Robinson+Cole

KENNETH C. BALDWIN

280 Trumbull Street
Hartford, CT 06103-3597
Main (860) 275-8200
Fax (860) 275-8299
kbaldwin@rc.com
Direct (860) 275-8345

Also admitted in Massachusetts

December 23, 2014

Melanie A. Bachman
Acting Executive Director
Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051

Re: **Notice of Exempt Modification – Facility Modification**
111 Upper Fish Rock Road, Southbury, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) antennas at the top of the existing 100-foot tower at 111 Upper Fish Rock Road in Southbury (the "Property"). The tower is owned by the Cellco and was approved by the Council in 2007 (Docket No. 325). Cellco now intends to modify its facility by replacing two (2) of its existing antennas with two (2) model LNX-6514DS-VTM, 700 MHZ antenna, at the same 100-foot level on the tower. Included in Attachment 1 are specifications for Cellco's replacement antennas.

Please accept this letter as notification pursuant to R.C.S.A. § 16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is being sent to Edward Edelson, First Selectman for the Town of Southbury. A copy of this letter is also being sent to Carl and Marilyn Ferencek, the owners of the Property.

The planned modifications to the facility fall squarely within those activities explicitly provided for in R.C.S.A. § 16-50j-72(b)(2).

1. The proposed modifications will not result in an increase in the height of the existing tower. Cellco's replacement antenna will be installed on its existing antenna platform at the 100-foot level.

13316645-v1

2. The proposed modifications will not involve any change to ground-mounted equipment and, therefore, will not require the extension of the site boundary.

3. The proposed modifications will not increase noise levels at the facility by six decibels or more, or to levels that exceed state and local criteria.

4. The operation of the replacement antennas will not increase radio frequency (RF) emissions at the facility to a level at or above the Federal Communications Commission (FCC) safety standard. A cumulative General Power Density table for Cellco's modified facility is included in Attachment 2.

5. The proposed modifications will not cause a change or alteration in the physical or environmental characteristics of the site.

6. The tower and its foundation can support Cellco's proposed modifications. (*See* Structural Analysis Report included in Attachment 3).

For the foregoing reasons, Cellco respectfully submits that the proposed modifications to the above-referenced telecommunications facility constitutes an exempt modification under R.C.S.A. § 16-50j-72(b)(2).

Sincerely,

Kenneth C. Baldwin

Enclosures
Copy to:
Edward Edelson, Southbury First Selectman
Carl and Marilyn Ferencek
Sandy M. Carter

ATTACHMENT 1

Product Specifications

COMMSCOPE®

LNX-6514DS-VTM

Andrew® Antenna, 698–896 MHz, 65° horizontal beamwidth, RET compatible

POWERED BY ANDREW.

Electrical Specifications

Frequency Band, MHz	698–806	806–896
Gain, dBi	15.7	16.3
Beamwidth, Horizontal, degrees	65	65
Beamwidth, Vertical, degrees	12.5	11.2
Beam Tilt, degrees	0–10	0–10
USLS, typical, dB	17	18
Front-to-Back Ratio at 180°, dB	32	30
CPR at Boresight, dB	20	20
CPR at Sector, dB	10	10
Isolation, dB	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153
Input Power per Port, maximum, watts	400	400
Polarization	±45°	±45°

Electrical Specifications, BASTA*

Frequency Band, MHz	698–806	806–896
Beamwidth, Horizontal Tolerance, degrees	±3	±3

* CommScope® supports NGMN recommendations on Base Station Antenna Standards (BASTA). To learn more about the benefits of BASTA, download the whitepaper Time to Raise the Bar on BSAs.

Mechanical Specifications

Color | Radome Material	Light gray | Fiberglass, UV resistant
Connector Interface | Location | Quantity	7-16 DIN Female | Bottom | 2
Wind Loading, maximum	617.7 N @ 150 km/h 138.9 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph
Antenna Dimensions, L x W x D	1847.0 mm x 301.0 mm x 181.0 mm | 72.7 in x 11.9 in x 7.1 in
Net Weight	14.2 kg | 31.3 lb
Model with factory installed AISG 2.0 RET	LNX-6514DS-A1M

ATTACHMENT 2

	General	Power	Density					
Site Name: Newtown NE								
Tower Height: 100ft								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*AT&T UMTS	2	500	90	0.0444	880	0.5867	7.57%	
*AT&T UMTS	1	500	90	0.0222	1900	1.0000	2.22%	
*AT&T LTE	1	500	90	0.0222	700	0.4667	4.76%	
*AT&T LTE	1	500	90	0.0222	1900	1.0000	2.22%	
*AT&T LTE	1	500	90	0.0222	2300	1.0000	2.22%	
Verizon PCS	**15**	**365**	**100**	**0.1969**	**1970**	**1.0000**	**19.69%**	
Verizon Cellular	**9**	**466**	**100**	**0.1508**	**869**	**0.5793**	**26.03%**	
Verizon AWS	**1**	**1750**	**100**	**0.0629**	**2145**	**1.0000**	**6.29%**	
Verizon 700	**1**	**857**	**100**	**0.0308**	**746**	**0.4973**	**6.20%**	
								77.19%
* Source: Siting Council								

ATTACHMENT 3

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

100-ft Existing EEI Monopole

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Newtown NE

111 Upper Fish Rock Road
Southbury, CT

CENTEK Project No. 14067.050

Date: December 8, 2014

Prepared for:

Verizon Wireless
99 East River Road, 9th Floor
East Hartford, CT 06108

63-2 North Branford Road, Branford, CT 06405 203.488.0580 Fax 203.488.8587 www.CentekEng.com

Table of Contents

Introduction

The purpose of this report is to summarize the results of the non-linear, P-Δ structural analysis of the antenna upgrade proposed by Verizon Wireless on the existing monopole (tower) located in Southbury, Connecticut.

The host tower is a 100-ft tall, three-section, eighteen sided, tapered monopole, originally designed and manufactured by Engineered Endeavors Incorporated (EEI); project no. 14859-E01 dated April 20, 2007. The tower geometry, structure member sizes and foundation system information were obtained from the original manufacturers design documents.

Antenna and appurtenance information were obtained from a previous structural analysis report prepared by Centek job no; 13338.000 dated April 28, 2014 and a Verizon RF data sheet.

The tower is made up of three (3) tapered vertical sections consisting of A572-65 pole sections. The vertical tower sections are slip joint connected. The diameter of the pole (flat-flat) is 41.34-in at the top and 70.00-in at the base.

Verizon Wireless proposes the removal of two (2) panel antennas and the installation of two (2) panel antennas mounted on the existing low profile platform. Refer to the Antenna and Appurtenance Summary below for a detailed description of the proposed antenna and appurtenance configuration.

Antenna and Appurtenance Summary

The existing tower was designed to support several communication antennas. The existing, proposed and future loads considered in this analysis consist of the following:

- TOWN (EXISTING):
  Antennas: One (1) 20-ft Omni-directional whip antenna mounted on the existing Verizon Wireless low profile platform with an elevation of 97-ft above grade level.
  Coax Cables: One (1) 1-1/4" ∅ coax cable running on the inside of the existing tower.

- AT&T (EXISTING):
  Antennas: Twelve (12) CCI HPA-65R-BUU-H8 panel antennas, nine (9) Ericsson RRUS-11 remote radio units, six (6) Ericsson RRUS-12 remote radio units, three (3) Ericsson RRUS-E2 remote radio units, three (3) Ericsson RRUS-32 remote radio units, six (6) Ericsson A2 units, and four (4) Raycap DC6-48-60-18-8F surge arrestors mounted on a Commscope platform p/n MTC3607R with a RAD center elevation of 90-ft above existing grade.
  Coax Cables: Two (2) fiber cable, eight (8) dc control cables and three (3) RET cables running on the inside of the existing tower.

- VERIZON WIRELESS (EXISTING TO REMAIN):
  Antennas: One (1) Antel BXA-70063-6CF, six (6) Antel LPA-80080-8CF and three (3) Antel BXA-171085-12BF panel antennas mounted on a low profile platform with a RAD center elevation of 100-ft above grade level.
  Coax Cables: Eighteen (18) 1-5/8" ∅ coax cables running on the inside of the existing tower.

- VERIZON WIRELESS (EXISTING TO REMOVE):
  Antennas: Two (2) Antel BXA-70063-6CF panel antennas mounted on a low profile platform with a RAD center elevation of 100-ft above grade level.

- **VERIZON WIRELESS (PROPOSED):**
  Antennas: One (1) Andrew LNX-4514DS and one (1) Andrew LNX-6514DS panel antennas mounted on a low profile platform with a RAD center elevation of 100-ft above grade level.

Primary Assumptions Used in the Analysis

- The tower structure's theoretical capacity not including any assessment of the condition of the tower.
- The tower carries the horizontal and vertical loads due to the weight of antennas, ice load and wind.
- Tower is properly installed and maintained.
- Tower is in plumb condition.
- Tower loading for antennas and mounts as listed in this report.
- All bolts are appropriately tightened providing the necessary connection continuity.
- All welds are fabricated with ER-70S-6 electrodes.
- All members are assumed to be as specified in the original tower design documents or reinforcement drawings.
- All members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
- All member protective coatings are in good condition.
- All tower members were properly designed, detailed, fabricated, installed and have been properly maintained since erection.
- Any deviation from the analyzed antenna loading will require a new analysis for verification of structural adequacy.
- All coax cables to be installed as indicated in this report.

Analysis

The existing tower was analyzed using a comprehensive computer program entitled tnxTower. The program analyzes the tower, considering the worst case loading condition. The tower is considered as loaded by concentric forces along the tower shaft, and the model assumes that the shaft members are subjected to bending, axial, and shear forces.

The existing tower was analyzed for the controlling basic wind speed (fastest mile) with no ice and a 75% reduction of wind force with ½ inch accumulative ice to determine stresses in members as per guidelines of TIA/EIA-222-F-96 entitled "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures", the American Institute of Steel Construction (AISC) and the Manual of Steel Construction; Allowable Stress Design (ASD).

The controlling wind speed is determined by evaluating the local available wind speed data as provided in Appendix K of the CSBC[1] and the wind speed data available in the TIA/EIA-222-F-96 Standard. The higher of the two wind speeds is utilized in preparation on the tower analysis.

Tower Loading

Tower loading was determined by the basic wind speed as applied to projected surface areas with modification factors per TIA/EIA-222-F, gravity loads of the tower structure and its components, and the application of ½" radial ice on the tower structure and its components.

Basic Wind Speed:	New Haven; v = 85 mph (fastest mile)	*[Section 16 of TIA/EIA-222-F-96]*
	Southbury; v = 95 mph (3 second gust) equivalent to v = 77.5 mph (fastest mile)	*[Appendix K of the 2005 CT Building Code Supplement]*
	TIA/EIA wind speed controls.	
Load Cases:	Load Case 1; 85 mph wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 2; 74 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 74 mph wind speed velocity represents 75% of the wind pressure generated by the 85 mph wind speed.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 3; Seismic – not checked	*[Section 1614.5 of State Bldg. Code 2005] does not control in the design of this structure type*

[1] The 2005 Connecticut State Building Code as amended by the 2009 CT State Supplement. (CSBC)

Tower Capacity

Tower stresses were calculated utilizing the structural analysis software tnxTower. Allowable stresses were determined based on Table 5 of the TIA/EIA code with a 1/3 increase per Section 3.1.1.1 of the same code.

- Calculated stresses were found to be within allowable limits. In Load Case 1, per tnxTower "Section Capacity Table", this tower was found to be at **23.9%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L1)	82.83'-100.00'	3.2%	**PASS**
Pole Shaft (L2)	46.16'-82.83'	16.6%	**PASS**
Pole Shaft (L3)	1.00'-46.16'	23.9%	**PASS**

Foundation and Anchors

The existing foundation consists of a 9-ft square x 3.0-ft long reinforced concrete pier on a 32.0-ft square x 3.0-ft thick reinforced concrete pad. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned original design documents prepared by EEI job no. 14859-E01 dated April 20, 2007. The base of the tower is connected to the foundation by means of (36) 2.25"∅, ASTM A615-75 anchor bolts embedded approximately 5-ft into the concrete foundation structure.

- The tower base reactions developed from the governing Load Case 1 were used in the verification of the foundation and its anchors:

Location	Vector	Proposed Reactions
Base	Shear	25 kips
	Compression	40 kips
	Moment	1889 kip-ft

- The foundation was found to be within allowable limits.

Foundation	Design Limit	IBC 2003/2005 CT State Building Code Section 3108.4.2 (FS)(1)	Proposed Loading (FS)(1)	Result
Reinforced Concrete Pad and Pier	OTM(2)	2.0	6.59	**PASS**

Note 1: FS denotes Factor of Safety.
Note 2: OTM denotes Overturning Moment.

- The anchor bolts and base plate were found to be within allowable limits.

Tower Component	Design Limit	Stress Ratio (percentage of capacity)	Result
Anchor Bolts	Combined Axial and Bending	17.1%	**PASS**
Base Plate	Bending	10.2%	**PASS**

Conclusion

This analysis shows that the subject tower **is adequate** to support the proposed modified antenna configuration.

The analysis is based, in part, on the information provided to this office by Verizon Wireless. If the existing conditions are different than the information in this report, Centek Engineering, Inc. must be contacted for resolution of any potential issues.

Please feel free to call with any questions or comments.

Respectfully Submitted by:

Timothy J. Lynn, PE
Structural Engineer

Standard Conditions for Furnishing of Professional Engineering Services on Existing Structures

All engineering services are performed on the basis that the information used is current and correct. This information may consist of, but is not necessarily limited to:

- Information supplied by the client regarding the structure itself, its foundations, the soil conditions, the antenna and feed line loading on the structure and its components, or other relevant information.
- Information from the field and/or drawings in the possession of Centek Engineering, Inc. or generated by field inspections or measurements of the structure.
- It is the responsibility of the client to ensure that the information provided to Centek Engineering, Inc. and used in the performance of our engineering services is correct and complete. In the absence of information to the contrary, we assume that all structures were constructed in accordance with the drawings and specifications and are in an un-corroded condition and have not deteriorated. It is therefore assumed that its capacity has not significantly changed from the "as new" condition.
- All services will be performed to the codes specified by the client, and we do not imply to meet any other codes or requirements unless explicitly agreed in writing. If wind and ice loads or other relevant parameters are to be different from the minimum values recommended by the codes, the client shall specify the exact requirement. In the absence of information to the contrary, all work will be performed in accordance with the latest revision of ANSI/ASCE10 & ANSI/EIA-222
- All services performed, results obtained, and recommendations made are in accordance with generally accepted engineering principles and practices. Centek Engineering, Inc. is not responsible for the conclusions, opinions and recommendations made by others based on the information we supply.

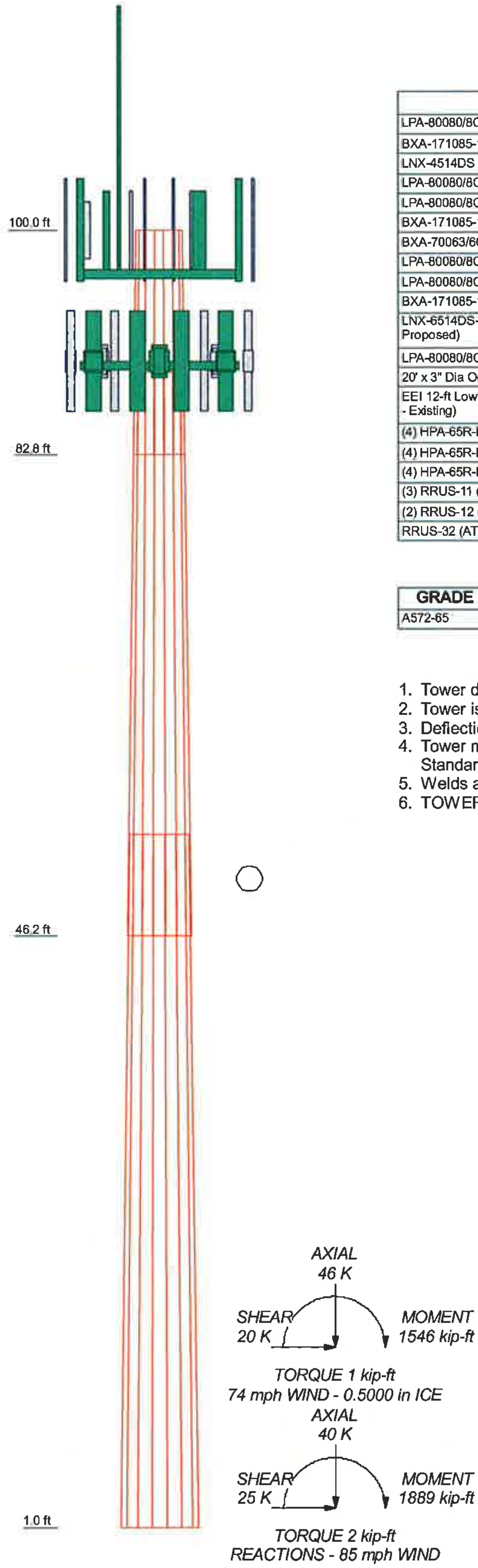
GENERAL DESCRIPTION OF STRUCTURAL ANALYSIS PROGRAM

tnxTower, is an integrated structural analysis and design software package for Designed specifically for the telecommunications industry, tnxTower, formerly ERITower, automates much of the tower analysis and design required by the TIA/EIA 222 Standard.

tnxTower Features:

- tnxTower can analyze and design 3- and 4-sided guyed towers, 3- and 4-sided self-supporting towers and either round or tapered ground mounted poles with or without guys.
- The program analyzes towers using the TIA-222-G (2005) standard or any of the previous TIA/EIA standards back to RS-222 (1959). Steel design is checked using the AISC ASD 9th Edition or the AISC LRFD specifications.
- Linear and non-linear (P-delta) analyses can be used in determining displacements and forces in the structure. Wind pressures and forces are automatically calculated.
- Extensive graphics plots include material take-off, shear-moment, leg compression, displacement, twist, feed line, guy anchor and stress plots.
- tnxTower contains unique features such as True Cable behavior, hog rod take-up, foundation stiffness and much more.

Section	Length (ft)	Number of Sides	Thickness (in)	Socket Length (ft)	Top Dia (in)	Bot Dia (in)	Grade	Weight (K)
1	17.17	18	0.3750	6.33	41.3400	46.6300	A572-65	3.0
2	43.00	18	0.4375	7.67	43.9288	57.0700		10.2
3	52.83	18	0.5000		53.8519	70.0000		17.5
								30.7



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
LPA-80080/8CF (Verizon - Existing)	100	RRUS-E2 (ATI - Existing)	90
BXA-171085-12BF (Verizon - Existing)	100	(2) A2 (ATI - Existing)	90
LNX-4514DS (Verizon - Proposed)	100	(3) RRUS-11 (ATI - Existing)	90
LPA-80080/8CF (Verizon - Existing)	100	(2) RRUS-12 (ATI - Existing)	90
LPA-80080/8CF (Verizon - Existing)	100	RRUS-32 (ATI - Existing)	90
BXA-171085-12BF (Verizon - Existing)	100	RRUS-E2 (ATI - Existing)	90
BXA-70063/6CF (Verizon - Existing)	100	(2) A2 (ATI - Existing)	90
LPA-80080/8CF (Verizon - Existing)	100	(3) RRUS-11 (ATI - Existing)	90
LPA-80080/8CF (Verizon - Existing)	100	(2) RRUS-12 (ATI - Existing)	90
BXA-171085-12BF (Verizon - Existing)	100	RRUS-32 (ATI - Existing)	90
LNX-6514DS-VTM (Verizon - Proposed)	100	RRUS-E2 (ATI - Existing)	90
		(2) A2 (ATI - Existing)	90
LPA-80080/8CF (Verizon - Existing)	100	DC6-48-60-18-8F Surge Arrestor (ATI - Existing)	90
20' x 3" Dia Omni (Town - Existing)	97		
EEI 12-ft Low Profile Platform (Verizon - Existing)	97	DC6-48-60-18-8F Surge Arrestor (ATI - Existing)	90
(4) HPA-65R-BUU-H8 (ATI - Existing)	90	DC6-48-60-18-8F Surge Arrestor (ATI - Existing)	90
(4) HPA-65R-BUU-H8 (ATI - Existing)	90		
(4) HPA-65R-BUU-H8 (ATI - Existing)	90	DC6-48-60-18-8F Surge Arrestor (ATI - Existing)	90
(3) RRUS-11 (ATI - Existing)	90		
(2) RRUS-12 (ATI - Existing)	90	Commscope MTC3607R Platform (ATI - Existing)	90
RRUS-32 (ATI - Existing)	90		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower designed for a 85 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 74 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
5. Welds are fabricated with ER-70S-6 electrodes.
6. TOWER RATING: 23.9%

Centek Engineering Inc.
63-2 North Branford Rd.
Branford, CT 06405
Phone: (203) 488-0580
FAX: (203) 488-8587

Job: **14067.050 - Newtown NE**		
Project: **100' EEI Monopole - 111 Upper Fish Rock Rd., Southbury, CT**		
Client: Verizon Wireless	Drawn by: TJL	App'd:
Code: TIA/EIA-222-F	Date: 12/08/14	Scale: NTS
Path:		Dwg No. E-1

Tower Input Data

There is a pole section.
This tower is designed using the TIA/EIA-222-F standard.
The following design criteria apply:

- Basic wind speed of 85 mph.
- Nominal ice thickness of 0.5000 in.
- Ice density of 56 pcf.
- A wind speed of 74 mph is used in combination with ice.
- Temperature drop of 50 °F.
- Deflections calculated using a wind speed of 50 mph.
- Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards..
- Welds are fabricated with ER-70S-6 electrodes..
- A non-linear (P-delta) analysis was used.
- Pressures are calculated at each section.
- Stress ratio used in pole design is 1.333.
- Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Options

Consider Moments - Legs	Distribute Leg Loads As Uniform	Treat Feedline Bundles As Cylinder
Consider Moments - Horizontals	Assume Legs Pinned	Use ASCE 10 X-Brace Ly Rules
Consider Moments - Diagonals	√ Assume Rigid Index Plate	Calculate Redundant Bracing Forces
Use Moment Magnification	Use Clear Spans For Wind Area	Ignore Redundant Members in FEA
√ Use Code Stress Ratios	Use Clear Spans For KL/r	SR Leg Bolts Resist Compression
√ Use Code Safety Factors - Guys	Retension Guys To Initial Tension	All Leg Panels Have Same Allowable
Escalate Ice	Bypass Mast Stability Checks	Offset Girt At Foundation
Always Use Max Kz	Use Azimuth Dish Coefficients	√ Consider Feedline Torque
Use Special Wind Profile	√ Project Wind Area of Appurt.	Include Angle Block Shear Check
Include Bolts In Member Capacity	Autocalc Torque Arm Areas	Poles
Leg Bolts Are At Top Of Section	SR Members Have Cut Ends	Include Shear-Torsion Interaction
Secondary Horizontal Braces Leg	√ Sort Capacity Reports By Component	Always Use Sub-Critical Flow
Use Diamond Inner Bracing (4 Sided)	Triangulate Diamond Inner Bracing	Use Top Mounted Sockets
Add IBC .6D+W Combination		

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	100.00-82.83	17.17	6.33	18	41.3400	46.6300	0.3750	1.5000	A572-65 (65 ksi)
L2	82.83-46.16	43.00	7.67	18	43.9288	57.0700	0.4375	1.7500	A572-65 (65 ksi)
L3	46.16-1.00	52.83		18	53.8519	70.0000	0.5000	2.0000	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	41.9777	48.7586	10337.4761	14.5426	21.0007	492.2439	20688.5545	24.3839	6.6158	17.642
	47.3493	55.0550	14881.6709	16.4205	23.6880	628.2356	29782.9235	27.5327	7.5469	20.125
L2	46.5718	60.3931	14432.1331	15.4394	22.3158	646.7213	28883.2565	30.2023	6.9615	15.912
	57.9504	78.6413	31865.4188	20.1045	28.9916	1099.1274	63772.7670	39.3281	9.2743	21.198
L3	57.0623	84.6695	30448.3683	18.9399	27.3568	1113.0106	60936.8013	42.3428	8.5979	17.196
	71.0799	110.2965	67308.3262	24.6725	35.5600	1892.8101	134705.218 4	55.1587	11.4400	22.88

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
L1 100.00-82.83				1	1	1		
L2 82.83-46.16				1	1	1		
L3 46.16-1.00				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight plf
1 5/8	C	No	Inside Pole	100.00 - 1.00	18	No Ice	0.00	1.04
(Verizon - Existing)						1/2" Ice	0.00	1.04
1 1/4	C	No	Inside Pole	100.00 - 1.00	1	No Ice	0.00	0.66
(Town - Existing)						1/2" Ice	0.00	0.66
Fiber Trunk	C	No	Inside Pole	90.00 - 1.00	2	No Ice	0.00	1.00
(AT&T - Existing)						1/2" Ice	0.00	1.00
DC Trunk	C	No	Inside Pole	90.00 - 1.00	8	No Ice	0.00	0.11
(AT&T - Existing)						1/2" Ice	0.00	0.11
0.3" dia RET	C	No	Inside Pole	90.00 - 1.00	3	No Ice	0.00	0.00
(AT&T - Existing)						1/2" Ice	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 K
L1	100.00-82.83	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.35
L2	82.83-46.16	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.82
L3	46.16-1.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	1.01

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 K
L1	100.00-82.83	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.35
L2	82.83-46.16	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.82
L3	46.16-1.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	1.01

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
L1	100.00-82.83	0.0000	0.0000	0.0000	0.0000
L2	82.83-46.16	0.0000	0.0000	0.0000	0.0000
L3	46.16-1.00	0.0000	0.0000	0.0000	0.0000

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
20' x 3" Dia Omni (Town - Existing)	C	From Face	2.50 3.00 10.00	0.0000	97.00	No Ice 1/2" Ice	6.00 8.03	6.00 8.03	0.05 0.09
LPA-80080/8CF (Verizon - Existing)	A	From Face	3.00 6.00 0.00	0.0000	100.00	No Ice 1/2" Ice	6.28 6.85	12.17 12.83	0.02 0.09
BXA-171085-12BF (Verizon - Existing)	A	From Face	3.00 4.00 0.00	0.0000	100.00	No Ice 1/2" Ice	4.73 5.18	3.57 4.01	0.02 0.04
LNX-4514DS (Verizon - Proposed)	A	From Face	3.00 -3.00 0.00	0.0000	100.00	No Ice 1/2" Ice	7.66 8.10	3.28 3.62	0.04 0.08
LPA-80080/8CF (Verizon - Existing)	A	From Face	3.00 -6.00 0.00	0.0000	100.00	No Ice 1/2" Ice	6.28 6.85	12.17 12.83	0.02 0.09
LPA-80080/8CF (Verizon - Existing)	B	From Face	3.00 6.00 0.00	0.0000	100.00	No Ice 1/2" Ice	6.28 6.85	12.17 12.83	0.02 0.09
BXA-171085-12BF (Verizon - Existing)	B	From Face	3.00 4.00 0.00	0.0000	100.00	No Ice 1/2" Ice	4.73 5.18	3.57 4.01	0.02 0.04

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert (ft ft ft)	Azimuth Adjustment (°)	Placement (ft)		C_AA_A Front (ft^2)	C_AA_A Side (ft^2)	Weight (K)
BXA-70063/6CF (Verizon - Existing)	B	From Face	3.00 -3.00 0.00	0.0000	100.00	No Ice 1/2" Ice	7.73 8.27	4.16 4.60	0.01 0.05
LPA-80080/8CF (Verizon - Existing)	B	From Face	3.00 -6.00 0.00	0.0000	100.00	No Ice 1/2" Ice	6.28 6.85	12.17 12.83	0.02 0.09
LPA-80080/8CF (Verizon - Existing)	C	From Face	3.00 6.00 0.00	0.0000	100.00	No Ice 1/2" Ice	6.28 6.85	12.17 12.83	0.02 0.09
BXA-171085-12BF (Verizon - Existing)	C	From Face	3.00 4.00 0.00	0.0000	100.00	No Ice 1/2" Ice	4.73 5.18	3.57 4.01	0.02 0.04
LNX-6514DS-VTM (Verizon - Proposed)	C	From Face	3.00 -3.00 0.00	0.0000	100.00	No Ice 1/2" Ice	8.41 8.96	5.41 5.86	0.04 0.09
LPA-80080/8CF (Verizon - Existing)	C	From Face	3.00 -6.00 0.00	0.0000	100.00	No Ice 1/2" Ice	6.28 6.85	12.17 12.83	0.02 0.09
EEI 12-ft Low Profile Platform (Verizon - Existing)	C	None		0.0000	97.00	No Ice 1/2" Ice	15.00 18.40	15.00 18.40	1.50 1.75
(4) HPA-65R-BUU-H8 (AT&T - Existing)	A	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	13.30 13.99	7.52 8.09	0.07 0.14
(4) HPA-65R-BUU-H8 (AT&T - Existing)	B	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	13.30 13.99	7.52 8.09	0.07 0.14
(4) HPA-65R-BUU-H8 (AT&T - Existing)	C	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	13.30 13.99	7.52 8.09	0.07 0.14
(3) RRUS-11 (AT&T - Existing)	A	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	2.99 3.23	1.25 1.41	0.05 0.07
(2) RRUS-12 (AT&T - Existing)	A	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	3.67 3.93	1.49 1.67	0.06 0.08
RRUS-32 (AT&T - Existing)	A	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	3.87 4.15	2.76 3.02	0.08 0.10
RRUS-E2 (AT&T - Existing)	A	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	3.67 3.93	1.49 1.67	0.06 0.08
(2) A2 (AT&T - Existing)	A	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	2.42 2.63	0.54 0.67	0.02 0.03
(3) RRUS-11 (AT&T - Existing)	B	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	2.99 3.23	1.25 1.41	0.05 0.07
(2) RRUS-12 (AT&T - Existing)	B	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	3.67 3.93	1.49 1.67	0.06 0.08
RRUS-32 (AT&T - Existing)	B	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	3.87 4.15	2.76 3.02	0.08 0.10
RRUS-E2 (AT&T - Existing)	B	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	3.67 3.93	1.49 1.67	0.06 0.08

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(2) A2 (AT&T - Existing)	B	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	2.42 2.63	0.54 0.67	0.02 0.03
(3) RRUS-11 (AT&T - Existing)	C	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	2.99 3.23	1.25 1.41	0.05 0.07
(2) RRUS-12 (AT&T - Existing)	C	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	3.67 3.93	1.49 1.67	0.06 0.08
RRUS-32 (AT&T - Existing)	C	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	3.87 4.15	2.76 3.02	0.08 0.10
RRUS-E2 (AT&T - Existing)	C	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	3.67 3.93	1.49 1.67	0.06 0.08
(2) A2 (AT&T - Existing)	C	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	2.42 2.63	0.54 0.67	0.02 0.03
DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	A	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	2.23 2.45	2.23 2.45	0.02 0.04
DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	A	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	2.23 2.45	2.23 2.45	0.02 0.04
DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	B	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	2.23 2.45	2.23 2.45	0.02 0.04
DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	C	From Face	3.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	2.23 2.45	2.23 2.45	0.02 0.04
Commscope MTC3607R Platform (AT&T - Existing)	C	None		0.0000	90.00	No Ice 1/2" Ice	53.00 68.00	53.00 68.00	2.52 3.20

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 100.00-82.83	91.24	1.337	25	62.935	A	0.000	62.935	62.935	100.00	0.000	0.000
					B	0.000	62.935		100.00	0.000	0.000
					C	0.000	62.935		100.00	0.000	0.000
L2 82.83-46.16	64.21	1.209	22	157.262	A	0.000	157.262	157.262	100.00	0.000	0.000
					B	0.000	157.262		100.00	0.000	0.000
					C	0.000	157.262		100.00	0.000	0.000
L3 46.16-1.00	22.84	1	19	237.473	A	0.000	237.473	237.473	100.00	0.000	0.000
					B	0.000	237.473		100.00	0.000	0.000

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
					C	0.000	237.473		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	t_Z in	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 100.00-82.83	91.24	1.337	19	0.5000	64.366	A	0.000	64.366	64.366	100.00	0.000	0.000
						B	0.000	64.366		100.00	0.000	0.000
						C	0.000	64.366		100.00	0.000	0.000
L2 82.83-46.16	64.21	1.209	17	0.5000	160.318	A	0.000	160.318	160.318	100.00	0.000	0.000
						B	0.000	160.318		100.00	0.000	0.000
						C	0.000	160.318		100.00	0.000	0.000
L3 46.16-1.00	22.84	1	14	0.5000	241.237	A	0.000	241.237	241.237	100.00	0.000	0.000
						B	0.000	241.237		100.00	0.000	0.000
						C	0.000	241.237		100.00	0.000	0.000

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 100.00-82.83	91.24	1.337	9	62.935	A	0.000	62.935	62.935	100.00	0.000	0.000
					B	0.000	62.935		100.00	0.000	0.000
					C	0.000	62.935		100.00	0.000	0.000
L2 82.83-46.16	64.21	1.209	8	157.262	A	0.000	157.262	157.262	100.00	0.000	0.000
					B	0.000	157.262		100.00	0.000	0.000
					C	0.000	157.262		100.00	0.000	0.000
L3 46.16-1.00	22.84	1	6	237.473	A	0.000	237.473	237.473	100.00	0.000	0.000
					B	0.000	237.473		100.00	0.000	0.000
					C	0.000	237.473		100.00	0.000	0.000

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 100.00-82.83	0.35	3.03	A	1	0.65	1	1	1	62.935	1.71	99.59	C
			B	1	0.65	1	1	1	62.935			
			C	1	0.65	1	1	1	62.935			
L2 82.83-46.16	0.82	10.17	A	1	0.65	1	1	1	157.262	3.85	105.00	C
			B	1	0.65	1	1	1	157.262			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
			C	1	0.65	1	1	1	157.262			
L3 46.16-1.00	1.01	17.52	A	1	0.65	1	1	1	237.473	4.86	107.54	C
			B	1	0.65	1	1	1	237.473			
			C	1	0.65	1	1	1	237.473			
Sum Weight:	2.18	30.73						OTM	503.71 kip-ft	10.42		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 100.00-82.83	0.35	3.03	A	1	0.65	1	1	1	62.935	1.71	99.59	C
			B	1	0.65	1	1	1	62.935			
			C	1	0.65	1	1	1	62.935			
L2 82.83-46.16	0.82	10.17	A	1	0.65	1	1	1	157.262	3.85	105.00	C
			B	1	0.65	1	1	1	157.262			
			C	1	0.65	1	1	1	157.262			
L3 46.16-1.00	1.01	17.52	A	1	0.65	1	1	1	237.473	4.86	107.54	C
			B	1	0.65	1	1	1	237.473			
			C	1	0.65	1	1	1	237.473			
Sum Weight:	2.18	30.73						OTM	503.71 kip-ft	10.42		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 100.00-82.83	0.35	3.03	A	1	0.65	1	1	1	62.935	1.71	99.59	C
			B	1	0.65	1	1	1	62.935			
			C	1	0.65	1	1	1	62.935			
L2 82.83-46.16	0.82	10.17	A	1	0.65	1	1	1	157.262	3.85	105.00	C
			B	1	0.65	1	1	1	157.262			
			C	1	0.65	1	1	1	157.262			
L3 46.16-1.00	1.01	17.52	A	1	0.65	1	1	1	237.473	4.86	107.54	C
			B	1	0.65	1	1	1	237.473			
			C	1	0.65	1	1	1	237.473			
Sum Weight:	2.18	30.73						OTM	503.71 kip-ft	10.42		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 100.00-82.83	0.35	3.50	A	1	0.65	1	1	1	64.366	1.31	76.39	C
			B	1	0.65	1	1	1	64.366			
			C	1	0.65	1	1	1	64.366			
L2 82.83-46.16	0.82	11.35	A	1	0.65	1	1	1	160.318	2.94	80.28	C
			B	1	0.65	1	1	1	160.318			
			C	1	0.65	1	1	1	160.318			
L3 46.16-1.00	1.01	19.30	A	1	0.65	1	1	1	241.237	3.70	81.94	C
			B	1	0.65	1	1	1	241.237			
			C	1	0.65	1	1	1	241.237			
Sum Weight:	2.18	34.15						OTM	385.22 kip-ft	7.96		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 100.00-82.83	0.35	3.50	A	1	0.65	1	1	1	64.366	1.31	76.39	C
			B	1	0.65	1	1	1	64.366			
			C	1	0.65	1	1	1	64.366			
L2 82.83-46.16	0.82	11.35	A	1	0.65	1	1	1	160.318	2.94	80.28	C
			B	1	0.65	1	1	1	160.318			
			C	1	0.65	1	1	1	160.318			
L3 46.16-1.00	1.01	19.30	A	1	0.65	1	1	1	241.237	3.70	81.94	C
			B	1	0.65	1	1	1	241.237			
			C	1	0.65	1	1	1	241.237			
Sum Weight:	2.18	34.15						OTM	385.22 kip-ft	7.96		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 100.00-82.83	0.35	3.50	A	1	0.65	1	1	1	64.366	1.31	76.39	C
			B	1	0.65	1	1	1	64.366			
			C	1	0.65	1	1	1	64.366			
L2 82.83-46.16	0.82	11.35	A	1	0.65	1	1	1	160.318	2.94	80.28	C
			B	1	0.65	1	1	1	160.318			
			C	1	0.65	1	1	1	160.318			
L3 46.16-1.00	1.01	19.30	A	1	0.65	1	1	1	241.237	3.70	81.94	C
			B	1	0.65	1	1	1	241.237			
			C	1	0.65	1	1	1	241.237			
Sum Weight:	2.18	34.15						OTM	385.22 kip-ft	7.96		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 100.00-82.83	0.35	3.03	A	1	0.65	1	1	1	62.935	0.59	34.46	C
			B	1	0.65	1	1	1	62.935			
			C	1	0.65	1	1	1	62.935			
L2 82.83-46.16	0.82	10.17	A	1	0.65	1	1	1	157.262	1.33	36.33	C
			B	1	0.65	1	1	1	157.262			
			C	1	0.65	1	1	1	157.262			
L3 46.16-1.00	1.01	17.52	A	1	0.65	1	1	1	237.473	1.68	37.21	C
			B	1	0.65	1	1	1	237.473			
			C	1	0.65	1	1	1	237.473			
Sum Weight:	2.18	30.73						OTM	174.29 kip-ft	3.60		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 100.00-82.83	0.35	3.03	A	1	0.65	1	1	1	62.935	0.59	34.46	C
			B	1	0.65	1	1	1	62.935			
			C	1	0.65	1	1	1	62.935			
L2 82.83-46.16	0.82	10.17	A	1	0.65	1	1	1	157.262	1.33	36.33	C
			B	1	0.65	1	1	1	157.262			
			C	1	0.65	1	1	1	157.262			
L3 46.16-1.00	1.01	17.52	A	1	0.65	1	1	1	237.473	1.68	37.21	C
			B	1	0.65	1	1	1	237.473			
			C	1	0.65	1	1	1	237.473			
Sum Weight:	2.18	30.73						OTM	174.29 kip-ft	3.60		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 100.00-82.83	0.35	3.03	A	1	0.65	1	1	1	62.935	0.59	34.46	C
			B	1	0.65	1	1	1	62.935			
			C	1	0.65	1	1	1	62.935			
L2 82.83-46.16	0.82	10.17	A	1	0.65	1	1	1	157.262	1.33	36.33	C
			B	1	0.65	1	1	1	157.262			
			C	1	0.65	1	1	1	157.262			
L3 46.16-1.00	1.01	17.52	A	1	0.65	1	1	1	237.473	1.68	37.21	C
			B	1	0.65	1	1	1	237.473			
			C	1	0.65	1	1	1	237.473			
Sum Weight:	2.18	30.73						OTM	174.29 kip-ft	3.60		

Force Totals

Load Case	*Vertical Forces* *K*	*Sum of Forces X* *K*	*Sum of Forces Z* *K*	*Sum of Overturning Moments, M_x* *kip-ft*	*Sum of Overturning Moments, M_z* *kip-ft*	*Sum of Torques* *kip-ft*
Leg Weight	30.73					
Bracing Weight	0.00					
Total Member Self-Weight	30.73			0.31	0.31	
Total Weight	39.51			0.31	0.31	
Wind 0 deg - No Ice		-0.01	-25.31	-1874.91	1.79	-0.93
Wind 30 deg - No Ice		12.66	-21.92	-1622.94	-938.08	-0.19
Wind 60 deg - No Ice		21.95	-12.64	-936.02	-1626.51	0.60
Wind 90 deg - No Ice		25.36	0.01	1.79	-1879.03	1.23
Wind 120 deg - No Ice		21.97	12.67	939.20	-1627.98	1.53
Wind 150 deg - No Ice		12.69	21.93	1625.04	-940.64	1.42
Wind 180 deg - No Ice		0.01	25.31	1875.54	-1.17	0.93
Wind 210 deg - No Ice		-12.66	21.92	1623.57	938.70	0.19
Wind 240 deg - No Ice		-21.95	12.64	936.65	1627.13	-0.60
Wind 270 deg - No Ice		-25.36	-0.01	-1.16	1879.65	-1.23
Wind 300 deg - No Ice		-21.97	-12.67	-938.58	1628.61	-1.53
Wind 330 deg - No Ice		-12.69	-21.93	-1624.42	941.26	-1.42
Member Ice	3.42					
Total Weight Ice	45.98			0.47	0.46	
Wind 0 deg - Ice		-0.01	-20.42	-1532.14	1.58	-0.91
Wind 30 deg - Ice		10.22	-17.68	-1326.25	-766.43	-0.19
Wind 60 deg - Ice		17.70	-10.20	-764.87	-1328.95	0.58
Wind 90 deg - Ice		20.45	0.01	1.59	-1535.26	1.19
Wind 120 deg - Ice		17.72	10.22	767.74	-1330.07	1.48
Wind 150 deg - Ice		10.23	17.69	1328.31	-768.36	1.38
Wind 180 deg - Ice		0.01	20.42	1533.09	-0.65	0.91
Wind 210 deg - Ice		-10.22	17.68	1327.20	767.36	0.19
Wind 240 deg - Ice		-17.70	10.20	765.81	1329.88	-0.58
Wind 270 deg - Ice		-20.45	-0.01	-0.64	1536.19	-1.19
Wind 300 deg - Ice		-17.72	-10.22	-766.80	1331.00	-1.48
Wind 330 deg - Ice		-10.23	-17.69	-1327.37	769.29	-1.38
Total Weight	39.51			0.31	0.31	
Wind 0 deg - Service		-0.01	-8.76	-648.55	0.82	-0.32
Wind 30 deg - Service		4.38	-7.58	-561.37	-324.39	-0.07
Wind 60 deg - Service		7.60	-4.38	-323.68	-562.60	0.21
Wind 90 deg - Service		8.77	0.01	0.82	-649.98	0.42
Wind 120 deg - Service		7.60	4.38	325.19	-563.11	0.53
Wind 150 deg - Service		4.39	7.59	562.50	-325.28	0.49
Wind 180 deg - Service		0.01	8.76	649.18	-0.20	0.32
Wind 210 deg - Service		-4.38	7.58	561.99	325.01	0.07
Wind 240 deg - Service		-7.60	4.38	324.30	563.22	-0.21
Wind 270 deg - Service		-8.77	-0.01	-0.20	650.60	-0.42
Wind 300 deg - Service		-7.60	-4.38	-324.56	563.74	-0.53
Wind 330 deg - Service		-4.39	-7.59	-561.88	325.90	-0.49

Load Combinations

Comb. No.	*Description*
1	Dead Only
2	Dead+Wind 0 deg - No Ice

Comb. No.	Description
3	Dead+Wind 30 deg - No Ice
4	Dead+Wind 60 deg - No Ice
5	Dead+Wind 90 deg - No Ice
6	Dead+Wind 120 deg - No Ice
7	Dead+Wind 150 deg - No Ice
8	Dead+Wind 180 deg - No Ice
9	Dead+Wind 210 deg - No Ice
10	Dead+Wind 240 deg - No Ice
11	Dead+Wind 270 deg - No Ice
12	Dead+Wind 300 deg - No Ice
13	Dead+Wind 330 deg - No Ice
14	Dead+Ice+Temp
15	Dead+Wind 0 deg+Ice+Temp
16	Dead+Wind 30 deg+Ice+Temp
17	Dead+Wind 60 deg+Ice+Temp
18	Dead+Wind 90 deg+Ice+Temp
19	Dead+Wind 120 deg+Ice+Temp
20	Dead+Wind 150 deg+Ice+Temp
21	Dead+Wind 180 deg+Ice+Temp
22	Dead+Wind 210 deg+Ice+Temp
23	Dead+Wind 240 deg+Ice+Temp
24	Dead+Wind 270 deg+Ice+Temp
25	Dead+Wind 300 deg+Ice+Temp
26	Dead+Wind 330 deg+Ice+Temp
27	Dead+Wind 0 deg - Service
28	Dead+Wind 30 deg - Service
29	Dead+Wind 60 deg - Service
30	Dead+Wind 90 deg - Service
31	Dead+Wind 120 deg - Service
32	Dead+Wind 150 deg - Service
33	Dead+Wind 180 deg - Service
34	Dead+Wind 210 deg - Service
35	Dead+Wind 240 deg - Service
36	Dead+Wind 270 deg - Service
37	Dead+Wind 300 deg - Service
38	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	100 - 82.83	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-12.04	0.46	-0.47
			Max. Mx	11	-5.24	80.38	-0.02
			Max. My	8	-5.24	0.02	-80.04
			Max. Vy	11	-16.07	64.84	-0.14
			Max. Vx	8	16.03	0.14	-64.39
			Max. Torque	12			1.53
L2	82.83 - 46.163	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-23.23	0.46	-0.47
			Max. Mx	11	-18.67	698.16	0.38
			Max. My	8	-18.67	-0.38	-696.24
			Max. Vy	11	-19.79	698.16	0.38
			Max. Vx	8	19.75	-0.38	-696.24
			Max. Torque	12			1.53
L3	46.163 - 1	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-45.98	0.46	-0.47
			Max. Mx	11	-39.51	1888.92	1.17

Section No.	*Elevation ft*	*Component Type*	*Condition*	*Gov. Load Comb.*	*Force K*	*Major Axis Moment kip-ft*	*Minor Axis Moment kip-ft*
			Max. My	8	-39.51	-1.17	-1884.78
			Max. Vy	11	-25.36	1888.92	1.17
			Max. Vx	8	25.32	-1.17	-1884.78
			Max. Torque	12			1.53

Maximum Reactions

Location	*Condition*	*Gov. Load Comb.*	*Vertical K*	*Horizontal, X K*	*Horizontal, Z K*
Pole	Max. Vert	24	45.98	20.45	0.01
	Max. H_x	11	39.51	25.36	0.01
	Max. H_z	2	39.51	0.01	25.31
	Max. M_x	2	1884.15	0.01	25.31
	Max. M_z	5	1888.29	-25.36	-0.01
	Max. Torsion	12	1.53	21.97	12.67
	Min. Vert	36	39.51	8.77	0.01
	Min. H_x	5	39.51	-25.36	-0.01
	Min. H_z	8	39.51	-0.01	-25.31
	Min. M_x	8	-1884.78	-0.01	-25.31
	Min. M_z	11	-1888.92	25.36	0.01
	Min. Torsion	6	-1.53	-21.97	-12.67

Tower Mast Reaction Summary

Load Combination	*Vertical K*	*Shear$_x$ K*	*Shear$_z$ K*	*Overturning Moment, M_x kip-ft*	*Overturning Moment, M_z kip-ft*	*Torque kip-ft*
Dead Only	39.51	0.00	0.00	0.31	0.31	0.00
Dead+Wind 0 deg - No Ice	39.51	-0.01	-25.31	-1884.15	1.80	-0.93
Dead+Wind 30 deg - No Ice	39.51	12.66	-21.92	-1630.94	-942.70	-0.19
Dead+Wind 60 deg - No Ice	39.51	21.95	-12.64	-940.63	-1634.52	0.60
Dead+Wind 90 deg - No Ice	39.51	25.36	0.01	1.80	-1888.29	1.23
Dead+Wind 120 deg - No Ice	39.51	21.97	12.67	943.84	-1636.01	1.53
Dead+Wind 150 deg - No Ice	39.51	12.69	21.93	1633.06	-945.28	1.42
Dead+Wind 180 deg - No Ice	39.51	0.01	25.31	1884.78	-1.17	0.93
Dead+Wind 210 deg - No Ice	39.51	-12.66	21.92	1631.57	943.33	0.19
Dead+Wind 240 deg - No Ice	39.51	-21.95	12.64	941.26	1635.15	-0.60
Dead+Wind 270 deg - No Ice	39.51	-25.36	-0.01	-1.17	1888.92	-1.23
Dead+Wind 300 deg - No Ice	39.51	-21.97	-12.67	-943.20	1636.64	-1.53
Dead+Wind 330 deg - No Ice	39.51	-12.69	-21.93	-1632.42	945.90	-1.42
Dead+Ice+Temp	45.98	0.00	0.00	0.47	0.46	0.00
Dead+Wind 0 deg+Ice+Temp	45.98	-0.01	-20.42	-1541.54	1.59	-0.91
Dead+Wind 30 deg+Ice+Temp	45.98	10.22	-17.68	-1334.39	-771.13	-0.19
Dead+Wind 60 deg+Ice+Temp	45.98	17.70	-10.20	-769.56	-1337.11	0.58
Dead+Wind 90 deg+Ice+Temp	45.98	20.45	0.01	1.60	-1544.68	1.19
Dead+Wind 120 deg+Ice+Temp	45.98	17.72	10.22	772.46	-1338.23	1.49
Dead+Wind 150 deg+Ice+Temp	45.98	10.23	17.69	1336.47	-773.08	1.38
Dead+Wind 180 deg+Ice+Temp	45.98	0.01	20.42	1542.50	-0.65	0.91
Dead+Wind 210 deg+Ice+Temp	45.98	-10.22	17.68	1335.34	772.07	0.19
Dead+Wind 240 deg+Ice+Temp	45.98	-17.70	10.20	770.51	1338.05	-0.58
Dead+Wind 270 deg+Ice+Temp	45.98	-20.45	-0.01	-0.65	1545.62	-1.19
Dead+Wind 300 deg+Ice+Temp	45.98	-17.72	-10.22	-771.50	1339.17	-1.49

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead+Wind 330 deg+Ice+Temp	45.98	-10.23	-17.69	-1335.51	774.02	-1.38
Dead+Wind 0 deg - Service	39.51	-0.01	-8.76	-651.75	0.83	-0.32
Dead+Wind 30 deg - Service	39.51	4.38	-7.58	-564.14	-325.99	-0.07
Dead+Wind 60 deg - Service	39.51	7.60	-4.38	-325.27	-565.38	0.21
Dead+Wind 90 deg - Service	39.51	8.77	0.01	0.83	-653.19	0.42
Dead+Wind 120 deg - Service	39.51	7.60	4.38	326.80	-565.89	0.53
Dead+Wind 150 deg - Service	39.51	4.39	7.59	565.28	-326.88	0.49
Dead+Wind 180 deg - Service	39.51	0.01	8.76	652.39	-0.20	0.32
Dead+Wind 210 deg - Service	39.51	-4.38	7.58	564.77	326.62	0.07
Dead+Wind 240 deg - Service	39.51	-7.60	4.38	325.91	566.01	-0.21
Dead+Wind 270 deg - Service	39.51	-8.77	-0.01	-0.20	653.82	-0.42
Dead+Wind 300 deg - Service	39.51	-7.60	-4.38	-326.16	566.52	-0.53
Dead+Wind 330 deg - Service	39.51	-4.39	-7.59	-564.65	327.51	-0.49

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
1	0.00	-39.51	0.00	0.00	39.51	0.00	0.000%
2	-0.01	-39.51	-25.31	0.01	39.51	25.31	0.000%
3	12.66	-39.51	-21.92	-12.66	39.51	21.92	0.000%
4	21.95	-39.51	-12.64	-21.95	39.51	12.64	0.000%
5	25.36	-39.51	0.01	-25.36	39.51	-0.01	0.000%
6	21.97	-39.51	12.67	-21.97	39.51	-12.67	0.000%
7	12.69	-39.51	21.93	-12.69	39.51	-21.93	0.000%
8	0.01	-39.51	25.31	-0.01	39.51	-25.31	0.000%
9	-12.66	-39.51	21.92	12.66	39.51	-21.92	0.000%
10	-21.95	-39.51	12.64	21.95	39.51	-12.64	0.000%
11	-25.36	-39.51	-0.01	25.36	39.51	0.01	0.000%
12	-21.97	-39.51	-12.67	21.97	39.51	12.67	0.000%
13	-12.69	-39.51	-21.93	12.69	39.51	21.93	0.000%
14	0.00	-45.98	0.00	0.00	45.98	0.00	0.000%
15	-0.01	-45.98	-20.42	0.01	45.98	20.42	0.000%
16	10.22	-45.98	-17.68	-10.22	45.98	17.68	0.000%
17	17.70	-45.98	-10.20	-17.70	45.98	10.20	0.000%
18	20.45	-45.98	0.01	-20.45	45.98	-0.01	0.000%
19	17.72	-45.98	10.22	-17.72	45.98	-10.22	0.000%
20	10.23	-45.98	17.69	-10.23	45.98	-17.69	0.000%
21	0.01	-45.98	20.42	-0.01	45.98	-20.42	0.000%
22	-10.22	-45.98	17.68	10.22	45.98	-17.68	0.000%
23	-17.70	-45.98	10.20	17.70	45.98	-10.20	0.000%
24	-20.45	-45.98	-0.01	20.45	45.98	0.01	0.000%
25	-17.72	-45.98	-10.22	17.72	45.98	10.22	0.000%
26	-10.23	-45.98	-17.69	10.23	45.98	17.69	0.000%
27	-0.01	-39.51	-8.76	0.01	39.51	8.76	0.000%
28	4.38	-39.51	-7.58	-4.38	39.51	7.58	0.000%
29	7.60	-39.51	-4.38	-7.60	39.51	4.38	0.000%
30	8.77	-39.51	0.01	-8.77	39.51	-0.01	0.000%
31	7.60	-39.51	4.38	-7.60	39.51	-4.38	0.000%
32	4.39	-39.51	7.59	-4.39	39.51	-7.59	0.000%
33	0.01	-39.51	8.76	-0.01	39.51	-8.76	0.000%
34	-4.38	-39.51	7.58	4.38	39.51	-7.58	0.000%
35	-7.60	-39.51	4.38	7.60	39.51	-4.38	0.000%
36	-8.77	-39.51	-0.01	8.77	39.51	0.01	0.000%
37	-7.60	-39.51	-4.38	7.60	39.51	4.38	0.000%
38	-4.39	-39.51	-7.59	4.39	39.51	7.59	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	4	0.00000001	0.00000001
3	Yes	4	0.00000001	0.00000609
4	Yes	4	0.00000001	0.00000572
5	Yes	4	0.00000001	0.00000001
6	Yes	4	0.00000001	0.00000897
7	Yes	4	0.00000001	0.00000573
8	Yes	4	0.00000001	0.00000001
9	Yes	4	0.00000001	0.00000649
10	Yes	4	0.00000001	0.00000722
11	Yes	4	0.00000001	0.00000001
12	Yes	4	0.00000001	0.00000579
13	Yes	4	0.00000001	0.00000868
14	Yes	4	0.00000001	0.00000001
15	Yes	4	0.00000001	0.00006564
16	Yes	4	0.00000001	0.00006904
17	Yes	4	0.00000001	0.00006908
18	Yes	4	0.00000001	0.00006581
19	Yes	4	0.00000001	0.00006954
20	Yes	4	0.00000001	0.00006923
21	Yes	4	0.00000001	0.00006572
22	Yes	4	0.00000001	0.00006920
23	Yes	4	0.00000001	0.00006931
24	Yes	4	0.00000001	0.00006588
25	Yes	4	0.00000001	0.00006930
26	Yes	4	0.00000001	0.00006944
27	Yes	4	0.00000001	0.00000001
28	Yes	4	0.00000001	0.00000001
29	Yes	4	0.00000001	0.00000001
30	Yes	4	0.00000001	0.00000001
31	Yes	4	0.00000001	0.00000001
32	Yes	4	0.00000001	0.00000001
33	Yes	4	0.00000001	0.00000001
34	Yes	4	0.00000001	0.00000001
35	Yes	4	0.00000001	0.00000001
36	Yes	4	0.00000001	0.00000001
37	Yes	4	0.00000001	0.00000001
38	Yes	4	0.00000001	0.00000001

Maximum Tower Deflections - Service Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °
L1	100 - 82.83	2.422	36	0.1882	0.0006
L2	89.163 - 46.163	1.996	36	0.1858	0.0005
L3	53.83 - 1	0.780	36	0.1295	0.0002

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
100.00	LPA-80080/8CF	36	2.422	0.1882	0.0006	406759
97.00	20' x 3" Dia Omni	36	2.304	0.1880	0.0006	406759
90.00	(4) HPA-65R-BUU-H8	36	2.029	0.1862	0.0005	186895

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	100 - 82.83	6.994	11	0.5434	0.0019
L2	89.163 - 46.163	5.766	11	0.5365	0.0015
L3	53.83 - 1	2.254	11	0.3741	0.0006

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
100.00	LPA-80080/8CF	11	6.994	0.5434	0.0019	142883
97.00	20' x 3" Dia Omni	11	6.653	0.5427	0.0018	142883
90.00	(4) HPA-65R-BUU-H8	11	5.860	0.5377	0.0015	65510

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
L1	100 - 82.83 (1)	TP46.63x41.34x0.375	17.17	99.00	72.3	24.063	55.0550	-5.24	1324.79	0.004
L2	82.83 - 46.163 (2)	TP57.07x43.9288x0.4375	43.00	99.00	61.6	27.151	75.3876	-18.67	2046.86	0.009
L3	46.163 - 1 (3)	TP70x53.8519x0.5	52.83	99.00	48.2	30.640	110.2970	-39.51	3379.43	0.012

Pole Bending Design Data

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$

Section No.	*Elevation ft*	*Size*	*Actual M_x kip-ft*	*Actual f_{bx} ksi*	*Allow. F_{bx} ksi*	*Ratio $\frac{f_{bx}}{F_{bx}}$*	*Actual M_y kip-ft*	*Actual f_{by} ksi*	*Allow. F_{by} ksi*	*Ratio $\frac{f_{by}}{F_{by}}$*
L1	100 - 82.83 (1)	TP46.63x41.34x0.375	80.38	-1.535	39.000	0.039	0.00	0.000	39.000	0.000
L2	82.83 - 46.163 (2)	TP57.07x43.9288x0.4375	698.16	-8.297	39.000	0.213	0.00	0.000	39.000	0.000
L3	46.163 - 1 (3)	TP70x53.8519x0.5	1888.97	-11.976	39.000	0.307	0.00	0.000	39.000	0.000

Pole Interaction Design Data

Section No.	*Elevation ft*	*Size*	*Ratio $\frac{P}{P_a}$*	*Ratio $\frac{f_{bx}}{F_{bx}}$*	*Ratio $\frac{f_{by}}{F_{by}}$*	*Comb. Stress Ratio*	*Allow. Stress Ratio*	*Criteria*
L1	100 - 82.83 (1)	TP46.63x41.34x0.375	0.004	0.039	0.000	0.043 ✔	1.333	H1-3 ✔
L2	82.83 - 46.163 (2)	TP57.07x43.9288x0.4375	0.009	0.213	0.000	0.222 ✔	1.333	H1-3 ✔
L3	46.163 - 1 (3)	TP70x53.8519x0.5	0.012	0.307	0.000	0.319 ✔	1.333	H1-3 ✔

Section Capacity Table

Section No.	*Elevation ft*	*Component Type*	*Size*	*Critical Element*	*P K*	*$SF*P_{allow}$ K*	*% Capacity*	*Pass Fail*
L1	100 - 82.83	Pole	TP46.63x41.34x0.375	1	-5.24	1765.94	3.2	Pass
L2	82.83 - 46.163	Pole	TP57.07x43.9288x0.4375	2	-18.67	2728.46	16.6	Pass
L3	46.163 - 1	Pole	TP70x53.8519x0.5	3	-39.51	4504.78	23.9	Pass
							Summary	
						Pole (L3)	23.9	Pass
						RATING =	**23.9**	**Pass**

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 1889 \cdot ft \cdot kips$	(Input From tnxTower)
Shear Force =	$Shear := 25 \cdot kips$	(Input From tnxTower)
Axial Force =	$Axial := 40 \cdot kips$	(Input From tnxTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	$N := 36$	(User Input)
Diameter of Bolt Circle =	$D_{bc} := 78.0 \cdot in$	(User Input)
Bolt "Column" Distance =	$l := 3.0 \cdot in$	(User Input)
Bolt Ultimate Strength =	$F_u := 100 \cdot ksi$	(User Input)
Bolt Yield Strength =	$F_y := 75 \cdot ksi$	(User Input)
Bolt Modulus =	$E := 29000 \cdot ksi$	(User Input)
Diameter of Anchor Bolts =	$D := 2.25 \cdot in$	(User Input)
Threads per Inch =	$n := 4.5$	(User Input)

Base Plate Data:

Use ASTM A572 60

Plate Yield Strength =	$Fy_{bp} := 60 \cdot ksi$	(User Input)
Base Plate Thickness =	$t_{bp} := 3.5 \cdot in$	(User Input)
Base Plate Diameter =	$D_{bp} := 84 \cdot in$	(User Input)
Outer Pole Diameter =	$D_{pole} := 70 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =: $R_{bc} := \frac{D_{bc}}{2} = 39 \cdot in$

Distance to Bolts = $i := 1..N$

$$d_i := \left| \begin{array}{l} \theta \leftarrow 2 \cdot \pi \cdot \left(\frac{i}{N}\right) \\ d \leftarrow R_{bc} \cdot \sin(\theta) \end{array} \right.$$

$d_1 = 6.77 \cdot in$	$d_7 = 36.65 \cdot in$
$d_2 = 13.34 \cdot in$	$d_8 = 38.41 \cdot in$
$d_3 = 19.50 \cdot in$	$d_9 = 39.00 \cdot in$
$d_4 = 25.07 \cdot in$	$d_{10} = 38.41 \cdot in$
$d_5 = 29.88 \cdot in$	$d_{11} = 36.65 \cdot in$
$d_6 = 33.77 \cdot in$	etc.

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 35 \cdot in$

Moment Arms of Bolts about Neutral Axis = $MA_i := if\left(d_i \geq R_{pole}, d_i - R_{pole}, 0in\right)$

$MA_1 = 0.00 \cdot in$	$MA_7 = 1.65 \cdot in$
$MA_2 = 0.00 \cdot in$	$MA_8 = 3.41 \cdot in$
$MA_3 = 0.00 \cdot in$	$MA_9 = 4.00 \cdot in$
$MA_4 = 0.00 \cdot in$	$MA_{10} = 3.41 \cdot in$
$MA_5 = 0.00 \cdot in$	$MA_{11} = 1.65 \cdot in$
$MA_6 = 0.00 \cdot in$	etc

Effective Width of Baseplate for Bending = $B_{eff} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 37.1 \cdot in$

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i (d_i)^2 = 2.738 \times 10^4 \cdot in^2$

Gross Area of Bolt = $A_g := \frac{\pi}{4} \cdot D^2 = 3.976 \cdot in^2$

Net Area of Bolt = $A_n := \frac{\pi}{4} \cdot \left(D - \frac{0.9743 \cdot in}{n}\right)^2 = 3.248 \cdot in^2$

Net Diameter = $D_n := \frac{2 \cdot \sqrt{A_n}}{\sqrt{\pi}} = 2.033 \cdot in$

Radius of Gyration of Bolt = $r := \frac{D_n}{4} = 0.508 \cdot in$

Section Modulus of Bolt = $S_x := \frac{\pi \cdot D_n^3}{32} = 0.826 \cdot in^3$

Check Anchor Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 31.2 \cdot kips$

Allowable Tensile Force = $T_{ALL.Gross} := 1.333 \cdot (0.33 \cdot A_g \cdot F_u) = 174.9 \cdot kips$ (1.333 increase allowed per TIA/EIA)

$T_{ALL.Net} := 1.333 \cdot (0.60 \cdot A_n \cdot F_y) = 194.812 \cdot kips$ (1.333 increase allowed per TIA/EIA)

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Net}} \cdot 100 = 16$ Bolts are "upset bolts". Use net area per AISC

Condition1 = Condition1 := if$\left(\frac{T_{Max}}{T_{ALL.Net}} \le 1.00, \text{"OK"}, \text{"Overstressed"}\right)$

Condition1 = "OK"

Check Anchor Bolt Bending Stress:

Maximum Bending Moment = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.174 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 2.5 \cdot ksi$

Allowable Bending Stress = $F_{bx} := 1.333 \cdot 0.6 \cdot F_y = 60 \cdot ksi$ (1.333 increase allowed per TIA/EIA)

Check Combined Stress Requirement:

Per ASCE Manual 72: "If the clearance between the base plate and concrete does not exceed two times the bolt diameter a bending stress analysis of the bolts is NOT normally required.

$$l := \begin{cases} l & \text{if } l > 2 \cdot D_n \\ 0 & \text{otherwise} \end{cases} = 0 \cdot in$$

$$f_{bx} := \begin{cases} f_{bx} & \text{if } l > 2 \cdot D_n \\ 0 & \text{otherwise} \end{cases} = 0 \cdot ksi$$

Check Anchor Bolt Compression/Combined Stress:

Maximum Compressive Force = $C_{Max} := OM \cdot \frac{R_{bc}}{I_p} + \frac{Axial}{N} = 33.4 \cdot kips$

Maximum Compressive Stress = $f_a := \frac{C_{Max}}{A_n} = 10.3 \cdot ksi$

$K := 0.65$

$$C_c := \sqrt{\frac{2 \cdot \pi^2 \cdot E}{F_y}} = 87.364$$

$$F_a := \begin{cases} \dfrac{\left[1 - \dfrac{\left(\frac{K \cdot l}{r}\right)^2}{2 \cdot C_c^2}\right] \cdot F_y}{\dfrac{5}{3} + \dfrac{3 \cdot \left(\frac{K \cdot l}{r}\right)}{8 \cdot C_c} - \dfrac{\left(\frac{K \cdot l}{r}\right)^3}{8 \cdot C_c^3}} & \text{if } \frac{K \cdot l}{r} \le C_c \\ \dfrac{12 \cdot \pi^2 \cdot E}{23 \cdot \left(\frac{K \cdot l}{r}\right)^2} & \text{if } \frac{K \cdot l}{r} > C_c \end{cases} = 45 \cdot ksi$$

Allowable Compressive Stress = $F_a := 1.333 \cdot F_a = 60 \cdot ksi$ (1.333 increase allowed per TIA/EIA)

Combined Stress % of Capacity = $\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) \cdot 100 = 17.1$

Condition 2 = $\text{Condition2} := \text{if}\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} \le 1.00, \text{"OK"}, \text{"Overstressed"}\right)$

Condition2 = "OK"

Base Plate Analysis:

Force from Bolts = $C_i := \frac{OM \cdot d_i}{I_p} + \frac{Axial}{N}$

$C_1 = 6.7 \cdot kips$	$C_7 = 31.5 \cdot kips$
$C_2 = 12.2 \cdot kips$	$C_8 = 32.9 \cdot kips$
$C_3 = 17.3 \cdot kips$	$C_9 = 33.4 \cdot kips$
$C_4 = 21.9 \cdot kips$	$C_{10} = 32.9 \cdot kips$
$C_5 = 25.8 \cdot kips$	$C_{11} = 31.5 \cdot kips$
$C_6 = 29.1 \cdot kips$	etc.

Maximum Bending Stress in Plate = $f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} \cdot t_{bp}^{\ 2}\right)} = 6.1 \cdot ksi$

Allowable Bending Stress in Plate = $F_{bp} := 1.33 \cdot 0.75 \cdot Fy_{bp} = 59.9 \cdot ksi$

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} \cdot 100 = 10.2$

Condition3 = Condition3 := if$\left(\frac{f_{bp}}{F_{bp}} < 1.00, \text{"Ok"}, \text{"Overstressed"}\right)$

Condition3 = "Ok"

Standard Monopole Foundation:

Input Data:

Tower Data

Overturning Moment =	$OM := 1889 \cdot ft \cdot kips$	(User Input from tnxTower)
Shear Force =	$Shear := 25 \cdot kip$	(User Input from tnxTower)
Axial Force =	$Axial := 40 \cdot kip$	(User Input from tnxTower)
Tower Height =	$H_t := 100 \cdot ft$	(User Input)

Footing Data:

Overall Depth of Footing =	$D_f := 5.0 \cdot ft$	(User Input)
Length of Pier =	$L_p := 3.0 \cdot ft$	(User Input)
Extension of Pier Above Grade =	$L_{pag} := 1.0 \cdot ft$	(User Input)
Diameter of Pier =	$d_p := 9.0 \cdot ft$	(User Input)
Thickness of Footing =	$T_f := 3.0 \cdot ft$	(User Input)
Width of Footing =	$W_f := 32.0 \cdot ft$	(User Input)

Anchor Bolt Data:

Length of Anchor Bolts =	$L_{st} := 72 \cdot in$	(User Input)
Projection of Anchor Bolts Above Pier =	$A_{BP} := 12.0 \cdot in$	(User Input)
Anchor Bolt Diameter =	$d_{anchor} := 2.25 \cdot in$	(User Input)
Base Plate Bolt Circle =	$MP := 78 \cdot in$	(User Input)

Material Properties:

Concrete Compressive Strength =	$f_c := 4000 \cdot psi$	(User Input)	
Steel Reinforcment Yield Strength =	$f_y := 60000 \cdot psi$	(User Input)	
Anchor Bolt Yield Strength =	$f_{ya} := 75000 \cdot psi$	(User Input)	
Internal Friction Angle of Soil =	$\Phi_s := 30 \cdot deg$	(User Input)	
Allowable Soil Bearing Capacity =	$q_s := 6000 \cdot psf$	(User Input)	
Unit Weight of Soil =	$\gamma_{soil} := 120 \cdot pcf$	(User Input)	
Unit Weight of Concrete =	$\gamma_{conc} := 150 \cdot pcf$	(User Input)	
Foundation Bouyancy =	$Bouyancy := 0$	(User Input)	(Yes=1 / No=0)
Depth to Neglect =	$n := 0 \cdot ft$	(User Input)	
Cohesion of Clay Type Soil =	$c := 0 \cdot ksf$	(User Input)	(Use 0 for Sandy Soil)
Seismic Zone Factor =	$Z := 2$	(User Input)	(UBC-1997 Fig 23-2)
Coefficient of Friction Between Concrete =	$\mu := 0.45$	(User Input)	

Pier Reinforcement:

Bar Size =	$BS_{pier} := 11$	(User Input)	
Bar Diameter =	$d_{bpier} := 1.41 \cdot in$	(User Input)	
Number of Bars =	$NB_{pier} := 30$	(User Input)	
Clear Cover of Reinforcement =	$Cvr_{pier} := 3 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Diameter of Tie =	$d_{Tie} := 0.5 \cdot in$	(User Input)	

Pad Reinforcement:

Bar Size =	$BS_{top} := 11$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 1.41 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 19$	(User Input)	(Top of Pad)
Bar Size =	$BS_{bot} := 11$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{bbot} := 1.41 \cdot in$	(User Input)	(Bottom of Pad)
Number of Bars =	$NB_{bot} := 37$	(User Input)	(Bottom of Pad)
Clear Cover of Reinforcement =	$Cvr_{pad} := 3.0 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)

Calculated Factors:

Pier Reinforcement Bar Area = $$A_{bpier} := \frac{\pi \cdot d_{bpier}^2}{4} = 1.561 \cdot in^2$$

Pad Top Reinforcement Bar Area = $$A_{btop} := \frac{\pi \cdot d_{btop}^2}{4} = 1.561 \cdot in^2$$

Pad Bottom Reinforcement Bar Area = $$A_{bbot} := \frac{\pi \cdot d_{bbot}^2}{4} = 1.561 \cdot in^2$$

Coefficient of Lateral Soil Pressure = $$K_p := \frac{1 + \sin(\Phi_s)}{1 - \sin(\Phi_s)} = 3$$

Load Factor = $$LF := \begin{cases} 1.333 & \text{if } H_t \le 700 \cdot ft \\ 1.7 & \text{if } H_t \ge 1200 \cdot ft \\ 1.333 + \left(\frac{H_t - 700ft}{1200ft - 700ft}\right) \cdot 0.4 & \text{otherwise} \end{cases} = 1.333$$

Stability of Footing:

Adjusted Concrete Unit Weight = $\gamma_c := \text{if}(\text{Bouyancy} = 1, \gamma_{conc} - 62.4\text{pcf}, \gamma_{conc}) = 150 \cdot \text{pcf}$

Adjusted Soil Unit Weight = $\gamma_s := \text{if}(\text{Bouyancy} = 1, \gamma_{soil} - 62.4\text{pcf}, \gamma_{soil}) = 120 \cdot \text{pcf}$

Passive Pressure = $P_{pn} := K_p \cdot \gamma_s \cdot n + c \cdot 2 \cdot \sqrt{K_p} = 0 \cdot \text{ksf}$

$P_{pt} := K_p \cdot \gamma_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p} = 0.72 \cdot \text{ksf}$

$P_{top} := \text{if}[n < (D_f - T_f), P_{pt}, P_{pn}] = 0.72 \cdot \text{ksf}$

$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p} = 1.8 \cdot \text{ksf}$

$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 1.26 \cdot \text{ksf}$

$T_p := \text{if}[n < (D_f - T_f), T_f, (D_f - n)] = 3$

$A_p := W_f \cdot T_p = 96$

Ultimate Shear = $S_u := P_{ave} \cdot A_p = 120.96 \cdot \text{kip}$

Weight of Concrete Pad = $WT_c := \left[\left(W_f^2 \cdot T_f\right) + d_p^2 \cdot L_p\right] \cdot \gamma_c = 497.25 \cdot \text{kip}$

Weight of Soil Above Footing = $WT_{s1} := \left[\left(W_f^2 - d_p^2\right) \cdot \begin{vmatrix} (L_p - L_{pag} - n) & \text{if } (L_p - L_{pag} - n) \geq 0 \\ 0 & \text{if } (L_p - L_{pag} - n) \leq 0 \end{vmatrix}\right] \cdot \gamma_s = 226.32 \cdot \text{kip}$

Weight of Soil Wedge at Back Face = $WT_{s2} := \left(\frac{D_f^2 \cdot \tan(\Phi_s)}{2} \cdot W_f\right) \cdot \gamma_s = 27.713 \cdot \text{kip}$

Weight of Soil Wedge at back face Corners = $WT_{s3} := 2 \cdot \left[(D_f)^3 \cdot \frac{\tan(\Phi_s)}{3}\right] \cdot \gamma_s = 5.774 \cdot \text{kips}$

Total Weight = $WT_{tot} := WT_c + WT_{s1} + \text{Axial} = 763.57 \cdot \text{kip}$

Resisting Moment = $M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + \left[(WT_{s2} + WT_{s3}) \cdot \left(W_f + \frac{D_f \cdot \tan(\Phi_s)}{3}\right)\right] = 13442 \cdot \text{kip} \cdot \text{ft}$

Overturning Moment = $M_{ot} := OM + \text{Shear} \cdot (L_p + T_f) = 2039 \cdot \text{kip} \cdot \text{ft}$

Factor of Safety Actual = $FS := \frac{M_r}{M_{ot}} = 6.59$

Factor of Safety Required = $FS_{req} := 2$

OverTurning_Moment_Check := if($FS \geq FS_{req}$, "Okay", "No Good")

OverTurning_Moment_Check = "Okay"

Shear Capacity in Pier:

Shear Resistance of Pier = $S_p := \frac{\mu \cdot WT_{tot}}{FS_{req}} = 171.803 \cdot kips$

Shear_Check := if(S_p > Shear, "Okay", "No Good")

Shear_Check = "Okay"

Bearing Pressure Caused by Footing:

Area of the Mat = $A_{mat} := W_f^2 = 1.024 \times 10^3$

Section Modulus of Mat = $S := \frac{W_f^3}{6} = 5461.33 \cdot ft^3$

Maximum Pressure in Mat = $P_{max} := \frac{(WT_c + Axial)}{A_{mat}} + \frac{M_{ot}}{S} = 0.898 \cdot ksf$

Max_Pressure_Check := if($P_{max} < q_s$, "Okay", "No Good")

Max_Pressure_Check = "Okay"

Minimum Pressure in Mat = $P_{min} := \frac{(WT_c + Axial)}{A_{mat}} - \frac{M_{ot}}{S} = 0.151 \cdot ksf$

Min_Pressure_Check := if[$(P_{min} \geq 0) \cdot (P_{min} < q_s)$, "Okay", "No Good"]

Min_Pressure_Check = "Okay"

Distance to Resultant of Pressure Distribution = $X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 12.828$

Distance to Kern = $X_k := \frac{W_f}{6} = 5.333$

Since Resultant Force is Not in Kern, Area to which Pressure is Applied Must be Reduced.

Eccentricity = $e := \frac{M_{ot}}{WT_{tot}} = 2.67$

Adjusted Soil Pressure = $P_a := \frac{2 \cdot (WT_c + Axial)}{3 \cdot W_f \cdot \left(\frac{W_f}{2} - e\right)} = 0.84 \cdot ksf$

$q_{adj} :=$ if($P_{min} < 0, P_a, P_{max}$) = 0.898·ksf

Pressure_Check := if($q_{adj} < q_s$, "Okay", "No Good")

Pressure_Check = "Okay"

Concrete Bearing Capacity:

Strength Reduction Factor = $\Phi_c := 0.65$ (ACI-2008 9.3.2.2)

Bearing Strength Between Pier and Pad = $P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot \frac{\pi \cdot d_p^2}{4} = 2.025 \times 10^4 \cdot kips$ (ACI-2008 10.14)

Bearing_Check := if(P_b > LF·Axial, "Okay", "No Good")

Bearing_Check = "Okay"

Shear Strength of Concrete:

Beam Shear: (Critical section located at a distance d from the face of Pier) (ACI 11.3.1.1)

$\phi_c := 0.85$ (ACI 9.3.2.5)

$d := T_f - Cvr_{pad} - d_{bbot} = 31.59 \cdot in$

$d_1 := \frac{W_f}{2} - \frac{d_p}{2}$

$d_2 := d_1 - d$

$L := \left(\frac{W_f}{2} - e\right) \cdot 3$

$Slope := if\left(L > W_f, \frac{P_{max} - P_{min}}{W_f}, \frac{q_{adj}}{L}\right)$

$V_{req} := LF \cdot \left[\left(q_{adj} - Slope \cdot d_1\right) + \left(\frac{Slope \cdot d_1}{2}\right)\right] \cdot W_f \cdot d_1$

$V_{Avail} := \phi_c \cdot 2 \cdot \sqrt{f_c \cdot psi} \cdot W_f \cdot d$ (ACI-2008 11.2.1.1)

Beam_Shear_Check := if($V_{req} < V_{Avail}$, "Okay", "No Good")

Beam_Shear_Check = "Okay"

Punching Shear: (Critical Section Located at a distance of d/2 from the face of pier) (ACI 11.11.1.2)

Critical Perimeter of Punching Shear = $b_o := \left(d_p + d\right) \cdot \pi = 36.5$

Area Included Inside Perimeter = $A_{bo} := \frac{\pi \cdot \left(d_p + d\right)^2}{4} = 106.3$

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 917.7$

Guess Value = $v_u := 1ksf$ (From "Foundation Analysis and design", By Joseph Bowles, Eq. 8-9)

Given $d^2 + d_p \cdot d = \frac{WT_{tot}}{\pi \cdot v_u}$

$v_u := Find(v_u) = 7.9 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f = 668.6 \cdot kips$

Required Shear Strength = $V_{req} := LF \cdot V_u = 891.3 \cdot kips$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 2978.9 \cdot kip$ (ACI-2008 11.11.2.1)

Punching_Shear_Check := if($V_{req} < V_{Avail}$, "Okay", "No Good")

Punching_Shear_Check = "Okay"

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

Strength Reduction Factor = $\phi_m := .90$ (ACI-2008 9.3.2.1)

$q_b := q_{adj} - d_1 \cdot Slope = 0.63 \cdot ksf$

Maximum Bending at Face of Pier = $M_u := LF \cdot \left[(q_{adj} - q_b) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f = 2280.7 \cdot kip \cdot ft$

$$\beta := \begin{cases} 0.85 & \text{if } 2500 \cdot psi \le f_c \le 4000 \cdot psi \\ 0.65 & \text{if } f_c > 8000 \cdot psi \\ \left[0.85 - \left[\frac{\left(\frac{f_c}{psi} - 4000 \right)}{1000} \right] \cdot 0.5 \right] & \text{otherwise} \end{cases} = 0.85$$

(ACI-200810.2.7.3)

$R_n := \frac{M_u}{\phi_m \cdot W_f \cdot d^2} = 79.4 \cdot psi$

$\rho := \frac{0.85 \cdot f_c}{f_y} \left(1 - \sqrt{1 - \frac{2 \cdot R_n}{0.85 \cdot f_c}} \right) = 0.0013$

$\rho_{min} := \rho = 0.00134$

Required Reinforcement for Temperature and Shrinkage:

$\rho_{sh} := \begin{cases} .0018 & \text{if } f_y \geq 60000 \cdot psi \\ .0020 & \text{otherwise} \end{cases}$ (ACI -2008 7.12.2.1)

Check Bottom Bars:

$As := \begin{cases} \rho_{min} \cdot W_f \cdot d & \text{if } \rho_{min} > \frac{\rho_{sh}}{2} \\ \rho_{sh} \cdot W_f \cdot \frac{d}{2} & \text{otherwise} \end{cases} = 16.235 \cdot in^2$

$As_{prov} := A_{bbot} \cdot NB_{bot} = 57.8 \cdot in^2$

Pad_Reinforcement_Bot := if(As_prov > As, "Okay", "No Good")

Pad_Reinforcement_Bot = "Okay"

Check top Bars:

$As := \rho_{sh} \cdot \left(W_f \cdot \frac{d}{2} \right) = 10.9 \cdot in^2$

$As_{prov} := A_{btop} \cdot NB_{top} = 29.7 \cdot in^2$

Pad_Reinforcement_Top := if(As_prov > As, "Okay", "No Good")

Pad_Reinforcement_Top = "Okay"

Developement Length Pad Reinforcement:

Bar Spacing = $B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 9.05 \cdot in$

Spacing or Cover Dimension = $c := if\left(Cvr_{pad} < \frac{B_{sPad}}{2}, Cvr_{pad}, \frac{B_{sPad}}{2} \right) = 3 \cdot in$

Transverse Reinforcement Index = $k_{tr} := 0$ (ACI-2008 12.2.3)

$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pad} \cdot \beta_{pad} \cdot \gamma_{pad} \cdot \lambda_{pad}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \frac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot} = 47.2 \cdot in$

Minimum Development Length = $L_{dbmin} := 12 \cdot in$ (ACI-2008 12.2.1)

$L_{dbtCheck} := if(L_{dbt} \geq L_{dbmin}, \text{"Use L.dbt"}, \text{"Use L.dbmin"})$

Available Length in Pad = $L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad} = 135 \cdot in$

Lpad_Check := if(L_Pad > L_dbt, "Okay", "No Good")

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

Area of Pier = $A_p := \frac{\pi \cdot d_p^2}{4} = 9160.88 \cdot in^2$

$A_{smin} := 0.01 \cdot 0.5 \cdot A_p = 45.8 \cdot in^2$ (ACI-2008 10.8.4 & 10.9.1)

$A_{sprov} := NB_{pier} \cdot A_{bpier} = 46.84 \cdot in^2$

Steel_Area_Check := if($A_{sprov} > A_{smin}$, "Okay", "No Good")

Steel_Area_Check = "Okay"

Bar Spacing In Pier = $B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 9.9 \cdot in$

Diameter of Reinforcement Cage = $Diam_{cage} := d_p - 2 \cdot Cvr_{pier} = 102 \cdot in$

Maximum Moment in Pier = $M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2} \right) \right] \cdot LF = 31616.1 \cdot in \cdot kips$

Pier Check evaluated from outside program and results are listed below;

$$\begin{pmatrix} D & N & n & P_u & M_{xu} \end{pmatrix} := \begin{pmatrix} d_p \cdot 12 & NB_{pier} & BS_{pier} & \frac{Axial \cdot 1.333}{kips} & \frac{M_p}{in \cdot kips} \end{pmatrix}$$

$$\begin{pmatrix} D & N & n & P_u & M_{xu} \end{pmatrix} = \begin{pmatrix} 108 & 30 & 11 & 53.32 & 3.162 \times 10^4 \end{pmatrix}$$

$$\begin{pmatrix} \phi P_n & \phi M_{xn} & f_{sp} & \rho \end{pmatrix} := \begin{pmatrix} 0 & 0 & 0 & 0 \end{pmatrix}$$

$$\begin{pmatrix} \phi P_n & \phi M_{xn} & f_{sp} & \rho \end{pmatrix} := \phi P'_n(D, N, n, P_u, M_{xu})^T$$

$$\begin{pmatrix} \phi P_n & \phi M_{xn} & f_{sp} & \rho \end{pmatrix} = \begin{pmatrix} 207.315 & 1.229 \times 10^5 & -60 & 5.109 \times 10^{-3} \end{pmatrix}$$

Axial_Load_Check := if($\phi P_n \geq P_u$, "Okay", "No Good")

Axial_Load_Check = "Okay"

Bending_Check := if($\phi M_{xn} \geq M_{xu}$, "Okay", "No Good")

Bending_Check = "Okay"

CENTEK engineering
Centered on Solutions
www.centekeng.com
63-2 North Branford Road
Branford, CT 06405
P: (203) 488-0580
F: (203) 488-8587

Development Length Pier Reinforcement:

Available Length in Foundation:

$L_{pier} := L_p - Cvr_{pier} = 33 \cdot in$

$L_{pad} := T_f - Cvr_{pad} = 33 \cdot in$

Tension: (ACI-2008 12.2.3)

Spacing or Cover Dimension = $c := if\left(Cvr_{pier} < \frac{B_{sPier}}{2}, Cvr_{pier}, \frac{B_{sPier}}{2}\right) = 3 \cdot in$

Transverse Reinforcement = $k_{tr} := 0$ (ACI-2008 12.2.3)

$$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 47.15 \cdot in$$

Minimum Development Length = $L_{dh} := \frac{1200 \cdot d_{bpier}}{\sqrt{\frac{f_c}{psi}}} \cdot .7 = 18.727 \cdot in$ (ACI 12.2.1)

Pier reinforcement bars are standard 90 degree hooks and therefore developement in the pad is computed as follows:

$L_{db} := max(L_{dbt}, L_{dbmin})$

$L_{tension\_Check} := if(L_{pier} + L_{pad} > L_{dbt}, \text{"Okay"}, \text{"No Good"})$

$L_{tension\_Check} = \text{"Okay"}$

Compression: (ACI-2008 12.3.2)

$$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot f_y}{\sqrt{f_c \cdot psi}} = 26.753 \cdot in$$

$$L_{dbmin} := 0.0003 \cdot \frac{in^2}{lb} \cdot (d_{bpier} \cdot f_y) = 25.38 \cdot in$$

$L_{dbc} := if(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}) = 26.753 \cdot in$

$L_{compression\_Check} := if(L_{pier} + L_{pad} > L_{dbc}, \text{"Okay"}, \text{"No Good"})$

$L_{compression\_Check} = \text{"Okay"}$

CENTEK engineering
Centered on Solutions
63-2 North Branford Road
Branford, CT 06405
www.centekeng.com
P: (203) 488-0580
F: (203) 488-8587

Tie Size and Spacing in Column:

Minimum Tie Size = $Tie_{min} := if(BS_{pier} \le 10, 3, 4) = 4$

Used #4 Ties

Seismic Factor = $z := if(Z \le 2, 1, 0.5) = 1$ (ACI-2008 21.10.5)

$s_{lim1} := 16 \cdot d_{bpier} \cdot z = 22.56 \cdot in$

$s_{lim2} := 48 \cdot d_{Tie} \cdot z = 24 \cdot in$

$s_{lim3} := D_f \cdot z = 60 \cdot in$

$s_{lim4} := 18in$

Maximum Spacing = $s_{tie} := min\left(\begin{pmatrix} s_{lim1} \\ s_{lim2} \\ s_{lim3} \\ s_{lim4} \end{pmatrix}\right) = 18 \cdot in$

Number of Ties Required = $n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 = 2.667$

Check Anchor Steel Embedment:

Depth Available = $D_{ab} := L_{st} - A_{BP} = 5 \cdot ft$

Length of Anchor Bolt = $L_{anchor} := \frac{(0.11 \cdot f_{ya}) \cdot in}{\sqrt{f_c \cdot psi}} = 10.87 \cdot ft$

$Depth\_Check := if(D_{ab} \ge L_{anchor}, \text{"Okay"}, \text{"No Good"})$

Depth_Check = "No Good"

Note: Anchor plate is provided

SITE NAME	065134_NEWTOWN_NE_CT	ECP - CELL #	0	5	134
LATITUDE	41.438278	LONGITUDE	-73.237742		
Additional Comments:		SAVE BUTTON			
		STRUCTURE TYPE	Lattice		

AWS - LTE Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE			
ANTENNA TYPE			
QTY OF ANTENNAS PER FACE			
ORIENTATION (DEG)			
DOWN TILT (MECH/DEG)			
RAD CTR (FT AGL)			
TMA - INSTALLED			
RRH - INSTALLED			
AWS - LTE Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE			
ANTENNA TYPE			
QTY OF ANTENNAS PER FACE			
ORIENTATION (DEG)			
DOWN TILT (MECH/DEG)			
RAD CTR (FT AGL)			
TMA - QTY / MODEL			
RRH - QTY/MODEL			
700 Mhz - LTE Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	ALU TRDU-2X40-700	ALU TRDU-2X40-700	ALU TRDU-2X40-700
ANTENNA TYPE	BXA-70063-6CF-2-750MHZ	BXA-70063-6CF-750MHZ	BXA-70063-6CF-750MHZ
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	330	110	240
DOWN TILT (MECH/DEG)	0	0	6
RAD CTR (FT AGL)	100	100	100
TMA - INSTALLED	No	No	No
RRH - INSTALLED	No	No	No
700 Mhz - LTE Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	ALU TRDU-2X40-700	ALU TRDU-2X40-700	ALU TRDU-2X40-700
ANTENNA TYPE	**LNX-4514DS-A1M_2DT_750MHZ**	BXA-70063-6CF-750MHZ	**LNX-6514DS-A1M_6DT_750MHZ**
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	**310**	110	240
DOWN TILT (MECH/DEG)	0	0	**0**
RAD CTR (FT AGL)	100	100	100
TMA - QTY / MODEL			
RRH - QTY/MODEL			
850 Celluar - Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	CELLULAR MOD 4.0B	CELLULAR MOD 4.0B	CELLULAR MOD 4.0B
ANTENNA TYPE	LPA-80080/8CF	LPA-80080/8CF	LPA-80080/8CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	330	90	210
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	99	99	99
TMA - INSTALLED	No	No	No
RRH - INSTALLED	No	No	No
850 Celluar - Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	CELLULAR MOD 4.0B	CELLULAR MOD 4.0B	CELLULAR MOD 4.0B
ANTENNA TYPE	LPA-80080/8CF	LPA-80080/8CF	LPA-80080/8CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	330	90	210
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	99	99	99
TMA - QTY / MODEL			
RRH - QTY/MODEL			
1900 PCS - Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	PCS MOD 4.0B	PCS MOD 4.0B	PCS MOD 4.0B
ANTENNA TYPE	BXA-171085-12BF-EDIN-2	BXA-171085-12BF-EDIN-2	BXA-171085-12BF-EDIN-2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	330	90	210
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	100	100	100
TMA - INSTALLED	No	No	No
RRH - INSTALLED	No	No	No
1900 PCS - Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	PCS MOD 4.0B	PCS MOD 4.0B	PCS MOD 4.0B
ANTENNA TYPE	BXA-171085-12BF-EDIN-2	BXA-171085-12BF-EDIN-2	BXA-171085-12BF-EDIN-2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	330	90	210
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	100	100	100
TMA - QTY / MODEL			
RRH - QTY/MODEL			

TX / RX FREQUENCIES			TX POWER OUTPUT	
Cellular A-Band	**PCS F / AWS-Band**	**700 Mhz C - Block**	Cellular (Watts)	20
TX - 869-880,890-891.5 MHz	TX - 1970-1975 / 2145-2155	TX - 746-757	PCS (Watts)	16
RX - 824-835,845-846.5 MHz	RX - 1890-1895 / 1745-1755	RX - 776-787	LTE/ AWS (Watts)	40

ALPHA				BETA				GAMMA			
Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code
A1	800	Tx1/Rx0	RED	A7	800	Tx2/Rx0	BLUE	A13	800	Tx3/Rx0	GREEN
A2	1900	Tx1/Rx0	RED/ WHITE	A8	1900	Tx2/Rx0	BLUE/ WHITE	A14	1900	Tx3/Rx0	GREEN/WHITE
A3	700	Tx1/Rx0	RED/ ORANGE	A9	700	Tx2/Rx0	BLUE/ ORANGE	A15	700	Tx3/Rx0	GREEN/ORANGE
A4	700	Tx4/Rx1	RED/RED/ ORANGE	A10	700	Tx5/Rx1	BLUE/BLUE/ ORANGE	A16	700	Tx6/Rx1	GREEN/GREEN/ ORANGE
A5	1900	Tx4/Rx1	RED/RED/ WHITE	A11	1900	Tx5/Rx1	BLUE/BLUE/ WHITE	A17	1900	Tx6/Rx1	GREEN/GREEN/ WHITE
A6	800	Tx4/Rx1	RED/RED	A12	800	Tx5/Rx1	BLUE/BLUE	A18	800	Tx6/Rx1	GREEN/GREEN
F1-A	1700	Tx/Rx	RED/ BROWN	F1-B	1700	Tx/Rx	BLUE/BROWN	F1-C	1700	Tx/Rx	GREEN/BROWN
F1-D	1700	Tx/Rx	RED/RED/ BROWN	F1-E	1700	Tx/Rx	BLUE/BLUE/BROWN	F1-F	1700	Tx/Rx	GREEN/GREEN/BROWN

System Performance Engineer	Performance Manager	INITIALS	DATE
Prepared By:Dany Bustamante	Alex Restrepo	DB	10/29/2014

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

LNX-6514DS-VTM

Andrew® Antenna, 698–896 MHz, 65° horizontal beamwidth, RET compatible

- Great solution to maximize network coverage and capacity
- Excellent gain, VSWR, front-to-back ratio, and PIM specifications for robust network performance
- Ideal choice for site collocations and tough zoning restrictions
- Excellent solution for site sharing and maximizing capacity
- Fully compatible with Andrew remote electrical tilt system for greater OpEx savings
- The RF connectors are designed for IP67 rating and the radome for IP56 rating

Electrical Specifications

Frequency Band, MHz	**698–806**	**806–896**
Gain, dBi	15.7	16.3
Beamwidth, Horizontal, degrees	65	65
Beamwidth, Horizontal Tolerance, degrees	±3	±3
Beamwidth, Vertical, degrees	12.5	11.2
Beam Tilt, degrees	0–10	0–10
USLS, typical, dB	17	18
Front-to-Back Ratio at 180°, dB	32	30
CPR at Boresight, dB	20	20
CPR at Sector, dB	10	10
Isolation, dB	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153
Input Power per Port, maximum, watts	400	400
Polarization	±45°	±45°
Impedance	50 ohm	50 ohm

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol®
Band	Single band
Brand	DualPol® | Teletilt®
Operating Frequency Band	698 – 896 MHz

Mechanical Specifications

Color	Light gray
Connector Interface	7-16 DIN Female
Connector Location	Bottom
Connector Quantity, total	2
Lightning Protection	dc Ground
Radiator Material	Aluminum
Radome Material	Fiberglass, UV resistant
Wind Loading, maximum	617.7 N @ 150 km/h 138.9 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

LNX-6514DS-VTM

Dimensions

Depth	181.0 mm | 7.1 in
Length	1847.0 mm | 72.7 in
Width	301.0 mm | 11.9 in
Net Weight	17.6 kg | 38.8 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 1.1 Actuator	LNX-6514DS-R2M
Model with Factory Installed AISG 2.0 Actuator	LNX-6514DS-A1M
RET System	Teletilt®

Regulatory Compliance/Certifications

Agency	Classification
RoHS 2011/65/EU	Compliant by Exemption
China RoHS SJ/T 11364-2006	Above Maximum Concentration Value (MCV)
ISO 9001:2008	Designed, manufactured and/or distributed under this quality management system

Included Products

DB380 — Pipe Mounting Kit for 2.4"-4.5" (60-115mm) OD round members on wide panel antennas. Includes 2 clamp sets and double nuts.

DB5083 — Downtilt Mounting Kit for 2.4"-4.5" (60 - 115 mm) OD round members. Includes a heavy-duty, galvanized steel downtilt mounting bracket assembly and associated hardware. This kit is compatible with the DB380 pipe mount kit for panel antennas that are equipped with two mounting brackets.

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

LNX-4514DS-VTM

Andrew® Antenna, 698–896 MHz, 45° horizontal beamwidth, RET compatible

- Broadband, providing future-ready single antenna for application in 700 MHz and existing 850 MHz cellular operation
- Air dielectric design provides superior PIM performance with repeatable antenna-to-antenna gain and pattern consistency
- Single piece radome provides long term mechanical stability
- Proven core design technology, with over 1,000,000 similar antennas deployed
- Specifically designed to have physical dimensions similar to most existing cellular antennas

Electrical Specifications

Frequency Band, MHz	**698–806**	**806–896**
Gain, dBi	15.5	16.4
Beamwidth, Horizontal, degrees	47	45
Beamwidth, Vertical, degrees	17.3	15.8
Beam Tilt, degrees	2–18	2–18
USLS, typical, dB	16	15
Front-to-Back Ratio at 180°, dB	32	28
Isolation, dB	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153
Input Power per Port, maximum, watts	500	500
Polarization	±45°	±45°
Impedance	50 ohm	50 ohm

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol®
Band	Single band
Brand	DualPol® | Teletilt®
Operating Frequency Band	698 – 896 MHz

Mechanical Specifications

Color	Light gray
Lightning Protection	dc Ground
Radiator Material	Aluminum
Radome Material	Fiberglass, UV resistant
RF Connector Interface	7-16 DIN Female
RF Connector Location	Bottom
RF Connector Quantity, total	2
Wind Loading, maximum	586.4 N @ 150 km/h 131.8 lbf @ 150 km/h
Wind Speed, maximum	241.4 km/h | 150.0 mph

Dimensions

Product Specifications

COMMSCOPE®

POWERED BY ANDREW

LNX-4514DS-VTM

Depth	163.0 mm | 6.4 in
Length	1308.0 mm | 51.5 in
Width	389.0 mm | 15.3 in
Net Weight	13.3 kg | 29.3 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 2.0 Actuator	LNX-4514DS-A1M
RET System	Teletilt®

Regulatory Compliance/Certifications

Agency	Classification
ISO 9001:2008	Designed, manufactured and/or distributed under this quality management system

Included Products

DB380 — Pipe Mounting Kit for 2.4"-4.5" (60-115mm) OD round members on wide panel antennas. Includes 2 clamp sets and double nuts.

DB5083 — Downtilt Mounting Kit for 2.4"-4.5" (60 - 115 mm) OD round members. Includes a heavy-duty, galvanized steel downtilt mounting bracket assembly and associated hardware. This kit is compatible with the DB380 pipe mount kit for panel antennas that are equipped with two mounting brackets.