ROBINSON & COL

EM-VER-005-120217A

KENNETH C. BALDWIN

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February 16, 2012

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

Re: **Notice of Exempt Modification – Antenna Swap**
5 Old Farm Road, Barkhamsted, 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 145-foot tower at the above-referenced address. The tower is owned by Cellco. The Council approved Cellco's use of the existing tower in 2005 (Docket No. 305). Cellco now intends to modify its installation by replacing six (6) of its existing antennas with three (3) model BXA-171063/12BF PCS antennas and three (3) model BXA-70063/6CF LTE antennas, all at the same 145-foot level on the tower. Cellco also intends to install six (6) additional coax cables attached to the exterior of 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 Donald S. Stein, First Selectman of the Town of Barkhamsted. A copy of this letter is also being sent to John and Ethel Lavieri, the owners 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 replacement antennas will be located at the same 145-foot level on the tower.

2. The proposed modifications will not involve any modifications 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 cumulative power density table for Cellco's modified facility is included behind Tab 2.

Also attached is a Structural Analysis Report confirming that the tower and foundation can support Cellco's proposed antennas modification. (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:
Donald S. Stein, Barkhamsted First Selectman
John and Ethel Lavieri
Sandy M. Carter

BXA-171063-12BF-EDIN-X

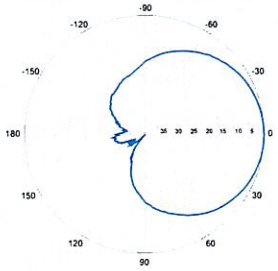
- Replace "X" with desired electrical downtilt.

X-Pol | FET Panel | 63° | 19.0 dBi

Electrical Characteristics	1710-2170 MHz		
Frequency bands	1710-1880 MHz	1850-1990 MHz	1920-2170 MHz
Polarization	±45°	±45°	±45°
Horizontal beamwidth	68°	65°	60°
Vertical beamwidth	4.5°	4.5°	4.5°
Gain	16.1 dBd / 18.2 dBi	16.5 dBd / 18.6 dBi	16.9 dBd / 19.0 dBi
Electrical downtilt (X)	0, 2, 5		
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 m² Side: 0.19 m²	Front: 3.1 ft² Side: 2.1 ft²	
Wind load @ 161 km/hr (100 mph)	Front: 460 N Side: 304 N	Front: 103 lbf Side: 68 lbf	

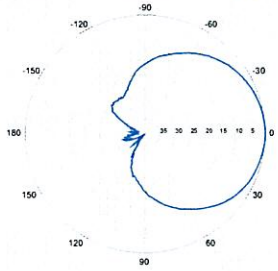
Mounting Options	Part Number	Fits Pipe Diameter	Weight
2-Point Mounting Bracket Kit	26799997	50-102 mm 2.0-4.0 in	2.3 kg 5 lbs
2-Point Mounting & Downtilt Bracket Kit	26799999	50-102 mm 2.0-4.0 in	3.6 kg 8 lbs
Concealment Configurations	For concealment configurations, order BXA-171063-12BF-EDIN-X-FP		

BXA-171063-12BF-EDIN-X



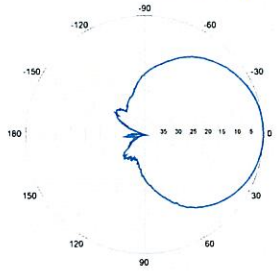
Horizontal | 1710-1880 MHz

BXA-171063-12BF-EDIN-X



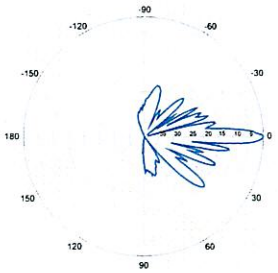
Horizontal | 1850-1990 MHz

BXA-171063-12BF-EDIN-X



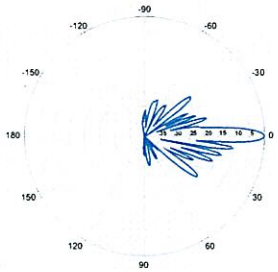
Horizontal | 1920-2170 MHz

BXA-171063-12BF-EDIN-0



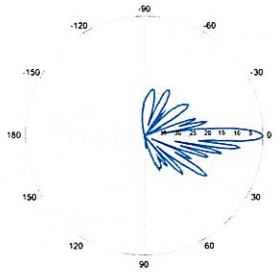
0° | Vertical | 1710-1880 MHz

BXA-171063-12BF-EDIN-0



0° | Vertical | 1850-1990 MHz

BXA-171063-12BF-EDIN-0

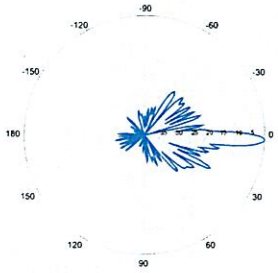


0° | Vertical | 1920-2170 MHz

BXA-171063-12BF-EDIN-X

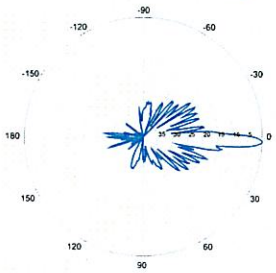
X-Pol | FET Panel | 63° | 19.0 dBi

BXA-171063-12BF-EDIN-2



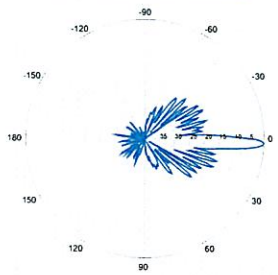
2° | Vertical | 1710-1880 MHz

BXA-171063-12BF-EDIN-2



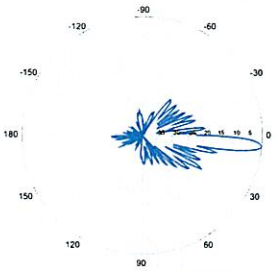
2° | Vertical | 1850-1990 MHz

BXA-171063-12BF-EDIN-2



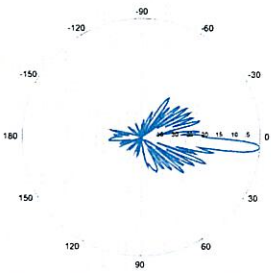
2° | Vertical | 1920-2170 MHz

BXA-171063-12BF-EDIN-5



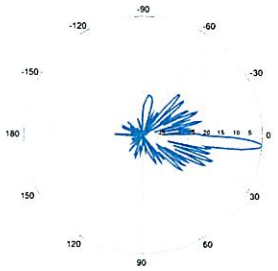
5° | Vertical | 1710-1880 MHz

BXA-171063-12BF-EDIN-5



5° | Vertical | 1850-1990 MHz

BXA-171063-12BF-EDIN-5



5° | Vertical | 1920-2170 MHz

Amphenol ANTENNA SOLUTIONS

BXA-70063-6CF-EDIN-X

X-Pol | FET Panel | 63° | 14.5 dBd

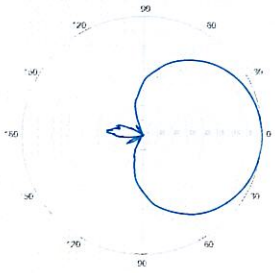
Replace "X" with desired electrical downtilt.

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

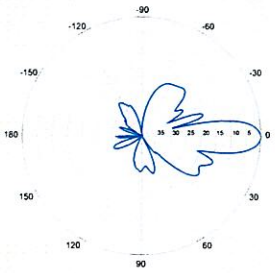
Mounting Options	Part Number	Fits Pipe Diameter	Weight
3-Point Mounting & Downtilt Bracket Kit	36210008	40-115 mm 1.57-4.5 in	6.9 kg 15.2 lbs
Concealment Configurations	For concealment configurations, order BXA-70063-6CF-EDIN-X-FP		

BXA-70063-6CF-EDIN-X



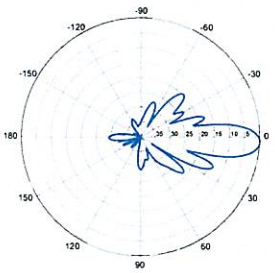
Horizontal | 750 MHz

BXA-70063-6CF-EDIN-0

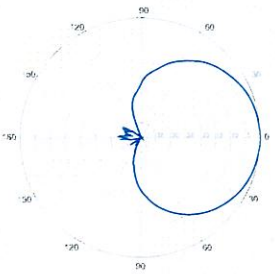


0° | Vertical | 750 MHz

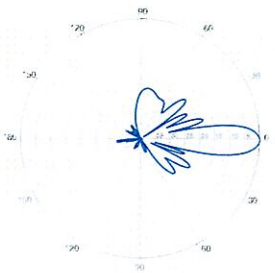
BXA-70063-6CF-EDIN-2



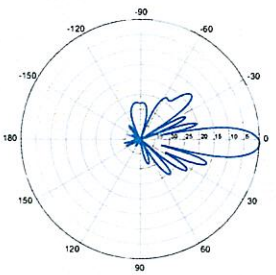
2° | Vertical | 750 MHz



Horizontal | 850 MHz



0° | Vertical | 850 MHz

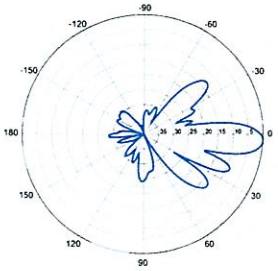


2° | Vertical | 850 MHz

BXA-70063-6CF-EDIN-X

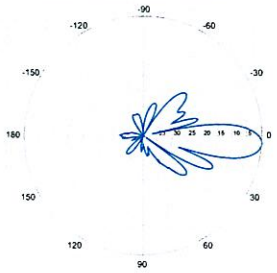
X-Pol | FET Panel | 63° | 14.5 dBd

BXA-70063-6CF-EDIN-3



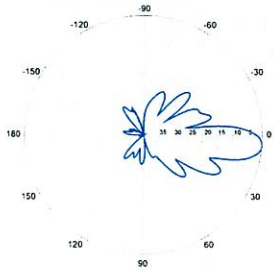
3° | Vertical | 750 MHz

BXA-70063-6CF-EDIN-4

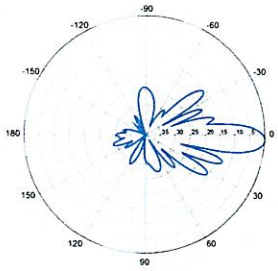


4° | Vertical | 750 MHz

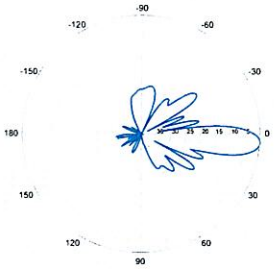
BXA-70063-6CF-EDIN-5



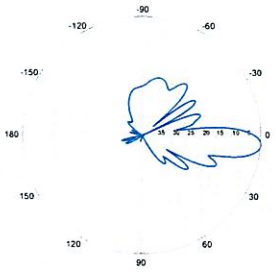
5° | Vertical | 750 MHz



3° | Vertical | 850 MHz

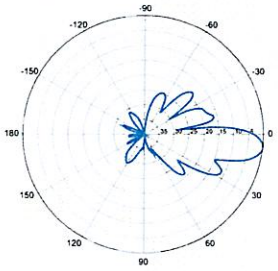


4° | Vertical | 850 MHz



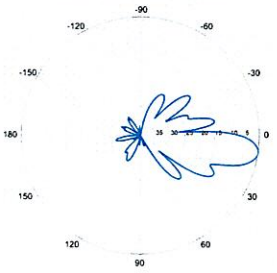
5° | Vertical | 850 MHz

BXA-70063-6CF-EDIN-6



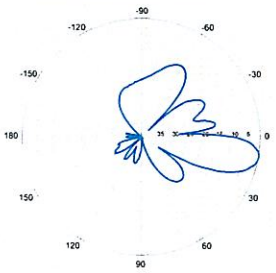
6° | Vertical | 750 MHz

BXA-70063-6CF-EDIN-8

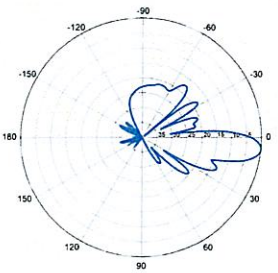


8° | Vertical | 750 MHz

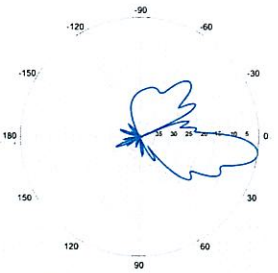
BXA-70063-6CF-EDIN-10



10° | Vertical | 750 MHz



6° | Vertical | 850 MHz



8° | Vertical | 850 MHz

10° | Vertical | 850 MHz

	General	Power	Density					
Site Name: Barkhamsted W								
Tower Height: Verizon @ 145ft								
CARRIER	# OF CHAN.	WATTS ERP	HEIGHT	CALC. POWER DENS	FREQ.	MAX. PERMISS. EXP.	FRACTION MPE	Total
*T-Mobile	8	162	124	0.0303	1945	1.0000	3.03%	
*Pocket	3	631	115	0.0515	2130	1.0000	5.15%	
*Cingular	2	296	105	0.0193	880	0.5867	3.29%	
*Cingular	2	427	105	0.0279	1930	1.0000	2.79%	
Verizon PCS	**11**	**247**	**145**	**0.0465**	**1970**	**1.0000**	**4.65%**	
Verizon Cellular	**9**	**255**	**145**	**0.0392**	**869**	**0.5793**	**6.78%**	
Verizon AWS	**1**	**670**	**145**	**0.0115**	**2145**	**1.0000**	**1.15%**	
Verizon 700	**1**	**836**	**145**	**0.0143**	**698**	**0.4653**	**3.07%**	
								29.89%
* Source: Siting Council								

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

145-ft Existing EEI Monopole

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Barkhamsted West

5 Old Farm Road
Barkhamsted, CT

Centek Project No. 12001.CO4

Date: December 19, 2011

Prepared for:

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

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

Table of Contents

Introduction

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

The host tower is a 145-ft tall, three-section, eighteen sided, tapered monopole, originally designed and manufactured by Engineered Endeavors Inc., job no; 13841-E01, dated December 6, 2005. 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 a previous structural report prepared by Centek (formally Natcomm) job no.; 08136.CO6 dated October 28, 2008, visual verification from grade by Centek personnel on December 14, 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 17.5-in at the top and 55.0-in at the base.

Verizon proposes the removal of six (6) panel antennas and the installation of six (6) panel antennas mounted to the existing low profile platform. Refer to the Antenna and Appurtenance Summary below for a detailed description of the proposed antenna and appurtenance configuration.

Antenna and Appurtenance Summary

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

- AT&T (EXISTING):
  Antennas: Six (6) Powerwave 7770 panel antennas, six (6) Powerwave LGP21401 TMA's and six (6) Powerwave LGP21901 Diplexers mounted on an existing low profile platform with a RAD center elevation of 135-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing tower.
- T-MOBILE (EXISTING):
  Antennas: Three (3) RFS APX16DWV-16DWVS-E-A20 panel antennas, three (3) RFS Twin AWS TMA's and three (3) Andrew Twin PCS TMA's mounted on an three (3) 12-ft T-arms with a RAD center elevation of 125-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing tower.
- METROPCS (EXISTING):
  Antennas: Three (3) RFS APXV18-206517S-C panel antennas flush mounted with a RAD center elevation of 115-ft above grade.
  Coax Cables: Six (6) 1-5/8" ∅ coax cables running on the inside of the existing tower.

- VERIZON (EXISTING TO REMAIN):
  Antennas: Six (6) Antel LPA-80063-4CF panel antennas mounted on an existing low profile platform with a RAD center elevation of 145-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing tower.
- VERIZON (EXISTING TO REMOVE):
  Antennas: Six (6) Antel LPA-185063-12CF panel antennas mounted on an existing low profile platform with a RAD center elevation of 145-ft above grade.
- **VERIZON (PROPOSED):**
  Antennas: Three (3) Antel BXA-70063-6CF and three (3) Antel BXA-171063-12BF panel antennas mounted on an existing low profile platform with a RAD center elevation of 145-ft above grade.
  Coax Cables: Six (6) 1-5/8" ∅ coax cables banded to the exterior of the existing tower.

Primary Assumptions Used in the Analysis

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

Analysis

The existing tower was analyzed using a comprehensive computer program entitled 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).

Tower Loading

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

Basic Wind Speed:	Litchfield; v = 80 mph (fastest mile)	*[Section 16 of TIA/EIA-222-F-96]*
	Barkhamsted; 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:	Load Case 1; 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]*
	Load Case 2; 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]*
	Load Case 3; 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 **73.3%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L1)	94.79'-145.00'	73.3%	**PASS**

Foundation and Anchors

The existing foundation consists of a 7.0-ft square x 5.5-ft long reinforced concrete pier on a 21.5-ft square x 3.5-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; 13841-E01, dated December 6, 2005. The base of the tower is connected to the foundation by means of (14) 2.25"∅, ASTM A615-75 anchor bolts embedded approximately 7-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	19 kips
	Compression	29 kips
	Moment	1916 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	3.28	**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	53.8%	**PASS**
Base Plate	Bending	71.4%	**PASS**

Conclusion

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

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

Please feel free to call with any questions or comments.

Respectfully Submitted by:

Carlo F. Centore, PE
Principal ~ Structural Engineer

STATE OF CONNECTICUT
CARLO F. CENTORE
No. 16694
LICENSED
PROFESSIONAL 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

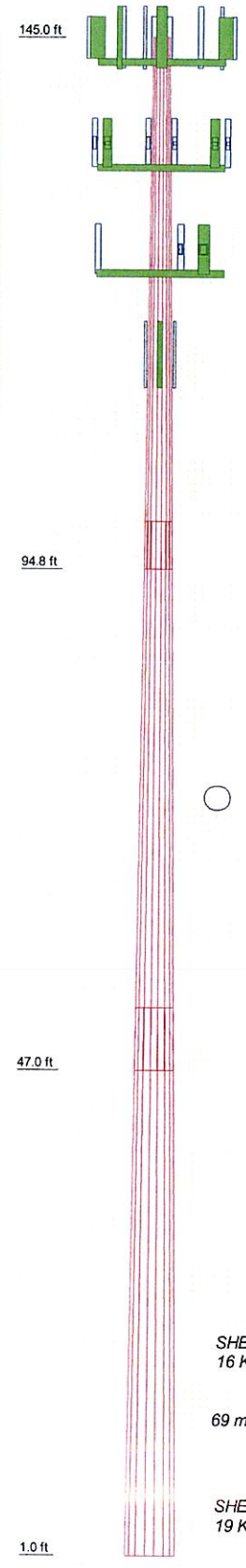
RISATower, is an integrated structural analysis and design software package for Designed specifically for the telecommunications industry, RISATower, formerly ERITower, automates much of the tower analysis and design required by the TIA/EIA 222 Standard.

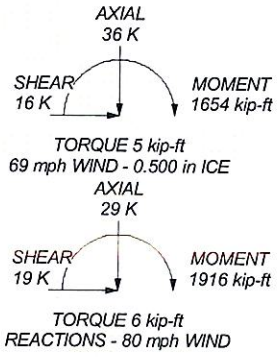
RISATower Features:

- 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	1	2	3
Length (ft)	50.210	52.210	52.000
Number of Sides	18	18	18
Thickness (in)	0.188	0.313	0.313
Socket Length (ft)	4.420	6.000	
Top Dia (in)	17.500	29.446	41.145
Bot Dia (in)	31.010	43.370	55.000
Grade		A572-65	
Weight (K)	2.4	6.4	8.4

17.2





DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
LPA-80063/4CF (Verizon - Existing)	145	APX16DWV-16DWVS-E-A20 (T-Mobile - Existing)	125
BXA-171063-12BF (Verizon - Proposed)	145	APX16DWV-16DWVS-E-A20 (T-Mobile - Existing)	125
BXA-70063/6CF (Verizon - Proposed)	145	ATMAA1412D-1A20 TMA (T-Mobile - Existing)	125
LPA-80063/4CF (Verizon - Existing)	145	ATMAA1412D-1A20 TMA (T-Mobile - Existing)	125
LPA-80063/4CF (Verizon - Existing)	145	ATMAA1412D-1A20 TMA (T-Mobile - Existing)	125
BXA-171063-12BF (Verizon - Proposed)	145	ETW190VS12UB TMA (T-Mobile - Existing)	125
BXA-70063/6CF (Verizon - Proposed)	145	ETW190VS12UB TMA (T-Mobile - Existing)	125
LPA-80063/4CF (Verizon - Existing)	145	ETW190VS12UB TMA (T-Mobile - Existing)	125
LPA-80063/4CF (Verizon - Existing)	145	Valmont T-Arm (1) (T-Mobile - Existing)	123
BXA-171063-12BF (Verizon - Proposed)	145	Valmont T-Arm (1) (T-Mobile - Existing)	123
BXA-70063/6CF (Verizon - Proposed)	145	Valmont T-Arm (1) (T-Mobile - Existing)	123
LPA-80063/4CF (Verizon - Existing)	145	APXV18-206517-C (MetroPCS - Existing)	115
EEI Low Profile Platform (Verizon - Existing)	143	APXV18-206517-C (MetroPCS - Existing)	115
(2) 7770.00 (ATI - Existing)	135	APXV18-206517-C (MetroPCS - Existing)	115
(2) 7770.00 (ATI - Existing)	135	Valmont Uni-Tri Bracket (MetroPCS - Existing)	115
(2) 7770.00 (ATI - Existing)	135		
(2) LGP21401 TMA (ATI - Existing)	135		
(2) LGP21401 TMA (ATI - Existing)	135		
(2) LGP21401 TMA (ATI - Existing)	135		
(2) LGP21901 Diplexer (ATI - Existing)	135		
(2) LGP21901 Diplexer (ATI - Existing)	135		
(2) LGP21901 Diplexer (ATI - Existing)	135		
EEI Low Profile Platform (ATI - Existing)	133		
APX16DWV-16DWVS-E-A20 (T-Mobile - Existing)	125		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. Weld together tower sections have flange connections.
5. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
6. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
7. Welds are fabricated with ER-70S-6 electrodes.
8. TOWER RATING: 73.3%

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

Job: *12001.CO4 - Barkhamsted West*		
Project: *145-ft EEI Monopole - 5 Old Farm Rd., Barkhamsted, CT*		
Client: Verizon Wireless	Drawn by: TJL	App'd:
Code: TIA/EIA-222-F	Date: 12/19/11	Scale: NTS
Path: J:\Jobs\1200100 W\CO4 - Barkhamsted West\Calcs\ERI Files\145' EEI Monopole Barkhamsted CT.eri		Dwg No. E-1

Tower Input Data

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

Basic wind speed of 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	145.000-94.790	50.210	4.420	18	17.500	31.010	0.188	0.750	A572-65 (65 ksi)
L2	94.790-47.000	52.210	6.000	18	29.446	43.370	0.313	1.250	A572-65 (65 ksi)
L3	47.000-1.000	52.000		18	41.145	55.000	0.313	1.250	A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
L1	17.770	10.303	390.144	6.146	8.890	43.886	780.801	5.153	2.750	14.667
	31.488	18.343	2201.655	10.942	15.753	139.760	4406.207	9.173	5.128	27.348
L2	31.097	28.897	3098.557	10.342	14.958	207.145	6201.191	14.451	4.632	14.824
	44.039	42.708	10003.243	15.285	22.032	454.033	20019.649	21.358	7.083	22.666
L3	43.403	40.501	8531.126	14.495	20.902	408.157	17073.478	20.254	6.691	21.413
	55.848	54.243	20495.504	19.414	27.940	733.554	41017.977	27.127	9.130	29.216

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in
L1 145.000-94.790				1	1	1		
L2 94.790-47.000				1	1	1		
L3 47.000-1.000				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight klf
1 5/8 (Verizon - Existing)	B	No	Inside Pole	145.000 - 4.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (AT&T - Existing)	B	No	Inside Pole	135.000 - 4.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (T-Mobile - Existing)	B	No	Inside Pole	125.000 - 4.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (MetroPCS - Existing)	B	No	Inside Pole	135.000 - 4.000	6	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (Verizon - Proposed)	B	No	CaAa (Out Of Face)	145.000 - 4.000	1	No Ice	0.198	0.001
						1/2" Ice	0.298	0.003
1 5/8 (Verizon - Proposed)	B	No	CaAa (Out Of Face)	145.000 - 4.000	5	No Ice	0.000	0.001
						1/2" Ice	0.000	0.003

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	145.000-94.790	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	9.942	2.070
		C	0.000	0.000	0.000	0.000	0.000
L2	94.790-47.000	A	0.000	0.000	0.000	0.000	0.000

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
		B	0.000	0.000	0.000	9.462	2.386
		C	0.000	0.000	0.000	0.000	0.000
L3	47.000-1.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	8.514	2.147
		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_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	145.000-94.790	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	14.963	2.525
		C		0.000	0.000	0.000	0.000	0.000
L2	94.790-47.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	14.241	2.819
		C		0.000	0.000	0.000	0.000	0.000
L3	47.000-1.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	12.814	2.536
		C		0.000	0.000	0.000	0.000	0.000

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
LPA-80063/4CF	A	From Face	3.500	0.000	145.000	No Ice	7.005	6.083	0.020
(Verizon - Existing)			6.000			1/2" Ice	7.415	6.480	0.073
			0.000						
BXA-171063-12BF	A	From Face	3.500	0.000	145.000	No Ice	4.734	3.572	0.015
(Verizon - Proposed)			4.000			1/2" Ice	5.180	4.007	0.042
			0.000						
BXA-70063/6CF	A	From Face	3.500	0.000	145.000	No Ice	7.731	4.158	0.017
(Verizon - Proposed)			0.000			1/2" Ice	8.268	4.595	0.059
			0.000						
LPA-80063/4CF	A	From Face	3.500	0.000	145.000	No Ice	7.005	6.083	0.020
(Verizon - Existing)			-6.000			1/2" Ice	7.415	6.480	0.073
			0.000						
LPA-80063/4CF	B	From Face	3.500	0.000	145.000	No Ice	7.005	6.083	0.020
(Verizon - Existing)			6.000			1/2" Ice	7.415	6.480	0.073
			0.000						
BXA-171063-12BF	B	From Face	3.500	0.000	145.000	No Ice	4.734	3.572	0.015
(Verizon - Proposed)			4.000			1/2" Ice	5.180	4.007	0.042
			0.000						
BXA-70063/6CF	B	From Face	3.500	0.000	145.000	No Ice	7.731	4.158	0.017
(Verizon - Proposed)			0.000			1/2" Ice	8.268	4.595	0.059
			0.000						
LPA-80063/4CF	B	From Face	3.500	0.000	145.000	No Ice	7.005	6.083	0.020
(Verizon - Existing)			-6.000			1/2" Ice	7.415	6.480	0.073
			0.000						

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
LPA-80063/4CF (Verizon - Existing)	C	From Face	3.500 6.000 0.000	0.000	145.000	No Ice 1/2" Ice	7.005 7.415	6.083 6.480	0.020 0.073
BXA-171063-12BF (Verizon - Proposed)	C	From Face	3.500 4.000 0.000	0.000	145.000	No Ice 1/2" Ice	4.734 5.180	3.572 4.007	0.015 0.042
BXA-70063/6CF (Verizon - Proposed)	C	From Face	3.500 0.000 0.000	0.000	145.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.017 0.059
LPA-80063/4CF (Verizon - Existing)	C	From Face	3.500 -6.000 0.000	0.000	145.000	No Ice 1/2" Ice	7.005 7.415	6.083 6.480	0.020 0.073
EEI Low Profile Platform (Verizon - Existing)	C	From Face	2.000 0.000 0.000	0.000	143.000	No Ice 1/2" Ice	22.500 28.200	22.500 28.200	1.500 2.250
(2) 7770.00 (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	135.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) 7770.00 (AT&T - Existing)	B	From Face	3.500 0.000 0.000	0.000	135.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) 7770.00 (AT&T - Existing)	C	From Face	3.500 0.000 0.000	0.000	135.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) LGP21401 TMA (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	135.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
(2) LGP21401 TMA (AT&T - Existing)	B	From Face	3.500 0.000 0.000	0.000	135.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
(2) LGP21401 TMA (AT&T - Existing)	C	From Face	3.500 0.000 0.000	0.000	135.000	No Ice 1/2" Ice	0.953 1.093	0.367 0.480	0.018 0.023
(2) LGP21901 Diplexer (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	135.000	No Ice 1/2" Ice	0.233 0.302	0.117 0.166	0.006 0.008
(2) LGP21901 Diplexer (AT&T - Existing)	B	From Face	3.500 0.000 0.000	0.000	135.000	No Ice 1/2" Ice	0.233 0.302	0.117 0.166	0.006 0.008
(2) LGP21901 Diplexer (AT&T - Existing)	C	From Face	3.500 0.000 0.000	0.000	135.000	No Ice 1/2" Ice	0.233 0.302	0.117 0.166	0.006 0.008
EEI Low Profile Platform (AT&T - Existing)	C	From Face	2.000 0.000 0.000	0.000	133.000	No Ice 1/2" Ice	22.500 28.200	22.500 28.200	1.500 2.250
APX16DWV-16DWVS-E-A 20 (T-Mobile - Existing)	A	From Face	3.500 -4.000 0.000	0.000	125.000	No Ice 1/2" Ice	7.065 7.516	2.150 2.490	0.041 0.074
APX16DWV-16DWVS-E-A 20 (T-Mobile - Existing)	B	From Face	3.500 -4.000 0.000	0.000	125.000	No Ice 1/2" Ice	7.065 7.516	2.150 2.490	0.041 0.074
APX16DWV-16DWVS-E-A 20 (T-Mobile - Existing)	C	From Face	3.500 -4.000 0.000	0.000	125.000	No Ice 1/2" Ice	7.065 7.516	2.150 2.490	0.041 0.074
ATMAA1412D-1A20 TMA (T-Mobile - Existing)	A	From Face	3.500 -4.000 0.000	0.000	125.000	No Ice 1/2" Ice	1.167 1.314	0.467 0.575	0.013 0.021

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
ATMAA1412D-1A20 TMA	B	From Face	3.500	0.000	125.000	No Ice	1.167	0.467	0.013
(T-Mobile - Existing)			-4.000			1/2" Ice	1.314	0.575	0.021
			0.000						
ATMAA1412D-1A20 TMA	C	From Face	3.500	0.000	125.000	No Ice	1.167	0.467	0.013
(T-Mobile - Existing)			-4.000			1/2" Ice	1.314	0.575	0.021
			0.000						
ETW190VS12UB TMA	A	From Face	3.500	0.000	125.000	No Ice	0.664	0.367	0.015
(T-Mobile - Existing)			-4.000			1/2" Ice	0.778	0.461	0.020
			0.000						
ETW190VS12UB TMA	B	From Face	3.500	0.000	125.000	No Ice	0.664	0.367	0.015
(T-Mobile - Existing)			-4.000			1/2" Ice	0.778	0.461	0.020
			0.000						
ETW190VS12UB TMA	C	From Face	3.500	0.000	125.000	No Ice	0.664	0.367	0.015
(T-Mobile - Existing)			-4.000			1/2" Ice	0.778	0.461	0.020
			0.000						
Valmont T-Arm (1)	A	From Face	2.000	0.000	123.000	No Ice	10.540	10.540	0.336
(T-Mobile - Existing)			0.000			1/2" Ice	14.450	14.450	0.412
			0.000						
Valmont T-Arm (1)	B	From Face	2.000	0.000	123.000	No Ice	10.540	10.540	0.336
(T-Mobile - Existing)			0.000			1/2" Ice	14.450	14.450	0.412
			0.000						
Valmont T-Arm (1)	C	From Face	2.000	0.000	123.000	No Ice	10.540	10.540	0.336
(T-Mobile - Existing)			0.000			1/2" Ice	14.450	14.450	0.412
			0.000						
APXV18-206517-C	A	From Face	0.500	0.000	115.000	No Ice	5.513	3.929	0.022
(MetroPCS - Existing)			0.000			1/2" Ice	5.983	4.385	0.053
			0.000						
APXV18-206517-C	B	From Face	0.500	0.000	115.000	No Ice	5.513	3.929	0.022
(MetroPCS - Existing)			0.000			1/2" Ice	5.983	4.385	0.053
			0.000						
APXV18-206517-C	C	From Face	0.500	0.000	115.000	No Ice	5.513	3.929	0.022
(MetroPCS - Existing)			0.000			1/2" Ice	5.983	4.385	0.053
			0.000						
Valmont Uni-Tri Bracket	A	From Face	0.500	0.000	115.000	No Ice	1.750	1.750	0.290
(MetroPCS - Existing)			0.000			1/2" Ice	1.940	1.940	0.306
			0.000						

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg % 	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1	117.932	1.439	0.024	101.487	A	0.000	101.487	101.487	100.00	0.000	0.000
145.000-94.79					B	0.000	101.487		100.00	0.000	9.942
0					C	0.000	101.487		100.00	0.000	0.000
L2	70.101	1.24	0.020	147.342	A	0.000	147.342	147.342	100.00	0.000	0.000
94.790-47.000					B	0.000	147.342		100.00	0.000	9.462

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft²	Face e	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L3 47.000-1.000	23.146	1	0.017	187.342	C	0.000	147.342		100.00	0.000	0.000
					A	0.000	187.342	187.342	100.00	0.000	0.000
					B	0.000	187.342		100.00	0.000	8.514
					C	0.000	187.342		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	A_G ft²	Face e	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 145.000-94.790	117.932	1.439	0.018	0.500	105.671	A	0.000	105.671	105.671	100.00	0.000	0.000
						B	0.000	105.671		100.00	0.000	14.963
						C	0.000	105.671		100.00	0.000	0.000
L2 94.790-47.000	70.101	1.24	0.015	0.500	151.324	A	0.000	151.324	151.324	100.00	0.000	0.000
						B	0.000	151.324		100.00	0.000	14.241
						C	0.000	151.324		100.00	0.000	0.000
L3 47.000-1.000	23.146	1	0.012	0.500	191.175	A	0.000	191.175	191.175	100.00	0.000	0.000
						B	0.000	191.175		100.00	0.000	12.814
						C	0.000	191.175		100.00	0.000	0.000

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft²	Face e	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 145.000-94.79	117.932	1.439	0.009	101.487	A	0.000	101.487	101.487	100.00	0.000	0.000
					B	0.000	101.487		100.00	0.000	9.942
0					C	0.000	101.487		100.00	0.000	0.000
L2 94.790-47.000	70.101	1.24	0.008	147.342	A	0.000	147.342	147.342	100.00	0.000	0.000
					B	0.000	147.342		100.00	0.000	9.462
					C	0.000	147.342		100.00	0.000	0.000
L3 47.000-1.000	23.146	1	0.006	187.342	A	0.000	187.342	187.342	100.00	0.000	0.000
					B	0.000	187.342		100.00	0.000	8.514
					C	0.000	187.342		100.00	0.000	0.000

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face e	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 145.000-94.79	2.070	2.447	A	1	0.65	1	1	1	101.487	3.018	0.060	C
			B	1	0.65	1	1	1	101.487			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
0			C	1	0.65	1	1	1	101.487			
L2	2.386	6.361	A	1	0.65	1	1	1	147.342	3.595	0.075	C
94.790-47.000			B	1	0.65	1	1	1	147.342			
			C	1	0.65	1	1	1	147.342			
L3	2.147	8.382	A	1	0.65	1	1	1	187.342	3.640	0.079	C
47.000-1.000			B	1	0.65	1	1	1	187.342			
			C	1	0.65	1	1	1	187.342			
Sum Weight:	6.602	17.190						OTM	681.921 kip-ft	10.252		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	2.070	2.447	A	1	0.65	1	1	1	101.487	3.018	0.060	C
145.000-94.79			B	1	0.65	1	1	1	101.487			
0			C	1	0.65	1	1	1	101.487			
L2	2.386	6.361	A	1	0.65	1	1	1	147.342	3.595	0.075	C
94.790-47.000			B	1	0.65	1	1	1	147.342			
			C	1	0.65	1	1	1	147.342			
L3	2.147	8.382	A	1	0.65	1	1	1	187.342	3.640	0.079	C
47.000-1.000			B	1	0.65	1	1	1	187.342			
			C	1	0.65	1	1	1	187.342			
Sum Weight:	6.602	17.190						OTM	681.921 kip-ft	10.252		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	2.070	2.447	A	1	0.65	1	1	1	101.487	3.018	0.060	C
145.000-94.79			B	1	0.65	1	1	1	101.487			
0			C	1	0.65	1	1	1	101.487			
L2	2.386	6.361	A	1	0.65	1	1	1	147.342	3.595	0.075	C
94.790-47.000			B	1	0.65	1	1	1	147.342			
			C	1	0.65	1	1	1	147.342			
L3	2.147	8.382	A	1	0.65	1	1	1	187.342	3.640	0.079	C
47.000-1.000			B	1	0.65	1	1	1	187.342			
			C	1	0.65	1	1	1	187.342			
Sum Weight:	6.602	17.190						OTM	681.921 kip-ft	10.252		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	2.070	2.447	A	1	0.65	1	1	1	101.487	3.018	0.060	C
145.000-94.79			B	1	0.65	1	1	1	101.487			
0			C	1	0.65	1	1	1	101.487			
L2	2.386	6.361	A	1	0.65	1	1	1	147.342	3.595	0.075	C
94.790-47.000			B	1	0.65	1	1	1	147.342			
			C	1	0.65	1	1	1	147.342			
L3	2.147	8.382	A	1	0.65	1	1	1	187.342	3.640	0.079	C
47.000-1.000			B	1	0.65	1	1	1	187.342			
			C	1	0.65	1	1	1	187.342			
Sum Weight:	6.602	17.190						OTM	681.921 kip-ft	10.252		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	2.525	3.214	A	1	0.65	1	1	1	105.671	2.495	0.050	C
145.000-94.79			B	1	0.65	1	1	1	105.671			
0			C	1	0.65	1	1	1	105.671			
L2	2.819	7.467	A	1	0.65	1	1	1	151.324	2.885	0.060	C
94.790-47.000			B	1	0.65	1	1	1	151.324			
			C	1	0.65	1	1	1	151.324			
L3	2.536	9.784	A	1	0.65	1	1	1	191.175	2.872	0.062	C
47.000-1.000			B	1	0.65	1	1	1	191.175			
			C	1	0.65	1	1	1	191.175			
Sum Weight:	7.879	20.465						OTM	554.627 kip-ft	8.251		

Tower Forces - With Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	2.525	3.214	A	1	0.65	1	1	1	105.671	2.495	0.050	C
145.000-94.79			B	1	0.65	1	1	1	105.671			
0			C	1	0.65	1	1	1	105.671			
L2	2.819	7.467	A	1	0.65	1	1	1	151.324	2.885	0.060	C
94.790-47.000			B	1	0.65	1	1	1	151.324			
			C	1	0.65	1	1	1	151.324			
L3	2.536	9.784	A	1	0.65	1	1	1	191.175	2.872	0.062	C
47.000-1.000			B	1	0.65	1	1	1	191.175			
			C	1	0.65	1	1	1	191.175			
Sum Weight:	7.879	20.465						OTM	554.627 kip-ft	8.251		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	2.525	3.214	A	1	0.65	1	1	1	105.671	2.495	0.050	C
145.000-94.79			B	1	0.65	1	1	1	105.671			
0			C	1	0.65	1	1	1	105.671			
L2	2.819	7.467	A	1	0.65	1	1	1	151.324	2.885	0.060	C
94.790-47.000			B	1	0.65	1	1	1	151.324			
			C	1	0.65	1	1	1	151.324			
L3	2.536	9.784	A	1	0.65	1	1	1	191.175	2.872	0.062	C
47.000-1.000			B	1	0.65	1	1	1	191.175			
			C	1	0.65	1	1	1	191.175			
Sum Weight:	7.879	20.465						OTM	554.627 kip-ft	8.251		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	2.525	3.214	A	1	0.65	1	1	1	105.671	2.495	0.050	C
145.000-94.79			B	1	0.65	1	1	1	105.671			
0			C	1	0.65	1	1	1	105.671			
L2	2.819	7.467	A	1	0.65	1	1	1	151.324	2.885	0.060	C
94.790-47.000			B	1	0.65	1	1	1	151.324			
			C	1	0.65	1	1	1	151.324			
L3	2.536	9.784	A	1	0.65	1	1	1	191.175	2.872	0.062	C
47.000-1.000			B	1	0.65	1	1	1	191.175			
			C	1	0.65	1	1	1	191.175			
Sum Weight:	7.879	20.465						OTM	554.627 kip-ft	8.251		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	2.070	2.447	A	1	0.65	1	1	1	101.487	1.179	0.023	C
145.000-94.79			B	1	0.65	1	1	1	101.487			
0			C	1	0.65	1	1	1	101.487			
L2	2.386	6.361	A	1	0.65	1	1	1	147.342	1.404	0.029	C
94.790-47.000			B	1	0.65	1	1	1	147.342			
			C	1	0.65	1	1	1	147.342			
L3	2.147	8.382	A	1	0.65	1	1	1	187.342	1.422	0.031	C
47.000-1.000			B	1	0.65	1	1	1	187.342			
			C	1	0.65	1	1	1	187.342			
Sum Weight:	6.602	17.190						OTM	266.375 kip-ft	4.005		

Tower Forces - Service - Wind 45 To Face

Section Elevation	Add Weight	Self Weight	Face	e	C_F	R_R	D_F	D_R	A_E	F	w	Ctrl. Face
ft	K	K							ft^2	K	klf	
L1	2.070	2.447	A	1	0.65	1	1	1	101.487	1.179	0.023	C
145.000-94.79			B	1	0.65	1	1	1	101.487			
0			C	1	0.65	1	1	1	101.487			
L2	2.386	6.361	A	1	0.65	1	1	1	147.342	1.404	0.029	C
94.790-47.000			B	1	0.65	1	1	1	147.342			
			C	1	0.65	1	1	1	147.342			
L3	2.147	8.382	A	1	0.65	1	1	1	187.342	1.422	0.031	C
47.000-1.000			B	1	0.65	1	1	1	187.342			
			C	1	0.65	1	1	1	187.342			
Sum Weight:	6.602	17.190						OTM	266.375 kip-ft	4.005		

Tower Forces - Service - Wind 60 To Face

Section Elevation	Add Weight	Self Weight	Face	e	C_F	R_R	D_F	D_R	A_E	F	w	Ctrl. Face
ft	K	K							ft^2	K	klf	
L1	2.070	2.447	A	1	0.65	1	1	1	101.487	1.179	0.023	C
145.000-94.79			B	1	0.65	1	1	1	101.487			
0			C	1	0.65	1	1	1	101.487			
L2	2.386	6.361	A	1	0.65	1	1	1	147.342	1.404	0.029	C
94.790-47.000			B	1	0.65	1	1	1	147.342			
			C	1	0.65	1	1	1	147.342			
L3	2.147	8.382	A	1	0.65	1	1	1	187.342	1.422	0.031	C
47.000-1.000			B	1	0.65	1	1	1	187.342			
			C	1	0.65	1	1	1	187.342			
Sum Weight:	6.602	17.190						OTM	266.375 kip-ft	4.005		

Tower Forces - Service - Wind 90 To Face

Section Elevation	Add Weight	Self Weight	Face	e	C_F	R_R	D_F	D_R	A_E	F	w	Ctrl. Face
ft	K	K							ft^2	K	klf	
L1	2.070	2.447	A	1	0.65	1	1	1	101.487	1.179	0.023	C
145.000-94.79			B	1	0.65	1	1	1	101.487			
0			C	1	0.65	1	1	1	101.487			
L2	2.386	6.361	A	1	0.65	1	1	1	147.342	1.404	0.029	C
94.790-47.000			B	1	0.65	1	1	1	147.342			
			C	1	0.65	1	1	1	147.342			
L3	2.147	8.382	A	1	0.65	1	1	1	187.342	1.422	0.031	C
47.000-1.000			B	1	0.65	1	1	1	187.342			
			C	1	0.65	1	1	1	187.342			
Sum Weight:	6.602	17.190						OTM	266.375	4.005		

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2 kip-ft	F K	w klf	Ctrl. Face

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	17.190					
Bracing Weight	0.000					
Total Member Self-Weight	17.190			8.196	0.393	
Total Weight	28.933			8.196	0.393	
Wind 0 deg - No Ice		0.000	-18.995	-1845.305	0.393	-0.094
Wind 30 deg - No Ice		9.498	-16.450	-1596.983	-926.358	2.523
Wind 45 deg - No Ice		13.432	-13.432	-1302.427	-1310.230	3.617
Wind 60 deg - No Ice		16.450	-9.498	-918.555	-1604.786	4.464
Wind 90 deg - No Ice		18.995	0.000	8.196	-1853.108	5.209
Wind 120 deg - No Ice		16.450	9.498	934.947	-1604.786	4.558
Wind 135 deg - No Ice		13.432	13.432	1318.819	-1310.230	3.750
Wind 150 deg - No Ice		9.498	16.450	1613.375	-926.358	2.686
Wind 180 deg - No Ice		0.000	18.995	1861.697	0.393	0.094
Wind 210 deg - No Ice		-9.498	16.450	1613.375	927.144	-2.523
Wind 225 deg - No Ice		-13.432	13.432	1318.819	1311.017	-3.617
Wind 240 deg - No Ice		-16.450	9.498	934.947	1605.572	-4.464
Wind 270 deg - No Ice		-18.995	0.000	8.196	1853.895	-5.209
Wind 300 deg - No Ice		-16.450	-9.498	-918.555	1605.572	-4.558
Wind 315 deg - No Ice		-13.432	-13.432	-1302.427	1311.017	-3.750
Wind 330 deg - No Ice		-9.498	-16.450	-1596.983	927.144	-2.686
Member Ice	3.275					
Total Weight Ice	36.225			12.395	0.415	
Wind 0 deg - Ice		0.000	-15.895	-1563.549	0.415	-0.078
Wind 30 deg - Ice		7.948	-13.766	-1352.413	-787.557	2.384
Wind 45 deg - Ice		11.240	-11.240	-1101.966	-1113.945	3.411
Wind 60 deg - Ice		13.766	-7.948	-775.577	-1364.392	4.207
Wind 90 deg - Ice		15.895	0.000	12.395	-1575.529	4.902
Wind 120 deg - Ice		13.766	7.948	800.367	-1364.392	4.285
Wind 135 deg - Ice		11.240	11.240	1126.755	-1113.945	3.522
Wind 150 deg - Ice		7.948	13.766	1377.202	-787.557	2.519
Wind 180 deg - Ice		0.000	15.895	1588.339	0.415	0.078
Wind 210 deg - Ice		-7.948	13.766	1377.202	788.387	-2.384
Wind 225 deg - Ice		-11.240	11.240	1126.755	1114.776	-3.411
Wind 240 deg - Ice		-13.766	7.948	800.367	1365.223	-4.207
Wind 270 deg - Ice		-15.895	0.000	12.395	1576.359	-4.902
Wind 300 deg - Ice		-13.766	-7.948	-775.577	1365.223	-4.285
Wind 315 deg - Ice		-11.240	-11.240	-1101.966	1114.776	-3.522
Wind 330 deg - Ice		-7.948	-13.766	-1352.413	788.387	-2.519
Total Weight	28.933			8.196	0.393	
Wind 0 deg - Service		0.000	-7.420	-715.828	0.393	-0.037
Wind 30 deg - Service		3.710	-6.426	-618.827	-361.619	0.986
Wind 45 deg - Service		5.247	-5.247	-503.766	-511.569	1.413
Wind 60 deg - Service		6.426	-3.710	-353.816	-626.630	1.744
Wind 90 deg - Service		7.420	0.000	8.196	-723.631	2.035
Wind 120 deg - Service		6.426	3.710	370.208	-626.630	1.780
Wind 135 deg - Service		5.247	5.247	520.158	-511.569	1.465
Wind 150 deg - Service		3.710	6.426	635.219	-361.619	1.049
Wind 180 deg - Service		0.000	7.420	732.220	0.393	0.037

Load Case	Vertical Forces K	Sum of Forces X K	Sum of Forces Z K	Sum of Overturning Moments, M_x kip-ft	Sum of Overturning Moments, M_z kip-ft	Sum of Torques kip-ft
Wind 210 deg - Service		-3.710	6.426	635.219	362.405	-0.986
Wind 225 deg - Service		-5.247	5.247	520.158	512.355	-1.413
Wind 240 deg - Service		-6.426	3.710	370.208	627.416	-1.744
Wind 270 deg - Service		-7.420	0.000	8.196	724.417	-2.035
Wind 300 deg - Service		-6.426	-3.710	-353.816	627.416	-1.780
Wind 315 deg - Service		-5.247	-5.247	-503.766	512.355	-1.465
Wind 330 deg - Service		-3.710	-6.426	-618.827	362.405	-1.049

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

Comb. No.	Description
45	Dead+Wind 225 deg - Service
46	Dead+Wind 240 deg - Service
47	Dead+Wind 270 deg - Service
48	Dead+Wind 300 deg - Service
49	Dead+Wind 315 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	145 - 94.79	Pole	Max Tension	35	0.000	-0.000	-0.000
			Max. Compression	18	-13.042	0.432	-13.034
			Max. Mx	14	-8.578	387.244	-8.319
			Max. My	10	-8.572	0.400	-395.271
			Max. Vy	14	-11.916	387.244	-8.319
			Max. Vx	10	11.921	0.400	-395.271
			Max. Torque	14			5.595
L2	94.79 - 47	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-22.536	0.444	-13.411
			Max. Mx	14	-16.855	1015.515	-8.600
			Max. My	10	-16.852	0.410	-1023.703
			Max. Vy	14	-15.311	1015.515	-8.600
			Max. Vx	10	15.314	0.410	-1023.703
			Max. Torque	14			5.535
L3	47 - 1	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-36.225	0.448	-13.535
			Max. Mx	14	-28.922	1907.471	-8.687
			Max. My	10	-28.922	0.414	-1915.733
			Max. Vy	14	-19.012	1907.471	-8.687
			Max. Vx	10	19.012	0.414	-1915.733
			Max. Torque	14			5.525

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	27	36.225	0.000	-15.895
	Max. H_x	14	28.933	18.995	0.000
	Max. H_z	2	28.933	0.000	18.995
	Max. M_x	2	1898.376	0.000	18.995
	Max. M_z	6	1906.645	-18.995	0.000
	Max. Torsion	14	5.522	18.995	0.000
	Min. Vert	1	28.933	0.000	-0.000
	Min. H_x	6	28.933	-18.995	0.000
	Min. H_z	10	28.933	0.000	-18.995
	Min. M_x	10	-1915.733	0.000	-18.995
	Min. M_z	14	-1907.471	18.995	0.000
	Min. Torsion	6	-5.521	-18.995	0.000

Tower Mast Reaction Summary

Load Combination	Vertical	$Shear_x$	$Shear_z$	Overturning Moment, M_x	Overturning Moment, M_z	Torque
	K	K	K	kip-ft	kip-ft	kip-ft
Dead Only	28.933	0.000	0.000	8.692	0.414	-0.000
Dead+Wind 0 deg - No Ice	28.933	0.000	-18.995	-1898.376	0.414	-0.081
Dead+Wind 30 deg - No Ice	28.933	9.498	-16.450	-1642.880	-953.119	2.691
Dead+Wind 45 deg - No Ice	28.933	13.432	-13.432	-1339.811	-1348.084	3.848
Dead+Wind 60 deg - No Ice	28.933	16.450	-9.498	-944.844	-1651.151	4.742
Dead+Wind 90 deg - No Ice	28.933	18.995	0.000	8.687	-1906.645	5.521
Dead+Wind 120 deg - No Ice	28.933	16.450	9.498	962.213	-1651.144	4.821
Dead+Wind 135 deg - No Ice	28.933	13.432	13.432	1357.176	-1348.076	3.960
Dead+Wind 150 deg - No Ice	28.933	9.498	16.450	1660.240	-953.112	2.830
Dead+Wind 180 deg - No Ice	28.933	0.000	18.995	1915.733	0.414	0.080
Dead+Wind 210 deg - No Ice	28.933	-9.498	16.450	1660.239	953.939	-2.691
Dead+Wind 225 deg - No Ice	28.933	-13.432	13.432	1357.175	1348.903	-3.847
Dead+Wind 240 deg - No Ice	28.933	-16.450	9.498	962.212	1651.970	-4.741
Dead+Wind 270 deg - No Ice	28.933	-18.995	0.000	8.687	1907.471	-5.522
Dead+Wind 300 deg - No Ice	28.933	-16.450	-9.498	-944.843	1651.978	-4.823
Dead+Wind 315 deg - No Ice	28.933	-13.432	-13.432	-1339.810	1348.911	-3.962
Dead+Wind 330 deg - No Ice	28.933	-9.498	-16.450	-1642.879	953.946	-2.832
Dead+Ice+Temp	36.225	-0.000	0.000	13.535	0.448	-0.001
Dead+Wind 0 deg+Ice+Temp	36.225	0.000	-15.895	-1627.163	0.448	-0.067
Dead+Wind 30 deg+Ice+Temp	36.225	7.948	-13.766	-1407.353	-819.892	2.610
Dead+Wind 45 deg+Ice+Temp	36.225	11.240	-11.240	-1146.619	-1159.687	3.725
Dead+Wind 60 deg+Ice+Temp	36.225	13.766	-7.948	-806.823	-1420.419	4.586
Dead+Wind 90 deg+Ice+Temp	36.225	15.895	-0.000	13.514	-1640.225	5.333
Dead+Wind 120 deg+Ice+Temp	36.225	13.766	7.948	833.847	-1420.413	4.651
Dead+Wind 135 deg+Ice+Temp	36.225	11.240	11.240	1173.639	-1159.679	3.816
Dead+Wind 150 deg+Ice+Temp	36.225	7.948	13.766	1434.369	-819.885	2.722
Dead+Wind 180 deg+Ice+Temp	36.225	0.000	15.895	1654.175	0.448	0.065
Dead+Wind 210 deg+Ice+Temp	36.225	-7.948	13.766	1434.369	820.780	-2.609
Dead+Wind 225 deg+Ice+Temp	36.225	-11.240	11.240	1173.638	1160.573	-3.724
Dead+Wind 240 deg+Ice+Temp	36.225	-13.766	7.948	833.846	1421.307	-4.586
Dead+Wind 270 deg+Ice+Temp	36.225	-15.895	-0.000	13.514	1641.119	-5.334
Dead+Wind 300 deg+Ice+Temp	36.225	-13.766	-7.948	-806.822	1421.314	-4.653
Dead+Wind 315 deg+Ice+Temp	36.225	-11.240	-11.240	-1146.618	1160.582	-3.819
Dead+Wind 330 deg+Ice+Temp	36.225	-7.948	-13.766	-1407.353	820.787	-2.725
Dead+Wind 0 deg - Service	28.933	0.000	-7.420	-736.724	0.416	-0.032
Dead+Wind 30 deg - Service	28.933	3.710	-6.426	-636.853	-372.309	1.058
Dead+Wind 45 deg - Service	28.933	5.247	-5.247	-518.387	-526.697	1.513
Dead+Wind 60 deg - Service	28.933	6.426	-3.710	-363.999	-645.162	1.864
Dead+Wind 90 deg - Service	28.933	7.420	0.000	8.725	-745.033	2.171
Dead+Wind 120 deg - Service	28.933	6.426	3.710	381.449	-645.161	1.896
Dead+Wind 135 deg - Service	28.933	5.247	5.247	535.836	-526.696	1.557
Dead+Wind 150 deg - Service	28.933	3.710	6.426	654.301	-372.308	1.113
Dead+Wind 180 deg - Service	28.933	0.000	7.420	754.172	0.416	0.031
Dead+Wind 210 deg - Service	28.933	-3.710	6.426	654.301	373.139	-1.059
Dead+Wind 225 deg - Service	28.933	-5.247	5.247	535.836	527.526	-1.513
Dead+Wind 240 deg - Service	28.933	-6.426	3.710	381.449	645.992	-1.865
Dead+Wind 270 deg - Service	28.933	-7.420	0.000	8.725	745.864	-2.172
Dead+Wind 300 deg - Service	28.933	-6.426	-3.710	-363.999	645.993	-1.897
Dead+Wind 315 deg - Service	28.933	-5.247	-5.247	-518.387	527.528	-1.558
Dead+Wind 330 deg - Service	28.933	-3.710	-6.426	-636.852	373.140	-1.114

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
1	0.000	-28.933	0.000	0.000	28.933	-0.000	0.000%
2	0.000	-28.933	-18.995	0.000	28.933	18.995	0.000%
3	9.498	-28.933	-16.450	-9.498	28.933	16.450	0.000%
4	13.432	-28.933	-13.432	-13.432	28.933	13.432	0.000%
5	16.450	-28.933	-9.498	-16.450	28.933	9.498	0.000%
6	18.995	-28.933	0.000	-18.995	28.933	0.000	0.000%
7	16.450	-28.933	9.498	-16.450	28.933	-9.498	0.000%
8	13.432	-28.933	13.432	-13.432	28.933	-13.432	0.000%
9	9.498	-28.933	16.450	-9.498	28.933	-16.450	0.000%
10	0.000	-28.933	18.995	0.000	28.933	-18.995	0.000%
11	-9.498	-28.933	16.450	9.498	28.933	-16.450	0.000%
12	-13.432	-28.933	13.432	13.432	28.933	-13.432	0.000%
13	-16.450	-28.933	9.498	16.450	28.933	-9.498	0.000%
14	-18.995	-28.933	0.000	18.995	28.933	0.000	0.000%
15	-16.450	-28.933	-9.498	16.450	28.933	9.498	0.000%
16	-13.432	-28.933	-13.432	13.432	28.933	13.432	0.000%
17	-9.498	-28.933	-16.450	9.498	28.933	16.450	0.000%
18	0.000	-36.225	0.000	0.000	36.225	-0.000	0.000%
19	0.000	-36.225	-15.895	0.000	36.225	15.895	0.000%
20	7.948	-36.225	-13.766	-7.948	36.225	13.766	0.000%
21	11.240	-36.225	-11.240	-11.240	36.225	11.240	0.000%
22	13.766	-36.225	-7.948	-13.766	36.225	7.948	0.000%
23	15.895	-36.225	0.000	-15.895	36.225	0.000	0.000%
24	13.766	-36.225	7.948	-13.766	36.225	-7.948	0.000%
25	11.240	-36.225	11.240	-11.240	36.225	-11.240	0.000%
26	7.948	-36.225	13.766	-7.948	36.225	-13.766	0.000%
27	0.000	-36.225	15.895	0.000	36.225	-15.895	0.000%
28	-7.948	-36.225	13.766	7.948	36.225	-13.766	0.000%
29	-11.240	-36.225	11.240	11.240	36.225	-11.240	0.000%
30	-13.766	-36.225	7.948	13.766	36.225	-7.948	0.000%
31	-15.895	-36.225	0.000	15.895	36.225	0.000	0.000%
32	-13.766	-36.225	-7.948	13.766	36.225	7.948	0.000%
33	-11.240	-36.225	-11.240	11.240	36.225	11.240	0.000%
34	-7.948	-36.225	-13.766	7.948	36.225	13.766	0.000%
35	0.000	-28.933	-7.420	0.000	28.933	7.420	0.000%
36	3.710	-28.933	-6.426	-3.710	28.933	6.426	0.000%
37	5.247	-28.933	-5.247	-5.247	28.933	5.247	0.000%
38	6.426	-28.933	-3.710	-6.426	28.933	3.710	0.000%
39	7.420	-28.933	0.000	-7.420	28.933	-0.000	0.000%
40	6.426	-28.933	3.710	-6.426	28.933	-3.710	0.000%
41	5.247	-28.933	5.247	-5.247	28.933	-5.247	0.000%
42	3.710	-28.933	6.426	-3.710	28.933	-6.426	0.000%
43	0.000	-28.933	7.420	0.000	28.933	-7.420	0.000%
44	-3.710	-28.933	6.426	3.710	28.933	-6.426	0.000%
45	-5.247	-28.933	5.247	5.247	28.933	-5.247	0.000%
46	-6.426	-28.933	3.710	6.426	28.933	-3.710	0.000%
47	-7.420	-28.933	0.000	7.420	28.933	-0.000	0.000%
48	-6.426	-28.933	-3.710	6.426	28.933	3.710	0.000%
49	-5.247	-28.933	-5.247	5.247	28.933	5.247	0.000%
50	-3.710	-28.933	-6.426	3.710	28.933	6.426	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	0.00005328
3	Yes	5	0.00000001	0.00011236
4	Yes	5	0.00000001	0.00011617
5	Yes	5	0.00000001	0.00008568
6	Yes	5	0.00000001	0.00004816
7	Yes	5	0.00000001	0.00012954
8	Yes	5	0.00000001	0.00012089
9	Yes	5	0.00000001	0.00009313
10	Yes	4	0.00000001	0.00005471
11	Yes	5	0.00000001	0.00009365
12	Yes	5	0.00000001	0.00012087
13	Yes	5	0.00000001	0.00012931
14	Yes	5	0.00000001	0.00004818
15	Yes	5	0.00000001	0.00008570
16	Yes	5	0.00000001	0.00011652
17	Yes	5	0.00000001	0.00011317
18	Yes	4	0.00000001	0.00005101
19	Yes	5	0.00000001	0.00010000
20	Yes	5	0.00000001	0.00027037
21	Yes	5	0.00000001	0.00028849
22	Yes	5	0.00000001	0.00023230
23	Yes	5	0.00000001	0.00014998
24	Yes	5	0.00000001	0.00030980
25	Yes	5	0.00000001	0.00030733
26	Yes	5	0.00000001	0.00025145
27	Yes	5	0.00000001	0.00010380
28	Yes	5	0.00000001	0.00025236
29	Yes	5	0.00000001	0.00030757
30	Yes	5	0.00000001	0.00030970
31	Yes	5	0.00000001	0.00015013
32	Yes	5	0.00000001	0.00023256
33	Yes	5	0.00000001	0.00028923
34	Yes	5	0.00000001	0.00027174
35	Yes	4	0.00000001	0.00001899
36	Yes	4	0.00000001	0.00030461
37	Yes	4	0.00000001	0.00031092
38	Yes	4	0.00000001	0.00021866
39	Yes	4	0.00000001	0.00027396
40	Yes	4	0.00000001	0.00041650
41	Yes	4	0.00000001	0.00034771
42	Yes	4	0.00000001	0.00022431
43	Yes	4	0.00000001	0.00002041
44	Yes	4	0.00000001	0.00022624
45	Yes	4	0.00000001	0.00034753
46	Yes	4	0.00000001	0.00041581
47	Yes	4	0.00000001	0.00027473
48	Yes	4	0.00000001	0.00022034
49	Yes	4	0.00000001	0.00031397
50	Yes	4	0.00000001	0.00030959

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	145 - 94.79	27.779	43	1.947	0.039
L2	99.21 - 47	11.882	43	1.205	0.009
L3	53 - 1	3.209	43	0.579	0.003

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
145.000	LPA-80063/4CF	43	27.779	1.947	0.039	24462
143.000	EEI Low Profile Platform	43	27.016	1.913	0.038	24462
135.000	(2) 7770.00	43	23.980	1.779	0.031	12231
133.000	EEI Low Profile Platform	43	23.229	1.746	0.030	10192
125.000	APX16DWV-16DWVS-E-A20	43	20.280	1.614	0.024	6115
123.000	Valmont T-Arm (1)	43	19.560	1.581	0.023	5559
115.000	APXV18-206517-C	43	16.776	1.451	0.017	4076

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	145 - 94.79	69.536	10	4.780	0.100
L2	99.21 - 47	30.040	10	3.035	0.024
L3	53 - 1	8.136	10	1.468	0.007

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
145.000	LPA-80063/4CF	10	69.536	4.780	0.100	10198
143.000	EEI Low Profile Platform	10	67.645	4.702	0.096	10198
135.000	(2) 7770.00	10	60.120	4.392	0.080	5098
133.000	EEI Low Profile Platform	10	58.258	4.314	0.076	4248
125.000	APX16DWV-16DWVS-E-A20	10	50.942	4.005	0.061	2547
123.000	Valmont T-Arm (1)	10	49.156	3.929	0.058	2315
115.000	APXV18-206517-C	10	42.239	3.624	0.045	1696

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
L1	145 - 94.79 (1)	TP31.01x17.5x0.188	50.210	0.000	0.0	38.108	17.636	-8.572	672.047	0.013
L2	94.79 - 47 (2)	TP43.37x29.446x0.313	52.210	0.000	0.0	39.000	41.120	-16.852	1603.700	0.011
L3	47 - 1 (3)	TP55x41.145x0.313	52.000	0.000	0.0	36.209	54.243	-28.922	1964.100	0.015

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$

Pole Bending Design Data

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
L1	145 - 94.79 (1)	TP31.01x17.5x0.188	395.271	36.726	38.108	0.964	0.000	0.000	38.108	0.000
L2	94.79 - 47 (2)	TP43.37x29.446x0.313	1023.700	29.193	39.000	0.749	0.000	0.000	39.000	0.000
L3	47 - 1 (3)	TP55x41.145x0.313	1915.733	31.339	36.209	0.865	0.000	0.000	36.209	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	145 - 94.79 (1)	TP31.01x17.5x0.188	11.921	0.676	26.000	0.052	0.080	0.004	26.000	0.000
L2	94.79 - 47 (2)	TP43.37x29.446x0.313	15.313	0.372	26.000	0.029	0.080	0.001	26.000	0.000
L3	47 - 1 (3)	TP55x41.145x0.313	19.012	0.350	26.000	0.027	0.080	0.001	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	145 - 94.79 (1)	0.013	0.964	0.000	0.052	0.000	0.977 ✓	1.333	H1-3+VT ✓
L2	94.79 - 47 (2)	0.011	0.749	0.000	0.029	0.000	0.759 ✓	1.333	H1-3+VT ✓
L3	47 - 1 (3)	0.015	0.865	0.000	0.027	0.000	0.880 ✓	1.333	H1-3+VT ✓

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
L1	145 - 94.79	Pole	TP31.01x17.5x0.188	1	-8.572	895.839	73.3	Pass
L2	94.79 - 47	Pole	TP43.37x29.446x0.313	2	-16.852	2137.732	57.0	Pass
L3	47 - 1	Pole	TP55x41.145x0.313	3	-28.922	2618.145	66.0	Pass

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
							Summary	
						Pole (L1)	73.3	Pass
						RATING =	**73.3**	**Pass**

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Subject:		Anchor Bolt and Baseplate Analysis
Location:		145-ft EEI Monopole Barkhamsted, CT
Rev. 0: 12/19/11		Prepared by: T.J.L. Checked by: C.F.C. Job No. 12001.CO4

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	OM := 1916·ft·kips	(Input From RisaTower)
Shear Force =	Shear := 19·kips	(Input From RisaTower)
Axial Force =	Axial := 29·kips	(Input From RisaTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	N := 14	(User Input)
Diameter of Bolt Circle =	D_{bc} := 64.0·in	(User Input)
Bolt "Column" Distance =	l := 3.25·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 60

Plate Yield Strength =	Fy_{bp} := 60·ksi	(User Input)
Base Plate Thickness =	t_{bp} := 1.75·in	(User Input)
Base Plate Diameter =	D_{bp} := 70.0·in	(User Input)
Outer Pole Diameter =	D_{pole} := 55.0·in	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =: $R_{bc} := \frac{D_{bc}}{2} = 32 \cdot in$

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

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

$d_1 = 13.88 \cdot in$ $d_7 = 0.00 \cdot in$

$d_2 = 25.02 \cdot in$ $d_8 = -13.88 \cdot in$

$d_3 = 31.20 \cdot in$ $d_9 = -25.02 \cdot in$

$d_4 = 31.20 \cdot in$ $d_{10} = -31.20 \cdot in$

$d_5 = 25.02 \cdot in$ $d_{11} = -31.20 \cdot in$

$d_6 = 13.88 \cdot in$ etc.

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 27.5 \cdot in$

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

$MA_1 = 0.00 \cdot in$ $MA_7 = 0.00 \cdot in$

$MA_2 = 0.00 \cdot in$ $MA_8 = 0.00 \cdot in$

$MA_3 = 3.70 \cdot in$ $MA_9 = 0.00 \cdot in$

$MA_4 = 3.70 \cdot in$ $MA_{10} = 0.00 \cdot in$

$MA_5 = 0.00 \cdot in$ $MA_{11} = 0.00 \cdot in$

$MA_6 = 0.00 \cdot in$ etc

Effective Width of Baseplate for Bending = $B_{eff} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 34.6 \cdot in$

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Subject:	Anchor Bolt and Baseplate Analysis
Location:	145-ft EEI Monopole Barkhamsted, CT
Rev. 0: 12/19/11	Prepared by: T.J.L. Checked by: C.F.C. Job No. 12001.CO4

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i \left(d_i\right)^2 = 7.168 \times 10^3 \cdot in^2$

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

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

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

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

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

Check Anchor Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 100.6 \cdot kips$

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

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

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Net}} = 51.6 \cdot \%$ Bolts are "upset bolts". Use net area per AISC

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

Condition1 = "OK"

Check Anchor Bolt Bending Stress:

Maximum Bending Moment = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.368 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 5.3 \cdot ksi$

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

Check Combined Stress Requirement:

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

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

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

Check Anchor Bolt Compression/Combined Stress:

Maximum Compressive Force =

$$C_{Max} := OM \cdot \frac{R_{bc}}{I_p} + \frac{Axial}{N} = 104.7 \cdot kips$$

Maximum Compressive Stress =

$$f_a := \frac{C_{Max}}{A_n} = 32.2 \cdot ksi$$

$$K := 0.65$$

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

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

Allowable Compressive Stress =

$$F_a := 1.333 \cdot F_a = 60 \cdot ksi$$

(1.333 increase allowed per TIA/EIA)

Combined Stress % of Capacity =

$$\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) = 53.8 \cdot \%$$

Condition 2 =

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

Condition2 = "OK"

Base Plate Analysis:

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

$C_1 = 46.6 \cdot kips$ $C_7 = 2.1 \cdot kips$

$C_2 = 82.3 \cdot kips$ $C_8 = -42.5 \cdot kips$

$C_3 = 102.1 \cdot kips$ $C_9 = -78.2 \cdot kips$

$C_4 = 102.1 \cdot kips$ $C_{10} = -98.0 \cdot kips$

$C_5 = 82.3 \cdot kips$ $C_{11} = -98.0 \cdot kips$

$C_6 = 46.6 \cdot kips$ etc.

Maximum Bending Stress in Plate = $f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} \cdot t_{bp}^2\right)} = 42.7 \cdot ksi$

Allowable Bending Stress in Plate = $F_{bp} := 1.33 \cdot 0.75 \cdot Fy_{bp} = 59.9 \cdot ksi$

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} = 71.4 \cdot \%$

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

Condition3 = "Ok"

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Subject:	FOUNDATION ANALYSIS
Location:	145-ft EEI Monopole Barkhamsted, CT
Rev. 0: 12/19/11	Prepared by: T.J.L. Checked by: C.F.C. Job No. 12001.CO4

Standard Monopole Foundation:

Input Data:

Tower Data

Overturning Moment =	OM := 1916·ft·kips	(User Input from RISATower)	
Shear Force =	Shear := 19·kip	(User Input from RISATower)	
Axial Force =	Axial := 29·kip	(User Input from RISATower)	
Tower Height =	H_t := 145·ft	(User Input)	

Footing Data:

Overall Depth of Footing =	D_f := 8·ft	(User Input)	
Length of Pier =	L_p := 5.5·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 := 3.5·ft	(User Input)	
Width of Footing =	W_f := 21.5·ft	(User Input)	

Anchor Bolt Data:

Length of Anchor Bolts =	L_{st} := 96·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 := 64.0·in	(User Input)	

Material Properties:

Concrete Compressive Strength =	f_c := 4000·psi	(User Input)	
Steel Reinforcment 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 =	$BS_{pier} := 8$	(User Input)	
Bar Diameter =	$d_{bpier} := 1.00 \cdot in$	(User Input)	
Number of Bars =	$NB_{pier} := 46$	(User Input)	
Clear Cover of Reinforcement =	$Cvr_{pier} := 3 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Diameter of Tie =	$d_{Tie} := 3 \cdot in$	(User Input)	

Pad Reinforcement:

Bar Size =	$BS_{top} := 8$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 1.00 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 22$	(User Input)	(Top of Pad)
Bar Size =	$BS_{bot} := 8$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{bbot} := 1.00 \cdot in$	(User Input)	(Bottom of Pad)
Number of Bars =	$NB_{bot} := 22$	(User Input)	(Bottom of Pad)
Clear Cover of Reinforcement =	$Cvr_{pad} := 3.0 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)

Calculated Factors:

Pier Reinforcement Bar Area =

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

Pad Top Reinforcement Bar Area =

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

Pad Bottom Reinforcement Bar Area =

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

Coefficient of Lateral Soil Pressure =

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

Load Factor =

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

Stability of Footing:

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

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

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

$P_{pt} := K_p \cdot \gamma_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p} = 1.35 \cdot ksf$

$P_{top} := if[n < (D_f - T_f), P_{pt}, P_{pn}] = 1.35 \cdot ksf$

$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p} = 2.4 \cdot ksf$

$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 1.875 \cdot ksf$

$T_p := if[n < (D_f - T_f), T_f, (D_f - n)] = 3.5$

$A_p := W_f \cdot T_p = 75.25$

Ultimate Shear = $S_u := P_{ave} \cdot A_p = 141.094 \cdot kip$

Weight of Concrete Pad = $WT_c := \left[\left(W_f^2 \cdot T_f\right) + \frac{d_p^2 \cdot \pi}{4} L_p\right] \cdot \gamma_c = 274.431 \cdot kip$

Weight of Soil Above Footing = $WT_{s1} := \left[\left(W_f^2 - \frac{d_p^2 \cdot \pi}{4}\right) \cdot \left(\left|L_p - L_{pag} - n\right|\right)\right] \cdot \gamma_s = 190.69 \cdot kip$

Weight of Soil Wedge at Back Face = $WT_{s2} := \left(\frac{D_f^2 \cdot \tan(\Phi_s)}{2} \cdot W_f\right) \cdot \gamma_s = 39.722 \cdot kip$

Weight of Soil Wedge at back face Corners = $WT_{s3} := 2 \cdot \left[(D_f)^3 \cdot \frac{\tan(\Phi_s)}{3}\right] \cdot \gamma_s = 19.707 \cdot kips$

Total Weight = $WT_{tot} := WT_c + WT_{s1} + Axial = 494.125 \cdot kip$

Resisting Moment = $M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + \left[(WT_{s2} + WT_{s3}) \cdot \left(W_f + \frac{D_f \tan(\Phi_s)}{3}\right)\right] = 6846 \cdot kip \cdot ft$

Overturning Moment = $M_{ot} := OM + Shear \cdot (L_p + T_f) = 2087 \cdot kip \cdot ft$

Factor of Safety Actual = $FS := \frac{M_r}{M_{ot}} = 3.28$

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

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

$OverTurning\_Moment\_Check = "Okay"$

Shear Capacity in Pier:

Shear Resistance of Pier =

$$S_p := \frac{P_{ave} \cdot A_p + \mu \cdot WT_{tot}}{FS_{req}} = 181.725 \cdot kips$$

$$Shear\_Check := if\left(S_p > Shear, "Okay", "No Good"\right)$$

Shear_Check = "Okay"

Bearing Pressure Caused by Footing:

Area of the Mat =

$$A_{mat} := W_f^{\,2} = 462.25$$

Section Modulus of Mat =

$$S := \frac{W_f^{\,3}}{6} = 1656.4 \cdot ft^3$$

Maximum Pressure in Mat =

$$P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S} = 2.329 \cdot ksf$$

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

Max_Pressure_Check = "Okay"

Minimum Pressure in Mat =

$$P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S} = -0.191 \cdot ksf$$

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

Min_Pressure_Check = "No Good"

Distance to Resultant of Pressure Distribution =

$$X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 6.623$$

Distance to Kern =

$$X_k := \frac{W_f}{6} = 3.583$$

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

Eccentricity =

$$e := \frac{M_{ot}}{WT_{tot}} = 4.224$$

Adjusted Soil Pressure =

$$P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \cdot \left(\frac{W_f}{2} - e\right)} = 2.348 \cdot ksf$$

$$q_{adj} := if\left(P_{min} < 0, P_a, P_{max}\right) = 2.348 \cdot ksf$$

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

Pressure_Check = "Okay"

Concrete Bearing Capacity:

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

Bearing Strength Between Pier and Pad = $P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot \frac{\pi \cdot d_p^2}{4} = 1.225 \times 10^4 \cdot kips$ (ACI-2008 10.14)

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

Bearing_Check = "Okay"

Shear Strength of Concrete:

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

$\phi_c := 0.85$ (ACI 9.3.2.5)

$d := T_f - Cvr_{pad} - d_{bbot}$

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

$d_2 := d_1 - d$

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

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

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

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

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

Beam_Shear_Check = "Okay"

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

Critical Perimeter of Punching Shear = $b_o := \left(d_p + d\right) \cdot \pi = 31.9$

Area Included Inside Perimeter = $A_{bo} := \frac{\pi \cdot \left(d_p + d\right)^2}{4} = 81.2$

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 381.1$

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

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

$v_u := \text{Find}(v_u) = 4.9 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f = 332.6 \cdot kips$

Required Shear Strength = $V_{req} := LF \cdot V_u = 443.4 \cdot kips$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 3131.9 \cdot kip$ (ACI-2008 11.11.2.1)

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

Punching_Shear_Check = "Okay"

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

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

$q_b := q_{adj} - d_1 \cdot Slope = 1.478 \cdot ksf$

Maximum Bending at Face of Pier = $M_n := \frac{1}{LF \cdot \phi_m} \cdot \left[\left(q_{adj} - q_b \right) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f = 969.2 \cdot kip \cdot ft$

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

(ACI-200810.2.7.3)

$R_u := \frac{M_n}{\phi_m \cdot W_f \cdot d^2} = 34.7 \cdot psi$

$\rho := \frac{0.85 \cdot f_c}{f_y} \left(1 - \sqrt{1 - \frac{2 \cdot R_u}{0.85 \cdot f_c}} \right) = 0.0006$

$\rho_{min} := 1.333 \cdot \rho = 0.00077$

Required Reinforcement for Temperature and Shrinkage:

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

Check Bottom Bars:

$$As := \max(\rho, \rho_{min}, \rho_{sh}) \cdot W_f \cdot d = 17.6 \cdot in^2$$

$$As_{prov} := A_{bbot} \cdot NB_{bot} = 17.3 \cdot in^2$$

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

Pad_Reinforcement_Bot = "No Good"

Check top Bars:

$$As := \rho_{sh} \cdot (W_f \cdot d) = 17.6 \cdot in^2$$

$$As_{prov} := A_{btop} \cdot NB_{top} = 17.3 \cdot in^2$$

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

Pad_Reinforcement_Top = "No Good"

Developement Length Pad Reinforcement:

Bar Spacing =

$$B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 10.95 \cdot in$$

Spacing or Cover Dimension =

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

Transverse Reinforcement Index =

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

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

Minimum Development Length =

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

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

Available Length in Pad =

$$L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad} = 84 \cdot in$$

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

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

Area of Pier =

$$A_p := \frac{\pi \cdot d_p^{\,2}}{4} = \blacksquare \cdot in^2$$

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

$$A_{sprov} := NB_{pier} \cdot A_{bpier} = 36.13 \cdot in^2$$

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

Steel_Area_Check = "Okay"

Bar Spacing In Pier =

$$B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 4.737 \cdot in$$

Diameter of Reinforcement Cage =

$$Diam_{cage} := d_p - 2 \cdot Cvr_{pier} = 78 \cdot in$$

Maximum Moment in Pier =

$$M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2}\right)\right] \cdot LF = 32471.9 \cdot in \cdot kips$$

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

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

$$\left(D \;\; N \;\; n \;\; P_u \;\; M_{xu}\right) = (84 \;\; 46 \;\; 8 \;\; 38.7 \;\; 32471.9)$$

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

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

$$\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho\right) = (83.5 \;\; 70103.3 \;\; -60 \;\; 0)$$

$$Axial\_Load\_Check := if\left(\phi P_n \geq P_u, \text{"Okay"}, \text{"No Good"}\right)$$

Axial_Load_Check = "Okay"

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

Bending_Check = "Okay"

Development Length Pier Reinforcement:

Available Length in Foundation:

$L_{pier} := L_p - Cvr_{pier} = 63 \cdot in$

$L_{pad} := T_f - Cvr_{pad} = 39 \cdot in$

Tension: (ACI-2008 12.2.3)

Spacing or Cover Dimension =

$c := if\left(Cvr_{pier} < \frac{B_{sPier}}{2}, Cvr_{pier}, \frac{B_{sPier}}{2}\right) = 2.368 \cdot in$

Transverse Reinforcement =

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

$L_{dbt} := \frac{3 \cdot f_y \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 30.04 \cdot in$

Minimum Development Length =

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

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

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

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

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

Compression: (ACI-2008 12.3.2)

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

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

$L_{dbc} := if\left(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}\right) = 18.974 \cdot in$

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

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

Tie Size and Spacing in Column:

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

Used #3 Ties

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

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

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

$s_{lim3} := D_f \cdot z = 96 \cdot in$

$s_{lim4} := 18in$

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

Number of Ties Required = $n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 = 4.75$

Check Anchor Steel Embedment:

Depth Available = $D_{ab} := L_{st} - A_{BP} = 7 \cdot ft$

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

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

Depth_Check = "No Good"

Note: Anchor plate is provided

SITE NAME	BARKHAMSTED W CT	ECP - CELL #	2	480
LATITUDE	41-54-52.29 N	LONGITUDE	73-01-20.39 W	
Additional Comments: LTE antenna add keeping with 12 antennas and adding 6 additional main lines		SAVE BUTTON		
		STRUCTURE TYPE	TOWER	

700 Mhz - LTE ANTENNA ADD	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	eNodeB	eNodeB	eNodeB
ANTENNA TYPE	BXA-70063-6CF_2	BXA-70063-6CF_2	BXA-70063-6CF_2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	0	120	250
DOWN TILT (MECH/DEG)	0	4	3
RAD CTR (FT AGL)	145	145	145
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			

850 Celluar - Current Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	#N/A	#N/A	#N/A
ANTENNA TYPE	LPA-80063/4CF	LPA-80063/4CF	LPA-80063/4CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	0	120	250
DOWN TILT (MECH/DEG)	0	3	3
RAD CTR (FT AGL)	145	145	145
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			

850 Celluar - Future Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	#N/A	#N/A	#N/A
ANTENNA TYPE	LPA-80063/4CF	LPA-80063/4CF	LPA-80063/4CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	0	120	250
DOWN TILT (MECH/DEG)	0	4	3
RAD CTR (FT AGL)	145	145	145
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-185063/12CF	LPA-185063/12CF	LPA-185063/12CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	0	120	250
DOWN TILT (MECH/DEG)	0	3	3
RAD CTR (FT AGL)	145	145	145
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			

1900 PCS - Future Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	#N/A	#N/A	#N/A
ANTENNA TYPE	BXA-171063-12BF_2	BXA-171063-12BF_2	BXA-171063-12BF_2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	0	120	250
DOWN TILT (MECH/DEG)	0	1	1
RAD CTR (FT AGL)	145	145	145
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE			

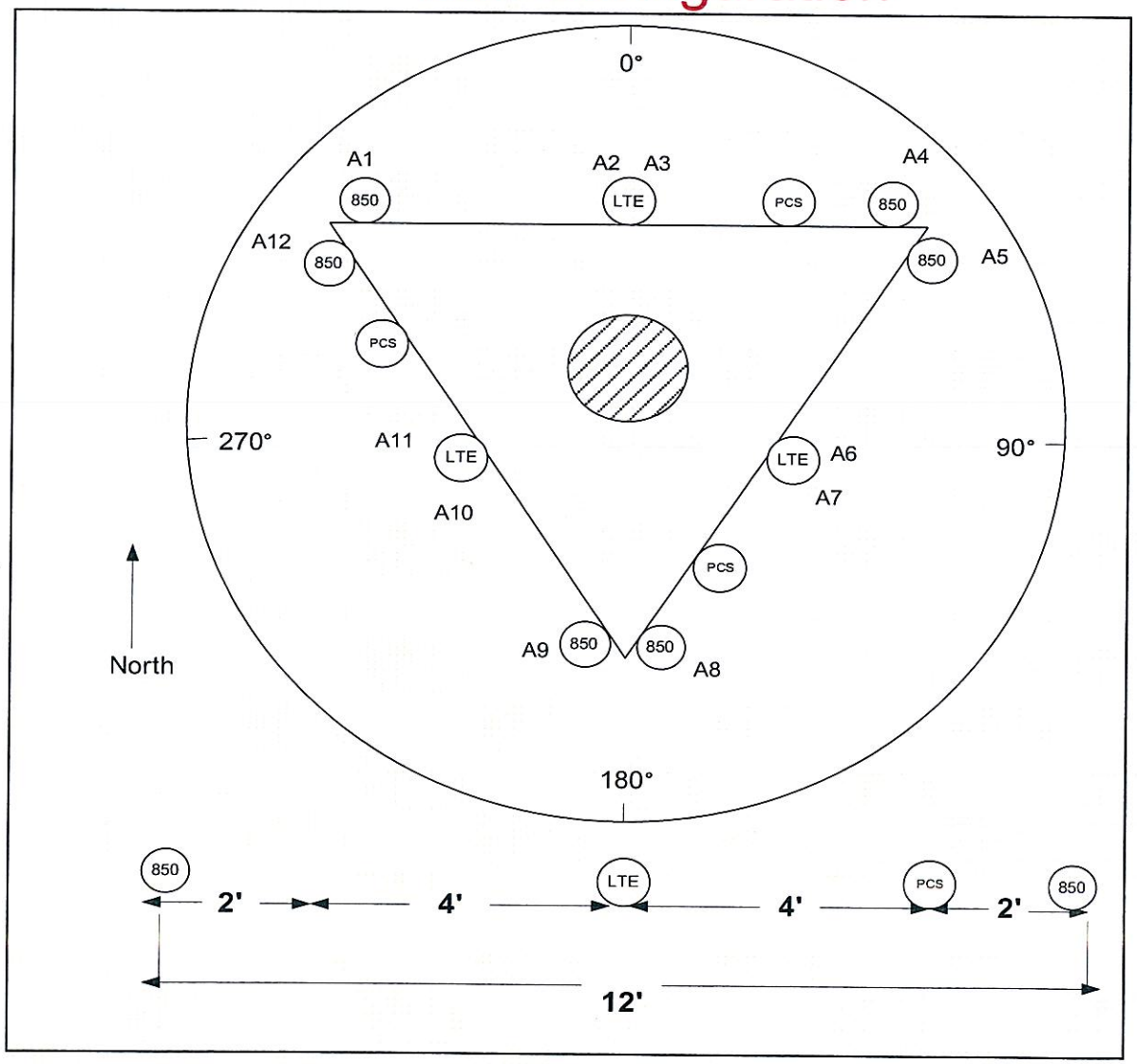
NUMBER OF CABLE'S NEEDED					ESTIMATED CABLE LENGTH			
MAINLINE SIZE	1 5/8"	TOTAL # OF MAINLINES		18	MAINLINE (FT)			
JUMPER SIZE	1/2 "	TOTAL # OF TOP JUMPERS		18	TOP JUMPER (FT)			12
Equipment Cable Ordering		MAIN CABLE	12 +	6	TOP JUMPER #	12	+	6

TX / RX FREQUENCIES			TX POWER OUTPUT	
Cellular A-Band	PCS F / AWS-Band	700 Mhz C - E	Cellular (Watts)	20
TX - 869-880,890-891.5 MHz	TX - 1970-1975 / 2145-21	TX - 746-757	PCS (Watts)	16
RX - 824-835,845-846.5 MHz	RX - 1890-1895 / 1745-17	RX - 776-787	LTE (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	8/31/2011

Site Configuration



BXA-70063-6CF-EDIN-X

X-Pol | FET Panel | 63° | 14.5 dBd

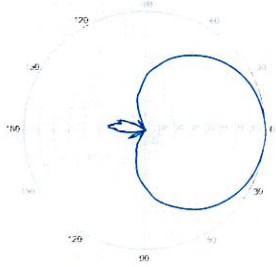
Replace "X" with desired electrical downtilt.

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 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

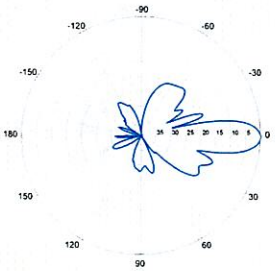
Mounting Options	Part Number	Fits Pipe Diameter	Weight
3-Point Mounting & Downtilt Bracket Kit	36210008	40-115 mm 1.57-4.5 in	6.9 kg 15.2 lbs
Concealment Configurations	For concealment configurations, order BXA-70063-6CF-EDIN-X-FP		

BXA-70063-6CF-EDIN-X



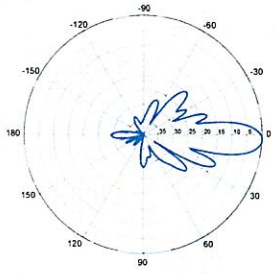
Horizontal | 750 MHz

BXA-70063-6CF-EDIN-0

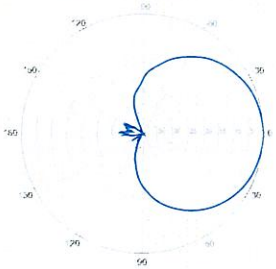


0° | Vertical | 750 MHz

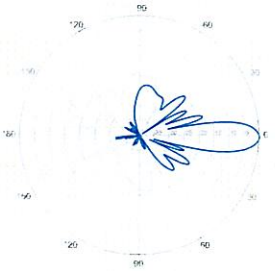
BXA-70063-6CF-EDIN-2



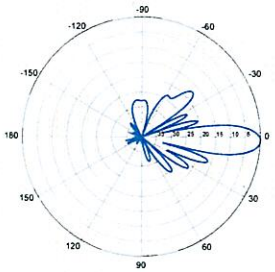
2° | Vertical | 750 MHz



Horizontal | 850 MHz



0° | Vertical | 850 MHz



2° | Vertical | 850 MHz

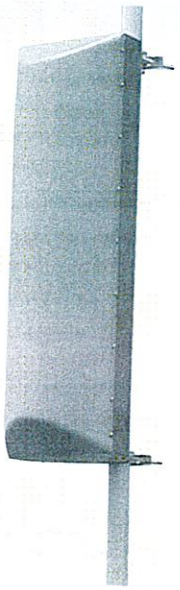
Amphenol ANTENNA SOLUTIONS

LPA-80063-4CF-EDIN-X

V-Pol | Log Periodic | 63° | 13.0 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.

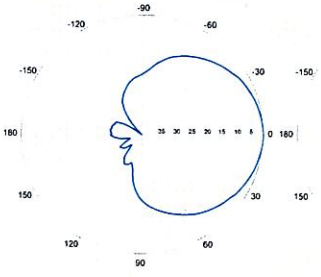


Electrical Characteristics	
Frequency bands	806-960 MHz
Polarization	Vertical
Horizontal beamwidth	63°
Vertical beamwidth	15°
Gain	13.0 dBd (15.1 dBi)
Electrical downtilt (X)	0, 2, 4, 5, 6, 8, 10, 12, 14
Impedance	50Ω
VSWR	≤1.4:1
Upper sidelobe suppression (0°)	-15.7 dB
Front-to-back ratio (+/-30°)	-31.7 dB
Null fill	5% (-26.02 dB)
Input power	500 W
Lightning protection	Direct Ground
Connector(s)	1 Port / EDIN or NE / Female / Center (Back)

Mechanical Characteristics		
Dimensions Length x Width x Depth	1205 x 385 x 332 mm	47.4 x 15.2 x 13.1 in
Depth of antenna with z-bracket	372 mm	14.6 in
Weight without mounting brackets	9.1 kg	20 lbs
Survival wind speed	> 201 km/hr	> 125 mph
Wind area	Front: 0.46 m² Side: 0.39 m²	Front: 5.0 ft² Side: 4.2 ft²
Wind load @ 161 km/hr (100 mph)	Front: 660 N Side: 550 N	Front: 149 lbf Side: 124 lbf

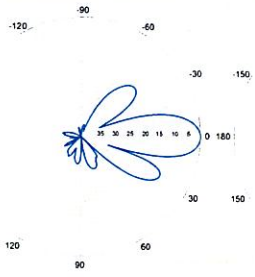
Mounting Options	Part Number	Fits Pipe Diameter	Weight
2-Point Mounting & Downtilt Bracket Kit (0-20°)	21699999	50-102 mm 2.0-4.0 in	5.4 kg 12 lbs
Lock-Down Brace	If the lock-down brace is used, the maximum diameter of the mounting pipe is 88.9 mm or 3.5 in.		

LPA-80063-4CF-EDIN-X



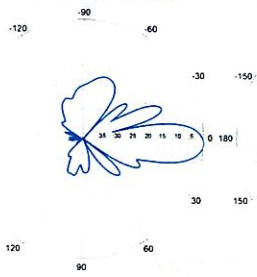
Horizontal

LPA-80063-4CF-EDIN-0



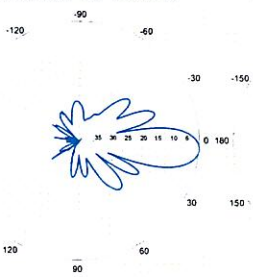
0° | Vertical

LPA-80063-4CF-EDIN-2



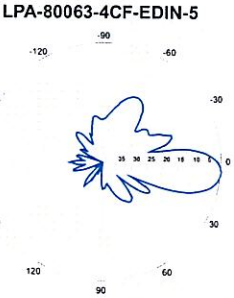
2° | Vertical

LPA-80063-4CF-EDIN-4



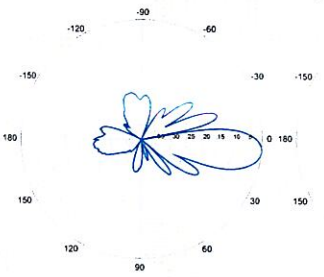
4° | Vertical

LPA-80063-4CF-EDIN-5



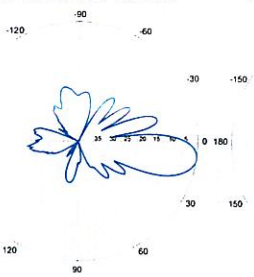
5° | Vertical

LPA-80063-4CF-EDIN-6



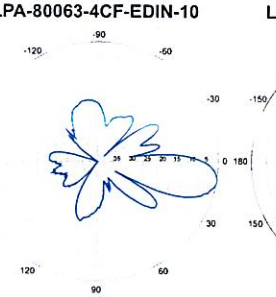
6° | Vertical

LPA-80063-4CF-EDIN-8



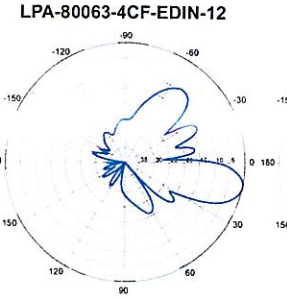
8° | Vertical

LPA-80063-4CF-EDIN-10



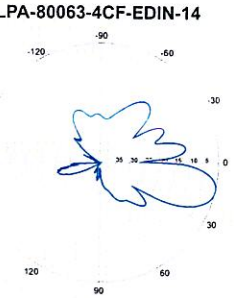
10° | Vertical

LPA-80063-4CF-EDIN-12



12° | Vertical

LPA-80063-4CF-EDIN-14



14° | Vertical

BXA-171063-12BF-EDIN-X

Replace "X" with desired electrical downtilt.

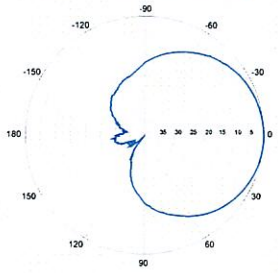
X-Pol | FET Panel | 63° | 19.0 dBi

Electrical Characteristics	1710-2170 MHz		
Frequency bands	1710-1880 MHz	1850-1990 MHz	1920-2170 MHz
Polarization	±45°	±45°	±45°
Horizontal beamwidth	68°	65°	60°
Vertical beamwidth	4.5°	4.5°	4.5°
Gain	16.1 dBd / 18.2 dBi	16.5 dBd / 18.6 dBi	16.9 dBd / 19.0 dBi
Electrical downtilt (X)	0, 2, 5		
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 m² Side: 0.19 m²	Front: 3.1 ft² Side: 2.1 ft²
Wind load @ 161 km/hr (100 mph)	Front: 460 N Side: 304 N	Front: 103 lbf Side: 68 lbf

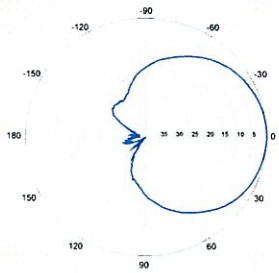
Mounting Options	Part Number	Fits Pipe Diameter	Weight
2-Point Mounting Bracket Kit	26799997	50-102 mm 2.0-4.0 in	2.3 kg 5 lbs
2-Point Mounting & Downtilt Bracket Kit	26799999	50-102 mm 2.0-4.0 in	3.6 kg 8 lbs
Concealment Configurations	For concealment configurations, order BXA-171063-12BF-EDIN-X-FP		

BXA-171063-12BF-EDIN-X



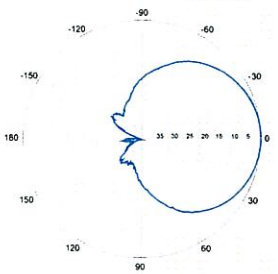
Horizontal | 1710-1880 MHz

BXA-171063-12BF-EDIN-X



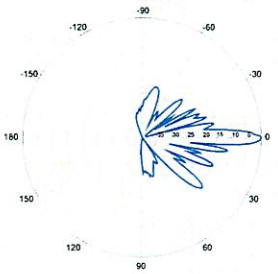
Horizontal | 1850-1990 MHz

BXA-171063-12BF-EDIN-X



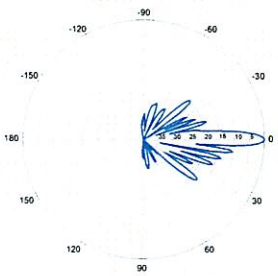
Horizontal | 1920-2170 MHz

BXA-171063-12BF-EDIN-0



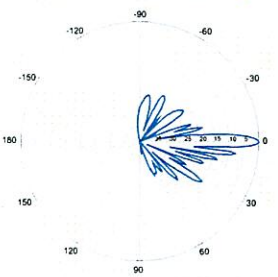
0° | Vertical | 1710-1880 MHz

BXA-171063-12BF-EDIN-0



0° | Vertical | 1850-1990 MHz

BXA-171063-12BF-EDIN-0



0° | Vertical | 1920-2170 MHz