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Also admitted in Massachusetts

February 20, 2014

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

Re: **Notice of Exempt Modification – Facility Modification**
165 Elmwood Hill Road, Putnam, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) wireless telecommunications antennas at the 147-foot level of the existing 150-foot tower at 165 Elmwood Hill Road in Putnam, Connecticut (the "Property"). The tower is owned by Cellco. The Council approved Cellco's use of the existing tower in 2008 (Docket No. 362). While not physically changing any antennas, Cellco intends to use three of its existing antennas for its 2100 MHz frequency service. At the same time, Cellco plans to install three (3) remote radio heads ("RRHs") behind the 2100 MHz antennas and one (1) HYBRIFLEX™ antenna cable inside the monopole. Included in Attachment 1 are specifications for Cellco's 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 Tony Falzarano, Mayor of the Town of Putnam. A copy of this letter is also being sent to Lois S. Pray, the record owner of the Property.

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

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1. The proposed modifications will not result in an increase in the height of the existing tower. The RRHs will be located on Cellco's existing antenna platform at the 147-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 modified facility with the use of the 2100 MHz frequencies and RRHs, will not increase radio frequency (RF) emissions at the facility to a level at or above the Federal Communications Commission (FCC) safety standard. A cumulative RF emissions calculation for Cellco's modified facility is included in Attachment 2.

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

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

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

Sincerely,

Kenneth C. Baldwin

Enclosures
Copy to:
Tony Falzarano, Putnam Mayor
Lois S. Pray
Sandy M. Carter

ATTACHMENT 1

Alcatel·Lucent

Alcatel-Lucent RRH2x40-AWS

REMOTE RADIO HEAD

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

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

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

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

Fast, low-cost installation and deployment

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

Excellent RF performance

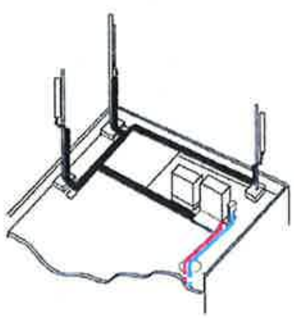
Because of its small size and weight, the Alcatel-Lucent RRH2x40-AWS can be installed close to the antenna. Operators can therefore locate the Alcatel-Lucent RRH2x40-AWS where RF engineering is deemed ideal, minimizing trade-offs between available sites and RF optimum sites. The RF feeder cost and installation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

Features

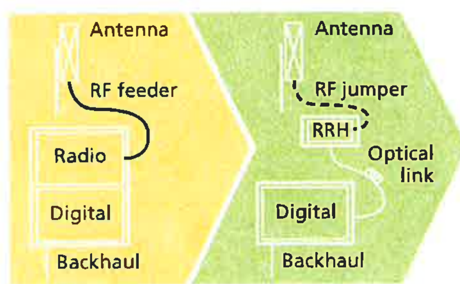
- Zero-footprint deployment
- Easy installation, with a lightweight unit can be carried and set up by one person
- Optimized RF power, with flexible site selection and elimination of a TMA
- Convection-cooled (fanless)
- Noise-free
- Best-in-class power efficiency, with significantly reduced energy consumption

Benefits

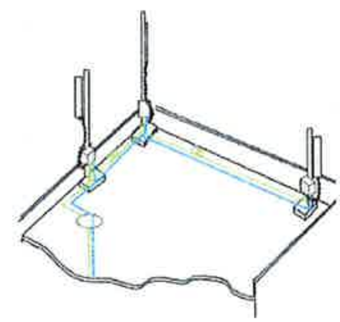
- Leverages existing real estate with lower site costs
- Reduces installation costs, with fewer installation materials and simplified logistics
- Decreases power costs and minimizes environmental impacts, with the potential for eco-sustainable power options
- Improves RF performance and adds flexibility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



Macro



RRH for space-constrained cell sites



Distributed

Technical specifications

Physical dimensions

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

Power

- Power supply: -48VDC

Operating environment

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

RF characteristics

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

Optical characteristics

Type/number of fibers

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

Optical fiber length

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

Digital Ports and Alarms

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

Product Data Sheet HB158-1-08U8-S8J18

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

Product Description

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

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

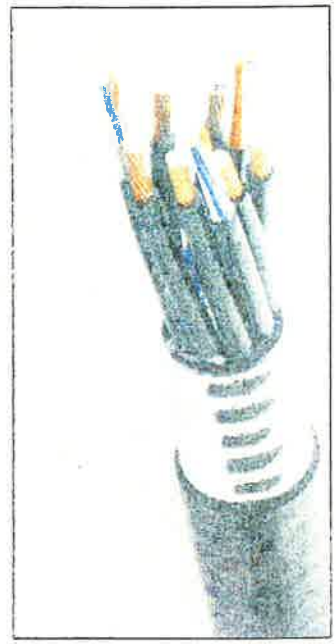


Figure 1: HYBRIFLEX Series

Features/Benefits

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

Technical Specifications

Outer Conductor Armor	Corrugated Aluminum	[mm (in)]	46.5 (1.83)
Jacket	Polyethylene, PE	[mm (in)]	50.3 (1.98)
UV-Protection	Individual and External Jacket		Yes
Weight, Approximate		[kg/m (lb/ft)]	1 9 (1 30)
Minimum Bending Radius, Single Bending		[mm (in)]	200 (8)
Minimum Bending Radius, Repeated Bending		[mm (in)]	500 (20)
Recommended/Maximum Clamp Spacing		[m (ft)]	1.0 / 1.2 (3.25 / 4.0)
DC-Resistance Outer Conductor Armor		[Ω/km (Ω/1000ft)]	068 (0.205)
DC-Resistance Power Cable, 8 4mm² (8AWG)		[Ω/km (Ω/1000ft)]	2.1 (0.307)
Version			Single-mode OM3
Quantity, Fiber Count			16 (8 pairs)
Core/Clad		[µm]	50/125
Primary Coating (Acrylate)		[µm]	245
Buffer Diameter, Nominal		[µm]	900
Secondary Protection, Jacket, Nominal		[mm (in)]	2.0 (0.08)
Minimum Bending Radius		[mm (in)]	104 (4.1)
Insertion Loss @ wavelength 850nm		dB/km	3.0
Insertion Loss @ wavelength 1310nm		dB/km	1.0
Standards (Meets or exceeds)			UL94-V0, UL1666 RoHS Compliant
Size (Power)		[mm (AWG)]	8.4 (8)
Quantity, Wire Count (Power)			16 (8 pairs)
Size (Alarm)		[mm (AWG)]	0.8 (18)
Quantity, Wire Count (Alarm)			4 (2 pairs)
Type			UV protected
Strands			19
Primary Jacket Diameter, Nominal		[mm (in)]	6.8 (0.27)
Standards (Meets or exceeds)			NFPA 130, ICEA S-95-658 UL Type XHHW-2, UL 44 UL-LS Limited Smoke, UL VW-1 IEEE-383 (1974), IEEE1202/FT4 RoHS Compliant
Installation Temperature		[°C (°F)]	-40 to +65 (-40 to149)
Operation Temperature		[°C (°F)]	-40 to +65 (-40 to149)

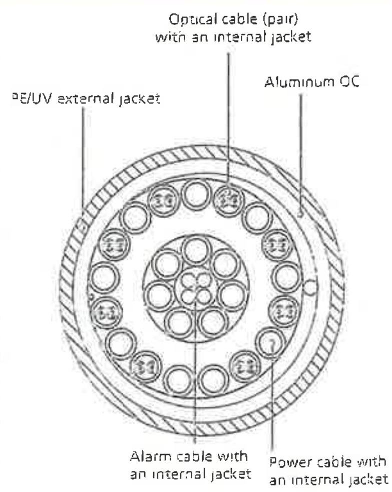


Figure 2: Construction Detail

* This data is provisional and subject to change

ATTACHMENT 2

	General	Power	Density					
Site Name: East Putnam								
Tower Height: Verizon @ 147ft								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*AT&T UMTS	2	565	137	0.0216	880	0.5867	3.69%	
*AT&T UMTS	2	875	137	0.0335	1900	1.0000	3.35%	
*AT&T GSM	1	283	137	0.0054	880	0.5867	0.92%	
*AT&T GSM	4	525	137	0.0402	1900	1.0000	4.02%	
*AT&T LTE	1	1771	137	0.0339	734	0.4893	6.93%	
Verizon	**11**	**411**	**147**	**0.0752**	**1970**	**1.0000**	**7.52%**	
Verizon	**9**	**388**	**147**	**0.0581**	**869**	**0.5793**	**10.03%**	
Verizon	**1**	**1750**	**147**	**0.0291**	**2145**	**1.0000**	**2.91%**	
Verizon	**1**	**1050**	**147**	**0.0175**	**698**	**0.4653**	**3.75%**	
								43.14%
* Source: Siting Council								

ATTACHMENT 3

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

150-ft Existing Valmont Monopole

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: East Putnam

165 Elmwood Hill Road
Putnam, CT

Centek Project No. 14001.018

Date: February 10, 2014

Prepared for:

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

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

Table of Contents

Introduction

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

The host tower is a 150-ft tall extendable to 167-ft, four-section, eighteen sided, tapered monopole, originally designed by DaVinci Engineering Inc., job no.; 09242-1124 and manufactured by Valmont Structures design no; 33683, dated February 20, 2009. The tower geometry, structure member sizes and foundation system information were obtained from the aforementioned DaVinci/Valmont design documents.

Antenna and appurtenance information were obtained from a previous structural analysis report prepared by Centek job no; 12044.CO9 dated September 25, 2012, visual verification from grade conducted by Centek personnel on January 30, 2014 and a Verizon RF data sheet.

The tower is made up of four (4) tapered vertical sections consisting of A572-65 pole sections. The vertical tower sections are slip joint connected. The diameter of the pole (flat-flat) is 28.03-in at the top and 70.28-in at the base.

Verizon proposes the installation of three (3) remote radio heads and one (1) main distribution box mounted to 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, proposed and future loads considered in this analysis consist of the following:

- AT&T (EXISTING):
  Antennas: Six (6) Powerwave 7770 panel antennas, three (3) KMW AM-X-CD-17-65-00T-RET panel antennas, six (6) Powerwave LGP21401 TMA's, six (6) Powerwave LGP13519 diplexers, six (6) Ericsson RRUS-11 remote radio heads and one (1) Raycap DC6-48-60-18-8F surge arrestor mounted on a 13-ft low profile platform with a RAD center elevation of 137-ft above existing grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables, one (1) fiber cable and two (2) dc control cables running on the inside of the existing tower.
- VERIZON (EXISTING TO REMAIN):
  Antennas: Three (3) Antel BXA-70063-6CF, six (6) Swedcom SC-E 6014 rev2, and three (3) Antel BXA-171063-12CF panel antennas mounted on an existing 13-ft square platform w/ handrails with a RAD center elevation of 147-ft above grade.
  Coax Cables: Eighteen (18) 1-5/8" ∅ coax cables running on the inside of the existing tower.
- **VERIZON (PROPOSED):**
  Antennas: Three (3) Alcatel-Lucent RRH2x40-AWS Remote Radio Heads and one (1) RFS DB-T1-6Z-8AB-0Z main distribution box mounted on a 13-ft square platform w/ handrails with a RAD center elevation of 147-ft above grade.
  Coax Cables: One (1) 1-5/8" ∅ fiber cable running on the inside of the monopole.

Primary Assumptions Used in the Analysis

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

Analysis

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

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

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

Tower Loading

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

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

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

Tower Capacity

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

- Calculated stresses were found to be within allowable limits. In Load Case 1, per tnxTower "Section Capacity Table", this tower was found to be at **34.8%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L4)	1.00'-47.25'	34.8%	**PASS**

Foundation and Anchors

The existing foundation consists of a 9.0-ft square x 2.5-ft long reinforced concrete pier on a 29.0-ft square x 4.0-ft thick reinforced concrete pad. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned design calculations by DaVinci Engineering Inc., job no.; 09242-1124 and design drawings by Valmont Structures design no; 33683, dated February 20, 2009. The base of the tower is connected to the foundation by means of (24) 2.25"∅, ASTM A615-75 anchor bolts embedded approximately 6-ft into the concrete foundation structure.

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

Location	Vector	Proposed Reactions
Base	Shear	24 kips
	Compression	43 kips
	Moment	2391 kip-ft

- The foundation was found to be within allowable limits.

Foundation	Design Limit	IBC 2003/2005 CT State Building Code Section 3108.4.2 (FS)[1]	Proposed Loading (FS)[1]	Result
Reinforced Concrete Pad and Pier	OTM[2]	2.0	4.68	**PASS**

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

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

Tower Component	Design Limit	Stress Ratio (percentage of capacity)	Result
Anchor Bolts	Combined Compression and Bending	32.2%	**PASS**
Base Plate	Bending	37.7%	**PASS**

Conclusion

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

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

Please feel free to call with any questions or comments.

Respectfully Submitted by:

Carlo F. Centore, PE
Principal ~ Structural Engineer

STATE OF CONNECTICUT
CARLO F. CENTORE
No. 16684
LICENSED
PROFESSIONAL ENGINEER

Prepared by:

Timothy J. Lynn, PE
Structural Engineer

Standard Conditions for Furnishing of Professional Engineering Services on Existing Structures

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

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

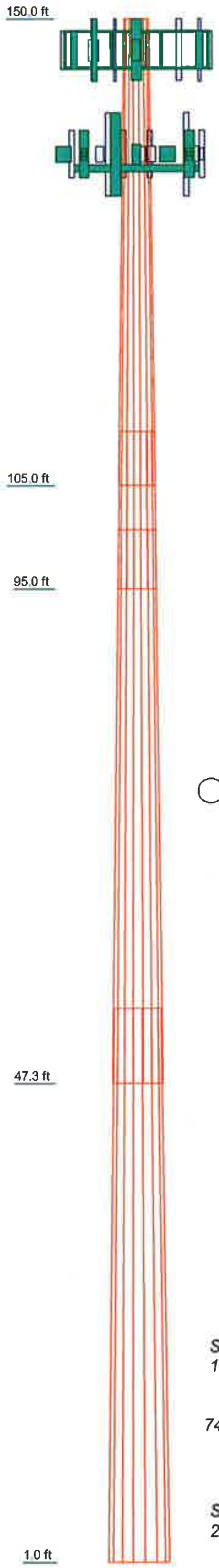
General Description of Structural Analysis Program

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

tnxTower Features:

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

Section	Length (ft)	Number of Sides	Thickness (in)	Socket Length (ft)	Top Dia (in)	Bot Dia (in)	Grade	Weight (K)
1	45.000	18	0.250	5.250	28.028	41.336	A572-65	4.2
2	15.250	18	0.281	5.750	39.283	43.793		1.9
3	53.500	18	0.375	7.250	41.530	57.352		10.6
4	53.500	18	0.438		54.458	70.280		15.7
								32.4



DESIGNED APPURTENANCE LOADING

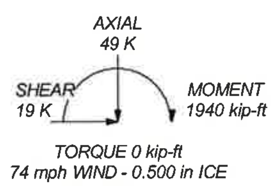
TYPE	ELEVATION	TYPE	ELEVATION
SC-E 6014 rev2 (Verizon - Existing)	147	(2) LGP13519 Diplexer (ATT - Existing)	137
BXA-171063-12CF (Verizon - Existing)	147	(2) LGP13519 Diplexer (ATT - Existing)	137
BXA-70063/6CF (Verizon - Existing)	147	(2) LGP13519 Diplexer (ATT - Existing)	137
SC-E 6014 rev2 (Verizon - Existing)	147	AM-X-CD-17-65-00T-RET (ATT - Existing)	137
SC-E 6014 rev2 (Verizon - Existing)	147	AM-X-CD-17-65-00T-RET (ATT - Existing)	137
BXA-171063-12CF (Verizon - Existing)	147	AM-X-CD-17-65-00T-RET (ATT - Existing)	137
BXA-70063/6CF (Verizon - Existing)	147	(2) RRUS-11 (ATT - Existing)	137
SC-E 6014 rev2 (Verizon - Existing)	147	(2) RRUS-11 (ATT - Existing)	137
SC-E 6014 rev2 (Verizon - Existing)	147	(2) RRUS-11 (ATT - Existing)	137
BXA-171063-12CF (Verizon - Existing)	147	DC6-48-60-18-8F Surge Arrestor (ATT - Existing)	137
BXA-70063/6CF (Verizon - Existing)	147	(2) 7770.00 (ATT - Existing)	137
SC-E 6014 rev2 (Verizon - Existing)	147	(2) 7770.00 (ATT - Existing)	137
13-ft Square Platform w/ rails (Verizon - Existing)	147	(2) 7770.00 (ATT - Existing)	137
RRH2x40-AWS (Verizon - Proposed)	147	(2) LGP21401 TMA (ATT - Existing)	137
RRH2x40-AWS (Verizon - Proposed)	147	Valmont 13' Low Profile Platform (ATT - Existing)	136
RRH2x40-AWS (Verizon - Proposed)	147		
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	147		
(2) LGP21401 TMA (ATT - Existing)	137		
(2) LGP21401 TMA (ATT - Existing)	137		

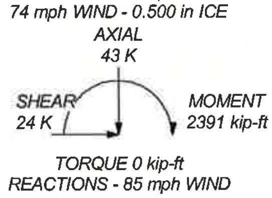
MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower designed for a 85 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 74 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. Weld together tower sections have flange connections.
5. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
6. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
7. Welds are fabricated with ER-70S-6 electrodes.
8. TOWER RATING: 34.8%





Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job: **14001.018 - East Putnam**		
	Project: **150-ft Valmont Monopole - 165 Elmwood Hill Rd., Putnam, CT**		
	Client: Verizon Wireless	Drawn by: TJL	App'd:
	Code: TIA/EIA-222-F	Date: 02/10/14	Scale: NTS
	Path:		Dwg No. E-1

Tower Input Data

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

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

Options

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

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

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

Tapered Pole Section Geometry

Section	Elevation *ft*	Section Length *ft*	Splice Length *ft*	Number of Sides	Top Diameter *in*	Bottom Diameter *in*	Wall Thickness *in*	Bend Radius *in*	Pole Grade
L1	150.000-105.000	45.000	5.250	18	28.028	41.336	0.250	1.000	A572-65 (65 ksi)
L2	105.000-95.000	15.250	5.750	18	39.283	43.793	0.281	1.125	A572-65 (65 ksi)
L3	95.000-47.250	53.500	7.250	18	41.530	57.352	0.375	1.500	A572-65 (65 ksi)

Section	*Elevation* *ft*	*Section Length* *ft*	*Splice Length* *ft*	*Number of Sides*	*Top Diameter* *in*	*Bottom Diameter* *in*	*Wall Thickness* *in*	*Bend Radius* *in*	*Pole Grade*
L4	47.250-1.000	53.500		18	54.458	70.280	0.438	1.750	A572-65 (65 ksi)

Tapered Pole Properties

Section	*Tip Dia.* *in*	*Area* *in^2*	*I* *in^4*	*r* *in*	*C* *in*	*I/C* *in^3*	*J* *in^4*	*It/Q* *in^2*	*w* *in*	*w/t*
L1	28.460	22.042	2148.757	9.861	14.238	150.915	4300.341	11.023	4.493	17.972
	41.974	32.602	6952.900	14.586	20.999	331.111	13914.948	16.304	6.835	27.341
L2	41.466	34.823	6692.341	13.846	19.956	335.355	13393.488	17.415	6.419	22.818
	44.469	38.849	9292.493	15.447	22.247	417.699	18597.214	19.428	7.212	25.64
L3	43.897	48.985	10482.028	14.610	21.097	496.843	20977.849	24.497	6.649	17.731
	58.237	67.817	27814.700	20.227	29.135	954.689	55665.999	33.915	9.434	25.157
L4	57.475	75.014	27656.419	19.177	27.665	999.704	55349.229	37.514	8.815	20.148
	71.364	96.985	59769.794	24.794	35.702	1674.119	119618.235	48.502	11.599	26.513

Tower Elevation *ft*	*Gusset Area (per face)* *ft^2*	*Gusset Thickness* *in*	*Gusset Grade*	*Adjust. Factor A_f*	*Adjust. Factor A_r*	*Weight Mult.*	*Double Angle Stitch Bolt Spacing Diagonals* *in*	*Double Angle Stitch Bolt Spacing Horizontals* *in*
L1 150.000-105.000				1	1	1		
L2 105.000-95.000				1	1	1		
L3 95.000-47.250				1	1	1		
L4 47.250-1.000				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	*Face or Leg*	*Allow Shield*	*Component Type*	*Placement* *ft*	*Total Number*		*C_AA_A* *ft^2/ft*	*Weight* *klf*
LCF158-50J (1 5/8 FOAM) (Verizon - Existing)	C	No	Inside Pole	149.000 - 4.000	18	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (AT&T - Existing)	C	No	Inside Pole	139.000 - 4.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
RG6-Fiber (AT&T - Existing)	C	No	Inside Pole	139.000 - 4.000	1	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
#8 AWG Copper WIre (AT&T - Existing)	C	No	Inside Pole	139.000 - 4.000	2	No Ice	0.000	0.000
						1/2" Ice	0.000	0.000
HYBRIFLEX 1-5/8" (Verizon - Proposed)	C	No	Inside Pole	149.000 - 4.000	1	No Ice	0.000	0.002
						1/2" Ice	0.000	0.002

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	150.000-105.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	1.274
L2	105.000-95.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.320
L3	95.000-47.250	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	1.530
L4	47.250-1.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	1.386

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	150.000-105.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	1.274
L2	105.000-95.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.320
L3	95.000-47.250	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	1.530
L4	47.250-1.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	1.386

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
SC-E 6014 rev2 (Verizon - Existing)	A	From Face	3.500 6.000 0.000	0.000	147.000	No Ice 1/2" Ice	3.595 3.936	3.383 3.721	0.015 0.042
BXA-171063-12CF (Verizon - Existing)	A	From Face	3.500 4.000 0.000	0.000	147.000	No Ice 1/2" Ice	4.791 5.242	3.618 4.058	0.015 0.042
BXA-70063/6CF (Verizon - Existing)	A	From Face	3.500 0.000 0.000	0.000	147.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.017 0.059
SC-E 6014 rev2 (Verizon - Existing)	A	From Face	3.500 -6.000	0.000	147.000	No Ice 1/2" Ice	3.595 3.936	3.383 3.721	0.015 0.042

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*
			0.000						
SC-E 6014 rev2 (Verizon - Existing)	B	From Face	3.500 6.000 0.000	0.000	147.000	No Ice 1/2" Ice	3.595 3.936	3.383 3.721	0.015 0.042
BXA-171063-12CF (Verizon - Existing)	B	From Face	3.500 4.000 0.000	0.000	147.000	No Ice 1/2" Ice	4.791 5.242	3.618 4.058	0.015 0.042
BXA-70063/6CF (Verizon - Existing)	B	From Face	3.500 0.000 0.000	0.000	147.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.017 0.059
SC-E 6014 rev2 (Verizon - Existing)	B	From Face	3.500 -6.000 0.000	0.000	147.000	No Ice 1/2" Ice	3.595 3.936	3.383 3.721	0.015 0.042
SC-E 6014 rev2 (Verizon - Existing)	C	From Face	3.500 6.000 0.000	0.000	147.000	No Ice 1/2" Ice	3.595 3.936	3.383 3.721	0.015 0.042
BXA-171063-12CF (Verizon - Existing)	C	From Face	3.500 4.000 0.000	0.000	147.000	No Ice 1/2" Ice	4.791 5.242	3.618 4.058	0.015 0.042
BXA-70063/6CF (Verizon - Existing)	C	From Face	3.500 0.000 0.000	0.000	147.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.017 0.059
SC-E 6014 rev2 (Verizon - Existing)	C	From Face	3.500 -6.000 0.000	0.000	147.000	No Ice 1/2" Ice	3.595 3.936	3.383 3.721	0.015 0.042
13-ft Square Platform w/ rails (Verizon - Existing)	C	None		0.000	147.000	No Ice 1/2" Ice	43.000 50.000	43.000 50.000	3.500 4.000
(2) 7770.00 (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	137.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) 7770.00 (AT&T - Existing)	B	From Face	3.000 0.000 0.000	0.000	137.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) 7770.00 (AT&T - Existing)	C	From Face	3.000 0.000 0.000	0.000	137.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) LGP21401 TMA (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	137.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
(2) LGP21401 TMA (AT&T - Existing)	B	From Face	3.000 0.000 0.000	0.000	137.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
(2) LGP21401 TMA (AT&T - Existing)	C	From Face	3.000 0.000 0.000	0.000	137.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
(2) LGP13519 Diplexer (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	137.000	No Ice 1/2" Ice	0.270 0.343	0.184 0.248	0.005 0.008
(2) LGP13519 Diplexer (AT&T - Existing)	B	From Face	3.000 0.000 0.000	0.000	137.000	No Ice 1/2" Ice	0.270 0.343	0.184 0.248	0.005 0.008
(2) LGP13519 Diplexer (AT&T - Existing)	C	From Face	3.000 0.000 0.000	0.000	137.000	No Ice 1/2" Ice	0.270 0.343	0.184 0.248	0.005 0.008
AM-X-CD-17-65-00T-RET (AT&T - Existing)	A	From Face	3.000 2.000 0.000	0.000	137.000	No Ice 1/2" Ice	11.311 11.927	6.800 7.384	0.060 0.121

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
AM-X-CD-17-65-00T-RET (AT&T - Existing)	B	From Face	3.000 2.000 0.000	0.000	137.000	No Ice 1/2" Ice	11.311 11.927	6.800 7.384	0.060 0.121
AM-X-CD-17-65-00T-RET (AT&T - Existing)	C	From Face	3.000 2.000 0.000	0.000	137.000	No Ice 1/2" Ice	11.311 11.927	6.800 7.384	0.060 0.121
(2) RRUS-11 (AT&T - Existing)	A	From Face	1.000 2.000 0.000	0.000	137.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Existing)	B	From Face	1.000 2.000 0.000	0.000	137.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Existing)	C	From Face	1.000 2.000 0.000	0.000	137.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	C	From Face	0.500 0.000 0.000	0.000	137.000	No Ice 1/2" Ice	2.228 2.447	2.228 2.447	0.020 0.039
Valmont 13' Low Profile Platform (AT&T - Existing)	C	None		0.000	136.000	No Ice 1/2" Ice	15.700 20.100	15.700 20.100	1.300 1.765
RRH2x40-AWS (Verizon - Proposed)	A	From Face	3.500 0.000 0.000	0.000	147.000	No Ice 1/2" Ice	2.522 2.753	1.589 1.795	0.044 0.061
RRH2x40-AWS (Verizon - Proposed)	B	From Face	3.500 0.000 0.000	0.000	147.000	No Ice 1/2" Ice	2.522 2.753	1.589 1.795	0.044 0.061
RRH2x40-AWS (Verizon - Proposed)	C	From Face	3.500 0.000 0.000	0.000	147.000	No Ice 1/2" Ice	2.522 2.753	1.589 1.795	0.044 0.061
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	A	From Face	3.500 0.000 0.000	0.000	147.000	No Ice 1/2" Ice	5.600 5.915	2.333 2.558	0.044 0.080

Tower Pressures - No Ice

G_H = 1.690

Section Elevation ft	*z* ft	*K_Z*	*q_z* ksf	*A_G* ft^2	*F a c e*	*A_F* ft^2	*A_R* ft^2	*A_{leg}* ft^2	*Leg %*	*C_AA_A In Face* ft^2	*C_AA_A Out Face* ft^2
L1 150.000-105.000	126.342	1.468	0.027	130.058	A	0.000	130.058	130.058	100.00	0.000	0.000
					B	0.000	130.058		100.00	0.000	0.000
					C	0.000	130.058		100.00	0.000	0.000
L2 105.000-95.000	99.942	1.372	0.025	35.262	A	0.000	35.262	35.262	100.00	0.000	0.000
					B	0.000	35.262		100.00	0.000	0.000
					C	0.000	35.262		100.00	0.000	0.000
L3 95.000-47.250	70.585	1.243	0.023	200.117	A	0.000	200.117	200.117	100.00	0.000	0.000
					B	0.000	200.117		100.00	0.000	0.000

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
					C	0.000	200.117		100.00	0.000	0.000
L4 47.250-1.000	23.413	1	0.019	244.512	A	0.000	244.512	244.512	100.00	0.000	0.000
					B	0.000	244.512		100.00	0.000	0.000
					C	0.000	244.512		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 150.000-105.000	126.342	1.468	0.020	0.500	133.808	A	0.000	133.808	133.808	100.00	0.000	0.000
						B	0.000	133.808		100.00	0.000	0.000
						C	0.000	133.808		100.00	0.000	0.000
L2 105.000-95.000	99.942	1.372	0.019	0.500	36.095	A	0.000	36.095	36.095	100.00	0.000	0.000
						B	0.000	36.095		100.00	0.000	0.000
						C	0.000	36.095		100.00	0.000	0.000
L3 95.000-47.250	70.585	1.243	0.017	0.500	204.097	A	0.000	204.097	204.097	100.00	0.000	0.000
						B	0.000	204.097		100.00	0.000	0.000
						C	0.000	204.097		100.00	0.000	0.000
L4 47.250-1.000	23.413	1	0.014	0.500	248.366	A	0.000	248.366	248.366	100.00	0.000	0.000
						B	0.000	248.366		100.00	0.000	0.000
						C	0.000	248.366		100.00	0.000	0.000

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 150.000-105.000	126.342	1.468	0.009	130.058	A	0.000	130.058	130.058	100.00	0.000	0.000
					B	0.000	130.058		100.00	0.000	0.000
					C	0.000	130.058		100.00	0.000	0.000
L2 105.000-95.000	99.942	1.372	0.009	35.262	A	0.000	35.262	35.262	100.00	0.000	0.000
					B	0.000	35.262		100.00	0.000	0.000
					C	0.000	35.262		100.00	0.000	0.000
L3 95.000-47.250	70.585	1.243	0.008	200.117	A	0.000	200.117	200.117	100.00	0.000	0.000
					B	0.000	200.117		100.00	0.000	0.000
					C	0.000	200.117		100.00	0.000	0.000
L4 47.250-1.000	23.413	1	0.006	244.512	A	0.000	244.512	244.512	100.00	0.000	0.000
					B	0.000	244.512		100.00	0.000	0.000
					C	0.000	244.512		100.00	0.000	0.000

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-105.000	1.274	4.184	A	1	0.65	1	1	1	130.058	3.872	0.086	C
			B	1	0.65	1	1	1	130.058			
			C	1	0.65	1	1	1	130.058			
L2 105.000-95.000	0.320	1.912	A	1	0.65	1	1	1	35.262	0.983	0.098	C
			B	1	0.65	1	1	1	35.262			
			C	1	0.65	1	1	1	35.262			
L3 95.000-47.250	1.530	10.632	A	1	0.65	1	1	1	200.117	5.026	0.105	C
			B	1	0.65	1	1	1	200.117			
			C	1	0.65	1	1	1	200.117			
L4 47.250-1.000	1.386	15.656	A	1	0.65	1	1	1	244.512	5.017	0.108	C
			B	1	0.65	1	1	1	244.512			
			C	1	0.65	1	1	1	244.512			
Sum Weight:	4.510	32.383						OTM	1044.820 kip-ft	14.898		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-105.000	1.274	4.184	A	1	0.65	1	1	1	130.058	3.872	0.086	C
			B	1	0.65	1	1	1	130.058			
			C	1	0.65	1	1	1	130.058			
L2 105.000-95.000	0.320	1.912	A	1	0.65	1	1	1	35.262	0.983	0.098	C
			B	1	0.65	1	1	1	35.262			
			C	1	0.65	1	1	1	35.262			
L3 95.000-47.250	1.530	10.632	A	1	0.65	1	1	1	200.117	5.026	0.105	C
			B	1	0.65	1	1	1	200.117			
			C	1	0.65	1	1	1	200.117			
L4 47.250-1.000	1.386	15.656	A	1	0.65	1	1	1	244.512	5.017	0.108	C
			B	1	0.65	1	1	1	244.512			
			C	1	0.65	1	1	1	244.512			
Sum Weight:	4.510	32.383						OTM	1044.820 kip-ft	14.898		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-105.000	1.274	4.184	A	1	0.65	1	1	1	130.058	3.872	0.086	C
			B	1	0.65	1	1	1	130.058			
			C	1	0.65	1	1	1	130.058			
L2 105.000-95.000	0.320	1.912	A	1	0.65	1	1	1	35.262	0.983	0.098	C
			B	1	0.65	1	1	1	35.262			
			C	1	0.65	1	1	1	35.262			
L3 95.000-47.250	1.530	10.632	A	1	0.65	1	1	1	200.117	5.026	0.105	C
			B	1	0.65	1	1	1	200.117			
			C	1	0.65	1	1	1	200.117			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L4 47.250-1.000	1.386	15.656	A	1	0.65	1	1	1	244.512	5.017	0.108	C
			B	1	0.65	1	1	1	244.512			
			C	1	0.65	1	1	1	244.512			
Sum Weight:	4.510	32.383						OTM	1044.820 kip-ft	14.898		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-105.000	1.274	4.184	A	1	0.65	1	1	1	130.058	3.872	0.086	C
			B	1	0.65	1	1	1	130.058			
			C	1	0.65	1	1	1	130.058			
L2 105.000-95.000	0.320	1.912	A	1	0.65	1	1	1	35.262	0.983	0.098	C
			B	1	0.65	1	1	1	35.262			
			C	1	0.65	1	1	1	35.262			
L3 95.000-47.250	1.530	10.632	A	1	0.65	1	1	1	200.117	5.026	0.105	C
			B	1	0.65	1	1	1	200.117			
			C	1	0.65	1	1	1	200.117			
L4 47.250-1.000	1.386	15.656	A	1	0.65	1	1	1	244.512	5.017	0.108	C
			B	1	0.65	1	1	1	244.512			
			C	1	0.65	1	1	1	244.512			
Sum Weight:	4.510	32.383						OTM	1044.820 kip-ft	14.898		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-105.000	1.274	5.161	A	1	0.65	1	1	1	133.808	2.988	0.066	C
			B	1	0.65	1	1	1	133.808			
			C	1	0.65	1	1	1	133.808			
L2 105.000-95.000	0.320	2.176	A	1	0.65	1	1	1	36.095	0.755	0.075	C
			B	1	0.65	1	1	1	36.095			
			C	1	0.65	1	1	1	36.095			
L3 95.000-47.250	1.530	12.129	A	1	0.65	1	1	1	204.097	3.844	0.081	C
			B	1	0.65	1	1	1	204.097			
			C	1	0.65	1	1	1	204.097			
L4 47.250-1.000	1.386	17.481	A	1	0.65	1	1	1	248.366	3.822	0.083	C
			B	1	0.65	1	1	1	248.366			
			C	1	0.65	1	1	1	248.366			
Sum Weight:	4.510	36.946						OTM	802.381 kip-ft	11.409		

Tower Forces - With Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 150.000-105.000	1.274	5.161	A	1	0.65	1	1	1	133.808	2.988	0.066	C
			B	1	0.65	1	1	1	133.808			
			C	1	0.65	1	1	1	133.808			
L2 105.000-95.000	0.320	2.176	A	1	0.65	1	1	1	36.095	0.755	0.075	C
			B	1	0.65	1	1	1	36.095			
			C	1	0.65	1	1	1	36.095			
L3 95.000-47.250	1.530	12.129	A	1	0.65	1	1	1	204.097	3.844	0.081	C
			B	1	0.65	1	1	1	204.097			
			C	1	0.65	1	1	1	204.097			
L4 47.250-1.000	1.386	17.481	A	1	0.65	1	1	1	248.366	3.822	0.083	C
			B	1	0.65	1	1	1	248.366			
			C	1	0.65	1	1	1	248.366			
Sum Weight:	4.510	36.946						OTM	802.381 kip-ft	11.409		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 150.000-105.000	1.274	5.161	A	1	0.65	1	1	1	133.808	2.988	0.066	C
			B	1	0.65	1	1	1	133.808			
			C	1	0.65	1	1	1	133.808			
L2 105.000-95.000	0.320	2.176	A	1	0.65	1	1	1	36.095	0.755	0.075	C
			B	1	0.65	1	1	1	36.095			
			C	1	0.65	1	1	1	36.095			
L3 95.000-47.250	1.530	12.129	A	1	0.65	1	1	1	204.097	3.844	0.081	C
			B	1	0.65	1	1	1	204.097			
			C	1	0.65	1	1	1	204.097			
L4 47.250-1.000	1.386	17.481	A	1	0.65	1	1	1	248.366	3.822	0.083	C
			B	1	0.65	1	1	1	248.366			
			C	1	0.65	1	1	1	248.366			
Sum Weight:	4.510	36.946						OTM	802.381 kip-ft	11.409		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 150.000-105.000	1.274	5.161	A	1	0.65	1	1	1	133.808	2.988	0.066	C
			B	1	0.65	1	1	1	133.808			
			C	1	0.65	1	1	1	133.808			
L2 105.000-95.000	0.320	2.176	A	1	0.65	1	1	1	36.095	0.755	0.075	C
			B	1	0.65	1	1	1	36.095			
			C	1	0.65	1	1	1	36.095			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L3 95.000-47.250	1.530	12.129	A	1	0.65	1	1	1	204.097	3.844	0.081	C
			B	1	0.65	1	1	1	204.097			
			C	1	0.65	1	1	1	204.097			
L4 47.250-1.000	1.386	17.481	A	1	0.65	1	1	1	248.366	3.822	0.083	C
			B	1	0.65	1	1	1	248.366			
			C	1	0.65	1	1	1	248.366			
Sum Weight:	4.510	36.946						OTM	802.381 kip-ft	11.409		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-105.000	1.274	4.184	A	1	0.65	1	1	1	130.058	1.340	0.030	C
			B	1	0.65	1	1	1	130.058			
			C	1	0.65	1	1	1	130.058			
L2 105.000-95.000	0.320	1.912	A	1	0.65	1	1	1	35.262	0.340	0.034	C
			B	1	0.65	1	1	1	35.262			
			C	1	0.65	1	1	1	35.262			
L3 95.000-47.250	1.530	10.632	A	1	0.65	1	1	1	200.117	1.739	0.036	C
			B	1	0.65	1	1	1	200.117			
			C	1	0.65	1	1	1	200.117			
L4 47.250-1.000	1.386	15.656	A	1	0.65	1	1	1	244.512	1.736	0.038	C
			B	1	0.65	1	1	1	244.512			
			C	1	0.65	1	1	1	244.512			
Sum Weight:	4.510	32.383						OTM	361.530 kip-ft	5.155		

Tower Forces - Service - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-105.000	1.274	4.184	A	1	0.65	1	1	1	130.058	1.340	0.030	C
			B	1	0.65	1	1	1	130.058			
			C	1	0.65	1	1	1	130.058			
L2 105.000-95.000	0.320	1.912	A	1	0.65	1	1	1	35.262	0.340	0.034	C
			B	1	0.65	1	1	1	35.262			
			C	1	0.65	1	1	1	35.262			
L3 95.000-47.250	1.530	10.632	A	1	0.65	1	1	1	200.117	1.739	0.036	C
			B	1	0.65	1	1	1	200.117			
			C	1	0.65	1	1	1	200.117			
L4 47.250-1.000	1.386	15.656	A	1	0.65	1	1	1	244.512	1.736	0.038	C
			B	1	0.65	1	1	1	244.512			
			C	1	0.65	1	1	1	244.512			
Sum Weight:	4.510	32.383						OTM	361.530 kip-ft	5.155		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-105.000	1.274	4.184	A	1	0.65	1	1	1	130.058	1.340	0.030	C
			B	1	0.65	1	1	1	130.058			
			C	1	0.65	1	1	1	130.058			
L2 105.000-95.000	0.320	1.912	A	1	0.65	1	1	1	35.262	0.340	0.034	C
			B	1	0.65	1	1	1	35.262			
			C	1	0.65	1	1	1	35.262			
L3 95.000-47.250	1.530	10.632	A	1	0.65	1	1	1	200.117	1.739	0.036	C
			B	1	0.65	1	1	1	200.117			
			C	1	0.65	1	1	1	200.117			
L4 47.250-1.000	1.386	15.656	A	1	0.65	1	1	1	244.512	1.736	0.038	C
			B	1	0.65	1	1	1	244.512			
			C	1	0.65	1	1	1	244.512			
Sum Weight:	4.510	32.383						OTM	361.530 kip-ft	5.155		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 150.000-105.000	1.274	4.184	A	1	0.65	1	1	1	130.058	1.340	0.030	C
			B	1	0.65	1	1	1	130.058			
			C	1	0.65	1	1	1	130.058			
L2 105.000-95.000	0.320	1.912	A	1	0.65	1	1	1	35.262	0.340	0.034	C
			B	1	0.65	1	1	1	35.262			
			C	1	0.65	1	1	1	35.262			
L3 95.000-47.250	1.530	10.632	A	1	0.65	1	1	1	200.117	1.739	0.036	C
			B	1	0.65	1	1	1	200.117			
			C	1	0.65	1	1	1	200.117			
L4 47.250-1.000	1.386	15.656	A	1	0.65	1	1	1	244.512	1.736	0.038	C
			B	1	0.65	1	1	1	244.512			
			C	1	0.65	1	1	1	244.512			
Sum Weight:	4.510	32.383						OTM	361.530 kip-ft	5.155		

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	32.383					
Bracing Weight	0.000					
Total Member Self-Weight	32.383			-0.067	0.179	
Total Weight	42.903			-0.067	0.179	

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 0 deg - No Ice		-0.068	-24.069	-2340.994	10.072	-0.455
Wind 30 deg - No Ice		12.015	-20.810	-2022.423	-1167.428	-0.430
Wind 45 deg - No Ice		17.027	-16.971	-1648.357	-1656.188	-0.373
Wind 60 deg - No Ice		20.878	-11.976	-1161.963	-2032.069	-0.290
Wind 90 deg - No Ice		24.147	0.068	9.825	-2352.170	-0.072
Wind 120 deg - No Ice		20.946	12.093	1178.963	-2041.961	0.166
Wind 135 deg - No Ice		17.122	17.067	1662.213	-1670.178	0.271
Wind 150 deg - No Ice		12.132	20.878	2032.181	-1184.562	0.359
Wind 180 deg - No Ice		0.068	24.069	2340.860	-9.713	0.455
Wind 210 deg - No Ice		-12.015	20.810	2022.289	1167.787	0.430
Wind 225 deg - No Ice		-17.027	16.971	1648.223	1656.546	0.373
Wind 240 deg - No Ice		-20.878	11.976	1161.829	2032.427	0.290
Wind 270 deg - No Ice		-24.147	-0.068	-9.959	2352.528	0.072
Wind 300 deg - No Ice		-20.946	-12.093	-1179.097	2042.320	-0.166
Wind 315 deg - No Ice		-17.122	-17.067	-1662.347	1670.536	-0.271
Wind 330 deg - No Ice		-12.132	-20.878	-2032.315	1184.921	-0.359
Member Ice	4.563					
Total Weight Ice	49.459			-0.117	0.327	
Wind 0 deg - Ice		-0.052	-19.136	-1894.427	7.952	-0.374
Wind 30 deg - Ice		9.553	-16.546	-1636.825	-944.628	-0.354
Wind 45 deg - Ice		13.537	-13.494	-1334.205	-1339.988	-0.306
Wind 60 deg - Ice		16.598	-9.523	-940.668	-1644.007	-0.238
Wind 90 deg - Ice		19.196	0.052	7.509	-1902.789	-0.059
Wind 120 deg - Ice		16.650	9.613	953.642	-1651.633	0.136
Wind 135 deg - Ice		13.611	13.568	1344.755	-1350.771	0.223
Wind 150 deg - Ice		9.643	16.598	1644.217	-957.835	0.295
Wind 180 deg - Ice		0.052	19.136	1894.194	-7.299	0.374
Wind 210 deg - Ice		-9.553	16.546	1636.592	945.281	0.354
Wind 225 deg - Ice		-13.537	13.494	1333.971	1340.641	0.306
Wind 240 deg - Ice		-16.598	9.523	940.435	1644.660	0.238
Wind 270 deg - Ice		-19.196	-0.052	-7.742	1903.442	0.059
Wind 300 deg - Ice		-16.650	-9.613	-953.876	1652.286	-0.136
Wind 315 deg - Ice		-13.611	-13.568	-1344.988	1351.424	-0.223
Wind 330 deg - Ice		-9.643	-16.598	-1644.450	958.488	-0.295
Total Weight	42.903			-0.067	0.179	
Wind 0 deg - Service		-0.023	-8.328	-810.076	3.602	-0.158
Wind 30 deg - Service		4.157	-7.201	-699.844	-403.837	-0.149
Wind 45 deg - Service		5.892	-5.872	-570.410	-572.958	-0.129
Wind 60 deg - Service		7.224	-4.144	-402.107	-703.021	-0.100
Wind 90 deg - Service		8.355	0.023	3.356	-813.782	-0.025
Wind 120 deg - Service		7.248	4.184	407.902	-706.444	0.057
Wind 135 deg - Service		5.925	5.906	575.116	-577.799	0.094
Wind 150 deg - Service		4.198	7.224	703.133	-409.766	0.124
Wind 180 deg - Service		0.023	8.328	809.942	-3.244	0.158
Wind 210 deg - Service		-4.157	7.201	699.710	404.196	0.149
Wind 225 deg - Service		-5.892	5.872	570.276	573.317	0.129
Wind 240 deg - Service		-7.224	4.144	401.973	703.379	0.100
Wind 270 deg - Service		-8.355	-0.023	-3.490	814.141	0.025
Wind 300 deg - Service		-7.248	-4.184	-408.036	706.802	-0.057
Wind 315 deg - Service		-5.925	-5.906	-575.250	578.157	-0.094
Wind 330 deg - Service		-4.198	-7.224	-703.267	410.124	-0.124

Load Combinations

Comb. No.	Description

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

Maximum Member Forces

Section No.	*Elevation ft*	*Component Type*	*Condition*	*Gov. Load Comb.*	*Force K*	*Major Axis Moment kip-ft*	*Minor Axis Moment kip-ft*
L1	150 - 105	Pole	Max Tension	23	0.000	0.000	-0.000
			Max. Compression	18	-13.584	0.327	0.117
			Max. Mx	14	-10.445	368.629	2.600

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. My	2	-10.449	2.708	365.593
			Max. Vy	14	-12.859	368.629	2.600
			Max. Vx	2	-12.780	2.708	365.593
			Max. Torque	3			0.523
L2	105 - 95	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-15.850	0.327	0.117
			Max. Mx	14	-12.475	495.306	3.257
			Max. My	2	-12.478	3.367	491.511
			Max. Vy	14	-13.803	495.306	3.257
			Max. Vx	2	-13.723	3.367	491.511
			Max. Torque	2			0.453
L3	95 - 47.25	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-28.464	0.327	0.117
			Max. Mx	14	-23.788	1243.117	6.457
			Max. My	2	-23.789	6.572	1235.628
			Max. Vy	14	-18.582	1243.117	6.457
			Max. Vx	2	-18.502	6.572	1235.628
			Max. Torque	2			0.453
L4	47.25 - 1	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-49.459	0.327	0.117
			Max. Mx	14	-42.897	2385.126	10.123
			Max. My	2	-42.897	10.238	2373.404
			Max. Vy	14	-24.157	2385.126	10.123
			Max. Vx	2	-24.079	10.238	2373.404
			Max. Torque	2			0.452

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	31	49.459	19.196	0.052
	Max. H_x	14	42.903	24.147	0.068
	Max. H_z	2	42.903	0.068	24.069
	Max. M_x	2	2373.404	0.068	24.069
	Max. M_z	6	2384.757	-24.147	-0.068
	Max. Torsion	2	0.452	0.068	24.069
	Min. Vert	48	42.903	7.248	4.184
	Min. H_x	6	42.903	-24.147	-0.068
	Min. H_z	10	42.903	-0.068	-24.069
	Min. M_x	10	-2373.267	-0.068	-24.069
	Min. M_z	14	-2385.126	24.147	0.068
	Min. Torsion	10	-0.452	-0.068	-24.069

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	42.903	0.000	0.000	-0.067	0.179	0.000
Dead+Wind 0 deg - No Ice	42.903	-0.068	-24.069	-2373.404	10.238	-0.452
Dead+Wind 30 deg - No Ice	42.903	12.015	-20.810	-2050.412	-1183.582	-0.427
Dead+Wind 45 deg - No Ice	42.903	17.027	-16.971	-1671.162	-1679.118	-0.370

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 60 deg - No Ice	42.903	20.878	-11.976	-1178.029	-2060.212	-0.287
Dead+Wind 90 deg - No Ice	42.903	24.147	0.068	9.986	-2384.757	-0.070
Dead+Wind 120 deg - No Ice	42.903	20.946	12.093	1195.303	-2070.262	0.165
Dead+Wind 135 deg - No Ice	42.903	17.122	17.067	1685.239	-1693.333	0.270
Dead+Wind 150 deg - No Ice	42.903	12.132	20.878	2060.324	-1200.994	0.357
Dead+Wind 180 deg - No Ice	42.903	0.068	24.069	2373.267	-9.870	0.452
Dead+Wind 210 deg - No Ice	42.903	-12.015	20.810	2050.275	1183.950	0.427
Dead+Wind 225 deg - No Ice	42.903	-17.027	16.971	1671.024	1679.486	0.370
Dead+Wind 240 deg - No Ice	42.903	-20.878	11.976	1177.892	2060.580	0.287
Dead+Wind 270 deg - No Ice	42.903	-24.147	-0.068	-10.123	2385.126	0.070
Dead+Wind 300 deg - No Ice	42.903	-20.946	-12.093	-1195.441	2070.630	-0.165
Dead+Wind 315 deg - No Ice	42.903	-17.122	-17.067	-1685.377	1693.701	-0.270
Dead+Wind 330 deg - No Ice	42.903	-12.132	-20.878	-2060.462	1201.362	-0.357
Dead+Ice+Temp	49.459	0.000	0.000	-0.117	0.327	0.000
Dead+Wind 0 deg+Ice+Temp	49.459	-0.052	-19.136	-1926.789	8.116	-0.370
Dead+Wind 30 deg+Ice+Temp	49.459	9.553	-16.546	-1664.776	-960.751	-0.349
Dead+Wind 45 deg+Ice+Temp	49.459	13.537	-13.494	-1356.981	-1362.874	-0.302
Dead+Wind 60 deg+Ice+Temp	49.459	16.598	-9.523	-956.718	-1672.095	-0.234
Dead+Wind 90 deg+Ice+Temp	49.459	19.196	0.052	7.658	-1935.311	-0.056
Dead+Wind 120 deg+Ice+Temp	49.459	16.650	9.613	969.949	-1679.872	0.136
Dead+Wind 135 deg+Ice+Temp	49.459	13.611	13.568	1367.738	-1373.872	0.222
Dead+Wind 150 deg+Ice+Temp	49.459	9.643	16.598	1672.311	-974.223	0.293
Dead+Wind 180 deg+Ice+Temp	49.459	0.052	19.136	1926.548	-7.441	0.370
Dead+Wind 210 deg+Ice+Temp	49.459	-9.553	16.546	1664.535	961.427	0.349
Dead+Wind 225 deg+Ice+Temp	49.459	-13.537	13.494	1356.740	1363.550	0.302
Dead+Wind 240 deg+Ice+Temp	49.459	-16.598	9.523	956.477	1672.771	0.234
Dead+Wind 270 deg+Ice+Temp	49.459	-19.196	-0.052	-7.899	1935.987	0.056
Dead+Wind 300 deg+Ice+Temp	49.459	-16.650	-9.613	-970.190	1680.547	-0.136
Dead+Wind 315 deg+Ice+Temp	49.459	-13.611	-13.568	-1367.980	1374.548	-0.222
Dead+Wind 330 deg+Ice+Temp	49.459	-9.643	-16.598	-1672.552	974.899	-0.293
Dead+Wind 0 deg - Service	42.903	-0.023	-8.328	-821.371	3.664	-0.157
Dead+Wind 30 deg - Service	42.903	4.157	-7.201	-709.598	-409.462	-0.148
Dead+Wind 45 deg - Service	42.903	5.892	-5.872	-578.357	-580.945	-0.128
Dead+Wind 60 deg - Service	42.903	7.224	-4.144	-407.707	-712.824	-0.099
Dead+Wind 90 deg - Service	42.903	8.355	0.023	3.411	-825.135	-0.024
Dead+Wind 120 deg - Service	42.903	7.248	4.184	413.595	-716.303	0.057
Dead+Wind 135 deg - Service	42.903	5.925	5.906	583.140	-585.865	0.094
Dead+Wind 150 deg - Service	42.903	4.198	7.224	712.939	-415.489	0.124
Dead+Wind 180 deg - Service	42.903	0.023	8.328	821.233	-3.295	0.157
Dead+Wind 210 deg - Service	42.903	-4.157	7.201	709.460	409.831	0.148
Dead+Wind 225 deg - Service	42.903	-5.892	5.872	578.219	581.314	0.128
Dead+Wind 240 deg - Service	42.903	-7.224	4.144	407.569	713.193	0.099
Dead+Wind 270 deg - Service	42.903	-8.355	-0.023	-3.548	825.504	0.024
Dead+Wind 300 deg - Service	42.903	-7.248	-4.184	-413.733	716.672	-0.057
Dead+Wind 315 deg - Service	42.903	-5.925	-5.906	-583.278	586.234	-0.094
Dead+Wind 330 deg - Service	42.903	-4.198	-7.224	-713.077	415.858	-0.124

Solution Summary

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
1	0.000	-42.903	0.000	0.000	42.903	0.000	0.000%
2	-0.068	-42.903	-24.069	0.068	42.903	24.069	0.000%
3	12.015	-42.903	-20.810	-12.015	42.903	20.810	0.000%
4	17.027	-42.903	-16.971	-17.027	42.903	16.971	0.000%
5	20.878	-42.903	-11.976	-20.878	42.903	11.976	0.000%
6	24.147	-42.903	0.068	-24.147	42.903	-0.068	0.000%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
7	20.946	-42.903	12.093	-20.946	42.903	-12.093	0.000%
8	17.122	-42.903	17.067	-17.122	42.903	-17.067	0.000%
9	12.132	-42.903	20.878	-12.132	42.903	-20.878	0.000%
10	0.068	-42.903	24.069	-0.068	42.903	-24.069	0.000%
11	-12.015	-42.903	20.810	12.015	42.903	-20.810	0.000%
12	-17.027	-42.903	16.971	17.027	42.903	-16.971	0.000%
13	-20.878	-42.903	11.976	20.878	42.903	-11.976	0.000%
14	-24.147	-42.903	-0.068	24.147	42.903	0.068	0.000%
15	-20.946	-42.903	-12.093	20.946	42.903	12.093	0.000%
16	-17.122	-42.903	-17.067	17.122	42.903	17.067	0.000%
17	-12.132	-42.903	-20.878	12.132	42.903	20.878	0.000%
18	0.000	-49.459	0.000	0.000	49.459	0.000	0.000%
19	-0.052	-49.459	-19.136	0.052	49.459	19.136	0.000%
20	9.553	-49.459	-16.546	-9.553	49.459	16.546	0.000%
21	13.537	-49.459	-13.494	-13.537	49.459	13.494	0.000%
22	16.598	-49.459	-9.523	-16.598	49.459	9.523	0.000%
23	19.196	-49.459	0.052	-19.196	49.459	-0.052	0.000%
24	16.650	-49.459	9.613	-16.650	49.459	-9.613	0.000%
25	13.611	-49.459	13.568	-13.611	49.459	-13.568	0.000%
26	9.643	-49.459	16.598	-9.643	49.459	-16.598	0.000%
27	0.052	-49.459	19.136	-0.052	49.459	-19.136	0.000%
28	-9.553	-49.459	16.546	9.553	49.459	-16.546	0.000%
29	-13.537	-49.459	13.494	13.537	49.459	-13.494	0.000%
30	-16.598	-49.459	9.523	16.598	49.459	-9.523	0.000%
31	-19.196	-49.459	-0.052	19.196	49.459	0.052	0.000%
32	-16.650	-49.459	-9.613	16.650	49.459	9.613	0.000%
33	-13.611	-49.459	-13.568	13.611	49.459	13.568	0.000%
34	-9.643	-49.459	-16.598	9.643	49.459	16.598	0.000%
35	-0.023	-42.903	-8.328	0.023	42.903	8.328	0.000%
36	4.157	-42.903	-7.201	-4.157	42.903	7.201	0.000%
37	5.892	-42.903	-5.872	-5.892	42.903	5.872	0.000%
38	7.224	-42.903	-4.144	-7.224	42.903	4.144	0.000%
39	8.355	-42.903	0.023	-8.355	42.903	-0.023	0.000%
40	7.248	-42.903	4.184	-7.248	42.903	-4.184	0.000%
41	5.925	-42.903	5.906	-5.925	42.903	-5.906	0.000%
42	4.198	-42.903	7.224	-4.198	42.903	-7.224	0.000%
43	0.023	-42.903	8.328	-0.023	42.903	-8.328	0.000%
44	-4.157	-42.903	7.201	4.157	42.903	-7.201	0.000%
45	-5.892	-42.903	5.872	5.892	42.903	-5.872	0.000%
46	-7.224	-42.903	4.144	7.224	42.903	-4.144	0.000%
47	-8.355	-42.903	-0.023	8.355	42.903	0.023	0.000%
48	-7.248	-42.903	-4.184	7.248	42.903	4.184	0.000%
49	-5.925	-42.903	-5.906	5.925	42.903	5.906	0.000%
50	-4.198	-42.903	-7.224	4.198	42.903	7.224	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	0.00002467
3	Yes	4	0.00000001	0.00026637
4	Yes	4	0.00000001	0.00031564
5	Yes	4	0.00000001	0.00027976
6	Yes	4	0.00000001	0.00001446
7	Yes	4	0.00000001	0.00028529

8	Yes	4	0.00000001	0.00032402
9	Yes	4	0.00000001	0.00027559
10	Yes	4	0.00000001	0.00002011
11	Yes	4	0.00000001	0.00028183
12	Yes	4	0.00000001	0.00031561
13	Yes	4	0.00000001	0.00026931
14	Yes	4	0.00000001	0.00001559
15	Yes	4	0.00000001	0.00027969
16	Yes	4	0.00000001	0.00032422
17	Yes	4	0.00000001	0.00028846
18	Yes	4	0.00000001	0.00000001
19	Yes	4	0.00000001	0.00054995
20	Yes	4	0.00000001	0.00071597
21	Yes	4	0.00000001	0.00076691
22	Yes	4	0.00000001	0.00072035
23	Yes	4	0.00000001	0.00055191
24	Yes	4	0.00000001	0.00072931
25	Yes	4	0.00000001	0.00077727
26	Yes	4	0.00000001	0.00072588
27	Yes	4	0.00000001	0.00054966
28	Yes	4	0.00000001	0.00072047
29	Yes	4	0.00000001	0.00076732
30	Yes	4	0.00000001	0.00071795
31	Yes	4	0.00000001	0.00055239
32	Yes	4	0.00000001	0.00072859
33	Yes	4	0.00000001	0.00077820
34	Yes	4	0.00000001	0.00073017
35	Yes	4	0.00000001	0.00000665
36	Yes	4	0.00000001	0.00001777
37	Yes	4	0.00000001	0.00002118
38	Yes	4	0.00000001	0.00001915
39	Yes	4	0.00000001	0.00000614
40	Yes	4	0.00000001	0.00001934
41	Yes	4	0.00000001	0.00002166
42	Yes	4	0.00000001	0.00001836
43	Yes	4	0.00000001	0.00000653
44	Yes	4	0.00000001	0.00001945
45	Yes	4	0.00000001	0.00002119
46	Yes	4	0.00000001	0.00001801
47	Yes	4	0.00000001	0.00000617
48	Yes	4	0.00000001	0.00001874
49	Yes	4	0.00000001	0.00002170
50	Yes	4	0.00000001	0.00001979

Maximum Tower Deflections - Service Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °
L1	150 - 105	9.848	48	0.591	0.001
L2	110.25 - 95	5.260	48	0.467	0.000
L3	100.75 - 47.25	4.365	48	0.426	0.000
L4	54.5 - 1	1.224	48	0.210	0.000

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
147.000	SC-E 6014 rev2	48	9.478	0.583	0.001	78983
137.000	(2) 7770.00	48	8.254	0.555	0.001	30378
136.000	Valmont 13' Low Profile Platform	48	8.134	0.553	0.001	28208

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	150 - 105	28.438	15	1.707	0.002
L2	110.25 - 95	15.194	15	1.348	0.001
L3	100.75 - 47.25	12.608	15	1.232	0.001
L4	54.5 - 1	3.535	15	0.606	0.000

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
147.000	SC-E 6014 rev2	15	27.370	1.684	0.002	27435
137.000	(2) 7770.00	15	23.839	1.604	0.002	10551
136.000	Valmont 13' Low Profile Platform	15	23.491	1.595	0.002	9798

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in²	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
L1	150 - 105 (1)	TP41.336x28.028x0.25	45.000	0.000	0.0	38.098	31.370	-10.443	1195.110	0.009
L2	105 - 95 (2)	TP43.793x39.283x0.281	15.250	0.000	0.0	39.000	37.331	-12.473	1455.910	0.009
L3	95 - 47.25 (3)	TP57.352x41.53x0.375	53.500	0.000	0.0	39.000	65.265	-23.787	2545.330	0.009
L4	47.25 - 1 (4)	TP70.28x54.458x0.438	53.500	0.000	0.0	37.929	96.985	-42.897	3678.540	0.012

Pole Bending Design Data

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
L1	150 - 105 (1)	TP41.336x28.028x0.25	370.100	14.491	38.098	0.380	0.000	0.000	38.098	0.000
L2	105 - 95 (2)	TP43.793x39.283x0.281	497.157	15.472	39.000	0.397	0.000	0.000	39.000	0.000

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
L3	95 - 47.25 (3)	TP57.352x41.53x0.375	1246.81 7	16.926	39.000	0.434	0.000	0.000	39.000	0.000
L4	47.25 - 1 (4)	TP70.28x54.458x0.438	2390.94 2	17.138	37.929	0.452	0.000	0.000	37.929	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	150 - 105 (1)	TP41.336x28.028x0.25	12.899	0.411	26.000	0.032	0.165	0.003	26.000	0.000
L2	105 - 95 (2)	TP43.793x39.283x0.281	13.843	0.371	26.000	0.029	0.165	0.003	26.000	0.000
L3	95 - 47.25 (3)	TP57.352x41.53x0.375	18.622	0.285	26.000	0.022	0.165	0.001	26.000	0.000
L4	47.25 - 1 (4)	TP70.28x54.458x0.438	24.197	0.249	26.000	0.019	0.165	0.001	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	150 - 105 (1)	0.009	0.380	0.000	0.032	0.000	0.389 ✔	1.333	H1-3+VT ✔
L2	105 - 95 (2)	0.009	0.397	0.000	0.029	0.000	0.405 ✔	1.333	H1-3+VT ✔
L3	95 - 47.25 (3)	0.009	0.434	0.000	0.022	0.000	0.443 ✔	1.333	H1-3+VT ✔
L4	47.25 - 1 (4)	0.012	0.452	0.000	0.019	0.000	0.464 ✔	1.333	H1-3+VT ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
L1	150 - 105	Pole	TP41.336x28.028x0.25	1	-10.443	1593.082	29.2	Pass
L2	105 - 95	Pole	TP43.793x39.283x0.281	2	-12.473	1940.728	30.4	Pass
L3	95 - 47.25	Pole	TP57.352x41.53x0.375	3	-23.787	3392.925	33.3	Pass
L4	47.25 - 1	Pole	TP70.28x54.458x0.438	4	-42.897	4903.494	34.8	Pass
							Summary	
						Pole (L4)	34.8	Pass
						RATING =	**34.8**	**Pass**

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Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 2391 \cdot ft \cdot kips$	(Input From RisaTower)
Shear Force =	$Shear := 24 \cdot kips$	(Input From RisaTower)
Axial Force =	$Axial := 43 \cdot kips$	(Input From RisaTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	$N := 24$	(User Input)
Diameter of Bolt Circle =	$D_{bc} := 78.0 \cdot in$	(User Input)
Bolt "Column" Distance =	$l := 3.0 \cdot in$	(User Input)
Bolt Ultimate Strenght =	$F_u := 100 \cdot ksi$	(User Input)
Bolt Yeild Strenght =	$F_y := 75 \cdot ksi$	(User Input)
Bolt Modulus =	$E := 29000 \cdot ksi$	(User Input)
Diameter of Anchor Bolts =	$D := 2.25 \cdot in$	(User Input)
Threads per Inch =	$n := 4.5$	(User Input)

Base Plate Data:

Use ASTM A572 Grade 50

Plate Yield Strength =	$Fy_{bp} := 50 \cdot ksi$	(User Input)
Base Plate Thickness =	$t_{bp} := 3.00 \cdot in$	(User Input)
Base Plate Diameter =	$D_{bp} := 77.0 \cdot in$	(User Input)
Outer Pole Diameter =	$D_{pole} := 70.28 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

d_1 := 38.875in (User Input)

d_2 := 38.0in (User Input)

d_3 := 36.375in (User Input)

d_4 := 14.625in (User Input)

d_5 := 9.0in (User Input)

d_6 := 3.0in (User Input)

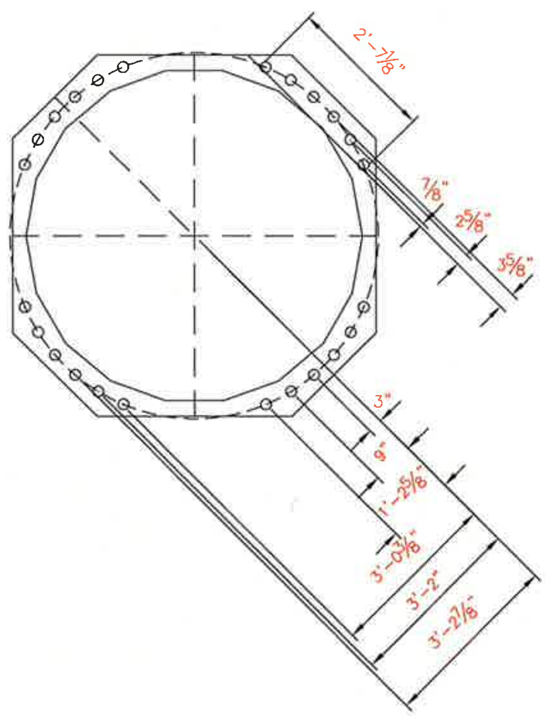
Critical Distances For Bending in Plate:

ma_1 := 3.625in (User Input)

ma_2 := 2.625in (User Input)

ma_3 := 0.875in (User Input)

Effective Width of Baseplate for Bending = B_{eff} := 31.125in (User Input)



ANCHOR BOLT AND PLATE GEOMETRY

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \left[(d_1)^2 \cdot 4 + (d_2)^2 \cdot 4 + (d_3)^2 \cdot 4 + (d_4)^2 \cdot 4 + (d_5)^2 \cdot 4 + (d_6)^2 \cdot 4\right] = 18329 \cdot in^2$

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

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

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

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

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

Check Anchor Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM \cdot \frac{d_1}{I_p} - \frac{Axial}{N} = 59.1 \cdot kips$

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

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

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Net}} = 30.3 \cdot \%$ Bolts are "upset bolts". Use net area per AISC

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

Condition1 = "OK"

Check Anchor Bolt Bending Stress:

Maximum Bending Moment = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.25 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 3.6 \cdot ksi$

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

Check Combined Stress Requirement:

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

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

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

Check Anchor Bolt Compression/Combined Stress:

Maximum Compressive Force = $C_{Max} := OM \cdot \frac{d_1}{I_p} + \frac{Axial}{N} = 62.6 \cdot kips$

Maximum Compressive Stress = $f_a := \frac{C_{Max}}{A_n} = 19.3 \cdot ksi$

$K := 0.65$

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

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

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

Combined Stress % of Capacity = $\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) = 32.2 \cdot \%$

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

Condition2 = "OK"

Base Plate Analysis:

Force from Bolts =

$$C_1 := \frac{OM \cdot d_1}{I_p} + \frac{Axial}{N} = 62.646 \cdot kips$$

$$C_2 := \frac{OM \cdot d_2}{I_p} + \frac{Axial}{N} = 61.276 \cdot kips$$

$$C_3 := \frac{OM \cdot d_3}{I_p} + \frac{Axial}{N} = 58.732 \cdot kips$$

Applied Bending Stress in Plate =

$$f_{bp} := \frac{6 \cdot \left(2C_1 \cdot ma_1 + 2C_2 \cdot ma_2 + 2C_3 \cdot ma_3\right)}{B_{eff} \cdot t_{bp}^{\ 2}} = 18.82 \cdot ksi$$

Allowable Bending Stress in Plate =

$$F_{bp} := 1.33 \cdot 0.75 \cdot Fy_{bp} = 49.9 \cdot ksi$$

Plate Bending Stress % of Capacity =

$$\frac{f_{bp}}{F_{bp}} = 37.7 \cdot \%$$

Condition3 =

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

Condition3 = "Ok"

Standard Monopole Foundation:

Input Data:

Tower Data

Overturning Moment =	$OM := 2391 \cdot ft \cdot kips$	(User Input from tnxTower)	
Shear Force =	$Shear := 24 \cdot kip$	(User Input from tnxTower)	
Axial Force =	$Axial := 43 \cdot kip$	(User Input from tnxTower)	
Tower Height =	$H_t := 150 \cdot ft$	(User Input)	

Footing Data:

Overall Depth of Footing =	$D_f := 6.0 \cdot ft$	(User Input)	
Length of Pier =	$L_p := 2.5 \cdot ft$	(User Input)	
Extension of Pier Above Grade =	$L_{pag} := 0.5 \cdot ft$	(User Input)	
Diameter of Pier =	$d_p := 9.0 \cdot ft$	(User Input)	
Thickness of Footing =	$T_f := 4.0 \cdot ft$	(User Input)	
Width of Footing =	$W_f := 29.0 \cdot ft$	(User Input)	

Anchor Bolt Data:

Length of Anchor Bolts =	$L_{st} := 84 \cdot in$	(User Input)	
Projection of Anchor Bolts Above Pier =	$A_{BP} := 12.0 \cdot in$	(User Input)	
Anchor Bolt Diameter =	$d_{anchor} := 2.25 \cdot in$	(User Input)	
Base Plate Bolt Circle =	$MP := 78.0 \cdot in$	(User Input)	

Material Properties:

Concrete Compressive Strength =	$f_c := 4000 \cdot psi$	(User Input)	
Steel Reinforcment Yield Strength =	$f_y := 60000 \cdot psi$	(User Input)	
Anchor Bolt Yield Strength =	$f_{ya} := 75000 \cdot psi$	(User Input)	
Internal Friction Angle of Soil =	$\Phi_s := 30 \cdot deg$	(User Input)	
Allowable Soil Bearing Capacity =	$q_s := 3000 \cdot psf$	(User Input)	
Unit Weight of Soil =	$\gamma_{soil} := 100 \cdot pcf$	(User Input)	
Unit Weight of Concrete =	$\gamma_{conc} := 150 \cdot pcf$	(User Input)	
Foundation Bouyancy =	$Bouyancy := 0$	(User Input)	(Yes=1 / No=0)
Depth to Neglect =	$n := 0 \cdot ft$	(User Input)	
Cohesion of Clay Type Soil =	$c := 0 \cdot ksf$	(User Input)	(Use 0 for Sandy Soil)
Seismic Zone Factor =	$Z := 2$	(User Input)	(UBC-1997 Fig 23-2)
Coefficient of Friction Between Concrete =	$\mu := 0.45$	(User Input)	

Pier Reinforcement:

Bar Size =	$BS_{pier} := 10$	(User Input)	
Bar Diameter =	$d_{bpier} := 1.27 \cdot in$	(User Input)	
Number of Bars =	$NB_{pier} := 52$	(User Input)	
Clear Cover of Reinforcement =	$Cvr_{pier} := 3 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Diameter of Tie =	$d_{Tie} := 0.5 \cdot in$	(User Input)	

Pad Reinforcement:

Bar Size =	$BS_{top} := 10$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 1.27 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 28$	(User Input)	(Top of Pad)
Bar Size =	$BS_{bot} := 10$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{bbot} := 1.27 \cdot in$	(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:

Pier Reinforcement Bar Area =

$$A_{bpier} := \frac{\pi \cdot d_{bpier}^2}{4} = 1.267 \cdot in^2$$

Pad Top Reinforcement Bar Area =

$$A_{btop} := \frac{\pi \cdot d_{btop}^2}{4} = 1.267 \cdot in^2$$

Pad Bottom Reinforcement Bar Area =

$$A_{bbot} := \frac{\pi \cdot d_{bbot}^2}{4} = 1.267 \cdot in^2$$

Coefficient of Lateral Soil Pressure =

$$K_p := \frac{1 + \sin(\Phi_s)}{1 - \sin(\Phi_s)} = 3$$

Load Factor =

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

Stability of Footing:

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

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

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

$P_{pt} := K_p\cdot\gamma_s\cdot(D_f - T_f) + c\cdot 2\cdot\sqrt{K_p} = 0.6\cdot\text{ksf}$

$P_{top} := \text{if}[n < (D_f - T_f), P_{pt}, P_{pn}] = 0.6\cdot\text{ksf}$

$P_{bot} := K_p\cdot\gamma_s\cdot D_f + c\cdot 2\cdot\sqrt{K_p} = 1.8\cdot\text{ksf}$

$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 1.2\cdot\text{ksf}$

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

$A_p := W_f\cdot T_p = 116$

Ultimate Shear = $S_u := P_{ave}\cdot A_p = 139.2\cdot\text{kip}$

Weight of Concrete Pad = $WT_c := \left[\left(W_f^2\cdot T_f\right) + d_p^2\cdot L_p\right]\cdot\gamma_c = 534.975\cdot\text{kip}$

Weight of Soil Above Footing = $WT_{s1} := \left[\left(W_f^2 - d_p^2\right)\cdot \begin{vmatrix} (L_p - L_{pag} - n) & \text{if } (L_p - L_{pag} - n) \ge 0 \\ 0 & \text{if } (L_p - L_{pag} - n) \le 0 \end{vmatrix}\right]\cdot\gamma_s = 152\cdot\text{kip}$

Weight of Soil Wedge at Back Face = $WT_{s2} := \left(\frac{D_f^2\cdot\tan(\Phi_s)}{2}\cdot W_f\right)\cdot\gamma_s = 30.138\cdot\text{kip}$

Weight of Soil Wedge at back face Corners = $WT_{s3} := 2\cdot\left[(D_f)^3\cdot\frac{\tan(\Phi_s)}{3}\right]\cdot\gamma_s = 8.314\cdot\text{kips}$

Total Weight = $WT_{tot} := WT_c + WT_{s1} + \text{Axial} = 729.975\cdot\text{kip}$

Resisting Moment = $M_r := (WT_{tot})\cdot\frac{W_f}{2} + S_u\cdot\frac{T_f}{3} + \left[(WT_{s2} + WT_{s3})\cdot\left(W_f + \frac{D_f\cdot\tan(\Phi_s)}{3}\right)\right] = 11930\cdot\text{kip}\cdot\text{ft}$

Overturning Moment = $M_{ot} := OM + \text{Shear}\cdot(L_p + T_f) = 2547\cdot\text{kip}\cdot\text{ft}$

Factor of Safety Actual = $FS := \frac{M_r}{M_{ot}} = 4.68$

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

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

OverTurning_Moment_Check = "Okay"

Shear Capacity in Pier:

Shear Resistance of Pier = $S_p := \frac{\mu \cdot WT_{tot}}{FS_{req}} = 164.244 \cdot kips$

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

Shear_Check = "Okay"

Bearing Pressure Caused by Footing:

Area of the Mat = $A_{mat} := W_f^{\,2} = 841$

Section Modulus of Mat = $S := \frac{W_f^{\,3}}{6} = 4064.83 \cdot ft^3$

Maximum Pressure in Mat = $P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S} = 1.495 \cdot ksf$

Max_Pressure_Check := if(P_max < q_s, "Okay", "No Good")

Max_Pressure_Check = "Okay"

Minimum Pressure in Mat = $P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S} = 0.241 \cdot ksf$

Min_Pressure_Check := if[(P_min ≥ 0)·(P_min < q_s), "Okay", "No Good"]

Min_Pressure_Check = "Okay"

Distance to Resultant of Pressure Distribution = $X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 11.529$

Distance to Kern = $X_k := \frac{W_f}{6} = 4.833$

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

Eccentricity = $e := \frac{M_{ot}}{WT_{tot}} = 3.489$

Adjusted Soil Pressure = $P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \left(\frac{W_f}{2} - e\right)} = 1.524 \cdot ksf$

$q_{adj} := \text{if}(P_{min} < 0, P_a, P_{max}) = 1.495 \cdot ksf$

Pressure_Check := if(q_adj < q_s, "Okay", "No Good")

Pressure_Check = "Okay"

Concrete Bearing Capacity:

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

Bearing Strength Between Pier and Pad = $P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot \frac{\pi \cdot d_p^{\,2}}{4} = 2.025 \times 10^4 \cdot kips$ (ACI-2008 10.14)

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

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

Shear Strength of Concrete:

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

$\phi_c := 0.85$ (ACI 9.3.2.5)

$d := T_f - Cvr_{pad} - d_{bbot} = 43.73 \cdot in$

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

$$d_2 := d_1 - d$$

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

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

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

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

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

$Beam\_Shear\_Check = \text{"Okay"}$

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

Critical Perimeter of Punching Shear = $b_o := (d_p + d) \cdot \pi = 39.7$

Area Included Inside Perimeter = $A_{bo} := \frac{\pi \cdot (d_p + d)^2}{4} = 125.6$

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 715.4$

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

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

$v_u := Find(v_u) = 5 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f = 532.9 \cdot kips$

Required Shear Strength = $V_{req} := LF \cdot V_u = 710.4 \cdot kips$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 4482.4 \cdot kip$ (ACI-2008 11.11.2.1)

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

Punching_Shear_Check = "Okay"

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

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

$q_b := q_{adj} - d_1 \cdot Slope = 1.062 \cdot ksf$

Maximum Bending at Face of Pier = $M_u := LF \cdot \left[(q_{adj} - q_b) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f = 2610.4 \cdot kip \cdot ft$

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

(ACI-200810.2.7.3)

$R_n := \frac{M_u}{\phi_m \cdot W_f \cdot d^2} = 52.3 \cdot psi$

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

$\rho_{min} := \rho = 0.00088$

Required Reinforcement for Temperature and Shrinkage:

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

Check Bottom Bars:

$As := \begin{cases} \rho_{min} \cdot W_f \cdot d & \text{if } \rho_{min} > \frac{\rho_{sh}}{2} \\ \rho_{sh} \cdot W_f \cdot \frac{d}{2} & \text{otherwise} \end{cases} = 13.696 \cdot in^2$

$As_{prov} := A_{bbot} \cdot NB_{bot} = 35.5 \cdot in^2$

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

Pad_Reinforcement_Bot = "Okay"

Check top Bars:

$As := \rho_{sh} \cdot \left(W_f \cdot \frac{d}{2}\right) = 13.7 \cdot in^2$

$As_{prov} := A_{btop} \cdot NB_{top} = 35.5 \cdot in^2$

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

Pad_Reinforcement_Top = "Okay"

Developement Length Pad Reinforcement:

Bar Spacing = $B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 11.35 \cdot in$

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

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

$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pad} \cdot \beta_{pad} \cdot \gamma_{pad} \cdot \lambda_{pad}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \frac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot} = 38.3 \cdot in$

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

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

Available Length in Pad = $L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad} = 117 \cdot in$

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

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

Area of Pier = $A_p := \frac{\pi \cdot d_p^2}{4} = 9160.88 \cdot in^2$

$A_{smin} := 0.01 \cdot 0.5 \cdot A_p = 45.8 \cdot in^2$ (ACI-2008 10.8.4 & 10.9.1)

$A_{sprov} := NB_{pier} \cdot A_{bpier} = 65.87 \cdot in^2$

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

Steel_Area_Check = "Okay"

Bar Spacing In Pier = $B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 5.255 \cdot in$

Diameter of Reinforcement Cage = $Diam_{cage} := d_p - 2 \cdot Cvr_{pier} = 102 \cdot in$

Maximum Moment in Pier = $M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2}\right)\right] \cdot LF = 39398.1 \cdot in \cdot kips$

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

$$\begin{pmatrix} D & N & n & P_u & M_{xu} \end{pmatrix} := \begin{pmatrix} d_p \cdot 12 & NB_{pier} & BS_{pier} & \frac{Axial \cdot 1.333}{kips} & \frac{M_p}{in \cdot kips} \end{pmatrix}$$

$$\begin{pmatrix} D & N & n & P_u & M_{xu} \end{pmatrix} = \begin{pmatrix} 108 & 52 & 10 & 57.319 & 3.94 \times 10^4 \end{pmatrix}$$

$$\begin{pmatrix} \phi P_n & \phi M_{xn} & f_{sp} & \rho \end{pmatrix} := \begin{pmatrix} 0 & 0 & 0 & 0 \end{pmatrix}$$

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

$$\begin{pmatrix} \phi P_n & \phi M_{xn} & f_{sp} & \rho \end{pmatrix} = \begin{pmatrix} 241.383 & 1.659 \times 10^5 & -60 & 7.209 \times 10^{-3} \end{pmatrix}$$

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

Axial_Load_Check = "Okay"

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

Bending_Check = "Okay"

Development Length Pier Reinforcement:

Available Length in Foundation:

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

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

Tension: (ACI-2008 12.2.3)

Spacing or Cover Dimension = $c := if\left(Cvr_{pier} < \frac{B_{sPier}}{2}, Cvr_{pier}, \frac{B_{sPier}}{2}\right) = 2.627 \cdot in$

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

$$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 43.68 \cdot in$$

Minimum Development Length = $L_{dh} := \frac{1200 \cdot d_{bpier}}{\sqrt{\frac{f_c}{psi}}} \cdot .7 = 16.868 \cdot in$ (ACI 12.2.1)

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

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

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

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

Compression: (ACI-2008 12.3.2)

$$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot f_y}{\sqrt{f_c \cdot psi}} = 24.097 \cdot in$$

$L_{dbmin} := 0.0003 \cdot \frac{in^2}{lb} \cdot (d_{bpier} \cdot f_y) = 22.86 \cdot in$

$L_{dbc} := if(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}) = 24.097 \cdot in$

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

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

Tie Size and Spacing in Column:

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

Used #4 Ties

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

$s_{lim1} := 16 \cdot d_{bpier} \cdot z = 20.32 \cdot in$

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

$s_{lim3} := D_f \cdot z = 72 \cdot in$

$s_{lim4} := 18in$

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

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

Check Anchor Steel Embedment:

Depth Available = $D_{ab} := L_{st} - A_{BP} = 6 \cdot ft$

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

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

Depth_Check = "No Good"

Note: Anchor plate is provided

SITE NAME	EAST PUTNAM CT	ECP - CELL #	AWS1 | 2 | 125
LATITUDE	41-55-45.32 N	LONGITUDE	71-48-36.17 W
Additional Comments: AWS RRH and fiber line add, utilize existing unused PCS antenna for AWS		SAVE BUTTON	
		STRUCTURE TYPE	MONOPOLE
AWS - LTE ANTENNA ADD	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	2100 MHz BBU	2100 MHz BBU	2100 MHz BBU
ANTENNA TYPE	use existing PCS antenna	use existing PCS antenna	use existing PCS antenna
QTY OF ANTENNAS PER FACE	0	0	0
ORIENTATION (DEG)	0	190	270
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	147	147	147
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL	1 ALU RH_2X40-AWS	1 ALU RH_2X40-AWS	1 ALU RH_2X40-AWS
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX	1	DB-T1-6Z-8AB-0Z	
700 Mhz - LTE Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	700 eNodeB	700 eNodeB	700 eNodeB
ANTENNA TYPE	BXA-70063-6CF-2-750MHZ	BXA-70063-6CF-2-750MHZ	BXA-70063-6CF-2-750MHZ
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	0	190	270
DOWN TILT (MECH/DEG)	4	4	4
RAD CTR (FT AGL)	137	137	137
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
700 Mhz - LTE Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	700 eNodeB	700 eNodeB	700 eNodeB
ANTENNA TYPE	BXA-70063-6CF-2-750MHZ	BXA-70063-6CF-2-750MHZ	BXA-70063-6CF-2-750MHZ
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	0	190	270
DOWN TILT (MECH/DEG)	4	4	4
RAD CTR (FT AGL)	137	137	137
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL			
850 Celluar - Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	Cellular Mod 4.0B	Cellular Mod 4.0B	Cellular Mod 4.0B
ANTENNA TYPE	SC-E 6014 REV2	SC-E 6014 REV2	SC-E 6014 REV2
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	0	190	270
DOWN TILT (MECH/DEG)	6	6	6
RAD CTR (FT AGL)	147	147	147
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
850 Celluar - Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	Cellular Mod 4.0B	Cellular Mod 4.0B	Cellular Mod 4.0B
ANTENNA TYPE	SC-E 6014 REV2	SC-E 6014 REV2	SC-E 6014 REV2
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	0	190	270
DOWN TILT (MECH/DEG)	6	6	6
RAD CTR (FT AGL)	147	147	147
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
DIPLEX WITH LTE CABLE			
1900 PCS - Current Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	PCS Mod 4.0B	PCS Mod 4.0B	PCS Mod 4.0B
ANTENNA TYPE	BXA-171063-12CF_2	BXA-171063-12CF_2	BXA-171063-12CF_2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	0	190	270
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	147	147	147
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
1900 PCS - Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	PCS Mod 4.0B	PCS Mod 4.0B	PCS Mod 4.0B
ANTENNA TYPE	BXA-171063-12CF_2	BXA-171063-12CF_2	BXA-171063-12CF_2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	0	190	270
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	147	147	147
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE			

NUMBER OF CABLE'S NEEDED							Fiber Lines Model number			
TOTAL # FIBER LINES	1	TOTAL # OF MAINLINES				18	FIBER LINE MODEL #			HB158-1-08U8-S8J18
TOTAL # TOP JUMPERS	3	TOTAL # OF TOP JUMPERS				18	FIBER TOP JUMPER MODEL #			HB114-1-08U4-S4J18
Equipment Cable Ordering		**MAIN CABLE**	18	+		0	**TOP JUMPER #**	18	+	

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

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

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

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Alcatel-Lucent RRH2x40-AWS

REMOTE RADIO HEAD

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

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

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

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

Fast, low-cost installation and deployment

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

Excellent RF performance

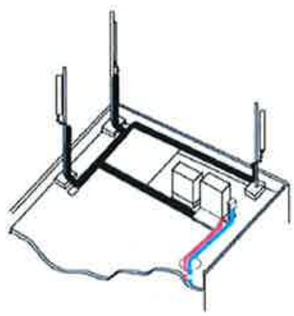
Because of its small size and weight, the Alcatel-Lucent RRH2x40-AWS can be installed close to the antenna. Operators can therefore locate the Alcatel-Lucent RRH2x40-AWS where RF engineering is deemed ideal, minimizing trade-offs between available sites and RF optimum sites. The RF feeder cost and installation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

Features

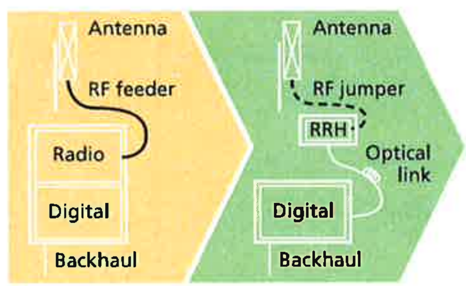
- Zero-footprint deployment
- Easy installation, with a lightweight unit can be carried and set up by one person
- Optimized RF power, with flexible site selection and elimination of a TMA
- Convection-cooled (fanless)
- Noise-free
- Best-in-class power efficiency, with significantly reduced energy consumption

Benefits

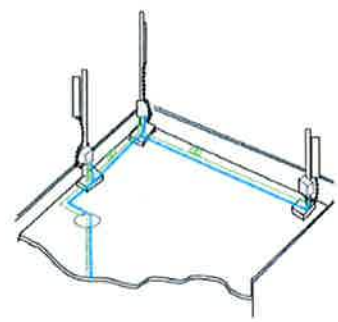
- Leverages existing real estate with lower site costs
- Reduces installation costs, with fewer installation materials and simplified logistics
- Decreases power costs and minimizes environmental impacts, with the potential for eco-sustainable power options
- Improves RF performance and adds flexibility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



Macro



RRH for space-constrained cell sites



Distributed

Technical specifications

Physical dimensions

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

Power

- Power supply: -48VDC

Operating environment

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

RF characteristics

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

Optical characteristics

Type/number of fibers

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

Optical fiber length

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

Digital Ports and Alarms

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

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

DC and Fiber Management Distribution Boxes for HYBRIFLEX™ Cable

Product Description

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

Features/Benefits

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

Technical Specifications

Mechanical Specifications

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

Electrical Specifications

Nominal Operating Voltage	48 VDC	
Nominal Discharge Current (I_n) per UL 1449 3rd Ed	20 kA 8/20 µs	N/A
Maximum Discharge Current (I_{max}) per NEMA LS-1	60 kA 8/20 µs	N/A
Maximum Impulse (Lightning) Current (I_{imp}) per IEC 61643-1	5 kA 10/350 µs	N/A
Maximum Continuous Operating Voltage (U_c)	75 VDC	N/A
Voltage Protection Rating per UL1449 3rd Ed	400 V	N/A
Protection Class as per IEC 61643-1	Class 1	N/A
Strikesorb OVP Compliance	ANSI/UL 1449-3rd Ed	N/A
	IEEE C62.41	N/A
	NEMA LS-1	N/A
	IEC 61643-1	N/A
	IEC 61643-12	N/A
	EN 61643-11	N/A

* This data is provisional and subject to change.