

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

December 23, 2011

Linda Roberts
Executive Director
Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051

Re: **Notice of Exempt Modification – Antenna Swap
North Street, Goshen, Connecticut**

Dear Ms. Roberts:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) wireless telecommunications antennas at the top of the existing 150-foot tower at the above-referenced address. The tower is owned by Cellco. The Council approved Cellco's use of the existing tower in 2007 (Docket No. 337). Cellco now intends to modify its installation by replacing six (6) of its existing antennas with three (3) model BXA-171085-12BF PCS antennas and three (3) model BXA-70063/6CF LTE antennas, all at the same 150-foot level on the tower. Cellco also intends to install six additional coax cables inside the monopole tower. Attached behind Tab 1 are the specifications for the proposed replacement antennas.

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 Thomas A. Breakell, First Selectman of the Town of Goshen. A copy of this letter is also being sent to Arca LLC, owner of the property on which the tower is located.

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

1. The proposed modifications will not result in an increase in the overall height of the existing tower. Cellco's antennas will be located at the same 150-foot level on the existing tower.



Law Offices

BOSTON

PROVIDENCE

HARTFORD

NEW LONDON

STAMFORD

WHITE PLAINS

NEW YORK CITY

ALBANY

SARASOTA

www.rc.com

11448808-v1

ROBINSON & COLE_{LLP}

Linda Roberts
December 23, 2011
Page 2

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

3. The proposed modifications will not increase noise levels at the facility by six decibels or more.

4. The operation of the replacement antennas will not increase radio frequency (RF) power density levels at the facility to a level at or above the Federal Communications Commission (FCC) adopted safety standard. A power density table for Cellco's modified facility is included behind Tab 2.

Also attached is a Structural Analysis confirming that the tower and foundation can support Cellco's proposed modifications. (See Tab 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:

Thomas A. Breakell, Goshen First Selectman
Arca LLC
Sandy M. Carter



BXA-171085-12BF-EDIN-X

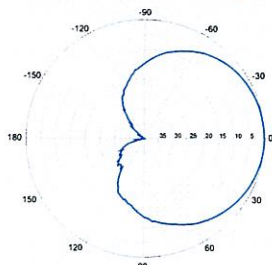
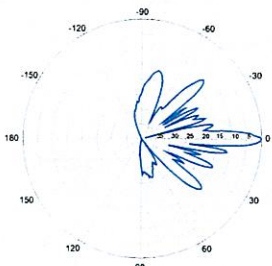
Replace "X" with desired electrical downtilt.

X-Pol | FET Panel | 85° | 18.0 dBi

Electrical Characteristics	1710-2170 MHz		
Frequency bands	1710-1880 MHz	1850-1990 MHz	1920-2170 MHz
Polarization	±45°	±45°	±45°
Horizontal beamwidth	88°	85°	80°
Vertical beamwidth	4.5°	4.5°	4.5°
Gain	15.1 dBd / 17.2 dBi	15.5 dBd / 17.6 dBi	15.9 dBd / 18.0 dBi
Electrical downtilt (X)	0, 2, 4		
Impedance	50Ω		
VSWR	≤1.5:1		
First upper sidelobe	< -17 dB		
Front-to-back ratio	> 30 dB		
In-band isolation	> 28 dB		
IM3 (20W carrier)	< -150 dBc		
Input power	300 W		
Lightning protection	Direct Ground		
Connector(s)	2 Ports / EDIN / Female / Bottom		
Operating temperature	-40° to +60° C / -40° to +140° F		
Mechanical Characteristics			
Dimensions Length x Width x Depth	1820 x 154 x 105 mm	71.7 x 6.1 x 4.1 in	
Depth with z-brackets	133 mm	5.2 in	
Weight without mounting brackets	6.8 kg	15 lbs	
Survival wind speed	> 201 km/hr	> 125 mph	
Wind area	Front: 0.28 m ² Side: 0.19 m ²	Front: 3.1 ft ²	Side: 2.1 ft ²
Wind load @ 161 km/hr (100 mph)	Front: 460 N Side: 304 N	Front: 103 lbf	Side: 68 lbf
Mounting Options	Part Number	Fits Pipe Diameter	Weight
2-Point Mounting Bracket Kit	26799997	50-102 mm 2.0-4.0 in	2.3 kg 5 lbs
2-Point Mounting & Downtilt Bracket Kit	26799999	50-102 mm 2.0-4.0 in	3.6 kg 8 lbs
Concealment Configurations	For concealment configurations, order BXA-171085-12BF-EDIN-X-FP		

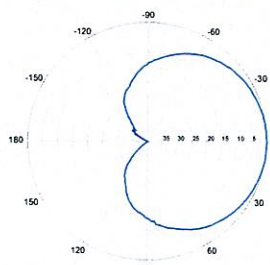
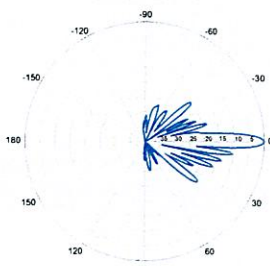


BXA-171085-12BF-EDIN-X

Horizontal | 1710-1880 MHz
BXA-171085-12BF-EDIN-0

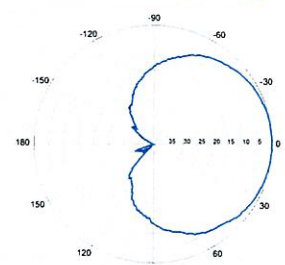
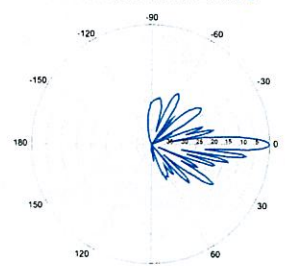
0° | Vertical | 1710-1880 MHz

BXA-171085-12BF-EDIN-X

Horizontal | 1850-1990 MHz
BXA-171085-12BF-EDIN-0

0° | Vertical | 1850-1990 MHz

BXA-171085-12BF-EDIN-X

Horizontal | 1920-2170 MHz
BXA-171085-12BF-EDIN-0

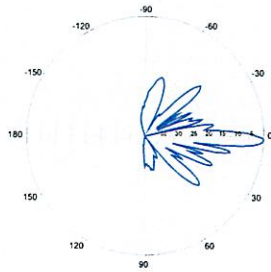
0° | Vertical | 1920-2170 MHz

Quoted performance parameters are provided to offer typical or range values only and may vary as a result of normal manufacturing and operational conditions. Extreme operational conditions and/or stress on structural supports is beyond our control. Such conditions may result in damage to this product. Improvements to product may be made without notice.

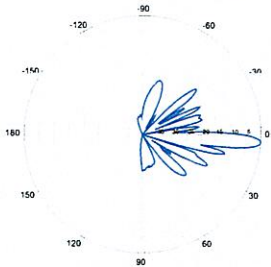
BXA-171085-12BF-EDIN-X

X-Pol | FET Panel | 85° | 18.0 dBi

BXA-171085-12BF-EDIN-2

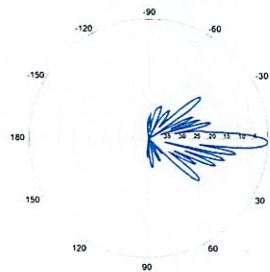


2° | Vertical | 1710-1880 MHz
BXA-171085-12BF-EDIN-4

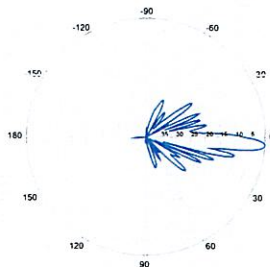


4° | Vertical | 1710-1880 MHz

BXA-171085-12BF-EDIN-2

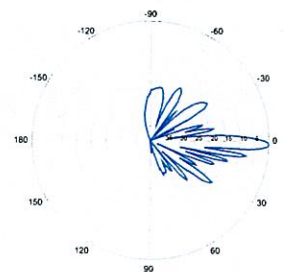


2° | Vertical | 1850-1990 MHz
BXA-171085-12BF-EDIN-4

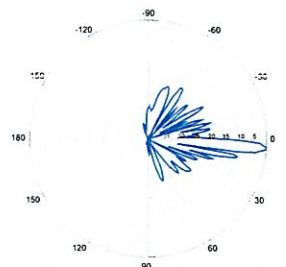


4° | Vertical | 1850-1990 MHz

BXA-171085-12BF-EDIN-2



2° | Vertical | 1920-2170 MHz
BXA-171085-12BF-EDIN-4



4° | Vertical | 1920-2170 MHz

Quoted performance parameters are provided to offer typical or range values only and may vary as a result of normal manufacturing and operational conditions. Extreme operational conditions and/or stress on structural supports is beyond our control. Such conditions may result in damage to this product. Improvements to product may be made without notice.

BXA-70063-6CF-EDIN-X

X-Pol | FET Panel | 63° | 14.5 dBd

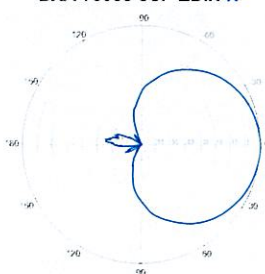
Replace "X" with desired electrical downtilt.

Antenna is also available with NE connector(s)
Replace "EDIN" with "NE" in the model number
when ordering.

Electrical Characteristics	696-900 MHz					
Frequency bands	696-806 MHz		806-900 MHz			
Polarization	±45°					
Horizontal beamwidth	65°		63°			
Vertical beamwidth	13°		11°			
Gain	14.0 dBd (16.1 dBi)		14.5 dBd (16.6 dBi)			
Electrical downtilt (X)	0, 2, 3, 4, 5, 6, 8, 10					
Impedance	50Ω					
VSWR	≤1.35:1					
Upper sidelobe suppression (0°)	-18.3 dB		-18.2 dB			
Front-to-back ratio (+/-30°)	-33.4 dB		-36.3 dB			
Null fill	5% (-26.02 dB)					
Isolation between ports	< -25 dB					
Input power with EDIN connectors	500 W					
Input power with NE connectors	300 W					
Lightning protection	Direct Ground					
Connector(s)	2 Ports / EDIN or NE / Female / Center (Back)					
Mechanical Characteristics						
Dimensions Length x Width x Depth	1804 x 285 x 132 mm		71.0 x 11.2 x 5.2 in			
Depth with z-brackets	172 mm		6.8 in			
Weight without mounting brackets	7.9 kg		17 lbs			
Survival wind speed	> 201 km/hr		> 125 mph			
Wind area	Front: 0.51 m ²	Side: 0.24 m ²	Front: 5.5 ft ²	Side: 2.6 ft ²		
Wind load @ 161 km/hr (100 mph)	Front: 759 N	Side: 391 N	Front: 169 lbf	Side: 89 lbf		
Mounting Options	Part Number		Fits Pipe Diameter		Weight	
3-Point Mounting & Downtilt Bracket Kit	36210008		40-115 mm 1.57-4.5 in		6.9 kg 15.2 lbs	
Concealment Configurations	For concealment configurations, order BXA-70063-6CF-EDIN-X-FP					

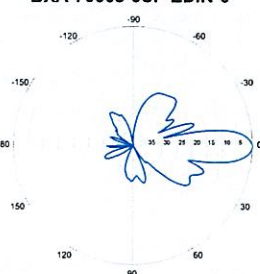


BXA-70063-6CF-EDIN-X



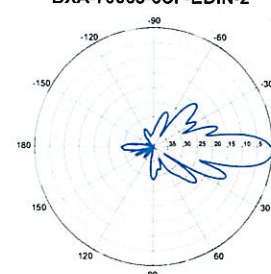
Horizontal | 750 MHz

BXA-70063-6CF-EDIN-0

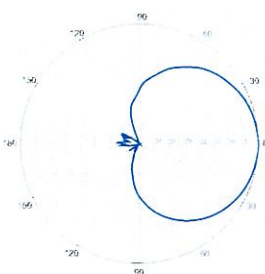


0° | Vertical | 750 MHz

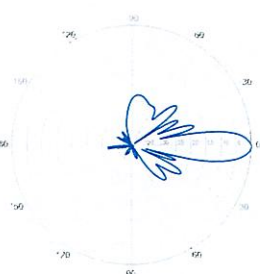
BXA-70063-6CF-EDIN-2



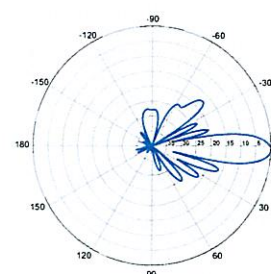
2° | Vertical | 750 MHz



Horizontal | 850 MHz



0° | Vertical | 850 MHz



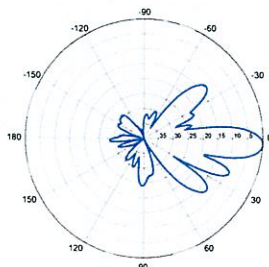
2° | Vertical | 850 MHz

Quoted performance parameters are provided to offer typical or range values only and may vary as a result of normal manufacturing and operational conditions. Extreme operational conditions and/or stress on structural supports is beyond our control. Such conditions may result in damage to this product. Improvements to product may be made without notice.

BXA-70063-6CF-EDIN-X

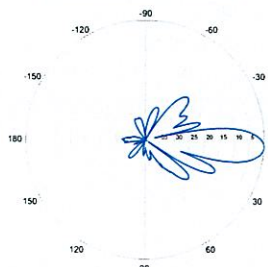
X-Pol | FET Panel | 63° | 14.5 dBd

BXA-70063-6CF-EDIN-3



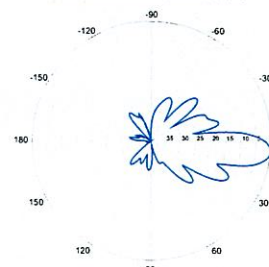
3° | Vertical | 750 MHz

BXA-70063-6CF-EDIN-4

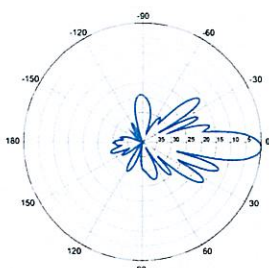


4° | Vertical | 750 MHz

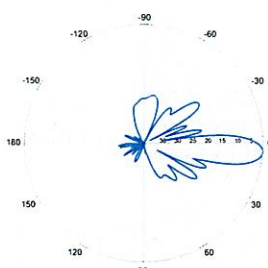
BXA-70063-6CF-EDIN-5



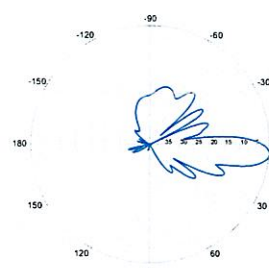
5° | Vertical | 750 MHz



3° | Vertical | 850 MHz

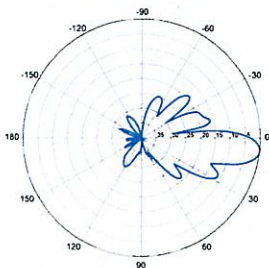


4° | Vertical | 850 MHz



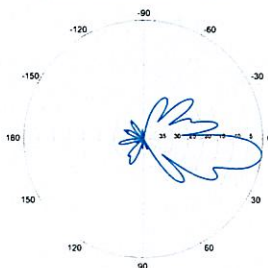
5° | Vertical | 850 MHz

BXA-70063-6CF-EDIN-6



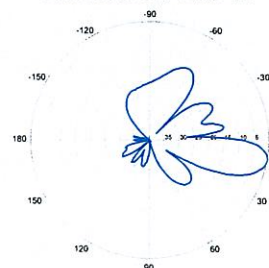
6° | Vertical | 750 MHz

BXA-70063-6CF-EDIN-8

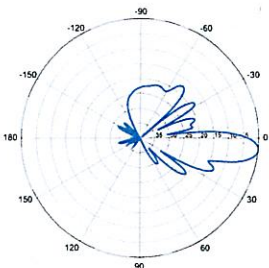


8° | Vertical | 750 MHz

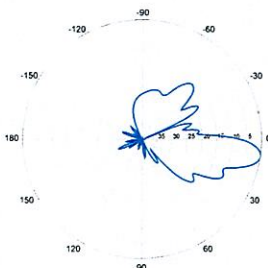
BXA-70063-6CF-EDIN-10



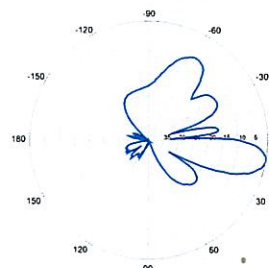
10° | Vertical | 750 MHz



6° | Vertical | 850 MHz



8° | Vertical | 850 MHz



10° | Vertical | 850 MHz

Quoted performance parameters are provided to offer typical or range values only and may vary as a result of normal manufacturing and operational conditions. Extreme operational conditions and/or stress on structural supports is beyond our control. Such conditions may result in damage to this product. Improvements to product may be made without notice.

General Power Density

Site Name: GOSHEN, CT
Cumulative Power Density

Operator	Operating Frequency (MHz)	Number of Trans.	ERP Per Trans. (watts)	Total ERP (watts)	Distance to Target (feet)	Calculated Power Density (mW/cm ²)	Maximum Permissible Exposure* (mW/cm ²)	Fraction of MPE (%)
VZW PCS	1970	7	268	1876	150	0.0300	1.0	3.00%
VZW Cellular	869	9	332	2988	150	0.0478	0.5793333333	8.24%
VZW AWS	2145	1	670	670	150	0.0107	1.0	1.07%
VZW 700	698	2	780	1560	150	0.0249	0.4653333333	5.36%
Total Percentage of Maximum Permissible Exposure								17.67%

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

MHz = Megahertz

mW/cm² = milliwatts per square centimeter

ERP = Effective Radiated Power

Absolute worst case maximum values used.

Structural Analysis Report

150-ft Existing EET Monopole

*Proposed Verizon Wireless
Antenna Upgrade*

Verizon Site Ref: Goshen

*North Street (Route 63)
Goshen, CT*

Centek Project No. 11001.CO66

~~Date: November 28, 2011~~

Rev 1: December 12, 2011



Prepared for:

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

Table of Contents

SECTION 1 - REPORT

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

SECTION 2 – CONDITIONS & SOFTWARE

- STANDARD ENGINEERING CONDITIONS.
- GENERAL DESCRIPTION OF STRUCTURAL ANALYSIS PROGRAM.

SECTION 3 – CALCULATIONS

- RISATower INPUT/OUTPUT SUMMARY.
- RISATower DETAILED OUTPUT.
- ANCHOR BOLT AND BASE PLATE ANALYSIS.
- SPREAD FOOTING W/ PIER ANALYSIS.

SECTION 4 – REFERENCE MATERIAL

- VERIZON RF DATA SHEET.
- ANTENNA CUT SHEETS.

I n t r o d u c t i o n

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 Goshen, CT.

The host tower is a 150-ft tall, three-section, eighteen sided, tapered monopole, originally designed and manufactured by Engineered Endeavors Inc., job no; 15244-E01, dated January 23, 2008. The tower geometry, structure member sizes and foundation system information were obtained from the aforementioned EEI design documents. Antenna and appurtenance information were obtained from visual verification from grade by Centek personnel on November 22, 2011 and a Verizon RF data sheet.

The tower is made up of three (3) tapered vertical sections consisting of A572-65 pole sections. The vertical tower sections are slip joint connected. The diameter of the pole (flat-flat) is 24.0-in at the top and 57.0-in at the base.

Verizon is proposing the removal of six (6) panel antennas and the installation of six (6) panel antennas mounted to the existing three (3) 12-ft T-Arms w/ work support platforms. Refer to the Antenna and Appurtenance Summary below for a detailed description of the proposed antenna and appurtenance configuration.

A n t e n n a a n d A p p u r t e n a n c e S u m m a r y

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

- UNKNOWN (Existing):
Antennas: One (1) 15-ft Omni-directional whip antenna mounted to the Verizon T-Arm with an elevation of 147.5-ft above the existing grade.
Coax Cables: One (1) 7/8" \varnothing coax cable running on the inside of the existing tower.
- UNKNOWN (Existing):
Antennas: One (1) 5-ft dipole antenna mounted to the Verizon T-Arm with an elevation of 147.5-ft above the existing grade.
Coax Cables: One (1) 7/8" \varnothing coax cable running on the inside of the existing tower.
- VERIZON (Existing to Remain):
Antennas: Six (6) Antel LPA-80080-6CF panel antennas mounted on three (3) 12-ft T-Arms w/ work support platforms with a RAD center elevation of 150-ft above grade.
Coax Cables: Twelve (12) 1-5/8" \varnothing coax cables running on the inside of the existing tower.
- VERIZON (Existing to Remove):
Antennas: Six (6) Antel LPA-185080-12CF panel antennas mounted on three (3) 12-ft T-Arms w/ work support platforms with a RAD center elevation of 150-ft above grade.

- **VERIZON (PROPOSED):**
Antennas: Three (3) Antel BXA-70063-6CF and three (3) Antel BXA-171085-12BF panel antennas mounted on three (3) 12-ft T-Arms w/ work support platforms with a RAD center elevation of 150-ft above grade.
Coax Cables: Six (6) 1-5/8" Ø coax cables running inside the existing tower to the exit ports at 138-ft A.G.L. then banded to the exterior of the existing tower the remaining 10-ft.

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.

A n a l y s i s

The existing tower was analyzed using a comprehensive computer program entitled RISATower. 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 80 mph basic wind speed (fastest mile) with no ice and 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).

T o w e r L o a d i n g

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 tower structure and its components.

Basic Wind Speed:	Litchfield; v = 80 mph (fastest mile)	[Section 16 of TIA/EIA-222-F-96]
	Goshen; v = 90 mph (3 second gust) equivalent to v = 75 mph (fastest mile)	[Appendix K of the 2005 CT Building Code Supplement]
	TIA/EIA-222-F wind speed controls.	
Load Cases:	<u>Load Case 1</u> ; 80 mph wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation. This load case typically controls the design of monopole towers.	[Section 2.3.16 of TIA/EIA-222-F-96]
	<u>Load Case 2</u> ; 69 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 69 mph wind speed velocity represents 75% of the wind pressure generated by the 80 mph wind speed. This load case typically controls the design of lattice towers.	[Section 2.3.16 of TIA/EIA-222-F-96]
	<u>Load Case 3</u> ; Seismic – not checked	[Section 1614.5 of State Bldg. Code 2005] does not control in the design of this structure type

Tower Capacity

Tower stresses were calculated utilizing the structural analysis software RISATower. 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 RISATower "Section Capacity Table", this tower was found to be at **39.3%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L3)	1.0'-48.04'	39.3%	PASS

Foundation and Anchors

The existing foundation consists of a 7.0-ft square x 3.0-ft long reinforced concrete pier on a 28.0-ft square x 3.0-ft thick reinforced concrete pad. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned EEI design documents; job no; 15244-E01, dated January 23, 2008. The base of the tower is connected to the foundation by means of (24) 2.25"Ø, ASTM A615-75 anchor bolts embedded approximately 5-ft into the concrete foundation structure.

Review of the foundation and anchor design consisted of verification of applied loads obtained from the tower design calculations and code checks of allowable stresses:

- 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	16 kips
	Compression	27 kips
	Moment	1570 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	5.08	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	Compression	25.4%	PASS
Base Plate	Bending	18.7%	PASS

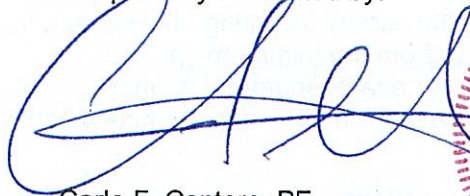
Conclusion

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



Prepared by:



Timothy J. Lynn, EIT
Structural Engineer

Standard Conditions for Furnishing of
Professional Engineering Services on
Existing Structures

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

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

GENERAL DESCRIPTION OF STRUCTURAL ANALYSIS PROGRAM

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

RISATower Features:

- RISATower 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.
- RISATower contains unique features such as True Cable behavior, hog rod take-up, foundation stiffness and much more.

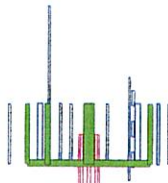
Section	Length (ft)	Number of Sides	Thickness (in)	Socket Length (ft)	Top Dia (in)	Bot Dia (in)	Grade	Weight (K)
1	53.540	18	0.250	5.083	24.000	36.350		4.3
2	53.500	18	0.313	6.417	34.678	46.900	A572-65	7.3
3	53.460	18	0.375		44.809	57.000		10.9
								22.6

150.0 ft

96.5 ft

48.0 ft

1.0 ft



DESIGNED APPURTENANCE LOADING

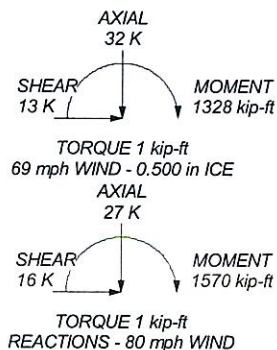
TYPE	ELEVATION	TYPE	ELEVATION
LPA-80080/6CF (Verizon - Existing)	150	BXA-70063/6CF (Verizon - Proposed)	150
BXA-171085-12BF (Verizon - Proposed)	150	LPA-80080-6CF (Verizon - Existing)	150
BXA-70063/6CF (Verizon - Proposed)	150	12-ft T-arm w/ Work Support Platform (Verizon - Existing)	147.5
LPA-80080-6CF (Verizon - Existing)	150	12-ft T-arm w/ Work Support Platform (Verizon - Existing)	147.5
LPA-80080/6CF (Verizon - Existing)	150	12-ft T-arm w/ Work Support Platform (Verizon - Existing)	147.5
BXA-171085-12BF (Verizon - Proposed)	150	12-ft T-arm w/ Work Support Platform (Verizon - Existing)	147.5
BXA-70063/6CF (Verizon - Proposed)	150	15' x 3" Dia Omni (Unknown - Existing)	147.5
LPA-80080-6CF (Verizon - Existing)	150	5-ft dipole (Unknown - Existing)	147.5
LPA-80080/6CF (Verizon - Existing)	150		
BXA-171085-12BF (Verizon - Proposed)	150		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower is located in Litchfield County, Connecticut.
2. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
3. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
4. Deflections are based upon a 50 mph wind.
5. Weld together tower sections have flange connections.
6. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
7. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
8. Welds are fabricated with ER-70S-6 electrodes.
9. TOWER RATING: 39.3%



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

Job: **11001.CO66 - Goshen**

Project: **150-ft EEI Monopole - North Street, Goshen, CT**

Client: Verizon Wireless

Drawn by: TJL

App'd:

Code: TIA/EIA-222-F

Date: 12/12/11

Scale: NTS

Path:

Dwg No: E-1

J:\Jobs\1100100 WDC066 - Goshen\Rev (1)\Calc\ERI Files\150' EEI Monopole - Goshen, CT.er

<i>RISATower</i> Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job	11001.CO66 - Goshen	Page	1 of 17
	Project	150-ft EEI Monopole - North Street, Goshen, CT	Date	08:35:25 12/12/11
	Client	Verizon Wireless	Designed by	TJL

Tower Input Data

There is a pole section.

This tower is designed using the TIA/EIA-222-F standard.

The following design criteria apply:

Tower is located in Litchfield County, Connecticut.

Basic wind speed of 80 mph.

Nominal ice thickness of 0.500 in.

Ice density of 56 pcf.

A wind speed of 69 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	Distribute Leg Loads As Uniform	Treat Feedline Bundles As Cylinder
Consider Moments - Horizontals	Assume Legs Pinned	Use ASCE 10 X-Brace Ly Rules
Consider Moments - Diagonals	✓ Assume Rigid Index Plate	Calculate Redundant Bracing Forces
Use Moment Magnification	Use Clear Spans For Wind Area	Ignore Redundant Members in FEA
✓ Use Code Stress Ratios	Use Clear Spans For KL/r	SR Leg Bolts Resist Compression
Use Code Safety Factors - Guys	Retension Guys To Initial Tension	All Leg Panels Have Same Allowable
Escalate Ice	✓ Bypass Mast Stability Checks	Offset Girt At Foundation
Always Use Max Kz	Use Azimuth Dish Coefficients	Consider Feedline Torque
Use Special Wind Profile	✓ Project Wind Area of Appurt.	Include Angle Block Shear Check
Include Bolts In Member Capacity	Autocalc Torque Arm Areas	Poles
Leg Bolts Are At Top Of Section	SR Members Have Cut Ends	✓ Include Shear-Torsion Interaction
Secondary Horizontal Braces Leg	✓ Sort Capacity Reports By Component	Always Use Sub-Critical Flow
Use Diamond Inner Bracing (4 Sided)	Triangulate Diamond Inner Bracing	Use Top Mounted Sockets
Add IBC .6D+W Combination		

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	150.000-96.460	53.540	5.083	18	24.000	36.350	0.250	1.000	A572-65 (65 ksi)
L2	96.460-48.043	53.500	6.417	18	34.678	46.900	0.313	1.250	A572-65 (65 ksi)
L3	48.043-1.000	53.460		18	44.809	57.000	0.375	1.500	A572-65

RISATower Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job	11001.CO66 - Goshen	Page	2 of 17
	Project	150-ft EEI Monopole - North Street, Goshen, CT	Date	08:35:25 12/12/11
	Client	Verizon Wireless	Designed by	TJL

Section	Elevation	Section Length	Splice Length	Number of Sides	Top Diameter	Bottom Diameter	Wall Thickness	Bend Radius	Pole Grade
	ft	ft	ft		in	in	in	in	(65 ksi)

Tapered Pole Properties

Section	Tip Dia.	Area	I	r	C	I/C	J	It/Q	w	w/t
	in	in ²	in ⁴	in	in	in ³	in ⁴	in ³	in	
L1	24.370	18.846	1342.998	8.431	12.192	110.154	2687.762	9.425	3.784	15.136
L2	36.911	28.645	4716.350	12.816	18.466	255.410	9438.905	14.325	5.958	23.83
	36.392	34.086	5085.619	12.200	17.616	288.690	10177.931	17.046	5.553	17.77
	47.624	46.209	12670.758	16.539	23.825	531.822	25358.189	23.109	7.704	24.654
L3	46.986	52.888	13192.330	15.774	22.763	579.552	26402.018	26.449	7.226	19.27
	57.879	67.398	27302.366	20.102	28.956	942.891	54640.657	33.705	9.372	24.992

Tower Elevation	Gusset Area (per face)	Gusset Thickness	Gusset Grade	Adjust. Factor A _f	Adjust. Factor A _r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals	Double Angle Stitch Bolt Spacing Horizontals
ft	ft ²	in					in	in
L1				1	1	1		
150.000-96.460								
L2				1	1	1		
96.460-48.043								
L3				1	1	1		
48.043-1.000								

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement	Total Number	C _A A _A	Weight
				ft		ft ² /ft	klf
1 5/8 (Verizon - Existing)	B	No	Inside Pole	150.000 - 4.000	12	No Ice 0.000 1/2" Ice 0.000	0.001 0.001
7/8 (Unknown - Existing)	B	No	Inside Pole	150.000 - 4.000	2	No Ice 0.000 1/2" Ice 0.000	0.001 0.001
1 5/8 (Verizon - Proposed)	B	No	Inside Pole	138.000 - 4.000	6	No Ice 0.000 1/2" Ice 0.000	0.001 0.001
1 5/8 (Verizon - Proposed)	B	No	CaAa (Out Of Face)	150.000 - 138.000	1	No Ice 0.198 1/2" Ice 0.298	0.001 0.003
1 5/8 (Verizon - Proposed)	B	No	CaAa (Out Of Face)	150.000 - 138.000	5	No Ice 0.000 1/2" Ice 0.000	0.001 0.003

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation	Face	A _R	A _F	C _A A _A In Face	C _A A _A Out Face	Weight
	ft		ft ²	ft ²	ft ²	ft ²	K
L1	150.000-96.460	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	2.376	1.060

RISATower Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job	11001.CO66 - Goshen	Page	3 of 17
	Project	150-ft EEI Monopole - North Street, Goshen, CT	Date	08:35:25 12/12/11
	Client	Verizon Wireless	Designed by	TJL

Tower Section	Tower Elevation ft	Face	A_R ft ²	A_F ft ²	C_{AA} In Face ft ²	C_{AA} Out Face ft ²	Weight K
L2	96.460-48.043	C	0.000	0.000	0.000	0.000	0.000
		A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.959
L3	48.043-1.000	C	0.000	0.000	0.000	0.000	0.000
		A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.872
		C	0.000	0.000	0.000	0.000	0.000

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft ²	A_F ft ²	C_{AA} In Face ft ²	C_{AA} Out Face ft ²	Weight K
L1	150.000-96.460	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	3.576	1.169
		C		0.000	0.000	0.000	0.000	0.000
L2	96.460-48.043	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.959
		C		0.000	0.000	0.000	0.000	0.000
L3	48.043-1.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.872
		C		0.000	0.000	0.000	0.000	0.000

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft	C_{AA} Front ft ²	C_{AA} Side ft ²	Weight K
LPA-80080/6CF (Verizon - Existing)	A	From Face	4.500	0.000	150.000	No Ice	4.326	9.088
			6.000			1/2" Ice	4.764	9.637
			0.000					0.021
BXA-171085-12BF (Verizon - Proposed)	A	From Face	4.500	0.000	150.000	No Ice	4.734	3.572
			4.000			1/2" Ice	5.180	4.007
			0.000					0.015
BXA-70063/6CF (Verizon - Proposed)	A	From Face	4.500	0.000	150.000	No Ice	7.731	4.158
			0.000			1/2" Ice	8.268	4.595
			0.000					0.017
LPA-80080-6CF (Verizon - Existing)	A	From Face	4.500	0.000	150.000	No Ice	4.326	9.088
			-6.000			1/2" Ice	4.764	9.637
			0.000					0.021
LPA-80080/6CF (Verizon - Existing)	B	From Face	4.500	0.000	150.000	No Ice	4.326	9.088
			6.000			1/2" Ice	4.764	9.637
			0.000					0.021
BXA-171085-12BF (Verizon - Proposed)	B	From Face	4.500	0.000	150.000	No Ice	4.734	3.572
			4.000			1/2" Ice	5.180	4.007
			0.000					0.015
BXA-70063/6CF (Verizon - Proposed)	B	From Face	4.500	0.000	150.000	No Ice	7.731	4.158
			0.000			1/2" Ice	8.268	4.595
			0.000					0.017
LPA-80080-6CF	B	From Face	4.500	0.000	150.000	No Ice	4.326	9.088

RISATower Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job	11001.CO66 - Goshen	Page 4 of 17
	Project	150-ft EEI Monopole - North Street, Goshen, CT	Date 08:35:25 12/12/11
	Client	Verizon Wireless	Designed by TJL

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C _A A _A Front ft ²	C _A A _A Side ft ²	Weight K
(Verizon - Existing)			-6.000 0.000			1/2" Ice	4.764	9.637	0.069
LPA-80080/6CF	C	From Face	4.500	0.000	150.000	No Ice	4.326	9.088	0.021
(Verizon - Existing)			6.000 0.000			1/2" Ice	4.764	9.637	0.069
BXA-171085-12BF	C	From Face	4.500	0.000	150.000	No Ice	4.734	3.572	0.015
(Verizon - Proposed)			4.000 0.000			1/2" Ice	5.180	4.007	0.042
BXA-70063/6CF	C	From Face	4.500	0.000	150.000	No Ice	7.731	4.158	0.017
(Verizon - Proposed)			0.000 0.000			1/2" Ice	8.268	4.595	0.059
LPA-80080-6CF	C	From Face	4.500	0.000	150.000	No Ice	4.326	9.088	0.021
(Verizon - Existing)			-6.000 0.000			1/2" Ice	4.764	9.637	0.069
12-ft T-arm w/ Work Support Platform	A	From Face	2.000	0.000	147.500	No Ice	14.200	14.200	0.486
(Verizon - Existing)			0.000 0.000			1/2" Ice	19.700	19.700	0.575
12-ft T-arm w/ Work Support Platform	B	From Face	2.000	0.000	147.500	No Ice	14.200	14.200	0.486
(Verizon - Existing)			0.000 0.000			1/2" Ice	19.700	19.700	0.575
12-ft T-arm w/ Work Support Platform	C	From Face	2.000	0.000	147.500	No Ice	14.200	14.200	0.486
(Verizon - Existing)			0.000 0.000			1/2" Ice	19.700	19.700	0.575
15' x 3" Dia Omni	A	From Face	3.500	0.000	147.500	No Ice	4.500	4.500	0.042
(Unknown - Existing)			0.000 7.500			1/2" Ice	6.033	6.033	0.074
5-ft dipole	B	From Face	3.500	0.000	147.500	No Ice	2.700	2.700	0.015
(Unknown - Existing)			0.000 3.000			1/2" Ice	4.500	4.500	0.025

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 _A A _A In Face ft ²	C _A A _A Out Face ft ²
L1 150.000-96.460	121.816	1.452	0.024	134.631	A	0.000	134.631	134.631	100.00	0.000	0.000
					B	0.000	134.631		100.00	0.000	2.376
					C	0.000	134.631		100.00	0.000	0.000
L2 96.460-48.043	71.757	1.248	0.020	166.915	A	0.000	166.915	166.915	100.00	0.000	0.000
					B	0.000	166.915		100.00	0.000	0.000
					C	0.000	166.915		100.00	0.000	0.000
L3 48.043-1.000	23.856	1	0.017	202.427	A	0.000	202.427	202.427	100.00	0.000	0.000
					B	0.000	202.427		100.00	0.000	0.000
					C	0.000	202.427		100.00	0.000	0.000

RISATower Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job	11001.CO66 - Goshen	Page	5 of 17
	Project	150-ft EEI Monopole - North Street, Goshen, CT	Date	08:35:25 12/12/11
	Client	Verizon Wireless	Designed by	TJL

Tower Pressure - With Ice

$$G_H = 1.690$$

Section Elevation	z	K _z	q _z	t _z	A _G	F a c e	A _F	A _R	A _{leg}	Leg %	C _A A _A In Face ft ²	C _A A _A Out Face ft ²
ft	ft		ksf	in	ft ²		ft ²	ft ²	ft ²			
L1 150.000-96.460	121.816	1.452	0.018	0.500	139.092	A	0.000	139.092	139.092	100.00	0.000	0.000
						B	0.000	139.092		100.00	0.000	3.576
						C	0.000	139.092		100.00	0.000	0.000
L2 96.460-48.043	71.757	1.248	0.015	0.500	170.950	A	0.000	170.950	170.950	100.00	0.000	0.000
						B	0.000	170.950		100.00	0.000	0.000
						C	0.000	170.950		100.00	0.000	0.000
L3 48.043-1.000	23.856	1	0.012	0.500	206.347	A	0.000	206.347	206.347	100.00	0.000	0.000
						B	0.000	206.347		100.00	0.000	0.000
						C	0.000	206.347		100.00	0.000	0.000

Tower Pressure - Service

$$G_H = 1.690$$

Section Elevation	z	K _z	q _z	A _G	F a c e	A _F	A _R	A _{leg}	Leg %	C _A A _A In Face ft ²	C _A A _A Out Face ft ²
ft	ft		ksf	ft ²		ft ²	ft ²	ft ²			
L1 150.000-96.460	121.816	1.452	0.009	134.631	A	0.000	134.631	134.631	100.00	0.000	0.000
					B	0.000	134.631		100.00	0.000	2.376
					C	0.000	134.631		100.00	0.000	0.000
L2 96.460-48.043	71.757	1.248	0.008	166.915	A	0.000	166.915	166.915	100.00	0.000	0.000
					B	0.000	166.915		100.00	0.000	0.000
					C	0.000	166.915		100.00	0.000	0.000
L3 48.043-1.000	23.856	1	0.006	202.427	A	0.000	202.427	202.427	100.00	0.000	0.000
					B	0.000	202.427		100.00	0.000	0.000
					C	0.000	202.427		100.00	0.000	0.000

Tower Forces - No Ice - Wind Normal To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	klf	
L1 150.000-96.460	1.060	4.326	A	1	0.65	1	1	1	134.631	3.607	0.067	C
			B	1	0.65	1	1	1	134.631			
			C	1	0.65	1	1	1	134.631			
L2 96.460-48.043	0.959	7.309	A	1	0.65	1	1	1	166.915	3.731	0.077	C
			B	1	0.65	1	1	1	166.915			
			C	1	0.65	1	1	1	166.915			
L3 48.043-1.000	0.872	10.941	A	1	0.65	1	1	1	202.427	3.688	0.078	C
			B	1	0.65	1	1	1	202.427			
			C	1	0.65	1	1	1	202.427			
Sum Weight:	2.891	22.576						OTM	784.019 kip-ft	11.025		

RISATower Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job	11001.CO66 - Goshen	Page	6 of 17
	Project	150-ft EEI Monopole - North Street, Goshen, CT	Date	08:35:25 12/12/11
	Client	Verizon Wireless	Designed by	TJL

Tower Forces - No Ice - Wind 45 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	klf	
L1	1.060	4.326	A	1	0.65	1	1	1	134.631	3.607	0.067	C
150.000-96.460			B	1	0.65	1	1	1	134.631			
			C	1	0.65	1	1	1	134.631			
L2	0.959	7.309	A	1	0.65	1	1	1	166.915	3.731	0.077	C
96.460-48.043			B	1	0.65	1	1	1	166.915			
			C	1	0.65	1	1	1	166.915			
L3	0.872	10.941	A	1	0.65	1	1	1	202.427	3.688	0.078	C
48.043-1.000			B	1	0.65	1	1	1	202.427			
			C	1	0.65	1	1	1	202.427			
Sum Weight:	2.891	22.576						OTM	784.019 kip-ft	11.025		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	klf	
L1	1.060	4.326	A	1	0.65	1	1	1	134.631	3.607	0.067	C
150.000-96.460			B	1	0.65	1	1	1	134.631			
			C	1	0.65	1	1	1	134.631			
L2	0.959	7.309	A	1	0.65	1	1	1	166.915	3.731	0.077	C
96.460-48.043			B	1	0.65	1	1	1	166.915			
			C	1	0.65	1	1	1	166.915			
L3	0.872	10.941	A	1	0.65	1	1	1	202.427	3.688	0.078	C
48.043-1.000			B	1	0.65	1	1	1	202.427			
			C	1	0.65	1	1	1	202.427			
Sum Weight:	2.891	22.576						OTM	784.019 kip-ft	11.025		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	klf	
L1	1.060	4.326	A	1	0.65	1	1	1	134.631	3.607	0.067	C
150.000-96.460			B	1	0.65	1	1	1	134.631			
			C	1	0.65	1	1	1	134.631			
L2	0.959	7.309	A	1	0.65	1	1	1	166.915	3.731	0.077	C
96.460-48.043			B	1	0.65	1	1	1	166.915			
			C	1	0.65	1	1	1	166.915			
L3	0.872	10.941	A	1	0.65	1	1	1	202.427	3.688	0.078	C
48.043-1.000			B	1	0.65	1	1	1	202.427			
			C	1	0.65	1	1	1	202.427			
Sum Weight:	2.891	22.576						OTM	784.019	11.025		

RISATower Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job	11001.CO66 - Goshen	Page	7 of 17
	Project	150-ft EEI Monopole - North Street, Goshen, CT	Date	08:35:25 12/12/11
	Client	Verizon Wireless	Designed by	TJL

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	klf	
									kip-ft			

Tower Forces - With Ice - Wind Normal To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	klf	
L1	1.169	5.340	A	1	0.65	1	1	1	139.092	2.828	0.053	C
150.000-96.460			B	1	0.65	1	1	1	139.092			
			C	1	0.65	1	1	1	139.092			
L2	0.959	8.560	A	1	0.65	1	1	1	170.950	2.866	0.059	C
96.460-48.043			B	1	0.65	1	1	1	170.950			
			C	1	0.65	1	1	1	170.950			
L3	0.872	12.454	A	1	0.65	1	1	1	206.347	2.819	0.060	C
48.043-1.000			B	1	0.65	1	1	1	206.347			
			C	1	0.65	1	1	1	206.347			
Sum Weight:	3.000	26.354						OTM	608.931 kip-ft	8.514		

Tower Forces - With Ice - Wind 45 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	klf	
L1	1.169	5.340	A	1	0.65	1	1	1	139.092	2.828	0.053	C
150.000-96.460			B	1	0.65	1	1	1	139.092			
			C	1	0.65	1	1	1	139.092			
L2	0.959	8.560	A	1	0.65	1	1	1	170.950	2.866	0.059	C
96.460-48.043			B	1	0.65	1	1	1	170.950			
			C	1	0.65	1	1	1	170.950			
L3	0.872	12.454	A	1	0.65	1	1	1	206.347	2.819	0.060	C
48.043-1.000			B	1	0.65	1	1	1	206.347			
			C	1	0.65	1	1	1	206.347			
Sum Weight:	3.000	26.354						OTM	608.931 kip-ft	8.514		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	klf	
L1	1.169	5.340	A	1	0.65	1	1	1	139.092	2.828	0.053	C
150.000-96.460			B	1	0.65	1	1	1	139.092			
			C	1	0.65	1	1	1	139.092			

RISATower Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job	11001.CO66 - Goshen	Page	8 of 17
	Project	150-ft EEI Monopole - North Street, Goshen, CT	Date	08:35:25 12/12/11
	Client	Verizon Wireless	Designed by	TJL

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	klf	
L2 96.460-48.043	0.959	8.560	A	1	0.65	1	1	1	170.950	2.866	0.059	C
			B	1	0.65	1	1	1	170.950			
			C	1	0.65	1	1	1	170.950			
L3 48.043-1.000	0.872	12.454	A	1	0.65	1	1	1	206.347	2.819	0.060	C
			B	1	0.65	1	1	1	206.347			
			C	1	0.65	1	1	1	206.347			
Sum Weight:	3.000	26.354						OTM	608.931 kip-ft	8.514		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	klf	
L1 150.000-96.460	1.169	5.340	A	1	0.65	1	1	1	139.092	2.828	0.053	C
			B	1	0.65	1	1	1	139.092			
			C	1	0.65	1	1	1	139.092			
L2 96.460-48.043	0.959	8.560	A	1	0.65	1	1	1	170.950	2.866	0.059	C
			B	1	0.65	1	1	1	170.950			
			C	1	0.65	1	1	1	170.950			
L3 48.043-1.000	0.872	12.454	A	1	0.65	1	1	1	206.347	2.819	0.060	C
			B	1	0.65	1	1	1	206.347			
			C	1	0.65	1	1	1	206.347			
Sum Weight:	3.000	26.354						OTM	608.931 kip-ft	8.514		

Tower Forces - Service - Wind Normal To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	klf	
L1 150.000-96.460	1.060	4.326	A	1	0.65	1	1	1	134.631	1.409	0.026	C
			B	1	0.65	1	1	1	134.631			
			C	1	0.65	1	1	1	134.631			
L2 96.460-48.043	0.959	7.309	A	1	0.65	1	1	1	166.915	1.457	0.030	C
			B	1	0.65	1	1	1	166.915			
			C	1	0.65	1	1	1	166.915			
L3 48.043-1.000	0.872	10.941	A	1	0.65	1	1	1	202.427	1.440	0.031	C
			B	1	0.65	1	1	1	202.427			
			C	1	0.65	1	1	1	202.427			
Sum Weight:	2.891	22.576						OTM	306.257 kip-ft	4.307		

Tower Forces - Service - Wind 45 To Face

RISATower Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job	11001.CO66 - Goshen	Page 9 of 17
	Project	150-ft EEI Monopole - North Street, Goshen, CT	Date 08:35:25 12/12/11
	Client	Verizon Wireless	Designed by TJL

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	klf	
L1	1.060	4.326	A	1	0.65	1	1	1	134.631	1.409	0.026	C
150.000-96.46			B	1	0.65	1	1	1	134.631			
0			C	1	0.65	1	1	1	134.631			
L2	0.959	7.309	A	1	0.65	1	1	1	166.915	1.457	0.030	C
96.460-48.043			B	1	0.65	1	1	1	166.915			
			C	1	0.65	1	1	1	166.915			
L3	0.872	10.941	A	1	0.65	1	1	1	202.427	1.440	0.031	C
48.043-1.000			B	1	0.65	1	1	1	202.427			
			C	1	0.65	1	1	1	202.427			
Sum Weight:	2.891	22.576						OTM	306.257 kip-ft	4.307		

Tower Forces - Service - Wind 60 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	klf	
L1	1.060	4.326	A	1	0.65	1	1	1	134.631	1.409	0.026	C
150.000-96.46			B	1	0.65	1	1	1	134.631			
0			C	1	0.65	1	1	1	134.631			
L2	0.959	7.309	A	1	0.65	1	1	1	166.915	1.457	0.030	C
96.460-48.043			B	1	0.65	1	1	1	166.915			
			C	1	0.65	1	1	1	166.915			
L3	0.872	10.941	A	1	0.65	1	1	1	202.427	1.440	0.031	C
48.043-1.000			B	1	0.65	1	1	1	202.427			
			C	1	0.65	1	1	1	202.427			
Sum Weight:	2.891	22.576						OTM	306.257 kip-ft	4.307		

Tower Forces - Service - Wind 90 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	klf	
L1	1.060	4.326	A	1	0.65	1	1	1	134.631	1.409	0.026	C
150.000-96.46			B	1	0.65	1	1	1	134.631			
0			C	1	0.65	1	1	1	134.631			
L2	0.959	7.309	A	1	0.65	1	1	1	166.915	1.457	0.030	C
96.460-48.043			B	1	0.65	1	1	1	166.915			
			C	1	0.65	1	1	1	166.915			
L3	0.872	10.941	A	1	0.65	1	1	1	202.427	1.440	0.031	C
48.043-1.000			B	1	0.65	1	1	1	202.427			
			C	1	0.65	1	1	1	202.427			
Sum Weight:	2.891	22.576						OTM	306.257 kip-ft	4.307		

RISATower

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

Job

11001.CO66 - Goshen

Page

10 of 17

Project

150-ft EEI Monopole - North Street, Goshen, CT

Date

08:35:25 12/12/11

Client

Verizon Wireless

Designed by

TJL

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	22.576					
Bracing Weight	0.000					
Total Member Self-Weight	22.576			-0.129	0.106	
Total Weight	27.203			-0.129	0.106	
Wind 0 deg - No Ice		0.000	-16.154	-1544.820	0.106	-0.308
Wind 30 deg - No Ice		8.077	-13.990	-1337.871	-772.240	-0.616
Wind 45 deg - No Ice		11.423	-11.423	-1092.391	-1092.156	-0.712
Wind 60 deg - No Ice		13.990	-8.077	-772.475	-1337.636	-0.759
Wind 90 deg - No Ice		16.154	0.000	-0.129	-1544.586	-0.699
Wind 120 deg - No Ice		13.990	8.077	772.217	-1337.636	-0.452
Wind 135 deg - No Ice		11.423	11.423	1092.133	-1092.156	-0.277
Wind 150 deg - No Ice		8.077	13.990	1337.613	-772.240	-0.083
Wind 180 deg - No Ice		0.000	16.154	1544.562	0.106	0.308
Wind 210 deg - No Ice		-8.077	13.990	1337.613	772.451	0.616
Wind 225 deg - No Ice		-11.423	11.423	1092.133	1092.368	0.712
Wind 240 deg - No Ice		-13.990	8.077	772.217	1337.848	0.759
Wind 270 deg - No Ice		-16.154	0.000	-0.129	1544.797	0.699
Wind 300 deg - No Ice		-13.990	-8.077	-772.475	1337.848	0.452
Wind 315 deg - No Ice		-11.423	-11.423	-1092.391	1092.368	0.277
Wind 330 deg - No Ice		-8.077	-13.990	-1337.871	772.451	0.083
Member Ice	3.778					
Total Weight Ice	31.899			-0.225	0.194	
Wind 0 deg - Ice		0.000	-13.177	-1300.308	0.194	-0.199
Wind 30 deg - Ice		6.588	-11.411	-1126.130	-649.848	-0.556
Wind 45 deg - Ice		9.317	-9.317	-919.523	-919.104	-0.683
Wind 60 deg - Ice		11.411	-6.588	-650.267	-1125.711	-0.764
Wind 90 deg - Ice		13.177	0.000	-0.225	-1299.889	-0.767
Wind 120 deg - Ice		11.411	6.588	649.816	-1125.711	-0.565
Wind 135 deg - Ice		9.317	9.317	919.072	-919.104	-0.402
Wind 150 deg - Ice		6.588	11.411	1125.680	-649.848	-0.211
Wind 180 deg - Ice		0.000	13.177	1299.858	0.194	0.199
Wind 210 deg - Ice		-6.588	11.411	1125.680	650.235	0.556
Wind 225 deg - Ice		-9.317	9.317	919.072	919.491	0.683
Wind 240 deg - Ice		-11.411	6.588	649.816	1126.099	0.764
Wind 270 deg - Ice		-13.177	0.000	-0.225	1300.277	0.767
Wind 300 deg - Ice		-11.411	-6.588	-650.267	1126.099	0.565
Wind 315 deg - Ice		-9.317	-9.317	-919.523	919.491	0.402
Wind 330 deg - Ice		-6.588	-11.411	-1126.130	650.235	0.211
Total Weight	27.203			-0.129	0.106	
Wind 0 deg - Service		0.000	-6.310	-603.524	0.106	-0.120
Wind 30 deg - Service		3.155	-5.465	-522.684	-301.592	-0.241
Wind 45 deg - Service		4.462	-4.462	-426.794	-426.559	-0.278
Wind 60 deg - Service		5.465	-3.155	-301.826	-522.450	-0.297
Wind 90 deg - Service		6.310	0.000	-0.129	-603.289	-0.273
Wind 120 deg - Service		5.465	3.155	301.569	-522.450	-0.177
Wind 135 deg - Service		4.462	4.462	426.536	-426.559	-0.108
Wind 150 deg - Service		3.155	5.465	522.427	-301.592	-0.033
Wind 180 deg - Service		0.000	6.310	603.266	0.106	0.120
Wind 210 deg - Service		-3.155	5.465	522.427	301.803	0.241
Wind 225 deg - Service		-4.462	4.462	426.536	426.771	0.278
Wind 240 deg - Service		-5.465	3.155	301.569	522.661	0.297
Wind 270 deg - Service		-6.310	0.000	-0.129	603.501	0.273
Wind 300 deg - Service		-5.465	-3.155	-301.826	522.661	0.177
Wind 315 deg - Service		-4.462	-4.462	-426.794	426.771	0.108
Wind 330 deg - Service		-3.155	-5.465	-522.684	301.803	0.033

<i>RISATower</i> Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job	11001.CO66 - Goshen	Page	11 of 17
	Project	150-ft EEI Monopole - North Street, Goshen, CT	Date	08:35:25 12/12/11
	Client	Verizon Wireless	Designed by	TJL

Load Combinations

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

Maximum Member Forces

RISATower Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job	11001.CO66 - Goshen	Page	12 of 17
	Project	150-ft EEI Monopole - North Street, Goshen, CT	Date	08:35:25 12/12/11
	Client	Verizon Wireless	Designed by	TJL

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	150 - 96.46	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-8.341	0.194	0.225
			Max. Mx	14	-6.275	325.975	0.121
			Max. My	2	-6.275	0.103	325.998
			Max. Vy	14	-8.541	325.975	0.121
			Max. Vx	2	-8.541	0.103	325.998
			Max. Torque	31			-0.774
L2	96.46 - 48.043	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-17.267	0.194	0.225
			Max. Mx	14	-14.085	813.290	0.131
			Max. My	2	-14.085	0.108	813.314
			Max. Vy	14	-12.164	813.290	0.131
			Max. Vx	2	-12.164	0.108	813.314
			Max. Torque	23			0.773
L3	48.043 - 1	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-31.899	0.194	0.225
			Max. Mx	14	-27.198	1570.211	0.132
			Max. My	2	-27.198	0.109	1570.235
			Max. Vy	14	-16.164	1570.211	0.132
			Max. Vx	2	-16.164	0.109	1570.235
			Max. Torque	23			0.773

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	19	31.899	0.000	13.177
	Max. H _x	14	27.203	16.154	0.000
	Max. H _z	2	27.203	0.000	16.154
	Max. M _x	2	1570.235	0.000	16.154
	Max. M _z	6	1569.993	-16.154	0.000
	Max. Torsion	23	0.773	-13.177	-0.000
	Min. Vert	1	27.203	0.000	0.000
	Min. H _x	6	27.203	-16.154	0.000
	Min. H _z	10	27.203	0.000	-16.154
	Min. M _x	10	-1569.969	0.000	-16.154
	Min. M _z	14	-1570.211	16.154	0.000
	Min. Torsion	31	-0.773	13.177	-0.000

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	27.203	0.000	0.000	-0.129	0.106	0.000
Dead+Wind 0 deg - No Ice	27.203	0.000	-16.154	-1570.235	0.109	-0.311
Dead+Wind 30 deg - No Ice	27.203	8.077	-13.990	-1359.881	-784.943	-0.620
Dead+Wind 45 deg - No Ice	27.203	11.423	-11.423	-1110.362	-1110.122	-0.717
Dead+Wind 60 deg - No Ice	27.203	13.990	-8.077	-785.183	-1359.640	-0.764
Dead+Wind 90 deg - No Ice	27.203	16.154	0.000	-0.132	-1569.993	-0.703
Dead+Wind 120 deg - No Ice	27.203	13.990	8.077	784.919	-1359.639	-0.453
Dead+Wind 135 deg - No Ice	27.203	11.423	11.423	1110.097	-1110.121	-0.277

RISATower Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job	11001.CO66 - Goshen	Page 13 of 17
	Project	150-ft EEI Monopole - North Street, Goshen, CT	Date 08:35:25 12/12/11
	Client	Verizon Wireless	Designed by TJL

Load Combination	Vertical K	Shear _x K	Shear _y K	Overturning Moment, M _x kip-ft	Overturning Moment, M _y kip-ft	Torque kip-ft
Dead+Wind 150 deg - No Ice	27.203	8.077	13.990	1359.616	-784.942	-0.082
Dead+Wind 180 deg - No Ice	27.203	0.000	16.154	1569.969	0.109	0.311
Dead+Wind 210 deg - No Ice	27.203	-8.077	13.990	1359.616	785.160	0.620
Dead+Wind 225 deg - No Ice	27.203	-11.423	11.423	1110.098	1110.338	0.717
Dead+Wind 240 deg - No Ice	27.203	-13.990	8.077	784.919	1359.857	0.764
Dead+Wind 270 deg - No Ice	27.203	-16.154	0.000	-0.132	1570.211	0.703
Dead+Wind 300 deg - No Ice	27.203	-13.990	-8.077	-785.184	1359.858	0.453
Dead+Wind 315 deg - No Ice	27.203	-11.423	-11.423	-1110.363	1110.339	0.277
Dead+Wind 330 deg - No Ice	27.203	-8.077	-13.990	-1359.881	785.160	0.082
Dead+Ice+Temp	31.899	0.000	0.000	-0.225	0.194	0.000
Dead+Wind 0 deg+Ice+Temp	31.899	0.000	-13.177	-1327.606	0.202	-0.205
Dead+Wind 30 deg+Ice+Temp	31.899	6.588	-11.411	-1149.772	-663.485	-0.564
Dead+Wind 45 deg+Ice+Temp	31.899	9.317	-9.317	-938.827	-938.393	-0.691
Dead+Wind 60 deg+Ice+Temp	31.899	11.411	-6.588	-663.919	-1149.337	-0.772
Dead+Wind 90 deg+Ice+Temp	31.899	13.177	0.000	-0.233	-1327.170	-0.773
Dead+Wind 120 deg+Ice+Temp	31.899	11.411	6.588	663.453	-1149.336	-0.567
Dead+Wind 135 deg+Ice+Temp	31.899	9.317	9.317	938.360	-938.392	-0.402
Dead+Wind 150 deg+Ice+Temp	31.899	6.588	11.411	1149.304	-663.484	-0.209
Dead+Wind 180 deg+Ice+Temp	31.899	0.000	13.177	1327.138	0.202	0.205
Dead+Wind 210 deg+Ice+Temp	31.899	-6.588	11.411	1149.304	663.887	0.564
Dead+Wind 225 deg+Ice+Temp	31.899	-9.317	9.317	938.360	938.795	0.691
Dead+Wind 240 deg+Ice+Temp	31.899	-11.411	6.588	663.453	1149.739	0.772
Dead+Wind 270 deg+Ice+Temp	31.899	-13.177	0.000	-0.233	1327.574	0.773
Dead+Wind 300 deg+Ice+Temp	31.899	-11.411	-6.588	-663.919	1149.740	0.567
Dead+Wind 315 deg+Ice+Temp	31.899	-9.317	-9.317	-938.827	938.796	0.402
Dead+Wind 330 deg+Ice+Temp	31.899	-6.588	-11.411	-1149.772	663.888	0.209
Dead+Wind 0 deg - Service	27.203	0.000	-6.310	-613.584	0.109	-0.122
Dead+Wind 30 deg - Service	27.203	3.155	-5.465	-531.397	-306.616	-0.243
Dead+Wind 45 deg - Service	27.203	4.462	-4.462	-433.908	-433.666	-0.280
Dead+Wind 60 deg - Service	27.203	5.465	-3.155	-306.858	-531.155	-0.299
Dead+Wind 90 deg - Service	27.203	6.310	0.000	-0.133	-613.341	-0.275
Dead+Wind 120 deg - Service	27.203	5.465	3.155	306.592	-531.154	-0.177
Dead+Wind 135 deg - Service	27.203	4.462	4.462	433.642	-433.666	-0.108
Dead+Wind 150 deg - Service	27.203	3.155	5.465	531.131	-306.616	-0.032
Dead+Wind 180 deg - Service	27.203	0.000	6.310	613.317	0.109	0.122
Dead+Wind 210 deg - Service	27.203	-3.155	5.465	531.131	306.834	0.243
Dead+Wind 225 deg - Service	27.203	-4.462	4.462	433.642	433.884	0.280
Dead+Wind 240 deg - Service	27.203	-5.465	3.155	306.592	531.373	0.299
Dead+Wind 270 deg - Service	27.203	-6.310	0.000	-0.133	613.560	0.275
Dead+Wind 300 deg - Service	27.203	-5.465	-3.155	-306.858	531.373	0.177
Dead+Wind 315 deg - Service	27.203	-4.462	-4.462	-433.908	433.884	0.108
Dead+Wind 330 deg - Service	27.203	-3.155	-5.465	-531.397	306.834	0.032

Solution Summary

Load Comb.	Sum of Applied Forces			Sum of Reactions			% Error
	PX K	PY K	PZ K	PX K	PY K	PZ K	
1	0.000	-27.203	0.000	0.000	27.203	0.000	0.000%
2	0.000	-27.203	-16.154	0.000	27.203	16.154	0.000%
3	8.077	-27.203	-13.990	-8.077	27.203	13.990	0.000%
4	11.423	-27.203	-11.423	-11.423	27.203	11.423	0.000%
5	13.990	-27.203	-8.077	-13.990	27.203	8.077	0.000%
6	16.154	-27.203	0.000	-16.154	27.203	0.000	0.000%
7	13.990	-27.203	8.077	-13.990	27.203	-8.077	0.000%
8	11.423	-27.203	11.423	-11.423	27.203	-11.423	0.000%
9	8.077	-27.203	13.990	-8.077	27.203	-13.990	0.000%
10	0.000	-27.203	16.154	0.000	27.203	-16.154	0.000%

<i>RISATower</i> Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job	11001.CO66 - Goshen	Page	14 of 17
	Project	150-ft EEI Monopole - North Street, Goshen, CT	Date	08:35:25 12/12/11
	Client	Verizon Wireless	Designed by	TJL

Load Comb.	Sum of Applied Forces			Sum of Reactions			% Error
	PX K	PY K	PZ K	PX K	PY K	PZ K	
11	-8.077	-27.203	13.990	8.077	27.203	-13.990	0.000%
12	-11.423	-27.203	11.423	11.423	27.203	-11.423	0.000%
13	-13.990	-27.203	8.077	13.990	27.203	-8.077	0.000%
14	-16.154	-27.203	0.000	16.154	27.203	0.000	0.000%
15	-13.990	-27.203	-8.077	13.990	27.203	8.077	0.000%
16	-11.423	-27.203	-11.423	11.423	27.203	11.423	0.000%
17	-8.077	-27.203	-13.990	8.077	27.203	13.990	0.000%
18	0.000	-31.899	0.000	0.000	31.899	0.000	0.000%
19	0.000	-31.899	-13.177	0.000	31.899	13.177	0.000%
20	6.588	-31.899	-11.411	-6.588	31.899	11.411	0.000%
21	9.317	-31.899	-9.317	-9.317	31.899	9.317	0.000%
22	11.411	-31.899	-6.588	-11.411	31.899	6.588	0.000%
23	13.177	-31.899	0.000	-13.177	31.899	-0.000	0.000%
24	11.411	-31.899	6.588	-11.411	31.899	-6.588	0.000%
25	9.317	-31.899	9.317	-9.317	31.899	-9.317	0.000%
26	6.588	-31.899	11.411	-6.588	31.899	-11.411	0.000%
27	0.000	-31.899	13.177	0.000	31.899	-13.177	0.000%
28	-6.588	-31.899	11.411	6.588	31.899	-11.411	0.000%
29	-9.317	-31.899	9.317	9.317	31.899	-9.317	0.000%
30	-11.411	-31.899	6.588	11.411	31.899	-6.588	0.000%
31	-13.177	-31.899	0.000	13.177	31.899	-0.000	0.000%
32	-11.411	-31.899	-6.588	11.411	31.899	6.588	0.000%
33	-9.317	-31.899	-9.317	9.317	31.899	9.317	0.000%
34	-6.588	-31.899	-11.411	6.588	31.899	11.411	0.000%
35	0.000	-27.203	-6.310	0.000	27.203	6.310	0.000%
36	3.155	-27.203	-5.465	-3.155	27.203	5.465	0.000%
37	4.462	-27.203	-4.462	-4.462	27.203	4.462	0.000%
38	5.465	-27.203	-3.155	-5.465	27.203	3.155	0.000%
39	6.310	-27.203	0.000	-6.310	27.203	0.000	0.000%
40	5.465	-27.203	3.155	-5.465	27.203	-3.155	0.000%
41	4.462	-27.203	4.462	-4.462	27.203	-4.462	0.000%
42	3.155	-27.203	5.465	-3.155	27.203	-5.465	0.000%
43	0.000	-27.203	6.310	0.000	27.203	-6.310	0.000%
44	-3.155	-27.203	5.465	3.155	27.203	-5.465	0.000%
45	-4.462	-27.203	4.462	4.462	27.203	-4.462	0.000%
46	-5.465	-27.203	3.155	5.465	27.203	-3.155	0.000%
47	-6.310	-27.203	0.000	6.310	27.203	0.000	0.000%
48	-5.465	-27.203	-3.155	5.465	27.203	3.155	0.000%
49	-4.462	-27.203	-4.462	4.462	27.203	4.462	0.000%
50	-3.155	-27.203	-5.465	3.155	27.203	5.465	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	0.00001909
3	Yes	4	0.00000001	0.00033256
4	Yes	4	0.00000001	0.00040085
5	Yes	4	0.00000001	0.00037124
6	Yes	4	0.00000001	0.00003963
7	Yes	4	0.00000001	0.00033619
8	Yes	4	0.00000001	0.00039870
9	Yes	4	0.00000001	0.00035020
10	Yes	4	0.00000001	0.00001908
11	Yes	4	0.00000001	0.00036658

RISATower

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

Job	11001.CO66 - Goshen	Page	15 of 17
Project	150-ft EEI Monopole - North Street, Goshen, CT	Date	08:35:25 12/12/11
Client	Verizon Wireless	Designed by	TJL

12	Yes	4	0.00000001	0.00040079
13	Yes	4	0.00000001	0.00032932
14	Yes	4	0.00000001	0.00003964
15	Yes	4	0.00000001	0.00036168
16	Yes	4	0.00000001	0.00039932
17	Yes	4	0.00000001	0.00034624
18	Yes	4	0.00000001	0.00000001
19	Yes	4	0.00000001	0.00051423
20	Yes	4	0.00000001	0.00076821
21	Yes	4	0.00000001	0.00084549
22	Yes	4	0.00000001	0.00078870
23	Yes	4	0.00000001	0.00051659
24	Yes	4	0.00000001	0.00076744
25	Yes	4	0.00000001	0.00084365
26	Yes	4	0.00000001	0.00077788
27	Yes	4	0.00000001	0.00051383
28	Yes	4	0.00000001	0.00078467
29	Yes	4	0.00000001	0.00084537
30	Yes	4	0.00000001	0.00076597
31	Yes	4	0.00000001	0.00051693
32	Yes	4	0.00000001	0.00078551
33	Yes	4	0.00000001	0.00084527
34	Yes	4	0.00000001	0.00077325
35	Yes	4	0.00000001	0.00000001
36	Yes	4	0.00000001	0.00002607
37	Yes	4	0.00000001	0.00003357
38	Yes	4	0.00000001	0.00003292
39	Yes	4	0.00000001	0.00000844
40	Yes	4	0.00000001	0.00002651
41	Yes	4	0.00000001	0.00003277
42	Yes	4	0.00000001	0.00002877
43	Yes	4	0.00000001	0.00000001
44	Yes	4	0.00000001	0.00003196
45	Yes	4	0.00000001	0.00003356
46	Yes	4	0.00000001	0.00002573
47	Yes	4	0.00000001	0.00000844
48	Yes	4	0.00000001	0.00003097
49	Yes	4	0.00000001	0.00003290
50	Yes	4	0.00000001	0.00002809

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	150 - 96.46	15.664	50	0.949	0.003
L2	101.543 - 48.043	7.065	49	0.680	0.001
L3	54.46 - 1	1.957	49	0.336	0.000

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
150.000	LPA-80080/6CF	50	15.664	0.949	0.003	66994

RISATower Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job	11001.CO66 - Goshen	Page	16 of 17
	Project	150-ft EEI Monopole - North Street, Goshen, CT	Date	08:35:25 12/12/11
	Client	Verizon Wireless	Designed by	TJL

Elevation	Appurtenance	Gov. Load Comb.	Deflection	Tilt	Twist	Radius of Curvature
ft			in	°	°	ft
147.500	12-ft T-arm w/ Work Support Platform	50	15.185	0.936	0.003	66994

Maximum Tower Deflections - Design Wind

Section No.	Elevation	Horz. Deflection	Gov. Load Comb.	Tilt	Twist
	ft	in		°	°
L1	150 - 96.46	40.059	2	2.425	0.008
L2	101.543 - 48.043	18.075	2	1.740	0.002
L3	54.46 - 1	5.007	17	0.859	0.001

Critical Deflections and Radius of Curvature - Design Wind

Elevation	Appurtenance	Gov. Load Comb.	Deflection	Tilt	Twist	Radius of Curvature
ft			in	°	°	ft
150.000	LPA-80080/6CF	2	40.059	2.425	0.008	26289
147.500	12-ft T-arm w/ Work Support Platform	2	38.835	2.393	0.007	26289

Compression Checks

Pole Design Data

Section No.	Elevation	Size	L	L _u	Kl/r	F _a	A	Actual P	Allow. P _a	Ratio P
	ft		ft	ft		ksi	in ²	K	K	P _a
L1	150 - 96.46 (1)	TP36.35x24x0.25	53.540	0.000	0.0	39.000	27.715	-6.275	1080.880	0.006
L2	96.46 - 48.043 (2)	TP46.9x34.678x0.313	53.500	0.000	0.0	39.000	44.755	-14.085	1745.440	0.008
L3	48.043 - 1 (3)	TP57x44.809x0.375	53.460	0.000	0.0	38.896	67.398	-27.198	2621.530	0.010

Pole Bending Design Data

Section No.	Elevation	Size	Actual M _x	Actual f _{bx}	Allow. F _{bx}	Ratio f _{bx}	Actual M _y	Actual f _{by}	Allow. F _{by}	Ratio f _{by}
	ft		kip-ft	ksi	ksi	F _{bx}	kip-ft	ksi	ksi	F _{by}
L1	150 - 96.46 (1)	TP36.35x24x0.25	326.036	16.368	39.000	0.420	0.000	0.000	39.000	0.000
L2	96.46 - 48.043 (2)	TP46.9x34.678x0.313	813.352	19.569	39.000	0.502	0.000	0.000	39.000	0.000
L3	48.043 - 1 (3)	TP57x44.809x0.375	1570.27	19.985	38.896	0.514	0.000	0.000	38.896	0.000

RISATower Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Job	11001.CO66 - Goshen	Page	17 of 17
	Project	150-ft EEI Monopole - North Street, Goshen, CT	Date	08:35:25 12/12/11
	Client	Verizon Wireless	Designed by	TJL

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 $\frac{f_{by}}{F_{by}}$
5										

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 - 96.46 (1)	TP36.35x24x0.25	8.542	0.308	26.000	0.024	0.277	0.007	26.000	0.000
L2	96.46 - 48.043 (2)	TP46.9x34.678x0.313	12.164	0.272	26.000	0.021	0.277	0.003	26.000	0.000
L3	48.043 - 1 (3)	TP57x44.809x0.375	16.164	0.240	26.000	0.018	0.277	0.002	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio P P_a	Ratio f_{bx} F_{bx}	Ratio f_{by} F_{by}	Ratio f_v F_v	Ratio f_{vt} F_{vt}	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	150 - 96.46 (1)	0.006	0.420	0.000	0.024	0.000	0.426	1.333	H1-3+VT ✓
L2	96.46 - 48.043 (2)	0.008	0.502	0.000	0.021	0.000	0.510	1.333	H1-3+VT ✓
L3	48.043 - 1 (3)	0.010	0.514	0.000	0.018	0.000	0.524	1.333	H1-3+VT ✓

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF \cdot P_{allow}$ K	% Capacity	Pass Fail
L1	150 - 96.46	Pole	TP36.35x24x0.25	1	-6.275	1440.813	31.9	Pass
L2	96.46 - 48.043	Pole	TP46.9x34.678x0.313	2	-14.085	2326.671	38.3	Pass
L3	48.043 - 1	Pole	TP57x44.809x0.375	3	-27.198	3494.499	39.3	Pass
							Summary	
							Pole (L3)	Pass
							RATING = 39.3	Pass

Anchor Bolt and Base Plate Analysis:**Input Data:**Tower Reactions:

Overturning Moment =	OM := 1570-ft-kips	(Input From RisaTower)
Shear Force =	Shear := 16-kips	(Input From RisaTower)
Axial Force =	Axial := 27-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} := 65.0-in	(User Input)
Bolt "Column" Distance =	l := 3.0-in	(User Input)
Bolt Ultimate Strength =	F _u := 100-ksi	(User Input)
Bolt Yield Strength =	F _y := 75-ksi	(User Input)
Bolt Modulus =	E := 29000-ksi	(User Input)
Diameter of Anchor Bolts =	D := 2.25-in	(User Input)
Threads per Inch =	n := 4.5	(User Input)

Base Plate Data:

Use ASTM A572 Mod 50

Plate Yield Strength =	F _{ybp} := 50-ksi	(User Input)
Base Plate Thickness =	t _{bp} := 3.0-in	(User Input)
Base Plate Diameter =	D _{bp} := 71.0-in	(User Input)
Outer Pole Diameter =	D _{pole} := 57.0-in	(User Input)

Geometric Layout Data:Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =:

$$R_{bc} := \frac{D_{bc}}{2} = 32.5\text{-in}$$

Distance to Bolts =

$$i := 1..N$$

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

$$d_1 = 8.41\text{-in}$$

$$d_7 = 31.39\text{-in}$$

$$d_2 = 16.25\text{-in}$$

$$d_8 = 28.15\text{-in}$$

$$d_3 = 22.98\text{-in}$$

$$d_9 = 22.98\text{-in}$$

$$d_4 = 28.15\text{-in}$$

$$d_{10} = 16.25\text{-in}$$

$$d_5 = 31.39\text{-in}$$

$$d_{11} = 8.41\text{-in}$$

$$d_6 = 32.50\text{-in}$$

etc.

Critical Distances For Bending in Plate:

Outer Pole Radius =

$$R_{pole} := \frac{D_{pole}}{2} = 28.5\text{-in}$$

Moment Arms of Bolts about Neutral Axis =

$$MA_i := \text{if}(d_i \geq R_{pole}, d_i - R_{pole}, 0\text{in})$$

$$MA_1 = 0.00\text{-in}$$

$$MA_7 = 2.89\text{-in}$$

$$MA_2 = 0.00\text{-in}$$

$$MA_8 = 0.00\text{-in}$$

$$MA_3 = 0.00\text{-in}$$

$$MA_9 = 0.00\text{-in}$$

$$MA_4 = 0.00\text{-in}$$

$$MA_{10} = 0.00\text{-in}$$

$$MA_5 = 2.89\text{-in}$$

$$MA_{11} = 0.00\text{-in}$$

$$MA_6 = 4.00\text{-in}$$

etc

Effective Width of Baseplate for Bending =

$$B_{eff} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2} \right)^2 - \left(\frac{D_{pole}}{2} \right)^2} = 33.9\text{-in}$$

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia =

$$I_p := \sum_i (d_i)^2 = 1.268 \times 10^4 \cdot \text{in}^2$$

Gross Area of Bolt =

$$A_g := \frac{\pi}{4} \cdot D^2 = 3.976 \cdot \text{in}^2$$

Net Area of Bolt =

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

Net Diameter =

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

Radius of Gyration of Bolt =

$$r := \frac{D_n}{4} = 0.508 \cdot \text{in}$$

Section Modulus of Bolt =

$$S_x := \frac{\pi \cdot D_n^3}{32} = 0.826 \cdot \text{in}^3$$

Check Anchor Bolt Tension Force:

Maximum Tensile Force =

$$T_{\text{Max}} := OM \cdot \frac{R_{bc}}{I_p} - \frac{\text{Axial}}{N} = 47.2 \cdot \text{kips}$$

Allowable Tensile Force =

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

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

Bolt Tension % of Capacity =

$$\frac{T_{\text{Max}}}{T_{\text{ALL.Net}}} = 24.2\% \quad \text{Bolts are "upset bolts". Use net area per AISC}$$

Condition1 =

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

Condition1 = "OK"

Check Anchor Bolt Bending Stress:

Maximum Bending Moment =

$$M_x := \left(\frac{\text{Shear}}{N} \right) \cdot l = 0.167 \cdot \text{ft-kips}$$

Maximum Bending Stress =

$$f_{bx} := \frac{M_x}{S_x} = 2.4 \cdot \text{ksi}$$

Allowable Bending Stress =

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

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."

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

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

Check Anchor Bolt Compression/Combined Stress:

Maximum Compressive Force =

$$C_{Max} := OM \cdot \frac{R_{bc}}{l_p} + \frac{\text{Axial}}{N} = 49.4 \text{ kips}$$

Maximum Compressive Stress =

$$f_a := \frac{C_{Max}}{A_n} = 15.2 \text{ ksi}$$

$$K := 0.65$$

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

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

Allowable Compressive Stress =

$$F_a := 1.333 \cdot F_a = 60 \text{ ksi} \quad (1.333 \text{ increase allowed per TIA/EIA})$$

Combined Stress % of Capacity =

$$\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} \right) = 25.4 \%$$

Condition 2 =

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

$$\text{Condition2} = \text{"OK"}$$

Base Plate Analysis:

Force from Bolts =

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

$$C_1 = 13.6 \text{ kips}$$

$$C_7 = 47.8 \text{ kips}$$

$$C_2 = 25.3 \text{ kips}$$

$$C_8 = 43.0 \text{ kips}$$

$$C_3 = 35.3 \text{ kips}$$

$$C_9 = 35.3 \text{ kips}$$

$$C_4 = 43.0 \text{ kips}$$

$$C_{10} = 25.3 \text{ kips}$$

$$C_5 = 47.8 \text{ kips}$$

$$C_{11} = 13.6 \text{ kips}$$

$$C_6 = 49.4 \text{ kips}$$

etc.

Maximum Bending Stress in Plate =

$$f_{bp} := \sum_i \frac{6 \cdot C_i \cdot M A_i}{(B_{eff} t_{bp})^2} = 9.3 \text{ ksi}$$

Allowable Bending Stress in Plate =

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

Plate Bending Stress % of Capacity =

$$\frac{f_{bp}}{F_{bp}} = 18.7\%$$

Condition3 =

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

Condition3 = "Ok"

Standard Monopole Foundation:**Input Data:**Tower Data

Overturing Moment =	OM := 1570-ft-kips	(User Input from RISATower)
Shear Force =	Shear := 16-kip	(User Input from RISATower)
Axial Force =	Axial := 27-kip	(User Input from RISATower)
Tower Height =	H _t := 150-ft	(User Input)

Footing Data:

Overall Depth of Footing =	D _f := 5-ft	(User Input)
Length of Pier =	L _p := 3-ft	(User Input)
Extension of Pier Above Grade =	L _{pag} := 1-ft	(User Input)
Diameter of Pier =	d _p := 7-ft	(User Input)
Thickness of Footing =	T _f := 3-ft	(User Input)
Width of Footing =	W _f := 28-ft	(User Input)

Anchor Bolt Data:

Length of Anchor Bolts =	L _{st} := 72-in	(User Input)
Projection of Anchor Bolts Above Pier =	A _{BP} := 12-in	(User Input)
Anchor Bolt Diameter =	d _{anchor} := 2.25-in	(User Input)
Base Plate Bolt Circle =	MP := 65.0-in	(User Input)

Material Properties:

Concrete Compressive Strength =	f _c := 4000-psi	(User Input)
Steel Reinforcement Yield Strength =	f _y := 60000-psi	(User Input)
Anchor Bolt Yield Strength =	f _{ya} := 75000-psi	(User Input)
Internal Friction Angle of Soil =	Φ _s := 30-deg	(User Input)
Allowable Soil Bearing Capacity =	q _s := 8000-psf	(User Input)
Unit Weight of Soil =	γ _{soil} := 100-pcf	(User Input)
Unit Weight of Concrete =	γ _{conc} := 150-pcf	(User Input)
Foundation Bouyancy =	Bouyancy := 0	(User Input) (Yes=1 / No=0)
Depth to Neglect =	n := 0-ft	(User Input)
Cohesion of Clay Type Soil =	c := 0-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 =	μ := 0.45	(User Input)

Pier Reinforcement:

Bar Size =	$BS_{\text{pier}} := 8$	(User Input)	
Bar Diameter =	$d_{\text{bpier}} := 1.00\text{-in}$	(User Input)	
Number of Bars =	$NB_{\text{pier}} := 34$	(User Input)	
Clear Cover of Reinforcement =	$Cvr_{\text{pier}} := 3\text{-in}$	(User Input)	
Reinforcement Location Factor =	$\alpha_{\text{pier}} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{\text{pier}} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{\text{pier}} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{\text{pier}} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Diameter of Tie =	$d_{\text{Tie}} := 3\text{-in}$	(User Input)	

Pad Reinforcement:

Bar Size =	$BS_{\text{top}} := 8$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{\text{btop}} := 1.00\text{-in}$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{\text{top}} := 28$	(User Input)	(Top of Pad)
Bar Size =	$BS_{\text{bot}} := 8$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{\text{bbot}} := 1.00\text{-in}$	(User Input)	(Bottom of Pad)
Number of Bars =	$NB_{\text{bot}} := 48$	(User Input)	(Bottom of Pad)
Clear Cover of Reinforcement =	$Cvr_{\text{pad}} := 3.0\text{-in}$	(User Input)	
Reinforcement Location Factor =	$\alpha_{\text{pad}} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{\text{pad}} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{\text{pad}} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{\text{pad}} := 1.0$	(User Input)	(ACI-2008 12.2.4)

Calculated Factors:

Pier Reinforcement Bar Area =	$A_{\text{bpier}} := \frac{\pi \cdot d_{\text{bpier}}^2}{4} = 0.785 \cdot \text{in}^2$	
Pad Top Reinforcement Bar Area =	$A_{\text{btop}} := \frac{\pi \cdot d_{\text{btop}}^2}{4} = 0.785 \cdot \text{in}^2$	
Pad Bottom Reinforcement Bar Area =	$A_{\text{bbot}} := \frac{\pi \cdot d_{\text{bbot}}^2}{4} = 0.785 \cdot \text{in}^2$	
Coefficient of Lateral Soil Pressure =	$K_p := \frac{1 + \sin(\Phi_s)}{1 - \sin(\Phi_s)} = 3$	
Load Factor =	$LF := \begin{cases} 1.333 & \text{if } H_t \leq 700\text{-ft} \\ 1.7 & \text{if } H_t \geq 1200\text{-ft} \\ 1.333 + \left(\frac{H_t - 700\text{ft}}{1200\text{ft} - 700\text{ft}} \right) \cdot 0.4 & \text{otherwise} \end{cases}$	= 1.333

Stability of Footing:

Adjusted Concrete Unit Weight =

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

Adjusted Soil Unit Weight =

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

Passive Pressure =

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

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

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

$$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p} = 1.5 \text{ksf}$$

$$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 1.05 \text{ksf}$$

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

$$A_p := W_f \cdot T_p = 84$$

Ultimate Shear =

$$S_u := P_{ave} \cdot A_p = 88.2 \text{kip}$$

Weight of Concrete Pad =

$$WT_c := \left[(W_f^2 \cdot T_f) + \frac{d_p^2 \cdot \pi}{4} L_p \right] \cdot \gamma_c = 370.118 \text{kip}$$

Weight of Soil Above Footing =

$$WT_{s1} := \left[\left(W_f^2 - \frac{d_p^2 \cdot \pi}{4} \right) \cdot (|L_p - L_{pag} - n|) \right] \cdot \gamma_s = 149.1 \text{kip}$$

Weight of Soil Wedge at Back Face =

$$WT_{s2} := \left(\frac{D_f^2 \cdot \tan(\Phi_s)}{2} \cdot W_f \right) \cdot \gamma_s = 20.207 \text{kip}$$

Weight of Soil Wedge at back face Corners =

$$WT_{s3} := 2 \cdot \left[(D_f)^3 \cdot \frac{\tan(\Phi_s)}{3} \right] \cdot \gamma_s = 4.811 \text{kips}$$

Total Weight =

$$WT_{tot} := WT_c + WT_{s1} + \text{Axial} = 546.221 \text{kip}$$

Resisting Moment =

$$M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + \left[(WT_{s2} + WT_{s3}) \cdot \left(W_f + \frac{D_f \tan(\Phi_s)}{3} \right) \right] = 8460 \text{kip-ft}$$

Overtuning Moment =

$$M_{ot} := OM + \text{Shear} \cdot (L_p + T_f) = 1666 \text{kip-ft}$$

Factor of Safety Actual =

$$FS := \frac{M_r}{M_{ot}} = 5.08$$

Factor of Safety Required =

$$FS_{req} := 2$$

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

$$\text{OverTurning_Moment_Check} = \text{"Okay"}$$

Shear Capacity in Pier:

Shear Resistance of Pier =

$$S_p := \frac{P_{ave} \cdot A_p + \mu \cdot W_{T_{tot}}}{FS_{req}} = 167 \cdot \text{kips}$$

$$\text{Shear_Check} := \text{if}(S_p > \text{Shear}, \text{"Okay"}, \text{"No Good"})$$

$$\text{Shear_Check} = \text{"Okay"}$$

Bearing Pressure Caused by Footing:

Area of the Mat =

$$A_{mat} := W_f^2 = 784$$

Section Modulus of Mat =

$$S := \frac{W_f^3}{6} = 3658.67 \cdot \text{ft}^3$$

Maximum Pressure in Mat =

$$P_{max} := \frac{W_{T_{tot}}}{A_{mat}} + \frac{M_{ot}}{S} = 1.152 \cdot \text{ksf}$$

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

$$\text{Max_Pressure_Check} = \text{"Okay"}$$

Minimum Pressure in Mat =

$$P_{min} := \frac{W_{T_{tot}}}{A_{mat}} - \frac{M_{ot}}{S} = 0.241 \cdot \text{ksf}$$

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

$$\text{Min_Pressure_Check} = \text{"Okay"}$$

Distance to Resultant of Pressure Distribution =

$$X_p := \frac{P_{max}}{P_{max} - P_{min}} \cdot \frac{1}{3} = 11.807$$

Distance to Kern =

$$X_k := \frac{W_f}{6} = 4.667$$

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

Eccentricity =

$$e := \frac{M_{ot}}{W_{T_{tot}}} = 3.05$$

Adjusted Soil Pressure =

$$P_a := \frac{2 \cdot W_{T_{tot}}}{3 \cdot W_f \left(\frac{W_f}{2} - e \right)} = 1.188 \cdot \text{ksf}$$

$$q_{adj} := \text{if}(P_{min} < 0, P_a, P_{max}) = 1.152 \cdot \text{ksf}$$

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

$$\text{Pressure_Check} = \text{"Okay"}$$

Concrete Bearing Capacity:

Strength Reduction Factor =

$$\Phi_c := 0.65 \quad (\text{ACI-2008 9.3.2.2})$$

Bearing Strength Between Pier and Pad =

$$P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot \frac{\pi \cdot d_p^2}{4} = 1.225 \times 10^4 \text{ kips} \quad (\text{ACI-2008 10.14})$$

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

$$\text{Bearing_Check} = \text{"Okay"}$$

Shear Strength of Concrete:

Beam Shear:

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

$$\phi_c := 0.85 \quad (\text{ACI 9.3.2.5})$$

$$d := T_f - \text{Cvr}_{\text{pad}} - d_{\text{bbot}}$$

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

$$d_2 := d_1 - d$$

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

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

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

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

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

$$\text{Beam_Shear_Check} = \text{"Okay"}$$

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 =

$$b_o := (d_p + d) \cdot \pi = 30.4$$

Area Included Inside Perimeter =

$$A_{bo} := \frac{\pi \cdot (d_p + d)^2}{4} = 73.4$$

Area Outside of Perimeter =

$$A_{\text{out}} := A_{\text{mat}} - A_{bo} = 710.6$$

Guess Value =

$$v_u := 1 \text{ ksf}$$

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

Given

$$d^2 + d_p \cdot d = \frac{W_{T_{\text{tot}}}}{\pi \cdot v_u}$$

$$v_u := \text{Find}(v_u) = 6.7 \cdot \text{ksf}$$

$$V_u := v_u \cdot d \cdot W_f = 503.6 \cdot \text{kips}$$

Required Shear Strength =

$$V_{\text{req}} := L F \cdot V_u = 671.3 \cdot \text{kips}$$

Available Shear Strength =

$$V_{\text{Avail}} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot \text{psi}} \cdot b_o \cdot d = 2507.6 \cdot \text{kip} \quad (\text{ACI-2008 11.11.2.1})$$

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

$$\text{Punching_Shear_Check} = \text{"Okay"}$$

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

Strength Reduction Factor =

$$\phi_m := .90$$

(ACI-2008 9.3.2.1)

$$q_b := q_{\text{adj}} - d_1 \cdot \text{Slope} = 0.811 \cdot \text{ksf}$$

Maximum Bending at Face of Pier =

$$M_n := \frac{1}{L F \cdot \phi_m} \cdot \left[(q_{\text{adj}} - q_b) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f = 1335.8 \cdot \text{kip-ft}$$

$$\beta := \begin{cases} 0.85 & \text{if } 2500 \cdot \text{psi} \leq f_c \leq 4000 \cdot \text{psi} \\ 0.65 & \text{if } f_c > 8000 \cdot \text{psi} \end{cases} = 0.85$$

$$\left[\left[0.85 - \left[\frac{\left(\frac{f_c}{\text{psi}} - 4000 \right)}{1000} \right] \cdot 0.5 \right] \right] \quad \text{otherwise} \quad (\text{ACI-2008 10.2.7.3})$$

$$R_u := \frac{M_n}{\phi_m \cdot W_f \cdot d^2} = 51.8 \cdot \text{psi}$$

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

$$\rho_{\text{min}} := 1.333 \cdot \rho = 0.00116$$

Required Reinforcement for Temperature and Shrinkage:

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

Check Bottom Bars:

$$A_s := \max(\rho, \rho_{min}, \rho_{sh}) \cdot W_f \cdot d = 19.4 \cdot \text{in}^2$$

$$A_{sprov} := A_{bbot} \cdot NB_{bot} = 37.7 \cdot \text{in}^2$$

$$\text{Pad_Reinforcement_Bot} := \text{if}(A_{sprov} > A_s, \text{"Okay"}, \text{"No Good"})$$

$$\text{Pad_Reinforcement_Bot} = \text{"Okay"}$$

Check top Bars:

$$A_s := \rho_{sh} \cdot (W_f \cdot d) = 19.4 \cdot \text{in}^2$$

$$A_{sprov} := A_{btop} \cdot NB_{top} = 22 \cdot \text{in}^2$$

$$\text{Pad_Reinforcement_Top} := \text{if}(A_{sprov} > A_s, \text{"Okay"}, \text{"No Good"})$$

$$\text{Pad_Reinforcement_Top} = \text{"Okay"}$$

Development Length Pad Reinforcement:

Bar Spacing =

$$B_{sPad} := \frac{W_f - 2 \cdot C_{vrpad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 6 \cdot \text{in}$$

Spacing or Cover Dimension =

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

Transverse Reinforcement Index =

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

$$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pad} \cdot \beta_{pad} \cdot \gamma_{pad} \cdot \lambda_{pad}}{40 \cdot \sqrt{f_c \cdot \text{psi}} \cdot \frac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot} = 23.7 \cdot \text{in}$$

Minimum Development Length =

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

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

Available Length in Pad =

$$L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - C_{vrpad} = 123 \cdot \text{in}$$

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

$$L_{pad_Check} = \text{"Okay"}$$

Steel Reinforcement in Pier:

Area of Pier =

$$A_p := \frac{\pi \cdot d_p^2}{4} = 5541.77 \cdot \text{in}^2$$

$$A_{smin} := 0.01 \cdot 0.05 \cdot A_p = 2.77 \cdot \text{in}^2 \quad (\text{ACI-2008 10.8.4 \& 10.9.1})$$

$$A_{sprov} := N_{B_{pier}} \cdot A_{B_{pier}} = 26.7 \cdot \text{in}^2$$

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

$$\text{Steel_Area_Check} = \text{"Okay"}$$

Bar Spacing In Pier =

$$B_{sPier} := \frac{d_p \cdot \pi}{N_{B_{pier}}} - d_{B_{pier}} = 6.762 \cdot \text{in}$$

Diameter of Reinforcement Cage =

$$\text{Diam}_{cage} := d_p - 2 \cdot C_{vr_{pier}} = 78 \cdot \text{in}$$

Maximum Moment in Pier =

$$M_p := \left[OM + \text{Shear} \cdot \left(L_p + \frac{A_{BP}}{2} \right) \right] \cdot LF = 26009.5 \cdot \text{in-kips}$$

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

$$(D \ N \ n \ P_u \ M_{xu}) := \left(d_p \cdot 12 \ N_{B_{pier}} \ B_{s_{pier}} \ \frac{\text{Axial} \cdot 1.333}{\text{kips}} \ \frac{M_p}{\text{in-kips}} \right)$$

$$(D \ N \ n \ P_u \ M_{xu}) = (84 \ 34 \ 8 \ 36 \ 26009.5)$$

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

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

$$(\phi P_n \ \phi M_{xn} \ f_{sp} \ \rho) = (74.2 \ 53591.8 \ -60 \ 0)$$

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

$$\text{Axial_Load_Check} = \text{"Okay"}$$

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

$$\text{Bending_Check} = \text{"Okay"}$$

Development Length Pier Reinforcement:
Available Length in Foundation:

$$L_{\text{pier}} := L_p - C_{\text{vr}}_{\text{pier}} = 33\text{-in}$$

$$L_{\text{pad}} := T_f - C_{\text{vr}}_{\text{pad}} = 33\text{-in}$$

Tension:

(ACI-2008 12.2.3)

Spacing or Cover Dimension =

$$c := \text{if} \left(C_{\text{vr}}_{\text{pier}} < \frac{B_{\text{sPier}}}{2}, C_{\text{vr}}_{\text{pier}}, \frac{B_{\text{sPier}}}{2} \right) = 3\text{-in}$$

Transverse Reinforcement =

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

$$L_{\text{dbt}} := \frac{3 \cdot f_y \cdot \alpha_{\text{pier}} \cdot \beta_{\text{pier}} \cdot \gamma_{\text{pier}} \cdot \lambda_{\text{pier}}}{40 \cdot \sqrt{f_c \cdot \text{psi}} \cdot \left(\frac{c + k_{\text{tr}}}{d_{\text{bpier}}} \right)} \cdot d_{\text{bpier}} = 23.72\text{-in}$$

Minimum Development Length =

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

$$L_{\text{dh}} := \frac{1200 \cdot d_{\text{bpier}}}{\sqrt{\frac{f_c}{\text{psi}}}} \cdot .7 = 13.282\text{-in} \quad (\text{ACI 12.2.1})$$

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

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

$$L_{\text{tension_Check}} = \text{"Okay"}$$

Compression:

(ACI-2008 12.3.2)

$$L_{\text{dbc1}} := \frac{.02 \cdot d_{\text{bpier}} \cdot f_y}{\sqrt{f_c \cdot \text{psi}}} = 18.974\text{-in}$$

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

$$L_{\text{dbc}} := \text{if}(L_{\text{dbc1}} \geq L_{\text{dbmin}}, L_{\text{dbc1}}, L_{\text{dbmin}}) = 18.974\text{-in}$$

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

$$L_{\text{compression_Check}} = \text{"Okay"}$$

Tie Size and Spacing in Column:

Minimum Tie Size =

$$Tie_{min} := \text{if}(BS_{pier} \leq 10, 3, 4) = 3$$

Used #3 Ties

Seismic Factor =

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

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

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

$$s_{lim3} := D_f \cdot z = 60 \cdot \text{in}$$

$$s_{lim4} := 18 \cdot \text{in}$$

Maximum Spacing =

$$s_{tie} := \min \begin{pmatrix} s_{lim1} \\ s_{lim2} \\ s_{lim3} \\ s_{lim4} \end{pmatrix} = 16 \cdot \text{in}$$

Number of Ties Required =

$$n_{tie} := \frac{L_{pier} - 3 \cdot \text{in}}{s_{tie}} + 1 = 2.875$$

Check Anchor Steel Embedment:

Depth Available =

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

Length of Anchor Bolt =

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

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

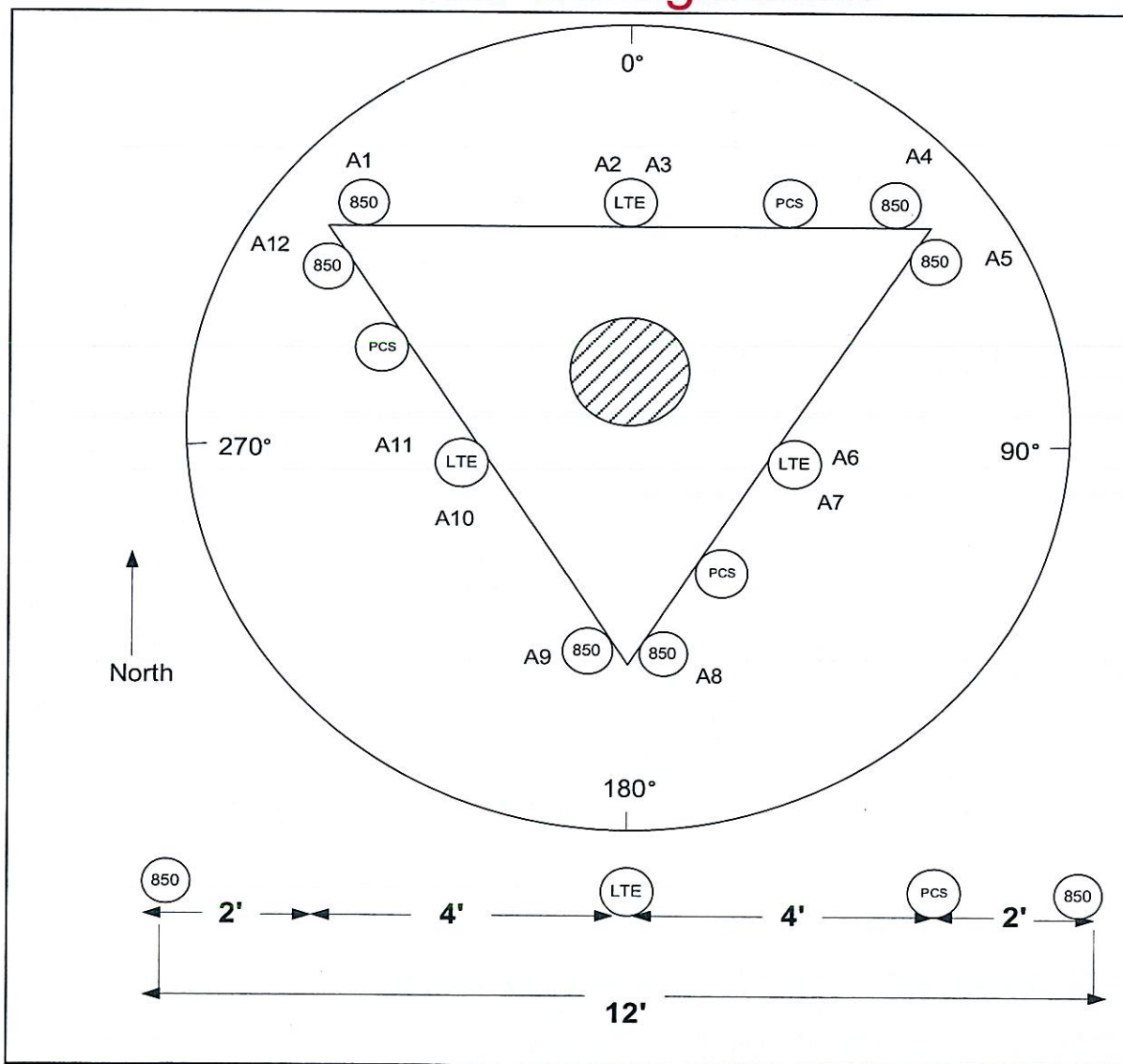
Depth_Check = "No Good"

Note: Anchor plate is provided

SITE NAME		GOSHEN CT		ECP - CELL #		2		426			
LATITUDE		41-51-22.78 N		LONGITUDE		73-14-29.69 W					
Additional Comments: LTE antenna add keeping with 12 antennas and adding 6 additional main lines				SAVE BUTTON							
				STRUCTURE TYPE							
700 Mhz - LTE ANTENNA ADD		ALPHA		BETA		GAMMA					
EQUIPMENT TYPE		eNodeB		eNodeB		eNodeB					
ANTENNA TYPE		BXA-70063-6CF_4		BXA-70063-6CF_4		BXA-70063-6CF_4					
QTY OF ANTENNAS PER FACE		1		1		1					
ORIENTATION (DEG)		60		180		300					
DOWN TILT (MECH/DEG)		2		2		2					
RAD CTR (FT AGL)		150		150		150					
TMA - QTY / MODEL											
DIPLEXER - QTY / MODEL											
850 Cellular - Current Config		ALPHA		BETA		GAMMA					
EQUIPMENT TYPE		#N/A		#N/A		#N/A					
ANTENNA TYPE		LPA-80080-6CF-5		LPA-80080-6CF-5		LPA-80080-6CF-5					
QTY OF ANTENNAS PER FACE		2		2		2					
ORIENTATION (DEG)		60		180		300					
DOWN TILT (MECH/DEG)		0		0		0					
RAD CTR (FT AGL)		150		150		150					
TMA - QTY / MODEL											
DIPLEXER - QTY / MODEL											
850 Cellular - Future Config		ALPHA		BETA		GAMMA					
EQUIPMENT TYPE		#N/A		#N/A		#N/A					
ANTENNA TYPE		LPA-80080-6CF-5		LPA-80080-6CF-5		LPA-80080-6CF-5					
QTY OF ANTENNAS PER FACE		2		2		2					
ORIENTATION (DEG)		60		180		300					
DOWN TILT (MECH/DEG)		0		0		0					
RAD CTR (FT AGL)		150		150		150					
TMA - QTY / MODEL											
DIPLEXER - QTY / MODEL											
DIPLEX WITH LTE CABLE											
1900 PCS - Current Config		ALPHA		BETA		GAMMA					
EQUIPMENT TYPE		#N/A		#N/A		#N/A					
ANTENNA TYPE		LPA-185080-12CF 2		LPA-185080-12CF 2		LPA-185080-12CF 2					
QTY OF ANTENNAS PER FACE		2		2		2					
ORIENTATION (DEG)		60		180		300					
DOWN TILT (MECH/DEG)		0		0		0					
RAD CTR (FT AGL)		150		150		150					
TMA - QTY / MODEL											
DIPLEXER - QTY / MODEL											
1900 PCS - Future Config		ALPHA		BETA		GAMMA					
EQUIPMENT TYPE		#N/A		#N/A		#N/A					
ANTENNA TYPE		BXA-171085-12BF_2		BXA-171085-12BF_2		BXA-171085-12BF_2					
QTY OF ANTENNAS PER FACE		1		1		1					
ORIENTATION (DEG)		60		180		300					
DOWN TILT (MECH/DEG)		0		0		0					
RAD CTR (FT AGL)		150		150		150					
TMA - QTY / MODEL											
DIPLEX WITH CELLULAR CABLE											
NUMBER OF CABLE'S NEEDED				ESTIMATED CABLE LENGTH							
MAINLINE SIZE		1 5/8"		TOTAL # OF MAINLINES		18		MAINLINE (FT)			
JUMPER SIZE		1/2 "		TOTAL # OF TOP JUMPERS		18		TOP JUMPER (FT)		12	
Equipment Cable Ordering		MAIN CABLE		12		+		6		TOP JUMPER #	
								12		+	
										6	
TX / RX FREQUENCIES				TX POWER OUTPUT							
Cellular A-Band		PCS F / AWS-Band		700 Mhz C - B		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 (Watts)		40			

ALPHA				BETA				GAMMA			
Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code
A1	800	Tx1/Rx0	RED	A7	800	Tx2/Rx0	BLUE	A13	800	Tx3/Rx0	GREEN
A2	1900	Tx1/Rx0	RED/WHITE	A8	1900	Tx2/Rx0	BLUE/WHITE	A14	1900	Tx3/Rx0	GREEN/WHITE
A3	700	Tx1/Rx0	RED/ORANGE	A9	700	Tx2/Rx0	BLUE/ORANGE	A15	700	Tx3/Rx0	GREEN/ORANGE
A4	700	Tx4/Rx1	RED/RED/ORANGE	A10	700	Tx5/Rx1	BLUE/BLUE/ORANGE	A16	700	Tx6/Rx1	GREEN/GREEN/ORANGE
A5	1900	Tx4/Rx1	RED/RED/WHITE	A11	1900	Tx5/Rx1	BLUE/BLUE/WHITE	A17	1900	Tx6/Rx1	GREEN/GREEN/WHITE
A6	800	Tx4/Rx1	RED/RED	A12	800	Tx5/Rx1	BLUE/BLUE	A18	800	Tx6/Rx1	GREEN/GREEN
RF ENGINEER				RF MANAGER				INITIALS		DATE	
Prepared By: Mark Brauer				Steve Weatherbee				MB		9/2/2011	

Site Configuration



BXA-70063-6CF-EDIN-X

X-Pol | FET Panel | 63° | 14.5 dBd

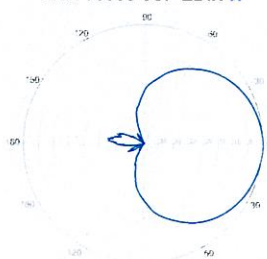
Replace "X" with desired electrical downtilt

Antenna is also available with NE connector(s). Replace "EDIN" with "NE" in the model number when ordering.

Electrical Characteristics	696-900 MHz			
Frequency bands	696-806 MHz		806-900 MHz	
Polarization	±45°			
Horizontal beamwidth	65°		63°	
Vertical beamwidth	13°		11°	
Gain	14.0 dBd (16.1 dBi)		14.5 dBd (16.6 dBi)	
Electrical downtilt (X)	0, 2, 3, 4, 5, 6, 8, 10			
Impedance	50Ω			
VSWR	≤1.35:1			
Upper sidelobe suppression (0°)	-18.3 dB		-18.2 dB	
Front-to-back ratio (+/-30°)	-33.4 dB		-36.3 dB	
Null fill	5% (-26.02 dB)			
Isolation between ports	< -25 dB			
Input power with EDIN connectors	500 W			
Input power with NE connectors	300 W			
Lightning protection	Direct Ground			
Connector(s)	2 Ports / EDIN or NE / Female / Center (Back)			
Mechanical Characteristics				
Dimensions Length x Width x Depth	1804 x 285 x 132 mm		71.0 x 11.2 x 5.2 in	
Depth with z-brackets	172 mm		6.8 in	
Weight without mounting brackets	7.9 kg		17 lbs	
Survival wind speed	> 201 km/hr		> 125 mph	
Wind area	Front: 0.51 m²	Side: 0.24 m²	Front: 5.5 ft²	Side: 2.6 ft²
Wind load @ 161 km/hr (100 mph)	Front: 759 N	Side: 391 N	Front: 169 lbf	Side: 89 lbf
Mounting Options	Part Number	Fits Pipe Diameter		Weight
3-Point Mounting & Downtilt Bracket Kit	36210008	40-115 mm	1.57-4.5 in	6.9 kg 15.2 lbs
Concealment Configurations	For concealment configurations, order BXA-70063-6CF-EDIN-X-FP			

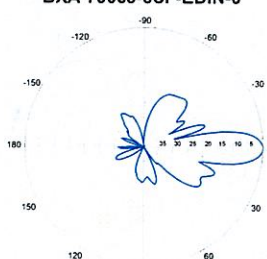


BXA-70063-6CF-EDIN-X



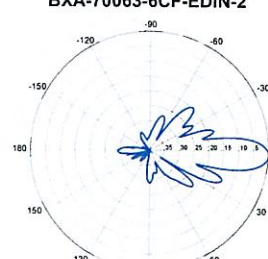
Horizontal | 750 MHz

BXA-70063-6CF-EDIN-0

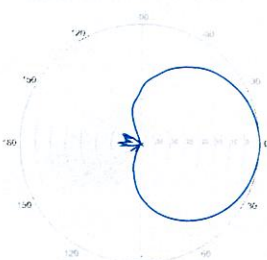


0° | Vertical | 750 MHz

BXA-70063-6CF-EDIN-2



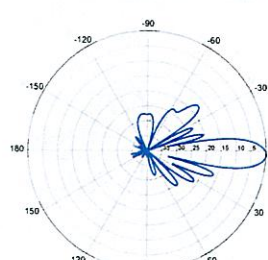
2° | Vertical | 750 MHz



Horizontal | 850 MHz



0° | Vertical | 850 MHz



2° | Vertical | 850 MHz

Quoted performance parameters are provided to offer typical or range values only and may vary as a result of normal manufacturing and operational conditions. Extreme operational conditions and/or stress on structural supports is beyond our control. Such conditions may result in damage to this product. Improvements to product may be made without notice.

BXA-171085-12BF-EDIN-X

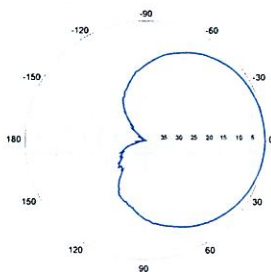
Replace 'X' with desired electrical downtilt.

X-Pol | FET Panel | 85° | 18.0 dBi

Electrical Characteristics	1710-2170 MHz		
Frequency bands	1710-1880 MHz	1850-1990 MHz	1920-2170 MHz
Polarization	±45°	±45°	±45°
Horizontal beamwidth	88°	85°	80°
Vertical beamwidth	4.5°	4.5°	4.5°
Gain	15.1 dBd / 17.2 dBi	15.5 dBd / 17.6 dBi	15.9 dBd / 18.0 dBi
Electrical downtilt (X)	0, 2, 4		
Impedance	50Ω		
VSWR	≤1.5:1		
First upper sidelobe	< -17 dB		
Front-to-back ratio	> 30 dB		
In-band isolation	> 28 dB		
IM3 (20W carrier)	< -150 dBc		
Input power	300 W		
Lightning protection	Direct Ground		
Connector(s)	2 Ports / EDIN / Female / Bottom		
Operating temperature	-40° to +60° C / -40° to +140° F		
Mechanical Characteristics			
Dimensions Length x Width x Depth	1820 x 154 x 105 mm	71.7 x 6.1 x 4.1 in	
Depth with z-brackets	133 mm	5.2 in	
Weight without mounting brackets	6.8 kg	15 lbs	
Survival wind speed	> 201 km/hr	> 125 mph	
Wind area	Front: 0.28 m ² Side: 0.19 m ²	Front: 3.1 ft ² Side: 2.1 ft ²	
Wind load @ 161 km/hr (100 mph)	Front: 460 N Side: 304 N	Front: 103 lbf Side: 68 lbf	
Mounting Options	Part Number	Fits Pipe Diameter	Weight
2-Point Mounting Bracket Kit	26799997	50-102 mm 2.0-4.0 in	2.3 kg 5 lbs
2-Point Mounting & Downtilt Bracket Kit	26799999	50-102 mm 2.0-4.0 in	3.6 kg 8 lbs
Concealment Configurations	For concealment configurations, order BXA-171085-12BF-EDIN-X-FP		

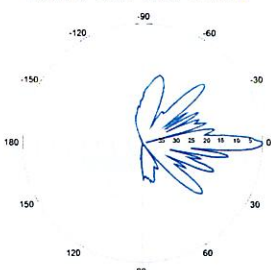


BXA-171085-12BF-EDIN-X



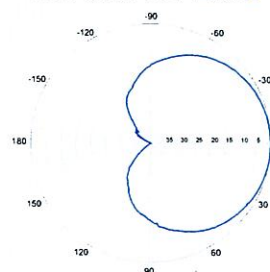
Horizontal | 1710-1880 MHz

BXA-171085-12BF-EDIN-0



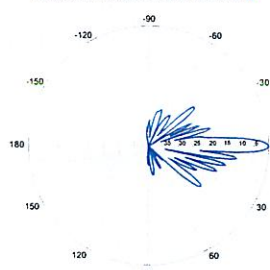
0° | Vertical | 1710-1880 MHz

BXA-171085-12BF-EDIN-X



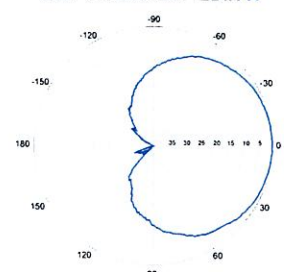
Horizontal | 1850-1990 MHz

BXA-171085-12BF-EDIN-0



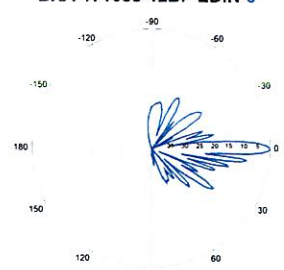
0° | Vertical | 1850-1990 MHz

BXA-171085-12BF-EDIN-X



Horizontal | 1920-2170 MHz

BXA-171085-12BF-EDIN-0



0° | Vertical | 1920-2170 MHz

Quoted performance parameters are provided to offer typical or range values only and may vary as a result of normal manufacturing and operational conditions. Extreme operational conditions and/or stress on structural supports is beyond our control. Such conditions may result in damage to this product. Improvements to product may be made without notice.

LPA-80080/6CF

When ordering replace "___" with connector type.

Mechanical specifications

Length	1800 mm	70.9 in
Width	140 mm	5.5 in
Depth	335 mm	13.2 in
Depth with z-bracket	375 mm	14.8 in
4) Weight	9.5 kg	21.0 lbs
Wind Area		
Fore/Aft	0.25 m ²	2.7 ft ²
Side	0.60 m ²	6.5 ft ²
Rated Wind Velocity (Safety factor 2.0)	>295 km/hr >183 mph	
Wind Load @ 100 mph (161 km/hr)		
Fore/Aft	415 N	93.3 lbs
Side	870 N	195.6 lbs

Antenna consisting of aluminum alloy with brass feedlines covered by a UV safe fiberglass radome.

Mounting and Downtilting

Mounting brackets attach to a pipe diameter of Ø50-102 mm (2.0-4.0 in). If the lock-down brace is used, the maximum diameter is Ø88.9 mm (3.5 in)

Mounting Bracket & Downtilt Bracket Kit
#21699999

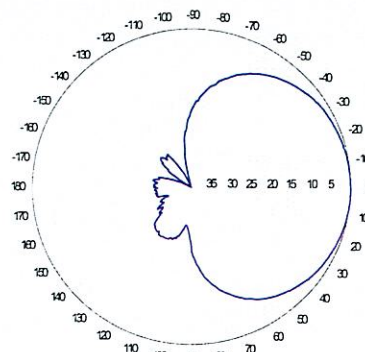
Electrical specifications

Frequency Range	806-960 MHz
Impedance	50Ω
3) Connector(s)	NE or E-DIN 1 port / center
1) VSWR	≤ 1.4:1
Polarization	Vertical
1) Gain	14 dBd
2) Power Rating	500 W
1) Half Power Angle	
H-Plane	80°
E-Plane	10°
1) Electrical Downtilt	0°
1) Null Fill	10%
Lightning Protection	Direct Ground

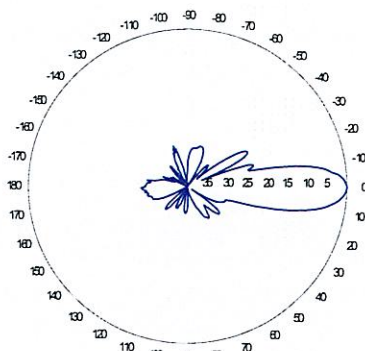
- 1) Typical values.
2) Power rating limited by connector only.
3) NE indicates an elongated N connector.
E-DIN indicates an elongated DIN connector.
4) The antenna weight listed above does not include the bracket weight.

Improvements to mechanical and/or electrical performance of the antenna may be made without notice.

Radiation pattern¹⁾



Horizontal

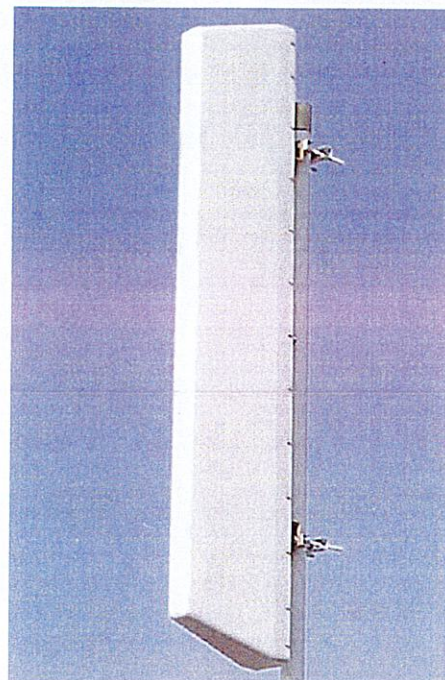


Vertical

Featuring upper side lobe suppression.

Radiation patterns for all antennas are measured with the antenna mounted on a fiberglass pole.

Mounting on a metal pole will typically improve the Front-to-Back ratio.



**Amphenol Antel's
Exclusive 3T (True
Transmission Line
Technology)
Antenna Design:**

- True log-periodic design allows for superior front-to-side characteristics to minimize sector overlap.
- Unique feedline design eliminates the need for conventional solder joints in the signal path.
- A non-collinear system with access to every radiating element for broad bandwidth and superior performance.
- Air as insulation for virtually no internal signal loss.

This Amphenol Antel antenna is under a five-year limited warranty for repair or replacement.

Antenna available with center-fed connector only.

CF Denotes a Center-Fed Connector.

806-960 MHz

**Amphenol
Antel, Inc.**
The Antenna Technology Company

Revision Date: 7/5/07