Robinson+Cole

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Also admitted in Massachusetts

July 8, 2015

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

Re: **Notice of Exempt Modification – Facility Modification**
478 Good Hill Road, Woodbury, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) wireless telecommunications antennas at the top of the existing 147-foot tower at 478 Good Hill Road in Woodbury, Connecticut (the "Property"). The tower is owned by Cellco. The Council approved the construction of this tower in 1998. Cellco now intends to modify its facility by replacing six (6) of its existing antennas with three (3) model SBNHH-1D65B, 700/2100 MHz antennas and three (3) model SBNHH-1D65B, 1900 MHz antennas, all at the same level on the tower. Cellco also intends to install nine (9) remote radio heads ("RRHs") and two (2) HYBRIFLEX™ antenna cables. Included in Attachment 1 are specifications for Cellco's replacement antennas, RRHs and HYBRIFLEX™ cables.

Please accept this letter as notification pursuant to R.C.S.A. § 16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is being sent to William J. Butterly, Jr., First Selectman of the Town of Woodbury. A copy of this letter is also being sent to Roxbury Land Trust, the owner of the Property.

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

1. The proposed modifications will not result in an increase in the height of the existing tower. The replacement antennas and RRHs will be located on Cellco's existing platform at the top of the tower.

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

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

4. The operation of the replacement antennas will not increase radio frequency (RF) emissions at the facility to a level at or above the Federal Communications Commission (FCC) safety standard. A cumulative General Power Density table 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:
William J. Butterly, Jr., Woodbury First Selectman
Roxbury Land Trust
Tim Parks

ATTACHMENT 1

Product Specifications

COMMSCOPE®

POWERED BY ANDREW®

SBNHH-1D65B

Andrew® Tri-band Antenna, 698–896 and 2x 1695–2360 MHz, 65° horizontal beamwidth, internal RET. Both high bands share the same electrical tilt.

- Interleaved dipole technology providing for attractive, low wind load mechanical package

Electrical Specifications

Frequency Band, MHz	**698–806**	**806–896**	**1695–1880**	**1850–1990**	**1920–2180**	**2300–2360**
Gain, dBi	14.9	14.7	17.7	18.2	18.6	18.6
Beamwidth, Horizontal, degrees	68	66	69	66	63	58
Beamwidth, Vertical, degrees	12.1	10.7	5.6	5.2	5.0	4.5
Beam Tilt, degrees	0–14	0–14	0–7	0–7	0–7	0–7
USLS, dB	14	13	15	15	15	13
Front-to-Back Ratio at 180°, dB	27	29	28	28	28	27
CPR at Boresight, dB	20	23	20	20	17	21
CPR at Sector, dB	14	10	12	10	9	1
Isolation, dB	25	25	25	25	25	25
Isolation, Intersystem, dB	30	30	30	30	30	30
VSWR | Return Loss, dB	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153	-153	-153	-153	-153
Input Power per Port, maximum, watts	350	350	350	350	350	300
Polarization	±45°	±45°	±45°	±45°	±45°	±45°
Impedance	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm

Electrical Specifications, BASTA*

Frequency Band, MHz	**698–806**	**806–896**	**1695–1880**	**1850–1990**	**1920–2180**	**2300–2360**
Gain by all Beam Tilts, average, dBi	14.5	14.3	17.4	17.9	18.2	18.3
Gain by all Beam Tilts Tolerance, dB	±0.5	±0.8	±0.4	±0.3	±0.5	±0.3
	0 ° | 14.6	0 ° | 14.5	0 ° | 17.4	0 ° | 17.8	0 ° | 18.1	0 ° | 18.2
Gain by Beam Tilt, average, dBi	7 ° | 14.6	7 ° | 14.4	3 ° | 17.5	3 ° | 17.9	3 ° | 18.3	3 ° | 18.4
	14 ° | 14.2	14 ° | 13.6	7 ° | 17.4	7 ° | 17.9	7 ° | 18.2	7 ° | 18.4
Beamwidth, Horizontal Tolerance, degrees	±2.2	±3.4	±2	±4.6	±5.7	±4.3
Beamwidth, Vertical Tolerance, degrees	±0.8	±1	±0.3	±0.2	±0.3	±0.2
USLS, dB	16	14	16	16	16	15
Front-to-Back Total Power at 180° ± 30°, dB	25	26	27	26	26	26
CPR at Boresight, dB	22	23	21	20	20	22
CPR at Sector, dB	13	11	16	12	11	4

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

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol® multiband with internal RET
Band	Multiband
Brand	DualPol® | Teletilt®
Operating Frequency Band	1695 – 2360 MHz | 698 – 896 MHz
Performance Note	Outdoor usage

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

SBNHH-1D65B

Mechanical Specifications

Color	Light gray
Lightning Protection	dc Ground
Radiator Material	Aluminum | Low loss circuit board
Radome Material	Fiberglass, UV resistant
Reflector Material	Aluminum
RF Connector Interface	7-16 DIN Female
RF Connector Location	Bottom
RF Connector Quantity, total	6
Wind Loading, maximum	617.7 N @ 150 km/h 138.9 lbf @ 150 km/h
Wind Speed, maximum	241.4 km/h | 150.0 mph

Dimensions

Depth	181.0 mm | 7.1 in
Length	1851.0 mm | 72.9 in
Width	301.0 mm | 11.9 in
Net Weight	18.4 kg | 40.6 lb

Remote Electrical Tilt (RET) Information

Input Voltage	10–30 Vdc
Power Consumption, idle state, maximum	2.0 W
Power Consumption, normal conditions, maximum	13.0 W
Protocol	3GPP/AISG 2.0 (Multi-RET)
RET Interface	8-pin DIN Female | 8-pin DIN Male
RET Interface, quantity	1 female | 1 male
RET System	Teletilt®

Regulatory Compliance/Certifications

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

Included Products

BSAMNT-1 — Wide Profile Antenna Downtilt Mounting Kit for 2.4 - 4.5 in (60 - 115 mm) OD round members. Kit contains one scissor top bracket set and one bottom bracket set.

* Footnotes

Performance Note	Severe environmental conditions may degrade optimum performance

ALCATEL-LUCENT B13 RRH4X30-4R

Alcatel-Lucent B13 Remote Radio Head 4x30-4R is the newest addition of Remote Radio Head to the extended product line of Alcatel-Lucent's distributed Base Station solutions, aimed at facilitating smooth RF site acquisition and related civil engineering.

Supporting 2Tx/4Tx MIMO and 4-way Rx diversity, Alcatel-Lucent B13 RRH4x30-4R allows operators to have a compact radio solution to deploy LTE in the 700U band (700 MHz, 3GPP band 13), providing them with the means to achieve high capacity, high quality and high coverage with minimum site requirements.

The Alcatel-Lucent B13 RRH4x30-4R product has four transmit RF paths, offering the possibility to **select, via software only, 2Tx or 4Tx MIMO configurations** with either 2x60 W or 4x30 W RF output power. It supports also 4-way Rx diversity and up to 10MHz instantaneous bandwidth.

The Alcatel-Lucent B13 RRH4x30-4R is a near zero-footprint solution and operates noise free, simplifying negotiations with site property owners and minimizing environmental impacts.

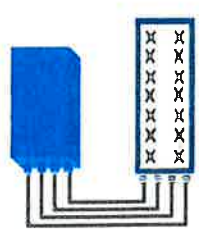
Its compactness and slim design makes the Alcatel-Lucent B13 RRH4x30-4R easy to install close to the antenna: operators can therefore locate this Remote Radio Head where RF design conditions are deemed ideal, minimizing trade-offs between available sites and RF optimum sites, together with reducing the RF feeder needs and installation costs.

FEATURES

- Supporting LTE in 700 MHz band (700U, 3GPP band 13)
- LTE 2Tx or 4Tx MIMO (SW switchable)
- Output power: Up to 2x60W or 4x30W
- 10MHz LTE carrier with 4Rx Diversity
- Convection-cooled (fan-less)
- Supports AISG 2.0 ALD devices (RET, TMA) through RS485 or RF ports

BENEFITS

- Compact to reduce additional footprint when adding LTE in 700U band
- MIMO scheme operation selection (2Tx or 4Tx) by software only
- Improves downlink spectral efficiency through MIMO4
- Increases LTE coverage thanks to 4Rx diversity capability and best in class Rx sensitivity
- Flexible mounting options: Pole or Wall



4x30W with 4T4R
or
2x60W with 2T4R

Can be switched between modes via SW w/o site visit

TECHNICAL SPECIFICATIONS

Features & performance	
Number of TX/RX paths	4 duplexed (either 4T4R or 2T4R by SW)
Frequency band	U700 (C) (3GPP bands 13): DL: 746 - 756 MHz / UL: 777 - 787 MHz
Instantaneous bandwidth - #carriers	10MHz – 1 LTE carrier (in 10MHz occupied bandwidth)
LTE carrier bandwidth	10 MHz
RF output power	2x60W or 4x30W (by SW)
Noise figure – RX Diversity scheme	2 dB typ. (<2.5 dB max) – 2 or 4 way Rx diversity
Sizes (HxWxD) in mm (in.) Volume in L Weight in kg (lb) (w/o mounting HW)	550 x 305 x 230 (21.6" x 12.0" x 9") (with solar shield) 38 (with solar shield) 26 (57.2) (with solar shield)
DC voltage range DC power consumption	-40.5 to -57V at full performance, -38 to -57V with relaxation on power consumption 550W typical @100% RF load (in 2Tx or 4TX mode)
Environmental conditions Wind load (@150km/h or 93mph)	-40°C (-40°F) /+55°C (+131°F) IP65 Frontal:<200N / Lateral :<150N
Antenna ports	4 ports 7/16 DIN female (50 ohms) VSWR < 1.5
CPRI ports	2 CPRI ports (HW ready for Rate7, 9.8 Gbps) SFP single mode dual fiber
AISG interfaces	1 AISG2.0 output (RS485) Integrated Smart Bias Tees (x2)
Misc. Interfaces	4 external alarms (1 connector) – 4 RF Tx & 4 RF Rx monitor ports - 1 DC connector (2 pins)
Installation conditions	Pole and wall mounting
Regulatory compliance	3GPP 36.141 / 3GPP 36.113 / GR-1089-CORE / GR-3108-CORE / UL 60950-1 / FCC Part 27

PCS RF MODULES

RRH1900 2X60 - HW CHARACTERISTICS

LA6.0.1/13.3

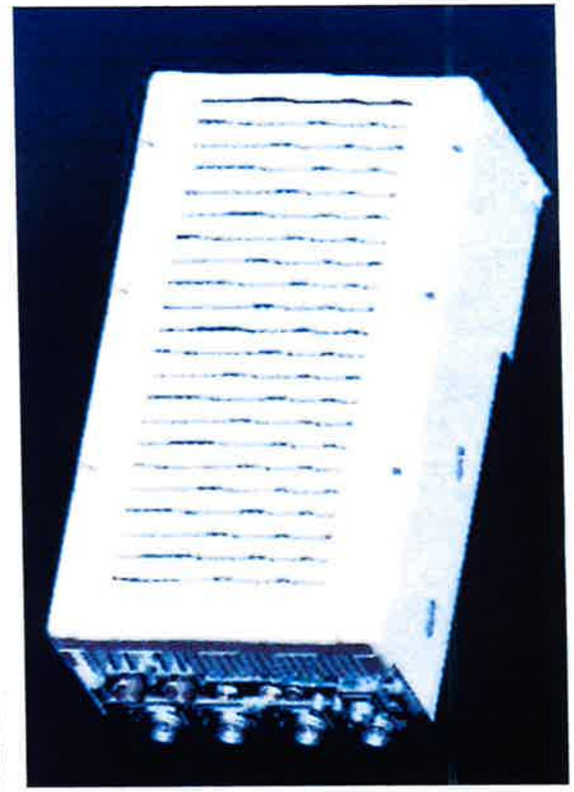
	RRH2x60
RF Output Power	2x60W
Instantaneous Bandwidth	20MHz
Transmitter	2 TX
Receiver — 1900 HW version 1900A HW version	2 Branch RX – LA6.0.1 4 Branch RX – LR13.3
Features	AISG 2.0 for RET/TMA
	Internal Smart Bias-T
Power	-48VDC
CPRI Ports	2 CPRI Rate 3 Ports
External Alarms	4 External User Alarms
Monitor Ports	TX
Environmental	GR487 Compliance
RF Connectors	7/16 DIN (top mounted)

** Not a Verizon Wireless deployed product

NEW PCS RF MODULES FOR VZW
RRH2X60 - HW CHARACTERISTICS

LR14.3

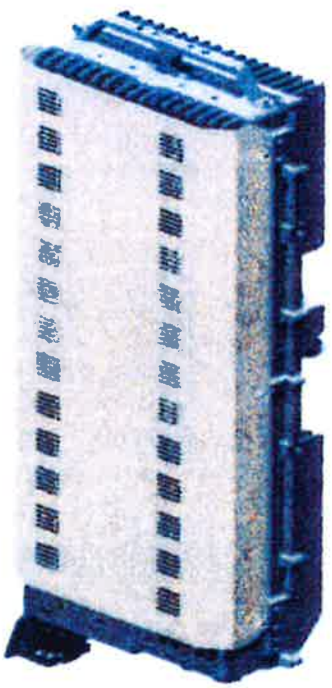
	RRH2x60
RF Output Power	2x60W (4x30W HW Ready)
Instantaneous Bandwidth	60MHz
Target Reliability (Annual Return Rate)	<2%
Receiver	4 Branch Rx
Features	AISG 2.0 for RET/TMA
Power	-48VDC
	Internal Smart Bias-T
CPRI Ports	2 CPRI Rate 5 Ports
External Alarms	4 External User Alarms
Monitor Ports	TX, RX
Environmental	GR487 Compliance
RF Connectors	7/16 DIN (downward facing)
Dimensions	22"(h) x 12"(w)x 9.4" (d)**
Weight	55lb**



**- Includes solar shield but not mounting brackets (8 lbs.)

ALCATEL-LUCENT WIRELESS PRODUCT DATASHEET

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



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

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

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

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

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

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

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

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

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

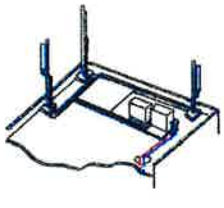
The Alcatel-Lucent RRH2x60-AWS is a very cost-effective solution to deploy LTE MIMO.

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

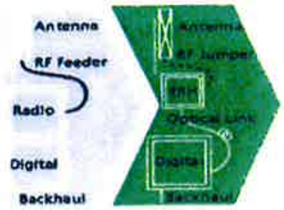
The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment. However, many of these sites can host an Alcatel-Lucent RRH2x60-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation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

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

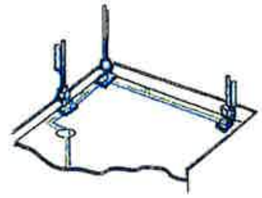
Installation can easily be done by a single person as the Alcatel–Lucent RRH2x60-AWS is compact and weighs about 20 kg, eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day.



Macro



RRH for space-constrained cell sites



Distributed

- RRH2x60-AWS integrates two power amplifiers of 60W rating (at each antenna connector)
- Support multiple carriers over the entire 3GPP band 4
- RRH2x60-AWS is optimized for LTE operation
- RRH2x60-AWS is a very compact and lightweight product
- Advanced power management techniques are embedded to provide power savings, such as PA bias control
- MIMO LTE operation with only one single unit per sector
- Improved uplink coverage with built-in 4-way receive diversity capability
- RRH can be mounted close to the antenna, eliminating nearly all losses in RF cables and thus reducing power consumption by 50% compared to conventional solutions
- Distributed configurations provide easily deployable and cost-effective solutions, near zero footprint and silent solutions, with minimum impact on the neighborhood, which ease the deployment
- RETA and TMA support without additional hardware thanks to the AISG v2.0 port and the integrated Bias-Tees. Bias-Tees support AISG DC supply and signaling.

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

Dimensions and weights

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

Electrical Data

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

RF Characteristics

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

Connectivity

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

Environmental specifications

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

Safety and Regulatory Data

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

Product Data Sheet HB158-1-08U8-S8J18

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

Product Description

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

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

Figure 1: HYBRIFLEX Series

Features/Benefits

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

Technical Specifications

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, 8.4mm^2 (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)

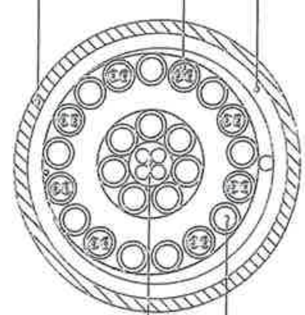


Figure 2: Construction Detail

* This data is provisional and subject to change

ATTACHMENT 2

	General	Power	Density					
Site Name: Woodbury								
Tower Height: 147Ft.								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*AT&T UMTS	2	565	124	0.0264	880	0.5867	4.50%	
*AT&T UMTS	2	875	124	0.0409	1900	1.0000	4.09%	
*AT&T GSM	1	283	124	0.0066	880	0.5867	1.13%	
*AT&T GSM	4	525	124	0.0491	1900	1.0000	4.91%	
*AT&T LTE	1	1313	124	0.0307	734	0.4893	6.27%	
Verizon PCS	**7**	**415**	**145**	**0.0497**	**1970**	**1.0000**	**4.97%**	
Verizon Cellular	**9**	**390**	**145**	**0.0600**	**869**	**0.5793**	**10.36%**	
Verizon AWS	**1**	**3500**	**145**	**0.0599**	**2145**	**1.0000**	**5.99%**	
Verizon 700	**1**	**2100**	**145**	**0.0359**	**746**	**0.4973**	**7.22%**	
								49.45%
* Source: Siting Council								

ATTACHMENT 3

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

147-ft Existing Summit Monopole

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Woodbury West

478 Good Hill Road
Woodbury, CT

Centek Project No. 15001.071

Date: June 19, 2015

STATE OF CONNECTICUT
TIMOTHY J. LYNN
No. 29336
LICENSED
PROFESSIONAL ENGINEER

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

Table of Contents

Introduction

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

The host tower is a 147-ft tall, four-section, eighteen sided, tapered monopole, originally designed by Paul J. Ford and Company; project no. 29200-1379 dated September 15, 2000 and manufactured by Summit Manufacturing Inc.; job no. 11443. The tower geometry, structure member sizes and foundation system information were obtained from a previous structural report prepared by Centek job no; 12063.CO26 dated September 27, 2012.

The tower consists of four (4) tapered vertical steel sections conforming to ASTM A572-65. The vertical tower sections are slip joint connected. The diameter of the pole (flat-flat) is 34.37-in at the top and 62.65-in at the base.

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

Verizon Wireless proposes the replacement of (6) of the existing (12) panel antennas and the installation of nine (9) remote radio heads and two (2) distribution boxes mounted on the existing low profile platform. Refer to the Antenna and Appurtenance Summary below for a detailed description of the proposed antenna and appurtenance configuration.

Antenna and Appurtenance Summary

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

- AT&T (EXISTING):
  Antennas: Two (2) KMW AM-X-CD-16-65-00T-RET panel antennas, one (1) Kathrein Scala 800-10764 panel antenna, six (6) Powerwave 7770.00 panel antennas, twelve (12) Powerwave LGP-21401 TMA's, six (6) Ericsson RRUS-11, one (1) Raycap DC6-48-60-18-8F surge arrestor and one (1) Andrew ABT-DFDM-ADBH Bias Tee mounted on a 13-ft low profile platform with a RAD center elevation of 124-ft above grade level.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables, one (1) fiber cable and two (2) dc control cables running on the inside of the existing tower.
- TOWN (EXISTING):
  Antennas: Two (2) 3' yagi antennas mounted on an adjustable slope mount with an elevation of 118-ft above grade level.
  Coax Cables: Two (2) 1/2" ∅ coax cables running on the inside of the existing tower.
- VERIZON (Existing to Remain):
  Antennas: Four (4) Antel LPA-80080/4CF and two (2) Antel LPA-80063/4CF panel antennas mounted on a low profile platform with a RAD center elevation of 145-ft above grade level.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing tower.

- VERIZON (Existing to Remove):
  Antennas: Three (3) Antel BXA-70063/6CF, two (2) Antel BXA-171085/8BF and one (1) Antel BXA-171063/8BF panel antennas mounted on a low profile platform with a RAD center elevation of 145-ft above grade level.
- **VERIZON (Proposed):**
  Antennas: Six (6) Andrew SBNHH-1D65B panel antennas, three (3) Alcatel-Lucent RRH2x60-700 remote radio heads, three (3) Alcatel-Lucent RRH2x60-PCS remote radio heads, three (3) Alcatel-Lucent RRH2x60-AWS remote radio heads and two (2) RFS DB-T1-6Z-8AB-0Z main distribution boxes mounted on a low profile platform with a RAD center elevation of 145-ft above grade level.
  Cables: Two (2) 1-5/8" ∅ fiber cables running on the inside of the existing tower.

Primary Assumptions Used in the Analysis

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

Analysis

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

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

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

Tower Loading

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

Basic Wind Speed:	Litchfield; v = 80 mph (fastest mile)	*[Section 16 of TIA/EIA-222-F-96]*
	Woodbury; v = 95 mph (3 second gust) equivalent to v = 77.5 mph (fastest mile)	*[Appendix K of the 2005 CT Building Code Supplement]*
	TIA/EIA wind speed controls.	
Load Cases:	Load Case 1; 80 mph wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 2; 69 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 69 mph wind speed velocity represents 75% of the wind pressure generated by the 80 mph wind speed.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 3; Seismic – not checked	*[Section 1614.5 of State Bldg. Code 2005] does not control in the design of this structure type*

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

Tower Capacity

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

- Calculated stresses were found to be within allowable limits. In Load Case 1, per tnxTower "Section Capacity Table", this tower was found to be at **38.4%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L1)	116.75'-147.00'	10.7%	**PASS**
Pole Shaft (L2)	77.00'-116.75'	23.8%	**PASS**
Pole Shaft (L3)	38.00'-77.00'	30.1%	**PASS**
Pole Shaft (L4)	0.00'-38.00'	38.4%	**PASS**

Foundation and Anchors

The existing foundation consists of a 6.0-ft square x 7.0-ft long reinforced concrete pier on a 28.0-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 URS structural report; job no; 36916460 (BA2047) dated May 22, 2003. The base of the tower is connected to the foundation by means of (24) 2.25"∅, ASTM A615-75 anchor bolts embedded approximately 7-ft into the concrete foundation structure.

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

Location	Vector	Proposed Reactions
Base	Shear	22 kips
	Compression	43 kips
	Moment	2155 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	4.38	**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	32.5%	**PASS**
Base Plate	Bending	27.9%	**PASS**

Conclusion

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

- **All coax cables routed as specified in Section 3 of this report.**

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

Please feel free to call with any questions or comments.

Respectfully Submitted by:

Timothy J. Lynn, PE
Structural Engineer

STATE OF CONNECTICUT
TIMOTHY J. LYNN
No. 29336
LICENSED
PROFESSIONAL ENGINEER

Standard Conditions for Furnishing of Professional Engineering Services on Existing Structures

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

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

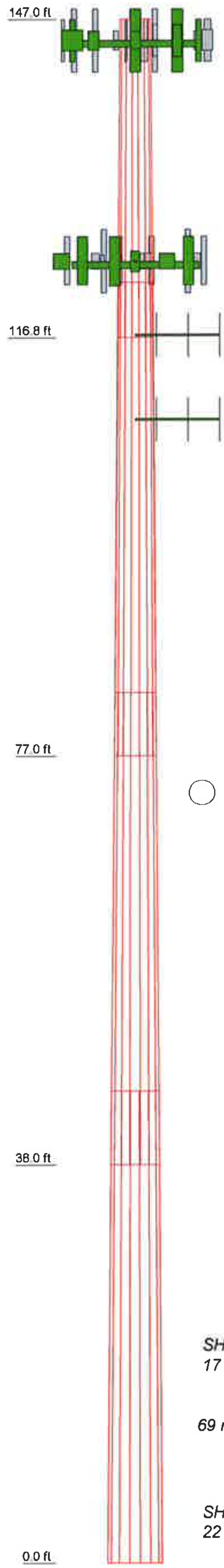
GENERAL DESCRIPTION OF STRUCTURAL ANALYSIS PROGRAM

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

tnxTower Features:

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

Section	Length (ft)	Number of Sides	Thickness (in)	Socket Length (ft)	Top Dia (in)	Bot Dia (in)	Grade	Weight (K)
1	30.250	18	0.281	5.250	34.365	40.636	A572-65	3.4
2	45.000	18	0.375	6.000	38.986	48.313	A572-65	7.9
3	45.000	18	0.438	7.000	46.319	55.648	A572-65	10.8
4	45.000	18	0.438		53.321	62.650	A572-65	12.3
								34.3



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
LPA-80080-4CF (Verizon - Existing)	145	(2) RRUS-11 (ATT - Existing)	124
SBNHH-1D65B (Verizon - Proposed)	145	(2) RRUS-11 (ATT - Existing)	124
SBNHH-1D65B (Verizon - Proposed)	145	(2) RRUS-11 (ATT - Existing)	124
LPA-80080-4CF (Verizon - Existing)	145	DC6-48-60-18-8F Surge Arrestor (ATT - Existing)	124
LPA-80063/4CF (Verizon - Existing)	145	ABT-DFDM-ADBH Bias Tee (ATT - Existing)	124
SBNHH-1D65B (Verizon - Proposed)	145	Andrew 12'-6" Low Profile Platform (ATT - Existing)	124
SBNHH-1D65B (Verizon - Proposed)	145	(2) 7770.00 (ATT - Existing)	124
LPA-80063/4CF (Verizon - Existing)	145	(2) 7770.00 (ATT - Existing)	124
LPA-80080-4CF (Verizon - Existing)	145	(2) 7770.00 (ATT - Existing)	124
SBNHH-1D65B (Verizon - Proposed)	145	(4) LPG21401 TMA (ATT - Existing)	124
SBNHH-1D65B (Verizon - Proposed)	145	(4) LPG21401 TMA (ATT - Existing)	124
LPA-80080-4CF (Verizon - Existing)	145	(4) LPG21401 TMA (ATT - Existing)	124
RRH2x60-07-U (Verizon - Proposed)	145	AM-X-CD-16-65-00T-RET(72") (ATT - Existing)	124
RRH2x60-07-U (Verizon - Proposed)	145	AM-X-CD-16-65-00T-RET(72") (ATT - Existing)	124
RRH2x60-07-U (Verizon - Proposed)	145	800-10764 (ATT - Existing)	124
RRH2x60-AWS (Verizon - Proposed)	145	3' Yagi (Town - Existing)	117
RRH2x60-AWS (Verizon - Proposed)	145	Adjustable Slope Mount (Town - Existing)	117
RRH2x60-AWS (Verizon - Proposed)	145	3' Yagi (Town - Existing)	109
RRH2x60-PCS (Verizon - Proposed)	145		
RRH2x60-PCS (Verizon - Proposed)	145		
RRH2x60-PCS (Verizon - Proposed)	145		
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	145		
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	145		
Andrew 12'-6" Low Profile Platform (Verizon - Existing)	145		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. Weld together tower sections have flange connections.
5. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
6. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
7. Welds are fabricated with ER-70S-6 electrodes.
8. TOWER RATING: 38.4%

AXIAL 49 K
SHEAR 17 K
MOMENT 1760 kip-ft
TORQUE 1 kip-ft
69 mph WIND - 0.500 in ICE

AXIAL 43 K
SHEAR 22 K
MOMENT 2155 kip-ft
TORQUE 2 kip-ft
REACTIONS - 80 mph WIND

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

Job: **15001.071 - Woodbury West**
Project: **147' Summit Monopole - 478 Good Hill Rd., Woodbury,**
Client: Verizon Wireless | Drawn by: TJL | App'd:
Code: TIA/EIA-222-F | Date: 06/19/15 | Scale: N
Path: | Dwg No.

Tower Input Data

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

- Basic wind speed of 80 mph.
- Nominal ice thickness of 0.500 in.
- Ice density of 56 pcf.
- A wind speed of 69 mph is used in combination with ice.
- Temperature drop of 50 °F.
- Deflections calculated using a wind speed of 50 mph.
- Weld together tower sections have flange connections..
- Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications..
- Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards..
- Welds are fabricated with ER-70S-6 electrodes..
- A non-linear (P-delta) analysis was used.
- Pressures are calculated at each section.
- Stress ratio used in pole design is 1.333.
- Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Options

Consider Moments - Legs
Consider Moments - Horizontals
Consider Moments - Diagonals
Use Moment Magnification
√ Use Code Stress Ratios
√ Use Code Safety Factors - Guys
Escalate Ice
Always Use Max Kz
Use Special Wind Profile
Include Bolts In Member Capacity
Leg Bolts Are At Top Of Section
Secondary Horizontal Braces Leg
Use Diamond Inner Bracing (4 Sided)
Add IBC .6D+W Combination

Distribute Leg Loads As Uniform
Assume Legs Pinned
√ Assume Rigid Index Plate
Use Clear Spans For Wind Area
Use Clear Spans For KL/r
Retension Guys To Initial Tension
√ Bypass Mast Stability Checks
Use Azimuth Dish Coefficients
√ Project Wind Area of Appurt.
Autocalc Torque Arm Areas
SR Members Have Cut Ends
√ Sort Capacity Reports By Component
Triangulate Diamond Inner Bracing

Treat Feedline Bundles As Cylinder
Use ASCE 10 X-Brace Ly Rules
Calculate Redundant Bracing Forces
Ignore Redundant Members in FEA
SR Leg Bolts Resist Compression
All Leg Panels Have Same Allowable
Offset Girt At Foundation
Consider Feedline Torque
Include Angle Block Shear Check

Poles

√ Include Shear-Torsion Interaction
Always Use Sub-Critical Flow
Use Top Mounted Sockets

Tapered Pole Section Geometry

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L1	147.000-116.75 0	30.250	5.250	18	34.365	40.636	0.281	1.124	A572-65 (65 ksi)
L2	116.750-77.000	45.000	6.000	18	38.986	48.313	0.375	1.500	A572-65 (65 ksi)
L3	77.000-38.000	45.000	7.000	18	46.319	55.648	0.438	1.752	A572-65 (65 ksi)

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L4	38.000-0.000	45.000		18	53.321	62.650	0.438	1.752	A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
L1	34.895	30.399	4461.721	12.100	17.457	255.577	8929.312	15.203	5.554	19.764
	41.263	35.992	7405.302	14.326	20.643	358.730	14820.347	18.000	6.657	23.692
L2	40.692	45.956	8655.593	13.707	19.805	437.047	17322.575	22.983	6.201	16.537
	49.058	57.058	16565.913	17.018	24.543	674.975	33153.624	28.535	7.843	20.915
L3	48.297	63.785	16963.956	16.288	23.530	720.943	33950.233	31.898	7.381	16.852
	56.506	76.754	29557.774	19.600	28.269	1045.583	59154.441	38.384	9.023	20.601
L4	55.617	73.518	25975.487	18.773	27.087	958.965	51985.154	36.766	8.614	19.666
	63.616	86.488	42290.320	22.085	31.826	1328.789	84636.287	43.252	10.256	23.414

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in
L1 147.000-116.750				1	1	1		
L2 116.750-77.000				1	1	1		
L3 77.000-38.000				1	1	1		
L4 38.000-0.000				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight klf
1/2 (Town - Existing)	B	No	Inside Pole	118.000 - 3.000	2	No Ice	0.000	0.000
						1/2" Ice	0.000	0.000
1 5/8 (AT&T - Existing)	C	No	Inside Pole	125.000 - 0.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
LCF158-50J (1 5/8 FOAM) (Verizon - Existing)	A	No	Inside Pole	147.000 - 0.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
HYBRIFLEX 1-5/8" (Verizon - Proposed)	C	No	Inside Pole	147.000 - 0.000	2	No Ice	0.000	0.002
						1/2" Ice	0.000	0.002
RG6-Fiber (AT&T - Existing)	C	No	Inside Pole	125.000 - 0.000	1	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
#8 AWG Copper WIre (AT&T - Existing)	C	No	Inside Pole	125.000 - 0.000	2	No Ice	0.000	0.000
						1/2" Ice	0.000	0.000

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	147.000-116.750	A	0.000	0.000	0.000	0.000	0.334
		B	0.000	0.000	0.000	0.000	0.001
		C	0.000	0.000	0.000	0.000	0.227
L2	116.750-77.000	A	0.000	0.000	0.000	0.000	0.439
		B	0.000	0.000	0.000	0.000	0.020
		C	0.000	0.000	0.000	0.000	0.691
L3	77.000-38.000	A	0.000	0.000	0.000	0.000	0.431
		B	0.000	0.000	0.000	0.000	0.020
		C	0.000	0.000	0.000	0.000	0.678
L4	38.000-0.000	A	0.000	0.000	0.000	0.000	0.420
		B	0.000	0.000	0.000	0.000	0.018
		C	0.000	0.000	0.000	0.000	0.660

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	147.000-116.750	A	0.500	0.000	0.000	0.000	0.000	0.334
		B		0.000	0.000	0.000	0.000	0.001
		C		0.000	0.000	0.000	0.000	0.227
L2	116.750-77.000	A	0.500	0.000	0.000	0.000	0.000	0.439
		B		0.000	0.000	0.000	0.000	0.020
		C		0.000	0.000	0.000	0.000	0.691
L3	77.000-38.000	A	0.500	0.000	0.000	0.000	0.000	0.431
		B		0.000	0.000	0.000	0.000	0.020
		C		0.000	0.000	0.000	0.000	0.678
L4	38.000-0.000	A	0.500	0.000	0.000	0.000	0.000	0.420
		B		0.000	0.000	0.000	0.000	0.018
		C		0.000	0.000	0.000	0.000	0.660

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
(2) 7770.00 (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	124.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) 7770.00 (AT&T - Existing)	B	From Face	3.000 0.000 0.000	0.000	124.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) 7770.00 (AT&T - Existing)	C	From Face	3.000 0.000 0.000	0.000	124.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068

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
(4) LPG21401 TMA (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	124.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
(4) LPG21401 TMA (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	124.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
(4) LPG21401 TMA (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	124.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
AM-X-CD-16-65-00T-RET(7 2") (AT&T - Existing)	A	From Face	3.000 2.000 0.000	0.000	124.000	No Ice 1/2" Ice	8.260 8.807	4.642 5.088	0.050 0.096
AM-X-CD-16-65-00T-RET(7 2") (AT&T - Existing)	B	From Face	3.000 2.000 0.000	0.000	124.000	No Ice 1/2" Ice	8.260 8.807	4.642 5.088	0.050 0.096
800-10764 (AT&T - Existing)	C	From Face	3.000 2.000 0.000	0.000	124.000	No Ice 1/2" Ice	6.333 6.771	3.389 3.740	0.041 0.078
(2) RRUS-11 (AT&T - Existing)	A	From Face	1.000 2.000 0.000	0.000	124.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Existing)	B	From Face	1.000 2.000 0.000	0.000	124.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Existing)	C	From Face	1.000 2.000 0.000	0.000	124.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	C	From Face	0.500 0.000 0.000	0.000	124.000	No Ice 1/2" Ice	2.228 2.447	2.228 2.447	0.020 0.039
ABT-DFDM-ADBH Bias Tee (AT&T - Existing)	C	None		0.000	124.000	No Ice 1/2" Ice	0.052 0.088	0.025 0.050	0.002 0.003
Andrew 12'-6" Low Profile Platform (AT&T - Existing)	C	None		0.000	124.000	No Ice 1/2" Ice	14.450 19.000	14.450 19.000	1.300 1.690
LPA-80080-4CF (Verizon - Existing)	A	From Face	3.000 -6.000 0.000	0.000	145.000	No Ice 1/2" Ice	2.619 2.922	6.057 6.453	0.012 0.045
SBNHH-1D65B (Verizon - Proposed)	A	From Face	3.000 -4.000 0.000	0.000	145.000	No Ice 1/2" Ice	8.330 8.878	5.342 5.795	0.042 0.092
SBNHH-1D65B (Verizon - Proposed)	A	From Face	3.000 0.000 0.000	0.000	145.000	No Ice 1/2" Ice	8.330 8.878	5.342 5.795	0.042 0.092
LPA-80080-4CF (Verizon - Existing)	A	From Face	3.000 6.000 0.000	0.000	145.000	No Ice 1/2" Ice	2.619 2.922	6.057 6.453	0.012 0.045
LPA-80063/4CF (Verizon - Existing)	B	From Face	3.000 -6.000 0.000	0.000	145.000	No Ice 1/2" Ice	7.005 7.415	6.083 6.480	0.020 0.073
SBNHH-1D65B (Verizon - Proposed)	B	From Face	3.000 -4.000 0.000	0.000	145.000	No Ice 1/2" Ice	8.330 8.878	5.342 5.795	0.042 0.092
SBNHH-1D65B (Verizon - Proposed)	B	From Face	3.000 0.000 0.000	0.000	145.000	No Ice 1/2" Ice	8.330 8.878	5.342 5.795	0.042 0.092

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*
LPA-80063/4CF (Verizon - Existing)	B	From Face	3.000 6.000 0.000	0.000	145.000	No Ice 1/2" Ice	7.005 7.415	6.083 6.480	0.020 0.073
LPA-80080-4CF (Verizon - Existing)	C	From Face	3.000 -6.000 0.000	0.000	145.000	No Ice 1/2" Ice	2.619 2.922	6.057 6.453	0.012 0.045
SBNHH-1D65B (Verizon - Proposed)	C	From Face	3.000 -4.000 0.000	0.000	145.000	No Ice 1/2" Ice	8.330 8.878	5.342 5.795	0.042 0.092
SBNHH-1D65B (Verizon - Proposed)	C	From Face	3.000 0.000 0.000	0.000	145.000	No Ice 1/2" Ice	8.330 8.878	5.342 5.795	0.042 0.092
LPA-80080-4CF (Verizon - Existing)	C	From Face	3.000 6.000 0.000	0.000	145.000	No Ice 1/2" Ice	2.619 2.922	6.057 6.453	0.012 0.045
RRH2x60-07-U (Verizon - Proposed)	A	From Face	3.000 0.000 0.000	0.000	145.000	No Ice 1/2" Ice	2.450 2.668	1.633 1.826	0.050 0.068
RRH2x60-07-U (Verizon - Proposed)	B	From Face	3.000 0.000 0.000	0.000	145.000	No Ice 1/2" Ice	2.450 2.668	1.633 1.826	0.050 0.068
RRH2x60-07-U (Verizon - Proposed)	C	From Face	3.000 0.000 0.000	0.000	145.000	No Ice 1/2" Ice	2.450 2.668	1.633 1.826	0.050 0.068
RRH2x60-AWS (Verizon - Proposed)	A	From Face	3.000 -4.000 0.000	0.000	145.000	No Ice 1/2" Ice	3.782 4.093	2.069 2.349	0.055 0.078
RRH2x60-AWS (Verizon - Proposed)	B	From Face	3.000 -4.000 0.000	0.000	145.000	No Ice 1/2" Ice	3.782 4.093	2.069 2.349	0.055 0.078
RRH2x60-AWS (Verizon - Proposed)	C	From Face	3.000 -4.000 0.000	0.000	145.000	No Ice 1/2" Ice	3.782 4.093	2.069 2.349	0.055 0.078
RRH2x60-PCS (Verizon - Proposed)	A	From Face	3.000 4.000 0.000	0.000	145.000	No Ice 1/2" Ice	2.508 2.730	1.547 1.738	0.055 0.073
RRH2x60-PCS (Verizon - Proposed)	B	From Face	3.000 4.000 0.000	0.000	145.000	No Ice 1/2" Ice	2.508 2.730	1.547 1.738	0.055 0.073
RRH2x60-PCS (Verizon - Proposed)	C	From Face	3.000 4.000 0.000	0.000	145.000	No Ice 1/2" Ice	2.508 2.730	1.547 1.738	0.055 0.073
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	B	From Face	3.000 6.000 0.000	0.000	145.000	No Ice 1/2" Ice	5.600 5.915	2.333 2.558	0.044 0.080
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	C	From Face	3.000 6.000 0.000	0.000	145.000	No Ice 1/2" Ice	5.600 5.915	2.333 2.558	0.044 0.080
Andrew 12'-6" Low Profile Platform (Verizon - Existing)	C	None		0.000	145.000	No Ice 1/2" Ice	14.450 19.000	14.450 19.000	1.300 1.690
3' Yagi (Town - Existing)	C	From Face	0.500 0.000 0.000	0.000	117.000	No Ice 1/2" Ice	2.083 3.787	2.083 3.787	0.031 0.052
3' Yagi (Town - Existing)	C	From Face	0.500 0.000 0.000	0.000	109.000	No Ice 1/2" Ice	2.083 3.787	2.083 3.787	0.031 0.052

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
Adjustable Slope Mount (Town - Existing)	A	None		0.000	117.000	No Ice 1/2" Ice	5.500 7.800	5.500 7.800	0.070 0.100

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 147.000-116.750	131.577	1.485	0.024	94.533	A	0.000	94.533	94.533	100.00	0.000	0.000
					B	0.000	94.533		100.00	0.000	0.000
					C	0.000	94.533		100.00	0.000	0.000
L2 116.750-77.000	96.549	1.359	0.022	146.391	A	0.000	146.391	146.391	100.00	0.000	0.000
					B	0.000	146.391		100.00	0.000	0.000
					C	0.000	146.391		100.00	0.000	0.000
L3 77.000-38.000	57.468	1.172	0.019	167.718	A	0.000	167.718	167.718	100.00	0.000	0.000
					B	0.000	167.718		100.00	0.000	0.000
					C	0.000	167.718		100.00	0.000	0.000
L4 38.000-0.000	18.575	1	0.016	185.918	A	0.000	185.918	185.918	100.00	0.000	0.000
					B	0.000	185.918		100.00	0.000	0.000
					C	0.000	185.918		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	A_G 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 147.000-116.750	131.577	1.485	0.018	0.500	97.053	A	0.000	97.053	97.053	100.00	0.000	0.000
						B	0.000	97.053		100.00	0.000	0.000
						C	0.000	97.053		100.00	0.000	0.000
L2 116.750-77.000	96.549	1.359	0.017	0.500	149.703	A	0.000	149.703	149.703	100.00	0.000	0.000
						B	0.000	149.703		100.00	0.000	0.000
						C	0.000	149.703		100.00	0.000	0.000
L3 77.000-38.000	57.468	1.172	0.014	0.500	170.968	A	0.000	170.968	170.968	100.00	0.000	0.000
						B	0.000	170.968		100.00	0.000	0.000
						C	0.000	170.968		100.00	0.000	0.000
L4 38.000-0.000	18.575	1	0.012	0.500	189.085	A	0.000	189.085	189.085	100.00	0.000	0.000
						B	0.000	189.085		100.00	0.000	0.000
						C	0.000	189.085		100.00	0.000	0.000

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G 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 147.000-116.750	131.577	1.485	0.009	94.533	A	0.000	94.533	94.533	100.00	0.000	0.000
					B	0.000	94.533		100.00	0.000	0.000
					C	0.000	94.533		100.00	0.000	0.000
L2 116.750-77.000	96.549	1.359	0.009	146.391	A	0.000	146.391	146.391	100.00	0.000	0.000
					B	0.000	146.391		100.00	0.000	0.000
					C	0.000	146.391		100.00	0.000	0.000
L3 77.000-38.000	57.468	1.172	0.007	167.718	A	0.000	167.718	167.718	100.00	0.000	0.000
					B	0.000	167.718		100.00	0.000	0.000
					C	0.000	167.718		100.00	0.000	0.000
L4 38.000-0.000	18.575	1	0.006	185.918	A	0.000	185.918	185.918	100.00	0.000	0.000
					B	0.000	185.918		100.00	0.000	0.000
					C	0.000	185.918		100.00	0.000	0.000

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 147.000-116.750	0.562	3.417	A	1	0.65	1	1	1	94.533	2.524	0.083	C
			B	1	0.65	1	1	1	94.533			
			C	1	0.65	1	1	1	94.533			
L2 116.750-77.000	1.150	7.887	A	1	0.65	1	1	1	146.391	3.574	0.090	C
			B	1	0.65	1	1	1	146.391			
			C	1	0.65	1	1	1	146.391			
L3 77.000-38.000	1.128	10.760	A	1	0.65	1	1	1	167.718	3.518	0.090	C
			B	1	0.65	1	1	1	167.718			
			C	1	0.65	1	1	1	167.718			
L4 38.000-0.000	1.097	12.251	A	1	0.65	1	1	1	185.918	3.346	0.088	C
			B	1	0.65	1	1	1	185.918			
			C	1	0.65	1	1	1	185.918			
Sum Weight:	3.936	34.315						OTM	941.504 kip-ft	12.962		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 147.000-116.750	0.562	3.417	A	1	0.65	1	1	1	94.533	2.524	0.083	C
			B	1	0.65	1	1	1	94.533			
			C	1	0.65	1	1	1	94.533			
L2 116.750-77.000	1.150	7.887	A	1	0.65	1	1	1	146.391	3.574	0.090	C
			B	1	0.65	1	1	1	146.391			
			C	1	0.65	1	1	1	146.391			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L3 77.000-38.000	1.128	10.760	A	1	0.65	1	1	1	167.718	3.518	0.090	C
			B	1	0.65	1	1	1	167.718			
			C	1	0.65	1	1	1	167.718			
L4 38.000-0.000	1.097	12.251	A	1	0.65	1	1	1	185.918	3.346	0.088	C
			B	1	0.65	1	1	1	185.918			
			C	1	0.65	1	1	1	185.918			
Sum Weight:	3.936	34.315						OTM	941.504 kip-ft	12.962		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 147.000-116.750	0.562	3.417	A	1	0.65	1	1	1	94.533	2.524	0.083	C
			B	1	0.65	1	1	1	94.533			
			C	1	0.65	1	1	1	94.533			
L2 116.750-77.000	1.150	7.887	A	1	0.65	1	1	1	146.391	3.574	0.090	C
			B	1	0.65	1	1	1	146.391			
			C	1	0.65	1	1	1	146.391			
L3 77.000-38.000	1.128	10.760	A	1	0.65	1	1	1	167.718	3.518	0.090	C
			B	1	0.65	1	1	1	167.718			
			C	1	0.65	1	1	1	167.718			
L4 38.000-0.000	1.097	12.251	A	1	0.65	1	1	1	185.918	3.346	0.088	C
			B	1	0.65	1	1	1	185.918			
			C	1	0.65	1	1	1	185.918			
Sum Weight:	3.936	34.315						OTM	941.504 kip-ft	12.962		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 147.000-116.750	0.562	3.417	A	1	0.65	1	1	1	94.533	2.524	0.083	C
			B	1	0.65	1	1	1	94.533			
			C	1	0.65	1	1	1	94.533			
L2 116.750-77.000	1.150	7.887	A	1	0.65	1	1	1	146.391	3.574	0.090	C
			B	1	0.65	1	1	1	146.391			
			C	1	0.65	1	1	1	146.391			
L3 77.000-38.000	1.128	10.760	A	1	0.65	1	1	1	167.718	3.518	0.090	C
			B	1	0.65	1	1	1	167.718			
			C	1	0.65	1	1	1	167.718			
L4 38.000-0.000	1.097	12.251	A	1	0.65	1	1	1	185.918	3.346	0.088	C
			B	1	0.65	1	1	1	185.918			
			C	1	0.65	1	1	1	185.918			
Sum Weight:	3.936	34.315						OTM	941.504 kip-ft	12.962		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 147.000-116.750	0.562	4.126	A	1	0.65	1	1	1	97.053	1.944	0.064	C
			B	1	0.65	1	1	1	97.053			
			C	1	0.65	1	1	1	97.053			
L2 116.750-77.000	1.150	8.984	A	1	0.65	1	1	1	149.703	2.741	0.069	C
			B	1	0.65	1	1	1	149.703			
			C	1	0.65	1	1	1	149.703			
L3 77.000-38.000	1.128	12.014	A	1	0.65	1	1	1	170.968	2.690	0.069	C
			B	1	0.65	1	1	1	170.968			
			C	1	0.65	1	1	1	170.968			
L4 38.000-0.000	1.097	13.639	A	1	0.65	1	1	1	189.085	2.552	0.067	C
			B	1	0.65	1	1	1	189.085			
			C	1	0.65	1	1	1	189.085			
Sum Weight:	3.936	38.763						OTM	722.358 kip-ft	9.927		

Tower Forces - With Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 147.000-116.750	0.562	4.126	A	1	0.65	1	1	1	97.053	1.944	0.064	C
			B	1	0.65	1	1	1	97.053			
			C	1	0.65	1	1	1	97.053			
L2 116.750-77.000	1.150	8.984	A	1	0.65	1	1	1	149.703	2.741	0.069	C
			B	1	0.65	1	1	1	149.703			
			C	1	0.65	1	1	1	149.703			
L3 77.000-38.000	1.128	12.014	A	1	0.65	1	1	1	170.968	2.690	0.069	C
			B	1	0.65	1	1	1	170.968			
			C	1	0.65	1	1	1	170.968			
L4 38.000-0.000	1.097	13.639	A	1	0.65	1	1	1	189.085	2.552	0.067	C
			B	1	0.65	1	1	1	189.085			
			C	1	0.65	1	1	1	189.085			
Sum Weight:	3.936	38.763						OTM	722.358 kip-ft	9.927		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 147.000-116.750	0.562	4.126	A	1	0.65	1	1	1	97.053	1.944	0.064	C
			B	1	0.65	1	1	1	97.053			
			C	1	0.65	1	1	1	97.053			
L2	1.150	8.984	A	1	0.65	1	1	1	149.703	2.741	0.069	C

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
116.750-77.00			B	1	0.65	1	1	1	149.703			
0			C	1	0.65	1	1	1	149.703			
L3	1.128	12.014	A	1	0.65	1	1	1	170.968	2.690	0.069	C
77.000-38.000			B	1	0.65	1	1	1	170.968			
			C	1	0.65	1	1	1	170.968			
L4	1.097	13.639	A	1	0.65	1	1	1	189.085	2.552	0.067	C
38.000-0.000			B	1	0.65	1	1	1	189.085			
			C	1	0.65	1	1	1	189.085			
Sum Weight:	3.936	38.763						OTM	722.358 kip-ft	9.927		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	0.562	4.126	A	1	0.65	1	1	1	97.053	1.944	0.064	C
147.000-116.7			B	1	0.65	1	1	1	97.053			
50			C	1	0.65	1	1	1	97.053			
L2	1.150	8.984	A	1	0.65	1	1	1	149.703	2.741	0.069	C
116.750-77.00			B	1	0.65	1	1	1	149.703			
0			C	1	0.65	1	1	1	149.703			
L3	1.128	12.014	A	1	0.65	1	1	1	170.968	2.690	0.069	C
77.000-38.000			B	1	0.65	1	1	1	170.968			
			C	1	0.65	1	1	1	170.968			
L4	1.097	13.639	A	1	0.65	1	1	1	189.085	2.552	0.067	C
38.000-0.000			B	1	0.65	1	1	1	189.085			
			C	1	0.65	1	1	1	189.085			
Sum Weight:	3.936	38.763						OTM	722.358 kip-ft	9.927		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	0.562	3.417	A	1	0.65	1	1	1	94.533	0.986	0.033	C
147.000-116.7			B	1	0.65	1	1	1	94.533			
50			C	1	0.65	1	1	1	94.533			
L2	1.150	7.887	A	1	0.65	1	1	1	146.391	1.396	0.035	C
116.750-77.00			B	1	0.65	1	1	1	146.391			
0			C	1	0.65	1	1	1	146.391			
L3	1.128	10.760	A	1	0.65	1	1	1	167.718	1.374	0.035	C
77.000-38.000			B	1	0.65	1	1	1	167.718			
			C	1	0.65	1	1	1	167.718			
L4	1.097	12.251	A	1	0.65	1	1	1	185.918	1.307	0.034	C
38.000-0.000			B	1	0.65	1	1	1	185.918			
			C	1	0.65	1	1	1	185.918			
Sum Weight:	3.936	34.315						OTM	367.775	5.063		

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Section Elevation *ft*	*Add Weight* *K*	*Self Weight* *K*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E *ft²*	*F* *K*	*w* *klf*	*Ctrl. Face*
									kip-ft			

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 *ft²*	*F* *K*	*w* *klf*	*Ctrl. Face*
L1	0.562	3.417	A	1	0.65	1	1	1	94.533	0.986	0.033	C
147.000-116.7			B	1	0.65	1	1	1	94.533			
50			C	1	0.65	1	1	1	94.533			
L2	1.150	7.887	A	1	0.65	1	1	1	146.391	1.396	0.035	C
116.750-77.00			B	1	0.65	1	1	1	146.391			
0			C	1	0.65	1	1	1	146.391			
L3	1.128	10.760	A	1	0.65	1	1	1	167.718	1.374	0.035	C
77.000-38.000			B	1	0.65	1	1	1	167.718			
			C	1	0.65	1	1	1	167.718			
L4	1.097	12.251	A	1	0.65	1	1	1	185.918	1.307	0.034	C
38.000-0.000			B	1	0.65	1	1	1	185.918			
			C	1	0.65	1	1	1	185.918			
Sum Weight:	3.936	34.315						OTM	367.775 kip-ft	5.063		

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 *ft²*	*F* *K*	*w* *klf*	*Ctrl. Face*
L1	0.562	3.417	A	1	0.65	1	1	1	94.533	0.986	0.033	C
147.000-116.7			B	1	0.65	1	1	1	94.533			
50			C	1	0.65	1	1	1	94.533			
L2	1.150	7.887	A	1	0.65	1	1	1	146.391	1.396	0.035	C
116.750-77.00			B	1	0.65	1	1	1	146.391			
0			C	1	0.65	1	1	1	146.391			
L3	1.128	10.760	A	1	0.65	1	1	1	167.718	1.374	0.035	C
77.000-38.000			B	1	0.65	1	1	1	167.718			
			C	1	0.65	1	1	1	167.718			
L4	1.097	12.251	A	1	0.65	1	1	1	185.918	1.307	0.034	C
38.000-0.000			B	1	0.65	1	1	1	185.918			
			C	1	0.65	1	1	1	185.918			
Sum Weight:	3.936	34.315						OTM	367.775 kip-ft	5.063		

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 *ft²*	*F* *K*	*w* *klf*	*Ctrl. Face*
L1 147.000-116.750	0.562	3.417	A	1	0.65	1	1	1	94.533	0.986	0.033	C
			B	1	0.65	1	1	1	94.533			
			C	1	0.65	1	1	1	94.533			
L2 116.750-77.000	1.150	7.887	A	1	0.65	1	1	1	146.391	1.396	0.035	C
			B	1	0.65	1	1	1	146.391			
			C	1	0.65	1	1	1	146.391			
L3 77.000-38.000	1.128	10.760	A	1	0.65	1	1	1	167.718	1.374	0.035	C
			B	1	0.65	1	1	1	167.718			
			C	1	0.65	1	1	1	167.718			
L4 38.000-0.000	1.097	12.251	A	1	0.65	1	1	1	185.918	1.307	0.034	C
			B	1	0.65	1	1	1	185.918			
			C	1	0.65	1	1	1	185.918			
Sum Weight:	3.936	34.315						OTM	367.775 kip-ft	5.063		

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	34.315					
Bracing Weight	0.000					
Total Member Self-Weight	34.315			-0.071	0.749	
Total Weight	42.780			-0.071	0.749	
Wind 0 deg - No Ice		0.096	-21.352	-2079.300	-15.818	-0.881
Wind 30 deg - No Ice		10.902	-18.540	-1809.020	-1072.058	-0.087
Wind 45 deg - No Ice		15.367	-15.166	-1482.023	-1507.853	0.333
Wind 60 deg - No Ice		18.786	-10.760	-1054.033	-1840.840	0.730
Wind 90 deg - No Ice		21.636	-0.096	-16.638	-2116.170	1.352
Wind 120 deg - No Ice		18.689	10.592	1025.196	-1824.273	1.611
Wind 135 deg - No Ice		15.231	15.030	1458.451	-1484.424	1.579
Wind 150 deg - No Ice		10.735	18.443	1792.310	-1043.362	1.439
Wind 180 deg - No Ice		-0.096	21.352	2079.158	17.316	0.881
Wind 210 deg - No Ice		-10.902	18.540	1808.878	1073.556	0.087
Wind 225 deg - No Ice		-15.367	15.166	1481.881	1509.351	-0.333
Wind 240 deg - No Ice		-18.786	10.760	1053.891	1842.338	-0.730
Wind 270 deg - No Ice		-21.636	0.096	16.496	2117.668	-1.352
Wind 300 deg - No Ice		-18.689	-10.592	-1025.338	1825.771	-1.611
Wind 315 deg - No Ice		-15.231	-15.030	-1458.593	1485.922	-1.579
Wind 330 deg - No Ice		-10.735	-18.443	-1792.452	1044.861	-1.439
Member Ice	4.449					
Total Weight Ice	49.394			0.049	0.804	
Wind 0 deg - Ice		0.072	-17.119	-1693.844	-11.679	-0.820
Wind 30 deg - Ice		8.732	-14.861	-1473.147	-871.566	-0.105
Wind 45 deg - Ice		12.312	-12.156	-1206.541	-1226.451	0.276
Wind 60 deg - Ice		15.053	-8.622	-857.708	-1497.702	0.638
Wind 90 deg - Ice		17.340	-0.072	-12.434	-1722.314	1.210
Wind 120 deg - Ice		14.980	8.497	836.185	-1485.218	1.458
Wind 135 deg - Ice		12.210	12.054	1188.986	-1208.798	1.436
Wind 150 deg - Ice		8.607	14.789	1460.762	-849.944	1.316
Wind 180 deg - Ice		-0.072	17.119	1693.943	13.287	0.820
Wind 210 deg - Ice		-8.732	14.861	1473.246	873.173	0.105
Wind 225 deg - Ice		-12.312	12.156	1206.640	1228.059	-0.276
Wind 240 deg - Ice		-15.053	8.622	857.807	1499.309	-0.638
Wind 270 deg - Ice		-17.340	0.072	12.532	1723.922	-1.210

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 300 deg - Ice		-14.980	-8.497	-836.087	1486.826	-1.458
Wind 315 deg - Ice		-12.210	-12.054	-1188.887	1210.405	-1.436
Wind 330 deg - Ice		-8.607	-14.789	-1460.664	851.552	-1.316
Total Weight	42.780			-0.071	0.749	
Wind 0 deg - Service		0.038	-8.341	-812.270	-5.723	-0.344
Wind 30 deg - Service		4.258	-7.242	-706.692	-418.316	-0.034
Wind 45 deg - Service		6.003	-5.924	-578.958	-588.549	0.130
Wind 60 deg - Service		7.338	-4.203	-411.775	-718.622	0.285
Wind 90 deg - Service		8.452	-0.038	-6.543	-826.172	0.528
Wind 120 deg - Service		7.301	4.138	400.424	-712.150	0.629
Wind 135 deg - Service		5.950	5.871	569.664	-579.397	0.617
Wind 150 deg - Service		4.193	7.204	700.078	-407.107	0.562
Wind 180 deg - Service		-0.038	8.341	812.128	7.221	0.344
Wind 210 deg - Service		-4.258	7.242	706.550	419.814	0.034
Wind 225 deg - Service		-6.003	5.924	578.816	590.047	-0.130
Wind 240 deg - Service		-7.338	4.203	411.633	720.120	-0.285
Wind 270 deg - Service		-8.452	0.038	6.401	827.670	-0.528
Wind 300 deg - Service		-7.301	-4.138	-400.566	713.648	-0.629
Wind 315 deg - Service		-5.950	-5.871	-569.806	580.895	-0.617
Wind 330 deg - Service		-4.193	-7.204	-700.220	408.605	-0.562

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

Comb. No.	Description
32	Dead+Wind 300 deg+Ice+Temp
33	Dead+Wind 315 deg+Ice+Temp
34	Dead+Wind 330 deg+Ice+Temp
35	Dead+Wind 0 deg - Service
36	Dead+Wind 30 deg - Service
37	Dead+Wind 45 deg - Service
38	Dead+Wind 60 deg - Service
39	Dead+Wind 90 deg - Service
40	Dead+Wind 120 deg - Service
41	Dead+Wind 135 deg - Service
42	Dead+Wind 150 deg - Service
43	Dead+Wind 180 deg - Service
44	Dead+Wind 210 deg - Service
45	Dead+Wind 225 deg - Service
46	Dead+Wind 240 deg - Service
47	Dead+Wind 270 deg - Service
48	Dead+Wind 300 deg - Service
49	Dead+Wind 315 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	147 - 116.75	Pole	Max Tension	23	0.000	0.000	0.000
			Max. Compression	18	-10.316	0.804	0.179
			Max. Mx	14	-7.396	148.113	-4.604
			Max. My	2	-7.408	-4.092	144.537
			Max. Vy	14	-10.535	148.113	-4.604
			Max. Vx	2	-10.247	-4.092	144.537
			Max. Torque	14			1.440
L2	116.75 - 77	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-20.014	0.804	-0.049
			Max. Mx	14	-15.962	640.968	-8.613
			Max. My	2	-15.973	-7.941	625.961
			Max. Vy	14	-14.500	640.968	-8.613
			Max. Vx	2	-14.210	-7.941	625.961
			Max. Torque	15			1.610
L3	77 - 38	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-32.411	0.804	-0.049
			Max. Mx	14	-27.238	1258.552	-12.395
			Max. My	2	-27.245	-11.705	1232.504
			Max. Vy	14	-17.944	1258.552	-12.395
			Max. Vx	2	-17.654	-11.705	1232.504
			Max. Torque	15			1.610
L4	38 - 0	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-49.394	0.804	-0.049
			Max. Mx	14	-42.775	2149.906	-16.806
			Max. My	2	-42.775	-16.112	2110.902
			Max. Vy	14	-21.647	2149.906	-16.806
			Max. Vx	2	-21.363	-16.112	2110.902
			Max. Torque	15			1.609

Maximum Reactions

Location	*Condition*	*Gov. Load Comb.*	*Vertical K*	*Horizontal, X K*	*Horizontal, Z K*
Pole	Max. Vert	31	49.394	17.340	-0.072
	Max. H_x	14	42.780	21.636	-0.096
	Max. H_z	2	42.780	-0.096	21.352
	Max. M_x	2	2110.902	-0.096	21.352
	Max. M_z	6	2148.370	-21.636	0.096
	Max. Torsion	15	1.609	18.689	10.592
	Min. Vert	46	42.780	7.338	-4.203
	Min. H_x	6	42.780	-21.636	0.096
	Min. H_z	10	42.780	0.096	-21.352
	Min. M_x	10	-2110.756	0.096	-21.352
	Min. M_z	14	-2149.906	21.636	-0.096
	Min. Torsion	7	-1.609	-18.689	-10.592

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	42.780	0.000	0.000	-0.071	0.749	0.000
Dead+Wind 0 deg - No Ice	42.780	0.096	-21.352	-2110.902	-16.112	-0.871
Dead+Wind 30 deg - No Ice	42.780	10.902	-18.540	-1836.539	-1088.421	-0.077
Dead+Wind 45 deg - No Ice	42.780	15.367	-15.166	-1504.584	-1530.837	0.342
Dead+Wind 60 deg - No Ice	42.780	18.786	-10.760	-1070.101	-1868.878	0.738
Dead+Wind 90 deg - No Ice	42.780	21.636	-0.096	-16.953	-2148.370	1.355
Dead+Wind 120 deg - No Ice	42.780	18.689	10.592	1040.721	-1852.007	1.609
Dead+Wind 135 deg - No Ice	42.780	15.231	15.030	1480.573	-1506.974	1.574
Dead+Wind 150 deg - No Ice	42.780	10.735	18.443	1819.520	-1059.189	1.432
Dead+Wind 180 deg - No Ice	42.780	-0.096	21.352	2110.756	17.647	0.871
Dead+Wind 210 deg - No Ice	42.780	-10.902	18.540	1836.393	1089.957	0.077
Dead+Wind 225 deg - No Ice	42.780	-15.367	15.166	1504.438	1532.374	-0.342
Dead+Wind 240 deg - No Ice	42.780	-18.786	10.760	1069.954	1870.414	-0.738
Dead+Wind 270 deg - No Ice	42.780	-21.636	0.096	16.806	2149.906	-1.355
Dead+Wind 300 deg - No Ice	42.780	-18.689	-10.592	-1040.869	1853.541	-1.609
Dead+Wind 315 deg - No Ice	42.780	-15.231	-15.030	-1480.719	1508.508	-1.574
Dead+Wind 330 deg - No Ice	42.780	-10.735	-18.443	-1819.666	1060.723	-1.432
Dead+Ice+Temp	49.394	0.000	0.000	0.049	0.804	0.000
Dead+Wind 0 deg+Ice+Temp	49.394	0.072	-17.119	-1725.784	-11.948	-0.812
Dead+Wind 30 deg+Ice+Temp	49.394	8.732	-14.861	-1500.951	-888.065	-0.097
Dead+Wind 45 deg+Ice+Temp	49.394	12.312	-12.156	-1229.330	-1249.642	0.284
Dead+Wind 60 deg+Ice+Temp	49.394	15.053	-8.622	-873.929	-1526.001	0.645
Dead+Wind 90 deg+Ice+Temp	49.394	17.340	-0.072	-12.727	-1754.827	1.213
Dead+Wind 120 deg+Ice+Temp	49.394	14.980	8.497	851.902	-1513.229	1.457
Dead+Wind 135 deg+Ice+Temp	49.394	12.210	12.054	1211.366	-1231.577	1.432
Dead+Wind 150 deg+Ice+Temp	49.394	8.607	14.789	1488.280	-865.938	1.310
Dead+Wind 180 deg+Ice+Temp	49.394	-0.072	17.119	1725.886	13.605	0.812
Dead+Wind 210 deg+Ice+Temp	49.394	-8.732	14.861	1501.053	889.723	0.097
Dead+Wind 225 deg+Ice+Temp	49.394	-12.312	12.156	1229.431	1251.301	-0.284
Dead+Wind 240 deg+Ice+Temp	49.394	-15.053	8.622	874.030	1527.660	-0.645
Dead+Wind 270 deg+Ice+Temp	49.394	-17.340	0.072	12.827	1756.486	-1.214
Dead+Wind 300 deg+Ice+Temp	49.394	-14.980	-8.497	-851.801	1514.887	-1.457
Dead+Wind 315 deg+Ice+Temp	49.394	-12.210	-12.054	-1211.265	1233.235	-1.432
Dead+Wind 330 deg+Ice+Temp	49.394	-8.607	-14.789	-1488.178	867.595	-1.310
Dead+Wind 0 deg - Service	42.780	0.038	-8.341	-824.681	-5.826	-0.341
Dead+Wind 30 deg - Service	42.780	4.258	-7.242	-717.502	-424.731	-0.030
Dead+Wind 45 deg - Service	42.780	6.003	-5.924	-587.822	-597.566	0.134
Dead+Wind 60 deg - Service	42.780	7.338	-4.203	-418.088	-729.624	0.288

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 90 deg - Service	42.780	8.452	-0.038	-6.667	-838.809	0.530
Dead+Wind 120 deg - Service	42.780	7.301	4.138	406.520	-723.030	0.629
Dead+Wind 135 deg - Service	42.780	5.950	5.871	578.350	-588.240	0.615
Dead+Wind 150 deg - Service	42.780	4.193	7.204	710.762	-413.310	0.560
Dead+Wind 180 deg - Service	42.780	-0.038	8.341	824.536	7.363	0.341
Dead+Wind 210 deg - Service	42.780	-4.258	7.242	717.356	426.268	0.030
Dead+Wind 225 deg - Service	42.780	-6.003	5.924	587.676	599.102	-0.134
Dead+Wind 240 deg - Service	42.780	-7.338	4.203	417.942	731.161	-0.288
Dead+Wind 270 deg - Service	42.780	-8.452	0.038	6.522	840.346	-0.530
Dead+Wind 300 deg - Service	42.780	-7.301	-4.138	-406.666	724.567	-0.629
Dead+Wind 315 deg - Service	42.780	-5.950	-5.871	-578.496	589.777	-0.615
Dead+Wind 330 deg - Service	42.780	-4.193	-7.204	-710.908	414.846	-0.560

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
1	0.000	-42.780	0.000	0.000	42.780	0.000	0.000%
2	0.096	-42.780	-21.352	-0.096	42.780	21.352	0.000%
3	10.902	-42.780	-18.540	-10.902	42.780	18.540	0.000%
4	15.367	-42.780	-15.166	-15.367	42.780	15.166	0.000%
5	18.786	-42.780	-10.760	-18.786	42.780	10.760	0.000%
6	21.636	-42.780	-0.096	-21.636	42.780	0.096	0.000%
7	18.689	-42.780	10.592	-18.689	42.780	-10.592	0.000%
8	15.231	-42.780	15.030	-15.231	42.780	-15.030	0.000%
9	10.735	-42.780	18.443	-10.735	42.780	-18.443	0.000%
10	-0.096	-42.780	21.352	0.096	42.780	-21.352	0.000%
11	-10.902	-42.780	18.540	10.902	42.780	-18.540	0.000%
12	-15.367	-42.780	15.166	15.367	42.780	-15.166	0.000%
13	-18.786	-42.780	10.760	18.786	42.780	-10.760	0.000%
14	-21.636	-42.780	0.096	21.636	42.780	-0.096	0.000%
15	-18.689	-42.780	-10.592	18.689	42.780	10.592	0.000%
16	-15.231	-42.780	-15.030	15.231	42.780	15.030	0.000%
17	-10.735	-42.780	-18.443	10.735	42.780	18.443	0.000%
18	0.000	-49.394	0.000	0.000	49.394	0.000	0.000%
19	0.072	-49.394	-17.119	-0.072	49.394	17.119	0.000%
20	8.732	-49.394	-14.861	-8.732	49.394	14.861	0.000%
21	12.312	-49.394	-12.156	-12.312	49.394	12.156	0.000%
22	15.053	-49.394	-8.622	-15.053	49.394	8.622	0.000%
23	17.340	-49.394	-0.072	-17.340	49.394	0.072	0.000%
24	14.980	-49.394	8.497	-14.980	49.394	-8.497	0.000%
25	12.210	-49.394	12.054	-12.210	49.394	-12.054	0.000%
26	8.607	-49.394	14.789	-8.607	49.394	-14.789	0.000%
27	-0.072	-49.394	17.119	0.072	49.394	-17.119	0.000%
28	-8.732	-49.394	14.861	8.732	49.394	-14.861	0.000%
29	-12.312	-49.394	12.156	12.312	49.394	-12.156	0.000%
30	-15.053	-49.394	8.622	15.053	49.394	-8.622	0.000%
31	-17.340	-49.394	0.072	17.340	49.394	-0.072	0.000%
32	-14.980	-49.394	-8.497	14.980	49.394	8.497	0.000%
33	-12.210	-49.394	-12.054	12.210	49.394	12.054	0.000%
34	-8.607	-49.394	-14.789	8.607	49.394	14.789	0.000%
35	0.038	-42.780	-8.341	-0.038	42.780	8.341	0.000%
36	4.258	-42.780	-7.242	-4.258	42.780	7.242	0.000%
37	6.003	-42.780	-5.924	-6.003	42.780	5.924	0.000%
38	7.338	-42.780	-4.203	-7.338	42.780	4.203	0.000%
39	8.452	-42.780	-0.038	-8.452	42.780	0.038	0.000%
40	7.301	-42.780	4.138	-7.301	42.780	-4.138	0.000%

	Sum of Applied Forces			*Sum of Reactions*			
Load Comb.	*PX K*	*PY K*	*PZ K*	*PX K*	*PY K*	*PZ K*	*% Error*
41	5.950	-42.780	5.871	-5.950	42.780	-5.871	0.000%
42	4.193	-42.780	7.204	-4.193	42.780	-7.204	0.000%
43	-0.038	-42.780	8.341	0.038	42.780	-8.341	0.000%
44	-4.258	-42.780	7.242	4.258	42.780	-7.242	0.000%
45	-6.003	-42.780	5.924	6.003	42.780	-5.924	0.000%
46	-7.338	-42.780	4.203	7.338	42.780	-4.203	0.000%
47	-8.452	-42.780	0.038	8.452	42.780	-0.038	0.000%
48	-7.301	-42.780	-4.138	7.301	42.780	4.138	0.000%
49	-5.950	-42.780	-5.871	5.950	42.780	5.871	0.000%
50	-4.193	-42.780	-7.204	4.193	42.780	7.204	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	0.00004505
3	Yes	4	0.00000001	0.00036022
4	Yes	4	0.00000001	0.00041620
5	Yes	4	0.00000001	0.00034286
6	Yes	4	0.00000001	0.00007852
7	Yes	4	0.00000001	0.00039981
8	Yes	4	0.00000001	0.00040451
9	Yes	4	0.00000001	0.00030724
10	Yes	4	0.00000001	0.00005944
11	Yes	4	0.00000001	0.00036258
12	Yes	4	0.00000001	0.00041840
13	Yes	4	0.00000001	0.00039076
14	Yes	4	0.00000001	0.00009391
15	Yes	4	0.00000001	0.00030474
16	Yes	4	0.00000001	0.00040205
17	Yes	4	0.00000001	0.00038735
18	Yes	4	0.00000001	0.00000001
19	Yes	4	0.00000001	0.00077020
20	Yes	5	0.00000001	0.00002197
21	Yes	5	0.00000001	0.00002341
22	Yes	5	0.00000001	0.00002197
23	Yes	4	0.00000001	0.00078453
24	Yes	4	0.00000001	0.00099992
25	Yes	5	0.00000001	0.00002289
26	Yes	4	0.00000001	0.00096936
27	Yes	4	0.00000001	0.00077109
28	Yes	5	0.00000001	0.00002204
29	Yes	5	0.00000001	0.00002347
30	Yes	5	0.00000001	0.00002229
31	Yes	4	0.00000001	0.00078704
32	Yes	4	0.00000001	0.00097480
33	Yes	5	0.00000001	0.00002291
34	Yes	4	0.00000001	0.00099330
35	Yes	4	0.00000001	0.00001122
36	Yes	4	0.00000001	0.00002966
37	Yes	4	0.00000001	0.00003437
38	Yes	4	0.00000001	0.00002760
39	Yes	4	0.00000001	0.00001649
40	Yes	4	0.00000001	0.00003893
41	Yes	4	0.00000001	0.00003649

42	Yes	4	0.00000001	0.00002581
43	Yes	4	0.00000001	0.00001203
44	Yes	4	0.00000001	0.00003007
45	Yes	4	0.00000001	0.00003475
46	Yes	4	0.00000001	0.00003473
47	Yes	4	0.00000001	0.00001752
48	Yes	4	0.00000001	0.00002616
49	Yes	4	0.00000001	0.00003621
50	Yes	4	0.00000001	0.00003689

Maximum Tower Deflections - Service Wind

Section No.	*Elevation ft*	*Horz. Deflection in*	*Gov. Load Comb.*	*Tilt °*	*Twist °*
L1	147 - 116.75	10.556	46	0.562	0.002
L2	122 - 77	7.662	46	0.533	0.001
L3	83 - 38	3.760	46	0.401	0.001
L4	45 - 0	1.179	46	0.232	0.000

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	*Appurtenance*	*Gov. Load Comb.*	*Deflection in*	*Tilt °*	*Twist °*	*Radius of Curvature ft*
145.000	LPA-80080-4CF	46	10.320	0.561	0.002	121611
124.000	(2) 7770.00	46	7.886	0.537	0.001	26562
117.000	3' Yagi	46	7.110	0.522	0.001	22526
109.000	3' Yagi	46	6.255	0.499	0.001	20146

Maximum Tower Deflections - Design Wind

Section No.	*Elevation ft*	*Horz. Deflection in*	*Gov. Load Comb.*	*Tilt °*	*Twist °*
L1	147 - 116.75	26.992	13	1.437	0.006
L2	122 - 77	19.593	13	1.362	0.004
L3	83 - 38	9.617	13	1.024	0.002
L4	45 - 0	3.017	13	0.593	0.001

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	*Appurtenance*	*Gov. Load Comb.*	*Deflection in*	*Tilt °*	*Twist °*	*Radius of Curvature ft*
145.000	LPA-80080-4CF	13	26.389	1.433	0.005	47735
124.000	(2) 7770.00	13	20.167	1.372	0.004	10425

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
117.000	3' Yagi	13	18.182	1.333	0.003	8838
109.000	3' Yagi	13	15.996	1.276	0.003	7900

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in²	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
L1	147 - 116.75 (1)	TP40.636x34.365x0.281	30.250	0.000	0.0	39.000	35.022	-7.394	1365.850	0.005
L2	116.75 - 77 (2)	TP48.313x38.986x0.375	45.000	0.000	0.0	39.000	55.578	-15.961	2167.540	0.007
L3	77 - 38 (3)	TP55.648x46.319x0.438	45.000	0.000	0.0	39.000	74.736	-27.238	2914.710	0.009
L4	38 - 0 (4)	TP62.65x53.321x0.438	45.000	0.000	0.0	39.000	86.488	-42.775	3373.030	0.013

Pole Bending Design Data

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
L1	147 - 116.75 (1)	TP40.636x34.365x0.281	151.331	5.348	39.000	0.137	0.000	0.000	39.000	0.000
L2	116.75 - 77 (2)	TP48.313x38.986x0.375	644.781	12.084	39.000	0.310	0.000	0.000	39.000	0.000
L3	77 - 38 (3)	TP55.648x46.319x0.438	1262.883	15.290	39.000	0.392	0.000	0.000	39.000	0.000
L4	38 - 0 (4)	TP62.65x53.321x0.438	2154.817	19.460	39.000	0.499	0.000	0.000	39.000	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	147 - 116.75 (1)	TP40.636x34.365x0.281	10.549	0.301	26.000	0.023	0.423	0.007	26.000	0.000
L2	116.75 - 77 (2)	TP48.313x38.986x0.375	14.514	0.261	26.000	0.020	0.738	0.007	26.000	0.000
L3	77 - 38 (3)	TP55.648x46.319x0.438	17.957	0.240	26.000	0.018	0.738	0.004	26.000	0.000
L4	38 - 0 (4)	TP62.65x53.321x0.438	21.660	0.250	26.000	0.019	0.738	0.003	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	147 - 116.75 (1)	0.005	0.137	0.000	0.023	0.000	0.143 ✔	1.333	H1-3+VT ✔
L2	116.75 - 77 (2)	0.007	0.310	0.000	0.020	0.000	0.317 ✔	1.333	H1-3+VT ✔
L3	77 - 38 (3)	0.009	0.392	0.000	0.018	0.000	0.401 ✔	1.333	H1-3+VT ✔
L4	38 - 0 (4)	0.013	0.499	0.000	0.019	0.000	0.512 ✔	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	147 - 116.75	Pole	TP40.636x34.365x0.281	1	-7.394	1820.678	10.7	Pass
L2	116.75 - 77	Pole	TP48.313x38.986x0.375	2	-15.961	2889.331	23.8	Pass
L3	77 - 38	Pole	TP55.648x46.319x0.438	3	-27.238	3885.308	30.1	Pass
L4	38 - 0	Pole	TP62.65x53.321x0.438	4	-42.775	4496.249	38.4	Pass
							Summary	
						Pole (L4)	38.4	Pass
						RATING =	**38.4**	**Pass**

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 2155 \cdot ft \cdot kips$	(Input From tnxTower)
Shear Force =	$Shear := 22 \cdot kips$	(Input From tnxTower)
Axial Force =	$Axial := 43 \cdot kips$	(Input From tnxTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	$N := 24$	(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 55

Plate Yield Strength =	$Fy_{bp} := 55 \cdot ksi$	(User Input)
Base Plate Thickness =	$t_{bp} := 3.00 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

$d_1 := 34.872in$ (User Input)

$d_2 := 33.841in$ (User Input)

$d_3 := 31.808in$ (User Input)

$d_4 := 14.603in$ (User Input)

$d_5 := 8.34in$ (User Input)

$d_6 := 3in$ (User Input)

Critical Distances For Bending in Plate:

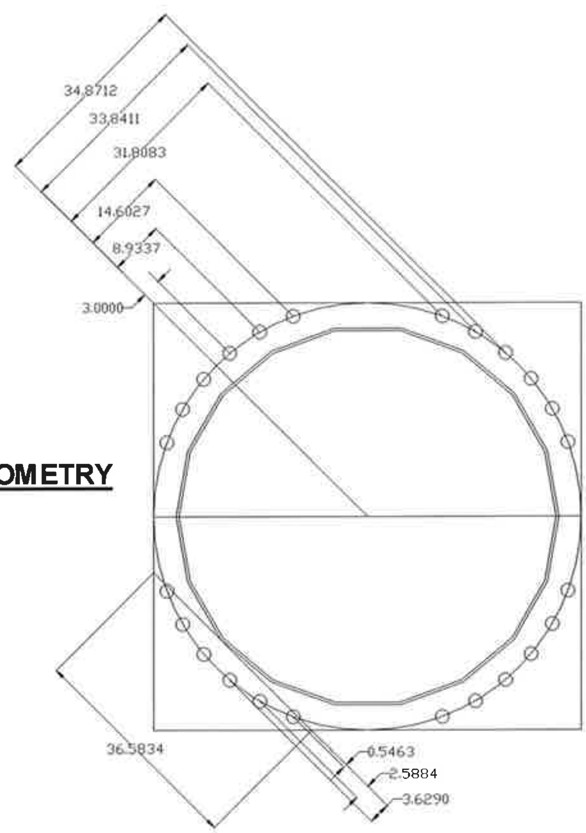
$ma_1 := 3.629in$ (User Input)

$ma_2 := 2.588in$ (User Input)

$ma_3 := 0.546in$ (User Input)

Effective Width of Baseplate for Bending = $B_{eff} := 36.583in$ (User Input)

ANCHOR BOLT AND BASE PLATE GEOMETRY



Anchor Bolt Analysis:

<u>Calculated Anchor Bolt Properties:</u>

Polar Moment of Inertia = $I_p := \left[(d_1)^2 \cdot 4 + (d_2)^2 \cdot 4 + (d_3)^2 \cdot 4 + (d_4)^2 \cdot 4 + (d_5)^2 \cdot 4 + (d_6)^2 \cdot 4\right] = 14659 \cdot in^2$

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

<u>Check Anchor Bolt Tension Force:</u>

Maximum Tensile Force = $T_{Max} := OM \cdot \frac{d_1}{I_p} - \frac{Axial}{N} = 59.7 \cdot kips$

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

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

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Net}} \cdot 100 = 30.7$ 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"

Note Shear stress is negligible

<u>Check Anchor Bolt Bending Stress:</u>

Maximum Bending Moment = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.229 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 3.3 \cdot ksi$

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:

Applied Compressive Force = $C_{Max} := OM \cdot \frac{d_1}{I_p} + \frac{Axial}{N} = 63.3 \cdot kips$

Applied Compressive Stress = $f_a := \frac{C_{Max}}{A_n} = 19.5 \cdot ksi$

$K := 0.65$

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

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

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

Combined Stress % of Capacity = $\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) \cdot 100 = 32.5$

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 =

$$C_1 := \frac{OM \cdot d_1}{I_p} + \frac{Axial}{N} = 63.308 \cdot kips$$

$$C_2 := \frac{OM \cdot d_2}{I_p} + \frac{Axial}{N} = 61.49 \cdot kips$$

$$C_3 := \frac{OM \cdot d_3}{I_p} + \frac{Axial}{N} = 57.903 \cdot kips$$

Applied Bending Stress in Plate =

$$f_{bp} := \frac{6 \cdot \left(2C_1 \cdot ma_1 + 2C_2 \cdot ma_2 + 2 \cdot C_3 \cdot ma_3\right)}{B_{eff} \cdot t_{bp}^{\,2}} = 15.33 \cdot ksi$$

Allowable Bending Stress in Plate =

$$F_{bp} := 1.33 \cdot 0.75 \cdot Fy_{bp} = 54.9 \cdot ksi$$

Plate Bending Stress % of Capacity =

$$\frac{f_{bp}}{F_{bp}} \cdot 100 = 27.9$$

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 =	$OM := 2155 \cdot ft \cdot kips$	(User Input from tnxTower)
Shear Force =	$Shear := 22 \cdot kip$	(User Input from tnxTower)
Axial Force =	$Axial := 43 \cdot kip$	(User Input from tnxTower)
Tower Height =	$H_t := 147 \cdot ft$	(User Input)

Footing Data:

Overall Depth of Footing =	$D_f := 10.0 \cdot ft$	(User Input)
Length of Pier =	$L_p := 7.0 \cdot ft$	(User Input)
Extension of Pier Above Grade =	$L_{pag} := 0.5 \cdot ft$	(User Input)
Diameter of Pier =	$d_p := 6.0 \cdot ft$	(User Input)
Thickness of Footing =	$T_f := 3.0 \cdot ft$	(User Input)
Width of Footing =	$W_f := 28.0 \cdot ft$	(User Input)

Anchor Bolt Data:

Length of Anchor Bolts =	$L_{st} := 84 \cdot in$	(User Input)
Projection of Anchor Bolts Above Pier =	$A_{BP} := 12.0 \cdot in$	(User Input)
Anchor Bolt Diameter =	$d_{anchor} := 2.25 \cdot in$	(User Input)
Base Plate Bolt Circle =	$MP := 69.5 \cdot in$	(User Input)

Material Properties:

Concrete Compressive Strength =	$f_c := 3000 \cdot psi$	(User Input)	
Steel Reinforcment Yield Strength =	$f_y := 60000 \cdot psi$	(User Input)	
Anchor Bolt Yield Strength =	$f_{ya} := 75000 \cdot psi$	(User Input)	
Internal Friction Angle of Soil =	$\Phi_s := 30 \cdot deg$	(User Input)	
Allowable Soil Bearing Capacity =	$q_s := 4000 \cdot psf$	(User Input)	
Unit Weight of Soil =	$\gamma_{soil} := 62.4 \cdot pcf$	(User Input)	
Unit Weight of Concrete =	$\gamma_{conc} := 87.6 \cdot pcf$	(User Input)	
Foundation Bouyancy =	$Bouyancy := 0$	(User Input)	(Yes=1 / No=0)
Depth to Neglect =	$n := 0 \cdot ft$	(User Input)	
Cohesion of Clay Type Soil =	$c := 0 \cdot ksf$	(User Input)	(Use 0 for Sandy Soil)
Seismic Zone Factor =	$Z := 2$	(User Input)	(UBC-1997 Fig 23-2)
Coefficient of Friction Between Concrete =	$\mu := 0.45$	(User Input)	

Pier Reinforcement:

Bar Size =	$BS_{pier} := 11$	(User Input)	
Bar Diameter =	$d_{bpier} := 1.41 \cdot in$	(User Input)	
Number of Bars =	$NB_{pier} := 48$	(User Input)	
Clear Cover of Reinforcement =	$Cvr_{pier} := 3 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Diameter of Tie =	$d_{Tie} := 0.5 \cdot in$	(User Input)	

Pad Reinforcement:

Bar Size =	$BS_{top} := 11$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 1.41 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 48$	(User Input)	(Top of Pad)
Bar Size =	$BS_{bot} := 11$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{bbot} := 1.41 \cdot in$	(User Input)	(Bottom of Pad)
Number of Bars =	$NB_{bot} := 48$	(User Input)	(Bottom of Pad)
Clear Cover of Reinforcement =	$Cvr_{pad} := 3.0 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)

Calculated Factors:

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

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

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

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

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

Stability of Footing:

Adjusted Concrete Unit Weight = $\gamma_c := \text{if}(\text{Bouyancy} = 1, \gamma_{conc} - 62.4\text{pcf}, \gamma_{conc}) = 87.6\cdot\text{pcf}$

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

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

$P_{pt} := K_p\cdot\gamma_s\cdot(D_f - T_f) + c\cdot 2\cdot\sqrt{K_p} = 1.31\cdot\text{ksf}$

$P_{top} := \text{if}\left[n < (D_f - T_f), P_{pt}, P_{pn}\right] = 1.31\cdot\text{ksf}$

$P_{bot} := K_p\cdot\gamma_s\cdot D_f + c\cdot 2\cdot\sqrt{K_p} = 1.872\cdot\text{ksf}$

$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 1.591\cdot\text{ksf}$

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

$A_p := W_f\cdot T_p = 84$

Ultimate Shear = $S_u := P_{ave}\cdot A_p = 133.661\cdot\text{kip}$

Weight of Concrete Pad = $WT_c := \left[\left(W_f^{\,2}\cdot T_f\right) + d_p^{\,2}\cdot L_p\right]\cdot\gamma_c = 228.11\cdot\text{kip}$

Weight of Soil Above Footing = $WT_{s1} := \left[\left(W_f^{\,2} - d_p^{\,2}\right)\cdot\left|\begin{array}{l}(L_p - L_{pag} - n) \text{ if } (L_p - L_{pag} - n) \ge 0\\ 0 \text{ if } (L_p - L_{pag} - n) \le 0\end{array}\right.\right]\cdot\gamma_s = 303.39\cdot\text{kip}$

Weight of Soil Wedge at Back Face = $WT_{s2} := \left(\frac{D_f^{\,2}\cdot\tan(\Phi_s)}{2}\cdot W_f\right)\cdot\gamma_s = 50.437\cdot\text{kip}$

Weight of Soil Wedge at back face Corners = $WT_{s3} := 2\cdot\left[(D_f)^3\cdot\frac{\tan(\Phi_s)}{3}\right]\cdot\gamma_s = 24.018\cdot\text{kips}$

Total Weight = $WT_{tot} := WT_c + WT_{s1} + \text{Axial} = 574.499\cdot\text{kip}$

Resisting Moment = $M_r := (WT_{tot})\cdot\frac{W_f}{2} + S_u\cdot\frac{T_f}{3} + \left[(WT_{s2} + WT_{s3})\cdot\left(W_f + \frac{D_f\cdot\tan(\Phi_s)}{3}\right)\right] = 10405\cdot\text{kip}\cdot\text{ft}$

Overturning Moment = $M_{ot} := OM + \text{Shear}\cdot(L_p + T_f) = 2375\cdot\text{kip}\cdot\text{ft}$

Factor of Safety Actual = $FS := \frac{M_r}{M_{ot}} = 4.38$

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

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

OverTurning_Moment_Check = "Okay"

Shear Capacity in Pier:

Shear Resistance of Pier = $S_p := \frac{\mu \cdot WT_{tot}}{FS_{req}} = 129.262 \cdot kips$

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

Shear_Check = "Okay"

Bearing Pressure Caused by Footing:

Area of the Mat = $A_{mat} := W_f^2 = 784$

Section Modulus of Mat = $S := \frac{W_f^3}{6} = 3658.67 \cdot ft^3$

Maximum Pressure in Mat = $P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S} = 1.382 \cdot ksf$

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

Max_Pressure_Check = "Okay"

Minimum Pressure in Mat = $P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S} = 0.084 \cdot ksf$

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

Min_Pressure_Check = "Okay"

Distance to Resultant of Pressure Distribution = $X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 9.935$

Distance to Kern = $X_k := \frac{W_f}{6} = 4.667$

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

Eccentricity = $e := \frac{M_{ot}}{WT_{tot}} = 4.134$

Adjusted Soil Pressure = $P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \left(\frac{W_f}{2} - e\right)} = 1.386 \cdot ksf$

$q_{adj} := if(P_{min} < 0, P_a, P_{max}) = 1.382 \cdot ksf$

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

Pressure_Check = "Okay"

Concrete Bearing Capacity:

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

Bearing Strength Between Pier and Pad = $P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot \frac{\pi \cdot d_p^2}{4} = 6.749 \times 10^3 \cdot kips$ (ACI-2008 10.14)

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

$Bearing\_Check = "Okay"$

Shear Strength of Concrete:

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

$\phi_c := 0.85$ (ACI 9.3.2.5)

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

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

$d_2 := d_1 - d$

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

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

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

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

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

$Beam\_Shear\_Check = "Okay"$

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

Critical Perimeter of Punching Shear = $b_o := \left(d_p + d\right) \cdot \pi = 27.1$

Area Included Inside Perimeter = $A_{bo} := \frac{\pi \cdot \left(d_p + d\right)^2}{4} = 58.5$

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 725.5$

Guess Value = $v_u := 1ksf$

(From "Foundation Analysis and design", By Joseph Bowles, Eq. 8-9)

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

$v_u := Find(v_u) = 8 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f = 593.1 \cdot kips$

Required Shear Strength = $V_{req} := LF \cdot V_u = 790.7 \cdot kips$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 1914.5 \cdot kip$ (ACI-2008 11.11.2.1)

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

Punching_Shear_Check = "Okay"

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

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

$q_b := q_{adj} - d_1 \cdot Slope = 0.872 \cdot ksf$

Maximum Bending at Face of Pier = $M_u := LF \cdot \left[(q_{adj} - q_b) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f = 2736.6 \cdot kip \cdot ft$

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

(ACI-200810.2.7.3)

$R_n := \frac{M_u}{\phi_m \cdot W_f \cdot d^2} = 108.8 \cdot psi$

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

$\rho_{min} := \rho = 0.00185$

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:

$$As := \begin{cases} \rho_{min} \cdot W_f \cdot d & \text{if } \rho_{min} > \frac{\rho_{sh}}{2} \\ \rho_{sh} \cdot W_f \cdot \frac{d}{2} & \text{otherwise} \end{cases} = 19.68 \cdot in^2$$

$$As_{prov} := A_{bbot} \cdot NB_{bot} = 74.9 \cdot in^2$$

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

Pad_Reinforcement_Bot = "Okay"

Check top Bars:

$$As := \rho_{sh} \cdot \left(W_f \cdot \frac{d}{2}\right) = 9.6 \cdot in^2$$

$$As_{prov} := A_{btop} \cdot NB_{top} = 74.9 \cdot in^2$$

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

Pad_Reinforcement_Top = "Okay"

Developement Length Pad Reinforcement:

Bar Spacing =

$$B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 5.58 \cdot in$$

Spacing or Cover Dimension =

$$c := if\left(Cvr_{pad} < \frac{B_{sPad}}{2}, Cvr_{pad}, \frac{B_{sPad}}{2}\right) = 2.791 \cdot in$$

Transverse Reinforcement Index =

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

$$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pad} \cdot \beta_{pad} \cdot \gamma_{pad} \cdot \lambda_{pad}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \frac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot} = 58.5 \cdot in$$

Minimum Development Length =

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

L$_{dbtCheck}$:= if(L$_{dbt}$ ≥ L$_{dbmin}$, "Use L.dbt", "Use L.dbmin")

Available Length in Pad =

$$L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad} = 129 \cdot in$$

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

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

Area of Pier = $A_p := \frac{\pi \cdot d_p^2}{4} = 4071.5 \cdot in^2$

$A_{smin} := 0.0033 \cdot A_p = 13.44 \cdot in^2$

$A_{sprov} := NB_{pier} \cdot A_{bpier} = 74.95 \cdot in^2$

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

Steel_Area_Check = "Okay"

Bar Spacing In Pier = $B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 3.302 \cdot in$

Diameter of Reinforcement Cage = $Diam_{cage} := d_p - 2 \cdot Cvr_{pier} = 66 \cdot in$

Maximum Moment in Pier = $M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2} \right) \right] \cdot LF = 37110.7 \cdot in \cdot kips$

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

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

$$\begin{pmatrix} D & N & n & P_u & M_{xu} \end{pmatrix} = \begin{pmatrix} 72 & 48 & 11 & 57.319 & 3.711 \times 10^4 \end{pmatrix}$$

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

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

$$\begin{pmatrix} \phi P_n & \phi M_{xn} & f_{sp} & \rho \end{pmatrix} = \begin{pmatrix} 165.432 & 1.071 \times 10^5 & -60 & 0.018 \end{pmatrix}$$

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

Axial_Load_Check = "Okay"

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

Bending_Check = "Okay"

Development Length Pier Reinforcement:

Available Length in Foundation:

$L_{pier} := L_p - Cvr_{pier} = 81 \cdot in$

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

Tension: (ACI-2008 12.2.3)

Spacing or Cover Dimension = $c := if\left(Cvr_{pier} < \frac{B_{sPier}}{2}, Cvr_{pier}, \frac{B_{sPier}}{2}\right) = 1.651 \cdot in$

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

$$L_{dbt} := \frac{3 \cdot f_y \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 98.92 \cdot in$$

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

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

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

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

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

Compression: (ACI-2008 12.3.2)

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

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

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

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

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

Tie Size and Spacing in Column:

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

Used #4 Ties

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

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

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

$s_{lim3} := D_f \cdot z = 120 \cdot in$

$s_{lim4} := 18in$

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

Number of Ties Required = $n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 = 5.333$

Check Anchor Steel Embedment:

Depth Available = $D_{ab} := L_{st} - A_{BP} = 6 \cdot ft$

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

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

Depth_Check = "No Good"

Note: Anchor plate is provided

SITE NAME	WOODBURY W CT	ECP - CELL #	0	2	434
LATITUDE	41-33-26.00 N	LONGITUDE	73-15-24.40 W		
		SAVE BUTTON			
AWS add, 700 tilt change plus RET antenna swap outs and RRH upgrades. The 60W 4 port 700 RRH will be connected to the low band ports on the AWS and PCS antenna. Please note the electrical tilt for 700 are on both the SBNHH antennas		STRUCTURE TYPE	MONOPOLE		

700 Mhz - LTE Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	700 eNodeB	700 eNodeB	700 eNodeB
ANTENNA TYPE	BXA-70063-6CF-2-750MHZ	BXA-70063-6CF-5°	BXA-70063-6CF-2-750MHZ
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	10	130	250
DOWN TILT (MECH/DEG)	0	2	0
RAD CTR (FT AGL)	143.6	143.6	143.6
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
700 Mhz - LTE Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	700 eNodeB	700 eNodeB	700 eNodeB
ANTENNA TYPE	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	10	130	250
DOWN TILT (MECH/DEG)	6 elect	9 elect	6 elect
RAD CTR (FT AGL)	143.6	143.6	143.6
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL	1 ALU RH_2X60-700U	1 ALU RH_2X60-700U	1 ALU RH_2X60-700U
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX	1 x DB-T1-6Z-8AB-0Z		
850 Celluar - Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	Cellular Mod 4.0B	Cellular Mod 4.0B	Cellular Mod 4.0B
ANTENNA TYPE	LPA-80080/4CF	LPA-80063/4CF	LPA-80080/4CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	10	130	250
DOWN TILT (MECH/DEG)	5	7	2
RAD CTR (FT AGL)	143.6	143.6	143.6
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
850 Celluar - Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	Cellular Mod 4.0B	Cellular Mod 4.0B	Cellular Mod 4.0B
ANTENNA TYPE	LPA-80080/4CF	LPA-80063/4CF	LPA-80080/4CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	10	130	250
DOWN TILT (MECH/DEG)	5	7	2
RAD CTR (FT AGL)	143.6	143.6	143.6
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
DIPLEX WITH LTE CABLE			
1900 PCS - Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	PCS Mod 4.0B	PCS Mod 4.0B	PCS Mod 4.0B
ANTENNA TYPE	BXA-171085-8BF-EDIN-2	BXA-171063-8BF-EDIN-2	BXA-171085-8BF-EDIN-2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	10	130	250
DOWN TILT (MECH/DEG)	0	2	0
RAD CTR (FT AGL)	143.6	143.6	143.6
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
1900 PCS - Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	PCS Mod 4.0B	PCS Mod 4.0B	PCS Mod 4.0B
ANTENNA TYPE	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	10	130	250
DOWN TILT (MECH/DEG)	3 elect	4 elect	3 elect
RAD CTR (FT AGL)	143.6	143.6	143.6
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE			
RRH - QTY/MODEL	1 ALU RH_2X60-PCS	1 ALU RH_2X60-PCS	1 ALU RH_2X60-PCS
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX			

2100 AWS - Future Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	eNodeB	eNodeB	eNodeB
ANTENNA TYPE	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B
QTY OF ANTENNAS PER FACE	Same antenna as 700	Same antenna as 700	Same antenna as 700
ORIENTATION (DEG)	10	130	250
DOWN TILT (MECH/DEG)	3 elect	4 elect	3 elect
RAD CTR (FT AGL)	143.6	143.6	143.6
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE			
RRH - QTY/MODEL	1 ALU RH_2X60-AWS	1 ALU RH_2X60-AWS	1 ALU RH_2X60-AWS
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX			

NUMBER OF CABLE'S NEEDED						Fiber Lines Model number			
TOTAL # FIBER LINES	2	TOTAL # OF MAINLINES			12	FIBER LINE MODEL #			HB158-1-08U8-S8J18
TOTAL # TOP JUMPERS	9	TOTAL # OF TOP JUMPERS			36	FIBER TOP JUMPER MODEL #			HB114-1-08U4-S4J18
Equipment Cable Ordering		MAIN CABLE	12	+	0	TOP JUMPER #	24	+	12

TX / RX FREQUENCIES			TX POWER OUTPUT	
Cellular A-Band	PCS F / AWS-Band	700 Mhz C - I	Cellular (Watts)	20
TX - 869-880,890-891.5 MHz	TX - 1970-1975 / 2145-21	TX - 746-757	PCS (Watts)	16
RX - 824-835,845-846.5 MHz	RX - 1890-1895 / 1745-17	RX - 776-787	LTE/ AWS (Watts)	40

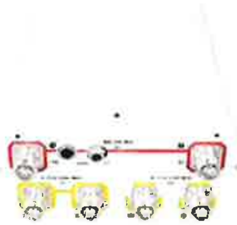
ALPHA				BETA				GAMMA			
Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code
A1	800	Tx1/Rx0	RED	A7	800	Tx2/Rx0	BLUE	A13	800	Tx3/Rx0	GREEN
A2	1900	Tx1/Rx0	RED/ WHITE	A8	1900	Tx2/Rx0	BLUE/ WHITE	A14	1900	Tx3/Rx0	GREEN/WHITE
A3	700	Tx1/Rx0	RED/ ORANGE	A9	700	Tx2/Rx0	BLUE/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

RF ENGINEER	RF MANAGER	INITIALS	DATE
Prepared By: Maria Montrose	Robert Hesselbach		4/22/2015

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.



SBNHH-1D65B

Andrew® Tri-band Antenna, 698–896 and 2 x 1710–2360 MHz, 65° horizontal beamwidth, internal RET. Both high bands share the same electrical tilt.

- Interleaved dipole technology providing for attractive, low wind load mechanical package

Electrical Specifications

Frequency Band, MHz	**698–806**	**806–896**	**1710–1880**	**1850–1990**	**1920–2180**	**2300–2360**
Gain, dBi	14.9	14.7	17.7	18.2	18.6	18.6
Beamwidth, Horizontal, degrees	68	66	69	66	63	58
Beamwidth, Vertical, degrees	12.1	10.7	5.6	5.2	5.0	4.5
Beam Tilt, degrees	0–14	0–14	0–7	0–7	0–7	0–7
USLS, dB	14	13	15	15	15	13
Front-to-Back Ratio at 180°, dB	27	29	28	28	28	27
CPR at Boresight, dB	20	23	20	20	17	21
CPR at Sector, dB	14	10	12	10	9	1
Isolation, dB	25	25	25	25	25	25
Isolation, Intersystem, dB	30	30	30	30	30	30
VSWR | Return Loss, dB	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153	-153	-153	-153	-153
Input Power per Port, maximum, watts	350	350	350	350	350	300
Polarization	±45°	±45°	±45°	±45°	±45°	±45°
Impedance	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm

Electrical Specifications, BASTA*

Frequency Band, MHz	**698–806**	**806–896**	**1710–1880**	**1850–1990**	**1920–2180**	**2300–2360**
Gain by all Beam Tilts, average, dBi	14.5	14.3	17.4	17.9	18.2	18.3
Gain by all Beam Tilts Tolerance, dB	±0.5	±0.8	±0.4	±0.3	±0.5	±0.3
Gain by Beam Tilt, average, dBi	0 ° | 14.6 7 ° | 14.6 14 ° | 14.2	0 ° | 14.5 7 ° | 14.4 14 ° | 13.6	0 ° | 17.4 3 ° | 17.5 7 ° | 17.4	0 ° | 17.8 3 ° | 17.9 7 ° | 17.9	0 ° | 18.1 3 ° | 18.3 7 ° | 18.2	0 ° | 18.2 3 ° | 18.4 7 ° | 18.4
Beamwidth, Horizontal Tolerance, degrees	±2.2	±3.4	±2	±4.6	±5.7	±4.3
Beamwidth, Vertical Tolerance, degrees	±0.8	±1	±0.3	±0.2	±0.3	±0.2
USLS, dB	16	14	16	16	16	15
Front-to-Back Total Power at 180° ± 30°, dB	25	26	27	26	26	26
CPR at Boresight, dB	22	23	21	20	20	22
CPR at Sector, dB	13	11	16	12	11	4

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

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol® multiband with internal RET
Band	Multiband
Brand	DualPol® | Teletilt®
Operating Frequency Band	1710 – 2360 MHz | 698 – 896 MHz

Mechanical Specifications

SBNHH-1D65B

Color	Light gray
Lightning Protection	dc Ground
Radiator Material	Aluminum | Low loss circuit board
Radome Material	Fiberglass, UV resistant
Reflector Material	Aluminum
RF Connector Interface	7-16 DIN Female
RF Connector Location	Bottom
RF Connector Quantity, total	6
Wind Loading, maximum	617.7 N @ 150 km/h 138.9 lbf @ 150 km/h
Wind Speed, maximum	241.4 km/h | 150.0 mph

Dimensions

Depth	181.0 mm | 7.1 in
Length	1828.0 mm | 72.0 in
Width	301.0 mm | 11.9 in
Net Weight	18.4 kg | 40.6 lb

Remote Electrical Tilt (RET) Information

Input Voltage	10–30 Vdc
Power Consumption, idle state, maximum	2.0 W
Power Consumption, normal conditions, maximum	13.0 W
Protocol	3GPP/AISG 2.0 (Multi-RET)
RET Interface	8-pin DIN Female | 8-pin DIN Male
RET Interface, quantity	1 female | 1 male
RET System	Teletilt®

Regulatory Compliance/Certifications

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

Included Products

BSAMNT-1 — Wide Profile Antenna Downtilt Mounting Kit for 2.4 - 4.5 in (60 - 115 mm) OD round members. Kit contains one scissor top bracket set and one bottom bracket set.

ALCATEL-LUCENT B13 RRH4X30-4R

Alcatel-Lucent B13 Remote Radio Head 4x30-4R is the newest addition of Remote Radio Head to the extended product line of Alcatel-Lucent's distributed Base Station solutions, aimed at facilitating smooth RF site acquisition and related civil engineering.

Supporting 2Tx/4Tx MIMO and 4-way Rx diversity, Alcatel-Lucent B13 RRH4x30-4R allows operators to have a compact radio solution to deploy LTE in the 700U band (700 MHz, 3GPP band 13), providing them with the means to achieve high capacity, high quality and high coverage with minimum site requirements.

The Alcatel-Lucent B13 RRH4x30-4R product has four transmit RF paths, offering the possibility to **select, via software only, 2Tx or 4Tx MIMO configurations** with either 2x60 W or 4x30 W RF output power. It supports also 4-way Rx diversity and up to 10MHz instantaneous bandwidth.

The Alcatel-Lucent B13 RRH4x30-4R is a near zero-footprint solution and operates noise free, simplifying negotiations with site property owners and minimizing environmental impacts.

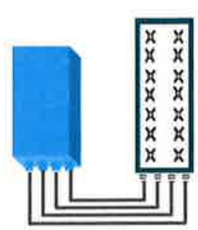
Its compactness and slim design makes the Alcatel-Lucent B13 RRH4x30-4R easy to install close to the antenna: operators can therefore locate this Remote Radio Head where RF design conditions are deemed ideal, minimizing trade-offs between available sites and RF optimum sites, together with reducing the RF feeder needs and installation costs.

FEATURES

- Supporting LTE in 700 MHz band (700U, 3GPP band 13)
- LTE 2Tx or 4Tx MIMO (SW switchable)
- Output power: Up to 2x60W or 4x30W
- 10MHz LTE carrier with 4Rx Diversity
- Convection-cooled (fan-less)
- Supports AISG 2.0 ALD devices (RET, TMA) through RS485 or RF ports

BENEFITS

- Compact to reduce additional footprint when adding LTE in 700U band
- MIMO scheme operation selection (2Tx or 4Tx) by software only
- Improves downlink spectral efficiency through MIMO4
- Increases LTE coverage thanks to 4Rx diversity capability and best in class Rx sensitivity
- Flexible mounting options: Pole or Wall



4x30W with 4T4R
or
2x60W with 2T4R

Can be switched between modes via SW w/o site visit

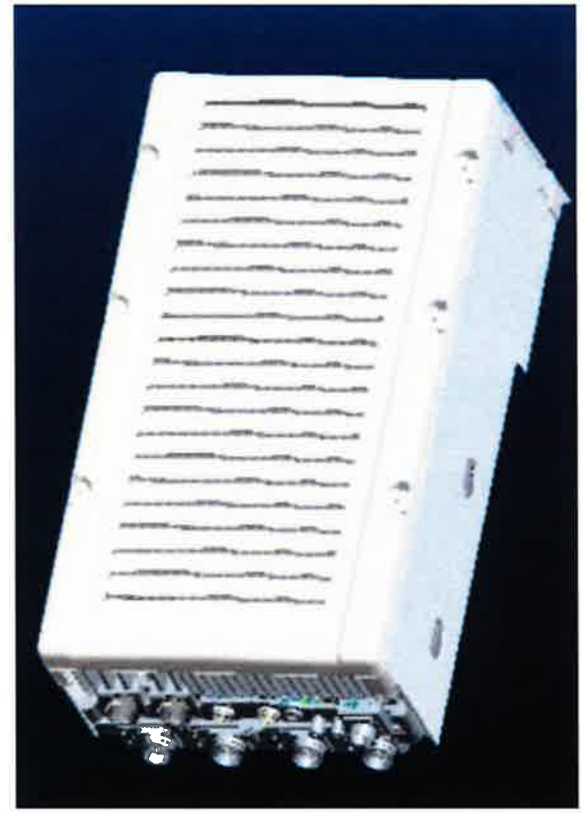
TECHNICAL SPECIFICATIONS

Features & performance	
Number of TX/RX paths	4 duplexed (either 4T4R or 2T4R by SW)
Frequency band	U700 (C) (3GPP bands 13): DL: 746 - 756 MHz / UL: 777 - 787 MHz
Instantaneous bandwidth - #carriers	10MHz – 1 LTE carrier (in 10MHz occupied bandwidth)
LTE carrier bandwidth	10 MHz
RF output power	2x60W or 4x30W (by SW)
Noise figure – RX Diversity scheme	2 dB typ. (<2.5 dB max) – 2 or 4 way Rx diversity
Sizes (HxWxD) in mm (in.) **Volume in L** **Weight in kg (lb) (w/o mounting HW)**	550 x 305 x 230 (21.6" x 12.0" x 9") (with solar shield) 38 (with solar shield) 26 (57.2) (with solar shield)
DC voltage range **DC power consumption**	-40.5 to -57V at full performance, -38 to -57V with relaxation on power consumption 550W typical @100% RF load (in 2Tx or 4TX mode)
Environmental conditions **Wind load (@150km/h or 93mph)**	-40°C (-40°F) /+55°C (+131°F) IP65 Frontal:<200N / Lateral :<150N
Antenna ports	4 ports 7/16 DIN female (50 ohms) VSWR < 1.5
CPRI ports	2 CPRI ports (HW ready for Rate7, 9.8 Gbps) SFP single mode dual fiber
AISG interfaces	1 AISG2.0 output (RS485) Integrated Smart Bias Tees (x2)
Misc. Interfaces	4 external alarms (1 connector) – 4 RF Tx & 4 RF Rx monitor ports - 1 DC connector (2 pins)
Installation conditions	Pole and wall mounting
Regulatory compliance	3GPP 36.141 / 3GPP 36.113 / GR-1089-CORE / GR-3108-CORE / UL 60950-1 / FCC Part 27

NEW PCS RF MODULES FOR VZW
RRH2X60 - HW CHARACTERISTICS

LR14.3

	RRH2x60
RF Output Power	2x60W (4x30W HW Ready)
Instantaneous Bandwidth	60MHz
Target Reliability (Annual Return Rate)	<2%
Receiver	4 Branch Rx
Features	AISG 2.0 for RET/TMA
Power	-48VDC
	Internal Smart Bias-T
CPRI Ports	2 CPRI Rate 5 Ports
External Alarms	4 External User Alarms
Monitor Ports	TX, RX
Environmental	GR487 Compliance
RF Connectors	7/16 DIN (downward facing)
Dimensions	22"(h) x 12"(w)x 9.4" (d)**
Weight	55lb**



**- Includes solar shield but not mounting brackets (8 lbs.)

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

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

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

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

SUPERIOR RF PERFORMANCE

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

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

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

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

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

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

OPTIMIZED TCO

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

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

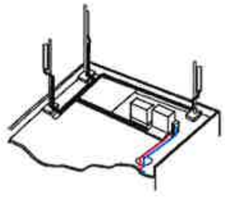
EASY INSTALLATION

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

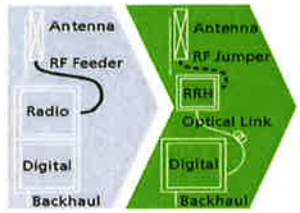
The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment. However, many of these sites can host an Alcatel-Lucent RRH2x60-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation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

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

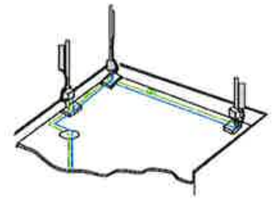
Installation can easily be done by a single person as the Alcatel–Lucent RRH2x60-AWS is compact and weighs about 20 kg, eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day.



Macro



RRH for space-constrained cell sites



Distributed

FEATURES

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

BENEFITS

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

TECHNICAL SPECIFICATIONS

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

36.7"x10.6"x5.8"

Dimensions and weights

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

Electrical Data

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

RF Characteristics

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

Connectivity

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

Environmental specifications

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

Safety and Regulatory Data

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

Alcatel·Lucent

AT THE SPEED OF IDEAS™

Product Data Sheet | DB-B1 and DB-T1 Series

RFS

DC and Fiber Management Distribution Boxes for HYBRIFLEX™ Cable

Product Description

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

Features/Benefits

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

Technical Specifications

Mechanical Specifications

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

Electrical Specifications

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

* This data is provisional and subject to change.