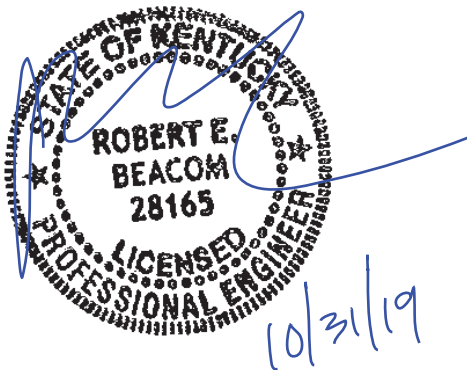


**Structural Design Report**  
195' Monopole  
Site: Ruddles Mill, KY

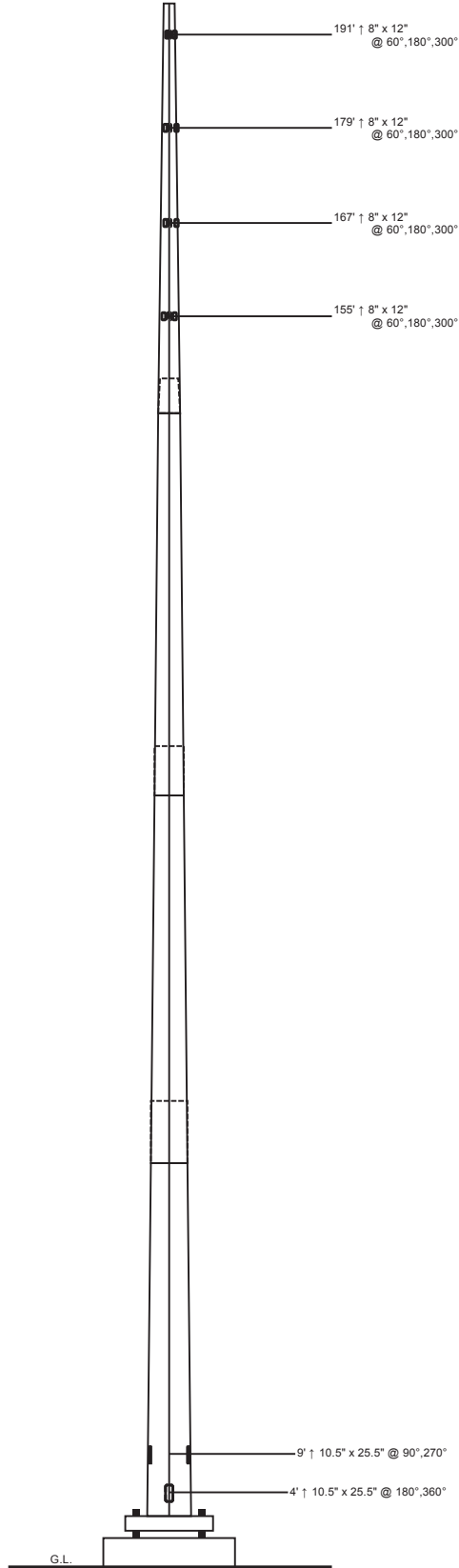
Prepared for: AT&T  
by: Sabre Towers & Poles™

Job Number: 444864  
Revision A  
October 31, 2019

Monopole Profile.....	1
Foundation Design Summary.....	2
Pole Calculations.....	3-13
Foundation Calculations.....	14-21



Length (ft)	53'-3"	53'-6"	53'-6"	52'-6"
Number Of Sides	18			
Thickness (in)	1/2"	7/16"	5/16"	
Lap Splice (ft)	8'-0"	6'-3"	A	
Top Diameter (in)	53.79"	42.41"	30.56"	18.25"
Bottom Diameter (in)	68.14"	56.82"	44.97"	32.39"
Taper (in/ft)		0.2694		
Grade		A572-65		
Weight (lbs)	20683	13176	10001	5083
Overall Steel Height (ft)		194		



### Designed Appurtenance Loading

Elev	Description	Tx-Line
193	(1) 278 sq. ft. EPA 6000# (no Ice)	(18) 1 5/8"
181	(1) 208 sq. ft. EPA 4000# (no ice)	(18) 1 5/8"
169	(1) 208 sq. ft. EPA 4000# (no ice)	(18) 1 5/8"
157	(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)	106 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	89.56	52.64	8537.27	18.99	12
3s Gusted Wind 0.9 Dead	67.23	52.63	8339.17	18.4	11.56
3s Gusted Wind&Ice	138.81	10.17	1849	4.42	2.75
Service Loads	74.71	15.75	2541.91	5.81	3.61

### Base Plate Dimensions

Shape	Diameter	Thickness	Bolt Circle	Bolt Qty	Bolt Diameter
Round	81.25"	2.5"	75.5"	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

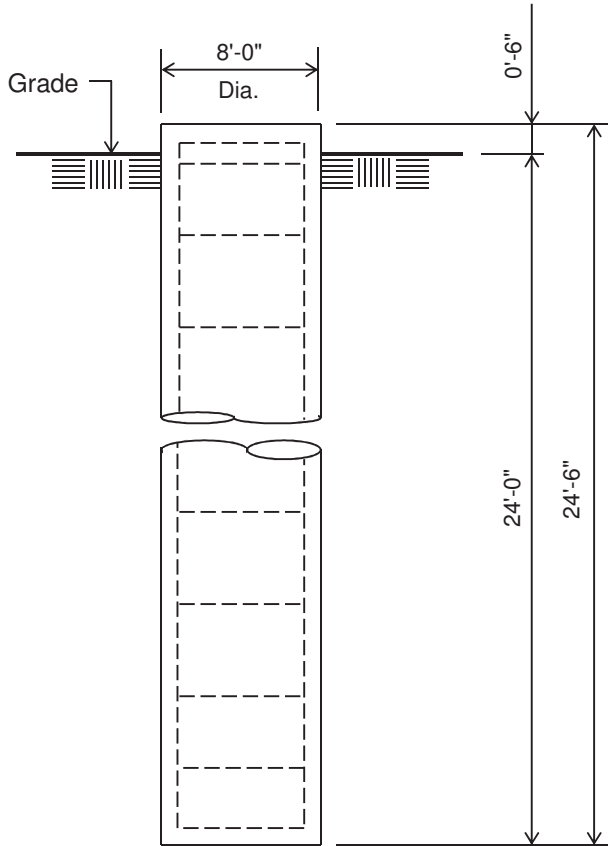
Display	Value
A	4' - 6"

### 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 2015 International Building Code.
- 6) Tower Rating: 100%

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------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Customer: AT&T**  
**Site: Ruddles Mill, 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 GPD Group Project No. 2019723.13800679.01, dated: 10/01/2019.
- 6) See the geotechnical report for drilled pier installation requirements, if specified.
- 7) The foundation is based on the following factored loads:  
Moment = 8,537.27 k-ft  
Axial = 89.56 k  
Shear = 52.64 k
- 8) Use Type V Portland cement with a maximum water-cement ratio of 0.45.

**Rebar Schedule for Pier**

Pier	(46) #10 vertical rebar w/ #6 ties, (2) within top 5" of pier, then 5" C/C
------	----------------------------------------------------------------------------

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 =====

195' Monopole / Ruddles Mill, KY

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

=====

POLE GEOMETRY

ELEV ft	SECTION NAME	No. SIDE	OUTSIDE DIAM in	THICK -NESS in	RESISTANCES ♦*Pn ♦*Mn kip ft-kip	SPLICE TYPE	...OVERLAP... LENGTH ft	RATIO	w/t
194.0	A	18	18.53	0.312	1321.9 483.3				8.5
146.0	A/B	18	31.65	0.312	2274.1 1440.3	SLIP	4.50	1.70	
141.5	B	18	32.27	0.438	3233.3 2072.0				11.0
98.7	B/C	18	43.94	0.438	4419.2 3884.7	SLIP	6.25	1.70	
92.5	C	18	44.79	0.438	4505.3 4038.4				16.0
53.2	C/D	18	55.50	0.438	5255.7 5860.0	SLIP	8.00	1.72	
45.2	D	18	56.83	0.500	6358.0 7245.0				18.0
0.0			69.19	0.500	7266.010113.5				

=====

POLE ASSEMBLY

SECTION NAME	BASE ELEV ft	BOLTS NUMBER	AT BASE TYPE	OF SECTION 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	TOP * in	BEND RAD in	MAT- ERIAL ID	FLANGE ID BOT	TOP	FLANGE WELD ..GROUP.ID.. BOT	TOP
A	18	52.50	32.89	18.53	0.000	1	0	0	0	0
B	18	53.50	45.66	31.03	0.000	2	0	0	0	0
C	18	53.50	57.70	43.06	0.000	3	0	0	0	0
D	18	53.25	69.19	54.62	0.000	4	0	0	0	0

\* - Diameter of circumscribed circle

MATERIAL TYPES

=====

TYPE OF SHAPE	TYPE NO	NO OF ELEM.	ORIENT	HEIGHT	WIDTH	.THICKNESS.		IRREGULARITY .PROJECTION.	
			& deg	in	in	WEB	FLANGE	% OF AREA	ORIENT deg
PL	1	1	0.0	32.89	0.31	0.312	0.312	0.00	0.0
PL	2	1	0.0	45.66	0.44	0.438	0.438	0.00	0.0
PL	3	1	0.0	57.70	0.44	0.438	0.438	0.00	0.0
PL	4	1	0.0	69.19	0.50	0.500	0.500	0.00	0.0

& - with respect to vertical

MATERIAL PROPERTIES

=====

MATERIAL TYPE NO.	ELASTIC MODULUS ksi	UNIT WEIGHT pcf	.. STRENGTH ..		THERMAL COEFFICIENT /deg
			Fu ksi	Fy ksi	
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

=====

106 mph Ultimate wind with no ice. Wind Azimuth: 0

LOADS ON POLE

=====

LOAD TYPE	ELEV ft	APPLY. RADIUS ft	LOAD. AT AZI	LOAD AZI	.....FORCES.....		.....MOMENTS.....	
					HORIZ kip	DOWN kip	VERTICAL ft-kip	TORSNAL ft-kip
C	192.000	0.00	0.0	0.0	0.0000	4.3131	0.0000	0.0000
C	192.000	0.00	0.0	0.0	11.6297	7.2000	0.0000	0.0000
C	180.000	0.00	0.0	0.0	0.0000	4.0435	0.0000	0.0000
C	180.000	0.00	0.0	0.0	8.5846	4.8000	0.0000	0.0000
C	168.000	0.00	0.0	0.0	0.0000	3.7740	0.0000	0.0000
C	168.000	0.00	0.0	0.0	8.4615	4.8000	0.0000	0.0000
C	156.000	0.00	0.0	0.0	0.0000	3.5044	0.0000	0.0000
C	156.000	0.00	0.0	0.0	8.3313	4.8000	0.0000	0.0000
D	194.000	0.00	180.0	0.0	0.0466	0.0816	0.0000	0.0000
D	178.000	0.00	180.0	0.0	0.0466	0.0816	0.0000	0.0000
D	178.000	0.00	180.0	0.0	0.0554	0.0989	0.0000	0.0000
D	162.000	0.00	180.0	0.0	0.0554	0.0989	0.0000	0.0000
D	162.000	0.00	180.0	0.0	0.0638	0.1161	0.0000	0.0000
D	146.000	0.00	180.0	0.0	0.0638	0.1161	0.0000	0.0000
D	146.000	0.00	180.0	0.0	0.0688	0.3018	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0688	0.3018	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0719	0.1888	0.0000	0.0000
D	127.250	0.00	180.0	0.0	0.0719	0.1888	0.0000	0.0000
D	127.250	0.00	180.0	0.0	0.0783	0.2104	0.0000	0.0000
D	113.000	0.00	180.0	0.0	0.0783	0.2104	0.0000	0.0000
D	113.000	0.00	180.0	0.0	0.0840	0.2319	0.0000	0.0000
D	98.750	0.00	180.0	0.0	0.0840	0.2319	0.0000	0.0000
D	98.750	0.00	180.0	0.0	0.0878	0.4905	0.0000	0.0000
D	92.500	0.00	180.0	0.0	0.0878	0.4905	0.0000	0.0000
D	92.500	0.00	180.0	0.0	0.0892	0.2577	0.0000	0.0000
D	79.417	0.00	180.0	0.0	0.0892	0.2577	0.0000	0.0000

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D	79.417	0.00	180.0	0.0	0.0928	0.2776	0.0000	0.0000
D	66.333	0.00	180.0	0.0	0.0928	0.2776	0.0000	0.0000
D	66.333	0.00	180.0	0.0	0.0955	0.2974	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0955	0.2974	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0966	0.6660	0.0000	0.0000
D	45.250	0.00	180.0	0.0	0.0966	0.6660	0.0000	0.0000
D	45.250	0.00	180.0	0.0	0.0952	0.3694	0.0000	0.0000
D	33.937	0.00	180.0	0.0	0.0952	0.3694	0.0000	0.0000
D	33.937	0.00	180.0	0.0	0.0926	0.3890	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0887	0.4282	0.0000	0.0000

LOADING CONDITION M

106 mph Ultimate wind with no ice. wind Azimuth: 0

LOADS ON POLE

LOAD TYPE	ELEV ft	APPLY.. RADIUS ft	LOAD..AT AZI	LOAD AZI	.....FORCES.....		.....MOMENTS.....	
					HORIZ kip	DOWN kip	VERTICAL ft-kip	TORSNAL ft-kip
C	192.000	0.00	0.0	0.0	0.0000	3.2348	0.0000	0.0000
C	192.000	0.00	0.0	0.0	11.6297	5.4000	0.0000	0.0000
C	180.000	0.00	0.0	0.0	0.0000	3.0326	0.0000	0.0000
C	180.000	0.00	0.0	0.0	8.5846	3.6000	0.0000	0.0000
C	168.000	0.00	0.0	0.0	0.0000	2.8305	0.0000	0.0000
C	168.000	0.00	0.0	0.0	8.4615	3.6000	0.0000	0.0000
C	156.000	0.00	0.0	0.0	0.0000	2.6283	0.0000	0.0000
C	156.000	0.00	0.0	0.0	8.3313	3.6000	0.0000	0.0000
D	194.000	0.00	180.0	0.0	0.0466	0.0612	0.0000	0.0000
D	178.000	0.00	180.0	0.0	0.0466	0.0612	0.0000	0.0000
D	178.000	0.00	180.0	0.0	0.0554	0.0742	0.0000	0.0000
D	162.000	0.00	180.0	0.0	0.0554	0.0742	0.0000	0.0000
D	162.000	0.00	180.0	0.0	0.0638	0.0871	0.0000	0.0000
D	146.000	0.00	180.0	0.0	0.0638	0.0871	0.0000	0.0000
D	146.000	0.00	180.0	0.0	0.0688	0.2264	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0688	0.2264	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0719	0.1416	0.0000	0.0000
D	127.250	0.00	180.0	0.0	0.0719	0.1416	0.0000	0.0000
D	127.250	0.00	180.0	0.0	0.0783	0.1578	0.0000	0.0000
D	113.000	0.00	180.0	0.0	0.0783	0.1578	0.0000	0.0000
D	113.000	0.00	180.0	0.0	0.0840	0.1739	0.0000	0.0000
D	98.750	0.00	180.0	0.0	0.0840	0.1739	0.0000	0.0000
D	98.750	0.00	180.0	0.0	0.0878	0.3678	0.0000	0.0000
D	92.500	0.00	180.0	0.0	0.0878	0.3678	0.0000	0.0000
D	92.500	0.00	180.0	0.0	0.0892	0.1933	0.0000	0.0000
D	79.417	0.00	180.0	0.0	0.0892	0.1933	0.0000	0.0000
D	79.417	0.00	180.0	0.0	0.0928	0.2082	0.0000	0.0000
D	66.333	0.00	180.0	0.0	0.0928	0.2082	0.0000	0.0000
D	66.333	0.00	180.0	0.0	0.0955	0.2230	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0955	0.2230	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0966	0.4995	0.0000	0.0000
D	45.250	0.00	180.0	0.0	0.0966	0.4995	0.0000	0.0000
D	45.250	0.00	180.0	0.0	0.0952	0.2771	0.0000	0.0000
D	33.937	0.00	180.0	0.0	0.0952	0.2771	0.0000	0.0000
D	33.937	0.00	180.0	0.0	0.0926	0.2918	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0887	0.3211	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.. RADIUS ft	LOAD..AT AZI	LOAD AZI	.....FORCES.....		.....MOMENTS.....	
					HORIZ kip	DOWN kip	VERTICAL ft-kip	TORSNAL ft-kip
C	192.000	0.00	0.0	0.0	0.0000	4.3131	0.0000	0.0000

					444864A		
C	192.000	0.00	0.0	0.0	1.6744	17.9386	0.0000
C	180.000	0.00	0.0	0.0	0.0000	4.0435	0.0000
C	180.000	0.00	0.0	0.0	1.9952	11.9132	0.0000
C	168.000	0.00	0.0	0.0	0.0000	3.7740	0.0000
C	168.000	0.00	0.0	0.0	1.9580	11.8646	0.0000
C	156.000	0.00	0.0	0.0	0.0000	3.5044	0.0000
C	156.000	0.00	0.0	0.0	1.9189	11.8128	0.0000
D	194.000	0.00	180.0	0.0	0.0084	0.1307	0.0000
D	178.000	0.00	180.0	0.0	0.0084	0.1307	0.0000
D	178.000	0.00	180.0	0.0	0.0098	0.1569	0.0000
D	162.000	0.00	180.0	0.0	0.0098	0.1569	0.0000
D	162.000	0.00	180.0	0.0	0.0110	0.1829	0.0000
D	146.000	0.00	180.0	0.0	0.0110	0.1829	0.0000
D	146.000	0.00	180.0	0.0	0.0118	0.3741	0.0000
D	141.500	0.00	180.0	0.0	0.0118	0.3741	0.0000
D	141.500	0.00	180.0	0.0	0.0122	0.2647	0.0000
D	127.250	0.00	180.0	0.0	0.0122	0.2647	0.0000
D	127.250	0.00	180.0	0.0	0.0132	0.2934	0.0000
D	113.000	0.00	180.0	0.0	0.0132	0.2934	0.0000
D	113.000	0.00	180.0	0.0	0.0140	0.3219	0.0000
D	98.750	0.00	180.0	0.0	0.0140	0.3219	0.0000
D	98.750	0.00	180.0	0.0	0.0146	0.5853	0.0000
D	92.500	0.00	180.0	0.0	0.0146	0.5853	0.0000
D	92.500	0.00	180.0	0.0	0.0148	0.3551	0.0000
D	79.417	0.00	180.0	0.0	0.0148	0.3551	0.0000
D	79.417	0.00	180.0	0.0	0.0153	0.3804	0.0000
D	66.333	0.00	180.0	0.0	0.0153	0.3804	0.0000
D	66.333	0.00	180.0	0.0	0.0156	0.4051	0.0000
D	53.250	0.00	180.0	0.0	0.0156	0.4051	0.0000
D	53.250	0.00	180.0	0.0	0.0157	0.7772	0.0000
D	45.250	0.00	180.0	0.0	0.0157	0.7772	0.0000
D	45.250	0.00	180.0	0.0	0.0156	0.4818	0.0000
D	11.312	0.00	180.0	0.0	0.0144	0.5227	0.0000
D	11.312	0.00	180.0	0.0	0.0144	0.5358	0.0000
D	0.000	0.00	180.0	0.0	0.0144	0.5358	0.0000

=====  
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195' Monopole / Ruddles Mill, KY

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

MAST ELEV ft	DEFLECTIONS (ft)			ROTATIONS (deg)		
	HORIZONTAL ALONG	ACROSS	DOWN	TILT ALONG	ACROSS	TWIST
194.0	18.99L	-0.07L	2.74L	12.00L	-0.03L	0.00X
178.0	15.81L	-0.06L	2.08L	11.66L	-0.03L	0.00X
162.0	12.80L	-0.05L	1.49L	10.65L	-0.03L	0.00L
146.0	10.10L	-0.04L	1.02L	9.19L	-0.03L	0.00L
141.5	9.41L	-0.04L	0.92L	8.85L	-0.03L	0.00L
127.2	7.39L	-0.03L	0.63L	7.70L	-0.03L	0.00L
113.0	5.64L	-0.03L	0.41L	6.56L	-0.03L	0.00L
98.7	4.16L	-0.02L	0.25L	5.49L	-0.02L	0.00L
92.5	3.59L	-0.02L	0.20L	5.05L	-0.02L	0.00L
79.4	2.56L	-0.01L	0.12L	4.11L	-0.02L	0.00L

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66.3	1.72L	-0.01L	0.06L	3.24L	-0.02L	0.00L
53.2	1.08L	-0.01L	0.03L	2.44L	-0.01L	0.00L
45.2	0.77L	0.00L	0.02L	2.03L	-0.01L	0.00L
33.9	0.42L	0.00L	0.01L	1.47L	-0.01L	0.00L
22.6	0.18L	0.00L	0.00L	0.95L	0.00L	0.00L
11.3	0.04L	0.00L	0.00AJ	0.46L	0.00L	0.00L
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. ALONG kip	WIND.DIR ACROSS kip	MOMENT.w.r.t. ALONG ft-kip	WIND.DIR ACROSS ft-kip	TORSION ft-kip
194.0	-0.01 U	0.00 D	0.00 C	0.01 T	0.00 C	0.00 C
178.0	40.30 AC	20.95 P	0.00 C	-215.76 L	-0.04 K	0.06 W
162.0	58.45 AD	30.28 U	-0.01 K	-671.32 L	0.18 E	0.18 W
146.0	76.69 AD	39.63 B	-0.01 K	-1332.26 L	0.33 E	0.36 W
141.5	78.37 AD	40.19 L	0.15 I	-1536.89 L	0.66 U	-0.40 K
127.2	82.14 AF	41.19 L	-0.29 L	-2194.43 L	4.20 L	-0.72 L
113.0	86.32 AF	42.28 K	-0.23 L	-2862.00 L	7.39 L	-1.15 L
98.7	90.91 AF	43.50 K	-0.24 L	-3540.61 L	10.71 L	-1.53 L
92.5	94.56 AF	44.12 X	-0.31 L	-3842.07 L	12.59 L	-1.72 L
79.4	99.21 AF	45.25 X	-0.38 L	-4481.13 L	17.45 L	-2.12 L
66.3	104.18 AF	46.50 X	-0.32 L	-5128.73 L	21.62 L	-2.38 L
53.2	109.48 AF	47.76 X	-0.33 L	-5784.41 L	25.97 L	-2.61 L
45.2	115.70 AF	48.50 L	-0.37 L	-6190.04 L	28.94 L	-2.73 L
33.9	121.23 AF	49.57 X	-0.37 L	-6769.45 L	33.12 L	-2.86 L
	126.91 AF	50.60 L	-0.36 L	-7354.15 L	37.22 L	-2.94 L



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22.6	126.91 AF	50.60 L	-0.37 L	-7354.15 L	37.23 L	-2.94 L
	132.75 AF	51.62 L	-0.37 L	-7943.63 L	41.46 L	-3.00 L
11.3	132.75 AF	51.63 L	-0.37 L	-7943.63 L	41.45 L	-3.00 L
	138.81 AF	52.64 L	-0.37 L	-8537.27 L	45.68 L	-3.01 L
base reaction	138.81 AF	-52.64 L	0.37 L	8537.27 L	-45.68 L	3.01 L

COMPLIANCE WITH 4.8.2 & 4.5.4

ELEV ft	AXIAL	BENDING	SHEAR + TORSIONAL	TOTAL	SATISFIED	D/t(w/t)	MAX ALLOWED
194.00	0.00U	0.00T	0.00D	0.00T	YES	8.53A	45.2
178.00	0.02AC	0.29L	0.03P	0.30L	YES	10.97A	45.2
	0.02AD	0.29L	0.03B	0.30L	YES	10.97A	45.2
162.00	0.03AD	0.63L	0.03U	0.65L	YES	13.40A	45.2
	0.03AD	0.63L	0.03B	0.65L	YES	13.40A	45.2
146.00	0.03AD	0.92L	0.03B	0.94L	YES	15.83A	45.2
	0.02AD	0.67I	0.03E	0.68I	YES	10.80A	45.2
141.50	0.02AD	0.71L	0.02E	0.73L	YES	11.29A	45.2
	0.02AF	0.74L	0.02L	0.76L	YES	11.04A	45.2
127.25	0.02AF	0.84L	0.02L	0.85L	YES	12.59A	45.2
	0.02AF	0.84L	0.02K	0.85L	YES	12.59A	45.2
113.00	0.02AF	0.89L	0.02X	0.90L	YES	14.14A	45.2
	0.02AF	0.89L	0.02K	0.90L	YES	14.14A	45.2
98.75	0.02AF	0.91L	0.02X	0.92L	YES	15.68A	45.2
	0.02AF	0.91L	0.02X	0.92L	YES	15.68A	45.2
92.50	0.02AF	0.92L	0.02X	0.93L	YES	16.36A	45.2
	0.02AF	0.95L	0.02X	0.96L	YES	16.01A	45.2
79.42	0.02AF	0.97L	0.02X	0.98L	YES	17.43A	45.2
	0.02AF	0.97L	0.02X	0.98L	YES	17.43A	45.2
66.33	0.02AF	0.98L	0.02X	0.99L	YES	18.85A	45.2
	0.02AF	0.98L	0.02X	0.99L	YES	18.85A	45.2
53.25	0.02AF	0.99L	0.02X	1.00L	YES	20.27A	45.2
	0.02AF	0.83L	0.02L	0.84L	YES	17.52A	45.2
45.25	0.02AF	0.83L	0.02L	0.84L	YES	18.28A	45.2
	0.02AF	0.85L	0.02L	0.87L	YES	17.97A	45.2
33.94	0.02AF	0.85L	0.02L	0.86L	YES	19.04A	45.2
	0.02AF	0.85L	0.02L	0.86L	YES	19.04A	45.2
22.62	0.02AF	0.85L	0.01L	0.86L	YES	20.12A	45.2
	0.02AF	0.85L	0.01L	0.86L	YES	20.12A	45.2

	0.02AF	0.85L	0.01L	0.86L	444864A YES	21.19A	45.2
11.31	0.02AF	0.85L	0.01L	0.86L	YES	21.19A	45.2
0.00	0.02AF	0.84L	0.01L	0.86L	YES	22.27A	45.2

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

DOWN	SHEAR.w.r.t.WIND.DIR	WIND.DIR	MOMENT.w.r.t.WIND.DIR	WIND.DIR	TORSION
kip	ALONG	ACROSS	ALONG	ACROSS	ft-kip
	kip	kip	ft-kip	ft-kip	
138.81	52.64	-0.37	-8537.27	45.68	-3.01
AF	L	L	L	L	L

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

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195' Monopole / Ruddles Mill, 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.. RADIUS ft	LOAD.. AZI	AT AZI	.....FORCES.....		.....MOMENTS.....	
					HORIZ kip	DOWN kip	VERTICAL ft-kip	TORSNAL ft-kip
C	192.000	0.00	0.0	0.0	0.0000	3.5942	0.0000	0.0000
C	192.000	0.00	0.0	0.0	3.4819	6.0000	0.0000	0.0000
C	180.000	0.00	0.0	0.0	0.0000	3.3696	0.0000	0.0000
C	180.000	0.00	0.0	0.0	2.5702	4.0000	0.0000	0.0000
C	168.000	0.00	0.0	0.0	0.0000	3.1450	0.0000	0.0000
C	168.000	0.00	0.0	0.0	2.5334	4.0000	0.0000	0.0000
C	156.000	0.00	0.0	0.0	0.0000	2.9203	0.0000	0.0000
C	156.000	0.00	0.0	0.0	2.4944	4.0000	0.0000	0.0000
D	194.000	0.00	180.0	0.0	0.0140	0.0680	0.0000	0.0000
D	178.000	0.00	180.0	0.0	0.0140	0.0680	0.0000	0.0000
D	178.000	0.00	180.0	0.0	0.0166	0.0824	0.0000	0.0000
D	162.000	0.00	180.0	0.0	0.0166	0.0824	0.0000	0.0000
D	162.000	0.00	180.0	0.0	0.0191	0.0968	0.0000	0.0000
D	146.000	0.00	180.0	0.0	0.0191	0.0968	0.0000	0.0000
D	146.000	0.00	180.0	0.0	0.0206	0.2515	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0206	0.2515	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0215	0.1574	0.0000	0.0000
D	127.250	0.00	180.0	0.0	0.0215	0.1574	0.0000	0.0000
D	127.250	0.00	180.0	0.0	0.0234	0.1753	0.0000	0.0000
D	113.000	0.00	180.0	0.0	0.0234	0.1753	0.0000	0.0000
D	113.000	0.00	180.0	0.0	0.0252	0.1932	0.0000	0.0000
D	98.750	0.00	180.0	0.0	0.0252	0.1932	0.0000	0.0000

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D	98.750	0.00	180.0	0.0	0.0263	0.4087	0.0000	0.0000
D	92.500	0.00	180.0	0.0	0.0263	0.4087	0.0000	0.0000
D	92.500	0.00	180.0	0.0	0.0267	0.2148	0.0000	0.0000
D	79.417	0.00	180.0	0.0	0.0267	0.2148	0.0000	0.0000
D	79.417	0.00	180.0	0.0	0.0278	0.2313	0.0000	0.0000
D	66.333	0.00	180.0	0.0	0.0278	0.2313	0.0000	0.0000
D	66.333	0.00	180.0	0.0	0.0286	0.2478	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0286	0.2478	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0289	0.5550	0.0000	0.0000
D	45.250	0.00	180.0	0.0	0.0289	0.5550	0.0000	0.0000
D	45.250	0.00	180.0	0.0	0.0285	0.3078	0.0000	0.0000
D	33.937	0.00	180.0	0.0	0.0285	0.3078	0.0000	0.0000
D	33.937	0.00	180.0	0.0	0.0277	0.3242	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0266	0.3568	0.0000	0.0000

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

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MAST ELEV ft	DEFLECTIONS (ft)			ROTATIONS (deg)		
	HORIZONTAL ALONG	ACROSS	DOWN	TILT ALONG	ACROSS	TWIST
194.0	5.81D	0.01H	0.26C	3.61D	0.00H	0.00F
178.0	4.82D	0.01H	0.20C	3.51D	0.00H	0.00F
162.0	3.88D	0.01H	0.14C	3.20D	0.00H	0.00F
146.0	3.05D	0.01H	0.10C	2.75D	0.00H	0.00F
141.5	2.83D	0.01H	0.09C	2.65D	0.00H	0.00F
127.2	2.22D	0.00H	0.06C	2.30D	0.00H	0.00F
113.0	1.69D	0.00H	0.04C	1.96D	0.00H	0.00F
98.7	1.24D	0.00H	0.02C	1.64D	0.00H	0.00F
92.5	1.07D	0.00H	0.02C	1.50D	0.00H	0.00F
79.4	0.76D	0.00H	0.01C	1.22D	0.00H	0.00F
66.3	0.51D	0.00H	0.01B	0.96D	0.00H	0.00F
53.2	0.32D	0.00H	0.00B	0.73D	0.00H	0.00F
45.2	0.23D	0.00H	0.00B	0.61D	0.00H	0.00F
33.9	0.13D	0.00H	0.00B	0.44D	0.00H	0.00F
22.6	0.05D	0.00H	0.00B	0.28D	0.00H	0.00F
11.3	0.01D	0.00H	0.00B	0.14D	0.00H	0.00F
0.0	0.00A	0.00A	0.00A	0.00A	0.00A	0.00A

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

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MAST ELEV ft	TOTAL	SHEAR.w.r.t.WIND.DIR		MOMENT.w.r.t.WIND.DIR		TORSION ft-kip
	AXIAL kip	ALONG kip	ACROSS kip	ALONG ft-kip	ACROSS ft-kip	
194.0	0.00 E	0.00 D	0.00 B	0.01 I	0.00 B	0.00 B
178.0	18.05 E	6.28 D	0.00 B	-65.28 L	0.02 F	0.01 F
162.0	18.05 B	6.28 A	0.00 F	-65.29 L	0.02 F	0.01 F
146.0	26.51 B	9.08 A	0.00 F	-202.68 B	0.05 F	0.02 F
127.2	26.51 B	9.08 K	0.00 I	-202.68 B	0.05 F	0.02 F
113.0	34.98 B	11.88 K	0.00 I	-401.06 B	0.11 F	0.04 F

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146.0	34.98 A	11.93 D	0.03 E	-401.16 K	0.12 K	0.04 F
141.5	36.11 A	12.02 D	0.03 E	-462.21 F	0.22 F	0.04 F
	36.12 B	11.98 K	-0.05 B	-462.25 F	0.23 F	0.04 F
127.2	38.36 B	12.29 K	-0.05 B	-657.55 D	0.71 B	0.07 F
	38.36 H	12.28 D	-0.04 B	-657.53 D	0.71 B	0.07 F
113.0	40.85 H	12.62 D	-0.04 B	-855.59 D	1.30 B	0.10 F
	40.85 H	12.61 D	-0.04 B	-855.58 D	1.30 B	0.10 F
98.7	43.60 H	12.97 D	-0.04 B	-1056.47 D	1.86 B	-0.13 B
	43.60 H	12.98 H	-0.05 B	-1056.50 D	1.83 B	-0.13 B
92.5	46.16 H	13.14 H	-0.05 B	-1145.72 D	2.14 B	-0.14 B
	46.16 H	13.18 D	0.05 H	-1145.83 D	2.05 B	-0.14 B
79.4	48.97 H	13.53 D	0.05 H	-1335.20 D	2.56 B	0.16 F
	48.97 H	13.55 D	0.05 H	-1335.22 D	2.57 B	0.16 F
66.3	51.99 H	13.91 D	0.05 H	-1527.32 D	-3.07 H	0.18 F
	51.99 H	13.92 D	0.05 H	-1527.33 D	-3.06 H	0.18 F
53.2	55.23 H	14.29 D	0.05 H	-1722.06 D	-3.74 H	0.19 F
	55.23 H	14.28 D	0.05 H	-1722.06 D	-3.76 H	0.19 F
45.2	59.67 H	14.51 D	0.05 H	-1842.49 D	-4.13 H	0.20 F
	59.67 H	14.50 D	0.05 H	-1842.49 D	-4.14 H	0.20 F
33.9	63.16 H	14.82 D	0.05 H	-2014.64 D	-4.66 H	0.21 F
	63.16 H	14.82 D	0.05 H	-2014.65 D	-4.65 H	0.21 F
22.6	66.88 H	15.13 D	0.05 H	-2188.67 D	-5.19 H	0.21 F
	66.88 H	15.14 D	0.05 H	-2188.67 D	-5.19 H	0.21 F
11.3	70.74 H	15.45 D	0.05 H	-2364.50 D	-5.70 H	0.22 F
	70.74 H	15.45 D	0.04 H	-2364.50 D	-5.70 H	0.22 F
	74.71 H	15.75 D	0.04 H	-2541.91 D	-6.21 H	0.22 F
base reaction	74.71 H	-15.75 D	-0.04 H	2541.91 D	6.21 H	-0.22 F

COMPLIANCE WITH 4.8.2 & 4.5.4

ELEV ft	AXIAL	BENDING	SHEAR + TORSIONAL	TOTAL	SATISFIED	D/t(w/t)	MAX ALLOWED
194.00	0.00E	0.00I	0.00B	0.00I	YES	8.53A	45.2
178.00	0.01E	0.09L	0.01D	0.10L	YES	10.97A	45.2
	0.01B	0.09L	0.01A	0.10L	YES	10.97A	45.2
162.00	0.01B	0.19B	0.01A	0.20B	YES	13.40A	45.2
	0.01B	0.19B	0.01K	0.20B	YES	13.40A	45.2
146.00	0.02B	0.28B	0.01K	0.29B	YES	15.83A	45.2
	0.01A	0.20K	0.01D	0.21K	YES	10.80A	45.2

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141.50	0.01A	0.21F	0.01D	0.23F	YES	11.29A	45.2
	0.01B	0.22F	0.01K	0.23F	YES	11.04A	45.2
127.25	0.01B	0.25D	0.01K	0.26D	YES	12.59A	45.2
	0.01H	0.25D	0.01D	0.26D	YES	12.59A	45.2
113.00	0.01H	0.27D	0.01D	0.28D	YES	14.14A	45.2
	0.01H	0.27D	0.01D	0.28D	YES	14.14A	45.2
98.75	0.01H	0.27D	0.01D	0.28D	YES	15.68A	45.2
	0.01H	0.27D	0.01H	0.28D	YES	15.68A	45.2
92.50	0.01H	0.27D	0.01H	0.28D	YES	16.36A	45.2
	0.01H	0.28D	0.01D	0.29D	YES	16.01A	45.2
79.42	0.01H	0.29D	0.01D	0.30D	YES	17.43A	45.2
	0.01H	0.29D	0.01D	0.30D	YES	17.43A	45.2
66.33	0.01H	0.29D	0.01D	0.30D	YES	18.85A	45.2
	0.01H	0.29D	0.01D	0.30D	YES	18.85A	45.2
53.25	0.01H	0.29D	0.01D	0.30D	YES	20.27A	45.2
	0.01H	0.25D	0.00D	0.26D	YES	17.52A	45.2
45.25	0.01H	0.25D	0.00D	0.26D	YES	18.28A	45.2
	0.01H	0.25D	0.00D	0.26D	YES	17.97A	45.2
33.94	0.01H	0.25D	0.00D	0.26D	YES	19.04A	45.2
	0.01H	0.25D	0.00D	0.26D	YES	19.04A	45.2
22.62	0.01H	0.25D	0.00D	0.26D	YES	20.12A	45.2
	0.01H	0.25D	0.00D	0.26D	YES	20.12A	45.2
11.31	0.01H	0.25D	0.00D	0.26D	YES	21.19A	45.2
	0.01H	0.25D	0.00D	0.26D	YES	21.19A	45.2
0.00	0.01H	0.25D	0.00D	0.26D	YES	22.27A	45.2

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

DOWN kip	SHEAR.w.r.t.WIND.DIR		MOMENT.w.r.t.WIND.DIR		TORSION ft-kip
	ALONG kip	ACROSS kip	ALONG ft-kip	ACROSS ft-kip	
74.71 H	15.75 D	0.04 H	-2541.91 D	-6.21 H	0.22 F

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

### Pole Data

Diameter: 68.140 in (flat to flat)  
Thickness: 0.5 in  
Yield (Fy): 65 ksi  
# of Sides: 18 "0" IF Round  
Strength (Fu): 80 ksi

### Reactions

Moment, Mu: 8537.27 ft-kips  
Axial, Pu: 89.56 kips  
Shear, Vu: 52.64 kips

### Anchor Rod Data

Quantity: 22  
Diameter: 2.25 in  
Rod Material: A615  
Strength (Fu): 100 ksi  
Yield (Fy): 75 ksi  
BC Diam. (in): 75.5 BC Override:

### Anchor Rod Results

Maximum Rod (Pu+ Vu/η): 255.6 Kips  
Allowable  $\Phi \cdot R_{nt}$ : 260.0 Kips (per 4.9.9)  
Anchor Rod Interaction Ratio: **98.3% Pass**

### Plate Data

Diameter (in): 81.25 Dia. Override:  
Thickness: 2.5 in  
Yield (Fy): 50 ksi  
Eff Width/Rod: 9.83 in  
Drain Hole: 2.625 in. diameter  
Drain Location: 32 in. center of pole to center of drain hole  
Center Hole: 56 in. diameter

### Base Plate Results

Base Plate (Mu/Z): 38.6 ksi  
Allowable  $\Phi \cdot F_y$ : 45.0 ksi (per AISC)  
Base Plate Interaction Ratio: **85.7% Pass**

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LPIle for windows(Beta), Version 2018-10.009

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

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

Name of input data file:  
444864.lp10

Name of output report file:  
444864.lp10

Name of plot output file:  
444864.lp10

Name of runtime message file:  
444864.lp10

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Date and Time of Analysis

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Date: October 9, 2019

Time: 14:04:55

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Problem Title

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Site : Ruddles Mill, KY

Tower : 195' Monopole

Prepared for : AT&T

Job Number : 444864

Engineer : MH

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Program Options and Settings

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## 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

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Pile Structural Properties and Geometry  
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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:  
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## 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

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Ground Slope and Pile Batter Angles  
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Ground Slope Angle = 0.000 degrees  
 = 0.000 radians  
 Pile Batter Angle = 0.000 degrees  
 = 0.000 radians  
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Soil and Rock Layering Information

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The soil profile is modelled using 5 layers

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

Distance from top of pile to top of layer	=	0.500000	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	=	14.400000	psf
Undrained cohesion at bottom of layer	=	14.400000	psf
Epsilon-50 at top of layer	=	0.100000	
Epsilon-50 at bottom of layer	=	0.100000	

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	=	9.000000	ft
Effective unit weight at top of layer	=	120.000000	pcf
Effective unit weight at bottom of layer	=	120.000000	pcf
Undrained cohesion at top of layer	=	1500.	psf
Undrained cohesion at bottom of layer	=	1500.	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	=	9.000000	ft
Distance from top of pile to bottom of layer	=	12.000000	ft
Effective unit weight at top of layer	=	130.000000	pcf
Effective unit weight at bottom of layer	=	130.000000	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 sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	12.000000	ft
Distance from top of pile to bottom of layer	=	17.000000	ft
Effective unit weight at top of layer	=	145.000000	pcf
Effective unit weight at bottom of layer	=	145.000000	pcf
Friction angle at top of layer	=	40.000000	deg.
Friction angle at bottom of layer	=	40.000000	deg.
Subgrade k at top of layer	=	280.000000	pci
Subgrade k at bottom of layer	=	280.000000	pci

Layer 5 is stiff clay without free water

Distance from top of pile to top of layer	=	17.000000	ft
Distance from top of pile to bottom of layer	=	27.000000	ft
Effective unit weight at top of layer	=	150.000000	pcf
Effective unit weight at bottom of layer	=	150.000000	pcf
Undrained cohesion at top of layer	=	15000.	psf
Undrained cohesion at bottom of layer	=	15000.	psf
Epsilon-50 at top of layer	=	0.0000100	
Epsilon-50 at bottom of layer	=	0.0000100	

(Depth of the lowest soil layer extends 2.500 ft below the pile tip)

\*\*\*\* Warning - Possible Input Data Error \*\*\*\*

Values entered for effective unit weights of soil were outside the limits of 20 pcf to 140 pcf.

The maximum input value, in layer 5, for effective unit weight = 150.00 pcf

This data may be erroneous. Please check your data.

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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	Angle of Friction deg.	E50 or krm	kpy pci
1	Soft Clay	0.5000 2.5000	120.0000	14.4000	--	0.10000	--
2	Stiff Clay w/o Free Water	2.5000 9.0000	120.0000	1500.	--	0.00700	--
3	Stiff Clay w/o Free Water	9.0000 12.0000	130.0000	3000.	--	0.00500	--
4	Sand (Reese, et al.)	12.0000 17.0000	145.0000	--	40.0000	--	280.0000
5	Stiff Clay w/o Free Water	17.0000 27.0000	150.0000	15000.	--	1.00E-05	--

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 = 70187. lbs	M = 136596320. in-lbs	119413.	No
2	1	V = 15750. lbs	M = 30502920. in-lbs	74710.	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

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Concrete Cover Thickness (to edge of long. rebar) = 3.625000 in  
 Number of Reinforcing Bars = 46 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 = 58.271360 sq. in.  
 Area Ratio of Steel Reinforcement = 0.81 percent  
 Edge-to-Edge Bar Spacing = 4.699846 in  
 Maximum Concrete Aggregate Size = 0.750000 in  
 Ratio of Bar Spacing to Aggregate Size = 6.27  
 Offset of Center of Rebar Cage from Center of Pile = 0.0000 in

Axial Structural Capacities:

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 Nom. Axial Structural Capacity =  $0.85 F_c A_c + F_y A_s$  = 30959.621 kips  
 Tensile Load for Cracking of Concrete = -3356.078 kips  
 Nominal Axial Tensile Capacity = -3496.282 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	43.332603	5.955929
3	1.270000	1.266769	42.118002	11.800911
4	1.270000	1.266769	40.118822	17.426064
5	1.270000	1.266769	37.372305	22.726602
6	1.270000	1.266769	33.929612	27.603787
7	1.270000	1.266769	29.854874	31.966765
8	1.270000	1.266769	25.223997	35.734263
9	1.270000	1.266769	20.123245	38.836099
10	1.270000	1.266769	14.647634	41.214493
11	1.270000	1.266769	8.899166	42.825138
12	1.270000	1.266769	2.984923	43.638032
13	1.270000	1.266769	-2.984923	43.638032
14	1.270000	1.266769	-8.899166	42.825138
15	1.270000	1.266769	-14.647634	41.214493
16	1.270000	1.266769	-20.123245	38.836099
17	1.270000	1.266769	-25.223997	35.734263
18	1.270000	1.266769	-29.854874	31.966765
19	1.270000	1.266769	-33.929612	27.603787
20	1.270000	1.266769	-37.372305	22.726602
21	1.270000	1.266769	-40.118822	17.426064
22	1.270000	1.266769	-42.118002	11.800911
23	1.270000	1.266769	-43.332603	5.955929
24	1.270000	1.266769	-43.740000	0.00000
25	1.270000	1.266769	-43.332603	-5.955929
26	1.270000	1.266769	-42.118002	-11.800911
27	1.270000	1.266769	-40.118822	-17.426064
28	1.270000	1.266769	-37.372305	-22.726602
29	1.270000	1.266769	-33.929612	-27.603787
30	1.270000	1.266769	-29.854874	-31.966765
31	1.270000	1.266769	-25.223997	-35.734263
32	1.270000	1.266769	-20.123245	-38.836099
33	1.270000	1.266769	-14.647634	-41.214493
34	1.270000	1.266769	-8.899166	-42.825138
35	1.270000	1.266769	-2.984923	-43.638032
36	1.270000	1.266769	2.984923	-43.638032
37	1.270000	1.266769	8.899166	-42.825138
38	1.270000	1.266769	14.647634	-41.214493
39	1.270000	1.266769	20.123245	-38.836099
40	1.270000	1.266769	25.223997	-35.734263
41	1.270000	1.266769	29.854874	-31.966765
42	1.270000	1.266769	33.929612	-27.603787
43	1.270000	1.266769	37.372305	-22.726602
44	1.270000	1.266769	40.118822	-17.426064
45	1.270000	1.266769	42.118002	-11.800911
46	1.270000	1.266769	43.332603	-5.955929

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

Minimum spacing between any two bars not equal to zero = 4.700 inches  
 between bars 31 and 32.

Ratio of bar spacing to maximum aggregate size = 6.27

## 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	74.710
2	119.413

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 Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1  
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Moment values interpolated at maximum compressive strain = 0.003  
 or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	74.710	144068.465	0.00300000
2	119.413	145654.043	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).

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 <sup>2</sup>
1	0.65	144068.	48.561500	93645.	3.3967E+09
2	0.65	145654.	77.618667	94675.	3.4383E+09
1	0.70	144068.	52.297000	100848.	3.3845E+09
2	0.70	145654.	83.589333	101958.	3.4233E+09
1	0.75	144068.	56.032500	108051.	3.2743E+09
2	0.75	145654.	89.560000	109241.	3.3151E+09

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 Layering Correction Equivalent Depths of Soil & Rock Layers  
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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	1959.
2	2.5000	0.05433	No	No	1959.	270784.
3	9.0000	3.5703	Yes	No	272743.	253416.
4	12.0000	7.9183	No	No	526159.	1025151.
5	17.0000	4.1090	No	No	1551309.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals

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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.

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Summary of Pile-head Responses for Conventional Analyses  
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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	70187.	M, in-lb	1.37E+08	119413.	4.0808	-0.02735	-1934725.	1.40E+08
2	V, lb	15750.	M, in-lb	3.05E+07	74710.	0.04718	-3.77E-04	-380199.	3.12E+07

Maximum pile-head deflection = 4.0807596705 inches  
Maximum pile-head rotation = -0.0273516951 radians = -1.567137 deg.

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Summary of Warning Messages  
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The following warning was reported 248 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)	8,537.27	
Shear (k)	52.64	
Caisson diameter (ft)	8	
Caisson height above ground (ft)	0.5	
Caisson height below ground (ft)	24	
Lateral soil pressure (lb/ft <sup>2</sup> )	743.75	
Ground to application of force, h (ft)	162.68	
Applied lateral force, P (lb)	52,640	
Lateral soil bearing pressure, S <sub>1</sub> (lb/ft)	5,950.00	
Diameter, b (ft)	8	
A	2.59	= (2.34P)/(S <sub>1</sub> b)
Minimum depth of embedment, d (ft)	22.75	= 0.5A[ 1 + ( 1 + ( 4.36h / A ) ) <sup>1/2</sup> ]