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

April 9, 2015

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

Re: **Notice of Exempt Modification – Facility Modification**
100 Universal Drive, North Haven, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) wireless telecommunications antennas at the top of an existing 80-foot self-supporting lattice tower at 100 Universal Drive in North Haven (the "Property"). The tower and underlying property are owned by CSX Transportation. The Council approved Cellco's use of this tower in 1997. Cellco now intends to modify its facility by replacing nine (9) of its existing antennas with three (3) model LNX-6514DS-VTM, 700 MHz antennas; three (3) model HBXX-6516DS-VTM, 1900 MHz antennas; and three (3) model HBXX-6516DS-VTM, 2100 MHz antennas, all at the same 80-foot level on the tower. Cellco also intends to install three (3) remote radio heads ("RRHs") behind its 1900 MHz antennas and one (1) HYBRIFLEX™ antenna cable. Included in Attachment 1 are specifications for Cellco's replacement antennas, RRHs and HYBRIFLEX™ cable.

Please accept this letter as notification pursuant to R.C.S.A. § 16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is being sent to Michael J. Freda, First Selectman for the Town of North Haven. A copy of this letter is also being sent to CSX Transportation, Inc., the owner of the Property.

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

1. The proposed modifications will not result in an increase in the height of the existing tower. Cellco's replacement antennas and RRHs will be installed on its existing antenna platform at the 80-foot level on the 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 General Power Density table with Cellco's modified facility is included in Attachment 2.

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

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

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

Sincerely,

Kenneth C. Baldwin

Enclosures
Copy to:
Michael J. Freda, North Haven First Selectman
CSX Transportation, Inc.
Tim Parks

ATTACHMENT 1

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

LNX-6514DS-VTM

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

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

Electrical Specifications

Frequency Band, MHz	**698–806**	**806–896**
Gain, dBi	15.8	15.9
Beamwidth, Horizontal, degrees	65	64
Beamwidth, Vertical, degrees	12.4	11.2
Beam Tilt, degrees	0–10	0–10
USLS, dB	17	18
Front-to-Back Ratio at 180°, dB	32	30
CPR at Boresight, dB	23	23
CPR at Sector, dB	12	10
Isolation, dB	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153
Input Power per Port, maximum, watts	400	400
Polarization	±45°	±45°
Impedance	50 ohm	50 ohm

Electrical Specifications, BASTA*

Frequency Band, MHz	**698–806**	**806–896**
Gain by all Beam Tilts, average, dBi	15.6	15.7
Gain by all Beam Tilts Tolerance, dB	±0.4	±0.5
Gain by Beam Tilt, average, dBi	0 ° | 15.7 5 ° | 15.7 10 ° | 15.3	0 ° | 15.9 5 ° | 15.8 10 ° | 15.3
Beamwidth, Horizontal Tolerance, degrees	±0.9	±1.4
Beamwidth, Vertical Tolerance, degrees	±0.8	±0.6
USLS, dB	18	20
Front-to-Back Total Power at 180° ± 30°, dB	25	23
CPR at Boresight, dB	25	24
CPR at Sector, dB	15	12

* 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®
Band	Single band
Brand	DualPol® | Teletilt®

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

LNX-6514DS-VTM

Operating Frequency Band	698 – 896 MHz

Mechanical Specifications

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

Dimensions

Depth	181.0 mm | 7.1 in
Length	1847.0 mm | 72.7 in
Width	301.0 mm | 11.9 in
Net Weight	14.2 kg | 31.3 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 2.0 Actuator	LNX-6514DS-A1M
RET System	Teletilt®

Regulatory Compliance/Certifications

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

Included Products

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

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

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
- The values presented on this datasheet have been calculated based on N-P-BASTA White Paper version 9.6 by the NGMN Alliance

Electrical Specifications

<table>
<tr><th>Frequency Band, MHz</th><th>1710–1880</th><th>1850–1990</th><th>1920–2180</th></tr>
<tr><td>Gain by all Beam Tilts, average, dBi</td><td>17.2</td><td>17.2</td><td>17.5</td></tr>
<tr><td>Gain by all Beam Tilts Tolerance, dB</td><td>±0.3</td><td>±0.3</td><td>±0.5</td></tr>
<tr><td>Gain by Beam Tilt, average, dBi</td><td>0 ° | 17.0
5 ° | 17.3
10 ° | 17.0</td><td>0 ° | 17.1
5 ° | 17.4
10 ° | 17.0</td><td>0 ° | 17.4
5 ° | 17.7
10 ° | 17.2</td></tr>
<tr><td>Beamwidth, Horizontal, degrees</td><td>67</td><td>66</td><td>64</td></tr>
<tr><td>Beamwidth, Horizontal Tolerance, degrees</td><td>±2.7</td><td>±2.3</td><td>±3.5</td></tr>
<tr><td>Beamwidth, Vertical, degrees</td><td>7.5</td><td>7.0</td><td>6.6</td></tr>
<tr><td>Beamwidth, Vertical Tolerance, degrees</td><td>±0.5</td><td>±0.4</td><td>±0.4</td></tr>
<tr><td>Beam Tilt, degrees</td><td>0–10</td><td>0–10</td><td>0–10</td></tr>
<tr><td>USLS, dB</td><td>18</td><td>19</td><td>19</td></tr>
<tr><td>Front-to-Back Total Power at 180° ± 30°, dB</td><td>26</td><td>26</td><td>26</td></tr>
<tr><td>CPR at Boresight, dB</td><td>22</td><td>22</td><td>22</td></tr>
<tr><td>CPR at Sector, dB</td><td>9</td><td>9</td><td>9</td></tr>
<tr><td>Isolation, dB</td><td>30</td><td>30</td><td>30</td></tr>
<tr><td>VSWR | Return Loss, dB</td><td>1.4 | 15.6</td><td>1.4 | 15.6</td><td>1.4 | 15.6</td></tr>
<tr><td>PIM, 3rd Order, 2 x 20 W, dBc</td><td>-153</td><td>-153</td><td>-153</td></tr>
<tr><td>Input Power per Port, maximum, watts</td><td>350</td><td>350</td><td>350</td></tr>
<tr><td>Polarization</td><td>±45°</td><td>±45°</td><td>±45°</td></tr>
<tr><td>Impedance</td><td>50 ohm</td><td>50 ohm</td><td>50 ohm</td></tr>
</table>

General Specifications

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

Mechanical Specifications

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

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
- The values presented on this datasheet have been calculated based on N-P-BASTA White Paper version 9.6 by the NGMN Alliance

Electrical Specifications

Frequency Band, MHz	1710–1880	1850–1990	1920–2180
Gain by all Beam Tilts, average, dBi	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, degrees	67	66	64
Beamwidth, Horizontal Tolerance, degrees	±2.7	±2.3	±3.5
Beamwidth, Vertical, degrees	7.5	7.0	6.6
Beamwidth, Vertical Tolerance, degrees	±0.5	±0.4	±0.4
Beam Tilt, degrees	0–10	0–10	0–10
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
Isolation, dB	30	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153	-153
Input Power per Port, maximum, watts	350	350	350
Polarization	±45°	±45°	±45°
Impedance	50 ohm	50 ohm	50 ohm

General Specifications

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

Mechanical Specifications

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

PCS RF MODULES
RRH1900 2X60 - HW CHARACTERISTICS

LA6.0.1/13.3

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

** Not a Verizon Wireless deployed product

Alcatel·Lucent

NEW PCS RF MODULES FOR VZW
RRH2X60 - HW CHARACTERISTICS

LR14.3

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

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

Product Data Sheet HB158-1-08U8-S8J18

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

Product Description

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

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

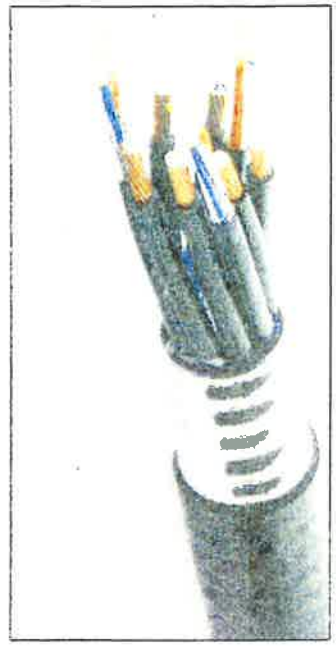


Figure 1: HYBRIFLEX Series

Features/Benefits

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

Technical Specifications

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

* This data is provisional and subject to change

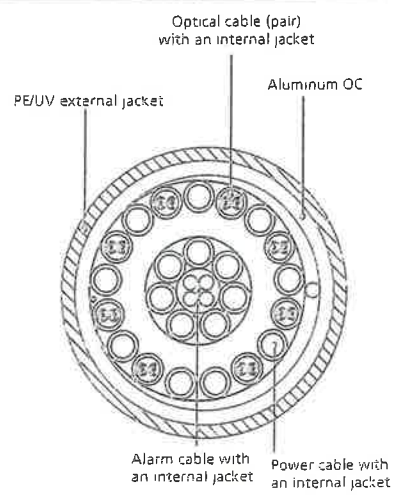


Figure 2: Construction Detail

ATTACHMENT 2

Site Name: ***NORTH HAVEN S CT***
Cumulative Power Density

Operator	Operating Frequency	Number of Trans.	ERP Per Trans.	Total ERP	Distance to Target	Calculated Power Density	Maximum Permissable Exposure*	Fraction of MPE
	(MHz)		(watts)	(watts)	(feet)	(mW/cm^2)	(mW/cm^2)	(%)
VZW 700	746	1	731	731	80	0.0411	0.4973	8.26%
VZW Cellular	869	9	302	2719	80	0.1528	0.5793	26.37%
VZW PCS	1970	1	1542	1542	80	0.0866	1.0000	8.66%
VZW AWS	2145	1	1422	1422	80	0.0799	1.0000	7.99%
Total Percentage of Maximum Permissible Exposure								51.28%

*Guidelines adopted by the FCC on August 1, 1996, 47 CFR Part 1 based on NCRP Report 86, 1986 and generally on ANSI/IEEE C95.1-1992

MHz = Megahertz
mW/cm^2 = milliwatts per square centimeter
ERP = Effective Radiated Power

Absolute worst case maximum values used.

ATTACHMENT 3

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

80' Existing Conrail Lattice Tower

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: North Haven South

100 Universal Drive
North Haven, CT

CENTEK Project No. 15001.028

Date: March 27, 2015

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

Prepared for:

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

Table of Contents

Introduction

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

The host tower is a 80-ft, four legged, tapered steel lattice tower. The manufacturer's drawings and calculations were unavailable for use in this report. The tower geometry, structure member sizes and foundation information were taken from a previous structural analysis report prepared by Centek Engineering; project no. 13075.046 dated October 31, 2013.

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

The existing structure was significantly reinforced by Verizon Wireless for the purpose of utilizing the structure as a communications tower. Reinforcements were prepared by URS Greiner, Inc. AES; project no. F301208.55/F12, dated July 24, 1997.

The tower is made of four (4) tapered vertical sections consisting of built-up structural steel angle legs. Diagonal lateral support bracing consists of structural steel angle shapes connected to the leg sections via single 5/8" ∅ bolts. The built-up steel leg sections are connected by intermittent welds along their length. The width of the tower face is 6.00-ft at the base and 2.88-ft at the top. Since the age, condition and properties of the original steel members is unknown only the steel utilized in the prior reinforcement of the tower conforming to ASTM Grade A36 was considered in this analysis.

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

Antenna and Appurtenance Summary

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

- VERIZON (Existing to be Remain):
  Antennas: Three (3) Antel BXA-80063-4BF panel antennas, three (3) Alcatel-Lucent RRH2x60-AWS Remote Radio Heads and one (1) RFS DB-T1-6Z-8AB-0Z main distribution box mounted on an existing platform with handrails with a RAD center elevation of ±80-ft above the existing tower base.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables and one (1) 1-5/8" ∅ fiber cable running on the face of the existing tower.
- VERIZON (Existing to be Remove):
  Antennas: Three (3) Antel BXA-70063-6CF panel antennas, six (6) RYMSA MG D3-800T0 panel antennas and six (6) RFS FD9R6004/2C-3L Diplexers mounted on an existing platform with handrails with a RAD center elevation of ±80-ft above the existing tower base.

- **VERIZON (Proposed):**
  Antennas: Three (3) Andrew LNX-6514DS panel antennas, six (6) Andrew HBXX-6516DS panel antennas and three (3) Alcatel-Lucent RRH2x60-PCS remote radio heads mounted on an existing platform with handrails with a RAD center elevation of ±80-ft above the existing tower base.

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:	New Haven; v = 85 mph (fastest mile)	*[Section 16 of TIA/EIA-222-F-96]*
	North Haven; v = 110 mph (3 second gust) equivalent to v = 90 mph (fastest mile)	*[Appendix K of the 2005 CT Building Code Supplement]*
	Appendix-K wind speed controls.	
Load Cases:	<u>Load Case 1</u>; 90 mph wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	<u>Load Case 2</u>; 78 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 78 mph wind speed velocity represents 75% of the wind pressure generated by the 90 mph wind speed.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	<u>Load Case 3</u>; Seismic – not checked	*[Section 1614.5 of State Bldg. Code 2005] does not control in the design of this structure type*

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

Tower Capacity

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

- Calculated stresses were found to be within allowable limits. In Load Case 1, per tnxTower "Section Capacity Table", this tower was found to be at **95.3%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Leg (T4)	0'-19.6'	95.3%	**PASS**
Diagonal Bolts (T4)	0'-19.6'	63.9%	**PASS**
Top Girt (T1)	58.7'-77.8'	5.6%	**PASS**

Foundation and Anchors

The existing foundation consists of a 14.5-ft square x 5-ft thick concrete mat bearing directly on the existing sub grade. Allowable soil bearing pressure was assumed to be 3000 psf for the analysis. The tower legs are directly 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	**13 kips**
	Compression	**9 kips**
	Moment	**641 kip-ft**
Leg	Shear	**6 kips**
	Uplift	**74 kips**
	Compression	**75 kips**

- 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	2.05	**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:

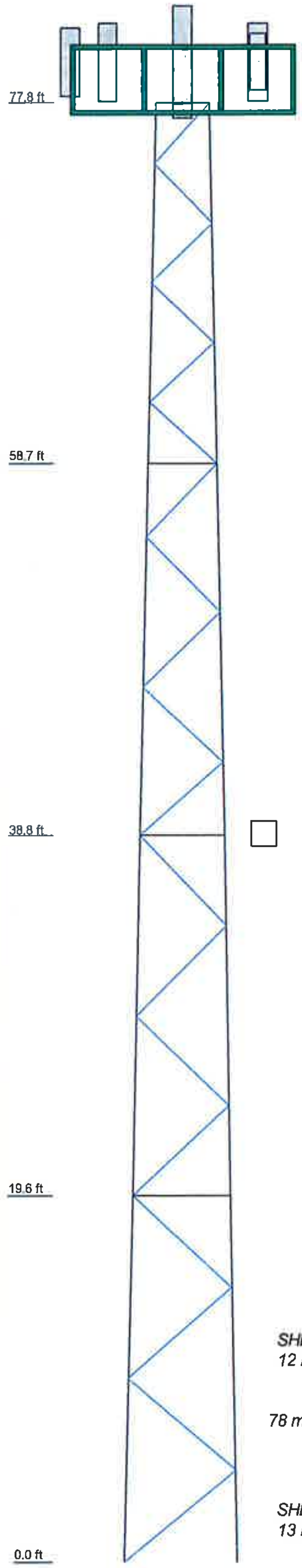
- Information supplied by the client regarding the structure itself, its foundations, the soil conditions, the antenna and feed line loading on the structure and its components, or other relevant information.
- Information from the field and/or drawings in the possession of Centek Engineering, Inc. or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



Section	Legs	Leg Grade	Diagonals	Diagonal Grade	Top Girts	Face Width (ft)	# Panels @ (ft)	Weight (K)
T1	Built Up L4.5x4.5x5/16	A36	L2 1/2x2 1/2x1/4	A36	L2x2x1/4	2.88	6 @ 3.18333	1.2
T2	Built Up L4.5x4.5x5/16	A36	L2 1/2x2 1/2x1/4	A36		3.65	5 @ 3.98	1.2
T3	Built Up L4.5x4.5x7/16	A36	L3x3x1/4	A36		4.44	4 @ 4.8	1.6
T4	Built Up L4.5x4.5x7/16	A36	L3x3x1/4	A36		5.21	4 @ 4.9	1.7
						6		5.6

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
BXA-80063-4BF (Verizon - Existing)	80	LNX-6514DS-VTM (Verizon - Proposed)	80
HBXX-6516DS (Verizon - Proposed)	80	HBXX-6516DS (Verizon - Proposed)	80
LNX-6514DS-VTM (Verizon - Proposed)	80	RRH2x60-PCS (Verizon - Proposed)	80
HBXX-6516DS (Verizon - Proposed)	80	RRH2x60-PCS (Verizon - Proposed)	80
BXA-80063-4BF (Verizon - Existing)	80	RRH2x60-PCS (Verizon - Proposed)	80
HBXX-6516DS (Verizon - Proposed)	80	RRH2x60-AWS (Verizon - Existing)	80
LNX-6514DS-VTM (Verizon - Proposed)	80	RRH2x60-AWS (Verizon - Existing)	80
		RRH2x60-AWS (Verizon - Existing)	80
HBXX-6516DS (Verizon - Proposed)	80	DB-T1-6Z-8AB-0Z (Verizon - Existing)	80
BXA-80063-4BF (Verizon - Existing)	80	Valmont 13' Platform w Rails (Verizon)	79
HBXX-6516DS (Verizon - Proposed)	80		

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A36	36 ksi	58 ksi			

TOWER DESIGN NOTES

1. Tower designed for a 90 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 78 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. Weld together tower sections have flange connections.
5. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
6. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
7. Welds are fabricated with ER-70S-6 electrodes.
8. TOWER RATING: 95.3%

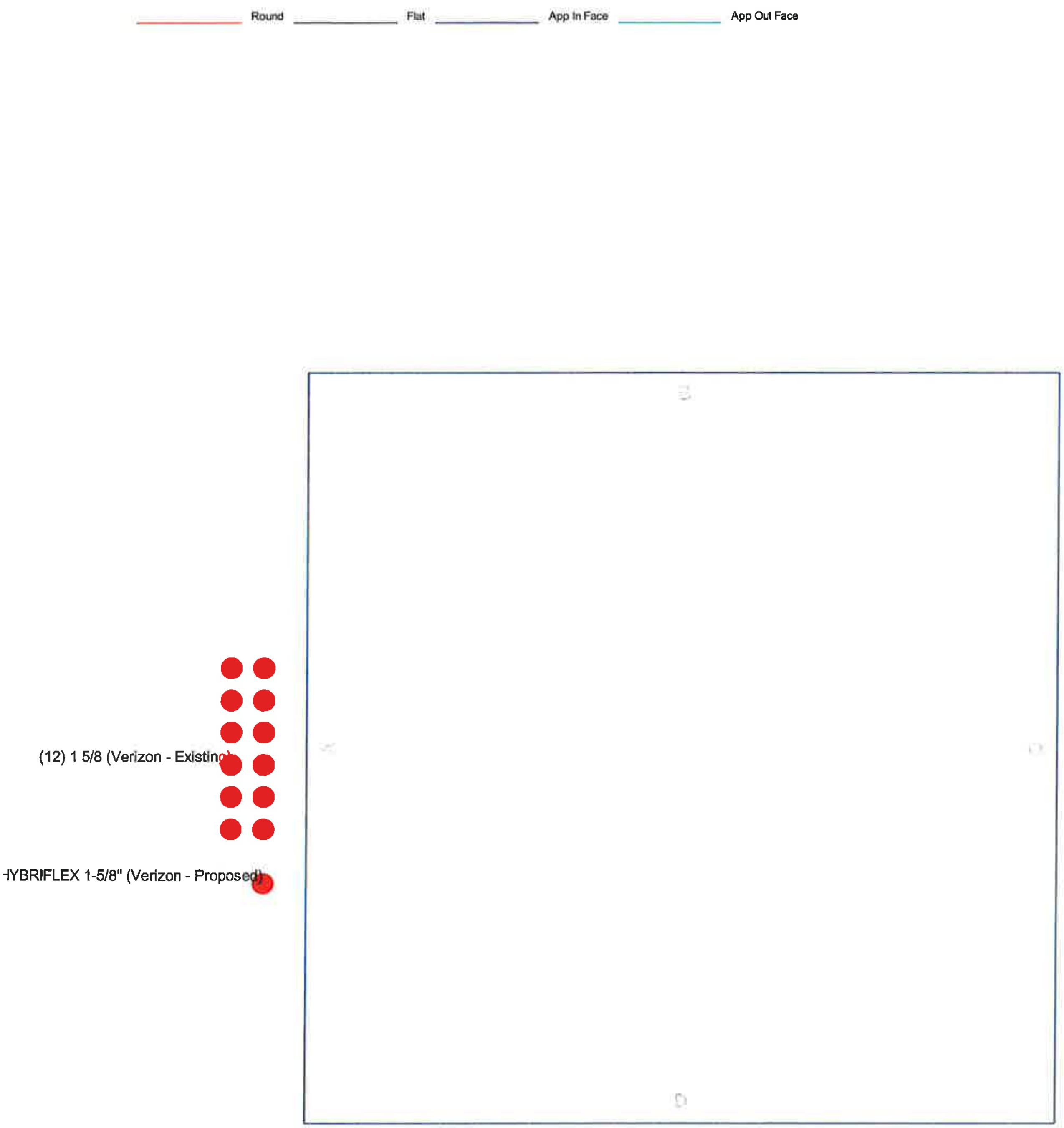
MAX. CORNER REACTIONS AT BASE:
DOWN: 75 K
UPLIFT: -74 K
SHEAR: 6 K

AXIAL 15 K
SHEAR 12 K
MOMENT 625 kip-ft
TORQUE 5 kip-ft
78 mph WIND - 0.5000 in ICE

AXIAL 9 K
SHEAR 13 K
MOMENT 641 kip-ft
TORQUE 6 kip-ft
REACTIONS - 90 mph WIND

Centek Engineering Inc.	Job: 15001.028 - North Haven South		
63-2 North Branford Rd.	Project: 80' Lattice Tower - 100 Universal Dr., North Haven, CT		
Branford, CT 06405	Client: Verizon Wireless	Drawn by: TJL	App'd:
Phone: (203) 488-0580	Code: TIA/EIA-222-F	Date: 03/27/15	Scale: NTS
FAX: (203) 488-8587	Path:		Dwg No. E-1

Feedline Plan



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63-2 North Branford Rd.
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Phone: (203) 488-0580
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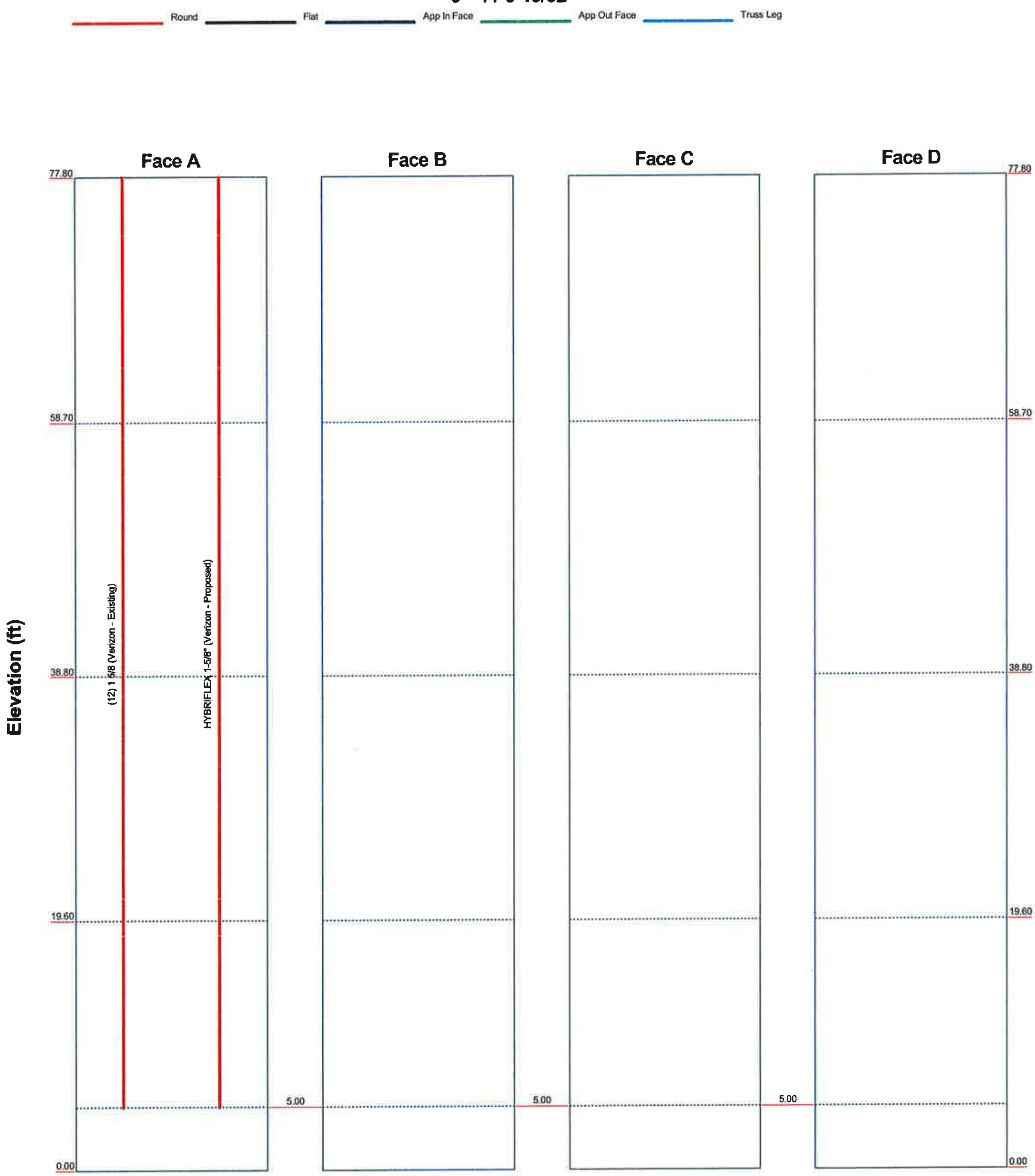
Project: ***80' Lattice Tower - 100 Universal Dr., North Haven, CT***		
Client: Verizon Wireless	Drawn by: TJL	App'd:
Code: TIA/EIA-222-F	Date: 03/27/15	Scale: NTS
Path:		Dwg No. E-7

Feedline Distribution Chart
0' - 77'9-19/32"



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FAX: (203) 488-8587	Path:		Dwg No. E-7

Tower Input Data

The main tower is a 4x free standing tower with an overall height of 77.80 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 2.88 ft at the top and 6.00 ft at the base.
This tower is designed using the TIA/EIA-222-F standard.
The following design criteria apply:

- Basic wind speed of 90 mph.
- Nominal ice thickness of 0.5000 in.
- Ice density of 56 pcf.
- A wind speed of 78 mph is used in combination with ice.
- Temperature drop of 50 °F.
- Deflections calculated using a wind speed of 50 mph.
- Weld together tower sections have flange connections..
- Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications..
- Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards..
- Welds are fabricated with ER-70S-6 electrodes..
- A non-linear (P-delta) analysis was used.
- Pressures are calculated at each section.
- Stress ratio used in tower member design is 1.333.
- Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Options

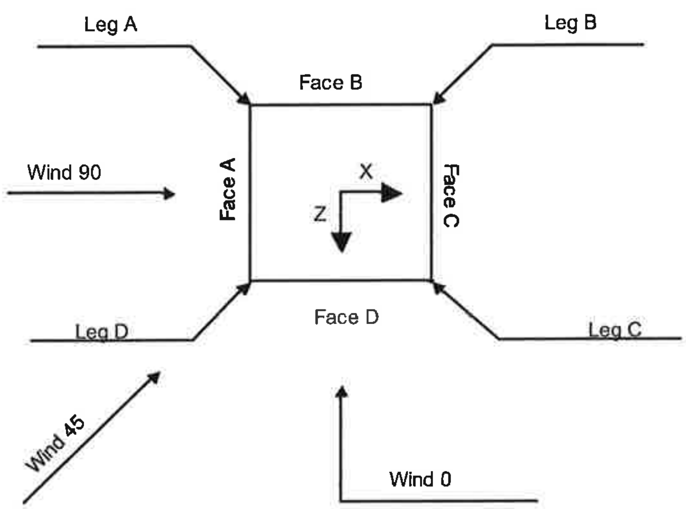
Consider Moments - Legs
Consider Moments - Horizontals
Consider Moments - Diagonals
Use Moment Magnification
√ Use Code Stress Ratios
√ Use Code Safety Factors - Guys
Escalate Ice
Always Use Max Kz
Use Special Wind Profile
√ Include Bolts In Member Capacity
Leg Bolts Are At Top Of Section
√ Secondary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

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

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

Poles

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



Square Tower

Tower Section Geometry

Tower Section	Tower Elevation ft	Assembly Database	Description	Section Width ft	Number of Sections	Section Length ft
T1	77.80-58.70			2.88	1	19.10
T2	58.70-38.80			3.65	1	19.90
T3	38.80-19.60			4.44	1	19.20
T4	19.60-0.00			5.21	1	19.60

Tower Section Geometry *(cont'd)*

Tower Section	Tower Elevation ft	Diagonal Spacing ft	Bracing Type	Has K Brace End Panels	Has Horizontals	Top Girt Offset in	Bottom Girt Offset in
T1	77.80-58.70	3.18	K Brace Right	No	No	0.0000	0.0000
T2	58.70-38.80	3.98	K Brace Left	No	No	0.0000	0.0000
T3	38.80-19.60	4.80	K Brace Left	No	No	0.0000	0.0000
T4	19.60-0.00	4.90	K Brace Left	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 77.80-58.70	Single Angle	Built Up L4.5x4.5x5/16	A36 (36 ksi)	Single Angle	L2 1/2x2 1/2x1/4	A36 (36 ksi)

Tower Elevation ft	Leg Type	Leg Size	Leg Grade	Diagonal Type	Diagonal Size	Diagonal Grade
T2 58.70-38.80	Single Angle	Built Up L4.5x4.5x5/16	A36 (36 ksi)	Single Angle	L2 1/2x2 1/2x1/4	A36 (36 ksi)
T3 38.80-19.60	Single Angle	Built Up L4.5x4.5x7/16	A36 (36 ksi)	Single Angle	L3x3x1/4	A36 (36 ksi)
T4 19.60-0.00	Single Angle	Built Up L4.5x4.5x7/16	A36 (36 ksi)	Single Angle	L3x3x1/4	A36 (36 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 77.80-58.70	Single Angle	L2x2x1/4	A36 (36 ksi)	Equal Angle		A36 (36 ksi)
T2 58.70-38.80	Single Angle	L2x2x1/4	A36 (36 ksi)	Equal Angle		A36 (36 ksi)
T3 38.80-19.60	Single Angle	L2x2x1/4	A36 (36 ksi)	Equal Angle		A36 (36 ksi)
T4 19.60-0.00	Single Angle	L2x2x1/4	A36 (36 ksi)	Equal Angle		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 77.80-58.70	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000
T2 58.70-38.80	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000
T3 38.80-19.60	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000
T4 19.60-0.00	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 77.80-58.70	No	No	0.9	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T2	No	No	0.9	1	1	1	1	1	1	1

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
T3 38.80-19.60	No	No	0.9	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T4 19.60-0.00	No	No	0.9	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 Net Width Deduct in	Leg U	Diagonal Net Width Deduct in	Diagonal U	Top Girt Net Width Deduct in	Top Girt U	Bottom Girt Net Width Deduct in	Bottom Girt U	Mid Girt Net Width Deduct in	Mid Girt U	Long Horizontal Net Width Deduct in	Long Horizontal U	Short Horizontal Net Width Deduct in	Short Horizontal U
T1 77.80-58.70	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1
T2 58.70-38.80	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1
T3 38.80-19.60	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	1
T4 19.60-0.00	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 Bolt Size in	Leg No.	Diagonal Bolt Size in	Diagonal No.	Top Girt Bolt Size in	Top Girt No.	Bottom Girt Bolt Size in	Bottom Girt No.	Mid Girt Bolt Size in	Mid Girt No.	Long Horizontal Bolt Size in	Long Horizontal No.	Short Horizontal Bolt Size in	Short Horizontal No.
T1 77.80-58.70	Flange	0.7500 A325N	0	0.6250 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T2 58.70-38.80	Flange	0.7500 A325N	0	0.6250 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.7500 A325X	0
T3 38.80-19.60	Flange	0.7500 A325N	0	0.6250 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.7500 A325X	2
T4 19.60-0.00	Flange	0.7500 A325N	0	0.6250 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	2

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
1 5/8 (Verizon - Existing)	A	Yes	Ar (CfAe)	77.80 - 5.00	3.0000	0	12	6	1.0000	1.9800		1.04

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
HYBRIFLEX 1-5/8" (Verizon - Proposed)	A	Yes	Ar (CfAe)	77.80 - 5.00	3.0000	-0.18	1	1	1.0000	1.9800		1.90

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
T1	77.80-58.70	A	22.061	0.000	0.000	0.000	0.27
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.00
		D	0.000	0.000	0.000	0.000	0.00
T2	58.70-38.80	A	22.985	0.000	0.000	0.000	0.29
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.00
		D	0.000	0.000	0.000	0.000	0.00
T3	38.80-19.60	A	22.176	0.000	0.000	0.000	0.28
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.00
		D	0.000	0.000	0.000	0.000	0.00
T4	19.60-0.00	A	16.863	0.000	0.000	0.000	0.21
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.00
		D	0.000	0.000	0.000	0.000	0.00

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
T1	77.80-58.70	A	0.500	9.486	23.716	0.000	0.000	0.79
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.00
		D		0.000	0.000	0.000	0.000	0.00
T2	58.70-38.80	A	0.500	9.884	24.709	0.000	0.000	0.83
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.00
		D		0.000	0.000	0.000	0.000	0.00
T3	38.80-19.60	A	0.500	9.536	23.840	0.000	0.000	0.80
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.00
		D		0.000	0.000	0.000	0.000	0.00
T4	19.60-0.00	A	0.500	7.251	18.128	0.000	0.000	0.61
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.00
		D		0.000	0.000	0.000	0.000	0.00

Feed Line Shielding

Section	Elevation ft	Face	A_R ft^2	A_R Ice ft^2	A_F ft^2	A_F Ice ft^2
T1	77.80-58.70	A	0.000	1.362	2.214	3.333
		B	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000
		D	0.000	0.000	0.000	0.000
T2	58.70-38.80	A	0.000	1.163	1.883	2.835
		B	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000
		D	0.000	0.000	0.000	0.000
T3	38.80-19.60	A	0.000	0.963	1.824	2.745
		B	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000
		D	0.000	0.000	0.000	0.000
T4	19.60-0.00	A	0.000	0.682	1.287	1.937
		B	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000
		D	0.000	0.000	0.000	0.000

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
T1	77.80-58.70	-4.9816	0.2019	-4.5593	0.2221
T2	58.70-38.80	-5.9661	0.2521	-5.5269	0.2789
T3	38.80-19.60	-6.5822	0.2864	-6.1824	0.3209
T4	19.60-0.00	-5.6579	0.2510	-5.3604	0.2831

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
Valmont 13' Platform w Rails (Verizon)	C	None		0.0000	79.00	No Ice 1/2" Ice	35.00 42.00	35.00 42.00	1.50 2.50
BXA-80063-4BF (Verizon - Existing)	A	From Face	3.00 -6.00 0.00	0.0000	80.00	No Ice 1/2" Ice	4.86 5.22	2.38 2.66	0.01 0.04
HBXX-6516DS (Verizon - Proposed)	A	From Face	3.00 -4.00 0.00	0.0000	80.00	No Ice 1/2" Ice	5.94 6.35	3.28 3.61	0.04 0.07
LNX-6514DS-VTM (Verizon - Proposed)	A	From Face	3.00 0.00 0.00	0.0000	80.00	No Ice 1/2" Ice	8.41 8.96	5.41 5.86	0.04 0.09
HBXX-6516DS (Verizon - Proposed)	A	From Face	3.00 4.00 0.00	0.0000	80.00	No Ice 1/2" Ice	5.94 6.35	3.28 3.61	0.04 0.07
BXA-80063-4BF	B	From Face	3.00	0.0000	80.00	No Ice	4.86	2.38	0.01

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(Verizon - Existing)			-6.00 0.00			1/2" Ice	5.22	2.66	0.04
HBXX-6516DS (Verizon - Proposed)	B	From Face	3.00 -4.00 0.00	0.0000	80.00	No Ice 1/2" Ice	5.94 6.35	3.28 3.61	0.04 0.07
LNX-6514DS-VTM (Verizon - Proposed)	B	From Face	3.00 0.00 0.00	0.0000	80.00	No Ice 1/2" Ice	8.41 8.96	5.41 5.86	0.04 0.09
HBXX-6516DS (Verizon - Proposed)	B	From Face	3.00 4.00 0.00	0.0000	80.00	No Ice 1/2" Ice	5.94 6.35	3.28 3.61	0.04 0.07
BXA-80063-4BF (Verizon - Existing)	C	From Face	3.00 -6.00 0.00	0.0000	80.00	No Ice 1/2" Ice	4.86 5.22	2.38 2.66	0.01 0.04
HBXX-6516DS (Verizon - Proposed)	C	From Face	3.00 -4.00 0.00	0.0000	80.00	No Ice 1/2" Ice	5.94 6.35	3.28 3.61	0.04 0.07
LNX-6514DS-VTM (Verizon - Proposed)	C	From Face	3.00 0.00 0.00	0.0000	80.00	No Ice 1/2" Ice	8.41 8.96	5.41 5.86	0.04 0.09
HBXX-6516DS (Verizon - Proposed)	C	From Face	3.00 4.00 0.00	0.0000	80.00	No Ice 1/2" Ice	5.94 6.35	3.28 3.61	0.04 0.07
RRH2x60-PCS (Verizon - Proposed)	A	From Face	3.00 -4.00 0.00	0.0000	80.00	No Ice 1/2" Ice	0.00 0.00	1.55 1.74	0.06 0.07
RRH2x60-PCS (Verizon - Proposed)	B	From Face	3.00 -4.00 0.00	0.0000	80.00	No Ice 1/2" Ice	0.00 0.00	1.55 1.74	0.06 0.07
RRH2x60-PCS (Verizon - Proposed)	C	From Face	3.00 -4.00 0.00	0.0000	80.00	No Ice 1/2" Ice	0.00 0.00	1.55 1.74	0.06 0.07
RRH2x60-AWS (Verizon - Existing)	A	From Face	3.00 4.00 0.00	0.0000	80.00	No Ice 1/2" Ice	3.78 4.09	2.07 2.35	0.06 0.08
RRH2x60-AWS (Verizon - Existing)	B	From Face	3.00 4.00 0.00	0.0000	80.00	No Ice 1/2" Ice	3.78 4.09	2.07 2.35	0.06 0.08
RRH2x60-AWS (Verizon - Existing)	C	From Face	3.00 4.00 0.00	0.0000	80.00	No Ice 1/2" Ice	3.78 4.09	2.07 2.35	0.06 0.08
DB-T1-6Z-8AB-0Z (Verizon - Existing)	A	From Face	3.00 -4.00 0.00	0.0000	80.00	No Ice 1/2" Ice	0.00 0.00	2.33 2.56	0.04 0.08

Tower Pressures - No Ice

$G_H = 1.181$

Section Elevation ft	z ft	Kz	qz psf	AG ft²	Face	AF ft²	AR ft²	Aleg ft²	Leg %	CAAA In Face ft²	CAAA Out Face ft²
T1 77.80-58.70	68.25	1.231	26	66.312	A	17.581	22.061	14.331	36.15	0.000	0.000
					B	19.796	0.000		72.39	0.000	0.000
					C	19.796	0.000		72.39	0.000	0.000
					D	19.796	0.000		72.39	0.000	0.000
T2 58.70-38.80	48.75	1.118	23	84.612	A	18.958	22.985	14.931	35.60	0.000	0.000
					B	20.842	0.000		71.64	0.000	0.000
					C	20.842	0.000		71.64	0.000	0.000
					D	20.842	0.000		71.64	0.000	0.000
T3 38.80-19.60	29.20	1	21	96.757	A	19.538	22.176	14.406	34.53	0.000	0.000
					B	21.362	0.000		67.44	0.000	0.000
					C	21.362	0.000		67.44	0.000	0.000
					D	21.362	0.000		67.44	0.000	0.000
T4 19.60-0.00	9.80	1	21	114.061	A	21.173	16.863	14.706	38.66	0.000	0.000
					B	22.460	0.000		65.48	0.000	0.000
					C	22.460	0.000		65.48	0.000	0.000
					D	22.460	0.000		65.48	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.181$

Section Elevation ft	z ft	Kz	qz psf	tz in	AG ft²	Face	AF ft²	AR ft²	Aleg ft²	Leg %	CAAA In Face ft²	CAAA Out Face ft²
T1 77.80-58.70	68.25	1.231	19	0.5000	67.904	A	40.179	13.537	17.515	32.61	0.000	0.000
						B	19.796	5.412		69.48	0.000	0.000
						C	19.796	5.412		69.48	0.000	0.000
						D	19.796	5.412		69.48	0.000	0.000
T2 58.70-38.80	48.75	1.118	17	0.5000	86.270	A	42.716	14.458	18.249	31.92	0.000	0.000
						B	20.842	5.737		68.66	0.000	0.000
						C	20.842	5.737		68.66	0.000	0.000
						D	20.842	5.737		68.66	0.000	0.000
T3 38.80-19.60	29.20	1	16	0.5000	98.357	A	42.457	14.206	17.607	31.07	0.000	0.000
						B	21.362	5.633		65.22	0.000	0.000
						C	21.362	5.633		65.22	0.000	0.000
						D	21.362	5.633		65.22	0.000	0.000
T4 19.60-0.00	9.80	1	16	0.5000	115.694	A	38.651	12.557	17.974	35.10	0.000	0.000
						B	22.460	5.987		63.18	0.000	0.000
						C	22.460	5.987		63.18	0.000	0.000
						D	22.460	5.987		63.18	0.000	0.000

Tower Pressure - Service

$G_H = 1.181$

Section Elevation ft	z ft	Kz	qz psf	AG ft²	Face	AF ft²	AR ft²	Aleg ft²	Leg %	CAAA In Face ft²	CAAA Out Face ft²
T1 77.80-58.70	68.25	1.231	8	66.312	A	17.581	22.061	14.331	36.15	0.000	0.000
					B	19.796	0.000		72.39	0.000	0.000

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
					C	19.796	0.000		72.39	0.000	0.000
					D	19.796	0.000		72.39	0.000	0.000
T2 58.70-38.80	48.75	1.118	7	84.612	A	18.958	22.985	14.931	35.60	0.000	0.000
					B	20.842	0.000		71.64	0.000	0.000
					C	20.842	0.000		71.64	0.000	0.000
					D	20.842	0.000		71.64	0.000	0.000
T3 38.80-19.60	29.20	1	6	96.757	A	19.538	22.176	14.406	34.53	0.000	0.000
					B	21.362	0.000		67.44	0.000	0.000
					C	21.362	0.000		67.44	0.000	0.000
					D	21.362	0.000		67.44	0.000	0.000
T4 19.60-0.00	9.80	1	6	114.061	A	21.173	16.863	14.706	38.66	0.000	0.000
					B	22.460	0.000		65.48	0.000	0.000
					C	22.460	0.000		65.48	0.000	0.000
					D	22.460	0.000		65.48	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 77.80-58.70	0.27	1.19	A	0.598	1.902	0.752	1	1	34.177	1.96	102.58	A
			B	0.299	2.595	0.615	1	1	19.796			
			C	0.299	2.595	0.615	1	1	19.796			
			D	0.299	2.595	0.615	1	1	19.796			
T2 58.70-38.80	0.29	1.24	A	0.496	2.058	0.695	1	1	34.940	1.97	98.92	A
			B	0.246	2.789	0.601	1	1	20.842			
			C	0.246	2.789	0.601	1	1	20.842			
			D	0.246	2.789	0.601	1	1	20.842			
T3 38.80-19.60	0.28	1.57	A	0.431	2.2	0.665	1	1	34.281	1.85	96.17	A
			B	0.221	2.892	0.595	1	1	21.362			
			C	0.221	2.892	0.595	1	1	21.362			
			D	0.221	2.892	0.595	1	1	21.362			
T4 19.60-0.00	0.21	1.65	A	0.333	2.477	0.627	1	1	31.741	1.93	98.23	A
			B	0.197	2.993	0.59	1	1	22.460			
			C	0.197	2.993	0.59	1	1	22.460			
			D	0.197	2.993	0.59	1	1	22.460			
Sum Weight:	1.05	5.65						OTM	302.48 kip-ft	7.70		

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 77.80-58.70	0.27	1.19	A	0.598	1.902	0.752	1.2	1.2	41.012	2.35	123.10	A
			B	0.299	2.595	0.615	1.2	1.2	23.755			
			C	0.299	2.595	0.615	1.2	1.2	23.755			
			D	0.299	2.595	0.615	1.2	1.2	23.755			
T2 58.70-38.80	0.29	1.24	A	0.496	2.058	0.695	1.2	1.2	41.928	2.36	118.70	A
			B	0.246	2.789	0.601	1.185	1.185	24.692			
			C	0.246	2.789	0.601	1.185	1.185	24.692			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
			D	0.246	2.789	0.601	1.185	1.185	24.692			
T3 38.80-19.60	0.28	1.57	A	0.431	2.2	0.665	1.2	1.2	41.137	2.22	115.41	A
			B	0.221	2.892	0.595	1.166	1.166	24.899			
			C	0.221	2.892	0.595	1.166	1.166	24.899			
			D	0.221	2.892	0.595	1.166	1.166	24.899			
T4 19.60-0.00	0.21	1.65	A	0.333	2.477	0.627	1.2	1.2	38.090	2.31	117.88	A
			B	0.197	2.993	0.59	1.148	1.148	25.777			
			C	0.197	2.993	0.59	1.148	1.148	25.777			
			D	0.197	2.993	0.59	1.148	1.148	25.777			
Sum Weight:	1.05	5.65						OTM	362.97 kip-ft	9.24		

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 ft^2	F K	w plf	Ctrl. Face
T1 77.80-58.70	0.79	1.76	A	0.791	1.836	0.889	1	1	52.215	2.17	113.43	A
			B	0.371	2.361	0.64	1	1	23.261			
			C	0.371	2.361	0.64	1	1	23.261			
			D	0.371	2.361	0.64	1	1	23.261			
T2 58.70-38.80	0.83	1.84	A	0.663	1.847	0.794	1	1	54.196	2.05	103.25	A
			B	0.308	2.562	0.618	1	1	24.389			
			C	0.308	2.562	0.618	1	1	24.389			
			D	0.308	2.562	0.618	1	1	24.389			
T3 38.80-19.60	0.80	2.20	A	0.576	1.929	0.739	1	1	52.959	1.88	97.69	A
			B	0.274	2.682	0.608	1	1	24.789			
			C	0.274	2.682	0.608	1	1	24.789			
			D	0.274	2.682	0.608	1	1	24.789			
T4 19.60-0.00	0.61	2.32	A	0.443	2.172	0.67	1	1	47.063	1.88	95.78	A
			B	0.246	2.791	0.601	1	1	26.057			
			C	0.246	2.791	0.601	1	1	26.057			
			D	0.246	2.791	0.601	1	1	26.057			
Sum Weight:	3.02	8.12						OTM	321.20 kip-ft	7.97		

Tower Forces - With Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
T1 77.80-58.70	0.79	1.76	A	0.791	1.836	0.889	1.2	1.2	62.658	2.60	136.12	A
			B	0.371	2.361	0.64	1.2	1.2	27.913			
			C	0.371	2.361	0.64	1.2	1.2	27.913			
			D	0.371	2.361	0.64	1.2	1.2	27.913			
T2 58.70-38.80	0.83	1.84	A	0.663	1.847	0.794	1.2	1.2	65.035	2.47	123.90	A
			B	0.308	2.562	0.618	1.2	1.2	29.267			
			C	0.308	2.562	0.618	1.2	1.2	29.267			
			D	0.308	2.562	0.618	1.2	1.2	29.267			

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 38.80-19.60	0.80	2.20	A	0.576	1.929	0.739	1.2	1.2	63.551	2.25	117.23	A
			B	0.274	2.682	0.608	1.2	1.2	29.747			
			C	0.274	2.682	0.608	1.2	1.2	29.747			
			D	0.274	2.682	0.608	1.2	1.2	29.747			
T4 19.60-0.00	0.61	2.32	A	0.443	2.172	0.67	1.2	1.2	56.476	2.25	114.94	A
			B	0.246	2.791	0.601	1.184	1.184	30.863			
			C	0.246	2.791	0.601	1.184	1.184	30.863			
			D	0.246	2.791	0.601	1.184	1.184	30.863			
Sum Weight:	3.02	8.12						OTM	385.44 kip-ft	9.57		

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 77.80-58.70	0.27	1.19	A	0.598	1.902	0.752	1	1	34.177	0.60	31.66	A
			B	0.299	2.595	0.615	1	1	19.796			
			C	0.299	2.595	0.615	1	1	19.796			
			D	0.299	2.595	0.615	1	1	19.796			
T2 58.70-38.80	0.29	1.24	A	0.496	2.058	0.695	1	1	34.940	0.61	30.53	A
			B	0.246	2.789	0.601	1	1	20.842			
			C	0.246	2.789	0.601	1	1	20.842			
			D	0.246	2.789	0.601	1	1	20.842			
T3 38.80-19.60	0.28	1.57	A	0.431	2.2	0.665	1	1	34.281	0.57	29.68	A
			B	0.221	2.892	0.595	1	1	21.362			
			C	0.221	2.892	0.595	1	1	21.362			
			D	0.221	2.892	0.595	1	1	21.362			
T4 19.60-0.00	0.21	1.65	A	0.333	2.477	0.627	1	1	31.741	0.59	30.32	A
			B	0.197	2.993	0.59	1	1	22.460			
			C	0.197	2.993	0.59	1	1	22.460			
			D	0.197	2.993	0.59	1	1	22.460			
Sum Weight:	1.05	5.65						OTM	93.36 kip-ft	2.38		

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 77.80-58.70	0.27	1.19	A	0.598	1.902	0.752	1.2	1.2	41.012	0.73	37.99	A
			B	0.299	2.595	0.615	1.2	1.2	23.755			
			C	0.299	2.595	0.615	1.2	1.2	23.755			
			D	0.299	2.595	0.615	1.2	1.2	23.755			
T2 58.70-38.80	0.29	1.24	A	0.496	2.058	0.695	1.2	1.2	41.928	0.73	36.64	A
			B	0.246	2.789	0.601	1.185	1.185	24.692			
			C	0.246	2.789	0.601	1.185	1.185	24.692			
			D	0.246	2.789	0.601	1.185	1.185	24.692			
T3	0.28	1.57	A	0.431	2.2	0.665	1.2	1.2	41.137	0.68	35.62	A

Section Elevation *ft*	*Add Weight* *K*	*Self Weight* *K*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *K*	*w* *plf*	*Ctrl. Face*
38.80-19.60			B	0.221	2.892	0.595	1.166	1.166	24.899			
			C	0.221	2.892	0.595	1.166	1.166	24.899			
			D	0.221	2.892	0.595	1.166	1.166	24.899			
T4 19.60-0.00	0.21	1.65	A	0.333	2.477	0.627	1.2	1.2	38.090	0.71	36.38	A
			B	0.197	2.993	0.59	1.148	1.148	25.777			
			C	0.197	2.993	0.59	1.148	1.148	25.777			
			D	0.197	2.993	0.59	1.148	1.148	25.777			
Sum Weight:	1.05	5.65						OTM	112.03 kip-ft	2.85		

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	3.42					
Bracing Weight	2.23					
Total Member Self-Weight	5.65			-0.84	2.97	
Total Weight	8.99			-0.84	2.97	
Wind 0 deg - No Ice		0.00	-10.92	-559.67	2.97	-4.48
Wind 30 deg - No Ice		6.37	-10.79	-537.19	-317.58	-5.69
Wind 45 deg - No Ice		9.00	-8.81	-438.77	-450.36	-5.34
Wind 60 deg - No Ice		11.02	-6.23	-310.50	-552.24	-4.62
Wind 90 deg - No Ice		11.19	0.00	-0.84	-577.64	-2.36
Wind 120 deg - No Ice		11.02	6.23	308.82	-552.24	0.60
Wind 135 deg - No Ice		9.00	8.81	437.08	-450.36	2.05
Wind 150 deg - No Ice		6.37	10.79	535.50	-317.58	3.36
Wind 180 deg - No Ice		0.00	10.92	557.98	2.97	4.48
Wind 210 deg - No Ice		-6.37	10.79	535.50	323.52	5.69
Wind 225 deg - No Ice		-9.00	8.81	437.08	456.30	5.34
Wind 240 deg - No Ice		-11.02	6.23	308.82	558.18	4.62
Wind 270 deg - No Ice		-11.19	0.00	-0.84	583.58	2.36
Wind 300 deg - No Ice		-11.02	-6.23	-310.50	558.18	-0.60
Wind 315 deg - No Ice		-9.00	-8.81	-438.77	456.30	-2.05
Wind 330 deg - No Ice		-6.37	-10.79	-537.19	323.52	-3.36
Member Ice	2.47					
Total Weight Ice	14.99			-1.36	8.48	
Wind 0 deg - Ice		0.00	-10.70	-539.25	8.48	-4.20
Wind 30 deg - Ice		6.25	-10.64	-522.82	-300.72	-5.19
Wind 45 deg - Ice		8.83	-8.69	-427.13	-428.79	-4.79
Wind 60 deg - Ice		10.82	-6.15	-302.43	-527.06	-4.07
Wind 90 deg - Ice		10.90	0.00	-1.36	-545.67	-1.90
Wind 120 deg - Ice		10.82	6.15	299.71	-527.06	0.84
Wind 135 deg - Ice		8.83	8.69	424.42	-428.79	2.16
Wind 150 deg - Ice		6.25	10.64	520.11	-300.72	3.32
Wind 180 deg - Ice		0.00	10.70	536.54	8.48	4.20
Wind 210 deg - Ice		-6.25	10.64	520.11	317.67	5.19
Wind 225 deg - Ice		-8.83	8.69	424.42	445.75	4.79
Wind 240 deg - Ice		-10.82	6.15	299.71	544.02	4.07
Wind 270 deg - Ice		-10.90	0.00	-1.36	562.63	1.90
Wind 300 deg - Ice		-10.82	-6.15	-302.43	544.02	-0.84
Wind 315 deg - Ice		-8.83	-8.69	-427.13	445.75	-2.16
Wind 330 deg - Ice		-6.25	-10.64	-522.82	317.67	-3.32
Total Weight	8.99			-0.84	2.97	
Wind 0 deg - Service		0.00	-3.37	-173.43	0.24	-1.38

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 30 deg - Service		1.96	-3.33	-166.49	-98.70	-1.75
Wind 45 deg - Service		2.78	-2.72	-136.11	-139.68	-1.65
Wind 60 deg - Service		3.40	-1.92	-96.52	-171.12	-1.43
Wind 90 deg - Service		3.45	0.00	-0.95	-178.96	-0.73
Wind 120 deg - Service		3.40	1.92	94.62	-171.12	0.18
Wind 135 deg - Service		2.78	2.72	134.21	-139.68	0.63
Wind 150 deg - Service		1.96	3.33	164.59	-98.70	1.04
Wind 180 deg - Service		0.00	3.37	171.53	0.24	1.38
Wind 210 deg - Service		-1.96	3.33	164.59	99.17	1.75
Wind 225 deg - Service		-2.78	2.72	134.21	140.15	1.65
Wind 240 deg - Service		-3.40	1.92	94.62	171.60	1.43
Wind 270 deg - Service		-3.45	0.00	-0.95	179.44	0.73
Wind 300 deg - Service		-3.40	-1.92	-96.52	171.60	-0.18
Wind 315 deg - Service		-2.78	-2.72	-136.11	140.15	-0.63
Wind 330 deg - Service		-1.96	-3.33	-166.49	99.17	-1.04

Load Combinations

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

Comb. No.	Description
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	77.8 - 58.7	Leg	Max Tension	12	15.98	-0.03	0.06
			Max. Compression	4	-17.97	-0.05	-0.10
			Max. Mx	34	0.55	0.21	-0.02
			Max. My	11	0.34	-0.05	0.18
			Max. Vy	6	1.12	0.00	-0.00
			Max. Vx	14	1.06	-0.00	0.00
		Diagonal	Max Tension	6	3.37	0.00	0.00
			Max. Compression	14	-3.38	0.00	0.00
			Max. Mx	31	2.31	-0.01	0.00
			Max. My	20	-1.01	0.00	-0.00
			Max. Vy	31	0.01	0.00	0.00
			Max. Vx	20	0.00	0.00	0.00
		Top Girt	Max Tension	6	1.08	0.00	0.00
			Max. Compression	14	-1.09	0.00	0.00
			Max. Mx	23	0.18	-0.01	0.00
			Max. My	22	-0.46	0.00	0.00
			Max. Vy	23	0.01	0.00	0.00
			Max. Vx	22	-0.00	0.00	0.00
T2	58.7 - 38.8	Leg	Max Tension	4	33.88	0.06	-0.03
			Max. Compression	12	-36.42	-0.19	-0.05
			Max. Mx	17	4.03	0.31	-0.10
			Max. My	28	2.78	-0.04	0.32
			Max. Vy	20	0.10	0.23	-0.06
			Max. Vx	26	-0.10	-0.08	0.24
		Diagonal	Max Tension	13	4.09	0.00	0.00
			Max. Compression	5	-4.06	0.00	0.00
			Max. Mx	31	3.80	-0.02	0.00
			Max. My	30	-1.42	0.00	0.00
			Max. Vy	31	0.01	0.00	0.00
			Max. Vx	20	-0.00	0.00	0.00
		Top Girt	Max Tension	33	0.12	0.00	0.00
			Max. Compression	8	-0.11	0.00	0.00
			Max. Mx	23	-0.06	-0.01	0.00
			Max. My	22	-0.08	0.00	0.00
			Max. Vy	23	-0.01	0.00	0.00
			Max. Vx	22	0.00	0.00	0.00
T3	38.8 - 19.6	Leg	Max Tension	16	52.14	0.13	-0.06
			Max. Compression	12	-54.57	-0.25	-0.04
			Max. Mx	17	6.93	0.40	-0.10

Section No.	*Elevation ft*	*Component Type*	*Condition*	*Gov. Load Comb.*	*Force K*	*Major Axis Moment kip-ft*	*Minor Axis Moment kip-ft*
			Max. My	15	-11.90	0.14	-0.43
			Max. Vy	33	0.10	0.39	-0.09
			Max. Vx	9	-0.12	-0.14	0.37
		Diagonal	Max Tension	13	4.87	0.00	0.00
			Max. Compression	13	-4.82	0.00	0.00
			Max. Mx	31	4.43	-0.03	0.00
			Max. My	30	-1.90	0.00	0.00
			Max. Vy	31	0.02	0.00	0.00
			Max. Vx	20	0.00	0.00	0.00
		Top Girt	Max Tension	13	0.12	0.00	0.00
			Max. Compression	4	-0.15	0.00	0.00
			Max. Mx	31	-0.09	-0.01	0.00
			Max. My	22	0.02	0.00	0.00
			Max. Vy	31	0.01	0.00	0.00
			Max. Vx	22	0.00	0.00	0.00
T4	19.6 - 0	Leg	Max Tension	16	71.94	0.21	-0.10
			Max. Compression	12	-73.22	0.00	-0.00
			Max. Mx	34	6.80	0.49	-0.15
			Max. My	28	7.22	-0.20	0.59
			Max. Vy	33	-0.12	0.49	-0.15
			Max. Vx	3	-0.16	0.15	-0.58
		Diagonal	Max Tension	13	5.42	0.00	0.00
			Max. Compression	3	-5.49	0.00	0.00
			Max. Mx	28	4.98	-0.04	0.00
			Max. My	28	3.49	0.00	0.00
			Max. Vy	28	0.02	0.00	0.00
			Max. Vx	28	0.00	0.00	0.00
		Top Girt	Max Tension	30	0.14	0.00	0.00
			Max. Compression	5	-0.19	0.00	0.00
			Max. Mx	18	0.02	-0.02	0.00
			Max. My	22	-0.01	0.00	0.00
			Max. Vy	18	0.01	0.00	0.00
			Max. Vx	22	-0.00	0.00	0.00

Maximum Reactions

Location	*Condition*	*Gov. Load Comb.*	*Vertical K*	*Horizontal, X K*	*Horizontal, Z K*
Leg D	Max. Vert	12	75.16	3.82	-1.48
	Max. H_x	13	73.19	4.53	-1.45
	Max. H_z	4	-73.81	-4.28	1.56
	Min. Vert	4	-73.81	-4.28	1.56
	Min. H_x	5	-71.36	-4.93	1.51
	Min. H_z	29	75.02	3.81	-1.49
Leg C	Max. Vert	8	74.64	-1.47	-4.06
	Max. H_x	16	-74.28	1.57	4.51
	Max. H_z	17	-71.18	1.50	4.96
	Min. Vert	16	-74.28	1.57	4.51
	Min. H_x	8	74.64	-1.47	-4.06
	Min. H_z	9	72.01	-1.43	-4.58
Leg B	Max. Vert	4	74.81	-4.72	1.47
	Max. H_x	13	-71.73	5.69	-1.51
	Max. H_z	4	74.81	-4.72	1.47
	Min. Vert	12	-74.17	5.15	-1.56
	Min. H_x	5	72.85	-5.31	1.44
	Min. H_z	12	-74.17	5.15	-1.56

Location	*Condition*	*Gov. Load Comb.*	*Vertical K*	*Horizontal, X K*	*Horizontal, Z K*
Leg A	Max. Vert	16	75.32	1.48	4.40
	Max. H_x	33	75.29	1.49	4.38
	Max. H_z	17	72.69	1.44	5.14
	Min. Vert	8	-73.69	-1.54	-4.83
	Min. H_x	8	-73.69	-1.54	-4.83
	Min. H_z	9	-70.58	-1.48	-5.51

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	8.99	0.00	0.00	-0.84	2.97	0.00
Dead+Wind 0 deg - No Ice	8.99	0.00	-10.92	-561.33	2.99	-4.49
Dead+Wind 30 deg - No Ice	8.99	6.37	-10.79	-538.76	-318.49	-5.70
Dead+Wind 45 deg - No Ice	8.99	9.00	-8.81	-440.05	-451.66	-5.35
Dead+Wind 60 deg - No Ice	8.99	11.02	-6.23	-311.41	-553.85	-4.64
Dead+Wind 90 deg - No Ice	8.99	11.19	0.00	-0.85	-579.37	-2.36
Dead+Wind 120 deg - No Ice	8.99	11.02	6.23	309.70	-553.86	0.60
Dead+Wind 135 deg - No Ice	8.99	9.00	8.81	438.35	-451.67	2.05
Dead+Wind 150 deg - No Ice	8.99	6.37	10.79	537.06	-318.50	3.37
Dead+Wind 180 deg - No Ice	8.99	-0.00	10.92	559.64	2.98	4.49
Dead+Wind 210 deg - No Ice	8.99	-6.37	10.79	537.05	324.47	5.70
Dead+Wind 225 deg - No Ice	8.99	-9.00	8.81	438.33	457.64	5.35
Dead+Wind 240 deg - No Ice	8.99	-11.02	6.23	309.69	559.82	4.64
Dead+Wind 270 deg - No Ice	8.99	-11.19	-0.00	-0.85	585.33	2.36
Dead+Wind 300 deg - No Ice	8.99	-11.02	-6.23	-311.39	559.82	-0.60
Dead+Wind 315 deg - No Ice	8.99	-9.00	-8.81	-440.03	457.63	-2.06
Dead+Wind 330 deg - No Ice	8.99	-6.37	-10.79	-538.75	324.46	-3.37
Dead+Ice+Temp	14.99	0.00	0.00	-1.37	8.50	-0.00
Dead+Wind 0 deg+Ice+Temp	14.99	0.00	-10.70	-541.80	8.53	-4.23
Dead+Wind 30 deg+Ice+Temp	14.99	6.25	-10.64	-525.26	-302.08	-5.22
Dead+Wind 45 deg+Ice+Temp	14.99	8.83	-8.69	-429.12	-430.75	-4.83
Dead+Wind 60 deg+Ice+Temp	14.99	10.82	-6.15	-303.84	-529.49	-4.10
Dead+Wind 90 deg+Ice+Temp	14.99	10.90	0.00	-1.38	-548.24	-1.91
Dead+Wind 120 deg+Ice+Temp	14.99	10.82	6.15	301.08	-529.50	0.85
Dead+Wind 135 deg+Ice+Temp	14.99	8.83	8.69	426.37	-430.77	2.17
Dead+Wind 150 deg+Ice+Temp	14.99	6.25	10.64	522.51	-302.10	3.35
Dead+Wind 180 deg+Ice+Temp	14.99	-0.00	10.70	539.05	8.53	4.23
Dead+Wind 210 deg+Ice+Temp	14.99	-6.25	10.64	522.48	319.16	5.22
Dead+Wind 225 deg+Ice+Temp	14.99	-8.83	8.69	426.34	447.82	4.83
Dead+Wind 240 deg+Ice+Temp	14.99	-10.82	6.15	301.06	546.56	4.10
Dead+Wind 270 deg+Ice+Temp	14.99	-10.90	-0.00	-1.38	565.29	1.91
Dead+Wind 300 deg+Ice+Temp	14.99	-10.82	-6.15	-303.81	546.54	-0.85
Dead+Wind 315 deg+Ice+Temp	14.99	-8.83	-8.69	-429.09	447.81	-2.18
Dead+Wind 330 deg+Ice+Temp	14.99	-6.25	-10.64	-525.23	319.14	-3.35
Dead+Wind 0 deg - Service	8.99	0.00	-3.37	-173.84	2.98	-1.39
Dead+Wind 30 deg - Service	8.99	1.96	-3.33	-166.87	-96.25	-1.76
Dead+Wind 45 deg - Service	8.99	2.78	-2.72	-136.41	-137.35	-1.65
Dead+Wind 60 deg - Service	8.99	3.40	-1.92	-96.70	-168.89	-1.43
Dead+Wind 90 deg - Service	8.99	3.45	0.00	-0.85	-176.76	-0.73
Dead+Wind 120 deg - Service	8.99	3.40	1.92	95.01	-168.89	0.19
Dead+Wind 135 deg - Service	8.99	2.78	2.72	134.71	-137.35	0.63
Dead+Wind 150 deg - Service	8.99	1.96	3.33	165.18	-96.25	1.04
Dead+Wind 180 deg - Service	8.99	-0.00	3.37	172.15	2.98	1.39
Dead+Wind 210 deg - Service	8.99	-1.96	3.33	165.18	102.21	1.76
Dead+Wind 225 deg - Service	8.99	-2.78	2.72	134.71	143.31	1.65

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead+Wind 240 deg - Service	8.99	-3.40	1.92	95.01	174.85	1.43
Dead+Wind 270 deg - Service	8.99	-3.45	-0.00	-0.85	182.72	0.73
Dead+Wind 300 deg - Service	8.99	-3.40	-1.92	-96.70	174.85	-0.19
Dead+Wind 315 deg - Service	8.99	-2.78	-2.72	-136.40	143.31	-0.63
Dead+Wind 330 deg - Service	8.99	-1.96	-3.33	-166.87	102.21	-1.04

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
1	0.00	-8.99	0.00	0.00	8.99	0.00	0.000%
2	0.00	-8.99	-10.92	-0.00	8.99	10.92	0.001%
3	6.37	-8.99	-10.79	-6.37	8.99	10.79	0.001%
4	9.00	-8.99	-8.81	-9.00	8.99	8.81	0.000%
5	11.02	-8.99	-6.23	-11.02	8.99	6.23	0.002%
6	11.19	-8.99	0.00	-11.19	8.99	-0.00	0.001%
7	11.02	-8.99	6.23	-11.02	8.99	-6.23	0.001%
8	9.00	-8.99	8.81	-9.00	8.99	-8.81	0.001%
9	6.37	-8.99	10.79	-6.37	8.99	-10.79	0.002%
10	0.00	-8.99	10.92	0.00	8.99	-10.92	0.001%
11	-6.37	-8.99	10.79	6.37	8.99	-10.79	0.002%
12	-9.00	-8.99	8.81	9.00	8.99	-8.81	0.000%
13	-11.02	-8.99	6.23	11.02	8.99	-6.23	0.002%
14	-11.19	-8.99	0.00	11.19	8.99	0.00	0.001%
15	-11.02	-8.99	-6.23	11.02	8.99	6.23	0.001%
16	-9.00	-8.99	-8.81	9.00	8.99	8.81	0.001%
17	-6.37	-8.99	-10.79	6.37	8.99	10.79	0.002%
18	0.00	-14.99	0.00	0.00	14.99	0.00	0.000%
19	0.00	-14.99	-10.70	-0.00	14.99	10.70	0.001%
20	6.25	-14.99	-10.64	-6.25	14.99	10.64	0.001%
21	8.83	-14.99	-8.69	-8.83	14.99	8.69	0.000%
22	10.82	-14.99	-6.15	-10.82	14.99	6.15	0.001%
23	10.90	-14.99	0.00	-10.90	14.99	-0.00	0.001%
24	10.82	-14.99	6.15	-10.82	14.99	-6.15	0.001%
25	8.83	-14.99	8.69	-8.83	14.99	-8.69	0.000%
26	6.25	-14.99	10.64	-6.25	14.99	-10.64	0.001%
27	0.00	-14.99	10.70	0.00	14.99	-10.70	0.001%
28	-6.25	-14.99	10.64	6.25	14.99	-10.64	0.001%
29	-8.83	-14.99	8.69	8.83	14.99	-8.69	0.000%
30	-10.82	-14.99	6.15	10.82	14.99	-6.15	0.001%
31	-10.90	-14.99	0.00	10.90	14.99	0.00	0.001%
32	-10.82	-14.99	-6.15	10.82	14.99	6.15	0.001%
33	-8.83	-14.99	-8.69	8.83	14.99	8.69	0.000%
34	-6.25	-14.99	-10.64	6.25	14.99	10.64	0.001%
35	0.00	-8.99	-3.37	-0.00	8.99	3.37	0.000%
36	1.96	-8.99	-3.33	-1.96	8.99	3.33	0.000%
37	2.78	-8.99	-2.72	-2.78	8.99	2.72	0.000%
38	3.40	-8.99	-1.92	-3.40	8.99	1.92	0.000%
39	3.45	-8.99	0.00	-3.45	8.99	-0.00	0.000%
40	3.40	-8.99	1.92	-3.40	8.99	-1.92	0.000%
41	2.78	-8.99	2.72	-2.78	8.99	-2.72	0.000%
42	1.96	-8.99	3.33	-1.96	8.99	-3.33	0.000%
43	0.00	-8.99	3.37	0.00	8.99	-3.37	0.000%
44	-1.96	-8.99	3.33	1.96	8.99	-3.33	0.000%
45	-2.78	-8.99	2.72	2.78	8.99	-2.72	0.000%
46	-3.40	-8.99	1.92	3.40	8.99	-1.92	0.000%
47	-3.45	-8.99	0.00	3.45	8.99	0.00	0.000%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
48	-3.40	-8.99	-1.92	3.40	8.99	1.92	0.000%
49	-2.78	-8.99	-2.72	2.78	8.99	2.72	0.000%
50	-1.96	-8.99	-3.33	1.96	8.99	3.33	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	0.00000462
3	Yes	4	0.00000001	0.00003759
4	Yes	4	0.00000001	0.00004432
5	Yes	4	0.00000001	0.00003946
6	Yes	4	0.00000001	0.00000449
7	Yes	4	0.00000001	0.00004137
8	Yes	4	0.00000001	0.00004748
9	Yes	4	0.00000001	0.00004140
10	Yes	4	0.00000001	0.00000505
11	Yes	4	0.00000001	0.00003928
12	Yes	4	0.00000001	0.00004564
13	Yes	4	0.00000001	0.00004035
14	Yes	4	0.00000001	0.00000468
15	Yes	4	0.00000001	0.00003623
16	Yes	4	0.00000001	0.00004201
17	Yes	4	0.00000001	0.00003702
18	Yes	4	0.00000001	0.00000001
19	Yes	4	0.00000001	0.00000479
20	Yes	4	0.00000001	0.00004232
21	Yes	4	0.00000001	0.00004944
22	Yes	4	0.00000001	0.00004351
23	Yes	4	0.00000001	0.00000525
24	Yes	4	0.00000001	0.00004867
25	Yes	4	0.00000001	0.00005583
26	Yes	4	0.00000001	0.00004870
27	Yes	4	0.00000001	0.00000649
28	Yes	4	0.00000001	0.00004224
29	Yes	4	0.00000001	0.00004873
30	Yes	4	0.00000001	0.00004271
31	Yes	4	0.00000001	0.00000569
32	Yes	4	0.00000001	0.00003628
33	Yes	4	0.00000001	0.00004216
34	Yes	4	0.00000001	0.00003691
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	77.8 - 58.7	1.574	48	0.1570	0.0251
T2	58.7 - 38.8	0.961	48	0.1389	0.0170
T3	38.8 - 19.6	0.448	48	0.0955	0.0089
T4	19.6 - 0	0.130	48	0.0529	0.0042

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
80.00	BXA-80063-4BF	48	1.574	0.1570	0.0251	122949
79.00	Valmont 13' Platform w Rails	48	1.574	0.1570	0.0251	122949

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	77.8 - 58.7	5.031	15	0.4998	0.0828
T2	58.7 - 38.8	3.075	15	0.4436	0.0615
T3	38.8 - 19.6	1.436	15	0.3057	0.0451
T4	19.6 - 0	0.417	15	0.1693	0.0310

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
80.00	BXA-80063-4BF	15	5.031	0.4998	0.0828	39069
79.00	Valmont 13' Platform w Rails	15	5.031	0.4998	0.0828	39069

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	77.8	Diagonal	A325N	0.6250	1	3.38	6.44	0.524 ✔	1.333	Bolt Shear
T2	58.7	Diagonal	A325N	0.6250	1	4.09	6.44	0.634 ✔	1.333	Bolt Shear
T3	38.8	Diagonal	A325N	0.6250	1	4.87	6.44	0.756 ✔	1.333	Bolt Shear
T4	19.6	Diagonal	A325N	0.6250	1	5.49	6.44	0.852 ✔	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 P/P_a
T1	77.8 - 58.7	Built Up L4.5x4.5x5/16	19.11	3.18	51.4 K=1.20	18.227	2.7148	-17.97	49.48	0.363 ✔
T2	58.7 - 38.8	Built Up L4.5x4.5x5/16	19.91	3.98	64.2 K=1.20	17.015	2.7148	-36.42	46.19	0.789 ✔
T3	38.8 - 19.6	Built Up L4.5x4.5x7/16	19.21	4.80	78.1 K=1.20	15.564	3.7461	-54.57	58.30	0.936 ✔
T4	19.6 - 0	Built Up L4.5x4.5x7/16	19.61	4.90	79.7 K=1.20	15.384	3.7461	-73.22	57.63	1.271 ✔

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 P/P_a
T1	77.8 - 58.7	L2 1/2x2 1/2x1/4	4.80	4.29	104.9 K=1.00	12.342	1.1900	-3.38	14.69	0.230 ✔
T2	58.7 - 38.8	L2 1/2x2 1/2x1/4	5.90	5.40	131.9 K=1.00	8.583	1.1900	-4.06	10.21	0.398 ✔
T3	38.8 - 19.6	L3x3x1/4	7.01	6.50	131.8 K=1.00	8.602	1.4400	-4.80	12.39	0.387 ✔
T4	19.6 - 0	L3x3x1/4	7.67	7.18	145.6 K=1.00	7.043	1.4400	-5.49	10.14	0.541 ✔

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	77.8 - 58.7	L2x2x1/4	2.88	2.50	76.9 K=1.00	15.699	0.9380	-1.09	14.73	0.074 ✔
T2	58.7 - 38.8	L2x2x1/4	3.65	3.27	100.5 K=1.00	12.913	0.9380	-0.11	12.11	0.009 ✔
T3	38.8 - 19.6	L2x2x1/4	4.44	4.06	124.8 K=1.00	9.590	0.9380	-0.15	9.00	0.017 ✔
T4	19.6 - 0	L2x2x1/4	5.21	4.84	148.4 K=1.00	6.782	0.9380	-0.19	6.36	0.030 ✔

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	77.8 - 58.7	Built Up L4.5x4.5x5/16	19.11	3.18	27.2	21.600	2.7148	15.98	58.64	0.273 ✔
T2	58.7 - 38.8	Built Up L4.5x4.5x5/16	19.91	3.98	34.0	21.600	2.7148	33.88	58.64	0.578 ✔
T3	38.8 - 19.6	Built Up L4.5x4.5x7/16	19.21	4.80	41.6	21.600	3.7461	52.14	80.92	0.644 ✔
T4	19.6 - 0	Built Up L4.5x4.5x7/16	19.61	4.90	42.4	21.600	3.7461	71.94	80.92	0.889 ✔

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 $\frac{P}{P_a}$
T1	77.8 - 58.7	L2 1/2x2 1/2x1/4	4.80	4.29	67.0	21.600	1.1900	3.37	25.70	0.131 ✔
T2	58.7 - 38.8	L2 1/2x2 1/2x1/4	5.90	5.40	84.2	21.600	1.1900	4.09	25.70	0.159 ✔
T3	38.8 - 19.6	L3x3x1/4	7.01	6.50	83.9	21.600	1.4400	4.87	31.10	0.157 ✔
T4	19.6 - 0	L3x3x1/4	7.67	7.18	92.7	21.600	1.4400	5.42	31.10	0.174 ✔

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	77.8 - 58.7	L2x2x1/4	2.88	2.50	49.4	21.600	0.9380	1.08	20.26	0.054 ✔
T2	58.7 - 38.8	L2x2x1/4	3.65	3.27	64.5	21.600	0.9380	0.12	20.26	0.006 ✔
T3	38.8 - 19.6	L2x2x1/4	4.44	4.06	80.1	21.600	0.9380	0.12	20.26	0.006 ✔
T4	19.6 - 0	L2x2x1/4	5.21	4.84	95.3	21.600	0.9380	0.14	20.26	0.007 ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	SF^*P_{allow} K	% Capacity	Pass Fail
T1	77.8 - 58.7	Leg	Built Up L4.5x4.5x5/16	3	-17.97	65.96	27.2	Pass
T2	58.7 - 38.8	Leg	Built Up L4.5x4.5x5/16	33	-36.42	61.57	59.2	Pass
T3	38.8 - 19.6	Leg	Built Up L4.5x4.5x7/16	61	-54.57	77.72	70.2	Pass
T4	19.6 - 0	Leg	Built Up L4.5x4.5x7/16	85	-73.22	76.82	95.3	Pass
T1	77.8 - 58.7	Diagonal	L2 1/2x2 1/2x1/4	11	-3.38	19.58	17.3 39.3 (b)	Pass
T2	58.7 - 38.8	Diagonal	L2 1/2x2 1/2x1/4	43	-4.06	13.62	29.8 47.6 (b)	Pass
T3	38.8 - 19.6	Diagonal	L3x3x1/4	72	-4.80	16.51	29.1 56.7 (b)	Pass
T4	19.6 - 0	Diagonal	L3x3x1/4	96	-5.49	13.52	40.6 63.9 (b)	Pass
T1	77.8 - 58.7	Top Girt	L2x2x1/4	7	-1.09	19.63	5.6	Pass
T2	58.7 - 38.8	Top Girt	L2x2x1/4	40	-0.11	16.15	0.7	Pass
T3	38.8 - 19.6	Top Girt	L2x2x1/4	68	-0.15	11.99	1.3	Pass
T4	19.6 - 0	Top Girt	L2x2x1/4	92	-0.19	8.48	2.2	Pass
							Summary	
						Leg (T4)	95.3	Pass
						Diagonal (T4)	63.9	Pass
						Top Girt (T1)	5.6	Pass
						Bolt Checks	63.9	Pass
						RATING =	**95.3**	**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

Mat Foundation Analysis:

Input Data:

Tower Data

Overturning Moment =	$OM := 641 \cdot ft \cdot kips$	(User Input from tnxTower)
Shear Force =	$S_t := 13 \cdot kip$	(User Input from tnxTower)
Axial Force =	$WT_t := 9 \cdot kip$	(User Input from tnxTower)
Max Compression Force =	$C_t := 76 \cdot kip$	(User Input from tnxTower)
Max Uplift Force =	$U_t := 75 \cdot kip$	(User Input from tnxTower)
Tower Height =	$H_t := 80 \cdot ft$	(User Input)
Tower Width =	$W_t := 6 \cdot ft$	(User Input)
Tower Position on Foundation (1=offset, 2=centered) =	$Pos_t := 2$	(User Input)

Footing Data:

Overall Depth of Footing =	$D_f := 4.5 \cdot ft$	(User Input)
Thickness of Footing =	$T_f := 5.0 \cdot ft$	(User Input)
Width of Footing =	$W_f := 14.5 \cdot ft$	(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 =	$\Phi_s := 30 \cdot deg$	(User Input)	
Allowable Soil Bearing Capacity =	$q_s := 3000 \cdot psf$	(User Input)	
Unit Weight of Soil =	$\gamma_{soil} := 120 \cdot pcf$	(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)	

Pad Reinforcement:

Bar Size =	$BS_{top} := 6$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 0.750 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 28$	(User Input)	(Top of Pad)
Bar Size =	$BS_{bot} := 6$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{bbot} := 0.750 \cdot in$	(User Input)	(Bottom of Pad)
Number of Bars =	$NB_{bot} := 28$	(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:

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

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

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

Load Factor =

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

Stability of Footing:

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

Adjusted Soil Unit Weight = $\gamma_s := \text{if}(\text{Bouyancy} = 1, \gamma_{soil} - 62.4\text{pcf}, \gamma_{soil}) = 120 \cdot \text{pcf}$

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

$P_{pt} := K_p \cdot \gamma_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p} = -0.18 \cdot \text{ksf}$

$P_{top} := \text{if}[n < (D_f - T_f), P_{pt}, P_{pn}] = 0 \cdot \text{ksf}$

$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p} = 1.62 \cdot \text{ksf}$

$$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 0.81 \cdot \text{ksf}$$

$T_p := \text{if}[n < (D_f - T_f), T_f, (D_f - n)] = 4.5$

$A_p := W_f \cdot T_p = 65.25$

Ultimate Shear = $S_u := P_{ave} \cdot A_p = 52.853 \cdot \text{kip}$

Weight of Concrete = $WT_c := (W_f^2 \cdot T_f) \cdot \gamma_c = 157.688 \cdot \text{kip}$

Weight of Soil Above Footing = $WT_{s1} := 0\text{kip}$

Weight of Soil Wedge at Back Face = $$WT_{s2} := \left[\frac{(D_f - n)^2 \cdot \tan(\Phi_s)}{2} \cdot W_f\right] \cdot \gamma_s = 10.171 \cdot \text{kip}$$

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

$X_t := \text{if}(\text{Pos}_t, X_{t1}, X_{t2}) = 4.25$

Total Weight = $WT_{tot} := WT_c + WT_t + WT_{s1} = 166.7 \cdot \text{kip}$

Resisting Moment = $$M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_p}{3} + WT_{s2} \cdot \left(W_f + \frac{T_p \cdot \tan(\Phi_s)}{3}\right) = 1444 \cdot \text{kip} \cdot \text{ft}$$

Overturning Moment = $M_{ot} := OM + S_t \cdot T_f = 706 \cdot \text{kip} \cdot \text{ft}$

Factor of Safety Actual = $$FS := \frac{M_r}{M_{ot}} = 2.05$$

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

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

OverTurning_Moment_Check = "Okay"

BEARING PRESSURES

Eccentricity = $e := \frac{M_{ot}}{WT_{tot}} = 4.235$

Distance to Kern = $X_k := \frac{W_f}{6} = 2.417$

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

Bearing Pressure Caused by Footing:

Total Load = $Load_{tot} := WT_c + WT_t + WT_{s1} = 167 \cdot kip$

Area of the Mat = $A_{mat} := W_f^{\,2} = 210.25$

Maximum Contact Pressure = $P_{max} := \begin{cases} \frac{Load_{tot}}{W_f^{\,2}} \cdot \left(1 + \frac{6 \cdot e}{W_f}\right) & \text{if } e \le X_k \\ \frac{2 \cdot Load_{tot}}{3 \cdot W_f \cdot \left(\frac{W_f}{2} - e\right)} & \text{otherwise} \end{cases}$

$P_{max} = 2.542 \cdot ksf$

Minimum Contact Pressure = $P_{min} := \begin{cases} \frac{Load_{tot}}{W_f^{\,2}} \cdot \left(1 - \frac{6 \cdot e}{W_f}\right) & \text{if } e \le X_k \\ 0ksf & \text{otherwise} \end{cases}$

$P_{min} = 0 \cdot ksf$

Distance to Resultant of Pressure Distribution = $P_{min} := \begin{cases} \frac{Load_{tot}}{W_f^{\,2}} \cdot \left(1 - \frac{6 \cdot e}{W_f}\right) & \text{if } e \le X_k \\ 0ksf & \text{otherwise} \end{cases}$

$P_{min} = 0 \cdot ksf$

Length of Applied Pressure = $X_p := \begin{cases} W_f & \text{if } e \le X_k \\ 3 \cdot \left(\frac{W_f}{2} - e\right) & \text{otherwise} \end{cases}$

$X_p = 9.044 \cdot ft$

Pressure Slope = $m_p := \frac{P_{max} - P_{min}}{X_p}$

$m_p = 0.281 \cdot ksf$

Beam (One-Way) Shear Action (ACI 11.3.1.1):

Shear Strength of Concrete:

Capacity Reduction Factor: (ACI 9.3.2.3) $\phi_c := 0.85$

$d := T_f - Cvr_{pad} - d_{bbot}$ $\quad d = 56.25 \cdot in$

Factored Pressure at "d" Distance = $P_d := LF \cdot \left[P_{max} - (X_t - d) \cdot m_p\right]$ $\quad P_d = 3.553 \cdot ksf$

Factored Pressure at Edge = $P_{edge} := LF \cdot P_{max}$ $\quad P_{edge} = 3.389 \cdot ksf$

Average Pressure = $P_{ave} := \dfrac{P_d + P_{edge}}{2}$ $\quad P_{ave} = 3.471 \cdot ksf$

Applied Shear Force = $V_{req} := P_{ave} \cdot (X_t - d) \cdot W_f$ $\quad V_{req} = -22.018 \cdot kips$

Available Shear = (ACI 11.3.1.1) $V_{Avail} := \phi_c \cdot 2 \cdot \sqrt{f'c \cdot psi} \cdot W_f \cdot d = 911 \cdot kip$ (ACI-2008 11.2.1.1)

Check Capacity = Beam_Shear_Check := if(V_req < V_Avail, "Okay", "No Good")

Beam_Shear_Check = "Okay"

Punching (Two-Way) Shear Action (ACI 11.12.2.1):

Critical Perimeter of Punching Shear = $b_o := 4(d)$ $\quad b_o = 18.75 \cdot ft$

Factored Maximum Punching Shear Force = $FL := LF \cdot C_t$ $\quad FL = 101.31 \cdot kip$

Available Shear Strength = (ACI-2008 11.11.2.1) $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f'c \cdot psi} \cdot b_o \cdot d$ $\quad V_{Avail} = 2356.92 \cdot kips$

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

Punching_Shear_Check = "Okay"

Maximim Bending Moment:

Distance From Edge of FTG To Face of Pier: $X_b := \frac{W_f}{2} - e$ $X_b = 3.015 \cdot ft$

Moment Due To Overturning:

Factored Pressure at "d" Distance: $P_{face} := LF \cdot (P_{max} - X_b \cdot m_p)$ $P_{face} = 2.259 \cdot ksf$

Factored Pressure at Edge: $P_{edge} := LF \cdot P_{max}$ $P_{edge} = 3.389 \cdot ksf$

Moment Due To Rectangular Loading: $M_1 := (P_{face} \cdot X_b \cdot W_f) \cdot \left(\frac{1}{2} \cdot X_b\right)$ $M_1 = 148.847 \cdot kip \cdot ft$

Moment Due to Triangular Loading: $M_2 := \left[\frac{1}{2} \cdot X_b \cdot (P_{edge} - P_{face})\right] \cdot \left(\frac{2}{3} \cdot X_b\right)$ $M_2 = 3.422 \cdot kip \cdot ft$

Sum Moments: $M_{ot} := M_1 + M_2$ $M_{ot} = 152.269 \cdot kip \cdot ft$

Moment Due To Uplift:

Pier Forces: $M_{nT} := LF \cdot \left[U_t \cdot \left(W_f - 2 \cdot X_b - \frac{d}{2} - d\right) + S_t \cdot (D_f)\right]$ $M_{nT} = 221.914 \cdot kip \cdot ft$

Concrete Resistance: $M_{nS} := \frac{1}{2} \cdot (W_f - X_b)^2 \cdot (T_f \cdot W_f) \cdot \gamma_s$ $M_{nS} = 573.835 \cdot kip \cdot ft$

Soil Resistance: $M_{nC} := \frac{1}{2} \cdot (W_f - X_b)^2 \cdot (T_f \cdot W_f) \cdot \gamma_c$ $M_{nC} = 717.293 \cdot kip \cdot ft$

Sum Moments $M_{uplift} := M_{nT} - M_{nS} - M_{nC}$ $M_{uplift} = -1.069 \times 10^3 \cdot kips \cdot ft$

Select Controlling Moment: $M_u := \begin{cases} M_{ot} & \text{if } M_{ot} \geq M_{uplift} \\ M_{uplift} & \text{otherwise} \end{cases}$ $M_u = 152.269 \cdot kips \cdot ft$

Size Reinforcing Steel:

Strength Reduction Factor: (ACI 9.3.2.2) $\phi_m := .90$

Effective Width: $b_{eff} := W_f$ $b_{eff} := W_f = 174 \cdot in$

(ACI-200810.2.7.3)

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

$$R_n := \frac{M_u}{\phi_m \cdot W_f \cdot d^2} = 3.7 \cdot psi$$

$$\rho := \frac{0.85 \cdot f'c}{f_y} \left(1 - \sqrt{1 - \frac{2 \cdot R_n}{0.85 \cdot f'c}} \right) \qquad \rho = 0.00006$$

$$\rho_{min} := 1.333 \cdot \rho = 0.00008$$

Required Reinforcement for Temperature and Shrinkage:

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

Area Required:

$$As := max(\rho, \rho_{min}, \rho_{sh}) \cdot \frac{b_{eff}}{2} \cdot d = 8.8 \cdot in^2$$

$$As_{prov} := A_{bbot} \cdot NB_{bot} = 12.4 \cdot in^2$$

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

Pad_Reinforcement_Bot = "Okay"

Development Length Pad Reinforcement:

Bar Spacing = $B_{sPad} := \dfrac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 5.44 \cdot in$

Spacing or Cover Dimension = $c := if\left(Cvr_{pad} < \dfrac{B_{sPad}}{2}, Cvr_{pad}, \dfrac{B_{sPad}}{2}\right) = 2.722 \cdot in$

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

$$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pad} \cdot \beta_{pad} \cdot \gamma_{pad} \cdot \lambda_{pad}}{40 \cdot \sqrt{f'c \cdot psi} \cdot \dfrac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot} = 17 \cdot in$$

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

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

Available Length in Pad = $L_{Pad} := \dfrac{W_f}{2} - \dfrac{W_t}{2} - Cvr_{pad} = 48 \cdot in$

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

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

SITE NAME	NORTH HAVEN S CT	ECP & CELL #	2	0215
Note: PCS carrier add. Remove 850/1900 diplexers.		LATITUDE	41-20-41.35 N	
		LONGITUDE	72-52-17.36 W	
		STRUCTURE TYPE	Monopole	

700 MHz LTE - CURRENT CONFIG	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	LTE-700U eNodeB	LTE-700U eNodeB	LTE-700U eNodeB
ANTENNA TYPE	BXA-70063-6CF-2-750MHZ	BXA-70063-6CF-2-750MHZ	BXA-70063-6CF-2-750MHZ
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	50	170	270
DOWN TILT (MECH/DEG)	0	2	0
RAD CTR (FT AGL)	82	82	82
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL			
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX			

700 MHz LTE - FUTURE CONFIG	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	LTE-700U eNodeB	LTE-700U eNodeB	LTE-700U eNodeB
ANTENNA TYPE	LNX-6514DS-A1M_2DT_750MHZ	LNX-6514DS-A1M_4DT_750MHZ	LNX-6514DS-A1M_2DT_750MHZ
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	50	170	270
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	82	82	82
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL			
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX			

850 MHz CELLULAR - CURRENT CONFIG	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	Cellular Mod 4.0B	Cellular Mod 4.0B	Cellular Mod 4.0B
ANTENNA TYPE	BXA-80063-4BF-EDIN-0	BXA-80063-4BF-EDIN-0	BXA-80063-4BF-EDIN-0
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	30	150	270
DOWN TILT (MECH/DEG)	2	0	0
RAD CTR (FT AGL)	82	82	82
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL	2 FD9R6004/2C-3L	2 FD9R6004/2C-3L	2 FD9R6004/2C-3L

850 MHz CELLULAR - FUTURE CONFIG	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	Cellular Mod 4.0B	Cellular Mod 4.0B	Cellular Mod 4.0B
ANTENNA TYPE	BXA-80063-4BF-EDIN-0	BXA-80063-4BF-EDIN-0	BXA-80063-4BF-EDIN-0
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	30	150	270
DOWN TILT (MECH/DEG)	2	0	0
RAD CTR (FT AGL)	82	82	82
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			

1900 MHz PCS - CURRENT CONFIG	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	PCS Mod 4.0B	PCS Mod 4.0B	PCS Mod 4.0B
ANTENNA TYPE	MG D3-800T0	MG D3-800T0	MG D3-800T0
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	30	150	270
DOWN TILT (MECH/DEG)	2	2	2
RAD CTR (FT AGL)	82	82	82
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE	YES	YES	YES
RRH - QTY / MODEL			
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX			

1900 MHz PCS - FUTURE CONFIG	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	LTE-PCS BBU+RRH	LTE-PCS BBU+RRH	LTE-PCS BBU+RRH
ANTENNA TYPE	HBXX-6516DS-A2M_PORT 1 - +45_02DT_1920	HBXX-6516DS-A2M_PORT 1 - +45_02DT_1920	HBXX-6516DS-A2M_PORT 1 - +45_02DT_1920
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	30	150	270
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	82	82	82
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE	NO	NO	NO
RRH - QTY / MODEL	1 ALU RH_2X60-PCS	1 ALU RH_2X60-PCS	1 ALU RH_2X60-PCS
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX			

2100 MHz AWS - CURRENT CONFIG	ALPHA		BETA		GAMMA	
EQUIPMENT TYPE	LTE-AWS BBU+RRH		LTE-AWS BBU+RRH		LTE-AWS BBU+RRH	
ANTENNA TYPE	MG D3-800T0		MG D3-800T0		MG D3-800T0	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	30		150		270	
DOWN TILT (MECH/DEG)	2		2		2	
RAD CTR (FT AGL)	82		82		82	
TMA - QTY / MODEL						
DIPLEX WITH LTE-700 CABLE						
RRH - QTY / MODEL	1	ALU RH_2X60-AWS	1	ALU RH_2X60-AWS	1	ALU RH_2X60-AWS
SECTOR DISTRIBUTION BOX						
MAIN DISTRIBUTION BOX	1			DB-T1-6Z-8AB-0Z		
2100 MHz AWS - FUTURE CONFIG	**ALPHA**		**BETA**		**GAMMA**	
EQUIPMENT TYPE	LTE-AWS BBU+RRH		LTE-AWS BBU+RRH		LTE-AWS BBU+RRH	
ANTENNA TYPE	HBXX-6516DS-A2M_PORT 1 - +45_02DT_2110		HBXX-6516DS-A2M_PORT 1 - +45_02DT_2110		HBXX-6516DS-A2M_PORT 1 - +45_02DT_2110	
QTY OF ANTENNAS PER FACE	1		1		1	
ORIENTATION (DEG)	30		150		270	
DOWN TILT (MECH/DEG)	0		0		0	
RAD CTR (FT AGL)	82		82		82	
TMA - QTY / MODEL						
DIPLEX WITH LTE-700 CABLE						
RRH - QTY / MODEL	1	ALU RH_2X60-AWS	1	ALU RH_2X60-AWS	1	ALU RH_2X60-AWS
SECTOR DISTRIBUTION BOX						
MAIN DISTRIBUTION BOX	1			DB-T1-6Z-8AB-0Z		

NUMBER OF CABLES NEEDED				FIBER LINES MODEL NUMBER	
TOTAL # FIBER LINES	1	TOTAL # OF MAINLINES	12	FIBER LINE MODEL #	HB158-1-08U8-S8J10
TOTAL # TOP JUMPERS	6	TOTAL # OF TOP JUMPERS	24	FIBER TOP JUMPER MODEL #	HB114-1-08U4-S4J18

EQUIPMENT CABLE ORDERING	MAIN CABLE #	12	+	0	TOP JUMPER #	24	+	0

TX / RX FREQUENCIES			TX POWER OUTPUT	
Cellular-A Band	**PCS-F/AWS Band**	**700 MHz C-Block**	Cellular (Watts)	20
TX: 869-880/890-891.5 MHz	TX: 1970-1975/2145-2155 MHz	TX: 746-757 MHz	PCS (Watts)	16
RX: 824-835/845-846.5 MHz	RX: 1890-1895/1745-1755 MHz	RX: 776-787 MHz	LTE/AWS/PCS (Watts)	40/60/60

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

RF ENGINEER	RF MANAGER	INITIALS	DATE
Prepared by: Jaime Laredo	Robert Hesselbach	JL	2/16/2015

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

HBXX-6516DS-VTM

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

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

Electrical Specifications

Frequency Band, MHz	**1710–1880**	**1850–1990**	**1920–2180**
Gain, dBi	17.7	18.0	18.0
Beamwidth, Horizontal, degrees	67	66	64
Beamwidth, Vertical, degrees	7.5	7.0	6.6
Beam Tilt, degrees	0–10	0–10	0–10
USLS, dB	18	18	18
Front-to-Back Ratio at 180°, dB	30	30	30
CPR at Boresight, dB	22	22	21
CPR at Sector, dB	8	9	9
Isolation, dB	30	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153	-153
Input Power per Port, maximum, watts	350	350	350
Polarization	±45°	±45°	±45°
Impedance	50 ohm	50 ohm	50 ohm

Electrical Specifications, BASTA*

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

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

General Specifications

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

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

HBXX-6516DS-VTM

Mechanical Specifications

Color	Light gray
Lightning Protection	dc Ground
Radiator Material	Low loss circuit board
Radome Material	PVC, UV resistant
RF Connector Interface	7-16 DIN Female
RF Connector Location	Bottom
RF Connector Quantity, total	4
Wind Loading, maximum	419.0 N @ 150 km/h 94.2 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Dimensions

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

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 1.1 Actuator	HBXX-6516DS-R2M
Model with Factory Installed AISG 2.0 Actuator	HBXX-6516DS-A2M
RET System	Teletilt®

Regulatory Compliance/Certifications

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

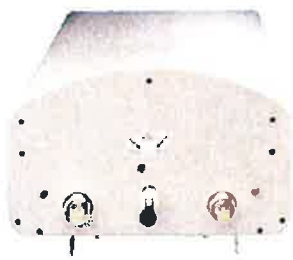
Included Products

600899A-2 — Downtilt Mounting Kit for 2.4 - 4.5 in (60 - 115 mm) OD round members. Kit contains one scissor top bracket set and one bottom bracket set.

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.



LNX-6514DS-VTM

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

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

Electrical Specifications

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

General Specifications

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

Mechanical Specifications

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

Product Specifications

LNX-6514DS-VTM

Dimensions

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

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 1.1 Actuator	LNX-6514DS-R2M
Model with Factory Installed AISG 2.0 Actuator	LNX-6514DS-A1M
RET System	Teletilt®

Regulatory Compliance/Certifications

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

Included Products

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

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

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.)