Robinson+Cole

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January 7, 2015

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

Re: **Notice of Exempt Modification – Facility Modification**
72 Boggy Hole Road, Old Lyme, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) wireless telecommunications antennas at the 162-foot level of the existing 175-foot tower at 72 Boggy Hole Road in Old Lyme, Connecticut (the "Property"). The tower is owned by Wireless Solutions. The Council approved Cellco's use of this tower in 2008. Cellco now intends to modify its facility by replacing nine (9) of its existing antennas with three (3) model LNX-6514DS-VTM, 850 MHz antennas; three (3) model HBXX-6517DS-VTM, 1900 MHz antennas; and three (3) model HBX-6517DS-VTM, 2100 MHz antennas, all at the same 162-foot level on the tower. Cellco also intends to install nine (9) remote radio heads ("RRHs") behind its 700 MHz, 1900 MHz and 2100 MHz antennas and two (2) HYBRIFLEX™ antenna cables, attached to the outside of the monopole. Included in Attachment 1 are specifications for Cellco's replacement antennas, RRHs and HYBRIFLEX™ cables.

Please accept this letter as notification pursuant to R.C.S.A. § 16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is being sent to Bonnie Reemsnyder, First Selectwoman of the Town of Old Lyme. A copy of this letter is also being sent to Michael Sanders, the owner of the Property.

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

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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 162-foot level on the 175-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 behind 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:
Bonnie Reemsnyder, First Selectwoman
Michael Sanders
Sandy M. Carter

ATTACHMENT 1

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

LNX-6514DS-VTM

Andrew® Antenna, 698–896 MHz, 65° horizontal beamwidth, RET compatible

- Great solution to maximize network coverage and capacity
- Excellent gain, VSWR, front-to-back ratio, and PIM specifications for robust network performance
- Ideal choice for site collocations and tough zoning restrictions
- Excellent solution for site sharing and maximizing capacity
- Fully compatible with Andrew remote electrical tilt system for greater OpEx savings
- The RF connectors are designed for IP67 rating and the radome for IP56 rating

Electrical Specifications

Frequency Band, MHz	**698–806**	**806–896**
Gain, dBi	15.7	16.3
Beamwidth, Horizontal, degrees	65	65
Beamwidth, Horizontal Tolerance, degrees	±3	±3
Beamwidth, Vertical, degrees	12.5	11.2
Beam Tilt, degrees	0–10	0–10
USLS, typical, dB	17	18
Front-to-Back Ratio at 180°, dB	32	30
CPR at Boresight, dB	20	20
CPR at Sector, dB	10	10
Isolation, dB	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153
Input Power per Port, maximum, watts	400	400
Polarization	±45°	±45°
Impedance	50 ohm	50 ohm

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol®
Band	Single band
Brand	DualPol® | Teletilt®
Operating Frequency Band	698 – 896 MHz

Mechanical Specifications

Color	Light gray
Connector Interface	7-16 DIN Female
Connector Location	Bottom
Connector Quantity, total	2
Lightning Protection	dc Ground
Radiator Material	Aluminum
Radome Material	Fiberglass, UV resistant
Wind Loading, maximum	617.7 N @ 150 km/h 138.9 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

HBXX-6517DS-VTM

Andrew® Quad Port Teletilt® Antenna, 1710–2180 MHz, 65° horizontal beamwidth, RET compatible

- Superior azimuth tracking and pattern symmetry with excellent passive intermodulation suppression
- The values presented on this datasheet have been calculated based on N-P-BASTA White Paper version 9.6 by the NGMN Alliance

Electrical Specifications

Frequency Band, MHz	**1710–1880**	**1850–1990**	**1920–2180**
Gain by all Beam Tilts, average, dBi	18.5	18.6	18.8
Gain by all Beam Tilts Tolerance, dB	±0.4	±0.3	±0.4
Gain by Beam Tilt, average, dBi	0 ° | 18.4 3 ° | 18.7 6 ° | 18.4	0 ° | 18.4 3 ° | 18.7 6 ° | 18.5	0 ° | 18.7 3 ° | 18.9 6 ° | 18.6
Beamwidth, Horizontal, degrees	67	66	65
Beamwidth, Horizontal Tolerance, degrees	±2.4	±1.7	±2.9
Beamwidth, Vertical, degrees	5.0	4.7	4.4
Beamwidth, Vertical Tolerance, degrees	±0.3	±0.3	±0.3
Beam Tilt, degrees	0–6	0–6	0–6
USLS, dB	18	19	19
Front-to-Back Total Power at 180° ± 30°, dB	25	26	26
CPR at Boresight, dB	22	23	22
CPR at Sector, dB	10	10	9
Isolation, dB	30	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153	-153
Input Power per Port, maximum, watts	350	350	350
Polarization	±45°	±45°	±45°
Impedance	50 ohm	50 ohm	50 ohm

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol® single band, quad
Band	Single band
Brand	DualPol® | Teletilt®
Operating Frequency Band	1710 – 2180 MHz
Number of Ports, all types	4

Mechanical Specifications

Color	Light gray
Lightning Protection	dc Ground
Radiator Material	Low loss circuit board
Radome Material	PVC, UV resistant
RF Connector Interface	7-16 DIN Female
RF Connector Location	Bottom

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

HBXX-6517DS-VTM

RF Connector Quantity, total	4
Wind Loading, maximum	668.0 N @ 150 km/h 150.2 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Dimensions

Depth	166.0 mm | 6.5 in
Length	1903.0 mm | 74.9 in
Width	305.0 mm | 12.0 in
Net Weight	19.5 kg | 43.0 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 1.1 Actuator	HBXX-6517DS-R2M
Model with Factory Installed AISG 2.0 Actuator	HBXX-6517DS-A2M
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

600899A-2 — 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.

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

LNX-6514DS-VTM

Dimensions

Depth	181.0 mm | 7.1 in
Length	1847.0 mm | 72.7 in
Width	301.0 mm | 11.9 in
Net Weight	17.6 kg | 38.8 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 1.1 Actuator	LNX-6514DS-R2M
Model with Factory Installed AISG 2.0 Actuator	LNX-6514DS-A1M
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

DB380 — Pipe Mounting Kit for 2.4"-4.5" (60-115mm) OD round members on wide panel antennas. Includes 2 clamp sets and double nuts.

DB5083 — Downtilt Mounting Kit for 2.4"-4.5" (60 - 115 mm) OD round members. Includes a heavy-duty, galvanized steel downtilt mounting bracket assembly and associated hardware. This kit is compatible with the DB380 pipe mount kit for panel antennas that are equipped with two mounting brackets.

Alcatel-Lucent RRH2x40-07-U

REMOTE RADIO HEAD

The Alcatel-Lucent RRH2x40-07-U is a high-power, small form-factor Remote Radio Head (RRH) operating in the North American Digital Dividend / 700MHz frequency band (3GPP Band 13). The Alcatel-Lucent RRH2x40-07-U is designed with an eco-efficient approach, providing operators with the means to achieve high quality and capacity coverage with minimum site requirements.

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

The Alcatel-Lucent RRH2x40-07-U is linked to the BBU by an optical-fiber connection carrying downlink and uplink digital radio signals along with operations, administration and maintenance (OA&M) information. The Alcatel-Lucent RRH2x40-07-U has two transmit RF paths, 40 W RF output power per transmit path, and is designed to manage up to two-way receive diversity. The device is ideally suited to support macro coverage, with multiple-input multiple-output (MIMO) 2x2 operation in up to 10 MHz of bandwidth.

The Alcatel-Lucent RRH2x40-07-U is designed to make available all the benefits of a distributed eNodeB, with excellent RF characteristics, with low capital expenditures (CAPEX) and low operating expenditures (OPEX). The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment or require costly cranes to be employed, leaving coverage holes. However, many of these sites can host an Alcatel-Lucent RRH2x40-07-U installation, providing more flexible site selection and improved network quality along with greatly reduced installation time and costs.

Fast, low-cost installation and deployment

The Alcatel-Lucent RRH2x40-07-U is a zero-footprint solution and operates noise-free, simplifying negotiations with site property owners and minimizing environmental impacts. Installation can easily be done by a single person because the Alcatel-Lucent RRH2x40-07-U is compact and weights less than 23 kg (50 lb), eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day — a fraction of the time required for a traditional BTS.

Excellent RF performance

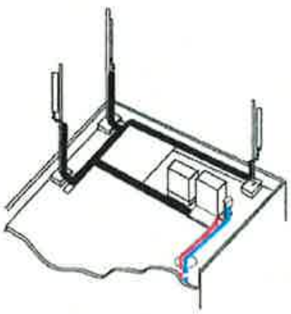
Because of its small size and weight, the Alcatel-Lucent RRH2x40-07-U can be installed close to the antenna. Operators can therefore locate the Alcatel-Lucent RRH2x40-07-U where RF engineering is deemed ideal, minimizing trade-offs between available sites and RF optimum sites. The RF feeder cost and installation costs are reduced or eliminated, and there is no need for a Tower Mounted Amplifier (TMA) because losses introduced by the RF feeder are greatly reduced. The Alcatel-Lucent RRH2x40-07-U provides more RF power while at the same time consuming less electricity.

Features

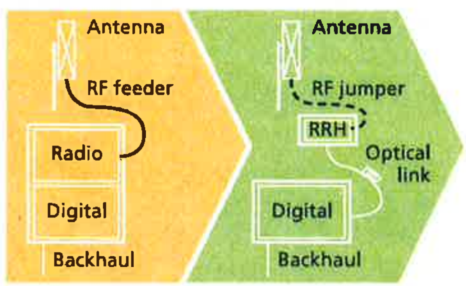
- Zero-footprint deployment
- Easy installation, with a lightweight unit can be carried and set up by one person
- Optimized RF power, with flexible site selection and elimination of a TMA
- Convection-cooled (fanless), noise-free, and heaterless unit
- Best-in-class power efficiency, with significantly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

Benefits

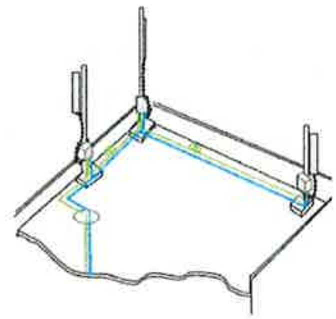
- Leverages existing real estate with lower site costs
- Reduces installation costs, with fewer installation materials and simplified logistics
- Decreases power costs and minimizes environmental impacts, with the potential for eco-sustainable power options
- Improves RF performance and adds flexibility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



Macro



RRH for space-constrained cell sites



Distributed

Technical specifications

Physical dimensions

- Height: 390 mm (15.4 in.)
- Width: 380 mm (15 in.)
- Depth: 210 mm (8.2 in.)
- Weight (without mounting kit): less than 23 kg (50 lb)

Power

- Power supply: -48V

Operating environment

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

RF characteristics

- Frequency band: 700 MHz; 3GPP Band 13
- Bandwidth: up to 10 MHz
- RF output power at antenna port:
  - 40 W nominal RF power for each Tx port
- Rx diversity: 2-way or 4-way
- Noise figure: below 2.5 dB typical
- ALD features
  - TMA
  - Remote electrical tilt (RET) support (AISG v2.0)

Optical characteristics

Type/number of fibers

- Up to 3.12 Gb/s line bit rate
- Single-mode variant
  - One SM fiber (9/125 µm) per RRH2x, carrying UL and DL using CWDM (at 1550/1310 nm)
- Multi-mode variant
  - Two MM fibers (50/125 µm) per RRH2x: one carrying UL, the other carrying DL (at 850 nm)

Optical fiber length

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

Alarms and ports

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

Alcatel·Lucent

PCS RF MODULES
RRH1900 2X60 - HW CHARACTERISTICS

LA6.0.1/13.3

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

** Not a Verizon Wireless deployed product

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

Alcatel-Lucent RRH2x40-AWS

REMOTE RADIO HEAD

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

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

The Alcatel-Lucent RRH2x40-AWS is linked to the BBU by an optical-fiber connection carrying downlink and uplink digital radio signals along with operations, administration and maintenance (OA&M) information. The Alcatel-Lucent RRH2x40-AWS has two transmit RF paths, 40 W RF output power per transmit path, and is designed to manage up to four-way receive diversity. The device is ideally suited to support macro coverage, with multiple-input multiple-output (MIMO) 2x2 operation in up to 20 MHz of bandwidth.

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

Fast, low-cost installation and deployment

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

Excellent RF performance

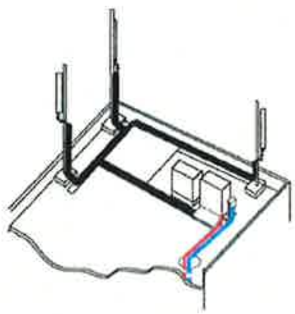
Because of its small size and weight, the Alcatel-Lucent RRH2x40-AWS can be installed close to the antenna. Operators can therefore locate the Alcatel-Lucent RRH2x40-AWS where RF engineering is deemed ideal, minimizing trade-offs between available sites and RF optimum sites. The RF feeder cost and installation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

Features

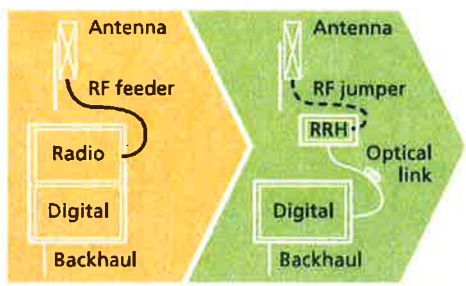
- Zero-footprint deployment
- Easy installation, with a lightweight unit can be carried and set up by one person
- Optimized RF power, with flexible site selection and elimination of a TMA
- Convection-cooled (fanless)
- Noise-free
- Best-in-class power efficiency, with significantly reduced energy consumption

Benefits

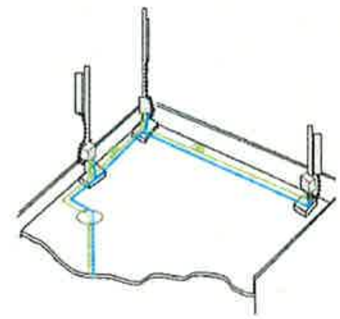
- Leverages existing real estate with lower site costs
- Reduces installation costs, with fewer installation materials and simplified logistics
- Decreases power costs and minimizes environmental impacts, with the potential for eco-sustainable power options
- Improves RF performance and adds flexibility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



Macro



RRH for space-constrained cell sites



Distributed

Technical specifications

Physical dimensions

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

Power

- Power supply: -48VDC

Operating environment

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

RF characteristics

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

Optical characteristics

Type/number of fibers

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

Optical fiber length

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

Digital Ports and Alarms

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

Product Data Sheet HB158-1-08U8-S8J18

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

Product Description

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

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

Figure 1: HYBRIFLEX Series

Features/Benefits

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

Technical Specifications

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

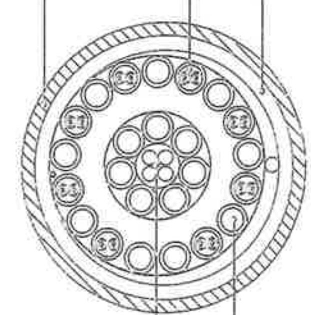


Figure 2: Construction Detail

* This data is provisional and subject to change

All information contained in the present datasheet is subject to confirmation at time of ordering

ATTACHMENT 2

	General	Power	Density					
Site Name: Old Lyme 2								
Tower Height: 175Ft								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*Nextel	9	100	132	0.0186	851	0.5673	3.27%	
*T-Mobile PCS/AWS	2	953	175	0.0224	1900	1.0000	2.24%	
*T-Mobile PCS/AWS	4	477	175	0.0224	2100	1.0000	2.24%	
*T-Mobile LTE	1	445	175	0.0052	700	0.4667	1.12%	
*AT&T UMTS	2	565	145	0.0193	880	0.5867	3.29%	
*AT&T UMTS	2	875	145	0.0299	1900	1.0000	2.99%	
*AT&T GSM	1	491	145	0.0084	880	0.5867	1.43%	
*AT&T GSM	4	813	145	0.0556	1900	1.0000	5.56%	
*AT&T LTE	1	1313	145	0.0225	734	0.4893	4.59%	
Verizon	**11**	**397**	**162**	**0.0598**	**1970**	**1.0000**	**5.98%**	
Verizon	**9**	**379**	**162**	**0.0467**	**869**	**0.5793**	**8.07%**	
Verizon	**1**	**1750**	**162**	**0.0240**	**2145**	**1.0000**	**2.40%**	
Verizon	**1**	**1050**	**162**	**0.0144**	**698**	**0.4653**	**3.09%**	
								46.28%
* Source: Siting Council								

ATTACHMENT 3

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

175-ft Existing EEI Monopole

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Old Lyme 2

72 Boggy Hole Road
Old Lyme, CT

Centek Project No. 14001.037

~~Date: March 25, 2014~~
Rev 1: January 6, 2015

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

Prepared for:

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

Table of Contents

Introduction

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

The host tower is a 175-ft tall, five-section, eighteen sided, tapered monopole, originally designed and manufactured by Engineered Endeavors Inc.; job no; 10886-PO1, dated June 21, 2002. The tower geometry, structure member sizes and foundation system information were obtained from the aforementioned EEI design documents.

Antenna and appurtenance information were obtained from a previous structural analysis report prepared by Atlantis Group dated February 17, 2014, construction drawings prepared by Hudson Design Group job no; 2198.01 dated November 15, 2012 and a Verizon RF data sheet.

The tower is made up of five (5) 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 24.21-in at the top and 66.00-in at the base.

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

Antenna and Appurtenance Summary

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

- T-MOBILE (EXISTING):
  Antennas: Six (6) Ericsson AIR 21 panel antennas and three (3) Ericsson KRY 112 TMA's mounted on an existing low profile platform with a RAD center elevation of 175-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables and one (1) 1-5/8" ∅ fiber cable running on the inside of the existing tower.
- METROPCS (EXISTING):
  Antennas: Three (3) RFS APXV18-206516S-C panel antennas mounted on an existing low profile platform with a RAD center elevation of 152-ft above grade.
  Coax Cables: Six (6) 1-5/8" ∅ coax cables running on the inside of the existing tower.
- METROPCS (RESERVED):
  Antennas: Three (3) RFS APXV18-206516S-C panel antennas mounted on an existing low profile platform with a RAD center elevation of 152-ft above grade.
  Coax Cables: Six (6) 1-5/8" ∅ coax cables running on the inside of the existing tower.

- AT&T (EXISTING):
  Antennas: Three (3) Powerwave 7770 panel antennas, two (2) KMW AM-X-CD-14-65-00T-RET panel antennas, four (4) KMW AM-X-CD-16-65-00T-RET panel antennas, six (6) CCI DTMABP7819VG12A TMA's, six (6) Ericsson RRUS-11 remote radio heads and one (1) Raycap DC6-48-60-18-8F surge arrestor mounted on an existing low profile platform with a RAD center elevation of 145-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables, one (1) fiber cable and two (2) dc control cables running on the inside of the existing tower.

- VERIZON (EXISTING TO REMAIN):
  Antennas: Three (3) Antel BXA-70063-6CF panel antennas mounted on an existing low profile platform with a RAD center elevation of 162-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing tower.

- VERIZON (EXISTING TO REMOVE):
  Antennas: Six (6) Antel LPA-80080-4CF panel antennas mounted on an existing low profile platform with a RAD center elevation of 162-ft above grade.
  Coax Cables: Six (6) 1-5/8" ∅ coax cables running on the exterior of the existing tower.

- **VERIZON (PROPOSED):**
  Antennas: Six (6) Andrew HBXX-6517DS panel antennas, three (3) Andrew LNX-6514DS panel antennas, three (3) Alcatel-Lucent RRH2x40-07-U Remote Radio Heads, three (3) Alcatel-Lucent RRH2x40-AWS Remote Radio Heads, three (3) Alcatel-Lucent RRH2x60-PCS Remote Radio Heads and two (2) RFS DB-T1-6Z-8AB-0Z main distribution boxes mounted on an existing low profile platform with a RAD center elevation of 162-ft above grade.
  Coax Cables: Two (2) 1-5/8" ∅ fiber cables running on the exterior of the existing tower.

Primary Assumptions Used in the Analysis

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

Analysis

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

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

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

Tower Loading

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

Basic Wind Speed:	New London; v = 85 mph (fastest mile)	*[Section 16 of TIA/EIA-222-F-96]*
	Old Lyme; v = 115 mph (3 second gust) equivalent to v = 95 mph (fastest mile)	*[Appendix K of the 2005 CT Building Code Supplement]*
	TIA/EIA-222-F wind speed controls.	
Load Cases:	Load Case 1; 95 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; 82 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 82 mph wind speed velocity represents 75% of the wind pressure generated by the 95 mph wind speed.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 3; Seismic – not checked	*[Section 1614.5 of State Bldg. Code 2005] does not control in the design of this structure type*

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

Tower Capacity

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

- Calculated stresses were found to be within allowable limits. In Load Case 1, per tnxTower "Section Capacity Table", this tower was found to be at **55.3%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L1)	154.87'-175.00'	18.8%	**PASS**
Pole Shaft (L2)	116.29'-154.87'	48.3%	**PASS**
Pole Shaft (L3)	74.17'-116.29'	53.3%	**PASS**
Pole Shaft (L4)	33.34'-74.17'	55.3%	**PASS**
Pole Shaft (L5)	0.00'-33.34'	54.1%	**PASS**

Foundation and Anchors

The existing foundation consists of a 8.0-ft square x 2.5-ft long reinforced concrete pier on a 34.0-ft square x 3.0-ft thick reinforced concrete pad. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned design calculations by Engineered Endeavors Inc.; job no; 10886-PO1, dated June 21, 2002. The base of the tower is connected to the foundation by means of (32) 2.25"∅, ASTM A615-75 anchor bolts embedded approximately 5-ft into the concrete foundation structure.

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

Location	Vector	Proposed Reactions
Base	Shear	40 kips
	Compression	67 kips
	Moment	4809 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	2.80	**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	50.4%	**PASS**
Base Plate	Bending	62.8%	**PASS**

Conclusion

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

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

Please feel free to call with any questions or comments.

Respectfully Submitted by:

Timothy J. Lynn, PE
Structural Engineer

Standard Conditions for Furnishing of Professional Engineering Services on Existing Structures

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

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

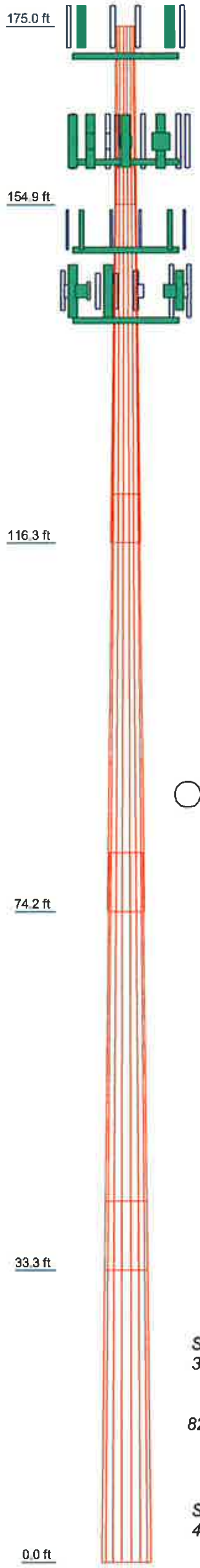
General Description of Structural Analysis Program

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

tnxTower Features:

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

Section	1	2	3	4	5
Length (ft)	20.130	42.830	47.540	47.500	41.170
Number of Sides	18	18	18	18	18
Thickness (in)	0.188	0.375	0.500	0.563	0.625
Socket Length (ft)	4.250	5.420	6.670	7.830	
Top Dia (in)	24.210	27.969	36.845	46.355	55.440
Bot Dia (in)	29.450	38.990	49.070	58.580	66.000
Grade	A572-65				
Weight (K) 49.4	1.1	5.7	10.9	15.0	16.7



DESIGNED APPURTENANCE LOADING

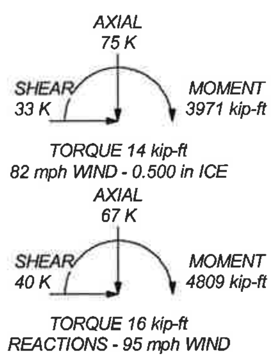
TYPE	ELEVATION
(2) AIR21 (T-Mobile - Existing)	175
(2) AIR21 (T-Mobile - Existing)	175
(2) AIR21 (T-Mobile - Existing)	175
KRY 112 TMA (T-Mobile - Existing)	175
KRY 112 TMA (T-Mobile - Existing)	175
KRY 112 TMA (T-Mobile - Existing)	175
EEI 14-ft Low Profile Platform (T-Mobile - Existing)	172
BXA-70063/6CF (Verizon - Existing)	162
BXA-70063/6CF (Verizon - Existing)	162
BXA-70063/6CF (Verizon - Existing)	162
LNX-6514DS-VTM (Verizon - Proposed)	162
HBXX-6517DS (Verizon - Proposed)	162
HBXX-6517DS (Verizon - Proposed)	162
LNX-6514DS-VTM (Verizon - Proposed)	162
HBXX-6517DS (Verizon - Proposed)	162
HBXX-6517DS (Verizon - Proposed)	162
LNX-6514DS-VTM (Verizon - Proposed)	162
HBXX-6517DS (Verizon - Proposed)	162
HBXX-6517DS (Verizon - Proposed)	162
RRH2x60-PCS (Verizon - Proposed)	162
RRH2x40-07-U (Verizon - Proposed)	162
RRH2x40-AWS (Verizon - Proposed)	162
RRH2x60-PCS (Verizon - Proposed)	162
RRH2x40-07-U (Verizon - Proposed)	162
RRH2x40-AWS (Verizon - Proposed)	162
RRH2x60-PCS (Verizon - Proposed)	162
RRH2x40-07-U (Verizon - Proposed)	162
RRH2x40-AWS (Verizon - Proposed)	162
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	162
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	162
EEI 14-ft Low Profile Platform (Verizon - Existing)	160
APXV18-206516S-C-A20 (MetroPCS - Existing)	152
APXV18-206516S-C-A20 (MetroPCS - Existing)	152
APXV18-206516S-C-A20 (MetroPCS - Existing)	152
APXV18-206516S-C-A20 (MetroPCS - Reserved)	152
APXV18-206516S-C-A20 (MetroPCS - Reserved)	152
APXV18-206516S-C-A20 (MetroPCS - Reserved)	152
EEI 14-ft Low Profile Platform (MetroPCS - Existing)	150
7770.00 (ATI - Existing)	145
AM-X-CD-14-65-00T-RET (ATI - Existing)	145
AM-X-CD-14-65-00T-RET (ATI - Existing)	145
7770.00 (ATI - Existing)	145
AM-X-CD-16-65-00T-RET(72") (ATI - Existing)	145
AM-X-CD-16-65-00T-RET(72") (ATI - Existing)	145
7770.00 (ATI - Existing)	145
AM-X-CD-16-65-00T-RET(72") (ATI - Existing)	145
AM-X-CD-16-65-00T-RET(72") (ATI - Existing)	145
(2) DTMABP7819VG12A TMA (ATI - Existing)	145
(2) DTMABP7819VG12A TMA (ATI - Existing)	145
(2) DTMABP7819VG12A TMA (ATI - Existing)	145
(2) RRUS-11 (ATI - Existing)	145
(2) RRUS-11 (ATI - Existing)	145
(2) RRUS-11 (ATI - Existing)	145
DC6-48-60-18-8F Surge Arrestor (ATI - Existing)	145
EEI 14-ft Low Profile Platform (ATI - Existing)	142

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower designed for a 95 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 82 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: 55.3%



Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job: **14001.037 - Old Lyme 2**		
	Project: **175-ft EEI Monopole - 72 Boggy Hole Rd., Old Lyme, CT**		
	Client: Verizon Wireless	Drawn by: TJL	App'd:
	Code: TIA/EIA-222-F	Date: 01/06/15	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 95 mph.
Nominal ice thickness of 0.500 in.
Ice density of 56 pcf.
A wind speed of 82 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	175.000-154.870	20.130	4.250	18	24.210	29.450	0.188	0.750	A572-65 (65 ksi)
L2	154.870-116.290	42.830	5.420	18	27.969	38.990	0.375	1.500	A572-65 (65 ksi)
L3	116.290-74.170	47.540	6.670	18	36.845	49.070	0.500	2.000	A572-65 (65 ksi)

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L4	74.170-33.340	47.500	7.830	18	46.355	58.580	0.563	2.250	A572-65 (65 ksi)
L5	33.340-0.000	41.170		18	55.440	66.000	0.625	2.500	A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
L1	24.583	14.296	1042.318	8.528	12.299	84.750	2086.008	7.150	3.931	20.965
	29.904	17.415	1883.996	10.388	14.961	125.930	3770.471	8.709	4.853	25.884
L2	29.511	32.843	3159.403	9.796	14.208	222.366	6322.963	16.425	4.262	11.367
	39.591	45.962	8658.522	13.708	19.807	437.146	17328.437	22.985	6.202	16.539
L3	38.829	57.680	9626.286	12.903	18.717	514.296	19265.238	28.845	5.605	11.21
	49.827	77.081	22973.052	17.242	24.928	921.592	45976.332	38.548	7.756	15.513
L4	48.813	81.756	21659.347	16.256	23.548	919.786	43347.193	40.886	7.168	12.744
	59.484	103.583	44049.799	20.596	29.759	1480.236	88157.560	51.801	9.320	16.569
L5	58.334	108.739	41277.881	19.459	28.163	1465.656	82610.076	54.380	8.657	13.852
	67.018	129.688	70026.028	23.208	33.528	2088.584	140144.199	64.856	10.516	16.826

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in
L1 175.000-154.870				1	1	1		
L2 154.870-116.290				1	1	1		
L3 116.290-74.170				1	1	1		
L4 74.170-33.340				1	1	1		
L5 33.340-0.000				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight klf
1 5/8 (T-Mobile - Existing)	B	No	Inside Pole	173.000 - 3.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
HYBRIFLEX 1-5/8" (T-Mobile - Existing)	B	No	Inside Pole	173.000 - 3.000	1	No Ice	0.000	0.002
						1/2" Ice	0.000	0.002
1 5/8 (Verizon - Existing)	B	No	Inside Pole	163.000 - 3.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (MetroPCS - Existing)	B	No	Inside Pole	153.000 - 3.000	6	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001

Description	*Face or Leg*	*Allow Shield*	*Component Type*	*Placement* *ft*	*Total Number*		C_AA_A *ft²/ft*	*Weight* *klf*
1 5/8	B	No	Inside Pole	153.000 - 3.000	6	No Ice	0.000	0.001
(MetroPCS - Reserved)						1/2" Ice	0.000	0.001
1 5/8	B	No	Inside Pole	143.000 - 3.000	12	No Ice	0.000	0.001
(AT&T - Existing)						1/2" Ice	0.000	0.001
Fiber Trunk	B	No	Inside Pole	143.000 - 3.000	1	No Ice	0.000	0.001
(AT&T - Existing)						1/2" Ice	0.000	0.001
DC Trunk	B	No	Inside Pole	143.000 - 3.000	2	No Ice	0.000	0.000
(AT&T - Existing)						1/2" Ice	0.000	0.000
HYBRIFLEX 1-5/8"	B	No	CaAa (Out Of	163.000 - 3.000	1	No Ice	0.198	0.002
(Verizon - Proposed)			Face)			1/2" Ice	0.298	0.003
HYBRIFLEX 1-5/8"	B	No	CaAa (Out Of	163.000 - 3.000	1	No Ice	0.000	0.002
(Verizon - Proposed)			Face)			1/2" Ice	0.000	0.003

Feed Line/Linear Appurtenances Section Areas

Tower Section	*Tower Elevation* *ft*	*Face*	A_R *ft²*	A_F *ft²*	C_AA_A *In Face* *ft²*	C_AA_A *Out Face* *ft²*	*Weight* *K*
L1	175.000-154.870	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	1.610	0.393
		C	0.000	0.000	0.000	0.000	0.000
L2	154.870-116.290	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	7.639	2.007
		C	0.000	0.000	0.000	0.000	0.000
L3	116.290-74.170	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	8.340	2.394
		C	0.000	0.000	0.000	0.000	0.000
L4	74.170-33.340	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	8.084	2.321
		C	0.000	0.000	0.000	0.000	0.000
L5	33.340-0.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	6.007	1.725
		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	175.000-154.870	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	2.423	0.418
		C		0.000	0.000	0.000	0.000	0.000
L2	154.870-116.290	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	11.497	2.124
		C		0.000	0.000	0.000	0.000	0.000
L3	116.290-74.170	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	12.552	2.522
		C		0.000	0.000	0.000	0.000	0.000
L4	74.170-33.340	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	12.167	2.444
		C		0.000	0.000	0.000	0.000	0.000
L5	33.340-0.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	9.041	1.816
		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*
(2) AIR21 (T-Mobile - Existing)	A	From Face	3.500 0.000 0.000	0.000	175.000	No Ice 1/2" Ice	6.533 6.978	4.356 4.775	0.083 0.125
(2) AIR21 (T-Mobile - Existing)	B	From Face	3.500 0.000 0.000	0.000	175.000	No Ice 1/2" Ice	6.533 6.978	4.356 4.775	0.083 0.125
(2) AIR21 (T-Mobile - Existing)	C	From Face	3.500 0.000 0.000	0.000	175.000	No Ice 1/2" Ice	6.533 6.978	4.356 4.775	0.083 0.125
KRY 112 TMA (T-Mobile - Existing)	A	From Face	3.500 0.000 0.000	0.000	175.000	No Ice 1/2" Ice	0.778 0.899	0.486 0.588	0.025 0.031
KRY 112 TMA (T-Mobile - Existing)	B	From Face	3.500 0.000 0.000	0.000	175.000	No Ice 1/2" Ice	0.778 0.899	0.486 0.588	0.025 0.031
KRY 112 TMA (T-Mobile - Existing)	C	From Face	3.500 0.000 0.000	0.000	175.000	No Ice 1/2" Ice	0.778 0.899	0.486 0.588	0.025 0.031
EEI 14-ft Low Profile Platform (T-Mobile - Existing)	C	From Face	2.000 0.000 0.000	0.000	172.000	No Ice 1/2" Ice	16.500 20.000	16.500 20.000	1.550 1.800
BXA-70063/6CF (Verizon - Existing)	A	From Face	3.500 0.000 0.000	0.000	162.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.012 0.054
BXA-70063/6CF (Verizon - Existing)	B	From Face	3.500 0.000 0.000	0.000	162.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.012 0.054
BXA-70063/6CF (Verizon - Existing)	C	From Face	3.500 0.000 0.000	0.000	162.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.012 0.054
LNX-6514DS-VTM (Verizon - Proposed)	A	From Face	3.500 6.000 0.000	0.000	162.000	No Ice 1/2" Ice	8.411 8.964	5.405 5.863	0.039 0.090
HBXX-6517DS (Verizon - Proposed)	A	From Face	3.500 4.000 0.000	0.000	162.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
HBXX-6517DS (Verizon - Proposed)	A	From Face	3.500 -4.000 0.000	0.000	162.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
LNX-6514DS-VTM (Verizon - Proposed)	B	From Face	3.500 6.000 0.000	0.000	162.000	No Ice 1/2" Ice	8.411 8.964	5.405 5.863	0.039 0.090
HBXX-6517DS (Verizon - Proposed)	B	From Face	3.500 4.000 0.000	0.000	162.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
HBXX-6517DS (Verizon - Proposed)	B	From Face	3.500 -4.000 0.000	0.000	162.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
LNX-6514DS-VTM (Verizon - Proposed)	C	From Face	3.500 6.000 0.000	0.000	162.000	No Ice 1/2" Ice	8.411 8.964	5.405 5.863	0.039 0.090

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)
HBXX-6517DS (Verizon - Proposed)	C	From Face	3.500 4.000 0.000	0.000	162.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
HBXX-6517DS (Verizon - Proposed)	C	From Face	3.500 -4.000 0.000	0.000	162.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
RRH2x60-PCS (Verizon - Proposed)	A	From Face	3.500 4.000 0.000	0.000	162.000	No Ice 1/2" Ice	2.578 2.804	2.030 2.239	0.063 0.083
RRH2x40-07-U (Verizon - Proposed)	A	From Face	3.500 0.000 0.000	0.000	162.000	No Ice 1/2" Ice	2.246 2.447	1.228 1.385	0.050 0.067
RRH2x40-AWS (Verizon - Proposed)	A	From Face	3.500 -4.000 0.000	0.000	162.000	No Ice 1/2" Ice	2.522 2.753	1.589 1.795	0.044 0.061
RRH2x60-PCS (Verizon - Proposed)	B	From Face	3.500 4.000 0.000	0.000	162.000	No Ice 1/2" Ice	2.578 2.804	2.030 2.239	0.063 0.083
RRH2x40-07-U (Verizon - Proposed)	B	From Face	3.500 0.000 0.000	0.000	162.000	No Ice 1/2" Ice	2.246 2.447	1.228 1.385	0.050 0.067
RRH2x40-AWS (Verizon - Proposed)	B	From Face	3.500 -4.000 0.000	0.000	162.000	No Ice 1/2" Ice	2.522 2.753	1.589 1.795	0.044 0.061
RRH2x60-PCS (Verizon - Proposed)	C	From Face	3.500 4.000 0.000	0.000	162.000	No Ice 1/2" Ice	2.578 2.804	2.030 2.239	0.063 0.083
RRH2x40-07-U (Verizon - Proposed)	C	From Face	3.500 0.000 0.000	0.000	162.000	No Ice 1/2" Ice	2.246 2.447	1.228 1.385	0.050 0.067
RRH2x40-AWS (Verizon - Proposed)	C	From Face	3.500 -4.000 0.000	0.000	162.000	No Ice 1/2" Ice	2.522 2.753	1.589 1.795	0.044 0.061
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	A	From Face	3.500 -4.000 0.000	0.000	162.000	No Ice 1/2" Ice	5.600 5.915	2.333 2.558	0.044 0.080
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	C	From Face	3.500 -4.000 0.000	0.000	162.000	No Ice 1/2" Ice	5.600 5.915	2.333 2.558	0.044 0.080
EEI 14-ft Low Profile Platform (Verizon - Existing)	C	From Face	2.000 0.000 0.000	0.000	160.000	No Ice 1/2" Ice	16.500 20.000	16.500 20.000	1.550 1.800
APXV18-206516S-C-A20 (MetroPCS - Existing)	A	From Face	3.500 -5.000 0.000	0.000	152.000	No Ice 1/2" Ice	3.621 3.965	2.008 2.332	0.032 0.052
APXV18-206516S-C-A20 (MetroPCS - Existing)	B	From Face	3.500 -5.000 0.000	0.000	152.000	No Ice 1/2" Ice	3.621 3.965	2.008 2.332	0.032 0.052
APXV18-206516S-C-A20 (MetroPCS - Existing)	C	From Face	3.500 -5.000 0.000	0.000	152.000	No Ice 1/2" Ice	3.621 3.965	2.008 2.332	0.032 0.052
APXV18-206516S-C-A20 (MetroPCS - Reserved)	A	From Face	3.500 5.000 0.000	0.000	152.000	No Ice 1/2" Ice	3.621 3.965	2.008 2.332	0.032 0.052
APXV18-206516S-C-A20 (MetroPCS - Reserved)	B	From Face	3.500 5.000 0.000	0.000	152.000	No Ice 1/2" Ice	3.621 3.965	2.008 2.332	0.032 0.052

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert* *ft ft ft*	*Azimuth Adjustment* *°*	*Placement* *ft*		*C_AA_A Front* *ft^2*	*C_AA_A Side* *ft^2*	*Weight* *K*
APXV18-206516S-C-A20 (MetroPCS - Reserved)	C	From Face	3.500 5.000 0.000	0.000	152.000	No Ice 1/2" Ice	3.621 3.965	2.008 2.332	0.032 0.052
EEI 14-ft Low Profile Platform (MetroPCS - Existing)	C	From Face	2.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice	16.500 20.000	16.500 20.000	1.550 1.800
7770.00 (AT&T - Existing)	A	From Face	3.500 -6.000 0.000	0.000	145.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
AM-X-CD-14-65-00T-RET (AT&T - Existing)	A	From Face	3.500 2.000 0.000	0.000	145.000	No Ice 1/2" Ice	5.507 5.899	2.828 3.137	0.037 0.069
AM-X-CD-14-65-00T-RET (AT&T - Existing)	A	From Face	3.500 6.000 0.000	0.000	145.000	No Ice 1/2" Ice	5.507 5.899	2.828 3.137	0.037 0.069
7770.00 (AT&T - Existing)	B	From Face	3.500 -6.000 0.000	0.000	145.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
AM-X-CD-16-65-00T-RET(72") (AT&T - Existing)	B	From Face	3.500 2.000 0.000	0.000	145.000	No Ice 1/2" Ice	8.260 8.807	4.642 5.088	0.050 0.096
AM-X-CD-16-65-00T-RET(72") (AT&T - Existing)	B	From Face	3.500 6.000 0.000	0.000	145.000	No Ice 1/2" Ice	8.260 8.807	4.642 5.088	0.050 0.096
7770.00 (AT&T - Existing)	C	From Face	3.500 -6.000 0.000	0.000	145.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
AM-X-CD-16-65-00T-RET(72") (AT&T - Existing)	C	From Face	3.500 2.000 0.000	0.000	145.000	No Ice 1/2" Ice	8.260 8.807	4.642 5.088	0.050 0.096
AM-X-CD-16-65-00T-RET(72") (AT&T - Existing)	C	From Face	3.500 6.000 0.000	0.000	145.000	No Ice 1/2" Ice	8.260 8.807	4.642 5.088	0.050 0.096
(2) DTMABP7819VG12A TMA (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	145.000	No Ice 1/2" Ice	1.588 1.759	0.578 0.701	0.020 0.030
(2) DTMABP7819VG12A TMA (AT&T - Existing)	B	From Face	3.500 0.000 0.000	0.000	145.000	No Ice 1/2" Ice	1.588 1.759	0.578 0.701	0.020 0.030
(2) DTMABP7819VG12A TMA (AT&T - Existing)	C	From Face	3.500 0.000 0.000	0.000	145.000	No Ice 1/2" Ice	1.588 1.759	0.578 0.701	0.020 0.030
(2) RRUS-11 (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	145.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Existing)	B	From Face	3.500 0.000 0.000	0.000	145.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Existing)	C	From Face	3.500 0.000 0.000	0.000	145.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	145.000	No Ice 1/2" Ice	2.228 2.447	2.228 2.447	0.020 0.039
EEI 14-ft Low Profile Platform (AT&T - Existing)	C	From Face	2.000 0.000 0.000	0.000	142.000	No Ice 1/2" Ice	16.500 20.000	16.500 20.000	1.550 1.800

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 175.000-154.870	164.607	1.583	0.037	45.007	A	0.000	45.007	45.007	100.00	0.000	0.000
					B	0.000	45.007		100.00	0.000	1.610
					C	0.000	45.007		100.00	0.000	0.000
L2 154.870-116.290	134.837	1.495	0.035	109.394	A	0.000	109.394	109.394	100.00	0.000	0.000
					B	0.000	109.394		100.00	0.000	7.639
					C	0.000	109.394		100.00	0.000	0.000
L3 116.290-74.170	94.692	1.351	0.031	153.227	A	0.000	153.227	153.227	100.00	0.000	0.000
					B	0.000	153.227		100.00	0.000	8.340
					C	0.000	153.227		100.00	0.000	0.000
L4 74.170-33.340	53.646	1.149	0.026	181.441	A	0.000	181.441	181.441	100.00	0.000	0.000
					B	0.000	181.441		100.00	0.000	8.084
					C	0.000	181.441		100.00	0.000	0.000
L5 33.340-0.000	16.285	1	0.023	171.490	A	0.000	171.490	171.490	100.00	0.000	0.000
					B	0.000	171.490		100.00	0.000	6.007
					C	0.000	171.490		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 175.000-154.870	164.607	1.583	0.027	0.500	46.685	A	0.000	46.685	46.685	100.00	0.000	0.000
						B	0.000	46.685		100.00	0.000	2.423
						C	0.000	46.685		100.00	0.000	0.000
L2 154.870-116.290	134.837	1.495	0.026	0.500	112.609	A	0.000	112.609	112.609	100.00	0.000	0.000
						B	0.000	112.609		100.00	0.000	11.497
						C	0.000	112.609		100.00	0.000	0.000
L3 116.290-74.170	94.692	1.351	0.023	0.500	156.737	A	0.000	156.737	156.737	100.00	0.000	0.000
						B	0.000	156.737		100.00	0.000	12.552
						C	0.000	156.737		100.00	0.000	0.000
L4 74.170-33.340	53.646	1.149	0.020	0.500	184.843	A	0.000	184.843	184.843	100.00	0.000	0.000
						B	0.000	184.843		100.00	0.000	12.167
						C	0.000	184.843		100.00	0.000	0.000
L5 33.340-0.000	16.285	1	0.017	0.500	174.268	A	0.000	174.268	174.268	100.00	0.000	0.000
						B	0.000	174.268		100.00	0.000	9.041
						C	0.000	174.268		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 ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 175.000-154.870	164.607	1.583	0.010	45.007	A	0.000	45.007	45.007	100.00	0.000	0.000
					B	0.000	45.007		100.00	0.000	1.610
					C	0.000	45.007		100.00	0.000	0.000
L2 154.870-116.290	134.837	1.495	0.010	109.394	A	0.000	109.394	109.394	100.00	0.000	0.000
					B	0.000	109.394		100.00	0.000	7.639
					C	0.000	109.394		100.00	0.000	0.000
L3 116.290-74.170	94.692	1.351	0.009	153.227	A	0.000	153.227	153.227	100.00	0.000	0.000
					B	0.000	153.227		100.00	0.000	8.340
					C	0.000	153.227		100.00	0.000	0.000
L4 74.170-33.340	53.646	1.149	0.007	181.441	A	0.000	181.441	181.441	100.00	0.000	0.000
					B	0.000	181.441		100.00	0.000	8.084
					C	0.000	181.441		100.00	0.000	0.000
L5 33.340-0.000	16.285	1	0.006	171.490	A	0.000	171.490	171.490	100.00	0.000	0.000
					B	0.000	171.490		100.00	0.000	6.007
					C	0.000	171.490		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 ft²	F K	w klf	Ctrl. Face
L1 175.000-154.870	0.393	1.086	A	1	0.65	1	1	1	45.007	1.907	0.095	C
			B	1	0.65	1	1	1	45.007			
			C	1	0.65	1	1	1	45.007			
L2 154.870-116.290	2.007	5.743	A	1	0.65	1	1	1	109.394	4.592	0.119	C
			B	1	0.65	1	1	1	109.394			
			C	1	0.65	1	1	1	109.394			
L3 116.290-74.170	2.394	10.900	A	1	0.65	1	1	1	153.227	5.683	0.135	C
			B	1	0.65	1	1	1	153.227			
			C	1	0.65	1	1	1	153.227			
L4 74.170-33.340	2.321	14.978	A	1	0.65	1	1	1	181.441	5.615	0.138	C
			B	1	0.65	1	1	1	181.441			
			C	1	0.65	1	1	1	181.441			
L5 33.340-0.000	1.725	16.701	A	1	0.65	1	1	1	171.490	4.587	0.138	C
			B	1	0.65	1	1	1	171.490			
			C	1	0.65	1	1	1	171.490			
Sum Weight:	8.839	49.408						OTM	1847.257 kip-ft	22.385		

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 ft²	F K	w klf	Ctrl. Face
L1 175.000-154.870	0.393	1.086	A	1	0.65	1	1	1	45.007	1.907	0.095	C
			B	1	0.65	1	1	1	45.007			
			C	1	0.65	1	1	1	45.007			

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
L2 154.870-116.290	2.007	5.743	A	1	0.65	1	1	1	109.394	4.592	0.119	C
			B	1	0.65	1	1	1	109.394			
			C	1	0.65	1	1	1	109.394			
L3 116.290-74.170	2.394	10.900	A	1	0.65	1	1	1	153.227	5.683	0.135	C
			B	1	0.65	1	1	1	153.227			
			C	1	0.65	1	1	1	153.227			
L4 74.170-33.340	2.321	14.978	A	1	0.65	1	1	1	181.441	5.615	0.138	C
			B	1	0.65	1	1	1	181.441			
			C	1	0.65	1	1	1	181.441			
L5 33.340-0.000	1.725	16.701	A	1	0.65	1	1	1	171.490	4.587	0.138	C
			B	1	0.65	1	1	1	171.490			
			C	1	0.65	1	1	1	171.490			
Sum Weight:	8.839	49.408						OTM	1847.257 kip-ft	22.385		

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 175.000-154.870	0.393	1.086	A	1	0.65	1	1	1	45.007	1.907	0.095	C
			B	1	0.65	1	1	1	45.007			
			C	1	0.65	1	1	1	45.007			
L2 154.870-116.290	2.007	5.743	A	1	0.65	1	1	1	109.394	4.592	0.119	C
			B	1	0.65	1	1	1	109.394			
			C	1	0.65	1	1	1	109.394			
L3 116.290-74.170	2.394	10.900	A	1	0.65	1	1	1	153.227	5.683	0.135	C
			B	1	0.65	1	1	1	153.227			
			C	1	0.65	1	1	1	153.227			
L4 74.170-33.340	2.321	14.978	A	1	0.65	1	1	1	181.441	5.615	0.138	C
			B	1	0.65	1	1	1	181.441			
			C	1	0.65	1	1	1	181.441			
L5 33.340-0.000	1.725	16.701	A	1	0.65	1	1	1	171.490	4.587	0.138	C
			B	1	0.65	1	1	1	171.490			
			C	1	0.65	1	1	1	171.490			
Sum Weight:	8.839	49.408						OTM	1847.257 kip-ft	22.385		

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 175.000-154.870	0.393	1.086	A	1	0.65	1	1	1	45.007	1.907	0.095	C
			B	1	0.65	1	1	1	45.007			
			C	1	0.65	1	1	1	45.007			
L2 154.870-116.290	2.007	5.743	A	1	0.65	1	1	1	109.394	4.592	0.119	C
			B	1	0.65	1	1	1	109.394			
			C	1	0.65	1	1	1	109.394			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L3	2.394	10.900	A	1	0.65	1	1	1	153.227	5.683	0.135	C
116.290-74.17			B	1	0.65	1	1	1	153.227			
0			C	1	0.65	1	1	1	153.227			
L4	2.321	14.978	A	1	0.65	1	1	1	181.441	5.615	0.138	C
74.170-33.340			B	1	0.65	1	1	1	181.441			
			C	1	0.65	1	1	1	181.441			
L5	1.725	16.701	A	1	0.65	1	1	1	171.490	4.587	0.138	C
33.340-0.000			B	1	0.65	1	1	1	171.490			
			C	1	0.65	1	1	1	171.490			
Sum Weight:	8.839	49.408						OTM	1847.257 kip-ft	22.385		

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	0.418	1.426	A	1	0.65	1	1	1	46.685	1.519	0.075	C
175.000-154.8			B	1	0.65	1	1	1	46.685			
70			C	1	0.65	1	1	1	46.685			
L2	2.124	6.565	A	1	0.65	1	1	1	112.609	3.705	0.096	C
154.870-116.2			B	1	0.65	1	1	1	112.609			
90			C	1	0.65	1	1	1	112.609			
L3	2.522	12.048	A	1	0.65	1	1	1	156.737	4.518	0.107	C
116.290-74.17			B	1	0.65	1	1	1	156.737			
0			C	1	0.65	1	1	1	156.737			
L4	2.444	16.335	A	1	0.65	1	1	1	184.843	4.422	0.108	C
74.170-33.340			B	1	0.65	1	1	1	184.843			
			C	1	0.65	1	1	1	184.843			
L5	1.816	17.981	A	1	0.65	1	1	1	174.268	3.582	0.107	C
33.340-0.000			B	1	0.65	1	1	1	174.268			
			C	1	0.65	1	1	1	174.268			
Sum Weight:	9.324	54.354						OTM	1472.913 kip-ft	17.745		

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	0.418	1.426	A	1	0.65	1	1	1	46.685	1.519	0.075	C
175.000-154.8			B	1	0.65	1	1	1	46.685			
70			C	1	0.65	1	1	1	46.685			
L2	2.124	6.565	A	1	0.65	1	1	1	112.609	3.705	0.096	C
154.870-116.2			B	1	0.65	1	1	1	112.609			
90			C	1	0.65	1	1	1	112.609			
L3	2.522	12.048	A	1	0.65	1	1	1	156.737	4.518	0.107	C
116.290-74.17			B	1	0.65	1	1	1	156.737			
0			C	1	0.65	1	1	1	156.737			

Section Elevation *ft*	*Add Weight* *K*	*Self Weight* *K*	*Face*	*e*	*C_F*	*R_R*	*D_F*	*D_R*	*A_E* *ft^2*	*F* *K*	*w* *klf*	*Ctrl. Face*
L4 74.170-33.340	2.444	16.335	A	1	0.65	1	1	1	184.843	4.422	0.108	C
			B	1	0.65	1	1	1	184.843			
			C	1	0.65	1	1	1	184.843			
L5 33.340-0.000	1.816	17.981	A	1	0.65	1	1	1	174.268	3.582	0.107	C
			B	1	0.65	1	1	1	174.268			
			C	1	0.65	1	1	1	174.268			
Sum Weight:	9.324	54.354						OTM	1472.913 kip-ft	17.745		

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 175.000-154.870	0.418	1.426	A	1	0.65	1	1	1	46.685	1.519	0.075	C
			B	1	0.65	1	1	1	46.685			
			C	1	0.65	1	1	1	46.685			
L2 154.870-116.290	2.124	6.565	A	1	0.65	1	1	1	112.609	3.705	0.096	C
			B	1	0.65	1	1	1	112.609			
			C	1	0.65	1	1	1	112.609			
L3 116.290-74.170	2.522	12.048	A	1	0.65	1	1	1	156.737	4.518	0.107	C
			B	1	0.65	1	1	1	156.737			
			C	1	0.65	1	1	1	156.737			
L4 74.170-33.340	2.444	16.335	A	1	0.65	1	1	1	184.843	4.422	0.108	C
			B	1	0.65	1	1	1	184.843			
			C	1	0.65	1	1	1	184.843			
L5 33.340-0.000	1.816	17.981	A	1	0.65	1	1	1	174.268	3.582	0.107	C
			B	1	0.65	1	1	1	174.268			
			C	1	0.65	1	1	1	174.268			
Sum Weight:	9.324	54.354						OTM	1472.913 kip-ft	17.745		

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 175.000-154.870	0.418	1.426	A	1	0.65	1	1	1	46.685	1.519	0.075	C
			B	1	0.65	1	1	1	46.685			
			C	1	0.65	1	1	1	46.685			
L2 154.870-116.290	2.124	6.565	A	1	0.65	1	1	1	112.609	3.705	0.096	C
			B	1	0.65	1	1	1	112.609			
			C	1	0.65	1	1	1	112.609			
L3 116.290-74.170	2.522	12.048	A	1	0.65	1	1	1	156.737	4.518	0.107	C
			B	1	0.65	1	1	1	156.737			
			C	1	0.65	1	1	1	156.737			
L4 74.170-33.340	2.444	16.335	A	1	0.65	1	1	1	184.843	4.422	0.108	C
			B	1	0.65	1	1	1	184.843			
			C	1	0.65	1	1	1	184.843			

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
L5 33.340-0.000	1.816	17.981	A	1	0.65	1	1	1	174.268	3.582	0.107	C
			B	1	0.65	1	1	1	174.268			
			C	1	0.65	1	1	1	174.268			
Sum Weight:	9.324	54.354						OTM	1472.913 kip-ft	17.745		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 175.000-154.870	0.393	1.086	A	1	0.65	1	1	1	45.007	0.528	0.026	C
			B	1	0.65	1	1	1	45.007			
			C	1	0.65	1	1	1	45.007			
L2 154.870-116.290	2.007	5.743	A	1	0.65	1	1	1	109.394	1.272	0.033	C
			B	1	0.65	1	1	1	109.394			
			C	1	0.65	1	1	1	109.394			
L3 116.290-74.170	2.394	10.900	A	1	0.65	1	1	1	153.227	1.574	0.037	C
			B	1	0.65	1	1	1	153.227			
			C	1	0.65	1	1	1	153.227			
L4 74.170-33.340	2.321	14.978	A	1	0.65	1	1	1	181.441	1.555	0.038	C
			B	1	0.65	1	1	1	181.441			
			C	1	0.65	1	1	1	181.441			
L5 33.340-0.000	1.725	16.701	A	1	0.65	1	1	1	171.490	1.271	0.038	C
			B	1	0.65	1	1	1	171.490			
			C	1	0.65	1	1	1	171.490			
Sum Weight:	8.839	49.408						OTM	511.706 kip-ft	6.201		

Tower Forces - Service - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 175.000-154.870	0.393	1.086	A	1	0.65	1	1	1	45.007	0.528	0.026	C
			B	1	0.65	1	1	1	45.007			
			C	1	0.65	1	1	1	45.007			
L2 154.870-116.290	2.007	5.743	A	1	0.65	1	1	1	109.394	1.272	0.033	C
			B	1	0.65	1	1	1	109.394			
			C	1	0.65	1	1	1	109.394			
L3 116.290-74.170	2.394	10.900	A	1	0.65	1	1	1	153.227	1.574	0.037	C
			B	1	0.65	1	1	1	153.227			
			C	1	0.65	1	1	1	153.227			
L4 74.170-33.340	2.321	14.978	A	1	0.65	1	1	1	181.441	1.555	0.038	C
			B	1	0.65	1	1	1	181.441			
			C	1	0.65	1	1	1	181.441			
L5 33.340-0.000	1.725	16.701	A	1	0.65	1	1	1	171.490	1.271	0.038	C
			B	1	0.65	1	1	1	171.490			
			C	1	0.65	1	1	1	171.490			

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
Sum Weight:	8.839	49.408						OTM	511.706 kip-ft	6.201		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 175.000-154.870	0.393	1.086	A	1	0.65	1	1	1	45.007	0.528	0.026	C
			B	1	0.65	1	1	1	45.007			
			C	1	0.65	1	1	1	45.007			
L2 154.870-116.290	2.007	5.743	A	1	0.65	1	1	1	109.394	1.272	0.033	C
			B	1	0.65	1	1	1	109.394			
			C	1	0.65	1	1	1	109.394			
L3 116.290-74.170	2.394	10.900	A	1	0.65	1	1	1	153.227	1.574	0.037	C
			B	1	0.65	1	1	1	153.227			
			C	1	0.65	1	1	1	153.227			
L4 74.170-33.340	2.321	14.978	A	1	0.65	1	1	1	181.441	1.555	0.038	C
			B	1	0.65	1	1	1	181.441			
			C	1	0.65	1	1	1	181.441			
L5 33.340-0.000	1.725	16.701	A	1	0.65	1	1	1	171.490	1.271	0.038	C
			B	1	0.65	1	1	1	171.490			
			C	1	0.65	1	1	1	171.490			
Sum Weight:	8.839	49.408						OTM	511.706 kip-ft	6.201		

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 175.000-154.870	0.393	1.086	A	1	0.65	1	1	1	45.007	0.528	0.026	C
			B	1	0.65	1	1	1	45.007			
			C	1	0.65	1	1	1	45.007			
L2 154.870-116.290	2.007	5.743	A	1	0.65	1	1	1	109.394	1.272	0.033	C
			B	1	0.65	1	1	1	109.394			
			C	1	0.65	1	1	1	109.394			
L3 116.290-74.170	2.394	10.900	A	1	0.65	1	1	1	153.227	1.574	0.037	C
			B	1	0.65	1	1	1	153.227			
			C	1	0.65	1	1	1	153.227			
L4 74.170-33.340	2.321	14.978	A	1	0.65	1	1	1	181.441	1.555	0.038	C
			B	1	0.65	1	1	1	181.441			
			C	1	0.65	1	1	1	181.441			
L5 33.340-0.000	1.725	16.701	A	1	0.65	1	1	1	171.490	1.271	0.038	C
			B	1	0.65	1	1	1	171.490			
			C	1	0.65	1	1	1	171.490			
Sum Weight:	8.839	49.408						OTM	511.706 kip-ft	6.201		

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	49.408					
Bracing Weight	0.000					
Total Member Self-Weight	49.408			20.238	0.116	
Total Weight	67.043			20.238	0.116	
Wind 0 deg - No Ice		-0.039	-40.337	-4660.012	7.182	-0.197
Wind 30 deg - No Ice		20.057	-34.914	-4029.444	-2321.691	7.693
Wind 45 deg - No Ice		28.385	-28.495	-3284.202	-3287.073	10.981
Wind 60 deg - No Ice		34.778	-20.135	-2313.768	-4028.438	13.521
Wind 90 deg - No Ice		40.181	0.039	27.304	-4655.737	15.727
Wind 120 deg - No Ice		34.817	20.202	2366.482	-4035.504	13.719
Wind 135 deg - No Ice		28.439	28.550	3334.670	-3297.065	11.260
Wind 150 deg - No Ice		20.124	34.952	4076.985	-2333.930	8.034
Wind 180 deg - No Ice		0.039	40.337	4700.487	-6.950	0.197
Wind 210 deg - No Ice		-20.057	34.914	4069.920	2321.923	-7.693
Wind 225 deg - No Ice		-28.385	28.495	3324.677	3287.305	-10.981
Wind 240 deg - No Ice		-34.778	20.135	2354.243	4028.670	-13.521
Wind 270 deg - No Ice		-40.181	-0.039	13.172	4655.969	-15.727
Wind 300 deg - No Ice		-34.817	-20.202	-2326.006	4035.736	-13.719
Wind 315 deg - No Ice		-28.439	-28.550	-3294.195	3297.298	-11.260
Wind 330 deg - No Ice		-20.124	-34.952	-4036.510	2334.162	-8.034
Member Ice	4.946					
Total Weight Ice	75.227			23.777	0.207	
Wind 0 deg - Ice		-0.030	-32.744	-3814.991	5.696	-0.178
Wind 30 deg - Ice		16.286	-28.342	-3297.949	-1905.045	6.831
Wind 45 deg - Ice		23.047	-23.132	-2686.761	-2697.068	9.752
Wind 60 deg - Ice		28.238	-16.346	-1890.853	-3305.276	12.009
Wind 90 deg - Ice		32.624	0.030	29.266	-3819.805	13.970
Wind 120 deg - Ice		28.268	16.398	1947.915	-3310.765	12.188
Wind 135 deg - Ice		23.090	23.175	2742.078	-2704.831	10.004
Wind 150 deg - Ice		16.338	28.372	3350.993	-1914.553	7.139
Wind 180 deg - Ice		0.030	32.744	3862.546	-5.282	0.178
Wind 210 deg - Ice		-16.286	28.342	3345.504	1905.459	-6.831
Wind 225 deg - Ice		-23.047	23.132	2734.315	2697.482	-9.752
Wind 240 deg - Ice		-28.238	16.346	1938.408	3305.690	-12.009
Wind 270 deg - Ice		-32.624	-0.030	18.288	3820.219	-13.970
Wind 300 deg - Ice		-28.268	-16.398	-1900.361	3311.179	-12.188
Wind 315 deg - Ice		-23.090	-23.175	-2694.523	2705.245	-10.004
Wind 330 deg - Ice		-16.338	-28.372	-3303.438	1914.967	-7.139
Total Weight	67.043			20.238	0.116	
Wind 0 deg - Service		-0.011	-11.174	-1276.230	2.073	-0.055
Wind 30 deg - Service		5.556	-9.671	-1101.558	-643.044	2.131
Wind 45 deg - Service		7.863	-7.893	-895.120	-910.462	3.042
Wind 60 deg - Service		9.634	-5.578	-626.301	-1115.827	3.746
Wind 90 deg - Service		11.130	0.011	22.195	-1289.594	4.357
Wind 120 deg - Service		9.645	5.596	670.167	-1117.784	3.800
Wind 135 deg - Service		7.878	7.909	938.363	-913.231	3.119
Wind 150 deg - Service		5.574	9.682	1143.991	-646.434	2.226
Wind 180 deg - Service		0.011	11.174	1316.706	-1.841	0.055
Wind 210 deg - Service		-5.556	9.671	1142.033	643.276	-2.131
Wind 225 deg - Service		-7.863	7.893	935.595	910.695	-3.042
Wind 240 deg - Service		-9.634	5.578	666.777	1116.059	-3.746
Wind 270 deg - Service		-11.130	-0.011	18.280	1289.826	-4.357
Wind 300 deg - Service		-9.645	-5.596	-629.691	1118.016	-3.800
Wind 315 deg - Service		-7.878	-7.909	-897.888	913.463	-3.119

Load Case	Vertical Forces K	Sum of Forces X K	Sum of Forces Z K	Sum of Overturning Moments, M_x kip-ft	Sum of Overturning Moments, M_z kip-ft	Sum of Torques kip-ft
Wind 330 deg - Service		-5.574	-9.682	-1103.515	646.666	-2.226

Load Combinations

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

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

Maximum Member Forces

Section No.	*Elevation ft*	*Component Type*	*Condition*	*Gov. Load Comb.*	*Force K*	*Major Axis Moment kip-ft*	*Minor Axis Moment kip-ft*
L1	175 - 154.87	Pole	Max Tension	18	0.000	-0.000	0.000
			Max. Compression	18	-7.705	0.163	-11.721
			Max. Mx	14	-5.099	81.350	-9.284
			Max. My	10	-5.075	-0.159	-91.478
			Max. Vy	14	-12.532	81.350	-9.284
			Max. Vx	10	12.639	-0.159	-91.478
			Max. Torque	14			7.953
L2	154.87 - 116.29	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-20.820	0.212	-24.331
			Max. Mx	14	-15.789	811.841	-17.774
			Max. My	10	-15.763	-2.319	-837.759
			Max. Vy	14	-24.352	811.841	-17.774
			Max. Vx	10	24.520	-2.319	-837.759
			Max. Torque	14			15.943
L3	116.29 - 74.17	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-34.331	0.216	-24.757
			Max. Mx	14	-28.360	1919.472	-16.682
			Max. My	10	-28.344	-3.954	-1952.262
			Max. Vy	14	-29.863	1919.472	-16.682
			Max. Vx	10	30.030	-3.954	-1952.262
			Max. Torque	14			15.930
L4	74.17 - 33.34	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-51.968	0.218	-24.997
			Max. Mx	14	-44.981	3211.131	-15.382
			Max. My	10	-44.973	-5.534	-3250.488
			Max. Vy	14	-35.127	3211.131	-15.382
			Max. Vx	10	35.290	-5.534	-3250.488
			Max. Torque	14			15.913
L5	33.34 - 0	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-75.227	0.218	-24.997
			Max. Mx	14	-67.031	4762.728	-13.839
			Max. My	10	-67.031	-7.145	-4808.690
			Max. Vy	14	-40.201	4762.728	-13.839
			Max. Vx	10	40.357	-7.145	-4808.690
			Max. Torque	14			15.903

Maximum Reactions

Location	*Condition*	*Gov. Load Comb.*	*Vertical K*	*Horizontal, X K*	*Horizontal, Z K*
Pole	Max. Vert	27	75.227	-0.030	-32.744
	Max. H_x	14	67.043	40.181	0.039
	Max. H_z	2	67.043	0.039	40.337
	Max. M_x	2	4766.492	0.039	40.337
	Max. M_z	6	4762.486	-40.181	-0.039
	Max. Torsion	14	15.901	40.181	0.039

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
	Min. Vert	43	67.043	-0.011	-11.174
	Min. H_x	6	67.043	-40.181	-0.039
	Min. H_z	10	67.043	-0.039	-40.337
	Min. M_x	10	-4808.690	-0.039	-40.337
	Min. M_z	14	-4762.728	40.181	0.039
	Min. Torsion	6	-15.901	-40.181	-0.039

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	67.043	0.000	0.000	21.062	0.121	-0.000
Dead+Wind 0 deg - No Ice	67.043	-0.039	-40.337	-4766.492	7.387	-0.195
Dead+Wind 30 deg - No Ice	67.043	20.057	-34.914	-4121.458	-2374.885	7.782
Dead+Wind 45 deg - No Ice	67.043	28.385	-28.495	-3359.117	-3362.411	11.107
Dead+Wind 60 deg - No Ice	67.043	34.778	-20.135	-2366.416	-4120.787	13.674
Dead+Wind 90 deg - No Ice	67.043	40.181	0.039	28.370	-4762.486	15.901
Dead+Wind 120 deg - No Ice	67.043	34.817	20.202	2421.198	-4128.035	13.866
Dead+Wind 135 deg - No Ice	67.043	28.439	28.550	3411.582	-3372.670	11.380
Dead+Wind 150 deg - No Ice	67.043	20.124	34.952	4170.909	-2387.459	8.118
Dead+Wind 180 deg - No Ice	67.043	0.039	40.337	4808.690	-7.145	0.195
Dead+Wind 210 deg - No Ice	67.043	-20.057	34.914	4163.659	2375.124	-7.780
Dead+Wind 225 deg - No Ice	67.043	-28.385	28.495	3401.321	3362.650	-11.104
Dead+Wind 240 deg - No Ice	67.043	-34.778	20.135	2408.622	4121.026	-13.672
Dead+Wind 270 deg - No Ice	67.043	-40.181	-0.039	13.837	4762.728	-15.901
Dead+Wind 300 deg - No Ice	67.043	-34.817	-20.202	-2378.994	4128.281	-13.869
Dead+Wind 315 deg - No Ice	67.043	-28.439	-28.550	-3369.380	3372.915	-11.382
Dead+Wind 330 deg - No Ice	67.043	-20.124	-34.952	-4128.710	2387.704	-8.120
Dead+Ice+Temp	75.227	-0.000	0.000	24.997	0.218	-0.000
Dead+Wind 0 deg+Ice+Temp	75.227	-0.030	-32.744	-3920.526	5.897	-0.176
Dead+Wind 30 deg+Ice+Temp	75.227	16.286	-28.342	-3389.086	-1957.995	6.928
Dead+Wind 45 deg+Ice+Temp	75.227	23.047	-23.132	-2760.884	-2772.057	9.888
Dead+Wind 60 deg+Ice+Temp	75.227	28.238	-16.346	-1942.823	-3397.193	12.175
Dead+Wind 90 deg+Ice+Temp	75.227	32.624	0.030	30.739	-3926.052	14.159
Dead+Wind 120 deg+Ice+Temp	75.227	28.268	16.398	2002.775	-3402.864	12.348
Dead+Wind 135 deg+Ice+Temp	75.227	23.090	23.175	2819.029	-2780.081	10.134
Dead+Wind 150 deg+Ice+Temp	75.227	16.338	28.372	3444.878	-1967.827	7.230
Dead+Wind 180 deg+Ice+Temp	75.227	0.030	32.744	3970.649	-5.460	0.176
Dead+Wind 210 deg+Ice+Temp	75.227	-16.286	28.342	3439.209	1958.433	-6.926
Dead+Wind 225 deg+Ice+Temp	75.227	-23.047	23.132	2811.007	2772.494	-9.886
Dead+Wind 240 deg+Ice+Temp	75.227	-28.238	16.346	1992.945	3397.630	-12.173
Dead+Wind 270 deg+Ice+Temp	75.227	-32.624	-0.030	19.382	3926.489	-14.159
Dead+Wind 300 deg+Ice+Temp	75.227	-28.268	-16.398	-1952.655	3403.299	-12.350
Dead+Wind 315 deg+Ice+Temp	75.227	-23.090	-23.175	-2768.908	2780.516	-10.137
Dead+Wind 330 deg+Ice+Temp	75.227	-16.338	-28.372	-3394.757	1968.262	-7.232
Dead+Wind 0 deg - Service	67.043	-0.011	-11.174	-1305.641	2.136	-0.054
Dead+Wind 30 deg - Service	67.043	5.556	-9.671	-1126.875	-658.077	2.164
Dead+Wind 45 deg - Service	67.043	7.863	-7.893	-915.601	-931.754	3.089
Dead+Wind 60 deg - Service	67.043	9.634	-5.578	-640.488	-1141.926	3.803
Dead+Wind 90 deg - Service	67.043	11.130	0.011	23.191	-1319.764	4.423
Dead+Wind 120 deg - Service	67.043	9.645	5.596	686.331	-1143.940	3.857
Dead+Wind 135 deg - Service	67.043	7.878	7.909	960.803	-934.602	3.165
Dead+Wind 150 deg - Service	67.043	5.574	9.682	1171.242	-661.565	2.258
Dead+Wind 180 deg - Service	67.043	0.011	11.174	1347.995	-1.893	0.054
Dead+Wind 210 deg - Service	67.043	-5.556	9.671	1169.228	658.320	-2.164
Dead+Wind 225 deg - Service	67.043	-7.863	7.893	957.955	931.997	-3.089

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 240 deg - Service	67.043	-9.634	5.578	682.842	1142.169	-3.803
Dead+Wind 270 deg - Service	67.043	-11.130	-0.011	19.163	1320.007	-4.423
Dead+Wind 300 deg - Service	67.043	-9.645	-5.596	-643.977	1144.183	-3.857
Dead+Wind 315 deg - Service	67.043	-7.878	-7.909	-918.450	934.846	-3.166
Dead+Wind 330 deg - Service	67.043	-5.574	-9.682	-1128.889	661.809	-2.258

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
1	0.000	-67.043	0.000	0.000	67.043	-0.000	0.000%
2	-0.039	-67.043	-40.337	0.039	67.043	40.337	0.000%
3	20.057	-67.043	-34.914	-20.057	67.043	34.914	0.000%
4	28.385	-67.043	-28.495	-28.385	67.043	28.495	0.000%
5	34.778	-67.043	-20.135	-34.778	67.043	20.135	0.000%
6	40.181	-67.043	0.039	-40.181	67.043	-0.039	0.000%
7	34.817	-67.043	20.202	-34.817	67.043	-20.202	0.000%
8	28.439	-67.043	28.550	-28.439	67.043	-28.550	0.000%
9	20.124	-67.043	34.952	-20.124	67.043	-34.952	0.000%
10	0.039	-67.043	40.337	-0.039	67.043	-40.337	0.000%
11	-20.057	-67.043	34.914	20.057	67.043	-34.914	0.000%
12	-28.385	-67.043	28.495	28.385	67.043	-28.495	0.000%
13	-34.778	-67.043	20.135	34.778	67.043	-20.135	0.000%
14	-40.181	-67.043	-0.039	40.181	67.043	0.039	0.000%
15	-34.817	-67.043	-20.202	34.817	67.043	20.202	0.000%
16	-28.439	-67.043	-28.550	28.439	67.043	28.550	0.000%
17	-20.124	-67.043	-34.952	20.124	67.043	34.952	0.000%
18	0.000	-75.227	0.000	0.000	75.227	-0.000	0.000%
19	-0.030	-75.227	-32.744	0.030	75.227	32.744	0.000%
20	16.286	-75.227	-28.342	-16.286	75.227	28.342	0.000%
21	23.047	-75.227	-23.132	-23.047	75.227	23.132	0.000%
22	28.238	-75.227	-16.346	-28.238	75.227	16.346	0.000%
23	32.624	-75.227	0.030	-32.624	75.227	-0.030	0.000%
24	28.268	-75.227	16.398	-28.268	75.227	-16.398	0.000%
25	23.090	-75.227	23.175	-23.090	75.227	-23.175	0.000%
26	16.338	-75.227	28.372	-16.338	75.227	-28.372	0.000%
27	0.030	-75.227	32.744	-0.030	75.227	-32.744	0.000%
28	-16.286	-75.227	28.342	16.286	75.227	-28.342	0.000%
29	-23.047	-75.227	23.132	23.047	75.227	-23.132	0.000%
30	-28.238	-75.227	16.346	28.238	75.227	-16.346	0.000%
31	-32.624	-75.227	-0.030	32.624	75.227	0.030	0.000%
32	-28.268	-75.227	-16.398	28.268	75.227	16.398	0.000%
33	-23.090	-75.227	-23.175	23.090	75.227	23.175	0.000%
34	-16.338	-75.227	-28.372	16.338	75.227	28.372	0.000%
35	-0.011	-67.043	-11.174	0.011	67.043	11.174	0.000%
36	5.556	-67.043	-9.671	-5.556	67.043	9.671	0.000%
37	7.863	-67.043	-7.893	-7.863	67.043	7.893	0.000%
38	9.634	-67.043	-5.578	-9.634	67.043	5.578	0.000%
39	11.130	-67.043	0.011	-11.130	67.043	-0.011	0.000%
40	9.645	-67.043	5.596	-9.645	67.043	-5.596	0.000%
41	7.878	-67.043	7.909	-7.878	67.043	-7.909	0.000%
42	5.574	-67.043	9.682	-5.574	67.043	-9.682	0.000%
43	0.011	-67.043	11.174	-0.011	67.043	-11.174	0.000%
44	-5.556	-67.043	9.671	5.556	67.043	-9.671	0.000%
45	-7.863	-67.043	7.893	7.863	67.043	-7.893	0.000%
46	-9.634	-67.043	5.578	9.634	67.043	-5.578	0.000%
47	-11.130	-67.043	-0.011	11.130	67.043	0.011	0.000%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
48	-9.645	-67.043	-5.596	9.645	67.043	5.596	0.000%
49	-7.878	-67.043	-7.909	7.878	67.043	7.909	0.000%
50	-5.574	-67.043	-9.682	5.574	67.043	9.682	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	0.00006543
3	Yes	5	0.00000001	0.00010267
4	Yes	5	0.00000001	0.00010436
5	Yes	5	0.00000001	0.00007332
6	Yes	5	0.00000001	0.00006016
7	Yes	5	0.00000001	0.00012402
8	Yes	5	0.00000001	0.00010914
9	Yes	5	0.00000001	0.00007834
10	Yes	4	0.00000001	0.00005706
11	Yes	5	0.00000001	0.00007761
12	Yes	5	0.00000001	0.00010797
13	Yes	5	0.00000001	0.00012284
14	Yes	5	0.00000001	0.00005937
15	Yes	5	0.00000001	0.00007433
16	Yes	5	0.00000001	0.00010558
17	Yes	5	0.00000001	0.00010416
18	Yes	4	0.00000001	0.00003244
19	Yes	5	0.00000001	0.00006685
20	Yes	5	0.00000001	0.00015398
21	Yes	5	0.00000001	0.00016281
22	Yes	5	0.00000001	0.00013251
23	Yes	5	0.00000001	0.00010467
24	Yes	5	0.00000001	0.00017917
25	Yes	5	0.00000001	0.00017136
26	Yes	5	0.00000001	0.00013790
27	Yes	5	0.00000001	0.00006846
28	Yes	5	0.00000001	0.00013694
29	Yes	5	0.00000001	0.00016995
30	Yes	5	0.00000001	0.00017771
31	Yes	5	0.00000001	0.00010410
32	Yes	5	0.00000001	0.00013373
33	Yes	5	0.00000001	0.00016432
34	Yes	5	0.00000001	0.00015576
35	Yes	4	0.00000001	0.00002027
36	Yes	4	0.00000001	0.00016592
37	Yes	4	0.00000001	0.00017783
38	Yes	4	0.00000001	0.00015687
39	Yes	4	0.00000001	0.00022306
40	Yes	4	0.00000001	0.00025801
41	Yes	4	0.00000001	0.00019959
42	Yes	4	0.00000001	0.00011618
43	Yes	4	0.00000001	0.00002169
44	Yes	4	0.00000001	0.00011351
45	Yes	4	0.00000001	0.00019631
46	Yes	4	0.00000001	0.00025509
47	Yes	4	0.00000001	0.00022233
48	Yes	4	0.00000001	0.00015937

49	Yes	4	0.00000001	0.00018120
50	Yes	4	0.00000001	0.00016989

Maximum Tower Deflections - Service Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °
L1	175 - 154.87	19.867	43	1.046	0.019
L2	159.12 - 116.29	16.433	43	1.008	0.016
L3	121.71 - 74.17	9.304	43	0.767	0.007
L4	80.84 - 33.34	3.929	43	0.471	0.003
L5	41.17 - 0	1.001	43	0.219	0.001

Critical Deflections and Radius of Curvature - Service Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
175.000	(2) AIR21	43	19.867	1.046	0.020	44887
172.000	EEI 14-ft Low Profile Platform	43	19.212	1.041	0.019	44887
162.000	BXA-70063/6CF	43	17.046	1.017	0.017	17312
160.000	EEI 14-ft Low Profile Platform	43	16.619	1.011	0.016	15233
152.000	APXV18-206516S-C-A20	43	14.948	0.976	0.015	11855
150.000	EEI 14-ft Low Profile Platform	43	14.539	0.966	0.014	11342
145.000	7770.00	43	13.538	0.936	0.013	10234
142.000	EEI 14-ft Low Profile Platform	43	12.951	0.917	0.012	9667

Maximum Tower Deflections - Design Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °
L1	175 - 154.87	69.503	10	3.580	0.070
L2	159.12 - 116.29	57.715	10	3.477	0.058
L3	121.71 - 74.17	32.925	10	2.696	0.026
L4	80.84 - 33.34	13.959	10	1.670	0.011
L5	41.17 - 0	3.566	10	0.778	0.004

Critical Deflections and Radius of Curvature - Design Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
175.000	(2) AIR21	10	69.503	3.580	0.070	15643
172.000	EEI 14-ft Low Profile Platform	10	67.257	3.567	0.068	15643
162.000	BXA-70063/6CF	10	59.825	3.505	0.061	6028

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
160.000	EEI 14-ft Low Profile Platform	10	58.358	3.486	0.059	5282
152.000	APXV18-206516S-C-A20	10	52.590	3.381	0.052	3909
150.000	EEI 14-ft Low Profile Platform	10	51.177	3.347	0.051	3695
145.000	7770.00	10	47.703	3.253	0.046	3250
142.000	EEI 14-ft Low Profile Platform	10	45.663	3.191	0.043	3031

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	175 - 154.87 (1)	TP29.45x24.21x0.188	20.130	0.000	0.0	38.990	16.757	-5.075	653.328	0.008
L2	154.87 - 116.29 (2)	TP38.99x27.969x0.375	42.830	0.000	0.0	39.000	44.301	-15.763	1727.760	0.009
L3	116.29 - 74.17 (3)	TP49.07x36.845x0.5	47.540	0.000	0.0	39.000	74.359	-28.344	2899.990	0.010
L4	74.17 - 33.34 (4)	TP58.58x46.355x0.563	47.500	0.000	0.0	39.000	99.985	-44.973	3899.420	0.012
L5	33.34 - 0 (5)	TP66x55.44x0.625	41.170	0.000	0.0	39.000	129.688	-67.031	5057.820	0.013

Pole Bending Design Data

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
L1	175 - 154.87 (1)	TP29.45x24.21x0.188	91.478	9.418	38.990	0.242	0.000	0.000	38.990	0.000
L2	154.87 - 116.29 (2)	TP38.99x27.969x0.375	837.758	24.762	39.000	0.635	0.000	0.000	39.000	0.000
L3	116.29 - 74.17 (3)	TP49.07x36.845x0.5	1952.267	27.326	39.000	0.701	0.000	0.000	39.000	0.000
L4	74.17 - 33.34 (4)	TP58.58x46.355x0.563	3250.492	28.291	39.000	0.725	0.000	0.000	39.000	0.000
L5	33.34 - 0 (5)	TP66x55.44x0.625	4808.692	27.628	39.000	0.708	0.000	0.000	39.000	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	175 - 154.87 (1)	TP29.45x24.21x0.188	12.639	0.754	26.000	0.058	0.111	0.006	26.000	0.000
L2	154.87 - 116.29 (2)	TP38.99x27.969x0.375	24.520	0.553	26.000	0.043	0.196	0.003	26.000	0.000

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio f_v / F_v	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio f_{vt} / F_{vt}
L3	116.29 - 74.17 (3)	TP49.07x36.845x0.5	30.030	0.404	26.000	0.031	0.195	0.001	26.000	0.000
L4	74.17 - 33.34 (4)	TP58.58x46.355x0.563	35.290	0.353	26.000	0.027	0.195	0.001	26.000	0.000
L5	33.34 - 0 (5)	TP66x55.44x0.625	40.357	0.311	26.000	0.024	0.195	0.001	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio P / P_a	Ratio f_{bx} / F_{bx}	Ratio f_{by} / F_{by}	Ratio f_v / F_v	Ratio f_{vt} / F_{vt}	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	175 - 154.87 (1)	0.008	0.242	0.000	0.058	0.000	0.250 ✔	1.333	H1-3+VT ✔
L2	154.87 - 116.29 (2)	0.009	0.635	0.000	0.043	0.000	0.645 ✔	1.333	H1-3+VT ✔
L3	116.29 - 74.17 (3)	0.010	0.701	0.000	0.031	0.000	0.711 ✔	1.333	H1-3+VT ✔
L4	74.17 - 33.34 (4)	0.012	0.725	0.000	0.027	0.000	0.737 ✔	1.333	H1-3+VT ✔
L5	33.34 - 0 (5)	0.013	0.708	0.000	0.024	0.000	0.722 ✔	1.333	H1-3+VT ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
L1	175 - 154.87	Pole	TP29.45x24.21x0.188	1	-5.075	870.886	18.8	Pass
L2	154.87 - 116.29	Pole	TP38.99x27.969x0.375	2	-15.763	2303.104	48.3	Pass
L3	116.29 - 74.17	Pole	TP49.07x36.845x0.5	3	-28.344	3865.687	53.3	Pass
L4	74.17 - 33.34	Pole	TP58.58x46.355x0.563	4	-44.973	5197.927	55.3	Pass
L5	33.34 - 0	Pole	TP66x55.44x0.625	5	-67.031	6742.074	54.1	Pass
							Summary	
						Pole (L4)	55.3	Pass
						RATING =	**55.3**	**Pass**

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	OM := 4809·ft·kips	(Input From tnxTower)
Shear Force =	Shear := 40·kips	(Input From tnxTower)
Axial Force =	Axial := 67·kips	(Input From tnxTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	N := 32	(User Input)
Diameter of Bolt Circle =	D_{bc} := 75.00·in	(User Input)
Bolt "Column" Distance =	l := 3.0·in	(User Input)
Bolt Ultimate Strength =	F_u := 100·ksi	(User Input)
Bolt Yield Strength =	F_y := 75·ksi	(User Input)
Bolt Modulus =	E := 29000·ksi	(User Input)
Diameter of Anchor Bolts =	D := 2.25·in	(User Input)
Threads per Inch =	n := 4.5	(User Input)

Base Plate Data:

Use ASTM A871 60

Plate Yield Strength =	Fy_{bp} := 60·ksi	(User Input)
Base Plate Thickness =	t_{bp} := 2.5·in	(User Input)
Base Plate Diameter =	D_{bp} := 81.00·in	(User Input)
Outer Pole Diameter =	D_{pole} := 66.00·in	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =: $R_{bc} := \frac{D_{bc}}{2} = 37.5 \cdot in$

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

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

$d_1 = 7.32 \cdot in$	$d_7 = 36.78 \cdot in$
$d_2 = 14.35 \cdot in$	$d_8 = 37.50 \cdot in$
$d_3 = 20.83 \cdot in$	$d_9 = 36.78 \cdot in$
$d_4 = 26.52 \cdot in$	$d_{10} = 34.65 \cdot in$
$d_5 = 31.18 \cdot in$	$d_{11} = 31.18 \cdot in$
$d_6 = 34.65 \cdot in$	etc.

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 33 \cdot in$

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

$MA_1 = 0.00 \cdot in$	$MA_7 = 3.78 \cdot in$
$MA_2 = 0.00 \cdot in$	$MA_8 = 4.50 \cdot in$
$MA_3 = 0.00 \cdot in$	$MA_9 = 3.78 \cdot in$
$MA_4 = 0.00 \cdot in$	$MA_{10} = 1.65 \cdot in$
$MA_5 = 0.00 \cdot in$	$MA_{11} = 0.00 \cdot in$
$MA_6 = 1.65 \cdot in$	etc

Effective Width of Baseplate for Bending = $B_{eff} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 37.6 \cdot in$

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i (d_i)^2 = 2.25 \times 10^4 \cdot in^2$

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

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

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

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

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

Check Anchor Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 94.1 \cdot kips$

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

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

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Net}} \cdot 100 = 48$ 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 = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.312 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 4.5 \cdot ksi$

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

Check Combined Stress Requirement:

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

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

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

Check Anchor Bolt Compression/Combined Stress:

Maximum Compressive Force = $C_{Max} := OM \cdot \frac{R_{bc}}{I_p} + \frac{Axial}{N} = 98.3 \cdot kips$

Maximum Compressive Stress = $f_a := \frac{C_{Max}}{A_n} = 30.3 \cdot ksi$

$K := 0.65$

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

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

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

Combined Stress % of Capacity = $\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) \cdot 100 = 50.4$

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

$C_1 = 20.9 \cdot kips$	$C_7 = 96.4 \cdot kips$
$C_2 = 38.9 \cdot kips$	$C_8 = 98.3 \cdot kips$
$C_3 = 55.5 \cdot kips$	$C_9 = 96.4 \cdot kips$
$C_4 = 70.1 \cdot kips$	$C_{10} = 91.0 \cdot kips$
$C_5 = 82.1 \cdot kips$	$C_{11} = 82.1 \cdot kips$
$C_6 = 91.0 \cdot kips$	etc.

Maximum Bending Stress in Plate = $f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} \cdot t_{bp}^2\right)} = 37.6 \cdot ksi$

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

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} \cdot 100 = 62.8$

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

Condition3 = "Ok"

Standard Monopole Foundation:

Input Data:

Tower Data

Overturning Moment =	$OM := 4809 \cdot ft \cdot kips$	(User Input from tnxTower)
Shear Force =	$Shear := 40 \cdot kip$	(User Input from tnxTower)
Axial Force =	$Axial := 67 \cdot kip$	(User Input from tnxTower)
Tower Height =	$H_t := 175 \cdot ft$	(User Input)

Footing Data:

Overall Depth of Footing =	$D_f := 4.5 \cdot ft$	(User Input)
Length of Pier =	$L_p := 2.5 \cdot ft$	(User Input)
Extension of Pier Above Grade =	$L_{pag} := 1.0 \cdot ft$	(User Input)
Diameter of Pier =	$d_p := 8.0 \cdot ft$	(User Input)
Thickness of Footing =	$T_f := 3.0 \cdot ft$	(User Input)
Width of Footing =	$W_f := 34.0 \cdot ft$	(User Input)

Anchor Bolt Data:

Length of Anchor Bolts =	$L_{st} := 72 \cdot in$	(User Input)
Projection of Anchor Bolts Above Pier =	$A_{BP} := 12.0 \cdot in$	(User Input)
Anchor Bolt Diameter =	$d_{anchor} := 2.25 \cdot in$	(User Input)
Base Plate Bolt Circle =	$MP := 75.00 \cdot in$	(User Input)

Material Properties:

Concrete Compressive Strength =	$f_c := 4000 \cdot psi$	(User Input)	
Steel Reinforcment Yield Strength =	$f_y := 60000 \cdot psi$	(User Input)	
Anchor Bolt Yield Strength =	$f_{ya} := 75000 \cdot psi$	(User Input)	
Internal Friction Angle of Soil =	$\Phi_s := 30 \cdot deg$	(User Input)	
Allowable Soil Bearing Capacity =	$q_s := 6000 \cdot psf$	(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 =	$NB_{pier} := 60$	(User Input)	
Clear Cover of Reinforcement =	$Cvr_{pier} := 3 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Diameter of Tie =	$d_{Tie} := 0.5 \cdot in$	(User Input)	

Pad Reinforcement:

Bar Size =	$BS_{top} := 9$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 1.128 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 36$	(User Input)	(Top of Pad)
Bar Size =	$BS_{bot} := 9$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{bbot} := 1.128 \cdot in$	(User Input)	(Bottom of Pad)
Number of Bars =	$NB_{bot} := 68$	(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 = $$A_{btop} := \frac{\pi \cdot d_{btop}^2}{4} = 0.999 \cdot in^2$$

Pad Bottom Reinforcement Bar Area = $$A_{bbot} := \frac{\pi \cdot d_{bbot}^2}{4} = 0.999 \cdot in^2$$

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

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

Stability of Footing:

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

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

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

$P_{pt} := K_p\cdot\gamma_s\cdot(D_f - T_f) + c\cdot 2\cdot\sqrt{K_p} = 0.45\cdot\text{ksf}$

$P_{top} := \text{if}\left[n < (D_f - T_f), P_{pt}, P_{pn}\right] = 0.45\cdot\text{ksf}$

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

$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 0.9\cdot\text{ksf}$

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

$A_p := W_f\cdot T_p = 102$

Ultimate Shear = $S_u := P_{ave}\cdot A_p = 91.8\cdot\text{kip}$

Weight of Concrete Pad = $WT_c := \left[\left(W_f^2\cdot T_f\right) + d_p^2\cdot L_p\right]\cdot\gamma_c = 544.2\cdot\text{kip}$

Weight of Soil Above Footing = $WT_{s1} := \left[\left(W_f^2 - d_p^2\right)\cdot\begin{vmatrix}(L_p - L_{pag} - n) & \text{if } (L_p - L_{pag} - n) \ge 0 \\ 0 & \text{if } (L_p - L_{pag} - n) \le 0\end{vmatrix}\right]\cdot\gamma_s = 163.8\cdot\text{kip}$

Weight of Soil Wedge at Back Face = $WT_{s2} := \left(\frac{D_f^2\cdot\tan(\Phi_s)}{2}\cdot W_f\right)\cdot\gamma_s = 19.875\cdot\text{kip}$

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

Total Weight = $WT_{tot} := WT_c + WT_{s1} + \text{Axial} = 775\cdot\text{kip}$

Resisting Moment = $M_r := (WT_{tot})\cdot\frac{W_f}{2} + S_u\cdot\frac{T_f}{3} + \left[(WT_{s2} + WT_{s3})\cdot\left(W_f + \frac{D_f\cdot\tan(\Phi_s)}{3}\right)\right] = 14082\cdot\text{kip}\cdot\text{ft}$

Overturning Moment = $M_{ot} := OM + \text{Shear}\cdot(L_p + T_f) = 5029\cdot\text{kip}\cdot\text{ft}$

Factor of Safety Actual = $FS := \frac{M_r}{M_{ot}} = 2.8$

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 = $S_p := \frac{\mu \cdot WT_{tot}}{FS_{req}} = 174.375 \cdot kips$

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

Shear_Check = "Okay"

Bearing Pressure Caused by Footing:

Area of the Mat = $A_{mat} := W_f^{\,2} = 1.156 \times 10^3$

Section Modulus of Mat = $S := \frac{W_f^{\,3}}{6} = 6550.67 \cdot ft^3$

Maximum Pressure in Mat = $P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S} = 1.438 \cdot ksf$

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

Max_Pressure_Check = "Okay"

Minimum Pressure in Mat = $P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S} = -0.097 \cdot ksf$

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

Min_Pressure_Check = "No Good"

Distance to Resultant of Pressure Distribution = $X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 10.615$

Distance to Kern = $X_k := \frac{W_f}{6} = 5.667$

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

Eccentricity = $e := \frac{M_{ot}}{WT_{tot}} = 6.489$

Adjusted Soil Pressure = $P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \left(\frac{W_f}{2} - e\right)} = 1.446 \cdot ksf$

$q_{adj} := \text{if}(P_{min} < 0, P_a, P_{max}) = 1.446 \cdot ksf$

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

Pressure_Check = "Okay"

Concrete Bearing Capacity:

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

Bearing Strength Between Pier and Pad = $P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot \frac{\pi \cdot d_p^2}{4} = 1.6 \times 10^4 \cdot kips$ (ACI-2008 10.14)

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

Bearing_Check = "Okay"

Shear Strength of Concrete:

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

$\phi_c := 0.85$ (ACI 9.3.2.5)

$d := T_f - Cvr_{pad} - d_{bbot} = 31.872 \cdot in$

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

$d_2 := d_1 - d$

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

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

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

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

Area Included Inside Perimeter = $A_{bo} := \frac{\pi \cdot (d_p + d)^2}{4} = 89.2$

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 1.1 \times 10^3$

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

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

$v_u := Find(v_u) = 8.7 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f = 787.1 \cdot kips$

Required Shear Strength = $V_{req} := LF \cdot V_u = 1 \times 10^3 \cdot kips$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 2753.2 \cdot kip$ (ACI-2008 11.11.2.1)

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

Punching_Shear_Check = "Okay"

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

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

$q_b := q_{adj} - d_1 \cdot Slope = 0.85 \cdot ksf$

Maximum Bending at Face of Pier = $M_u := LF \cdot \left[(q_{adj} - q_b) \cdot \frac{d_1^{\,2}}{3} + q_b \cdot \frac{d_1^{\,2}}{2} \right] \cdot W_f = 4775.9 \cdot kip \cdot ft$

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

(ACI-200810.2.7.3)

$R_n := \frac{M_u}{\phi_m \cdot W_f \cdot d^2} = 153.6 \cdot psi$

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

$\rho_{min} := \rho = 0.00262$

Required Reinforcement for Temperature and Shrinkage:

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

Check Bottom Bars:

$$As := \begin{vmatrix} \rho_{min} \cdot W_f \cdot d \text{ if } \rho_{min} > \frac{\rho_{sh}}{2} \\ \rho_{sh} \cdot W_f \cdot \frac{d}{2} \text{ otherwise} \end{vmatrix} = 34.087 \cdot in^2$$

$As_{prov} := A_{bbot} \cdot NB_{bot} = 68 \cdot in^2$

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

Pad_Reinforcement_Bot = "Okay"

Check top Bars:

$$As := \rho_{sh} \cdot \left(W_f \cdot \frac{d}{2} \right) = 11.7 \cdot in^2$$

$As_{prov} := A_{btop} \cdot NB_{top} = 36 \cdot in^2$

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

Pad_Reinforcement_Top = "Okay"

Developement Length Pad Reinforcement:

Bar Spacing = $$B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 4.86 \cdot in$$

Spacing or Cover Dimension = $$c := \text{if}\left(Cvr_{pad} < \frac{B_{sPad}}{2}, Cvr_{pad}, \frac{B_{sPad}}{2} \right) = 2.428 \cdot in$$

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

$$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pad} \cdot \beta_{pad} \cdot \gamma_{pad} \cdot \lambda_{pad}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \frac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot} = 37.3 \cdot in$$

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 = $$L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad} = 153 \cdot in$$

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

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

Area of Pier = $A_p := \frac{\pi \cdot d_p^2}{4} = 7238.23 \cdot in^2$

$A_{smin} := 0.01 \cdot 0.5 \cdot A_p = 36.19 \cdot in^2$ (ACI-2008 10.8.4 & 10.9.1)

$A_{sprov} := NB_{pier} \cdot A_{bpier} = 59.96 \cdot in^2$

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

Steel_Area_Check = "Okay"

Bar Spacing In Pier = $B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 3.899 \cdot in$

Diameter of Reinforcement Cage = $Diam_{cage} := d_p - 2 \cdot Cvr_{pier} = 90 \cdot in$

Maximum Moment in Pier = $M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2} \right) \right] \cdot LF = 78844.3 \cdot in \cdot kips$

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

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

$$\left(D \;\; N \;\; n \;\; P_u \;\; M_{xu}\right) = \left(96 \;\; 60 \;\; 9 \;\; 89.311 \;\; 7.884 \times 10^4\right)$$

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

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

$$\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho\right) = \left(147.15 \;\; 1.299 \times 10^5 \;\; -60 \;\; 8.289 \times 10^{-3}\right)$$

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:

$L_{pier} := L_p - Cvr_{pier} = 27 \cdot in$

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

Tension: (ACI-2008 12.2.3)

Spacing or Cover Dimension = $c := if\left(Cvr_{pier} < \frac{B_{sPier}}{2}, Cvr_{pier}, \frac{B_{sPier}}{2}\right) = 1.949 \cdot in$

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

$$L_{dbt} := \frac{3 \cdot f_y \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 46.44 \cdot in$$

Minimum Development Length = $L_{dh} := \frac{1200 \cdot d_{bpier}}{\sqrt{\frac{f_c}{psi}}} \cdot .7 = 14.982 \cdot in$ (ACI 12.2.1)

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

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

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

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

Compression: (ACI-2008 12.3.2)

$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot f_y}{\sqrt{f_c \cdot psi}} = 21.402 \cdot in$

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

$L_{dbc} := if(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}) = 21.402 \cdot in$

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

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

Tie Size and Spacing in Column:

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

Used #4 Ties

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

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

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

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

$s_{lim4} := 18in$

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

Number of Ties Required = $n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 = 2.333$

Check Anchor Steel Embedment:

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

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

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

Depth_Check = "No Good"

Note: Anchor plate is provided

SITE NAME	OLD LYME 2 CT		ECP - CELL #	AWS1	2	311
LATITUDE	41-19-19.43 N		LONGITUDE	72-18-26.73 W		
Additional Comments: AWS RRH, PCS RRH, 2 fiber line add with associated distro boxes, zero variable tilt,swap out 850 & 1900 antennas, add AWS .			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	HBXX-6517DS-VTM		HBXX-6517DS-VTM		HBXX-6517DS-VTM	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	30		150		270	
DOWN TILT (MECH/ELECT)	0M/3E		0M/4E		0M/3E	
RAD CTR (FT AGL)	160		160		160	
DIPLEXER - QTY / MODEL						
RRH - QTY/MODEL	1	ALU RH_2X40-AWS	1	ALU RH_2X40-AWS	1	ALU RH_2X40-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		BXA-70063-6CF-2		BXA-70063-6CF-2	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	30		150		270	
DOWN TILT (MECH/DEG)	0		4		0	
RAD CTR (FT AGL)	160		160		160	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL						
700 Mhz - LTE Future Config	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	700 eNodeB		700 eNodeB		700 eNodeB	
ANTENNA TYPE	BXA-70063-6CF-2		BXA-70063-6CF-2		BXA-70063-6CF-2	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	30		150		270	
DOWN TILT (MECH/DEG)	0		0		0	
RAD CTR (FT AGL)	160		160		160	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL						
RRH - QTY/MODEL	1	RRH 2X40 700	1	RRH 2X40 700	1	RRH 2X40 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-80063-4CF-4		LPA-80063-4CF-4		LPA-80063-4CF-4	
QTY OF ANTENNAS PER FACE	2		2		2	
ORIENTATION (DEG)	30		150		270	
DOWN TILT (MECH/DEG)	0		4		0	
RAD CTR (FT AGL)	160		160		160	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL						
850 Celluar - Future Config	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	Cellular Mod 4.0B		Cellular Mod 4.0B		Cellular Mod 4.0B	
ANTENNA TYPE	LNX-6514DS-VTM		LNX-6514DS-VTM		LNX-6514DS-VTM	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	30		150		270	
DOWN TILT (MECH/DEG)	0M/0E		M0/4E		0M/0E	
RAD CTR (FT AGL)	160		160		160	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL						
DIPLEX WITH LTE CABLE						
1900 PCS - Current Config	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	PCS Mod 4.0B		PCS Mod 4.0B		PCS Mod 4.0B	
ANTENNA TYPE	BXA-171063-8BF_2		BXA-171063-8BF_2		BXA-171063-8BF_2	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	30		150		270	
DOWN TILT (MECH/DEG)	0		0		0	
RAD CTR (FT AGL)	160		160		160	
TMA - QTY / MODEL						
DIPLEXER - QTY / MODEL						
1900 PCS - Future Config	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	1900 MHz BBU		1900 MHz BBU		1900 MHz BBU	
ANTENNA TYPE	HBXX-6517DS-VTM		HBXX-6517DS-VTM		HBXX-6517DS-VTM	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	30		150		270	
DOWN TILT (MECH/ELECT)	0M/3E		0M/2E		0M/2E	
RAD CTR (FT AGL)	160		160		160	
DIPLEXER - QTY / MODEL						
RRH - QTY/MODEL	1	ALU RH_2X60-PCS	1	ALU RH_2X60-PCS	1	ALU RH_2X60-PCS
SECTOR DISTRIBUTION BOX						
MAIN DISTRIBUTION BOX	1		DB-T1-6Z-8AB-0Z			

NUMBER OF CABLE'S NEEDED						Fiber Lines Model number			
TOTAL # FIBER LINES	2	TOTAL # OF MAINLINES			12	FIBER LINE MODEL #			
TOTAL # TOP JUMPERS	6	TOTAL # OF TOP JUMPERS			12	FIBER TOP JUMPER MODEL #			
Equipment Cable Ordering		**MAIN CABLE**	12	+	0	**TOP JUMPER #**	12	+	

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

ALPHA				BETA				GAMMA			
Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code
A1-A	800	Tx1/Rx0	RED	A5-A	800	Tx2/Rx0	BLUE	A9-A	800	Tx3/Rx0	GREEN
A1-B	1900	Tx1/Rx0	RED/ WHITE	A5-B	1900	Tx2/Rx0	BLUE/ WHITE	A9-B	1900	Tx3/Rx0	GREEN/WHITE
A2	700	Tx1/Rx0	RED/ ORANGE	A6	700	Tx2/Rx0	BLUE/ ORANGE	A10	700	Tx3/Rx0	GREEN/ORANGE
A3	700	Tx4/Rx1	RED/RED/ ORANGE	A7	700	Tx5/Rx1	BLUE/BLUE/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

RF ENGINEER	RF MANAGER	INITIALS	DATE
Prepared By: Mark Brauer	Robert Hesselbach	MB	2/17/2014

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

HBXX-6517DS-VTM

Andrew® Quad Port Teletilt® Antenna, 1710–2180 MHz, 65° horizontal beamwidth, RET compatible

- Superior azimuth tracking and pattern symmetry with excellent passive intermodulation suppression
- The values presented on this datasheet have been calculated based on N-P-BASTA White Paper version 9.6 by the NGMN Alliance

Electrical Specifications

Frequency Band, MHz	**1710–1880**	**1850–1990**	**1920–2180**
Gain by all Beam Tilts, average, dBi	18.5	18.6	18.8
Gain by all Beam Tilts Tolerance, dB	±0.4	±0.3	±0.4
Gain by Beam Tilt, average, dBi	0 ° | 18.4 3 ° | 18.7 6 ° | 18.4	0 ° | 18.4 3 ° | 18.7 6 ° | 18.5	0 ° | 18.7 3 ° | 18.9 6 ° | 18.6
Beamwidth, Horizontal, degrees	67	66	65
Beamwidth, Horizontal Tolerance, degrees	±2.4	±1.7	±2.9
Beamwidth, Vertical, degrees	5.0	4.7	4.4
Beamwidth, Vertical Tolerance, degrees	±0.3	±0.3	±0.3
Beam Tilt, degrees	0–6	0–6	0–6
USLS, dB	18	19	19
Front-to-Back Total Power at 180° ± 30°, dB	25	26	26
CPR at Boresight, dB	22	23	22
CPR at Sector, dB	10	10	9
Isolation, dB	30	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153	-153
Input Power per Port, maximum, watts	350	350	350
Polarization	±45°	±45°	±45°
Impedance	50 ohm	50 ohm	50 ohm

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol® single band, quad
Band	Single band
Brand	DualPol® | Teletilt®
Operating Frequency Band	1710 – 2180 MHz
Number of Ports, all types	4

Mechanical Specifications

Color	Light gray
Lightning Protection	dc Ground
Radiator Material	Low loss circuit board
Radome Material	PVC, UV resistant
RF Connector Interface	7-16 DIN Female
RF Connector Location	Bottom

Product Specifications

COMMSCOPE® POWERED BY ANDREW.

HBXX-6517DS-VTM

RF Connector Quantity, total	4
Wind Loading, maximum	668.0 N @ 150 km/h 150.2 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Dimensions

Depth	166.0 mm | 6.5 in
Length	1903.0 mm | 74.9 in
Width	305.0 mm | 12.0 in
Net Weight	19.5 kg | 43.0 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 1.1 Actuator	HBXX-6517DS-R2M
Model with Factory Installed AISG 2.0 Actuator	HBXX-6517DS-A2M
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

600899A-2 — 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.

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

LNX-6514DS-VTM

Andrew® Antenna, 698–896 MHz, 65° horizontal beamwidth, RET compatible

- Great solution to maximize network coverage and capacity
- Excellent gain, VSWR, front-to-back ratio, and PIM specifications for robust network performance
- Ideal choice for site collocations and tough zoning restrictions
- Excellent solution for site sharing and maximizing capacity
- Fully compatible with Andrew remote electrical tilt system for greater OpEx savings
- The RF connectors are designed for IP67 rating and the radome for IP56 rating

Electrical Specifications

Frequency Band, MHz	**698–806**	**806–896**
Gain, dBi	15.7	16.3
Beamwidth, Horizontal, degrees	65	65
Beamwidth, Horizontal Tolerance, degrees	±3	±3
Beamwidth, Vertical, degrees	12.5	11.2
Beam Tilt, degrees	0–10	0–10
USLS, typical, dB	17	18
Front-to-Back Ratio at 180°, dB	32	30
CPR at Boresight, dB	20	20
CPR at Sector, dB	10	10
Isolation, dB	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153
Input Power per Port, maximum, watts	400	400
Polarization	±45°	±45°
Impedance	50 ohm	50 ohm

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol®
Band	Single band
Brand	DualPol® | Teletilt®
Operating Frequency Band	698 – 896 MHz

Mechanical Specifications

Color	Light gray
Connector Interface	7-16 DIN Female
Connector Location	Bottom
Connector Quantity, total	2
Lightning Protection	dc Ground
Radiator Material	Aluminum
Radome Material	Fiberglass, UV resistant
Wind Loading, maximum	617.7 N @ 150 km/h 138.9 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

LNX-6514DS-VTM

Dimensions

Depth	181.0 mm | 7.1 in
Length	1847.0 mm | 72.7 in
Width	301.0 mm | 11.9 in
Net Weight	17.6 kg | 38.8 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 1.1 Actuator	LNX-6514DS-R2M
Model with Factory Installed AISG 2.0 Actuator	LNX-6514DS-A1M
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

DB380 — Pipe Mounting Kit for 2.4"-4.5" (60-115mm) OD round members on wide panel antennas. Includes 2 clamp sets and double nuts.

DB5083 — Downtilt Mounting Kit for 2.4"-4.5" (60 - 115 mm) OD round members. Includes a heavy-duty, galvanized steel downtilt mounting bracket assembly and associated hardware. This kit is compatible with the DB380 pipe mount kit for panel antennas that are equipped with two mounting brackets.

Alcatel-Lucent RRH2x40-AWS

REMOTE RADIO HEAD

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

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

The Alcatel-Lucent RRH2x40-AWS is linked to the BBU by an optical-fiber connection carrying downlink and uplink digital radio signals along with operations, administration and maintenance (OA&M) information. The Alcatel-Lucent RRH2x40-AWS has two transmit RF paths, 40 W RF output power per transmit path, and is designed to manage up to four-way receive diversity. The device is ideally suited to support macro coverage, with multiple-input multiple-output (MIMO) 2x2 operation in up to 20 MHz of bandwidth.

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

Fast, low-cost installation and deployment

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

Excellent RF performance

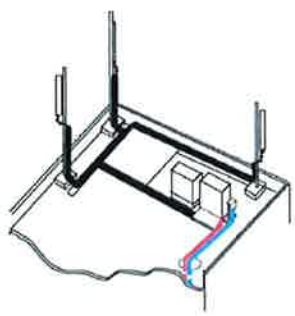
Because of its small size and weight, the Alcatel-Lucent RRH2x40-AWS can be installed close to the antenna. Operators can therefore locate the Alcatel-Lucent RRH2x40-AWS where RF engineering is deemed ideal, minimizing trade-offs between available sites and RF optimum sites. The RF feeder cost and installation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

Features

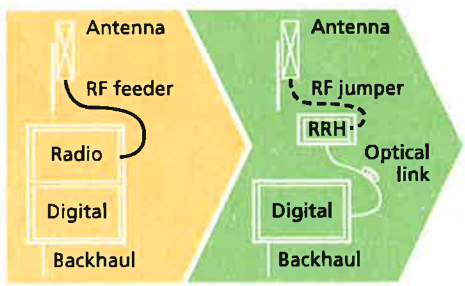
- Zero-footprint deployment
- Easy installation, with a lightweight unit can be carried and set up by one person
- Optimized RF power, with flexible site selection and elimination of a TMA
- Convection-cooled (fanless)
- Noise-free
- Best-in-class power efficiency, with significantly reduced energy consumption

Benefits

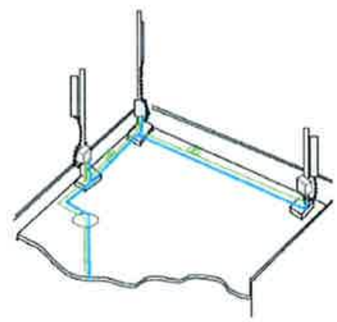
- Leverages existing real estate with lower site costs
- Reduces installation costs, with fewer installation materials and simplified logistics
- Decreases power costs and minimizes environmental impacts, with the potential for eco-sustainable power options
- Improves RF performance and adds flexibility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



Macro



RRH for space-constrained cell sites



Distributed

Technical specifications

Physical dimensions

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

Power

- Power supply: -48VDC

Operating environment

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

RF characteristics

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

Optical characteristics

Type/number of fibers

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

Optical fiber length

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

Digital Ports and Alarms

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

CPG2809100912 (09)

Alcatel·Lucent

Alcatel-Lucent RRH2x40-07-U

REMOTE RADIO HEAD

The Alcatel-Lucent RRH2x40-07-U is a high-power, small form-factor Remote Radio Head (RRH) operating in the North American Digital Dividend / 700MHz frequency band (3GPP Band 13). The Alcatel-Lucent RRH2x40-07-U is designed with an eco-efficient approach, providing operators with the means to achieve high quality and capacity coverage with minimum site requirements.

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

The Alcatel-Lucent RRH2x40-07-U is linked to the BBU by an optical-fiber connection carrying downlink and uplink digital radio signals along with operations, administration and maintenance (OA&M) information. The Alcatel-Lucent RRH2x40-07-U has two transmit RF paths, 40 W RF output power per transmit path, and is designed to manage up to two-way receive diversity. The device is ideally suited to support macro coverage, with multiple-input multiple-output (MIMO) 2x2 operation in up to 10 MHz of bandwidth.

The Alcatel-Lucent RRH2x40-07-U is designed to make available all the benefits of a distributed eNodeB, with excellent RF characteristics, with low capital expenditures (CAPEX) and low operating expenditures (OPEX). The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment or require costly cranes to be employed, leaving coverage holes. However, many of these sites can host an Alcatel-Lucent RRH2x40-07-U installation, providing more flexible site selection and improved network quality along with greatly reduced installation time and costs.

Fast, low-cost installation and deployment

The Alcatel-Lucent RRH2x40-07-U is a zero-footprint solution and operates noise-free, simplifying negotiations with site property owners and minimizing environmental impacts. Installation can easily be done by a single person because the Alcatel-Lucent RRH2x40-07-U is compact and weights less than 23 kg (50 lb), eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day — a fraction of the time required for a traditional BTS.

Excellent RF performance

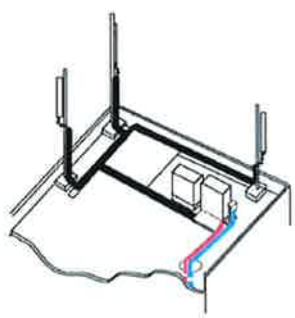
Because of its small size and weight, the Alcatel-Lucent RRH2x40-07-U can be installed close to the antenna. Operators can therefore locate the Alcatel-Lucent RRH2x40-07-U where RF engineering is deemed ideal, minimizing trade-offs between available sites and RF optimum sites. The RF feeder cost and installation costs are reduced or eliminated, and there is no need for a Tower Mounted Amplifier (TMA) because losses introduced by the RF feeder are greatly reduced. The Alcatel-Lucent RRH2x40-07-U provides more RF power while at the same time consuming less electricity.

Features

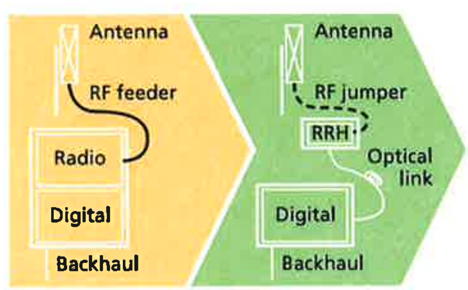
- Zero-footprint deployment
- Easy installation, with a lightweight unit can be carried and set up by one person
- Optimized RF power, with flexible site selection and elimination of a TMA
- Convection-cooled (fanless), noise-free, and heaterless unit
- Best-in-class power efficiency, with significantly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

Benefits

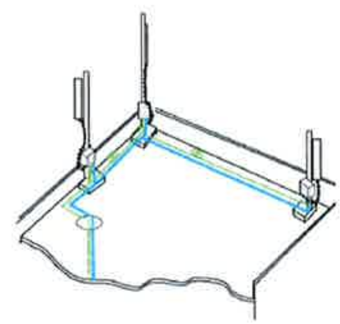
- Leverages existing real estate with lower site costs
- Reduces installation costs, with fewer installation materials and simplified logistics
- Decreases power costs and minimizes environmental impacts, with the potential for eco-sustainable power options
- Improves RF performance and adds flexibility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



Macro



RRH for space-constrained cell sites



Distributed

Technical specifications

Physical dimensions

- Height: 390 mm (15.4 in.)
- Width: 380 mm (15 in.)
- Depth: 210 mm (8.2 in.)
- Weight (without mounting kit): less than 23 kg (50 lb)

Power

- Power supply: -48V

Operating environment

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

RF characteristics

- Frequency band: 700 MHz; 3GPP Band 13
- Bandwidth: up to 10 MHz
- RF output power at antenna port:
  - 40 W nominal RF power for each Tx port
- Rx diversity: 2-way or 4-way
- Noise figure: below 2.5 dB typical
- ALD features
  - TMA
  - Remote electrical tilt (RET) support (AISG v2.0)

Optical characteristics

Type/number of fibers

- Up to 3.12 Gb/s line bit rate
- Single-mode variant
  - One SM fiber (9/125 µm) per RRH2x, carrying UL and DL using CWDM (at 1550/1310 nm)
- Multi-mode variant
  - Two MM fibers (50/125 µm) per RRH2x: one carrying UL, the other carrying DL (at 850 nm)

Optical fiber length

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

Alarms and ports

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

www.alcatel-lucent.com
CPG2809100913 (09)

Alcatel·Lucent

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

DC and Fiber Management Distribution Boxes for HYBRIFLEX™ Cable

Product Description

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

Features/Benefits

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

Technical Specifications

Mechanical Specifications

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

Electrical Specifications

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