Robinson+Cole

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Also admitted in Massachusetts

October 21, 2015

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

Re: **Notice of Exempt Modification – Facility Modification**
720 Quinebaug Road, Thompson, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) wireless telecommunications antennas at the 120-foot level on an existing 130-foot tower at 720 Quinebaug Road in Thompson, Connecticut (the "Property"). The tower and underlying property are owned by the Quinebaug Volunteer Fire Department. Cellco's use of the tower was approved by the Council in 2007. Cellco now intends to modify its facility by replacing six (6) of its existing antennas with three (3) model SBNHH-1D65B, 700/2100 MHz antennas; and three (3) model SBNHH-1D65B, 1900 MHz antennas, all at the same 120-foot level on the tower. Cellco also intends to replace three (3) remote radio heads ("RRHs") and install six (6) new RRHs and install one (1) HYBRIFLEX™ antenna cable inside the monopole. Included in Attachment 1 are specifications for Cellco's replacement antennas, RRHs and HYBRIFLEX™ cable.

Please accept this letter as notification pursuant to R.C.S.A. § 16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is being sent to Paul A. Lenky, First Selectman in the Town of Thompson. A copy of this letter is also being sent to Quinebaug Volunteer Fire Department, the owner of the Property and the tower.

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

14191745-v1

1. The proposed modifications will not result in an increase in the height of the existing tower. The replacement antennas and RRHs will be located at the 120-foot level on the 130-foot tower.

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

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

4. The operation of the modified facility will not increase radio frequency (RF) emissions at the facility to a level at or above the Federal Communications Commission (FCC) safety standard. A cumulative General Power Density table for Cellco's modified facility is included in Attachment 2.

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

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

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

Sincerely,

Kenneth C. Baldwin

Enclosures
Copy to:
Paul A. Lenky, Thompson First Selectman
Quinebaug Volunteer Fire Department
Tim Parks

ATTACHMENT 1

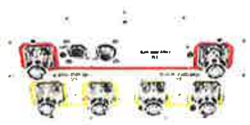
Product Specifications

COMMSCOPE®

POWERED BY ANDREW

SBNHH-1D65B

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



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

Electrical Specifications

Frequency Band, MHz	**698–806**	**806–896**	**1695–1880**	**1850–1990**	**1920–2200**	**2300–2360**
Gain, dBi	14.9	14.7	17.7	18.2	18.6	18.6
Beamwidth, Horizontal, degrees	68	66	69	66	63	58
Beamwidth, Vertical, degrees	12.1	10.7	5.6	5.2	5.0	4.5
Beam Tilt, degrees	0–14	0–14	0–7	0–7	0–7	0–7
USLS, dB	14	13	15	15	15	13
Front-to-Back Ratio at 180°, dB	27	29	28	28	28	27
CPR at Boresight, dB	20	23	20	20	17	21
CPR at Sector, dB	14	10	12	10	9	1
Isolation, dB	25	25	25	25	25	25
Isolation, Intersystem, dB	30	30	30	30	30	30
VSWR | Return Loss, dB	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153	-153	-153	-153	-153
Input Power per Port, maximum, watts	350	350	350	350	350	300
Polarization	±45°	±45°	±45°	±45°	±45°	±45°
Impedance	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm

Electrical Specifications, BASTA*

Frequency Band, MHz	**698–806**	**806–896**	**1695–1880**	**1850–1990**	**1920–2200**	**2300–2360**
Gain by all Beam Tilts, average, dBi	14.5	14.3	17.4	17.9	18.2	18.3
Gain by all Beam Tilts Tolerance, dB	±0.5	±0.8	±0.4	±0.3	±0.5	±0.3
	0 ° | 14.6	0 ° | 14.5	0 ° | 17.4	0 ° | 17.8	0 ° | 18.1	0 ° | 18.2
Gain by Beam Tilt, average, dBi	7 ° | 14.6	7 ° | 14.4	3 ° | 17.5	3 ° | 17.9	3 ° | 18.3	3 ° | 18.4
	14 ° | 14.2	14 ° | 13.6	7 ° | 17.4	7 ° | 17.9	7 ° | 18.2	7 ° | 18.4
Beamwidth, Horizontal Tolerance, degrees	±2.2	±3.4	±2	±4.6	±5.7	±4.3
Beamwidth, Vertical Tolerance, degrees	±0.8	±1	±0.3	±0.2	±0.3	±0.2
USLS, dB	16	14	16	16	16	15
Front-to-Back Total Power at 180° ± 30°, dB	25	26	27	26	26	26
CPR at Boresight, dB	22	23	21	20	20	22
CPR at Sector, dB	13	11	16	12	11	4

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

General Specifications

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

Product Specifications

SBNHH-1D65B

Mechanical Specifications

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

Dimensions

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

Remote Electrical Tilt (RET) Information

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

Packed Dimensions

Depth	299.0 mm | 11.8 in
Length	1970.0 mm | 77.6 in
Width	409.0 mm | 16.1 in
Shipping Weight	31.0 kg | 68.3 lb

Regulatory Compliance/Certifications

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

Included Products

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

* Footnotes

Performance Note	Severe environmental conditions may degrade optimum performance

ALCATEL-LUCENT B13 RRH4X30-4R

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

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

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

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

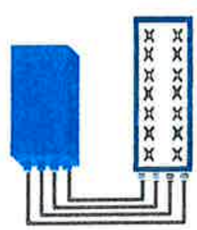
Its compactness and slim design makes the Alcatel-Lucent B13 RRH4x30-4R easy to install close to the antenna: operators can therefore locate this Remote Radio Head where RF design conditions are deemed ideal, minimizing trade-offs between available sites and RF optimum sites, together with reducing the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

FEATURES

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

BENEFITS

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



4x30W with 4T4R
or
2x60W with 2T4R

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

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

PCS RF MODULES
RRH1900 2X60 - HW CHARACTERISTICS

LA6.0.1/13.3

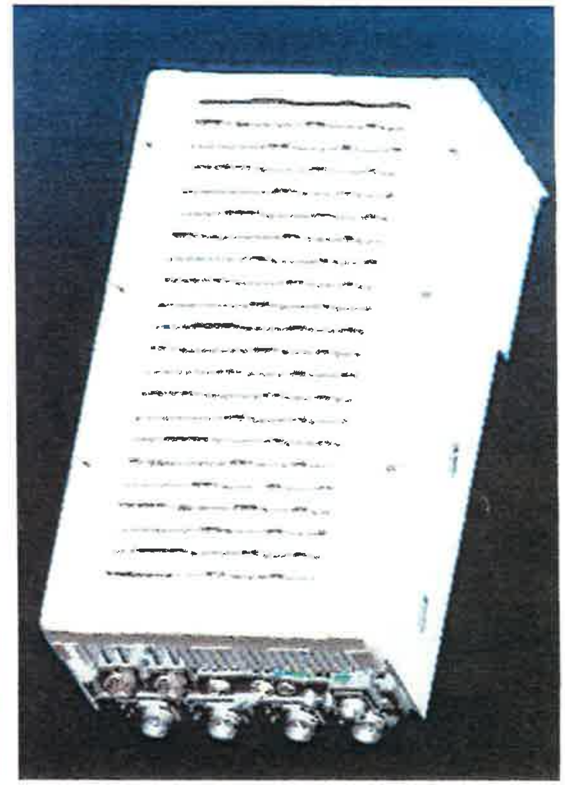
	RRH2x60
RF Output Power	2x60W
Instantaneous Bandwidth	20MHz
Transmitter	2 TX
Receiver 1900 HW version 1900A HW version	2 Branch RX – LA6.0.1 4 Branch RX – LR13.3
Features	AISG 2.0 for RET/TMA
	Internal Smart Bias-T
Power	-48VDC
CPRI Ports	2 CPRI Rate 3 Ports
External Alarms	4 External User Alarms
Monitor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

** Not a Verizon Wireless deployed product

NEW PCS RF MODULES FOR VZW
RRH2X60 - HW CHARACTERISTICS

LR14.3

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



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

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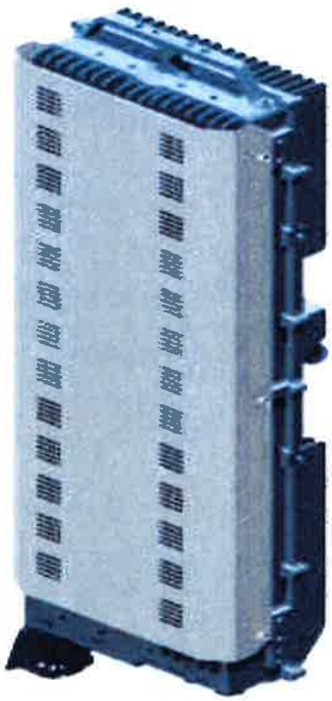
ALCATEL-LUCENT WIRELESS PRODUCT DATASHEET

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.

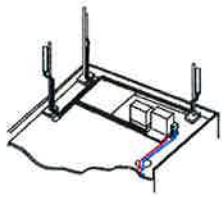
EASY INSTALLATION

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.



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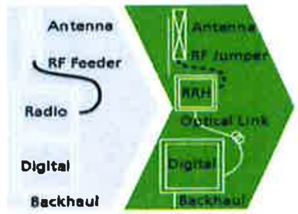
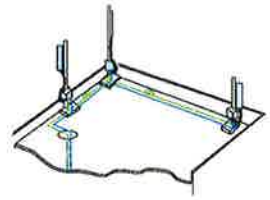


RRH for space-constrained cell sites



Distributed

FEATURES

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

BENEFITS

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

TECHNICAL SPECIFICATIONS

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

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

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

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

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

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

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

Alcatel·Lucent

AT THE SPEED OF IDEAS™

ALCATEL-LUCENT WIRELESS PRODUCT DATASHEET

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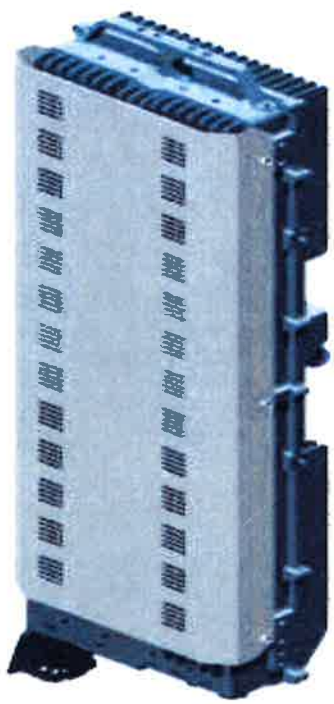

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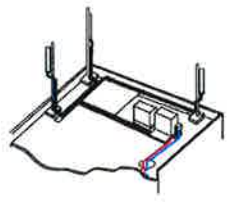

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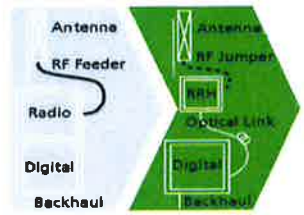

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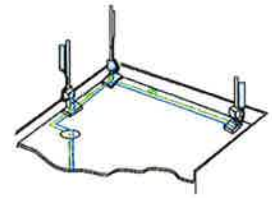

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- Six external alarms
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- Operating temperature: -40°C to 55°C including solar load
- Operating relative humidity: 8% to 100%
- Environmental Conditions : ETS 300 019-1-4 class 4.1E
- Ingress Protection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

Safety and Regulatory Data

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

Alcatel·Lucent

AT THE SPEED OF IDEAS™

Product Data Sheet HB158-1-08U8-S8J18

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

Product Description

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

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

Figure 1: HYBRIFLEX Series

Features/Benefits

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

Technical Specifications

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

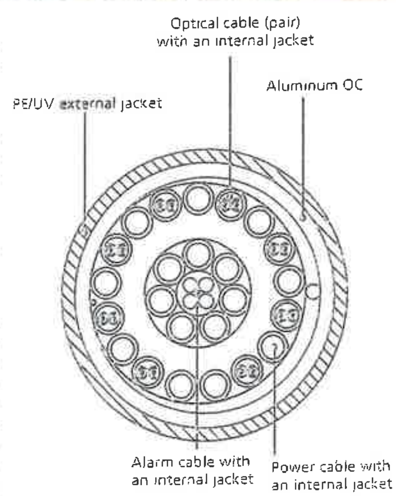

Figure 2: Construction Detail

* This data is provisional and subject to change

ATTACHMENT 2

	General	Power	Density					
Site Name: Quinebaug (Thompson)								
Tower Height: 130'								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*Quinebaug FD	1	100	133	0.0022	155	0.2000	0.11%	
*Quinebaug FD	1	100	90	0.0051	465	0.3100	0.16%	
*Quinebaug FD	1	100	70	0.0088	33.9	0.2000	0.44%	
*AT&T UMTS	2	565	130	0.0264	880	0.5867	0.45%	
*AT&T UMTS	2	875	130	0.0409	1900	1.0000	0.41%	
*AT&T GSM	1	283	130	0.0066	880	0.5867	0.11%	
*AT&T GSM	4	525	130	0.0491	1900	1.0000	0.49%	
*AT&T LTE	1	1771	130	0.0414	734	0.4893	0.85%	
Verizon	**11**	**0**	**120**	**0.0000**	**1970**	**1.0000**	**0.00%**	
Verizon	**9**	**381**	**120**	**0.0856**	**869**	**0.5793**	**14.78%**	
Verizon	**1**	**2302**	**120**	**0.0575**	**2145**	**1.0000**	**5.75%**	
Verizon	**1**	**847**	**120**	**0.0211**	**746**	**0.4973**	**4.25%**	
								27.8%
* Source: Siting Council								

ATTACHMENT 3

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

130-ft Existing Valmont Monopole

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Quinebaug

720 Quinebaug Road
Quinebaug, CT

Centek Project No. 15001.099

Date: August 25, 2015

Prepared for:

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

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

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Introduction

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

The host tower is a 130-ft tall, three-section, twelve sided, tapered monopole, originally designed and manufactured by Valmont; job no; 18435-65, dated August 4, 2005. The tower geometry, structure member sizes and foundation system information were obtained from the aforementioned Valmont design documents.

Antenna and appurtenance information were obtained from a previous structural analysis report prepared by Centek project no. 14001.046 dated April 24, 2014 and a Verizon RF data sheet.

The tower is made up of three (3) tapered vertical sections consisting of A572-65 pole sections. The vertical tower sections are slip joint connected. The diameter of the pole (flat-flat) is 19.94-in at the top and 47.60-in at the base.

Verizon proposes the removal of six (6) panel antennas and three (3) remote radio heads and the installation of six (6) panel antennas, nine (9) Remote Radio Heads and one (1) main distribution box mounted to the existing low profile platform. Refer to the Antenna and Appurtenance Summary below for a detailed description of the proposed antenna and appurtenance configuration.

Antenna and Appurtenance Summary

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

- TOWN (EXISTING):
  Antennas: One (1) 4-bay dipole antenna, one (1) 20-ft Omni-directional whip antenna and one (1) 8.5-ft Omni-directional whip antenna mounted on the existing AT&T low profile platform with an elevation of 130-ft above grade.
  Coax Cables: Three (3) 7/8" ∅ coax cables running on the inside of the existing tower.
- AT&T (EXISTING):
  Antennas: Six (6) Powerwave 7770.00 panel antennas, one (1) Kathrein 800-10764 panel antenna, one (1) Kathrein 800-10766 panel antenna, one (1) KMW AM-X-CD-17-65-00T panel antenna, six (6) Powerwave LGP21401 TMA's, six (6) Powerwave LGP21901 diplexers, six (6) Ericsson RRUS-11 and one (1) Raycap DC6-48-60-18-8F surge arrestor mounted on an existing low profile platform with a RAD center elevation of 130-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables, one (1) 5/8" ∅ fiber cable and two (2) #8 DC control cables running on the inside of the existing tower.
- VERIZON (EXISTING TO REMAIN):
  Antennas: Six (6) Antel LPA-80080-6CF panel antennas and one (1) RFS DB-T1-6Z-8AB-0Z main distribution box mounted on an existing low profile platform with a RAD center elevation of 120-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables and one (1) 1-5/8" ∅ Hybriflex fiber line running on the inside of the existing tower.

- VERIZON (EXISTING TO REMOVE):
  Antennas: Three (3) Antel BXA-70063-6CF panel antennas, three (3) Antel BXA-171085-12CF panel antennas three (3) Alcatel-Lucent RRH2x40-AWS Remote Radio Heads and mounted on an existing low profile platform with a RAD center elevation of 120-ft above grade.
- **VERIZON (PROPOSED):**
  Misc. Equipment: 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 one (1) RFS DB-T1-6Z-8AB-0Z main distribution box mounted on an existing low profile platform with a RAD center elevation of 120-ft above grade.
  Coax Cables: One (1) 1-5/8" ∅ Hybriflex fiber line running on the interior of the monopole.

Primary Assumptions Used in the Analysis

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

Analysis

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

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

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

Tower Loading

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

Basic Wind Speed:	Windham; v = 85 mph (fastest mile)	*[Section 16 of TIA/EIA-222-F-96]*
	Quinebaug (Thompson); v = 100 mph (3 second gust) equivalent to v = 80 mph (fastest mile)	*[Appendix K of the 2005 CT Building Code Supplement]*
	TIA/EIA-222-F wind speed controls.	
Load Cases:	Load Case 1; 85 mph wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 2; 74 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 74 mph wind speed velocity represents 75% of the wind pressure generated by the 85 mph wind speed.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 3; Seismic – not checked	*[Section 1614.5 of State Bldg. Code 2005] does not control in the design of this structure type*

[1] The 2005 Connecticut State Building Code as amended by the 2005 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 **98.5%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L3)	0.00'-39.42'	98.5%	**PASS**

Foundation and Anchors

The existing foundation consists of a 7.0-ft square x 5-ft long reinforced concrete pier on a 20.0-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 Valmont design documents; job no; 18435-65, dated August 4, 2005. The base of the tower is connected to the foundation by means of (12) 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	22 kips
	Moment	2034 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	2.53	**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	76.8%	**PASS**
Base Plate	Bending	36.5%	**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:

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

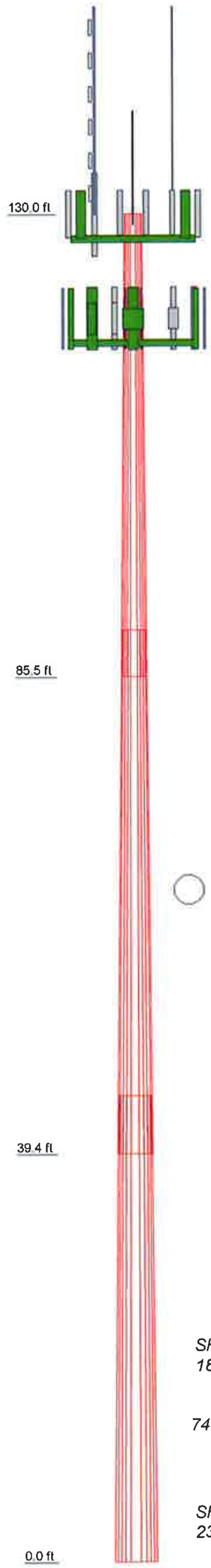
GENERAL DESCRIPTION OF STRUCTURAL ANALYSIS PROGRAM

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

tnxTower Features:

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

Section	Length (ft)	Number of Sides	Thickness (in)	Socket Length (ft)	Top Dia (in)	Bot Dia (in)	Grade	Weight (K)
1	44.500	12	0.188	4.500	19.940	29.730		2.3
2	50.583	12	0.281	5.583	28.365	39.390	A572-65	5.2
3	45.000	12	0.313		37.611	47.600		6.5
								14.0



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
4-bay dipole	130	SBNHH-1D65B (Verizon - Proposed)	120
20-ft x 3" whip	130	SBNHH-1D65B (Verizon - Proposed)	120
8.5-ft x 1.5" whip	130	LPA-80080-6CF (Verizon - Existing)	120
Lightning Rod 3/4"x8'	130	LPA-80080-6CF (Verizon - Existing)	120
(2) 7770.00 (ATT - Existing)	130	SBNHH-1D65B (Verizon - Proposed)	120
(2) 7770.00 (ATT - Existing)	130	SBNHH-1D65B (Verizon - Proposed)	120
(2) 7770.00 (ATT - Existing)	130	LPA-80080-6CF (Verizon - Existing)	120
(2) LGP21401 TMA (ATT - Existing)	130	LPA-80080-6CF (Verizon - Existing)	120
(2) LGP21401 TMA (ATT - Existing)	130	SBNHH-1D65B (Verizon - Proposed)	120
(2) LGP21401 TMA (ATT - Existing)	130	SBNHH-1D65B (Verizon - Proposed)	120
(2) LGP21901 Diplexer (ATT - Existing)	130	LPA-80080-6CF (Verizon - Existing)	120
(2) LGP21901 Diplexer (ATT - Existing)	130	RRH2x60-AWS (Verizon - Proposed)	120
(2) LGP21901 Diplexer (ATT - Existing)	130	RRH2x60-AWS (Verizon - Proposed)	120
AM-X-CD-17-65-00T-RET (ATT - Existing)	130	RRH2x60-AWS (Verizon - Proposed)	120
		RRH2x60-PCS (Verizon - Proposed)	120
800-10764 (ATT - Existing)	130	RRH2x60-PCS (Verizon - Proposed)	120
800-10766 (ATT - Existing)	130	RRH2x60-PCS (Verizon - Proposed)	120
(2) RRUS-11 (ATT - Existing)	130	RRH2x60-07-U (Verizon - Proposed)	120
(2) RRUS-11 (ATT - Existing)	130	RRH2x60-07-U (Verizon - Proposed)	120
(2) RRUS-11 (ATT - Existing)	130	RRH2x60-07-U (Verizon - Proposed)	120
DC6-48-60-18-8F Surge Arrestor (ATT - Existing)	130	DB-T1-6Z-8AB-0Z (Verizon - Proposed)	120
Andrew 12'-6" Low Profile Platform (ATT - Existing)	128	DB-T1-6Z-8AB-0Z (Verizon - Existing)	120
LPA-80080-6CF (Verizon - Existing)	120	Valmont 13' Low Profile Platform (Verizon - Existing)	118

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower designed for a 85 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 74 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. Weld together tower sections have flange connections.
5. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
6. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
7. Welds are fabricated with ER-70S-6 electrodes.
8. TOWER RATING: 98.5%

AXIAL 27 K
SHEAR 18 K
MOMENT 1690 kip-ft
TORQUE 4 kip-ft
74 mph WIND - 0.500 in ICE

AXIAL 22 K
SHEAR 23 K
MOMENT 2034 kip-ft
TORQUE 4 kip-ft
REACTIONS - 85 mph WIND

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

Job: **15001.099 - Quinebaug**			
Project: **130ft Valmont Monopole - 720 Quinebaug Rd, Quinebaug,**			
Client: Verizon Wireless	Drawn by: TJL	App'd:	
Code: TIA/EIA-222-F	Date: 08/25/15	Scale: NTS	
Path:		Dwg No. E-1	

Tower Input Data

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

- Basic wind speed of 85 mph.
- Nominal ice thickness of 0.500 in.
- Ice density of 56 pcf.
- A wind speed of 74 mph is used in combination with ice.
- Temperature drop of 50 °F.
- Deflections calculated using a wind speed of 50 mph.
- Weld together tower sections have flange connections..
- Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications..
- Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards..
- Welds are fabricated with ER-70S-6 electrodes..
- A non-linear (P-delta) analysis was used.
- Pressures are calculated at each section.
- Stress ratio used in pole design is 1.333.
- Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Options

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

Poles

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

Tapered Pole Section Geometry

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L1	130.000-85.500	44.500	4.500	12	19.940	29.730	0.188	0.750	A572-65 (65 ksi)
L2	85.500-39.417	50.583	5.583	12	28.365	39.390	0.281	1.125	A572-65 (65 ksi)
L3	39.417-0.000	45.000		12	37.611	47.600	0.313	1.250	A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in²	I in⁴	r in	C in	I/C in³	J in⁴	It/Q in²	w in	w/t
L1	20.643	11.926	593.895	7.071	10.329	57.498	1203.391	5.869	4.841	25.821
	30.779	17.836	1986.940	10.576	15.400	129.021	4026.080	8.778	7.465	39.814
L2	30.381	25.433	2560.352	10.054	14.693	174.256	5187.967	12.518	6.848	24.349
	40.780	35.418	6914.426	14.001	20.404	338.876	14010.502	17.432	9.803	34.854
L3	40.220	37.531	6664.280	13.353	19.482	342.068	13503.639	18.472	9.242	29.575
	49.279	47.583	13580.974	16.929	24.657	550.800	27518.735	23.419	11.919	38.142

Tower Elevation ft	Gusset Area (per face) ft²	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in
L1 130.000-85.500				1	1	1		
L2 85.500-39.417				1	1	1		
L3 39.417-0.000				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft²/ft	Weight klf
7/8	B	No	Inside Pole	130.000 - 3.000	3	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (AT&T - Existing)	B	No	Inside Pole	130.000 - 3.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (Verizon - Existing)	B	No	Inside Pole	120.000 - 3.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
HYBRIFLEX 1-5/8" (Verizon - Existing)	B	No	Inside Pole	120.000 - 3.000	1	No Ice	0.000	0.002
						1/2" Ice	0.000	0.002
DC Trunk (AT&T - Existing)	B	No	Inside Pole	130.000 - 3.000	2	No Ice	0.000	0.000
						1/2" Ice	0.000	0.000
Fiber Trunk (AT&T - Existing)	B	No	Inside Pole	130.000 - 3.000	1	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
HYBRIFLEX 1-5/8" (Verizon - Proposed)	B	No	Inside Pole	120.000 - 3.000	1	No Ice	0.000	0.002
						1/2" Ice	0.000	0.002

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	130.000-85.500	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	1.243

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
		C	0.000	0.000	0.000	0.000	0.000
L2	85.500-39.417	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	1.456
		C	0.000	0.000	0.000	0.000	0.000
L3	39.417-0.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	1.151
		C	0.000	0.000	0.000	0.000	0.000

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	130.000-85.500	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	1.243
		C		0.000	0.000	0.000	0.000	0.000
L2	85.500-39.417	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	1.456
		C		0.000	0.000	0.000	0.000	0.000
L3	39.417-0.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	1.151
		C		0.000	0.000	0.000	0.000	0.000

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
4-bay dipole	A	From Face	3.500 0.000 10.000	0.000	130.000	No Ice 1/2" Ice	3.150 5.670	3.150 5.670	0.032 0.042
20-ft x 3" whip	B	From Face	3.500 0.000 10.000	0.000	130.000	No Ice 1/2" Ice	0.790 0.910	0.790 0.910	0.010 0.015
8.5-ft x 1.5" whip	C	From Face	3.500 0.000 5.000	0.000	130.000	No Ice 1/2" Ice	1.125 2.004	1.125 2.004	0.004 0.014
Lightning Rod 3/4"x8'	C	From Face	3.500 0.000 4.000	0.000	130.000	No Ice 1/2" Ice	0.600 1.415	0.600 1.415	0.014 0.020
(2) 7770.00 (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) 7770.00 (AT&T - Existing)	B	From Face	3.500 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) 7770.00 (AT&T - Existing)	C	From Face	3.500 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) LGP21401 TMA	A	From Face	3.500	0.000	130.000	No Ice	0.953	0.367	0.018

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*
(AT&T - Existing)			0.000 0.000			1/2" Ice	1.093	0.480	0.023
(2) LGP21401 TMA (AT&T - Existing)	B	From Face	3.500 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
(2) LGP21401 TMA (AT&T - Existing)	C	From Face	3.500 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
(2) LGP21901 Diplexer (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	0.233 0.302	0.117 0.166	0.006 0.008
(2) LGP21901 Diplexer (AT&T - Existing)	B	From Face	3.500 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	0.233 0.302	0.117 0.166	0.006 0.008
(2) LGP21901 Diplexer (AT&T - Existing)	C	From Face	3.500 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	0.233 0.302	0.117 0.166	0.006 0.008
AM-X-CD-17-65-00T-RET (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	11.311 11.927	6.800 7.384	0.060 0.121
800-10764 (AT&T - Existing)	B	From Face	3.500 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	6.333 6.771	3.389 3.740	0.041 0.078
800-10766 (AT&T - Existing)	C	From Face	3.500 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	11.311 11.927	6.800 7.384	0.059 0.120
(2) RRUS-11 (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	0.000 0.000	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Existing)	B	From Face	3.500 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	0.000 0.000	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Existing)	C	From Face	3.500 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	0.000 0.000	1.246 1.412	0.050 0.070
DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	2.228 2.447	2.228 2.447	0.020 0.039
Andrew 12'-6" Low Profile Platform (AT&T - Existing)	C	From Face	2.000 0.000 0.000	0.000	128.000	No Ice 1/2" Ice	14.450 19.000	14.450 19.000	1.300 1.690
LPA-80080-6CF (Verizon - Existing)	A	From Face	3.500 6.000 0.000	0.000	120.000	No Ice 1/2" Ice	4.326 4.764	9.088 9.637	0.021 0.069
SBNHH-1D65B (Verizon - Proposed)	A	From Face	3.500 4.000 0.000	0.000	120.000	No Ice 1/2" Ice	8.330 8.878	5.342 5.795	0.042 0.092
SBNHH-1D65B (Verizon - Proposed)	A	From Face	3.500 0.000 0.000	0.000	120.000	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	3.500 -6.000 0.000	0.000	120.000	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	3.500 6.000 0.000	0.000	120.000	No Ice 1/2" Ice	4.326 4.764	9.088 9.637	0.021 0.069
SBNHH-1D65B	B	From Face	3.500	0.000	120.000	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 ft²	C_AA_A Side ft²	Weight K
(Verizon - Proposed)			4.000 0.000			1/2" Ice	8.878	5.795	0.092
SBNHH-1D65B (Verizon - Proposed)	B	From Face	3.500 0.000 0.000	0.000	120.000	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	3.500 -6.000 0.000	0.000	120.000	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	3.500 6.000 0.000	0.000	120.000	No Ice 1/2" Ice	4.326 4.764	9.088 9.637	0.021 0.069
SBNHH-1D65B (Verizon - Proposed)	C	From Face	3.500 4.000 0.000	0.000	120.000	No Ice 1/2" Ice	8.330 8.878	5.342 5.795	0.042 0.092
SBNHH-1D65B (Verizon - Proposed)	C	From Face	3.500 0.000 0.000	0.000	120.000	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	3.500 -6.000 0.000	0.000	120.000	No Ice 1/2" Ice	4.326 4.764	9.088 9.637	0.021 0.069
RRH2x60-AWS (Verizon - Proposed)	A	From Face	3.500 4.000 0.000	0.000	120.000	No Ice 1/2" Ice	3.782 4.093	2.069 2.349	0.055 0.078
RRH2x60-AWS (Verizon - Proposed)	B	From Face	3.500 4.000 0.000	0.000	120.000	No Ice 1/2" Ice	3.782 4.093	2.069 2.349	0.055 0.078
RRH2x60-AWS (Verizon - Proposed)	C	From Face	3.500 4.000 0.000	0.000	120.000	No Ice 1/2" Ice	3.782 4.093	2.069 2.349	0.055 0.078
RRH2x60-PCS (Verizon - Proposed)	A	From Face	3.500 -4.000 0.000	0.000	120.000	No Ice 1/2" Ice	0.000 0.000	1.547 1.738	0.055 0.073
RRH2x60-PCS (Verizon - Proposed)	B	From Face	3.500 -4.000 0.000	0.000	120.000	No Ice 1/2" Ice	0.000 0.000	1.547 1.738	0.055 0.073
RRH2x60-PCS (Verizon - Proposed)	C	From Face	3.500 -4.000 0.000	0.000	120.000	No Ice 1/2" Ice	0.000 0.000	1.547 1.738	0.055 0.073
RRH2x60-07-U (Verizon - Proposed)	A	From Face	3.500 0.000 0.000	0.000	120.000	No Ice 1/2" Ice	0.000 0.000	1.633 1.826	0.050 0.068
RRH2x60-07-U (Verizon - Proposed)	B	From Face	3.500 0.000 0.000	0.000	120.000	No Ice 1/2" Ice	0.000 0.000	1.633 1.826	0.050 0.068
RRH2x60-07-U (Verizon - Proposed)	C	From Face	3.500 0.000 0.000	0.000	120.000	No Ice 1/2" Ice	0.000 0.000	1.633 1.826	0.050 0.068
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	C	From Face	3.500 0.000 0.000	0.000	120.000	No Ice 1/2" Ice	5.600 5.915	2.333 2.558	0.044 0.080
DB-T1-6Z-8AB-0Z (Verizon - Existing)	B	From Face	3.500 0.000 0.000	0.000	120.000	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	From Face	2.000 0.000 0.000	0.000	118.000	No Ice 1/2" Ice	15.700 20.100	15.700 20.100	1.300 1.765

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 130.000-85.500	106.614	1.398	0.026	92.096	A	0.000	92.096	92.096	100.00	0.000	0.000
					B	0.000	92.096		100.00	0.000	0.000
					C	0.000	92.096		100.00	0.000	0.000
L2 85.500-39.417	61.950	1.197	0.022	131.981	A	0.000	131.981	131.981	100.00	0.000	0.000
					B	0.000	131.981		100.00	0.000	0.000
					C	0.000	131.981		100.00	0.000	0.000
L3 39.417-0.000	19.044	1	0.018	141.983	A	0.000	141.983	141.983	100.00	0.000	0.000
					B	0.000	141.983		100.00	0.000	0.000
					C	0.000	141.983		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 130.000-85.500	106.614	1.398	0.019	0.500	95.805	A	0.000	95.805	95.805	100.00	0.000	0.000
						B	0.000	95.805		100.00	0.000	0.000
						C	0.000	95.805		100.00	0.000	0.000
L2 85.500-39.417	61.950	1.197	0.017	0.500	135.822	A	0.000	135.822	135.822	100.00	0.000	0.000
						B	0.000	135.822		100.00	0.000	0.000
						C	0.000	135.822		100.00	0.000	0.000
L3 39.417-0.000	19.044	1	0.014	0.500	145.268	A	0.000	145.268	145.268	100.00	0.000	0.000
						B	0.000	145.268		100.00	0.000	0.000
						C	0.000	145.268		100.00	0.000	0.000

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 130.000-85.500	106.614	1.398	0.009	92.096	A	0.000	92.096	92.096	100.00	0.000	0.000
					B	0.000	92.096		100.00	0.000	0.000
					C	0.000	92.096		100.00	0.000	0.000
L2 85.500-39.417	61.950	1.197	0.008	131.981	A	0.000	131.981	131.981	100.00	0.000	0.000
					B	0.000	131.981		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
					C	0.000	131.981		100.00	0.000	0.000
L3 39.417-0.000	19.044	1	0.006	141.983	A	0.000	141.983	141.983	100.00	0.000	0.000
					B	0.000	141.983		100.00	0.000	0.000
					C	0.000	141.983		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 130.000-85.500	1.243	2.253	A	1	1.03	1	1	1	92.096	4.137	0.093	C
			B	1	1.03	1	1	1	92.096			
			C	1	1.03	1	1	1	92.096			
L2 85.500-39.417	1.456	5.237	A	1	1.03	1	1	1	131.981	5.055	0.110	C
			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3 39.417-0.000	1.151	6.517	A	1	1.03	1	1	1	141.983	4.571	0.116	C
			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.850	14.007						OTM	841.262 kip-ft	13.763		

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 130.000-85.500	1.243	2.253	A	1	1.03	1	1	1	92.096	4.137	0.093	C
			B	1	1.03	1	1	1	92.096			
			C	1	1.03	1	1	1	92.096			
L2 85.500-39.417	1.456	5.237	A	1	1.03	1	1	1	131.981	5.055	0.110	C
			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3 39.417-0.000	1.151	6.517	A	1	1.03	1	1	1	141.983	4.571	0.116	C
			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.850	14.007						OTM	841.262 kip-ft	13.763		

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 130.000-85.50	1.243	2.253	A	1	1.03	1	1	1	92.096	4.137	0.093	C
			B	1	1.03	1	1	1	92.096			

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
0			C	1	1.03	1	1	1	92.096			
L2	1.456	5.237	A	1	1.03	1	1	1	131.981	5.055	0.110	C
85.500-39.417			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3	1.151	6.517	A	1	1.03	1	1	1	141.983	4.571	0.116	C
39.417-0.000			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.850	14.007						OTM	841.262 kip-ft	13.763		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	1.243	2.253	A	1	1.03	1	1	1	92.096	4.137	0.093	C
130.000-85.50			B	1	1.03	1	1	1	92.096			
0			C	1	1.03	1	1	1	92.096			
L2	1.456	5.237	A	1	1.03	1	1	1	131.981	5.055	0.110	C
85.500-39.417			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3	1.151	6.517	A	1	1.03	1	1	1	141.983	4.571	0.116	C
39.417-0.000			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.850	14.007						OTM	841.262 kip-ft	13.763		

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	1.243	2.959	A	1	1.03	1	1	1	95.805	3.228	0.073	C
130.000-85.50			B	1	1.03	1	1	1	95.805			
0			C	1	1.03	1	1	1	95.805			
L2	1.456	6.243	A	1	1.03	1	1	1	135.822	3.901	0.085	C
85.500-39.417			B	1	1.03	1	1	1	135.822			
			C	1	1.03	1	1	1	135.822			
L3	1.151	7.596	A	1	1.03	1	1	1	145.268	3.508	0.089	C
39.417-0.000			B	1	1.03	1	1	1	145.268			
			C	1	1.03	1	1	1	145.268			
Sum Weight:	3.850	16.798						OTM	652.611 kip-ft	10.637		

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 130.000-85.500	1.243	2.959	A	1	1.03	1	1	1	95.805	3.228	0.073	C
			B	1	1.03	1	1	1	95.805			
			C	1	1.03	1	1	1	95.805			
L2 85.500-39.417	1.456	6.243	A	1	1.03	1	1	1	135.822	3.901	0.085	C
			B	1	1.03	1	1	1	135.822			
			C	1	1.03	1	1	1	135.822			
L3 39.417-0.000	1.151	7.596	A	1	1.03	1	1	1	145.268	3.508	0.089	C
			B	1	1.03	1	1	1	145.268			
			C	1	1.03	1	1	1	145.268			
Sum Weight:	3.850	16.798						OTM	652.611 kip-ft	10.637		

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 130.000-85.500	1.243	2.959	A	1	1.03	1	1	1	95.805	3.228	0.073	C
			B	1	1.03	1	1	1	95.805			
			C	1	1.03	1	1	1	95.805			
L2 85.500-39.417	1.456	6.243	A	1	1.03	1	1	1	135.822	3.901	0.085	C
			B	1	1.03	1	1	1	135.822			
			C	1	1.03	1	1	1	135.822			
L3 39.417-0.000	1.151	7.596	A	1	1.03	1	1	1	145.268	3.508	0.089	C
			B	1	1.03	1	1	1	145.268			
			C	1	1.03	1	1	1	145.268			
Sum Weight:	3.850	16.798						OTM	652.611 kip-ft	10.637		

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 130.000-85.500	1.243	2.959	A	1	1.03	1	1	1	95.805	3.228	0.073	C
			B	1	1.03	1	1	1	95.805			
			C	1	1.03	1	1	1	95.805			
L2 85.500-39.417	1.456	6.243	A	1	1.03	1	1	1	135.822	3.901	0.085	C
			B	1	1.03	1	1	1	135.822			
			C	1	1.03	1	1	1	135.822			
L3 39.417-0.000	1.151	7.596	A	1	1.03	1	1	1	145.268	3.508	0.089	C
			B	1	1.03	1	1	1	145.268			
			C	1	1.03	1	1	1	145.268			
Sum Weight:	3.850	16.798						OTM	652.611 kip-ft	10.637		

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 ft²	F K	w klf	Ctrl. Face
L1 130.000-85.500	1.243	2.253	A	1	1.03	1	1	1	92.096	1.432	0.032	C
			B	1	1.03	1	1	1	92.096			
			C	1	1.03	1	1	1	92.096			
L2 85.500-39.417	1.456	5.237	A	1	1.03	1	1	1	131.981	1.749	0.038	C
			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3 39.417-0.000	1.151	6.517	A	1	1.03	1	1	1	141.983	1.582	0.040	C
			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.850	14.007						OTM	291.094 kip-ft	4.762		

Tower Forces - Service - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 130.000-85.500	1.243	2.253	A	1	1.03	1	1	1	92.096	1.432	0.032	C
			B	1	1.03	1	1	1	92.096			
			C	1	1.03	1	1	1	92.096			
L2 85.500-39.417	1.456	5.237	A	1	1.03	1	1	1	131.981	1.749	0.038	C
			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3 39.417-0.000	1.151	6.517	A	1	1.03	1	1	1	141.983	1.582	0.040	C
			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.850	14.007						OTM	291.094 kip-ft	4.762		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 130.000-85.500	1.243	2.253	A	1	1.03	1	1	1	92.096	1.432	0.032	C
			B	1	1.03	1	1	1	92.096			
			C	1	1.03	1	1	1	92.096			
L2 85.500-39.417	1.456	5.237	A	1	1.03	1	1	1	131.981	1.749	0.038	C
			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3 39.417-0.000	1.151	6.517	A	1	1.03	1	1	1	141.983	1.582	0.040	C
			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.850	14.007						OTM	291.094 kip-ft	4.762		

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 130.000-85.500	1.243	2.253	A	1	1.03	1	1	1	92.096	1.432	0.032	C
			B	1	1.03	1	1	1	92.096			
			C	1	1.03	1	1	1	92.096			
L2 85.500-39.417	1.456	5.237	A	1	1.03	1	1	1	131.981	1.749	0.038	C
			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3 39.417-0.000	1.151	6.517	A	1	1.03	1	1	1	141.983	1.582	0.040	C
			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.850	14.007						OTM	291.094 kip-ft	4.762		

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	14.007					
Bracing Weight	0.000					
Total Member Self-Weight	14.007			7.605	0.060	
Total Weight	22.297			7.605	0.060	
Wind 0 deg - No Ice		0.033	-22.893	-1966.137	-3.533	-0.992
Wind 30 deg - No Ice		11.420	-19.842	-1703.502	-983.137	1.276
Wind 45 deg - No Ice		16.133	-16.211	-1390.582	-1388.531	2.318
Wind 60 deg - No Ice		19.747	-11.475	-982.378	-1699.295	3.202
Wind 90 deg - No Ice		22.783	-0.033	4.012	-1960.111	4.270
Wind 120 deg - No Ice		19.714	11.418	991.364	-1695.702	4.194
Wind 135 deg - No Ice		16.087	16.165	1400.711	-1383.450	3.721
Wind 150 deg - No Ice		11.363	19.809	1715.119	-976.914	2.995
Wind 180 deg - No Ice		-0.033	22.893	1981.347	3.653	0.992
Wind 210 deg - No Ice		-11.420	19.842	1718.712	983.258	-1.276
Wind 225 deg - No Ice		-16.133	16.211	1405.792	1388.651	-2.318
Wind 240 deg - No Ice		-19.747	11.475	997.587	1699.415	-3.202
Wind 270 deg - No Ice		-22.783	0.033	11.198	1960.232	-4.270
Wind 300 deg - No Ice		-19.714	-11.418	-976.155	1695.822	-4.194
Wind 315 deg - No Ice		-16.087	-16.165	-1385.501	1383.570	-3.721
Wind 330 deg - No Ice		-11.363	-19.809	-1699.910	977.035	-2.995
Member Ice	2.791					
Total Weight Ice	27.350			10.211	0.105	
Wind 0 deg - Ice		0.027	-18.413	-1608.875	-2.859	-1.093
Wind 30 deg - Ice		9.188	-15.959	-1393.440	-806.886	1.133
Wind 45 deg - Ice		12.980	-13.039	-1136.751	-1139.619	2.168
Wind 60 deg - Ice		15.887	-9.229	-801.899	-1394.681	3.056
Wind 90 deg - Ice		18.330	-0.027	7.247	-1608.744	4.159
Wind 120 deg - Ice		15.861	9.183	817.187	-1391.718	4.148
Wind 135 deg - Ice		12.942	13.001	1152.982	-1135.428	3.714
Wind 150 deg - Ice		9.142	15.933	1410.898	-801.753	3.026
Wind 180 deg - Ice		-0.027	18.413	1629.297	3.069	1.093
Wind 210 deg - Ice		-9.188	15.959	1413.862	807.096	-1.133

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 225 deg - Ice		-12.980	13.039	1157.173	1139.829	-2.168
Wind 240 deg - Ice		-15.887	9.229	822.320	1394.891	-3.056
Wind 270 deg - Ice		-18.330	0.027	13.175	1608.954	-4.159
Wind 300 deg - Ice		-15.861	-9.183	-796.765	1391.928	-4.148
Wind 315 deg - Ice		-12.942	-13.001	-1132.560	1135.638	-3.714
Wind 330 deg - Ice		-9.142	-15.933	-1390.477	801.963	-3.026
Total Weight	22.297			7.605	0.060	
Wind 0 deg - Service		0.011	-7.921	-675.351	-1.183	-0.343
Wind 30 deg - Service		3.951	-6.866	-584.474	-340.146	0.441
Wind 45 deg - Service		5.582	-5.609	-476.197	-480.421	0.802
Wind 60 deg - Service		6.833	-3.970	-334.950	-587.952	1.108
Wind 90 deg - Service		7.883	-0.011	6.362	-678.200	1.478
Wind 120 deg - Service		6.821	3.951	348.006	-586.709	1.451
Wind 135 deg - Service		5.566	5.593	489.648	-478.663	1.288
Wind 150 deg - Service		3.932	6.854	598.440	-337.993	1.036
Wind 180 deg - Service		-0.011	7.921	690.561	1.303	0.343
Wind 210 deg - Service		-3.951	6.866	599.683	340.267	-0.441
Wind 225 deg - Service		-5.582	5.609	491.407	480.542	-0.802
Wind 240 deg - Service		-6.833	3.970	350.159	588.072	-1.108
Wind 270 deg - Service		-7.883	0.011	8.848	678.320	-1.478
Wind 300 deg - Service		-6.821	-3.951	-332.796	586.829	-1.451
Wind 315 deg - Service		-5.566	-5.593	-474.439	478.783	-1.288
Wind 330 deg - Service		-3.932	-6.854	-583.231	338.114	-1.036

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

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

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	130 - 85.5	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-10.426	0.110	-10.634
			Max. Mx	14	-6.630	393.155	-8.339
			Max. My	10	-6.607	0.719	-404.628
			Max. Vy	14	-13.181	393.155	-8.339
			Max. Vx	10	13.298	0.719	-404.628
			Max. Torque	14			4.401
L2	85.5 - 39.417	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-17.627	0.113	-10.932
			Max. Mx	14	-13.189	1094.837	-10.128
			Max. My	10	-13.178	2.258	-1111.578
			Max. Vy	14	-18.020	1094.837	-10.128
			Max. Vx	10	18.135	2.258	-1111.578
			Max. Torque	14			4.390
L3	39.417 - 0	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-27.350	0.114	-11.015
			Max. Mx	14	-22.280	2012.392	-11.688
			Max. My	10	-22.279	3.750	-2034.236
			Max. Vy	14	-22.800	2012.392	-11.688
			Max. Vx	10	22.910	3.750	-2034.236
			Max. Torque	14			4.377

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	27	27.350	0.027	-18.413
	Max. H_x	14	22.297	22.783	-0.033
	Max. H_z	2	22.297	-0.033	22.893
	Max. M_x	2	2018.295	-0.033	22.893
	Max. M_z	6	2012.263	-22.783	0.033
	Max. Torsion	14	4.372	22.783	-0.033
	Min. Vert	1	22.297	0.000	-0.000
	Min. H_x	6	22.297	-22.783	0.033
	Min. H_z	10	22.297	0.033	-22.893
	Min. M_x	10	-2034.236	0.033	-22.893
	Min. M_z	14	-2012.392	22.783	-0.033
	Min. Torsion	6	-4.372	-22.783	0.033

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	22.297	0.000	0.000	8.027	0.064	0.000
Dead+Wind 0 deg - No Ice	22.297	0.033	-22.893	-2018.295	-3.634	-1.003
Dead+Wind 30 deg - No Ice	22.297	11.420	-19.842	-1748.668	-1009.292	1.317
Dead+Wind 45 deg - No Ice	22.297	16.133	-16.211	-1427.420	-1425.470	2.382
Dead+Wind 60 deg - No Ice	22.297	19.747	-11.475	-1008.351	-1744.504	3.285
Dead+Wind 90 deg - No Ice	22.297	22.783	-0.033	4.303	-2012.263	4.372
Dead+Wind 120 deg - No Ice	22.297	19.714	11.418	1017.943	-1740.806	4.287
Dead+Wind 135 deg - No Ice	22.297	16.087	16.165	1438.178	-1420.239	3.800
Dead+Wind 150 deg - No Ice	22.297	11.363	19.809	1760.943	-1002.885	3.055
Dead+Wind 180 deg - No Ice	22.297	-0.033	22.893	2034.236	3.750	1.005
Dead+Wind 210 deg - No Ice	22.297	-11.420	19.842	1764.626	1009.391	-1.314
Dead+Wind 225 deg - No Ice	22.297	-16.133	16.211	1443.392	1425.569	-2.380
Dead+Wind 240 deg - No Ice	22.297	-19.747	11.475	1024.334	1744.609	-3.283
Dead+Wind 270 deg - No Ice	22.297	-22.783	0.033	11.687	2012.392	-4.372
Dead+Wind 300 deg - No Ice	22.297	-19.714	-11.418	-1001.970	1740.952	-4.289
Dead+Wind 315 deg - No Ice	22.297	-16.087	-16.165	-1422.219	1420.385	-3.802
Dead+Wind 330 deg - No Ice	22.297	-11.363	-19.809	-1744.995	1003.024	-3.056
Dead+Ice+Temp	27.350	-0.000	0.000	11.015	0.114	0.001
Dead+Wind 0 deg+Ice+Temp	27.350	0.027	-18.413	-1668.355	-2.972	-1.119
Dead+Wind 30 deg+Ice+Temp	27.350	9.188	-15.959	-1444.901	-836.890	1.176
Dead+Wind 45 deg+Ice+Temp	27.350	12.980	-13.039	-1178.662	-1181.991	2.242
Dead+Wind 60 deg+Ice+Temp	27.350	15.887	-9.229	-831.351	-1446.537	3.155
Dead+Wind 90 deg+Ice+Temp	27.350	18.330	-0.027	7.901	-1668.556	4.288
Dead+Wind 120 deg+Ice+Temp	27.350	15.861	9.183	847.974	-1443.452	4.272
Dead+Wind 135 deg+Ice+Temp	27.350	12.942	13.001	1196.256	-1177.629	3.822
Dead+Wind 150 deg+Ice+Temp	27.350	9.142	15.933	1463.760	-831.548	3.113
Dead+Wind 180 deg+Ice+Temp	27.350	-0.027	18.413	1690.274	3.184	1.120
Dead+Wind 210 deg+Ice+Temp	27.350	-9.188	15.959	1466.836	837.090	-1.172
Dead+Wind 225 deg+Ice+Temp	27.350	-12.980	13.039	1200.608	1182.193	-2.238
Dead+Wind 240 deg+Ice+Temp	27.350	-15.887	9.229	853.306	1446.745	-3.151
Dead+Wind 270 deg+Ice+Temp	27.350	-18.330	0.027	14.057	1668.785	-4.287
Dead+Wind 300 deg+Ice+Temp	27.350	-15.861	-9.183	-826.032	1443.692	-4.273
Dead+Wind 315 deg+Ice+Temp	27.350	-12.942	-13.001	-1174.325	1177.867	-3.824
Dead+Wind 330 deg+Ice+Temp	27.350	-9.142	-15.933	-1441.839	831.780	-3.114
Dead+Wind 0 deg - Service	22.297	0.011	-7.921	-693.885	-1.216	-0.351
Dead+Wind 30 deg - Service	22.297	3.951	-6.866	-600.483	-349.586	0.460
Dead+Wind 45 deg - Service	22.297	5.582	-5.609	-489.199	-493.753	0.832
Dead+Wind 60 deg - Service	22.297	6.833	-3.970	-344.028	-604.268	1.148
Dead+Wind 90 deg - Service	22.297	7.883	-0.011	6.765	-697.019	1.528

Load Combination	Vertical K	Shear$_x$ K	Shear$_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead+Wind 120 deg - Service	22.297	6.821	3.951	357.899	-602.987	1.498
Dead+Wind 135 deg - Service	22.297	5.566	5.593	503.475	-491.942	1.328
Dead+Wind 150 deg - Service	22.297	3.932	6.854	615.288	-347.369	1.068
Dead+Wind 180 deg - Service	22.297	-0.011	7.921	709.967	1.342	0.351
Dead+Wind 210 deg - Service	22.297	-3.951	6.866	616.567	349.710	-0.459
Dead+Wind 225 deg - Service	22.297	-5.582	5.609	505.284	493.878	-0.831
Dead+Wind 240 deg - Service	22.297	-6.833	3.970	360.115	604.393	-1.147
Dead+Wind 270 deg - Service	22.297	-7.883	0.011	9.323	697.147	-1.527
Dead+Wind 300 deg - Service	22.297	-6.821	-3.951	-341.813	603.117	-1.498
Dead+Wind 315 deg - Service	22.297	-5.566	-5.593	-487.391	492.072	-1.328
Dead+Wind 330 deg - Service	22.297	-3.932	-6.854	-599.206	347.498	-1.067

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	-22.297	0.000	0.000	22.297	-0.000	0.000%
2	0.033	-22.297	-22.893	-0.033	22.297	22.893	0.000%
3	11.420	-22.297	-19.842	-11.420	22.297	19.842	0.000%
4	16.133	-22.297	-16.211	-16.133	22.297	16.211	0.000%
5	19.747	-22.297	-11.475	-19.747	22.297	11.475	0.000%
6	22.783	-22.297	-0.033	-22.783	22.297	0.033	0.000%
7	19.714	-22.297	11.418	-19.714	22.297	-11.418	0.000%
8	16.087	-22.297	16.165	-16.087	22.297	-16.165	0.000%
9	11.363	-22.297	19.809	-11.363	22.297	-19.809	0.000%
10	-0.033	-22.297	22.893	0.033	22.297	-22.893	0.000%
11	-11.420	-22.297	19.842	11.420	22.297	-19.842	0.000%
12	-16.133	-22.297	16.211	16.133	22.297	-16.211	0.000%
13	-19.747	-22.297	11.475	19.747	22.297	-11.475	0.000%
14	-22.783	-22.297	0.033	22.783	22.297	-0.033	0.000%
15	-19.714	-22.297	-11.418	19.714	22.297	11.418	0.000%
16	-16.087	-22.297	-16.165	16.087	22.297	16.165	0.000%
17	-11.363	-22.297	-19.809	11.363	22.297	19.809	0.000%
18	0.000	-27.350	0.000	0.000	27.350	-0.000	0.000%
19	0.027	-27.350	-18.413	-0.027	27.350	18.413	0.000%
20	9.188	-27.350	-15.959	-9.188	27.350	15.959	0.000%
21	12.980	-27.350	-13.039	-12.980	27.350	13.039	0.000%
22	15.887	-27.350	-9.229	-15.887	27.350	9.229	0.000%
23	18.330	-27.350	-0.027	-18.330	27.350	0.027	0.000%
24	15.861	-27.350	9.183	-15.861	27.350	-9.183	0.000%
25	12.942	-27.350	13.001	-12.942	27.350	-13.001	0.000%
26	9.142	-27.350	15.933	-9.142	27.350	-15.933	0.000%
27	-0.027	-27.350	18.413	0.027	27.350	-18.413	0.000%
28	-9.188	-27.350	15.959	9.188	27.350	-15.959	0.000%
29	-12.980	-27.350	13.039	12.980	27.350	-13.039	0.000%
30	-15.887	-27.350	9.229	15.887	27.350	-9.229	0.000%
31	-18.330	-27.350	0.027	18.330	27.350	-0.027	0.000%
32	-15.861	-27.350	-9.183	15.861	27.350	9.183	0.000%
33	-12.942	-27.350	-13.001	12.942	27.350	13.001	0.000%
34	-9.142	-27.350	-15.933	9.142	27.350	15.933	0.000%
35	0.011	-22.297	-7.921	-0.011	22.297	7.921	0.000%
36	3.951	-22.297	-6.866	-3.951	22.297	6.866	0.000%
37	5.582	-22.297	-5.609	-5.582	22.297	5.609	0.000%
38	6.833	-22.297	-3.970	-6.833	22.297	3.970	0.000%
39	7.883	-22.297	-0.011	-7.883	22.297	0.011	0.000%
40	6.821	-22.297	3.951	-6.821	22.297	-3.951	0.000%
41	5.566	-22.297	5.593	-5.566	22.297	-5.593	0.000%

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
42	3.932	-22.297	6.854	-3.932	22.297	-6.854	0.000%
43	-0.011	-22.297	7.921	0.011	22.297	-7.921	0.000%
44	-3.951	-22.297	6.866	3.951	22.297	-6.866	0.000%
45	-5.582	-22.297	5.609	5.582	22.297	-5.609	0.000%
46	-6.833	-22.297	3.970	6.833	22.297	-3.970	0.000%
47	-7.883	-22.297	0.011	7.883	22.297	-0.011	0.000%
48	-6.821	-22.297	-3.951	6.821	22.297	3.951	0.000%
49	-5.566	-22.297	-5.593	5.566	22.297	5.593	0.000%
50	-3.932	-22.297	-6.854	3.932	22.297	6.854	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	0.00033962
3	Yes	5	0.00000001	0.00018980
4	Yes	5	0.00000001	0.00020048
5	Yes	5	0.00000001	0.00016371
6	Yes	5	0.00000001	0.00005197
7	Yes	5	0.00000001	0.00021700
8	Yes	5	0.00000001	0.00020743
9	Yes	5	0.00000001	0.00016824
10	Yes	4	0.00000001	0.00039906
11	Yes	5	0.00000001	0.00017878
12	Yes	5	0.00000001	0.00020516
13	Yes	5	0.00000001	0.00020956
14	Yes	5	0.00000001	0.00005382
15	Yes	5	0.00000001	0.00015887
16	Yes	5	0.00000001	0.00020333
17	Yes	5	0.00000001	0.00020256
18	Yes	4	0.00000001	0.00004703
19	Yes	5	0.00000001	0.00010385
20	Yes	5	0.00000001	0.00039932
21	Yes	5	0.00000001	0.00043789
22	Yes	5	0.00000001	0.00035722
23	Yes	5	0.00000001	0.00015755
24	Yes	5	0.00000001	0.00046261
25	Yes	5	0.00000001	0.00046382
26	Yes	5	0.00000001	0.00037398
27	Yes	5	0.00000001	0.00010691
28	Yes	5	0.00000001	0.00039334
29	Yes	5	0.00000001	0.00045922
30	Yes	5	0.00000001	0.00044734
31	Yes	5	0.00000001	0.00016001
32	Yes	5	0.00000001	0.00034969
33	Yes	5	0.00000001	0.00044397
34	Yes	5	0.00000001	0.00042509
35	Yes	4	0.00000001	0.00007191
36	Yes	4	0.00000001	0.00046470
37	Yes	4	0.00000001	0.00050097
38	Yes	4	0.00000001	0.00035324
39	Yes	4	0.00000001	0.00032138
40	Yes	4	0.00000001	0.00065887
41	Yes	4	0.00000001	0.00059111
42	Yes	4	0.00000001	0.00040276

43	Yes	4	0.00000001	0.00007994
44	Yes	4	0.00000001	0.00043593
45	Yes	4	0.00000001	0.00056227
46	Yes	4	0.00000001	0.00060979
47	Yes	4	0.00000001	0.00032531
48	Yes	4	0.00000001	0.00035741
49	Yes	4	0.00000001	0.00053401
50	Yes	4	0.00000001	0.00054314

Maximum Tower Deflections - Service Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °
L1	130 - 85.5	28.230	43	1.986	0.024
L2	90 - 39.417	13.290	43	1.423	0.008
L3	45 - 0	3.265	43	0.667	0.002

Critical Deflections and Radius of Curvature - Service Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
130.000	4-bay dipole	43	28.230	1.986	0.024	22482
128.000	Andrew 12'-6" Low Profile Platform	43	27.426	1.959	0.023	22482
120.000	LPA-80080-6CF	43	24.228	1.853	0.019	11241
118.000	Valmont 13' Low Profile Platform	43	23.437	1.826	0.018	9367

Maximum Tower Deflections - Design Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °
L1	130 - 85.5	79.850	10	5.539	0.068
L2	90 - 39.417	37.875	10	4.040	0.023
L3	45 - 0	9.339	10	1.906	0.007

Critical Deflections and Radius of Curvature - Design Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
130.000	4-bay dipole	10	79.850	5.539	0.069	8340
128.000	Andrew 12'-6" Low Profile Platform	10	77.596	5.470	0.066	8340
120.000	LPA-80080-6CF	10	68.627	5.191	0.056	4169
118.000	Valmont 13' Low Profile Platform	10	66.408	5.120	0.053	3474

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	130 - 85.5 (1)	TP29.73x19.94x0.188	44.500	0.000	0.0	33.966	17.239	-6.607	585.527	0.011
L2	85.5 - 39.417 (2)	TP39.39x28.365x0.281	50.583	0.000	0.0	36.733	34.316	-13.178	1260.520	0.010
L3	39.417 - 0 (3)	TP47.6x37.611x0.313	45.000	0.000	0.0	34.117	47.583	-22.279	1623.410	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	130 - 85.5 (1)	TP29.73x19.94x0.188	404.628	40.298	33.966	1.186	0.000	0.000	33.966	0.000
L2	85.5 - 39.417 (2)	TP39.39x28.365x0.281	1111.583	41.941	36.733	1.142	0.000	0.000	36.733	0.000
L3	39.417 - 0 (3)	TP47.6x37.611x0.313	2034.242	44.319	34.117	1.299	0.000	0.000	34.117	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	130 - 85.5 (1)	TP29.73x19.94x0.188	13.298	0.771	26.000	0.060	1.010	0.048	26.000	0.002
L2	85.5 - 39.417 (2)	TP39.39x28.365x0.281	18.136	0.528	26.000	0.041	1.006	0.018	26.000	0.001
L3	39.417 - 0 (3)	TP47.6x37.611x0.313	22.910	0.481	26.000	0.038	1.005	0.010	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	130 - 85.5 (1)	0.011	1.186	0.000	0.060	0.002	1.199 ✔	1.333	H1-3+VT ✔
L2	85.5 - 39.417 (2)	0.010	1.142	0.000	0.041	0.001	1.153 ✔	1.333	H1-3+VT ✔
L3	39.417 - 0 (3)	0.014	1.299	0.000	0.038	0.000	1.313 ✔	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	130 - 85.5	Pole	TP29.73x19.94x0.188	1	-6.607	780.507	89.9	Pass
L2	85.5 - 39.417	Pole	TP39.39x28.365x0.281	2	-13.178	1680.273	86.5	Pass
L3	39.417 - 0	Pole	TP47.6x37.611x0.313	3	-22.279	2164.005	98.5	Pass
							Summary	
						Pole (L3)	98.5	Pass
						RATING =	**98.5**	**Pass**

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 2034 \cdot ft \cdot kips$	(Input From tnxTower)
Shear Force =	$Shear := 23 \cdot kips$	(Input From tnxTower)
Axial Force =	$Axial := 22 \cdot kips$	(Input From tnxTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	$N := 12$	(User Input)
Diameter of Bolt Circle =	$D_{bc} := 55.03 \cdot in$	(User Input)
Bolt "Column" Distance =	$l := 3.00 \cdot in$	(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 A633-60

Plate Yield Strength =	$Fy_{bp} := 60 \cdot ksi$	(User Input)
Base Plate Thickness =	$t_{bp} := 2.25 \cdot in$	(User Input)
Base Plate Diameter =	$D_{bp} := 61.03 \cdot in$	(User Input)
Outer Pole Diameter =	$D_{pole} := 47.60 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =: $R_{bc} := \frac{D_{bc}}{2} = 27.515 \cdot in$

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

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

$d_1 = 13.76 \cdot in$	$d_7 = -13.76 \cdot in$
$d_2 = 23.83 \cdot in$	$d_8 = -23.83 \cdot in$
$d_3 = 27.52 \cdot in$	$d_9 = -27.52 \cdot in$
$d_4 = 23.83 \cdot in$	$d_{10} = -23.83 \cdot in$
$d_5 = 13.76 \cdot in$	$d_{11} = -13.76 \cdot in$
$d_6 = 0.00 \cdot in$	etc.

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 23.8 \cdot in$

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

$MA_1 = 0.00 \cdot in$	$MA_7 = 0.00 \cdot in$
$MA_2 = 0.03 \cdot in$	$MA_8 = 0.00 \cdot in$
$MA_3 = 3.72 \cdot in$	$MA_9 = 0.00 \cdot in$
$MA_4 = 0.03 \cdot in$	$MA_{10} = 0.00 \cdot in$
$MA_5 = 0.00 \cdot in$	$MA_{11} = 0.00 \cdot in$
$MA_6 = 0.00 \cdot in$	etc

Effective Width of Baseplate for Bending = $B_{eff} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 30.6 \cdot in$

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i (d_i)^2 = 4.542 \times 10^3 \cdot in^2$

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

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

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

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

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

Check Anchor Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 146 \cdot kips$

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

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

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Net}} = 75.0 \cdot \%$ 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 = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.479 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 7 \cdot ksi$

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

Check Combined Stress Requirement:

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

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

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

Check Anchor Bolt Compression/Combined Stress:

Maximum Compressive Force = $C_{Max} := OM\cdot\frac{R_{bc}}{I_p} + \frac{Axial}{N} = 149.7\cdot kips$

Maximum Compressive Stress = $f_a := \frac{C_{Max}}{A_n} = 46.1\cdot ksi$

$K := 0.65$

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

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

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

Combined Stress % of Capacity = $\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) = 76.8\cdot\%$

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

$C_1 = 75.8 \cdot kips$	$C_7 = -72.1 \cdot kips$
$C_2 = 129.9 \cdot kips$	$C_8 = -126.2 \cdot kips$
$C_3 = 149.7 \cdot kips$	$C_9 = -146.0 \cdot kips$
$C_4 = 129.9 \cdot kips$	$C_{10} = -126.2 \cdot kips$
$C_5 = 75.8 \cdot kips$	$C_{11} = -72.1 \cdot kips$
$C_6 = 1.8 \cdot kips$	etc.

Maximum Bending Stress in Plate = $f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} t_{bp}^{\ 2}\right)} = 21.9 \cdot ksi$

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

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} = 36.5 \cdot \%$

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

$Condition3 = "Ok"$

Standard Monopole Foundation:

Input Data:

Tower Data

Overturning Moment =	$OM := 2034 \cdot ft \cdot kips$	(User Input from tnxTower)	
Shear Force =	$Shear := 23 \cdot kip$	(User Input from tnxTower)	
Axial Force =	$Axial := 22 \cdot kip$	(User Input from tnxTower)	
Tower Height =	$H_t := 130 \cdot ft$	(User Input)	

Footing Data:

Overall Depth of Footing =	$D_f := 8 \cdot ft$	(User Input)	
Length of Pier =	$L_p := 5.0 \cdot ft$	(User Input)	
Extension of Pier Above Grade =	$L_{pag} := 0.5 \cdot ft$	(User Input)	
Diameter of Pier =	$d_p := 7.0 \cdot ft$	(User Input)	
Thickness of Footing =	$T_f := 3.5 \cdot ft$	(User Input)	
Width of Footing =	$W_f := 20.0 \cdot ft$	(User Input)	

Anchor Bolt Data:

Length of Anchor Bolts =	$L_{st} := 96 \cdot in$	(User Input)	
Projection of Anchor Bolts Above Pier =	$A_{BP} := 9.25 \cdot in$	(User Input)	
Anchor Bolt Diameter =	$d_{anchor} := 2.25 \cdot in$	(User Input)	
Base Plate Bolt Circle =	$MP := 55.03 \cdot in$	(User Input)	

Material Properties:

Concrete Compressive Strength =	$f_c := 3000 \cdot psi$	(User Input)	
Steel Reinforcment Yield Strength =	$f_y := 60000 \cdot psi$	(User Input)	
Anchor Bolt Yield Strength =	$f_{ya} := 75000 \cdot psi$	(User Input)	
Internal Friction Angle of Soil =	$\Phi_s := 30 \cdot deg$	(User Input)	
Allowable Soil Bearing Capacity =	$q_s := 5000 \cdot psf$	(User Input)	
Unit Weight of Soil =	$\gamma_{soil} := 100 \cdot pcf$	(User Input)	
Unit Weight of Concrete =	$\gamma_{conc} := 150 \cdot pcf$	(User Input)	
Foundation Bouyancy =	$Bouyancy := 0$	(User Input)	(Yes=1 / No=0)
Depth to Neglect =	$n := 0 \cdot ft$	(User Input)	
Cohesion of Clay Type Soil =	$c := 0 \cdot ksf$	(User Input)	(Use 0 for Sandy Soil)
Seismic Zone Factor =	$Z := 2$	(User Input)	(UBC-1997 Fig 23-2)
Coefficient of Friction Between Concrete =	$\mu := 0.45$	(User Input)	

Pier Reinforcement:

Bar Size =	$BS_{pier} := 9$	(User Input)	
Bar Diameter =	$d_{bpier} := 1.128 \cdot in$	(User Input)	
Number of Bars =	$NB_{pier} := 36$	(User Input)	
Clear Cover of Reinforcement =	$Cvr_{pier} := 3.0 \cdot in$	(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 =	$BS_{top} := 6$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 0.75 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 15$	(User Input)	(Top of Pad)
Bar Size =	$BS_{bot} := 7$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{bbot} := 0.875 \cdot in$	(User Input)	(Bottom of Pad)
Number of Bars =	$NB_{bot} := 22$	(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 = $A_{bpier} := \frac{\pi \cdot d_{bpier}^2}{4} = 0.999 \cdot in^2$

Pad Top Reinforcement Bar Area = $A_{btop} := \frac{\pi \cdot d_{btop}^2}{4} = 0.442 \cdot in^2$

Pad Bottom Reinforcement Bar Area = $A_{bbot} := \frac{\pi \cdot d_{bbot}^2}{4} = 0.601 \cdot in^2$

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

Load Factor =

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

Stability of Footing:

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

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

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

$P_{pt} := K_p\cdot\gamma_s\cdot(D_f - T_f) + c\cdot 2\cdot\sqrt{K_p} = 1.35\cdot\text{ksf}$

$P_{top} := \text{if}[n < (D_f - T_f), P_{pt}, P_{pn}] = 1.35\cdot\text{ksf}$

$P_{bot} := K_p\cdot\gamma_s\cdot D_f + c\cdot 2\cdot\sqrt{K_p} = 2.4\cdot\text{ksf}$

$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 1.875\cdot\text{ksf}$

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

$A_p := W_f\cdot T_p = 70$

Ultimate Shear = $S_u := P_{ave}\cdot A_p = 131.25\cdot\text{kip}$

Weight of Concrete Pad = $WT_c := \left[(W_f^2\cdot T_f) + d_p^2\cdot L_p\right]\cdot\gamma_c = 246.75\cdot\text{kip}$

Weight of Soil Above Footing = $WT_{s1} := \left[(W_f^2 - d_p^2)\cdot\begin{cases}(L_p - L_{pag} - n) & \text{if } (L_p - L_{pag} - n) \ge 0 \\ 0 & \text{if } (L_p - L_{pag} - n) \le 0\end{cases}\right]\cdot\gamma_s = 157.95\cdot\text{kip}$

Weight of Soil Wedge at Back Face = $WT_{s2} := \left(\frac{D_f^2\cdot\tan(\Phi_s)}{2}\cdot W_f\right)\cdot\gamma_s = 36.95\cdot\text{kip}$

Weight of Soil Wedge at back face Corners = $WT_{s3} := 2\cdot\left[(D_f)^3\cdot\frac{\tan(\Phi_s)}{3}\right]\cdot\gamma_s = 19.707\cdot\text{kips}$

Total Weight = $WT_{tot} := WT_c + WT_{s1} + \text{Axial} = 426.7\cdot\text{kip}$

Resisting Moment = $M_r := (WT_{tot})\cdot\frac{W_f}{2} + S_u\cdot\frac{T_f}{3} + \left[(WT_{s2} + WT_{s3})\cdot\left(W_f + \frac{D_f\tan(\Phi_s)}{3}\right)\right] = 5641\cdot\text{kip}\cdot\text{ft}$

Overturning Moment = $M_{ot} := OM + \text{Shear}\cdot(L_p + T_f) = 2230\cdot\text{kip}\cdot\text{ft}$

Factor of Safety Actual = $FS := \frac{M_r}{M_{ot}} = 2.53$

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 = $S_p := \frac{\mu \cdot WT_{tot}}{FS_{req}} = 96.007 \cdot kips$

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

Shear_Check = "Okay"

Bearing Pressure Caused by Footing:

Area of the Mat = $A_{mat} := W_f^2 = 400$

Section Modulus of Mat = $S := \frac{W_f^3}{6} = 1333.33 \cdot ft^3$

Maximum Pressure in Mat = $P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S} = 2.739 \cdot ksf$

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

Max_Pressure_Check = "Okay"

Minimum Pressure in Mat = $P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S} = -0.605 \cdot ksf$

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

Min_Pressure_Check = "No Good"

Distance to Resultant of Pressure Distribution = $X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 5.46$

Distance to Kern = $X_k := \frac{W_f}{6} = 3.333$

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

Eccentricity = $e := \frac{M_{ot}}{WT_{tot}} = 5.225$

Adjusted Soil Pressure = $P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \left(\frac{W_f}{2} - e \right)} = 2.979 \cdot ksf$

$q_{adj} :=$ if($P_{min} < 0, P_a, P_{max}$) = 2.979·ksf

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

Pressure_Check = "Okay"

Concrete Bearing Capacity:

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

Bearing Strength Between Pier and Pad = $P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot \frac{\pi \cdot d_p^2}{4} = 9.185 \times 10^3 \cdot kips$ (ACI-2008 10.14)

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

Bearing_Check = "Okay"

Shear Strength of Concrete:

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

$\phi_c := 0.85$ (ACI 9.3.2.5)

$d := T_f - Cvr_{pad} - d_{bbot} = 38.125 \cdot in$

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

$d_2 := d_1 - d$

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

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

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

$V_{Avail} := \phi_c \cdot 2 \cdot \sqrt{f_c \cdot psi} \cdot W_f \cdot d$ (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 = $b_o := (d_p + d) \cdot \pi = 32$

Area Included Inside Perimeter = $A_{bo} := \frac{\pi \cdot (d_p + d)^2}{4} = 81.3$

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 318.7$

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

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

$v_u := \text{Find}(v_u) = 4.2 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f = 266.9 \cdot kips$

Required Shear Strength = $V_{req} := LF \cdot V_u = 355.8 \cdot kips$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 2724 \cdot kip$ (ACI-2008 11.11.2.1)

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

Punching_Shear_Check = "Okay"

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

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

$q_b := q_{adj} - d_1 \cdot Slope = 1.627 \cdot ksf$

Maximum Bending at Face of Pier = $M_u := LF \cdot \left[(q_{adj} - q_b) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f = 1423.8 \cdot kip \cdot ft$

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

(ACI-200810.2.7.3)

$R_n := \frac{M_u}{\phi_m \cdot W_f \cdot d^2} = 54.4 \cdot psi$

$\rho := \frac{0.85 \cdot f_c}{f_y} \left(1 - \sqrt{1 - \frac{2 \cdot R_n}{0.85 \cdot f_c}} \right) = 0.0009$

$\rho_{min} := \rho = 0.00092$

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)

$$As := \begin{cases} \rho_{min} \cdot W_f \cdot d & \text{if } \rho_{min} > \dfrac{\rho_{sh}}{2} \\ \rho_{sh} \cdot W_f \cdot \dfrac{d}{2} & \text{otherwise} \end{cases} = 8.39 \cdot in^2$$

$$As_{prov} := A_{bbot} \cdot NB_{bot} = 13.2 \cdot in^2$$

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

Pad_Reinforcement_Bot = "Okay"

$$As := \rho_{sh} \cdot (W_f \cdot T_f) = 18.1 \cdot in^2$$

$$As_{prov} := A_{btop} \cdot NB_{top} + A_{bbot} \cdot NB_{bot} = 19.9 \cdot in^2$$

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

Pad_Reinforcement = "Okay"

Developement Length Pad Reinforcement:

Bar Spacing = $$B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 10.23 \cdot in$$

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

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

$$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pad} \cdot \beta_{pad} \cdot \gamma_{pad} \cdot \lambda_{pad}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \dfrac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot} = 21 \cdot in$$

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 = $$L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad} = 75 \cdot in$$

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

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

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

$A_{smin} := 0.0033 \cdot A_p = 18.29 \cdot in^2$

$A_{sprov} := NB_{pier} \cdot A_{bpier} = 35.98 \cdot in^2$

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

Steel_Area_Check = "Okay"

Bar Spacing In Pier = $B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 6.202 \cdot in$

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

Maximum Moment in Pier = $M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2}\right)\right] \cdot LF = 34517.2 \cdot in \cdot kips$

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

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

$$\left(D\ \ N\ \ n\ \ P_u\ \ M_{xu}\right) = \left(84\ \ 36\ \ 9\ \ 29.326\ \ 3.452 \times 10^4\right)$$

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

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

$$\left(\phi P_n\ \ \phi M_{xn}\ \ f_{sp}\ \ \rho\right) = \left(58.536\ \ 6.89 \times 10^4\ \ -60\ \ 6.496 \times 10^{-3}\right)$$

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:

$L_{pier} := L_p - Cvr_{pier} = 57 \cdot in$

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

Tension: (ACI-2008 12.2.3)

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

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

$$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 34.85 \cdot in$$

Minimum Development Length = $L_{dh} := \frac{1200 \cdot d_{bpier}}{\sqrt{\frac{f_c}{psi}}} \cdot .7 = 17.299 \cdot in$ (ACI 12.2.1)

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

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

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

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

Compression: (ACI-2008 12.3.2)

$$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot f_y}{\sqrt{f_c \cdot psi}} = 24.713 \cdot in$$

$L_{dbmin} := 0.0003 \cdot \frac{in^2}{lb} \cdot \left(d_{bpier} \cdot f_y\right) = 20.304 \cdot in$

$L_{dbc} := if\left(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}\right) = 24.713 \cdot in$

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

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

Tie Size and Spacing in Column:

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

Used #4 Ties

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

$s_{lim1} := 16 \cdot d_{bpier} \cdot z = 18.048 \cdot in$

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

$s_{lim3} := D_f \cdot z = 96 \cdot in$

$s_{lim4} := 18in$

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

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

Check Anchor Steel Embedment:

Depth Available = $D_{ab} := L_{st} - A_{BP} = 7.229 \cdot ft$

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

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

Depth_Check = "No Good"

Note: Anchor plate is provided

SITE NAME	QUINEBAUG CT	ECP - CELL #	AWS1	2	20
LATITUDE	42-01-21.90 N	LONGITUDE	71-56-57.48 W		
Change 700,PCS to RET AWS add with RRH 2X60 AWS remove any un-necessary diplexers Add RRH 2X60 700		SAVE BUTTON			
		STRUCTURE TYPE	MONOPOLE		

AWS - LTE ANTENNA ADD	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	2100 MHz BBU		2100 MHz BBU		2100 MHz BBU	
ANTENNA TYPE	SBNHH-1D65B		SBNHH-1D65B		SBNHH-1D65B	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	0		120		240	
DOWN TILT (MECH/ELEC)	0/2		0/2		0/2	
RAD CTR (FT AGL)	120		120		120	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL						
RRH - QTY/MODEL	1	ALU RH_2X60-AWS	1	ALU RH_2X60-AWS	1	ALU RH_2X60-AWS
SECTOR DISTRIBUTION BOX						
MAIN DISTRIBUTION BOX	1		DB-T1-6Z-8AB-0Z			
700 Mhz - LTE Current Config	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	700 eNodeB		700 eNodeB		700 eNodeB	
ANTENNA TYPE	BXA-70063-6CF-2-750MHZ		BXA-70063-6CF-2-750MHZ		BXA-70063-6CF-2-750MHZ	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	0		120		240	
DOWN TILT (MECH/DEG)	0		0		0	
RAD CTR (FT AGL)	120		120		120	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL						
700 Mhz - LTE Future Config	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	700 eNodeB		700 eNodeB		700 eNodeB	
ANTENNA TYPE	SBNHH-1D65B		SBNHH-1D65B		SBNHH-1D65B	
QTY OF ANTENNAS PER FACE	0		0		0	
ORIENTATION (DEG)	0		120		240	
DOWN TILT (MECH/ELEC)	0/2		0/2		0/2	
RAD CTR (FT AGL)	120		120		120	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL						
RRH - QTY/MODEL	1	ALU RH_2X60-700	1	ALU RH_2X60-700	1	ALU RH_2X60-700
850 Celluar - Current Config	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	Cellular Mod 4.0B		Cellular Mod 4.0B		Cellular Mod 4.0B	
ANTENNA TYPE	LPA-80080-6CF		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)	120		120		120	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL	2	FD9R 6004/2C-3L	2	FD9R 6004/2C-3L	2	FD9R 6004/2C-3L
850 Celluar - Future Config	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	Cellular Mod 4.0B		Cellular Mod 4.0B		Cellular Mod 4.0B	
ANTENNA TYPE	LPA-80080-6CF		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)	120		120		120	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL	0		0		0	
DIPLEX WITH LTE CABLE						

1900 PCS - Current Config	ALPHA		BETA		GAMMA	
EQUIPMENT TYPE	PCS Mod 4.0B		PCS Mod 4.0B		PCS Mod 4.0B	
ANTENNA TYPE	BXA-171085-12BF-EDIN-2		BXA-171085-12BF-EDIN-2		BXA-171085-12BF-EDIN-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)	120		120		120	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL		K WITH CELLULAR		PLEX WITH CELLULAR CAE		DIPLEX WITH CELLULAR CABLE

1900 PCS - Future Config	ALPHA		BETA		GAMMA	
EQUIPMENT TYPE	NA		NA		NA	
ANTENNA TYPE	SBNHH-1D65B		SBNHH-1D65B		SBNHH-1D65B	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	0		120		240	
DOWN TILT (MECH/DEG)	0		0		0	
RAD CTR (FT AGL)	120		120		120	
TMA - QTY / MODEL						
RRH - QTY/MODEL	1	ALU RH_2X60-PCS	1	ALU RH_2X60-PCS	1	ALU RH_2X60-PCS
DIPLEX WITH CELLULAR CABLE						

CABLE'S NEEDED						Fiber Lines Model number			
TOTAL # FIBER LINES	2	TOTAL # OF MAINLINES			12	FIBER LINE MODEL #			HB158-1-08U8-S8J18
TOTAL # TOP JUMPERS	6	TOTAL # OF TOP JUMPERS			12	FIBER TOP JUMPER MODEL #			HB114-1-08U4-S4J18
Equipment Cable Ordering		MAIN CABLE	12	+	0	TOP JUMPER #	12	+	

FREQUENCIES			TX POWER OUTPUT	
Cellular A-Band	PCS F / AWS-Band	700 Mhz C - E		
TX - 869-880,890-891.5 MHz	TX - 1970-1975 / 2145-21	TX - 746-757	Cellular (Watts)	20
RX - 824-835,845-846.5 MHz	RX - 1890-1895 / 1745-17	RX - 776-787	PCS (Watts)	16
			LTE/ AWS (Watts)	60/60

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

ENGINEER	RF MANAGER	INITIALS	DATE
Prepared By: Mark Brauer	Robert Hesselbach	MB	11/20/2013

Product Specifications

COMMSCOPE®

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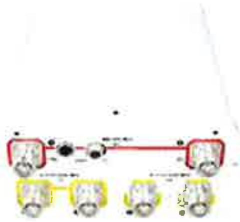


SBNHH-1D65B

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

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

Electrical Specifications

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

Electrical Specifications, BASTA*

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

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

General Specifications

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

Mechanical Specifications

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

SBNHH-1D65B

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

Dimensions

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

Remote Electrical Tilt (RET) Information

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

Regulatory Compliance/Certifications

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

Included Products

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

ALCATEL-LUCENT B13 RRH4X30-4R

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

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

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

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

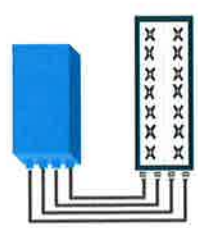
Its compactness and slim design makes the Alcatel-Lucent B13 RRH4x30-4R easy to install close to the antenna: operators can therefore locate this Remote Radio Head where RF design conditions are deemed ideal, minimizing trade-offs between available sites and RF optimum sites, together with reducing the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

FEATURES

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

BENEFITS

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



4x30W with 4T4R
or
2x60W with 2T4R

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

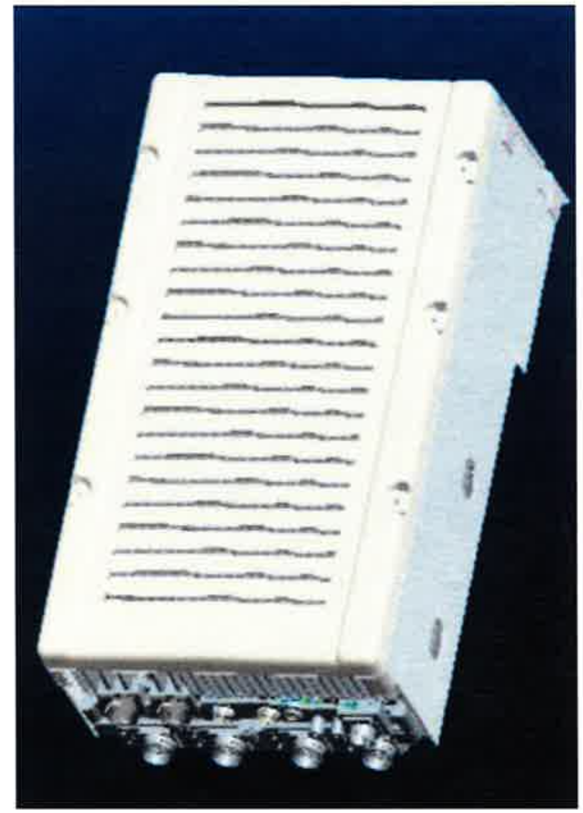
TECHNICAL SPECIFICATIONS

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

NEW PCS RF MODULES FOR VZW
RRH2X60 - HW CHARACTERISTICS

LR14.3

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



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

ALCATEL-LUCENT WIRELESS PRODUCT DATASHEET

RRH2X60-AWS FOR BAND 4 APPLICATIONS

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

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

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

SUPERIOR RF PERFORMANCE

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

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

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

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

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

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

OPTIMIZED TCO

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

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

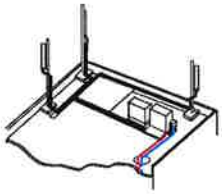
EASY INSTALLATION

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

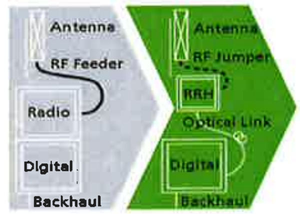
The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment. However, many of these sites can host an Alcatel-Lucent RRH2x60-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation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

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

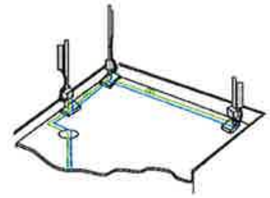
Installation can easily be done by a single person as the Alcatel–Lucent RRH2x60-AWS is compact and weighs about 20 kg, eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day.



Macro



RRH for space-constrained cell sites



Distributed

FEATURES

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

BENEFITS

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

TECHNICAL SPECIFICATIONS

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

36.7"x10.6"x5.8"

Dimensions and weights

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

Electrical Data

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

RF Characteristics

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

Connectivity

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

Environmental specifications

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

Safety and Regulatory Data

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

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

* This data is provisional and subject to change.