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Structural Analysis Report

140-ft Existing Valmont Monopole

Proposed AT&T Mobility
Antenna Upgrade

AT&T Site Ref: CT1043

Verizon Site Ref: Woodstock NW

40 Sherman Road
Woodstock, CT

CENTEK Project No. 13212

~~Date: August 5, 2013~~
Rev 1: August 13, 2013

STATE OF CONNECTICUT
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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 AT&T Mobility on the existing monopole (tower) located in Woodstock, CT.

The host tower is a 140-ft tall extendable to 157-ft, three-section, eighteen sided, tapered monopole, originally designed and manufactured by Valmont; project no. 12650-69 dated June 26, 2009. The tower geometry, structure member sizes and foundation system information were obtained from the original manufacturers design documents.

Antenna and appurtenance information were obtained from a previous structural analysis report prepared by Centek job no. 12044.CO12 dated October 8, 2012.

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 28.58-in at the top and 65.00-in at the base.

AT&T Mobility proposes the installation of six (6) Remote Radio Units (RRU's) and one (1) surge arrestor mounted on a proposed universal ring mount. 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:

- VERIZON (RESERVED):
  Antennas: Six (6) Antel LPA-80063-6CF panel antennas, six (6) Antel BXA-70063-6CF panel antennas, six (6) LPA-171063-12CF panel antennas, six (6) RRH's and one (1) main distribution box mounted to a 13-ft low profile platform with a RAD center elevation of 137-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing tower. Six (6) 1-5/8" ∅ coax cables and two (2) 1-5/8" ∅ fiber cable banded to the exterior of the existing tower.

- AT&T (EXISTING):
  Antennas: Six (6) Powerwave 7770.00 panel antennas, two (2) KMW AM-X-CD-17-65-00T-RET panel antennas, one (1) Powerwave P65-17-XLH-RR panel antenna, six (6) Powerwave TT08-19DB111-001 TMA's and six (6) RET's mounted on a 13-ft low profile platform with a RAD center elevation of 127-ft above grade level.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing tower.

- AT&T (RESERVED):
  Antennas: Three (3) Powerwave 7770.00 panel antennas, three (3) Powerwave TT08-19DB111-001 TMA's and three (3) RET's mounted on a 13-ft low profile platform with a RAD center elevation of 127-ft above grade level.
  Coax Cables: Six (6) 1-5/8" ∅ coax cables banded to the exterior of the existing tower.

- AT&T (EXISTING):
  Antennas: Six (6) Ericsson RRUS-11 and one (1) Raycap DC6-48-60-18-8F surge arrestor mounted to one (1) universal ring mount with a RAD center elevation of 125-ft above grade level.
  Coax Cables: One (1) fiber cable and two (2) dc control cables running inside of the existing tower.
- **AT&T (PROPOSED):**
  Antennas: Six (6) Ericsson RRUS-11 and one (1) Raycap DC6-48-60-18-8F surge arrestor mounted to one (1) universal ring mount with a RAD center elevation of 129-ft above grade level.
  Coax Cables: One (1) fiber cable and two (2) dc control cables running inside of the existing tower.

Primary Assumptions Used in the Analysis

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

Analysis

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

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

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

Tower Loading

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

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

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

Tower Capacity

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

- Calculated stresses were found to be within allowable limits. In Load Case 1, per RISATower "Section Capacity Table", this tower was found to be at **49.5%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L3)	0.00'-46.08'	49.5%	**PASS**

Foundation and Anchors

The existing foundation consists of a 8.5-ft Ø x 4.5-ft long reinforced concrete pier on a 26.0-ft square x 3.0-ft thick reinforce concrete pad. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned original design report prepared by Valmont job no. 12650-69 dated June 26, 2009. The base of the tower is connected to the foundation by means of (20) 2.25"∅, ASTM A615-75 anchor bolts embedded approximately 6-ft into the concrete foundation structure.

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

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

Location	Vector	Proposed Reactions
Base	Shear	31 kips
	Compression	40 kips
	Moment	3015 kip-ft

- The foundation was found to be within allowable limits.

Foundation	Design Limit	IBC 2003/2005 CT State Building Code Section 3108.4.2 (FS)(1)	Proposed Loading (FS)(1)	Result
Reinforced Concrete Pad and Pier	OTM(2)	2.0	2.76	**PASS**

Note 1: FS denotes Factor of Safety.

Note 2: OTM denotes Overturning Moment

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

Tower Component	Design Limit	Stress Ratio (percentage of capacity)	Result
Anchor Bolts	Compression	52.0%	**PASS**
Base Plate	Bending	23.5%	**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 AT&T Mobility. If the existing conditions are different than the information in this report, Centek Engineering, Inc. must be contacted for resolution of any potential issues.

Please feel free to call with any questions or comments.

Respectfully Submitted by:

Carlo F. Centore, PE
Principal ~ Structural Engineer

STATE OF CONNECTICUT CARLO F. CENTORE No.16884 LICENSED PROFESSIONAL ENGINEER

Prepared by:

Timothy J. Lynn, EIT
Structural Engineer

Standard Conditions for Furnishing of Professional Engineering Services on Existing Structures

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

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

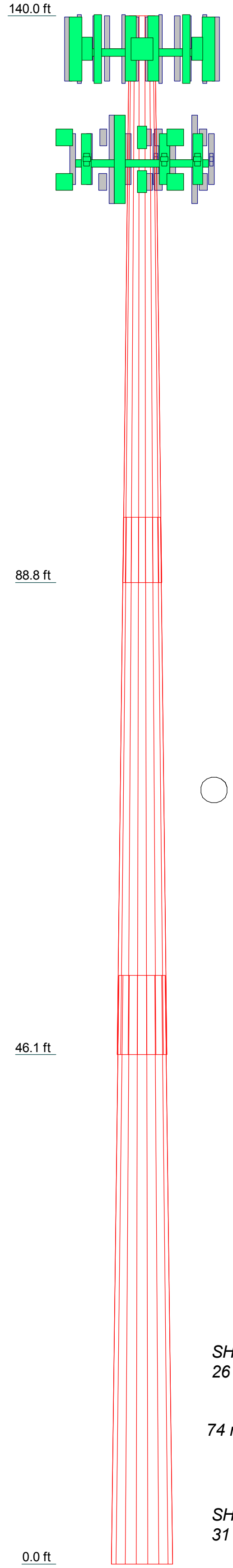
General Description of Structural Analysis Program

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

tnxTower Features:

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

Section	Length (ft)	Number of Sides	Thickness (in)	Socket Length (ft)	Top Dia (in)	Bot Dia (in)	Grade	Weight (K)
1	51.247	18	0.281	5.917	28.583	42.393	A572-65	5.5
2	48.587	18	0.375	7.167	40.236	53.330	A572-65	9.1
3	53.250	18	0.438		50.649	65.000	A572-65	14.4
								29.1



DESIGNED APPURTENANCE LOADING

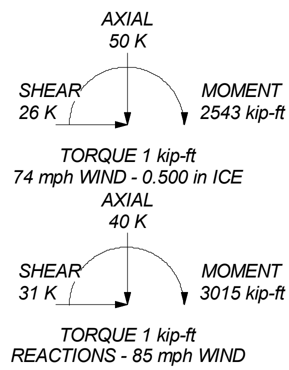
TYPE	ELEVATION	TYPE	ELEVATION
LPA-80063/6CF (Verizon - Reserved)	137	(2) TT08-19DB111-001 TMA (ATT - Existing)	127
LPA-171063-12CF (Verizon - Reserved)	137	(2) RET (ATT - Existing)	127
BXA-70063/6CF (Verizon - Reserved)	137	(2) RET (ATT - Existing)	127
BXA-70063/6CF (Verizon - Reserved)	137	(2) RET (ATT - Existing)	127
LPA-171063-12CF (Verizon - Reserved)	137	7770.00 (ATT - Reserved)	127
LPA-80063/6CF (Verizon - Reserved)	137	7770.00 (ATT - Reserved)	127
LPA-80063/6CF (Verizon - Reserved)	137	7770.00 (ATT - Reserved)	127
LPA-171063-12CF (Verizon - Reserved)	137	TT08-19DB111-001 TMA (ATT - Reserved)	127
BXA-70063/6CF (Verizon - Reserved)	137	TT08-19DB111-001 TMA (ATT - Reserved)	127
BXA-70063/6CF (Verizon - Reserved)	137	TT08-19DB111-001 TMA (ATT - Reserved)	127
LPA-171063-12CF (Verizon - Reserved)	137	RET (ATT - Reserved)	127
LPA-80063/6CF (Verizon - Reserved)	137	RET (ATT - Reserved)	127
LPA-80063/6CF (Verizon - Reserved)	137	RET (ATT - Reserved)	127
LPA-171063-12CF (Verizon - Reserved)	137	Valmont 13' Low Profile Platform (ATT - Existing)	127
BXA-70063/6CF (Verizon - Reserved)	137	P65-17-XLH-RR (ATT - Existing)	127
BXA-70063/6CF (Verizon - Reserved)	137	AM-X-CD-17-65-00T-RET (ATT - Existing)	127
LPA-171063-12CF (Verizon - Reserved)	137	AM-X-CD-17-65-00T-RET (ATT - Existing)	127
LPA-80063/6CF (Verizon - Reserved)	137	(2) 7770.00 (ATT - Existing)	127
(2) RRH (Verizon - Reserved)	137	(2) 7770.00 (ATT - Existing)	127
(2) RRH (Verizon - Reserved)	137	(2) 7770.00 (ATT - Existing)	127
(2) RRH (Verizon - Reserved)	137	(2) TT08-19DB111-001 TMA (ATT - Existing)	127
DB-T1-6Z-8AB-0Z (Verizon - Reserved)	137	(2) TT08-19DB111-001 TMA (ATT - Existing)	127
Valmont 13' Low Profile Platform (Verizon - Existing)	137	(2) RRUS-11 (ATT - Existing)	125
(2) RRUS-11 (ATT - Proposed)	129	(2) RRUS-11 (ATT - Existing)	125
(2) RRUS-11 (ATT - Proposed)	129	(2) RRUS-11 (ATT - Existing)	125
(2) RRUS-11 (ATT - Proposed)	129	DC6-48-60-18-8F Surge Arrestor (ATT - Existing)	125
DC6-48-60-18-8F Surge Arrestor (ATT - Proposed)	129	Valmont Uni-Tri Bracket (ATT - Existing)	125
Valmont Uni-Tri Bracket (ATT - Proposed)	129		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower is located in Windham County, Connecticut.
2. Tower designed for a 85 mph basic wind in accordance with the TIA/EIA-222-F Standard.
3. Tower is also designed for a 74 mph basic wind with 0.50 in ice.
4. Deflections are based upon a 60 mph wind.
5. Weld together tower sections have flange connections.
6. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
7. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
8. Welds are fabricated with ER-70S-6 electrodes.
9. TOWER RATING: 49.5%



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

Job: 13212 - CT1043		
Project: 140' Valmont Monopole - 40 Sherman Rd., Woodstock, CT		
Client: AT&T Mobility	Drawn by: TJL	App'd:
Code: TIA/EIA-222-F	Date: 08/13/13	Scale: NTS
Path: J:\Jobs\1321200.WI\Rev (1)\Calcs\ERI\140' Monopole.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:

- Tower is located in Windham County, Connecticut.
- Basic wind speed of 85 mph.
- Nominal ice thickness of 0.500 in.
- Ice density of 56 pcf.
- A wind speed of 74 mph is used in combination with ice.
- Temperature drop of 50 °F.
- Deflections calculated using a wind speed of 60 mph.
- Weld together tower sections have flange connections..
- Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications..
- Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards..
- Welds are fabricated with ER-70S-6 electrodes..
- A non-linear (P-delta) analysis was used.
- Pressures are calculated at each section.
- Stress ratio used in pole design is 1.333.
- Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Options

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

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

Treat Feedline Bundles As Cylinder
Use ASCE 10 X-Brace Ly Rules
Calculate Redundant Bracing Forces
Ignore Redundant Members in FEA
SR Leg Bolts Resist Compression
All Leg Panels Have Same Allowable
Offset Girt At Foundation
Consider Feedline Torque
Include Angle Block Shear Check

Poles

√ Include Shear-Torsion Interaction
Always Use Sub-Critical Flow
Use Top Mounted Sockets

Tapered Pole Section Geometry

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L1	140.000-88.753	51.247	5.917	18	28.583	42.393	0.281	1.125	A572-65 (65 ksi)
L2	88.753-46.083	48.587	7.167	18	40.236	53.330	0.375	1.500	A572-65 (65 ksi)
L3	46.083-0.000	53.250		18	50.649	65.000	0.438	1.750	A572-65

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
									(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	29.024	25.265	2556.682	10.047	14.520	176.078	5116.729	12.635	4.536	16.127
	43.047	37.593	8422.612	14.950	21.536	391.101	16856.306	18.800	6.966	24.769
L2	42.476	47.445	9524.012	14.151	20.440	465.952	19060.557	23.727	6.422	17.124
	54.153	63.030	22330.403	18.799	27.092	824.254	44690.189	31.521	8.726	23.27
L3	53.391	69.724	22208.518	17.825	25.729	863.156	44446.259	34.869	8.144	18.615
	66.003	89.653	47213.201	22.920	33.020	1429.836	94488.526	44.835	10.670	24.389

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 140.000-88.753				1	1	1		
L2 88.753-46.083				1	1	1		
L3 46.083-0.000				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight klf
1 5/8 (Verizon - Existing)	C	No	Inside Pole	137.000 - 3.000	12	No Ice 1/2" Ice	0.000 0.000	0.001 0.001
1 5/8 (AT&T - Existing)	C	No	Inside Pole	127.000 - 3.000	12	No Ice 1/2" Ice	0.000 0.000	0.001 0.001
1 5/8 (Verizon - Reserved)	C	No	CaAa (Out Of Face)	137.000 - 3.000	1	No Ice 1/2" Ice	0.198 0.298	0.001 0.003
1 5/8 (Verizon - Reserved)	C	No	CaAa (Out Of Face)	137.000 - 3.000	5	No Ice 1/2" Ice	0.000 0.000	0.001 0.003
1 5/8 (AT&T - Reserved)	C	No	CaAa (Out Of Face)	127.000 - 3.000	1	No Ice 1/2" Ice	0.198 0.298	0.001 0.003
1 5/8 (AT&T - Reserved)	C	No	CaAa (Out Of Face)	127.000 - 3.000	5	No Ice 1/2" Ice	0.000 0.000	0.001 0.003
HYBRIFLEX 1-5/8" (Verizon - Reserved)	C	No	CaAa (Out Of Face)	137.000 - 3.000	2	No Ice 1/2" Ice	0.198 0.298	0.002 0.003
RG6-Fiber (AT&T - Existing)	C	No	Inside Pole	127.000 - 3.000	1	No Ice 1/2" Ice	0.000 0.000	0.001 0.001
#8 AWG Copper WIre (AT&T - Existing)	C	No	Inside Pole	127.000 - 3.000	2	No Ice 1/2" Ice	0.000 0.000	0.000 0.000
RG6-Fiber (AT&T - Proposed)	C	No	Inside Pole	127.000 - 3.000	1	No Ice 1/2" Ice	0.000 0.000	0.001 0.001
#8 AWG Copper WIre	C	No	Inside Pole	127.000 - 3.000	2	No Ice	0.000	0.000

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft²/ft	Weight klf
(AT&T - Proposed)						1/2" Ice	0.000	0.000

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	140.000-88.753	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	36.232	1.887
L2	88.753-46.083	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	33.795	1.854
L3	46.083-0.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	34.122	1.872

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	140.000-88.753	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	54.530	2.816
L2	88.753-46.083	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	50.862	2.756
L3	46.083-0.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	51.355	2.783

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
LPA-80063/6CF	A	From Face	3.000	0.000	137.000	No Ice	10.308	9.005	0.027
(Verizon - Reserved)			6.000			1/2" Ice	10.868	9.554	0.101
			0.000						
LPA-171063-12CF	A	From Face	3.000	0.000	137.000	No Ice	5.994	6.054	0.012
(Verizon - Reserved)			4.000			1/2" Ice	6.462	6.523	0.055
			0.000						
BXA-70063/6CF	A	From Face	3.000	0.000	137.000	No Ice	7.731	4.158	0.017
(Verizon - Reserved)			1.000			1/2" Ice	8.268	4.595	0.059
			0.000						
BXA-70063/6CF	A	From Face	3.000	0.000	137.000	No Ice	7.731	4.158	0.017

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert*	*Azimuth Adjustment*	*Placement*		*C_AA_A Front*	*C_AA_A Side*	*Weight*
			ft ft ft	*°*	*ft*		*ft^2*	*ft^2*	*K*
(Verizon - Reserved)			-1.000			1/2" Ice	8.268	4.595	0.059
			0.000						
LPA-171063-12CF	A	From Face	3.000	0.000	137.000	No Ice	5.994	6.054	0.012
(Verizon - Reserved)			-4.000			1/2" Ice	6.462	6.523	0.055
			0.000						
LPA-80063/6CF	A	From Face	3.000	0.000	137.000	No Ice	10.308	9.005	0.027
(Verizon - Reserved)			-6.000			1/2" Ice	10.868	9.554	0.101
			0.000						
LPA-80063/6CF	B	From Face	3.000	0.000	137.000	No Ice	10.308	9.005	0.027
(Verizon - Reserved)			6.000			1/2" Ice	10.868	9.554	0.101
			0.000						
LPA-171063-12CF	B	From Face	3.000	0.000	137.000	No Ice	5.994	6.054	0.012
(Verizon - Reserved)			4.000			1/2" Ice	6.462	6.523	0.055
			0.000						
BXA-70063/6CF	B	From Face	3.000	0.000	137.000	No Ice	7.731	4.158	0.017
(Verizon - Reserved)			1.000			1/2" Ice	8.268	4.595	0.059
			0.000						
BXA-70063/6CF	B	From Face	3.000	0.000	137.000	No Ice	7.731	4.158	0.017
(Verizon - Reserved)			-1.000			1/2" Ice	8.268	4.595	0.059
			0.000						
LPA-171063-12CF	B	From Face	3.000	0.000	137.000	No Ice	5.994	6.054	0.012
(Verizon - Reserved)			-4.000			1/2" Ice	6.462	6.523	0.055
			0.000						
LPA-80063/6CF	B	From Face	3.000	0.000	137.000	No Ice	10.308	9.005	0.027
(Verizon - Reserved)			-6.000			1/2" Ice	10.868	9.554	0.101
			0.000						
LPA-80063/6CF	C	From Face	3.000	0.000	137.000	No Ice	10.308	9.005	0.027
(Verizon - Reserved)			6.000			1/2" Ice	10.868	9.554	0.101
			0.000						
LPA-171063-12CF	C	From Face	3.000	0.000	137.000	No Ice	5.994	6.054	0.012
(Verizon - Reserved)			4.000			1/2" Ice	6.462	6.523	0.055
			0.000						
BXA-70063/6CF	C	From Face	3.000	0.000	137.000	No Ice	7.731	4.158	0.017
(Verizon - Reserved)			1.000			1/2" Ice	8.268	4.595	0.059
			0.000						
BXA-70063/6CF	C	From Face	3.000	0.000	137.000	No Ice	7.731	4.158	0.017
(Verizon - Reserved)			-1.000			1/2" Ice	8.268	4.595	0.059
			0.000						
LPA-171063-12CF	C	From Face	3.000	0.000	137.000	No Ice	5.994	6.054	0.012
(Verizon - Reserved)			-4.000			1/2" Ice	6.462	6.523	0.055
			0.000						
LPA-80063/6CF	C	From Face	3.000	0.000	137.000	No Ice	10.308	9.005	0.027
(Verizon - Reserved)			-6.000			1/2" Ice	10.868	9.554	0.101
			0.000						
(2) RRH	A	From Face	3.000	0.000	137.000	No Ice	2.917	2.188	0.050
(Verizon - Reserved)			0.000			1/2" Ice	3.161	2.412	0.072
			0.000						
(2) RRH	B	From Face	3.000	0.000	137.000	No Ice	2.917	2.188	0.050
(Verizon - Reserved)			0.000			1/2" Ice	3.161	2.412	0.072
			0.000						
(2) RRH	C	From Face	3.000	0.000	137.000	No Ice	2.917	2.188	0.050
(Verizon - Reserved)			0.000			1/2" Ice	3.161	2.412	0.072
			0.000						
DB-T1-6Z-8AB-0Z	C	From Face	3.000	0.000	137.000	No Ice	5.600	2.333	0.044
(Verizon - Reserved)			0.000			1/2" Ice	5.915	2.558	0.080
			0.000						
Valmont 13' Low Profile	C	None		0.000	137.000	No Ice	15.700	15.700	1.300

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
Platform (Verizon - Existing)						1/2" Ice	20.100	20.100	1.765
(2) 7770.00 (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	127.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) 7770.00 (AT&T - Existing)	B	From Face	3.000 0.000 0.000	0.000	127.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) 7770.00 (AT&T - Existing)	C	From Face	3.000 0.000 0.000	0.000	127.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) TT08-19DB111-001 TMA (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	127.000	No Ice 1/2" Ice	0.925 1.065	0.746 0.877	0.022 0.030
(2) TT08-19DB111-001 TMA (AT&T - Existing)	B	From Face	3.000 0.000 0.000	0.000	127.000	No Ice 1/2" Ice	0.925 1.065	0.746 0.877	0.022 0.030
(2) TT08-19DB111-001 TMA (AT&T - Existing)	C	From Face	3.000 0.000 0.000	0.000	127.000	No Ice 1/2" Ice	0.925 1.065	0.746 0.877	0.022 0.030
(2) RET (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	127.000	No Ice 1/2" Ice	0.408 0.500	0.122 0.174	0.003 0.006
(2) RET (AT&T - Existing)	B	From Face	3.000 0.000 0.000	0.000	127.000	No Ice 1/2" Ice	0.408 0.500	0.122 0.174	0.003 0.006
(2) RET (AT&T - Existing)	C	From Face	3.000 0.000 0.000	0.000	127.000	No Ice 1/2" Ice	0.408 0.500	0.122 0.174	0.003 0.006
7770.00 (AT&T - Reserved)	A	From Face	3.000 -2.000 0.000	0.000	127.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
7770.00 (AT&T - Reserved)	B	From Face	3.000 -2.000 0.000	0.000	127.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
7770.00 (AT&T - Reserved)	C	From Face	3.000 -2.000 0.000	0.000	127.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
TT08-19DB111-001 TMA (AT&T - Reserved)	A	From Face	3.000 -2.000 0.000	0.000	127.000	No Ice 1/2" Ice	0.925 1.065	0.746 0.877	0.022 0.030
TT08-19DB111-001 TMA (AT&T - Reserved)	B	From Face	3.000 -2.000 0.000	0.000	127.000	No Ice 1/2" Ice	0.925 1.065	0.746 0.877	0.022 0.030
TT08-19DB111-001 TMA (AT&T - Reserved)	C	From Face	3.000 -2.000 0.000	0.000	127.000	No Ice 1/2" Ice	0.925 1.065	0.746 0.877	0.022 0.030
RET (AT&T - Reserved)	A	From Face	3.000 -2.000 0.000	0.000	127.000	No Ice 1/2" Ice	0.408 0.500	0.122 0.174	0.003 0.006
RET (AT&T - Reserved)	B	From Face	3.000 -2.000 0.000	0.000	127.000	No Ice 1/2" Ice	0.408 0.500	0.122 0.174	0.003 0.006
RET (AT&T - Reserved)	C	From Face	3.000 -2.000 0.000	0.000	127.000	No Ice 1/2" Ice	0.408 0.500	0.122 0.174	0.003 0.006
Valmont 13' Low Profile	C	None		0.000	127.000	No Ice	15.700	15.700	1.300

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
Platform (AT&T - Existing)						1/2" Ice	20.100	20.100	1.765
P65-17-XLH-RR (AT&T - Existing)	A	From Face	3.000 2.000 0.000	0.000	127.000	No Ice 1/2" Ice	11.467 12.083	6.800 7.384	0.062 0.124
AM-X-CD-17-65-00T-RET (AT&T - Existing)	B	From Face	3.000 2.000 0.000	0.000	127.000	No Ice 1/2" Ice	11.311 11.927	6.800 7.384	0.060 0.121
AM-X-CD-17-65-00T-RET (AT&T - Existing)	C	From Face	3.000 2.000 0.000	0.000	127.000	No Ice 1/2" Ice	11.311 11.927	6.800 7.384	0.060 0.121
(2) RRUS-11 (AT&T - Existing)	A	From Face	1.000 2.000 0.000	0.000	125.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Existing)	B	From Face	1.000 2.000 0.000	0.000	125.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Existing)	C	From Face	1.000 2.000 0.000	0.000	125.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	C	From Face	0.500 0.000 0.000	0.000	125.000	No Ice 1/2" Ice	2.228 2.447	2.228 2.447	0.020 0.039
Valmont Uni-Tri Bracket (AT&T - Existing)	C	None		0.000	125.000	No Ice 1/2" Ice	1.750 1.940	1.750 1.940	0.290 0.306
(2) RRUS-11 (AT&T - Proposed)	A	From Face	1.000 2.000 0.000	0.000	129.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Proposed)	B	From Face	1.000 2.000 0.000	0.000	129.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Proposed)	C	From Face	1.000 2.000 0.000	0.000	129.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
DC6-48-60-18-8F Surge Arrestor (AT&T - Proposed)	C	From Face	0.500 0.000 0.000	0.000	129.000	No Ice 1/2" Ice	2.228 2.447	2.228 2.447	0.020 0.039
Valmont Uni-Tri Bracket (AT&T - Proposed)	C	None		0.000	129.000	No Ice 1/2" Ice	1.750 1.940	1.750 1.940	0.290 0.306

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 140.000-88.75	113.123	1.422	0.026	151.554	A B	0.000 0.000	151.554 151.554	151.554	100.00 100.00	0.000 0.000	0.000 0.000

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
3					C	0.000	151.554		100.00	0.000	36.232
L2	67.045	1.224	0.023	169.188	A	0.000	169.188	169.188	100.00	0.000	0.000
88.753-46.083					B	0.000	169.188		100.00	0.000	0.000
					C	0.000	169.188		100.00	0.000	33.795
L3	22.296	1	0.019	225.769	A	0.000	225.769	225.769	100.00	0.000	0.000
46.083-0.000					B	0.000	225.769		100.00	0.000	0.000
					C	0.000	225.769		100.00	0.000	34.122

Tower Pressure - With Ice

G_H = 1.690

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1	113.123	1.422	0.020	0.500	155.825	A	0.000	155.825	155.825	100.00	0.000	0.000
140.000-88.753						B	0.000	155.825		100.00	0.000	0.000
						C	0.000	155.825		100.00	0.000	54.530
L2	67.045	1.224	0.017	0.500	172.743	A	0.000	172.743	172.743	100.00	0.000	0.000
88.753-46.083						B	0.000	172.743		100.00	0.000	0.000
						C	0.000	172.743		100.00	0.000	50.862
L3 46.083-0.000	22.296	1	0.014	0.500	229.609	A	0.000	229.609	229.609	100.00	0.000	0.000
						B	0.000	229.609		100.00	0.000	0.000
						C	0.000	229.609		100.00	0.000	51.355

Tower Pressure - Service

G_H = 1.690

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1	113.123	1.422	0.013	151.554	A	0.000	151.554	151.554	100.00	0.000	0.000
140.000-88.75					B	0.000	151.554		100.00	0.000	0.000
3					C	0.000	151.554		100.00	0.000	36.232
L2	67.045	1.224	0.011	169.188	A	0.000	169.188	169.188	100.00	0.000	0.000
88.753-46.083					B	0.000	169.188		100.00	0.000	0.000
					C	0.000	169.188		100.00	0.000	33.795
L3	22.296	1	0.009	225.769	A	0.000	225.769	225.769	100.00	0.000	0.000
46.083-0.000					B	0.000	225.769		100.00	0.000	0.000
					C	0.000	225.769		100.00	0.000	34.122

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 140.000-88.753	1.887	5.481	A	1	0.65	1	1	1	151.554	5.975	0.117	C
			B	1	0.65	1	1	1	151.554			
			C	1	0.65	1	1	1	151.554			
L2 88.753-46.083	1.854	9.132	A	1	0.65	1	1	1	169.188	5.477	0.128	C
			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3 46.083-0.000	1.872	14.439	A	1	0.65	1	1	1	225.769	5.685	0.123	C
			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.612	29.053						OTM	1169.837 kip-ft	17.136		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 140.000-88.753	1.887	5.481	A	1	0.65	1	1	1	151.554	5.975	0.117	C
			B	1	0.65	1	1	1	151.554			
			C	1	0.65	1	1	1	151.554			
L2 88.753-46.083	1.854	9.132	A	1	0.65	1	1	1	169.188	5.477	0.128	C
			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3 46.083-0.000	1.872	14.439	A	1	0.65	1	1	1	225.769	5.685	0.123	C
			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.612	29.053						OTM	1169.837 kip-ft	17.136		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 140.000-88.753	1.887	5.481	A	1	0.65	1	1	1	151.554	5.975	0.117	C
			B	1	0.65	1	1	1	151.554			
			C	1	0.65	1	1	1	151.554			
L2 88.753-46.083	1.854	9.132	A	1	0.65	1	1	1	169.188	5.477	0.128	C
			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3 46.083-0.000	1.872	14.439	A	1	0.65	1	1	1	225.769	5.685	0.123	C
			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.612	29.053						OTM	1169.837 kip-ft	17.136		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 140.000-88.753	1.887	5.481	A	1	0.65	1	1	1	151.554	5.975	0.117	C
			B	1	0.65	1	1	1	151.554			
			C	1	0.65	1	1	1	151.554			
L2 88.753-46.083	1.854	9.132	A	1	0.65	1	1	1	169.188	5.477	0.128	C
			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3 46.083-0.000	1.872	14.439	A	1	0.65	1	1	1	225.769	5.685	0.123	C
			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.612	29.053						OTM	1169.837 kip-ft	17.136		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 140.000-88.753	2.816	6.619	A	1	0.65	1	1	1	155.825	5.182	0.101	C
			B	1	0.65	1	1	1	155.825			
			C	1	0.65	1	1	1	155.825			
L2 88.753-46.083	2.756	10.399	A	1	0.65	1	1	1	172.743	4.661	0.109	C
			B	1	0.65	1	1	1	172.743			
			C	1	0.65	1	1	1	172.743			
L3 46.083-0.000	2.783	16.126	A	1	0.65	1	1	1	229.609	4.728	0.103	C
			B	1	0.65	1	1	1	229.609			
			C	1	0.65	1	1	1	229.609			
Sum Weight:	8.355	33.143						OTM	1004.154 kip-ft	14.572		

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 ft^2	F K	w klf	Ctrl. Face
L1 140.000-88.753	2.816	6.619	A	1	0.65	1	1	1	155.825	5.182	0.101	C
			B	1	0.65	1	1	1	155.825			
			C	1	0.65	1	1	1	155.825			
L2 88.753-46.083	2.756	10.399	A	1	0.65	1	1	1	172.743	4.661	0.109	C
			B	1	0.65	1	1	1	172.743			
			C	1	0.65	1	1	1	172.743			
L3 46.083-0.000	2.783	16.126	A	1	0.65	1	1	1	229.609	4.728	0.103	C
			B	1	0.65	1	1	1	229.609			
			C	1	0.65	1	1	1	229.609			
Sum Weight:	8.355	33.143						OTM	1004.154 kip-ft	14.572		

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 ft^2	F K	w klf	Ctrl. Face
L1 140.000-88.753	2.816	6.619	A	1	0.65	1	1	1	155.825	5.182	0.101	C
			B	1	0.65	1	1	1	155.825			
			C	1	0.65	1	1	1	155.825			
L2 88.753-46.083	2.756	10.399	A	1	0.65	1	1	1	172.743	4.661	0.109	C
			B	1	0.65	1	1	1	172.743			
			C	1	0.65	1	1	1	172.743			
L3 46.083-0.000	2.783	16.126	A	1	0.65	1	1	1	229.609	4.728	0.103	C
			B	1	0.65	1	1	1	229.609			
			C	1	0.65	1	1	1	229.609			
Sum Weight:	8.355	33.143						OTM	1004.154 kip-ft	14.572		

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 ft^2	F K	w klf	Ctrl. Face
L1 140.000-88.753	2.816	6.619	A	1	0.65	1	1	1	155.825	5.182	0.101	C
			B	1	0.65	1	1	1	155.825			
			C	1	0.65	1	1	1	155.825			
L2 88.753-46.083	2.756	10.399	A	1	0.65	1	1	1	172.743	4.661	0.109	C
			B	1	0.65	1	1	1	172.743			
			C	1	0.65	1	1	1	172.743			
L3 46.083-0.000	2.783	16.126	A	1	0.65	1	1	1	229.609	4.728	0.103	C
			B	1	0.65	1	1	1	229.609			
			C	1	0.65	1	1	1	229.609			
Sum Weight:	8.355	33.143						OTM	1004.154 kip-ft	14.572		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 140.000-88.753	1.887	5.481	A	1	0.65	1	1	1	151.554	2.977	0.058	C
			B	1	0.65	1	1	1	151.554			
			C	1	0.65	1	1	1	151.554			
L2 88.753-46.083	1.854	9.132	A	1	0.65	1	1	1	169.188	2.729	0.064	C
			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3 46.083-0.000	1.872	14.439	A	1	0.65	1	1	1	225.769	2.832	0.061	C
			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.612	29.053						OTM	582.894	8.539		

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

Tower Forces - Service - Wind 45 To Face

Section Elevation *ft*	*Add Weight* *K*	*Self Weight* *K*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *K*	*w* *klf*	*Ctrl. Face*
L1	1.887	5.481	A	1	0.65	1	1	1	151.554	2.977	0.058	C
140.000-88.75			B	1	0.65	1	1	1	151.554			
3			C	1	0.65	1	1	1	151.554			
L2	1.854	9.132	A	1	0.65	1	1	1	169.188	2.729	0.064	C
88.753-46.083			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3	1.872	14.439	A	1	0.65	1	1	1	225.769	2.832	0.061	C
46.083-0.000			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.612	29.053						OTM	582.894 kip-ft	8.539		

Tower Forces - Service - Wind 60 To Face

Section Elevation *ft*	*Add Weight* *K*	*Self Weight* *K*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *K*	*w* *klf*	*Ctrl. Face*
L1	1.887	5.481	A	1	0.65	1	1	1	151.554	2.977	0.058	C
140.000-88.75			B	1	0.65	1	1	1	151.554			
3			C	1	0.65	1	1	1	151.554			
L2	1.854	9.132	A	1	0.65	1	1	1	169.188	2.729	0.064	C
88.753-46.083			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3	1.872	14.439	A	1	0.65	1	1	1	225.769	2.832	0.061	C
46.083-0.000			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.612	29.053						OTM	582.894 kip-ft	8.539		

Tower Forces - Service - Wind 90 To Face

Section Elevation *ft*	*Add Weight* *K*	*Self Weight* *K*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *K*	*w* *klf*	*Ctrl. Face*
L1	1.887	5.481	A	1	0.65	1	1	1	151.554	2.977	0.058	C
140.000-88.75			B	1	0.65	1	1	1	151.554			
3			C	1	0.65	1	1	1	151.554			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L2 88.753-46.083	1.854	9.132	A	1	0.65	1	1	1	169.188	2.729	0.064	C
			B	1	0.65	1	1	1	169.188			
			C	1	0.65	1	1	1	169.188			
L3 46.083-0.000	1.872	14.439	A	1	0.65	1	1	1	225.769	2.832	0.061	C
			B	1	0.65	1	1	1	225.769			
			C	1	0.65	1	1	1	225.769			
Sum Weight:	5.612	29.053						OTM	582.894 kip-ft	8.539		

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	29.053					
Bracing Weight	0.000					
Total Member Self-Weight	29.053			0.252	0.006	
Total Weight	39.886			0.252	0.006	
Wind 0 deg - No Ice		-0.003	-30.728	-2973.809	0.399	0.007
Wind 30 deg - No Ice		15.286	-26.610	-2575.164	-1476.406	0.419
Wind 45 deg - No Ice		21.620	-21.726	-2102.449	-2088.160	0.589
Wind 60 deg - No Ice		26.480	-15.361	-1486.438	-2557.608	0.719
Wind 90 deg - No Ice		30.578	0.003	0.645	-2953.499	0.826
Wind 120 deg - No Ice		26.483	15.367	1487.622	-2558.001	0.712
Wind 135 deg - No Ice		21.624	21.730	2103.508	-2088.716	0.579
Wind 150 deg - No Ice		15.292	26.613	2576.060	-1477.087	0.407
Wind 180 deg - No Ice		0.003	30.728	2974.312	-0.387	-0.007
Wind 210 deg - No Ice		-15.286	26.610	2575.667	1476.417	-0.419
Wind 225 deg - No Ice		-21.620	21.726	2102.952	2088.171	-0.589
Wind 240 deg - No Ice		-26.480	15.361	1486.941	2557.619	-0.719
Wind 270 deg - No Ice		-30.578	-0.003	-0.141	2953.510	-0.826
Wind 300 deg - No Ice		-26.483	-15.367	-1487.119	2558.012	-0.712
Wind 315 deg - No Ice		-21.624	-21.730	-2103.005	2088.727	-0.579
Wind 330 deg - No Ice		-15.292	-26.613	-2575.557	1477.098	-0.407
Member Ice	4.091					
Total Weight Ice	49.656			0.473	0.007	
Wind 0 deg - Ice		-0.002	-25.809	-2494.736	0.304	0.005
Wind 30 deg - Ice		12.845	-22.350	-2160.293	-1239.414	0.345
Wind 45 deg - Ice		18.166	-18.248	-1763.696	-1752.952	0.485
Wind 60 deg - Ice		22.250	-12.903	-1246.874	-2147.030	0.592
Wind 90 deg - Ice		25.694	0.002	0.770	-2479.349	0.681
Wind 120 deg - Ice		22.252	12.907	1248.334	-2147.326	0.587
Wind 135 deg - Ice		18.170	18.251	1765.061	-1753.372	0.478
Wind 150 deg - Ice		12.849	22.353	2161.535	-1239.928	0.336
Wind 180 deg - Ice		0.002	25.809	2495.681	-0.289	-0.005
Wind 210 deg - Ice		-12.845	22.350	2161.238	1239.428	-0.345
Wind 225 deg - Ice		-18.166	18.248	1764.642	1752.967	-0.485
Wind 240 deg - Ice		-22.250	12.903	1247.820	2147.044	-0.592
Wind 270 deg - Ice		-25.694	-0.002	0.176	2479.363	-0.681
Wind 300 deg - Ice		-22.252	-12.907	-1247.388	2147.341	-0.587
Wind 315 deg - Ice		-18.170	-18.251	-1764.116	1753.387	-0.478
Wind 330 deg - Ice		-12.849	-22.353	-2160.589	1239.942	-0.336
Total Weight	39.886			0.252	0.006	
Wind 0 deg - Service		-0.002	-15.311	-1481.633	0.201	0.004
Wind 30 deg - Service		7.617	-13.259	-1283.000	-735.646	0.209

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 45 deg - Service		10.772	-10.825	-1047.461	-1040.464	0.294
Wind 60 deg - Service		13.194	-7.654	-740.521	-1274.376	0.358
Wind 90 deg - Service		15.236	0.002	0.447	-1471.637	0.412
Wind 120 deg - Service		13.196	7.657	741.364	-1274.572	0.355
Wind 135 deg - Service		10.775	10.827	1048.241	-1040.741	0.289
Wind 150 deg - Service		7.619	13.260	1283.699	-735.985	0.203
Wind 180 deg - Service		0.002	15.311	1482.136	-0.190	-0.004
Wind 210 deg - Service		-7.617	13.259	1283.504	735.657	-0.209
Wind 225 deg - Service		-10.772	10.825	1047.964	1040.475	-0.294
Wind 240 deg - Service		-13.194	7.654	741.024	1274.387	-0.358
Wind 270 deg - Service		-15.236	-0.002	0.056	1471.648	-0.412
Wind 300 deg - Service		-13.196	-7.657	-740.860	1274.583	-0.355
Wind 315 deg - Service		-10.775	-10.827	-1047.738	1040.752	-0.289
Wind 330 deg - Service		-7.619	-13.260	-1283.196	735.996	-0.203

Load Combinations

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

Comb. No.	Description
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	140 - 88.753	Pole	Max Tension	27	0.000	0.000	0.000
			Max. Compression	18	-16.372	0.007	-0.473
			Max. Mx	14	-11.040	635.253	-0.141
			Max. My	10	-11.030	-0.096	-641.970
			Max. Vy	14	-18.992	635.253	-0.141
			Max. Vx	10	19.144	-0.096	-641.970
			Max. Torque	6			-0.824
L2	88.753 - 46.083	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-28.542	0.007	-0.473
			Max. Mx	14	-21.348	1532.277	-0.022
			Max. My	10	-21.342	-0.227	-1545.324
			Max. Vy	14	-24.297	1532.277	-0.022
			Max. Vx	10	24.449	-0.227	-1545.324
			Max. Torque	6			-0.823
L3	46.083 - 0	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-49.656	0.007	-0.473
			Max. Mx	14	-39.875	2994.089	0.142
			Max. My	10	-39.874	-0.393	-3015.207
			Max. Vy	14	-30.593	2994.089	0.142
			Max. Vx	10	30.743	-0.393	-3015.207
			Max. Torque	6			-0.823

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	27	49.656	-0.002	-25.809
	Max. H_x	14	39.886	30.578	0.003
	Max. H_z	2	39.886	0.003	30.728
	Max. M_x	2	3014.691	0.003	30.728
	Max. M_z	6	2994.077	-30.578	-0.003
	Max. Torsion	14	0.823	30.578	0.003
	Min. Vert	1	39.886	0.000	0.000
	Min. H_x	6	39.886	-30.578	-0.003

Location	*Condition*	*Gov. Load Comb.*	*Vertical K*	*Horizontal, X K*	*Horizontal, Z K*
	Min. H_z	10	39.886	-0.003	-30.728
	Min. M_x	10	-3015.207	-0.003	-30.728
	Min. M_z	14	-2994.089	30.578	0.003
	Min. Torsion	6	-0.823	-30.578	-0.003

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	39.886	0.000	0.000	0.252	0.006	0.000
Dead+Wind 0 deg - No Ice	39.886	-0.003	-30.728	-3014.691	0.405	0.007
Dead+Wind 30 deg - No Ice	39.886	15.286	-26.610	-2610.569	-1496.685	0.418
Dead+Wind 45 deg - No Ice	39.886	21.620	-21.726	-2131.357	-2116.844	0.587
Dead+Wind 60 deg - No Ice	39.886	26.480	-15.361	-1506.877	-2592.744	0.716
Dead+Wind 90 deg - No Ice	39.886	30.578	0.003	0.656	-2994.077	0.823
Dead+Wind 120 deg - No Ice	39.886	26.483	15.367	1508.082	-2593.143	0.709
Dead+Wind 135 deg - No Ice	39.886	21.624	21.730	2132.435	-2117.408	0.576
Dead+Wind 150 deg - No Ice	39.886	15.292	26.613	2611.482	-1497.377	0.405
Dead+Wind 180 deg - No Ice	39.886	0.003	30.728	3015.207	-0.393	-0.007
Dead+Wind 210 deg - No Ice	39.886	-15.286	26.610	2611.084	1496.697	-0.417
Dead+Wind 225 deg - No Ice	39.886	-21.620	21.726	2131.871	2116.856	-0.586
Dead+Wind 240 deg - No Ice	39.886	-26.480	15.361	1507.391	2592.756	-0.716
Dead+Wind 270 deg - No Ice	39.886	-30.578	-0.003	-0.142	2994.089	-0.823
Dead+Wind 300 deg - No Ice	39.886	-26.483	-15.367	-1507.568	2593.154	-0.709
Dead+Wind 315 deg - No Ice	39.886	-21.624	-21.730	-2131.920	2117.419	-0.577
Dead+Wind 330 deg - No Ice	39.886	-15.292	-26.613	-2610.967	1497.387	-0.405
Dead+Ice+Temp	49.656	0.000	0.000	0.473	0.007	0.000
Dead+Wind 0 deg+Ice+Temp	49.656	-0.002	-25.809	-2541.922	0.311	0.006
Dead+Wind 30 deg+Ice+Temp	49.656	12.845	-22.350	-2201.154	-1262.837	0.343
Dead+Wind 45 deg+Ice+Temp	49.656	18.166	-18.248	-1797.056	-1786.083	0.483
Dead+Wind 60 deg+Ice+Temp	49.656	22.250	-12.903	-1270.457	-2187.610	0.589
Dead+Wind 90 deg+Ice+Temp	49.656	25.694	0.002	0.792	-2526.213	0.677
Dead+Wind 120 deg+Ice+Temp	49.656	22.252	12.907	1271.960	-2187.914	0.583
Dead+Wind 135 deg+Ice+Temp	49.656	18.170	18.251	1798.462	-1786.512	0.474
Dead+Wind 150 deg+Ice+Temp	49.656	12.849	22.353	2202.435	-1263.362	0.333
Dead+Wind 180 deg+Ice+Temp	49.656	0.002	25.809	2542.901	-0.295	-0.006
Dead+Wind 210 deg+Ice+Temp	49.656	-12.845	22.350	2202.133	1262.853	-0.343
Dead+Wind 225 deg+Ice+Temp	49.656	-18.166	18.248	1798.034	1786.099	-0.482
Dead+Wind 240 deg+Ice+Temp	49.656	-22.250	12.903	1271.435	2187.626	-0.589
Dead+Wind 270 deg+Ice+Temp	49.656	-25.694	-0.002	0.186	2526.228	-0.677
Dead+Wind 300 deg+Ice+Temp	49.656	-22.252	-12.907	-1270.982	2187.928	-0.583
Dead+Wind 315 deg+Ice+Temp	49.656	-18.170	-18.251	-1797.484	1786.527	-0.475
Dead+Wind 330 deg+Ice+Temp	49.656	-12.849	-22.353	-2201.456	1263.377	-0.334
Dead+Wind 0 deg - Service	39.886	-0.002	-15.311	-1502.299	0.204	0.004
Dead+Wind 30 deg - Service	39.886	7.617	-13.259	-1300.896	-745.898	0.208
Dead+Wind 45 deg - Service	39.886	10.772	-10.825	-1062.071	-1054.965	0.293
Dead+Wind 60 deg - Service	39.886	13.194	-7.654	-750.849	-1292.137	0.357
Dead+Wind 90 deg - Service	39.886	15.236	0.002	0.457	-1492.147	0.411
Dead+Wind 120 deg - Service	39.886	13.196	7.657	751.710	-1292.336	0.354
Dead+Wind 135 deg - Service	39.886	10.775	10.827	1062.868	-1055.246	0.288
Dead+Wind 150 deg - Service	39.886	7.619	13.260	1301.611	-746.242	0.202
Dead+Wind 180 deg - Service	39.886	0.002	15.311	1502.816	-0.193	-0.004
Dead+Wind 210 deg - Service	39.886	-7.617	13.259	1301.412	745.909	-0.208
Dead+Wind 225 deg - Service	39.886	-10.772	10.825	1062.587	1054.976	-0.293
Dead+Wind 240 deg - Service	39.886	-13.194	7.654	751.365	1292.148	-0.357
Dead+Wind 270 deg - Service	39.886	-15.236	-0.002	0.059	1492.159	-0.411

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 300 deg - Service	39.886	-13.196	-7.657	-751.194	1292.347	-0.354
Dead+Wind 315 deg - Service	39.886	-10.775	-10.827	-1062.352	1055.257	-0.288
Dead+Wind 330 deg - Service	39.886	-7.619	-13.260	-1301.095	746.254	-0.202

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
1	0.000	-39.886	0.000	0.000	39.886	0.000	0.000%
2	-0.003	-39.886	-30.728	0.003	39.886	30.728	0.000%
3	15.286	-39.886	-26.610	-15.286	39.886	26.610	0.000%
4	21.620	-39.886	-21.726	-21.620	39.886	21.726	0.000%
5	26.480	-39.886	-15.361	-26.480	39.886	15.361	0.000%
6	30.578	-39.886	0.003	-30.578	39.886	-0.003	0.000%
7	26.483	-39.886	15.367	-26.483	39.886	-15.367	0.000%
8	21.624	-39.886	21.730	-21.624	39.886	-21.730	0.000%
9	15.292	-39.886	26.613	-15.292	39.886	-26.613	0.000%
10	0.003	-39.886	30.728	-0.003	39.886	-30.728	0.000%
11	-15.286	-39.886	26.610	15.286	39.886	-26.610	0.000%
12	-21.620	-39.886	21.726	21.620	39.886	-21.726	0.000%
13	-26.480	-39.886	15.361	26.480	39.886	-15.361	0.000%
14	-30.578	-39.886	-0.003	30.578	39.886	0.003	0.000%
15	-26.483	-39.886	-15.367	26.483	39.886	15.367	0.000%
16	-21.624	-39.886	-21.730	21.624	39.886	21.730	0.000%
17	-15.292	-39.886	-26.613	15.292	39.886	26.613	0.000%
18	0.000	-49.656	0.000	0.000	49.656	0.000	0.000%
19	-0.002	-49.656	-25.809	0.002	49.656	25.809	0.000%
20	12.845	-49.656	-22.350	-12.845	49.656	22.350	0.000%
21	18.166	-49.656	-18.248	-18.166	49.656	18.248	0.000%
22	22.250	-49.656	-12.903	-22.250	49.656	12.903	0.000%
23	25.694	-49.656	0.002	-25.694	49.656	-0.002	0.000%
24	22.252	-49.656	12.907	-22.252	49.656	-12.907	0.000%
25	18.170	-49.656	18.251	-18.170	49.656	-18.251	0.000%
26	12.849	-49.656	22.353	-12.849	49.656	-22.353	0.000%
27	0.002	-49.656	25.809	-0.002	49.656	-25.809	0.000%
28	-12.845	-49.656	22.350	12.845	49.656	-22.350	0.000%
29	-18.166	-49.656	18.248	18.166	49.656	-18.248	0.000%
30	-22.250	-49.656	12.903	22.250	49.656	-12.903	0.000%
31	-25.694	-49.656	-0.002	25.694	49.656	0.002	0.000%
32	-22.252	-49.656	-12.907	22.252	49.656	12.907	0.000%
33	-18.170	-49.656	-18.251	18.170	49.656	18.251	0.000%
34	-12.849	-49.656	-22.353	12.849	49.656	22.353	0.000%
35	-0.002	-39.886	-15.311	0.002	39.886	15.311	0.000%
36	7.617	-39.886	-13.259	-7.617	39.886	13.259	0.000%
37	10.772	-39.886	-10.825	-10.772	39.886	10.825	0.000%
38	13.194	-39.886	-7.654	-13.194	39.886	7.654	0.000%
39	15.236	-39.886	0.002	-15.236	39.886	-0.002	0.000%
40	13.196	-39.886	7.657	-13.196	39.886	-7.657	0.000%
41	10.775	-39.886	10.827	-10.775	39.886	-10.827	0.000%
42	7.619	-39.886	13.260	-7.619	39.886	-13.260	0.000%
43	0.002	-39.886	15.311	-0.002	39.886	-15.311	0.000%
44	-7.617	-39.886	13.259	7.617	39.886	-13.259	0.000%
45	-10.772	-39.886	10.825	10.772	39.886	-10.825	0.000%
46	-13.194	-39.886	7.654	13.194	39.886	-7.654	0.000%
47	-15.236	-39.886	-0.002	15.236	39.886	0.002	0.000%
48	-13.196	-39.886	-7.657	13.196	39.886	7.657	0.000%
49	-10.775	-39.886	-10.827	10.775	39.886	10.827	0.000%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
50	-7.619	-39.886	-13.260	7.619	39.886	13.260	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	0.00001108
3	Yes	4	0.00000001	0.00035761
4	Yes	4	0.00000001	0.00040241
5	Yes	4	0.00000001	0.00034195
6	Yes	4	0.00000001	0.00002476
7	Yes	4	0.00000001	0.00036118
8	Yes	4	0.00000001	0.00040268
9	Yes	4	0.00000001	0.00034701
10	Yes	4	0.00000001	0.00001109
11	Yes	4	0.00000001	0.00034659
12	Yes	4	0.00000001	0.00040242
13	Yes	4	0.00000001	0.00036103
14	Yes	4	0.00000001	0.00002456
15	Yes	4	0.00000001	0.00034231
16	Yes	4	0.00000001	0.00040267
17	Yes	4	0.00000001	0.00035770
18	Yes	4	0.00000001	0.00000001
19	Yes	4	0.00000001	0.00060439
20	Yes	4	0.00000001	0.00090965
21	Yes	4	0.00000001	0.00098625
22	Yes	4	0.00000001	0.00090132
23	Yes	4	0.00000001	0.00060204
24	Yes	4	0.00000001	0.00091181
25	Yes	4	0.00000001	0.00098750
26	Yes	4	0.00000001	0.00090544
27	Yes	4	0.00000001	0.00060486
28	Yes	4	0.00000001	0.00090502
29	Yes	4	0.00000001	0.00098714
30	Yes	4	0.00000001	0.00091151
31	Yes	4	0.00000001	0.00060203
32	Yes	4	0.00000001	0.00090173
33	Yes	4	0.00000001	0.00098664
34	Yes	4	0.00000001	0.00090995
35	Yes	4	0.00000001	0.00000723
36	Yes	4	0.00000001	0.00006442
37	Yes	4	0.00000001	0.00007216
38	Yes	4	0.00000001	0.00005982
39	Yes	4	0.00000001	0.00001023
40	Yes	4	0.00000001	0.00006563
41	Yes	4	0.00000001	0.00007224
42	Yes	4	0.00000001	0.00006119
43	Yes	4	0.00000001	0.00000723
44	Yes	4	0.00000001	0.00006109
45	Yes	4	0.00000001	0.00007219
46	Yes	4	0.00000001	0.00006562
47	Yes	4	0.00000001	0.00001020
48	Yes	4	0.00000001	0.00005990
49	Yes	4	0.00000001	0.00007221
50	Yes	4	0.00000001	0.00006442

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	140 - 88.753	19.158	43	1.191	0.002
L2	94.67 - 46.083	8.807	43	0.887	0.001
L3	53.25 - 0	2.767	43	0.475	0.000

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
137.000	LPA-80063/6CF	43	18.422	1.173	0.002	48145
129.000	(2) RRUS-11	43	16.469	1.127	0.002	21884
127.000	(2) 7770.00	43	15.986	1.115	0.001	18517
125.000	(2) RRUS-11	43	15.505	1.103	0.001	16048

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	140 - 88.753	38.423	10	2.387	0.004
L2	94.67 - 46.083	17.667	10	1.779	0.001
L3	53.25 - 0	5.551	10	0.952	0.000

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
137.000	LPA-80063/6CF	10	36.947	2.353	0.004	24075
129.000	(2) RRUS-11	10	33.032	2.260	0.003	10942
127.000	(2) 7770.00	10	32.062	2.236	0.003	9259
125.000	(2) RRUS-11	10	31.098	2.212	0.003	8024

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	140 - 88.753 (1)	TP42.393x28.583x0.281	51.247	0.000	0.0	39.000	36.169	-11.030	1410.600	0.008
L2	88.753 - 46.083 (2)	TP53.33x40.236x0.375	48.587	0.000	0.0	39.000	60.731	-21.342	2368.500	0.009
L3	46.083 - 0 (3)	TP65x50.649x0.438	53.250	0.000	0.0	39.000	89.653	-39.874	3496.470	0.011

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	140 - 88.753 (1)	TP42.393x28.583x0.281	641.970	21.284	39.000	0.546	0.000	0.000	39.000	0.000
L2	88.753 - 46.083 (2)	TP53.33x40.236x0.375	1545.325	24.240	39.000	0.622	0.000	0.000	39.000	0.000
L3	46.083 - 0 (3)	TP65x50.649x0.438	3015.208	25.305	39.000	0.649	0.000	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	140 - 88.753 (1)	TP42.393x28.583x0.281	19.144	0.529	26.000	0.041	0.007	0.000	26.000	0.000
L2	88.753 - 46.083 (2)	TP53.33x40.236x0.375	24.450	0.403	26.000	0.031	0.007	0.000	26.000	0.000
L3	46.083 - 0 (3)	TP65x50.649x0.438	30.743	0.343	26.000	0.026	0.007	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	140 - 88.753 (1)	0.008	0.546	0.000	0.041	0.000	0.554 ✔	1.333	H1-3+VT ✔
L2	88.753 - 46.083 (2)	0.009	0.622	0.000	0.031	0.000	0.631 ✔	1.333	H1-3+VT ✔
L3	46.083 - 0 (3)	0.011	0.649	0.000	0.026	0.000	0.660 ✔	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	140 - 88.753	Pole	TP42.393x28.583x0.281	1	-11.030	1880.330	41.6	Pass
L2	88.753 - 46.083	Pole	TP53.33x40.236x0.375	2	-21.342	3157.210	47.3	Pass
L3	46.083 - 0	Pole	TP65x50.649x0.438	3	-39.874	4660.794	49.5	Pass
							Summary	
						Pole (L3)	49.5	Pass
						RATING =	**49.5**	**Pass**

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 3015 \cdot ft \cdot kips$	(Input From RisaTower)
Shear Force =	$Shear := 31 \cdot kips$	(Input From RisaTower)
Axial Force =	$Axial := 30 \cdot kips$	(Input From RisaTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	$N := 20$	(User Input)
Diameter of Bolt Circle =	$D_{bc} := 72.50 \cdot in$	(User Input)
Bolt "Column" Distance =	$l := 3.0 \cdot in$	(User Input)
Bolt Ultimate Strenght =	$F_u := 100 \cdot ksi$	(User Input)
Bolt Yeild Strenght =	$F_y := 75 \cdot ksi$	(User Input)
Bolt Modulus =	$E := 29000 \cdot ksi$	(User Input)
Diameter of Anchor Bolts =	$D := 2.25 \cdot in$	(User Input)
Threads per Inch =	$n := 4.5$	(User Input)

Base Plate Data:

Use ASTM A572 50

Plate Yield Strength =	$Fy_{bp} := 50 \cdot ksi$	(User Input)
Base Plate Thickness =	$t_{bp} := 3.25 \cdot in$	(User Input)
Base Plate Diameter =	$D_{bp} := 79.71 \cdot in$	(User Input)
Outer Pole Diameter =	$D_{pole} := 65.00 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =: $R_{bc} := \frac{D_{bc}}{2} = 36.25 \cdot in$

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

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

$d_1 = 11.20 \cdot in$ $d_7 = 29.33 \cdot in$

$d_2 = 21.31 \cdot in$ $d_8 = 21.31 \cdot in$

$d_3 = 29.33 \cdot in$ $d_9 = 11.20 \cdot in$

$d_4 = 34.48 \cdot in$ $d_{10} = 0.00 \cdot in$

$d_5 = 36.25 \cdot in$ $d_{11} = -11.20 \cdot in$

$d_6 = 34.48 \cdot in$ etc.

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 32.5 \cdot in$

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

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

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

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

$MA_4 = 1.98 \cdot in$ $MA_{10} = 0.00 \cdot in$

$MA_5 = 3.75 \cdot in$ $MA_{11} = 0.00 \cdot in$

$MA_6 = 1.98 \cdot in$ etc

Effective Width of Baseplate for Bending = $B_{eff} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 36.9 \cdot in$

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i (d_i)^2 = 1.314 \times 10^4 \cdot in^2$

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 = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 98.3 \cdot kips$

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

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

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Net}} \cdot 100 = 50$ Bolts are "upset bolts". Use net area per AISC

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

Condition1 = "OK"

Check Anchor Bolt Bending Stress:

Maximum Bending Moment = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.387 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 5.6 \cdot ksi$

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

Check Combined Stress Requirement:

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

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

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

Check Anchor Bolt Compression/Combined Stress:

Maximum Compressive Force = $C_{Max} := OM \cdot \frac{R_{bc}}{I_p} + \frac{Axial}{N} = 101.3 \cdot kips$

Maximum Compressive Stress = $f_a := \frac{C_{Max}}{A_n} = 31.2 \cdot ksi$

$K := 0.65$

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

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

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

Combined Stress % of Capacity = $\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) \cdot 100 = 52$

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

Condition2 = "OK"

Base Plate Analysis:

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

$C_1 = 32.3 \cdot kips$	$C_7 = 82.2 \cdot kips$
$C_2 = 60.2 \cdot kips$	$C_8 = 60.2 \cdot kips$
$C_3 = 82.2 \cdot kips$	$C_9 = 32.3 \cdot kips$
$C_4 = 96.4 \cdot kips$	$C_{10} = 1.5 \cdot kips$
$C_5 = 101.3 \cdot kips$	$C_{11} = -29.3 \cdot kips$
$C_6 = 96.4 \cdot kips$	etc.

Maximum Bending Stress in Plate = $f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} t_{bp}^2\right)} = 11.7 \cdot ksi$

Allowable Bending Stress in Plate = $F_{bp} := 1.33 \cdot 0.75 \cdot Fy_{bp} = 49.9 \cdot ksi$

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} \cdot 100 = 23.5$

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

Condition3 = "Ok"

Standard Monopole Foundation:

Input Data:

Tower Data

Overturning Moment =	$OM := 3015 \cdot ft \cdot kips$	(User Input from RISATower)
Shear Force =	$Shear := 31 \cdot kip$	(User Input from RISATower)
Axial Force =	$Axial := 40 \cdot kip$	(User Input from RISATower)
Tower Height =	$H_t := 140 \cdot ft$	(User Input)

Footing Data:

Overall Depth of Footing =	$D_f := 7 \cdot ft$	(User Input)
Length of Pier =	$L_p := 4.5 \cdot ft$	(User Input)
Extension of Pier Above Grade =	$L_{pag} := 0.5 \cdot ft$	(User Input)
Diameter of Pier =	$d_p := 8.5 \cdot ft$	(User Input)
Thickness of Footing =	$T_f := 3 \cdot ft$	(User Input)
Width of Footing =	$W_f := 26 \cdot ft$	(User Input)

Anchor Bolt Data:

Length of Anchor Bolts =	$L_{st} := 84 \cdot in$	(User Input)
Projection of Anchor Bolts Above Pier =	$A_{BP} := 10.25 \cdot in$	(User Input)
Anchor Bolt Diameter =	$d_{anchor} := 2.25 \cdot in$	(User Input)
Base Plate Bolt Circle =	$MP := 72.5 \cdot in$	(User Input)

Material Properties:

Concrete Compressive Strength =	$f_c := 3000 \cdot psi$	(User Input)	
Steel Reinforcment Yield Strength =	$f_y := 60000 \cdot psi$	(User Input)	
Anchor Bolt Yield Strength =	$f_{ya} := 75000 \cdot psi$	(User Input)	
Internal Friction Angle of Soil =	$\Phi_s := 30 \cdot deg$	(User Input)	
Allowable Soil Bearing Capacity =	$q_s := 12000 \cdot psf$	(User Input)	
Unit Weight of Soil =	$\gamma_{soil} := 100 \cdot pcf$	(User Input)	
Unit Weight of Concrete =	$\gamma_{conc} := 150 \cdot pcf$	(User Input)	
Foundation Bouyancy =	$Bouyancy := 0$	(User Input)	(Yes=1 / No=0)
Depth to Neglect =	$n := 1 \cdot ft$	(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 =	$BS_{pier} := 11$	(User Input)	
Bar Diameter =	$d_{bpier} := 1.41 \cdot in$	(User Input)	
Number of Bars =	$NB_{pier} := 52$	(User Input)	
Clear Cover of Reinforcement =	$Cvr_{pier} := 3 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Diameter of Tie =	$d_{Tie} := 0.5 \cdot in$	(User Input)	

Pad Reinforcement:

Bar Size =	$BS_{top} := 7$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 0.875 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 21$	(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 =	$NB_{bot} := 34$	(User Input)	(Bottom of Pad)
Clear Cover of Reinforcement =	$Cvr_{pad} := 3.0 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)

Calculated Factors:

Pier Reinforcement Bar Area = $A_{bpier} := \frac{\pi \cdot d_{bpier}^2}{4} = 1.561 \cdot in^2$

Pad Top Reinforcement Bar Area = $A_{btop} := \frac{\pi \cdot d_{btop}^2}{4} = 0.601 \cdot in^2$

Pad Bottom Reinforcement Bar Area = $A_{bbot} := \frac{\pi \cdot d_{bbot}^2}{4} = 0.999 \cdot in^2$

Coefficient of Lateral Soil Pressure = $K_p := \frac{1 + \sin(\Phi_s)}{1 - \sin(\Phi_s)} = 3$

Load Factor =

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

Stability of Footing:

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

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

Passive Pressure = $P_{pn} := K_p \cdot \gamma_s \cdot n + c \cdot 2 \cdot \sqrt{K_p} = 0.3 \cdot \text{ksf}$

$P_{pt} := K_p \cdot \gamma_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p} = 1.2 \cdot \text{ksf}$

$P_{top} := \text{if}\left[n < (D_f - T_f), P_{pt}, P_{pn}\right] = 1.2 \cdot \text{ksf}$

$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p} = 2.1 \cdot \text{ksf}$

$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 1.65 \cdot \text{ksf}$

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

$A_p := W_f \cdot T_p = 78$

Ultimate Shear = $S_u := P_{ave} \cdot A_p = 128.7 \cdot \text{kip}$

Weight of Concrete Pad = $WT_c := \left[\left(W_f^{\,2} \cdot T_f\right) + d_p^{\,2} \cdot L_p\right] \cdot \gamma_c = 352.969 \cdot \text{kip}$

Weight of Soil Above Footing = $WT_{s1} := \left[\left(W_f^{\,2} - d_p^{\,2}\right) \cdot \begin{vmatrix} (L_p - L_{pag} - n) & \text{if } (L_p - L_{pag} - n) \ge 0 \\ 0 & \text{if } (L_p - L_{pag} - n) \le 0 \end{vmatrix}\right] \cdot \gamma_s = 181.13 \cdot \text{kip}$

Weight of Soil Wedge at Back Face = $WT_{s2} := \left(\frac{D_f^{\,2} \cdot \tan(\Phi_s)}{2} \cdot W_f\right) \cdot \gamma_s = 36.777 \cdot \text{kip}$

Weight of Soil Wedge at back face Corners = $WT_{s3} := 2 \cdot \left[(D_f)^3 \cdot \frac{\tan(\Phi_s)}{3}\right] \cdot \gamma_s = 13.202 \cdot \text{kips}$

Total Weight = $WT_{tot} := WT_c + WT_{s1} + \text{Axial} = 574.094 \cdot \text{kip}$

Resisting Moment = $M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + \left[(WT_{s2} + WT_{s3}) \cdot \left(W_f + \frac{D_f \cdot \tan(\Phi_s)}{3}\right)\right] = 8959 \cdot \text{kip} \cdot \text{ft}$

Overturning Moment = $M_{ot} := OM + \text{Shear} \cdot (L_p + T_f) = 3248 \cdot \text{kip} \cdot \text{ft}$

Factor of Safety Actual = $FS := \frac{M_r}{M_{ot}} = 2.76$

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

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

OverTurning_Moment_Check = "Okay"

Shear Capacity in Pier:

Shear Resistance of Pier = $S_p := \frac{\mu \cdot WT_{tot}}{FS_{req}} = 129.171 \cdot kips$

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

$Shear\_Check = "Okay"$

Bearing Pressure Caused by Footing:

Area of the Mat = $A_{mat} := W_f^2 = 676$

Section Modulus of Mat = $S := \frac{W_f^3}{6} = 2929.33 \cdot ft^3$

Maximum Pressure in Mat = $P_{max} := \frac{(WT_c + Axial)}{A_{mat}} + \frac{M_{ot}}{S} = 1.69 \cdot ksf$

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

$Max\_Pressure\_Check = "Okay"$

Minimum Pressure in Mat = $P_{min} := \frac{(WT_c + Axial)}{A_{mat}} - \frac{M_{ot}}{S} = -0.527 \cdot ksf$

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

$Min\_Pressure\_Check = "No Good"$

Distance to Resultant of Pressure Distribution = $X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 6.606$

Distance to Kern = $X_k := \frac{W_f}{6} = 4.333$

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

Eccentricity = $e := \frac{M_{ot}}{WT_{tot}} = 5.657$

Adjusted Soil Pressure = $P_a := \frac{2 \cdot (WT_c + Axial)}{3 \cdot W_f \cdot \left(\frac{W_f}{2} - e\right)} = 1.372 \cdot ksf$

$q_{adj} := if(P_{min} < 0, P_a, P_{max}) = 1.372 \cdot ksf$

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

$Pressure\_Check = "Okay"$

Concrete Bearing Capacity:

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

Bearing Strength Between Pier and Pad = $P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot \frac{\pi \cdot d_p^2}{4} = 1.354 \times 10^4 \cdot kips$ (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 = $b_o := \left(d_p + d\right) \cdot \pi = 35$

Area Included Inside Perimeter = $A_{bo} := \frac{\pi \cdot \left(d_p + d\right)^2}{4} = 97.7$

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 578.3$

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

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

$v_u := \text{Find}(v_u) = 6.2 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f = 425.9 \cdot kips$

Required Shear Strength = $V_{req} := LF \cdot V_u = 567.7 \cdot kips$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 2496.3 \cdot kip$ (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)

$q_b := q_{adj} - d_1 \cdot Slope = 0.827 \cdot ksf$

Maximum Bending at Face of Pier = $M_u := LF \cdot \left[\left(q_{adj} - q_b \right) \cdot \frac{d_1^{\ 2}}{3} + q_b \cdot \frac{d_1^{\ 2}}{2} \right] \cdot W_f = 1579.5 \cdot kip \cdot ft$

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

(ACI-200810.2.7.3)

$R_n := \frac{M_u}{\phi_m \cdot W_f \cdot d^2} = 66.4 \cdot psi$

$\rho := \frac{0.85 \cdot f_c}{f_y} \left(1 - \sqrt{1 - \frac{2 \cdot R_n}{0.85 \cdot f_c}} \right) = 0.0011$

$\rho_{min} := \rho = 0.00112$

Required Reinforcement for Temperature and Shrinkage:

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

Check Bottom Bars:

$$As := \begin{cases} \rho_{min} \cdot W_f \cdot d & \text{if } \rho_{min} > \frac{\rho_{sh}}{2} \\ \rho_{sh} \cdot W_f \cdot \frac{d}{2} & \text{otherwise} \end{cases} = 11.16 \cdot in^2$$

$$As_{prov} := A_{bbot} \cdot NB_{bot} = 34 \cdot in^2$$

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

Pad_Reinforcement_Bot = "Okay"

Check top Bars:

$$As := \rho_{sh} \cdot \left(W_f \cdot \frac{d}{2} \right) = 8.9 \cdot in^2$$

$$As_{prov} := A_{btop} \cdot NB_{top} = 12.6 \cdot in^2$$

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

Pad_Reinforcement_Top = "Okay"

Developement Length Pad Reinforcement:

Bar Spacing = $$B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 8.11 \cdot in$$

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)

$$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pad} \cdot \beta_{pad} \cdot \gamma_{pad} \cdot \lambda_{pad}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \frac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot} = 34.8 \cdot in$$

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 = $$L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad} = 102 \cdot in$$

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

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

Area of Pier = $A_p := \frac{\pi \cdot d_p^{\,2}}{4} = 8171.28 \cdot in^2$

$A_{smin} := 0.01 \cdot 0.05 \cdot A_p = 4.09 \cdot in^2$ (ACI-2008 10.8.4 & 10.9.1)

$A_{sprov} := NB_{pier} \cdot A_{bpier} = 81.2 \cdot in^2$

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

Steel_Area_Check = "Okay"

Bar Spacing In Pier = $B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 4.752 \cdot in$

Diameter of Reinforcement Cage = $Diam_{cage} := d_p - 2 \cdot Cvr_{pier} = 96 \cdot in$

Maximum Moment in Pier = $M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2} \right) \right] \cdot LF = 50671.2 \cdot in \cdot kips$

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

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

$$\begin{pmatrix} D & N & n & P_u & M_{xu} \end{pmatrix} = \begin{pmatrix} 102 & 52 & 11 & 53.32 & 5.067 \times 10^4 \end{pmatrix}$$

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

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

$$\begin{pmatrix} \phi P_n & \phi M_{xn} & f_{sp} & \rho \end{pmatrix} = \begin{pmatrix} 192.393 & 1.828 \times 10^5 & -60 & 9.927 \times 10^{-3} \end{pmatrix}$$

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

Axial_Load_Check = "Okay"

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

Bending_Check = "Okay"

Development Length Pier Reinforcement:

Available Length in Foundation:

$L_{pier} := L_p - Cvr_{pier} = 51 \cdot in$

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

Tension: (ACI-2008 12.2.3)

Spacing or Cover Dimension = $c := if\left(Cvr_{pier} < \frac{B_{sPier}}{2}, Cvr_{pier}, \frac{B_{sPier}}{2}\right) = 2.376 \cdot in$

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

$$L_{dbt} := \frac{3 \cdot f_y \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 68.74 \cdot in$$

Minimum Development Length = $L_{dh} := \frac{1200 \cdot d_{bpier}}{\sqrt{\frac{f_c}{psi}}} \cdot .7 = 21.624 \cdot in$ (ACI 12.2.1)

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

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

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

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

Compression: (ACI-2008 12.3.2)

$$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot f_y}{\sqrt{f_c \cdot psi}} = 30.892 \cdot in$$

$L_{dbmin} := 0.0003 \cdot \frac{in^2}{lb} \cdot (d_{bpier} \cdot f_y) = 25.38 \cdot in$

$L_{dbc} := if(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}) = 30.892 \cdot in$

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

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

Tie Size and Spacing in Column:

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

Used #4 Ties

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

$s_{lim1} := 16 \cdot d_{bpier} \cdot z = 22.56 \cdot in$

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

$s_{lim3} := D_f \cdot z = 84 \cdot in$

$s_{lim4} := 18in$

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 = $n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 = 3.667$

Check Anchor Steel Embedment:

Depth Available = $D_{ab} := L_{st} - A_{BP} = 6.146 \cdot ft$

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

Depth_Check := if(D_ab ≥ L_anchor, "Okay", "No Good")

Depth_Check = "No Good"

Note: Anchor plate is provided

RRUS 11

Frequency (AT&T)
- ✓ Band 12 (Lower 700 MHz)
- ✓ Band 4 (AWS, 17/2100 MHz) — 2Q2011

RF Characteristics
- ✓ Output power: 2x30 Watts
- ✓ 2x2 MIMO Capable
- ✓ IBW of 20 MHz
- ✓ Rx Sens.: Better than -105 dBm (5 MHz)

RET/TMA Support
- ✓ AISG 2.0 Compatible
- ✓ Via RET Port and Centre Conductor
- ✓ Cascading
- ✓ 30 VDC Bias

Environmental
- ✓ Self Convection
- ✓ Temperature -40 to 131 F

Power
- ✓ Input voltage: -48 VDC or AC (exemption)
- ✓ Fuse size: 13 – 32 A
  - Recommended: 25 A
- ✓ Power Consumption:
  - Typical 200 Watts
  - Max 310 Watts
  - Excl. RET and TMA load

RRUS 11 Mechanics

Wall and pole mounting brackets
- Reused from RRUW and RRU22
- Vertical Mount Only

Clearing distances:
- Above >= 16 in.
- Below >= 12 in.
- Side >= 0 mm

DC connector
- Bayonet
- Screw terminals in connector plug
- Supported outer cable diameter: 6-18 mm

CPRI connector
- LCD with proprietary cover
- Separate cover available from 1Q2011

Size & Weight
- Band 4: 44 lbs
- Band 12: 50 lbs
- 17.8” x 17.3” x 7.2” incl. sun shield

POWER

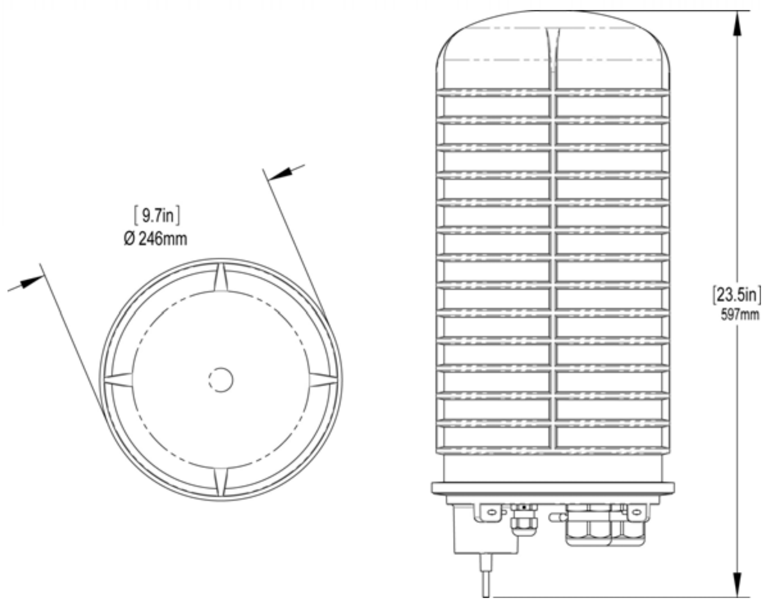
DC6-48-60-18-8F

DC Surge Suppression Solution

The DC6-48-60-18 is a dual chambered, DC surge suppression system for use in multi-circuit, Distributed Antenna Systems. The system will protect up to 6 Remote Radio Heads from voltage surges and lightning, and connect up to 18 fiber pairs. The system is enclosed in a NEMA 4 rated, waterproof enclosure.

FEATURES

- Protects up to 6 Remote Radio Heads, each with its own protection circuit.
- Flexible design allows for installation at the top of a tower for Remote Radio Head protection.
- Includes fiber connections for up to 18 pairs of fiber.
- LED indicators on individual circuits provide visual indication of suppressor status.
- Form ‘C’ relays allow for remote monitoring of the suppressor status.
- Patented Strikesorb technology provides over 60 kA of surge current capacity per circuit.
- Strikesorb suppression modules are fully recognized to UL 1449-3rd Edition Safety Standard, meeting all intermediate and high current fault requirements to facilitate use in OEM applications.
- Raycap recommends that DC protection system be installed within 2 meters or 6 feet of the radio.
- Dome design is lightweight and aerodynamic providing maximum flexibility for installation on top of towers.



DC6-48-60-18-8F

DC Power Surge Protection

Electrical Specifications	
Model Number	DC6-48-60-18-8F
Nominal Operating Voltage	48 VDC
Nominal Discharge Current (I_n)	20 kA 8/20 µs
Maximum Discharge Current (I_{max}) per NEMA LS-1	60 kA 8/20 µs
Maximum Continuous Operating Voltage (U_c)	75 VDC
Voltage Protection Rating	400 V

Mechanical Specifications	
Suppression Connection Method	Compression lug, #2-#14 AWG Copper, #2-#12 Aluminum
Fiber Connection Method	LC-LC Single mode duplex
Environmental Rating	IP 68, 7m 72hrs
Operating Temperature	-40° C to + 80° C
Storage Temperature	-70° C to + 80° C
Cold Temperature Cycling	IEC 61300-2-22e -30° C to + 60° C 200 hrs @ 5 psi
Resistance to Aggressive Materials	CEI IEC 61073-2 including acids and bases
UV Protection	ISO 4892-2 Method A Xenon-Arc 2160 hrs
Weight	20 lbs without Mounting Bracket

STANDARDS

Strikesorb modules are compliant to the following Surge Protection Device (SPD) Standards:

- ANSI/UL 1449 – 3rd Edition
- IEEE C62.41
- NEMA LS-1, IEC 61643-1:2005 2nd Edition:2005
- IEC 61643-12
- EN 61643-11:2002 (including A11:2007)

GS-07F-0435V

Certified to ISO 9001:2000

TUV Rheinland of North America

Raycap

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