ROBINSON & COLE LLP

KENNETH C. BALDWIN

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Hartford, CT 06103-3597
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Direct (860) 275-8345

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**
14 Canton Spring Road, Canton, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains fifteen (15) wireless telecommunications antennas at the 120-foot level of the existing 140-foot tower at 14 Canton Spring Road in Canton, Connecticut (the "Property"). Cellco owns this tower. The Council approved Cellco's use of the tower in 1999. Cellco now intends to replace six (6) of its existing antennas with three (3) model 742 213V01, 1900 MHz antennas and three (3) model 742 213V01, 2100 MHz antennas, all at the 120-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 monopole. 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 Richard Barlow, First Selectman of the Town of Canton. A copy of this letter is also being sent to Canton Volunteer Fire Company Inc., the owner of the Property.

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

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12744107-v1

1. The proposed modifications will not result in an increase in the height of the existing tower. The replaced antennas and RRHs will be located on Cellco's platform at the 120-foot level on the 140-foot tower.

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

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

4. The operation of the 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 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:
Richard Barlow, Canton First Selectman
Canton Volunteer Fire Company Inc.
Sandy M. Carter

ATTACHMENT 1

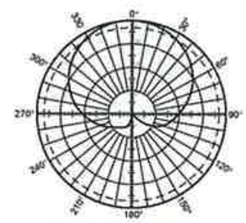
KATHREIN
SCALA DIVISION

742 213V01

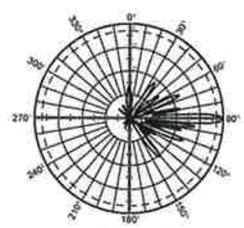
65° Panel Antenna

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

RoHS
Lead-Free

11271-B
936.3740/b

* 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.

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

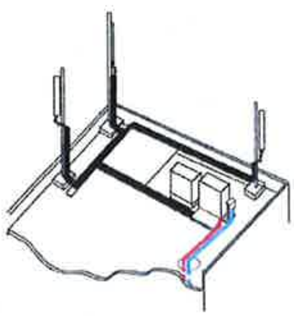
Because of its small size and weight, the Alcatel-Lucent RRH2x40-AWS can be installed close to the antenna. Operators can therefore locate the Alcatel-Lucent RRH2x40-AWS where RF engineering is deemed ideal, minimizing trade-offs between available sites and RF optimum sites. The RF feeder cost and installation 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

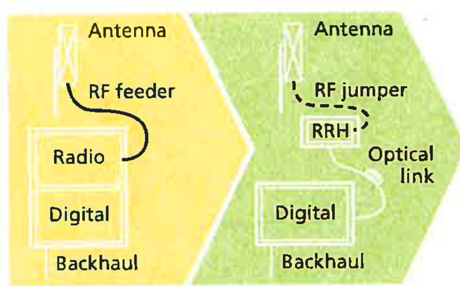
- Zero-footprint deployment
- Easy installation, with a lightweight unit can be carried and set up by one person
- Optimized RF power, with flexible site selection and elimination of a TMA
- Convection-cooled (fanless)
- Noise-free
- Best-in-class power efficiency, with significantly reduced energy consumption

Benefits

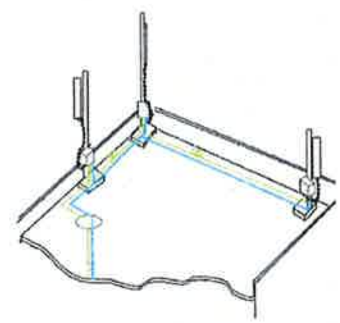
- Leverages existing real estate with lower site costs
- Reduces installation costs, with fewer installation materials and simplified logistics
- Decreases power costs and minimizes environmental impacts, with the potential for eco-sustainable power options
- Improves RF performance and adds flexibility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

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.

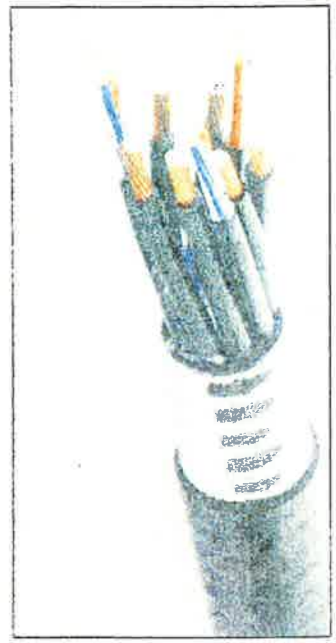


Figure 1: HYBRIFLEX Series

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

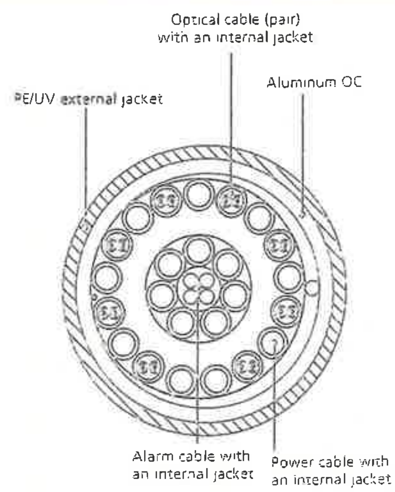


Figure 2: Construction Detail

ATTACHMENT 2

	General	Power	Density					
Site Name: Canton								
Tower Height: Verizon @ 120ft								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*AT&T UMTS	2	565	130	0.0240	880	0.5867	4.10%	
*AT&T UMTS	2	1077	130	0.0458	1900	1.0000	4.58%	
*AT&T LTE	1	1615	130	0.0344	734	0.4893	7.02%	
*AT&T GSM	4	934	130	0.0795	1900	1.0000	7.95%	
*AT&T GSM	1	647	130	0.0138	880	0.5867	2.35%	
*Pocket (now MetroPCS)	3	631	83	0.0988	2130	1.0000	9.88%	
*Sprint CDMA/LTE	2	693	90	0.0615	1900	1.0000	6.15%	
*Sprint CDMA/LTE	1	390	90	0.0173	850	0.5667	3.06%	
*Canton FD	1	71	140	0.0013	300	0.2000	0.65%	
*Nextel	9	100	110	0.0267	851	0.5673	4.71%	
*T-Mobile	8	121	100	0.0348	1935	1.0000	3.48%	
Verizon	**11**	**438**	**120**	**0.1203**	**1970**	**1.0000**	**12.03%**	
Verizon	**9**	**403**	**120**	**0.0906**	**869**	**0.5793**	**15.63%**	
Verizon	**1**	**1750**	**120**	**0.0437**	**2145**	**1.0000**	**4.37%**	
Verizon	**1**	**1050**	**120**	**0.0262**	**698**	**0.4653**	**5.63%**	
								91.60%
* Source: Siting Council								

ATTACHMENT 3

Centered on Solutions℠

Structural Analysis Report

140-ft Existing EEI Monopole

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Canton

14 Canton Springs Road
Canton, CT

Centek Project No. 13001.107

Date: January 6, 2014

STATE OF CONNECTICUT
No. 16684
LICENSED
PROFESSIONAL ENGINEER

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 Canton, CT.

The host tower is a 140-ft, four-section, eighteen sided, tapered monopole, originally designed and manufactured by Engineered Endeavors Inc (EEI)—job no: 4960, dated May 13, 1999. The tower geometry, structure member sizes and foundation system information were obtained from a previous structural report prepared by Centek Engineering job no. 13027 dated February 26, 2013.

Antenna and appurtenance information were obtained from the aforementioned structural report, visual verification from grade by Centek personnel on January 6, 2014 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 18.00-in at the top and 51.00-in at the base.

Verizon proposes the removal of six (6) panel antennas and the installation of six (6) panel antennas, three (3) remote radio heads and one (1) main distribution box mounted to the existing 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:

- TOWN (Existing):
  Antennas: One (1) 20-ft x 2” dia. Omni-directional whip antenna mounted on a 4-ft side arm with an elevation of 138-ft above exiting grade.
  Coax Cables: Two (2) 7/8” ∅ coax cables running on the inside of the existing monopole.
- AT&T (Existing):
  Antennas: Three (3) Kathrein 800-10121 panel antennas, one (1) KMW AM-X-CD-14-65-00T-RET panel antenna, two (2) KMW AM-X-CD-17-65-00T-RET panel antennas, three (3) Andrew SBNH-1D6565C panel antennas, six (6) CCI DTMABP7819VG12A TMA’s six (6) Ericsson RRUS-11 remote radio heads, one (1) Raycap DC6-48-60-18-8F surge arrestor, mounted on a 13-ft platform w/ handrails with a RAD center elevation of 130-ft above exiting grade.
  Coax Cables: Twelve (12) 7/8” ∅ coax cables running on the inside of the existing monopole. One (1) fiber cable and two (2) dc control cables running within the interior of the existing monopole.

- T-MOBILE (Existing):
  Antennas: Four (4) EMS RR90-17-02DP panel antennas mounted on a 14-ft low profile platform with a RAD center elevation of 100-ft above exiting grade.
  Coax Cables: Eight (8) 1-5/8" ∅ coax cables running on the inside of the existing monopole.
- SPRINT (Existing):
  Antennas: One (1) RFS APXVSPP18-C-A20 panel antenna, one (1) RFS APXV9ERR18-C-A20 panel antenna, one (1) Powerwave P40-16-XLPP-RR-A panel antenna, three (3) 1900MHz 4X40W RRH's and three (3) 800MHz 2X50W RRH's mounted on a 14-ft low profile platform with a RAD center elevation of 90-ft above exiting grade.
  Coax Cables: Three (3) 1-5/8"∅ Hybriflex running on the inside of the existing monopole.
- METROPCS (Existing):
  Antennas: Three (3) RFS APXV18-206517S panel antennas flush mounted with a RAD center elevation of 83-ft above exiting grade.
  Coax Cables: Six (6) 1-5/8" ∅ coax cables running on the inside of the existing monopole.
- Verizon (Existing to Remain):
  Antennas: Three (3) Antel BXA-70063-6CF panel antennas, four (4) Antel LPA-80080-4CF panel antennas, two (2) Antel LPA-80063-4CF panel antennas and one (1) GPS mounted to one (1) 13-ft platform w/ handrails with a RAD center elevation of 120-ft above existing grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ and one (1) 1/2" ∅ 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 (Existing to Remove):
  Antennas: Six (6) Antel LPA-171063-8CF panel antennas mounted to one (1) 13-ft platform w/ handrails with a RAD center elevation of 120-ft above existing grade.
- **VERIZON (Proposed):**
  Antennas: Six (6) 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 to one (1) 13-ft platform w/ handrails with a RAD center elevation of 120-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:	Hartford; v = 80 mph (fastest mile)	*[Section 16 of TIA/EIA-222-F-96]*
	Canton; v = 95 mph (3 second gust) equivalent to v = 77.5 mph (fastest mile)	*[Appendix K of the 2005 CT Building Code Supplement]*
	TIA/EIA-222-F wind speed controls.	
Load Cases:	<u>Load Case 1</u>; 80 mph wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	<u>Load Case 2</u>; 69 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 69 mph wind speed velocity represents 75% of the wind pressure generated by the 80 mph wind speed.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	<u>Load Case 3</u>; Seismic – not checked	*[Section 1614.5 of State Bldg. Code 2005] does not control in the design of this structure type*

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

Tower Capacity

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

- Calculated stresses were found to be within allowable limits. In Load Case 1, per tnxTower "Section Capacity Table", this tower was found to be at **55.4%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L3)	40.26'-79.83'	55.4%	**PASS**

Foundation and Anchors

The existing foundation consists of a 6.5-ft square x 4.5-ft long reinforced concrete pier on a 24.0-ft square x 3.0-ft thick reinforced concrete pad. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned structural report. The base of the tower is connected to the foundation by means of (20) 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	24 kips
	Compression	38 kips
	Moment	2342 kip-ft

- The foundation was found to be within allowable limits.

Foundation	Design Limit	IBC 2003/2005 CT State Building Code Section 3108.4.2 (FS)(1)	Proposed Loading (FS)(1)	Result
Reinforced Concrete Pad and Pier	OTM(2)	2.0	3.01	**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	49.1%	**PASS**
Base Plate	Bending	58.0%	**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.

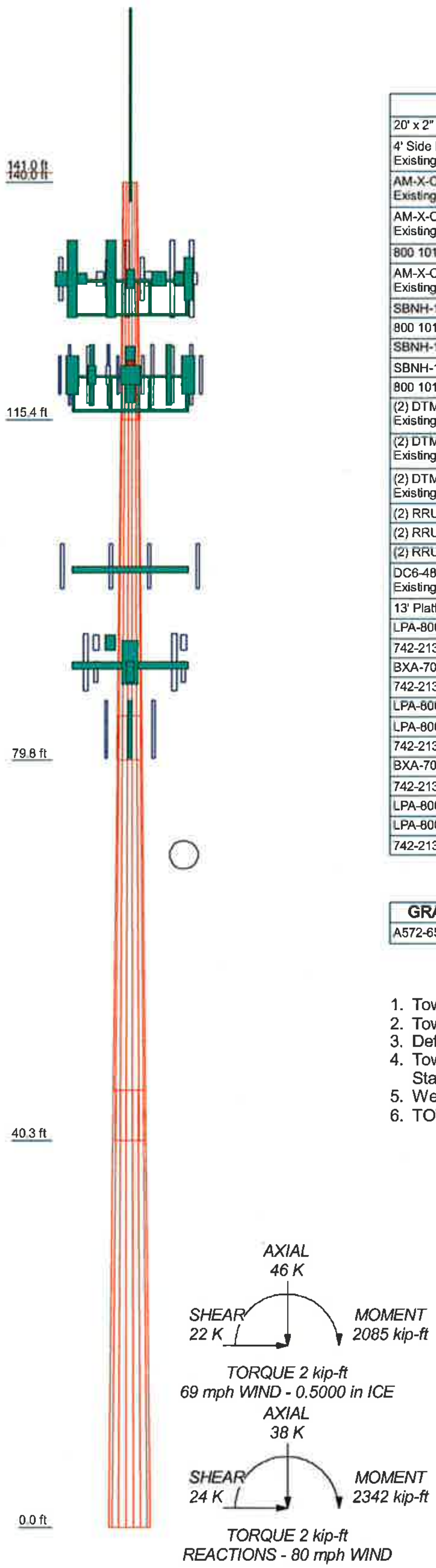
General Description of Structural Analysis Program

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)	45.54	44.16	39.06	24.64	
Number of Sides	18	18	18	18	
Thickness (in)	0.5000	0.4375	0.3125	0.1875	
Socket Length (ft)		5.28	4.59	3.53	
Top Dia (in)	39.7436	30.9366	22.9814	18.0000	
Bot Dia (in)	51.0000	41.9334	32.7041	24.2521	
Grade	A572-65				
Weight (K)	11.0	7.5	3.6	1.0	23.2



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
20' x 2" Dia Omni (Town - Existing)	148	BXA-70063/6CF (Verizon - Existing)	120
4' Side Mount Standoff (Town - Existing)	138	742-213 (Verizon - Proposed)	120
AM-X-CD-17-65-00T-RET (ATI - Existing)	130	LPA-80063/4CF (Verizon - Existing)	120
AM-X-CD-14-65-00T-RET (ATI - Existing)	130	RRH2x40-AWS (Verizon - Proposed)	120
800 10121 (ATI - Existing)	130	RRH2x40-AWS (Verizon - Proposed)	120
AM-X-CD-17-65-00T-RET (ATI - Existing)	130	RRH2x40-AWS (Verizon - Proposed)	120
SBNH-1D6565C (ATI - Existing)	130	GPS (Verizon - Existing)	120
800 10121 (ATI - Existing)	130	DB-T1-6Z-8AB-0Z (Verizon - Proposed)	120
SBNH-1D6565C (ATI - Existing)	130	13' Platform w/rails (Verizon - Existing)	118
SBNH-1D6565C (ATI - Existing)	130	(2) RR90-17-02DP (T-Mobile - Existing)	100
800 10121 (ATI - Existing)	130	(2) RR90-17-02DP (T-Mobile - Existing)	100
(2) DTMABP7819VG12A TMA (ATI - Existing)	130	14-ft Low Profile Platform (T-Mobile - Existing)	100
(2) DTMABP7819VG12A TMA (ATI - Existing)	130	APXVSPP18-C-A20 w/ Mount (Sprint - Existing)	90
(2) DTMABP7819VG12A TMA (ATI - Existing)	130	APXV9ERR18-C-A20 w/ Mount (Sprint - Existing)	90
(2) RRUS-11 (ATI - Existing)	130	P40-16-XLPP-RR-A w/ Mount (Sprint - Existing)	90
(2) RRUS-11 (ATI - Existing)	130	FD-RRH 2x50 800 w/ Mount (Sprint - Existing)	90
(2) RRUS-11 (ATI - Existing)	130	FD-RRH 4x40 1900 (Sprint - Existing)	90
DC6-48-60-18-8F Surge Arrestor (ATI - Existing)	130	FD-RRH 2x50 800 w/ Mount (Sprint - Existing)	90
13' Platform w/rails (ATI - Existing)	128	FD-RRH 4x40 1900 (Sprint - Existing)	90
LPA-80080-4CF (Verizon - Existing)	120	FD-RRH 2x50 800 w/ Mount (Sprint - Existing)	90
742-213 (Verizon - Proposed)	120	FD-RRH 4x40 1900 (Sprint - Existing)	90
BXA-70063/6CF (Verizon - Existing)	120	14-ft Low Profile Platform (Sprint - Existing)	90
742-213 (Verizon - Proposed)	120	APXV18-206517S (MetroPCS - Existing)	83
LPA-80080-4CF (Verizon - Existing)	120	APXV18-206517S (MetroPCS - Existing)	83
LPA-80080-4CF (Verizon - Existing)	120	APXV18-206517S (MetroPCS - Existing)	83
742-213 (Verizon - Proposed)	120	Uni-Tri Bracket (MetroPCS - Existing)	83
BXA-70063/6CF (Verizon - Existing)	120		
742-213 (Verizon - Proposed)	120		
LPA-80080-4CF (Verizon - Existing)	120		
LPA-80063/4CF (Verizon - Existing)	120		
742-213 (Verizon - Proposed)	120		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
5. Welds are fabricated with ER-70S-6 electrodes.
6. TOWER RATING: 55.4%

Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job: 13001.107 - Canton		
	Project: 140' EEI Monopole - 14 Canton Springs Rd, Canton, CT		
	Client: Verizon Wireless	Drawn by: TJL	App'd:
	Code: TIA/EIA-222-F	Date: 01/06/14	Scale: NTS
	Path: [illegible]		Dwg No. E-1

Tower Input Data

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

- Basic wind speed of 80 mph.
- Nominal ice thickness of 0.5000 in.
- Ice density of 56 pcf.
- A wind speed of 69 mph is used in combination with ice.
- Temperature drop of 50 °F.
- Deflections calculated using a wind speed of 50 mph.
- Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards..
- Welds are fabricated with ER-70S-6 electrodes..
- A non-linear (P-delta) analysis was used.
- Pressures are calculated at each section.
- Stress ratio used in pole design is 1.333.
- Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Options

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

Tapered Pole Section Geometry

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L1	140.00-115.36	24.64	3.53	18	18.0000	24.2521	0.1875	0.7500	A572-65 (65 ksi)
L2	115.36-79.83	39.06	4.59	18	22.9814	32.7041	0.3125	1.2500	A572-65 (65 ksi)
L3	79.83-40.26	44.16	5.28	18	30.9366	41.9334	0.4375	1.7500	A572-65 (65 ksi)
L4	40.26-0.00	45.54		18	39.7436	51.0000	0.5000	2.0000	A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in²	I in⁴	r in	C in	I/C in³	J in⁴	It/Q in²	w in	w/t
L1	18.2777	10.6007	424.9328	6.3234	9.1440	46.4712	850.4248	5.3013	2.8380	15.136
	24.6262	14.3214	1047.8077	8.5429	12.3201	85.0489	2096.9941	7.1621	3.9384	21.005
L2	24.2282	22.4847	1459.7753	8.0475	11.6746	125.0391	2921.4715	11.2445	3.4947	11.183
	33.2086	32.1284	4258.8427	11.4990	16.6137	256.3455	8523.2892	16.0673	5.2059	16.659
L3	32.5745	42.3518	4977.1676	10.8272	15.7158	316.6988	9960.8842	21.1799	4.6748	10.685
	42.5803	57.6222	12535.3942	14.7310	21.3022	588.4563	25087.2828	28.8166	6.6103	15.109
L4	41.6819	62.2795	12117.6844	13.9315	20.1897	600.1905	24251.3135	31.1457	6.1149	12.23
	51.7868	80.1435	25821.9188	17.9275	25.9080	996.6774	51677.8148	40.0794	8.0960	16.192

Tower Elevation ft	Gusset Area (per face) ft²	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in
L1 140.00-115.36				1	1	1		
L2 115.36-79.83				1	1	1		
L3 79.83-40.26				1	1	1		
L4 40.26-0.00				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft²/ft	Weight plf
7/8	A	No	Inside Pole	140.00 - 3.00	2	No Ice	0.00	0.54
(Town - Existing)						1/2" Ice	0.00	0.54
7/8	A	No	Inside Pole	130.00 - 3.00	12	No Ice	0.00	0.54
(AT&T - Existing)						1/2" Ice	0.00	0.54
RG6-Fiber	C	No	CaAa (Out Of	130.00 - 3.00	1	No Ice	0.05	1.00
(AT&T - Existing)			Face)			1/2" Ice	0.15	1.61
#8 AWG Copper WIre	C	No	CaAa (Out Of	130.00 - 3.00	2	No Ice	0.01	0.05
(AT&T - Existing)			Face)			1/2" Ice	0.11	0.43
1 5/8	B	No	Inside Pole	120.00 - 3.00	12	No Ice	0.00	1.04
(Verizon - Existing)						1/2" Ice	0.00	1.04
1/2	B	No	Inside Pole	120.00 - 3.00	1	No Ice	0.00	0.25
(Verizon - Existing)						1/2" Ice	0.00	0.25
1 5/8	B	No	CaAa (Out Of	120.00 - 3.00	1	No Ice	0.20	1.04
(Verizon - Existing)			Face)			1/2" Ice	0.30	2.55
1 5/8	B	No	CaAa (Out Of	120.00 - 3.00	5	No Ice	0.00	1.04
(Verizon - Existing)			Face)			1/2" Ice	0.00	2.55
HYBRIFLEX 1-5/8"	C	No	CaAa (Out Of	120.00 - 3.00	1	No Ice	0.20	1.90
(Verizon - Proposed)			Face)			1/2" Ice	0.30	3.41
1 5/8	A	No	Inside Pole	100.00 - 3.00	8	No Ice	0.00	1.04
(T-Mobile - Existing)						1/2" Ice	0.00	1.04
HYBRIFLEX 1-5/8"	C	No	Inside Pole	90.00 - 3.00	3	No Ice	0.00	1.90
(Sprint - Existing)						1/2" Ice	0.00	1.90
1 5/8	C	No	Inside Pole	83.00 - 3.00	6	No Ice	0.00	1.04
(MetroPCS - Existing)						1/2" Ice	0.00	1.04

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	140.00-115.36	A	0.000	0.000	0.000	0.000	0.12
		B	0.000	0.000	0.000	0.919	0.09
		C	0.000	0.000	0.000	2.027	0.02
L2	115.36-79.83	A	0.000	0.000	0.000	0.000	0.44
		B	0.000	0.000	0.000	7.035	0.67
		C	0.000	0.000	0.000	9.725	0.18
L3	79.83-40.26	A	0.000	0.000	0.000	0.000	0.63
		B	0.000	0.000	0.000	7.835	0.75
		C	0.000	0.000	0.000	10.830	0.59
L4	40.26-0.00	A	0.000	0.000	0.000	0.000	0.59
		B	0.000	0.000	0.000	7.377	0.71
		C	0.000	0.000	0.000	10.198	0.56

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	140.00-115.36	A	0.500	0.000	0.000	0.000	0.000	0.12
		B		0.000	0.000	0.000	1.383	0.13
		C		0.000	0.000	0.000	6.883	0.05
L2	115.36-79.83	A	0.500	0.000	0.000	0.000	0.000	0.44
		B		0.000	0.000	0.000	10.588	1.00
		C		0.000	0.000	0.000	23.936	0.29
L3	79.83-40.26	A	0.500	0.000	0.000	0.000	0.000	0.63
		B		0.000	0.000	0.000	11.792	1.11
		C		0.000	0.000	0.000	26.658	0.71
L4	40.26-0.00	A	0.500	0.000	0.000	0.000	0.000	0.59
		B		0.000	0.000	0.000	11.103	1.04
		C		0.000	0.000	0.000	25.102	0.66

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
L1	140.00-115.36	-0.0580	0.0921	-0.2483	0.2195
L2	115.36-79.83	-0.0819	0.2948	-0.3371	0.5034
L3	79.83-40.26	-0.0853	0.3068	-0.3636	0.5430
L4	40.26-0.00	-0.0811	0.2916	-0.3567	0.5326

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
20' x 2" Dia Omni (Town - Existing)	C	From Face	4.00 0.00 0.00	0.0000	148.00	No Ice 1/2" Ice	4.00 6.03	4.00 6.03	0.02 0.05
4' Side Mount Standoff (Town - Existing)	C	From Face	2.00 0.00 0.00	0.0000	138.00	No Ice 1/2" Ice	2.72 4.91	2.72 4.91	0.05 0.09
AM-X-CD-17-65-00T-RET (AT&T - Existing)	A	From Face	3.00 6.00 0.00	0.0000	130.00	No Ice 1/2" Ice	11.31 11.93	6.80 7.38	0.06 0.12
AM-X-CD-14-65-00T-RET (AT&T - Existing)	A	From Face	3.00 2.00 0.00	0.0000	130.00	No Ice 1/2" Ice	5.51 5.90	2.83 3.14	0.04 0.07
800 10121 (AT&T - Existing)	A	From Face	4.00 -6.00 0.00	0.0000	130.00	No Ice 1/2" Ice	5.46 5.88	3.29 3.64	0.05 0.08
AM-X-CD-17-65-00T-RET (AT&T - Existing)	B	From Face	3.00 6.00 0.00	0.0000	130.00	No Ice 1/2" Ice	11.31 11.93	6.80 7.38	0.06 0.12
SBNH-1D6565C (AT&T - Existing)	B	From Face	3.00 2.00 0.00	0.0000	130.00	No Ice 1/2" Ice	11.41 12.03	7.70 8.29	0.06 0.13
800 10121 (AT&T - Existing)	B	From Face	4.00 -6.00 0.00	0.0000	130.00	No Ice 1/2" Ice	5.46 5.88	3.29 3.64	0.05 0.08
SBNH-1D6565C (AT&T - Existing)	C	From Face	3.00 6.00 0.00	0.0000	130.00	No Ice 1/2" Ice	11.41 12.03	7.70 8.29	0.06 0.13
SBNH-1D6565C (AT&T - Existing)	C	From Face	3.00 2.00 0.00	0.0000	130.00	No Ice 1/2" Ice	11.41 12.03	7.70 8.29	0.06 0.13
800 10121 (AT&T - Existing)	C	From Face	4.00 -6.00 0.00	0.0000	130.00	No Ice 1/2" Ice	5.46 5.88	3.29 3.64	0.05 0.08
(2) DTMABP7819VG12A TMA (AT&T - Existing)	A	From Face	4.00 0.00 0.00	0.0000	130.00	No Ice 1/2" Ice	1.59 1.76	0.58 0.70	0.02 0.03
(2) DTMABP7819VG12A TMA (AT&T - Existing)	B	From Face	4.00 0.00 0.00	0.0000	130.00	No Ice 1/2" Ice	1.59 1.76	0.58 0.70	0.02 0.03
(2) DTMABP7819VG12A TMA (AT&T - Existing)	C	From Face	4.00 0.00 0.00	0.0000	130.00	No Ice 1/2" Ice	1.59 1.76	0.58 0.70	0.02 0.03
(2) RRUS-11 (AT&T - Existing)	A	From Face	1.00 2.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.99 3.23	1.25 1.41	0.05 0.07
(2) RRUS-11 (AT&T - Existing)	B	From Face	1.00 2.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.99 3.23	1.25 1.41	0.05 0.07
(2) RRUS-11 (AT&T - Existing)	C	From Face	1.00 2.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.99 3.23	1.25 1.41	0.05 0.07
DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	C	From Face	0.50 0.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.23 2.45	2.23 2.45	0.02 0.04
13' Platform w/rails (AT&T - Existing)	C	None		0.0000	128.00	No Ice 1/2" Ice	31.30 40.20	31.30 40.20	1.82 2.45
LPA-80080-4CF	A	From Face	4.00	0.0000	120.00	No Ice	2.62	6.06	0.01

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert*	*Azimuth Adjustment*	*Placement*		*C_AA_A Front*	*C_AA_A Side*	*Weight*
			ft ft ft	*°*	*ft*		*ft²*	*ft²*	*K*
(Verizon - Existing)			-6.00			1/2" Ice	2.92	6.45	0.05
			0.00						
742-213	A	From Face	4.00	0.0000	120.00	No Ice	5.17	2.99	0.02
(Verizon - Proposed)			-4.00			1/2" Ice	5.65	3.57	0.05
			0.00						
BXA-70063/6CF	A	From Face	4.00	0.0000	120.00	No Ice	7.73	4.16	0.02
(Verizon - Existing)			0.00			1/2" Ice	8.27	4.60	0.06
			0.00						
742-213	A	From Face	4.00	0.0000	120.00	No Ice	5.17	2.99	0.02
(Verizon - Proposed)			4.00			1/2" Ice	5.65	3.57	0.05
			0.00						
LPA-80080-4CF	A	From Face	4.00	0.0000	120.00	No Ice	2.62	6.06	0.01
(Verizon - Existing)			6.00			1/2" Ice	2.92	6.45	0.05
			0.00						
LPA-80080-4CF	B	From Face	4.00	0.0000	120.00	No Ice	2.62	6.06	0.01
(Verizon - Existing)			-6.00			1/2" Ice	2.92	6.45	0.05
			0.00						
742-213	B	From Face	4.00	0.0000	120.00	No Ice	5.17	2.99	0.02
(Verizon - Proposed)			-4.00			1/2" Ice	5.65	3.57	0.05
			0.00						
BXA-70063/6CF	B	From Face	4.00	0.0000	120.00	No Ice	7.73	4.16	0.02
(Verizon - Existing)			0.00			1/2" Ice	8.27	4.60	0.06
			0.00						
742-213	B	From Face	4.00	0.0000	120.00	No Ice	5.17	2.99	0.02
(Verizon - Proposed)			4.00			1/2" Ice	5.65	3.57	0.05
			0.00						
LPA-80080-4CF	B	From Face	4.00	0.0000	120.00	No Ice	2.62	6.06	0.01
(Verizon - Existing)			6.00			1/2" Ice	2.92	6.45	0.05
			0.00						
LPA-80063/4CF	C	From Face	4.00	0.0000	120.00	No Ice	7.00	6.08	0.02
(Verizon - Existing)			-6.00			1/2" Ice	7.41	6.48	0.07
			0.00						
742-213	C	From Face	4.00	0.0000	120.00	No Ice	5.17	2.99	0.02
(Verizon - Proposed)			-4.00			1/2" Ice	5.65	3.57	0.05
			0.00						
BXA-70063/6CF	C	From Face	4.00	0.0000	120.00	No Ice	7.73	4.16	0.02
(Verizon - Existing)			0.00			1/2" Ice	8.27	4.60	0.06
			0.00						
742-213	C	From Face	4.00	0.0000	120.00	No Ice	5.17	2.99	0.02
(Verizon - Proposed)			4.00			1/2" Ice	5.65	3.57	0.05
			0.00						
LPA-80063/4CF	C	From Face	4.00	0.0000	120.00	No Ice	7.00	6.08	0.02
(Verizon - Existing)			6.00			1/2" Ice	7.41	6.48	0.07
			0.00						
RRH2x40-AWS	A	From Face	4.00	0.0000	120.00	No Ice	2.52	1.59	0.04
(Verizon - Proposed)			4.00			1/2" Ice	2.75	1.80	0.06
			0.00						
RRH2x40-AWS	B	From Face	4.00	0.0000	120.00	No Ice	2.52	1.59	0.04
(Verizon - Proposed)			4.00			1/2" Ice	2.75	1.80	0.06
			0.00						
RRH2x40-AWS	C	From Face	4.00	0.0000	120.00	No Ice	2.52	1.59	0.04
(Verizon - Proposed)			4.00			1/2" Ice	2.75	1.80	0.06
			0.00						
GPS	C	From Face	2.00	0.0000	120.00	No Ice	1.00	1.00	0.01
(Verizon - Existing)			0.00			1/2" Ice	1.50	1.50	0.01
			0.00						
DB-T1-6Z-8AB-0Z	C	From Face	4.00	0.0000	120.00	No Ice	5.60	2.33	0.04

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
(Verizon - Proposed)			0.00 0.00			1/2" Ice	5.92	2.56	0.08
13' Platform w/rails (Verizon - Existing)	C	None		0.0000	118.00	No Ice 1/2" Ice	31.30 40.20	31.30 40.20	1.82 2.45
(2) RR90-17-02DP (T-Mobile - Existing)	A	From Face	4.00 0.00 0.00	0.0000	100.00	No Ice 1/2" Ice	4.36 4.77	1.97 2.31	0.02 0.04
(2) RR90-17-02DP (T-Mobile - Existing)	B	From Face	4.00 0.00 0.00	0.0000	100.00	No Ice 1/2" Ice	4.36 4.77	1.97 2.31	0.02 0.04
14-ft Low Profile Platform (T-Mobile - Existing)	C	None		0.0000	100.00	No Ice 1/2" Ice	16.50 20.00	16.50 20.00	1.55 1.80
APXVSPP18-C-A20 w/ Mount (Sprint - Existing)	A	From Face	4.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	8.96 9.66	8.08 9.14	0.12 0.20
APXV9ERR18-C-A20 w/ Mount (Sprint - Existing)	B	From Face	4.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	8.96 9.66	8.61 9.67	0.12 0.21
P40-16-XLPP-RR-A w/ Mount (Sprint - Existing)	C	From Face	4.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	11.73 12.47	6.32 7.27	0.11 0.20
FD-RRH 2x50 800 w/ Mount (Sprint - Existing)	A	From Face	4.00 2.00 2.00	0.0000	90.00	No Ice 1/2" Ice	4.92 5.52	5.39 6.08	0.14 0.20
FD-RRH 4x40 1900 (Sprint - Existing)	A	From Face	4.00 2.00 -1.00	0.0000	90.00	No Ice 1/2" Ice	2.61 2.84	2.71 2.95	0.06 0.08
FD-RRH 2x50 800 w/ Mount (Sprint - Existing)	B	From Face	4.00 2.00 2.00	0.0000	90.00	No Ice 1/2" Ice	4.92 5.52	5.39 6.08	0.14 0.20
FD-RRH 4x40 1900 (Sprint - Existing)	B	From Face	4.00 2.00 -1.00	0.0000	90.00	No Ice 1/2" Ice	2.61 2.84	2.71 2.95	0.06 0.08
FD-RRH 2x50 800 w/ Mount (Sprint - Existing)	C	From Face	4.00 2.00 2.00	0.0000	90.00	No Ice 1/2" Ice	4.92 5.52	5.39 6.08	0.14 0.20
FD-RRH 4x40 1900 (Sprint - Existing)	C	From Face	4.00 0.00 -1.00	0.0000	90.00	No Ice 1/2" Ice	2.61 2.84	2.71 2.95	0.06 0.08
14-ft Low Profile Platform (Sprint - Existing)	C	None		0.0000	90.00	No Ice 1/2" Ice	16.50 20.00	16.50 20.00	1.55 1.80
APXV18-206517S (MetroPCS - Existing)	A	From Face	1.50 0.00 0.00	0.0000	83.00	No Ice 1/2" Ice	5.17 5.62	3.04 3.47	0.03 0.05
APXV18-206517S (MetroPCS - Existing)	B	From Face	1.50 0.00 0.00	0.0000	83.00	No Ice 1/2" Ice	5.17 5.62	3.04 3.47	0.03 0.05
APXV18-206517S (MetroPCS - Existing)	C	From Face	1.50 0.00 0.00	0.0000	83.00	No Ice 1/2" Ice	5.17 5.62	3.04 3.47	0.03 0.05
Uni-Tri Bracket (MetroPCS - Existing)	C	None		0.0000	83.00	No Ice 1/2" Ice	1.75 1.94	1.75 1.94	0.00 0.00

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 140.00-115.36	127.07	1.47	24	43.379	A	0.000	43.379	43.379	100.00	0.000	0.000
					B	0.000	43.379		100.00	0.000	0.919
					C	0.000	43.379		100.00	0.000	2.027
L2 115.36-79.83	96.90	1.36	22	83.739	A	0.000	83.739	83.739	100.00	0.000	0.000
					B	0.000	83.739		100.00	0.000	7.035
					C	0.000	83.739		100.00	0.000	9.725
L3 79.83-40.26	59.64	1.184	19	122.029	A	0.000	122.029	122.029	100.00	0.000	0.000
					B	0.000	122.029		100.00	0.000	7.835
					C	0.000	122.029		100.00	0.000	10.830
L4 40.26-0.00	19.40	1	16	154.412	A	0.000	154.412	154.412	100.00	0.000	0.000
					B	0.000	154.412		100.00	0.000	7.377
					C	0.000	154.412		100.00	0.000	10.198

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	t_Z in	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 140.00-115.36	127.07	1.47	18	0.5000	45.432	A	0.000	45.432	45.432	100.00	0.000	0.000
						B	0.000	45.432		100.00	0.000	1.383
						C	0.000	45.432		100.00	0.000	6.883
L2 115.36-79.83	96.90	1.36	17	0.5000	86.699	A	0.000	86.699	86.699	100.00	0.000	0.000
						B	0.000	86.699		100.00	0.000	10.588
						C	0.000	86.699		100.00	0.000	23.936
L3 79.83-40.26	59.64	1.184	14	0.5000	125.326	A	0.000	125.326	125.326	100.00	0.000	0.000
						B	0.000	125.326		100.00	0.000	11.792
						C	0.000	125.326		100.00	0.000	26.658
L4 40.26-0.00	19.40	1	12	0.5000	157.767	A	0.000	157.767	157.767	100.00	0.000	0.000
						B	0.000	157.767		100.00	0.000	11.103
						C	0.000	157.767		100.00	0.000	25.102

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 140.00-115.36	127.07	1.47	9	43.379	A	0.000	43.379	43.379	100.00	0.000	0.000
					B	0.000	43.379		100.00	0.000	0.919
					C	0.000	43.379		100.00	0.000	2.027

Section Elevation *ft*	*z* *ft*	K_Z	q_z *psf*	A_G ft^2	*F a c e*	A_F ft^2	A_R ft^2	A_{leg} ft^2	*Leg %*	C_AA_A *In Face* ft^2	C_AA_A *Out Face* ft^2
L2 115.36-79.83	96.90	1.36	9	83.739	A	0.000	83.739	83.739	100.00	0.000	0.000
					B	0.000	83.739		100.00	0.000	7.035
					C	0.000	83.739		100.00	0.000	9.725
L3 79.83-40.26	59.64	1.184	8	122.029	A	0.000	122.029	122.029	100.00	0.000	0.000
					B	0.000	122.029		100.00	0.000	7.835
					C	0.000	122.029		100.00	0.000	10.830
L4 40.26-0.00	19.40	1	6	154.412	A	0.000	154.412	154.412	100.00	0.000	0.000
					B	0.000	154.412		100.00	0.000	7.377
					C	0.000	154.412		100.00	0.000	10.198

Tower Forces - No Ice - 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* *plf*	*Ctrl. Face*
L1 140.00-115.36	0.23	1.04	A	1	0.65	1	1	1	43.379	1.27	51.44	C
			B	1	0.65	1	1	1	43.379			
			C	1	0.65	1	1	1	43.379			
L2 115.36-79.83	1.29	3.63	A	1	0.65	1	1	1	83.739	2.68	75.36	C
			B	1	0.65	1	1	1	83.739			
			C	1	0.65	1	1	1	83.739			
L3 79.83-40.26	1.97	7.51	A	1	0.65	1	1	1	122.029	3.20	80.78	C
			B	1	0.65	1	1	1	122.029			
			C	1	0.65	1	1	1	122.029			
L4 40.26-0.00	1.86	11.04	A	1	0.65	1	1	1	154.412	3.27	81.12	C
			B	1	0.65	1	1	1	154.412			
			C	1	0.65	1	1	1	154.412			
Sum Weight:	5.35	23.22						OTM	674.51 kip-ft	10.41		

Tower Forces - No Ice - 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* *plf*	*Ctrl. Face*
L1 140.00-115.36	0.23	1.04	A	1	0.65	1	1	1	43.379	1.27	51.44	C
			B	1	0.65	1	1	1	43.379			
			C	1	0.65	1	1	1	43.379			
L2 115.36-79.83	1.29	3.63	A	1	0.65	1	1	1	83.739	2.68	75.36	C
			B	1	0.65	1	1	1	83.739			
			C	1	0.65	1	1	1	83.739			
L3 79.83-40.26	1.97	7.51	A	1	0.65	1	1	1	122.029	3.20	80.78	C
			B	1	0.65	1	1	1	122.029			
			C	1	0.65	1	1	1	122.029			
L4 40.26-0.00	1.86	11.04	A	1	0.65	1	1	1	154.412	3.27	81.12	C
			B	1	0.65	1	1	1	154.412			
			C	1	0.65	1	1	1	154.412			
Sum Weight:	5.35	23.22						OTM	674.51 kip-ft	10.41		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 140.00-115.36	0.23	1.04	A	1	0.65	1	1	1	43.379	1.27	51.44	C
			B	1	0.65	1	1	1	43.379			
			C	1	0.65	1	1	1	43.379			
L2 115.36-79.83	1.29	3.63	A	1	0.65	1	1	1	83.739	2.68	75.36	C
			B	1	0.65	1	1	1	83.739			
			C	1	0.65	1	1	1	83.739			
L3 79.83-40.26	1.97	7.51	A	1	0.65	1	1	1	122.029	3.20	80.78	C
			B	1	0.65	1	1	1	122.029			
			C	1	0.65	1	1	1	122.029			
L4 40.26-0.00	1.86	11.04	A	1	0.65	1	1	1	154.412	3.27	81.12	C
			B	1	0.65	1	1	1	154.412			
			C	1	0.65	1	1	1	154.412			
Sum Weight:	5.35	23.22						OTM	674.51 kip-ft	10.41		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 140.00-115.36	0.23	1.04	A	1	0.65	1	1	1	43.379	1.27	51.44	C
			B	1	0.65	1	1	1	43.379			
			C	1	0.65	1	1	1	43.379			
L2 115.36-79.83	1.29	3.63	A	1	0.65	1	1	1	83.739	2.68	75.36	C
			B	1	0.65	1	1	1	83.739			
			C	1	0.65	1	1	1	83.739			
L3 79.83-40.26	1.97	7.51	A	1	0.65	1	1	1	122.029	3.20	80.78	C
			B	1	0.65	1	1	1	122.029			
			C	1	0.65	1	1	1	122.029			
L4 40.26-0.00	1.86	11.04	A	1	0.65	1	1	1	154.412	3.27	81.12	C
			B	1	0.65	1	1	1	154.412			
			C	1	0.65	1	1	1	154.412			
Sum Weight:	5.35	23.22						OTM	674.51 kip-ft	10.41		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 140.00-115.36	0.30	1.37	A	1	0.65	1	1	1	45.432	1.15	46.82	C
			B	1	0.65	1	1	1	45.432			
			C	1	0.65	1	1	1	45.432			
L2	1.72	4.26	A	1	0.65	1	1	1	86.699	2.56	72.15	C

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
115.36-79.83			B	1	0.65	1	1	1	86.699			
			C	1	0.65	1	1	1	86.699			
L3 79.83-40.26	2.44	8.43	A	1	0.65	1	1	1	125.326	2.93	74.15	C
			B	1	0.65	1	1	1	125.326			
			C	1	0.65	1	1	1	125.326			
L4 40.26-0.00	2.30	12.19	A	1	0.65	1	1	1	157.767	2.88	71.57	C
			B	1	0.65	1	1	1	157.767			
			C	1	0.65	1	1	1	157.767			
Sum Weight:	6.77	26.25						OTM	625.89 kip-ft	9.53		

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 plf	Ctrl. Face
L1 140.00-115.36	0.30	1.37	A	1	0.65	1	1	1	45.432	1.15	46.82	C
			B	1	0.65	1	1	1	45.432			
			C	1	0.65	1	1	1	45.432			
L2 115.36-79.83	1.72	4.26	A	1	0.65	1	1	1	86.699	2.56	72.15	C
			B	1	0.65	1	1	1	86.699			
			C	1	0.65	1	1	1	86.699			
L3 79.83-40.26	2.44	8.43	A	1	0.65	1	1	1	125.326	2.93	74.15	C
			B	1	0.65	1	1	1	125.326			
			C	1	0.65	1	1	1	125.326			
L4 40.26-0.00	2.30	12.19	A	1	0.65	1	1	1	157.767	2.88	71.57	C
			B	1	0.65	1	1	1	157.767			
			C	1	0.65	1	1	1	157.767			
Sum Weight:	6.77	26.25						OTM	625.89 kip-ft	9.53		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 140.00-115.36	0.30	1.37	A	1	0.65	1	1	1	45.432	1.15	46.82	C
			B	1	0.65	1	1	1	45.432			
			C	1	0.65	1	1	1	45.432			
L2 115.36-79.83	1.72	4.26	A	1	0.65	1	1	1	86.699	2.56	72.15	C
			B	1	0.65	1	1	1	86.699			
			C	1	0.65	1	1	1	86.699			
L3 79.83-40.26	2.44	8.43	A	1	0.65	1	1	1	125.326	2.93	74.15	C
			B	1	0.65	1	1	1	125.326			
			C	1	0.65	1	1	1	125.326			
L4 40.26-0.00	2.30	12.19	A	1	0.65	1	1	1	157.767	2.88	71.57	C
			B	1	0.65	1	1	1	157.767			
			C	1	0.65	1	1	1	157.767			
Sum Weight:	6.77	26.25						OTM	625.89	9.53		

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
									kip-ft			

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 140.00-115.36	0.30	1.37	A	1	0.65	1	1	1	45.432	1.15	46.82	C
			B	1	0.65	1	1	1	45.432			
			C	1	0.65	1	1	1	45.432			
L2 115.36-79.83	1.72	4.26	A	1	0.65	1	1	1	86.699	2.56	72.15	C
			B	1	0.65	1	1	1	86.699			
			C	1	0.65	1	1	1	86.699			
L3 79.83-40.26	2.44	8.43	A	1	0.65	1	1	1	125.326	2.93	74.15	C
			B	1	0.65	1	1	1	125.326			
			C	1	0.65	1	1	1	125.326			
L4 40.26-0.00	2.30	12.19	A	1	0.65	1	1	1	157.767	2.88	71.57	C
			B	1	0.65	1	1	1	157.767			
			C	1	0.65	1	1	1	157.767			
Sum Weight:	6.77	26.25						OTM	625.89 kip-ft	9.53		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 140.00-115.36	0.23	1.04	A	1	0.65	1	1	1	43.379	0.50	20.09	C
			B	1	0.65	1	1	1	43.379			
			C	1	0.65	1	1	1	43.379			
L2 115.36-79.83	1.29	3.63	A	1	0.65	1	1	1	83.739	1.05	29.44	C
			B	1	0.65	1	1	1	83.739			
			C	1	0.65	1	1	1	83.739			
L3 79.83-40.26	1.97	7.51	A	1	0.65	1	1	1	122.029	1.25	31.56	C
			B	1	0.65	1	1	1	122.029			
			C	1	0.65	1	1	1	122.029			
L4 40.26-0.00	1.86	11.04	A	1	0.65	1	1	1	154.412	1.28	31.69	C
			B	1	0.65	1	1	1	154.412			
			C	1	0.65	1	1	1	154.412			
Sum Weight:	5.35	23.22						OTM	263.48 kip-ft	4.07		

Tower Forces - Service - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 140.00-115.36	0.23	1.04	A	1	0.65	1	1	1	43.379	0.50	20.09	C
			B	1	0.65	1	1	1	43.379			
			C	1	0.65	1	1	1	43.379			
L2 115.36-79.83	1.29	3.63	A	1	0.65	1	1	1	83.739	1.05	29.44	C
			B	1	0.65	1	1	1	83.739			
			C	1	0.65	1	1	1	83.739			
L3 79.83-40.26	1.97	7.51	A	1	0.65	1	1	1	122.029	1.25	31.56	C
			B	1	0.65	1	1	1	122.029			
			C	1	0.65	1	1	1	122.029			
L4 40.26-0.00	1.86	11.04	A	1	0.65	1	1	1	154.412	1.28	31.69	C
			B	1	0.65	1	1	1	154.412			
			C	1	0.65	1	1	1	154.412			
Sum Weight:	5.35	23.22						OTM	263.48 kip-ft	4.07		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 140.00-115.36	0.23	1.04	A	1	0.65	1	1	1	43.379	0.50	20.09	C
			B	1	0.65	1	1	1	43.379			
			C	1	0.65	1	1	1	43.379			
L2 115.36-79.83	1.29	3.63	A	1	0.65	1	1	1	83.739	1.05	29.44	C
			B	1	0.65	1	1	1	83.739			
			C	1	0.65	1	1	1	83.739			
L3 79.83-40.26	1.97	7.51	A	1	0.65	1	1	1	122.029	1.25	31.56	C
			B	1	0.65	1	1	1	122.029			
			C	1	0.65	1	1	1	122.029			
L4 40.26-0.00	1.86	11.04	A	1	0.65	1	1	1	154.412	1.28	31.69	C
			B	1	0.65	1	1	1	154.412			
			C	1	0.65	1	1	1	154.412			
Sum Weight:	5.35	23.22						OTM	263.48 kip-ft	4.07		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 140.00-115.36	0.23	1.04	A	1	0.65	1	1	1	43.379	0.50	20.09	C
			B	1	0.65	1	1	1	43.379			
			C	1	0.65	1	1	1	43.379			
L2 115.36-79.83	1.29	3.63	A	1	0.65	1	1	1	83.739	1.05	29.44	C
			B	1	0.65	1	1	1	83.739			
			C	1	0.65	1	1	1	83.739			
L3 79.83-40.26	1.97	7.51	A	1	0.65	1	1	1	122.029	1.25	31.56	C
			B	1	0.65	1	1	1	122.029			
			C	1	0.65	1	1	1	122.029			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L4 40.26-0.00	1.86	11.04	A	1	0.65	1	1	1	154.412	1.28	31.69	C
			B	1	0.65	1	1	1	154.412			
			C	1	0.65	1	1	1	154.412			
Sum Weight:	5.35	23.22						OTM	263.48 kip-ft	4.07		

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	23.22					
Bracing Weight	0.00					
Total Member Self-Weight	23.22			1.23	-0.66	
Total Weight	37.87			1.23	-0.66	
Wind 0 deg - No Ice		0.01	-24.37	-2284.00	-2.28	0.61
Wind 30 deg - No Ice		11.96	-21.11	-1978.65	-1117.74	1.46
Wind 45 deg - No Ice		16.91	-17.24	-1615.82	-1579.62	1.74
Wind 60 deg - No Ice		20.71	-12.19	-1142.79	-1933.88	1.91
Wind 90 deg - No Ice		23.91	-0.01	-0.39	-2232.02	1.85
Wind 120 deg - No Ice		20.70	12.18	1142.44	-1932.26	1.30
Wind 135 deg - No Ice		16.90	17.23	1615.99	-1577.32	0.88
Wind 150 deg - No Ice		11.94	21.10	1979.49	-1114.93	0.40
Wind 180 deg - No Ice		-0.01	24.37	2286.47	0.97	-0.61
Wind 210 deg - No Ice		-11.96	21.11	1981.12	1116.43	-1.46
Wind 225 deg - No Ice		-16.91	17.24	1618.29	1578.30	-1.74
Wind 240 deg - No Ice		-20.71	12.19	1145.26	1932.57	-1.91
Wind 270 deg - No Ice		-23.91	0.01	2.86	2230.70	-1.85
Wind 300 deg - No Ice		-20.70	-12.18	-1139.98	1930.94	-1.30
Wind 315 deg - No Ice		-16.90	-17.23	-1613.53	1576.00	-0.88
Wind 330 deg - No Ice		-11.94	-21.10	-1977.03	1113.61	-0.40
Member Ice	3.03					
Total Weight Ice	46.05			2.95	-1.74	
Wind 0 deg - Ice		0.01	-21.56	-2013.28	-2.85	0.28
Wind 30 deg - Ice		10.61	-18.68	-1743.71	-990.17	1.29
Wind 45 deg - Ice		15.00	-15.25	-1423.53	-1399.01	1.68
Wind 60 deg - Ice		18.37	-10.79	-1006.13	-1712.64	1.96
Wind 90 deg - Ice		21.21	-0.01	1.83	-1976.67	2.10
Wind 120 deg - Ice		18.36	10.78	1010.10	-1711.52	1.68
Wind 135 deg - Ice		14.99	15.24	1427.85	-1397.44	1.29
Wind 150 deg - Ice		10.60	18.67	1748.50	-988.24	0.81
Wind 180 deg - Ice		-0.01	21.56	2019.18	-0.62	-0.28
Wind 210 deg - Ice		-10.61	18.68	1749.61	986.70	-1.29
Wind 225 deg - Ice		-15.00	15.25	1429.43	1395.54	-1.68
Wind 240 deg - Ice		-18.37	10.79	1012.03	1709.17	-1.96
Wind 270 deg - Ice		-21.21	0.01	4.07	1973.20	-2.10
Wind 300 deg - Ice		-18.36	-10.78	-1004.20	1708.05	-1.68
Wind 315 deg - Ice		-14.99	-15.24	-1421.95	1393.97	-1.29
Wind 330 deg - Ice		-10.60	-18.67	-1742.60	984.77	-0.81
Total Weight	37.87			1.23	-0.66	
Wind 0 deg - Service		0.00	-9.52	-892.27	-0.80	0.24
Wind 30 deg - Service		4.67	-8.25	-772.99	-436.53	0.57
Wind 45 deg - Service		6.61	-6.73	-631.26	-616.95	0.68
Wind 60 deg - Service		8.09	-4.76	-446.48	-755.33	0.75
Wind 90 deg - Service		9.34	-0.00	-0.23	-871.79	0.72

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 120 deg - Service		8.09	4.76	446.19	-754.70	0.51
Wind 135 deg - Service		6.60	6.73	631.17	-616.05	0.34
Wind 150 deg - Service		4.67	8.24	773.16	-435.43	0.16
Wind 180 deg - Service		-0.00	9.52	893.07	0.47	-0.24
Wind 210 deg - Service		-4.67	8.25	773.79	436.19	-0.57
Wind 225 deg - Service		-6.61	6.73	632.06	616.61	-0.68
Wind 240 deg - Service		-8.09	4.76	447.29	755.00	-0.75
Wind 270 deg - Service		-9.34	0.00	1.04	871.46	-0.72
Wind 300 deg - Service		-8.09	-4.76	-445.38	754.36	-0.51
Wind 315 deg - Service		-6.60	-6.73	-630.36	615.72	-0.34
Wind 330 deg - Service		-4.67	-8.24	-772.36	435.10	-0.16

Load Combinations

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

Comb. No.	Description
41	Dead+Wind 135 deg - Service
42	Dead+Wind 150 deg - Service
43	Dead+Wind 180 deg - Service
44	Dead+Wind 210 deg - Service
45	Dead+Wind 225 deg - Service
46	Dead+Wind 240 deg - Service
47	Dead+Wind 270 deg - Service
48	Dead+Wind 300 deg - Service
49	Dead+Wind 315 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	140 - 115.36	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-6.63	-0.12	-1.55
			Max. Mx	6	-3.78	-74.24	-0.34
			Max. My	10	-3.73	0.17	-75.34
			Max. Vy	6	9.49	-74.24	-0.34
			Max. Vx	10	9.96	0.17	-75.34
			Max. Torque	6			-2.82
L2	115.36 - 79.83	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-19.72	-0.64	-1.55
			Max. Mx	6	-14.04	-524.51	0.22
			Max. My	10	-14.00	0.54	-540.00
			Max. Vy	6	17.16	-524.51	0.22
			Max. Vx	10	17.64	0.54	-540.00
			Max. Torque	6			-2.84
L3	79.83 - 40.26	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-30.07	-1.11	-2.17
			Max. Mx	6	-23.27	-1270.20	0.32
			Max. My	10	-23.24	0.77	-1304.41
			Max. Vy	6	20.69	-1270.20	0.32
			Max. Vx	10	21.16	0.77	-1304.41
			Max. Torque	23			-2.00
L4	40.26 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-46.05	-1.76	-3.00
			Max. Mx	6	-37.86	-2286.34	0.41
			Max. My	10	-37.86	1.00	-2342.16
			Max. Vy	6	23.92	-2286.34	0.41
			Max. Vx	10	24.39	1.00	-2342.16
			Max. Torque	23			-2.15

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	27	46.05	0.01	-21.56
	Max. H_x	14	37.87	23.91	-0.01
	Max. H_z	2	37.87	-0.01	24.37
	Max. M_x	2	2339.62	-0.01	24.37
	Max. M_z	6	2286.34	-23.91	0.01

Location	*Condition*	*Gov. Load Comb.*	*Vertical K*	*Horizontal, X K*	*Horizontal, Z K*
	Max. Torsion	31	2.15	21.21	-0.01
	Min. Vert	1	37.87	0.00	0.00
	Min. H_x	6	37.87	-23.91	0.01
	Min. H_z	10	37.87	0.01	-24.37
	Min. M_x	10	-2342.16	0.01	-24.37
	Min. M_z	14	-2284.99	23.91	-0.01
	Min. Torsion	23	-2.15	-21.21	0.01

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	37.87	0.00	0.00	1.23	-0.66	-0.00
Dead+Wind 0 deg - No Ice	37.87	0.01	-24.37	-2339.62	-2.35	0.61
Dead+Wind 30 deg - No Ice	37.87	11.96	-21.11	-2026.85	-1144.93	1.46
Dead+Wind 45 deg - No Ice	37.87	16.91	-17.24	-1655.20	-1618.04	1.75
Dead+Wind 60 deg - No Ice	37.87	20.71	-12.19	-1170.66	-1980.94	1.92
Dead+Wind 90 deg - No Ice	37.87	23.91	-0.01	-0.41	-2286.34	1.87
Dead+Wind 120 deg - No Ice	37.87	20.70	12.18	1170.29	-1979.27	1.31
Dead+Wind 135 deg - No Ice	37.87	16.90	17.23	1655.37	-1615.68	0.89
Dead+Wind 150 deg - No Ice	37.87	11.94	21.10	2027.72	-1142.04	0.40
Dead+Wind 180 deg - No Ice	37.87	-0.01	24.37	2342.16	1.00	-0.61
Dead+Wind 210 deg - No Ice	37.87	-11.96	21.11	2029.39	1143.59	-1.46
Dead+Wind 225 deg - No Ice	37.87	-16.91	17.24	1657.74	1616.70	-1.75
Dead+Wind 240 deg - No Ice	37.87	-20.71	12.19	1173.19	1979.59	-1.92
Dead+Wind 270 deg - No Ice	37.87	-23.91	0.01	2.94	2284.99	-1.87
Dead+Wind 300 deg - No Ice	37.87	-20.70	-12.18	-1167.75	1977.92	-1.31
Dead+Wind 315 deg - No Ice	37.87	-16.90	-17.23	-1652.83	1614.32	-0.89
Dead+Wind 330 deg - No Ice	37.87	-11.94	-21.10	-2025.18	1140.68	-0.41
Dead+Ice+Temp	46.05	0.00	0.00	3.00	-1.76	0.00
Dead+Wind 0 deg+Ice+Temp	46.05	0.01	-21.56	-2079.04	-2.96	0.28
Dead+Wind 30 deg+Ice+Temp	46.05	10.61	-18.68	-1800.68	-1022.50	1.32
Dead+Wind 45 deg+Ice+Temp	46.05	15.00	-15.25	-1470.04	-1444.69	1.72
Dead+Wind 60 deg+Ice+Temp	46.05	18.37	-10.79	-1039.01	-1768.55	2.00
Dead+Wind 90 deg+Ice+Temp	46.05	21.21	-0.01	1.91	-2041.21	2.15
Dead+Wind 120 deg+Ice+Temp	46.05	18.36	10.78	1043.15	-1767.39	1.72
Dead+Wind 135 deg+Ice+Temp	46.05	14.99	15.24	1474.56	-1443.05	1.32
Dead+Wind 150 deg+Ice+Temp	46.05	10.60	18.67	1805.69	-1020.49	0.83
Dead+Wind 180 deg+Ice+Temp	46.05	-0.01	21.56	2085.21	-0.63	-0.28
Dead+Wind 210 deg+Ice+Temp	46.05	-10.61	18.68	1806.85	1018.90	-1.31
Dead+Wind 225 deg+Ice+Temp	46.05	-15.00	15.25	1476.21	1441.09	-1.71
Dead+Wind 240 deg+Ice+Temp	46.05	-18.37	10.79	1045.17	1764.96	-2.00
Dead+Wind 270 deg+Ice+Temp	46.05	-21.21	0.01	4.24	2037.61	-2.15
Dead+Wind 300 deg+Ice+Temp	46.05	-18.36	-10.78	-1036.99	1763.79	-1.72
Dead+Wind 315 deg+Ice+Temp	46.05	-14.99	-15.24	-1468.40	1439.44	-1.32
Dead+Wind 330 deg+Ice+Temp	46.05	-10.60	-18.67	-1799.52	1016.88	-0.83
Dead+Wind 0 deg - Service	37.87	0.00	-9.52	-913.56	-1.33	0.24
Dead+Wind 30 deg - Service	37.87	4.67	-8.25	-791.33	-447.86	0.57
Dead+Wind 45 deg - Service	37.87	6.61	-6.73	-646.08	-632.75	0.69
Dead+Wind 60 deg - Service	37.87	8.09	-4.76	-456.71	-774.56	0.75
Dead+Wind 90 deg - Service	37.87	9.34	-0.00	0.62	-893.91	0.73
Dead+Wind 120 deg - Service	37.87	8.09	4.76	458.12	-773.91	0.52
Dead+Wind 135 deg - Service	37.87	6.60	6.73	647.70	-631.82	0.35
Dead+Wind 150 deg - Service	37.87	4.67	8.24	793.22	-446.72	0.16
Dead+Wind 180 deg - Service	37.87	-0.00	9.52	916.11	-0.02	-0.24
Dead+Wind 210 deg - Service	37.87	-4.67	8.25	793.87	446.50	-0.57

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 225 deg - Service	37.87	-6.61	6.73	648.62	631.39	-0.69
Dead+Wind 240 deg - Service	37.87	-8.09	4.76	459.26	773.21	-0.75
Dead+Wind 270 deg - Service	37.87	-9.34	0.00	1.93	892.55	-0.73
Dead+Wind 300 deg - Service	37.87	-8.09	-4.76	-455.58	772.55	-0.52
Dead+Wind 315 deg - Service	37.87	-6.60	-6.73	-645.15	630.47	-0.35
Dead+Wind 330 deg - Service	37.87	-4.67	-8.24	-790.67	445.37	-0.16

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
1	0.00	-37.87	0.00	0.00	37.87	0.00	0.000%
2	0.01	-37.87	-24.37	-0.01	37.87	24.37	0.000%
3	11.96	-37.87	-21.11	-11.96	37.87	21.11	0.000%
4	16.91	-37.87	-17.24	-16.91	37.87	17.24	0.000%
5	20.71	-37.87	-12.19	-20.71	37.87	12.19	0.000%
6	23.91	-37.87	-0.01	-23.91	37.87	0.01	0.000%
7	20.70	-37.87	12.18	-20.70	37.87	-12.18	0.000%
8	16.90	-37.87	17.23	-16.90	37.87	-17.23	0.000%
9	11.94	-37.87	21.10	-11.94	37.87	-21.10	0.000%
10	-0.01	-37.87	24.37	0.01	37.87	-24.37	0.000%
11	-11.96	-37.87	21.11	11.96	37.87	-21.11	0.000%
12	-16.91	-37.87	17.24	16.91	37.87	-17.24	0.000%
13	-20.71	-37.87	12.19	20.71	37.87	-12.19	0.000%
14	-23.91	-37.87	0.01	23.91	37.87	-0.01	0.000%
15	-20.70	-37.87	-12.18	20.70	37.87	12.18	0.000%
16	-16.90	-37.87	-17.23	16.90	37.87	17.23	0.000%
17	-11.94	-37.87	-21.10	11.94	37.87	21.10	0.000%
18	0.00	-46.05	0.00	-0.00	46.05	-0.00	0.000%
19	0.01	-46.05	-21.56	-0.01	46.05	21.56	0.000%
20	10.61	-46.05	-18.68	-10.61	46.05	18.68	0.000%
21	15.00	-46.05	-15.25	-15.00	46.05	15.25	0.000%
22	18.37	-46.05	-10.79	-18.37	46.05	10.79	0.000%
23	21.21	-46.05	-0.01	-21.21	46.05	0.01	0.000%
24	18.36	-46.05	10.78	-18.36	46.05	-10.78	0.000%
25	14.99	-46.05	15.24	-14.99	46.05	-15.24	0.000%
26	10.60	-46.05	18.67	-10.60	46.05	-18.67	0.000%
27	-0.01	-46.05	21.56	0.01	46.05	-21.56	0.000%
28	-10.61	-46.05	18.68	10.61	46.05	-18.68	0.000%
29	-15.00	-46.05	15.25	15.00	46.05	-15.25	0.000%
30	-18.37	-46.05	10.79	18.37	46.05	-10.79	0.000%
31	-21.21	-46.05	0.01	21.21	46.05	-0.01	0.000%
32	-18.36	-46.05	-10.78	18.36	46.05	10.78	0.000%
33	-14.99	-46.05	-15.24	14.99	46.05	15.24	0.000%
34	-10.60	-46.05	-18.67	10.60	46.05	18.67	0.000%
35	0.00	-37.87	-9.52	-0.00	37.87	9.52	0.000%
36	4.67	-37.87	-8.25	-4.67	37.87	8.25	0.000%
37	6.61	-37.87	-6.73	-6.61	37.87	6.73	0.000%
38	8.09	-37.87	-4.76	-8.09	37.87	4.76	0.000%
39	9.34	-37.87	-0.00	-9.34	37.87	0.00	0.000%
40	8.09	-37.87	4.76	-8.09	37.87	-4.76	0.000%
41	6.60	-37.87	6.73	-6.60	37.87	-6.73	0.000%
42	4.67	-37.87	8.24	-4.67	37.87	-8.24	0.000%
43	-0.00	-37.87	9.52	0.00	37.87	-9.52	0.000%
44	-4.67	-37.87	8.25	4.67	37.87	-8.25	0.000%
45	-6.61	-37.87	6.73	6.61	37.87	-6.73	0.000%
46	-8.09	-37.87	4.76	8.09	37.87	-4.76	0.000%

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
47	-9.34	-37.87	0.00	9.34	37.87	-0.00	0.000%
48	-8.09	-37.87	-4.76	8.09	37.87	4.76	0.000%
49	-6.60	-37.87	-6.73	6.60	37.87	6.73	0.000%
50	-4.67	-37.87	-8.24	4.67	37.87	8.24	0.000%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	4	0.00000001	0.00000001
2	Yes	4	0.00000001	0.00017485
3	Yes	5	0.00000001	0.00010119
4	Yes	5	0.00000001	0.00010616
5	Yes	5	0.00000001	0.00008418
6	Yes	4	0.00000001	0.00072318
7	Yes	5	0.00000001	0.00010057
8	Yes	5	0.00000001	0.00010417
9	Yes	5	0.00000001	0.00008937
10	Yes	4	0.00000001	0.00016062
11	Yes	5	0.00000001	0.00008609
12	Yes	5	0.00000001	0.00010543
13	Yes	5	0.00000001	0.00010397
14	Yes	4	0.00000001	0.00073630
15	Yes	5	0.00000001	0.00008501
16	Yes	5	0.00000001	0.00010425
17	Yes	5	0.00000001	0.00009540
18	Yes	4	0.00000001	0.00000459
19	Yes	5	0.00000001	0.00007501
20	Yes	5	0.00000001	0.00022082
21	Yes	5	0.00000001	0.00023853
22	Yes	5	0.00000001	0.00019790
23	Yes	5	0.00000001	0.00008706
24	Yes	5	0.00000001	0.00022404
25	Yes	5	0.00000001	0.00023748
26	Yes	5	0.00000001	0.00020438
27	Yes	5	0.00000001	0.00007527
28	Yes	5	0.00000001	0.00020128
29	Yes	5	0.00000001	0.00023866
30	Yes	5	0.00000001	0.00022738
31	Yes	5	0.00000001	0.00008718
32	Yes	5	0.00000001	0.00019755
33	Yes	5	0.00000001	0.00023550
34	Yes	5	0.00000001	0.00021396
35	Yes	4	0.00000001	0.00003818
36	Yes	4	0.00000001	0.00033070
37	Yes	4	0.00000001	0.00033696
38	Yes	4	0.00000001	0.00024210
39	Yes	4	0.00000001	0.00014665
40	Yes	4	0.00000001	0.00033130
41	Yes	4	0.00000001	0.00031985
42	Yes	4	0.00000001	0.00025472
43	Yes	4	0.00000001	0.00003732
44	Yes	4	0.00000001	0.00024111
45	Yes	4	0.00000001	0.00033356
46	Yes	4	0.00000001	0.00035479
47	Yes	4	0.00000001	0.00014743

48	Yes	4	0.00000001	0.00023923
49	Yes	4	0.00000001	0.00031881
50	Yes	4	0.00000001	0.00029086

Maximum Tower Deflections - Service Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °
L1	140 - 115.36	22.970	43	1.4225	0.0144
L2	118.89 - 79.83	16.758	43	1.3567	0.0068
L3	84.42 - 40.26	8.215	43	0.9490	0.0019
L4	45.54 - 0	2.320	43	0.4740	0.0007

Critical Deflections and Radius of Curvature - Service Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
148.00	20' x 2" Dia Omni	43	22.970	1.4225	0.0144	30733
138.00	4' Side Mount Standoff	43	22.370	1.4197	0.0136	30733
130.00	AM-X-CD-17-65-00T-RET	43	19.982	1.4049	0.0105	15366
128.00	13' Platform w/rails	43	19.391	1.3993	0.0098	12805
120.00	LPA-80080-4CF	43	17.072	1.3638	0.0072	7772
118.00	13' Platform w/rails	43	16.507	1.3506	0.0066	7245
100.00	(2) RR90-17-02DP	43	11.749	1.1619	0.0032	5309
90.00	APXVSPP18-C-A20 w/ Mount	43	9.410	1.0261	0.0023	4644
83.00	APXV18-206517S	43	7.925	0.9297	0.0018	4343

Maximum Tower Deflections - Design Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °
L1	140 - 115.36	58.639	10	3.6268	0.0387
L2	118.89 - 79.83	42.801	10	3.4629	0.0180
L3	84.42 - 40.26	20.994	10	2.4247	0.0052
L4	45.54 - 0	5.930	10	1.2115	0.0018

Critical Deflections and Radius of Curvature - Design Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
148.00	20' x 2" Dia Omni	10	58.639	3.6268	0.0387	12249
138.00	4' Side Mount Standoff	10	57.109	3.6202	0.0365	12249
130.00	AM-X-CD-17-65-00T-RET	10	51.022	3.5840	0.0281	6124

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
128.00	13' Platform w/rails	10	49.517	3.5701	0.0261	5103
120.00	LPA-80080-4CF	10	43.603	3.4807	0.0189	3095
118.00	13' Platform w/rails	10	42.161	3.4475	0.0174	2884
100.00	(2) RR90-17-02DP	10	30.018	2.9677	0.0085	2096
90.00	APXVSPP18-C-A20 w/ Mount	10	24.046	2.6215	0.0061	1827
83.00	APXV18-206517S	10	20.252	2.3755	0.0050	1706

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	140 - 115.36 (1)	TP24.2521x18x0.1875	24.64	0.00	0.0	39.000	13.7884	-3.74	537.75	0.007
L2	115.36 - 79.83 (2)	TP32.7041x22.9814x0.3125	39.06	0.00	0.0	39.000	30.9952	-14.00	1208.81	0.012
L3	79.83 - 40.26 (3)	TP41.9334x30.9366x0.4375	44.16	0.00	0.0	39.000	55.7964	-23.24	2176.06	0.011
L4	40.26 - 0 (4)	TP51x39.7436x0.5	45.54	0.00	0.0	39.000	80.1435	-37.86	3125.60	0.012

Pole Bending Design Data

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
L1	140 - 115.36 (1)	TP24.2521x18x0.1875	75.29	11.463	39.000	0.294	0.00	0.000	39.000	0.000
L2	115.36 - 79.83 (2)	TP32.7041x22.9814x0.3125	540.00	27.170	39.000	0.697	0.00	0.000	39.000	0.000
L3	79.83 - 40.26 (3)	TP41.9334x30.9366x0.4375	1304.41	28.379	39.000	0.728	0.00	0.000	39.000	0.000
L4	40.26 - 0 (4)	TP51x39.7436x0.5	2342.17	28.200	39.000	0.723	0.00	0.000	39.000	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	140 - 115.36 (1)	TP24.2521x18x0.1875	9.86	0.715	26.000	0.055	1.75	0.130	26.000	0.005
L2	115.36 - 79.83 (2)	TP32.7041x22.9814x0.3125	17.64	0.569	26.000	0.044	0.66	0.016	26.000	0.001
L3	79.83 - 40.26 (3)	TP41.9334x30.9366x0.4375	21.16	0.379	26.000	0.029	0.64	0.007	26.000	0.000
L4	40.26 - 0 (4)	TP51x39.7436x0.5	24.39	0.304	26.000	0.023	0.61	0.004	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	140 - 115.36 (1)	0.007	0.294	0.000	0.055	0.005	0.302 ✔	1.333	H1-3+VT ✔
L2	115.36 - 79.83 (2)	0.012	0.697	0.000	0.044	0.001	0.709 ✔	1.333	H1-3+VT ✔
L3	79.83 - 40.26 (3)	0.011	0.728	0.000	0.029	0.000	0.739 ✔	1.333	H1-3+VT ✔
L4	40.26 - 0 (4)	0.012	0.723	0.000	0.023	0.000	0.735 ✔	1.333	H1-3+VT ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	SF^*P_{allow} K	% Capacity	Pass Fail
L1	140 - 115.36	Pole	TP24.2521x18x0.1875	1	-3.74	716.82	22.7	Pass
L2	115.36 - 79.83	Pole	TP32.7041x22.9814x0.3125	2	-14.00	1611.34	53.2	Pass
L3	79.83 - 40.26	Pole	TP41.9334x30.9366x0.4375	3	-23.24	2900.69	55.4	Pass
L4	40.26 - 0	Pole	TP51x39.7436x0.5	4	-37.86	4166.42	55.2	Pass
							Summary	
						Pole (L3)	55.4	Pass
						RATING =	**55.4**	**Pass**

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 2342 \cdot ft \cdot kips$	(Input From tnxTower)
Shear Force =	$Shear := 24 \cdot kips$	(Input From tnxTower)
Axial Force =	$Axial := 38 \cdot kips$	(Input From tnxTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	$N := 20$	(User Input)
Diameter of Bolt Circle =	$D_{bc} := 60 \cdot in$	(User Input)
Bolt "Column" Distance =	$l := 3.0 \cdot in$	(User Input)
Bolt Ultimate Strength =	$F_u := 100 \cdot ksi$	(User Input)
Bolt Yield Strength =	$F_y := 75 \cdot ksi$	(User Input)
Bolt Modulus =	$E := 29000 \cdot ksi$	(User Input)
Diameter of Anchor Bolts =	$D := 2.25 \cdot in$	(User Input)
Threads per Inch =	$n := 4.5$	(User Input)

Base Plate Data:

Use ASTM A572 Grade 60

Plate Yield Strength =	$Fy_{bp} := 60 \cdot ksi$	(User Input)
Base Plate Thickness =	$t_{bp} := 2.25 \cdot in$	(User Input)
Base Plate Diameter =	$D_{bp} := 66.0 \cdot in$	(User Input)
Outer Pole Diameter =	$D_{pole} := 51.0 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =: $R_{bc} := \frac{D_{bc}}{2} = 30 \cdot in$

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

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

$d_1 = 9.27 \cdot in$	$d_7 = 24.27 \cdot in$
$d_2 = 17.63 \cdot in$	$d_8 = 17.63 \cdot in$
$d_3 = 24.27 \cdot in$	$d_9 = 9.27 \cdot in$
$d_4 = 28.53 \cdot in$	$d_{10} = 0.00 \cdot in$
$d_5 = 30.00 \cdot in$	$d_{11} = -9.27 \cdot in$
$d_6 = 28.53 \cdot in$	etc.

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 25.5 \cdot in$

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

$MA_1 = 0.00 \cdot in$	$MA_7 = 0.00 \cdot in$
$MA_2 = 0.00 \cdot in$	$MA_8 = 0.00 \cdot in$
$MA_3 = 0.00 \cdot in$	$MA_9 = 0.00 \cdot in$
$MA_4 = 3.03 \cdot in$	$MA_{10} = 0.00 \cdot in$
$MA_5 = 4.50 \cdot in$	$MA_{11} = 0.00 \cdot in$
$MA_6 = 3.03 \cdot in$	etc

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

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i (d_i)^2 = 9 \times 10^3 \cdot in^2$

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 = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 91.8 \cdot kips$

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 = $\frac{T_{Max}}{T_{ALL.Net}} \cdot 100 = 47$ 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 = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.3 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 4.4 \cdot ksi$

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 = $C_{Max} := OM \cdot \frac{R_{bc}}{I_p} + \frac{Axial}{N} = 95.6 \cdot kips$

Maximum Compressive Stress = $f_a := \frac{C_{Max}}{A_n} = 29.4 \cdot ksi$

$K := 0.65$

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

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

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

Combined Stress % of Capacity = $\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) \cdot 100 = 49.1$

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

Condition2 = "OK"

Base Plate Analysis:

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

$C_1 = 30.8 \cdot kips$	$C_7 = 77.7 \cdot kips$
$C_2 = 57.0 \cdot kips$	$C_8 = 57.0 \cdot kips$
$C_3 = 77.7 \cdot kips$	$C_9 = 30.8 \cdot kips$
$C_4 = 91.0 \cdot kips$	$C_{10} = 1.9 \cdot kips$
$C_5 = 95.6 \cdot kips$	$C_{11} = -27.0 \cdot kips$
$C_6 = 91.0 \cdot kips$	etc.

Maximum Bending Stress in Plate = $f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} t_{bp}{}^2\right)} = 34.7 \cdot ksi$

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

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} \cdot 100 = 58$

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 =	$OM := 2342 \cdot ft \cdot kips$	(User Input from tnxTower)	
Shear Force =	$Shear := 24 \cdot kip$	(User Input from tnxTower)	
Axial Force =	$Axial := 38 \cdot kip$	(User Input from tnxTower)	
Tower Height =	$H_t := 140 \cdot ft$	(User Input)	

Footing Data:

Overall Depth of Footing =	$D_f := 6.5 \cdot ft$	(User Input)	
Length of Pier =	$L_p := 4.5 \cdot ft$	(User Input)	
Extension of Pier Above Grade =	$L_{pag} := 0.5 \cdot ft$	(User Input)	
Diameter of Pier =	$d_p := 6.5 \cdot ft$	(User Input)	
Thickness of Footing =	$T_f := 3.0 \cdot ft$	(User Input)	
Width of Footing =	$W_f := 24.0 \cdot ft$	(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 =	$MP := 60.0 \cdot in$	(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 =	$q_s := 4000 \cdot psf$	(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 =	$NB_{pier} := 44$	(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 =	$NB_{top} := 28$	(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 =	$NB_{bot} := 40$	(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 = $P_{pn} := K_p \cdot \gamma_s \cdot n + c \cdot 2 \cdot \sqrt{K_p} = 0 \cdot \text{ksf}$

$$P_{pt} := K_p \cdot \gamma_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p} = 1.05 \cdot \text{ksf}$$

$$P_{top} := \text{if}\left[n < (D_f - T_f), P_{pt}, P_{pn}\right] = 1.05 \cdot \text{ksf}$$

$$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p} = 1.95 \cdot \text{ksf}$$

$$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 1.5 \cdot \text{ksf}$$

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

$$A_p := W_f \cdot T_p = 72$$

Ultimate Shear = $S_u := P_{ave} \cdot A_p = 108 \cdot \text{kip}$

Weight of Concrete Pad = $WT_c := \left[\left(W_f^2 \cdot T_f\right) + d_p^2 \cdot L_p\right] \cdot \gamma_c = 287.719 \cdot \text{kip}$

Weight of Soil Above Footing =

$$WT_{s1} := \left[\left(W_f^2 - d_p^2\right) \cdot \begin{vmatrix} (L_p - L_{pag} - n) & \text{if } (L_p - L_{pag} - n) \ge 0 \\ 0 & \text{if } (L_p - L_{pag} - n) \le 0 \end{vmatrix}\right] \cdot \gamma_s = 213.5 \cdot \text{kip}$$

Weight of Soil Wedge at Back Face = $WT_{s2} := \left(\frac{D_f^2 \cdot \tan(\Phi_s)}{2} \cdot W_f\right) \cdot \gamma_s = 29.272 \cdot \text{kip}$

Weight of Soil Wedge at back face Corners = $WT_{s3} := 2 \cdot \left[(D_f)^3 \cdot \frac{\tan(\Phi_s)}{3}\right] \cdot \gamma_s = 10.57 \cdot \text{kips}$

Total Weight = $WT_{tot} := WT_c + WT_{s1} + \text{Axial} = 539.219 \cdot \text{kip}$

Resisting Moment =

$$M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + \left[(WT_{s2} + WT_{s3}) \cdot \left(W_f + \frac{D_f \cdot \tan(\Phi_s)}{3}\right)\right] = 7585 \cdot \text{kip} \cdot \text{ft}$$

Overturning Moment = $M_{ot} := \text{OM} + \text{Shear} \cdot (L_p + T_f) = 2522 \cdot \text{kip} \cdot \text{ft}$

Factor of Safety Actual = $FS := \frac{M_r}{M_{ot}} = 3.01$

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 = $S_p := \frac{\mu \cdot WT_{tot}}{FS_{req}} = 121.324 \cdot kips$

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

Shear_Check = "Okay"

Bearing Pressure Caused by Footing:

Area of the Mat = $A_{mat} := W_f^2 = 576$

Section Modulus of Mat = $S := \frac{W_f^3}{6} = 2304 \cdot ft^3$

Maximum Pressure in Mat = $P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S} = 2.031 \cdot ksf$

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

Max_Pressure_Check = "Okay"

Minimum Pressure in Mat = $P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S} = -0.158 \cdot ksf$

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

Min_Pressure_Check = "No Good"

Distance to Resultant of Pressure Distribution = $X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 7.421$

Distance to Kern = $X_k := \frac{W_f}{6} = 4$

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

Eccentricity = $e := \frac{M_{ot}}{WT_{tot}} = 4.677$

Adjusted Soil Pressure = $P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \left(\frac{W_f}{2} - e\right)} = 2.045 \cdot ksf$

$q_{adj} :=$ if($P_{min} < 0, P_a, P_{max}$) = 2.045·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 = $P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot \frac{\pi \cdot d_p^2}{4} = 1.056 \times 10^4 \cdot kips$ (ACI-2008 10.14)

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

Bearing_Check = "Okay"

Shear Strength of Concrete:

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

$\phi_c := 0.85$ (ACI 9.3.2.5)

$d := T_f - Cvr_{pad} - d_{bbot} = 32 \cdot in$

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

$d_2 := d_1 - d$

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

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

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

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

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

Beam_Shear_Check = "Okay"

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

Critical Perimeter of Punching Shear = $b_o := \left(d_p + d\right) \cdot \pi = 28.8$

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

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 510$

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

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

$v_u := \text{Find}(v_u) = 7 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f = 449.4 \cdot kips$

Required Shear Strength = $V_{req} := LF \cdot V_u = 599 \cdot kips$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 2377.9 \cdot kip$ (ACI-2008 11.11.2.1)

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

Punching_Shear_Check = "Okay"

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

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

$q_b := q_{adj} - d_1 \cdot Slope = 1.231 \cdot ksf$

Maximum Bending at Face of Pier = $M_u := LF \cdot \left[(q_{adj} - q_b) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f = 2172.4 \cdot kip \cdot ft$

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

(ACI-200810.2.7.3)

$R_n := \frac{M_u}{\phi_m \cdot W_f \cdot d^2} = 98.2 \cdot psi$

$\rho := \frac{0.85 \cdot f_c}{f_y} \left(1 - \sqrt{1 - \frac{2 \cdot R_n}{0.85 \cdot f_c}} \right) = 0.0017$

$\rho_{min} := \rho = 0.00166$

Required Reinforcement for Temperature and Shrinkage:

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

Check Bottom Bars:

$As := \begin{cases} \rho_{min} \cdot W_f \cdot d & \text{if } \rho_{min} > \frac{\rho_{sh}}{2} \\ \rho_{sh} \cdot W_f \cdot \frac{d}{2} & \text{otherwise} \end{cases} = 15.311 \cdot in^2$

$As_{prov} := A_{bbot} \cdot NB_{bot} = 31.4 \cdot in^2$

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

Pad_Reinforcement_Bot = "Okay"

Check top Bars:

$As := \rho_{sh} \cdot \left(W_f \cdot \frac{d}{2}\right) = 8.3 \cdot in^2$

$As_{prov} := A_{btop} \cdot NB_{top} = 22 \cdot in^2$

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

Pad_Reinforcement_Top = "Okay"

Developement Length Pad Reinforcement:

Bar Spacing = $B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 6.21 \cdot in$

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

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

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

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

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

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

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

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

Area of Pier = $A_p := \frac{\pi \cdot d_p^2}{4} = 4778.36 \cdot in^2$

$A_{smin} := 0.01 \cdot 0.5 \cdot A_p = 23.89 \cdot in^2$ (ACI-2008 10.8.4 & 10.9.1)

$A_{sprov} := NB_{pier} \cdot A_{bpier} = 34.56 \cdot in^2$

$Steel\_Area\_Check := if(A_{sprov} > A_{smin}, "Okay", "No Good")$

$Steel\_Area\_Check = "Okay"$

Bar Spacing In Pier = $B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 4.569 \cdot in$

Diameter of Reinforcement Cage = $Diam_{cage} := d_p - 2 \cdot Cvr_{pier} = 72 \cdot in$

Maximum Moment in Pier = $M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2} \right) \right] \cdot LF = 39382.2 \cdot in \cdot kips$

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

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

$(D\ \ N\ \ n\ \ P_u\ \ M_{xu}) = (78\ \ 44\ \ 8\ \ 50.654\ \ 3.938 \times 10^4)$

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

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

$(\phi P_n\ \ \phi M_{xn}\ \ f_{sp}\ \ \rho) = (78.924\ \ 6.136 \times 10^4\ \ -60\ \ 7.274 \times 10^{-3})$

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

$Axial\_Load\_Check = "Okay"$

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

$Bending\_Check = "Okay"$

Development Length Pier Reinforcement:

Available Length in Foundation:

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

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

Tension: (ACI-2008 12.2.3)

Spacing or Cover Dimension = $c := if\left(Cvr_{pier} < \frac{B_{sPier}}{2}, Cvr_{pier}, \frac{B_{sPier}}{2}\right) = 2.285 \cdot in$

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

$$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 31.14 \cdot in$$

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:

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

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

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

Compression: (ACI-2008 12.3.2)

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

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

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

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

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

Tie Size and Spacing in Column:

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

Used #4 Ties

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

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

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

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

$s_{lim4} := 18in$

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

Number of Ties Required = $n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 = 4$

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	CANTON CT	ECP & CELL #	8	0013
Note: AWS Add (Root Metric Site).		LATITUDE	41-49-22.35 N	
		LONGITUDE	72-53-42.36 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_00.0	742213_2110_P45_02.0	742213_2110_P45_00.0
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	340	100	220
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	120	120	120.1
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-2-750MHZ	BXA-70063-6CF-2-750MHZ	BXA-70063-6CF-2-750MHZ
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	340	100	220
DOWN TILT (MECH/DEG)	0	2	0
RAD CTR (FT AGL)	120	120	120.1
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-2-750MHZ	BXA-70063-6CF-2-750MHZ	BXA-70063-6CF-2-750MHZ
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	340	100	220
DOWN TILT (MECH/DEG)	0	2	0
RAD CTR (FT AGL)	120	120	120.1
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-80080/4CF	LPA-80080/4CF	LPA-80063/4CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	340	100	220
DOWN TILT (MECH/DEG)	0	2	0
RAD CTR (FT AGL)	120	120	120.1
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-80080/4CF	LPA-80080/4CF	LPA-80063/4CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	340	100	220
DOWN TILT (MECH/DEG)	0	2	0
RAD CTR (FT AGL)	120	120	120.1
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	LPA-171063-8CF-2	LPA-171063-8CF-2	LPA-171063-8CF-2
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	340	100	220
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	120	120	120.1
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	742213_1950_P45_02.0	742213_1950_P45_02.0	742213_1950_P45_02.0
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	340	100	220
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	120	120	120.1
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	11/25/2013

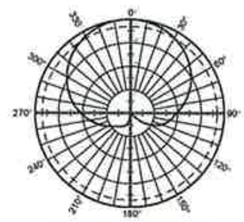
KATHREIN
SCALA DIVISION

742 213V01

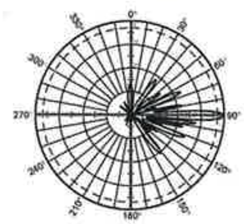
65° Panel Antenna

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

RoHS
Lead-Free

11271-B
936.3740/b

* 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.

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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

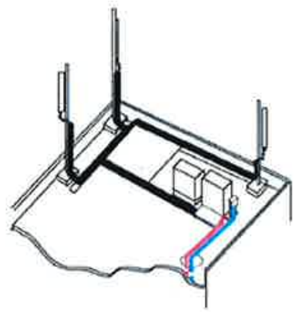
Because of its small size and weight, the Alcatel-Lucent RRH2x40-AWS can be installed close to the antenna. Operators can therefore locate the Alcatel-Lucent RRH2x40-AWS where RF engineering is deemed ideal, minimizing trade-offs between available sites and RF optimum sites. The RF feeder cost and installation 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

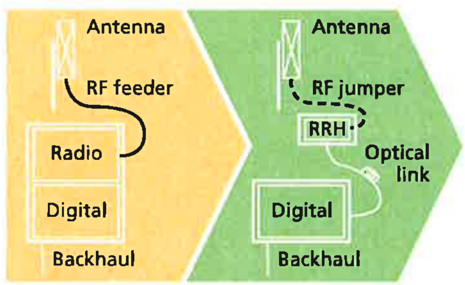
- Zero-footprint deployment
- Easy installation, with a lightweight unit can be carried and set up by one person
- Optimized RF power, with flexible site selection and elimination of a TMA
- Convection-cooled (fanless)
- Noise-free
- Best-in-class power efficiency, with significantly reduced energy consumption

Benefits

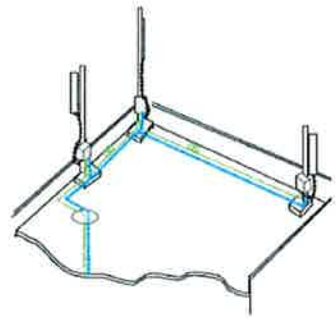
- Leverages existing real estate with lower site costs
- Reduces installation costs, with fewer installation materials and simplified logistics
- Decreases power costs and minimizes environmental impacts, with the potential for eco-sustainable power options
- Improves RF performance and adds flexibility 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 | DB-B1 and DB-T1 Series

DC and Fiber Management Distribution Boxes for HYBRIFLEX™ Cable

Product Description

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

Features/Benefits

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

Technical Specifications

Mechanical Specifications

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

Electrical Specifications

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

* This data is provisional and subject to change.