Sabre Industries™
Towers and Poles

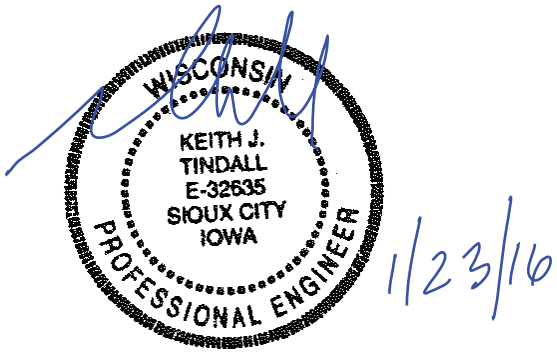
Structural Design Report

100' Monopine
Site: Waukesha Airport II, WI
Site Number: 784719

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

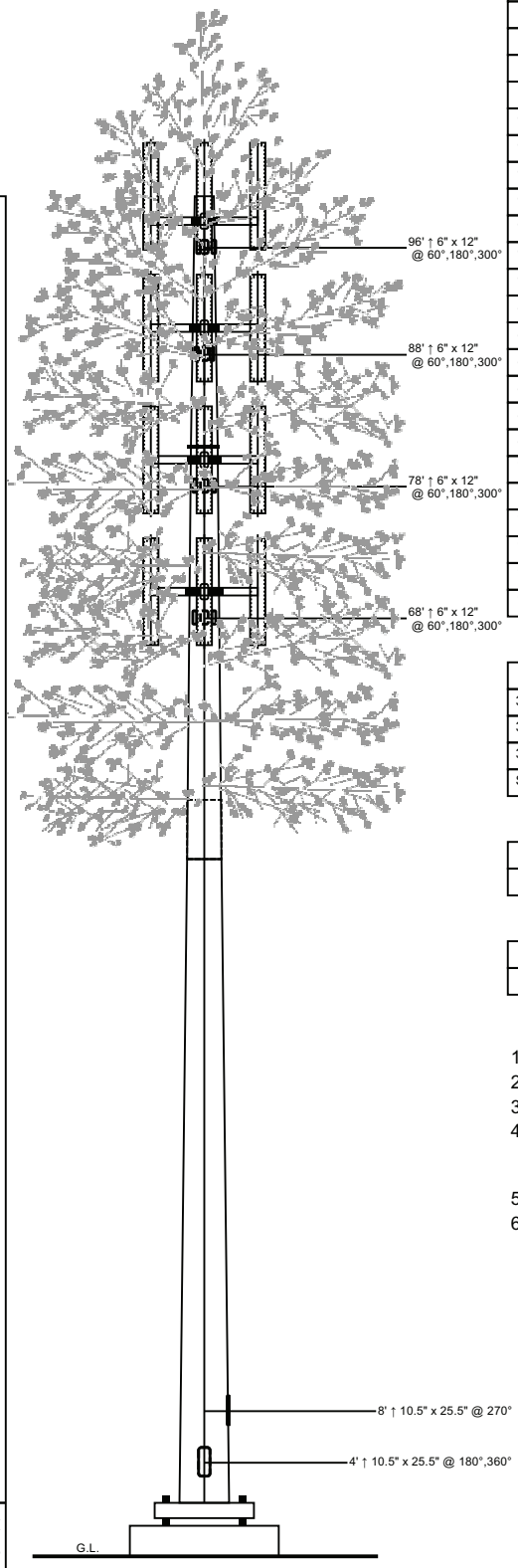
Job Number: 155276
Revision A

January 23, 2017



1/23/16

Length (ft)	19' - 0"	31' - 3"	53' - 3"
Number Of Sides		18	
Thickness (in)	1/4"	5/16"	3/8"
Lap Splice (ft)		4' - 6"	
Top Diameter (in)	18"	23.55"	30.57"
Bottom Diameter (in)	23.43"	32.48"	45.78"
Taper (in/ft)	0.2857		
Grade	A572-65		
Weight (lbs)	1495	3472	9438
Overall Steel Height (ft)	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	33.99	44.34	3379.09	6.12	6.24
3s Gusted Wind 0.9 Dead	25.49	44.3	3349.79	6.05	6.16
3s Gusted Wind&Ice	62.28	8.75	674.67	1.24	1.25
Service Loads	28.32	11.02	838.01	1.53	1.55

Base Plate Dimensions

Shape	Diameter	Thickness	Bolt Circle	Bolt Qty	Bolt Diameter
Round	58"	2.25"	52.25"	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: 96.2%
6) This structure has been designed to support pine tree branches starting at the 50' elevation to an overall height of 105'.

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:	**155276A**
Customer:	US CELLULAR CORP
Site Name:	Waukesha Airport II, WI 784719
Description:	100' Monopine
Date:	1/23/2017 By: KJT

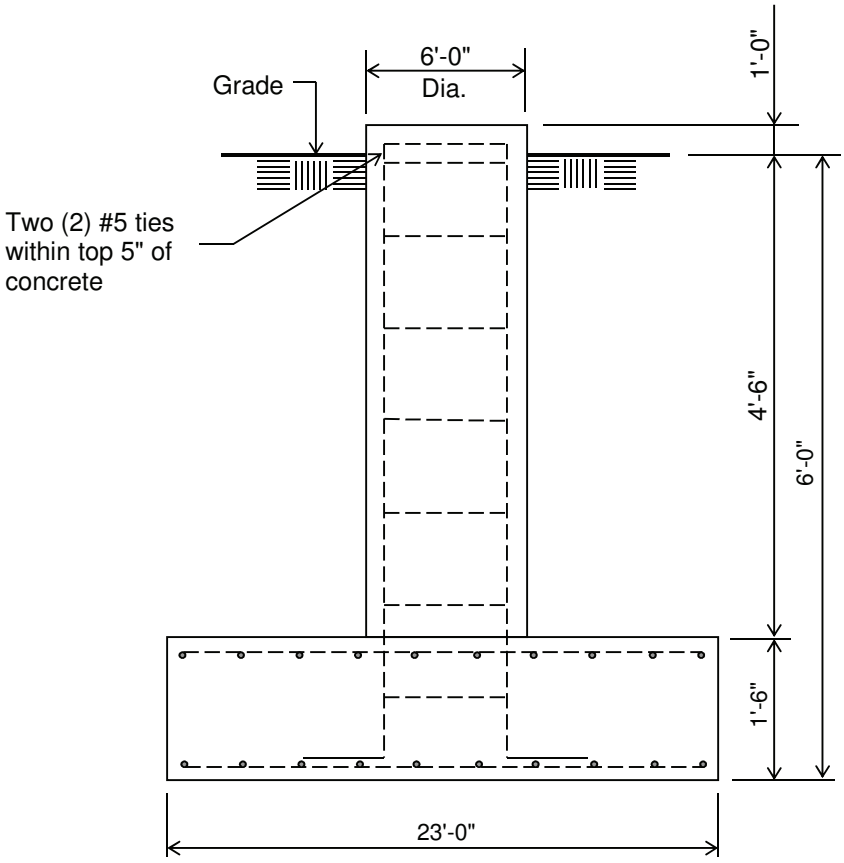
Sabre Industries™
Towers and Poles

No.: 155276

Date: 1/23/17
By: KJT
Revision A

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) = 3379.09
Axial (kips) = 33.99
Shear (kips) = 44.34

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.

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

Processed under license at:

Sabre Towers and Poles on: 23 jan 2017 at: 9:27:48

100' Monopine / Waukesha Airport II, WI

* 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	ϕ*Mn ft-kip	SPLICE TYPE	...OVERLAP... LENGTH ft	RATIO	w/t
99.0										
			18.28	0.250	1046.4	379.8				
	A	18								10.9
			23.79	0.250	1366.4	649.6				
80.0										
			23.92	0.312	1712.6	814.3				
	B	18								11.5
			31.67	0.312	2275.1	1441.6				
53.2										
			31.67	0.312	2275.1	1441.6				
	B/C	18					SLIP	4.50	1.69	
			32.36	0.375	2784.7	1796.7				
48.7										
			32.36	0.375	2784.7	1796.7				
	C	18								13.2
			46.49	0.375	3801.6	3549.4				
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	80.000	0	A325	0.00	92.0	0	80.000
B	48.750	0	A325	0.00	92.0	0	48.750
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	TOP * in	THICK-NESS in	MAT-ERIAL ID	FLANGE.ID BOT	TOP	FLANGE.WELD ..GROUP.ID.. BOT	TOP
A	18	19.00	23.79	18.28	0.250	1	0	0	0	0
B	18	31.25	32.98	23.92	0.312	2	0	0	0	0
C	18	53.25	46.49	31.04	0.375	3	0	0	0	0

* - Diameter of circumscribed circle

MATERIAL TYPES

TYPE OF SHAPE	TYPE NO	NO OF ELEM.	ORIENT & deg	HEIGHT in	WIDTH in	.THICKNESS. WEB in	FLANGE in	IRREGULARITY .PROJECTION. % OF AREA	ORIENT deg
PL	1	1	0.0	23.79	0.25	0.250	0.250	0.00	0.0
PL	2	1	0.0	32.98	0.31	0.312	0.312	0.00	0.0
PL	3	1	0.0	46.49	0.38	0.375	0.375	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
* RRUs/TMAs were assumed to be behind antennas

LOADING CONDITION A

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

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	100.500	0.00	0.0	0.0	1.1004	0.3000	0.0000	0.0000
C	99.000	0.00	0.0	0.0	4.6832	1.9881	0.0000	0.0000
C	97.000	0.00	0.0	0.0	0.0000	0.3189	0.0000	0.0000
C	97.000	0.00	0.0	0.0	0.4675	1.0740	0.0000	0.0000
C	95.500	0.00	0.0	0.0	1.0888	0.3000	0.0000	0.0000
C	90.500	0.00	0.0	0.0	2.1533	0.6000	0.0000	0.0000
C	89.000	0.00	0.0	0.0	0.0000	0.2926	0.0000	0.0000
C	89.000	0.00	0.0	0.0	4.1236	3.0621	0.0000	0.0000
C	85.500	0.00	0.0	0.0	2.1280	0.6000	0.0000	0.0000
C	80.500	0.00	0.0	0.0	2.1015	0.6000	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.0000	0.2598	0.0000	0.0000
C	79.000	0.00	0.0	0.0	4.0226	3.0621	0.0000	0.0000
C	75.500	0.00	0.0	0.0	2.0737	0.6000	0.0000	0.0000
C	70.500	0.00	0.0	0.0	2.0444	0.6000	0.0000	0.0000
C	69.000	0.00	0.0	0.0	0.0000	0.2269	0.0000	0.0000
C	69.000	0.00	0.0	0.0	3.9111	3.0621	0.0000	0.0000
C	65.500	0.00	0.0	0.0	2.0134	0.6000	0.0000	0.0000
C	60.500	0.00	0.0	0.0	1.9806	0.6000	0.0000	0.0000
C	55.500	0.00	0.0	0.0	1.9455	0.6000	0.0000	0.0000
C	50.500	0.00	0.0	0.0	1.9079	0.6000	0.0000	0.0000
C	49.750	0.00	0.0	0.0	0.2853	0.0900	0.0000	0.0000
D	99.000	0.00	180.0	0.0	0.0449	0.0598	0.0000	0.0000
D	80.000	0.00	180.0	0.0	0.0529	0.0728	0.0000	0.0000
D	80.000	0.00	180.0	0.0	0.0566	0.0994	0.0000	0.0000
D	71.083	0.00	180.0	0.0	0.0566	0.0994	0.0000	0.0000
D	71.083	0.00	180.0	0.0	0.0608	0.1096	0.0000	0.0000
D	62.167	0.00	180.0	0.0	0.0608	0.1096	0.0000	0.0000
D	62.167	0.00	180.0	0.0	0.0646	0.1199	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0646	0.1199	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0670	0.2778	0.0000	0.0000
D	48.750	0.00	180.0	0.0	0.0670	0.2778	0.0000	0.0000
D	48.750	0.00	180.0	0.0	0.0681	0.1617	0.0000	0.0000
D	36.562	0.00	180.0	0.0	0.0681	0.1617	0.0000	0.0000
D	36.562	0.00	180.0	0.0	0.0702	0.1785	0.0000	0.0000
D	24.375	0.00	180.0	0.0	0.0702	0.1785	0.0000	0.0000
D	24.375	0.00	180.0	0.0	0.0692	0.1952	0.0000	0.0000
D	12.187	0.00	180.0	0.0	0.0692	0.1952	0.0000	0.0000
D	12.187	0.00	180.0	0.0	0.0714	0.2120	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0714	0.2120	0.0000	0.0000

==========

LOADING CONDITION M ==========

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

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

LOAD TYPE	ELEV ft	APPLY..LOAD..AT RADIUS ft	AZI	LOAD AZI	......FORCES..... HORIZ kip	DOWN kip	......MOMENTS..... VERTICAL ft-kip	TORSNAL ft-kip
C	100.500	0.00	0.0	0.0	1.1004	0.2250	0.0000	0.0000
C	99.000	0.00	0.0	0.0	4.6832	1.4911	0.0000	0.0000
C	97.000	0.00	0.0	0.0	0.0000	0.2392	0.0000	0.0000
C	97.000	0.00	0.0	0.0	0.4675	0.8055	0.0000	0.0000
C	95.500	0.00	0.0	0.0	1.0888	0.2250	0.0000	0.0000
C	90.500	0.00	0.0	0.0	2.1533	0.4500	0.0000	0.0000
C	89.000	0.00	0.0	0.0	0.0000	0.2195	0.0000	0.0000
C	89.000	0.00	0.0	0.0	4.1236	2.2966	0.0000	0.0000
C	85.500	0.00	0.0	0.0	2.1280	0.4500	0.0000	0.0000
C	80.500	0.00	0.0	0.0	2.1015	0.4500	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.0000	0.1948	0.0000	0.0000
C	79.000	0.00	0.0	0.0	4.0226	2.2966	0.0000	0.0000
C	75.500	0.00	0.0	0.0	2.0737	0.4500	0.0000	0.0000
C	70.500	0.00	0.0	0.0	2.0444	0.4500	0.0000	0.0000
C	69.000	0.00	0.0	0.0	0.0000	0.1702	0.0000	0.0000
C	69.000	0.00	0.0	0.0	3.9111	2.2966	0.0000	0.0000
C	65.500	0.00	0.0	0.0	2.0134	0.4500	0.0000	0.0000
C	60.500	0.00	0.0	0.0	1.9806	0.4500	0.0000	0.0000
C	55.500	0.00	0.0	0.0	1.9455	0.4500	0.0000	0.0000
C	50.500	0.00	0.0	0.0	1.9079	0.4500	0.0000	0.0000
C	49.750	0.00	0.0	0.0	0.2853	0.0675	0.0000	0.0000
D	99.000	0.00	180.0	0.0	0.0449	0.0448	0.0000	0.0000
D	80.000	0.00	180.0	0.0	0.0529	0.0546	0.0000	0.0000
D	80.000	0.00	180.0	0.0	0.0567	0.0746	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0646	0.0899	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0670	0.2083	0.0000	0.0000
D	48.750	0.00	180.0	0.0	0.0670	0.2083	0.0000	0.0000
D	48.750	0.00	180.0	0.0	0.0681	0.1213	0.0000	0.0000
D	36.562	0.00	180.0	0.0	0.0681	0.1213	0.0000	0.0000
D	36.562	0.00	180.0	0.0	0.0702	0.1338	0.0000	0.0000
D	24.375	0.00	180.0	0.0	0.0702	0.1338	0.0000	0.0000
D	24.375	0.00	180.0	0.0	0.0692	0.1464	0.0000	0.0000
D	12.187	0.00	180.0	0.0	0.0692	0.1464	0.0000	0.0000
D	12.187	0.00	180.0	0.0	0.0714	0.1590	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0714	0.1590	0.0000	0.0000

==========

LOADING CONDITION Y ==========

40 mph wind with 0.75 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	100.500	0.00	0.0	0.0	0.1723	0.9713	0.0000	0.0000
C	99.000	0.00	0.0	0.0	0.8648	5.2768	0.0000	0.0000
C	97.000	0.00	0.0	0.0	0.0000	0.3189	0.0000	0.0000
C	97.000	0.00	0.0	0.0	0.1397	1.2952	0.0000	0.0000
C	95.500	0.00	0.0	0.0	0.1703	0.9680	0.0000	0.0000
C	90.500	0.00	0.0	0.0	0.3718	1.2644	0.0000	0.0000
C	89.000	0.00	0.0	0.0	0.0000	0.2926	0.0000	0.0000
C	89.000	0.00	0.0	0.0	0.8101	6.5352	0.0000	0.0000
C	85.500	0.00	0.0	0.0	0.3669	1.2607	0.0000	0.0000
C	80.500	0.00	0.0	0.0	0.3617	1.2568	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.0000	0.2598	0.0000	0.0000
C	79.000	0.00	0.0	0.0	0.7868	6.4945	0.0000	0.0000
C	75.500	0.00	0.0	0.0	0.3563	1.2526	0.0000	0.0000
C	70.500	0.00	0.0	0.0	0.3506	1.2482	0.0000	0.0000
C	69.000	0.00	0.0	0.0	0.0000	0.2269	0.0000	0.0000
C	69.000	0.00	0.0	0.0	0.7613	6.4490	0.0000	0.0000
C	65.500	0.00	0.0	0.0	0.3446	1.2435	0.0000	0.0000
C	60.500	0.00	0.0	0.0	0.3382	1.2385	0.0000	0.0000
C	55.500	0.00	0.0	0.0	0.3314	1.2331	0.0000	0.0000
C	50.500	0.00	0.0	0.0	0.3242	1.2273	0.0000	0.0000
C	49.750	0.00	0.0	0.0	0.3231	1.2264	0.0000	0.0000
D	99.000	0.00	180.0	0.0	0.0120	0.1020	0.0000	0.0000
D	80.000	0.00	180.0	0.0	0.0138	0.1226	0.0000	0.0000
D	80.000	0.00	180.0	0.0	0.0146	0.1530	0.0000	0.0000
D	71.083	0.00	180.0	0.0	0.0146	0.1530	0.0000	0.0000
D	71.083	0.00	180.0	0.0	0.0155	0.1676	0.0000	0.0000
D	62.167	0.00	180.0	0.0	0.0155	0.1676	0.0000	0.0000
D	62.167	0.00	180.0	0.0	0.0163	0.1819	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0163	0.1819	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0167	0.3428	0.0000	0.0000
D	48.750	0.00	180.0	0.0	0.0167	0.3428	0.0000	0.0000
D	48.750	0.00	180.0	0.0	0.0169	0.2289	0.0000	0.0000
D	36.562	0.00	180.0	0.0	0.0169	0.2289	0.0000	0.0000
D	36.562	0.00	180.0	0.0	0.0173	0.2499	0.0000	0.0000
D	24.375	0.00	180.0	0.0	0.0173	0.2499	0.0000	0.0000
D	24.375	0.00	180.0	0.0	0.0169	0.2692	0.0000	0.0000
D	12.187	0.00	180.0	0.0	0.0169	0.2692	0.0000	0.0000
D	12.187	0.00	180.0	0.0	0.0172	0.2843	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0172	0.2843	0.0000	0.0000

Sabre Towers and Poles on: 23 jan 2017 at: 9:27:48

100' Monopine / Waukesha Airport II, WI

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

MAST ELEV ft	.....DEFLECTIONS (ft)..... HORIZONTAL ..... ALONG	ACROSS	DOWN	.....ROTATIONS (deg)..... TILT ..... ALONG	ACROSS	TWIST
99.0	6.12C	0.01B	0.50C	6.24C	0.01B	0.00U
94.2	5.61C	0.01B	0.44C	6.20C	0.01B	0.00U
89.5	5.10C	0.00B	0.39C	6.11C	0.01B	0.00U
84.7	4.61C	0.00B	0.34C	5.96C	0.01B	0.00U
80.0	4.13C	0.00B	0.29C	5.74C	0.01B	0.00U
71.1	3.27C	0.00B	0.20C	5.29C	0.01B	0.00U
62.2	2.50C	0.00R	0.14C	4.70C	0.00B	0.00U
53.2	1.83H	0.00R	0.08C	4.00C	0.00B	0.00U
48.7	1.53H	0.00R	0.06C	3.68C	0.00B	0.00U
36.6	0.85H	0.00R	0.03C	2.73H	0.00R	0.00U
24.4	0.37H	0.00R	0.01C	1.77H	0.00R	0.00U
12.2	0.09H	0.00R	0.00C	0.86H	0.00R	0.00F
0.0	0.00A	0.00A	0.00A	0.00A	0.00A	0.00A

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

MAST ELEV ft	TOTAL AXIAL kip	SHEAR.w.r.t.WIND.DIR ALONG kip	ACROSS kip	MOMENT.w.r.t.WIND.DIR ALONG ft-kip	ACROSS ft-kip	TORSION ft-kip
99.0	6.25 AJ	5.79 U	0.01 O	-1.68 O	0.01 O	0.00 O
	9.33 AJ	7.56 U	0.01 O	-33.63 C	-0.01 O	0.01 X

94.2						
	9.33 AG	7.58 A	-0.02 L	-33.64 C	0.04 E	0.01 X
	11.11 AG	9.96 A	-0.02 L	-74.16 A	-0.08 B	0.01 X
89.5						
	11.11 Z	9.97 T	0.04 T	-74.17 H	-0.10 B	-0.01 T
	19.75 Z	16.46 T	0.04 T	-144.62 H	-0.24 B	0.02 U
84.7						
	19.75 Z	16.46 C	0.04 W	-144.65 H	-0.22 B	0.02 U
	21.57 Z	18.81 C	0.04 W	-228.25 H	-0.39 B	0.04 U
80.0						
	21.57 Z	18.83 C	0.04 B	-228.24 H	-0.38 B	0.04 U
	30.95 Z	25.42 C	0.04 B	-449.31 C	-0.72 B	0.08 U
71.1						
	30.95 Z	25.43 O	0.04 B	-449.32 C	-0.72 B	0.08 U
	41.61 Z	33.94 O	0.04 B	-741.47 C	-1.09 B	0.12 U
62.2						
	41.61 Z	33.93 H	0.04 B	-741.45 C	-1.08 B	0.12 U
	45.70 Z	38.43 H	0.04 B	-1078.16 C	-1.48 B	0.15 U
53.2						
	45.70 Z	38.44 H	0.03 B	-1078.18 C	-1.48 B	0.15 U
	49.70 Z	40.93 H	0.03 B	-1261.73 C	-1.62 B	0.17 U
48.7						
	49.70 Z	40.95 H	0.04 R	-1261.70 C	-1.64 B	0.16 U
	52.49 Z	41.78 H	0.04 R	-1781.70 C	-1.73 B	0.17 U
36.6						
	52.49 Z	41.78 H	0.04 R	-1781.70 C	-1.73 B	0.17 U
	55.53 Z	42.63 H	0.04 R	-2308.32 H	-2.06 R	0.19 U
24.4						
	55.53 Z	42.63 H	-0.05 F	-2308.32 H	-2.05 R	0.19 U
	58.81 Z	43.47 H	-0.05 F	-2841.10 H	-2.48 R	-0.19 F
12.2						
	58.81 Z	43.47 H	-0.05 F	-2841.10 H	-2.49 R	-0.19 F
	62.28 Z	44.34 H	-0.05 F	-3379.09 H	-2.92 R	-0.20 F
base reaction	62.28 Z	-44.34 H	0.05 F	3379.09 H	2.92 R	0.20 F

COMPLIANCE WITH 4.8.2 & 4.5.4

ELEV ft	AXIAL	BENDING	SHEAR + TORSIONAL	TOTAL	SATISFIED	D/t(w/t)	MAX ALLOWED
99.00							
	0.01AJ	0.00O	0.01U	0.01B	YES	10.93A	45.2
	0.01AJ	0.08C	0.01U	0.08C	YES	11.89A	45.2
94.25							
	0.01AG	0.08C	0.01A	0.08C	YES	11.89A	45.2
	0.01AG	0.15A	0.02A	0.15L	YES	12.85A	45.2
89.50							
	0.01Z	0.15H	0.02T	0.15H	YES	12.85A	45.2
	0.02Z	0.25H	0.03T	0.26H	YES	13.80A	45.2
84.75							
	0.02Z	0.25H	0.03C	0.26H	YES	13.80A	45.2
	0.02Z	0.35H	0.03C	0.36H	YES	14.76A	45.2
80.00							
	0.01Z	0.28H	0.02C	0.29H	YES	11.53A	45.2
	0.02Z	0.45C	0.03C	0.46C	YES	12.96A	45.2
71.08							
	0.02Z	0.45C	0.03O	0.46C	YES	12.96A	45.2
	0.02Z	0.61C	0.03O	0.62C	YES	14.40A	45.2
62.17							
	0.02Z	0.61C	0.03H	0.62C	YES	14.40A	45.2
	0.02Z	0.75C	0.03H	0.76C	YES	15.84A	45.2
53.25							
	0.02Z	0.63C	0.03H	0.64C	YES	12.91A	45.2
	0.02Z	0.68C	0.03H	0.69C	YES	13.51A	45.2
48.75							
	0.02Z	0.70C	0.03H	0.71C	YES	13.22A	45.2
	0.02Z	0.80C	0.03H	0.81C	YES	14.85A	45.2
36.56							
	0.02Z	0.80C	0.03H	0.81C	YES	14.85A	45.2
	0.02Z	0.87H	0.03H	0.88H	YES	16.49A	45.2
24.37							
	0.02Z	0.87H	0.03H	0.88H	YES	16.49A	45.2
	0.02Z	0.92H	0.02H	0.93H	YES	18.13A	45.2
12.19							
	0.02Z	0.92H	0.02H	0.93H	YES	18.13A	45.2
	0.02Z	0.95H	0.02H	0.96H	YES	19.77A	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
62.28	44.34	-0.05	-3379.09	-2.92	-0.20
Z	H	F	H	R	F

==========

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

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

Processed under license at:

Sabre Towers and Poles on: 23 jan 2017 at: 9:27:57
==========

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	APPLY..LOAD..AT RADIUS	AZI	LOAD AZI	.....FORCES..... HORIZ	DOWN	.....MOMENTS..... VERTICAL	TORSNAL
	ft	ft			kip	kip	ft-kip	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	0.0112	0.0498	0.0000	0.0000
D	80.000	0.00	180.0	0.0	0.0131	0.0607	0.0000	0.0000
D	80.000	0.00	180.0	0.0	0.0141	0.0829	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0161	0.0999	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0166	0.2315	0.0000	0.0000
D	48.750	0.00	180.0	0.0	0.0166	0.2315	0.0000	0.0000
D	48.750	0.00	180.0	0.0	0.0169	0.1348	0.0000	0.0000
D	36.562	0.00	180.0	0.0	0.0169	0.1348	0.0000	0.0000
D	36.562	0.00	180.0	0.0	0.0174	0.1487	0.0000	0.0000
D	24.375	0.00	180.0	0.0	0.0174	0.1487	0.0000	0.0000
D	24.375	0.00	180.0	0.0	0.0172	0.1627	0.0000	0.0000
D	12.187	0.00	180.0	0.0	0.0172	0.1627	0.0000	0.0000
D	12.187	0.00	180.0	0.0	0.0177	0.1767	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0177	0.1767	0.0000	0.0000

==========

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

MAST ELEV	.....DEFLECTIONS (ft)..... HORIZONTAL ..... ALONG	ACROSS	DOWN	.....ROTATIONS (deg)..... TILT ..... ALONG	ACROSS	TWIST
ft						
99.0	1.53L	0.00I	0.03L	1.55L	0.00I	0.00I
94.2	1.40L	0.00I	0.03L	1.54L	0.00I	0.00I
89.5	1.27L	0.00I	0.03L	1.52L	0.00I	0.00I
84.7	1.15L	0.00I	0.02L	1.48L	0.00I	0.00I
80.0	1.03L	0.00I	0.02L	1.43L	0.00I	0.00I
71.1	0.82L	0.00I	0.01L	1.32L	0.00I	0.00I
62.2	0.62L	0.00I	0.01L	1.17L	0.00I	0.00I
53.2	0.45F	0.00I	0.01L	0.99L	0.00I	0.00I

48.7	0.38F	0.00I	0.00L	0.91L	0.00I	0.00I
36.6	0.21F	0.00I	0.00L	0.68F	0.00I	0.00I
24.4	0.09F	0.00I	0.00L	0.44F	0.00I	0.00I
12.2	0.02F	0.00I	0.00L	0.21F	0.00I	0.00I
0.0	0.00A	0.00A	0.00A	0.00A	0.00A	0.00A

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

MAST ELEV ft	TOTAL AXIAL kip	SHEAR.w.r.t.WIND.DIR ALONG kip	ACROSS kip	MOMENT.w.r.t.WIND.DIR ALONG ft-kip	ACROSS ft-kip	TORSION ft-kip
99.0	1.91 H	1.44 C	0.00 I	-0.41 F	0.00 I	0.00 L
	3.56 H	1.88 C	0.00 I	-8.38 C	0.00 I	0.00 L
94.2	3.56 B	1.88 B	0.00 E	-8.39 C	-0.01 L	0.00 L
	4.32 B	2.47 B	0.00 E	-18.46 B	0.02 E	0.00 L
89.5	4.32 B	2.49 L	-0.01 E	-18.45 A	0.02 K	0.00 L
	7.88 B	4.10 L	-0.01 E	-35.99 L	0.05 E	0.00 L
84.7	7.88 D	4.09 F	0.01 B	-35.98 L	0.05 E	0.00 L
	8.66 D	4.67 F	0.01 B	-56.76 L	-0.08 C	0.00 L
80.0	8.66 D	4.67 L	0.01 I	-56.76 L	0.08 E	0.00 L
	12.70 D	6.32 L	0.01 I	-111.68 L	-0.17 I	0.00 I
71.1	12.70 B	6.32 L	0.01 I	-111.68 L	-0.17 I	0.00 I
	17.25 B	8.43 L	0.01 I	-184.19 L	-0.27 I	0.01 I
62.2	17.25 B	8.43 L	0.01 I	-184.19 L	-0.27 I	0.01 I
	19.12 B	9.55 L	0.01 I	-267.68 L	-0.36 I	0.01 I
53.2	19.12 B	9.55 F	0.01 I	-267.68 L	-0.36 I	0.01 I
	20.73 B	10.17 F	0.01 I	-313.18 L	-0.41 I	0.01 I
48.7	20.73 B	10.17 F	0.01 I	-313.19 L	-0.42 I	0.01 I
	22.38 B	10.37 F	0.01 I	-441.97 L	-0.54 I	0.01 I
36.6	22.38 B	10.38 F	0.01 I	-441.97 L	-0.54 I	0.01 I
	24.19 B	10.59 F	0.01 I	-572.41 L	-0.69 I	0.01 I
24.4	24.19 B	10.59 F	0.01 I	-572.41 L	-0.69 I	0.01 I
	26.17 B	10.80 F	0.01 I	-704.48 F	-0.83 I	0.01 I
12.2	26.17 B	10.80 F	0.01 I	-704.48 F	-0.83 I	0.01 I
	28.32 B	11.02 F	0.01 I	-838.01 F	-0.97 I	0.01 I
base reaction	28.32 B	-11.02 F	-0.01 I	838.01 F	0.97 I	-0.01 I

COMPLIANCE WITH 4.8.2 & 4.5.4

ELEV ft	AXIAL	BENDING	SHEAR + TORSIONAL	TOTAL	SATISFIED	D/t(w/t)	MAX ALLOWED
99.00	0.00H	0.00F	0.00C	0.00F	YES	10.93A	45.2
	0.00H	0.02C	0.00C	0.02C	YES	11.89A	45.2
94.25	0.00B	0.02C	0.00B	0.02C	YES	11.89A	45.2
	0.00B	0.04B	0.00B	0.04B	YES	12.85A	45.2
89.50	0.00B	0.04A	0.00L	0.04B	YES	12.85A	45.2
	0.01B	0.06L	0.01L	0.07L	YES	13.80A	45.2
84.75	0.01D	0.06L	0.01F	0.07L	YES	13.80A	45.2
	0.01D	0.09L	0.01F	0.09L	YES	14.76A	45.2
80.00	0.01D	0.07L	0.01L	0.07L	YES	11.53A	45.2
	0.01D	0.11L	0.01L	0.12L	YES	12.96A	45.2
71.08	0.01B	0.11L	0.01L	0.12L	YES	12.96A	45.2
	0.01B	0.15L	0.01L	0.16L	YES	14.40A	45.2
62.17	0.01B	0.15L	0.01L	0.16L	YES	14.40A	45.2
	0.01B	0.19L	0.01L	0.19L	YES	15.84A	45.2
53.25							

```
            0.01B     0.16L     0.01F     0.16L     YES      12.91A       45.2

            0.01B     0.17L     0.01F     0.18L     YES      13.51A       45.2
 48.75  ..........................................................................
            0.01B     0.17L     0.01F     0.18L     YES      13.22A       45.2

            0.01B     0.20L     0.01F     0.21L     YES      14.85A       45.2
 36.56  ..........................................................................
            0.01B     0.20L     0.01F     0.21L     YES      14.85A       45.2

            0.01B     0.21L     0.01F     0.22L     YES      16.49A       45.2
 24.37  ..........................................................................
            0.01B     0.21L     0.01F     0.22L     YES      16.49A       45.2

            0.01B     0.23F     0.01F     0.23F     YES      18.13A       45.2
 12.19  ..........................................................................
            0.01B     0.23F     0.01F     0.23F     YES      18.13A       45.2

            0.01B     0.24F     0.01F     0.24F     YES      19.77A       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
28.32	11.02	0.01	-838.01	-0.97	0.01
B	F	I	F	I	I

==========

Sabre Industries™
Towers and Poles

SO#: 155276A
Site Name: Waukesha Airport II, WI
Date: 1/23/2017

Round Flange Plate and Bolts per ANSI/TIA 222-G
Elevation = 80 feet

Pole Data

Diameter:	23.43	in
Thickness:	0.25	in
Yield (Fy):	65	ksi
# of Sides:	18	"0" IF Round
Strength (Fu):	80	ksi

Reactions

Moment, Mu:	228.25	ft-kips
Axial, Pu:	10.42	kips
Shear, Vu:	18.83	kips

Bolt Data

Quantity:	10	
Diameter:	0.875	in
Bolt Material:	A325	
Strength (Fu):	120	ksi
Yield (Fy):	92	ksi
BC Diam. (in):	26.75	BC Override:

Flange Bolt Results

Allowable Φ*Rnt:	41.58 kips
Adjusted Φ*Rnt (due to shear):	41.50 kips
Maximum Bolt Tension:	39.92 kips
Bolt Interaction Ratio:	**96.2%** **Pass**

Plate Data

Diameter (in):	29	Dia. Override:
Thickness:	1.5	in
Center Hole Diam.:	15	in
Yield (Fy):	50	ksi
Single-Rod B-eff:	7.44	in
Drain Hole:	1	in. diameter
Drain Location:	10.75	in. center of pole to center of drain hole

Flange Plate Results

Compression Side Plate (Mu/Z):	11.1 ksi
Allowable Φ*Fy:	45.0 ksi
Compr. Plate Interaction Ratio:	**24.6%** **Pass**

Sabre Industries™
Towers and Poles

SO#: 155276A
Site Name: Waukesha Airport II, WI
Date: 1/23/2017

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

Pole Data

Diameter:	45.780	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:	3379.09	ft-kips
Axial, Pu:	33.99	kips
Shear, Vu:	44.34	kips

Anchor Rod Data

Quantity:	14		
Diameter:	2.25	in	
Rod Material:	A615		
Strength (Fu):	100	ksi	
Yield (Fy):	75	ksi	
BC Diam. (in):	52.25	BC Override:	

Anchor Rod Results

Maximum Rod (Pu+ Vu/η):	230.5 Kips	
Allowable Φ*Rnt:	260.0 Kips	(per 4.9.9)
Anchor Rod Interaction Ratio:	**88.7%** **Pass**	

Plate Data

Diameter (in):	58	Dia. Override:	
Thickness:	2.25	in	
Yield (Fy):	50	ksi	
Eff Width/Rod:	10.38	in	
Drain Hole:	2.625	in. diameter	
Drain Location:	20.75	in. center of pole to center of drain hole	
Center Hole:	33.5	in. diameter	

Base Plate Results

Base Plate (Mu/Z):	35.4 ksi	
Allowable Φ*Fy:	45.0 ksi	(per AISC)
Base Plate Interaction Ratio:	**78.6%** **Pass**	

MAT FOUNDATION DESIGN BY SABRE TOWERS & POLES

100' Monopole US CELLULAR CORP Waukesha Airport II, WI (155276) 1-23-17 KJT

Overall Loads:			
Factored Moment (ft-kips)	3379.09		
Factored Axial (kips)	33.99		
Factored Shear (kips)	44.34		
Bearing Design Strength (ksf)	5.25	Max. Net Bearing Press. (ksf)	4.88
Water Table Below Grade (ft)	999		
Width of Mat (ft)	23	Allowable Bearing Pressure (ksf)	3.50
Thickness of Mat (ft)	1.5	Safety Factor	2.00
Depth to Bottom of Slab (ft)	6	Ultimate Bearing Pressure (ksf)	7.00
Quantity of Bolts in Bolt Circle	14	Bearing Φs	0.75
Bolt Circle Diameter (in)	52.25		
Top of Concrete to Top of Bottom Threads (in)	60		
Diameter of Pier (ft)	6	Minimum Pier Diameter (ft)	5.69
Ht. of Pier Above Ground (ft)	1	Equivalent Square b (ft)	5.32
Ht. of Pier Below Ground (ft)	4.5	Square Pier? (Y/N)	N
Quantity of Bars in Mat	44		
Bar Diameter in Mat (in)	1		
Area of Bars in Mat (in^2)	34.56		
Spacing of Bars in Mat (in)	6.26	Recommended Spacing (in)	5 to 12
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^2)	26.70	Minimum Pier A_s (in^2)	20.36
Spacing of Bars in Pier (in)	5.89	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)	35.15		
Two-Way Shear Action:			
Average d (in)	14		
ϕv_c (ksi)	0.228	v_u (ksi)	0.220
$\phi v_c = \phi(2 + 4/\beta_c)f'_c{}^{1/2}$	0.342		
$\phi v_c = \phi(\alpha_s d/b_o + 2)f'_c{}^{1/2}$	0.232		
$\phi v_c = \phi 4 f'_c{}^{1/2}$	0.228		
Shear perimeter, b_o (in)	270.18		
β_c	1		
One-Way Shear:			
ϕV_c (kips)	440.6	V_u (kips)	267.7
Stability:			
Overturning Design Strength (ft-k)	4448.4	Total Applied M (ft-k)	3689.5

Pier Design:

ϕV_n (kips)	474.9	V_u (kips)	44.3
$\phi V_c=\phi 2(1+N_u/(2000A_g))f'_c{}^{1/2}b_w d$	474.9		
V_s (kips)	0.0	*** V_s 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:

ϕM_n (ft-kips)	2024.4	M_u (ft-kips)	2017.4
a (in)	1.96		
Steel Ratio	0.00894		
β_1	0.825		
Maximum Steel Ratio (ρ_t)	0.0197		
Minimum Steel Ratio	0.0018		
Rebar Development in Pad (in)	103.10	Required Development in Pad (in)	26.70

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
Overturning	1
Flexure	1
Steel Ratio	1
Length of Development in Pad	1
Hook Development	1