June 2, 2021

Solomon Hu
Harmoni Towers
10802 Executive Center Dr., Suite 100
Little Rock, AR 72211
(303) 242-4650

Tower Engineering Professionals
326 Tryon Road
Raleigh, NC 27603
(919) 661-6351
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Subject: **Structural Analysis Report**

Carrier Designation:	***Dish Wireless* Co-Locate**	
	Carrier Site Number:	N/A
	Carrier Site Name:	MWMKE00182A
Client Designation:	**Site Number:**	WIMIL2026
	Site Name:	Waterford North
Engineering Firm Designation:	**TEP Project Number:**	267747.554971
Site Data:	**6839 Caldwell Rd., Waterford, Racine County, WI 53185** **Latitude *42° 48' 44.64"*, Longitude *-88° 16' 33.73"*** **200 Foot - Self-Support Tower**	

Dear Solomon Hu,

Tower Engineering Professionals is pleased to submit this **"Structural Analysis Report"** to determine the structural integrity of the above-mentioned tower.

The purpose of the analysis is to determine acceptability of the tower stress level. Based on our analysis we have determined the stress level for the tower and foundation structure, under the following load case, to be:

LC1: Existing + Proposed + Reserved Loading **Sufficient Capacity**
Note: See Table 1 for the existing, proposed, and reserved loading

Structure Capacity	Foundation Capacity
82.8%	69.1%

The analysis has been performed in accordance with the ANSI/TIA-222-G-2-2009 Structural Standard for Antenna Supporting Structures and Antennas – Addendum 2 and the 2015 International Building Code.

All modifications and equipment proposed in this report shall be installed in accordance with the appurtenances listed in Table 1 for the determined available structural capacity to be effective.

We at *Tower Engineering Professionals* appreciate the opportunity of providing our continuing professional services to you and *Harmoni Towers.* If you have any questions or need further assistance on this or any other projects please give us a call.

Structural analysis prepared by: Austin E. Wilson, E.I.T. / RHN

Respectfully submitted by:

Jordan W. Shelley, P.E.

06/02/2021

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1) INTRODUCTION

The tower is a 200 foot self-support tower designed by Sabre in May of 2019. The tower was originally designed for a basic wind speed of 107 mph with no ice, 40 mph with 1.50 inch radial ice thickness and 60 mph under service loads using Risk Category II, Exposure Category C, and Topographic Factor Procedure Method 1 per ANSI/TIA-222-H. All information provided to TEP was assumed to be accurate and complete.

2) ANALYSIS CRITERIA

TIA-222 Revision:	ANSI/TIA-222-G-2-2009
Type of Analysis:	Rigorous
Structure Class:	II
Wind Speed:	115 mph (Ultimate)
Exposure Category:	C
Topographic Category:	1 (Kzt = 1.0)
Ice Thickness:	0.75 in
Wind Speed with Ice:	40 mph
Seismic Design Category:	B
Seismic Ss:	0.096
Seismic S1:	0.049
Service Wind Speed:	60 mph

Table 1 - Existing, Proposed, and Reserved Antenna and Cable Information

Existing/ Proposed/ Reserved	Mount Level (ft)	Ant CL (ft)	Qty	Antenna Model	Mount Type	Qty Coax	Coax Size	Coax Location	Owner/ Tenant
Existing	190	190	Existing			12	1 5/8	CA Face	Future Carrier
Proposed	***170***	***170***	***3***	***JMA MX08FR0665-21***	***(3) Mounts[2]***	***1***	***1.75" Hybrid***	***AB Face***	***Dish Wireless[1]***
			3	***Fujitsu TA08025-B604***					
			3	***Fujitsu TA08025-B605***					
			1	***Raycap RDIDC-9181-PF-48***					

Notes:
1) The model was analyzed for 15,000 in^2 of loading, the proposed loading configuration does not exceed those limits.
2) The proposed mounts are assumed to be less than a total EPA of 40 ft^2.

3) ANALYSIS PROCEDURE

Table 2 - Documents Provided

Document	Remarks	Source
Tower and Foundation Design	Sabre Industries, dated September 24, 2019 Job No. 443774	Harmoni Towers
Geotechnical Report	G2, dated August 30, 2019 Project No. 192349	Harmoni Towers
Correspondence	Correspondence in reference to the existing, proposed, and reserved loading.	Harmoni Towers

3.1) Analysis Method

tnxTower (version 8.0.9.0), a commercially available analysis software package, was used to create a three-dimensional model of the tower and calculate member stresses for various loading cases. Selected output from the analysis is included in Appendix A.

3.2) Analysis Assumptions

1) The tower and foundation were built and maintained in accordance with the manufacturer's specification.
2) The configuration of existing antennas, transmission cables, mounts and other appurtenances are as specified in the tower mapping report by TEP.
3) Unless specified by the client or tower mapping, the location of the existing and proposed coax is assumed by TEP and listed in Table 1.
4) All tower components are in sufficient condition to carry their full design capacity.
5) Serviceability with respect to antenna twist, tilt, roll, or lateral translation, is not checked and is left to the carrier or tower owner to ensure conformance.
6) All antenna mounts and mounting hardware are structurally sufficient to carry the full design capacity requirements of appurtenance wind area and weight as provided by the original manufacturer specifications. It is the carrier's responsibility to ensure compliance to the structural limitations of the existing and/or proposed antenna mounts. TEP did not perform a site visit to verify the size, condition or capacity of the antenna mounts and did not analyze antennas supporting mounts as part of this structural analysis report.

This analysis may be affected if any assumptions are not valid or have been made in error. Tower Engineering Professionals should be notified to determine the effect on the structural integrity of the tower.

4) ANALYSIS RESULTS

Table 3 - Section Capacity (Summary)

Section No.	Elevation (ft)	Component Type	Size	Critical Element	P (lb)	ϕP_{allow} (lb)	% Capacity	Pass / Fail
T1	200 - 180	Leg	Sabre 2.375"x0.154"	2	-18763.699	31617.199	59.3	Pass
T2	180 - 160	Leg	Sabre 3.5" x 0.216"	32	-54363.602	82509.500	65.9	Pass
T3	160 - 140	Leg	Sabre 4" x 0.318"	62	-85389.500	141805.000	60.2	Pass
T4	140 - 120	Leg	Sabre 5.563" x 0.258"	89	-110630.000	169352.000	65.3	Pass
T5	120 - 100	Leg	Sabre 5.563 x .375	110	-135436.000	239358.000	56.6	Pass
T6	100 - 80	Leg	Sabre 5.563 x .375	131	-159078.000	239358.000	66.5	Pass
T7	80 - 60	Leg	Sabre 8.625" x 0.322"	152	-180110.000	334421.000	53.9	Pass
T8	60 - 40	Leg	Sabre 8.625" x 0.322"	167	-203033.000	334421.000	60.7	Pass
T9	40 - 20	Leg	Sabre 8.625" x 0.322"	182	-225623.000	334421.000	67.5	Pass
T10	20 - 0	Leg	Sabre 8.625" x 0.5"	197	-248322.000	505555.000	49.1	Pass
T1	200 - 180	Diagonal	L2x2x1/8	11	-4277.350	9528.170	44.9 59.1 (b)	Pass
T2	180 - 160	Diagonal	L2x2x1/8	42	-4051.820	7450.490	54.4 57.9 (b)	Pass
T3	160 - 140	Diagonal	L2x2x1/8	69	-3692.040	5159.030	71.6	Pass
T4	140 - 120	Diagonal	L2 1/2x2 1/2x3/16	93	-4198.720	9482.650	44.3	Pass
T5	120 - 100	Diagonal	L2 1/2x2 1/2x3/16	114	-4436.810	7245.580	61.2	Pass
T6	100 - 80	Diagonal	L2 1/2x2 1/2x3/16	135	-4696.770	5672.750	82.8	Pass
T7	80 - 60	Diagonal	L3x3x3/16	156	-5582.850	6958.570	80.2	Pass
T8	60 - 40	Diagonal	L3 1/2x3 1/2x1/4	171	-6113.600	12239.100	50.0	Pass
T9	40 - 20	Diagonal	L3 1/2x3 1/2x1/4	186	-6723.890	10351.800	65.0	Pass
T10	20 - 0	Diagonal	L 4 x 4 x 1/4	201	-7545.070	13324.600	56.6	Pass
T1	200 - 180	Top Girt	L2x2x1/8	6	-738.405	6013.860	12.3	Pass
T2	180 - 160	Top Girt	L2x2x1/8	34	-942.780	6274.360	15.0	Pass
							Summary	
						Leg (T9)	67.5	Pass
						Diagonal (T6)	82.8	Pass
						Top Girt (T2)	15.0	Pass
						Bolt Checks	59.1	Pass
						RATING =	**82.8**	**Pass**

Table 4 - Tower Component Stresses vs. Capacity

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1	Anchor Rods	-	36.2	Pass
1	Base Foundation Soil Interaction	-	69.1	Pass
1	Base Foundation Structural	-	13.6	Pass

Structure Rating (max from all components) =	**82.8%**

Notes:
1) See additional documentation in "Appendix B - Additional Calculations" for calculations supporting the % capacity listed.

Table 5 - Dish Twist/Sway Results for 60 mph Service Wind Speed

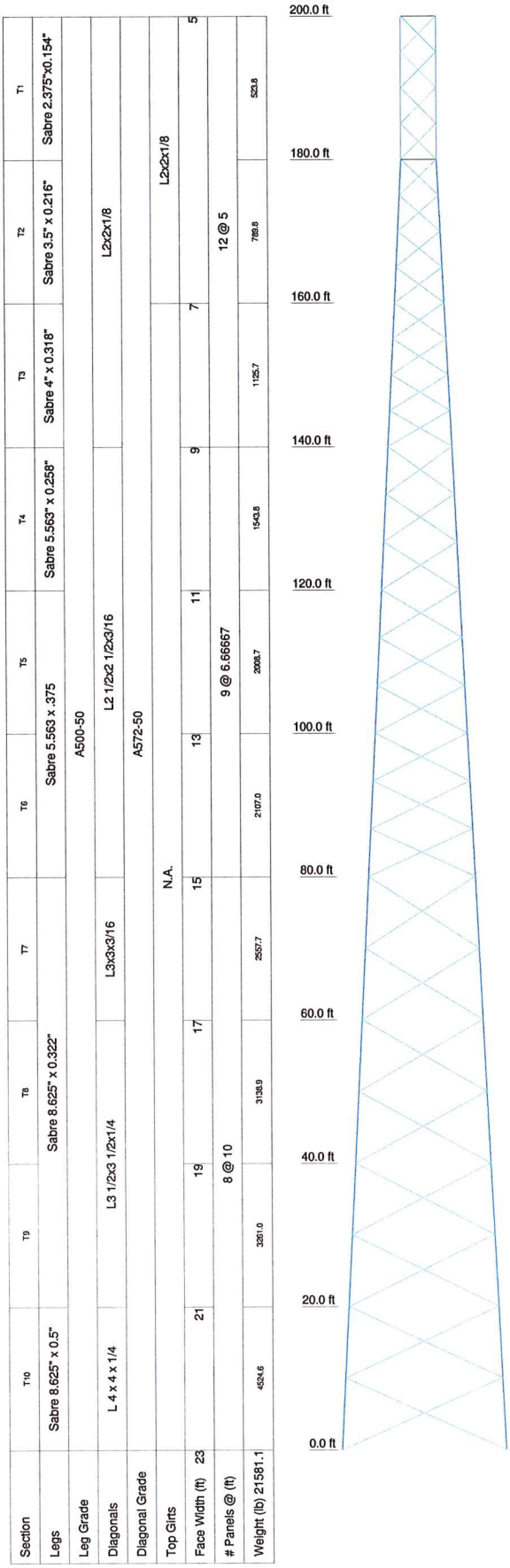
Elevation (ft)	Dish Model	Beam Deflection		
		Deflection (in)	Tilt (deg)	Twist (deg)
-	-	-	-	-

4.1) Recommendations

1) If the load differs from that described in Table 1 of this report or the provisions of this analysis are found to be invalid, another structural analysis should be performed.
2) The tower and its foundation have sufficient capacity to carry the proposed load configuration. No modifications are required at this time.

APPENDIX A

TNX TOWER OUTPUT



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
4-ft x 3/4-in Lightning Rod	200	Existing Loading (40,000 sq in)	190
12" x 24" Beacon	200	DISH Loading (15,000 sq. in.)	170

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A500-50	50 ksi	62 ksi	A572-50	50 ksi	65 ksi

TOWER DESIGN NOTES

1. Tower is located in Racine County, Wisconsin.
2. Tower designed for Exposure C to the TIA-222-G Standard.
3. Tower designed for a 89 mph basic wind in accordance with the TIA-222-G Standard.
4. Tower is also designed for a 40 mph basic wind with 0.75 in ice. Ice is considered to increase in thickness with height.
5. Deflections are based upon a 60 mph wind.
6. Tower Structure Class II.
7. Topographic Category 1 with Crest Height of 0.000 ft
8. TOWER RATING: 82.8%

ALL REACTIONS ARE FACTORED

MAX. CORNER REACTIONS AT BASE:
DOWN: 253961 lb
SHEAR: 26073 lb

UPLIFT: -219786 lb
SHEAR: 22573 lb

AXIAL 94930 lb
SHEAR 8372 lb *MOMENT 1007385 lb-ft*
TORQUE 4929 lb-ft
40 mph WIND - 0.750 in ICE

AXIAL 39905 lb
SHEAR 41395 lb *MOMENT 4796756 lb-ft*
TORQUE 18908 lb-ft
REACTIONS - 89 mph WIND

Tower Engineering Professionals

Tower Engineering Professionals, Inc.
326 Tryon Rd.
Raleigh, NC 27603
Phone: (919) 661-6351
FAX: (919) 661-6350

Job: *WIMIL2026 - Waterford North*			
Project: *TEP No. 267747.554971*			
Client: Uniti Towers LLC	Drawn by: aewilson		App'd:
Code: TIA-222-G	Date: 06/02/21		Scale: NTS
Path:			Dwg No. E-1

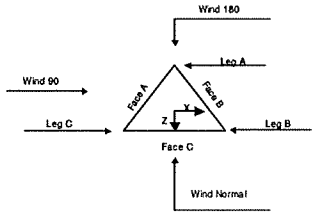
Tower Input Data

The main tower is a 3x free standing tower with an overall height of 200.000 ft above the ground line.
The base of the tower is set at an elevation of 0.000 ft above the ground line.
The face width of the tower is 5.000 ft at the top and 23.000 ft at the base.
This tower is designed using the TIA-222-G standard.
The following design criteria apply:

Tower is located in Racine County, Wisconsin.
Basic wind speed of 89 mph.
Structure Class II.
Exposure Category C.
Topographic Category 1.
Crest Height 0.000 ft.
Nominal ice thickness of 0.750 in.
Ice thickness is considered to increase with height.
Ice density of 56 pcf.
A wind speed of 40 mph is used in combination with ice.
Deflections calculated using a wind speed of 60 mph.
Pressures are calculated at each section.
Stress ratio used in tower member design is 1.
Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

Options

Consider Moments - Legs	Distribute Leg Loads As Uniform	Use ASCE 10 X-Brace Ly Rules
Consider Moments - Horizontals	Assume Legs Pinned	√ Calculate Redundant Bracing Forces
Consider Moments - Diagonals	√ Assume Rigid Index Plate	Ignore Redundant Members in FEA
Use Moment Magnification	√ Use Clear Spans For Wind Area	√ SR Leg Bolts Resist Compression
√ Use Code Stress Ratios	√ Use Clear Spans For KL/r	All Leg Panels Have Same Allowable
√ Use Code Safety Factors - Guys	Retension Guys To Initial Tension	Offset Girt At Foundation
Escalate Ice	√ Bypass Mast Stability Checks	√ Consider Feed Line Torque
Always Use Max Kz	√ Use Azimuth Dish Coefficients	√ Include Angle Block Shear Check
Use Special Wind Profile	√ Project Wind Area of Appurt.	Use TIA-222-G Bracing Resist. Exemption
√ Include Bolts In Member Capacity	Autocale Torque Arm Areas	Use TIA-222-G Tension Splice Exemption
Leg Bolts Are At Top Of Section	Add IBC .6D+W Combination	Poles
√ Secondary Horizontal Braces Leg	Sort Capacity Reports By Component	Include Shear-Torsion Interaction
Use Diamond Inner Bracing (4 Sided)	Triangulate Diamond Inner Bracing	Always Use Sub-Critical Flow
SR Members Have Cut Ends	Treat Feed Line Bundles As Cylinder	Use Top Mounted Sockets
SR Members Are Concentric	Ignore KL/ry For 60 Deg. Angle Legs	Pole Without Linear Attachments
		Pole With Shroud Or No Appurtenances
		Outside and Inside Corner Radii Are Known



Triangular Tower

Tower Section Geometry

Tower Section	Tower Elevation ft	Assembly Database	Description	Section Width ft	Number of Sections	Section Length ft
T1	200.000-180.000			5.000	1	20.000
T2	180.000-160.000			5.000	1	20.000
T3	160.000-140.000			7.000	1	20.000
T4	140.000-120.000			9.000	1	20.000
T5	120.000-100.000			11.000	1	20.000
T6	100.000-80.000			13.000	1	20.000
T7	80.000-60.000			15.000	1	20.000
T8	60.000-40.000			17.000	1	20.000
T9	40.000-20.000			19.000	1	20.000
T10	20.000-0.000			21.000	1	20.000

Tower Section Geometry *(cont'd)*

Tower Section	Tower Elevation ft	Diagonal Spacing ft	Bracing Type	Has K Brace End Panels	Has Horizontals	Top Girt Offset in	Bottom Girt Offset in
T1	200.000-180.000	5.000	X Brace	No	No	0.000	0.000
T2	180.000-160.000	5.000	X Brace	No	No	0.000	0.000
T3	160.000-140.000	5.000	X Brace	No	No	0.000	0.000
T4	140.000-120.000	6.667	X Brace	No	No	0.000	0.000
T5	120.000-100.000	6.667	X Brace	No	No	0.000	0.000

Tower Section	Tower Elevation ft	Diagonal Spacing ft	Bracing Type	Has K Brace End Panels	Has Horizontals	Top Girt Offset in	Bottom Girt Offset in
T6	100.000-80.000	6.667	X Brace	No	No	0.000	0.000
T7	80.000-60.000	10.000	X Brace	No	No	0.000	0.000
T8	60.000-40.000	10.000	X Brace	No	No	0.000	0.000
T9	40.000-20.000	10.000	X Brace	No	No	0.000	0.000
T10	20.000-0.000	10.000	X Brace	No	No	0.000	0.000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg Type	Leg Size	Leg Grade	Diagonal Type	Diagonal Size	Diagonal Grade
T1 200.000-180.000	Pipe	Sabre 2.375"x0.154"	A500-50 (50 ksi)	Equal Angle	L2x2x1/8	A572-50 (50 ksi)
T2 180.000-160.000	Pipe	Sabre 3.5" x 0.216"	A500-50 (50 ksi)	Equal Angle	L2x2x1/8	A572-50 (50 ksi)
T3 160.000-140.000	Pipe	Sabre 4" x 0.318"	A500-50 (50 ksi)	Equal Angle	L2x2x1/8	A572-50 (50 ksi)
T4 140.000-120.000	Pipe	Sabre 5.563" x 0.258"	A500-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A572-50 (50 ksi)
T5 120.000-100.000	Pipe	Sabre 5.563 x .375	A500-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A572-50 (50 ksi)
T6 100.000-80.000	Pipe	Sabre 5.563 x .375	A500-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A572-50 (50 ksi)
T7 80.000-60.000	Pipe	Sabre 8.625" x 0.322"	A500-50 (50 ksi)	Equal Angle	L3x3x3/16	A572-50 (50 ksi)
T8 60.000-40.000	Pipe	Sabre 8.625" x 0.322"	A500-50 (50 ksi)	Equal Angle	L3 1/2x3 1/2x1/4	A572-50 (50 ksi)
T9 40.000-20.000	Pipe	Sabre 8.625" x 0.322"	A500-50 (50 ksi)	Equal Angle	L3 1/2x3 1/2x1/4	A572-50 (50 ksi)
T10 20.000-0.000	Pipe	Sabre 8.625" x 0.5"	A500-50 (50 ksi)	Equal Angle	L 4 x 4 x 1/4	A572-50 (50 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Top Girt Type	Top Girt Size	Top Girt Grade	Bottom Girt Type	Bottom Girt Size	Bottom Girt Grade
T1 200.000-180.000	Equal Angle	L2x2x1/8	A572-50 (50 ksi)	Flat Bar		A36 (36 ksi)
T2 180.000-160.000	Equal Angle	L2x2x1/8	A572-50 (50 ksi)	Flat Bar		A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Gusset Area (per face) ft²	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in	Double Angle Stitch Bolt Spacing Redundants in
T1 200.000-180.000	0.000	0.375	A572-50 (50 ksi)	1	1	1	36.000	36.000	36.000
T2 180.000-160.000	0.000	0.375	A572-50 (50 ksi)	1	1	1	36.000	36.000	36.000
T3 160.000-140.000	0.000	0.375	A572-50 (50 ksi)	1	1	1	36.000	36.000	36.000
T4 140.000-120.000	0.000	0.375	A572-50 (50 ksi)	1	1	1	36.000	36.000	36.000
T5 120.000-100.000	0.000	0.375	A572-50 (50 ksi)	1	1	1	36.000	36.000	36.000
T6 100.000-80.000	0.000	0.375	A572-50 (50 ksi)	1	1	1	36.000	36.000	36.000
T7 80.000-60.000	0.000	0.375	A572-50 (50 ksi)	1	1	1	36.000	36.000	36.000
T8 60.000-40.000	0.000	0.375	A572-50 (50 ksi)	1	1	1	36.000	36.000	36.000
T9 40.000-20.000	0.000	0.375	A572-50 (50 ksi)	1	1	1	36.000	36.000	36.000
T10 20.000-0.000	0.000	0.375	A572-50 (50 ksi)	1	1	1	36.000	36.000	36.000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Calc K Single Angles	Calc K Solid Rounds	K Factors[1] Legs	X Brace Diags X	X Brace Diags Y	Single Diags X	Single Diags Y	Girts X	Horiz X	Horiz Y	Sec. Horiz. X	Sec. Horiz. Y	Inner Brace X
T1 200.000-180.000	Yes	Yes	1	1	1	1	1	1	1	1	1	1	1
T2 180.000-160.000	Yes	Yes	1	1	1	1	1	1	1	1	1	1	1
T3 160.000-140.000	Yes	Yes	1	1	1	1	1	1	1	1	1	1	1
T4 140.000-120.000	Yes	Yes	1	1	1	1	1	1	1	1	1	1	1
T5 120.000-100.000	Yes	Yes	1	1	1	1	1	1	1	1	1	1	1
T6 100.000-80.000	Yes	Yes	1	1	1	1	1	1	1	1	1	1	1
T7 80.000-60.000	Yes	Yes	1	1	1	1	1	1	1	1	1	1	1

Tower Elevation ft	Calc K Single Angles	Calc K Solid Rounds	K Factors[1] Legs	X Brace Diags X Y	K Brace Diags X Y	Single Diags X Y	Girts X Y	Horiz. X Y	Sec. Horiz. X Y	Inner Brace X Y
T8 60.000-40.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T9 40.000-20.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T10 20.000-0.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1

[1]Note: K factors are applied to member segment lengths. K-braces without inner supporting members will have the K factor in the out-of-plane direction applied to the overall length.

Tower Section Geometry (cont'd)

Tower Elevation ft	Leg Net Width Deduct in	U	Diagonal Net Width Deduct in	U	Top Girt Net Width Deduct in	U	Bottom Girt Net Width Deduct in	U	Mid Girt Net Width Deduct in	U	Long Horizontal Net Width Deduct in	U	Short Horizontal Net Width Deduct in	U
T1 200.000-180.000	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T2 180.000-160.000	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T3 160.000-140.000	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T4 140.000-120.000	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T5 120.000-100.000	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T6 100.000-80.000	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T7 80.000-60.000	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T8 60.000-40.000	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T9 40.000-20.000	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T10 20.000-0.000	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75

Tower Elevation ft	Redundant Horizontal Net Width Deduct in	U	Redundant Diagonal Net Width Deduct in	U	Redundant Sub-Diagonal Net Width Deduct in	U	Redundant Sub-Horizontal Net Width Deduct in	U	Redundant Vertical Net Width Deduct in	U	Redundant Hip Net Width Deduct in	U	Redundant Hip Diagonal Net Width Deduct in	U
T1 200.000-180.000	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T2 180.000-160.000	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T3 160.000-140.000	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T4 140.000-120.000	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T5 120.000-100.000	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T6 100.000-80.000	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T7 80.000-60.000	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T8 60.000-40.000	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T9 40.000-20.000	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T10 20.000-0.000	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75

Tower Section Geometry (cont'd)

Tower Elevation ft	Leg Connection Type	Leg Bolt Size in	No.	Diagonal Bolt Size in	No.	Top Girt Bolt Size in	No.	Bottom Girt Bolt Size in	No.	Mid Girt Bolt Size in	No.	Long Horizontal Bolt Size in	No.	Short Horizontal Bolt Size in	No.
T1 200.000-180.000	Flange	0.750 A325N	6	0.625 A325X	1	0.625 A325X	1	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0
T2 180.000-160.000	Flange	1.000 A325N	6	0.625 A325X	1	0.625 A325X	1	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0
T3 160.000-140.000	Flange	1.000 A325N	6	0.625 A325X	1	0.625 A325X	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0
T4 140.000-120.000	Flange	1.000 A325N	6	0.625 A325X	1	0.625 A325X	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0
T5 120.000-100.000	Flange	1.000 A325N	6	0.625 A325X	1	0.625 A325X	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0
T6 100.000-80.000	Flange	1.250 A325N	6	0.750 A325X	1	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0

Tower Elevation ft	Leg Connection Type	Leg Bolt Size in	Leg No.	Diagonal Bolt Size in	Diagonal No.	Top Girt Bolt Size in	Top Girt No.	Bottom Girt Bolt Size in	Bottom Girt No.	Mid Girt Bolt Size in	Mid Girt No.	Long Horizontal Bolt Size in	Long Horizontal No.	Short Horizontal Bolt Size in	Short Horizontal No.
T7	Flange	1.250	6	0.750	1	0.625	0	0.625	0	0.625	0	0.625	0	0.750	0
80.000-60.000		A325N		A325X		A325N		A325N		A325N		A325N		A325N	
T8	Flange	1.250	6	0.750	1	0.625	0	0.625	0	0.625	0	0.625	0	0.750	0
60.000-40.000		A325N		A325X		A325N		A325N		A325N		A325N		A325N	
T9	Flange	1.250	6	0.750	1	0.625	0	0.625	0	0.625	0	0.625	0	0.750	0
40.000-20.000		A325N		A325X		A325N		A325N		A325N		A325N		A325N	
T10	Flange	1.500	0	0.750	1	0.625	0	0.625	0	0.625	0	0.625	0	0.750	0
20.000-0.000		F1554-105		A325X		A325N		A325N		A325N		A325N		A325N	

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#	# Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight plf
Safety Line 3/8	A	No	No	Ar (CaAa)	200.000 - 0.000	0.000	0.5	1	1	0.375	0.375		0.220
Step Pegs (5/8" SR) 7-in. w/30" step	A	No	No	Ar (CaAa)	200.000 - 0.000	0.000	0.5	1	1	0.292	0.350		0.487
Step Pegs (5/8" SR) 7-in. w/30" step	B	No	No	Ar (CaAa)	100.000 - 0.000	0.000	0.5	1	1	0.292	0.350		0.487
Step Pegs (5/8" SR) 7-in. w/30" step	C	No	No	Ar (CaAa)	100.000 - 0.000	0.000	0.5	1	1	0.292	0.350		0.487
18" Waveguide 50% Shielded	A	No	No	Af (CaAa)	190.000 - 0.000	0.000	0	1	1	0.500	4.600		8.299
LDF7-50A (1-5/8 FOAM)	A	No	No	Ar (CaAa)	190.000 - 0.000	0.000	0	12	6	0.500	1.980		0.820
12" Waveguide 0% Shielded	B	No	No	Af (CaAa)	170.000 - 0.000	0.000	0	1	1	0.500	4.800		7.660
CU12PSM6P4XXX_4AWG	B	No	No	Ar (CaAa)	170.000 - 0.000	0.000	0	1	1	0.500	1.750		2.716

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight lb
T1	200.000-180.000	A	0.000	0.000	32.877	0.000	195.530
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.000
T2	180.000-160.000	A	0.000	0.000	64.303	0.000	376.920
		B	0.000	0.000	9.750	0.000	103.760
		C	0.000	0.000	0.000	0.000	0.000

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight lb
T3	160.000-140.000	A	0.000	0.000	64.303	0.000	376.920
		B	0.000	0.000	19.500	0.000	207.520
		C	0.000	0.000	0.000	0.000	0.000
T4	140.000-120.000	A	0.000	0.000	64.303	0.000	376.920
		B	0.000	0.000	19.500	0.000	207.520
		C	0.000	0.000	0.000	0.000	0.000
T5	120.000-100.000	A	0.000	0.000	64.303	0.000	376.920
		B	0.000	0.000	19.500	0.000	207.520
		C	0.000	0.000	0.000	0.000	0.000
T6	100.000-80.000	A	0.000	0.000	64.303	0.000	376.920
		B	0.000	0.000	20.200	0.000	217.260
		C	0.000	0.000	0.700	0.000	9.740
T7	80.000-60.000	A	0.000	0.000	64.303	0.000	376.920
		B	0.000	0.000	20.200	0.000	217.260
		C	0.000	0.000	0.700	0.000	9.740
T8	60.000-40.000	A	0.000	0.000	64.303	0.000	376.920
		B	0.000	0.000	20.200	0.000	217.260
		C	0.000	0.000	0.700	0.000	9.740
T9	40.000-20.000	A	0.000	0.000	64.303	0.000	376.920
		B	0.000	0.000	20.200	0.000	217.260
		C	0.000	0.000	0.700	0.000	9.740
T10	20.000-0.000	A	0.000	0.000	64.303	0.000	376.920
		B	0.000	0.000	20.200	0.000	217.260
		C	0.000	0.000	0.700	0.000	9.740

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight lb
T1	200.000-180.000	A	1.787	0.000	0.000	51.573	0.000	966.292
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.000
T2	180.000-160.000	A	1.767	0.000	0.000	87.033	0.000	1714.440
		B		0.000	0.000	16.819	0.000	357.622
		C		0.000	0.000	0.000	0.000	0.000
T3	160.000-140.000	A	1.745	0.000	0.000	86.624	0.000	1696.410
		B		0.000	0.000	33.462	0.000	706.861
		C		0.000	0.000	0.000	0.000	0.000
T4	140.000-120.000	A	1.720	0.000	0.000	86.163	0.000	1676.191
		B		0.000	0.000	33.263	0.000	697.468
		C		0.000	0.000	0.000	0.000	0.000
T5	120.000-100.000	A	1.692	0.000	0.000	85.633	0.000	1653.106
		B		0.000	0.000	33.035	0.000	686.753
		C		0.000	0.000	0.000	0.000	0.000
T6	100.000-80.000	A	1.658	0.000	0.000	85.008	0.000	1626.096
		B		0.000	0.000	40.100	0.000	765.346
		C		0.000	0.000	7.333	0.000	91.116
T7	80.000-60.000	A	1.617	0.000	0.000	84.243	0.000	1593.340
		B		0.000	0.000	39.606	0.000	746.531
		C		0.000	0.000	7.169	0.000	87.471
T8	60.000-40.000	A	1.564	0.000	0.000	83.249	0.000	1551.275
		B		0.000	0.000	38.964	0.000	722.467
		C		0.000	0.000	6.955	0.000	82.854
T9	40.000-20.000	A	1.486	0.000	0.000	81.803	0.000	1491.110
		B		0.000	0.000	38.029	0.000	688.247
		C		0.000	0.000	6.643	0.000	76.386
T10	20.000-0.000	A	1.331	0.000	0.000	78.935	0.000	1375.363

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight lb
		B		0.000	0.000	36.174	0.000	623.130
		C		0.000	0.000	6.025	0.000	64.424

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
T1	200.000-180.000	-3.280	-3.207	-2.627	-5.239
T2	180.000-160.000	-3.936	-5.296	-3.105	-7.121
T3	160.000-140.000	-3.015	-6.731	-1.938	-8.964
T4	140.000-120.000	-3.264	-7.415	-2.174	-10.211
T5	120.000-100.000	-3.579	-8.250	-2.403	-11.372
T6	100.000-80.000	-3.815	-8.526	-2.481	-9.510
T7	80.000-60.000	-4.164	-9.283	-2.714	-10.324
T8	60.000-40.000	-4.137	-9.386	-2.824	-10.729
T9	40.000-20.000	-4.340	-9.920	-3.010	-11.308
T10	20.000-0.000	-4.178	-9.687	-3.100	-11.340

Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T1	3	Safety Line 3/8	180.00 - 200.00	0.6000	0.5697
T1	4	Step Pegs (5/8" SR) 7-in. w/30° step	180.00 - 200.00	0.6000	0.5697
T1	8	18" Waveguide 50% Shielded	180.00 - 190.00	0.6000	0.5697
T1	9	LDF7-50A (1-5/8 FOAM)	180.00 - 190.00	0.6000	0.5697
T2	3	Safety Line 3/8	160.00 - 180.00	0.6000	0.5969
T2	4	Step Pegs (5/8" SR) 7-in. w/30° step	160.00 - 180.00	0.6000	0.5969
T2	8	18" Waveguide 50% Shielded	160.00 - 180.00	0.6000	0.5969
T2	9	LDF7-50A (1-5/8 FOAM)	160.00 - 180.00	0.6000	0.5969
T2	11	12" Waveguide 0% Shielded	160.00 - 170.00	0.6000	0.5969
T2	12	CU12PSM6P4XXX_4AWG	160.00 - 170.00	0.6000	0.5969
T3	3	Safety Line 3/8	140.00 - 160.00	0.6000	0.6000
T3	4	Step Pegs (5/8" SR) 7-in. w/30° step	140.00 - 160.00	0.6000	0.6000
T3	8	18" Waveguide 50% Shielded	140.00 - 160.00	0.6000	0.6000
T3	9	LDF7-50A (1-5/8 FOAM)	140.00 - 160.00	0.6000	0.6000

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T3	11	12" Waveguide 0% Shielded	140.00 - 160.00	0.6000	0.6000
T3	12	CU12PSM6P4XXX_4AWG	140.00 - 160.00	0.6000	0.6000
T4	3	Safety Line 3/8	120.00 - 140.00	0.6000	0.6000
T4	4	Step Pegs (5/8" SR) 7-in. w/30° step	120.00 - 140.00	0.6000	0.6000
T4	8	18" Waveguide 50% Shielded	120.00 - 140.00	0.6000	0.6000
T4	9	LDF7-50A (1-5/8 FOAM)	120.00 - 140.00	0.6000	0.6000
T4	11	12" Waveguide 0% Shielded	120.00 - 140.00	0.6000	0.6000
T4	12	CU12PSM6P4XXX_4AWG	120.00 - 140.00	0.6000	0.6000
T5	3	Safety Line 3/8	100.00 - 120.00	0.6000	0.6000
T5	4	Step Pegs (5/8" SR) 7-in. w/30° step	100.00 - 120.00	0.6000	0.6000
T5	8	18" Waveguide 50% Shielded	100.00 - 120.00	0.6000	0.6000
T5	9	LDF7-50A (1-5/8 FOAM)	100.00 - 120.00	0.6000	0.6000
T5	11	12" Waveguide 0% Shielded	100.00 - 120.00	0.6000	0.6000
T5	12	CU12PSM6P4XXX_4AWG	100.00 - 120.00	0.6000	0.6000
T6	3	Safety Line 3/8	80.00 - 100.00	0.6000	0.6000
T6	4	Step Pegs (5/8" SR) 7-in. w/30° step	80.00 - 100.00	0.6000	0.6000
T6	5	Step Pegs (5/8" SR) 7-in. w/30° step	80.00 - 100.00	0.6000	0.6000
T6	6	Step Pegs (5/8" SR) 7-in. w/30° step	80.00 - 100.00	0.6000	0.6000
T6	8	18" Waveguide 50% Shielded	80.00 - 100.00	0.6000	0.6000
T6	9	LDF7-50A (1-5/8 FOAM)	80.00 - 100.00	0.6000	0.6000
T6	11	12" Waveguide 0% Shielded	80.00 - 100.00	0.6000	0.6000
T6	12	CU12PSM6P4XXX_4AWG	80.00 - 100.00	0.6000	0.6000
T7	3	Safety Line 3/8	60.00 - 80.00	0.6000	0.6000
T7	4	Step Pegs (5/8" SR) 7-in. w/30° step	60.00 - 80.00	0.6000	0.6000
T7	5	Step Pegs (5/8" SR) 7-in. w/30° step	60.00 - 80.00	0.6000	0.6000
T7	6	Step Pegs (5/8" SR) 7-in. w/30° step	60.00 - 80.00	0.6000	0.6000
T7	8	18" Waveguide 50% Shielded	60.00 - 80.00	0.6000	0.6000
T7	9	LDF7-50A (1-5/8 FOAM)	60.00 - 80.00	0.6000	0.6000
T7	11	12" Waveguide 0% Shielded	60.00 - 80.00	0.6000	0.6000
T7	12	CU12PSM6P4XXX_4AWG	60.00 - 80.00	0.6000	0.6000
T8	3	Safety Line 3/8	40.00 - 60.00	0.6000	0.6000
T8	4	Step Pegs (5/8" SR) 7-in. w/30° step	40.00 - 60.00	0.6000	0.6000
T8	5	Step Pegs (5/8" SR) 7-in. w/30° step	40.00 - 60.00	0.6000	0.6000
T8	6	Step Pegs (5/8" SR) 7-in. w/30° step	40.00 - 60.00	0.6000	0.6000
T8	8	18" Waveguide 50% Shielded	40.00 - 60.00	0.6000	0.6000
T8	9	LDF7-50A (1-5/8 FOAM)	40.00 - 60.00	0.6000	0.6000
T8	11	12" Waveguide 0% Shielded	40.00 - 60.00	0.6000	0.6000
T8	12	CU12PSM6P4XXX_4AWG	40.00 - 60.00	0.6000	0.6000
T9	3	Safety Line 3/8	20.00 - 40.00	0.6000	0.6000

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T9	4	Step Pegs (5/8" SR) 7-in. w/30° step	20.00 - 40.00	0.6000	0.6000
T9	5	Step Pegs (5/8" SR) 7-in. w/30° step	20.00 - 40.00	0.6000	0.6000
T9	6	Step Pegs (5/8" SR) 7-in. w/30° step	20.00 - 40.00	0.6000	0.6000
T9	8	18" Waveguide 50% Shielded	20.00 - 40.00	0.6000	0.6000
T9	9	LDF7-50A (1-5/8 FOAM)	20.00 - 40.00	0.6000	0.6000
T9	11	12" Waveguide 0% Shielded	20.00 - 40.00	0.6000	0.6000
T9	12	CU12PSM6P4XXX_4AWG	20.00 - 40.00	0.6000	0.6000
T10	3	Safety Line 3/8	0.00 - 20.00	0.6000	0.6000
T10	4	Step Pegs (5/8" SR) 7-in. w/30° step	0.00 - 20.00	0.6000	0.6000
T10	5	Step Pegs (5/8" SR) 7-in. w/30° step	0.00 - 20.00	0.6000	0.6000
T10	6	Step Pegs (5/8" SR) 7-in. w/30° step	0.00 - 20.00	0.6000	0.6000
T10	8	18" Waveguide 50% Shielded	0.00 - 20.00	0.6000	0.6000
T10	9	LDF7-50A (1-5/8 FOAM)	0.00 - 20.00	0.6000	0.6000
T10	11	12" Waveguide 0% Shielded	0.00 - 20.00	0.6000	0.6000
T10	12	CU12PSM6P4XXX_4AWG	0.00 - 20.00	0.6000	0.6000

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft	Vert ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight lb
4-ft x 3/4-in Lightning Rod	A	From Leg	0.000		0.000	200.000	No Ice	0.300	0.300	6.000
			0.000				1/2" Ice	0.715	0.715	9.132
			2.000				1" Ice	1.001	1.001	14.937
12" x 24" Beacon	B	From Leg	0.000		0.000	200.000	No Ice	1.000	1.000	30.000
			0.000				1/2" Ice	1.580	1.580	49.573
			1.000				1" Ice	1.769	1.769	71.742
**										
Existing Loading (40,000 sq in)	C	None			0.000	190.000	No Ice	277.000	277.000	4500.000
							1/2" Ice	319.440	319.440	5170.000
							1" Ice	361.880	361.880	5840.000
**										
DISH Loading (15,000 sq. in.)	C	None			0.000	170.000	No Ice	104.170	104.140	1688.000
							1/2" Ice	119.790	119.790	1941.000
							1" Ice	135.410	135.440	2194.000
**										

Load Combinations

Comb. No.	Description
1	Dead Only
2	1.2 Dead+1.6 Wind 0 deg - No Ice
3	0.9 Dead+1.6 Wind 0 deg - No Ice
4	1.2 Dead+1.6 Wind 30 deg - No Ice
5	0.9 Dead+1.6 Wind 30 deg - No Ice
6	1.2 Dead+1.6 Wind 60 deg - No Ice
7	0.9 Dead+1.6 Wind 60 deg - No Ice
8	1.2 Dead+1.6 Wind 90 deg - No Ice
9	0.9 Dead+1.6 Wind 90 deg - No Ice
10	1.2 Dead+1.6 Wind 120 deg - No Ice
11	0.9 Dead+1.6 Wind 120 deg - No Ice
12	1.2 Dead+1.6 Wind 150 deg - No Ice
13	0.9 Dead+1.6 Wind 150 deg - No Ice
14	1.2 Dead+1.6 Wind 180 deg - No Ice
15	0.9 Dead+1.6 Wind 180 deg - No Ice
16	1.2 Dead+1.6 Wind 210 deg - No Ice
17	0.9 Dead+1.6 Wind 210 deg - No Ice
18	1.2 Dead+1.6 Wind 240 deg - No Ice
19	0.9 Dead+1.6 Wind 240 deg - No Ice
20	1.2 Dead+1.6 Wind 270 deg - No Ice
21	0.9 Dead+1.6 Wind 270 deg - No Ice
22	1.2 Dead+1.6 Wind 300 deg - No Ice
23	0.9 Dead+1.6 Wind 300 deg - No Ice
24	1.2 Dead+1.6 Wind 330 deg - No Ice
25	0.9 Dead+1.6 Wind 330 deg - No Ice
26	1.2 Dead+1.0 Ice
27	1.2 Dead+1.0 Wind 0 deg+1.0 Ice
28	1.2 Dead+1.0 Wind 30 deg+1.0 Ice
29	1.2 Dead+1.0 Wind 60 deg+1.0 Ice
30	1.2 Dead+1.0 Wind 90 deg+1.0 Ice
31	1.2 Dead+1.0 Wind 120 deg+1.0 Ice
32	1.2 Dead+1.0 Wind 150 deg+1.0 Ice
33	1.2 Dead+1.0 Wind 180 deg+1.0 Ice
34	1.2 Dead+1.0 Wind 210 deg+1.0 Ice
35	1.2 Dead+1.0 Wind 240 deg+1.0 Ice
36	1.2 Dead+1.0 Wind 270 deg+1.0 Ice
37	1.2 Dead+1.0 Wind 300 deg+1.0 Ice
38	1.2 Dead+1.0 Wind 330 deg+1.0 Ice
39	Dead+Wind 0 deg - Service
40	Dead+Wind 30 deg - Service
41	Dead+Wind 60 deg - Service
42	Dead+Wind 90 deg - Service
43	Dead+Wind 120 deg - Service
44	Dead+Wind 150 deg - Service
45	Dead+Wind 180 deg - Service
46	Dead+Wind 210 deg - Service
47	Dead+Wind 240 deg - Service
48	Dead+Wind 270 deg - Service
49	Dead+Wind 300 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	200 - 180	5.956	43	0.309	0.023
T2	180 - 160	4.660	43	0.288	0.022
T3	160 - 140	3.514	43	0.236	0.019

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T4	140 - 120	2.570	43	0.192	0.014
T5	120 - 100	1.828	43	0.150	0.012
T6	100 - 80	1.238	43	0.118	0.009
T7	80 - 60	0.774	43	0.087	0.006
T8	60 - 40	0.431	43	0.063	0.004
T9	40 - 20	0.194	43	0.039	0.003
T10	20 - 0	0.055	43	0.016	0.001

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
200.000	4-ft x 3/4-in Lightning Rod	43	5.956	0.309	0.023	109813
190.000	Existing Loading (40.000 sq in)	43	5.297	0.301	0.022	54906
170.000	DISH Loading (15.000 sq. in.)	43	4.063	0.264	0.020	25239

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	200 - 180	20.965	11	1.090	0.079
T2	180 - 160	16.389	11	1.016	0.076
T3	160 - 140	12.345	11	0.834	0.065
T4	140 - 120	9.016	11	0.678	0.051
T5	120 - 100	6.404	11	0.526	0.042
T6	100 - 80	4.330	11	0.416	0.032
T7	80 - 60	2.702	11	0.304	0.022
T8	60 - 40	1.501	11	0.222	0.014
T9	40 - 20	0.675	11	0.138	0.009
T10	20 - 0	0.191	11	0.055	0.004

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
200.000	4-ft x 3/4-in Lightning Rod	11	20.965	1.090	0.079	31094
190.000	Existing Loading (40.000 sq in)	11	18.638	1.065	0.078	15547
170.000	DISH Loading (15.000 sq. in.)	11	14.283	0.931	0.071	7144

Bolt Design Data

Section No.	Elevation ft	Component Type	Bolt Grade	Bolt Size in	Number Of Bolts	Maximum Load per Bolt lb	Allowable Load per Bolt lb	Ratio Load / Allowable	Allowable Ratio	Criteria
T1	200	Leg	A325N	0.750	6	2495.390	29820.600	0.084	1	Bolt Tension
		Diagonal	A325X	0.625	1	4234.590	7160.160	0.591	1	Member Block Shear
		Top Girt	A325X	0.625	1	731.122	7160.160	0.102	1	Member Block Shear
T2	180	Leg	A325N	1.000	6	7977.690	53014.398	0.150	1	Bolt Tension
		Diagonal	A325X	0.625	1	4148.120	7160.160	0.579	1	Member Block Shear
		Top Girt	A325X	0.625	1	942.780	7160.160	0.132	1	Member Block Shear
T3	160	Leg	A325N	1.000	6	12823.200	53014.398	0.242	1	Bolt Tension
		Diagonal	A325X	0.625	1	3883.440	7160.160	0.542	1	Member Block Shear
T4	140	Leg	A325N	1.000	6	16650.400	53014.398	0.314	1	Bolt Tension
		Diagonal	A325X	0.625	1	4157.080	13025.400	0.319	1	Member Block Shear
T5	120	Leg	A325N	1.000	6	20302.000	53014.398	0.383	1	Bolt Tension
		Diagonal	A325X	0.625	1	4421.010	13025.400	0.339	1	Member Block Shear
T6	100	Leg	A325N	1.250	6	23720.100	82835.000	0.286	1	Bolt Tension
		Diagonal	A325X	0.750	1	4693.960	12111.300	0.388	1	Member Block Shear
T7	80	Leg	A325N	1.250	6	26696.301	82835.000	0.322	1	Bolt Tension
		Diagonal	A325X	0.750	1	5535.010	13939.500	0.397	1	Member Block Shear
T8	60	Leg	A325N	1.250	6	29864.500	82835.000	0.361	1	Bolt Tension
		Diagonal	A325X	0.750	1	6005.780	21206.301	0.283	1	Gusset Bearing
T9	40	Leg	A325N	1.250	6	32945.000	82835.000	0.398	1	Bolt Tension
		Diagonal	A325X	0.750	1	6723.890	21868.400	0.307	1	Bolt Shear
T10	20	Diagonal	A325X	0.750	1	7545.070	21868.400	0.345	1	Bolt Shear

Compression Checks

Leg Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
T1	200 - 180	Sabre 2.375"x0.154"	20.000	5.000	76.2 K=1.00	1.075	-18763.699	31617.199	0.593 [1]
T2	180 - 160	Sabre 3.5" x 0.216"	20.033	5.008	51.7 K=1.00	2.228	-54363.602	82509.500	0.659 [1]
T3	160 - 140	Sabre 4" x 0.318"	20.033	5.008	46.0 K=1.00	3.678	-85389.500	141805.000	0.602 [1]
T4	140 - 120	Sabre 5.563" x 0.258"	20.033	6.678	42.7 K=1.00	4.299	-110630.000	169352.000	0.653 [1]
T5	120 - 100	Sabre 5.563 x .375	20.033	6.678	43.6 K=1.00	6.111	-135436.000	239358.000	0.566 [1]
T6	100 - 80	Sabre 5.563 x .375	20.033	6.678	43.6 K=1.00	6.111	-159078.000	239358.000	0.665 [1]
T7	80 - 60	Sabre 8.625" x 0.322"	20.033	10.017	40.9 K=1.00	8.399	-180110.000	334421.000	0.539 [1]

Section No.	Elevation	Size	L	L_u	Kl/r	A	P_u	ϕP_n	Ratio $\frac{P_u}{\phi P_n}$
	ft		ft	ft		in^2	lb	lb	
T8	60 - 40	Sabre 8.625" x 0.322"	20.033	10.017	40.9 K=1.00	8.399	-203033.000	334421.000	0.607 [1]
T9	40 - 20	Sabre 8.625" x 0.322"	20.033	10.017	40.9 K=1.00	8.399	-225623.000	334421.000	0.675 [1]
T10	20 - 0	Sabre 8.625" x 0.5"	20.033	10.017	41.8 K=1.00	12.763	-248322.000	505555.000	0.491 [1]

[1] P_u / ϕP_n controls

Diagonal Design Data (Compression)

Section No.	Elevation	Size	L	L_u	Kl/r	A	P_u	ϕP_n	Ratio $\frac{P_u}{\phi P_n}$
	ft		ft	ft		in^2	lb	lb	
T1	200 - 180	L2x2x1/8	7.071	3.229	103.1 K=1.06	0.484	-4277.350	9528.170	0.449 [1]
T2	180 - 160	L2x2x1/8	8.401	4.008	121.0 K=1.00	0.484	-4051.820	7450.490	0.544 [1]
T3	160 - 140	L2x2x1/8	10.079	4.825	145.6 K=1.00	0.484	-3692.040	5159.030	0.716 [1]
T4	140 - 120	L2 1/2x2 1/2x3/16	12.580	6.047	146.6 K=1.00	0.902	-4198.720	9482.650	0.443 [1]
T5	120 - 100	L2 1/2x2 1/2x3/16	14.315	6.917	167.7 K=1.00	0.902	-4436.810	7245.580	0.612 [1]
T6	100 - 80	L2 1/2x2 1/2x3/16	16.112	7.818	189.6 K=1.00	0.902	-4696.770	5672.750	0.828 [1]
T7	80 - 60	L3x3x3/16	19.296	9.343	188.1 K=1.00	1.090	-5582.850	6958.570	0.802 [1]
T8	60 - 40	L3 1/2x3 1/2x1/4	21.032	10.214	176.6 K=1.00	1.690	-6113.600	12239.100	0.500 [1]
T9	40 - 20	L3 1/2x3 1/2x1/4	22.811	11.107	192.0 K=1.00	1.690	-6723.890	10351.800	0.650 [1]
T10	20 - 0	L 4 x 4 x 1/4	24.624	12.015	181.4 K=1.00	1.940	-7545.070	13324.600	0.566 [1]

[1] P_u / ϕP_n controls

Top Girt Design Data (Compression)

Section No.	Elevation	Size	L	L_u	Kl/r	A	P_u	ϕP_n	Ratio $\frac{P_u}{\phi P_n}$
	ft		ft	ft		in^2	lb	lb	
T1	200 - 180	L2x2x1/8	5.000	4.469	134.9 K=1.00	0.484	-738.405	6013.860	0.123 [1]
T2	180 - 160	L2x2x1/8	5.000	4.375	132.1 K=1.00	0.484	-942.780	6274.360	0.150 [1]

[1] P_u / ϕP_n controls

Tension Checks

Leg Design Data (Tension)

Section No.	Elevation	Size	L	L_u	Kl/r	A	P_u	ϕP_n	Ratio $\frac{P_u}{\phi P_n}$
	ft		ft	ft		in^2	lb	lb	
T1	200 - 180	Sabre 2.375"x0.154"	20.000	5.000	76.2	1.075	14972.400	48353.898	0.310 [1]
T2	180 - 160	Sabre 3.5" x 0.216"	20.033	5.008	51.7	2.228	47866.102	100281.000	0.477 [1]
T3	160 - 140	Sabre 4" x 0.318"	20.033	5.008	46.0	3.678	76939.500	165529.000	0.465 [1]
T4	140 - 120	Sabre 5.563" x 0.258"	20.033	6.678	42.7	4.299	99902.297	193476.000	0.516 [1]
T5	120 - 100	Sabre 5.563 x .375	20.033	6.678	43.6	6.111	121812.000	275012.000	0.443 [1]
T6	100 - 80	Sabre 5.563 x .375	20.033	6.678	43.6	6.111	142321.000	275012.000	0.518 [1]
T7	80 - 60	Sabre 8.625" x 0.322"	20.033	10.017	40.9	8.399	160178.000	377967.000	0.424 [1]
T8	60 - 40	Sabre 8.625" x 0.322"	20.033	10.017	40.9	8.399	179187.000	377967.000	0.474 [1]
T9	40 - 20	Sabre 8.625" x 0.322"	20.033	10.017	40.9	8.399	197670.000	377967.000	0.523 [1]
T10	20 - 0	Sabre 8.625" x 0.5"	20.033	10.017	41.8	12.763	215469.000	574322.000	0.375 [1]

[1] P_u / ϕP_n controls

Diagonal Design Data (Tension)

Section No.	Elevation	Size	L	L_u	Kl/r	A	P_u	ϕP_n	Ratio $\frac{P_u}{\phi P_n}$
	ft		ft	ft		in^2	lb	lb	
T1	200 - 180	L2x2x1/8	7.071	3.229	65.1	0.293	4234.590	14282.200	0.296 [1]
T2	180 - 160	L2x2x1/8	8.005	3.815	76.3	0.293	4148.120	14282.200	0.290 [1]
T3	160 - 140	L2x2x1/8	8.808	4.197	83.6	0.293	3883.440	14282.200	0.272 [1]
T4	140 - 120	L2 1/2x2 1/2x3/16	12.580	6.047	95.8	0.571	4157.080	27850.301	0.149 [1]
T5	120 - 100	L2 1/2x2 1/2x3/16	14.315	6.917	109.2	0.571	4421.010	27850.301	0.159 [1]
T6	100 - 80	L2 1/2x2 1/2x3/16	16.112	7.818	123.1	0.554	4693.960	26993.400	0.174 [1]
T7	80 - 60	L3x3x3/16	19.296	9.343	121.7	0.694	5535.010	33854.602	0.163 [1]
T8	60 - 40	L3 1/2x3 1/2x1/4	21.032	10.214	114.4	1.103	6905.780	53792.602	0.112 [1]
T9	40 - 20	L3 1/2x3 1/2x1/4	22.811	11.107	124.2	1.103	6395.830	53792.602	0.119 [1]
T10	20 - 0	L 4 x 4 x 1/4	24.624	12.015	117.0	1.291	6907.250	62933.199	0.110 [1]

[1] P_u / ϕP_n controls

Top Girt Design Data (Tension)

Section No.	Elevation	Size	L	L_u	Kl/r	A	P_u	ϕP_n	Ratio $\frac{P_u}{\phi P_n}$
	ft		ft	ft		in^2	lb	lb	
T1	200 - 180	L2x2x1/8	5.000	4.469	92.0	0.293	731.122	14282.200	0.051 [1]
T2	180 - 160	L2x2x1/8	5.000	4.375	90.2	0.293	942.780	14282.200	0.066 [1]

[1] P_u / ϕP_n controls

tnxTower	Job	Page
	WIMIL2026 - Waterford North	17 of 17
Tower Engineering Professionals, Inc. 326 Tryon Rd. Raleigh, NC 27603 Phone: (919) 661-6351 FAX: (919) 661-6350	Project TEP No. 267747.554971	Date 14:40:05 06/02/21
	Client Uniti Towers LLC	Designed by aewilson

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	ϕP_{allow} lb	% Capacity	Pass Fail
T1	200 - 180	Leg	Sabre 2.375"x0.154"	2	-18763.699	31617.199	59.3	Pass
T2	180 - 160	Leg	Sabre 3.5" x 0.216"	32	-54363.602	82509.500	65.9	Pass
T3	160 - 140	Leg	Sabre 4" x 0.318"	62	-83389.500	141805.000	60.2	Pass
T4	140 - 120	Leg	Sabre 5.563" x 0.258"	89	-110630.000	169352.000	65.3	Pass
T5	120 - 100	Leg	Sabre 5.563 x .375	110	-135436.000	239358.000	56.6	Pass
T6	100 - 80	Leg	Sabre 5.563 x .375	131	-159078.000	239358.000	66.5	Pass
T7	80 - 60	Leg	Sabre 8.625" x 0.322"	152	-180110.000	334421.000	53.9	Pass
T8	60 - 40	Leg	Sabre 8.625" x 0.322"	167	-203033.000	334421.000	60.7	Pass
T9	40 - 20	Leg	Sabre 8.625" x 0.322"	182	-225623.000	334421.000	67.5	Pass
T10	20 - 0	Leg	Sabre 8.625" x 0.5"	197	-248322.000	505555.000	49.1	Pass
T1	200 - 180	Diagonal	L2x2x1/8	11	-4277.350	9528.170	44.9 59.1 (b)	Pass
T2	180 - 160	Diagonal	L2x2x1/8	42	-4051.820	7450.490	54.4 57.9 (b)	Pass
T3	160 - 140	Diagonal	L2x2x1/8	69	-3692.040	5159.030	71.6	Pass
T4	140 - 120	Diagonal	L2 1/2x2 1/2x3/16	93	-4198.720	9482.650	44.3	Pass
T5	120 - 100	Diagonal	L2 1/2x2 1/2x3/16	114	-4436.810	7245.580	61.2	Pass
T6	100 - 80	Diagonal	L2 1/2x2 1/2x3/16	135	-4696.770	5672.750	82.8	Pass
T7	80 - 60	Diagonal	L3x3x3/16	156	-5582.850	6958.570	80.2	Pass
T8	60 - 40	Diagonal	L3 1/2x3 1/2x1/4	171	-6113.600	12239.100	50.0	Pass
T9	40 - 20	Diagonal	L3 1/2x3 1/2x1/4	186	-6723.890	10351.800	65.0	Pass
T10	20 - 0	Diagonal	L 4 x 4 x 1/4	201	-7545.070	13324.600	56.6	Pass
T1	200 - 180	Top Girt	L2x2x1/8	6	-738.405	6013.860	12.3	Pass
T2	180 - 160	Top Girt	L2x2x1/8	34	-942.780	6274.360	15.0	Pass
							Summary	
							Leg (T9) 67.5	Pass
							Diagonal (T6) 82.8	Pass
							Top Girt (T2) 15.0	Pass
							Bolt Checks 59.1	Pass
							RATING = **82.8**	Pass

APPENDIX B

ADDITIONAL CALCULATIONS

Self Support Anchor Rod Capacity

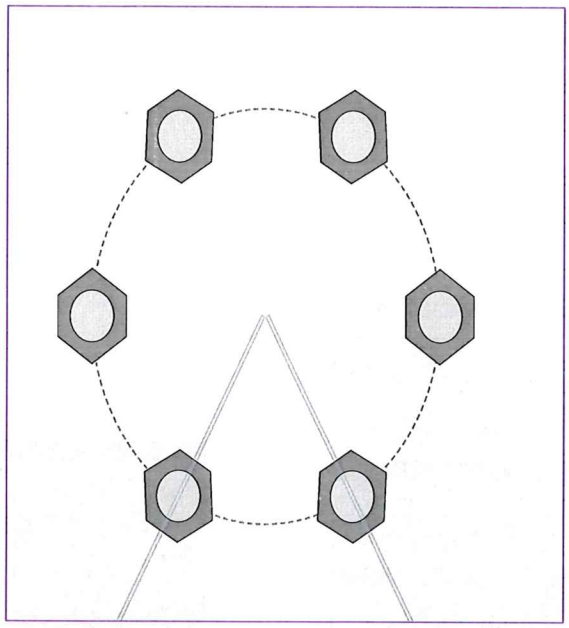
Site Info	
Site #	WIMIL2026
Site Name	Waterford North
TEP #	267747.554971

Analysis Considerations	
TIA-222 Revision	G
Grout Considered:	No
l_{ar} (in)	1.5
Eta Factor, η	0.5

Applied Loads		
	Comp.	Uplift
Axial Force (kips)	253.96	219.79
Shear Force (kips)	26.07	22.57

Considered Eccentricity	
Leg Mod Eccentricity (in)	0.000
Anchor Rod N.A Shift (in)	0.000
Total Eccentricity (in)	0.000

**Anchor Rod Eccentricity Applied*



Connection Properties

Anchor Rod Data

(6) 1-1/2" ø bolts (F1554-105 N; Fy=105 ksi, Fu=125 ksi)

l_{ar} (in): 1.5

Analysis Results

Anchor Rod Summary *(units of kips, kip-in)*

Pu_c = 42.33	ϕPn_t = 141	**Stress Rating**
Vu = 4.35	ϕVn = n/a	**36.2%**
Mu = n/a	ϕMn = n/a	**Pass**

Drilled Pier Foundation

Site # :	WIMIL2026
Site Name:	Waterford
TEP Number:	267747.554971

TIA-222 Revison:	G
Tower Type:	Self Support

Applied Loads	Comp.	Uplift
Moment (kip-ft)	0	0
Axial Force (kips)	253.961	219.786
Shear Force (kips)	26.073	22.573

Material Properties		
Concrete Strength, f'c:	4.5	ksi
Rebar Strength, Fy:	60	ksi
Tie Yield Strength, Fyt:	60	ksi

Pier Design Data		
Depth	29	ft
Ext. Above Grade	0.5	ft
Pier Section 1		
From 0.5' above grade to 29' below grade		
Pier Diameter	5	ft
Rebar Quantity	14	
Rebar Size	10	
Clear Cover to Ties	3	in
Tie Size	4	
Tie Spacing	12	in

Rebar & Pier Options

Embedded Pole Inputs

Belled Pier Inputs

Analysis Results		
Soil Lateral Check	*Compression*	*Uplift*
D_{v50} (ft from TOC)	15.24	15.24
Soil Safety Factor	19.78	22.85
Max Moment (kip-ft)	276.91	239.74
Rating	*6.7%*	*5.8%*
Soil Vertical Check	*Compression*	*Uplift*
Skin Friction (kips)	240.57	240.57
End Bearing (kips)	530.14	-
Weight of Concrete (kips)	103.52	77.64
Total Capacity (kips)	770.71	318.21
Axial (kips)	357.49	219.79
Rating	*46.4%*	*69.1%*
Reinforced Concrete Flexure	*Compression*	*Uplift*
Critical Depth (ft from TOC)	15.30	14.60
Critical Moment (kip-ft)	276.90	239.10
Critical Moment Capacity	2440.16	1754.54
Rating	*11.3%*	*13.6%*
Reinforced Concrete Shear	*Compression*	*Uplift*
Critical Depth (ft from TOC)	22.95	22.95
Critical Shear (kip)	39.30	34.02
Critical Shear Capacity	534.83	305.93
Rating	*7.3%*	*11.1%*

Soil Interaction Rating	**69.1%**
Structural Foundation Rating	**13.6%**

Check Limitation	
N/A	☑
Load Z Normalization:	☐
Shear Design Options	
Check Shear along Depth of Pier:	☑
Utilize Shear-Friction Methodology:	☐
Override Critical Depth:	☐

Go to Soil Calculations

Soil Profile

Groundwater Depth	28.5

# of Layers	6

Layer	Top (ft)	Bottom (ft)	Thickness (ft)	γ_{soil} (pcf)	$\gamma_{concrete}$ (pcf)	Cohesion (ksf)	Angle of Friction (degrees)	Calculated Ultimate Skin Friction Comp (ksf)	Calculated Ultimate Skin Friction Uplift (ksf)	Ultimate Skin Friction Comp Override (ksf)	Ultimate Skin Friction Uplift Override (ksf)	Ult. Gross Bearing Capacity (ksf)	SPT Blow Count	Soil Type
1	0	3	3	110	150	0	0	0.000	0.000	0.00	0.00			Cohesionless
2	3	12	9	110	150	0	30	0.000	0.000	0.32	0.32			Cohesionless
3	12	17	5	110	150	0	30	0.000	0.000	0.70	0.70			Cohesionless
4	17	27	10	110	150	2.75	0	1.513	1.513	1.10	1.10			Cohesive
5	27	28.5	1.5	110	150	0	30	0.000	0.000	1.52	1.52			Cohesionless
6	28.5	29	0.5	47.6	87.6	0	30	0.000	0.000	1.52	1.52	36		Cohesionless