Testing Engineers & Consultants, Inc.

Wayne State University
5454 Cass Avenue
Detroit, Michigan 48202

GEOTECHNICAL INVESTIGATION

FOR

Proposed Softball Field Lighting
Wayne State University Athletic Field
5071 John C. Lodge Service Drive
Detroit, Michigan

TEC Report: 60663

By:

Testing Engineers & Consultants, Inc.
1343 Rochester Road
P.O. Box 249
Troy, Michigan 48099-0249
(248) 588-6200

March 3, 2020

Testing Engineers & Consultants, Inc.
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Engineering Client Success

TEC Report: 60663
Date Issued: March 3, 2020

Ms. Alyesa Valentine, Construction Project Manager
Wayne State University
5454 Cass Avenue
Detroit, Michigan 48202

Re: Geotechnical Investigation for
Proposed Softball Field Lighting
Wayne State University Athletic Field
5071 John C. Lodge Service Drive
Detroit, Michigan

Dear Ms. Valentine:

Please find enclosed the results of a geotechnical investigation performed at the above referenced site. This geotechnical report presents our field and laboratory results; engineering analysis; and our recommendations for design of foundation for the proposed outdoor sports lighting fixtures.

As you may know, Testing Engineers & Consultants, Inc. (TEC) has fifty three years of experience in Quality Control Testing and Construction Inspection. We would be pleased to provide these services on this project.

Should you have any questions regarding this report, please let us know. It has been a pleasure to be of service to you.

Respectfully submitted,

TESTING ENGINEERS & CONSULTANTS, INC.

Carey J. Suhan, P.E.,
Vice President, Geotechnical
& Environmental Services

CJS/ln
Enclosure

Testing Engineers & Consultants, Inc.

Ms. Alyesa Valentine
Wayne State University
March 3, 2020

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Ms. Alyesa Valentine
Wayne State University
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1.0 INTRODUCTION

This report presents the results of a geotechnical investigation for the proposed light towers for the softball field at the Wayne State University athletic field. Authorization to perform this investigation was given verbally by Ms. Alyesa Valentine on January 22, 2020 in accordance with TEC Proposal 060-19-378 and our Master Agreement and Contract for Professional Services with Wayne State University.

The purpose of this investigation was to obtain information necessary to determine basic engineering properties of soils at the site through a series of test borings and laboratory tests performed on the soil samples obtained during the field investigation. This information has been evaluated to provide the general recommendations for site development preparations, foundation requirements and other geotechnical information.

2.0 FIELD INVESTIGATION

Six test borings were drilled on the site at the locations shown on the Test Boring Location Plan. Boring No. 1 was relocated 10 feet to the east from its original location due to conflict with underground utilities. Boring No. 2 was relocated 31 feet to the east from its original location due to the obstruction of a fence. The locations are accurate to within a short distance of the locations shown on the location plan included in the appendix. The test borings were drilled on February 4 and 5, 2020 with auger equipment mounted on an all-terrain vehicle (ATV) to depths of 23 and 30 feet. Boring No. 4 was to be drilled to a depth of 30 feet but was terminated at a depth of 23 feet due to the obstruction of a possible sewer. We believe the sewer was penetrated by the augers. The borehole was plugged above this depth, but the sewer should be permanently repaired. This was discussed with the client. The ATV drill rig was required to minimize damage to the lawn areas.

Drilling methods and standard penetration tests were performed in general accordance with the current ASTM D1452 and D1586 procedures, respectively. These procedures specify that a standard 2-inch O.D. split-barrel sampler be driven by a 140-pound hammer with a free fall of 30 inches. The number of hammer blows required to drive the split-barrel sampler through three successive 6-inch increments is recorded on the Test Boring Log. The first 6-inch increment is used for setting the sampler firmly in the soil and the sum of the hammer blows for the second and third increments is referred to as the "Standard Penetration Index" (N).

From the standard penetration test a soil sample is recovered in the liner sampler tubes that are located inside the split-barrel sampler. Upon recovery of a soil sample, the liner tubes are removed from the split-barrel sampler and placed in a container which is sealed to minimize

2.0 FIELD INVESTIGATION (Cont'd)

moisture losses during transportation to the laboratory. Standard penetration tests are usually made at depths of 2 ½, 5, 7 ½ and 10 feet and at 5-foot depth intervals thereafter. These parameters may vary for a given project depending on the nature of the subsoils and the geotechnical information required.

3.0 LABORATORY TESTING

The laboratory testing consisted of determining the unconfined compressive strength, the natural bulk density and the natural moisture content of the soil samples recovered in the liner sampler tubes. In the unconfined compression tests, the compressive strength of the soil is determined by axially loading a soil sample until failure is observed or 15% strain, whichever occurs first. The above referenced test data are recorded on the boring logs. Some test results may deviate from the norm because of variations in texture, imperfect samples, presence of pebbles and/or sand streaks, etc. The results are still reported although they may not be relevant.

In addition to the above tests, the Atterberg Limits of three fine-grained soil samples were determined. The Atterberg Limits are water contents at which cohesive fine-grained soils change behavior. They are used for soil classification, and they have been correlated to several important engineering properties of a soil. As such, they can be used to obtain inexpensive estimates of fine-grained soil behavior. The Atterberg Limits are included in the corresponding boring logs in the appendix.

Samples taken in the field are retained in our laboratory for 60 days and are then destroyed unless special disposition is requested by the client. Samples retained over a long period of time are subject to moisture loss and are then no longer representative of the conditions initially encountered.

4.0 GENERAL SUBSURFACE CONDITIONS

4.1 Subsoil Conditions

The soil conditions encountered in the borings are presented on the individual boring logs. Each log presents the soil types encountered at that location as well as laboratory test data, ground water data, and other pertinent information. Descriptions of the various soil consistencies, relative densities and particle sizes are given in the Appendix. Definitions of the terms and symbols utilized in this report may be found in ASTM D653.

4.1 Subsoil Conditions (Cont'd)

The ground surface at the boring locations was covered with 8 inches to 1.8 feet of clayey topsoil. Fill was encountered below the topsoil in all of the borings. The fill generally consisted of plastic to extremely stiff clay that extended to depths ranging from 2 to 5 ½ feet at Boring Nos. 1 through 3, 5 and 6. At Boring No. 4, the fill extended to the terminal depth of the boring which terminated at a depth of 23 feet due to the obstruction of a possible underground sewer. The deep fill is likely backfill over the deep sewer. A trace to some concrete and brick were encountered in the upper 3 to 5 ½ feet of the fill.

At Boring No. 3, a layer of loose clayey sand fill with some concrete and brick was encountered at a depth of 3 feet below existing ground surface extending to a depth of 5 ½ feet. At Boring No. 5, the fill consisted of broken concrete and brick. The fill extended to a depth of 2 feet. At Boring No. 6, a layer of broken concrete fill was encountered at a depth of 1.3 feet. The fill was 8 ½ inches thick. Additional fill consisting of loose sand extended to a depth of 4 feet.

The underlying native soils were plastic to extremely stiff clay with some silt that extended to the terminal depth of the borings. The clays generally increased in consistency (strength) with depth, becoming stiff to extremely stiff at depths ranging from 4 to 8 feet and then decreasing in consistency at depths ranging from 12 ½ to 21 feet. Atterberg Limits tests indicate the clays are low to medium in plasticity.

Standard penetration values range from 2 to 43 blows per foot with unconfined compressive strengths of 1,650 to 12,960 pounds per square foot (psf). Bulk densities range from 117 to 140 pounds per cubic foot with moisture contents of 10.5 to 24 percent of the dry weight of the soil.

4.2 Ground Water Observations

Water level readings were taken in the bore holes during and after the completion of drilling. These observations are noted on the respective Test Boring Logs. Ground water was first encountered in Boring No. 4 at a depth of 22 feet below existing ground surface. After completion of drilling and removal of the hollow stem augers, which act as casing during drilling, the borehole caved in at a depth of 15 feet. No water was noted in the other borings either during drilling or after completion of drilling.

5.0 ANALYSIS AND RECOMMENDATIONS

5.1 Proposed Project

The proposed development is to consist of construction of six light towers around an existing softball field. The light pole bases will be Musco precast foundations.

5.2 Foundation Recommendations

No data on the foundation and pole assembly was provided. We have used in our analysis design parameters previously used on MUSCO lighting fixtures analyses from other TEC projects. The foundations were analyzed for vertical, shear and moment loading conditions. Horizontal and moment loading governs this design. The loads below are similar to loads provided by MUSCO lighting from previous projects.

Vertical Load – 1.93 kips
Shear Load – 1.35 kips
Moment – 66.1 ft.-kips

The native soils beginning at a depth of about 12 feet below existing ground surface will provide adequate support for the new light pole fixtures. Lateral deflection at the ground surface is expected to be less than 0.5 inch.

Deep foundation analyses were performed using All Pile 7.0, by Civil Tech Software™. We used a 30 inch diameter concrete pier installed for each light pole location. The deep foundation analyses considered vertical loading, shear and moment and a "Free Head" condition. Since the soils encountered at Boring No. 4 was deep fill that is considered to be backfill over a sewer pipe, we recommend that the light pole foundation be offset so that the foundation bears on the native clays at a depth of 12 feet. We assume that the soil conditions outside of the deep fill zone are similar to those found in the other borings.

Lightpole Foundation

Boring No.	1
Topsoil (Inches)	13
Fill[A] (Feet)	4.5/12
Native Clay[A] (Feet)	30/4900
Ground Water Table	None
Recommended Foundation Invert Depth	**12**
Pier Bottom In	Extremely Stiff Clay With Some Silt
Lateral Deflection (Inches)	0.25
NOTES: A – Depth to bottom of layer in feet/average N-value or shear strength in psf. B – Casing required.	

5.2 Foundation Recommendations (Cont'd)

Boring No.	2
Topsoil (Inches)	10
Fill[A] (Feet)	4.5/17
Native Clay[A] (Feet)	30/4320
Ground Water Table	None
Recommended Foundation Invert Depth	**12**
Pier Bottom In	Extremely Stiff Clay With Some Silt
Lateral Deflection (Inches)	0.36
NOTES: A – Depth to bottom of layer in feet/average N-value or shear strength in psf. B – Casing required.	

Boring No.	3
Topsoil (Inches)	8
Fill[A] (Feet)	5.5/11
Native Clay[A] (Feet)	30/6480
Ground Water Table	None
Recommended Foundation Invert Depth	**12 (B)**
Pier Bottom In	Extremely Stiff Clay With Some Silt
Lateral Deflection (Inches)	0.39
NOTES: A – Depth to bottom of layer in feet/average N-value of shear strength in psf. B – Casing required.	

Boring No.	5
Topsoil (Inches)	15 ½
Fill[A] (Feet)	2
Native Clay[A] (Feet)	30/6140
Ground Water Table	None
Recommended Foundation Invert Depth	**12**
Pier Bottom In	Extremely Stiff Clay With Some Silt
Lateral Deflection (Inches)	0.09
NOTES: A – Depth to bottom of layer in feet/average N-value of shear strength in psf. B – Casing required.	

5.2 Foundation Recommendations (Cont'd)

Boring No.	6
Topsoil (Inches)	10
Fill[A] (Feet)	4/5'3"
Native Clay[A] (Feet)	30
Ground Water Table	None
Recommended Foundation Invert Depth	**12 (B)**
Pier Bottom In	Extremely Stiff Clay With Some Silt
Lateral Deflection (Inches)	0.31
NOTES: A – Depth to bottom of layer in feet/average N-value of shear strength in psf. B – Casing required.	

TEC recommends the use of 30-inch diameter concrete piers extending to 12 feet below existing grade. Lateral deflection at the pile head is relatively small for each condition.

Casing will be required in the pier holes at Boring Nos. 3 and 6 extending to depths of 5 ½ and 4 feet, respectively, due to loose clayey sand fill and broken concrete fill.

6.0 DESIGN REVIEW AND FIELD MONITORING

Soil conditions at the site could vary from those generalized on the basis of test borings made at specific locations. It is therefore recommended that Testing Engineers & Consultants, Inc. be retained to provide soil engineering services during the site preparation, excavation and foundation phases of the proposed project. This is to observe compliance with the design concepts, specifications and recommendations. Also, this provides opportunity for design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction.

Gary E. Putt, P.E.
Senior Project Engineer

Carey J. Suhan, P.E.
Vice President, Geotechnical
& Environmental Services

GEP/CJS/ln
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Testing Engineers & Consultants, Inc.

Ms. Alyesa Valentine
Wayne State University
March 3, 2020

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APPENDIX

Test Boring Location Plan

Logs Of Test Borings

All-Pile Foundation Analysis

General Notes For Soil Classification

Testing Engineers & Consultants, Inc.

Ms. Alyesa Valentine
Wayne State University
March 3, 2020

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SOIL DESCRIPTIONS

In order to provide uniformity throughout our projects, the following nomenclature has been adopted to describe soil characteristics:

CONSISTENCY AND RELATIVE DENSITY

COHESIVE SOILS			GRANULAR SOILS	
UNCONFINED COMPRESSIVE STRENGTH, PSF	**"N" VALUES**	**CONSISTENCY**	**"N" VALUES**	**RELATIVE DENSITY**
Below 500	0 – 2	Very Soft	0 – 4	Very Loose
500 – 1,000	3 – 4	Soft	5 – 10	Loose
1,000 – 2,000	5 – 8	Plastic	11 – 30	Medium Compact
2,000 – 4,000	9 – 15	Firm	31 – 50	Compact
4,000 – 8,000	16 – 30	Stiff	50+	Dense
8,000 – 16,000	31 – 50	Ex. Stiff		
Over 16,000	51+	Hard		

Material Types By Particle Size	**ASTM D2487**
BOULDERS	Stones Over 12" In Diameter
COBBLES	Stones 3" To 12" In Diameter
GRAVEL	#4 To 3" Diameter
COARSE SAND	#10 To #4 Sieves
MEDIUM SAND	#40 To #10 Sieves

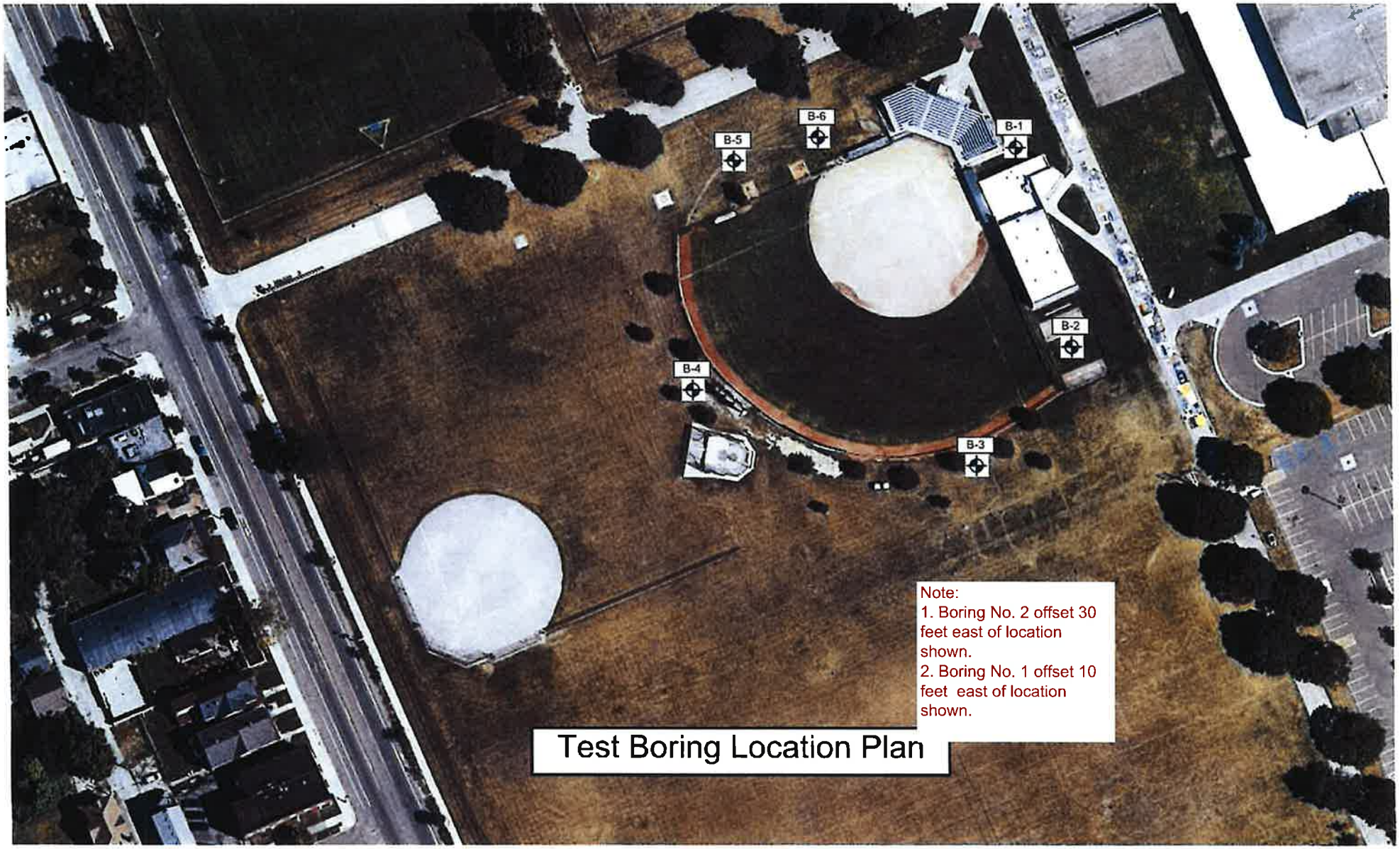
Testing Engineers & Consultants, Inc.

Ms. Alyesa Valentine
Wayne State University
March 3, 2020

TEC Report: 60663

SOIL DESCRIPTIONS (Cont'd)

Material Types By Particle Size	**ASTM D2487**
FINE SAND	#200 To #40 Sieves
SILT	Minus #200 Sieve Material, Fairly Non-Plastic, Falls Below "A"-Line
CLAY	Minus #200 Sieve Material Plastic Material That Has A Tendency To Stick Together, Can Be Rolled Into Fine Rods When Moistened; Falls Above "A"-Line
PEAT	Black Organic Material Containing Partially Decayed Vegetable Matter
MARL	Fresh Water Deposits Of Calcium Carbonate, Often Containing Percentages Of Peat, Clay & Fine Sand
SWAMP BOTTOM DEPOSITS	Mixtures Of Peat, Marl, Vegetation & Fine Sand Containing Large Amounts Of Decayable Organic Material



Test Boring Location Plan

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(248) 588-6200 or (313) T-E-S-T-I-N-G
Fax (248) 588-6232

Boring No.: 1 **Job No.:** 60663

Project: Proposed Softball Field Lighting

Client: Wayne State University

Location: Detroit, Michigan

Type of Rig: All-Terrain Vehicle

Drilled By: I. Mickle

Drilling Method: Hollow Stem Augers

Started: 2/4/2020

Ground Surface Elevation:

Completed: 2/4/2020

Depth (ft)	Sample Type	N	Strata Change	Soil Classification	w	d	qu
	LS	3 8 12	1.1	Moist Dark Brown Clayey TOPSOIL	18.4	131	
2.5			3	Stiff Moist Dark Brown Clay With Some Silt, Trace Of Brick, Concrete & Wire-FILL			
	LS	4 2 3	4.5	Plastic Moist Dark Brown Clay With Some Silt-FILL	24.1	125	
5.0				Firm Moist Brown Oxidized CLAY With Some Silt LL=20 PL=14 PI=6			
	LS	3 4 6			20.0	129	
7.5			8				
	LS	7 13 19		Extremely Stiff Moist Brown CLAY With Some Silt & Trace Of Gravel	12.5	120	9810
10.0							
12.5							
	LS	9 18 25			13.1	135	11540
15.0							
			16.5				
17.5				Stiff Moist Gray CLAY With Some Silt & Trace Of Gravel			
	LS	3 6 8			13.2	137	4530
20.0			21				
				Firm Moist Gray CLAY With Some Silt & Trace Of Gravel			
22.5							
	LS	4 4 6			16.9	127	2470

"N" - Standard Penetration Resistance
SS - 2") D. Split Spoon Sample
LS - Sectional Liner Sample
ST - Shelby Tube Sample
AS - Auger Sample

w - H2O, % of dry weight
d - Bulk Density, pcf
qu - Unconfined Compression, tsf
DP - Direct Push
RC - Rock Core

Water Encountered: None

At Completion: None

Boring No. 1

Testing Engineers & Consultants, Inc.

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Boring No.: 1 **Job No.:** 60663

Project: Proposed Softball Field Lighting

Client: Wayne State University

Location: Detroit, Michigan

Type of Rig: All-Terrain Vehicle

Drilled By: I. Mickle

Drilling Method: Hollow Stem Augers

Started: 2/4/2020

Ground Surface Elevation:

Completed: 2/4/2020

Depth (ft)	Sample Type	N	Strata Change	Soil Classification	w	d	qu
27.5	LS	3 4 4	30		15.6	137	
30.0				Moved 10' East Due To Utilities Bottom of Boring at 30'			
32.5							
35.0							
37.5							
40.0							
42.5							
45.0							
47.5							

"N" - Standard Penetration Resistance
SS - 2" I.D. Split Spoon Sample
LS - Sectional Liner Sample
ST - Shelby Tube Sample
AS - Auger Sample

w - H2O, % of dry weight
d - Bulk Density, pcf
qu - Unconfined Compression, tsf
DP - Direct Push
RC - Rock Core

Water Encountered: None

At Completion: None

Boring No. 1

Testing Engineers & Consultants, Inc.

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Boring No.: 2 **Job No.:** 60663

Project: Proposed Softball Field Lighting

Client: Wayne State University

Location: Detroit, Michigan

Type of Rig: All-Terrain Vehicle

Drilled By: I. Mickle

Drilling Method: Hollow Stem Augers

Started: 2/5/2020

Groumd Surface Elevation:

Completed: 2/5/2020

Depth (ft)	Sample Type	N	Strata Change	Soil Classification	w	d	qu
			.83	Moist Dark Brown Clayey TOPSOIL (10")			
	LS	5 10			11.8	139	
2.5		16	3	Stiff Moist Dark Brown Clay With Some Silt & Broken Concrete At 2.7'-FILL			
	LS	3 4	4.5	Plastic Moist Dark Brown Clay With Some Silt-FILL	17.9	131	
5.0		4		Plastic Moist Brown Oxidized CLAY With Some Silt			
	LS	2 2			16.6	133	
7.5		4	8				
	LS	7 16		Extremely Stiff Moist Brown CLAY With Some Silt & Thin Sand Seams	12.2	137	8650
10.0		23					
12.5			13				
	LS	4 10		Extremely Stiff Moist Gray Oxidized CLAY With Some Silt & Trace Of Gravel	12.1	137	8650
15.0		14	16				
17.5				Stiff Moist Gray CLAY With Some Silt, Trace Of Gravel & Occasional Sand Seams			
	LS	3 6			12.9	137	4370
20.0		8	21				
22.5				Firm Moist Gray CLAY With Some Silt, Trace Of Gravel & Occasional Sand Seams			
	LS	3 5 7			14.0	137	3430

"N" - Standard Penetration Resistance
SS - 2" I.D. Split Spoon Sample
LS - Sectional Liner Sample
ST - Shelby Tube Sample
AS - Auger Sample

w - H2O, % of dry weight
d - Bulk Density, pcf
qu - Unconfined Compression, tsf
DP - Direct Push
RC - Rock Core

Water Encountered: None

At Completion: None

Boring No. 2

Testing Engineers & Consultants, Inc.

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Boring No.: 2 **Job No.:** 60663

Project: Proposed Softball Field Lighting

Client: Wayne State University

Location: Detroit, Michigan

Type of Rig: All-Terrain Vehicle

Drilled By: I. Mickle

Drilling Method: Hollow Stem Augers

Started: 2/5/2020

Groumd Surface Elevation:

Completed: 2/5/2020

Depth (ft)	Sample Type	N	Strata Change	Soil Classification	w	d	qu
27.5	LS	3 5 5	28 30	Plastic Moist Gray CLAY With Some Silt, Trace Of Gravel & Occasional Sand Seams	13.9	130	1650
30.0				Moved 31' East Due To Fence Bottom of Boring at 30'			
32.5							
35.0							
37.5							
40.0							
42.5							
45.0							
47.5							

"N" - Standard Penetration Resistance
SS - 2") D. Split Spoon Sample
LS - Sectional Liner Sample
ST - Shelby Tube Sample
AS - Auger Sample

w - H2O, % of dry weight
d - Bulk Density, pcf
qu - Unconfined Compression, tsf
DP - Direct Push
RC - Rock Core

Water Encountered: None

At Completion: None

Boring No. 2

Testing Engineers & Consultants, Inc.

1343 Rochester Road - PO Box 249 - Troy, Michigan - 48099-0249
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Boring No.: 3 **Job No.:** 60663

Project: Proposed Softball Field Lighting

Client: Wayne State University

Location: Detroit, Michigan

Type of Rig: All-Terrain Vehicle

Drilled By: I. Mickle

Drilling Method: Hollow Stem Augers

Started: 2/5/2020

Ground Surface Elevation:

Completed: 2/5/2020

Depth (ft)	Sample Type	N	Strata Change	Soil Classification	w	d	qu
			.67	Moist Dark Brown Clayey TOPSOIL (8")			
	LS	4			11.0	140	
		8					
2.5		8	3	Stiff Moist Brown Clay With Some Silt, Trace Of Concrete & Brick-FILL			
	LS	2			17.3	130	
		3		Loose Very Moist Dark Gray Clayey Sand With Concrete & Brick-FILL			
5.0		3	5.5				
	LS	3		Stiff Moist Variegated CLAY With Some Silt	14.6	128	
		6					
7.5		11	8				
	LS	7		Extremely Stiff Moist Brown Oxidized CLAY With Some Silt	12.0	135	12960
		14					
10.0		24					
12.5			13				
	LS	6		Stiff Moist Gray Oxidized CLAY With Some Silt LL=29 PL=12 PI=17	13.0	137	
		14					
15.0		15	16				
				Stiff Moist Gray CLAY With Some Silt & Trace Of Gravel			
17.5							
	LS	3			12.9	138	4370
		6					
20.0		7					
			21				
				Firm Moist Gray CLAY With Some Silt & Trace Of Gravel			
22.5							
	LS	4			12.6	137	3730
		5					
		7					

"N" - Standard Penetration Resistance
SS - 2") D. Split Spoon Sample
LS - Sectional Liner Sample
ST - Shelby Tube Sample
AS - Auger Sample

w - H2O, % of dry weight
d - Bulk Density, pcf
qu - Unconfined Compression, tsf
DP - Direct Push
RC - Rock Core

Water Encountered: None

At Completion: None

Boring No. 3

Testing Engineers & Consultants, Inc.

1343 Rochester Road - PO Box 249 - Troy, Michigan - 48099-0249
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Boring No.: 3 **Job No.:** 60663

Project: Proposed Softball Field Lighting

Client: Wayne State University

Location: Detroit, Michigan

Type of Rig: All-Terrain Vehicle

Drilled By: I. Mickle

Drilling Method: Hollow Stem Augers

Started: 2/5/2020

Ground Surface Elevation:

Completed: 2/5/2020

Depth (ft)	Sample Type	N	Strata Change	Soil Classification	w	d	qu
27.5			28				
	LS	3 4 6		Plastic Moist Gray CLAY With Some Silt & Trace Of Gravel	15.0	131	1650
30.0			30	Bottom of Boring at 30'			
32.5							
35.0							
37.5							
40.0							
42.5							
45.0							
47.5							

"N" - Standard Penetration Resistance
SS - 2").D. Split Spoon Sample
LS - Sectional Liner Sample
ST - Shelby Tube Sample
AS - Auger Sample

w - H2O, % of dry weight
d - Bulk Density, pcf
qu - Unconfined Compression, tsf
DP - Direct Push
RC - Rock Core

Water Encountered: None

At Completion: None

Boring No. 3

Testing Engineers & Consultants, Inc.

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Boring No.: 4 **Job No.:** 60663

Project: Proposed Softball Field Lighting

Client: Wayne State University

Location: Detroit, Michigan

Type of Rig: All-Terrain Vehicle

Drilled By: I. Mickle

Drilling Method: Hollow Stem Augers

Started: 2/5/2020

Ground Surface Elevation:

Completed: 2/5/2020

Depth (ft)	Sample Type	N	Strata Change	Soil Classification	w	d	qu
	LS	3 7 10	1.8	Firm Moist Dark Brown Clayey TOPSOIL	13.3	117	
2.5				Extremely Stiff Moist Brown Clay With Some Silt, Trace Of Brick & Concrete-FILL			
	LS	4 5 9			13.2	138	8240
5.0			5.5				
	LS	3 5 8		Stiff Moist Brown Oxidized Clay With Some Silt-FILL	15.4	133	5360
7.5			8				
	LS	6 14 21		Extremely Stiff Moist Brown Oxidized Clay With Some Silt-FILL	13.3	134	11950
10.0							
12.5			13				
	LS	2 1 1		Soft Moist Gray Oxidized Clay With Some Silt-FILL	14.4	135	
15.0							
17.5			18				
	LS	3 7 3		Firm Gray Clay & Brick-FILL	15.0	127	
20.0							
22.5			23				
				Bottom of Boring at 23'			

"N" - Standard Penetration Resistance
SS - 2").D. Split Spoon Sample
LS - Sectional Liner Sample
ST - Shelby Tube Sample
AS - Auger Sample

w - H2O, % of dry weight
d - Bulk Density, pcf
qu - Unconfined Compression, tsf
DP - Direct Push
RC - Rock Core

Water Encountered: 22'0"

At Completion: Caved In 15'0"

Boring No. 4

Testing Engineers & Consultants, Inc.

1343 Rochester Road - PO Box 249 - Troy, Michigan - 48099-0249
(248) 588-6200 or (313) T-E-S-T-I-N-G
Fax (248) 588-6232

Boring No.: 5 **Job No.:** 60663

Project: Proposed Softball Field Lighting

Client: Wayne State University

Location: Detroit, Michigan

Type of Rig: All-Terrain Vehicle

Drilled By: I. Mickle

Drilling Method: Hollow Stem Augers

Started: 2/4/2020

Groumd Surface Elevation:

Completed: 2/4/2020

Depth (ft)	Sample Type	N	Strata Change	Soil Classification	w	d	qu
	LS	14/4"	1.3	Moist Dark Brown Clayey TOPSOIL	18.9		
			2	Broken Concrete & Brick-FILL			
2.5	LS	3		Firm Moist Brown Oxidized CLAY With Some Silt	14.5	119	2470
		5					
5.0		6					
			5.5				
	LS	4		Stiff Moist Brown Oxidized CLAY With Some Silt	13.2	130	7420
		9					
7.5		12					
			8				
	LS	6		Extremely Stiff Moist Brown CLAY With Some Silt	13.1	132	12280
		16					
10.0		24					
			12.5				
12.5							
	LS	5		Stiff Moist Gray CLAY With Some Silt & Trace Of Gravel	11.8	139	6780
		9					
15.0		12					
			17				
17.5				Firm Moist Gray CLAY With Some Silt & Trace Of Gravel			
	LS	3			15.1	134	3210
		5					
20.0		7					
22.5							
	LS	4			13.1	135	2880
		6					
		7					

"N" - Standard Penetration Resistance
SS - 2" I.D. Split Spoon Sample
LS - Sectional Liner Sample
ST - Shelby Tube Sample
AS - Auger Sample

w - H2O, % of dry weight
d - Bulk Density, pcf
qu - Unconfined Compression, tsf
DP - Direct Push
RC - Rock Core

Water Encountered: None

At Completion: None

Boring No. 5

Testing Engineers & Consultants, Inc.

1343 Rochester Road - PO Box 249 - Troy, Michigan - 48099-0249
(248) 588-6200 or (313) T-E-S-T-I-N-G
Fax (248) 588-6232

Boring No.: 5 **Job No.:** 60663

Project: Proposed Softball Field Lighting

Client: Wayne State University

Location: Detroit, Michigan

Type of Rig: All-Terrain Vehicle

Drilled By: I. Mickle

Drilling Method: Hollow Stem Augers

Started: 2/4/2020

Groumd Surface Elevation:

Completed: 2/4/2020

Depth (ft)	Sample Type	N	Strata Change	Soil Classification	w	d	qu
27.5	LS	3 4 6	30		15.0	133	2470
30.0				Bottom of Boring at 30'			
32.5							
35.0							
37.5							
40.0							
42.5							
45.0							
47.5							

"N" - Standard Penetration Resistance
SS - 2").D. Split Spoon Sample
LS - Sectional Liner Sample
ST - Shelby Tube Sample
AS - Auger Sample

w - H2O, % of dry weight
d - Bulk Density, pcf
qu - Unconfined Compression, tsf
DP - Direct Push
RC - Rock Core

Water Encountered: None

At Completion: None

Boring No. 5

Testing Engineers & Consultants, Inc.

1343 Rochester Road - PO Box 249 - Troy, Michigan - 48099-0249
(248) 588-6200 or (313) T-E-S-T-I-N-G
Fax (248) 588-6232

Boring No.: 6 **Job No.:** 60663

Project: Proposed Softball Field Lighting

Client: Wayne State University

Location: Detroit, Michigan

Type of Rig: All-Terrain Vehicle

Drilled By: I. Mickle

Drilling Method: Hollow Stem Augers

Started: 2/4/2020

Ground Surface Elevation:

Completed: 2/4/2020

Depth (ft)	Sample Type	N	Strata Change	Soil Classification	w	d	qu
	LS	5/3"	.83 1.3 2	Moist Dark Brown Clayey TOPSOIL (10") Firm Moist Brown Clay With Some Silt-FILL (5 1/2")	13.7		
2.5							
	LS	3 4 7	4	Broken CONCRETE (8 1/2") Loose Moist Brown Sand-FILL	14.3	126	4940
5.0							
	LS	5 8 11		Stiff Moist Brown Oxidized CLAY With Some Silt	13.1	129	5770
7.5			8				
	LS	6 13 21		Extremely Stiff Moist Brown Oxidized CLAY With Some Silt	13.4	134	12960
10.0							
12.5			12.5				
	LS	6 9 12		Firm Moist Gray CLAY With Some Silt LL=24 PL=13 PI=11	10.5	127	3710
15.0							
17.5			17				
	LS	4 6 7		Firm Moist Gray CLAY With Some Silt & Trace Of Gravel	13.2	139	3710
20.0							
22.5							
	LS	3 4 5			14.9	135	2060

"N" - Standard Penetration Resistance
SS - 2") .D. Split Spoon Sample
LS - Sectional Liner Sample
ST - Shelby Tube Sample
AS - Auger Sample

w - H2O, % of dry weight
d - Bulk Density, pcf
qu - Unconfined Compression, tsf
DP - Direct Push
RC - Rock Core

Water Encountered: None

At Completion: None

Boring No. 6

Testing Engineers & Consultants, Inc.

1343 Rochester Road - PO Box 249 - Troy, Michigan - 48099-0249
(248) 588-6200 or (313) T-E-S-T-I-N-G
Fax (248) 588-6232

Boring No.: 6 **Job No.:** 60663

Project: Proposed Softball Field Lighting

Client: Wayne State University

Location: Detroit, Michigan

Type of Rig: All-Terrain Vehicle

Drilled By: I. Mickle

Drilling Method: Hollow Stem Augers

Started: 2/4/2020

Ground Surface Elevation:

Completed: 2/4/2020

Depth (ft)	Sample Type	N	Strata Change	Soil Classification	w	d	qu
27.5			28				
	LS	3 3 5	30	Plastic Moist Gray CLAY With Some Silt & Trace Of Gravel	13.0	136	1730
30.0				Bottom of Boring at 30'			
32.5							
35.0							
37.5							
40.0							
42.5							
45.0							
47.5							

"N" - Standard Penetration Resistance
SS - 2").D. Split Spoon Sample
LS - Sectional Liner Sample
ST - Shelby Tube Sample
AS - Auger Sample

w - H2O, % of dry weight
d - Bulk Density, pcf
qu - Unconfined Compression, tsf
DP - Direct Push
RC - Rock Core

Water Encountered: None

At Completion: None

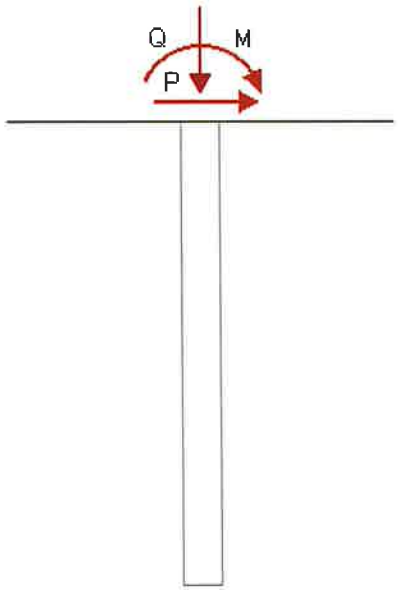
Boring No. 6

FOUNDATION PROFILE & SOIL CONDITIONS

Diameter more than 24in (61cm).
For bell section, select "Belled" in Diameter Variation (Pile Section Screen, Item 4).
Recommendation: 2 to 4 in Item 3 of Page F.

FOUNDATION PROPERTIES

Depth	Width-in	A'-in2	Per.-in	I'-in4	E -kp/i2	W -kp/f
0.0	30	706.9	94.2	39760.8	3000	0.736
Concrete (rough)						
12.0	30	706.9	94.2	39760.8	3000	0.736
Concrete (rough)						



SOIL PROPERTIES

Depth	γ -lb/f3	ϕ	C-kp/f2	k-lb/i3	e50 %	Nspt
0.0	97.0	25.8	0.00	0.3		1
Sand/Gravel						
3.0	118.8	0.0	0.61	39.8	1.35	5
Soft Clay						
4.5	128.8	0.0	1.20	128.2	0.89	10
Soft Clay						
8.0	139.1	0.0	5.04	846.2	0.37	40
Stiff Clay						

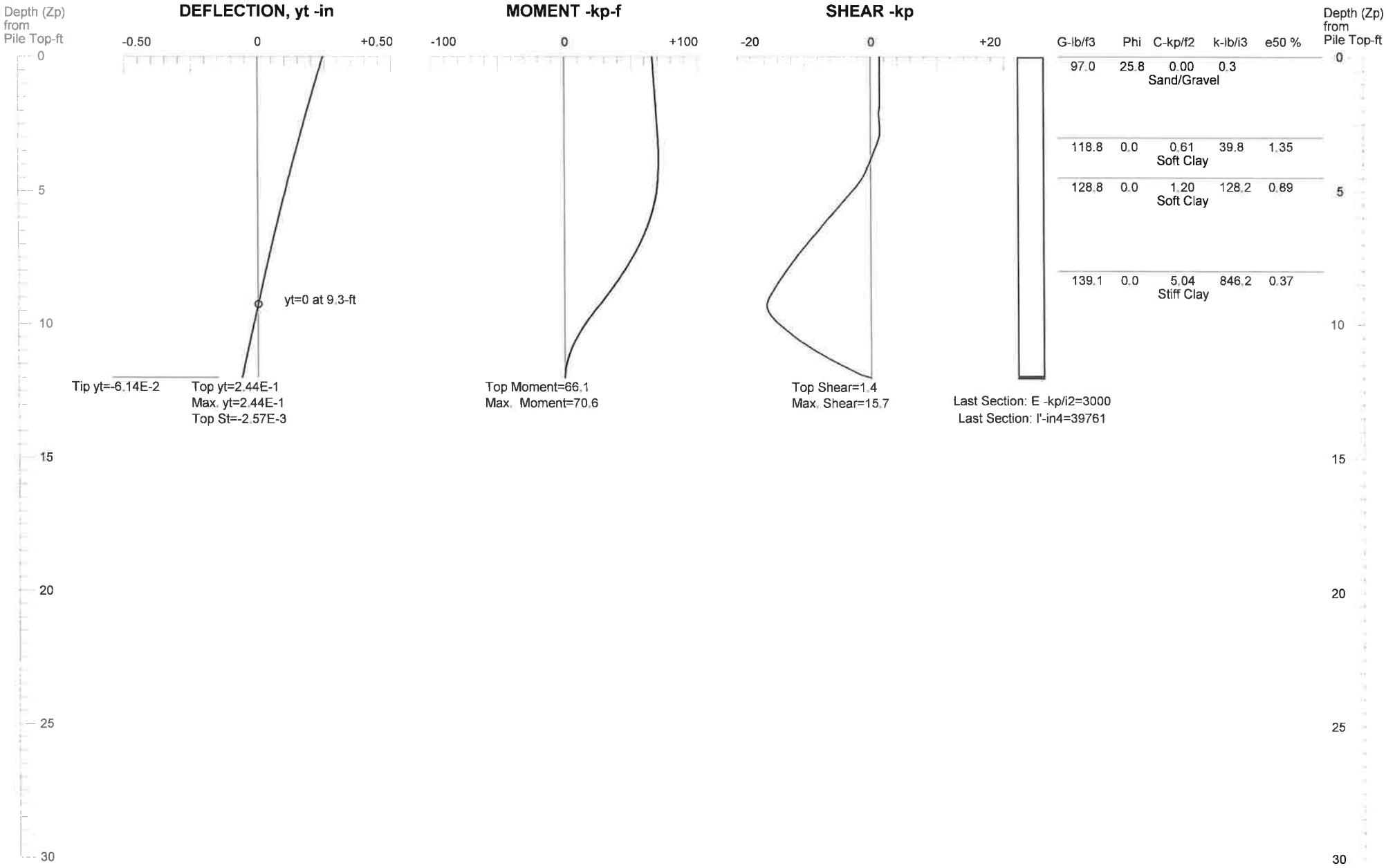
Depth from Ground-ft: 0, 5, 10, 15, 20, 25, 30

Water below Pile Tip (not to scale)

Batter Angle=0 (Pile diameter not to scale) Surface Angle=0

PILE DEFLECTION & FORCE vs DEPTH

Single Pile, Khead=1, Kbc=1



CivilTech Software

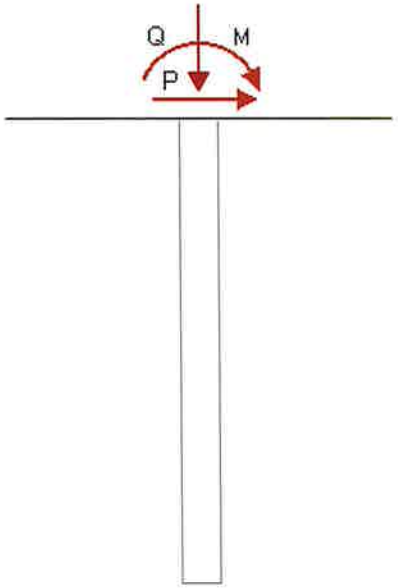
Boring No.1, Proposed Softball Field Lighting
Wayne State University Athletic Field Figure 2

FOUNDATION PROFILE & SOIL CONDITIONS

Diameter more than 24in (61cm).
For bell section, select "Belled" in Diameter Variation (Pile Section Screen, Item 4).
Recommendation: 2 to 4 in Item 3 of Page F.

FOUNDATION PROPERTIES

Depth	Width-in	A'-in2	Per.-in	I'-in4	E -kp/i2	W -kp/f
0.0	30	706.9	94.2	39760.8	3000	0.736
Concrete (rough)						
12.0	30	706.9	94.2	39760.8	3000	0.736
Concrete (rough)						



SOIL PROPERTIES

Depth	γ -lb/f3	ϕ	C-kp/f2	k-lb/i3	e50 %	Nspt
0.0	97.0	25.8	0.00	0.3		1
Sand/Gravel						
3.0	125.9	0.0	0.95	89.3	1.03	8
Soft Clay						
4.5	122.2	0.0	0.75	59.5	1.19	6
Soft Clay						
8.0	137.5	0.0	4.31	705.3	0.41	35
Stiff Clay						

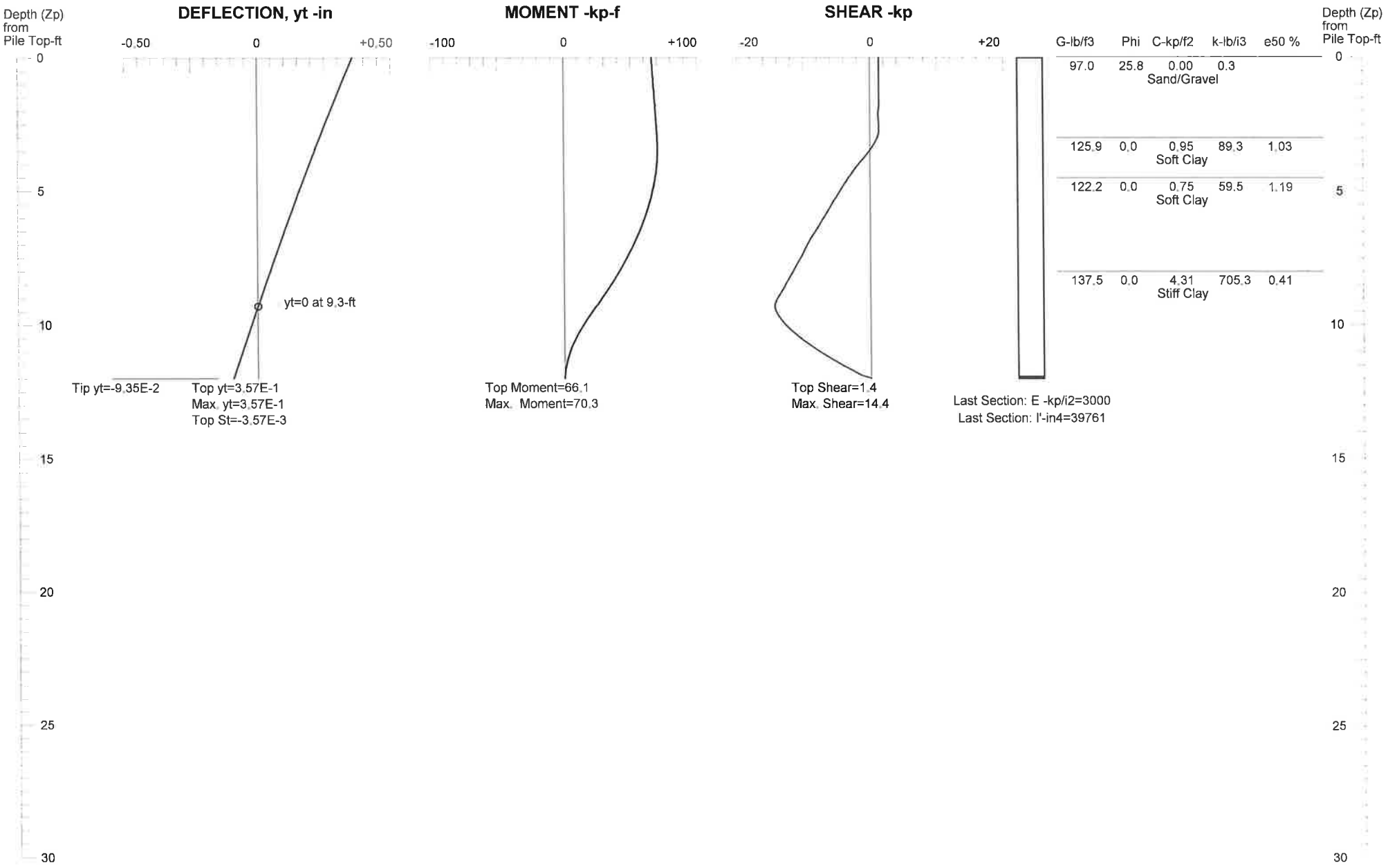
Depth from Ground-ft: 0, 5, 10, 15, 20, 25, 30

Water below Pile Tip (not to scale)

Batter Angle=0 (Pile diameter not to scale) Surface Angle=0

PILE DEFLECTION & FORCE vs DEPTH

Single Pile, Khead=1, Kbc=1



CivilTech Software

Boring No.2, Proposed Softball Field Lighting
Wayne State University Athletic Field Figure 2

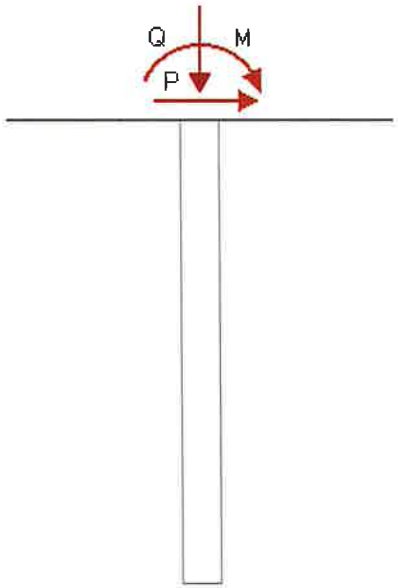
FOUNDATION PROFILE & SOIL CONDITIONS

Diameter more than 24in (61cm).
For bell section, select "Belled" in Diameter Variation (Pile Section Screen, Item 4).
Recommendation: 2 to 4 in Item 3 of Page F.

Depth from Ground-ft

FOUNDATION PROPERTIES

Depth	Width-in	A'-in2	Per.-in	I'-in4	E -kp/i2	W -kp/f
0.0	30	706.9	94.2	39760.8	3000	0.736
Concrete (rough)						
12.0	30	706.9	94.2	39760.8	3000	0.736
Concrete (rough)						



SOIL PROPERTIES

Depth	γ -lb/f3	ϕ	C-kp/f2	k-lb/i3	e50 %	Nspt
0.0	97.0	25.8	0.00	0.3		1
Sand/Gravel						
3.0	109.6	30.8	0.00	21.9		6
Sand/Gravel						
5.5	132.2	0.0	2.10	281.0	0.64	17
Stiff Clay						
8.0	139.8	0.0	6.48	1106.7	0.32	52
Stiff Clay						

Depth from Ground-ft

0 5 10 15 20 25 30

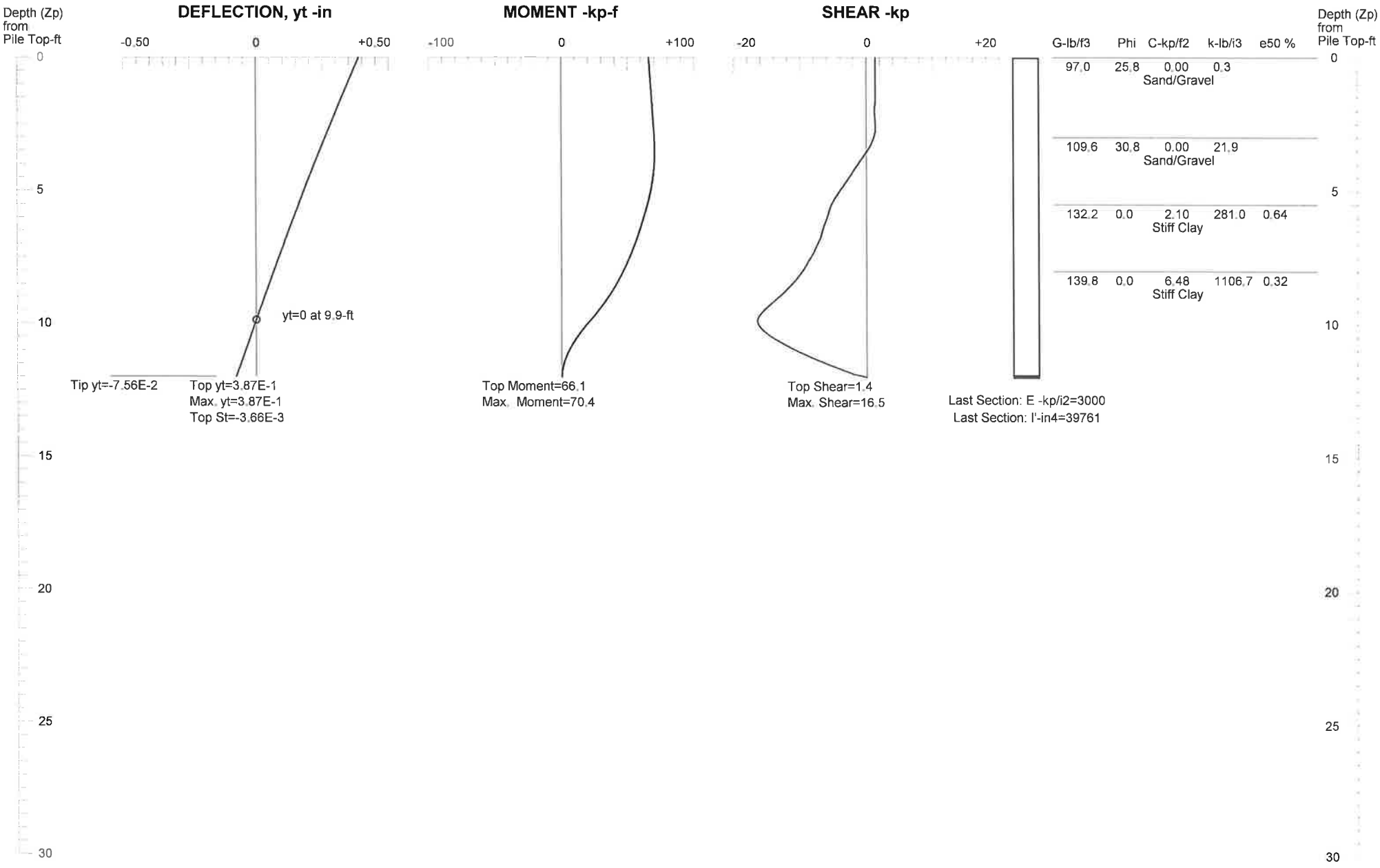
Water below Pile Tip (not to scale)

Batter Angle=0 (Pile diameter not to scale) Surface Angle=0

CivilTech Software

Boring No.3, Proposed Softball Field Lighting
Wayne State University Athletic Field **Figure 1**

PILE DEFLECTION & FORCE vs DEPTH
Single Pile, Khead=1, Kbc=1



CivilTech Software

Boring No.3, Proposed Softball Field Lighting
Wayne State University Athletic Field Figure 2

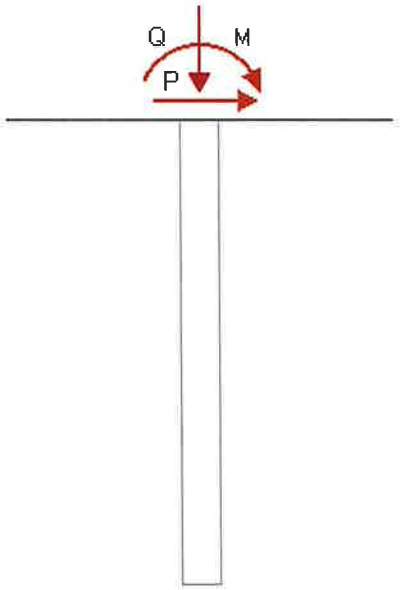
FOUNDATION PROFILE & SOIL CONDITIONS

Diameter more than 24in (61cm).
For bell section, select "Belled" in Diameter Variation (Pile Section Screen, Item 4).
Recommendation: 2 to 4 in Item 3 of Page F.

Depth from Ground-ft

FOUNDATION PROPERTIES

Depth	Width-in	A'-in2	Per.-in	I'-in4	E -kp/i2	W -kp/f
0.0	30	706.9	94.2	39760.8	3000	0.736
Concrete (rough)						
12.0	30	706.9	94.2	39760.8	3000	0.736
Concrete (rough)						



SOIL PROPERTIES

Depth	γ -lb/f3	ϕ	C-kp/f2	k-lb/i3	e50 %	Nspt
0.0	97.0	25.8	0.00	0.3		1
Sand/Gravel						
3.0	129.0	0.0	1.23	132.2	0.88	10
Soft Clay						
5.5	135.6	0.0	3.70	584.9	0.45	30
Stiff Clay						
8.0	139.7	0.0	6.14	1048.9	0.33	49
Stiff Clay						

Depth from Ground-ft

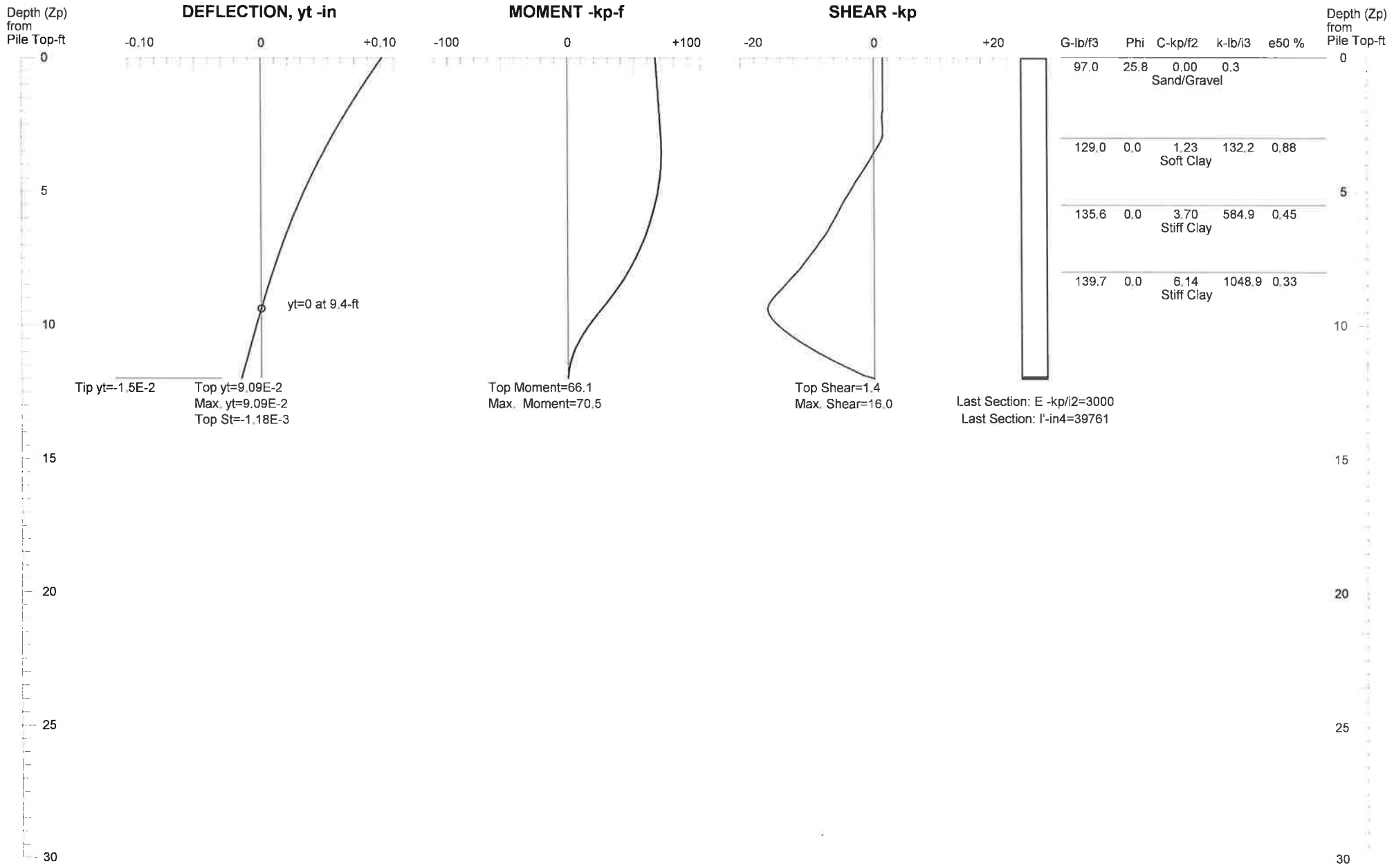
0 5 10 15 20 25 30

Water below Pile Tip (not to scale)

Batter Angle=0 (Pile diameter not to scale) Surface Angle=0

PILE DEFLECTION & FORCE vs DEPTH

Single Pile, Khead=1, Kbc=1



CivilTech Software

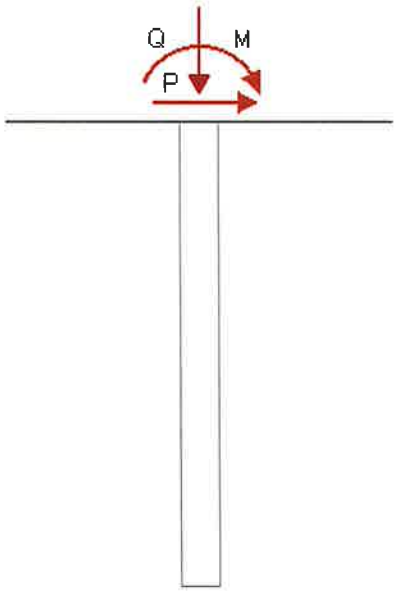
Boring No.5, Proposed Softball Field Lighting
Wayne State University Athletic Field **Figure 2**

FOUNDATION PROFILE & SOIL CONDITIONS

Diameter more than 24in (61cm).
For bell section, select "Belled" in Diameter Variation (Pile Section Screen, Item 4).
Recommendation: 2 to 4 in Item 3 of Page F.

FOUNDATION PROPERTIES

Depth	Width-in	A'-in2	Per.-in	I'-in4	E -kp/i2	W -kp/f
0.0	30	706.9	94.2	39760.8	3000	0.736
		Concrete (rough)				
12.0	30	706.9	94.2	39760.8	3000	0.736
		Concrete (rough)				



SOIL PROPERTIES

Depth	γ -lb/f3	ϕ	C-kp/f2	k-lb/i3	e50 %	Nspt
0.0	97.0	25.8	0.00	0.3		1
			Sand/Gravel			
3.0	107.2	29.8	0.00	14.8		5
			Sand/Gravel			
4.0	132.6	0.0	2.46	347.2	0.58	20
			Stiff Clay			
8.0	139.8	0.0	6.49	1108.8	0.32	52
			Stiff Clay			

Depth from Ground-ft: 0, 5, 10, 15, 20, 25, 30

Water below Pile Tip (not to scale)

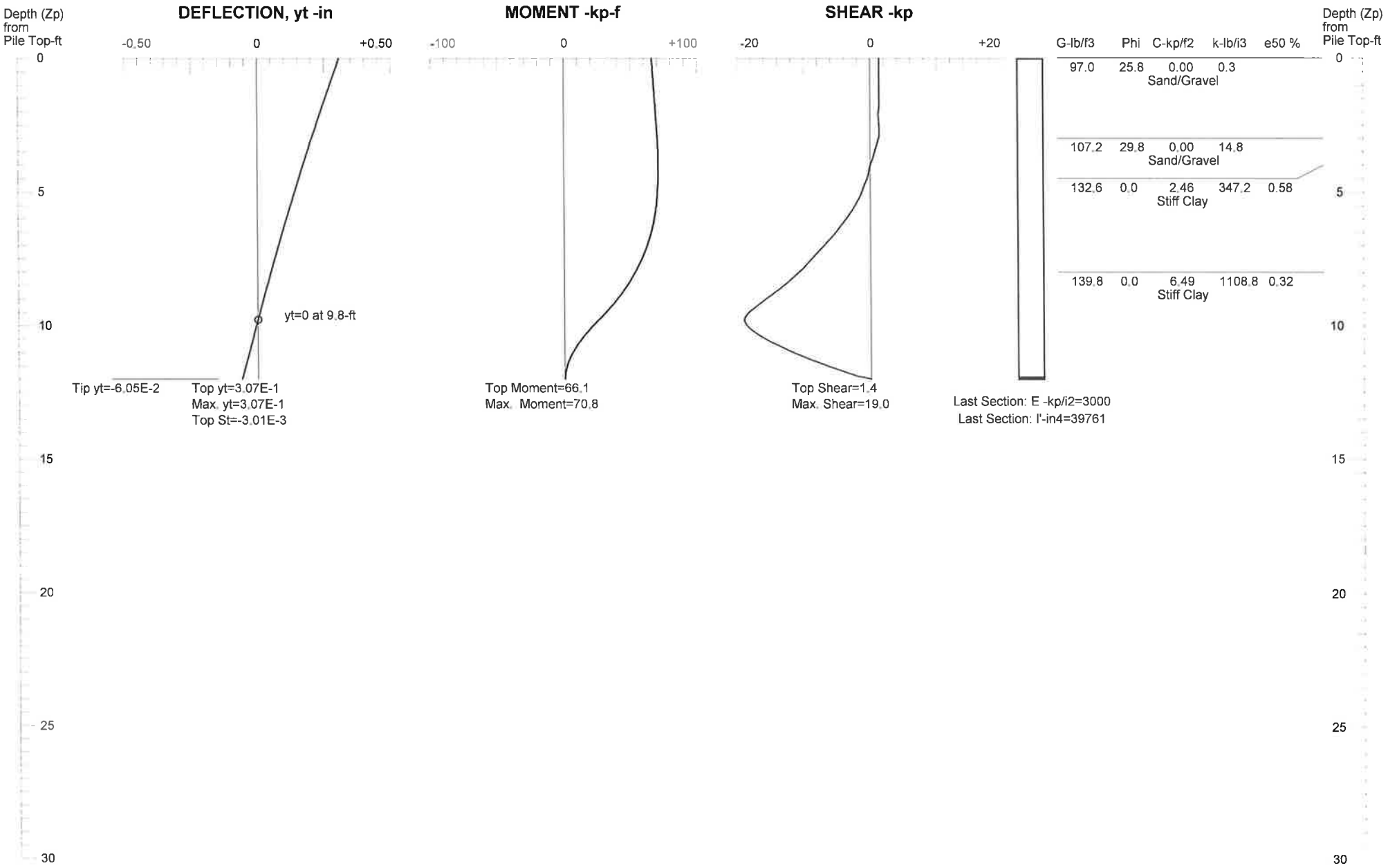
Batter Angle=0 (Pile diameter not to scale) Surface Angle=0

CivilTech Software

Boring No.6, Proposed Softball Field Lighting
Wayne State University Athletic Field **Figure 1**

PILE DEFLECTION & FORCE vs DEPTH

Single Pile, Khead=1, Kbc=1



CivilTech Software

Boring No.6, Proposed Softball Field Lighting
Wayne State University Athletic Field Figure 2

Testing Engineers & Consultants, Inc.

Ms. Alyesa Valentine
Wayne State University
March 3, 2020

TEC Report: 60663

SOIL DESCRIPTIONS

In order to provide uniformity throughout our projects, the following nomenclature has been adopted to describe soil characteristics:

CONSISTENCY AND RELATIVE DENSITY

COHESIVE SOILS			GRANULAR SOILS	
UNCONFINED COMPRESSIVE STRENGTH, PSF	**"N" VALUES**	**CONSISTENCY**	**"N" VALUES**	**RELATIVE DENSITY**
Below 500	0 – 2	Very Soft	0 – 4	Very Loose
500 – 1,000	3 – 4	Soft	5 – 10	Loose
1,000 – 2,000	5 – 8	Plastic	11 – 30	Medium Compact
2,000 – 4,000	9 – 15	Firm	31 – 50	Compact
4,000 – 8,000	16 – 30	Stiff	50+	Dense
8,000 – 16,000	31 – 50	Ex. Stiff		
Over 16,000	51+	Hard		

Material Types By Particle Size	**ASTM D2487**
BOULDERS	Stones Over 12" In Diameter
COBBLES	Stones 3" To 12" In Diameter
GRAVEL	#4 To 3" Diameter
COARSE SAND	#10 To #4 Sieves
MEDIUM SAND	#40 To #10 Sieves

Testing Engineers & Consultants, Inc.

Ms. Alyesa Valentine
Wayne State University
March 3, 2020

TEC Report: 60663

SOIL DESCRIPTIONS (Cont'd)

Material Types By Particle Size	**ASTM D2487**
FINE SAND	#200 To #40 Sieves
SILT	Minus #200 Sieve Material, Fairly Non-Plastic, Falls Below "A"-Line
CLAY	Minus #200 Sieve Material Plastic Material That Has A Tendency To Stick Together, Can Be Rolled Into Fine Rods When Moistened; Falls Above "A"-Line
PEAT	Black Organic Material Containing Partially Decayed Vegetable Matter
MARL	Fresh Water Deposits Of Calcium Carbonate, Often Containing Percentages Of Peat, Clay & Fine Sand
SWAMP BOTTOM DEPOSITS	Mixtures Of Peat, Marl, Vegetation & Fine Sand Containing Large Amounts Of Decayable Organic Material