Dewberry

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Structural Analysis Report For a 120-ft Monopole Tower

Hartford 9 CT
Site No.: 468180
Fuze#: 16232035
250 Silas Deane Highway
Wethersfield, CT 06109
Hartford County

Prepared for:
Verizon Wireless
118 Flanders Road
Westborough, MA 01581-3956

December 30, 2020

Prepared by:
Dewberry Engineers Inc.
99 Summer Street, Suite 700
Boston, MA 02110
Dewberry Project Number: 50121823

Tower Controlling Member	% Capacity	Result
Tower Components	92.7	Sufficient
Base Plate	34.9	Sufficient
Anchor Bolts	64.8	Sufficient
Foundation	-	Sufficient

Tower/Foundation Previously Reinforced?	YES ☒ / NO ☐
Previous Reinforcement Verified?	YES ☒ / NO ☐ Date: **07/26/19**
Additional Reinforcement Required?	YES ☐ / NO ☒

Prepared by:

Brandon Kelsey
Structural Project Engineer

Checked by:

Deep Patel
Structural Project Engineer

Approved by:

Benjamin Revette, P.E.
Associate Vice President

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1.0 INTRODUCTION AND PROJECT SUMMARY

The objective of this report is to assess the proposed installation of new antennas and support equipment on an existing 120 ft. steel monopole located in Wethersfield, CT. This report is limited to the analysis of the tower only. The telecommunication upgrade is proposed by Verizon Wireless. For the Antenna mount modification please refer to the Mount Modification Report by Maser Consulting dated December 16, 2020.

Please refer to the appendices for the structural analysis package regarding the structural analysis.

2.0 CODES, STANDARDS, AND REFERENCES

The structural analysis was completed according to the provisions of the following Codes and standards:

- *2018 Connecticut State Building Code – Amendments to IBC 2015*
- *International Building Code (IBC) 2015,* International Code Council
- ASCE 7-10 Minimum design Loads for Buildings and Other Structures, American Society of Civil Engineers
- *TIA-222-G-4, Structural Standard for Antenna Supporting Structures and Antennas*
- *Steel Construction Manual 14th Ed,* American Institute of Steel Construction

The analysis was in compliance with the minimum requirements as specified by TIA-222-G for the County of Hartford, CT under the following load parameters:

Risk Category:	II	
Exposure Category:	C	IBC 2015
Design Ultimate Wind Speed	125 mph	2018 CT Bld. Code Appendix N
Design Basic Wind Speed	97 mph	Except. #5, Sect. 1609.3.1, Eqn. 16-33, IBC 15
Design Ice Wind Speed:	50 mph	ASCE 7-10 Hazard Tool
Design Ice Thickness:	1.00 in.	ASCE 7-10 Hazard Tool
Serviceability Wind Speed:	60 mph	Sect. 2.8.3, TIA Rev G

The tower geometry, member sizes, existing antenna loading, and foundation design loading were referenced from the following reports, all of which can be found in Appendix B:

- Structural Analysis Report by CENTEK Engineering dated November 14, 2016
- Structural Analysis Report (Rev 3) by Dewberry Engineers Inc. dated November 21, 2019
- Radio Frequency Design Sheet (RFDS name: Hartford 9 CT) by Verizon Wireless dated October 8, 2020.
- Site Visit by Dewberry Engineers on October 20, 2020
- Post-Mod Antenna Mount Analysis Report by Maser Consulting dated December 16, 2020

3.0 EXISTING AND PROPOSED TOWER LOADING

3.1 Existing (includes Reserved, if applicable) Antenna and Cable information:

Mounting Elevation (ft)	Center Line Elevation (ft)	Carrier	QTY.	APPURTENANCES DESCRIPTION	FEEDLINE
117	123	Public Safety	2	DB809-XC Omni (Reserve)	(2) 7/8"
110	110	Public Safety	1	2' Dish	(2) 1/2"
			2	1' Dish (Reserve)	(6) 7/8"
			2	2' Dish (Reserve)	
105	106	Metro PCS	6	Air21	(1) 1-5/8"
	105		3	4' Standoff T-Arm	
90	92	VZW	3	B2/B66A RRH	(12) 1-5/8" (1)* Hybriflex
			1*	OVP Box	
	90		6**	BXA 80063 6CF	
			6	SBNHH-1D65B	
			3	BSAMNT-SBS-1-2	
	88		3	B5/B13 RRH	
	90		3***	4' Standoff T-Arm	
54	63	Public Safety	1	PD1142	(5) 1/2"
	56.5		1	5'x1" Omni	
			1	DB404	
	52		2	DB583	
	54		3	4' Side Mount Standoff	

* To be removed
** 3 To be removed
*** To be modified

3.2 Proposed Antenna Loading and Cable information:

Mounting Elevation (ft)	Center Line Elevation (ft)	Carrier	QTY.	APPURTENANCES DESCRIPTION	FEEDLINE
90	92	VZW	2	6-OVP	(2) Hybriflex
	90		3	Licensed Sub 6 Ant. w/ integrated VZS01 RRH	

3.3 Final Appurtenance Loading Configuration on Tower:

Mounting Elevation (ft)	Center Line Elevation (ft)	Carrier	QTY.	APPURTENANCES DESCRIPTION	FEEDLINE
90	92	VZW	3	B2/B66A RRH	(12) 1-5/8" (2) Hybriflex
			2	6-OVP	
	90		3	BXA 80063 6CF	
			3	Licensed Sub 6 Ant. w/ integrated VZS01 RRH	
			6	SBNHH-1D65B	
			3	BSAMNT-SBS-1-2	
	88		3	B5/B13 RRH	
	90		3	Modified 4' T-Boom	

3.4 Method:

tnxTower, a commercially available engineering software program, was used to create a three dimensional model of the tower members and calculate primary member stresses under various loading conditions. Selected output from the analysis is included in Appendix A.

4.0 TOWER ANALYSIS RESULTS SUMMARY

4.1 Tower Structure Results

Section No.	*Elevation ft*	*Component Type*	*Size*	*Critical Element*	*P lb*	*øP$_{allow}$ lb*	*% Capacity*	*Pass Fail*
L1	120 - 89.75	Pole	TP21.287x16x0.188	1	-3270.95	892475.00	28.6	Pass
L2	89.75 - 70	Pole	TP24.3628x20.4443x0.188	2	-9899.60	995069.00	83.4	Pass
L3	70 - 44.417	Pole	TP28.8342x24.3628x0.275	3	-12805.00	1804540.00	77.0	Pass
L4	44.417 - 35	Pole	TP29.93x27.6579x0.275	4	-15011.70	1885590.00	92.7	Pass
L5	35 - 0	Pole	TP36.0472x29.93x0.364	5	-22025.80	3062890.00	84.8	Pass
							Summary	
						Pole (L4)	92.7	Pass
						RATING =	**92.7**	**Pass**

Table above displays the summary of the ratio (as the percentage) of force in the member to their capacities. Values greater than 100% indicate the maximum force in the member exceeds its capacity.

**Note: Capacities up to 105% are considered acceptable (where applicable)*

4.2 Foundation results

The foundation reactions are summarized below:

Tower Component	Condition	Utilization	Pass/Fail
Base Plate	Bending (kip-ft)	34.9%	Pass
Anchor Bolts	Tensile (kip)	64.8%	Pass
Foundation	Overturning Moment (kip-ft)	1.19 F.S.	Pass

**Note: A foundation-soil interaction of 110% or less is within engineering tolerances for foundations and is considered acceptable.*

5.0 CONCLUSIONS AND COMMENTARY

After analysis, it was determined that the existing tower structure and foundation **is adequate** to support the proposed forces as a result of the telecommunication upgrade.

This engineering analysis is based upon the theoretical capacity of the structure. It is not a condition assessment of the tower and its foundation. Dewberry Engineers Inc. reserves the right to add to or modify this report if more information becomes available. The conclusions reached by Dewberry Engineers Inc. in this report are only applicable to the previously mentioned existing structural elements supporting the proposed wireless telecommunications installation. The results of this report are based on the assumption that existing structural elements have been installed per the original design documents, have been well maintained and are uncompromised. This report does not imply that a thorough inspection of the existing structure has been performed. Any deviation of the support condition, loading, location, placement, equipment configuration, etc, will require Dewberry Engineers Inc. to generate an additional structural analysis.

6.0 ASSUMPTIONS

This structural analysis is based on the theoretical capacity of the members and is not a condition assessment of the tower. This analysis is from information supplied, and therefore, its results are based on and are as accurate as that supplied data. Dewberry Engineers Inc. has made no independent determination, nor is it required to, of its accuracy. The following assumptions were made for this structural analysis.

1. The tower member sizes and shapes are considered accurate as supplied. The material grade is as per data supplied and/or as assumed and as stated in the materials section.
2. The antenna configuration is as supplied and/or as modeled in the analysis. It is assumed to be complete and accurate. All antennas, mounts, coax and waveguides are assumed to be properly installed and supported as per manufacturer requirements.
3. Some assumptions are made regarding antennas and mount sizes and their projected areas based on best interpretation of data supplied and of best knowledge of antenna type and industry practice.
4. All mounts, if applicable, are considered adequate to support the loading. No actual analysis of the mount(s) is performed. This analysis is limited to analyzing the tower only.
5. The soil parameters are as per data supplied or as assumed and stated in the calculations.
6. Foundations are properly designed and constructed to resist the original design loads indicated in the documents provided.
7. The tower and structures have been properly maintained in accordance with TIA Standards and/or with manufacturer's specifications.
8. All welds and connections are assumed to develop at least the member capacity unless determined otherwise and explicitly stated in this report.
9. All prior structural modifications are assumed to be as per data supplied/ available and to have been properly installed.
10. Loading interpreted from photos is accurate to ±5' AGL, antenna size accurate to ±3.3 sf, and coax equal to the number of existing antennas without reserves

If any of these assumptions are not valid or have been made in error, this analysis may be affected, and Dewberry Engineering Inc. should be allowed to review any new information to determine its effect on the structural integrity of the tower.

7.0 DISCLAIMER OF WARRANTIES

If the existing conditions are not as represented on the tower elevation contained in this report, we should be contacted immediately to evaluate the significance of the discrepancy. This is not a condition assessment of the tower or foundation. This report does not replace a full tower inspection. The tower and foundations are assumed to have been properly fabricated, erected, maintained, in good condition, twist free, and plumb.

The engineering services rendered by Dewberry Engineers Inc. in connection with this Structural Analysis are limited to a computer analysis of the tower structure and theoretical capacity of its main structural members. All tower components have been assumed to only resist dead loads when no other loads are applied. No allowance was made for any damaged, bent, missing, loose or rusted members (above and below ground). No allowance was made for loose bolts or cracked welds.

This analysis is limited to the designated maximum wind and seismic conditions per the governing tower standards and code. Wind forces resulting in tower vibrations near the structure's resonant frequencies were not considered in this analysis and are outside the scope of this analysis. Lateral loading from any dynamic response was not evaluated under a time-domain based fatigue analysis.

Dewberry Engineers Inc. does not analyze the fabrication of the structure (including welding). It is not possible to have all the very detailed information needed to perform a thorough analysis of every structural sub-component and connection of an existing tower. Dewberry Engineers Inc. provides a limited scope of service in that we cannot verify the adequacy of every weld, plate connection detail, etc. The purpose of this report is to calculate the structural integrity for the existing tower under existing and proposed loadings.

It is the owner's responsibility to determine the amount of ice accumulation in excess of the code specified amount, if any, that should be considered in the structural analysis.

The attached sketches are a schematic representation of the analyzed tower. If any material is fabricated from these sketches, the contractor shall be responsible for field verifying the existing condition, proper fit, and clearance in the field. Any mentions of structural modifications are reasonable estimates and should not be used as a precise construction document. Precise modification drawings are obtainable from Dewberry Engineering Inc., but are beyond the scope of this report.

Miscellaneous items such as antenna mounts, etc., have not been designed or detailed as a part of our work. We recommend that material of adequate size and strength be purchased from a reputable tower manufacturer.

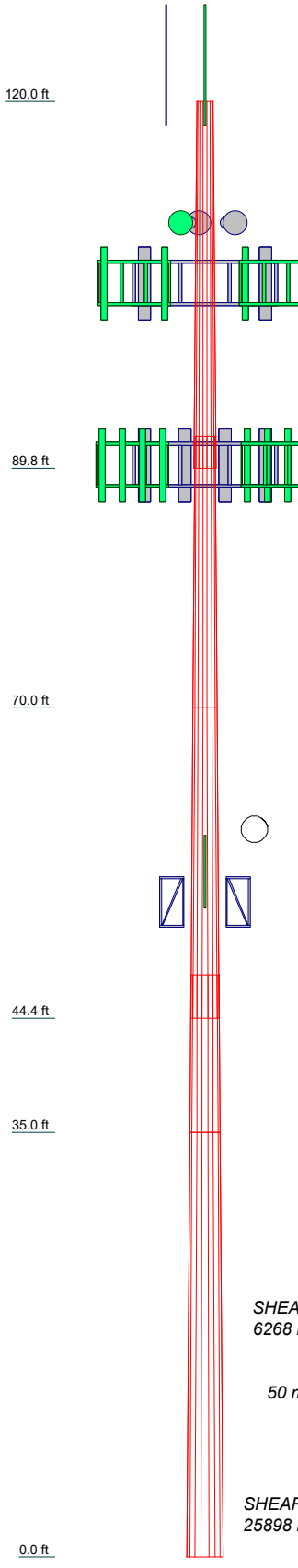
Towers are designed to carry gravity, wind, and ice loads. All members, legs, diagonals, struts, and redundant members provide structural stability to the tower with little redundancy. Absence or removal of a member can trigger catastrophic failure unless a substitute is provided before any removal. Legs carry axial loads and derive their strength from shorter unbraced lengths by the presence of redundant members and their connections to the diagonals with bolts or welds. If the bolts or welds are removed without providing any substitute to the frame, the leg is subjected to a higher unbraced length that immediately reduces its load carrying capacity. If a diagonal is also removed in addition to the connection, the unbraced length of the leg is greatly increased, jeopardizing its load carrying capacity. Failure of one leg can result in a tower collapse because there is no redundancy. Redundant members and diagonals are critical to the stability of the tower.

Dewberry Engineers Inc. makes no warranties, expresses and/or implied in connection with this report and disclaims any liability arising from material, fabrication, and erection of this tower. Dewberry will not be responsible whatsoever for, or on account of, consequential or incidental damages sustained by any person, firm, or organization as a result of any data or conclusions contained in this report. The maximum liability of Dewberry pursuant to this report will be limited to the total fee received for preparation of this report.

APPENDIX A

tnxTOWER OUTPUT FOR PROPOSED LOADING

Section	Length (ft)	Number of Sides	Thickness (in)	Socket Length (ft)	Top Dia (in)	Bot Dia (in)	Grade	Weight (lb)
1	30.25	18	0.1880	2.67	16.0000	21.2870	A572-65	1133.6
2	22.42	18	0.1880		20.4443	24.3628		1011.3
3	25.58	18	0.2750	3.58	24.3628	28.8342		2000.2
4	13.00	18	0.2750		27.6579	29.9300		1101.2
5	35.00	18	0.3640		29.9300	36.0472		4489.1
								9735.3



ALL REACTIONS ARE FACTORED

AXIAL 49668 lb

SHEAR 6268 lb *MOMENT 532960 lb-ft*

TORQUE 749 lb-ft
50 mph WIND - 1.0000 in ICE

AXIAL 22143 lb

SHEAR 25898 lb *MOMENT 1885147 lb-ft*

TORQUE 3952 lb-ft
REACTIONS - 97 mph WIND

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
DB809K-XC	117	B2/B66A RRH	90
DB809K-XC	117	B5/B13 RRH	90
6' Long 2-3/8" Mast Pipe	110	Licensed Sub 6 5G w/ radio _mast pipe	90
6' Long 2-3/8" Mast Pipe	110	DB-T1-6Z-12AB-OZ OVP	90
6' Long 2-3/8" Mast Pipe	110	(2) 4' T-Boom (7' Face)	90
2' Diameter Dish w/o Radome	110	BXA-80063-6CF w/ mast pipe	90
2' Diameter Dish w/o Radome	110	(2) SBNHH-1D65B SBS-1-2	90
2' Diameter Dish w/o Radome	110	B2/B66A RRH	90
1' Dish w/o Radome	110	B5/B13 RRH	90
1' Dish w/o Radome	110	Licensed Sub 6 5G w/ radio _mast pipe	90
Ericsson Air 21 B2A w/ mast pipe	105	(2) 4' T-Boom (7' Face)	90
4' T-Arm (7' Face)	105	BXA-80063-6CF w/ mast pipe	90
Ericsson Air 21 B2A w/ mast pipe	105	(2) SBNHH-1D65B SBS-1-2	90
Ericsson Air 21 B2A w/ mast pipe	105	B2/B66A RRH	90
4' T-Arm (7' Face)	105	B5/B13 RRH	90
Ericsson Air 21 B2A w/ mast pipe	105	DB404 4-bay Dipole	54
Ericsson Air 21 B2A w/ mast pipe	105	Pirod 4' Side Mount Standoff	54
4' T-Arm (7' Face)	105	5' Omni	54
Ericsson Air 21 B2A w/ mast pipe	105	Pirod 4' Side Mount Standoff	54
Licensed Sub 6 5G w/ radio _mast pipe	90	PD1142-1	54
DB-T1-6Z-12AB-OZ OVP	90	DB583	54
(2) 4' T-Boom (7' Face)	90	Pirod 4' Side Mount Standoff	54
BXA-80063-6CF w/ mast pipe	90	DB583	54
(2) SBNHH-1D65B SBS-1-2	90		

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-65	65 ksi	80 ksi			

TOWER DESIGN NOTES

1. Tower designed for Exposure C to the TIA-222-G Standard.
2. Tower designed for a 97 mph basic wind in accordance with the TIA-222-G Standard.
3. Tower is also designed for a 50 mph basic wind with 1.00 in ice. Ice is considered to increase in thickness with height.
4. Deflections are based upon a 60 mph wind.
5. Tower Structure Class II.
6. Topographic Category 1 with Crest Height of 0.00 ft
7. TOWER RATING: 92.7%

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Job: **Hartford 9 CT**			
Project: **50002925 / 50114613**			
Client: VZW	Drawn by: bkelsey	App'd:	
Code: TIA-222-G	Date: 12/30/20	Scale: NTS	
Path: \\capecod\projects\50121487\50121823 - Hartford 9 CT\Engineering\Structural\Rev 0\TNX Tower\Hartford 9 CT Tower 12-29-2020.eri		Dwg No. E-1	

Feed Line Plan
35'

Round Flat App In Face App Out Face

Section @ 35'

Dewberry Engineers Inc. 99 Summer Street, Suite 700 Boston, MA 02110 Phone: (617) 531-0744 FAX:	Job: ***Hartford 9 CT***		
	Project: ***50002925 / 50114613***		
	Client: VZW	Drawn by: bkelsey	App'd:
	Code: TIA-222-G	Date: 12/30/20	Scale: NTS
	Path: \\capecod\projects\50121487\50121823 - Hartford 9 CT\Engineering\Structural\Rev 0\TNX Tower\Hartford 9 CT Tower 12-29-2020.eri		Dwg No. E-7

Tower Input Data

The tower is a monopole.
This tower is designed using the TIA-222-G standard.
The following design criteria apply:

ASCE 7-10 Wind Data is used (wind speeds converted to nominal values).
Basic wind speed of 97 mph.
Structure Class II.
Exposure Category C.
Topographic Category 1.
Crest Height 0.00 ft.
Nominal ice thickness of 1.0000 in.
Ice thickness is considered to increase with height.
Ice density of 56 pcf.
A wind speed of 50 mph is used in combination with ice.
Temperature drop of 50 °F.
Deflections calculated using a wind speed of 60 mph.
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in pole design is 1.
Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

Tapered Pole Section Geometry

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L1	120.00-89.75	30.25	2.67	18	16.0000	21.2870	0.1880	0.7520	A572-65 (65 ksi)
L2	89.75-70.00	22.42	0.00	18	20.4443	24.3628	0.1880	0.7520	A572-65 (65 ksi)
L3	70.00-44.42	25.58	3.58	18	24.3628	28.8342	0.2750	1.1000	A572-65 (65 ksi)
L4	44.42-35.00	13.00	0.00	18	27.6579	29.9300	0.2750	1.1000	A572-65 (65 ksi)
L5	35.00-0.00	35.00		18	29.9300	36.0472	0.3640	1.4560	A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
L1	16.2178	9.4352	298.0318	5.6133	8.1280	36.6673	596.4558	4.7185	2.4851	13.219
	21.5864	12.5900	708.0890	7.4901	10.8138	65.4802	1417.1097	6.2962	3.4156	18.168
L2	21.2046	12.0872	626.5930	7.1910	10.3857	60.3321	1254.0105	6.0448	3.2673	17.379
	24.7097	14.4254	1065.1069	8.5821	12.3763	86.0600	2131.6153	7.2141	3.9570	21.048
L3	24.6963	21.0251	1541.2419	8.5512	12.3763	124.5315	3084.5118	10.5145	3.8039	13.832
	29.2365	24.9279	2568.6995	10.1385	14.6478	175.3648	5140.7791	12.4663	4.5908	16.694
L4	28.6781	23.9012	2264.2116	9.7209	14.0502	161.1512	4531.4024	11.9529	4.3838	15.941

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
L5	30.3493	25.8844	2875.8902	10.5275	15.2045	189.1478	5755.5646	12.9447	4.7837	17.395
	30.3356	34.1587	3772.4625	10.4959	15.2045	248.1156	7549.8888	17.0826	4.6270	12.712
	36.5472	41.2261	6631.9001	12.6675	18.3120	362.1616	13272.5267	20.6170	5.7037	15.669

Tower Elevation ft	Gusset Area (per face) ft^2	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
L1 120.00-89.75				1	1	1			
L2 89.75-70.00				1	1	1			
L3 70.00-44.42				1	1	1			
L4 44.42-35.00				1	1	1			
L5 35.00-0.00				1	1	1			

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#		C_AA_A ft^2/ft	Weight plf
LDF4P-50A (1/2 FOAM)	A	No	No	Inside Pole	110.00 - 4.00	0.0000	0	2	No Ice 1/2" Ice 1" Ice	0.00 0.00 0.00	0.15 0.15 0.15
LDF4P-50A (1/2 FOAM)	A	No	No	Inside Pole	55.00 - 4.00	0.0000	0	5	No Ice 1/2" Ice 1" Ice	0.00 0.00 0.00	0.15 0.15 0.15
**********											
Hybriflex	C	No	No	Inside Pole	105.00 - 7.00	0.0000	0	1	No Ice 1/2" Ice 1" Ice	0.00 0.00 0.00	0.82 0.82 0.82
**********											
Hybriflex	B	No	No	Inside Pole	90.00 - 4.00	0.0000	0	2	No Ice 1/2" Ice 1" Ice	0.00 0.00 0.00	0.82 0.82 0.82
LDF7-50A (1-5/8 FOAM)	B	No	No	Inside Pole	90.00 - 4.00	0.0000	0	12	No Ice 1/2" Ice 1" Ice	0.00 0.00 0.00	0.82 0.82 0.82
**********											
Safety Line 3/8	C	No	No	CaAa (Out Of Face)	120.00 - 4.00	4.0000	0	1	No Ice 1/2" Ice 1" Ice	0.04 0.14 0.24	0.22 0.75 1.28
Step Pegs (5/8" SR) 7-in.	C	No	No	CaAa (Out Of Face)	120.00 - 12.00	4.0000	0	2	No Ice	0.30 0.14	0.49 1.01

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#		C_AA_A ft^2/ft	Weight plf
w/30" step									1/2" Ice 1" Ice	0.23	1.53
**********											
LDF5-50A (7/8 FOAM)	A	No	No	Inside Pole	117.00 - 4.00	0.0000	0	2	No Ice 1/2" Ice 1" Ice	0.00 0.00 0.00	0.33 0.33 0.33
LDF5-50A (7/8 FOAM)	A	No	No	Inside Pole	110.00 - 4.00	0.0000	0	6	No Ice 1/2" Ice 1" Ice	0.00 0.00 0.00	0.33 0.33 0.33
*****											
SC - SwitchBlade (SC - Reinf.)	A	No	No	CaAa (Out Of Face)	35.00 - 0.00	0.0000	0	1	No Ice 1/2" Ice 1" Ice	0.00 0.00 0.00	0.00 0.00 0.00
SC - SwitchBlade (SC - Reinf.)	B	No	No	CaAa (Out Of Face)	70.00 - 0.00	0.0000	0	1	No Ice 1/2" Ice 1" Ice	0.35 0.45 0.55	0.00 0.00 0.00

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight lb
L1	120.00-89.75	A	0.000	0.000	0.000	0.000	64.16
		B	0.000	0.000	0.000	0.000	2.87
		C	0.000	0.000	0.000	19.284	48.81
L2	89.75-70.00	A	0.000	0.000	0.000	0.000	58.06
		B	0.000	0.000	0.000	0.000	226.73
		C	0.000	0.000	0.000	12.591	39.90
L3	70.00-44.42	A	0.000	0.000	0.000	0.000	83.15
		B	0.000	0.000	0.000	8.954	293.69
		C	0.000	0.000	0.000	16.309	51.68
L4	44.42-35.00	A	0.000	0.000	0.000	0.000	34.75
		B	0.000	0.000	0.000	3.296	108.11
		C	0.000	0.000	0.000	6.003	19.02
L5	35.00-0.00	A	0.000	0.000	0.000	0.000	114.39
		B	0.000	0.000	0.000	12.250	355.88
		C	0.000	0.000	0.000	14.962	52.32

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight lb
L1	120.00-89.75	A	2.244	0.000	0.000	0.000	0.000	64.16
		B		0.000	0.000	0.000	0.000	2.87

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
		C		0.000	0.000	0.000	14.710	261.94
L2	89.75-70.00	A	2.184	0.000	0.000	0.000	0.000	58.06
		B		0.000	0.000	0.000	0.000	226.73
		C		0.000	0.000	0.000	9.604	179.05
L3	70.00-44.42	A	2.112	0.000	0.000	0.000	0.000	83.15
		B		0.000	0.000	0.000	19.759	293.69
		C		0.000	0.000	0.000	11.764	221.32
L4	44.42-35.00	A	2.037	0.000	0.000	0.000	0.000	34.75
		B		0.000	0.000	0.000	7.273	108.11
		C		0.000	0.000	0.000	4.330	81.47
L5	35.00-0.00	A	1.877	0.000	0.000	0.000	0.000	114.39
		B		0.000	0.000	0.000	25.386	355.88
		C		0.000	0.000	0.000	14.103	203.77

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
L1	120.00-89.75	-2.0360	1.1755	-1.3895	0.8022
L2	89.75-70.00	-2.1304	1.2300	-1.4808	0.8549
L3	70.00-44.42	-0.8988	1.7824	0.8272	1.8831
L4	44.42-35.00	-0.9199	1.8243	0.8579	1.9531
L5	35.00-0.00	-0.2239	1.5300	0.9649	1.9108

Note: For pole sections, center of pressure calculations do not consider feed line shielding.

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight lb
DB809K-XC	A	From Face	3.00 0.00 6.00	0.0000	117.00	No Ice 1/2" Ice 1" Ice	3.66 4.91 6.18	3.66 4.91 6.18	30.00 56.00 91.00
DB809K-XC	C	From Face	3.00 0.00 6.00	0.0000	117.00	No Ice 1/2" Ice 1" Ice	3.66 4.91 6.18	3.66 4.91 6.18	30.00 56.00 91.00
6' Long 2-3/8" Mast Pipe	A	None		0.0000	110.00	No Ice 1/2" Ice 1" Ice	1.43 1.92 2.29	1.43 1.92 2.29	21.96 32.79 47.67
6' Long 2-3/8" Mast Pipe	B	None		0.0000	110.00	No Ice 1/2" Ice 1" Ice	1.43 1.92 2.29	1.43 1.92 2.29	21.96 32.79 47.67
6' Long 2-3/8" Mast Pipe	C	None		0.0000	110.00	No Ice 1/2" Ice 1" Ice	1.43 1.92 2.29	1.43 1.92 2.29	21.96 32.79 47.67

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight lb
**********									
4' T-Arm (7' Face)	A	From Face	2.00	0.0000	105.00	No Ice	5.00	5.00	500.00
			0.00			1/2" Ice	8.00	8.00	750.00
			0.00			1" Ice	11.00	11.00	1000.00
Ericsson Air 21 B2A w/ mast pipe	A	From Face	4.00	0.0000	105.00	No Ice	6.26	5.64	104.90
			-3.50			1/2" Ice	6.74	6.49	161.79
			1.00			1" Ice	7.20	7.21	225.40
Ericsson Air 21 B2A w/ mast pipe	A	From Face	4.00	0.0000	105.00	No Ice	6.26	5.64	104.90
			3.50			1/2" Ice	6.74	6.49	161.79
			1.00			1" Ice	7.20	7.21	225.40
4' T-Arm (7' Face)	B	From Face	2.00	0.0000	105.00	No Ice	5.00	5.00	500.00
			0.00			1/2" Ice	8.00	8.00	750.00
			0.00			1" Ice	11.00	11.00	1000.00
Ericsson Air 21 B2A w/ mast pipe	B	From Face	4.00	0.0000	105.00	No Ice	6.26	5.64	104.90
			-3.50			1/2" Ice	6.74	6.49	161.79
			1.00			1" Ice	7.20	7.21	225.40
Ericsson Air 21 B2A w/ mast pipe	B	From Face	4.00	0.0000	105.00	No Ice	6.26	5.64	104.90
			3.50			1/2" Ice	6.74	6.49	161.79
			1.00			1" Ice	7.20	7.21	225.40
4' T-Arm (7' Face)	C	From Face	2.00	0.0000	105.00	No Ice	5.00	5.00	500.00
			0.00			1/2" Ice	8.00	8.00	750.00
			0.00			1" Ice	11.00	11.00	1000.00
Ericsson Air 21 B2A w/ mast pipe	C	From Face	4.00	0.0000	105.00	No Ice	6.26	5.64	104.90
			-3.50			1/2" Ice	6.74	6.49	161.79
			1.00			1" Ice	7.20	7.21	225.40
Ericsson Air 21 B2A w/ mast pipe	C	From Face	4.00	0.0000	105.00	No Ice	6.26	5.64	104.90
			3.50			1/2" Ice	6.74	6.49	161.79
			1.00			1" Ice	7.20	7.21	225.40
**********									
(2) 4' T-Boom (7' Face)	A	From Face	2.00	0.0000	90.00	No Ice	5.00	5.00	500.00
			0.00			1/2" Ice	8.00	8.00	750.00
			0.00			1" Ice	11.00	11.00	1000.00
BXA-80063-6CF w/ mast pipe	A	From Face	4.00	0.0000	90.00	No Ice	7.60	5.19	36.80
			-3.50			1/2" Ice	8.05	6.12	93.34
			0.00			1" Ice	8.51	6.93	157.38
(2) SBNHH-1D65B SBS-1-2	A	From Face	4.00	0.0000	90.00	No Ice	14.76	6.85	128.50
			-1.25			1/2" Ice	15.28	7.81	226.26
			0.00			1" Ice	15.81	8.64	332.62
B2/B66A RRH	A	From Face	4.00	0.0000	90.00	No Ice	1.88	1.25	97.50
			1.25			1/2" Ice	2.05	1.39	115.84
			2.00			1" Ice	2.22	1.54	136.97
B5/B13 RRH	A	From Face	4.00	0.0000	90.00	No Ice	1.88	1.01	82.00
			1.25			1/2" Ice	2.05	1.14	98.43
			-2.00			1" Ice	2.22	1.28	117.53
Licensed Sub 6 5G w/ radio & mast pipe	A	From Face	4.00	0.0000	90.00	No Ice	7.30	4.30	166.74
			3.50			1/2" Ice	7.79	4.93	225.67
			0.00			1" Ice	8.29	5.57	291.64
DB-T1-6Z-12AB-OZ OVP	A	From Face	0.50	0.0000	90.00	No Ice	2.82	1.85	26.00
			0.00			1/2" Ice	3.04	2.03	51.02
			2.00			1" Ice	3.25	2.22	79.31
(2) 4' T-Boom (7' Face)	B	From Face	2.00	0.0000	90.00	No Ice	5.00	5.00	500.00
			0.00			1/2" Ice	8.00	8.00	750.00
			0.00			1" Ice	11.00	11.00	1000.00
BXA-80063-6CF w/ mast pipe	B	From Face	4.00	0.0000	90.00	No Ice	7.60	5.19	36.80
			-3.50			1/2" Ice	8.05	6.12	93.34
			0.00			1" Ice	8.51	6.93	157.38
(2) SBNHH-1D65B SBS-1-2	B	From Face	4.00	0.0000	90.00	No Ice	14.76	6.85	128.50

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft	Offsets: Vert ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight lb
			-1.25				1/2" Ice	15.28	7.81	226.26
			0.00				1" Ice	15.81	8.64	332.62
B2/B66A RRH	B	From Face	4.00		0.0000	90.00	No Ice	1.88	1.25	97.50
			1.25				1/2" Ice	2.05	1.39	115.84
			2.00				1" Ice	2.22	1.54	136.97
B5/B13 RRH	B	From Face	4.00		0.0000	90.00	No Ice	1.88	1.01	82.00
			1.25				1/2" Ice	2.05	1.14	98.43
			-2.00				1" Ice	2.22	1.28	117.53
Licensed Sub 6 5G w/ radio & mast pipe	B	From Face	4.00		0.0000	90.00	No Ice	7.30	4.30	166.74
			3.50				1/2" Ice	7.79	4.93	225.67
			0.00				1" Ice	8.29	5.57	291.64
DB-T1-6Z-12AB-OZ OVP	B	From Face	0.50		0.0000	90.00	No Ice	2.82	1.85	26.00
			0.00				1/2" Ice	3.04	2.03	51.02
			2.00				1" Ice	3.25	2.22	79.31
(2) 4' T-Boom (7' Face)	C	From Face	2.00		0.0000	90.00	No Ice	5.00	5.00	500.00
			0.00				1/2" Ice	8.00	8.00	750.00
			0.00				1" Ice	11.00	11.00	1000.00
BXA-80063-6CF w/ mast pipe	C	From Face	4.00		0.0000	90.00	No Ice	7.60	5.19	36.80
			-3.50				1/2" Ice	8.05	6.12	93.34
			0.00				1" Ice	8.51	6.93	157.38
(2) SBNHH-1D65B SBS-1-2	C	From Face	4.00		0.0000	90.00	No Ice	14.76	6.85	128.50
			-1.25				1/2" Ice	15.28	7.81	226.26
			0.00				1" Ice	15.81	8.64	332.62
B2/B66A RRH	C	From Face	4.00		0.0000	90.00	No Ice	1.88	1.25	97.50
			1.25				1/2" Ice	2.05	1.39	115.84
			2.00				1" Ice	2.22	1.54	136.97
B5/B13 RRH	C	From Face	4.00		0.0000	90.00	No Ice	1.88	1.01	82.00
			1.25				1/2" Ice	2.05	1.14	98.43
			-2.00				1" Ice	2.22	1.28	117.53
Licensed Sub 6 5G w/ radio & mast pipe	C	From Face	4.00		0.0000	90.00	No Ice	7.30	4.30	166.74
			3.50				1/2" Ice	7.79	4.93	225.67
			0.00				1" Ice	8.29	5.57	291.64
**********										
Pirod 4' Side Mount Standoff	A	From Face	2.00		0.0000	54.00	No Ice	2.72	2.72	50.00
			0.00				1/2" Ice	4.91	4.91	89.00
			0.00				1" Ice	7.10	7.10	128.00
PD1142-1	A	From Face	4.00		0.0000	54.00	No Ice	1.32	1.32	10.00
			0.00				1/2" Ice	3.21	3.21	24.00
			9.00				1" Ice	5.12	5.12	49.00
DB583	A	From Face	4.00		0.0000	54.00	No Ice	0.54	0.54	6.20
			0.00				1/2" Ice	0.71	0.71	12.00
			-2.00				1" Ice	0.89	0.89	19.00
Pirod 4' Side Mount Standoff	B	From Face	2.00		0.0000	54.00	No Ice	2.72	2.72	50.00
			0.00				1/2" Ice	4.91	4.91	89.00
			0.00				1" Ice	7.10	7.10	128.00
DB583	B	From Face	4.00		0.0000	54.00	No Ice	0.54	0.54	6.20
			0.00				1/2" Ice	0.71	0.71	12.00
			-2.00				1" Ice	0.89	0.89	19.00
DB404 4-bay Dipole	B	From Face	4.00		0.0000	54.00	No Ice	1.14	1.14	14.00
			0.00				1/2" Ice	2.05	2.05	18.20
			2.50				1" Ice	2.96	2.96	22.40
Pirod 4' Side Mount Standoff	C	From Face	2.00		0.0000	54.00	No Ice	2.72	2.72	50.00
			0.00				1/2" Ice	4.91	4.91	89.00
			0.00				1" Ice	7.10	7.10	128.00
5' Omni	C	From Face	4.00		0.0000	54.00	No Ice	1.58	1.58	10.00
			0.00				1/2" Ice	2.40	2.40	20.00
			2.50				1" Ice	3.22	3.22	30.00

Dishes

Description	Face or Leg	Dish Type	Offset Type	Offsets: Horz Lateral Vert ft	Azimuth Adjustment °	3 dB Beam Width °	Elevation ft	Outside Diameter ft		Aperture Area ft²	Weight lb
2' Diameter Dish w/o Radome	C	Paraboloid w/o Radome	From Face	1.00 2.00 0.00	0.0000		110.00	2.00	No Ice 1/2" Ice 1" Ice	3.14 3.41 3.68	35.00 52.50 70.01
2' Diameter Dish w/o Radome	A	Paraboloid w/o Radome	From Face	1.00 2.00 0.00	0.0000		110.00	2.00	No Ice 1/2" Ice 1" Ice	3.14 3.41 3.68	35.00 52.50 70.01
2' Diameter Dish w/o Radome	B	Paraboloid w/o Radome	From Face	1.00 2.00 0.00	0.0000		110.00	2.00	No Ice 1/2" Ice 1" Ice	3.14 3.41 3.68	35.00 52.50 70.01
1' Dish w/o Radome	A	Paraboloid w/o Radome	From Face	1.00 0.50 0.00	0.0000		110.00	1.00	No Ice 1/2" Ice 1" Ice	0.79 0.92 1.06	10.00 20.00 30.00
1' Dish w/o Radome	B	Paraboloid w/o Radome	From Face	1.00 0.50 0.00	0.0000		110.00	1.00	No Ice 1/2" Ice 1" Ice	0.79 0.92 1.06	10.00 20.00 30.00

Tower Pressures - No Ice

$G_H = 1.100$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg % %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1	104.27	1.277	29	47.649	A	0.000	47.649	47.649	100.00	0.000	0.000
120.00-89.75					B	0.000	47.649		100.00	0.000	0.000
					C	0.000	47.649		100.00	0.000	19.284
L2 89.75-70.00	79.62	1.206	28	37.784	A	0.000	37.784	37.784	100.00	0.000	0.000
					B	0.000	37.784		100.00	0.000	0.000
					C	0.000	37.784		100.00	0.000	12.591
L3 70.00-44.42	56.85	1.124	26	57.490	A	0.000	57.490	57.490	100.00	0.000	0.000
					B	0.000	57.490		100.00	0.000	8.954
					C	0.000	57.490		100.00	0.000	16.309
L4 44.42-35.00	39.66	1.042	24	23.161	A	0.000	23.161	23.161	100.00	0.000	0.000
					B	0.000	23.161		100.00	0.000	3.296
					C	0.000	23.161		100.00	0.000	6.003
L5 35.00-0.00	17.46	0.876	21	97.537	A	0.000	97.537	97.537	100.00	0.000	0.000
					B	0.000	97.537		100.00	0.000	12.250
					C	0.000	97.537		100.00	0.000	14.962

Tower Pressure - With Ice

$G_H = 1.100$

Section Elevation ft	z ft	K_Z	q_z psf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 120.00-89.75	104.27	1.277	8	2.2439	58.962	A	0.000	58.962	58.962	100.00	0.000	0.000
						B	0.000	58.962		100.00	0.000	0.000
						C	0.000	58.962		100.00	0.000	14.710
L2 89.75-70.00	79.62	1.206	7	2.1842	45.170	A	0.000	45.170	45.170	100.00	0.000	0.000
						B	0.000	45.170		100.00	0.000	0.000
						C	0.000	45.170		100.00	0.000	9.604
L3 70.00-44.42	56.85	1.124	7	2.1118	66.494	A	0.000	66.494	66.494	100.00	0.000	0.000
						B	0.000	66.494		100.00	0.000	19.759
						C	0.000	66.494		100.00	0.000	11.764
L4 44.42-35.00	39.66	1.042	6	2.0371	26.475	A	0.000	26.475	26.475	100.00	0.000	0.000
						B	0.000	26.475		100.00	0.000	7.273
						C	0.000	26.475		100.00	0.000	4.330
L5 35.00-0.00	17.46	0.876	5	1.8767	108.485	A	0.000	108.485	108.485	100.00	0.000	0.000
						B	0.000	108.485		100.00	0.000	25.386
						C	0.000	108.485		100.00	0.000	14.103

Tower Pressure - Service

$G_H = 1.100$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1	104.27	1.277	10	47.649	A	0.000	47.649	47.649	100.00	0.000	0.000
120.00-89.75					B	0.000	47.649		100.00	0.000	0.000
					C	0.000	47.649		100.00	0.000	19.284
L2 89.75-70.00	79.62	1.206	9	37.784	A	0.000	37.784	37.784	100.00	0.000	0.000
					B	0.000	37.784		100.00	0.000	0.000
					C	0.000	37.784		100.00	0.000	12.591
L3 70.00-44.42	56.85	1.124	9	57.490	A	0.000	57.490	57.490	100.00	0.000	0.000
					B	0.000	57.490		100.00	0.000	8.954
					C	0.000	57.490		100.00	0.000	16.309
L4 44.42-35.00	39.66	1.042	8	23.161	A	0.000	23.161	23.161	100.00	0.000	0.000
					B	0.000	23.161		100.00	0.000	3.296
					C	0.000	23.161		100.00	0.000	6.003
L5 35.00-0.00	17.46	0.876	7	97.537	A	0.000	97.537	97.537	100.00	0.000	0.000
					B	0.000	97.537		100.00	0.000	12.250
					C	0.000	97.537		100.00	0.000	14.962

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	115.83	1133.58	A	1	1.2	29	1	1	47.649	2455.80	81.18	C
120.00-89.75			B	1	1.2		1	1	47.649			
			C	1	1.2		1	1	47.649			
L2	324.69	1011.33	A	1	1.2	28	1	1	37.784	1759.06	89.07	C
89.75-70.00			B	1	1.2		1	1	37.784			

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
			C	1	1.2		1	1	37.784			
L3	428.52	2000.18	A	1	1.2	26	1	1	57.490	2665.97	104.21	C
70.00-44.42			B	1	1.2		1	1	57.490			
			C	1	1.2		1	1	57.490			
L4	161.88	1101.17	A	1	1.2	24	1	1	23.161	972.61	103.28	C
44.42-35.00			B	1	1.2		1	1	23.161			
			C	1	1.2		1	1	23.161			
L5 35.00-0.00	522.59	4489.08	A	1	1.2	21	1	1	97.537	3266.37	93.32	C
			B	1	1.2		1	1	97.537			
			C	1	1.2		1	1	97.537			
Sum Weight:	1553.51	9735.34						OTM	643314.72 lb-ft	11119.81		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	115.83	1133.58	A	1	1.2	29	1	1	47.649	2455.80	81.18	C
120.00-89.75			B	1	1.2		1	1	47.649			
			C	1	1.2		1	1	47.649			
L2	324.69	1011.33	A	1	1.2	28	1	1	37.784	1759.06	89.07	C
89.75-70.00			B	1	1.2		1	1	37.784			
			C	1	1.2		1	1	37.784			
L3	428.52	2000.18	A	1	1.2	26	1	1	57.490	2665.97	104.21	C
70.00-44.42			B	1	1.2		1	1	57.490			
			C	1	1.2		1	1	57.490			
L4	161.88	1101.17	A	1	1.2	24	1	1	23.161	972.61	103.28	C
44.42-35.00			B	1	1.2		1	1	23.161			
			C	1	1.2		1	1	23.161			
L5 35.00-0.00	522.59	4489.08	A	1	1.2	21	1	1	97.537	3266.37	93.32	C
			B	1	1.2		1	1	97.537			
			C	1	1.2		1	1	97.537			
Sum Weight:	1553.51	9735.34						OTM	643314.72 lb-ft	11119.81		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	115.83	1133.58	A	1	1.2	29	1	1	47.649	2455.80	81.18	C
120.00-89.75			B	1	1.2		1	1	47.649			
			C	1	1.2		1	1	47.649			
L2	324.69	1011.33	A	1	1.2	28	1	1	37.784	1759.06	89.07	C
89.75-70.00			B	1	1.2		1	1	37.784			
			C	1	1.2		1	1	37.784			

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L3	428.52	2000.18	A	1	1.2	26	1	1	57.490	2665.97	104.21	C
70.00-44.42			B	1	1.2		1	1	57.490			
			C	1	1.2		1	1	57.490			
L4	161.88	1101.17	A	1	1.2	24	1	1	23.161	972.61	103.28	C
44.42-35.00			B	1	1.2		1	1	23.161			
			C	1	1.2		1	1	23.161			
L5 35.00-0.00	522.59	4489.08	A	1	1.2	21	1	1	97.537	3266.37	93.32	C
			B	1	1.2		1	1	97.537			
			C	1	1.2		1	1	97.537			
Sum Weight:	1553.51	9735.34						OTM	643314.72 lb-ft	11119.81		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	328.96	2883.58	A	1	1.2	8	1	1	58.962	729.32	24.11	C
120.00-89.75			B	1	1.2		1	1	58.962			
			C	1	1.2		1	1	58.962			
L2	463.84	2332.94	A	1	1.2	7	1	1	44.973	512.90	25.97	C
89.75-70.00			B	1	1.2		1	1	44.973			
			C	1	1.2		1	1	44.973			
L3	598.16	3914.76	A	1	1.2	7	1	1	66.494	836.61	32.70	C
70.00-44.42			B	1	1.2		1	1	66.494			
			C	1	1.2		1	1	66.494			
L4	224.32	1838.63	A	1	1.2	6	1	1	26.358	301.21	31.99	C
44.42-35.00			B	1	1.2		1	1	26.358			
			C	1	1.2		1	1	26.358			
L5 35.00-0.00	674.04	7315.80	A	1	1.2	5	1	1	108.485	1020.77	29.16	C
			B	1	1.2		1	1	108.485			
			C	1	1.2		1	1	108.485			
Sum Weight:	2289.33	18285.71						OTM	194221.55 lb-ft	3400.82		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	328.96	2883.58	A	1	1.2	8	1	1	58.962	729.32	24.11	C
120.00-89.75			B	1	1.2		1	1	58.962			
			C	1	1.2		1	1	58.962			
L2	463.84	2332.94	A	1	1.2	7	1	1	44.973	512.90	25.97	C
89.75-70.00			B	1	1.2		1	1	44.973			
			C	1	1.2		1	1	44.973			
L3	598.16	3914.76	A	1	1.2	7	1	1	66.494	836.61	32.70	C

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
70.00-44.42			B	1	1.2		1	1	66.494			
			C	1	1.2		1	1	66.494			
L4	224.32	1838.63	A	1	1.2	6	1	1	26.358	301.21	31.99	C
44.42-35.00			B	1	1.2		1	1	26.358			
			C	1	1.2		1	1	26.358			
L5 35.00-0.00	674.04	7315.80	A	1	1.2	5	1	1	108.485	1020.77	29.16	C
			B	1	1.2		1	1	108.485			
			C	1	1.2		1	1	108.485			
Sum Weight:	2289.33	18285.71						OTM	194221.55 lb-ft	3400.82		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	328.96	2883.58	A	1	1.2	8	1	1	58.962	729.32	24.11	C
120.00-89.75			B	1	1.2		1	1	58.962			
			C	1	1.2		1	1	58.962			
L2	463.84	2332.94	A	1	1.2	7	1	1	44.973	512.90	25.97	C
89.75-70.00			B	1	1.2		1	1	44.973			
			C	1	1.2		1	1	44.973			
L3	598.16	3914.76	A	1	1.2	7	1	1	66.494	836.61	32.70	C
70.00-44.42			B	1	1.2		1	1	66.494			
			C	1	1.2		1	1	66.494			
L4	224.32	1838.63	A	1	1.2	6	1	1	26.358	301.21	31.99	C
44.42-35.00			B	1	1.2		1	1	26.358			
			C	1	1.2		1	1	26.358			
L5 35.00-0.00	674.04	7315.80	A	1	1.2	5	1	1	108.485	1020.77	29.16	C
			B	1	1.2		1	1	108.485			
			C	1	1.2		1	1	108.485			
Sum Weight:	2289.33	18285.71						OTM	194221.55 lb-ft	3400.82		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	115.83	1133.58	A	1	1.2	10	1	1	47.649	840.71	27.79	C
120.00-89.75			B	1	1.2		1	1	47.649			
			C	1	1.2		1	1	47.649			
L2	324.69	1011.33	A	1	1.2	9	1	1	37.784	602.19	30.49	C
89.75-70.00			B	1	1.2		1	1	37.784			
			C	1	1.2		1	1	37.784			
L3	428.52	2000.18	A	1	1.2	9	1	1	57.490	912.66	35.67	C
70.00-44.42			B	1	1.2		1	1	57.490			

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
			C	1	1.2		1	1	57.490			
L4	161.88	1101.17	A	1	1.2	8	1	1	23.161	332.96	35.36	C
44.42-35.00			B	1	1.2		1	1	23.161			
			C	1	1.2		1	1	23.161			
L5 35.00-0.00	522.59	4489.08	A	1	1.2	7	1	1	97.537	1118.20	31.95	C
			B	1	1.2		1	1	97.537			
			C	1	1.2		1	1	97.537			
Sum Weight:	1553.51	9735.34						OTM	220230.69 lb-ft	3806.73		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	115.83	1133.58	A	1	1.2	10	1	1	47.649	840.71	27.79	C
120.00-89.75			B	1	1.2		1	1	47.649			
			C	1	1.2		1	1	47.649			
L2	324.69	1011.33	A	1	1.2	9	1	1	37.784	602.19	30.49	C
89.75-70.00			B	1	1.2		1	1	37.784			
			C	1	1.2		1	1	37.784			
L3	428.52	2000.18	A	1	1.2	9	1	1	57.490	912.66	35.67	C
70.00-44.42			B	1	1.2		1	1	57.490			
			C	1	1.2		1	1	57.490			
L4	161.88	1101.17	A	1	1.2	8	1	1	23.161	332.96	35.36	C
44.42-35.00			B	1	1.2		1	1	23.161			
			C	1	1.2		1	1	23.161			
L5 35.00-0.00	522.59	4489.08	A	1	1.2	7	1	1	97.537	1118.20	31.95	C
			B	1	1.2		1	1	97.537			
			C	1	1.2		1	1	97.537			
Sum Weight:	1553.51	9735.34						OTM	220230.69 lb-ft	3806.73		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	115.83	1133.58	A	1	1.2	10	1	1	47.649	840.71	27.79	C
120.00-89.75			B	1	1.2		1	1	47.649			
			C	1	1.2		1	1	47.649			
L2	324.69	1011.33	A	1	1.2	9	1	1	37.784	602.19	30.49	C
89.75-70.00			B	1	1.2		1	1	37.784			
			C	1	1.2		1	1	37.784			
L3	428.52	2000.18	A	1	1.2	9	1	1	57.490	912.66	35.67	C
70.00-44.42			B	1	1.2		1	1	57.490			
			C	1	1.2		1	1	57.490			

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L4	161.88	1101.17	A	1	1.2	8	1	1	23.161	332.96	35.36	C
44.42-35.00			B	1	1.2		1	1	23.161			
			C	1	1.2		1	1	23.161			
L5 35.00-0.00	522.59	4489.08	A	1	1.2	7	1	1	97.537	1118.20	31.95	C
			B	1	1.2		1	1	97.537			
			C	1	1.2		1	1	97.537			
Sum Weight:	1553.51	9735.34						OTM	220230.69 lb-ft	3806.73		

Force Totals

Load Case	Vertical Forces lb	Sum of Forces X lb	Sum of Forces Z lb	Sum of Overturning Moments, M_x lb-ft	Sum of Overturning Moments, M_z lb-ft	Sum of Torques lb-ft
Leg Weight	9735.34					
Bracing Weight	0.00					
Total Member Self-Weight	9735.34			28.62	192.18	
Total Weight	18452.15			28.62	192.18	
Wind 0 deg - No Ice		0.00	-16113.22	-1119762.26	192.18	-1592.16
Wind 30 deg - No Ice		7988.00	-13969.32	-971373.40	-551936.24	-672.70
Wind 60 deg - No Ice		14039.59	-8054.84	-559671.49	-978559.16	105.01
Wind 90 deg - No Ice		16135.41	97.76	10782.32	-1121600.51	1345.00
Wind 120 deg - No Ice		13998.32	8064.79	560823.25	-974019.62	1884.71
Wind 150 deg - No Ice		8147.01	13891.32	962850.45	-569427.96	1827.61
Wind 180 deg - No Ice		0.00	16167.24	1125761.81	192.18	973.93
Wind 210 deg - No Ice		-8147.01	13891.32	962850.45	569812.31	371.54
Wind 240 deg - No Ice		-13998.32	8064.79	560823.25	974403.98	-698.80
Wind 270 deg - No Ice		-16135.41	97.76	10782.32	1121984.87	-1679.21
Wind 300 deg - No Ice		-14039.59	-8054.84	-559671.49	978943.52	-2509.51
Wind 330 deg - No Ice		-7988.00	-13969.32	-971373.40	552320.60	-2174.20
Member Ice	8550.37					
Total Weight Ice	45517.94			249.90	1396.81	
Wind 0 deg - Ice		0.00	-6239.95	-458570.96	1396.81	-417.25
Wind 30 deg - Ice		3093.97	-5409.28	-397686.52	-225086.49	-156.82
Wind 60 deg - Ice		5437.53	-3117.44	-228881.38	-399533.01	24.65
Wind 90 deg - Ice		6249.01	37.96	4425.71	-458289.06	381.14
Wind 120 deg - Ice		5421.04	3123.82	230083.85	-397719.08	509.84
Wind 150 deg - Ice		3154.86	5380.62	395034.23	-231784.97	467.87
Wind 180 deg - Ice		0.00	6261.99	461495.25	1396.81	186.69
Wind 210 deg - Ice		-3154.86	5380.62	395034.23	234578.60	47.39
Wind 240 deg - Ice		-5421.04	3123.82	230083.85	400512.71	-243.70
Wind 270 deg - Ice		-6249.01	37.96	4425.71	461082.69	-506.14
Wind 300 deg - Ice		-5437.53	-3117.44	-228881.38	402326.64	-743.49
Wind 330 deg - Ice		-3093.97	-5409.28	-397686.52	227880.12	-598.71
Total Weight	18452.15			28.62	192.18	
Wind 0 deg - Service		0.00	-5516.16	-383386.46	73.05	-545.05
Wind 30 deg - Service		2734.59	-4782.22	-332587.40	-188941.16	-230.29
Wind 60 deg - Service		4806.28	-2757.47	-191646.44	-334990.14	35.95
Wind 90 deg - Service		5523.75	33.47	3641.23	-383958.54	460.45
Wind 120 deg - Service		4792.15	2760.88	191940.82	-333436.08	645.21
Wind 150 deg - Service		2789.03	4755.52	329569.77	-194929.22	625.66
Wind 180 deg - Service		0.00	5534.65	385340.42	73.05	333.41
Wind 210 deg - Service		-2789.03	4755.52	329569.77	195075.33	127.19

Load Case	Vertical Forces lb	Sum of Forces X lb	Sum of Forces Z lb	Sum of Overturning Moments, M_x lb-ft	Sum of Overturning Moments, M_z lb-ft	Sum of Torques lb-ft
Wind 240 deg - Service		-4792.15	2760.88	191940.82	333582.19	-239.23
Wind 270 deg - Service		-5523.75	33.47	3641.23	384104.65	-574.86
Wind 300 deg - Service		-4806.28	-2757.47	-191646.44	335136.25	-859.10
Wind 330 deg - Service		-2734.59	-4782.22	-332587.40	189087.26	-744.31

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+1.0 Temp
27	1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp
28	1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp
29	1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp
30	1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp
31	1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp
32	1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp
33	1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp
34	1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp
35	1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp
36	1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp
37	1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp
38	1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp
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

Comb. No.	Description
48	Dead+Wind 270 deg - Service
49	Dead+Wind 300 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial lb	Major Axis Moment lb-ft	Minor Axis Moment lb-ft
L1	120 - 89.75	Pole	Max Tension	33	0.01	-0.30	0.67
			Max. Compression	26	-22165.70	356.76	45.53
			Max. Mx	20	-3290.00	105127.84	-2817.40
			Max. My	14	-3273.04	110.51	-106652.72
			Max. Vy	8	8982.93	-65480.08	-1677.44
			Max. Vx	14	9006.16	54.87	-66424.02
			Max. Torque	22			1942.83
L2	89.75 - 70	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-32185.10	947.87	-152.90
			Max. Mx	20	-9937.48	403701.17	-6671.36
			Max. My	14	-9925.14	133.77	-406436.77
			Max. Vy	20	-15407.84	403701.17	-6671.36
			Max. Vx	14	15463.27	133.77	-406436.77
			Max. Torque	22			2403.46
L3	70 - 44.417	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-37354.63	1350.76	-102.69
			Max. Mx	20	-12859.71	783354.04	-10359.66
			Max. My	14	-12850.73	160.50	-787256.12
			Max. Vy	20	-19339.90	783354.04	-10359.66
			Max. Vx	14	19394.42	160.50	-787256.12
			Max. Torque	23			2974.65
L4	44.417 - 35	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-40675.44	1458.24	-164.79
			Max. Mx	20	-15075.70	1048404.52	-12532.85
			Max. My	14	-15069.08	185.31	-1053003.14
			Max. Vy	20	-21373.37	1048404.52	-12532.85
			Max. Vx	14	21427.18	185.31	-1053003.14
			Max. Torque	23			3337.05
L5	35 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-49667.63	1674.68	-289.97
			Max. Mx	20	-22110.68	1875650.13	-18177.61
			Max. My	14	-22110.51	228.10	-1882068.38
			Max. Vy	20	-25843.98	1875650.13	-18177.61
			Max. Vx	14	25895.01	228.10	-1882068.38
			Max. Torque	23			3952.40

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical lb	Horizontal, X lb	Horizontal, Z lb
Pole	Max. Vert	37	49667.63	5437.60	3117.47

Location	Condition	Gov. Load Comb.	Vertical lb	Horizontal, X lb	Horizontal, Z lb
	Max. H_x	20	22142.58	25816.66	-156.42
	Max. H_z	2	22142.58	0.00	25781.16
	Max. M_x	2	1872032.34	0.00	25781.16
	Max. M_z	8	1875158.42	-25816.66	-156.42
	Max. Torsion	23	3952.42	22463.34	12887.74
	Min. Vert	23	16606.93	22463.34	12887.74
	Min. H_x	8	22142.58	-25816.66	-156.42
	Min. H_z	14	22142.58	0.00	-25867.59
	Min. M_x	14	-1882068.38	0.00	-25867.59
	Min. M_z	20	-1875650.14	25816.66	-156.42
	Min. Torsion	11	-2972.76	-22397.31	-12903.66

Tower Mast Reaction Summary

Load Combination	Vertical lb	$Shear_x$ lb	$Shear_z$ lb	Overturning Moment, M_x lb-ft	Overturning Moment, M_z lb-ft	Torque lb-ft
Dead Only	18452.15	0.00	0.00	28.62	192.18	0.00
1.2 Dead+1.6 Wind 0 deg - No Ice	22142.58	-0.00	-25781.16	-1872032.34	209.77	-2504.81
0.9 Dead+1.6 Wind 0 deg - No Ice	16606.93	-0.00	-25781.16	-1849841.41	154.70	-2504.21
1.2 Dead+1.6 Wind 30 deg - No Ice	22142.58	12780.80	-22350.91	-1624003.69	-922685.73	-1051.65
0.9 Dead+1.6 Wind 30 deg - No Ice	16606.93	12780.80	-22350.91	-1604746.58	-911842.66	-1050.78
1.2 Dead+1.6 Wind 60 deg - No Ice	22142.58	22463.34	-12887.74	-935613.50	-1636092.48	180.66
0.9 Dead+1.6 Wind 60 deg - No Ice	16606.93	22463.34	-12887.74	-924532.35	-1616716.59	181.00
1.2 Dead+1.6 Wind 90 deg - No Ice	22142.58	25816.66	156.42	18186.45	-1875158.42	2127.25
0.9 Dead+1.6 Wind 90 deg - No Ice	16606.93	25816.66	156.42	17913.21	-1852981.84	2127.69
1.2 Dead+1.6 Wind 120 deg - No Ice	22142.58	22397.31	12903.66	937536.01	-1628473.06	2972.62
0.9 Dead+1.6 Wind 120 deg - No Ice	16606.93	22397.31	12903.66	926412.91	-1609205.03	2972.76
1.2 Dead+1.6 Wind 150 deg - No Ice	22142.58	13035.22	22226.11	1609555.44	-952244.91	2880.78
0.9 Dead+1.6 Wind 150 deg - No Ice	16606.93	13035.22	22226.11	1590497.14	-940961.16	2880.37
1.2 Dead+1.6 Wind 180 deg - No Ice	22142.58	-0.00	25867.59	1882068.38	227.53	1539.74
0.9 Dead+1.6 Wind 180 deg - No Ice	16606.93	-0.00	25867.59	1859714.44	167.53	1538.26
1.2 Dead+1.6 Wind 210 deg - No Ice	22142.58	-13035.22	22226.11	1609579.15	952696.84	586.10
0.9 Dead+1.6 Wind 210 deg - No Ice	16606.93	-13035.22	22226.11	1590514.29	941294.00	584.73
1.2 Dead+1.6 Wind 240 deg - No Ice	22142.58	-22397.31	12903.66	937557.15	1628952.46	-1102.07
0.9 Dead+1.6 Wind 240 deg - No Ice	16606.93	-22397.31	12903.66	926428.21	1609557.74	-1103.37
1.2 Dead+1.6 Wind 270 deg - No Ice	22142.58	-25816.66	156.42	18176.65	1875650.14	-2648.41
0.9 Dead+1.6 Wind 270 deg -	16606.93	-25816.66	156.42	17906.14	1853343.47	-2649.42

Load Combination	Vertical	$Shear_x$	$Shear_z$	Overturning Moment, M_x	Overturning Moment, M_z	Torque
	lb	lb	lb	lb-ft	lb-ft	lb-ft
No Ice 1.2 Dead+1.6 Wind 300 deg - No Ice	22142.58	-22463.34	-12887.74	-935665.72	1636554.15	-3951.44
0.9 Dead+1.6 Wind 300 deg - No Ice	16606.93	-22463.34	-12887.74	-924570.09	1617056.50	-3952.42
1.2 Dead+1.6 Wind 330 deg - No Ice	22142.58	-12780.80	-22350.91	-1624035.57	923120.94	-3426.65
0.9 Dead+1.6 Wind 330 deg - No Ice	16606.93	-12780.80	-22350.91	-1604769.63	912163.42	-3426.61
1.2 Dead+1.0 Ice+1.0 Temp	49667.63	-0.01	0.00	289.97	1674.68	-0.00
1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp	49667.63	-0.00	-6240.02	-527754.33	1772.94	-429.12
1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp	49667.63	3094.00	-5409.34	-457702.88	-258766.51	-166.66
1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp	49667.63	5437.55	-3117.44	-263395.69	-459777.56	19.36
1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp	49667.63	6249.09	37.96	5262.29	-527287.21	381.50
1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp	49667.63	5421.06	3123.83	264836.98	-457625.18	516.12
1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp	49667.63	3154.90	5380.69	454565.16	-266726.31	478.59
1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp	49667.63	-0.00	6262.06	531241.31	1777.16	199.21
1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp	49667.63	-3154.87	5380.63	454579.03	270284.77	57.53
1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp	49667.63	-5421.06	3123.83	264840.41	461182.66	-237.70
1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp	49667.63	-6249.09	37.96	5259.86	530846.64	-505.83
1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp	49667.63	-5437.60	-3117.47	-263400.94	463320.75	-749.28
1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp	49667.63	-3093.97	-5409.29	-457718.93	262320.88	-609.40
Dead+Wind 0 deg - Service	18452.15	-0.00	-5516.16	-398390.91	203.69	-546.23
Dead+Wind 30 deg - Service	18452.15	2734.59	-4782.22	-345601.74	-196214.12	-231.18
Dead+Wind 60 deg - Service	18452.15	4806.28	-2757.47	-199110.49	-348062.56	35.56
Dead+Wind 90 deg - Service	18452.15	5523.76	33.47	3893.38	-398929.96	460.42
Dead+Wind 120 deg - Service	18452.15	4792.15	2760.88	199563.75	-346432.31	645.71
Dead+Wind 150 deg - Service	18452.15	2789.03	4755.52	342578.98	-202499.37	626.69
Dead+Wind 180 deg - Service	18452.15	-0.00	5534.65	400585.85	204.36	334.83
Dead+Wind 210 deg - Service	18452.15	-2789.03	4755.52	342579.88	202907.97	128.37
Dead+Wind 240 deg - Service	18452.15	-4792.15	2760.88	199564.55	346841.96	-238.41
Dead+Wind 270 deg - Service	18452.15	-5523.76	33.47	3893.01	399340.08	-574.65
Dead+Wind 300 deg - Service	18452.15	-4806.28	-2757.47	-199112.48	348471.54	-859.55
Dead+Wind 330 deg - Service	18452.15	-2734.59	-4782.22	-345602.96	196622.09	-745.42

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX	PY	PZ	PX	PY	PZ	% Error
	lb	lb	lb	lb	lb	lb	
1	0.00	-18452.15	0.00	0.00	18452.15	0.00	0.000%
2	0.00	-22142.58	-25781.16	0.00	22142.58	25781.16	0.000%
3	0.00	-16606.93	-25781.16	0.00	16606.93	25781.16	0.000%
4	12780.80	-22142.58	-22350.91	-12780.80	22142.58	22350.91	0.000%
5	12780.80	-16606.93	-22350.91	-12780.80	16606.93	22350.91	0.000%
6	22463.34	-22142.58	-12887.74	-22463.34	22142.58	12887.74	0.000%

Load Comb.	Sum of Applied Forces PX lb	PY lb	PZ lb	Sum of Reactions PX lb	PY lb	PZ lb	% Error
7	22463.34	-16606.93	-12887.74	-22463.34	16606.93	12887.74	0.000%
8	25816.66	-22142.58	156.42	-25816.66	22142.58	-156.42	0.000%
9	25816.66	-16606.93	156.42	-25816.66	16606.93	-156.42	0.000%
10	22397.31	-22142.58	12903.66	-22397.31	22142.58	-12903.66	0.000%
11	22397.31	-16606.93	12903.66	-22397.31	16606.93	-12903.66	0.000%
12	13035.22	-22142.58	22226.11	-13035.22	22142.58	-22226.11	0.000%
13	13035.22	-16606.93	22226.11	-13035.22	16606.93	-22226.11	0.000%
14	0.00	-22142.58	25867.59	0.00	22142.58	-25867.59	0.000%
15	0.00	-16606.93	25867.59	0.00	16606.93	-25867.59	0.000%
16	-13035.22	-22142.58	22226.11	13035.22	22142.58	-22226.11	0.000%
17	-13035.22	-16606.93	22226.11	13035.22	16606.93	-22226.11	0.000%
18	-22397.31	-22142.58	12903.66	22397.31	22142.58	-12903.66	0.000%
19	-22397.31	-16606.93	12903.66	22397.31	16606.93	-12903.66	0.000%
20	-25816.66	-22142.58	156.42	25816.66	22142.58	-156.42	0.000%
21	-25816.66	-16606.93	156.42	25816.66	16606.93	-156.42	0.000%
22	-22463.34	-22142.58	-12887.74	22463.34	22142.58	12887.74	0.000%
23	-22463.34	-16606.93	-12887.74	22463.34	16606.93	12887.74	0.000%
24	-12780.80	-22142.58	-22350.91	12780.80	22142.58	22350.91	0.000%
25	-12780.80	-16606.93	-22350.91	12780.80	16606.93	22350.91	0.000%
26	0.00	-49667.63	0.00	0.01	49667.63	-0.00	0.000%
27	0.00	-49667.63	-6239.95	0.00	49667.63	6240.02	0.000%
28	3093.97	-49667.63	-5409.28	-3094.00	49667.63	5409.34	0.000%
29	5437.53	-49667.63	-3117.44	-5437.55	49667.63	3117.44	0.000%
30	6249.01	-49667.63	37.96	-6249.09	49667.63	-37.96	0.000%
31	5421.04	-49667.63	3123.82	-5421.06	49667.63	-3123.83	0.000%
32	3154.86	-49667.63	5380.62	-3154.90	49667.63	-5380.69	0.000%
33	0.00	-49667.63	6261.99	0.00	49667.63	-6262.06	0.000%
34	-3154.86	-49667.63	5380.62	3154.87	49667.63	-5380.63	0.000%
35	-5421.04	-49667.63	3123.82	5421.06	49667.63	-3123.83	0.000%
36	-6249.01	-49667.63	37.96	6249.09	49667.63	-37.96	0.000%
37	-5437.53	-49667.63	-3117.44	5437.60	49667.63	3117.47	0.000%
38	-3093.97	-49667.63	-5409.28	3093.97	49667.63	5409.29	0.000%
39	0.00	-18452.15	-5516.16	0.00	18452.15	5516.16	0.000%
40	2734.59	-18452.15	-4782.22	-2734.59	18452.15	4782.22	0.000%
41	4806.28	-18452.15	-2757.47	-4806.28	18452.15	2757.47	0.000%
42	5523.75	-18452.15	33.47	-5523.76	18452.15	-33.47	0.000%
43	4792.15	-18452.15	2760.88	-4792.15	18452.15	-2760.88	0.000%
44	2789.03	-18452.15	4755.52	-2789.03	18452.15	-4755.52	0.000%
45	0.00	-18452.15	5534.65	0.00	18452.15	-5534.65	0.000%
46	-2789.03	-18452.15	4755.52	2789.03	18452.15	-4755.52	0.000%
47	-4792.15	-18452.15	2760.88	4792.15	18452.15	-2760.88	0.000%
48	-5523.75	-18452.15	33.47	5523.76	18452.15	-33.47	0.000%
49	-4806.28	-18452.15	-2757.47	4806.28	18452.15	2757.47	0.000%
50	-2734.59	-18452.15	-4782.22	2734.59	18452.15	4782.22	0.000%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	4	0.00000001	0.00000001
2	Yes	5	0.00000001	0.00059212
3	Yes	5	0.00000001	0.00024931
4	Yes	6	0.00000001	0.00032631
5	Yes	6	0.00000001	0.00008792
6	Yes	6	0.00000001	0.00034873
7	Yes	6	0.00000001	0.00009433

8	Yes	5	0.00000001	0.00049825
9	Yes	5	0.00000001	0.00020710
10	Yes	6	0.00000001	0.00036238
11	Yes	6	0.00000001	0.00009906
12	Yes	6	0.00000001	0.00032377
13	Yes	6	0.00000001	0.00008600
14	Yes	5	0.00000001	0.00031967
15	Yes	5	0.00000001	0.00013383
16	Yes	6	0.00000001	0.00034971
17	Yes	6	0.00000001	0.00009471
18	Yes	6	0.00000001	0.00034628
19	Yes	6	0.00000001	0.00009366
20	Yes	5	0.00000001	0.00064452
21	Yes	5	0.00000001	0.00026878
22	Yes	6	0.00000001	0.00031650
23	Yes	6	0.00000001	0.00008351
24	Yes	6	0.00000001	0.00036826
25	Yes	6	0.00000001	0.00010185
26	Yes	4	0.00000001	0.00008007
27	Yes	6	0.00000001	0.00052333
28	Yes	6	0.00000001	0.00095243
29	Yes	7	0.00000001	0.00018530
30	Yes	6	0.00000001	0.00051354
31	Yes	7	0.00000001	0.00018791
32	Yes	6	0.00000001	0.00097071
33	Yes	6	0.00000001	0.00051893
34	Yes	7	0.00000001	0.00018825
35	Yes	7	0.00000001	0.00018644
36	Yes	6	0.00000001	0.00052292
37	Yes	6	0.00000001	0.00097862
38	Yes	7	0.00000001	0.00018956
39	Yes	4	0.00000001	0.00075044
40	Yes	5	0.00000001	0.00009894
41	Yes	5	0.00000001	0.00011788
42	Yes	4	0.00000001	0.00045110
43	Yes	5	0.00000001	0.00013207
44	Yes	5	0.00000001	0.00010045
45	Yes	4	0.00000001	0.00042873
46	Yes	5	0.00000001	0.00011910
47	Yes	5	0.00000001	0.00011572
48	Yes	4	0.00000001	0.00062522
49	Yes	5	0.00000001	0.00009906
50	Yes	5	0.00000001	0.00013897

Maximum Tower Deflections - Service Wind

Section No.	*Elevation*	*Horz. Deflection*	*Gov. Load Comb.*	*Tilt*	*Twist*
	ft	*in*		°	°
L1	120 - 89.75	25.739	49	1.7244	0.0104
L2	92.42 - 70	15.950	49	1.6180	0.0068
L3	70 - 44.417	9.081	49	1.2453	0.0041
L4	48 - 35	4.231	49	0.8458	0.0023
L5	35 - 0	2.217	49	0.6031	0.0015

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
117.00	DB809K-XC	49	24.649	1.7236	0.0150	34948
110.00	2' Diameter Dish w/o Radome	49	22.114	1.7175	0.0135	17474
105.00	4' T-Arm (7' Face)	49	20.323	1.7050	0.0125	11649
90.00	(2) 4' T-Boom (7' Face)	49	15.139	1.5888	0.0093	5493
54.00	Pirod 4' Side Mount Standoff	49	5.373	0.9551	0.0037	3367

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	120 - 89.75	120.592	22	8.1036	0.0499
L2	92.42 - 70	74.819	22	7.6088	0.0328
L3	70 - 44.417	42.639	22	5.8577	0.0191
L4	48 - 35	19.879	22	3.9777	0.0107
L5	35 - 0	10.416	22	2.8358	0.0069

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
117.00	DB809K-XC	22	115.494	8.1007	0.0683	7774
110.00	2' Diameter Dish w/o Radome	22	103.647	8.0733	0.0616	3885
105.00	4' T-Arm (7' Face)	22	95.274	8.0159	0.0567	2588
90.00	(2) 4' T-Boom (7' Face)	22	71.023	7.4718	0.0423	1213
54.00	Pirod 4' Side Mount Standoff	22	25.241	4.4920	0.0168	725

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
L1	120 - 89.75 (1)	TP21.287x16x0.188	30.25	0.00	0.0	12.3116	-3271.09	892475.00	0.004
L2	89.75 - 70 (2)	TP24.3628x20.4443x0.188	22.42	0.00	0.0	14.4254	-9919.00	995069.00	0.010
L3	70 - 44.417 (3)	TP28.8342x24.3628x0.275	25.58	0.00	0.0	24.3813	-12846.10	1804540.00	0.007
L4	44.417 - 35 (4)	TP29.93x27.6579x0.275	13.00	0.00	0.0	25.8844	-15065.60	1885590.00	0.008
L5	35 - 0 (5)	TP36.0472x29.93x0.364	35.00	0.00	0.0	41.2261	-22110.40	3062890.00	0.007

Pole Bending Design Data

Section No.	Elevation ft	Size	M_{ux} lb-ft	ϕM_{nx} lb-ft	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	M_{uy} lb-ft	ϕM_{ny} lb-ft	Ratio $\frac{M_{uy}}{\phi M_{ny}}$
L1	120 - 89.75 (1)	TP21.287x16x0.188	106708.33	378179.17	0.282	0.00	378179.17	0.000
L2	89.75 - 70 (2)	TP24.3628x20.4443x0.188	407262.50	494703.33	0.823	0.00	494703.33	0.000
L3	70 - 44.417 (3)	TP28.8342x24.3628x0.275	788840.83	1034475.00	0.763	0.00	1034475.00	0.000
L4	44.417 - 35 (4)	TP29.93x27.6579x0.275	1055000.00	1148233.33	0.919	0.00	1148233.33	0.000
L5	35 - 0 (5)	TP36.0472x29.93x0.364	1885150.00	2242233.33	0.841	0.00	2242233.33	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V_u lb	ϕV_n lb	Ratio $\frac{V_u}{\phi V_n}$	Actual T_u lb-ft	ϕT_n lb-ft	Ratio $\frac{T_u}{\phi T_n}$
L1	120 - 89.75 (1)	TP21.287x16x0.188	7261.62	446237.00	0.016	1942.83	758324.17	0.003
L2	89.75 - 70 (2)	TP24.3628x20.4443x0.188	15495.60	497535.00	0.031	2403.46	991783.33	0.002
L3	70 - 44.417 (3)	TP28.8342x24.3628x0.275	19426.40	902268.00	0.022	2974.29	2074550.00	0.001
L4	44.417 - 35 (4)	TP29.93x27.6579x0.275	21458.80	942795.00	0.023	3336.39	2302483.33	0.001
L5	35 - 0 (5)	TP36.0472x29.93x0.364	25925.20	1531450.00	0.017	3951.42	4496850.00	0.001

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P_u}{\phi P_n}$	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	Ratio $\frac{M_{uy}}{\phi M_{ny}}$	Ratio $\frac{V_u}{\phi V_n}$	Ratio $\frac{T_u}{\phi T_n}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	120 - 89.75 (1)	0.004	0.282	0.000	0.016	0.003	0.286 ✔	1.000	4.8.2 ✔
L2	89.75 - 70 (2)	0.010	0.823	0.000	0.031	0.002	0.834 ✔	1.000	4.8.2 ✔
L3	70 - 44.417 (3)	0.007	0.763	0.000	0.022	0.001	0.770 ✔	1.000	4.8.2 ✔
L4	44.417 - 35 (4)	0.008	0.919	0.000	0.023	0.001	0.927 ✔	1.000	4.8.2 ✔
L5	35 - 0 (5)	0.007	0.841	0.000	0.017	0.001	0.848 ✔	1.000	4.8.2 ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	ϕP_{allow} lb	% Capacity	Pass Fail
L1	120 - 89.75	Pole	TP21.287x16x0.188	1	-3271.09	892475.00	28.6	Pass
L2	89.75 - 70	Pole	TP24.3628x20.4443x0.188	2	-9919.00	995069.00	83.4	Pass

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	ϕP_{allow} lb	% Capacity	Pass Fail
L3	70 - 44.417	Pole	TP28.8342x24.3628x0.275	3	-12846.10	1804540.00	77.0	Pass
L4	44.417 - 35	Pole	TP29.93x27.6579x0.275	4	-15065.60	1885590.00	92.7	Pass
L5	35 - 0	Pole	TP36.0472x29.93x0.364	5	-22110.40	3062890.00	84.8	Pass
							Summary	
						Pole (L4)	92.7	Pass
						RATING =	**92.7**	**Pass**

Dewberry

Job Number	50121823
Made by:	BGK
Date:	12/29/2020
Checked by:	DAP
Date:	12/30/2020

(Hartford 9 CT) - Anchor Bolt & Base Plate

\\capecod\projects\50121487\50121823 - Hartford 9 CT\Engineering\Structural\Rev 0\Calcs\50110171 - Monopole Anchor Bolts, Base Plate and Foundation Check.xlsx

-TIA 222 Rev G

Site Name: Hartford 9 CT

Monopole Anchor Bolt & Base Plate Check

	LRFD Loads	
Global Axial Force (1.2DL), P_L =	22.1 kips	*(TNX Tower MTO)*
Global Shear Force (1.6WL), S_L =	25.9 kips	*(TNX Tower MTO)*
Global Moment (1.6WL), M_L =	1885.1 kip-ft	*(TNX Tower MTO)*

Existing Anchor Bolt Data:

Number of Anchor Bolts, N =	6
Diameter of Bolt Circle, d_{bc} =	41.50 in
Bolt "Column" Distance, l =	3.50 in
Bolt Ultimate Strength, F_u =	100 ksi
Bolt Yield Strength, F_y =	75 ksi
Bolt Modulus of Elasticity, E =	29000 ksi
Diameter of Anchor Bolt Circle, d_{ab} =	2.25 in
Threads per Inch, n =	4.5
Top of Concrete to Bolt Leveling Nut, l_{ar} =	2.00 in

Reinforcement Anchor Bolt Data:

Number of Anchor Bolts, N_o =	6
Diameter of Bolt Circle, d_{bco} =	50.38 in
Bolt "Column" Distance, l_o =	3.00 in
Bolt Ultimate Strength, F_{uo} =	100 ksi
Bolt Yield Strength, F_{yo} =	75 ksi
Bolt Modulus of Elasticity, E_o =	29000 ksi
Diameter of Anchor Bolt Circle, d_{abo} =	2.75 in
Threads per Inch, n_o =	4

Base Plate Data:

Plate Yield Strength, F_{ybp} =	50 ksi	Base Plate Diameter, d_{bp} =	47.50 in
Base Plate Thickness, t_{bp} =	2.25 in	Monopole Outside Diameter, d_{mp} =	36.00 in
η =	0.5	*per TIA-222-G Section 4.9.9 (detail type d)*	

Geometry:

Distance from Bolts to Centroid of Monopole:

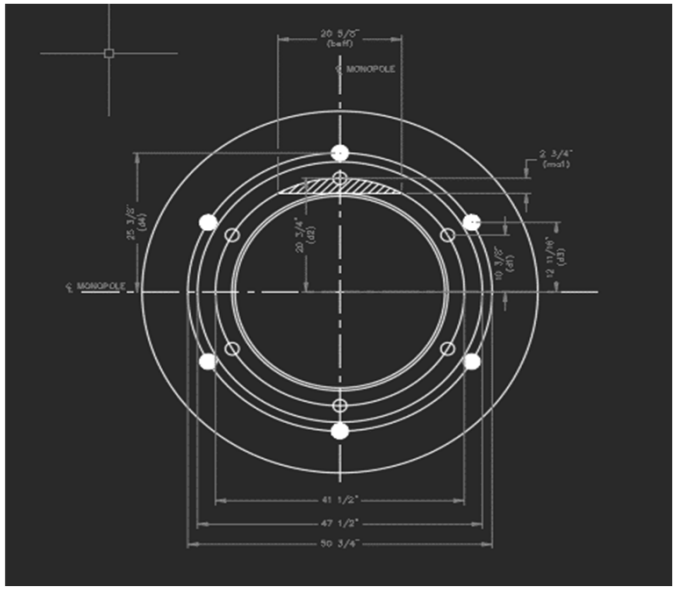
d_1 =	10.38 in
d_2 =	20.75 in
d_3 =	12.69 in
d_4 =	25.38 in

Critical Distances for Bending in Plate:

m_{a1} =	2.75 in

Effective Width of Base Plate (Bending):

b_{eff} =	20.63 in



Analysis of Inner Anchor Bolts:

Total Polar Moment of Inertia, $I_p = d_1^2 * 4 + d_2^2 * 2 + d_3^2 * 4 + d_4^2 * 2$
$= 3224.54 \text{ in}^2$

Gross Area of Inner Bolts, $A_{gi} = \pi / 4 * d_{ab}^2$
$= 3.98 \text{ in}^2$

Net Area of Inner Bolts, $A_{ni} = \pi / 4 * (d_{ab} - 0.9743 / n)^2$ *per TIA-222-G Section 4.9.9 (detail type d)*
$= 3.25 \text{ in}^2$

Net Diameter of Inner Bolts, $d_{ni} = 2 * \sqrt{A_{ni}} / \sqrt{\pi}$
$= 2.03 \text{ in}$

Radius of Gyration of Inner Bolts, $r_i = d_{ni} / 4$
$= 0.51 \text{ in}$

Section Modulus of Inner Bolts, $S_{xi} = \pi * d_{ni}^3 / 32$
$= 0.83 \text{ in}^3$

Plastic Modulus of Inner Bolts, $Z_{xi} = d_{ni}^3 / 6$
$= 1.40 \text{ in}^3$

Anchor Bolt Tension Force Check:

Maximum Tensile Force, $T_{MAX} = M_L * d_2 / I_p - P_L / N$
$= 141.9 \text{ kips}$

Maximum Compressive Force, $P_u = M_L * d_2 / I_p + P_L / N$
$= 149.3 \text{ kips}$

Maximum Shear Force, $V_u = S_L / N$
$= 4.3 \text{ kips}$

Tensile Check:

Design Tensile Strength, $\Phi R_{nt} = 0.75 * F_u * A_{ni}$
$= 243.6 \text{ kips}$

Tensile Capacity of Bolt = $(P_u + V_u / \eta) / \Phi R_{nt}$
$= 64.8\% \leq 100\%$ **OK!**

Shear Check:

Design Shear Strength, $\Phi R_{nv} = 0.75 * 0.45 * F_u * A_{gi}$
$= 134.2 \text{ kips}$

Shear Capacity of Bolt = $V_u / \Phi R_{nv}$
$= 3.2\% \leq 100\%$ **OK!**

Flexure Check:

Design Flexure Strength, $\Phi R_{nm} = 0.9 * F_y * Z_{xi}$
$= 94.6 \text{ kip-ft}$

M_u = if $l_{ar} < d_{ab}$, 0; otherwise, $0.65 * l_{ar} * V_u$
$= 0.0 \text{ kip-ft}$

Flexure Capacity of Bolt = $M_u / \Phi R_{nm}$
$= 0.0\% \leq 100\%$ **OK!**

Combined Check:

Capacity of Bolt = $(V_u / \Phi R_{nv})^2 + (P_u / \Phi R_{nt} + M_u / \Phi R_{nm})^2$
$= 37.6\% \leq 100\%$ **OK!**

Analysis of Outer Anchor Bolts:

Total Polar Moment of Inertia, $I_p = d_1^2 * 4 + d_2^2 * 2 + d_3^2 * 4 + d_4^2 * 2$
$= 3224.54 \text{ in}^2$

Gross Area of Outer Bolts, $A_{go} = \pi / 4 * d_{abo}^2$
$= 5.94 \text{ in}^2$

Net Area of Outer Bolts, $A_{no} = \pi / 4 * (d_{abo} - 0.9743 / n_o)^2$ *per TIA-222-G Section 4.9.9 (detail type d)*
$= 4.93 \text{ in}^2$

Net Diameter of Outer Bolts, $d_{no} = 2 * \sqrt{A_{no}} / \sqrt{\pi}$
$= 2.51 \text{ in}$

Radius of Gyration of Outer Bolts, $r_o = d_{no} / 4$
$= 0.63 \text{ in}$

Section Modulus of Outer Bolts, $S_{xo} = \pi * d_{no}^3 / 32$
$= 1.55 \text{ in}^3$

Plastic Modulus of Outer Bolts, $Z_{xo} = d_{no}^3 / 6$
$= 2.62 \text{ in}^3$

Anchor Bolt Tension Force Check:

Maximum Tensile Force, $T_{MAX} = M_L * d_4 / I_p - P_L / N_o$
$= 174.4 \text{ kips}$

Maximum Compressive Force, $P_u = M_L * d_4 / I_p + P_L / N_o$
$= 181.7 \text{ kips}$

Maximum Shear Force, $V_u = S_L / N_o$
$= 4.3 \text{ kips}$

Tensile Check:

Design Tensile Strength, $\Phi R_{nt} = 0.8 * F_{uo} * A_{no}$
$= 394.7 \text{ kips}$

Tensile Capacity of Bolt = $(P_u + V_u / \eta) / \Phi R_{nt}$
$= 48.2\% \leq 100\%$ **OK!**

Shear Check:

Design Shear Strength, $\Phi R_{nv} = 0.75 * 0.45 * F_{uo} * A_{go}$
$= 200.5 \text{ kips}$

Shear Capacity of Bolt = $V_u / \Phi R_{nv}$
$= 2.2\% \leq 100\%$ **OK!**

Flexure Check:

Design Flexure Strength, $\Phi R_{nm} = 0.9 * F_{yo} * Z_{xo}$
$= 177.1 \text{ kip-ft}$

M_u = if $I_{ar} < d_{abo}$, 0; otherwise, $0.65 * I_{ar} * V_u$
$= 0.0 \text{ kip-ft}$

Flexure Capacity of Bolt = $M_u / \Phi R_{nm}$
$= 0.0\% \leq 100\%$ **OK!**

Combined Check:

Capacity of Bolt = $(V_u / \Phi R_{nv})^2 + (P_u / \Phi R_{nt} + M_u / \Phi R_{nm})^2$
$= 21.2\%$ **OK!**

Base Plate Analysis:

Force from Bolts, $C_1 = M_L * d_2 / I_p + P_L / N_o$
$= 149.3 \text{ kips}$

Applied Bending Stress in Plate, $f_{bp} = 4 * C_1 * m_{a1} / (b_{eff} + t_{bp}^2)$
$= 15.7 \text{ ksi}$

Allowable Bending Stress in Plate, $F_{bp} = 0.9 * F_{ybp}$
$= 45.0 \text{ ksi}$

Capacity of Base Plate = f_{bp} / F_{bp}
$= 34.9\% \leq 100\%$ **OK!**

Dewberry

Job Number	50121487
Made by:	BGK
Date:	12/29/2020
Checked by:	DAP
Date:	12/30/2020

(Hartford 9 CT) - Foundation

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-TIA 222 Rev G

Site Name: Hartford 9 CT

Monopole Foundation Check

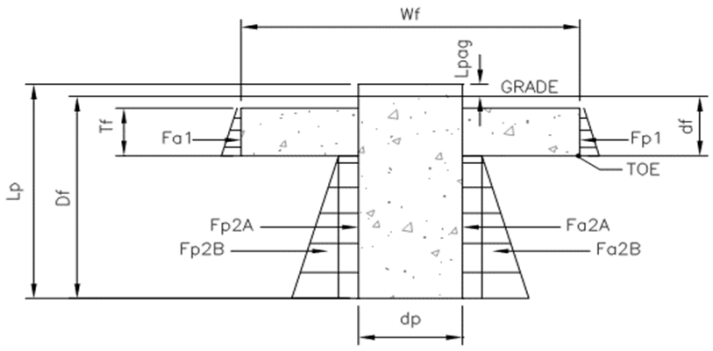
	LRFD Loads	
Global Axial Force (1.2DL), P_L =	22.1 kips	*(TNX Tower MTO)*
Global Shear Force (1.6WL), S_L =	25.9 kips	*(TNX Tower MTO)*
Global Moment (1.6WL), M_L =	1885.1 kip-ft	*(TNX Tower MTO)*

Tower & Monopole Data:

Monopole Height, H_t =	120.00 ft	Footing Thickness, T_f =	2.00 ft
Depth of Footing, D_f =	19.00 ft	Footing Width, W_f =	14.50 ft
Pier Length, L_p =	19.50 ft	Water Depth, d_{water} =	0.00 ft
Pier Extension Above Grade, L_{pag} =	0.50 ft	Distance from Grade to Bottom of Pad, d_f =	4.00 ft
Cassion Diameter, d_p =	5.50 ft		

Material Properties:

Unit Weight of Concrete, γ_c =	150 psf	Internal Friction Angle of Soil, Φ_{s1} =	33 °	*(mat)*
Unit Weight of Soil, γ_{s1} =	120 psf	Internal Friction Angle of Soil, Φ_{s2} =	33 °	*(below mat)*
Unit Weight of Soil, γ_{s2} =	58 psf	Ultimate Soil Bearing Capacity, q_s =	8000 psf	
Concrete Compressive Strength, f'_c =	3000 psi	Depth to Neglect Foundation Bouyancy, n =	0.00 ft	*(if applicable)*
Steel Reinforcement Yield Strength, f_y =	60000 psi	Cohesion of Clay Type Soil, c =	0 ksf	*(0 for Sandy Soil)*
Anchor Bolt Yield Strength, f_{ya} =	75000 psi	Seismic Zone Factor, z =	2	*(UBC-1997, Fig. 23-2)*



Coefficient of Lateral Soil Factors:

$k_{p1} = (1 + \sin(\Phi_{s1}) / (1 - \sin(\Phi_{s1}))$ = 3.39

$k_{a1} = (1 - \sin(\Phi_{s1}) / (1 + \sin(\Phi_{s1}))$ = 0.29

$k_{p2} = (1 + \sin(\Phi_{s2}) / (1 - \sin(\Phi_{s2}))$ = 3.39

$k_{a2} = (1 - \sin(\Phi_{s2}) / (1 + \sin(\Phi_{s2}))$ = 0.29

Footing Stability Check:

Passive Pressure 1, $P_{p1top} = k_{p1} * \gamma_{s1} * (d_f - T_f)$ = 0.814 ksf

Passive Pressure 1, $P_{p1bot} = k_{p1} * \gamma_{s1} * d_f$ = 1.628 ksf

Passive Pressure 1, $P_{p1ave} = (P_{p1top} + P_{p1bot}) / 2$ = 1.221 ksf

Active Pressure 1, $P_{a1top} = k_{a1} * \gamma_{s1} * (d_f - T_f)$ = 0.071 ksf

Active Pressure 1, $P_{a1bot} = k_{a1} * \gamma_{s1} * d_f$ = 0.142 ksf

Active Pressure 1, $P_{a1ave} = (P_{a1top} + P_{a1bot}) / 2$ = 0.106 ksf

Area of Pressure 1, $A_{p1} = T_f * W_f$ = 29.0 ft²

Passive Force 1, $F_{p1} = P_{p1ave} * A_{p1}$ = 35.4 kips

Active Force 1, $F_{a1} = P_{a1ave} * A_{p1}$ = 3.1 kips

Ultimate Shear 1, $S_{u1} = F_{p1} - F_{a1}$ = 32.3 kips

Passive Pressure 2, $P_{p2top} = k_{p2} * \gamma_{s2} * d_f$ = 0.787 ksf

Passive Pressure 2, $P_{p2bot} = k_{p2} * \gamma_{s2} * D_f$ = 3.738 ksf

Active Pressure 2, $P_{a2top} = k_{a2} * \gamma_{s2} * d_f$ = 0.068 ksf

Active Pressure 2, $P_{a2bot} = k_{a2} * \gamma_{s2} * D_f$ = 0.325 ksf

Area of Pressure 2, $A_{p2} = (D_f - d_f) * d_p$ = 82.5 ft²

Passive Force 2, $F_{p2T} = P_{p2top} * A_{p2}$ = 64.9 kips

Passive Force 2, $F_{p2B} = 0.5 * (P_{p2bot} - P_{p2top}) * A_{p2}$ = 121.7 kips

Active Force 2, $F_{a2T} = P_{a2top} * A_{p2}$ = 5.6 kips

Active Force 2, $F_{a2B} = 0.5 * (P_{a2bot} - P_{a2top}) * A_{p2}$ = 10.6 kips

Ultimate Shear 2, $S_{u2T} = F_{p2T} - F_{a2T}$ = 59.3 kips

Ultimate Shear 2, $S_{u2B} = F_{p2B} - F_{a2B}$ = 111.2 kips

Concrete Mat Weight, $W_{mat} = (W_f^2 - d_p^2 * \pi / 4) * T_f * \gamma_c$ = 55.9 kips

Concrete Cassion Weight, $W_{cas} = (d_p^2 * \pi / 4) * L_p * \gamma_c$ = 69.5 kips

Soil Above Mat Weight, $W_{s1} = (W_f^2 - d_p^2 * \pi / 4) * (d_f - T_f) * \gamma_{s1}$ = 44.8 kips

Total Weight, $W_{tot} = 0.9 * (W_{mat} + W_{cas} + P_L) + 0.75W_{s1}$ = 166.4 kips

Overturning Moment, $M_{ot} = M_L + S_L * (d_f + L_{pag})$ = 2001.7 kip-ft

Resisting Moment, $M_r = W_{tot} * W_f / 2 + 0.75 * (S_{u1} * T_f / 3 + S_{u2T} * (D_f - d_f) / 2 + S_{u2B} * 2 * (D_f - d_f) / 3)$ = 2389.4 kip-ft

Factor of Safety, $FS = M_r / M_{ot}$ = 1.19 > 1.00 **OK!**

Footing Stability Check:

Area of Mat, $A_{mat} = W_f^2 - d_p^2 * \pi / 4$ = 186.5 ft²

Section Modulus of Mat, $S_{mat} = W_f^3 / 6 - d_p^3 * \pi / 32$ = 491.8 ft³

Axial Force, $P_{mat} = W_{mat} + W_{s1}$ = 100.7 kips

Cassion Resisting Moment Capacity, $M_{cap} = S_{u2T} * (D_f - d_f) / 2 + S_{u2B} * 2 * (D_f - d_f) / 3$ = 1556.2 kip-ft

Matt Residual Moment Capacity, $M_{mat} = (M_L - M_{cap}) + S_L * (d_f + L_{pag}) \geq 0$ = 445.5 kip-ft

Maximum Matt Pressure, $p_{MAX} = P_{mat} / A_{mat} + M_{mat} / S_{mat}$ = 1.446 ksf ≤ $0.75q_s$ = 6.000 ksf **OK!**

Minimum Matt Pressure, $p_{MIN} = P_{mat} / A_{mat} - M_{mat} / S_{mat}$ = -0.366 ksf ≤ $0.75q_s$ = 6.000 ksf **OK!**

APPENDIX B

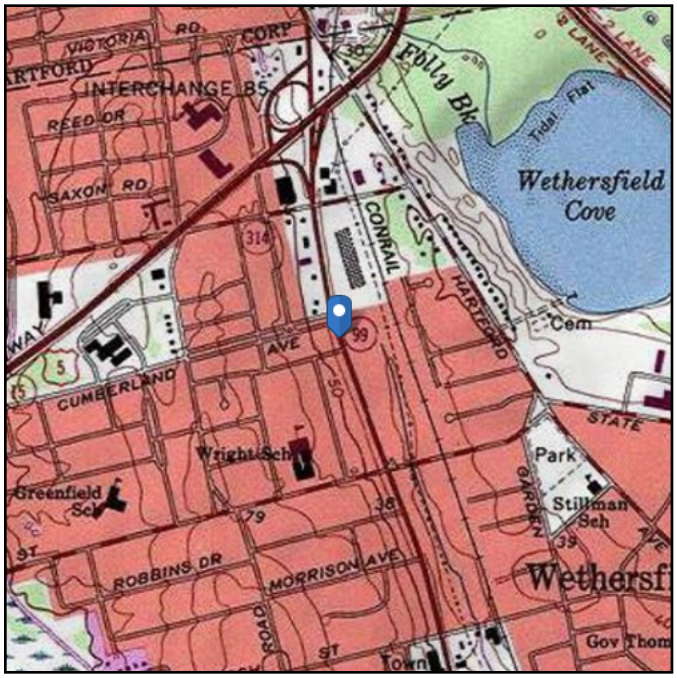
REFERENCE MATERIAL

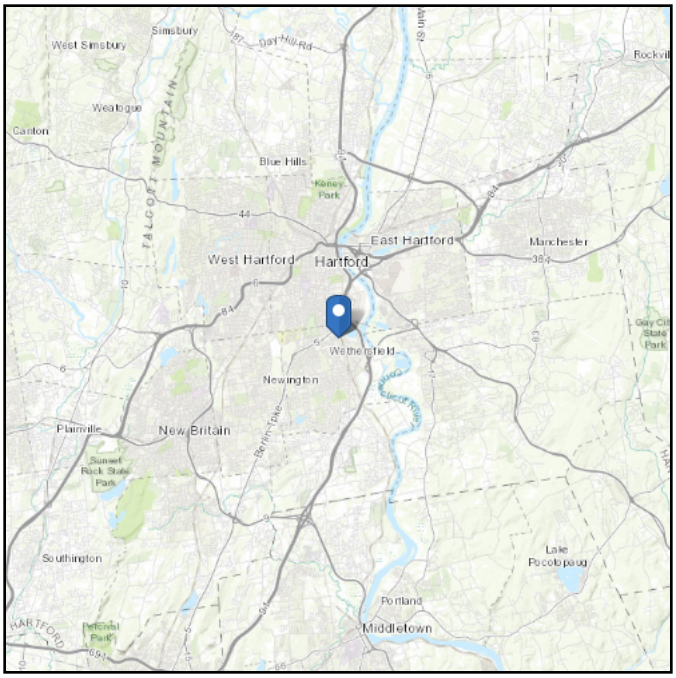
ASCE 7 Hazards Report

Address:
250 Silas Deane Hwy
Wethersfield, Connecticut
06109

Standard: ASCE/SEI 7-10
Risk Category: II
Soil Class:

Elevation: 36.77 ft (NAVD 88)
Latitude: 41.720291
Longitude: -72.667228





Ice

Results:

Ice Thickness:	1.00 in.
Concurrent Temperature:	5 F
Gust Speed:	50 mph

Data Source: Standard ASCE/SEI 7-10, Figs. 10-2 through 10-8

Date Accessed: Mon Jul 29 2019

Ice thicknesses on structures in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

Values provided are equivalent radial ice thicknesses due to freezing rain with concurrent 3-second gust speeds, for a 50-year mean recurrence interval, and temperatures concurrent with ice thicknesses due to freezing rain. Thicknesses for ice accretions caused by other sources shall be obtained from local meteorological studies. Ice thicknesses in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided “as is” and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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verizon fuze | RFDS

NORTH EAST > North East > New England > New England West > HARTFORD 9 CT

Brauer, Mark - mark.brauer2@verizonwireless.com - 10/8/2020 10:30:18

Project Details

Carrier Aggregation:	false
MPT Id:	
eCIP-0:	false
Project Name:	5G L-Sub6 - Carrier Add
FUZE Project ID:	16232035
Designed Sector Carrier 4G:	13
Designed Sector Carrier 5G:	N/A
Additional Sector Carrier 4G:	N/A
Additional Sector Carrier 5G:	N/A
SiteTraker Project Id:	
FP Solution Type & Tech Type:	;
RFDS Project Scope:	Sub 6 add Update 10/08/2020 per Andrew Leone: Added: (2) 6-OVP (2) LI 6x12 Hybrid cables Removed: (1) 6-OVP (1) 6x12 hybrid cable
Suffix:	

Location Information

Site ID:	674932
E-NodeB ID:	068620
PSLC:	468180
Switch Name:	Windsor 1
Tower Owner:	
Tower Type:	Monopole
Site Type:	MACRO
Street Address:	250 Silas Deane Highway
City:	Wethersfield
State:	CT
Zip Code:	06109
County:	Hartford
Latitude:	41.720597 / 41° 43' 14.1492" N
Longitude:	-72.666044 / 72° 39' 57.7584" W

Antenna Summary

Added

700	850	1900	AWS	AWS3	28 GHz	31 GHz	39 GHz	CBRS	LAA	L-Sub6	Make	Model	Centerline	Tip Height	Azimuth	RET	4xRx	Inst. Type	Quantity
											TBD	nL-Sub6 Antenna	90	93	30(0001) 180(0002) 300(0003)	false	false	PHYSICAL	3

Removed

700	850	1900	AWS	AWS3	28 GHz	31 GHz	39 GHz	CBRS	LAA	L-Sub6	Make	Model	Centerline	Tip Height	Azimuth	RET	4xRx	Inst. Type	Quantity
											Antel	BXA-80063/6CF	90	93	30(D1) 180(D2) 300(D3)	false	false	PHYSICAL	3

Retained

700	850	1900	AWS	AWS3	28 GHz	31 GHz	39 GHz	CBRS	LAA	L-Sub6	Make	Model	Centerline	Tip Height	Azimuth	RET	4xRx	Inst. Type	Quantity
LTE	LTE	LTE	LTE								ANDREW	SBNHH-1D65B	90	93	30(D1) 180(D2) 300(D3)	true	true	PHYSICAL	3
	CDMA										ANTEL	BXA-80063/6CF (181901)	90	93	30(D1) 180(D2) 300(D3)	false	false	PHYSICAL	3

Added: 3 | **Removed:** 3 | **Retained:** 6

Equipment Summary

Added

Equipment Type	Location	700	850	1900	AWS	AWS3	28 GHz	31 GHz	39 GHz	CBRS	LAA	L-Sub6	Make	Model	Cable Length	Cable Size	Install Type	Quantity
RRU	Tower												Samsung	VZS01			PHYSICAL	3
Hybrid Cable	Tower													6x12 LI			PHYSICAL	2
OVP Box	Tower													OVP-6			PHYSICAL	2

Removed

Equipment Type	Location	700	850	1900	AWS	AWS3	28 GHz	31 GHz	39 GHz	CBRS	LAA	L-Sub6	Make	Model	Cable Length	Cable Size	Install Type	Quantity
Hybrid Cable	Tower													6x12			PHYSICAL	1
OVP Box	Tower													OVP-6			PHYSICAL	1

Retained

Equipment Type	Location	700	850	1900	AWS	AWS3	28 GHz	31 GHz	39 GHz	CBRS	LAA	L-Sub6	Make	Model	Cable Length	Cable Size	Install Type	Quantity
RRU	Tower			LTE	LTE								Samsung	B2/B66A RRH-BR049 (RFV01U-D1A)			PHYSICAL	3
RRU	Tower	LTE	LTE										Samsung	B5/B13 RRH-BR04C (RFV01U-D2A)			PHYSICAL	3
Coaxial Cables	Tower																PHYSICAL	6

Service Info

1900 MHZ LTE		0000			5GLS	
Sector	**D1**	**D2**	**D3**	**D1**	**D2**	**D3**
Azimuth	30	180	300	30	180	300
Cell / ENode B ID	068620	068620	068620	068620	068620	068620
Antenna Model	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B
Antenna Make	ANDREW	ANDREW	ANDREW	ANDREW	ANDREW	ANDREW
Antenna Centerline(Ft)	90	90	90	90	90	90
Mechanical Down-Tilt(Deg.)	0	0	0	0	0	0
Electrical Down-Tilt	2	2	1	2	2	1
Tip Height	93	93	93	93	93	93
Regulatory Power	290.31	290.31	289.24	290.31	290.31	289.24
TMA Make						
TMA Model						
RRU Make	Samsung	Samsung	Samsung	Samsung	Samsung	Samsung
RRU Model	B2/B66A RRH-BR049 (RFV01U-D1A)	B2/B66A RRH-BR049 (RFV01U-D1A)	B2/B66A RRH-BR049 (RFV01U-D1A)	B2/B66A RRH-BR049 (RFV01U-D1A)	B2/B66A RRH-BR049 (RFV01U-D1A)	B2/B66A RRH-BR049 (RFV01U-D1A)
Number of Tx, Rx Lines	4,4	4,4	4,4	4,4	4,4	4,4
Position						
Transmitter Id	3431029	3431030	3431031	7476631	7476632	7476633
Source	ATOLL_API	ATOLL_API	ATOLL_API	ATOLL_API	ATOLL_API	ATOLL_API

2100 MHZ LTE		0000			5GLS	
Sector	**D1**	**D2**	**D3**	**D1**	**D2**	**D3**
Azimuth	30	180	300	30	180	300
Cell / ENode B ID	068620	068620	068620	068620	068620	068620
Antenna Model	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B
Antenna Make	ANDREW	ANDREW	ANDREW	ANDREW	ANDREW	ANDREW
Antenna Centerline(Ft)	90	90	90	90	90	90
Mechanical Down-Tilt(Deg.)	0	0	0	0	0	0
Electrical Down-Tilt	2	2	1	2	2	1
Tip Height	93	93	93	93	93	93
Regulatory Power	142.44	142.44	143.23	142.44	142.44	143.23
TMA Make						
TMA Model						
RRU Make	Samsung	Samsung	Samsung	Samsung	Samsung	Samsung
RRU Model	B2/B66A RRH-BR049 (RFV01U-D1A)	B2/B66A RRH-BR049 (RFV01U-D1A)	B2/B66A RRH-BR049 (RFV01U-D1A)	B2/B66A RRH-BR049 (RFV01U-D1A)	B2/B66A RRH-BR049 (RFV01U-D1A)	B2/B66A RRH-BR049 (RFV01U-D1A)
Number of Tx, Rx Lines	4,4	4,4	4,4	4,4	4,4	4,4
Position						
Transmitter Id	3430965	3430967	3430969	7476626	7476628	7476630
Source	ATOLL_API	ATOLL_API	ATOLL_API	ATOLL_API	ATOLL_API	ATOLL_API

850 MHZ CDMA		0000			5GLS	
Sector	**D1**	**D2**	**D3**	**D1**	**D2**	**D3**
Azimuth	30	180	300	30	180	300
Cell / ENode B ID						
Antenna Model	BXA-80063/6CF (181901)	BXA-80063/6CF (181901)	BXA-80063/6CF (181901)	BXA-80063/6CF (181901)	BXA-80063/6CF (181901)	BXA-80063/6CF (181901)
Antenna Make	ANTEL	ANTEL	ANTEL	ANTEL	ANTEL	ANTEL
Antenna Centerline(Ft)	90	90	90	90	90	90
Mechanical Down-Tilt(Deg.)	3	0	3	3	0	3
Electrical Down-Tilt	0	0	0	0	0	0
Tip Height	93	93	93	93	93	93
Regulatory Power	497.74	497.74	497.74	497.74	497.74	497.74
TMA Make						
TMA Model						
RRU Make						
RRU Model						
Number of Tx, Rx Lines						
Position						
Transmitter Id						
Source	ATOLL_API	ATOLL_API	ATOLL_API	ATOLL_API	ATOLL_API	ATOLL_API

850 MHZ LTE

	0000			5GLS		
Sector	**D1**	**D2**	**D3**	**D1**	**D2**	**D3**
Azimuth	30	180	300	30	180	300
Cell / ENode B ID	068620	068620	068620	068620	068620	068620
Antenna Model	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B
Antenna Make	ANDREW	ANDREW	ANDREW	ANDREW	ANDREW	ANDREW
Antenna Centerline(Ft)	90	90	90	90	90	90
Mechanical Down-Tilt(Deg.)	0	0	0	0	0	0
Electrical Down-Tilt	5	3	3	5	3	3
Tip Height	93	93	93	93	93	93
Regulatory Power	329.75	328.54	328.54	328.97	327.76	327.76
TMA Make						
TMA Model						
RRU Make	Samsung	Samsung	Samsung	Samsung	Samsung	Samsung
RRU Model	B5/B13 RRH-BR04C (RFV01U-D2A)	B5/B13 RRH-BR04C (RFV01U-D2A)	B5/B13 RRH-BR04C (RFV01U-D2A)	B5/B13 RRH-BR04C (RFV01U-D2A)	B5/B13 RRH-BR04C (RFV01U-D2A)	B5/B13 RRH-BR04C (RFV01U-D2A)
Number of Tx, Rx Lines	4,4	4,4	4,4	4,4	4,4	4,4
Position						
Transmitter Id	3431032	3431033	3431034	7476634	7476635	7476636
Source	ATOLL_API	ATOLL_API	ATOLL_API	ATOLL_API	ATOLL_API	ATOLL_API

700 MHZ LTE

	0000			5GLS		
Sector	**D1**	**D2**	**D3**	**D1**	**D2**	**D3**
Azimuth	30	180	300	30	180	300
Cell / ENode B ID	068620	068620	068620	068620	068620	068620
Antenna Model	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B
Antenna Make	ANDREW	ANDREW	ANDREW	ANDREW	ANDREW	ANDREW
Antenna Centerline(Ft)	90	90	90	90	90	90
Mechanical Down-Tilt(Deg.)	0	0	0	0	0	0
Electrical Down-Tilt	5	3	3	5	3	3
Tip Height	93	93	93	93	93	93
Regulatory Power	77.44	76.99	76.99	77.44	76.99	76.99
TMA Make						
TMA Model						
RRU Make	Samsung	Samsung	Samsung	Samsung	Samsung	Samsung
RRU Model	B5/B13 RRH-BR04C (RFV01U-D2A)	B5/B13 RRH-BR04C (RFV01U-D2A)	B5/B13 RRH-BR04C (RFV01U-D2A)	B5/B13 RRH-BR04C (RFV01U-D2A)	B5/B13 RRH-BR04C (RFV01U-D2A)	B5/B13 RRH-BR04C (RFV01U-D2A)
Number of Tx, Rx Lines	4,4	4,4	4,4	4,4	4,4	4,4
Position						
Transmitter Id	3430964	3430966	3430968	7476625	7476627	7476629
Source	ATOLL_API	ATOLL_API	ATOLL_API	ATOLL_API	ATOLL_API	ATOLL_API

nL-Sub6

				5GLS		
Sector				**0001**	**0002**	**0003**
Azimuth				30	180	300
Cell / ENode B ID				0068620	0068620	0068620
Antenna Model				nL-Sub6 Antenna	nL-Sub6 Antenna	nL-Sub6 Antenna
Antenna Make				TBD	TBD	TBD
Antenna Centerline(Ft)				90	90	90
Mechanical Down-Tilt(Deg.)				0	0	0
Electrical Down-Tilt				3	3	3
Tip Height				93	93	93
Regulatory Power				142.44	142.44	143.23
TMA Make						
TMA Model						
RRU Make				Samsung	Samsung	Samsung
RRU Model				VZS01	VZS01	VZS01
Number of Tx, Rx Lines				4,4	4,4	4,4
Position						
Transmitter Id				7476685	7476686	7476687
Source				ATOLL_API	ATOLL_API	ATOLL_API

Service Comments

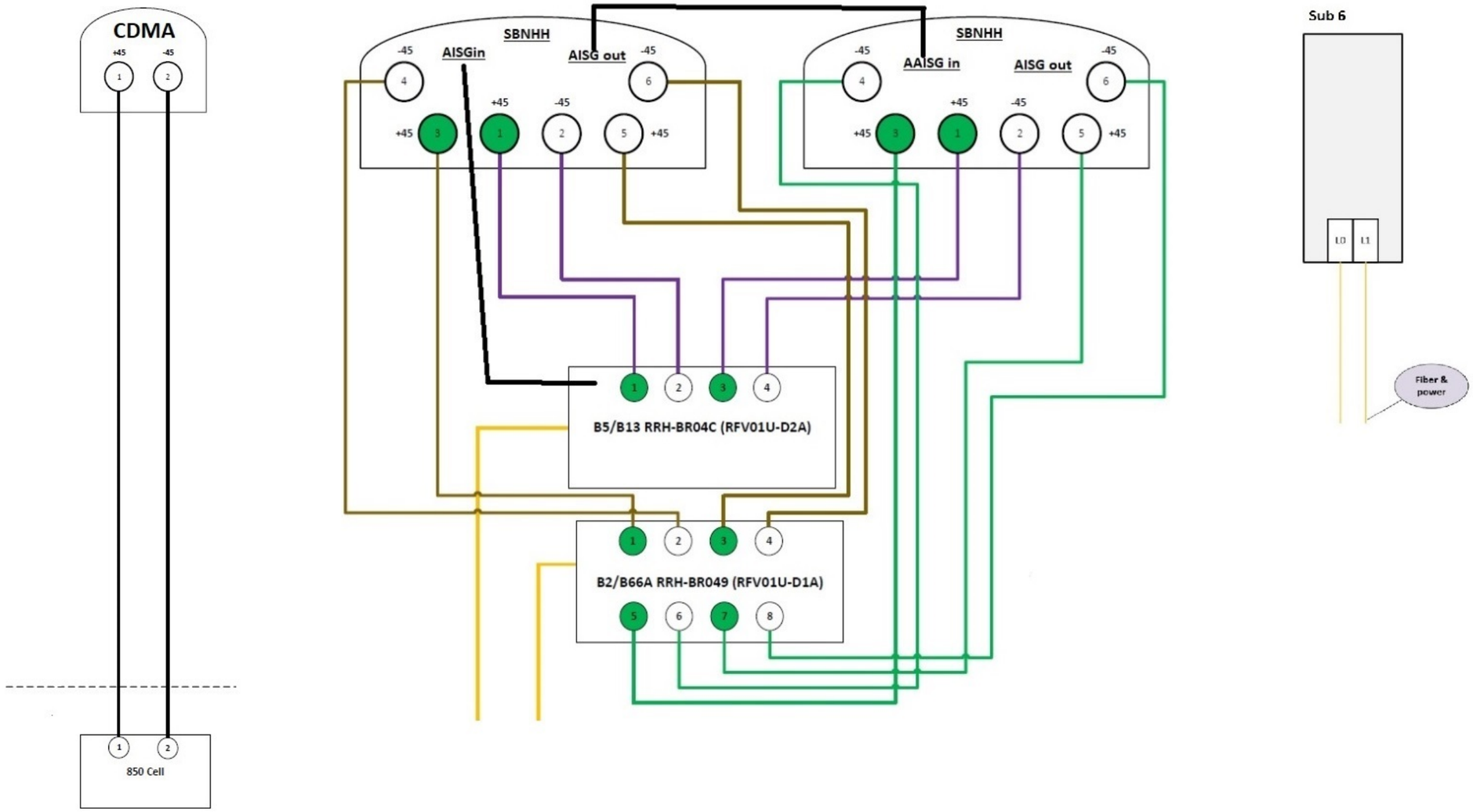
Callsigns Per Antenna

Sector	Antenna Make	Antenna Mode	Ant CL Height AGL	Tip Height	Azimuth (TN)	Electrical Tilt	Mechanical Tilt	Gain	Beamwidth	Regulatory Power	Callsigns						
											700	850	1900	2100	28 GHz	31 GHz	39 GHz
D1	ANDREW	SBNHH-1D65B	90	93	30	2	0	16.139	61.5	142.44				WQGA906 WQGB276			
D3	ANTEL	BXA-80063/6CF (181901)	90	93	300	0	3	14.5	61.25	368.13		KNKA404					
D2	ANDREW	SBNHH-1D65B	90	93	180	2	0	16.221001	53	290.31			KNLH251 WPOJ730				
D1	ANDREW	SBNHH-1D65B	90	93	30	5	0	12.632	69.25	77.44	WQJQ689						
D2	ANDREW	SBNHH-1D65B	90	93	180	3	0	12.607	69	76.99	WQJQ689						
D3	ANDREW	SBNHH-1D65B	90	93	300	3	0	13.335	66	327.76		KNKA404					
D3	ANDREW	SBNHH-1D65B	90	93	300	1	0	16.163	61	143.23				WQGA906 WQGB276			
D3	ANDREW	SBNHH-1D65B	90	93	300	3	0	12.607	69	76.99	WQJQ689						
D2	ANDREW	SBNHH-1D65B	90	93	180	2	0	16.139	61.5	142.44				WQGA906 WQGB276			
D2	ANTEL	BXA-80063/6CF (181901)	90	93	180	0	0	14.5	61.25	368.13		KNKA404					
D1	ANDREW	SBNHH-1D65B	90	93	30	5	0	13.351	64.5	328.97		KNKA404					
D3	ANDREW	SBNHH-1D65B	90	93	300	1	0	16.205	52.75	289.24			KNLH251 WPOJ730				
D2	ANTEL	BXA-80063/6CF (181901)	90	93	180	0	0	14.5	61.25	497.74		KNKA404					
D1	ANDREW	SBNHH-1D65B	90	93	30	2	0	16.221001	53	290.31			KNLH251 WPOJ730				
D1	ANTEL	BXA-80063/6CF (181901)	90	93	30	0	3	14.5	61.25	368.13		KNKA404					
D1	ANTEL	BXA-80063/6CF (181901)	90	93	30	0	3	14.5	61.25	497.74		KNKA404					
D3	ANTEL	BXA-80063/6CF (181901)	90	93	300	0	3	14.5	61.25	497.74		KNKA404					
D2	ANDREW	SBNHH-1D65B	90	93	180	3	0	13.335	66	327.76		KNKA404					

Callsigns

Callsign	Market	Radio Code	Market Number	Block	State	County	Licensee Name	Wholly Owned	Total MHZ	Freq Range 1	Freq Range 2	Freq Range 3	Freq Range 4	Regulatory Power	Threshold (W)	POPs/Sq Mi	Status	Action	Approved for Insvc
WQJQ689	*Northeast*	*WU*	*REA001*	*C*	*CT*	*Hartford*	*Cellco Partnership*	*Yes*	*22.000*	*746.000-757.000*	*776.000-787.000*	*.000-.000*	*.000-.000*	*77.44*	*1000*	*1216.19*	*Active*	*retained*	*Yes*
KNKA404	*Hartford-New Britain-Bristol, CT*	*CL*	*CMA032*	*A*	*CT*	*Hartford*	*Cellco Partnership*	*Yes*	*25.000*	*824.000-835.000*	*869.000-880.000*	*845.000-846.500*	*890.000-891.500*	*497.74*	*500*	*1216.19*	*Active*	*added*	*Yes*
WPOJ730	*Hartford, CT*	*CW*	*BTA184*	*C*	*CT*	*Hartford*	*Cellco Partnership*	*Yes*	*15.000*	*1895.000-1902.500*	*1975.000-1982.500*	*.000-.000*	*.000-.000*	*290.31*	*1640*	*1216.19*	*Active*	*retained*	*Yes*
KNLH251	*Hartford, CT*	*CW*	*BTA184*	*F*	*CT*	*Hartford*	*Cellco Partnership*	*Yes*	*10.000*	*1890.000-1895.000*	*1970.000-1975.000*	*.000-.000*	*.000-.000*	*290.31*	*1640*	*1216.19*	*Active*	*retained*	*Yes*
WQGB276	*Hartford-New Britain-Bristol, CT*	*AW*	*CMA032*	*A*	*CT*	*Hartford*	*Cellco Partnership*	*Yes*	*20.000*	*1710.000-1720.000*	*2110.000-2120.000*	*.000-.000*	*.000-.000*	*143.23*	*1640*	*1216.19*	*Active*	*retained*	*Yes*
WQGA906	*New York-No. New Jer.-Long Island, NY-NJ-CT-PA-MA-*	*AW*	*BEA010*	*B*	*CT*	*Hartford*	*Cellco Partnership*	*Yes*	*20.000*	*1720.000-1730.000*	*2120.000-2130.000*	*.000-.000*	*.000-.000*	*143.23*	*1640*	*1216.19*	*Active*	*retained*	*Yes*
WPOH943	Hartford, CT	LD	BTA184	A	CT	Hartford	Cellco Partnership	Yes	300.000	29100.000-29250.000	31075.000-31225.000	.000-.000	.000-.000			1216.19	Active		No
WPLM398	Hartford, CT	LD	BTA184	B	CT	Hartford	Cellco Partnership	Yes	150.000	31000.000-31075.000	31225.000-31300.000	.000-.000	.000-.000			1216.19	Active		No
WRBA708	Hartford, CT	UU	BTA184	L1	CT	Hartford	Cellco Partnership	Yes	325.000	27500.000-27600.000	27700.000-27925.000	.000-.000	.000-.000			1216.19	Active		Yes
WRBA709	Hartford, CT	UU	BTA184	L2	CT	Hartford	Cellco Partnership	Yes	325.000	27925.000-28050.000	28150.000-28350.000	.000-.000	.000-.000			1216.19	Active		Yes
WRHD609	New York, NY	UU	PEA001	M1	CT	Hartford	Straight Path Spectrum, LLC	Yes	100.000	37600.000-37700.000	.000-.000	.000-.000	.000-.000			1216.19	Active		Yes
WRHD610	New York, NY	UU	PEA001	M10	CT	Hartford	Straight Path Spectrum, LLC	Yes	100.000	38500.000-38600.000	.000-.000	.000-.000	.000-.000			1216.19	Active		Yes
WRHD611	New York, NY	UU	PEA001	M2	CT	Hartford	Straight Path Spectrum, LLC	Yes	100.000	37700.000-37800.000	.000-.000	.000-.000	.000-.000			1216.19	Active		Yes
WRHD612	New York, NY	UU	PEA001	M3	CT	Hartford	Straight Path Spectrum, LLC	Yes	100.000	37800.000-37900.000	.000-.000	.000-.000	.000-.000			1216.19	Active		Yes
WRHD613	New York, NY	UU	PEA001	M4	CT	Hartford	Straight Path Spectrum, LLC	Yes	100.000	37900.000-38000.000	.000-.000	.000-.000	.000-.000			1216.19	Active		Yes
WRHD614	New York, NY	UU	PEA001	M5	CT	Hartford	Straight Path Spectrum, LLC	Yes	100.000	38000.000-38100.000	.000-.000	.000-.000	.000-.000			1216.19	Active		Yes
WRHD615	New York, NY	UU	PEA001	M6	CT	Hartford	Straight Path Spectrum, LLC	Yes	100.000	38100.000-38200.000	.000-.000	.000-.000	.000-.000			1216.19	Active		Yes
WRHD616	New York, NY	UU	PEA001	M7	CT	Hartford	Straight Path Spectrum, LLC	Yes	100.000	38200.000-38300.000	.000-.000	.000-.000	.000-.000			1216.19	Active		Yes

WRHD617	New York, NY	UU	PEA001	M8	CT	Hartford	Straight Path Spectrum, LLC	Yes	100.000	38300.000-38400.000	.000-.000	.000-.000	.000-.000			1216.19	Active		Yes
WRHD618	New York, NY	UU	PEA001	M9	CT	Hartford	Straight Path Spectrum, LLC	Yes	100.000	38400.000-38500.000	.000-.000	.000-.000	.000-.000			1216.19	Active		Yes
WRHD619	New York, NY	UU	PEA001	N1	CT	Hartford	Straight Path Spectrum, LLC	Yes	100.000	38600.000-38700.000	.000-.000	.000-.000	.000-.000			1216.19	Active		No
WRDG500	New York, NY	UU	PEA001	S2	CT	Hartford	Cellco Partnership	Yes	400.000	37800.000-38200.000	.000-.000	.000-.000	.000-.000			1216.19	Active		Yes


CDMA
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B5/B13 RRH-BR04C (RFV01U-D2A)
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B2/B66A RRH-BR049 (RFV01U-D1A)
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850 Cell
Sub 6
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