Robinson+Cole

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Also admitted in Massachusetts

September 29, 2014

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

Re: **Notice of Exempt Modification – Facility Modification**
40 Sherman Road, Woodstock, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) antennas at the top of the existing 140-foot tower at 40 Sherman Road in Woodstock, Connecticut (the Property"). The tower is owned by Cellco. The Council approved Cellco's use of this tower in 2012 (Docket No. 369). Cellco now intends to modify its facility by replacing nine (9) of its existing antennas with three (3) model LNX-8514DS-VTM, 850 MHz antennas; three (3) model HBXX-6517DS-VTM, 1900 MHz antennas; and three (3) 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 cables. Included in Attachment 1 are specifications for Cellco's replacement antennas, RRHs and HYBRIFLEX™ cable.

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 Allan D. Walker, Jr., First Selectman for the Town of Woodstock. A copy of this letter is also being sent to Colin G. Hallquest and Karin and Wayne Scheufler, the owners of the Property.

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

13141039-v1

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 at the top of the existing 140-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:
Allan D. Walker, Jr., Woodstock First Selectman
Colin G. Hallquest and Karin and Wayne Scheufler
Sandy M. Carter

ATTACHMENT 1

Product Specifications

COMMSCOPE®

LNX-8514DS-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 by all Beam Tilts, average, dBi	15.7	16.2
Gain by all Beam Tilts Tolerance, dB	±0.3	±0.2
Gain by Beam Tilt, average, dBi	0 ° | 15.7 4 ° | 15.7 8 ° | 15.5	0 ° | 16.3 4 ° | 16.3 8 ° | 16.1
Beamwidth, Horizontal, degrees	85	84
Beamwidth, Horizontal Tolerance, degrees	±1.2	±1.3
Beamwidth, Vertical, degrees	8.6	7.8
Beamwidth, Vertical Tolerance, degrees	±0.5	±0.4
Beam Tilt, degrees	0–8	0–8
USLS, dB	20	22
Front-to-Back Total Power at 180° ± 30°, dB	22	23
CPR at Boresight, dB	18	18
CPR at Sector, dB	12	11
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°

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

Mechanical Specifications

Color | Radome Material	Light gray | Fiberglass, UV resistant
Connector Interface | Location | Quantity	7-16 DIN Female | Bottom | 2
Wind Loading, maximum	879.0 N @ 150 km/h 197.6 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph
Antenna Dimensions, L x W x D	2449.0 mm x 301.0 mm x 181.0 mm | 96.4 in x 11.9 in x 7.1 in
Net Weight	23.1 kg | 50.9 lb
Model with factory installed AISG 2.0 RET	LNX-8514DS-A1M

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

HBXX-6517DS-VTM

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

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.

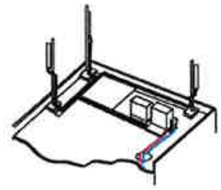
EASY INSTALLATION

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.

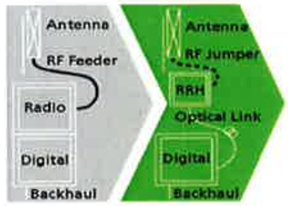
The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment. However, many of these sites can host an Alcatel-Lucent RRH2x60-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation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

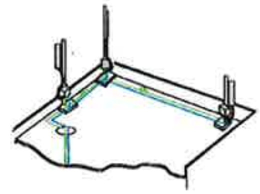
Installation can easily be done by a single person as the Alcatel-Lucent RRH2x60-AWS is compact and weighs about 20 kg, eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day.



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

Product Data Sheet HB158-1-08U8-S8J18

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

Structure			
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
Mechanical Properties			
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)
Electrical Properties			
DC-Resistance Outer Conductor Armor		[Ω/km (Ω/1000ft)]	068 (0.205)
DC-Resistance Power Cable, $8.4 mm^2$ (8AWG)		[Ω/km (Ω/1000ft)]	2.1 (0.307)
Fiber Optic Properties			
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
DC Power Cable Properties			
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
Environment			
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

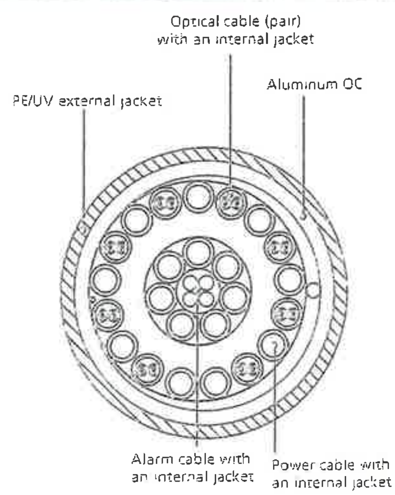


Figure 2: Construction Detail

ATTACHMENT 2

	General	Power	Density					
Site Name: Woodstock NW								
Tower Height: Verizon @ 140 ft								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*AT&T UMTS	2	565	127	0.0252	880	0.5867	4.29%	
*AT&T UMTS	2	875	127	0.0390	1900	1.0000	3.90%	
*AT&T GSM	1	283	127	0.0063	880	0.5867	1.08%	
*AT&T GSM	4	525	127	0.0468	1900	1.0000	4.68%	
*AT&T LTE	1	1771	127	0.0395	734	0.4893	8.07%	
Verizon	**11**	**421**	**137**	**0.0887**	**1970**	**1.0000**	**8.87%**	
Verizon	**9**	**393**	**137**	**0.0678**	**869**	**0.5793**	**11.70%**	
Verizon	**1**	**1750**	**137**	**0.0335**	**2145**	**1.0000**	**3.35%**	
Verizon	**1**	**1050**	**137**	**0.0201**	**698**	**0.4973**	**4.04%**	
								49.99%
* Source: Siting Council								

ATTACHMENT 3

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

140-ft Existing Valmont Monopole

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Woodstock NW

40 Sherman Road
Woodstock, CT

CENTEK Project No. 14001.052

Date: September 10, 2014

STATE OF CONNECTICUT
TIMOTHY J. LYNN
No. 28330
LICENSED
PROFESSIONAL ENGINEER

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 monopole (tower) located in Woodstock, CT.

The host tower is a 140-ft tall extendable to 157-ft, three-section, eighteen sided, tapered monopole, originally designed and manufactured by Valmont; project no. 12650-69 dated June 26, 2009. The tower geometry, structure member sizes and foundation system information were obtained from the original manufacturers design documents.

Antenna and appurtenance information were obtained from a previous structural analysis report prepared by Centek job no. 13212.000 dated August 13, 2013 and a Verizon RF data sheet.

The tower is made up of three (3) tapered vertical sections consisting of A572-65 pole sections. The vertical tower sections are slip joint connected. The diameter of the pole (flat-flat) is 28.58-in at the top and 65.00-in at the base.

Verizon Wireless proposes the removal of twelve (12) panel antennas and the installation of nine (9) panel antennas, three (3) remote radio heads and one (1) surge arrestor mounted on the existing low profile platform. Refer to the Antenna and Appurtenance Summary below for a detailed description of the proposed antenna and appurtenance configuration.

Antenna and Appurtenance Summary

The existing, proposed and future loads considered in this analysis consist of the following:

- AT&T (EXISTING):
  Antennas: Six (6) Ericsson RRUS-11 and one (1) Raycap DC6-48-60-18-8F surge arrestor mounted to one (1) universal ring mount with a RAD center elevation of 129-ft above grade level.
  Coax Cables: One (1) fiber cable and two (2) dc control cables running inside of the existing tower.
- AT&T (EXISTING):
  Antennas: Six (6) Powerwave 7770.00 panel antennas, two (2) KMW AM-X-CD-17-65-00T-RET panel antennas, one (1) Powerwave P65-17-XLH-RR panel antenna, six (6) Powerwave TT08-19DB111-001 TMA's and six (6) RET's mounted on a 13-ft low profile platform with a RAD center elevation of 127-ft above grade level.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing tower.
- AT&T (RESERVED):
  Antennas: Three (3) Powerwave 7770.00 panel antennas, three (3) Powerwave TT08-19DB111-001 TMA's and three (3) RET's mounted on a 13-ft low profile platform with a RAD center elevation of 127-ft above grade level.
  Coax Cables: Six (6) 1-5/8" ∅ coax cables banded to the exterior of the existing tower.

- AT&T (EXISTING):
  Antennas: Six (6) Ericsson RRUS-11 and one (1) Raycap DC6-48-60-18-8F surge arrestor mounted to one (1) universal ring mount with a RAD center elevation of 125-ft above grade level.
  Coax Cables: One (1) fiber cable and two (2) dc control cables running inside of the existing tower.
- VERIZON (EXISTING TO REMAIN):
  Antennas: Three (3) Antel BXA-70063-6CF panel antennas mounted to a 13-ft low profile platform with a RAD center elevation of 137-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing tower.
- VERIZON (EXISTING TO REMOVE):
  Antennas: Six (6) Antel LPA-80080-6CF panel antennas mounted to a 13-ft low profile platform with a RAD center elevation of 137-ft above grade.
- VERIZON (RESERVED):
  Coax Cables: Six (6) 1-5/8" ∅ coax cables running on the exterior of the existing tower.
- **VERIZON (PROPOSED):**
  Antennas: Six (6) Andrew HBXX-6517DS panel antennas, three (3) Andrew LNX-8514DS panel antennas, three (3) Alcatel-Lucet RRH-2x60-AWS remote radio heads and one (1) RFS DB-T1-6Z-8AB main distribution box mounted to a 13-ft low profile platform with a RAD center elevation of 137-ft above grade.
  Coax Cables: One (1) 1-5/8" ∅ fiber cable running on the inside of 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:	Windham; v = 85 mph (fastest mile)	*[Section 16 of TIA/EIA-222-F-96]*
	Woodstock; v = 100 mph (3 second gust) equivalent to v = 80 mph (fastest mile)	*[Appendix K of the 2005 CT Building Code Supplement]*
	TIA-EIA-222-F wind speed controls.	
Load Cases:	<u>Load Case 1</u>; 85 mph wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	<u>Load Case 2</u>; 74 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 74 mph wind speed velocity represents 75% of the wind pressure generated by the 85 mph wind speed.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	<u>Load Case 3</u>; 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 **41.4%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L1)	88.75'-140.0'	33.6%	**PASS**
Pole Shaft (L2)	46.08'-88.75'	39.0%	**PASS**
Pole Shaft (L3)	0.00'-46.08'	41.4%	**PASS**

Foundation and Anchors

The existing foundation consists of a 8.5-ft Ø x 4.5-ft long reinforced concrete pier on a 26.0-ft square x 3.0-ft thick reinforce concrete pad. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned original design report prepared by Valmont job no. 12650-69 dated June 26, 2009. The base of the tower is connected to the foundation by means of (20) 2.25"Ø, ASTM A615-75 anchor bolts embedded approximately 6-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	26 kips
	Compression	40 kips
	Moment	2510 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	3.31	**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	Compression	43.7%	**PASS**
Base Plate	Bending	19.7%	**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.

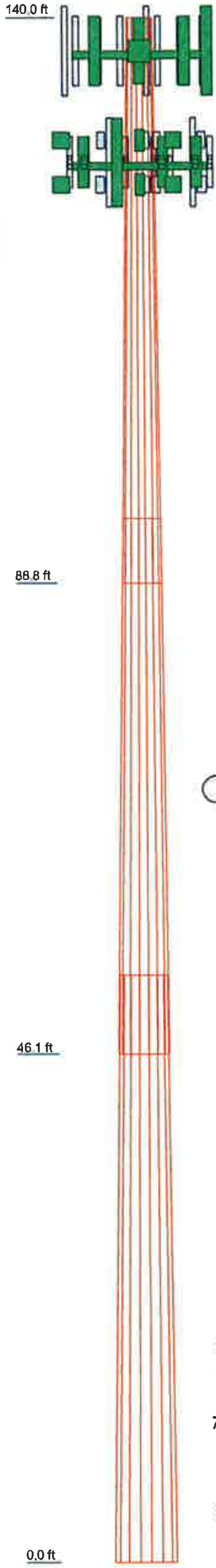
General Description of Structural Analysis Program

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	
Length (ft)	51.247	48.587	53.250	
Number of Sides	18	18	18	
Thickness (in)	0.281	0.375	0.438	
Socket Length (ft)	5.917	7.167		
Top Dia (in)	28.583	40.236	50.649	
Bot Dia (in)	42.393	53.330	65.000	
Grade	A572-65			
Weight (K)	5.5	9.1	14.4	29.1



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
LNX-8514DS (Verizon - Proposed)	137	7770.00 (ATI - Reserved)	127
HBXX-6517DS (Verizon - Proposed)	137	7770.00 (ATI - Reserved)	127
BXA-70063/6CF (Verizon - Existing)	137	TT08-19DB111-001 TMA (ATI - Reserved)	127
HBXX-6517DS (Verizon - Proposed)	137	TT08-19DB111-001 TMA (ATI - Reserved)	127
LNX-8514DS (Verizon - Proposed)	137	TT08-19DB111-001 TMA (ATI - Reserved)	127
HBXX-6517DS (Verizon - Proposed)	137	RET (ATI - Reserved)	127
BXA-70063/6CF (Verizon - Existing)	137	RET (ATI - Reserved)	127
HBXX-6517DS (Verizon - Proposed)	137	RET (ATI - Reserved)	127
LNX-8514DS (Verizon - Proposed)	137	Valmont 13' Low Profile Platform (ATI - Existing)	127
HBXX-6517DS (Verizon - Proposed)	137	P65-17-XLH-RR (ATI - Existing)	127
BXA-70063/6CF (Verizon - Existing)	137	AM-X-CD-17-65-00T-RET (ATI - Existing)	127
HBXX-6517DS (Verizon - Proposed)	137	AM-X-CD-17-65-00T-RET (ATI - Existing)	127
RRH2x60-AWS (Verizon - Proposed)	137	(2) 7770.00 (ATI - Existing)	127
RRH2x60-AWS (Verizon - Proposed)	137	(2) 7770.00 (ATI - Existing)	127
RRH2x60-AWS (Verizon - Proposed)	137	(2) 7770.00 (ATI - Existing)	127
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	137	(2) TT08-19DB111-001 TMA (ATI - Existing)	127
Valmont 13' Low Profile Platform (Verizon - Existing)	137	(2) TT08-19DB111-001 TMA (ATI - Existing)	127
(2) RRUS-11 (ATI - Existing)	129	(2) RRUS-11 (ATI - Existing)	125
(2) RRUS-11 (ATI - Existing)	129	(2) RRUS-11 (ATI - Existing)	125
(2) RRUS-11 (ATI - Existing)	129	(2) RRUS-11 (ATI - Existing)	125
DC6-48-60-18-8F Surge Arrestor (ATI - Existing)	129	DC6-48-60-18-8F Surge Arrestor (ATI - Existing)	125
Valmont Uni-Tri Bracket (ATI - Existing)	129	Valmont Uni-Tri Bracket (ATI - Existing)	125
(2) TT08-19DB111-001 TMA (ATI - Existing)	127		
(2) RET (ATI - Existing)	127		
(2) RET (ATI - Existing)	127		
(2) RET (ATI - Existing)	127		
7770.00 (ATI - Reserved)	127		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower is located in Windham County, Connecticut.
2. Tower designed for a 85 mph basic wind in accordance with the TIA/EIA-222-F Standard.
3. Tower is also designed for a 74 mph basic wind with 0.50 in ice.
4. Deflections are based upon a 50 mph wind.
5. Weld together tower sections have flange connections.
6. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
7. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
8. Welds are fabricated with ER-70S-6 electrodes.
9. TOWER RATING: 41.4%

AXIAL 49 K
SHEAR 21 K
MOMENT 2085 kip-ft
TORQUE 1 kip-ft
74 mph WIND - 0.500 in ICE

AXIAL 40 K
SHEAR 26 K
MOMENT 2510 kip-ft
TORQUE 1 kip-ft
REACTIONS - 85 mph WIND

Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job: 14001.052 - Woodstock NW		
	Project: 140' Valmont Monopole - 40 Sherman Rd., Woodstock, CT		
	Client: Verizon Wireless	Drawn by: TJL	App'd:
	Code: TIA/EIA-222-F	Date: 09/10/14	Scale: NTS
	Path: J:\Jobs\1400100.WI\052 - Woodstock NW\Backup Documentation\Calcs\ERI\140' Monopole.eri		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:

- Tower is located in Windham County, Connecticut.
- Basic wind speed of 85 mph.
- Nominal ice thickness of 0.500 in.
- Ice density of 56 pcf.
- A wind speed of 74 mph is used in combination with ice.
- Temperature drop of 50 °F.
- Deflections calculated using a wind speed of 50 mph.
- 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	140.000-88.753	51.247	5.917	18	28.583	42.393	0.281	1.125	A572-65 (65 ksi)
L2	88.753-46.083	48.587	7.167	18	40.236	53.330	0.375	1.500	A572-65 (65 ksi)
L3	46.083-0.000	53.250		18	50.649	65.000	0.438	1.750	A572-65

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
									(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	29.024	25.265	2556.682	10.047	14.520	176.078	5116.729	12.635	4.536	16.127
	43.047	37.593	8422.612	14.950	21.536	391.101	16856.306	18.800	6.966	24.769
L2	42.476	47.445	9524.012	14.151	20.440	465.952	19060.557	23.727	6.422	17.124
	54.153	63.030	22330.403	18.799	27.092	824.254	44690.189	31.521	8.726	23.27
L3	53.391	69.724	22208.518	17.825	25.729	863.156	44446.259	34.869	8.144	18.615
	66.003	89.653	47213.201	22.920	33.020	1429.836	94488.526	44.835	10.670	24.389

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 140.000-88.753				1	1	1		
L2 88.753-46.083				1	1	1		
L3 46.083-0.000				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
1 5/8 (Verizon - Existing)	C	No	Inside Pole	137.000 - 3.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (AT&T - Existing)	C	No	Inside Pole	127.000 - 3.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (AT&T - Reserved)	C	No	CaAa (Out Of Face)	127.000 - 3.000	1	No Ice	0.198	0.001
						1/2" Ice	0.298	0.003
1 5/8 (AT&T - Reserved)	C	No	CaAa (Out Of Face)	127.000 - 3.000	5	No Ice	0.000	0.001
						1/2" Ice	0.000	0.003
RG6-Fiber (AT&T - Existing)	C	No	Inside Pole	127.000 - 3.000	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	127.000 - 3.000	2	No Ice	0.000	0.000
						1/2" Ice	0.000	0.000
RG6-Fiber (AT&T - Existing)	C	No	Inside Pole	127.000 - 3.000	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	127.000 - 3.000	2	No Ice	0.000	0.000
						1/2" Ice	0.000	0.000
1 5/8 (Verizon - Reserved)	C	No	CaAa (Out Of Face)	137.000 - 3.000	1	No Ice	0.198	0.001
						1/2" Ice	0.298	0.003
1 5/8 (Verizon - Reserved)	C	No	CaAa (Out Of Face)	137.000 - 3.000	5	No Ice	0.000	0.001
						1/2" Ice	0.000	0.003
HYBRIFLEX 1-5/8"	C	No	Inside Pole	137.000 - 3.000	1	No Ice	0.000	0.002

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft²/ft	Weight klf
(Verizon - Proposed)						1/2" Ice	0.000	0.002

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	140.000-88.753	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	17.126	1.795
L2	88.753-46.083	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	16.897	1.773
L3	46.083-0.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	17.061	1.790

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	140.000-88.753	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	25.775	2.579
L2	88.753-46.083	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	25.431	2.546
L3	46.083-0.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	25.677	2.570

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
LNX-8514DS	A	From Face	3.000	0.000	137.000	No Ice	11.445	7.696	0.055
(Verizon - Proposed)			-6.000			1/2" Ice	12.064	8.289	0.121
			0.000						
HBXX-6517DS	A	From Face	3.000	0.000	137.000	No Ice	8.738	5.243	0.050
(Verizon - Proposed)			-4.000			1/2" Ice	9.306	5.709	0.100
			0.000						
BXA-70063/6CF	A	From Face	3.000	0.000	137.000	No Ice	7.731	4.158	0.017
(Verizon - Existing)			0.000			1/2" Ice	8.268	4.595	0.059
			0.000						
HBXX-6517DS	A	From Face	3.000	0.000	137.000	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 ft²	C_AA_A Side ft²	Weight K
(Verizon - Proposed)			4.000 0.000			1/2" Ice	9.306	5.709	0.100
LNX-8514DS (Verizon - Proposed)	B	From Face	3.000 -6.000 0.000	0.000	137.000	No Ice 1/2" Ice	11.445 12.064	7.696 8.289	0.055 0.121
HBXX-6517DS (Verizon - Proposed)	B	From Face	3.000 -4.000 0.000	0.000	137.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
BXA-70063/6CF (Verizon - Existing)	B	From Face	3.000 0.000 0.000	0.000	137.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.017 0.059
HBXX-6517DS (Verizon - Proposed)	B	From Face	3.000 4.000 0.000	0.000	137.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
LNX-8514DS (Verizon - Proposed)	C	From Face	3.000 -6.000 0.000	0.000	137.000	No Ice 1/2" Ice	11.445 12.064	7.696 8.289	0.055 0.121
HBXX-6517DS (Verizon - Proposed)	C	From Face	3.000 -4.000 0.000	0.000	137.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
BXA-70063/6CF (Verizon - Existing)	C	From Face	3.000 0.000 0.000	0.000	137.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.017 0.059
HBXX-6517DS (Verizon - Proposed)	C	From Face	3.000 4.000 0.000	0.000	137.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
RRH2x60-AWS (Verizon - Proposed)	A	From Face	3.000 -4.000 0.000	0.000	137.000	No Ice 1/2" Ice	0.292 0.417	1.430 1.612	0.050 0.057
RRH2x60-AWS (Verizon - Proposed)	B	From Face	3.000 -4.000 0.000	0.000	137.000	No Ice 1/2" Ice	0.292 0.417	1.430 1.612	0.050 0.057
RRH2x60-AWS (Verizon - Proposed)	C	From Face	3.000 -4.000 0.000	0.000	137.000	No Ice 1/2" Ice	0.292 0.417	1.430 1.612	0.050 0.057
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	C	From Face	3.000 0.000 0.000	0.000	137.000	No Ice 1/2" Ice	5.600 5.915	2.333 2.558	0.044 0.080
Valmont 13' Low Profile Platform (Verizon - Existing)	C	None		0.000	137.000	No Ice 1/2" Ice	15.700 20.100	15.700 20.100	1.300 1.765
(2) 7770.00 (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	127.000	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	127.000	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	127.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) TT08-19DB111-001 TMA (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	127.000	No Ice 1/2" Ice	0.925 1.065	0.746 0.877	0.022 0.030
(2) TT08-19DB111-001 TMA (AT&T - Existing)	B	From Face	3.000 0.000 0.000	0.000	127.000	No Ice 1/2" Ice	0.925 1.065	0.746 0.877	0.022 0.030
(2) TT08-19DB111-001	C	From Face	3.000	0.000	127.000	No Ice	0.925	0.746	0.022

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert*	*Azimuth Adjustment*	*Placement*		*C_AA_A Front*	*C_AA_A Side*	*Weight*
			ft ft ft	°	*ft*		*ft²*	*ft²*	*K*
TMA			0.000			1/2" Ice	1.065	0.877	0.030
(AT&T - Existing)			0.000						
(2) RET	A	From Face	3.000	0.000	127.000	No Ice	0.408	0.122	0.003
(AT&T - Existing)			0.000			1/2" Ice	0.500	0.174	0.006
			0.000						
(2) RET	B	From Face	3.000	0.000	127.000	No Ice	0.408	0.122	0.003
(AT&T - Existing)			0.000			1/2" Ice	0.500	0.174	0.006
			0.000						
(2) RET	C	From Face	3.000	0.000	127.000	No Ice	0.408	0.122	0.003
(AT&T - Existing)			0.000			1/2" Ice	0.500	0.174	0.006
			0.000						
7770.00	A	From Face	3.000	0.000	127.000	No Ice	5.882	2.928	0.035
(AT&T - Reserved)			-2.000			1/2" Ice	6.314	3.273	0.068
			0.000						
7770.00	B	From Face	3.000	0.000	127.000	No Ice	5.882	2.928	0.035
(AT&T - Reserved)			-2.000			1/2" Ice	6.314	3.273	0.068
			0.000						
7770.00	C	From Face	3.000	0.000	127.000	No Ice	5.882	2.928	0.035
(AT&T - Reserved)			-2.000			1/2" Ice	6.314	3.273	0.068
			0.000						
TT08-19DB111-001 TMA	A	From Face	3.000	0.000	127.000	No Ice	0.925	0.746	0.022
(AT&T - Reserved)			-2.000			1/2" Ice	1.065	0.877	0.030
			0.000						
TT08-19DB111-001 TMA	B	From Face	3.000	0.000	127.000	No Ice	0.925	0.746	0.022
(AT&T - Reserved)			-2.000			1/2" Ice	1.065	0.877	0.030
			0.000						
TT08-19DB111-001 TMA	C	From Face	3.000	0.000	127.000	No Ice	0.925	0.746	0.022
(AT&T - Reserved)			-2.000			1/2" Ice	1.065	0.877	0.030
			0.000						
RET	A	From Face	3.000	0.000	127.000	No Ice	0.408	0.122	0.003
(AT&T - Reserved)			-2.000			1/2" Ice	0.500	0.174	0.006
			0.000						
RET	B	From Face	3.000	0.000	127.000	No Ice	0.408	0.122	0.003
(AT&T - Reserved)			-2.000			1/2" Ice	0.500	0.174	0.006
			0.000						
RET	C	From Face	3.000	0.000	127.000	No Ice	0.408	0.122	0.003
(AT&T - Reserved)			-2.000			1/2" Ice	0.500	0.174	0.006
			0.000						
Valmont 13' Low Profile	C	None		0.000	127.000	No Ice	15.700	15.700	1.300
Platform						1/2" Ice	20.100	20.100	1.765
(AT&T - Existing)									
P65-17-XLH-RR	A	From Face	3.000	0.000	127.000	No Ice	11.467	6.800	0.062
(AT&T - Existing)			2.000			1/2" Ice	12.083	7.384	0.124
			0.000						
AM-X-CD-17-65-00T-RET	B	From Face	3.000	0.000	127.000	No Ice	11.311	6.800	0.060
(AT&T - Existing)			2.000			1/2" Ice	11.927	7.384	0.121
			0.000						
AM-X-CD-17-65-00T-RET	C	From Face	3.000	0.000	127.000	No Ice	11.311	6.800	0.060
(AT&T - Existing)			2.000			1/2" Ice	11.927	7.384	0.121
			0.000						
(2) RRUS-11	A	From Face	1.000	0.000	125.000	No Ice	2.994	1.246	0.050
(AT&T - Existing)			2.000			1/2" Ice	3.226	1.412	0.070
			0.000						
(2) RRUS-11	B	From Face	1.000	0.000	125.000	No Ice	2.994	1.246	0.050
(AT&T - Existing)			2.000			1/2" Ice	3.226	1.412	0.070
			0.000						
(2) RRUS-11	C	From Face	1.000	0.000	125.000	No Ice	2.994	1.246	0.050

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)			2.000			1/2" Ice	3.226	1.412	0.070
			0.000						
DC6-48-60-18-8F Surge	C	From Face	0.500	0.000	125.000	No Ice	2.228	2.228	0.020
Arrestor			0.000			1/2" Ice	2.447	2.447	0.039
(AT&T - Existing)			0.000						
Valmont Uni-Tri Bracket	C	None		0.000	125.000	No Ice	1.750	1.750	0.290
(AT&T - Existing)						1/2" Ice	1.940	1.940	0.306
(2) RRUS-11	A	From Face	1.000	0.000	129.000	No Ice	2.994	1.246	0.050
(AT&T - Existing)			2.000			1/2" Ice	3.226	1.412	0.070
			0.000						
(2) RRUS-11	B	From Face	1.000	0.000	129.000	No Ice	2.994	1.246	0.050
(AT&T - Existing)			2.000			1/2" Ice	3.226	1.412	0.070
			0.000						
(2) RRUS-11	C	From Face	1.000	0.000	129.000	No Ice	2.994	1.246	0.050
(AT&T - Existing)			2.000			1/2" Ice	3.226	1.412	0.070
			0.000						
DC6-48-60-18-8F Surge	C	From Face	0.500	0.000	129.000	No Ice	2.228	2.228	0.020
Arrestor			0.000			1/2" Ice	2.447	2.447	0.039
(AT&T - Existing)			0.000						
Valmont Uni-Tri Bracket	C	None		0.000	129.000	No Ice	1.750	1.750	0.290
(AT&T - Existing)						1/2" Ice	1.940	1.940	0.306

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 140.000-88.753	113.123	1.422	0.026	151.554	A	0.000	151.554	151.554	100.00	0.000	0.000
					B	0.000	151.554		100.00	0.000	0.000
					C	0.000	151.554		100.00	0.000	17.126
L2 88.753-46.083	67.045	1.224	0.023	169.188	A	0.000	169.188	169.188	100.00	0.000	0.000
					B	0.000	169.188		100.00	0.000	0.000
					C	0.000	169.188		100.00	0.000	16.897
L3 46.083-0.000	22.296	1	0.019	225.769	A	0.000	225.769	225.769	100.00	0.000	0.000
					B	0.000	225.769		100.00	0.000	0.000
					C	0.000	225.769		100.00	0.000	17.061

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 140.000-88.753	113.123	1.422	0.020	0.500	155.825	A	0.000	155.825	155.825	100.00	0.000	0.000
						B	0.000	155.825		100.00	0.000	0.000
						C	0.000	155.825		100.00	0.000	25.775
L2 88.753-46.083	67.045	1.224	0.017	0.500	172.743	A	0.000	172.743	172.743	100.00	0.000	0.000
						B	0.000	172.743		100.00	0.000	0.000
						C	0.000	172.743		100.00	0.000	25.431
L3 46.083-0.000	22.296	1	0.014	0.500	229.609	A	0.000	229.609	229.609	100.00	0.000	0.000
						B	0.000	229.609		100.00	0.000	0.000
						C	0.000	229.609		100.00	0.000	25.677

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 140.000-88.753	113.123	1.422	0.009	151.554	A	0.000	151.554	151.554	100.00	0.000	0.000
					B	0.000	151.554		100.00	0.000	0.000
					C	0.000	151.554		100.00	0.000	17.126
L2 88.753-46.083	67.045	1.224	0.008	169.188	A	0.000	169.188	169.188	100.00	0.000	0.000
					B	0.000	169.188		100.00	0.000	0.000
					C	0.000	169.188		100.00	0.000	16.897
L3 46.083-0.000	22.296	1	0.006	225.769	A	0.000	225.769	225.769	100.00	0.000	0.000
					B	0.000	225.769		100.00	0.000	0.000
					C	0.000	225.769		100.00	0.000	17.061

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 140.000-88.753	1.795	5.481	A	1	0.65	1	1	1	151.554	5.128	0.100	C
			B	1	0.65	1	1	1	151.554			
			C	1	0.65	1	1	1	151.554			
L2 88.753-46.083	1.773	9.132	A	1	0.65	1	1	1	169.188	4.833	0.113	C
			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3 46.083-0.000	1.790	14.439	A	1	0.65	1	1	1	225.769	5.148	0.112	C
			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.357	29.053						OTM	1018.885 kip-ft	15.109		

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 ft^2	F K	w klf	Ctrl. Face
L1	1.795	5.481	A	1	0.65	1	1	1	151.554	5.128	0.100	C
140.000-88.75			B	1	0.65	1	1	1	151.554			
3			C	1	0.65	1	1	1	151.554			
L2	1.773	9.132	A	1	0.65	1	1	1	169.188	4.833	0.113	C
88.753-46.083			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3	1.790	14.439	A	1	0.65	1	1	1	225.769	5.148	0.112	C
46.083-0.000			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.357	29.053						OTM	1018.885 kip-ft	15.109		

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	1.795	5.481	A	1	0.65	1	1	1	151.554	5.128	0.100	C
140.000-88.75			B	1	0.65	1	1	1	151.554			
3			C	1	0.65	1	1	1	151.554			
L2	1.773	9.132	A	1	0.65	1	1	1	169.188	4.833	0.113	C
88.753-46.083			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3	1.790	14.439	A	1	0.65	1	1	1	225.769	5.148	0.112	C
46.083-0.000			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.357	29.053						OTM	1018.885 kip-ft	15.109		

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	1.795	5.481	A	1	0.65	1	1	1	151.554	5.128	0.100	C
140.000-88.75			B	1	0.65	1	1	1	151.554			
3			C	1	0.65	1	1	1	151.554			
L2	1.773	9.132	A	1	0.65	1	1	1	169.188	4.833	0.113	C
88.753-46.083			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3	1.790	14.439	A	1	0.65	1	1	1	225.769	5.148	0.112	C
46.083-0.000			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.357	29.053						OTM	1018.885 kip-ft	15.109		

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 140.000-88.753	2.579	6.619	A	1	0.65	1	1	1	155.825	4.226	0.082	C
			B	1	0.65	1	1	1	155.825			
			C	1	0.65	1	1	1	155.825			
L2 88.753-46.083	2.546	10.399	A	1	0.65	1	1	1	172.743	3.935	0.092	C
			B	1	0.65	1	1	1	172.743			
			C	1	0.65	1	1	1	172.743			
L3 46.083-0.000	2.570	16.126	A	1	0.65	1	1	1	229.609	4.123	0.089	C
			B	1	0.65	1	1	1	229.609			
			C	1	0.65	1	1	1	229.609			
Sum Weight:	7.695	33.143						OTM	833.764 kip-ft	12.284		

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 140.000-88.753	2.579	6.619	A	1	0.65	1	1	1	155.825	4.226	0.082	C
			B	1	0.65	1	1	1	155.825			
			C	1	0.65	1	1	1	155.825			
L2 88.753-46.083	2.546	10.399	A	1	0.65	1	1	1	172.743	3.935	0.092	C
			B	1	0.65	1	1	1	172.743			
			C	1	0.65	1	1	1	172.743			
L3 46.083-0.000	2.570	16.126	A	1	0.65	1	1	1	229.609	4.123	0.089	C
			B	1	0.65	1	1	1	229.609			
			C	1	0.65	1	1	1	229.609			
Sum Weight:	7.695	33.143						OTM	833.764 kip-ft	12.284		

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 140.000-88.753	2.579	6.619	A	1	0.65	1	1	1	155.825	4.226	0.082	C
			B	1	0.65	1	1	1	155.825			
			C	1	0.65	1	1	1	155.825			
L2 88.753-46.083	2.546	10.399	A	1	0.65	1	1	1	172.743	3.935	0.092	C
			B	1	0.65	1	1	1	172.743			
			C	1	0.65	1	1	1	172.743			
L3 46.083-0.000	2.570	16.126	A	1	0.65	1	1	1	229.609	4.123	0.089	C
			B	1	0.65	1	1	1	229.609			
			C	1	0.65	1	1	1	229.609			
Sum Weight:	7.695	33.143						OTM	833.764 kip-ft	12.284		

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	2.579	6.619	A	1	0.65	1	1	1	155.825	4.226	0.082	C
140.000-88.75			B	1	0.65	1	1	1	155.825			
3			C	1	0.65	1	1	1	155.825			
L2	2.546	10.399	A	1	0.65	1	1	1	172.743	3.935	0.092	C
88.753-46.083			B	1	0.65	1	1	1	172.743			
			C	1	0.65	1	1	1	172.743			
L3	2.570	16.126	A	1	0.65	1	1	1	229.609	4.123	0.089	C
46.083-0.000			B	1	0.65	1	1	1	229.609			
			C	1	0.65	1	1	1	229.609			
Sum Weight:	7.695	33.143						OTM	833.764 kip-ft	12.284		

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	1.795	5.481	A	1	0.65	1	1	1	151.554	1.774	0.035	C
140.000-88.75			B	1	0.65	1	1	1	151.554			
3			C	1	0.65	1	1	1	151.554			
L2	1.773	9.132	A	1	0.65	1	1	1	169.188	1.672	0.039	C
88.753-46.083			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3	1.790	14.439	A	1	0.65	1	1	1	225.769	1.781	0.039	C
46.083-0.000			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.357	29.053						OTM	352.555 kip-ft	5.228		

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	1.795	5.481	A	1	0.65	1	1	1	151.554	1.774	0.035	C
140.000-88.75			B	1	0.65	1	1	1	151.554			
3			C	1	0.65	1	1	1	151.554			
L2	1.773	9.132	A	1	0.65	1	1	1	169.188	1.672	0.039	C
88.753-46.083			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3	1.790	14.439	A	1	0.65	1	1	1	225.769	1.781	0.039	C
46.083-0.000			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.357	29.053						OTM	352.555	5.228		

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
									kip-ft			

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	1.795	5.481	A	1	0.65	1	1	1	151.554	1.774	0.035	C
140.000-88.75			B	1	0.65	1	1	1	151.554			
3			C	1	0.65	1	1	1	151.554			
L2	1.773	9.132	A	1	0.65	1	1	1	169.188	1.672	0.039	C
88.753-46.083			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3	1.790	14.439	A	1	0.65	1	1	1	225.769	1.781	0.039	C
46.083-0.000			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.357	29.053						OTM	352.555 kip-ft	5.228		

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	1.795	5.481	A	1	0.65	1	1	1	151.554	1.774	0.035	C
140.000-88.75			B	1	0.65	1	1	1	151.554			
3			C	1	0.65	1	1	1	151.554			
L2	1.773	9.132	A	1	0.65	1	1	1	169.188	1.672	0.039	C
88.753-46.083			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3	1.790	14.439	A	1	0.65	1	1	1	225.769	1.781	0.039	C
46.083-0.000			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.357	29.053						OTM	352.555 kip-ft	5.228		

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	29.053					
Bracing Weight	0.000					
Total Member Self-Weight	29.053			0.252	0.006	

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*
Total Weight	39.662			0.252	0.006	
Wind 0 deg - No Ice		-0.003	-26.166	-2475.622	0.399	0.007
Wind 30 deg - No Ice		13.005	-22.659	-2143.721	-1227.313	0.419
Wind 45 deg - No Ice		18.394	-18.500	-1750.178	-1735.888	0.589
Wind 60 deg - No Ice		22.529	-13.080	-1237.345	-2126.165	0.719
Wind 90 deg - No Ice		26.016	0.003	0.645	-2455.312	0.826
Wind 120 deg - No Ice		22.532	13.086	1238.529	-2126.558	0.712
Wind 135 deg - No Ice		18.399	18.504	1751.236	-1736.444	0.579
Wind 150 deg - No Ice		13.011	22.662	2144.617	-1227.994	0.407
Wind 180 deg - No Ice		0.003	26.166	2476.125	-0.387	-0.007
Wind 210 deg - No Ice		-13.005	22.659	2144.224	1227.324	-0.419
Wind 225 deg - No Ice		-18.394	18.500	1750.681	1735.899	-0.589
Wind 240 deg - No Ice		-22.529	13.080	1237.848	2126.176	-0.719
Wind 270 deg - No Ice		-26.016	-0.003	-0.141	2455.323	-0.826
Wind 300 deg - No Ice		-22.532	-13.086	-1238.026	2126.569	-0.712
Wind 315 deg - No Ice		-18.399	-18.504	-1750.733	1736.455	-0.579
Wind 330 deg - No Ice		-13.011	-22.662	-2144.114	1228.005	-0.407
Member Ice	4.091					
Total Weight Ice	48.585			0.473	0.007	
Wind 0 deg - Ice		-0.002	-21.492	-2046.421	0.304	0.005
Wind 30 deg - Ice		10.686	-18.612	-1772.041	-1015.256	0.345
Wind 45 deg - Ice		15.114	-15.196	-1446.690	-1435.946	0.485
Wind 60 deg - Ice		18.512	-10.744	-1022.717	-1758.778	0.592
Wind 90 deg - Ice		21.377	0.002	0.770	-2031.034	0.681
Wind 120 deg - Ice		18.514	10.748	1024.177	-1759.074	0.587
Wind 135 deg - Ice		15.117	15.199	1448.055	-1436.366	0.478
Wind 150 deg - Ice		10.690	18.614	1773.283	-1015.770	0.336
Wind 180 deg - Ice		0.002	21.492	2047.366	-0.289	-0.005
Wind 210 deg - Ice		-10.686	18.612	1772.986	1015.271	-0.345
Wind 225 deg - Ice		-15.114	15.196	1447.635	1435.961	-0.485
Wind 240 deg - Ice		-18.512	10.744	1023.663	1758.792	-0.592
Wind 270 deg - Ice		-21.377	-0.002	0.176	2031.049	-0.681
Wind 300 deg - Ice		-18.514	-10.748	-1023.231	1759.089	-0.587
Wind 315 deg - Ice		-15.117	-15.199	-1447.110	1436.380	-0.478
Wind 330 deg - Ice		-10.690	-18.614	-1772.338	1015.785	-0.336
Total Weight	39.662			0.252	0.006	
Wind 0 deg - Service		-0.001	-9.054	-856.452	0.141	0.002
Wind 30 deg - Service		4.500	-7.840	-741.608	-424.672	0.145
Wind 45 deg - Service		6.365	-6.401	-605.433	-600.650	0.204
Wind 60 deg - Service		7.796	-4.526	-427.982	-735.694	0.249
Wind 90 deg - Service		9.002	0.001	0.388	-849.585	0.286
Wind 120 deg - Service		7.797	4.528	428.721	-735.830	0.246
Wind 135 deg - Service		6.366	6.403	606.129	-600.842	0.200
Wind 150 deg - Service		4.502	7.842	742.247	-424.908	0.141
Wind 180 deg - Service		0.001	9.054	856.955	-0.130	-0.002
Wind 210 deg - Service		-4.500	7.840	742.111	424.683	-0.145
Wind 225 deg - Service		-6.365	6.401	605.936	600.661	-0.204
Wind 240 deg - Service		-7.796	4.526	428.486	735.705	-0.249
Wind 270 deg - Service		-9.002	-0.001	0.116	849.596	-0.286
Wind 300 deg - Service		-7.797	-4.528	-428.218	735.841	-0.246
Wind 315 deg - Service		-6.366	-6.403	-605.626	600.853	-0.200
Wind 330 deg - Service		-4.502	-7.842	-741.744	424.919	-0.141

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
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	140 - 88.753	Pole	Max Tension	27	0.000	0.000	0.000
			Max. Compression	18	-15.750	0.007	-0.473
			Max. Mx	14	-11.180	509.981	-0.143

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. My	10	-11.172	-0.096	-516.702
			Max. Vy	14	-15.658	509.981	-0.143
			Max. Vx	10	15.810	-0.096	-516.702
			Max. Torque	6			-0.824
L2	88.753 - 46.083	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-27.718	0.007	-0.473
			Max. Mx	14	-21.345	1255.116	-0.023
			Max. My	10	-21.340	-0.227	-1268.168
			Max. Vy	14	-20.320	1255.116	-0.023
			Max. Vx	10	20.472	-0.227	-1268.168
			Max. Torque	6			-0.824
L3	46.083 - 0	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-48.585	0.007	-0.473
			Max. Mx	14	-39.653	2488.745	0.142
			Max. My	10	-39.653	-0.393	-2509.869
			Max. Vy	14	-26.029	2488.745	0.142
			Max. Vx	10	26.179	-0.393	-2509.869
			Max. Torque	6			-0.824

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	27	48.585	-0.002	-21.492
	Max. H_x	14	39.662	26.016	0.003
	Max. H_z	2	39.662	0.003	26.166
	Max. M_x	2	2509.353	0.003	26.166
	Max. M_z	6	2488.734	-26.016	-0.003
	Max. Torsion	14	0.824	26.016	0.003
	Min. Vert	1	39.662	0.000	0.000
	Min. H_x	6	39.662	-26.016	-0.003
	Min. H_z	10	39.662	-0.003	-26.166
	Min. M_x	10	-2509.869	-0.003	-26.166
	Min. M_z	14	-2488.745	26.016	0.003
	Min. Torsion	6	-0.824	-26.016	-0.003

Tower Mast Reaction Summary

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead Only	39.662	0.000	0.000	0.252	0.006	0.000
Dead+Wind 0 deg - No Ice	39.662	-0.003	-26.166	-2509.353	0.405	0.007
Dead+Wind 30 deg - No Ice	39.662	13.005	-22.659	-2172.932	-1244.015	0.418
Dead+Wind 45 deg - No Ice	39.662	18.394	-18.500	-1774.027	-1759.514	0.588
Dead+Wind 60 deg - No Ice	39.662	22.529	-13.080	-1254.206	-2155.105	0.717
Dead+Wind 90 deg - No Ice	39.662	26.016	0.003	0.656	-2488.734	0.824
Dead+Wind 120 deg - No Ice	39.662	22.532	13.086	1255.412	-2155.504	0.709
Dead+Wind 135 deg - No Ice	39.662	18.399	18.504	1775.106	-1760.078	0.577
Dead+Wind 150 deg - No Ice	39.662	13.011	22.662	2173.846	-1244.706	0.405
Dead+Wind 180 deg - No Ice	39.662	0.003	26.166	2509.869	-0.393	-0.007

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 210 deg - No Ice	39.662	-13.005	22.659	2173.447	1244.027	-0.418
Dead+Wind 225 deg - No Ice	39.662	-18.394	18.500	1774.542	1759.526	-0.587
Dead+Wind 240 deg - No Ice	39.662	-22.529	13.080	1254.721	2155.116	-0.717
Dead+Wind 270 deg - No Ice	39.662	-26.016	-0.003	-0.142	2488.745	-0.824
Dead+Wind 300 deg - No Ice	39.662	-22.532	-13.086	-1254.897	2155.514	-0.710
Dead+Wind 315 deg - No Ice	39.662	-18.399	-18.504	-1774.591	1760.089	-0.578
Dead+Wind 330 deg - No Ice	39.662	-13.011	-22.662	-2173.331	1244.717	-0.406
Dead+Ice+Temp	48.585	0.000	0.000	0.473	0.007	0.000
Dead+Wind 0 deg+Ice+Temp	48.585	-0.002	-21.492	-2083.590	0.310	0.005
Dead+Wind 30 deg+Ice+Temp	48.585	10.686	-18.612	-1804.226	-1033.677	0.344
Dead+Wind 45 deg+Ice+Temp	48.585	15.114	-15.196	-1472.965	-1462.000	0.483
Dead+Wind 60 deg+Ice+Temp	48.585	18.512	-10.744	-1041.290	-1790.691	0.590
Dead+Wind 90 deg+Ice+Temp	48.585	21.377	0.002	0.791	-2067.889	0.678
Dead+Wind 120 deg+Ice+Temp	48.585	18.514	10.748	1042.792	-1790.994	0.584
Dead+Wind 135 deg+Ice+Temp	48.585	15.117	15.199	1474.371	-1462.429	0.475
Dead+Wind 150 deg+Ice+Temp	48.585	10.690	18.614	1805.507	-1034.201	0.334
Dead+Wind 180 deg+Ice+Temp	48.585	0.002	21.492	2084.568	-0.295	-0.005
Dead+Wind 210 deg+Ice+Temp	48.585	-10.686	18.612	1805.204	1033.692	-0.343
Dead+Wind 225 deg+Ice+Temp	48.585	-15.114	15.196	1473.943	1462.016	-0.483
Dead+Wind 240 deg+Ice+Temp	48.585	-18.512	10.744	1042.268	1790.707	-0.590
Dead+Wind 270 deg+Ice+Temp	48.585	-21.377	-0.002	0.186	2067.904	-0.678
Dead+Wind 300 deg+Ice+Temp	48.585	-18.514	-10.748	-1041.814	1791.009	-0.584
Dead+Wind 315 deg+Ice+Temp	48.585	-15.117	-15.199	-1473.393	1462.443	-0.476
Dead+Wind 330 deg+Ice+Temp	48.585	-10.690	-18.614	-1804.528	1034.216	-0.334
Dead+Wind 0 deg - Service	39.662	-0.001	-9.054	-868.252	0.144	0.003
Dead+Wind 30 deg - Service	39.662	4.500	-7.840	-751.825	-430.517	0.145
Dead+Wind 45 deg - Service	39.662	6.365	-6.401	-613.774	-608.917	0.204
Dead+Wind 60 deg - Service	39.662	7.796	-4.526	-433.878	-745.820	0.248
Dead+Wind 90 deg - Service	39.662	9.002	0.001	0.396	-861.279	0.285
Dead+Wind 120 deg - Service	39.662	7.797	4.528	434.633	-745.958	0.246
Dead+Wind 135 deg - Service	39.662	6.366	6.403	614.486	-609.112	0.200
Dead+Wind 150 deg - Service	39.662	4.502	7.842	752.480	-430.756	0.140
Dead+Wind 180 deg - Service	39.662	0.001	9.054	868.769	-0.132	-0.003
Dead+Wind 210 deg - Service	39.662	-4.500	7.840	752.342	430.528	-0.145
Dead+Wind 225 deg - Service	39.662	-6.365	6.401	614.291	608.928	-0.204
Dead+Wind 240 deg - Service	39.662	-7.796	4.526	434.394	745.831	-0.248
Dead+Wind 270 deg - Service	39.662	-9.002	-0.001	0.120	861.290	-0.285
Dead+Wind 300 deg - Service	39.662	-7.797	-4.528	-434.117	745.969	-0.246
Dead+Wind 315 deg - Service	39.662	-6.366	-6.403	-613.969	609.123	-0.200
Dead+Wind 330 deg - Service	39.662	-4.502	-7.842	-751.963	430.767	-0.141

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	-39.662	0.000	0.000	39.662	0.000	0.000%
2	-0.003	-39.662	-26.166	0.003	39.662	26.166	0.000%
3	13.005	-39.662	-22.659	-13.005	39.662	22.659	0.000%
4	18.394	-39.662	-18.500	-18.394	39.662	18.500	0.000%
5	22.529	-39.662	-13.080	-22.529	39.662	13.080	0.000%
6	26.016	-39.662	0.003	-26.016	39.662	-0.003	0.000%
7	22.532	-39.662	13.086	-22.532	39.662	-13.086	0.000%
8	18.399	-39.662	18.504	-18.399	39.662	-18.504	0.000%
9	13.011	-39.662	22.662	-13.011	39.662	-22.662	0.000%
10	0.003	-39.662	26.166	-0.003	39.662	-26.166	0.000%
11	-13.005	-39.662	22.659	13.005	39.662	-22.659	0.000%
12	-18.394	-39.662	18.500	18.394	39.662	-18.500	0.000%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	*PX K*	*PY K*	*PZ K*	*PX K*	*PY K*	*PZ K*	*% Error*
13	-22.529	-39.662	13.080	22.529	39.662	-13.080	0.000%
14	-26.016	-39.662	-0.003	26.016	39.662	0.003	0.000%
15	-22.532	-39.662	-13.086	22.532	39.662	13.086	0.000%
16	-18.399	-39.662	-18.504	18.399	39.662	18.504	0.000%
17	-13.011	-39.662	-22.662	13.011	39.662	22.662	0.000%
18	0.000	-48.585	0.000	0.000	48.585	0.000	0.000%
19	-0.002	-48.585	-21.492	0.002	48.585	21.492	0.000%
20	10.686	-48.585	-18.612	-10.686	48.585	18.612	0.000%
21	15.114	-48.585	-15.196	-15.114	48.585	15.196	0.000%
22	18.512	-48.585	-10.744	-18.512	48.585	10.744	0.000%
23	21.377	-48.585	0.002	-21.377	48.585	-0.002	0.000%
24	18.514	-48.585	10.748	-18.514	48.585	-10.748	0.000%
25	15.117	-48.585	15.199	-15.117	48.585	-15.199	0.000%
26	10.690	-48.585	18.614	-10.690	48.585	-18.614	0.000%
27	0.002	-48.585	21.492	-0.002	48.585	-21.492	0.000%
28	-10.686	-48.585	18.612	10.686	48.585	-18.612	0.000%
29	-15.114	-48.585	15.196	15.114	48.585	-15.196	0.000%
30	-18.512	-48.585	10.744	18.512	48.585	-10.744	0.000%
31	-21.377	-48.585	-0.002	21.377	48.585	0.002	0.000%
32	-18.514	-48.585	-10.748	18.514	48.585	10.748	0.000%
33	-15.117	-48.585	-15.199	15.117	48.585	15.199	0.000%
34	-10.690	-48.585	-18.614	10.690	48.585	18.614	0.000%
35	-0.001	-39.662	-9.054	0.001	39.662	9.054	0.000%
36	4.500	-39.662	-7.840	-4.500	39.662	7.840	0.000%
37	6.365	-39.662	-6.401	-6.365	39.662	6.401	0.000%
38	7.796	-39.662	-4.526	-7.796	39.662	4.526	0.000%
39	9.002	-39.662	0.001	-9.002	39.662	-0.001	0.000%
40	7.797	-39.662	4.528	-7.797	39.662	-4.528	0.000%
41	6.366	-39.662	6.403	-6.366	39.662	-6.403	0.000%
42	4.502	-39.662	7.842	-4.502	39.662	-7.842	0.000%
43	0.001	-39.662	9.054	-0.001	39.662	-9.054	0.000%
44	-4.500	-39.662	7.840	4.500	39.662	-7.840	0.000%
45	-6.365	-39.662	6.401	6.365	39.662	-6.401	0.000%
46	-7.796	-39.662	4.526	7.796	39.662	-4.526	0.000%
47	-9.002	-39.662	-0.001	9.002	39.662	0.001	0.000%
48	-7.797	-39.662	-4.528	7.797	39.662	4.528	0.000%
49	-6.366	-39.662	-6.403	6.366	39.662	6.403	0.000%
50	-4.502	-39.662	-7.842	4.502	39.662	7.842	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	0.00000992
3	Yes	4	0.00000001	0.00022331
4	Yes	4	0.00000001	0.00025042
5	Yes	4	0.00000001	0.00020957
6	Yes	4	0.00000001	0.00002234
7	Yes	4	0.00000001	0.00022650
8	Yes	4	0.00000001	0.00025055
9	Yes	4	0.00000001	0.00021381
10	Yes	4	0.00000001	0.00000993
11	Yes	4	0.00000001	0.00021347
12	Yes	4	0.00000001	0.00025035
13	Yes	4	0.00000001	0.00022639

14	Yes	4	0.00000001	0.00002218
15	Yes	4	0.00000001	0.00020985
16	Yes	4	0.00000001	0.00025063
17	Yes	4	0.00000001	0.00022336
18	Yes	4	0.00000001	0.00000001
19	Yes	4	0.00000001	0.00049175
20	Yes	4	0.00000001	0.00065056
21	Yes	4	0.00000001	0.00069285
22	Yes	4	0.00000001	0.00064492
23	Yes	4	0.00000001	0.00048895
24	Yes	4	0.00000001	0.00065146
25	Yes	4	0.00000001	0.00069384
26	Yes	4	0.00000001	0.00064825
27	Yes	4	0.00000001	0.00049224
28	Yes	4	0.00000001	0.00064793
29	Yes	4	0.00000001	0.00069355
30	Yes	4	0.00000001	0.00065122
31	Yes	4	0.00000001	0.00048895
32	Yes	4	0.00000001	0.00064524
33	Yes	4	0.00000001	0.00069316
34	Yes	4	0.00000001	0.00065081
35	Yes	4	0.00000001	0.00000442
36	Yes	4	0.00000001	0.00001549
37	Yes	4	0.00000001	0.00001702
38	Yes	4	0.00000001	0.00001394
39	Yes	4	0.00000001	0.00000538
40	Yes	4	0.00000001	0.00001601
41	Yes	4	0.00000001	0.00001704
42	Yes	4	0.00000001	0.00001431
43	Yes	4	0.00000001	0.00000443
44	Yes	4	0.00000001	0.00001428
45	Yes	4	0.00000001	0.00001703
46	Yes	4	0.00000001	0.00001601
47	Yes	4	0.00000001	0.00000537
48	Yes	4	0.00000001	0.00001396
49	Yes	4	0.00000001	0.00001703
50	Yes	4	0.00000001	0.00001548

Maximum Tower Deflections - Service Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °
L1	140 - 88.753	10.911	43	0.671	0.001
L2	94.67 - 46.083	5.048	43	0.506	0.000
L3	53.25 - 0	1.593	43	0.273	0.000

Critical Deflections and Radius of Curvature - Service Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
137.000	LNX-8514DS	43	10.495	0.662	0.001	87232
129.000	(2) RRUS-11	43	9.391	0.637	0.001	39651
127.000	(2) 7770.00	43	9.117	0.630	0.001	33551

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
125.000	(2) RRUS-11	43	8.845	0.624	0.001	29077

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	140 - 88.753	31.506	10	1.936	0.004
L2	94.67 - 46.083	14.581	10	1.461	0.001
L3	53.25 - 0	4.600	10	0.787	0.000

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
137.000	LNX-8514DS	10	30.305	1.910	0.004	30298
129.000	(2) RRUS-11	10	27.118	1.838	0.003	13771
127.000	(2) 7770.00	10	26.328	1.820	0.003	11652
125.000	(2) RRUS-11	10	25.543	1.801	0.003	10099

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in²	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
L1	140 - 88.753 (1)	TP42.393x28.583x0.281	51.247	0.000	0.0	39.000	36.169	-11.172	1410.600	0.008
L2	88.753 - 46.083 (2)	TP53.33x40.236x0.375	48.587	0.000	0.0	39.000	60.731	-21.340	2368.500	0.009
L3	46.083 - 0 (3)	TP65x50.649x0.438	53.250	0.000	0.0	39.000	89.653	-39.653	3496.470	0.011

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	140 - 88.753 (1)	TP42.393x28.583x0.281	516.702	17.131	39.000	0.439	0.000	0.000	39.000	0.000
L2	88.753 - 46.083 (2)	TP53.33x40.236x0.375	1268.167	19.892	39.000	0.510	0.000	0.000	39.000	0.000

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 $\frac{f_{by}}{F_{by}}$
L3	46.083 - 0 (3)	TP65x50.649x0.438	2509.867	21.064	39.000	0.540	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	140 - 88.753 (1)	TP42.393x28.583x0.281	15.810	0.437	26.000	0.034	0.007	0.000	26.000	0.000
L2	88.753 - 46.083 (2)	TP53.33x40.236x0.375	20.473	0.337	26.000	0.026	0.007	0.000	26.000	0.000
L3	46.083 - 0 (3)	TP65x50.649x0.438	26.179	0.292	26.000	0.022	0.007	0.000	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	140 - 88.753 (1)	0.008	0.439	0.000	0.034	0.000	0.447 ✔	1.333	H1-3+VT ✔
L2	88.753 - 46.083 (2)	0.009	0.510	0.000	0.026	0.000	0.519 ✔	1.333	H1-3+VT ✔
L3	46.083 - 0 (3)	0.011	0.540	0.000	0.022	0.000	0.552 ✔	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	140 - 88.753	Pole	TP42.393x28.583x0.281	1	-11.172	1880.330	33.6	Pass
L2	88.753 - 46.083	Pole	TP53.33x40.236x0.375	2	-21.340	3157.210	39.0	Pass
L3	46.083 - 0	Pole	TP65x50.649x0.438	3	-39.653	4660.794	41.4	Pass
							Summary	
						Pole (L3)	41.4	Pass
						RATING =	**41.4**	**Pass**

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 2510 \cdot ft \cdot kips$	(Input From tnxTower)
Shear Force =	$Shear := 26 \cdot kips$	(Input From tnxTower)
Axial Force =	$Axial := 40 \cdot kips$	(Input From tnxTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	$N := 20$	(User Input)
Diameter of Bolt Circle =	$D_{bc} := 72.50 \cdot in$	(User Input)
Bolt "Column" Distance =	$l := 3.0 \cdot in$	(User Input)
Bolt Ultimate Strenght =	$F_u := 100 \cdot ksi$	(User Input)
Bolt Yeild Strenght =	$F_y := 75 \cdot ksi$	(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 50

Plate Yield Strength =	$Fy_{bp} := 50 \cdot ksi$	(User Input)
Base Plate Thickness =	$t_{bp} := 3.25 \cdot in$	(User Input)
Base Plate Diameter =	$D_{bp} := 79.71 \cdot in$	(User Input)
Outer Pole Diameter =	$D_{pole} := 65.00 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =: $R_{bc} := \frac{D_{bc}}{2} = 36.25 \cdot in$

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

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

$d_1 = 11.20 \cdot in$	$d_7 = 29.33 \cdot in$
$d_2 = 21.31 \cdot in$	$d_8 = 21.31 \cdot in$
$d_3 = 29.33 \cdot in$	$d_9 = 11.20 \cdot in$
$d_4 = 34.48 \cdot in$	$d_{10} = 0.00 \cdot in$
$d_5 = 36.25 \cdot in$	$d_{11} = -11.20 \cdot in$
$d_6 = 34.48 \cdot in$	etc.

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 32.5 \cdot in$

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

$MA_1 = 0.00 \cdot in$	$MA_7 = 0.00 \cdot in$
$MA_2 = 0.00 \cdot in$	$MA_8 = 0.00 \cdot in$
$MA_3 = 0.00 \cdot in$	$MA_9 = 0.00 \cdot in$
$MA_4 = 1.98 \cdot in$	$MA_{10} = 0.00 \cdot in$
$MA_5 = 3.75 \cdot in$	$MA_{11} = 0.00 \cdot in$
$MA_6 = 1.98 \cdot in$	etc

Effective Width of Baseplate for Bending = $B_{eff} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 36.9 \cdot in$

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i (d_i)^2 = 1.314 \times 10^4 \cdot in^2$

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 = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 81.1 \cdot kips$

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

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

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Net}} \cdot 100 = 42$ 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 = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.325 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 4.7 \cdot ksi$

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 = $C_{Max} := OM \cdot \frac{R_{bc}}{I_p} + \frac{Axial}{N} = 85.1 \cdot kips$

Maximum Compressive Stress = $f_a := \frac{C_{Max}}{A_n} = 26.2 \cdot ksi$

$K := 0.65$

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

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

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

Combined Stress % of Capacity = $\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) \cdot 100 = 43.7$

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

$Condition2 = \text{"OK"}$

Base Plate Analysis:

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

$C_1 = 27.7 \cdot kips$	$C_7 = 69.2 \cdot kips$
$C_2 = 50.8 \cdot kips$	$C_8 = 50.8 \cdot kips$
$C_3 = 69.2 \cdot kips$	$C_9 = 27.7 \cdot kips$
$C_4 = 81.0 \cdot kips$	$C_{10} = 2.0 \cdot kips$
$C_5 = 85.1 \cdot kips$	$C_{11} = -23.7 \cdot kips$
$C_6 = 81.0 \cdot kips$	etc.

Maximum Bending Stress in Plate = $f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} \cdot t_{bp}^{\,2}\right)} = 9.8 \cdot ksi$

Allowable Bending Stress in Plate = $F_{bp} := 1.33 \cdot 0.75 \cdot Fy_{bp} = 49.9 \cdot ksi$

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} \cdot 100 = 19.7$

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 =	$OM := 2510 \cdot ft \cdot kips$	(User Input from tnxTower)
Shear Force =	$Shear := 26 \cdot kip$	(User Input from tnxTower)
Axial Force =	$Axial := 40 \cdot kip$	(User Input from tnxTower)
Tower Height =	$H_t := 140 \cdot ft$	(User Input)

Footing Data:

Overall Depth of Footing =	$D_f := 7.0 \cdot ft$	(User Input)
Length of Pier =	$L_p := 4.5 \cdot ft$	(User Input)
Extension of Pier Above Grade =	$L_{pag} := 0.5 \cdot ft$	(User Input)
Diameter of Pier =	$d_p := 8.5 \cdot ft$	(User Input)
Thickness of Footing =	$T_f := 3.0 \cdot ft$	(User Input)
Width of Footing =	$W_f := 26.0 \cdot ft$	(User Input)

Anchor Bolt Data:

Length of Anchor Bolts =	$L_{st} := 84 \cdot in$	(User Input)
Projection of Anchor Bolts Above Pier =	$A_{BP} := 10.25 \cdot in$	(User Input)
Anchor Bolt Diameter =	$d_{anchor} := 2.25 \cdot in$	(User Input)
Base Plate Bolt Circle =	$MP := 72.5 \cdot in$	(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 =	$\Phi_s := 30 \cdot deg$	(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 =	$n := 1 \cdot ft$	(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 =	$NB_{pier} := 52$	(User Input)	
Clear Cover of Reinforcement =	$Cvr_{pier} := 3 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Diameter of Tie =	$d_{Tie} := 0.5 \cdot in$	(User Input)	

Pad Reinforcement:

Bar Size =	$BS_{top} := 7$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 0.875 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 21$	(User Input)	(Top of Pad)
Bar Size =	$BS_{bot} := 9$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{bbot} := 1.128 \cdot in$	(User Input)	(Bottom of Pad)
Number of Bars =	$NB_{bot} := 34$	(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 = $A_{btop} := \frac{\pi \cdot d_{btop}^2}{4} = 0.601 \cdot in^2$

Pad Bottom Reinforcement Bar Area = $A_{bbot} := \frac{\pi \cdot d_{bbot}^2}{4} = 0.999 \cdot in^2$

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

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

Stability of Footing:

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

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

Passive Pressure = $P_{pn} := K_p \cdot \gamma_s \cdot n + c \cdot 2 \cdot \sqrt{K_p} = 0.3 \cdot \text{ksf}$

$P_{pt} := K_p \cdot \gamma_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p} = 1.2 \cdot \text{ksf}$

$P_{top} := \text{if}\left[n < (D_f - T_f), P_{pt}, P_{pn}\right] = 1.2 \cdot \text{ksf}$

$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p} = 2.1 \cdot \text{ksf}$

$$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 1.65 \cdot \text{ksf}$$

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

$A_p := W_f \cdot T_p = 78$

Ultimate Shear = $S_u := P_{ave} \cdot A_p = 128.7 \cdot \text{kip}$

Weight of Concrete Pad = $WT_c := \left[\left(W_f^{\,2} \cdot T_f\right) + d_p^{\,2} \cdot L_p\right] \cdot \gamma_c = 352.969 \cdot \text{kip}$

Weight of Soil Above Footing =
$$WT_{s1} := \left[\left(W_f^{\,2} - d_p^{\,2}\right) \cdot \begin{cases} (L_p - L_{pag} - n) & \text{if } (L_p - L_{pag} - n) \ge 0 \\ 0 & \text{if } (L_p - L_{pag} - n) \le 0 \end{cases}\right] \cdot \gamma_s = 181.13 \cdot \text{kip}$$

Weight of Soil Wedge at Back Face =
$$WT_{s2} := \left(\frac{D_f^{\,2} \cdot \tan(\Phi_s)}{2} \cdot W_f\right) \cdot \gamma_s = 36.777 \cdot \text{kip}$$

Weight of Soil Wedge at back face Corners =
$$WT_{s3} := 2 \cdot \left[(D_f)^3 \cdot \frac{\tan(\Phi_s)}{3}\right] \cdot \gamma_s = 13.202 \cdot \text{kips}$$

Total Weight = $WT_{tot} := WT_c + WT_{s1} + \text{Axial} = 574.094 \cdot \text{kip}$

Resisting Moment =
$$M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + \left[(WT_{s2} + WT_{s3}) \cdot \left(W_f + \frac{D_f \cdot \tan(\Phi_s)}{3}\right)\right] = 8959 \cdot \text{kip} \cdot \text{ft}$$

Overturning Moment = $M_{ot} := OM + \text{Shear} \cdot (L_p + T_f) = 2705 \cdot \text{kip} \cdot \text{ft}$

Factor of Safety Actual =
$$FS := \frac{M_r}{M_{ot}} = 3.31$$

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

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

OverTurning_Moment_Check = "Okay"

Shear Capacity in Pier:

Shear Resistance of Pier = $S_p := \frac{\mu \cdot WT_{tot}}{FS_{req}} = 129.171 \cdot kips$

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

Shear_Check = "Okay"

Bearing Pressure Caused by Footing:

Area of the Mat = $A_{mat} := W_f^{\,2} = 676$

Section Modulus of Mat = $S := \frac{W_f^{\,3}}{6} = 2929.33 \cdot ft^3$

Maximum Pressure in Mat = $P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S} = 1.773 \cdot ksf$

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

Max_Pressure_Check = "Okay"

Minimum Pressure in Mat = $P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S} = -0.074 \cdot ksf$

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

Min_Pressure_Check = "No Good"

Distance to Resultant of Pressure Distribution = $X_p := \frac{P_{max}}{\frac{P_{max}-P_{min}}{W_f}} \cdot \frac{1}{3} = 8.319$

Distance to Kern = $X_k := \frac{W_f}{6} = 4.333$

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

Eccentricity = $e := \frac{M_{ot}}{WT_{tot}} = 4.712$

Adjusted Soil Pressure = $P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \left(\frac{W_f}{2} - e\right)} = 1.776 \cdot ksf$

$q_{adj} := \text{if}(P_{min} < 0, P_a, P_{max}) = 1.776 \cdot ksf$

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

Pressure_Check = "Okay"

Concrete Bearing Capacity:

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

Bearing Strength Between Pier and Pad = $P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot \frac{\pi \cdot d_p^2}{4} = 1.354 \times 10^4 \cdot kips$ (ACI-2008 10.14)

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

Bearing_Check = "Okay"

Shear Strength of Concrete:

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

$\phi_c := 0.85$ (ACI 9.3.2.5)

$d := T_f - Cvr_{pad} - d_{bbot} = 31.872 \cdot in$

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

$d_2 := d_1 - d$

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

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

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

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

Beam_Shear_Check := if(V_req < V_Avail, "Okay", "No Good")

Beam_Shear_Check = "Okay"

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

Critical Perimeter of Punching Shear = $b_o := \left(d_p + d\right) \cdot \pi = 35$

Area Included Inside Perimeter = $A_{bo} := \frac{\pi \cdot \left(d_p + d\right)^2}{4} = 97.7$

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 578.3$

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

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

$v_u := Find(v_u) = 6.2 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f = 425.9 \cdot kips$

Required Shear Strength = $V_{req} := LF \cdot V_u = 567.7 \cdot kips$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 2496.3 \cdot kip$ (ACI-2008 11.11.2.1)

Punching_Shear_Check := if(V_req < V_Avail, "Okay", "No Good")

Punching_Shear_Check = "Okay"

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

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

$q_b := q_{adj} - d_1 \cdot Slope = 1.151 \cdot ksf$

Maximum Bending at Face of Pier = $M_u := LF \cdot \left[(q_{adj} - q_b) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f = 2080 \cdot kip \cdot ft$

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

(ACI-200810.2.7.3)

$R_n := \frac{M_u}{\phi_m \cdot W_f \cdot d^2} = 87.5 \cdot psi$

$\rho := \frac{0.85 \cdot f_c}{f_y} \left(1 - \sqrt{1 - \frac{2 \cdot R_n}{0.85 \cdot f_c}} \right) = 0.0015$

$\rho_{min} := \rho = 0.00148$

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:

$As := \begin{cases} \rho_{min} \cdot W_f \cdot d & \text{if } \rho_{min} > \frac{\rho_{sh}}{2} \\ \rho_{sh} \cdot W_f \cdot \frac{d}{2} & \text{otherwise} \end{cases} = 14.76 \cdot in^2$

$As_{prov} := A_{bbot} \cdot NB_{bot} = 34 \cdot in^2$

Pad_Reinforcement_Bot := if($As_{prov} > As$, "Okay", "No Good")

Pad_Reinforcement_Bot = "Okay"

Check top Bars:

$As := \rho_{sh} \cdot \left(W_f \cdot \frac{d}{2}\right) = 8.9 \cdot in^2$

$As_{prov} := A_{btop} \cdot NB_{top} = 12.6 \cdot in^2$

Pad_Reinforcement_Top := if($As_{prov} > As$, "Okay", "No Good")

Pad_Reinforcement_Top = "Okay"

Developement Length Pad Reinforcement:

Bar Spacing = $B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 8.11 \cdot in$

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)

$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pad} \cdot \beta_{pad} \cdot \gamma_{pad} \cdot \lambda_{pad}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \frac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot} = 34.8 \cdot in$

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

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

Available Length in Pad = $L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad} = 102 \cdot in$

Lpad_Check := if($L_{Pad} > L_{dbt}$, "Okay", "No Good")

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

Area of Pier = $A_p := \frac{\pi \cdot d_p^2}{4} = 8171.28 \cdot in^2$

$A_{smin} := 0.01 \cdot 0.5 \cdot A_p = 40.86 \cdot in^2$ (ACI-2008 10.8.4 & 10.9.1)

$A_{sprov} := NB_{pier} \cdot A_{bpier} = 81.2 \cdot in^2$

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

Steel_Area_Check = "Okay"

Bar Spacing In Pier = $B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 4.752 \cdot in$

Diameter of Reinforcement Cage = $Diam_{cage} := d_p - 2 \cdot Cvr_{pier} = 96 \cdot in$

Maximum Moment in Pier = $M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2}\right)\right] \cdot LF = 42199.1 \cdot in \cdot kips$

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

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

$$\left(D \;\; N \;\; n \;\; P_u \;\; M_{xu}\right) = \left(102 \;\; 52 \;\; 11 \;\; 53.32 \;\; 4.22 \times 10^4\right)$$

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

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

$$\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho\right) = \left(231.918 \;\; 1.835 \times 10^5 \;\; -60 \;\; 9.927 \times 10^{-3}\right)$$

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

Axial_Load_Check = "Okay"

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

Bending_Check = "Okay"

Development Length Pier Reinforcement:

Available Length in Foundation:

$L_{pier} := L_p - Cvr_{pier} = 51 \cdot in$

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

Tension: (ACI-2008 12.2.3)

Spacing or Cover Dimension = $c := if\left(Cvr_{pier} < \frac{B_{sPier}}{2}, Cvr_{pier}, \frac{B_{sPier}}{2}\right) = 2.376 \cdot in$

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

$$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 68.74 \cdot in$$

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:

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

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

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

Compression: (ACI-2008 12.3.2)

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

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

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

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

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

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)

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

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

$s_{lim3} := D_f \cdot z = 84 \cdot in$

$s_{lim4} := 18in$

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

Number of Ties Required = $n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 = 3.667$

Check Anchor Steel Embedment:

Depth Available = $D_{ab} := L_{st} - A_{BP} = 6.146 \cdot ft$

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

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

Depth_Check = "No Good"

Note: Anchor plate is provided

SITE NAME	WOODSTOCK NW CT	ECP - CELL #	2 / 568
LATITUDE	41-58-43.15 N	LONGITUDE	72-05-39.93 W
Notes: AWS AB Carrier Add, Change 1900 to 4 port HBXX-6517DS-A2M, Add ALU RRH 2X60 and 2100 HBXX-6517DS-A2M		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)	100	190	300
DOWN TILT (MECH/ELEC)	0/4	0/4	0/4
RAD CTR (FT AGL)	137	137	137
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-750MHZ	BXA-70063-6CF-750MHZ	BXA-70063-6CF-750MHZ
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	100	190	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-750MHZ	BXA-70063-6CF-750MHZ	BXA-70063-6CF-750MHZ
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	100	190	300
DOWN TILT (MECH/DEG)	3	3	3
RAD CTR (FT AGL)	137	137	137
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
850 Cellular - Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	#N/A	#N/A	#N/A
ANTENNA TYPE	LPA-80080/6CF	LPA-80080/6CF	LPA-80080/6CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	100	190	300
DOWN TILT (MECH/DEG)	2	2	2
RAD CTR (FT AGL)	137	137	137
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
850 Cellular - Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	#N/A	#N/A	#N/A
ANTENNA TYPE	LNX-8514DS-A1M	LNX-8514DS-A1M	LNX-8514DS-A1M
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	100	190	300
DOWN TILT (MECH/DEG)	0/2	0/2	0/2
RAD CTR (FT AGL)	137	137	137
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
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	LPA-185080-12CF 2	LPA-185080-12CF 2	LPA-185080-12CF 2
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	100	190	300
DOWN TILT (MECH/DEG)	2	2	2
RAD CTR (FT AGL)	137	137	137
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
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)	100	190	300
DOWN TILT (MECH/ELEC)	0/2	0/2	0/2
RAD CTR (FT AGL)	137	137	137
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE			

NUMBER OF CABLE'S NEEDED						ESTIMATED CABLE LENGTH			
MAINLINE SIZE	1 5/8"	TOTAL # OF MAINLINES			18	MAINLINE (FT)			
JUMPER SIZE	1/2 "	TOTAL # OF TOP JUMPERS			18	TOP JUMPER (FT)			12
Equipment Cable Ordering		**MAIN CABLE**	18	+	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 - B**	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: Ray Paradis	Rob Hesselbach	RLP	7/8/2014

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

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°
Impedance	50 ohm	50 ohm	50 ohm

General Specifications

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

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

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

LNX-8514DS-VTM

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

- Great solution to maximize network coverage and capacity
- Excellent front-to-back ratio, USLS, VSWR, and PIM specifications to enhance network quality
- Fully compatible with Andrew remote electrical tilt system for greater OpEx savings
- Vertical beam optimized for capacity efficiency
- The RF connectors are designed for IP67 rating and the radome for IP56 rating
- 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

Frequency Band, MHz	**698–806**	**806–896**
Gain by all Beam Tilts, average, dBi	15.7	16.2
Gain by all Beam Tilts Tolerance, dB	±0.3	±0.2
Gain by Beam Tilt, average, dBi	0 ° | 15.7 4 ° | 15.7 8 ° | 15.5	0 ° | 16.3 4 ° | 16.3 8 ° | 16.1
Beamwidth, Horizontal, degrees	85	84
Beamwidth, Horizontal Tolerance, degrees	±1.2	±1.3
Beamwidth, Vertical, degrees	8.6	7.8
Beamwidth, Vertical Tolerance, degrees	±0.5	±0.4
Beam Tilt, degrees	0–8	0–8
USLS, dB	20	22
Front-to-Back Total Power at 180° ± 30°, dB	22	23
CPR at Boresight, dB	18	18
CPR at Sector, dB	12	11
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
Number of Ports, all types	2

Mechanical Specifications

Color	Light gray
Lightning Protection	dc Ground
Radiator Material	Aluminum
Radome Material	Fiberglass, UV resistant

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

LNX-8514DS-VTM

RF Connector Interface	7-16 DIN Female
RF Connector Location	Bottom
RF Connector Quantity, total	2
Wind Loading, maximum	879.0 N @ 150 km/h 197.6 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Dimensions

Depth	181.0 mm | 7.1 in
Length	2449.0 mm | 96.4 in
Width	301.0 mm | 11.9 in
Net Weight	23.1 kg | 50.9 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 1.1 Actuator	LNX-8514DS-R2M
Model with Factory Installed AISG 2.0 Actuator	LNX-8514DS-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)

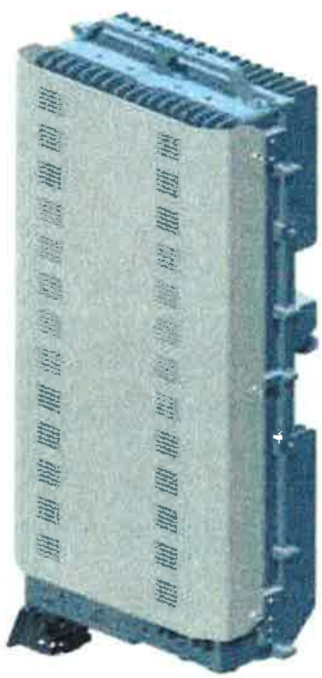
Included Products

DB380-3 — Pipe Mounting Kit for 2.4 - 4.5 in (60 - 115 mm) OD round members. Used for wide panel antennas. Includes three clamp sets.

DB5083D — Downtilt Mounting Kit for 2.4"-4.5" (60-115 mm) OD round members. Consists of two DB5083 heavy-duty, galvanized steel downtilt mounting brackets. This kit is compatible with the DB380-3 pipe mount for panel antennas with three mounting points.

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.

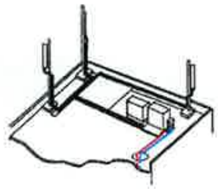
EASY INSTALLATION

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.

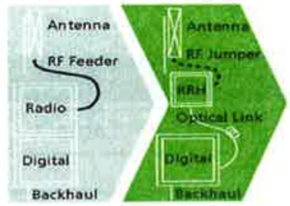
The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment. However, many of these sites can host an Alcatel-Lucent RRH2x60-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation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

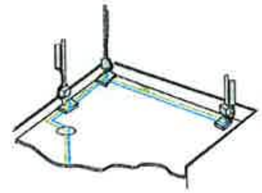
Installation can easily be done by a single person as the Alcatel–Lucent RRH2x60-AWS is compact and weighs about 20 kg, eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day.



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.