ROBINSON & COLE LLP

KENNETH C. BALDWIN

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

Also admitted in Massachusetts

December 28, 2012

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

Re: **EM-VER-063-120423 – 185 Fiske Road, Hampton, Connecticut**
EM-VER-075-120423 – 333 Grassy Hill Road, Lyme, Connecticut
EM-VER-086-120330 – 557 Route 82, Montville, Connecticut
EM-VER-097-120522 – 201 South Main Street, Newtown, Connecticut
EM-VER-107-111219 – Ogg Meadow Road, Orange, Connecticut
EM-VER-141-120423 – 720 Quinebaug Road, Thompson, Connecticut
EM-VER-121-120229 – 399 West Road, Salem, Connecticut

Completion of Construction Activity

Dear Ms. Roberts:

The purpose of this letter is to notify the Siting Council that construction activity associated with the above-referenced Cellco Partnership d/b/a Verizon Wireless telecommunications facilities has been completed.

If you have any questions or need any additional information regarding this facility please do not hesitate to contact me.

Sincerely,

Kenneth C. Baldwin

Copy to:
Sandy M. Carter

12012142-v1

STATE OF CONNECTICUT
CONNECTICUT SITING COUNCIL
Ten Franklin Square, New Britain, CT 06051
Phone: (860) 827-2935 Fax: (860) 827-2950
E-Mail: siting.council@ct.gov
www.ct.gov/csc

May 11, 2012

Kenneth C. Baldwin, Esq.
Robinson & Cole LLP
280 Trumbull Street
Hartford, CT 06103

RE: **EM-VER-141-120423**- Cellco Partnership d/b/a Verizon Wireless notice of intent to modify an existing telecommunications facility located at 720 Quinebaug Road, Thompson, Connecticut.

Dear Attorney Baldwin:

The Connecticut Siting Council (Council) hereby acknowledges your notice to modify this existing telecommunications facility, pursuant to Section 16-50j-73 of the Regulations of Connecticut State Agencies with the following conditions:

- Any deviation from the proposed modification as specified in this notice and supporting materials with Council shall render this acknowledgement invalid;
- Any material changes to this modification as proposed shall require the filing of a new notice with the Council;
- Not less than 45 days after completion of construction, the Council shall be notified in writing that construction has been completed;
- The validity of this action shall expire one year from the date of this letter; and
- The applicant may file a request for an extension of time beyond the one year deadline provided that such request is submitted to the Council not less than 60 days prior to the expiration;

The proposed modifications including the placement of all necessary equipment and shelters within the tower compound are to be implemented as specified here and in your notice dated April 20, 2012. The modifications are in compliance with the exception criteria in Section 16-50j-72 (b) of the Regulations of Connecticut State Agencies as changes to an existing facility site that would not increase tower height, extend the boundaries of the tower site, increase noise levels at the tower site boundary by six decibels, and increase the total radio frequencies electromagnetic radiation power density measured at the tower site boundary to or above the standard adopted by the State Department of Environmental Protection pursuant to General Statutes § 22a-162. This facility has also been carefully modeled to ensure that radio frequency emissions are conservatively below State and federal standards applicable to the frequencies now used on this tower.

This decision is under the exclusive jurisdiction of the Council. Please be advised that the validity of this action shall expire one year from the date of this letter. Any additional change to this facility will require explicit notice to this agency pursuant to Regulations of Connecticut State Agencies Section 16-50j-73. Such notice shall include all relevant information regarding the proposed change with cumulative worst-case modeling of radio frequency exposure at the closest point of uncontrolled access to the tower base, consistent with Federal Communications Commission, Office of Engineering and Technology, Bulletin 65. Thank you for your attention and cooperation.

Very truly yours,

Linda Roberts HAB
Linda Roberts
Executive Director

LR/CDM/laf

c: The Honorable Larry Groh, First Selectman, Town of Thompson
John E. Mahon, Jr., Zoning Enforcement Officer, Town of Thompson
Quinebaug Volunteer Fire Department

CSC
CONNECTICUT SITING COUNCIL

STATE OF CONNECTICUT
CONNECTICUT SITING COUNCIL
Ten Franklin Square, New Britain, CT 06051
Phone: (860) 827-2935 Fax: (860) 827-2950
E-Mail: siting.council@ct.gov
www.ct.gov/csc

April 26, 2012

The Honorable Larry Groh
First Selectman
Town of Thompson
Town Office Building
815 Riverside Drive
P. O. Box 899
North Grosvenordale, CT 06255

RE: **EM-VER-141-120423**- Cellco Partnership d/b/a Verizon Wireless notice of intent to modify an existing telecommunications facility located at 720 Quinebaug Road, Thompson, Connecticut.

Dear First Selectman Groh:

The Connecticut Siting Council (Council) received this request to modify an existing telecommunications facility, pursuant to Regulations of Connecticut State Agencies Section 16-50j-72.

If you have any questions or comments regarding this proposal, please call me or inform the Council by May 10, 2012.

Thank you for your cooperation and consideration.

Very truly yours,

Linda Roberts

Linda Roberts
Executive Director

LR/jbw

Enclosure: Notice of Intent

c: John E. Mahon, Jr., Zoning Enforcement Officer, Town of Thompson

ROBINSON & COLE

EM-VER-141-120423

KENNETH C. BALDWIN

280 Trumbull Street
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Direct (860) 275-8345

April 20, 2012

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

Re: **Notice of Exempt Modification – Antenna Swap**
720 Quinebaug Road, Thompson, Connecticut

Dear Ms. Roberts:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) wireless telecommunications antennas at the 120-foot level on an existing 130-foot tower at the above-referenced address. The tower and underlying property are owned by Quinebaug Volunteer Fire Department. Cellco's use of the tower was approved by the Council in 2007. Cellco now intends to replace six (6) of its existing antennas with three (3) model BXA-171085-12CF PCS antennas and three (3) model BXA-70063-6CF LTE antennas, all at the same 120-foot level. Cellco also intends to install six (6) coax cable diplexers on its antenna platform. Attached behind Tab 1 are the specifications for the replacement antennas and diplexers.

Please accept this letter as notification pursuant to R.C.S.A. § 16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is being sent to Lawrence K. Groh, Jr., First Selectman of the Town of Thompson.

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

1. The proposed modifications will not result in an increase in the height of the existing tower. Cellco's replacement antennas and diplexers will be located at the 120-foot level on the existing 130-foot tower.

2. The proposed modifications will not involve any change to ground-mounted equipment and, therefore, will not require the extension of the site 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 modifications. (See Tab 3).

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

Sincerely,

Kenneth C. Baldwin

Enclosures
Copy to:
Lawrence K. Groh, Jr., Thompson First Selectman
Sandy M. Carter

Amphenol ANTENNA SOLUTIONS

BXA-171085-12CF-EDIN-X

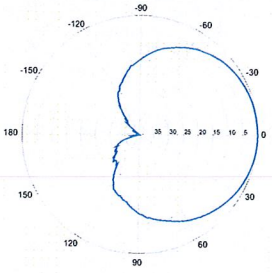
Replace "X" with desired electrical downtilt.

X-Pol | FET Panel | 85° | 18.0 dBi

Electrical Characteristics	1710-2170 MHz		
Frequency bands	1710-1880 MHz	1850-1990 MHz	1920-2170 MHz
Polarization	±45°	±45°	±45°
Horizontal beamwidth	88°	85°	80°
Vertical beamwidth	4.5°	4.5°	4.5°
Gain	15.1 dBd / 17.2 dBi	15.5 dBd / 17.6 dBi	15.9 dBd / 18.0 dBi
Electrical downtilt (X)	0, 2, 4		
Impedance	50Ω		
VSWR	≤1.5:1		
First upper sidelobe	< -17 dB		
Front-to-back ratio	> 30 dB		
In-band isolation	> 28 dB		
IM3 (20W carrier)	< -150 dBc		
Input power	300 W		
Lightning protection	Direct Ground		
Connector(s)	2 Ports / EDIN / Female / Center (Back)		
Operating temperature	-40° to +60° C / -40° to +140° F		
Mechanical Characteristics			
Dimensions Length x Width x Depth	1840 x 154 x 105 mm	72.4 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	

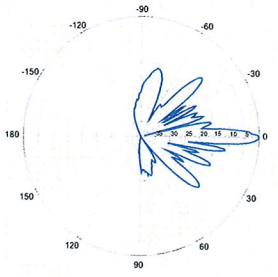
Mounting Options	Part Number	Fits Pipe Diameter	Weight
2-Point Mounting Bracket Kit	26799997	50-102 mm 2.0-4.0 in	2.3 kg 5 lbs
2-Point Mounting & Downtilt Bracket Kit	26799999	50-102 mm 2.0-4.0 in	3.6 kg 8 lbs
Concealment Configurations	For concealment configurations, order BXA-171085-12CF-EDIN-X-FP		

BXA-171085-12CF-EDIN-X



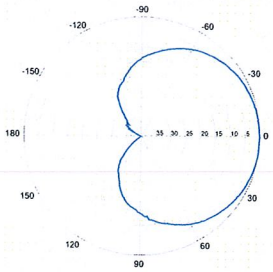
Horizontal | 1710-1880 MHz

BXA-171085-12CF-EDIN-0



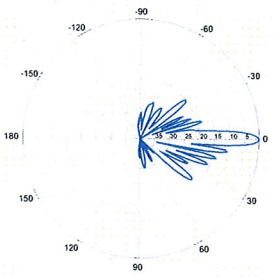
0° | Vertical | 1710-1880 MHz

BXA-171085-12CF-EDIN-X



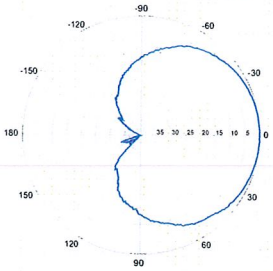
Horizontal | 1850-1990 MHz

BXA-171085-12CF-EDIN-0



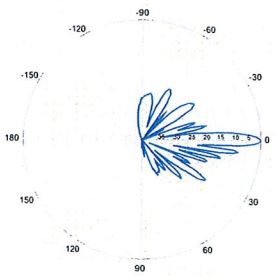
0° | Vertical | 1850-1990 MHz

BXA-171085-12CF-EDIN-X



Horizontal | 1920-2170 MHz

BXA-171085-12CF-EDIN-0



0° | Vertical | 1920-2170 MHz

Amphenol ANTENNA SOLUTIONS

BXA-70063-6CF-EDIN-X

X-Pol | FET Panel | 63° | 14.5 dBd

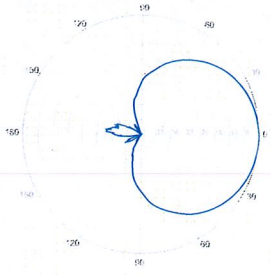
Replace "X" with desired electrical downtilt.

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

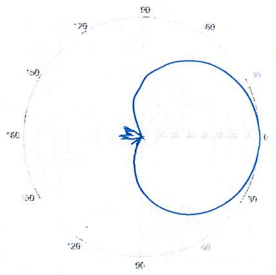
Electrical Characteristics	696-900 MHz	
Frequency bands	696-806 MHz	806-900 MHz
Polarization	±45°	
Horizontal beamwidth	65°	63°
Vertical beamwidth	13°	11°
Gain	14.0 dBd (16.1 dBi)	14.5 dBd (16.6 dBi)
Electrical downtilt (X)	0, 2, 3, 4, 5, 6, 8, 10	
Impedance	50Ω	
VSWR	≤1.35:1	
Upper sidelobe suppression (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

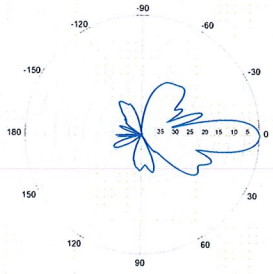


Horizontal | 750 MHz

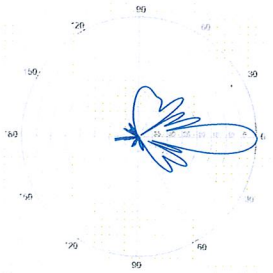


Horizontal | 850 MHz

BXA-70063-6CF-EDIN-0

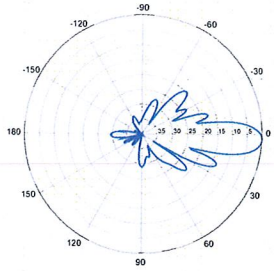


0° | Vertical | 750 MHz

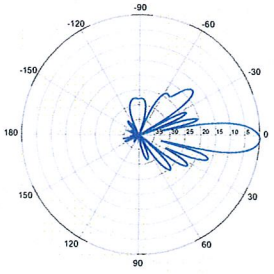


0° | Vertical | 850 MHz

BXA-70063-6CF-EDIN-2



2° | Vertical | 750 MHz



2° | Vertical | 850 MHz

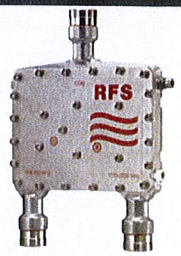
Quoted performance parameters are provided to offer typical or range values only and may vary as a result of normal manufacturing and operational conditions. Extreme operational conditions and/or stress on structural supports is beyond our control. Such conditions may result in damage to this product.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

Product Data Sheet **FD9R6004/2C-3L**

ShareLite Wideband Diplexer – In-line 698-960 MHz/1710-2200 MHz, DC pass in high frequency path

Product Description

The ShareLite FD9R6004 Series of diplexers are designed to enable feeder sharing between systems in the 698-960 MHz range and in the 1710-2200 MHz range. The diplexer is equipped with in-line connector placement so it can be installed in the BTS cabinet or at the tower top. This is especially valuable in crowded sites or when the feeders are not easily accessible. Due to its wideband design, the FD9R6004 Series can accommodate many combining solutions between 698-960 MHz and 1710-2200 MHz systems such as LTE 700 MHz, Cellular 800 MHz with PCS, GSM900 with GSM1800, or GSM900 with UMTS. This diplexer features a highly selective filter. It provides a high level of isolation between ports, while keeping the insertion loss on both paths at an extremely low level. The FD9R6004 diplexers are available with various DC pass options, helpful in configurations with or without the Tower Mount Amplifiers installed.



Features/Benefits

- **LTE ready design**
- **Extremely Low Insertion Loss**
- **High level of Rejection between bands – Protection against interferences**
- **Extremely High Power Handling Capability**
- **Integrated DC block/bypass versions available**
- **Very compact & small size design – Easy installation and reduced tower load**
- **In-line long-neck connectors for easy connection & waterproofing**
- **Exceptional reliability & environmental protection (IP 67)**
- **Equipped with 1 * Breathable Vent – Prevent any humidity inside the product**
- **Mounting hardware for Wall and Pole mount provided (P/N SEM2-1A)**
- **Grounding already provided through the mounting bracket**
- **Kit available for easy dual mount**

Technical Specifications

Product Type	Diplexer/Cross Band Coupler
Frequency Range 1, MHz	698-960
Frequency Range 2, MHz	1710-2200
Application	LTE700, GSM900, UMTS, GSM1800, Cellular 800, PCS
Configuration	Sharelite Single diplexer, outdoor, DC pass in the 1710-2170MHz path, with mounting hardware SEM2-1A
Mounting	Wall Mounting: With 4 screws (maximum 6mm diameter); Pole Mounting: With included clamp set 40-110mm (1.57-4.33)
Return Loss All Ports Min/Typ, dB	19/23
Power Handling Continuous, Max, W	1250 at common port; 750 in low frequency path & 500 in high frequency path
Power Handling Peak, Max, W	15000 in low frequency path & 8000 in high frequency path
Impedance, Ohms	50
Insertion Loss, Path 1, dB	0.07 typ.
Insertion Loss, Path 2, dB	0.13 typ.
Rejection Between Bands Min/Typ, dB	58/64@698-960MHz; 60/70@1710-2200MHz
IMP Level at the COM Port, Typ, dBm	-112 @ 2x43
DC Pass in Low Frequency Path	No
DC Pass in High Frequency Path	Yes
Temperature Range, °C (°F)	-40 to +60 (-40 to +140)
Environmental	ETSI 300-019-2-4 Class 4.1E
Ingress Protection	IP 67
Lightning Protection	EN/IEC61000-4-5 Level 4
Connectors	In-line long-neck 7-16-Female
Weight, kg (lb)	1.2 (2.6)
Shipping Weight, kg (lb)	3.2 (7) for 2 * single units in 1 * box, 9.8 (21.6) for 6 * units = 3 * Boxes in 1 * overwrap
Dimensions, H x W x D, mm (in)	147 x 164 x 37 (5.8 x 6.5 x 1.5)
Shipping Dimensions, H x W x D, mm (in)	254 x 406 x 82 (10 x 16 x 3.2) for 2 * Single Units in 1 * box, 280 x 406 x 241 (11 x 16 x 9.5) for 6 * units = 3 * Boxes in 1 * overwrap
Volume, L	0.43
Housing	Aluminum

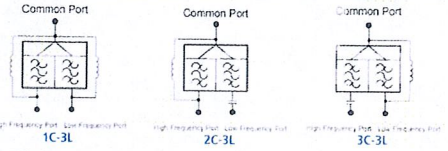
Notes

ShareLite Wideband Diplexer – In-line 698-960 MHz/1710-2200 MHz, DC pass in high frequency path

Other Documentation

FD9R6004/2C-3L Installation Instructions: Wideband_Diplexer_Installation_Rev5.pdf

Selection Guide Diplexer 698-960 / 1710-2200MHz					
	Model Number	Full DC Pass	DC Pass High Band	DC Pass Low Band	Mounting Hardware Included
Single	FD9R6004/1C-3L				X
	FD9R6004/2C-3L				X
	FD9R6004/3C-3L				X
Dual	KIT-FD9R6004/1C-DL				X
	KIT-FD9R6004/2C-DL				X
	KIT-FD9R6004/3C-DL				X



1C-3L 2C-3L 3C-3L

The FD9R6004 Series is upgradeable to a Dual Diplexer kit by means of 2 diplexers and mounting hardware kits SEM2-1A and SEM2-3

Mounting Hardware and Ground Cable Ordering Information		
Model Number	Description	
SEM2-1A	Mounting Hardware, Pole mount ø40-110mm (Included with the Single and Dual Diplexer) Wall Screws M6 (Not included with the product)	
SEM2-3	Assembly kit for 2 pcs of FD9R6004/xC-3L (Can be ordered separately but included with the Dual Diplexer Kit)	
CA020-2	Ground Cable, 2m, includes lugs (Optional)	
CA030-2	Ground Cable, 2m, includes lugs (Optional)	
SEM6	Mounting Hardware for 6 Diplexers, Tower Base (Optional)	

	General	Power	Density					
Site Name: Quinebaug (Thompson)								
Tower Height: Verizon @ 120ft								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*Quinebaug FD	1	100	133	0.0020	155	0.2000	1.02%	
*Cingular	6	296	130	0.0378	880	0.5867	6.44%	
*Cingular	3	427	130	0.0273	1930	1.0000	2.73%	
*Quinebaug FD	1	100	90	0.0044	465	0.3100	1.43%	
*Quinebaug FD	1	100	70	0.0073	33.9	0.2000	3.67%	
Verizon PCS	**11**	**267**	**120**	**0.0733**	**1970**	**1.0000**	**7.33%**	
Verizon Cellular	**9**	**268**	**120**	**0.0602**	**869**	**0.5793**	**10.40%**	
Verizon AWS	**1**	**665**	**120**	**0.0166**	**2145**	**1.0000**	**1.66%**	
Verizon 700	**1**	**872**	**120**	**0.0218**	**698**	**0.4653**	**4.68%**	
* Source: Siting Council								**39.35%**

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

130-ft Existing Valmont Monopole

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Quinebaug

720 Quinebaug Road
Quinebaug, CT

Centek Project No. 12001.CO19

Date: March 7, 2012

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 Quinebaug, CT.

The host tower is a 130-ft tall, three-section, twelve sided, tapered monopole, originally designed and manufactured by Valmont; job no; 18435-65, dated August 4, 2005. The tower geometry, structure member sizes and foundation system information were obtained from the aforementioned Valmont design documents. Antenna and appurtenance information were obtained from visual verification from grade conducted by Centek personnel on February 21, 2012 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 19.94-in at the top and 47.60-in at the base.

Verizon proposes the removal of six (6) panel antennas and the installation of six (6) panel antennas and six (6) diplexers 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:

- TOWN (EXISTING):
  Antennas: One (1) 4-bay dipole antenna, one (1) 20-ft Omni-directional whip antenna and one (1) 10-ft Omni-directional whip antenna mounted on the existing AT&T low profile platform with an elevation of 130-ft above grade.
  Coax Cables: Three (3) 7/8" ∅ coax cables running on the inside of the existing tower.
- AT&T (EXISTING):
  Antennas: Six (6) Powerwave 7770 panel antennas, six (6) TMA's and six (6) Diplexers mounted on an existing low profile platform with a RAD center elevation of 130-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing tower.
- VERIZON (EXISTING TO REMAIN):
  Antennas: Six (6) Antel LPA-80080-6CF panel antennas mounted on an existing low profile platform with a RAD center elevation of 120-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-185080-12CF panel antennas mounted on an existing low profile platform with a RAD center elevation of 120-ft above grade.

- **VERIZON (PROPOSED):**
  Antennas: Three (3) Antel BXA-70063-6CF panel antennas, three (3) Antel BXA-171085-12CF panel antennas and six (6) RFS FD9R6004/2C-3L Diplexers mounted on an existing low profile platform with a RAD center elevation of 120-ft above grade.

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

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

Tower Loading

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

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

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

Tower Capacity

Tower stresses were calculated utilizing the structural analysis software 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 **81.0%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L3)	0.00'-39.42'	81.0%	**PASS**

Foundation and Anchors

The existing foundation consists of a 7.0-ft square x 5-ft long reinforced concrete pier on a 20.0-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 Valmont design documents; job no; 18435-65, dated August 4, 2005. The base of the tower is connected to the foundation by means of (12) 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	20 kips
	Compression	20 kips
	Moment	1670 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	3.05	**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	63.2%	**PASS**
Base Plate	Bending	30.0%	**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:

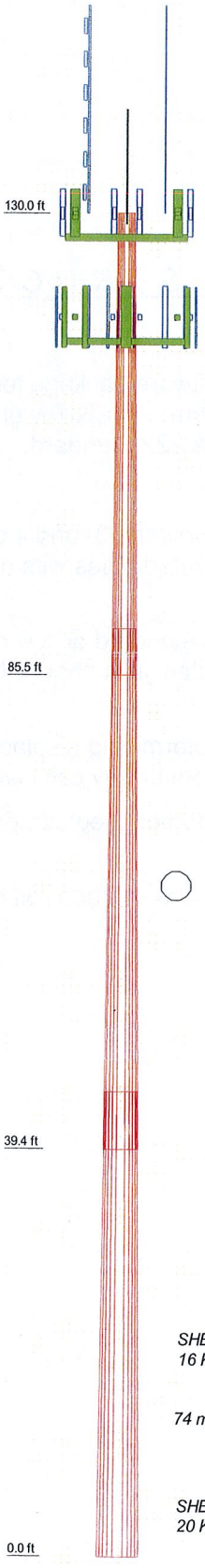
- Information supplied by the client regarding the structure itself, its foundations, the soil conditions, the antenna and feed line loading on the structure and its components, or other relevant information.
- Information from the field and/or drawings in the possession of Centek Engineering, Inc. or 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	Length (ft)	Number of Sides	Thickness (in)	Socket Length (ft)	Top Dia (in)	Bot Dia (in)	Grade	Weight (K)
1	44.500	12	0.188	4.500	19.940	29.730		2.3
2	50.583	12	0.281	5.583	28.365	39.390	A572-65	5.2
3	45.000	12	0.313		37.611	47.600		6.5
								14.0

AXIAL 25 K
SHEAR 16 K *MOMENT 1391 kip-ft*
TORQUE 4 kip-ft
74 mph WIND - 0.500 in ICE

AXIAL 20 K
SHEAR 20 K *MOMENT 1670 kip-ft*
TORQUE 4 kip-ft
REACTIONS - 85 mph WIND

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
4-bay dipole	130	LPA-80080-6CF (Verizon - Existing)	120
20-ft x 3" whip	130	LPA-80080-6CF (Verizon - Existing)	120
8.5-ft x 1.5" whip	130	BXA-171085-12CF (Verizon - Proposed)	120
Lightning Rod 3/4"x8'	130	BXA-70063/6CF (Verizon - Proposed)	120
(2) 7770.00 (ATI - Existing)	130	LPA-80080-6CF (Verizon - Existing)	120
(2) 7770.00 (ATI - Existing)	130	LPA-80080-6CF (Verizon - Existing)	120
(2) 7770.00 (ATI - Existing)	130	BXA-171085-12CF (Verizon - Proposed)	120
(2) LGP21401 TMA (ATI - Existing)	130	BXA-70063/6CF (Verizon - Proposed)	120
(2) LGP21401 TMA (ATI - Existing)	130	LPA-80080-6CF (Verizon - Existing)	120
(2) LGP21401 TMA (ATI - Existing)	130	(2) FD9R6004/2C-3L Diplexer (Verizon - Proposed)	120
(2) LGP21901 Diplexer (ATI - Existing)	130	(2) FD9R6004/2C-3L Diplexer (Verizon - Proposed)	120
(2) LGP21901 Diplexer (ATI - Existing)	130	(2) FD9R6004/2C-3L Diplexer (Verizon - Proposed)	120
(2) LGP21901 Diplexer (ATI - Existing)	130	Valmont 13' Low Profile Platform (Verizon - Existing)	118
Andrew 12'-6" Low Profile Platform (ATI - Existing)	128		
LPA-80080-6CF (Verizon - Existing)	120		
BXA-171085-12CF (Verizon - Proposed)	120		
BXA-70063/6CF (Verizon - Proposed)	120		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower designed for a 85 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 74 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. Weld together tower sections have flange connections.
5. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
6. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
7. Welds are fabricated with ER-70S-6 electrodes.
8. TOWER RATING: 81%

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

Job: *12001.CO19 - Quinebaug*			
Project: *130-ft Valmont Monopole - 720 Quinebaug Rd., Quinebaug, CT*			
Client: Verizon Wireless	Drawn by: TJL	App'd:	
Code: TIA/EIA-222-F	Date: 03/07/12	Scale: NTS	
Path: J:\Jobs\12000100.WI\CO19- Quinebaug\Calcs\ERI Files\130' Valmont Monopole Quinebaug CT.er		Dwg No. E-1	

Tower Input Data

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

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

Options

Consider Moments - Legs	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	130.000-85.500	44.500	4.500	12	19.940	29.730	0.188	0.750	A572-65 (65 ksi)
L2	85.500-39.417	50.583	5.583	12	28.365	39.390	0.281	1.125	A572-65 (65 ksi)
L3	39.417-0.000	45.000		12	37.611	47.600	0.313	1.250	A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia.	Area	I	r	C	I/C	J	It/Q	w	w/t
	in	in²	in⁴	in	in	in³	in⁴	in²	in	
L1	20.643	11.926	593.895	7.071	10.329	57.498	1203.391	5.869	4.841	25.821
	30.779	17.836	1986.940	10.576	15.400	129.021	4026.080	8.778	7.465	39.814
L2	30.381	25.433	2560.352	10.054	14.693	174.256	5187.967	12.518	6.848	24.349
	40.780	35.418	6914.426	14.001	20.404	338.876	14010.502	17.432	9.803	34.854
L3	40.220	37.531	6664.280	13.353	19.482	342.068	13503.639	18.472	9.242	29.575
	49.279	47.583	13580.974	16.929	24.657	550.800	27518.735	23.419	11.919	38.142

Tower Elevation	Gusset Area (per face)	Gusset Thickness	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals	Double Angle Stitch Bolt Spacing Horizontals
ft	ft²	in					in	in
L1 130.000-85.500				1	1	1		
L2 85.500-39.417				1	1	1		
L3 39.417-0.000				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement	Total Number		C_AA_A	Weight
				ft			ft²/ft	klf
1 5/8 (AT&T - Existing)	B	No	Inside Pole	130.000 - 3.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (Verizon - Existing)	B	No	Inside Pole	112.000 - 3.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
7/8	B	No	Inside Pole	130.000 - 3.000	3	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation	Face	A_R	A_F	C_AA_A In Face	C_AA_A Out Face	Weight
	ft		ft²	ft²	ft²	ft²	K
L1	130.000-85.500	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.958
		C	0.000	0.000	0.000	0.000	0.000
L2	85.500-39.417	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	1.225
		C	0.000	0.000	0.000	0.000	0.000
L3	39.417-0.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.968
		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 ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	130.000-85.500	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.958
		C		0.000	0.000	0.000	0.000	0.000
L2	85.500-39.417	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	1.225
		C		0.000	0.000	0.000	0.000	0.000
L3	39.417-0.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.968
		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	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
4-bay dipole	A	From Face	3.500 0.000 10.000	0.000	130.000	No Ice 1/2" Ice	3.150 5.670	3.150 5.670	0.032 0.042
20-ft x 3" whip	B	From Face	3.500 0.000 10.000	0.000	130.000	No Ice 1/2" Ice	0.790 0.910	0.790 0.910	0.010 0.015
8.5-ft x 1.5" whip	C	From Face	3.500 0.000 5.000	0.000	130.000	No Ice 1/2" Ice	1.125 2.004	1.125 2.004	0.004 0.014
Lightning Rod 3/4"x8'	C	From Face	3.500 0.000 4.000	0.000	130.000	No Ice 1/2" Ice	0.600 1.415	0.600 1.415	0.014 0.020
(2) 7770.00 (AT&T - Existing)	A	From Face	3.500 0.000 0.000	0.000	130.000	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	130.000	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	130.000	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	130.000	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	130.000	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	130.000	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	130.000	No Ice 1/2" Ice	0.233 0.302	0.117 0.166	0.006 0.008

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
(2) LGP21901 Diplexer	B	From Face	3.500	0.000	130.000	No Ice	0.233	0.117	0.006
(AT&T - Existing)			0.000			1/2" Ice	0.302	0.166	0.008
			0.000						
(2) LGP21901 Diplexer	C	From Face	3.500	0.000	130.000	No Ice	0.233	0.117	0.006
(AT&T - Existing)			0.000			1/2" Ice	0.302	0.166	0.008
			0.000						
Andrew 12'-6" Low Profile	C	From Face	2.000	0.000	128.000	No Ice	14.450	14.450	1.300
Platform			0.000			1/2" Ice	19.000	19.000	1.690
(AT&T - Existing)			0.000						
LPA-80080-6CF	A	From Face	3.500	0.000	120.000	No Ice	4.326	9.088	0.021
(Verizon - Existing)			6.000			1/2" Ice	4.764	9.637	0.069
			0.000						
BXA-171085-12CF	A	From Face	3.500	0.000	120.000	No Ice	4.791	3.618	0.015
(Verizon - Proposed)			4.000			1/2" Ice	5.242	4.058	0.042
			0.000						
BXA-70063/6CF	A	From Face	3.500	0.000	120.000	No Ice	7.731	4.158	0.017
(Verizon - Proposed)			0.000			1/2" Ice	8.268	4.595	0.059
			0.000						
LPA-80080-6CF	A	From Face	3.500	0.000	120.000	No Ice	4.326	9.088	0.021
(Verizon - Existing)			-6.000			1/2" Ice	4.764	9.637	0.069
			0.000						
LPA-80080-6CF	B	From Face	3.500	0.000	120.000	No Ice	4.326	9.088	0.021
(Verizon - Existing)			6.000			1/2" Ice	4.764	9.637	0.069
			0.000						
BXA-171085-12CF	B	From Face	3.500	0.000	120.000	No Ice	4.791	3.618	0.015
(Verizon - Proposed)			4.000			1/2" Ice	5.242	4.058	0.042
			0.000						
BXA-70063/6CF	B	From Face	3.500	0.000	120.000	No Ice	7.731	4.158	0.017
(Verizon - Proposed)			0.000			1/2" Ice	8.268	4.595	0.059
			0.000						
LPA-80080-6CF	B	From Face	3.500	0.000	120.000	No Ice	4.326	9.088	0.021
(Verizon - Existing)			-6.000			1/2" Ice	4.764	9.637	0.069
			0.000						
LPA-80080-6CF	C	From Face	3.500	0.000	120.000	No Ice	4.326	9.088	0.021
(Verizon - Existing)			6.000			1/2" Ice	4.764	9.637	0.069
			0.000						
BXA-171085-12CF	C	From Face	3.500	0.000	120.000	No Ice	4.791	3.618	0.015
(Verizon - Proposed)			4.000			1/2" Ice	5.242	4.058	0.042
			0.000						
BXA-70063/6CF	C	From Face	3.500	0.000	120.000	No Ice	7.731	4.158	0.017
(Verizon - Proposed)			0.000			1/2" Ice	8.268	4.595	0.059
			0.000						
LPA-80080-6CF	C	From Face	3.500	0.000	120.000	No Ice	4.326	9.088	0.021
(Verizon - Existing)			-6.000			1/2" Ice	4.764	9.637	0.069
			0.000						
(2) FD9R6004/2C-3L	A	From Face	3.500	0.000	120.000	No Ice	0.367	0.085	0.003
Diplexer			0.000			1/2" Ice	0.451	0.136	0.005
(Verizon - Proposed)			0.000						
(2) FD9R6004/2C-3L	B	From Face	3.500	0.000	120.000	No Ice	0.367	0.085	0.003
Diplexer			0.000			1/2" Ice	0.451	0.136	0.005
(Verizon - Proposed)			0.000						
(2) FD9R6004/2C-3L	C	From Face	3.500	0.000	120.000	No Ice	0.367	0.085	0.003
Diplexer			0.000			1/2" Ice	0.451	0.136	0.005
(Verizon - Proposed)			0.000						
Valmont 13' Low Profile	C	From Face	2.000	0.000	118.000	No Ice	15.700	15.700	1.300
Platform			0.000			1/2" Ice	20.100	20.100	1.765
(Verizon - Existing)			0.000						

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 130.000-85.500	106.614	1.398	0.026	92.096	A	0.000	92.096	92.096	100.00	0.000	0.000
					B	0.000	92.096		100.00	0.000	0.000
					C	0.000	92.096		100.00	0.000	0.000
L2 85.500-39.417	61.950	1.197	0.022	131.981	A	0.000	131.981	131.981	100.00	0.000	0.000
					B	0.000	131.981		100.00	0.000	0.000
					C	0.000	131.981		100.00	0.000	0.000
L3 39.417-0.000	19.044	1	0.018	141.983	A	0.000	141.983	141.983	100.00	0.000	0.000
					B	0.000	141.983		100.00	0.000	0.000
					C	0.000	141.983		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	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 130.000-85.500	106.614	1.398	0.019	0.500	95.805	A	0.000	95.805	95.805	100.00	0.000	0.000
						B	0.000	95.805		100.00	0.000	0.000
						C	0.000	95.805		100.00	0.000	0.000
L2 85.500-39.417	61.950	1.197	0.017	0.500	135.822	A	0.000	135.822	135.822	100.00	0.000	0.000
						B	0.000	135.822		100.00	0.000	0.000
						C	0.000	135.822		100.00	0.000	0.000
L3 39.417-0.000	19.044	1	0.014	0.500	145.268	A	0.000	145.268	145.268	100.00	0.000	0.000
						B	0.000	145.268		100.00	0.000	0.000
						C	0.000	145.268		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	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 130.000-85.500	106.614	1.398	0.009	92.096	A	0.000	92.096	92.096	100.00	0.000	0.000
					B	0.000	92.096		100.00	0.000	0.000
					C	0.000	92.096		100.00	0.000	0.000
L2 85.500-39.417	61.950	1.197	0.008	131.981	A	0.000	131.981	131.981	100.00	0.000	0.000
					B	0.000	131.981		100.00	0.000	0.000

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L3 39.417-0.000	19.044	1	0.006	141.983	C	0.000	131.981		100.00	0.000	0.000
					A	0.000	141.983	141.983	100.00	0.000	0.000
					B	0.000	141.983		100.00	0.000	0.000
					C	0.000	141.983		100.00	0.000	0.000

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 130.000-85.50	0.958	2.253	A	1	1.03	1	1	1	92.096	4.137	0.093	C
			B	1	1.03	1	1	1	92.096			
0			C	1	1.03	1	1	1	92.096			
L2 85.500-39.417	1.225	5.237	A	1	1.03	1	1	1	131.981	5.055	0.110	C
			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3 39.417-0.000	0.968	6.517	A	1	1.03	1	1	1	141.983	4.571	0.116	C
			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.151	14.007						OTM	841.262 kip-ft	13.763		

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 130.000-85.50	0.958	2.253	A	1	1.03	1	1	1	92.096	4.137	0.093	C
			B	1	1.03	1	1	1	92.096			
0			C	1	1.03	1	1	1	92.096			
L2 85.500-39.417	1.225	5.237	A	1	1.03	1	1	1	131.981	5.055	0.110	C
			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3 39.417-0.000	0.968	6.517	A	1	1.03	1	1	1	141.983	4.571	0.116	C
			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.151	14.007						OTM	841.262 kip-ft	13.763		

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 130.000-85.50	0.958	2.253	A	1	1.03	1	1	1	92.096	4.137	0.093	C
			B	1	1.03	1	1	1	92.096			

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	1.03	1	1	1	92.096			
L2	1.225	5.237	A	1	1.03	1	1	1	131.981	5.055	0.110	C
85.500-39.417			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3	0.968	6.517	A	1	1.03	1	1	1	141.983	4.571	0.116	C
39.417-0.000			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.151	14.007						OTM	841.262 kip-ft	13.763		

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	0.958	2.253	A	1	1.03	1	1	1	92.096	4.137	0.093	C
130.000-85.50			B	1	1.03	1	1	1	92.096			
0			C	1	1.03	1	1	1	92.096			
L2	1.225	5.237	A	1	1.03	1	1	1	131.981	5.055	0.110	C
85.500-39.417			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3	0.968	6.517	A	1	1.03	1	1	1	141.983	4.571	0.116	C
39.417-0.000			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.151	14.007						OTM	841.262 kip-ft	13.763		

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	0.958	2.959	A	1	1.03	1	1	1	95.805	3.228	0.073	C
130.000-85.50			B	1	1.03	1	1	1	95.805			
0			C	1	1.03	1	1	1	95.805			
L2	1.225	6.243	A	1	1.03	1	1	1	135.822	3.901	0.085	C
85.500-39.417			B	1	1.03	1	1	1	135.822			
			C	1	1.03	1	1	1	135.822			
L3	0.968	7.596	A	1	1.03	1	1	1	145.268	3.508	0.089	C
39.417-0.000			B	1	1.03	1	1	1	145.268			
			C	1	1.03	1	1	1	145.268			
Sum Weight:	3.151	16.798						OTM	652.611 kip-ft	10.637		

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	0.958	2.959	A	1	1.03	1	1	1	95.805	3.228	0.073	C
130.000-85.50			B	1	1.03	1	1	1	95.805			
0			C	1	1.03	1	1	1	95.805			
L2	1.225	6.243	A	1	1.03	1	1	1	135.822	3.901	0.085	C
85.500-39.417			B	1	1.03	1	1	1	135.822			
			C	1	1.03	1	1	1	135.822			
L3	0.968	7.596	A	1	1.03	1	1	1	145.268	3.508	0.089	C
39.417-0.000			B	1	1.03	1	1	1	145.268			
			C	1	1.03	1	1	1	145.268			
Sum Weight:	3.151	16.798						OTM	652.611 kip-ft	10.637		

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	0.958	2.959	A	1	1.03	1	1	1	95.805	3.228	0.073	C
130.000-85.50			B	1	1.03	1	1	1	95.805			
0			C	1	1.03	1	1	1	95.805			
L2	1.225	6.243	A	1	1.03	1	1	1	135.822	3.901	0.085	C
85.500-39.417			B	1	1.03	1	1	1	135.822			
			C	1	1.03	1	1	1	135.822			
L3	0.968	7.596	A	1	1.03	1	1	1	145.268	3.508	0.089	C
39.417-0.000			B	1	1.03	1	1	1	145.268			
			C	1	1.03	1	1	1	145.268			
Sum Weight:	3.151	16.798						OTM	652.611 kip-ft	10.637		

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	0.958	2.959	A	1	1.03	1	1	1	95.805	3.228	0.073	C
130.000-85.50			B	1	1.03	1	1	1	95.805			
0			C	1	1.03	1	1	1	95.805			
L2	1.225	6.243	A	1	1.03	1	1	1	135.822	3.901	0.085	C
85.500-39.417			B	1	1.03	1	1	1	135.822			
			C	1	1.03	1	1	1	135.822			
L3	0.968	7.596	A	1	1.03	1	1	1	145.268	3.508	0.089	C
39.417-0.000			B	1	1.03	1	1	1	145.268			
			C	1	1.03	1	1	1	145.268			
Sum Weight:	3.151	16.798						OTM	652.611 kip-ft	10.637		

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	0.958	2.253	A	1	1.03	1	1	1	92.096	1.432	0.032	C
130.000-85.50			B	1	1.03	1	1	1	92.096			
0			C	1	1.03	1	1	1	92.096			
L2	1.225	5.237	A	1	1.03	1	1	1	131.981	1.749	0.038	C
85.500-39.417			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3	0.968	6.517	A	1	1.03	1	1	1	141.983	1.582	0.040	C
39.417-0.000			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.151	14.007						OTM	291.094 kip-ft	4.762		

Tower Forces - Service - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	0.958	2.253	A	1	1.03	1	1	1	92.096	1.432	0.032	C
130.000-85.50			B	1	1.03	1	1	1	92.096			
0			C	1	1.03	1	1	1	92.096			
L2	1.225	5.237	A	1	1.03	1	1	1	131.981	1.749	0.038	C
85.500-39.417			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3	0.968	6.517	A	1	1.03	1	1	1	141.983	1.582	0.040	C
39.417-0.000			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.151	14.007						OTM	291.094 kip-ft	4.762		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	0.958	2.253	A	1	1.03	1	1	1	92.096	1.432	0.032	C
130.000-85.50			B	1	1.03	1	1	1	92.096			
0			C	1	1.03	1	1	1	92.096			
L2	1.225	5.237	A	1	1.03	1	1	1	131.981	1.749	0.038	C
85.500-39.417			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3	0.968	6.517	A	1	1.03	1	1	1	141.983	1.582	0.040	C
39.417-0.000			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.151	14.007						OTM	291.094 kip-ft	4.762		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	0.958	2.253	A	1	1.03	1	1	1	92.096	1.432	0.032	C
130.000-85.50			B	1	1.03	1	1	1	92.096			
0			C	1	1.03	1	1	1	92.096			
L2	1.225	5.237	A	1	1.03	1	1	1	131.981	1.749	0.038	C
85.500-39.417			B	1	1.03	1	1	1	131.981			
			C	1	1.03	1	1	1	131.981			
L3	0.968	6.517	A	1	1.03	1	1	1	141.983	1.582	0.040	C
39.417-0.000			B	1	1.03	1	1	1	141.983			
			C	1	1.03	1	1	1	141.983			
Sum Weight:	3.151	14.007						OTM	291.094 kip-ft	4.762		

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	14.007					
Bracing Weight	0.000					
Total Member Self-Weight	14.007			7.514	0.083	
Total Weight	20.412			7.514	0.083	
Wind 0 deg - No Ice		0.000	-20.112	-1618.975	0.083	-0.418
Wind 30 deg - No Ice		10.056	-17.417	-1401.067	-813.162	1.597
Wind 45 deg - No Ice		14.221	-14.221	-1142.588	-1150.019	2.475
Wind 60 deg - No Ice		17.417	-10.056	-805.731	-1408.499	3.185
Wind 90 deg - No Ice		20.112	0.000	7.514	-1626.407	3.919
Wind 120 deg - No Ice		17.417	10.056	820.759	-1408.499	3.603
Wind 135 deg - No Ice		14.221	14.221	1157.616	-1150.019	3.067
Wind 150 deg - No Ice		10.056	17.417	1416.095	-813.162	2.321
Wind 180 deg - No Ice		0.000	20.112	1634.003	0.083	0.418
Wind 210 deg - No Ice		-10.056	17.417	1416.095	813.327	-1.597
Wind 225 deg - No Ice		-14.221	14.221	1157.616	1150.184	-2.475
Wind 240 deg - No Ice		-17.417	10.056	820.759	1408.664	-3.185
Wind 270 deg - No Ice		-20.112	0.000	7.514	1626.572	-3.919
Wind 300 deg - No Ice		-17.417	-10.056	-805.731	1408.664	-3.603
Wind 315 deg - No Ice		-14.221	-14.221	-1142.588	1150.184	-3.067
Wind 330 deg - No Ice		-10.056	-17.417	-1401.067	813.327	-2.321
Member Ice	2.791					
Total Weight Ice	24.842			10.028	0.100	
Wind 0 deg - Ice		0.000	-16.185	-1330.819	0.100	-0.632
Wind 30 deg - Ice		8.093	-14.017	-1151.179	-670.324	1.391
Wind 45 deg - Ice		11.445	-11.445	-938.094	-948.022	2.295
Wind 60 deg - Ice		14.017	-8.093	-660.395	-1161.108	3.042
Wind 90 deg - Ice		16.185	0.000	10.028	-1340.747	3.877
Wind 120 deg - Ice		14.017	8.093	680.452	-1161.108	3.674
Wind 135 deg - Ice		11.445	11.445	958.150	-948.022	3.189
Wind 150 deg - Ice		8.093	14.017	1171.236	-670.324	2.486
Wind 180 deg - Ice		0.000	16.185	1350.875	0.100	0.632
Wind 210 deg - Ice		-8.093	14.017	1171.236	670.523	-1.391

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 225 deg - Ice		-11.445	11.445	958.150	948.222	-2.295
Wind 240 deg - Ice		-14.017	8.093	680.452	1161.307	-3.042
Wind 270 deg - Ice		-16.185	0.000	10.028	1340.947	-3.877
Wind 300 deg - Ice		-14.017	-8.093	-660.395	1161.307	-3.674
Wind 315 deg - Ice		-11.445	-11.445	-938.094	948.222	-3.189
Wind 330 deg - Ice		-8.093	-14.017	-1151.179	670.523	-2.486
Total Weight	20.412			7.514	0.083	
Wind 0 deg - Service		0.000	-6.959	-555.285	0.083	-0.145
Wind 30 deg - Service		3.480	-6.027	-479.884	-281.317	0.553
Wind 45 deg - Service		4.921	-4.921	-390.445	-397.877	0.856
Wind 60 deg - Service		6.027	-3.480	-273.886	-487.316	1.102
Wind 90 deg - Service		6.959	0.000	7.514	-562.717	1.356
Wind 120 deg - Service		6.027	3.480	288.914	-487.316	1.247
Wind 135 deg - Service		4.921	4.921	405.473	-397.877	1.061
Wind 150 deg - Service		3.480	6.027	494.912	-281.317	0.803
Wind 180 deg - Service		0.000	6.959	570.313	0.083	0.145
Wind 210 deg - Service		-3.480	6.027	494.912	281.482	-0.553
Wind 225 deg - Service		-4.921	4.921	405.473	398.042	-0.856
Wind 240 deg - Service		-6.027	3.480	288.914	487.481	-1.102
Wind 270 deg - Service		-6.959	0.000	7.514	562.882	-1.356
Wind 300 deg - Service		-6.027	-3.480	-273.886	487.481	-1.247
Wind 315 deg - Service		-4.921	-4.921	-390.445	398.042	-1.061
Wind 330 deg - Service		-3.480	-6.027	-479.884	281.482	-0.803

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

Comb. No.	Description
29	Dead+Wind 225 deg+Ice+Temp
30	Dead+Wind 240 deg+Ice+Temp
31	Dead+Wind 270 deg+Ice+Temp
32	Dead+Wind 300 deg+Ice+Temp
33	Dead+Wind 315 deg+Ice+Temp
34	Dead+Wind 330 deg+Ice+Temp
35	Dead+Wind 0 deg - Service
36	Dead+Wind 30 deg - Service
37	Dead+Wind 45 deg - Service
38	Dead+Wind 60 deg - Service
39	Dead+Wind 90 deg - Service
40	Dead+Wind 120 deg - Service
41	Dead+Wind 135 deg - Service
42	Dead+Wind 150 deg - Service
43	Dead+Wind 180 deg - Service
44	Dead+Wind 210 deg - Service
45	Dead+Wind 225 deg - Service
46	Dead+Wind 240 deg - Service
47	Dead+Wind 270 deg - Service
48	Dead+Wind 300 deg - Service
49	Dead+Wind 315 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	130 - 85.5	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-8.361	0.103	-10.344
			Max. Mx	14	-5.533	293.777	-7.553
			Max. My	10	-5.527	0.072	-301.338
			Max. Vy	14	-10.334	293.777	-7.553
			Max. Vx	10	10.338	0.072	-301.338
			Max. Torque	6			-4.024
L2	85.5 - 39.417	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-15.330	0.105	-10.586
			Max. Mx	14	-11.704	868.000	-7.778
			Max. My	10	-11.701	0.083	-875.687
			Max. Vy	14	-15.219	868.000	-7.778
			Max. Vx	10	15.221	0.083	-875.687
			Max. Torque	6			-4.019
L3	39.417 - 0	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-24.842	0.106	-10.653
			Max. Mx	14	-20.399	1661.965	-7.841
			Max. My	10	-20.399	0.085	-1669.704
			Max. Vy	14	-20.125	1661.965	-7.841
			Max. Vx	10	20.125	0.085	-1669.704
			Max. Torque	6			-4.011

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	27	24.842	0.000	-16.185
	Max. H_x	14	20.412	20.112	-0.000
	Max. H_z	2	20.412	0.000	20.112
	Max. M_x	2	1654.052	0.000	20.112
	Max. M_z	6	1661.793	-20.112	-0.000
	Max. Torsion	14	4.008	20.112	-0.000
	Min. Vert	1	20.412	0.000	-0.000
	Min. H_x	6	20.412	-20.112	-0.000
	Min. H_z	10	20.412	0.000	-20.112
	Min. M_x	10	-1669.704	0.000	-20.112
	Min. M_z	14	-1661.965	20.112	-0.000
	Min. Torsion	6	-4.008	-20.112	-0.000

Tower Mast Reaction Summary

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead Only	20.412	0.000	0.000	7.848	0.086	0.000
Dead+Wind 0 deg - No Ice	20.412	-0.000	-20.112	-1654.052	0.085	-0.421
Dead+Wind 30 deg - No Ice	20.412	10.056	-17.417	-1431.399	-830.861	1.640
Dead+Wind 45 deg - No Ice	20.412	14.221	-14.221	-1167.292	-1175.048	2.537
Dead+Wind 60 deg - No Ice	20.412	17.417	-10.056	-823.102	-1439.150	3.261
Dead+Wind 90 deg - No Ice	20.412	20.112	0.000	7.840	-1661.793	4.008
Dead+Wind 120 deg - No Ice	20.412	17.417	10.056	838.775	-1439.138	3.682
Dead+Wind 135 deg - No Ice	20.412	14.221	14.221	1182.958	-1175.034	3.132
Dead+Wind 150 deg - No Ice	20.412	10.056	17.417	1447.058	-830.849	2.369
Dead+Wind 180 deg - No Ice	20.412	-0.000	20.112	1669.704	0.085	0.421
Dead+Wind 210 deg - No Ice	20.412	-10.056	17.417	1447.059	831.019	-1.639
Dead+Wind 225 deg - No Ice	20.412	-14.221	14.221	1182.959	1175.205	-2.536
Dead+Wind 240 deg - No Ice	20.412	-17.417	10.056	838.776	1439.310	-3.260
Dead+Wind 270 deg - No Ice	20.412	-20.112	0.000	7.840	1661.965	-4.008
Dead+Wind 300 deg - No Ice	20.412	-17.417	-10.056	-823.103	1439.322	-3.682
Dead+Wind 315 deg - No Ice	20.412	-14.221	-14.221	-1167.293	1175.219	-3.133
Dead+Wind 330 deg - No Ice	20.412	-10.056	-17.417	-1431.400	831.031	-2.369
Dead+Ice+Temp	24.842	-0.000	0.000	10.653	0.106	0.000
Dead+Wind 0 deg+Ice+Temp	24.842	0.000	-16.185	-1370.112	0.103	-0.636
Dead+Wind 30 deg+Ice+Temp	24.842	8.093	-14.017	-1185.123	-690.273	1.442
Dead+Wind 45 deg+Ice+Temp	24.842	11.445	-11.445	-965.694	-976.235	2.369
Dead+Wind 60 deg+Ice+Temp	24.842	14.017	-8.093	-679.731	-1195.660	3.133
Dead+Wind 90 deg+Ice+Temp	24.842	16.185	-0.000	10.643	-1380.639	3.984
Dead+Wind 120 deg+Ice+Temp	24.842	14.017	8.093	701.011	-1195.650	3.768
Dead+Wind 135 deg+Ice+Temp	24.842	11.445	11.445	986.969	-976.224	3.266
Dead+Wind 150 deg+Ice+Temp	24.842	8.093	14.017	1206.392	-690.264	2.542
Dead+Wind 180 deg+Ice+Temp	24.842	0.000	16.185	1391.375	0.103	0.636
Dead+Wind 210 deg+Ice+Temp	24.842	-8.093	14.017	1206.395	690.472	-1.441
Dead+Wind 225 deg+Ice+Temp	24.842	-11.445	11.445	986.972	976.433	-2.367
Dead+Wind 240 deg+Ice+Temp	24.842	-14.017	8.093	701.013	1195.861	-3.132
Dead+Wind 270 deg+Ice+Temp	24.842	-16.185	-0.000	10.643	1380.851	-3.984
Dead+Wind 300 deg+Ice+Temp	24.842	-14.017	-8.093	-679.733	1195.870	-3.769
Dead+Wind 315 deg+Ice+Temp	24.842	-11.445	-11.445	-965.697	976.444	-3.267
Dead+Wind 330 deg+Ice+Temp	24.842	-8.093	-14.017	-1185.126	690.481	-2.543
Dead+Wind 0 deg - Service	20.412	0.000	-6.959	-567.552	0.086	-0.147
Dead+Wind 30 deg - Service	20.412	3.480	-6.027	-490.460	-287.624	0.571
Dead+Wind 45 deg - Service	20.412	4.921	-4.921	-399.015	-406.797	0.883
Dead+Wind 60 deg - Service	20.412	6.027	-3.480	-279.842	-498.242	1.135
Dead+Wind 90 deg - Service	20.412	6.959	0.000	7.868	-575.333	1.395

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead+Wind 120 deg - Service	20.412	6.027	3.480	295.577	-498.241	1.281
Dead+Wind 135 deg - Service	20.412	4.921	4.921	414.750	-406.796	1.090
Dead+Wind 150 deg - Service	20.412	3.480	6.027	506.194	-287.623	0.824
Dead+Wind 180 deg - Service	20.412	0.000	6.959	583.286	0.086	0.147
Dead+Wind 210 deg - Service	20.412	-3.480	6.027	506.195	287.795	-0.570
Dead+Wind 225 deg - Service	20.412	-4.921	4.921	414.750	406.968	-0.882
Dead+Wind 240 deg - Service	20.412	-6.027	3.480	295.577	498.413	-1.135
Dead+Wind 270 deg - Service	20.412	-6.959	0.000	7.868	575.506	-1.395
Dead+Wind 300 deg - Service	20.412	-6.027	-3.480	-279.842	498.415	-1.281
Dead+Wind 315 deg - Service	20.412	-4.921	-4.921	-399.015	406.970	-1.090
Dead+Wind 330 deg - Service	20.412	-3.480	-6.027	-490.461	287.797	-0.824

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	-20.412	0.000	0.000	20.412	-0.000	0.000%
2	0.000	-20.412	-20.112	0.000	20.412	20.112	0.000%
3	10.056	-20.412	-17.417	-10.056	20.412	17.417	0.000%
4	14.221	-20.412	-14.221	-14.221	20.412	14.221	0.000%
5	17.417	-20.412	-10.056	-17.417	20.412	10.056	0.000%
6	20.112	-20.412	0.000	-20.112	20.412	-0.000	0.000%
7	17.417	-20.412	10.056	-17.417	20.412	-10.056	0.000%
8	14.221	-20.412	14.221	-14.221	20.412	-14.221	0.000%
9	10.056	-20.412	17.417	-10.056	20.412	-17.417	0.000%
10	0.000	-20.412	20.112	0.000	20.412	-20.112	0.000%
11	-10.056	-20.412	17.417	10.056	20.412	-17.417	0.000%
12	-14.221	-20.412	14.221	14.221	20.412	-14.221	0.000%
13	-17.417	-20.412	10.056	17.417	20.412	-10.056	0.000%
14	-20.112	-20.412	0.000	20.112	20.412	-0.000	0.000%
15	-17.417	-20.412	-10.056	17.417	20.412	10.056	0.000%
16	-14.221	-20.412	-14.221	14.221	20.412	14.221	0.000%
17	-10.056	-20.412	-17.417	10.056	20.412	17.417	0.000%
18	0.000	-24.842	0.000	0.000	24.842	-0.000	0.000%
19	0.000	-24.842	-16.185	0.000	24.842	16.185	0.000%
20	8.093	-24.842	-14.017	-8.093	24.842	14.017	0.000%
21	11.445	-24.842	-11.445	-11.445	24.842	11.445	0.000%
22	14.017	-24.842	-8.093	-14.017	24.842	8.093	0.000%
23	16.185	-24.842	0.000	-16.185	24.842	0.000	0.000%
24	14.017	-24.842	8.093	-14.017	24.842	-8.093	0.000%
25	11.445	-24.842	11.445	-11.445	24.842	-11.445	0.000%
26	8.093	-24.842	14.017	-8.093	24.842	-14.017	0.000%
27	0.000	-24.842	16.185	0.000	24.842	-16.185	0.000%
28	-8.093	-24.842	14.017	8.093	24.842	-14.017	0.000%
29	-11.445	-24.842	11.445	11.445	24.842	-11.445	0.000%
30	-14.017	-24.842	8.093	14.017	24.842	-8.093	0.000%
31	-16.185	-24.842	0.000	16.185	24.842	0.000	0.000%
32	-14.017	-24.842	-8.093	14.017	24.842	8.093	0.000%
33	-11.445	-24.842	-11.445	11.445	24.842	11.445	0.000%
34	-8.093	-24.842	-14.017	8.093	24.842	14.017	0.000%
35	0.000	-20.412	-6.959	0.000	20.412	6.959	0.000%
36	3.480	-20.412	-6.027	-3.480	20.412	6.027	0.000%
37	4.921	-20.412	-4.921	-4.921	20.412	4.921	0.000%
38	6.027	-20.412	-3.480	-6.027	20.412	3.480	0.000%
39	6.959	-20.412	0.000	-6.959	20.412	-0.000	0.000%
40	6.027	-20.412	3.480	-6.027	20.412	-3.480	0.000%
41	4.921	-20.412	4.921	-4.921	20.412	-4.921	0.000%

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
42	3.480	-20.412	6.027	-3.480	20.412	-6.027	0.000%
43	0.000	-20.412	6.959	0.000	20.412	-6.959	0.000%
44	-3.480	-20.412	6.027	3.480	20.412	-6.027	0.000%
45	-4.921	-20.412	4.921	4.921	20.412	-4.921	0.000%
46	-6.027	-20.412	3.480	6.027	20.412	-3.480	0.000%
47	-6.959	-20.412	0.000	6.959	20.412	-0.000	0.000%
48	-6.027	-20.412	-3.480	6.027	20.412	3.480	0.000%
49	-4.921	-20.412	-4.921	4.921	20.412	4.921	0.000%
50	-3.480	-20.412	-6.027	3.480	20.412	6.027	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	0.00009763
3	Yes	5	0.00000001	0.00006724
4	Yes	5	0.00000001	0.00007026
5	Yes	5	0.00000001	0.00005365
6	Yes	4	0.00000001	0.00093660
7	Yes	5	0.00000001	0.00007870
8	Yes	5	0.00000001	0.00007395
9	Yes	5	0.00000001	0.00005768
10	Yes	4	0.00000001	0.00009922
11	Yes	5	0.00000001	0.00005934
12	Yes	5	0.00000001	0.00007295
13	Yes	5	0.00000001	0.00007676
14	Yes	4	0.00000001	0.00093681
15	Yes	5	0.00000001	0.00005322
16	Yes	5	0.00000001	0.00007133
17	Yes	5	0.00000001	0.00007034
18	Yes	4	0.00000001	0.00003220
19	Yes	5	0.00000001	0.00005043
20	Yes	5	0.00000001	0.00014171
21	Yes	5	0.00000001	0.00015341
22	Yes	5	0.00000001	0.00012429
23	Yes	5	0.00000001	0.00007501
24	Yes	5	0.00000001	0.00016710
25	Yes	5	0.00000001	0.00016523
26	Yes	5	0.00000001	0.00013317
27	Yes	5	0.00000001	0.00005189
28	Yes	5	0.00000001	0.00013606
29	Yes	5	0.00000001	0.00016246
30	Yes	5	0.00000001	0.00016203
31	Yes	5	0.00000001	0.00007503
32	Yes	5	0.00000001	0.00012423
33	Yes	5	0.00000001	0.00015641
34	Yes	5	0.00000001	0.00014925
35	Yes	4	0.00000001	0.00001994
36	Yes	4	0.00000001	0.00018992
37	Yes	4	0.00000001	0.00019749
38	Yes	4	0.00000001	0.00013708
39	Yes	4	0.00000001	0.00017507
40	Yes	4	0.00000001	0.00028087
41	Yes	4	0.00000001	0.00023753
42	Yes	4	0.00000001	0.00015278

43	Yes	4	0.00000001	0.00002135
44	Yes	4	0.00000001	0.00015447
45	Yes	4	0.00000001	0.00022581
46	Yes	4	0.00000001	0.00026662
47	Yes	4	0.00000001	0.00017520
48	Yes	4	0.00000001	0.00014458
49	Yes	4	0.00000001	0.00021025
50	Yes	4	0.00000001	0.00021205

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	130 - 85.5	22.283	43	1.543	0.021
L2	90 - 39.417	10.629	43	1.122	0.007
L3	45 - 0	2.650	43	0.538	0.002

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
130.000	4-bay dipole	43	22.283	1.543	0.021	30119
128.000	Andrew 12'-6" Low Profile Platform	43	21.658	1.523	0.020	30119
120.000	LPA-80080-6CF	43	19.170	1.444	0.017	15059
118.000	Valmont 13' Low Profile Platform	43	18.555	1.424	0.016	12549

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	130 - 85.5	62.812	10	4.269	0.061
L2	90 - 39.417	30.236	10	3.176	0.021
L3	45 - 0	7.569	10	1.536	0.006

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
130.000	4-bay dipole	10	62.812	4.269	0.061	11287
128.000	Andrew 12'-6" Low Profile Platform	10	61.069	4.220	0.059	11287
120.000	LPA-80080-6CF	10	54.132	4.019	0.050	5643
118.000	Valmont 13' Low Profile Platform	10	52.415	3.968	0.047	4702

Compression Checks

Pole Design Data

Section No.	Elevation	Size	L	L_u	Kl/r	F_a	A	Actual P	Allow. P_a	Ratio $\frac{P}{P_a}$
	ft		ft	ft		ksi	in^2	K	K	
L1	130 - 85.5 (1)	TP29.73x19.94x0.188	44.500	0.000	0.0	33.966	17.239	-5.527	585.527	0.009
L2	85.5 - 39.417 (2)	TP39.39x28.365x0.281	50.583	0.000	0.0	36.733	34.316	-11.701	1260.520	0.009
L3	39.417 - 0 (3)	TP47.6x37.611x0.313	45.000	0.000	0.0	34.117	47.583	-20.399	1623.410	0.013

Pole Bending Design Data

Section No.	Elevation	Size	Actual M_x	Actual f_{bx}	Allow. F_{bx}	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y	Actual f_{by}	Allow. F_{by}	Ratio $\frac{f_{by}}{F_{by}}$
	ft		kip-ft	ksi	ksi		kip-ft	ksi	ksi	
L1	130 - 85.5 (1)	TP29.73x19.94x0.188	301.338	30.011	33.966	0.884	0.000	0.000	33.966	0.000
L2	85.5 - 39.417 (2)	TP39.39x28.365x0.281	875.683	33.040	36.733	0.899	0.000	0.000	36.733	0.000
L3	39.417 - 0 (3)	TP47.6x37.611x0.313	1669.708	36.377	34.117	1.066	0.000	0.000	34.117	0.000

Pole Shear Design Data

Section No.	Elevation	Size	Actual V	Actual f_v	Allow. F_v	Ratio $\frac{f_v}{F_v}$	Actual T	Actual f_{vt}	Allow. F_{vt}	Ratio $\frac{f_{vt}}{F_{vt}}$
	ft		K	ksi	ksi		kip-ft	ksi	ksi	
L1	130 - 85.5 (1)	TP29.73x19.94x0.188	10.338	0.600	26.000	0.047	0.422	0.020	26.000	0.001
L2	85.5 - 39.417 (2)	TP39.39x28.365x0.281	15.221	0.444	26.000	0.035	0.422	0.008	26.000	0.000
L3	39.417 - 0 (3)	TP47.6x37.611x0.313	20.125	0.423	26.000	0.033	0.421	0.004	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation	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
	ft								
L1	130 - 85.5 (1)	0.009	0.884	0.000	0.047	0.001	0.894 ✔	1.333	H1-3+VT ✔
L2	85.5 - 39.417 (2)	0.009	0.899	0.000	0.035	0.000	0.909 ✔	1.333	H1-3+VT ✔
L3	39.417 - 0 (3)	0.013	1.066	0.000	0.033	0.000	1.079 ✔	1.333	H1-3+VT ✔

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

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
L1	130 - 85.5	Pole	TP29.73x19.94x0.188	1	-5.527	780.507	67.0	Pass
L2	85.5 - 39.417	Pole	TP39.39x28.365x0.281	2	-11.701	1680.273	68.2	Pass
L3	39.417 - 0	Pole	TP47.6x37.611x0.313	3	-20.399	2164.005	81.0	Pass
							Summary	
						Pole (L3)	81.0	Pass
						RATING =	**81.0**	**Pass**

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Subject:		Anchor Bolt and Baseplate Analysis
Location:		130-ft Valmont Monopole Quinebaug, CT
Rev. 0: 3/7/12		Prepared by: T.J.L. Checked by: C.F.C. Job No. 12001.CO19

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	OM := 1670·ft·kips	(Input From RisaTower)
Shear Force =	Shear := 20·kips	(Input From RisaTower)
Axial Force =	Axial := 20·kips	(Input From RisaTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	N := 12	(User Input)
Diameter of Bolt Circle =	D_{bc} := 55.03·in	(User Input)
Bolt "Column" Distance =	l := 3.00·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 A633-60

Plate Yield Strength =	Fy_{bp} := 60·ksi	(User Input)
Base Plate Thickness =	t_{bp} := 2.25·in	(User Input)
Base Plate Diameter =	D_{bp} := 61.03·in	(User Input)
Outer Pole Diameter =	D_{pole} := 47.60·in	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =: $R_{bc} := \frac{D_{bc}}{2} = 27.515 \cdot in$

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

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

$d_1 = 13.76 \cdot in$ $d_7 = -13.76 \cdot in$

$d_2 = 23.83 \cdot in$ $d_8 = -23.83 \cdot in$

$d_3 = 27.52 \cdot in$ $d_9 = -27.52 \cdot in$

$d_4 = 23.83 \cdot in$ $d_{10} = -23.83 \cdot in$

$d_5 = 13.76 \cdot in$ $d_{11} = -13.76 \cdot in$

$d_6 = 0.00 \cdot in$ etc.

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 23.8 \cdot in$

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

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

$MA_2 = 0.03 \cdot in$ $MA_8 = 0.00 \cdot in$

$MA_3 = 3.72 \cdot in$ $MA_9 = 0.00 \cdot in$

$MA_4 = 0.03 \cdot in$ $MA_{10} = 0.00 \cdot in$

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

$MA_6 = 0.00 \cdot in$ etc

Effective Width of Baseplate for Bending = $B_{eff} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 30.6 \cdot in$

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Subject:	Anchor Bolt and Baseplate Analysis
Location:	130-ft Valmont Monopole Quinebaug, CT
Rev. 0: 3/7/12	Prepared by: T.J.L. Checked by: C.F.C. Job No. 12001.CO19

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i \left(d_i\right)^2 = 4.542 \times 10^3 \cdot in^2$

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 = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 119.7 \cdot kips$

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 = $\frac{T_{Max}}{T_{ALL.Net}} = 61.5 \cdot \%$ 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 = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.417 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 6.1 \cdot ksi$

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.

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

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

Check Anchor Bolt Compression/Combined Stress:

Maximum Compressive Force =

$$C_{Max} := OM \cdot \frac{R_{bc}}{I_p} + \frac{Axial}{N} = 123.1 \cdot kips$$

Maximum Compressive Stress =

$$f_a := \frac{C_{Max}}{A_n} = 37.9 \cdot ksi$$

$$K := 0.65$$

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

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

Allowable Compressive Stress =

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

(1.333 increase allowed per TIA/EIA)

Combined Stress % of Capacity =

$$\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) = 63.2 \cdot \%$$

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 =

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

$C_1 = 62.4 \cdot kips$ $C_7 = -59.0 \cdot kips$

$C_2 = 106.8 \cdot kips$ $C_8 = -103.5 \cdot kips$

$C_3 = 123.1 \cdot kips$ $C_9 = -119.7 \cdot kips$

$C_4 = 106.8 \cdot kips$ $C_{10} = -103.5 \cdot kips$

$C_5 = 62.4 \cdot kips$ $C_{11} = -59.0 \cdot kips$

$C_6 = 1.7 \cdot kips$ etc.

Maximum Bending Stress in Plate =

$$f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} t_{bp}^2\right)} = 18 \cdot ksi$$

Allowable Bending Stress in Plate =

$$F_{bp} := 1.33 \cdot 0.75 \cdot Fy_{bp} = 59.9 \cdot ksi$$

Plate Bending Stress % of Capacity =

$$\frac{f_{bp}}{F_{bp}} = 30.0 \cdot \%$$

Condition3 =

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

Condition3 = "Ok"

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Subject: FOUNDATION ANALYSIS

Location: 130-ft Valmont Monopole
Quinebaug, CT

Rev. 0: 3/7/12

Prepared by: T.J.L. Checked by: C.F.C.
Job No. 12001.CO19

Standard Monopole Foundation:

Input Data:

Tower Data

Overturning Moment =	$OM := 1670 \cdot ft \cdot kips$	(User Input from RISATower)	
Shear Force =	$Shear := 20 \cdot kip$	(User Input from RISATower)	
Axial Force =	$Axial := 20 \cdot kip$	(User Input from RISATower)	
Tower Height =	$H_t := 130 \cdot ft$	(User Input)	

Footing Data:

Overall Depth of Footing =	$D_f := 8 \cdot ft$	(User Input)	
Length of Pier =	$L_p := 5.0 \cdot ft$	(User Input)	
Extension of Pier Above Grade =	$L_{pag} := 0.5 \cdot ft$	(User Input)	
Width of Pier =	$d_p := 7 \cdot ft$	(User Input)	
Thickness of Footing =	$T_f := 3.5 \cdot ft$	(User Input)	
Width of Footing =	$W_f := 20.0 \cdot ft$	(User Input)	

Anchor Bolt Data:

Length of Anchor Bolts =	$L_{st} := 96 \cdot in$	(User Input)	
Projection of Anchor Bolts Above Pier =	$A_{BP} := 9.25 \cdot in$	(User Input)	
Anchor Bolt Diameter =	$d_{anchor} := 2.25 \cdot in$	(User Input)	
Base Plate Bolt Circle =	$MP := 55.03 \cdot in$	(User Input)	

Material Properties:

Concrete Compressive Strength =	$f_c := 3000 \cdot psi$	(User Input)	
Steel Reinforcment Yield Strength =	$f_y := 60000 \cdot psi$	(User Input)	
Anchor Bolt Yield Strength =	$f_{ya} := 75000 \cdot psi$	(User Input)	
Internal Friction Angle of Soil =	$\Phi_s := 30 \cdot deg$	(User Input)	
Allowable Soil Bearing Capacity =	$q_s := 5000 \cdot psf$	(User Input)	
Unit Weight of Soil =	$\gamma_{soil} := 100 \cdot pcf$	(User Input)	
Unit Weight of Concrete =	$\gamma_{conc} := 150 \cdot pcf$	(User Input)	
Foundation Bouyancy =	$Bouyancy := 0$	(User Input)	(Yes=1 / No=0)
Depth to Neglect =	$n := 0 \cdot ft$	(User Input)	
Cohesion of Clay Type Soil =	$c := 0 \cdot ksf$	(User Input)	(Use 0 for Sandy Soil)
Seismic Zone Factor =	$Z := 2$	(User Input)	(UBC-1997 Fig 23-2)
Coefficient of Friction Between Concrete =	$\mu := 0.45$	(User Input)	

Pier Reinforcement:

Bar Size =	$BS_{pier} := 9$	(User Input)	
Bar Diameter =	$d_{bpier} := 1.128 \cdot in$	(User Input)	
Number of Bars =	$NB_{pier} := 36$	(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 =	$BS_{top} := 6$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 0.75 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 15$	(User Input)	(Top of Pad)
Bar Size =	$BS_{bot} := 7$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{bbot} := 0.875 \cdot in$	(User Input)	(Bottom of Pad)
Number of Bars =	$NB_{bot} := 22$	(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 =

$$A_{bpier} := \frac{\pi \cdot d_{bpier}^2}{4} = 0.999 \cdot in^2$$

Pad Top Reinforcement Bar Area =

$$A_{btop} := \frac{\pi \cdot d_{btop}^2}{4} = 0.442 \cdot in^2$$

Pad Bottom Reinforcement Bar Area =

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

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

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

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

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

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

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

$A_p := W_f \cdot T_p = 70$

Ultimate Shear = $S_u := P_{ave} \cdot A_p = 131.25 \cdot kip$

Weight of Concrete Pad = $WT_c := \left[\left(W_f^2 \cdot T_f\right) + d_p^2 \cdot L_p\right] \cdot \gamma_c = 246.75 \cdot kip$

Weight of Soil Above Footing = $WT_{s1} := \left[\left(W_f^2 - d_p^2\right) \cdot \left(\left|L_p - L_{pag} - n\right|\right)\right] \cdot \gamma_s = 157.95 \cdot kip$

Weight of Soil Wedge at Back Face = $WT_{s2} := \left(\frac{D_f^2 \cdot \tan(\Phi_s)}{2} \cdot W_f\right) \cdot \gamma_s = 36.95 \cdot kip$

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 = $WT_{tot} := WT_c + WT_{s1} + Axial = 424.7 \cdot kip$

Resisting Moment = $M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + \left[(WT_{s2} + WT_{s3}) \cdot \left(W_f + \frac{D_f \cdot \tan(\Phi_s)}{3}\right)\right] = 5621 \cdot kip \cdot ft$

Overturning Moment = $M_{ot} := OM + Shear \cdot (L_p + T_f) = 1840 \cdot kip \cdot ft$

Factor of Safety Actual = $FS := \frac{M_r}{M_{ot}} = 3.05$

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 =

$$S_p := \frac{P_{ave} \cdot A_p + \mu \cdot WT_{tot}}{FS_{req}} = 161.183 \cdot kips$$

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

Shear_Check = "Okay"

Bearing Pressure Caused by Footing:

Area of the Mat =

$$A_{mat} := W_f^{\,2} = 400$$

Section Modulus of Mat =

$$S := \frac{W_f^{\,3}}{6} = 1333.33 \cdot ft^3$$

Maximum Pressure in Mat =

$$P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S} = 2.442 \cdot ksf$$

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

Max_Pressure_Check = "Okay"

Minimum Pressure in Mat =

$$P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S} = -0.318 \cdot ksf$$

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

Min_Pressure_Check = "No Good"

Distance to Resultant of Pressure Distribution =

$$X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 5.898$$

Distance to Kern =

$$X_k := \frac{W_f}{6} = 3.333$$

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

Eccentricity =

$$e := \frac{M_{ot}}{WT_{tot}} = 4.332$$

Adjusted Soil Pressure =

$$P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \cdot \left(\frac{W_f}{2} - e\right)} = 2.498 \cdot ksf$$

$$q_{adj} := if\left(P_{min} < 0, P_a, P_{max}\right) = 2.498 \cdot ksf$$

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

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 = $P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot d_p^2 = 1.17 \times 10^4 \cdot kips$ (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 = $b_o := \left(d_p + d\right) \cdot \pi = 32$

Area Included Inside Perimeter = $A_{bo} := \frac{\pi \cdot \left(d_p + d\right)^2}{4} = 81.3$

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 318.7$

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

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

$v_u := \text{Find}(v_u) = 4.2 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f = 265.7 \cdot kips$

Required Shear Strength = $V_{req} := LF \cdot V_u = 354.1 \cdot kips$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 2724 \cdot kip$ (ACI-2008 11.11.2.1)

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

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

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

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

$q_b := q_{adj} - d_1 \cdot Slope = 1.543 \cdot ksf$

Maximum Bending at Face of Pier = $M_n := \frac{1}{LF \cdot \phi_m} \cdot \left[\left(q_{adj} - q_b \right) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f = 767.6 \cdot kip \cdot ft$

$$\beta := \begin{cases} 0.85 \text{ if } 2500 \cdot psi \le f_c \le 4000 \cdot psi \\ 0.65 \text{ if } f_c > 8000 \cdot psi \\ \left[0.85 - \left[\frac{\left(\frac{f_c}{psi} - 4000 \right)}{1000} \right] \cdot 0.5 \right] \text{ otherwise} \end{cases} = 0.85$$ (ACI-200810.2.7.3)

$R_u := \frac{M_n}{\phi_m \cdot W_f \cdot d^2} = 29.3 \cdot psi$

$\rho := \frac{0.85 \cdot f_c}{f_y} \left(1 - \sqrt{1 - \frac{2 \cdot R_u}{0.85 \cdot f_c}} \right) = 0.0005$

$\rho_{min} := 1.333 \cdot \rho = 0.00066$

Required Reinforcement for Temperature and Shrinkage:

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

Check Bottom Bars:

$$As := \begin{cases} \rho \cdot W_f \cdot d & \text{if } \rho > \frac{\rho_{sh}}{2} \\ \rho_{sh} \cdot W_f \cdot \frac{d}{2} & \text{otherwise} \end{cases} = 8.235 \cdot in^2$$

$As_{prov} := A_{bbot} \cdot NB_{bot} = 13.2 \cdot in^2$

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

Pad_Reinforcement_Bot = "Okay"

Check top Bars:

$As := \rho_{sh} \cdot (W_f \cdot d) = 16.5 \cdot in^2$

$As_{prov} := A_{btop} \cdot NB_{top} + A_{bbot} \cdot NB_{bot} = 19.9 \cdot in^2$

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

Pad_Reinforcement_Top = "Okay"

Developement Length Pad Reinforcement:

Bar Spacing =

$$B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 10.23 \cdot in$$

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)

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

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 =

$$L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad} = 75 \cdot in$$

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

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

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

$A_{smin} := 0.01 \cdot 0.5 \cdot A_p = 27.71 \cdot in^2$ (ACI-2008 10.8.4 & 10.9.1)

$A_{sprov} := NB_{pier} \cdot A_{bpier} = 35.98 \cdot in^2$

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

Steel_Area_Check = "Okay"

Bar Spacing In Pier = $B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 6.202 \cdot in$

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

Maximum Moment in Pier = $M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2} \right) \right] \cdot LF = 28436.2 \cdot in \cdot kips$

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

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

$\left(D \;\; N \;\; n \;\; P_u \;\; M_{xu} \right) = (84 \;\; 36 \;\; 9 \;\; 26.7 \;\; 28436.2)$

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

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

$\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho \right) = (64.7 \;\; 69032.2 \;\; -60 \;\; 0)$

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

Axial_Load_Check = "Okay"

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

Bending_Check = "Okay"

Development Length Pier Reinforcement:

Available Length in Foundation:

$L_{pier} := L_p - Cvr_{pier} = 57 \cdot in$

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

Tension: (ACI-2008 12.2.3)

Spacing or Cover Dimension =

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

Transverse Reinforcement =

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

$L_{dbt} := \frac{3 \cdot f_y \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 34.85 \cdot in$

Minimum Development Length =

$L_{dh} := \frac{1200 \cdot d_{bpier}}{\sqrt{\frac{f_c}{psi}}} \cdot .7 = 17.299 \cdot in$ (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)

$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot f_y}{\sqrt{f_c \cdot psi}} = 24.713 \cdot in$

$L_{dbmin} := 0.0003 \cdot \frac{in^2}{lb} \cdot \left(d_{bpier} \cdot f_y\right) = 20.304 \cdot in$

$L_{dbc} := if\left(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}\right) = 24.713 \cdot in$

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

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

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)

$s_{lim1} := 16 \cdot d_{bpier} \cdot z = 18.048 \cdot in$

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

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

$s_{lim4} := 18in$

Maximum Spacing =

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

Number of Ties Required =

$n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 = 4$

Check Anchor Steel Embedment:

Depth Available =

$D_{ab} := L_{st} - A_{BP} = 7.229 \cdot ft$

Length of Anchor Bolt =

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

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

Depth_Check = "No Good"

Note: Anchor plate is provided

SITE NAME	QUINEBAUG CT	ECP - CELL #	2	20
LATITUDE	42-01-21.90 N	LONGITUDE	71-56-57.48 W	
Additional Comments: Keeping with 12 antennas and adding diplexers to the main lines		SAVE BUTTON		
		STRUCTURE TYPE	MONOPOLE	

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	240
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	112	112	112
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			

850 Celluar - Current Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	Cellular Modcell 4.0B	Cellular Modcell 4.0B	Cellular Modcell 4.0B
ANTENNA TYPE	LPA-80080/6CF	LPA-80080/6CF	LPA-80080/6CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	0	120	240
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	112	112	112
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			

850 Celluar - Future Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	Cellular Modcell 4.0B	Cellular Modcell 4.0B	Cellular Modcell 4.0B
ANTENNA TYPE	LPA-80080/6CF	LPA-80080/6CF	LPA-80080/6CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	0	120	240
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	112	112	112
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL	2 FD9R6004/2C-3L	2 FD9R6004/2C-3L	2 FD9R6004/2C-3L
DIPLEX WITH LTE CABLE			

1900 PCS - Current Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	PCS Modcell 4.0B	PCS Modcell 4.0B	PCS Modcell 4.0B
ANTENNA TYPE	LPA-185080-12CF 2	LPA-185080-12CF 2	LPA-185080-12CF 2
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	0	120	240
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	115	115	115
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			

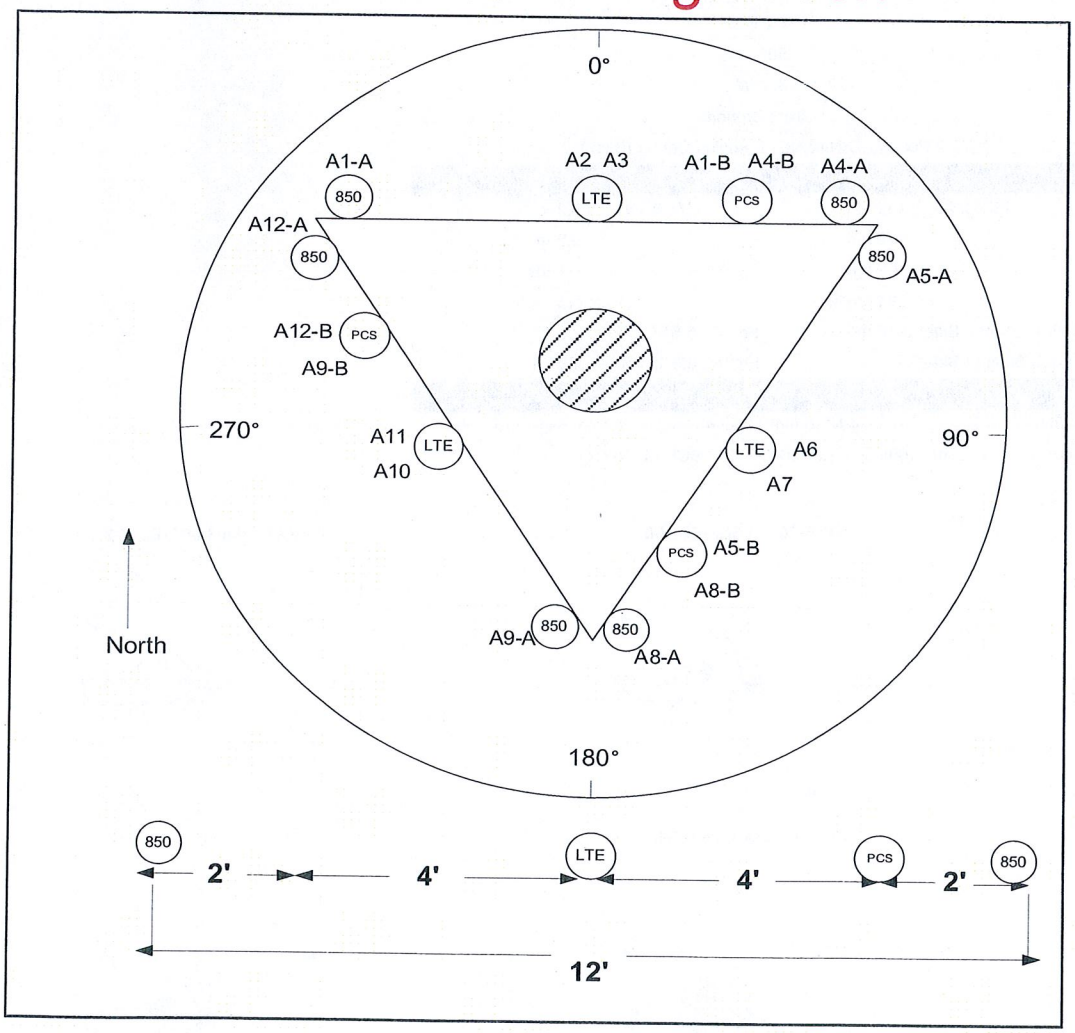
1900 PCS - Future Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	PCS Modcell 4.0B	PCS Modcell 4.0B	PCS Modcell 4.0B
ANTENNA TYPE	BXA-171085-12CF 2	BXA-171085-12CF 2	BXA-171085-12CF 2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	0	120	240
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	115	115	115
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE	DIPLEX with Cellular Cable	DIPLEX with Cellular Cable	DIPLEX with Cellular Cable

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

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-A	800	Tx1/Rx0	RED	A5-A	800	Tx2/Rx0	BLUE	A9-A	800	Tx3/Rx0	GREEN
A1-B	1900	Tx1/Rx0	RED/ WHITE	A5-B	1900	Tx2/Rx0	BLUE/ WHITE	A9-B	1900	Tx3/Rx0	GREEN/WHITE
A2	700	Tx1/Rx0	RED/ ORANGE	A6	700	Tx2/Rx0	BLUE/ ORANGE	A10	700	Tx3/Rx0	GREEN/ORANGE
A3	700	Tx4/Rx1	RED/RED/ ORANGE	A7	700	Tx5/Rx1	BLUE/BLUE/ ORANGE	A11	700	Tx6/Rx1	GREEN/GREEN/ ORANGE
A4-B	1900	Tx4/Rx1	RED/RED/ WHITE	A8-B	1900	Tx5/Rx1	BLUE/BLUE/ WHITE	A12-B	1900	Tx6/Rx1	GREEN/GREEN/ WHITE
A4-A	800	Tx4/Rx1	RED/RED	A8-A	800	Tx5/Rx1	BLUE/BLUE	A12-A	800	Tx6/Rx1	GREEN/GREEN
RF ENGINEER				RF MANAGER				INITIALS			DATE
Prepared By: Mark Brauer				Steve Weatherbee				MB			2/14/2012

Site Configuration



BXA-70063-6CF-EDIN-X

X-Pol | FET Panel | 63° | 14.5 dBd

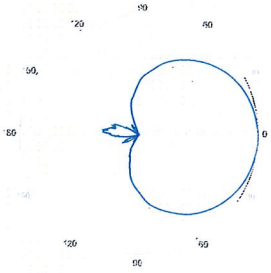
Replace "X" with desired electrical downtilt.

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

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

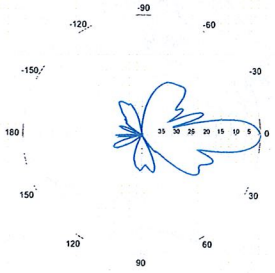
Mounting Options	Part Number	Fits Pipe Diameter	Weight
3-Point Mounting & Downtilt Bracket Kit	36210008	40-115 mm 1.57-4.5 in	6.9 kg 15.2 lbs
Concealment Configurations	For concealment configurations, order BXA-70063-6CF-EDIN-X-FP		

BXA-70063-6CF-EDIN-X



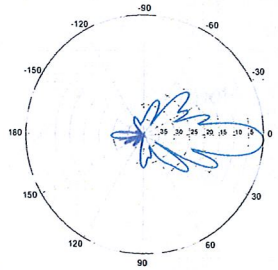
Horizontal | 750 MHz

BXA-70063-6CF-EDIN-0

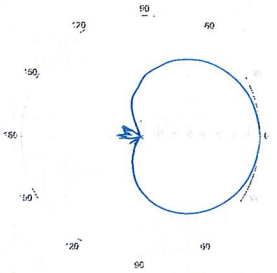


0° | Vertical | 750 MHz

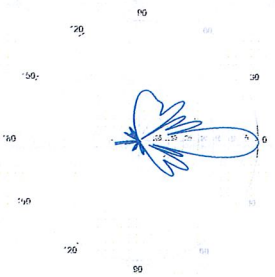
BXA-70063-6CF-EDIN-2



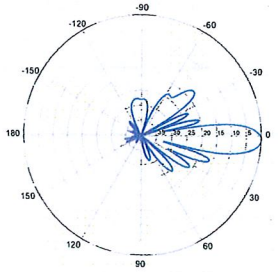
2° | Vertical | 750 MHz



Horizontal | 850 MHz



0° | Vertical | 850 MHz



2° | Vertical | 850 MHz

Vertically Polarized, Log Periodic 80° / 14 dBd

LPA-80080/6CF ___

When ordering replace "___" with connector type.

Mechanical specifications

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

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

Mounting and Downtilting

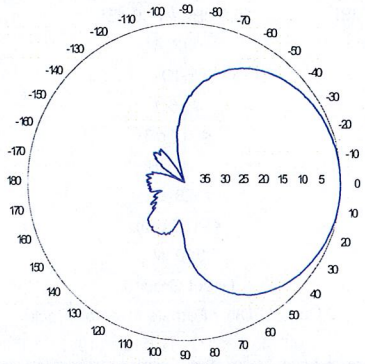
Mounting brackets attach to a pipe diameter of Ø50-102 mm (2.0-4.0 in). If the lock-down brace is used, the maximum diameter is Ø88.9 mm (3.5 in)

Mounting Bracket & Downtilt Bracket Kit #21699999

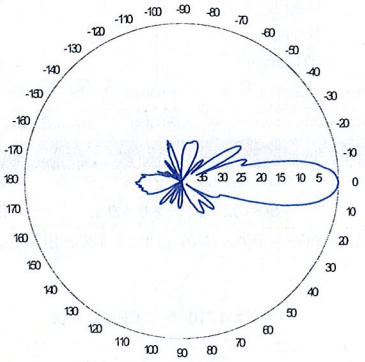
Electrical specifications

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

Radiation pattern[1]



Horizontal

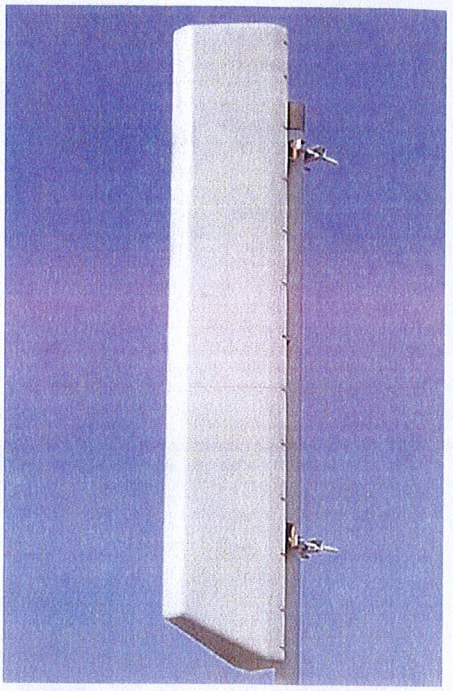


Vertical

Featuring upper side lobe suppression.

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

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



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

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

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

Antenna available with center-fed connector only.

CF Denotes a Center-Fed Connector.

806-960 MHz

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

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

Amphenol Antel, Inc. 1300 Capital Drive Rockford, Illinois 61109 USA Tel. (815) 399-0001
Toll-Free (888) 417-9562 Fax. (815) 399-0156 antel@antelinc.com www.antelinc.com

Amphenol Antel, Inc. The Antenna Technology Company

Revision Date: 7/5/07

BXA-171085-12CF-EDIN-X

Replace "X" with desired electrical downtilt.

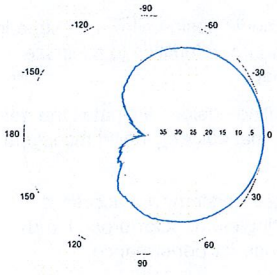
X-Pol | FET Panel | 85° | 18.0 dBi

Electrical Characteristics	1710-2170 MHz		
Frequency bands	1710-1880 MHz	1850-1990 MHz	1920-2170 MHz
Polarization	±45°	±45°	±45°
Horizontal beamwidth	88°	85°	80°
Vertical beamwidth	4.5°	4.5°	4.5°
Gain	15.1 dBd / 17.2 dBi	15.5 dBd / 17.6 dBi	15.9 dBd / 18.0 dBi
Electrical downtilt (X)	0, 2, 4		
Impedance	50Ω		
VSWR	≤1.5:1		
First upper sidelobe	< -17 dB		
Front-to-back ratio	> 30 dB		
In-band isolation	> 28 dB		
IM3 (20W carrier)	< -150 dBc		
Input power	300 W		
Lightning protection	Direct Ground		
Connector(s)	2 Ports / EDIN / Female / Center (Back)		
Operating temperature	-40° to +60° C / -40° to +140° F		

Mechanical Characteristics		
Dimensions Length x Width x Depth	1840 x 154 x 105 mm	72.4 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

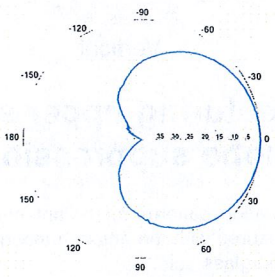
Mounting Options	Part Number	Fits Pipe Diameter	Weight
2-Point Mounting Bracket Kit	26799997	50-102 mm 2.0-4.0 in	2.3 kg 5 lbs
2-Point Mounting & Downtilt Bracket Kit	26799999	50-102 mm 2.0-4.0 in	3.6 kg 8 lbs
Concealment Configurations	For concealment configurations, order BXA-171085-12CF-EDIN-X-FP		

BXA-171085-12CF-EDIN-X



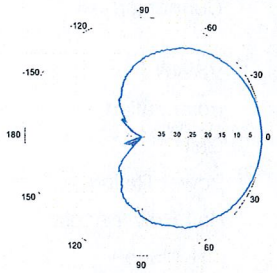
Horizontal | 1710-1880 MHz

BXA-171085-12CF-EDIN-X



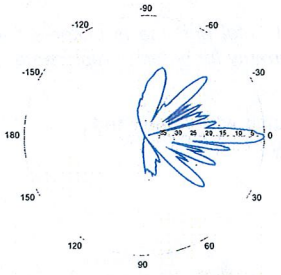
Horizontal | 1850-1990 MHz

BXA-171085-12CF-EDIN-X



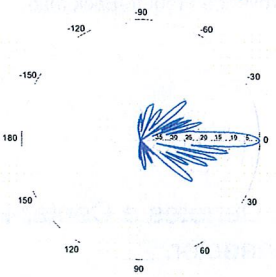
Horizontal | 1920-2170 MHz

BXA-171085-12CF-EDIN-0



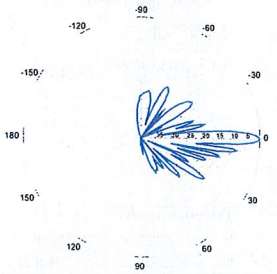
0° | Vertical | 1710-1880 MHz

BXA-171085-12CF-EDIN-0



0° | Vertical | 1850-1990 MHz

BXA-171085-12CF-EDIN-0



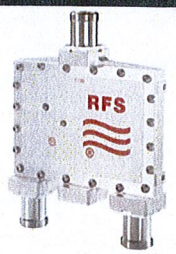
0° | Vertical | 1920-2170 MHz

Product Data Sheet **FD9R6004/2C-3L**

ShareLite Wideband Diplexer – In-line 698-960 MHz/1710-2200 MHz, DC pass in high frequency path

Product Description

The ShareLite FD9R6004 Series of diplexers are designed to enable feeder sharing between systems in the 698-960 MHz range and in the 1710-2200 MHz range. The diplexer is equipped with in-line connector placement so it can be installed in the BTS cabinet or at the tower top. This is especially valuable in crowded sites or when the feeders are not easily accessible. Due to its wideband design, the FD9R6004 Series can accommodate many combining solutions between 698-960 MHz and 1710-2200 MHz systems such as LTE 700 MHz, Cellular 800 MHz with PCS, GSM900 with GSM1800, or GSM900 with UMTS. This diplexer features a highly selective filter. It provides a high level of isolation between ports, while keeping the insertion loss on both paths at an extremely low level. The FD9R6004 diplexers are available with various DC pass options, helpful in configurations with or without the Tower Mount Amplifiers installed.



Features/Benefits

- **LTE ready design**
- **Extremely Low Insertion Loss**
- **High level of Rejection between bands – Protection against interferences**
- **Extremely High Power Handling Capability**
- **Integrated DC block/bypass versions available**
- **Very compact & small size design – Easy installation and reduced tower load**
- **In-line long-neck connectors for easy connection & waterproofing**
- **Exceptional reliability & environmental protection (IP 67)**
- **Mounting hardware for Wall and Pole mount provided (P/N SEM2-1A)**
- **Grounding already provided through the mounting bracket**
- **Kit available for easy dual mount**

Technical Specifications

Product Type	Diplexer/Cross Band Coupler
Frequency Band, MHz	698-2200
Configuration	Sharelite Single diplexer, outdoor, DC pass in the 1710 - 2170 MHz path, with mounting hardware SEM2-1A
Mounting	Wall, pole
Frequency Range Low Frequency Path, MHz	698-960
Frequency Range High Frequency Path, MHz	1710-2200
Return Loss All Ports, Min, dB	19
Power Handling Continuous, Max, W	1250 at common port; 750 in low frequency path & 500 in high frequency path
Power Handling Peak, Max, W	15000 in low frequency path & 8000 in high frequency path
Impedance, Ohms	50
Insertion Loss 698-960 MHz Path, Typ, dB	0.07
Insertion Loss 1710-2200MHz path, Typ, dB	0.13
Rejection Between Bands Min/Typ, dB	58/64@698-960MHz; 60/70@1710-2200MHz
Rejection between Bands, Min, dB	60
IMP Level at the COM Port, Typ, dBm	-112 @ 2x43
DC Pass in Low Frequency Path	No
DC Pass in High Frequency Path	Yes
Temperature Range, °C (°F)	-40 to +60 (-40 to +140)
Environmental	ETSI 300-019-2-4 Class 4.1E
Ingress Protection	IP 67
Lightning Protection	EN/IEC61000-4-5 Level 4
Connectors	In-line long-neck 7-16-Female
Weight, kg (lb)	1.2 (2.6)
Shipping Weight, kg (lb)	3.2 (7) for 2 * single units in 1 * box, 9.8 (21.6) for 6 * units = 3 * Boxes in 1 * overwrap
Application	LTE 700MHz, GSM900/3G/UMTS, GSM900/GSM1800, Cellular 800/PCS
Dimensions, H x W x D, mm (in)	147 x 164 x 37 (5.8 x 6.5 x 1.5)
Shipping Dimensions, H x W x D, mm (in)	254 x 406 x 82 (10 x 16 x 3.2) for 2 * Single Units in 1 * box, 280 x 406 x 241 (11 x 16 x 9.5) for 6 * units = 3 * Boxes in 1 * overwrap
Volume, L	0.43
Housing	Aluminum

Notes