



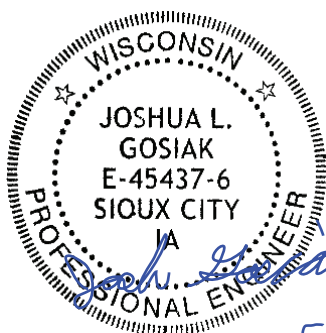
Structural Design Report
135' Extendible to 165' Monopole
Site: Jenna Dr, WI
Site Number: WI-00-1477

Prepared for: CENTRAL STATES TOWER
by: Sabre Towers & Poles™

Job Number: 162371

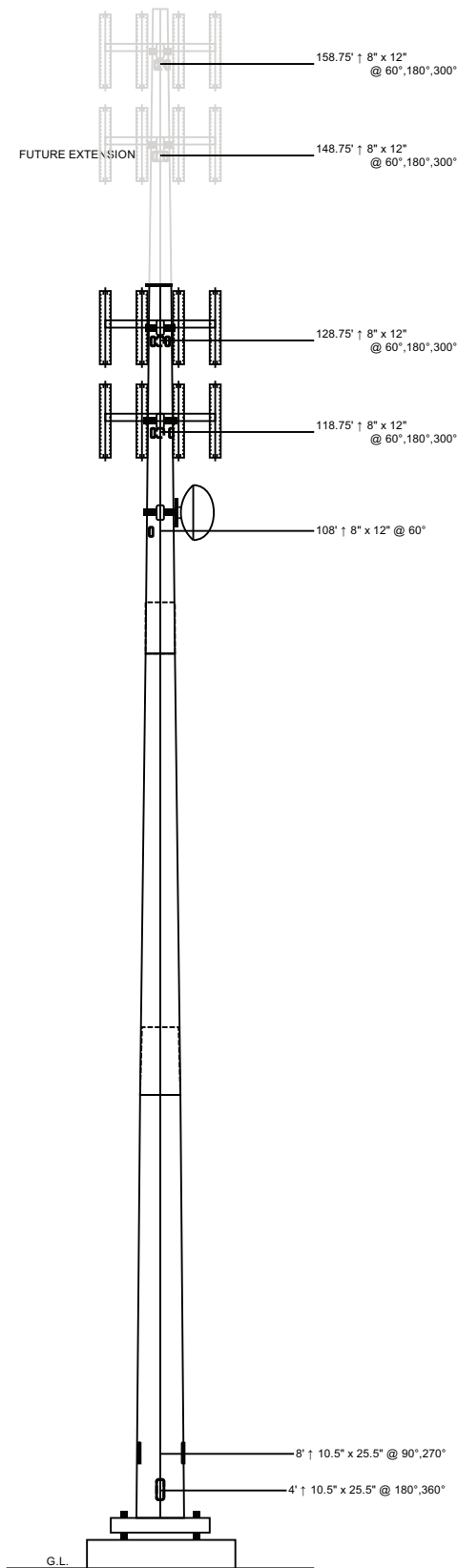
May 1, 2017

Monopole Profile.....	1
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Foundation Calculations.....	15-16



5/1/17

Length (ft)	53'-3"	53'-6"	18	40'-0"	30'-0"
Number Of Sides					
Thickness (in)	3/8"	5/16"		1/4"	
Lap Splice (ft)		7'-3"		5'-6"	
Top Diameter (in)	48.88"	36.56"		27.4"	19"
Bottom Diameter (in)	63.8"	51.54"		38.6"	27.4"
Taper (in/ft)			0.28		
Grade			A572-65		
Weight (lbs)	14565	8381		4257	2452
Overall Steel Height (ft)		134			30 (Extension)



Designed Appurtenance Loading

Elev	Description	Tx-Line
160***	Commscope Tri-Sector Platform Mount - MTC3607	
160***	(12) 8' X 1' X 6IN	(13) 1 5/8"
160***	(6) 17' x 12' x 6" TMA	
160***	(12) 24" x 12" x 10" RRH	
160***	(3) DC6-48-60-18-8F	
150***	Commscope Tri-Sector Platform Mount - MTC3607	
150***	(12) 8' X 1' X 6IN	(13) 1 5/8"
150***	(6) 17' x 12' x 6" TMA	
150***	(3) DC6-48-60-18-8F	
150***	(12) 24" x 12" x 10" RRH	
130	SitePro1 Cage Platform	
130	(6) CBC78-DF-8-DCB	
130	(18) RRUS 12	
130	(3) DC6-48-60-18-8F	
130	(12) 8' X 1' X 6IN	(13) 1 5/8"
130	(6) RRUS A2 Module	
130	(6) TTMAV-700C	
120	Commscope Tri-Sector Platform Mount - MTC3607	
120	(12) 8' X 1' X 6IN	(13) 1 5/8"
120	(6) 17' x 12' x 6" TMA	
120	(3) DC6-48-60-18-8F	
120	(12) 24" x 12" x 10" RRH	
110	(1) Dish Mount (Monopole Only) - Pipe Mount (up to 6' Dish)	
110	(1) 6' Solid Dish W/ Radome	(1) EW52

Load Case Reactions

Description	Axial (kips)	Shear (kips)	Moment (ft-k)	Deflection (ft)	Sway (deg)
3s Gusted Wind	64.31	42.37	5247.61	12.03	8.12
3s Gusted Wind 0.9 Dead	48.23	42.33	5146.84	11.71	7.88
3s Gusted Wind&Ice	103.09	9.88	1296.58	3.11	2.1
Service Loads	53.62	10.54	1296.3	3.01	2.01

Base Plate Dimensions

Shape	Diameter	Thickness	Bolt Circle	Bolt Qty	Bolt Diameter
Round	76.5"	2"	70.75"	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) 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) Full Height Step Bolts
 - 6) Tower Rating: 99.6%
- *** These Appurtenances cannot be installed until the Monopole has been extended.



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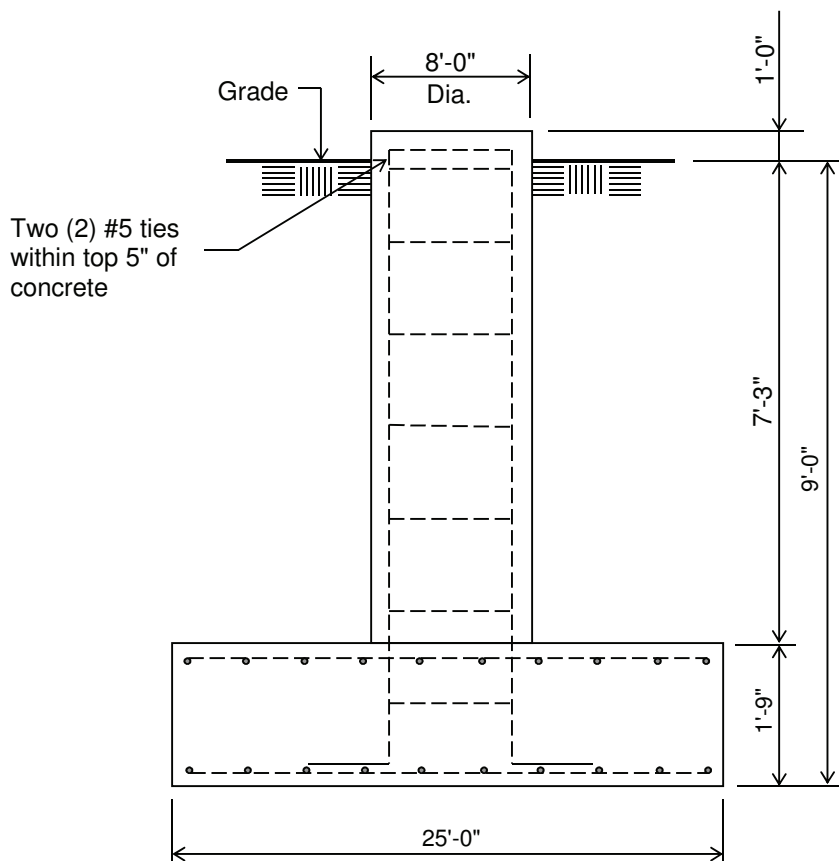
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Job: **162371**
Customer: **CENTRAL STATES TOWER**
Site Name: **Jenna Dr, WI WI-00-1477**
Description: **135' ext. 165' Monopole**
Date: **5/1/2017** By: **JLG**

Customer: CENTRAL STATES TOWER

Site: Jenna Dr, WI WI-00-1477

135' Extendible to 165' 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

(55.87 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, Project No. 15154, dated April 20, 2017.
- 6). See the geotechnical report for compaction requirements, if specified.
- 7). The foundation is based on the following factored loads:
Moment (kip-ft) = 5247.61
Axial (kips) = 64.31
Shear (kips) = 42.37

Rebar Schedule per Pad and Pier	
Pier	(48) #8 vertical rebar w/ hooks at bottom w/ #5 ties, two within top 5" of top of pier then 12" C/C
Pad	(39) #8 horizontal rebar evenly spaced each way top and bottom (156 total)

- 8). 7.25 ft of soil cover is required over the entire area of the foundation slab.

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135' ext. 165' Monopole / Jenna Dr, 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 ♦*Pn ♦*Mn kip ft-kip	SPLICE TYPE	...OVERLAP... LENGTH ft	RATIO	w/t
164.0			19.29	0.250	1105.4 424.1				
	A	18	27.82	0.250	1565.5 873.1				11.6
134.0			27.82	0.250	1565.5 873.1				
	B	18	37.62	0.250	1911.7 1448.6				17.6
99.5			37.62	0.250	1911.7 1448.6				
	B/C	18	38.70	0.312	2637.8 2049.9	SLIP	5.50	1.73	
94.0			38.70	0.312	2637.8 2049.9				
	C	18	50.26	0.312	3101.0 3142.1				19.7
53.2			50.26	0.312	3101.0 3142.1				
	C/D	18	51.71	0.375	4078.0 4242.0	SLIP	7.25	1.71	
46.0			51.71	0.375	4078.0 4242.0				
	D	18	64.78	0.375	4632.8 6054.9				22.2
0.0									

POLE ASSEMBLY

SECTION NAME	BASE ELEV ft	 NUMBER	BOLTS TYPE	AT BASE DIAM in	OF SECTION STRENGTH ksi	 THREADS IN SHEAR PLANE	CALC BASE ELEV ft
A	134.000	0	A325	0.00	92.0	0	134.000
B	94.000	0	A325	0.00	92.0	0	94.000
C	46.000	0	A325	0.00	92.0	0	46.000
D	0.000	0	A325	0.00	92.0	0	0.000

POLE SECTIONS

SECTION NAME	No.of SIDES	LENGTH ft	OUTSIDE BOT * in	DIAMETER TOP * in	THICK- NESS in	MAT- ERIAL ID	FLANGE.ID BOT TOP	FLANGE.WELD ..GROUP.ID.. BOT TOP
A	18	30.00	27.82	19.29	0.250	1	0 0	0 0
B	18	40.00	39.20	27.82	0.250	2	0 0	0 0
C	18	53.50	52.34	37.12	0.312	3	0 0	0 0
D	18	53.25	64.78	49.64	0.375	4	0 0	0 0

* - Diameter of circumscribed circle

MATERIAL TYPES

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TYPE OF TYPE NO OF ORIENT HEIGHT WIDTH .THICKNESS. IRREGULARITY

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SHAPE	NO	ELEM.		WEB	FLANGE	.PROJECTION. % OF ORIENT AREA	
			& deg	in	in	in	in
PL	1	1	0.0	27.82	0.25	0.250	0.250
PL	2	1	0.0	39.20	0.25	0.250	0.250
PL	3	1	0.0	52.34	0.31	0.312	0.312
PL	4	1	0.0	64.78	0.38	0.375	0.375

& - with respect to vertical

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
3	29000.0	490.0	80.0	65.0	0.00001170
4	29000.0	490.0	80.0	65.0	0.00001170

- * Only 3 condition(s) shown in full
- * RRUS/TMAS were assumed to be behind antennas
- * Some concentrated wind loads may have been derived from full-scale wind tunnel testing

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..LOAD..AT RADIUS ft AZI	LOAD AZI	FORCES..... HORIZ kip DOWN kip		MOMENTS..... VERTICAL ft-kip TORSNAL ft-kip	
C	159.000	0.00 0.0	0.0	0.0000	2.5796	0.0000	0.0000
C	159.000	0.00 0.0	0.0	6.5872	5.5260	0.0000	0.0000
C	149.000	0.00 0.0	0.0	0.0000	2.4174	0.0000	0.0000
C	149.000	0.00 0.0	0.0	6.4983	5.5260	0.0000	0.0000
C	129.000	0.00 0.0	0.0	0.0000	2.0929	0.0000	0.0000
C	129.000	0.00 0.0	0.0	7.4113	7.9891	0.0000	0.0000
C	119.000	0.00 0.0	0.0	0.0000	1.9307	0.0000	0.0000
C	119.000	0.00 0.0	0.0	6.2001	5.5260	0.0000	0.0000
C	109.000	0.00 0.0	0.0	0.0000	0.0772	0.0000	0.0000
D	164.000	0.00 180.0	0.0	0.0542	0.0650	0.0000	0.0000
D	122.500	0.00 180.0	0.0	0.0748	0.0943	0.0000	0.0000
D	122.500	0.00 180.0	0.0	0.0805	0.1036	0.0000	0.0000
D	111.000	0.00 180.0	0.0	0.0805	0.1036	0.0000	0.0000
D	111.000	0.00 180.0	0.0	0.0867	0.1140	0.0000	0.0000
D	99.500	0.00 180.0	0.0	0.0867	0.1140	0.0000	0.0000
D	99.500	0.00 180.0	0.0	0.0909	0.2718	0.0000	0.0000
D	94.000	0.00 180.0	0.0	0.0909	0.2718	0.0000	0.0000
D	94.000	0.00 180.0	0.0	0.0940	0.1609	0.0000	0.0000
D	80.417	0.00 180.0	0.0	0.0940	0.1609	0.0000	0.0000
D	80.417	0.00 180.0	0.0	0.0994	0.1762	0.0000	0.0000
D	66.833	0.00 180.0	0.0	0.0994	0.1762	0.0000	0.0000
D	66.833	0.00 180.0	0.0	0.1036	0.1915	0.0000	0.0000
D	53.250	0.00 180.0	0.0	0.1036	0.1915	0.0000	0.0000
D	53.250	0.00 180.0	0.0	0.1057	0.4441	0.0000	0.0000
D	46.000	0.00 180.0	0.0	0.1057	0.4441	0.0000	0.0000
D	46.000	0.00 180.0	0.0	0.1052	0.2536	0.0000	0.0000
D	34.500	0.00 180.0	0.0	0.1052	0.2536	0.0000	0.0000
D	34.500	0.00 180.0	0.0	0.1042	0.2691	0.0000	0.0000
D	23.000	0.00 180.0	0.0	0.1042	0.2691	0.0000	0.0000
D	23.000	0.00 180.0	0.0	0.0995	0.2847	0.0000	0.0000
D	11.500	0.00 180.0	0.0	0.0995	0.2847	0.0000	0.0000
D	11.500	0.00 180.0	0.0	0.1008	0.3002	0.0000	0.0000
D	0.000	0.00 180.0	0.0	0.1008	0.3002	0.0000	0.0000

ANTENNA LOADING

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.....ANTENNA.....			ATTACHMENT		ANTENNA FORCES.....			
TYPE	ELEV ft	AZI	RAD ft	AZI	AXIAL kip	SHEAR kip	GRAVITY kip	TORSION ft-kip
STD+R	109.0	0.0	2.1	0.0	1.09	0.00	0.24	0.00

LOADING CONDITION M

90 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	159.000	0.00	0.0	0.0	0.0000	1.9347	0.0000	0.0000
C	159.000	0.00	0.0	0.0	6.5872	4.1445	0.0000	0.0000
C	149.000	0.00	0.0	0.0	0.0000	1.8130	0.0000	0.0000
C	149.000	0.00	0.0	0.0	6.4983	4.1445	0.0000	0.0000
C	129.000	0.00	0.0	0.0	0.0000	1.5697	0.0000	0.0000
C	129.000	0.00	0.0	0.0	7.4113	5.9918	0.0000	0.0000
C	119.000	0.00	0.0	0.0	0.0000	1.4480	0.0000	0.0000
C	119.000	0.00	0.0	0.0	6.2001	4.1445	0.0000	0.0000
C	109.000	0.00	0.0	0.0	0.0000	0.0579	0.0000	0.0000
D	164.000	0.00	180.0	0.0	0.0544	0.0487	0.0000	0.0000
D	99.500	0.00	180.0	0.0	0.0882	0.0864	0.0000	0.0000
D	99.500	0.00	180.0	0.0	0.0909	0.2038	0.0000	0.0000
D	94.000	0.00	180.0	0.0	0.0909	0.2038	0.0000	0.0000
D	94.000	0.00	180.0	0.0	0.0940	0.1207	0.0000	0.0000
D	80.417	0.00	180.0	0.0	0.0940	0.1207	0.0000	0.0000
D	80.417	0.00	180.0	0.0	0.0994	0.1321	0.0000	0.0000
D	66.833	0.00	180.0	0.0	0.0994	0.1321	0.0000	0.0000
D	66.833	0.00	180.0	0.0	0.1036	0.1436	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.1036	0.1436	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.1057	0.3331	0.0000	0.0000
D	46.000	0.00	180.0	0.0	0.1057	0.3331	0.0000	0.0000
D	46.000	0.00	180.0	0.0	0.1052	0.1902	0.0000	0.0000
D	34.500	0.00	180.0	0.0	0.1052	0.1902	0.0000	0.0000
D	34.500	0.00	180.0	0.0	0.1042	0.2019	0.0000	0.0000
D	23.000	0.00	180.0	0.0	0.1042	0.2019	0.0000	0.0000
D	23.000	0.00	180.0	0.0	0.0995	0.2135	0.0000	0.0000
D	11.500	0.00	180.0	0.0	0.0995	0.2135	0.0000	0.0000
D	11.500	0.00	180.0	0.0	0.1008	0.2252	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.1008	0.2252	0.0000	0.0000

ANTENNA LOADING

.....ANTENNA.....			ATTACHMENT		ANTENNA FORCES.....			
TYPE	ELEV ft	AZI	RAD ft	AZI	AXIAL kip	SHEAR kip	GRAVITY kip	TORSION ft-kip
STD+R	109.0	0.0	2.1	0.0	1.09	0.00	0.18	0.00

LOADING CONDITION Y

40 mph wind with 0.75 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	159.000	0.00	0.0	0.0	0.0000	2.5796	0.0000	0.0000
C	159.000	0.00	0.0	0.0	1.4883	11.2083	0.0000	0.0000
C	149.000	0.00	0.0	0.0	0.0000	2.4174	0.0000	0.0000
C	149.000	0.00	0.0	0.0	1.4644	11.1718	0.0000	0.0000
C	129.000	0.00	0.0	0.0	0.0000	2.0929	0.0000	0.0000
C	129.000	0.00	0.0	0.0	1.7874	15.5772	0.0000	0.0000
C	119.000	0.00	0.0	0.0	0.0000	1.9307	0.0000	0.0000

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C	119.000	0.00	0.0	0.0	1.3850	11.0472	0.0000	0.0000
C	109.000	0.00	0.0	0.0	0.0000	0.0772	0.0000	0.0000
D	164.000	0.00	180.0	0.0	0.0143	0.1118	0.0000	0.0000
D	156.500	0.00	180.0	0.0	0.0143	0.1118	0.0000	0.0000
D	156.500	0.00	180.0	0.0	0.0154	0.1228	0.0000	0.0000
D	149.000	0.00	180.0	0.0	0.0154	0.1228	0.0000	0.0000
D	149.000	0.00	180.0	0.0	0.0165	0.1338	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0165	0.1338	0.0000	0.0000
D	141.500	0.00	180.0	0.0	0.0175	0.1447	0.0000	0.0000
D	134.000	0.00	180.0	0.0	0.0175	0.1447	0.0000	0.0000
D	134.000	0.00	180.0	0.0	0.0188	0.1588	0.0000	0.0000
D	122.500	0.00	180.0	0.0	0.0188	0.1588	0.0000	0.0000
D	122.500	0.00	180.0	0.0	0.0203	0.1753	0.0000	0.0000
D	111.000	0.00	180.0	0.0	0.0203	0.1753	0.0000	0.0000
D	111.000	0.00	180.0	0.0	0.0216	0.1916	0.0000	0.0000
D	99.500	0.00	180.0	0.0	0.0216	0.1916	0.0000	0.0000
D	99.500	0.00	180.0	0.0	0.0225	0.3537	0.0000	0.0000
D	94.000	0.00	180.0	0.0	0.0225	0.3537	0.0000	0.0000
D	94.000	0.00	180.0	0.0	0.0232	0.2463	0.0000	0.0000
D	80.417	0.00	180.0	0.0	0.0232	0.2463	0.0000	0.0000
D	80.417	0.00	180.0	0.0	0.0243	0.2679	0.0000	0.0000
D	66.833	0.00	180.0	0.0	0.0243	0.2679	0.0000	0.0000
D	66.833	0.00	180.0	0.0	0.0252	0.2888	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0252	0.2888	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0256	0.5452	0.0000	0.0000
D	46.000	0.00	180.0	0.0	0.0256	0.5452	0.0000	0.0000
D	46.000	0.00	180.0	0.0	0.0255	0.3567	0.0000	0.0000
D	11.500	0.00	180.0	0.0	0.0239	0.3909	0.0000	0.0000
D	11.500	0.00	180.0	0.0	0.0239	0.4010	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0239	0.4010	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	109.0	0.0	2.1	0.0	0.15	0.00	0.78	0.00

=====

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135' ext. 165' Monopole / Jenna Dr, WI

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

MAST	DEFLECTIONS (ft).....	ROTATIONS (deg).....				
ELEV	 HORIZONTAL	 TILT	DOWN			TWIST
ft	ALONG	ACROSS		ALONG	ACROSS	
164.0	12.03A	-0.03J	1.25L	8.12A	-0.02J	-0.01I
156.5	10.99A	-0.03J	1.10L	8.11A	-0.02J	-0.01I
149.0	9.96A	-0.03J	0.95L	8.01A	-0.02J	-0.01I
141.5	8.94A	-0.03J	0.81L	7.79A	-0.02J	-0.01I
134.0	7.96A	-0.02J	0.68L	7.48A	-0.02J	-0.01I
122.5	6.54A	-0.02J	0.50L	6.88A	-0.02J	-0.01I
111.0	5.25A	-0.02J	0.36L	6.13A	-0.02J	-0.01J
99.5	4.11A	-0.01J	0.24L	5.28A	-0.01J	-0.01J
94.0	3.63A	-0.01J	0.20L	4.93A	-0.01J	0.00J
80.4	2.57A	-0.01J	0.12L	4.05A	-0.01J	0.00J

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66.8	1.71A	-0.01J	0.06L	3.19A	-0.01J	0.00J
53.2	1.06A	0.00J	0.03L	2.37A	-0.01J	0.00J
46.0	0.78A	0.00J	0.02L	2.02A	-0.01J	0.00J
34.5	0.43A	0.00J	0.01L	1.47A	-0.01J	0.00J
23.0	0.19A	0.00J	0.00L	0.95A	0.00J	0.00J
11.5	0.05A	0.00J	0.00AE	0.46A	0.00J	0.00J
0.0	0.00A	0.00A	0.00A	0.00A	0.00A	0.00A

MAXIMUM ANTENNA AND REFLECTOR ROTATIONS

ELEV ft	ANT AZI deg	ANT TYPE	 ROLL	BEAM YAW	DEFLECTIONS (deg) PITCH	 TOTAL
109.0	0.0	STD+R	5.921 D	0.272 K	5.981 A	5.981 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	WIND.DIR ACROSS kip	MOMENT.w.r.t.WIND.DIR ALONG ft-kip	WIND.DIR ACROSS ft-kip	TORSION ft-kip
164.0	-0.01 K	0.01 B	0.00 K	-0.03 E	-0.02 K	0.00 K
156.5	14.63 Y	7.01 R	0.00 K	-20.76 B	0.03 K	-0.01 O
149.0	14.63 AC	7.03 G	-0.01 W	-20.75 B	0.04 E	-0.01 E
141.5	15.55 AC	7.48 V	-0.01 W	-83.18 G	0.11 W	-0.02 O
134.0	29.14 AC	13.98 A	0.01 N	-83.15 G	0.11 W	-0.02 O
122.5	30.14 AC	14.45 A	0.01 N	-205.24 A	0.14 F	-0.05 D
111.0	30.15 AC	14.46 U	0.02 N	-205.26 A	0.15 W	0.05 J
99.5	31.23 AC	14.96 U	0.02 N	-331.17 A	0.24 K	-0.08 D
94.0	31.23 AC	14.96 K	0.02 W	-331.19 A	0.26 K	-0.08 D
80.4	50.73 AC	23.21 M	0.02 W	-587.16 A	0.40 T	0.16 K
66.8	50.73 AC	23.22 W	0.03 U	-587.16 A	0.42 T	0.16 K
53.2	65.72 AC	30.32 W	0.03 U	-949.76 A	-0.68 U	0.25 K
	65.72 AC	30.32 U	-0.03 X	-949.75 A	-0.69 U	0.25 K
	68.78 AC	32.39 M	-0.17 V	-1354.10 A	-1.69 AG	-2.16 I
	68.78 AC	32.39 A	-0.17 V	-1353.99 A	-1.71 AG	-2.16 I
	70.72 AC	32.89 A	-0.17 V	-1551.76 A	2.48 V	-2.18 I
	70.72 AC	32.85 A	-0.17 V	-1551.76 A	2.48 V	-2.18 I
	74.07 AC	34.12 A	-0.17 V	-2048.48 A	4.87 J	-2.17 J
	74.07 AC	34.16 A	-0.18 W	-2048.49 A	4.87 J	-2.17 J
	77.70 AC	35.50 A	-0.18 W	-2557.70 A	7.27 J	-2.22 J
	77.70 AC	35.50 A	-0.18 W	-2557.71 A	7.27 J	-2.22 J
	81.63 AC	36.91 A	-0.18 W	-3079.17 A	9.65 J	-2.25 J
	81.63 AC	36.92 A	-0.19 W	-3079.17 A	9.65 J	-2.25 J
	85.58 AC	37.68 A	-0.19 W	-3362.98 A	10.91 J	-2.26 J

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46.0	85.58 AC	37.67 A	-0.17 W	-3362.99 A	10.91 J	-2.26 J
34.5	89.75 AC	38.88 A	-0.17 W	-3821.19 A	12.91 J	-2.27 J
	89.75 AC	38.88 A	-0.18 W	-3821.20 A	12.91 J	-2.27 J
23.0	94.04 AC	40.07 A	-0.18 W	-4288.50 A	14.89 J	-2.28 J
	94.04 AC	40.07 A	-0.17 W	-4288.51 A	14.89 J	-2.28 J
11.5	98.47 AC	41.22 A	-0.17 W	-4764.17 A	16.85 J	-2.28 J
	98.47 AC	41.21 A	-0.17 W	-4764.17 A	16.85 J	-2.28 J
	103.09 AC	42.37 A	-0.17 W	-5247.61 A	18.80 J	-2.28 J
base reaction	103.09 AC	-42.37 A	0.17 W	5247.61 A	-18.80 J	2.28 J

COMPLIANCE WITH 4.8.2 & 4.5.4
=====

ELEV ft	AXIAL	BENDING	SHEAR + TORSIONAL	TOTAL	SATISFIED	D/t(w/t)	MAX ALLOWED
164.00	0.00K	0.00E	0.00B	0.00E	YES	11.64A	45.2
	0.01Y	0.04B	0.01R	0.05B	YES	13.12A	45.2
156.50	0.01AC	0.04B	0.01G	0.05B	YES	13.12A	45.2
	0.01AC	0.13G	0.01V	0.14G	YES	14.60A	45.2
149.00	0.02AC	0.13G	0.02A	0.14F	YES	14.60A	45.2
	0.02AC	0.27A	0.02A	0.28A	YES	16.08A	45.2
141.50	0.02AC	0.27A	0.02U	0.28A	YES	16.08A	45.2
	0.02AC	0.38A	0.02U	0.39A	YES	17.56A	45.2
134.00	0.02AC	0.38A	0.02K	0.39A	YES	17.56A	45.2
	0.03AC	0.56A	0.03M	0.57A	YES	19.83A	45.2
122.50	0.03AC	0.56A	0.03W	0.57A	YES	19.83A	45.2
	0.04AC	0.76A	0.03W	0.78A	YES	22.11A	45.2
111.00	0.04AC	0.76A	0.03U	0.78A	YES	22.11A	45.2
	0.04AC	0.93A	0.03M	0.96A	YES	24.38A	45.2
99.50	0.03AC	0.69A	0.03A	0.71A	YES	19.15A	45.2
	0.03AC	0.74A	0.02A	0.76A	YES	20.02A	45.2
94.00	0.03AC	0.76A	0.02A	0.77A	YES	19.74A	45.2
	0.03AC	0.85A	0.02A	0.87A	YES	21.88A	45.2
80.42	0.03AC	0.85A	0.02A	0.87A	YES	21.88A	45.2
	0.03AC	0.92A	0.02A	0.94A	YES	24.03A	45.2
66.83	0.03AC	0.92A	0.02A	0.94A	YES	24.03A	45.2
	0.03AC	0.98A	0.02A	1.00A	YES	26.17A	45.2
53.25	0.02AC	0.76A	0.02A	0.77A	YES	21.52A	45.2
	0.02AC	0.78A	0.02A	0.79A	YES	22.47A	45.2
46.00	0.02AC	0.79A	0.02A	0.81A	YES	22.18A	45.2
	0.02AC	0.82A	0.02A	0.83A	YES	23.69A	45.2
34.50	0.02AC	0.82A	0.02A	0.83A	YES	23.69A	45.2

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23.00	0.02AC	0.83A	0.02A	0.85A	YES	25.21A	45.2
.....	0.02AC	0.83A	0.02A	0.85A	YES	25.21A	45.2
11.50	0.02AC	0.85A	0.02A	0.87A	YES	26.72A	45.2
.....	0.02AC	0.85A	0.02A	0.87A	YES	26.72A	45.2
0.00	0.02AC	0.87A	0.02A	0.88A	YES	28.23A	45.2
.....							

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

DOWN	SHEAR.w.r.t.WIND.DIR	MOMENT.w.r.t.WIND.DIR	TORSION
kip	ALONG kip	ACROSS ft-kip	ft-kip
103.09	42.37	-0.17	-2.28
AC	A	W	J

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

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135' ext. 165' Monopole / Jenna Dr, WI

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

- * Only 1 condition(s) shown in full
- * RRUS/TMAS were assumed to be behind antennas
- * Some concentrated wind loads may have been derived from full-scale wind tunnel testing

LOADING CONDITION A =====

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

LOADS ON POLE

LOAD TYPE	ELEV ft	APPLY..RADIUS ft	LOAD..AT AZI	LOAD AZI	FORCES.....		MOMENTS.....	
					HORIZ kip	DOWN kip	VERTICAL ft-kip	TORSNAL ft-kip
C	159.000	0.00	0.0	0.0	0.0000	2.1497	0.0000	0.0000
C	159.000	0.00	0.0	0.0	1.6388	4.6050	0.0000	0.0000
C	149.000	0.00	0.0	0.0	0.0000	2.0145	0.0000	0.0000
C	149.000	0.00	0.0	0.0	1.6167	4.6050	0.0000	0.0000
C	129.000	0.00	0.0	0.0	0.0000	1.7441	0.0000	0.0000
C	129.000	0.00	0.0	0.0	1.8438	6.6576	0.0000	0.0000
C	119.000	0.00	0.0	0.0	0.0000	1.6089	0.0000	0.0000
C	119.000	0.00	0.0	0.0	1.5429	4.6050	0.0000	0.0000
C	109.000	0.00	0.0	0.0	0.0000	0.0643	0.0000	0.0000
D	164.000	0.00	180.0	0.0	0.0135	0.0541	0.0000	0.0000
D	99.500	0.00	180.0	0.0	0.0219	0.0960	0.0000	0.0000
D	99.500	0.00	180.0	0.0	0.0226	0.2265	0.0000	0.0000
D	94.000	0.00	180.0	0.0	0.0226	0.2265	0.0000	0.0000
D	94.000	0.00	180.0	0.0	0.0234	0.1341	0.0000	0.0000
D	80.417	0.00	180.0	0.0	0.0234	0.1341	0.0000	0.0000
D	80.417	0.00	180.0	0.0	0.0247	0.1468	0.0000	0.0000
D	66.833	0.00	180.0	0.0	0.0247	0.1468	0.0000	0.0000
D	66.833	0.00	180.0	0.0	0.0257	0.1596	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0257	0.1596	0.0000	0.0000
D	53.250	0.00	180.0	0.0	0.0263	0.3701	0.0000	0.0000

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D	46.000	0.00	180.0	0.0	0.0263	0.3701	0.0000	0.0000
D	46.000	0.00	180.0	0.0	0.0261	0.2113	0.0000	0.0000
D	34.500	0.00	180.0	0.0	0.0261	0.2113	0.0000	0.0000
D	34.500	0.00	180.0	0.0	0.0259	0.2243	0.0000	0.0000
D	23.000	0.00	180.0	0.0	0.0259	0.2243	0.0000	0.0000
D	23.000	0.00	180.0	0.0	0.0247	0.2372	0.0000	0.0000
D	11.500	0.00	180.0	0.0	0.0247	0.2372	0.0000	0.0000
D	11.500	0.00	180.0	0.0	0.0251	0.2502	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0251	0.2502	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	109.0	0.0	2.1	0.0	0.27	0.00	0.20	0.00

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

MAST ELEV ft	DEFLECTIONS (ft).....			ROTATIONS (deg).....		
	HORIZONTAL ALONG	ACROSS	DOWN	TILT ALONG	ACROSS	TWIST
164.0	3.01A	0.01C	0.08A	2.01A	0.00C	0.00I
156.5	2.74A	0.01C	0.07A	2.01A	0.00C	0.00I
149.0	2.48A	0.01C	0.06A	1.98A	0.00C	0.00I
141.5	2.23A	0.01C	0.05A	1.93A	0.00C	0.00I
134.0	1.98B	0.01C	0.05A	1.85A	0.00C	0.00I
122.5	1.62B	0.00C	0.03A	1.70A	0.00C	0.00J
111.0	1.30B	0.00C	0.02A	1.51A	0.00C	0.00J
99.5	1.02B	0.00C	0.02A	1.30B	0.00C	0.00J
94.0	0.90B	0.00C	0.01A	1.22B	0.00C	0.00J
80.4	0.64B	0.00C	0.01B	1.00B	0.00C	0.00J
66.8	0.42B	0.00C	0.01B	0.79B	0.00C	0.00J
53.2	0.26B	0.00C	0.00B	0.59B	0.00C	0.00J
46.0	0.19B	0.00C	0.00B	0.50B	0.00C	0.00J
34.5	0.11B	0.00C	0.00B	0.36B	0.00C	0.00J
23.0	0.05B	0.00C	0.00B	0.23B	0.00C	0.00I
11.5	0.01B	0.00C	0.00B	0.11B	0.00C	0.00I
0.0	0.00A	0.00A	0.00A	0.00A	0.00A	0.00A

MAXIMUM ANTENNA AND REFLECTOR ROTATIONS

ELEV ft	ANT AZI deg	ANT TYPE	 BEAM DEFLECTIONS (deg)			
			ROLL	YAW	PITCH	TOTAL
109.0	0.0	STD+R	-1.466 J	0.017 C	1.477 A	1.477 A

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

MAST ELEV ft	TOTAL AXIAL kip	SHEAR.w.r.t.WIND.DIR		MOMENT.w.r.t.WIND.DIR		TORSION ft-kip
		ALONG kip	ACROSS kip	ALONG ft-kip	ACROSS ft-kip	

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164.0	0.00 I	0.00 A	0.00 I	0.01 A	0.00 I	0.00 I
156.5	7.18 J	1.75 A	0.00 I	-5.13 A	0.00 H	0.00 I
	7.18 G	1.75 H	0.00 C	-5.13 D	0.01 I	0.00 I
149.0	7.64 G	1.86 H	0.00 C	-20.57 H	0.02 C	0.00 C
	14.26 G	3.48 H	0.00 E	-20.57 H	0.02 C	0.00 H
141.5	14.76 G	3.60 H	0.00 E	-50.77 H	-0.05 E	0.00 I
	14.76 H	3.60 H	-0.01 B	-50.78 H	-0.05 E	0.00 I
134.0	15.29 H	3.72 H	-0.01 B	-81.89 H	-0.08 E	0.00 I
	15.29 H	3.73 J	-0.01 B	-81.89 H	-0.08 E	0.00 I
122.5	24.58 H	5.78 J	-0.01 B	-145.10 H	0.17 B	-0.01 I
	24.58 H	5.78 J	-0.01 B	-145.10 H	0.17 B	-0.01 I
111.0	31.77 H	7.55 J	-0.01 B	-234.53 H	0.29 B	-0.01 D
	31.77 H	7.55 H	-0.01 B	-234.53 H	0.29 B	-0.01 D
99.5	33.10 H	8.05 A	-0.04 J	-333.91 H	-0.59 H	-0.55 J
	33.10 H	8.07 B	-0.04 J	-333.88 H	-0.57 H	-0.55 J
94.0	34.34 H	8.19 B	-0.04 J	-382.48 A	-0.67 H	-0.56 J
	34.34 H	8.18 A	0.04 C	-382.48 A	-0.68 H	-0.56 J
80.4	36.16 H	8.49 A	0.04 C	-504.93 A	0.88 J	-0.56 J
	36.16 H	8.50 B	0.05 C	-504.92 A	0.88 J	-0.56 J
66.8	38.16 H	8.83 B	0.05 C	-630.38 A	-1.53 C	-0.57 J
	38.16 H	8.84 B	0.05 C	-630.38 A	-1.53 C	-0.57 J
53.2	40.32 H	9.18 B	0.05 C	-759.09 B	-2.19 C	-0.57 J
	40.32 H	9.18 B	0.05 C	-759.07 B	-2.20 C	-0.57 J
46.0	43.01 H	9.37 B	0.05 C	-829.19 B	-2.57 C	-0.57 J
	43.01 H	9.37 B	0.05 C	-829.19 B	-2.57 C	-0.57 J
34.5	45.44 H	9.67 B	0.05 C	-942.46 B	-3.20 C	-0.57 J
	45.44 H	9.67 B	0.05 C	-942.46 B	-3.20 C	-0.57 J
23.0	48.02 H	9.97 B	0.05 C	-1058.16 B	-3.83 C	-0.57 I
	48.02 H	9.97 B	0.05 C	-1058.16 B	-3.83 C	-0.57 I
11.5	50.74 H	10.25 B	0.05 C	-1176.16 B	-4.42 C	-0.57 I
	50.74 H	10.25 B	0.05 C	-1176.16 B	-4.41 C	-0.57 I
	53.62 H	10.54 B	0.05 C	-1296.30 B	-5.01 C	-0.57 I
base reaction	53.62 H	-10.54 B	-0.05 C	1296.30 B	5.01 C	0.57 I

COMPLIANCE WITH 4.8.2 & 4.5.4

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ELEV ft	AXIAL	BENDING	SHEAR + TORSIONAL	TOTAL SATISFIED	D/t(w/t)	MAX ALLOWED
164.00	0.00I	0.00A	0.00A	0.00A	YES	11.64A
	0.01J	0.01A	0.00A	0.02A	YES	13.12A
156.50	0.01G	0.01D	0.00H	0.02D	YES	13.12A

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	0.01G	0.03H	0.00H	0.04H	YES	14.60A	45.2
149.00	0.01G	0.03H	0.01H	0.04H	YES	14.60A	45.2
141.50	0.01G	0.07H	0.00H	0.08H	YES	16.08A	45.2
	0.01H	0.07H	0.00H	0.08H	YES	16.08A	45.2
134.00	0.01H	0.09H	0.00H	0.10H	YES	17.56A	45.2
	0.01H	0.09H	0.00J	0.10H	YES	17.56A	45.2
122.50	0.01H	0.14H	0.01J	0.15H	YES	19.83A	45.2
	0.01H	0.14H	0.01J	0.15H	YES	19.83A	45.2
111.00	0.02H	0.19H	0.01J	0.21H	YES	22.11A	45.2
	0.02H	0.19H	0.01H	0.21H	YES	22.11A	45.2
99.50	0.02H	0.23H	0.01A	0.25H	YES	24.38A	45.2
	0.01H	0.17H	0.01B	0.18H	YES	19.15A	45.2
94.00	0.01H	0.18A	0.01B	0.20A	YES	20.02A	45.2
	0.01H	0.19A	0.01A	0.20A	YES	19.74A	45.2
80.42	0.01H	0.21A	0.01A	0.22A	YES	21.88A	45.2
	0.01H	0.21A	0.01B	0.22A	YES	21.88A	45.2
66.83	0.01H	0.23A	0.01B	0.24A	YES	24.03A	45.2
	0.01H	0.23A	0.01B	0.24A	YES	24.03A	45.2
53.25	0.01H	0.24B	0.01B	0.25B	YES	26.17A	45.2
	0.01H	0.19B	0.00B	0.20B	YES	21.52A	45.2
46.00	0.01H	0.19B	0.00B	0.20B	YES	22.47A	45.2
	0.01H	0.20B	0.00B	0.21B	YES	22.18A	45.2
34.50	0.01H	0.20B	0.00B	0.21B	YES	23.69A	45.2
	0.01H	0.20B	0.00B	0.21B	YES	23.69A	45.2
23.00	0.01H	0.21B	0.00B	0.22B	YES	25.21A	45.2
	0.01H	0.21B	0.00B	0.22B	YES	25.21A	45.2
11.50	0.01H	0.21B	0.00B	0.22B	YES	26.72A	45.2
	0.01H	0.21B	0.00B	0.22B	YES	26.72A	45.2
0.00	0.01H	0.21B	0.00B	0.23B	YES	28.23A	45.2

DOWN	SHEAR.w.r.t.WIND.DIR	MOMENT.w.r.t.WIND.DIR			TORSION
kip	ALONG kip	ACROSS kip	ALONG ft-kip	ACROSS ft-kip	ft-kip
53.62	10.54	0.05	-1296.30	-5.01	-0.57
H	B	C	B	C	I

Round Flange Plate and Bolts per ANSI/TIA 222-G

Elevation = 134 feet

Pole Data

Diameter:	27.4	in
Thickness:	0.25	in
Yield (Fy):	65	ksi
# of Sides:	18	"0" IF Round
Strength (Fu):	80	ksi

Reactions

Moment, Mu:	331.19	ft-kips
Axial, Pu:	18.33	kips
Shear, Vu:	14.96	kips

Bolt Data

Quantity:	10	
Diameter:	1	in
Bolt Material:	A325	
Strength (Fu):	120	ksi
Yield (Fy):	92	ksi
BC Diam. (in):	31	BC Override:

Flange Bolt Results

Allowable Φ *Rnt:	54.54 kips
Adjusted Φ *Rnt (due to shear):	54.50 kips
Maximum Bolt Tension:	49.45 kips
Bolt Interaction Ratio:	90.7% Pass

Plate Data

Diameter (in):	33.5	Dia. Override:	
Thickness:	1.5	in	
Center Hole Diam.:	18	in	
Yield (Fy):	50	ksi	
Single-Rod B-eff:	8.20	in	
Drain Hole:	1	in. diameter	
Drain Location:	12.75	in. center of pole to center of drain hole	

Flange Plate Results

Compression Side Plate (Mu/Z):	12.9 ksi
Allowable Φ *Fy:	45.0 ksi
Compr. Plate Interaction Ratio:	28.7% Pass

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

Pole Data

Diameter: 63.800 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: 5247.61 ft-kips
Axial, Pu: 64.31 kips
Shear, Vu: 42.37 kips

Anchor Rod Data

Quantity: 16
Diameter: 2.25 in
Rod Material: A615
Strength (Fu): 100 ksi
Yield (Fy): 75 ksi
BC Diam. (in): 70.75 BC Override:

Anchor Rod Results

Maximum Rod (Pu+ Vu/η): 231.8 Kips
Allowable $\Phi \cdot R_{nt}$: 260.0 Kips (per 4.9.9)
Anchor Rod Interaction Ratio: **89.2% Pass**

Plate Data

Diameter (in): 76.5 Dia. Override:
Thickness: 2 in
Yield (Fy): 50 ksi
Eff Width/Rod: 12.66 in
Drain Hole: 2.625 in. diameter
Drain Location: 29.75 in. center of pole to center of drain hole
Center Hole: 51.5 in. diameter

Base Plate Results

Base Plate (Mu/Z): 40.6 ksi
Allowable $\Phi \cdot F_y$: 45.0 ksi (per AISC)
Base Plate Interaction Ratio: **90.3% Pass**

MAT FOUNDATION DESIGN BY SABRE TOWERS & POLES

165' Monopole CENTRAL STATES TOWER Jenna Dr, WI (162371) 5-1-17 TTW

Overall Loads:

Factored Moment (ft-kips)	5247.61
Factored Axial (kips)	64.31
Factored Shear (kips)	42.37
Bearing Design Strength (ksf)	3.75
Water Table Below Grade (ft)	999
Width of Mat (ft)	25
Thickness of Mat (ft)	1.75
Depth to Bottom of Slab (ft)	9
Quantity of Bolts in Bolt Circle	16
Bolt Circle Diameter (in)	70.75
Top of Concrete to Top of Bottom Threads (in)	60
Diameter of Pier (ft)	8
Ht. of Pier Above Ground (ft)	1
Ht. of Pier Below Ground (ft)	7.25
Quantity of Bars in Mat	39
Bar Diameter in Mat (in)	1
Area of Bars in Mat (in ²)	30.63
Spacing of Bars in Mat (in)	7.71
Quantity of Bars Pier	48
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)	37.70
Spacing of Bars in Pier (in)	5.74
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) 3.26

Allowable Bearing Pressure (ksf) 2.50

Safety Factor 2.00

Ultimate Bearing Pressure (ksf) 5.00

Bearing Φs 0.75

Minimum Pier Diameter (ft) 7.23

Equivalent Square b (ft) 7.09

Square Pier? (Y/N) N

Recommended Spacing (in) 5 to 12

Minimum Pier A_s (in²) 36.19

Recommended Spacing (in) 5 to 12

Volume of Concrete (yd³) 55.87

Two-Way Shear Action:

Average d (in) 17

φv_c (ksi) 0.223

φv_c = φ(2 + 4/β_c)f'_c^{1/2} 0.342

φv_c = φ(α_sd/b_o + 2)f'_c^{1/2} 0.223

φv_c = φ4f'_c^{1/2} 0.228

Shear perimeter, b_o (in) 355.00

β_c 1

v_u (ksi) 0.167

One-Way Shear:

φV_c (kips) 581.6

V_u (kips) 370.1

Stability:

Overturning Design Strength (ft-k) 8539.2

Total Applied M (ft-k) 5671.3

Pier Design:

ϕV_n (kips)	844.5	V_u (kips)	42.4
$\phi V_c = \phi 2(1 + N_u / (2000 A_g)) f'_c{}^{1/2} b_w d$	844.5		
V_s (kips)	0.0	*** $V_s \text{ max} = 4 f'_c{}^{1/2} b_w d$ (kips)	1978.3
Maximum Spacing (in)	7.62	(Only if Shear Ties are Required)	
Actual Hook Development (in)	16.00	Req'd Hook Development l_{dh} (in)	12.02
		*** Ref. To Spacing Requirements ACI 11.5.4.3	

Flexure in Slab:

ϕM_n (ft-kips)	2232.9	M_u (ft-kips)	2221.4
a (in)	1.60		
Steel Ratio	0.00601		
β_1	0.825		
Maximum Steel Ratio (ρ_t)	0.0197		
Minimum Steel Ratio	0.0018		
Rebar Development in Pad (in)	104.46	Required Development in Pad (in)	26.65

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