COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION

RECEIVED

OCT 4 2019

PUBLIC SERVICE
COMMISSION

In the Matter of:

THE APPLICATION OF	)
NEW CINGULAR WIRELESS PCS, LLC,	)
A DELAWARE LIMITED LIABILITY COMPANY,	)
D/B/A AT&T MOBILITY	)
FOR ISSUANCE OF A CERTIFICATE OF PUBLIC	) CASE NO.: 2019-00211
CONVENIENCE AND NECESSITY TO CONSTRUCT	)
A WIRELESS COMMUNICATIONS FACILITY	)
IN THE COMMONWEALTH OF KENTUCKY	)
IN THE COUNTY OF MARION	)

SITE NAME: PENICK

* * * * * * *

SECOND RESPONSE TO NOTICE OF FILING DEFICIENCY

New Cingular Wireless PCS, LLC, a Delaware Limited Liability Company, d/b/a AT&T Mobility ("Applicant"), by counsel and in further response to the Commission's letter dated July 11, 2019 requesting additional information to cure a deficiency in the within matter, states as follows:

1. Applicant submits the within information and documentation to complete its Response to the Commission's requests to address deficiencies, which deficiencies were previously addressed, in part, in Applicant's Response filed July 17, 2019.

2. In response to the filing requirement pursuant to 807 KAR 5:001: Section 1(1)(d), a geotechnical report, signed and sealed by a professional engineer registered in Kentucky, that includes boring logs and foundation design recommendations is attached as **EXHIBIT G-1** hereto. Findings prepared by a land surveyor as to the proximity of the proposed site to flood hazard areas are contained in the original application, as part of **EXHIBIT B** (see Sheet B-1.2).

3. The tower and foundation design plans and a description of the standard according to which the tower was designed signed and sealed by a professional engineer registered in Kentucky, pursuant to 807 KAR 5:001: Section 1(1)(j), have been updated in accordance with the findings reported in **EXHIBIT G-1**, and revised and updated plans are attached as **EXHIBIT C-1.**

WHEREFORE, Applicant respectfully request that the PSC accept the foregoing information for filing, and having met the requirements of KRS §§ 278.020(1), 278.650, and 278.665 and all applicable rules and regulations of the PSC, lift the abeyance entered as of August 13, 2019 and proceed to grant a Certificate of Public Convenience and Necessity to construct and operate the WCF at the location set forth in the subject application.

Respectfully submitted,

David A. Pike
Pike Legal Group, PLLC
1578 Highway 44 East, Suite 6
P. O. Box 369
Shepherdsville, KY 40165-0369
Telephone: (502) 955-4400
Telefax: (502) 543-4410
Email: dpike@pikelegal.com
Attorney for New Cingular Wireless PCS, LLC
d/b/a AT&T Mobility

EXHIBIT C-1

TOWER AND FOUNDATION DESIGN

Sabre Industries™
Towers and Poles

Structural Design Report

195' Monopole
Site: Penick, KY

Prepared for: AT&T
by: Sabre Towers & Poles ™

Job Number: 444346

October 3, 2019

Monopole Profile 1

Foundation Design Summary (Option 1) 2

Foundation Design Summary (Option 2) 3

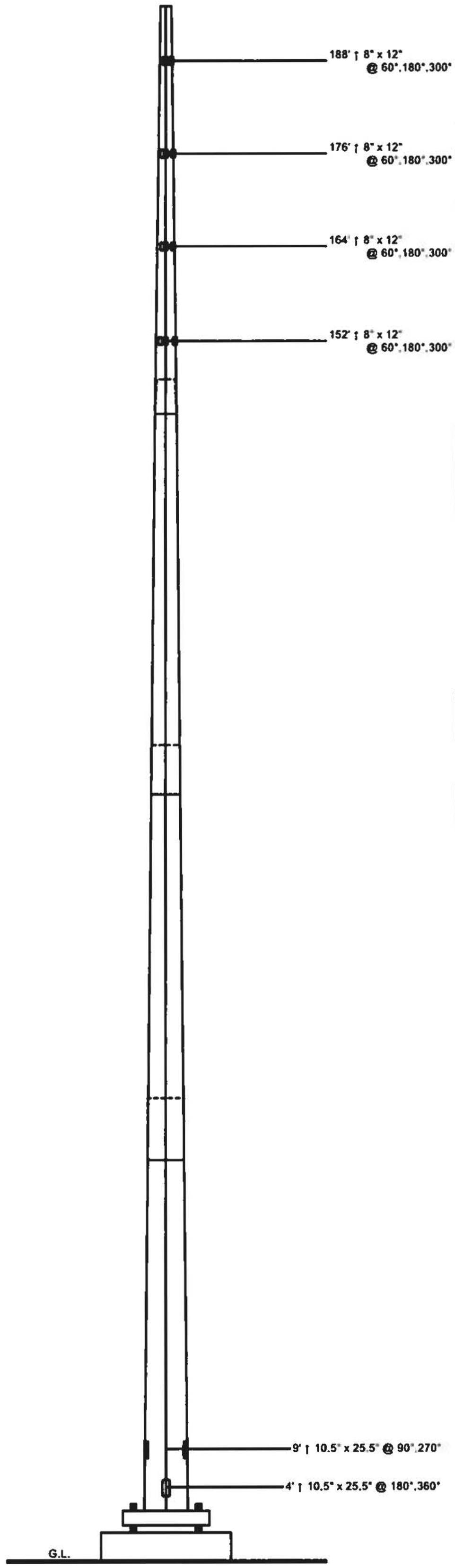
Pole Calculations 4-14

Foundation Calculations 15-24

STATE OF KENTUCKY
ROBERT E. BEACOM
28165
LICENSED PROFESSIONAL ENGINEER

10/3/19

Length (ft)	52'-6"	53'-6"	53'-6"	53'-3"
Number Of Sides	18	18	18	18
Thickness (in)	5/16"	7/16"	7/16"	7/16"
Lap Splice (ft)	A	6' - 3"	8' - 0"	
Top Diameter (in)	18"	30.46"	42.46"	53.98"
Bottom Diameter (in)	32.31"	45.03"	57.03"	68.49"
Taper (in/ft)	0.2725	0.2725	0.2725	0.2725
Grade	A572-65	A572-65	A572-65	A572-65
Weight (lbs)	5052	9995	13211	18278
Overall Steel Height (ft)	194			



Designed Appurtenance Loading

Elev	Description	Tx-Line
190	(1) 278 sq. ft. EPA 6000# (no ice)	(18) 1 5/8"
178	(1) 208 sq. ft. EPA 4000# (no ice)	(18) 1 5/8"
166	(1) 208 sq. ft. EPA 4000# (no ice)	(18) 1 5/8"
154	(1) 208 sq. ft. EPA 4000# (no ice)	(18) 1 5/8"

Design Criteria - ANSI/TIA-222-G

ASCE 7-16 Ultimate Wind Speed (No Ice)	105 mph
Wind Speed (Ice)	30 mph
Design Ice Thickness	1.50 in
Structure Class	II
Risk Category	II
Exposure Category	C
Topographic Category	1

Load Case Reactions

Description	Axial (kips)	Shear (kips)	Moment (ft-k)	Deflection (ft)	Sway (deg)
3s Gusted Wind	86.85	51.15	8185.9	18.59	11.16
3s Gusted Wind 0.9 Dead	65.1	51.2	7996.05	18.01	10.77
3s Gusted Wind&Ice	136	10.12	1810.05	4.38	2.59
Service Loads	72.41	15.72	2498.12	5.81	3.44

Base Plate Dimensions

Shape	Diameter	Thickness	Bolt Circle	Bolt Qty	Bolt Diameter
Round	81.5"	2.25"	75.75"	22	2.25"

Anchor Bolt Dimensions

Length	Diameter	Hole Diameter	Weight	Type	Finish
84"	2.25"	2.625"	2664.2	A615-75	Galv

Material List

Display	Value
A	4' - 6"

Notes

1) Antenna Feed Lines Run Inside Pole
2) All dimensions are above ground level, unless otherwise specified.
3) Weights shown are estimates. Final weights may vary.
4) Full Height Step Bolts
5) This tower design and, if applicable, the foundation design(s) shown on the following page(s) also meet or exceed the requirements of the 2018 Kentucky Building Code.
6) Tower Rating: 99.6%

Sabre Industries Towers and Poles
Sabre Communications Corporation
7101 Southbridge Drive
P.O. Box 658
Sioux City, IA 51102-0658
Phone: (712) 258-6690
Fax: (712) 279-0814

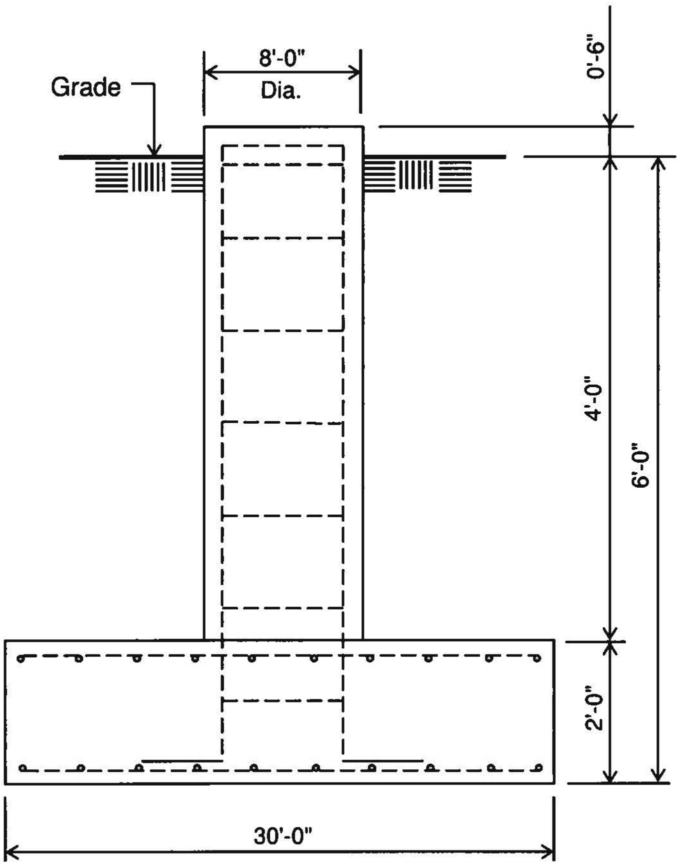
Job:	444346
Customer:	AT&T
Site Name:	Penick, KY
Description:	195' Monopole
Date:	10/3/2019 By: REB

Sabre Industries
Towers and Poles

No.: 444346

Date: 10/03/19
By: REB

Customer: AT&T
Site: Penick, KY
195' Monopole



ELEVATION VIEW
(75.04 Cu. Yds.)
(1 REQUIRED; NOT TO SCALE)

Notes:

1) Concrete shall have a minimum 28-day compressive strength of 4,500 psi, in accordance with ACI 318-11.

2) Rebar to conform to ASTM specification A615 Grade 60.

3) All rebar to have a minimum of 3" concrete cover.

4) All exposed concrete corners to be chamfered 3/4".

5) The foundation design is based on the geotechnical report by POD project no. 18-26563, dated: 9/20/19.

6) See the geotechnical report for compaction requirements, if specified.

7) 4 ft of soil cover is required over the entire area of the foundation slab.

8) The foundation is based on the following factored loads:
   Moment = 8,185.90 k-ft
   Axial = 86.85 k
   Shear = 51.15 k

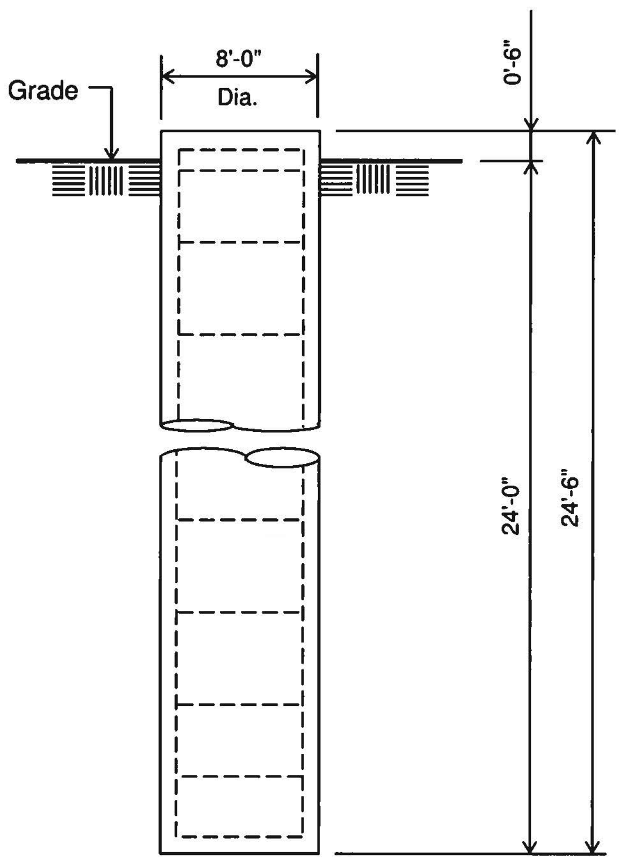
Rebar Schedule for Pad and Pier	
Pier	(44) #9 vertical rebar w/ hooks at bottom w/ #5 ties, (2) within top 5" of pier, then 12" C/C
Pad	(66) #8 horizontal rebar evenly spaced each way top and bottom (264 total)

Sabre Industries™
Towers and Poles

No.: 444346

Date: 10/03/19
By: REB

Customer: AT&T
Site: Penick, KY
195' Monopole



ELEVATION VIEW
(45.61 Cu. Yds.)
(1 REQUIRED; NOT TO SCALE)

Notes:

1) Concrete shall have a minimum 28-day compressive strength of 4,500 psi, in accordance with ACI 318-11.
2) Rebar to conform to ASTM specification A615 Grade 60.
3) All rebar to have a minimum of 3" concrete cover.
4) All exposed concrete corners to be chamfered 3/4".
5) The foundation design is based on the geotechnical report by POD project no. 18-26563, dated: 9/20/19.
6) See the geotechnical report for drilled pier installation requirements, if specified.
7) The foundation is based on the following factored loads:
   Moment = 8,185.90 k-ft
   Axial = 86.85 k
   Shear = 51.15 k

Rebar Schedule for Pier	
Pier	(44) #10 vertical rebar w/ #5 ties, (2) within top 5" of pier, then 7" C/C

7101 Southbridge Drive - P.O. Box 658 - Sioux City, IA 51102-0658 - Phone 712.258.6690 - Fax 712.279.0814

===
(USA 222-G) - Monopole Spatial Analysis (c)2015 Guymast Inc.

Tel:(416)736-7453 Fax:(416)736-4372 Web:www.guymast.com

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Sabre Towers and Poles on: 3 oct 2019 at: 13:35:17
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195' Monopole / Penick, KY

* All pole diameters shown on the following pages are across corners.
See profile drawing for widths across flats.

POLE GEOMETRY
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ELEV ft	SECTION NAME	No. SIDE	OUTSIDE DIAM in	THICK -NESS in	RESISTANCES ♦*Pn kip	RESISTANCES ♦*Mn ft-kip	SPLICE TYPE	...OVERLAP... LENGTH ft	...OVERLAP... RATIO	w/t
194.0										
			18.28	0.312	1303.4	469.8				
	A	18								8.4
			31.55	0.312	2266.6	1430.8				
146.0										
			31.55	0.312	2266.6	1430.8				
	A/B	18					SLIP	4.50	1.70	
			32.18	0.438	3224.4	2060.5				
141.5										
			32.18	0.438	3224.4	2060.5				
	B	18								11.0
			43.99	0.438	4423.8	3893.0				
98.7										
			43.99	0.438	4423.8	3893.0				
	B/C	18					SLIP	6.25	1.70	
			44.85	0.438	4511.1	4049.6				
92.5										
			44.85	0.438	4511.1	4049.6				
	C	18								16.0
			55.69	0.438	5267.8	5893.7				
53.2										
			55.69	0.438	5267.8	5893.7				
	C/D	18					SLIP	8.00	1.71	
			57.04	0.438	5352.7	6136.5				
45.2										
			57.04	0.438	5352.7	6136.5				
	D	18								20.9
			69.55	0.438	6039.1	8465.3				
0.0										

POLE ASSEMBLY
=============

SECTION NAME	BASE ELEV ft	...BOLTS AT BASE OF SECTION... NUMBER	TYPE	DIAM in	STRENGTH ksi	THREADS IN SHEAR PLANE	CALC BASE ELEV ft
A	141.500	0	A325	0.00	92.0	0	141.500
B	92.500	0	A325	0.00	92.0	0	92.500
C	45.250	0	A325	0.00	92.0	0	45.250
D	0.000	0	A325	0.00	92.0	0	0.000

POLE SECTIONS
=============

SECTION NAME	No.of SIDES	LENGTH ft	OUTSIDE.DIAMETER BOT * in	OUTSIDE.DIAMETER TOP * in	BEND RAD in	MAT-ERIAL ID	FLANGE.ID BOT	FLANGE.ID TOP	FLANGE.WELD ..GROUP.ID.. BOT	FLANGE.WELD ..GROUP.ID.. TOP
A	18	52.50	32.81	18.28	0.000	1	0	0	0	0
B	18	53.50	45.73	30.92	0.000	2	0	0	0	0
C	18	53.50	57.91	43.11	0.000	3	0	0	0	0
D	18	53.25	69.55	54.81	0.000	4	0	0	0	0

* - Diameter of circumscribed circle

MATERIAL TYPES
==============

TYPE OF SHAPE	TYPE NO	NO OF ELEM.	ORIENT & deg	HEIGHT in	WIDTH in	.THICKNESS. WEB in	FLANGE in	IRREGULARITY .PROJECTION. % OF AREA	ORIENT deg
PL	1	1	0.0	32.80	0.31	0.312	0.312	0.00	0.0
PL	2	1	0.0	45.73	0.44	0.438	0.438	0.00	0.0
PL	3	1	0.0	57.91	0.44	0.438	0.438	0.00	0.0
PL	4	1	0.0	69.55	0.44	0.438	0.438	0.00	0.0

& - With respect to vertical

MATERIAL PROPERTIES
===================

MATERIAL TYPE NO.	ELASTIC MODULUS ksi	UNIT WEIGHT pcf	.. STRENGTH .. Fu ksi	Fy ksi	THERMAL COEFFICIENT /deg
1	29000.0	490.0	80.0	65.0	0.00001170
2	29000.0	490.0	80.0	65.0	0.00001170
3	29000.0	490.0	80.0	65.0	0.00001170
4	29000.0	490.0	80.0	65.0	0.00001170

* Only 3 condition(s) shown in full
* Some concentrated wind loads may have been derived from full-scale wind tunnel testing

==

LOADING CONDITION A ==

105 mph Ultimate wind with no ice. Wind Azimuth: 0♦

LOADS ON POLE
=============

LOAD TYPE	ELEV ft	APPLY..LOAD..AT RADIUS ft	AZI	LOAD AZI	......FORCES...... HORIZ kip	DOWN kip	......MOMENTS..... VERTICAL ft-kip	TORSNAL ft-kip
C	189.000	0.00	0.0	0.0	0.0000	4.2457	0.0000	0.0000
C	189.000	0.00	0.0	0.0	11.3104	7.2000	0.0000	0.0000
C	177.000	0.00	0.0	0.0	0.0000	3.9761	0.0000	0.0000
C	177.000	0.00	0.0	0.0	8.3470	4.8000	0.0000	0.0000
C	165.000	0.00	0.0	0.0	0.0000	3.7066	0.0000	0.0000
C	165.000	0.00	0.0	0.0	8.2253	4.8000	0.0000	0.0000
C	153.000	0.00	0.0	0.0	0.0000	3.4370	0.0000	0.0000
C	153.000	0.00	0.0	0.0	8.0964	4.8000	0.0000	0.0000
D	194.000	0.00	180.0	0.0	0.0450	0.0807	0.0000	0.0000
D	178.000	0.00	180.0	0.0	0.0450	0.0807	0.0000	0.0000
D	178.000	0.00	180.0	0.0	0.0537	0.0982	0.0000	0.0000
D	162.000	0.00	180.0	0.0	0.0537	0.0982	0.0000	0.0000
D	162.000	0.00	180.0	0.0	0.0620	0.1156	0.0000	0.0000
D	146.000	0.00	180.0	0.0	0.0620	0.1156	0.0000	0.0000
D	146.000	0.00	180.0	0.0	0.0670	0.3009	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0670	0.3009	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0701	0.1885	0.0000	0.0000
D	127.250	0.00	180.0	0.0	0.0701	0.1885	0.0000	0.0000
D	127.250	0.00	180.0	0.0	0.0763	0.2102	0.0000	0.0000
D	113.000	0.00	180.0	0.0	0.0763	0.2102	0.0000	0.0000
D	113.000	0.00	180.0	0.0	0.0821	0.2320	0.0000	0.0000
D	98.750	0.00	180.0	0.0	0.0821	0.2320	0.0000	0.0000
D	98.750	0.00	180.0	0.0	0.0858	0.4911	0.0000	0.0000
D	92.500	0.00	180.0	0.0	0.0858	0.4911	0.0000	0.0000
D	92.500	0.00	180.0	0.0	0.0872	0.2582	0.0000	0.0000
D	79.417	0.00	180.0	0.0	0.0872	0.2582	0.0000	0.0000

D	79.417	0.00	180.0	0.0	0.0908	0.2783	0.0000	0.0000
D	66.333	0.00	180.0	0.0	0.0908	0.2783	0.0000	0.0000
D	66.333	0.00	180.0	0.0	0.0934	0.2983	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0934	0.2983	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0946	0.6245	0.0000	0.0000
D	45.250	0.00	180.0	0.0	0.0946	0.6245	0.0000	0.0000
D	45.250	0.00	180.0	0.0	0.0933	0.3249	0.0000	0.0000
D	33.938	0.00	180.0	0.0	0.0933	0.3249	0.0000	0.0000
D	33.938	0.00	180.0	0.0	0.0908	0.3422	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0870	0.3769	0.0000	0.0000

==

LOADING CONDITION M ==

105 mph Ultimate wind with no ice. Wind Azimuth: 0♦

LOADS ON POLE
=============

LOAD TYPE	ELEV ft	APPLY..LOAD..AT RADIUS ft	AZI	LOAD AZI	......FORCES...... HORIZ kip	DOWN kip	......MOMENTS..... VERTICAL ft-kip	TORSNAL ft-kip
C	189.000	0.00	0.0	0.0	0.0000	3.1843	0.0000	0.0000
C	189.000	0.00	0.0	0.0	11.3104	5.4000	0.0000	0.0000
C	177.000	0.00	0.0	0.0	0.0000	2.9821	0.0000	0.0000
C	177.000	0.00	0.0	0.0	8.3470	3.6000	0.0000	0.0000
C	165.000	0.00	0.0	0.0	0.0000	2.7799	0.0000	0.0000
C	165.000	0.00	0.0	0.0	8.2253	3.6000	0.0000	0.0000
C	153.000	0.00	0.0	0.0	0.0000	2.5777	0.0000	0.0000
C	153.000	0.00	0.0	0.0	8.0964	3.6000	0.0000	0.0000
D	194.000	0.00	180.0	0.0	0.0450	0.0605	0.0000	0.0000
D	178.000	0.00	180.0	0.0	0.0450	0.0605	0.0000	0.0000
D	178.000	0.00	180.0	0.0	0.0537	0.0736	0.0000	0.0000
D	162.000	0.00	180.0	0.0	0.0537	0.0736	0.0000	0.0000
D	162.000	0.00	180.0	0.0	0.0620	0.0867	0.0000	0.0000
D	146.000	0.00	180.0	0.0	0.0620	0.0867	0.0000	0.0000
D	146.000	0.00	180.0	0.0	0.0670	0.2257	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0670	0.2257	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0701	0.1413	0.0000	0.0000
D	127.250	0.00	180.0	0.0	0.0701	0.1413	0.0000	0.0000
D	127.250	0.00	180.0	0.0	0.0763	0.1577	0.0000	0.0000
D	113.000	0.00	180.0	0.0	0.0763	0.1577	0.0000	0.0000
D	113.000	0.00	180.0	0.0	0.0821	0.1740	0.0000	0.0000
D	98.750	0.00	180.0	0.0	0.0821	0.1740	0.0000	0.0000
D	98.750	0.00	180.0	0.0	0.0858	0.3683	0.0000	0.0000
D	92.500	0.00	180.0	0.0	0.0858	0.3683	0.0000	0.0000
D	92.500	0.00	180.0	0.0	0.0872	0.1937	0.0000	0.0000
D	79.417	0.00	180.0	0.0	0.0872	0.1937	0.0000	0.0000
D	79.417	0.00	180.0	0.0	0.0908	0.2087	0.0000	0.0000
D	66.333	0.00	180.0	0.0	0.0908	0.2087	0.0000	0.0000
D	66.333	0.00	180.0	0.0	0.0934	0.2237	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0934	0.2237	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0946	0.4684	0.0000	0.0000
D	45.250	0.00	180.0	0.0	0.0946	0.4684	0.0000	0.0000
D	45.250	0.00	180.0	0.0	0.0933	0.2436	0.0000	0.0000
D	33.938	0.00	180.0	0.0	0.0933	0.2436	0.0000	0.0000
D	33.938	0.00	180.0	0.0	0.0908	0.2567	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0870	0.2827	0.0000	0.0000

==

LOADING CONDITION Y ==

30 mph wind with 1.5 ice. Wind Azimuth: 0♦

LOADS ON POLE
=============

LOAD TYPE	ELEV ft	APPLY..LOAD..AT RADIUS ft	AZI	LOAD AZI	......FORCES...... HORIZ kip	DOWN kip	......MOMENTS..... VERTICAL ft-kip	TORSNAL ft-kip
C	189.000	0.00	0.0	0.0	0.0000	4.2457	0.0000	0.0000

444346

C	189.000	0.00	0.0	0.0	1.6678	17.9218	0.0000	0.0000
C	177.000	0.00	0.0	0.0	0.0000	3.9761	0.0000	0.0000
C	177.000	0.00	0.0	0.0	1.9861	11.9014	0.0000	0.0000
C	165.000	0.00	0.0	0.0	0.0000	3.7066	0.0000	0.0000
C	165.000	0.00	0.0	0.0	1.9484	11.8520	0.0000	0.0000
C	153.000	0.00	0.0	0.0	0.0000	3.4370	0.0000	0.0000
C	153.000	0.00	0.0	0.0	1.9087	11.7993	0.0000	0.0000
D	194.000	0.00	180.0	0.0	0.0084	0.1293	0.0000	0.0000
D	178.000	0.00	180.0	0.0	0.0084	0.1293	0.0000	0.0000
D	178.000	0.00	180.0	0.0	0.0097	0.1558	0.0000	0.0000
D	162.000	0.00	180.0	0.0	0.0097	0.1558	0.0000	0.0000
D	162.000	0.00	180.0	0.0	0.0110	0.1821	0.0000	0.0000
D	146.000	0.00	180.0	0.0	0.0110	0.1821	0.0000	0.0000
D	146.000	0.00	180.0	0.0	0.0117	0.3730	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0117	0.3730	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0122	0.2642	0.0000	0.0000
D	127.250	0.00	180.0	0.0	0.0122	0.2642	0.0000	0.0000
D	127.250	0.00	180.0	0.0	0.0132	0.2933	0.0000	0.0000
D	113.000	0.00	180.0	0.0	0.0132	0.2933	0.0000	0.0000
D	113.000	0.00	180.0	0.0	0.0140	0.3221	0.0000	0.0000
D	98.750	0.00	180.0	0.0	0.0140	0.3221	0.0000	0.0000
D	98.750	0.00	180.0	0.0	0.0146	0.5860	0.0000	0.0000
D	92.500	0.00	180.0	0.0	0.0146	0.5860	0.0000	0.0000
D	92.500	0.00	180.0	0.0	0.0148	0.3558	0.0000	0.0000
D	79.417	0.00	180.0	0.0	0.0148	0.3558	0.0000	0.0000
D	79.417	0.00	180.0	0.0	0.0153	0.3814	0.0000	0.0000
D	66.333	0.00	180.0	0.0	0.0153	0.3814	0.0000	0.0000
D	66.333	0.00	180.0	0.0	0.0157	0.4064	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0157	0.4064	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0158	0.7361	0.0000	0.0000
D	45.250	0.00	180.0	0.0	0.0158	0.7361	0.0000	0.0000
D	45.250	0.00	180.0	0.0	0.0156	0.4377	0.0000	0.0000
D	11.312	0.00	180.0	0.0	0.0145	0.4742	0.0000	0.0000
D	11.312	0.00	180.0	0.0	0.0144	0.4851	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0144	0.4851	0.0000	0.0000

195' Monopole / Penick, KY

MAXIMUM POLE DEFORMATIONS CALCULATED(w.r.t. wind direction)

MAST ELEV ft	DEFLECTIONS (ft) HORIZONTAL ALONG	ACROSS	DOWN	ROTATIONS (deg) TILT ALONG	ACROSS	TWIST
194.0	18.59I	-0.05B	2.55H	11.16I	-0.02B	0.00U
178.0	15.59I	-0.04E	1.97H	10.96I	-0.02B	0.00U
162.0	12.73H	-0.04E	1.44H	10.15I	-0.02B	0.00U
146.0	10.14H	-0.03E	1.01H	8.88I	-0.02B	0.00N
141.5	9.47H	-0.03E	0.90H	8.58I	-0.02B	0.00N
127.2	7.50H	-0.03E	0.63H	7.53I	-0.02B	0.00N
113.0	5.79H	-0.02E	0.42H	6.48H	-0.02B	0.00N
98.7	4.32H	-0.02E	0.27F	5.49H	-0.02E	0.00N
92.5	3.75H	-0.01E	0.21F	5.07H	-0.02E	0.00N
79.4	2.70H	-0.01E	0.13F	4.19H	-0.01E	0.00N

66.3	1.84H	-0.01E	0.07F	3.37H	-0.01E	0.00N
53.2	1.16H	0.00E	0.04F	2.62H	-0.01E	0.00N
45.2	0.82H	0.00E	0.02F	2.19H	-0.01E	0.00N
33.9	0.45H	0.00E	0.01F	1.58H	-0.01E	0.00N
22.6	0.20H	0.00E	0.00F	1.02H	0.00E	0.00N
11.3	0.05H	0.00E	0.00AD	0.49H	0.00E	0.00N
0.0	0.00A	0.00A	0.00A	0.00A	0.00A	0.00A

MAXIMUM POLE FORCES CALCULATED(w.r.t. to wind direction)

MAST ELEV ft	TOTAL AXIAL kip	SHEAR.w.r.t.WIND.DIR ALONG kip	ACROSS kip	MOMENT.w.r.t.WIND.DIR ALONG ft-kip	ACROSS ft-kip	TORSION ft-kip
194.0						
	0.01 C	0.00 C	0.00 N	-0.01 C	-0.01 U	0.00 U
	24.23 AA	12.02 X	0.00 N	-150.77 F	-0.03 K	-0.05 U
178.0						
	24.23 AA	12.02 N	0.00 W	-150.78 F	-0.04 K	-0.05 U
	58.16 AA	29.44 N	0.00 W	-554.85 F	-0.19 U	-0.16 U
162.0						
	58.16 AG	29.44 I	0.00 W	-554.87 F	-0.19 U	-0.16 U
	76.31 AG	38.52 I	0.00 W	-1169.44 F	-0.35 U	-0.34 U
146.0						
	76.31 AD	38.75 N	0.18 E	-1169.47 F	0.37 X	-0.36 U
	77.99 AD	39.05 N	0.18 E	-1367.78 H	-0.70 K	-0.38 U
141.5						
	78.00 AD	38.97 D	-0.19 B	-1367.95 I	-0.85 K	-0.37 U
	81.76 AD	39.96 D	-0.19 B	-2006.11 I	2.84 B	-0.69 U
127.2						
	81.76 AD	40.03 I	-0.24 O	-2006.06 I	2.83 B	-0.71 U
	85.94 AD	41.11 I	-0.24 O	-2656.16 I	5.97 B	-0.92 U
113.0						
	85.94 AD	41.10 H	-0.26 O	-2656.13 I	6.01 B	-0.93 U
	90.53 AD	42.26 H	-0.26 O	-3317.00 I	9.06 B	1.20 N
98.7						
	90.53 AD	42.27 H	-0.23 E	-3316.91 I	9.19 B	1.21 N
	94.19 AD	42.80 H	-0.23 E	-3610.48 I	10.39 B	1.31 N
92.5						
	94.19 AD	42.84 M	-0.24 E	-3610.62 I	10.46 B	1.32 N
	98.85 AD	43.97 M	-0.24 E	-4233.05 I	12.79 B	1.52 N
79.4						
	98.85 AD	43.98 M	-0.25 E	-4233.12 I	12.76 B	1.52 N
	103.84 AD	45.16 M	-0.25 E	-4864.50 H	15.29 B	1.74 N
66.3						
	103.84 AD	45.15 M	-0.26 E	-4864.47 H	15.28 B	1.74 N
	109.15 AD	46.37 M	-0.26 E	-5504.57 H	18.39 E	1.93 N
53.2						
	109.15 AD	46.37 M	-0.27 E	-5504.47 H	18.34 E	1.94 N
	115.04 AD	47.12 M	-0.27 E	-5900.38 H	20.51 E	2.01 N
45.2						
	115.04 AD	47.14 M	-0.26 E	-5900.40 H	20.49 E	2.01 N
	120.06 AD	48.19 M	-0.26 E	-6465.28 H	23.48 E	2.10 N
33.9						
	120.06 AD	48.18 M	-0.28 E	-6465.28 H	23.48 E	2.10 N
	125.22 AD	49.20 M	-0.28 E	-7035.15 H	26.65 E	2.16 N

22.6	125.22 AD	49.19 M	-0.28 E	-7035.14 H	26.65 E	2.16 N
	130.51 AD	50.20 M	-0.28 E	-7608.82 H	29.79 E	2.20 N
11.3	130.51 AD	50.20 M	-0.29 E	-7608.83 H	29.80 E	2.20 N
	136.00 AD	51.20 M	-0.29 E	-8185.90 H	33.05 E	2.21 N
base reaction	136.00 AD	-51.20 M	0.29 E	8185.90 H	-33.05 E	-2.21 N

COMPLIANCE WITH 4.8.2 & 4.5.4
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ELEV ft	AXIAL	BENDING	SHEAR + TORSIONAL	TOTAL	SATISFIED	D/t(w/t)	MAX ALLOWED
194.00	0.00C	0.00C	0.00C	0.00C	YES	8.39A	45.2
	0.01AA	0.21F	0.01X	0.21F	YES	10.85A	45.2
178.00	0.01AA	0.21F	0.01N	0.21F	YES	10.85A	45.2
	0.03AA	0.53F	0.03N	0.54F	YES	13.31A	45.2
162.00	0.03AG	0.53F	0.03I	0.54F	YES	13.31A	45.2
	0.03AG	0.82F	0.03I	0.84F	YES	15.77A	45.2
146.00	0.02AD	0.59F	0.02N	0.60F	YES	10.76A	45.2
	0.02AD	0.64H	0.02N	0.65H	YES	11.26A	45.2
141.50	0.02AD	0.66I	0.02D	0.68I	YES	11.01A	45.2
	0.02AD	0.77I	0.02D	0.78I	YES	12.57A	45.2
127.25	0.02AD	0.77I	0.02I	0.78I	YES	12.57A	45.2
	0.02AD	0.83I	0.02I	0.84I	YES	14.14A	45.2
113.00	0.02AD	0.83I	0.02H	0.84I	YES	14.14A	45.2
	0.02AD	0.85I	0.02H	0.86I	YES	15.70A	45.2
98.75	0.02AD	0.85I	0.02H	0.86I	YES	15.70A	45.2
	0.02AD	0.86I	0.02H	0.87I	YES	16.39A	45.2
92.50	0.02AD	0.89I	0.02M	0.90I	YES	16.03A	45.2
	0.02AD	0.91I	0.02H	0.92I	YES	17.47A	45.2
79.42	0.02AD	0.91I	0.02H	0.92I	YES	17.47A	45.2
	0.02AD	0.93H	0.02H	0.94H	YES	18.91A	45.2
66.33	0.02AD	0.93H	0.02H	0.94H	YES	18.91A	45.2
	0.02AD	0.93H	0.02H	0.95H	YES	20.35A	45.2
53.25	0.02AD	0.93H	0.02U	0.95H	YES	20.35A	45.2
	0.02AD	0.94H	0.02U	0.95H	YES	21.22A	45.2
45.25	0.02AD	0.96H	0.02U	0.98H	YES	20.87A	45.2
	0.02AD	0.96H	0.02U	0.98H	YES	22.11A	45.2
33.94	0.02AD	0.96H	0.02U	0.98H	YES	22.11A	45.2
	0.02AD	0.97H	0.02U	0.98H	YES	23.36A	45.2
22.62	0.02AD	0.97H	0.02U	0.98H	YES	23.36A	45.2

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	0.02AD	0.97H	0.02U	0.98H	YES	24.60A	45.2
11.31	....						
	0.02AD	0.97H	0.02U	0.98H	YES	24.60A	45.2
	0.02AD	0.97H	0.02U	0.98H	YES	25.84A	45.2
0.00	....						

MAXIMUM LOADS ONTO FOUNDATION(w.r.t. wind direction)

DOWN	SHEAR.w.r.t.WIND.DIR ALONG	ACROSS	MOMENT.w.r.t.WIND.DIR ALONG	ACROSS	TORSION
kip	kip	kip	ft-kip	ft-kip	ft-kip
136.00	51.20	-0.29	-8185.90	33.05	2.21
AD	M	E	H	E	N

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195' Monopole / Penick, KY

*************************** Service Load Condition ***************************

* Only 1 condition(s) shown in full
* Some concentrated wind loads may have been derived from full-scale wind tunnel testing

LOADING CONDITION A

60 mph wind with no ice. Wind Azimuth: 0♦

LOADS ON POLE

LOAD TYPE	ELEV ft	APPLY..LOAD..AT RADIUS ft	AZI	LOAD AZI	......FORCES...... HORIZ kip	DOWN kip	......MOMENTS..... VERTICAL ft-kip	TORSNAL ft-kip
C	189.000	0.00	0.0	0.0	0.0000	3.5381	0.0000	0.0000
C	189.000	0.00	0.0	0.0	3.4705	6.0000	0.0000	0.0000
C	177.000	0.00	0.0	0.0	0.0000	3.3134	0.0000	0.0000
C	177.000	0.00	0.0	0.0	2.5612	4.0000	0.0000	0.0000
C	165.000	0.00	0.0	0.0	0.0000	3.0888	0.0000	0.0000
C	165.000	0.00	0.0	0.0	2.5238	4.0000	0.0000	0.0000
C	153.000	0.00	0.0	0.0	0.0000	2.8642	0.0000	0.0000
C	153.000	0.00	0.0	0.0	2.4843	4.0000	0.0000	0.0000
D	194.000	0.00	180.0	0.0	0.0138	0.0673	0.0000	0.0000
D	178.000	0.00	180.0	0.0	0.0138	0.0673	0.0000	0.0000
D	178.000	0.00	180.0	0.0	0.0165	0.0818	0.0000	0.0000
D	162.000	0.00	180.0	0.0	0.0165	0.0818	0.0000	0.0000
D	162.000	0.00	180.0	0.0	0.0190	0.0963	0.0000	0.0000
D	146.000	0.00	180.0	0.0	0.0190	0.0963	0.0000	0.0000
D	146.000	0.00	180.0	0.0	0.0206	0.2508	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0206	0.2508	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0215	0.1571	0.0000	0.0000
D	127.250	0.00	180.0	0.0	0.0215	0.1571	0.0000	0.0000
D	127.250	0.00	180.0	0.0	0.0234	0.1752	0.0000	0.0000
D	113.000	0.00	180.0	0.0	0.0234	0.1752	0.0000	0.0000
D	113.000	0.00	180.0	0.0	0.0252	0.1933	0.0000	0.0000
D	98.750	0.00	180.0	0.0	0.0252	0.1933	0.0000	0.0000

D	98.750	0.00	180.0	0.0	0.0263	0.4092	0.0000	0.0000
D	92.500	0.00	180.0	0.0	0.0263	0.4092	0.0000	0.0000
D	92.500	0.00	180.0	0.0	0.0268	0.2152	0.0000	0.0000
D	79.417	0.00	180.0	0.0	0.0268	0.2152	0.0000	0.0000
D	79.417	0.00	180.0	0.0	0.0279	0.2319	0.0000	0.0000
D	66.333	0.00	180.0	0.0	0.0279	0.2319	0.0000	0.0000
D	66.333	0.00	180.0	0.0	0.0287	0.2486	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0287	0.2486	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0290	0.5204	0.0000	0.0000
D	45.250	0.00	180.0	0.0	0.0290	0.5204	0.0000	0.0000
D	45.250	0.00	180.0	0.0	0.0286	0.2707	0.0000	0.0000
D	33.938	0.00	180.0	0.0	0.0286	0.2707	0.0000	0.0000
D	33.938	0.00	180.0	0.0	0.0279	0.2852	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0267	0.3141	0.0000	0.0000

MAXIMUM POLE DEFORMATIONS CALCULATED(w.r.t. wind direction)

MAST ELEV ft	DEFLECTIONS (ft) HORIZONTAL ALONG	ACROSS	DOWN	ROTATIONS (deg) TILT ALONG	ACROSS	TWIST
194.0	5.81C	0.02E	0.25C	3.44C	0.01E	0.00E
178.0	4.86C	0.02E	0.19C	3.37C	0.01E	0.00E
162.0	3.95C	0.01E	0.14C	3.12C	0.01E	0.00I
146.0	3.13C	-0.01I	0.10C	2.72C	0.01E	0.00E
141.5	2.92C	-0.01I	0.09C	2.63C	0.01E	0.00E
127.2	2.31C	0.01E	0.06C	2.31C	-0.01I	0.00I
113.0	1.78C	0.01E	0.04C	1.98C	-0.01I	0.00I
98.7	1.32C	0.01E	0.03C	1.68C	-0.01I	0.00I
92.5	1.15C	0.00E	0.02C	1.55C	-0.01I	0.00I
79.4	0.82C	0.00E	0.01C	1.28C	0.01E	0.00I
66.3	0.56C	0.00E	0.01C	1.03C	0.00E	0.00I
53.2	0.35C	0.00E	0.00C	0.80C	0.00E	0.00I
45.2	0.25C	0.00E	0.00C	0.67C	0.00E	0.00I
33.9	0.14C	0.00E	0.00C	0.48C	0.00E	0.00I
22.6	0.06C	0.00E	0.00C	0.31C	0.00E	0.00I
11.3	0.01C	0.00E	0.00F	0.15C	0.00E	0.00I
0.0	0.00A	0.00A	0.00A	0.00A	0.00A	0.00A

MAXIMUM POLE FORCES CALCULATED(w.r.t. to wind direction)

MAST ELEV ft	TOTAL AXIAL kip	SHEAR.w.r.t.WIND.DIR ALONG kip	ACROSS kip	MOMENT.w.r.t.WIND.DIR ALONG ft-kip	ACROSS ft-kip	TORSION ft-kip
194.0						
	0.00 I	0.00 B	0.00 I	0.00 B	0.00 I	0.00 I
	10.61 I	3.69 C	0.00 I	-46.54 F	-0.01 I	0.00 E
178.0						
	10.62 C	3.69 I	0.00 F	-46.54 C	0.01 B	0.00 E
	26.32 C	9.04 I	0.00 F	-170.98 F	0.03 E	-0.01 I
162.0						
	26.32 K	9.04 D	0.00 F	-170.98 F	-0.03 I	0.01 E
	34.73 K	11.83 D	0.00 F	-359.54 F	0.06 E	-0.02 I

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146.0						
	34.74 F	11.90 F	0.04 C	-359.57 C	0.13 B	-0.02 I
	35.86 F	12.00 F	0.04 C	-420.32 F	-0.14 C	0.03 E
141.5						
	35.88 K	11.94 C	-0.07 I	-420.38 F	-0.10 C	0.03 E
	38.12 K	12.24 C	-0.07 I	-614.92 C	-0.99 E	0.08 E
127.2						
	38.11 D	12.25 C	-0.07 I	-614.91 C	-0.98 E	0.08 E
	40.60 D	12.59 C	-0.07 I	-812.52 C	2.00 I	-0.13 I
113.0						
	40.61 D	12.59 C	-0.07 I	-812.52 C	1.99 I	-0.13 I
	43.36 D	12.95 C	-0.07 I	-1013.26 C	2.98 I	-0.17 I
98.7						
	43.36 D	12.96 C	0.07 E	-1013.26 C	3.00 I	-0.17 I
	45.92 D	13.13 C	0.07 E	-1102.56 C	3.38 I	-0.19 I
92.5						
	45.92 D	13.15 C	-0.08 I	-1102.49 C	3.36 I	0.19 E
	48.73 D	13.50 C	-0.08 I	-1291.92 C	4.39 I	-0.22 I
79.4						
	48.73 D	13.48 C	0.08 E	-1291.91 C	4.39 I	-0.22 I
	51.77 D	13.85 C	0.08 E	-1483.79 C	5.43 I	-0.25 I
66.3						
	51.77 D	13.85 C	0.09 E	-1483.79 C	5.43 I	-0.25 I
	55.02 D	14.22 C	0.09 E	-1678.43 C	6.52 I	-0.27 I
53.2						
	55.02 D	14.23 C	0.09 E	-1678.43 C	6.51 I	-0.27 I
	59.18 D	14.47 C	0.09 E	-1799.03 C	7.19 I	-0.28 I
45.2						
	59.18 D	14.46 C	0.09 E	-1799.01 C	7.19 I	-0.28 I
	62.24 D	14.79 C	0.09 E	-1971.27 C	-8.16 E	-0.30 I
33.9						
	62.24 D	14.79 C	-0.09 I	-1971.28 C	-8.17 E	-0.30 I
	65.52 D	15.10 C	-0.09 I	-2145.34 C	-9.15 E	-0.31 I
22.6						
	65.52 D	15.11 C	0.09 E	-2145.34 C	-9.15 E	-0.31 I
	68.91 D	15.41 C	0.09 E	-2321.00 C	-10.13 E	-0.31 I
11.3						
	68.91 D	15.41 C	0.09 E	-2321.00 C	-10.13 E	-0.31 I
	72.41 D	15.72 C	0.09 E	-2498.12 C	-11.11 E	-0.31 I
base reaction	72.41 D	-15.72 C	-0.09 E	2498.12 C	11.11 E	0.31 I

COMPLIANCE WITH 4.8.2 & 4.5.4

ELEV ft	AXIAL	BENDING	SHEAR + TORSIONAL	TOTAL	SATISFIED	D/t(w/t)	MAX ALLOWED
194.00							
	0.00I	0.00B	0.00B	0.00B	YES	8.39A	45.2
	0.01I	0.06F	0.00C	0.07F	YES	10.85A	45.2
178.00							
	0.01C	0.06C	0.00I	0.07C	YES	10.85A	45.2
	0.01C	0.16F	0.01I	0.18F	YES	13.31A	45.2
162.00							
	0.01K	0.16F	0.01D	0.18F	YES	13.31A	45.2
	0.02K	0.25F	0.01D	0.27F	YES	15.77A	45.2
146.00							
	0.01F	0.18C	0.01F	0.19C	YES	10.76A	45.2

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	0.01F	0.20F	0.01F	0.21F	YES	11.26A	45.2
141.50							
	0.01K	0.20F	0.01C	0.22K	YES	11.01A	45.2
	0.01K	0.24C	0.01C	0.25C	YES	12.57A	45.2
127.25							
	0.01D	0.24C	0.01C	0.25C	YES	12.57A	45.2
	0.01D	0.25C	0.01C	0.26C	YES	14.14A	45.2
113.00							
	0.01D	0.25C	0.01C	0.26C	YES	14.14A	45.2
	0.01D	0.26C	0.01C	0.27C	YES	15.70A	45.2
98.75							
	0.01D	0.26C	0.01C	0.27C	YES	15.70A	45.2
	0.01D	0.26C	0.01C	0.27C	YES	16.39A	45.2
92.50							
	0.01D	0.27C	0.01C	0.28C	YES	16.03A	45.2
	0.01D	0.28C	0.01C	0.29C	YES	17.47A	45.2
79.42							
	0.01D	0.28C	0.01C	0.29C	YES	17.47A	45.2
	0.01D	0.28C	0.01C	0.29C	YES	18.91A	45.2
66.33							
	0.01D	0.28C	0.01C	0.29C	YES	18.91A	45.2
	0.01D	0.28C	0.01C	0.30C	YES	20.35A	45.2
53.25							
	0.01D	0.28C	0.01C	0.30C	YES	20.35A	45.2
	0.01D	0.29C	0.01C	0.30C	YES	21.22A	45.2
45.25							
	0.01D	0.29C	0.01C	0.30C	YES	20.87A	45.2
	0.01D	0.29C	0.01C	0.31C	YES	22.11A	45.2
33.94							
	0.01D	0.29C	0.01C	0.31C	YES	22.11A	45.2
	0.01D	0.29C	0.01C	0.31C	YES	23.36A	45.2
22.62							
	0.01D	0.29C	0.01C	0.31C	YES	23.36A	45.2
	0.01D	0.29C	0.01C	0.31C	YES	24.60A	45.2
11.31							
	0.01D	0.29C	0.01C	0.31C	YES	24.60A	45.2
	0.01D	0.30C	0.01C	0.31C	YES	25.84A	45.2
0.00							

MAXIMUM LOADS ONTO FOUNDATION(w.r.t. wind direction)

DOWN	SHEAR.w.r.t.WIND.DIR		MOMENT.w.r.t.WIND.DIR		TORSION
	ALONG	ACROSS	ALONG	ACROSS	
kip	kip	kip	ft-kip	ft-kip	ft-kip
72.41	15.72	0.09	-2498.12	-11.11	-0.31
D	C	E	C	E	I

Sabre Industries™
Towers and Poles

SO#: 444346
Site Name: Penick, KY
Date: 10/3/2019

Round Base Plate and Anchor Rods, per ANSI/TIA 222-G

Pole Data

Diameter:	68.490	in (flat to flat)
Thickness:	0.4375	in
Yield (Fy):	65	ksi
# of Sides:	18	"0" IF Round
Strength (Fu):	80	ksi

Reactions

Moment, Mu:	8185.9	ft-kips
Axial, Pu:	86.85	kips
Shear, Vu:	51.15	kips

Anchor Rod Data

Quantity:	22		
Diameter:	2.25	in	
Rod Material:	A615		
Strength (Fu):	100	ksi	
Yield (Fy):	75	ksi	
BC Diam. (in):	75.75	BC Override:	

Anchor Rod Results

Maximum Rod (Pu+ Vu/η):	244.4 Kips	
Allowable Φ*Rnt:	260.0 Kips	(per 4.9.9)
Anchor Rod Interaction Ratio:	**94.0%** **Pass**	

Plate Data

Diameter (in):	81.5	Dia. Override:	
Thickness:	2.25	in	
Yield (Fy):	50	ksi	
Eff Width/Rod:	9.88	in	
Drain Hole:	2.625	in. diameter	
Drain Location:	32.25	in. center of pole to center of drain hole	
Center Hole:	56.5	in. diameter	

Base Plate Results

Base Plate (Mu/Z):	44.8 ksi	
Allowable Φ*Fy:	45.0 ksi	(per AISC)
Base Plate Interaction Ratio:	**99.6%** **Pass**	

MAT FOUNDATION DESIGN BY SABRE TOWERS & POLES

195' Monopole AT&T Penick, KY (444346) 10/03/19 REB

Overall Loads:			
Factored Moment (ft-kips)	8185.9		
Factored Axial (kips)	86.85		
Factored Shear (kips)	51.15		
Bearing Design Strength (ksf)	6	Max. Net Bearing Press. (ksf)	5.04
Water Table Below Grade (ft)	999		
Width of Mat (ft)	30	Allowable Bearing Pressure (ksf)	4.00
Thickness of Mat (ft)	2	Safety Factor	2.00
Depth to Bottom of Slab (ft)	6	Ultimate Bearing Pressure (ksf)	8.00
Quantity of Bolts in Bolt Circle	22	Bearing Φs	0.75
Bolt Circle Diameter (in)	75.75		
Top of Concrete to Top of Bottom Threads (in)	60		
Diameter of Pier (ft)	8	Minimum Pier Diameter (ft)	7.65
Ht. of Pier Above Ground (ft)	0.5	Equivalent Square b (ft)	7.09
Ht. of Pier Below Ground (ft)	4	Square Pier? (Y/N)	N
Quantity of Bars in Mat	66		
Bar Diameter in Mat (in)	1		
Area of Bars in Mat (in^2)	51.84		
Spacing of Bars in Mat (in)	5.43	Recommended Spacing (in)	5 to 12
Quantity of Bars Pier	44		
Bar Diameter in Pier (in)	1.128		
Tie Bar Diameter in Pier (in)	0.625		
Spacing of Ties (in)	12		
Area of Bars in Pier (in^2)	43.97	Minimum Pier A_s (in^2)	36.19
Spacing of Bars in Pier (in)	6.26	Recommended Spacing (in)	5 to 12
f'c (ksi)	4.5		
fy (ksi)	60		
Unit Wt. of Soil (kcf)	0.11		
Unit Wt. of Concrete (kcf)	0.15		
Volume of Concrete (yd^3)	75.04		
Two-Way Shear Action:			
Average d (in)	20		
ϕv_c (ksi)	0.228	v_u (ksi)	0.201
$\phi v_c = \phi(2 + 4/\beta_c)f'_c{}^{1/2}$	0.342		
$\phi v_c = \phi(\alpha_s d/b_o + 2)f'_c{}^{1/2}$	0.239		
$\phi v_c = \phi 4 f'_c{}^{1/2}$	0.228		
Shear perimeter, b_o (in)	364.42		
β_c	1		
One-Way Shear:			
ϕV_c (kips)	821.1	V_u (kips)	485.3
Stability:			
Overturning Design Strength (ft-k)	10127.5	Total Applied M (ft-k)	8518.4

Pier Design:

ϕV_n (kips)	845.8	V_u (kips)	51.2
$\phi V_c = \phi 2(1+N_u/(2000A_g))f'_c{}^{1/2}b_w d$	845.8		
V_s (kips)	0.0	*** V_s max = 4 $f'_c{}^{1/2}b_w d$ (kips)	1978.3
Maximum Spacing (in)	7.62	(Only if Shear Ties are Required)	
Actual Hook Development (in)	19.00	Req'd Hook Development l_{dh} (in)	14.12
		*** Ref. To Spacing Requirements ACI 11.5.4.3	

Flexure in Slab:

ϕM_n (ft-kips)	4401.8	M_u (ft-kips)	4398.1
a (in)	2.26		
Steel Ratio	0.00720		
β_1	0.825		
Maximum Steel Ratio (ρ_t)	0.0197		
Minimum Steel Ratio	0.0018		
Rebar Development in Pad (in)	134.46	Required Development in Pad (in)	26.83

Condition	1 is OK, 0 Fails
Maximum Soil Bearing Pressure	1
Pier Area of Steel	1
Pier Shear	1
Interaction Diagram	1
Two-Way Shear Action	1
One-Way Shear Action	1
Overturning	1
Flexure	1
Steel Ratio	1
Length of Development in Pad	1
Hook Development	1

==

LPile for Windows(Beta), Version 2018-10.009

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

==

This copy of LPile is being used by:

Robert Beacom
Sabre Tower and Poles

Serial Number of Security Device: 160777296

This copy of LPile is licensed for exclusive use by:

Sabre Communications Corporation

Use of this program by any entity other than Sabre Communications Corporation is a violation of the software license agreement.

Files Used for Analysis

Path to file locations:
\Program Files (x86)\Ensoft\Lpile2018\files\

Name of input data file:
444346.lp10

Name of output report file:
444346.lp10

Name of plot output file:
444346.lp10

Name of runtime message file:
444346.lp10

Date and Time of Analysis

Date: October 3, 2019   Time: 13:42:05

Problem Title

Site   : Penick, KY

Tower   : 195' Monopole

Prepared for : AT&T

Job Number : 444346

Engineer   : REB

Program Options and Settings

Computational Options:
- Use unfactored loads in computations (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	=	999
- 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.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined	=	1
Total length of pile	=	24.500 ft
Depth of ground surface below top of pile	=	0.5000 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	96.0000
2	24.500	96.0000

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	=	24.500000 ft
Shaft Diameter	=	96.000000 in
Shear capacity of section	=	0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle	=	0.000 degrees
	=	0.000 radians
Pile Batter Angle	=	0.000 degrees
	=	0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is stiff clay without free water

```
Distance from top of pile to top of layer         =     0.500000 ft
Distance from top of pile to bottom of layer      =     2.500000 ft
Effective unit weight at top of layer             =   120.000000 pcf
Effective unit weight at bottom of layer          =   120.000000 pcf
Undrained cohesion at top of layer                =   500.000000 psf
Undrained cohesion at bottom of layer             =   500.000000 psf
Epsilon-50 at top of layer                        =     0.020000
Epsilon-50 at bottom of layer                     =     0.020000
```

Layer 2 is stiff clay without free water

```
Distance from top of pile to top of layer         =     2.500000 ft
Distance from top of pile to bottom of layer      =     6.500000 ft
Effective unit weight at top of layer             =   120.000000 pcf
Effective unit weight at bottom of layer          =   120.000000 pcf
Undrained cohesion at top of layer                =        2000. psf
Undrained cohesion at bottom of layer             =        2000. psf
Epsilon-50 at top of layer                        =     0.007000
Epsilon-50 at bottom of layer                     =     0.007000
```

Layer 3 is stiff clay without free water

```
Distance from top of pile to top of layer         =     6.500000 ft
Distance from top of pile to bottom of layer      =    14.500000 ft
Effective unit weight at top of layer             =   135.000000 pcf
Effective unit weight at bottom of layer          =   135.000000 pcf
Undrained cohesion at top of layer                =        3000. psf
Undrained cohesion at bottom of layer             =        3000. psf
Epsilon-50 at top of layer                        =     0.005000
Epsilon-50 at bottom of layer                     =     0.005000
```

Layer 4 is stiff clay without free water

```
Distance from top of pile to top of layer         =    14.500000 ft
Distance from top of pile to bottom of layer      =    27.500000 ft
Effective unit weight at top of layer             =   135.000000 pcf
Effective unit weight at bottom of layer          =   135.000000 pcf
Undrained cohesion at top of layer                =       15000. psf
Undrained cohesion at bottom of layer             =       15000. psf
Epsilon-50 at top of layer                        =     0.004000
Epsilon-50 at bottom of layer                     =     0.004000
```

(Depth of the lowest soil layer extends 3.000 ft below the pile tip)

Summary of Input Soil Properties

Layer Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	E50 or krm
1	Stiff Clay	0.5000	120.0000	500.0000	0.02000
	w/o Free Water	2.5000	120.0000	500.0000	0.02000
2	Stiff Clay	2.5000	120.0000	2000.	0.00700
	w/o Free Water	6.5000	120.0000	2000.	0.00700
3	Stiff Clay	6.5000	135.0000	3000.	0.00500
	w/o Free Water	14.5000	135.0000	3000.	0.00500
4	Stiff Clay	14.5000	135.0000	15000.	0.00400
	w/o Free Water	27.5000	135.0000	15000.	0.00400

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
1	1	V = 68200. lbs	M = 130974400. in-lbs	115800.	No
2	1	V = 15720. lbs	M = 29977440. in-lbs	72410.	No

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	=	24.500000	ft
Shaft Diameter	=	96.000000	in
Concrete Cover Thickness (to edge of long. rebar)	=	3.625000	in
Number of Reinforcing Bars	=	44	bars
Yield Stress of Reinforcing Bars	=	60000.	psi
Modulus of Elasticity of Reinforcing Bars	=	29000000.	psi
Gross Area of Shaft	=	7238.	sq. in.
Total Area of Reinforcing Steel	=	55.737823	sq. in.
Area Ratio of Steel Reinforcement	=	0.77	percent
Edge-to-Edge Bar Spacing	=	4.970752	in
Maximum Concrete Aggregate Size	=	0.750000	in
Ratio of Bar Spacing to Aggregate Size	=	6.63	
Offset of Center of Rebar Cage from Center of Pile	=	0.0000	in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	30817.300	kips
Tensile Load for Cracking of Concrete	=	-3348.733	kips
Nominal Axial Tensile Capacity	=	-3344.269	kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.270000	1.266769	43.740000	0.00000
2	1.270000	1.266769	43.294790	6.224851
3	1.270000	1.266769	41.968223	12.322982
4	1.270000	1.266769	39.787303	18.170253
5	1.270000	1.266769	36.796430	23.647629
6	1.270000	1.266769	33.056486	28.643609
7	1.270000	1.266769	28.643609	33.056486
8	1.270000	1.266769	23.647629	36.796430
9	1.270000	1.266769	18.170253	39.787303
10	1.270000	1.266769	12.322982	41.968223
11	1.270000	1.266769	6.224851	43.294790
12	1.270000	1.266769	0.00000	43.740000
13	1.270000	1.266769	-6.224851	43.294790

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14	1.270000	1.266769	-12.322982	41.968223
15	1.270000	1.266769	-18.170253	39.787303
16	1.270000	1.266769	-23.647629	36.796430
17	1.270000	1.266769	-28.643609	33.056486
18	1.270000	1.266769	-33.056486	28.643609
19	1.270000	1.266769	-36.796430	23.647629
20	1.270000	1.266769	-39.787303	18.170253
21	1.270000	1.266769	-41.968223	12.322982
22	1.270000	1.266769	-43.294790	6.224851
23	1.270000	1.266769	-43.740000	0.00000
24	1.270000	1.266769	-43.294790	-6.224851
25	1.270000	1.266769	-41.968223	-12.322982
26	1.270000	1.266769	-39.787303	-18.170253
27	1.270000	1.266769	-36.796430	-23.647629
28	1.270000	1.266769	-33.056486	-28.643609
29	1.270000	1.266769	-28.643609	-33.056486
30	1.270000	1.266769	-23.647629	-36.796430
31	1.270000	1.266769	-18.170253	-39.787303
32	1.270000	1.266769	-12.322982	-41.968223
33	1.270000	1.266769	-6.224851	-43.294790
34	1.270000	1.266769	0.00000	-43.740000
35	1.270000	1.266769	6.224851	-43.294790
36	1.270000	1.266769	12.322982	-41.968223
37	1.270000	1.266769	18.170253	-39.787303
38	1.270000	1.266769	23.647629	-36.796430
39	1.270000	1.266769	28.643609	-33.056486
40	1.270000	1.266769	33.056486	-28.643609
41	1.270000	1.266769	36.796430	-23.647629
42	1.270000	1.266769	39.787303	-18.170253
43	1.270000	1.266769	41.968223	-12.322982
44	1.270000	1.266769	43.294790	-6.224851

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

Minimum spacing between any two bars not equal to zero = 4.971 inches between bars 15 and 16.

Ratio of bar spacing to maximum aggregate size = 6.63

Concrete Properties:

Compressive Strength of Concrete	=	4500. psi
Modulus of Elasticity of Concrete	=	3823676. psi
Modulus of Rupture of Concrete	=	-503.115295 psi
Compression Strain at Peak Stress	=	0.002001
Tensile Strain at Fracture of Concrete	=	-0.0001152
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	72.410
2	115.800

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

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

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	72.410	138385.019	0.00300000
2	115.800	139911.037	0.00300000

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 (0.70).

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The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 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 for Moment	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	138385.	47.066500	89950.	3.2764E+09
2	0.65	139911.	75.270000	90942.	3.3175E+09
1	0.70	138385.	50.687000	96870.	3.2654E+09
2	0.70	139911.	81.060000	97938.	3.3037E+09
1	0.75	138385.	54.307500	103789.	3.1592E+09
2	0.75	139911.	86.850000	104933.	3.2003E+09

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.5000	0.00	N.A.	No	0.00	26545.
2	2.5000	0.5469	Yes	No	26545.	211900.
3	6.5000	3.1430	Yes	No	238445.	723805.
4	14.5000	2.5933	Yes	No	962250.	N.A.

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

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

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

Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	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	68200.	M, in-lb	1.31E+08	115800.	9.3356	-0.05020	-1321759.	1.34E+08
2	V, lb	15720.	M, in-lb	3.00E+07	72410.	0.04650	-3.71E-04	-268238.	3.05E+07

Maximum pile-head deflection = 9.3356259556 inches
Maximum pile-head rotation = -0.0502003819 radians = -2.876270 deg.

Summary of Warning Messages

The following warning was reported 861 times

**** Warning ****

An unreasonable input value for shear strength has been specified for a layer.

defined using the stiff clay without free water criteria. The input value is greater than 8000 psf. Please check your input data for correctness.

The analysis ended normally.

1807.3.2.1 (2009 IBC, 2012 IBC, & 2015 IBC)

Moment (ft·k)	8,185.90	
Shear (k)	51.15	
Caisson diameter (ft)	8	
Caisson height above ground (ft)	0.5	
Caisson height below ground (ft)	24	
Lateral soil pressure (lb/ft^2)	675.00	
Ground to application of force, h (ft)	160.54	
Applied lateral force, P (lb)	51,150	
Lateral soil bearing pressure, S_1 (lb/ft)	5,400.00	
Diameter, b (ft)	8	
A	2.77	$= (2.34P)/(S_1 b)$
Minimum depth of embedment, d (ft)	23.45	$= 0.5A[\,1 + (\,1 + (\,4.36h\,/\,A\,)\,)^{1/2}\,]$

EXHIBIT G-1

GEOTECHNICAL REPORT

Date: September 20, 2019 POD Job Number: 18-26563

GEOTECHNICAL REPORT

PENICK

(10589975)

37° 35' 12.75" N
85° 07' 18.78" W

325 Hourigan Lane,
Lebanon, KY 40033

Prepared For:

at&t

Prepared By:

POD
POWER OF DESIGN

11490 Bluegrass Parkway | Louisville, Kentucky 40299 | 502.437.5252
POWER OF DESIGN GROUP, LLC

POD
POWER OF DESIGN

September 20, 2019

Ms. Michelle Ward
AT&T
534 Armory Place
4th Floor
Louisville, KY 40202

Re: Geotechnical Report – **PROPOSED 195' MONOPOLE TOWER w/ 4' LIGHTNING ARRESTOR**
Site Name: **PENICK (10589975)**
Site Address: 325 Hourigan Lane, Lebanon, Marion County, Kentucky
Coordinates: N37° 35' 12.75", W85° 07' 18.78"
POD Project No. 18-26563

Dear Ms. Ward:

Attached is our geotechnical engineering report for the referenced project. This report contains our findings, an engineering interpretation of these findings with respect to the available project characteristics, and recommendations to aid design and construction of the tower and equipment support foundations.

We appreciate the opportunity to be of service to you on this project. If you have any questions regarding this report, please contact our office.

Cordially,

Mark Patterson, P.E.
Project Engineer
License No.: KY 16300

STATE OF KENTUCKY
MARK E. PATTERSON
16,300
LICENSED
PROFESSIONAL ENGINEER

Copies submitted: (3) Ms. Michelle Ward

LETTER OF TRANSMITTAL

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Geotechnical Report
PROPOSED 195' MONOPOLE TOWER w/ 4' LIGHTNING ARRESTOR
Site Name: **PENICK (10589975)**
325 Hourigan Lane, Lebanon, Marion County, Kentucky
N37° 35' 12.75", W85° 07' 18.78"

1. PURPOSE AND SCOPE

The purpose of this study was to determine the general subsurface conditions at the site of the proposed tower by drilling three borings and to evaluate this data with respect to foundation concept and design for the proposed tower and shelter. Also included is an evaluation of the site with respect to potential construction problems and recommendations dealing with quality control during construction.

2. PROJECT CHARACTERISTICS

AT&T is proposing to construct a monopole tower and either an equipment shelter, slab or platform at N37° 35' 12.75", W85° 07' 18.78", 325 Hourigan Lane, Lebanon, Marion County, Kentucky. The site is located in a corn field in a rural area of Marion County between Lebanon and Danville. The proposed lease area will be 10,000 square feet and will be accessed by a long, new road off from Hourigan Lane running west to the site. The elevation at the proposed tower location is about EL 960 and there is about 3 feet change in elevation across the proposed lease area. The development will also include a small equipment shelter near the base of the tower. The proposed tower location is shown on the Boring Location Plan in the Appendix.

3. SUBSURFACE CONDITIONS

The subsurface conditions were explored by drilling three test borings near the base of the proposed tower. The Geotechnical Soil Test Boring Logs, which are included in the Appendix, describes the materials and conditions encountered. A sheet defining the terms and symbols used on the boring logs is also included in the Appendix. The general subsurface conditions disclosed by the test borings are discussed in the following paragraphs.

According to the Kentucky Geological Survey, Kentucky Geologic Map Information Services, the site is underlain by the Upper Ordovician Calloway Creek Limestone. This limestone formation has minor shale and a medium karst potential. No sinkholes were mapped with a half-mile of the site.

The borings encountered about 6 inches of topsoil at the existing ground surface. Below the topsoil, the borings encountered clay (CH) of medium to high plasticity. The SPT N-values in the clay were between 13 and to over 50 blows per foot (bpf) generally indicating a stiff to hard consistency. The borings encountered auger refusal in the clay between 5.2 and 6.7 feet. Auger refusal is defined as the depth at which the boring can no longer be advanced using the current drilling method.

The refusal material was cored in Boring T-1 from 6.7 to 26.7 feet below the ground surface. Limestone that was moderately hard, weathered and light gray to gray was encountered from 6.7 to about 14 feet. Below 14 feet, limestone that was hard, and moderately weathered. The recoveries of the cores were about 95 to 100 percent with RQD values of 0, 33, 50 and 55 percent. These values generally represent fair quality rock from a foundation support viewpoint.

Observations made at the completion of soil drilling operations indicated the borings to be dry. It must be noted, however, that short-term water readings in test borings are not necessarily a reliable indication of the actual groundwater level. Furthermore, it must be emphasized that the groundwater level is not stationary but will fluctuate seasonally.

Based on the limited subsurface conditions encountered at the site and using Table 1615.1.1 of the 2018 Kentucky Building Code, the site class is considered "C". Seismic design requirements for telecommunication towers are given in section 1622 of the code. A detailed seismic study was beyond the scope of this report.

4. FOUNDATION DESIGN RECOMMENDATIONS

The following design recommendations are based on the previously described project information, the subsurface conditions encountered in our borings, the results of our laboratory testing, empirical correlations for the soil types encountered, our analyses, and our experience. If there is any change in the project criteria or structure location, you should retain us to review our recommendations so that we can determine if any modifications are required. The findings of such a review can then be presented in a supplemental report or addendum.

We recommend that the geotechnical engineer be retained to review the near-final project plans and specifications, pertaining to the geotechnical aspects of the project, prior to bidding and construction. We recommend this review to check that our assumptions and evaluations are appropriate based on the current project information provided to us, and to check that our foundation and earthwork recommendations were properly interpreted and implemented.

4.1. Proposed Tower

Our findings indicate that the proposed monopole tower can be supported on drilled piers or on a common mat foundation.

4.1.1. Drilled Piers

The following table summarizes the recommended values for use in analyzing lateral and frictional resistance for the various strata encountered at the test boring. It is important to note that these values are estimated based on the standard penetration test results and soil types and were not directly measured. The all values provided are ultimate values and appropriate factors of safety should be used in conjunction with these values. If the piers will bear deeper than about 27 feet, a deeper boring should be drilled to determine the nature of the deeper material.

Depth Below Ground Surface, feet	0 - 2	2 – 6	6 - 14	14 - 27
Ultimate Bearing Pressure (psf)		11,000	16,500	83,000
C Undrained Shear Strength, psf	500	2000	3000	15,000
Ø Angle of Internal Friction degrees	0	0	0	0
Total Unit Weight, pcf	120	120	135	135
Soil Modulus Parameter k, pci	30	750	1000	2000
Passive Soil Pressure, psf/one foot of depth		1,300 + 40(D-2)	2,000 + 45(D-6)	10,000 + 45(D-14)
Side Friction, psf		500	800	1200

Note: D = Depth below ground surface (in feet) to point at which the passive pressure is calculated.

It is important that the drilled piers be installed by an experienced, competent drilled pier contractor who will be responsible for properly installing the piers in accordance with industry standards and generally accepted methods, without causing deterioration of the subgrade. The recommendations contained herein relate only to the soil-pier interaction and do not account for the structural design of the piers.

4.1.2. Mat Foundation

The tower could be supported on a common mat foundation bearing on the silty clay at a minimum of 4 feet can be designed using an allowable soil pressure of 4,000 pounds per square foot may be used. This value may be increased by 30 percent for the maximum edge pressure under transient loads. A friction value of 0.30 may be used between the concrete and the silty clay soil. The passive pressures given for the drilled pier foundation may be used to resist lateral forces.

It is important that the mat be designed with an adequate factor of safety with regard to overturning under the maximum design wind load.

4.2. Equipment Platform

An equipment platform may be supported on shallow piers bearing in the natural clay and designed for a net allowable soil pressure of 2,500 pounds per square foot. The piers should bear at a depth of at least 24 inches to minimize the effects of frost action. All existing topsoil or soft natural soil should be removed beneath footings.

4.3. Equipment Slab

A concrete slab supporting the equipment must be supported on at least 6-inch layer of relatively clean granular material such as gravel or crushed stone containing not more than 10 percent material that passes through a No. 4 sieve. This is to help distribute concentrated loads and equalize moisture conditions beneath the slab. Provided that a minimum of 6 in. of granular material is placed below the slab, a modulus of subgrade reaction (k30) of 110 lbs/cu.in. can be used for design of the slab. All existing topsoil or soft natural soil should be removed beneath crushed stone layer.

4.4. Equipment Building

If an equipment building support on a slab is chosen in place of the equipment platform, it may be supported on shallow spread footings bearing in the natural clay soil and designed for a net allowable soil pressure of 2,500 pounds per square foot.

The footings should be at least ten inches wide. If the footings bear on soil, they should bear at a depth of at least 24 inches to minimize the effects of frost action. All existing topsoil or soft natural soil should be removed beneath footings.

The floor slab for the new equipment building can be supported on firm natural soils or on new compacted structural fill. Existing fill may be left in place below the slab if the owner can accept the possibility of greater than normal settlement and cracking. This risk can be reduced if the underlying subgrade is properly proof-rolled and any unstable areas disclosed by the proof-roll are improved as necessary.

Floor slabs must be supported on at least 4-inch layer of relatively clean granular material such as gravel or crushed stone containing not more than 10 percent material that passes through a No. 4 sieve. This is to help distribute concentrated loads and equalize moisture conditions beneath the slab. Provided that a minimum of 4 in. of granular material is placed below the slab, a modulus of subgrade reaction (k30) of 110 lbs/cu.in. can be used for design of the floor slabs.

4.5. Drainage and Groundwater Considerations

Good site drainage must be provided. Surface run-off water should be drained away from the tower and platform and not allowed to pond. It is recommended that all foundation concrete be placed the same day the excavation is made.

At the time of this investigation, groundwater was not encountered. Therefore, no special provisions regarding groundwater control are considered necessary for shallow foundations. Any seepage should be able to be pumped with sumps.

5. GENERAL CONSTRUCTION PROCEDURES AND RECOMMENDATIONS

It is possible that variations in subsurface conditions will be encountered during construction. Although only minor variations that can be readily evaluated and adjusted for during construction are anticipated, it is recommended the geotechnical engineer, or a qualified representative be retained to perform continuous inspection and review during construction of the soils-related phases of the work. This will permit correlation between the test boring data and the actual soil conditions encountered during construction.

5.1 Drilled Piers

The following recommendations are recommended for drilled pier construction:

- All piers must be poured the same day drilling is completed so that any shale is not allowed to swell. Clean the foundation bearing area so it is nearly level or suitably benched and is free of ponded water or loose material.

- Make provisions for ground water removal from the drilled shaft excavation. While the borings were dry prior to rock coring and significant seepage is not anticipated, the drilled pier contractor should have pumps on hand to remove water in the event seepage into the drilled pier is encountered.

- Specify concrete slumps ranging from 4 to 7 inches for the drilled shaft construction. These slumps are recommended to fill irregularities along the sides and bottom of the drilled hole, displace water as it is placed, and permit placement of reinforcing cages into the fluid concrete.

- Retain the geotechnical engineer to observe foundation excavations after the bottom of the hole is leveled, cleaned of any mud or extraneous material, and dewatered.

- Install a temporary protective steel casing to prevent side wall collapse, prevent excessive mud and water intrusion in the drilled shaft.

- The protective steel casing may be extracted as the concrete is placed provided a sufficient head of concrete is maintained inside the steel casing to prevent soil or water intrusion into the newly placed concrete.

- Direct the concrete placement into the drilled hole through a centering chute to reduce side flow or segregation.

5.2 Fill Compaction

All engineered fill placed adjacent to and above the tower foundation should be compacted to a dry density of at least 95 percent of the standard Proctor maximum dry density (ASTM D-698). This minimum compaction requirement should be increased to 98 percent for any fill placed below the tower foundation bearing elevation. Any fill placed beneath the tower foundation should be limited to well-graded sand and gravel or crushed stone. The compaction should be accomplished by placing the fill in about 8 inch (or less) loose lifts and mechanically compacting each lift to at least the specified minimum dry density. Field density tests should be performed on each lift as necessary to ensure that adequate moisture conditioning and compaction is being achieved.

Compaction by flooding is not considered acceptable. This method will generally not achieve the desired compaction and the large quantities of water will tend to soften the foundation soils.

5.3 Construction Dewatering

If groundwater is encountered in the shallow foundations, it should be minor and can be handled by conventional dewatering methods such as pumping from sumps.

If groundwater is encountered in the drilled pier excavations, it may be more difficult since pumping directly from the excavations could cause a deterioration of the bottom of the excavation. If the pier excavations are not dewatered, concrete should be placed by the tremie method. If groundwater sits on the bottom of the foundation for longer than an hour, the bottom should be cleaned again before the pier is poured.

6 FIELD INVESTIGATION

Three soil test borings were drilled near the base of the proposed tower. Split-spoon samples were obtained by the Standard Penetration Test (SPT) procedure (ASTM D1586) in all test borings. The borings encountered auger refusal between 5.2 and 6.7 feet. A sample of the refusal material was cored in Boring T-1 from 6.7 to 26.7 feet below the ground surface. The split-spoon samples were inspected and visually classified by a geotechnical engineer. Representative portions of the soil samples were sealed in glass jars and returned to our laboratory.

The boring logs are included in the Appendix along with a sheet defining the terms and symbols used on the logs and an explanation of the Standard Penetration Test (SPT) procedure. The log present visual descriptions of the soil strata encountered, Unified System soil classifications, groundwater observations, sampling information, laboratory test results, and other pertinent field data and observations.

7 WARRANTY AND LIMITATIONS OF STUDY

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties, either express or implied. POD Group is not responsible for the independent conclusions, opinions or recommendations made by others based on the field exploration and laboratory test data presented in this report.

A geotechnical study is inherently limited since the engineering recommendations are developed from information obtained from test borings, which depict subsurface conditions only at the specific locations, times and depths shown on the logs. Soil conditions at other locations may differ from those encountered in the test borings, and the passage of time may cause the soil conditions to change from those described in this report.

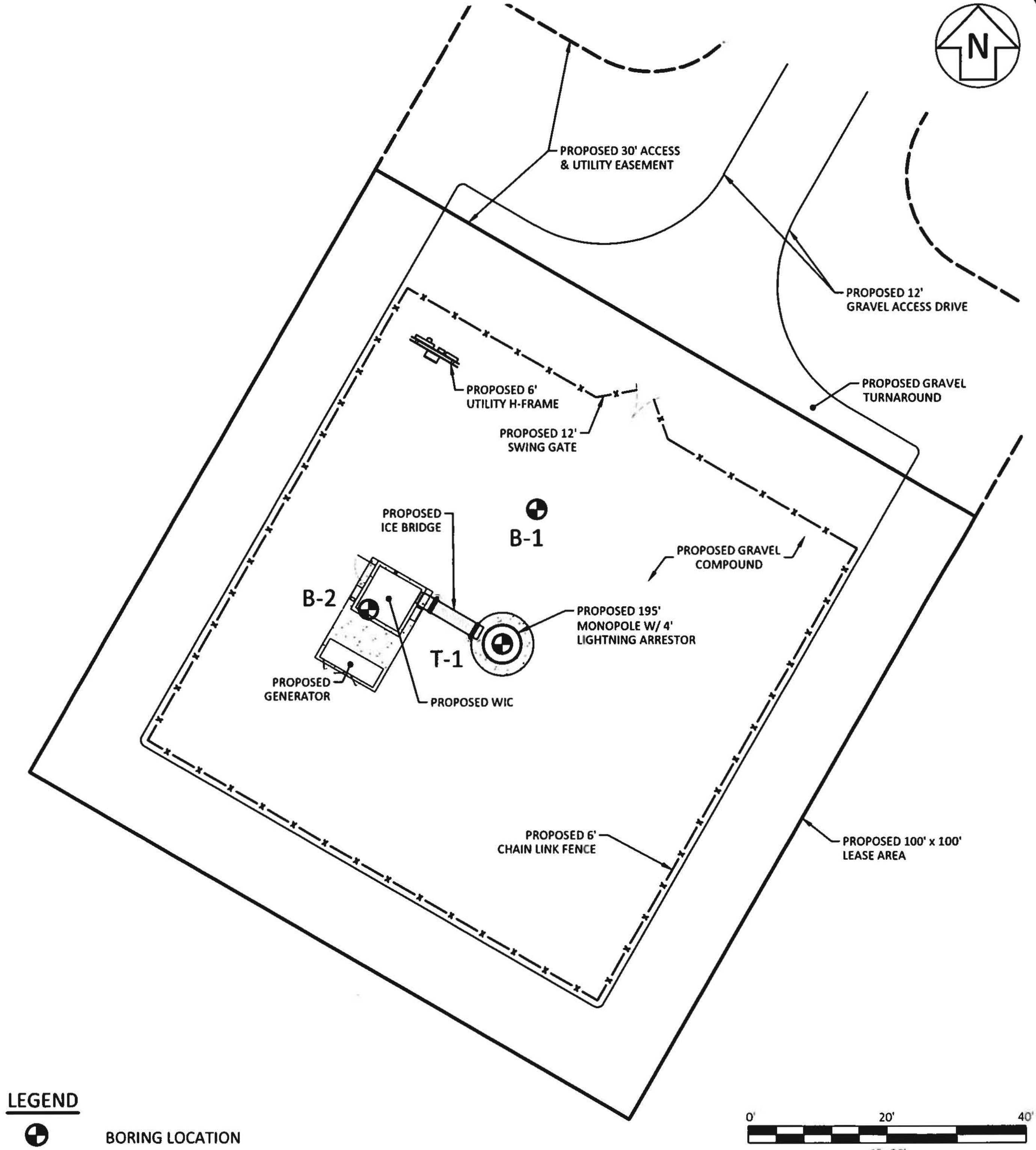
The nature and extent of variation and change in the subsurface conditions at the site may not become evident until the course of construction. Construction monitoring by the geotechnical engineer or a representative is therefore considered necessary to verify the subsurface conditions and to check that the soils connected construction phases are properly completed. If significant variations or changes are in evidence, it may then be necessary to reevaluate the recommendations of this report. Furthermore, if the project characteristics are altered significantly from those discussed in this report, if the project information contained in this report is incorrect, or if additional information becomes available, a review must be made by this office to determine if any modification in the recommendations will be required.

APPENDIX

BORING LOCATION PLAN

BORING LOGS

SOIL SAMPLE CLASSIFICATION



SHEET TITLE:	FA NUMBER:	SITE INFORMATION:	PREPARED BY:
BORING LOCATION PLAN	10589975 LATITUDE: 37° 35' 12.75" LONGITUDE: -85° 07' 18.78"	PENICK 325 HOURIGAN LANE LEBANON, KY 40033 MARION COUNTY	POD POWER OF DESIGN 11490 BLUEGRASS PKWY LOUISVILLE, KY 40299 502-437-5252
SHEET NUMBER: 1	POD NUMBER: 18-26563 DRAWN BY: KDP CHECKED BY: MEP DATE: 9.20.2019		PREPARED FOR: MasTec

POD
POWER OF DESIGN

Boring Log

Project:	**Penick**	**City, State**	**Lebanon, KY**

Method: H.S.A.	**Boring Date:** 12-Sep-19	**Location:** Proposed Tower Center
Inside Diameter: 3 1/4"	**Drill Rig Type:** D-50	**Hammer Type:** Auto
Groundwater: DRY		**Weather:**
Driller: Strata Group, LLC	**Note:** About 6 inches of topsoil were encountered at the existing ground surface	

From (ft)	To (ft)	Material Description	Sample Depth (ft)	Sample Type	Blows per 6-inch increment	Recovery (in)	SPT-N value	Rock Quality (RQD,%)	Atterberg Limits	Moisture Content (%)	% Fines (clay & silt)	Unconfined Compressive Strength, (ksf)
0.5	6.7	CLAY (CH) - stiff, dry, orange brown	0 - 1.5	SS	9, 11, 6	6	17,			14%		
	1.5	- very stiff, tan	1.5 - 3	SS	7, 11, 10	8	21,			18%		
	4.0	- trace rock fragments	4 - 5.5	SS	3, 6, 9	9	15,			8%		
	6.0	- shale and limestone fragments	6.5-6.7	SS	4, 7, 10	12	17,					
6.7	26.7	LIMESTONE - moderately hard, weathered, light to dark gray with calcium deposits	6.7-11.7	RC		95		0%				
			11.7-16.7	RC		98		33%				
	14.0	- hard, moderately weathered										
			16.7-21.7	RC		100		50%				
			21.7-26.7	RC		100		55%				
		Boring Terminated at 26.7 feet										

POD
POWER OF DESIGN

Boring Log

Project: Penick **City, State** Lebanon, KY

Method: H.S.A.	**Boring Date:** 12-Sep-19		**Location:** North of Tower Center
Inside Diameter: 3 1/4"	**Drill Rig Type:** D-50		**Hammer Type:** Auto
Groundwater: DRY			**Weather:**
Driller: Strata Group, LLC	**Note:** About 6 inches of topsoil were encountered at the existing ground surface		

From (ft)	To (ft)	Material Description	Sample Depth (ft)	Sample Type	Blows per 6-inch increment	Recovery (in)	SPT-N value	Rock Quality (RQD,%)	Atterberg Limits	Moisture Content (%)	% Fines (clay & silt)	Unconfined Compressive Strength, (ksf)
0.5	6.0	CLAY (CH) - very stiff, dry, orange brown	0 - 1.5	SS	6, 8, 8	4	16,			20%		
			1.5 - 3	SS	8, 10, 11	7	21,			20%		
	4.0	- hard with limestone fragments	4 - 5.5	SS	8, 21, 34	12	55,			15%		
		Auger Refusal at 6 feet										

POD
POWER OF DESIGN

Boring Log

Project:	**Penick**	**City, State**	**Lebanon, KY**

Method: H.S.A.	**Boring Date:** 12-Sep-19	**Location:** South of Tower Center
Inside Diameter: 3 1/4"	**Drill Rig Type:** D-50	**Hammer Type:** Auto
Groundwater: DRY		**Weather:**
Driller: Strata Group, LLC	**Note:** About 6 inches of topsoil were encountered at the existing ground surface	

From (ft)	To (ft)	Material Description		Sample Depth (ft)	Sample Type	Blows per 6-inch increment	Recovery (in)	SPT-N value	Rock Quality (RQD,%)	Atterberg Limits	Moisture Content (%)	% Fines (clay & silt)	Unconfined Compressive Strength, (ksf)
0.5	6.0	CLAY (CH) - stiff to very stiff, dry, orange brown		0 - 1.5	SS	7, 6, 7	6	13,			15%		
				1.5 - 3	SS	10, 9, 9	3	18,			21%		
	4.0	- hard		4 - 5.2	SS	10, 19, 50	8	69,			12%		
		Auger Refusal at 5.2 feet											

SOIL SAMPLE CLASSIFICATION

FINE AND COARSE GRAINED SOIL INFORMATION

COARSE GRAINED SOILS (SANDS & GRAVELS)

N	Relative Density
0-4	Very Loose
5-10	Loose
11-20	Firm
21-30	Very Firm
31-50	Dense
Over 50	Very Dense

FINE GRAINED SOILS (SILTS & CLAYS)

N	Consistency	Qu, KSF Estimated
0-1	Very Soft	0-0.5
2-4	Soft	0.5-1
5-8	Firm	1-2
9-15	Stiff	2-4
16-30	Very Stiff	4-8
Over 31	Hard	8+

PARTICLE SIZE

Boulders	Greater than 300 mm (12 in)
Cobbles	75 mm to 300 mm (3 to 12 in)
Gravel	4.74 mm to 75 mm (3/16 to 3 in)
Coarse Sand	2 mm to 4.75 mm
Medium Sand	0.425 mm to 2 mm
Fine Sand	0.075 mm to 0.425 mm
Silts & Clays	Less than 0.075 mm

The **STANDARD PENETRATION TEST** as defined by ASTM D 1586 is a method to obtain a disturbed soil sample for examination and testing and to obtain relative density and consistency information. A standard 1.4-inch I.D./2-inch O.D. split-barrel sampler is driven three 6-inch increments with a 140 lb. hammer falling 30 inches. The hammer can either be of a trip, free-fall design, or actuated by a rope and cathead. The blow counts required to drive the sampler the final two increments are added together and designate the N-value defined in the above tables.

ROCK PROPERTIES

ROCK QUALITY DESIGNATION (RQD)

Percent RQD	Quality
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

ROCK HARDNESS

Very Hard:	Rock can be broken by heavy hammer blows.
Hard:	Rock cannot be broken by thumb pressure, but can be broken by moderate hammer blows.
Moderately Hard:	Small pieces can be broken off along sharp edges by considerable hard thumb pressure; can be broken with light hammer blows.
Soft:	Rock is coherent but breaks very easily with thumb pressure at sharp edges and crumbles with firm hand pressure.
Very Soft:	Rock disintegrates or easily compresses when touched; can be hard to very hard soil.

$$\text{Recovery} = \frac{\text{Length of Rock Core Recovered}}{\text{Length of Core Run}} \times 100$$

$$\text{RQD} = \frac{\text{Sum of 4 in. and longer Rock Pieces Recovered}}{\text{Length of Core Run}} \times 100$$

63 REC
NQ
43 RQD

Core Diameter	Inches
BQ	1-7/16
NQ	1-7/8
HQ	2-1/2

SYMBOLS

KEY TO MATERIAL TYPES

SOILS Group Symbols	Typical Names
GW	Well graded gravel - sand mixture, little or no fines
GP	Poorly graded gravels or gravel - sand mixture, little or no fines
GM	Silty gravels, gravel - sand silt mixtures
GC	Clayey gravels, gravel - sand - clay mixtures
SW	Well graded sands, gravelly sands, little or no fines
SP	Poorly graded sands or gravelly sands, little or no fines
SM	Silty sands, sand - silt mixtures
SC	Clayey sands, sand - clay mixtures
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts
OL	Organic silts and organic silty clays of low plasticity
CL	Inorganic clays of low range plasticity, gravelly clays, sandy clays, silty clays, lean clays
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
CH	Inorganic clays of high range plasticity, fat clays

ROCKS Symbols	Typical Names
	Limestone or Dolomite
	Shale
	Sandstone

SOIL PROPERTY SYMBOLS

N:	Standard Penetration, BPF
M:	Moisture Content, %
LL:	Liquid Limit, %
PI:	Plasticity Index, %
Qp:	Pocket Penetrometer Value, TSF
Qu:	Unconfined Compressive Strength Estimated Qu, TSF
γ_D:	Dry Unit Weight, PCF
F:	Fines Content

SAMPLING SYMBOLS

SS	Split Spoon Sample
UD	Relatively Undisturbed Sample
Core 1	Rock Core Sample