

GEOTECHNICAL DESIGN MEMORANDUM

Date: October 03, 2025
To: Mr. Craig Litmer, P.E., American StructurePoint
From: Chunmei (Melinda) He, Ph.D., P.E. & Momen A. Alassi, M.Sc, E.I., NEAS Inc.
**RE: Geotechnical Design Memorandum
PRE-70-00.00
PID: 117139**

1. INTRODUCTION

This memorandum presents our geotechnical design recommendations for the proposed PRE-70-0.00 project (PID: 117139), located in Preble County, Ohio. The project involves the construction and installation of high mast light poles within the truck parking lot along Interstate 70 (IR-70). This document provides soil property information as well as our recommendations for foundation design and construction.

NEAS's analyses have been performed in accordance with Load and Resistance Factor Design (LRFD) method as set forth in AASHTO's Publication Bridge Design Specifications, 10th Edition (BDS) (AASHTO, 2020), ODOT's Bridge Design Manual (BDM) (ODOT, 2025) and ODOT's Geotechnical Design Manual (GDM) (ODOT, 2025).

2. PROPOSED CONSTRUCTION AND NEARBY BORINGS

National Engineering & Architectural Services, Inc. (NEAS) has been contracted to perform geotechnical engineering services for the project. The purpose of the geotechnical engineering services was to perform geotechnical explorations within the project limits to obtain information concerning the subsurface soil and groundwater conditions relevant to the design and construction of the project. NEAS drilled two borings, designated B-001-0-25 and B-002-1-25, for the proposed light poles on July 18, 2025. The locations of these borings are summarized in Table 1. The boring locations are depicted on the site plan provided in Appendix A. The corresponding boring logs and laboratory testing are included in Appendix B.

Table 1: Summary of Project Borings

Boring Number	Latitude	Longitude	Elevation (NAVD 88) (ft)	Depth (ft)	Substructure
B-001-0-25	39.830216	-84.761380	1223.0	25.0	Light Tower
B-002-0-25	39.829972	-84.758691	1216.3	25.0	Light Tower
Notes: 1. As-drilled boring location and corresponding ground surface elevation was surveyed in the field by NEAS.					

3. FIELD RECONNAISSANCE

A field reconnaissance visit for the overall project area was conducted on July 25th, 2025, within the project limits. Site condition, including existing land and pavement conditions, were observed and photographed during the visit. Photographs of notable features and a summary of our observations are provided below.

The majority of the project area consists of ODOT ROW (Right of Way) and farmland/agricultural land.

At the time of our reconnaissance, pavement within the project limits was generally in good condition, though some weathering and surface wear were noted. Occasionally low severity joint spalling and iron staining were observed, along with extensive vegetation growth along pavement joints throughout the area (Photograph 1). The surrounding area was vegetated with tall grass, shrubs, and young deciduous and coniferous trees.

In the vicinity of B-001-0-25, standing water and the presence of cattails were observed (Photograph 2). Drainage appeared to flow northwest near B-001-0-25, and south near B-002-0-25, directing water toward the embankment. No evidence of geotechnical instability was observed during reconnaissance.

Photograph 1: Pavement conditions



Photograph 2: Evidence of standing water



4. ANALYSES AND RECOMMENDATIONS

4.1. Soil Profile and Soil Properties

For analysis purposes, each nearby boring log was reviewed, and a generalized material profile was developed for analysis. Utilizing the generalized soil profile, engineering properties for each soil strata were estimated based on their field (i.e., SPT N_{60} Values, hand penetrometer values, etc.) and laboratory (i.e., Atterberg Limits, grain size, etc.) test results using correlations provided in published engineering manuals, research reports and guidance documents. The developed soil profile and estimated engineering soil and rock properties (with cited correlation/reference material) used in our evaluation is summarized per boring within Tables 2 and 5 below.

Table 2: Soil Profile and Estimated Soil Parameters – B-001-0-25

High Mast Lighting Tower: Soil Profile B-001-0-25				
Soil Description	Unit Weight ⁽¹⁾ (pcf)	Undrained Shear Strength ⁽²⁾ (psf)	Effective Cohesion ⁽³⁾ (psf)	Effective Friction Angle ⁽³⁾ (degrees)
Gravel with Sand (A-1-b) Depth (1223 ft - 1221 ft)	130	-	-	40
Sandy Silt (A-4a) Depth (1221 ft - 1212.5 ft)	122	-	-	31
Sandy Silt (A-4a) Depth (1212.5 ft - 1198 ft)	122	1750	200	25
Notes:				
1. Values interpreted from ODOT Geotechnical Design Manual (GDM) Section 405.				
2. Values calculated from Terzaghi and Peck (1967) if $N_{160} < 52$, else Stroud and Butler (1975) was used.				
3. Values interpreted from LRFD BDS Table 10.4.6.2.4-1 and ODOT GDM Table 400-3.				

Table 3: Soil Profile and Estimated Soil Parameters – B-002-0-25

High Mast Lighting Tower: Soil Profile B-002-0-25				
Soil Description	Unit Weight ⁽¹⁾ (pcf)	Undrained Shear Strength ⁽²⁾ (psf)	Effective Cohesion ⁽³⁾ (psf)	Effective Friction Angle ⁽³⁾ (degrees)
Sandy Silt (A-4a) Depth (1216.3 ft - 1205.8 ft)	122	-	-	31
Sandy Silt (A-4a) Depth (1205.8 ft - 1191.3 ft)	122	2150	200	25
Notes:				
1. Values interpreted from ODOT Geotechnical Design Manual (GDM) Section 405.				
2. Values calculated from Terzaghi and Peck (1967) if $N_{160} < 52$, else Stroud and Butler (1975) was used.				
3. Values interpreted from LRFD BDS Table 10.4.6.2.4-1 and ODOT GDM Table 400-3.				

Table 4: LPILE p-y Curves Soil Parameters – B-001-0-25

High Mast Lighting Tower: Soil Profile B-001-0-25							
Soil Layer Number (No.)	Top Elev. (ft)	Bottom Elev. (ft)	Layer Depth (ft)	Soil Class	LPILE Model	Soil Strain Parameter ϵ_{50}	Soil Modulus Parameter k (pci)
1	1223.0	1221.0	2	A-1-b	Sand (Reese)	-	965
2	1221.0	1212.5	10.5	A-4a	Sand (Reese)	-	56
3	1212.5	1198.0	25	A-4a	Stiff Clay w/o Water	0.0067	590

Table 5: LPILE p-y Curves Soil Parameters – B-002-0-25

High Mast Lighting Tower: Soil Profile B-002-0-25							
Soil Layer Number (No.)	Top Elev. (ft)	Bottom Elev. (ft)	Layer Depth (ft)	Soil Class	LPILE Model	Soil Strain Parameter ϵ_{50}	Soil Modulus Parameter k (pci)
1	1216.3	1205.8	10.5	A-4a	Sand (Reese)	-	56
2	1205.8	1191.3	25	A-4a	Stiff Clay w/o Water	0.0060	729

4.2. High Mast Camera Poles Foundation Analysis and Recommendations

We understand that new High Mast Camera poles are planned for installation in the vicinity of borings B-001-0-25 and B-002-0-25. For this study, High Mast Camera poles with a height of 90 feet above ground were assumed. Both concrete and steel pole options were evaluated based on the loading specifications and pole geometry report provided by American Structurepoint Inc. on September 19, 2025.

A lateral load (p-y) analysis was conducted using LPILE v2016 (Ensoft, Inc.) to assess lateral deflection at the Service Limit State and overturning at the Extreme and Strength Limit States. Load combinations for the analysis were supplied by American Structurepoint, Inc. via email dated September 19, 2025. The were performed based on:

1. Estimated engineering soil properties and lateral load analysis soil parameters provided in Tables 2 through 5 of this report.
2. Loads, load combinations, deflection criteria, and concrete and steel poles properties listed in the loading specifications and pole geometry report provided by American Structurepoint Inc.
3. ODOT standard drawing TC-21.21 (Foundations).
4. An embedded concrete pole foundation system.
5. Fixed-Tip, Non-Fixed Tip, and failure criteria specified in the ODOT'S GDM Section 1200.

For analysis purposes, the top 3 feet of soil from the proposed ground surface was assumed to consist of soft clay with undrained shear strength $S_u = 250$ psf to account for soil weakened by freeze-thaw cycles or other disturbances. Groundwater was assumed to be located 3 ft below the proposed ground surface, in accordance with ODOT's GDM Section 1200.

Based on the results of our p-y analysis, we recommend that the concrete pole be embedded 18 feet into the ground for the Fixed Tip condition with a base diameter of 29.84 inches. For the steel pole option, a drilled shaft with a diameter of 42 inches is recommended with an embedment depth of 23 feet below the ground surface for the Fixed-Tip condition and 14 ft below the ground surface for the Non-Fixed Tip condition. NEAS recommends that Non-Fixed Tip condition for the Steel Camera Pole be utilized for plan development. Reinforcement shall conform to ODOT Standard Drawing TC-21.21 for a 42-inch diameter drilled shaft.

The calculated deflections at the Service Limit State at the top of the poles are presented in Tables 6 and 7. The results indicated that the calculated deflection satisfy the permitted deflection criteria. A summary of the p-y analysis results is in Tables 6 through 8 below.

Table 6: **Fixed-Tip** - Concrete Camera Pole p-y Analysis Results

High Mast Camera Pole Location	High Mast Camera Pole Height Above Ground (ft)	High Mast Camera Pole Foundation Depth (ft)	Service I Limit State						
			A	B	C=A+B	C/A	Fixed-Tip Criterion Met (Differential Deflection / Foundation Head Deflection < 1.005)	Lateral Rotation at Foundation Head (radians)	Lateral Deflection at Pole Head (in)
			Foundation Head Deflection (in)	Foundation Tip Deflection (in)	Differential Deflection over Foundation Length (in)	Differential Deflection / Foundation Head Deflection			
B-001-0-25	90	18	0.01396	0.000063	0.014023	1.004499	Yes	0.00020	0.23
B-002-0-25	90	18	0.01388	0.000042	0.013922	1.003033	Yes	0.00020	0.23

Table 7: Fixed-Tip - Steel Camera Pole p-y Analysis Results

High Mast Camera Pole Location	High Mast Camera Pole Height Above Ground (ft)	High Mast Camera Pole Foundation Depth (ft)	Drilled Shaft Diameter (in)	Service I Limit State						
				A	B	C=A+B	C/A	Fixed-Tip Criterion Met (Differential Deflection / Foundation Head Deflection <1.005)	Lateral Rotation at Foundation Head (radians)	Lateral Deflection at Pole Head (in)
				Foundation Head Deflection (in)	Foundation Tip Deflection (in)	Differential Deflection over Foundation Length (in)	Differential Deflection / Foundation Head Deflection			
B-001-0-25	90	23	42	0.00237	0.000007	0.002377	1.002810	Yes	0.00003	0.03
B-002-0-25	90	23	42	0.00234	0.000002	0.002342	1.000778	Yes	0.00003	0.03

Table 8: Non-Fixed Tip - Steel Camera Pole p-y Analysis Results

High Mast Camera Pole Location	High Mast Camera Pole Height Above Ground (ft)	High Mast Camera Pole Foundation Depth (ft)	Drilled Shaft Diameter (in)	Service I Limit State						
				A	B	C=A+B	C/A	Non-Fixed Tip Criterion Met (1.005<Differential Deflection / Foundation Head Deflection<1.15)	Lateral Rotation at Foundation Head (radians)	Lateral Deflection at Pole Head (in)
				Foundation Head Deflection (in)	Foundation Tip Deflection (in)	Differential Deflection over Foundation Length (in)	Differential Deflection / Foundation Head Deflection			
B-001-0-25	90	14	42	0.00494	0.000593	0.005533	1.120040	Yes	0.00005	0.06
B-002-0-25	90	14	42	0.00468	0.000534	0.005214	1.114103	Yes	0.00004	0.05

5. Qualifications

This investigation was performed in accordance with accepted geotechnical engineering practice for the purpose of characterizing the subsurface conditions at the site of the proposed PRE-70-0.00 (PID: 117139) project. This report has been prepared for American Structurepoint Inc., ODOT and their design consultants to be used solely in evaluating the soils underlying the indicated structures and presenting geotechnical engineering recommendations specific to this project. The assessment of general site environmental conditions or the presence of pollutants in the soil, rock and groundwater of the site was beyond the scope of this geotechnical exploration. Our recommendations are based on the results of our field explorations, laboratory tests results from representative soil samples, loading specifications and pole geometry report provided by American Structurepoint Inc., and geotechnical engineering analyses. This design memo does not reflect any variations that may occur between the borings or elsewhere on the site, or variations whose nature and extent may not become evident until a later stage of construction. In the event that any changes occur in the nature, design or location of the proposed structural work, the conclusions and recommendations contained in this memo should not be considered valid until they are reviewed and have been modified or verified in writing by a geotechnical engineer.

It has been a pleasure to be of service to American Structurepoint in performing this geotechnical exploration for the PRE-70-0.00 (PID: 117139) project. Please call if there are any questions, or if we can be of further service.

REFERENCES

- AASHTO. (2020). *LRFD Bridge Design Specifications*. Washington, D.C.: American Association of State Highway and Transportation Officials.
- ODOT [1]. (2025). *Specifications for Geotechnical Explorations*. Ohio Department of Transportation: Office of Geotechnical Engineering.
- ODOT [2]. (2025). *Geotechnical Design Manual*. Ohio Department of Transportation: Office of Geotechnical Engineering.
- ODOT [3]. (2025). *Standard Construction Drawing TC-21.21: Foundations*. Columbus: Ohio Department of Transportation: Office of Roadway Engineering – Traffic.
- ODOT. (2025). *2025 Bridge Design Manual*. Columbus, OH: Ohio Department of Transportation: Office of Structural Engineering.

APPENDIX A

SITE PLAN

PRE-70-0.00 PID 117139

BORING PLAN
TRUCK PARKING HIGH MAST LIGHT POLES

Legend

 BORING

B-001-0-25

B-002-0-25

Dwight D. Eisenhower Hwy

Dwight D. Eisenhower Hwy

Google Earth

Image © 2025 Airbus



800 ft

APPENDIX B

BORING LOGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT GDT - 7/28/25 08:43 - X11ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\PRE-70 TRUCK STOP\GINT FILES\PRE-70-0.00 TRUCKSTOP.G

PROJECT: PRE-70-0.00		DRILLING FIRM / OPERATOR: NEAS INC. / RW		DRILL RIG: CME 45B		STATION / OFFSET:		EXPLORATION ID												
TYPE: LIGHT TOWER		SAMPLING FIRM / LOGGER: NEAS INC. / NS		HAMMER: CME AUTOMATIC		ALIGNMENT:		B-001-0-25												
PID: SFN:		DRILLING METHOD: 2.25 HSA		CALIBRATION DATE: 3/8/24		ELEVATION: 1223.0 (MSL) EOB: 25.0 ft.		PAGE												
START: 7/18/25 END: 7/18/25		SAMPLING METHOD: SPT		ENERGY RATIO (%): 79		LAT / LONG: 39.830216, -84.761380		1 OF 1												
MATERIAL DESCRIPTION AND NOTES		ELEV.	DEPTHS		SPT/RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	BACK FILL
		1223.0								GR	CS	FS	SI	CL	LL	PL	PI			
6.0" TOPSOIL (DRILLERS DESCRIPTION)		1222.5																		
VERY DENSE, GRAY, GRAVEL WITH SAND, LITTLE SILT, TRACE CLAY, DAMP		1221.0	1		50/2"	-	100	SS-1	-	-	-	-	-	-	-	-	-	4	A-1-b (V)	
VERY STIFF, BROWN, SANDY SILT, LITTLE CLAY, LITTLE GRAVEL, DAMP			2																	
			3																	
			4		2															
			5		4	12	56	SS-2	3.75	11	15	26	32	16	17	12	5	10	A-4a (3)	
			6																	
			7		3															
			8																	
			9		3															
			10		4	12	44	SS-4	4.00	-	-	-	-	-	-	-	-	11	A-4a (V)	
		1212.5	11																	
VERY STIFF TO HARD, GRAY BECOMING BROWNISH GRAY, SANDY SILT, LITTLE CLAY, TRACE TO LITTLE GRAVEL, DAMP TO MOIST			12		3	9	50	SS-5	3.50	12	13	20	37	18	18	12	6	11	A-4a (4)	
			13																	
			14		2															
			15		5	17	44	SS-6	4.25	-	-	-	-	-	-	-	-	10	A-4a (V)	
			16																	
			17		3															
			18		4	13	67	SS-7	3.50	14	14	22	35	15	18	11	7	10	A-4a (3)	
			19																	
			20		3															
			21		4	13	72	SS-8	4.50	-	-	-	-	-	-	-	-	12	A-4a (V)	
			22																	
			23		3															
			24		6	17	50	SS-9	2.75	-	-	-	-	-	-	-	-	12	A-4a (V)	
			25																	
		1198.0	24		4	16	56	SS-10	4.25	-	-	-	-	-	-	-	-	12	A-4a (V)	
			25		6															
			EOB																	
NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE CAVE-IN 23.0'. BORING OFFSET 5' NORTH.																				
ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 1 BAG HOLE PLUG; SHOVELED SOIL CUTTINGS																				

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT GDT - 7/28/25 08:43 - X11ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\PRE-70 TRUCK STOP\GINT FILES\PRE-70-0.00 TRUCKSTOP.G

PROJECT: PRE-70-0.00		DRILLING FIRM / OPERATOR: NEAS INC. / RW		DRILL RIG: CME 45B		STATION / OFFSET:		EXPLORATION ID												
TYPE: LIGHT TOWER		SAMPLING FIRM / LOGGER: NEAS INC. / NS		HAMMER: CME AUTOMATIC		ALIGNMENT:		B-002-0-25												
PID: SFN:		DRILLING METHOD: 2.25 HSA		CALIBRATION DATE: 3/8/24		ELEVATION: 1216.3 (MSL) EOB: 25.0 ft.		PAGE												
START: 7/18/25 END: 7/18/25		SAMPLING METHOD: SPT		ENERGY RATIO (%): 79		LAT / LONG: 39.829972, -84.758691		1 OF 1												
MATERIAL DESCRIPTION AND NOTES			ELEV.	DEPTHS		SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			ODOT CLASS (GI)	BACK FILL
			1216.3								GR	CS	FS	SI	CL	LL	PL	PI	WC	
6.0" TOPSOIL (DRILLERS DESCRIPTION)			1215.8																	
HARD, BROWN, SANDY SILT, LITTLE GRAVEL, LITTLE CLAY, MOIST TO DAMP				1		5													17	A-4a (V)
				2		5	14	17	SS-1	4.50	-	-	-	-	-	-	-	-		
				3																
@3.5'; SS-2 CONTAINS NO INTACT SOIL FOR HP READINGS				4		3	9	17	SS-2	-	-	-	-	-	-	-	-	-	17	A-4a (V)
				5		4														
				6		5														
				7		6	18	72	SS-3	4.50	16	13	25	31	15	19	13	6	10	A-4a (2)
				8		8														
				9		2														
				10		6	16	78	SS-4	4.25	-	-	-	-	-	-	-	-	11	A-4a (V)
VERY STIFF TO HARD, GRAY BECOMING BROWNISH GRAY, SANDY SILT, LITTLE CLAY, TRACE TO LITTLE GRAVEL, DAMP TO MOIST			1205.8																	
				11		4														
				12		7	25	72	SS-5	4.50	18	11	19	34	18	20	13	7	10	A-4a (3)
				13		12														
				14		3														
				15		4	13	78	SS-6	4.50	-	-	-	-	-	-	-	-	10	A-4a (V)
				16		6														
				17		3	18	67	SS-7	4.50	-	-	-	-	-	-	-	-	10	A-4a (V)
				18		8														
				19		2														
				20		5	14	61	SS-8	4.25	-	-	-	-	-	-	-	-	10	A-4a (V)
				21		6														
				22		3	18	56	SS-9	3.50	10	11	25	36	18	18	10	8	12	A-4a (4)
				23		8														
				24		4														
			1191.3	25		6	17	56	SS-10	4.00	-	-	-	-	-	-	-	-	11	A-4a (V)
				EOB		7														
NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE CAVE-IN 23.0'. DRILLED AS STAKED.																				
ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 1 BAG HOLE PLUG; SHOVELED SOIL CUTTINGS																				