Sabre Industries™
Towers and Poles

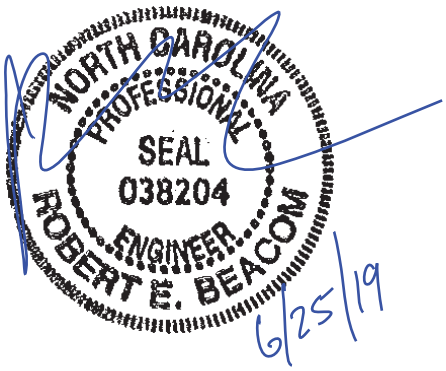
Structural Design Report

150' Monopole
Site: SE Erwin, NC
Site Number: 556891

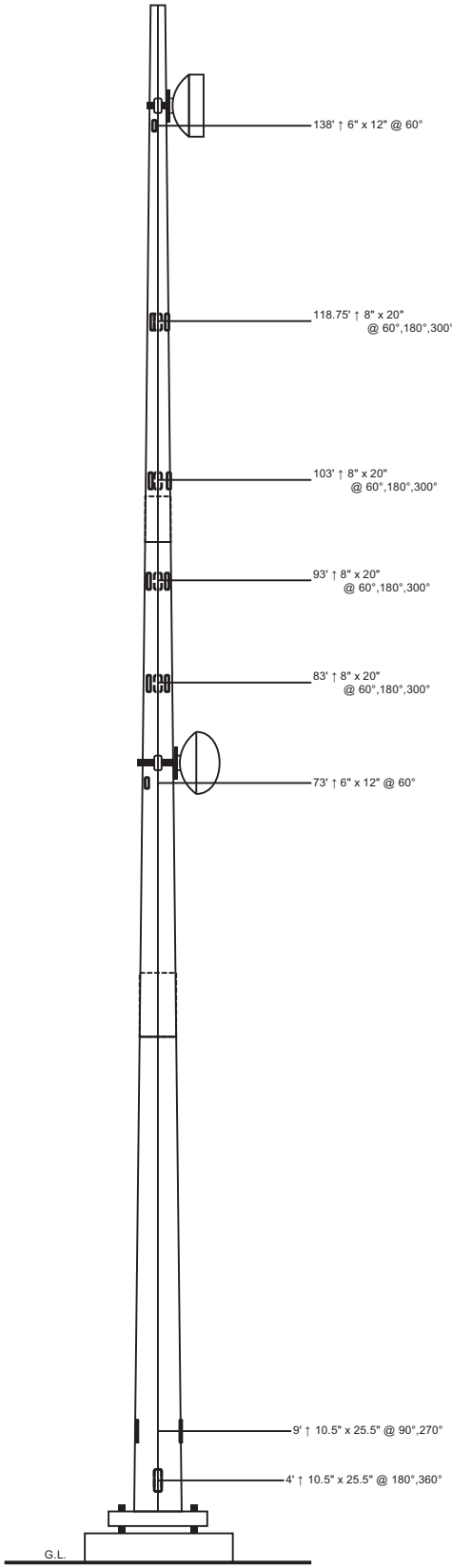
Prepared for: US CELLULAR CORP
by: Sabre Towers & Poles ™

Job Number: 20-1204-JDS

June 25, 2019



Length (ft)	53'-3"	53'-6"	53'-0"							
Number Of Sides		18								
Thickness (in)			1/2"						1/4"	
Lap Splice (ft)			6' - 3"					4' - 6"		
Top Diameter (in)	42.08"	29.47"							16"	
Bottom Diameter (in)	57.41"	44.88"							31.26"	
Taper (in/ft)						0.288				
Grade							A572-65			
Weight (lbs)	17036	11560							3897	
Overall Steel Height (ft)										149



Designed Appurtenance Loading

Elev	Description	Tx-Line
145	(1) 6' Ice Shield	
140	(1) Dish Mount (Monopole Only) - Pipe Mount (up to 6' Dish)	
140	(1) 6' H.P. Dish	(1) 1 5/8"
120	(1) 250 sq.ft. (no ice) 280 sq.ft. (ice)	(12) 1 5/8"
105	(1) 200 sq.ft. (no ice) 225 sq.ft. (ice)	(12) 1 5/8"
95	(1) 200 sq.ft. (no ice) 225 sq.ft. (ice)	(12) 1 5/8"
85	(1) 200 sq.ft. (no ice) 225 sq.ft. (ice)	(12) 1 5/8"
80	(1) 6' Ice Shield	
75	(1) Dish Mount (Monopole Only) - Pipe Mount (up to 6' Dish)	
75	(1) 6' Solid Dish W/ Radome	(1) 1 5/8"

Design Criteria - ANSI/TIA-222-G

ASCE 7-16 Ultimate Wind Speed (No Ice)	119 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	59.75	54.58	5324.79	7.95	5
3s Gusted Wind 0.9 Dead	44.84	54.56	5281.67	7.87	4.95
3s Gusted Wind&Ice	91.6	5.55	541.54	0.83	0.53
Service Loads	49.81	12.96	1259.91	1.89	1.18

Base Plate Dimensions

Shape	Width	Thickness	Bolt Circle	Bolt Qty	Bolt Diameter
Square	62.25"	3"	64.5"	16	2.25"

Anchor Bolt Dimensions

Length	Diameter	Hole Diameter	Weight	Type	Finish
84"	2.25"	2.625"	1937.6	A615-75	Galv

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: 99.3%

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

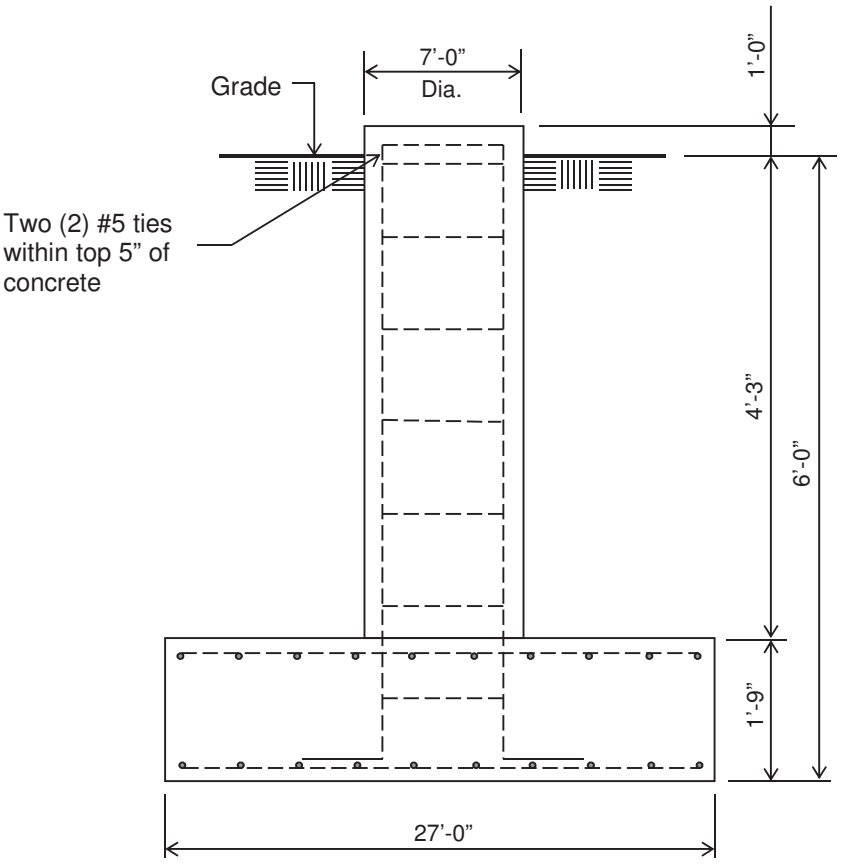
Job:	**20-1204-JDS**
Customer:	US CELLULAR CORP
Site Name:	SE Erwin, NC 556891
Description:	150' Monopole
Date:	6/25/2019 By: REB

Sabre Industries™
Towers and Poles

No.: 20-1204-JDS

Date: 06/25/19
By: NM

Customer: US CELLULAR CORP
Site: SE Erwin, NC 556891
150' Monopole



ELEVATION VIEW
(54.73 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 Edge Consulting Engineers, Inc., Project No. 18683 dated: June 13th, 2019.

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

7) 4.25 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 = 5,324.79 k-ft
   Axial = 59.75 k
   Shear = 54.58 k

Rebar Schedule for Pad and Pier	
Pier	(44) #8 vertical rebar w/ hooks at bottom w/ #5 ties, two within top 5" of pier, then 12" C/C
Pad	(50) #8 horizontal rebar evenly spaced each way top and bottom (200 total)

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

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Towers and Poles

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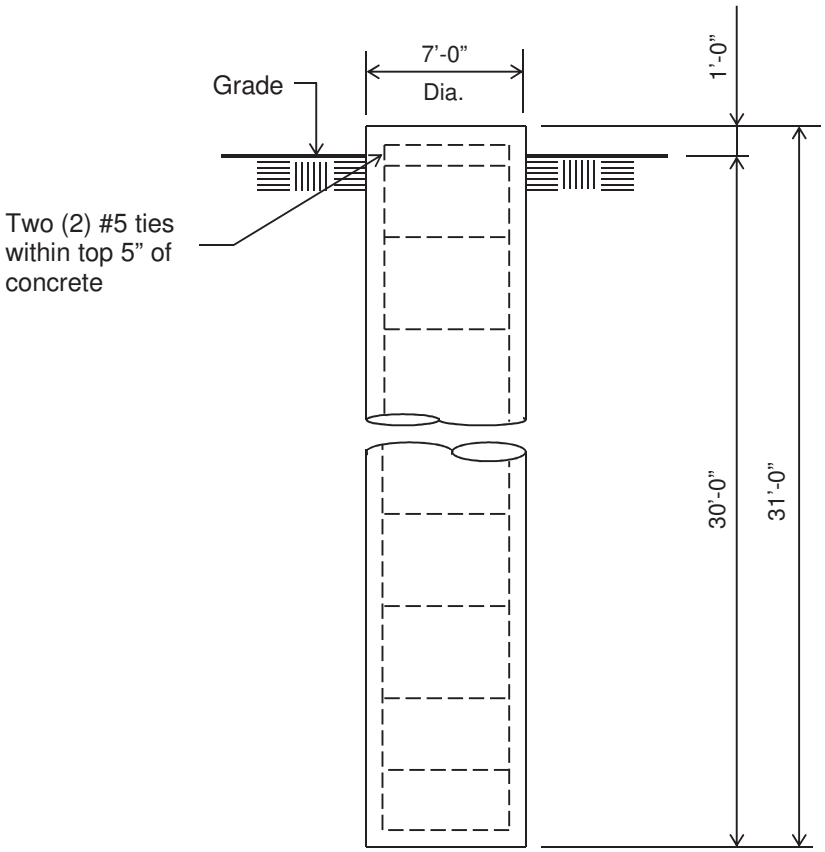
150' Monopole



ELEVATION VIEW
(44.19 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 Edge Consulting Engineers, Inc., Project No. 18683 dated: June 13th, 2019.

6) See the geotechnical report for drilled pier installation requirements, if specified.

7) The foundation is based on the following factored loads:
   Moment = 5,324.79 k-ft
   Axial = 59.75 k
   Shear = 54.58 k

Rebar Schedule for Pier	
Pier	(32) #10 vertical rebar w/ #5 ties, two within top 5" of pier, then 8" 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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150' Monopole / SE Erwin, NC

* 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 ϕ*Pn kip	RESISTANCES ϕ*Mn ft-kip	SPLICE TYPE	...OVERLAP... LENGTH ft	...OVERLAP... RATIO	w/t
149.0										
			16.25	0.250	928.5	298.5				
	A	18								9.5
			30.42	0.250	1668.1	1018.9				
100.5										
			30.42	0.250	1668.1	1018.9				
	A/B	18					SLIP	4.50	1.75	
			31.25	0.500	3569.2	2203.9				
96.0										
			31.25	0.500	3569.2	2203.9				
	B	18								9.1
			43.72	0.500	5018.1	4376.5				
53.2										
			43.72	0.500	5018.1	4376.5				
	B/C	18					SLIP	6.25	1.71	
			44.57	0.500	5116.0	4549.9				
47.0										
			44.57	0.500	5116.0	4549.9				
	C	18								13.7
			58.30	0.500	6475.4	7573.4				
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	96.000	0	A325	0.00	92.0	0	96.000
B	47.000	0	A325	0.00	92.0	0	47.000
C	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	53.00	31.75	16.25	0.000	1	0	0	0	0
B	18	53.50	45.57	29.92	0.000	2	0	0	0	0
C	18	53.25	58.30	42.72	0.000	3	0	0	0	0

* - Diameter of circumscribed circle

MATERIAL TYPES

TYPE OF SHAPE	TYPE NO	NO OF ELEM.	ORIENT	HEIGHT	WIDTH	.THICKNESS. WEB	.THICKNESS. FLANGE	IRREGULARITY .PROJECTION. % OF	IRREGULARITY .PROJECTION. ORIENT

			& deg	in	in	in	in	AREA	deg
PL	1	1	0.0	31.75	0.25	0.250	0.250	0.00	0.0
PL	2	1	0.0	45.57	0.50	0.500	0.500	0.00	0.0
PL	3	1	0.0	58.30	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 .. 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

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

LOADING CONDITION A

119 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	144.000	0.00	0.0	0.0	0.2975	0.7200	0.0000	0.0000
C	139.000	0.00	0.0	0.0	0.0000	0.1735	0.0000	0.0000
C	119.000	0.00	0.0	0.0	0.0000	1.7821	0.0000	0.0000
C	119.000	0.00	0.0	0.0	11.9114	6.6000	0.0000	0.0000
C	104.000	0.00	0.0	0.0	0.0000	1.5575	0.0000	0.0000
C	104.000	0.00	0.0	0.0	9.2650	3.7200	0.0000	0.0000
C	94.000	0.00	0.0	0.0	0.0000	1.4077	0.0000	0.0000
C	94.000	0.00	0.0	0.0	9.0718	3.7200	0.0000	0.0000
C	84.000	0.00	0.0	0.0	0.0000	1.2580	0.0000	0.0000
C	84.000	0.00	0.0	0.0	8.8619	3.7200	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.2625	0.7200	0.0000	0.0000
C	74.000	0.00	0.0	0.0	0.0000	0.0924	0.0000	0.0000
D	149.000	0.00	180.0	0.0	0.0498	0.0588	0.0000	0.0000
D	132.833	0.00	180.0	0.0	0.0498	0.0588	0.0000	0.0000
D	132.833	0.00	180.0	0.0	0.0608	0.0737	0.0000	0.0000
D	116.667	0.00	180.0	0.0	0.0608	0.0737	0.0000	0.0000
D	116.667	0.00	180.0	0.0	0.0711	0.0886	0.0000	0.0000
D	100.500	0.00	180.0	0.0	0.0711	0.0886	0.0000	0.0000
D	100.500	0.00	180.0	0.0	0.0771	0.2907	0.0000	0.0000
D	96.000	0.00	180.0	0.0	0.0771	0.2907	0.0000	0.0000
D	96.000	0.00	180.0	0.0	0.0809	0.2098	0.0000	0.0000
D	81.750	0.00	180.0	0.0	0.0809	0.2098	0.0000	0.0000
D	81.750	0.00	180.0	0.0	0.0878	0.2361	0.0000	0.0000
D	67.500	0.00	180.0	0.0	0.0878	0.2361	0.0000	0.0000
D	67.500	0.00	180.0	0.0	0.0934	0.2623	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0934	0.2623	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0963	0.5569	0.0000	0.0000
D	47.000	0.00	180.0	0.0	0.0963	0.5569	0.0000	0.0000
D	47.000	0.00	180.0	0.0	0.0958	0.2924	0.0000	0.0000
D	35.250	0.00	180.0	0.0	0.0958	0.2924	0.0000	0.0000
D	35.250	0.00	180.0	0.0	0.0961	0.3141	0.0000	0.0000
D	23.500	0.00	180.0	0.0	0.0961	0.3141	0.0000	0.0000
D	23.500	0.00	180.0	0.0	0.0927	0.3358	0.0000	0.0000
D	11.750	0.00	180.0	0.0	0.0927	0.3358	0.0000	0.0000
D	11.750	0.00	180.0	0.0	0.0944	0.3575	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0944	0.3575	0.0000	0.0000

ANTENNA LOADING

TYPE	ANTENNA ELEV ft	AZI	ATTACHMENT RAD ft	AZI	ANTENNA FORCES AXIAL kip	SHEAR kip	GRAVITY kip	TORSION ft-kip
STD+R	74.0	0.0	2.2	0.0	1.05	0.00	0.24	0.00
HP	139.0	0.0	1.5	0.0	1.76	0.00	0.34	0.00

LOADING CONDITION M

119 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	144.000	0.00	0.0	0.0	0.2975	0.5400	0.0000	0.0000
C	139.000	0.00	0.0	0.0	0.0000	0.1301	0.0000	0.0000
C	119.000	0.00	0.0	0.0	0.0000	1.3366	0.0000	0.0000
C	119.000	0.00	0.0	0.0	11.9114	4.9500	0.0000	0.0000
C	104.000	0.00	0.0	0.0	0.0000	1.1681	0.0000	0.0000
C	104.000	0.00	0.0	0.0	9.2650	2.7900	0.0000	0.0000
C	94.000	0.00	0.0	0.0	0.0000	1.0558	0.0000	0.0000
C	94.000	0.00	0.0	0.0	9.0718	2.7900	0.0000	0.0000
C	84.000	0.00	0.0	0.0	0.0000	0.9435	0.0000	0.0000
C	84.000	0.00	0.0	0.0	8.8619	2.7900	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.2625	0.5400	0.0000	0.0000
C	74.000	0.00	0.0	0.0	0.0000	0.0693	0.0000	0.0000
D	149.000	0.00	180.0	0.0	0.0498	0.0441	0.0000	0.0000
D	132.833	0.00	180.0	0.0	0.0498	0.0441	0.0000	0.0000
D	132.833	0.00	180.0	0.0	0.0608	0.0553	0.0000	0.0000
D	116.667	0.00	180.0	0.0	0.0608	0.0553	0.0000	0.0000
D	116.667	0.00	180.0	0.0	0.0711	0.0665	0.0000	0.0000
D	100.500	0.00	180.0	0.0	0.0711	0.0665	0.0000	0.0000
D	100.500	0.00	180.0	0.0	0.0771	0.2180	0.0000	0.0000
D	96.000	0.00	180.0	0.0	0.0771	0.2180	0.0000	0.0000
D	96.000	0.00	180.0	0.0	0.0809	0.1574	0.0000	0.0000
D	81.750	0.00	180.0	0.0	0.0809	0.1574	0.0000	0.0000
D	81.750	0.00	180.0	0.0	0.0878	0.1771	0.0000	0.0000
D	67.500	0.00	180.0	0.0	0.0878	0.1771	0.0000	0.0000
D	67.500	0.00	180.0	0.0	0.0934	0.1967	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0934	0.1967	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0963	0.4177	0.0000	0.0000
D	47.000	0.00	180.0	0.0	0.0963	0.4177	0.0000	0.0000
D	47.000	0.00	180.0	0.0	0.0958	0.2193	0.0000	0.0000
D	35.250	0.00	180.0	0.0	0.0958	0.2193	0.0000	0.0000
D	35.250	0.00	180.0	0.0	0.0961	0.2356	0.0000	0.0000
D	23.500	0.00	180.0	0.0	0.0961	0.2356	0.0000	0.0000
D	23.500	0.00	180.0	0.0	0.0927	0.2518	0.0000	0.0000
D	11.750	0.00	180.0	0.0	0.0927	0.2518	0.0000	0.0000
D	11.750	0.00	180.0	0.0	0.0944	0.2681	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0944	0.2681	0.0000	0.0000

ANTENNA LOADING

TYPE	ANTENNA ELEV ft	AZI	ATTACHMENT RAD ft	AZI	ANTENNA FORCES AXIAL kip	SHEAR kip	GRAVITY kip	TORSION ft-kip
STD+R	74.0	0.0	2.2	0.0	1.05	0.00	0.18	0.00
HP	139.0	0.0	1.5	0.0	1.76	0.00	0.25	0.00

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	144.000	0.00	0.0	0.0	0.0312	1.0679	0.0000	0.0000
C	139.000	0.00	0.0	0.0	0.0000	0.1735	0.0000	0.0000
C	119.000	0.00	0.0	0.0	0.0000	1.7821	0.0000	0.0000
C	119.000	0.00	0.0	0.0	1.1159	13.4268	0.0000	0.0000
C	104.000	0.00	0.0	0.0	0.0000	1.5575	0.0000	0.0000
C	104.000	0.00	0.0	0.0	0.8750	7.7618	0.0000	0.0000
C	94.000	0.00	0.0	0.0	0.0000	1.4077	0.0000	0.0000
C	94.000	0.00	0.0	0.0	0.8542	7.7215	0.0000	0.0000
C	84.000	0.00	0.0	0.0	0.0000	1.2580	0.0000	0.0000
C	84.000	0.00	0.0	0.0	0.8317	7.6772	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.0270	1.0478	0.0000	0.0000
C	74.000	0.00	0.0	0.0	0.0000	0.0924	0.0000	0.0000
D	149.000	0.00	180.0	0.0	0.0072	0.1019	0.0000	0.0000
D	132.833	0.00	180.0	0.0	0.0072	0.1019	0.0000	0.0000
D	132.833	0.00	180.0	0.0	0.0086	0.1262	0.0000	0.0000
D	116.667	0.00	180.0	0.0	0.0086	0.1262	0.0000	0.0000
D	116.667	0.00	180.0	0.0	0.0098	0.1501	0.0000	0.0000
D	100.500	0.00	180.0	0.0	0.0098	0.1501	0.0000	0.0000
D	100.500	0.00	180.0	0.0	0.0105	0.3578	0.0000	0.0000
D	96.000	0.00	180.0	0.0	0.0105	0.3578	0.0000	0.0000
D	96.000	0.00	180.0	0.0	0.0109	0.2807	0.0000	0.0000
D	81.750	0.00	180.0	0.0	0.0109	0.2807	0.0000	0.0000
D	81.750	0.00	180.0	0.0	0.0117	0.3140	0.0000	0.0000
D	67.500	0.00	180.0	0.0	0.0117	0.3140	0.0000	0.0000
D	67.500	0.00	180.0	0.0	0.0123	0.3467	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0123	0.3467	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0126	0.6454	0.0000	0.0000
D	47.000	0.00	180.0	0.0	0.0126	0.6454	0.0000	0.0000
D	47.000	0.00	180.0	0.0	0.0125	0.3821	0.0000	0.0000
D	35.250	0.00	180.0	0.0	0.0125	0.3821	0.0000	0.0000
D	35.250	0.00	180.0	0.0	0.0125	0.4071	0.0000	0.0000
D	23.500	0.00	180.0	0.0	0.0125	0.4071	0.0000	0.0000
D	23.500	0.00	180.0	0.0	0.0120	0.4302	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0121	0.4481	0.0000	0.0000

ANTENNA LOADING
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.....ANTENNA..... TYPE	ELEV ft	AZI	ATTACHMENT RAD ft	AZI	.....ANTENNA FORCES..... AXIAL kip	SHEAR kip	GRAVITY kip	TORSION ft-kip
STD+R	74.0	0.0	2.2	0.0	0.08	0.00	0.76	0.00
HP	139.0	0.0	1.5	0.0	0.13	0.00	1.10	0.00

150' Monopole / SE Erwin, NC

MAXIMUM POLE DEFORMATIONS CALCULATED(w.r.t. wind direction)
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MAST ELEV ft	.....DEFLECTIONS (ft)..... HORIZONTAL ..... ALONG	ACROSS	DOWN	.....ROTATIONS (deg)..... TILT ..... ALONG	ACROSS	TWIST
149.0	7.95A	-0.32W	0.54A	5.00A	-0.26W	0.03D
132.8	6.55A	-0.24W	0.42A	4.97A	-0.26W	0.02D

116.7	5.19A	-0.17W	0.31A	4.78A	-0.21W	0.01D
100.5	3.91A	-0.12W	0.20A	4.24A	-0.15W	0.01D
96.0	3.58A	-0.11W	0.18A	4.13A	-0.15W	0.01D
81.7	2.62A	-0.08W	0.11A	3.66A	-0.12W	0.01D
67.5	1.78A	-0.05W	0.06A	3.07A	-0.09W	0.01D
53.2	1.10A	-0.03W	0.03A	2.42A	-0.07W	0.00D
47.0	0.85A	-0.02W	0.02A	2.14A	-0.06W	0.00D
35.2	0.47A	-0.01W	0.01A	1.57A	-0.04W	0.00D
23.5	0.21A	-0.01W	0.00A	1.02A	-0.03W	0.00D
11.7	0.05A	0.00W	0.00A	0.50A	-0.01W	0.00D
0.0	0.00A	0.00A	0.00A	0.00A	0.00A	0.00A

MAXIMUM ANTENNA AND REFLECTOR ROTATIONS

ELEV	ANT AZI	ANT TYPE	.... BEAM DEFLECTIONS (deg) .... ROLL	YAW	PITCH	TOTAL
ft	deg					
139.0	0.0	HP	4.712 D	0.202 K	4.982 A	4.982 A
74.0	0.0	STD+R	3.226 D	0.086 K	3.341 A	3.341 A

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
149.0	0.00 H	0.00 T	0.00 W	0.00 I	0.00 U	0.00 O
	3.99 AG	2.86 A	0.88 O	-21.61 A	-5.15 O	-2.05 V
132.8	3.99 AI	2.86 M	0.88 O	-21.61 A	-5.15 O	-2.05 V
	21.24 AI	15.75 M	0.88 O	-108.31 A	-19.54 O	1.94 C
116.7	21.24 Y	15.75 A	0.88 O	-108.32 A	-19.54 O	1.94 C
	32.98 Y	26.16 A	0.88 O	-420.09 A	-34.39 C	-2.12 W
100.5	32.98 Y	26.17 A	-0.90 W	-420.09 A	-34.44 C	-2.12 W
	34.59 Y	26.52 A	-0.90 W	-544.04 A	-38.54 C	-2.12 W
96.0	34.59 AH	26.54 M	-0.93 W	-544.12 A	-38.59 C	-2.12 W
	56.66 AH	45.62 M	-0.93 W	-1084.73 A	52.20 W	-1.88 W
81.7	56.66 AH	45.63 M	-0.95 W	-1084.72 A	52.20 W	-1.88 W
	63.03 AH	48.19 M	-1.09 W	-1780.22 A	66.93 W	4.15 D
67.5	63.03 AH	48.19 A	-1.09 W	-1780.23 A	66.94 W	4.15 D
	67.97 AH	49.52 A	-1.09 W	-2501.44 A	82.98 W	4.26 D
53.2	67.97 AH	49.53 M	-1.09 W	-2501.44 A	82.98 W	4.26 D
	72.01 AH	50.13 M	-1.09 W	-2822.90 A	90.00 W	4.30 D
47.0	72.01 AI	50.12 A	-1.10 W	-2822.90 A	90.01 W	4.30 D

	76.49 AH	51.25 A	-1.10 W	-3435.30 A	103.21 W	4.35 D
35.2						
	76.49 AI	51.26 A	-1.10 W	-3435.29 A	103.21 W	4.35 D
	81.28 AI	52.38 A	-1.10 W	-4057.02 A	116.35 W	4.39 D
23.5						
	81.28 AI	52.38 A	-1.10 W	-4057.02 A	116.35 W	4.39 D
	86.39 AI	53.47 A	-1.10 W	-4687.09 A	129.49 W	4.40 D
11.7						
	86.39 AI	53.47 A	-1.10 W	-4687.10 A	129.49 W	4.40 D
	91.60 AI	54.58 A	-1.10 W	-5324.79 A	142.49 W	4.41 D
base reaction	91.60 AI	-54.58 A	1.10 W	5324.79 A	-142.49 W	-4.41 D

COMPLIANCE WITH 4.8.2 & 4.5.4

ELEV ft	AXIAL	BENDING	SHEAR + TORSIONAL	TOTAL	SATISFIED	D/t(w/t)	MAX ALLOWED
149.00	0.00H	0.00I	0.00T	0.00T	YES	9.52A	45.2
	0.00AG	0.04A	0.00A	0.04A	YES	12.81A	45.2
132.83	0.00AI	0.04A	0.00M	0.04A	YES	12.81A	45.2
	0.01AI	0.14A	0.02M	0.15A	YES	16.09A	45.2
116.67	0.01Y	0.14A	0.02A	0.15A	YES	16.09A	45.2
	0.02Y	0.41A	0.03A	0.42A	YES	19.37A	45.2
100.50	0.01Y	0.20A	0.02A	0.21A	YES	8.81A	45.2
	0.01Y	0.24A	0.01A	0.24A	YES	9.26A	45.2
96.00	0.01AH	0.25A	0.01M	0.25A	YES	9.09A	45.2
	0.01AH	0.38A	0.02M	0.39A	YES	10.53A	45.2
81.75	0.01AH	0.38A	0.02M	0.39A	YES	10.53A	45.2
	0.01AH	0.50A	0.02M	0.51A	YES	11.98A	45.2
67.50	0.01AH	0.50A	0.02A	0.51A	YES	11.98A	45.2
	0.01AH	0.57A	0.02A	0.58A	YES	13.43A	45.2
53.25	0.01AH	0.57A	0.02M	0.58A	YES	13.43A	45.2
	0.01AH	0.59A	0.02M	0.60A	YES	14.06A	45.2
47.00	0.01AI	0.62A	0.02A	0.63A	YES	13.71A	45.2
	0.01AH	0.65A	0.02A	0.66A	YES	14.90A	45.2
35.25	0.01AI	0.65A	0.02A	0.66A	YES	14.90A	45.2
	0.01AI	0.67A	0.02A	0.68A	YES	16.10A	45.2
23.50	0.01AI	0.67A	0.02A	0.68A	YES	16.10A	45.2
	0.01AI	0.69A	0.02A	0.70A	YES	17.29A	45.2
11.75	0.01AI	0.69A	0.02A	0.70A	YES	17.29A	45.2
	0.01AI	0.70A	0.02A	0.71A	YES	18.48A	45.2
0.00							

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

DOWN	SHEAR.w.r.t.WIND.DIR ALONG	SHEAR.w.r.t.WIND.DIR ACROSS	MOMENT.w.r.t.WIND.DIR ALONG	MOMENT.w.r.t.WIND.DIR ACROSS	TORSION
kip	kip	kip	ft-kip	ft-kip	ft-kip
91.60	54.58	-1.10	-5324.79	142.49	4.41
AI	A	W	A	W	D

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150' Monopole / SE Erwin, NC

****
********** 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	APPLY..LOAD..AT RADIUS	AZI	LOAD AZI	.....FORCES..... HORIZ	DOWN	.....MOMENTS..... VERTICAL	TORSNAL
	ft	ft			kip	kip	ft-kip	ft-kip
C	144.000	0.00	0.0	0.0	0.0708	0.6000	0.0000	0.0000
C	139.000	0.00	0.0	0.0	0.0000	0.1446	0.0000	0.0000
C	119.000	0.00	0.0	0.0	0.0000	1.4851	0.0000	0.0000
C	119.000	0.00	0.0	0.0	2.8331	5.5000	0.0000	0.0000
C	104.000	0.00	0.0	0.0	0.0000	1.2979	0.0000	0.0000
C	104.000	0.00	0.0	0.0	2.2037	3.1000	0.0000	0.0000
C	94.000	0.00	0.0	0.0	0.0000	1.1731	0.0000	0.0000
C	94.000	0.00	0.0	0.0	2.1577	3.1000	0.0000	0.0000
C	84.000	0.00	0.0	0.0	0.0000	1.0483	0.0000	0.0000
C	84.000	0.00	0.0	0.0	2.1078	3.1000	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.0624	0.6000	0.0000	0.0000
C	74.000	0.00	0.0	0.0	0.0000	0.0770	0.0000	0.0000
D	149.000	0.00	180.0	0.0	0.0118	0.0490	0.0000	0.0000
D	132.833	0.00	180.0	0.0	0.0118	0.0490	0.0000	0.0000
D	132.833	0.00	180.0	0.0	0.0145	0.0614	0.0000	0.0000
D	116.667	0.00	180.0	0.0	0.0145	0.0614	0.0000	0.0000
D	116.667	0.00	180.0	0.0	0.0169	0.0739	0.0000	0.0000
D	100.500	0.00	180.0	0.0	0.0169	0.0739	0.0000	0.0000
D	100.500	0.00	180.0	0.0	0.0183	0.2423	0.0000	0.0000
D	96.000	0.00	180.0	0.0	0.0183	0.2423	0.0000	0.0000
D	96.000	0.00	180.0	0.0	0.0192	0.1749	0.0000	0.0000
D	81.750	0.00	180.0	0.0	0.0192	0.1749	0.0000	0.0000
D	81.750	0.00	180.0	0.0	0.0209	0.1967	0.0000	0.0000
D	67.500	0.00	180.0	0.0	0.0209	0.1967	0.0000	0.0000
D	67.500	0.00	180.0	0.0	0.0222	0.2186	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0222	0.2186	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0229	0.4641	0.0000	0.0000
D	47.000	0.00	180.0	0.0	0.0229	0.4641	0.0000	0.0000
D	47.000	0.00	180.0	0.0	0.0228	0.2436	0.0000	0.0000
D	35.250	0.00	180.0	0.0	0.0228	0.2436	0.0000	0.0000
D	35.250	0.00	180.0	0.0	0.0228	0.2617	0.0000	0.0000
D	23.500	0.00	180.0	0.0	0.0228	0.2617	0.0000	0.0000

D	23.500	0.00	180.0	0.0	0.0220	0.2798	0.0000	0.0000
D	11.750	0.00	180.0	0.0	0.0220	0.2798	0.0000	0.0000
D	11.750	0.00	180.0	0.0	0.0224	0.2979	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0224	0.2979	0.0000	0.0000

ANTENNA LOADING
==========

.....ANTENNA.....			ATTACHMENT		.....ANTENNA FORCES.....			
TYPE	ELEV	AZI	RAD	AZI	AXIAL	SHEAR	GRAVITY	TORSION
	ft		ft		kip	kip	kip	ft-kip
STD+R	74.0	0.0	2.2	0.0	0.25	0.00	0.20	0.00
HP	139.0	0.0	1.5	0.0	0.42	0.00	0.28	0.00

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

MAST ELEV	.....DEFLECTIONS (ft).....			.....ROTATIONS (deg).....		
	..... HORIZONTAL		DOWN	..... TILT		TWIST
ft	ALONG	ACROSS		ALONG	ACROSS	
149.0	1.89A	0.07C	0.03A	1.18A	0.06C	-0.01J
132.8	1.56A	0.06C	0.03A	1.17A	0.06C	-0.01J
116.7	1.23A	0.04C	0.02A	1.13A	0.05C	0.00J
100.5	0.93A	0.03C	0.01A	1.00A	0.04C	0.00J
96.0	0.85A	0.03C	0.01A	0.98A	0.03C	0.00J
81.7	0.62A	0.02C	0.01A	0.87A	0.03C	0.00J
67.5	0.42A	0.01C	0.00A	0.73A	0.02C	0.00J
53.2	0.26A	0.01C	0.00A	0.57A	0.02C	0.00J
47.0	0.20A	0.01C	0.00A	0.51A	0.01C	0.00J
35.2	0.11A	0.00C	0.00A	0.37A	0.01C	0.00J
23.5	0.05A	0.00C	0.00A	0.24A	0.01C	0.00J
11.7	0.01A	0.00K	0.00A	0.12A	0.00K	0.00J
0.0	0.00A	0.00A	0.00A	0.00A	0.00A	0.00A

MAXIMUM ANTENNA AND REFLECTOR ROTATIONS
==========

ELEV	ANT AZI	ANT TYPE	.... BEAM DEFLECTIONS (deg)			
			ROLL	YAW	PITCH	TOTAL
ft	deg					
139.0	0.0	HP	-1.117 J	0.013 C	1.178 A	1.178 A
74.0	0.0	STD+R	-0.764 J	0.005 C	0.790 A	0.790 A

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

MAST ELEV	TOTAL AXIAL	SHEAR.w.r.t.WIND.DIR ALONG	ACROSS	MOMENT.w.r.t.WIND.DIR ALONG	ACROSS	TORSION
ft	kip	kip	kip	ft-kip	ft-kip	ft-kip
149.0	0.00 K	0.00 K	0.00 F	0.00 K	0.00 L	0.00 F
	1.82 C	0.68 A	0.21 C	-5.14 G	-1.18 I	-0.50 J
132.8	1.82 D	0.68 A	0.21 C	-5.14 G	1.18 E	-0.50 J

	9.80 D	3.75 A	0.21 C	-25.38 A	-4.39 C	-0.49 J
116.7						
	9.80 K	3.75 A	-0.21 K	-25.38 A	-4.39 C	-0.49 J
	15.39 K	6.22 A	-0.21 K	-99.30 A	7.93 K	-0.49 J
100.5						
	15.39 E	6.22 A	0.22 C	-99.29 A	7.95 K	-0.49 J
	16.48 E	6.30 A	0.22 C	-128.68 A	-8.93 C	-0.49 J
96.0						
	16.48 F	6.30 A	0.22 C	-128.66 A	-8.94 C	-0.49 J
	27.39 F	10.84 A	0.22 C	-256.64 A	-12.17 C	-0.49 J
81.7						
	27.39 B	10.83 A	0.21 C	-256.64 A	-12.17 C	-0.49 J
	31.07 B	11.44 A	0.25 C	-420.84 A	-15.21 C	-1.03 J
67.5						
	31.07 B	11.44 A	0.25 C	-420.84 A	-15.21 C	-1.03 J
	34.18 B	11.76 A	0.25 C	-591.43 A	-18.85 C	-1.04 J
53.2						
	34.18 B	11.76 A	0.24 C	-591.42 A	-18.85 C	-1.04 J
	37.09 B	11.90 A	0.24 C	-667.45 A	-20.44 C	-1.04 J
47.0						
	37.09 B	11.90 A	-0.24 K	-667.45 A	-20.43 C	-1.04 J
	39.95 B	12.17 A	-0.24 K	-812.28 A	-23.34 C	-1.04 J
35.2						
	39.95 B	12.16 A	-0.25 K	-812.28 A	-23.34 C	-1.04 J
	43.02 B	12.43 A	-0.25 K	-959.38 A	-26.20 C	-1.05 J
23.5						
	43.02 B	12.44 A	-0.25 K	-959.38 A	-26.20 C	-1.05 J
	46.31 B	12.69 A	-0.25 K	-1108.65 A	-29.04 C	-1.05 J
11.7						
	46.31 B	12.69 A	-0.25 K	-1108.65 A	-29.05 C	-1.05 J
	49.81 B	12.96 A	-0.25 K	-1259.91 A	31.92 K	-1.05 J
base reaction	49.81 B	-12.96 A	0.25 K	1259.91 A	-31.92 K	1.05 J

COMPLIANCE WITH 4.8.2 & 4.5.4

ELEV ft	AXIAL	BENDING	SHEAR + TORSIONAL		TOTAL	SATISFIED	D/t(w/t)	MAX ALLOWED
149.00	0.00K	0.00K	0.00K	0.00K	YES		9.52A	45.2
	0.00C	0.01G	0.00A	0.01G	YES		12.81A	45.2
132.83	0.00D	0.01G	0.00A	0.01G	YES		12.81A	45.2
	0.01D	0.03A	0.01A	0.04A	YES		16.09A	45.2
116.67	0.01K	0.03A	0.01A	0.04A	YES		16.09A	45.2
	0.01K	0.10A	0.01A	0.11A	YES		19.37A	45.2
100.50	0.00E	0.05A	0.00A	0.05A	YES		8.81A	45.2
	0.00E	0.06A	0.00A	0.06A	YES		9.26A	45.2
96.00	0.00F	0.06A	0.00A	0.06A	YES		9.09A	45.2
	0.01F	0.09A	0.01A	0.10A	YES		10.53A	45.2
81.75	0.01B	0.09A	0.01A	0.10A	YES		10.53A	45.2
	0.01B	0.12A	0.01A	0.12A	YES		11.98A	45.2
67.50								

	0.01B	0.12A	0.01A	0.12A	YES	11.98A	45.2
	0.01B	0.14A	0.00A	0.14A	YES	13.43A	45.2
53.25							
	0.01B	0.14A	0.00A	0.14A	YES	13.43A	45.2
	0.01B	0.14A	0.00A	0.15A	YES	14.06A	45.2
47.00							
	0.01B	0.15A	0.00A	0.15A	YES	13.71A	45.2
	0.01B	0.15A	0.00A	0.16A	YES	14.90A	45.2
35.25							
	0.01B	0.15A	0.00A	0.16A	YES	14.90A	45.2
	0.01B	0.16A	0.00A	0.17A	YES	16.10A	45.2
23.50							
	0.01B	0.16A	0.00A	0.17A	YES	16.10A	45.2
	0.01B	0.16A	0.00A	0.17A	YES	17.29A	45.2
11.75							
	0.01B	0.16A	0.00A	0.17A	YES	17.29A	45.2
	0.01B	0.17A	0.00A	0.17A	YES	18.48A	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
49.81	12.96	-0.25	-1259.91	31.92	-1.05
B	A	K	A	K	J

==========

Sabre Industries™
Towers and Poles

SO#: 20-1204-JDS
Site Name: SE Erwin, NC
Date: 6/25/2019

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

Pole Data

Diameter:	57.410	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:	5324.79	ft-kips
Axial, Pu:	59.75	kips
Shear, Vu:	54.58	kips

Anchor Rod Data

Quantity:	16	(multiple of 4)	
Diameter:	2.25	in	
Rod Material:	A615		
Strength (Fu):	100	ksi	
Yield (Fy):	75	ksi	
BC Diam. (in):	64.5	BC Override:	
Rod Spacing:	6	in	

Anchor Rod Results

Maximum Rod (Pu+ Vu/η):	258.2	Kips	
Allowable Φ*Rnt:	260.0	Kips	(per 4.9.9)
Anchor Rod Interaction Ratio:	**99.3%**	**Pass**	

Plate Data

Width (in):	62.25	Width Override:	
Thickness:	3	in	
Yield (Fy)	50	ksi	
Eff. Width:	30.62	in	
Corner Clip	12.00	in	
Drain Hole:	2.625	in. diameter	
Drain Location:	26.5	in. center of pole to center of drain hole	
Center Hole:	45	in. diameter	

Base Plate Results

Base Plate (Mu/Z):	40.8	ksi	
Allowable Φ*Fy:	45	ksi	(per AISC)
Base Plate Interaction Ratio:	**90.8%**	**Pass**	

MAT FOUNDATION DESIGN BY SABRE TOWERS & POLES

150' Monopole US CELLULAR CORP SE Erwin, NC (20-1204-JDS) 06/25/19 NM

Overall Loads:			
Factored Moment (ft-kips)	5324.79		
Factored Axial (kips)	59.75		
Factored Shear (kips)	54.58		
Bearing Design Strength (ksf)	4.5	Max. Net Bearing Press. (ksf)	3.65
Water Table Below Grade (ft)	7		
Width of Mat (ft)	27	Allowable Bearing Pressure (ksf)	3.00
Thickness of Mat (ft)	1.75	Safety Factor	2.00
Depth to Bottom of Slab (ft)	6	Ultimate Bearing Pressure (ksf)	6.00
Quantity of Bolts in Bolt Circle	16	Bearing Φs	0.75
Bolt Circle Diameter (in)	64.5		
Top of Concrete to Top of Bottom Threads (in)	60		
Diameter of Pier (ft)	7	Minimum Pier Diameter (ft)	6.71
Ht. of Pier Above Ground (ft)	1	Equivalent Square b (ft)	6.20
Ht. of Pier Below Ground (ft)	4.25	Square Pier? (Y/N)	N
Quantity of Bars in Mat	50		
Bar Diameter in Mat (in)	1		
Area of Bars in Mat (in^2)	39.27		
Spacing of Bars in Mat (in)	6.47	Recommended Spacing (in)	5 to 12
Quantity of Bars Pier	44		
Bar Diameter in Pier (in)	1		
Tie Bar Diameter in Pier (in)	0.625		
Spacing of Ties (in)	12		
Area of Bars in Pier (in^2)	34.56	Minimum Pier A_s (in^2)	27.71
Spacing of Bars in Pier (in)	5.41	Recommended Spacing (in)	5 to 12
f'c (ksi)	4.5		
fy (ksi)	60		
Unit Wt. of Soil (kcf)	0.115		
Unit Wt. of Concrete (kcf)	0.15		
Volume of Concrete (yd^3)	54.73		
Two-Way Shear Action:			
Average d (in)	17		
ϕv_c (ksi)	0.228	v_u (ksi)	0.206
$\phi v_c = \phi(2 + 4/\beta_c)f'_c{}^{1/2}$	0.342		
$\phi v_c = \phi(\alpha_s d/b_o + 2)f'_c{}^{1/2}$	0.236		
$\phi v_c = \phi 4 f'_c{}^{1/2}$	0.228		
Shear perimeter, b_o (in)	317.30		
β_c	1		
One-Way Shear:			
ϕV_c (kips)	628.1	V_u (kips)	383.0
Stability:			
Overturning Design Strength (ft-k)	7398.7	Total Applied M (ft-k)	5706.9

Pier Design:

ϕV_n (kips)	647.2	V_u (kips)	54.6
$\phi V_c=\phi 2(1+N_u/(2000A_g))f'_c{}^{1/2}b_wd$	647.2		
V_s (kips)	0.0	*** V_s max = 4 $f'_c{}^{1/2}b_wd$ (kips)	1514.7
Maximum Spacing (in)	8.71	(Only if Shear Ties are Required)	
Actual Hook Development (in)	16.00	Req'd Hook Development l_{dh} (in)	12.52
		*** Ref. To Spacing Requirements ACI 11.5.4.3	

Flexure in Slab:

ϕM_n (ft-kips)	2836.2	M_u (ft-kips)	2813.4
a (in)	1.90		
Steel Ratio	0.00713		
β_1	0.825		
Maximum Steel Ratio (ρ_t)	0.0197		
Minimum Steel Ratio	0.0018		
Rebar Development in Pad (in)	121.78	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:

Nicholas Milbrodt
Sabre Towers & Poles

Serial Number of Security Device: 227886555

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Use of this program by any entity other than Sabre Industries, Sioux City, IA
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:
20-1204-JDS.lp10

Name of output report file:
20-1204-JDS.lp10

Name of plot output file:
20-1204-JDS.lp10

Name of runtime message file:
20-1204-JDS.lp10

Date and Time of Analysis

Date: June 25, 2019 Time: 13:35:36

Problem Title

Site : SE Erwin, NC

Tower : 150' Monopole

Prepared for : US CELLULAR CORP

Job Number : 20-1204-JDS

Engineer : NM

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 = 31.000 ft
Depth of ground surface below top of pile = 1.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	84.0000
2	31.000	84.0000

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 = 31.000000 ft
Shaft Diameter = 84.000000 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	=	1.000000 ft
Distance from top of pile to bottom of layer	=	8.000000 ft
Effective unit weight at top of layer	=	115.000000 pcf
Effective unit weight at bottom of layer	=	115.000000 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 2 is stiff clay without free water

Distance from top of pile to top of layer	=	8.000000 ft
Distance from top of pile to bottom of layer	=	18.000000 ft
Effective unit weight at top of layer	=	60.600000 pcf
Effective unit weight at bottom of layer	=	60.600000 pcf
Undrained cohesion at top of layer	=	1000.000000 psf
Undrained cohesion at bottom of layer	=	1000.000000 psf
Epsilon-50 at top of layer	=	0.010000
Epsilon-50 at bottom of layer	=	0.010000

Layer 3 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	18.000000 ft
Distance from top of pile to bottom of layer	=	27.000000 ft
Effective unit weight at top of layer	=	61.600000 pcf
Effective unit weight at bottom of layer	=	61.600000 pcf
Friction angle at top of layer	=	30.000000 deg.
Friction angle at bottom of layer	=	30.000000 deg.
Subgrade k at top of layer	=	20.000000 pci
Subgrade k at bottom of layer	=	20.000000 pci

Layer 4 is stiff clay without free water

Distance from top of pile to top of layer	=	27.000000 ft
Distance from top of pile to bottom of layer	=	34.000000 ft
Effective unit weight at top of layer	=	61.600000 pcf
Effective unit weight at bottom of layer	=	61.600000 pcf
Undrained cohesion at top of layer	=	1000.000000 psf
Undrained cohesion at bottom of layer	=	1000.000000 psf
Epsilon-50 at top of layer	=	0.010000
Epsilon-50 at bottom of layer	=	0.010000

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

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Angle of Friction deg.	E50 or krm	kpy pci
1	Stiff Clay	1.0000	115.0000	1500.	--	0.00700	--
	w/o Free Water	8.0000	115.0000	1500.	--	0.00700	--
2	Stiff Clay	8.0000	60.6000	1000.0000	--	0.01000	--
	w/o Free Water	18.0000	60.6000	1000.0000	--	0.01000	--
3	Sand	18.0000	61.6000	--	30.0000	--	20.0000
	(Reese, et al.)	27.0000	61.6000	--	30.0000	--	20.0000

4	Stiff Clay	27.0000	61.6000	1000.0000	--	0.01000	--
	w/o Free Water	34.0000	61.6000	1000.0000	--	0.01000	--

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 = 72773. lbs	M =	85196640. in-lbs	79667.	No
2	1	V = 12960. lbs	M =	15118920. in-lbs	49810.	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	=	31.000000 ft
Shaft Diameter	=	84.000000 in
Concrete Cover Thickness (to edge of long. rebar)	=	3.625000 in
Number of Reinforcing Bars	=	32 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	5542. sq. in.
Total Area of Reinforcing Steel	=	40.536598 sq. in.
Area Ratio of Steel Reinforcement	=	0.73 percent
Edge-to-Edge Bar Spacing	=	6.128334 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	8.17
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	=	23474.412 kips
Tensile Load for Cracking of Concrete	=	-2557.676 kips
Nominal Axial Tensile Capacity	=	-2432.196 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	37.740000	0.00000

2	1.270000	1.266769	37.014836	7.362709
3	1.270000	1.266769	34.867214	14.442473
4	1.270000	1.266769	31.379663	20.967221
5	1.270000	1.266769	26.686210	26.686210
6	1.270000	1.266769	20.967221	31.379663
7	1.270000	1.266769	14.442473	34.867214
8	1.270000	1.266769	7.362709	37.014836
9	1.270000	1.266769	0.00000	37.740000
10	1.270000	1.266769	-7.362709	37.014836
11	1.270000	1.266769	-14.442473	34.867214
12	1.270000	1.266769	-20.967221	31.379663
13	1.270000	1.266769	-26.686210	26.686210
14	1.270000	1.266769	-31.379663	20.967221
15	1.270000	1.266769	-34.867214	14.442473
16	1.270000	1.266769	-37.014836	7.362709
17	1.270000	1.266769	-37.740000	0.00000
18	1.270000	1.266769	-37.014836	-7.362709
19	1.270000	1.266769	-34.867214	-14.442473
20	1.270000	1.266769	-31.379663	-20.967221
21	1.270000	1.266769	-26.686210	-26.686210
22	1.270000	1.266769	-20.967221	-31.379663
23	1.270000	1.266769	-14.442473	-34.867214
24	1.270000	1.266769	-7.362709	-37.014836
25	1.270000	1.266769	0.00000	-37.740000
26	1.270000	1.266769	7.362709	-37.014836
27	1.270000	1.266769	14.442473	-34.867214
28	1.270000	1.266769	20.967221	-31.379663
29	1.270000	1.266769	26.686210	-26.686210
30	1.270000	1.266769	31.379663	-20.967221
31	1.270000	1.266769	34.867214	-14.442473
32	1.270000	1.266769	37.014836	-7.362709

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

Minimum spacing between any two bars not equal to zero = 6.128 inches
between bars 1 and 32.

Ratio of bar spacing to maximum aggregate size = 8.17

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	49.810
2	79.667

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	49.810	87858.963	0.00300000
2	79.667	88792.595	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^2
1	0.65	87859.	32.376500	57108.	1.8153E+09
2	0.65	88793.	51.783333	57715.	1.8372E+09
1	0.70	87859.	34.867000	61501.	1.8092E+09
2	0.70	88793.	55.766667	62155.	1.8295E+09
1	0.75	87859.	37.357500	65894.	1.7490E+09
2	0.75	88793.	59.750000	66594.	1.7706E+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	1.0000	0.00	N.A.	No	0.00	258455.
2	8.0000	9.5020	Yes	No	258455.	376816.
3	18.0000	15.2078	No	No	635270.	872568.
4	27.0000	37.4449	No	No	1507838.	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	72773.	M, in-lb	8.52E+07	79667.	17.4309	-0.08120	-574667.	8.75E+07
2	V, lb	12960.	M, in-lb	1.51E+07	49810.	0.06977	-5.03E-04	-72379.	1.54E+07

Maximum pile-head deflection = 17.4309327087 inches
Maximum pile-head rotation = -0.0811966464 radians = -4.652225 deg.

The analysis ended normally.

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

Moment (ft·k)	5,324.79	
Shear (k)	54.58	
Caisson diameter (ft)	7	
Caisson height above ground (ft)	1	
Caisson height below ground (ft)	28	
Lateral soil pressure (lb/ft^2)	**348.21**	
Ground to application of force, h (ft)	98.56	
Applied lateral force, P (lb)	54,580	
Lateral soil bearing pressure, S_1 (lb/ft)	3,250.00	
Diameter, b (ft)	7	
A	5.61	$= (2.34P)/(S_1 b)$
Minimum depth of embedment, d (ft)	27.53	$= 0.5A[\ 1 + (\ 1 + (\ 4.36h\ /\ A\ )\ )^{1/2}\ ]$