

**Structural Design Report**  
100' Monopine  
Site: Waukesha Airport II, WI  
Site Number: 784719

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

Job Number: 155276

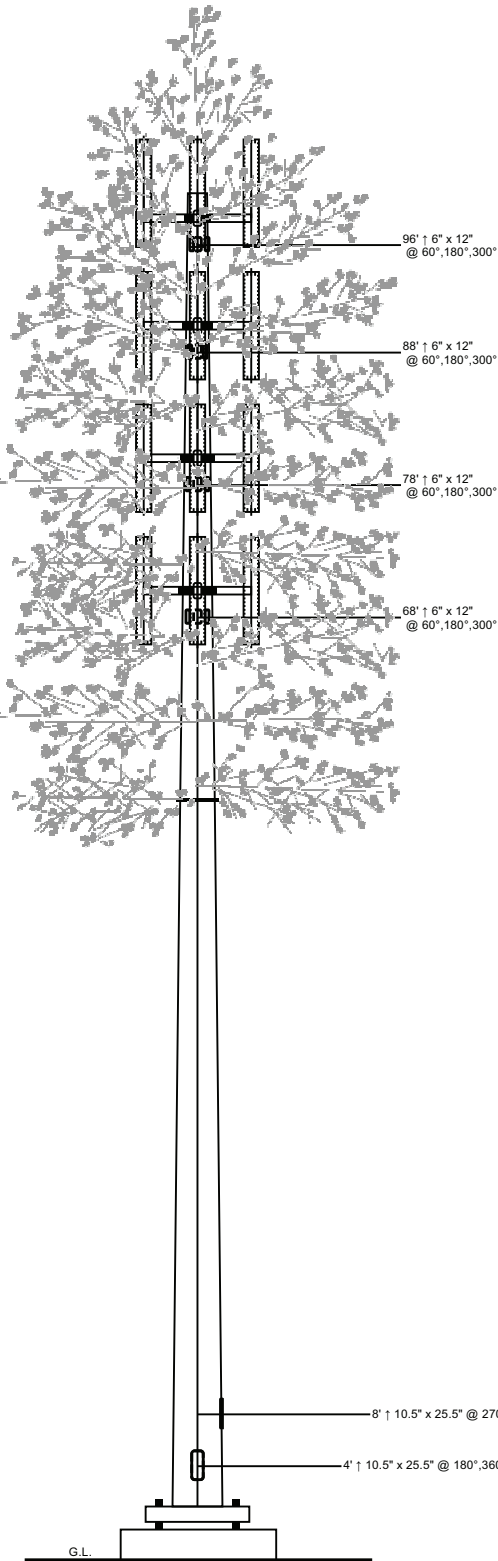
January 16, 2017

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1/16/17

Length (ft)	53'-3"	45'-9"
Number Of Sides	18	
Thickness (in)	3/8"	1/4"
Lap Splice (ft)		
Top Diameter (in)	31.46"	18"
Bottom Diameter (in)	46.84"	31.21"
Taper (in/ft)		
Grade	0.2888	
Weight (lbs)	A572-65	3882
Overall Steel Height (ft)	10491	99



### Designed Appurtenance Loading

Elev	Description	Tx-Line
100	(6) AM-X-CD-17-65-00T-RET	(1) 1 1/4"
100	(3) BXA-70080/8CF-EDIN	(2) 1 5/8"
100	(6) DBC0056F1Vx-1	
100	(3) RUSDC-6267-PF-48	
100	(15) RRUS 11	
98	3T-Arm - 8' Face - 3' Standoff	
90	3T-Arm - 8' Face - 3' Standoff	
90	(6) DBC0056F1Vx-1	
90	(3) RUSDC-6267-PF-48	
90	(3) BXA-70080/8CF-EDIN	(2) 1 5/8"
90	(6) AM-X-CD-17-65-00T-RET	(1) 1 1/4"
90	(15) RRUS 11	
80	3T-Arm - 8' Face - 3' Standoff	
80	(6) AM-X-CD-17-65-00T-RET	(1) 1 1/4"
80	(15) RRUS 11	
80	(3) RUSDC-6267-PF-48	
80	(6) DBC0056F1Vx-1	
80	(3) BXA-70080/8CF-EDIN	(2) 1 5/8"
70	3T-Arm - 8' Face - 3' Standoff	
70	(6) DBC0056F1Vx-1	
70	(6) AM-X-CD-17-65-00T-RET	(1) 1 1/4"
70	(15) RRUS 11	
70	(3) RUSDC-6267-PF-48	
70	(3) BXA-70080/8CF-EDIN	(2) 1 5/8"

### Load Case Reactions

Description	Axial (kips)	Shear (kips)	Moment (ft-k)	Deflection (ft)	Sway (deg)
3s Gusted Wind	33.07	44.36	3370.78	6	6.37
3s Gusted Wind 0.9 Dead	24.81	44.37	3347.45	5.94	6.3
3s Gusted Wind&Ice	61.46	8.76	672.8	1.21	1.28
Service Loads	27.57	11.03	836.93	1.5	1.59

### Base Plate Dimensions

Shape	Diameter	Thickness	Bolt Circle	Bolt Qty	Bolt Diameter
Round	59"	2"	53.25"	14	2.25"

### Anchor Bolt Dimensions

Length	Diameter	Hole Diameter	Weight	Type	Finish
84"	2.25"	2.625"	1695.4	A615-75	Galv-18"

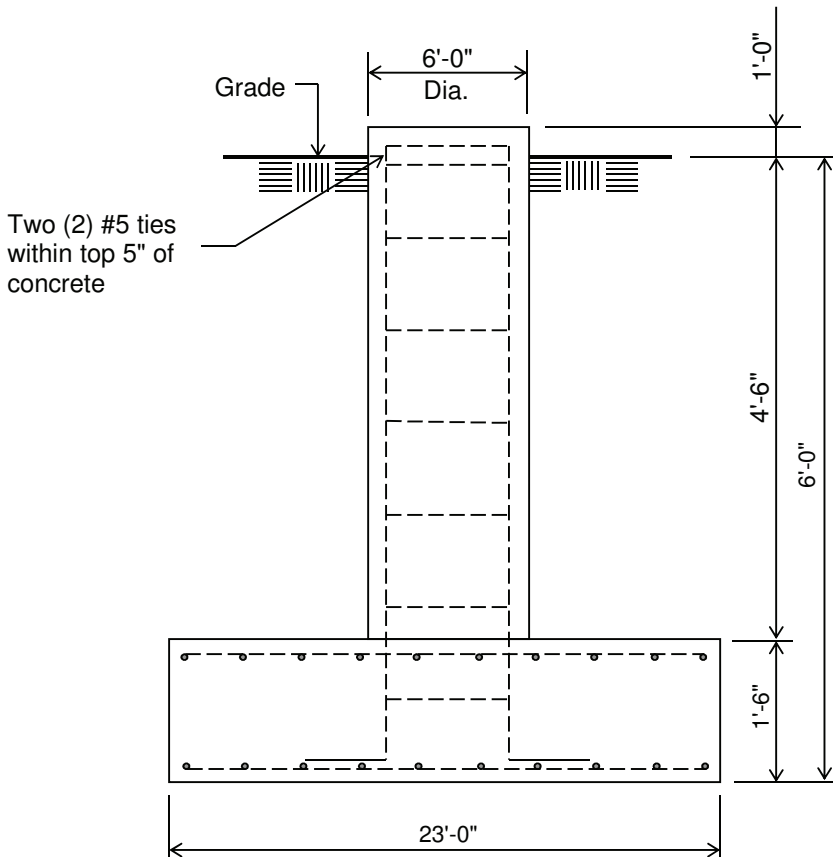
### Notes

- 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) The Monopole was designed for a basic wind speed of 90 mph with 0" of radial ice, and 40 mph with 3/4" of radial ice, in accordance with ANSI/TIA-222-G, Structure Class II, Exposure Category C, Topographic Category 1.
- 5) Tower Rating: 100%
- 6) This structure has been designed to support pine tree branches starting at the 50' elevation to an overall height of 105'.

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		By: <b>BD</b>

**Customer: US CELLULAR CORP**  
**Site: Waukesha Airport II, WI 784719**

100' Monopole at  
90 mph Wind with no ice and 40 mph Wind with 0.75 in. Ice per ANSI/TIA-222-G.  
Antenna Loading per Page 1



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

**Notes:**

- 1). Concrete shall have a minimum 28-day compressive strength of 4500 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, Project No. 13540, dated June 28, 2016
- 6). See the geotechnical report for compaction requirements, if specified.
- 7). The foundation is based on the following factored loads:  
Moment (kip-ft) = 3370.78  
Axial (kips) = 33.07  
Shear (kips) = 44.36

Rebar Schedule per Pad and Pier	
Pier	(34) #8 vertical rebar w/ hooks at bottom w/ #5 ties, two within top 5" of top of pier then 12" C/C
Pad	(44) #8 horizontal rebar evenly spaced each way top and bottom (176 total)

- 8). 4.5 ft of soil cover is required over the entire area of the foundation slab.

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100' Monopine / waukesha Airport II, WI

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

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POLE GEOMETRY

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ELEV ft	SECTION NAME	No. SIDE	OUTSIDE DIAM in	THICK- NESS in	RESISTANCES ♦*Pn kip	♦*Mn ft-kip	SPLICE TYPE	...OVERLAP... LENGTH ft	RATIO	w/t
99.0	A	18	18.28	0.250	1046.4	379.8				
			31.69	0.250	1715.5	1092.3				10.9
53.2	B	18	31.95	0.375	2749.1	1750.7				
			47.56	0.375	3861.0	3689.5				13.0
0.0										

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POLE ASSEMBLY

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SECTION NAME	BASE ELEV ft	BOLTS NUMBER	AT TYPE	BASE DIAM in	OF SECTION STRENGTH ksi	THREADS IN SHEAR PLANE	CALC BASE ELEV ft
A	53.250	0	A325	0.00	92.0	0	53.250
B	0.000	0	A325	0.00	92.0	0	0.000

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POLE SECTIONS

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SECTION NAME	No.of SIDES	LENGTH ft	OUTSIDE DIAMETER BOT * in	TOP * in	THICK- NESS in	MAT- ERIAL ID	FLANGE.ID BOT TOP	FLANGE.WELD ..GROUP.ID.. BOT TOP
A	18	45.75	31.69	18.28	0.250	1	0 0	0 0
B	18	53.25	47.56	31.95	0.375	2	0 0	0 0

\* - Diameter of circumscribed circle

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MATERIAL TYPES

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TYPE OF SHAPE	TYPE NO	NO OF ELEM.	ORIENT & deg	HEIGHT in	WIDTH in	.THICKNESS. WEB FLANGE in in	IRREGULARITY .PROJECTION. % OF ORIENT AREA deg
PL	1	1	0.0	31.69	0.25	0.250 0.250	0.00 0.0
PL	2	1	0.0	47.56	0.38	0.375 0.375	0.00 0.0

& - with respect to vertical

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MATERIAL PROPERTIES

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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

\* Only 3 condition(s) shown in full  
\* RRUS/TMAS were assumed to be behind antennas

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LOADING CONDITION A

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

LOADS ON POLE

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LOAD TYPE	ELEV ft	APPLY. RADIUS ft	LOAD. AZI	AT AZI	LOAD AZI	.....FORCES.....		.....MOMENTS.....	
						HORIZ kip	DOWN kip	VERTICAL ft-kip	TORSNAL ft-kip
C	100.500	0.00	0.0	0.0	0.0	1.1004	0.3000	0.0000	0.0000
C	99.000	0.00	0.0	0.0	0.0	4.6832	1.9881	0.0000	0.0000
C	97.000	0.00	0.0	0.0	0.0	0.0000	0.3189	0.0000	0.0000
C	97.000	0.00	0.0	0.0	0.0	0.4675	1.0740	0.0000	0.0000
C	95.500	0.00	0.0	0.0	0.0	1.0888	0.3000	0.0000	0.0000
C	90.500	0.00	0.0	0.0	0.0	2.1533	0.6000	0.0000	0.0000
C	89.000	0.00	0.0	0.0	0.0	0.0000	0.2926	0.0000	0.0000
C	89.000	0.00	0.0	0.0	0.0	4.1236	3.0621	0.0000	0.0000
C	85.500	0.00	0.0	0.0	0.0	2.1280	0.6000	0.0000	0.0000
C	80.500	0.00	0.0	0.0	0.0	2.1015	0.6000	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.0	0.0000	0.2598	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.0	4.0226	3.0621	0.0000	0.0000
C	75.500	0.00	0.0	0.0	0.0	2.0737	0.6000	0.0000	0.0000
C	70.500	0.00	0.0	0.0	0.0	2.0444	0.6000	0.0000	0.0000
C	69.000	0.00	0.0	0.0	0.0	0.0000	0.2269	0.0000	0.0000
C	69.000	0.00	0.0	0.0	0.0	3.9111	3.0621	0.0000	0.0000
C	65.500	0.00	0.0	0.0	0.0	2.0134	0.6000	0.0000	0.0000
C	60.500	0.00	0.0	0.0	0.0	1.9806	0.6000	0.0000	0.0000
C	55.500	0.00	0.0	0.0	0.0	1.9455	0.6000	0.0000	0.0000
C	50.500	0.00	0.0	0.0	0.0	1.9079	0.6000	0.0000	0.0000
C	49.750	0.00	0.0	0.0	0.0	0.2853	0.0900	0.0000	0.0000
=====									
D	99.000	0.00	180.0	0.0	0.0	0.0468	0.0630	0.0000	0.0000
D	87.562	0.00	180.0	0.0	0.0	0.0468	0.0630	0.0000	0.0000
D	87.562	0.00	180.0	0.0	0.0	0.0532	0.0736	0.0000	0.0000
D	76.125	0.00	180.0	0.0	0.0	0.0532	0.0736	0.0000	0.0000
D	76.125	0.00	180.0	0.0	0.0	0.0590	0.0842	0.0000	0.0000
D	64.687	0.00	180.0	0.0	0.0	0.0590	0.0842	0.0000	0.0000
D	64.687	0.00	180.0	0.0	0.0	0.0641	0.0948	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0	0.0641	0.0948	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0	0.0689	0.1607	0.0000	0.0000
D	39.937	0.00	180.0	0.0	0.0	0.0689	0.1607	0.0000	0.0000
D	39.937	0.00	180.0	0.0	0.0	0.0717	0.1792	0.0000	0.0000
D	26.625	0.00	180.0	0.0	0.0	0.0717	0.1792	0.0000	0.0000
D	26.625	0.00	180.0	0.0	0.0	0.0713	0.1977	0.0000	0.0000
D	13.312	0.00	180.0	0.0	0.0	0.0713	0.1977	0.0000	0.0000
D	13.312	0.00	180.0	0.0	0.0	0.0728	0.2162	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0	0.0728	0.2162	0.0000	0.0000

LOADING CONDITION M

90 mph wind with no ice. Wind Azimuth: 0

LOADS ON POLE

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LOAD TYPE	ELEV ft	APPLY. RADIUS ft	LOAD. AZI	AT AZI	LOAD AZI	.....FORCES.....		.....MOMENTS.....	
						HORIZ kip	DOWN kip	VERTICAL ft-kip	TORSNAL ft-kip
C	100.500	0.00	0.0	0.0	0.0	1.1004	0.2250	0.0000	0.0000
C	99.000	0.00	0.0	0.0	0.0	4.6832	1.4911	0.0000	0.0000
C	97.000	0.00	0.0	0.0	0.0	0.0000	0.2392	0.0000	0.0000
C	97.000	0.00	0.0	0.0	0.0	0.4675	0.8055	0.0000	0.0000
C	95.500	0.00	0.0	0.0	0.0	1.0888	0.2250	0.0000	0.0000
C	90.500	0.00	0.0	0.0	0.0	2.1533	0.4500	0.0000	0.0000
C	89.000	0.00	0.0	0.0	0.0	0.0000	0.2195	0.0000	0.0000
C	89.000	0.00	0.0	0.0	0.0	4.1236	2.2966	0.0000	0.0000
C	85.500	0.00	0.0	0.0	0.0	2.1280	0.4500	0.0000	0.0000
C	80.500	0.00	0.0	0.0	0.0	2.1015	0.4500	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.0	0.0000	0.1948	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.0	4.0226	2.2966	0.0000	0.0000
C	75.500	0.00	0.0	0.0	0.0	2.0737	0.4500	0.0000	0.0000
C	70.500	0.00	0.0	0.0	0.0	2.0444	0.4500	0.0000	0.0000
C	69.000	0.00	0.0	0.0	0.0	0.0000	0.1702	0.0000	0.0000
C	69.000	0.00	0.0	0.0	0.0	3.9111	2.2966	0.0000	0.0000
C	65.500	0.00	0.0	0.0	0.0	2.0134	0.4500	0.0000	0.0000
C	60.500	0.00	0.0	0.0	0.0	1.9806	0.4500	0.0000	0.0000
C	55.500	0.00	0.0	0.0	0.0	1.9455	0.4500	0.0000	0.0000
C	50.500	0.00	0.0	0.0	0.0	1.9079	0.4500	0.0000	0.0000
C	49.750	0.00	0.0	0.0	0.0	0.2853	0.0675	0.0000	0.0000
=====									
D	99.000	0.00	180.0	0.0	0.0	0.0471	0.0473	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0	0.0645	0.0711	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0	0.0689	0.1205	0.0000	0.0000
D	39.937	0.00	180.0	0.0	0.0	0.0689	0.1205	0.0000	0.0000
D	39.937	0.00	180.0	0.0	0.0	0.0717	0.1344	0.0000	0.0000
D	26.625	0.00	180.0	0.0	0.0	0.0717	0.1344	0.0000	0.0000
D	26.625	0.00	180.0	0.0	0.0	0.0713	0.1483	0.0000	0.0000
D	13.312	0.00	180.0	0.0	0.0	0.0713	0.1483	0.0000	0.0000
D	13.312	0.00	180.0	0.0	0.0	0.0728	0.1622	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0	0.0728	0.1622	0.0000	0.0000

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LOADING CONDITION Y =====

40 mph wind with 0.75 ice. Wind Azimuth: 0°

LOADS ON POLE

LOAD TYPE	ELEV ft	APPLY... RADIUS ft	LOAD... AZI	AT AZI	LOAD AZI	.....FORCES.....		.....MOMENTS.....	
						HORIZ kip	DOWN kip	VERTICAL ft-kip	TORSNAL ft-kip
C	100.500	0.00	0.0	0.0	0.0	0.1723	0.9713	0.0000	0.0000
C	99.000	0.00	0.0	0.0	0.0	0.8648	5.2768	0.0000	0.0000
C	97.000	0.00	0.0	0.0	0.0	0.0000	0.3189	0.0000	0.0000
C	97.000	0.00	0.0	0.0	0.0	0.1397	1.2952	0.0000	0.0000
C	95.500	0.00	0.0	0.0	0.0	0.1703	0.9680	0.0000	0.0000
C	90.500	0.00	0.0	0.0	0.0	0.3718	1.2644	0.0000	0.0000
C	89.000	0.00	0.0	0.0	0.0	0.0000	0.2926	0.0000	0.0000
C	89.000	0.00	0.0	0.0	0.0	0.8101	6.5352	0.0000	0.0000
C	85.500	0.00	0.0	0.0	0.0	0.3669	1.2607	0.0000	0.0000
C	80.500	0.00	0.0	0.0	0.0	0.3617	1.2568	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.0	0.0000	0.2598	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.0	0.7868	6.4945	0.0000	0.0000
C	75.500	0.00	0.0	0.0	0.0	0.3563	1.2526	0.0000	0.0000
C	70.500	0.00	0.0	0.0	0.0	0.3506	1.2482	0.0000	0.0000
C	69.000	0.00	0.0	0.0	0.0	0.0000	0.2269	0.0000	0.0000
C	69.000	0.00	0.0	0.0	0.0	0.7613	6.4490	0.0000	0.0000
C	65.500	0.00	0.0	0.0	0.0	0.3446	1.2435	0.0000	0.0000
C	60.500	0.00	0.0	0.0	0.0	0.3382	1.2385	0.0000	0.0000
C	55.500	0.00	0.0	0.0	0.0	0.3314	1.2331	0.0000	0.0000
C	50.500	0.00	0.0	0.0	0.0	0.3242	1.2273	0.0000	0.0000
C	49.750	0.00	0.0	0.0	0.0	0.3231	1.2264	0.0000	0.0000
D	99.000	0.00	180.0	0.0	0.0	0.0125	0.1070	0.0000	0.0000
D	87.562	0.00	180.0	0.0	0.0	0.0125	0.1070	0.0000	0.0000
D	87.562	0.00	180.0	0.0	0.0	0.0138	0.1238	0.0000	0.0000
D	76.125	0.00	180.0	0.0	0.0	0.0138	0.1238	0.0000	0.0000
D	76.125	0.00	180.0	0.0	0.0	0.0151	0.1402	0.0000	0.0000
D	64.687	0.00	180.0	0.0	0.0	0.0151	0.1402	0.0000	0.0000
D	64.687	0.00	180.0	0.0	0.0	0.0162	0.1563	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0	0.0162	0.1563	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0	0.0171	0.2281	0.0000	0.0000
D	39.937	0.00	180.0	0.0	0.0	0.0171	0.2281	0.0000	0.0000
D	39.937	0.00	180.0	0.0	0.0	0.0176	0.2515	0.0000	0.0000
D	26.625	0.00	180.0	0.0	0.0	0.0176	0.2515	0.0000	0.0000
D	26.625	0.00	180.0	0.0	0.0	0.0174	0.2733	0.0000	0.0000
D	13.312	0.00	180.0	0.0	0.0	0.0174	0.2733	0.0000	0.0000
D	13.312	0.00	180.0	0.0	0.0	0.0175	0.2905	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0	0.0175	0.2905	0.0000	0.0000

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

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Sabre Towers and Poles on: 16 jan 2017 at: 10:18:19

100' Monopine / waukesha Airport II, WI

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

MAST ELEV ft	.....DEFLECTIONS (ft).....			.....ROTATIONS (deg).....		
	HORIZONTAL ALONG	ACROSS	DOWN	TILT	ACROSS	TWIST
99.0	6.00C	0.00R	0.49D	6.37C	0.00R	0.00H
87.6	4.76C	0.00R	0.35D	6.19E	0.00R	0.00H
76.1	3.58C	0.00R	0.23D	5.66C	0.00R	0.00H
64.7	2.54C	0.00R	0.14D	4.80C	0.00R	0.00H
53.2	1.69C	0.00R	0.07D	3.71C	0.00R	0.00H
39.9	0.94C	0.00R	0.03D	2.77E	0.00R	0.00H
26.6	0.41C	0.00R	0.01D	1.81C	0.00R	0.00H
13.3	0.10C	0.00R	0.00D	0.88C	0.00R	0.00H
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
99.0	6.25 AC	5.78 O	0.00 C	-1.65 T	0.00 C	0.00 H
87.6	18.15 AC	14.18 O	0.00 C	-100.72 I	0.00 R	0.00 I
	18.15 AJ	14.18 U	0.00 O	-100.72 C	-0.01 X	0.00 I
76.1	28.83 AJ	23.04 U	0.00 O	-317.03 F	-0.02 T	0.00 H
	28.83 AJ	23.04 R	0.00 R	-317.03 F	-0.02 T	0.00 H
64.7	40.86 AJ	33.75 R	0.00 R	-651.46 C	-0.03 T	-0.01 H
	40.86 AJ	33.75 N	0.00 N	-651.46 C	-0.03 T	-0.01 H
53.2	45.12 AJ	38.38 N	0.00 N	-1075.71 C	-0.07 N	-0.01 H
	45.12 AJ	38.39 R	0.01 C	-1075.71 C	-0.07 N	-0.01 H
39.9	50.61 AJ	41.50 R	0.01 C	-1631.91 E	0.13 R	-0.01 H
	50.61 AJ	41.50 R	-0.01 R	-1631.91 E	0.12 R	-0.01 H
26.6	53.95 AJ	42.45 R	-0.01 R	-2203.63 E	0.23 R	-0.01 H
	53.95 AG	42.45 R	-0.01 R	-2203.63 E	0.22 R	-0.01 H
13.3	57.59 AG	43.40 R	-0.01 R	-2783.59 C	0.31 R	-0.02 H
	57.59 AG	43.40 R	-0.01 R	-2783.58 E	0.31 R	-0.02 H
	61.46 AG	44.37 R	-0.01 R	-3370.78 C	0.41 R	-0.02 H
base reaction	61.46 AG	-44.37 R	0.01 R	3370.78 C	-0.41 R	0.02 H

## COMPLIANCE WITH 4.8.2 &amp; 4.5.4

ELEV ft	AXIAL	BENDING	SHEAR + TORSIONAL	TOTAL	SATISFIED	D/t(w/t)	MAX ALLOWED
99.00	0.01AC	0.00T	0.01O	0.01L	YES	10.93A	45.2
87.56	0.01AC	0.19I	0.02O	0.20I	YES	13.26A	45.2
	0.01AJ	0.19C	0.02U	0.20F	YES	13.26A	45.2
76.12	0.02AJ	0.44F	0.03U	0.45F	YES	15.59A	45.2
	0.02AJ	0.44F	0.03R	0.45F	YES	15.59A	45.2
64.69	0.03AJ	0.72C	0.04R	0.74C	YES	17.92A	45.2
	0.03AJ	0.72C	0.04N	0.74C	YES	17.92A	45.2
53.25	0.03AJ	0.98C	0.04N	1.00C	YES	20.25A	45.2
	0.02AJ	0.61C	0.03R	0.62C	YES	13.03A	45.2
39.94	0.02AJ	0.74E	0.03R	0.75C	YES	14.84A	45.2
	0.02AJ	0.74E	0.03R	0.75E	YES	14.84A	45.2
26.62	0.02AJ	0.81E	0.02R	0.82C	YES	16.65A	45.2
	0.02AG	0.81E	0.02R	0.82E	YES	16.65A	45.2
13.31	0.02AG	0.87C	0.02R	0.88C	YES	18.45A	45.2
	0.02AG	0.87E	0.02R	0.88C	YES	18.45A	45.2
0.00	0.02AG	0.91C	0.02R	0.92C	YES	20.26A	45.2

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

DOWN 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
61.46 AG	44.37 R	-0.01 R	-3370.78 C	0.41 R	-0.02 H

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100' Monopine / waukesha Airport II, WI

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

\* Only 1 condition(s) shown in full  
 \* RRUS/TMAS were assumed to be behind antennas

LOADING CONDITION A =====

60 mph 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	100.500	0.00	0.0	0.0	0.2735	0.2500	0.0000	0.0000
C	99.000	0.00	0.0	0.0	1.1640	1.6567	0.0000	0.0000
C	97.000	0.00	0.0	0.0	0.0000	0.2658	0.0000	0.0000
C	97.000	0.00	0.0	0.0	0.1162	0.8950	0.0000	0.0000
C	95.500	0.00	0.0	0.0	0.2706	0.2500	0.0000	0.0000
C	90.500	0.00	0.0	0.0	0.5352	0.5000	0.0000	0.0000
C	89.000	0.00	0.0	0.0	0.0000	0.2439	0.0000	0.0000
C	89.000	0.00	0.0	0.0	1.0249	2.5517	0.0000	0.0000
C	85.500	0.00	0.0	0.0	0.5289	0.5000	0.0000	0.0000
C	80.500	0.00	0.0	0.0	0.5223	0.5000	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.0000	0.2165	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.9998	2.5517	0.0000	0.0000
C	75.500	0.00	0.0	0.0	0.5154	0.5000	0.0000	0.0000
C	70.500	0.00	0.0	0.0	0.5081	0.5000	0.0000	0.0000
C	69.000	0.00	0.0	0.0	0.0000	0.1891	0.0000	0.0000
C	69.000	0.00	0.0	0.0	0.9721	2.5517	0.0000	0.0000
C	65.500	0.00	0.0	0.0	0.5004	0.5000	0.0000	0.0000
C	60.500	0.00	0.0	0.0	0.4922	0.5000	0.0000	0.0000
C	55.500	0.00	0.0	0.0	0.4835	0.5000	0.0000	0.0000
C	50.500	0.00	0.0	0.0	0.4742	0.5000	0.0000	0.0000
C	49.750	0.00	0.0	0.0	0.0709	0.0750	0.0000	0.0000
D	99.000	0.00	180.0	0.0	0.0117	0.0525	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0160	0.0790	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0171	0.1339	0.0000	0.0000
D	39.937	0.00	180.0	0.0	0.0171	0.1339	0.0000	0.0000
D	39.937	0.00	180.0	0.0	0.0178	0.1494	0.0000	0.0000
D	26.625	0.00	180.0	0.0	0.0178	0.1494	0.0000	0.0000
D	26.625	0.00	180.0	0.0	0.0177	0.1648	0.0000	0.0000
D	13.312	0.00	180.0	0.0	0.0177	0.1648	0.0000	0.0000
D	13.312	0.00	180.0	0.0	0.0181	0.1802	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0181	0.1802	0.0000	0.0000

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

=====

MAST ELEV ft	.....DEFLECTIONS (ft).....			.....ROTATIONS (deg).....		
	HORIZONTAL ALONG	ACROSS	DOWN	TILT ALONG	ACROSS	TWIST
99.0	1.50A	0.00L	0.03A	1.59A	0.00E	0.00E
87.6	1.19A	0.00L	0.02A	1.54A	0.00E	0.00E
76.1	0.89A	0.00B	0.02A	1.41A	0.00E	0.00E
64.7	0.63A	0.00B	0.01A	1.19A	0.00L	0.00B
53.2	0.42A	0.00B	0.01A	0.92A	0.00B	0.00B
39.9	0.23A	0.00B	0.00A	0.69A	0.00B	0.00B
26.6	0.10A	0.00B	0.00A	0.45A	0.00B	0.00B



13.3	0.02A	0.00B	0.00F	0.22A	0.00B	0.00B
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)

MAST ELEV ft	TOTAL AXIAL kip	SHEAR.w.r.t.WIND.DIR ALONG kip	WIND.DIR ACROSS kip	MOMENT.w.r.t.WIND.DIR ALONG ft-kip	WIND.DIR ACROSS ft-kip	TORSION ft-kip
99.0	1.91 E	1.44 B	0.00 B	-0.41 K	0.00 B	0.00 L
87.6	7.25 E	3.52 B	0.00 B	-25.11 A	0.00 E	0.00 H
76.1	11.73 H	5.73 F	0.00 I	-79.00 F	-0.01 I	0.00 I
64.7	16.76 L	8.39 A	0.00 H	-162.16 A	-0.01 I	0.00 E
53.2	18.63 B	9.54 A	0.00 L	-267.45 A	0.01 E	0.00 E
39.9	20.99 B	10.31 A	0.00 B	-405.40 A	-0.01 L	0.00 B
26.6	22.98 B	10.55 A	0.00 B	-547.17 A	-0.02 L	0.00 B
13.3	25.17 B	10.79 A	0.00 B	-691.06 A	0.04 B	0.00 B
base reaction	27.57 B	-11.03 A	0.00 B	836.93 A	-0.06 B	0.00 B

COMPLIANCE WITH 4.8.2 & 4.5.4

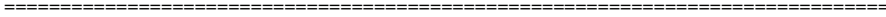
ELEV ft	AXIAL	BENDING	SHEAR + TORSIONAL	TOTAL	SATISFIED	D/t(w/t)	MAX ALLOWED
99.00	0.00E	0.00K	0.00B	0.00K	YES	10.93A	45.2
87.56	0.01E	0.05A	0.01B	0.05A	YES	13.26A	45.2
76.12	0.01H	0.11F	0.01F	0.12F	YES	15.59A	45.2
64.69	0.01L	0.18A	0.01A	0.19A	YES	17.92A	45.2
53.25	0.01B	0.24A	0.01A	0.26A	YES	20.25A	45.2
39.94	0.01B	0.18A	0.01A	0.19A	YES	14.84A	45.2
26.62	0.01B	0.20A	0.01A	0.21A	YES	16.65A	45.2
13.31	0.01B	0.22A	0.01A	0.22A	YES	18.45A	45.2
0.00	0.01B	0.23A	0.01A	0.23A	YES	20.26A	45.2

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

DOWN	SHEAR.w.r.t.WIND.DIR ALONG	WIND.DIR ACROSS	MOMENT.w.r.t.WIND.DIR ALONG	WIND.DIR ACROSS	TORSION
------	----------------------------	-----------------	-----------------------------	-----------------	---------

kip	kip	kip	ft-kip	ft-kip	ft-kip
27.57	11.03	0.00	-836.93	0.06	0.00
B	A	B	A	B	B

155276



**Round Flange Plate and Bolts per ANSI/TIA 222-G**  
**Elevation = 53.3 feet**

**Pole Data**

Diameter: 31.21 in  
Thickness: 0.25 in  
Yield (Fy): 65 ksi  
# of Sides: 18 "0" IF Round  
Strength (Fu): 80 ksi

**Reactions**

Moment, Mu: 1075.71 ft-kips  
Axial, Pu: 22.35 kips  
Shear, Vu: 38.38 kips

**Bolt Data**

Quantity: 16  
Diameter: 1.375 in  
Bolt Material: A325  
Strength (Fu): 105 ksi  
Yield (Fy): 81 ksi  
BC Diam. (in): 35.5 BC Override:

**Flange Bolt Results**

Allowable  $\Phi$ \*Rnt: 91.35 kips  
Adjusted  $\Phi$ \*Rnt (due to shear): 91.29 kips  
Maximum Bolt Tension: 89.51 kips  
Bolt Interaction Ratio: **98.1% Pass**

**Plate Data**

Diameter (in): 39 Dia. Override:  
Thickness: 1.5 in  
Center Hole Diam.: 21 in  
Yield (Fy): 50 ksi  
Single-Rod B-eff: 6.19 in  
Drain Hole: 1 in. diameter  
Drain Location: 14.5 in. center of pole to center of drain hole

**Flange Plate Results**

Compression Side Plate (Mu/Z): 35.1 ksi  
Allowable  $\Phi$ \*Fy: 45.0 ksi  
Compr. Plate Interaction Ratio: **77.9% Pass**

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

### Pole Data

Diameter: 46.840 in (flat to flat)  
Thickness: 0.375 in  
Yield (Fy): 65 ksi  
# of Sides: 18 "0" IF Round  
Strength (Fu): 80 ksi

### Reactions

Moment, Mu: 3370.78 ft-kips  
Axial, Pu: 33.07 kips  
Shear, Vu: 44.36 kips

### Anchor Rod Data

Quantity: 14  
Diameter: 2.25 in  
Rod Material: A615  
Strength (Fu): 100 ksi  
Yield (Fy): 75 ksi  
BC Diam. (in): 53.25 BC Override:

### Anchor Rod Results

Maximum Rod (Pu+ Vu/η): 225.7 Kips  
Allowable  $\Phi \cdot R_{nt}$ : 260.0 Kips (per 4.9.9)  
Anchor Rod Interaction Ratio: **86.8% Pass**

### Plate Data

Diameter (in): 59 Dia. Override:  
Thickness: 2 in  
Yield (Fy): 50 ksi  
Eff Width/Rod: 10.62 in  
Drain Hole: 2.625 in. diameter  
Drain Location: 21.25 in. center of pole to center of drain hole  
Center Hole: 34.5 in. diameter

### Base Plate Results

Base Plate (Mu/Z): 42.9 ksi  
Allowable  $\Phi \cdot F_y$ : 45.0 ksi (per AISC)  
Base Plate Interaction Ratio: **95.3% Pass**

**MAT FOUNDATION DESIGN BY SABRE TOWERS & POLES**

100' Monopole US CELLULAR CORP Waukesha Airport II, WI (155276) 1-16-17 BD

**Overall Loads:**

Factored Moment (ft-kips)	3370.78
Factored Axial (kips)	33.07
Factored Shear (kips)	44.36
Bearing Design Strength (ksf)	5.25
Water Table Below Grade (ft)	999
Width of Mat (ft)	23
Thickness of Mat (ft)	1.5
Depth to Bottom of Slab (ft)	6
Quantity of Bolts in Bolt Circle	14
Bolt Circle Diameter (in)	53.25
Top of Concrete to Top of Bottom Threads (in)	60
Diameter of Pier (ft)	6
Ht. of Pier Above Ground (ft)	1
Ht. of Pier Below Ground (ft)	4.5
Quantity of Bars in Mat	44
Bar Diameter in Mat (in)	1
Area of Bars in Mat (in <sup>2</sup> )	34.56
Spacing of Bars in Mat (in)	6.26
Quantity of Bars Pier	34
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 <sup>2</sup> )	26.70
Spacing of Bars in Pier (in)	5.89
f'c (ksi)	4.5
fy (ksi)	60
Unit Wt. of Soil (kcf)	0.115
Unit Wt. of Concrete (kcf)	0.15

Max. Net Bearing Press. (ksf)	4.90
Allowable Bearing Pressure (ksf)	3.50
Safety Factor	2.00
Ultimate Bearing Pressure (ksf)	7.00
Bearing Φs	0.75

Minimum Pier Diameter (ft)	5.77
Equivalent Square b (ft)	5.32
Square Pier? (Y/N)	N

Recommended Spacing (in)	5 to 12
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Minimum Pier A <sub>s</sub> (in <sup>2</sup> )	20.36
Recommended Spacing (in)	5 to 12

Volume of Concrete (yd<sup>3</sup>) 35.15

**Two-Way Shear Action:**

Average d (in)	14
φv <sub>c</sub> (ksi)	0.228
φv <sub>c</sub> = φ(2 + 4/β <sub>c</sub> )f' <sub>c</sub> <sup>1/2</sup>	0.342
φv <sub>c</sub> = φ(α <sub>s</sub> d/b <sub>o</sub> +2)f' <sub>c</sub> <sup>1/2</sup>	0.232
φv <sub>c</sub> = φ4f' <sub>c</sub> <sup>1/2</sup>	0.228
Shear perimeter, b <sub>o</sub> (in)	270.18
β <sub>c</sub>	1

v <sub>u</sub> (ksi)	0.220
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**One-Way Shear:**

φV <sub>c</sub> (kips)	440.6
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V <sub>u</sub> (kips)	266.8
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**Stability:**

Overturning Design Strength (ft-k)	4440.5
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Total Applied M (ft-k)	3681.3
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**Pier Design:**

$\phi V_n$ (kips)	474.9	$V_u$ (kips)	44.4
$\phi V_c = \phi 2(1 + N_u / (2000 A_g)) f'_c{}^{1/2} b_w d$	474.9		
$V_s$ (kips)	0.0	*** $V_s \text{ max} = 4 f'_c{}^{1/2} b_w d$ (kips)	1112.8
Maximum Spacing (in)	10.16	(Only if Shear Ties are Required)	
Actual Hook Development (in)	13.00	Req'd Hook Development $l_{dh}$ (in)	11.96
		*** Ref. To Spacing Requirements ACI 11.5.4.3	

**Flexure in Slab:**

$\phi M_n$ (ft-kips)	2024.4	$M_u$ (ft-kips)	2017.2
$a$ (in)	1.96		
Steel Ratio	0.00894		
$\beta_1$	0.825		
Maximum Steel Ratio ( $\rho_t$ )	0.0197		
Minimum Steel Ratio	0.0018		
Rebar Development in Pad (in)	103.10	Required Development in Pad (in)	26.69

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