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 12, 2015

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

Re: **Notice of Exempt Modification – Facility Modification**
1323 King Street, Greenwich, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains ten (10) antennas at the 98-foot level on the existing 100-foot self-supporting lattice tower at the Bruce Memorial Golf Course, 1323 King Street in Greenwich (the "Property"). The tower and Property are owned by the Town of Greenwich. Cellco's shared use of this tower was approved by the Council in 1993. Cellco now intends to modify its facility by replacing six (6) of its existing antennas with two (2) model 800 10734V01, 700 MHz antennas; two (2) 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 two (2) remote radio heads ("RRHs") behind its 1900 MHz antennas and four (4) coaxial cable diplexers. Included in Attachment 1 are specifications for Cellco's replacement antennas, RRHs and cable diplexers.

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).

Robinson+Cole

1. The proposed modifications will not result in an increase in the height of the existing tower. Cellco's replacement antennas, RRHs and cable diplexers will be installed on the existing T-arm frames at the 98-foot level of the 100-foot tower.

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

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

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

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

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

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

Sincerely,

Kenneth C. Baldwin

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

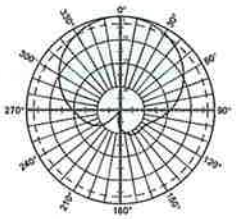
ATTACHMENT 1

KATHREIN
SCALA DIVISION

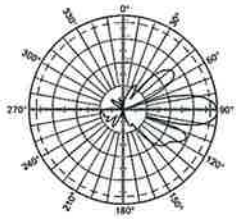
800 10734
700 MHz Single Band 4', 65 Degree Antenna RET

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:	**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!

TÜV 11219-A 936.4130

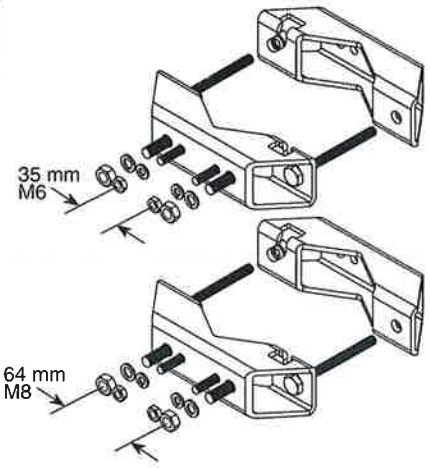
RoHS Lead-Free Mar 15, 2011

AISG Antenna Interface Standards Group

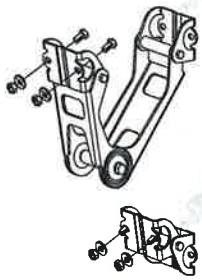
Kathrein Inc., Scala Division Post Office Box 4580 Medford, OR 97501 (USA) Phone: (541) 779-6500 Fax: (541) 779-3991
Email: communications@kathrein.com Internet: www.kathrein-scala.com

KATHREIN
SCALA DIVISION

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



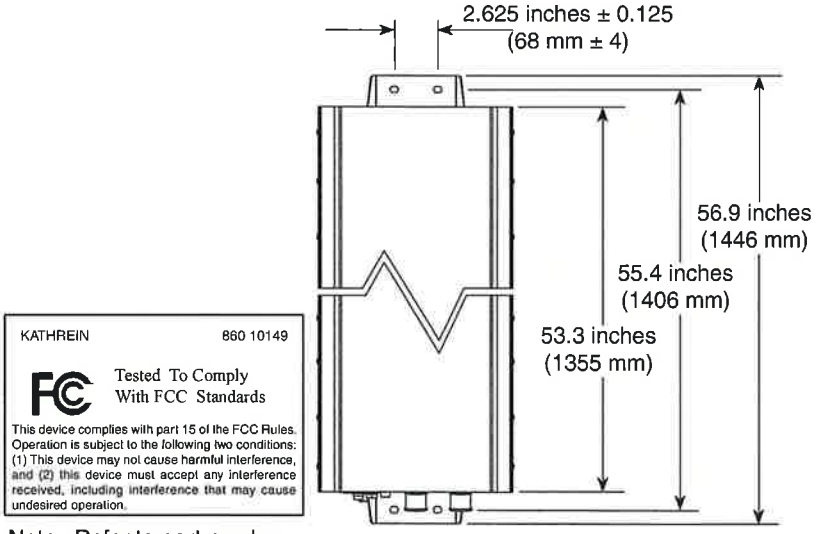
Mounting Brackets
for use with 2-point mount antennas
Mast dia. 2–4.5 inches (50–115 mm)
Weight: 4 lb (1.8 kg)



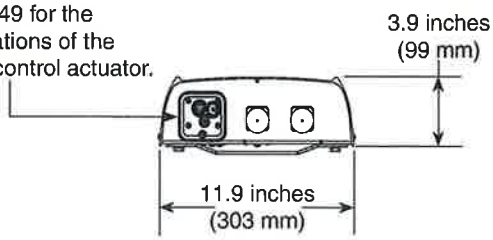
Mechanical Tilt Brackets
for use with 2-point mount antennas
Weight: 7.4 lb (3.7 kg)
(Model 850 10013)

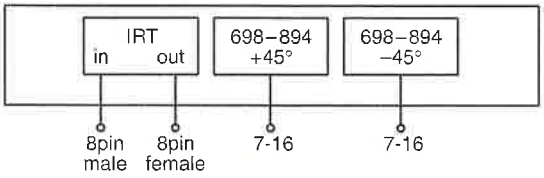
Mechanical specifications:

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.	



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

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

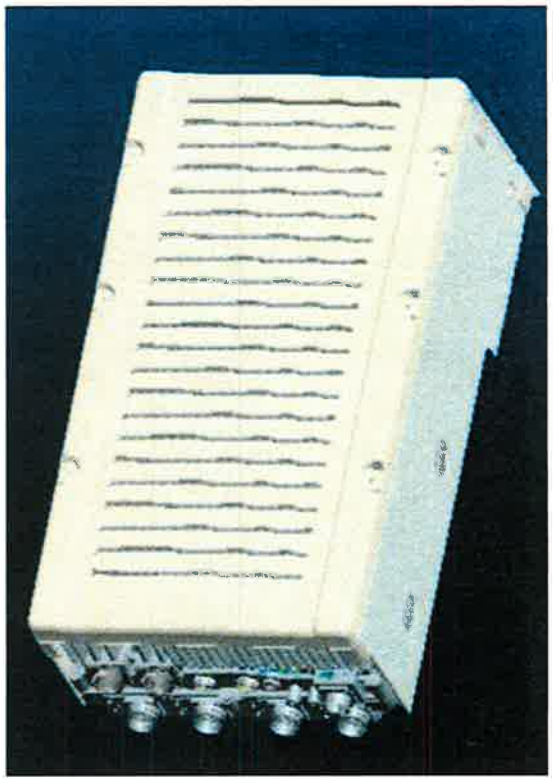
		RRH2x60
RF Output Power		2x60W
Instantaneous Bandwidth		20MHz
Transmitter		2 TX
Receiver	1900 HW version 1900A HW version	2 Branch RX – LA6.0.1 4 Branch RX – LR13.3
Features		AISG 2.0 for RET/TMA
		Internal Smart Bias-T
Power		-48VDC
CPRI Ports		2 CPRI Rate 3 Ports
External Alarms		4 External User Alarms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

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

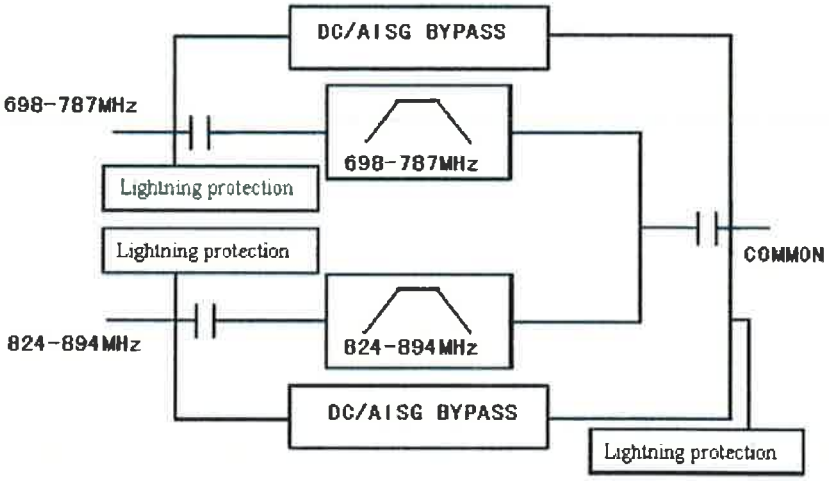
Electrical Specifications (Branch 2)

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

ATTACHMENT 2

	General	Power	Density					
Site Name: Bruce CT (Greenwich)								
Tower Height: 100ft								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*AT&T UMTS	1	500	88	0.0232	880	0.5867	3.96%	
*AT&T UMTS	1	500	88	0.0232	1900	1.0000	2.32%	
*AT&T GSM	4	296	88	0.0550	880	0.5867	9.37%	
*AT&T GSM	4	427	88	0.0793	1900	1.0000	7.93%	
*AT&T LTE	1	500	88	0.0232	740	0.4933	4.71%	
Verizon PCS	**15**	**327**	**98**	**0.1836**	**1970**	**1.0000**	**18.36%**	
Verizon Cellular	**9**	**234**	**98**	**0.0788**	**869**	**0.5793**	**13.61%**	
Verizon AWS	**1**	**1419**	**98**	**0.0531**	**2145**	**1.0000**	**5.31%**	
Verizon 700	**1**	**518**	**98**	**0.0194**	**746**	**0.4973**	**3.90%**	
								69.47%
* Source: Siting Council								

ATTACHMENT 3

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

100' Existing Rohn Lattice Tower

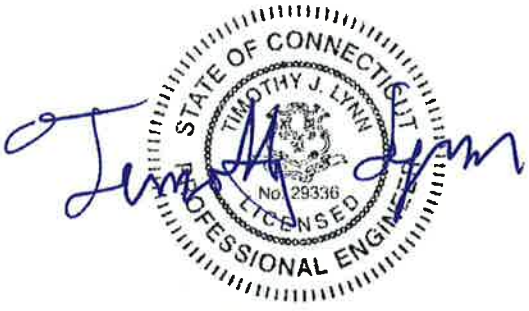
Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Bruces

1323 King Street
Greenwich, CT

CENTEK Project No. 15001.004

~~Date: January 8, 2015~~
Rev 1: February 3, 2015



Prepared for:

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

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

Table of Contents

SECTION 1 - REPORT

- INTRODUCTION
- ANTENNA AND APPURTENANCE SUMMARY
- PRIMARY ASSUMPTIONS USED IN THE ANALYSIS
- ANALYSIS
- TOWER LOADING
- TOWER CAPACITY
- FOUNDATION AND ANCHORS
- CONCLUSION

SECTION 2 – CONDITIONS & SOFTWARE

- STANDARD ENGINEERING CONDITIONS
- GENERAL DESCRIPTION OF STRUCTURAL ANALYSIS PROGRAM

SECTION 3 – CALCULATIONS

- tnxTower INPUT/OUTPUT SUMMARY
- tnxTower FEED LINE PLAN
- tnxTower FEED LINE DISTRIBUTION
- tnxTower DETAILED OUTPUT
- FOUNDATION ANALYSIS

SECTION 4 – REFERENCE MATERIALS

- VERIZON RF DATA SHEET
- ANTENNA CUT SHEETS

Introduction

The purpose of this report is to summarize the results of the non-linear, P-Δ structural analysis of the antenna modification proposed by Verizon Wireless on the existing lattice tower located in Greenwich, Connecticut.

The host tower is a 100-ft, three legged, lattice tower originally manufactured by ROHN eng. file no. 29307JC dated 4/23/93. The tower geometry, structure member sizes and foundation information were taken from a previous structural report prepared by Centek engineering job no. 13001.078 dated November 14, 2013.

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

The tower consists of five (5) tapered vertical sections consisting of steel pipe legs conforming to ASTM A572 Gr. 50 and lateral bracing conforming to ASTM A572 Gr. 50 and ASTM A36. The vertical tower sections are connected by bolted flange plates with the diagonal and horizontal bracing to pipe legs consisting of bolted connections. The width of the tower face is 8-ft 6-in at the top and 17-ft 5-in at the bottom.

Verizon Wireless proposes the replacement of six (6) existing panel antennas with six (6) proposed panel antennas and the installation of two (2) remote radio heads and four (4) diplexers mounted on two (2) existing T-Frames. 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 tower supports several communication antennas. The existing and proposed loads considered in the analysis consist of the following:

- UNKNOWN (Existing):
  Antenna: One (1) 8-ft Omni-directional whip antenna leg mounted with an elevation of ±100-ft above grade level.
  Coax Cable: One (1) 7/8" ∅ coax cable running on a leg/face of the existing tower as specified in Section 3 of this report.
- AT&T (Existing):
  Antenna: Six (6) Powerwave 7770 panel antennas, three (3) Powerwave P65-16-XLH-RR panel antennas and twelve (12) Powerwave LGP21401TMA's mounted on three (3) 12-ft Wireless Frames with a RAD center elevation of ±88-ft above grade level.
  Coax Cable: Twelve (12) 1-5/8" ∅ coax cables running on a leg/face of the existing tower as specified in Section 3 of this report.
- AT&T (Existing):
  Antennas: Six (6) Ericsson RRUS-11 and one (1) Raycap DC6-48-60-18-8F surge arrestor mounted with an elevation of 86-ft above grade level.
  Coax Cables: One (1) fiber cable and two (2) dc control cables running inside of the existing tower.
- UNKNOWN (Existing):
  Antenna: One (1) 4-ft ∅ dish leg mounted with an elevation of ±84-ft above grade level.
  Coax Cable: One (1) EW90 cable running on a leg/face of the existing tower as specified in Section 3 of this report.

- UNKNOWN (Existing):
  Antenna: One (1) 4-ft ∅ dish leg mounted with an elevation of ±70-ft above grade level.
  Coax Cable: One (1) EW90 cable running on a leg/face of the existing tower as specified in Section 3 of this report.
- VERIZON (Existing to Remain):
  Antennas: Four (4) Andrew DB844H90E-XY panel antennas, two (2) Alcatel-Lucent RRH2x40-AWS Remote Radio Head and one (1) RFS DB-T1-6Z-8AB-0Z main distribution box mounted on two (2) 12-ft T-Frames with a RAD center elevation of ±98-ft above grade level.
  Coax Cables: Twelve (12) 7/8" ∅ coax cables and one (1) 1-5/8" ∅ fiber cable running on a leg/face of the existing tower as specified in Section 3 of this report.
- VERIZON (Existing to Remove):
  Antennas: Two (2) Swedcom SLCP 2X6015 and four (4) Antel BXA-171063-8BF panel antennas mounted on two (2) 12-ft T-Frames with a RAD center elevation of ±98-ft above grade level.
- **VERIZON (Proposed):**
  Antennas: Two (2) Kathrein 800-10734 panel antennas, four (4) Andrew HBXX-6516DS panel antennas, two (2) Alcatel-Lucent RRH2x60-PCS remote radio heads and four (4) Andrew CBC78-DF diplexers mounted on two (2) 12-ft T-Frames with a RAD center elevation of ±98-ft above grade level.

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.
- 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 coax cables should be routed as specified in section 3 of 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 of 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-222-F wind speed controls.	
Load Cases:	Load Case 1; 85 mph wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 2; 74 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 74 mph wind speed velocity represents 75% of the wind pressure generated by the 85 mph wind speed.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 3; Seismic – not checked	*[Section 1614.5 of State Bldg. Code 2005] does not control in the design of this structure type*

[1] The 2005 Connecticut State Building Code as amended by the 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 **52.3%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Diagonal (T5)	0'-0"-20'-0"	44.2%	**PASS**
Leg (T3)	40'-0"-60'-0"	52.3%	**PASS**

Foundation and Anchors

The existing foundation consists of three (3) 3-ft ∅ x 3-ft long reinforced concrete piers on a 24-ft square x 4-ft thick reinforced concrete pad bearing directly on existing sub grade. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned structural report prepared by Centek. Tower legs are connected to the foundation by means of (4) 1"∅, ASTM A354-BC anchor bolts per leg, embedded into the concrete foundation structure.

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

Reactions	Vector	Proposed Base Reactions
Base	Shear	**18 kips**
	Compression	**14 kips**
	Moment	**1108 kip-ft**
Leg	Shear	**10 kips**
	Uplift	**68 kips**
	Compression	**77 kips**

- The anchor bolts were found to be within allowable limits.

Tower Component	Design Limit	Stress Ratio (percentage of capacity)	Result
Anchor Bolts	Tension	36.2%	**PASS**

- 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 Mat	OM[2]	2.0	4.11	**PASS**

Note 1: FS denotes Factor of Safety
Note 2: OM denotes Overturning Moment.

Conclusion

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

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

Please feel free to call with any questions or comments.

Respectfully Submitted by:

Timothy J. Lynn, PE
Structural Engineer

Standard Conditions for Furnishing of Professional Engineering Services on Existing Structures

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

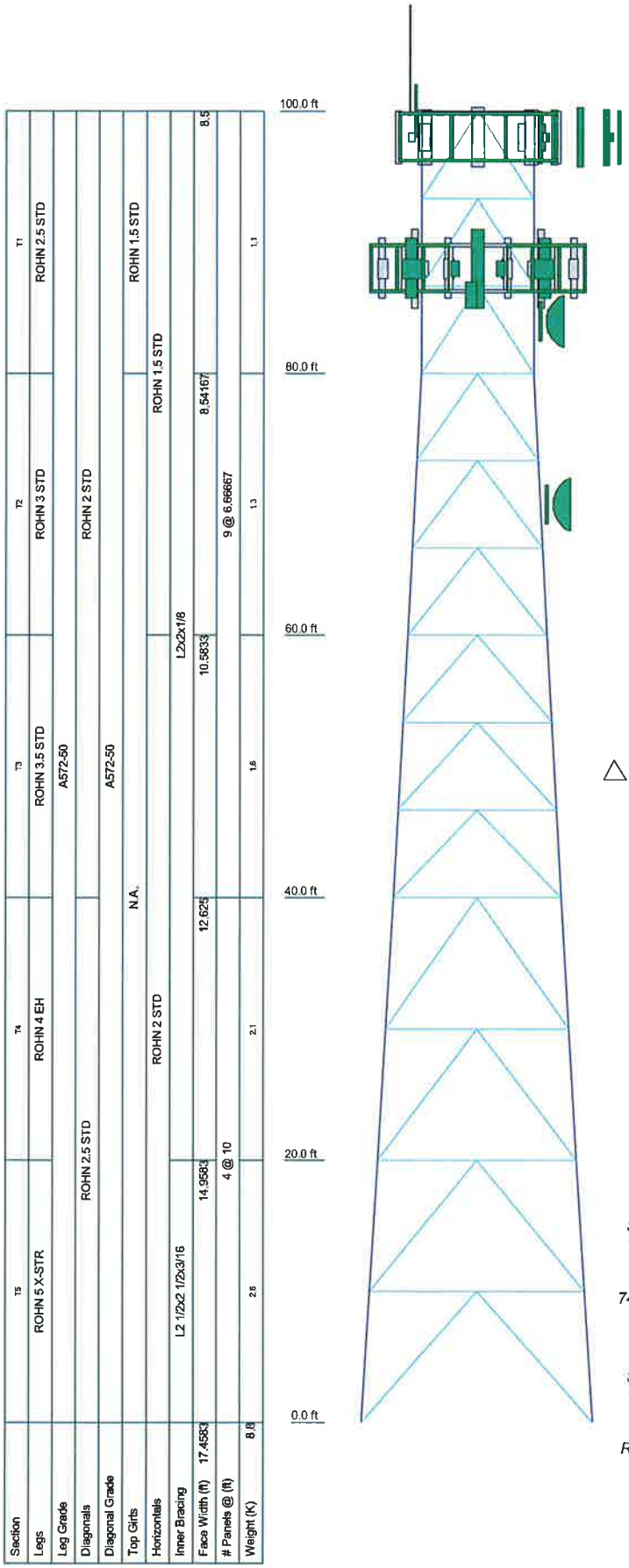
- Information supplied by the client regarding the structure itself, its foundations, the soil conditions, the antenna and feed line loading on the structure and its components, or other relevant information.
- Information from the field and/or drawings in the possession of Centek Engineering, Inc. or generated by field inspections or measurements of the structure.
- It is the responsibility of the client to ensure that the information 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.



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
8' x 3" Dia Omni	100	P1000 Unistrut (9' Long) (ATI Existing)	88.5 - 88
4' x 2.875" Pipe Mount	100	12' Frame (ATI Existing)	88
Pirod 12' T-Frame Sector Mount (1) (Verizon Existing)	98	12' Frame (ATI Existing)	88
		12' Frame (ATI Existing)	88
Pirod 12' T-Frame Sector Mount (1) (Verizon Existing)	98	(2) 7770.00 (ATI Existing)	88
		(2) 7770.00 (ATI Existing)	88
DB844H90-XY (Verizon Existing)	98	(2) 7770.00 (ATI Existing)	88
HBXX-6516DS (Verizon Proposed)	98	P65-16-XLH-RR (ATI Existing)	88
800-10734 (Verizon Proposed)	98	P65-16-XLH-RR (ATI Existing)	88
HBXX-6516DS (Verizon Proposed)	98	P65-16-XLH-RR (ATI Existing)	88
DB844H90-XY (Verizon Existing)	98	(4) LPG21401 TMA (ATI Existing)	88
DB844H90-XY (Verizon Existing)	98	(4) LPG21401 TMA (ATI Existing)	88
HBXX-6516DS (Verizon Proposed)	98	(4) LPG21401 TMA (ATI Existing)	88
800-10734 (Verizon Proposed)	98	(2) RRUS-11 (ATI Existing)	88
HBXX-6516DS (Verizon Proposed)	98	(2) RRUS-11 (ATI Existing)	88
DB844H90-XY (Verizon Existing)	98	(2) RRUS-11 (ATI Existing)	88
RRH2x40-AWS (Verizon Existing)	98	DC6-48-60-18-8F Surge Arrestor (ATI Existing)	86
RRH2x40-AWS (Verizon Existing)	98	3' x 4.5" Pipe Mont	84
DB-T1-6Z-8AB-0Z (Verizon Existing)	98	4 FT DISH	84
RRH2x60-PCS (Verizon Proposed)	98	P1000 Unistrut (9' Long) (ATI Existing)	78.5
RRH2x60-PCS (Verizon Proposed)	98	P1000 Unistrut (9' Long) (ATI Existing)	78.5
(2) CBC78-DF (Verizon Proposed)	98	P1000 Unistrut (9' Long) (ATI Existing)	78.5
(2) CBC78-DF (Verizon Proposed)	98	3' x 4.5" Pipe Mont	70
P1000 Unistrut (9' Long) (ATI Existing)	88.5 - 88	4 FT DISH	70
P1000 Unistrut (9' Long) (ATI Existing)	88.5 - 88		

MATERIAL STRENGTH

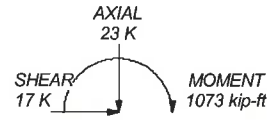
GRADE	Fy	Fu	GRADE	Fy	Fu
A572-50	50 ksi	65 ksi			

TOWER DESIGN NOTES

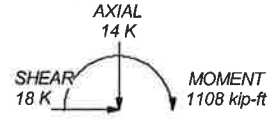
1. Tower designed for a 85 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 74 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. TOWER RATING: 52.3%

△

MAX. CORNER REACTIONS AT BASE:
DOWN: 77 K
UPLIFT: -68 K
SHEAR: 10 K



TORQUE 23 kip-ft
74 mph WIND - 0.5000 in ICE



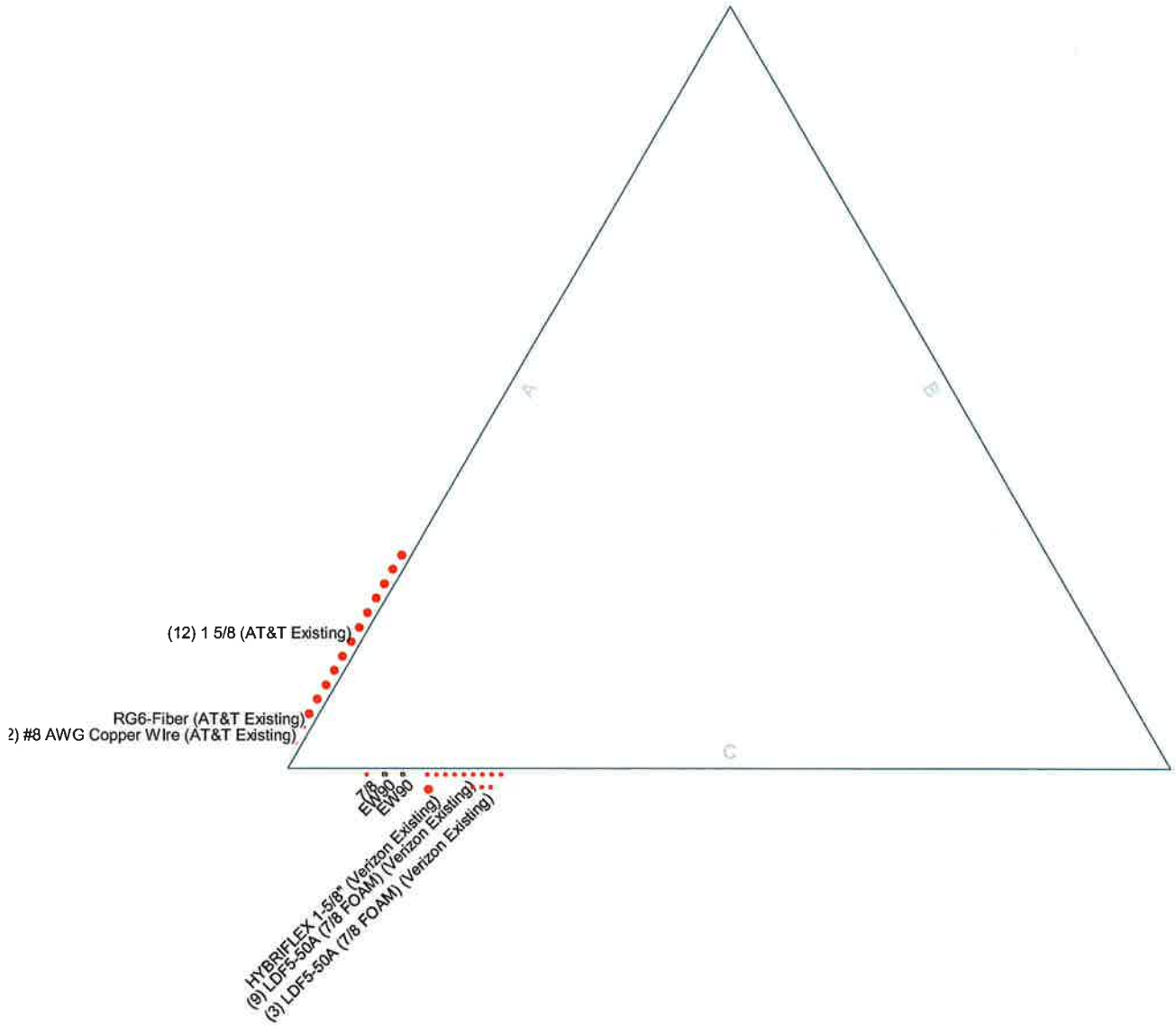
TORQUE 18 kip-ft
REACTIONS - 85 mph WIND

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

Job: *15001.004 - Bruces*		
Project: *100' Rohn Lattice Tower - 1323 King St., Greenwich, CT*		
Client: Verizon Wireless	Drawn by: TJL	App'd:
Code: TIA/EIA-222-F	Date: 02/03/15	Scale: NTS
Path:		Dwg No. E-1

Feedline Plan

Round Flat App In Face App Out Face

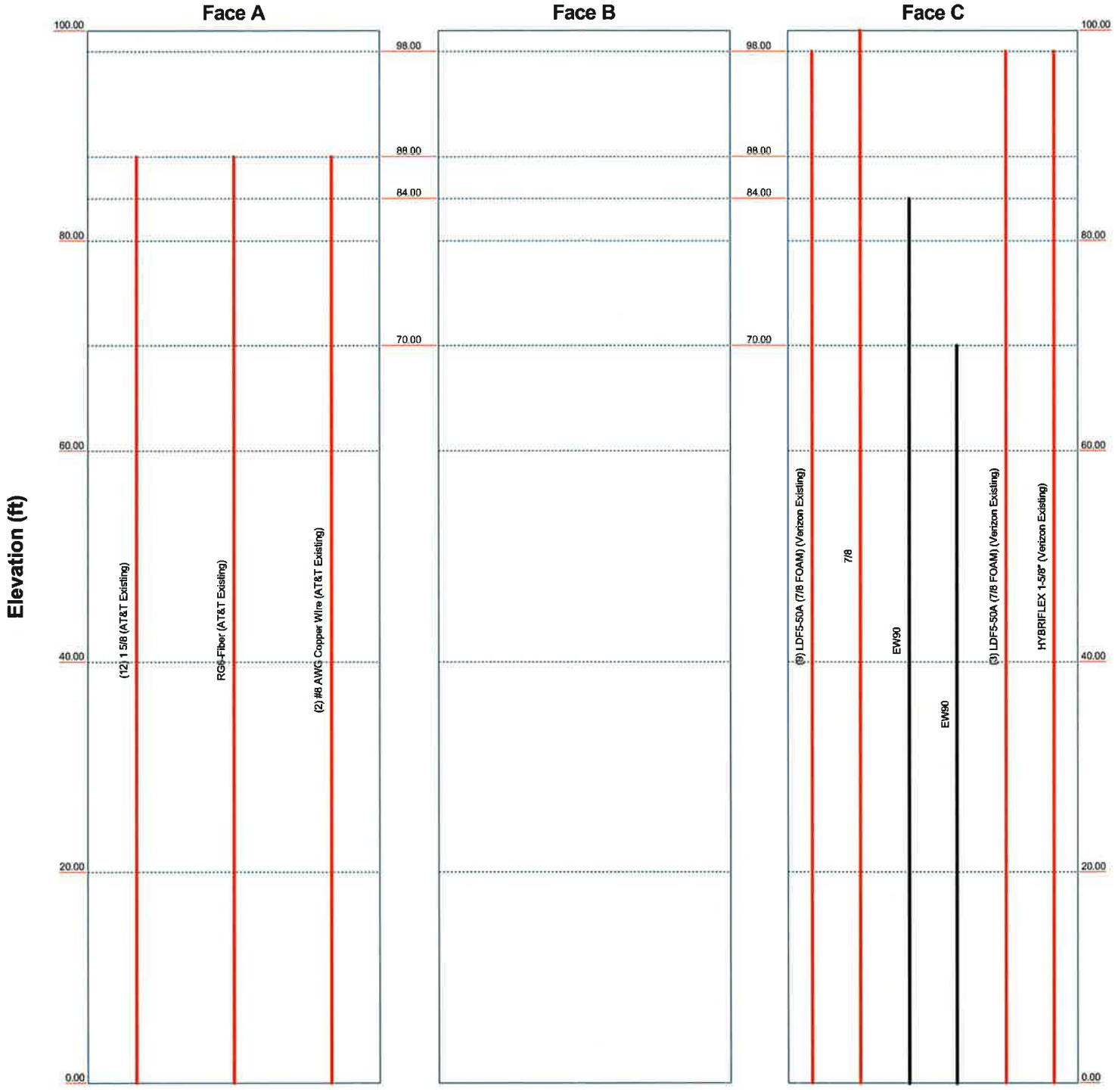


Centek Engineering Inc.
63-2 North Branford Rd.
Branford, CT 06405
Phone: (203) 488-0580
FAX: (203) 488-8587

Job: ***15001.004 - Bruces***			
Project: ***100' Rohn Lattice Tower - 1323 King St., Greenwich, CT***			
Client: Verizon Wireless	Drawn by: TJL	App'd:	
Code: TIA/EIA-222-F	Date: 02/03/15	Scale: NTS	
Path:		Dwg No. E-7	

Feedline Distribution Chart
0' - 100'

Round | Flat | App In Face | App Out Face | Truss Leg



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

Job: *15001.004 - Bruces*		
Project: *100' Rohn Lattice Tower - 1323 King St., Greenwich, CT*		
Client: Verizon Wireless	Drawn by: TJL	App'd:
Code: TIA/EIA-222-F	Date: 02/03/15	Scale: NTS
Path:		Dwg No. E-7

tnxTower	Job	Page
	15001.004 - Bruces	1 of 30
Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Project 100' Rohn Lattice Tower - 1323 King St., Greenwich, CT	Date 16:51:50 02/03/15
	Client Verizon Wireless	Designed by TJL

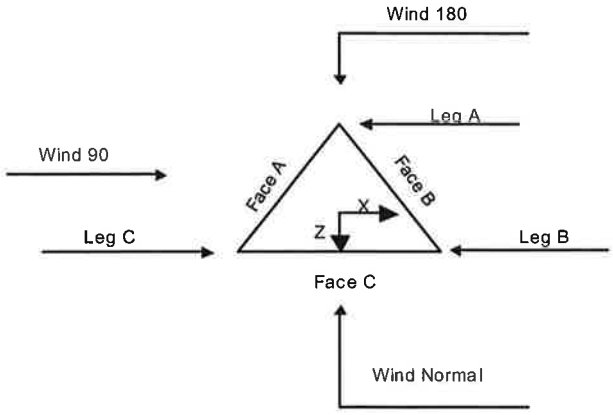
Tower Input Data

The main tower is a 3x free standing tower with an overall height of 100.00 ft above the ground line.
The base of the tower is set at an elevation of 0.00 ft above the ground line.
The face width of the tower is 8.50 ft at the top and 17.46 ft at the base.
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 0.5000 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.
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in tower member design is 1.333.
Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Options

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



Triangular Tower

Tower Section Geometry

Tower Section	Tower Elevation	Assembly Database	Description	Section Width	Number of Sections	Section Length
	ft			ft		ft
T1	100.00-80.00			8.50	1	20.00
T2	80.00-60.00			8.54	1	20.00
T3	60.00-40.00			10.58	1	20.00
T4	40.00-20.00			12.63	1	20.00
T5	20.00-0.00			14.96	1	20.00

Tower Section Geometry *(cont'd)*

Tower Section	Tower Elevation	Diagonal Spacing	Bracing Type	Has K Brace End Panels	Has Horizontals	Top Girt Offset	Bottom Girt Offset
	ft	ft				in	in
T1	100.00-80.00	6.67	K Brace Down	No	Yes	0.0000	0.0000
T2	80.00-60.00	6.67	K Brace Down	No	Yes	0.0000	0.0000
T3	60.00-40.00	6.67	K Brace Down	No	Yes	0.0000	0.0000
T4	40.00-20.00	10.00	K Brace Down	No	Yes	0.0000	0.0000
T5	20.00-0.00	10.00	K Brace Down	No	Yes	0.0000	0.0000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg Type	Leg Size	Leg Grade	Diagonal Type	Diagonal Size	Diagonal Grade
T1 100.00-80.00	Pipe	ROHN 2.5 STD	A572-50 (50 ksi)	Pipe	ROHN 2 STD	A572-50 (50 ksi)
T2 80.00-60.00	Pipe	ROHN 3 STD	A572-50 (50 ksi)	Pipe	ROHN 2 STD	A572-50 (50 ksi)
T3 60.00-40.00	Pipe	ROHN 3.5 STD	A572-50 (50 ksi)	Pipe	ROHN 2 STD	A572-50 (50 ksi)
T4 40.00-20.00	Pipe	ROHN 4 EH	A572-50 (50 ksi)	Pipe	ROHN 2.5 STD	A572-50 (50 ksi)
T5 20.00-0.00	Pipe	ROHN 5 X-STR	A572-50 (50 ksi)	Pipe	ROHN 2.5 STD	A572-50 (50 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Top Girt Type	Top Girt Size	Top Girt Grade	Bottom Girt Type	Bottom Girt Size	Bottom Girt Grade
T1 100.00-80.00	Pipe	ROHN 1.5 STD	A572-50 (50 ksi)	Single Angle		A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	No. of Mid Girts	Mid Girt Type	Mid Girt Size	Mid Girt Grade	Horizontal Type	Horizontal Size	Horizontal Grade
T1 100.00-80.00	None	Single Angle		A36 (36 ksi)	Pipe	ROHN 1.5 STD	A572-50 (50 ksi)
T2 80.00-60.00	None	Solid Round		A572-50 (50 ksi)	Pipe	ROHN 1.5 STD	A572-50 (50 ksi)
T3 60.00-40.00	None	Single Angle		A36 (36 ksi)	Pipe	ROHN 2 STD	A572-50 (50 ksi)
T4 40.00-20.00	None	Single Angle		A36 (36 ksi)	Pipe	ROHN 2 STD	A572-50 (50 ksi)
T5 20.00-0.00	None	Single Angle		A36 (36 ksi)	Pipe	ROHN 2 STD	A572-50 (50 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Secondary Horizontal Type	Secondary Horizontal Size	Secondary Horizontal Grade	Inner Bracing Type	Inner Bracing Size	Inner Bracing Grade
T1 100.00-80.00	Single Angle		A36 (36 ksi)	Single Angle	L2x2x1/8	A36 (36 ksi)
T2 80.00-60.00	Single Angle		A36 (36 ksi)	Single Angle	L2x2x1/8	A36 (36 ksi)

Tower Elevation ft	Secondary Horizontal Type	Secondary Horizontal Size	Secondary Horizontal Grade	Inner Bracing Type	Inner Bracing Size	Inner Bracing Grade
T3 60.00-40.00	Single Angle		A36 (36 ksi)	Single Angle	L2x2x1/8	A36 (36 ksi)
T4 40.00-20.00	Single Angle		A36 (36 ksi)	Single Angle	L2x2x1/8	A36 (36 ksi)
T5 20.00-0.00	Single Angle		A36 (36 ksi)	Single Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Gusset Area (per face) ft²	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in
T1 100.00-80.00	0.00	0.0000	A36 (36 ksi)	1	1	1	30.0000	30.0000
T2 80.00-60.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000
T3 60.00-40.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000
T4 40.00-20.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000
T5 20.00-0.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Calc K Single Angles	Calc K Solid Rounds	K Factors[1] Legs	X Brace Diags X Y	K Brace Diags X Y	Single Diags X Y	Girts X Y	Horiz. X Y	Sec. Horiz. X Y	Inner Brace X Y
T1	Yes	Yes	1	1	1	1	1	1	1	1
100.00-80.00				1	1	1	1	1	1	1
T2	Yes	Yes	1	1	1	1	1	1	1	1
80.00-60.00				1	1	1	1	1	1	1
T3	Yes	Yes	1	1	1	1	1	1	1	1
60.00-40.00				1	1	1	1	1	1	1
T4	Yes	Yes	1	1	1	1	1	1	1	1
40.00-20.00				1	1	1	1	1	1	1
T5 20.00-0.00	Yes	Yes	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1

[1]*Note: K factors are applied to member segment lengths. K-braces without inner supporting members will have the K factor in the out-of-plane direction applied to the overall length.*

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg		Diagonal		Top Girt		Bottom Girt		Mid Girt		Long Horizontal		Short Horizontal	
	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U
T1 100.00-80.00	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	0.75	0.0000	1	0.0000	0.75
T2 80.00-60.00	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1
T3 60.00-40.00	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1
T4 40.00-20.00	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1
T5 20.00-0.00	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg Connection Type	Leg		Diagonal		Top Girt		Bottom Girt		Mid Girt		Long Horizontal		Short Horizontal	
		Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.
T1 100.00-80.00	Flange	0.7500 A325N	4	0.6250 A325N	3	0.6250 A325N	2	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	2	0.6250 A325N	0
T2 80.00-60.00	Flange	0.8750 A325N	4	0.6250 A325N	3	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	2	0.6250 A325N	0
T3 60.00-40.00	Flange	0.8750 A325N	4	0.6250 A325N	3	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	2	0.6250 A325N	0
T4 40.00-20.00	Flange	1.0000 A325N	4	0.6250 A325N	3	0.6250 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	2	0.6250 A325N	0
T5 20.00-0.00	Flange	1.0000 A354-BC	4	0.6250 A325N	3	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	2	0.6250 A325N	0

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#	# Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight plf
LDF5-50A (7/8 FOAM) (Verizon Existing)	C	Yes	Ar (CfAe)	98.00 - 0.00	1.0000	0.3	9	9	1.0900	1.0900		0.33
1 5/8 (AT&T Existing)	A	Yes	Ar (CfAe)	88.00 - 0.00	1.0000	-0.33	12	12	1.9800	1.9800		1.04
RG6-Fiber (AT&T Existing)	A	Yes	Ar (CfAe)	88.00 - 0.00	1.0000	-0.45	1	1	0.5000	0.5000		1.00
#8 AWG Copper WIre (AT&T Existing)	A	Yes	Ar (CfAe)	88.00 - 0.00	1.0000	-0.47	2	2	0.2500	0.1285		0.05
7/8	C	Yes	Ar (CfAe)	100.00 - 0.00	1.0000	0.41	1	1	1.1100	1.1100		0.54
EW90	C	Yes	Af (CfAe)	84.00 - 0.00	1.0000	0.39	1	1	0.9869	0.9869	3.2550	0.32
EW90	C	Yes	Af (CfAe)	70.00 - 0.00	1.0000	0.37	1	1	0.9869	0.9869	3.2550	0.32
LDF5-50A	C	Yes	Ar (CfAe)	98.00 - 0.00	4.0000	0.28	3	3	1.0900	1.0900		0.33

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#	# Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight plf
(7/8 FOAM) (Verizon Existing) HYBRIFLEX 1-5/8" (Verizon Existing)	C	Yes	Ar (CfAe)	98.00 - 0.00	4.0000	0.34	1	1	1.9800	1.9800		1.90

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
T1	100.00-80.00	A	16.345	0.000	0.000	0.000	0.11
		B	0.000	0.000	0.000	0.000	0.00
		C	24.440	0.329	0.000	0.000	0.12
T2	80.00-60.00	A	40.862	0.000	0.000	0.000	0.27
		B	0.000	0.000	0.000	0.000	0.00
		C	26.950	2.467	0.000	0.000	0.14
T3	60.00-40.00	A	40.862	0.000	0.000	0.000	0.27
		B	0.000	0.000	0.000	0.000	0.00
		C	26.950	3.290	0.000	0.000	0.14
T4	40.00-20.00	A	40.862	0.000	0.000	0.000	0.27
		B	0.000	0.000	0.000	0.000	0.00
		C	26.950	3.290	0.000	0.000	0.14
T5	20.00-0.00	A	40.862	0.000	0.000	0.000	0.27
		B	0.000	0.000	0.000	0.000	0.00
		C	26.950	3.290	0.000	0.000	0.14

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
T1	100.00-80.00	A	0.500	25.592	0.252	0.000	0.000	0.26
		B		0.000	0.000	0.000	0.000	0.00
		C		45.607	0.551	0.000	0.000	0.38
T2	80.00-60.00	A	0.500	63.981	0.631	0.000	0.000	0.66
		B		0.000	0.000	0.000	0.000	0.00
		C		50.283	4.134	0.000	0.000	0.45
T3	60.00-40.00	A	0.500	63.981	0.631	0.000	0.000	0.66
		B		0.000	0.000	0.000	0.000	0.00
		C		50.283	5.512	0.000	0.000	0.46
T4	40.00-20.00	A	0.500	63.981	0.631	0.000	0.000	0.66
		B		0.000	0.000	0.000	0.000	0.00
		C		50.283	5.512	0.000	0.000	0.46
T5	20.00-0.00	A	0.500	63.981	0.631	0.000	0.000	0.66
		B		0.000	0.000	0.000	0.000	0.00
		C		50.283	5.512	0.000	0.000	0.46

Feed Line Shielding

Section	Elevation	Face	A_R	A_R Ice	A_F	A_F Ice
	ft		ft^2	ft^2	ft^2	ft^2
T1	100.00-80.00	A	1.289	2.960	0.000	0.000
		B	0.000	0.000	0.000	0.000
		C	1.953	5.300	0.000	0.000
T2	80.00-60.00	A	3.009	6.922	0.000	0.000
		B	0.000	0.000	0.000	0.000
		C	2.166	5.919	0.000	0.000
T3	60.00-40.00	A	3.033	6.816	0.000	0.000
		B	0.000	0.000	0.000	0.000
		C	2.245	6.003	0.000	0.000
T4	40.00-20.00	A	2.487	5.394	0.000	0.000
		B	0.000	0.000	0.000	0.000
		C	1.841	4.751	0.000	0.000
T5	20.00-0.00	A	2.330	5.059	0.000	0.000
		B	0.000	0.000	0.000	0.000
		C	1.724	4.455	0.000	0.000

Feed Line Center of Pressure

Section	Elevation	CP_X	CP_Z	CP_X Ice	CP_Z Ice
	ft	in	in	in	in
T1	100.00-80.00	-13.1593	8.8866	-14.2799	10.1491
T2	80.00-60.00	-20.2005	11.0366	-21.3453	12.3327
T3	60.00-40.00	-22.3362	12.2723	-24.0959	13.9729
T4	40.00-20.00	-25.9806	14.2798	-28.7687	16.6752
T5	20.00-0.00	-27.8712	15.3233	-31.5085	18.2564

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
8' x 3" Dia Omni	C	From Leg	1.00 0.00 4.00	0.0000	100.00	No Ice 1/2" Ice	2.40 3.19	2.40 3.19	0.03 0.04
4' x 2.875" Pipe Mount	C	From Leg	0.50 0.00 0.00	0.0000	100.00	No Ice 1/2" Ice	0.97 1.22	0.97 1.22	0.02 0.03
Pirod 12' T-Frame Sector Mount (1) (Verizon Existing)	A	None		0.0000	98.00	No Ice 1/2" Ice	13.60 18.40	13.60 18.40	0.47 0.60
Pirod 12' T-Frame Sector Mount (1) (Verizon Existing)	B	None		0.0000	98.00	No Ice 1/2" Ice	13.60 18.40	13.60 18.40	0.47 0.60
DB844H90-XY	A	From Leg	4.00	0.0000	98.00	No Ice	2.87	3.97	0.01

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(Verizon Existing)			-6.00 0.00			1/2" Ice	3.18	4.34	0.04
HBXX-6516DS	A	From Leg	4.00	0.0000	98.00	No Ice	5.94	3.28	0.04
(Verizon Proposed)			-4.00 0.00			1/2" Ice	6.35	3.61	0.07
800-10734	A	From Leg	4.00	0.0000	98.00	No Ice	6.17	2.34	0.03
(Verizon Proposed)			0.00 0.00			1/2" Ice	6.59	2.67	0.06
HBXX-6516DS	A	From Leg	4.00	0.0000	98.00	No Ice	5.94	3.28	0.04
(Verizon Proposed)			4.00 0.00			1/2" Ice	6.35	3.61	0.07
DB844H90-XY	A	From Leg	4.00	0.0000	98.00	No Ice	2.87	3.97	0.01
(Verizon Existing)			6.00 0.00			1/2" Ice	3.18	4.34	0.04
DB844H90-XY	B	From Leg	4.00	0.0000	98.00	No Ice	2.87	3.97	0.01
(Verizon Existing)			-6.00 0.00			1/2" Ice	3.18	4.34	0.04
HBXX-6516DS	B	From Leg	4.00	0.0000	98.00	No Ice	5.94	3.28	0.04
(Verizon Proposed)			-4.00 0.00			1/2" Ice	6.35	3.61	0.07
800-10734	B	From Leg	4.00	0.0000	98.00	No Ice	6.17	2.34	0.03
(Verizon Proposed)			0.00 0.00			1/2" Ice	6.59	2.67	0.06
HBXX-6516DS	B	From Leg	4.00	0.0000	98.00	No Ice	5.94	3.28	0.04
(Verizon Proposed)			4.00 0.00			1/2" Ice	6.35	3.61	0.07
DB844H90-XY	B	From Leg	4.00	0.0000	98.00	No Ice	2.87	3.97	0.01
(Verizon Existing)			6.00 0.00			1/2" Ice	3.18	4.34	0.04
RRH2x40-AWS	A	From Leg	4.00	0.0000	98.00	No Ice	2.52	1.59	0.04
(Verizon Existing)			-4.00 0.00			1/2" Ice	2.75	1.80	0.06
RRH2x40-AWS	B	From Leg	4.00	0.0000	98.00	No Ice	2.52	1.59	0.04
(Verizon Existing)			-4.00 0.00			1/2" Ice	2.75	1.80	0.06
DB-T1-6Z-8AB-0Z	A	From Leg	4.00	0.0000	98.00	No Ice	5.60	2.33	0.04
(Verizon Existing)			4.00 0.00			1/2" Ice	5.92	2.56	0.08
RRH2x60-PCS	A	From Leg	4.00	0.0000	98.00	No Ice	2.58	2.03	0.06
(Verizon Proposed)			-4.00 0.00			1/2" Ice	2.80	2.24	0.08
RRH2x60-PCS	B	From Leg	4.00	0.0000	98.00	No Ice	2.58	2.03	0.06
(Verizon Proposed)			-4.00 0.00			1/2" Ice	2.80	2.24	0.08
(2) CBC78-DF	A	From Leg	4.00	0.0000	98.00	No Ice	0.45	0.20	0.01
(Verizon Proposed)			0.00 0.00			1/2" Ice	0.55	0.27	0.01
(2) CBC78-DF	B	From Leg	4.00	0.0000	98.00	No Ice	0.45	0.20	0.01
(Verizon Proposed)			0.00 0.00			1/2" Ice	0.55	0.27	0.01
12' Frame	A	From Leg	1.00	0.0000	88.00	No Ice	9.80	9.80	0.26
(AT&T Existing)			0.00 0.00			1/2" Ice	14.80	14.80	0.36
12' Frame	B	From Leg	1.00	0.0000	88.00	No Ice	9.80	9.80	0.26
(AT&T Existing)			0.00 0.00			1/2" Ice	14.80	14.80	0.36
12' Frame	C	From Leg	1.00	0.0000	88.00	No Ice	9.80	9.80	0.26

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(AT&T Existing)			0.00 0.00			1/2" Ice	14.80	14.80	0.36
P1000 Unistrut (9' Long)	A	From Face	3.00	0.0000	88.00 - 88.50	No Ice	1.71	0.03	0.02
(AT&T Existing)			0.00 0.00			1/2" Ice	2.42	0.05	0.03
P1000 Unistrut (9' Long)	A	From Face	3.00	0.0000	78.50	No Ice	1.71	0.03	0.02
(AT&T Existing)			0.00 0.00			1/2" Ice	2.42	0.05	0.03
P1000 Unistrut (9' Long)	B	From Face	3.00	0.0000	88.00 - 88.50	No Ice	1.71	0.03	0.02
(AT&T Existing)			0.00 0.00			1/2" Ice	2.42	0.05	0.03
P1000 Unistrut (9' Long)	B	From Face	3.00	0.0000	78.50	No Ice	1.71	0.03	0.02
(AT&T Existing)			0.00 0.00			1/2" Ice	2.42	0.05	0.03
P1000 Unistrut (9' Long)	C	From Face	3.00	0.0000	88.00 - 88.50	No Ice	1.71	0.03	0.02
(AT&T Existing)			0.00 0.00			1/2" Ice	2.42	0.05	0.03
P1000 Unistrut (9' Long)	C	From Face	3.00	0.0000	78.50	No Ice	1.71	0.03	0.02
(AT&T Existing)			0.00 0.00			1/2" Ice	2.42	0.05	0.03
(2) 7770.00	A	From Face	3.00	0.0000	88.00	No Ice	5.88	2.93	0.04
(AT&T Existing)			0.00 0.00			1/2" Ice	6.31	3.27	0.07
(2) 7770.00	B	From Face	3.00	0.0000	88.00	No Ice	5.88	2.93	0.04
(AT&T Existing)			0.00 0.00			1/2" Ice	6.31	3.27	0.07
(2) 7770.00	C	From Face	3.00	0.0000	88.00	No Ice	5.88	2.93	0.04
(AT&T Existing)			0.00 0.00			1/2" Ice	6.31	3.27	0.07
P65-16-XLH-RR	A	From Face	3.00	0.0000	88.00	No Ice	8.40	4.70	0.06
(AT&T Existing)			0.00 0.00			1/2" Ice	8.95	5.15	0.11
P65-16-XLH-RR	B	From Face	3.00	0.0000	88.00	No Ice	8.40	4.70	0.06
(AT&T Existing)			0.00 0.00			1/2" Ice	8.95	5.15	0.11
P65-16-XLH-RR	C	From Face	3.00	0.0000	88.00	No Ice	8.40	4.70	0.06
(AT&T Existing)			0.00 0.00			1/2" Ice	8.95	5.15	0.11
(4) LPG21401 TMA	A	From Face	3.00	0.0000	88.00	No Ice	0.95	0.37	0.02
(AT&T Existing)			0.00 0.00			1/2" Ice	1.09	0.48	0.02
(4) LPG21401 TMA	B	From Face	3.00	0.0000	88.00	No Ice	0.95	0.37	0.02
(AT&T Existing)			0.00 0.00			1/2" Ice	1.09	0.48	0.02
(4) LPG21401 TMA	C	From Face	3.00	0.0000	88.00	No Ice	0.95	0.37	0.02
(AT&T Existing)			0.00 0.00			1/2" Ice	1.09	0.48	0.02
(2) RRUS-11	A	From Face	3.00	0.0000	88.00	No Ice	2.99	1.25	0.05
(AT&T Existing)			0.00 0.00			1/2" Ice	3.23	1.41	0.07
(2) RRUS-11	B	From Face	3.00	0.0000	88.00	No Ice	2.99	1.25	0.05
(AT&T Existing)			0.00 0.00			1/2" Ice	3.23	1.41	0.07
(2) RRUS-11	C	From Face	3.00	0.0000	88.00	No Ice	2.99	1.25	0.05
(AT&T Existing)			0.00 0.00			1/2" Ice	3.23	1.41	0.07
DC6-48-60-18-8F Surge	C	From Face	0.50	0.0000	86.00	No Ice	2.23	2.23	0.02

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
Arrestor			0.50			1/2" Ice	2.45	2.45	0.04
(AT&T Existing)			0.00						
3' x 4.5" Pipe Mont	B	From Leg	0.50	0.0000	84.00	No Ice	0.93	0.93	0.03
			0.00			1/2" Ice	1.13	1.13	0.04
			0.00						
3' x 4.5" Pipe Mont	B	From Leg	0.50	0.0000	70.00	No Ice	0.93	0.93	0.03
			0.00			1/2" Ice	1.13	1.13	0.04
			0.00						

Dishes

Description	Face or Leg	Dish Type	Offset Type	Offsets: Horz Lateral ft / Vert ft	Azimuth Adjustment °	3 dB Beam Width °	Elevation ft	Outside Diameter ft		Aperture Area ft^2	Weight K
4 FT DISH	B	Paraboloid w/o Radome	From Leg	1.00	0.0000		84.00	4.00	No Ice	12.56	0.17
				0.00					1/2" Ice	13.09	0.24
				0.00							
4 FT DISH	B	Paraboloid w/o Radome	From Leg	1.00	0.0000		70.00	4.00	No Ice	12.56	0.17
				0.00					1/2" Ice	13.09	0.24
				0.00							

Tower Pressures - No Ice

$G_H = 1.162$

Section Elevation ft	z ft	K_Z	q_z psf	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
T1	90.00	1.332	25	175.208	A	0.000	37.703	9.583	25.42	0.000	0.000
100.00-80.00					B	0.000	22.647		42.32	0.000	0.000
					C	0.329	45.134		21.08	0.000	0.000
T2 80.00-60.00	70.00	1.24	23	197.091	A	0.000	63.367	11.687	18.44	0.000	0.000
					B	0.000	25.514		45.81	0.000	0.000
					C	2.467	50.298		22.15	0.000	0.000
T3 60.00-40.00	50.00	1.126	21	238.758	A	0.000	68.020	13.356	19.64	0.000	0.000
					B	0.000	30.192		44.24	0.000	0.000
					C	3.290	54.897		22.95	0.000	0.000
T4 40.00-20.00	30.00	1	18	283.346	A	0.000	69.997	15.034	21.48	0.000	0.000
					B	0.000	31.623		47.54	0.000	0.000
					C	3.290	56.732		25.05	0.000	0.000
T5 20.00-0.00	10.00	1	18	333.456	A	0.000	75.314	18.592	24.69	0.000	0.000
					B	0.000	36.782		50.55	0.000	0.000
					C	3.290	62.008		28.47	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.162$

Section Elevation ft	z ft	K_Z	q_z psf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
T1 100.00-80.00	90.00	1.332	18	0.5000	176.875	A	0.252	54.526	12.917	23.58	0.000	0.000
						B	0.000	31.895		40.50	0.000	0.000
						C	0.551	72.201		17.75	0.000	0.000
T2 80.00-60.00	70.00	1.24	17	0.5000	198.759	A	0.631	92.181	15.026	16.19	0.000	0.000
						B	0.000	35.122		42.78	0.000	0.000
						C	4.134	79.486		17.97	0.000	0.000
T3 60.00-40.00	50.00	1.126	16	0.5000	240.427	A	0.631	97.785	16.696	16.96	0.000	0.000
						B	0.000	40.620		41.10	0.000	0.000
						C	5.512	84.900		18.47	0.000	0.000
T4 40.00-20.00	30.00	1	14	0.5000	285.015	A	0.631	99.693	18.375	18.32	0.000	0.000
						B	0.000	41.106		44.70	0.000	0.000
						C	5.512	86.639		19.94	0.000	0.000
T5 20.00-0.00	10.00	1	14	0.5000	335.126	A	0.631	105.812	21.934	20.61	0.000	0.000
						B	0.000	46.890		46.78	0.000	0.000
						C	5.512	92.718		22.33	0.000	0.000

Tower Pressure - Service

$G_H = 1.162$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
T1	90.00	1.332	9	175.208	A	0.000	37.703	9.583	25.42	0.000	0.000
100.00-80.00					B	0.000	22.647		42.32	0.000	0.000
					C	0.329	45.134		21.08	0.000	0.000
T2 80.00-60.00	70.00	1.24	8	197.091	A	0.000	63.367	11.687	18.44	0.000	0.000
					B	0.000	25.514		45.81	0.000	0.000
					C	2.467	50.298		22.15	0.000	0.000
T3 60.00-40.00	50.00	1.126	7	238.758	A	0.000	68.020	13.356	19.64	0.000	0.000
					B	0.000	30.192		44.24	0.000	0.000
					C	3.290	54.897		22.95	0.000	0.000
T4 40.00-20.00	30.00	1	6	283.346	A	0.000	69.997	15.034	21.48	0.000	0.000
					B	0.000	31.623		47.54	0.000	0.000
					C	3.290	56.732		25.05	0.000	0.000
T5 20.00-0.00	10.00	1	6	333.456	A	0.000	75.314	18.592	24.69	0.000	0.000
					B	0.000	36.782		50.55	0.000	0.000
					C	3.290	62.008		28.47	0.000	0.000

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
T1	0.23	1.14	A	0.215	2.546	0.594	1	1	22.381	1.90	95.21	C
100.00-80.00			B	0.129	2.849	0.579	1	1	13.102			
			C	0.259	2.409	0.604	1	1	27.605			
T2	0.41	1.30	A	0.322	2.24	0.623	1	1	39.460	2.36	117.78	A
80.00-60.00			B	0.129	2.849	0.579	1	1	14.761			
			C	0.268	2.385	0.607	1	1	32.976			
T3	0.41	1.59	A	0.285	2.337	0.611	1	1	41.587	2.35	117.62	A
60.00-40.00			B	0.126	2.86	0.578	1	1	17.456			
			C	0.244	2.457	0.6	1	1	36.244			
T4	0.41	2.11	A	0.247	2.446	0.601	1	1	42.077	2.21	110.63	A
40.00-20.00			B	0.112	2.918	0.576	1	1	18.226			
			C	0.212	2.557	0.593	1	1	36.925			
T5 20.00-0.00	0.41	2.65	A	0.226	2.512	0.596	1	1	44.888	2.42	121.18	A
			B	0.11	2.923	0.576	1	1	21.194			
			C	0.196	2.61	0.59	1	1	39.847			
Sum Weight:	1.87	8.79						OTM	544.50 kip-ft	11.25		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
T1	0.23	1.14	A	0.215	2.546	0.594	0.825	1	22.381	1.90	95.01	C
100.00-80.00			B	0.129	2.849	0.579	0.825	1	13.102			
			C	0.259	2.409	0.604	0.825	1	27.548			
T2	0.41	1.30	A	0.322	2.24	0.623	0.825	1	39.460	2.36	117.78	A
80.00-60.00			B	0.129	2.849	0.579	0.825	1	14.761			
			C	0.268	2.385	0.607	0.825	1	32.544			
T3	0.41	1.59	A	0.285	2.337	0.611	0.825	1	41.587	2.35	117.62	A
60.00-40.00			B	0.126	2.86	0.578	0.825	1	17.456			
			C	0.244	2.457	0.6	0.825	1	35.668			
T4	0.41	2.11	A	0.247	2.446	0.601	0.825	1	42.077	2.21	110.63	A
40.00-20.00			B	0.112	2.918	0.576	0.825	1	18.226			
			C	0.212	2.557	0.593	0.825	1	36.350			
T5 20.00-0.00	0.41	2.65	A	0.226	2.512	0.596	0.825	1	44.888	2.42	121.18	A
			B	0.11	2.923	0.576	0.825	1	21.194			
			C	0.196	2.61	0.59	0.825	1	39.271			
Sum Weight:	1.87	8.79						OTM	544.15 kip-ft	11.24		

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 ft²	F K	w plf	Ctrl. Face
T1	0.23	1.14	A	0.215	2.546	0.594	0.8	1	22.381	1.90	94.98	C
100.00-80.00			B	0.129	2.849	0.579	0.8	1	13.102			
			C	0.259	2.409	0.604	0.8	1	27.539			

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 plf	Ctrl. Face
T2	0.41	1.30	A	0.322	2.24	0.623	0.8	1	39.460	2.36	117.78	A
80.00-60.00			B	0.129	2.849	0.579	0.8	1	14.761			
			C	0.268	2.385	0.607	0.8	1	32.482			
T3	0.41	1.59	A	0.285	2.337	0.611	0.8	1	41.587	2.35	117.62	A
60.00-40.00			B	0.126	2.86	0.578	0.8	1	17.456			
			C	0.244	2.457	0.6	0.8	1	35.586			
T4	0.41	2.11	A	0.247	2.446	0.601	0.8	1	42.077	2.21	110.63	A
40.00-20.00			B	0.112	2.918	0.576	0.8	1	18.226			
			C	0.212	2.557	0.593	0.8	1	36.267			
T5 20.00-0.00	0.41	2.65	A	0.226	2.512	0.596	0.8	1	44.888	2.42	121.18	A
			B	0.11	2.923	0.576	0.8	1	21.194			
			C	0.196	2.61	0.59	0.8	1	39.189			
Sum Weight:	1.87	8.79						OTM	544.09 kip-ft	11.24		

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 ft²	F K	w plf	Ctrl. Face
T1	0.23	1.14	A	0.215	2.546	0.594	0.85	1	22.381	1.90	95.04	C
100.00-80.00			B	0.129	2.849	0.579	0.85	1	13.102			
			C	0.259	2.409	0.604	0.85	1	27.556			
T2	0.41	1.30	A	0.322	2.24	0.623	0.85	1	39.460	2.36	117.78	A
80.00-60.00			B	0.129	2.849	0.579	0.85	1	14.761			
			C	0.268	2.385	0.607	0.85	1	32.605			
T3	0.41	1.59	A	0.285	2.337	0.611	0.85	1	41.587	2.35	117.62	A
60.00-40.00			B	0.126	2.86	0.578	0.85	1	17.456			
			C	0.244	2.457	0.6	0.85	1	35.751			
T4	0.41	2.11	A	0.247	2.446	0.601	0.85	1	42.077	2.21	110.63	A
40.00-20.00			B	0.112	2.918	0.576	0.85	1	18.226			
			C	0.212	2.557	0.593	0.85	1	36.432			
T5 20.00-0.00	0.41	2.65	A	0.226	2.512	0.596	0.85	1	44.888	2.42	121.18	A
			B	0.11	2.923	0.576	0.85	1	21.194			
			C	0.196	2.61	0.59	0.85	1	39.353			
Sum Weight:	1.87	8.79						OTM	544.20 kip-ft	11.24		

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 ft²	F K	w plf	Ctrl. Face
T1	0.64	1.70	A	0.31	2.271	0.619	1	1	34.000	2.10	105.09	C
100.00-80.00			B	0.18	2.663	0.587	1	1	18.709			
			C	0.411	2.042	0.656	1	1	47.936			
T2	1.11	1.91	A	0.467	1.947	0.681	1	1	63.425	2.47	123.37	A
80.00-60.00			B	0.177	2.676	0.586	1	1	20.579			
			C	0.421	2.024	0.66	1	1	56.616			

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 plf	Ctrl. Face
T3	1.12	2.32	A	0.409	2.046	0.655	1	1	64.724	2.40	120.18	A
60.00-40.00			B	0.169	2.703	0.585	1	1	23.744			
			C	0.376	2.113	0.642	1	1	60.028			
T4	1.12	2.82	A	0.352	2.167	0.633	1	1	63.755	2.23	111.36	A
40.00-20.00			B	0.144	2.793	0.581	1	1	23.866			
			C	0.323	2.236	0.623	1	1	59.515			
T5 20.00-0.00	1.12	3.47	A	0.318	2.25	0.621	1	1	66.388	2.41	120.41	A
			B	0.14	2.809	0.58	1	1	27.196			
			C	0.293	2.314	0.614	1	1	62.424			
Sum Weight:	5.12	12.21						OTM	572.97 kip-ft	11.61		

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 ft²	F K	w plf	Ctrl. Face
T1	0.64	1.70	A	0.31	2.271	0.619	0.825	1	33.956	2.10	104.88	C
100.00-80.00			B	0.18	2.663	0.587	0.825	1	18.709			
			C	0.411	2.042	0.656	0.825	1	47.839			
T2	1.11	1.91	A	0.467	1.947	0.681	0.825	1	63.314	2.46	123.16	A
80.00-60.00			B	0.177	2.676	0.586	0.825	1	20.579			
			C	0.421	2.024	0.66	0.825	1	55.893			
T3	1.12	2.32	A	0.409	2.046	0.655	0.825	1	64.614	2.40	119.98	A
60.00-40.00			B	0.169	2.703	0.585	0.825	1	23.744			
			C	0.376	2.113	0.642	0.825	1	59.063			
T4	1.12	2.82	A	0.352	2.167	0.633	0.825	1	63.645	2.22	111.16	A
40.00-20.00			B	0.144	2.793	0.581	0.825	1	23.866			
			C	0.323	2.236	0.623	0.825	1	58.550			
T5 20.00-0.00	1.12	3.47	A	0.318	2.25	0.621	0.825	1	66.278	2.40	120.21	A
			B	0.14	2.809	0.58	0.825	1	27.196			
			C	0.293	2.314	0.614	0.825	1	61.459			
Sum Weight:	5.12	12.21						OTM	571.93 kip-ft	11.59		

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 ft²	F K	w plf	Ctrl. Face
T1	0.64	1.70	A	0.31	2.271	0.619	0.8	1	33.949	2.10	104.85	C
100.00-80.00			B	0.18	2.663	0.587	0.8	1	18.709			
			C	0.411	2.042	0.656	0.8	1	47.825			
T2	1.11	1.91	A	0.467	1.947	0.681	0.8	1	63.298	2.46	123.13	A
80.00-60.00			B	0.177	2.676	0.586	0.8	1	20.579			
			C	0.421	2.024	0.66	0.8	1	55.789			
T3	1.12	2.32	A	0.409	2.046	0.655	0.8	1	64.598	2.40	119.95	A
60.00-40.00			B	0.169	2.703	0.585	0.8	1	23.744			
			C	0.376	2.113	0.642	0.8	1	58.926			

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 plf	Ctrl. Face
T4	1.12	2.82	A	0.352	2.167	0.633	0.8	1	63.629	2.22	111.13	A
40.00-20.00			B	0.144	2.793	0.581	0.8	1	23.866			
			C	0.323	2.236	0.623	0.8	1	58.413			
T5 20.00-0.00	1.12	3.47	A	0.318	2.25	0.621	0.8	1	66.262	2.40	120.18	A
			B	0.14	2.809	0.58	0.8	1	27.196			
			C	0.293	2.314	0.614	0.8	1	61.322			
Sum Weight:	5.12	12.21						OTM	571.78 kip-ft	11.58		

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 ft²	F K	w plf	Ctrl. Face
T1	0.64	1.70	A	0.31	2.271	0.619	0.85	1	33.962	2.10	104.91	C
100.00-80.00			B	0.18	2.663	0.587	0.85	1	18.709			
			C	0.411	2.042	0.656	0.85	1	47.853			
T2	1.11	1.91	A	0.467	1.947	0.681	0.85	1	63.330	2.46	123.19	A
80.00-60.00			B	0.177	2.676	0.586	0.85	1	20.579			
			C	0.421	2.024	0.66	0.85	1	55.996			
T3	1.12	2.32	A	0.409	2.046	0.655	0.85	1	64.630	2.40	120.01	A
60.00-40.00			B	0.169	2.703	0.585	0.85	1	23.744			
			C	0.376	2.113	0.642	0.85	1	59.201			
T4	1.12	2.82	A	0.352	2.167	0.633	0.85	1	63.661	2.22	111.19	A
40.00-20.00			B	0.144	2.793	0.581	0.85	1	23.866			
			C	0.323	2.236	0.623	0.85	1	58.688			
T5 20.00-0.00	1.12	3.47	A	0.318	2.25	0.621	0.85	1	66.293	2.40	120.24	A
			B	0.14	2.809	0.58	0.85	1	27.196			
			C	0.293	2.314	0.614	0.85	1	61.597			
Sum Weight:	5.12	12.21						OTM	572.08 kip-ft	11.59		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
T1	0.23	1.14	A	0.215	2.546	0.594	1	1	22.381	0.66	32.94	C
100.00-80.00			B	0.129	2.849	0.579	1	1	13.102			
			C	0.259	2.409	0.604	1	1	27.605			
T2	0.41	1.30	A	0.322	2.24	0.623	1	1	39.460	0.82	40.75	A
80.00-60.00			B	0.129	2.849	0.579	1	1	14.761			
			C	0.268	2.385	0.607	1	1	32.976			
T3	0.41	1.59	A	0.285	2.337	0.611	1	1	41.587	0.81	40.70	A
60.00-40.00			B	0.126	2.86	0.578	1	1	17.456			
			C	0.244	2.457	0.6	1	1	36.244			
T4	0.41	2.11	A	0.247	2.446	0.601	1	1	42.077	0.77	38.28	A
40.00-20.00			B	0.112	2.918	0.576	1	1	18.226			
			C	0.212	2.557	0.593	1	1	36.925			

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 plf	Ctrl. Face
T5 20.00-0.00	0.41	2.65	A	0.226	2.512	0.596	1	1	44.888	0.84	41.93	A
			B	0.11	2.923	0.576	1	1	21.194			
			C	0.196	2.61	0.59	1	1	39.847			
Sum Weight:	1.87	8.79						OTM	188.41 kip-ft	3.89		

Tower Forces - Service - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
T1	0.23	1.14	A	0.215	2.546	0.594	0.825	1	22.381	0.66	32.88	C
100.00-80.00			B	0.129	2.849	0.579	0.825	1	13.102			
			C	0.259	2.409	0.604	0.825	1	27.548			
T2	0.41	1.30	A	0.322	2.24	0.623	0.825	1	39.460	0.82	40.75	A
80.00-60.00			B	0.129	2.849	0.579	0.825	1	14.761			
			C	0.268	2.385	0.607	0.825	1	32.544			
T3	0.41	1.59	A	0.285	2.337	0.611	0.825	1	41.587	0.81	40.70	A
60.00-40.00			B	0.126	2.86	0.578	0.825	1	17.456			
			C	0.244	2.457	0.6	0.825	1	35.668			
T4	0.41	2.11	A	0.247	2.446	0.601	0.825	1	42.077	0.77	38.28	A
40.00-20.00			B	0.112	2.918	0.576	0.825	1	18.226			
			C	0.212	2.557	0.593	0.825	1	36.350			
T5 20.00-0.00	0.41	2.65	A	0.226	2.512	0.596	0.825	1	44.888	0.84	41.93	A
			B	0.11	2.923	0.576	0.825	1	21.194			
			C	0.196	2.61	0.59	0.825	1	39.271			
Sum Weight:	1.87	8.79						OTM	188.29 kip-ft	3.89		

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 plf	Ctrl. Face
T1	0.23	1.14	A	0.215	2.546	0.594	0.8	1	22.381	0.66	32.87	C
100.00-80.00			B	0.129	2.849	0.579	0.8	1	13.102			
			C	0.259	2.409	0.604	0.8	1	27.539			
T2	0.41	1.30	A	0.322	2.24	0.623	0.8	1	39.460	0.82	40.75	A
80.00-60.00			B	0.129	2.849	0.579	0.8	1	14.761			
			C	0.268	2.385	0.607	0.8	1	32.482			
T3	0.41	1.59	A	0.285	2.337	0.611	0.8	1	41.587	0.81	40.70	A
60.00-40.00			B	0.126	2.86	0.578	0.8	1	17.456			
			C	0.244	2.457	0.6	0.8	1	35.586			
T4	0.41	2.11	A	0.247	2.446	0.601	0.8	1	42.077	0.77	38.28	A
40.00-20.00			B	0.112	2.918	0.576	0.8	1	18.226			
			C	0.212	2.557	0.593	0.8	1	36.267			
T5 20.00-0.00	0.41	2.65	A	0.226	2.512	0.596	0.8	1	44.888	0.84	41.93	A
			B	0.11	2.923	0.576	0.8	1	21.194			
			C	0.196	2.61	0.59	0.8	1	39.189			

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 plf	Ctrl. Face
Sum Weight:	1.87	8.79						OTM	188.27 kip-ft	3.89		

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 plf	Ctrl. Face
T1	0.23	1.14	A	0.215	2.546	0.594	0.85	1	22.381	0.66	32.89	C
100.00-80.00			B	0.129	2.849	0.579	0.85	1	13.102			
			C	0.259	2.409	0.604	0.85	1	27.556			
T2	0.41	1.30	A	0.322	2.24	0.623	0.85	1	39.460	0.82	40.75	A
80.00-60.00			B	0.129	2.849	0.579	0.85	1	14.761			
			C	0.268	2.385	0.607	0.85	1	32.605			
T3	0.41	1.59	A	0.285	2.337	0.611	0.85	1	41.587	0.81	40.70	A
60.00-40.00			B	0.126	2.86	0.578	0.85	1	17.456			
			C	0.244	2.457	0.6	0.85	1	35.751			
T4	0.41	2.11	A	0.247	2.446	0.601	0.85	1	42.077	0.77	38.28	A
40.00-20.00			B	0.112	2.918	0.576	0.85	1	18.226			
			C	0.212	2.557	0.593	0.85	1	36.432			
T5 20.00-0.00	0.41	2.65	A	0.226	2.512	0.596	0.85	1	44.888	0.84	41.93	A
			B	0.11	2.923	0.576	0.85	1	21.194			
			C	0.196	2.61	0.59	0.85	1	39.353			
Sum Weight:	1.87	8.79						OTM	188.30 kip-ft	3.89		

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	3.50					
Bracing Weight	5.28					
Total Member Self-Weight	8.79			4.29	5.32	
Total Weight	14.43			4.29	5.32	
Wind 0 deg - No Ice		-1.01	-17.57	-1113.80	85.73	-15.26
Wind 30 deg - No Ice		8.34	-14.74	-926.16	-515.07	-7.83
Wind 45 deg - No Ice		12.07	-11.92	-746.28	-753.08	-3.29
Wind 60 deg - No Ice		14.77	-8.44	-526.37	-923.44	1.66
Wind 90 deg - No Ice		17.22	0.15	17.98	-1081.29	10.44
Wind 120 deg - No Ice		15.09	8.89	573.52	-950.24	15.37
Wind 135 deg - No Ice		12.30	12.44	797.82	-774.23	16.22
Wind 150 deg - No Ice		8.74	15.15	968.84	-549.84	16.17
Wind 180 deg - No Ice		0.23	17.28	1100.25	-14.67	13.70
Wind 210 deg - No Ice		-8.33	14.75	935.37	524.63	7.83
Wind 225 deg - No Ice		-12.45	11.72	738.98	793.30	3.45
Wind 240 deg - No Ice		-15.41	7.91	493.70	983.46	-0.11
Wind 270 deg - No Ice		-17.54	-0.67	-49.49	1116.62	-8.22
Wind 300 deg - No Ice		-15.38	-9.06	-577.88	983.31	-15.36

Load Case	Vertical Forces K	Sum of Forces X K	Sum of Forces Z K	Sum of Overturning Moments, M_x kip-ft	Sum of Overturning Moments, M_z kip-ft	Sum of Torques kip-ft
Wind 315 deg - No Ice		-12.77	-12.50	-793.82	821.21	-17.64
Wind 330 deg - No Ice		-9.35	-15.17	-961.60	607.55	-18.39
Member Ice	3.42					
Total Weight Ice	22.85			12.25	17.99	
Wind 0 deg - Ice		-0.79	-17.24	-1072.21	80.71	-18.84
Wind 30 deg - Ice		8.27	-14.54	-896.85	-493.95	-9.78
Wind 45 deg - Ice		11.90	-11.79	-722.84	-723.41	-4.18
Wind 60 deg - Ice		14.57	-8.34	-507.48	-889.82	1.84
Wind 90 deg - Ice		16.95	0.11	22.81	-1041.47	12.76
Wind 120 deg - Ice		14.83	8.70	562.32	-911.38	19.47
Wind 135 deg - Ice		12.08	12.19	780.72	-739.74	20.79
Wind 150 deg - Ice		8.57	14.86	947.86	-520.88	20.90
Wind 180 deg - Ice		0.18	16.99	1078.54	2.51	17.58
Wind 210 deg - Ice		-8.26	14.55	921.84	529.09	9.78
Wind 225 deg - Ice		-12.20	11.63	734.93	782.52	4.30
Wind 240 deg - Ice		-15.08	7.93	500.17	965.16	-0.63
Wind 270 deg - Ice		-17.20	-0.52	-29.64	1096.76	-11.03
Wind 300 deg - Ice		-15.04	-8.82	-547.50	964.15	-19.42
Wind 315 deg - Ice		-12.45	-12.23	-759.81	804.14	-21.90
Wind 330 deg - Ice		-9.05	-14.88	-924.40	593.66	-22.63
Total Weight	14.43			4.29	5.32	
Wind 0 deg - Service		-0.35	-6.08	-387.24	24.11	-5.28
Wind 30 deg - Service		2.89	-5.10	-322.32	-183.78	-2.71
Wind 45 deg - Service		4.18	-4.13	-260.07	-266.14	-1.14
Wind 60 deg - Service		5.11	-2.92	-183.98	-325.09	0.57
Wind 90 deg - Service		5.96	0.05	4.38	-379.70	3.61
Wind 120 deg - Service		5.22	3.08	196.60	-334.36	5.32
Wind 135 deg - Service		4.26	4.30	274.22	-273.46	5.61
Wind 150 deg - Service		3.02	5.24	333.40	-195.81	5.60
Wind 180 deg - Service		0.08	5.98	378.87	-10.63	4.74
Wind 210 deg - Service		-2.88	5.10	321.82	175.98	2.71
Wind 225 deg - Service		-4.31	4.05	253.86	268.94	1.19
Wind 240 deg - Service		-5.33	2.74	168.99	334.74	-0.04
Wind 270 deg - Service		-6.07	-0.23	-18.97	380.82	-2.85
Wind 300 deg - Service		-5.32	-3.13	-201.80	334.69	-5.32
Wind 315 deg - Service		-4.42	-4.32	-276.52	278.60	-6.10
Wind 330 deg - Service		-3.23	-5.25	-334.58	204.67	-6.36

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

Comb. No.	Description
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
T1	100 - 80	Leg	Max Tension	15	3.56	-0.46	0.08
			Max. Compression	24	-7.13	0.00	-0.03
			Max. Mx	10	-0.71	1.02	0.14
			Max. My	15	-0.77	0.32	1.31
			Max. Vy	15	0.75	-0.46	0.08
			Max. Vx	17	-0.81	0.05	0.52
		Diagonal	Max Tension	9	4.97	0.00	0.00
			Max. Compression	9	-5.03	0.00	0.00
			Max. Mx	34	4.45	0.02	0.00
			Max. My	32	0.13	0.00	0.00
			Max. Vy	34	-0.01	0.00	0.00
			Max. Vx	32	-0.00	0.00	0.00
		Horizontal	Max Tension	16	2.80	0.00	0.00
			Max. Compression	8	-2.74	-0.01	-0.00
			Max. Mx	22	0.08	-0.02	-0.01
			Max. My	15	-0.47	-0.01	-0.01
			Max. Vy	22	-0.01	-0.02	-0.01

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Vx	15	0.00	-0.01	-0.01
		Top Girt	Max Tension	16	0.82	-0.01	0.00
			Max. Compression	8	-0.82	-0.01	-0.00
			Max. Mx	21	-0.10	-0.01	-0.00
			Max. My	2	0.18	-0.01	0.00
			Max. Vy	21	0.01	-0.01	-0.00
			Max. Vx	2	-0.00	0.00	0.00
		Inner Bracing	Max Tension	8	0.01	0.00	0.00
			Max. Compression	8	-0.01	0.00	0.00
			Max. Mx	18	-0.00	-0.01	0.00
			Max. My	32	-0.00	0.00	0.00
			Max. Vy	18	0.01	0.00	0.00
			Max. Vx	32	-0.00	0.00	0.00
T2	80 - 60	Leg	Max Tension	15	20.97	-0.16	0.04
			Max. Compression	7	-25.24	0.05	-0.04
			Max. Mx	13	6.49	0.23	0.08
			Max. My	13	-18.34	0.12	-0.22
			Max. Vy	15	0.12	-0.16	0.04
			Max. Vx	17	0.15	0.03	0.20
		Diagonal	Max Tension	9	4.40	0.00	0.00
			Max. Compression	9	-4.46	0.00	0.00
			Max. Mx	34	3.87	0.03	0.00
			Max. My	32	0.02	0.00	0.00
			Max. Vy	34	-0.01	0.00	0.00
			Max. Vx	32	-0.00	0.00	0.00
		Horizontal	Max Tension	17	2.70	0.00	0.00
			Max. Compression	9	-2.68	-0.01	-0.00
			Max. Mx	27	0.24	-0.02	-0.00
			Max. My	15	-0.23	-0.01	-0.01
			Max. Vy	27	-0.02	-0.02	-0.00
			Max. Vx	15	0.00	-0.01	-0.01
		Inner Bracing	Max Tension	7	0.00	0.00	0.00
			Max. Compression	32	-0.00	0.00	0.00
			Max. Mx	18	-0.00	-0.01	0.00
			Max. My	32	-0.00	0.00	0.00
			Max. Vy	18	0.01	0.00	0.00
			Max. Vx	32	-0.00	0.00	0.00
T3	60 - 40	Leg	Max Tension	15	37.72	-0.09	0.03
			Max. Compression	2	-42.49	0.14	0.05
			Max. Mx	15	37.70	-0.14	0.06
			Max. My	17	-4.37	-0.00	0.21
			Max. Vy	22	0.04	-0.14	-0.00
			Max. Vx	34	-0.08	-0.01	0.21
		Diagonal	Max Tension	23	4.39	0.00	0.00
			Max. Compression	23	-4.55	0.00	0.00
			Max. Mx	31	4.32	0.04	0.00
			Max. My	32	-0.42	0.00	0.00
			Max. Vy	31	-0.02	0.00	0.00
			Max. Vx	32	-0.00	0.00	0.00
		Horizontal	Max Tension	23	3.08	0.00	0.00
			Max. Compression	23	-3.03	-0.03	-0.00
			Max. Mx	32	0.41	-0.05	-0.01
			Max. My	15	-0.39	-0.03	-0.01
			Max. Vy	32	-0.02	-0.05	-0.01
			Max. Vx	15	0.00	-0.03	-0.01
		Inner Bracing	Max Tension	2	0.00	0.00	0.00
			Max. Compression	32	-0.00	0.00	0.00
			Max. Mx	18	-0.00	-0.02	0.00
			Max. My	32	-0.00	0.00	0.00
			Max. Vy	18	-0.01	0.00	0.00
			Max. Vx	32	0.00	0.00	0.00

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
T4	40 - 20	Leg	Max Tension	15	49.93	-0.18	0.08
			Max. Compression	30	-55.83	0.07	0.00
			Max. Mx	22	41.34	-0.19	-0.00
			Max. My	17	-5.03	-0.01	0.27
			Max. Vy	22	0.05	-0.17	-0.00
			Max. Vx	26	0.11	-0.02	-0.27
		Diagonal	Max Tension	23	5.37	0.00	0.00
			Max. Compression	23	-5.58	0.00	0.00
			Max. Mx	31	5.24	0.09	0.00
			Max. My	32	-0.86	0.00	0.00
			Max. Vy	31	-0.03	0.00	0.00
			Max. Vx	32	-0.00	0.00	0.00
		Horizontal	Max Tension	23	3.27	0.00	0.00
			Max. Compression	23	-3.24	-0.04	-0.00
			Max. Mx	32	0.54	-0.05	-0.01
			Max. My	15	-0.57	-0.04	-0.01
			Max. Vy	32	-0.03	-0.05	-0.01
			Max. Vx	15	0.00	-0.04	-0.01
		Inner Bracing	Max Tension	2	0.00	0.00	0.00
			Max. Compression	32	-0.01	0.00	0.00
			Max. Mx	18	-0.00	-0.02	0.00
			Max. My	32	-0.01	0.00	0.00
			Max. Vy	18	0.01	0.00	0.00
			Max. Vx	32	-0.00	0.00	0.00
T5	20 - 0	Leg	Max Tension	15	62.58	-0.33	0.09
			Max. Compression	30	-70.68	0.00	-0.00
			Max. Mx	24	-62.57	0.49	-0.10
			Max. My	17	-6.64	-0.02	0.42
			Max. Vy	5	-0.09	-0.33	0.00
			Max. Vx	17	0.15	-0.02	0.42
		Diagonal	Max Tension	23	5.32	0.00	0.00
			Max. Compression	23	-5.59	0.00	0.00
			Max. Mx	23	5.32	0.11	0.00
			Max. My	32	-1.07	0.00	0.00
			Max. Vy	23	0.03	0.00	0.00
			Max. Vx	32	-0.00	0.00	0.00
		Horizontal	Max Tension	23	3.61	0.00	0.00
			Max. Compression	23	-3.51	-0.03	-0.00
			Max. Mx	32	0.68	-0.05	-0.01
			Max. My	15	-0.73	-0.04	-0.01
			Max. Vy	32	-0.03	-0.04	-0.01
			Max. Vx	15	0.00	-0.04	-0.01
		Inner Bracing	Max Tension	1	0.00	0.00	0.00
			Max. Compression	23	-0.01	0.00	0.00
			Max. Mx	18	-0.00	-0.04	0.00
			Max. My	19	-0.00	0.00	-0.00
			Max. Vy	18	0.02	0.00	0.00
			Max. Vx	19	0.00	0.00	0.00

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Leg C	Max. Vert	30	77.05	8.90	-5.05
	Max. H_x	30	77.05	8.90	-5.05
	Max. H_z	4	-60.82	-7.36	4.90

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
	Min. Vert	5	-63.23	-7.96	4.53
	Min. H_x	5	-63.23	-7.96	4.53
	Min. H_z	29	74.43	8.27	-5.42
Leg B	Max. Vert	24	76.02	-9.25	-4.58
	Max. H_x	15	-68.37	8.62	4.40
	Max. H_z	16	-66.30	8.18	4.58
	Min. Vert	15	-68.37	8.62	4.40
	Min. H_x	24	76.02	-9.25	-4.58
	Min. H_z	8	73.36	-8.64	-4.90
Leg A	Max. Vert	2	76.22	-0.44	10.32
	Max. H_x	13	-26.71	1.57	-4.01
	Max. H_z	19	76.14	-0.58	10.32
	Min. Vert	10	-65.70	0.44	-9.34
	Min. H_x	5	38.49	-1.47	5.17
	Min. H_z	10	-65.70	0.44	-9.34

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	14.43	0.00	0.00	4.29	5.32	0.00
Dead+Wind 0 deg - No Ice	14.43	-1.01	-17.57	-1079.66	85.85	-15.26
Dead+Wind 30 deg - No Ice	14.43	8.34	-14.74	-896.56	-497.95	-7.83
Dead+Wind 45 deg - No Ice	14.43	12.07	-11.92	-722.10	-728.90	-3.29
Dead+Wind 60 deg - No Ice	14.43	14.77	-8.44	-509.27	-893.84	1.66
Dead+Wind 90 deg - No Ice	14.43	17.22	0.15	18.01	-1047.12	10.45
Dead+Wind 120 deg - No Ice	14.43	15.09	8.89	556.48	-920.66	15.37
Dead+Wind 135 deg - No Ice	14.43	12.30	12.44	773.71	-750.08	16.23
Dead+Wind 150 deg - No Ice	14.43	8.74	15.15	939.30	-532.76	16.18
Dead+Wind 180 deg - No Ice	14.43	0.23	17.28	1066.11	-14.69	13.71
Dead+Wind 210 deg - No Ice	14.43	-8.33	14.75	905.78	507.51	7.83
Dead+Wind 225 deg - No Ice	14.43	-12.45	11.72	714.78	769.17	3.44
Dead+Wind 240 deg - No Ice	14.43	-15.41	7.91	476.55	953.91	-0.12
Dead+Wind 270 deg - No Ice	14.43	-17.54	-0.67	-49.55	1082.49	-8.23
Dead+Wind 300 deg - No Ice	14.43	-15.38	-9.06	-560.84	953.78	-15.37
Dead+Wind 315 deg - No Ice	14.43	-12.77	-12.50	-769.70	797.13	-17.64
Dead+Wind 330 deg - No Ice	14.43	-9.35	-15.17	-932.03	590.56	-18.39
Dead+Ice+Temp	22.85	0.00	0.00	12.25	17.99	0.00
Dead+Wind 0 deg+Ice+Temp	22.85	-0.79	-17.24	-1035.99	80.85	-18.86
Dead+Wind 30 deg+Ice+Temp	22.85	8.27	-14.54	-865.48	-475.79	-9.79
Dead+Wind 45 deg+Ice+Temp	22.85	11.90	-11.79	-697.22	-697.78	-4.18
Dead+Wind 60 deg+Ice+Temp	22.85	14.57	-8.34	-489.35	-858.45	1.85
Dead+Wind 90 deg+Ice+Temp	22.85	16.95	0.11	22.86	-1005.26	12.78
Dead+Wind 120 deg+Ice+Temp	22.85	14.83	8.70	544.27	-879.99	19.49
Dead+Wind 135 deg+Ice+Temp	22.85	12.08	12.19	755.21	-714.15	20.81
Dead+Wind 150 deg+Ice+Temp	22.85	8.57	14.86	916.58	-502.78	20.92
Dead+Wind 180 deg+Ice+Temp	22.85	0.18	16.99	1042.41	2.50	17.60
Dead+Wind 210 deg+Ice+Temp	22.85	-8.26	14.55	890.50	510.98	9.79
Dead+Wind 225 deg+Ice+Temp	22.85	-12.20	11.63	709.32	756.97	4.30
Dead+Wind 240 deg+Ice+Temp	22.85	-15.08	7.93	482.03	933.88	-0.64
Dead+Wind 270 deg+Ice+Temp	22.85	-17.20	-0.52	-29.70	1060.62	-11.05
Dead+Wind 300 deg+Ice+Temp	22.85	-15.04	-8.82	-529.44	932.90	-19.45
Dead+Wind 315 deg+Ice+Temp	22.85	-12.45	-12.23	-734.24	778.65	-21.92
Dead+Wind 330 deg+Ice+Temp	22.85	-9.05	-14.88	-893.07	575.68	-22.65
Dead+Wind 0 deg - Service	14.43	-0.35	-6.08	-370.76	33.19	-5.28
Dead+Wind 30 deg - Service	14.43	2.89	-5.10	-307.41	-168.81	-2.71

Load Combination	Vertical	$Shear_x$	$Shear_z$	Overturning Moment, M_x	Overturning Moment, M_z	Torque
	K	K	K	kip-ft	kip-ft	kip-ft
Dead+Wind 45 deg - Service	14.43	4.18	-4.13	-247.04	-248.73	-1.14
Dead+Wind 60 deg - Service	14.43	5.11	-2.92	-173.40	-305.80	0.58
Dead+Wind 90 deg - Service	14.43	5.96	0.05	9.04	-358.84	3.61
Dead+Wind 120 deg - Service	14.43	5.22	3.08	195.36	-315.07	5.32
Dead+Wind 135 deg - Service	14.43	4.26	4.30	270.53	-256.05	5.62
Dead+Wind 150 deg - Service	14.43	3.02	5.24	327.83	-180.86	5.60
Dead+Wind 180 deg - Service	14.43	0.08	5.98	371.71	-1.60	4.74
Dead+Wind 210 deg - Service	14.43	-2.88	5.10	316.22	179.09	2.71
Dead+Wind 225 deg - Service	14.43	-4.31	4.05	250.13	269.62	1.19
Dead+Wind 240 deg - Service	14.43	-5.33	2.74	167.70	333.54	-0.04
Dead+Wind 270 deg - Service	14.43	-6.07	-0.23	-14.33	378.05	-2.85
Dead+Wind 300 deg - Service	14.43	-5.32	-3.13	-191.25	333.51	-5.32
Dead+Wind 315 deg - Service	14.43	-4.42	-4.32	-263.52	279.31	-6.10
Dead+Wind 330 deg - Service	14.43	-3.23	-5.25	-319.68	207.83	-6.36

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX	PY	PZ	PX	PY	PZ	% Error
	K	K	K	K	K	K	
1	0.00	-14.43	0.00	0.00	14.43	0.00	0.000%
2	-1.01	-14.43	-17.57	1.01	14.43	17.57	0.000%
3	8.34	-14.43	-14.74	-8.34	14.43	14.74	0.000%
4	12.07	-14.43	-11.92	-12.07	14.43	11.92	0.000%
5	14.77	-14.43	-8.44	-14.77	14.43	8.44	0.000%
6	17.22	-14.43	0.15	-17.22	14.43	-0.15	0.000%
7	15.09	-14.43	8.89	-15.09	14.43	-8.89	0.000%
8	12.30	-14.43	12.44	-12.30	14.43	-12.44	0.000%
9	8.74	-14.43	15.15	-8.74	14.43	-15.15	0.000%
10	0.23	-14.43	17.28	-0.23	14.43	-17.28	0.000%
11	-8.33	-14.43	14.75	8.33	14.43	-14.75	0.000%
12	-12.45	-14.43	11.72	12.45	14.43	-11.72	0.000%
13	-15.41	-14.43	7.91	15.41	14.43	-7.91	0.000%
14	-17.54	-14.43	-0.67	17.54	14.43	0.67	0.000%
15	-15.38	-14.43	-9.06	15.38	14.43	9.06	0.000%
16	-12.77	-14.43	-12.50	12.77	14.43	12.50	0.000%
17	-9.35	-14.43	-15.17	9.35	14.43	15.17	0.000%
18	0.00	-22.85	0.00	0.00	22.85	0.00	0.000%
19	-0.79	-22.85	-17.24	0.79	22.85	17.24	0.000%
20	8.27	-22.85	-14.54	-8.27	22.85	14.54	0.000%
21	11.90	-22.85	-11.79	-11.90	22.85	11.79	0.000%
22	14.57	-22.85	-8.34	-14.57	22.85	8.34	0.000%
23	16.95	-22.85	0.11	-16.95	22.85	-0.11	0.000%
24	14.83	-22.85	8.70	-14.83	22.85	-8.70	0.000%
25	12.08	-22.85	12.19	-12.08	22.85	-12.19	0.000%
26	8.57	-22.85	14.86	-8.57	22.85	-14.86	0.000%
27	0.18	-22.85	16.99	-0.18	22.85	-16.99	0.000%
28	-8.26	-22.85	14.55	8.26	22.85	-14.55	0.000%
29	-12.20	-22.85	11.63	12.20	22.85	-11.63	0.000%
30	-15.08	-22.85	7.93	15.08	22.85	-7.93	0.000%
31	-17.20	-22.85	-0.52	17.20	22.85	0.52	0.000%
32	-15.04	-22.85	-8.82	15.04	22.85	8.82	0.000%
33	-12.45	-22.85	-12.23	12.45	22.85	12.23	0.000%
34	-9.05	-22.85	-14.88	9.05	22.85	14.88	0.000%
35	-0.35	-14.43	-6.08	0.35	14.43	6.08	0.000%
36	2.89	-14.43	-5.10	-2.89	14.43	5.10	0.000%
37	4.18	-14.43	-4.13	-4.18	14.43	4.13	0.000%
38	5.11	-14.43	-2.92	-5.11	14.43	2.92	0.000%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
39	5.96	-14.43	0.05	-5.96	14.43	-0.05	0.000%
40	5.22	-14.43	3.08	-5.22	14.43	-3.08	0.000%
41	4.26	-14.43	4.30	-4.26	14.43	-4.30	0.000%
42	3.02	-14.43	5.24	-3.02	14.43	-5.24	0.000%
43	0.08	-14.43	5.98	-0.08	14.43	-5.98	0.000%
44	-2.88	-14.43	5.10	2.88	14.43	-5.10	0.000%
45	-4.31	-14.43	4.05	4.31	14.43	-4.05	0.000%
46	-5.33	-14.43	2.74	5.33	14.43	-2.74	0.000%
47	-6.07	-14.43	-0.23	6.07	14.43	0.23	0.000%
48	-5.32	-14.43	-3.13	5.32	14.43	3.13	0.000%
49	-4.42	-14.43	-4.32	4.42	14.43	4.32	0.000%
50	-3.23	-14.43	-5.25	3.23	14.43	5.25	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	0.00000001
3	Yes	4	0.00000001	0.00000001
4	Yes	4	0.00000001	0.00000001
5	Yes	4	0.00000001	0.00000001
6	Yes	4	0.00000001	0.00000001
7	Yes	4	0.00000001	0.00000001
8	Yes	4	0.00000001	0.00000001
9	Yes	4	0.00000001	0.00000001
10	Yes	4	0.00000001	0.00000001
11	Yes	4	0.00000001	0.00000001
12	Yes	4	0.00000001	0.00000001
13	Yes	4	0.00000001	0.00000001
14	Yes	4	0.00000001	0.00000001
15	Yes	4	0.00000001	0.00000001
16	Yes	4	0.00000001	0.00000001
17	Yes	4	0.00000001	0.00000001
18	Yes	4	0.00000001	0.00000001
19	Yes	4	0.00000001	0.00000001
20	Yes	4	0.00000001	0.00000001
21	Yes	4	0.00000001	0.00000001
22	Yes	4	0.00000001	0.00000001
23	Yes	4	0.00000001	0.00000001
24	Yes	4	0.00000001	0.00000001
25	Yes	4	0.00000001	0.00000001
26	Yes	4	0.00000001	0.00000001
27	Yes	4	0.00000001	0.00000001
28	Yes	4	0.00000001	0.00000001
29	Yes	4	0.00000001	0.00000001
30	Yes	4	0.00000001	0.00000001
31	Yes	4	0.00000001	0.00000001
32	Yes	4	0.00000001	0.00000001
33	Yes	4	0.00000001	0.00000001
34	Yes	4	0.00000001	0.00000001
35	Yes	4	0.00000001	0.00000001
36	Yes	4	0.00000001	0.00000001
37	Yes	4	0.00000001	0.00000001
38	Yes	4	0.00000001	0.00000001
39	Yes	4	0.00000001	0.00000001

40	Yes	4	0.00000001	0.00000001
41	Yes	4	0.00000001	0.00000001
42	Yes	4	0.00000001	0.00000001
43	Yes	4	0.00000001	0.00000001
44	Yes	4	0.00000001	0.00000001
45	Yes	4	0.00000001	0.00000001
46	Yes	4	0.00000001	0.00000001
47	Yes	4	0.00000001	0.00000001
48	Yes	4	0.00000001	0.00000001
49	Yes	4	0.00000001	0.00000001
50	Yes	4	0.00000001	0.00000001

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	100 - 80	1.028	49	0.0821	0.0046
T2	80 - 60	0.672	49	0.0785	0.0097
T3	60 - 40	0.359	49	0.0603	0.0112
T4	40 - 20	0.146	49	0.0344	0.0083
T5	20 - 0	0.039	49	0.0151	0.0044

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
100.00	8' x 3" Dia Omni	49	1.028	0.0821	0.0046	448029
98.00	Pirod 12' T-Frame Sector Mount (1)	49	0.991	0.0820	0.0051	448029
88.50	P1000 Unistrut (9' Long)	49	0.821	0.0813	0.0073	194795
88.25	P1000 Unistrut (9' Long)	49	0.816	0.0813	0.0074	190651
88.00	12' Frame	49	0.812	0.0812	0.0075	186679
86.00	DC6-48-60-18-8F Surge Arrestor	49	0.777	0.0808	0.0081	160010
84.00	4 FT DISH	49	0.741	0.0802	0.0087	139982
78.50	P1000 Unistrut (9' Long)	49	0.646	0.0777	0.0101	100359
70.00	4 FT DISH	49	0.506	0.0711	0.0112	61505

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	100 - 80	2.982	16	0.2387	0.0344
T2	80 - 60	1.947	16	0.2280	0.0476
T3	60 - 40	1.039	16	0.1750	0.0448
T4	40 - 20	0.423	16	0.0995	0.0310
T5	20 - 0	0.113	16	0.0435	0.0159

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
100.00	8' x 3" Dia Omni	16	2.982	0.2387	0.0344	164554
98.00	Pirod 12' T-Frame Sector Mount (1)	16	2.877	0.2385	0.0361	164554
88.50	P1000 Unistrut (9' Long)	16	2.380	0.2361	0.0434	71545
88.25	P1000 Unistrut (9' Long)	16	2.367	0.2360	0.0435	70023
88.00	12' Frame	16	2.354	0.2359	0.0437	68564
86.00	DC6-48-60-18-8F Surge Arrestor	16	2.251	0.2345	0.0449	58769
84.00	4 FT DISH	16	2.149	0.2328	0.0460	51406
78.50	P1000 Unistrut (9' Long)	16	1.872	0.2256	0.0480	35842
70.00	4 FT DISH	16	1.465	0.2068	0.0483	21567

Bolt Design Data

Section No.	Elevation ft	Component Type	Bolt Grade	Bolt Size in	Number Of Bolts	Maximum Load per Bolt K	Allowable Load K	Ratio Load / Allowable	Allowable Ratio	Criteria
T1	100	Leg	A325N	0.7500	4	0.89	19.44	0.046 ✔	1.333	Bolt Tension
		Diagonal	A325N	0.6250	3	1.68	6.44	0.260 ✔	1.333	Bolt Shear
		Horizontal	A325N	0.6250	2	1.40	6.44	0.217 ✔	1.333	Bolt Shear
		Top Girt	A325N	0.6250	2	0.41	6.44	0.064 ✔	1.333	Bolt Shear
T2	80	Leg	A325N	0.8750	4	5.24	26.46	0.198 ✔	1.333	Bolt Tension
		Diagonal	A325N	0.6250	3	1.49	6.44	0.231 ✔	1.333	Bolt Shear
		Horizontal	A325N	0.6250	2	1.35	6.44	0.210 ✔	1.333	Bolt Shear
T3	60	Leg	A325N	0.8750	4	9.43	26.46	0.356 ✔	1.333	Bolt Tension
		Diagonal	A325N	0.6250	3	1.52	6.44	0.235 ✔	1.333	Bolt Shear
		Horizontal	A325N	0.6250	2	1.54	6.44	0.239 ✔	1.333	Bolt Shear
T4	40	Leg	A325N	1.0000	4	12.48	34.56	0.361 ✔	1.333	Bolt Tension
		Diagonal	A325N	0.6250	3	1.86	6.44	0.289 ✔	1.333	Bolt Shear
		Horizontal	A325N	0.6250	2	1.63	6.44	0.254 ✔	1.333	Bolt Shear
T5	20	Leg	A354-BC	1.0000	4	15.64	32.40	0.483 ✔	1.333	Bolt Tension
		Diagonal	A325N	0.6250	3	1.86	6.44	0.289 ✔	1.333	Bolt Shear
		Horizontal	A325N	0.6250	2	1.81	6.44	0.280 ✔	1.333	Bolt Shear

Compression Checks

Leg Design Data (Compression)

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 $\frac{P}{P_a}$
T1	100 - 80	ROHN 2.5 STD	20.00	6.67	84.4 K=1.00	18.110	1.7040	-7.13	30.86	0.231 ✔
T2	80 - 60	ROHN 3 STD	20.03	6.68	68.9 K=1.00	21.146	2.2285	-25.24	47.12	0.536 ✔
T3	60 - 40	ROHN 3.5 STD	20.03	6.68	60.0 K=1.00	22.726	2.6795	-42.49	60.89	0.698 ✔
T4	40 - 20	ROHN 4 EH	20.05	10.02	81.4 K=1.00	18.721	4.4074	-55.83	82.51	0.677 ✔
T5	20 - 0	ROHN 5 X-STR	20.05	10.03	65.4 K=1.00	21.771	6.1120	-70.68	133.06	0.531 ✔

Diagonal Design Data (Compression)

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 $\frac{P}{P_a}$
T1	100 - 80	ROHN 2 STD	7.92	7.70	117.3 K=1.00	10.850	1.0745	-5.03	11.66	0.431 ✔
T2	80 - 60	ROHN 2 STD	8.51	8.28	126.2 K=1.00	9.373	1.0745	-4.38	10.07	0.434 ✔
T3	60 - 40	ROHN 2 STD	9.18	8.94	136.3 K=1.00	8.038	1.0745	-4.55	8.64	0.526 ✔
T4	40 - 20	ROHN 2.5 STD	12.49	12.18	154.3 K=1.00	6.275	1.7040	-5.58	10.69	0.522 ✔
T5	20 - 0	ROHN 2.5 STD	13.28	12.93	163.7 K=1.00	5.571	1.7040	-5.59	9.49	0.589 ✔

Horizontal Design Data (Compression)

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 $\frac{P}{P_a}$
T1	100 - 80	ROHN 1.5 STD	8.53	4.14	79.9 K=1.00	19.038	0.7995	-2.74	15.22	0.180 ✔
T2	80 - 60	ROHN 1.5 STD	9.90	4.81	92.6 K=1.00	16.368	0.7995	-2.68	13.09	0.205 ✔
T3	60 - 40	ROHN 2 STD	11.94	5.81	88.5 K=1.00	17.257	1.0745	-3.03	18.54	0.164 ✔
T4	40 - 20	ROHN 2 STD	13.79	6.71	102.3 K=1.00	14.176	1.0745	-3.24	15.23	0.213 ✔
T5	20 - 0	ROHN 2 STD	16.21	7.87	120.0 K=1.00	10.367	1.0745	-3.51	11.14	0.315 ✔

Top Girt Design Data (Compression)

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 $\frac{P}{P_a}$
T1	100 - 80	ROHN 1.5 STD	8.50	4.13	79.6 K=1.00	19.091	0.7995	-0.82	15.26	0.054 ✔

Inner Bracing Design Data (Compression)

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 $\frac{P}{P_a}$
T1	100 - 80	L2x2x1/8	4.25	4.25	128.3 K=1.00	9.074	0.4844	-0.01	4.39	0.003 ✔
T2	80 - 60	L2x2x1/8	4.95	4.95	149.5 K=1.00	6.685	0.4844	-0.00	3.24	0.001 ✔
T3	60 - 40	L2x2x1/8	5.97	5.97	180.3 K=1.00	4.595	0.4844	-0.00	2.23	0.002 ✔
T4	40 - 20	L2x2x1/8	6.90	6.90	208.2 K=1.00	3.447	0.4844	-0.01	1.67	0.003 ✔
T5	20 - 0	L2 1/2x2 1/2x3/16	8.10	8.10	196.5 K=1.00	3.869	0.9020	-0.01	3.49	0.002 ✔

Tension Checks

Leg Design Data (Tension)

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 $\frac{P}{P_a}$
T1	100 - 80	ROHN 2.5 STD	20.00	6.67	84.4	30.000	1.7040	3.56	51.12	0.070 ✔
T2	80 - 60	ROHN 3 STD	20.03	6.68	68.9	30.000	2.2285	20.97	66.85	0.314 ✔
T3	60 - 40	ROHN 3.5 STD	20.03	6.68	60.0	30.000	2.6795	37.72	80.39	0.469 ✔
T4	40 - 20	ROHN 4 EH	20.05	10.02	81.4	30.000	4.4074	49.93	132.22	0.378 ✔
T5	20 - 0	ROHN 5 X-STR	20.05	10.03	65.4	30.000	6.1120	62.58	183.36	0.341 ✔

Diagonal Design Data (Tension)

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 $\frac{P}{P_a}$

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 $\frac{P}{P_a}$
T1	100 - 80	ROHN 2 STD	7.92	7.70	117.3	30.000	1.0745	4.97	32.24	0.154 ✔
T2	80 - 60	ROHN 2 STD	8.11	7.87	120.0	30.000	1.0745	4.40	32.24	0.136 ✔
T3	60 - 40	ROHN 2 STD	9.18	8.94	136.3	30.000	1.0745	4.39	32.24	0.136 ✔
T4	40 - 20	ROHN 2.5 STD	12.49	12.18	154.3	30.000	1.7040	5.37	51.12	0.105 ✔
T5	20 - 0	ROHN 2.5 STD	13.28	12.93	163.7	30.000	1.7040	5.32	51.12	0.104 ✔

Horizontal Design Data (Tension)

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 $\frac{P}{P_a}$
T1	100 - 80	ROHN 1.5 STD	8.53	4.14	79.9	30.000	0.7995	2.80	23.98	0.117 ✔
T2	80 - 60	ROHN 1.5 STD	9.90	4.81	92.6	30.000	0.7995	2.70	23.98	0.113 ✔
T3	60 - 40	ROHN 2 STD	11.94	5.81	88.5	30.000	1.0745	3.08	32.24	0.096 ✔
T4	40 - 20	ROHN 2 STD	13.79	6.71	102.3	30.000	1.0745	3.27	32.24	0.101 ✔
T5	20 - 0	ROHN 2 STD	16.21	7.87	120.0	30.000	1.0745	3.61	32.24	0.112 ✔

Top Girt Design Data (Tension)

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 $\frac{P}{P_a}$
T1	100 - 80	ROHN 1.5 STD	8.50	4.13	79.6	30.000	0.7995	0.82	23.98	0.034 ✔

Inner Bracing Design Data (Tension)

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 $\frac{P}{P_a}$
T1	100 - 80	L2x2x1/8	4.25	4.25	81.4	21.600	0.4844	0.01	10.46	0.001 ✔
T2	80 - 60	L2x2x1/8	4.27	4.27	81.8	21.600	0.4844	0.00	10.46	0.000 ✔

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 $\frac{P}{P_a}$
T3	60 - 40	L2x2x1/8	5.29	5.29	101.4	21.600	0.4844	0.00	10.46	0.000 ✔
T4	40 - 20	L2x2x1/8	6.31	6.31	121.0	21.600	0.4844	0.00	10.46	0.000 ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
T1	100 - 80	Leg	ROHN 2.5 STD	2	-7.13	41.14	17.3	Pass
T2	80 - 60	Leg	ROHN 3 STD	41	-25.24	62.81	40.2	Pass
T3	60 - 40	Leg	ROHN 3.5 STD	81	-42.49	81.17	52.3	Pass
T4	40 - 20	Leg	ROHN 4 EH	118	-55.83	109.99	50.8	Pass
T5	20 - 0	Leg	ROHN 5 X-STR	145	-70.68	177.37	39.8	Pass
T1	100 - 80	Diagonal	ROHN 2 STD	11	-5.03	15.54	32.4	Pass
T2	80 - 60	Diagonal	ROHN 2 STD	47	-4.38	13.43	32.6	Pass
T3	60 - 40	Diagonal	ROHN 2 STD	84	-4.55	11.51	39.5	Pass
T4	40 - 20	Diagonal	ROHN 2.5 STD	123	-5.58	14.25	39.2	Pass
T5	20 - 0	Diagonal	ROHN 2.5 STD	150	-5.59	12.65	44.2	Pass
T1	100 - 80	Horizontal	ROHN 1.5 STD	10	-2.74	20.29	13.5 16.3 (b)	Pass
T2	80 - 60	Horizontal	ROHN 1.5 STD	46	-2.68	17.44	15.4 15.7 (b)	Pass
T3	60 - 40	Horizontal	ROHN 2 STD	82	-3.03	24.72	12.3 17.9 (b)	Pass
T4	40 - 20	Horizontal	ROHN 2 STD	121	-3.24	20.31	16.0 19.0 (b)	Pass
T5	20 - 0	Horizontal	ROHN 2 STD	148	-3.51	14.85	23.6	Pass
T1	100 - 80	Top Girt	ROHN 1.5 STD	5	-0.82	20.34	4.0 4.8 (b)	Pass
T1	100 - 80	Inner Bracing	L2x2x1/8	37	-0.01	5.86	0.2	Pass
T2	80 - 60	Inner Bracing	L2x2x1/8	53	-0.00	4.32	0.2	Pass
T3	60 - 40	Inner Bracing	L2x2x1/8	91	-0.00	2.97	0.2	Pass
T4	40 - 20	Inner Bracing	L2x2x1/8	131	-0.01	2.23	0.3	Pass
T5	20 - 0	Inner Bracing	L2 1/2x2 1/2x3/16	157	-0.01	4.65	0.2	Pass
							Summary	
						Leg (T3)	52.3	Pass
						Diagonal (T5)	44.2	Pass
						Horizontal (T5)	23.6	Pass
						Top Girt (T1)	4.8	Pass
						Inner Bracing (T4)	0.3	Pass
						Bolt Checks	36.2	Pass
						RATING =	**52.3**	**Pass**

CENTEK engineering
Centered on Solutions
63-2 North Branford Road
Branford, CT 06405
www.centekeng.com
P: (203) 488-0580
F: (203) 488-8587

Subject:	FOUNDATION ANALYSIS
Location:	Greenwich, CT
Rev. 1: 2/3/15	Prepared by: T.J.L. Checked by: C.F.C. Job No. 15001.004

Mat Foundation Analysis:

Input Data:

Tower Data

Overturning Moment =	$OM := 1108 \cdot ft \cdot kips$	(User Input from tnxTower)	
Shear Force =	$S_t := 18 \cdot kip$	(User Input from tnxTower)	
Axial Force =	$WT_t := 14 \cdot kip$	(User Input from tnxTower)	
Max Compression Force =	$C_t := 77 \cdot kip$	(User Input from tnxTower)	
Max Uplift Force =	$U_t := 68 \cdot kip$	(User Input from tnxTower)	
Tower Height =	$H_t := 100 \cdot ft$	(User Input)	
Tower Width =	$W_t := 17.45 \cdot ft$	(User Input)	
Tower Position on Foundation (1=offset, 2=centered) =	$Pos_t := 2$	(User Input)	

Footing Data:

Overall Depth of Footing =	$D_f := 6.5 \cdot ft$	(User Input)	
Thickness of Footing =	$T_f := 4 \cdot ft$	(User Input)	
Width of Footing =	$W_f := 24 \cdot ft$	(User Input)	
Length of Pier =	$L_p := 3 \cdot ft$	(User Input)	
Extension of Pier Above Grade =	$L_{pag} := 0.5 \cdot ft$	(User Input)	
Diameter of Pier =	$d_p := 3 \cdot ft$	(User Input)	

Material Properties:

Concrete Compressive Strength =	$f_c := 3000 \cdot psi$	(User Input)	
Steel Reinforcment Yield Strength =	$f_y := 60000 \cdot psi$	(User Input)	
Internal Friction Angle of Soil =	$\Phi_s := 0 \cdot deg$	(User Input)	
Allowable Soil Bearing Capacity =	$q_s := 6000 \cdot psf$	(User Input)	
Unit Weight of Soil =	$\gamma_{soil} := 100 \cdot pcf$	(User Input)	
Unit Weight of Concrete =	$\gamma_{conc} := 150 \cdot pcf$	(User Input)	
Foundation Bouyancy =	$Bouyancy := 0$	(User Input)	(Yes=1 / No=0)
Depth to Neglect =	$n := 0 \cdot ft$	(User Input)	
Cohesion of Clay Type Soil =	$c := 0 \cdot ksf$	(User Input)	(Use 0 for Sandy Soil)
Seismic Zone Factor =	$Z := 2$	(User Input)	(UBC-1997 Fig 23-2)
Coefficient of Friction Between Concrete =	$\mu := 0.45$	(User Input)	

Pier Reinforcement:

Bar Size =	$BS_{pier} := 8$	(User Input)	
Bar Diameter =	$d_{bpier} := 1.0 \cdot in$	(User Input)	
Number of Bars =	$NB_{pier} := 12$	(User Input)	
Clear Cover of Reinforcement =	$Cvr_{pier} := 3.0 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Diameter of Tie =	$d_{Tie} := 3 \cdot in$	(User Input)	

Pad Reinforcement:

Bar Size =	$BS_{top} := 7$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 0.875 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 25$	(User Input)	(Top of Pad)
Bar Size =	$BS_{bot} := 7$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{bbot} := 0.875 \cdot in$	(User Input)	(Bottom of Pad)
Number of Bars =	$NB_{bot} := 25$	(User Input)	(Bottom of Pad)
Clear Cover of Reinforcement =	$Cvr_{pad} := 3.0 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)

Calculated Factors:

Pier Reinforcement Bar Area =

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

Pad Top Reinforcement Bar Area =

$$A_{btop} := \frac{\pi \cdot d_{btop}^2}{4} = 0.601 \cdot in^2$$

Pad Bottom Reinforcement Bar Area =

$$A_{bbot} := \frac{\pi \cdot d_{bbot}^2}{4} = 0.601 \cdot in^2$$

Coefficient of Lateral Soil Pressure =

$$K_p := \frac{1 + \sin(\Phi_s)}{1 - \sin(\Phi_s)} = 1$$

Load Factor =

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

Stability of Footing:

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

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

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

$P_{pt} := K_p\cdot\gamma_s\cdot(D_f - T_f) + c\cdot 2\cdot\sqrt{K_p} = 0.25\cdot ksf$

$P_{top} := if[n < (D_f - T_f), P_{pt}, P_{pn}] = 0.25\cdot ksf$

$P_{bot} := K_p\cdot\gamma_s\cdot D_f + c\cdot 2\cdot\sqrt{K_p} = 0.65\cdot ksf$

$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 0.45\cdot ksf$

$T_p := if[n < (D_f - T_f), T_f, (D_f - n)] = 4$

$A_p := W_f\cdot T_p = 96$

Ultimate Shear = $S_u := P_{ave}\cdot A_p = 43.2\cdot kip$

Weight of Concrete Pad Above Water Table = $WT_{pad.AWT} := \left(W_f^2\cdot 1.5\cdot ft\right)\cdot\gamma_c = 129.6\cdot kip$

Weight of Concrete Pad Below Water Table = $WT_{pad.BWT} := \left(W_f^2\cdot 2.5\cdot ft\right)\cdot(\gamma_c - 62.4pcf) = 126.144\cdot kip$ (Water Table @ 4-ft Below Grade)

Weight of Concrete Piers = $WT_{pier} := 3\cdot\left[\left(L_p\cdot\frac{d_p^2\cdot\pi}{4}\right)\cdot\gamma_c\right] = 9.543\cdot kip$

Total Weight of Concrete = $WT_c := WT_{pad.AWT} + WT_{pad.BWT} + WT_{pier} = 265\cdot kip$

Weight of Soil Above Footing = $WT_{s1} := \left(W_f^2 - 3\cdot\frac{d_p^2\cdot\pi}{4}\right)\cdot(L_p - L_{pag})\cdot\gamma_s = 139\cdot kip$

Tower Offset = $X_{t1} := \left[\frac{W_f}{2} - \frac{(W_t\cdot\cos(30\cdot deg))}{2}\right]$ $X_{t2} := \frac{W_f}{2} - \frac{(W_t\cdot\cos(30\cdot deg))}{3}$

$X_t := if(Pos_t, X_{t1}, X_{t2}) = 4.444$

$X_{off} := \frac{W_f}{2} - \left[\frac{(W_t\cdot\cos(30\cdot deg))}{3} + X_t\right] = 2.519$

Resisting Moment = $M_r := (WT_c + WT_{s1} + WT_t)\cdot\frac{W_f}{2} + S_u\cdot\frac{T_f}{3} = 5073\cdot kip\cdot ft$

Overturning Moment = $M_{ot} := OM + S_t\cdot(L_p + T_f) = 1234\cdot kip\cdot ft$

Factor of Safety Actual = $FS := \frac{M_r}{M_{ot}} = 4.11$

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

$OverTurning\_Moment\_Check := if(FS \geq FS_{req}, "Okay", "No Good")$

$OverTurning\_Moment\_Check = "Okay"$

Bearing Pressure Caused by Footing:

Total Load = $Load_{tot} := WT_c + WT_{s1} + WT_t = 418 \cdot kip$

Area of the Mat = $A_{mat} := W_f^2 = 576$

Section Modulus of Mat = $S := \frac{W_f^3}{6} = 2304 \cdot ft^3$

Maximum Pressure in Mat = $P_{max} := \frac{Load_{tot}}{A_{mat}} + \frac{M_{ot}}{S} = 1.261 \cdot ksf$

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

Max_Pressure_Check = "Okay"

Minimum Pressure in Mat = $P_{min} := \frac{Load_{tot}}{A_{mat}} - \frac{M_{ot}}{S} = 0.19 \cdot ksf$

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

Min_Pressure_Check = "Okay"

Distance to Resultant of Pressure Distribution = $X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 9.42$

Distance to Kern = $X_k := \frac{W_f}{6} = 4$

Eccentricity = $e := \frac{M_{ot}}{Load_{tot}} = 2.952$

Adjusted Soil Pressure = $P_a := \frac{2 \cdot Load_{tot}}{3 \cdot W_f \left(\frac{W_f}{2} - e\right)} = 1.283 \cdot ksf$

$q_{adj} := if(P_{min} < 0, P_a, P_{max}) = 1.261 \cdot ksf$

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

Pressure_Check = "Okay"

Concrete Bearing Capacity:

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

Bearing Strength Between Pier and Pad = $P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot \frac{\pi \cdot d_p^2}{4} = 1.687 \times 10^3 \cdot kips$ (ACI-2008 10.14)

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

Bearing_Check = "Okay"

Shear Strength of Concrete:

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

$\phi_c := 0.85$ (ACI 9.3.2.5)

$d := T_f - Cvr_{pad} - d_{bbot} = 44.125 \cdot in$

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

$d_2 := d_1 - d$

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

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

$V_{req} := LF \cdot \left[\left(q_{adj} - Slope \cdot d_1\right) + \left(\frac{Slope \cdot d_1}{2}\right)\right] \cdot W_f \cdot d_1 = 344.965 \cdot kip$

$V_{Avail} := \phi_c \cdot 2 \cdot \sqrt{f_c \cdot psi} \cdot W_f \cdot d = 1183 \cdot kip$ (ACI-2008 11.2.1.1)

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

Beam_Shear_Check = "Okay"

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

Critical Perimeter of Punching Shear = $b_o := \left(d_p + d\right) \cdot \pi = 21$

Area Included Inside Perimeter = $A_{bo} := \frac{\pi \cdot \left(d_p + d\right)^2}{4} = 35$

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 541$

Guess Value = $v_u := 1ksf$

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

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

$v_u := Find\left(v_u\right) = 5.4 \times 10^3 lbf$

$V_u := v_u \cdot d \cdot W_f = 478.2 \cdot kips$

Required Shear Strength =

$V_{req} := LF \cdot V_u = 637.5 \cdot kips$

Available Shear Strength =

$V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 2068.4 \cdot kip$ (ACI-2008 11.11.2.1)

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

$Punching\_Shear\_Check = "Okay"$

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

Strength Reduction Factor =

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

$M_{max} := 662 \cdot kip \cdot ft$

Design Moment =

$$M_n := \frac{LF \cdot M_{max}}{\phi_m} = 980.496 \cdot kip \cdot ft$$

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

(ACI-200810.2.7.3)

$b_{eff} := W_t \cdot \cos(30 \cdot deg) + d_p = 217.346 \cdot in$

$d := T_f - Cvr_{pad} - d_{bbot} = 44.125 \cdot in$

$$A_s := \frac{M_n}{(f_y \cdot d)} = 4.444 \cdot in^2$$

$$a := \frac{A_s \cdot f_y}{\beta \cdot f_c \cdot b_{eff}} = 0.481 \cdot in$$

$$A_s := \frac{M_n}{f_y \cdot \left(d - \frac{a}{2}\right)} = 4.469 \cdot in^2$$

$$\rho := \frac{A_s}{b_{eff} d} = 0.00047$$

Required Reinforcement for Temperature and Shrinkage:

$$\rho_{sh} := \begin{cases} .0018 & \text{if } f_y \geq 60000 \cdot psi \\ .0020 & \text{otherwise} \end{cases} = 0.0018 \qquad \text{(ACI -2008 7.12.2.1)}$$

Check Bottom Bars:

$$As := \begin{cases} \left(\rho \cdot b_{eff} \cdot d\right) & \text{if } \left(\rho \cdot b_{eff} \cdot d\right) > \rho_{sh} \cdot \frac{b_{eff}}{2} \cdot d \\ \rho_{sh} \cdot \frac{b_{eff}}{2} \cdot d & \text{otherwise} \end{cases} = 8.631 \cdot in^2$$

$$As_{prov} := A_{bbot} \cdot NB_{bot} = 15 \cdot in^2$$

$$Pad\_Reinforcement\_Bot := if\left(As_{prov} > As, "Okay", "No\ Good"\right)$$

Pad_Reinforcement_Bot = "Okay"

Check top Bars:

$$As := if\left(\rho \geq \rho_{sh}, A_s, \rho_{sh} \cdot \frac{b_{eff}}{2} \cdot d\right) = 8.6 \cdot in^2$$

$$As_{prov} := A_{btop} \cdot NB_{top} = 15 \cdot in^2$$

$$Pad\_Reinforcement\_Top := if\left(As_{prov} > As, "Okay", "No\ Good"\right)$$

Pad_Reinforcement_Top = "Okay"

Developement Length Pad Reinforcement:

Bar Spacing =

$$B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 10.84 \cdot in$$

Spacing or Cover Dimension =

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

Transverse Reinforcement Index =

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

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

Minimum Development Length =

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

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

Available Length in Pad =

$$L_{Pad} := \frac{W_f}{2} - \frac{W_t}{2} - Cvr_{pad} = 36.3 \cdot in$$

$$Lpad\_Check := if\left(L_{Pad} > L_{dbt}, "Okay", "No\ Good"\right)$$

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

Area of Pier = $A_p := \frac{\pi \cdot d_p^2}{4} = 1017.88 \cdot in^2$

$A_{smin} := 0.01 \cdot 0.5 \cdot A_p = 5.09 \cdot in^2$ (ACI-2008 10.8.4 & 10.9.1)

$A_{sprov} := NB_{pier} \cdot A_{bpier} = 9.42 \cdot in^2$

$Steel\_Area\_Check := if(A_{sprov} > A_{smin}, "Okay", "No Good")$

Steel_Area_Check = "Okay"

Bar Spacing In Pier = $B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 8.425 \cdot in$

Diameter of Reinforcement Cage = $Diam_{cage} := d_p - 2 \cdot Cvr_{pier} = 30 \cdot in$

Maximum Moment in Pier = $M_p := \left[S_t \cdot \left(L_p + \frac{A_{BP}}{2}\right)\right] \cdot LF = 1007.7 \cdot in \cdot kips$

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

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

$(D\ N\ n\ P_u\ M_{xu}) = (36\ \ 12\ \ 8\ \ 102.6\ \ 1007.7)$

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

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

$(\phi P_n\ \ \phi M_{xn}\ \ f_{sp}\ \ \rho) = (1002.3\ \ 9840.8\ \ -58.1\ \ 0)$

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

Axial_Load_Check = "Okay"

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

Bending_Check = "Okay"

Development Length Pier Reinforcement:

Available Length in Foundation:

$L_{pier} := L_p - Cvr_{pier} = 33 \cdot in$

$L_{pad} := T_f - Cvr_{pad} = 45 \cdot in$

Tension: (ACI-2008 12.2.3)

Spacing or Cover Dimension =

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

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

$L_{dbt} := \frac{3 \cdot f_y \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 27.39 \cdot in$

Minimum Development Length = $L_{dh} := \frac{1200 \cdot d_{bpier}}{\sqrt{\frac{f_c}{psi}}} \cdot .7 = 15.336 \cdot in$ (ACI 12.2.1)

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

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

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

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

Compression: (ACI-2008 12.3.2)

$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot f_y}{\sqrt{f_c \cdot psi}} = 21.909 \cdot in$

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

$L_{dbc} := if\left(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}\right) = 21.909 \cdot in$

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

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

Tie Size and Spacing in Column:

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

Used #3 Ties

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

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

$s_{lim2} := \frac{48 \cdot d_{Tie}}{8} \cdot z = 18 \cdot in$

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

$s_{lim4} := 18in$

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

Number of Ties Required = $n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 = 2.875$

Check Anchor Steel Embedment:

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

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

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

Depth_Check = "No Good"

Note: Anchor plate is provided

SITE NAME	BRUCES CT	ECP - CELL #	5	121
LATITUDE	41-04-27.34 N	LONGITUDE	73-41-50.46 W	
NOTE: Please Order Appropriate RET Cables. Replace existing antennas with RET capable models. Adjust azimuths and antenna tilts as needed. Lease for 700 Diplexers and PCS 60W RRH's for future LTE use.		SAVE BUTTON	0009	
		STRUCTURE TYPE	SELF-SUPPORT TOWER	

700 LTE - Current Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	ALU 700 MHz TRDU	ALU 700 MHz TRDU	None
ANTENNA TYPE	SLCP 2X6015	SLCP 2X6015	
QTY OF ANTENNAS PER FACE	1	1	
ORIENTATION (DEG)	0	110	
DOWN TILT (ELEC + MECH)	0 Elec + 5 Mech	0 Elec + 8 Mech	
RAD CTR (FT AGL)	98	98	
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	None
ANTENNA TYPE	**Kathrein 800 10734V01**	**Kathrein 800 10734V01**	
QTY OF ANTENNAS PER FACE	1	1	
ORIENTATION (DEG)	**350**	**90**	
DOWN TILT (ELEC + MECH)	**4 Elec + 0 Mech**	**8 Elec + 0 Mech**	
RAD CTR (FT AGL)	98	98	
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL	**2 CBC78-DF**	**2 CBC78-DF**	
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	None
ANTENNA TYPE	BXA-171063-8BF-EDIN-2	BXA-171063-8BF-EDIN-2	
QTY OF ANTENNAS PER FACE	1	1	
ORIENTATION (DEG)	0	110	
DOWN TILT (ELEC + MECH)	0 Elec + 2 Mech	0 Elec + 2 Mech	
RAD CTR (FT AGL)	98	98	
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
DIPLEXER KIT - QTY / MODEL			

1900 PCS - Future Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	**ALU 1900 MHz RRH**	**ALU 1900 MHz RRH**	None
ANTENNA TYPE	**HBXX-6516DS-A2M**	**HBXX-6516DS-A2M**	
QTY OF ANTENNAS PER FACE	1	1	
ORIENTATION (DEG)	0	110	
DOWN TILT (ELEC + MECH)	**0 Elec + 2 Mech**	**0 Elec + 2 Mech**	
RAD CTR (FT AGL)	98	98	
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE			
RRH - QTY/MODEL	**1 ALU RH_2X60-PCS**	**1 ALU RH_2X60-PCS**	
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	None
ANTENNA TYPE	BXA-171063-8BF-EDIN-0	BXA-171063-8BF-EDIN-0	
QTY OF ANTENNAS PER FACE	1	1	
ORIENTATION (DEG)	0	110	
DOWN TILT (ELEC + MECH)	0 Elec + 0 Mech	0 Elec + 0 Mech	
RAD CTR (FT AGL)	98	98	
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL	1 ALU RH_2X40-AWS	1 ALU RH_2X40-AWS	
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX	1		DB-T1-6Z-8AB-0Z

2100 LTE - Future Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	ALU 2100 MHz RRH	ALU 2100 MHz RRH	None
ANTENNA TYPE	**HBXX-6516DS-A2M**	**HBXX-6516DS-A2M**	
QTY OF ANTENNAS PER FACE	1	1	
ORIENTATION (DEG)	**350**	**90**	
DOWN TILT (ELEC + MECH)	**2 Elec + 0 Mech**	**2 Elec + 0 Mech**	
RAD CTR (FT AGL)	98	98	
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL	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	None
ANTENNA TYPE	DB844H90-XY	DB844H90-XY	
QTY OF ANTENNAS PER FACE	2	2	
ORIENTATION (DEG)	30	150	
DOWN TILT (ELEC + MECH)	0	7	
RAD CTR (FT AGL)	98	98	
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
DIPLEXER KIT - QTY / MODEL			

NUMBER OF CABLE'S NEEDED						ESTIMATED CABLE LENGTH			
MAINLINE SIZE	1 5/8"	TOTAL # OF MAINLINES			12	MAINLINE (FT)			
JUMPER SIZE	1/2 "	TOTAL # OF TOP JUMPERS			12	TOP JUMPER (FT)			12
Equipment Cable Ordering		MAIN CABLE #	12	+	0	TOP JUMPER #	12	+	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 - B	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

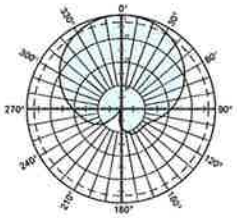
Site Configuration

KATHREIN
SCALA DIVISION

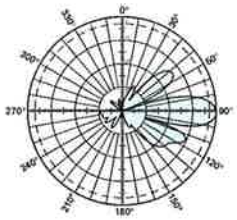
800 10734
700 MHz Single Band 4', 65 Degree Antenna RET

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

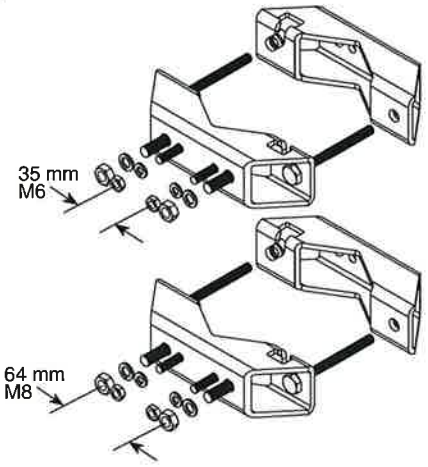
RoHS
Lead-Free
Mar 15, 2011

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

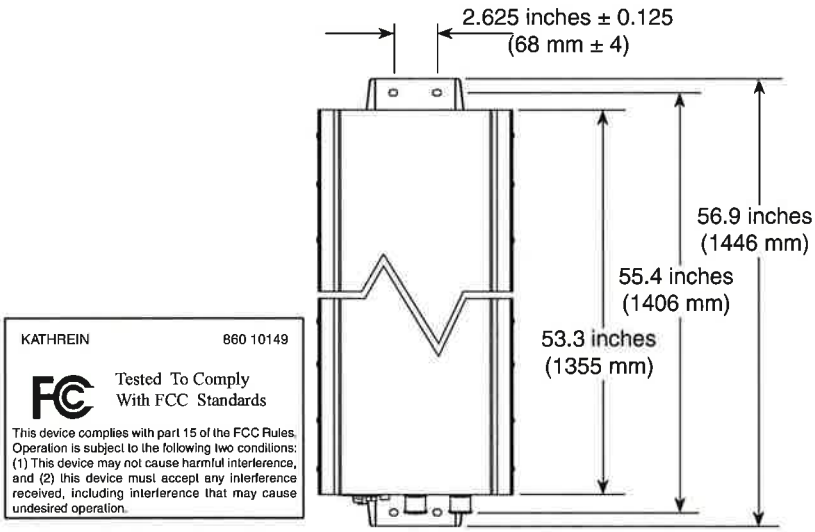


Mounting Brackets
for use with 2-point mount antennas
Mast dia. 2–4.5 inches (50–115 mm)
Weight: 4 lb (1.8 kg)

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 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.

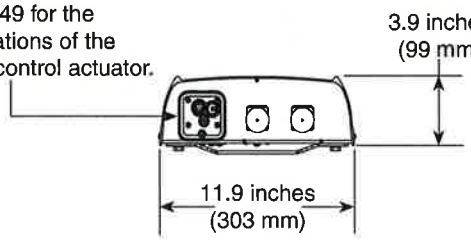


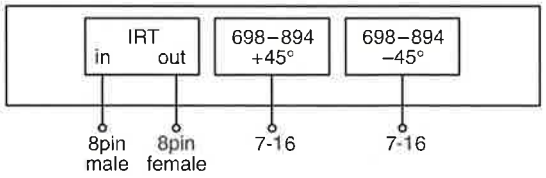
KATHREIN 860 10149

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

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.

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

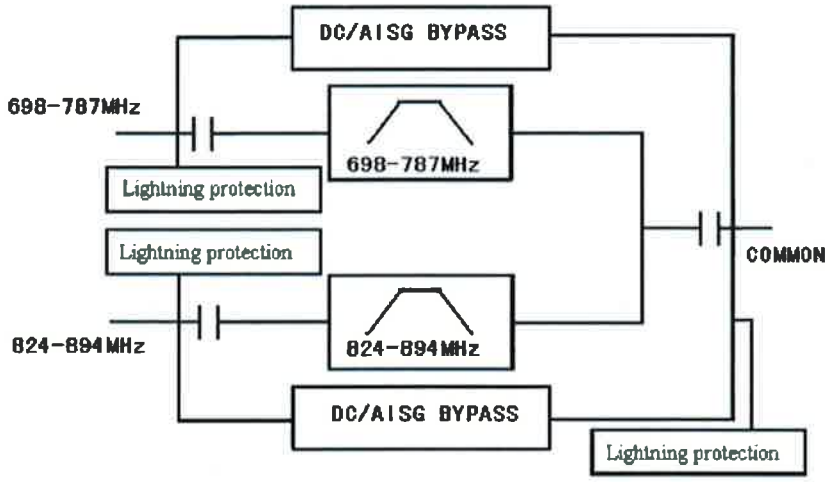
Electrical Specifications (Branch 2)

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