Robinson+Cole

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Also admitted in Massachusetts

January 16, 2015

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

Re: **Notice of Exempt Modification – Facility Modification**
33 Boardman Road, New Milford, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) antennas at the 130-foot level on the existing 153-foot tower at 33 Boardman Road in New Milford (the "Property"). The tower is owned by Quarry Stone and Gravel, LLC. Cellco's shared use of this tower was approved by the Council in 2006. Cellco now intends to modify its facility by replacing nine (9) of its existing antennas with three (3) model LNX-8513DS-VTM, 850 MHz antennas; three (3) model HBXX-6517DS-VTM, 1900 MHz antennas; and three (3) model HBXX-6517DS-VTM, 2100 MHz antennas, all at the same level on the tower. Cellco also intends to install three (3) remote radio heads ("RRHs") behind its 2100 MHz antennas and one (1) HYBRIFLEX™ antenna cable, inside the monopole tower. Included in Attachment 1 are specifications for Cellco's replacement antennas, RRHs and HYBRIFLEX™ cables.

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 Patricia Murphy, Mayor of the Town of New Milford. A copy of this letter is also being sent to Quarry Stone and Gravel, LLC, the owner 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 antennas and RRHs will be installed on its existing antenna platform at the 130-foot level of the 153-foot tower.

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:
Patricia Murphy, New Milford Mayor
Quarry Stone and Gravel, LLC
Sandy M. Carter

ATTACHMENT 1

Product Specifications

COMMSCOPE®

LNX-8513DS-VTM

Andrew® Teletilt® Antenna, 698–896 MHz, 85° horizontal beamwidth, RET compatible

POWERED BY ANDREW.

Electrical Specifications

Frequency Band, MHz	698–806	806–896
Gain, dBi	14.6	15.3
Beamwidth, Horizontal, degrees	85	85
Beamwidth, Vertical, degrees	12.2	11.0
Beam Tilt, degrees	0–10	0–10
USLS, typical, dB	17	17
Front-to-Back Ratio at 180°, dB	25	26
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°

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	17.8 kg | 39.2 lb
Model with factory installed AISG 2.0 RET	LNX-8513DS-A1M

Product Specifications

HBXX-6517DS-VTM

Andrew® Quad Port Teletilt® Antenna, 1710–2180 MHz, 65° horizontal beamwidth, RET compatible

POWERED BY ANDREW

Electrical Specifications

Frequency Band, MHz	**1710–1880**	**1850–1990**	**1920–2180**
Gain by all Beam Tilts, average, dBi	18.5	18.6	18.8
Gain by all Beam Tilts Tolerance, dB	±0.4	±0.3	±0.4
Gain by Beam Tilt, average, dBi	0 ° | 18.4 3 ° | 18.7 6 ° | 18.4	0 ° | 18.4 3 ° | 18.7 6 ° | 18.5	0 ° | 18.7 3 ° | 18.9 6 ° | 18.6
Beamwidth, Horizontal, degrees	67	66	65
Beamwidth, Horizontal Tolerance, degrees	±2.4	±1.7	±2.9
Beamwidth, Vertical, degrees	5.0	4.7	4.4
Beamwidth, Vertical Tolerance, degrees	±0.3	±0.3	±0.3
Beam Tilt, degrees	0–6	0–6	0–6
USLS, dB	18	19	19
Front-to-Back Total Power at 180° ± 30°, dB	25	26	26
CPR at Boresight, dB	22	23	22
CPR at Sector, dB	10	10	9
Isolation, dB	30	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153	-153
Input Power per Port, maximum, watts	350	350	350
Polarization	±45°	±45°	±45°

**Values calculated using NGMN Alliance N-P-BASTA v9.6*

Mechanical Specifications

Color | Radome Material	Light gray | PVC, UV resistant
Connector Interface | Location | Quantity	7-16 DIN Female | Bottom | 4
Wind Loading, maximum	668.0 N @ 150 km/h 150.2 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph
Antenna Dimensions, L x W x D	1903.0 mm x 305.0 mm x 166.0 mm | 74.9 in x 12.0 in x 6.5 in
Net Weight	19.5 kg | 43.0 lb
Model with factory installed AISG 2.0 RET	HBXX-6517DS-A2M

ALCATEL-LUCENT
WIRELESS PRODUCT DATASHEET
RRH2X60-AWS FOR BAND 4 APPLICATIONS

The Alcatel-Lucent RRH2x60-AWS is a high power, small form factor Remote Radio Head operating in the AWS frequency band (3GPP Band 4) for LTE technology. It is designed with an eco-efficient approach, providing operators with the means to achieve high quality and high capacity coverage with minimum site requirements and efficient operation.

A distributed Node B expands the deployment options by using two components, a Base Band Unit (BBU) containing the digital assets and a separate RRH containing the radio-frequency (RF) elements. This modular design optimizes available space and allows the main components of a Node B to be installed separately, within the same site or several kilometers apart.

The Alcatel-Lucent RRH2x60-AWS is linked to the BBU by an optical-fiber connection carrying downlink and uplink digital radio signals along with operations, administration and maintenance (OA&M) information.

SUPERIOR RF PERFORMANCE

The Alcatel-Lucent RRH2x60-AWS integrates all the latest technologies. This allows to offer best-in-class characteristics.

It delivers an outstanding 120 watts of total RF power thanks to its two transmit RF paths of 60 W each.

It is ideally suited to support multiple-input multiple-output (MIMO) 2x2 operation.

It includes four RF receivers to natively support 4-way uplink reception diversity. This improves the radio uplink coverage and this can be used to extend the cell radius commensurate with 2x2MIMO 2x60 W for the downlink.

It supports multiple discontinuous LTE carriers within an instantaneous bandwidth of 45 MHz corresponding to the entire AWS B4 spectrum.

The latest generation power amplifiers (PA) used in this product achieve high efficiency (>40%), resulting in improved power consumption figures.

OPTIMIZED TCO

The Alcatel-Lucent RRH2x60-AWS is designed to make available all the benefits of a distributed Node B, with excellent RF characteristics, with low capital expenditures (CAPEX) and low operating expenditures (OPEX).

The Alcatel-Lucent RRH2x60-AWS is a very cost-effective solution to deploy LTE MIMO.

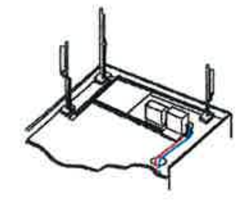
EASY INSTALLATION

The RRH2x60-AWS includes a reversible mounting bracket which allows for ease of installation behind an antenna, or on a rooftop knee wall while providing easy access to the mid body RF connectors.

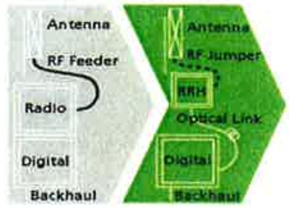
The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment. However, many of these sites can host an Alcatel-Lucent RRH2x60-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation time and costs.

The Alcatel-Lucent RRH2x60-AWS is a zero-footprint solution and is convection cooled without fans for silent operation, simplifying negotiations with site property owners and minimizing environmental impacts.

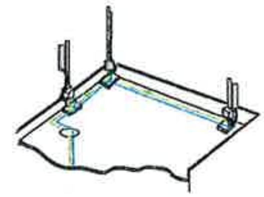
Installation can easily be done by a single person as the Alcatel–Lucent RRH2x60-AWS is compact and weighs about 20 kg, eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day.



Macro



RRH for space-constrained cell sites



Distributed

FEATURES

- RRH2x60-AWS integrates two power amplifiers of 60W rating (at each antenna connector)
- Support multiple carriers over the entire 3GPP band 4
- RRH2x60-AWS is optimized for LTE operation
- RRH2x60-AWS is a very compact and lightweight product
- Advanced power management techniques are embedded to provide power savings, such as PA bias control

BENEFITS

- MIMO LTE operation with only one single unit per sector
- Improved uplink coverage with built-in 4-way receive diversity capability
- RRH can be mounted close to the antenna, eliminating nearly all losses in RF cables and thus reducing power consumption by 50% compared to conventional solutions
- Distributed configurations provide easily deployable and cost-effective solutions, near zero footprint and silent solutions, with minimum impact on the neighborhood, which ease the deployment
- RETA and TMA support without additional hardware thanks to the AISG v2.0 port and the integrated Bias-Tees. Bias-Tees support AISG DC supply and signaling.

TECHNICAL SPECIFICATIONS

Specifications listed are hardware capabilities. Some capabilities depend on support in a specific software release or future release.

Dimensions and weights

- HxWxD : 510x285x186mm (27 l with solar shield)
- Weight : 20 kg (44 lbs)

Electrical Data

- Power Supply : -48V DC (-40.5 to -57V)
- Power Consumption (ETSI average traffic load reference) : 250W @2x60W

RF Characteristics

- Frequency band: 1710-1755, UL / 2110-2155 MHz, DL (3GPP band 4)
- Output power: 2x60W at antenna connectors
- Technology supported: LTE
- Instantaneous bandwidth: 45 MHz
- Rx diversity: 2-way and 4-way uplink reception
- Typical sensitivity without Rx diversity: -105 dBm for LTE

Connectivity

- Two CPRI optical ports for daisychaining and up to six RRHs per fiber
- Type of optical fiber: Single-Mode (SM) and Multi-Mode (MM) SFPs
- Optical fiber length: up to 500m using MM fiber, up to 20km using SM fiber
- TMA/RETA : AISG 2.0 (RS485 connector and internal Bias-Tee)
- Six external alarms
- Surge protection for all external ports (DC and RF)

Environmental specifications

- Operating temperature: -40°C to 55°C including solar load
- Operating relative humidity: 8% to 100%
- Environmental Conditions : ETS 300 019-1-4 class 4.1E
- Ingress Protection : IEC 60529 IP65
- Acoustic Noise : Noiseless (natural convection cooling)

Safety and Regulatory Data

- EMC : 3GPP 25113, EN 301 489-1, EN 301 489-23, GR 1089, GR 3108, OET-65
- Safety : IEC60950-1, EN 60825-1, UL, ANSI/NFPA 70, CAN/CSA-C22.2
- Regulatory : FCC Part 15 Class B, CE Mark – European Directive : 2002/95/EC (ROHS); 2002/96/EC (WEEE); 1999/5/EC (R&TTE)
- Health : EN 50385

Alcatel·Lucent

AT THE SPEED OF IDEAS™

HYBRIFLEX™ RRH Hybrid Feeder Cabling Solution, 1-5/8", Single-Mode Fiber

Product Description

RFS' HYBRIFLEX Remote Radio Head (RRH) hybrid feeder cabling solution combines optical fiber and DC power for RRHs in a single lightweight aluminum corrugated cable, making it the world's most innovative solution for RRH deployments.

It was developed to reduce installation complexity and costs at Cellular sites. HYBRIFLEX allows mobile operators deploying an RRH architecture to standardize the RRH installation process and eliminate the need for and cost of cable grounding. HYBRIFLEX combines optical fiber (multi-mode or single-mode) and power in a single corrugated cable. It eliminates the need for junction boxes and can connect multiple RRHs with a single feeder. Standard RFS CELLFLEX® accessories can be used with HYBRIFLEX cable. Both pre-connectorized and on-site options are available.

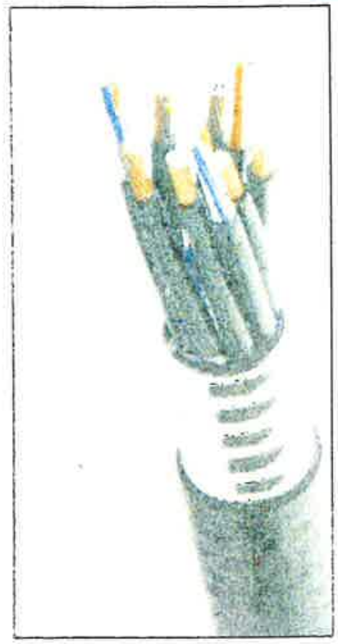


Figure 1: HYBRIFLEX Series

Features/Benefits

- Aluminum corrugated armor with outstanding bending characteristics – minimizes installation time and enables mechanical protection and shielding
- Same accessories as 1 5/8" coaxial cable
- Outer conductor grounding – Eliminates typical grounding requirements and saves on installation costs
- Lightweight solution and compact design – Decreases tower loading
- Robust cabling – Eliminates need for expensive cable trays and ducts
- Installation of tight bundled fiber optic cable pairs directly to the RRH – Reduces CAPEX and wind load by eliminating need for interconnection
- Optical fiber and power cables housed in single corrugated cable – Saves CAPEX by standardizing RRH cable installation and reducing installation requirements
- Outdoor polyethylene jacket – Ensures long-lasting cable protection

Technical Specifications

Outer Conductor Armor	Corrugated Aluminum	[mm (in)]	46.5 (1.83)
Jacket	Polyethylene, PE	[mm (in)]	50.3 (1.98)
UV-Protection	Individual and External Jacket		Yes
Weight, Approximate		[kg/m (lb/ft)]	1.9 (1.30)
Minimum Bending Radius, Single Bending		[mm (in)]	200 (8)
Minimum Bending Radius, Repeated Bending		[mm (in)]	500 (20)
Recommended/Maximum Clamp Spacing		[m (ft)]	1.0 / 1.2 (3.25 / 4.0)
DC-Resistance Outer Conductor Armor		[Ω/km (Ω/1000ft)]	.068 (0.205)
DC-Resistance Power Cable, 8.4mm² (8AWG)		[Ω/km (Ω/1000ft)]	2.1 (0.307)
Version			Single-mode OM3
Quantity, Fiber Count			16 (8 pairs)
Core/Clad		[µm]	50/125
Primary Coating (Acrylate)		[µm]	245
Buffer Diameter, Nominal		[µm]	900
Secondary Protection, Jacket, Nominal		[mm (in)]	2.0 (0.08)
Minimum Bending Radius		[mm (in)]	104 (4.1)
Insertion Loss @ wavelength 850nm		dB/km	3.0
Insertion Loss @ wavelength 1310nm		dB/km	1.0
Standards (Meets or exceeds)			UL94-V0, UL1666 RoHS Compliant
Size (Power)		[mm (AWG)]	8.4 (8)
Quantity, Wire Count (Power)			16 (8 pairs)
Size (Alarm)		[mm (AWG)]	0.8 (18)
Quantity, Wire Count (Alarm)			4 (2 pairs)
Type			UV protected
Strands			19
Primary Jacket Diameter, Nominal		[mm (in)]	6.8 (0.27)
Standards (Meets or exceeds)			NFPA 130, ICEA S-95-658 UL Type XHHW-2, UL 44 UL-LS Limited Smoke, UL VW-1 IEEE-383 (1974), IEEE1202/FT4 RoHS Compliant
Installation Temperature		[°C (°F)]	-40 to +65 (-40 to149)
Operation Temperature		[°C (°F)]	-40 to +65 (-40 to149)

* This data is provisional and subject to change

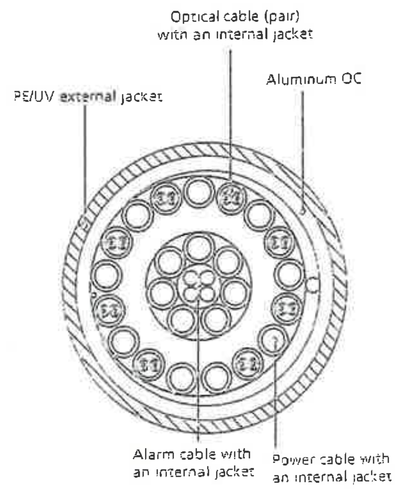


Figure 2: Construction Detail

ATTACHMENT 2

	General	Power	Density					
Site Name: New Milford W								
Tower Height: 153ft								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*Sprint CDMA/LTE	3	778	150	0.0373	1900	1.0000	3.73%	
*Sprint CDMA/LTE	1	438	150	0.0070	850	0.5667	1.24%	
*AT&T UMTS	2	565	120	0.0282	880	0.5867	4.81%	
*AT&T UMTS	2	875	120	0.0437	1900	1.0000	4.37%	
*AT&T GSM	1	283	120	0.0071	880	0.5867	1.20%	
*AT&T GSM	4	525	120	0.0524	1900	1.0000	5.24%	
*AT&T LTE	1	1615	120	0.0403	734	0.4893	8.24%	
*T-Mobile	8	110	140	0.0161	1945	1.0000	1.61%	
Verizon PCS	**11**	**428**	**130**	**0.1002**	**1970**	**1.0000**	**10.02%**	
Verizon Cellular	**9**	**397**	**130**	**0.0760**	**869**	**0.5793**	**13.12%**	
Verizon AWS	**1**	**1750**	**130**	**0.0372**	**2145**	**1.0000**	**3.72%**	
Verizon 700	**1**	**1050**	**130**	**0.0223**	**746**	**0.4973**	**4.49%**	
								61.80%
* Source: Siting Council								

ATTACHMENT 3

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

153-ft Existing EEI Monopine

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: New Milford West

33 Boardman Road
New Milford, CT

CENTEK Project No. 14001.060

Date: December 1, 2014

Prepared for:

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

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 monopine (tower) located in New Milford, CT.

The host tower is a 153-ft tall, four-section, eighteen sided, tapered monopine, originally designed and manufactured by Engineered Endeavors Inc., job no; 13200, dated March 2, 2005. The tower geometry, structure member sizes and foundation system information were obtained from a previous structural report prepared by Centek job no. 13071.CO2 dated April 10, 2013.

Antenna and appurtenance information were obtained from the aforementioned Centek structural report and a Verizon RF sheet.

The tower is made up of four (4) 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 25.25-in at the top and 61.0-in at the base.

Verizon Wireless proposes the removal of nine (9) panel antennas and the installation of nine (9) panel antennas, three (3) remote radio heads and one (1) main distribution box mounted on the existing T-Arms. 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, proposed and future loads considered in this analysis consist of the following:

- MOTOROLA (EXISTING):
  Antennas: One (1) RFI BA40-41 Omni-directional whip antenna, one (1) Radiowave HP2-4.7 microwave dish and one (1) Radiowave HP3-4.7 microwave dish pipe mounted on one (1) universal tri-bracket to the top of the tower.
  Coax Cables: Three (3) 7/8" ∅ coax cables running within the interior of the existing tower.
- SPRINT (EXISTING):
  Antennas: Six (6) 72"x6.5"x8" panel antennas, three (3) RFS APXVSPP18-C-A20 panel antennas, three (3) ALU 1900 MHz RRH's and three (3) ALU 800 MHz RRH's mounted on three (3) existing 10-ft T-Arms with a RAD center elevation of 150-ft above grade.
  Coax Cables: Nine (9) 1-5/8" ∅ coax cables and three (3) 1-1/4" ∅ Hybriflex cables running within the interior of the existing tower.
- T-MOBILE (EXISTING):
  Antennas: Three (3) 53"x7"x3" panel antennas and six (6) TMA's mounted on three (3) existing 10-ft T-Arms with a RAD center elevation of 140-ft above grade.
  Coax Cables: Six (6) 1-5/8" ∅ coax cables running within the interior of the existing tower.

- AT&T (EXISTING):
  Antennas: Six (6) Powerwave 7770 panel antennas, two (2) KMW AM-X-CD-16-65-00T-RET panel antennas, one (1) KMW-AM-X-CD-17-65-00T-RET panel antenna, six (6) Powerwave LGP21401 TMA's, six (6) Powerwave LGP21901 Diplexers, six (6) Ericsson RRUS-11 Remote Radio Heads and one (1) Raycap DC6-48-60-18-8F surge arrestor mounted on three (3) existing 10-ft T-Arms with a RAD center elevation of 120-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables, one (1) fiber cable and two (2) dc control cables running within the interior of the existing tower.
- VERIZON (EXISTING TO REMAIN):
  Antennas: Three (3) Antel BXA-70063-6CF panel antennas and six (6) RFS FD9R6004/2C-3L Diplexers mounted on three (3) existing 10-ft T-Arms with a RAD center elevation of 130-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running within the interior of the existing tower.
- VERIZON (EXISTING TO REMOVE):
  Antennas: Six (6) Antel LPA-80080-4CF and three (3) Antel BXA-171085-8BF panel antennas mounted on three (3) existing 10-ft T-Arms with a RAD center elevation of 130-ft above grade.
- **VERIZON (PROPOSED):**
  Antennas: Six (6) Andrew HBXX-6517DS panel antennas, three (3) Andrew LNX-8513DS panel antennas, three (3) Alcatel-Lucent RRH-2x60-AWS remote radio heads and one (1) RFD DB-T1-6Z-8AB-0Z main distribution box mounted on three (3) existing 10-ft T-Arms with a RAD center elevation of 130-ft above grade.
  Coax Cables: One (1) 1-5/8" ∅ fiber cable mounted within the existing tower.

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 existing 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:	Litchfield; v = 80 mph (fastest mile)	*[Section 16 of TIA/EIA-222-F-96]*
	New Milford; 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-222-F wind speed controls.	
Load Cases:	Load Case 1; 80 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; 69 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 69 mph wind speed velocity represents 75% of the wind pressure generated by the 80 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 **97.7%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L1)	134.83'-154.00'	25.2%	**PASS**
Pole Shaft (L2)	89.16'-134.83'	97.7%	**PASS**
Pole Shaft (L3)	44.54'-89.16'	95.0%	**PASS**
Pole Shaft (L4)	1.00'-44.54'	97.3%	**PASS**

Foundation and Anchors

The existing foundation consists of a 7.5-ft square x 3.5-ft long reinforced concrete pier on a 32.0-ft square x 4.0-ft thick reinforced concrete pad. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned structural report prepared by Centek. The base of the tower is connected to the foundation by means of (28) 2.25"∅, ASTM A615-75 anchor bolts embedded approximately 7-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	58 kips
	Compression	62 kips
	Moment	6691 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	2.1	**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 Compression and Bending	87.7%	**PASS**
Base Plate	Bending	50.6%	**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 provide 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.

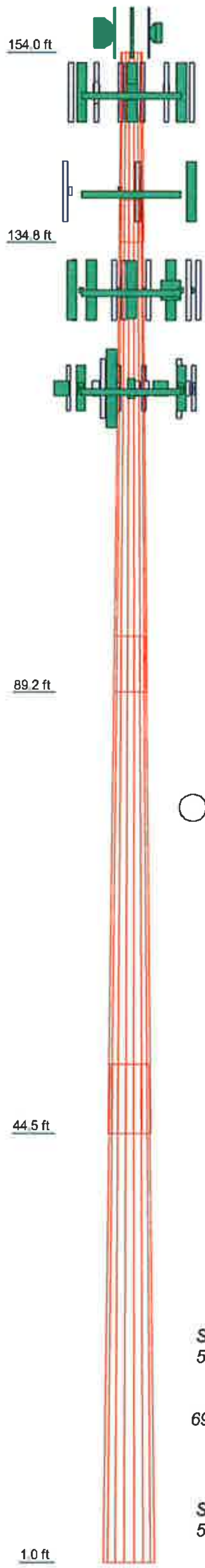
General Description of Structural Analysis Program

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	1	2	3	4	
Length (ft)	19.170	50.000	50.290	50.460	
Number of Sides	18	18	18	18	
Thickness (in)	0.188	0.313	0.500	0.563	
Socket Length (ft)	4.330	5.670	6.920		
Top Dia (in)	25.250	28.575	38.886	48.575	
Bot Dia (in)	30.030	40.910	51.280	61.000	
Grade	A572-65				
Weight (K)	1.1	5.8	12.1	16.6	35.6

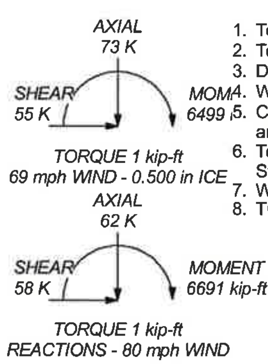


DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
HP2-4.7 (Motorola - Existing)	156	HBXX-6517DS (Verizon - Proposed)	130
HP3-4.7 (Motorola - Existing)	156	HBXX-6517DS (Verizon - Proposed)	130
BA40-41 (Motorola - Existing)	154	RRH2x60-AWS (Verizon - Proposed)	130
Valmont Uni-Tri Bracket (Motorola - Existing)	154	RRH2x60-AWS (Verizon - Proposed)	130
5'0"x4.5" Pipe Mount (Motorola - Existing)	154	RRH2x60-AWS (Verizon - Proposed)	130
5'0"x4.5" Pipe Mount (Motorola - Existing)	154	DB-T1-6Z-8AB-0Z (Verizon - Proposed)	130
5'0"x4.5" Pipe Mount (Motorola - Existing)	154	(2) FD9R6004/2C-3L Diplexer (Verizon - Existing)	130
(2) 72"x6.5"x8" Panel (Sprint - Existing)	150	(2) FD9R6004/2C-3L Diplexer (Verizon - Existing)	130
(2) 72"x6.5"x8" Panel (Sprint - Existing)	150	(2) FD9R6004/2C-3L Diplexer (Verizon - Existing)	130
(2) 72"x6.5"x8" Panel (Sprint - Existing)	150	EEI 10' Universal T-Arm (Verizon - Existing)	130
APXVSPP18-C-A20 (Sprint - Existing)	150	EEI 10' Universal T-Arm (Verizon - Existing)	130
APXVSPP18-C-A20 (Sprint - Existing)	150	EEI 10' Universal T-Arm (Verizon - Existing)	130
APXVSPP18-C-A20 (Sprint - Existing)	150	EEI Pine Branches	130
FD-RRH 2x50 800 (Sprint - Existing)	150	BXA-70063/6CF (Verizon - Existing)	130
FD-RRH 2x50 800 (Sprint - Existing)	150	(2) 7770.00 (ATI - Existing)	120
FD-RRH 2x50 800 (Sprint - Existing)	150	(2) LGP21401 TMA (ATI - Existing)	120
FD-RRH 4x40 1900 (Sprint - Existing)	150	(2) LGP21401 TMA (ATI - Existing)	120
FD-RRH 4x40 1900 (Sprint - Existing)	150	(2) LGP21401 TMA (ATI - Existing)	120
FD-RRH 4x40 1900 (Sprint - Existing)	150	(2) LGP21901 Diplexer (ATI - Existing)	120
EEI 10' Universal T-Arm (Sprint - Existing)	150	(2) LGP21901 Diplexer (ATI - Existing)	120
EEI 10' Universal T-Arm (Sprint - Existing)	150	(2) LGP21901 Diplexer (ATI - Existing)	120
EEI 10' Universal T-Arm (Sprint - Existing)	150	EEI 10' Universal T-Arm (ATI - Existing)	120
EEI Pine Branches	150	EEI 10' Universal T-Arm (ATI - Existing)	120
53"x7"x3" Panel (T-Mobile - Existing)	140	EEI 10' Universal T-Arm (ATI - Existing)	120
53"x7"x3" Panel (T-Mobile - Existing)	140	AM-X-CD-16-65-00T-RET(72") (ATI - Existing)	120
53"x7"x3" Panel (T-Mobile - Existing)	140	AM-X-CD-16-65-00T-RET(72") (ATI - Existing)	120
(2) TMA 10"x8"x3" (T-Mobile - Existing)	140	AM-X-CD-17-65-00T-RET (ATI - Existing)	120
(2) TMA 10"x8"x3" (T-Mobile - Existing)	140	(2) RRUS-11 (ATI - Existing)	120
(2) TMA 10"x8"x3" (T-Mobile - Existing)	140	(2) RRUS-11 (ATI - Existing)	120
EEI 10' Universal T-Arm (T-Mobile - Existing)	140	(2) RRUS-11 (ATI - Existing)	120
EEI 10' Universal T-Arm (T-Mobile - Existing)	140	DC6-48-60-18-8F Surge Arrestor (ATI - Existing)	120
EEI 10' Universal T-Arm (T-Mobile - Existing)	140	(2) 7770.00 (ATI - Existing)	120
EEI Pine Branches	140	EEI Pine Branches	120
BXA-70063/6CF (Verizon - Existing)	130	(2) 7770.00 (ATI - Existing)	120
BXA-70063/6CF (Verizon - Existing)	130	EEI Pine Branches	110
LNX-8513DS (Verizon - Proposed)	130	EEI Pine Branches	100
HBXX-6517DS (Verizon - Proposed)	130	EEI Pine Branches	90
HBXX-6517DS (Verizon - Proposed)	130	EEI Pine Branches	80
LNX-8513DS (Verizon - Proposed)	130		
HBXX-6517DS (Verizon - Proposed)	130		
HBXX-6517DS (Verizon - Proposed)	130		
LNX-8513DS (Verizon - Proposed)	130		

MATERIAL STRENGTH

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



TOWER DESIGN NOTES

1. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. Weld together tower sections have flange connections.
5. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
6. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
7. Welds are fabricated with ER-70S-6 electrodes.
8. TOWER RATING: 97.7%

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

Job: 14001.060 - New Milford West		
Project: 153-ft EEI Monopine - 33 Boardman Rd., New Milford, CT		
Client: Verizon Wireless	Drawn by: TJL	App'd:
Code: TIA/EIA-222-F	Date: 12/02/14	Scale: NTS
Path: [illegible]		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 80 mph.
- Nominal ice thickness of 0.500 in.
- Ice density of 56 pcf.
- A wind speed of 69 mph is used in combination with ice.
- Temperature drop of 50 °F.
- Deflections calculated using a wind speed of 50 mph.
- Weld together tower sections have flange connections..
- Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications..
- 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
Consider Moments - Horizontals
Consider Moments - Diagonals
Use Moment Magnification
√ Use Code Stress Ratios
Use Code Safety Factors - Guys
Escalate Ice
Always Use Max Kz
Use Special Wind Profile
Include Bolts In Member Capacity
Leg Bolts Are At Top Of Section
Secondary Horizontal Braces Leg
Use Diamond Inner Bracing (4 Sided)
Add IBC .6D+W Combination
Distribute Leg Loads As Uniform
Assume Legs Pinned
√ Assume Rigid Index Plate
Use Clear Spans For Wind Area
Use Clear Spans For KL/r
Retension Guys To Initial Tension
√ Bypass Mast Stability Checks
Use Azimuth Dish Coefficients
√ Project Wind Area of Appurt.
Autocalc Torque Arm Areas
SR Members Have Cut Ends
√ Sort Capacity Reports By Component
Triangulate Diamond Inner Bracing
Treat Feedline Bundles As Cylinder
Use ASCE 10 X-Brace Ly Rules
Calculate Redundant Bracing Forces
Ignore Redundant Members in FEA
SR Leg Bolts Resist Compression
All Leg Panels Have Same Allowable
Offset Girt At Foundation
Consider Feedline Torque
Include Angle Block Shear Check
Poles
√ Include Shear-Torsion Interaction
Always Use Sub-Critical Flow
Use Top Mounted Sockets

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	154.000-134.830	19.170	4.330	18	25.250	30.030	0.188	0.750	A572-65 (65 ksi)
L2	134.830-89.160	50.000	5.670	18	28.575	40.910	0.313	1.250	A572-65 (65 ksi)
L3	89.160-44.540	50.290	6.920	18	38.886	51.280	0.500	2.000	A572-65 (65 ksi)

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
L4	44.540-1.000	50.460		18	48.575	61.000	0.563	2.250	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	25.640	14.915	1183.638	8.897	12.827	92.277	2368.833	7.459	4.114	21.941
	30.493	17.760	1998.257	10.594	15.255	130.988	3999.143	8.882	4.955	26.428
L2	30.101	28.033	2829.053	10.033	14.516	194.888	5661.828	14.019	4.479	14.334
	41.541	40.268	8384.791	14.412	20.782	403.459	16780.616	20.138	6.650	21.281
L3	40.905	60.919	11340.739	13.627	19.754	574.092	22696.401	30.465	5.964	11.928
	52.071	80.588	26253.818	18.027	26.050	1007.815	52542.181	40.302	8.145	16.291
L4	51.054	85.720	24964.271	17.044	24.676	1011.687	49961.392	42.868	7.559	13.438
	61.941	107.904	49795.073	21.455	30.988	1606.915	99655.668	53.962	9.746	17.326

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 154.000-134.830				1	1	1		
L2 134.830-89.160				1	1	1		
L3 89.160-44.540				1	1	1		
L4 44.540-1.000				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 klf
7/8 (Town - Existing)	B	No	Inside Pole	151.000 - 4.000	3	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (Sprint - Existing)	B	No	Inside Pole	151.000 - 4.000	9	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (T-Mobile - Existing)	B	No	Inside Pole	141.000 - 4.000	6	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (Verizon - Existing)	B	No	Inside Pole	131.000 - 4.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (AT&T - Existing)	B	No	Inside Pole	121.000 - 4.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
RG6-Fiber (AT&T - Existing)	C	No	Inside Pole	121.000 - 4.000	1	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
#8 AWG Copper WIre (AT&T - Existing)	C	No	Inside Pole	121.000 - 4.000	2	No Ice	0.000	0.000
						1/2" Ice	0.000	0.000
HYBRIFLEX 1-1/4"	C	No	Inside Pole	151.000 - 4.000	3	No Ice	0.000	0.001

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight klf
(Sprint - Existing)						1/2" Ice	0.000	0.001
HYBRIFLEX 1-5/8"	B	No	Inside Pole	131.000 - 4.000	1	No Ice	0.000	0.002
(Verizon - Proposed)						1/2" Ice	0.000	0.002

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	154.000-134.830	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.216
		C	0.000	0.000	0.000	0.000	0.063
L2	134.830-89.160	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	1.785
		C	0.000	0.000	0.000	0.000	0.213
L3	89.160-44.540	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	1.967
		C	0.000	0.000	0.000	0.000	0.223
L4	44.540-1.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	1.787
		C	0.000	0.000	0.000	0.000	0.203

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 K
L1	154.000-134.830	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.216
		C		0.000	0.000	0.000	0.000	0.063
L2	134.830-89.160	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	1.785
		C		0.000	0.000	0.000	0.000	0.213
L3	89.160-44.540	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	1.967
		C		0.000	0.000	0.000	0.000	0.223
L4	44.540-1.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	1.787
		C		0.000	0.000	0.000	0.000	0.203

Discrete Tower Loads

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
EEI Pine Branches	C	None		0.000	150.000	No Ice	90.000	90.000	1.500
						1/2" Ice	130.000	130.000	1.900

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
EEI Pine Branches	C	None		0.000	140.000	No Ice 1/2" Ice	90.000 130.000	90.000 130.000	1.500 1.900
EEI Pine Branches	C	None		0.000	130.000	No Ice 1/2" Ice	90.000 130.000	90.000 130.000	1.500 1.900
EEI Pine Branches	C	None		0.000	120.000	No Ice 1/2" Ice	90.000 130.000	90.000 130.000	1.500 1.900
EEI Pine Branches	C	None		0.000	110.000	No Ice 1/2" Ice	90.000 130.000	90.000 130.000	1.500 1.900
EEI Pine Branches	C	None		0.000	100.000	No Ice 1/2" Ice	90.000 130.000	90.000 130.000	1.500 1.900
EEI Pine Branches	C	None		0.000	90.000	No Ice 1/2" Ice	90.000 130.000	90.000 130.000	1.500 1.900
EEI Pine Branches	C	None		0.000	80.000	No Ice 1/2" Ice	90.000 130.000	90.000 130.000	1.500 1.900
(2) 72"x6.5"x8" Panel (Sprint - Existing)	A	From Face	3.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	5.093 5.547	6.063 6.525	0.015 0.055
(2) 72"x6.5"x8" Panel (Sprint - Existing)	B	From Face	3.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	5.093 5.547	6.063 6.525	0.015 0.055
(2) 72"x6.5"x8" Panel (Sprint - Existing)	C	From Face	3.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	5.093 5.547	6.063 6.525	0.015 0.055
APXVSPP18-C-A20 (Sprint - Existing)	A	From Face	3.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	8.260 8.807	5.283 5.736	0.057 0.107
APXVSPP18-C-A20 (Sprint - Existing)	B	From Face	3.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	8.260 8.807	5.283 5.736	0.057 0.107
APXVSPP18-C-A20 (Sprint - Existing)	C	From Face	3.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	8.260 8.807	5.283 5.736	0.057 0.107
FD-RRH 2x50 800 (Sprint - Existing)	A	From Face	3.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	2.401 2.613	2.254 2.460	0.064 0.086
FD-RRH 2x50 800 (Sprint - Existing)	B	From Face	3.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	2.401 2.613	2.254 2.460	0.064 0.086
FD-RRH 2x50 800 (Sprint - Existing)	C	From Face	3.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	2.401 2.613	2.254 2.460	0.064 0.086
FD-RRH 4x40 1900 (Sprint - Existing)	A	From Face	3.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	2.609 2.845	2.709 2.948	0.060 0.083
FD-RRH 4x40 1900 (Sprint - Existing)	B	From Face	3.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	2.609 2.845	2.709 2.948	0.060 0.083
FD-RRH 4x40 1900 (Sprint - Existing)	C	From Face	3.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	2.609 2.845	2.709 2.948	0.060 0.083
EEI 10' Universal T-Arm (Sprint - Existing)	A	None		0.000	150.000	No Ice 1/2" Ice	13.340 16.800	13.340 16.800	0.450 0.600
EEI 10' Universal T-Arm (Sprint - Existing)	B	None		0.000	150.000	No Ice 1/2" Ice	13.340 16.800	13.340 16.800	0.450 0.600
EEI 10' Universal T-Arm (Sprint - Existing)	C	None		0.000	150.000	No Ice 1/2" Ice	13.340 16.800	13.340 16.800	0.450 0.600
53"x7"x3" Panel	A	From Face	3.000	0.000	140.000	No Ice	3.506	2.003	0.019

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*
(T-Mobile - Existing)			-6.000 0.000			1/2" Ice	3.848	2.326	0.039
53"x7"x3" Panel (T-Mobile - Existing)	B	From Face	3.000 -6.000 0.000	0.000	140.000	No Ice 1/2" Ice	3.506 3.848	2.003 2.326	0.019 0.039
53"x7"x3" Panel (T-Mobile - Existing)	C	From Face	3.000 -6.000 0.000	0.000	140.000	No Ice 1/2" Ice	3.506 3.848	2.003 2.326	0.019 0.039
(2) TMA 10"x8"x3" (T-Mobile - Existing)	A	From Face	3.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	0.778 0.899	0.292 0.380	0.015 0.020
(2) TMA 10"x8"x3" (T-Mobile - Existing)	A	From Face	3.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	0.778 0.899	0.292 0.380	0.015 0.020
(2) TMA 10"x8"x3" (T-Mobile - Existing)	A	From Face	3.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	0.778 0.899	0.292 0.380	0.015 0.020
EEI 10' Universal T-Arm (T-Mobile - Existing)	A	None		0.000	140.000	No Ice 1/2" Ice	13.340 16.800	13.340 16.800	0.450 0.600
EEI 10' Universal T-Arm (T-Mobile - Existing)	B	None		0.000	140.000	No Ice 1/2" Ice	13.340 16.800	13.340 16.800	0.450 0.600
EEI 10' Universal T-Arm (T-Mobile - Existing)	C	None		0.000	140.000	No Ice 1/2" Ice	13.340 16.800	13.340 16.800	0.450 0.600
BXA-70063/6CF (Verizon - Existing)	A	From Face	3.000 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.012 0.054
BXA-70063/6CF (Verizon - Existing)	B	From Face	3.000 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.012 0.054
BXA-70063/6CF (Verizon - Existing)	C	From Face	3.000 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.012 0.054
LNX-8513DS (Verizon - Proposed)	A	From Face	3.000 6.000 0.000	0.000	130.000	No Ice 1/2" Ice	8.411 8.964	5.405 5.863	0.045 0.096
HBXX-6517DS (Verizon - Proposed)	A	From Face	3.000 4.000 0.000	0.000	130.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
HBXX-6517DS (Verizon - Proposed)	A	From Face	3.000 -4.000 0.000	0.000	130.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
LNX-8513DS (Verizon - Proposed)	B	From Face	3.000 6.000 0.000	0.000	130.000	No Ice 1/2" Ice	8.411 8.964	5.405 5.863	0.045 0.096
HBXX-6517DS (Verizon - Proposed)	B	From Face	3.000 4.000 0.000	0.000	130.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
HBXX-6517DS (Verizon - Proposed)	B	From Face	3.000 -4.000 0.000	0.000	130.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
LNX-8513DS (Verizon - Proposed)	C	From Face	3.000 6.000 0.000	0.000	130.000	No Ice 1/2" Ice	8.411 8.964	5.405 5.863	0.045 0.096
HBXX-6517DS (Verizon - Proposed)	C	From Face	3.000 4.000 0.000	0.000	130.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
HBXX-6517DS	C	From Face	3.000	0.000	130.000	No Ice	8.738	5.243	0.050

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
(Verizon - Proposed)			-4.000 0.000			1/2" Ice	9.306	5.709	0.100
RRH2x60-AWS (Verizon - Proposed)	A	From Face	3.000 -4.000 0.000	0.000	130.000	No Ice 1/2" Ice	2.193 2.400	1.430 1.612	0.050 0.066
RRH2x60-AWS (Verizon - Proposed)	B	From Face	3.000 -4.000 0.000	0.000	130.000	No Ice 1/2" Ice	2.193 2.400	1.430 1.612	0.050 0.066
RRH2x60-AWS (Verizon - Proposed)	C	From Face	3.000 -4.000 0.000	0.000	130.000	No Ice 1/2" Ice	2.193 2.400	1.430 1.612	0.050 0.066
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	C	From Face	3.000 -4.000 0.000	0.000	130.000	No Ice 1/2" Ice	5.600 5.915	2.333 2.558	0.044 0.080
(2) FD9R6004/2C-3L Diplexer (Verizon - Existing)	A	From Face	3.000 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	0.367 0.451	0.085 0.136	0.003 0.005
(2) FD9R6004/2C-3L Diplexer (Verizon - Existing)	B	From Face	3.000 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	0.367 0.451	0.085 0.136	0.003 0.005
(2) FD9R6004/2C-3L Diplexer (Verizon - Existing)	C	From Face	3.000 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	0.367 0.451	0.085 0.136	0.003 0.005
EEI 10' Universal T-Arm (Verizon - Existing)	A	None		0.000	130.000	No Ice 1/2" Ice	13.340 16.800	13.340 16.800	0.450 0.600
EEI 10' Universal T-Arm (Verizon - Existing)	B	None		0.000	130.000	No Ice 1/2" Ice	13.340 16.800	13.340 16.800	0.450 0.600
EEI 10' Universal T-Arm (Verizon - Existing)	C	None		0.000	130.000	No Ice 1/2" Ice	13.340 16.800	13.340 16.800	0.450 0.600
(2) 7770.00 (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	120.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) 7770.00 (AT&T - Existing)	B	From Face	3.000 0.000 0.000	0.000	120.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) 7770.00 (AT&T - Existing)	C	From Face	3.000 0.000 0.000	0.000	120.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) LGP21401 TMA (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	120.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
(2) LGP21401 TMA (AT&T - Existing)	B	From Face	3.000 0.000 0.000	0.000	120.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
(2) LGP21401 TMA (AT&T - Existing)	C	From Face	3.000 0.000 0.000	0.000	120.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
(2) LGP21901 Diplexer (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	120.000	No Ice 1/2" Ice	0.233 0.302	0.117 0.166	0.006 0.008
(2) LGP21901 Diplexer (AT&T - Existing)	B	From Face	3.000 0.000 0.000	0.000	120.000	No Ice 1/2" Ice	0.233 0.302	0.117 0.166	0.006 0.008
(2) LGP21901 Diplexer (AT&T - Existing)	C	From Face	3.000 0.000 0.000	0.000	120.000	No Ice 1/2" Ice	0.233 0.302	0.117 0.166	0.006 0.008
EEI 10' Universal T-Arm	A	None		0.000	120.000	No Ice	13.340	13.340	0.450

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
(AT&T - Existing)						1/2" Ice	16.800	16.800	0.600
EEI 10' Universal T-Arm	B	None		0.000	120.000	No Ice	13.340	13.340	0.450
(AT&T - Existing)						1/2" Ice	16.800	16.800	0.600
EEI 10' Universal T-Arm	C	None		0.000	120.000	No Ice	13.340	13.340	0.450
(AT&T - Existing)						1/2" Ice	16.800	16.800	0.600
AM-X-CD-16-65-00T-RET(72") (AT&T - Existing)	A	From Face	3.000 2.000 0.000	0.000	120.000	No Ice 1/2" Ice	8.260 8.807	4.642 5.088	0.050 0.096
AM-X-CD-16-65-00T-RET(72") (AT&T - Existing)	B	From Face	3.000 2.000 0.000	0.000	120.000	No Ice 1/2" Ice	8.260 8.807	4.642 5.088	0.050 0.096
AM-X-CD-17-65-00T-RET (AT&T - Existing)	C	From Face	3.000 2.000 0.000	0.000	120.000	No Ice 1/2" Ice	11.311 11.927	6.800 7.384	0.060 0.121
(2) RRUS-11 (AT&T - Existing)	A	From Face	1.000 2.000 0.000	0.000	120.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Existing)	B	From Face	1.000 2.000 0.000	0.000	120.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Existing)	C	From Face	1.000 2.000 0.000	0.000	120.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	C	From Face	0.500 0.000 0.000	0.000	120.000	No Ice 1/2" Ice	2.228 2.447	2.228 2.447	0.020 0.039
BA40-41 (Motorola - Existing)	A	From Leg	1.000 0.000 5.000	0.000	154.000	No Ice 1/2" Ice	4.480 7.660	4.480 7.660	0.032 0.040
Valmont Uni-Tri Bracket (Motorola - Existing)	A	From Face	0.000 0.000 0.000	0.000	154.000	No Ice 1/2" Ice	1.750 1.940	1.750 1.940	0.290 0.306
5'0"x4.5" Pipe Mount (Motorola - Existing)	A	From Face	1.000 0.000 2.000	0.000	154.000	No Ice 1/2" Ice	1.764 2.076	1.764 2.076	0.054 0.070
5'0"x4.5" Pipe Mount (Motorola - Existing)	B	From Face	1.000 0.000 2.000	0.000	154.000	No Ice 1/2" Ice	1.764 2.076	1.764 2.076	0.054 0.070
5'0"x4.5" Pipe Mount (Motorola - Existing)	C	From Face	1.000 0.000 2.000	0.000	154.000	No Ice 1/2" Ice	1.764 2.076	1.764 2.076	0.054 0.070

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* K
HP2-4.7 (Motorola - Existing)	B	Paraboloid w/Shroud (HP)	From Leg	1.000 0.000	Worst		156.000	2.000	No Ice 1/2" Ice	3.142 3.409	0.027 0.044

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 K
HP3-4.7 (Motorola - Existing)	C	Paraboloid w/Shroud (HP)	From Leg	0.000 1.000 0.000 0.000	Worst		156.000	3.000	No Ice 1/2" Ice	7.069 7.467	0.050 0.067

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	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 154.000-134.830	144.139	1.524	0.025	44.155	A	0.000	44.155	44.155	100.00	0.000	0.000
					B	0.000	44.155		100.00	0.000	0.000
					C	0.000	44.155		100.00	0.000	0.000
L2 134.830-89.160	111.111	1.415	0.023	134.257	A	0.000	134.257	134.257	100.00	0.000	0.000
					B	0.000	134.257		100.00	0.000	0.000
					C	0.000	134.257		100.00	0.000	0.000
L3 89.160-44.540	66.493	1.222	0.020	170.232	A	0.000	170.232	170.232	100.00	0.000	0.000
					B	0.000	170.232		100.00	0.000	0.000
					C	0.000	170.232		100.00	0.000	0.000
L4 44.540-1.000	22.093	1	0.016	201.878	A	0.000	201.878	201.878	100.00	0.000	0.000
					B	0.000	201.878		100.00	0.000	0.000
					C	0.000	201.878		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	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 154.000-134.830	144.139	1.524	0.019	0.500	45.752	A	0.000	45.752	45.752	100.00	0.000	0.000
						B	0.000	45.752		100.00	0.000	0.000
						C	0.000	45.752		100.00	0.000	0.000
L2 134.830-89.160	111.111	1.415	0.017	0.500	138.063	A	0.000	138.063	138.063	100.00	0.000	0.000
						B	0.000	138.063		100.00	0.000	0.000
						C	0.000	138.063		100.00	0.000	0.000
L3 89.160-44.540	66.493	1.222	0.015	0.500	173.950	A	0.000	173.950	173.950	100.00	0.000	0.000
						B	0.000	173.950		100.00	0.000	0.000
						C	0.000	173.950		100.00	0.000	0.000
L4 44.540-1.000	22.093	1	0.012	0.500	205.506	A	0.000	205.506	205.506	100.00	0.000	0.000
						B	0.000	205.506		100.00	0.000	0.000
						C	0.000	205.506		100.00	0.000	0.000

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	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 154.000-134.830	144.139	1.524	0.010	44.155	A	0.000	44.155	44.155	100.00	0.000	0.000
					B	0.000	44.155		100.00	0.000	0.000
					C	0.000	44.155		100.00	0.000	0.000
L2 134.830-89.160	111.111	1.415	0.009	134.257	A	0.000	134.257	134.257	100.00	0.000	0.000
					B	0.000	134.257		100.00	0.000	0.000
					C	0.000	134.257		100.00	0.000	0.000
L3 89.160-44.540	66.493	1.222	0.008	170.232	A	0.000	170.232	170.232	100.00	0.000	0.000
					B	0.000	170.232		100.00	0.000	0.000
					C	0.000	170.232		100.00	0.000	0.000
L4 44.540-1.000	22.093	1	0.006	201.878	A	0.000	201.878	201.878	100.00	0.000	0.000
					B	0.000	201.878		100.00	0.000	0.000
					C	0.000	201.878		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 ft²	F K	w klf	Ctrl. Face
L1 154.000-134.830	0.279	1.066	A	1	0.65	1	1	1	44.155	1.211	0.063	C
			B	1	0.65	1	1	1	44.155			
			C	1	0.65	1	1	1	44.155			
L2 134.830-89.160	1.999	5.810	A	1	0.65	1	1	1	134.257	3.412	0.075	C
			B	1	0.65	1	1	1	134.257			
			C	1	0.65	1	1	1	134.257			
L3 89.160-44.540	2.190	12.108	A	1	0.65	1	1	1	170.232	3.723	0.083	C
			B	1	0.65	1	1	1	170.232			
			C	1	0.65	1	1	1	170.232			
L4 44.540-1.000	1.990	16.623	A	1	0.65	1	1	1	201.878	3.640	0.084	C
			B	1	0.65	1	1	1	201.878			
			C	1	0.65	1	1	1	201.878			
Sum Weight:	6.457	35.607						OTM	869.635 kip-ft	11.986		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 154.000-134.830	0.279	1.066	A	1	0.65	1	1	1	44.155	1.211	0.063	C
			B	1	0.65	1	1	1	44.155			
			C	1	0.65	1	1	1	44.155			
L2 134.830-89.160	1.999	5.810	A	1	0.65	1	1	1	134.257	3.412	0.075	C
			B	1	0.65	1	1	1	134.257			
			C	1	0.65	1	1	1	134.257			
L3 89.160-44.540	2.190	12.108	A	1	0.65	1	1	1	170.232	3.723	0.083	C
			B	1	0.65	1	1	1	170.232			
			C	1	0.65	1	1	1	170.232			

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 klf	Ctrl. Face
L4 44.540-1.000	1.990	16.623	A	1	0.65	1	1	1	201.878	3.640	0.084	C
			B	1	0.65	1	1	1	201.878			
			C	1	0.65	1	1	1	201.878			
Sum Weight:	6.457	35.607						OTM	869.635 kip-ft	11.986		

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 klf	Ctrl. Face
L1 154.000-134.830	0.279	1.066	A	1	0.65	1	1	1	44.155	1.211	0.063	C
			B	1	0.65	1	1	1	44.155			
			C	1	0.65	1	1	1	44.155			
L2 134.830-89.160	1.999	5.810	A	1	0.65	1	1	1	134.257	3.412	0.075	C
			B	1	0.65	1	1	1	134.257			
			C	1	0.65	1	1	1	134.257			
L3 89.160-44.540	2.190	12.108	A	1	0.65	1	1	1	170.232	3.723	0.083	C
			B	1	0.65	1	1	1	170.232			
			C	1	0.65	1	1	1	170.232			
L4 44.540-1.000	1.990	16.623	A	1	0.65	1	1	1	201.878	3.640	0.084	C
			B	1	0.65	1	1	1	201.878			
			C	1	0.65	1	1	1	201.878			
Sum Weight:	6.457	35.607						OTM	869.635 kip-ft	11.986		

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 klf	Ctrl. Face
L1 154.000-134.830	0.279	1.066	A	1	0.65	1	1	1	44.155	1.211	0.063	C
			B	1	0.65	1	1	1	44.155			
			C	1	0.65	1	1	1	44.155			
L2 134.830-89.160	1.999	5.810	A	1	0.65	1	1	1	134.257	3.412	0.075	C
			B	1	0.65	1	1	1	134.257			
			C	1	0.65	1	1	1	134.257			
L3 89.160-44.540	2.190	12.108	A	1	0.65	1	1	1	170.232	3.723	0.083	C
			B	1	0.65	1	1	1	170.232			
			C	1	0.65	1	1	1	170.232			
L4 44.540-1.000	1.990	16.623	A	1	0.65	1	1	1	201.878	3.640	0.084	C
			B	1	0.65	1	1	1	201.878			
			C	1	0.65	1	1	1	201.878			
Sum Weight:	6.457	35.607						OTM	869.635 kip-ft	11.986		

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 klf	Ctrl. Face
L1 154.000-134.830	0.279	1.399	A	1	0.65	1	1	1	45.752	0.941	0.049	C
			B	1	0.65	1	1	1	45.752			
			C	1	0.65	1	1	1	45.752			
L2 134.830-89.160	1.999	6.819	A	1	0.65	1	1	1	138.063	2.631	0.058	C
			B	1	0.65	1	1	1	138.063			
			C	1	0.65	1	1	1	138.063			
L3 89.160-44.540	2.190	13.382	A	1	0.65	1	1	1	173.950	2.853	0.064	C
			B	1	0.65	1	1	1	173.950			
			C	1	0.65	1	1	1	173.950			
L4 44.540-1.000	1.990	18.132	A	1	0.65	1	1	1	205.506	2.779	0.064	C
			B	1	0.65	1	1	1	205.506			
			C	1	0.65	1	1	1	205.506			
Sum Weight:	6.457	39.731						OTM	669.946 kip-ft	9.205		

Tower Forces - With Ice - Wind 45 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 klf	Ctrl. Face
L1 154.000-134.830	0.279	1.399	A	1	0.65	1	1	1	45.752	0.941	0.049	C
			B	1	0.65	1	1	1	45.752			
			C	1	0.65	1	1	1	45.752			
L2 134.830-89.160	1.999	6.819	A	1	0.65	1	1	1	138.063	2.631	0.058	C
			B	1	0.65	1	1	1	138.063			
			C	1	0.65	1	1	1	138.063			
L3 89.160-44.540	2.190	13.382	A	1	0.65	1	1	1	173.950	2.853	0.064	C
			B	1	0.65	1	1	1	173.950			
			C	1	0.65	1	1	1	173.950			
L4 44.540-1.000	1.990	18.132	A	1	0.65	1	1	1	205.506	2.779	0.064	C
			B	1	0.65	1	1	1	205.506			
			C	1	0.65	1	1	1	205.506			
Sum Weight:	6.457	39.731						OTM	669.946 kip-ft	9.205		

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 klf	Ctrl. Face
L1 154.000-134.830	0.279	1.399	A	1	0.65	1	1	1	45.752	0.941	0.049	C
			B	1	0.65	1	1	1	45.752			
			C	1	0.65	1	1	1	45.752			
L2 134.830-89.160	1.999	6.819	A	1	0.65	1	1	1	138.063	2.631	0.058	C
			B	1	0.65	1	1	1	138.063			
			C	1	0.65	1	1	1	138.063			

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 klf	Ctrl. Face
L3 89.160-44.540	2.190	13.382	A	1	0.65	1	1	1	173.950	2.853	0.064	C
			B	1	0.65	1	1	1	173.950			
			C	1	0.65	1	1	1	173.950			
L4 44.540-1.000	1.990	18.132	A	1	0.65	1	1	1	205.506	2.779	0.064	C
			B	1	0.65	1	1	1	205.506			
			C	1	0.65	1	1	1	205.506			
Sum Weight:	6.457	39.731						OTM	669.946 kip-ft	9.205		

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 klf	Ctrl. Face
L1 154.000-134.830	0.279	1.399	A	1	0.65	1	1	1	45.752	0.941	0.049	C
			B	1	0.65	1	1	1	45.752			
			C	1	0.65	1	1	1	45.752			
L2 134.830-89.160	1.999	6.819	A	1	0.65	1	1	1	138.063	2.631	0.058	C
			B	1	0.65	1	1	1	138.063			
			C	1	0.65	1	1	1	138.063			
L3 89.160-44.540	2.190	13.382	A	1	0.65	1	1	1	173.950	2.853	0.064	C
			B	1	0.65	1	1	1	173.950			
			C	1	0.65	1	1	1	173.950			
L4 44.540-1.000	1.990	18.132	A	1	0.65	1	1	1	205.506	2.779	0.064	C
			B	1	0.65	1	1	1	205.506			
			C	1	0.65	1	1	1	205.506			
Sum Weight:	6.457	39.731						OTM	669.946 kip-ft	9.205		

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 klf	Ctrl. Face
L1 154.000-134.830	0.279	1.066	A	1	0.65	1	1	1	44.155	0.473	0.025	C
			B	1	0.65	1	1	1	44.155			
			C	1	0.65	1	1	1	44.155			
L2 134.830-89.160	1.999	5.810	A	1	0.65	1	1	1	134.257	1.333	0.029	C
			B	1	0.65	1	1	1	134.257			
			C	1	0.65	1	1	1	134.257			
L3 89.160-44.540	2.190	12.108	A	1	0.65	1	1	1	170.232	1.454	0.033	C
			B	1	0.65	1	1	1	170.232			
			C	1	0.65	1	1	1	170.232			
L4 44.540-1.000	1.990	16.623	A	1	0.65	1	1	1	201.878	1.422	0.033	C
			B	1	0.65	1	1	1	201.878			
			C	1	0.65	1	1	1	201.878			
Sum Weight:	6.457	35.607						OTM	339.701 kip-ft	4.682		

Tower Forces - Service - Wind 45 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 klf	Ctrl. Face
L1 154.000-134.830	0.279	1.066	A	1	0.65	1	1	1	44.155	0.473	0.025	C
			B	1	0.65	1	1	1	44.155			
			C	1	0.65	1	1	1	44.155			
L2 134.830-89.160	1.999	5.810	A	1	0.65	1	1	1	134.257	1.333	0.029	C
			B	1	0.65	1	1	1	134.257			
			C	1	0.65	1	1	1	134.257			
L3 89.160-44.540	2.190	12.108	A	1	0.65	1	1	1	170.232	1.454	0.033	C
			B	1	0.65	1	1	1	170.232			
			C	1	0.65	1	1	1	170.232			
L4 44.540-1.000	1.990	16.623	A	1	0.65	1	1	1	201.878	1.422	0.033	C
			B	1	0.65	1	1	1	201.878			
			C	1	0.65	1	1	1	201.878			
Sum Weight:	6.457	35.607						OTM	339.701 kip-ft	4.682		

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 klf	Ctrl. Face
L1 154.000-134.830	0.279	1.066	A	1	0.65	1	1	1	44.155	0.473	0.025	C
			B	1	0.65	1	1	1	44.155			
			C	1	0.65	1	1	1	44.155			
L2 134.830-89.160	1.999	5.810	A	1	0.65	1	1	1	134.257	1.333	0.029	C
			B	1	0.65	1	1	1	134.257			
			C	1	0.65	1	1	1	134.257			
L3 89.160-44.540	2.190	12.108	A	1	0.65	1	1	1	170.232	1.454	0.033	C
			B	1	0.65	1	1	1	170.232			
			C	1	0.65	1	1	1	170.232			
L4 44.540-1.000	1.990	16.623	A	1	0.65	1	1	1	201.878	1.422	0.033	C
			B	1	0.65	1	1	1	201.878			
			C	1	0.65	1	1	1	201.878			
Sum Weight:	6.457	35.607						OTM	339.701 kip-ft	4.682		

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 klf	Ctrl. Face
L1 154.000-134.830	0.279	1.066	A	1	0.65	1	1	1	44.155	0.473	0.025	C
			B	1	0.65	1	1	1	44.155			
			C	1	0.65	1	1	1	44.155			
L2	1.999	5.810	A	1	0.65	1	1	1	134.257	1.333	0.029	C

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 klf	Ctrl. Face
134.830-89.16			B	1	0.65	1	1	1	134.257			
0			C	1	0.65	1	1	1	134.257			
L3	2.190	12.108	A	1	0.65	1	1	1	170.232	1.454	0.033	C
89.160-44.540			B	1	0.65	1	1	1	170.232			
			C	1	0.65	1	1	1	170.232			
L4	1.990	16.623	A	1	0.65	1	1	1	201.878	1.422	0.033	C
44.540-1.000			B	1	0.65	1	1	1	201.878			
			C	1	0.65	1	1	1	201.878			
Sum Weight:	6.457	35.607						OTM	339.701 kip-ft	4.682		

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	35.607					
Bracing Weight	0.000					
Total Member Self-Weight	35.607			-0.058	0.476	
Total Weight	62.322			-0.058	0.476	
Wind 0 deg - No Ice		-0.053	-57.970	-6512.151	7.822	-0.041
Wind 30 deg - No Ice		28.885	-50.177	-5636.023	-3242.691	0.432
Wind 45 deg - No Ice		40.877	-40.953	-4599.609	-4589.857	0.632
Wind 60 deg - No Ice		50.083	-28.939	-3249.743	-5624.200	0.789
Wind 90 deg - No Ice		57.861	0.053	7.288	-6498.582	0.935
Wind 120 deg - No Ice		50.136	29.031	3262.350	-5631.546	0.831
Wind 135 deg - No Ice		40.951	41.028	4609.881	-4600.246	0.691
Wind 150 deg - No Ice		28.976	50.230	5643.253	-3255.414	0.504
Wind 180 deg - No Ice		0.053	57.970	6512.035	-6.869	0.041
Wind 210 deg - No Ice		-28.885	50.177	5635.907	3243.644	-0.432
Wind 225 deg - No Ice		-40.877	40.953	4599.493	4590.810	-0.632
Wind 240 deg - No Ice		-50.083	28.939	3249.627	5625.153	-0.789
Wind 270 deg - No Ice		-57.861	-0.053	-7.404	6499.534	-0.935
Wind 300 deg - No Ice		-50.136	-29.031	-3262.466	5632.498	-0.831
Wind 315 deg - No Ice		-40.951	-41.028	-4609.997	4601.198	-0.691
Wind 330 deg - No Ice		-28.976	-50.230	-5643.369	3256.367	-0.504
Member Ice	4.124					
Total Weight Ice	73.374			0.145	0.487	
Wind 0 deg - Ice		-0.042	-55.250	-6276.910	6.363	-0.072
Wind 30 deg - Ice		27.549	-47.827	-5433.006	-3128.220	0.207
Wind 45 deg - Ice		38.982	-39.038	-4434.248	-4427.214	0.330
Wind 60 deg - Ice		47.759	-27.589	-3133.293	-5424.468	0.431
Wind 90 deg - Ice		55.171	0.042	6.021	-6267.105	0.539
Wind 120 deg - Ice		47.801	27.662	3143.762	-5430.345	0.503
Wind 135 deg - Ice		39.042	39.098	4442.849	-4435.525	0.432
Wind 150 deg - Ice		27.622	47.869	5439.172	-3138.398	0.332
Wind 180 deg - Ice		0.042	55.250	6277.200	-5.390	0.072
Wind 210 deg - Ice		-27.549	47.827	5433.296	3129.193	-0.207
Wind 225 deg - Ice		-38.982	39.038	4434.538	4428.188	-0.330
Wind 240 deg - Ice		-47.759	27.589	3133.583	5425.442	-0.431
Wind 270 deg - Ice		-55.171	-0.042	-5.731	6268.078	-0.539
Wind 300 deg - Ice		-47.801	-27.662	-3143.472	5431.318	-0.503
Wind 315 deg - Ice		-39.042	-39.098	-4442.558	4436.498	-0.432
Wind 330 deg - Ice		-27.622	-47.869	-5438.882	3139.371	-0.332
Total Weight	62.322			-0.058	0.476	

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*
Wind 0 deg - Service		-0.021	-22.644	-2543.844	3.346	-0.016
Wind 30 deg - Service		11.283	-19.600	-2201.607	-1266.386	0.169
Wind 45 deg - Service		15.967	-15.997	-1796.758	-1792.623	0.247
Wind 60 deg - Service		19.564	-11.304	-1269.466	-2196.663	0.308
Wind 90 deg - Service		22.602	0.021	2.811	-2538.218	0.365
Wind 120 deg - Service		19.584	11.340	1274.320	-2199.532	0.325
Wind 135 deg - Service		15.997	16.027	1800.700	-1796.681	0.270
Wind 150 deg - Service		11.319	19.621	2204.360	-1271.356	0.197
Wind 180 deg - Service		0.021	22.644	2543.728	-2.393	0.016
Wind 210 deg - Service		-11.283	19.600	2201.491	1267.339	-0.169
Wind 225 deg - Service		-15.967	15.997	1796.642	1793.575	-0.247
Wind 240 deg - Service		-19.564	11.304	1269.350	2197.615	-0.308
Wind 270 deg - Service		-22.602	-0.021	-2.927	2539.171	-0.365
Wind 300 deg - Service		-19.584	-11.340	-1274.436	2200.485	-0.325
Wind 315 deg - Service		-15.997	-16.027	-1800.815	1797.633	-0.270
Wind 330 deg - Service		-11.319	-19.621	-2204.476	1272.308	-0.197

Load Combinations

Comb. No.	*Description*
1	Dead Only
2	Dead+Wind 0 deg - No Ice
3	Dead+Wind 30 deg - No Ice
4	Dead+Wind 45 deg - No Ice
5	Dead+Wind 60 deg - No Ice
6	Dead+Wind 90 deg - No Ice
7	Dead+Wind 120 deg - No Ice
8	Dead+Wind 135 deg - No Ice
9	Dead+Wind 150 deg - No Ice
10	Dead+Wind 180 deg - No Ice
11	Dead+Wind 210 deg - No Ice
12	Dead+Wind 225 deg - No Ice
13	Dead+Wind 240 deg - No Ice
14	Dead+Wind 270 deg - No Ice
15	Dead+Wind 300 deg - No Ice
16	Dead+Wind 315 deg - No Ice
17	Dead+Wind 330 deg - No Ice
18	Dead+Ice+Temp
19	Dead+Wind 0 deg+Ice+Temp
20	Dead+Wind 30 deg+Ice+Temp
21	Dead+Wind 45 deg+Ice+Temp
22	Dead+Wind 60 deg+Ice+Temp
23	Dead+Wind 90 deg+Ice+Temp
24	Dead+Wind 120 deg+Ice+Temp
25	Dead+Wind 135 deg+Ice+Temp
26	Dead+Wind 150 deg+Ice+Temp
27	Dead+Wind 180 deg+Ice+Temp
28	Dead+Wind 210 deg+Ice+Temp
29	Dead+Wind 225 deg+Ice+Temp
30	Dead+Wind 240 deg+Ice+Temp
31	Dead+Wind 270 deg+Ice+Temp
32	Dead+Wind 300 deg+Ice+Temp
33	Dead+Wind 315 deg+Ice+Temp
34	Dead+Wind 330 deg+Ice+Temp
35	Dead+Wind 0 deg - Service

Comb. No.	Description
36	Dead+Wind 30 deg - Service
37	Dead+Wind 45 deg - Service
38	Dead+Wind 60 deg - Service
39	Dead+Wind 90 deg - Service
40	Dead+Wind 120 deg - Service
41	Dead+Wind 135 deg - Service
42	Dead+Wind 150 deg - Service
43	Dead+Wind 180 deg - Service
44	Dead+Wind 210 deg - Service
45	Dead+Wind 225 deg - Service
46	Dead+Wind 240 deg - Service
47	Dead+Wind 270 deg - Service
48	Dead+Wind 300 deg - Service
49	Dead+Wind 315 deg - Service
50	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	154 - 134.83	Pole	Max Tension	18	0.000	0.000	0.000
			Max. Compression	18	-10.734	0.757	0.382
			Max. Mx	14	-6.475	127.253	0.370
			Max. My	2	-6.479	0.618	126.904
			Max. Vy	14	-17.097	127.253	0.370
			Max. Vx	2	-17.037	0.618	126.904
			Max. Torque	10			-0.742
L2	134.83 - 89.16	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-32.726	0.487	-0.145
			Max. Mx	14	-22.446	1567.140	2.560
			Max. My	2	-22.433	2.959	1569.660
			Max. Vy	14	-45.097	1567.140	2.560
			Max. Vx	2	-45.208	2.959	1569.660
			Max. Torque	14			0.919
L3	89.16 - 44.54	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-50.830	0.487	-0.145
			Max. Mx	14	-39.625	3821.240	4.918
			Max. My	2	-39.618	5.349	3828.592
			Max. Vy	14	-55.023	3821.240	4.918
			Max. Vx	2	-55.134	5.349	3828.592
			Max. Torque	14			0.916
L4	44.54 - 1	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-73.374	0.487	-0.145
			Max. Mx	14	-62.278	6674.890	7.635
			Max. My	2	-62.278	8.070	6687.800
			Max. Vy	14	-57.909	6674.890	7.635
			Max. Vx	2	-58.018	8.070	6687.800
			Max. Torque	14			0.914

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K

Location	*Condition*	*Gov. Load Comb.*	*Vertical K*	*Horizontal, X K*	*Horizontal, Z K*
Pole	Max. Vert	19	73.374	0.042	55.250
	Max. H_x	14	62.322	57.861	0.053
	Max. H_z	2	62.322	0.053	57.970
	Max. M_x	2	6687.800	0.053	57.970
	Max. M_z	6	6673.891	-57.861	-0.053
	Max. Torsion	14	0.913	57.861	0.053
	Min. Vert	1	62.322	0.000	0.000
	Min. H_x	6	62.322	-57.861	-0.053
	Min. H_z	10	62.322	-0.053	-57.970
	Min. M_x	10	-6687.677	-0.053	-57.970
	Min. M_z	14	-6674.890	57.861	0.053
	Min. Torsion	6	-0.911	-57.861	-0.053

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	62.322	0.000	0.000	-0.058	0.476	0.000
Dead+Wind 0 deg - No Ice	62.322	-0.053	-57.970	-6687.800	8.070	-0.067
Dead+Wind 30 deg - No Ice	62.322	28.885	-50.177	-5788.063	-3330.137	0.399
Dead+Wind 45 deg - No Ice	62.322	40.877	-40.953	-4723.694	-4713.660	0.598
Dead+Wind 60 deg - No Ice	62.322	50.083	-28.939	-3337.410	-5775.920	0.756
Dead+Wind 90 deg - No Ice	62.322	57.861	0.053	7.499	-6673.891	0.911
Dead+Wind 120 deg - No Ice	62.322	50.136	29.031	3350.363	-5783.457	0.822
Dead+Wind 135 deg - No Ice	62.322	40.951	41.028	4734.232	-4724.334	0.692
Dead+Wind 150 deg - No Ice	62.322	28.976	50.230	5795.467	-3343.229	0.514
Dead+Wind 180 deg - No Ice	62.322	0.053	57.970	6687.677	-7.064	0.068
Dead+Wind 210 deg - No Ice	62.322	-28.885	50.177	5787.934	3331.147	-0.396
Dead+Wind 225 deg - No Ice	62.322	-40.877	40.953	4723.561	4714.669	-0.596
Dead+Wind 240 deg - No Ice	62.322	-50.083	28.939	3337.274	5776.926	-0.756
Dead+Wind 270 deg - No Ice	62.322	-57.861	-0.053	-7.635	6674.890	-0.913
Dead+Wind 300 deg - No Ice	62.322	-50.136	-29.031	-3350.493	5784.452	-0.825
Dead+Wind 315 deg - No Ice	62.322	-40.951	-41.028	-4734.358	4725.330	-0.694
Dead+Wind 330 deg - No Ice	62.322	-28.976	-50.230	-5795.591	3344.227	-0.515
Dead+Ice+Temp	73.374	0.000	0.000	0.145	0.487	0.000
Dead+Wind 0 deg+Ice+Temp	73.374	-0.042	-55.250	-6495.555	6.628	-0.096
Dead+Wind 30 deg+Ice+Temp	73.374	27.549	-47.827	-5622.264	-3237.161	0.178
Dead+Wind 45 deg+Ice+Temp	73.374	38.982	-39.038	-4588.714	-4581.420	0.301
Dead+Wind 60 deg+Ice+Temp	73.374	47.759	-27.589	-3242.434	-5613.427	0.403
Dead+Wind 90 deg+Ice+Temp	73.374	55.171	0.042	6.255	-6485.425	0.520
Dead+Wind 120 deg+Ice+Temp	73.374	47.801	27.662	3253.294	-5619.508	0.498
Dead+Wind 135 deg+Ice+Temp	73.374	39.042	39.098	4597.624	-4590.033	0.435
Dead+Wind 150 deg+Ice+Temp	73.374	27.622	47.869	5628.645	-3247.724	0.343
Dead+Wind 180 deg+Ice+Temp	73.374	0.042	55.250	6495.860	-5.584	0.097
Dead+Wind 210 deg+Ice+Temp	73.374	-27.549	47.827	5622.564	3238.206	-0.176
Dead+Wind 225 deg+Ice+Temp	73.374	-38.982	39.038	4589.012	4582.464	-0.299
Dead+Wind 240 deg+Ice+Temp	73.374	-47.759	27.589	3242.732	5614.469	-0.403
Dead+Wind 270 deg+Ice+Temp	73.374	-55.171	-0.042	-5.957	6486.464	-0.521
Dead+Wind 300 deg+Ice+Temp	73.374	-47.801	-27.662	-3252.992	5620.545	-0.500
Dead+Wind 315 deg+Ice+Temp	73.374	-39.042	-39.098	-4597.320	4591.070	-0.437
Dead+Wind 330 deg+Ice+Temp	73.374	-27.622	-47.869	-5628.340	3248.763	-0.344
Dead+Wind 0 deg - Service	62.322	-0.021	-22.644	-2615.470	3.464	-0.027
Dead+Wind 30 deg - Service	62.322	11.283	-19.600	-2263.597	-1302.022	0.157
Dead+Wind 45 deg - Service	62.322	15.967	-15.997	-1847.346	-1843.079	0.235
Dead+Wind 60 deg - Service	62.322	19.564	-11.304	-1305.206	-2258.499	0.298
Dead+Wind 90 deg - Service	62.322	22.602	0.021	2.897	-2609.674	0.359

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 120 deg - Service	62.322	19.584	11.340	1310.207	-2261.458	0.325
Dead+Wind 135 deg - Service	62.322	15.997	16.027	1851.406	-1847.264	0.273
Dead+Wind 150 deg - Service	62.322	11.319	19.621	2266.430	-1307.149	0.203
Dead+Wind 180 deg - Service	62.322	0.021	22.644	2615.346	-2.456	0.027
Dead+Wind 210 deg - Service	62.322	-11.283	19.600	2263.472	1303.031	-0.156
Dead+Wind 225 deg - Service	62.322	-15.967	15.997	1847.221	1844.087	-0.235
Dead+Wind 240 deg - Service	62.322	-19.564	11.304	1305.081	2259.507	-0.298
Dead+Wind 270 deg - Service	62.322	-22.602	-0.021	-3.023	2610.681	-0.360
Dead+Wind 300 deg - Service	62.322	-19.584	-11.340	-1310.332	2262.464	-0.325
Dead+Wind 315 deg - Service	62.322	-15.997	-16.027	-1851.530	1848.271	-0.273
Dead+Wind 330 deg - Service	62.322	-11.319	-19.621	-2266.554	1308.156	-0.203

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	0.000	-62.322	0.000	0.000	62.322	0.000	0.000%
2	-0.053	-62.322	-57.970	0.053	62.322	57.970	0.000%
3	28.885	-62.322	-50.177	-28.885	62.322	50.177	0.000%
4	40.877	-62.322	-40.953	-40.877	62.322	40.953	0.000%
5	50.083	-62.322	-28.939	-50.083	62.322	28.939	0.000%
6	57.861	-62.322	0.053	-57.861	62.322	-0.053	0.000%
7	50.136	-62.322	29.031	-50.136	62.322	-29.031	0.000%
8	40.951	-62.322	41.028	-40.951	62.322	-41.028	0.000%
9	28.976	-62.322	50.230	-28.976	62.322	-50.230	0.000%
10	0.053	-62.322	57.970	-0.053	62.322	-57.970	0.000%
11	-28.885	-62.322	50.177	28.885	62.322	-50.177	0.000%
12	-40.877	-62.322	40.953	40.877	62.322	-40.953	0.000%
13	-50.083	-62.322	28.939	50.083	62.322	-28.939	0.000%
14	-57.861	-62.322	-0.053	57.861	62.322	0.053	0.000%
15	-50.136	-62.322	-29.031	50.136	62.322	29.031	0.000%
16	-40.951	-62.322	-41.028	40.951	62.322	41.028	0.000%
17	-28.976	-62.322	-50.230	28.976	62.322	50.230	0.000%
18	0.000	-73.374	0.000	0.000	73.374	0.000	0.000%
19	-0.042	-73.374	-55.250	0.042	73.374	55.250	0.000%
20	27.549	-73.374	-47.827	-27.549	73.374	47.827	0.000%
21	38.982	-73.374	-39.038	-38.982	73.374	39.038	0.000%
22	47.759	-73.374	-27.589	-47.759	73.374	27.589	0.000%
23	55.171	-73.374	0.042	-55.171	73.374	-0.042	0.000%
24	47.801	-73.374	27.662	-47.801	73.374	-27.662	0.000%
25	39.042	-73.374	39.098	-39.042	73.374	-39.098	0.000%
26	27.622	-73.374	47.869	-27.622	73.374	-47.869	0.000%
27	0.042	-73.374	55.250	-0.042	73.374	-55.250	0.000%
28	-27.549	-73.374	47.827	27.549	73.374	-47.827	0.000%
29	-38.982	-73.374	39.038	38.982	73.374	-39.038	0.000%
30	-47.759	-73.374	27.589	47.759	73.374	-27.589	0.000%
31	-55.171	-73.374	-0.042	55.171	73.374	0.042	0.000%
32	-47.801	-73.374	-27.662	47.801	73.374	27.662	0.000%
33	-39.042	-73.374	-39.098	39.042	73.374	39.098	0.000%
34	-27.622	-73.374	-47.869	27.622	73.374	47.869	0.000%
35	-0.021	-62.322	-22.644	0.021	62.322	22.644	0.000%
36	11.283	-62.322	-19.600	-11.283	62.322	19.600	0.000%
37	15.967	-62.322	-15.997	-15.967	62.322	15.997	0.000%
38	19.564	-62.322	-11.304	-19.564	62.322	11.304	0.000%
39	22.602	-62.322	0.021	-22.602	62.322	-0.021	0.000%
40	19.584	-62.322	11.340	-19.584	62.322	-11.340	0.000%
41	15.997	-62.322	16.027	-15.997	62.322	-16.027	0.000%

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
42	11.319	-62.322	19.621	-11.319	62.322	-19.621	0.000%
43	0.021	-62.322	22.644	-0.021	62.322	-22.644	0.000%
44	-11.283	-62.322	19.600	11.283	62.322	-19.600	0.000%
45	-15.967	-62.322	15.997	15.967	62.322	-15.997	0.000%
46	-19.564	-62.322	11.304	19.564	62.322	-11.304	0.000%
47	-22.602	-62.322	-0.021	22.602	62.322	0.021	0.000%
48	-19.584	-62.322	-11.340	19.584	62.322	11.340	0.000%
49	-15.997	-62.322	-16.027	15.997	62.322	16.027	0.000%
50	-11.319	-62.322	-19.621	11.319	62.322	19.621	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	0.00013441
3	Yes	5	0.00000001	0.00035798
4	Yes	5	0.00000001	0.00038502
5	Yes	5	0.00000001	0.00035472
6	Yes	4	0.00000001	0.00023322
7	Yes	5	0.00000001	0.00036224
8	Yes	5	0.00000001	0.00038630
9	Yes	5	0.00000001	0.00035593
10	Yes	4	0.00000001	0.00008695
11	Yes	5	0.00000001	0.00035657
12	Yes	5	0.00000001	0.00038523
13	Yes	5	0.00000001	0.00035994
14	Yes	4	0.00000001	0.00016083
15	Yes	5	0.00000001	0.00035553
16	Yes	5	0.00000001	0.00038671
17	Yes	5	0.00000001	0.00036172
18	Yes	4	0.00000001	0.00000001
19	Yes	5	0.00000001	0.00012458
20	Yes	5	0.00000001	0.00079675
21	Yes	5	0.00000001	0.00088440
22	Yes	5	0.00000001	0.00079584
23	Yes	5	0.00000001	0.00012459
24	Yes	5	0.00000001	0.00080368
25	Yes	5	0.00000001	0.00088750
26	Yes	5	0.00000001	0.00079743
27	Yes	5	0.00000001	0.00012445
28	Yes	5	0.00000001	0.00079816
29	Yes	5	0.00000001	0.00088517
30	Yes	5	0.00000001	0.00079926
31	Yes	5	0.00000001	0.00012445
32	Yes	5	0.00000001	0.00079804
33	Yes	5	0.00000001	0.00088830
34	Yes	5	0.00000001	0.00080410
35	Yes	4	0.00000001	0.00005140
36	Yes	5	0.00000001	0.00004611
37	Yes	5	0.00000001	0.00005262
38	Yes	5	0.00000001	0.00004534
39	Yes	4	0.00000001	0.00006762
40	Yes	5	0.00000001	0.00004709
41	Yes	5	0.00000001	0.00005297
42	Yes	5	0.00000001	0.00004561

43	Yes	4	0.00000001	0.00004880
44	Yes	5	0.00000001	0.00004585
45	Yes	5	0.00000001	0.00005273
46	Yes	5	0.00000001	0.00004660
47	Yes	4	0.00000001	0.00006227
48	Yes	5	0.00000001	0.00004558
49	Yes	5	0.00000001	0.00005317
50	Yes	5	0.00000001	0.00004708

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	154 - 134.83	38.670	50	2.181	0.002
L2	139.16 - 89.16	31.941	50	2.130	0.001
L3	94.83 - 44.54	14.528	50	1.473	0.000
L4	51.46 - 1	4.171	50	0.758	0.000

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
156.000	HP2-4.7	50	38.670	2.181	0.002	21758
154.000	BA40-41	50	38.670	2.181	0.002	21758
150.000	EEI Pine Branches	50	36.841	2.173	0.002	21758
140.000	EEI Pine Branches	50	32.316	2.135	0.001	7920
130.000	EEI Pine Branches	50	27.937	2.047	0.001	5741
120.000	EEI Pine Branches	50	23.767	1.913	0.001	4642
110.000	EEI Pine Branches	50	19.856	1.747	0.001	3895
100.000	EEI Pine Branches	50	16.253	1.567	0.001	3354
90.000	EEI Pine Branches	50	13.008	1.387	0.000	3105
80.000	EEI Pine Branches	50	10.149	1.215	0.000	3056

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	154 - 134.83	98.637	17	5.566	0.004
L2	139.16 - 89.16	81.499	17	5.438	0.003
L3	94.83 - 44.54	37.109	17	3.763	0.001
L4	51.46 - 1	10.661	17	1.938	0.000

Critical Deflections and Radius of Curvature - Design Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* *°*	*Twist* *°*	*Radius of Curvature* *ft*
156.000	HP2-4.7	17	98.637	5.566	0.004	8718
154.000	BA40-41	17	98.637	5.566	0.004	8718
150.000	EEI Pine Branches	17	93.980	5.546	0.004	8718
140.000	EEI Pine Branches	17	82.453	5.452	0.003	3171
130.000	EEI Pine Branches	17	71.297	5.228	0.003	2292
120.000	EEI Pine Branches	17	60.670	4.885	0.002	1848
110.000	EEI Pine Branches	17	50.699	4.463	0.002	1546
100.000	EEI Pine Branches	17	41.510	4.003	0.001	1328
90.000	EEI Pine Branches	17	33.230	3.544	0.001	1226
80.000	EEI Pine Branches	17	25.931	3.106	0.001	1204

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	154 - 134.83 (1)	TP30.03x25.25x0.188	19.170	0.000	0.0	38.627	17.118	-6.470	661.204	0.010
L2	134.83 - 89.16 (2)	TP40.91x28.575x0.313	50.000	0.000	0.0	39.000	38.880	-22.430	1516.330	0.015
L3	89.16 - 44.54 (3)	TP51.28x38.886x0.5	50.290	0.000	0.0	39.000	77.881	-39.616	3037.370	0.013
L4	44.54 - 1 (4)	TP61x48.575x0.563	50.460	0.000	0.0	39.000	107.904	-62.278	4208.240	0.015

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* $\frac{f_{by}}{F_{by}}$
L1	154 - 134.83 (1)	TP30.03x25.25x0.188	127.365	12.563	38.627	0.325	0.000	0.000	38.627	0.000
L2	134.83 - 89.16 (2)	TP40.91x28.575x0.313	1571.283	50.143	39.000	1.286	0.000	0.000	39.000	0.000
L3	89.16 - 44.54 (3)	TP51.28x38.886x0.5	3831.067	48.858	39.000	1.253	0.000	0.000	39.000	0.000
L4	44.54 - 1 (4)	TP61x48.575x0.563	6691.241	49.968	39.000	1.281	0.000	0.000	39.000	0.000

Pole Shear Design Data

Section No.	*Elevation* *ft*	*Size*	*Actual V* *K*	*Actual* f_v *ksi*	*Allow.* F_v *ksi*	*Ratio* $\frac{f_v}{F_v}$	*Actual T* *kip-ft*	*Actual* f_{vt} *ksi*	*Allow.* F_{vt} *ksi*	*Ratio* $\frac{f_{vt}}{F_{vt}}$
L1	154 - 134.83 (1)	TP30.03x25.25x0.188	17.129	1.001	26.000	0.077	0.341	0.016	26.000	0.001
L2	134.83 - 89.16	TP40.91x28.575x0.313	45.228	1.163	26.000	0.089	0.517	0.008	26.000	0.000

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
	(2)									
L3	89.16 - 44.54 (3)	TP51.28x38.886x0.5	55.154	0.708	26.000	0.054	0.516	0.003	26.000	0.000
L4	44.54 - 1 (4)	TP61x48.575x0.563	58.036	0.538	26.000	0.041	0.515	0.002	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	154 - 134.83 (1)	0.010	0.325	0.000	0.077	0.001	0.337 ✔	1.333	H1-3+VT ✔
L2	134.83 - 89.16 (2)	0.015	1.286	0.000	0.089	0.000	1.303 ✔	1.333	H1-3+VT ✔
L3	89.16 - 44.54 (3)	0.013	1.253	0.000	0.054	0.000	1.267 ✔	1.333	H1-3+VT ✔
L4	44.54 - 1 (4)	0.015	1.281	0.000	0.041	0.000	1.296 ✔	1.333	H1-3+VT ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	SF^*P_{allow} K	% Capacity	Pass Fail
L1	154 - 134.83	Pole	TP30.03x25.25x0.188	1	-6.470	881.385	25.2	Pass
L2	134.83 - 89.16	Pole	TP40.91x28.575x0.313	2	-22.430	2021.268	97.7	Pass
L3	89.16 - 44.54	Pole	TP51.28x38.886x0.5	3	-39.616	4048.814	95.0	Pass
L4	44.54 - 1	Pole	TP61x48.575x0.563	4	-62.278	5609.584	97.3	Pass
							Summary	
						Pole (L2)	97.7	Pass
						RATING =	**97.7**	**Pass**

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 6691 \cdot ft \cdot kips$	(Input From tnxTower)
Shear Force =	$Shear := 58 \cdot kips$	(Input From tnxTower)
Axial Force =	$Axial := 62 \cdot kips$	(Input From tnxTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	$N := 28$	(User Input)
Diameter of Bolt Circle =	$D_{bc} := 68.0 \cdot in$	(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 Mod 60

Plate Yield Strength =	$Fy_{bp} := 60 \cdot ksi$	(User Input)
Base Plate Thickness =	$t_{bp} := 3.0 \cdot in$	(User Input)
Base Plate Diameter =	$D_{bp} := 74.0 \cdot in$	(User Input)
Outer Pole Diameter =	$D_{pole} := 61.0 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =: $R_{bc} := \frac{D_{bc}}{2} = 34 \cdot in$

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

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

$d_1 = 7.57 \cdot in$	$d_7 = 34.00 \cdot in$
$d_2 = 14.75 \cdot in$	$d_8 = 33.15 \cdot in$
$d_3 = 21.20 \cdot in$	$d_9 = 30.63 \cdot in$
$d_4 = 26.58 \cdot in$	$d_{10} = 26.58 \cdot in$
$d_5 = 30.63 \cdot in$	$d_{11} = 21.20 \cdot in$
$d_6 = 33.15 \cdot in$	etc.

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 30.5 \cdot in$

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

$MA_1 = 0.00 \cdot in$	$MA_7 = 3.50 \cdot in$
$MA_2 = 0.00 \cdot in$	$MA_8 = 2.65 \cdot in$
$MA_3 = 0.00 \cdot in$	$MA_9 = 0.13 \cdot in$
$MA_4 = 0.00 \cdot in$	$MA_{10} = 0.00 \cdot in$
$MA_5 = 0.13 \cdot in$	$MA_{11} = 0.00 \cdot in$
$MA_6 = 2.65 \cdot in$	etc

Effective Width of Baseplate for Bending = $B_{eff} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 33.5 \cdot in$

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i (d_i)^2 = 1.618 \times 10^4 \cdot in^2$

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 = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 166.5 \cdot kips$

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 = $\frac{T_{Max}}{T_{ALL.Net}} = 85.4 \cdot \%$ 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 = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.518 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 7.5 \cdot ksi$

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 = $C_{Max} := OM \cdot \frac{R_{bc}}{I_p} + \frac{Axial}{N} = 170.9 \cdot kips$

Maximum Compressive Stress = $f_a := \frac{C_{Max}}{A_n} = 52.6 \cdot ksi$

$K := 0.65$

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

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

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

Combined Stress % of Capacity = $\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) = 87.7 \cdot \%$

Condition 2 = Condition2 := 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 = $C_i := \frac{OM \cdot d_i}{I_p} + \frac{Axial}{N}$

$C_1 = 39.7 \cdot kips$	$C_7 = 170.9 \cdot kips$
$C_2 = 75.4 \cdot kips$	$C_8 = 166.7 \cdot kips$
$C_3 = 107.4 \cdot kips$	$C_9 = 154.2 \cdot kips$
$C_4 = 134.1 \cdot kips$	$C_{10} = 134.1 \cdot kips$
$C_5 = 154.2 \cdot kips$	$C_{11} = 107.4 \cdot kips$
$C_6 = 166.7 \cdot kips$	etc.

Maximum Bending Stress in Plate = $f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} \cdot t_{bp}^{\,2}\right)} = 30.3 \cdot ksi$

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

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} = 50.6 \cdot \%$

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 =	$OM := 6691 \cdot ft \cdot kips$	(User Input from tnxTower)
Shear Force =	$Shear := 58 \cdot kip$	(User Input from tnxTower)
Axial Force =	$Axial := 62 \cdot kip$	(User Input from tnxTower)
Tower Height =	$H_t := 153 \cdot ft$	(User Input)

Footing Data:

Overall Depth of Footing =	$D_f := 6.5 \cdot ft$	(User Input)
Length of Pier =	$L_p := 3.5 \cdot ft$	(User Input)
Extension of Pier Above Grade =	$L_{pag} := 1 \cdot ft$	(User Input)
Diameter of Pier =	$d_p := 7.5 \cdot ft$	(User Input)
Thickness of Footing =	$T_f := 4 \cdot ft$	(User Input)
Width of Footing =	$W_f := 32 \cdot ft$	(User Input)

Anchor Bolt Data:

Length of Anchor Bolts =	$L_{st} := 96 \cdot in$	(User Input)
Projection of Anchor Bolts Above Pier =	$A_{BP} := 12 \cdot in$	(User Input)
Anchor Bolt Diameter =	$d_{anchor} := 2.25 \cdot in$	(User Input)
Base Plate Bolt Circle =	$MP := 68.0 \cdot in$	(User Input)

Material Properties:

Concrete Compressive Strength =	$f_c := 3000 \cdot psi$	(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 =	$\Phi_s := 10 \cdot deg$	(User Input)	
Allowable Soil Bearing Capacity =	$q_s := 6000 \cdot psf$	(User Input)	
Unit Weight of Soil =	$\gamma_{soil} := 100 \cdot pcf$	(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 =	$n := 0.5 \cdot ft$	(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 =	$NB_{pier} := 36$	(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 =	$d_{Tie} := 3 \cdot in$	(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 =	$NB_{top} := 42$	(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 =	$NB_{bot} := 42$	(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 =

$$K_p := \frac{1 + \sin(\Phi_s)}{1 - \sin(\Phi_s)} = 1.42$$

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 = $\gamma_s := \text{if}(\text{Bouyancy} = 1, \gamma_{soil} - 62.4\text{pcf}, \gamma_{soil}) = 100 \cdot \text{pcf}$

Passive Pressure = $P_{pn} := K_p \cdot \gamma_s \cdot n + c \cdot 2 \cdot \sqrt{K_p} = 0.071 \cdot \text{ksf}$

$P_{pt} := K_p \cdot \gamma_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p} = 0.355 \cdot \text{ksf}$

$P_{top} := \text{if}\left[n < (D_f - T_f), P_{pt}, P_{pn}\right] = 0.355 \cdot \text{ksf}$

$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p} = 0.923 \cdot \text{ksf}$

$$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 0.639 \cdot \text{ksf}$$

$T_p := \text{if}\left[n < (D_f - T_f), T_f, (D_f - n)\right] = 4$

$A_p := W_f \cdot T_p = 128$

Ultimate Shear = $S_u := P_{ave} \cdot A_p = 81.808 \cdot \text{kip}$

Weight of Concrete Pad = $WT_c := \left[\left(W_f^2 \cdot T_f\right) + d_p^2 \cdot L_p\right] \cdot \gamma_c = 643.931 \cdot \text{kip}$

Weight of Soil Above Footing =
$$WT_{s1} := \left[\left(W_f^2 - d_p^2\right) \cdot \begin{cases} (L_p - L_{pag} - n) & \text{if } (L_p - L_{pag} - n) \geq 0 \\ 0 & \text{if } (L_p - L_{pag} - n) \leq 0 \end{cases}\right] \cdot \gamma_s = 193.55 \cdot \text{kip}$$

Weight of Soil Wedge at Back Face =
$$WT_{s2} := \left(\frac{D_f^2 \cdot \tan(\Phi_s)}{2} \cdot W_f\right) \cdot \gamma_s = 11.92 \cdot \text{kip}$$

Weight of Soil Wedge at back face Corners =
$$WT_{s3} := 2 \cdot \left[(D_f)^3 \cdot \frac{\tan(\Phi_s)}{3}\right] \cdot \gamma_s = 3.228 \cdot \text{kips}$$

Total Weight = $WT_{tot} := WT_c + WT_{s1} + \text{Axial} = 899.481 \cdot \text{kip}$

Resisting Moment =
$$M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + \left[(WT_{s2} + WT_{s3}) \cdot \left(W_f + \frac{D_f \tan(\Phi_s)}{3}\right)\right] = 14991 \cdot \text{kip} \cdot \text{ft}$$

Overturning Moment = $M_{ot} := OM + \text{Shear} \cdot (L_p + T_f) = 7126 \cdot \text{kip} \cdot \text{ft}$

Factor of Safety Actual =
$$FS := \frac{M_r}{M_{ot}} = 2.1$$

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 = $S_p := \frac{\mu \cdot WT_{tot}}{FS_{req}} = 202.383 \cdot kips$

$Shear\_Check := if(S_p > Shear, \text{"Okay"}, \text{"No Good"})$

$Shear\_Check = \text{"Okay"}$

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 = $P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S} = 2.183 \cdot ksf$

$Max\_Pressure\_Check := if(P_{max} < q_s, \text{"Okay"}, \text{"No Good"})$

$Max\_Pressure\_Check = \text{"Okay"}$

Minimum Pressure in Mat = $P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S} = -0.426 \cdot ksf$

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

$Min\_Pressure\_Check = \text{"No Good"}$

Distance to Resultant of Pressure Distribution = $X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 8.924$

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 = $e := \frac{M_{ot}}{WT_{tot}} = 7.922$

Adjusted Soil Pressure = $P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \left(\frac{W_f}{2} - e\right)} = 2.32 \cdot ksf$

$q_{adj} := if(P_{min} < 0, P_a, P_{max}) = 2.32 \cdot ksf$

$Pressure\_Check := if(q_{adj} < q_s, \text{"Okay"}, \text{"No Good"})$

$Pressure\_Check = \text{"Okay"}$

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

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

$v_u := \text{Find}(v_u) = 7.1\cdot\text{ksf}$

$V_u := v_u \cdot d \cdot W_f = 823\cdot\text{kips}$

Required Shear Strength = $V_{req} := LF \cdot V_u = 1.1 \times 10^3 \cdot \text{kips}$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot \text{psi}} \cdot b_o \cdot d = 3406.8\cdot\text{kip}$ (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)

$q_b := q_{adj} - d_1 \cdot \text{Slope} = 1.147\cdot\text{ksf}$

Maximum Bending at Face of Pier = $M_u := LF \cdot \left[(q_{adj} - q_b) \cdot \dfrac{d_1^{\,2}}{3} + q_b \cdot \dfrac{d_1^{\,2}}{2} \right] \cdot W_f = 6173.7\cdot\text{kip}\cdot\text{ft}$

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

(ACI-200810.2.7.3)

$R_n := \dfrac{M_u}{\phi_m \cdot W_f \cdot d^2} = 112.8\cdot\text{psi}$

$\rho := \dfrac{0.85 \cdot f_c}{f_y} \left(1 - \sqrt{1 - \dfrac{2 \cdot R_n}{0.85 \cdot f_c}}\right) = 0.0019$

$\rho_{min} := \rho = 0.00192$

Required Reinforcement for Temperature and Shrinkage:

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

Check Bottom Bars:

$$As := \begin{cases} \rho_{min} \cdot W_f \cdot d & \text{if } \rho_{min} > \dfrac{\rho_{sh}}{2} \\ \rho_{sh} \cdot W_f \cdot \dfrac{d}{2} & \text{otherwise} \end{cases} = 32.203 \cdot in^2$$

$$As_{prov} := A_{bbot} \cdot NB_{bot} = 65.6 \cdot in^2$$

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

Pad_Reinforcement_Bot = "Okay"

Check top Bars:

$$As := \rho_{sh} \cdot \left(W_f \cdot \frac{d}{2}\right) = 15.1 \cdot in^2$$

$$As_{prov} := A_{btop} \cdot NB_{top} = 65.6 \cdot in^2$$

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

Pad_Reinforcement_Top = "Okay"

Developement Length Pad Reinforcement:

Bar Spacing =

$$B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 7.78 \cdot in$$

Spacing or Cover Dimension =

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

Transverse Reinforcement Index =

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

$$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pad} \cdot \beta_{pad} \cdot \gamma_{pad} \cdot \lambda_{pad}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \dfrac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot} = 54.4 \cdot in$$

Minimum Development Length =

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

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

Available Length in Pad =

$$L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad} = 144 \cdot in$$

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

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

Area of Pier = $A_p := \frac{\pi \cdot d_p^2}{4} = 6361.73 \cdot in^2$

$A_{smin} := 0.01 \cdot 0.5 \cdot A_p = 31.81 \cdot in^2$ (ACI-2008 10.8.4 & 10.9.1)

$A_{sprov} := NB_{pier} \cdot A_{bpier} = 56.21 \cdot in^2$

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

Steel_Area_Check = "Okay"

Bar Spacing In Pier = $B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 6.444 \cdot in$

Diameter of Reinforcement Cage = $Diam_{cage} := d_p - 2 \cdot Cvr_{pier} = 84 \cdot in$

Maximum Moment in Pier = $M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2}\right)\right] \cdot LF = 1.1 \times 10^5 \cdot in \cdot kips$

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

$$\left(D \;\; N \;\; n \;\; P_u \;\; M_{xu}\right) := \left(d_p \cdot 12 \;\; NB_{pier} \;\; BS_{pier} \;\; \frac{Axial \cdot 1.333}{kips} \;\; \frac{M_p}{in \cdot kips}\right)$$

$$\left(D \;\; N \;\; n \;\; P_u \;\; M_{xu}\right) = \left(90 \;\; 36 \;\; 11 \;\; 82.646 \;\; 1.107 \times 10^5\right)$$

$$\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho\right) := (0 \;\; 0 \;\; 0 \;\; 0)$$

$$\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho\right) := \phi P'_n\left(D, N, n, P_u, M_{xu}\right)^T$$

$$\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho\right) = \left(83.314 \;\; 1.116 \times 10^5 \;\; -60 \;\; 8.828 \times 10^{-3}\right)$$

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

Axial_Load_Check = "Okay"

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

Bending_Check = "Okay"

Development Length Pier Reinforcement:

Available Length in Foundation:

$$L_{pier} := L_p - Cvr_{pier} = 39 \cdot in$$

$$L_{pad} := T_f - Cvr_{pad} = 45 \cdot in$$

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)

$$L_{dbt} := \frac{3 \cdot f_y \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 54.45 \cdot in$$

Minimum Development Length = $L_{dh} := \frac{1200 \cdot d_{bpier}}{\sqrt{\frac{f_c}{psi}}} \cdot .7 = 21.624 \cdot in$ (ACI 12.2.1)

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

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

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

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

Compression: (ACI-2008 12.3.2)

$$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot f_y}{\sqrt{f_c \cdot psi}} = 30.892 \cdot in$$

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

$$L_{dbc} := if\left(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}\right) = 30.892 \cdot in$$

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

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

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)

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

$s_{lim2} := 48 \cdot d_{Tie} \cdot z = 144 \cdot in$

$s_{lim3} := D_f \cdot z = 78 \cdot in$

$s_{lim4} := 18in$

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 = $n_{tie} := \dfrac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 = 3$

Check Anchor Steel Embedment:

Depth Available = $D_{ab} := L_{st} - A_{BP} = 7 \cdot ft$

Length of Anchor Bolt = $L_{anchor} := \dfrac{(0.11 \cdot f_{ya}) \cdot in}{\sqrt{f_c \cdot psi}} = 12.552 \cdot ft$

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

Depth_Check = "No Good"

Note: Anchor plate is provided

SITE NAME	NEW MILFORD W CT		ECP - CELL #		2	494
LATITUDE	41.599411		LONGITUDE		-73.437478	
Notes: AWS B Carrier Add, Change 1900 to 4 port HBXX-6517DS-A2M, Add ALU RRH 2X60 Add 2100 HBXX-6517DS-A2M CHANGE 850 LPA-80080/4CF TO LNX-8513DS-A1M			SAVE BUTTON			
			STRUCTURE TYPE		Monoploe	
AWS - LTE ANTENNA ADD	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	2100 MHz BBU		2100 MHz BBU		2100 MHz BBU	
ANTENNA TYPE	HBXX-6517DS-A2M		HBXX-6517DS-A2M		HBXX-6517DS-A2M	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	60		180		300	
DOWN TILT (MECH/ELEC)	0/6		0/6		0/6	
RAD CTR (FT AGL)	130		130		130	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL						
RRH - QTY/MODEL	1	ALU RH_2X60-AWS	1	ALU RH_2X60-AWS	1	ALU RH_2X60-AWS
SECTOR DISTRIBUTION BOX						
MAIN DISTRIBUTION BOX	1		DB-T1-6Z-8AB-0Z			
700 Mhz - LTE Current Config	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	eNodeB		eNodeB		eNodeB	
ANTENNA TYPE	BXA-70063-6CF-2-750MHZ		BXA-70063-6CF-2-750MHZ		BXA-70063-6CF-2-750MHZ	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	60		180		300	
DOWN TILT (MECH/DEG)	3		3		3	
RAD CTR (FT AGL)	130		130		130	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL						
700 Mhz - LTE Future Config	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	eNodeB		eNodeB		eNodeB	
ANTENNA TYPE	BXA-70063-6CF-2-750MHZ		BXA-70063-6CF-2-750MHZ		BXA-70063-6CF-2-750MHZ	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	60		180		300	
DOWN TILT (MECH/DEG)	3		3		3	
RAD CTR (FT AGL)	140		140		140	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL	2	FD9R6004/2C-3L	2	FD9R6004/2C-3L	2	FD9R6004/2C-3L
850 Cellular - Current Config	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	#N/A		#N/A		#N/A	
ANTENNA TYPE	LPA-80080/4CF		LPA-80080/4CF		LPA-80080/4CF	
QTY OF ANTENNAS PER FACE	2		2		2	
ORIENTATION (DEG)	60		180		300	
DOWN TILT (MECH/DEG)	0		4		3	
RAD CTR (FT AGL)	130		130		130	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL						
850 Cellular - Future Config	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	#N/A		#N/A		#N/A	
ANTENNA TYPE	LNX-8513DS-A1M		LNX-8513DS-A1M		LNX-8513DS-A1M	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	60		180		300	
DOWN TILT (MECH/ELEC)	0/0		0/4		0/3	
RAD CTR (FT AGL)	130		130		130	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL	2	FD9R6004/2C-3L	2	FD9R6004/2C-3L	2	FD9R6004/2C-3L
DIPLEX WITH LTE CABLE						
1900 PCS - Current Config	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	PCS Modcell 4.0		PCS Modcell 4.0		PCS Modcell 4.0	
ANTENNA TYPE	BXA-171085-8BF-EDIN-2		BXA-171085-8BF-EDIN-2		BXA-171085-8BF-EDIN-2	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	60		180		300	
DOWN TILT (MECH/DEG)	3		3		3	
RAD CTR (FT AGL)	130		130		130	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL						
DIPLEX WITH CELLULAR CABLE	DIPLEX with Cellular Cable		DIPLEX with Cellular Cable		DIPLEX with Cellular Cable	
1900 PCS - Future Config	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	PCS Modcell 4.0		PCS Modcell 4.0		PCS Modcell 4.0	
ANTENNA TYPE	HBXX-6517DS-A2M		HBXX-6517DS-A2M		HBXX-6517DS-A2M	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	60		180		300	
DOWN TILT (MECH/ELEC)	0/3		0/3		0/3	
RAD CTR (FT AGL)	130		130		130	
TMA - QTY / MODEL						
DIPLEX WITH CELLULAR CABLE	DIPLEX with Cellular Cable		DIPLEX with Cellular Cable		DIPLEX with Cellular Cable	

NUMBER OF CABLE'S NEEDED						ESTIMATED CABLE LENGTH			
MAINLINE SIZE		TOTAL # OF MAINLINES			12	MAINLINE (FT)			
JUMPER SIZE	1/2 "	TOTAL # OF TOP JUMPERS			18	TOP JUMPER (FT)			12
Equipment Cable Ordering		**MAIN CABLE**	12	+	0	**TOP JUMPER #**	18	+	0
FIBER LINE SIZE	1 5/8"	TOTAL # OF FIBER LINES			1	FIBER LINE MODEL #			158-1-08U8-S8
JUMPER SIZE	5/8"	TOTAL # OF TOP JUMPERS			3	TOP JUMPER MODEL #			058-1-08U1-S1
Fiber Cable Ordering		**FIBER CABLE**	0	+	1	**TOP JUMPER #**	0	+	3

TX / RX FREQUENCIES			TX POWER OUTPUT	
Cellular A-Band	**PCS F / AWS-Band**	**700 Mhz C - E**	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 (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

RF ENGINEER	RF MANAGER	INITIALS	DATE
Prepared By: Mark Brauer	Rob Hesselbach	MB	12/1/2014

Site Configuration

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

HBXX-6517DS-VTM

Andrew® Quad Port Teletilt® Antenna, 1710–2180 MHz, 65° horizontal beamwidth, RET compatible

- Superior azimuth tracking and pattern symmetry with excellent passive intermodulation suppression
- The values presented on this datasheet have been calculated based on N-P-BASTA White Paper version 9.6 by the NGMN Alliance

Electrical Specifications

<table>
<tr><th>Frequency Band, MHz</th><th>1710–1880</th><th>1850–1990</th><th>1920–2180</th></tr>
<tr><td>Gain by all Beam Tilts, average, dBi</td><td>18.5</td><td>18.6</td><td>18.8</td></tr>
<tr><td>Gain by all Beam Tilts Tolerance, dB</td><td>±0.4</td><td>±0.3</td><td>±0.4</td></tr>
<tr><td>Gain by Beam Tilt, average, dBi</td><td>0 ° | 18.4
3 ° | 18.7
6 ° | 18.4</td><td>0 ° | 18.4
3 ° | 18.7
6 ° | 18.5</td><td>0 ° | 18.7
3 ° | 18.9
6 ° | 18.6</td></tr>
<tr><td>Beamwidth, Horizontal, degrees</td><td>67</td><td>66</td><td>65</td></tr>
<tr><td>Beamwidth, Horizontal Tolerance, degrees</td><td>±2.4</td><td>±1.7</td><td>±2.9</td></tr>
<tr><td>Beamwidth, Vertical, degrees</td><td>5.0</td><td>4.7</td><td>4.4</td></tr>
<tr><td>Beamwidth, Vertical Tolerance, degrees</td><td>±0.3</td><td>±0.3</td><td>±0.3</td></tr>
<tr><td>Beam Tilt, degrees</td><td>0–6</td><td>0–6</td><td>0–6</td></tr>
<tr><td>USLS, dB</td><td>18</td><td>19</td><td>19</td></tr>
<tr><td>Front-to-Back Total Power at 180° ± 30°, dB</td><td>25</td><td>26</td><td>26</td></tr>
<tr><td>CPR at Boresight, dB</td><td>22</td><td>23</td><td>22</td></tr>
<tr><td>CPR at Sector, dB</td><td>10</td><td>10</td><td>9</td></tr>
<tr><td>Isolation, dB</td><td>30</td><td>30</td><td>30</td></tr>
<tr><td>VSWR | Return Loss, dB</td><td>1.4 | 15.6</td><td>1.4 | 15.6</td><td>1.4 | 15.6</td></tr>
<tr><td>PIM, 3rd Order, 2 x 20 W, dBc</td><td>-153</td><td>-153</td><td>-153</td></tr>
<tr><td>Input Power per Port, maximum, watts</td><td>350</td><td>350</td><td>350</td></tr>
<tr><td>Polarization</td><td>±45°</td><td>±45°</td><td>±45°</td></tr>
<tr><td>Impedance</td><td>50 ohm</td><td>50 ohm</td><td>50 ohm</td></tr>
</table>

General Specifications

<table>
<tr><td>Antenna Brand</td><td>Andrew®</td></tr>
<tr><td>Antenna Type</td><td>DualPol® single band, quad</td></tr>
<tr><td>Band</td><td>Single band</td></tr>
<tr><td>Brand</td><td>DualPol® | Teletilt®</td></tr>
<tr><td>Operating Frequency Band</td><td>1710 – 2180 MHz</td></tr>
<tr><td>Number of Ports, all types</td><td>4</td></tr>
</table>

Mechanical Specifications

Color	Light gray
Lightning Protection	dc Ground
Radiator Material	Low loss circuit board
Radome Material	PVC, UV resistant
RF Connector Interface	7-16 DIN Female
RF Connector Location	Bottom

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

HBXX-6517DS-VTM

RF Connector Quantity, total	4
Wind Loading, maximum	668.0 N @ 150 km/h 150.2 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Dimensions

Depth	166.0 mm | 6.5 in
Length	1903.0 mm | 74.9 in
Width	305.0 mm | 12.0 in
Net Weight	19.5 kg | 43.0 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 1.1 Actuator	HBXX-6517DS-R2M
Model with Factory Installed AISG 2.0 Actuator	HBXX-6517DS-A2M
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

600899A-2 — Downtilt Mounting Kit for 2.4 - 4.5 in (60 - 115 mm) OD round members. Kit contains one scissor top bracket set and one bottom bracket set.

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

LNX-8513DS-VTM

Andrew® Teletilt® Antenna, 698–896 MHz, 85° horizontal beamwidth, RET compatible

- Fully compatible with Andrew remote electrical tilt system for greater OpEx savings
- Excellent front-to-back ratio, USLS, VSWR, and PIM specifications to enhance network quality
- Great solution to maximize network coverage and capacity
- Extended elevation tilt for maximum flexibility in urban core areas
- 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	14.6	15.3
Beamwidth, Horizontal, degrees	85	85
Beamwidth, Vertical, degrees	12.2	11.0
Beam Tilt, degrees	0–10	0–10
USLS, typical, dB	17	17
Front-to-Back Ratio at 180°, dB	25	26
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
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	617.7 N @ 150 km/h 138.9 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Dimensions

Depth	181.0 mm | 7.1 in
Length	1847.0 mm | 72.7 in
Width	301.0 mm | 11.9 in

LNX-8513DS-VTM

Net Weight	17.8 kg | 39.2 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 1.1 Actuator	LNX-8513DS-R2M
Model with Factory Installed AISG 2.0 Actuator	LNX-8513DS-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)

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.

ALCATEL-LUCENT
WIRELESS PRODUCT DATASHEET
RRH2X60-AWS FOR BAND 4 APPLICATIONS

The Alcatel-Lucent RRH2x60-AWS is a high power, small form factor Remote Radio Head operating in the AWS frequency band (3GPP Band 4) for LTE technology. It is designed with an eco-efficient approach, providing operators with the means to achieve high quality and high capacity coverage with minimum site requirements and efficient operation.

A distributed Node B expands the deployment options by using two components, a Base Band Unit (BBU) containing the digital assets and a separate RRH containing the radio-frequency (RF) elements. This modular design optimizes available space and allows the main components of a Node B to be installed separately, within the same site or several kilometers apart.

The Alcatel-Lucent RRH2x60-AWS is linked to the BBU by an optical-fiber connection carrying downlink and uplink digital radio signals along with operations, administration and maintenance (OA&M) information.

SUPERIOR RF PERFORMANCE

The Alcatel-Lucent RRH2x60-AWS integrates all the latest technologies. This allows to offer best-in-class characteristics.

It delivers an outstanding 120 watts of total RF power thanks to its two transmit RF paths of 60 W each.

It is ideally suited to support multiple-input multiple-output (MIMO) 2x2 operation.

It includes four RF receivers to natively support 4-way uplink reception diversity. This improves the radio uplink coverage and this can be used to extend the cell radius commensurate with 2x2MIMO 2x60 W for the downlink.

It supports multiple discontinuous LTE carriers within an instantaneous bandwidth of 45 MHz corresponding to the entire AWS B4 spectrum.

The latest generation power amplifiers (PA) used in this product achieve high efficiency (>40%), resulting in improved power consumption figures.

OPTIMIZED TCO

The Alcatel-Lucent RRH2x60-AWS is designed to make available all the benefits of a distributed Node B, with excellent RF characteristics, with low capital expenditures (CAPEX) and low operating expenditures (OPEX).

The Alcatel-Lucent RRH2x60-AWS is a very cost-effective solution to deploy LTE MIMO.

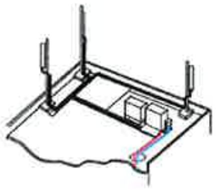
EASY INSTALLATION

The RRH2x60-AWS includes a reversible mounting bracket which allows for ease of installation behind an antenna, or on a rooftop knee wall while providing easy access to the mid body RF connectors.

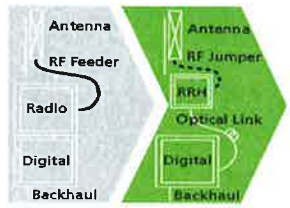
The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment. However, many of these sites can host an Alcatel-Lucent RRH2x60-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation time and costs.

The Alcatel-Lucent RRH2x60-AWS is a zero-footprint solution and is convection cooled without fans for silent operation, simplifying negotiations with site property owners and minimizing environmental impacts.

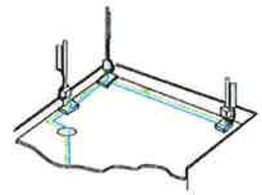
Installation can easily be done by a single person as the Alcatel–Lucent RRH2x60-AWS is compact and weighs about 20 kg, eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day.



Macro



RRH for space-constrained cell sites



Distributed

FEATURES

- RRH2x60-AWS integrates two power amplifiers of 60W rating (at each antenna connector)
- Support multiple carriers over the entire 3GPP band 4
- RRH2x60-AWS is optimized for LTE operation
- RRH2x60-AWS is a very compact and lightweight product
- Advanced power management techniques are embedded to provide power savings, such as PA bias control

BENEFITS

- MIMO LTE operation with only one single unit per sector
- Improved uplink coverage with built-in 4-way receive diversity capability
- RRH can be mounted close to the antenna, eliminating nearly all losses in RF cables and thus reducing power consumption by 50% compared to conventional solutions
- Distributed configurations provide easily deployable and cost-effective solutions, near zero footprint and silent solutions, with minimum impact on the neighborhood, which ease the deployment
- RETA and TMA support without additional hardware thanks to the AISG v2.0 port and the integrated Bias-Tees. Bias-Tees support AISG DC supply and signaling.

TECHNICAL SPECIFICATIONS

Specifications listed are hardware capabilities. Some capabilities depend on support in a specific software release or future release.

Dimensions and weights

- HxWxD : 510x285x186mm (27 l with solar shield)
- Weight : 20 kg (44 lbs)

Electrical Data

- Power Supply : -48V DC (-40.5 to -57V)
- Power Consumption (ETSI average traffic load reference) : 250W @2x60W

RF Characteristics

- Frequency band: 1710-1755, UL / 2110-2155 MHz, DL (3GPP band 4)
- Output power: 2x60W at antenna connectors
- Technology supported: LTE
- Instantaneous bandwidth: 45 MHz
- Rx diversity: 2-way and 4-way uplink reception
- Typical sensitivity without Rx diversity: -105 dBm for LTE

Connectivity

- Two CPRI optical ports for daisychaining and up to six RRHs per fiber
- Type of optical fiber: Single-Mode (SM) and Multi-Mode (MM) SFPs
- Optical fiber length: up to 500m using MM fiber, up to 20km using SM fiber
- TMA/RETA : AISG 2.0 (RS485 connector and internal Bias-Tee)
- Six external alarms
- Surge protection for all external ports (DC and RF)

Environmental specifications

- Operating temperature: -40°C to 55°C including solar load
- Operating relative humidity: 8% to 100%
- Environmental Conditions : ETS 300 019-1-4 class 4.1E
- Ingress Protection : IEC 60529 IP65
- Acoustic Noise : Noiseless (natural convection cooling)

Safety and Regulatory Data

- EMC : 3GPP 25113, EN 301 489-1, EN 301 489-23, GR 1089, GR 3108, OET-65
- Safety : IEC60950-1, EN 60825-1, UL, ANSI/NFPA 70, CAN/CSA-C22.2
- Regulatory : FCC Part 15 Class B, CE Mark – European Directive : 2002/95/EC (ROHS); 2002/96/EC (WEEE); 1999/5/EC (R&TTE)
- Health : EN 50385

Alcatel·Lucent

AT THE SPEED OF IDEAS™

Product Data Sheet DB-B1 and DB-T1 Series

DC and Fiber Management Distribution Boxes for HYBRIFLEX™ Cable

Product Description

The RFS Distribution Box design comes with the option for pluggable over voltage protection (OVP) for up to 6 remote radios and the connection for 6 pairs of optical fiber with LC optical fiber cable management. There is a hybrid cable input with a jumper configuration for power and optical fiber to the remote radio heads (RRHs). A custom wall, a 2-inch pole, and an H-Frame mounting bracket are included. Both the compact and standard design are available with lightening protection.

Features/Benefits

- Designed to accommodate varying diameters of HYBRIFLEX™ (combined power and fiber optic) cables – up to 2 inches
- Supports Single- and Multi-Mode Optical fiber
- NEMA 4x rated enclosure – allows **flexibility for indoor or outdoor installation** on a roof or tower top
- Weatherproof enclosure and ports – **improves system reliability**
- Modular design – makes replacement or addition of OVP easy without removal of other components within the box
- Strikesorb OVP technology – protects equipment from damaging surges up to 60 kA on an 8/20 waveform and up to 5 kA on a 10/350 waveform (certain models only)
- Low residual voltage and high impedance – **ideally suited for RRH technology** – won't shut down the RRH the way spark gap technology does (certain models only)

Technical Specifications

Mechanical Specifications

Model Number	DB-B1-6C-8AB-0Z	DB-T1-6Z-8AB-0Z
Enclosure Design	Standard, 6 OVP's	Standard without OVP
Dimensions - H x W x D, mm (in)	610 x 610 x 254 (24 x 24 x 10)	610 x 610 x 254 (24 x 24 x 10)
Weight, kg (lb)	20 (44)	20 (44)
Suppression Connection Method	Compression lug, #2-#14 AWG Copper, #2-#12 Aluminum	
Fiber Connection Method	LC-LC Single- or Multi-mode duplex	
Environmental Rating	NEMA 4x	
Operating Temperature, °C (°F)	-40 to +80 (-40 to +176)	
UV Protection	ISO 4892-2 Method A Xenon-Arc 2160 hrs	

Electrical Specifications

Nominal Operating Voltage	48 VDC	
Nominal Discharge Current (I_n) per UL 1449 3rd Ed	20 kA 8/20 µs	N/A
Maximum Discharge Current (I_{max}) per NEMA LS-1	60 kA 8/20 µs	N/A
Maximum Impulse (Lightning) Current (I_{imp}) per IEC 61643-1	5 kA 10/350 µs	N/A
Maximum Continuous Operating Voltage (U_c)	75 VDC	N/A
Voltage Protection Rating per UL1449 3rd Ed	400 V	N/A
Protection Class as per IEC 61643-1	Class 1	N/A
Strikesorb OVP Compliance	ANSI/UL 1449-3rd Ed IEEE C62.41 NEMA LS-1 IEC 61643-1 IEC 61643-12 EN 61643-11	N/A N/A N/A N/A N/A N/A

* This data is provisional and subject to change.