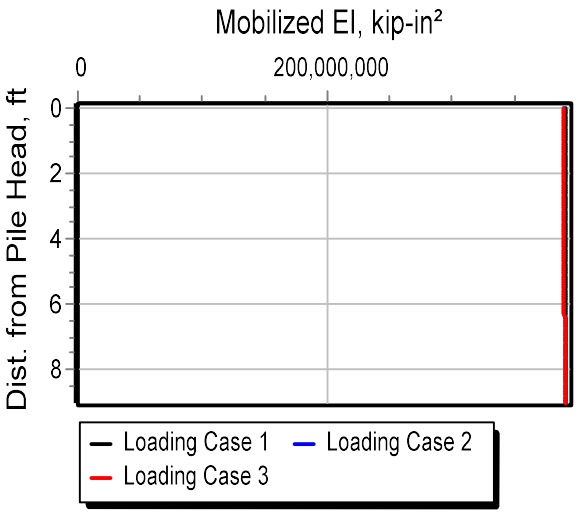
The analysis ended normally.

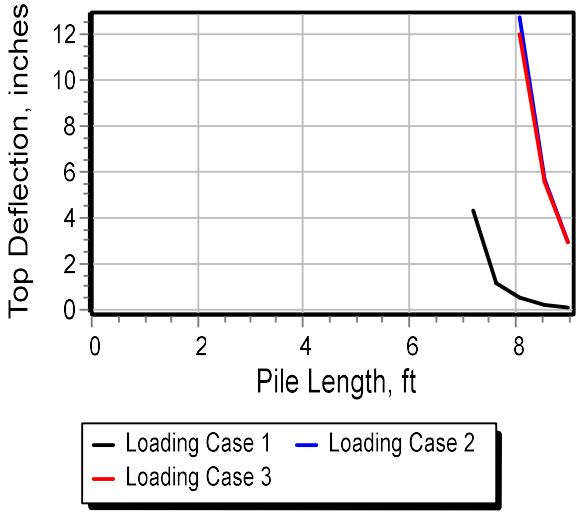

Deflection, inches
0
1
2
3
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
200
400
600
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-20
-15
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 3.80 kips
Section 1, Thrust = 4.20 kips
Section 1, Thrust = 4.60 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
12
10
8
6
4
2
0
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

==========

LPile Version 2022-12.013

License ID : 5831629170
License Type : (Enterprise Cloud License)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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This model was prepared by:
Amanda Warren

Files Used for Analysis

Path to file locations on this computer:
\Users\awarren\OneDrive - Terracon Consultants Inc\Desktop\Projects\AW Lpile runs Site 14\3 luminaire loading\

Name of the input data file:
N4255372_ALL_B-20.lp12d

Name of the output report file:
N4255372_ALL_B-20.lp12o

Name of the plot output file:
N4255372_ALL_B-20.lp12p

Name of the runtime message file:
N4255372_ALL_B-20.lp12r

Date and Time of Analysis

Date: July 23, 2026 Time: 11:38:38

Problem Title

Project Name: N4255372 Allen County T.P.Site #14 Expansion (PID 122869)

Job Number: N4255372

Client: GFT

Engineer: AW

Description: HIGH MAST TOWER FOUNDATION B-020-0-25

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	=	100

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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 1.0000 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 feet	Pile Diameter inches
1	0.000	36.0000
2	9.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 36.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	4.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	250.000000 psf
Undrained cohesion at bottom of layer	=	250.000000 psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	4.000000 ft
Distance from top of pile to bottom of layer	=	9.500000 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	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	9.500000 ft
Distance from top of pile to bottom of layer	=	19.500000 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	=	2500. psf
Undrained cohesion at bottom of layer	=	2500. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	19.500000 ft

```
   Distance from top of pile to bottom of layer        =    24.500000 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                  =  1000.000000 psf
   Undrained cohesion at bottom of layer               =  1000.000000 psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is stiff clay without free water

   Distance from top of pile to top of layer           =    24.500000 ft
   Distance from top of pile to bottom of layer        =    26.000000 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                  =  1000.000000 psf
   Undrained cohesion at bottom of layer               =  1000.000000 psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 17.000 ft below the pile tip)



-------------------------------------------------------------------------------
                      Modification Factors for p-y Curves
-------------------------------------------------------------------------------

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

Point      Depth X         p-mult         y-mult
 No.          ft
-----     ----------     ----------     ----------
  1           1.000         1.0000         1.0000
  2          20.000         1.0000         1.0000



-------------------------------------------------------------------------------
                               Static Loading Type
-------------------------------------------------------------------------------

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

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 1000.000000 lbs	M = 315600. in-lbs	4200.
2	1	V = 2250. lbs	M = 724800. in-lbs	4600.
3	1	V = 2250. lbs	M = 724800. in-lbs	3800.

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:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	9.000000 ft
Shaft Diameter	=	36.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	2.500000 in
Number of Reinforcing Bars	=	16 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1018. sq. in.
Total Area of Reinforcing Steel	=	16.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.57 percent
Edge-to-Edge Bar Spacing	=	4.455875 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.94

Offset of Center of Rebar Cage from Center of Pile = 0.0000 in
Transverse Reinforcement
Type: Spiral
Number of Transverse Reinf. (per spacing) = 29
Spacing of Transverse Reinf. = 4.500000 in
Yield Stress of Transverse Reinf. = 60000. psi
Diameter of Transverse Reinf. = 0.625000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 4366.378 kips
Tensile Load for Cracking of Concrete = -470.222 kips
Nominal Axial Tensile Capacity = -960.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.128000	1.000000	14.311000	0.00000
2	1.128000	1.000000	13.221640	5.476583
3	1.128000	1.000000	10.119405	10.119405
4	1.128000	1.000000	5.476583	13.221640
5	1.128000	1.000000	0.00000	14.311000
6	1.128000	1.000000	-5.47658	13.221640
7	1.128000	1.000000	-10.11941	10.119405
8	1.128000	1.000000	-13.22164	5.476583
9	1.128000	1.000000	-14.31100	0.00000
10	1.128000	1.000000	-13.22164	-5.47658
11	1.128000	1.000000	-10.11941	-10.11941
12	1.128000	1.000000	-5.47658	-13.22164
13	1.128000	1.000000	0.00000	-14.31100
14	1.128000	1.000000	5.476583	-13.22164
15	1.128000	1.000000	10.119405	-10.11941
16	1.128000	1.000000	13.221640	-5.47658

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 4.456 inches
between bars 11 and 12.

Ratio of bar spacing to maximum aggregate size = 5.94

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 3

Number	Axial Thrust Force kips
1	3.800
2	4.200
3	4.600

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	3.800	12540.163	0.00300000	-0.00993952
2	4.200	12544.175	0.00300000	-0.00993534
3	4.600	12548.187	0.00300000	-0.00993115

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for

reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	3.800000	12540.	2.470000	8151.	96860090.
2	0.65	4.200000	12544.	2.730000	8154.	96895160.
3	0.65	4.600000	12548.	2.990000	8156.	96930231.
1	0.75	3.800000	12540.	2.850000	9405.	95244260.
2	0.75	4.200000	12544.	3.150000	9408.	95279011.
3	0.75	4.600000	12548.	3.450000	9411.	95313752.
1	0.90	3.800000	12540.	3.420000	11286.	72486643.
2	0.90	4.200000	12544.	3.780000	11290.	72529052.
3	0.90	4.600000	12548.	4.140000	11293.	72571461.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below 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	1.0000	0.00	N.A.	No	0.00	8998.
2	4.0000	0.6492	No	No	8998.	83446.
3	9.5000	8.5000	No	No	92444.	0.00
4	19.5000	18.5000	No	No	0.00	0.00
5	24.5000	23.5000	No	No	0.00	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.

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 1000. lbs
Moment = 315600. in-lbs
Axial Load = 4200. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	0.17398496	339618.	-9746.
8.55000	0.31798538	337362.	-10308.
8.10000	0.67213906	336250.	-11058.
7.65000	1.46992501	335977.	-11922.
7.20000	3.25496434	336302.	-12872.
6.75000	10.04266651	344076.	-14811.

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

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

Shear force at pile head = 2250.0 lbs
Applied moment at pile head = 724800.0 in-lbs
Axial thrust load on pile head = 4600.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	4.08709	724800.	2250.	0.000	3.882E+11

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     4.08709243 inches
Computed slope at pile head      =     -0.0521343 radians
Maximum bending moment           =        780328. inch-lbs
Maximum shear force              =        -22098. lbs
Depth of maximum bending moment  =     2.61000000 feet below pile head
Depth of maximum shear force     =     6.57000000 feet below pile head
Number of iterations             =             48
Number of zero deflection points =              1
Pile deflection at ground        =     3.46161729 inches
```

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 1, Shear and Moment

```
Shear      =           2250. lbs
Moment     =         724800. in-lbs
Axial Load =           4600. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	4.08709243	780328.	-22098.
8.55000	7.92843291	781370.	-23846.
8.10000	22.82761984	803225.	-27912.

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

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

```
Shear force at pile head                          =       2250.0 lbs
Applied moment at pile head                       =     724800.0 in-lbs
Axial thrust load on pile head                    =       3800.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	4.00831	724800.	2250.	0.000	3.882E+11

Output Summary for Load Case No. 3:

```
Pile-head deflection             =     4.00830926 inches
Computed slope at pile head      =     -0.0511218 radians
Maximum bending moment           =        779047. inch-lbs
Maximum shear force              =        -21980. lbs
Depth of maximum bending moment  =     2.61000000 feet below pile head
Depth of maximum shear force     =     6.57000000 feet below pile head
Number of iterations             =             48
Number of zero deflection points =              1
Pile deflection at ground        =     3.39498446 inches
```

Pile-head Deflection vs. Pile Length for Load Case 3

Boundary Condition Type 1, Shear and Moment

```
Shear      =           2250. lbs
Moment     =         724800. in-lbs
Axial Load =           3800. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
9.00000	4.00830926	779047.	-21980.
8.55000	7.61669104	778775.	-23586.
8.10000	19.01753851	790466.	-26612.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

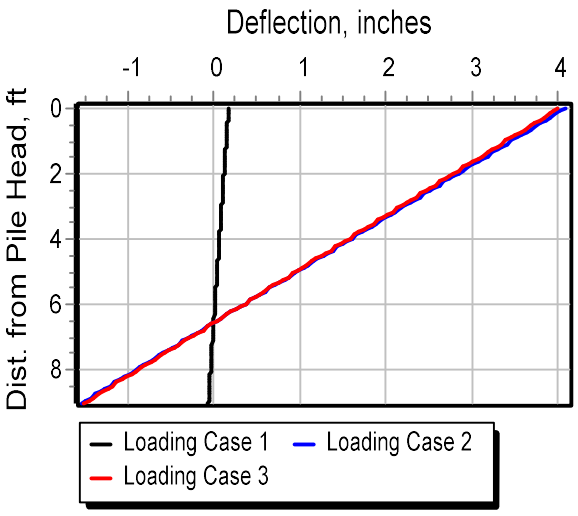
```
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs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

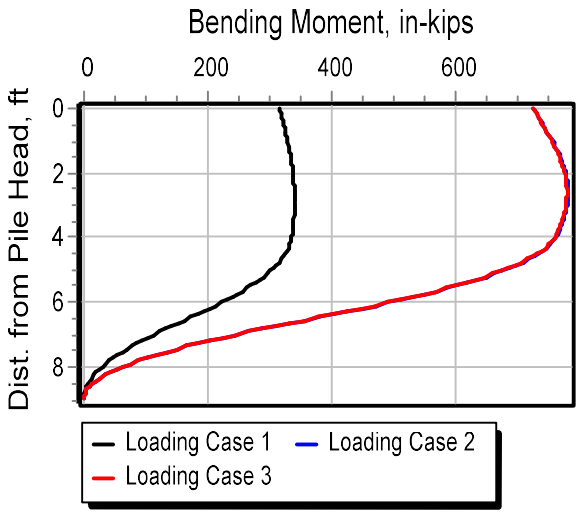
Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.173985	-0.00223	-9746.	339618.

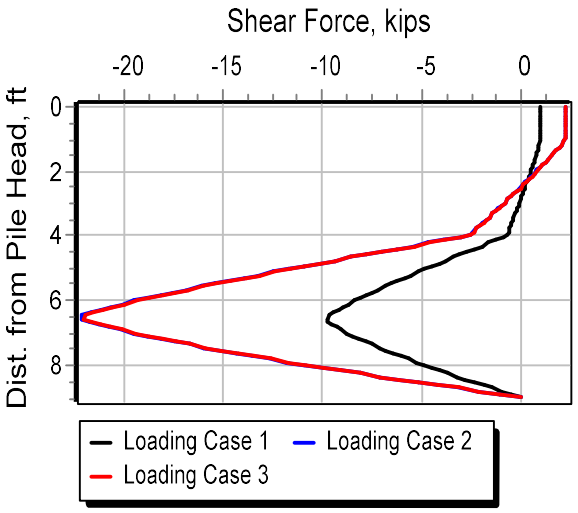
2	1	4.087092	-0.05213	-22098.	780328.
3	1	4.008309	-0.05112	-21980.	779047.

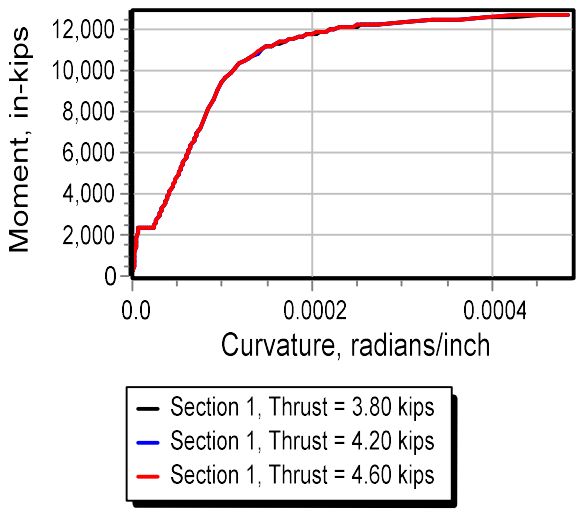
Maximum pile-head deflection = 4.0870924286 inches
Maximum pile-head rotation = -0.0521342925 radians = -2.987075 deg.

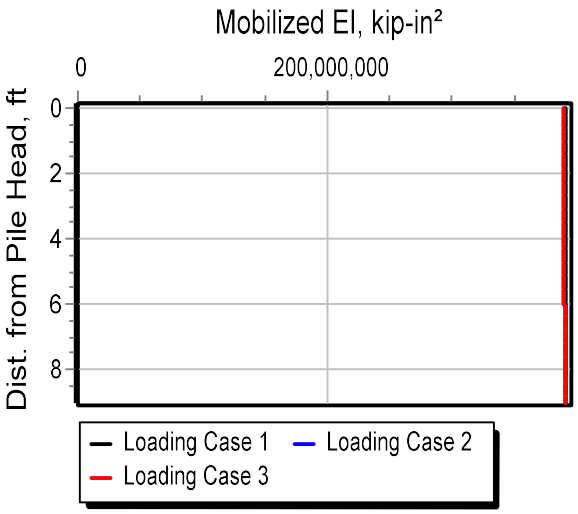
The analysis ended normally.

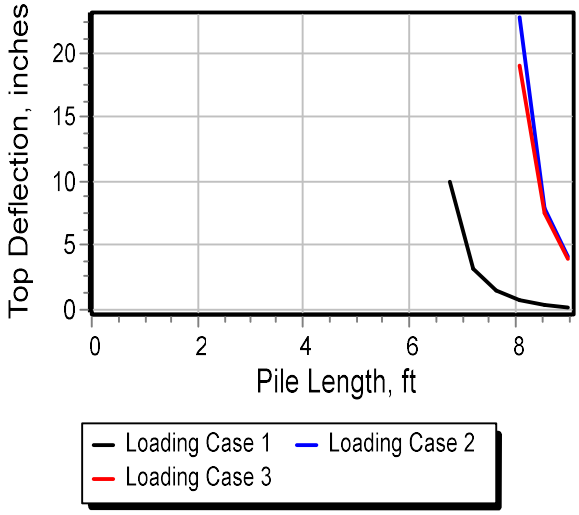

Deflection, inches
-1
0
1
2
3
4
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Bending Moment, in-kips
0
200
400
600
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Shear Force, kips
-20
-15
-10
-5
0
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Moment, in-kips
12,000
10,000
8,000
6,000
4,000
2,000
0
0.0
0.0002
0.0004
Curvature, radians/inch
Section 1, Thrust = 3.80 kips
Section 1, Thrust = 4.20 kips
Section 1, Thrust = 4.60 kips


Mobilized EI, kip-in²
0
200,000,000
Dist. from Pile Head, ft
0
2
4
6
8
Loading Case 1
Loading Case 2
Loading Case 3


Top Deflection, inches
20
15
10
5
0
0
2
4
6
8
Pile Length, ft
Loading Case 1
Loading Case 2
Loading Case 3

B-001-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.007456	-0.0001276	-9857.	354068.
2	1	0.124987	-0.00164	-24502.	807575.
3	1	0.124918	-0.00164	-24498.	807518.

Service limit state Deflection: .007 + .0001 X 12 X45= **0.06"**

B-005-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.476439	-0.0001	-9175.	336977.
2	1	12.635139	-0.16404	-21778.	787002.
3	1	11.795408	-0.15302	-21359.	782641.

Service limit state Deflection: .5 + .0001 X 12 X45= **0.55"**

B-006-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.102207	-0.00134	-8957.	328329.
2	1	2.109091	-0.02724	-19840.	750969.
3	1	2.088948	-0.02697	-19787.	750558.

Service limit state Deflection: .1 + .001 X 12 X45= **0.64"**

B-007-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.476439	-0.00613	-9175.	336977.
2	1	12.635139	-0.16404	-21778.	787002.
3	1	11.795408	-0.15302	-21359.	782641.

Service limit state Deflection: .5 + .006 X 12 X45= **3.74"**

B-010-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.011652	-0.0001799	-10233.	352265.
2	1	0.235634	-0.00303	-24181.	801472.
3	1	0.235384	-0.00302	-24175.	801367.

Service limit state Deflection: .01 + .0001 X 12 X45= **0.06"**

B-013-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.409091	-0.00468	-9613.	337127.

2	1	9.378137	-0.10728	-21918.	781526.
3	1	9.008386	-0.10305	-21676.	778937.

Service limit state Deflection: .4 + .005 X 12 X45= **3.10"**

B-014-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.473505	-0.00632	-7565.	323816.
2	1	10.237801	-0.13947	-17525.	748201.
3	1	9.696544	-0.13209	-17251.	746435.

Service limit state Deflection: .5 + .006 X 12 X45= **3.74"**

B-016-0-25

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.017898	-0.0002579	-10359.	350315.
2	1	0.389812	-0.00496	-23881.	795776.
3	1	0.389122	-0.00495	-23869.	795607.

Service limit state Deflection: .02 + .0003 X 12 X45= **0.18"**

B-017-0-25

Load Case	Load	Pile-head Deflection	Pile-head Rotation	Max Shear in Pile	Max Moment in Pile

Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.136404	-0.00156	-10871.	340264.
2	1	3.001490	-0.03358	-24162.	779678.
3	1	2.966157	-0.03318	-24085.	778850.

Service limit state Deflection: .14 + .002 X 12 X45= **1.22"**

B-020-0-25

Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.173985	-0.00223	-9746.	339618.
2	1	4.087092	-0.05213	-22098.	780328.
3	1	4.008309	-0.05112	-21980.	779047.

Service limit state Deflection: .2 + .002 X 12 X45= **1.28"**

Supporting Information

Contents:

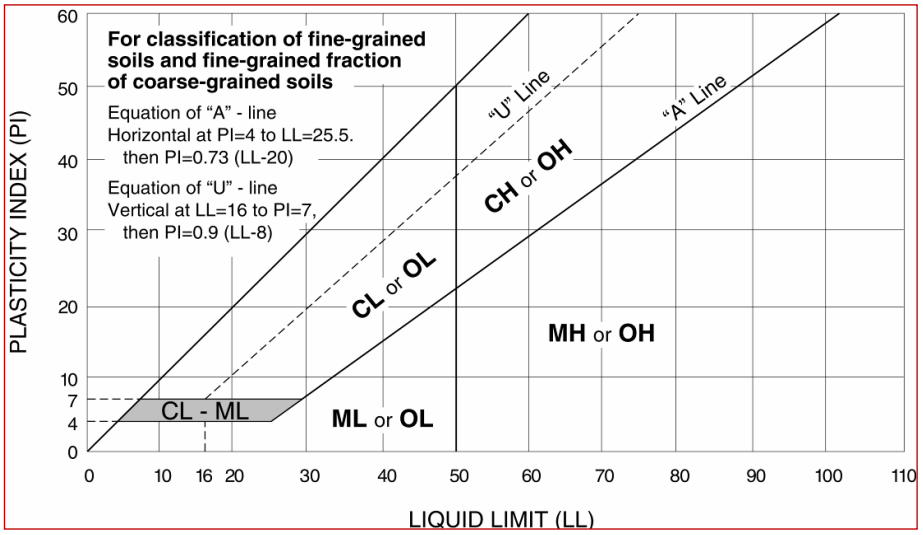
Unified Soil Classification System
ODOT Quick Reference for Visual Description of Soils
ODOT Classification of Soils

Note: All attachments are one page unless noted above.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 4 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu≥4 and 1≤Cc≤3 [E]	GW	Well-graded gravel [F]
			Cu<4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu≥6 and 1≤Cc≤3 [E]	SW	Well-graded sand [I]
			Cu<6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.
[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.



APPENDIX A.1 - ODOT Quick Reference for Visual Description of Soils

1) STRENGTH OF SOIL:

Non-Cohesive (granular) Soils - Compactness	
Description	**Blows Per Ft.**
Very Loose	≤ 4
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 – 50
Very Dense	> 50

2) COLOR :

If a color is a uniform color throughout, the term is single, modified by an adjective such as light or dark. If the predominate 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"

3) PRIMARY COMPONENT

Use **DESCRIPTION** from ODOT Soil Classification Chart on Back

Cohesive (fine grained) Soils - Consistency

Description	Qu (TSF)	Blows Per Ft.	Hand Manipulation
Very Soft	<0.25	<2	Easily penetrates 2" by fist
Soft	0.25-0.5	2 - 4	Easily penetrates 2" by thumb
Medium Stiff	0.5-1.0	5 - 8	Penetrates by thumb with moderate effort
Stiff	1.0-2.0	9 - 15	Readily indents by thumb, but not penetrate
Very Stiff	2.0-4.0	16 - 30	Readily indents by thumbnail
Hard	>4.0	>30	Indent with difficulty by thumbnail

4) COMPONENT MODIFIERS:

Description	Percentage By Weight
Trace	0% - 10%
Little	>10% - 20%
Some	>20% - 35%
"And"	>35%

5) Soil Organic Content

Description	% by Weight
Slightly Organic	2% - 4%
Moderately Organic	4% - 10%
Highly Organic	> 10%

6) Relative Visual Moisture

Description	Criteria	
	Cohesive Soil	**Non-cohesive Soils**
Dry	Powdery; Cannot be rolled; Water content well below the plastic limit	No moisture present
Damp	Leaves very little moisture when pressed between fingers; Crumbles at or before rolled to $^1/_8$"; Water content below plastic limit	Internal moisture, but no to little surface moisture
Moist	Leaves small amounts of moisture when pressed between fingers; Rolled to $^1/_8$" or smaller before crumbling; Water content above plastic limit to -3% of the liquid limit	Free water on surface, moist (shiny) appearance
Wet	Very mushy; Rolled multiple times to $^1/_8$" or smaller before crumbles; Near or above the liquid limit	Voids filled with free water, can be poured from split spoon.

CLASSIFICATION OF SOILS

Ohio Department of Transportation

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

SYMBOL	DESCRIPTION	Classifcation AASHTO	Classifcation OHIO	LL_0/LL x 100*	% Pass #40	% Pass #200	Liquid Limit (LL)	Plastic Index (PI)	Group Index Max.	REMARKS
	Gravel and/or Stone Fragments	A-1-a			30 Max.	15 Max.		6 Max.	0	Min. of 50% combined gravel, cobble and boulder sizes
	Gravel and/or Stone Fragments with Sand	A-1-b			50 Max.	25 Max.		6 Max.	0	
F S	Fine Sand	A-3			51 Min.	10 Max.	NON-PLASTIC		0	
	Coarse and Fine Sand	--	A-3a			35 Max.		6 Max.	0	Min. of 50% combined coarse and fine sand sizes
	Gravel and/or Stone Fragments with Sand and Silt	A-2-4				35 Max.	40 Max.	10 Max.	0	
		A-2-5					41 Min.			
	Gravel and/or Stone Fragments with Sand, Silt and Clay	A-2-6				35 Max.	40 Max.	11 Min.	4	
		A-2-7					41 Min.			
	Sandy Silt	A-4	A-4a	76 Min.		36 Min.	40 Max.	10 Max.	8	Less than 50% silt sizes
	Silt	A-4	A-4b	76 Min.		50 Min.	40 Max.	10 Max.	8	50% or more silt sizes
	Elastic Silt and Clay	A-5		76 Min.		36 Min.	41 Min.	10 Max.	12	
	Silt and Clay	A-6	A-6a	76 Min.		36 Min.	40 Max.	11 - 15	10	
	Silty Clay	A-6	A-6b	76 Min.		36 Min.	40 Max.	16 Min.	16	
	Elastic Clay	A-7-5		76 Min.		36 Min.	41 Min.	$\leq$ LL-30	20	
	Clay	A-7-6		76 Min.		36 Min.	41 Min.	>LL-30	20	
	Organic Silt	A-8	A-8a	75 Max.		36 Min.				W/o organics would classify as A-4a or A-4b
	Organic Clay	A-8	A-8b	75 Max.		36 Min.				W/o organics would classify as A-5, A-6a, A-6b, A-7-5 or A-7-6

MATERIAL CLASSIFIED BY VISUAL INSPECTION

Sod and Topsoil

Pavement or Base

Uncontrolled Fill (Describe)

Bouldery Zone

P Peat

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