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Also admitted in Massachusetts

February 20, 2014

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

Re: **Notice of Exempt Modification – Antenna Swap**
484 Meriden Road, Middlefield, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) wireless telecommunications antennas at the top of the existing 150-foot tower at 484 Meriden Road in Middlefield, Connecticut (the "Property"). Cellco is the owner of the tower . The Council approved Cellco's use of the existing tower in 1999 (Docket No. 223). Cellco now intends to modify its facility by adding three (3) model 742 213V01, 2100 MHz antennas, all at the 150-foot level on the tower. Cellco also intends to install three (3) remote radio heads ("RRHs") behind its 2100 MHz antennas and one (1) HYBRIFLEX™ antenna cable attached to the outside of the tower. 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 Jon A. Brayshaw, First Selectman of the Town of Middlefield. A copy of this letter is also being sent to Land Management, Inc., owner of the Property.

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

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1. The proposed modifications will not result in an increase in the height of the existing tower. The additional antennas and RRHs will be located on Cellco's existing platform at the 150-foot level on the 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 modified facility 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 worst-case RF emissions calculation 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:
Jon A. Brayshaw, Middlefield First Selectman
Land Management, Inc.
Sandy M. Carter

ATTACHMENT 1

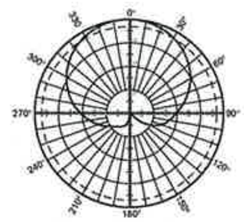
KATHREIN
SCALA DIVISION

742 213V01

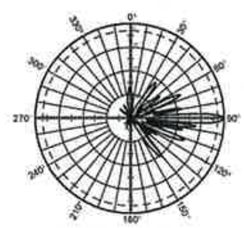
65° Panel Antenna

Kathrein's X-polarized adjustable electrical downtilt antennas offer the wireless carrier the ability to tailor polarization diversity sites for optimum performance. Using variable downtilt, only a few models need be procured to accommodate the needs of widely varying conditions. Remotely controlled downtilt is available as a retrofitable option.

- 0-6° downtilt range.
- UV resistant pulltruded fiberglass radome.
- DC Grounded metallic parts for impulse suppression.
- No moving electrical connections.
- Wideband vector dipole technology.
- Optional remote downtilt Control.
- Will accomodate future 3G / UMTS applications.



Horizontal pattern
±45°- polarization



Vertical pattern
±45°- polarization
0°–6° electrical downtilt

General specifications:

Frequency range	1710–2200 MHz
VSWR	< 1.5:1
Impedance	50 ohms
Intermodulation (2x20w)	IM3: <-150 dBc
Polarization	+45° and -45°
Front-to-back ratio (180°±30°)	>30 dB (co-polar) >25 dB (total power)
Maximum input power	300 watts per input (at 50°C)
Electrical downtilt continuously adjustable	0–6 degrees
Connector	2 x 7-16 DIN female
Isolation	>30 dB
Cross polar ratio Main direction 0° Sector ±60°	 25 dB (typical) >10 dB
Tracking, average	0.5 dB
Squint	±2.0°
Weight	19.8 lb (9 kg) 24.3 lb (11 kg) clamps included
Dimensions	76.9 x 6.1 x 2.8 inches (1954 x 155 x 70 mm)
Wind load Front/Side/Rear Mounting category	at 93 mph (150kph) 115 lbf / 32 lbf / 115 lbf (510 N) / (140 N) / (510 N) M (Medium)
Wind survival rating*	120 mph (200 kph)
Shipping dimensions	88 x 6.8 x 3.6 inches (2235 x 172 x 92 mm)
Shipping weight	28.7 lb (13 kg)
Mounting	Fixed mounts for 2 to 4.6 inch (50 to 115 mm) OD masts are included and tilt options are available.

See reverse for order information.

Specifications:	1710–1880 MHz	1850–1990 MHz	1920–2200 MHz
Gain	19 dBi	19.2 dBi	19.5 dBi
+45° and -45° polarization horizontal beamwidth	67° (half-power)	65° (half-power)	63° (half-power)
+45° and -45° polarization vertical beamwidth	4.7° (half-power)	4.5° (half-power)	4.3° (half-power)
Sidelobe suppression for first sidelobe above main beam	0° 2° 4° 6° T 18 18 16 15 dB	0° 2° 4° 6° T 18 18 17 16 dB	0° 2° 4° 6° T 18 18 18 18 dB

*Mechanical design is based on environmental conditions as stipulated in TIA-222-G-2 (December 2009) and/or ETS 300 019-1-4 which include the static mechanical load imposed on an antenna by wind at maximum velocity. See the Engineering Section of the catalog for further details.

RoHS
Lead-Free

11271-B
936.3740/b

Kathrein Inc., Scala Division Post Office Box 4580 Medford, OR 97501 (USA) Phone: (541) 779-6500 Fax: (541) 779-3991
Email: communications@kathrein.com Internet: www.kathrein-scala.com

Alcatel·Lucent

Alcatel-Lucent RRH2x40-AWS

REMOTE RADIO HEAD

The Alcatel-Lucent RRH2x40-AWS is a high-power, small form-factor Remote Radio Head (RRH) operating in the AWS frequency band (1700/2100MHz - 3GPP Band 4). The Alcatel-Lucent RRH2x40-AWS is designed with an eco-efficient approach, providing operators with the means to achieve high quality and capacity coverage with minimum site requirements.

A distributed eNodeB expands 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 an eNodeB to be installed separately, within the same site or several kilometres apart.

The Alcatel-Lucent RRH2x40-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. The Alcatel-Lucent RRH2x40-AWS has two transmit RF paths, 40 W RF output power per transmit path, and is designed to manage up to four-way receive diversity. The device is ideally suited to support macro coverage, with multiple-input multiple-output (MIMO) 2x2 operation in up to 20 MHz of bandwidth.

The Alcatel-Lucent RRH2x40-AWS is designed to make available all the benefits of a distributed eNodeB, with excellent RF characteristics, with low capital expenditures (CAPEX) and low operating expenditures (OPEX). The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment or require costly cranes to be employed, leaving coverage holes. However, many of these sites can host an Alcatel-Lucent RRH2x40-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation time and costs.

Fast, low-cost installation and deployment

The Alcatel-Lucent RRH2x40-AWS is a zero-footprint solution and operates noise-free, simplifying negotiations with site property owners and minimizing environmental impacts. Installation can easily be done by a single person because the Alcatel-Lucent RRH2x40-AWS is compact and weighs less than 20 kg (44 lb), 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 — a fraction of the time required for a traditional BTS.

Excellent RF performance

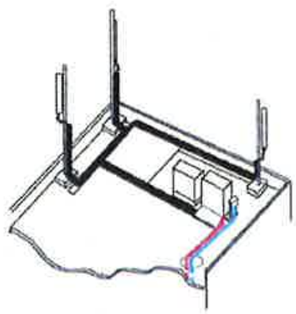
Because of its small size and weight, the Alcatel-Lucent RRH2x40-AWS can be installed close to the antenna. Operators can therefore locate the Alcatel-Lucent RRH2x40-AWS where RF engineering is deemed ideal, minimizing trade-offs between available sites and RF optimum sites. The RF feeder cost and installation costs are reduced or eliminated, and there is no need for a Tower Mounted Amplifier (TMA) because losses introduced by the RF feeder are greatly reduced. The Alcatel-Lucent RRH2x40-AWS provides more RF power while at the same time consuming less electricity.

Features

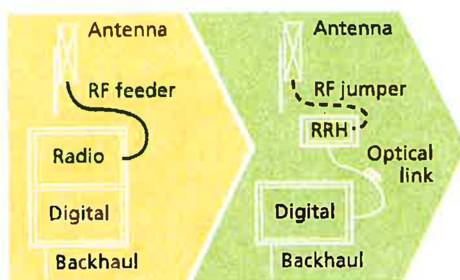
- Zero-footprint deployment
- Easy installation, with a lightweight unit can be carried and set up by one person
- Optimized RF power, with flexible site selection and elimination of a TMA
- Convection-cooled (fanless)
- Noise-free
- Best-in-class power efficiency, with significantly reduced energy consumption

Benefits

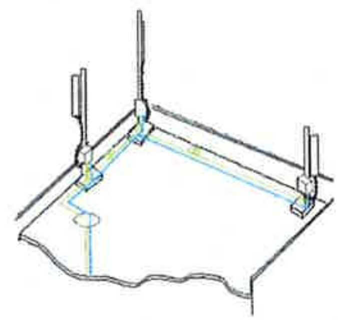
- Leverages existing real estate with lower site costs
- Reduces installation costs, with fewer installation materials and simplified logistics
- Decreases power costs and minimizes environmental impacts, with the potential for eco-sustainable power options
- Improves RF performance and adds flexibility to network planning



Macro



RRH for space-constrained cell sites



Distributed

Technical specifications

Physical dimensions

- Height: 620 mm (24.4 in.)
- Width: 270 mm (10.63 in.)
- Depth: 170m (6.7 in.)
- Weight (without mounting kit): less than 20 kg (44 lb)

Power

- Power supply: -48VDC

Operating environment

- Outdoor temperature range:
  - With solar load: -40°C to +50°C (-40°F to +122°F)
  - Without solar load: -40°C to +55°C (-40°F to +131°F)
- Passive convection cooling (no fans)
- Enclosure protection
  - IP65 (International Protection rating)

RF characteristics

- Frequency band: 1700/2100 MHz (AWS); 3GPP Band 4
- Bandwidth: up to 20 MHz
- RF output power at antenna port: 40 W nominal RF power for each Tx port
- Rx diversity: 2-way or 4-way with optional Rx Diversity module
- Noise figure: below 2.0 dB typical
- Antenna Line Device features
  - TMA and Remote electrical tilt (RET) support via AISG v2.0

Optical characteristics

Type/number of fibers

- Single-mode variant
  - One Single Mode Single Fiber per RRH2x, carrying UL and DL using CWDM
  - Single mode dual fiber (SM/DF)
- Multi-mode variant
  - Two Multi-mode fibers per RRH2x: one carrying UL, the other carrying DL

Optical fiber length

- Up to 500 m (0.31 mi), using MM fiber
- Up to 20 km (12.43 mi), using SM fiber

Digital Ports and Alarms

- Two optical ports to support daisy-chaining
- Six external alarms

Alcatel·Lucent

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.

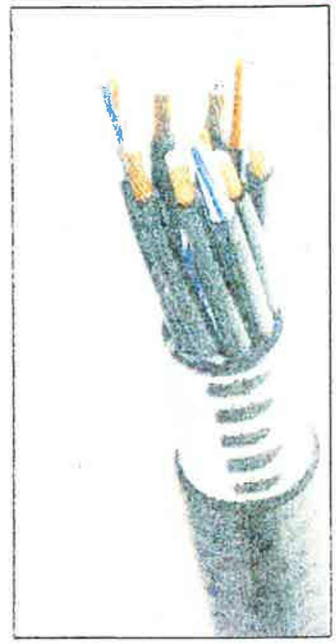


Figure 1: HYBRIFLEX Series

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

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

* This data is provisional and subject to change

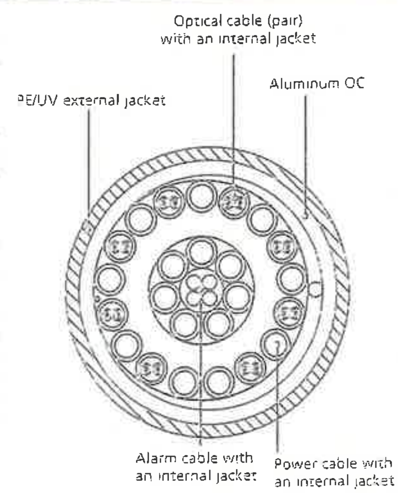


Figure 2: Construction Detail

ATTACHMENT 2

	General	Power	Density					
Site Name: Middlefield								
Tower Height: Verizon @ 150ft								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*AT&T UMTS	2	565	134	0.0226	880	0.5867	3.86%	
*AT&T UMTS	2	875	134	0.0350	1900	1.0000	3.50%	
*AT&T GSM	1	283	134	0.0057	880	0.5867	0.97%	
*AT&T GSM	4	525	134	0.0421	1900	1.0000	4.21%	
*AT&T LTE	1	1313	134	0.0263	734	0.4893	5.37%	
*T-Mobile	8	166	137	0.0254	1935	1.0000	2.54%	
Verizon	**11**	**410**	**150**	**0.0721**	**1970**	**1.0000**	**7.21%**	
Verizon	**9**	**387**	**150**	**0.0557**	**869**	**0.5793**	**9.61%**	
Verizon	**1**	**2163**	**150**	**0.0346**	**2145**	**1.0000**	**3.46%**	
Verizon	**1**	**805**	**150**	**0.0129**	**698**	**0.4653**	**2.76%**	
								43.49%
* Source: Siting Council								

ATTACHMENT 3

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

150-ft Existing EEI Monopole

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Middlefield

484 Meriden Road
Middlefield, CT

Centek Project No. 13001.106

Date: January 2, 2014

Prepared for:

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

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

Table of Contents

Introduction

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

The host tower is a 150-ft, four-section, eighteen sided, tapered monopole, originally designed and manufactured by Engineered Endeavors Inc (EEI)—job no: 11121, dated September 17, 2002. The tower geometry, structure member sizes and foundation system information were obtained from the aforementioned EEI design report.

Antenna and appurtenance information were obtained from a previous structural analysis report prepared by Centek project no. 12044.CO20 dated April 24, 2012 and a RF data sheet.

The tower is made up of four (4) tapered vertical sections consisting of A572-65 pole sections. The vertical tower sections are slip joint connected. The diameter of the pole (flat-flat) is 19.50-in at the top and 56.50-in at the base.

Verizon proposes the installation of three (3) panel antennas, three (3) remote radio heads and one (1) main distribution box mounted to 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:

- T-Mobile (Existing):
  Antennas: Six (6) EMS RR90-17-02DP panel antennas and six (6) Remec 10"x8"x5" TMA's mounted to one (1) 4-Sector T-Arm frame w/ work supports with a RAD center elevation of 140-ft above grade level.
  Coax Cables: Twelve (12) 1 5/8" ∅ coax cables running on the inside of the monopole.
- AT&T (Existing):
  Antennas: Three (3) KMW AM-X-CD-16-65-00T panel antennas, six (6) Powerwave 7770 panel antennas, six (6) Powerwave LGP21401 TMA's, six (6) Powerwave LGP21901 Diplexers and three (3) Kathrein Smart Bias-T mounted on one (1) low profile platform at a RAD center elevation of 134-ft above grade level.
  Coax Cables: Twelve (12) 1 5/8" ∅ coax cables running on the inside of monopole.
- 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 136-ft above grade level.
  Coax Cables: One (1) fiber cable and two (2) dc control cables running on the inside of the monopole.
- Verizon (Existing):
  GPS: One (1) GPS antenna mounted on a 4-ft standoff arm with a RAD center elevation of 83-ft above grade level.
  Coax Cables: One (1) 7/8" ∅ coax cable running on the inside of monopole.

- Verizon (Existing to Remain):
  Antennas: Three (3) Antel BXA-70063-6CF, six (6) Antel LPA-80063-6CF and three (3) Antel BXA-171063-12BF panel antennas mounted to one (1) low profile platform with a RAD center elevation of 150-ft above existing grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the monopole and six (6) 1-5/8" ∅ coax cables running on the exterior of the monopole.
- **VERIZON (Proposed):**
  Antennas: Three (3) Kathrein 742-213 panel antennas, three (3) Alcatel-Lucent RRH2x40-AWS Remote Radio Heads and one (1) RFS DB-T1-6Z-8AB-0Z main distribution box mounted on an existing low profile platform with a RAD center elevation of 150-ft above existing grade.
  Coax Cables: One (1) 1-5/8" ∅ fiber cable running on the exterior 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:	Middlesex; v = 85 mph (fastest mile)	*[Section 16 of TIA/EIA-222-F-96]*
	Middlefield; v = 105 mph (3 second gust) equivalent to v = 85 mph (fastest mile)	*[Appendix K of the 2005 CT Building Code Supplement]*
	TIA/EIA-222-F and Appendix K wind speeds are equal.	
Load Cases:	Load Case 1; 85 mph wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 2; 74 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 74 mph wind speed velocity represents 75% of the wind pressure generated by the 85 mph wind speed.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 3; Seismic – not checked	*[Section 1614.5 of State Bldg. Code 2005] does not control in the design of this structure type*

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

Tower Capacity

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

- Calculated stresses were found to be within allowable limits. In Load Case 1, per tnxTower "Section Capacity Table", this tower was found to be at **85.0%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L2)	86.49'-123.58'	85.0%	**PASS**

Foundation and Anchors

The existing foundation consists of a 7-ft square x 3.0-ft long reinforced concrete pier on a 27.0-ft square x 2.5-ft thick reinforced concrete pad. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned EEI design report; job no: 11121, dated September 17, 2002. The base of the tower is connected to the foundation by means of (16) 2.25"∅, ASTM A615-75 anchor bolts embedded approximately 5-ft into the concrete foundation structure.

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

Location	Vector	Proposed Reactions
Base	Shear	26 kips
	Compression	35 kips
	Moment	2870 kip-ft

- The foundation was found to be within allowable limits.

Foundation	Design Limit	IBC 2003/2005 CT State Building Code Section 3108.4.2 (FS)(1)	Proposed Loading (FS)(1)	Result
Reinforced Concrete Pad and Pier	OTM(2)	2.0	2.29	**PASS**

Note 1: FS denotes Factor of Safety.

Note 2: OTM denotes Overturning Moment

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

Tower Component	Design Limit	Stress Ratio (percentage of capacity)	Result
Anchor Bolts	Combined Compression and Bending	68.1%	**PASS**
Base Plate	Bending	82.8%	**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:

Carlo F. Centore, PE
Principal ~ Structural Engineer

Prepared 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.

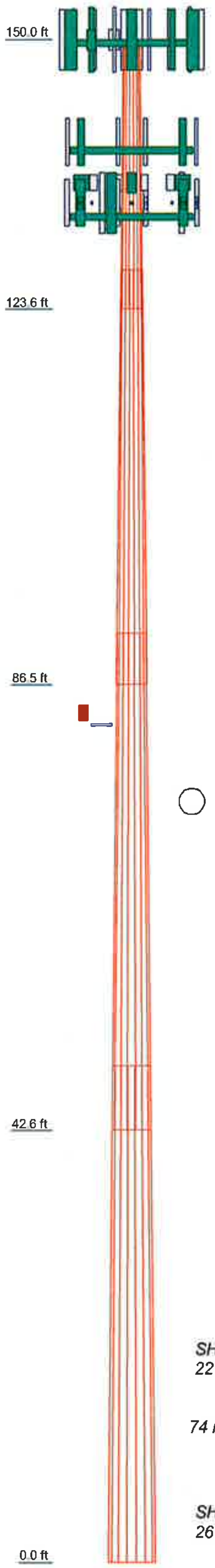
General Description of Structural Analysis Program

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	4	3	2	1
Length (ft)	48.906	48.920	40.920	26.420
Number of Sides	18	18	18	18
Thickness (in)	0.375	0.375	0.250	0.188
Socket Length (ft)		6.333	5.000	3.833
Top Dia (in)	43.922	33.726	24.998	19.500
Bot Dia (in)	56.500	46.300	35.510	26.370
Grade	A572-65			
Weight (K) 22.3	9.9	7.9	3.3	1.2



DESIGNED APPURTENANCE LOADING

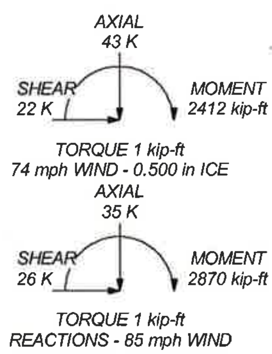
TYPE	ELEVATION	TYPE	ELEVATION
LPA-80063-6CF (Verizon - Existing)	150	(2) RRUS-11 (AT&T - Existing)	136
BXA-171063-12BF (Verizon - Existing)	150	(2) RRUS-11 (AT&T - Existing)	136
BXA-70063/6CF (Verizon - Existing)	150	(2) RRUS-11 (AT&T - Existing)	136
LPA-80063-6CF (Verizon - Existing)	150	DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	136
LPA-80063-6CF (Verizon - Existing)	150	Valmont Uni-Tri Bracket (AT&T - Existing)	136
BXA-171063-12BF (Verizon - Existing)	150	(2) 7770.00 (AT&T - Existing)	134
BXA-70063/6CF (Verizon - Existing)	150	AM-X-CD-16-65-00T-RET(72") (AT&T - Existing)	134
LPA-80063-6CF (Verizon - Existing)	150	(2) 7770.00 (AT&T - Existing)	134
LPA-80063-6CF (Verizon - Existing)	150	AM-X-CD-16-65-00T-RET(72") (AT&T - Existing)	134
BXA-171063-12BF (Verizon - Existing)	150	(2) 7770.00 (AT&T - Existing)	134
BXA-70063/6CF (Verizon - Existing)	150	AM-X-CD-16-65-00T-RET(72") (AT&T - Existing)	134
LPA-80063-6CF (Verizon - Existing)	150	(2) LGP21401 TMA (AT&T - Existing)	134
742-213 (Verizon - Proposed)	150	(2) LGP21401 TMA (AT&T - Existing)	134
742-213 (Verizon - Proposed)	150	(2) LGP21401 TMA (AT&T - Existing)	134
742-213 (Verizon - Proposed)	150	(2) LGP21901 Diplexer (AT&T - Existing)	134
RRH2x40-AWS (Verizon - Proposed)	150	(2) LGP21901 Diplexer (AT&T - Existing)	134
RRH2x40-AWS (Verizon - Proposed)	150	(2) LGP21901 Diplexer (AT&T - Existing)	134
RRH2x40-AWS (Verizon - Proposed)	150	Smart Bias T (AT&T - Existing)	134
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	150	Smart Bias T (AT&T - Existing)	134
EEI 14-ft Low Profile Platform (Verizon - Existing)	150	Smart Bias T (AT&T - Existing)	134
(2) RR90-17-02DP (T-Mobile Existing)	140	Valmont 13' Low Profile Platform (AT&T - Existing)	133
(2) RR90-17-02DP (T-Mobile Existing)	140	GPS (Verizon - Existing)	83
(2) RR90-17-02DP (T-Mobile Existing)	140	4-ft Standoff (Verizon - Existing)	82.5
(2) TMA 10"x8"x5" (T-Mobile Existing)	140		
(2) TMA 10"x8"x5" (T-Mobile Existing)	140		
(2) TMA 10"x8"x5" (T-Mobile Existing)	140		
4-Sector T-Arm w/ Work Support (T-Mobile Existing)	139.5		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

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



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Job: **13001.106 - Middlefield**			
Project: **150' EEI Monopole - 484 Meriden Rd., Middlefield, CT**			
Client: Verizon Wireless	Drawn by: TJL	App'd:	
Code: TIA/EIA-222-F	Date: 01/02/14	Scale: NTS	
Path:		Dwg No. E-1	

Tower Input Data

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

- Basic wind speed of 85 mph.
- Nominal ice thickness of 0.500 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	150.000-123.58 0	26.420	3.833	18	19.500	26.370	0.188	0.750	A572-65 (65 ksi)
L2	123.580-86.493	40.920	5.000	18	24.998	35.510	0.250	1.000	A572-65 (65 ksi)
L3	86.493-42.573	48.920	6.333	18	33.726	46.300	0.375	1.500	A572-65 (65 ksi)

Section	*Elevation* *ft*	*Section Length* *ft*	*Splice Length* *ft*	*Number of Sides*	*Top Diameter* *in*	*Bottom Diameter* *in*	*Wall Thickness* *in*	*Bend Radius* *in*	*Pole Grade*
L4	42.573-0.000	48.906		18	43.922	56.500	0.375	1.500	A572-65 (65 ksi)

Tapered Pole Properties

Section	*Tip Dia.* *in*	*Area* in^2	*I* in^4	*r* *in*	*C* *in*	*I/C* in^3	*J* in^4	*It/Q* in^2	*w* *in*	*w/t*
L1	19.801	11.493	541.578	6.856	9.906	54.672	1083.869	5.748	3.102	16.544
	26.777	15.582	1349.519	9.295	13.396	100.741	2700.814	7.792	4.311	22.993
L2	26.384	19.638	1519.570	8.786	12.699	119.659	3041.139	9.821	3.960	15.839
	36.058	27.979	4394.721	12.517	18.039	243.622	8795.225	13.992	5.810	23.239
L3	35.551	39.696	5578.094	11.839	17.133	325.584	11163.527	19.852	5.276	14.069
	47.014	54.662	14565.424	16.303	23.520	619.268	29150.014	27.336	7.489	19.97
L4	46.254	51.832	12418.103	15.459	22.312	556.555	24852.545	25.921	7.070	18.854
	57.372	66.803	26585.492	19.924	28.702	926.259	53205.966	33.408	9.284	24.757

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 150.000-123.580				1	1	1		
L2 123.580-86.493				1	1	1		
L3 86.493-42.573				1	1	1		
L4 42.573-0.000				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	150.000 - 1.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (T-Mobile - Existing)	C	No	Inside Pole	140.000 - 1.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (AT&T - Existing)	C	No	Inside Pole	134.000 - 1.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
7/8 (Verizon - Existing)	C	No	Inside Pole	83.000 - 1.000	1	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (Verizon - Existing)	C	No	CaAa (Out Of Face)	150.000 - 1.000	1	No Ice	0.198	0.001
						1/2" Ice	0.298	0.003
1 5/8 (Verizon - Existing)	C	No	CaAa (Out Of Face)	150.000 - 1.000	5	No Ice	0.000	0.001
						1/2" Ice	0.000	0.003
RG6-Fiber (AT&T - Existing)	C	No	Inside Pole	134.000 - 1.000	1	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
#8 AWG Copper WIre	C	No	Inside Pole	134.000 - 1.000	2	No Ice	0.000	0.000

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft²/ft	Weight klf
(AT&T - Existing) HYBRIFLEX 1-5/8" (Verizon - Proposed)	C	No	CaAa (Out Of Face)	83.000 - 1.000	1	1/2" Ice	0.000	0.000
						No Ice	0.198	0.002
						1/2" Ice	0.298	0.003

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	150.000-123.580	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	5.231	0.841
L2	123.580-86.493	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	7.343	1.661
L3	86.493-42.573	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	16.701	2.065
L4	42.573-0.000	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	16.463	1.963

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	150.000-123.580	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	7.873	1.080
L2	123.580-86.493	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	11.052	1.997
L3	86.493-42.573	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	25.135	2.525
L4	42.573-0.000	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	24.777	2.403

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
LPA-80063-6CF (Verizon - Existing)	A	From Face	3.500 -6.000	0.000	150.000	No Ice	10.308	9.005	0.027
						1/2" Ice	10.868	9.554	0.101

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
			0.000						
BXA-171063-12BF (Verizon - Existing)	A	From Face	3.500 -4.000 0.000	0.000	150.000	No Ice 1/2" Ice	4.734 5.180	3.572 4.007	0.015 0.042
BXA-70063/6CF (Verizon - Existing)	A	From Face	3.500 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.017 0.059
LPA-80063-6CF (Verizon - Existing)	A	From Face	3.500 6.000 0.000	0.000	150.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
LPA-80063-6CF (Verizon - Existing)	B	From Face	3.500 -6.000 0.000	0.000	150.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
BXA-171063-12BF (Verizon - Existing)	B	From Face	3.500 -4.000 0.000	0.000	150.000	No Ice 1/2" Ice	4.734 5.180	3.572 4.007	0.015 0.042
BXA-70063/6CF (Verizon - Existing)	B	From Face	3.500 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.017 0.059
LPA-80063-6CF (Verizon - Existing)	B	From Face	3.500 6.000 0.000	0.000	150.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
LPA-80063-6CF (Verizon - Existing)	C	From Face	3.500 -6.000 0.000	0.000	150.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
BXA-171063-12BF (Verizon - Existing)	C	From Face	3.500 -4.000 0.000	0.000	150.000	No Ice 1/2" Ice	4.734 5.180	3.572 4.007	0.015 0.042
BXA-70063/6CF (Verizon - Existing)	C	From Face	3.500 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.017 0.059
LPA-80063-6CF (Verizon - Existing)	C	From Face	3.500 6.000 0.000	0.000	150.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
742-213 (Verizon - Proposed)	A	From Face	3.500 4.000 0.000	0.000	150.000	No Ice 1/2" Ice	5.169 5.645	2.991 3.571	0.020 0.046
742-213 (Verizon - Proposed)	B	From Face	3.500 4.000 0.000	0.000	150.000	No Ice 1/2" Ice	5.169 5.645	2.991 3.571	0.020 0.046
742-213 (Verizon - Proposed)	C	From Face	3.500 4.000 0.000	0.000	150.000	No Ice 1/2" Ice	5.169 5.645	2.991 3.571	0.020 0.046
RRH2x40-AWS (Verizon - Proposed)	A	From Face	3.500 4.000 0.000	0.000	150.000	No Ice 1/2" Ice	2.522 2.753	1.589 1.795	0.044 0.061
RRH2x40-AWS (Verizon - Proposed)	B	From Face	3.500 4.000 0.000	0.000	150.000	No Ice 1/2" Ice	2.522 2.753	1.589 1.795	0.044 0.061
RRH2x40-AWS (Verizon - Proposed)	C	From Face	3.500 4.000 0.000	0.000	150.000	No Ice 1/2" Ice	2.522 2.753	1.589 1.795	0.044 0.061
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	A	From Face	3.500 4.000 0.000	0.000	150.000	No Ice 1/2" Ice	5.600 5.915	2.333 2.558	0.044 0.080
EEI 14-ft Low Profile Platform	C	None		0.000	150.000	No Ice 1/2" Ice	16.500 20.000	16.500 20.000	1.550 1.800

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 - Existing)									
(2) RR90-17-02DP (T-Mobile Existing)	A	From Face	3.500 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	4.356 4.775	1.974 2.312	0.018 0.040
(2) RR90-17-02DP (T-Mobile Existing)	B	From Face	3.500 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	4.356 4.775	1.974 2.312	0.018 0.040
(2) RR90-17-02DP (T-Mobile Existing)	C	From Face	3.500 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	4.356 4.775	1.974 2.312	0.018 0.040
(2) TMA 10"x8"x5" (T-Mobile Existing)	A	From Face	3.500 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	0.778 0.899	0.486 0.588	0.020 0.026
(2) TMA 10"x8"x5" (T-Mobile Existing)	B	From Face	3.500 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	0.778 0.899	0.486 0.588	0.020 0.026
(2) TMA 10"x8"x5" (T-Mobile Existing)	C	From Face	3.500 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	0.778 0.899	0.486 0.588	0.020 0.026
4-Sector T-Arm w/ Work Support (T-Mobile Existing)	C	None		0.000	139.500	No Ice 1/2" Ice	40.000 46.000	40.000 46.000	1.375 1.900
(2) RRUS-11 (AT&T - Existing)	A	From Face	0.500 0.000 0.000	0.000	136.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Existing)	B	From Face	0.500 0.000 0.000	0.000	136.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Existing)	C	From Face	0.500 0.000 0.000	0.000	136.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	C	From Face	0.500 0.000 0.000	0.000	136.000	No Ice 1/2" Ice	2.228 2.447	2.228 2.447	0.020 0.039
Valmont Uni-Tri Bracket (AT&T - Existing)	C	None		0.000	136.000	No Ice 1/2" Ice	1.750 1.940	1.750 1.940	0.290 0.306
(2) 7770.00 (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	134.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
AM-X-CD-16-65-00T-RET(72") (AT&T - Existing)	A	From Face	3.500 2.000 0.000	0.000	134.000	No Ice 1/2" Ice	8.260 8.807	4.642 5.088	0.050 0.096
(2) 7770.00 (AT&T - Existing)	B	From Face	3.500 0.000 0.000	0.000	134.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
AM-X-CD-16-65-00T-RET(72") (AT&T - Existing)	B	From Face	3.500 2.000 0.000	0.000	134.000	No Ice 1/2" Ice	8.260 8.807	4.642 5.088	0.050 0.096
(2) 7770.00 (AT&T - Existing)	C	From Face	3.500 0.000 0.000	0.000	134.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
AM-X-CD-16-65-00T-RET(72") (AT&T - Existing)	C	From Face	3.500 2.000 0.000	0.000	134.000	No Ice 1/2" Ice	8.260 8.807	4.642 5.088	0.050 0.096
(2) LGP21401 TMA (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	134.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023

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
(2) LGP21401 TMA (AT&T - Existing)	B	From Face	3.500 0.000 0.000	0.000	134.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
(2) LGP21401 TMA (AT&T - Existing)	C	From Face	3.500 0.000 0.000	0.000	134.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
(2) LGP21901 Diplexer (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	134.000	No Ice 1/2" Ice	0.233 0.302	0.117 0.166	0.006 0.008
(2) LGP21901 Diplexer (AT&T - Existing)	B	From Face	3.500 0.000 0.000	0.000	134.000	No Ice 1/2" Ice	0.233 0.302	0.117 0.166	0.006 0.008
(2) LGP21901 Diplexer (AT&T - Existing)	C	From Face	3.500 0.000 0.000	0.000	134.000	No Ice 1/2" Ice	0.233 0.302	0.117 0.166	0.006 0.008
Smart Bias T (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	134.000	No Ice 1/2" Ice	0.156 0.212	0.078 0.121	0.002 0.003
Smart Bias T (AT&T - Existing)	B	From Face	3.500 0.000 0.000	0.000	134.000	No Ice 1/2" Ice	0.156 0.212	0.078 0.121	0.002 0.003
Smart Bias T (AT&T - Existing)	C	From Face	3.500 0.000 0.000	0.000	134.000	No Ice 1/2" Ice	0.156 0.212	0.078 0.121	0.002 0.003
Valmont 13' Low Profile Platform (AT&T - Existing)	C	None		0.000	133.000	No Ice 1/2" Ice	15.700 20.100	15.700 20.100	1.300 1.765
GPS (Verizon - Existing)	A	From Face	4.000 0.000 0.000	0.000	83.000	No Ice 1/2" Ice	1.000 1.500	1.000 1.500	0.010 0.015
4-ft Standoff (Verizon - Existing)	A	From Face	2.000 0.000 0.000	0.000	82.500	No Ice 1/2" Ice	1.400 1.735	0.087 0.131	0.030 0.041

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 150.000-123.5 80	136.131	1.499	0.028	50.495	A B C	0.000 0.000 0.000	50.495 50.495 50.495	50.495	100.00 100.00 100.00	0.000 0.000 0.000	0.000 0.000 5.231
L2 123.580-86.49 3	104.312	1.389	0.026	95.025	A B C	0.000 0.000 0.000	95.025 95.025 95.025	95.025	100.00 100.00 100.00	0.000 0.000 0.000	0.000 0.000 7.343
L3 86.493-42.573	64.055	1.209	0.022	148.799	A B	0.000 0.000	148.799 148.799	148.799	100.00 100.00	0.000 0.000	0.000 0.000

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
					C	0.000	148.799		100.00	0.000	16.701
L4 42.573-0.000	20.525	1	0.018	181.026	A	0.000	181.026	181.026	100.00	0.000	0.000
					B	0.000	181.026		100.00	0.000	0.000
					C	0.000	181.026		100.00	0.000	16.463

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 150.000-123.580	136.131	1.499	0.021	0.500	52.697	A	0.000	52.697	52.697	100.00	0.000	0.000
						B	0.000	52.697		100.00	0.000	0.000
						C	0.000	52.697		100.00	0.000	7.873
L2 123.580-86.493	104.312	1.389	0.019	0.500	98.115	A	0.000	98.115	98.115	100.00	0.000	0.000
						B	0.000	98.115		100.00	0.000	0.000
						C	0.000	98.115		100.00	0.000	11.052
L3 86.493-42.573	64.055	1.209	0.017	0.500	152.459	A	0.000	152.459	152.459	100.00	0.000	0.000
						B	0.000	152.459		100.00	0.000	0.000
						C	0.000	152.459		100.00	0.000	25.135
L4 42.573-0.000	20.525	1	0.014	0.500	184.573	A	0.000	184.573	184.573	100.00	0.000	0.000
						B	0.000	184.573		100.00	0.000	0.000
						C	0.000	184.573		100.00	0.000	24.777

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 150.000-123.580	136.131	1.499	0.010	50.495	A	0.000	50.495	50.495	100.00	0.000	0.000
					B	0.000	50.495		100.00	0.000	0.000
					C	0.000	50.495		100.00	0.000	5.231
L2 123.580-86.493	104.312	1.389	0.009	95.025	A	0.000	95.025	95.025	100.00	0.000	0.000
					B	0.000	95.025		100.00	0.000	0.000
					C	0.000	95.025		100.00	0.000	7.343
L3 86.493-42.573	64.055	1.209	0.008	148.799	A	0.000	148.799	148.799	100.00	0.000	0.000
					B	0.000	148.799		100.00	0.000	0.000
					C	0.000	148.799		100.00	0.000	16.701
L4 42.573-0.000	20.525	1	0.006	181.026	A	0.000	181.026	181.026	100.00	0.000	0.000
					B	0.000	181.026		100.00	0.000	0.000
					C	0.000	181.026		100.00	0.000	16.463

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 150.000-123.580	0.841	1.217	A	1	0.65	1	1	1	50.495	1.783	0.067	C
			B	1	0.65	1	1	1	50.495			
			C	1	0.65	1	1	1	50.495			
L2 123.580-86.493	1.661	3.315	A	1	0.65	1	1	1	95.025	2.997	0.081	C
			B	1	0.65	1	1	1	95.025			
			C	1	0.65	1	1	1	95.025			
L3 86.493-42.573	2.065	7.854	A	1	0.65	1	1	1	148.799	4.262	0.097	C
			B	1	0.65	1	1	1	148.799			
			C	1	0.65	1	1	1	148.799			
L4 42.573-0.000	1.963	9.871	A	1	0.65	1	1	1	181.026	4.193	0.098	C
			B	1	0.65	1	1	1	181.026			
			C	1	0.65	1	1	1	181.026			
Sum Weight:	6.530	22.257						OTM	914.407 kip-ft	13.235		

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 150.000-123.580	0.841	1.217	A	1	0.65	1	1	1	50.495	1.783	0.067	C
			B	1	0.65	1	1	1	50.495			
			C	1	0.65	1	1	1	50.495			
L2 123.580-86.493	1.661	3.315	A	1	0.65	1	1	1	95.025	2.997	0.081	C
			B	1	0.65	1	1	1	95.025			
			C	1	0.65	1	1	1	95.025			
L3 86.493-42.573	2.065	7.854	A	1	0.65	1	1	1	148.799	4.262	0.097	C
			B	1	0.65	1	1	1	148.799			
			C	1	0.65	1	1	1	148.799			
L4 42.573-0.000	1.963	9.871	A	1	0.65	1	1	1	181.026	4.193	0.098	C
			B	1	0.65	1	1	1	181.026			
			C	1	0.65	1	1	1	181.026			
Sum Weight:	6.530	22.257						OTM	914.407 kip-ft	13.235		

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 150.000-123.580	0.841	1.217	A	1	0.65	1	1	1	50.495	1.783	0.067	C
			B	1	0.65	1	1	1	50.495			
			C	1	0.65	1	1	1	50.495			
L2 123.580-86.493	1.661	3.315	A	1	0.65	1	1	1	95.025	2.997	0.081	C
			B	1	0.65	1	1	1	95.025			
			C	1	0.65	1	1	1	95.025			
L3 86.493-42.573	2.065	7.854	A	1	0.65	1	1	1	148.799	4.262	0.097	C
			B	1	0.65	1	1	1	148.799			
			C	1	0.65	1	1	1	148.799			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L4 42.573-0.000	1.963	9.871	A	1	0.65	1	1	1	181.026	4.193	0.098	C
			B	1	0.65	1	1	1	181.026			
			C	1	0.65	1	1	1	181.026			
Sum Weight:	6.530	22.257						OTM	914.407 kip-ft	13.235		

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 150.000-123.580	0.841	1.217	A	1	0.65	1	1	1	50.495	1.783	0.067	C
			B	1	0.65	1	1	1	50.495			
			C	1	0.65	1	1	1	50.495			
L2 123.580-86.493	1.661	3.315	A	1	0.65	1	1	1	95.025	2.997	0.081	C
			B	1	0.65	1	1	1	95.025			
			C	1	0.65	1	1	1	95.025			
L3 86.493-42.573	2.065	7.854	A	1	0.65	1	1	1	148.799	4.262	0.097	C
			B	1	0.65	1	1	1	148.799			
			C	1	0.65	1	1	1	148.799			
L4 42.573-0.000	1.963	9.871	A	1	0.65	1	1	1	181.026	4.193	0.098	C
			B	1	0.65	1	1	1	181.026			
			C	1	0.65	1	1	1	181.026			
Sum Weight:	6.530	22.257						OTM	914.407 kip-ft	13.235		

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 150.000-123.580	1.080	1.599	A	1	0.65	1	1	1	52.697	1.481	0.056	C
			B	1	0.65	1	1	1	52.697			
			C	1	0.65	1	1	1	52.697			
L2 123.580-86.493	1.997	4.030	A	1	0.65	1	1	1	98.115	2.434	0.066	C
			B	1	0.65	1	1	1	98.115			
			C	1	0.65	1	1	1	98.115			
L3 86.493-42.573	2.525	8.969	A	1	0.65	1	1	1	152.459	3.501	0.080	C
			B	1	0.65	1	1	1	152.459			
			C	1	0.65	1	1	1	152.459			
L4 42.573-0.000	2.403	11.225	A	1	0.65	1	1	1	184.573	3.393	0.080	C
			B	1	0.65	1	1	1	184.573			
			C	1	0.65	1	1	1	184.573			
Sum Weight:	8.004	25.824						OTM	749.321 kip-ft	10.809		

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	1.080	1.599	A	1	0.65	1	1	1	52.697	1.481	0.056	C
150.000-123.5			B	1	0.65	1	1	1	52.697			
80			C	1	0.65	1	1	1	52.697			
L2	1.997	4.030	A	1	0.65	1	1	1	98.115	2.434	0.066	C
123.580-86.49			B	1	0.65	1	1	1	98.115			
3			C	1	0.65	1	1	1	98.115			
L3	2.525	8.969	A	1	0.65	1	1	1	152.459	3.501	0.080	C
86.493-42.573			B	1	0.65	1	1	1	152.459			
			C	1	0.65	1	1	1	152.459			
L4	2.403	11.225	A	1	0.65	1	1	1	184.573	3.393	0.080	C
42.573-0.000			B	1	0.65	1	1	1	184.573			
			C	1	0.65	1	1	1	184.573			
Sum Weight:	8.004	25.824						OTM	749.321 kip-ft	10.809		

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	1.080	1.599	A	1	0.65	1	1	1	52.697	1.481	0.056	C
150.000-123.5			B	1	0.65	1	1	1	52.697			
80			C	1	0.65	1	1	1	52.697			
L2	1.997	4.030	A	1	0.65	1	1	1	98.115	2.434	0.066	C
123.580-86.49			B	1	0.65	1	1	1	98.115			
3			C	1	0.65	1	1	1	98.115			
L3	2.525	8.969	A	1	0.65	1	1	1	152.459	3.501	0.080	C
86.493-42.573			B	1	0.65	1	1	1	152.459			
			C	1	0.65	1	1	1	152.459			
L4	2.403	11.225	A	1	0.65	1	1	1	184.573	3.393	0.080	C
42.573-0.000			B	1	0.65	1	1	1	184.573			
			C	1	0.65	1	1	1	184.573			
Sum Weight:	8.004	25.824						OTM	749.321 kip-ft	10.809		

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	1.080	1.599	A	1	0.65	1	1	1	52.697	1.481	0.056	C
150.000-123.5			B	1	0.65	1	1	1	52.697			
80			C	1	0.65	1	1	1	52.697			
L2	1.997	4.030	A	1	0.65	1	1	1	98.115	2.434	0.066	C
123.580-86.49			B	1	0.65	1	1	1	98.115			
3			C	1	0.65	1	1	1	98.115			

Section Elevation *ft*	*Add Weight* *K*	*Self Weight* *K*	*F a c e*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *K*	*w* *klf*	*Ctrl. Face*
L3	2.525	8.969	A	1	0.65	1	1	1	152.459	3.501	0.080	C
86.493-42.573			B	1	0.65	1	1	1	152.459			
			C	1	0.65	1	1	1	152.459			
L4	2.403	11.225	A	1	0.65	1	1	1	184.573	3.393	0.080	C
42.573-0.000			B	1	0.65	1	1	1	184.573			
			C	1	0.65	1	1	1	184.573			
Sum Weight:	8.004	25.824						OTM	749.321 kip-ft	10.809		

Tower Forces - Service - Wind Normal To Face

Section Elevation *ft*	*Add Weight* *K*	*Self Weight* *K*	*F a c e*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *K*	*w* *klf*	*Ctrl. Face*
L1	0.841	1.217	A	1	0.65	1	1	1	50.495	0.617	0.023	C
150.000-123.5			B	1	0.65	1	1	1	50.495			
80			C	1	0.65	1	1	1	50.495			
L2	1.661	3.315	A	1	0.65	1	1	1	95.025	1.037	0.028	C
123.580-86.49			B	1	0.65	1	1	1	95.025			
3			C	1	0.65	1	1	1	95.025			
L3	2.065	7.854	A	1	0.65	1	1	1	148.799	1.475	0.034	C
86.493-42.573			B	1	0.65	1	1	1	148.799			
			C	1	0.65	1	1	1	148.799			
L4	1.963	9.871	A	1	0.65	1	1	1	181.026	1.451	0.034	C
42.573-0.000			B	1	0.65	1	1	1	181.026			
			C	1	0.65	1	1	1	181.026			
Sum Weight:	6.530	22.257						OTM	316.404 kip-ft	4.579		

Tower Forces - Service - Wind 45 To Face

Section Elevation *ft*	*Add Weight* *K*	*Self Weight* *K*	*F a c e*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *K*	*w* *klf*	*Ctrl. Face*
L1	0.841	1.217	A	1	0.65	1	1	1	50.495	0.617	0.023	C
150.000-123.5			B	1	0.65	1	1	1	50.495			
80			C	1	0.65	1	1	1	50.495			
L2	1.661	3.315	A	1	0.65	1	1	1	95.025	1.037	0.028	C
123.580-86.49			B	1	0.65	1	1	1	95.025			
3			C	1	0.65	1	1	1	95.025			
L3	2.065	7.854	A	1	0.65	1	1	1	148.799	1.475	0.034	C
86.493-42.573			B	1	0.65	1	1	1	148.799			
			C	1	0.65	1	1	1	148.799			
L4	1.963	9.871	A	1	0.65	1	1	1	181.026	1.451	0.034	C
42.573-0.000			B	1	0.65	1	1	1	181.026			
			C	1	0.65	1	1	1	181.026			
Sum Weight:	6.530	22.257						OTM	316.404 kip-ft	4.579		

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 150.000-123.580	0.841	1.217	A	1	0.65	1	1	1	50.495	0.617	0.023	C
			B	1	0.65	1	1	1	50.495			
			C	1	0.65	1	1	1	50.495			
L2 123.580-86.493	1.661	3.315	A	1	0.65	1	1	1	95.025	1.037	0.028	C
			B	1	0.65	1	1	1	95.025			
			C	1	0.65	1	1	1	95.025			
L3 86.493-42.573	2.065	7.854	A	1	0.65	1	1	1	148.799	1.475	0.034	C
			B	1	0.65	1	1	1	148.799			
			C	1	0.65	1	1	1	148.799			
L4 42.573-0.000	1.963	9.871	A	1	0.65	1	1	1	181.026	1.451	0.034	C
			B	1	0.65	1	1	1	181.026			
			C	1	0.65	1	1	1	181.026			
Sum Weight:	6.530	22.257						OTM	316.404 kip-ft	4.579		

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 150.000-123.580	0.841	1.217	A	1	0.65	1	1	1	50.495	0.617	0.023	C
			B	1	0.65	1	1	1	50.495			
			C	1	0.65	1	1	1	50.495			
L2 123.580-86.493	1.661	3.315	A	1	0.65	1	1	1	95.025	1.037	0.028	C
			B	1	0.65	1	1	1	95.025			
			C	1	0.65	1	1	1	95.025			
L3 86.493-42.573	2.065	7.854	A	1	0.65	1	1	1	148.799	1.475	0.034	C
			B	1	0.65	1	1	1	148.799			
			C	1	0.65	1	1	1	148.799			
L4 42.573-0.000	1.963	9.871	A	1	0.65	1	1	1	181.026	1.451	0.034	C
			B	1	0.65	1	1	1	181.026			
			C	1	0.65	1	1	1	181.026			
Sum Weight:	6.530	22.257						OTM	316.404 kip-ft	4.579		

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	22.257					
Bracing Weight	0.000					
Total Member Self-Weight	22.257			-0.298	0.215	
Total Weight	34.894			-0.298	0.215	

Load Case	*Vertical Forces* *K*	*Sum of Forces X* *K*	*Sum of Forces Z* *K*	*Sum of Overturning Moments, M_x* *kip-ft*	*Sum of Overturning Moments, M_z* *kip-ft*	*Sum of Torques* *kip-ft*
Wind 0 deg - No Ice		-0.091	-26.239	-2769.346	12.341	-0.085
Wind 30 deg - No Ice		13.093	-22.678	-2392.301	-1380.809	-0.644
Wind 45 deg - No Ice		18.564	-18.489	-1949.736	-1959.124	-0.868
Wind 60 deg - No Ice		22.769	-13.040	-1374.320	-2403.914	-1.032
Wind 90 deg - No Ice		26.344	0.091	11.828	-2782.836	-1.142
Wind 120 deg - No Ice		22.860	13.198	1394.728	-2416.041	-0.947
Wind 135 deg - No Ice		18.693	18.618	1966.289	-1976.274	-0.748
Wind 150 deg - No Ice		13.251	22.769	2403.831	-1401.812	-0.498
Wind 180 deg - No Ice		0.091	26.239	2768.750	-11.911	0.085
Wind 210 deg - No Ice		-13.093	22.678	2391.705	1381.238	0.644
Wind 225 deg - No Ice		-18.564	18.489	1949.140	1959.554	0.868
Wind 240 deg - No Ice		-22.769	13.040	1373.724	2404.344	1.032
Wind 270 deg - No Ice		-26.344	-0.091	-12.424	2783.265	1.142
Wind 300 deg - No Ice		-22.860	-13.198	-1395.324	2416.471	0.947
Wind 315 deg - No Ice		-18.693	-18.618	-1966.885	1976.703	0.748
Wind 330 deg - No Ice		-13.251	-22.769	-2404.427	1402.242	0.498
Member Ice	3.567					
Total Weight Ice	42.719			-0.506	0.336	
Wind 0 deg - Ice		-0.074	-21.722	-2304.089	9.961	-0.148
Wind 30 deg - Ice		10.840	-18.775	-1990.655	-1148.677	-0.601
Wind 45 deg - Ice		15.368	-15.308	-1622.579	-1629.596	-0.774
Wind 60 deg - Ice		18.849	-10.797	-1143.962	-1999.438	-0.894
Wind 90 deg - Ice		21.807	0.074	9.119	-2314.361	-0.947
Wind 120 deg - Ice		18.923	10.925	1159.620	-2009.063	-0.746
Wind 135 deg - Ice		15.472	15.412	1635.178	-1643.208	-0.565
Wind 150 deg - Ice		10.968	18.849	1999.267	-1165.348	-0.345
Wind 180 deg - Ice		0.074	21.722	2303.076	-9.289	0.148
Wind 210 deg - Ice		-10.840	18.775	1989.642	1149.349	0.601
Wind 225 deg - Ice		-15.368	15.308	1621.566	1630.268	0.774
Wind 240 deg - Ice		-18.849	10.797	1142.949	2000.110	0.894
Wind 270 deg - Ice		-21.807	-0.074	-10.132	2315.033	0.947
Wind 300 deg - Ice		-18.923	-10.925	-1160.633	2009.735	0.746
Wind 315 deg - Ice		-15.472	-15.412	-1636.191	1643.880	0.565
Wind 330 deg - Ice		-10.968	-18.849	-2000.280	1166.020	0.345
Total Weight	34.894			-0.298	0.215	
Wind 0 deg - Service		-0.032	-9.079	-958.446	4.411	-0.029
Wind 30 deg - Service		4.530	-7.847	-827.981	-477.648	-0.223
Wind 45 deg - Service		6.423	-6.398	-674.844	-677.757	-0.300
Wind 60 deg - Service		7.879	-4.512	-475.738	-831.664	-0.357
Wind 90 deg - Service		9.116	0.032	3.898	-962.778	-0.395
Wind 120 deg - Service		7.910	4.567	482.410	-835.860	-0.328
Wind 135 deg - Service		6.468	6.442	680.182	-683.691	-0.259
Wind 150 deg - Service		4.585	7.879	831.581	-484.916	-0.172
Wind 180 deg - Service		0.032	9.079	957.850	-3.981	0.029
Wind 210 deg - Service		-4.530	7.847	827.385	478.078	0.223
Wind 225 deg - Service		-6.423	6.398	674.248	678.187	0.300
Wind 240 deg - Service		-7.879	4.512	475.142	832.094	0.357
Wind 270 deg - Service		-9.116	-0.032	-4.494	963.208	0.395
Wind 300 deg - Service		-7.910	-4.567	-483.006	836.290	0.328
Wind 315 deg - Service		-6.468	-6.442	-680.778	684.121	0.259
Wind 330 deg - Service		-4.585	-7.879	-832.177	485.345	0.172

Load Combinations

Comb. No.	*Description*

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	150 - 123.58	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-11.096	0.139	0.394
			Max. Mx	14	-6.483	226.733	1.744

Section No.	*Elevation ft*	*Component Type*	*Condition*	*Gov. Load Comb.*	*Force K*	*Major Axis Moment kip-ft*	*Minor Axis Moment kip-ft*
			Max. My	2	-6.498	1.670	225.051
			Max. Vy	14	-15.152	226.733	1.744
			Max. Vx	2	-15.070	1.670	225.051
			Max. Torque	14			-1.196
L2	123.58 - 86.493	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-16.696	0.139	0.394
			Max. Mx	14	-11.418	822.114	4.358
			Max. My	2	-11.428	4.240	817.449
			Max. Vy	14	-18.027	822.114	4.358
			Max. Vx	2	-17.944	4.240	817.449
			Max. Torque	6			1.042
L3	86.493 - 42.573	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-27.391	0.336	0.507
			Max. Mx	14	-20.997	1677.340	8.264
			Max. My	2	-21.004	8.183	1668.167
			Max. Vy	14	-22.095	1677.340	8.264
			Max. Vx	2	-21.986	8.183	1668.167
			Max. Torque	14			-1.157
L4	42.573 - 0	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-42.719	0.336	0.506
			Max. Mx	14	-34.878	2862.549	12.809
			Max. My	2	-34.879	12.726	2848.063
			Max. Vy	14	-26.364	2862.549	12.809
			Max. Vx	2	-26.257	12.726	2848.063
			Max. Torque	14			-1.155

Maximum Reactions

Location	*Condition*	*Gov. Load Comb.*	*Vertical K*	*Horizontal, X K*	*Horizontal, Z K*
Pole	Max. Vert	18	42.719	-0.000	-0.000
	Max. H_x	14	34.894	26.343	0.091
	Max. H_z	2	34.894	0.091	26.236
	Max. M_x	2	2848.063	0.091	26.236
	Max. M_z	6	2861.920	-26.342	-0.091
	Max. Torsion	6	1.154	-26.342	-0.091
	Min. Vert	6	34.894	-26.342	-0.091
	Min. H_x	6	34.894	-26.342	-0.091
	Min. H_z	10	34.894	-0.091	-26.236
	Min. M_x	10	-2847.436	-0.091	-26.236
	Min. M_z	14	-2862.549	26.343	0.091
	Min. Torsion	14	-1.154	26.343	0.091

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	34.894	-0.000	-0.000	-0.298	0.215	0.000
Dead+Wind 0 deg - No Ice	34.894	-0.091	-26.236	-2848.063	12.726	-0.094

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 30 deg - No Ice	34.894	13.093	-22.678	-2460.564	-1420.205	-0.659
Dead+Wind 45 deg - No Ice	34.894	18.564	-18.489	-2005.358	-2015.033	-0.883
Dead+Wind 60 deg - No Ice	34.894	22.769	-13.040	-1413.508	-2472.514	-1.046
Dead+Wind 90 deg - No Ice	34.894	26.342	0.091	12.193	-2861.920	-1.154
Dead+Wind 120 deg - No Ice	34.894	22.860	13.198	1434.514	-2484.958	-0.952
Dead+Wind 135 deg - No Ice	34.894	18.693	18.618	2022.368	-2032.658	-0.750
Dead+Wind 150 deg - No Ice	34.894	13.251	22.769	2472.390	-1441.823	-0.496
Dead+Wind 180 deg - No Ice	34.894	0.091	26.236	2847.436	-12.276	0.094
Dead+Wind 210 deg - No Ice	34.894	-13.093	22.678	2459.939	1420.649	0.659
Dead+Wind 225 deg - No Ice	34.894	-18.564	18.489	2004.736	2015.476	0.883
Dead+Wind 240 deg - No Ice	34.894	-22.769	13.040	1412.890	2472.958	1.047
Dead+Wind 270 deg - No Ice	34.894	-26.343	-0.091	-12.809	2862.549	1.154
Dead+Wind 300 deg - No Ice	34.894	-22.860	-13.198	-1435.131	2485.412	0.952
Dead+Wind 315 deg - No Ice	34.894	-18.693	-18.618	-2022.987	2033.113	0.749
Dead+Wind 330 deg - No Ice	34.894	-13.251	-22.769	-2473.012	1442.278	0.495
Dead+Ice+Temp	42.719	0.000	0.000	-0.506	0.336	0.000
Dead+Wind 0 deg+Ice+Temp	42.719	-0.074	-21.721	-2394.365	10.389	-0.161
Dead+Wind 30 deg+Ice+Temp	42.719	10.840	-18.775	-2068.785	-1193.744	-0.628
Dead+Wind 45 deg+Ice+Temp	42.719	15.368	-15.308	-1686.254	-1693.548	-0.805
Dead+Wind 60 deg+Ice+Temp	42.719	18.849	-10.797	-1188.843	-2077.908	-0.927
Dead+Wind 90 deg+Ice+Temp	42.719	21.806	0.074	9.491	-2405.023	-0.977
Dead+Wind 120 deg+Ice+Temp	42.719	18.923	10.925	1205.120	-2087.905	-0.766
Dead+Wind 135 deg+Ice+Temp	42.719	15.472	15.412	1699.329	-1707.701	-0.578
Dead+Wind 150 deg+Ice+Temp	42.719	10.967	18.849	2077.700	-1211.098	-0.350
Dead+Wind 180 deg+Ice+Temp	42.719	0.074	21.721	2393.275	-9.673	0.160
Dead+Wind 210 deg+Ice+Temp	42.719	-10.840	18.775	2067.697	1194.455	0.628
Dead+Wind 225 deg+Ice+Temp	42.719	-15.368	15.308	1685.169	1694.258	0.805
Dead+Wind 240 deg+Ice+Temp	42.719	-18.849	10.797	1187.761	2078.618	0.927
Dead+Wind 270 deg+Ice+Temp	42.719	-21.807	-0.074	-10.571	2405.837	0.978
Dead+Wind 300 deg+Ice+Temp	42.719	-18.923	-10.925	-1206.201	2088.624	0.766
Dead+Wind 315 deg+Ice+Temp	42.719	-15.472	-15.412	-1700.412	1708.422	0.578
Dead+Wind 330 deg+Ice+Temp	42.719	-10.967	-18.849	-2078.786	1211.818	0.350
Dead+Wind 0 deg - Service	34.894	-0.032	-9.078	-986.765	4.556	-0.032
Dead+Wind 30 deg - Service	34.894	4.530	-7.846	-852.441	-491.751	-0.230
Dead+Wind 45 deg - Service	34.894	6.423	-6.397	-694.778	-697.775	-0.308
Dead+Wind 60 deg - Service	34.894	7.878	-4.512	-489.789	-856.232	-0.366
Dead+Wind 90 deg - Service	34.894	9.115	0.032	4.017	-991.224	-0.403
Dead+Wind 120 deg - Service	34.894	7.909	4.566	496.661	-860.560	-0.333
Dead+Wind 135 deg - Service	34.894	6.467	6.442	700.272	-703.898	-0.262
Dead+Wind 150 deg - Service	34.894	4.585	7.878	856.140	-499.250	-0.174
Dead+Wind 180 deg - Service	34.894	0.032	9.078	986.135	-4.106	0.032
Dead+Wind 210 deg - Service	34.894	-4.530	7.846	851.811	492.200	0.230
Dead+Wind 225 deg - Service	34.894	-6.423	6.397	694.149	698.225	0.308
Dead+Wind 240 deg - Service	34.894	-7.878	4.512	489.160	856.681	0.366
Dead+Wind 270 deg - Service	34.894	-9.115	-0.032	-4.645	991.674	0.404
Dead+Wind 300 deg - Service	34.894	-7.909	-4.566	-497.289	861.010	0.333
Dead+Wind 315 deg - Service	34.894	-6.467	-6.442	-700.901	704.348	0.262
Dead+Wind 330 deg - Service	34.894	-4.585	-7.878	-856.769	499.701	0.174

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	-34.894	0.000	0.000	34.894	0.000	0.000%
2	-0.091	-34.894	-26.239	0.091	34.894	26.236	0.006%
3	13.093	-34.894	-22.678	-13.093	34.894	22.678	0.000%
4	18.564	-34.894	-18.489	-18.564	34.894	18.489	0.000%

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
5	22.769	-34.894	-13.040	-22.769	34.894	13.040	0.000%
6	26.344	-34.894	0.091	-26.342	34.894	-0.091	0.006%
7	22.860	-34.894	13.198	-22.860	34.894	-13.198	0.000%
8	18.693	-34.894	18.618	-18.693	34.894	-18.618	0.000%
9	13.251	-34.894	22.769	-13.251	34.894	-22.769	0.000%
10	0.091	-34.894	26.239	-0.091	34.894	-26.236	0.006%
11	-13.093	-34.894	22.678	13.093	34.894	-22.678	0.000%
12	-18.564	-34.894	18.489	18.564	34.894	-18.489	0.000%
13	-22.769	-34.894	13.040	22.769	34.894	-13.040	0.000%
14	-26.344	-34.894	-0.091	26.343	34.894	0.091	0.002%
15	-22.860	-34.894	-13.198	22.860	34.894	13.198	0.000%
16	-18.693	-34.894	-18.618	18.693	34.894	18.618	0.000%
17	-13.251	-34.894	-22.769	13.251	34.894	22.769	0.000%
18	0.000	-42.719	0.000	-0.000	42.719	-0.000	0.000%
19	-0.074	-42.719	-21.722	0.074	42.719	21.721	0.002%
20	10.840	-42.719	-18.775	-10.840	42.719	18.775	0.000%
21	15.368	-42.719	-15.308	-15.368	42.719	15.308	0.000%
22	18.849	-42.719	-10.797	-18.849	42.719	10.797	0.000%
23	21.807	-42.719	0.074	-21.806	42.719	-0.074	0.002%
24	18.923	-42.719	10.925	-18.923	42.719	-10.925	0.000%
25	15.472	-42.719	15.412	-15.472	42.719	-15.412	0.000%
26	10.968	-42.719	18.849	-10.967	42.719	-18.849	0.000%
27	0.074	-42.719	21.722	-0.074	42.719	-21.721	0.002%
28	-10.840	-42.719	18.775	10.840	42.719	-18.775	0.000%
29	-15.368	-42.719	15.308	15.368	42.719	-15.308	0.000%
30	-18.849	-42.719	10.797	18.849	42.719	-10.797	0.000%
31	-21.807	-42.719	-0.074	21.807	42.719	0.074	0.001%
32	-18.923	-42.719	-10.925	18.923	42.719	10.925	0.000%
33	-15.472	-42.719	-15.412	15.472	42.719	15.412	0.000%
34	-10.968	-42.719	-18.849	10.967	42.719	18.849	0.000%
35	-0.032	-34.894	-9.079	0.032	34.894	9.078	0.002%
36	4.530	-34.894	-7.847	-4.530	34.894	7.846	0.002%
37	6.423	-34.894	-6.398	-6.423	34.894	6.397	0.002%
38	7.879	-34.894	-4.512	-7.878	34.894	4.512	0.002%
39	9.116	-34.894	0.032	-9.115	34.894	-0.032	0.002%
40	7.910	-34.894	4.567	-7.909	34.894	-4.566	0.002%
41	6.468	-34.894	6.442	-6.467	34.894	-6.442	0.002%
42	4.585	-34.894	7.879	-4.585	34.894	-7.878	0.002%
43	0.032	-34.894	9.079	-0.032	34.894	-9.078	0.002%
44	-4.530	-34.894	7.847	4.530	34.894	-7.846	0.002%
45	-6.423	-34.894	6.398	6.423	34.894	-6.397	0.002%
46	-7.879	-34.894	4.512	7.878	34.894	-4.512	0.002%
47	-9.116	-34.894	-0.032	9.115	34.894	0.032	0.002%
48	-7.910	-34.894	-4.567	7.909	34.894	4.566	0.002%
49	-6.468	-34.894	-6.442	6.467	34.894	6.442	0.002%
50	-4.585	-34.894	-7.879	4.585	34.894	7.878	0.002%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	6	0.00000001	0.00000001
2	Yes	14	0.00006336	0.00009542
3	Yes	18	0.00000001	0.00007240
4	Yes	18	0.00000001	0.00008398
5	Yes	18	0.00000001	0.00007529

6	Yes	14	0.00006332	0.00012699
7	Yes	18	0.00000001	0.00007352
8	Yes	18	0.00000001	0.00008586
9	Yes	18	0.00000001	0.00007628
10	Yes	14	0.00006336	0.00009745
11	Yes	18	0.00000001	0.00007425
12	Yes	18	0.00000001	0.00008389
13	Yes	18	0.00000001	0.00007171
14	Yes	15	0.00002687	0.00007318
15	Yes	18	0.00000001	0.00007735
16	Yes	18	0.00000001	0.00008606
17	Yes	18	0.00000001	0.00007423
18	Yes	6	0.00000001	0.00000001
19	Yes	15	0.00004181	0.00014079
20	Yes	18	0.00000001	0.00007528
21	Yes	18	0.00000001	0.00008742
22	Yes	18	0.00000001	0.00007792
23	Yes	15	0.00004179	0.00014667
24	Yes	18	0.00000001	0.00007643
25	Yes	18	0.00000001	0.00008913
26	Yes	18	0.00000001	0.00007873
27	Yes	15	0.00004181	0.00014060
28	Yes	18	0.00000001	0.00007697
29	Yes	18	0.00000001	0.00008728
30	Yes	18	0.00000001	0.00007465
31	Yes	16	0.00000001	0.00007015
32	Yes	18	0.00000001	0.00007987
33	Yes	18	0.00000001	0.00008948
34	Yes	18	0.00000001	0.00007723
35	Yes	14	0.00000001	0.00004499
36	Yes	14	0.00000001	0.00010156
37	Yes	14	0.00000001	0.00012027
38	Yes	14	0.00000001	0.00011540
39	Yes	14	0.00000001	0.00004825
40	Yes	14	0.00000001	0.00010123
41	Yes	14	0.00000001	0.00012351
42	Yes	14	0.00000001	0.00011424
43	Yes	14	0.00000001	0.00004497
44	Yes	14	0.00000001	0.00011032
45	Yes	14	0.00000001	0.00011985
46	Yes	14	0.00000001	0.00009843
47	Yes	14	0.00000001	0.00004927
48	Yes	14	0.00000001	0.00011940
49	Yes	14	0.00000001	0.00012444
50	Yes	14	0.00000001	0.00010442

Maximum Tower Deflections - Service Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* *°*	*Twist* *°*
L1	150 - 123.58	30.211	48	1.983	0.007
L2	127.413 - 86.493	21.189	48	1.764	0.003
L3	91.493 - 42.573	10.219	48	1.098	0.001
L4	48.906 - 0	2.852	48	0.542	0.000

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
150.000	LPA-80063-6CF	48	30.211	1.983	0.007	14363
140.000	(2) RR90-17-02DP	48	26.102	1.903	0.005	7181
139.500	4-Sector T-Arm w/ Work Support	48	25.900	1.899	0.005	6839
136.000	(2) RRUS-11	48	24.496	1.865	0.004	5129
134.000	(2) 7770.00	48	23.707	1.845	0.004	4488
133.000	Valmont 13' Low Profile Platform	48	23.316	1.834	0.004	4224
83.000	GPS	48	8.284	0.958	0.001	3632
82.500	4-ft Standoff	48	8.177	0.950	0.001	3638

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	150 - 123.58	86.971	15	5.712	0.020
L2	127.413 - 86.493	61.043	15	5.083	0.008
L3	91.493 - 42.573	29.468	15	3.165	0.003
L4	48.906 - 0	8.228	15	1.563	0.001

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
150.000	LPA-80063-6CF	15	86.971	5.712	0.020	5093
140.000	(2) RR90-17-02DP	15	75.165	5.482	0.014	2546
139.500	4-Sector T-Arm w/ Work Support	15	74.583	5.469	0.014	2424
136.000	(2) RRUS-11	15	70.550	5.374	0.012	1817
134.000	(2) 7770.00	15	68.280	5.314	0.011	1590
133.000	Valmont 13' Low Profile Platform	15	67.157	5.283	0.011	1496
83.000	GPS	15	23.890	2.763	0.003	1267
82.500	4-ft Standoff	15	23.583	2.741	0.003	1269

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
L1	150 - 123.58 (1)	TP26.37x19.5x0.188	26.420	0.000	0.0	39.000	14.989	-6.475	584.559	0.011
L2	123.58 - 86.493 (2)	TP35.51x24.998x0.25	40.920	0.000	0.0	39.000	26.960	-11.413	1051.430	0.011

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
L3	86.493 - 42.573 (3)	TP46.3x33.726x0.375	48.920	0.000	0.0	39.000	52.725	-20.994	2056.260	0.010
L4	42.573 - 0 (4)	TP56.5x43.922x0.375	48.906	0.000	0.0	39.000	66.803	-34.878	2605.310	0.013

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	150 - 123.58 (1)	TP26.37x19.5x0.188	227.748	29.327	39.000	0.752	0.000	0.000	39.000	0.000
L2	123.58 - 86.493 (2)	TP35.51x24.998x0.25	824.631	43.759	39.000	1.122	0.000	0.000	39.000	0.000
L3	86.493 - 42.573 (3)	TP46.3x33.726x0.375	1682.11 7	35.046	39.000	0.899	0.000	0.000	39.000	0.000
L4	42.573 - 0 (4)	TP56.5x43.922x0.375	2869.99 2	37.182	39.000	0.953	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	150 - 123.58 (1)	TP26.37x19.5x0.188	15.196	1.014	26.000	0.078	0.959	0.060	26.000	0.002
L2	123.58 - 86.493 (2)	TP35.51x24.998x0.25	18.070	0.670	26.000	0.052	0.955	0.025	26.000	0.001
L3	86.493 - 42.573 (3)	TP46.3x33.726x0.375	22.151	0.420	26.000	0.032	0.953	0.010	26.000	0.000
L4	42.573 - 0 (4)	TP56.5x43.922x0.375	26.418	0.395	26.000	0.030	0.952	0.006	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	150 - 123.58 (1)	0.011	0.752	0.000	0.078	0.002	0.765 ✔	1.333	H1-3+VT ✔
L2	123.58 - 86.493 (2)	0.011	1.122	0.000	0.052	0.001	1.134 ✔	1.333	H1-3+VT ✔
L3	86.493 - 42.573 (3)	0.010	0.899	0.000	0.032	0.000	0.909 ✔	1.333	H1-3+VT ✔
L4	42.573 - 0 (4)	0.013	0.953	0.000	0.030	0.000	0.967 ✔	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	150 - 123.58	Pole	TP26.37x19.5x0.188	1	-6.475	779.217	57.4	Pass
L2	123.58 - 86.493	Pole	TP35.51x24.998x0.25	2	-11.413	1401.556	85.0	Pass
L3	86.493 - 42.573	Pole	TP46.3x33.726x0.375	3	-20.994	2740.994	68.2	Pass
L4	42.573 - 0	Pole	TP56.5x43.922x0.375	4	-34.878	3472.878	72.5	Pass
							Summary	
						Pole (L2)	85.0	Pass
						RATING =	**85.0**	**Pass**

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 2870 \cdot ft \cdot kips$	(Input From tnxTower)
Shear Force =	$Shear := 26 \cdot kips$	(Input From tnxTower)
Axial Force =	$Axial := 35 \cdot kips$	(Input From tnxTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	$N := 16$	(User Input)
Diameter of Bolt Circle =	$D_{bc} := 66 \cdot in$	(User Input)
Bolt "Column" Distance =	$l := 3.0 \cdot in$	(User Input)
Bolt Ultimate Strength =	$F_u := 100 \cdot ksi$	(User Input)
Bolt Yield Strength =	$F_y := 75 \cdot ksi$	(User Input)
Bolt Modulus =	$E := 29000 \cdot ksi$	(User Input)
Diameter of Anchor Bolts =	$D := 2.25 \cdot in$	(User Input)
Threads per Inch =	$n := 4.5$	(User Input)

Base Plate Data:

Use ASTM A871 60

Plate Yield Strength =	$Fy_{bp} := 60 \cdot ksi$	(User Input)
Base Plate Thickness =	$t_{bp} := 2 \cdot in$	(User Input)
Base Plate Diameter =	$D_{bp} := 72 \cdot in$	(User Input)
Outer Pole Diameter =	$D_{pole} := 56.5 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =: $R_{bc} := \frac{D_{bc}}{2} = 33 \cdot in$

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

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

$d_1 = 12.63 \cdot in$	$d_7 = 12.63 \cdot in$
$d_2 = 23.33 \cdot in$	$d_8 = 0.00 \cdot in$
$d_3 = 30.49 \cdot in$	$d_9 = -12.63 \cdot in$
$d_4 = 33.00 \cdot in$	$d_{10} = -23.33 \cdot in$
$d_5 = 30.49 \cdot in$	$d_{11} = -30.49 \cdot in$
$d_6 = 23.33 \cdot in$	etc.

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 28.3 \cdot in$

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

$MA_1 = 0.00 \cdot in$	$MA_7 = 0.00 \cdot in$
$MA_2 = 0.00 \cdot in$	$MA_8 = 0.00 \cdot in$
$MA_3 = 2.24 \cdot in$	$MA_9 = 0.00 \cdot in$
$MA_4 = 4.75 \cdot in$	$MA_{10} = 0.00 \cdot in$
$MA_5 = 2.24 \cdot in$	$MA_{11} = 0.00 \cdot in$
$MA_6 = 0.00 \cdot in$	etc

Effective Width of Baseplate for Bending = $B_{eff} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 35.7 \cdot in$

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i (d_i)^2 = 8.712 \times 10^3 \cdot in^2$

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 = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 128.3 \cdot kips$

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 = $\frac{T_{Max}}{T_{ALL.Net}} \cdot 100 = 66$ 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 = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.406 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 5.9 \cdot ksi$

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 = $C_{Max} := OM \cdot \frac{R_{bc}}{I_p} + \frac{Axial}{N} = 132.6 \cdot kips$

Maximum Compressive Stress = $f_a := \frac{C_{Max}}{A_n} = 40.8 \cdot ksi$

$K := 0.65$

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

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

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

Combined Stress % of Capacity = $\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) \cdot 100 = 68.1$

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

Condition2 = "OK"

Base Plate Analysis:

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

$C_1 = 52.1 \cdot kips$	$C_7 = 52.1 \cdot kips$
$C_2 = 94.4 \cdot kips$	$C_8 = 2.2 \cdot kips$
$C_3 = 122.7 \cdot kips$	$C_9 = -47.7 \cdot kips$
$C_4 = 132.6 \cdot kips$	$C_{10} = -90.1 \cdot kips$
$C_5 = 122.7 \cdot kips$	$C_{11} = -118.3 \cdot kips$
$C_6 = 94.4 \cdot kips$	etc.

Maximum Bending Stress in Plate = $f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} \cdot t_{bp}^2\right)} = 49.5 \cdot ksi$

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

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} \cdot 100 = 82.8$

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 =	$OM := 2870 \cdot ft \cdot kips$	(User Input from tnxTower)	
Shear Force =	$Shear := 26 \cdot kip$	(User Input from tnxTower)	
Axial Force =	$Axial := 35 \cdot kip$	(User Input from tnxTower)	
Tower Height =	$H_t := 150 \cdot ft$	(User Input)	

Footing Data:

Overall Depth of Footing =	$D_f := 4.5 \cdot ft$	(User Input)	
Length of Pier =	$L_p := 3.0 \cdot ft$	(User Input)	
Extension of Pier Above Grade =	$L_{pag} := 1.0 \cdot ft$	(User Input)	
Diameter of Pier =	$d_p := 7.0 \cdot ft$	(User Input)	
Thickness of Footing =	$T_f := 2.5 \cdot ft$	(User Input)	
Width of Footing =	$W_f := 27.0 \cdot ft$	(User Input)	

Anchor Bolt Data:

Length of Anchor Bolts =	$L_{st} := 72 \cdot in$	(User Input)	
Projection of Anchor Bolts Above Pier =	$A_{BP} := 12.0 \cdot in$	(User Input)	
Anchor Bolt Diameter =	$d_{anchor} := 2.25 \cdot in$	(User Input)	
Base Plate Bolt Circle =	$MP := 66.0 \cdot in$	(User Input)	

Material Properties:

Concrete Compressive Strength =	$f_c := 4000 \cdot psi$	(User Input)	
Steel Reinforcment Yield Strength =	$f_y := 60000 \cdot psi$	(User Input)	
Anchor Bolt Yield Strength =	$f_{ya} := 75000 \cdot psi$	(User Input)	
Internal Friction Angle of Soil =	$\Phi_s := 30 \cdot deg$	(User Input)	
Allowable Soil Bearing Capacity =	$q_s := 3000 \cdot psf$	(User Input)	
Unit Weight of Soil =	$\gamma_{soil} := 100 \cdot pcf$	(User Input)	
Unit Weight of Concrete =	$\gamma_{conc} := 150 \cdot pcf$	(User Input)	
Foundation Bouyancy =	$Bouyancy := 0$	(User Input)	(Yes=1 / No=0)
Depth to Neglect =	$n := 0 \cdot ft$	(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 =	$BS_{pier} := 8$	(User Input)	
Bar Diameter =	$d_{bpier} := 1.0 \cdot in$	(User Input)	
Number of Bars =	$NB_{pier} := 40$	(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 =	$BS_{top} := 8$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 1.0 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 24$	(User Input)	(Top of Pad)
Bar Size =	$BS_{bot} := 8$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{bbot} := 1.0 \cdot in$	(User Input)	(Bottom of Pad)
Number of Bars =	$NB_{bot} := 44$	(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 = $A_{bpier} := \frac{\pi \cdot d_{bpier}^2}{4} = 0.785 \cdot in^2$

Pad Top Reinforcement Bar Area = $A_{btop} := \frac{\pi \cdot d_{btop}^2}{4} = 0.785 \cdot in^2$

Pad Bottom Reinforcement Bar Area = $A_{bbot} := \frac{\pi \cdot d_{bbot}^2}{4} = 0.785 \cdot in^2$

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

$P_{pt} := K_p \cdot \gamma_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p} = 0.6 \cdot \text{ksf}$

$P_{top} := \text{if}[n < (D_f - T_f), P_{pt}, P_{pn}] = 0.6 \cdot \text{ksf}$

$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p} = 1.35 \cdot \text{ksf}$

$P_{ave} := \dfrac{P_{top} + P_{bot}}{2} = 0.975 \cdot \text{ksf}$

$T_p := \text{if}[n < (D_f - T_f), T_f, (D_f - n)] = 2.5$

$A_p := W_f \cdot T_p = 67.5$

Ultimate Shear = $S_u := P_{ave} \cdot A_p = 65.813 \cdot \text{kip}$

Weight of Concrete Pad = $WT_c := \left[\left(W_f^{\,2} \cdot T_f\right) + d_p^{\,2} \cdot L_p\right] \cdot \gamma_c = 295.425 \cdot \text{kip}$

Weight of Soil Above Footing = $WT_{s1} := \left[\left(W_f^{\,2} - d_p^{\,2}\right) \cdot \begin{cases} (L_p - L_{pag} - n) & \text{if } (L_p - L_{pag} - n) \geq 0 \\ 0 & \text{if } (L_p - L_{pag} - n) \leq 0 \end{cases}\right] \cdot \gamma_s = 136 \cdot \text{kip}$

Weight of Soil Wedge at Back Face = $WT_{s2} := \left(\dfrac{D_f^{\,2} \cdot \tan(\Phi_s)}{2} \cdot W_f\right) \cdot \gamma_s = 15.783 \cdot \text{kip}$

Weight of Soil Wedge at back face Corners = $WT_{s3} := 2 \left[(D_f)^3 \cdot \dfrac{\tan(\Phi_s)}{3}\right] \cdot \gamma_s = 3.507 \cdot \text{kips}$

Total Weight = $WT_{tot} := WT_c + WT_{s1} + \text{Axial} = 466.425 \cdot \text{kip}$

Resisting Moment = $M_r := (WT_{tot}) \cdot \dfrac{W_f}{2} + S_u \cdot \dfrac{T_f}{3} + \left[(WT_{s2} + WT_{s3}) \cdot \left(W_f + \dfrac{D_f \cdot \tan(\Phi_s)}{3}\right)\right] = 6889 \cdot \text{kip} \cdot \text{ft}$

Overturning Moment = $M_{ot} := OM + \text{Shear} \cdot (L_p + T_f) = 3013 \cdot \text{kip} \cdot \text{ft}$

Factor of Safety Actual = $FS := \dfrac{M_r}{M_{ot}} = 2.29$

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

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

OverTurning_Moment_Check = "Okay"

Shear Capacity in Pier:

Shear Resistance of Pier = $S_p := \frac{\mu \cdot WT_{tot}}{FS_{req}} = 104.946 \cdot kips$

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

Shear_Check = "Okay"

Bearing Pressure Caused by Footing:

Area of the Mat = $A_{mat} := W_f^{\,2} = 729$

Section Modulus of Mat = $S := \frac{W_f^{\,3}}{6} = 3280.5 \cdot ft^3$

Maximum Pressure in Mat = $P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S} = 1.558 \cdot ksf$

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

Max_Pressure_Check = "Okay"

Minimum Pressure in Mat = $P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S} = -0.279 \cdot ksf$

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

Min_Pressure_Check = "No Good"

Distance to Resultant of Pressure Distribution = $X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 7.635$

Distance to Kern = $X_k := \frac{W_f}{6} = 4.5$

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

Eccentricity = $e := \frac{M_{ot}}{WT_{tot}} = 6.46$

Adjusted Soil Pressure = $P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \left(\frac{W_f}{2} - e\right)} = 1.636 \cdot ksf$

$q_{adj} := \text{if}(P_{min} < 0, P_a, P_{max}) = 1.636 \cdot ksf$

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 = $P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot \frac{\pi \cdot d_p^2}{4} = 1.225 \times 10^4 \cdot \text{kips}$ (ACI-2008 10.14)

$\text{Bearing\_Check} := \text{if}(P_b > LF \cdot Axial, \text{"Okay"}, \text{"No Good"})$

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)

$d := T_f - Cvr_{pad} - d_{bbot} = 26 \cdot in$

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

$d_2 := d_1 - d$

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

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

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

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

$\text{Beam\_Shear\_Check} := \text{if}(V_{req} < V_{Avail}, \text{"Okay"}, \text{"No Good"})$

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 = $b_o := (d_p + d) \cdot \pi = 28.8$

Area Included Inside Perimeter = $A_{bo} := \frac{\pi \cdot (d_p + d)^2}{4} = 66$

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 663$

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

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

$v_u := Find(v_u) = 7.5 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f = 437.3 \cdot kips$

Required Shear Strength = $V_{req} := LF \cdot V_u = 582.9 \cdot kips$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 1932.1 \cdot kip$ (ACI-2008 11.11.2.1)

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

Punching_Shear_Check = "Okay"

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

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

$q_b := q_{adj} - d_1 \cdot Slope = 0.861 \cdot ksf$

Maximum Bending at Face of Pier = $M_u := LF \cdot \left[(q_{adj} - q_b) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f = 2479.2 \cdot kip \cdot ft$

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

(ACI-200810.2.7.3)

$R_n := \frac{M_u}{\phi_m \cdot W_f \cdot d^2} = 150.9 \cdot psi$

$\rho := \frac{0.85 \cdot f_c}{f_y} \left(1 - \sqrt{1 - \frac{2 \cdot R_n}{0.85 \cdot f_c}} \right) = 0.0026$

$\rho_{min} := \rho = 0.00257$

Required Reinforcement for Temperature and Shrinkage:

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

Check Bottom Bars:

$As := \begin{cases} \rho_{min} \cdot W_f \cdot d & \text{if } \rho_{min} > \dfrac{\rho_{sh}}{2} \\ \rho_{sh} \cdot W_f \cdot \dfrac{d}{2} & \text{otherwise} \end{cases} = 21.682 \cdot in^2$

$As_{prov} := A_{bbot} \cdot NB_{bot} = 34.6 \cdot in^2$

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

Pad_Reinforcement_Bot = "Okay"

Check top Bars:

$As := \rho_{sh} \cdot \left(W_f \cdot \dfrac{d}{2}\right) = 7.6 \cdot in^2$

$As_{prov} := A_{btop} \cdot NB_{top} = 18.8 \cdot in^2$

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

Pad_Reinforcement_Top = "Okay"

Developement Length Pad Reinforcement:

Bar Spacing = $B_{sPad} := \dfrac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 6.37 \cdot in$

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

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

$L_{dbt} := \dfrac{3 \cdot f_y \alpha_{pad} \cdot \beta_{pad} \cdot \gamma_{pad} \cdot \lambda_{pad}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \dfrac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot} = 23.7 \cdot in$

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

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

Available Length in Pad = $L_{Pad} := \dfrac{W_f}{2} - \dfrac{d_p}{2} - Cvr_{pad} = 117 \cdot in$

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

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

Area of Pier = $A_p := \frac{\pi \cdot d_p^2}{4} = 5541.77 \cdot in^2$

$A_{smin} := 0.01 \cdot 0.5 \cdot A_p = 27.71 \cdot in^2$ (ACI-2008 10.8.4 & 10.9.1)

$A_{sprov} := NB_{pier} \cdot A_{bpier} = 31.42 \cdot in^2$

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

Steel_Area_Check = "Okay"

Bar Spacing In Pier = $B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 5.597 \cdot in$

Diameter of Reinforcement Cage = $Diam_{cage} := d_p - 2 \cdot Cvr_{pier} = 78 \cdot in$

Maximum Moment in Pier = $M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2}\right)\right] \cdot LF = 47364.2 \cdot in \cdot kips$

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

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

$$\left(D \;\; N \;\; n \;\; P_u \;\; M_{xu}\right) = \left(84 \;\; 40 \;\; 8 \;\; 46.655 \;\; 4.736 \times 10^4\right)$$

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

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

$$\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho\right) = \left(60.566 \;\; 6.149 \times 10^4 \;\; -60 \;\; 5.702 \times 10^{-3}\right)$$

Axial_Load_Check := if$\left(\phi P_n \geq P_u, \text{"Okay"}, \text{"No Good"}\right)$

Axial_Load_Check = "Okay"

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

Bending_Check = "Okay"

Development Length Pier Reinforcement:

Available Length in Foundation:

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

$L_{pad} := T_f - Cvr_{pad} = 27 \cdot in$

Tension: (ACI-2008 12.2.3)

Spacing or Cover Dimension = $c := if\left(Cvr_{pier} < \frac{B_{sPier}}{2}, Cvr_{pier}, \frac{B_{sPier}}{2}\right) = 2.799 \cdot in$

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

$$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 25.42 \cdot in$$

Minimum Development Length = $L_{dh} := \frac{1200 \cdot d_{bpier}}{\sqrt{\frac{f_c}{psi}}} \cdot .7 = 13.282 \cdot in$ (ACI 12.2.1)

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

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

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

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

Compression: (ACI-2008 12.3.2)

$$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot f_y}{\sqrt{f_c \cdot psi}} = 18.974 \cdot in$$

$L_{dbmin} := 0.0003 \cdot \frac{in^2}{lb} \cdot \left(d_{bpier} \cdot f_y\right) = 18 \cdot in$

$L_{dbc} := if\left(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}\right) = 18.974 \cdot in$

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

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

Tie Size and Spacing in Column:

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

Used #4 Ties

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

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

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

$s_{lim3} := D_f \cdot z = 54 \cdot in$

$s_{lim4} := 18in$

Maximum Spacing = $s_{tie} := min\left(\left(\begin{matrix} s_{lim1} \\ s_{lim2} \\ s_{lim3} \\ s_{lim4} \end{matrix}\right)\right) = 16 \cdot in$

Number of Ties Required = $n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 = 2.875$

Check Anchor Steel Embedment:

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

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

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

Depth_Check = "No Good"

Note: Anchor plate is provided

SITE NAME	MIDDLEFIELD CT	ECP & CELL #	2	0029
Note: AWS Add (Root Metric Site).		LATITUDE	41-32-07.85 N	
		LONGITUDE	72-43-55.54 W	
		STRUCTURE TYPE	Monopole	

AWS - LTE ANTENNA ADD	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	2100 MHz BBU	2100 MHz BBU	2100 MHz BBU
ANTENNA TYPE	742213_2110_P45_03.0	742213_2110_P45_02.0	742213_2110_P45_00.0
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	40	150	240
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	148	148	148
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL	1 x ALU RH_2X40-AWS	1 x ALU RH_2X40-AWS	1 x ALU RH_2X40-AWS
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX	1 x DB-T1-6Z-8AB-0Z		
700 LTE - CURRENT CONFIG	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	700 eNodeB	700 eNodeB	700 eNodeB
ANTENNA TYPE	BXA-70063-6CF-4-750MHZ	BXA-70063-6CF-5-750MHZ	BXA-70063-6CF-2-750MHZ
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	40	150	240
DOWN TILT (MECH/DEG)	1	2	0
RAD CTR (FT AGL)	148	148	148
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
700 Mhz - LTE Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	700 eNodeB	700 eNodeB	700 eNodeB
ANTENNA TYPE	BXA-70063-6CF-4-750MHZ	BXA-70063-6CF-5-750MHZ	BXA-70063-6CF-2-750MHZ
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	40	150	240
DOWN TILT (MECH/DEG)	1	2	0
RAD CTR (FT AGL)	148	148	148
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL			
850 CELLULAR - CURRENT CONFIG	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	Cellular Mod 4.0B	Cellular Mod 4.0B	Cellular Mod 4.0B
ANTENNA TYPE	LPA-80063-6CF-EDIN-4	LPA-80063-6CF-EDIN-4	LPA-80063-6CF-EDIN-2
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	40	150	240
DOWN TILT (MECH/DEG)	1	2	0
RAD CTR (FT AGL)	148	148	148
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
850 CELLULAR - FUTURE CONFIG	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	Cellular Mod 4.0B	Cellular Mod 4.0B	Cellular Mod 4.0B
ANTENNA TYPE	LPA-80063-6CF-EDIN-4	LPA-80063-6CF-EDIN-4	LPA-80063-6CF-EDIN-2
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	40	150	240
DOWN TILT (MECH/DEG)	1	2	0
RAD CTR (FT AGL)	148	148	148
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
DIPLEX WITH LTE CABLE			
1900 PCS - CURRENT CONFIG	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	PCS Mod 4.0B	PCS Mod 4.0B	PCS Mod 4.0B
ANTENNA TYPE	BXA-171063-12BF-EDIN-2	BXA-171063-12BF-EDIN-2	BXA-171063-12BF-EDIN-2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	40	150	240
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	148	148	148
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE			
1900 PCS - FUTURE CONFIG	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	PCS Mod 4.0B	PCS Mod 4.0B	PCS Mod 4.0B
ANTENNA TYPE	BXA-171063-12BF-EDIN-2	BXA-171063-12BF-EDIN-2	BXA-171063-12BF-EDIN-2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	40	150	240
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	148	148	148
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE			

NUMBER OF CABLES NEEDED				FIBER LINES MODEL NUMBER	
TOTAL # FIBER LINES	1	TOTAL # OF MAINLINES	18	FIBER LINE MODEL #	HB158-1-08U8-S8J18
TOTAL # TOP JUMPERS	3	TOTAL # OF TOP JUMPERS	18	FIBER TOP JUMPER MODEL #	HB114-1-08U4-S4J18

EQUIPMENT CABLE ORDERING	MAIN CABLE #				TOP JUMPER #		
	18	+	0		18	+	0

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

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

RF ENGINEER	RF MANAGER	INITIALS	DATE
Prepared by: Jaime Laredo	Robert Hesselbach	JL	11/26/2013

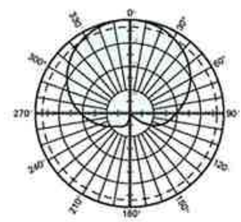
KATHREIN
SCALA DIVISION

742 213V01

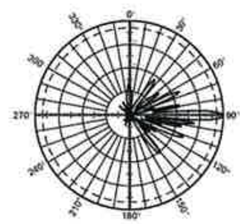
65° Panel Antenna

Kathrein's X-polarized adjustable electrical downtilt antennas offer the wireless carrier the ability to tailor polarization diversity sites for optimum performance. Using variable downtilt, only a few models need be procured to accommodate the needs of widely varying conditions. Remotely controlled downtilt is available as a retrofitable option.

- 0-6° downtilt range.
- UV resistant pulltruded fiberglass radome.
- DC Grounded metallic parts for impulse suppression.
- No moving electrical connections.
- Wideband vector dipole technology.
- Optional remote downtilt Control.
- Will accomodate future 3G / UMTS applications.



Horizontal pattern
±45°- polarization



Vertical pattern
±45°- polarization
0°–6° electrical downtilt

General specifications:

Frequency range	1710–2200 MHz
VSWR	< 1.5:1
Impedance	50 ohms
Intermodulation (2x20w)	IM3: <-150 dBc
Polarization	+45° and -45°
Front-to-back ratio (180°±30°)	>30 dB (co-polar) >25 dB (total power)
Maximum input power	300 watts per input (at 50°C)
Electrical downtilt continuously adjustable	0–6 degrees
Connector	2 x 7-16 DIN female
Isolation	>30 dB
Cross polar ratio Main direction 0° Sector ±60°	 25 dB (typical) >10 dB
Tracking, average	0.5 dB
Squint	±2.0°
Weight	19.8 lb (9 kg) 24.3 lb (11 kg) clamps included
Dimensions	76.9 x 6.1 x 2.8 inches (1954 x 155 x 70 mm)
Wind load Front/Side/Rear Mounting category	at 93 mph (150kph) 115 lbf / 32 lbf / 115 lbf (510 N) / (140 N) / (510 N) M (Medium)
Wind survival rating*	120 mph (200 kph)
Shipping dimensions	88 x 6.8 x 3.6 inches (2235 x 172 x 92 mm)
Shipping weight	28.7 lb (13 kg)
Mounting	Fixed mounts for 2 to 4.6 inch (50 to 115 mm) OD masts are included and tilt options are available.

See reverse for order information.

Specifications:	1710–1880 MHz	1850–1990 MHz	1920–2200 MHz
Gain	19 dBi	19.2 dBi	19.5 dBi
+45° and -45° polarization horizontal beamwidth	67° (half-power)	65° (half-power)	63° (half-power)
+45° and -45° polarization vertical beamwidth	4.7° (half-power)	4.5° (half-power)	4.3° (half-power)
Sidelobe suppression for first sidelobe above main beam	0° 2° 4° 6° T 18 18 16 15 dB	0° 2° 4° 6° T 18 18 17 16 dB	0° 2° 4° 6° T 18 18 18 18 dB

*Mechanical design is based on environmental conditions as stipulated in TIA-222-G-2 (December 2009) and/or ETS 300 019-1-4 which include the static mechanical load imposed on an antenna by wind at maximum velocity. See the Engineering Section of the catalog for further details.

TÜV RoHS Lead-Free

11271-B
936.3740/b

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Alcatel·Lucent

Alcatel-Lucent RRH2x40-AWS

REMOTE RADIO HEAD

The Alcatel-Lucent RRH2x40-AWS is a high-power, small form-factor Remote Radio Head (RRH) operating in the AWS frequency band (1700/2100MHz - 3GPP Band 4). The Alcatel-Lucent RRH2x40-AWS is designed with an eco-efficient approach, providing operators with the means to achieve high quality and capacity coverage with minimum site requirements.

A distributed eNodeB expands 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 an eNodeB to be installed separately, within the same site or several kilometres apart.

The Alcatel-Lucent RRH2x40-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. The Alcatel-Lucent RRH2x40-AWS has two transmit RF paths, 40 W RF output power per transmit path, and is designed to manage up to four-way receive diversity. The device is ideally suited to support macro coverage, with multiple-input multiple-output (MIMO) 2x2 operation in up to 20 MHz of bandwidth.

The Alcatel-Lucent RRH2x40-AWS is designed to make available all the benefits of a distributed eNodeB, with excellent RF characteristics, with low capital expenditures (CAPEX) and low operating expenditures (OPEX). The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment or require costly cranes to be employed, leaving coverage holes. However, many of these sites can host an Alcatel-Lucent RRH2x40-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation time and costs.

Fast, low-cost installation and deployment

The Alcatel-Lucent RRH2x40-AWS is a zero-footprint solution and operates noise-free, simplifying negotiations with site property owners and minimizing environmental impacts. Installation can easily be done by a single person because the Alcatel-Lucent RRH2x40-AWS is compact and weighs less than 20 kg (44 lb), 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 — a fraction of the time required for a traditional BTS.

Excellent RF performance

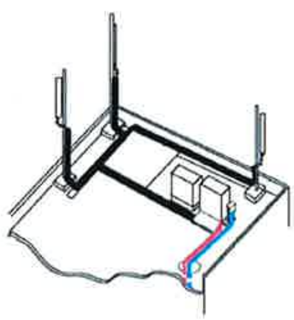
Because of its small size and weight, the Alcatel-Lucent RRH2x40-AWS can be installed close to the antenna. Operators can therefore locate the Alcatel-Lucent RRH2x40-AWS where RF engineering is deemed ideal, minimizing trade-offs between available sites and RF optimum sites. The RF feeder cost and installation costs are reduced or eliminated, and there is no need for a Tower Mounted Amplifier (TMA) because losses introduced by the RF feeder are greatly reduced. The Alcatel-Lucent RRH2x40-AWS provides more RF power while at the same time consuming less electricity.

Features

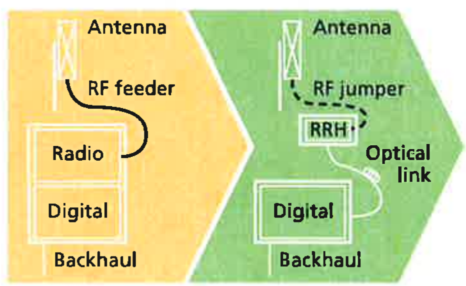
- Zero-footprint deployment
- Easy installation, with a lightweight unit can be carried and set up by one person
- Optimized RF power, with flexible site selection and elimination of a TMA
- Convection-cooled (fanless)
- Noise-free
- Best-in-class power efficiency, with significantly reduced energy consumption

Benefits

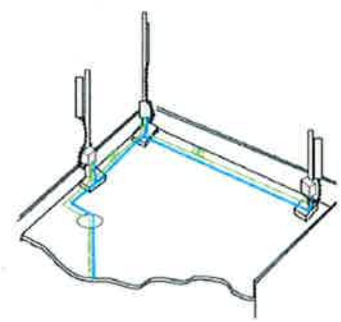
- Leverages existing real estate with lower site costs
- Reduces installation costs, with fewer installation materials and simplified logistics
- Decreases power costs and minimizes environmental impacts, with the potential for eco-sustainable power options
- Improves RF performance and adds flexibility to network planning



Macro



RRH for space-constrained cell sites



Distributed

Technical specifications

Physical dimensions

- Height: 620 mm (24.4 in.)
- Width: 270 mm (10.63 in.)
- Depth: 170m (6.7 in.)
- Weight (without mounting kit): less than 20 kg (44 lb)

Power

- Power supply: -48VDC

Operating environment

- Outdoor temperature range:
  - ¬ With solar load: -40°C to +50°C (-40°F to +122°F)
  - ¬ Without solar load: -40°C to +55°C (-40°F to +131°F)
- Passive convection cooling (no fans)
- Enclosure protection
  - ¬ IP65 (International Protection rating)

RF characteristics

- Frequency band: 1700/2100 MHz (AWS); 3GPP Band 4
- Bandwidth: up to 20 MHz
- RF output power at antenna port: 40 W nominal RF power for each Tx port
- Rx diversity: 2-way or 4-way with optional Rx Diversity module
- Noise figure: below 2.0 dB typical
- Antenna Line Device features
  - ¬ TMA and Remote electrical tilt (RET) support via AISG v2.0

Optical characteristics

Type/number of fibers

- Single-mode variant
  - ¬ One Single Mode Single Fiber per RRH2x, carrying UL and DL using CWDM
  - ¬ Single mode dual fiber (SM/DF)
- Multi-mode variant
  - ¬ Two Multi-mode fibers per RRH2x: one carrying UL, the other carrying DL

Optical fiber length

- Up to 500 m (0.31 mi), using MM fiber
- Up to 20 km (12.43 mi), using SM fiber

Digital Ports and Alarms

- Two optical ports to support daisy-chaining
- Six external alarms

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	N/A
	IEEE C62.41	N/A
	NEMA LS-1	N/A
	IEC 61643-1	N/A
	IEC 61643-12	N/A
	EN 61643-11	N/A

* This data is provisional and subject to change.