ROBINSON & COL

EM-VER-023-111114B

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November 9, 2011

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CONNECTICUT
SITING COUNCIL

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

Re: **Notice of Exempt Modification – Antenna Swap**
650 Albany Turnpike, Canton, Connecticut

Dear Ms. Roberts:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains wireless telecommunications antennas at the top of the existing 120-foot tower at the above-referenced address. The tower is owned by Cellco. The Council approved Cellco's use of the existing tower in Docket No. 204 in 2002. Cellco now intends to modify its installation by replacing six (6) of its existing antennas with three (3) model BXA-171085-12BF PCS antennas and three (3) model BXA-70063/6CF LTE antennas, all at the same 120-foot level on the tower. Cellco also intends to install six (6) additional coax cables inside the existing monopole tower. Attached behind Tab 1 are the specifications for the proposed replacement antennas.

Please accept this letter as notification pursuant to R.C.S.A. § 16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is being sent to Richard Barlow, First Selectman of the Town of Canton. A copy of this letter is also being sent to Andrew C. Chellman, the owner of the property on which the tower is located.

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

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

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

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

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

Also attached is a Structural Analysis Report confirming that the tower and foundation can support Cellco's proposed antennas modification. (See Tab 3).

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

Sincerely,

Kenneth C. Baldwin

Enclosures
Copy to:
Richard Barlow, Canton First Selectman
Andrew C. Chellman
Sandy M. Carter

BXA-171085-12BF-EDIN-X

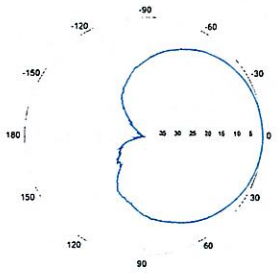
Replace "X" with desired electrical downtilt.

X-Pol | FET Panel | 85° | 18.0 dBi

Electrical Characteristics	1710-2170 MHz		
Frequency bands	1710-1880 MHz	1850-1990 MHz	1920-2170 MHz
Polarization	±45°	±45°	±45°
Horizontal beamwidth	88°	85°	80°
Vertical beamwidth	4.5°	4.5°	4.5°
Gain	15.1 dBd / 17.2 dBi	15.5 dBd / 17.6 dBi	15.9 dBd / 18.0 dBi
Electrical downtilt (X)	0, 2, 4		
Impedance	50Ω		
VSWR	≤1.5:1		
First upper sidelobe	< -17 dB		
Front-to-back ratio	> 30 dB		
In-band isolation	> 28 dB		
IM3 (20W carrier)	< -150 dBc		
Input power	300 W		
Lightning protection	Direct Ground		
Connector(s)	2 Ports / EDIN / Female / Bottom		
Operating temperature	-40° to +60° C / -40° to +140° F		
Mechanical Characteristics			
Dimensions Length x Width x Depth	1820 x 154 x 105 mm		71.7 x 6.1 x 4.1 in
Depth with z-brackets	133 mm		5.2 in
Weight without mounting brackets	6.8 kg		15 lbs
Survival wind speed	> 201 km/hr		> 125 mph
Wind area	Front: 0.28 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

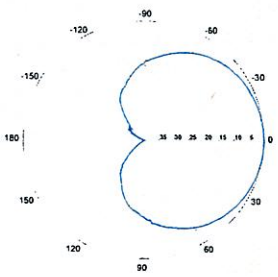
Mounting Options	Part Number	Fits Pipe Diameter	Weight
2-Point Mounting Bracket Kit	26799997	50-102 mm 2.0-4.0 in	2.3 kg 5 lbs
2-Point Mounting & Downtilt Bracket Kit	26799999	50-102 mm 2.0-4.0 in	3.6 kg 8 lbs
Concealment Configurations	For concealment configurations, order BXA-171085-12BF-EDIN-X-FP		

BXA-171085-12BF-EDIN-X



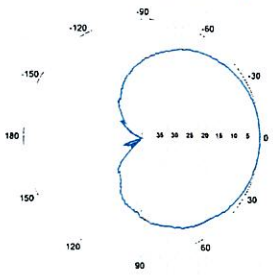
Horizontal | 1710-1880 MHz

BXA-171085-12BF-EDIN-X



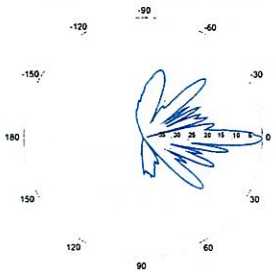
Horizontal | 1850-1990 MHz

BXA-171085-12BF-EDIN-X



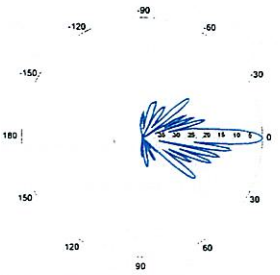
Horizontal | 1920-2170 MHz

BXA-171085-12BF-EDIN-0



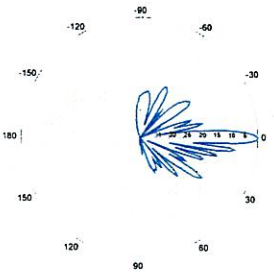
0° | Vertical | 1710-1880 MHz

BXA-171085-12BF-EDIN-0



0° | Vertical | 1850-1990 MHz

BXA-171085-12BF-EDIN-0



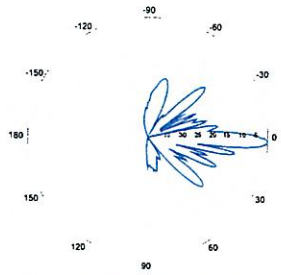
0° | Vertical | 1920-2170 MHz

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

BXA-171085-12BF-EDIN-X

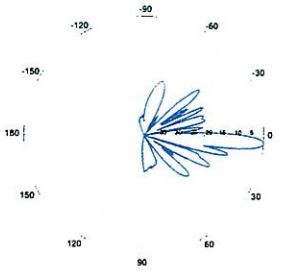
X-Pol | FET Panel | 85° | 18.0 dBi

BXA-171085-12BF-EDIN-2



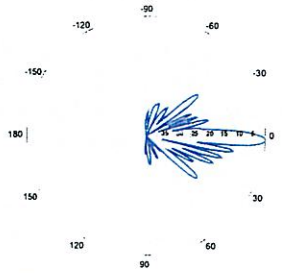
2° | Vertical | 1710-1880 MHz

BXA-171085-12BF-EDIN-4



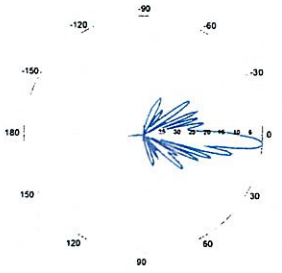
4° | Vertical | 1710-1880 MHz

BXA-171085-12BF-EDIN-2



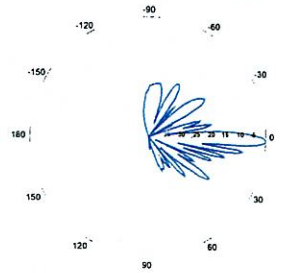
2° | Vertical | 1850-1990 MHz

BXA-171085-12BF-EDIN-4



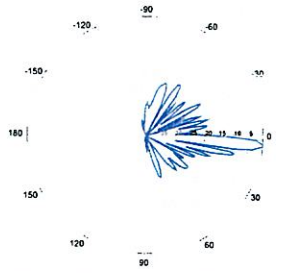
4° | Vertical | 1850-1990 MHz

BXA-171085-12BF-EDIN-2



2° | Vertical | 1920-2170 MHz

BXA-171085-12BF-EDIN-4



4° | Vertical | 1920-2170 MHz

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

BXA-70063-6CF-EDIN-X

X-Pol | FET Panel | 63° | 14.5 dBd

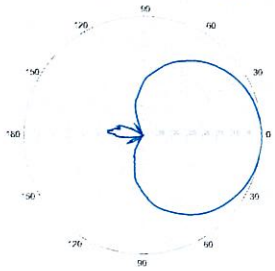
Replace "X" with desired electrical downtilt.

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

Electrical Characteristics	696-900 MHz	
Frequency bands	696-806 MHz	806-900 MHz
Polarization	±45°	
Horizontal beamwidth	65°	63°
Vertical beamwidth	13°	11°
Gain	14.0 dBd (16.1 dBi)	14.5 dBd (16.6 dBi)
Electrical downtilt (X)	0, 2, 3, 4, 5, 6, 8, 10	
Impedance	50Ω	
VSWR	≤1.35:1	
Upper sidelobe suppression (0°)	-18.3 dB	-18.2 dB
Front-to-back ratio (+/-30°)	-33.4 dB	-36.3 dB
Null fill	5% (-26.02 dB)	
Isolation between ports	< -25 dB	
Input power	500 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

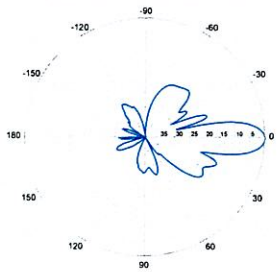
Mounting Options	Part Number	Fits Pipe Diameter	Weight
3-Point Mounting Bracket Kit	36210003	50-160 mm 2.0-6.3 in	6.3 kg 14 lbs
3-Point Downtilt Bracket Kit (0-14°)	36210004	50-160 mm 2.0-6.3 in	7.3 kg 16 lbs
Downtilt Mounting Applications	A mounting bracket and downtilt bracket kit must be ordered for downtilt applications		
Concealment Configurations	For concealment configurations, order BXA-70063-6CF-EDIN-X-FP		

BXA-70063-6CF-EDIN-X



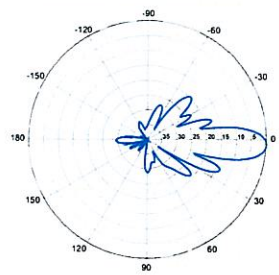
Horizontal | 750 MHz

BXA-70063-6CF-EDIN-0

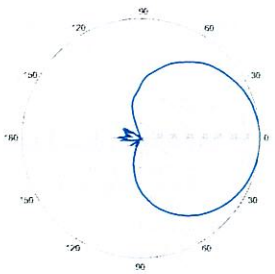


0° | Vertical | 750 MHz

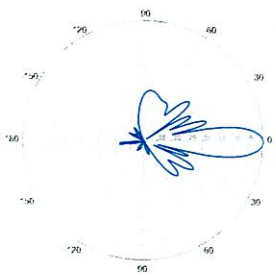
BXA-70063-6CF-EDIN-2



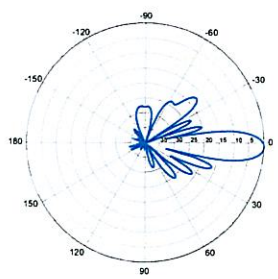
2° | Vertical | 750 MHz



Horizontal | 850 MHz



0° | Vertical | 850 MHz



2° | Vertical | 850 MHz

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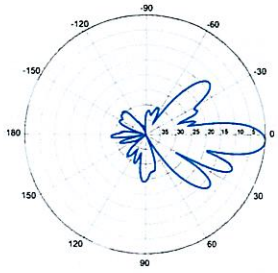
BXA-70063-6CF-EDIN-X

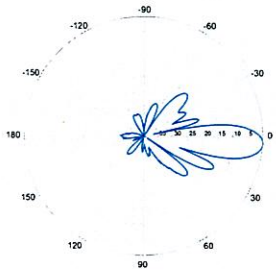
X-Pol | FET Panel | 63° | 14.5 dBd

BXA-70063-6CF-EDIN-3



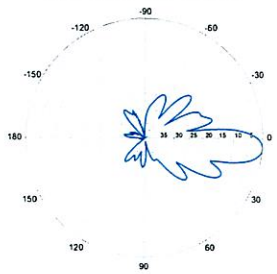
3° | Vertical | 750 MHz

BXA-70063-6CF-EDIN-4

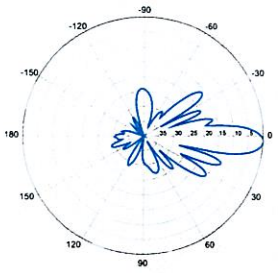


4° | Vertical | 750 MHz

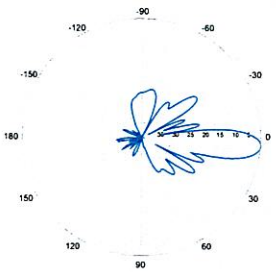
BXA-70063-6CF-EDIN-5



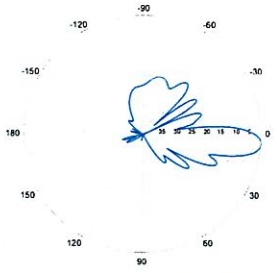
5° | Vertical | 750 MHz



3° | Vertical | 850 MHz

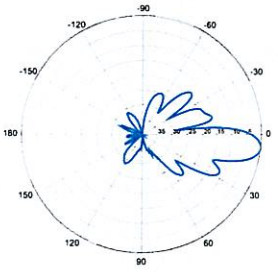


4° | Vertical | 850 MHz



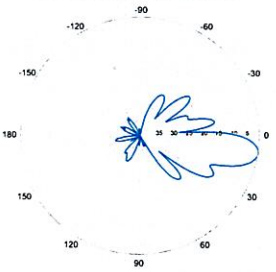
5° | Vertical | 850 MHz

BXA-70063-6CF-EDIN-6



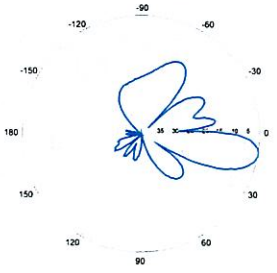
6° | Vertical | 750 MHz

BXA-70063-6CF-EDIN-8

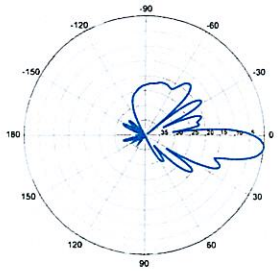


8° | Vertical | 750 MHz

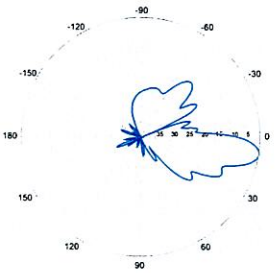
BXA-70063-6CF-EDIN-10



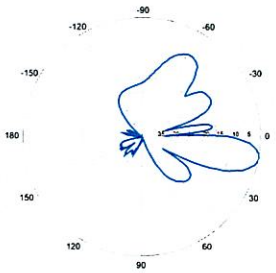
10° | Vertical | 750 MHz



6° | Vertical | 850 MHz



8° | Vertical | 850 MHz



10° | Vertical | 850 MHz

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	General	Power	Density					
Site Name: Collinsville								
Tower Height: Verizon @ 120ft								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*Pocket	3	631	90	0.0840	2130	1.0000	8.40%	
*T-Mobile	8	173	100	0.0498	1945	1.0000	4.98%	
*AT&T GSM	4	296	110	0.0352	880	0.5867	6.00%	
*AT&T GSM	2	427	110	0.0254	1900	1.0000	2.54%	
*AT&T UMTS	1	500	110	0.0149	1900	1.0000	1.49%	
*AT&T UMTS	1	500	110	0.0149	880	0.5867	2.53%	
Verizon PCS	**7**	**186**	**120**	**0.0325**	**1970**	**1.0000**	**3.25%**	
Verizon Cellular	**9**	**276**	**120**	**0.0620**	**869**	**0.5793**	**10.71%**	
Verizon AWS	**1**	**464**	**120**	**0.0116**	**2145**	**1.0000**	**1.16%**	
Verizon 700	**2**	**722**	**120**	**0.0361**	**698**	**0.4653**	**7.75%**	
								48.80%
* Source: Siting Council								

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

120-ft Existing EEI Monopole

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Collinsville

650 Albany Turnpike
Canton, CT

Centek Project No. 11074.CO24

Date: September 29, 2011

Prepared for:

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

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

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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 Canton, CT.

The host tower is a 120-ft tall, three-section, eighteen sided, tapered monopole extendable to 150-ft, originally designed and manufactured by EEI job no; 11936-E01, dated September 11, 2003. The tower geometry, structure member sizes and foundation system information were obtained from a previous structural report prepared by Centek Engineering dated January 9, 2009. Antenna and appurtenance information were obtained from the tower mapping and inventory report prepared by JWB Tower Services, LLC (JWB) dated September 11, 2011 and a Verizon RF data sheet.

The tower is made up of three (3) tapered vertical sections consisting of A572-65 pole sections. The vertical tower sections are slip joint connected. The diameter of the pole (flat-flat) is 26.90-in at the top and 49.00-in at the base.

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

Antenna and Appurtenance Summary

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

- AT&T (Existing):
  Antennas: Six (6) Powerwave P65-15-XLH-RR panel antennas and six (6) TT19-08BP111-001 TMA's mounted on a 12-ft 6-in low profile platform with a RAD center elevation of 110-ft above exiting grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing monopole.
- T-MOBILE (Existing):
  Antennas: Three (3) RFS APX16DWV-16DWVS panel antennas, three (3) RFS ATM1900D-1CWA TMA's and three (3) RFS ATMAP1412D-1A20 TMA's mounted to three (3) T-Arms with a RAD center elevation of 100-ft above exiting grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing monopole.
- METROPCS (Existing):
  Antennas: Three (3) RFS APXV18-206517S flush mounted with a RAD center elevation of 91-ft above exiting grade.
  Coax Cables: Six (6) 1-5/8" ∅ coax cables running on the inside of the existing monopole.

- VERIZON (Existing to Remain):
  Antennas: Six (6) Antel LPA-80080/6CF panel antennas mounted to one (1) low profile platform with a RAD center elevation of 120-ft above exiting grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing monopole.
- **VERIZON (Existing to Remove):**
  Antennas: Six (6) Andrew DB950F85E-M panel antennas mounted to one (1) low profile platform with a RAD center elevation of 120-ft above exiting grade.
- **VERIZON (Proposed):**
  Antennas: Three (3) Antel BXA-70063-6CF and three (3) Antel BXA-171085-12BF panel antennas mounted to one (1) low profile platform with a RAD center elevation of 120-ft above exiting grade.
  Coax Cables: Six (6) 1-5/8" ∅ coax cables running on the inside of the existing monopole.

Primary Assumptions Used in the Analysis

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

Analysis

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

The existing tower was analyzed for 80 mph basic wind speed (fastest mile) with no ice and 75% reduction of wind force with ½ inch accumulative ice to determine stresses in members as per guidelines of TIA/EIA-222-F-96 entitled "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures", the American Institute of Steel Construction (AISC) and the Manual of Steel Construction; Allowable Stress Design (ASD).

Tower Loading

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

Basic Wind Speed:	Hartford; v = 80 mph (fastest mile)	*[Section 16 of TIA/EIA-222-F-96]*
	Canton; v = 95 mph (3 second gust) equivalent to v = 77.5 mph (fastest mile)	*[Appendix K of the 2005 CT Building Code Supplement]*
	TIA/EIA wind speed controls.	
Load Cases:	Load Case 1; 80 mph wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation. This load case typically controls the design of monopole towers.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 2; 69 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 69 mph wind speed velocity represents 75% of the wind pressure generated by the 80 mph wind speed. This load case typically controls the design of lattice towers.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 3; Seismic – not checked	*[Section 1614.5 of State Bldg. Code 2005] does not control in the design of this structure type*

Tower Capacity

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

Calculated stresses were found to be within allowable limits. In Load Case 1, per RISATower "Section Capacity Table", this tower was found to be at **37.7%** of its total capacity.

Tower Section	Component	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L3)	0.00-46.16'	37.7%	**PASS**

Foundation and Anchors

The existing foundation consists of a 7-ft Ø x 5-ft long reinforced concrete pier on a 24.0-ft square x 3-ft thick reinforce concrete pad. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned structural analysis report prepared by Centek. Engineering The base of the tower is connected to the foundation by means of (18) 2.25"Ø, 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:

Reactions	Vector	Proposed Load
Base	Shear	**15 kips**
	Axial	**30 kips**
	Moment	**1288 ft-kips**

- The foundation was found to be within allowable limits.

Foundation	Design Limit	IBC 2003/2005 CT State Building Code Section 3108.4.2 FS[1]	Proposed Loading FS[1]	Result
Reinf. Conc. Pad and Pier	OTM[2]	2.0	6.22	**PASS**

1. FS denote Factor of Safety
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	31.3%	**PASS**
Base Plate	Bending	42.0%	**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

Prepared by:

Timothy J. Lynn, EIT
Structural Engineer

Standard Conditions for Furnishing of Professional Engineering Services on Existing Structures

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

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

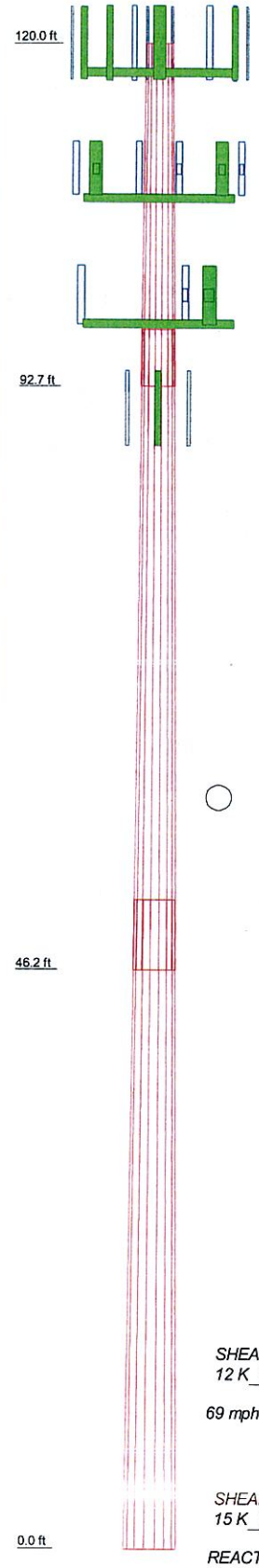
GENERAL DESCRIPTION OF STRUCTURAL ANALYSIS PROGRAM

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

RISATower Features:

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

Section	1	2	3
Length (ft)	27.29	51.13	51.83
Number of Sides	18	18	18
Thickness (in)	0.2500	0.3750	0.4375
Socket Length (ft)	4.58	5.67	
Top Dia (in)	26.9000	30.8688	38.9487
Bot Dia (in)	32.2700	40.8000	49.0000
Grade		A572-65	
Weight (K)	2.2	7.3	10.7



AXIAL
35 K
SHEAR
12 K
MOMENT
1070 kip-ft

69 mph WIND - 0.5000 in ICE

AXIAL
30 K
SHEAR
15 K
MOMENT
1288 kip-ft

REACTIONS - 80 mph WIND

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
LPA-80080-6CF (Verizon - Existing)	120	Andrew 12'-6" Low Profile Platform (ATI - Existing)	108
BXA-171085-12BF (Verizon - Proposed)	120	APX16DWV-16DWVS-E-A20 (T-Mobile - Existing)	100
BXA-70063/6CF (Verizon - Proposed)	120	APX16DWV-16DWVS-E-A20 (T-Mobile - Existing)	100
LPA-80080-6CF (Verizon - Existing)	120	APX16DWV-16DWVS-E-A20 (T-Mobile - Existing)	100
LPA-80080-6CF (Verizon - Existing)	120	ATM1900D-1CWA (T-Mobile - Existing)	100
BXA-171085-12BF (Verizon - Proposed)	120	ATM1900D-1CWA (T-Mobile - Existing)	100
BXA-70063/6CF (Verizon - Proposed)	120	ATM1900D-1CWA (T-Mobile - Existing)	100
LPA-80080-6CF (Verizon - Existing)	120	ATMAP1412D-1A20 (T-Mobile - Existing)	100
LPA-80080-6CF (Verizon - Existing)	120	ATMAP1412D-1A20 (T-Mobile - Existing)	100
BXA-171085-12BF (Verizon - Proposed)	120	ATMAP1412D-1A20 (T-Mobile - Existing)	100
BXA-70063/6CF (Verizon - Proposed)	120	Valmont T-Arm (3) (T-Mobile - Existing)	98
LPA-80080-6CF (Verizon - Existing)	120	Uni-Tri Bracket (MetroPCS - Existing)	91
EEI 14-ft Low Profile Platform (Verizon - Existing)	118	APXV18-206517S (MetroPCS - Existing)	91
(2) P65-15-XLH-RR (ATI - Existing)	110	APXV18-206517S (MetroPCS - Existing)	91
(2) P65-15-XLH-RR (ATI - Existing)	110	APXV18-206517S (MetroPCS - Existing)	91
(2) P65-15-XLH-RR (ATI - Existing)	110		
(2) TT19-08BP111-001 TMA (ATI - Existing)	110		
(2) TT19-08BP111-001 TMA (ATI - Existing)	110		
(2) TT19-08BP111-001 TMA (ATI - Existing)	110		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. TOWER RATING: 37.7%

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

Job: *11074.CO24 - Collinsville*		
Project: *120' EEI Monopole - 650 Albany Turnpike - Canton, CT*		
Client: Verizon Wireless	Drawn by: TJL	App'd:
Code: TIA/EIA-222-F	Date: 09/29/11	Scale: NTS
Path: J:\2011\11074\CO24 - Verizon - Collinsville\Calcs\ER Rev\120' EEI Monopole_Extendable to 150_Canton, CT.eri		Dwg No. E-1

Tower Input Data

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

Basic wind speed of 80 mph.
Nominal ice thickness of 0.5000 in.
Ice density of 56 pcf.
A wind speed of 69 mph is used in combination with ice.
Temperature drop of 50 °F.
Deflections calculated using a wind speed of 50 mph.
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	120.00-92.71	27.29	4.58	18	26.9000	32.2700	0.2500	1.0000	A572-65 (65 ksi)
L2	92.71-46.16	51.13	5.67	18	30.8688	40.8000	0.3750	1.5000	A572-65 (65 ksi)
L3	46.16-0.00	51.83		18	38.9487	49.0000	0.4375	1.7500	A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
L1	27.3150	21.1468	1897.4748	9.4608	13.6652	138.8545	3797.4464	10.5754	4.2944	17.178
	32.7678	25.4079	3291.1552	11.3671	16.3932	200.7639	6586.6410	12.7063	5.2395	20.958
L2	32.2483	36.2952	4263.9191	10.8253	15.6813	271.9105	8533.4488	18.1511	4.7729	12.728
	41.4294	48.1159	9934.0359	14.3509	20.7264	479.2938	19881.1433	24.0625	6.5208	17.389
L3	40.6661	53.4776	10020.3566	13.6715	19.7859	506.4384	20053.8983	26.7439	6.0850	13.909
	49.7559	67.4351	20092.1096	17.2397	24.8920	807.1714	40210.6569	33.7240	7.8540	17.952

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in
L1 120.00-92.71				1	1	1		
L2 92.71-46.16				1	1	1		
L3 46.16-0.00				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight plf
1 5/8 (Verizon - Existing)	C	No	Inside Pole	120.00 - 3.00	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
1 5/8 (AT&T - Existing)	C	No	Inside Pole	110.00 - 3.00	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
1 5/8 (T-Mobile - Existing)	C	No	Inside Pole	100.00 - 3.00	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
1 5/8 (MetroPCS - Existing)	C	No	Inside Pole	90.00 - 3.00	6	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
1 5/8 (Verizon - Proposed)	C	No	Inside Pole	120.00 - 3.00	6	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	120.00-92.71	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.82
L2	92.71-46.16	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	2.31
L3	46.16-0.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	2.15

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	120.00-92.71	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.82
L2	92.71-46.16	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	2.31
L3	46.16-0.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	2.15

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
EEI 14-ft Low Profile Platform (Verizon - Existing)	C	None		0.0000	118.00	No Ice	16.50	16.50	1.55
						1/2" Ice	20.00	20.00	1.80
LPA-80080-6CF (Verizon - Existing)	A	From Face	3.50 -6.00 0.00	0.0000	120.00	No Ice	4.33	9.09	0.02
						1/2" Ice	4.76	9.64	0.07
BXA-171085-12BF (Verizon - Proposed)	A	From Face	3.50 4.00 0.00	0.0000	120.00	No Ice	4.73	3.57	0.02
						1/2" Ice	5.18	4.01	0.04
BXA-70063/6CF (Verizon - Proposed)	A	From Face	3.50 0.00 0.00	0.0000	120.00	No Ice	7.73	4.16	0.02
						1/2" Ice	8.27	4.60	0.06
LPA-80080-6CF (Verizon - Existing)	A	From Face	3.50 6.00 0.00	0.0000	120.00	No Ice	4.33	9.09	0.02
						1/2" Ice	4.76	9.64	0.07
LPA-80080-6CF (Verizon - Existing)	B	From Face	3.50 -6.00 0.00	0.0000	120.00	No Ice	4.33	9.09	0.02
						1/2" Ice	4.76	9.64	0.07
BXA-171085-12BF (Verizon - Proposed)	B	From Face	3.50 4.00 0.00	0.0000	120.00	No Ice	4.73	3.57	0.02
						1/2" Ice	5.18	4.01	0.04
BXA-70063/6CF (Verizon - Proposed)	B	From Face	3.50 0.00 0.00	0.0000	120.00	No Ice	7.73	4.16	0.02
						1/2" Ice	8.27	4.60	0.06
LPA-80080-6CF (Verizon - Existing)	B	From Face	3.50 6.00 0.00	0.0000	120.00	No Ice	4.33	9.09	0.02
						1/2" Ice	4.76	9.64	0.07
LPA-80080-6CF (Verizon - Existing)	C	From Face	3.50 -6.00 0.00	0.0000	120.00	No Ice	4.33	9.09	0.02
						1/2" Ice	4.76	9.64	0.07
BXA-171085-12BF (Verizon - Proposed)	C	From Face	3.50 4.00 0.00	0.0000	120.00	No Ice	4.73	3.57	0.02
						1/2" Ice	5.18	4.01	0.04
BXA-70063/6CF (Verizon - Proposed)	C	From Face	3.50 0.00 0.00	0.0000	120.00	No Ice	7.73	4.16	0.02
						1/2" Ice	8.27	4.60	0.06
LPA-80080-6CF (Verizon - Existing)	C	From Face	3.50 6.00	0.0000	120.00	No Ice	4.33	9.09	0.02
						1/2" Ice	4.76	9.64	0.07

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
			0.00						
Andrew 12'-6" Low Profile Platform (AT&T - Existing)	C	None		0.0000	108.00	No Ice	14.45	14.45	1.30
						1/2" Ice	19.00	19.00	1.69
(2) P65-15-XLH-RR (AT&T - Existing)	A	From Face	3.50	0.0000	110.00	No Ice	5.95	3.08	0.04
			0.00			1/2" Ice	6.36	3.41	0.08
			0.00						
(2) P65-15-XLH-RR (AT&T - Existing)	B	From Face	3.50	0.0000	110.00	No Ice	5.95	3.08	0.04
			0.00			1/2" Ice	6.36	3.41	0.08
			0.00						
(2) P65-15-XLH-RR (AT&T - Existing)	C	From Face	3.50	0.0000	110.00	No Ice	5.95	3.08	0.04
			0.00			1/2" Ice	6.36	3.41	0.08
			0.00						
(2) TT19-08BP111-001 TMA (AT&T - Existing)	A	From Face	3.50	0.0000	110.00	No Ice	0.64	0.52	0.02
			0.00			1/2" Ice	0.76	0.62	0.02
			0.00						
(2) TT19-08BP111-001 TMA (AT&T - Existing)	B	From Face	3.50	0.0000	110.00	No Ice	0.64	0.52	0.02
			0.00			1/2" Ice	0.76	0.62	0.02
			0.00						
(2) TT19-08BP111-001 TMA (AT&T - Existing)	C	From Face	3.50	0.0000	110.00	No Ice	0.64	0.52	0.02
			0.00			1/2" Ice	0.76	0.62	0.02
			0.00						
Valmont T-Arm (3) (T-Mobile - Existing)	C	None		0.0000	98.00	No Ice	21.00	21.00	1.01
						1/2" Ice	29.00	29.00	1.24
APX16DWV-16DWVS-E-A20 (T-Mobile - Existing)	A	From Face	3.50	0.0000	100.00	No Ice	7.07	2.15	0.04
			-4.00			1/2" Ice	7.52	2.49	0.07
			0.00						
APX16DWV-16DWVS-E-A20 (T-Mobile - Existing)	B	From Face	3.50	0.0000	100.00	No Ice	7.07	2.15	0.04
			-4.00			1/2" Ice	7.52	2.49	0.07
			0.00						
APX16DWV-16DWVS-E-A20 (T-Mobile - Existing)	C	From Face	3.50	0.0000	100.00	No Ice	7.07	2.15	0.04
			-4.00			1/2" Ice	7.52	2.49	0.07
			0.00						
ATM1900D-1CWA (T-Mobile - Existing)	A	From Face	3.50	0.0000	100.00	No Ice	0.85	0.27	0.01
			-4.00			1/2" Ice	0.98	0.36	0.01
			0.00						
ATM1900D-1CWA (T-Mobile - Existing)	B	From Face	3.50	0.0000	100.00	No Ice	0.85	0.27	0.01
			-4.00			1/2" Ice	0.98	0.36	0.01
			0.00						
ATM1900D-1CWA (T-Mobile - Existing)	C	From Face	3.50	0.0000	100.00	No Ice	0.85	0.27	0.01
			-4.00			1/2" Ice	0.98	0.36	0.01
			0.00						
ATMAP1412D-1A20 (T-Mobile - Existing)	A	From Face	3.50	0.0000	100.00	No Ice	1.17	0.47	0.01
			-4.00			1/2" Ice	1.31	0.57	0.02
			0.00						
ATMAP1412D-1A20 (T-Mobile - Existing)	B	From Face	3.50	0.0000	100.00	No Ice	1.17	0.47	0.01
			-4.00			1/2" Ice	1.31	0.57	0.02
			0.00						
ATMAP1412D-1A20 (T-Mobile - Existing)	C	From Face	3.50	0.0000	100.00	No Ice	1.17	0.47	0.01
			-4.00			1/2" Ice	1.31	0.57	0.02
			0.00						
Uni-Tri Bracket (MetroPCS - Existing)	C	None		0.0000	91.00	No Ice	1.75	1.75	0.29
						1/2" Ice	1.94	1.94	0.31
APXV18-206517S (MetroPCS - Existing)	A	From Face	1.50	0.0000	91.00	No Ice	5.17	3.04	0.03
			0.00			1/2" Ice	5.62	3.47	0.05
			0.00						
APXV18-206517S	B	From Face	1.50	0.0000	91.00	No Ice	5.17	3.04	0.03

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(MetroPCS - Existing)			0.00 0.00			1/2" Ice	5.62	3.47	0.05
APXV18-206517S	C	From Face	1.50	0.0000	91.00	No Ice	5.17	3.04	0.03
(MetroPCS - Existing)			0.00 0.00			1/2" Ice	5.62	3.47	0.05

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 120.00-92.71	105.94	1.396	23	67.281	A	0.000	67.281	67.281	100.00	0.000	0.000
					B	0.000	67.281		100.00	0.000	0.000
					C	0.000	67.281		100.00	0.000	0.000
L2 92.71-46.16	69.03	1.235	20	140.733	A	0.000	140.733	140.733	100.00	0.000	0.000
					B	0.000	140.733		100.00	0.000	0.000
					C	0.000	140.733		100.00	0.000	0.000
L3 46.16-0.00	22.38	1	16	171.269	A	0.000	171.269	171.269	100.00	0.000	0.000
					B	0.000	171.269		100.00	0.000	0.000
					C	0.000	171.269		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	t_Z in	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 120.00-92.71	105.94	1.396	17	0.5000	69.555	A	0.000	69.555	69.555	100.00	0.000	0.000
						B	0.000	69.555		100.00	0.000	0.000
						C	0.000	69.555		100.00	0.000	0.000
L2 92.71-46.16	69.03	1.235	15	0.5000	144.612	A	0.000	144.612	144.612	100.00	0.000	0.000
						B	0.000	144.612		100.00	0.000	0.000
						C	0.000	144.612		100.00	0.000	0.000
L3 46.16-0.00	22.38	1	12	0.5000	175.116	A	0.000	175.116	175.116	100.00	0.000	0.000
						B	0.000	175.116		100.00	0.000	0.000
						C	0.000	175.116		100.00	0.000	0.000

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 120.00-92.71	105.94	1.396	9	67.281	A	0.000	67.281	67.281	100.00	0.000	0.000
					B	0.000	67.281		100.00	0.000	0.000
					C	0.000	67.281		100.00	0.000	0.000
L2 92.71-46.16	69.03	1.235	8	140.733	A	0.000	140.733	140.733	100.00	0.000	0.000
					B	0.000	140.733		100.00	0.000	0.000
					C	0.000	140.733		100.00	0.000	0.000
L3 46.16-0.00	22.38	1	6	171.269	A	0.000	171.269	171.269	100.00	0.000	0.000
					B	0.000	171.269		100.00	0.000	0.000
					C	0.000	171.269		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 plf	Ctrl. Face
L1 120.00-92.71	0.82	2.16	A	1	0.65	1	1	1	67.281	1.69	61.92	C
			B	1	0.65	1	1	1	67.281			
			C	1	0.65	1	1	1	67.281			
L2 92.71-46.16	2.31	7.34	A	1	0.65	1	1	1	140.733	3.11	66.83	C
			B	1	0.65	1	1	1	140.733			
			C	1	0.65	1	1	1	140.733			
L3 46.16-0.00	2.15	10.66	A	1	0.65	1	1	1	171.269	3.10	67.16	C
			B	1	0.65	1	1	1	171.269			
			C	1	0.65	1	1	1	171.269			
Sum Weight:	5.28	20.17						OTM	463.15 kip-ft	7.90		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 120.00-92.71	0.82	2.16	A	1	0.65	1	1	1	67.281	1.69	61.92	C
			B	1	0.65	1	1	1	67.281			
			C	1	0.65	1	1	1	67.281			
L2 92.71-46.16	2.31	7.34	A	1	0.65	1	1	1	140.733	3.11	66.83	C
			B	1	0.65	1	1	1	140.733			
			C	1	0.65	1	1	1	140.733			
L3 46.16-0.00	2.15	10.66	A	1	0.65	1	1	1	171.269	3.10	67.16	C
			B	1	0.65	1	1	1	171.269			
			C	1	0.65	1	1	1	171.269			
Sum Weight:	5.28	20.17						OTM	463.15 kip-ft	7.90		

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 plf	Ctrl. Face
L1 120.00-92.71	0.82	2.16	A	1	0.65	1	1	1	67.281	1.69	61.92	C
			B	1	0.65	1	1	1	67.281			
			C	1	0.65	1	1	1	67.281			
L2 92.71-46.16	2.31	7.34	A	1	0.65	1	1	1	140.733	3.11	66.83	C
			B	1	0.65	1	1	1	140.733			
			C	1	0.65	1	1	1	140.733			
L3 46.16-0.00	2.15	10.66	A	1	0.65	1	1	1	171.269	3.10	67.16	C
			B	1	0.65	1	1	1	171.269			
			C	1	0.65	1	1	1	171.269			
Sum Weight:	5.28	20.17						OTM	463.15 kip-ft	7.90		

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 plf	Ctrl. Face
L1 120.00-92.71	0.82	2.16	A	1	0.65	1	1	1	67.281	1.69	61.92	C
			B	1	0.65	1	1	1	67.281			
			C	1	0.65	1	1	1	67.281			
L2 92.71-46.16	2.31	7.34	A	1	0.65	1	1	1	140.733	3.11	66.83	C
			B	1	0.65	1	1	1	140.733			
			C	1	0.65	1	1	1	140.733			
L3 46.16-0.00	2.15	10.66	A	1	0.65	1	1	1	171.269	3.10	67.16	C
			B	1	0.65	1	1	1	171.269			
			C	1	0.65	1	1	1	171.269			
Sum Weight:	5.28	20.17						OTM	463.15 kip-ft	7.90		

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 plf	Ctrl. Face
L1 120.00-92.71	0.82	2.67	A	1	0.65	1	1	1	69.555	1.31	48.01	C
			B	1	0.65	1	1	1	69.555			
			C	1	0.65	1	1	1	69.555			
L2 92.71-46.16	2.31	8.40	A	1	0.65	1	1	1	144.612	2.40	51.51	C
			B	1	0.65	1	1	1	144.612			
			C	1	0.65	1	1	1	144.612			
L3 46.16-0.00	2.15	11.95	A	1	0.65	1	1	1	175.116	2.38	51.50	C
			B	1	0.65	1	1	1	175.116			
			C	1	0.65	1	1	1	175.116			
Sum Weight:	5.28	23.01						OTM	357.51 kip-ft	6.09		

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 plf	Ctrl. Face
L1 120.00-92.71	0.82	2.67	A	1	0.65	1	1	1	69.555	1.31	48.01	C
			B	1	0.65	1	1	1	69.555			
			C	1	0.65	1	1	1	69.555			
L2 92.71-46.16	2.31	8.40	A	1	0.65	1	1	1	144.612	2.40	51.51	C
			B	1	0.65	1	1	1	144.612			
			C	1	0.65	1	1	1	144.612			
L3 46.16-0.00	2.15	11.95	A	1	0.65	1	1	1	175.116	2.38	51.50	C
			B	1	0.65	1	1	1	175.116			
			C	1	0.65	1	1	1	175.116			
Sum Weight:	5.28	23.01						OTM	357.51 kip-ft	6.09		

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 plf	Ctrl. Face
L1 120.00-92.71	0.82	2.67	A	1	0.65	1	1	1	69.555	1.31	48.01	C
			B	1	0.65	1	1	1	69.555			
			C	1	0.65	1	1	1	69.555			
L2 92.71-46.16	2.31	8.40	A	1	0.65	1	1	1	144.612	2.40	51.51	C
			B	1	0.65	1	1	1	144.612			
			C	1	0.65	1	1	1	144.612			
L3 46.16-0.00	2.15	11.95	A	1	0.65	1	1	1	175.116	2.38	51.50	C
			B	1	0.65	1	1	1	175.116			
			C	1	0.65	1	1	1	175.116			
Sum Weight:	5.28	23.01						OTM	357.51 kip-ft	6.09		

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 plf	Ctrl. Face
L1 120.00-92.71	0.82	2.67	A	1	0.65	1	1	1	69.555	1.31	48.01	C
			B	1	0.65	1	1	1	69.555			
			C	1	0.65	1	1	1	69.555			
L2 92.71-46.16	2.31	8.40	A	1	0.65	1	1	1	144.612	2.40	51.51	C
			B	1	0.65	1	1	1	144.612			
			C	1	0.65	1	1	1	144.612			
L3 46.16-0.00	2.15	11.95	A	1	0.65	1	1	1	175.116	2.38	51.50	C
			B	1	0.65	1	1	1	175.116			
			C	1	0.65	1	1	1	175.116			
Sum Weight:	5.28	23.01						OTM	357.51	6.09		

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

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 120.00-92.71	0.82	2.16	A	1	0.65	1	1	1	67.281	0.66	24.19	C
			B	1	0.65	1	1	1	67.281			
			C	1	0.65	1	1	1	67.281			
L2 92.71-46.16	2.31	7.34	A	1	0.65	1	1	1	140.733	1.22	26.11	C
			B	1	0.65	1	1	1	140.733			
			C	1	0.65	1	1	1	140.733			
L3 46.16-0.00	2.15	10.66	A	1	0.65	1	1	1	171.269	1.21	26.23	C
			B	1	0.65	1	1	1	171.269			
			C	1	0.65	1	1	1	171.269			
Sum Weight:	5.28	20.17						OTM	180.92 kip-ft	3.09		

Tower Forces - Service - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 120.00-92.71	0.82	2.16	A	1	0.65	1	1	1	67.281	0.66	24.19	C
			B	1	0.65	1	1	1	67.281			
			C	1	0.65	1	1	1	67.281			
L2 92.71-46.16	2.31	7.34	A	1	0.65	1	1	1	140.733	1.22	26.11	C
			B	1	0.65	1	1	1	140.733			
			C	1	0.65	1	1	1	140.733			
L3 46.16-0.00	2.15	10.66	A	1	0.65	1	1	1	171.269	1.21	26.23	C
			B	1	0.65	1	1	1	171.269			
			C	1	0.65	1	1	1	171.269			
Sum Weight:	5.28	20.17						OTM	180.92 kip-ft	3.09		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 120.00-92.71	0.82	2.16	A	1	0.65	1	1	1	67.281	0.66	24.19	C
			B	1	0.65	1	1	1	67.281			
			C	1	0.65	1	1	1	67.281			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L2 92.71-46.16	2.31	7.34	A	1	0.65	1	1	1	140.733	1.22	26.11	C
			B	1	0.65	1	1	1	140.733			
			C	1	0.65	1	1	1	140.733			
L3 46.16-0.00	2.15	10.66	A	1	0.65	1	1	1	171.269	1.21	26.23	C
			B	1	0.65	1	1	1	171.269			
			C	1	0.65	1	1	1	171.269			
Sum Weight:	5.28	20.17						OTM	180.92 kip-ft	3.09		

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 plf	Ctrl. Face
L1 120.00-92.71	0.82	2.16	A	1	0.65	1	1	1	67.281	0.66	24.19	C
			B	1	0.65	1	1	1	67.281			
			C	1	0.65	1	1	1	67.281			
L2 92.71-46.16	2.31	7.34	A	1	0.65	1	1	1	140.733	1.22	26.11	C
			B	1	0.65	1	1	1	140.733			
			C	1	0.65	1	1	1	140.733			
L3 46.16-0.00	2.15	10.66	A	1	0.65	1	1	1	171.269	1.21	26.23	C
			B	1	0.65	1	1	1	171.269			
			C	1	0.65	1	1	1	171.269			
Sum Weight:	5.28	20.17						OTM	180.92 kip-ft	3.09		

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	20.17					
Bracing Weight	0.00					
Total Member Self-Weight	20.17			0.00	0.00	
Total Weight	30.46			0.00	0.00	
Wind 0 deg - No Ice		0.00	-15.14	-1265.07	0.00	0.00
Wind 30 deg - No Ice		7.57	-13.11	-1095.59	-632.54	0.00
Wind 45 deg - No Ice		10.70	-10.70	-894.54	-894.54	0.00
Wind 60 deg - No Ice		13.11	-7.57	-632.54	-1095.59	0.00
Wind 90 deg - No Ice		15.14	0.00	0.00	-1265.07	0.00
Wind 120 deg - No Ice		13.11	7.57	632.54	-1095.59	0.00
Wind 135 deg - No Ice		10.70	10.70	894.54	-894.54	0.00
Wind 150 deg - No Ice		7.57	13.11	1095.59	-632.54	0.00
Wind 180 deg - No Ice		0.00	15.14	1265.07	0.00	0.00
Wind 210 deg - No Ice		-7.57	13.11	1095.59	632.54	0.00
Wind 225 deg - No Ice		-10.70	10.70	894.54	894.54	0.00
Wind 240 deg - No Ice		-13.11	7.57	632.54	1095.59	0.00
Wind 270 deg - No Ice		-15.14	0.00	0.00	1265.07	0.00
Wind 300 deg - No Ice		-13.11	-7.57	-632.54	1095.59	0.00

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 315 deg - No Ice		-10.70	-10.70	-894.54	894.54	0.00
Wind 330 deg - No Ice		-7.57	-13.11	-1095.59	632.54	0.00
Member Ice	2.85					
Total Weight Ice	35.12			0.00	0.00	
Wind 0 deg - Ice		0.00	-12.33	-1046.98	0.00	0.00
Wind 30 deg - Ice		6.16	-10.68	-906.71	-523.49	0.00
Wind 45 deg - Ice		8.72	-8.72	-740.33	-740.33	0.00
Wind 60 deg - Ice		10.68	-6.16	-523.49	-906.71	0.00
Wind 90 deg - Ice		12.33	0.00	0.00	-1046.98	0.00
Wind 120 deg - Ice		10.68	6.16	523.49	-906.71	0.00
Wind 135 deg - Ice		8.72	8.72	740.33	-740.33	0.00
Wind 150 deg - Ice		6.16	10.68	906.71	-523.49	0.00
Wind 180 deg - Ice		0.00	12.33	1046.98	0.00	0.00
Wind 210 deg - Ice		-6.16	10.68	906.71	523.49	0.00
Wind 225 deg - Ice		-8.72	8.72	740.33	740.33	0.00
Wind 240 deg - Ice		-10.68	6.16	523.49	906.71	0.00
Wind 270 deg - Ice		-12.33	0.00	0.00	1046.98	0.00
Wind 300 deg - Ice		-10.68	-6.16	-523.49	906.71	0.00
Wind 315 deg - Ice		-8.72	-8.72	-740.33	740.33	0.00
Wind 330 deg - Ice		-6.16	-10.68	-906.71	523.49	0.00
Total Weight	30.46			0.00	0.00	
Wind 0 deg - Service		0.00	-5.91	-494.17	0.00	0.00
Wind 30 deg - Service		2.96	-5.12	-427.96	-247.08	0.00
Wind 45 deg - Service		4.18	-4.18	-349.43	-349.43	0.00
Wind 60 deg - Service		5.12	-2.96	-247.08	-427.96	0.00
Wind 90 deg - Service		5.91	0.00	0.00	-494.17	0.00
Wind 120 deg - Service		5.12	2.96	247.08	-427.96	0.00
Wind 135 deg - Service		4.18	4.18	349.43	-349.43	0.00
Wind 150 deg - Service		2.96	5.12	427.96	-247.08	0.00
Wind 180 deg - Service		0.00	5.91	494.17	0.00	0.00
Wind 210 deg - Service		-2.96	5.12	427.96	247.08	0.00
Wind 225 deg - Service		-4.18	4.18	349.43	349.43	0.00
Wind 240 deg - Service		-5.12	2.96	247.08	427.96	0.00
Wind 270 deg - Service		-5.91	0.00	0.00	494.17	0.00
Wind 300 deg - Service		-5.12	-2.96	-247.08	427.96	0.00
Wind 315 deg - Service		-4.18	-4.18	-349.43	349.43	0.00
Wind 330 deg - Service		-2.96	-5.12	-427.96	247.08	0.00

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

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

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	120 - 92.71	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-9.22	0.00	0.00
			Max. Mx	6	-6.87	-118.97	0.00
			Max. My	2	-6.87	0.00	118.97
			Max. Vy	6	8.28	-118.97	0.00
			Max. Vx	2	-8.28	0.00	118.97
			Max. Torque	17			0.00
L2	92.71 - 46.16	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-19.68	0.00	0.00
			Max. Mx	6	-16.26	-586.54	0.00
			Max. My	2	-16.26	0.00	586.54
			Max. Vy	6	11.90	-586.54	0.00
			Max. Vx	2	-11.90	0.00	586.54
			Max. Torque	17			0.00
L3	46.16 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-35.12	0.00	0.00
			Max. Mx	6	-30.46	-1287.59	0.00

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. My	2	-30.46	0.00	1287.59
			Max. Vy	6	15.15	-1287.59	0.00
			Max. Vx	2	-15.15	0.00	1287.59
			Max. Torque	17			0.00

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	19	35.12	0.00	12.33
	Max. H_x	14	30.46	15.14	0.00
	Max. H_z	2	30.46	0.00	15.14
	Max. M_x	2	1287.59	0.00	15.14
	Max. M_z	6	1287.59	-15.14	0.00
	Max. Torsion	17	0.00	7.57	13.11
	Min. Vert	1	30.46	0.00	0.00
	Min. H_x	6	30.46	-15.14	0.00
	Min. H_z	10	30.46	0.00	-15.14
	Min. M_x	10	-1287.59	0.00	-15.14
	Min. M_z	14	-1287.59	15.14	0.00
	Min. Torsion	3	-0.00	-7.57	13.11

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	30.46	0.00	0.00	0.00	0.00	0.00
Dead+Wind 0 deg - No Ice	30.46	0.00	-15.14	-1287.59	0.00	0.00
Dead+Wind 30 deg - No Ice	30.46	7.57	-13.11	-1115.09	-643.80	0.00
Dead+Wind 45 deg - No Ice	30.46	10.70	-10.70	-910.46	-910.46	0.00
Dead+Wind 60 deg - No Ice	30.46	13.11	-7.57	-643.80	-1115.09	-0.00
Dead+Wind 90 deg - No Ice	30.46	15.14	0.00	0.00	-1287.59	0.00
Dead+Wind 120 deg - No Ice	30.46	13.11	7.57	643.80	-1115.09	0.00
Dead+Wind 135 deg - No Ice	30.46	10.70	10.70	910.46	-910.46	0.00
Dead+Wind 150 deg - No Ice	30.46	7.57	13.11	1115.09	-643.80	-0.00
Dead+Wind 180 deg - No Ice	30.46	0.00	15.14	1287.59	0.00	0.00
Dead+Wind 210 deg - No Ice	30.46	-7.57	13.11	1115.09	643.80	0.00
Dead+Wind 225 deg - No Ice	30.46	-10.70	10.70	910.46	910.46	0.00
Dead+Wind 240 deg - No Ice	30.46	-13.11	7.57	643.80	1115.09	-0.00
Dead+Wind 270 deg - No Ice	30.46	-15.14	0.00	0.00	1287.59	0.00
Dead+Wind 300 deg - No Ice	30.46	-13.11	-7.57	-643.80	1115.09	0.00
Dead+Wind 315 deg - No Ice	30.46	-10.70	-10.70	-910.46	910.46	0.00
Dead+Wind 330 deg - No Ice	30.46	-7.57	-13.11	-1115.09	643.80	-0.00
Dead+Ice+Temp	35.12	0.00	0.00	0.00	0.00	0.00
Dead+Wind 0 deg+Ice+Temp	35.12	0.00	-12.33	-1069.99	0.00	0.00
Dead+Wind 30 deg+Ice+Temp	35.12	6.16	-10.68	-926.64	-534.99	0.00
Dead+Wind 45 deg+Ice+Temp	35.12	8.72	-8.72	-756.59	-756.59	0.00
Dead+Wind 60 deg+Ice+Temp	35.12	10.68	-6.16	-534.99	-926.64	-0.00
Dead+Wind 90 deg+Ice+Temp	35.12	12.33	0.00	0.00	-1069.99	0.00
Dead+Wind 120 deg+Ice+Temp	35.12	10.68	6.16	534.99	-926.64	0.00
Dead+Wind 135 deg+Ice+Temp	35.12	8.72	8.72	756.59	-756.59	0.00

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 150 deg+Ice+Temp	35.12	6.16	10.68	926.64	-534.99	-0.00
Dead+Wind 180 deg+Ice+Temp	35.12	0.00	12.33	1069.99	0.00	0.00
Dead+Wind 210 deg+Ice+Temp	35.12	-6.16	10.68	926.64	534.99	0.00
Dead+Wind 225 deg+Ice+Temp	35.12	-8.72	8.72	756.59	756.59	0.00
Dead+Wind 240 deg+Ice+Temp	35.12	-10.68	6.16	534.99	926.64	-0.00
Dead+Wind 270 deg+Ice+Temp	35.12	-12.33	0.00	0.00	1069.99	0.00
Dead+Wind 300 deg+Ice+Temp	35.12	-10.68	-6.16	-534.99	926.64	0.00
Dead+Wind 315 deg+Ice+Temp	35.12	-8.72	-8.72	-756.59	756.59	0.00
Dead+Wind 330 deg+Ice+Temp	35.12	-6.16	-10.68	-926.64	534.99	-0.00
Dead+Wind 0 deg - Service	30.46	0.00	-5.91	-503.03	0.00	0.00
Dead+Wind 30 deg - Service	30.46	2.96	-5.12	-435.63	-251.51	0.00
Dead+Wind 45 deg - Service	30.46	4.18	-4.18	-355.69	-355.69	0.00
Dead+Wind 60 deg - Service	30.46	5.12	-2.96	-251.51	-435.63	-0.00
Dead+Wind 90 deg - Service	30.46	5.91	0.00	0.00	-503.03	0.00
Dead+Wind 120 deg - Service	30.46	5.12	2.96	251.51	-435.63	0.00
Dead+Wind 135 deg - Service	30.46	4.18	4.18	355.69	-355.69	0.00
Dead+Wind 150 deg - Service	30.46	2.96	5.12	435.63	-251.51	-0.00
Dead+Wind 180 deg - Service	30.46	0.00	5.91	503.03	0.00	0.00
Dead+Wind 210 deg - Service	30.46	-2.96	5.12	435.63	251.51	0.00
Dead+Wind 225 deg - Service	30.46	-4.18	4.18	355.69	355.69	0.00
Dead+Wind 240 deg - Service	30.46	-5.12	2.96	251.51	435.63	-0.00
Dead+Wind 270 deg - Service	30.46	-5.91	0.00	0.00	503.03	0.00
Dead+Wind 300 deg - Service	30.46	-5.12	-2.96	-251.51	435.63	0.00
Dead+Wind 315 deg - Service	30.46	-4.18	-4.18	-355.69	355.69	0.00
Dead+Wind 330 deg - Service	30.46	-2.96	-5.12	-435.63	251.51	-0.00

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
1	0.00	-30.46	0.00	0.00	30.46	0.00	0.000%
2	0.00	-30.46	-15.14	0.00	30.46	15.14	0.000%
3	7.57	-30.46	-13.11	-7.57	30.46	13.11	0.000%
4	10.70	-30.46	-10.70	-10.70	30.46	10.70	0.000%
5	13.11	-30.46	-7.57	-13.11	30.46	7.57	0.000%
6	15.14	-30.46	0.00	-15.14	30.46	0.00	0.000%
7	13.11	-30.46	7.57	-13.11	30.46	-7.57	0.000%
8	10.70	-30.46	10.70	-10.70	30.46	-10.70	0.000%
9	7.57	-30.46	13.11	-7.57	30.46	-13.11	0.000%
10	0.00	-30.46	15.14	0.00	30.46	-15.14	0.000%
11	-7.57	-30.46	13.11	7.57	30.46	-13.11	0.000%
12	-10.70	-30.46	10.70	10.70	30.46	-10.70	0.000%
13	-13.11	-30.46	7.57	13.11	30.46	-7.57	0.000%
14	-15.14	-30.46	0.00	15.14	30.46	0.00	0.000%
15	-13.11	-30.46	-7.57	13.11	30.46	7.57	0.000%
16	-10.70	-30.46	-10.70	10.70	30.46	10.70	0.000%
17	-7.57	-30.46	-13.11	7.57	30.46	13.11	0.000%
18	0.00	-35.12	0.00	0.00	35.12	0.00	0.000%
19	0.00	-35.12	-12.33	0.00	35.12	12.33	0.000%
20	6.16	-35.12	-10.68	-6.16	35.12	10.68	0.000%
21	8.72	-35.12	-8.72	-8.72	35.12	8.72	0.000%
22	10.68	-35.12	-6.16	-10.68	35.12	6.16	0.000%
23	12.33	-35.12	0.00	-12.33	35.12	0.00	0.000%
24	10.68	-35.12	6.16	-10.68	35.12	-6.16	0.000%
25	8.72	-35.12	8.72	-8.72	35.12	-8.72	0.000%
26	6.16	-35.12	10.68	-6.16	35.12	-10.68	0.000%
27	0.00	-35.12	12.33	0.00	35.12	-12.33	0.000%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
28	-6.16	-35.12	10.68	6.16	35.12	-10.68	0.000%
29	-8.72	-35.12	8.72	8.72	35.12	-8.72	0.000%
30	-10.68	-35.12	6.16	10.68	35.12	-6.16	0.000%
31	-12.33	-35.12	0.00	12.33	35.12	0.00	0.000%
32	-10.68	-35.12	-6.16	10.68	35.12	6.16	0.000%
33	-8.72	-35.12	-8.72	8.72	35.12	8.72	0.000%
34	-6.16	-35.12	-10.68	6.16	35.12	10.68	0.000%
35	0.00	-30.46	-5.91	0.00	30.46	5.91	0.000%
36	2.96	-30.46	-5.12	-2.96	30.46	5.12	0.000%
37	4.18	-30.46	-4.18	-4.18	30.46	4.18	0.000%
38	5.12	-30.46	-2.96	-5.12	30.46	2.96	0.000%
39	5.91	-30.46	0.00	-5.91	30.46	0.00	0.000%
40	5.12	-30.46	2.96	-5.12	30.46	-2.96	0.000%
41	4.18	-30.46	4.18	-4.18	30.46	-4.18	0.000%
42	2.96	-30.46	5.12	-2.96	30.46	-5.12	0.000%
43	0.00	-30.46	5.91	0.00	30.46	-5.91	0.000%
44	-2.96	-30.46	5.12	2.96	30.46	-5.12	0.000%
45	-4.18	-30.46	4.18	4.18	30.46	-4.18	0.000%
46	-5.12	-30.46	2.96	5.12	30.46	-2.96	0.000%
47	-5.91	-30.46	0.00	5.91	30.46	0.00	0.000%
48	-5.12	-30.46	-2.96	5.12	30.46	2.96	0.000%
49	-4.18	-30.46	-4.18	4.18	30.46	4.18	0.000%
50	-2.96	-30.46	-5.12	2.96	30.46	5.12	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	0.00001071
3	Yes	4	0.00000001	0.00052548
4	Yes	4	0.00000001	0.00060369
5	Yes	4	0.00000001	0.00052548
6	Yes	4	0.00000001	0.00001071
7	Yes	4	0.00000001	0.00052548
8	Yes	4	0.00000001	0.00060369
9	Yes	4	0.00000001	0.00052548
10	Yes	4	0.00000001	0.00001071
11	Yes	4	0.00000001	0.00052548
12	Yes	4	0.00000001	0.00060369
13	Yes	4	0.00000001	0.00052548
14	Yes	4	0.00000001	0.00001071
15	Yes	4	0.00000001	0.00052548
16	Yes	4	0.00000001	0.00060369
17	Yes	4	0.00000001	0.00052548
18	Yes	4	0.00000001	0.00000001
19	Yes	4	0.00000001	0.00069536
20	Yes	5	0.00000001	0.00002758
21	Yes	5	0.00000001	0.00003007
22	Yes	5	0.00000001	0.00002758
23	Yes	4	0.00000001	0.00069536
24	Yes	5	0.00000001	0.00002758
25	Yes	5	0.00000001	0.00003007
26	Yes	5	0.00000001	0.00002758
27	Yes	4	0.00000001	0.00069536
28	Yes	5	0.00000001	0.00002758

29	Yes	5	0.00000001	0.00003007
30	Yes	5	0.00000001	0.00002758
31	Yes	4	0.00000001	0.00069536
32	Yes	5	0.00000001	0.00002758
33	Yes	5	0.00000001	0.00003007
34	Yes	5	0.00000001	0.00002758
35	Yes	4	0.00000001	0.00000001
36	Yes	4	0.00000001	0.00004041
37	Yes	4	0.00000001	0.00004655
38	Yes	4	0.00000001	0.00004041
39	Yes	4	0.00000001	0.00000001
40	Yes	4	0.00000001	0.00004041
41	Yes	4	0.00000001	0.00004655
42	Yes	4	0.00000001	0.00004041
43	Yes	4	0.00000001	0.00000001
44	Yes	4	0.00000001	0.00004041
45	Yes	4	0.00000001	0.00004655
46	Yes	4	0.00000001	0.00004041
47	Yes	4	0.00000001	0.00000001
48	Yes	4	0.00000001	0.00004041
49	Yes	4	0.00000001	0.00004655
50	Yes	4	0.00000001	0.00004041

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	120 - 92.71	9.545	39	0.6376	0.0000
L2	97.29 - 46.16	6.586	39	0.5896	0.0000
L3	51.83 - 0	1.976	39	0.3431	0.0000

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
120.00	LPA-80080-6CF	39	9.545	0.6376	0.0000	81262
118.00	EEI 14-ft Low Profile Platform	39	9.279	0.6345	0.0000	81262
110.00	(2) P65-15-XLH-RR	39	8.221	0.6209	0.0000	40631
108.00	Andrew 12'-6" Low Profile Platform	39	7.959	0.6170	0.0000	33859
100.00	APX16DWV-16DWVS-E-A20	39	6.928	0.5978	0.0000	20328
98.00	Valmont T-Arm (3)	39	6.675	0.5919	0.0000	18540
91.00	Uni-Tri Bracket	39	5.813	0.5667	0.0000	14523

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	120 - 92.71	24.428	6	1.6320	0.0000

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L2	97.29 - 46.16	16.857	6	1.5091	0.0000
L3	51.83 - 0	5.057	6	0.8781	0.0000

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
120.00	LPA-80080-6CF	6	24.428	1.6320	0.0000	31800
118.00	EEI 14-ft Low Profile Platform	6	23.748	1.6240	0.0000	31800
110.00	(2) P65-15-XLH-RR	6	21.042	1.5892	0.0000	15900
108.00	Andrew 12'-6" Low Profile Platform	6	20.371	1.5792	0.0000	13249
100.00	APX16DWV-16DWVS-E-A20	6	17.731	1.5300	0.0000	7954
98.00	Valmont T-Arm (3)	6	17.085	1.5148	0.0000	7254
91.00	Uni-Tri Bracket	6	14.878	1.4504	0.0000	5681

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
L1	120 - 118.805	TP32.27x26.9x0.25	27.29	0.00	0.0	39.000	21.3334	-0.28	832.00	0.000
	118.805 - 117.609					39.000	21.5200	-1.93	839.28	0.002
	117.609 - 116.414					39.000	21.7067	-2.05	846.56	0.002
	116.414 - 115.219					39.000	21.8933	-2.18	853.84	0.003
	115.219 - 114.024					39.000	22.0799	-2.30	861.12	0.003
	114.024 - 112.828					39.000	22.2666	-2.42	868.40	0.003
	112.828 - 111.633					39.000	22.4532	-2.55	875.67	0.003
	111.633 - 110.438					39.000	22.6398	-2.67	882.95	0.003
	110.438 - 109.243					39.000	22.8264	-3.13	890.23	0.004
	109.243 - 108.047					39.000	23.0131	-3.25	897.51	0.004
	108.047 - 106.852					39.000	23.1997	-4.67	904.79	0.005
	106.852 - 105.657					39.000	23.3863	-4.80	912.07	0.005
	105.657 - 104.462					39.000	23.5730	-4.93	919.35	0.005
	104.462 - 103.266					39.000	23.7596	-5.06	926.62	0.005

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
	103.266 - 102.071					39.000	23.9462	-5.19	933.90	0.006
	102.071 - 100.876					39.000	24.1329	-5.32	941.18	0.006
	100.876 - 99.6805					39.000	24.3195	-5.61	948.46	0.006
	99.6805 - 98.4853					39.000	24.5061	-5.75	955.74	0.006
	98.4853 - 97.29					39.000	24.6927	-6.87	963.02	0.007
	97.29 - 92.71					39.000	25.4079	-3.26	990.91	0.003
L2	97.29 - 92.71	TP40.8x30.8688x0.375	51.13	0.00	0.0	39.000	37.3540	-4.70	1456.81	0.003
	92.71 - 90.4389					39.000	37.8791	-8.74	1477.29	0.006
	90.4389 - 88.1678					39.000	38.4042	-9.14	1497.76	0.006
	88.1678 - 85.8967					39.000	38.9292	-9.55	1518.24	0.006
	85.8967 - 83.6256					39.000	39.4543	-9.97	1538.72	0.006
	83.6256 - 81.3544					39.000	39.9793	-10.39	1559.19	0.007
	81.3544 - 79.0833					39.000	40.5044	-10.82	1579.67	0.007
	79.0833 - 76.8122					39.000	41.0294	-11.25	1600.15	0.007
	76.8122 - 74.5411					39.000	41.5545	-11.68	1620.62	0.007
	74.5411 - 72.27					39.000	42.0795	-12.12	1641.10	0.007
	72.27 - 69.9989					39.000	42.6046	-12.56	1661.58	0.008
	69.9989 - 67.7278					39.000	43.1296	-13.01	1682.06	0.008
	67.7278 - 65.4567					39.000	43.6547	-13.46	1702.53	0.008
	65.4567 - 63.1856					39.000	44.1797	-13.92	1723.01	0.008
	63.1856 - 60.9144					39.000	44.7048	-14.38	1743.49	0.008
	60.9144 - 58.6433					39.000	45.2299	-14.84	1763.96	0.008
	58.6433 - 56.3722					39.000	45.7549	-15.31	1784.44	0.009
	56.3722 - 54.1011					39.000	46.2800	-15.78	1804.92	0.009
	54.1011 - 51.83					39.000	46.8050	-16.26	1825.40	0.009
	51.83 - 46.16					39.000	48.1159	-8.71	1876.52	0.005
L3	51.83 - 46.16	TP49x38.9487x0.4375	51.83	0.00	0.0	39.000	55.0045	-9.80	2145.18	0.005
	46.16 - 43.7305					39.000	55.6587	-19.09	2170.69	0.009
	43.7305 - 41.3011					39.000	56.3130	-19.67	2196.21	0.009
	41.3011 - 38.8716					39.000	56.9672	-20.26	2221.72	0.009
	38.8716 - 36.4421					39.000	57.6215	-20.85	2247.24	0.009
	36.4421 - 34.0126					39.000	58.2757	-21.46	2272.75	0.009
	34.0126 - 31.5832					39.000	58.9300	-22.06	2298.27	0.010
	31.5832 - 29.1537					39.000	59.5842	-22.67	2323.78	0.010
	29.1537 - 26.7242					39.000	60.2384	-23.29	2349.30	0.010

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
	26.7242 - 24.2947					39.000	60.8927	-23.91	2374.81	0.010
	24.2947 - 21.8653					39.000	61.5469	-24.54	2400.33	0.010
	21.8653 - 19.4358					39.000	62.2012	-25.18	2425.85	0.010
	19.4358 - 17.0063					39.000	62.8554	-25.82	2451.36	0.011
	17.0063 - 14.5768					39.000	63.5096	-26.46	2476.88	0.011
	14.5768 - 12.1474					39.000	64.1639	-27.11	2502.39	0.011
	12.1474 - 9.7179					39.000	64.8181	-27.77	2527.91	0.011
	9.7179 - 7.28842					39.000	65.4724	-28.43	2553.42	0.011
	7.28842 - 4.85895					39.000	66.1266	-29.10	2578.94	0.011
	4.85895 - 2.42947					39.000	66.7809	-29.78	2604.45	0.011
	2.42947 - 0					39.000	67.4351	-30.46	2629.97	0.012

Pole Bending Design Data

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
L1	120 - 118.805	TP32.27x26.9x0.25	3.43	0.291	39.000	0.007	0.00	0.000	39.000	0.000
	118.805 - 117.609		7.21	0.602	39.000	0.015	0.00	0.000	39.000	0.000
	117.609 - 116.414		11.64	0.955	39.000	0.024	0.00	0.000	39.000	0.000
	116.414 - 115.219		16.16	1.303	39.000	0.033	0.00	0.000	39.000	0.000
	115.219 - 114.024		20.77	1.646	39.000	0.042	0.00	0.000	39.000	0.000
	114.024 - 112.828		25.47	1.984	39.000	0.051	0.00	0.000	39.000	0.000
	112.828 - 111.633		30.25	2.318	39.000	0.059	0.00	0.000	39.000	0.000
	111.633 - 110.438		35.13	2.647	39.000	0.068	0.00	0.000	39.000	0.000
	110.438 - 109.243		41.01	3.039	39.000	0.078	0.00	0.000	39.000	0.000
	109.243 - 108.047		47.50	3.464	39.000	0.089	0.00	0.000	39.000	0.000
	108.047 - 106.852		54.77	3.930	39.000	0.101	0.00	0.000	39.000	0.000
	106.852 - 105.657		62.16	4.389	39.000	0.113	0.00	0.000	39.000	0.000
	105.657 - 104.462		69.65	4.839	39.000	0.124	0.00	0.000	39.000	0.000
	104.462 - 103.266		77.23	5.281	39.000	0.135	0.00	0.000	39.000	0.000
	103.266 - 102.071		84.90	5.715	39.000	0.147	0.00	0.000	39.000	0.000

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
	102.071 - 100.876		92.66	6.142	39.000	0.157	0.00	0.000	39.000	0.000
	100.876 - 99.6805		100.74	6.575	39.000	0.169	0.00	0.000	39.000	0.000
	99.6805 - 98.4853		109.52	7.039	39.000	0.180	0.00	0.000	39.000	0.000
	98.4853 - 97.29		118.97	7.531	39.000	0.193	0.00	0.000	39.000	0.000
	97.29 - 92.71		65.44	3.911	39.000	0.100	0.00	0.000	39.000	0.000
L2	97.29 - 92.71	TP40.8x30.8688x0.375	92.22	3.841	39.000	0.098	0.00	0.000	39.000	0.000
	92.71 - 90.4389		177.69	7.196	39.000	0.185	0.00	0.000	39.000	0.000
	90.4389 - 88.1678		198.97	7.838	39.000	0.201	0.00	0.000	39.000	0.000
	88.1678 - 85.8967		220.60	8.456	39.000	0.217	0.00	0.000	39.000	0.000
	85.8967 - 83.6256		242.57	9.051	39.000	0.232	0.00	0.000	39.000	0.000
	83.6256 - 81.3544		264.88	9.624	39.000	0.247	0.00	0.000	39.000	0.000
	81.3544 - 79.0833		287.54	10.177	39.000	0.261	0.00	0.000	39.000	0.000
	79.0833 - 76.8122		310.55	10.710	39.000	0.275	0.00	0.000	39.000	0.000
	76.8122 - 74.5411		333.90	11.225	39.000	0.288	0.00	0.000	39.000	0.000
	74.5411 - 72.27		357.60	11.722	39.000	0.301	0.00	0.000	39.000	0.000
	72.27 - 69.9989		381.65	12.202	39.000	0.313	0.00	0.000	39.000	0.000
	69.9989 - 67.7278		406.04	12.666	39.000	0.325	0.00	0.000	39.000	0.000
	67.7278 - 65.4567		430.79	13.115	39.000	0.336	0.00	0.000	39.000	0.000
	65.4567 - 63.1856		455.87	13.549	39.000	0.347	0.00	0.000	39.000	0.000
	63.1856 - 60.9144		481.31	13.969	39.000	0.358	0.00	0.000	39.000	0.000
	60.9144 - 58.6433		507.10	14.376	39.000	0.369	0.00	0.000	39.000	0.000
	58.6433 - 56.3722		533.23	14.771	39.000	0.379	0.00	0.000	39.000	0.000
	56.3722 - 54.1011		559.71	15.153	39.000	0.389	0.00	0.000	39.000	0.000
	54.1011 - 51.83		586.54	15.523	39.000	0.398	0.00	0.000	39.000	0.000
	51.83 - 46.16		312.55	7.825	39.000	0.201	0.00	0.000	39.000	0.000
L3	51.83 - 46.16	TP49x38.9487x0.4375	342.58	7.671	39.000	0.197	0.00	0.000	39.000	0.000
	46.16 - 43.7305		685.19	14.982	39.000	0.384	0.00	0.000	39.000	0.000
	43.7305 - 41.3011		715.61	15.283	39.000	0.392	0.00	0.000	39.000	0.000
	41.3011 - 38.8716		746.38	15.574	39.000	0.399	0.00	0.000	39.000	0.000
	38.8716 - 36.4421		777.50	15.855	39.000	0.407	0.00	0.000	39.000	0.000
	36.4421 - 34.0126		808.97	16.127	39.000	0.414	0.00	0.000	39.000	0.000
	34.0126 - 31.5832		840.79	16.390	39.000	0.420	0.00	0.000	39.000	0.000

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
	31.5832 - 29.1537		872.98	16.643	39.000	0.427	0.00	0.000	39.000	0.000
	29.1537 - 26.7242		905.52	16.889	39.000	0.433	0.00	0.000	39.000	0.000
	26.7242 - 24.2947		938.42	17.127	39.000	0.439	0.00	0.000	39.000	0.000
	24.2947 - 21.8653		971.69	17.357	39.000	0.445	0.00	0.000	39.000	0.000
	21.8653 - 19.4358		1005.33	17.580	39.000	0.451	0.00	0.000	39.000	0.000
	19.4358 - 17.0063		1039.32	17.796	39.000	0.456	0.00	0.000	39.000	0.000
	17.0063 - 14.5768		1073.68	18.006	39.000	0.462	0.00	0.000	39.000	0.000
	14.5768 - 12.1474		1108.40	18.210	39.000	0.467	0.00	0.000	39.000	0.000
	12.1474 - 9.7179		1143.50	18.407	39.000	0.472	0.00	0.000	39.000	0.000
	9.7179 - 7.28842		1178.96	18.599	39.000	0.477	0.00	0.000	39.000	0.000
	7.28842 - 4.85895		1214.80	18.785	39.000	0.482	0.00	0.000	39.000	0.000
	4.85895 - 2.42947		1251.01	18.966	39.000	0.486	0.00	0.000	39.000	0.000
	2.42947 - 0		1287.59	19.142	39.000	0.491	0.00	0.000	39.000	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	120 - 118.805	TP32.27x26.9x0.25	2.90	0.136	26.000	0.010	0.00	0.000	26.000	0.000
	118.805 - 117.609		3.67	0.171	26.000	0.013	0.00	0.000	26.000	0.000
	117.609 - 116.414		3.75	0.173	26.000	0.013	0.00	0.000	26.000	0.000
	116.414 - 115.219		3.82	0.174	26.000	0.013	0.00	0.000	26.000	0.000
	115.219 - 114.024		3.89	0.176	26.000	0.014	0.00	0.000	26.000	0.000
	114.024 - 112.828		3.97	0.178	26.000	0.014	0.00	0.000	26.000	0.000
	112.828 - 111.633		4.04	0.180	26.000	0.014	0.00	0.000	26.000	0.000
	111.633 - 110.438		4.12	0.182	26.000	0.014	0.00	0.000	26.000	0.000
	110.438 - 109.243		5.40	0.236	26.000	0.018	0.00	0.000	26.000	0.000
	109.243 - 108.047		5.47	0.238	26.000	0.018	0.00	0.000	26.000	0.000
	108.047 - 106.852		6.15	0.265	26.000	0.020	0.00	0.000	26.000	0.000
	106.852 - 105.657		6.22	0.266	26.000	0.020	0.00	0.000	26.000	0.000
	105.657 - 104.462		6.30	0.267	26.000	0.021	0.00	0.000	26.000	0.000

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
	104.462 - 103.266		6.38	0.268	26.000	0.021	0.00	0.000	26.000	0.000
	103.266 - 102.071		6.46	0.270	26.000	0.021	0.00	0.000	26.000	0.000
	102.071 - 100.876		6.54	0.271	26.000	0.021	0.00	0.000	26.000	0.000
	100.876 - 99.6805		7.30	0.300	26.000	0.023	0.00	0.000	26.000	0.000
	99.6805 - 98.4853		7.38	0.301	26.000	0.023	0.00	0.000	26.000	0.000
	98.4853 - 97.29		8.28	0.335	26.000	0.026	0.00	0.000	26.000	0.000
	97.29 - 92.71		3.66	0.144	26.000	0.011	0.00	0.000	26.000	0.000
L2	97.29 - 92.71	TP40.8x30.8688x0.375	4.95	0.133	26.000	0.010	0.00	0.000	26.000	0.000
	92.71 - 90.4389		9.30	0.245	26.000	0.019	0.00	0.000	26.000	0.000
	90.4389 - 88.1678		9.45	0.246	26.000	0.019	0.00	0.000	26.000	0.000
	88.1678 - 85.8967		9.60	0.247	26.000	0.019	0.00	0.000	26.000	0.000
	85.8967 - 83.6256		9.75	0.247	26.000	0.019	0.00	0.000	26.000	0.000
	83.6256 - 81.3544		9.90	0.248	26.000	0.019	0.00	0.000	26.000	0.000
	81.3544 - 79.0833		10.06	0.248	26.000	0.019	0.00	0.000	26.000	0.000
	79.0833 - 76.8122		10.21	0.249	26.000	0.019	0.00	0.000	26.000	0.000
	76.8122 - 74.5411		10.36	0.249	26.000	0.019	0.00	0.000	26.000	0.000
	74.5411 - 72.27		10.52	0.250	26.000	0.019	0.00	0.000	26.000	0.000
	72.27 - 69.9989		10.67	0.250	26.000	0.019	0.00	0.000	26.000	0.000
	69.9989 - 67.7278		10.82	0.251	26.000	0.019	0.00	0.000	26.000	0.000
	67.7278 - 65.4567		10.98	0.251	26.000	0.019	0.00	0.000	26.000	0.000
	65.4567 - 63.1856		11.13	0.252	26.000	0.019	0.00	0.000	26.000	0.000
	63.1856 - 60.9144		11.28	0.252	26.000	0.019	0.00	0.000	26.000	0.000
	60.9144 - 58.6433		11.44	0.253	26.000	0.019	0.00	0.000	26.000	0.000
	58.6433 - 56.3722		11.59	0.253	26.000	0.019	0.00	0.000	26.000	0.000
	56.3722 - 54.1011		11.74	0.254	26.000	0.020	0.00	0.000	26.000	0.000
	54.1011 - 51.83		11.90	0.254	26.000	0.020	0.00	0.000	26.000	0.000
	51.83 - 46.16		5.98	0.124	26.000	0.010	0.00	0.000	26.000	0.000
L3	51.83 - 46.16	TP49x38.9487x0.4375	6.34	0.115	26.000	0.009	0.00	0.000	26.000	0.000
	46.16 - 43.7305		12.45	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	43.7305 - 41.3011		12.60	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	41.3011 - 38.8716		12.74	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	38.8716 - 36.4421		12.89	0.224	26.000	0.017	0.00	0.000	26.000	0.000

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
	36.4421 - 34.0126		13.04	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	34.0126 - 31.5832		13.18	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	31.5832 - 29.1537		13.33	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	29.1537 - 26.7242		13.48	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	26.7242 - 24.2947		13.63	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	24.2947 - 21.8653		13.78	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	21.8653 - 19.4358		13.93	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	19.4358 - 17.0063		14.08	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	17.0063 - 14.5768		14.23	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	14.5768 - 12.1474		14.38	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	12.1474 - 9.7179		14.53	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	9.7179 - 7.28842		14.69	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	7.28842 - 4.85895		14.84	0.224	26.000	0.017	0.00	0.000	26.000	0.000
	4.85895 - 2.42947		14.99	0.225	26.000	0.017	0.00	0.000	26.000	0.000
	2.42947 - 0		15.15	0.225	26.000	0.017	0.00	0.000	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	120 - 118.805	0.000	0.007	0.000	0.010	0.000	0.008 ✔	1.333	H1-3+VT ✔
	118.805 - 117.609	0.002	0.015	0.000	0.013	0.000	0.018 ✔	1.333	H1-3+VT ✔
	117.609 - 116.414	0.002	0.024	0.000	0.013	0.000	0.027 ✔	1.333	H1-3+VT ✔
	116.414 - 115.219	0.003	0.033	0.000	0.013	0.000	0.036 ✔	1.333	H1-3+VT ✔
	115.219 - 114.024	0.003	0.042	0.000	0.014	0.000	0.045 ✔	1.333	H1-3+VT ✔
	114.024 - 112.828	0.003	0.051	0.000	0.014	0.000	0.054 ✔	1.333	H1-3+VT ✔
	112.828 - 111.633	0.003	0.059	0.000	0.014	0.000	0.062 ✔	1.333	H1-3+VT ✔
	111.633 - 110.438	0.003	0.068	0.000	0.014	0.000	0.071 ✔	1.333	H1-3+VT ✔
	110.438 - 109.243	0.004	0.078	0.000	0.018	0.000	0.082 ✔	1.333	H1-3+VT ✔
	109.243 - 108.047	0.004	0.089	0.000	0.018	0.000	0.093 ✔	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
	108.047 - 106.852	0.005	0.101	0.000	0.020	0.000	0.106 ✔	1.333	H1-3+VT ✔
	106.852 - 105.657	0.005	0.113	0.000	0.020	0.000	0.118 ✔	1.333	H1-3+VT ✔
	105.657 - 104.462	0.005	0.124	0.000	0.021	0.000	0.130 ✔	1.333	H1-3+VT ✔
	104.462 - 103.266	0.005	0.135	0.000	0.021	0.000	0.141 ✔	1.333	H1-3+VT ✔
	103.266 - 102.071	0.006	0.147	0.000	0.021	0.000	0.152 ✔	1.333	H1-3+VT ✔
	102.071 - 100.876	0.006	0.157	0.000	0.021	0.000	0.163 ✔	1.333	H1-3+VT ✔
	100.876 - 99.6805	0.006	0.169	0.000	0.023	0.000	0.175 ✔	1.333	H1-3+VT ✔
	99.6805 - 98.4853	0.006	0.180	0.000	0.023	0.000	0.187 ✔	1.333	H1-3+VT ✔
	98.4853 - 97.29	0.007	0.193	0.000	0.026	0.000	0.200 ✔	1.333	H1-3+VT ✔
	97.29 - 92.71	0.003	0.100	0.000	0.011	0.000	0.104 ✔	1.333	H1-3+VT ✔
L2	97.29 - 92.71	0.003	0.098	0.000	0.010	0.000	0.102 ✔	1.333	H1-3+VT ✔
	92.71 - 90.4389	0.006	0.185	0.000	0.019	0.000	0.191 ✔	1.333	H1-3+VT ✔
	90.4389 - 88.1678	0.006	0.201	0.000	0.019	0.000	0.207 ✔	1.333	H1-3+VT ✔
	88.1678 - 85.8967	0.006	0.217	0.000	0.019	0.000	0.223 ✔	1.333	H1-3+VT ✔
	85.8967 - 83.6256	0.006	0.232	0.000	0.019	0.000	0.239 ✔	1.333	H1-3+VT ✔
	83.6256 - 81.3544	0.007	0.247	0.000	0.019	0.000	0.254 ✔	1.333	H1-3+VT ✔
	81.3544 - 79.0833	0.007	0.261	0.000	0.019	0.000	0.268 ✔	1.333	H1-3+VT ✔
	79.0833 - 76.8122	0.007	0.275	0.000	0.019	0.000	0.282 ✔	1.333	H1-3+VT ✔
	76.8122 - 74.5411	0.007	0.288	0.000	0.019	0.000	0.295 ✔	1.333	H1-3+VT ✔
	74.5411 - 72.27	0.007	0.301	0.000	0.019	0.000	0.308 ✔	1.333	H1-3+VT ✔
	72.27 - 69.9989	0.008	0.313	0.000	0.019	0.000	0.321 ✔	1.333	H1-3+VT ✔
	69.9989 - 67.7278	0.008	0.325	0.000	0.019	0.000	0.333 ✔	1.333	H1-3+VT ✔
	67.7278 - 65.4567	0.008	0.336	0.000	0.019	0.000	0.344 ✔	1.333	H1-3+VT ✔
	65.4567 - 63.1856	0.008	0.347	0.000	0.019	0.000	0.356 ✔	1.333	H1-3+VT ✔
	63.1856 - 60.9144	0.008	0.358	0.000	0.019	0.000	0.367 ✔	1.333	H1-3+VT ✔
	60.9144 - 58.6433	0.008	0.369	0.000	0.019	0.000	0.377 ✔	1.333	H1-3+VT ✔
	58.6433 - 56.3722	0.009	0.379	0.000	0.019	0.000	0.387 ✔	1.333	H1-3+VT ✔
	56.3722 - 54.1011	0.009	0.389	0.000	0.020	0.000	0.397 ✔	1.333	H1-3+VT ✔
	54.1011 - 51.83	0.009	0.398	0.000	0.020	0.000	0.407 ✔	1.333	H1-3+VT ✔
	51.83 - 46.16	0.005	0.201	0.000	0.010	0.000	0.205 ✔	1.333	H1-3+VT ✔
L3	51.83 - 46.16	0.005	0.197	0.000	0.009	0.000	0.201 ✔	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
	46.16 - 43.7305	0.009	0.384	0.000	0.017	0.000	0.393 ✔	1.333	H1-3+VT ✔
	43.7305 - 41.3011	0.009	0.392	0.000	0.017	0.000	0.401 ✔	1.333	H1-3+VT ✔
	41.3011 - 38.8716	0.009	0.399	0.000	0.017	0.000	0.409 ✔	1.333	H1-3+VT ✔
	38.8716 - 36.4421	0.009	0.407	0.000	0.017	0.000	0.416 ✔	1.333	H1-3+VT ✔
	36.4421 - 34.0126	0.009	0.414	0.000	0.017	0.000	0.423 ✔	1.333	H1-3+VT ✔
	34.0126 - 31.5832	0.010	0.420	0.000	0.017	0.000	0.430 ✔	1.333	H1-3+VT ✔
	31.5832 - 29.1537	0.010	0.427	0.000	0.017	0.000	0.437 ✔	1.333	H1-3+VT ✔
	29.1537 - 26.7242	0.010	0.433	0.000	0.017	0.000	0.443 ✔	1.333	H1-3+VT ✔
	26.7242 - 24.2947	0.010	0.439	0.000	0.017	0.000	0.449 ✔	1.333	H1-3+VT ✔
	24.2947 - 21.8653	0.010	0.445	0.000	0.017	0.000	0.455 ✔	1.333	H1-3+VT ✔
	21.8653 - 19.4358	0.010	0.451	0.000	0.017	0.000	0.461 ✔	1.333	H1-3+VT ✔
	19.4358 - 17.0063	0.011	0.456	0.000	0.017	0.000	0.467 ✔	1.333	H1-3+VT ✔
	17.0063 - 14.5768	0.011	0.462	0.000	0.017	0.000	0.472 ✔	1.333	H1-3+VT ✔
	14.5768 - 12.1474	0.011	0.467	0.000	0.017	0.000	0.478 ✔	1.333	H1-3+VT ✔
	12.1474 - 9.7179	0.011	0.472	0.000	0.017	0.000	0.483 ✔	1.333	H1-3+VT ✔
	9.7179 - 7.28842	0.011	0.477	0.000	0.017	0.000	0.488 ✔	1.333	H1-3+VT ✔
	7.28842 - 4.85895	0.011	0.482	0.000	0.017	0.000	0.493 ✔	1.333	H1-3+VT ✔
	4.85895 - 2.42947	0.011	0.486	0.000	0.017	0.000	0.498 ✔	1.333	H1-3+VT ✔
	2.42947 - 0	0.012	0.491	0.000	0.017	0.000	0.502 ✔	1.333	H1-3+VT ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
L1	120 - 92.71	Pole	TP32.27x26.9x0.25	1	-6.87	1283.70	15.0	Pass
L2	92.71 - 46.16	Pole	TP40.8x30.8688x0.375	2	-16.26	2433.26	30.5	Pass
L3	46.16 - 0	Pole	TP49x38.9487x0.4375	3	-30.46	3505.75	37.7	Pass
							Summary	
						Pole (L3)	37.7	Pass
						RATING =	**37.7**	**Pass**

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Subject:		Anchor Bolt and Baseplate Analysis
Location:		120-ft Monopole Canton, CT
Rev. 0: 9/29/11		Prepared by: T.J.L. Checked by: C.F.C. Job No. 11074.CO24

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	OM := 1288·ft·kips	(Input From RisaTower)
Shear Force =	Shear := 12·kips	(Input From RisaTower)
Axial Force =	Axial := 30·kips	(Input From RisaTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	N := 18	(User Input)
Diameter of Bolt Circle =	D_{bc} := 58.0·in	(User Input)
Bolt "Column" Distance =	l := 3.0·in	(User Input)
Bolt Ultimate Strenght =	F_u := 100·ksi	(User Input)
Bolt Yield Strenght =	F_y := 75·ksi	(User Input)
Bolt Modulus =	E := 29000·ksi	(User Input)
Diameter of Anchor Bolts =	D := 2.25·in	(User Input)
Threads per Inch =	n := 4.5	(User Input)

Base Plate Data:

Use ASTM A572 Grade 60

Plate Yield Strength =	Fy_{bp} := 60·ksi	(User Input)
Base Plate Thickness =	t_{bp} := 2.0·in	(User Input)
Base Plate Diameter =	D_{bp} := 64.0·in	(User Input)
Outer Pole Diameter =	D_{pole} := 49.0·in	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =: $R_{bc} := \frac{D_{bc}}{2} = 29 \cdot in$

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

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

$d_1 = 9.92 \cdot in$	$d_9 = 0.00 \cdot in$
$d_2 = 18.64 \cdot in$	$d_{10} = -9.92 \cdot in$
$d_3 = 25.11 \cdot in$	$d_{11} = -18.64 \cdot in$
$d_4 = 28.56 \cdot in$	$d_{12} = -25.11 \cdot in$
$d_5 = 28.56 \cdot in$	$d_{13} = -28.56 \cdot in$
$d_6 = 25.11 \cdot in$	$d_{14} = -28.56 \cdot in$
$d_7 = 18.64 \cdot in$	$d_{15} = -25.11 \cdot in$
$d_8 = 9.92 \cdot in$	$d_{16} = -18.64 \cdot in$

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 24.5 \cdot in$

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

$MA_1 = 0.00 \cdot in$	$MA_9 = 0.00 \cdot in$
$MA_2 = 0.00 \cdot in$	$MA_{10} = 0.00 \cdot in$
$MA_3 = 0.61 \cdot in$	$MA_{11} = 0.00 \cdot in$
$MA_4 = 4.06 \cdot in$	$MA_{12} = 0.00 \cdot in$
$MA_5 = 4.06 \cdot in$	$MA_{13} = 0.00 \cdot in$
$MA_6 = 0.61 \cdot in$	$MA_{14} = 0.00 \cdot in$
$MA_7 = 0.00 \cdot in$	$MA_{15} = 0.00 \cdot in$
$MA_8 = 0.00 \cdot in$	$MA_{16} = 0.00 \cdot in$

Effective Width of Baseplate for Bending = $B_{eff} := 0.8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 32.9 \cdot in$

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i \left(d_i\right)^2 = 7.569 \times 10^3 \cdot in^2$

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 = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 57.6 \cdot kips$

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

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

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Net}} = 29.5 \cdot \%$ 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 = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.167 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 2.4 \cdot ksi$

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

Check Combined Stress Requirement:

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

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

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

Check Anchor Bolt Compression/Combined Stress:

Maximum Compressive Force =

$$C_{Max} := OM \cdot \frac{R_{bc}}{I_p} + \frac{Axial}{N} = 60.9 \cdot kips$$

Maximum Compressive Stress =

$$f_a := \frac{C_{Max}}{A_n} = 18.7 \cdot ksi$$

$$K := 0.65$$

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

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

Allowable Compressive Stress =

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

(1.333 increase allowed per TIA/EIA)

Combined Stress % of Capacity =

$$\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) = 31.3 \cdot \%$$

Condition 2 =

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

Condition2 = "OK"

Base Plate Analysis:

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

$C_1 = 21.9 \cdot kips$ $C_9 = 1.7 \cdot kips$

$C_2 = 39.7 \cdot kips$ $C_{10} = -18.6 \cdot kips$

$C_3 = 53.0 \cdot kips$ $C_{11} = -36.4 \cdot kips$

$C_4 = 60.0 \cdot kips$ $C_{12} = -49.6 \cdot kips$

$C_5 = 60.0 \cdot kips$ $C_{13} = -56.7 \cdot kips$

$C_6 = 53.0 \cdot kips$ $C_{14} = -56.7 \cdot kips$

$C_7 = 39.7 \cdot kips$ $C_{15} = -49.6 \cdot kips$

$C_8 = 21.9 \cdot kips$ $C_{16} = -36.4 \cdot kips$

Maximum Bending Stress in Plate = $f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} \cdot t_{bp}^2\right)} = 25.1 \cdot ksi$

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

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} = 42.0 \cdot \%$

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

Condition3 = "Ok"

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Subject:	Foundation Analysis
Location:	120-ft Monopole Canton, CT
Rev. 0: 9/29/11	Prepared by: T.J.L. Checked by: C.F.C. Job No. 11074.CO24

Standard Monopole Foundation:

Input Data:

Tower Data

Overturning Moment =	$OM := 1288 \cdot ft \cdot kips$	(User Input from RISATower)	
Shear Force =	$Shear := 15 \cdot kip$	(User Input from RISATower)	
Axial Force =	$Axial := 30 \cdot kip$	(User Input from RISATower)	
Tower Height =	$H_t := 120 \cdot ft$	(User Input)	

Footing Data:

Overall Depth of Footing =	$D_f := 8.0 \cdot ft$	(User Input)	
Length of Pier =	$L_p := 5.0 \cdot ft$	(User Input)	
Extension of Pier Above Grade =	$L_{pag} := 1.0 \cdot ft$	(User Input)	
Diameter of Pier =	$d_p := 7.0 \cdot ft$	(User Input)	
Thickness of Footing =	$T_f := 3.0 \cdot ft$	(User Input)	
Width of Footing =	$W_f := 24.0 \cdot ft$	(User Input)	

Anchor Bolt Data:

Length of Anchor Bolts =	$L_{st} := 96 \cdot in$	(User Input)	
Projection of Anchor Bolts Above Pier =	$A_{BP} := 12.0 \cdot in$	(User Input)	
Anchor Bolt Diameter =	$d_{anchor} := 2.25 \cdot in$	(User Input)	
Base Plate Bolt Circle =	$MP := 58.0 \cdot in$	(User Input)	

Material Properties:

Concrete Compressive Strength =	$f_c := 4000 \cdot psi$	(User Input)	
Steel Reinforcment Yield Strength =	$f_y := 60000 \cdot psi$	(User Input)	
Anchor Bolt Yield Strength =	$f_{ya} := 75000 \cdot psi$	(User Input)	
Internal Friction Angle of Soil =	$\Phi_s := 33 \cdot deg$	(User Input)	
Allowable Soil Bearing Capacity =	$q_s := 5000 \cdot psf$	(User Input)	
Unit Weight of Soil =	$\gamma_{soil} := 125 \cdot pcf$	(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 =	$n := 1 \cdot ft$	(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 =	$NB_{pier} := 30$	(User Input)	
Clear Cover of Reinforcement =	$Cvr_{pier} := 3 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Diameter of Tie =	$d_{Tie} := 0.5 \cdot in$	(User Input)	

Pad Reinforcement:

Bar Size =	$BS_{top} := 9$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 1.128 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 20$	(User Input)	(Top of Pad)
Bar Size =	$BS_{bot} := 9$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{bbot} := 1.128 \cdot in$	(User Input)	(Bottom of Pad)
Number of Bars =	$NB_{bot} := 36$	(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 =

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

Pad Bottom Reinforcement Bar Area =

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

Coefficient of Lateral Soil Pressure =

$$K_p := \frac{1 + \sin(\Phi_s)}{1 - \sin(\Phi_s)} = 3.392$$

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 =

$\gamma_s := if(Bouyancy = 1, \gamma_{soil} - 62.4pcf, \gamma_{soil}) = 125 \cdot pcf$

Passive Pressure =

$P_{pn} := K_p \cdot \gamma_s \cdot n + c \cdot 2 \cdot \sqrt{K_p} = 0.424 \cdot ksf$

$P_{pt} := K_p \cdot \gamma_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p} = 2.12 \cdot ksf$

$P_{top} := if[n < (D_f - T_f), P_{pt}, P_{pn}] = 2.12 \cdot ksf$

$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p} = 3.392 \cdot ksf$

$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 2.756 \cdot ksf$

$T_p := if[n < (D_f - T_f), T_f, (D_f - n)] = 3$

$A_p := W_f \cdot T_p = 72$

Ultimate Shear =

$S_u := P_{ave} \cdot A_p = 198.439 \cdot kip$

Weight of Concrete Pad =

$WT_c := \left[\left(W_f^2 \cdot T_f\right) + \frac{d_p^2 \cdot \pi}{4} L_p\right] \cdot \gamma_c = 288.063 \cdot kip$

Weight of Soil Above Footing =

$WT_{s1} := \left[\left(W_f^2 - \frac{d_p^2 \cdot \pi}{4}\right) \cdot \left(\left|L_p - L_{pag} - n\right|\right)\right] \cdot \gamma_s = 201.57 \cdot kip$

Weight of Soil Wedge at Back Face =

$WT_{s2} := \left(\frac{D_f^2 \cdot \tan(\Phi_s)}{2} \cdot W_f\right) \cdot \gamma_s = 62.343 \cdot kip$

Weight of Soil Wedge at back face Corners =

$WT_{s3} := 2 \cdot \left[(D_f)^3 \cdot \frac{\tan(\Phi_s)}{3}\right] \cdot \gamma_s = 27.708 \cdot kips$

Total Weight =

$WT_{tot} := WT_c + WT_{s1} + Axial = 519.632 \cdot kip$

Resisting Moment =

$M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + \left[(WT_{s2} + WT_{s3}) \cdot \left(W_f + \frac{D_f \cdot \tan(\Phi_s)}{3}\right)\right] = 8751 \cdot kip \cdot ft$

Overturning Moment =

$M_{ot} := OM + Shear \cdot (L_p + T_f) = 1408 \cdot kip \cdot ft$

Factor of Safety Actual =

$FS := \frac{M_r}{M_{ot}} = 6.22$

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 = $S_p := \frac{\mu \cdot WT_{tot}}{FS_{req}} = 116.917 \cdot kips$

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

Shear_Check = "Okay"

Bearing Pressure Caused by Footing:

Area of the Mat = $A_{mat} := W_f^2 = 576$

Section Modulus of Mat = $S := \frac{W_f^3}{6} = 2304 \cdot ft^3$

Maximum Pressure in Mat = $P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S} = 1.513 \cdot ksf$

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

Max_Pressure_Check = "Okay"

Minimum Pressure in Mat = $P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S} = 0.291 \cdot ksf$

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

Min_Pressure_Check = "Okay"

Distance to Resultant of Pressure Distribution = $X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 9.905$

Distance to Kern = $X_k := \frac{W_f}{6} = 4$

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

Eccentricity = $e := \frac{M_{ot}}{WT_{tot}} = 2.71$

Adjusted Soil Pressure = $P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \cdot \left(\frac{W_f}{2} - e\right)} = 1.554 \cdot ksf$

$q_{adj} := if(P_{min} < 0, P_a, P_{max}) = 1.513 \cdot ksf$

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

Pressure_Check = "Okay"

Concrete Bearing Capacity:

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

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

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

Bearing_Check = "Okay"

Shear Strength of Concrete:

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

$\phi_c := 0.85$ (ACI 9.3.2.5)

$d := T_f - Cvr_{pad} - d_{bbot} = 31.872 \cdot in$

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

$d_2 := d_1 - d$

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

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

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

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

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

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 = $b_o := \left(d_p + d\right) \cdot \pi = 30.3$

Area Included Inside Perimeter = $A_{bo} := \frac{\pi \cdot \left(d_p + d\right)^2}{4} = 73.2$

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 502.8$

Guess Value = $v_u := 1ksf$

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

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

$v_u := Find(v_u) = 6.4 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f = 411.1 \cdot kips$

Required Shear Strength = $V_{req} := LF \cdot V_u = 548 \cdot kips$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 2494.9 \cdot kip$ (ACI-2008 11.11.2.1)

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

Punching_Shear_Check = "Okay"

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

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

$q_b := q_{adj} - d_1 \cdot Slope = 1.08 \cdot ksf$

Maximum Bending at Face of Pier = $M_n := \frac{1}{LF \cdot \phi_m} \cdot \left[(q_{adj} - q_b) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f = 989.3 \cdot kip \cdot ft$

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

(ACI-200810.2.7.3)

$R_u := \frac{M_n}{\phi_m \cdot W_f \cdot d^2} = 6.5 \cdot ksf$

$\rho := \frac{0.85 \cdot f_c}{f_y} \left(1 - \sqrt{1 - \frac{2 \cdot R_u}{0.85 \cdot f_c}} \right) = 0.0008$

$\rho_{min} := 1.333 \cdot \rho = 0.00101$

Required Reinforcement for Temperature and Shrinkage:

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

Check Bottom Bars:

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

$$As_{prov} := A_{bbot} \cdot NB_{bot} = 36 \cdot in^2$$

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

Pad_Reinforcement_Bot = "Okay"

Check top Bars:

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

$$As_{prov} := A_{btop} \cdot NB_{top} = 20 \cdot in^2$$

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

Pad_Reinforcement_Top = "Okay"

Developement Length Pad Reinforcement:

Bar Spacing =

$$B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 6.9 \cdot in$$

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)

$$L_{dbt} := \frac{3 \cdot f_y \alpha_{pad} \cdot \beta_{pad} \cdot \gamma_{pad} \cdot \lambda_{pad}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \frac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot} = 30.2 \cdot in$$

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 =

$$L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad} = 99 \cdot in$$

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

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

Area of Pier =

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

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

$$A_{sprov} := NB_{pier} \cdot A_{bpier} = 29.98 \cdot in^2$$

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

Steel_Area_Check = "Okay"

Bar Spacing In Pier =

$$B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 7.668 \cdot in$$

Diameter of Reinforcement Cage =

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

Maximum Moment in Pier =

$$M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2} \right) \right] \cdot LF = 21922.5 \cdot in \cdot kips$$

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

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

$$\left(D \;\; N \;\; n \;\; P_u \;\; M_{xu} \right) = \left(84 \;\; 30 \;\; 9 \;\; 39.99 \;\; 2.192 \times 10^4 \right)$$

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

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

$$\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho \right) = \left(109.251 \;\; 5.989 \times 10^4 \;\; -60 \;\; 5.413 \times 10^{-3} \right)$$

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

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:

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

$L_{pad} := T_f - Cvr_{pad} = 33 \cdot in$

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)

$L_{dbt} := \frac{3 \cdot f_y \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 30.18 \cdot in$

Minimum Development Length =

$L_{dh} := \frac{1200 \cdot d_{bpier}}{\sqrt{\frac{f_c}{psi}}} \cdot .7 = 14.982 \cdot in$ (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)

$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot f_y}{\sqrt{f_c \cdot psi}} = 21.402 \cdot in$

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

$L_{dbc} := if\left(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}\right) = 21.402 \cdot in$

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

$L_{compression_Check} = "Okay"$

Tie Size and Spacing in Column:

Minimum Tie Size =

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

Used #4 Ties

Seismic Factor =

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

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

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

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

$s_{lim4} := 18in$

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 =

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

Length of Anchor Bolt =

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

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

Depth_Check = "No Good"

Note: Anchor plate is provided

SITE NAME	COLLINSVILLE CT	ECP - CELL #	2	486
LATITUDE	41-51-02.03 N	LONGITUDE	72-56-55.41 W	
Additional Comments: LTE antenna add keeping with 12 antennas and adding 6 additional main lines		SAVE BUTTON		
		STRUCTURE TYPE		

700 Mhz - LTE ANTENNA ADD	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	eNodeB	eNodeB	eNodeB
ANTENNA TYPE	BXA-70063-6CF_2	BXA-70063-6CF_2	BXA-70063-6CF_2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	30	140	270
DOWN TILT (MECH/DEG)	0	4	0
RAD CTR (FT AGL)	120	120	120
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			

850 Celluar - Current Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	#N/A	#N/A	#N/A
ANTENNA TYPE	LPA-80080/6CF	LPA-80080/6CF	LPA-80080/6CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	30	150	270
DOWN TILT (MECH/DEG)	0	4	0
RAD CTR (FT AGL)	120	120	120
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			

850 Celluar - Future Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	#N/A	#N/A	#N/A
ANTENNA TYPE	LPA-80080/6CF	LPA-80080/6CF	LPA-80080/6CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	30	**140**	270
DOWN TILT (MECH/DEG)	0	4	0
RAD CTR (FT AGL)	120	120	120
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
DIPLEX WITH LTE CABLE			

1900 PCS - Current Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	#N/A	#N/A	#N/A
ANTENNA TYPE	DB950F85E-M_0	DB950F85E-M_0	DB950F85E-M_0
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	30	150	270
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	120	120	120
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			

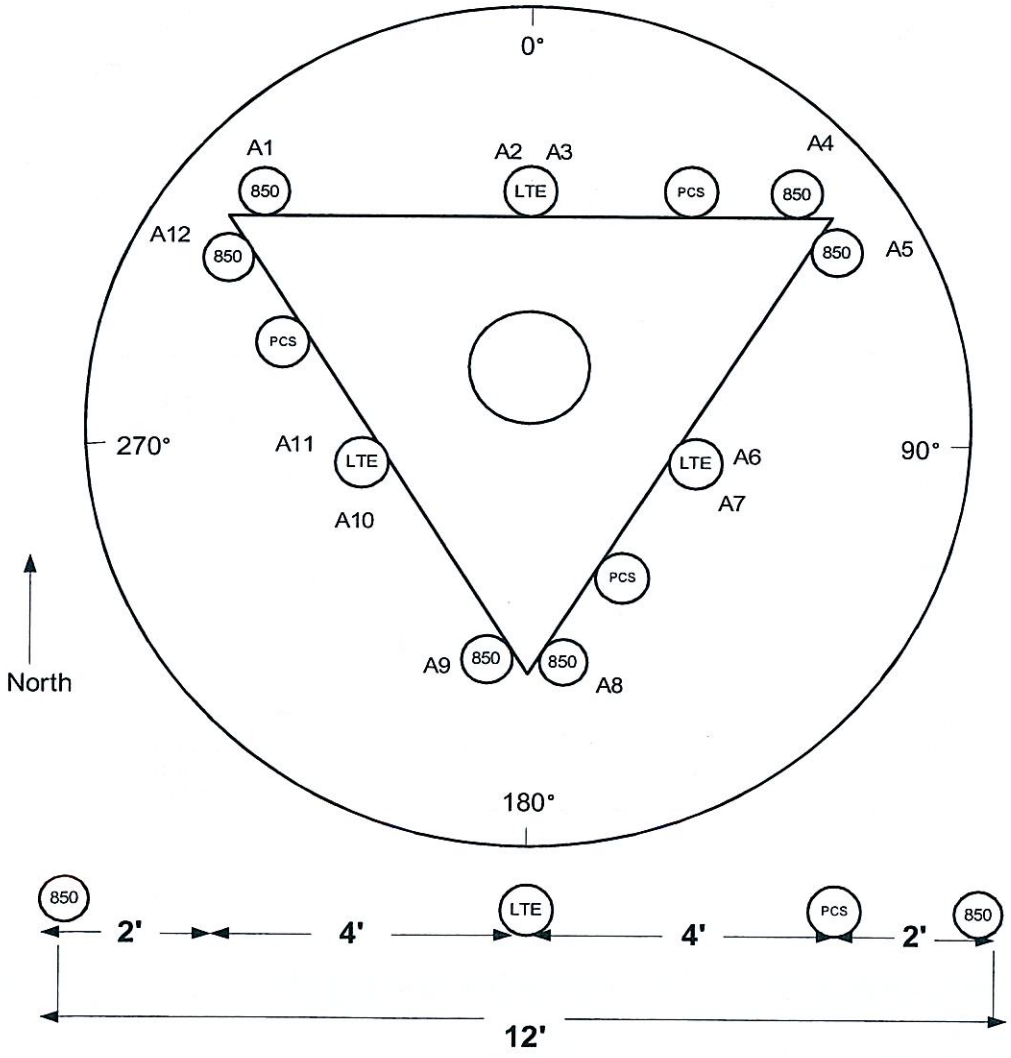
1900 PCS - Future Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	#N/A	#N/A	#N/A
ANTENNA TYPE	**BXA-171085-12BF_2**	**BXA-171085-12BF_2**	**BXA-171085-12BF_2**
QTY OF ANTENNAS PER FACE	**1**	**1**	**1**
ORIENTATION (DEG)	30	**140**	270
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	120	120	120
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE			

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

TX / RX FREQUENCIES			TX POWER OUTPUT	
Cellular A-Band	**PCS F / AWS-Band**	**700 Mhz C - E**	Cellular (Watts)	20

TX - 869-880,890-891.5 MHz				TX - 1970-1975 / 2145-21				TX - 746-757			PCS (Watts)	16
RX - 824-835,845-846.5 MHz				RX - 1890-1895 / 1745-17				RX - 776-787			LTE (Watts)	40
ALPHA				**BETA**				**GAMMA**				
Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code	
A1	800	Tx1/Rx0	RED	A7	800	Tx2/Rx0	BLUE	A13	800	Tx3/Rx0	GREEN	
A2	1900	Tx1/Rx0	RED/ WHITE	A8	1900	Tx2/Rx0	BLUE/ WHITE	A14	1900	Tx3/Rx0	GREEN/WHITE	
A3	700	Tx1/Rx0	RED/ ORANGE	A9	700	Tx2/Rx0	BLUE/ ORANGE	A15	700	Tx3/Rx0	GREEN/ORANGE	
A4	700	Tx4/Rx1	RED/RED/ ORANGE	A10	700	Tx5/Rx1	BLUE/BLUE/ ORANGE	A16	700	Tx6/Rx1	GREEN/GREEN/ ORANGE	
A5	1900	Tx4/Rx1	RED/RED/ WHITE	A11	1900	Tx5/Rx1	BLUE/BLUE/ WHITE	A17	1900	Tx6/Rx1	GREEN/GREEN/ WHITE	
A6	800	Tx4/Rx1	RED/RED	A12	800	Tx5/Rx1	BLUE/BLUE	A18	800	Tx6/Rx1	GREEN/GREEN	
RF ENGINEER				**RF MANAGER**				**INITIALS**			**DATE**	
Prepared By: Mark Brauer				Steve Weatherbee				MB			9/1/2011	

Site Configuration



Slant ±45° Dual Polarized FET Panel 63° / 14.5 dBd
696-900 MHz

Mechanical specifications

Length	1804	mm	71.0	in
Width	285	mm	11.2	in
Depth	114	mm	4.5	in
Depth with z-bracket	154	mm	6.1	in
Weight [4]	7.9	kg	17.0	lbs
Wind Area Fore/Aft	0.51	m^2	5.5	ft^2
Wind Area Side	0.21	m^2	2.2	ft^2
Max Wind Survivability	>201	km/hr	>125	mph
Wind Load @ 100 mph (161 km/hr)				
Fore/Aft	753	N	169	lbf
Side	351	N	79	lbf

Antenna consisting of aluminum alloy with brass feedlines covered by a UV safe fiber-glass radome.

Mounting & Downtilting

Mounting hardware attaches to pipe diameter Ø50-160 mm; Ø2.0-6.3 in

Mounting Bracket Kit	36210002
Downtilt Bracket Kit	36114003

Electrical specifications

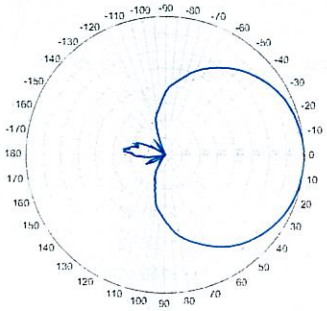
Frequency Range	696-900 MHz
Impedance	50Ω
Connector [3]	NE or E-DIN Female 2 ports / Center
VSWR [1]	≤ 1.4:1
Polarization	Slant ±45°
Isolation Between Ports [1]	< -25 dB
Gain [1]	14.5 dBd
Power Rating [2]	500 W
Half Power Angle [1]	
Horizontal Beamwidth	63°
Vertical Beamwidth	11°
Electrical downtilt [5]	0°
Null fill [1]	5%
Lightning protection	Direct ground

Patented Dipole Design: U.S. Patent No. 6,608,600 B2

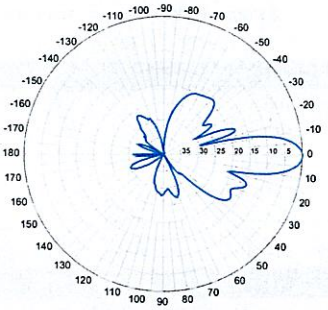
1) Typical values.
2) Power rating limited by connector only.
3) NE indicates an elongated N connector. E-DIN indicates an elongated DIN connector.
4) Antenna weight does not include brackets.
5) Add'l downtilts may be available. Check website for details.

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

Radiation-pattern[1]
750 MHz

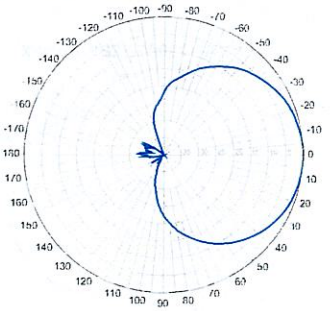


Horizontal

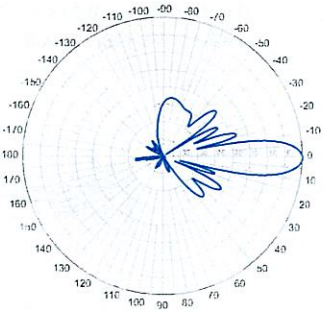


Vertical

850 MHz



Horizontal

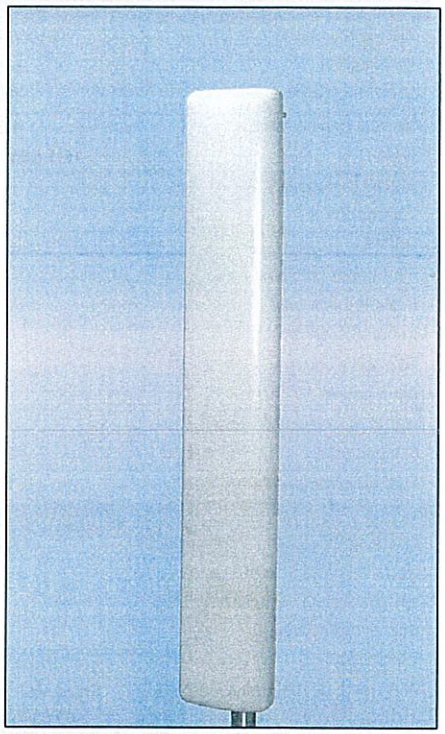


Vertical

696-900 MHz

BXA-70063/6CF __

When ordering replace "__" with connector type.



Featuring our Exclusive 3T Technology™ Antenna Design:

- Watercut brass feedline assembly for consistent performance.
- 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.

Warranty:
This antenna is under a five-year limited warranty for repair or replacement.

Revision Date: 08/07/08

815.399.0001 • antel@antelinc.com • www.antelinc.com

Amphenol Antel, Inc. The Antenna Technology Company

BXA-171085-12BF-EDIN-X

Replace "X" with desired electrical downtilt

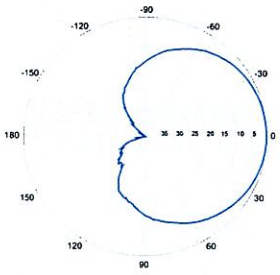
X-Pol | FET Panel | 85° | 18.0 dBi

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

Mechanical Characteristics		
Dimensions Length x Width x Depth	1820 x 154 x 105 mm	71.7 x 6.1 x 4.1 in
Depth with z-brackets	133 mm	5.2 in
Weight without mounting brackets	6.8 kg	15 lbs
Survival wind speed	> 201 km/hr	> 125 mph
Wind area	Front: 0.28 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

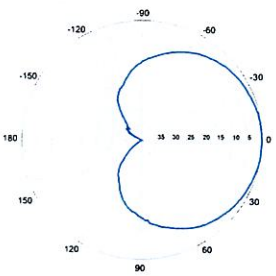
Mounting Options	Part Number	Fits Pipe Diameter	Weight
2-Point Mounting Bracket Kit	26799997	50-102 mm 2.0-4.0 in	2.3 kg 5 lbs
2-Point Mounting & Downtilt Bracket Kit	26799999	50-102 mm 2.0-4.0 in	3.6 kg 8 lbs
Concealment Configurations	For concealment configurations, order BXA-171085-12BF-EDIN-X-FP		

BXA-171085-12BF-EDIN-X



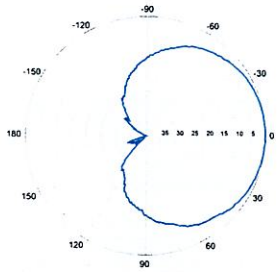
Horizontal | 1710-1880 MHz

BXA-171085-12BF-EDIN-X



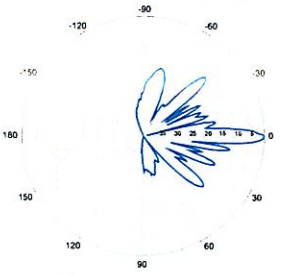
Horizontal | 1850-1990 MHz

BXA-171085-12BF-EDIN-X



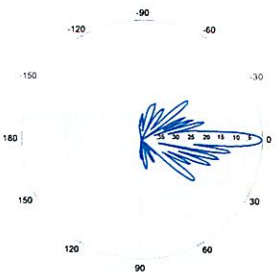
Horizontal | 1920-2170 MHz

BXA-171085-12BF-EDIN-0



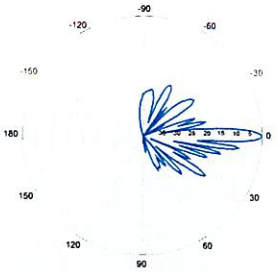
0° | Vertical | 1710-1880 MHz

BXA-171085-12BF-EDIN-0



0° | Vertical | 1850-1990 MHz

BXA-171085-12BF-EDIN-0



0° | Vertical | 1920-2170 MHz

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

JWB Tower Services, LLC
148 Governor Street
New Britain, CT 06053
(800) 819-3084
(860) 256-8175 fax

Monopole Inventory
General Information

Site Name:		Collinsville
Site Number:		
FCC Number:		
Manufacturer ID #		EEI
Street Address:		650 Albany Turnpike
City/State/Zip Code:		Canton, CT
County:		
Lat:	N/S	41° 51' 02"
Long:	E/W	72° 56' 55"
Performed By:		JWB
Date:		9/11/2011

Antenna Information:

CARRIER Verizon **PIC #** 3

MOUNT

Type:	Lo-pro Plat	Manf.:	EEI				
Elev. C/L:	118'	Bottom:		Top:		Leg:	
Face Width:	14'	Height:	4"	Projection:	N/A	Azimuth/s:	

ANTENNA 1 - Outer

Type:	Panel	Manf.:	Antel/Amphenol	Model:	LPA-80080/6CF		
Elev. C/L:	120'	Bottom:		Top:		Leg:	
Quantity:	6	Dim: (HxWxD)				Azimuth/s:	

ANTENNA 2 - Inner

Type:	Panel	Manf.:	Andrew/Decibel	Model:	DB950F85E-M		
Elev. C/L:	120'	Bottom:		Top:		Leg:	
Quantity:	6	Dim: (HxWxD)				Azimuth/s:	

TMA'S

Quantity:	N/A	Manf.:		Model:	

COAX

Quantity:	12	Size:	1 5/8"	Jumper:	1/2"	Color:	N/A

CARRIER AT&T **PIC #** 4

MOUNT

Type:	Lo-pro Plat	Manf.:	Valmont / SitePro				
Elev. C/L:	108'	Bottom:		Top:		Leg:	
Face Width:	12'-6"	Height:	4"	Projection:	N/A	Azimuth/s:	

ANTENNA

Type:	Panel	Manf.:	Powerwave	Model:	P65-15-XLH-RR H		
Elev. C/L:	110'	Bottom:		Top:		Leg:	
Quantity:	6	Dim: (HxWxD)				Azimuth/s:	

TMA'S

Quantity:	6	Manf.:	Powerwave	Model:	TT19-08BP111-001

COAX

Quantity:	12	Size:	1 5/8"	Jumper:	1/2"	Color:	N/A

CARRIER	T-Mobile					PIC #	5

MOUNT

Type:	T-Arm	Manf.:	Valmont / SitePro				
Elev. C/L:	98'	Bottom:		Top:		Leg:	
Face Width:	12'	Height:	4"	Projection:	N/A	Azimuth/s:	

ANTENNA

Type:	Panel	Manf.:	RFS	Model:	APX16DWV-16DWVS		
Elev. C/L:	100'	Bottom:		Top:		Leg:	
Quantity:	3	Dim: (HxWxD)				Azimuth/s:	

TMA'S

Quantity:	3	Manf.:	RFS	Model:	ATM1900D-1CWA

TMA'S

Quantity:	3	Manf.:	RFS	Model:	ATMAP1412D-1A20

COAX

Quantity:	12	Size:	1 5/8"	Jumper:	1/2"	Color:	N/A

CARRIER	MetroPCS					PIC #	6

MOUNT

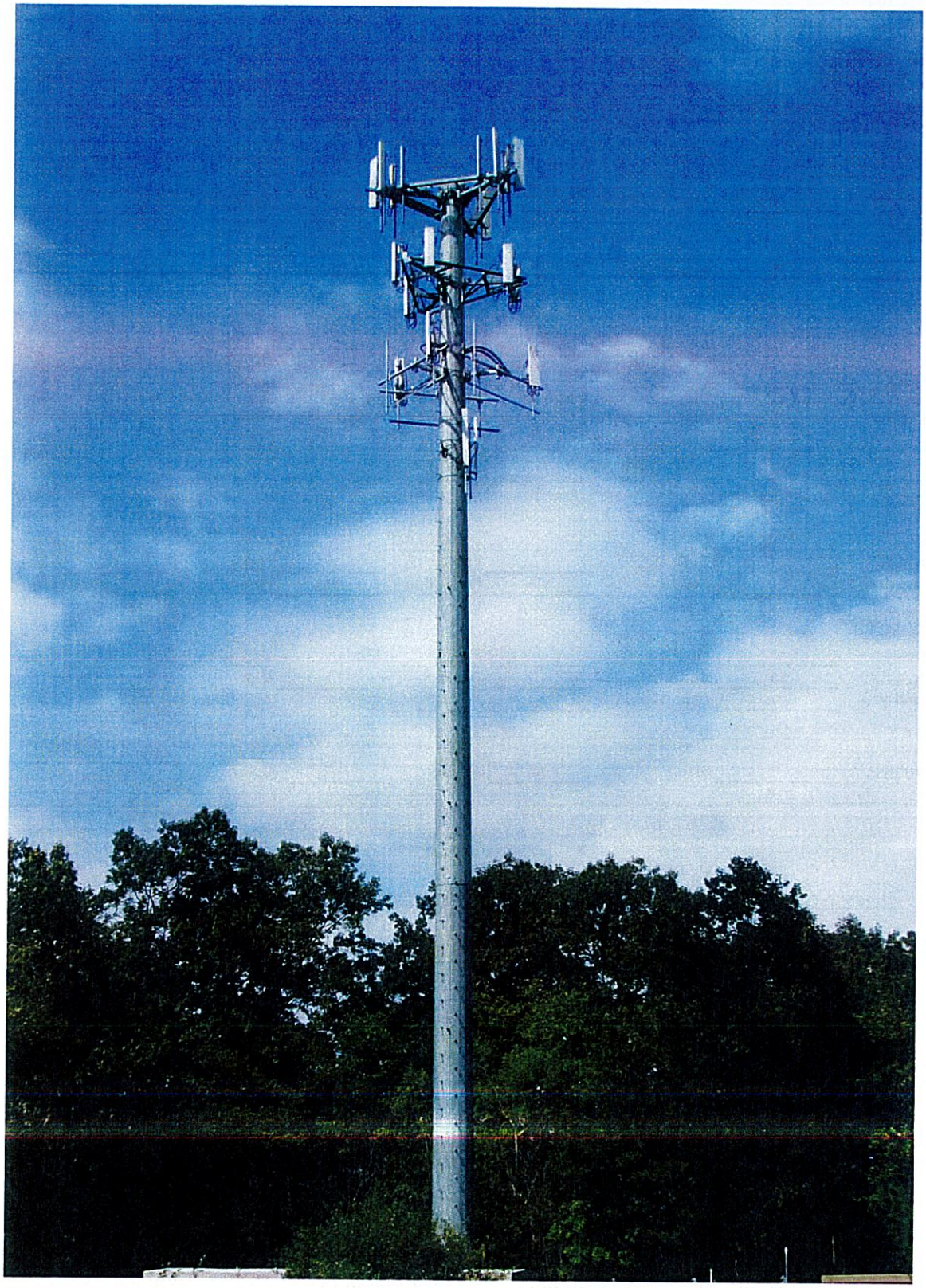
Type:	Flush	Manf.:	Unknown/Chain Mount				
Elev. C/L:	91'	Bottom:		Top:		Leg:	
Face Width:	2.5"	Height:	N/A	Projection:	N/A	Azimuth/s:	

ANTENNA

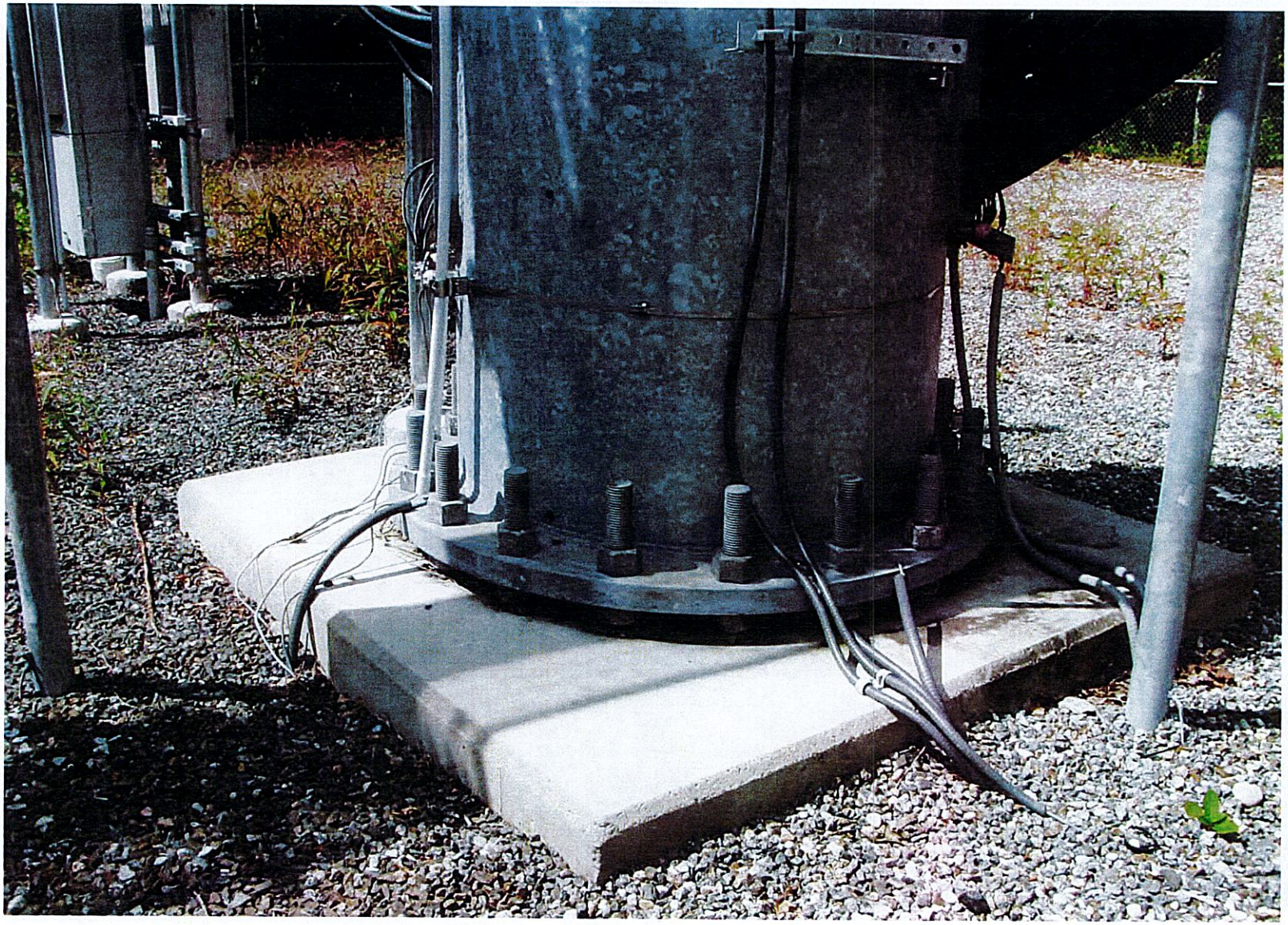
Type:	Panel	Manf.:	RFS	Model:	APXV18-206517S		
Elev. C/L:	91'	Bottom:		Top:		Leg:	
Quantity:	3	Dim: (HxWxD)				Azimuth/s:	

COAX

Quantity:	6	Size:	1 5/8"	Jumper:	1/2"	Color:	N/A

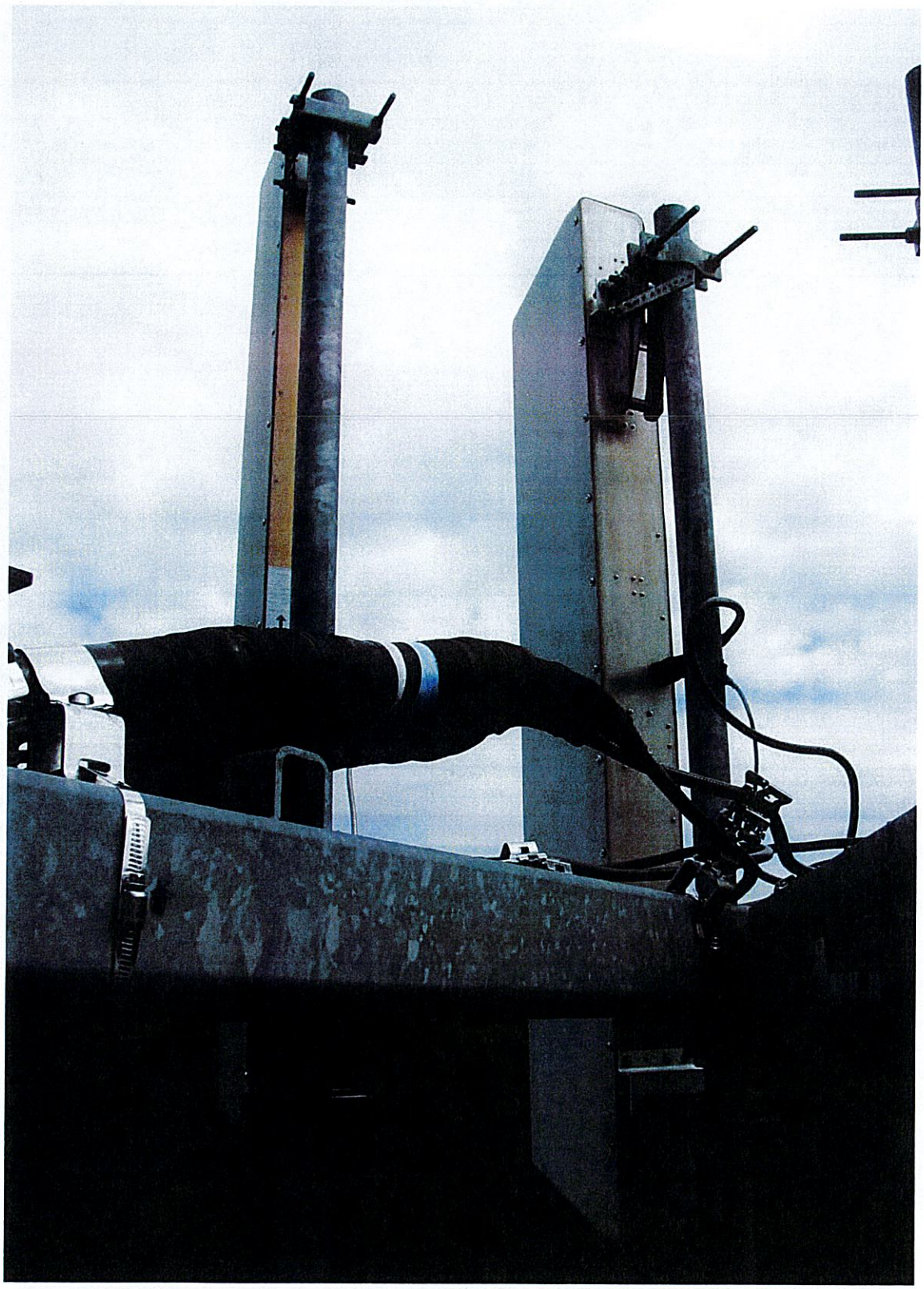


1.0 Elevation



2.0 Base

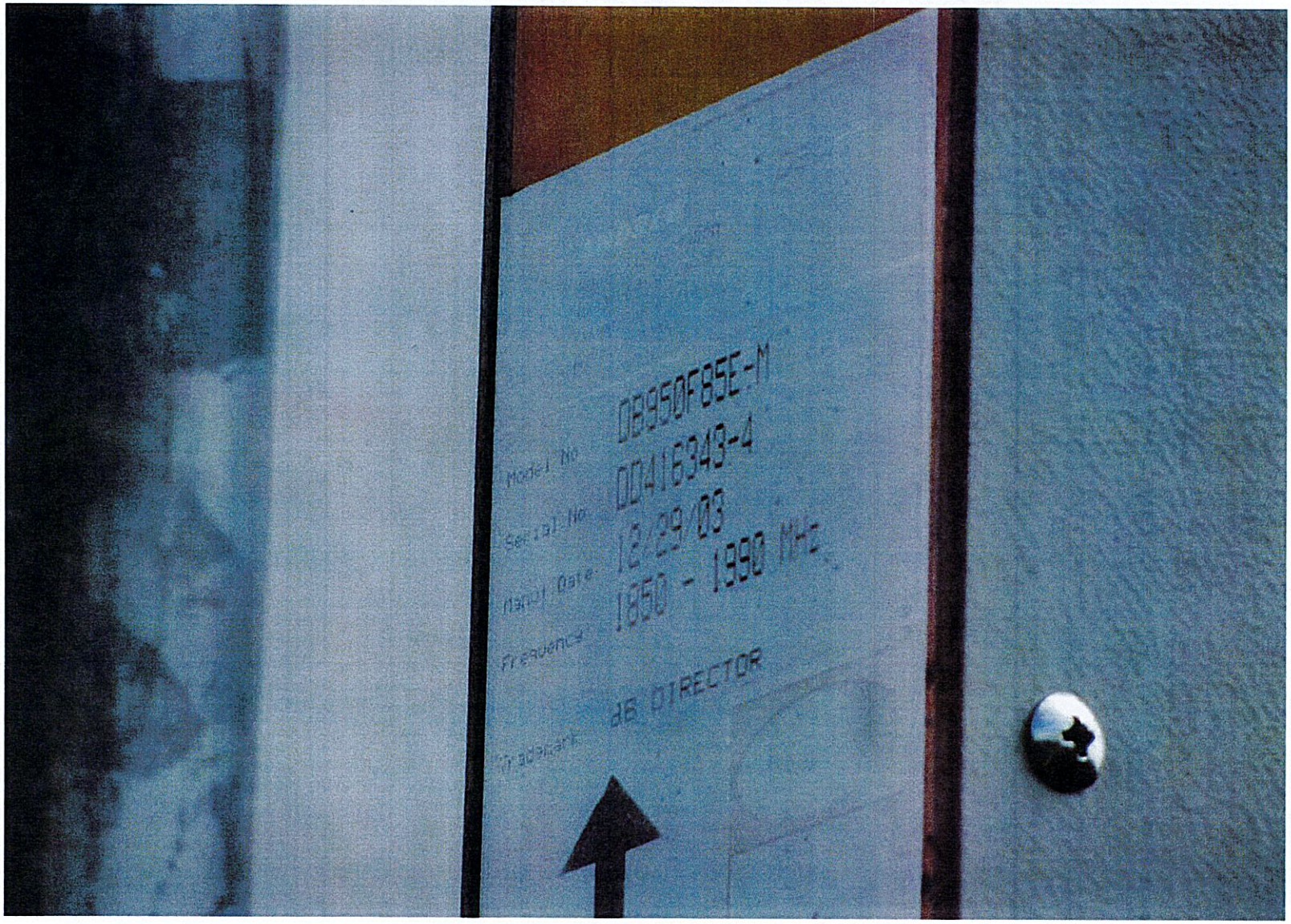
3.1 Verizon



3.2 Verizon

Amphenol
Antel, Inc.
SERIAL NUMBER:
397093
806-900 MHz
500 WATTS
1300 CAPITAL DRIVE, ROCKFORD, IL 61109, USA
50 OHMS

3.3 Verizon


Model No
DB950F65E-M
Serial No
DD416343-4
Mfgr Date
12/29/03
Frequency
1850 - 1990 MHz
Trademark
86 DIRECTOR

3.4 Verizon

4.1 ATT

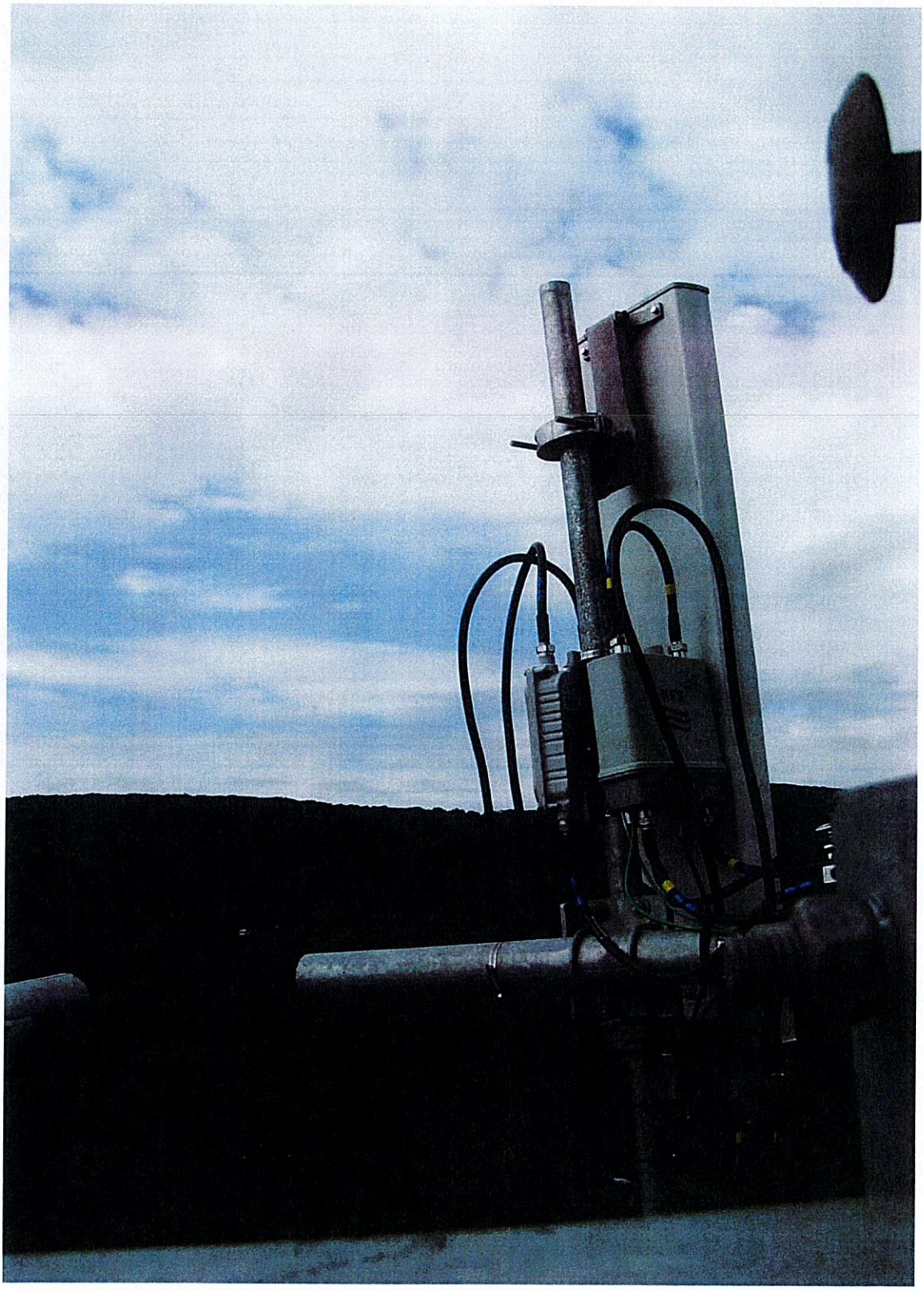
DBB65 698-894/1710-2170-15i-Ai-D
P65-15-XLH-RR H
B9111192124
UP
Assembled in China
Powerwave

4.3 ATT

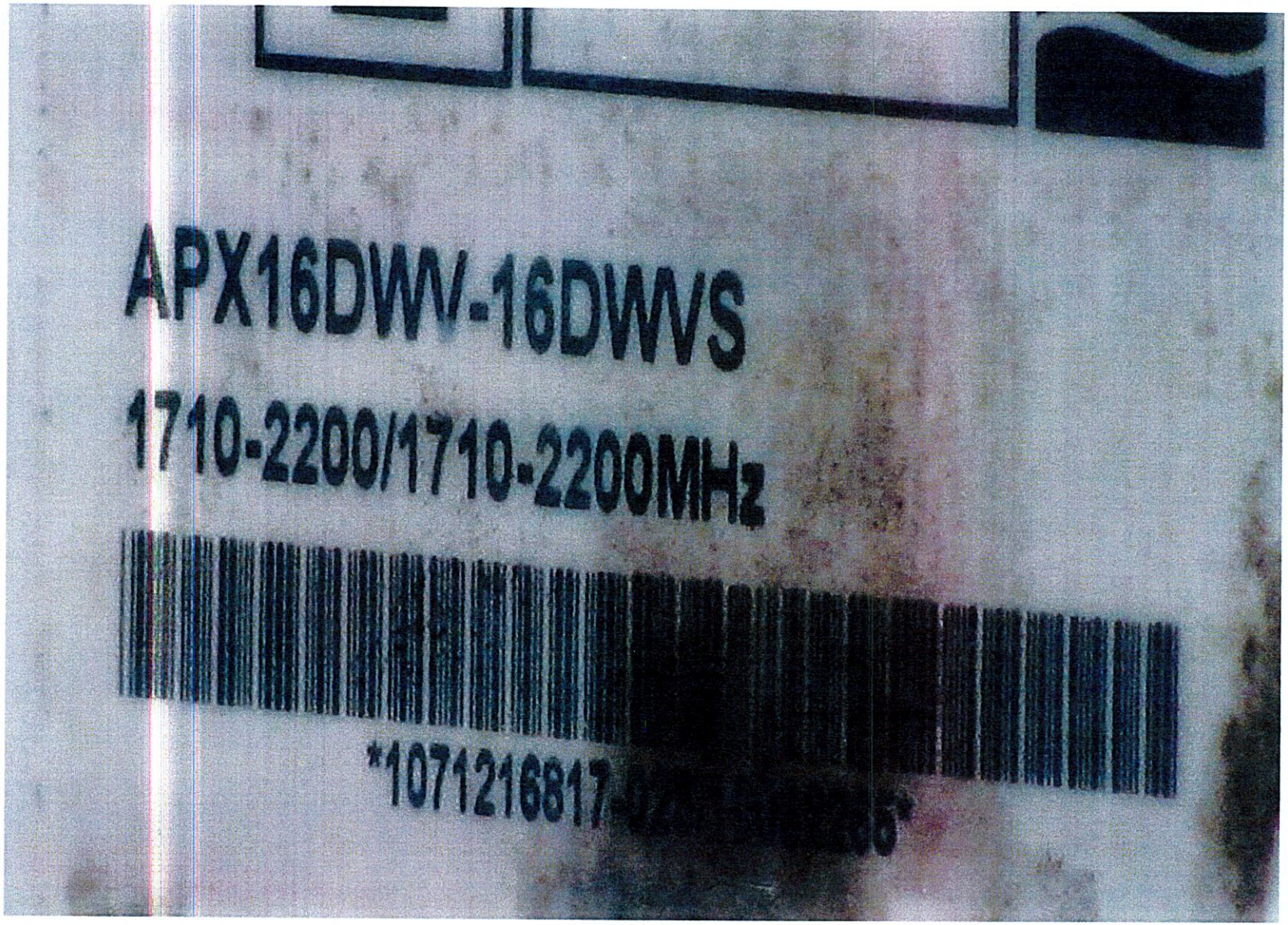
TT19-08BP111-001
TMA 1900/850
Powerwave technologies
BYPASS TWIN
824-849 1850-1910MHz
FC61046A1AA4
ASSEMBLED IN CHINA

4.4 ATT

5.1 T-Mobile



5.2 T-Mobile



5.3 T-Mobile

RADIO FREQUENCY SYSTEMS
Twin1900 PCS TMA
MODEL: ATM1900D-1CWA
S/N: RFSM2510358?
BETA 6

5.4 T-Mobile

6.1 MetroPCS

6.2 MetroPCS