Robinson+Cole

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April 29, 2015

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

Re: **Notice of Exempt Modification – Facility Modification**
38 Maple Street, Kent, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) wireless telecommunications antennas at the top of the existing 150-foot monopole tower at 38 Maple Street in Kent (the "Property"). The tower is owned by Cellco. Cellco's use of the tower was approved by the Council in 2008 (Docket No. 353). Cellco now intends to modify its facility by replacing six (6) of its existing antennas with three (3) model SBNHH-1D65A, 1900 MHz antennas and three (3) model SBNHH-1D65A, 2100 MHz antennas, all at the same level on the tower. Cellco also intends to install nine (9) remote radio heads ("RRHs"), three (3) each behind its 700 MHz, 1900 MHz and 2100 MHz antennas and two (2) HYBRIFLEX™ antenna cables, inside of the shaft of the monopole tower. Included in Attachment 1 are specifications for Cellco's replacement antennas, RRHs and HYBRIFLEX™ cables.

Please accept this letter as notification pursuant to R.C.S.A. § 16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is being sent to Bruce K. Adams, First Selectman of the Town of Kent. The Town of Kent is 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 installed on Cellco's existing antenna platform at the 150-foot level on the tower.

13774194-v1

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 with Cellco's modified facility is included in Attachment 2.

5. The proposed modifications will not cause a change or alteration in the physical or environmental characteristics of the site.

6. The tower and its foundation can support Cellco's proposed modifications. (*See* Structural Analysis Report included in Attachment 3).

For the foregoing reasons, Cellco respectfully submits that the proposed modifications to the above-referenced telecommunications facility constitutes an exempt modification under R.C.S.A. § 16-50j-72(b)(2).

Sincerely,

Kenneth C. Baldwin

Enclosures
Copy to:
Bruce K. Adams, Kent First Selectman
Tim Parks

ATTACHMENT 1

Product Specifications

COMMSCOPE®

SBNHH-1D65A

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

POWERED BY ANDREW.

Electrical Specifications

Frequency Band, MHz	698–806	806–896	1695–1880	1850–1990	1920–2180	2300–2360
Gain, dBi	13.6	13.7	16.5	16.9	17.1	17.6
Beamwidth, Horizontal, degrees	66	61	70	65	62	61
Beamwidth, Vertical, degrees	17.6	15.9	7.1	6.6	6.2	5.5
Beam Tilt, degrees	0–18	0–18	0–10	0–10	0–10	0–10
USLS, dB	16	13	13	13	12	12
Front-to-Back Ratio at 180°, dB	25	27	28	28	27	29
CPR at Boresight, dB	20	16	20	23	17	20
CPR at Sector, dB	10	5	11	6	1	4
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°

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	13.1	13.1	16.1	16.5	16.7	17.2
Gain by all Beam Tilts Tolerance, dB	±0.5	±0.5	±0.5	±0.3	±0.5	±0.4
Gain by Beam Tilt, average, dBi	0 ° | 13.4 9 ° | 13.1 18 ° | 12.7	0 ° | 13.4 9 ° | 13.1 18 ° | 12.7	0 ° | 16.0 5 ° | 16.2 10 ° | 16.1	0 ° | 16.3 5 ° | 16.5 10 ° | 16.5	0 ° | 16.5 5 ° | 16.8 10 ° | 16.6	0 ° | 17.0 5 ° | 17.3 10 ° | 16.9
Beamwidth, Horizontal Tolerance, degrees	±3.1	±5.4	±2.8	±4	±6.6	±4.6
Beamwidth, Vertical Tolerance, degrees	±1.8	±1.4	±0.3	±0.4	±0.5	±0.3
USLS, dB	15	14	15	15	15	14
Front-to-Back Total Power at 180° ± 30°, dB	22	21	26	26	24	25
CPR at Boresight, dB	22	16	22	25	21	22
CPR at Sector, dB	10	6	12	8	5	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.

Mechanical Specifications

Color | Radome Material	Light gray | Fiberglass, UV resistant
Connector Interface | Location | Quantity	7-16 DIN Female | Bottom | 6
Wind Loading, maximum	445.0 N @ 150 km/h 100.0 lbf @ 150 km/h
Wind Speed, maximum	241.4 km/h | 150.0 mph
Antenna Dimensions, L x W x D	1409.0 mm x 301.0 mm x 180.0 mm | 55.5 in x 11.9 in x 7.1 in
Net Weight	15.2 kg | 33.5 lb

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.

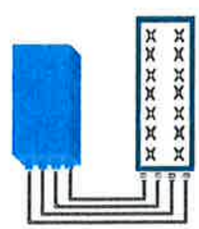
Its compactness and slim design makes the Alcatel-Lucent B13 RRH4x30-4R easy to install close to the antenna: operators can therefore locate this Remote Radio Head where RF design conditions are deemed ideal, minimizing trade-offs between available sites and RF optimum sites, together with reducing the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

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

Alcatel·Lucent

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

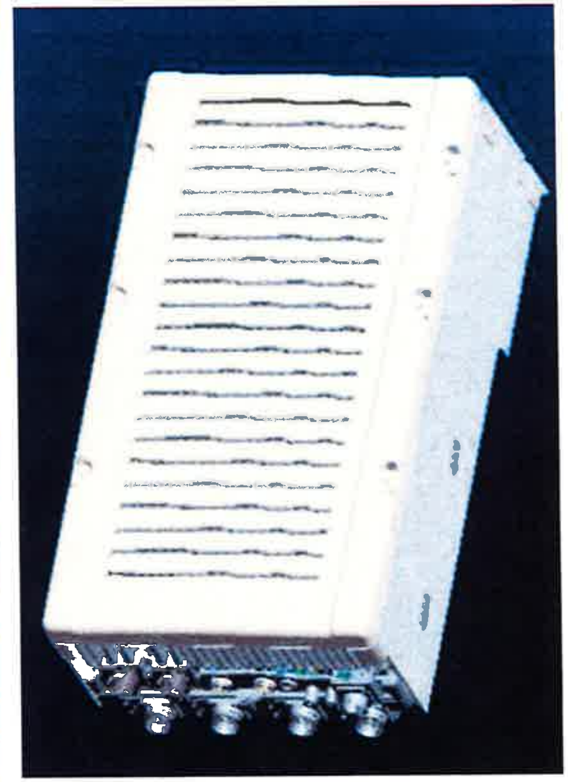
Alcatel·Lucent

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**

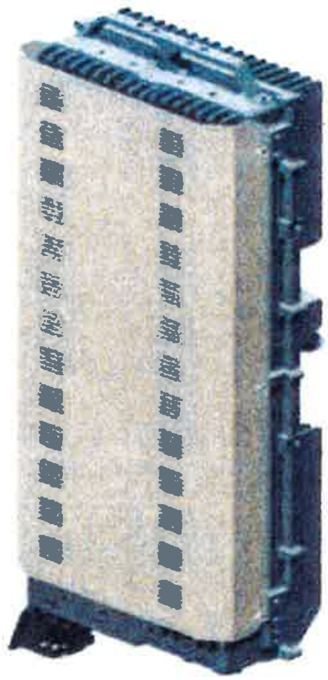


**- Includes solar shield but not mounting brackets (8 lbs.)

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.

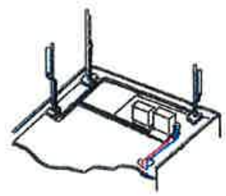
EASY INSTALLATION

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.

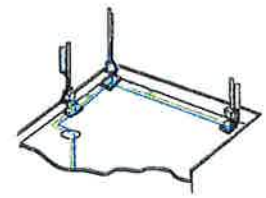
The Alcatel-Lucent RRH2x60-AWS is a zero-footprint solution and is convection cooled without fans for silent operation, simplifying negotiations with site property owners and minimizing environmental impacts.

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.

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

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.

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

Figure 1: HYBRIFLEX Series

Technical Specifications

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

* This data is provisional and subject to change

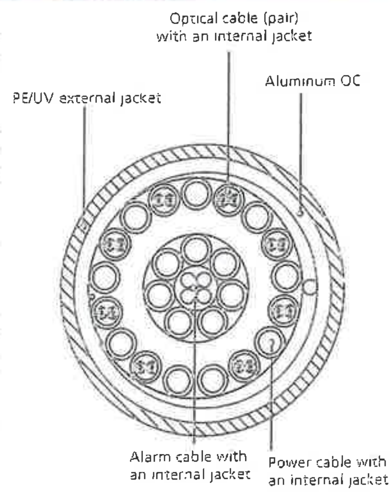


Figure 2: Construction Detail

ATTACHMENT 2

	General	Power	Density					
Site Name: Kent								
Tower Height: Verizon @ 150Ft.								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*AT&T UMTS	2	565	140	0.0207	880	0.5867	3.53%	
*AT&T UMTS	2	875	140	0.0321	1900	1.0000	3.21%	
*AT&T GSM	1	283	140	0.0052	880	0.5867	0.88%	
*AT&T GSM	4	525	140	0.0385	1900	1.0000	3.85%	
*AT&T LTE	1	1313	140	0.0241	734	0.4893	4.92%	
Verizon PCS	**11**	**408**	**150**	**0.0717**	**1970**	**1.0000**	**7.17%**	
Verizon Cellular	**9**	**386**	**150**	**0.0555**	**869**	**0.5793**	**9.58%**	
Verizon AWS	**1**	**1750**	**150**	**0.0280**	**2145**	**1.0000**	**2.80%**	
Verizon 700	**1**	**1050**	**150**	**0.0168**	**746**	**0.4973**	**3.37%**	
								39.33%
* Source: Siting Council								

ATTACHMENT 3

CENTEK engineering
Centered on Solutions℠

Structural Analysis Report

150-ft Existing EEI Monopole

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Kent

36 Maple Street
Kent, CT

Centek Project No. 15001.042

Date: April 16, 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 on the existing monopole (tower) located in Kent, CT.

The host tower is a 150-ft tall extendable to 170-ft, four-section, eighteen sided, tapered monopole, originally designed and manufactured by Engineered Endeavors Incorporated (EEI); project no. 15320 dated March 13, 2008. The tower geometry, structure member sizes and foundation system information were obtained from the aforementioned EEI design documents.

Antenna and appurtenance information were obtained from a previous structural analysis report prepared by Centek project no. 15054.000 dated April 16, 2015, a tower mapping report prepared by Eastern Communications dated March 30, 2015 and a AT&T RF data sheet.

The tower is made up of four (4) tapered vertical sections consisting of A572-65 pole sections. The vertical tower sections are slip joint connected. The diameter of the pole (flat-flat) is 26.37-in at the top and 60.50-in at the base.

Verizon proposes the removal of six (6) panel antennas and the installation of six (6) panel antennas, nine (9) Remote Radio Heads and two (2) main distribution boxes mounted to the existing low profile platform. Refer to the Antenna and Appurtenance Summary below for a detailed description of the proposed antenna and appurtenance configuration.

Antenna and Appurtenance Summary

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

- TOWN (EXISTING):
  Antennas: Two (2) PD220 Omni-directional whip antennas and one (1) 3' yagi antenna mounted on the Verizon 13-ft low profile platform with an elevation of 150-ft above grade level.
  Coax Cables: Three (3) 7/8" ∅ coax cables running on the inside of the existing tower.
- AT&T (EXISTING TO REMAIN):
  Antennas: Six (6) Powerwave P90-15-XLH-RR panel antennas, one (1) CCI HPA-65R-BUU-H6 panel antenna, two (2) Andrew SBNHH-1D65A panel antennas, six (6) Powerwave TT19-08DB111-001 TMA's, six (6) Ericsson RRUS-11 remote radio heads, three (3) A2 units and one (1) Raycap DC6-48-60-18-8F surge arrestor mounted on a 13-ft low profile platform with a RAD center elevation of 140-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) DB222 dipole antennas and one (1) 3' yagi antenna mounted on two (2) 6-ft standoff mounts with an elevation of 118-ft above grade level.
  Coax Cables: Three (3) 7/8-in ∅ coax cables running on the inside of the existing tower.

- VERIZON WIRELESS (Existing to Remain):
  Antennas: Six (6) Antel LPA-80080-6CF panel antennas mounted on a low profile platform with a RAD center elevation of 150-ft above existing grade.
  Coax Cables: Eighteen (18) 1-5/8" ∅ coax cables running on the inside of the existing tower.
- VERIZON WIRELESS (Existing to Remove):
  Antennas: Three (3) Antel BXA-70063-6CF and three (3) Antel BXA-171085-12BF panel antennas mounted on a low profile platform with a RAD center elevation of 150-ft above existing grade.
- **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 150-ft above existing grade.
  Coax 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]*
	Kent; v = 90 mph (3 second gust) equivalent to v = 75 mph (fastest mile)	*[Appendix K of the 2005 CT Building Code Supplement]*
	TIA/EIA-222-F wind speed controls.	
Load Cases:	<u>Load Case 1</u>; 80 mph wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	<u>Load Case 2</u>; 69 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 69 mph wind speed velocity represents 75% of the wind pressure generated by the 80 mph wind speed.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	<u>Load Case 3</u>; Seismic – not checked	*[Section 1614.5 of State Bldg. Code 2005] does not control in the design of this structure type*

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

Tower Capacity

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

- Calculated stresses were found to be within allowable limits. In Load Case 1, per tnxTower "Section Capacity Table", this tower was found to be at **55.9%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L4)	1.00'-46.08'	55.9%	**PASS**

Foundation and Anchors

The existing foundation consists of a 7.5-ft square x 4.0-ft long reinforced concrete pier on a 30.0-ft square x 3.5-ft thick reinforced concrete pad. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned EEI design documents; job no; 15320, dated March 13, 2008. 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	23 kips
	Compression	37 kips
	Moment	2451 kip-ft

- The foundation was found to be within allowable limits.

Foundation	Design Limit	IBC 2003/2005 CT State Building Code Section 3108.4.2 (FS)[1]	Proposed Loading (FS)[1]	Result
Reinforced Concrete Pad and Pier	OTM[2]	2.0	2.90	**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	37.3%	**PASS**
Base Plate	Bending	23.8%	**PASS**

Conclusion

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

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

Please feel free to call with any questions or comments.

Respectfully Submitted by:

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

Timothy J. Lynn, PE
Structural Engineer

Standard Conditions for Furnishing of Professional Engineering Services on Existing Structures

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

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

General Description of Structural Analysis Program

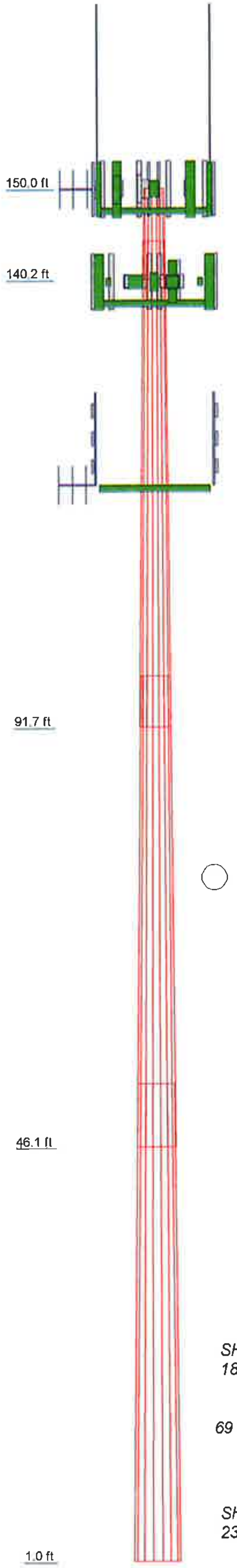
tnxTower, is an integrated structural analysis and design software package for Designed specifically for the telecommunications industry, tnxTower, formerly ERITower, automates much of the tower analysis and design required by the TIA/EIA 222 Standard.

tnxTower Features:

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

Section	1	2	3	4
Length (ft)	9.830	52.630	51.210	51.913
Number of Sides	18	18	18	18
Thickness (in)	0.188	0.313	0.375	0.375
Socket Length (ft)	4.167	5.583	6.833	
Top Dia (in)	26.370	27.372	38.080	48.006
Bot Dia (in)	28.760	40.050	50.400	60.500
Grade	A572-65	A572-65	A572-65	A572-65
Weight (K)	0.5	5.9	9.1	11.3

Weight (K) total: 26.9



DESIGNED APPURTENANCE LOADING

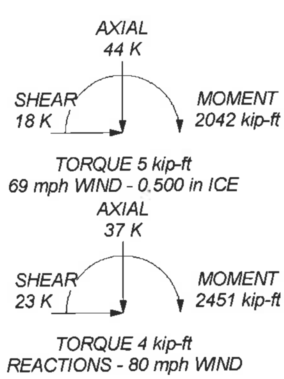
TYPE	ELEVATION	TYPE	ELEVATION
LPA-80080-6CF (Verizon - Existing)	150	SBNHH-1D65A (ATT - Existing)	140
SBNHH-1D65B (Verizon - Proposed)	150	P90-15-XLH-RR (ATT - Existing)	140
SBNHH-1D65B (Verizon - Proposed)	150	(2) TT19-08BP111-001 TMA (ATT - Existing)	140
LPA-80080-6CF (Verizon - Existing)	150	(2) TT19-08BP111-001 TMA (ATT - Existing)	140
LPA-80080-6CF (Verizon - Existing)	150	(2) TT19-08BP111-001 TMA (ATT - Existing)	140
SBNHH-1D65B (Verizon - Proposed)	150	RRUS-11 (ATT - Existing)	140
SBNHH-1D65B (Verizon - Proposed)	150	RRUS-11 (ATT - Existing)	140
LPA-80080-6CF (Verizon - Existing)	150	RRUS-11 (ATT - Existing)	140
LPA-80080-6CF (Verizon - Existing)	150	DC6-48-60-18-8F Surge Arrestor (ATT - Existing)	140
SBNHH-1D65B (Verizon - Proposed)	150	RRUS-11 (ATT - Existing)	140
SBNHH-1D65B (Verizon - Proposed)	150	RRUS-11 (ATT - Existing)	140
LPA-80080-6CF (Verizon - Existing)	150	RRUS-11 (ATT - Existing)	140
RRH2x60-PCS (Verizon - Proposed)	150	A2 (ATT - Existing)	140
RRH2x60-PCS (Verizon - Proposed)	150	A2 (ATT - Existing)	140
RRH2x60-PCS (Verizon - Proposed)	150	A2 (ATT - Existing)	140
RRH2x60-07-U (Verizon - Proposed)	150	P90-15-XLH-RR (ATT - Existing)	140
RRH2x60-07-U (Verizon - Proposed)	150	P90-15-XLH-RR (ATT - Existing)	140
RRH2x60-07-U (Verizon - Proposed)	150	HPA-65R-BUU-H6 (ATT - Existing)	140
RRH2x60-AWS (Verizon - Proposed)	150	Valmont 13' Low Profile Platform (ATT - Existing)	138
RRH2x60-AWS (Verizon - Proposed)	150	DB222-F (Town - Existing)	118
RRH2x60-AWS (Verizon - Proposed)	150	3' Yagi (Town - Existing)	118
(2) DB-T1-6Z-8AB-0Z (Verizon - Proposed)	150	DB222-F (Town - Existing)	118
PD220-1 (Town - Existing)	150	6' Extension Arm Mount (Town - Existing)	118
3' Yagi (Town - Existing)	150	6' Extension Arm Mount (Town - Existing)	118
PD220-1 (Town - Existing)	150		
Valmont 13' Low Profile Platform (Verizon - Existing)	148		
P90-15-XLH-RR (ATT - Existing)	140		
SBNHH-1D65A (ATT - Existing)	140		
P90-15-XLH-RR (ATT - Existing)	140		
P90-15-XLH-RR (ATT - Existing)	140		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower is located in Litchfield County, Connecticut.
2. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
3. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
4. Deflections are based upon a 50 mph wind.
5. Weld together tower sections have flange connections.
6. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
7. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
8. Welds are fabricated with ER-70S-6 electrodes.
9. TOWER RATING: 55.9%



Centek Engineering Inc.	Job: 15001.042 - Kent		
63-2 North Branford Rd.	Project: 150' EEI Monopole - 36 Maple St., Kent, CT		
Branford, CT 06405	Client: Verizon Wireless	Drawn by: TJL	App'd:
Phone: (203) 488-0580	Code: TIA/EIA-222-F	Date: 04/16/15	Scale: N
FAX: (203) 488-8587	Path: J:\Jobs\1500100.WI\042 - Kent\Backup Documentation\Calcs\ERI\150' Monopole.eri		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:

- Tower is located in Litchfield County, Connecticut.
- 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	150.000-140.170	9.830	4.167	18	26.370	28.760	0.188	0.750	A572-65 (65 ksi)
L2	140.170-91.707	52.630	5.583	18	27.372	40.050	0.313	1.250	A572-65 (65 ksi)
L3	91.707-46.080	51.210	6.833	18	38.080	50.400	0.375	1.500	A572-65

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L4	46.080-1.000	51.913		18	48.006	60.500	0.375	1.500	(65 ksi) 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	26.777	15.582	1349.519	9.295	13.396	100.741	2700.814	7.792	4.311	22.993
	29.204	17.004	1753.842	10.143	14.610	120.043	3509.991	8.504	4.732	25.236
L2	28.813	26.840	2482.831	9.606	13.905	178.558	4968.929	13.422	4.267	13.656
	40.668	39.415	7863.140	14.107	20.345	386.482	15736.627	19.711	6.499	20.796
L3	40.031	44.878	8060.760	13.385	19.345	416.691	16132.126	22.444	6.042	16.112
	51.178	59.542	18825.084	17.759	25.603	735.263	37674.939	29.777	8.210	21.894
L4	50.417	56.693	16249.825	16.909	24.387	666.328	32521.031	28.352	7.789	20.771
	61.433	71.564	32684.429	21.344	30.734	1063.462	65411.866	35.789	9.988	26.635

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in
L1 150.000-140.170				1	1	1		
L2 140.170-91.707				1	1	1		
L3 91.707-46.080				1	1	1		
L4 46.080-1.000				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight klf
LCF78-50J (7/8 FOAM) (Town - Existing)	B	No	Inside Pole	150.000 - 4.000	3	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
LCF78-50J (7/8 FOAM) (Town - Existing)	B	No	Inside Pole	118.000 - 4.000	3	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (AT&T - Existing)	C	No	Inside Pole	140.000 - 8.670	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	150.000 - 8.670	18	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
HYBRIFLEX 1-5/8" (Verizon - Proposed)	C	No	Inside Pole	150.000 - 1.000	2	No Ice	0.000	0.002
						1/2" Ice	0.000	0.002
Fiber Trunk (AT&T - Existing)	C	No	Inside Pole	140.000 - 4.000	1	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
DC Trunk	C	No	Inside Pole	140.000 - 4.000	2	No Ice	0.000	0.000

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft²/ft	Weight klf
(AT&T - Existing)						1/2" Ice	0.000	0.000

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	150.000-140.170	A	0.000	0.000	0.000	0.000	0.163
		B	0.000	0.000	0.000	0.000	0.016
		C	0.000	0.000	0.000	0.000	0.037
L2	140.170-91.707	A	0.000	0.000	0.000	0.000	0.803
		B	0.000	0.000	0.000	0.000	0.119
		C	0.000	0.000	0.000	0.000	0.846
L3	91.707-46.080	A	0.000	0.000	0.000	0.000	0.756
		B	0.000	0.000	0.000	0.000	0.145
		C	0.000	0.000	0.000	0.000	0.798
L4	46.080-1.000	A	0.000	0.000	0.000	0.000	0.620
		B	0.000	0.000	0.000	0.000	0.134
		C	0.000	0.000	0.000	0.000	0.690

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	150.000-140.170	A	0.500	0.000	0.000	0.000	0.000	0.163
		B		0.000	0.000	0.000	0.000	0.016
		C		0.000	0.000	0.000	0.000	0.037
L2	140.170-91.707	A	0.500	0.000	0.000	0.000	0.000	0.803
		B		0.000	0.000	0.000	0.000	0.119
		C		0.000	0.000	0.000	0.000	0.846
L3	91.707-46.080	A	0.500	0.000	0.000	0.000	0.000	0.756
		B		0.000	0.000	0.000	0.000	0.145
		C		0.000	0.000	0.000	0.000	0.798
L4	46.080-1.000	A	0.500	0.000	0.000	0.000	0.000	0.620
		B		0.000	0.000	0.000	0.000	0.134
		C		0.000	0.000	0.000	0.000	0.690

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
LPA-80080-6CF	A	From Face	3.000	0.000	150.000	No Ice	4.326	9.088	0.021
(Verizon - Existing)			-6.000			1/2" Ice	4.764	9.637	0.069
			0.000						
SBNHH-1D65B	A	From Face	3.000	0.000	150.000	No Ice	8.330	5.342	0.042

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(Verizon - Proposed)			-4.000 0.000			1/2" Ice	8.878	5.795	0.092
SBNHH-1D65B (Verizon - Proposed)	A	From Face	3.000 4.000 0.000	0.000	150.000	No Ice 1/2" Ice	8.330 8.878	5.342 5.795	0.042 0.092
LPA-80080-6CF (Verizon - Existing)	A	From Face	3.000 6.000 0.000	0.000	150.000	No Ice 1/2" Ice	4.326 4.764	9.088 9.637	0.021 0.069
LPA-80080-6CF (Verizon - Existing)	B	From Face	3.000 -6.000 0.000	0.000	150.000	No Ice 1/2" Ice	4.326 4.764	9.088 9.637	0.021 0.069
SBNHH-1D65B (Verizon - Proposed)	B	From Face	3.000 -4.000 0.000	0.000	150.000	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 4.000 0.000	0.000	150.000	No Ice 1/2" Ice	8.330 8.878	5.342 5.795	0.042 0.092
LPA-80080-6CF (Verizon - Existing)	B	From Face	3.000 6.000 0.000	0.000	150.000	No Ice 1/2" Ice	4.326 4.764	9.088 9.637	0.021 0.069
LPA-80080-6CF (Verizon - Existing)	C	From Face	3.000 -6.000 0.000	0.000	150.000	No Ice 1/2" Ice	4.326 4.764	9.088 9.637	0.021 0.069
SBNHH-1D65B (Verizon - Proposed)	C	From Face	3.000 -4.000 0.000	0.000	150.000	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 4.000 0.000	0.000	150.000	No Ice 1/2" Ice	8.330 8.878	5.342 5.795	0.042 0.092
LPA-80080-6CF (Verizon - Existing)	C	From Face	3.000 6.000 0.000	0.000	150.000	No Ice 1/2" Ice	4.326 4.764	9.088 9.637	0.021 0.069
RRH2x60-PCS (Verizon - Proposed)	A	From Face	3.000 -4.000 0.000	0.000	150.000	No Ice 1/2" Ice	2.508 2.730	1.547 1.738	0.055 0.073
RRH2x60-PCS (Verizon - Proposed)	A	From Face	3.000 -4.000 0.000	0.000	150.000	No Ice 1/2" Ice	2.508 2.730	1.547 1.738	0.055 0.073
RRH2x60-PCS (Verizon - Proposed)	A	From Face	3.000 -4.000 0.000	0.000	150.000	No Ice 1/2" Ice	2.508 2.730	1.547 1.738	0.055 0.073
RRH2x60-07-U (Verizon - Proposed)	A	From Face	3.000 0.000 0.000	0.000	150.000	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	150.000	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	150.000	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	150.000	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	150.000	No Ice 1/2" Ice	3.782 4.093	2.069 2.349	0.055 0.078
RRH2x60-AWS	C	From Face	3.000	0.000	150.000	No Ice	3.782	2.069	0.055

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(Verizon - Proposed)			4.000 0.000			1/2" Ice	4.093	2.349	0.078
(2) DB-T1-6Z-8AB-0Z (Verizon - Proposed)	A	From Face	3.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	5.600 5.915	2.333 2.558	0.044 0.080
Valmont 13' Low Profile Platform (Verizon - Existing)	C	None		0.000	148.000	No Ice 1/2" Ice	15.700 20.100	15.700 20.100	1.300 1.765
P90-15-XLH-RR (AT&T - Existing)	A	From Face	3.000 -6.000 0.000	0.000	140.000	No Ice 1/2" Ice	8.400 8.949	5.458 5.913	0.064 0.115
HPA-65R-BUU-H6 (AT&T - Existing)	A	From Face	3.000 -2.000 0.000	0.000	140.000	No Ice 1/2" Ice	10.360 10.927	6.450 6.913	0.051 0.114
P90-15-XLH-RR (AT&T - Existing)	A	From Face	3.000 6.000 0.000	0.000	140.000	No Ice 1/2" Ice	8.400 8.949	5.458 5.913	0.064 0.115
P90-15-XLH-RR (AT&T - Existing)	B	From Face	3.000 -6.000 0.000	0.000	140.000	No Ice 1/2" Ice	8.400 8.949	5.458 5.913	0.064 0.115
SBNHH-1D65A (AT&T - Existing)	B	From Face	3.000 -2.000 0.000	0.000	140.000	No Ice 1/2" Ice	6.363 6.801	3.864 4.220	0.040 0.079
P90-15-XLH-RR (AT&T - Existing)	B	From Face	3.000 6.000 0.000	0.000	140.000	No Ice 1/2" Ice	8.400 8.949	5.458 5.913	0.064 0.115
P90-15-XLH-RR (AT&T - Existing)	C	From Face	3.000 -6.000 0.000	0.000	140.000	No Ice 1/2" Ice	8.400 8.949	5.458 5.913	0.064 0.115
SBNHH-1D65A (AT&T - Existing)	C	From Face	3.000 -2.000 0.000	0.000	140.000	No Ice 1/2" Ice	6.363 6.801	3.864 4.220	0.040 0.079
P90-15-XLH-RR (AT&T - Existing)	C	From Face	3.000 6.000 0.000	0.000	140.000	No Ice 1/2" Ice	8.400 8.949	5.458 5.913	0.064 0.115
(2) TT19-08BP111-001 TMA (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	0.645 0.757	0.520 0.623	0.016 0.022
(2) TT19-08BP111-001 TMA (AT&T - Existing)	B	From Face	3.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	0.645 0.757	0.520 0.623	0.016 0.022
(2) TT19-08BP111-001 TMA (AT&T - Existing)	C	From Face	3.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	0.645 0.757	0.520 0.623	0.016 0.022
RRUS-11 (AT&T - Existing)	A	From Face	1.000 2.000 0.000	0.000	140.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
RRUS-11 (AT&T - Existing)	B	From Face	1.000 2.000 0.000	0.000	140.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
RRUS-11 (AT&T - Existing)	C	From Face	1.000 2.000 0.000	0.000	140.000	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	140.000	No Ice 1/2" Ice	2.228 2.447	2.228 2.447	0.020 0.039
RRUS-11	A	From Face	1.000	0.000	140.000	No Ice	2.994	1.246	0.050

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
(AT&T - Existing)			-2.000 0.000			1/2" Ice	3.226	1.412	0.070
RRUS-11 (AT&T - Existing)	B	From Face	1.000 -2.000 0.000	0.000	140.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
RRUS-11 (AT&T - Existing)	C	From Face	1.000 -2.000 0.000	0.000	140.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
A2 (AT&T - Existing)	A	From Face	1.000 -2.000 0.000	0.000	140.000	No Ice 1/2" Ice	2.424 2.633	0.542 0.675	0.022 0.035
A2 (AT&T - Existing)	B	From Face	1.000 -2.000 0.000	0.000	140.000	No Ice 1/2" Ice	2.424 2.633	0.542 0.675	0.022 0.035
A2 (AT&T - Existing)	C	From Face	1.000 -2.000 0.000	0.000	140.000	No Ice 1/2" Ice	2.424 2.633	0.542 0.675	0.022 0.035
Valmont 13' Low Profile Platform (AT&T - Existing)	C	None		0.000	138.000	No Ice 1/2" Ice	15.700 20.100	15.700 20.100	1.300 1.765
PD220-1 (Town - Existing)	A	From Face	6.000 0.000 10.000	0.000	150.000	No Ice 1/2" Ice	5.500 7.531	5.500 7.531	0.025 0.065
3' Yagi (Town - Existing)	A	From Face	6.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	2.083 3.787	2.083 3.787	0.031 0.052
PD220-1 (Town - Existing)	B	From Face	6.000 0.000 10.000	0.000	150.000	No Ice 1/2" Ice	5.500 7.531	5.500 7.531	0.025 0.065
DB222-F (Town - Existing)	A	From Face	6.000 0.000 5.000	0.000	118.000	No Ice 1/2" Ice	1.600 2.880	1.600 2.880	0.016 0.021
3' Yagi (Town - Existing)	A	From Face	6.000 0.000 0.000	0.000	118.000	No Ice 1/2" Ice	2.083 3.787	2.083 3.787	0.031 0.052
DB222-F (Town - Existing)	B	From Face	6.000 0.000 5.000	0.000	118.000	No Ice 1/2" Ice	1.600 2.880	1.600 2.880	0.016 0.021
6' Extension Arm Mount (Town - Existing)	A	None		0.000	118.000	No Ice 1/2" Ice	5.010 6.770	5.010 6.770	0.130 0.165
6' Extension Arm Mount (Town - Existing)	B	None		0.000	118.000	No Ice 1/2" Ice	5.010 6.770	5.010 6.770	0.130 0.165

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 150.000-140.170	145.014	1.526	0.025	22.580	A	0.000	22.580	22.580	100.00	0.000	0.000
					B	0.000	22.580		100.00	0.000	0.000
					C	0.000	22.580		100.00	0.000	0.000
L2 140.170-91.707	114.921	1.428	0.023	138.171	A	0.000	138.171	138.171	100.00	0.000	0.000
					B	0.000	138.171		100.00	0.000	0.000
					C	0.000	138.171		100.00	0.000	0.000
L3 91.707-46.080	68.508	1.232	0.020	170.765	A	0.000	170.765	170.765	100.00	0.000	0.000
					B	0.000	170.765		100.00	0.000	0.000
					C	0.000	170.765		100.00	0.000	0.000
L4 46.080-1.000	22.877	1	0.016	206.900	A	0.000	206.900	206.900	100.00	0.000	0.000
					B	0.000	206.900		100.00	0.000	0.000
					C	0.000	206.900		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 150.000-140.170	145.014	1.526	0.019	0.500	23.399	A	0.000	23.399	23.399	100.00	0.000	0.000
						B	0.000	23.399		100.00	0.000	0.000
						C	0.000	23.399		100.00	0.000	0.000
L2 140.170-91.707	114.921	1.428	0.018	0.500	142.210	A	0.000	142.210	142.210	100.00	0.000	0.000
						B	0.000	142.210		100.00	0.000	0.000
						C	0.000	142.210		100.00	0.000	0.000
L3 91.707-46.080	68.508	1.232	0.015	0.500	174.567	A	0.000	174.567	174.567	100.00	0.000	0.000
						B	0.000	174.567		100.00	0.000	0.000
						C	0.000	174.567		100.00	0.000	0.000
L4 46.080-1.000	22.877	1	0.012	0.500	210.656	A	0.000	210.656	210.656	100.00	0.000	0.000
						B	0.000	210.656		100.00	0.000	0.000
						C	0.000	210.656		100.00	0.000	0.000

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 150.000-140.170	145.014	1.526	0.010	22.580	A	0.000	22.580	22.580	100.00	0.000	0.000
					B	0.000	22.580		100.00	0.000	0.000
					C	0.000	22.580		100.00	0.000	0.000
L2 140.170-91.707	114.921	1.428	0.009	138.171	A	0.000	138.171	138.171	100.00	0.000	0.000
					B	0.000	138.171		100.00	0.000	0.000
					C	0.000	138.171		100.00	0.000	0.000
L3 91.707-46.080	68.508	1.232	0.008	170.765	A	0.000	170.765	170.765	100.00	0.000	0.000
					B	0.000	170.765		100.00	0.000	0.000
					C	0.000	170.765		100.00	0.000	0.000
L4	22.877	1	0.006	206.900	A	0.000	206.900	206.900	100.00	0.000	0.000

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
46.080-1.000					B	0.000	206.900		100.00	0.000	0.000
					C	0.000	206.900		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 150.000-140.170	0.216	0.545	A	1	0.65	1	1	1	22.580	0.620	0.063	C
			B	1	0.65	1	1	1	22.580			
			C	1	0.65	1	1	1	22.580			
L2 140.170-91.707	1.767	5.933	A	1	0.65	1	1	1	138.171	3.545	0.073	C
			B	1	0.65	1	1	1	138.171			
			C	1	0.65	1	1	1	138.171			
L3 91.707-46.080	1.699	9.098	A	1	0.65	1	1	1	170.765	3.767	0.083	C
			B	1	0.65	1	1	1	170.765			
			C	1	0.65	1	1	1	170.765			
L4 46.080-1.000	1.443	11.328	A	1	0.65	1	1	1	206.900	3.748	0.083	C
			B	1	0.65	1	1	1	206.900			
			C	1	0.65	1	1	1	206.900			
Sum Weight:	5.125	26.904						OTM	829.478 kip-ft	11.680		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-140.170	0.216	0.545	A	1	0.65	1	1	1	22.580	0.620	0.063	C
			B	1	0.65	1	1	1	22.580			
			C	1	0.65	1	1	1	22.580			
L2 140.170-91.707	1.767	5.933	A	1	0.65	1	1	1	138.171	3.545	0.073	C
			B	1	0.65	1	1	1	138.171			
			C	1	0.65	1	1	1	138.171			
L3 91.707-46.080	1.699	9.098	A	1	0.65	1	1	1	170.765	3.767	0.083	C
			B	1	0.65	1	1	1	170.765			
			C	1	0.65	1	1	1	170.765			
L4 46.080-1.000	1.443	11.328	A	1	0.65	1	1	1	206.900	3.748	0.083	C
			B	1	0.65	1	1	1	206.900			
			C	1	0.65	1	1	1	206.900			
Sum Weight:	5.125	26.904						OTM	829.478 kip-ft	11.680		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-140.170	0.216	0.545	A	1	0.65	1	1	1	22.580	0.620	0.063	C
			B	1	0.65	1	1	1	22.580			
			C	1	0.65	1	1	1	22.580			
L2 140.170-91.707	1.767	5.933	A	1	0.65	1	1	1	138.171	3.545	0.073	C
			B	1	0.65	1	1	1	138.171			
			C	1	0.65	1	1	1	138.171			
L3 91.707-46.080	1.699	9.098	A	1	0.65	1	1	1	170.765	3.767	0.083	C
			B	1	0.65	1	1	1	170.765			
			C	1	0.65	1	1	1	170.765			
L4 46.080-1.000	1.443	11.328	A	1	0.65	1	1	1	206.900	3.748	0.083	C
			B	1	0.65	1	1	1	206.900			
			C	1	0.65	1	1	1	206.900			
Sum Weight:	5.125	26.904						OTM	829.478 kip-ft	11.680		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-140.170	0.216	0.545	A	1	0.65	1	1	1	22.580	0.620	0.063	C
			B	1	0.65	1	1	1	22.580			
			C	1	0.65	1	1	1	22.580			
L2 140.170-91.707	1.767	5.933	A	1	0.65	1	1	1	138.171	3.545	0.073	C
			B	1	0.65	1	1	1	138.171			
			C	1	0.65	1	1	1	138.171			
L3 91.707-46.080	1.699	9.098	A	1	0.65	1	1	1	170.765	3.767	0.083	C
			B	1	0.65	1	1	1	170.765			
			C	1	0.65	1	1	1	170.765			
L4 46.080-1.000	1.443	11.328	A	1	0.65	1	1	1	206.900	3.748	0.083	C
			B	1	0.65	1	1	1	206.900			
			C	1	0.65	1	1	1	206.900			
Sum Weight:	5.125	26.904						OTM	829.478 kip-ft	11.680		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-140.170	0.216	0.715	A	1	0.65	1	1	1	23.399	0.482	0.049	C
			B	1	0.65	1	1	1	23.399			
			C	1	0.65	1	1	1	23.399			
L2 140.170-91.707	1.767	6.971	A	1	0.65	1	1	1	142.210	2.736	0.056	C
			B	1	0.65	1	1	1	142.210			
			C	1	0.65	1	1	1	142.210			
L3 91.707-46.080	1.699	10.377	A	1	0.65	1	1	1	174.567	2.888	0.063	C
			B	1	0.65	1	1	1	174.567			
			C	1	0.65	1	1	1	174.567			

Section Elevation *ft*	*Add Weight* *K*	*Self Weight* *K*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *K*	*w* *klf*	*Ctrl. Face*
L4 46.080-1.000	1.443	12.874	A	1	0.65	1	1	1	210.656	2.862	0.063	C
			B	1	0.65	1	1	1	210.656			
			C	1	0.65	1	1	1	210.656			
Sum Weight:	5.125	30.937						OTM	638.754 kip-ft	8.969		

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 150.000-140.170	0.216	0.715	A	1	0.65	1	1	1	23.399	0.482	0.049	C
			B	1	0.65	1	1	1	23.399			
			C	1	0.65	1	1	1	23.399			
L2 140.170-91.707	1.767	6.971	A	1	0.65	1	1	1	142.210	2.736	0.056	C
			B	1	0.65	1	1	1	142.210			
			C	1	0.65	1	1	1	142.210			
L3 91.707-46.080	1.699	10.377	A	1	0.65	1	1	1	174.567	2.888	0.063	C
			B	1	0.65	1	1	1	174.567			
			C	1	0.65	1	1	1	174.567			
L4 46.080-1.000	1.443	12.874	A	1	0.65	1	1	1	210.656	2.862	0.063	C
			B	1	0.65	1	1	1	210.656			
			C	1	0.65	1	1	1	210.656			
Sum Weight:	5.125	30.937						OTM	638.754 kip-ft	8.969		

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 150.000-140.170	0.216	0.715	A	1	0.65	1	1	1	23.399	0.482	0.049	C
			B	1	0.65	1	1	1	23.399			
			C	1	0.65	1	1	1	23.399			
L2 140.170-91.707	1.767	6.971	A	1	0.65	1	1	1	142.210	2.736	0.056	C
			B	1	0.65	1	1	1	142.210			
			C	1	0.65	1	1	1	142.210			
L3 91.707-46.080	1.699	10.377	A	1	0.65	1	1	1	174.567	2.888	0.063	C
			B	1	0.65	1	1	1	174.567			
			C	1	0.65	1	1	1	174.567			
L4 46.080-1.000	1.443	12.874	A	1	0.65	1	1	1	210.656	2.862	0.063	C
			B	1	0.65	1	1	1	210.656			
			C	1	0.65	1	1	1	210.656			
Sum Weight:	5.125	30.937						OTM	638.754 kip-ft	8.969		

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 150.000-140.170	0.216	0.715	A	1	0.65	1	1	1	23.399	0.482	0.049	C
			B	1	0.65	1	1	1	23.399			
			C	1	0.65	1	1	1	23.399			
L2 140.170-91.707	1.767	6.971	A	1	0.65	1	1	1	142.210	2.736	0.056	C
			B	1	0.65	1	1	1	142.210			
			C	1	0.65	1	1	1	142.210			
L3 91.707-46.080	1.699	10.377	A	1	0.65	1	1	1	174.567	2.888	0.063	C
			B	1	0.65	1	1	1	174.567			
			C	1	0.65	1	1	1	174.567			
L4 46.080-1.000	1.443	12.874	A	1	0.65	1	1	1	210.656	2.862	0.063	C
			B	1	0.65	1	1	1	210.656			
			C	1	0.65	1	1	1	210.656			
Sum Weight:	5.125	30.937						OTM	638.754 kip-ft	8.969		

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 150.000-140.170	0.216	0.545	A	1	0.65	1	1	1	22.580	0.242	0.025	C
			B	1	0.65	1	1	1	22.580			
			C	1	0.65	1	1	1	22.580			
L2 140.170-91.707	1.767	5.933	A	1	0.65	1	1	1	138.171	1.385	0.029	C
			B	1	0.65	1	1	1	138.171			
			C	1	0.65	1	1	1	138.171			
L3 91.707-46.080	1.699	9.098	A	1	0.65	1	1	1	170.765	1.472	0.032	C
			B	1	0.65	1	1	1	170.765			
			C	1	0.65	1	1	1	170.765			
L4 46.080-1.000	1.443	11.328	A	1	0.65	1	1	1	206.900	1.464	0.032	C
			B	1	0.65	1	1	1	206.900			
			C	1	0.65	1	1	1	206.900			
Sum Weight:	5.125	26.904						OTM	324.015 kip-ft	4.563		

Tower Forces - Service - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-140.170	0.216	0.545	A	1	0.65	1	1	1	22.580	0.242	0.025	C
			B	1	0.65	1	1	1	22.580			
			C	1	0.65	1	1	1	22.580			
L2 140.170-91.707	1.767	5.933	A	1	0.65	1	1	1	138.171	1.385	0.029	C
			B	1	0.65	1	1	1	138.171			
			C	1	0.65	1	1	1	138.171			

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 91.707-46.080	1.699	9.098	A	1	0.65	1	1	1	170.765	1.472	0.032	C
			B	1	0.65	1	1	1	170.765			
			C	1	0.65	1	1	1	170.765			
L4 46.080-1.000	1.443	11.328	A	1	0.65	1	1	1	206.900	1.464	0.032	C
			B	1	0.65	1	1	1	206.900			
			C	1	0.65	1	1	1	206.900			
Sum Weight:	5.125	26.904						OTM	324.015 kip-ft	4.563		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-140.1 70	0.216	0.545	A	1	0.65	1	1	1	22.580	0.242	0.025	C
			B	1	0.65	1	1	1	22.580			
			C	1	0.65	1	1	1	22.580			
L2 140.170-91.70 7	1.767	5.933	A	1	0.65	1	1	1	138.171	1.385	0.029	C
			B	1	0.65	1	1	1	138.171			
			C	1	0.65	1	1	1	138.171			
L3 91.707-46.080	1.699	9.098	A	1	0.65	1	1	1	170.765	1.472	0.032	C
			B	1	0.65	1	1	1	170.765			
			C	1	0.65	1	1	1	170.765			
L4 46.080-1.000	1.443	11.328	A	1	0.65	1	1	1	206.900	1.464	0.032	C
			B	1	0.65	1	1	1	206.900			
			C	1	0.65	1	1	1	206.900			
Sum Weight:	5.125	26.904						OTM	324.015 kip-ft	4.563		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-140.1 70	0.216	0.545	A	1	0.65	1	1	1	22.580	0.242	0.025	C
			B	1	0.65	1	1	1	22.580			
			C	1	0.65	1	1	1	22.580			
L2 140.170-91.70 7	1.767	5.933	A	1	0.65	1	1	1	138.171	1.385	0.029	C
			B	1	0.65	1	1	1	138.171			
			C	1	0.65	1	1	1	138.171			
L3 91.707-46.080	1.699	9.098	A	1	0.65	1	1	1	170.765	1.472	0.032	C
			B	1	0.65	1	1	1	170.765			
			C	1	0.65	1	1	1	170.765			
L4 46.080-1.000	1.443	11.328	A	1	0.65	1	1	1	206.900	1.464	0.032	C
			B	1	0.65	1	1	1	206.900			
			C	1	0.65	1	1	1	206.900			
Sum Weight:	5.125	26.904						OTM	324.015 kip-ft	4.563		

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	26.904					
Bracing Weight	0.000					
Total Member Self-Weight	26.904			-0.438	1.668	
Total Weight	36.976			-0.438	1.668	
Wind 0 deg - No Ice		-0.200	-22.244	-2345.975	31.153	-3.690
Wind 30 deg - No Ice		11.064	-19.164	-2016.991	-1162.589	-4.335
Wind 45 deg - No Ice		15.751	-15.588	-1638.135	-1660.103	-4.221
Wind 60 deg - No Ice		19.364	-10.949	-1147.672	-2044.369	-3.819
Wind 90 deg - No Ice		22.475	0.200	29.047	-2377.915	-2.279
Wind 120 deg - No Ice		19.563	11.295	1197.865	-2073.854	-0.129
Wind 135 deg - No Ice		16.033	15.870	1678.956	-1701.800	0.998
Wind 150 deg - No Ice		11.410	19.364	2045.599	-1213.658	2.056
Wind 180 deg - No Ice		0.200	22.244	2345.100	-27.816	3.690
Wind 210 deg - No Ice		-11.064	19.164	2016.115	1165.926	4.335
Wind 225 deg - No Ice		-15.751	15.588	1637.259	1663.439	4.221
Wind 240 deg - No Ice		-19.364	10.949	1146.796	2047.706	3.819
Wind 270 deg - No Ice		-22.475	-0.200	-29.923	2381.252	2.279
Wind 300 deg - No Ice		-19.563	-11.295	-1198.741	2077.190	0.129
Wind 315 deg - No Ice		-16.033	-15.870	-1679.832	1705.137	-0.998
Wind 330 deg - No Ice		-11.410	-19.364	-2046.475	1216.994	-2.056
Member Ice	4.033					
Total Weight Ice	43.636			-0.956	2.590	
Wind 0 deg - Ice		-0.154	-18.080	-1943.975	25.304	-3.605
Wind 30 deg - Ice		8.996	-15.581	-1672.303	-962.362	-4.537
Wind 45 deg - Ice		12.801	-12.676	-1358.817	-1373.816	-4.550
Wind 60 deg - Ice		15.735	-8.907	-952.795	-1691.470	-4.253
Wind 90 deg - Ice		18.258	0.154	21.757	-1966.656	-2.830
Wind 120 deg - Ice		15.888	9.173	990.224	-1714.184	-0.649
Wind 135 deg - Ice		13.019	12.893	1389.027	-1405.938	0.548
Wind 150 deg - Ice		9.262	15.735	1693.104	-1001.704	1.707
Wind 180 deg - Ice		0.154	18.080	1942.063	-20.123	3.605
Wind 210 deg - Ice		-8.996	15.581	1670.390	967.543	4.537
Wind 225 deg - Ice		-12.801	12.676	1356.904	1378.997	4.550
Wind 240 deg - Ice		-15.735	8.907	950.882	1696.651	4.253
Wind 270 deg - Ice		-18.258	-0.154	-23.670	1971.837	2.830
Wind 300 deg - Ice		-15.888	-9.173	-992.136	1719.365	0.649
Wind 315 deg - Ice		-13.019	-12.893	-1390.939	1411.119	-0.548
Wind 330 deg - Ice		-9.262	-15.735	-1695.017	1006.884	-1.707
Total Weight	36.976			-0.438	1.668	
Wind 0 deg - Service		-0.078	-8.689	-916.664	13.186	-1.441
Wind 30 deg - Service		4.322	-7.486	-788.154	-453.120	-1.693
Wind 45 deg - Service		6.153	-6.089	-640.163	-647.461	-1.649
Wind 60 deg - Service		7.564	-4.277	-448.576	-797.565	-1.492
Wind 90 deg - Service		8.779	0.078	11.079	-927.856	-0.890
Wind 120 deg - Service		7.642	4.412	467.649	-809.082	-0.050
Wind 135 deg - Service		6.263	6.199	655.575	-663.749	0.390
Wind 150 deg - Service		4.457	7.564	798.795	-473.068	0.803
Wind 180 deg - Service		0.078	8.689	915.788	-9.849	1.441
Wind 210 deg - Service		-4.322	7.486	787.278	456.456	1.693
Wind 225 deg - Service		-6.153	6.089	639.287	650.798	1.649
Wind 240 deg - Service		-7.564	4.277	447.700	800.902	1.492
Wind 270 deg - Service		-8.779	-0.078	-11.955	931.193	0.890
Wind 300 deg - Service		-7.642	-4.412	-468.525	812.419	0.050
Wind 315 deg - Service		-6.263	-6.199	-656.451	667.086	-0.390

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 330 deg - Service		-4.457	-7.564	-799.671	476.405	-0.803

Load Combinations

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

Comb. No.	Description
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	150 - 140.17	Pole	Max Tension	18	0.000	-0.000	-0.000
			Max. Compression	18	-4.261	2.102	0.666
			Max. Mx	14	-2.436	40.588	1.151
			Max. My	2	-2.453	2.300	38.257
			Max. Vy	14	-6.518	40.588	1.151
			Max. Vx	10	6.315	0.311	-37.784
			Max. Torque	21			3.180
L2	140.17 - 91.707	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-16.165	2.647	0.976
			Max. Mx	14	-11.933	622.813	10.932
			Max. My	2	-11.951	12.166	609.434
			Max. Vy	14	-14.948	622.813	10.932
			Max. Vx	2	-14.711	12.166	609.434
			Max. Torque	21			4.624
L3	91.707 - 46.08	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-27.491	2.647	0.976
			Max. Mx	14	-22.231	1367.165	20.113
			Max. My	2	-22.241	21.381	1343.215
			Max. Vy	14	-18.575	1367.165	20.113
			Max. Vx	2	-18.338	21.381	1343.215
			Max. Torque	21			4.622
L4	46.08 - 1	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-43.636	2.647	0.976
			Max. Mx	14	-36.966	2433.664	30.666
			Max. My	2	-36.966	31.945	2397.527
			Max. Vy	14	-22.491	2433.664	30.666
			Max. Vx	2	-22.260	31.945	2397.527
			Max. Torque	21			4.620

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	31	43.636	18.258	0.154
	Max. H_x	14	36.976	22.475	0.200
	Max. H_z	2	36.976	0.200	22.244
	Max. M_x	2	2397.527	0.200	22.244
	Max. M_z	6	2430.197	-22.475	-0.200
	Max. Torsion	21	4.619	-12.801	12.676
	Min. Vert	1	36.976	0.000	0.000
	Min. H_x	6	36.976	-22.475	-0.200
	Min. H_z	10	36.976	-0.200	-22.244
	Min. M_x	10	-2396.618	-0.200	-22.244
	Min. M_z	14	-2433.664	22.475	0.200
	Min. Torsion	29	-4.615	12.801	-12.676

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	36.976	0.000	0.000	-0.440	1.678	0.000
Dead+Wind 0 deg - No Ice	36.976	-0.200	-22.244	-2397.527	31.944	-3.744
Dead+Wind 30 deg - No Ice	36.976	11.064	-19.164	-2061.282	-1188.095	-4.385
Dead+Wind 45 deg - No Ice	36.976	15.751	-15.588	-1674.078	-1696.572	-4.263
Dead+Wind 60 deg - No Ice	36.976	19.364	-10.949	-1172.817	-2089.304	-3.851
Dead+Wind 90 deg - No Ice	36.976	22.475	0.200	29.766	-2430.197	-2.282
Dead+Wind 120 deg - No Ice	36.976	19.563	11.295	1224.227	-2119.474	-0.100
Dead+Wind 135 deg - No Ice	36.976	16.033	15.870	1715.866	-1739.260	1.040
Dead+Wind 150 deg - No Ice	36.976	11.410	19.364	2090.551	-1240.403	2.109
Dead+Wind 180 deg - No Ice	36.976	0.200	22.244	2396.618	-28.489	3.750
Dead+Wind 210 deg - No Ice	36.976	-11.064	19.164	2060.381	1191.549	4.385
Dead+Wind 225 deg - No Ice	36.976	-15.751	15.588	1673.179	1700.029	4.259
Dead+Wind 240 deg - No Ice	36.976	-19.364	10.949	1171.920	2092.764	3.844
Dead+Wind 270 deg - No Ice	36.976	-22.475	-0.200	-30.666	2433.664	2.275
Dead+Wind 300 deg - No Ice	36.976	-19.563	-11.295	-1225.133	2122.942	0.100
Dead+Wind 315 deg - No Ice	36.976	-16.033	-15.870	-1716.776	1742.725	-1.036
Dead+Wind 330 deg - No Ice	36.976	-11.410	-19.364	-2091.462	1243.864	-2.102
Dead+Ice+Temp	43.636	-0.000	-0.000	-0.976	2.647	-0.000
Dead+Wind 0 deg+Ice+Temp	43.636	-0.154	-18.080	-1999.654	26.167	-3.681
Dead+Wind 30 deg+Ice+Temp	43.636	8.996	-15.581	-1720.166	-989.841	-4.613
Dead+Wind 45 deg+Ice+Temp	43.636	12.801	-12.676	-1397.682	-1413.107	-4.619
Dead+Wind 60 deg+Ice+Temp	43.636	15.735	-8.907	-980.017	-1739.882	-4.309
Dead+Wind 90 deg+Ice+Temp	43.636	18.258	0.154	22.448	-2022.978	-2.848
Dead+Wind 120 deg+Ice+Temp	43.636	15.888	9.173	1018.613	-1763.300	-0.623
Dead+Wind 135 deg+Ice+Temp	43.636	13.019	12.893	1428.815	-1446.238	0.594
Dead+Wind 150 deg+Ice+Temp	43.636	9.262	15.735	1741.582	-1030.434	1.770
Dead+Wind 180 deg+Ice+Temp	43.636	0.154	18.080	1997.643	-20.727	3.686
Dead+Wind 210 deg+Ice+Temp	43.636	-8.996	15.581	1718.164	995.279	4.613
Dead+Wind 225 deg+Ice+Temp	43.636	-12.801	12.676	1395.684	1418.548	4.615
Dead+Wind 240 deg+Ice+Temp	43.636	-15.735	8.907	978.021	1745.326	4.303
Dead+Wind 270 deg+Ice+Temp	43.636	-18.258	-0.154	-24.446	2028.431	2.843
Dead+Wind 300 deg+Ice+Temp	43.636	-15.888	-9.173	-1020.620	1768.754	0.623
Dead+Wind 315 deg+Ice+Temp	43.636	-13.019	-12.893	-1430.825	1451.690	-0.591
Dead+Wind 330 deg+Ice+Temp	43.636	-9.262	-15.735	-1743.595	1035.882	-1.764
Dead+Wind 0 deg - Service	36.976	-0.078	-8.689	-937.119	13.544	-1.467
Dead+Wind 30 deg - Service	36.976	4.322	-7.486	-805.726	-463.188	-1.717
Dead+Wind 45 deg - Service	36.976	6.153	-6.089	-654.426	-661.878	-1.669
Dead+Wind 60 deg - Service	36.976	7.564	-4.277	-458.560	-815.343	-1.507
Dead+Wind 90 deg - Service	36.976	8.779	0.078	11.354	-948.560	-0.893
Dead+Wind 120 deg - Service	36.976	7.642	4.412	478.101	-827.148	-0.039
Dead+Wind 135 deg - Service	36.976	6.263	6.199	670.214	-678.574	0.407
Dead+Wind 150 deg - Service	36.976	4.457	7.564	816.621	-483.639	0.825
Dead+Wind 180 deg - Service	36.976	0.078	8.689	936.208	-10.073	1.468
Dead+Wind 210 deg - Service	36.976	-4.322	7.486	804.817	466.659	1.717
Dead+Wind 225 deg - Service	36.976	-6.153	6.089	653.518	665.349	1.668
Dead+Wind 240 deg - Service	36.976	-7.564	4.277	457.651	818.814	1.506
Dead+Wind 270 deg - Service	36.976	-8.779	-0.078	-12.263	952.033	0.892
Dead+Wind 300 deg - Service	36.976	-7.642	-4.412	-479.012	830.620	0.039
Dead+Wind 315 deg - Service	36.976	-6.263	-6.199	-671.124	682.046	-0.406
Dead+Wind 330 deg - Service	36.976	-4.457	-7.564	-817.532	487.110	-0.824

Solution Summary

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
1	0.000	-36.976	0.000	0.000	36.976	0.000	0.000%
2	-0.200	-36.976	-22.244	0.200	36.976	22.244	0.000%
3	11.064	-36.976	-19.164	-11.064	36.976	19.164	0.000%
4	15.751	-36.976	-15.588	-15.751	36.976	15.588	0.000%
5	19.364	-36.976	-10.949	-19.364	36.976	10.949	0.000%
6	22.475	-36.976	0.200	-22.475	36.976	-0.200	0.000%
7	19.563	-36.976	11.295	-19.563	36.976	-11.295	0.000%
8	16.033	-36.976	15.870	-16.033	36.976	-15.870	0.000%
9	11.410	-36.976	19.364	-11.410	36.976	-19.364	0.000%
10	0.200	-36.976	22.244	-0.200	36.976	-22.244	0.000%
11	-11.064	-36.976	19.164	11.064	36.976	-19.164	0.000%
12	-15.751	-36.976	15.588	15.751	36.976	-15.588	0.000%
13	-19.364	-36.976	10.949	19.364	36.976	-10.949	0.000%
14	-22.475	-36.976	-0.200	22.475	36.976	0.200	0.000%
15	-19.563	-36.976	-11.295	19.563	36.976	11.295	0.000%
16	-16.033	-36.976	-15.870	16.033	36.976	15.870	0.000%
17	-11.410	-36.976	-19.364	11.410	36.976	19.364	0.000%
18	0.000	-43.636	0.000	0.000	43.636	0.000	0.000%
19	-0.154	-43.636	-18.080	0.154	43.636	18.080	0.000%
20	8.996	-43.636	-15.581	-8.996	43.636	15.581	0.000%
21	12.801	-43.636	-12.676	-12.801	43.636	12.676	0.000%
22	15.735	-43.636	-8.907	-15.735	43.636	8.907	0.000%
23	18.258	-43.636	0.154	-18.258	43.636	-0.154	0.000%
24	15.888	-43.636	9.173	-15.888	43.636	-9.173	0.000%
25	13.019	-43.636	12.893	-13.019	43.636	-12.893	0.000%
26	9.262	-43.636	15.735	-9.262	43.636	-15.735	0.000%
27	0.154	-43.636	18.080	-0.154	43.636	-18.080	0.000%
28	-8.996	-43.636	15.581	8.996	43.636	-15.581	0.000%
29	-12.801	-43.636	12.676	12.801	43.636	-12.676	0.000%
30	-15.735	-43.636	8.907	15.735	43.636	-8.907	0.000%
31	-18.258	-43.636	-0.154	18.258	43.636	0.154	0.000%
32	-15.888	-43.636	-9.173	15.888	43.636	9.173	0.000%
33	-13.019	-43.636	-12.893	13.019	43.636	12.893	0.000%
34	-9.262	-43.636	-15.735	9.262	43.636	15.735	0.000%
35	-0.078	-36.976	-8.689	0.078	36.976	8.689	0.000%
36	4.322	-36.976	-7.486	-4.322	36.976	7.486	0.000%
37	6.153	-36.976	-6.089	-6.153	36.976	6.089	0.000%
38	7.564	-36.976	-4.277	-7.564	36.976	4.277	0.000%
39	8.779	-36.976	0.078	-8.779	36.976	-0.078	0.000%
40	7.642	-36.976	4.412	-7.642	36.976	-4.412	0.000%
41	6.263	-36.976	6.199	-6.263	36.976	-6.199	0.000%
42	4.457	-36.976	7.564	-4.457	36.976	-7.564	0.000%
43	0.078	-36.976	8.689	-0.078	36.976	-8.689	0.000%
44	-4.322	-36.976	7.486	4.322	36.976	-7.486	0.000%
45	-6.153	-36.976	6.089	6.153	36.976	-6.089	0.000%
46	-7.564	-36.976	4.277	7.564	36.976	-4.277	0.000%
47	-8.779	-36.976	-0.078	8.779	36.976	0.078	0.000%
48	-7.642	-36.976	-4.412	7.642	36.976	4.412	0.000%
49	-6.263	-36.976	-6.199	6.263	36.976	6.199	0.000%
50	-4.457	-36.976	-7.564	4.457	36.976	7.564	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	0.00054812
3	Yes	5	0.00000001	0.00003193
4	Yes	5	0.00000001	0.00004453
5	Yes	5	0.00000001	0.00004507
6	Yes	4	0.00000001	0.00024139
7	Yes	5	0.00000001	0.00003954
8	Yes	5	0.00000001	0.00004486
9	Yes	5	0.00000001	0.00003641
10	Yes	4	0.00000001	0.00045012
11	Yes	5	0.00000001	0.00004616
12	Yes	5	0.00000001	0.00004424
13	Yes	5	0.00000001	0.00003217
14	Yes	4	0.00000001	0.00034271
15	Yes	5	0.00000001	0.00003998
16	Yes	5	0.00000001	0.00004511
17	Yes	5	0.00000001	0.00004378
18	Yes	4	0.00000001	0.00000479
19	Yes	5	0.00000001	0.00004960
20	Yes	5	0.00000001	0.00007914
21	Yes	5	0.00000001	0.00009586
22	Yes	5	0.00000001	0.00009295
23	Yes	5	0.00000001	0.00004641
24	Yes	5	0.00000001	0.00008567
25	Yes	5	0.00000001	0.00009601
26	Yes	5	0.00000001	0.00008395
27	Yes	5	0.00000001	0.00004820
28	Yes	5	0.00000001	0.00009396
29	Yes	5	0.00000001	0.00009590
30	Yes	5	0.00000001	0.00007933
31	Yes	5	0.00000001	0.00004768
32	Yes	5	0.00000001	0.00008855
33	Yes	5	0.00000001	0.00009714
34	Yes	5	0.00000001	0.00009100
35	Yes	4	0.00000001	0.00010138
36	Yes	4	0.00000001	0.00011759
37	Yes	4	0.00000001	0.00017452
38	Yes	4	0.00000001	0.00018593
39	Yes	4	0.00000001	0.00005429
40	Yes	4	0.00000001	0.00012923
41	Yes	4	0.00000001	0.00015134
42	Yes	4	0.00000001	0.00011500
43	Yes	4	0.00000001	0.00009382
44	Yes	4	0.00000001	0.00019682
45	Yes	4	0.00000001	0.00017352
46	Yes	4	0.00000001	0.00011127
47	Yes	4	0.00000001	0.00006224
48	Yes	4	0.00000001	0.00013291
49	Yes	4	0.00000001	0.00015393
50	Yes	4	0.00000001	0.00016415

Maximum Tower Deflections - Service Wind

Section No.	*Elevation ft*	*Horz. Deflection in*	*Gov. Load Comb.*	*Tilt °*	*Twist °*
L1	150 - 140.17	19.568	48	1.145	0.011
L2	144.337 - 91.707	18.216	48	1.134	0.009
L3	97.29 - 46.08	8.312	48	0.810	0.004
L4	52.913 - 1	2.445	48	0.431	0.001

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
150.000	LPA-80080-6CF	48	19.568	1.145	0.011	18699
148.000	Valmont 13' Low Profile Platform	48	19.089	1.142	0.010	18699
140.000	P90-15-XLH-RR	48	17.194	1.121	0.008	13417
138.000	Valmont 13' Low Profile Platform	48	16.728	1.113	0.008	12793
118.000	DB222-F	48	12.308	0.988	0.005	8748

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	150 - 140.17	49.924	15	2.915	0.029
L2	144.337 - 91.707	46.481	15	2.890	0.024
L3	97.29 - 46.08	21.230	15	2.067	0.009
L4	52.913 - 1	6.248	15	1.101	0.004

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
150.000	LPA-80080-6CF	15	49.924	2.915	0.029	7535
148.000	Valmont 13' Low Profile Platform	15	48.705	2.908	0.027	7535
140.000	P90-15-XLH-RR	15	43.879	2.858	0.021	5387
138.000	Valmont 13' Low Profile Platform	15	42.694	2.838	0.020	5127
118.000	DB222-F	15	31.427	2.522	0.013	3465

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
L1	150 - 140.17 (1)	TP28.76x26.37x0.188	9.830	0.000	0.0	39.000	16.401	-2.428	639.649	0.004
L2	140.17 - 91.707	TP40.05x27.372x0.313	52.630	0.000	0.0	39.000	38.081	-11.925	1485.150	0.008

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
	(2)									
L3	91.707 - 46.08 (3)	TP50.4x38.08x0.375	51.210	0.000	0.0	39.000	57.586	-22.226	2245.840	0.010
L4	46.08 - 1 (4)	TP60.5x48.006x0.375	51.913	0.000	0.0	37.851	71.564	-36.966	2708.780	0.014

Pole Bending Design Data

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
L1	150 - 140.17 (1)	TP28.76x26.37x0.188	41.090	4.416	39.000	0.113	0.000	0.000	39.000	0.000
L2	140.17 - 91.707 (2)	TP40.05x27.372x0.313	628.870	20.924	39.000	0.537	0.000	0.000	39.000	0.000
L3	91.707 - 46.08 (3)	TP50.4x38.08x0.375	1378.500	24.059	39.000	0.617	0.000	0.000	39.000	0.000
L4	46.08 - 1 (4)	TP60.5x48.006x0.375	2451.092	27.658	37.851	0.731	0.000	0.000	37.851	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	150 - 140.17 (1)	TP28.76x26.37x0.188	6.619	0.404	26.000	0.031	0.160	0.008	26.000	0.000
L2	140.17 - 91.707 (2)	TP40.05x27.372x0.313	15.067	0.396	26.000	0.030	0.100	0.002	26.000	0.000
L3	91.707 - 46.08 (3)	TP50.4x38.08x0.375	18.694	0.325	26.000	0.025	0.100	0.001	26.000	0.000
L4	46.08 - 1 (4)	TP60.5x48.006x0.375	22.606	0.316	26.000	0.024	0.100	0.001	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	150 - 140.17 (1)	0.004	0.113	0.000	0.031	0.000	0.117 ✔	1.333	H1-3+VT ✔
L2	140.17 - 91.707 (2)	0.008	0.537	0.000	0.030	0.000	0.545 ✔	1.333	H1-3+VT ✔
L3	91.707 - 46.08 (3)	0.010	0.617	0.000	0.025	0.000	0.627 ✔	1.333	H1-3+VT ✔
L4	46.08 - 1 (4)	0.014	0.731	0.000	0.024	0.000	0.744 ✔	1.333	H1-3+VT ✔

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

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
L1	150 - 140.17	Pole	TP28.76x26.37x0.188	1	-2.428	852.652	8.8	Pass
L2	140.17 - 91.707	Pole	TP40.05x27.372x0.313	2	-11.925	1979.705	40.9	Pass
L3	91.707 - 46.08	Pole	TP50.4x38.08x0.375	3	-22.226	2993.705	47.0	Pass
L4	46.08 - 1	Pole	TP60.5x48.006x0.375	4	-36.966	3610.804	55.9	Pass
							Summary	
						Pole (L4)	55.9	Pass
						RATING =	**55.9**	**Pass**

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 2451 \cdot ft \cdot kips$	(Input From tnxTower)
Shear Force =	$Shear := 23 \cdot kips$	(Input From tnxTower)
Axial Force =	$Axial := 37 \cdot kips$	(Input From tnxTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	$N := 24$	(User Input)
Diameter of Bolt Circle =	$D_{bc} := 69 \cdot in$	(User Input)
Bolt "Column" Distance =	$l := 3.0 \cdot in$	(User Input)
Bolt Ultimate Strength =	$F_u := 100 \cdot ksi$	(User Input)
Bolt Yield Strength =	$F_y := 75 \cdot ksi$	(User Input)
Bolt Modulus =	$E := 29000 \cdot ksi$	(User Input)
Diameter of Anchor Bolts =	$D := 2.25 \cdot in$	(User Input)
Threads per Inch =	$n := 4.5$	(User Input)

Base Plate Data:

Use ASTM A572 50

Plate Yield Strength =	$Fy_{bp} := 50 \cdot ksi$	(User Input)
Base Plate Thickness =	$t_{bp} := 3.25 \cdot in$	(User Input)
Base Plate Diameter =	$D_{bp} := 75 \cdot in$	(User Input)
Outer Pole Diameter =	$D_{pole} := 60.5 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =: $R_{bc} := \frac{D_{bc}}{2} = 34.5 \cdot in$

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

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

$d_1 = 8.93 \cdot in$	$d_7 = 33.32 \cdot in$
$d_2 = 17.25 \cdot in$	$d_8 = 29.88 \cdot in$
$d_3 = 24.40 \cdot in$	$d_9 = 24.40 \cdot in$
$d_4 = 29.88 \cdot in$	$d_{10} = 17.25 \cdot in$
$d_5 = 33.32 \cdot in$	$d_{11} = 8.93 \cdot in$
$d_6 = 34.50 \cdot in$	etc.

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 30.3 \cdot in$

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

$MA_1 = 0.00 \cdot in$	$MA_7 = 3.07 \cdot in$
$MA_2 = 0.00 \cdot in$	$MA_8 = 0.00 \cdot in$
$MA_3 = 0.00 \cdot in$	$MA_9 = 0.00 \cdot in$
$MA_4 = 0.00 \cdot in$	$MA_{10} = 0.00 \cdot in$
$MA_5 = 3.07 \cdot in$	$MA_{11} = 0.00 \cdot in$
$MA_6 = 4.25 \cdot in$	etc

Effective Width of Baseplate for Bending = $B_{eff} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 35.5 \cdot in$

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i (d_i)^2 = 1.428 \times 10^4 \cdot in^2$

Gross Area of Bolt = $A_g := \frac{\pi}{4} \cdot D^2 = 3.976 \cdot in^2$

Net Area of Bolt = $A_n := \frac{\pi}{4} \cdot \left(D - \frac{0.9743 \cdot in}{n}\right)^2 = 3.248 \cdot in^2$

Net Diameter = $D_n := \frac{2 \cdot \sqrt{A_n}}{\sqrt{\pi}} = 2.033 \cdot in$

Radius of Gyration of Bolt = $r := \frac{D_n}{4} = 0.508 \cdot in$

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

Check Anchor Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 69.5 \cdot kips$

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

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

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Net}} \cdot 100 = 36$ Bolts are "upset bolts". Use net area per AISC

Condition1 = $Condition1 := if\left(\frac{T_{Max}}{T_{ALL.Net}} \le 1.00, \text{"OK"}, \text{"Overstressed"}\right)$

Condition1 = "OK"

Check Anchor Bolt Bending Stress:

Maximum Bending Moment = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.24 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 3.5 \cdot ksi$

Allowable Bending Stress = $F_{bx} := 1.333 \cdot 0.6 \cdot F_y = 60 \cdot ksi$ (1.333 increase allowed per TIA/EIA)

Check Combined Stress Requirement:

Per ASCE Manual 72: "If the clearance between the base plate and concrete does not exceed two times the bolt diameter a bending stress analysis of the bolts is NOT normally required.

$$l := \begin{cases} l & \text{if } l > 2 \cdot D_n \\ 0 & \text{otherwise} \end{cases} = 0 \cdot in$$

$$f_{bx} := \begin{cases} f_{bx} & \text{if } l > 2 \cdot D_n \\ 0 & \text{otherwise} \end{cases} = 0 \cdot ksi$$

Check Anchor Bolt Compression/Combined Stress:

Maximum Compressive Force = $C_{Max} := OM \cdot \frac{R_{bc}}{I_p} + \frac{Axial}{N} = 72.6 \cdot kips$

Maximum Compressive Stress = $f_a := \frac{C_{Max}}{A_n} = 22.3 \cdot ksi$

$K := 0.65$

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

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

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

Combined Stress % of Capacity = $\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) \cdot 100 = 37.3$

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

Condition2 = "OK"

Base Plate Analysis:

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

$C_1 = 19.9 \cdot kips$	$C_7 = 70.2 \cdot kips$
$C_2 = 37.1 \cdot kips$	$C_8 = 63.1 \cdot kips$
$C_3 = 51.8 \cdot kips$	$C_9 = 51.8 \cdot kips$
$C_4 = 63.1 \cdot kips$	$C_{10} = 37.1 \cdot kips$
$C_5 = 70.2 \cdot kips$	$C_{11} = 19.9 \cdot kips$
$C_6 = 72.6 \cdot kips$	etc.

Maximum Bending Stress in Plate = $f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} t_{bp}^{\ 2}\right)} = 11.9 \cdot ksi$

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

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} \cdot 100 = 23.8$

Condition3 = Condition3 := if$\left(\frac{f_{bp}}{F_{bp}} < 1.00, \text{"Ok"}, \text{"Overstressed"}\right)$

Condition3 = "Ok"

Standard Monopole Foundation:

Input Data:

Tower Data

Overturning Moment =	$OM := 2451 \cdot ft \cdot kips$	(User Input from tnxTower)	
Shear Force =	$Shear := 23 \cdot kip$	(User Input from tnxTower)	
Axial Force =	$Axial := 37 \cdot kip$	(User Input from tnxTower)	
Tower Height =	$H_t := 150 \cdot ft$	(User Input)	

Footing Data:

Overall Depth of Footing =	$D_f := 6.5 \cdot ft$	(User Input)	
Length of Pier =	$L_p := 4.0 \cdot ft$	(User Input)	
Extension of Pier Above Grade =	$L_{pag} := 1.0 \cdot ft$	(User Input)	
Diameter of Pier =	$d_p := 7.5 \cdot ft$	(User Input)	
Thickness of Footing =	$T_f := 3.5 \cdot ft$	(User Input)	
Width of Footing =	$W_f := 30.0 \cdot ft$	(User Input)	

Anchor Bolt Data:

Length of Anchor Bolts =	$L_{st} := 96 \cdot in$	(User Input)	
Projection of Anchor Bolts Above Pier =	$A_{BP} := 12.0 \cdot in$	(User Input)	
Anchor Bolt Diameter =	$d_{anchor} := 2.25 \cdot in$	(User Input)	
Base Plate Bolt Circle =	$MP := 69 \cdot in$	(User Input)	

Material Properties:

Concrete Compressive Strength =	$f_c := 4000 \cdot psi$	(User Input)	
Steel Reinforcment Yield Strength =	$f_y := 60000 \cdot psi$	(User Input)	
Anchor Bolt Yield Strength =	$f_{ya} := 75000 \cdot psi$	(User Input)	
Internal Friction Angle of Soil =	$\Phi_s := 30 \cdot deg$	(User Input)	
Allowable Soil Bearing Capacity =	$q_s := 4000 \cdot psf$	(User Input)	
Unit Weight of Soil =	$\gamma_{soil} := 125 \cdot pcf$	(User Input)	
Unit Weight of Concrete =	$\gamma_{conc} := 150 \cdot pcf$	(User Input)	
Foundation Bouyancy =	$Bouyancy := 1$	(User Input)	(Yes=1 / No=0)
Depth to Neglect =	$n := 1 \cdot ft$	(User Input)	
Cohesion of Clay Type Soil =	$c := 0 \cdot ksf$	(User Input)	(Use 0 for Sandy Soil)
Seismic Zone Factor =	$Z := 2$	(User Input)	(UBC-1997 Fig 23-2)
Coefficient of Friction Between Concrete =	$\mu := 0.45$	(User Input)	

Pier Reinforcement:

Bar Size =	$BS_{pier} := 8$	(User Input)	
Bar Diameter =	$d_{bpier} := 1.0 \cdot in$	(User Input)	
Number of Bars =	$NB_{pier} := 36$	(User Input)	
Clear Cover of Reinforcement =	$Cvr_{pier} := 5.5 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Diameter of Tie =	$d_{Tie} := 0.5 \cdot in$	(User Input)	

Pad Reinforcement:

Bar Size =	$BS_{top} := 8$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 1.0 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 34$	(User Input)	(Top of Pad)
Bar Size =	$BS_{bot} := 8$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{bbot} := 1.0 \cdot in$	(User Input)	(Bottom of Pad)
Number of Bars =	$NB_{bot} := 34$	(User Input)	(Bottom of Pad)
Clear Cover of Reinforcement =	$Cvr_{pad} := 3.0 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)

Calculated Factors:

Pier Reinforcement Bar Area = $A_{bpier} := \frac{\pi \cdot d_{bpier}^2}{4} = 0.785 \cdot in^2$

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

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

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

Load Factor =

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

Stability of Footing:

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

Adjusted Soil Unit Weight = $\gamma_s := \text{if}(\text{Bouyancy} = 1, \gamma_{soil} - 62.4\text{pcf}, \gamma_{soil}) = 62.6\cdot\text{pcf}$

Passive Pressure = $P_{pn} := K_p\cdot\gamma_s\cdot n + c\cdot 2\cdot\sqrt{K_p} = 0.188\cdot\text{ksf}$

$P_{pt} := K_p\cdot\gamma_s\cdot(D_f - T_f) + c\cdot 2\cdot\sqrt{K_p} = 0.563\cdot\text{ksf}$

$P_{top} := \text{if}\left[n < (D_f - T_f), P_{pt}, P_{pn}\right] = 0.563\cdot\text{ksf}$

$P_{bot} := K_p\cdot\gamma_s\cdot D_f + c\cdot 2\cdot\sqrt{K_p} = 1.221\cdot\text{ksf}$

$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 0.892\cdot\text{ksf}$

$T_p := \text{if}\left[n < (D_f - T_f), T_f, (D_f - n)\right] = 3.5$

$A_p := W_f\cdot T_p = 105$

Ultimate Shear = $S_u := P_{ave}\cdot A_p = 93.665\cdot\text{kip}$

Weight of Concrete Pad = $WT_c := \left[(W_f^2\cdot T_f) + d_p^2\cdot L_p\right]\cdot\gamma_c = 295.65\cdot\text{kip}$

Weight of Soil Above Footing = $WT_{s1} := \left[(W_f^2 - d_p^2)\cdot\begin{cases}(L_p - L_{pag} - n) & \text{if } (L_p - L_{pag} - n) \ge 0 \\ 0 & \text{if } (L_p - L_{pag} - n) \le 0\end{cases}\right]\cdot\gamma_s = 105.64\cdot\text{kip}$

Weight of Soil Wedge at Back Face = $WT_{s2} := \left(\frac{D_f^2\cdot\tan(\Phi_s)}{2}\cdot W_f\right)\cdot\gamma_s = 22.905\cdot\text{kip}$

Weight of Soil Wedge at back face Corners = $WT_{s3} := 2\cdot\left[(D_f)^3\cdot\frac{\tan(\Phi_s)}{3}\right]\cdot\gamma_s = 6.617\cdot\text{kips}$

Total Weight = $WT_{tot} := WT_c + WT_{s1} + \text{Axial} = 438.288\cdot\text{kip}$

Resisting Moment = $M_r := (WT_{tot})\cdot\frac{W_f}{2} + S_u\cdot\frac{T_f}{3} + \left[(WT_{s2} + WT_{s3})\cdot\left(W_f + \frac{D_f\cdot\tan(\Phi_s)}{3}\right)\right] = 7606\cdot\text{kip}\cdot\text{ft}$

Overturning Moment = $M_{ot} := OM + \text{Shear}\cdot(L_p + T_f) = 2624\cdot\text{kip}\cdot\text{ft}$

Factor of Safety Actual = $FS := \frac{M_r}{M_{ot}} = 2.9$

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

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

OverTurning_Moment_Check = "Okay"

Shear Capacity in Pier:

Shear Resistance of Pier = $S_p := \frac{\mu \cdot WT_{tot}}{FS_{req}} = 98.615 \cdot kips$

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

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

Bearing Pressure Caused by Footing:

Area of the Mat = $A_{mat} := W_f^2 = 900$

Section Modulus of Mat = $S := \frac{W_f^3}{6} = 4500 \cdot ft^3$

Maximum Pressure in Mat = $P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S} = 1.07 \cdot ksf$

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

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

Minimum Pressure in Mat = $P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S} = -0.096 \cdot ksf$

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

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

Distance to Resultant of Pressure Distribution = $X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 9.177$

Distance to Kern = $X_k := \frac{W_f}{6} = 5$

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

Eccentricity = $e := \frac{M_{ot}}{WT_{tot}} = 5.986$

Adjusted Soil Pressure = $P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \left(\frac{W_f}{2} - e\right)} = 1.08 \cdot ksf$

$q_{adj} := if(P_{min} < 0, P_a, P_{max}) = 1.08 \cdot ksf$

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

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

Concrete Bearing Capacity:

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

Bearing Strength Between Pier and Pad = $P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot \frac{\pi \cdot d_p^2}{4} = 1.406 \times 10^4 \cdot kips$ (ACI-2008 10.14)

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

Bearing_Check = "Okay"

Shear Strength of Concrete:

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

$\phi_c := 0.85$ (ACI 9.3.2.5)

$d := T_f - Cvr_{pad} - d_{bbot} = 38 \cdot in$

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

$d_2 := d_1 - d$

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

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

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

$V_{Avail} := \phi_c \cdot 2 \cdot \sqrt{f_c \cdot psi} \cdot W_f \cdot d$ (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 = $b_o := \left(d_p + d\right) \cdot \pi = 33.5$

Area Included Inside Perimeter = $A_{bo} := \frac{\pi \cdot \left(d_p + d\right)^2}{4} = 89.4$

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 810.6$

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

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

$v_u := Find(v_u) = 4.1 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f = 392.4 \cdot kips$

Required Shear Strength = $V_{req} := LF \cdot V_u = 523 \cdot kips$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 3285.9 \cdot kip$ (ACI-2008 11.11.2.1)

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

Punching_Shear_Check = "Okay"

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

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

$q_b := q_{adj} - d_1 \cdot Slope = 0.631 \cdot ksf$

Maximum Bending at Face of Pier = $M_u := LF \cdot \left[(q_{adj} - q_b) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f = 2355.1 \cdot kip \cdot ft$

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

(ACI-200810.2.7.3)

$R_n := \frac{M_u}{\phi_m \cdot W_f \cdot d^2} = 60.4 \cdot psi$

$\rho := \frac{0.85 \cdot f_c}{f_y} \left(1 - \sqrt{1 - \frac{2 \cdot R_n}{0.85 \cdot f_c}} \right) = 0.001$

$\rho_{min} := \rho = 0.00102$

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:

$$As := \begin{cases} \rho_{min} \cdot W_f \cdot d & \text{if } \rho_{min} > \frac{\rho_{sh}}{2} \\ \rho_{sh} \cdot W_f \cdot \frac{d}{2} & \text{otherwise} \end{cases} = 13.897 \cdot in^2$$

$$As_{prov} := A_{bbot} \cdot NB_{bot} = 26.7 \cdot in^2$$

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

Pad_Reinforcement_Bot = "Okay"

Check top Bars:

$$As := \rho_{sh} \cdot \left(W_f \cdot \frac{d}{2} \right) = 12.3 \cdot in^2$$

$$As_{prov} := A_{btop} \cdot NB_{top} = 26.7 \cdot in^2$$

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

Pad_Reinforcement_Top = "Okay"

Developement Length Pad Reinforcement:

Bar Spacing =

$$B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 9.7 \cdot in$$

Spacing or Cover Dimension =

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

Transverse Reinforcement Index =

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

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

Minimum Development Length =

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

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

Available Length in Pad =

$$L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad} = 132 \cdot in$$

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

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

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

$A_{smin} := 0.0033 \cdot A_p = 20.99 \cdot in^2$

$A_{sprov} := NB_{pier} \cdot A_{bpier} = 28.27 \cdot in^2$

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

Steel_Area_Check = "Okay"

Bar Spacing In Pier = $B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 6.854 \cdot in$

Diameter of Reinforcement Cage = $Diam_{cage} := d_p - 2 \cdot Cvr_{pier} = 79 \cdot in$

Maximum Moment in Pier = $M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2}\right)\right] \cdot LF = 40861.8 \cdot in \cdot kips$

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

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

$$\left(D \;\; N \;\; n \;\; P_u \;\; M_{xu}\right) = \left(90 \;\; 36 \;\; 8 \;\; 49.321 \;\; 4.086 \times 10^4\right)$$

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

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

$$\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho\right) = \left(73.959 \;\; 6.127 \times 10^4 \;\; -60 \;\; 4.47 \times 10^{-3}\right)$$

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

Axial_Load_Check = "Okay"

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

Bending_Check = "Okay"

Development Length Pier Reinforcement:

Available Length in Foundation:

$L_{pier} := L_p - Cvr_{pier} = 42.5 \cdot in$

$L_{pad} := T_f - Cvr_{pad} = 39 \cdot in$

Tension: (ACI-2008 12.2.3)

Spacing or Cover Dimension = $c := if\left(Cvr_{pier} < \frac{B_{sPier}}{2}, Cvr_{pier}, \frac{B_{sPier}}{2}\right) = 3.427 \cdot in$

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

$$L_{dbt} := \frac{3 \cdot f_y \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 20.76 \cdot in$$

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

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

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

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

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

Compression: (ACI-2008 12.3.2)

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

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

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

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

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

Tie Size and Spacing in Column:

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

Used #4 Ties

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

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

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

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

$s_{lim4} := 18in$

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

Number of Ties Required = $n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 = 3.469$

Check Anchor Steel Embedment:

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

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

$Depth\_Check := if(D_{ab} \geq L_{anchor}, \text{"Okay"}, \text{"No Good"})$

Depth_Check = "No Good"

Note: Anchor plate is provided

SITE NAME	KENT CT	ECP - CELL #	2 | 424
LATITUDE	41-43-18.85 N	LONGITUDE	73-28-29.87 W
700 azimuth change plus RET antenna swap outs and RRH upgrade. 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 is on the SBNHH antennas.		SAVE BUTTON	
		STRUCTURE TYPE	MONOPOLE

700 Mhz - Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	eNodeB	eNodeB	eNodeB
ANTENNA TYPE	BXA-70063-6CF_2	BXA-70063-6CF_2	BXA-70063-6CF_2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	0	120	240
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	147	147	147
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
700 Mhz - Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	eNodeB	eNodeB	eNodeB
ANTENNA TYPE	BXA-70063-6CF_2	BXA-70063-6CF_2	BXA-70063-6CF_2
QTY OF ANTENNAS PER FACE	0	0	0
ORIENTATION (DEG)	350	120	240
DOWN TILT (MECH/DEG)	2 elect	2 elect	2 elect
RAD CTR (FT AGL)	147	147	147
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL	1 x ALU RH_2X60-700U	1 x ALU RH_2X60-700U	1 x 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 Modcell 4.0B	Cellular Modcell 4.0B	Cellular Modcell 4.0B
ANTENNA TYPE	LPA-80080/6CF	LPA-80080/6CF	LPA-80080/6CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	0	120	240
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	147	147	147
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
850 Celluar - Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	Cellular Modcell 4.0B	Cellular Modcell 4.0B	Cellular Modcell 4.0B
ANTENNA TYPE	LPA-80080/6CF	LPA-80080/6CF	LPA-80080/6CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	0	120	240
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	147	147	147
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
DIPLEX WITH LTE CABLE			
1900 PCS - Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	#N/A	#N/A	#N/A
ANTENNA TYPE	BXA-171085-12BF_2	BXA-171085-12BF_2	BXA-171085-12BF_2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	0	120	240
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	147	147	147
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
1900 PCS - Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	#N/A	#N/A	#N/A
ANTENNA TYPE	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	350	120	240
DOWN TILT (MECH/DEG)	2 elect	2 elect	2 elect
RAD CTR (FT AGL)	147	147	147
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE			
RRH - QTY/MODEL	1 x ALU RH_2X60-PCS	1 x ALU RH_2X60-PCS	1 x ALU RH_2X60-PCS
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX			

2100 AWS - Current Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	#N/A	#N/A	#N/A
ANTENNA TYPE	#N/A	#N/A	#N/A
QTY OF ANTENNAS PER FACE	#N/A	#N/A	#N/A
ORIENTATION (DEG)	#N/A	#N/A	#N/A
DOWN TILT (MECH/DEG)	#N/A	#N/A	#N/A
RAD CTR (FT AGL)	#N/A	#N/A	#N/A
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			

2100 AWS - Future Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	#N/A	#N/A	#N/A
ANTENNA TYPE	SBNHH-1D65B	SBNHH-1D65B	SBNHH-1D65B
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	350	120	240
DOWN TILT (MECH/DEG)	2 elect	2 elect	2 elect
RAD CTR (FT AGL)	147	147	147
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE			
RRH - QTY/MODEL	1 x ALU RH_2X60-AWS	1 x ALU RH_2X60-AWS	1 x ALU RH_2X60-AWS
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX			

NUMBER OF CABLE'S NEEDED						ESTIMATED CABLE LENGTH			
TOTAL # FIBER LINES	2					FIBER LINE MODEL #	HB158-1-08U8-S8J18		
TOTAL # TOP JUMPERS	3					FIBER TOP JUMPER MODEL #	HB114-1-08U4-S4J18		
MAINLINE SIZE	1 5/8"	TOTAL # OF MAINLINES	18			MAINLINE (FT)			
JUMPER SIZE	1/2 "	TOTAL # OF TOP JUMPERS	36			TOP JUMPER (FT)			12
Equipment Cable Ordering		MAIN CABLE	18	+	0	TOP JUMPER #	24	+	12

TX / RX FREQUENCIES			TX POWER OUTPUT	
Cellular A-Band	PCS F / AWS-Band	700 Mhz C -	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 (Watts)	40

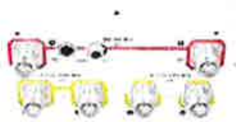
ALPHA				BETA				GAMMA			
Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code
A1	800	Tx1/Rx0	RED	A7	800	Tx2/Rx0	BLUE	A13	800	Tx3/Rx0	GREEN
A2	1900	Tx1/Rx0	RED/ WHITE	A8	1900	Tx2/Rx0	BLUE/ WHITE	A14	1900	Tx3/Rx0	GREEN/WHITE
A3	700	Tx1/Rx0	RED/ ORANGE	A9	700	Tx2/Rx0	BLUE/ ORANGE	A15	700	Tx3/Rx0	GREEN/ORANGE
A4	700	Tx4/Rx1	RED/RED/ ORANGE	A10	700	Tx5/Rx1	BLUE/BLUE/ ORANGE	A16	700	Tx6/Rx1	GREEN/GREEN/ ORANGE
A5	1900	Tx4/Rx1	RED/RED/ WHITE	A11	1900	Tx5/Rx1	BLUE/BLUE/ WHITE	A17	1900	Tx6/Rx1	GREEN/GREEN/ WHITE
A6	800	Tx4/Rx1	RED/RED	A12	800	Tx5/Rx1	BLUE/BLUE	A18	800	Tx6/Rx1	GREEN/GREEN

RF ENGINEER	RF MANAGER	INITIALS	DATE
Prepared By: Mark Brauer	Rob Hesselbach	MB	3/27/2015

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
	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	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.

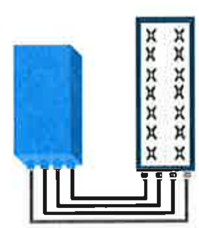
Its compactness and slim design makes the Alcatel-Lucent B13 RRH4x30-4R easy to install close to the antenna: operators can therefore locate this Remote Radio Head where RF design conditions are deemed ideal, minimizing trade-offs between available sites and RF optimum sites, together with reducing the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

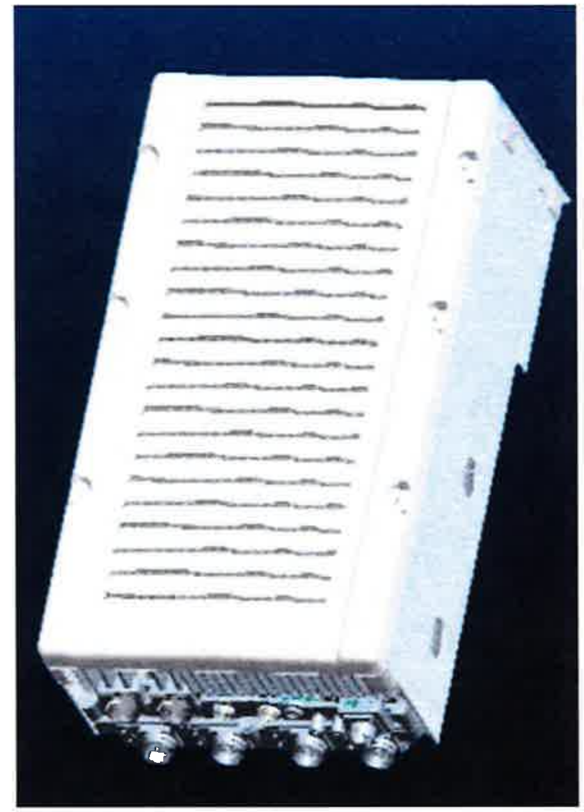
Features & performance	
Number of TX/RX paths	4 duplexed (either 4T4R or 2T4R by SW)
Frequency band	U700 (C) (3GPP bands 13): DL: 746 - 756 MHz / UL: 777 - 787 MHz
Instantaneous bandwidth - #carriers	10MHz – 1 LTE carrier (in 10MHz occupied bandwidth)
LTE carrier bandwidth	10 MHz
RF output power	2x60W 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

Alcatel·Lucent

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.

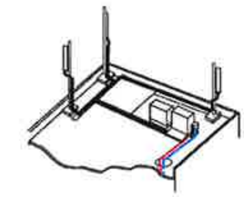
EASY INSTALLATION

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.

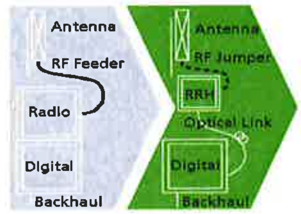
The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment. However, many of these sites can host an Alcatel-Lucent RRH2x60-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation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

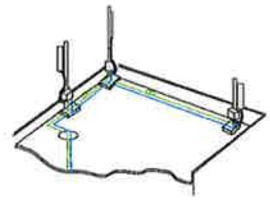
Installation can easily be done by a single person as the Alcatel–Lucent RRH2x60-AWS is compact and weighs about 20 kg, eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day.



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

Product Data Sheet DB-B1 and DB-T1 Series

DC and Fiber Management Distribution Boxes for HYBRIFLEX™ Cable

Product Description

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

Features/Benefits

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

Technical Specifications

Mechanical Specifications

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

Electrical Specifications

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

* This data is provisional and subject to change.