Geotechnical Exploration Report

SCI-335-10.31; PID 107644
Minford, Scioto County, Ohio
October 16, 2023
Terracon Project No. N1215380

Prepared for:
American Structurepoint
Columbus, Ohio

Prepared by:
Terracon Consultants, Inc.
Cincinnati, Ohio

October 16, 2023

American Structurepoint
2550 Corporate Exchange Drive, Suite 300
Columbus, Ohio 43231

Attn: Mr. Christopher Bettinger, P.E.
P: (614) 901-2235
E: cbettinger@structirepoint.com

Re: Geotechnical Exploration Report
SCI-335-10.31; PID 107644
Minford, Scioto County, Ohio
Terracon Project No. N1215380

Dear Mr. Bettinger:

This report includes recommendations for the bridge foundations, earthwork, and roadway subgrade recommendations services for the SCI-335-10.31; PID 107644 project located in Scioto County, Ohio. In addition, we have included the plan/profile sheets for the Soil Profile and Structure Foundation Exploration. This study was performed in general accordance with Terracon Proposal No. PN1215380 dated December 3, 2021 and authorized on January 17, 2022.

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 Consultants, Inc.

Ayanda T. Ncube, E.I.T.
Staff Engineer

David W. Westendorf, P.E.
Principal/Group Manager

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange 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 ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Exploration Report

SCI-335-10.31; PID 107644

Minford, Scioto County, Ohio

Terracon Project No. N1215380

October 16, 2023

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed SCI-335-10.31: PID 107644 located in Minford, Scioto County, Ohio. The bridge crosses over Rocky Fort Creek. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil (and rock) conditions
- Short-term groundwater conditions
- Site preparation and earthwork
- Bridge foundation recommendations
- Lateral earth pressures
- Pavement design and construction

The geotechnical engineering Scope of Services for this project included the advancement of four (4) test borings to depths ranging from approximately 22.5 to 34 feet below existing site grades.

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

GEOLOGY AND OBSERVATIONS

The overburden soils in the project area consist of existing cohesive fill associated with existing bridge abutments and roadway embankment and native cohesive and granular soils of alluvial origin. According to USDA Soil Survey mapping, the native overburden soils in the project area consist of soils of the Omulga and Tioga Series.

The USGS bedrock geology indicates the project area lies within the Maxville Limestone; Logan and Cuyahoga Formations which consists of interbedded shale, siltstone, and sandstone.

EXPLORATION

Four (4) test borings were performed by Terracon on February 9 to February 10, 2022. Two borings were drilled on the existing roadway adjacent to the bridge abutments. Two borings (B-002-0-21 and B-003-0-21 were drilled through the bridge deck. Ground surface elevations were obtained with a handheld GPS device capable of accuracy of +/- 1 foot.

The test borings were drilled using a CME-55 track-mounted drill rig. The test borings were drilled to depths of 22.5 to 34.5 feet below the top of the existing pavement.

Rock core was obtained in all borings using NQ2-size coring tools. Drilling and sampling procedures were performed in general accordance with the ODOT Specifications for Geotechnical Exploration (SGE). The average drill rod energy ratio (ER) for the CME-55 drill rig was calibrated to be 89.5 percent (calibration date 5/8/2020).

Groundwater levels were observed during and at completion of the drilling activities at each test boring location. No long-term (24-hour) water level readings were obtained at the test boring locations. Upon completion of the drilling activities and following water level observations, the boreholes were backfilled with auger cuttings and bentonite chips. The pavement was repaired at the surface with asphalt cold patches after backfilling operations. The bridge deck was repaired with quick set concrete per SGE requirements.

LABORATORY TESTING

Selected soil samples were tested in the laboratory for Atterberg Limits, sieve/hydrometer analysis, Slake Durability, and moisture content (index-property classification testing). Moisture content tests were performed on the remaining soil samples. The laboratory tests were performed in accordance with the ODOT SGE. A hand penetrometer was used to estimate the approximate unconfined compressive strength of cohesive soil samples. The hand penetrometer has been correlated with unconfined compression tests and provides a better estimate of soil consistency than visual examination alone. Moisture content, Atterberg limits, sieve/hydrometer analysis, and hand penetrometer results are provided on the boring logs. Graphs of the sieve and hydrometer analysis and slake durability results are provided separately.

FINDINGS

The test borings identified up to 12 inches of asphalt pavement. Test borings B-002-0-21 and B-003-0-21 were drilled through the existing bridge deck which measured 17.4 and 14.4 inches, respectively, in thickness. At B-001-0-21, the boring encountered native overburden soils consisting of silt and clay (A-6a) and sandy silt (A-4a and A-4b). The consistency of the soils was generally very stiff. At B-004-0-21, the boring encountered fill which was approximately 2.5 feet thick. Under the fill, the native overburden soils found consisted of silty clay (A-6b), gravel with sand and silt (A-2-4), and sandy silt (A-4a). The consistency of the fine-grained soils was generally very stiff. The relative density of the granular soils was generally loose.

Siltstone bedrock was encountered at elevations between 592 and 606 feet, MSL. The sampled top of bedrock was brown, weak to slightly strong and moderately weathered. Occasional brown

shale seams were encountered. At deeper depths, the bedrock was dark gray, strong and slightly weathered to un-weathered.

Groundwater was observed in test boring B-004-0-21 at 8.5 feet below the ground surface (corresponding to an elevation of approximately 599.5 feet, MSL). Groundwater was not encountered in all other borings during drilling. Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Groundwater amongst profiles of this type is typically found within granular seams in overburden soils, near the interface of native soils and bedrock, or along fractures and bedding within the bedrock system.

Conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types. In situ, the transition between materials may be gradual.

ANALYSES AND RECOMMENDATIONS

Earthwork

Prior to placing any new embankment fill, all vegetation, topsoil, existing pavement and any otherwise unsuitable material should be removed from the construction areas. Wet or dry material should either be removed, or moisture conditioned and recompacted. After stripping and grubbing, the subgrade should be proof-rolled, where possible, to aid in locating loose or soft areas. Soft, dry and low-density soil should be removed or compacted in place prior to placing fill.

We recommend all earthwork and embankment fill placement be performed per the ODOT Construction and Materials Specifications (ODOT CMS). Generally, the on-site soils appear suitable for re-use as embankment fill following proper moisture conditioning. Some undercutting and removing of unsuitable soils should be anticipated.

Bridge Foundation Recommendations

Both shallow foundations and drilled shafts were initially considered for the bridge foundations. Per BDM, the bottom of the footings should be located directly on scour-resistant rock. Based on the test boring findings the scour resistance of the bedrock was determined using the criteria in BDM. The bedrock at the site does not meet the requirements for slake durability and erodibility index and therefore is not considered scour-resistant.

Based on conditions encountered in the test borings, it is recommended that the proposed bridge abutments be supported on drilled shaft foundations bearing in the siltstone bedrock. The following sections provide recommendations regarding the design of drilled shaft foundations to resist axial compressive and uplift loads, as well as soil and bedrock parameters to design the

drilled shafts to resist lateral loads. Our recommendations consider the soil and bedrock conditions encountered in the test borings.

Drilled Shaft Design

Anticipated Top of Bedrock Elevation (feet) [1]	Minimum Shaft Diameter (inches)	Unfactored Nominal Unit Tip Resistance, q_p (tsf) [2]	Unfactored Nominal Unit Side Resistance, q_s (tsf) [2,3]	Resistance Factor, φ_{stat}
606.5 (Boring B-001-0-21) 594.0 (Boring B-002-0-21) 592.5 (Boring B-003-0-21) 593.0 (Boring B-004-0-21)	30	50	4.5	0.5 (Tip) 0.55 (Side)

1. See Geotechnical Characterization and the boring logs for soil and bedrock stratigraphy details. The drilled shaft lengths vary depending upon the depth of the gray shale and limestone bedrock encountered in the test borings.
2. Minimum shaft length of 10-feet or 3 shaft diameters, whichever is longer, is required for the drilled shafts to behave as deep foundations.
3. Only applicable for portion of socket that is below 1.5 times the diameter and assumes shaft concrete is poured directly against the soil/rock socket (i.e. no permanent casing is used). Can be used to resist either compressive or uplift forces. For uplift, a resistance factor of 0.4 should be applied to the Nominal Unit Side Resistance. The weight of the shaft can also be used to resist any uplift forces. The buoyant weight of the shaft should be used below the anticipated groundwater level to resist uplift forces.

The drilled shaft length will need to be designed to satisfy axial compressive, uplift, and lateral load requirements. The penetration of the drilled shaft into shale and limestone bedrock may need to be increased over the minimum rock socket for bearing capacity based on the lateral resistance or uplift resistance requirements of the drilled shaft foundations

The following table provides input values for use in LPILE analyses. LPILE estimated values of k_h and E_{50} based on strength; however, non-default values of k_h were used where provided. The soil parameters were estimated based on the test borings, laboratory test results, and our experience with these soil types. The portion of the drilled shaft within 30 inches of finished grade should ignore any lateral soil resistance due to frost considerations.

Soil Layer/Type[1]	LPILE Model	Unit Weight (pcf)		Soil Friction Angle (deg)	Undrained Cohesion (psf)	ε_{50}	K (pci)	Uniaxial Compressive Strength (psi)
		Moist	Buoyant[2]					
Silt and Clay (A-6a) Silty Clay (A-6b) Sandy Silt (A-4b)	Stiff Clay w/o Free Water (Reese)	120	57.6	-	2500	0.006	-	-
Gravel with Sand and Silt (A-2-4) Gravel and Stone Fragments with Sand, Silt and Clay (A-2-6	Sand (Reese)	125	62.6	28	-	-	20	-
Siltstone Bedrock	Weak Rock	135	-	K_rm	Initial Modulus (psi)		RQD (%)	3000
				0.0003	100,000		70	

1. See test boring logs and **Findings** for more details on Stratigraphy.
2. Buoyant unit weight values should be used below the water table.

LPILE Analysis

As requested by Structurepoint, an L-Pile analysis was performed for drilled shafts. The analyzed shafts were 30-inch diameter and embedded 10 feet into bedrock. The assumed reinforcing for the analysis consisted of ten #8 bars (1.12% steel) for the full length of the shaft. Two cases at each abutment were analyzed in LPILE, a service case and a strength case to determine lateral pile deflection, bending moment and shear force. The following values were provided by Structurepoint for the analysis of both cases:

	Service Case	Strength Case
Vertical	336 k/shaft	455 k/shaft
Lateral	41 k/shaft	57 k/shaft
Moment	144 k-ft/shaft	190 k-ft/shaft

The L-Pile input and results are attached in the appendix.

Drilled Shaft Construction Considerations

In general, the following additional consideration during drilled pier installation should be adhered to such that:

1. The concrete shall have a minimum 28-day specified compressive strength of 4,000 psi.
2. It is recommended that the top of rock and design rock socket 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.
3. The 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 from the examination of materials brought to the surface on the augers by the geotechnical technician working under the supervision of the project geotechnical engineer.
4. The specifications should require that no concrete be placed until the dimensions, bottom elevation, bearing socket depth, and excavation for each shaft have been observed and approved by the field geotechnical technician. Water seepage from the creek and subsurface groundwater may enter the shaft excavation. It is recommended that the specifications state that the depth of water or loose/soft material at the bottom of the shaft excavation, just before placing concrete shall be less than 2 inches.
5. If more than 2 inches of water is present in the shaft excavation, a means of preventing concrete from intermixing with the water must be provided. This is commonly done with a bottom discharge gate or rubber ball for a tremie pipe. In no case should the concrete discharge point be above standing water in the shafts.
6. The specifications should state that casing shall be made available on-site (by the contractor) and be placed wherever required to stabilize loose or caving materials or to seal off any water-bearing zones. Water or bentonite slurry may also be used in conjunction with the casing to stabilize the borehole. If a casing is installed into an oversized shaft excavation, the annulus space between the casing and soils should be grouted.
7. It is recommended that the specifications state that the structural steel and concrete be placed on the same day as the shaft excavation is completed. No completed drilled shaft excavation should be allowed to remain open overnight. It is suitable, however, for the contractor to excavate a portion of the drilled shaft and to complete the shaft excavation the next day. Seepage into shaft excavations shall be pumped out and the reinforcing steel and concrete shall be placed immediately after reaching design bearing elevation.

The bottom of the shaft excavation should be free of any soft material before placing reinforcing steel and shaft concrete.

Lateral Earth Pressures

The proposed bridge abutments should be designed using the earth pressure parameters recommended in the following paragraphs. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. If the bridge is supported directly on the abutment retaining walls we recommend at-rest earth pressures be considered, and if the bridge is supported on separate abutments beyond the abutment retaining walls then active earth pressures are recommended. The backfill immediately behind the wall should include a free-draining aggregate (Item 518 Porous Backfill) within a 2-foot rectangular zone behind the abutment walls. Concrete or a two-foot-thick cohesive soil cap should be placed at the surface of the porous backfill to limit surface water infiltration into the porous backfill. Based on the anticipated wall heights and soil conditions, there is sufficient allowable movement in the abutments to develop active earth pressures.

DESCRIPTION	DESIGN STATIC LATERAL PRESSURES	
	DRAINED[3]	UNDRAINED[4]
Bridge Supported on Separate Abutments beyond Retaining Wall with level backslope [1]	Lateral earth pressure[5]: 50H psf (triangular distribution) + Surcharge pressure[5]: 0.42S psf (rectangular distribution)	Lateral earth pressure[5]: 25H psf (triangular distribution) + Hydrostatic Pressure[6]: 62h psf (triangular distribution) + Surcharge pressure[5]: 0.42S psf (rectangular distribution)
Bridge Abutments Supported on a full height Retaining Wall with level backslope [1]	Lateral earth pressure[5]: 70H psf (triangular distribution) + Surcharge pressure[5]: 0.58S psf (rectangular distribution)	Lateral earth pressure[5]: 34H psf (triangular distribution) + Hydrostatic Pressure[6]: 62h psf (triangular distribution) + Surcharge pressure[5]: 0.58S psf (rectangular distribution)

1. The earth pressures recommended above assume the abutments allow at least 0.1 inches of movement at the top of the abutment wall to fully develop “active” earth pressure conditions.
2. Assumes no lateral movement at the top of the retaining wall supporting the bridge abutment.
3. Effective drainage is provided, and hydrostatic pressures are not allowed to develop behind the wall.
4. Hydrostatic pressures can develop behind the wall.

5. "H" is the design height of the wall in feet; "S" is uniform surface surcharge in psf.
6. "h" is the height of water behind the wall in feet. If "h" < "H", then lateral earth pressures from the drained upper portion of the wall backfill should be added to the recommended undrained lateral earth pressure values.

Seismic Considerations

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with AASHTO LRFD Bridge Design Specification 3.10.3.1. Based on the soil properties encountered at the site and as described in the exploration logs and results, it is our professional opinion that the **Seismic Site Classification is C**. Subsurface explorations at this site were extended to a maximum depth of about 34.5 feet and encountered bedrock at a depth of 7.5 to 19.5 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of the geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

PAVEMENT SUBGRADE

The test borings performed in this study encountered asphalt pavement underlain by cohesive and granular soils. Based on the anticipated roadway alignment, we anticipate the cohesive overburden soils will primarily comprise the subgrade material for the roadway.

The over-burden soils at/near the anticipated subgrade level typically classify as A-2-4, A-2-6, A-6a, and A-6b per the ODOT Classification system. Based on laboratory testing, the existing subgrade soils have moisture contents ranging from about 10 to 21 percent, with an average moisture content of the subgrade soils across the project area of about 17 percent. Plasticity indices in subgrade soils ranged from 3 to 13, with an average plasticity index of about 9.

The moisture contents of the existing subgrade soils in the upper 6 feet of boring locations below the pavement ranged from approximately 2% to 7% above and 2% below the estimated optimum moisture contents (M_{OPT}) for the corresponding material type per the attached ODOT Subgrade Analysis. The estimated optimum moisture contents are based on the soil types and corresponding M_{OPT} as outlined in the current ODOT Geotechnical Bulletin GB1.

The N_{60L} values (low N-values) for the anticipated subgrade soils encountered in the test borings ranged from 12 to 14 bpf (blows per foot). A summary of the subgrade soils is tabulated on ODOT's Subgrade Analysis spreadsheet in the Appendix.

Currently, ODOT uses two options for establishing a stable subgrade: chemical stabilization or excavate and replace. Based on the results of the subgrade analysis, up to 12 inches of excavate/replace may be required for the pavement replaced for the rear approach. It should also be noted that subgrade conditions are dependent on the time of the year of construction (i.e., seasonally wet/dry months). Areas, where subgrade soils have deteriorated either due to trafficking or water-softening, may require an additional undercut to provide a suitable surface for structural fill placement and/or stabilization methods.

Laboratory California Bearing Ratio (CBR) testing was not performed on the anticipated subgrade soils for this project. Thus, the provided CBR value is based on the soil index testing and more specifically the ODOT Group Index relationship to the CBR value. The average Group Index for the proposed roadway subgrade soils encountered at the test boring locations was about 9. Thus, based on ODOT's guidelines for determining CBR, we recommend an average CBR value of 6 to be utilized in pavement design. Construction of the subgrade stabilization/improvement should follow current ODOT Construction & Materials Specifications (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. Natural 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 or collaboration through this system 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 impact 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. 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

Exploration Plan
Test Boring Logs
ODOT Test Boring Terminology
ODOT Soil Classification
Supporting Information

EXPLORATION PLAN

SCI-335-10.31 ■ Minford, OH

March 24, 2023 ■ Terracon Project No. N1215380

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

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

PROJECT: SCI-335-10.31	DRILLING FIRM / OPERATOR: TERRACON / KH	DRILL RIG: CME 55	STATION / OFFSET: 530+57, 6' RT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: TERRACON / AR	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-335
PID: 107644 SFN: 7305109	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 5/8/20	ELEVATION: 614.0 (MSL) EOB: 22.5 ft.
START: 2/10/22 END: 2/10/22	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 89.5	LAT / LONG: 38.874141, -82.864070

EXPLORATION ID B-001-0-21

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 614.0	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
ASPHALT (12 INCHES)	613.0																		
STIFF TO VERY STIFF, YELLOW BROWN AND BROWN, **SILT AND CLAY**, LITTLE GRAVEL, SOME SAND, DAMP	610.0	1	7 3 5	12	89	SS-1	2.25	11	16	16	29	28	27	16	11	18	A-6a (5)	-	
		2																	
		3	5 9 12	31	61	SS-2	3.25	0	2	10	47	41	33	20	13	21	A-6a (9)	-	
VERY STIFF, YELLOW BROWN, **SANDY SILT**, AND CLAY, DAMP	608.5	4																	
		5	10 6 10	24	100	SS-3	3.50	0	2	18	43	37	26	22	4	19	A-4a (8)	-	
VERY STIFF, GRAY, **SILT**, TRACE GRAVEL, SOME CLAY AND SAND, DAMP	607.0	6																	
		7	10 11 50/5"	-	94	SS-4	-	1	1	20	53	25	22	19	3	21	A-4b (8)	-	
OLIVE BROWN, **STONE FRAGMENTS**, WEATHERED SILTSTONE, DRY	606.5		50/3"	-	100	SS-5	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	-	
SILTSTONE, BROWN, HIGHLY WEATHERED, VERY WEAK, WITH BROWN SHALE SEAMS, MODERATELY FRACTURED, RANGES IN THICKNESS FROM 2 TO 10 INCHES; RQD 71%, REC 88%.	604.5	TR 8	71		88	NQ2-1											CORE		
		9																	
SILTSTONE, BROWN AND DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, WITH GRAY SHALE SEAMS, MODERATELY FRACTURED, RANGES IN THICKNESS FROM 4 TO 7 INCHES, UNCONFINED COMPRESSIVE STRENGTH AT 9,5 FEET: 2,990 PSI, SLAKE DURABILITY INDEX AT 9.5 FEET: 89.3%; RQD 77%, REC 100%.	599.5	10																	
		11																	
		12	77		100	NQ2-2											CORE		
		13																	
		14																	
SILTSTONE, DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, THINLY LAMINATED, INTACT, RANGES IN THICKNESS FROM 7 TO 15 INCHES; RQD 98%, REC 100%.		15																	
		16																	
		17	95		100	NQ2-3											CORE		
		18																	
		19																	
		20																	
		21	100		100	NQ2-4											CORE		
		22																	
	591.5	EOB																	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (11 X 17) - OH DOT.GDT - 9/13/22 09:55 - N:\PROJECTS\2021\N1215380\WORKING FILES\LABORATORY-FIELD DATA-BORING LOGS\N1215380 ODOT .GPJ

PROJECT: SCI-335-10.31	DRILLING FIRM / OPERATOR: TERRACON / KH	DRILL RIG: CME 55	STATION / OFFSET: 531+39, 5' LT.	EXPLORATION ID B-002-0-21
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: TERRACON / AR	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-335	
PID: 107644 SFN: 7305109	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 5/8/20	ELEVATION: 594.0 (MSL) EOB: 15.0 ft.	PAGE 1 OF 1
START: 2/10/22 END: 2/10/22	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 89.5	LAT / LONG: 38.874290, -82.864152	

MATERIAL DESCRIPTION AND NOTES	ELEV. 594.0	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	ABAN-DONED
SILTSTONE, DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, THINLY LAMINATED, INTACT, RANGES IN THICKNESS FROM 5 TO 24 INCHES, UNCONFINED COMPRESSIVE STRENGTH TEST AT 24 FEET: 5,600 PSI; RQD 98%, REC 100%.		TR																	
		1																	
		2	92		100	NQ2-1											CORE		
		3																	
		4																	
		5																	
		6	100		100	NQ2-2											CORE		
		7																	
		8																	
		9																	
		10																	
		11	100		100	NQ2-3											CORE		
		12																	
		13																	
		14																	
	579.0	EOB 15	100		100	NQ2-4											CORE		

NOTES: BORING DRILLED THROUGH BRIDGE DECK. BRIDGE DECK ELEVATION = 611.3 FT

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED QUICKCRETE

STANDARD ODOT LOG W/ SULFATES (11 X 17) - OH DOT.GDT - 9/13/22 09:55 - N:\PROJECTS\2021\N1215380\WORKING FILES\LABORATORY-FIELD DATA-BORING LOGS\N1215380 ODOT .GPJ

PROJECT: SCI-335-10.31	DRILLING FIRM / OPERATOR: TERRACON / KH	DRILL RIG: CME 55	STATION / OFFSET: 531+74, 6' RT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: TERRACON / AR	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-335
PID: 107644 SFN: 7305109	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 5/8/20	ELEVATION: 594.0 (MSL) EOB: 16.5 ft.
START: 2/10/22 END: 2/10/22	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 89.5	LAT / LONG: 38.874393, -82.864119

EXPLORATION ID B-003-0-21

MATERIAL DESCRIPTION AND NOTES	ELEV. 594.0	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	ABAN-DONED
DENSE TO VERY DENSE, BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, WET			3 30 50/2"	-	100	SS-1	-	-	-	-	-	-	-	-	-	12	A-2-6 (V)	-	
	592.5	TR																	
SILTSTONE, DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, THINLY LAMINATED, INTACT, RANGES IN THICKNESS FROM 10 TO 24 INCHES, UNCONFINED COMPRESSIVE STRENGTH AT 28.5 FEET: 5,531 PSI; RQD 94%, REC 97%.			77		88	NQ2-1											CORE		
			100		100	NQ2-2											CORE		
			100		100	NQ2-3											CORE		
			100		100	NQ2-4											CORE		
	577.5	EOB																	

NOTES: BORING DRILLED THROUGH BRIDGE DECK. BRIDGE DECK ELEVATION = 610.5 FT

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED QUICKCRETE

STANDARD ODOT LOG W/ SULFATES (11 X 17) - OH DOT.GDT - 9/13/22 09:55 - N:\PROJECTS\2021\N1215380\WORKING FILES\LABORATORY-FIELD DATA-BORING LOGS\N1215380 ODOT .GPJ

PROJECT: SCI-335-10.31	DRILLING FIRM / OPERATOR: TERRACON / KH	DRILL RIG: CME 55	STATION / OFFSET: 532+51, 6' LT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: TERRACON / AR	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-335
PID: 107644 SFN: 7305109	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 5/8/20	ELEVATION: 611.0 (MSL) EOB: 33.0 ft.
START: 2/10/22 END: 2/10/22	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 89.5	LAT / LONG: 38.874595, -82.864225

EXPLORATION ID B-004-0-21

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 611.0	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
ASPHALT (12 INCHES)	610.0																		
MEDIUM DENSE, DARK BROWN, **GRAVEL WITH SAND AND SILT**, DAMP	608.5	1	8 13 11	36	100	SS-1	2.50	35	19	16	30		NP	NP	NP	10	A-2-4 (0)	-	
VERY STIFF, DARK BROWN AND GREENISH-GRAY, **SILTY CLAY**, TRACE GRAVEL, DAMP	607.0	3	13 15 22	55	100	SS-2	3.25	-	-	-	-	-	-	-	-	-	A-6b (V)	-	
VERY STIFF, BROWN, **SILTY CLAY**, TRACE GRAVEL, DAMP	604.0	4 5 6	7 4 6	15	89	SS-3	3.00	-	-	-	-	-	-	-	-	-	A-6b (V)	-	
		6	7 5 5	15	67	SS-4	3.50	-	-	-	-	-	29	16	13	14	A-6b (V)	-	
LOOSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, WET		7 8 9	2 2 3	7	89	SS-5	-	4	9	31	39	17	NP	NP	NP	17	A-2-4 (0)	-	
			1 1 1	3	100	SS-6	-	-	-	-	-	-	-	-	-	26	A-2-4 (V)	-	
		10 11	0 1 1	3	89	SS-7	-	-	-	-	-	-	19	18	1	21	A-2-4 (V)	-	
		12	0 1 1	3	100	SS-8	-	-	-	-	-	-	-	-	-	21	A-2-4 (V)	-	
	596.5	13 14	0 0 1	1	61	SS-9	-	1	2	55	35	7	NP	NP	NP	23	A-2-4 (0)	-	
SOFT, BROWN, **SANDY SILT**, LITTLE CLAY, WET	595.0	15 16	2 1 2	4	100	SS-10	-	0	1	45	42	12	19	16	3	26	A-4a (4)	-	
LOOSE, BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET	593.0	17	2 2 5	10	100	SS-11	-	0	5	63	26	6	NP	NP	NP	26	A-2-4 (0)	-	
		18 TR	50	-	100	SS-12	-	-	-	-	-	-	-	-	-	-	A-2-4 (V)	-	
SILTSTONE, BROWN AND GRAY, MODERATELY TO SLIGHTLY WEATHERED, SLIGHTLY STRONG, WITH BROWN SHALE SEAMS, FRACTURED, RANGES IN THICKNESS FROM 1 TO 4 INCHES; RQD 33%, REC 67%.	592.0		33		67	NQ2-1											CORE		
SILTSTONE, DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, THINLY LAMINATED, WITH GRAY SHALE SEAMS, MODERATELY FRACTURED, RANGES IN THICKNESS FROM 4 TO 11 INCHES; RQD 72%, REC 100%.	587.0	19 20 21 22 23	72		100	NQ2-2											CORE		
SILTSTONE, DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, THINLY LAMINATED, INTACT, RANGES IN THICKNESS FROM 10 TO 24 INCHES, UNCONFINED COMPRESSIVE STRENGTH AT 24 FEET: 5,600 PSI; RQD 99%, REC 98%.		24 25 26 27 28	97		98	NQ2-3											CORE		
	578.0	29 30 31 32 EOB 33	100		100	NQ2-4											CORE		

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (11 X 17) - OH DOT.GDT - 9/13/22 09:55 - N:\PROJECTS\2021\N1215380\WORKING FILES\LABORATORY-FIELD DATA-BORING LOGS\N1215380 ODOT .GPJ

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Office of Geotechnical Engineering

B-001-0-21

Run #:	Depth		Recovery		RQD	
NQ2-1	7.5’	9.5’	21/24	88%	17/24	71%
NQ2-2	9.5’	14.5’	60/60	100%	46/60	77%
SCI-335-10.31 PID 107644						

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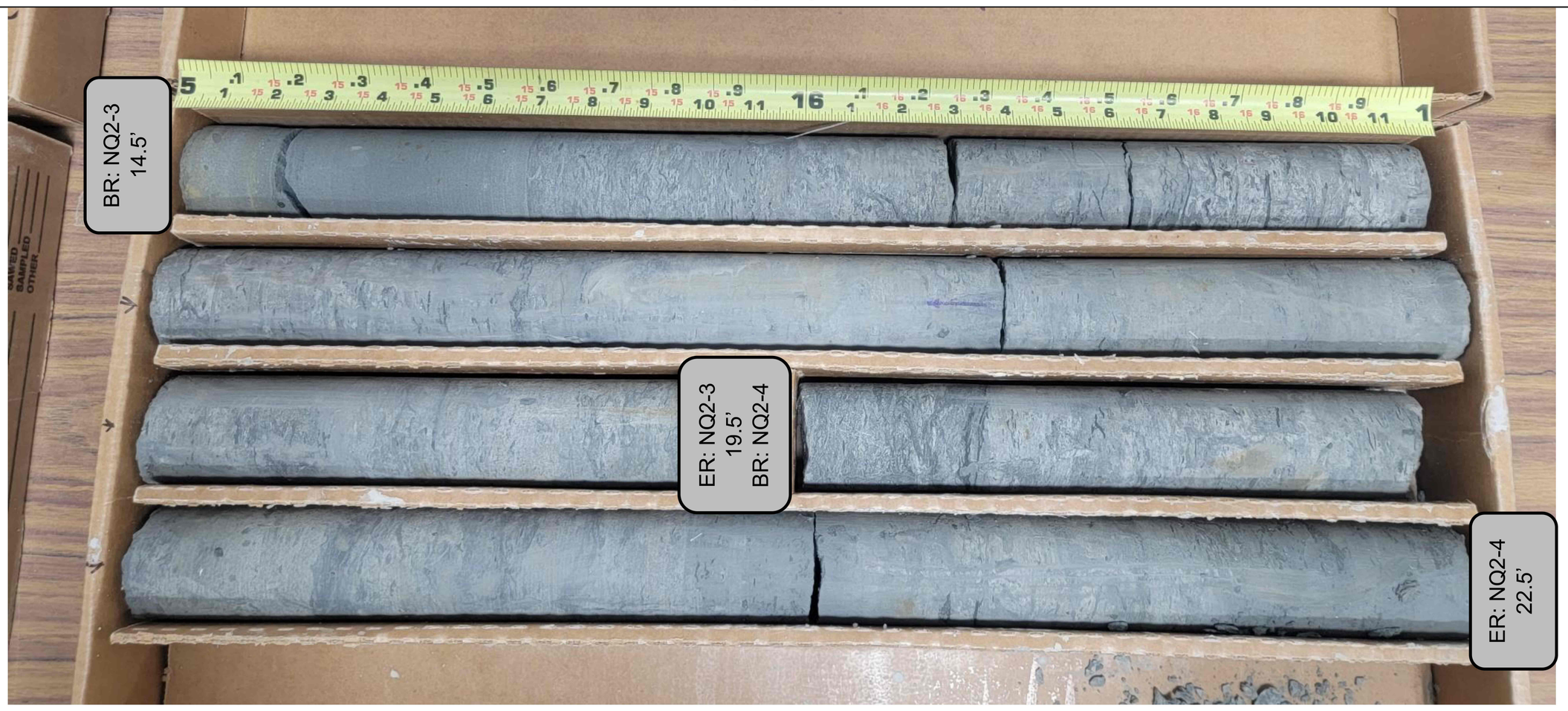
B-001-0-21



Run #:	Depth		Recovery		RQD	
NQ2-3	14.5’	19.5’	60/60	100%	57/60	95%
NQ2-4	19.5’	22.5’	36/36	100%	36/36	100%
SCI-335-10.31 PID 107644						

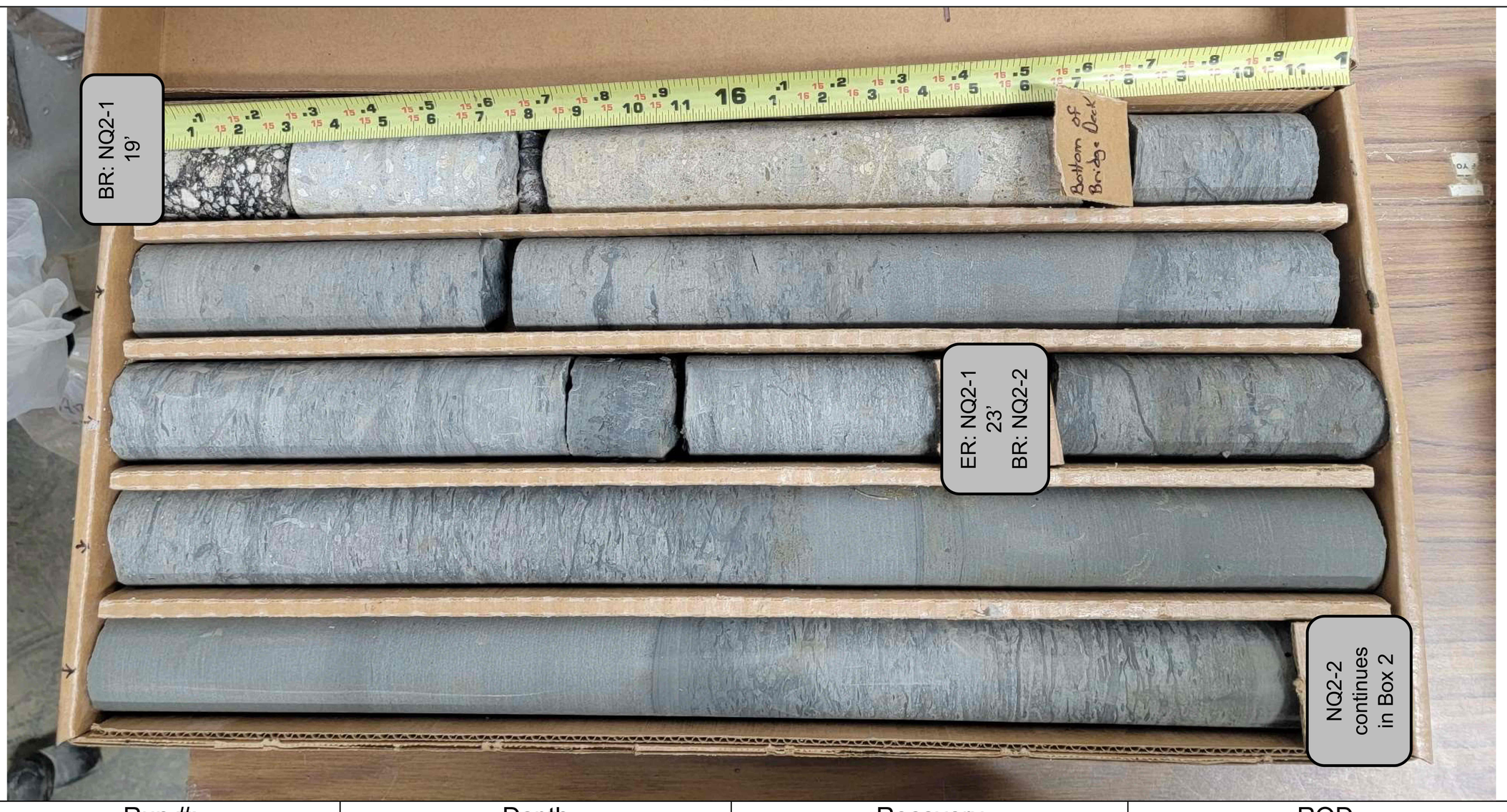
SHEET 7 TOTAL 10
PROJECT ID 107644
REVIEWER DWW 06-24-22
DESIGNER DWW
DESIGN AGENCY Terracon Consulting Engineers and Scientists

GEOTECHNICAL PROFILE - BRIDGE
LABORATORY TEST DATA

OHIO DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING

Office of Geotechnical Engineering

B-002-0-21



Run #:	Depth		Recovery		RQD	
NQ2-1	19’	23’	48/48	100%	44/48	92%
NQ2-2	23’	28’	60/60	100%	60/60	100%
SCI-335-10.31 PID 107644						

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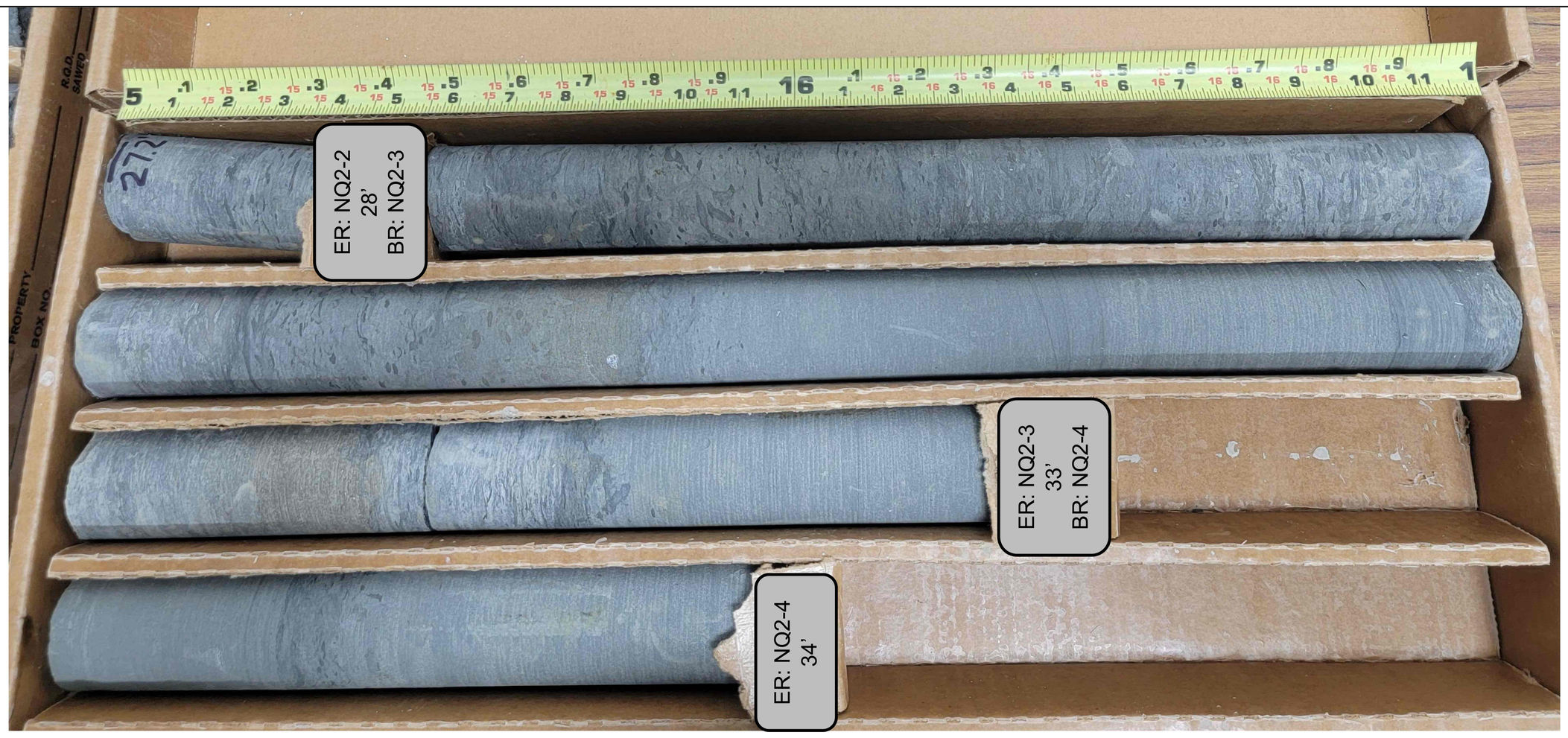
B-002-0-21



Run #:	Depth		Recovery		RQD	
NQ2-3	28’	33’	60/60	100%	60/60	100%
NQ2-4	33’	34’	12/12	100%	12/12	100%
SCI-335-10.31 PID 107644						

SHEET 8 TOTAL 10 | PROJECT ID 107644 | REVIEWER DWW 06-24-22 | DESIGNER DWW | DESIGN AGENCY Terracon Consulting Engineers and Scientists

GEOTECHNICAL PROFILE - BRIDGE
LABORATORY TEST DATA

OHIO DEPARTMENT OF TRANSPORTATION
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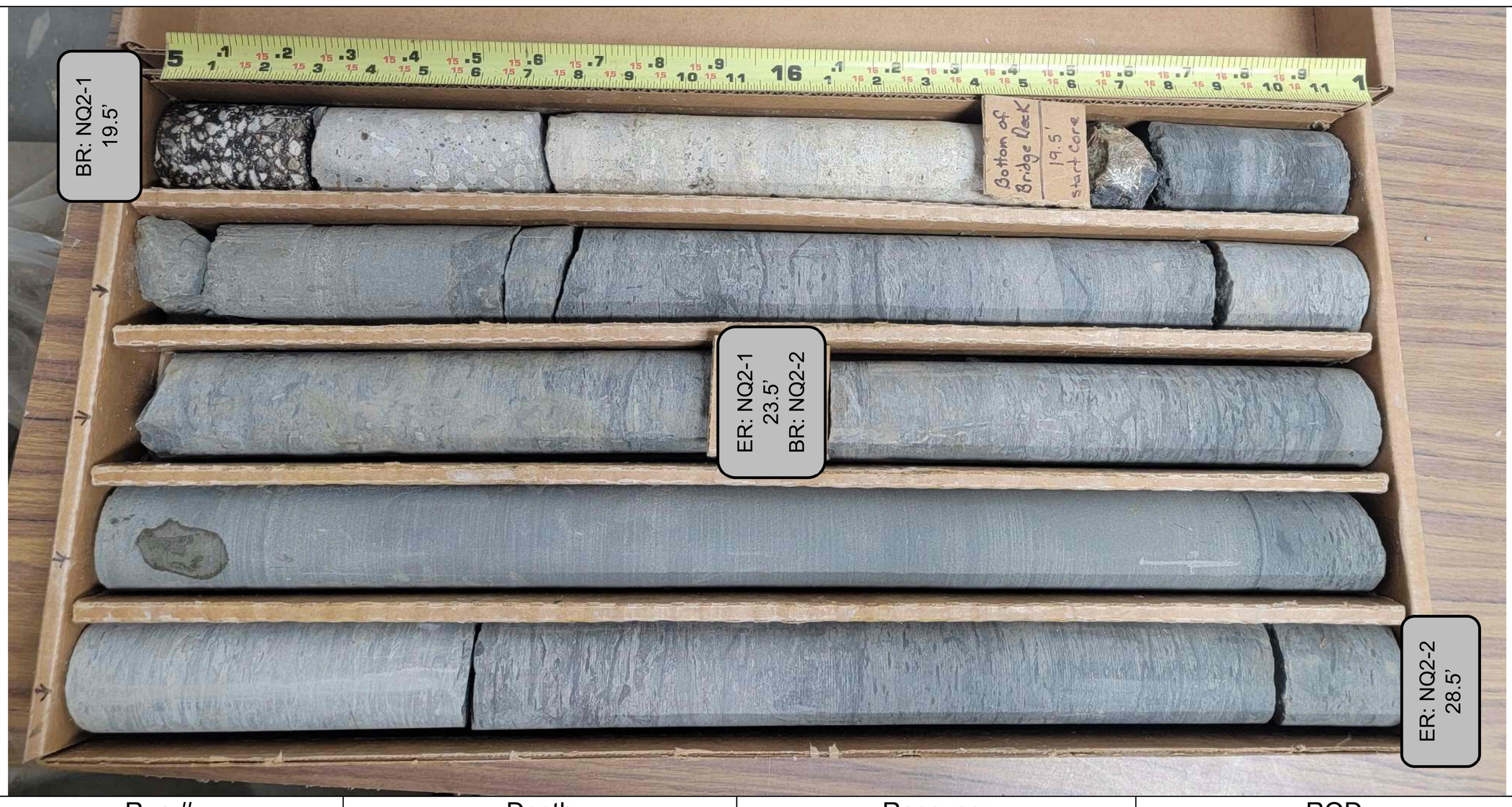
B-003-0-21



Run #:	Depth		Recovery		RQD	
NQ2-1	19.5’	23.5’	42/48	88%	37/48	77%
NQ2-2	23.5’	28.5’	60/60	100%	60/60	100%
SCI-335-10.31 PID 107644						

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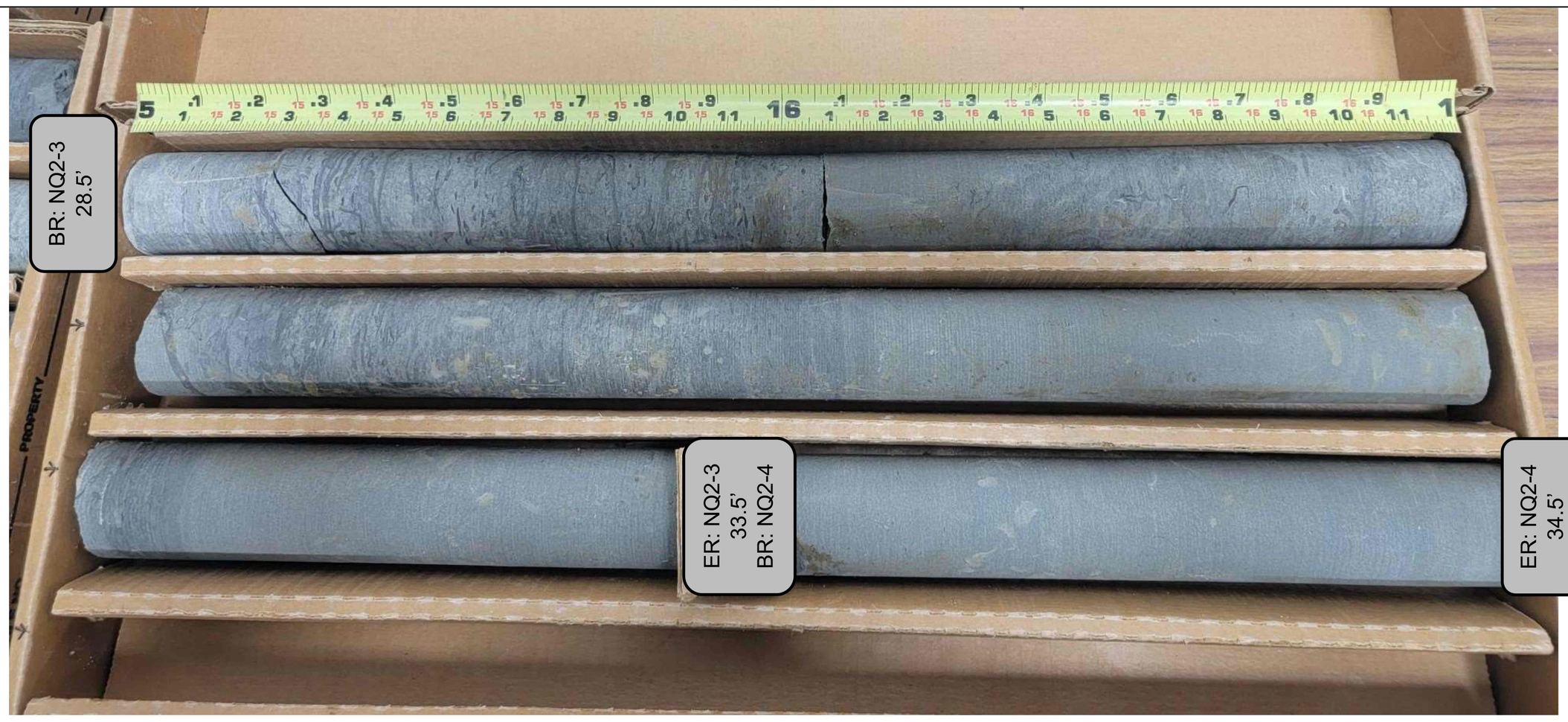

Run #:	Depth		Recovery		RQD	
NQ2-3	28.5’	23.5’	60/60	100%	60/60	100%
NQ2-4	33.5’	34.5’	12/12	100%	12/12	100%
SCI-335-10.31 PID 107644						

SHEET 9 | TOTAL 10
PROJECT ID 107644
REVIEWER DWW 06-24-22
DESIGNER DWW
Terracon Consulting Engineers and Scientists
DESIGN AGENCY

GEOTECHNICAL PROFILE - BRIDGE
LABORATORY TEST DATA

OHIO DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING

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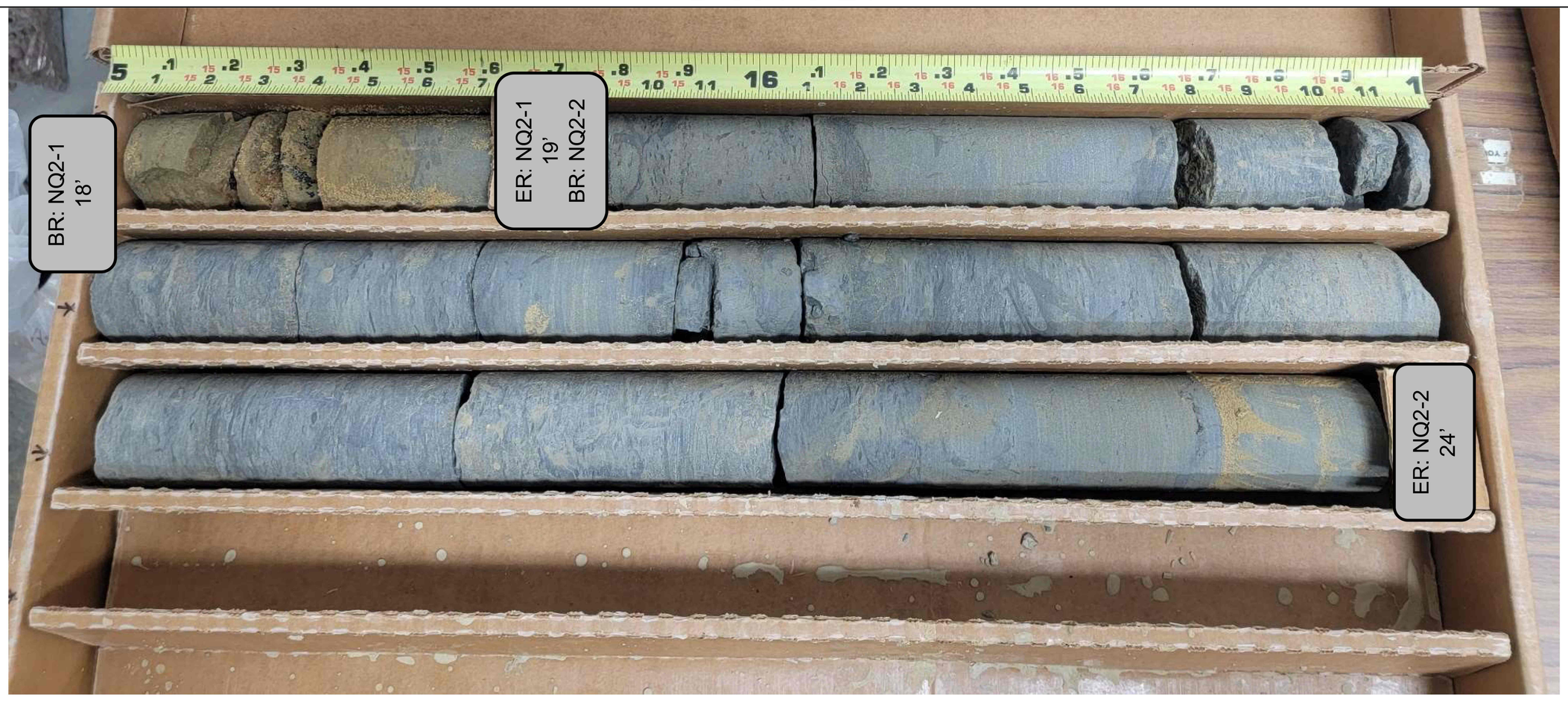
B-004-0-21



Run #:	Depth		Recovery		RQD	
NQ2-1	18’	19’	8/12	67%	4/12	33%
NQ2-2	19’	24’	60/60	100%	43/60	72%
SCI-335-10.31 PID 107644						

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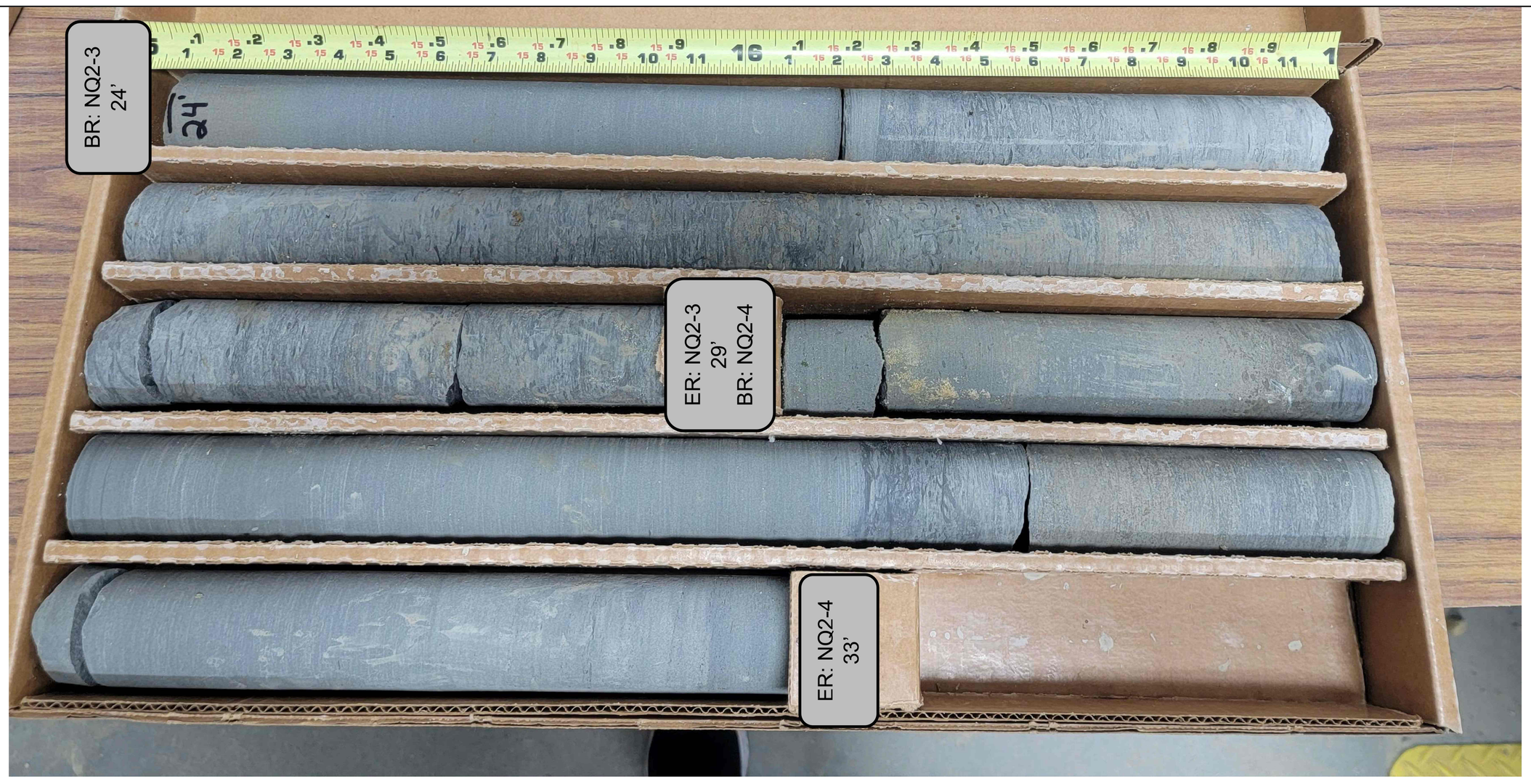


Run #:	Depth		Recovery		RQD	
NQ2-3	24’	29’	59/60	98%	58/60	97%
NQ2-4	29’	33’	48/48	100%	48/48	100%
SCI-335-10.31 PID 107644						

SHEET 10 | TOTAL 10
PROJECT ID 107644
REVIEWER DWW 06-24-22
DESIGNER DWW
Terracon Consulting Engineers and Scientists
DESIGN AGENCY

GEOTECHNICAL PROFILE - BRIDGE
LABORATORY TEST DATA

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		$LL_O/LL \times 100$*	% Pass #40	% Pass #200	Liquid Limit (LL)	Plastic Index (PI)	Group Index Max.	REMARKS
		AASHTO	OHIO							
	Gravel and/or Stone Fragments	A-1-a			30 Max.	15 Max.		6 Max.	0	Min. of 50% combined gravel, cobble and boulder sizes
	Gravel and/or Stone Fragments with Sand	A-1-b			50 Max.	25 Max.		6 Max.	0	
	Fine Sand	A-3			51 Min.	10 Max.	NON-PLASTIC		0	
	Coarse and Fine Sand	--	A-3a			35 Max.		6 Max.	0	Min. of 50% combined coarse and fine sand sizes
	Gravel and/or Stone Fragments with Sand and Silt	A-2-4				35 Max.	40 Max.	10 Max.	0	
		A-2-5					41 Min.			
	Gravel and/or Stone Fragments with Sand, Silt and Clay	A-2-6				35 Max.	40 Max.	11 Min.	4	
		A-2-7					41 Min.			
	Sandy Silt	A-4	A-4a	75 Min.		36 Min.	40 Max.	10 Max.	8	Less than 50% silt sizes
	Silt	A-4	A-4b	75 Min.		50 Min.	40 Max.	10 Max.	8	50% or more silt sizes
	Elastic Silt and Clay	A-5		75 Min.		36 Min.	41 Min.	10 Max.	12	
	Silt and Clay	A-6	A-6a	75 Min.		36 Min.	40 Max.	11 - 15	10	
	Silty Clay	A-6	A-6b	75 Min.		36 Min.	40 Max.	16 Min.	16	
	Elastic Clay	A-7-5		75 Min.		36 Min.	41 Min.	$\leq$LL-30	20	
	Clay	A-7-6		75 Min.		36 Min.	41 Min.	>LL-30	20	
	Organic Silt	A-8	A-8a	74 Max.		36 Min.				W/o organics would classify as A-4a or A-4b
	Organic Clay	A-8	A-8b	74 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

Peat

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

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 procedes 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% -50%

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.

APPENDIX A.2 – ODOT Quick Reference Guide for Rock Description

1: ROCK TYPE: Common rock types are: Claystone; Coal; Dolomite; Limestone; Sandstone; Siltstone; & Shale.

2: COLOR: To be determined when rock is wet. When using the GSA Color charts use only Name, not code.

3: WEATHERING

Description	Field Parameter
Unweathered	No evidence of any chemical or mechanical alternation of the rock mass. Mineral crystals have a bright appearance with no discoloration. Fractures show little or no staining on surfaces.
Slightly weathered	Slight discoloration of the rock surface with minor alterations along discontinuities. Less than 10% of the rock volume presents alteration.
Moderately weathered	Portions of the rock mass are discolored as evident by a dull appearance. Surfaces may have a pitted appearance with weathering "halos" evident. Isolated zones of varying rock strengths due to alteration may be present. 10 to 15% of the rock volume presents alterations.
Highly weathered	Entire rock mass appears discolored and dull. Some pockets of slightly too moderately weathered rock may be present and some areas of severely weathered materials may be present.
Severely weathered	Majority of the rock mass reduced to a soil-like state with relic rock structure discernable. Zones of more resistant rock may be present, but the material can generally be molded and crumbled by hand pressures.

4: TEXTURE

Component		Grain Diameter
Boulder		>12″
Cobble		3″-12″
Gravel		0.08″-3″
Sand	Coarse	0.02″-0.08″
	Medium	0.01″-0.02″
	Fine	0.005″-0.01″
	Very Fine	0.003″-0.005″

5: RELATIVE STRENGTH

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

6: BEDDING

Description	Thickness
Very Thick	>36"
Thick	18" – 36"
Medium	10" – 18"
Thin	2" – 10"
Very Thin	0.4" – 2"
Laminated	0.1" – 0.4"
Thinly Laminated	<0.1"

7: DESCRIPTORS

Arenaceous – sandy	Argillaceous - clayey	Brecciated – contains angular to subangular gravel
Calcareous - contains calcium carbonate	Carbonaceous - contains carbon	Cherty- contains chert fragments
Conglomeritic - contains rounded to subrounded gravel	Crystalline – contains crystalline structure	Dolomitic- contains calcium/magnesium carbonate
Ferriferous – contains iron	Fissile – thin planner partings	Fossiliferous – contains fossils
Friable – easily broken down	Micaceous – contains mica	Pyritic – contains pyrite
Siliceous – contains silica	Stylolitic – contain stylotites (suture like structure)	Vuggy – contains openings

APPENDIX A.2 – ODOT Quick Reference Guide for Rock Description

8: DISCONTINUITIES

a: Discontinuity Types

Type	Parameters
Fault	Fracture which expresses displacement parallel to the surface that does not result in a polished surface.
Joint	Planar fracture that does not express displacement. Generally occurs at regularly spaced intervals.
Shear	Fracture which expresses displacement parallel to the surface that results in polished surfaces or slickensides.
Bedding	A surface produced along a bedding plane.
Contact	A surface produced along a contact plane. (generally not seen in Ohio)

b: Degree of Fracturing

Description	Spacing
Unfractured	> 10 ft.
Intact	3 ft. – 10 ft.
Slightly fractured	1 ft. – 3 ft.
Moderately fractured	4 in. – 12 in.
Fractured	2 in. – 4 in.
Highly fractured	< 2 in.

c: Aperture Width

Description	Spacing
Open	> 0.2 in.
Narrow	0.05 in. - 0.2 in.
Tight	<0.05 in.

d: Surface Roughness

Description	Criteria
Very Rough	Near vertical steps and ridges occur on the discontinuity surface.
Slightly Rough	Asperities on the discontinuity surface are distinguishable and can be felt.
Slickensided	Surface has a smooth, glassy finish with visual evidence of striation.

11: RECOVERY

$Run\ \text{Recovery} = \left(\frac{R_R}{L_R}\right) * 100$	$Unit\ \text{Recovery} = \left(\frac{R_U}{L_U}\right) * 100$
L_R = Run Length R_R – Run Recovery	L_U = Rock Unit Length R_U – Rock Unit Recovery

9: GSI DESCRIPTION

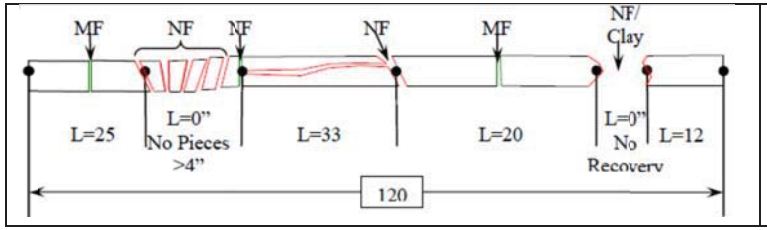
a: Structure

Description	Parameters
Intact or Massive	Intact rock with few widely spaced discontinuities
Blocky	Well interlocked undisturbed rock mass consisting of cubical blocks formed by three interesting discontinuity sets
Very Blocky	Interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets
Blocky/Disturbed/ Seamy	Angular blocks formed by many intersecting discontinuity sets, Persistence of bedding planes
Disintegrated	Poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces
Laminated/Sheared	Lack of blockiness due to close spacing of weak shear planes

b: Surface Condition

Description	Parameters
Very Good	Very rough, fresh unweathered surfaces
Good	Rough, slightly weathered, iron stained surface
Fair	Smooth, moderately weathered and altered surfaces
Poor	Slickensided, highly weathered surface with compact coatings or fillings or angular fragments
Very Poor	Slickensided, highly weathered surfaces with soft clay coating or fillings

10: RQD



$$RQD = \left(\frac{\sum Length\ of\ Pieces > 4inches}{Total\ Length\ of\ Core}\right) * 100$$

$$RQD = \left(\frac{25+33+20+12}{120}\right) * 100 = 75\%$$

SUPPORTING INFORMATION

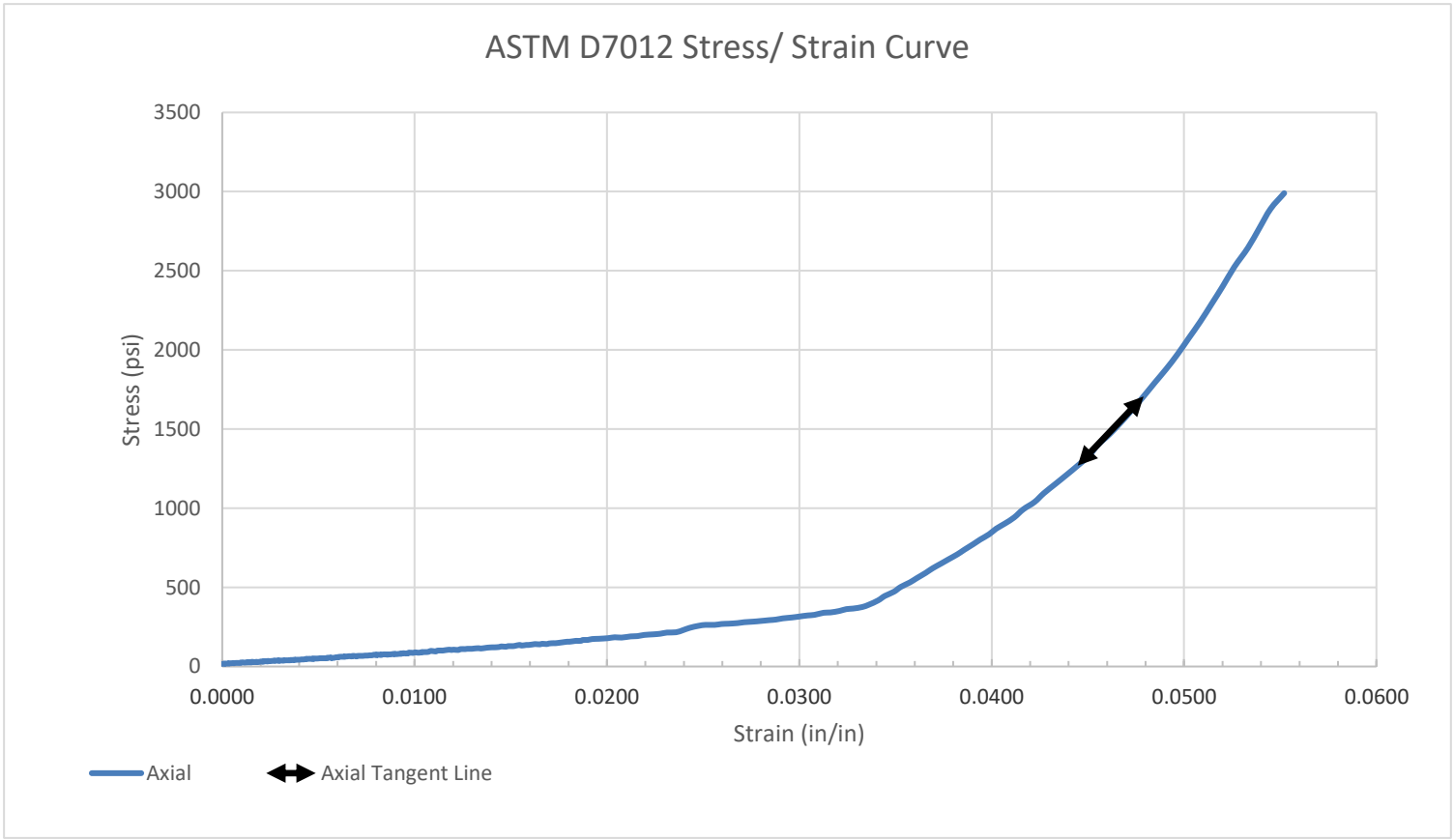
Laboratory Test Results
Drilled Shaft Calculations
Seismic Site Classification Calculation
L-Pile Analysis Results
L-Pile Analysis Plots
ODOT GB-1 Subgrade Analysis Spreadsheet
Certification of Geotechnical Plan Review
Structure Foundation Sheets

Rock Core D7012 Method C

Client
American Structurepoint Inc

Project
SCI-335-10.31

Project No. N1215380



SAMPLE LOCATION

Site:	SCI-335-10.31		
Description:	Siltstone		
Boring:	B-1	Depth (feet):	9.5-14.5

SPECIMEN INFORMATION

Sample No.:	Core-2	Mass (g):	544.35
Length (in.):	4.31	Diameter (in.):	1.98
L/D Ratio:	2.177	Density (pcf):	156.264

TEST RESULTS

Failure Load (lbs):	9207
Failure Strain (in/in):	0.058
Unconfined Compressive Strength (psi):	2,990
Elastic Modulus, E, (ksi):	128
Time of Failure (min):	04:10
Rate of Loading (in/sec):	0.04
Moisture Content Post-break:	3.29%

Rock Core D7012 Method C

Client
American Structurepoint Inc

Project
SCI-335-10.31

Project No. N1215380

Equipment:	TICCS ID:
Calipers	W-44049
Scale	B-71466
Dial Indicator	C-70608
Compression (spherically seated)	C-48999

Samples were prepared and tested in accordance with ASTM D4543 and D7012. Deviations, if any, are noted below:
Notes:

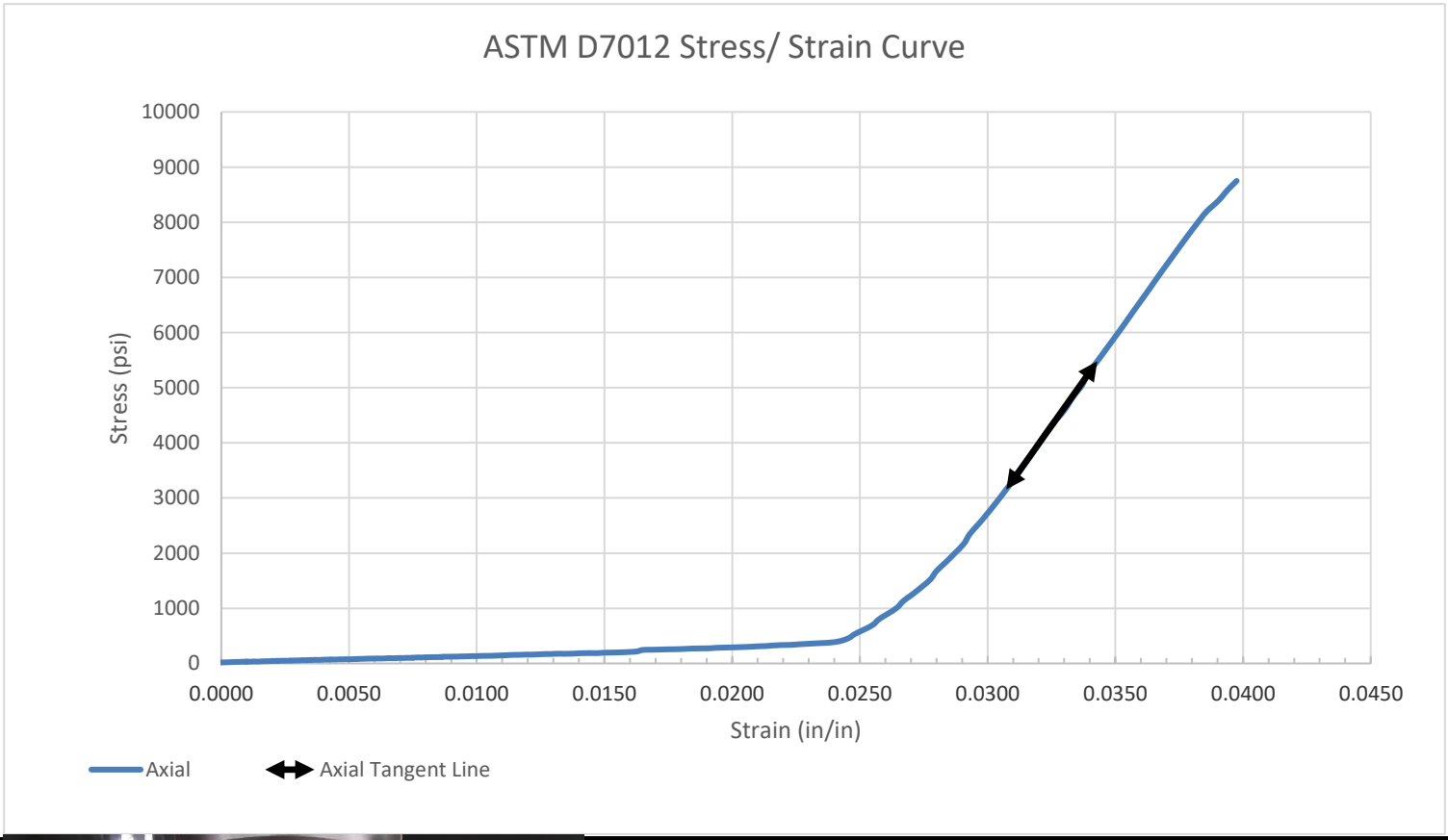
Per ASTM D4543, this specimen has not met the requirements for perpendicularity, by exceeding 0.250º.
Per ASTM D4543, this specimen has not met the requirements for flatness, by exceeding 0.001 inches.
Per ASTM D4543, this specimen has not met the requirements for parallelism, by exceeding 0.25º.

Rock Core D7012 Method C

Client
American Structurepoint Inc

Project
SCI-335-10.31

Project No. N1215380



SAMPLE LOCATION

Site:	SCI-335-10.31		
Description:	Siltstone		
Boring:	B-2	Depth (feet):	23.0-28.0

SPECIMEN INFORMATION

Sample No.:	Core-4	Mass (g):	492.91
Length (in.):	4.22	Diameter (in.):	1.97
L/D Ratio:	2.142	Density (pcf):	145.986

TEST RESULTS

Failure Load (lbs):	26669
Failure Strain (in/in):	0.042
Unconfined Compressive Strength (psi):	8,749
Elastic Modulus, E, (ksi):	652
Time of Failure (min):	03:17
Rate of Loading (in/sec):	0.04
Moisture Content Post-break:	5.44%

Rock Core D7012 Method C

Client
American Structurepoint Inc

Project
SCI-335-10.31

Project No. N1215380

Equipment:	TICCS ID:
Calipers	W-44049
Scale	B-71466
Dial Indicator	C-70608
Compression (spherically seated)	C-48999

Samples were prepared and tested in accordance with ASTM D4543 and D7012. Deviations, if any, are noted below:
Notes:

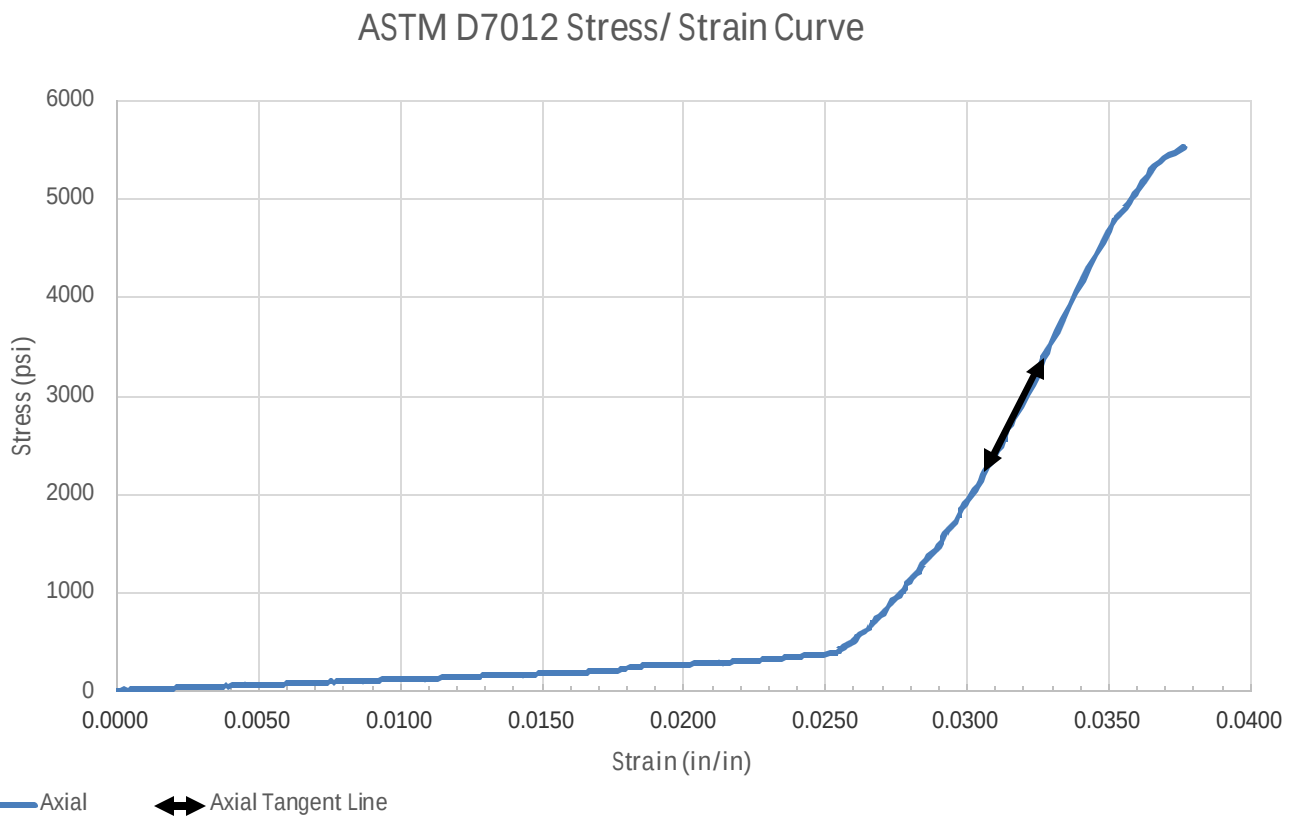
Per ASTM D4543, this specimen has not met the requirements for perpendicularity, by exceeding 0.250º.
Per ASTM D4543, this specimen has not met the requirements for flatness, by exceeding 0.001 inches.
Per ASTM D4543, this specimen has not met the requirements for parallelism, by exceeding 0.25º.

Rock Core D7012 Method C

Client
American Structurepoint Inc

Project
SCI-335-10.31

Project No. N1215380



SAMPLE LOCATION

Site:	SCI-335-10.31		
Description:	Siltstone		
Boring:	B-3	Depth (feet):	28.5-33.5

SPECIMEN INFORMATION

Sample No.:	Core-3	Mass (g):	518.7
Length (in.):	4.37	Diameter (in.):	1.97
L/D Ratio:	2.218	Density (pcf):	148.351

TEST RESULTS

Failure Load (lbs):	16858
Failure Strain (in/in):	0.048
Unconfined Compressive Strength (psi):	5,531
Elastic Modulus, E, (ksi):	550
Time of Failure (min):	03:22
Rate of Loading (in/sec):	0.04
Moisture Content Post-break:	5.38%

Rock Core D7012 Method C

Client
American Structurepoint Inc

Project
SCI-335-10.31

Project No. N1215380

Equipment:	TICCS ID:
Calipers	W-44049
Scale	B-71466
Dial Indicator	C-70608
Compression (spherically seated)	C-48999

Samples were prepared and tested in accordance with ASTM D4543 and D7012. Deviations, if any, are noted below:
Notes:

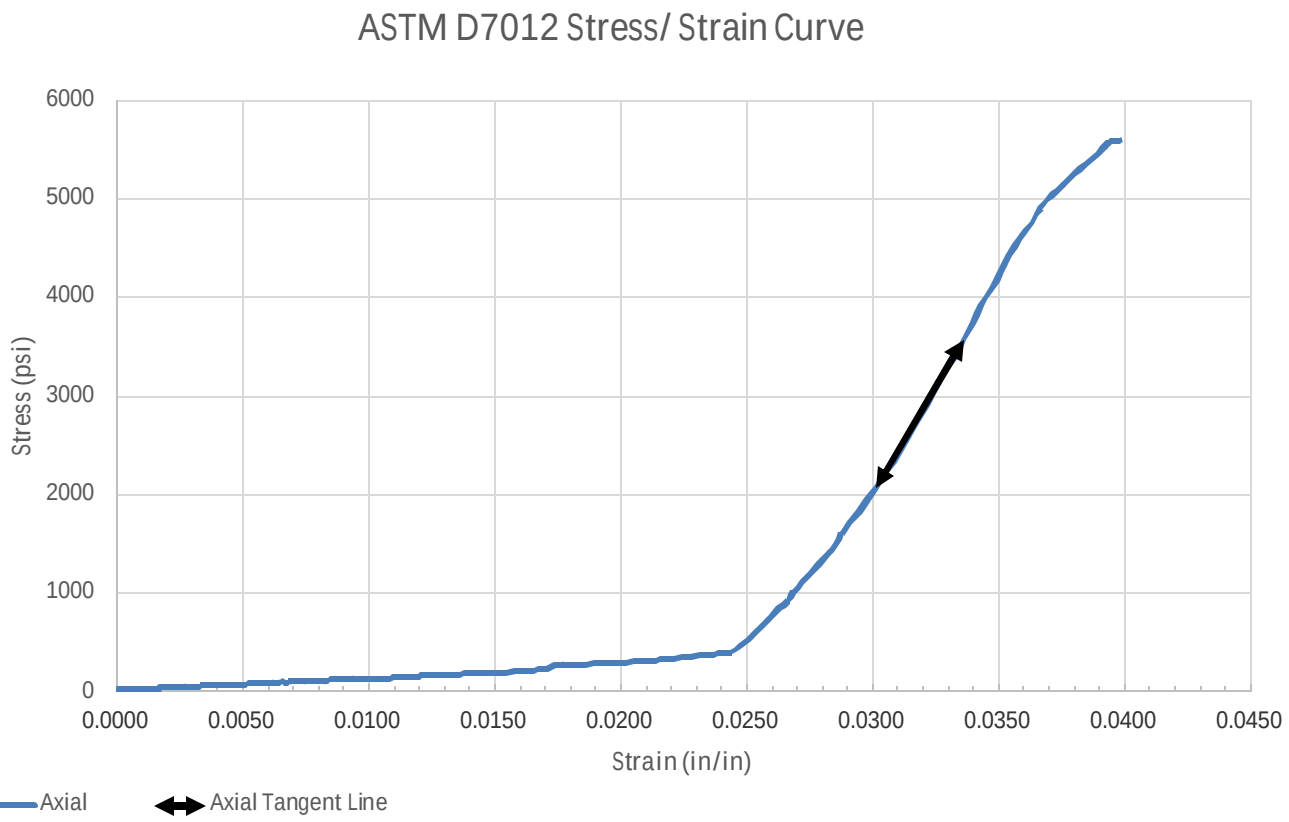
Per ASTM D4543, this specimen has not met the requirements for perpendicularity, by exceeding 0.250º.
Per ASTM D4543, this specimen has not met the requirements for flatness, by exceeding 0.001 inches.
Per ASTM D4543, this specimen has not met the requirements for parallelism, by exceeding 0.25º.

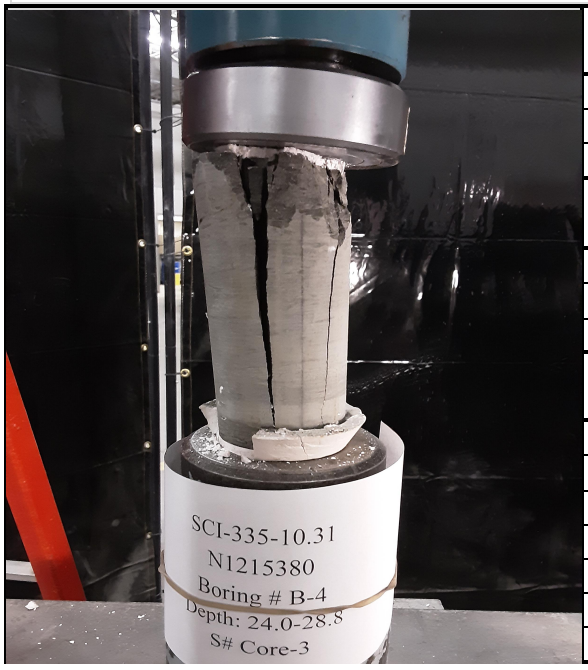
Rock Core D7012 Method C

Client
American Structurepoint Inc

Project
SCI-335-10.31

Project No. N1215380





SAMPLE LOCATION

Site:	SCI-335-10.31		
Description:	Laminated Siltstone		
Boring:	B-4	Depth (feet):	24.0-28.8

SPECIMEN INFORMATION

Sample No.:	Core-3	Mass (g):	565.35
Length (in.):	4.48	Diameter (in.):	1.98
L/D Ratio:	2.263	Density (pcf):	156.134

TEST RESULTS

Failure Load (lbs):	17419
Failure Strain (in/in):	0.078
Unconfined Compressive Strength (psi):	5,600
Elastic Modulus, E, (ksi):	429
Time of Failure (min):	03:23
Rate of Loading (in/sec):	0.04
Moisture Content Post-break:	2.73%

Rock Core D7012 Method C

Client
American Structurepoint Inc

Project
SCI-335-10.31

Project No. N1215380

Equipment:	TICCS ID:
Calipers	W-44049
Scale	B-71466
Dial Indicator	C-70608
Compression (spherically seated)	C-48999

Samples were prepared and tested in accordance with ASTM D4543 and D7012. Deviations, if any, are noted below:
Notes:

Per ASTM D4543, this specimen has not met the requirements for flatness, by exceeding 0.001 inches.
Per ASTM D4543, this specimen has not met the requirements for parallelism, by exceeding 0.25º.

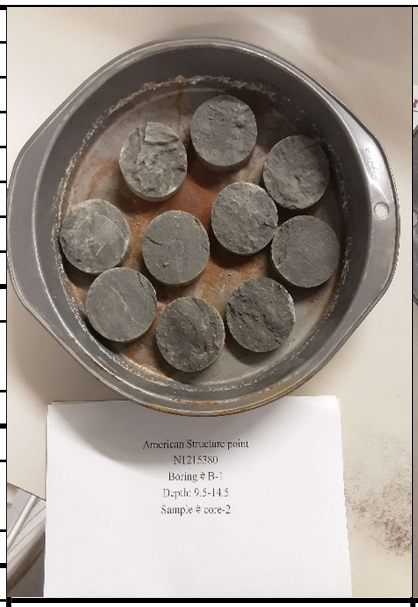
SLAKE DURABILITY INDEX (SDI)
TEST SUMMARY (ASTM D644)

Client: American Structurepoint Inc **Date:** 2/17/2022

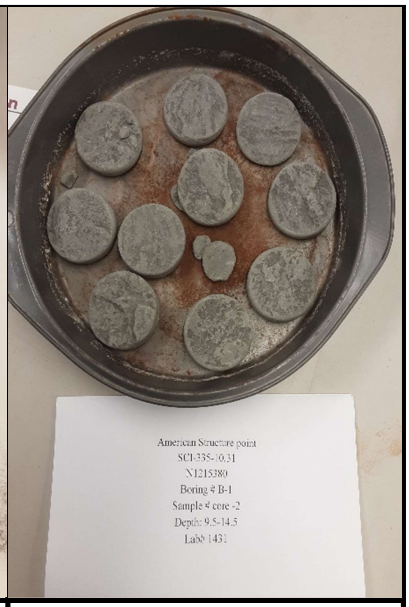
Project: SCI-335-10.31 **Project No:** N1215380

Location:

Lab No.:			1431
Boring No.:			B-1
Sample No.:			Core-2
Depth (ft):			9.5-14.5
Tare Weight (grams):			305.0
Moist weight, Sample+Tare (grams):			914.6
Dry weight, Sample+Tare (grams):			888.8
Natural Moisture Content (%):			**4.4**
After Cycle No. 1			
Temperature (°F)			Dry Weight, Sample +Tare (grams)
Start	End	Average	
21	21	21	863.5
After Cycle No. 2			
Temperature (°F)			Dry Weight, Sample +Tare (grams)
Start	End	Average	
21	21	21	826.4
SLAKE DURABILITY INDEX (%):			**89.3**
Fragment Type (1, 2 or 3):			**1**



Before Test



After Test

Material Description:	Shale
Notes/Comments:	

Drilled Shaft Calculations

Unfactored Unit Tip Resistance

Unconfined Compressive Strength of Siltstone Bedrock (Qu) = 20 tsf

Using FHWA Drilled Shaft Manual Eq. 13-20

Unfactored Unit Tip Resistance (q_p) = 2.5 * Qu

= 2.5 * 20 tsf

= 50 tsf

Unfactored Unit Side Resistance

For drilled shafts socketed into bedrock, side resistance in the overburden soils is disregarded due to insufficient shaft movement to mobilize this resistance. Side resistance in portion of rock socket below 1.5 pier diameter can be used.

Unconfined Compressive Strength of Siltstone Bedrock (Qu) = 20 tsf

Using FHWA Drilled Shaft Manual Eq. 13-18

Unfactored Unit Side Resistance (q_s) = 1 * √Qu

= 1 * √(20 tsf)

= 4.5 tsf

Seismic Site Class Calculations

Project: SCI-335-10.31; PID 107644
Proj#: N1215380
Case: Northbound Bridge B-001-0-21 through B-004-0-21

Calculated By: DWW **Reviewed By: JDD**

References:
ODOT SGE 7-16-21, ODOT BDM 2020 1-15-21, ODOT C&MS, FHWA-NHI-16-064 (FHWA GEC 012)

Per BDM- In the absence of sufficient geotechnical information, designers shall assume Site Class C for the project soil profile. Use blow counts corrected to equivalent rod energy ration of 60%, N_{60}, for the avg N

Boring B-001-0-21		Boring B-003-0-21					
Depth, ft	N_{60}	Depth, ft	N_{60}	Depth, ft	N_{60}	Depth, ft	N_{60}
1	12	1	36				
2.5	31	2.5	55				
4	24	4	15				
5.5			15				
7			7				
8.5			3				
10			3				
11.5			3				
13			1				
14.5			4				
16			10				
Weighted Avg N=	6	Weighted Avg N=	35	Weighted Avg N=	#####	Weighted Avg N=	#####

Site Class Definition

A-Hard Rock w/ vs>5000 ft/s

B-Rock w/ 2500<vs<5000 ft/s

C-V. Dense Soil and Soil Rock with 1200<vs<2500 ft/s or N>50bpf

D-Stiff Soil with 600<vs<1200 ft/s or 15<N<50bpf

E/F- See FHWA-NHI-16-009

See FHWA-NHI-16-009 for more details.

Based on the Average N60 Values, a Seismic Site Classification of C is recommended.

==========

LPile for Windows, Version 2022-12.007

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

Path to file locations:
\Projects\2021\N1215380\Working Files\Calculations-Analyses\101623 Lpile\

Name of input data file:
Rear Abutment.lp12d

Name of output report file:
Rear Abutment.lp12o

Name of plot output file:
Rear Abutment.lp12p

Name of runtime message file:
Rear Abutment.lp12r

Date and Time of Analysis

Date: October 16, 2023 Time: 12:42:30

Problem Title

Project Name: SCI 335

Job Number: N1215380

Client: ODOT

Engineer: ATN

Description: Abutment

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

- Use of p-y modification factors for p-y curves not selected

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

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

Pile Structural Properties and Geometry

Number of pile sections defined	=	1
Total length of pile	=	13.000 ft
Depth of ground surface below top of pile	=	3.0000 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	30.0000
2	13.000	30.0000

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	=	13.000000 ft
Shaft Diameter	=	30.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 1 layers

Layer 1 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	3.000000 ft
Distance from top of pile to bottom of layer	=	20.000000 ft
Effective unit weight at top of layer	=	135.000000 pcf
Effective unit weight at bottom of layer	=	135.000000 pcf
Uniaxial compressive strength at top of layer	=	3000. psi
Uniaxial compressive strength at bottom of layer	=	3000. psi
Initial modulus of rock at top of layer	=	100000. psi
Initial modulus of rock at bottom of layer	=	100000. psi
RQD of rock at top of layer	=	70.000000 %
RQD of rock at bottom of layer	=	70.000000 %
k rm of rock at top of layer	=	0.0003000
k rm of rock at bottom of layer	=	0.0003000

(Depth of the lowest soil layer extends 7.000 ft below the pile tip)

Summary of Input Soil Properties

Layer Num.	Soil Type Rock Mass Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Uniaxial qu psi	RQD %	E50 or krm	Modulus psi
1	Weak Rock	3.0000 20.0000	135.0000 135.0000	3000. 3000.	70.0000 70.0000	3.00E-04 3.00E-04	100000. 100000.

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 = 2

Load    Load         Condition               Condition            Axial Thrust
Compute Top y     Run Analysis
 No.    Type             1                       2                 Force, lbs
vs. Pile Length
-----   ----   --------------------   ----------------------   ----------------
---------------    ------------
   1     1     V =       41000. lbs   M =     1728000. in-lbs           336000.
    No               Yes
   2     1     V =       57000. lbs   M =     2280000. in-lbs           455000.
    No               Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.



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

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

Number of Pile Sections Analyzed = 1

Pile Section No. 1:
-------------------

Dimensions and Properties of Drilled Shaft (Bored Pile):
--------------------------------------------------------

Length of Section                                    =    13.000000 ft
Shaft Diameter                                       =    30.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)  =     3.000000 in
Number of Reinforcing Bars                           =            8 bars
Yield Stress of Reinforcing Bars                     =       60000. psi
Modulus of Elasticity of Reinforcing Bars            =    29000000. psi
Gross Area of Shaft                                  =   706.858347 sq. in.
```

Total Area of Reinforcing Steel	=	8.000000	sq. in.
Area Ratio of Steel Reinforcement	=	1.13	percent
Edge-to-Edge Bar Spacing	=	7.242052	in
Maximum Concrete Aggregate Size	=	0.750000	in
Ratio of Bar Spacing to Aggregate Size	=	9.66	
Offset of Center of Rebar Cage from Center of Pile	=	0.0000	in
Transverse Reinforcement			
Type: Hoop			
Number of Transverse Reinf. (per spacing)	=	1	
Spacing of Transverse Reinf.	=	12.000000	in
Yield Stress of Transverse Reinf.	=	60000.	psi
Diameter of Transverse Reinf.	=	0.500000	in
Confined Section			
Total Area of Confinement Steel	=	0.200000	sq. in.
rho_s	=	0.002721	
ke	=	0.778517	
f'cc	=	4425.	psi
f'l	=	63.552419	psi
Epsilon cc	=	0.003062	
Epsilon cu	=	0.008649	
r	=	1.669101	

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	2856.118	kips
Tensile Load for Cracking of Concrete	=	-317.428	kips
Nominal Axial Tensile Capacity	=	-480.000	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	10.936000	0.00000
2	1.128000	1.000000	7.732920	7.732920
3	1.128000	1.000000	0.00000	10.936000
4	1.128000	1.000000	-7.73292	7.732920
5	1.128000	1.000000	-10.93600	0.00000
6	1.128000	1.000000	-7.73292	-7.73292
7	1.128000	1.000000	0.00000	-10.93600
8	1.128000	1.000000	7.732920	-7.73292

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

Minimum spacing between any two bars not equal to zero = 7.242 inches
between bars 1 and 2.

Ratio of bar spacing to maximum aggregate size = 9.66

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 = 2

Number	Axial Thrust Force kips
1	336.000
2	455.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318-14, Section 21.2.3.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 336.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conf Stress ksi	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
0.00000125	206.3521206	165081697.	107.7461599	0.0001347	0.00009718	0.4809535	0.5500813	3.7807358	

```
0.00000250   412.6893662    165075746.    61.3950639     0.0001535    0.00007849
0.5464671     0.6230215     4.2010171
0.00000375   618.9866423    165063105.    45.9544622     0.0001723    0.00005983
0.6117542     0.6953235     4.6223603
0.00000500   825.2238745    165044775.    38.2414798     0.0001912    0.00004121
0.6767867     0.7669826     5.0447646
0.00000625        1031.     165020938.    33.6195401     0.0002101    0.00002262
0.7415379     0.8379941     5.4682292
0.00000750        1237.     164991629.    30.5431161     0.0002291    0.00000407
0.8059819     0.9083533     5.8927528
0.00000875        1443.     164954125.    28.3497705     0.0002481   -0.00001444
0.8700922     0.9780530     6.3183168
0.00001000        1649.     164884883.    26.7077085     0.0002671   -0.00003292
0.9338238     1.0470655     6.7447355
0.00001125        1854.     164816621.    25.4340193     0.0002861   -0.00005137
0.9971869     1.1154215     7.1722862
0.00001250        2060.     164768863.    24.4190976     0.0003052   -0.00006976
1.0601974     1.1831562     7.6012978
0.00001375        2265.     164715512.    23.5919452     0.0003244   -0.00008811
1.1228144     1.2502428     8.0316006
0.00001500        2470.     164638619.    22.9050919     0.0003436    -0.000106
1.1849917     1.3166481     8.4629650
0.00001625        2470.     151974110.    21.4834940     0.0003491    -0.000138
1.2023734     1.3351757     8.4982841 C
0.00001750        2470.     141118816.    20.8246885     0.0003644    -0.000161
1.2513695     1.3873206     8.8176544 C
0.00002000        2508.     125412846.    19.7082778     0.0003942    -0.000206
1.3453157     1.4869829     9.4298010 C
0.00002250        2661.     118271109.    18.7948187     0.0004229    -0.000252
1.4346249     1.5813588    10.0124942 C
0.00002500        2800.     112015809.    18.0301953     0.0004508    -0.000299
1.5199273     1.6711903    10.5706417 C
0.00002750        2930.     106530326.    17.3794826     0.0004779    -0.000347
1.6017866     1.7571292    11.1087624 C
0.00003000        3051.     101695090.    16.8176769     0.0005045    -0.000395
1.6805876     1.8396253    11.6298790 C
0.00003250        3166.      97415506.    16.3275159     0.0005306    -0.000444
1.7567040     1.9191058    12.1370588 C
0.00003500        3276.      93592042.    15.8941240     0.0005563    -0.000494
1.8302355     1.9957044    12.6307859 C
0.00003750        3382.      90174288.    15.5094748     0.0005816    -0.000543
1.9015883     2.0698675    13.1146784 C
0.00004000        3484.      87097694.    15.1650322     0.0006066    -0.000593
1.9708666     2.1417223    13.5894375 C
0.00004250        3583.      84312364.    14.8543381     0.0006313    -0.000644
2.0381800     2.2113976   -14.414903 C
0.00004500        3680.      81778981.    14.5724410     0.0006558    -0.000694
2.1036436     2.2790251   -15.630715 C
0.00004750        3775.      79465983.    14.3155065     0.0006800    -0.000745
2.1673778     2.3447388   -16.853015 C
0.00005000        3867.      77347586.    14.0805455     0.0007040    -0.000796
```

```
2.2295084     2.4086759    -18.080709 C
0.00005250         3959.     75402386.    13.8652208     0.0007279     -0.000847
2.2901662     2.4709765    -19.312576 C
0.00005500         4049.     73609884.    13.6672490     0.0007517     -0.000898
2.3494243     2.5317190    -20.547988 C
0.00006000         4224.     70404354.    13.3133949     0.0007988     -0.001001
2.4636221     2.6484157    -23.031693 C
0.00006500         4396.     67628175.    13.0079366     0.0008455     -0.001104
2.5726714     2.7593533    -25.526789 C
0.00007000         4564.     65200656.    12.7421833     0.0008920     -0.001208
2.6769664     2.8649193    -28.029868 C
0.00007500         4729.     63053521.    12.5078539     0.0009381     -0.001312
2.7765623     2.9651435    -30.541668 C
0.00008000         4891.     61143085.    12.3007733     0.0009841     -0.001416
2.8718683     3.0604003    -33.058206 C
0.00008500         5052.     59433999.    12.1177779     0.0010300     -0.001520
2.9632590     3.1510127    -35.575427 C
0.00009000         5210.     57887707.    11.9530836     0.0010758     -0.001624
3.0505015     3.2366928    -38.097953 C
0.00009500         5366.     56487266.    11.8064177     0.0011216     -0.001728
3.1341625     3.3179319    -40.618569 C
0.00010000         5521.     55206200.    11.6734091     0.0011673     -0.001833
3.2140122     3.3944345    -43.142114 C
 0.0001050         5674.     54035255.    11.5550182     0.0012133     -0.001937
3.2906617     3.4667050    -45.659719 C
 0.0001150         5974.     51950364.    11.3478165     0.0013050     -0.002145
3.4333633     3.5972717    -50.699284 C
 0.0001250         6269.     50153205.    11.1781031     0.0013973     -0.002353
3.5636232     3.7101553    -55.723126 C
 0.0001350         6558.     48574199.    11.0371265     0.0014900     -0.002560
3.6818991     3.8049705    -60.000000 CY
 0.0001450         6787.     46808529.    10.8949299     0.0015798     -0.002770
3.7849348     3.8788629    -60.000000 CY
 0.0001550         6983.     45050902.    10.7602292     0.0016678     -0.002982
3.8758505     3.9343321    -60.000000 CY
 0.0001650         7173.     43473997.    10.6466277     0.0017567     -0.003193
3.9580728     3.9732245    -60.000000 CY
 0.0001750         7304.     41734585.    10.5170043     0.0018405     -0.003410
4.0273618     3.9941647    -60.000000 CY
 0.0001850         7367.     39823245.    10.3713301     0.0019187     -0.003631
4.0853190     3.9985343    -60.000000 CY
 0.0001950         7426.     38083658.    10.2390260     0.0019966     -0.003853
4.1370903     3.9985502    -60.000000 CY
 0.0002050         7482.     36499476.    10.1225481     0.0020751     -0.004075
4.1836529     3.9992166    -60.000000 CY
 0.0002150         7536.     35049003.    10.0189270     0.0021541     -0.004296
4.2251810     3.9994333    -60.000000 CY
 0.0002250         7585.     33712995.     9.9243102     0.0022330     -0.004517
4.2617460     3.9993224    -60.000000 CY
 0.0002350         7633.     32482177.     9.8408257     0.0023126     -0.004737
4.2940025     3.9988541    -60.000000 CY
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 0.0002450         7679.     31344426.     9.7669458     0.0023929     -0.004957
4.3221510     3.9977618    -60.000000 CY
 0.0002550         7723.     30286880.     9.6983636     0.0024731     -0.005177
4.3461813     3.9959048    -60.000000 CY
 0.0002650         7765.     29302931.     9.6363346     0.0025536     -0.005396
4.3665332     3.9999208    -60.000000 CY
 0.0002750         7806.     28385631.     9.5810253     0.0026348     -0.005615
4.3834927     3.9986040    -60.000000 CY
 0.0002850         7846.     27528942.     9.5314078     0.0027165     -0.005834
4.3972447     3.9948672    -60.000000 CY
 0.0002950         7884.     26726778.     9.4868937     0.0027986     -0.006051
4.4079905     3.9996794    -60.000000 CY
 0.0003050         7922.     25974039.     9.4466445     0.0028812     -0.006269
4.4159147     3.9963096    -60.000000 CY
 0.0003150         7959.     25265515.     9.4078625     0.0029635     -0.006487
4.4211735     3.9998976    -60.000000 CY
 0.0003250         7994.     24598232.     9.3728576     0.0030462     -0.006704
4.4240315     3.9961075    -60.000000 CY
 0.0003350         8030.     23969140.     9.3409995     0.0031292     -0.006921
4.4246537     3.9998016    -60.000000 CY
 0.0003450         8061.     23364061.     9.3086871     0.0032115     -0.007139
4.4246955     3.9941682    -60.000000 CY
 0.0003550         8087.     22781044.     9.2754403     0.0032928     -0.007357
4.4245019     3.9989029    -60.000000 CY
 0.0003650         8106.     22208455.     9.2382322     0.0033720     -0.007578
4.4244932     3.9976693    60.0000000 CY
 0.0003750         8118.     21647960.     9.1973257     0.0034490     -0.007801
4.4246936     3.9947212    60.0000000 CY
 0.0003850         8126.     21106484.     9.1564779     0.0035252     -0.008025
4.4241902     3.9985610    60.0000000 CY
 0.0003950         8128.     20576761.     9.1116178     0.0035991     -0.008251
4.4246977     3.9999668    60.0000000 CY
 0.0004050         8129.     20072396.     9.0689660     0.0036729     -0.008477
4.4241752     3.9921900    60.0000000 CY
 0.0004150         8131.     19592052.     9.0287818     0.0037469     -0.008703
4.4247003     3.9946357    60.0000000 CY
 0.0004250         8131.     19131615.     8.9931914     0.0038221     -0.008928
4.4241603     3.9981638    60.0000000 CY
 0.0004350         8131.     18691807.     8.9910892     0.0039111     -0.009139
4.4247001     3.9993407    60.0000000 CY
 0.0004450         8131.     18271767.     9.0164552     0.0040123     -0.009338
4.4242872     3.9933866    60.0000000 CY
 0.0004550         8131.     17870189.     8.9869618     0.0040891     -0.009561
4.4246983     3.9972506    60.0000000 CY
 0.0004650         8131.     17485884.     9.0334305     0.0042005     -0.009749
4.4243462     3.9960733    60.0000000 CY
 0.0004750         8131.     17117760.     9.0950436     0.0043201     -0.009930
4.4243553     3.9959696    60.0000000 CY
 0.0004850         8131.     16764817.     9.0673688     0.0043977     -0.010152
4.4243557     3.9986348    60.0000000 CY
 0.0004950         8131.     16426134.     9.1418942     0.0045252     -0.010325
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4.4242694	3.9873911	60.0000000 CY				
0.0005050	8131.	16100864.	9.2195632	0.0046559	-0.010494	
4.4246985	3.9987652	60.0000000 CY				
0.0005450	8131.	14919149.	9.3517685	0.0050967	-0.011253	
4.4246881	3.9930420	60.0000000 CY				
0.0005850	8131.	13899036.	9.5117616	0.0055644	-0.011986	
4.4244159	3.9898239	60.0000000 CY				
0.0006250	8131.	13009498.	9.6186112	0.0060116	-0.012738	
4.4244044	3.9901951	60.0000000 CY				
0.0006650	8131.	12226972.	9.6177896	0.0063958	-0.013554	
4.4244217	3.9934758	60.0000000 CY				
0.0007050	8131.	11533243.	9.6169566	0.0067800	-0.014370	
4.4246552	3.9934093	60.0000000 CY				
0.0007450	8131.	10914008.	9.6197418	0.0071667	-0.015183	
4.4245586	3.9911628	60.0000000 CY				
0.0007850	8131.	10357880.	9.6257099	0.0075562	-0.015994	
4.4231345	3.9887941	60.0000000 CY				
0.0008250	8131.	9855680.	9.6407744	0.0079536	-0.016796	
4.4240359	3.9988657	60.0000000 CY				
0.0008650	8131.	9399926.	9.6638007	0.0083592	-0.017591	
4.4246211	3.9765801	60.0000000 CY				
0.0009050	8131.	8984460.	9.6218207	0.0087077	-0.018442	
4.4237125	3.9883556	60.0000000 CY				

Axial Thrust Force = 455.000 kips

Bending Max Conf Curvature Stress rad/in. ksi	Bending Max Conc Moment Stress in-kip ksi	Bending Max Steel Stiffness Stress kip-in2 ksi	Run Msg	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in
0.00000125	202.7569303	162205544.		141.4140044	0.0001768	0.0001393
0.6285392	0.7138525	5.0011952				
0.00000250	405.5013811	162200552.		78.2303156	0.0001956	0.0001206
0.6932271	0.7850436	5.4215729				
0.00000375	608.2069775	162188527.		57.1794422	0.0002144	0.0001019
0.7576383	0.8556012	5.8430768				
0.00000500	810.8542628	162170853.		46.6617706	0.0002333	0.00008331
0.8217477	0.9255202	6.2657067				
0.00000625	1013.	162147798.		40.3573774	0.0002522	0.00006473
0.8855311	0.9947958	6.6894622				
0.00000750	1216.	162119446.		36.1596208	0.0002712	0.00004620
0.9489654	1.0634230	7.1143425				
0.00000875	1418.	162085822.		33.1656535	0.0002902	0.00002770
1.0120283	1.1313968	7.5403471				
0.00001000	1620.	162046927.		30.9240512	0.0003092	0.00000924
1.0746986	1.1987120	7.9674749				

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0.00001125         1823.    162002439.    29.1840144     0.0003283   -0.00000918
1.1369555     1.2653635     8.3957222
0.00001250         2024.    161942888.    27.7948243     0.0003474   -0.00002756
1.1987694     1.3313354     8.8249988
0.00001375         2225.    161853025.    26.6603055     0.0003666   -0.00004592
1.2601003     1.3966001     9.2551094
0.00001500         2426.    161754700.    25.7173210     0.0003858   -0.00006424
1.3209567     1.4611810     9.6862847
0.00001625         2627.    161659232.    24.9221119     0.0004050   -0.00008252
1.3813445     1.5250972    10.1187328
0.00001750         2827.    161555880.    24.2428040     0.0004242     -0.000101
1.4412355     1.5883310    10.5523478
0.00002000         2828.    141394260.    22.5178728     0.0004504     -0.000150
1.5210124     1.6723311    11.0593662 C
0.00002250         3029.    134608178.    21.4273636     0.0004821     -0.000193
1.6166995     1.7727585    11.7302298 C
0.00002500         3208.    128318102.    20.5150955     0.0005129     -0.000237
1.7076313     1.8678868    12.3721943 C
0.00002750         3371.    122571718.    19.7381185     0.0005428     -0.000282
1.7943960     1.9583920    12.9897742 C
0.00003000         3521.    117362229.    19.0674643     0.0005720     -0.000328
1.8775244     2.0448737    13.5871940 C
0.00003250         3660.    112630302.    18.4806759     0.0006006     -0.000374
1.9573003     2.1276632    14.1664121 C
0.00003500         3792.    108330774.    17.9621782     0.0006287     -0.000421
2.0340415     2.2071179    14.7298609 C
0.00003750         3916.    104427295.    17.5010468     0.0006563     -0.000469
2.1081004     2.2836244    15.2805135 C
0.00004000         4034.    100860454.    17.0867800     0.0006835     -0.000517
2.1795663     2.3572914    15.8186649 C
0.00004250         4148.     97603738.    16.7133429     0.0007103     -0.000565
2.2487475     2.4284492    16.3470702 C
0.00004500         4258.     94616432.    16.3744097     0.0007368     -0.000613
2.3157481     2.4972142    16.8663548 C
0.00004750         4364.     91865979.    16.0650442     0.0007631     -0.000662
2.3806760     2.5637033    17.3772235 C
0.00005000         4466.     89325908.    15.7813567     0.0007891     -0.000711
2.4436425     2.6280352    17.8804673 C
0.00005250         4566.     86974352.    15.5202607     0.0008148     -0.000760
2.5047619     2.6903292    18.3769711 C
0.00005500         4664.     84792996.    15.2792961     0.0008404     -0.000810
2.5641524     2.7507061    18.8677273 C
0.00006000         4853.     80880599.    14.8503004     0.0008910     -0.000909
2.6782311     2.8661959   -20.357477 C
0.00006500         5034.     77453463.    14.4770375     0.0009410     -0.001009
2.7860460     2.9746530   -22.757536 C
0.00007000         5211.     74436890.    14.1510023     0.0009906     -0.001109
2.8883407     3.0767896   -25.169965 C
0.00007500         5382.     71759244.    13.8638039     0.0010398     -0.001210
2.9854598     3.1728987   -27.592476 C
0.00008000         5549.     69365931.    13.6092879     0.0010887     -0.001311
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3.0777468     3.2632580    -30.022452 C
0.00008500         5713.      67210406.    13.3819589     0.0011375     -0.001413
3.1653986     3.3479908    -32.459221 C
0.00009000         5873.      65255848.    13.1773855     0.0011860     -0.001514
3.2485846     3.4271875    -34.902524 C
0.00009500         6031.      63480629.    12.9942135     0.0012345     -0.001616
3.3278036     3.5012391    -37.346192 C
0.00010000         6185.      61854233.    12.8281425     0.0012828     -0.001717
3.4029935     3.5699981    -39.793387 C
 0.0001050         6338.      60360375.    12.6778589     0.0013312     -0.001819
3.4744621     3.6336558    -42.240670 C
 0.0001150         6636.      57704299.    12.4173213     0.0014280     -0.002022
3.6068101     3.7457823    -47.132483 C
 0.0001250         6926.      55404863.    12.2000514     0.0015250     -0.002225
3.7258189     3.8376501    -52.018563 C
 0.0001350         7207.      53387632.    12.0180511     0.0016224     -0.002428
3.8325382     3.9092711    -56.892582 C
 0.0001450         7478.      51575740.    11.8655502     0.0017205     -0.002629
3.9279195     3.9604698    -60.000000 CY
 0.0001550         7685.      49580650.    11.7091816     0.0018149     -0.002835
4.0091255     3.9899396    -60.000000 CY
 0.0001650         7869.      47689336.    11.5700271     0.0019091     -0.003041
4.0805445     3.9999957    -60.000000 CY
 0.0001750         8045.      45972740.    11.4492319     0.0020036     -0.003246
4.1434500     3.9997826    -60.000000 CY
 0.0001850         8177.      44199264.    11.3266001     0.0020954     -0.003455
4.1966874     3.9981469    -60.000000 CY
 0.0001950         8239.      42253824.    11.1850400     0.0021811     -0.003669
4.2399261     3.9991842    -60.000000 CY
 0.0002050         8292.      40447748.    11.0546773     0.0022662     -0.003884
4.2772686     3.9995587    -60.000000 CY
 0.0002150         8341.      38797051.    10.9395997     0.0023520     -0.004098
4.3096807     3.9996355    -60.000000 CY
 0.0002250         8387.      37275858.    10.8329398     0.0024374     -0.004313
4.3371279     3.9994253    -60.000000 CY
 0.0002350         8431.      35876129.    10.7382748     0.0025235     -0.004527
4.3603313     3.9988106    -60.000000 CY
 0.0002450         8473.      34583932.    10.6539043     0.0026102     -0.004740
4.3795386     3.9974298    -60.000000 CY
 0.0002550         8513.      33382918.    10.5740161     0.0026964     -0.004954
4.3948205     3.9978513    -60.000000 CY
 0.0002650         8551.      32267732.    10.5019817     0.0027830     -0.005167
4.4066859     3.9996559    -60.000000 CY
 0.0002750         8588.      31230032.    10.4369060     0.0028701     -0.005380
4.4153737     3.9974771    -60.000000 CY
 0.0002850         8625.      30262242.    10.3778532     0.0029577     -0.005592
4.4211090     3.9991638    -60.000000 CY
 0.0002950         8660.      29355606.    10.3226166     0.0030452     -0.005805
4.4241030     3.9985552    -60.000000 CY
 0.0003050         8694.      28504729.    10.2705667     0.0031325     -0.006017
4.4246024     3.9965506    60.0000000 CY
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 0.0003150        8727.     27704742.    10.2234578     0.0032204     -0.006230
4.4246556     3.9985323    60.0000000 CY
 0.0003250        8759.     26949621.    10.1814210     0.0033090     -0.006441
4.4246984     3.9971968    60.0000000 CY
 0.0003350        8788.     26233896.    10.1446544     0.0033985     -0.006652
4.4246644     3.9976663    60.0000000 CY
 0.0003450        8816.     25555040.    10.1123928     0.0034888     -0.006861
4.4244602     3.9999966    60.0000000 CY
 0.0003550        8843.     24908678.    10.0848787     0.0035801     -0.007070
4.4244619     3.9954827    60.0000000 CY
 0.0003650        8868.     24294611.    10.0606336     0.0036721     -0.007278
4.4246899     3.9995094    60.0000000 CY
 0.0003750        8890.     23707780.    10.0397268     0.0037649     -0.007485
4.4245743     3.9929844    60.0000000 CY
 0.0003850        8890.     23091993.    10.0477965     0.0038684     -0.007682
4.4242167     3.9982796    60.0000000 CY
 0.0003950        8890.     22507386.    10.0764079     0.0039802     -0.007870
4.4245627     3.9936793    60.0000000 CY
 0.0004050        8890.     21951648.    10.0570066     0.0040731     -0.008077
4.4246274     3.9958259    60.0000000 CY
 0.0004150        8890.     21422692.    10.0972957     0.0041904     -0.008260
4.4242286     3.9997315    60.0000000 CY
 0.0004250        8890.     20918629.    10.1492453     0.0043134     -0.008437
4.4244460     3.9960744    60.0000000 CY
 0.0004350        8890.     20437741.    10.2117407     0.0044421     -0.008608
4.4246843     3.9965242    60.0000000 CY
 0.0004450        8890.     19978466.    10.2840922     0.0045764     -0.008774
4.4246329     3.9975587    60.0000000 CY
 0.0004550        8890.     19539379.    10.3641703     0.0047157     -0.008934
4.4242600     3.9902255    60.0000000 CY
 0.0004650        8890.     19119177.    10.4459049     0.0048573     -0.009093
4.4242838     3.9991075    60.0000000 CY
 0.0004750        8890.     18716668.    10.4182635     0.0049487     -0.009301
4.4244833     3.9999980    60.0000000 CY
 0.0004850        8890.     18330757.    10.5067883     0.0050958     -0.009454
4.4239503     3.9953622    60.0000000 CY
 0.0004950        8890.     17960439.    10.6034895     0.0052487     -0.009601
4.4245229     3.9933513    60.0000000 CY
 0.0005050        8890.     17604787.    10.6788047     0.0053928     -0.009757
4.4246533     3.9967551    60.0000000 CY
 0.0005450        8890.     16312692.    10.6553212     0.0058072     -0.010543
4.4243479     3.9919022    60.0000000 CY
 0.0005850        8890.     15197295.    10.7119682     0.0062665     -0.011283
4.4244175     3.9898497    60.0000000 CY
 0.0006250        8890.     14224668.    10.7837397     0.0067398     -0.012010
4.4246256     3.9850846    60.0000000 CY
 0.0006650        8890.     13369049.    10.7969221     0.0071800     -0.012770
4.4245738     3.9978265    60.0000000 CY
 0.0007050        8890.     12610521.    10.8303132     0.0076354     -0.013515
4.4245916     3.9949307    60.0000000 CY
 0.0007450        8890.     11933446.    10.8707753     0.0080987     -0.014251
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   4.4246897     3.9792426    60.0000000 CY
    0.0007850          8890.     11325372.    10.9183643     0.0085709     -0.014979
   4.4246001     3.9991741    60.0000000 CY
    0.0008250          8890.     10776263.    10.9687866     0.0090492     -0.015701
   4.4237563     3.9785059    60.0000000 CY


-------------------------------------------------------------------------------
   Summary of Results for Nominal Moment Capacity for Section 1
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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              336.000             7974.442           0.00300000
-0.00658249
   2              455.000             8641.746           0.00300000
-0.00569510

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     Resist.       Nominal        Nominal     Ult. (Fac)    Ult. (Fac)   Bend.
Stiff.
Load      Factor       Ax. Thrust    Moment Cap    Ax. Thrust    Moment Cap    at
Ult Mom
 No.                      kips         in-kips        kips         in-kips
kip-in^2
-----  ------------   ------------  ------------  ------------  ------------
------------
   1       0.65         336.000000         7974.    218.400000         5183.
58147108.
   2       0.65         455.000000         8642.    295.750000         5617.
68471881.
```

```
   1       0.75         336.000000         7974.    252.000000         5981.
51910504.
   2       0.75         455.000000         8642.    341.250000         6481.
59082287.

   1       0.90         336.000000         7974.    302.400000         7177.
43423437.
   2       0.90         455.000000         8642.    409.500000         7778.
48627774.
```

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

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

Shear force at pile head = 41000.0 lbs
Applied moment at pile head = 1728000.0 in-lbs
Axial thrust load on pile head = 336000.0 lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*H	Soil Spr. Lat. Load	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	lb/inch	lb/inch	lb/inch
0.00	0.03699	1728000.	41000.	-0.00119	0.00	1.65E+11	0.00	0.00	0.00
0.1300	0.03514	1792581.	41000.	-0.00118	0.00	1.65E+11	0.00	0.00	0.00
0.2600	0.03332	1857153.	41000.	-0.00116	0.00	1.65E+11	0.00	0.00	0.00
0.3900	0.03152	1921715.	41000.	-0.00114	0.00	1.65E+11	0.00	0.00	0.00
0.5200	0.02976	1986268.	41000.	-0.00112	0.00	1.65E+11	0.00	0.00	0.00
0.6500	0.02802	2050812.	41000.	-0.00110	0.00	1.65E+11	0.00	0.00	0.00
0.7800	0.02632	2115345.	41000.	-0.00108	0.00	1.65E+11	0.00	0.00	0.00
0.9100	0.02464	2179867.	41000.	-0.00106	0.00	1.65E+11	0.00	0.00	0.00
1.0400	0.02300	2244379.	41000.	-0.00104	0.00	1.65E+11	0.00	0.00	0.00

```
    1.1700    0.02139   2308880.     41000.   -0.00102       0.00   1.65E+11
0.00       0.00       0.00
    1.3000    0.01982   2373369.     41000.  -9.98E-04       0.00   1.65E+11
0.00       0.00       0.00
    1.4300    0.01828   2437846.     41000.  -9.76E-04       0.00   1.65E+11
0.00       0.00       0.00
    1.5600    0.01677   2502311.     41000.  -9.50E-04       0.00   1.38E+11
0.00       0.00       0.00
    1.6900    0.01531   2566762.     41000.  -9.19E-04       0.00   1.23E+11
0.00       0.00       0.00
    1.8200    0.01390   2631195.     41000.  -8.86E-04       0.00   1.20E+11
0.00       0.00       0.00
    1.9500    0.01255   2695611.     41000.  -8.51E-04       0.00   1.17E+11
0.00       0.00       0.00
    2.0800    0.01125   2760007.     41000.  -8.14E-04       0.00   1.14E+11
0.00       0.00       0.00
    2.2100    0.01001   2824384.     41000.  -7.75E-04       0.00   1.11E+11
0.00       0.00       0.00
    2.3400    0.00883   2888739.     41000.  -7.34E-04       0.00   1.08E+11
0.00       0.00       0.00
    2.4700    0.00772   2953073.     41000.  -6.92E-04       0.00   1.06E+11
0.00       0.00       0.00
    2.6000    0.00668   3017384.     41000.  -6.47E-04       0.00   1.03E+11
0.00       0.00       0.00
    2.7300    0.00570   3081671.     41000.  -6.00E-04       0.00   1.00E+11
0.00       0.00       0.00
    2.8600    0.00480   3145933.     41000.  -5.51E-04       0.00   9.81E+10
0.00       0.00       0.00
    2.9900    0.00398   3210169.     41000.  -5.00E-04       0.00   9.58E+10
0.00       0.00       0.00
    3.1200    0.00324   3274378.     25520.  -4.47E-04       0.00   9.36E+10
-19846.   9547135.       0.00
    3.2500    0.00259   3290261.     -5589.  -3.92E-04       0.00   9.31E+10
-20038.   1.21E+07       0.00
    3.3800    0.00202   3257350.    -36848.  -3.37E-04       0.00   9.42E+10
-20037.   1.55E+07       0.00
    3.5100    0.00154   3175648.    -67722.  -2.85E-04       0.00   9.71E+10
-19544.   1.98E+07       0.00
    3.6400    0.00113   3046357.    -94811.  -2.36E-04       0.00   1.02E+11
-15185.   2.09E+07       0.00
    3.7700   8.00E-04   2880086.   -115463.  -1.92E-04       0.00   1.09E+11
-11292.   2.20E+07       0.00
    3.9000   5.33E-04   2686313.   -130430.  -1.53E-04       0.00   1.17E+11
-7896.   2.31E+07       0.00
    4.0300   3.22E-04   2473306.   -140483.  -1.23E-04       0.00   1.62E+11
-4994.   2.42E+07       0.00
    4.1600   1.48E-04   2248134.   -146250.  -1.01E-04       0.00   1.65E+11
-2399.   2.53E+07       0.00
    4.2900   7.30E-06   2017113.   -148217.  -8.08E-05       0.00   1.65E+11
-123.150   2.63E+07       0.00
    4.4200  -1.04E-04   1785782.   -146890.  -6.28E-05       0.00   1.65E+11
```

```
1824.   2.74E+07       0.00
    4.5500  -1.89E-04   1558883.   -142780.  -4.70E-05       0.00   1.65E+11
3444.   2.85E+07       0.00
    4.6800  -2.50E-04   1340358.   -136392.  -3.32E-05       0.00   1.65E+11
4746.   2.96E+07       0.00
    4.8100  -2.92E-04   1133375.   -128210.  -2.15E-05       0.00   1.65E+11
5744.   3.07E+07       0.00
    4.9400  -3.18E-04    940367.   -118690.  -1.17E-05       0.00   1.65E+11
6461.   3.17E+07       0.00
    5.0700  -3.29E-04    763076.   -108253.  -3.69E-06       0.00   1.65E+11
6920.   3.28E+07       0.00
    5.2000  -3.29E-04    602623.    -97277.   2.76E-06       0.00   1.65E+11
7151.   3.39E+07       0.00
    5.3300  -3.20E-04    459570.    -86095.   7.78E-06       0.00   1.65E+11
7183.   3.50E+07       0.00
    5.4600  -3.05E-04    333997.    -74996.   1.15E-05       0.00   1.65E+11
7047.   3.61E+07       0.00
    5.5900  -2.84E-04    225570.    -64218.   1.42E-05       0.00   1.65E+11
6771.   3.71E+07       0.00
    5.7200  -2.61E-04    133620.    -53957.   1.59E-05       0.00   1.65E+11
6385.   3.82E+07       0.00
    5.8500  -2.35E-04     57209.    -44360.   1.68E-05       0.00   1.65E+11
5917.   3.93E+07       0.00
    5.9800  -2.08E-04     -4802.    -35539.   1.70E-05       0.00   1.65E+11
5392.   4.04E+07       0.00
    6.1100  -1.82E-04    -53691.    -27565.   1.67E-05       0.00   1.65E+11
4831.   4.15E+07       0.00
    6.2400  -1.56E-04    -90823.    -20478.   1.61E-05       0.00   1.65E+11
4255.   4.26E+07       0.00
    6.3700  -1.32E-04   -117599.    -14287.   1.51E-05       0.00   1.65E+11
3681.   4.36E+07       0.00
    6.5000  -1.09E-04   -135415.     -8979.   1.39E-05       0.00   1.65E+11
3123.   4.47E+07       0.00
    6.6300  -8.83E-05   -145629.     -4521.   1.26E-05       0.00   1.65E+11
2592.   4.58E+07       0.00
    6.7600  -6.98E-05   -149533.   -862.948   1.12E-05       0.00   1.65E+11
2097.   4.69E+07       0.00
    6.8900  -5.35E-05   -148333.      2056.   9.75E-06       0.00   1.65E+11
1645.   4.80E+07       0.00
    7.0200  -3.94E-05   -143130.      4304.   8.37E-06       0.00   1.65E+11
1238.   4.90E+07       0.00
    7.1500  -2.74E-05   -134913.      5955.   7.06E-06       0.00   1.65E+11
879.2011   5.01E+07       0.00
    7.2800  -1.73E-05   -124557.      7085.   5.83E-06       0.00   1.65E+11
569.2968   5.12E+07       0.00
    7.4100  -9.16E-06   -112814.      7769.   4.71E-06       0.00   1.65E+11
307.0494   5.23E+07       0.00
    7.5400  -2.64E-06   -100324.      8078.   3.70E-06       0.00   1.65E+11
90.3557   5.34E+07       0.00
    7.6700   2.40E-06    -87614.      8084.   2.82E-06       0.00   1.65E+11
-83.753   5.45E+07       0.00
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    7.8000   6.15E-06    -75106.      7848.   2.05E-06       0.00   1.65E+11
-218.870   5.55E+07       0.00
    7.9300   8.79E-06    -63131.      7428.   1.39E-06       0.00   1.65E+11
-319.001   5.66E+07       0.00
    8.0600   1.05E-05    -51932.      6876.   8.51E-07       0.00   1.65E+11
-388.373   5.77E+07       0.00
    8.1900   1.14E-05    -41678.      6237.   4.09E-07       0.00   1.65E+11
-431.271   5.88E+07       0.00
    8.3200   1.18E-05    -32473.      5548.   5.86E-08       0.00   1.65E+11
-451.902   5.99E+07       0.00
    8.4500   1.16E-05    -24368.      4841.  -2.10E-07       0.00   1.65E+11
-454.291   6.09E+07       0.00
    8.5800   1.11E-05    -17368.      4142.  -4.07E-07       0.00   1.65E+11
-442.191   6.20E+07       0.00
    8.7100   1.04E-05    -11445.      3470.  -5.43E-07       0.00   1.65E+11
-419.031   6.31E+07       0.00
    8.8400   9.43E-06     -6540.      2841.  -6.28E-07       0.00   1.65E+11
-387.870   6.42E+07       0.00
    8.9700   8.40E-06     -2580.      2264.  -6.71E-07       0.00   1.65E+11
-351.384   6.53E+07       0.00
    9.1000   7.33E-06   524.7083      1747.  -6.81E-07       0.00   1.65E+11
-311.853   6.64E+07       0.00
    9.2300   6.27E-06      2871.      1292.  -6.65E-07       0.00   1.65E+11
-271.178   6.74E+07       0.00
    9.3600   5.26E-06      4557.   900.5515  -6.30E-07       0.00   1.65E+11
-230.894   6.85E+07       0.00
    9.4900   4.31E-06      5681.   570.5392  -5.82E-07       0.00   1.65E+11
-192.198   6.96E+07       0.00
    9.6200   3.44E-06      6338.   298.9595  -5.25E-07       0.00   1.65E+11
-155.981   7.07E+07       0.00
    9.7500   2.67E-06      6615.    81.4631  -4.64E-07       0.00   1.65E+11
-122.861   7.18E+07       0.00
    9.8800   2.00E-06      6592.    -87.083  -4.01E-07       0.00   1.65E+11
-93.224   7.28E+07       0.00
   10.0100   1.42E-06      6343.   -212.257  -3.40E-07       0.00   1.65E+11
-67.257   7.39E+07       0.00
   10.1400   9.36E-07      5930.   -299.806  -2.82E-07       0.00   1.65E+11
-44.985   7.50E+07       0.00
   10.2700   5.39E-07      5408.   -355.414  -2.28E-07       0.00   1.65E+11
-26.307   7.61E+07       0.00
   10.4000   2.23E-07      4822.   -384.531  -1.80E-07       0.00   1.65E+11
-11.023   7.72E+07       0.00
   10.5300  -2.26E-08      4209.   -392.246  -1.37E-07       0.00   1.65E+11
1.1309   7.80E+07       0.00
   10.6600  -2.06E-07      3598.   -383.329  -1.01E-07       0.00   1.65E+11
10.3015   7.80E+07       0.00
   10.7900  -3.36E-07      3013.   -362.174  -6.93E-08       0.00   1.65E+11
16.8199   7.80E+07       0.00
   10.9200  -4.22E-07      2468.   -332.583  -4.34E-08       0.00   1.65E+11
21.1177   7.80E+07       0.00
   11.0500  -4.72E-07      1975.   -297.706  -2.24E-08       0.00   1.65E+11
```

```
23.5962   7.80E+07       0.00
   11.1800  -4.92E-07      1539.   -260.098  -5.84E-09       0.00   1.65E+11
24.6189   7.80E+07       0.00
   11.3100  -4.90E-07      1164.   -221.780   6.93E-09       0.00   1.65E+11
24.5069   7.80E+07       0.00
   11.4400  -4.71E-07   847.4184   -184.306   1.64E-08       0.00   1.65E+11
23.5373   7.80E+07       0.00
   11.5700  -4.39E-07   588.5309   -148.831   2.32E-08       0.00   1.65E+11
21.9431   7.80E+07       0.00
   11.7000  -3.98E-07   383.0411   -116.182   2.78E-08       0.00   1.65E+11
19.9150   7.80E+07       0.00
   11.8300  -3.52E-07   226.0146    -86.916   3.07E-08       0.00   1.65E+11
17.6046   7.80E+07       0.00
   11.9600  -3.03E-07   111.8295    -61.385   3.23E-08       0.00   1.65E+11
15.1276   7.80E+07       0.00
   12.0900  -2.51E-07    34.4585    -39.783   3.30E-08       0.00   1.65E+11
12.5682   7.80E+07       0.00
   12.2200  -2.00E-07    -12.327    -22.192   3.31E-08       0.00   1.65E+11
9.9834   7.80E+07       0.00
   12.3500  -1.48E-07    -34.816     -8.627   3.29E-08       0.00   1.65E+11
7.4077   7.80E+07       0.00
   12.4800  -9.72E-08    -39.278     0.9397   3.25E-08       0.00   1.65E+11
4.8576   7.80E+07       0.00
   12.6100  -4.67E-08    -31.918     6.5511   3.22E-08       0.00   1.65E+11
2.3365   7.80E+07       0.00
   12.7400   3.22E-09    -18.872     8.2480   3.19E-08       0.00   1.65E+11
-0.161   7.80E+07       0.00
   12.8700   5.29E-08     -6.218     6.0595   3.18E-08       0.00   1.65E+11
-2.645   7.80E+07       0.00
   13.0000   1.02E-07       0.00       0.00   3.18E-08       0.00   1.65E+11
-5.124   3.90E+07       0.00
```

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     0.03698541 inches
Computed slope at pile head      =     -0.0011925 radians
Maximum bending moment           =       3290261. inch-lbs
Maximum shear force              =       -148217. lbs
Depth of maximum bending moment  =     3.25000000 feet below pile head
Depth of maximum shear force     =     4.29000000 feet below pile head
Number of iterations             =             15
Number of zero deflection points =              4
Pile deflection at ground        =     0.00392516 inches
```

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 = 57000.0 lbs
Applied moment at pile head = 2280000.0 in-lbs
Axial thrust load on pile head = 455000.0 lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*H	Soil Spr. Lat. Load	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	lb/inch	lb/inch	lb/inch
0.00	0.05545	2280000.	57000.	-0.00176	0.00	1.62E+11	0.00	0.00	0.00
0.1300	0.05273	2370161.	57000.	-0.00174	0.00	1.62E+11	0.00	0.00	0.00
0.2600	0.05003	2460305.	57000.	-0.00171	0.00	1.62E+11	0.00	0.00	0.00
0.3900	0.04738	2550433.	57000.	-0.00169	0.00	1.62E+11	0.00	0.00	0.00
0.5200	0.04476	2640543.	57000.	-0.00166	0.00	1.62E+11	0.00	0.00	0.00
0.6500	0.04219	2730636.	57000.	-0.00164	0.00	1.62E+11	0.00	0.00	0.00
0.7800	0.03965	2820709.	57000.	-0.00161	0.00	1.62E+11	0.00	0.00	0.00
0.9100	0.03716	2910763.	57000.	-0.00158	0.00	1.38E+11	0.00	0.00	0.00
1.0400	0.03472	3000794.	57000.	-0.00155	0.00	1.35E+11	0.00	0.00	0.00
1.1700	0.03233	3090800.	57000.	-0.00151	0.00	1.32E+11	0.00	0.00	0.00
1.3000	0.03000	3180781.	57000.	-0.00147	0.00	1.29E+11	0.00	0.00	0.00
1.4300	0.02773	3270734.	57000.	-0.00144	0.00	1.26E+11	0.00	0.00	0.00
1.5600	0.02552	3360659.	57000.	-0.00139	0.00	1.23E+11	0.00	0.00	0.00
1.6900	0.02338	3450553.	57000.	-0.00135	0.00	1.20E+11	0.00	0.00	0.00
1.8200	0.02131	3540415.	57000.	-0.00130	0.00	1.17E+11			

```
0.00       0.00       0.00
    1.9500    0.01931   3630244.     57000.   -0.00126       0.00   1.14E+11
0.00       0.00       0.00
    2.0800    0.01739   3720037.     57000.   -0.00120       0.00   1.11E+11
0.00       0.00       0.00
    2.2100    0.01556   3809793.     57000.   -0.00115       0.00   1.08E+11
0.00       0.00       0.00
    2.3400    0.01380   3899510.     57000.   -0.00109       0.00   1.05E+11
0.00       0.00       0.00
    2.4700    0.01214   3989185.     57000.   -0.00103       0.00   1.02E+11
0.00       0.00       0.00
    2.6000    0.01058   4078818.     57000.  -9.72E-04       0.00   9.96E+10
0.00       0.00       0.00
    2.7300    0.00911   4168405.     57000.  -9.06E-04       0.00   9.70E+10
0.00       0.00       0.00
    2.8600    0.00775   4257945.     57000.  -8.38E-04       0.00   9.46E+10
0.00       0.00       0.00
    2.9900    0.00650   4347434.     57000.  -7.66E-04       0.00   9.23E+10
0.00       0.00       0.00
    3.1200    0.00536   4436872.     39447.  -6.91E-04       0.00   9.00E+10
-22504.   6548881.       0.00
    3.2500    0.00434   4471490.      4105.  -6.13E-04       0.00   8.92E+10
-22806.   8192054.       0.00
    3.3800    0.00345   4450551.    -31547.  -5.35E-04       0.00   8.97E+10
-22901.   1.04E+07       0.00
    3.5100    0.00267   4373824.    -67177.  -4.60E-04       0.00   9.16E+10
-22779.   1.33E+07       0.00
    3.6400    0.00201   4241610.   -102436.  -3.87E-04       0.00   9.51E+10
-22424.   1.74E+07       0.00
    3.7700    0.00146   4054774.   -136030.  -3.21E-04       0.00   1.00E+11
-20645.   2.20E+07       0.00
    3.9000    0.00101   3817653.   -163812.  -2.62E-04       0.00   1.07E+11
-14973.   2.31E+07       0.00
    4.0300   6.46E-04   3544053.   -183302.  -2.10E-04       0.00   1.17E+11
-10014.   2.42E+07       0.00
    4.1600   3.55E-04   3246048.   -195596.  -1.67E-04       0.00   1.27E+11
-5747.   2.53E+07       0.00
    4.2900   1.26E-04   2934030.   -201736.  -1.30E-04       0.00   1.38E+11
-2126.   2.63E+07       0.00
    4.4200  -5.13E-05   2616815.   -202692.  -1.01E-04       0.00   1.62E+11
901.0690   2.74E+07       0.00
    4.5500  -1.89E-04   2301776.   -199295.  -7.72E-05       0.00   1.62E+11
3454.   2.85E+07       0.00
    4.6800  -2.92E-04   1995126.   -192278.  -5.65E-05       0.00   1.62E+11
5542.   2.96E+07       0.00
    4.8100  -3.66E-04   1701949.   -182352.  -3.87E-05       0.00   1.62E+11
7183.   3.07E+07       0.00
    4.9400  -4.13E-04   1426242.   -170192.  -2.37E-05       0.00   1.62E+11
8406.   3.17E+07       0.00
    5.0700  -4.39E-04   1170983.   -156424.  -1.12E-05       0.00   1.62E+11
9245.   3.28E+07       0.00
```

```
    5.2000  -4.48E-04    938216.   -141617.  -1.04E-06       0.00   1.62E+11
9738.   3.39E+07       0.00
    5.3300  -4.43E-04    729140.   -126278.   6.98E-06       0.00   1.62E+11
9927.   3.50E+07       0.00
    5.4600  -4.26E-04    544218.   -110847.   1.31E-05       0.00   1.62E+11
9856.   3.61E+07       0.00
    5.5900  -4.02E-04    383278.    -95697.   1.76E-05       0.00   1.62E+11
9567.   3.71E+07       0.00
    5.7200  -3.71E-04    245619.    -81133.   2.06E-05       0.00   1.62E+11
9104.   3.82E+07       0.00
    5.8500  -3.38E-04    130113.    -67397.   2.24E-05       0.00   1.62E+11
8506.   3.93E+07       0.00
    5.9800  -3.02E-04     35307.    -54671.   2.32E-05       0.00   1.62E+11
7810.   4.04E+07       0.00
    6.1100  -2.65E-04    -40492.    -43080.   2.32E-05       0.00   1.62E+11
7050.   4.15E+07       0.00
    6.2400  -2.29E-04    -99134.    -32700.   2.25E-05       0.00   1.62E+11
6257.   4.26E+07       0.00
    6.3700  -1.95E-04   -142548.    -23565.   2.13E-05       0.00   1.62E+11
5455.   4.36E+07       0.00
    6.5000  -1.63E-04   -172687.    -15670.   1.98E-05       0.00   1.62E+11
4667.   4.47E+07       0.00
    6.6300  -1.33E-04   -191467.     -8980.   1.81E-05       0.00   1.62E+11
3910.   4.58E+07       0.00
    6.7600  -1.06E-04   -200730.     -3435.   1.62E-05       0.00   1.62E+11
3199.   4.69E+07       0.00
    6.8900  -8.27E-05   -202207.      1044.   1.42E-05       0.00   1.62E+11
2543.   4.80E+07       0.00
    7.0200  -6.20E-05   -197494.      4548.   1.23E-05       0.00   1.62E+11
1949.   4.90E+07       0.00
    7.1500  -4.43E-05   -188036.      7178.   1.05E-05       0.00   1.62E+11
1423.   5.01E+07       0.00
    7.2800  -2.94E-05   -175115.      9039.   8.72E-06       0.00   1.62E+11
963.6143   5.12E+07       0.00
    7.4100  -1.71E-05   -159847.     10237.   7.11E-06       0.00   1.62E+11
572.0951   5.23E+07       0.00
    7.5400  -7.18E-06   -143186.     10874.   5.65E-06       0.00   1.62E+11
245.5884   5.34E+07       0.00
    7.6700   5.63E-07   -125927.     11051.   4.36E-06       0.00   1.62E+11
-19.643   5.45E+07       0.00
    7.8000   6.41E-06   -108714.     10857.   3.23E-06       0.00   1.62E+11
-228.349   5.55E+07       0.00
    7.9300   1.06E-05    -92056.     10378.   2.26E-06       0.00   1.62E+11
-385.973   5.66E+07       0.00
    8.0600   1.35E-05    -76338.      9688.   1.45E-06       0.00   1.62E+11
-498.366   5.77E+07       0.00
    8.1900   1.52E-05    -61831.      8854.   7.89E-07       0.00   1.62E+11
-571.541   5.88E+07       0.00
    8.3200   1.59E-05    -48715.      7931.   2.57E-07       0.00   1.62E+11
-611.467   5.99E+07       0.00
    8.4500   1.60E-05    -37086.      6967.  -1.56E-07       0.00   1.62E+11
```

```
-623.904   6.09E+07       0.00
    8.5800   1.54E-05    -26976.      6002.  -4.64E-07       0.00   1.62E+11
-614.266   6.20E+07       0.00
    8.7100   1.45E-05    -18360.      5064.  -6.82E-07       0.00   1.62E+11
-587.534   6.31E+07       0.00
    8.8400   1.33E-05    -11174.      4178.  -8.24E-07       0.00   1.62E+11
-548.184   6.42E+07       0.00
    8.9700   1.20E-05     -5322.      3361.  -9.03E-07       0.00   1.62E+11
-500.154   6.53E+07       0.00
    9.1000   1.05E-05   -687.636      2622.  -9.32E-07       0.00   1.62E+11
-446.830   6.64E+07       0.00
    9.2300   9.05E-06      2860.      1969.  -9.21E-07       0.00   1.62E+11
-391.050   6.74E+07       0.00
    9.3600   7.63E-06      5456.      1402.  -8.81E-07       0.00   1.62E+11
-335.133   6.85E+07       0.00
    9.4900   6.30E-06      7236.   921.6125  -8.20E-07       0.00   1.62E+11
-280.903   6.96E+07       0.00
    9.6200   5.07E-06      8332.   523.3095  -7.46E-07       0.00   1.62E+11
-229.742   7.07E+07       0.00
    9.7500   3.97E-06      8869.   201.6583  -6.63E-07       0.00   1.62E+11
-182.632   7.18E+07       0.00
    9.8800   3.00E-06      8962.    -50.157  -5.77E-07       0.00   1.62E+11
-140.209   7.28E+07       0.00
   10.0100   2.17E-06      8714.   -239.716  -4.92E-07       0.00   1.62E+11
-102.816   7.39E+07       0.00
   10.1400   1.47E-06      8215.   -374.944  -4.11E-07       0.00   1.62E+11
-70.554   7.50E+07       0.00
   10.2700   8.88E-07      7545.   -463.773  -3.35E-07       0.00   1.62E+11
-43.329   7.61E+07       0.00
   10.4000   4.23E-07      6769.   -513.871  -2.66E-07       0.00   1.62E+11
-20.900   7.72E+07       0.00
   10.5300   5.82E-08      5942.   -532.444  -2.05E-07       0.00   1.62E+11
-2.910   7.80E+07       0.00
   10.6600  -2.17E-07      5108.   -526.252  -1.52E-07       0.00   1.62E+11
10.8478   7.80E+07       0.00
   10.7900  -4.15E-07      4300.   -501.587  -1.07E-07       0.00   1.62E+11
20.7745   7.80E+07       0.00
   10.9200  -5.50E-07      3543.   -463.952  -6.89E-08       0.00   1.62E+11
27.4756   7.80E+07       0.00
   11.0500  -6.30E-07      2852.   -417.936  -3.81E-08       0.00   1.62E+11
31.5190   7.80E+07       0.00
   11.1800  -6.68E-07      2239.   -367.282  -1.36E-08       0.00   1.62E+11
33.4226   7.80E+07       0.00
   11.3100  -6.73E-07      1707.   -314.968   5.33E-09       0.00   1.62E+11
33.6466   7.80E+07       0.00
   11.4400  -6.52E-07      1256.   -263.303   1.96E-08       0.00   1.62E+11
32.5905   7.80E+07       0.00
   11.5700  -6.12E-07   885.0653   -214.020   2.99E-08       0.00   1.62E+11
30.5920   7.80E+07       0.00
   11.7000  -5.59E-07   588.3936   -168.374   3.70E-08       0.00   1.62E+11
27.9295   7.80E+07       0.00
```

```
   11.8300  -4.97E-07   359.6872   -127.224   4.15E-08       0.00   1.62E+11
24.8257   7.80E+07       0.00
   11.9600  -4.29E-07   191.3942    -91.128   4.42E-08       0.00   1.62E+11
21.4521   7.80E+07       0.00
   12.0900  -3.59E-07    75.3057    -60.406   4.55E-08       0.00   1.62E+11
17.9348   7.80E+07       0.00
   12.2200  -2.87E-07     2.8628    -35.215   4.58E-08       0.00   1.62E+11
14.3611   7.80E+07       0.00
   12.3500  -2.16E-07    -34.631    -15.601   4.57E-08       0.00   1.62E+11
10.7853   7.80E+07       0.00
   12.4800  -1.45E-07    -45.877     -1.545   4.53E-08       0.00   1.62E+11
7.2354   7.80E+07       0.00
   12.6100  -7.44E-08    -39.515     7.0002   4.49E-08       0.00   1.62E+11
3.7199   7.80E+07       0.00
   12.7400  -4.68E-09    -24.100    10.0843   4.46E-08       0.00   1.62E+11
0.2341   7.80E+07       0.00
   12.8700   6.47E-08     -8.115     7.7446   4.44E-08       0.00   1.62E+11
-3.234   7.80E+07       0.00
   13.0000   1.34E-07       0.00       0.00   4.44E-08       0.00   1.62E+11
-6.695   3.90E+07       0.00
```

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     0.05545273 inches
Computed slope at pile head      =     -0.0017591 radians
Maximum bending moment           =       4471490. inch-lbs
Maximum shear force              =       -202692. lbs
Depth of maximum bending moment  =     3.25000000 feet below pile head
Depth of maximum shear force     =     4.42000000 feet below pile head
Number of iterations             =             14
Number of zero deflection points =              4
Pile deflection at ground        =     0.00641060 inches
```

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 Type	Pile-head Load 1	Load Type	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	41000.	M, in-lb	1728000.	336000.	0.03699	-0.00119	-148217.	3290261.
2	V, lb	57000.	M, in-lb	2280000.	455000.	0.05545	-0.00176	-202692.	4471490.

Maximum pile-head deflection = 0.0554527341 inches
Maximum pile-head rotation = -0.0017590982 radians = -0.100789 deg.

Summary of Warning Messages

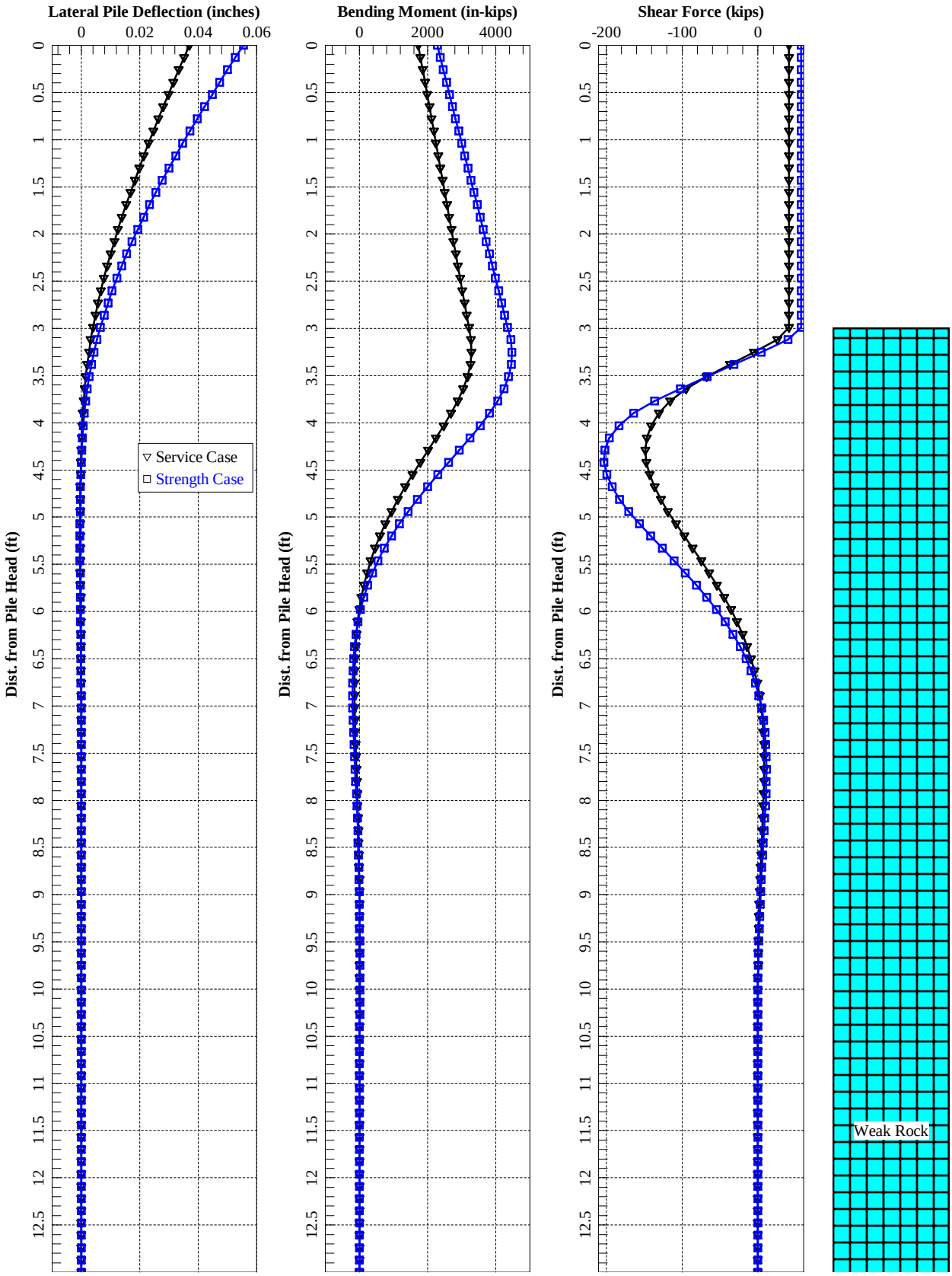
The following warning was reported 1155 times

**** Warning ****

An unreasonable input value for unconfined compressive strength has been specified for a soil defined using the weak rock criteria. The input value is greater than 500 psi. Please check your input data for correctness.

The analysis ended normally.

Rear Abutment



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LPile for Windows, Version 2022-12.007

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

Path to file locations:
\Projects\2021\N1215380\Working Files\Calculations-Analyses\101623 Lpile\

Name of input data file:
Forward Abutment.lp12d

Name of output report file:
Forward Abutment.lp12o

Name of plot output file:
Forward Abutment.lp12p

Name of runtime message file:
Forward Abutment.lp12r

Date and Time of Analysis

Date: October 16, 2023 Time: 12:48:49

Problem Title

Project Name: SCI 335

Job Number: N1215380

Client: ODOT

Engineer: ATN

Description: Abutment

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

- Use of p-y modification factors for p-y curves not selected

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

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

Pile Structural Properties and Geometry

Number of pile sections defined = 2
Total length of pile = 21.000 ft
Depth of ground surface below top of pile = 8.0000 ft

Pile diameters used for p-y curve computations are defined using 4 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	8.000	36.0000
3	8.000	30.0000
4	21.000	30.0000

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 = 8.000000 ft
Shaft Diameter = 36.000000 in

Pile Section No. 2:

Section 2 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 13.000000 ft
Shaft Diameter = 30.000000 in

Soil and Rock Layering Information

The soil profile is modelled using 1 layers

Layer 1 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer = 8.000000 ft
Distance from top of pile to bottom of layer = 25.000000 ft
Effective unit weight at top of layer = 135.000000 pcf
Effective unit weight at bottom of layer = 135.000000 pcf
Uniaxial compressive strength at top of layer = 3000. psi
Uniaxial compressive strength at bottom of layer = 3000. psi
Initial modulus of rock at top of layer = 100000. psi
Initial modulus of rock at bottom of layer = 100000. psi
RQD of rock at top of layer = 70.000000 %
RQD of rock at bottom of layer = 70.000000 %
k rm of rock at top of layer = 0.0003000
k rm of rock at bottom of layer = 0.0003000

(Depth of the lowest soil layer extends 4.000 ft below the pile tip)

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Uniaxial qu psi	RQD %	E50 or Rock Mass Modulus krm psi
1	Weak Rock	8.0000 25.0000	135.0000 135.0000	3000. 3000.	70.0000 70.0000	3.00E-04 3.00E-04	100000. 100000.

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 = 2

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	1	V = 41000. lbs	M = 1728000. in-lbs	336000.	No	Yes
2	1	V = 57000. lbs	M = 2280000. in-lbs	455000.	No	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

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

Number of Pile Sections Analyzed = 2

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	8.000000	ft
Shaft Diameter	=	36.000000	in
Concrete Cover Thickness (to edge of trans. reinf.)	=	6.000000	in
Number of Reinforcing Bars	=	10	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	=	10.000000	sq. in.
Area Ratio of Steel Reinforcement	=	0.98	percent
Edge-to-Edge Bar Spacing	=	5.630820	in
Maximum Concrete Aggregate Size	=	0.750000	in
Ratio of Bar Spacing to Aggregate Size	=	7.51	
Offset of Center of Rebar Cage from Center of Pile	=	0.0000	in
Transverse Reinforcement			
Type: Hoop			
Number of Transverse Reinf. (per spacing)	=	1	
Spacing of Transverse Reinf.	=	12.000000	in
Yield Stress of Transverse Reinf.	=	60000.	psi
Diameter of Transverse Reinf.	=	0.500000	in
Confined Section			
Total Area of Confinement Steel	=	0.200000	sq. in.
rho_s	=	0.002721	
ke	=	0.781891	
f'cc	=	4426.	psi
f'l	=	63.827875	psi
Epsilon cc	=	0.003066	
Epsilon cu	=	0.008647	
r	=	1.667935	

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	4026.778	kips
Tensile Load for Cracking of Concrete	=	-452.643	kips
Nominal Axial Tensile Capacity	=	-600.000	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	10.936000	0.00000
2	1.128000	1.000000	8.847410	6.428020
3	1.128000	1.000000	3.379410	10.400754
4	1.128000	1.000000	-3.37941	10.400754
5	1.128000	1.000000	-8.84741	6.428020
6	1.128000	1.000000	-10.93600	0.00000
7	1.128000	1.000000	-8.84741	-6.42802
8	1.128000	1.000000	-3.37941	-10.40075

9	1.128000	1.000000	3.379410	-10.40075
10	1.128000	1.000000	8.847410	-6.42802

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

Minimum spacing between any two bars not equal to zero = 5.631 inches
between bars 1 and 2.

Ratio of bar spacing to maximum aggregate size = 7.51

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 = 2

Number	Axial Thrust Force kips
1	336.000
2	455.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318-14, Section 21.2.3.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 336.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conf Stress ksi	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
6.25000E-07	215.1591207	344254593.	144.0963525	0.00009006	0.00006756	0.3229182	0.3723882	2.4845089	
0.00000125	430.4610577	344368846.	81.0661862	0.0001013	0.00005633	0.3626599	0.4173227	2.6841743	
0.00000188	645.7511567	344400617.	60.0640474	0.0001126	0.00004512	0.4023559	0.4620363	2.8842701	
0.00000250	861.0233820	344409353.	49.5689152	0.0001239	0.00003392	0.4419992	0.5065280	3.0847964	
0.00000313	1076.	344406940.	43.2765854	0.0001352	0.00002274	0.4815827	0.5507967	3.2857531	
0.00000375	1291.	344397338.	39.0856567	0.0001466	0.00001157	0.5210996	0.5948411	3.4871402	
0.00000438	1507.	344382239.	36.0955282	0.0001579	4.17936E-07	0.5605435	0.6386603	3.6889577	
0.00000500	1722.	344357421.	33.8558290	0.0001693	-0.00001072	0.5999066	0.6822516	3.8911952	
0.00000563	1937.	344295154.	32.1159780	0.0001807	-0.00002185	0.6391743	0.7256045	4.0937814	
0.00000625	2151.	344175155.	30.7255272	0.0001920	-0.00003297	0.6783300	0.7687064	4.2966268	
0.00000688	2365.	343994442.	29.5888641	0.0002034	-0.00004408	0.7173603	0.8115482	4.4996673	
0.00000750	2578.	343788252.	28.6430004	0.0002148	-0.00005518	0.7562718	0.8541423	4.7030026	
0.00000813	2792.	343575075.	27.8442610	0.0002262	-0.00006627	0.7950690	0.8964988	4.9067165	
0.00000875	3004.	343346577.	27.1609790	0.0002377	-0.00007734	0.8337425	0.9386121	5.1107734	
0.00001000	3428.	342825922.	26.0537138	0.0002605	-0.00009946	0.9106814	1.0220879	5.5197770	
0.00001125	3428.	304734153.	23.6215327	0.0002657	-0.000139	0.9275011	1.0402843	5.4162499	C
0.00001250	3428.	274260738.	22.6177277	0.0002827	-0.000167	0.9838291	1.1010923	5.6541762	C
0.00001375	3428.	249327944.	21.7618526	0.0002992	-0.000196	1.0381687	1.1595700	5.8783137	C
0.00001500	3428.	228550615.	21.0202898	0.0003153	-0.000225	1.0907095	1.2159484	6.0901261	C
0.00001625	3453.	212492575.	20.3709517	0.0003310	-0.000254	1.1417007	1.2705171	6.2916360	C
0.00001750	3564.	203630825.	19.7958552	0.0003464	-0.000284	1.1912605	1.3234213	6.4837465	C
0.00001875	3669.	195673571.	19.2840861	0.0003616	-0.000313				

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1.2396428     1.3749478     6.6685969 C
0.00002000         3769.    188460169.    18.8231985     0.0003765     -0.000344
1.2868219     1.4250826     6.8458552 C
0.00002125         3866.    181912637.    18.4065384     0.0003911     -0.000374
1.3329678     1.4740184     7.0169543 C
0.00002250         3959.    175947545.    18.0278620     0.0004056     -0.000404
1.3781702     1.5218604     7.1826300 C
0.00002375         4049.    170491219.    17.6819062     0.0004199     -0.000435
1.4224923     1.5686843     -7.781562 C
0.00002500         4137.    165483798.    17.3645368     0.0004341     -0.000466
1.4660018     1.6145696     -8.421211 C
0.00002625         4223.    160875925.    17.0724874     0.0004482     -0.000497
1.5087717     1.6596001     -9.064594 C
0.00002750         4307.    156608717.    16.8016035     0.0004620     -0.000528
1.5507482     1.7037256     -9.712271 C
0.00003000         4470.    148988633.    16.3170222     0.0004895     -0.000590
1.6327370     1.7897207    -11.016791 C
0.00003250         4627.    142375132.    15.8949191     0.0005166     -0.000653
1.7122236     1.8728614    -12.332689 C
0.00003500         4781.    136588237.    15.5243421     0.0005434     -0.000717
1.7894932     1.9534766    -13.657493 C
0.00003750         4931.    131481571.    15.1962558     0.0005699     -0.000780
1.8647098     2.0317628    -14.989822 C
0.00004000         5078.    126943802.    14.9040361     0.0005962     -0.000844
1.9380485     2.1079220    -16.328118 C
0.00004250         5222.    122875609.    14.6409455     0.0006222     -0.000908
2.0094802     2.1819408    -17.672885 C
0.00004500         5364.    119210440.    14.4031676     0.0006481     -0.000972
2.0791552     2.2539884    -19.022766 C
0.00004750         5505.    115901629.    14.1890330     0.0006740     -0.001036
2.1473871     2.3243988    -20.374557 C
0.00005000         5644.    112880435.    13.9923288     0.0006996     -0.001100
2.2138317     2.3928247    -21.732124 C
0.00005250         5782.    110128155.    13.8140017     0.0007252     -0.001165
2.2789779     2.4597750    -23.090232 C
0.00005750         6053.    105271394.    13.4994281     0.0007762     -0.001294
2.4048889     2.5887596    -25.813854 C
0.00006250         6320.    101113721.    13.2301231     0.0008269     -0.001423
2.5251027     2.7113430    -28.546652 C
0.00006750         6583.     97519589.    12.9994277     0.0008775     -0.001553
2.6402566     2.8281584    -31.281970 C
0.00007250         6843.     94379980.    12.8011273     0.0009281     -0.001682
2.7506960     2.9395156    -34.016081 C
0.00007750         7099.     91598091.    12.6261156     0.0009785     -0.001811
2.8560099     3.0449455    -36.755355 C
0.00008250         7353.     89124746.    12.4746360     0.0010292     -0.001941
2.9570524     3.1452317    -39.489084 C
0.00008750         7604.     86900408.    12.3404252     0.0010798     -0.002070
3.0534843     3.2399496    -42.222921 C
0.00009250         7852.     84887489.    12.2216920     0.0011305     -0.002199
3.1455687     3.3292625    -44.954161 C
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0.00009750        8098.     83058087.    12.1178710     0.0011815     -0.002329
3.2336880     3.4134280    -47.677670 C
 0.0001025        8342.     81381930.    12.0255053     0.0012326     -0.002457
3.3176708     3.4921585    -50.397235 C
 0.0001075        8582.     79835807.    11.9422770     0.0012838     -0.002586
3.3974812     3.5652999    -53.115101 C
 0.0001125        8821.     78406374.    11.8690507     0.0013353     -0.002715
3.4735713     3.6331332    -55.824472 C
 0.0001175        9057.     77078211.    11.8046223     0.0013870     -0.002843
3.5460105     3.6955687    -58.525100 C
 0.0001225        9286.     75804835.    11.7463706     0.0014389     -0.002971
3.6146143     3.7523032    -60.000000 CY
 0.0001275        9454.     74148235.    11.6708329     0.0014880     -0.003102
3.6759140     3.8005623    -60.000000 CY
 0.0001325        9584.     72331279.    11.5867937     0.0015353     -0.003235
3.7316752     3.8420153    -60.000000 CY
 0.0001375        9712.     70634634.    11.5107545     0.0015827     -0.003367
3.7847460     3.8788362    -60.000000 CY
 0.0001425        9839.     69045332.    11.4419223     0.0016305     -0.003500
3.8351880     3.9109477    -60.000000 CY
 0.0001475        9964.     67552168.    11.3796140     0.0016785     -0.003632
3.8830644     3.9382695    -60.000000 CY
 0.0001525       10086.     66134564.    11.3217127     0.0017266     -0.003763
3.9282228     3.9606199    -60.000000 CY
 0.0001575       10188.     64683342.    11.2594517     0.0017734     -0.003897
3.9696098     3.9775677    -60.000000 CY
 0.0001625       10256.     63111393.    11.1875647     0.0018180     -0.004032
4.0067651     3.9893037    -60.000000 CY
 0.0001675       10306.     61530225.    11.1139734     0.0018616     -0.004168
4.0410154     3.9966202    -60.000000 CY
 0.0001725       10356.     60034126.    11.0460391     0.0019054     -0.004305
4.0734878     3.9998414    -60.000000 CY
 0.0001775       10404.     58615009.    10.9834211     0.0019496     -0.004440
4.1042395     3.9988079    -60.000000 CY
 0.0001825       10450.     57261188.    10.9223871     0.0019933     -0.004577
4.1329185     3.9973304    -60.000000 CY
 0.0001875       10495.     55972331.    10.8659281     0.0020374     -0.004713
4.1599913     3.9996494    -60.000000 CY
 0.0001925       10538.     54744015.    10.8138475     0.0020817     -0.004848
4.1855138     3.9975002    -60.000000 CY
 0.0001975       10580.     53572144.    10.7657416     0.0021262     -0.004984
4.2095134     3.9999112    -60.000000 CY
 0.0002025       10621.     52451835.    10.7214577     0.0021711     -0.005119
4.2320414     3.9978994    -60.000000 CY
 0.0002075       10662.     51380767.    10.6804840     0.0022162     -0.005254
4.2531094     3.9999565    -60.000000 CY
 0.0002125       10700.     50354217.    10.6428325     0.0022616     -0.005388
4.2727791     3.9976809    -60.000000 CY
 0.0002175       10738.     49369916.    10.6071496     0.0023071     -0.005523
4.2909886     3.9998906    -60.000000 CY
 0.0002225       10774.     48423344.    10.5729015     0.0023525     -0.005658
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4.3077632    3.9966669   -60.000000 CY
 0.0002275        10810.     47514750.    10.5412070     0.0023981     -0.005792
4.3232580    3.9995277   -60.000000 CY
 0.0002325        10844.     46641422.    10.5119780     0.0024440     -0.005926
4.3375159    3.9957003   -60.000000 CY
 0.0002375        10878.     45800988.    10.4850996     0.0024902     -0.006060
4.3505753    3.9984351   -60.000000 CY
 0.0002425        10911.     44992594.    10.4601699     0.0025366     -0.006193
4.3624552    3.9999779   -60.000000 CY
 0.0002475        10943.     44212753.    10.4374492     0.0025833     -0.006327
4.3732155    3.9959052   -60.000000 CY
 0.0002525        10974.     43461317.    10.4164441     0.0026302     -0.006460
4.3828695    3.9990696   -60.000000 CY
 0.0002725        11069.     40618444.    10.3316718     0.0028154     -0.006995
4.4106831    3.9999909   -60.000000 CY
 0.0002925        11101.     37952038.    10.2290421     0.0029920     -0.007538
4.4238225    3.9999768   -60.000000 CY
 0.0003125        11114.     35564251.    10.1313510     0.0031660     -0.008084
4.4261774    3.9997805   -60.000000 CY
 0.0003325        11123.     33452999.    10.0517892     0.0033422     -0.008628
4.4263864    3.9981741   -60.000000 CY
 0.0003525        11129.     31572781.     9.9867073     0.0035203     -0.009170
4.4264562    3.9929648   -60.000000 CY
 0.0003725        11133.     29887786.     9.9331739     0.0037001     -0.009710
4.4263274    3.9989070   -60.000000 CY
 0.0003925        11133.     28364841.     9.9259625     0.0038959     -0.010234
4.4260448    3.9982742   -60.000000 CY
 0.0004125        11133.     26989576.     9.9539082     0.0041060     -0.010744
4.4256210    3.9924345   -60.000000 CY
 0.0004325        11133.     25741503.    10.1056096     0.0043707     -0.011199
4.4264150    3.9919452   -60.000000 CY
 0.0004525        11133.     24603757.    10.1870080     0.0046096     -0.011680
4.4264692    3.9888698   -60.000000 CY
 0.0004725        11133.     23562328.    10.4071130     0.0049174     -0.012093
4.4258203    3.9849350   -60.000000 CY
 0.0004925        11133.     22605483.    10.5119240     0.0051771     -0.012553
4.4256778    3.9966134   -60.000000 CY
 0.0005125        11133.     21723317.    10.6262592     0.0054460     -0.013004
4.4256440    3.9983712   -60.000000 CY
 0.0005325        11133.     20907418.    10.7351440     0.0057165     -0.013454
4.4258745    3.9888348   -60.000000 CY
 0.0005525        11133.     20150589.    10.8531173     0.0059963     -0.013894
4.4261430    3.9897708   60.0000000 CY
 0.0005725        11133.     19446638.    11.1465385     0.0063814     -0.014229
4.4252878    3.9799431   60.0000000 CY
 0.0005925        11133.     18790211.    11.3016027     0.0066962     -0.014634
4.4247491    3.9966519   60.0000000 CY
 0.0006125        11133.     18176653.    11.4662427     0.0070231     -0.015027
4.4250099    3.9977288   60.0000000 CY
 0.0006325        11133.     17601897.    11.6491742     0.0073681     -0.015402
4.4252530    3.9894618   60.0000000 CY
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0.0006525	11133.	17062376.	11.8207340	0.0077130	-0.015777
4.4257970	3.9775178	60.0000000 CY			
0.0006725	11133.	16554944.	11.9647185	0.0080463	-0.016164
4.4264265	3.9997937	60.0000000 CY			
0.0006925	11133.	16076823.	11.9435823	0.0082709	-0.016659
4.4251259	3.9913750	60.0000000 CY			
0.0007125	11133.	15625544.	12.0767460	0.0086047	-0.017045
4.4263839	3.9930123	60.0000000 CY			
0.0007325	11133.	15198908.	12.0596107	0.0088337	-0.017536
4.4250160	3.9981418	60.0000000 CY			

Axial Thrust Force = 455.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conf Stress ksi	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
6.25000E-07	212.2504591	339600734.	189.6256746	0.0001185	0.00009602	0.4240550	0.4864089	3.3097279	
0.00000125	424.6889763	339751181.	103.8312994	0.0001298	0.00008479	0.4635349	0.5306316	3.5094096	
0.00000188	637.1156455	339795011.	75.2412985	0.0001411	0.00007358	0.5029534	0.5746341	3.7095331	
0.00000250	849.5244416	339809777.	60.9523914	0.0001524	0.00006238	0.5423039	0.6184150	3.9100984	
0.00000313	1062.	339810987.	52.3839219	0.0001637	0.00005120	0.5815802	0.6619735	4.1111054	
0.00000375	1274.	339803812.	46.6756713	0.0001750	0.00004003	0.6207759	0.7053082	4.3125543	
0.00000438	1487.	339790462.	42.6018317	0.0001864	0.00002888	0.6598849	0.7484180	4.5144449	
0.00000500	1699.	339772045.	39.5494990	0.0001977	0.00001775	0.6989015	0.7913018	4.7167774	
0.00000563	1911.	339749171.	37.1781710	0.0002091	0.00000663	0.7378198	0.8339584	4.9195517	
0.00000625	2123.	339722059.	35.2835444	0.0002205	-0.00000448	0.7766343	0.8763866	5.1227674	
0.00000688	2335.	339683017.	33.7354966	0.0002319	-0.00001557	0.8153367	0.9185824	5.3264022	
0.00000750	2547.	339614330.	32.4470851	0.0002434	-0.00002665	0.8539142	0.9605364	5.5303910	
0.00000813	2758.	339504751.	31.3581098	0.0002548	-0.00003772	0.8923539	1.0022392	5.7346671	
0.00000875	2969.	339350038.	30.4256131	0.0002662	-0.00004878	0.9306445	1.0436830	5.9391742	
0.00001000	3389.	338928088.	28.9125560	0.0002891	-0.00007087				

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1.0067554     1.1257860     6.3488412
0.00001125         3807.    338437836.    27.7394502     0.0003121   -0.00009293
1.0822496     1.2068810     6.7597207
0.00001250         4223.    337877712.    26.8040468     0.0003351     -0.000115
1.1570821     1.2869501     7.1717170
0.00001375         4223.    307161556.    24.7854125     0.0003408     -0.000154
1.1751241     1.3062100     7.0839583 C
0.00001500         4223.    281564760.    23.9040065     0.0003586     -0.000181
1.2320757     1.3668966     7.3445426 C
0.00001625         4223.    259905932.    23.1311073     0.0003759     -0.000209
1.2871153     1.4253941     7.5923593 C
0.00001750         4223.    241341223.    22.4474488     0.0003928     -0.000237
1.3404914     1.4819877     7.8294302 C
0.00001875         4312.    229968320.    21.8369157     0.0004094     -0.000266
1.3923288     1.5368274     8.0566979 C
0.00002000         4437.    221826153.    21.2874961     0.0004257     -0.000294
1.4427544     1.5900625     8.2751478 C
0.00002125         4555.    214345188.    20.7906279     0.0004418     -0.000323
1.4919326     1.6418797     8.4861495 C
0.00002250         4668.    207458825.    20.3388657     0.0004576     -0.000352
1.5399696     1.6924017     8.6905599 C
0.00002375         4776.    201075987.    19.9244940     0.0004732     -0.000382
1.5868361     1.7416074     8.8879703 C
0.00002500         4879.    195171280.    19.5440045     0.0004886     -0.000411
1.6327052     1.7896875     9.0799033 C
0.00002625         4979.    189694376.    19.1931514     0.0005038     -0.000441
1.6776350     1.8367098     9.2668116 C
0.00002750         5077.    184603345.    18.8685233     0.0005189     -0.000471
1.7216871     1.8827454     9.4491974 C
0.00003000         5262.    175408518.    18.2849681     0.0005485     -0.000531
1.8072084     1.9719312     9.8005223 C
0.00003250         5439.    167365571.    17.7766400     0.0005777     -0.000592
1.8897652     2.0578006    -10.559167 C
0.00003500         5609.    160253362.    17.3278582     0.0006065     -0.000654
1.9694594     2.1404899    -11.826924 C
0.00003750         5773.    153936342.    16.9296363     0.0006349     -0.000715
2.0466515     2.2203964    -13.104770 C
0.00004000         5931.    148286112.    16.5734837     0.0006629     -0.000777
2.1214931     2.2976950    -14.391559 C
0.00004250         6086.    143203181.    16.2530271     0.0006908     -0.000839
2.1941437     2.3725642    -15.685994 C
0.00004500         6237.    138608867.    15.9634357     0.0007184     -0.000902
2.2647701     2.4451857    -16.986616 C
0.00004750         6385.    134430295.    15.6998812     0.0007457     -0.000964
2.3334090     2.5156040    -18.293364 C
0.00005000         6530.    130608325.    15.4583145     0.0007729     -0.001027
2.4000756     2.5838395    -19.606444 C
0.00005250         6674.    127114676.    15.2381544     0.0008000     -0.001090
2.4651302     2.6502626    -20.921960 C
0.00005750         6953.    120922092.    14.8476891     0.0008537     -0.001216
2.5900435     2.7773011    -23.565628 C
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0.00006250        7226.    115611891.    14.5141153     0.0009071     -0.001343
2.7087275     2.8972852    -26.219416 C
0.00006750        7493.    111004544.    14.2265733     0.0009603     -0.001470
2.8216027     3.0105923    -28.879833 C
0.00007250        7754.    106953364.    13.9743889     0.0010131     -0.001597
2.9286472     3.1171366    -31.549298 C
0.00007750        8011.    103373289.    13.7544588     0.0010660     -0.001724
3.0305995     3.2175715    -34.219404 C
0.00008250        8265.    100179283.    13.5610197     0.0011188     -0.001851
3.1275846     3.3119194    -36.889910 C
0.00008750        8514.     97304630.    13.3889621     0.0011715     -0.001978
3.2196348     3.4001033    -39.562259 C
0.00009250        8760.     94704594.    13.2366101     0.0012244     -0.002106
3.3071622     3.4823982    -42.231645 C
0.00009750        9003.     92339169.    13.1014445     0.0012774     -0.002233
3.3903478     3.5588391    -44.896616 C
 0.0001025        9242.     90167717.    12.9790954     0.0013304     -0.002360
3.4690095     3.6291266    -47.562689 C
 0.0001075        9479.     88173016.    12.8709861     0.0013836     -0.002486
3.5437770     3.6936795    -50.219851 C
 0.0001125        9712.     86330375.    12.7751047     0.0014372     -0.002613
3.6147042     3.7523758    -52.868472 C
 0.0001175        9942.     84612373.    12.6868456     0.0014907     -0.002739
3.6814318     3.8047760    -55.518923 C
 0.0001225       10169.     83011369.    12.6085617     0.0015445     -0.002865
3.7445902     3.8512316    -58.159536 C
 0.0001275       10390.     81492507.    12.5381723     0.0015986     -0.002991
3.8041323     3.8915410    -60.000000 CY
 0.0001325       10566.     79742773.    12.4595613     0.0016509     -0.003119
3.8581141     3.9244527    -60.000000 CY
 0.0001375       10694.     77777148.    12.3702842     0.0017009     -0.003249
3.9065927     3.9503714    -60.000000 CY
 0.0001425       10816.     75904005.    12.2862366     0.0017508     -0.003379
3.9519937     3.9708112    -60.000000 CY
 0.0001475       10936.     74143752.    12.2100040     0.0018010     -0.003509
3.9948455     3.9859367    -60.000000 CY
 0.0001525       11054.     72484902.    12.1408801     0.0018515     -0.003639
4.0352183     3.9956454    -60.000000 CY
 0.0001575       11169.     70917384.    12.0782521     0.0019023     -0.003768
4.0731818     3.9998300    -60.000000 CY
 0.0001625       11279.     69409136.    12.0183399     0.0019530     -0.003897
4.1084450     3.9995023    -60.000000 CY
 0.0001675       11366.     67855039.    11.9541994     0.0020023     -0.004028
4.1404315     3.9986469    -60.000000 CY
 0.0001725       11421.     66206647.    11.8820530     0.0020497     -0.004160
4.1689995     3.9974500    -60.000000 CY
 0.0001775       11465.     64590035.    11.8115297     0.0020965     -0.004293
4.1953747     3.9997989    -60.000000 CY
 0.0001825       11507.     63053575.    11.7465519     0.0021437     -0.004426
4.2200703     3.9983616    -60.000000 CY
 0.0001875       11548.     61590588.    11.6856852     0.0021911     -0.004559
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4.2430405     3.9996723    -60.000000 CY
 0.0001925        11587.     60190886.    11.6270106     0.0022382     -0.004692
4.2642130     3.9990400    -60.000000 CY
 0.0001975        11624.     58856543.    11.5726246     0.0022856     -0.004824
4.2838624     3.9974064    -60.000000 CY
 0.0002025        11660.     57581578.    11.5224223     0.0023333     -0.004957
4.3020499     3.9991907    -60.000000 CY
 0.0002075        11695.     56363108.    11.4758679     0.0023812     -0.005089
4.3187993     3.9970461    -60.000000 CY
 0.0002125        11729.     55196252.    11.4328803     0.0024295     -0.005221
4.3341672     3.9989519    -60.000000 CY
 0.0002175        11762.     54079026.    11.3929325     0.0024780     -0.005352
4.3481775     3.9986073    -60.000000 CY
 0.0002225        11794.     53006552.    11.3561301     0.0025267     -0.005483
4.3608935     3.9981667    -60.000000 CY
 0.0002275        11825.     51976653.    11.3205666     0.0025754     -0.005615
4.3722679     3.9999450    -60.000000 CY
 0.0002325        11854.     50985298.    11.2867334     0.0026242     -0.005746
4.3823961     3.9963146    -60.000000 CY
 0.0002375        11883.     50032693.    11.2552490     0.0026731     -0.005877
4.3913643     3.9992747    -60.000000 CY
 0.0002425        11911.     49116418.    11.2259878     0.0027223     -0.006008
4.3992152     3.9979053    -60.000000 CY
 0.0002475        11938.     48233326.    11.1990531     0.0027718     -0.006138
4.4059968     3.9971832    -60.000000 CY
 0.0002525        11964.     47383074.    11.1739179     0.0028214     -0.006269
4.4117346     3.9995810    -60.000000 CY
 0.0002725        12063.     44269085.    11.0908797     0.0030223     -0.006788
4.4250661     3.9975408    -60.000000 CY
 0.0002925        12141.     41507513.    11.0219953     0.0032239     -0.007306
4.4264718     3.9932866    -60.000000 CY
 0.0003125        12170.     38944706.    10.9374112     0.0034179     -0.007832
4.4261904     3.9959493    -60.000000 CY
 0.0003325        12173.     36610267.    10.8487641     0.0036072     -0.008363
4.4264710     3.9997568    -60.000000 CY
 0.0003525        12173.     34533089.    10.7742121     0.0037979     -0.008892
4.4262946     3.9965606    -60.000000 CY
 0.0003725        12173.     32678963.    10.8175766     0.0040295     -0.009380
4.4261850     3.9945895    -60.000000 CY
 0.0003925        12173.     31013793.    10.9545621     0.0042997     -0.009830
4.4263084     3.9960393    -60.000000 CY
 0.0004125        12173.     29510094.    11.0137403     0.0045432     -0.010307
4.4257983     3.9908222    -60.000000 CY
 0.0004325        12173.     28145466.    11.2141139     0.0048501     -0.010720
4.4264649     3.9941207    -60.000000 CY
 0.0004525        12173.     26901467.    11.3038225     0.0051150     -0.011175
4.4264472     3.9862130    -60.000000 CY
 0.0004725        12173.     25762781.    11.5448793     0.0054550     -0.011555
4.4254960     3.9912017    60.0000000 CY
 0.0004925        12173.     24716576.    11.6586139     0.0057419     -0.011988
4.4256242     3.9863158    60.0000000 CY
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    0.0005125        12173.     23752027.    11.9700855     0.0061347     -0.012315
   4.4263803     3.9914218    60.0000000 CY
    0.0005325        12173.     22859932.    12.1290069     0.0064587     -0.012711
   4.4262506     3.9826513    60.0000000 CY
    0.0005525        12173.     22032423.    12.4949882     0.0069035     -0.012987
   4.4262003     3.9966313    60.0000000 CY
    0.0005725        12173.     21262732.    12.6568101     0.0072460     -0.013364
   4.4261452     3.9883272    60.0000000 CY
    0.0005925        12173.     20545002.    12.7946233     0.0075808     -0.013749
   4.4256511     3.9868027    60.0000000 CY
    0.0006125        12173.     19874145.    12.9052189     0.0079044     -0.014146
   4.4250282     3.9976650    60.0000000 CY
    0.0006325        12173.     19245714.    12.8748479     0.0081433     -0.014627
   4.4261322     3.9999754    60.0000000 CY
    0.0006525        12173.     18655807.    12.9808492     0.0084700     -0.015020
   4.4243534     3.9861692    60.0000000 CY
    0.0006725        12173.     18100987.    13.0850571     0.0087997     -0.015410
   4.4261699     3.9957423    60.0000000 CY


--------------------------------------------------------------------------------
   Summary of Results for Nominal Moment Capacity for Section 1
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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               336.000             11101.562           0.00300000
-0.00756311
   2               455.000             12052.340           0.00300000
-0.00673019

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	336.000000	11102.	218.400000	7216.	90456931.
2	0.65	455.000000	12052.	295.750000	7834.	105841650.
1	0.75	336.000000	11102.	252.000000	8326.	81488467.
2	0.75	455.000000	12052.	341.250000	9039.	92010564.
1	0.90	336.000000	11102.	302.400000	9991.	67231963.
2	0.90	455.000000	12052.	409.500000	10847.	75451977.

Pile Section No. 2:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	13.000000 ft
Shaft Diameter	=	30.000000 in
Concrete Cover Thickness (to edge of trans. reinf.)	=	3.000000 in
Number of Reinforcing Bars	=	10 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	706.858347 sq. in.
Total Area of Reinforcing Steel	=	10.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.41 percent
Edge-to-Edge Bar Spacing	=	5.630820 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	7.51
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Transverse Reinforcement
Type: Hoop

Number of Transverse Reinf. (per spacing)	=	1
Spacing of Transverse Reinf.	=	12.000000 in
Yield Stress of Transverse Reinf.	=	60000. psi
Diameter of Transverse Reinf.	=	0.500000 in

Confined Section

Total Area of Confinement Steel = 0.200000 sq. in.
rho_s = 0.002721
ke = 0.781891
f'cc = 4426. psi
f'l = 63.827875 psi
Epsilon cc = 0.003066
Epsilon cu = 0.008647
r = 1.667935

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 2969.318 kips
Tensile Load for Cracking of Concrete = -323.287 kips
Nominal Axial Tensile Capacity = -600.000 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	10.936000	0.00000
2	1.128000	1.000000	8.847410	6.428020
3	1.128000	1.000000	3.379410	10.400754
4	1.128000	1.000000	-3.37941	10.400754
5	1.128000	1.000000	-8.84741	6.428020
6	1.128000	1.000000	-10.93600	0.00000
7	1.128000	1.000000	-8.84741	-6.42802
8	1.128000	1.000000	-3.37941	-10.40075
9	1.128000	1.000000	3.379410	-10.40075
10	1.128000	1.000000	8.847410	-6.42802

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

Minimum spacing between any two bars not equal to zero = 5.631 inches
between bars 1 and 2.

Ratio of bar spacing to maximum aggregate size = 7.51

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 = 2

Number	Axial Thrust Force kips
1	336.000
2	455.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318-14, Section 21.2.3.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 336.000 kips

Bending Max Conf Curvature Stress rad/in. ksi	Bending Max Conc Moment Stress in-kip ksi	Bending Max Steel Stiffness Stress kip-in2 ksi	Run Msg	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in
0.00000125	210.8810634	168704851.		105.8970432	0.0001324	0.00009487
0.4727854	0.5409713	3.6919553				
0.00000250	421.7486794	168699472.		60.4700044	0.0001512	0.00007618
0.5383329	0.6140033	4.0904503				
0.00000375	632.5765833	168687089.		45.3371979	0.0001700	0.00005751
0.6036538	0.6863942	4.4899828				
0.00000500	843.3448228	168668965.		37.7779451	0.0001889	0.00003889
0.6687200	0.7581394	4.8905520				
0.00000625	1054.	168645330.		33.2481084	0.0002078	0.00002030
0.7335045	0.8292343	5.2921572				
0.00000750	1265.	168616233.		30.2329736	0.0002267	0.00000175
0.7979815	0.8996741	5.6947968				
0.00000875	1475.	168577137.		28.0832658	0.0002457	-0.00001677

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0.8621231     0.9694506     6.0984412
0.00001000         1685.    168504286.    26.4738051     0.0002647   -0.00003526
0.9258842     1.0385358     6.5029032
0.00001125         1895.    168444373.    25.2257644     0.0002838   -0.00005371
0.9892901     1.1069772     6.9085931
0.00001250         2105.    168401946.    24.2312805     0.0003029   -0.00007211
1.0523423     1.1747943     7.3157141
0.00001375         2315.    168349895.    23.4207090     0.0003220   -0.00009047
1.1149967     1.2419572     7.7240702
0.00001500         2524.    168271394.    22.7475376     0.0003412     -0.000109
1.1772069     1.3084323     8.1334289
0.00001625         2524.    155327441.    21.3149364     0.0003464     -0.000141
1.1933842     1.3256854     8.1361013 C
0.00001750         2524.    144232624.    20.6683514     0.0003617     -0.000163
1.2424505     1.3779344     8.4338130 C
0.00002000         2560.    127993421.    19.5746934     0.0003915     -0.000209
1.3367203     1.4779936     9.0043222 C
0.00002250         2721.    120947265.    18.6815011     0.0004203     -0.000255
1.4265273     1.5729429     9.5470545 C
0.00002500         2870.    114804618.    17.9357278     0.0004484     -0.000302
1.5125183     1.6635414    10.0671527 C
0.00002750         3009.    109435365.    17.3024327     0.0004758     -0.000349
1.5952141     1.7503950    10.5688152 C
0.00003000         3141.    104710959.    16.7564476     0.0005027     -0.000397
1.6749447     1.8338962    11.0546095 C
0.00003250         3267.    100537827.    16.2809255     0.0005291     -0.000446
1.7520829     1.9144713    11.5276474 C
0.00003500         3389.     96823530.    15.8620719     0.0005552     -0.000495
1.8268062     1.9923350    11.9892530 C
0.00003750         3506.     93506411.    15.4908483     0.0005809     -0.000544
1.8994011     2.0678092    12.4419223 C
0.00004000         3621.     90523435.    15.1589612     0.0006064     -0.000594
1.9699712     2.1410202    12.8863951 C
0.00004250         3733.     87825818.    14.8601376     0.0006316     -0.000643
2.0386254     2.2120966    -13.668255 C
0.00004500         3842.     85375053.    14.5895702     0.0006565     -0.000693
2.1054780     2.2811687    -14.825361 C
0.00004750         3949.     83140162.    14.3435380     0.0006813     -0.000744
2.1706483     2.3483696    -15.987901 C
0.00005000         4055.     81095773.    14.1191419     0.0007060     -0.000794
2.2342604     2.4138342    -17.154744 C
0.00005250         4159.     79220754.    13.9141166     0.0007305     -0.000845
2.2964435     2.4777003    -18.324632 C
0.00005500         4262.     77487225.    13.7247896     0.0007549     -0.000895
2.3570694     2.5398397    -19.499210 C
0.00006000         4464.     74399833.    13.3893460     0.0008034     -0.000997
2.4743151     2.6596271    -21.855538 C
0.00006500         4662.     71724711.    13.1004284     0.0008515     -0.001098
2.5863084     2.7735130    -24.221442 C
0.00007000         4857.     69383031.    12.8493451     0.0008995     -0.001201
2.6933693     2.8818036    -26.594329 C
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0.00007500        5049.     67315925.    12.6298838     0.0009472     -0.001303
2.7958231     2.9847928    -28.971253 C
0.00008000        5238.     65478165.    12.4375584     0.0009950     -0.001405
2.8939976     3.0827591    -31.348864 C
0.00008500        5425.     63823781.    12.2656635     0.0010426     -0.001507
2.9876451     3.1753964    -33.731889 C
0.00009000        5610.     62333689.    12.1140995     0.0010903     -0.001610
3.0774438     3.2633052    -36.111700 C
0.00009500        5793.     60975870.    11.9776007     0.0011379     -0.001712
3.1630972     3.3461154    -38.493961 C
0.00010000        5974.     59738922.    11.8568930     0.0011857     -0.001814
3.2452226     3.4243345    -40.870010 C
 0.0001050        6153.     58597713.    11.7465885     0.0012334     -0.001917
3.3233268     3.4974001    -43.249388 C
 0.0001150        6506.     56572534.    11.5602817     0.0013294     -0.002121
3.4694135     3.6294818    -47.989710 C
 0.0001250        6852.     54812640.    11.4066370     0.0014258     -0.002324
3.6017314     3.7418514    -52.719692 C
 0.0001350        7191.     53265652.    11.2828429     0.0015232     -0.002527
3.7217084     3.8347987    -57.421920 C
 0.0001450        7509.     51783350.    11.1740683     0.0016202     -0.002730
3.8285358     3.9068943    -60.000000 CY
 0.0001550        7705.     49710572.    11.0319659     0.0017100     -0.002940
3.9166075     3.9552260    -60.000000 CY
 0.0001650        7877.     47737920.    10.9016231     0.0017988     -0.003151
3.9945023     3.9858340    -60.000000 CY
 0.0001750        8043.     45961021.    10.7884533     0.0018880     -0.003362
4.0641157     3.9993229    -60.000000 CY
 0.0001850        8204.     44345649.    10.6923324     0.0019781     -0.003572
4.1262882     3.9975230    -60.000000 CY
 0.0001950        8323.     42683593.    10.5894114     0.0020649     -0.003785
4.1790144     3.9992350    -60.000000 CY
 0.0002050        8385.     40904409.    10.4694340     0.0021462     -0.004004
4.2224193     3.9996832    -60.000000 CY
 0.0002150        8439.     39253094.    10.3611008     0.0022276     -0.004222
4.2605953     3.9997986    -60.000000 CY
 0.0002250        8490.     37732338.    10.2610893     0.0023087     -0.004441
4.2937537     3.9997022    -60.000000 CY
 0.0002350        8538.     36332006.    10.1719354     0.0023904     -0.004660
4.3225875     3.9993188    -60.000000 CY
 0.0002450        8585.     35038894.    10.0926344     0.0024727     -0.004877
4.3473726     3.9983487    -60.000000 CY
 0.0002550        8629.     33839539.    10.0201904     0.0025551     -0.005095
4.3682329     3.9962348    -60.000000 CY
 0.0002650        8672.     32723516.     9.9529858     0.0026375     -0.005312
4.3854133     3.9999822    -60.000000 CY
 0.0002750        8713.     31683961.     9.8926898     0.0027205     -0.005530
4.3993038     3.9988466    -60.000000 CY
 0.0002850        8754.     30714106.     9.8381576     0.0028039     -0.005746
4.4100982     3.9951553    -60.000000 CY
 0.0002950        8793.     29806965.     9.7887769     0.0028877     -0.005962
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4.4180064    3.9997001   -60.000000 CY
 0.0003050         8832.     28956342.     9.7435816     0.0029718     -0.006178
4.4232217    3.9961883   -60.000000 CY
 0.0003150         8869.     28156118.     9.7000274     0.0030555     -0.006394
4.4259331    3.9998378   -60.000000 CY
 0.0003250         8906.     27403042.     9.6603376     0.0031396     -0.006610
4.4263769    3.9955505   -60.000000 CY
 0.0003350         8942.     26693364.     9.6239602     0.0032240     -0.006826
4.4264640    3.9995944   -60.000000 CY
 0.0003450         8978.     26023182.     9.5906805     0.0033088     -0.007041
4.4264306    3.9931188   -60.000000 CY
 0.0003550         9012.     25384817.     9.5587316     0.0033933     -0.007257
4.4261397    3.9984467   -60.000000 CY
 0.0003650         9041.     24770844.     9.5262685     0.0034771     -0.007473
4.4263528    3.9990384   -60.000000 CY
 0.0003750         9064.     24170450.     9.4903776     0.0035589     -0.007691
4.4264429    3.9943121   -60.000000 CY
 0.0003850         9083.     23591696.     9.4544303     0.0036400     -0.007910
4.4260218    3.9984969    60.0000000 CY
 0.0003950         9092.     23018945.     9.4116759     0.0037176     -0.008132
4.4264718    3.9999671    60.0000000 CY
 0.0004050         9100.     22468664.     9.3691739     0.0037945     -0.008355
4.4259163    3.9921636    60.0000000 CY
 0.0004150         9100.     21927251.     9.3553664     0.0038825     -0.008568
4.4264641    3.9962124    60.0000000 CY
 0.0004250         9100.     21411315.     9.3181221     0.0039602     -0.008790
4.4258490    3.9990004    60.0000000 CY
 0.0004350         9100.     20919101.     9.3352060     0.0040608     -0.008989
4.4264324    3.9933239    60.0000000 CY
 0.0004450         9100.     20449009.     9.3726628     0.0041708     -0.009179
4.4263279    3.9969967    60.0000000 CY
 0.0004550         9100.     19999580.     9.4283091     0.0042899     -0.009360
4.4258531    3.9953411    60.0000000 CY
 0.0004650         9100.     19569482.     9.3987266     0.0043704     -0.009580
4.4264018    3.9895064    60.0000000 CY
 0.0004750         9100.     19157493.     9.4726224     0.0044995     -0.009751
4.4258347    3.9994040    60.0000000 CY
 0.0004850         9100.     18762493.     9.5518608     0.0046327     -0.009917
4.4262394    3.9907172    60.0000000 CY
 0.0004950         9100.     18383452.     9.6417849     0.0047727     -0.010077
4.4264716    3.9999020    60.0000000 CY
 0.0005050         9100.     18019424.     9.6186980     0.0048574     -0.010293
4.4261007    3.9946947    60.0000000 CY
 0.0005450         9100.     16696897.     9.9033283     0.0053973     -0.010953
4.4262215    3.9999801    60.0000000 CY
 0.0005850         9100.     15555229.    10.0220102     0.0058629     -0.011687
4.4255779    3.9912668    60.0000000 CY
 0.0006250         9100.     14559694.    10.0291469     0.0062682     -0.012482
4.4254564    3.9993359    60.0000000 CY
 0.0006650         9100.     13683923.    10.1041609     0.0067193     -0.013231
4.4262457    3.9966295    60.0000000 CY
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0.0007050	9100.	12907530.	10.1085686	0.0071265	-0.014023
4.4258149	3.9816526	60.0000000 CY			
0.0007450	9100.	12214509.	10.1151657	0.0075358	-0.014814
4.4245982	3.9972206	60.0000000 CY			
0.0007850	9100.	11592113.	10.1238369	0.0079472	-0.015603
4.4260340	3.9825395	60.0000000 CY			
0.0008250	9100.	11030071.	10.0814271	0.0083172	-0.016433
4.4256757	3.9816257	60.0000000 CY			
0.0008650	9100.	10520010.	10.0950672	0.0087322	-0.017218
4.4253236	3.9989344	60.0000000 CY			

Axial Thrust Force = 455.000 kips

Bending Max Conf Curvature Stress rad/in. ksi	Bending Max Conc Moment Stress in-kip ksi	Bending Max Steel Stiffness Stress kip-in2 ksi	Run Msg	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in
0.00000125	207.3695689	165895655.		138.8576366	0.0001736	0.0001361
0.6173784	0.7015572	4.8867768				
0.00000250	414.7285956	165891438.		76.9515755	0.0001924	0.0001174
0.6821245	0.7728768	5.2853642				
0.00000375	622.0491084	165879762.		56.3263299	0.0002112	0.00009872
0.7465944	0.8435597	5.6850509				
0.00000500	829.3118188	165862364.		46.0212858	0.0002301	0.00008011
0.8107627	0.9136012	6.0858365				
0.00000625	1036.	165839583.		39.8443198	0.0002490	0.00006153
0.8746053	0.9829963	6.4877205				
0.00000750	1244.	165811524.		35.7313899	0.0002680	0.00004299
0.9380989	1.0517402	6.8907023				
0.00000875	1451.	165778221.		32.7979059	0.0002870	0.00002448
1.0012212	1.1198280	7.2947811				
0.00001000	1657.	165739678.		30.6015721	0.0003060	0.00000602
1.0639508	1.1872548	7.6999559				
0.00001125	1864.	165695015.		28.8966465	0.0003251	-0.00001241
1.1262664	1.2540148	8.1062184				
0.00001250	2070.	165631627.		27.5353768	0.0003442	-0.00003081
1.1881352	1.3200888	8.5134491				
0.00001375	2276.	165538364.		26.4236464	0.0003633	-0.00004917
1.2495215	1.3854542	8.9214916				
0.00001500	2482.	165444157.		25.4998263	0.0003825	-0.00006750
1.3104446	1.4501457	9.3306745				
0.00001625	2687.	165350533.		24.7207396	0.0004017	-0.00008579
1.3708969	1.5141685	9.7410857				
0.00001750	2892.	165248295.		24.0552045	0.0004210	-0.000104
1.4308528	1.5775075	10.1526411				
0.00002000	2892.	144592258.		22.3279757	0.0004466	-0.000153

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1.5091778     1.6600274    10.6012260 C
0.00002250         3086.     137148035.    21.2559479     0.0004783     -0.000197
1.6048853     1.7605358    11.2268811 C
0.00002500         3272.     130880090.    20.3610974     0.0005090     -0.000241
1.6960376     1.8559490    11.8255457 C
0.00002750         3443.     125188670.    19.6005806     0.0005390     -0.000286
1.7831973     1.9469156    12.4015873 C
0.00003000         3601.     120032877.    18.9441732     0.0005683     -0.000332
1.8667571     2.0338911    12.9579305 C
0.00003250         3750.     115375135.    18.3714866     0.0005971     -0.000378
1.9471405     2.1173520    13.4980012 C
0.00003500         3891.     111160936.    17.8668962     0.0006253     -0.000425
2.0246466     2.1976363    14.0241497 C
0.00003750         4025.     107325351.    17.4173607     0.0006532     -0.000472
2.0994001     2.2748947    14.5370048 C
0.00004000         4154.     103841738.    17.0154508     0.0006806     -0.000519
2.1717724     2.3495275    15.0399230 C
0.00004250         4278.     100663152.    16.6534934     0.0007078     -0.000567
2.2418928     2.4216801    15.5338057 C
0.00004500         4399.      97745017.    16.3248095     0.0007346     -0.000615
2.3098049     2.4914062    16.0186265 C
0.00004750         4516.      95065160.    16.0256418     0.0007612     -0.000664
2.3757329     2.5589428    16.4964467 C
0.00005000         4630.      92596630.    15.7521925     0.0007876     -0.000712
2.4397916     2.6244108    16.9681793 C
0.00005250         4741.      90309424.    15.5004304     0.0008138     -0.000761
2.5019702     2.6878014    17.4332798 C
0.00005500         4850.      88189859.    15.2684801     0.0008398     -0.000810
2.5624462     2.7492958    17.8934759 C
0.00006000         5064.      84392923.    14.8566112     0.0008914     -0.000909
2.6787469     2.8670507   -19.302496 C
0.00006500         5270.      81072457.    14.4997125     0.0009425     -0.001008
2.7888594     2.9778154   -21.583793 C
0.00007000         5471.      78150687.    14.1888204     0.0009932     -0.001107
2.8934105     3.0821757   -23.875194 C
0.00007500         5667.      75558698.    13.9159751     0.0010437     -0.001206
2.9927579     3.1804276   -26.174004 C
0.00008000         5859.      73240078.    13.6745628     0.0010940     -0.001306
3.0871375     3.2727322   -28.479014 C
0.00008500         6048.      71149621.    13.4591308     0.0011440     -0.001406
3.1767175     3.3591746   -30.789992 C
0.00009000         6233.      69259268.    13.2673236     0.0011941     -0.001506
3.2619544     3.4401050   -33.101785 C
0.00009500         6416.      67537754.    13.0954221     0.0012441     -0.001606
3.3429657     3.5155345   -35.414362 C
0.00010000         6596.      65959008.    12.9399337     0.0012940     -0.001706
3.4197947     3.5854029   -37.729192 C
 0.0001050         6773.      64509069.    12.8003646     0.0013440     -0.001806
3.4928576     3.6499798   -40.040640 C
 0.0001150         7121.      61921986.    12.5583668     0.0014442     -0.002006
3.6277175     3.7628292   -44.661096 C
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 0.0001250         7460.     59678113.    12.3592472     0.0015449     -0.002205
3.7488086     3.8542078    -49.266479 C
 0.0001350         7790.     57702947.    12.1947919     0.0016463     -0.002404
3.8571009     3.9238716    -53.851639 C
 0.0001450         8111.     55939841.    12.0578579     0.0017484     -0.002602
3.9533399     3.9713523    -58.416458 C
 0.0001550         8397.     54177240.    11.9331007     0.0018496     -0.002800
4.0370612     3.9959676    -60.000000 CY
 0.0001650         8573.     51955879.    11.7828671     0.0019442     -0.003006
4.1054906     3.9996996    -60.000000 CY
 0.0001750         8731.     49890778.    11.6489778     0.0020386     -0.003211
4.1652494     3.9988880    -60.000000 CY
 0.0001850         8883.     48016414.    11.5350418     0.0021340     -0.003416
4.2176651     3.9999953    -60.000000 CY
 0.0001950         9029.     46300403.    11.4348152     0.0022298     -0.003620
4.2628846     3.9984832    -60.000000 CY
 0.0002050         9153.     44648355.    11.3403519     0.0023248     -0.003825
4.3009983     3.9994182    -60.000000 CY
 0.0002150         9222.     42891322.    11.2295457     0.0024144     -0.004036
4.3313149     3.9995427    -60.000000 CY
 0.0002250         9269.     41194809.    11.1174583     0.0025014     -0.004249
4.3560061     3.9992346    -60.000000 CY
 0.0002350         9314.     39635095.    11.0175356     0.0025891     -0.004461
4.3765219     3.9984275    -60.000000 CY
 0.0002450         9358.     38195086.    10.9267818     0.0026771     -0.004673
4.3930738     3.9966658    -60.000000 CY
 0.0002550         9399.     36858931.    10.8415970     0.0027646     -0.004885
4.4058863     3.9999978    -60.000000 CY
 0.0002650         9439.     35619404.    10.7646598     0.0028526     -0.005097
4.4153994     3.9991568    -60.000000 CY
 0.0002750         9478.     34466880.    10.6947794     0.0029411     -0.005309
4.4218468     3.9960923    -60.000000 CY
 0.0002850         9517.     33391243.    10.6299887     0.0030295     -0.005520
4.4254519     3.9998646    -60.000000 CY
 0.0002950         9553.     32383428.    10.5683588     0.0031177     -0.005732
4.4264636     3.9969770    -60.000000 CY
 0.0003050         9589.     31439767.    10.5118321     0.0032061     -0.005944
4.4264707     3.9999463    -60.000000 CY
 0.0003150         9624.     30553860.    10.4600569     0.0032949     -0.006155
4.4264630     3.9964615    -60.000000 CY
 0.0003250         9659.     29720896.    10.4123726     0.0033840     -0.006366
4.4263850     3.9997951    -60.000000 CY
 0.0003350         9692.     28932203.    10.3700375     0.0034740     -0.006576
4.4261559     3.9944031    60.0000000 CY
 0.0003450         9724.     28186805.    10.3297279     0.0035638     -0.006786
4.4263144     3.9989703    60.0000000 CY
 0.0003550         9753.     27471834.    10.2956998     0.0036550     -0.006995
4.4264704     3.9964094    60.0000000 CY
 0.0003650         9779.     26793115.    10.2651837     0.0037468     -0.007203
4.4263177     3.9965085    60.0000000 CY
 0.0003750         9804.     26142917.    10.2404228     0.0038402     -0.007410
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   4.4261892     3.9997517    60.0000000 CY
    0.0003850          9804.     25463880.    10.2466173     0.0039449     -0.007605
   4.4264473     3.9931474    60.0000000 CY
    0.0003950          9804.     24819225.    10.2788484     0.0040601     -0.007790
   4.4264440     3.9996204    60.0000000 CY
    0.0004050          9804.     24206404.    10.3289103     0.0041832     -0.007967
   4.4262510     3.9941214    60.0000000 CY
    0.0004150          9804.     23623117.    10.3867335     0.0043105     -0.008140
   4.4258890     3.9999860    60.0000000 CY
    0.0004250          9804.     23067279.    10.4528887     0.0044425     -0.008308
   4.4262532     3.9962775    60.0000000 CY
    0.0004350          9804.     22536997.    10.5278821     0.0045796     -0.008470
   4.4264466     3.9943228    60.0000000 CY
    0.0004450          9804.     22030548.    10.6113560     0.0047221     -0.008628
   4.4264457     3.9986644    60.0000000 CY
    0.0004550          9804.     21546360.    10.6982712     0.0048677     -0.008782
   4.4262007     3.9909327    60.0000000 CY
    0.0004650          9804.     21082997.    10.7886370     0.0050167     -0.008933
   4.4257770     3.9999225    60.0000000 CY
    0.0004750          9804.     20639145.    10.8860536     0.0051709     -0.009079
   4.4262426     3.9953742    60.0000000 CY
    0.0004850          9804.     20213595.    10.8697653     0.0052718     -0.009278
   4.4260781     3.9987244    60.0000000 CY
    0.0004950          9804.     19805240.    10.9500690     0.0054203     -0.009430
   4.4260489     3.9877850    60.0000000 CY
    0.0005050          9804.     19413057.    11.0102709     0.0055602     -0.009590
   4.4264667     3.9983908    60.0000000 CY
    0.0005450          9804.     17988245.    11.0775046     0.0060372     -0.010313
   4.4260097     3.9996243    60.0000000 CY
    0.0005850          9804.     16758280.    11.0607751     0.0064706     -0.011079
   4.4264213     3.9950333    60.0000000 CY
    0.0006250          9804.     15685750.    11.1024407     0.0069390     -0.011811
   4.4263401     3.9879581    60.0000000 CY
    0.0006650          9804.     14742246.    11.0825918     0.0073699     -0.012580
   4.4264390     3.9999924    60.0000000 CY
    0.0007050          9804.     13905807.    11.0698462     0.0078042     -0.013346
   4.4264041     3.9864515    60.0000000 CY
    0.0007450          9804.     13159186.    11.0641332     0.0082428     -0.014107
   4.4255468     3.9998029    60.0000000 CY
    0.0007850          9804.     12488654.    11.0713145     0.0086910     -0.014859
   4.4252239     3.9771588    60.0000000 CY


-------------------------------------------------------------------------------
   Summary of Results for Nominal Moment Capacity for Section 2
-------------------------------------------------------------------------------

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.
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Tens. No.	kips	in-kip	Strain	Strain
1	336.000	8844.317	0.00300000	-0.00625108
2	455.000	9503.778	0.00300000	-0.00544982

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	336.000000	8844.	218.400000	5749.	61302188.
2	0.65	455.000000	9504.	295.750000	6177.	69828347.
1	0.75	336.000000	8844.	252.000000	6633.	55924055.
2	0.75	455.000000	9504.	341.250000	7128.	61876909.
1	0.90	336.000000	8844.	302.400000	7960.	46850349.
2	0.90	455.000000	9504.	409.500000	8553.	52200773.

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

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

Shear force at pile head = 41000.0 lbs
Applied moment at pile head = 1728000.0 in-lbs
Axial thrust load on pile head = 336000.0 lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*H	Soil Spr. Lat. Load	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	lb/inch	lb/inch	lb/inch
0.00	0.2877	1728000.	41000.	-0.00353	0.00	3.44E+11	0.00	0.00	0.00
0.2100	0.2788	1834302.	41000.	-0.00352	0.00	3.44E+11	0.00	0.00	0.00
0.4200	0.2700	1940593.	41000.	-0.00350	0.00	3.44E+11	0.00	0.00	0.00
0.6300	0.2612	2046872.	41000.	-0.00349	0.00	3.44E+11	0.00	0.00	0.00
0.8400	0.2524	2153138.	41000.	-0.00347	0.00	3.44E+11	0.00	0.00	0.00
1.0500	0.2437	2259391.	41000.	-0.00346	0.00	3.44E+11	0.00	0.00	0.00
1.2600	0.2350	2365630.	41000.	-0.00344	0.00	3.44E+11	0.00	0.00	0.00
1.4700	0.2264	2471854.	41000.	-0.00342	0.00	3.44E+11	0.00	0.00	0.00
1.6800	0.2178	2578063.	41000.	-0.00340	0.00	3.44E+11	0.00	0.00	0.00
1.8900	0.2092	2684255.	41000.	-0.00338	0.00	3.44E+11	0.00	0.00	0.00
2.1000	0.2007	2790432.	41000.	-0.00336	0.00	3.44E+11	0.00	0.00	0.00
2.3100	0.1923	2896590.	41000.	-0.00334	0.00	3.43E+11	0.00	0.00	0.00
2.5200	0.1839	3002731.	41000.	-0.00332	0.00	3.43E+11	0.00	0.00	0.00
2.7300	0.1755	3108853.	41000.	-0.00330	0.00	3.43E+11	0.00	0.00	0.00
2.9400	0.1673	3214956.	41000.	-0.00327	0.00	3.43E+11	0.00	0.00	0.00
3.1500	0.1590	3321039.	41000.	-0.00325	0.00	3.43E+11	0.00	0.00	0.00
3.3600	0.1509	3427101.	41000.	-0.00323	0.00	3.43E+11			

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0.00       0.00       0.00
    3.5700     0.1428   3533142.     41000.   -0.00319       0.00   2.06E+11
0.00       0.00       0.00
    3.7800     0.1348   3639146.     41000.   -0.00315       0.00   1.98E+11
0.00       0.00       0.00
    3.9900     0.1269   3745111.     41000.   -0.00310       0.00   1.90E+11
0.00       0.00       0.00
    4.2000     0.1192   3851034.     41000.   -0.00305       0.00   1.83E+11
0.00       0.00       0.00
    4.4100     0.1116   3956912.     41000.   -0.00299       0.00   1.76E+11
0.00       0.00       0.00
    4.6200     0.1041   4062742.     41000.   -0.00293       0.00   1.70E+11
0.00       0.00       0.00
    4.8300    0.09677   4168521.     41000.   -0.00287       0.00   1.64E+11
0.00       0.00       0.00
    5.0400    0.08961   4274246.     41000.   -0.00281       0.00   1.58E+11
0.00       0.00       0.00
    5.2500    0.08262   4379913.     41000.   -0.00274       0.00   1.53E+11
0.00       0.00       0.00
    5.4600    0.07582   4485519.     41000.   -0.00266       0.00   1.48E+11
0.00       0.00       0.00
    5.6700    0.06921   4591061.     41000.   -0.00258       0.00   1.44E+11
0.00       0.00       0.00
    5.8800    0.06280   4696534.     41000.   -0.00250       0.00   1.40E+11
0.00       0.00       0.00
    6.0900    0.05661   4801936.     41000.   -0.00241       0.00   1.36E+11
0.00       0.00       0.00
    6.3000    0.05063   4907262.     41000.   -0.00232       0.00   1.32E+11
0.00       0.00       0.00
    6.5100    0.04490   5012509.     41000.   -0.00223       0.00   1.29E+11
0.00       0.00       0.00
    6.7200    0.03941   5117673.     41000.   -0.00213       0.00   1.26E+11
0.00       0.00       0.00
    6.9300    0.03418   5222750.     41000.   -0.00202       0.00   1.23E+11
0.00       0.00       0.00
    7.1400    0.02922   5327736.     41000.   -0.00191       0.00   1.20E+11
0.00       0.00       0.00
    7.3500    0.02454   5432628.     41000.   -0.00180       0.00   1.18E+11
0.00       0.00       0.00
    7.5600    0.02016   5537421.     41000.   -0.00168       0.00   1.15E+11
0.00       0.00       0.00
    7.7700    0.01608   5642112.     41000.   -0.00156       0.00   1.13E+11
0.00       0.00       0.00
    7.9800    0.01232   5746696.     41000.   -0.00143       0.00   1.11E+11
0.00       0.00       0.00
    8.1900    0.00889   5851169.      7648.   -0.00124       0.00   6.06E+10
-26470.   7506326.       0.00
    8.4000    0.00607   5787340.    -59245.  -9.99E-04       0.00   6.10E+10
-26619.   1.11E+07       0.00
    8.6100    0.00385   5554266.   -125599.  -7.68E-04       0.00   6.28E+10
-26042.   1.70E+07       0.00
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    8.8200    0.00220   5155625.   -189427.  -5.59E-04       0.00   6.63E+10
-24615.   2.82E+07       0.00
    9.0300    0.00104   4600502.   -240659.  -3.81E-04       0.00   7.25E+10
-16045.   3.90E+07       0.00
    9.2400   2.78E-04   3943348.   -266696.  -2.41E-04       0.00   8.33E+10
-4619.   4.19E+07       0.00
    9.4500  -1.79E-04   3256761.   -268521.  -1.41E-04       0.00   1.01E+11
3170.   4.47E+07       0.00
    9.6600  -4.31E-04   2590239.   -254298.  -7.41E-05       0.00   1.27E+11
8118.   4.75E+07       0.00
    9.8700  -5.52E-04   1975224.   -230168.  -3.36E-05       0.00   1.68E+11
11033.   5.03E+07       0.00
   10.0800  -6.00E-04   1430248.   -200327.  -8.10E-06       0.00   1.69E+11
12650.   5.32E+07       0.00
   10.2900  -5.93E-04    965589.   -167784.   9.81E-06       0.00   1.69E+11
13177.   5.60E+07       0.00
   10.5000  -5.50E-04    584598.   -135002.   2.14E-05       0.00   1.69E+11
12841.   5.88E+07       0.00
   10.7100  -4.85E-04    285143.   -103866.   2.79E-05       0.00   1.69E+11
11870.   6.16E+07       0.00
   10.9200  -4.10E-04     61064.    -75705.   3.05E-05       0.00   1.69E+11
10480.   6.44E+07       0.00
   11.1300  -3.32E-04    -96465.    -51339.   3.02E-05       0.00   1.69E+11
8859.   6.73E+07       0.00
   11.3400  -2.58E-04   -197737.    -31151.   2.80E-05       0.00   1.69E+11
7164.   7.01E+07       0.00
   11.5500  -1.91E-04   -253514.    -15172.   2.46E-05       0.00   1.69E+11
5518.   7.29E+07       0.00
   11.7600  -1.33E-04   -274246.     -3168.   2.07E-05       0.00   1.69E+11
4009.   7.57E+07       0.00
   11.9700  -8.64E-05   -269515.      5278.   1.66E-05       0.00   1.69E+11
2694.   7.86E+07       0.00
   12.1800  -4.96E-05   -247674.     10689.   1.28E-05       0.00   1.69E+11
1601.   8.14E+07       0.00
   12.3900  -2.21E-05   -215663.     13635.   9.31E-06       0.00   1.69E+11
736.8934   8.42E+07       0.00
   12.6000  -2.65E-06   -178970.     14679.   6.36E-06       0.00   1.69E+11
91.6122   8.70E+07       0.00
   12.8100   1.00E-05   -141693.     14344.   3.97E-06       0.00   1.69E+11
-356.937   8.98E+07       0.00
   13.0200   1.73E-05   -106681.     13091.   2.11E-06       0.00   1.69E+11
-637.719   9.27E+07       0.00
   13.2300   2.07E-05    -75717.     11301.   7.50E-07       0.00   1.69E+11
-782.754   9.55E+07       0.00
   13.4400   2.11E-05    -49724.      9277.  -1.87E-07       0.00   1.69E+11
-824.019   9.83E+07       0.00
   13.6500   1.97E-05    -28962.      7242.  -7.75E-07       0.00   1.69E+11
-791.208   1.01E+08       0.00
   13.8600   1.72E-05    -13224.      5350.  -1.09E-06       0.00   1.69E+11
-710.271   1.04E+08       0.00
   14.0700   1.42E-05     -1997.      3695.  -1.20E-06       0.00   1.69E+11
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-602.648   1.07E+08       0.00
   14.2800   1.12E-05      5403.      2325.  -1.18E-06       0.00   1.69E+11
-485.045   1.10E+08       0.00
   14.4900   8.29E-06      9723.      1248.  -1.06E-06       0.00   1.69E+11
-369.639   1.12E+08       0.00
   14.7000   5.78E-06     11695.   449.0193  -9.05E-07       0.00   1.69E+11
-264.549   1.15E+08       0.00
   14.9100   3.72E-06     11987.   -104.161  -7.28E-07       0.00   1.69E+11
-174.483   1.18E+08       0.00
   15.1200   2.11E-06     11171.   -451.834  -5.55E-07       0.00   1.69E+11
-101.448   1.21E+08       0.00
   15.3300   9.26E-07      9711.   -636.930  -3.99E-07       0.00   1.69E+11
-45.453   1.24E+08       0.00
   15.5400   1.03E-07      7962.   -700.662  -2.67E-07       0.00   1.69E+11
-5.128   1.26E+08       0.00
   15.7500  -4.21E-07      6180.   -680.599  -1.62E-07       0.00   1.69E+11
21.0514   1.26E+08       0.00
   15.9600  -7.12E-07      4532.   -609.219  -8.16E-08       0.00   1.69E+11
35.5991   1.26E+08       0.00
   16.1700  -8.32E-07      3110.   -511.927  -2.45E-08       0.00   1.69E+11
41.6173   1.26E+08       0.00
   16.3800  -8.36E-07      1952.   -406.843   1.33E-08       0.00   1.69E+11
41.7826   1.26E+08       0.00
   16.5900  -7.65E-07      1059.   -305.971   3.58E-08       0.00   1.69E+11
38.2742   1.26E+08       0.00
   16.8000  -6.55E-07   409.7195   -216.453   4.67E-08       0.00   1.69E+11
32.7722   1.26E+08       0.00
   17.0100  -5.30E-07    -31.725   -141.771   4.96E-08       0.00   1.69E+11
26.4990   1.26E+08       0.00
   17.2200  -4.06E-07   -304.891    -82.823   4.70E-08       0.00   1.69E+11
20.2855   1.26E+08       0.00
   17.4300  -2.93E-07   -449.231    -38.809   4.14E-08       0.00   1.69E+11
14.6459   1.26E+08       0.00
   17.6400  -1.97E-07   -500.559     -7.942   3.43E-08       0.00   1.69E+11
9.8517   1.26E+08       0.00
   17.8500  -1.20E-07   -489.318    12.0307   2.69E-08       0.00   1.69E+11
5.9997   1.26E+08       0.00
   18.0600  -6.14E-08   -439.970    23.4568   2.00E-08       0.00   1.69E+11
3.0686   1.26E+08       0.00
   18.2700  -1.93E-08   -371.129    28.5399   1.39E-08       0.00   1.69E+11
0.9656   1.26E+08       0.00
   18.4800   8.78E-09   -296.152    29.2035   8.94E-09       0.00   1.69E+11
-0.439   1.26E+08       0.00
   18.6900   2.57E-08   -223.959    27.0301   5.05E-09       0.00   1.69E+11
-1.286   1.26E+08       0.00
   18.9000   3.42E-08   -159.929    23.2531   2.18E-09       0.00   1.69E+11
-1.712   1.26E+08       0.00
   19.1100   3.67E-08   -106.767    18.7827   1.92E-10       0.00   1.69E+11
-1.836   1.26E+08       0.00
   19.3200   3.52E-08    -65.264    14.2516  -1.09E-09       0.00   1.69E+11
-1.760   1.26E+08       0.00
```

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   19.5300   3.12E-08    -34.937    10.0675  -1.84E-09       0.00   1.69E+11
-1.561   1.26E+08       0.00
   19.7400   2.59E-08    -14.521     6.4683  -2.21E-09       0.00   1.69E+11
-1.296   1.26E+08       0.00
   19.9500   2.01E-08     -2.333     3.5711  -2.34E-09       0.00   1.69E+11
-1.004   1.26E+08       0.00
   20.1600   1.41E-08     3.4816     1.4160  -2.33E-09       0.00   1.69E+11
-0.707   1.26E+08       0.00
   20.3700   8.34E-09     4.8072   8.93E-05  -2.27E-09       0.00   1.69E+11
-0.417   1.26E+08       0.00
   20.5800   2.72E-09     3.4859     -0.696  -2.20E-09       0.00   1.69E+11
-0.136   1.26E+08       0.00
   20.7900  -2.77E-09     1.3025     -0.692  -2.17E-09       0.00   1.69E+11
0.1387   1.26E+08       0.00
   21.0000  -8.22E-09       0.00       0.00  -2.16E-09       0.00   1.69E+11
0.4108   6.30E+07       0.00
```

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     0.28772315 inches
Computed slope at pile head      =     -0.0035284 radians
Maximum bending moment           =       5851169. inch-lbs
Maximum shear force              =       -268521. lbs
Depth of maximum bending moment  =     8.19000000 feet below pile head
Depth of maximum shear force     =     9.45000000 feet below pile head
Number of iterations             =             23
Number of zero deflection points =              5
Pile deflection at ground        =     0.01199209 inches
```

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                          =      57000.0 lbs
Applied moment at pile head                       =    2280000.0 in-lbs
Axial thrust load on pile head                    =     455000.0 lbs
```

```
   Depth    Deflect.    Bending     Shear      Slope      Total     Bending   Soil
```

Res. X	Soil Spr. y	Distrib. Moment	Force	S	Stress	Stiffness	p
Es*H	Lat. Load						
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	
lb/inch	lb/inch	lb/inch					
0.00	0.4429	2280000.	57000.	-0.00536	0.00	3.40E+11	
0.00	0.00	0.00					
0.2100	0.4294	2429778.	57000.	-0.00534	0.00	3.40E+11	
0.00	0.00	0.00					
0.4200	0.4160	2579535.	57000.	-0.00533	0.00	3.40E+11	
0.00	0.00	0.00					
0.6300	0.4026	2729270.	57000.	-0.00531	0.00	3.40E+11	
0.00	0.00	0.00					
0.8400	0.3892	2878982.	57000.	-0.00528	0.00	3.39E+11	
0.00	0.00	0.00					
1.0500	0.3760	3028670.	57000.	-0.00526	0.00	3.39E+11	
0.00	0.00	0.00					
1.2600	0.3627	3178332.	57000.	-0.00524	0.00	3.39E+11	
0.00	0.00	0.00					
1.4700	0.3495	3327966.	57000.	-0.00522	0.00	3.39E+11	
0.00	0.00	0.00					
1.6800	0.3364	3477573.	57000.	-0.00519	0.00	3.39E+11	
0.00	0.00	0.00					
1.8900	0.3234	3627149.	57000.	-0.00516	0.00	3.39E+11	
0.00	0.00	0.00					
2.1000	0.3104	3776695.	57000.	-0.00514	0.00	3.38E+11	
0.00	0.00	0.00					
2.3100	0.2975	3926208.	57000.	-0.00511	0.00	3.38E+11	
0.00	0.00	0.00					
2.5200	0.2847	4075688.	57000.	-0.00508	0.00	3.38E+11	
0.00	0.00	0.00					
2.7300	0.2719	4225133.	57000.	-0.00505	0.00	3.37E+11	
0.00	0.00	0.00					
2.9400	0.2592	4374542.	57000.	-0.00501	0.00	2.26E+11	
0.00	0.00	0.00					
3.1500	0.2467	4523895.	57000.	-0.00496	0.00	2.16E+11	
0.00	0.00	0.00					
3.3600	0.2342	4673187.	57000.	-0.00490	0.00	2.07E+11	
0.00	0.00	0.00					
3.5700	0.2220	4822414.	57000.	-0.00484	0.00	1.98E+11	
0.00	0.00	0.00					
3.7800	0.2098	4971571.	57000.	-0.00478	0.00	1.90E+11	
0.00	0.00	0.00					
3.9900	0.1979	5120653.	57000.	-0.00471	0.00	1.82E+11	
0.00	0.00	0.00					
4.2000	0.1861	5269653.	57000.	-0.00464	0.00	1.75E+11	
0.00	0.00	0.00					
4.4100	0.1745	5418566.	57000.	-0.00456	0.00	1.68E+11	
0.00	0.00	0.00					

```
    4.6200     0.1631   5567386.     57000.   -0.00447       0.00   1.62E+11
0.00       0.00       0.00
    4.8300     0.1520   5716107.     57000.   -0.00439       0.00   1.56E+11
0.00       0.00       0.00
    5.0400     0.1410   5864722.     57000.   -0.00429       0.00   1.51E+11
0.00       0.00       0.00
    5.2500     0.1303   6013225.     57000.   -0.00419       0.00   1.46E+11
0.00       0.00       0.00
    5.4600     0.1199   6161608.     57000.   -0.00408       0.00   1.41E+11
0.00       0.00       0.00
    5.6700     0.1098   6309864.     57000.   -0.00397       0.00   1.37E+11
0.00       0.00       0.00
    5.8800    0.09991   6457987.     57000.   -0.00385       0.00   1.32E+11
0.00       0.00       0.00
    6.0900    0.09037   6605970.     57000.   -0.00372       0.00   1.29E+11
0.00       0.00       0.00
    6.3000    0.08115   6753803.     57000.   -0.00359       0.00   1.25E+11
0.00       0.00       0.00
    6.5100    0.07228   6901482.     57000.   -0.00345       0.00   1.22E+11
0.00       0.00       0.00
    6.7200    0.06376   7048996.     57000.   -0.00330       0.00   1.19E+11
0.00       0.00       0.00
    6.9300    0.05562   7196340.     57000.   -0.00315       0.00   1.16E+11
0.00       0.00       0.00
    7.1400    0.04788   7343504.     57000.   -0.00299       0.00   1.13E+11
0.00       0.00       0.00
    7.3500    0.04054   7490481.     57000.   -0.00283       0.00   1.11E+11
0.00       0.00       0.00
    7.5600    0.03364   7637264.     57000.   -0.00265       0.00   1.09E+11
0.00       0.00       0.00
    7.7700    0.02718   7783843.     57000.   -0.00247       0.00   1.07E+11
0.00       0.00       0.00
    7.9800    0.02118   7930212.     57000.   -0.00228       0.00   1.04E+11
0.00       0.00       0.00
    8.1900    0.01566   8076361.     18570.   -0.00201       0.00   5.61E+10
-30500.   4906630.       0.00
    8.4000    0.01106   8028406.    -58836.   -0.00165       0.00   5.64E+10
-30933.   7045311.       0.00
    8.6100    0.00737   7783604.   -136403.   -0.00130       0.00   5.77E+10
-30629.   1.05E+07       0.00
    8.8200    0.00453   7343908.   -212161.  -9.74E-04       0.00   6.04E+10
-29497.   1.64E+07       0.00
    9.0300    0.00246   6716545.   -283809.  -6.90E-04       0.00   6.50E+10
-27367.   2.80E+07       0.00
    9.2400    0.00105   5915095.   -340268.  -4.57E-04       0.00   7.26E+10
-17443.   4.19E+07       0.00
    9.4500   1.56E-04   5002643.   -365737.  -2.81E-04       0.00   8.54E+10
-2771.   4.47E+07       0.00
    9.6600  -3.65E-04   4072423.   -360548.  -1.59E-04       0.00   1.06E+11
6890.   4.75E+07       0.00
    9.8700  -6.43E-04   3185843.   -335682.  -8.02E-05       0.00   1.34E+11
```

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12846.   5.03E+07       0.00
   10.0800  -7.69E-04   2380769.   -299047.  -3.20E-05       0.00   1.65E+11
16230.   5.32E+07       0.00
   10.2900  -8.04E-04   1678719.   -256084.  -1.10E-06       0.00   1.66E+11
17868.   5.60E+07       0.00
   10.5000  -7.75E-04   1090107.   -210786.   1.99E-05       0.00   1.66E+11
18083.   5.88E+07       0.00
   10.7100  -7.04E-04    616311.   -166315.   3.29E-05       0.00   1.66E+11
17212.   6.16E+07       0.00
   10.9200  -6.09E-04    251805.   -125001.   3.95E-05       0.00   1.66E+11
15578.   6.44E+07       0.00
   11.1300  -5.05E-04    -13783.    -88396.   4.13E-05       0.00   1.66E+11
13474.   6.73E+07       0.00
   11.3400  -4.01E-04   -193805.    -57368.   3.97E-05       0.00   1.66E+11
11151.   7.01E+07       0.00
   11.5500  -3.05E-04   -303009.    -32216.   3.60E-05       0.00   1.66E+11
8811.   7.29E+07       0.00
   11.7600  -2.20E-04   -356257.    -12795.   3.10E-05       0.00   1.66E+11
6603.   7.57E+07       0.00
   11.9700  -1.49E-04   -367570.      1357.   2.55E-05       0.00   1.66E+11
4630.   7.86E+07       0.00
   12.1800  -9.14E-05   -349474.     10910.   2.00E-05       0.00   1.66E+11
2952.   8.14E+07       0.00
   12.3900  -4.77E-05   -312628.     16637.   1.50E-05       0.00   1.66E+11
1593.   8.42E+07       0.00
   12.6000  -1.59E-05   -265659.     19336.   1.06E-05       0.00   1.66E+11
549.5096   8.70E+07       0.00
   12.8100   5.68E-06   -215196.     19774.   6.93E-06       0.00   1.66E+11
-202.587   8.98E+07       0.00
   13.0200   1.90E-05   -166016.     18636.   4.04E-06       0.00   1.66E+11
-700.130   9.27E+07       0.00
   13.2300   2.60E-05   -121280.     16511.   1.86E-06       0.00   1.66E+11
-986.780   9.55E+07       0.00
   13.4400   2.84E-05    -82807.     13871.   3.07E-07       0.00   1.66E+11
-1108.   9.83E+07       0.00
   13.6500   2.76E-05    -51369.     11080.  -7.12E-07       0.00   1.66E+11
-1107.   1.01E+08       0.00
   13.8600   2.48E-05    -26963.      8395.  -1.31E-06       0.00   1.66E+11
-1024.   1.04E+08       0.00
   14.0700   2.10E-05     -9056.      5984.  -1.58E-06       0.00   1.66E+11
-890.019   1.07E+08       0.00
   14.2800   1.68E-05      3200.      3939.  -1.62E-06       0.00   1.66E+11
-732.804   1.10E+08       0.00
   14.4900   1.28E-05     10801.      2295.  -1.52E-06       0.00   1.66E+11
-571.745   1.12E+08       0.00
   14.7000   9.20E-06     14772.      1045.  -1.32E-06       0.00   1.66E+11
-420.560   1.15E+08       0.00
   14.9100   6.14E-06     16071.   152.5534  -1.09E-06       0.00   1.66E+11
-287.760   1.18E+08       0.00
   15.1200   3.70E-06     15543.   -433.841  -8.50E-07       0.00   1.66E+11
-177.632   1.21E+08       0.00
```

```
   15.3300   1.86E-06     13886.   -772.633  -6.26E-07       0.00   1.66E+11
-91.250   1.24E+08       0.00
   15.5400   5.46E-07     11650.   -922.023  -4.32E-07       0.00   1.66E+11
-27.313   1.26E+08       0.00
   15.7500  -3.20E-07      9240.   -936.262  -2.74E-07       0.00   1.66E+11
16.0118   1.26E+08       0.00
   15.9600  -8.33E-07      6932.   -863.608  -1.51E-07       0.00   1.66E+11
41.6502   1.26E+08       0.00
   16.1700  -1.08E-06      4888.   -743.062  -6.11E-08       0.00   1.66E+11
54.0207   1.26E+08       0.00
   16.3800  -1.14E-06      3187.   -603.132   2.83E-10       0.00   1.66E+11
57.0352   1.26E+08       0.00
   16.5900  -1.08E-06      1848.   -463.291   3.85E-08       0.00   1.66E+11
53.9495   1.26E+08       0.00
   16.8000  -9.47E-07   852.1825   -335.684   5.90E-08       0.00   1.66E+11
47.3258   1.26E+08       0.00
   17.0100  -7.81E-07   156.4519   -226.824   6.67E-08       0.00   1.66E+11
39.0711   1.26E+08       0.00
   17.2200  -6.10E-07   -291.164   -139.143   6.57E-08       0.00   1.66E+11
30.5170   1.26E+08       0.00
   17.4300  -4.50E-07   -544.980    -72.316   5.93E-08       0.00   1.66E+11
22.5201   1.26E+08       0.00
   17.6400  -3.11E-07   -655.775    -24.328   5.02E-08       0.00   1.66E+11
15.5663   1.26E+08       0.00
   17.8500  -1.97E-07   -667.706     7.7193   4.02E-08       0.00   1.66E+11
9.8677   1.26E+08       0.00
   18.0600  -1.09E-07   -616.962    27.0157   3.04E-08       0.00   1.66E+11
5.4470   1.26E+08       0.00
   18.2700  -4.41E-08   -531.617    36.6600   2.17E-08       0.00   1.66E+11
2.2072   1.26E+08       0.00
   18.4800   3.03E-10   -432.246    39.4219   1.44E-08       0.00   1.66E+11
-0.01515   1.26E+08       0.00
   18.6900   2.82E-08   -332.963    37.6260   8.54E-09       0.00   1.66E+11
-1.410   1.26E+08       0.00
   18.9000   4.34E-08   -242.630    33.1177   4.17E-09       0.00   1.66E+11
-2.168   1.26E+08       0.00
   19.1100   4.92E-08   -166.060    27.2850   1.07E-09       0.00   1.66E+11
-2.461   1.26E+08       0.00
   19.3200   4.87E-08   -105.116    21.1135  -9.93E-10       0.00   1.66E+11
-2.437   1.26E+08       0.00
   19.5300   4.42E-08    -59.645    15.2572  -2.24E-09       0.00   1.66E+11
-2.211   1.26E+08       0.00
   19.7400   3.74E-08    -28.215    10.1135  -2.91E-09       0.00   1.66E+11
-1.871   1.26E+08       0.00
   19.9500   2.95E-08     -8.667     5.8942  -3.19E-09       0.00   1.66E+11
-1.477   1.26E+08       0.00
   20.1600   2.13E-08     1.4993     2.6883  -3.25E-09       0.00   1.66E+11
-1.067   1.26E+08       0.00
   20.3700   1.32E-08     4.8896     0.5130  -3.20E-09       0.00   1.66E+11
-0.659   1.26E+08       0.00
   20.5800   5.22E-09     4.0923     -0.647  -3.13E-09       0.00   1.66E+11
```

```
-0.261   1.26E+08       0.00
   20.7900  -2.58E-09     1.6361     -0.813  -3.09E-09       0.00   1.66E+11
0.1291   1.26E+08       0.00
   21.0000  -1.03E-08       0.00       0.00  -3.07E-09       0.00   1.66E+11
0.5164   6.30E+07       0.00

* This analysis computed pile response using nonlinear moment-curvature rela-
  tionships. Values of total stress due to combined axial and bending stresses
  are computed only for elastic sections only and do not equal the actual
  stresses in concrete and steel. Stresses in concrete and steel may be inter-
  polated from the output for nonlinear bending properties relative to the
  magnitude of bending moment developed in the pile.


Output Summary for Load Case No. 2:

Pile-head deflection             =     0.44291857 inches
Computed slope at pile head      =     -0.0053616 radians
Maximum bending moment           =       8076361. inch-lbs
Maximum shear force              =       -365737. lbs
Depth of maximum bending moment  =     8.19000000 feet below pile head
Depth of maximum shear force     =     9.45000000 feet below pile head
Number of iterations             =             20
Number of zero deflection points =              5
Pile deflection at ground        =     0.02065355 inches


--------------------------------------------------------------------------------
            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 Load                Load                  Axial    Pile-head  Pile-head  Max
Shear Max Moment
Case Type   Pile-head    Type     Pile-head   Loading  Deflection  Rotation    in
Pile    in Pile
 No.  1      Load 1       2        Load 2       lbs      inches     radians      lbs
     in-lbs
---- ----- ---------- ---------- ---------- ---------- ---------- ----------
---------- ----------
  1  V, lb     41000.  M, in-lb    1728000.    336000.     0.2877   -0.00353
-268521.   5851169.
  2  V, lb     57000.  M, in-lb    2280000.    455000.     0.4429   -0.00536
```

-365737.   8076361.

Maximum pile-head deflection = 0.4429185671 inches
Maximum pile-head rotation   = -0.0053615668 radians = -0.307195 deg.

Summary of Warning Messages

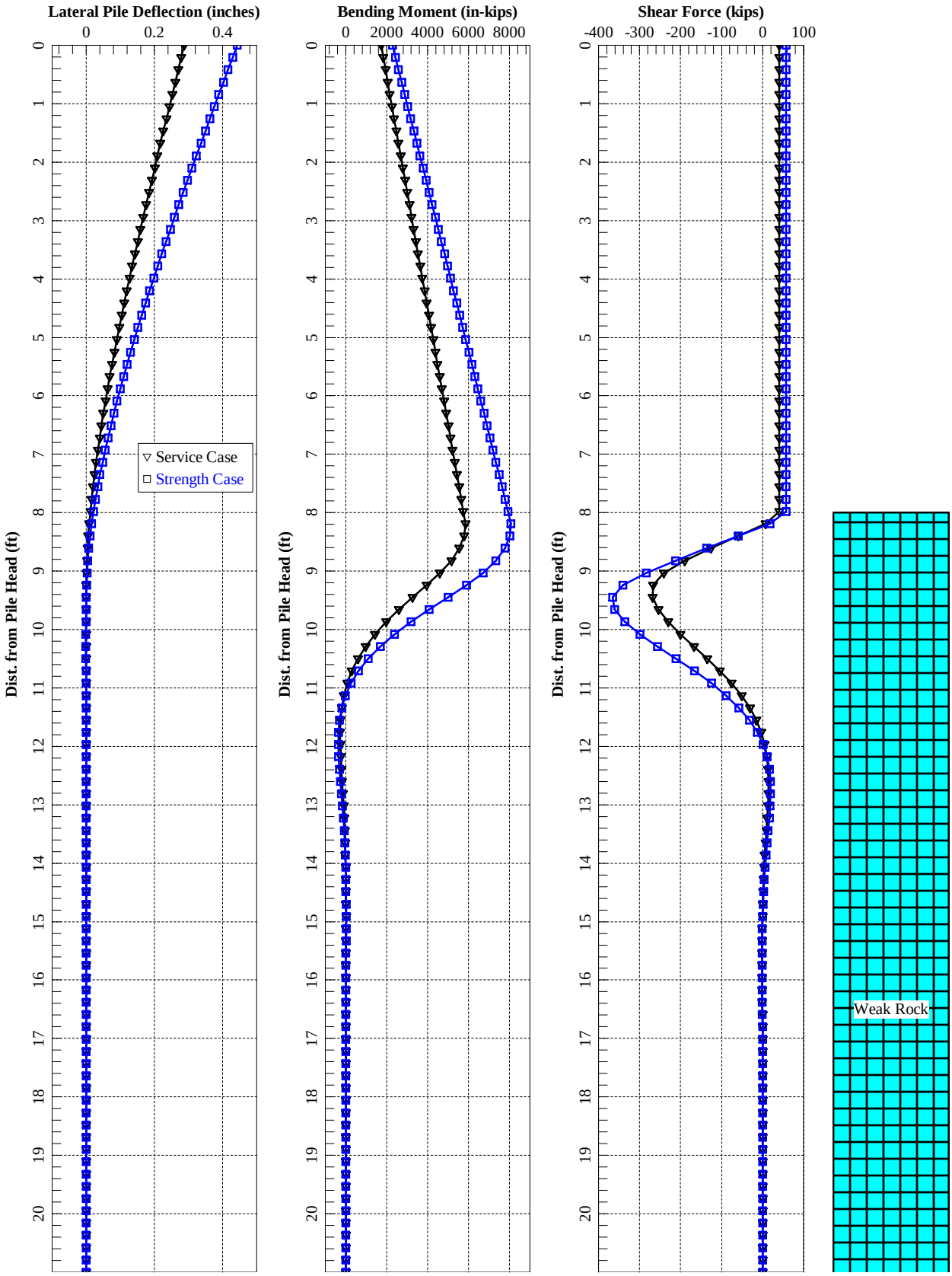
The following warning was reported 1302 times

**** Warning ****

An unreasonable input value for unconfined compressive strength has been specified for a soil defined using the weak rock criteria. The input value is greater than 500 psi. Please check your input data for correctness.

The analysis ended normally.

Forward Abutment



OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Bulletin GB1

SCI-335-10.31
PID 107644

Terracon Consultants

Prepared By: David Westendorf
Date prepared: Tuesday, August 9, 2022

David Westendorf
611 Lunken Park Drive
Cincinnati, OH
513-612-9095
david.westendorf@terracon.com

NO. OF BORINGS: 2

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-001-0-21	SCI-335-10.31	530+57	6	Right	CME 55/300	90	614.0	614.0	0.0
2	B-004-0-21	SCI-335-10.31	532+51	6	Left	CME 55/300	90	611.0	611.0	0.0

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

#	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	1.0	2.5	1.0	2.5	12		2.25	27	16	11	29	28	57	18	14	A-6a	5			N_{60} & Mc		12''	12''
	001-0	2	2.5	4.0	2.5	4.0	31		3.25	33	20	13	47	41	88	21	15	A-6a	9						
	21	3	4.0	5.5	4.0	5.5	24		3.5	26	22	4	43	37	80	19	17	A-4a	8						
		4	5.5	7.0	5.5	7.0		12		22	19	3	53	25	78	21	14	A-4b							
2	B	1	1.0	2.5	1.0	2.5	36		2.5	NP	NP	NP	15	15	30	10	10	A-2-4	0						
	004-0	2	2.5	4.0	2.5	4.0	55		3.25								16	A-6b	16						
	21	3	4.0	5.5	4.0	5.5	15		3								16	A-6b	16						
		4	5.5	7.0	5.5	7.0	15	15	3.5	29	16	13				14	16	A-6b							

PID: PID 107644

County-Route-Section: SCI-335-10.31
No. of Borings: 2

Geotechnical Consultant: Terracon Consultants
Prepared By: David Westendorf
Date prepared: 8/9/2022

Chemical Stabilization Options		
320	Rubblize & Roll	Option
206	Cement Stabilization	Option
	Lime Stabilization	No
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	6

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	0%	HP ≤ 0.5	0%
$N_{60} < 12$	0%	0.5 < HP ≤ 1	0%
$12 \leq N_{60} < 15$	13%	1 < HP ≤ 2	0%
$N_{60} \geq 20$	50%	HP > 2	88%
M+	13%		
Rock	0%		
Unsuitable	13%		

Excavate and Replace at Surface	
Average	6''
Maximum	12''
Minimum	0''

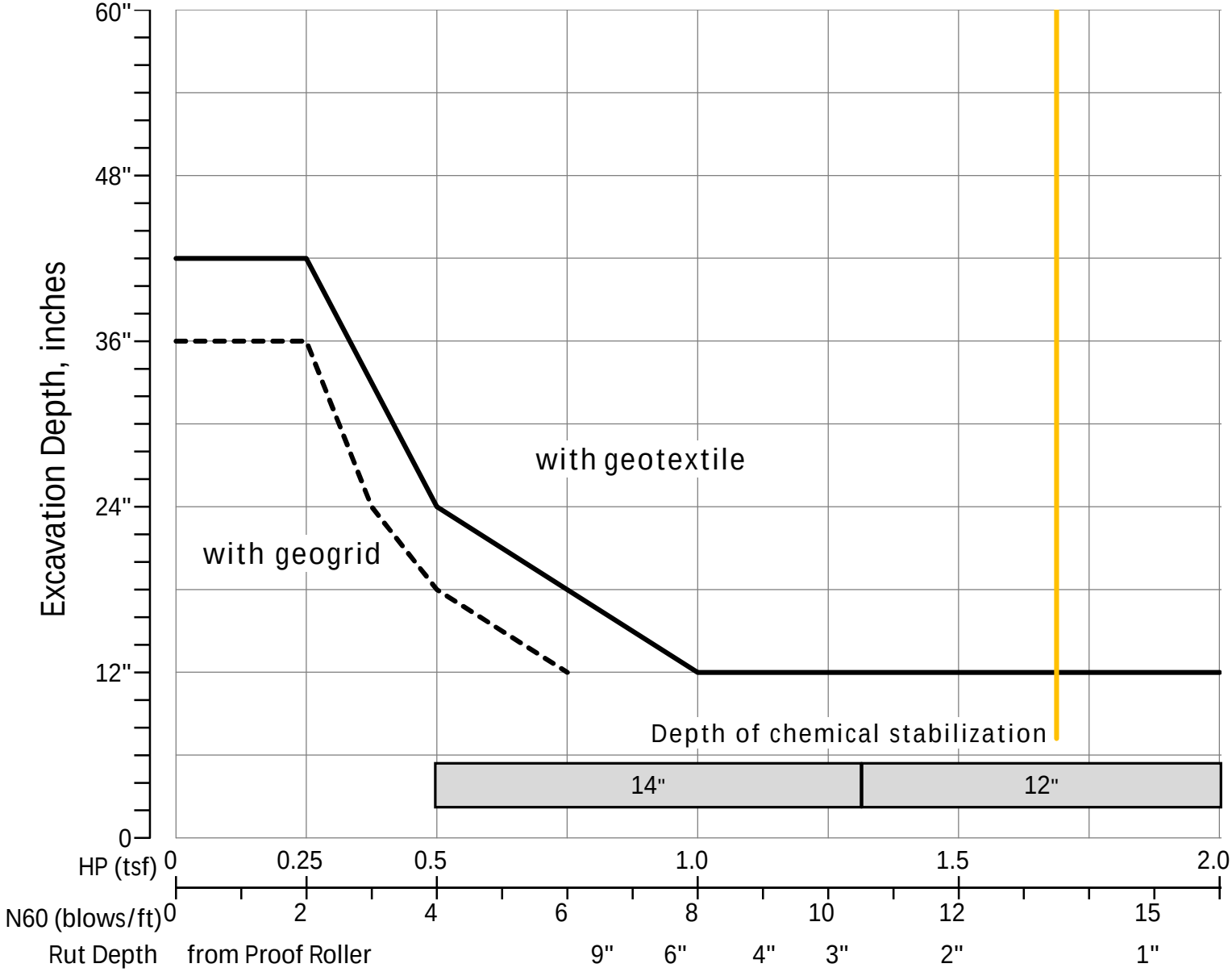
% Proposed Subgrade Surface	
Unstable & Unsuitable	25%
Unstable	25%
Unsuitable	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	27	14	3.04	27	19	9	37	29	67	17	15	9
Maximum	55	15	3.50	33	22	13	53	41	88	21	17	16
Minimum	12	12	2.25	22	16	3	15	15	30	10	10	0

Classification Counts by Sample

ODOT Class	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	0	0	1	0	0	0	0	0	1	1	0	2	3	0	0	0	0	8
Percent	0%	0%	0%	13%	0%	0%	0%	0%	0%	13%	13%	0%	25%	38%	0%	0%	0%	0%	100%
% Rock|Granular|Cohesive	0%	25%									75%								100%
Surface Class Count	0	0	0	1	0	0	0	0	0	0	0	0	2	1	0	0	0	0	4
Surface Class Percent	0%	0%	0%	25%	0%	0%	0%	0%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%	100%

GB1 Figure B – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
3.04		☐ HP
13.50		☐ N60L

Average HP
Average N_{60L}

611 Lunken Park Dr.
Cincinnati, Ohio 45226
P (513) 321-5816
Terracon.com

3/27/2023

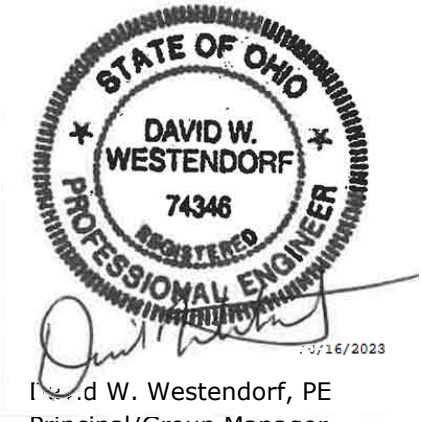
American Structurepoint
2550 Corporate Exchange Drive, Suite 300
Columbus, Ohio 43231

Re: C/R/S: SCI-335-10.31
PID: 107644
Terracon Project Number: N1215380

Dear Mr. Bettinger:

As the Geotechnical Engineer of Record for the subject project, I certify that I have reviewed the Stage 2 plans (or equivalent) for the subject project.

Respectfully,
Terracon Consultants, Inc.



Ayanda T. Ncube, EIT
Staff Engineer

David W. Westendorf, PE
Principal/Group Manager

PROJECT DESCRIPTION

THE PROJECT CONSISTS OF THE REPLACEMENT OF THE EXISTING BRIDGE CARRYING SCI-335 OVER ROCKY FORK CREEK. THE EXISTING BRIDGE IS 2 LANES AND 3 SPANS WITH A TOTAL LENGTH OF APPROXIMATELY 125 FEET. THE REPLACEMENT BRIDGE IS ANTICIPATED TO EITHER BE A 3-SPAN OR SINGLE-SPAN BRIDGE.

HISTORIC RECORDS

FIELD LOGS FROM 1954 FOR THE ORIGINAL CONSTRUCTION OF THE BRIDGE WERE LOCATED ON ODOT TIMS AND CONSIDERED IN THE GEOTECHNICAL STUDY. FINAL BORING LOGS WERE NOT LOCATED AND THEREFORE THE LOGS HAVE NOT BEEN SHOWN ON THE STRUCTURE FOUNDATION SHEETS.

GEOLOGY

THIS PROJECT IS LOCATED WITHIN THE LAKE BASIN/DEPOSITS OF THE HURON-ERI LAKE PLAINS. THE OVERBURDEN SOILS IN THE PROJECT AREA CONSIST OF EXISTING COHESIVE FILL ASSOCIATED WITH EXISTING BRIDGE ABUTMENTS AND ROADWAY EMBANKMENTS AND NATIVE COHESIVE AND GRANULAR SOILS OF ALLUVIAL ORIGIN. ACCORDING TO USDA SOIL SURVEY MAPPING, THE NATIVE OVERBURDEN SOILS IN THE PROJECT AREA CONSIST OF SOILS OF THE OMULGA AND TIOGA SERIES. THE USGS BEDROCK GEOLOGY INDICATES THE PROJECT AREA LIES WITHIN THE MAXVILLE LIMESTONE; LOGAN AND CUYAHOGA FORMATIONS WHICH CONSIST OF INTERBEDDED SHALE, SILTSTONE, AND SANDSTONE.

RECONNAISSANCE

FIELD RECONNAISSANCE WAS COMPLETED ON JANUARY 19, 2022 BY TERRACON STAFF. THE SURROUNDING LAND USAGE WAS NOTED AS BEING AGRICULTURAL LAND. THE BRIDGE DECK WAS AS THICK AS 1.5-FEET. THE STREAM BOTTOM CONSISTED OF GRAVEL AND COBBLES. THE PAVEMENT CONSISTED OF ASPHALT IN MODERATE CONDITION WITH NO PATCHING.

SUBSURFACE EXPLORATION

FOUR (4) BORINGS, B-001-0-21 THROUGH B-004-0-21 WERE COMPLETED BY TERRACON FROM FEBRUARY 9 TO FEBRUARY 10, 2022. TWO BORINGS WERE DRILLED ON THE EXISTING ROADWAY ADJACENT TO THE BRIDGE ABUTMENTS. TWO BORINGS (B-002-0-21 AND B-003-0-21 WERE DRILLED THROUGH THE BRIDGE DECK. THE TEST BORINGS WERE DRILLED USING A CME-55 TRACK-MOUNTED DRILL RIG. THE TEST BORINGS WERE DRILLED TO DEPTHS OF 22.5 TO 34.5 FEET BELOW THE TOP OF THE EXISTING PAVEMENT. ROCK CORE WAS OBTAINED IN ALL BORINGS USING NQ2-SIZE CORING TOOLS. DRILLING AND SAMPLING PROCEDURES WERE PERFORMED IN GENERAL ACCORDANCE WITH THE ODOT SPECIFICATIONS FOR GEOTECHNICAL EXPLORATION (SGE). THE AVERAGE DRILL ROD ENERGY RATIO (ER) FOR THE CME-55 DRILL RIG WAS CALIBRATED TO BE 89.5 PERCENT (CALIBRATION DATE 5/8/2020).

GROUNDWATER LEVELS WERE OBSERVED DURING AND AT THE COMPLETION OF THE DRILLING ACTIVITIES AT EACH TEST BORING LOCATION. NO LONG-TERM (24-HOUR) WATER LEVEL READINGS WERE OBTAINED AT THE TEST BORING LOCATIONS. UPON COMPLETION OF THE DRILLING ACTIVITIES AND FOLLOWING WATER LEVEL OBSERVATIONS, THE BOREHOLES WERE BACKFILLED WITH AUGER CUTTINGS AND BENTONITE CHIPS. THE PAVEMENT WAS REPAIRED AT THE SURFACE WITH ASPHALT COLD PATCH AFTER BACKFILLING OPERATIONS. THE BRIDGE DECK WAS REPAIRED WITH QUICK-SET CONCRETE PER SGE REQUIREMENTS.

EXPLORATION FINDINGS

THE TEST BORINGS IDENTIFIED UP TO 12-INCHES OF ASPHALT PAVEMENT. TEST BORINGS B-002-0-21 AND B-003-0-21 WERE DRILLED THROUGH THE EXISTING BRIDGE DECK WHICH MEASURED 17.4 AND 14.4 INCHES, RESPECTIVELY, IN THICKNESS. AT B-001-0-21, THE BORING ENCOUNTERED NATIVE OVERBURDEN SOILS CONSISTING OF SILT AND CLAY (A-6A) AND SANDY SILT (A-4A AND A-4B). THE CONSISTENCY OF THE SOILS WAS GENERALLY VERY STIFF. AT B-004-0-21, THE BORING ENCOUNTERED FILL THAT WAS APPROXIMATELY 2.5 FEET THICK. UNDER THE FILL, THE NATIVE OVERBURDEN SOILS FOUND CONSISTED OF SILTY CLAY (A-6B), GRAVEL WITH SAND AND SILT (A-2-4), AND SANDY SILT (A-4A). THE CONSISTENCY OF THE FINE-GRAINED SOILS WAS GENERALLY VERY STIFF. THE RELATIVE DENSITY OF THE GRANULAR SOILS WAS GENERALLY LOOSE.

SILTSTONE BEDROCK WAS ENCOUNTERED AT ELEVATIONS BETWEEN 592 AND 606 FEET, MSL. THE SAMPLED TOP OF BEDROCK WAS BROWN, WEAK TO SLIGHTLY STRONG, AND MODERATELY WEATHERED. OCCASIONAL BROWN SHALE SEAMS WERE ENCOUNTERED. AT DEEPER DEPTHS, THE BEDROCK WAS DARK GRAY, STRONG, AND SLIGHTLY WEATHERED TO UN-WEATHERED. GROUNDWATER WAS OBSERVED IN TEST BORING B-004-0-21 AT 8.5 FEET BELOW THE GROUND SURFACE (CORRESPONDING TO AN ELEVATION OF APPROXIMATELY 599.5 FEET, MSL). GROUNDWATER WAS NOT ENCOUNTERED IN ALL OTHER BORINGS DURING DRILLING.

SPECIFICATIONS

THIS GEOTECHNICAL EXPLORATION WAS PERFORMED IN ACCORDANCE WITH THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, OFFICE OF GEOTECHNICAL ENGINEERING, SPECIFICATIONS FOR GEOTECHNICAL EXPLORATIONS, DATED JANUARY, 2022.

AVAILABLE INFORMATION

THE SOIL, BEDROCK, AND GROUNDWATER INFORMATION COLLECTED FOR THIS SUBSURFACE EXPLORATION THAT CAN BE CONVENIENTLY DISPLAYED ON THE STRUCTURE FOUNDATION EXPLORATION SHEETS HAS BEEN PRESENTED. GEOTECHNICAL REPORTS, IF PREPARED, ARE AVAILABLE FOR REVIEW ON THE OFFICE OF CONTRACT SALES WEBSITE.

LEGEND

DESCRIPTION	ODOT CLASS	CLASSIFIED MECH./VISUAL	
GRAVEL AND/OR STONE FRAGMENTS WITH SAND & SILT	A-2-4	-	3
GRAVEL AND/OR STONE FRAGMENTS WITH SAND, SILT & CLAY	A-2-6	2	-
SANDY SILT	A-4a	1	-
SILT	A-4b	2	-
SILT AND CLAY	A-6a	-	1
SILTY CLAY	A-6b	4	4
	TOTAL	9	8
SILTSTONE	VISUAL		
PAVEMENT OR BASE = X = APPROXIMATE THICKNESS	VISUAL		

BORING LOCATION - PLAN VIEW.

DRIVE SAMPLE AND/OR ROCK CORE BORING PLOTTED TO VERTICAL SCALE ONLY. HORIZONTAL BAR INDICATES A CHANGE IN STRATIGRAPHY.

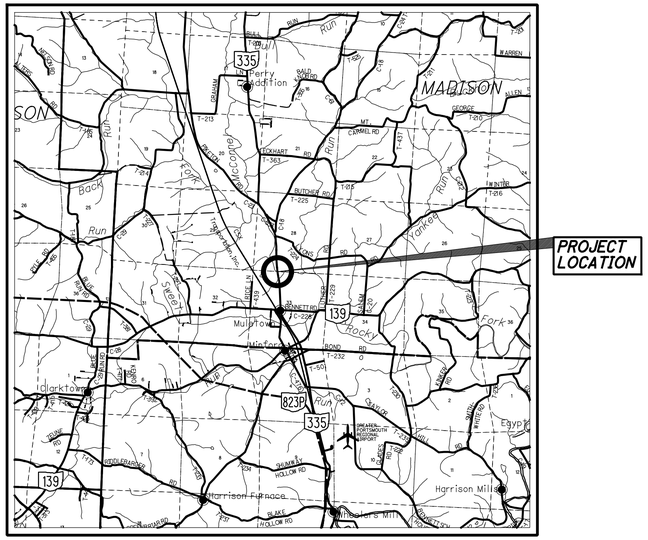
WC — INDICATES WATER CONTENT IN PERCENT.

N_{60} — INDICATES STANDARD PENETRATION RESISTANCE NORMALIZED TO 60% DRILL ROD ENERGY RATIO.

X/Y/Z — NUMBER OF BLOWS FOR STANDARD PENETRATION TEST (SPT):
X= NUMBER OF BLOWS FOR FIRST 6 INCHES.
Y= NUMBER OF BLOWS FOR SECOND 6 INCHES.
Z= NUMBER OF BLOWS FOR THIRD 6 INCHES.

SS — INDICATES A SPLIT SPOON SAMPLE.

TR — INDICATES TOP OF ROCK.



LOCATION MAP

SCALE IN MILES

0 1 2 3 4

N

PARTICLE SIZE DEFINITIONS

12"	3"	2.0 mm	0.42 mm	0.074 mm	0.005 mm
BOULDERS	COBBLES	GRAVEL	COARSE SAND	FINE SAND	SILT	CLAY
		No. 10 SIEVE	No. 40 SIEVE	No. 200 SIEVE		

D_{50} VALUES

BORING NO.	SAMPLE NO.	ELEVATION	D_{50} VALUE	D_{95} VALUE
B-001-0-21	SS-1	613.0' - 611.5'	0.0392 mm	4.6929 mm
	SS-2	611.5' - 610.0'	0.0085 mm	0.2796 mm
	SS-3	610.0' - 608.5'	0.0111 mm	0.3114 mm
	SS-4	608.5' - 607.0'	0.0177 mm	0.3283 mm
B-004-0-21	SS-1	610.0' - 608.5'	0.5716 mm	10.8876 mm
	SS-5	604.0 - 602.5'	0.0499 mm	1.8082 mm
	SS-9	598.0' - 596.5'	0.0976 mm	0.3994 mm
	SS-10	596.5' - 595.0'	0.0589 mm	0.3674 mm
	SS-11	595.0' - 593.5'	0.1222 mm	0.4336 mm

BEDROCK TEST SUMMARY

BORING NO.	SAMPLE	DEPTH	QU (PSI)
B-001-0-21	CORE-2	9.5' - 14.5'	2,990
B-002-0-21	CORE-4	23.0' - 28.0'	8,749
B-003-0-21	CORE-3	28.5' - 33.5'	5,531
B-004-0-21	CORE-3	24.0' - 28.8'	5,600

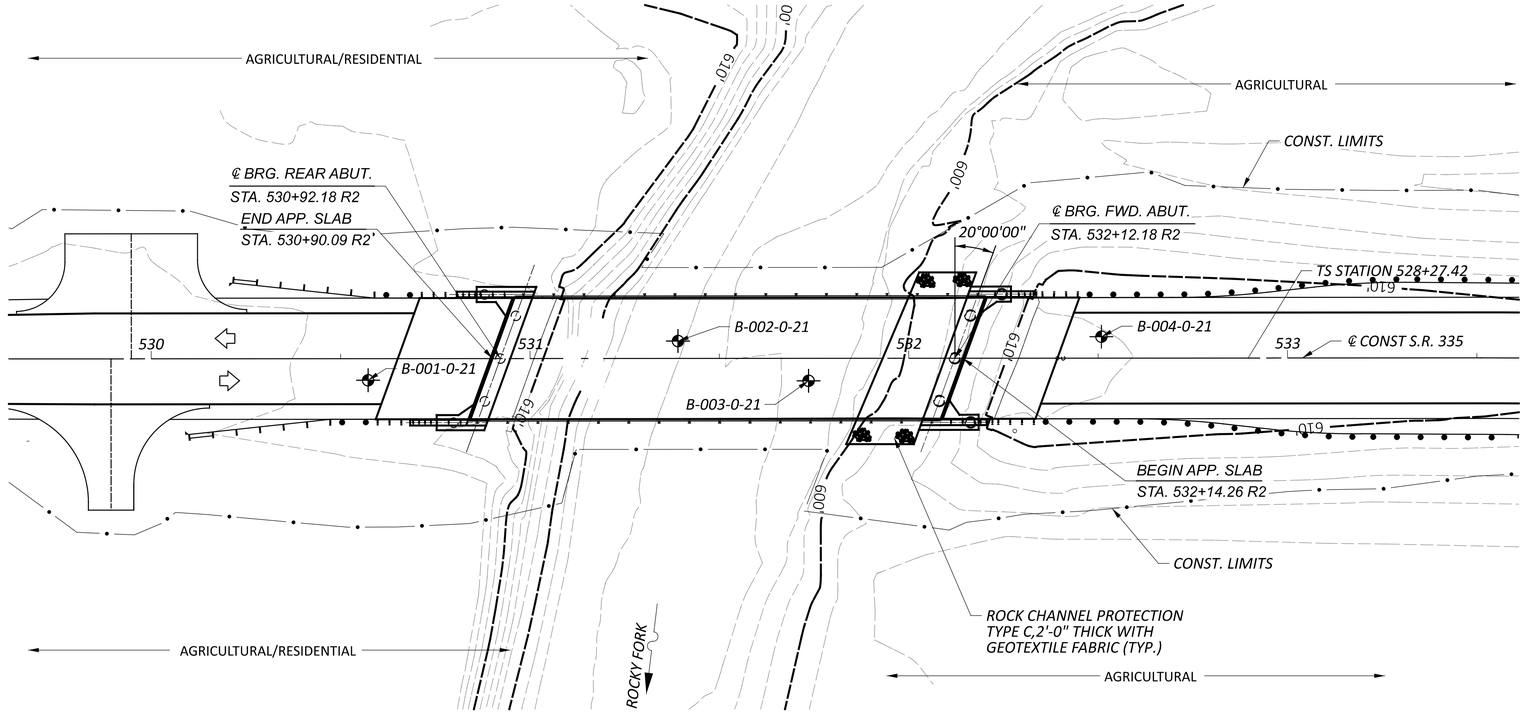
RECON. - CF 1/19/2022
DRILLING - TERRACON 2/10/2022
DRAWN - KJM 6/22/2022
REVIEWED - DWW 6/24/2022

GEOTECHNICAL PROFILE - BRIDGE

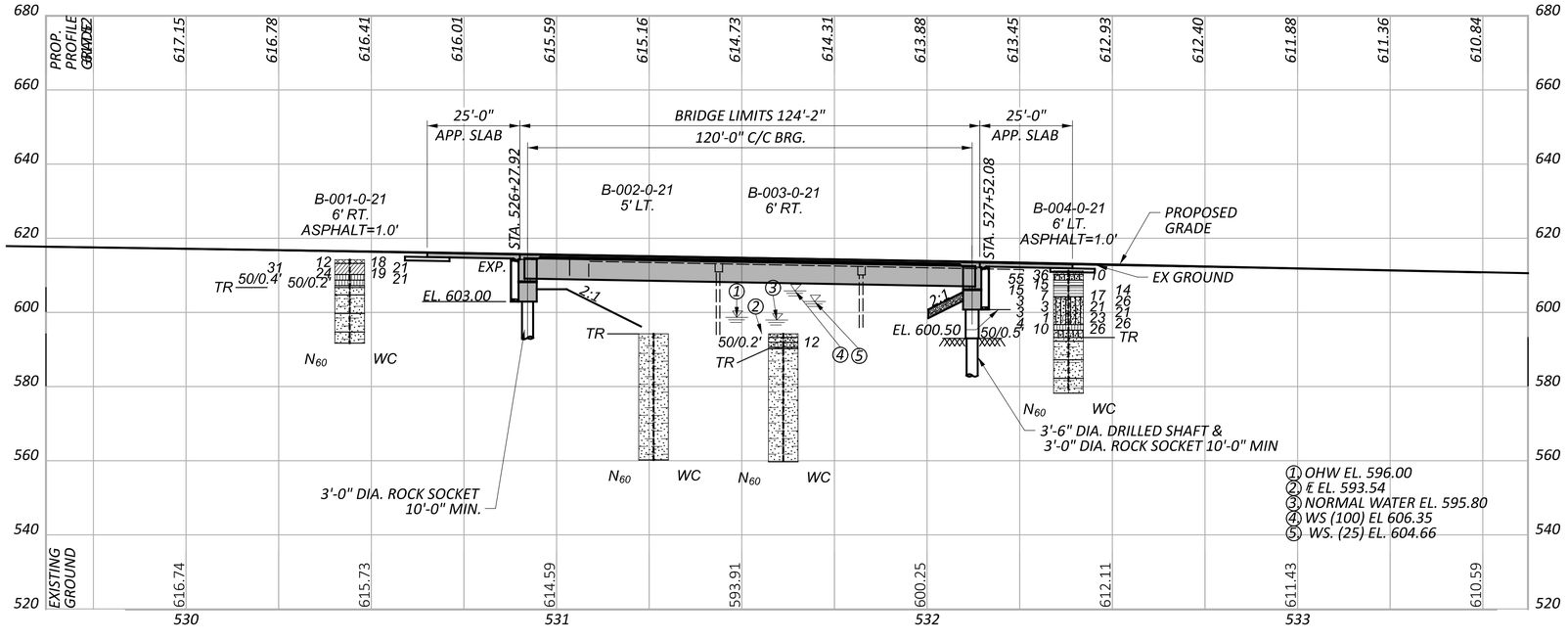
DESIGN AGENCY
Terracon
Consulting Engineers and Scientists

DESIGNER DWW
REVIEWER DWW 06/24/22
PROJECT ID 107644
SHEET 1 TOTAL 10

MODEL: Design PAPERSIZE: 34x22 (in.) DATE: 3/22/2023 TIME: 8:04:09 AM USER: kjmankin
C:\Users\kjmankin\OneDrive - Terracon Consultants Inc\Desktop\DRAWINGS\11215380\107644_ZC001.dgn



PLAN



PROFILE

ALONGE ℄ STRUCTURE

GEOTECHNICAL PROFILE - BRIDGE
BRIDGE NO SCI-335-10.31
S.R. 335 OVER ROCKY FORK

DESIGN AGENCY
Terracon
Consulting Engineers and Scientists

DESIGNER	DWW
REVIEWER	DWW 06-24-22
PROJECT ID	107644
SHEET	2
TOTAL	10

MODEL: SITE PLAN SHEET PAPERSIZE: 34x22 (in.) DATE: 3/22/2023 TIME: 2:50:12 PM USER: kjmankin
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MODEL: Design PAPERSIZE: 34x22 (in.) DATE: 3/22/2023 TIME: 8:24:34 AM USER: kjmankin
C:\Users\kjmankin\OneDrive - Terracon Consultants Inc\Desktop\DRAWINGS\1215380\107644_ZL001.dgn

PROJECT: SCI-335-10.31	DRILLING FIRM / OPERATOR: TERRACON / KH	DRILL RIG: CME 55	STATION / OFFSET: 530+57, 6' RT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: TERRACON / AR	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-335
PID: 107644 SFN: 7305109	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 5/8/20	ELEVATION: 614.0 (MSL) EOB: 22.5 ft.
START: 2/10/22 END: 2/10/22	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 89.5	LAT / LONG: 38.874141, -82.864070

EXPLORATION ID B-001-0-21

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
ASPHALT (12 INCHES)	614.0																		
	613.0																		
STIFF TO VERY STIFF, YELLOW BROWN AND BROWN, **SILT AND CLAY**, LITTLE GRAVEL, SOME SAND, DAMP		1	7 3 5	12	89	SS-1	2.25	11	16	16	29	28	27	16	11	18	A-6a (5)	-	
		2																	
		3	5 9 12	31	61	SS-2	3.25	0	2	10	47	41	33	20	13	21	A-6a (9)	-	
	610.0	4																	
VERY STIFF, YELLOW BROWN, **SANDY SILT**, AND CLAY, DAMP		5	10 6 10	24	100	SS-3	3.50	0	2	18	43	37	26	22	4	19	A-4a (8)	-	
	608.5	6																	
VERY STIFF, GRAY, **SILT**, TRACE GRAVEL, SOME CLAY AND SAND, DAMP		7	10 11 50/5"	-	94	SS-4	-	1	1	20	53	25	22	19	3	21	A-4b (8)	-	
	607.0																		
OLIVE BROWN, **STONE FRAGMENTS**, WEATHERED SILTSTONE, DRY			50/3"	-	100	SS-5	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	-	
	606.5	TR																	
SILTSTONE, BROWN, HIGHLY WEATHERED, VERY WEAK, WITH BROWN SHALE SEAMS, MODERATELY FRACTURED, RANGES IN THICKNESS FROM 2 TO 10 INCHES; RQD 71%, REC 88%.		8	71		88	NQ2-1											CORE		
	604.5	9																	
SILTSTONE, BROWN AND DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, WITH GRAY SHALE SEAMS, MODERATELY FRACTURED, RANGES IN THICKNESS FROM 4 TO 7 INCHES, UNCONFINED COMPRESSIVE STRENGTH AT 9,5 FEET: 2,990 PSI, SLAKE DURABILITY INDEX AT 9.5 FEET: 89.3%; RQD 77%, REC 100%.		10																	
		11																	
		12	77		100	NQ2-2											CORE		
		13																	
	599.5	14																	
SILTSTONE, DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, THINLY LAMINATED, INTACT, RANGES IN THICKNESS FROM 7 TO 15 INCHES; RQD 98%, REC 100%.		15																	
		16																	
		17	95		100	NQ2-3											CORE		
		18																	
		19																	
		20																	
		21	100		100	NQ2-4											CORE		
	591.5	22																	
		EOB																	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (11 X 17) - OH DOT.GDT - 9/13/22 09:55 - N:\PROJECTS\2021\N1215380\WORKING FILES\LABORATORY-FIELD DATA-BORING LOGS\N1215380 ODOT .GPJ

SHEET	PROJECT ID	REVIEWER	DESIGNER	DESIGN AGENCY
3 / TOTAL 10	107644	DWW 06-24-22	DWW	Terracon Consulting Engineers and Scientists

GEOTECHNICAL PROFILE - BRIDGE
BORING LOG B-001-0-21

MODEL: Design PAPERSIZE: 34x22 (in.) DATE: 3/22/2023 TIME: 8:26:11 AM USER: kjmankin
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PROJECT: SCI-335-10.31	DRILLING FIRM / OPERATOR: TERRACON / KH	DRILL RIG: CME 55	STATION / OFFSET: 531+39, 5' LT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: TERRACON / AR	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-335
PID: 107644 SFN: 7305109	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 5/8/20	ELEVATION: 594.0 (MSL) EOB: 15.0 ft.
START: 2/10/22 END: 2/10/22	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 89.5	LAT / LONG: 38.874290, -82.864152

EXPLORATION ID B-002-0-21

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	ABAN-DONED
SILTSTONE, DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, THINLY LAMINATED, INTACT, RANGES IN THICKNESS FROM 5 TO 24 INCHES, UNCONFINED COMPRESSIVE STRENGTH TEST AT 24 FEET: 5,600 PSI; RQD 98%, REC 100%.	594.0	TR																	
		1																	
		2	92		100	NQ2-1											CORE		
		3																	
		4																	
		5																	
		6	100		100	NQ2-2											CORE		
		7																	
		8																	
		9																	
		10																	
		11	100		100	NQ2-3											CORE		
		12																	
		13																	
		14																	
		15	100		100	NQ2-4											CORE		
	579.0	EOB																	

NOTES: BORING DRILLED THROUGH BRIDGE DECK. BRIDGE DECK ELEVATION = 611.3 FT

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED QUICKCRETE

STANDARD ODOT LOG W/ SULFATES (11 X 17) - OH DOT GDT - 9/13/22 09:55 - N:\PROJECTS\2021\N1215380\WORKING FILES\LABORATORY-FIELD DATA-BORING LOGS\N1215380 ODOT .GPJ

SHEET 4 | TOTAL 10

PROJECT ID 107644

REVIEWER DWW 06-24-22

DESIGNER DWW

Terracon Consulting Engineers and Scientists

DESIGN AGENCY

GEOTECHNICAL PROFILE - BRIDGE
BORING LOG B-002-0-21

MODEL: Design PAPERSIZE: 34x22 (in.) DATE: 3/22/2023 TIME: 8:27:51 AM USER: kjmankin
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PROJECT: SCI-335-10.31	DRILLING FIRM / OPERATOR: TERRACON / KH	DRILL RIG: CME 55	STATION / OFFSET: 531+74, 6' RT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: TERRACON / AR	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-335
PID: 107644 SFN: 7305109	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 5/8/20	ELEVATION: 594.0 (MSL) EOB: 16.5 ft.
START: 2/10/22 END: 2/10/22	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 89.5	LAT / LONG: 38.874393, -82.864119

EXPLORATION ID: B-003-0-21
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	ABAN-DONED
DENSE TO VERY DENSE, BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, WET	594.0		3 30 50/2"	-	100	SS-1	-	-	-	-	-	-	-	-	-	12	A-2-6 (V)	-	
	592.5	TR																	
SILTSTONE, DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, THINLY LAMINATED, INTACT, RANGES IN THICKNESS FROM 10 TO 24 INCHES, UNCONFINED COMPRESSIVE STRENGTH AT 28.5 FEET: 5,531 PSI; RQD 94%, REC 97%.		1																	
		2																	
		3	77		88	NQ2-1											CORE		
		4																	
		5																	
		6																	
		7																	
		8	100		100	NQ2-2											CORE		
		9																	
		10																	
		11																	
		12																	
		13	100		100	NQ2-3											CORE		
		14																	
		15																	
		16	100		100	NQ2-4											CORE		
	577.5	EOB																	

NOTES: BORING DRILLED THROUGH BRIDGE DECK. BRIDGE DECK ELEVATION = 610.5 FT

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED QUICKCRETE

STANDARD ODOT LOG W/ SULFATES (11 X 17) - OH DOT.GDT - 9/13/22 09:55 - N:\PROJECTS\2021\N1215380\WORKING FILES\LABORATORY-FIELD DATA-BORING LOGS\N1215380 ODOT .GPJ

SHEET	TOTAL	PROJECT ID	REVIEWER	DESIGNER	DESIGN AGENCY
5	10	107644	DWW 06-24-22	DWW	Terracon Consulting Engineers and Scientists

GEOTECHNICAL PROFILE - BRIDGE
BORING LOG B-003-0-21

MODEL: Design PAPERSIZE: 34x22 (in.) DATE: 3/22/2023 TIME: 8:29:22 AM USER: kjmankin
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PROJECT: SCI-335-10.31	DRILLING FIRM / OPERATOR: TERRACON / KH	DRILL RIG: CME 55	STATION / OFFSET: 532+51, 6' LT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: TERRACON / AR	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-335
PID: 107644 SFN: 7305109	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 5/8/20	ELEVATION: 611.0 (MSL) EOB: 33.0 ft.
START: 2/10/22 END: 2/10/22	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 89.5	LAT / LONG: 38.874595, -82.864225

EXPLORATION ID B-004-0-21

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
ASPHALT (12 INCHES)	611.0																		
	610.0																		
MEDIUM DENSE, DARK BROWN, **GRAVEL WITH SAND AND SILT**, DAMP		1	8 13 11	36	100	SS-1	2.50	35	19	16	30		NP	NP	NP	10	A-2-4 (0)	-	
	608.5	2																	
VERY STIFF, DARK BROWN AND GREENISH-GRAY, **SILTY CLAY**, TRACE GRAVEL, DAMP		3	13 15 22	55	100	SS-2	3.25	-	-	-	-	-	-	-	-	-	A-6b (V)	-	
	607.0	4																	
VERY STIFF, BROWN, **SILTY CLAY**, TRACE GRAVEL, DAMP		5	7 4 6	15	89	SS-3	3.00	-	-	-	-	-	-	-	-	-	A-6b (V)	-	
		6	7 5 5	15	67	SS-4	3.50	-	-	-	-	-	29	16	13	14	A-6b (V)	-	
	604.0	7																	
LOOSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, WET		8	2 2 3	7	89	SS-5	-	4	9	31	39	17	NP	NP	NP	17	A-2-4 (0)	-	
		9	1 1 1	3	100	SS-6	-	-	-	-	-	-	-	-	-	26	A-2-4 (V)	-	
		10	0 1 1	3	89	SS-7	-	-	-	-	-	-	19	18	1	21	A-2-4 (V)	-	
		11	0 1 1	3	100	SS-8	-	-	-	-	-	-	-	-	-	21	A-2-4 (V)	-	
		12	0 0 1	1	61	SS-9	-	1	2	55	35	7	NP	NP	NP	23	A-2-4 (0)	-	
	596.5	13																	
SOFT, BROWN, **SANDY SILT**, LITTLE CLAY, WET		14	2 1 2	4	100	SS-10	-	0	1	45	42	12	19	16	3	26	A-4a (4)	-	
	595.0	15																	
LOOSE, BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET		16	2 2 5	10	100	SS-11	-	0	5	63	26	6	NP	NP	NP	26	A-2-4 (0)	-	
	593.0	17	50	-	100	SS-12	-	-	-	-	-	-	-	-	-	-	A-2-4 (V)	-	
SILTSTONE, BROWN AND GRAY, MODERATELY TO SLIGHTLY WEATHERED, SLIGHTLY STRONG, WITH BROWN SHALE SEAMS, FRACTURED, RANGES IN THICKNESS FROM 1 TO 4 INCHES; RQD 33%, REC 67%.		TR 18	33		67	NQ2-1											CORE		
	592.0	19																	
SILTSTONE, DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, THINLY LAMINATED, WITH GRAY SHALE SEAMS, MODERATELY FRACTURED, RANGES IN THICKNESS FROM 4 TO 11 INCHES; RQD 72%, REC 100%.		20	72		100	NQ2-2											CORE		
	587.0	24																	
SILTSTONE, DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, THINLY LAMINATED, INTACT, RANGES IN THICKNESS FROM 10 TO 24 INCHES, UNCONFINED COMPRESSIVE STRENGTH AT 24 FEET: 5,600 PSI; RQD 99%, REC 98%.		25	97		98	NQ2-3											CORE		
		30	100		100	NQ2-4											CORE		
	578.0	EOB 33																	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (11 X 17) - OH DOT.GDT - 9/13/22 09:55 - N:\PROJECTS\2021\N1215380\WORKING FILES\LABORATORY-FIELD DATA-BORING LOGS\N1215380 ODOT .GPJ

GEOTECHNICAL PROFILE - BRIDGE
BORING LOG B-004-0-21