Robinson+Cole

KENNETH C. BALDWIN

280 Trumbull Street
Hartford, CT 06103-3597
Main (860) 275-8200
Fax (860) 275-8299
kbaldwin@rc.com
Direct (860) 275-8345

Also admitted in Massachusetts

February 11, 2015

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

Re: **Notice of Exempt Modification – Facility Modification**
36 Ritch Avenue, Greenwich, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) antennas at the 57-foot level on the existing 77-foot tree tower at 36 Ritch Avenue in Greenwich (the "Property"). The tower is owned by Cellco. Cellco's shared use of this tower was approved by the Council in 2011 (Docket No. 414). Cellco now intends to modify its facility by replacing nine (9) of its existing antennas with three (3) model 800 10734V01, 700 MHz antennas; three (3) model HBXX-6516DS-VTM, 1900 MHz antennas; and two (2) model HBXX-6516DS-VTM, 2100 MHz antennas, all at the same level on the tower. Cellco also intends to install three (3) remote radio heads ("RRHs") behind its 1900 MHz antennas and six (6) coaxial cable diplexers. Cellco also intends to install one (1) HYBRIFLEX™ antenna cable inside the monopole tower. Included in Attachment 1 are specifications for Cellco's replacement antennas, RRHs, cable diplexers and HYBRIFLEX™ cable.

Please accept this letter as notification pursuant to R.C.S.A. § 16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is being sent to Peter Tesei, First Selectman for the Town of Greenwich.

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

13421742-v1

1. The proposed modifications will not result in an increase in the height of the existing tower. Cellco's replacement antennas, RRHs and diplexers will be installed on its existing T-arms at the 57-foot level of the 77-foot tree tower.

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

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

4. The operation of the replacement antennas will not increase radio frequency (RF) emissions at the facility to a level at or above the Federal Communications Commission (FCC) safety standard. Far Field Approximation tables for RF emissions at each of Cellco's operating frequencies, as modified, are included behind Attachment 2. These tables demonstrate how the modified facility will comply with the RF emissions standards established by the FCC.

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:
Peter Tesei, Greenwich First Selectman
Katie Deluca, Planning Director
Sandy M. Carter

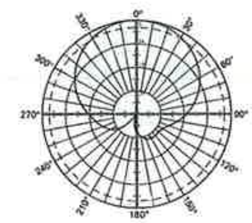
ATTACHMENT 1

KATHREIN
SCALA DIVISION

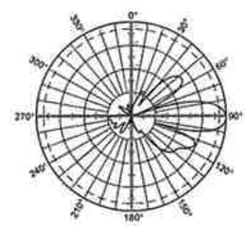
800 10734
700 MHz Single Band 4', 65 Degree Antenna RET

Kathrein's X-polarized antennas are designed for use in digital polarization diversity systems.

- X-polarized (+45° and -45°).
- UV resistant fiberglass radomes.
- Wideband vector dipole technology.
- DC Grounded metallic parts for impulse suppression.
- RET motor housed inside the radome and field replaceable.



Horizontal pattern
±45°- polarization



Vertical pattern
±45°- polarization
0°–16° electrical downtilt

General specifications:

Frequency range	698–894 MHz
VSWR	<1.5:1
Impedance	50 ohms
Intermodulation (2x20w)	IM3: <-150 dBc
Polarization	+45° and -45°
Maximum input power	500 watts per input (at 50°C)
Connector	2 x 7-16 DIN female (long neck) (bottom mounted)
Isolation	>30 dB
Electrical downtilt	0–16 degrees (continuously adjustable)

See reverse for order information.

Specifications:

Specifications:	698–806 MHz	824–894 MHz
Gain	14.2 dBi	14.8 dBi
Front-to-back ratio	>30 dB (co-polar) 32 dB (average)	>30 dB (co-polar) 33 dB (average)
+45° and -45° polarization horizontal beamwidth	68° (half-power)	65° (half-power)
+45° and -45° polarization vertical beamwidth	16° (half-power)	14.8° (half-power)
Min. sidelobe suppression for first sidelobe above main beam average	0° 8° 16° T 16 17 17 dB 19 20 20 dB	0° 8° 16° T 18 17 16 dB 25 23 23 dB
Cross polar ratio Main direction 0° Sector ±60°	 24 dB (typical) >10 dB, Average: 15 dB	 23 dB (typical) >10 dB, Average: 16 dB

IRT specifications:

Logical interface ex factory[1]	AISG 1.1
Protocols	AISG 1.1 and 3GPP/AISG 2.0 compliant
Hardware interface[2]	2 x 8 pin connector acc. IEC 60130-9; according to AISG: – IRT in (male): Control / Daisy chain in – IRT in (female): Daisy chain out
Power supply	10–30 V
Power consumption	<1 watt (standby) <8.5 watts (motor activated)
Adjustment time (full range)	40 sec.
Adjustment cycles	>50,000
Certification	FCC 15.107 Class B Computing Devices

[1] The protocol of the logical interface can be switched from AISG 1.1 to 3GPP/AISG 2.0 and vice versa with a vendor specific command. Start-up operation of the RCU 86010149 is possible in an RET system supporting AISG 1.1 or supporting 3GPP/AISG 2.0 after performing a layer 2 reset before address assignment. The protocol can also be changed as follows: AISG 1.1 to 3GPP: Enter "3GPP" into the additional data filed "Installer's ID" and perform a layer 7 reset or a power reset. 3GPP to AISG 1.1: Enter "AISG 1" into the additional datafield "Installer's ID" and perform a layer 2 reset or a power reset. After switching the protocol any other information can be entered into the "Installer's ID" field.

[2] The tightning torque for fixing the connector must be 0.5 – 1.0 Nm ('hand-tightened'). The connector should be tightened by hand only!

11219-A
936.4130

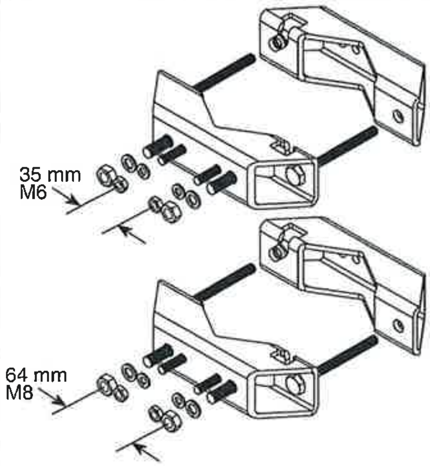
RoHS
Lead-Free
Mar 15, 2011

AISG
Antenna Interface Standards Group

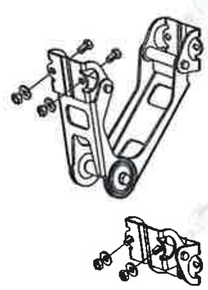
Kathrein Inc., Scala Division Post Office Box 4580 Medford, OR 97501 (USA) Phone: (541) 779-6500 Fax: (541) 779-3991
Email: communications@kathrein.com Internet: www.kathrein-scala.com

KATHREIN SCALA DIVISION

800 10734
700 MHz Single Band 4', 65 Degree Antenna
RET



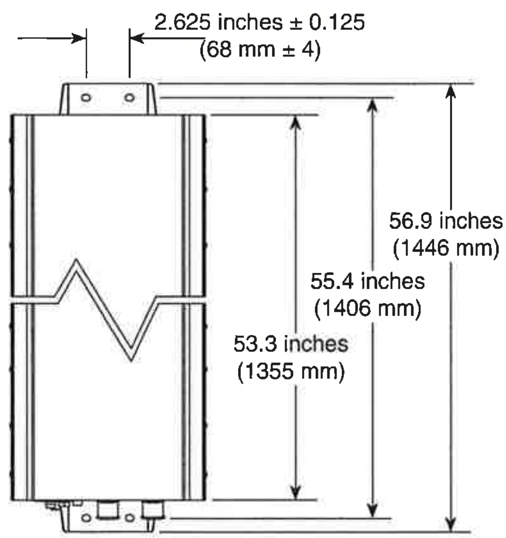
Mounting Brackets
for use with 2-point mount antennas
Mast dia. 2–4.5 inches (50–115 mm)
Weight: 4 lb (1.8 kg)



Mechanical Tilt Brackets
for use with 2-point mount antennas
Weight: 7.4 lb (3.7 kg)
(Model 850 10013)

Mechanical specifications:

Weight	24.3 lb (11 kg) 28.7 lb (13 kg) clamps included
Dimensions H x W x D	53.3 x 11.9 x 3.9 inches (1355 x 303 x 99 mm)
Wind load Front/Side/Rear Mounting category	at 93 mph (150kph) 140 lbf / 45 lbf / 160 lbf (620 N) / (200 N) / (710 N) M (Medium)
Wind survival rating*	150 mph (240 kph)
Shipping dimensions	56.3 x 12.4 x 4.5 inches (1430 x 315 x 115 mm)
Shipping weight	33.1 lb (15 kg)
Mounting bracket	2-point hot-dip galvanized with stainless steel hardware for 2 to 4.5 inch (50 to 115 mm) OD masts.

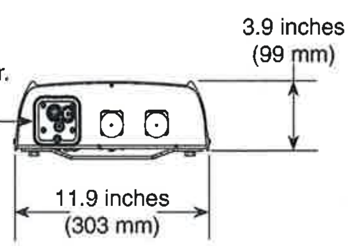


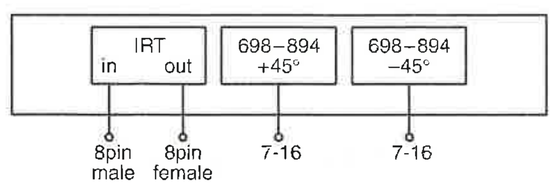
KATHREIN 860 10149

FC Tested To Comply With FCC Standards

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note: Refer to part number 860 10149 for the specifications of the remote control actuator.





Order Information:

Model	Description
800 10734	Antenna with mounting bracket 0°–16° electrical downtilt
800 10734 K	Antenna with Antenna with mounting bracket and mechanical tilt bracket 0°–16° electrical downtilt

* Mechanical design is based on environmental conditions as stipulated in TIA-222-G-2 (December 2009) and/or ETS 300 019-1-4 which include the static mechanical load imposed on an antenna by wind at maximum velocity. See the Engineering Section of the catalog for further details.

All specifications are subject to change without notice. The latest specifications are available at www.kathrein-scala.com.

Kathrein Inc., Scala Division Post Office Box 4580 Medford, OR 97501 (USA) Phone: (541) 779-6500 Fax: (541) 779-3991
Email: communications@kathrein.com Internet: www.kathrein-scala.com

Product Specifications

COMMSCOPE®

POWERED BY ANDREW

HBXX-6516DS-VTM

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

- Each DualPol® array can be independently adjusted for greater flexibility
- Excellent gain, VSWR, front-to-back ratio, and PIM specifications for robust network performance
- Ideal choice for site collocations and tough zoning restrictions
- Great solution to maximize network coverage and capacity

Electrical Specifications

Frequency Band, MHz	**1710–1880**	**1850–1990**	**1920–2180**
Gain, dBi	17.7	18.0	18.0
Beamwidth, Horizontal, degrees	67	66	64
Beamwidth, Vertical, degrees	7.5	7.0	6.6
Beam Tilt, degrees	0–10	0–10	0–10
USLS, dB	18	18	18
Front-to-Back Ratio at 180°, dB	30	30	30
CPR at Boresight, dB	22	22	21
CPR at Sector, dB	8	9	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

Electrical Specifications, BASTA*

Frequency Band, MHz	**1710–1880**	**1850–1990**	**1920–2180**
Gain by all Beam Tilts, average, dBi	17.2	17.2	17.5
Gain by all Beam Tilts Tolerance, dB	±0.3	±0.3	±0.5
Gain by Beam Tilt, average, dBi	0 ° | 17.0 5 ° | 17.3 10 ° | 17.0	0 ° | 17.1 5 ° | 17.4 10 ° | 17.0	0 ° | 17.4 5 ° | 17.7 10 ° | 17.2
Beamwidth, Horizontal Tolerance, degrees	±2.7	±2.3	±3.5
Beamwidth, Vertical Tolerance, degrees	±0.5	±0.4	±0.4
USLS, dB	18	19	19
Front-to-Back Total Power at 180° ± 30°, dB	26	26	26
CPR at Boresight, dB	22	22	22
CPR at Sector, dB	9	9	9

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

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol® quad
Band	Single band
Brand	DualPol® | Teletilt®
Operating Frequency Band	1710 – 2180 MHz

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

HBXX-6516DS-VTM

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
RF Connector Quantity, total	4
Wind Loading, maximum	419.0 N @ 150 km/h 94.2 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Dimensions

Depth	166.0 mm | 6.5 in
Length	1294.0 mm | 50.9 in
Width	305.0 mm | 12.0 in
Net Weight	13.9 kg | 30.6 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 1.1 Actuator	HBXX-6516DS-R2M
Model with Factory Installed AISG 2.0 Actuator	HBXX-6516DS-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.

PCS RF MODULES
RRH1900 2X60 - HW CHARACTERISTICS

LA6.0.1/13.3

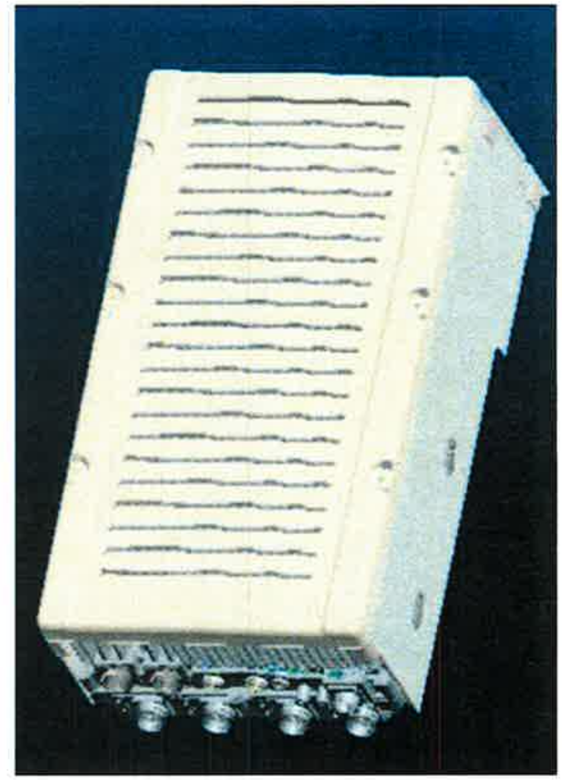
	RRH2x60
RF Output Power	2x60W
Instantaneous Bandwidth	20MHz
Transmitter	2 TX
Receiver — 1900 HW version 1900A HW version	2 Branch RX – LA6.0.1 4 Branch RX – LR13.3
Features	AISG 2.0 for RET/TMA
	Internal Smart Bias-T
Power	-48VDC
CPRI Ports	2 CPRI Rate 3 Ports
External Alarms	4 External User Alarms
Monitor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

Product Specifications

COMMSCOPE®

POWERED BY ANDREW

CBC78-DF

Crossband Coupler, 698–787 MHz/Cellular

Electrical Specifications

dc Pass-through	Band 1 | Band 2
3rd Order IMD Test Method	Two +43 dBm carriers
3rd Order IMD, maximum	-110 dBm
Isolation Between Paths, minimum	50.0 dB
Lightning Surge Current	10 kA
Lightning Surge Current Waveform	8/20 waveform
Return Loss, minimum	22.00 dB
Return Loss, typical	24.00 dB
Spurious Signals/2nd Order Harmonics, minimum	40 dB
Spurious Signals/3rd Order Harmonics, minimum	30 dB

Electrical Specifications (Branch 1)

Operating Frequency Band	698 – 787 MHz
Insertion Loss, maximum	0.25 dB
Output Power, maximum composite	500 W
Peak Power	5 kW
Total Group Delay, maximum	25 ns

Electrical Specifications (Branch 2)

Operating Frequency Band	824 – 894 MHz
Insertion Loss, maximum	0.25 dB
Output Power, maximum composite	500 W
Peak Power	5 kW
Total Group Delay, maximum	25 ns

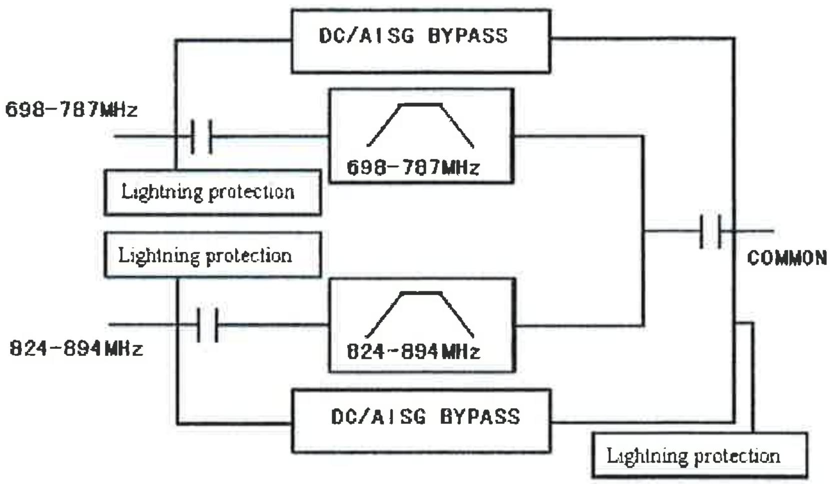
Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

CBC78-DF

Block Diagram



General Specifications

Product Type	Diplexer
Application	Indoor | Outdoor
Includes	Mounting hardware

Mechanical Specifications

Color	Gray
Connector Interface	7-16 DIN Female
Connector Interface Style	Long neck
Ground Screw Diameter	0.25 in

Environmental Specifications

Ingress Protection Test Method	IEC 60529:2001, IP67
Operating Temperature	-40 °C to +65 °C (-40 °F to +149 °F)
Relative Humidity	5%–100%

Dimensions

Depth	66.5 mm | 2.6 in
Height	200.0 mm | 7.9 in
Volume	2.0 L
Width	150.0 mm | 5.9 in
Weight, without mounting hardware	3.0 kg | 6.6 lb

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

Product Description

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

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


Figure 1: HYBRIFLEX Series

Features/Benefits

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

Technical Specifications

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

* This data is provisional and subject to change

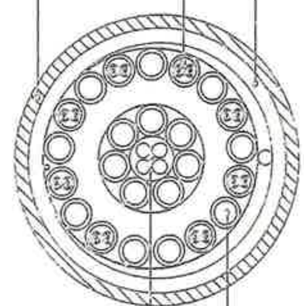


Figure 2: Construction Detail

ATTACHMENT 2

Far Field Approximation
with downtilt variation

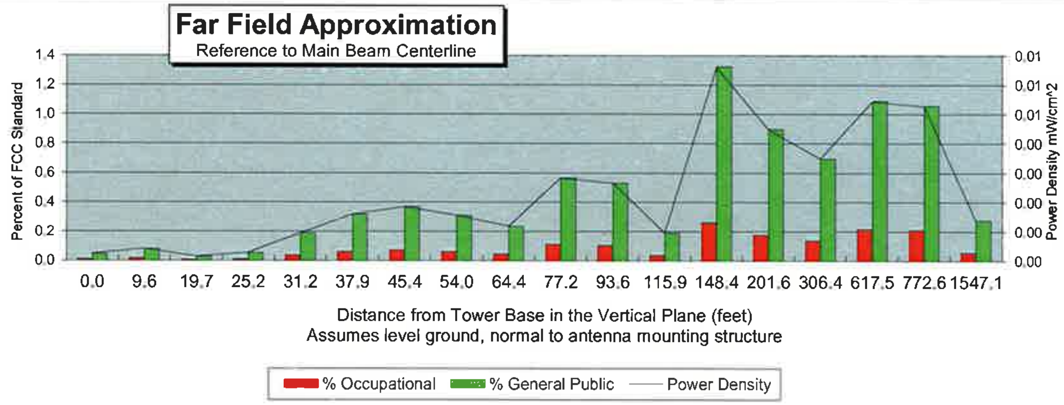
Estimated Radiated Emission

Single Emitter Far Field Model

Dipole / Wire/ Yagi Antenna Types

Location:	BYRAM PARK, CT
Site #:	5-0008
Date:	02/10/15
Name:	Ryan Ulanday
File Name:	BYRAM PARK, CT - FF Power

Operating Freq. (MHz)	746.0
Antenna Height (ft):	57.0
Antenna Gain (dBi):	14.4
Antenna Size (in.):	53.3
Downtilt (degrees):	0.0
Feedline Loss (dB):	0.0
Power @ J4 (w):	543.0



This approximation is only valid in the far field, which begins at: 35.3 Feet

Enter Main Beam Distance in feet below:

Calc Angle	90.0	80.0	70.0	65.0	60.0	55.0	50.0	45.0	40.0	35.0	30.0	25.0	20.0	15.0	10.0	5.0	4.0	2.0	
Solve for r, dx to antenna	54.0	54.8	57.5	59.6	62.4	65.9	70.5	76.4	84.0	94.2	108.0	127.8	158.0	208.7	311.1	619.9	774.5	1548.1	
Distance from Antenna Structure Base in Horizontal plane	0.0	9.6	19.7	25.2	31.2	37.9	45.4	54.0	64.4	77.2	93.6	115.9	148.4	201.6	306.4	617.5	772.6	1547.1	#NUM!
Angle from Main Beam (reference to horizontal plane)	90	80	70	65	60	55	50	45	40	35	30	25	20	15	10	5	4	2	0
dB down from centerline (referenced to centerline)	36.76	34.35	38.52	35.34	29.54	26.8	25.59	25.63	25.99	21.21	20.29	23.24	13.03	12.3	9.92	2	0.2	0	0
Reflection Coefficient (1 to 4, 2.56 typical)	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56
Power Density (mW/cm^2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	#NUM!
Percent of Occupational Standard	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.3	0.2	0.1	0.2	0.2	0.1	#NUM!
Percent of General Population Standard	0.0	0.1	0.0	0.1	0.2	0.3	0.4	0.3	0.2	0.6	0.5	0.2	1.3	0.9	0.7	1.1	1.1	0.3	#NUM!

Antenna Type Kathrein 800 10734V01
Max% 1.33%

Instructions:
1) Fill in Site Location, Site number, Date, Name of Person Responsible for Date, and enter File Name to ba saved as.
2) References to J4 refer to a point where the transmission line exits the equipment shelter and proceeds to the antenna(s). There is typically a connector located here where power measurements are made.
3) Enter Antenna Height (in feet to bottom of antenna), Antenna Gain (expressed as dBi, add 2.17 to dBd to obtain dBi), Antenna Size (vertical size in inches), Downtilt (in Degrees, enter zero if none), Feedline loss from J4 to Antenna, and J4 Pc
4) From manufacturer's plots, or data sheet, input Angle from mainbeam and dB below mainbeam centerline.
5) Enter Reflection coefficient (2.56 would be typical, 1 for free space)
6) Spreadsheet calculates actual power density, then relates as Occupational or General Population percentage of FCC Standard.
7) An odd distance may be entered in the rightmost column of the lower table.

Far Field Approximation
with downtilt variation

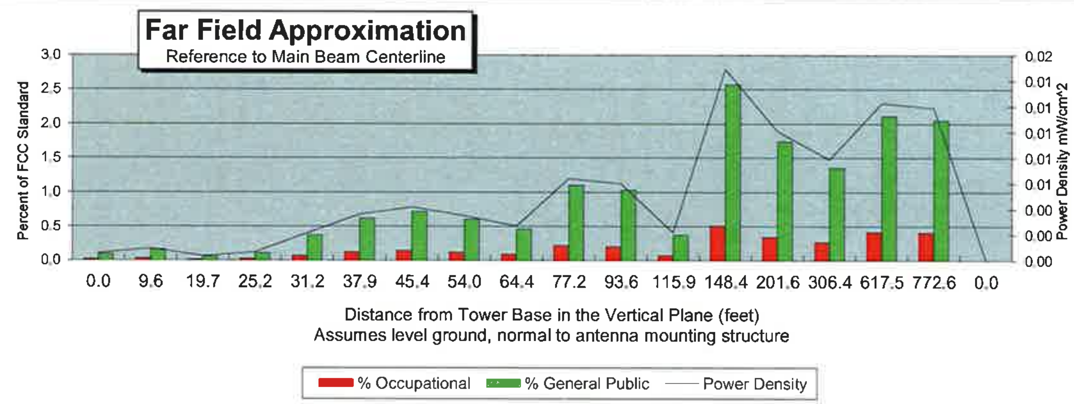
Estimated Radiated Emission

Single Emitter Far Field Model

Dipole / Wire/ Yagi Antenna Types

Location:	BYRAM PARK, CT
Site #:	5-0008
Date:	02/10/15
Name:	Ryan Ulanday
File Name:	BYRAM PARK, CT - FF Power

Operating Freq. (MHz)	869.0
Antenna Height (ft):	57.0
Antenna Gain (dBi):	16.7
Antenna Size (in.):	70.9
Downtilt (degrees):	0.0
Feedline Loss (dB):	0.0
Power @ J4 (w):	3987.0



This approximation is only valid in the far field, which begins at: 62.4 Feet

Enter Main Beam Distance in feet below:

Distance from Antenna Structure Base in Horizontal plane	0.0	9.6	19.7	25.2	31.2	37.9	45.4	54.0	64.4	77.2	93.6	115.9	148.4	201.6	306.4	617.5	772.6	#DIV/0!	#NUM!
Angle from Main Beam (reference to horizontal plane)	90	80	70	65	60	55	50	45	40	35	30	25	20	15	10	5	4	0	0
dB down from centerline (referenced to centerline)	36.76	34.35	38.52	35.34	29.54	26.8	25.59	25.63	25.99	21.21	20.29	23.24	13.03	12.3	9.92	2	0.2	0	0
Reflection Coefficient (1 to 4, 2.56 typical)	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56
Power Density (mW/cm^2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	#DIV/0!	#NUM!
Percent of Occupational Standard	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.5	0.3	0.3	0.4	0.4	#DIV/0!	#NUM!
Percent of General Population Standard	0.1	0.2	0.1	0.1	0.4	0.6	0.7	0.6	0.5	1.1	1.0	0.4	2.6	1.7	1.4	2.1	2.1	#DIV/0!	#NUM!

Antenna Type LNX-6514DS-A2M
2.57%

Instructions:

1) Fill in Site Location, Site number, Date, Name of Person Responsible for Date, and enter File Name to ba saved as.
2) References to J4 refer to a point where the transmission line exits the equipment shelter and proceeds to the antenna(s). There is typically a connector located here where power measurements are made.
3) Enter Antenna Height (in feet to bottom of antenna), Antenna Gain (expressed as dBi, add 2.17 to dBd to obtain dBi), Antenna Size (vertical size in inches), Downtilt (in Degrees, enter zero if none), Feedline loss from J4 to Antenna, and J4 Po
4) From manufacturer's plots, or data sheet, input Angle from mainbeam and dB below mainbeam centerline.
5) Enter Reflection coefficient (2.56 would be typical, 1 for free space)
6) Spreadsheet calculates actual power density, then relates as Occupational or General Population percentage of FCC Standard.
7) An odd distance may be entered in the rightmost column of the lower table.

Far Field Approximation
with downtilt variation

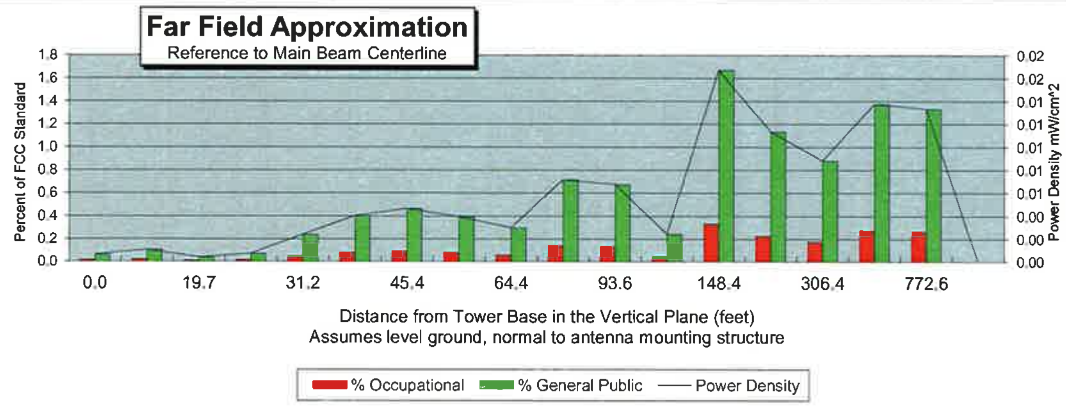
Estimated Radiated Emission

Single Emitter Far Field Model

Dipole / Wire/ Yagi Antenna Types

Location:	BYRAM PARK, CT
Site #:	5-0008
Date:	02/10/15
Name:	Ryan Ulanday
File Name:	BYRAM PARK, CT - FF Power

Operating Freq. (MHz)	1971.0
Antenna Height (ft):	57.0
Antenna Gain (dBi):	17.2
Antenna Size (in.):	50.9
Downtilt (degrees):	0.0
Feedline Loss (dB):	0.0
Power @ J4 (w):	5400.0



This approximation is only valid in the far field, which begins at: 32.2 Feet

Enter Main Beam Distance in feet below:

Distance from Antenna Structure Base in Horizontal plane	0.0	9.6	19.7	25.2	31.2	37.9	45.4	54.0	64.4	77.2	93.6	115.9	148.4	201.6	306.4	617.5	772.6	#####	#NUM!
Angle from Main Beam (reference to horizontal plane)	90	80	70	65	60	55	50	45	40	35	30	25	20	15	10	5	4	0	0
dB down from centerline (referenced to centerline)	36.76	34.35	38.52	35.34	29.54	26.8	25.59	25.63	25.99	21.21	20.29	23.24	13.03	12.3	9.92	2	0.2	0	0
Reflection Coefficient (1 to 4, 2.56 typical)	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56
Power Density (mW/cm^2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.02	0.01	0.01	0.01	0.01	#####	#NUM!
Percent of Occupational Standard	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.3	0.2	0.2	0.3	0.3	#####	#NUM!
Percent of General Population Standard	0.1	0.1	0.0	0.1	0.2	0.4	0.5	0.4	0.3	0.7	0.7	0.2	1.7	1.1	0.9	1.4	1.3	#####	#NUM!

Antenna Type HBXX-6516DS-A2M
1.67%

Instructions:

1) Fill in Site Location, Site number, Date, Name of Person Responsible for Date, and enter File Name to ba saved as.
2) References to J4 refer to a point where the transmission line exits the equipment shelter and proceeds to the antenna(s). There is typically a connector located here where power measurements are made.
3) Enter Antenna Height (in feet to bottom of antenna), Antenna Gain (expressed as dBi, add 2.17 to dBd to obtain dBi), Antenna Size (vertical size in inches), Downtilt (in Degrees, enter zero if none), Feedline loss from J4 to Antenna, and J4 P
4) From manufacturer's plots, or data sheet, input Angle from mainbeam and dB below mainbeam centerline.
5) Enter Reflection coefficient (2.56 would be typical, 1 for free space)
6) Spreadsheet calculates actual power density, then relates as Occupational or General Population percentage of FCC Standard.
7) An odd distance may be entered in the rightmost column of the lower table.

Far Field Approximation
with downtilt variation

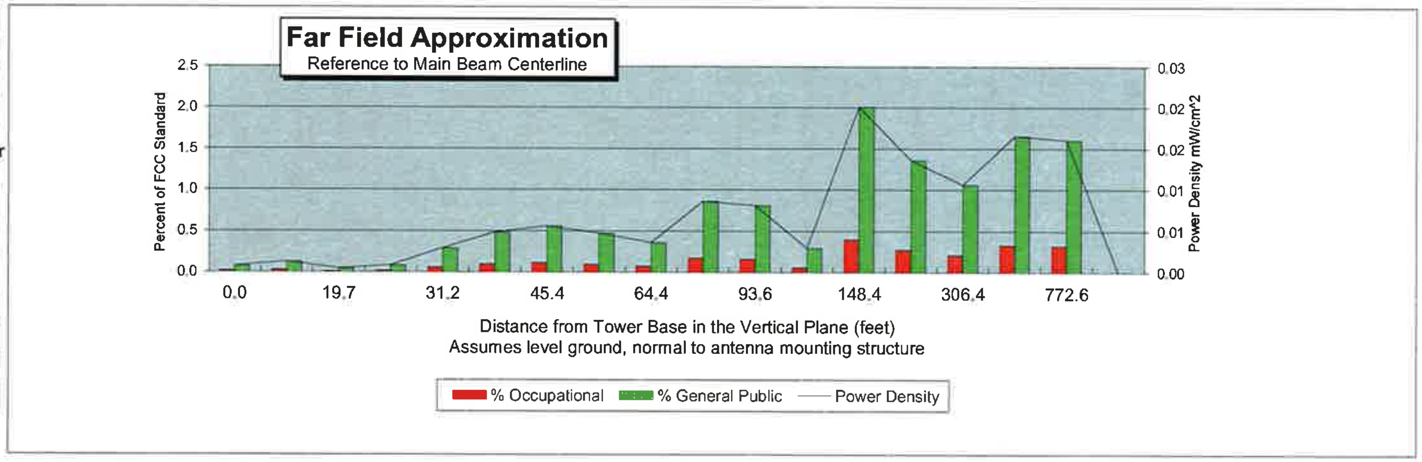
Estimated Radiated Emission

Single Emitter Far Field Model

Dipole / Wire/ Yagi Antenna Types

Location:	BYRAM PARK, CT
Site #:	5-0008
Date:	02/10/15
Name:	Ryan Ulanday
File Name:	BYRAM PARK, CT - FF Power

Operating Freq. (MHz)	2110.0
Antenna Height (ft):	57.0
Antenna Gain (dBi):	18.0
Antenna Size (in.):	50.9
Downtilt (degrees):	0.0
Feedline Loss (dB):	0.0
Power @ J4 (w):	1750.0



This approximation is only valid in the far field, which begins at: 32.2 Feet

Enter Main Beam Distance in feet below:

Distance from Antenna Structure Base in Horizontal plane	0.0	9.6	19.7	25.2	31.2	37.9	45.4	54.0	64.4	77.2	93.6	115.9	148.4	201.6	306.4	617.5	772.6	#####	#NUM!
Angle from Main Beam (reference to horizontal plane)	90	80	70	65	60	55	50	45	40	35	30	25	20	15	10	5	4	0	0
dB down from centerline (referenced to centerline)	36.76	34.35	38.52	35.34	29.54	26.8	25.59	25.63	25.99	21.21	20.29	23.24	13.03	12.3	9.92	2	0.2	0	0
Reflection Coefficient (1 to 4, 2.56 typical)	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56
Power Density (mW/cm^2)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.02	0.01	0.01	0.02	0.02	#####	#NUM!
Percent of Occupational Standard	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.4	0.3	0.2	0.3	0.3	#####	#NUM!
Percent of General Population Standard	0.1	0.1	0.0	0.1	0.3	0.5	0.6	0.5	0.4	0.9	0.8	0.3	2.0	1.4	1.1	1.7	1.6	#####	#NUM!

Antenna Type HBXX-6516DS-A2M
2.01%

Instructions:

1) Fill in Site Location, Site number, Date, Name of Person Responsible for Date, and enter File Name to ba saved as.
2) References to J4 refer to a point where the transmission line exits the equipment shelter and proceeds to the antenna(s). There is typically a connector located here where power measurements are made.
3) Enter Antenna Height (in feet to bottom of antenna), Antenna Gain (expressed as dBi, add 2.17 to dBd to obtain dBi), Antenna Size (vertical size in inches), Downtilt (in Degrees, enter zero if none), Feedline loss from J4 to Antenna, and J4 Pc
4) From manufacturer's plots, or data sheet, input Angle from mainbeam and dB below mainbeam centerline.
5) Enter Reflection coefficient (2.56 would be typical, 1 for free space)
6) Spreadsheet calculates actual power density, then relates as Occupational or General Population percentage of FCC Standard.
7) An odd distance may be entered in the rightmost column of the lower table.

ATTACHMENT 3

Centered on Solutions

Structural Analysis Report

77-ft Existing EEI Monopine

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Byram Park

36 Ritch Ave
Greenwich, CT

CENTEK Project No. 14067.062

~~Date: December 17, 2014~~
Rev 1: February 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 monopine (tower) located in Greenwich, CT.

The host tower is a 77-ft tall, three-section, eighteen sided, tapered monopine, originally designed and manufactured by Engineered Endeavors job no; 16733, dated December 9, 2011. The tower geometry and structure member sizes were obtained from the aforementioned design documents. The foundation system information was taken from the foundation design drawing prepared by Centek Engineering job no; 09129 dated February 14, 2012.

Antenna and appurtenance information were obtained from a previous structural analysis report prepared by Centek job no; 13001.064 dated October 1, 2013 and a Verizon RF data sheet.

The tower is made up of three (3) tapered vertical sections consisting of A572-65 pole sections. The vertical tower sections are slip joint connected. The diameter of the pole (flat-flat) is 27.75-in at the top and 52.0-in at the base.

Verizon proposes the replacement of nine (9) existing panel antennas with nine (9) proposed panel antennas and the installation of three (3) remote radio heads, one (1) main distribution box and six (6) diplexers mounted on the existing T-arm array. 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 (Reserved):
  Antennas: Three (3) Ericsson AIR21 panel antennas mounted on a 10-ft T-arm array with a RAD center elevation of 77-ft above the existing tower base plate.
  Coax Cables: One (1) 1-5/8" ∅ fiber cable running on the inside of the existing tower.
- AT&T (Existing):
  Antennas: Nine (9) Powerwave P65-16-XLH-RR panel antennas and six (6) CCI DTMABP7819VG12A TMA's mounted on a 10-ft T-arm array with a RAD center elevation of 67-ft above the existing tower base plate.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing tower.
- AT&T (Existing):
  Antennas: Six (6) Ericsson RRUS-11 and one (1) Raycap DC6-48-60-18-8F surge arrestor mounted to one (1) universal ring mount with a RAD center elevation of 64-ft above grade level.
  Coax Cables: One (1) fiber cable and two (2) dc control cables running inside of the existing tower.

- VERIZON (Existing to Remain):
  Antennas: Six (6) Antel LPA-80063-6CF panel antennas, three (3) Alcatel-Lucent RRH2x40-AWS Remote Radio Heads and one (1) RFS DB-T1-6Z-8AB-0Z main distribution box mounted on a 10-ft T-arm array with a RAD center elevation of 57-ft above the existing tower base plate.
  Cables: Eighteen (18) 1-5/8" ∅ coax cables and one (1) 1-5/8" ∅ fiber cable running on the inside of the existing tower.
- VERIZON (Existing to Remove):
  Antennas: Three (3) Swedcom SLXW 5514 and six (6) BXA-171063-12BF panel antennas mounted on a 10-ft T-arm array with a RAD center elevation of 57-ft above the existing tower base plate.
- **VERIZON (Proposed):**
  Antennas: Three (3) Kathrein 800-10734 panel antennas, six (6) Andrew HBXX-6516DS panel antennas, three (3) Alcatel-Lucent RRH2x60-PCS remote radio heads, one (1) RFS DB-T1-6Z-8AB-0Z main distribution box and six (6) Andrew CBC78-DF diplexers mounted on a 10-ft T-arm array with a RAD center elevation of 57-ft above the existing tower base plate.
  Cables: One (1) 1-5/8" ∅ fiber cable running on the inside of the existing tower.

Primary Assumptions Used in the Analysis

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

Analysis

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

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

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

Tower Loading

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

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

[1] The 2005 Connecticut State Building Code as amended by the 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 **59.6%** of its total capacity.

Tower Section	Elevation (AGL)	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L1)	48.39'-78.00'	38.4%	**PASS**
Pole Shaft (L2)	23.92'-48.39'	49.4%	**PASS**
Pole Shaft (L3)	1.00'-23.92'	59.6%	**PASS**

Foundation and Anchors

The existing foundation consists of an 8.0-ft square x 2.0-ft long reinforced concrete pier on a 14.0-ft square x 4.0-ft thick reinforced concrete pad with sixteen (16) 1-3/8" ∅ x 34-ft long Williams 150 ksi rock anchors. The sub-grade conditions used in the analysis of the existing foundation were obtained from the geotechnical report prepared by Design Earth Technology (DET) job no; 2010.14 dated October 4, 2010 and addendum letter dated February 13, 2012. The base of the tower is connected to the foundation by means of (20) 2.25"∅, ASTM A615-75 anchor bolts embedded approximately 5-ft into the concrete foundation structure.

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

Location	Vector	Proposed Reactions
Base	Shear	49 kips
	Compression	36 kips
	Moment	2638 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 w/ Rock Anchors	Uplift	2.0	2.75	**PASS**

Note 1: FS denotes Factor of Safety.

- 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 Axial and Bending	55.1%	**PASS**
Base Plate	Bending	46.3%	**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:

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

Timothy J. Lynn, PE
Structural Engineer

Standard Conditions for Furnishing of Professional Engineering Services on Existing Structures

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

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

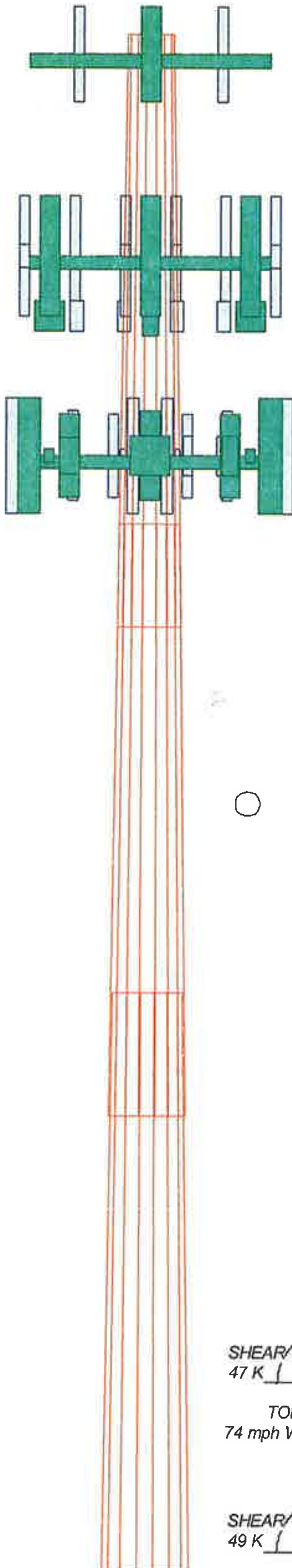
GENERAL DESCRIPTION OF STRUCTURAL ANALYSIS PROGRAM

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

TnxTower Features:

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

Section	Length (ft)	Number of Sides	Thickness (in)	Socket Length (ft)	Top Dia (in)	Bot Dia (in)	Grade	Weight (K)
1	29.609	18	0.313	5.219	27.750	37.761	A572-65	3.2
2	29.693	18	0.438	6.164	35.371	45.307		5.6
3	29.081	18	0.500		42.370	52.000		7.3
								16.2



DESIGNED APPURTENANCE LOADING

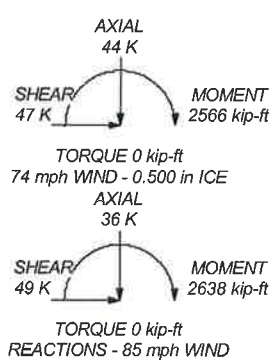
TYPE	ELEVATION	TYPE	ELEVATION
Byram Tower Branch	95	LPA-80063-6CF (Verizon - Existing)	57
Byram Tower Branch	90	HBXX-6516DS (Verizon - Proposed)	57
Byram Tower Branch	85	800-10734 (Verizon - Proposed)	57
Byram Tower Branch	80	HBXX-6516DS (Verizon - Proposed)	57
AIR21 (T-Mobile - Reserved)	77	LPA-80063-6CF (Verizon - Existing)	57
AIR21 (T-Mobile - Reserved)	77	LPA-80063-6CF (Verizon - Existing)	57
AIR21 (T-Mobile - Reserved)	77	HBXX-6516DS (Verizon - Proposed)	57
EEI 10-ft T-Arm Array (T-Mobile - Reserved)	77	800-10734 (Verizon - Proposed)	57
		HBXX-6516DS (Verizon - Proposed)	57
Byram Tower Branch	75	LPA-80063-6CF (Verizon - Existing)	57
Byram Tower Branch	70	RRH2x40-AWS (Verizon - Existing)	57
(3) P65-16-XLH-RR (AT&T - Existing)	67	RRH2x40-AWS (Verizon - Existing)	57
(3) P65-16-XLH-RR (AT&T - Existing)	67	RRH2x40-AWS (Verizon - Existing)	57
(3) P65-16-XLH-RR (AT&T - Existing)	67	DB-T1-6Z-8AB-0Z (Verizon - Existing)	57
(2) DTMABP7819VG12A TMA (AT&T - Existing)	67	RRH2x60-PCS (Verizon - Proposed)	57
		RRH2x60-PCS (Verizon - Proposed)	57
(2) DTMABP7819VG12A TMA (AT&T - Existing)	67	RRH2x60-PCS (Verizon - Proposed)	57
(2) DTMABP7819VG12A TMA (AT&T - Existing)	67	DB-T1-6Z-8AB-0Z (Verizon - Proposed)	57
EEI 10-ft T-Arm Array (AT&T - Existing)	67	(2) CBC78-DF (Verizon - Proposed)	57
Byram Tower Branch	65	(2) CBC78-DF (Verizon - Proposed)	57
(2) RRUS-11 (AT&T - Existing)	64	(2) CBC78-DF (Verizon - Proposed)	57
DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	64	EEI 10-ft T-Arm Array (Verizon - Existing)	57
Valmont Uni-Tri Bracket (AT&T - Existing)	64	Byram Tower Branch	55
(2) RRUS-11 (AT&T - Existing)	64	Byram Tower Branch	50
(2) RRUS-11 (AT&T - Existing)	64	Byram Tower Branch	45
Byram Tower Branch	60	Byram Tower Branch	40
LPA-80063-6CF (Verizon - Existing)	57	Byram Tower Branch	35
HBXX-6516DS (Verizon - Proposed)	57	Byram Tower Branch	30
800-10734 (Verizon - Proposed)	57	Byram Tower Branch	25
HBXX-6516DS (Verizon - Proposed)	57	Byram Tower Branch	20
LPA-80063-6CF (Verizon - Existing)	57	Byram Tower Branch	15

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower designed for a 85 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 74 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. Weld together tower sections have flange connections.
5. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
6. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
7. Welds are fabricated with ER-70S-6 electrodes.
8. TOWER RATING: 59.6%



Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job: 14067.062 - Byram Park		
	Project: 77-ft EEI Monopine - 36 Ritch Ave., Greenwich, CT		
	Client: Verizon Wireless	Drawn by: TJL	App'd:
	Code: TIA/EIA-222-F	Date: 02/06/15	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 85 mph.
- Nominal ice thickness of 0.500 in.
- Ice density of 56 pcf.
- A wind speed of 74 mph is used in combination with ice.
- Temperature drop of 50 °F.
- Deflections calculated using a wind speed of 50 mph.
- Weld together tower sections have flange connections..
- Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications..
- Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards..
- Welds are fabricated with ER-70S-6 electrodes..
- A non-linear (P-delta) analysis was used.
- Pressures are calculated at each section.
- Stress ratio used in pole design is 1.333.
- Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Options

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

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

Treat Feedline Bundles As Cylinder
Use ASCE 10 X-Brace Ly Rules
Calculate Redundant Bracing Forces
Ignore Redundant Members in FEA
SR Leg Bolts Resist Compression
All Leg Panels Have Same Allowable
Offset Girt At Foundation
Consider Feedline Torque
Include Angle Block Shear Check
Poles
√ Include Shear-Torsion Interaction
√ Always Use Sub-Critical Flow
Use Top Mounted Sockets

Tapered Pole Section Geometry

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L1	78.000-48.391	29.609	5.219	18	27.750	37.761	0.313	1.250	A572-65 (65 ksi)
L2	48.391-23.917	29.693	6.164	18	35.371	45.307	0.438	1.750	A572-65 (65 ksi)
L3	23.917-1.000	29.081		18	42.370	52.000	0.500	2.000	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	28.178	27.215	2588.380	9.740	14.097	183.612	5180.166	13.610	4.334	13.869
	38.343	37.144	6580.929	13.294	19.182	343.071	13170.518	18.575	6.096	19.507
L2	37.690	48.510	7479.270	12.401	17.969	416.241	14968.381	24.260	5.455	12.469
	46.006	62.308	15848.590	15.929	23.016	688.584	31718.035	31.160	7.204	16.467
L3	45.096	66.447	14716.933	14.864	21.524	683.750	29453.231	33.230	6.577	13.154
	52.802	81.731	27386.470	18.282	26.416	1036.738	54808.977	40.873	8.272	16.544

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 78.000-48.391				1	1	1		
L2 48.391-23.917				1	1	1		
L3 23.917-1.000				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight klf
1 5/8 (AT&T - Existing)	C	No	Inside Pole	68.000 - 4.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
RG6-Fiber (AT&T - Existing)	C	No	Inside Pole	68.000 - 4.000	1	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
#8 AWG Copper WIre (AT&T - Existing)	C	No	Inside Pole	68.000 - 4.000	2	No Ice	0.000	0.000
						1/2" Ice	0.000	0.000
1 5/8 (Verizon - Existing)	B	No	Inside Pole	58.000 - 4.000	18	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
HYBRIFLEX 1-5/8" (Verizon - Existing)	B	No	Inside Pole	58.000 - 4.000	1	No Ice	0.000	0.002
						1/2" Ice	0.000	0.002
HYBRIFLEX 1-5/8" (T-Mobile - Reserved)	B	No	Inside Pole	78.000 - 4.000	1	No Ice	0.000	0.002
						1/2" Ice	0.000	0.002
HYBRIFLEX 1-5/8" (Verizon - Proposed)	B	No	Inside Pole	58.000 - 4.000	1	No Ice	0.000	0.002
						1/2" Ice	0.000	0.002

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	78.000-48.391	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.273
		C	0.000	0.000	0.000	0.000	0.266

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
L2	48.391-23.917	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.598
		C	0.000	0.000	0.000	0.000	0.332
L3	23.917-1.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.486
		C	0.000	0.000	0.000	0.000	0.270

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	78.000-48.391	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.273
		C		0.000	0.000	0.000	0.000	0.266
L2	48.391-23.917	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.598
		C		0.000	0.000	0.000	0.000	0.332
L3	23.917-1.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.486
		C		0.000	0.000	0.000	0.000	0.270

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
(3) P65-16-XLH-RR (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	67.000	No Ice 1/2" Ice	8.400 8.949	4.700 5.147	0.060 0.107
(3) P65-16-XLH-RR (AT&T - Existing)	B	From Face	3.000 0.000 0.000	0.000	67.000	No Ice 1/2" Ice	8.400 8.949	4.700 5.147	0.060 0.107
(3) P65-16-XLH-RR (AT&T - Existing)	C	From Face	3.000 0.000 0.000	0.000	67.000	No Ice 1/2" Ice	8.400 8.949	4.700 5.147	0.060 0.107
(2) DTMABP7819VG12A TMA (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	67.000	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	3.000 0.000 0.000	0.000	67.000	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	3.000 0.000 0.000	0.000	67.000	No Ice 1/2" Ice	1.588 1.759	0.578 0.701	0.020 0.030
EEI 10-ft T-Arm Array (AT&T - Existing)	C	None		0.000	67.000	No Ice 1/2" Ice	23.000 26.500	23.000 26.500	1.600 1.850
(2) RRUS-11 (AT&T - Existing)	A	From Face	0.000 0.000 0.000	0.000	64.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert (ft ft ft)	Azimuth Adjustment (°)	Placement (ft)		C_AA_A Front (ft^2)	C_AA_A Side (ft^2)	Weight (K)
(2) RRUS-11 (AT&T - Existing)	B	From Face	0.000 0.000 0.000	0.000	64.000	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	0.000 0.000 0.000	0.000	64.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	C	From Face	0.000 0.000 0.000	0.000	64.000	No Ice 1/2" Ice	2.228 2.447	2.228 2.447	0.020 0.039
Valmont Uni-Tri Bracket (AT&T - Existing)	C	None		0.000	64.000	No Ice 1/2" Ice	1.750 1.940	1.750 1.940	0.290 0.306
Byram Tower Branch	C	None		0.000	95.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	90.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	85.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	80.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	75.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	70.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	65.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	60.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	55.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	50.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	45.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	40.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	35.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	30.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	25.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	20.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
Byram Tower Branch	C	None		0.000	15.000	No Ice 1/2" Ice	45.000 65.000	45.000 65.000	0.600 0.800
LPA-80063-6CF (Verizon - Existing)	A	From Face	3.000 -6.000 0.000	0.000	57.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
HBXX-6516DS (Verizon - Proposed)	A	From Face	3.000 -4.000 0.000	0.000	57.000	No Ice 1/2" Ice	5.938 6.350	3.280 3.610	0.035 0.070
800-10734 (Verizon - Proposed)	A	From Face	3.000 0.000 0.000	0.000	57.000	No Ice 1/2" Ice	6.167 6.593	2.342 2.671	0.025 0.056
HBXX-6516DS (Verizon - Proposed)	A	From Face	3.000 4.000 0.000	0.000	57.000	No Ice 1/2" Ice	5.938 6.350	3.280 3.610	0.035 0.070

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert* *ft* *ft* *ft*	*Azimuth Adjustment* °	*Placement* *ft*		C_AA_A *Front* ft^2	C_AA_A *Side* ft^2	*Weight* *K*
LPA-80063-6CF (Verizon - Existing)	A	From Face	3.000 6.000 0.000	0.000	57.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
LPA-80063-6CF (Verizon - Existing)	B	From Face	3.000 -6.000 0.000	0.000	57.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
HBXX-6516DS (Verizon - Proposed)	B	From Face	3.000 -4.000 0.000	0.000	57.000	No Ice 1/2" Ice	5.938 6.350	3.280 3.610	0.035 0.070
800-10734 (Verizon - Proposed)	B	From Face	3.000 0.000 0.000	0.000	57.000	No Ice 1/2" Ice	6.167 6.593	2.342 2.671	0.025 0.056
HBXX-6516DS (Verizon - Proposed)	B	From Face	3.000 4.000 0.000	0.000	57.000	No Ice 1/2" Ice	5.938 6.350	3.280 3.610	0.035 0.070
LPA-80063-6CF (Verizon - Existing)	B	From Face	3.000 6.000 0.000	0.000	57.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
LPA-80063-6CF (Verizon - Existing)	C	From Face	3.000 -6.000 0.000	0.000	57.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
HBXX-6516DS (Verizon - Proposed)	C	From Face	3.000 -4.000 0.000	0.000	57.000	No Ice 1/2" Ice	5.938 6.350	3.280 3.610	0.035 0.070
800-10734 (Verizon - Proposed)	C	From Face	3.000 0.000 0.000	0.000	57.000	No Ice 1/2" Ice	6.167 6.593	2.342 2.671	0.025 0.056
HBXX-6516DS (Verizon - Proposed)	C	From Face	3.000 4.000 0.000	0.000	57.000	No Ice 1/2" Ice	5.938 6.350	3.280 3.610	0.035 0.070
LPA-80063-6CF (Verizon - Existing)	C	From Face	3.000 6.000 0.000	0.000	57.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
RRH2x40-AWS (Verizon - Existing)	A	From Face	3.000 -4.000 0.000	0.000	57.000	No Ice 1/2" Ice	2.522 2.753	1.589 1.795	0.044 0.061
RRH2x40-AWS (Verizon - Existing)	B	From Face	3.000 -4.000 0.000	0.000	57.000	No Ice 1/2" Ice	2.522 2.753	1.589 1.795	0.044 0.061
RRH2x40-AWS (Verizon - Existing)	C	From Face	3.000 -4.000 0.000	0.000	57.000	No Ice 1/2" Ice	2.522 2.753	1.589 1.795	0.044 0.061
DB-T1-6Z-8AB-0Z (Verizon - Existing)	C	From Face	3.000 0.000 0.000	0.000	57.000	No Ice 1/2" Ice	5.600 5.915	2.333 2.558	0.044 0.080
RRH2x60-PCS (Verizon - Proposed)	A	From Face	3.000 4.000 0.000	0.000	57.000	No Ice 1/2" Ice	2.578 2.804	2.030 2.239	0.063 0.083
RRH2x60-PCS (Verizon - Proposed)	B	From Face	3.000 4.000 0.000	0.000	57.000	No Ice 1/2" Ice	2.578 2.804	2.030 2.239	0.063 0.083
RRH2x60-PCS (Verizon - Proposed)	C	From Face	3.000 4.000 0.000	0.000	57.000	No Ice 1/2" Ice	2.578 2.804	2.030 2.239	0.063 0.083
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	B	From Face	3.000 0.000 0.000	0.000	57.000	No Ice 1/2" Ice	5.600 5.915	2.333 2.558	0.044 0.080

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(2) CBC78-DF (Verizon - Proposed)	A	From Face	3.000 0.000 0.000	0.000	57.000	No Ice 1/2" Ice	0.453 0.547	0.200 0.272	0.007 0.010
(2) CBC78-DF (Verizon - Proposed)	B	From Face	3.000 0.000 0.000	0.000	57.000	No Ice 1/2" Ice	0.453 0.547	0.200 0.272	0.007 0.010
(2) CBC78-DF (Verizon - Proposed)	C	From Face	3.000 0.000 0.000	0.000	57.000	No Ice 1/2" Ice	0.453 0.547	0.200 0.272	0.007 0.010
EEI 10-ft T-Arm Array (Verizon - Existing)	C	None		0.000	57.000	No Ice 1/2" Ice	23.000 26.500	23.000 26.500	1.600 1.850
AIR21 (T-Mobile - Reserved)	A	From Face	3.000 0.000 0.000	0.000	77.000	No Ice 1/2" Ice	6.533 6.978	4.356 4.775	0.083 0.125
AIR21 (T-Mobile - Reserved)	B	From Face	3.000 0.000 0.000	0.000	77.000	No Ice 1/2" Ice	6.533 6.978	4.356 4.775	0.083 0.125
AIR21 (T-Mobile - Reserved)	C	From Face	3.000 0.000 0.000	0.000	77.000	No Ice 1/2" Ice	6.533 6.978	4.356 4.775	0.083 0.125
EEI 10-ft T-Arm Array (T-Mobile - Reserved)	C	None		0.000	77.000	No Ice 1/2" Ice	23.000 26.500	23.000 26.500	1.600 1.850

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 78.000-48.391	62.441	1.2	0.022	80.822	A	0.000	80.822	80.822	100.00	0.000	0.000
					B	0.000	80.822		100.00	0.000	0.000
					C	0.000	80.822		100.00	0.000	0.000
L2 48.391-23.917	35.748	1.023	0.019	84.053	A	0.000	84.053	84.053	100.00	0.000	0.000
					B	0.000	84.053		100.00	0.000	0.000
					C	0.000	84.053		100.00	0.000	0.000
L3 23.917-1.000	12.158	1	0.018	92.059	A	0.000	92.059	92.059	100.00	0.000	0.000
					B	0.000	92.059		100.00	0.000	0.000
					C	0.000	92.059		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 78.000-48.391	62.441	1.2	0.017	0.500	83.290	A	0.000	83.290	83.290	100.00	0.000	0.000
						B	0.000	83.290		100.00	0.000	0.000
						C	0.000	83.290		100.00	0.000	0.000
L2 48.391-23.917	35.748	1.023	0.014	0.500	86.092	A	0.000	86.092	86.092	100.00	0.000	0.000
						B	0.000	86.092		100.00	0.000	0.000
						C	0.000	86.092		100.00	0.000	0.000
L3 23.917-1.000	12.158	1	0.014	0.500	93.969	A	0.000	93.969	93.969	100.00	0.000	0.000
						B	0.000	93.969		100.00	0.000	0.000
						C	0.000	93.969		100.00	0.000	0.000

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 78.000-48.391	62.441	1.2	0.008	80.822	A	0.000	80.822	80.822	100.00	0.000	0.000
					B	0.000	80.822		100.00	0.000	0.000
					C	0.000	80.822		100.00	0.000	0.000
L2 48.391-23.917	35.748	1.023	0.007	84.053	A	0.000	84.053	84.053	100.00	0.000	0.000
					B	0.000	84.053		100.00	0.000	0.000
					C	0.000	84.053		100.00	0.000	0.000
L3 23.917-1.000	12.158	1	0.006	92.059	A	0.000	92.059	92.059	100.00	0.000	0.000
					B	0.000	92.059		100.00	0.000	0.000
					C	0.000	92.059		100.00	0.000	0.000

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 78.000-48.391	0.539	3.242	A	1	1.2	1	1	1	80.822	3.638	0.123	C
			B	1	1.2	1	1	1	80.822			
			C	1	1.2	1	1	1	80.822			
L2 48.391-23.917	0.930	5.598	A	1	1.2	1	1	1	84.053	3.226	0.132	C
			B	1	1.2	1	1	1	84.053			
			C	1	1.2	1	1	1	84.053			
L3 23.917-1.000	0.757	7.332	A	1	1.2	1	1	1	92.059	3.453	0.151	C
			B	1	1.2	1	1	1	92.059			
			C	1	1.2	1	1	1	92.059			
Sum Weight:	2.226	16.172						OTM	374.111 kip-ft	10.316		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 78.000-48.391	0.539	3.242	A	1	1.2	1	1	1	80.822	3.638	0.123	C
			B	1	1.2	1	1	1	80.822			
			C	1	1.2	1	1	1	80.822			
L2 48.391-23.917	0.930	5.598	A	1	1.2	1	1	1	84.053	3.226	0.132	C
			B	1	1.2	1	1	1	84.053			
			C	1	1.2	1	1	1	84.053			
L3 23.917-1.000	0.757	7.332	A	1	1.2	1	1	1	92.059	3.453	0.151	C
			B	1	1.2	1	1	1	92.059			
			C	1	1.2	1	1	1	92.059			
Sum Weight:	2.226	16.172						OTM	374.111 kip-ft	10.316		

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 78.000-48.391	0.539	3.242	A	1	1.2	1	1	1	80.822	3.638	0.123	C
			B	1	1.2	1	1	1	80.822			
			C	1	1.2	1	1	1	80.822			
L2 48.391-23.917	0.930	5.598	A	1	1.2	1	1	1	84.053	3.226	0.132	C
			B	1	1.2	1	1	1	84.053			
			C	1	1.2	1	1	1	84.053			
L3 23.917-1.000	0.757	7.332	A	1	1.2	1	1	1	92.059	3.453	0.151	C
			B	1	1.2	1	1	1	92.059			
			C	1	1.2	1	1	1	92.059			
Sum Weight:	2.226	16.172						OTM	374.111 kip-ft	10.316		

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 78.000-48.391	0.539	3.242	A	1	1.2	1	1	1	80.822	3.638	0.123	C
			B	1	1.2	1	1	1	80.822			
			C	1	1.2	1	1	1	80.822			
L2 48.391-23.917	0.930	5.598	A	1	1.2	1	1	1	84.053	3.226	0.132	C
			B	1	1.2	1	1	1	84.053			
			C	1	1.2	1	1	1	84.053			
L3 23.917-1.000	0.757	7.332	A	1	1.2	1	1	1	92.059	3.453	0.151	C
			B	1	1.2	1	1	1	92.059			
			C	1	1.2	1	1	1	92.059			
Sum Weight:	2.226	16.172						OTM	374.111 kip-ft	10.316		

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 78.000-48.391	0.539	3.850	A	1	1.2	1	1	1	83.290	2.811	0.095	C
			B	1	1.2	1	1	1	83.290			
			C	1	1.2	1	1	1	83.290			
L2 48.391-23.917	0.930	6.228	A	1	1.2	1	1	1	86.092	2.478	0.101	C
			B	1	1.2	1	1	1	86.092			
			C	1	1.2	1	1	1	86.092			
L3 23.917-1.000	0.757	8.020	A	1	1.2	1	1	1	93.969	2.644	0.115	C
			B	1	1.2	1	1	1	93.969			
			C	1	1.2	1	1	1	93.969			
Sum Weight:	2.226	18.099						OTM	288.340 kip-ft	7.933		

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 78.000-48.391	0.539	3.850	A	1	1.2	1	1	1	83.290	2.811	0.095	C
			B	1	1.2	1	1	1	83.290			
			C	1	1.2	1	1	1	83.290			
L2 48.391-23.917	0.930	6.228	A	1	1.2	1	1	1	86.092	2.478	0.101	C
			B	1	1.2	1	1	1	86.092			
			C	1	1.2	1	1	1	86.092			
L3 23.917-1.000	0.757	8.020	A	1	1.2	1	1	1	93.969	2.644	0.115	C
			B	1	1.2	1	1	1	93.969			
			C	1	1.2	1	1	1	93.969			
Sum Weight:	2.226	18.099						OTM	288.340 kip-ft	7.933		

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 78.000-48.391	0.539	3.850	A	1	1.2	1	1	1	83.290	2.811	0.095	C
			B	1	1.2	1	1	1	83.290			
			C	1	1.2	1	1	1	83.290			
L2 48.391-23.917	0.930	6.228	A	1	1.2	1	1	1	86.092	2.478	0.101	C
			B	1	1.2	1	1	1	86.092			
			C	1	1.2	1	1	1	86.092			
L3 23.917-1.000	0.757	8.020	A	1	1.2	1	1	1	93.969	2.644	0.115	C
			B	1	1.2	1	1	1	93.969			
			C	1	1.2	1	1	1	93.969			
Sum Weight:	2.226	18.099						OTM	288.340 kip-ft	7.933		

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 78.000-48.391	0.539	3.850	A	1	1.2	1	1	1	83.290	2.811	0.095	C
			B	1	1.2	1	1	1	83.290			
			C	1	1.2	1	1	1	83.290			
L2 48.391-23.917	0.930	6.228	A	1	1.2	1	1	1	86.092	2.478	0.101	C
			B	1	1.2	1	1	1	86.092			
			C	1	1.2	1	1	1	86.092			
L3 23.917-1.000	0.757	8.020	A	1	1.2	1	1	1	93.969	2.644	0.115	C
			B	1	1.2	1	1	1	93.969			
			C	1	1.2	1	1	1	93.969			
Sum Weight:	2.226	18.099						OTM	288.340 kip-ft	7.933		

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 78.000-48.391	0.539	3.242	A	1	1.2	1	1	1	80.822	1.259	0.043	C
			B	1	1.2	1	1	1	80.822			
			C	1	1.2	1	1	1	80.822			
L2 48.391-23.917	0.930	5.598	A	1	1.2	1	1	1	84.053	1.116	0.046	C
			B	1	1.2	1	1	1	84.053			
			C	1	1.2	1	1	1	84.053			
L3 23.917-1.000	0.757	7.332	A	1	1.2	1	1	1	92.059	1.195	0.052	C
			B	1	1.2	1	1	1	92.059			
			C	1	1.2	1	1	1	92.059			
Sum Weight:	2.226	16.172						OTM	129.450 kip-ft	3.570		

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 78.000-48.391	0.539	3.242	A	1	1.2	1	1	1	80.822	1.259	0.043	C
			B	1	1.2	1	1	1	80.822			
			C	1	1.2	1	1	1	80.822			
L2 48.391-23.917	0.930	5.598	A	1	1.2	1	1	1	84.053	1.116	0.046	C
			B	1	1.2	1	1	1	84.053			
			C	1	1.2	1	1	1	84.053			
L3 23.917-1.000	0.757	7.332	A	1	1.2	1	1	1	92.059	1.195	0.052	C
			B	1	1.2	1	1	1	92.059			
			C	1	1.2	1	1	1	92.059			
Sum Weight:	2.226	16.172						OTM	129.450	3.570		

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

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 78.000-48.391	0.539	3.242	A	1	1.2	1	1	1	80.822	1.259	0.043	C
			B	1	1.2	1	1	1	80.822			
			C	1	1.2	1	1	1	80.822			
L2 48.391-23.917	0.930	5.598	A	1	1.2	1	1	1	84.053	1.116	0.046	C
			B	1	1.2	1	1	1	84.053			
			C	1	1.2	1	1	1	84.053			
L3 23.917-1.000	0.757	7.332	A	1	1.2	1	1	1	92.059	1.195	0.052	C
			B	1	1.2	1	1	1	92.059			
			C	1	1.2	1	1	1	92.059			
Sum Weight:	2.226	16.172						OTM	129.450 kip-ft	3.570		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 78.000-48.391	0.539	3.242	A	1	1.2	1	1	1	80.822	1.259	0.043	C
			B	1	1.2	1	1	1	80.822			
			C	1	1.2	1	1	1	80.822			
L2 48.391-23.917	0.930	5.598	A	1	1.2	1	1	1	84.053	1.116	0.046	C
			B	1	1.2	1	1	1	84.053			
			C	1	1.2	1	1	1	84.053			
L3 23.917-1.000	0.757	7.332	A	1	1.2	1	1	1	92.059	1.195	0.052	C
			B	1	1.2	1	1	1	92.059			
			C	1	1.2	1	1	1	92.059			
Sum Weight:	2.226	16.172						OTM	129.450 kip-ft	3.570		

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	16.172					
Bracing Weight	0.000					
Total Member Self-Weight	16.172			0.125	-0.170	

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
Total Weight	35.815			0.125	-0.170	
Wind 0 deg - No Ice		0.052	-48.823	-2617.038	-3.064	0.329
Wind 30 deg - No Ice		24.426	-42.307	-2267.852	-1309.587	0.437
Wind 45 deg - No Ice		34.517	-34.559	-1852.536	-1850.467	0.447
Wind 60 deg - No Ice		42.256	-24.456	-1310.963	-2265.252	0.427
Wind 90 deg - No Ice		48.763	-0.052	-2.769	-2613.991	0.304
Wind 120 deg - No Ice		42.204	24.367	1306.200	-2262.358	0.099
Wind 135 deg - No Ice		34.444	34.486	1848.692	-1846.374	-0.018
Wind 150 deg - No Ice		24.337	42.256	2265.208	-1304.574	-0.133
Wind 180 deg - No Ice		-0.052	48.823	2617.289	2.725	-0.329
Wind 210 deg - No Ice		-24.426	42.307	2268.102	1309.248	-0.437
Wind 225 deg - No Ice		-34.517	34.559	1852.786	1850.128	-0.447
Wind 240 deg - No Ice		-42.256	24.456	1311.213	2264.913	-0.427
Wind 270 deg - No Ice		-48.763	0.052	3.020	2613.652	-0.304
Wind 300 deg - No Ice		-42.204	-24.367	-1305.950	2262.019	-0.099
Wind 315 deg - No Ice		-34.444	-34.486	-1848.442	1846.034	0.018
Wind 330 deg - No Ice		-24.337	-42.256	-2264.958	1304.234	0.133
Member Ice	1.927					
Total Weight Ice	43.609			0.232	-0.309	
Wind 0 deg - Ice		0.040	-46.807	-2541.506	-2.540	0.270
Wind 30 deg - Ice		23.415	-40.556	-2202.093	-1271.822	0.359
Wind 45 deg - Ice		33.093	-33.126	-1798.626	-1797.345	0.368
Wind 60 deg - Ice		40.516	-23.438	-1272.569	-2200.403	0.352
Wind 90 deg - Ice		46.761	-0.040	-2.000	-2539.470	0.250
Wind 120 deg - Ice		40.476	23.369	1269.168	-2198.172	0.081
Wind 135 deg - Ice		33.037	33.069	1795.934	-1794.189	-0.014
Wind 150 deg - Ice		23.346	40.516	2200.325	-1267.957	-0.109
Wind 180 deg - Ice		-0.040	46.807	2541.969	1.922	-0.270
Wind 210 deg - Ice		-23.415	40.556	2202.557	1271.204	-0.359
Wind 225 deg - Ice		-33.093	33.126	1799.089	1796.727	-0.368
Wind 240 deg - Ice		-40.516	23.438	1273.033	2199.785	-0.352
Wind 270 deg - Ice		-46.761	0.040	2.463	2538.852	-0.250
Wind 300 deg - Ice		-40.476	-23.369	-1268.705	2197.554	-0.081
Wind 315 deg - Ice		-33.037	-33.069	-1795.471	1793.571	0.014
Wind 330 deg - Ice		-23.346	-40.516	-2199.862	1267.339	0.109
Total Weight	35.815			0.125	-0.170	
Wind 0 deg - Service		0.018	-16.894	-905.468	-1.171	0.114
Wind 30 deg - Service		8.452	-14.639	-784.642	-453.255	0.151
Wind 45 deg - Service		11.944	-11.958	-640.934	-640.411	0.155
Wind 60 deg - Service		14.621	-8.462	-453.539	-783.935	0.148
Wind 90 deg - Service		16.873	-0.018	-0.877	-904.606	0.105
Wind 120 deg - Service		14.603	8.431	452.054	-782.934	0.034
Wind 135 deg - Service		11.918	11.933	639.768	-638.995	-0.006
Wind 150 deg - Service		8.421	14.621	783.891	-451.520	-0.046
Wind 180 deg - Service		-0.018	16.894	905.718	0.832	-0.114
Wind 210 deg - Service		-8.452	14.639	784.892	452.916	-0.151
Wind 225 deg - Service		-11.944	11.958	641.184	640.072	-0.155
Wind 240 deg - Service		-14.621	8.462	453.789	783.596	-0.148
Wind 270 deg - Service		-16.873	0.018	1.127	904.267	-0.105
Wind 300 deg - Service		-14.603	-8.431	-451.804	782.594	-0.034
Wind 315 deg - Service		-11.918	-11.933	-639.518	638.655	0.006
Wind 330 deg - Service		-8.421	-14.621	-783.641	451.181	0.046

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
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	78 - 48.3906	Pole	Max Tension	18	0.000	0.000	0.000
			Max. Compression	18	-20.414	-0.309	-0.232
			Max. Mx	23	-19.807	-502.204	-0.091

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. My	27	-19.805	-0.168	-502.288
			Max. Vy	6	30.029	-497.264	0.058
			Max. Vx	10	30.089	0.013	-497.427
			Max. Torque	4			-0.446
L2	48.3906 - 23.9167	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-29.950	-0.309	-0.232
			Max. Mx	6	-23.328	-1316.237	1.279
			Max. My	10	-23.326	1.234	-1317.813
			Max. Vy	6	39.106	-1316.237	1.279
			Max. Vx	10	39.166	1.234	-1317.813
			Max. Torque	4			-0.446
L3	23.9167 - 1	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-43.609	-0.309	-0.232
			Max. Mx	6	-35.801	-2632.698	2.787
			Max. My	10	-35.801	2.742	-2636.017
			Max. Vy	6	48.773	-2632.698	2.787
			Max. Vx	10	48.833	2.742	-2636.017
			Max. Torque	4			-0.446

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	27	43.609	0.040	-46.807
	Max. H_x	14	35.815	48.763	-0.052
	Max. H_z	2	35.815	-0.052	48.823
	Max. M_x	2	2635.764	-0.052	48.823
	Max. M_z	6	2632.698	-48.763	0.052
	Max. Torsion	12	0.444	34.517	-34.559
	Min. Vert	40	35.815	-14.603	-8.431
	Min. H_x	6	35.815	-48.763	0.052
	Min. H_z	10	35.815	0.052	-48.823
	Min. M_x	10	-2636.017	0.052	-48.823
	Min. M_z	14	-2632.355	48.763	-0.052
	Min. Torsion	4	-0.446	-34.517	34.559

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	35.815	0.000	0.000	0.125	-0.170	0.000
Dead+Wind 0 deg - No Ice	35.815	0.052	-48.823	-2635.764	-3.085	0.325
Dead+Wind 30 deg - No Ice	35.815	24.426	-42.307	-2284.079	-1318.958	0.434
Dead+Wind 45 deg - No Ice	35.815	34.517	-34.559	-1865.790	-1863.709	0.446
Dead+Wind 60 deg - No Ice	35.815	42.256	-24.456	-1320.342	-2281.463	0.427
Dead+Wind 90 deg - No Ice	35.815	48.763	-0.052	-2.787	-2632.698	0.304
Dead+Wind 120 deg - No Ice	35.815	42.204	24.367	1315.549	-2278.550	0.099
Dead+Wind 135 deg - No Ice	35.815	34.444	34.486	1861.923	-1859.589	-0.018
Dead+Wind 150 deg - No Ice	35.815	24.337	42.256	2281.419	-1313.912	-0.133
Dead+Wind 180 deg - No Ice	35.815	-0.052	48.823	2636.017	2.742	-0.328

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 210 deg - No Ice	35.815	-24.426	42.307	2284.331	1318.615	-0.434
Dead+Wind 225 deg - No Ice	35.815	-34.517	34.559	1866.043	1863.366	-0.444
Dead+Wind 240 deg - No Ice	35.815	-42.256	24.456	1320.595	2281.120	-0.424
Dead+Wind 270 deg - No Ice	35.815	-48.763	0.052	3.040	2632.355	-0.301
Dead+Wind 300 deg - No Ice	35.815	-42.204	-24.367	-1315.296	2278.207	-0.099
Dead+Wind 315 deg - No Ice	35.815	-34.444	-34.486	-1861.670	1859.246	0.016
Dead+Wind 330 deg - No Ice	35.815	-24.337	-42.256	-2281.166	1313.568	0.130
Dead+Ice+Temp	43.609	0.000	0.000	0.232	-0.309	0.000
Dead+Wind 0 deg+Ice+Temp	43.609	0.040	-46.807	-2564.819	-2.564	0.266
Dead+Wind 30 deg+Ice+Temp	43.609	23.415	-40.556	-2222.292	-1283.490	0.356
Dead+Wind 45 deg+Ice+Temp	43.609	33.093	-33.126	-1815.123	-1813.835	0.365
Dead+Wind 60 deg+Ice+Temp	43.609	40.516	-23.438	-1284.241	-2220.591	0.350
Dead+Wind 90 deg+Ice+Temp	43.609	46.761	-0.040	-2.015	-2562.770	0.250
Dead+Wind 120 deg+Ice+Temp	43.609	40.476	23.369	1280.814	-2218.341	0.082
Dead+Wind 135 deg+Ice+Temp	43.609	33.037	33.069	1812.412	-1810.653	-0.014
Dead+Wind 150 deg+Ice+Temp	43.609	23.346	40.516	2220.513	-1279.593	-0.108
Dead+Wind 180 deg+Ice+Temp	43.609	-0.040	46.807	2565.290	1.937	-0.268
Dead+Wind 210 deg+Ice+Temp	43.609	-23.415	40.556	2222.762	1282.863	-0.356
Dead+Wind 225 deg+Ice+Temp	43.609	-33.093	33.126	1815.594	1813.208	-0.364
Dead+Wind 240 deg+Ice+Temp	43.609	-40.516	23.438	1284.711	2219.964	-0.347
Dead+Wind 270 deg+Ice+Temp	43.609	-46.761	0.040	2.485	2562.143	-0.247
Dead+Wind 300 deg+Ice+Temp	43.609	-40.476	-23.369	-1280.344	2217.714	-0.082
Dead+Wind 315 deg+Ice+Temp	43.609	-33.037	-33.069	-1811.942	1810.026	0.012
Dead+Wind 330 deg+Ice+Temp	43.609	-23.346	-40.516	-2220.043	1278.966	0.106
Dead+Wind 0 deg - Service	35.815	0.018	-16.894	-912.035	-1.180	0.113
Dead+Wind 30 deg - Service	35.815	8.452	-14.639	-790.333	-456.544	0.150
Dead+Wind 45 deg - Service	35.815	11.944	-11.958	-645.582	-645.057	0.154
Dead+Wind 60 deg - Service	35.815	14.621	-8.462	-456.828	-789.623	0.148
Dead+Wind 90 deg - Service	35.815	16.873	-0.018	-0.882	-911.169	0.105
Dead+Wind 120 deg - Service	35.815	14.603	8.431	455.332	-788.611	0.034
Dead+Wind 135 deg - Service	35.815	11.918	11.933	644.409	-643.631	-0.006
Dead+Wind 150 deg - Service	35.815	8.421	14.621	789.578	-454.797	-0.046
Dead+Wind 180 deg - Service	35.815	-0.018	16.894	912.288	0.837	-0.113
Dead+Wind 210 deg - Service	35.815	-8.452	14.639	790.586	456.200	-0.150
Dead+Wind 225 deg - Service	35.815	-11.944	11.958	645.835	644.714	-0.154
Dead+Wind 240 deg - Service	35.815	-14.621	8.462	457.081	789.279	-0.147
Dead+Wind 270 deg - Service	35.815	-16.873	0.018	1.135	910.826	-0.105
Dead+Wind 300 deg - Service	35.815	-14.603	-8.431	-455.079	788.267	-0.034
Dead+Wind 315 deg - Service	35.815	-11.918	-11.933	-644.153	643.285	0.006
Dead+Wind 330 deg - Service	35.815	-8.421	-14.621	-789.325	454.454	0.045

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	-35.815	0.000	0.000	35.815	0.000	0.000%
2	0.052	-35.815	-48.823	-0.052	35.815	48.823	0.000%
3	24.426	-35.815	-42.307	-24.426	35.815	42.307	0.000%
4	34.517	-35.815	-34.559	-34.517	35.815	34.559	0.000%
5	42.256	-35.815	-24.456	-42.256	35.815	24.456	0.000%
6	48.763	-35.815	-0.052	-48.763	35.815	0.052	0.000%
7	42.204	-35.815	24.367	-42.204	35.815	-24.367	0.000%
8	34.444	-35.815	34.486	-34.444	35.815	-34.486	0.000%
9	24.337	-35.815	42.256	-24.337	35.815	-42.256	0.000%
10	-0.052	-35.815	48.823	0.052	35.815	-48.823	0.000%
11	-24.426	-35.815	42.307	24.426	35.815	-42.307	0.000%
12	-34.517	-35.815	34.559	34.517	35.815	-34.559	0.000%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	*PX K*	*PY K*	*PZ K*	*PX K*	*PY K*	*PZ K*	*% Error*
13	-42.256	-35.815	24.456	42.256	35.815	-24.456	0.000%
14	-48.763	-35.815	0.052	48.763	35.815	-0.052	0.000%
15	-42.204	-35.815	-24.367	42.204	35.815	24.367	0.000%
16	-34.444	-35.815	-34.486	34.444	35.815	34.486	0.000%
17	-24.337	-35.815	-42.256	24.337	35.815	42.256	0.000%
18	0.000	-43.609	0.000	0.000	43.609	0.000	0.000%
19	0.040	-43.609	-46.807	-0.040	43.609	46.807	0.000%
20	23.415	-43.609	-40.556	-23.415	43.609	40.556	0.000%
21	33.093	-43.609	-33.126	-33.093	43.609	33.126	0.000%
22	40.516	-43.609	-23.438	-40.516	43.609	23.438	0.000%
23	46.761	-43.609	-0.040	-46.761	43.609	0.040	0.000%
24	40.476	-43.609	23.369	-40.476	43.609	-23.369	0.000%
25	33.037	-43.609	33.069	-33.037	43.609	-33.069	0.000%
26	23.346	-43.609	40.516	-23.346	43.609	-40.516	0.000%
27	-0.040	-43.609	46.807	0.040	43.609	-46.807	0.000%
28	-23.415	-43.609	40.556	23.415	43.609	-40.556	0.000%
29	-33.093	-43.609	33.126	33.093	43.609	-33.126	0.000%
30	-40.516	-43.609	23.438	40.516	43.609	-23.438	0.000%
31	-46.761	-43.609	0.040	46.761	43.609	-0.040	0.000%
32	-40.476	-43.609	-23.369	40.476	43.609	23.369	0.000%
33	-33.037	-43.609	-33.069	33.037	43.609	33.069	0.000%
34	-23.346	-43.609	-40.516	23.346	43.609	40.516	0.000%
35	0.018	-35.815	-16.894	-0.018	35.815	16.894	0.000%
36	8.452	-35.815	-14.639	-8.452	35.815	14.639	0.000%
37	11.944	-35.815	-11.958	-11.944	35.815	11.958	0.000%
38	14.621	-35.815	-8.462	-14.621	35.815	8.462	0.000%
39	16.873	-35.815	-0.018	-16.873	35.815	0.018	0.000%
40	14.603	-35.815	8.431	-14.603	35.815	-8.431	0.000%
41	11.918	-35.815	11.933	-11.918	35.815	-11.933	0.000%
42	8.421	-35.815	14.621	-8.421	35.815	-14.621	0.000%
43	-0.018	-35.815	16.894	0.018	35.815	-16.894	0.000%
44	-8.452	-35.815	14.639	8.452	35.815	-14.639	0.000%
45	-11.944	-35.815	11.958	11.944	35.815	-11.958	0.000%
46	-14.621	-35.815	8.462	14.621	35.815	-8.462	0.000%
47	-16.873	-35.815	0.018	16.873	35.815	-0.018	0.000%
48	-14.603	-35.815	-8.431	14.603	35.815	8.431	0.000%
49	-11.918	-35.815	-11.933	11.918	35.815	11.933	0.000%
50	-8.421	-35.815	-14.621	8.421	35.815	14.621	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	0.00000660
3	Yes	4	0.00000001	0.00007609
4	Yes	4	0.00000001	0.00008535
5	Yes	4	0.00000001	0.00007299
6	Yes	4	0.00000001	0.00000644
7	Yes	4	0.00000001	0.00007455
8	Yes	4	0.00000001	0.00008498
9	Yes	4	0.00000001	0.00007462
10	Yes	4	0.00000001	0.00000648
11	Yes	4	0.00000001	0.00007296
12	Yes	4	0.00000001	0.00008533
13	Yes	4	0.00000001	0.00007605

14	Yes	4	0.00000001	0.00000656
15	Yes	4	0.00000001	0.00007373
16	Yes	4	0.00000001	0.00008491
17	Yes	4	0.00000001	0.00007366
18	Yes	4	0.00000001	0.00000001
19	Yes	4	0.00000001	0.00024885
20	Yes	4	0.00000001	0.00032613
21	Yes	4	0.00000001	0.00034716
22	Yes	4	0.00000001	0.00032509
23	Yes	4	0.00000001	0.00024888
24	Yes	4	0.00000001	0.00032539
25	Yes	4	0.00000001	0.00034681
26	Yes	4	0.00000001	0.00032539
27	Yes	4	0.00000001	0.00024892
28	Yes	4	0.00000001	0.00032504
29	Yes	4	0.00000001	0.00034712
30	Yes	4	0.00000001	0.00032610
31	Yes	4	0.00000001	0.00024879
32	Yes	4	0.00000001	0.00032487
33	Yes	4	0.00000001	0.00034654
34	Yes	4	0.00000001	0.00032484
35	Yes	4	0.00000001	0.00000362
36	Yes	4	0.00000001	0.00000818
37	Yes	4	0.00000001	0.00000897
38	Yes	4	0.00000001	0.00000777
39	Yes	4	0.00000001	0.00000362
40	Yes	4	0.00000001	0.00000797
41	Yes	4	0.00000001	0.00002200
42	Yes	4	0.00000001	0.00000799
43	Yes	4	0.00000001	0.00000362
44	Yes	4	0.00000001	0.00000777
45	Yes	4	0.00000001	0.00000896
46	Yes	4	0.00000001	0.00000818
47	Yes	4	0.00000001	0.00000362
48	Yes	4	0.00000001	0.00000785
49	Yes	4	0.00000001	0.00000889
50	Yes	4	0.00000001	0.00002160

Maximum Tower Deflections - Service Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* *°*	*Twist* *°*
L1	78 - 48.3906	5.080	44	0.557	0.000
L2	53.6094 - 23.9167	2.517	44	0.422	0.000
L3	30.0807 - 1	0.817	44	0.244	0.000

Critical Deflections and Radius of Curvature - Service Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* *°*	*Twist* *°*	*Radius of Curvature* *ft*
95.000	Byram Tower Branch	44	5.080	0.557	0.000	38458
90.000	Byram Tower Branch	44	5.080	0.557	0.000	38458
85.000	Byram Tower Branch	44	5.080	0.557	0.000	38458
80.000	Byram Tower Branch	44	5.080	0.557	0.000	38458

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* *°*	*Twist* *°*	*Radius of Curvature* *ft*
77.000	AIR21	44	4.968	0.552	0.000	38458
75.000	Byram Tower Branch	44	4.746	0.542	0.000	38458
70.000	Byram Tower Branch	44	4.195	0.517	0.000	24036
67.000	(3) P65-16-XLH-RR	44	3.869	0.501	0.000	17481
65.000	Byram Tower Branch	44	3.656	0.490	0.000	14792
64.000	(2) RRUS-11	44	3.550	0.485	0.000	13735
60.000	Byram Tower Branch	44	3.137	0.462	0.000	10683
57.000	LPA-80063-6CF	44	2.839	0.444	0.000	9163
55.000	Byram Tower Branch	44	2.647	0.431	0.000	8424
50.000	Byram Tower Branch	44	2.192	0.398	0.000	7399
45.000	Byram Tower Branch	44	1.778	0.362	0.000	6812
40.000	Byram Tower Branch	44	1.407	0.324	0.000	6313
35.000	Byram Tower Branch	44	1.085	0.284	0.000	5882
30.000	Byram Tower Branch	44	0.813	0.243	0.000	5743
25.000	Byram Tower Branch	44	0.593	0.202	0.000	6679
20.000	Byram Tower Branch	44	0.419	0.160	0.000	8437
15.000	Byram Tower Branch	44	0.280	0.118	0.000	11450

Maximum Tower Deflections - Design Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* *°*	*Twist* *°*
L1	78 - 48.3906	14.676	11	1.610	0.001
L2	53.6094 - 23.9167	7.271	11	1.221	0.001
L3	30.0807 - 1	2.360	11	0.705	0.000

Critical Deflections and Radius of Curvature - Design Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* *°*	*Twist* *°*	*Radius of Curvature* *ft*
95.000	Byram Tower Branch	11	14.676	1.610	0.001	13001
90.000	Byram Tower Branch	11	14.676	1.610	0.001	13001
85.000	Byram Tower Branch	11	14.676	1.610	0.001	13001
80.000	Byram Tower Branch	11	14.676	1.610	0.001	13001
77.000	AIR21	11	14.354	1.595	0.001	13001
75.000	Byram Tower Branch	11	13.712	1.566	0.001	13001
70.000	Byram Tower Branch	11	12.119	1.493	0.001	8126
67.000	(3) P65-16-XLH-RR	11	11.180	1.447	0.001	5909
65.000	Byram Tower Branch	11	10.563	1.416	0.001	5000
64.000	(2) RRUS-11	11	10.258	1.400	0.001	4643
60.000	Byram Tower Branch	11	9.065	1.335	0.001	3611
57.000	LPA-80063-6CF	11	8.203	1.283	0.001	3097
55.000	Byram Tower Branch	11	7.648	1.247	0.001	2850
50.000	Byram Tower Branch	11	6.334	1.150	0.000	2526
45.000	Byram Tower Branch	11	5.137	1.046	0.000	2354
40.000	Byram Tower Branch	11	4.067	0.936	0.000	2186
35.000	Byram Tower Branch	11	3.134	0.821	0.000	2037
30.000	Byram Tower Branch	11	2.349	0.703	0.000	1988
25.000	Byram Tower Branch	11	1.715	0.583	0.000	2312
20.000	Byram Tower Branch	11	1.210	0.463	0.000	2920

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
15.000	Byram Tower Branch	11	0.808	0.342	0.000	3963

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	78 - 48.3906 (1)	TP37.761x27.75x0.313	29.609	0.000	0.0	39.000	35.394	-19.805	1380.360	0.014
L2	48.3906 - 23.9167 (2)	TP45.308x35.371x0.438	29.693	0.000	0.0	39.000	59.443	-23.326	2318.290	0.010
L3	23.9167 - 1 (3)	TP52x42.37x0.5	29.081	0.000	0.0	39.000	81.730	-35.801	3187.490	0.011

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	78 - 48.3906 (1)	TP37.761x27.75x0.313	502.288	19.358	39.000	0.496	0.000	0.000	39.000	0.000
L2	48.3906 - 23.9167 (2)	TP45.308x35.371x0.438	1318.525	25.258	39.000	0.648	0.000	0.000	39.000	0.000
L3	23.9167 - 1 (3)	TP52x42.37x0.5	2637.600	30.530	39.000	0.783	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	78 - 48.3906 (1)	TP37.761x27.75x0.313	28.918	0.817	26.000	0.063	0.269	0.005	26.000	0.000
L2	48.3906 - 23.9167 (2)	TP45.308x35.371x0.438	39.196	0.659	26.000	0.051	0.434	0.004	26.000	0.000
L3	23.9167 - 1 (3)	TP52x42.37x0.5	48.863	0.598	26.000	0.046	0.434	0.002	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	78 - 48.3906 (1)	0.014	0.496	0.000	0.063	0.000	0.512 ✔	1.333	H1-3+VT ✔
L2	48.3906 - 23.9167 (2)	0.010	0.648	0.000	0.051	0.000	0.658 ✔	1.333	H1-3+VT ✔
L3	23.9167 - 1 (3)	0.011	0.783	0.000	0.046	0.000	0.795 ✔	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	78 - 48.3906	Pole	TP37.761x27.75x0.313	1	-19.805	1840.020	38.4	Pass
L2	48.3906 - 23.9167	Pole	TP45.308x35.371x0.438	2	-23.326	3090.280	49.4	Pass
L3	23.9167 - 1	Pole	TP52x42.37x0.5	3	-35.801	4248.924	59.6	Pass
							Summary	
						Pole (L3)	59.6	Pass
						RATING =	**59.6**	**Pass**

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 2638 \cdot ft \cdot kips$	(Input From tnxTower)
Shear Force =	$Shear := 49 \cdot kips$	(Input From tnxTower)
Axial Force =	$Axial := 36 \cdot kips$	(Input From tnxTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

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

Base Plate Data:

Use ASTM A572 Grade 50

Plate Yield Strength =	$Fy_{bp} := 50 \cdot ksi$	(User Input)
Base Plate Thickness =	$t_{bp} := 2.75 \cdot in$	(User Input)
Base Plate Diameter =	$D_{bp} := 66 \cdot in$	(User Input)
Outer Pole Diameter =	$D_{pole} := 52.0 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

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

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

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

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

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 26 \cdot in$

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

$MA_1 = 0.00 \cdot in$	$MA_7 = 0.00 \cdot in$
$MA_2 = 0.00 \cdot in$	$MA_8 = 0.00 \cdot in$
$MA_3 = 0.00 \cdot in$	$MA_9 = 0.00 \cdot in$
$MA_4 = 2.53 \cdot in$	$MA_{10} = 0.00 \cdot in$
$MA_5 = 4.00 \cdot in$	$MA_{11} = 0.00 \cdot in$
$MA_6 = 2.53 \cdot in$	etc

Effective Width of Baseplate for Bending = $B_{eff} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 32.5 \cdot in$

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

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

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

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

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

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

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

Check Anchor Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 103.7 \cdot kips$

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 = $\frac{T_{Max}}{T_{ALL.Net}} = 53.2 \cdot \%$ Bolts are "upset bolts". Use net area per AISC

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

Condition1 = "OK"

Check Anchor Bolt Bending Stress:

Maximum Bending Moment = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.612 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 8.9 \cdot ksi$

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 = $C_{Max} := OM \cdot \frac{R_{bc}}{I_p} + \frac{Axial}{N} = 107.3 \cdot kips$

Maximum Compressive Stress = $f_a := \frac{C_{Max}}{A_n} = 33 \cdot ksi$

$K := 0.65$

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

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

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

Combined Stress % of Capacity = $\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) = 55.1 \cdot \%$

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

Condition2 = "OK"

Base Plate Analysis:

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

$C_1 = 34.4 \cdot kips$	$C_7 = 87.2 \cdot kips$
$C_2 = 63.8 \cdot kips$	$C_8 = 63.8 \cdot kips$
$C_3 = 87.2 \cdot kips$	$C_9 = 34.4 \cdot kips$
$C_4 = 102.2 \cdot kips$	$C_{10} = 1.8 \cdot kips$
$C_5 = 107.3 \cdot kips$	$C_{11} = -30.8 \cdot kips$
$C_6 = 102.2 \cdot kips$	etc.

Maximum Bending Stress in Plate = $f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} t_{bp}^2\right)} = 23.1 \cdot ksi$

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

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} = 46.3 \cdot \%$

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

Condition3 = "Ok"

Rock Anchor Design:

Input Data:

Max Pier Reactions:

Moment =	$Moment := 2638 \cdot ft \cdot kips$	user input	
Shear =	$Shear := 49 \cdot kips$	user input	
Compression =	$Axial := 36 \cdot kips$	user input	

Structure:

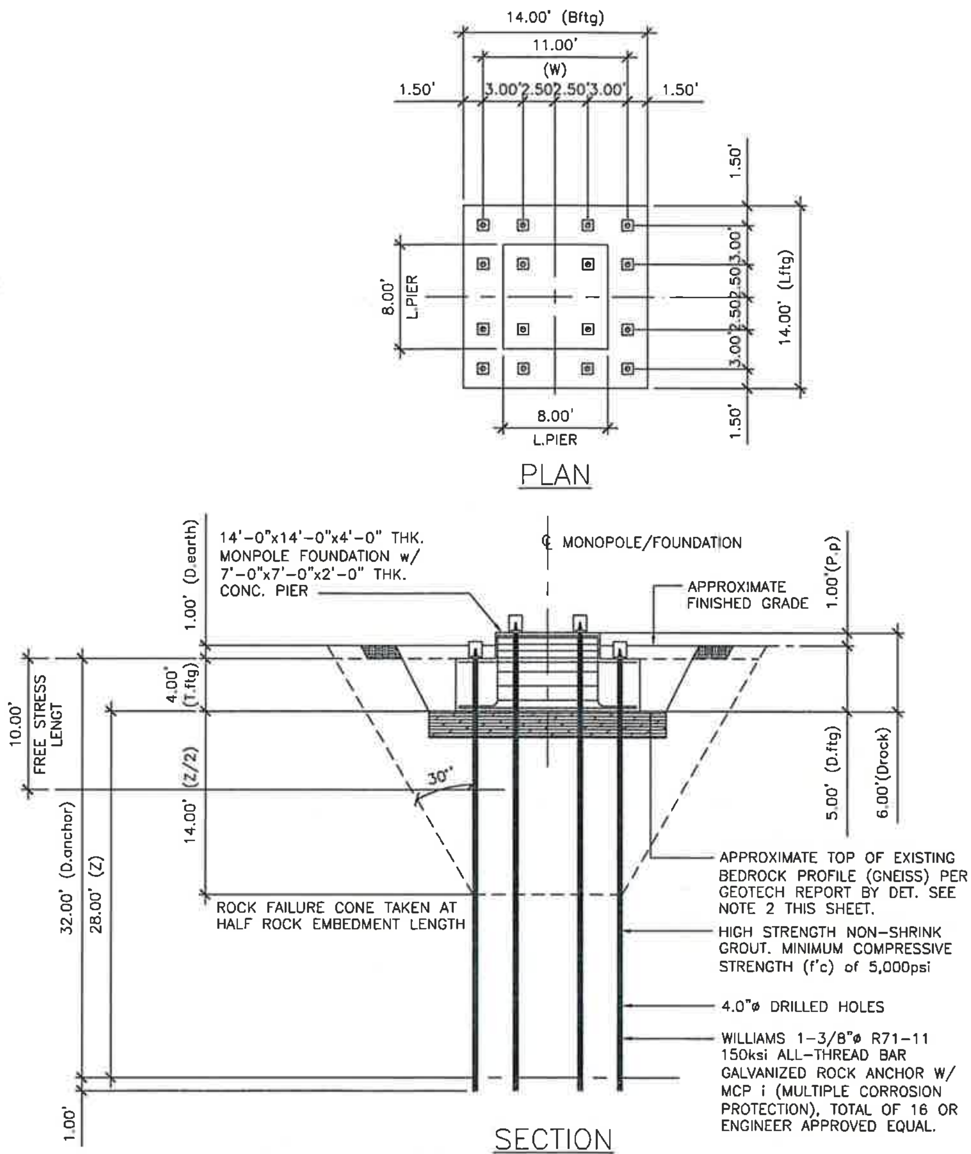
Footing Width =	$W_{ftg} := 14ft$	user input	
Footing Length =	$L_{ftg} := 14ft$	user input	
Footing Thickness =	$T_{ftg} := 4.0ft$	user input	
Pier Length=	$L_{pier} := 8.0ft$	user input	
Pier Depth =	$T_{pier} := 2.0ft$	user input	
Pier Projection Above Grade =	$P_p := 1.0 \cdot ft$	user input	

Depths:

Depth to Bottom of Footing =	$D_{ftg} := 5.0ft$	user input	(from grade line)
Depth to Sound (Competent) Rock Per Geo-tech Report =	$D_{rock} := 5.0ft$	user input	(from grade line)
Depth to Suitable Earth =	$D_{earth} := 1.0ft$	user input	(from grade line)
Anchor Depth =	$D_{anchor} := 32ft$	user input	(from grade line)

Subgrade Properties:

Internal Friction Angle =	$\phi := 30deg$	user input	
Unit Weight of Earth =	$\gamma_{earth} := 125 \frac{lb}{ft^3}$	user input	
Unit Weight of Rock =	$\gamma_{rock} := 165 \frac{lb}{ft^3}$	user input	
Unit Weight of Conc =	$\gamma_{conc} := 150 \frac{lb}{ft^3}$	user input	*(Based on Addendum Letter to Geotechnical Report prepared by Design Earth Technology (DET), dated October 4, 2010. Gneiss Bedrock with average RQD of 70% and average Uniaxial Compressive Strength of 6,870psi at boring B-1.*
Allowable Bearing =	$q_s := 20000 \cdot psf$	user input	



Rock Anchor Foundation Geometry:

Rock Anchor Properties:

Number of Anchors (along width) =	$N_{anchor} := 4$	*user input*	
Hole Diameter =	$hole_d := 4in$	*user input*	
Ultimate Bond Stress Between Rock and Grout =	$\sigma_{bond} := 75 \cdot psi$	*user input*	
Allowable Bond Stress Between Rock and Grout =	$\sigma_{allbond} := \sigma_{bond} \cdot 0.5 = 37.5psi$	*user input*	
Grout Allowable Compressive Stress =	$fc_g := 5000 \cdot psi$	*user input*	
Anchor Spacing* (along length) =	$S_{anchor} := 11ft$	*user input*	
Required Factor of Safety =	$F_S := 2.0$	*user input*	
Rock Anchor Ultimate Strength =	$Fu_{anchor} := 150.0ksi$	*user input*	Williams R71-14 1.75" dia. 150ksi
Rock Anchor Yield Strength =	$Fy_{anchor} := 127.7ksi$	*user input*	Per Recommendation of PTI For Prestressed Rock Soil and Soil Anchors Section 6.6 Design Load Should Be Designed so that the design load is not more than 60% of Specified Minimum Tensile Strength per Recommendation per PTI Section 6.6
Rock Anchor Diameter =	$d_{ra} := 1.375in$	*user input*	
Rock Anchor Area per Group =	$A_g := 1.580in^2$	*user input*	
Rock Anchor Ultimate Tensile Strength =	$P_u := 237kips$	*user input*	
Rock Anchor Allowable Tension =	$P_{all} := 0.60 \cdot P_u = 142.2 \cdot kips$		
Rock Anchor Maximum Working Load to Yield =	$T_y := 0.80 \cdot P_u = 189.6 \cdot kips$		
Rock Anchor Shear Capacity =	$Sh := 0.4 \cdot T_y = 75.84 \cdot kips$		
Number of Rock Anchors =	$n_{anchor} := 16$	*user input*	

Rock Anchor Tension/Shear Check:

Overturning Moment = $OM := Moment + Shear \cdot (T_{ftg} + T_{pier}) = 2932 \cdot ft \cdot kips$

Weight of Pad = $W_{pad} := (W_{ftg} \cdot L_{ftg} \cdot T_{ftg}) \cdot \gamma_{conc} = 117.6 \cdot kips$

Weight of Pier = $W_{pier} := (L_{pier}^2 \cdot T_{pier}) \cdot \gamma_{conc} = 19.2 \cdot kips$

Weight of Soil = $W_{soil} := \left[\left[(W_{ftg} \cdot L_{ftg}) - L_{pier}^2\right] \cdot D_{earth}\right] \cdot \gamma_{earth} = 16.5 \cdot kips$

Total Weight = $W_{conc} := W_{pad} + W_{pier} = 136.8 \cdot kips$

Total Weight of Foundation = $W_{tot} := W_{conc} + W_{soil} + Axial = 189.3 \cdot kips$

Resisting Moment = $M_r := W_{tot} \cdot \left(\frac{W_{ftg}}{2}\right) = 1325.1 ft \cdot kips$

Net Moment Required = $M_{net} := OM - M_r = 1606.9 ft \cdot kips$

Check Perpendicular:

Rock Anchor Distance 1 =	$d_1 := 2.5 \cdot ft$	*user input*
Rock Anchor Distance 2 =	$d_2 := 5.5 \cdot ft$	*user input*
Number of Rock Anchors in Group 1 =	$n_1 := 8$	*user input*
Number of Rock Anchors in Group 2 =	$n_2 := 8$	*user input*
Polar Moment of Inertia =	$I_{p1} := d_1^2 \cdot n_1 + d_2^2 \cdot n_2 = 292 ft^2$	
Tension Force per Anchor Perp =	$P_{perp} := \frac{d_2}{I_{p1}} \cdot (M_{net}) = 30.3 \cdot kips$	

Check @ 45 Degree Angle:

Rock Anchor Distance 1 =	$d_3 := 2.13 \cdot ft$	*user input*
Rock Anchor Distance 2 =	$d_4 := 3.5 \cdot ft$	*user input*
Rock Anchor Distance 2 =	$d_5 := 5.63 \cdot ft$	*user input*
	$d_6 := 7.75 \cdot ft$	*user input*
Number of Rock Anchors in Group =	$n_3 := 4$	*user input*
	$n_4 := 2$	*user input*
	$n_5 := 4$	*user input*
	$n_6 := 2$	*user input*
Polar Moment of Inertia =	$I_{p2} := d_3^2 \cdot n_3 + d_4^2 \cdot n_4 + d_5^2 \cdot n_5 + d_6^2 \cdot n_6 = 289.56 ft^2$	
Tension Force per Anchor Diag =	$P_{diag} := \frac{d_6}{I_{p2}} \cdot (M_{net}) = 43 \cdot kips$	
Tension Force per Anchor =	$P_{anchor} := \begin{cases} P_{perp} & \text{if } P_{perp} \geq P_{diag} \\ P_{diag} & \text{otherwise} \end{cases} = 43 \cdot kips$	
Anchor Lock off Load =	$Lock_{anchor} := 68 \cdot kips$	
Provided Safety Factor =	$\frac{P_{anchor}}{Lock_{anchor}} = 0.63$	

$$Rock\_Anchor := if\left(\frac{P_{anchor}}{Lock_{anchor}} \leq 1.0, \text{"OK"}, \text{"Overstressed"}\right)$$

Rock_Anchor = "OK"

Rock Anchor Req'd Development Length in Rock:

Minimum Free Stress Length Provided = $F_{stressprov} := 10ft$ *user input*

Rock Anchor/Grout Bond Length = $L_{bprov} := D_{anchor} - F_{stressprov} = 22\,ft$

Rock/Grout Bond Length Required = $L_{breq} := \dfrac{Lock_{anchor}}{\pi \cdot hole_d \cdot \sigma_{allbond}} = 12.03\,ft$

$Bond\_Length\_Check := if\left(\dfrac{L_{breq}}{L_{bprov}} \le 1.00, \text{"OK"}, \text{"Increase Length"}\right)$

$\dfrac{L_{breq}}{L_{bprov}} = 0.55$

Bond_Length_Check = "OK"

Resistance Calculations:

Intermediate Dimension:

Total Anchor Width = $W := S_{anchor} = 11\,ft$

Volumes:

Base Area 1 of Resisting Pyramid = $B_1 := W^2 = 121\,ft^2$

Base Area 2 of Resisting Pyramid = $B_2 := \left[\tan(\phi)\cdot\left[\left(D_{anchor}\right)\cdot 0.55 - \left(T_{ftg} + T_{pier}\right)\right]\cdot 2 + W\right]^2 = 595.1\,ft^2$

Base Area 3 of Resisting Pyramid = $B_3 := \left[\tan(\phi)\cdot\left[\left(D_{anchor}\right)\cdot 0.55 - P_p\right]\cdot 2 + W\right]^2 = 910.1\,ft^2$

Volume of Rock = $V_{rock} := \dfrac{\left[\left[\left(D_{anchor}\right)\cdot 0.55 - \left(T_{ftg} + T_{pier}\right)\right]\cdot\left(B_1 + B_2 + \sqrt{B_1 \cdot B_2}\right)\right]}{3} = 3806.5\cdot ft^3$

Volume of Concrete = $V_{conc} := \left(W_{ftg}\cdot L_{ftg}\cdot T_{ftg}\right) + \left(L_{pier}^{\ 2}\cdot T_{pier}\right) = 912\cdot ft^3$

$V_{top} := \dfrac{\left[\left(T_{ftg} + T_{pier} - P_p\right)\cdot\left(B_2 + B_3 + \sqrt{B_2 \cdot B_3}\right)\right]}{3} = 3735.2\cdot ft^3$

Volume of Earth = $V_{earth} := V_{top} - V_{conc} = 2823.2\cdot ft^3$

Resisting Forces:

Resisting Rock Force = $W_{rock} := V_{rock} \cdot \gamma_{rock} = 628.1 \cdot kips$

Resisting Earth Force = $W_{earth} := V_{earth} \cdot \gamma_{earth} = 352.9 \cdot kips$

Resisting Concrete Force = $W_{conc} = 136.8 \cdot kips$

Total Resisting Force = $W_{total} := W_{rock} + W_{earth} + W_{conc} + Axial = 1153.8 \cdot kips$

Foundation Uplift Check:

Check Perpendicular to Foundation =

Uplift Force = $Uplift_{perp} := \dfrac{OM}{\left(\dfrac{W_{ftg}}{2}\right)} = 418.9 \cdot kips$

Factor of Safety = $\dfrac{W_{total}}{Uplift_{perp}} = 2.75$

$Uplift\_Perp\_Check := if\left(\dfrac{W_{total}}{Uplift_{perp}} \geq 2.0, "OK", "Overstressed"\right)$

$Uplift\_Perp\_Check = "OK"$

Check @ 45 Degree Angle to Foundation =

Uplift Force = $Uplift_{Diag} := \dfrac{OM}{\left(\dfrac{\sqrt{2} \cdot L_{ftg}}{2}\right)} = 296.2 \cdot kips$

Factor of Safety = $\dfrac{W_{total}}{Uplift_{Diag}} = 3.90$

$Uplift\_Diag\_Check := if\left(\dfrac{W_{total}}{Uplift_{Diag}} \geq 2.0, "OK", "Overstressed"\right)$

$Uplift\_Diag\_Check = "OK"$

Rock Bearing Capacity Check:

Bearing Force = $MaxBearing := \left[\dfrac{(Axial + W_{conc}) + (n_{anchor} Lock_{anchor})}{W_{ftg} \cdot L_{ftg}}\right] + \dfrac{OM}{\left(\dfrac{W_{ftg}^{3}}{6}\right)}$

$MaxBearing = 12.84 \cdot ksf$

$\dfrac{MaxBearing}{q_s} = 0.64$

$Rock\_Bearing\_Check := if\left(\dfrac{MaxBearing}{q_s} \leq 1.00, "OK", "Overstressed"\right)$

$Rock\_Bearing\_Check = "OK"$

SITE NAME	BYRAM PARK CT	ECP - CELL #	5 8
LATITUDE	41-00-18.23 N	LONGITUDE	73-38-53.92 W
NOTE: Please Order Appropriate RET Cables. Replace existing antennas with RET capable models. Adjust azimuths and antenna tilts as needed. Lease for 2nd Fiber Line, PCS RRH's, and 700 diplexers.		SAVE BUTTON	0009
		STRUCTURE TYPE	MONOPOLE

700 LTE - Current Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	ALU 700 MHz TRDU	ALU 700 MHz TRDU	ALU 700 MHz TRDU
ANTENNA TYPE	SLXW5514	SLXW5514	SLXW5514
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	340	70	230
DOWN TILT (ELEC + MECH)	0 Elec + 4 Mech	0 Elec + 0 Mech	0 Elec + 6 Mech
RAD CTR (FT AGL)	57	57	57
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL			
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX			
700 LTE - Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	ALU 700 MHz TRDU	ALU 700 MHz TRDU	ALU 700 MHz TRDU
ANTENNA TYPE	**Kathrein 800 10734V01**	**Kathrein 800 10734V01**	**Kathrein 800 10734V01**
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	340	**60**	230
DOWN TILT (ELEC + MECH)	**2 Elec + 0 Mech**	**0 Elec + 0 Mech**	**6 Elec + 0 Mech**
RAD CTR (FT AGL)	57	57	57
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL	**2 CBC78-DF**	**2 CBC78-DF**	**2 CBC78-DF**
MCPA BRICKS (QTY)			
RRH - QTY/MODEL			
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX			
1900 PCS - Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	PCS Modcell 4.0	PCS Modcell 4.0	PCS Modcell 4.0
ANTENNA TYPE	BXA-171063-12BF-EDIN-0	BXA-171063-12BF-EDIN-0	BXA-171063-12BF-EDIN-0
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	340	80	230
DOWN TILT (ELEC + MECH)	0 Elec + 0 Mech	0 Elec + 0 Mech	0 Elec + 0 Mech
RAD CTR (FT AGL)	57	57	57
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
1900 PCS - Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	**ALU 1900 MHz RRH**	**ALU 1900 MHz RRH**	**ALU 1900 MHz RRH**
ANTENNA TYPE	**HBXX-6516DS-A2M**	**HBXX-6516DS-A2M**	**HBXX-6516DS-A2M**
QTY OF ANTENNAS PER FACE	**1**	**1**	**1**
ORIENTATION (DEG)	340	80	230
DOWN TILT (ELEC + MECH)	**2 Elec + 0 Mech**	**2 Elec + 0 Mech**	**2 Elec + 0 Mech**
RAD CTR (FT AGL)	57	57	57
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL	**1 ALU RH_2X60-AWS**	**1 ALU RH_2X60-AWS**	**1 ALU RH_2X60-AWS**
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX	**1**		**DB-T1-6Z-8AB-0Z**
2100 LTE - Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	ALU 2100 MHz RRH	ALU 2100 MHz RRH	ALU 2100 MHz RRH
ANTENNA TYPE	BXA-171063-12BF-EDIN-0	BXA-171063-12BF-EDIN-0	BXA-171063-12BF-EDIN-0
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	340	80	230
DOWN TILT (ELEC + MECH)	0 Elec + 0 Mech	0 Elec + 0 Mech	0 Elec + 0 Mech
RAD CTR (FT AGL)	57	57	57
TMA - QTY / MODEL			
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
2100 LTE - Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	ALU 2100 MHz RRH	ALU 2100 MHz RRH	ALU 2100 MHz RRH
ANTENNA TYPE	**HBXX-6516DS-A2M**	**HBXX-6516DS-A2M**	**HBXX-6516DS-A2M**
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	340	**60**	230
DOWN TILT (ELEC + MECH)	**2 Elec + 0 Mech**	**2 Elec + 0 Mech**	**2 Elec + 0 Mech**
RAD CTR (FT AGL)	57	57	57
TMA - QTY / MODEL			
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
850 Cellular - No Change	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	Cellular Modcell 4.0HD	Cellular Modcell 4.0HD	Cellular Modcell 4.0HD
ANTENNA TYPE	LPA-80063/6CF	LPA-80063/6CF	LPA-80063/6CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	340	80	230
DOWN TILT (ELEC + MECH)	0 Elec + 2 Mech	0 Elec + 2 Mech	0 Elec + 2 Mech
RAD CTR (FT AGL)	57	57	57
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
DIPLEXER KIT - QTY / MODEL			
MCPA BRICKS (QTY)			

NUMBER OF CABLE'S NEEDED					ESTIMATED CABLE LENGTH			
MAINLINE SIZE	1 5/8"	TOTAL # OF MAINLINES		18	MAINLINE (FT)			
JUMPER SIZE	1/2 "	TOTAL # OF TOP JUMPERS		18	TOP JUMPER (FT)			12
Equipment Cable Ordering		**MAIN CABLE**	18	+ 0	**TOP JUMPER #**	18	+	0
FIBER LINE SIZE	1 5/8"	TOTAL # OF FIBER LINES		1	FIBER LINE MODEL #			HB158-1-08U8-S8J18
JUMPER SIZE	5/8"	TOTAL # OF TOP JUMPERS		3	TOP JUMPER MODEL #			HB058-1-08U1-S1J18
Fiber Cable Ordering		FIBER CABLE #		1	TOP JUMPER #			3

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

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

RF ENGINEER	RF MANAGER	INITIALS	DATE
Prepared By: Ryan Ulanday	Robert Hesselbach	RU	1/29/2015

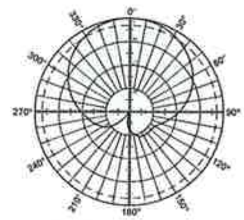
Site Configuration

KATHREIN
SCALA DIVISION

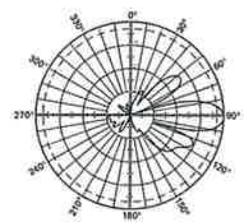
800 10734
700 MHz Single Band 4', 65 Degree Antenna RET

Kathrein's X-polarized antennas are designed for use in digital polarization diversity systems.

- X-polarized (+45° and -45°).
- UV resistant fiberglass radomes.
- Wideband vector dipole technology.
- DC Grounded metallic parts for impulse suppression.
- RET motor housed inside the radome and field replaceable.



Horizontal pattern
±45°- polarization



Vertical pattern
±45°- polarization
0°–16° electrical downtilt

General specifications:

Frequency range	698–894 MHz
VSWR	<1.5:1
Impedance	50 ohms
Intermodulation (2x20w)	IM3: <-150 dBc
Polarization	+45° and -45°
Maximum input power	500 watts per input (at 50°C)
Connector	2 x 7-16 DIN female (long neck) (bottom mounted)
Isolation	>30 dB
Electrical downtilt	0–16 degrees (continuously adjustable)

See reverse for order information.

Specifications:	698–806 MHz	824–894 MHz
Gain	14.2 dBi	14.8 dBi
Front-to-back ratio	>30 dB (co-polar) 32 dB (average)	>30 dB (co-polar) 33 dB (average)
+45° and -45° polarization horizontal beamwidth	68° (half-power)	65° (half-power)
+45° and -45° polarization vertical beamwidth	16° (half-power)	14.8° (half-power)
Min. sidelobe suppression for first sidelobe above main beam average	0° 8° 16° T 16 17 17 dB 19 20 20 dB	0° 8° 16° T 18 17 16 dB 25 23 23 dB
Cross polar ratio Main direction 0° Sector ±60°	 24 dB (typical) >10 dB, Average: 15 dB	 23 dB (typical) >10 dB, Average: 16 dB

IRT specifications:

Logical interface ex factory[1]	AISG 1.1
Protocols	AISG 1.1 and 3GPP/AISG 2.0 compliant
Hardware interface[2]	2 x 8 pin connector acc. IEC 60130-9; according to AISG: – IRT in (male): Control / Daisy chain in – IRT in (female): Daisy chain out
Power supply	10–30 V
Power consumption	<1 watt (standby) <8.5 watts (motor activated)
Adjustment time (full range)	40 sec.
Adjustment cycles	>50,000
Certification	FCC 15.107 Class B Computing Devices

[1] The protocol of the logical interface can be switched from AISG 1.1 to 3GPP/AISG 2.0 and vice versa with a vendor specific command. Start-up operation of the RCU 86010149 is possible in an RET system supporting AISG 1.1 or supporting 3GPP/AISG 2.0 after performing a layer 2 reset before address assignment. The protocol can also be changed as follows: AISG 1.1 to 3GPP: Enter "3GPP" into the additional data filed "Installer's ID" and perform a layer 7 reset or a power reset. 3GPP to AISG 1.1: Enter "AISG 1" into the additional datafield "Installer's ID" and perform a layer 2 reset or a power reset. After switching the protocol any other information can be entered into the "Installer's ID" field.

[2] The tightning torque for fixing the connector must be 0.5 – 1.0 Nm ('hand-tightened'). The connector should be tightened by hand only!

11219-A
936.4130

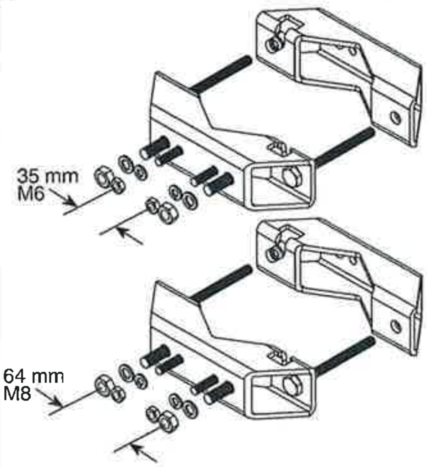
RoHS
Lead-Free
Mar 15, 2011

AISG
Antenna Interface Standards Group

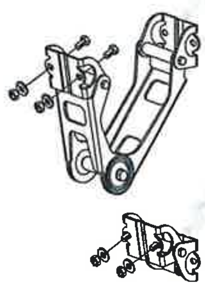
Kathrein Inc., Scala Division Post Office Box 4580 Medford, OR 97501 (USA) Phone: (541) 779-6500 Fax: (541) 779-3991
Email: communications@kathrein.com Internet: www.kathrein-scala.com

KATHREIN
SCALA DIVISION

800 10734
700 MHz Single Band 4', 65 Degree Antenna RET



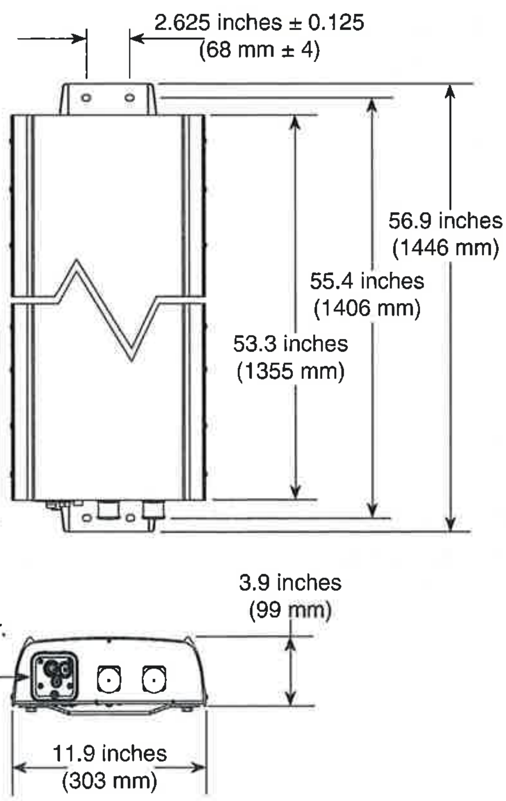
Mounting Brackets
for use with 2-point mount antennas
Mast dia. 2–4.5 inches (50–115 mm)
Weight: 4 lb (1.8 kg)



Mechanical Tilt Brackets
for use with 2-point mount antennas
Weight: 7.4 lb (3.7 kg)
(Model 850 10013)

Mechanical specifications:

Weight	24.3 lb (11 kg) 28.7 lb (13 kg) clamps included
Dimensions H x W x D	53.3 x 11.9 x 3.9 inches (1355 x 303 x 99 mm)
Wind load	at 93 mph (150kph)
Front/Side/Rear	140 lbf / 45 lbf / 160 lbf (620 N) / (200 N) / (710 N)
Mounting category	M (Medium)
Wind survival rating*	150 mph (240 kph)
Shipping dimensions	56.3 x 12.4 x 4.5 inches (1430 x 315 x 115 mm)
Shipping weight	33.1 lb (15 kg)
Mounting bracket	2-point hot-dip galvanized with stainless steel hardware for 2 to 4.5 inch (50 to 115 mm) OD masts.

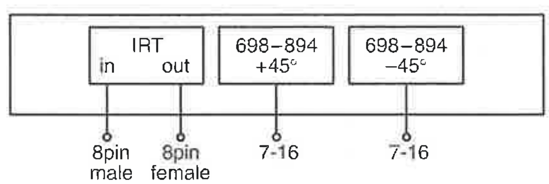


KATHREIN 860 10149

FC Tested To Comply With FCC Standards

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note: Refer to part number 860 10149 for the specifications of the remote control actuator.



Order Information:

Model	Description
800 10734	Antenna with mounting bracket 0°–16° electrical downtilt
800 10734 K	Antenna with Antenna with mounting bracket and mechanical tilt bracket 0°–16° electrical downtilt

* Mechanical design is based on environmental conditions as stipulated in TIA-222-G-2 (December 2009) and/or ETS 300 019-1-4 which include the static mechanical load imposed on an antenna by wind at maximum velocity. See the Engineering Section of the catalog for further details.

Kathrein Inc., Scala Division Post Office Box 4580 Medford, OR 97501 (USA) Phone: (541) 779-6500 Fax: (541) 779-3991
Email: communications@kathrein.com Internet: www.kathrein-scala.com

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

HBXX-6516DS-VTM

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

- Each DualPol® array can be independently adjusted for greater flexibility
- Excellent gain, VSWR, front-to-back ratio, and PIM specifications for robust network performance
- Ideal choice for site collocations and tough zoning restrictions
- Great solution to maximize network coverage and capacity

Electrical Specifications

Frequency Band, MHz	**1710–1880**	**1850–1990**	**1920–2180**
Gain, dBi	17.7	18.0	18.0
Beamwidth, Horizontal, degrees	67	66	64
Beamwidth, Vertical, degrees	7.5	7.0	6.6
Beam Tilt, degrees	0–10	0–10	0–10
USLS, dB	18	18	18
Front-to-Back Ratio at 180°, dB	30	30	30
CPR at Boresight, dB	22	22	21
CPR at Sector, dB	8	9	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

Electrical Specifications, BASTA*

Frequency Band, MHz	**1710–1880**	**1850–1990**	**1920–2180**
Gain by all Beam Tilts, average, dBi	17.2	17.2	17.5
Gain by all Beam Tilts Tolerance, dB	±0.3	±0.3	±0.5
Gain by Beam Tilt, average, dBi	0 ° | 17.0 5 ° | 17.3 10 ° | 17.0	0 ° | 17.1 5 ° | 17.4 10 ° | 17.0	0 ° | 17.4 5 ° | 17.7 10 ° | 17.2
Beamwidth, Horizontal Tolerance, degrees	±2.7	±2.3	±3.5
Beamwidth, Vertical Tolerance, degrees	±0.5	±0.4	±0.4
USLS, dB	18	19	19
Front-to-Back Total Power at 180° ± 30°, dB	26	26	26
CPR at Boresight, dB	22	22	22
CPR at Sector, dB	9	9	9

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

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol® quad
Band	Single band
Brand	DualPol® | Teletilt®
Operating Frequency Band	1710 – 2180 MHz

Product Specifications

COMMSCOPE®

HBXX-6516DS-VTM

POWERED BY ANDREW.

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
RF Connector Quantity, total	4
Wind Loading, maximum	419.0 N @ 150 km/h 94.2 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Dimensions

Depth	166.0 mm | 6.5 in
Length	1294.0 mm | 50.9 in
Width	305.0 mm | 12.0 in
Net Weight	13.9 kg | 30.6 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 1.1 Actuator	HBXX-6516DS-R2M
Model with Factory Installed AISG 2.0 Actuator	HBXX-6516DS-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.

CBC78-DF

Crossband Coupler, 698–787 MHz/Cellular

Electrical Specifications

dc Pass-through	Band 1 | Band 2
3rd Order IMD Test Method	Two +43 dBm carriers
3rd Order IMD, maximum	-110 dBm
Isolation Between Paths, minimum	50.0 dB
Lightning Surge Current	10 kA
Lightning Surge Current Waveform	8/20 waveform
Return Loss, minimum	22.00 dB
Return Loss, typical	24.00 dB
Spurious Signals/2nd Order Harmonics, minimum	40 dB
Spurious Signals/3rd Order Harmonics, minimum	30 dB

Electrical Specifications (Branch 1)

Operating Frequency Band	698 – 787 MHz
Insertion Loss, maximum	0.25 dB
Output Power, maximum composite	500 W
Peak Power	5 kW
Total Group Delay, maximum	25 ns

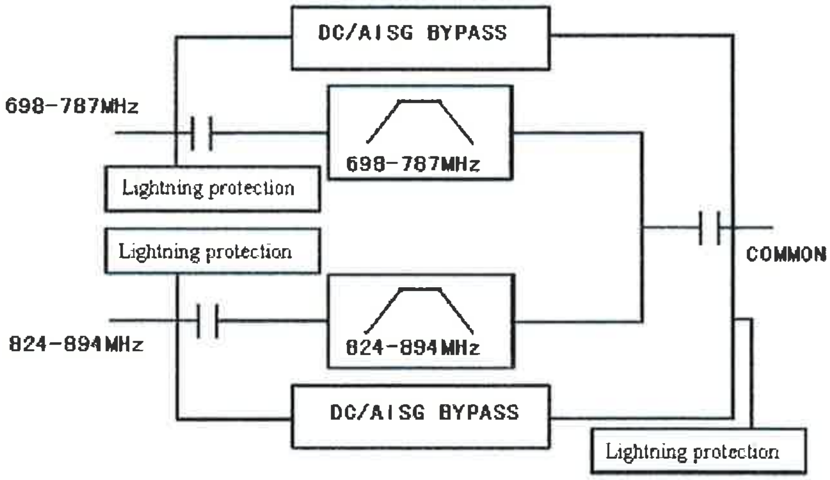
Electrical Specifications (Branch 2)

Operating Frequency Band	824 – 894 MHz
Insertion Loss, maximum	0.25 dB
Output Power, maximum composite	500 W
Peak Power	5 kW
Total Group Delay, maximum	25 ns

Product Specifications

CBC78-DF

Block Diagram



General Specifications

Product Type	Diplexer
Application	Indoor | Outdoor
Includes	Mounting hardware

Mechanical Specifications

Color	Gray
Connector Interface	7-16 DIN Female
Connector Interface Style	Long neck
Ground Screw Diameter	0.25 in

Environmental Specifications

Ingress Protection Test Method	IEC 60529:2001, IP67
Operating Temperature	-40 °C to +65 °C (-40 °F to +149 °F)
Relative Humidity	5%–100%

Dimensions

Depth	66.5 mm | 2.6 in
Height	200.0 mm | 7.9 in
Volume	2.0 L
Width	150.0 mm | 5.9 in
Weight, without mounting hardware	3.0 kg | 6.6 lb